Section VII-8: Tender Drawings and Documents

A- Tender Drawings
B- Documents

Note: Tenderer shall download Section VII-8: Tender Drawings and Documents from HRIDC website. Section VII-8: Tender Drawings and Documents are available for downloading under Active Tender Section on HRIDC website (https://hridc.co.in/active-tender.php). Section VII-8: Tender Drawings and Documents uploaded on HRIDC website for Package C-5 shall be deemed to form part of Tender Documents. List of Tender Drawings and Documents are enclosed hereunder.

Section VII-8A
Tender Drawings

Tenderer shall download Section VII-8: Tender Drawings and Documents from HRIDC website. Section VII-8: Tender Drawings and Documents are available for downloading under Active Tender Section on HRIDC website (https://hridc.co.in/active-tender.php). Section VII-8: Tender Drawings and Documents uploaded on HRIDC website for Package C-5 shall be deemed to form part of Tender Documents. List of Tender Drawings are enclosed hereunder.

	- **Black colour shows Tender drawings which have not been revised**
	- **Blue colour shows Tender drawings which have been revised**
	- **Red colour shows New additional Tender drawings**

List of Tender Drawings
I. Civil Drawings

S. No	TITLE	DRAWING NO.
1. ALIGNMENT PLAN & L-SECTION		
1.	Conceptual Plan & longitudinal section (-2.296KM to -0.6KM)	GC-HRIDC-ALL-DRW-ALN-P&P-(-2.296) - (-0.6) KM_A0
2.	Conceptual Plan & longitudinal section (-0.6 KM TO 0.0 KM)	GC-HRIDC-ALL-DRW-ALN-P&P-(-0.6) - (0.0) KM_A0
3.	Conceptual Plan & longitudinal section (0.0 KM TO 5.0 KM)	GC-HRIDC-ALL-DRW-ALN-P&P-0-5KM_A1
4.	Conceptual Plan & longitudinal section (5.0 KM TO 10.0 KM)	GC-HRIDC-ALL-DRW-ALN-P&P-5-10KM_A0
5.	Conceptual Plan and longitudinal section (10.0KM to 15.0KM)	GC-HRIDC-ALL-DRW-ALN-P&P-10-15KM_A2
6.	Conceptual Plan and longitudinal section (15.0KM to 20.0KM)	GC-HRIDC-ALL-DRW-ALN-P&P-15-20KM_A2
7.	Conceptual Plan & longitudinal section (20.0 KM TO 25.0 KM)	GC-HRIDC-ALL-DRW-ALN-P&P-20-25KM_A1
2. ESP/YARD PLAN		
1.	Detailed Design Yard Layout Plan for New Prithala Junction Station.	14YLPLT4103 Rev 2 dated 22.09.2023
2.	Conceptual Engineering Scale Plan Prithla Junction Yard Ch:00m F/Prithla	GC-HRIDC-C5-DRW-STN-ESP-PRI01_A0
3.	Conceptual Engineering Scale Plan Silani Station Yard CH:10341.882m F/Prithla	GC-HRIDC-C5-DRW-STN-ESP-SIL01_A0
4.	Conceptual Engineering Scale Plan IMT Sohna	GC-HRIDC-C5-DRW-STN-ESP-SOH01_A1
3. STATION BUILDING AND SUBWAY		
1.	Conceptual Plan of Prithla Station & Subway No. 8 & 8A	GC-HRIDC-C5-DRW-STN-SAD-PRI01_A0 (Sheet 1 of 3)

S. No	TITLE	DRAWING NO.
	Conceptual Architectural Drawing Prithla Station Building	GC-HRIDC-C5-DRW-STN-SAD-PRI01_A1 (Sheet 2 of 3)
	Conceptual Architectural Drawing Prithla Building	GC-HRIDC-C5-DRW-STN-SAD-PRI01_A1 (Sheet 3 of 3)
2.	Conceptual Plan of SILANI Station and Subway No. 39 & 39A	GC-HRIDC-C5-DRW-STN-SAD-SIL01_A0 (Sheet 1 of 1)
3.	Conceptual Plan of Sohna Station and Subway No. 66 & 66A	GC-HRIDC-C5-DRW-STN-SAD-SOH01_A0 (Sheet 1 of 3)
	Conceptual Architectural Drawing IMT Sohna Station Building	GC-HRIDC-C5-DRW-STN-SAD-SOH01_A1 (Sheet 2 of 3)
		GC-HRIDC-C5-DRW-STN-SAD-SOH01_A1 (Sheet 3 of 3)
4. BRIDGES		
4.1	**MINOR BRIDGES**	
4.1.1	**MAIN LINE**	
1.	Conceptual General Arrangement Drawing For Balancing Culvert Bridge No.6 1x 2x 2m RCC Box at Ch.-574.471	GC-HRIDC-C5-DRW-BRD-GAD_01006_A0
2.	Conceptual General Arrangement Drawing For Road Under Bridge No. 07, Span 1.0x4.6x5.65 RCC Box at Ch:-252.537	GC-HRIDC-C5-DRW-BRD-GAD_01007_A0
3.	Conceptual General Arrangement Drawing For Road Under Bridge No. 09 Span 1.0x4.6x4.15 RCC Box at Ch:139.953	GC-HRIDC-C5-DRW-BRD-GAD_01009_A0
4.	Conceptual General Arrangement Drawing For Balancing Culvert + RUB Bridge No. 10 Span 1x5.2x5.0 + 1x4.7x5 RCC Box at Ch: 371.033 (CANAL CROSSING DHATIR DISTRIBUTORY RD 25000)	GC-HRIDC-C5-DRW-BRD-GAD_010010_A1
5.	Conceptual General Arrangement Drawing For Road Under Bridge No 11 Span 1x4.6x4.15 RCC Box at Ch: 958.395	GC-HRIDC-C5-DRW-BRD-GAD_01011_A0
6.	Conceptual General Arrangement Drawing For Road Under Bridge No 13 Span 1x4.60x4.15, RCC box at Ch: 2034.968	GC-HRIDC-C5-DRW-BRD-GAD-01013_A0
7.	Conceptual General Arrangement Drawing For RUB + Balancing Culvert Bridge No. 14 Span 2x5.2x4.15 RCC Box at Ch: 2493.015 (CANAL CROSSING CHANDPUR MINOR RD 6500)	GC-HRIDC-C5-DRW-BRD-GAD_01014_A1
8.	Conceptual General Arrangement Drawing For Balancing Culvert Bridge No. 15 Span 1x2x2 RCC Box at Ch: 3153.203	GC-HRIDC-C5-DRW-BRD-GAD_01015_A0
9.	Conceptual General Arrangement Drawing For Road Under Bridge No. 18	GC-HRIDC-C5-DRW-BRD-GAD_01018_A0

S. No	TITLE	DRAWING NO.
	1x9.75mx6.70m RCC Box at Ch.4373.615m	
10.	Conceptual General Arrangement Drawing For Road Under Bridge No 19 Span 1.0x4.6x4.15 RCC Box at Ch: 4858.791	GC-HRIDC-C5-DRW-BRD-GAD-01019_A1
11.	Conceptual General Arrangement Drawing For Balancing Culvert Bridge No 20 Span 1x2.0x2.0 RCC Box at Ch.4891.994	GC-HRIDC-C5-DRW-BRD-GAD-01020_A1
12.	Conceptual General Arrangement Drawing For Road Under Bridge No. 21 1 x 4.6 x 4.15m RCC Box at Ch.5340.10m	GC-HRIDC-C5-DRW-BRD-GAD_01021_A0
13.	Conceptual General Arrangement Drawing For Road Under Bridge No. 22 1x 4.6 x 4.15m RCC Box at Ch.5807.675m	GC-HRIDC-C5-DRW-BRD-GAD_01022_A0
14.	Conceptual General Arrangement Drawing For Balancing Culvert No. 23 1x 3 x 3m RCC Box at Ch.6409.986m	GC-HRIDC-C5-DRW-BRD-GAD_0023_A0
15.	Conceptual General Arrangement Drawing For Road Under Bridge No. 24 1x 4.6 x 4.150 m RCC Box at Ch.6881.539m	GC-HRIDC-C5-DRW-BRD-GAD_01024_A0
16.	Conceptual General Arrangement Drawing For Road Under Bridge No 25 Span 1.0x4.60x4.50 RCC Box at Ch: 7548.737	GC-HRIDC-C5-DRW-BRD-GAD-01025_A0
17.	Conceptual General Arrangement Drawing For Balancing Culvert Bridge No. 27 Span 1x2x2 RCC Box at Ch: 7941.374	GC-HRIDC-C5-DRW-BRD-GAD_01027_A0
18.	Conceptual General Arrangement Drawing For Balancing Culvert Bridge No. 29 Span 1x2x2 RCC Box at Ch: 8141.419	GC-HRIDC-C5-DRW-BRD-GAD_01029_A0
19.	Conceptual General Arrangement Drawing For Balancing Culvert Bridge No. 31, 1 x 4 x 3.0m RCC Box at Ch.8593.734m	GC-HRIDC-C5-DRW-BRD-GAD_01031_A1
20.	Conceptual General Arrangement Drawing For Balancing Culvert No. 32 1x4.0x3.7m RCC Box at Ch: 8891.591m	GC-HRIDC-C5-DRW-BRD-GAD_01032_A0
21.	Conceptual General Arrangement Drawing For Road Under Bridge No. 33 1 x 7.00 x 4.15m RCC Box at Ch.9293.620m	GC-HRIDC-C5-DRW-BRD-GAD_01033_A0
22.	Conceptual General Arrangement Drawing For Balancing Culvert Bridge No. 35 Span 1x2x2 RCC Box at Ch: 9591.677	GC-HRIDC-C5-DRW-BRD-GAD_01035_A0
23.	Conceptual General Arrangement Drawing For Balancing Culvert Bridge No. 36 Span 1x2x2 RCC Box at Ch: 9882.453	GC-HRIDC-C5-DRW-BRD-GAD_01036_A0
24.	Conceptual General Arrangement Drawing For Road Under Bridge No. 37 1 x 5.70 x 4.15m RCC Box at Ch.9894.460m	GC-HRIDC-C5-DRW-BRD-GAD_01037_A0

S. No	TITLE	DRAWING NO.
25.	Conceptual General Arrangement Drawing For Balancing Culvert Bridge No. 38 Span 1x3x3 RCC Box at Ch: 10090.792	GC-HRIDC-C5-DRW-BRD-GAD_01038_A1
26.	Conceptual General Arrangement Drawing For Road Under Bridge No. 40 Span 1x8.40x5.15 RCC Box at Ch: 10410.702	GC-HRIDC-C5-DRW-BRD-GAD_01040_A1
27.	Conceptual General Arrangement Drawing For Balancing Culvert Bridge No. 42 Span 1x2x2 RCC Box at Ch: 10907.894	GC-HRIDC-C5-DRW-BRD-GAD_01042_A0
28.	Conceptual General Arrangement Drawing For Road Under Bridge No. 43 Span 1.0x4.70x5.65 RCC Box at Ch: 11203.249	GC-HRIDC-C5-DRW-BRD-GAD_01043_A0
29.	Conceptual General Arrangement Drawing For Balancing Culvert Bridge No. 44 Span 1x2.0x2.0 RCC Box at Ch: 11403.443	GC-HRIDC-C5-DRW-BRD-GAD_01044_A1
30.	Conceptual General Arrangement Drawing For Road Under Bridge No. 64 Span 2x6.0x4.0 RCC Box at Ch: 18558.00	GC-HRIDC-C5-DRW-BRD-GAD_01064_A1
31.	Conceptual General Arrangement Drawing For Balancing Culvert Bridge No. 65 Span 1x2x2 RCC Box at Ch: 18735.000	GC-HRIDC-C5-DRW-BRD-GAD_01065_A0
32.	Conceptual General Arrangement Drawing For Road + Balancing Culvert No. 67 Span 2.0x7.5x7.5 RCC Box at Ch: 19435.000 (CANAL CROSSING REWASAN DRAIN RD 10350)	GC-HRIDC-C5-DRW-BRD-GAD-01067_A1
4.1.2	**CONNECTING LINE**	
A. PRITHLA TO NEW PRITHLA		
1.	Conceptual General Arrangement Drawing For Pipe Culvert Bridge No. 1 1x1.2m Dia ,at Ch:-1950.000	GC-HRIDC-C5-DRW-BRD-GAD_01001_A0
2.	Conceptual General Arrangement Drawing For Balancing Culvert + RUB Bridge No. 02 Span 1x2.5x5.05+1x3.6x5.05, RCC Box, at Ch: -1832.759	GC-HRIDC-C5-DRW-BRD-GAD_01002_A1
3.	Conceptual General Arrangement Drawing For Road Under Bridge No. 03, Span 1.0x4.60x5.65 RCC Box at Ch: -1312.056	GC-HRIDC-C5-DRW-BRD-GAD_01003_A0
4.2	**MAJOR BRIDGES**	
4.2.1	**MAIN LINE**	
1.	Conceptual General Arrangement Drawing for Prop Canal Crossing Bridge No. 4,	GC-HRIDC-C5-DRW-BRD-GAD_01004_A0

S. No	TITLE	DRAWING NO.
	1x8x7.5+1x24.4+1x8x7.5m (CG+ RCC Box) at Ch. -795.733	
2.	Conceptual General Arrangement Drawing for Road No. 5, 1x 12 x 6.10m RCC Box at Ch. -592.612m	GC-HRIDC-C5-DRW-BRD-GAD_01005_A0
3.	Conceptual General Arrangement Drawing Proposed RUB Bridge No.12 1x12.2 PSC U Slab Ch:1696.624	GC-HRIDC-C5-DRW-BRD-GAD_01012_A0
4.	Conceptual General Arrangement Drawing Proposed Major Bridge No. 16 1x12x6.10 m, RCC box Ch: 3472.548m	GC-HRIDC-C5-DRW-BRD-GAD_01016_A0
5.	Conceptual General Arrangement Drawing for Proposed Major RUB No.17 4x30.5 Open web Girder at Ch:4256.298m (NH-148A DND-2)	GC-HRIDC-C5-DRG-BRD-GAD_00017_A0 (Sheet 1 of 2)
		GC-HRIDC-C5-DRG-BRD-GAD_00017_A0 (Sheet 2 of 2)
6.	Conceptual General Arrangement Drawing Proposed RUB Bridge No. 26 1x12x6.10 m, RCC Box Ch: 7753.296m	GC-HRIDC-C5-DRW-BRD-GAD_01026_A0
7.	Conceptual General Arrangement Drawing For Prop. Major Bridge No. 28 18.3X30.5+18.3(OWG+CG) AT CH: 8036.354m (CANAL CROSSING GURGAON CANAL RD 79150)	GC-HRIDC-C5-DRG-BRD-GAD_01028_A0
8.	Conceptual General Arrangement Drawing For Prop. Drain Crossing Bridge No.30, 1X30.5 (Composite Girder) AT CH: 8298.110m (CANAL CROSSING NUH DRAIN RD 87645)	GC-HRIDC-C5-DRG-BRD-GAD_01030_A0
9.	Conceptual General Arrangement Drawing Proposed IOCL Crossing Bridge No. 34 1 x24.4m (CG) AT CH.9536.901m	GC-HRIDC-C5-DRW-BRD-GAD_01034_A0
10.	Conceptual General Arrangement Drawing for Road Under Bridge no. 41 Span 1x12x5.650 RCC Box at Ch: 10709.675	GC-HRIDC-C5-DRW-BRD-GAD_01041_A0
11.	Conceptual General Arrangement Drawing for Prop. Major Bridge No.045, at Ch: 11543.518m 2X76.2 (Open Web Girder) (NH 919 PALWAL SOHNA ROAD)	GC-HRIDC-C5-DRW-BRD-GAD_01045_A0
12.	Conceptual General Arrangement Drawing For Stream Bridge No.53 2x24.4 m CG at Ch:14472.112	GC-HRIDC-C4-DRW-BRD-GAD_01053_A2

S. No	TITLE	DRAWING NO.
13.	Conceptual General Arrangement Drawing for Prop. Drain Crossing bridge no.63 1x5x4.9+1x12.2m+1x5x4.9 (PSC U Slab +RCC Box) at CH: 18310 (CANAL CROSSING INDRI DISTRIBUTARY RD 11260)	GC-HRIDC-C5-DRW-BRD-GAD_01063_A0
14.	Conceptual General Arrangement Drawing for Prop. Major RUB No.68 2x61(OWG) at Ch: 20184 (CANAL CROSSING REWASAN DRAIN RD 6670) NH-248A	GC-HRIDC-C5-DRG-BRD-GAD_01068_A0
15.	Conceptual General Arrangement Drawing for Prop. Major Bridge no.69 12.2+2X18.3+12.2 (CG+PSC U Slab) at Ch: 20400m	GC-HRIDC-C5-DRG-BRD-GAD_01069_A0
16.	Conceptual General Arrangement Drawing for Viaduct Br. No.70, Span: 105X24.4+1X30.5+41x24.4 +1x30+1x11.10 (Composite Girder) from Ch: 20942.473m to 24843.543m	GC-HRIDC-C5-DRG-BRD-GAD_01070_A0 (Sheet 1 of 15 to 15 of 15)
		GC-HRIDC-C5-DRG-BRD-GAD_01070_A0 (Sheet 2 of 15)
		GC-HRIDC-C5-DRG-BRD-GAD_01070_A0 (Sheet 3 of 15)
		GC-HRIDC-C5-DRG-BRD-GAD_01070_A0 (Sheet 4 of 15)
		GC-HRIDC-C5-DRG-BRD-GAD_01070_A0 (Sheet 5 of 15)
		GC-HRIDC-C5-DRG-BRD-GAD_01070_A0 (Sheet 6 of 15)
		GC-HRIDC-C5-DRG-BRD-GAD_01070_A0 (Sheet 7 of 15)
		GC-HRIDC-C5-DRG-BRD-GAD_01070_A0 (Sheet 8 of 15)
		GC-HRIDC-C5-DRG-BRD-GAD_01070_A0 (Sheet 9 of 15)
		GC-HRIDC-C5-DRG-BRD-GAD_01070_A0 (Sheet 10 of 15)
		GC-HRIDC-C5-DRG-BRD-GAD_01070_A0 (Sheet 11 of 15)
		GC-HRIDC-C5-DRG-BRD-GAD_01070_A0 (Sheet 12 of 15)
		GC-HRIDC-C5-DRG-BRD-GAD_01070_A0 (Sheet 13 of 15)
		GC-HRIDC-C5-DRG-BRD-GAD_01070_A0 (Sheet 14 of 15)
		GC-HRIDC-C5-DRG-BRD-GAD_01070_A0 (Sheet 15 of 15)

S. No	TITLE	DRAWING NO.
5. MISCELLANEOUS DRAWINGS (CONCEPTUAL PLANS)		
1.	Conceptual Plan Typical Embankment/Cutting Profile	GC-HRIDC-SK-GEN-001_A1
2.	Conceptual Plan Mini Platform Shelter	GC-HRIDC-SK-GEN-003
3.	Conceptual Plan R.C. Pre-Cast Fencing for End Platform	GC-HRIDC-SK-GEN-004
4.	Conceptual Plan Station Name Board	GC-HRIDC-SK-GEN-005
5.	Conceptual Plan Proposed Toilet Block on End Platforms	GC-HRIDC-SK-GEN-007_A1
6.	Conceptual Plan Drains for Embankment	GC-HRIDC-SK-GEN-008_A1
7.	Conceptual Plan Steel Barricade	GC-HRIDC-SK-GEN-009
8.	Conceptual Plan Water Booth with One Side Taps Arrangement (End Platform)	GC-HRIDC-SK-GEN-010_A1
9.	Conceptual Plan Water Booth with Both Side Taps Arrangement (Island Platform)	GC-HRIDC-SK-GEN-011_A1
10.	Conceptual Plan of Auto Location Hut (S&T)	GC-HRIDC-SK-GEN-012_A1
11.	Conceptual Plan Ticket Counter	GC-HRIDC-SK-GEN-013
12.	Conceptual Plan CC Toe Wall	GC-HRIDC-SK-GEN-014_A1
13.	Conceptual Plan Typical Details of Protection Work of Bridge Approaches	GC-HRIDC-SK-GEN-015_A1
14.	Conceptual Plan Barbed Wire Fencing	GC-HRIDC-SK-GEN-016_A1
15.	Conceptual Plan RCC Duct of Signalling Cable	GC-HRIDC-SK-GEN-017
16.	Conceptual Plan for Transition System of Bridge Approaches	GC-HRIDC-SK-GEN-019
17.	Conceptual Plan for Self-Supporting Roof Covering Shed	GC-HRIDC-SK-GEN-020
18.	Conceptual Plan for Formation Details Below of Subway and Lift Well	GC-HRIDC-SK-GEN-021
19.	Conceptual Plan for Trolley Refuge in Embankment	GC-HRIDC-SK-GEN-022
20.	Conceptual Plan for Trolley Refuge in Cutting	GC-HRIDC-SK-GEN-023
21.	Conceptual Sketch for RCC Platform Wall	GC-HRIDC-SK-GEN-024
22.	Conceptual Plan for Single and Double Lane Road	GC-HRIDC-SK-GEN-025
23.	Conceptual Sketch for Reinforced Earth Wall with Geogrid Reinforcement	GC-HRIDC-SK-GEN-026
24.	Conceptual Plan OHE Portal for OWG Girder	GC-HRIDC-SK-GEN-035
25.	Conceptual Plan for Mild Steel Pipe 323.9mm Outer Dia for Future Utilities	GC-HRIDC-SK-GEN-030

S. No	TITLE	DRAWING NO.
26.	Jurisdictional Sketch Of C-5 Package	GC-HRIDC-C5-SK-CIVIL-001_A0
27.	Conceptual Plan Drainage Arrangement (Prithla)	GC-HRIDC-C5-SK-CIVIL-002_A1
28.	Conceptual Plan Drainage Arrangement (Silani)	GC-HRIDC-C5-SK-CIVIL-003_A1
29.	Conceptual Plan Drainage Arrangement (IMT Sohna)	GC-HRIDC-C5-SK-CIVIL-004_A1
30.	Conceptual Plan Bank/Cutting Benching at Interface Locations	GC-HRIDC-C5-SK-CIVIL-009_A0
31.	Type Plan Powder Toilet for Divyangs	N.R.H.Q.E PLAN NO. HQ/20/11-2021
32.	Conceptual Plan OWG With Concrete Deck for BLT	GC-HRIDC-SK-GEN-036
33.	Conceptual Plan Ground Improvement for Embankment at Pond/Water Logged Area.	GC-HRIDC-SK-GEN-037
34.	Conceptual Plan for OHE Earthing & OHE Bolt Fixing Arrangement on Bridges	GC-HRIDC- C5-SK-GEN-038
35.	Conceptual Plan Location of Signal Post for Composite Girder Bridges	GC-HRIDC-SK-GEN-034
36.	Conceptual Plan Location of OHE Mast In Viaduct	GC-HRIDC-SK-GEN-032
37.	Conceptual Plan Location of OHE Mast for Composite Girder Bridges	GC-HRIDC- SK-GEN-031
38.	Indicative OHE Guy Rod Arrangement on Viaduct	GC-HRIDC-SYS1-DRW-ELE-007_A0
39.	Conceptual Plan Typical Embankment/Cutting Profile	GC-HRIDC-SK-GEN-001_A1
40.	Conceptual Cross- sectional sketch of ALH	GC-HRIDC- SK-GEN-039_A0
41.	Conceptual Plan drains between HORC embankment & DFC	GC-HRIDC- SK-GEN-041_A0
42.	Conceptual Plan S&T hut	GC-HRIDC- SK-GEN-002_A0
43.	Typical Conceptual Cross-sectional sketch of Platform	GC-HRIDC- SK-GEN-042_A0
44.	Typical Cross section of Road in RUB (Minor bridge)	GC-HRIDC- SK-GEN-043_A0

II. General Electrical Services Drawings

S. No	TITLE	DRAWING NO.
1.	Indicative LT Supply System with Local, DG and Auxiliary Transformer Supply	GC-HRIDC-C5-DRW-ELE-001-A1
2.	Indicative LT Supply Distribution Diagram	GC-HRIDC-C5-DRW-ELE-002-A0
3.	Indicative Arrangement of Decorative Street Light Pole at Station and Platform	GC-HRIDC-C5-DRW-ELE-03-A1
4.	Indicative Cable Route Plan for Track Crossing of Power Cable and Route Marker	GC-HRIDC-C5-DRW-ELE-04-A0

5.	Indicative Earthing Arrangement of Electrical System by Copper Cladded Electrode	GC-HRIDC-C5-DRW-ELE-05-A0
6.	Indicative Schematic Drawing Of 11 KV Power Supply Arrangement	GC-HRIDC-C5-DRW-ELE-06-A0
7.	Indicative LT Supply System With Local & Auxilary Transformer Supply	GC-HRIDC-C5-DRW-ELE-007-A1
8.	Indicative Compact Substation (CSS) Single Line Diagram	GC-HRIDC-C5-DRW-ELE-08-A0
9.	Indicative Viaduct Lighting and Railing Earthing Arrangement	GC-HRIDC-C5-DRW-ELE-09-A0

III. Signalling & Telecommunication Drawings

S. No	TITLE	DRAWING NO.
1.	Typical Main Cable Distribution Plan for Double Line (4 Lines) P.I. Station	SDO/CABLE LAYING/001
2.	Position of Trenches for Cable Laying	SDO/CABLE LAYING/002
3.	Cable Trench	SDO/CABLE LAYING/003
4.	Laying Of Signalling Cable & Telecom/ Power Cable in Same Trench	SDO/CABLE LAYING/004
5.	Laying Of Cables in Rocky Area	NR/SIG/CABLE/004
6.	Track Crossings	NR/SIG/CABLE/005
7.	Road Crossings	NR/SIG/CABLE/006
8.	Cable Laying on Culverts with Low Flood Level	SDO/CABLE LAYING/011
9.	Cable Laying on Culverts with High Flood Level	NR/SIG/CABLE/007
10.	Cable Laying on Metallic Bridges	SDO/CABLE LAYING/013
11.	Cable Trough for Metallic Bridges	SDO/CABLE LAYING/014
12.	Cable Laying on Arch Bridges	NR/SIG/CABLE/008
13.	Brick Masonry Channel for Arch Bridge	SDO/CABLE LAYING/016
14.	Arrangement of Jumper cable	SDO/CABLE LAYING/017
15.	CI Cable Marker & Concreting	SDO/CABLE LAYING/018
16.	CI Cable Marker	SDO/CABLE LAYING/019
17.	Concrete Cable Marker	SDO/CABLE LAYING/020
18.	Method of Unrolling Cable	SDO/CABLE LAYING/021
19.	Rule Made of Pipe for Measuring Trench Depth	SDO/CABLE LAYING/022

Section VII-8B
Documents

Tenderer shall download Section VII-8: Tender Drawings and Documents from HRIDC website. Section VII-8: Tender Drawings and Documents are available for downloading under Active Tender Section on HRIDC website (https://hridc.co.in/active-tender.php). Section VII-8: Tender Drawings and Documents uploaded on HRIDC website for Package C-5 shall be deemed to form part of Tender Documents. List of Documents are enclosed hereunder.

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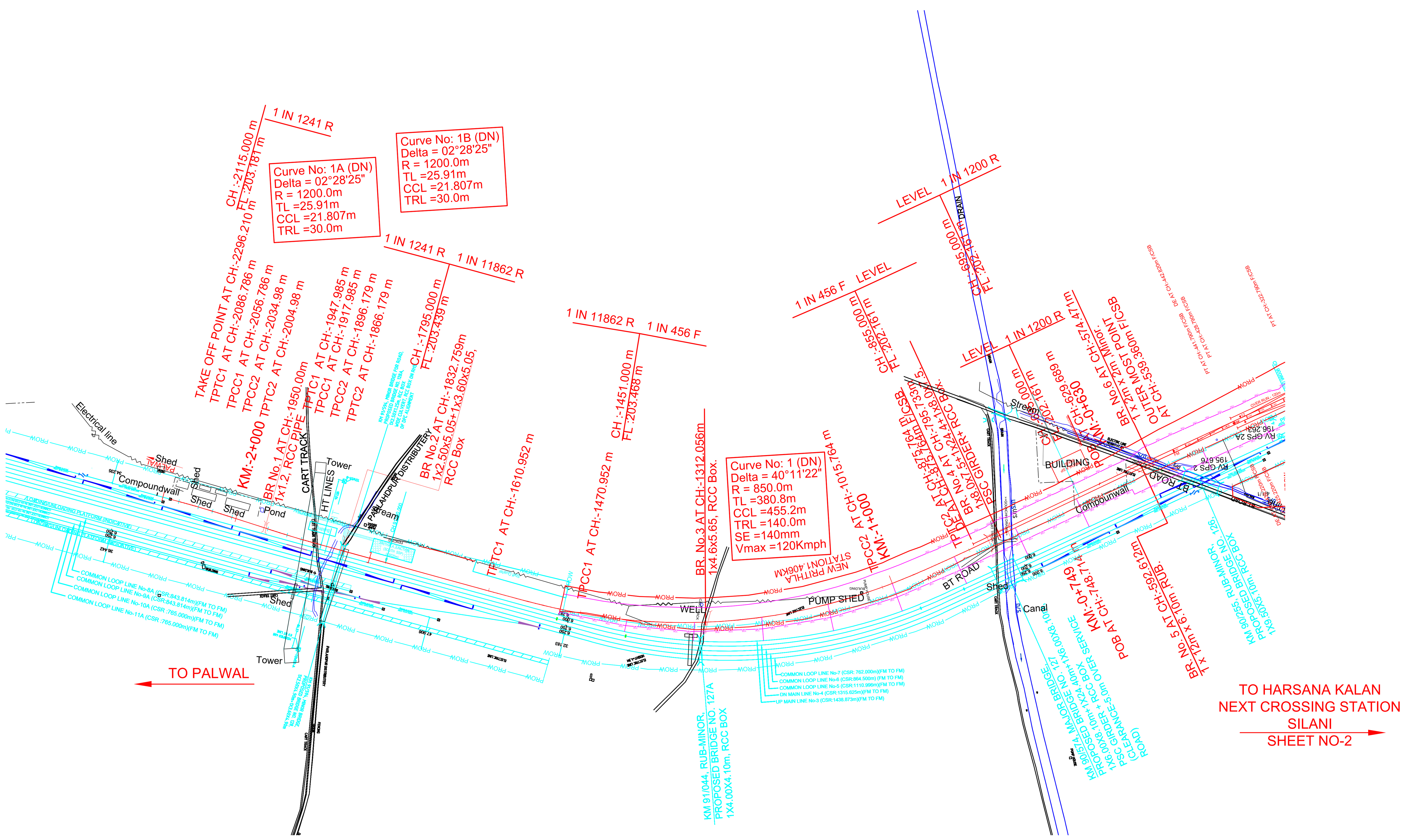
VII-8A : Tender Drawings

I. Civil Drawings

1. ALIGNMENT PLAN & L-SECTION



LEGEND:

EXISTING RAILWAY TRACK	
PROPOSED UP & DN LINE	
DFCC WORKS	
DISMANTLING WORKS	
PROPOSED DIVERSIONS	
EXISTING ROAD	
PRO.HORC BOUNDARY	PROW
DFCC BOUNDARY	PROW
HT LINE	
ELECTRICAL LINE(LT)	
STREAM / CANAL / DRAIN	
WELL	
POND	
PRO.TOE LINE	TOE TOE

NOTE:-

1. ALL DIMENSIONS ARE IN METRE UNLESS OTHERWISE STATED
2. ALL THE LEVELS ARE WITH RESPECT TO MEAN SEA LEVEL.
3. TRACK CETRE BETWEEN MAIN LINES OF HORC HAS BEEN KEPT AS MIN 5.30m
4. PUBLIC UTILITIES HT/LT LINES OFC CABLES WATER /SEWER LINES ETC INTERFERING WITH DFC TRACKS SHALL BE RELOCATED.
5. ARRANGEMENT & SIZE OF THE BRIDGE SHOWN IN THE DRAWING IS TENTATIVE AND MAY CHANGE AS PER THE APPROVED GAD.
6. VERTICAL CLEARANCE FROM LOWEST CONDUCTOR OF HT POWER LINE TO PROPOSED RAIL LEVEL ARE SHOWN

PROPOSED TRACK STRUCTURE (TO SUIT FOR 25T AXLE LOAD)

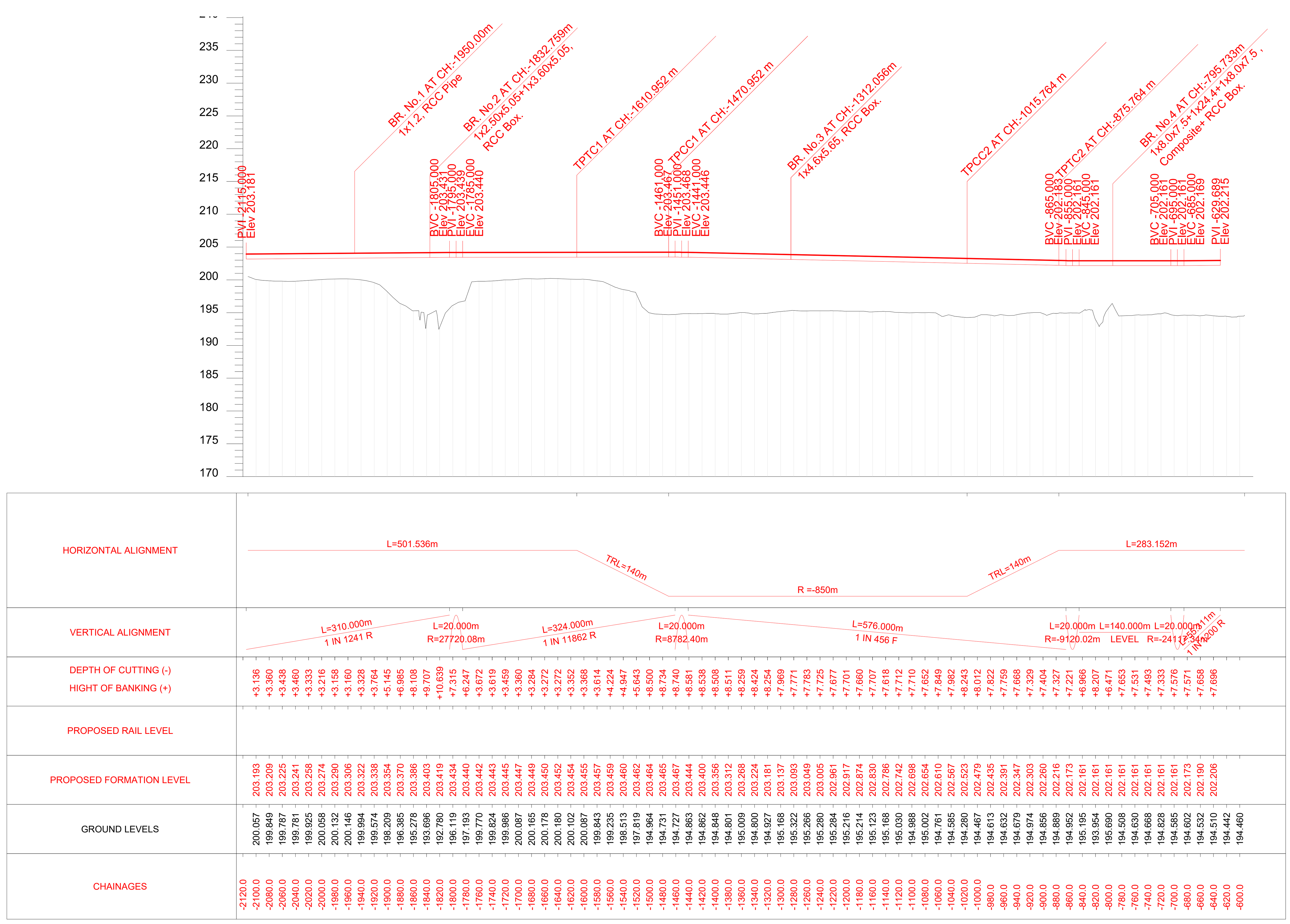
I. FOR RAIL CORRIDOR: 160KMPH Speed
- * TRACK = 60KG RAILS
- * SLEEPER DENSITY : PSC SLEEPERS = 1660 No.S PER KM
- * BALLAST CUSHION : 350mm
- * ALL TURNOUTS ARE 1 in 12 UNLESS OTHERWISE SPECIFIED.

ABBREVIATIONS:-

1. BVC - BEGIN OF VERTICAL CURVE
2. PVI - POINT OF VERTICAL INTERSECTION
2. EVC - END OF VERTICAL CURVE

LEGEND FOR PROFILE :

- PROPOSED RAIL PROFILE
- PROPOSED FORMATION PROFILE
- GROUND PROFILE



LONGITUDINAL PROFILE

GC/HORC	
NAME / DESIGNATION	SIGN
CHAHATEY RAM *PD*	Chahatey Ram
SUDHIR AGRAWAL *DPD/CIVIL*	
KRISHAN CHAND SAINSI *CRE/CIVIL*	

HRIDC	
NAME / DESIGNATION	SIGN
NEERAJ BHANDARI *CPM/SOUTH*	
RAJU SOLANKI *DGM/CIVIL*	

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

GENERAL CONSULTANT:
GENERAL CONSULTANT FOR
HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

TITLE : CONCEPTUAL PLAN & LONGITUDINAL SECTION (-2.296 KM TO -0.6 KM)

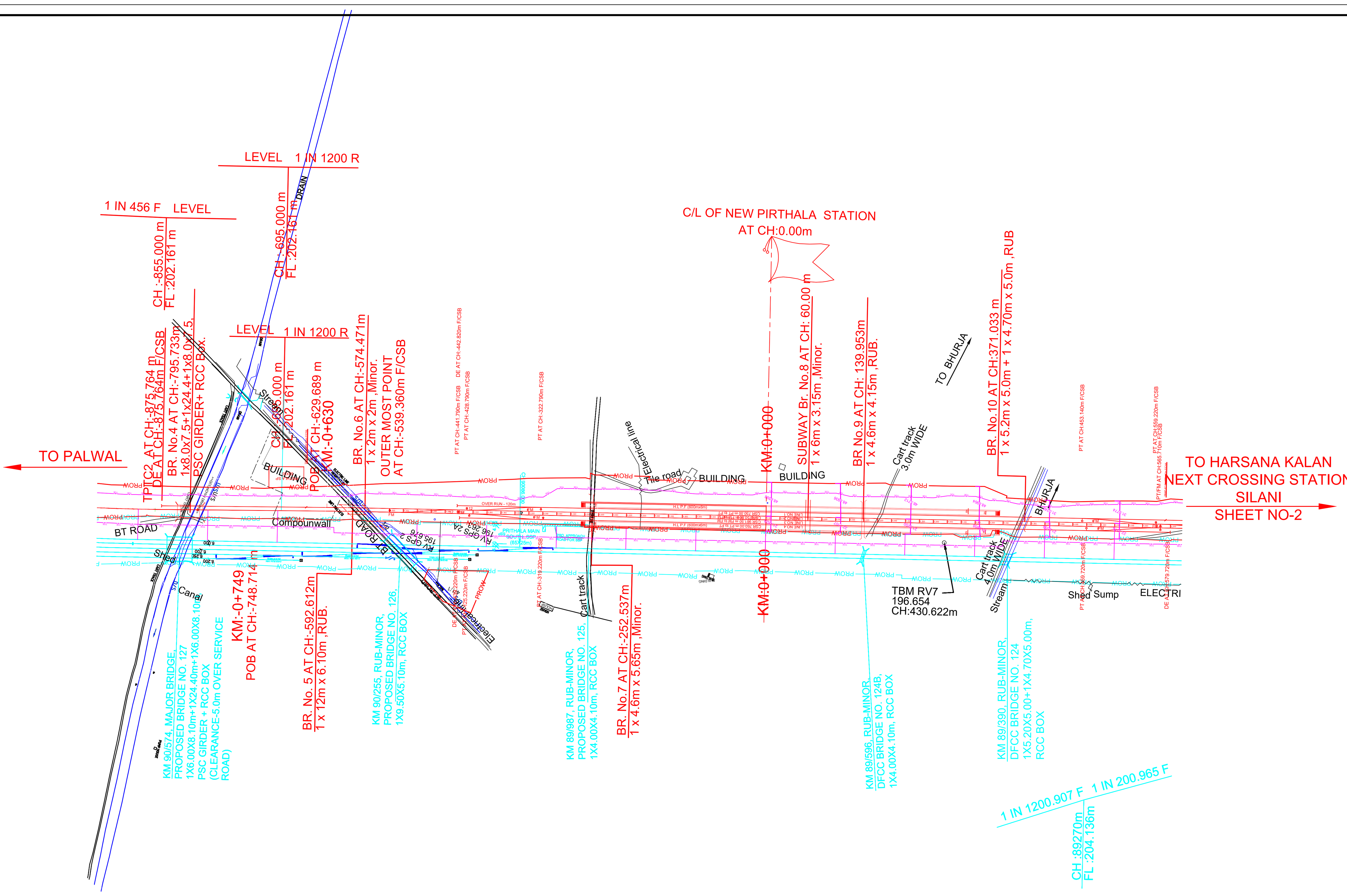
GC DRG.NO. GC-HRIDC-ALL-DRW-ALN-P&P-(-2.296)-(-0.6)KM_A0

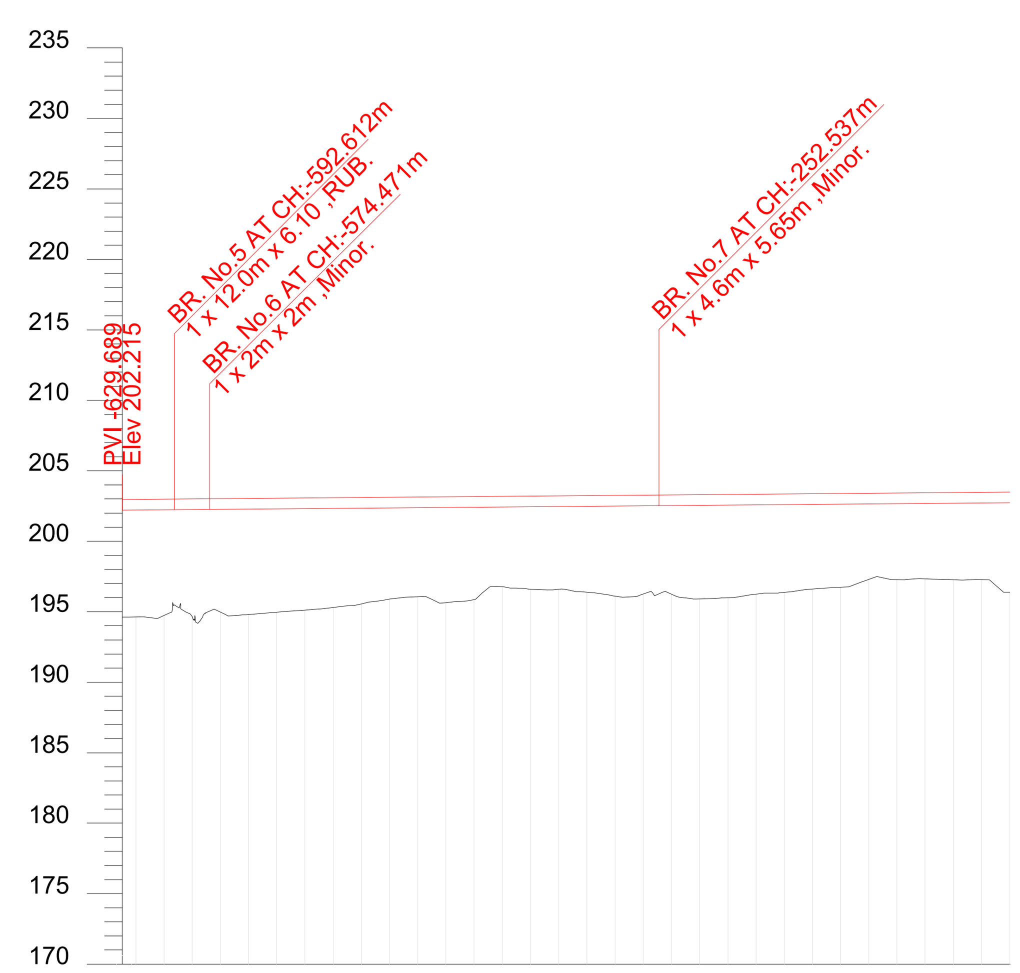
ISSUE Dt: 22.06.2023 | REVISED Dt:

CONSULTANTS :
aarvee associates
architects engineers & consultants pvt.ltd.
Ravula Residency, Srinagar Colony Main Rd., Hyderabad-82, India
Tel: 91-40-23737633; Fax: 91-40-23736277
e-mail: railways@aarvee.net; web:www.aarvee.net

AARVEE ASSOCIATES		
TANMAY (AM CAD) DRAWN	G.PRASAD (M) CHECKED	N.J. RAO (VP) APPROVED

DRG.NO.AA/2245/AL/DR/P&P/R3 | SHEET No. 1 OF 24
SCALE : H = 1:5000 V = 1:500 | ISSUED Dt: 26.11.2019 | REV Dt: 06-08-2022





HORIZONTAL ALIGNMENT: L=1544.246m

VERTICAL ALIGNMENT: L=1478.535m, 1 IN 1200 R

CHAINAGES	GROUND LEVELS	PROPOSED FORMATION LEVEL	PROPOSED RAIL LEVEL	DEPTH OF CUTTING (-) HIGHT OF BANKING (+)
-629.7	194.610	202.223	202.965	+7.588
-620.0	194.635			
-600.0	194.741	202.240	202.982	+7.499
-580.0	194.654	202.257	202.999	+7.603
-560.0	194.973	202.273	203.015	+7.300
-540.0	194.805	202.290	203.032	+7.485
-520.0	194.969	202.307	203.049	+7.338
-500.0	195.118	202.323	203.065	+7.205
-480.0	195.304	202.340	203.082	+7.036
-460.0	195.546	202.357	203.099	+6.811
-440.0	195.907	202.373	203.115	+6.466
-420.0	196.073	202.390	203.132	+6.317
-400.0	195.654	202.407	203.149	+6.753
-380.0	195.856	202.423	203.165	+6.567
-360.0	196.768	202.440	203.182	+5.672
-340.0	196.600	202.457	203.199	+5.857
-320.0	196.598	202.473	203.215	+5.875
-300.0	196.390	202.490	203.232	+6.100
-280.0	196.105	202.507	203.249	+6.402
-260.0	196.267	202.523	203.265	+6.256
-240.0	196.254	202.540	203.282	+6.286
-220.0	195.912	202.557	203.299	+6.645
-200.0	195.998	202.573	203.315	+6.575
-180.0	196.240	202.590	203.332	+6.350
-160.0	196.376	202.607	203.349	+6.231
-140.0	196.615	202.623	203.365	+6.008
-120.0	196.739	202.640	203.382	+5.901
-100.0	197.299	202.657	203.399	+5.358
-80.0	197.283	202.673	203.415	+5.390
-60.0	197.332	202.690	203.432	+5.358
-40.0	197.274	202.707	203.449	+5.433
-20.0	197.282	202.723	203.465	+5.441
0.0	196.393	202.740	203.482	+6.347

LONGITUDINAL PROFILE

LEGEND:

- EXISTING RAILWAY TRACK
- PROPOSED UP & DN LINE
- DFCC WORKS
- DISMANTLING WORKS
- PROPOSED DIVERSIONS
- EXISTING ROAD
- PRO.HORC BOUNDARY — PROW
- DFCC BOUNDARY — PROW
- HT LINE
- ELECTRICAL LINE(LT)
- STREAM / CANAL / DRAIN
- WELL
- POND
- PRO.TOE LINE

NOTE:-

1. ALL DIMENSIONS ARE IN METRE UNLESS OTHERWISE STATED
2. ALL THE LEVELS ARE WITH RESPECT TO MEAN SEA LEVEL.
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PROPOSED TRACK STRUCTURE (TO SUIT FOR 25T AXLE LOAD)

I. FOR RAIL CORRIDOR: 160KMPH Speed
* TRACK = 60KG RAILS
* SLEEPER DENSITY : PSC SLEEPERS = 1660 No.S PER KM
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* ALL TURNOUTS ARE 1 in 12 UNLESS OTHERWISE SPECIFIED.

ABBREVIATIONS:-

1. BVC - BEGIN OF VERTICAL CURVE
2. PVI - POINT OF VERTICAL INTERSECTION
2. EVC - END OF VERTICAL CURVE

LEGEND FOR PROFILE :

- PROPOSED RAIL PROFILE
- PROPOSED FORMATION PROFILE
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GC/HORC	
NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram
SUDHIR AGRAWAL DPD/CIVIL	
KRISHAN CHAND SAINSI CRE/CIVIL	

HRIDC	
NAME / DESIGNATION	SIGN
SHIV OM DWIVEDI CPM/HRIDC	
RAJU SOLANKI DGM/CIVIL	

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

GENERAL CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE | SMEC

TITLE : CONCEPTUAL PLAN & LONGITUDINAL SECTION (-0.6 KM TO 0.0 KM)

GC DRG.NO. GC-HRIDC-ALL-DRW-ALN-P&P-(-0.6)-(0.0)KM_A0

ISSUE Dt: 22.06.2023 | REVISED Dt:

CONSULTANTS : AARVEE ASSOCIATES

aarvee associates
architects engineers & consultants pvt.ltd.
Ravula Residency, Srinagar Colony Main Rd., Hyderabad-82, India
Tel: 91-40-23737633; Fax: 91-40-23736277
e-mail: railways@aarvee.net; web:www.aarvee.net

TANMAY (AM CAD) DRAWN | G.PRASAD (M) CHECKED | N.J. RAO (VP) APPROVED

DRG.NO.AA/2245/AL/DR/P&P/R3 | SHEET No. 2 OF 24

SCALE : H = 1:5000 V = 1:500 | ISSUED Dt: 26.11.2019 | REV Dt: 06-08-2022

LEGEND:

- EXISTING RAILWAY TRACK
- PROPOSED UP & DN LINE
- DFCC WORKS
- DISMANTLING WORKS
- PROPOSED DIVERSIONS
- EXISTING ROAD
- PRO.HORC BOUNDARY — PROW
- DFCC BOUNDARY — PROW
- HT LINE
- ELECTRICAL LINE(LT)
- STREAM / CANAL / DRAIN
- WELL
- POND
- PRO.TOE LINE — TOE TOE

NOTE:-

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ABBREVIATIONS:-

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2. PVI - POINT OF VERTICAL INTERSECTION
2. EVC - END OF VERTICAL CURVE

LEGEND FOR PROFILE :

- PROPOSED RAIL PROFILE
- PROPOSED FORMATION PROFILE
- GROUND PROFILE

GC/HORC	
NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram
SUDHIR AGRAWAL DPD/CIVIL	
KRISHAN CHAND SAINSI CRE/CIVIL	

HRIDC	
NAME / DESIGNATION	SIGN
NEERAJ BHANDARI CPM/HRIDC	
RAJU SOLANKI DGM/CIVIL	

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

GENERAL CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE | SMEC

TITLE : CONCEPTUAL PLAN & LONGITUDINAL SECTION (0.0 KM TO 5.0 KM)

GC DRG.NO. GC-HRIDC-ALL-DRW-ALN-P&P-0-5KM_A1

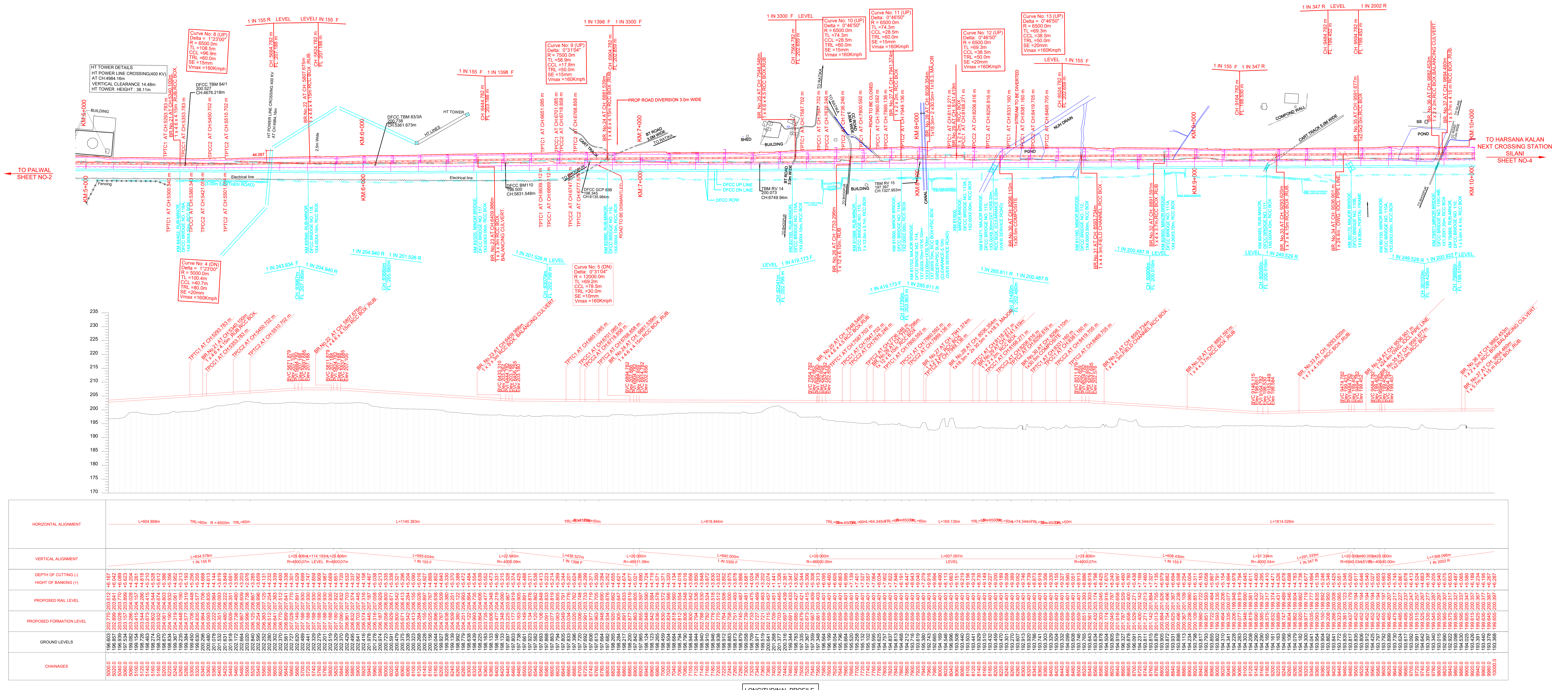
ISSUE Dt: 22.06.2023 | REVISED Dt: 11.12.2023

CONSULTANTS : aarvee associates
architects engineers & consultants pvt.ltd.
Ravula Residency, Srinagar Colony Main Rd., Hyderabad-82, India
Tel: 91-40-23737633; Fax: 91-40-23736277
e-mail: railways@aarvee.net; web:www.aarvee.net

AARVEE ASSOCIATES

TANMAY (AM CAD) DRAWN	G.PRASAD (M) CHECKED	N.J. RAO (VP) APPROVED

DRG.NO.AA/2245/AL/DR/P&P/R3 | SHEET No. 3 OF 24
SCALE : H = 1:5000 V = 1:500 | ISSUED Dt: 26.11.2019 | REV Dt: 06-08-2022



LEGEND:

EXISTING RAILWAY TRACK	
PROPOSED UP & DN LINE	
DFCC WORKS	
DISMANTLING WORKS	
PROPOSED DIVERSIONS	
EXISTING ROAD	
PRO.HORC BOUNDARY	PROW
DFCC BOUNDARY	PROW
HT LINE	
ELECTRICAL LINE(LT)	
STREAM / CANAL / DRAIN	
WELL	
POND	
PRO.TOE LINE	TOE TOE

NOTE:-
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I. FOR RAIL CORRIDOR: 160KMPH Speed
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ABBREVIATIONS:-
1. BVC - BEGIN OF VERTICAL CURVE
2. PVI - POINT OF VERTICAL INTERSECTION
2. EVC - END OF VERTICAL CURVE

LEGEND FOR PROFILE :
PROPOSED RAIL PROFILE
PROPOSED FORMATION PROFILE
GROUND PROFILE

GC/HORC

NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	
SUDHIR AGRAWAL DPD/CIVIL	
KRISHAN CHAND SAINSI CRE/CIVIL	

HRIDC

NAME / DESIGNATION	SIGN
SHIV OM DWIVEDI CPM/HRIDC	
RAJU SOLANKI DGM/CIVIL	

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

GENERAL CONSULTANT:
GENERAL CONSULTANT FOR
HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

TITLE : CONCEPTUAL PLAN & LONGITUDINAL SECTION (5.0 KM TO 10.0 KM)

GC DRG.NO. GC-HRIDC-ALL-DRW-ALN-P&P-5-10KM_A0

ISSUE Dt: 22.06.2023 | REVISED Dt:

CONSULTANTS : aarvee associates
architects engineers & consultants pvt.ltd.
Ravula Residency, Srinagar Colony Main Rd., Hyderabad-82, India
Tel: 91-40-23737633; Fax: 91-40-23736277
e-mail: railways@aarvee.net; web:www.aarvee.net

AARVEE ASSOCIATES
TANMAY (AM CAD) DRAWN | G.PRASAD (M) CHECKED | N.J. RAO (VP) APPROVED

DRG.NO.AA/2245/AL/DR/P&P/R3 | SHEET No. 4 OF 24
SCALE : H = 1:5000 V = 1:500 | ISSUED Dt: 26.11.2019 | REV Dt: 06-08-2022

LEGEND:

EXISTING RAILWAY TRACK	
PROPOSED UP & DN LINE	
DFCC WORKS	
DISMANTLING WORKS	
PROPOSED DIVERSIONS	
EXISTING ROAD	
PRO.HORC BOUNDARY	PROW
DFCC BOUNDARY	PROW
HT LINE	
ELECTRICAL LINE(LT)	
STREAM / CANAL / DRAIN	
WELL	
POND	
PRO.TOE LINE	TOE TOE

NOTE:-
1. ALL DIMENSIONS ARE IN METRE UNLESS OTHERWISE STATED
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3. TRACK CETRE BETWEEN MAIN LINES OF HORC HAS BEEN KEPT AS MIN 5.30m
4. PUBLIC UTILITIES HT/LT LINES OFC CABLES WATER /SEWER LINES ETC INTERFERING WITH DFC TRACKS SHALL BE RELOCATED.
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6. VERTICAL CLEARANCE FROM LOWEST CONDUCTOR OF HT POWER LINE TO PROPOSED RAIL LEVEL ARE SHOWN

PROPOSED TRACK STRUCTURE (TO SUIT FOR 25T AXLE LOAD)

I. FOR RAIL CORRIDOR: 160KMPH Speed
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* SLEEPER DENSITY : PSC SLEEPERS = 1660 No.S PER KM
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ABBREVIATIONS:-
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LEGEND FOR PROFILE :
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GC/HORC

NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram
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KRISHAN CHAND SAINSI CRE/CIVIL	

HRIDC

NAME / DESIGNATION	SIGN
SHIV OM DWIVEDI CPM/HRIDC	
RAJU SOLANKI DGM/CIVIL	

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

GENERAL CONSULTANT:
GENERAL CONSULTANT FOR
HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE | SMEC

TITLE : CONCEPTUAL PLAN & LONGITUDINAL SECTION
10 KM TO 15 KM

GC DRG.NO. GC-HRIDC-ALL-DRW-ALN-P&P-10-15KM_A2

ISSUE Dt: 07.11.2022 | REVISED Dt: 22.06.2023

CONSULTANTS : aarvee associates
architects engineers & consultants pvt.ltd.
Ravula Residency, Srinagar Colony Main Rd., Hyderabad-82, India
Tel: 91-40-23737633; Fax: 91-40-23736277
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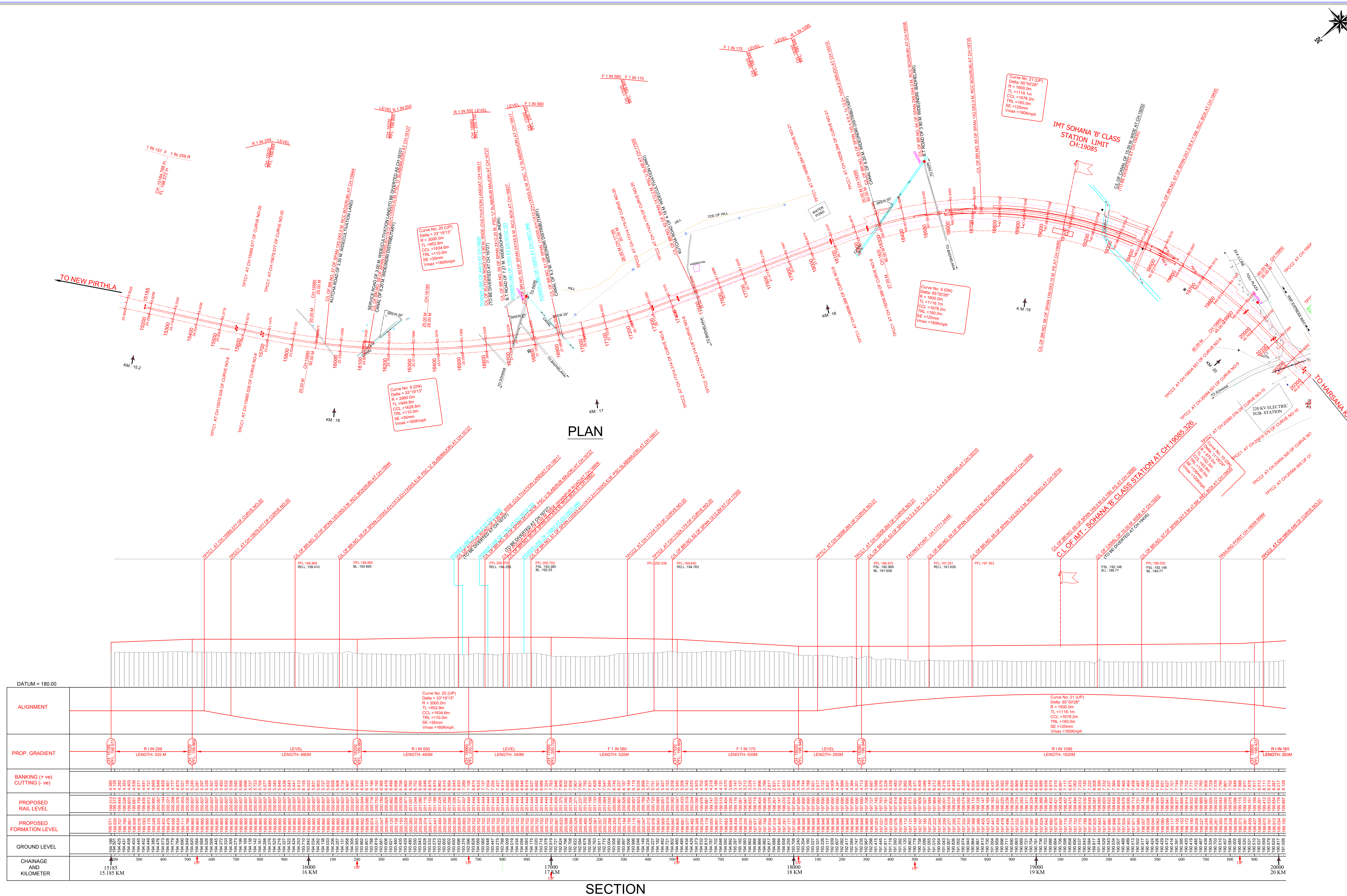
AARVEE ASSOCIATES

TANMAY (AM CAD) DRAWN	G.PRASAD (M) CHECKED	N.J. RAO (VP) APPROVED

DRG.NO.AA/2245/AL/DR/P&P/R3 | SHEET No. 5 OF 24
SCALE : H = 1:5000 V = 1:500 | ISSUED Dt: 26.11.2019 | REV Dt: 06-08-2022



LEGEND:

- EXISTING RAILWAY TRACK
- PROPOSED UP & DN LINE
- EXPRESSWAY
- DISMANTLING WORKS
- PROPOSED DIVERSIONS
- EXISTING ROAD
- PRO.HORC BOUNDARY
- EXPRESSWAY BOUNDARY
- HT LINE
- ELECTRICAL LINE(LT)
- STREAM / CANAL / DRAIN
- WELL
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- PROPOSED FORMATION PROFILE
- GROUND PROFILE

LIST OF TBM

TBM No.	Easting	Northing	Elevation
SM-1	705588.878	3121113.675	194.387
SM-2	704934.348	3119300.444	193.774
SM-3	703675.564	3118674.358	193.601

GC/HORC

NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	
SUDHIR AGRAWAL DPD/CIVIL	
KRISHAN CHAND SAINSI CRE/CIVIL	

HRIDC

NAME / DESIGNATION	SIGN
SHIV OM DWIVEDI CPM/HRIDC	
RAJU SOLANKI DGM/CIVIL	

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
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GENERAL CONSULTANT:
GENERAL CONSULTANT FOR
HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

TITLE : CONCEPTUAL PLAN & LONGITUDINAL SECTION 15 KM TO 20 KM

GC DRG.NO. GC-HRIDC-ALL-DRW-ALN-P&P-15-20KM_A2

ISSUE Dt: 07.11.2022 | REVISED Dt: 22.06.2023

SCALE: HORIZONTAL 1 :5000 VERTICAL 1:500

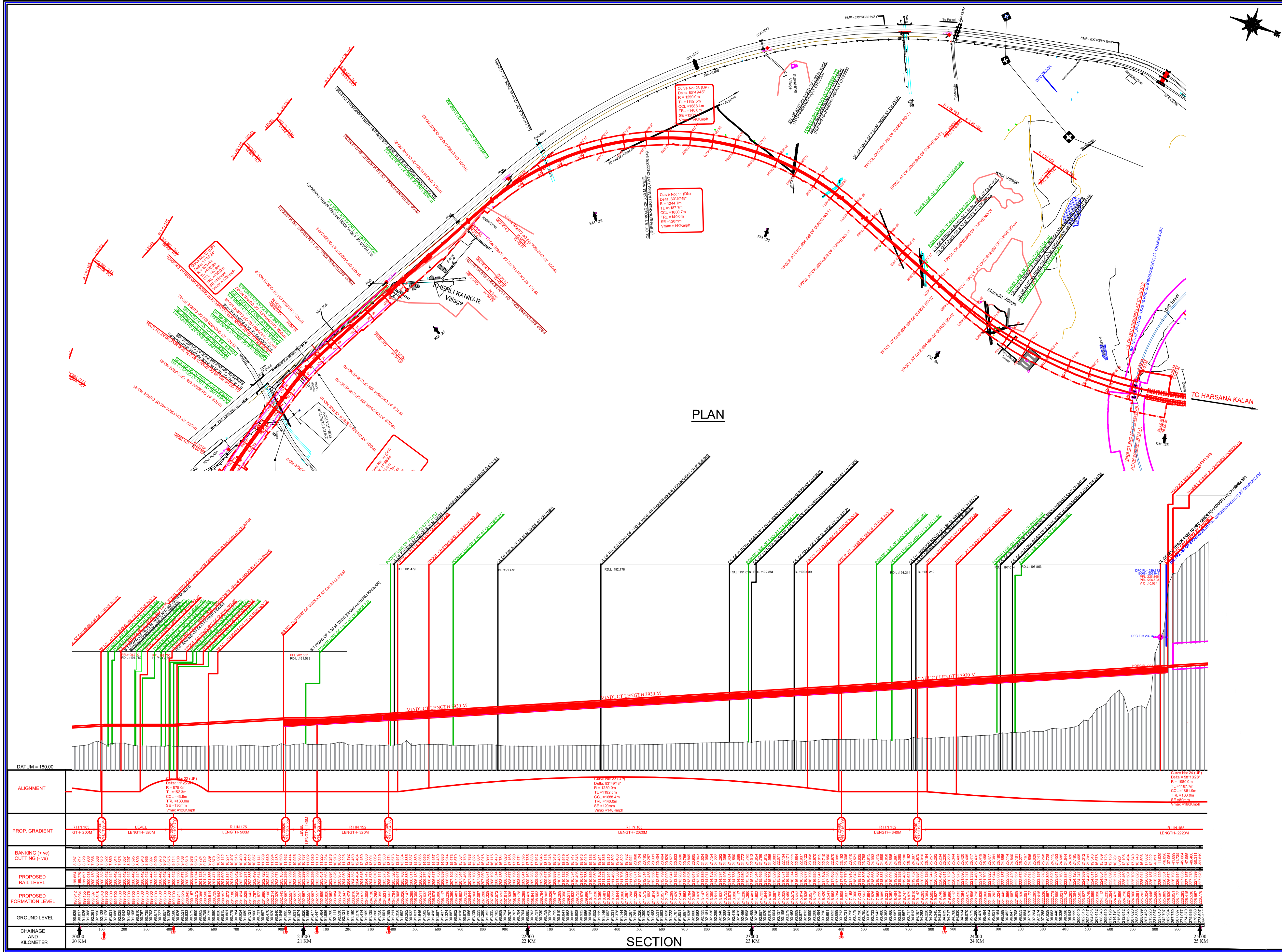
SMC DRG. NO:- SMC/HRIDC/TUNNEL/LS- (R-4)

CONSULTANT: S.M.C. S.M. CONSULTANTS
An ISO 9001 Company
Bhubaneswar / Balasore / Secunderabad / South Andaman / New Delhi
Web : www.smcindia.com , E-Mail : support@smcindia.com

DRAWN BY:- L.MOHANTY | CHECKED BY:- SIVRAM J

A. A. SAMANT
PROJECT INCHARGE

RELEASED FOR: PRELIMINARY FOR APPROVAL | ☑ TENDER | CONSTRUCTION



LEGEND:

- EXISTING RAILWAY TRACK
- PROPOSED UP & DN LINE
- DFCC WORKS
- DISMANTLING WORKS
- PROPOSED DIVERSIONS
- EXISTING ROAD
- PRO.HORC BOUNDARY
- EXPRESSWAY BOUNDARY
- HT LINE
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2. ALL THE LEVELS ARE WITH RESPECT TO MEAN SEA LEVEL.
3. TRACK CETRE BETWEEN MAIN LINES OF HORC HAS BEEN KEPT AS MIN 5.30m
4. PUBLIC UTILITIES HT/LT LINES OFC CABLES WATER /SEWER LINES ETC INTERFERING WITH DFC TRACKS SHALL BE RELOCATED.
5. ARRANGEMENT & SIZE OF THE BRIDGE SHOWN IN THE DRAWING IS TENTATIVE AND MAY CHANGE AS PER THE APPROVED GAD.
6. VERTICAL CLEARANCE FROM LOWEST CONDUCTOR OF HT POWER LINE TO PROPOSED RAIL LEVEL ARE SHOWN

PROPOSED TRACK STRUCTURE (TO SUIT FOR 25T AXLE LOAD)

I. FOR RAIL CORRIDOR: 160KMPH Speed

* TRACK = 60KG RAILS
* SLEEPER DENSITY : PSC SLEEPERS = 1660 No.S PER KM
* BALLAST CUSHION : 350mm
* ALL TURNOUTS ARE 1 in 12 UNLESS OTHERWISE SPECIFIED.

ABBREVIATIONS:-

1. BVC - BEGIN OF VERTICAL CURVE
2. PVI - POINT OF VERTICAL INTERSECTION
2. EVC - END OF VERTICAL CURVE

LEGEND FOR PROFILE :

- PROPOSED RAIL PROFILE
- PROPOSED FORMATION PROFILE
- GROUND PROFILE

GC/HORC	
NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	
SUDHIR AGRAWAL DPD/CIVIL	
KRISHAN CHAND SAINSI CRE/CIVIL	

HRIDC	
NAME / DESIGNATION	SIGN
NEERAJ BHANDARI CPM/HRIDC	
RAJU SOLANKI DGM/CIVIL	

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

GENERAL CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

TITLE : CONCEPTUAL PLAN & LONGITUDINAL SECTION 20 KM TO 25 KM

GC DRG.NO. GC-HRIDC-ALL-DRW-ALN-P&P-20-25KM_A1

ISSUE Dt: 22.06.2023 | REVISED Dt: 11.12.2023

SCALE HORIZONTAL 1:5000 VERTICAL 1:500

SMC DRG. NO:- SMC/HRIDC/TUNNEL/LS- (R-4)

CONSULTANT: S.M. CONSULTANTS
An ISO 9001 Company
Bhubaneswar / Balasore / Secunderabad / South Andaman / New Delhi
Web : www.smcindia.com , E-Mail : support@smcindia.com

DRAWN BY:- L.MOHANTY | CHECKED BY:- SIVRAM J

A. A. SAMANT
PROJECT INCHARGE

RELEASED FOR: ☐ PRELIMINARY FOR APPROVAL ☑ TENDER ☐ CONSTRUCTION

2. ESP/YARD PLAN

NEW PRITHALA YARD

LINE NO	LINE NOTATION	START		END		TOTAL LENGTH OF CSR
LINE No-3A	UP MAIN LINE	FM	90321.538	FM	91760.411	1439
LINE No-4A	DN MAIN LINE	FM	90321.538	FM	91637.160	1316
LINE No-5	COMMON LOOP	FM	90397.519	FM	91508.515	1111
LINE No-6	COMMON LOOP	FM	90520.767	FM	91385.267	864
LINE No-7	COMMON LOOP	FM	90520.767	FM	91282.767	762

NEW PRITHALA YARD

LINE NO	LINE NOTATION	START		END		TOTAL LENGTH OF CSR
LINE No-1B	COMMON LOOP	FM	92309.396	FM	92974.730	765
LINE No-8B	GOODS SIDING	DS	92050.792	BS	[illegible]	860
LINE No-9B	COMMON LOOP	FM	91746.798	FM	92520.798	774
LINE No-10B	COMMON LOOP	FM	91680.321	FM	92442.321	762
LINE No-11B	GOODS SIDING	BS	91358.467	FM	92273.469	915
LINE No-8B	GOODS SIDING	DS	91914.604	BS	92785.553	871

NEW PRITHALA YARD

LINE NO	LINE NOTATION	START		END		TOTAL LENGTH OF CSR
~~LINE No-1B~~	~~COMMON LOOP~~	~~FM~~	~~92119.555~~	~~FM~~	~~92974.730~~	~~855~~
LINE No-2B	COMMON LOOP	FM	92119.555	FM	92884.555	765
LINE No-3B	UP MAIN LINE	FM	91990.907	FM	92884.555	894
LINE No-4B	DN MAIN LINE	FM	91867.659	FM	93114.505	1247
LINE No-5B	COMMON LOOP	FM	91747.411	FM	93020.505	1273
LINE No-6B	COMMON LOOP	FM	91624.163	FM	92930.330	1306
LINE No-7B	COMMON LOOP	FM	91495.515	FM	92852.180	1357
~~LINE No-8B~~	~~COMMON LOOP~~	~~FM~~	~~91678.140~~	~~FM~~	~~92521.954~~	~~844~~
~~LINE No-9B~~	~~COMMON LOOP~~	~~FM~~	~~91678.140~~	~~FM~~	~~92521.954~~	~~844~~
~~LINE No-10B~~	~~COMMON LOOP~~	~~FM~~	~~91717.547~~	~~FM~~	~~92482.547~~	~~765~~
~~LINE No-11B~~	~~COMMON LOOP~~	~~FM~~	~~91717.547~~	~~FM~~	~~92482.547~~	~~765~~

C.O
GGM/Elect.
GGM/S&T
ED/AM/WDFC
GGM/OP&Safety

R2 DATE 22.09.2023
NOTES FOR R2:-

... DFC UP Main Line no. 3A has been revised from 7m to 7.2m.
... and Common Loop Line no. 1B has been revised from 10.5m to 8.0m and length of Machine Siding has been revised from 300m to 200m, ...
... o. 13 and Common Loop Line no. 1B has been revised from 10.5m to 8.0m and length of Tower Wagon Siding has been revised from 150m to 100m ... dingly, DS and BS has been revised. Therefore now CSR of Common Loop Line No. 1B has been revised from 765m to 779.8m.
... d and lines of Prithala Container Handling Depot have been revised and are as below:
... o. 8B has been revised. Therefore now CSR of Goods Siding No. 8B has been revised from 860m to 871m.
... en revised from 280m to 120m and will be same as per REV 0, due to infringement of Signaling East Cabin at Ch: 94350.
... ined in Line no. 2 at Dadri End at Ch: 94734.956 and (BS at Ch: 94734.956m to be dismantled).
... ection and DFC UP Main Line will be 6.6m instead of 6.25m in REV 0.

GC HORC / HRIDC	NR	DFCCIL		
		FIELD UNIT		C.O
PM	C.E./Survey/NR	PM/Elect.	GM/Elect.	GGM/Elect.
	Dy. C.E./Survey/NR	DPM/S&T	Dy. CPM/S&T	GGM/S&T
		APM/DPM/Engg.	Dy. CPM/Engg.	ED/AM/WDFC
		APM/DPM/OP&Safety	CGM	GGM/OP&Safety

NEW PRITHALA YARD

LINE NO	LINE NOTATION	START		END		TOTAL LENGTH OF CSR
LINE No-1	COMMON LOOP	FM	93158.874	FM	93920.874	762
LINE No-2	COMMON LOOP	FM	93055.730	FM	93920.874	865
LINE No-3	UP MAIN LINE	FM	92961.730	FM	94049.522	1088
LINE No-4A	DN MAIN LINE	FM	93191.680	FM	94205.545	1014
LINE No-5A	COMMON LOOP	FM	93191.680	FM	94076.897	885
LINE No-6A	COMMON LOOP	FM	93101.505	FM	93953.649	852
LINE No-7A	COMMON LOOP	FM	93007.505	FM	93850.505	843

DFCC CROSS OVER LENGTHS

LEGEND:

DFCC WORKS UNDER CONSTRUCTION	
EXISTING IR RAILWAY TRACK.	
PROPOSED UP & DN LINE DETAILS	
EXISTING DISMANTLING WORKS	
PROPOSED DIVERSIONS	
EXISTING ROAD	
FENCE	
HORC BOUNDARY	PROW PROW
PROPOSED RETAINING WALL	
HT LINE	
ELECTRICAL LINE(LT)	
STREAM / CANAL / DRAIN	
WELL	
POND	

F/PRITHLA, CH: m F/CSB-FROM CENTER LINE OF STN. BLDG.	RH - RIGHT HANDED
TP1 & TP2 - TANGENT POINT	LH - LEFT HANDED
R - RADIUS	FM - FOULING MARK
CCL - CIRCULAR CURVE LENGTH	SRJ - STOCK RAIL JOINT
TL - TANGENT LENGTH	TS - TRAP SWITCH
TR - TRANSITION LENGTH	DE - DEAD END
SE - SUPERELEVATION	Rr - RESULTANT RADIUS
Δ - DEFLECTION ANGLE	D - DEGREE OF CURVE
CSR - CLEAR STANDING ROOM	RH - RELAY HUT
SSP - SUB SECTIONING & PARALLING POST	

NOTE:

1. ALL DIMENSIONS ARE SHOWN IN METRES.
2. CH:0.00 IS RECKONED AS C.L OF STATION BUILDING.
3. THROUGH CHAINAGES ARE RECKONED FROM C.L OF PRITHLA STATION.
4. RULING GRADIENT FOR PRITHLA TO HARSANA KALAN SECTION IS 1 IN 150 COMPENSATED.
5. EI/SSI WITH STD. - IIIR DISTRIBUTED INTERLOCKING AND MACL AUTOMATIC SIGNALING SYSTEM SHALL BE PROVIDED.
6. ALL MAIN LINE POINTS & CROSSINGS ARE TO BE LAID WITH 60 Kg, 1 IN 12 THICK WEB SWITCH WITH WELDABLE CMS CROSSING.
7. TRACK STRUCTURE OF ALL NEW / REPLACEMENT OF LINES SHALL BE WITH 60 Kg RAILS ON WIDE BASE PSC SLEEPERS AT : SLEEPER DENSITY OF 1660 Nos/Km & BALLAST CUSHION 350 mm FOR MAIN LINE, SLEEPER DENSITY OF 1540 Nos/Km & BALLAST CUSHION 250 MM FOR LOOP LINE.

PROPOSED TRACK STRUCTURE (TO SUIT FOR 25T AXLE LOAD

I. FOR RAIL CORRIDOR: 160KMPH Speed
* TRACK = 60KG RAILS
* SLEEPER DENSITY : PSC SLEEPERS = 1660 No.S PER KM
* BALLAST CUSHION : 350mm
* ALL TURNOUTS ARE 1 in 12 UNLESS OTHERWISE SPECIFIED.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
RAJENDRA KR. BHAUGUNA DPD/EST			
KRISHAN CHAND SAINSI CRE/CIVIL			
C.S TEWARI SRE/S&T			
A.S. JANGHU CRE/ELECT.			

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE | SMEC

TITLE : CONCEPTUAL ENGINEERING SCALE PLAN PRITHLA JUNCTION YARD CH:00.00m F/PRITHLA

GC DRG.NO.: GC-HRIDC-C5-DRW-STN-ESP-PRI01_A0

ISSUED Dt: 15.06.2023 | REVISED Dt:

CONSULTANTS : aarvee associates
architects engineers & consultants pvt.ltd.
Ravula Residency, Srinagar Colony Main Rd., Hyderabad-82, India
Tel: 91-40-23737633; Fax: 91-40-23736277
e-mail: railways@aarvee.net; web:www.aarvee.net

AARVEE ASSOCIATES

MANISHA (AM CAD) DRAWN	G.PRASAD (M) CHECKED	N.J. RAO (VP) APPROVED

DRG.NO. AA/RLY/2245/HRIDC/ESP-02/REV-4 | SHEET No. 1
SCALE : 1:1000 | ISSUED Dt: 26.11.2019 | REV Dt: 28-09-2023

LEGEND:
EXISTING RAILWAY TRACK
PROPOSED UP & DN LINE
DFCC WORKS UNDER CONSTRUCTION
PROPOSED DIVERSIONS
EXISTING ROAD
PRO HORC BOUNDARY
EXPRESSWAY BOUNDARY
HT LINE
ELECTRICAL LINE(LT)
STREAM / CANAL / DRAIN
WELL
POND

F/CSB-FROM CENTER LINE OF STN BLDG	RH - RIGHT HANDED
TP1 & TP2 - TANGENT POINT	LH - LEFT HANDED
R - RADIUS	FM - FOULING MARK
CCL - CIRCULAR CURVE LENGTH	SRJ - STOCK RAIL JOINT
TL - TANGENT LENGTH	TS - TRAP SWITCH
TR - TRANSITION LENGTH	DE - DEAD END
SE - SUPERELEVATION	Rr - RESULTANT RADIUS
Δ - DEFLECTION ANGLE	D - DEGREE OF CURVE
CSR - CLEAR STANDING ROOM	RH - RELAY HUT
SSP - SUB SECTIONING & PARALLING POST	

NOTE:

1. ALL DIMENSIONS ARE SHOWN IN METRES.
2. CH:0.00 IS RECKONED AS C.L OF STATION BUILDING.
3. THROUGH CHAINAGES ARE RECKONED FROM C.L OF PRITHLA STATION.
4. RULING GRADIENT FOR PRITHLA TO HARSANA KALAN SECTION IS 1 IN 150 COMPENSATED.
5. EI/SSI WITH STD. - IIIR DISTRIBUTED INTERLOCKING AND MACL AUTOMATIC SIGNALING SYSTEM SHALL BE PROVIDED.
6. ALL MAIN LINE POINTS & CROSSINGS ARE TO BE LAID WITH 60 Kg, 1 IN 12 THICK WEB SWITCH WITH WELDABLE CMS CROSSING.
7. TRACK STRUCTURE OF ALL NEW / REPLACEMENT OF LINES SHALL BE WITH 60 Kg RAILS ON WIDE BASE PSC SLEEPERS AT :
SLEEPER DENSITY OF 1660 Nos/Km & BALLAST CUSHION 350 mm FOR MAIN LINE,
SLEEPER DENSITY OF 1540 Nos/Km & BALLAST CUSHION 250 MM FOR LOOP LINE.

PROPOSED TRACK STRUCTURE (TO SUIT FOR 25T AXLE LOAD

I. FOR RAIL CORRIDOR: 160KMPH Speed
* TRACK = 60KG RAILS
* SLEEPER DENSITY : PSC SLEEPERS = 1660 No.S PER KM
* BALLAST CUSHION : 350mm
* ALL TURNOUTS ARE 1 in 12 UNLESS OTHERWISE SPECIFIED.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		NEERAJ BHANDARI CPM SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
RAJENDRA KR. BHAUGUNA DPD/S&T			
KRISHAN CHAND SAINSI CRE/CIVIL			
C.S TEWARI SRE/S&T			
A.S. JANGHU CRE/ELECT.			

HARYANA ORBITAL RAIL CORRIDOR

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

TITLE: CONCEPTUAL ENGINEERING SCALE PLAN

AARVEE ASSOCIATES

X-OVER DETAILS

SL. NO	CHAINAGE START	CHAINAGE END	LENGTH OF X-OVER	OUTSIDE CURVE	INSIDE CURVE	TRACK CENTRE	THEORETICAL LENGTH
1	700.600	569.082	131.518	1 IN 12	1 IN 16	6.7	131.518
2	556.082	410.808	145.274	1 IN 12	1 IN 16	7.7	145.274
3	609.911	488.021	121.89	1 IN 12	1 IN 16	6	121.890
4	261.979	383.869	121.89	1 IN 12	1 IN 16	6	121.890
5	396.869	551.772	154.903	1 IN 12	1 IN 16	8.4	154.903
6	564.772	719.675	154.903	1 IN 12	1 IN 16	8.4	154.903
7	498.772	339.192	159.58	1 IN 12	1 IN 16	8.74	159.580

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/ HRIDC	
SUDHIR AGRAWAL DPD/CIVIL		VIKRAM YADAV GM/ IE / HRIDC	
RAJENDRA KR. BHAUGUNA DPD/EST		RAJU SOLANKI DGM/CIVIL	
KRISHAN CHAND SAINSI CRE/CIVIL		JYOTI SANGWAN DGM/ELEC.	Jyoti Sangwan
A.S. JANGHU CRE/ELECT.		AM/S&T	

NORTHERN RAILWAY

DELHI DIVISION

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

GENERAL CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International SRJy. Ltd.

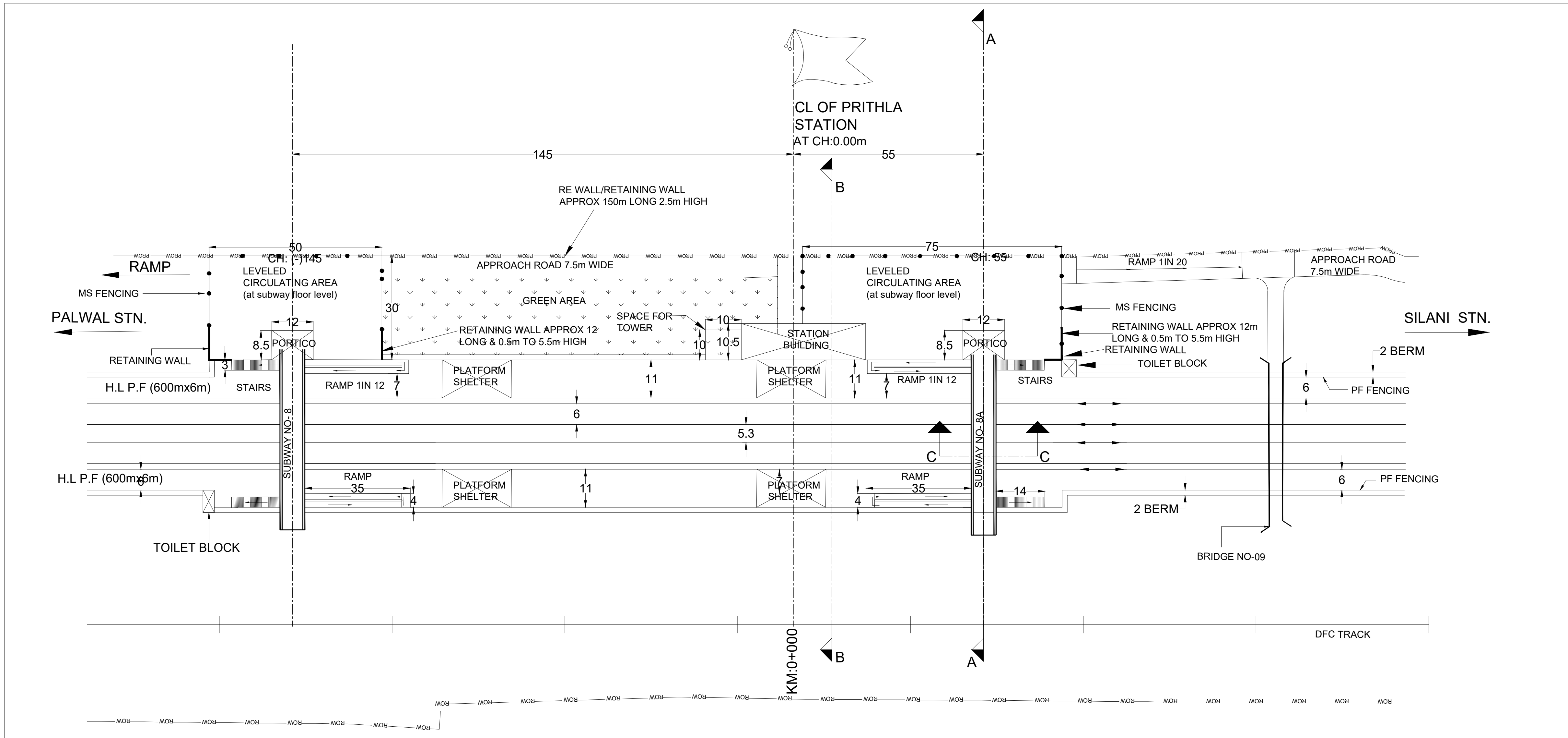
RITES THE INFRASTRUCTURE PEOPLE | SMEC

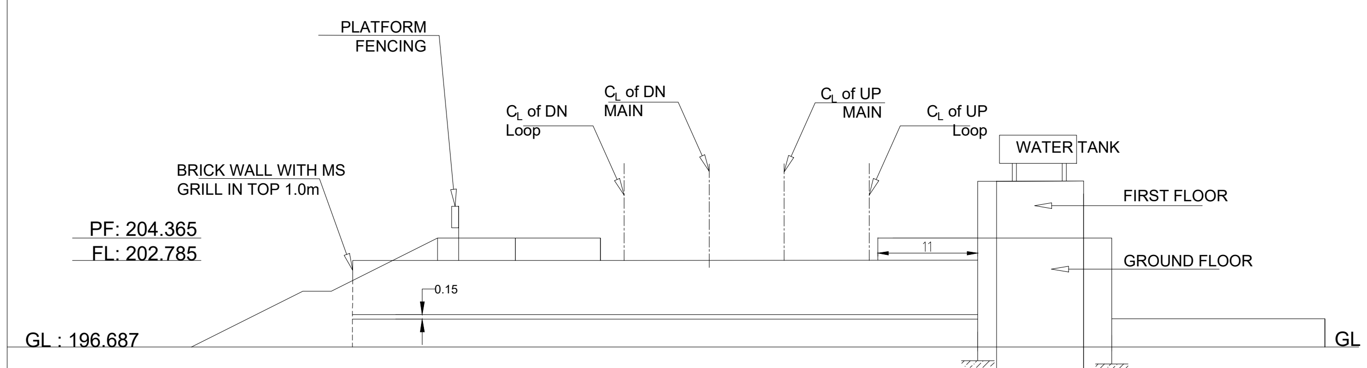
DRAWING NAME	CONCEPTUAL ENGINEERING SCALE PLAN IMT SOHNA
GC/HORC DRG. NO:-	GC-HRIDC-C5-DRW-STN-ESP-SOH01-A1
ISSUE DATE:	05.08.2023 — REVISED DATE: 01.12.2023
SCALE	1:1000 1MM:1METRE (8 4 0 10 20 30 METRES; 10 6 2)
SMC DRG. NO:-	HRIDC/PS/LP-1
CONSULTANT:	S.M.C. S.M. CONSULTANTS An ISO 9001 Company Bhubaneswar / Balasore / Secunderabad / South Andaman / New Delhi Web : www.smcindia.com , E-Mail : support@smcindia.com
DRAWN BY:-	R.DAS — CHECKED BY:- A. A SAMANT
RELEASED FOR	☐ PRELIMINARY FOR APPROVAL — ☑ TENDER — ☐ CONSTRUCTION

S. M. CONSULTANTS BHUBANESWAR

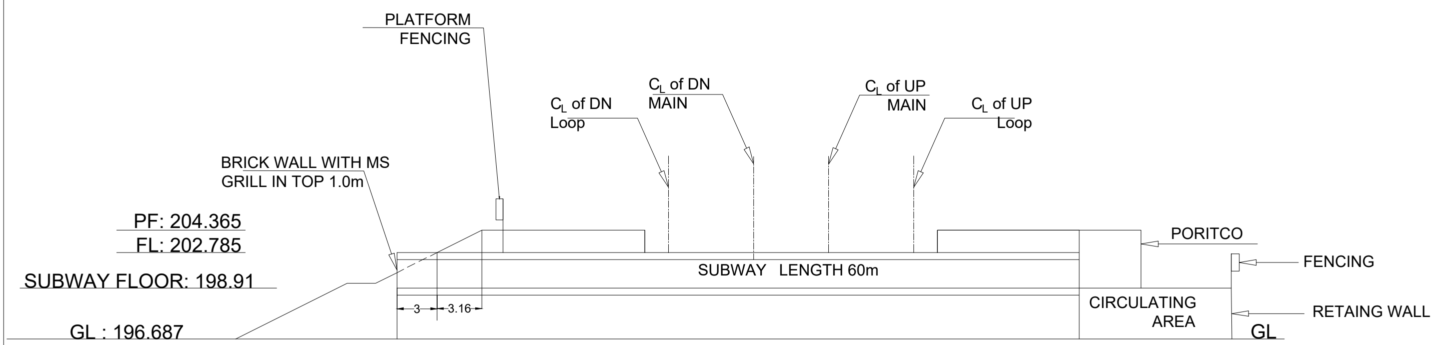
A. A. SAMANT
PROJECT INCHARGE

3. STATION BUILDING AND SUBWAY

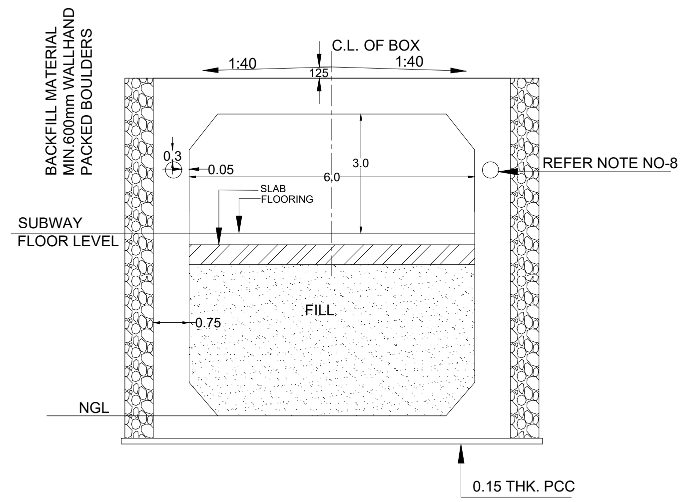




SECTION AT B-B



SECTION AT A-A



SECTION AT C-C

BRIDGE NO.	CHAINAGE	GL	SUBWAY FLOOR LEVEL	FORMATION LEVEL
8	-0145	196.615	198.748	202.623
8A	+55	196.687	198.910	202.785

NOTES:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE MENTIONED.
2. ALL LEVEL ARE IN METERS.
3. PROTECTION WORK ON SLOPES OF BANK UP TO 15M, BOTH SIDES ON APPROACHES OF SUBWAY SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015.
4. STAINLESS STEEL (SS 304) HAND RAIL SHALL BE FIXED WITH WALL IN STAIRCASE & RAMP.
5. SELF-SUPPORTING SHED SHALL BE PROVIDED OVER STAIRS AND RAMP AS PER SKETCH NO. GC-HRIDC-SK-GEN-020.
6. FOUNDING LEVEL OF SUBWAY SHALL BE BELOW NATURAL GROUND LEVEL CONSIDERING DESIGN, BEARING CAPACITY AND SAFETY REQUIREMENTS.HOWEVER CLEAR OPENING OF THE SUBWAY SHALL NOT BE LESS THAN THAT SHOWN IN THE DRAWING.
7. CIRCULATING AREA AND STATION APPROACH ROAD INCLUDING ITS RETAINING STRUCTURE SHALL BE PAID UNDER SCHEDULE 'B'.
8. CONTRACTOR SHALL LAY 32mm DIA GI CONDUIT IN BOTH SIDE WALL OF SUBWAY AND PROVIDE JUNCTION BOX AT EVERY 5m DISTANCE WITH OPENING IN SUBWAY.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

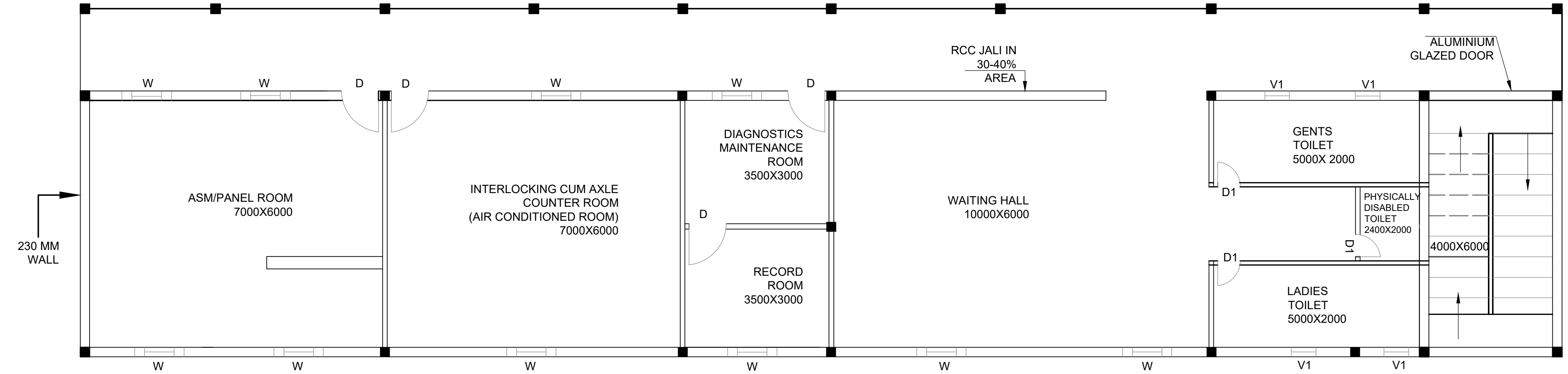
THE INFRASTRUCTURE PEOPLE

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM *PD*	Chahatey Ram	NEERAJ BHANDARI *CPM SOUTH*	[signature]
SUDHIR AGRAWAL *DPD/CIVIL*	[signature]	VIKRAM YADAV *GM/ IE / HRIDC*	
RAJENDRA KR. BHAUGUNA *DPD/EST*	राजेन्द्र बहुगुणा	RAJU SOLANKI *DGM/CIVIL*	[signature]
A.S. JANGHU *CRE/ELECT.*	[signature]	JYOTI SANGWAN *DGM/ELEC.*	Jyoti
REETU PATIAL *CDE/CIVIL*	[signature]		

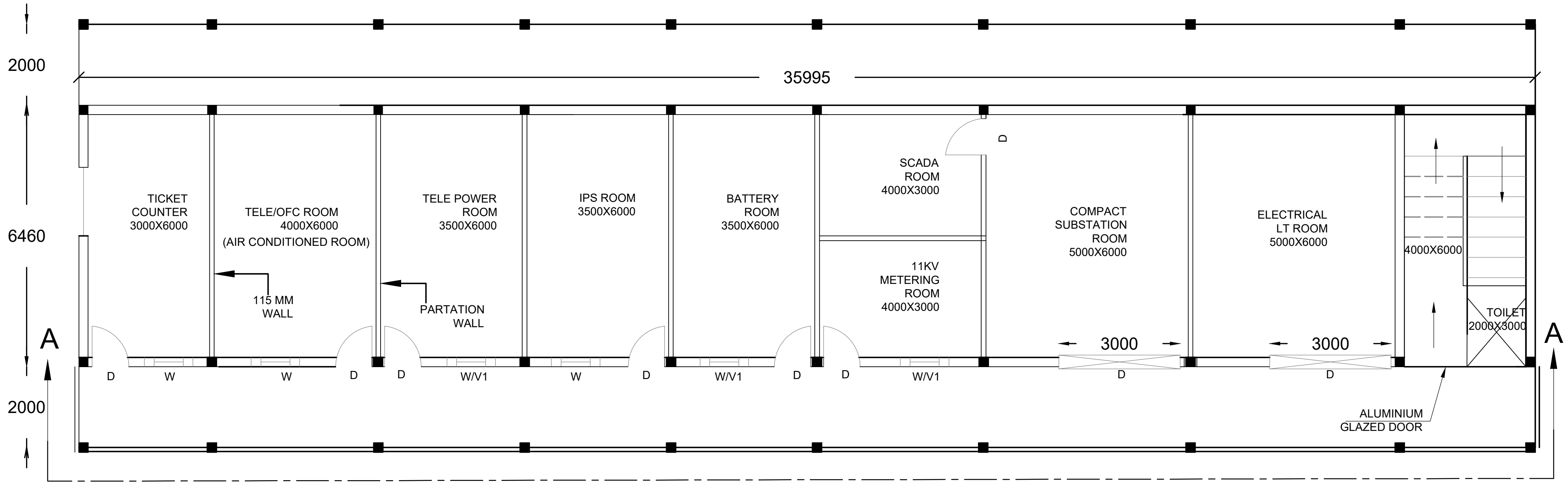
TITLE:- CONCEPTUAL PLAN OF PRITHLA STATION AND SUBWAY NO.8 & 8A

DRG. NO.
GC-HRIDC-C5-DRW-STN-SAD-PRI01_A0

SCALE :	ISSUE DATE	REVISED DATE
NTS	27.09.2023	



STATION BUILDING
FIRST FLOOR PLAN



STATION BUILDING
GROUND FLOOR PLAN

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. ALL OUTERS WALLS ARE OF 230MM THICK & PARTITION WALLS ARE OF 115MM.
3. THE FLOOR LEVEL OF PANEL ROOM SHALL BE ABOUT 300 MM ABOVE PLATFORM LEVEL.
4. FOR ANY FURTHER DETAIL OF S&T SERVICE BUILDING REFER NR TYPE PLAN NO. O-99/2021 SHEET NO. 1 TO 5.
5. FOR PHYSICALLY HANDICAPPED TOILET REFER DRAWING NO. O-104/2021 SHEET 1 OF 1.
6. SUITABLE ARRANGEMENT FOR SEPTIC TANK & SOAK PIT TO BE PROVIDED.
7. DETAILING OF TICKET COUNTER SHALL BE AS PER SKETCH NO. GC-HRIDC-SK-GEN0-013.
8. STAINLESS STEEL HANDRAIL SHALL BE FIXED WITH WALLS IN STAIRCASE PORTION.
9. FOR DETAILING OF LADIES AND GENTS TOILETS REFER DRAWING NO. GC-HRIDC-SK-GEN-007.
10. HEAVY DUTY TWO RCC SHELF IN BATTERY ROOM ON TWO SIDES 1000MM WIDE FOR BATTERIES, 100MM PLINTH SHALL BE MADE BELOW SHELF. FIRST SHELF AT 1000MM & SECOND SHELF AT 1600MM FROM GROUND LEVEL.
11. POWER CABLE ENTRY 300mm(L)x300mm(H)x600mm DEEP IN POWER ROOM.
12. TELECOM/OFC CABLE ENTRY IN POWER ROOM 300mm(L)X300mm(H)X600mm DEEP.
13. HEAVY DUTY EXHAUST FAN IN IPS & BATTERY ROOM FRONT WALL WITH SELF CLOSING FLAP.

TYPE	OPENING SIZE		DESCRIPTION
D	1000	2100	Panelled Door
D1	750	2100	PVC Framed Door
W	1500	1200	Glazed with MS Grill
V1	600	500	Glazed Louvered Ventilator

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		NEERAJ BHANDARI CPM SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
RAJENDRA KR. BHAUGUNA DPD/EST		DGM/S&T	
A.S JANGHU CRE/ELECT		DGM/Elect.	
REETU PATIAL CDE/CIVIL			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

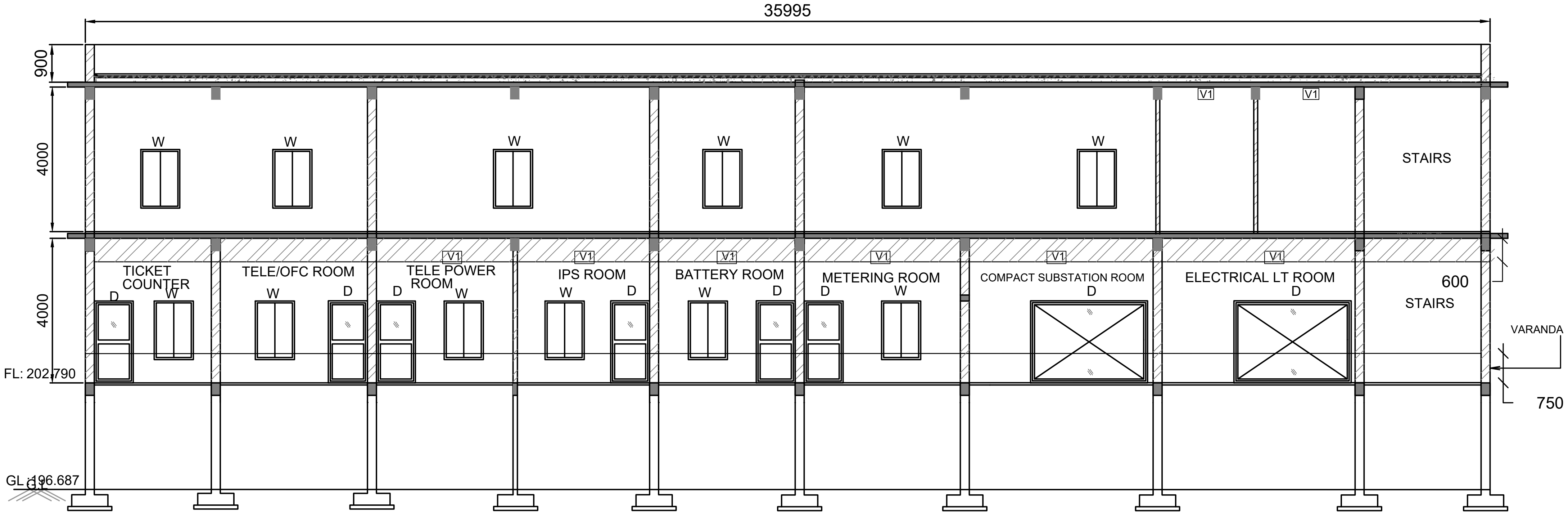
CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC

TITLE:-
CONCEPTUAL ARCHITECTURAL DRAWING
PRITHLA STATION BUILDING

DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-STN-SAD-PRI01_A1		2 OF 3
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	07.08.2023	12.12.2023



GROUND FLOOR & FIRST FLOOR ELEVATION PLAN

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. ALL OUTERS WALLS ARE OF 230MM THICK & PARTITION WALLS ARE OF 115MM.
3. THE FLOOR LEVEL OF PANEL ROOM SHALL BE ABOUT 300 MM ABOVE PLATFORM LEVEL.
4. FOR ANY FURTHER DETAIL OF S&T SERVICE BUILDING REFER NR TYPE PLAN NO. O-99/2021 SHEET NO. 1 TO 5.
5. FOR PHYSICALLY HANDICAPPED TOILET REFER DRAWING NO. O-104/2021 SHEET 1 OF 1.
6. SUITABLE ARRANGEMENT FOR SEPTIC TANK & SOAK PIT TO BE PROVIDED.
7. DETAILING OF TICKET COUNTER SHALL BE AS PER SKETCH NO. GC-HRIDC-SK-GEN0-013.
8. STAINLESS STEEL HANDRAIL SHALL BE FIXED WITH WALLS IN STAIRCASE PORTION.
9. FOR DETAILING OF LADIES AND GENTS TOILETS REFER DRAWING NO. GC-HRIDC-SK-GEN-007.
10. SELF IN BATTERY ROOM ON 3 SIDES 1M WIDE @800MM.

TYPE	OPENING SIZE		DESCRIPTION
D	1000	2100	Panelled Door
D1	750	2100	PVC Framed Door
W	1500	1200	Glazed with MS Grill
V1	600	500	Glazed Louvered Ventilator

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	ChahateyRam	NEERAJ BHANDARI CPM SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
RAJENDRA KR. BHAUGUNA DPD/EST	राजेन्द्र बहुगुणा	DGM/S&T	
A.S JANGHU CRE/ELECT		DGM/Elect.	
REETU PATIAL CDE/CIVIL			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

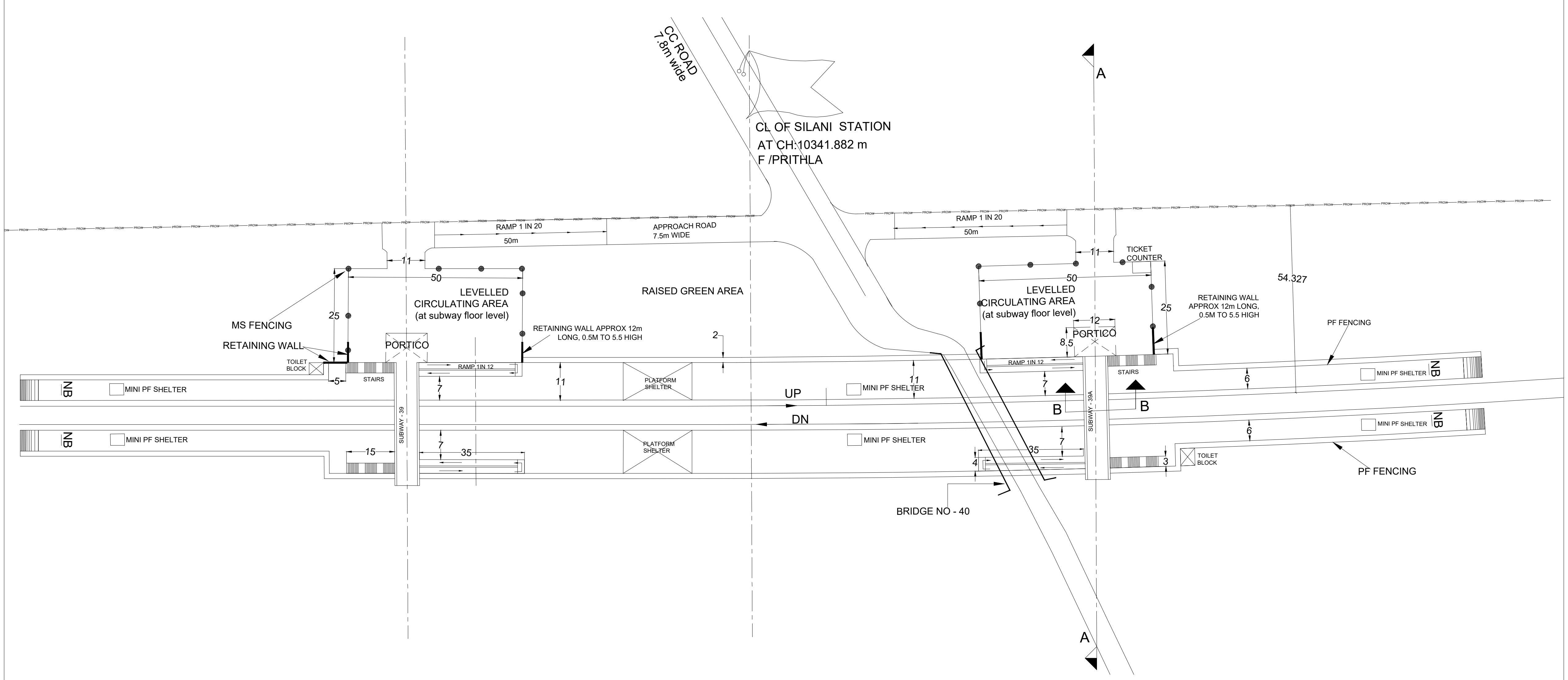
CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

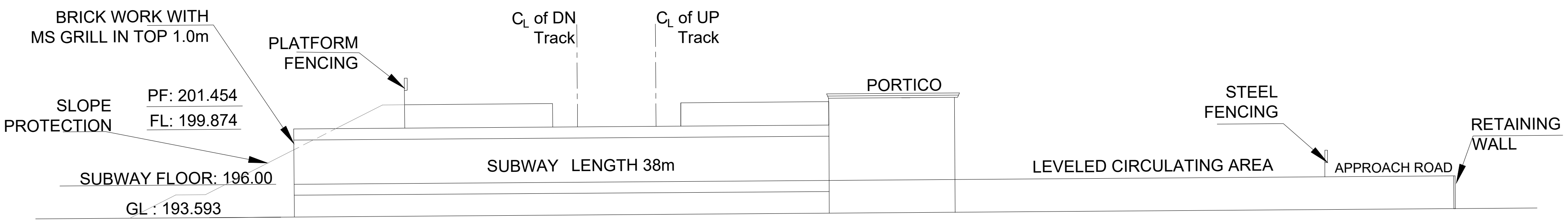
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC

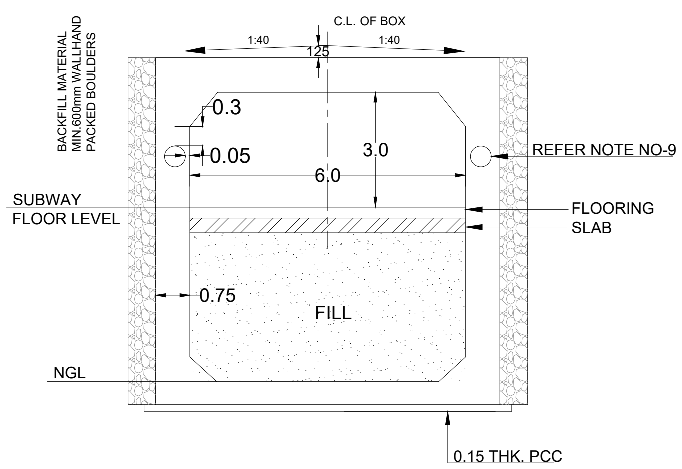
TITLE:- CONCEPTUAL ARCHITECTURAL DRAWING PRITHLA BUILDING

DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-STN-SAD-PRI01_A1		3 OF 3
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	07.08.2023	12.12.2023





SECTION A-A



SECTION AT B-B

NOTES:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE MENTIONED.
2. ALL LEVEL ARE IN METERS.
3. PROTECTION WORK ON SLOPES OF BANK UP TO 15M, BOTH SIDES ON APPROACHES OF SUBWAY SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015.
4. DETAILING OF TICKET COUNTER SHALL BE AS PER SKETCH NO. GC-HRIDC-SK-GEN-013.
5. STEEL HANDRAIL SHALL BE FIXED WITH WALLS IN STAIRCASE AND RAMP PORTION.
6. SELF-SUPPORTING SHED SHALL BE PROVIDED OVER STAIRS & RAMP PROVIDED AS PER SKETCH NO. GC-HRIDC-SK-GEN-020.
7. FOUNDING LEVEL OF SUBWAY SHALL BE BELOW NATURAL GROUND LEVEL CONSIDERING DESIGN, BEARING CAPACITY AND SAFETY REQUIREMENTS.HOWEVER CLEAR OPENING OF THE SUBWAY SHALL NOT BE LESS THAN THAT SHOWN IN THE DRAWING.
8. CIRCULATION AREA AND STATION APPROACH ROAD INCLUDING ITS RETAINING STRUCTURE SHALL BE PAID UNDER SCHEDULE 'B'.
9. CONTRACTOR SHALL LAY 32mm DIA GI CONDUIT IN BOTH SIDE WALL OF SUBWAY AND PROVIDE JUNCTION BOX AT EVERY 5m DISTANCE WITH OPENING IN SUBWAY.

BRIDGE NO.	CHAINAGE	GL	SUBWAY FLOOR LEVEL	PFL
39	10240	193.845	195.9	199.775
39A	10440	193.593	196.00	199.874

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		NEERAJ BHANDARI CPM SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		VIKRAM YADAV GM/ IE / HRIDC	
RAJENDRA KR. BHAUGUNA DPD/EST		RAJU SOLANKI DGM/CIVIL	
A.S. JANGHU CRE/ELECT.		JYOTI SANGWAN DGM/ELEC.	Jyoti
REETU PATIAL CDE/CIVIL			

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

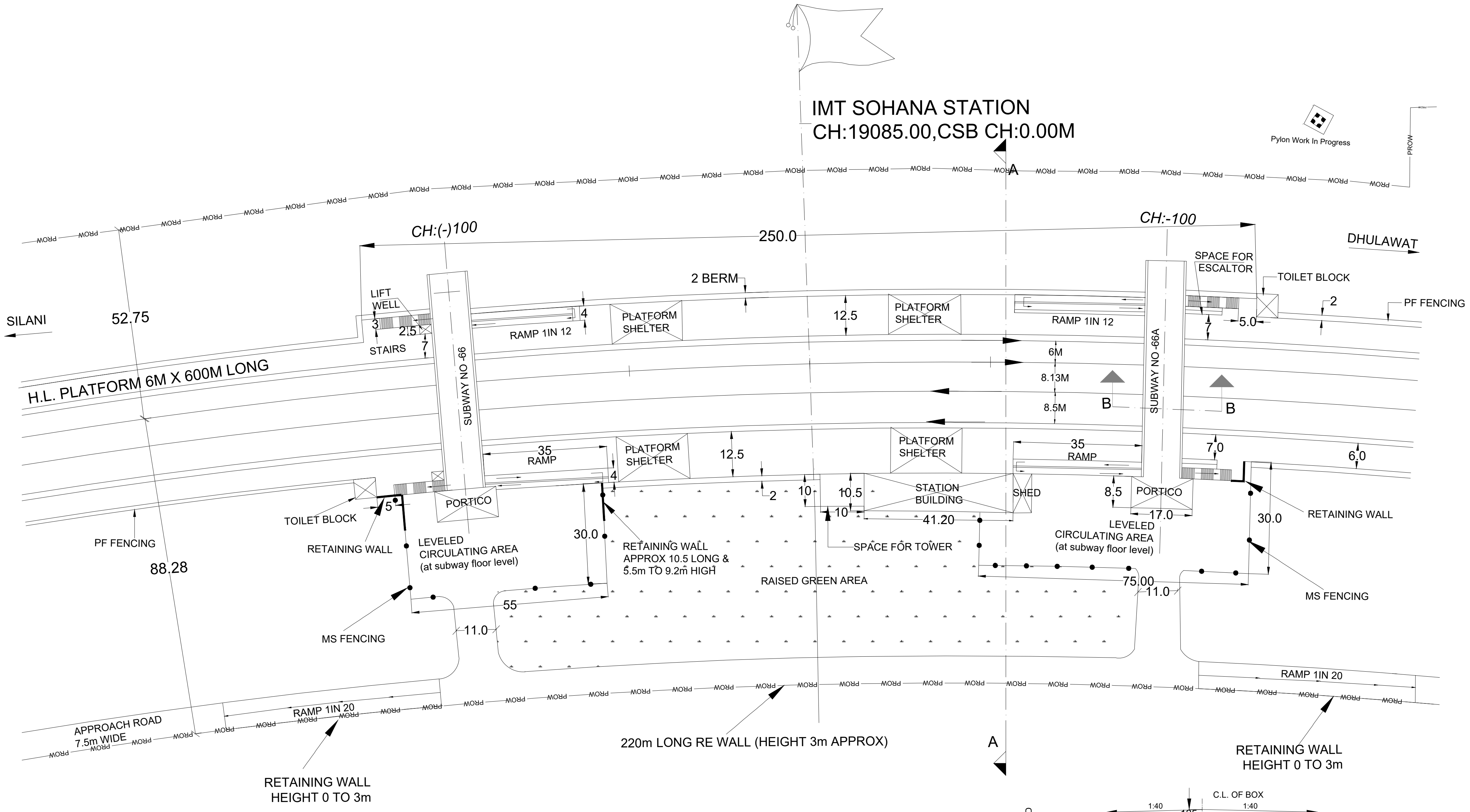
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

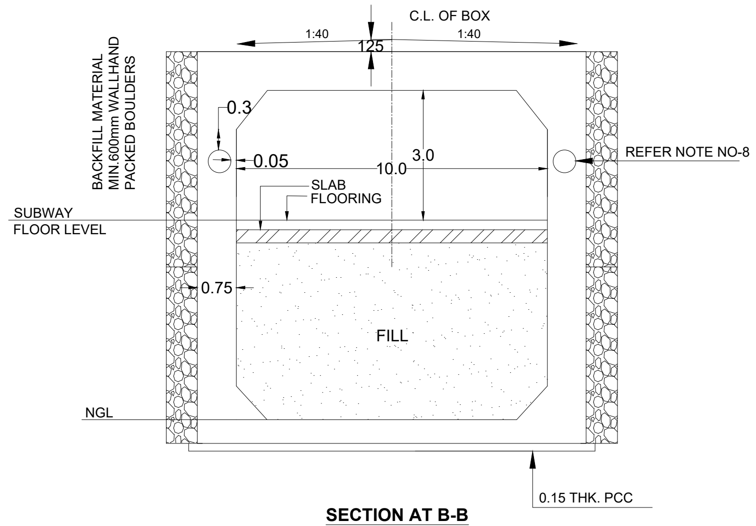
SMEC

TITLE:- CONCEPTUAL PLAN OF SILANI STATION AND SUBWAY NO.39 & 39A

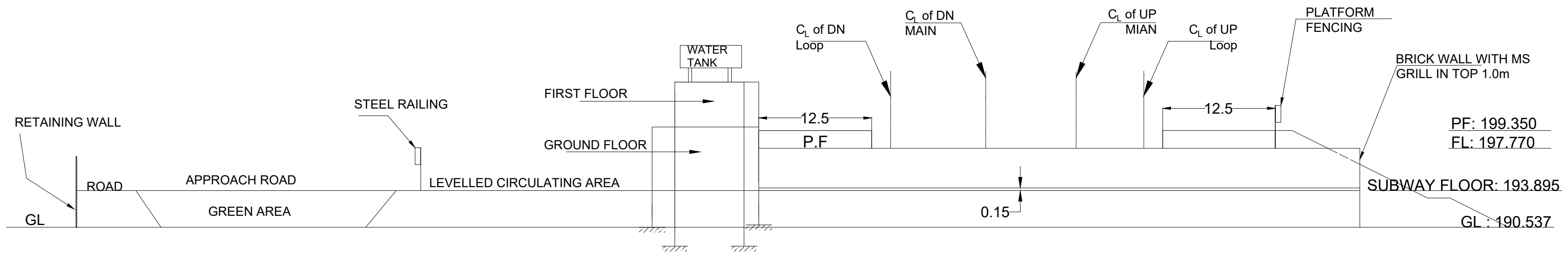
DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-STN-SAD-SIL01_A0		
SCALE :	ISSUE DATE	REVISED DATE
NTS	27.09.2023	



BRIDGE NO.	CHAINAGE	GL	SUBWAY FLOOR LEVEL	PFL
66	18985	190.754	193.712	197.587
66A	19185	190.537	193.895	197.770



SECTION AT B-B



SECTION AT A-A

NOTES:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE MENTIONED.
2. ALL LEVEL ARE IN METERS.
3. PROTECTION WORK ON SLOPES OF BANK UP TO 15M, BOTH SIDES ON APPROACHES OF SUBWAY SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015.
4. STAINLESS STEEL (SS 304) HAND RAIL SHALL BE FIXED WITH WALL IN STAIRCASE & RAMP.
5. SELF-SUPPORTING SHED SHALL BE PROVIDED OVER STAIRS AND RAMP AS PER SKETCH NO. GC-HRIDC-SK-GEN-020.
6. FOUNDING LEVEL OF SUBWAY SHALL BE BELOW NATURAL GROUND LEVEL CONSIDERING DESIGN, BEARING CAPACITY AND SAFETY REQUIREMENTS.HOWEVER CLEAR OPENING OF THE SUBWAY SHALL NOT BE LESS THAN THAT SHOWN IN THE DRAWING.
7. CIRCULATION AREA AND STATION APPROACH ROAD INCLUDING ITS RETAINING STRUCTURE SHALL BE PAID UNDER SCHEDULE 'B'.
8. CONTRACTOR SHALL LAY 32mm DIA GI CONDUIT IN BOTH SIDE WALL OF SUBWAY AND PROVIDE JUNCTION BOX AT EVERY 5m DISTANCE WITH OPENING IN SUBWAY.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

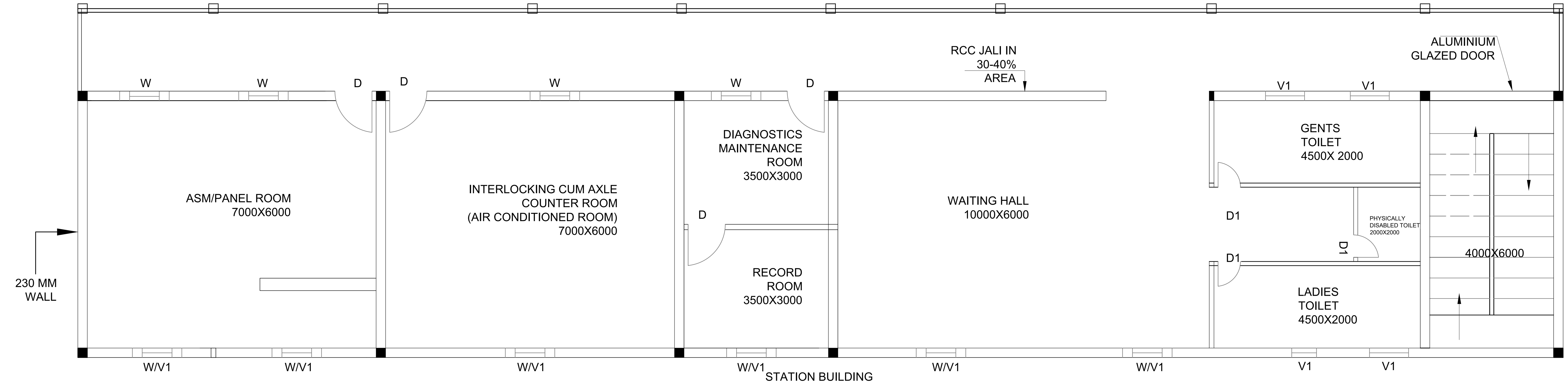
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

THE INFRASTRUCTURE PEOPLE

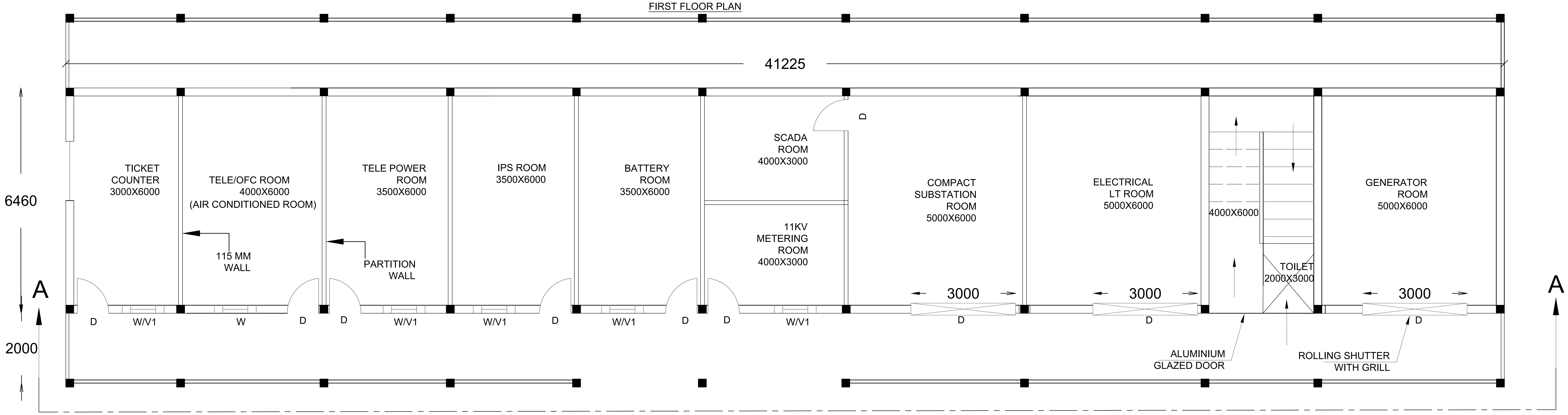
GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		VIKRAM YADAV GM/ IE / HRIDC	
RAJENDRA KR. BHAUGUNA DPD/EST	राजेन्द्र बहुगुणा	RAJU SOLANKI DGM/CIVIL	
A.S. JANGHU CRE/ELECT.		JYOTI SANGWAN DGM/ELEC.	Jyoti
REETU PATIAL CDE/CIVIL			

TITLE:- CONCEPTUAL PLAN OF SOHNA STATION AND SUBWAY NO.66 & 66A

DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-STN-SAD-SOH01_A0		
SCALE :	ISSUE DATE	REVISED DATE
NTS	27.09.2023	



STATION BUILDING
FIRST FLOOR PLAN



STATION BUILDING
GROUND FLOOR PLAN

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. ALL OUTERS WALLS ARE OF 230MM THICK & PARTITION WALLS ARE OF 115MM.
3. THE FLOOR LEVEL OF PANEL ROOM SHALL BE ABOUT 300 MM ABOVE PLATFORM LEVEL.
4. FOR ANY FURTHER DETAIL OF S&T SERVICE BUILDING REFER NR TYPE PLAN NO. O-99/2021 SHEET NO. 1 TO 5.
5. FOR PHYSICALLY HANDICAPPED TOILET REFER DRAWING NO. O-104/2021 SHEET 1 OF 1.
6. SUITABLE ARRANGEMENT FOR SEPTIC TANK & SOAK PIT TO BE PROVIDED.
7. DETAILING OF TICKET COUNTER SHALL BE AS PER SKETCH NO. GC-HRIDC-SK-GEN0-013.
8. STAINLESS STEEL HANDRAIL SHALL BE FIXED WITH WALLS IN STAIRCASE PORTION.
9. FOR DETAILING OF LADIES AND GENTS TOILETS REFER DRAWING NO. GC-HRIDC-SK-GEN-007.
10. HEAVY DUTY TWO RCC SHELF IN BATTERY ROOM ON TWO SIDES 1000MM WIDE FOR BATTERIES, 100MM PLINTH SHALL BE MADE BELOW SHELF. FIRST SHELF AT 1000MM & SECOND SHELF AT 1600MM FROM GROUND LEVEL.
11. POWER CABLE ENTRY 300mm(L)x300mm(H)x600mm DEEP IN POWER ROOM.
12. TELECOM/OFC CABLE ENTRY IN POWER ROOM 300mm(L)X300mm(H)X600mm DEEP.
13. HEAVY DUTY EXHAUST FAN IN IPS & BATTERY ROOM FRONT WALL WITH SELF CLOSING FLAP.

TYPE	OPENING SIZE		DESCRIPTION
D	1000	2100	Panelled Door
D1	750	2100	PVC Framed Door
W	1500	1200	Glazed with MS Grill
V1	600	500	Glazed Louvered Ventilator

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
RAJENDRA KR. BHAUGUNA DPD/EST		DGM/S&T	
A.S JANGHU CRE/ELECT		DGM/Elect.	
REETU PATIAL CDE/CIVIL			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

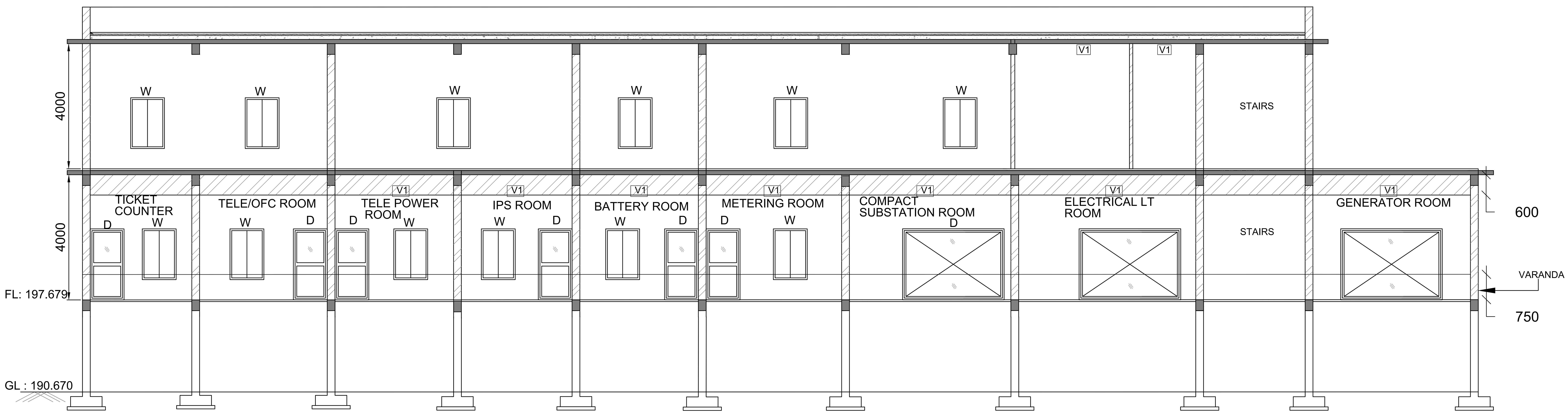
CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:-
CONCEPTUAL ARCHITECTURAL DRAWING
IMT SOHNA STATION BUILDING

DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-STN-SAD-SOH01_A1		2 OF 3
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	24.08.2023	12-12-2023



SECTIONAL ELEVATION -A

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. ALL OUTERS WALLS ARE OF 230MM THICK & PARTITION WALLS ARE OF 115MM.
3. THE FLOOR LEVEL OF PANEL ROOM SHALL BE ABOUT 300 MM ABOVE PLATFORM LEVEL.
4. FOR ANY FURTHER DETAIL OF S&T SERVICE BUILDING REFER NR TYPE PLAN NO. O-99/2021 SHEET NO. 1 TO 5.
5. FOR PHYSICALLY HANDICAPPED TOILET REFER DRAWING NO. O-104/2021 SHEET 1 OF 1.
6. SUITABLE ARRANGEMENT FOR SEPTIC TANK & SOAK PIT TO BE PROVIDED.
7. DETAILING OF TICKET COUNTER SHALL BE AS PER SKETCH NO. GC-HRIDC-SK-GEN0-013.
8. STAINLESS STEEL HANDRAIL SHALL BE FIXED WITH WALLS IN STAIRCASE PORTION.
9. FOR DETAILING OF LADIES AND GENTS TOILETS REFER DRAWING NO. GC-HRIDC-SK-GEN-007.
10. SELF IN BATTERY ROOM ON 3 SIDES 1M WIDE @800MM.

TYPE	OPENING SIZE		DESCRIPTION
D	1000	2100	Panelled Door
D1	750	2100	PVC Framed Door
W	1500	1200	Glazed with MS Grill
V1	600	500	Glazed Louvered Ventilator

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
RAJENDRA KR. BHAUGUNA DPD/EST	राजेन्द्र बहुगुणा	DGM/S&T	
A.S JANGHU CRE/ELECT		DGM/Elect.	
REETU PATIAL CDE/CIVIL	Reetu		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

SMEC Member of the Surbana Jurong Group

TITLE:-

CONCEPTUAL ARCHITECTURAL DRAWING
IMT SOHNA STATION BUILDING

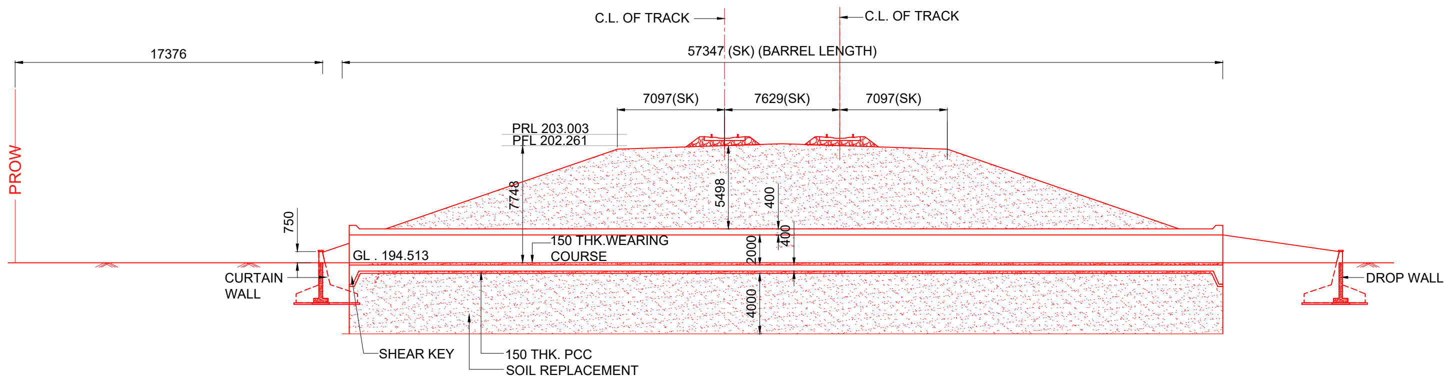
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-STN-SAD-SOH01_A1	3 OF 3

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	24.08.2023	12.12.2023

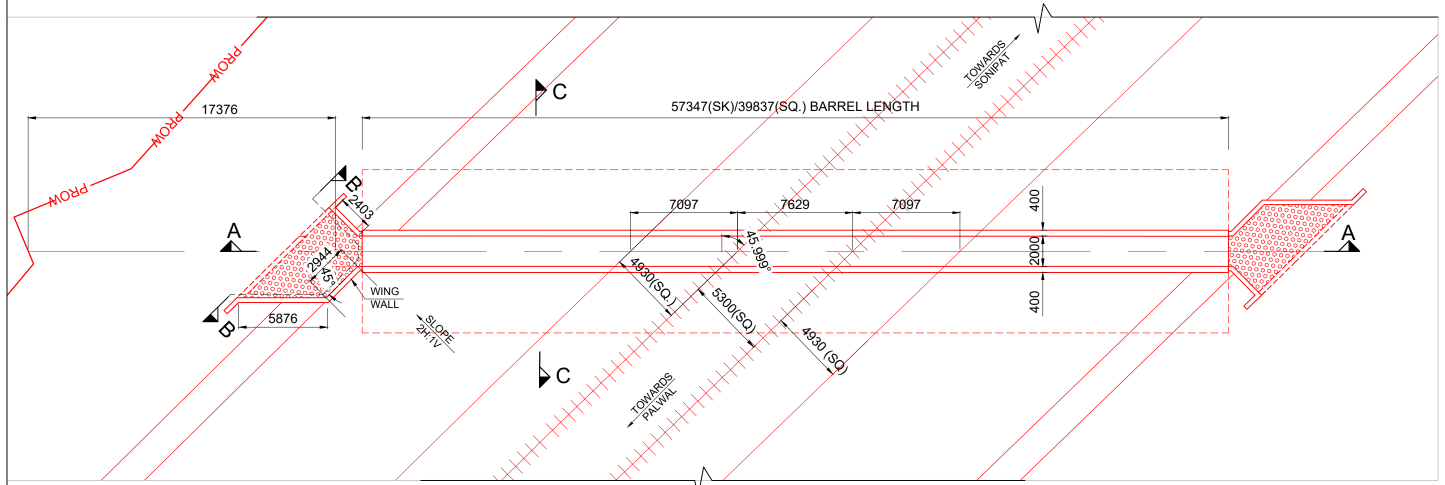
4. BRIDGES

4.1 MINOR BRIDGES

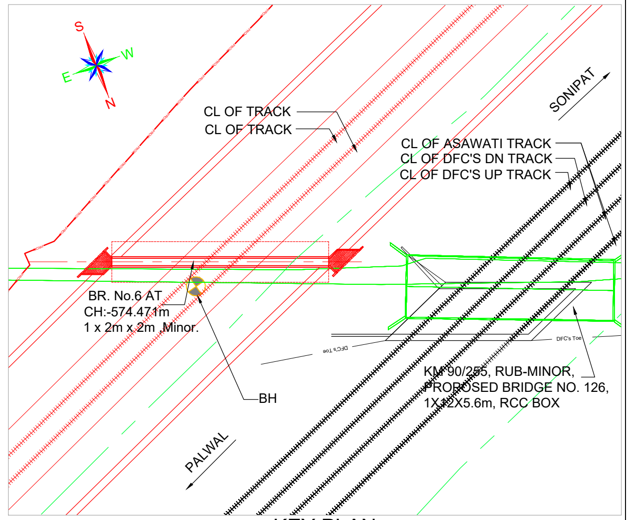
4.1.1 MAIN LINE



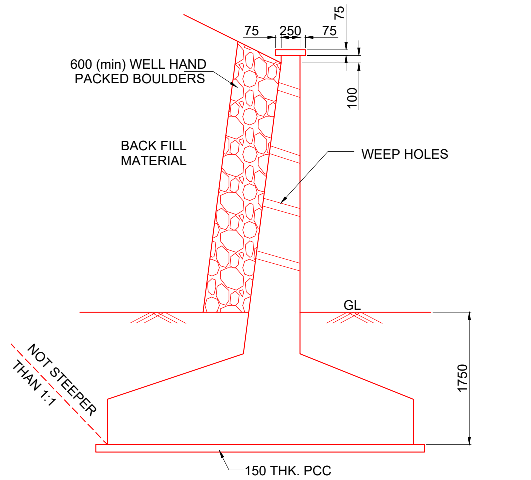
SECTIONAL ELEVATION AT A-A
SCALE 1:250



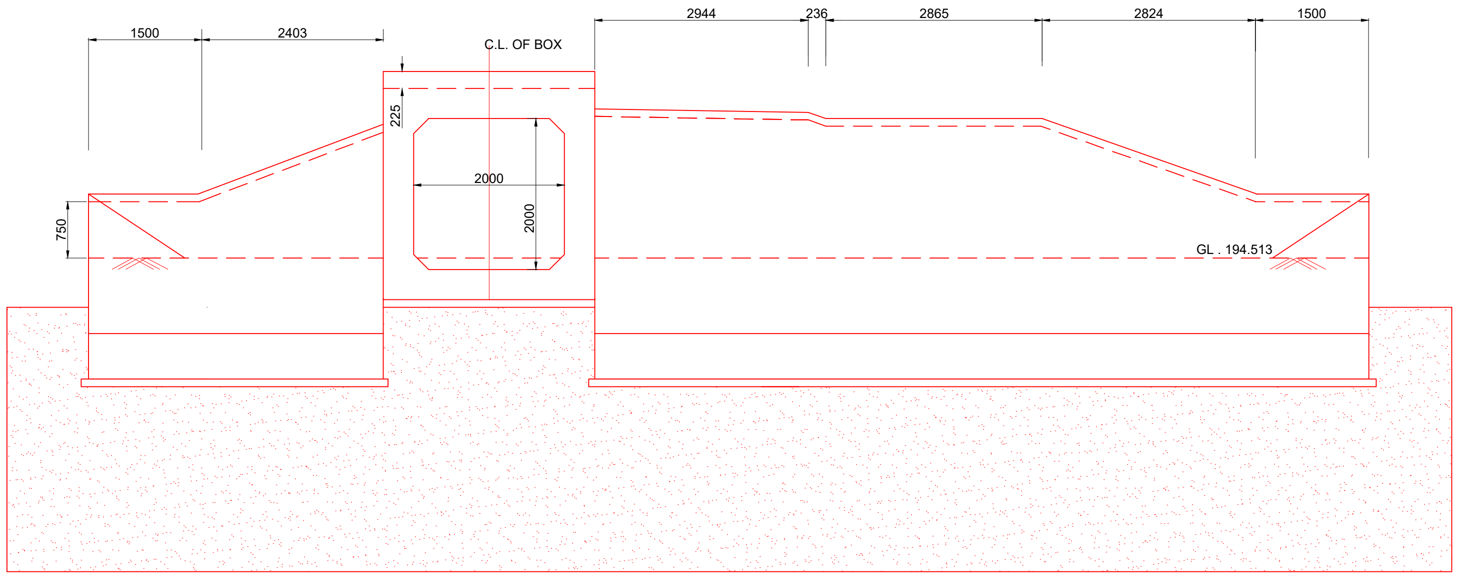
PLAN AT TOP
SCALE 1:200



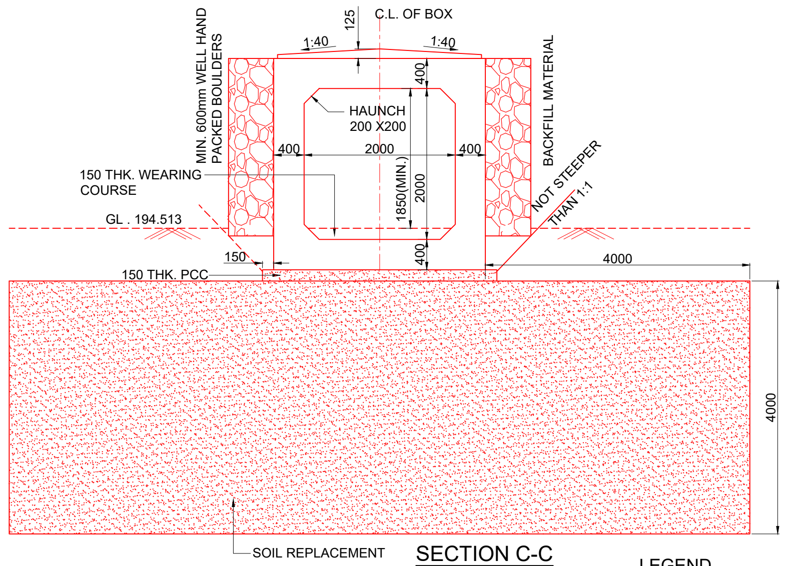
KEY PLAN
SCALE NTS



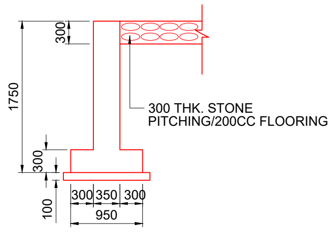
TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



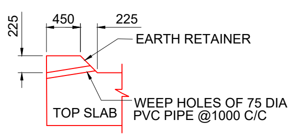
VIEW AT B-B
SCALE 1:50



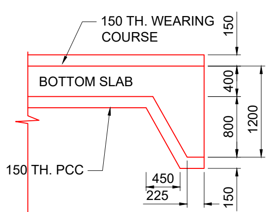
SECTION C-C
SCALE 1:50



DROP / CURTAIN WALL DETAILS
SCALE 1:50



EARTH RETAINER
SCALE 1:50



SHEAR KEY
SCALE 1:50

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL, BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE.
   GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB-STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.
2. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

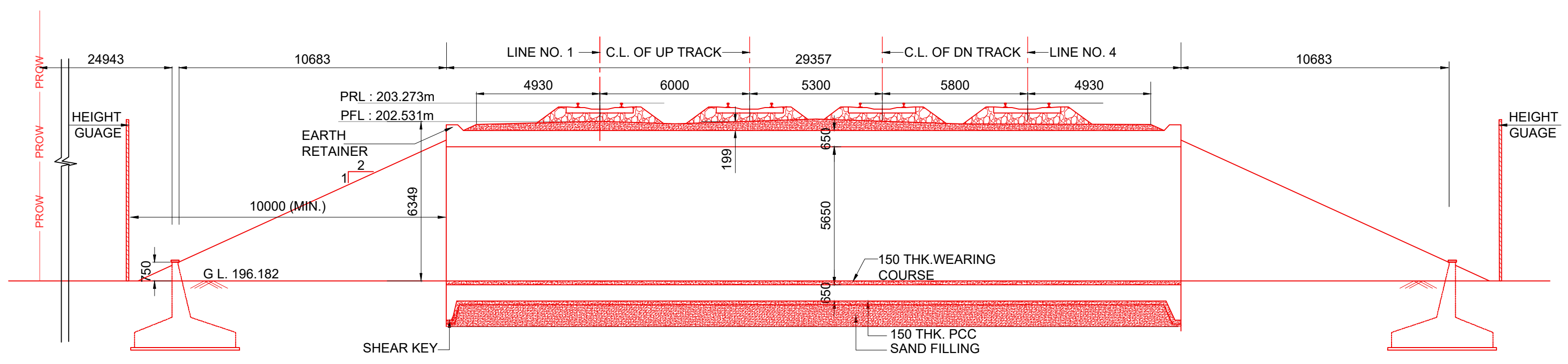
CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.
RITES THE INFRASTRUCTURE PEOPLE
SMEC

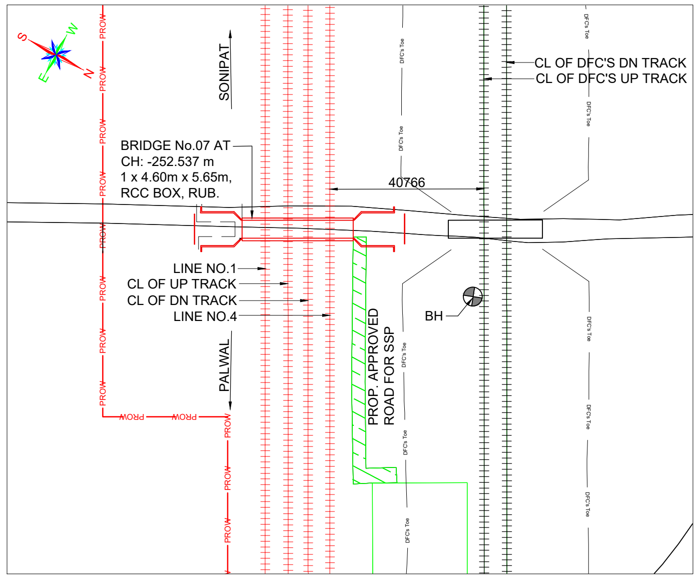
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR BALANCING CULVERT BRIDGE NO. 6
1x 2x 2m RCC BOX AT CH. -574.471m

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01006_A0	1 OF 1

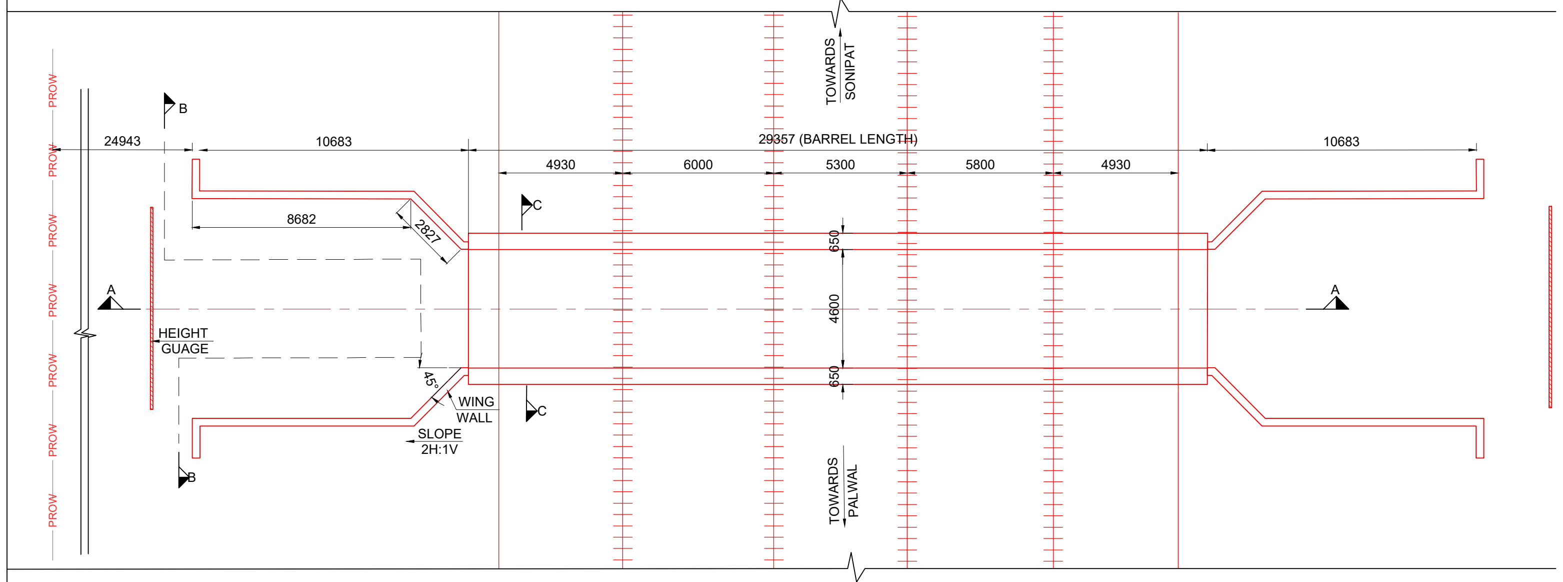
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	

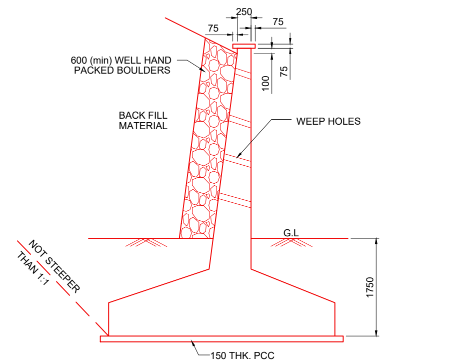


SECTIONAL ELEVATION AT A-A
SCALE 1:150

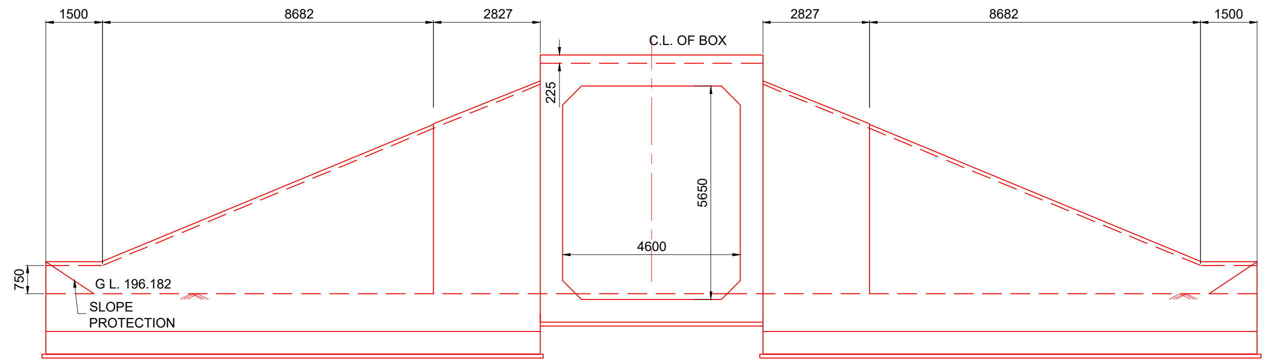


KEY PLAN
SCALE : NTS

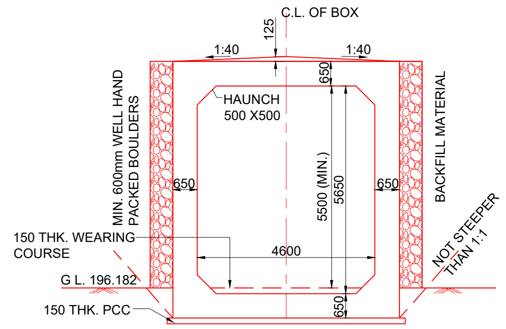




TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



VIEW AT B-B
SCALE 1:100



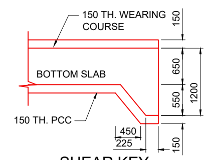
SECTION AT C-C
SCALE 1:100

LEGEND

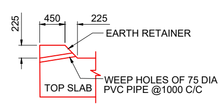
	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
VC	VERTICAL CLEARANCE
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW



SHEAR KEY
SCALE 1:50



EARTH RETAINER
SCALE 1:50

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL, BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.

IMPORTANT NOTE:
TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

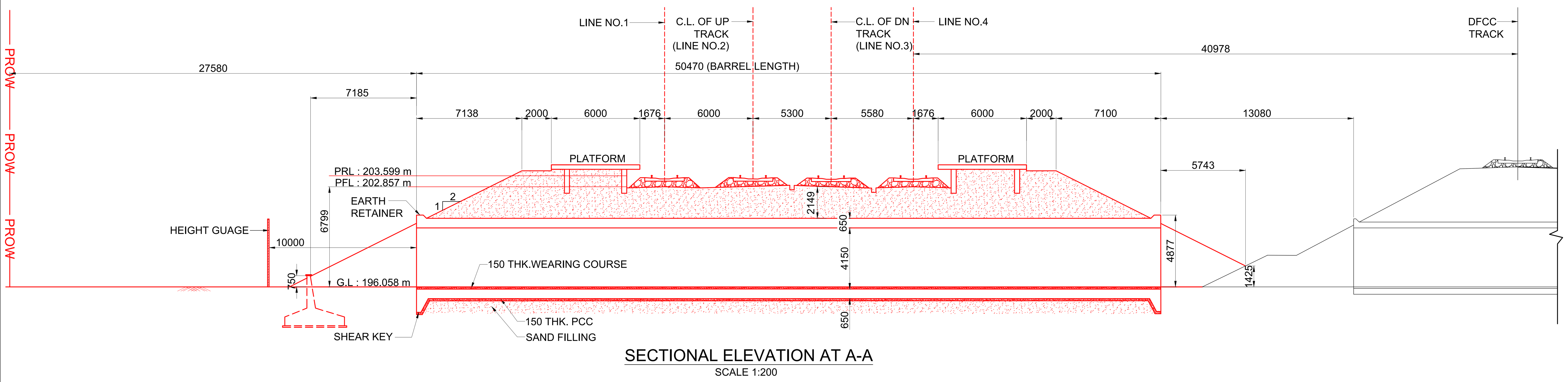
THE INFRASTRUCTURE PEOPLE

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL		MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL			

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO. 07, SPAN 1X4.60X5.65, RCC BOX AT CH: -252.537

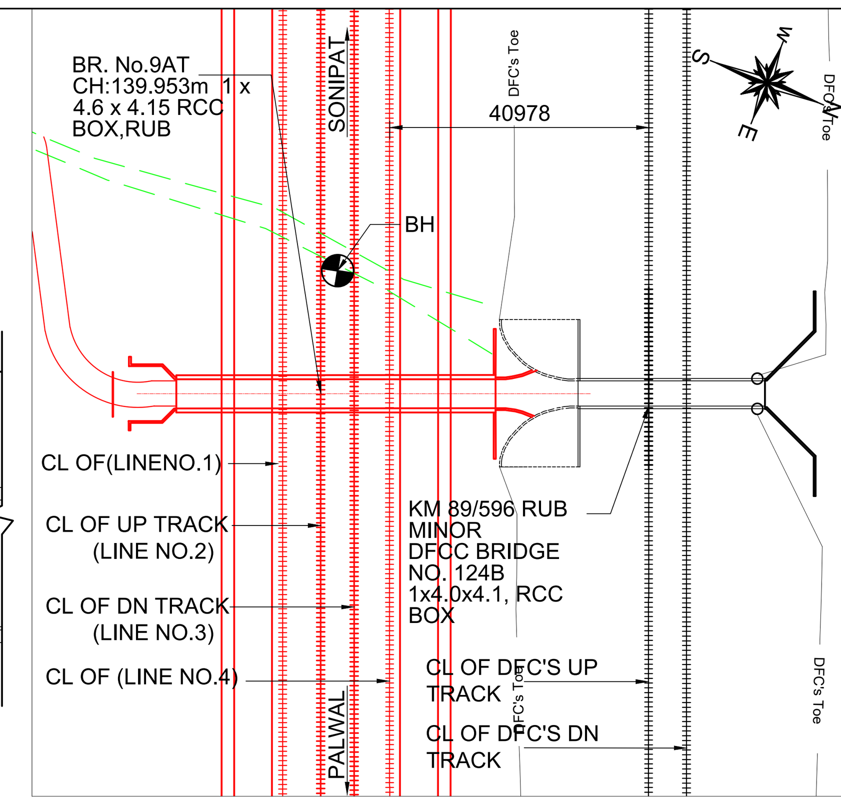
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01007_A0	1 OF 1

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



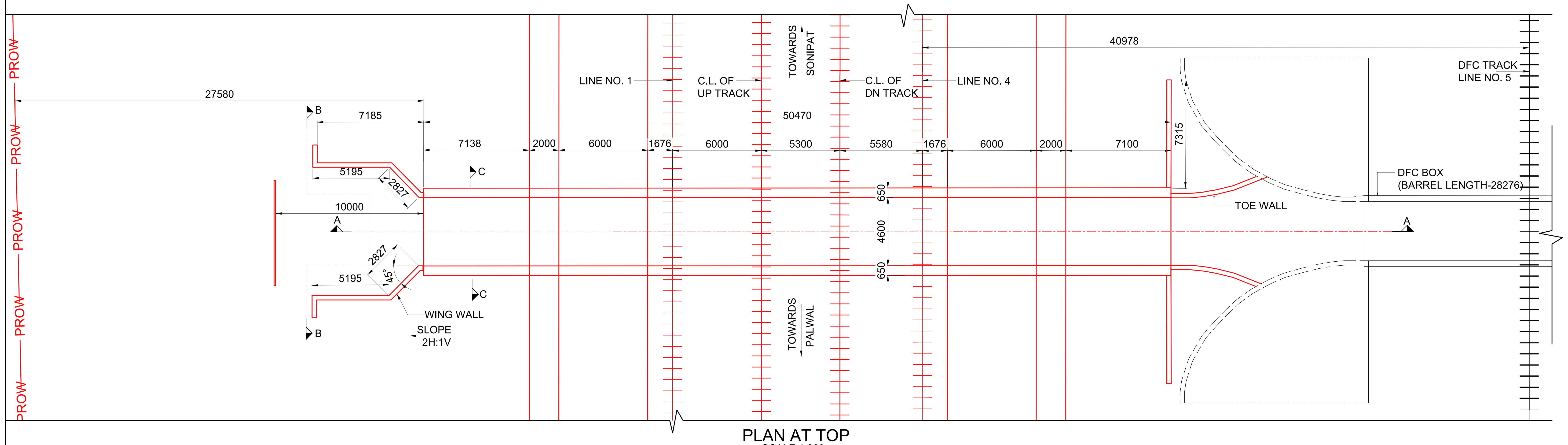
SECTIONAL ELEVATION AT A-A

SCALE 1:200



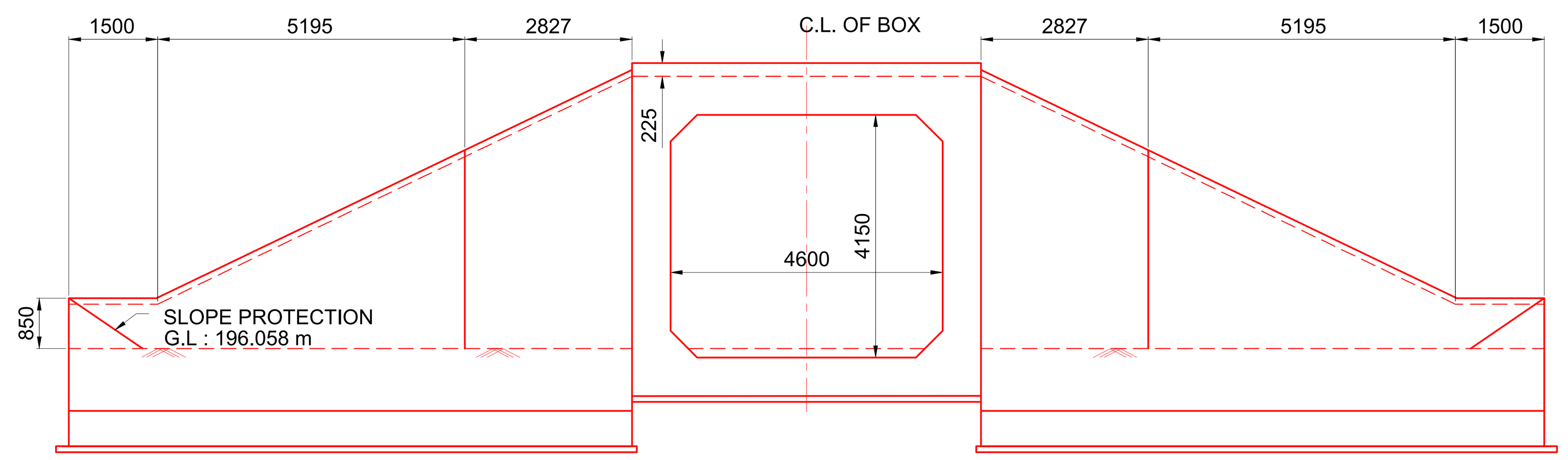
KEY PLAN

SCALE : NTS



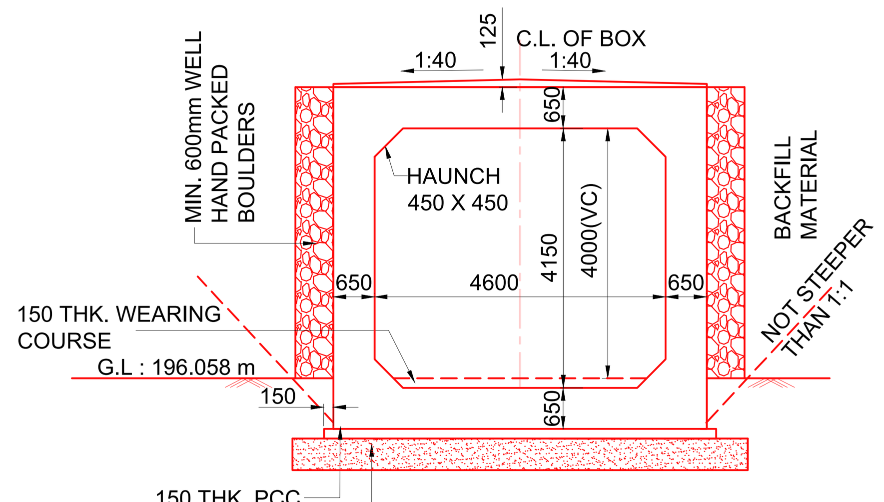
PLAN AT TOP

SCALE 1:200



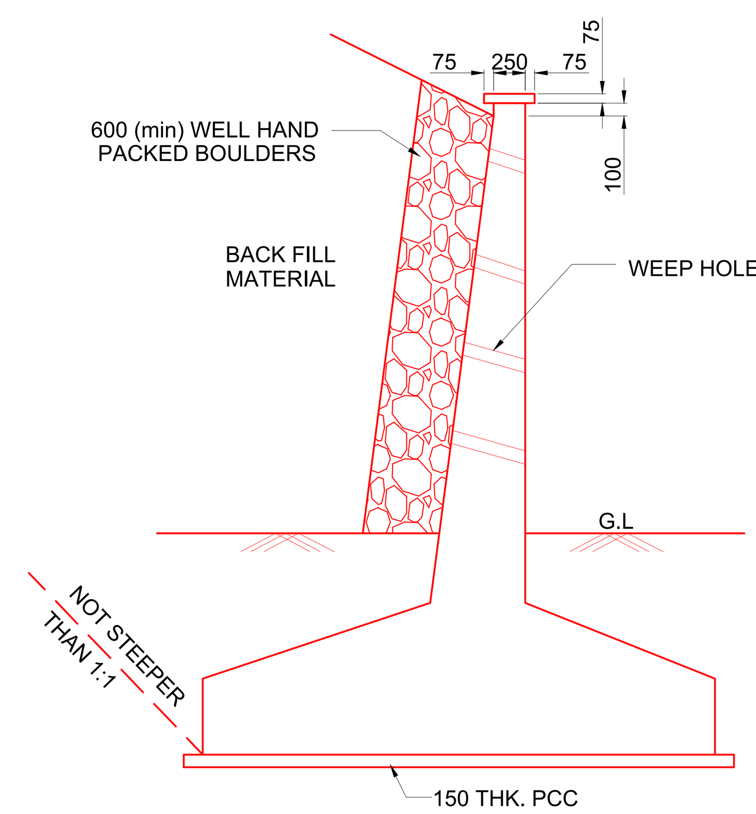
VIEW AT B-B

SCALE 1:100



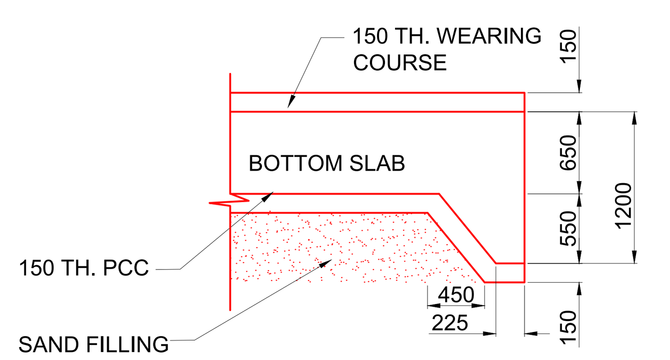
SECTION C-C

SCALE 1:100



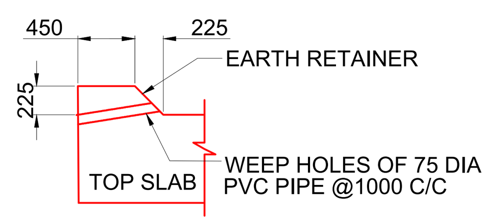
TYPICAL DETAIL OF RETURN WALL / WING WALL

SCALE 1:50



SHEAR KEY

SCALE 1:50



EARTH RETAINER

SCALE 1:50

NOTES :

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3. SEISMIC ZONE- IV
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   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
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6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
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16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.
17. DETAIL OF TOE WALL SHALL BE PROVIDED AS PER SKETCH NO. GC-HRIDC-SK-GEN-014_A1

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.

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LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
VC	VERTICAL CLEARANCE
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

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CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

SMEC Member of the Surbana Jurong Group

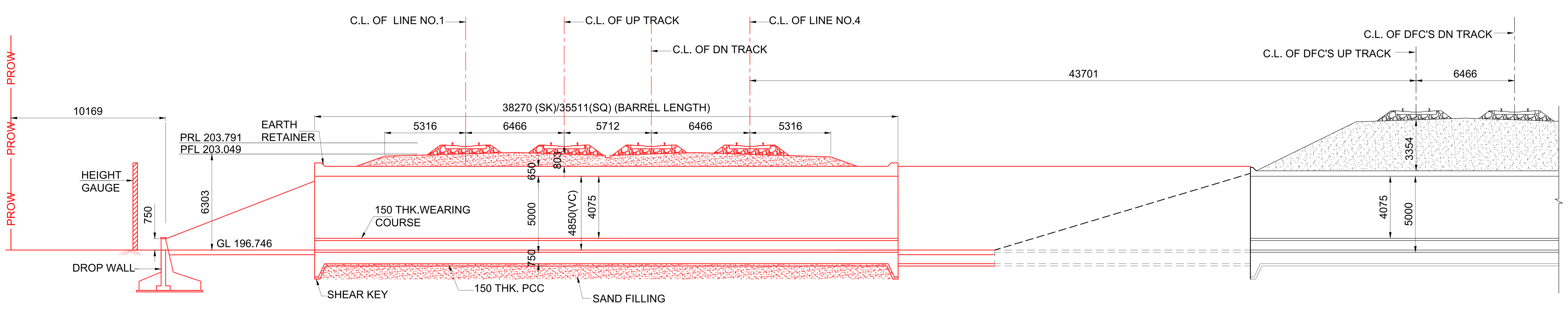
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING

FOR ROAD UNDER BRIDGE NO. 09

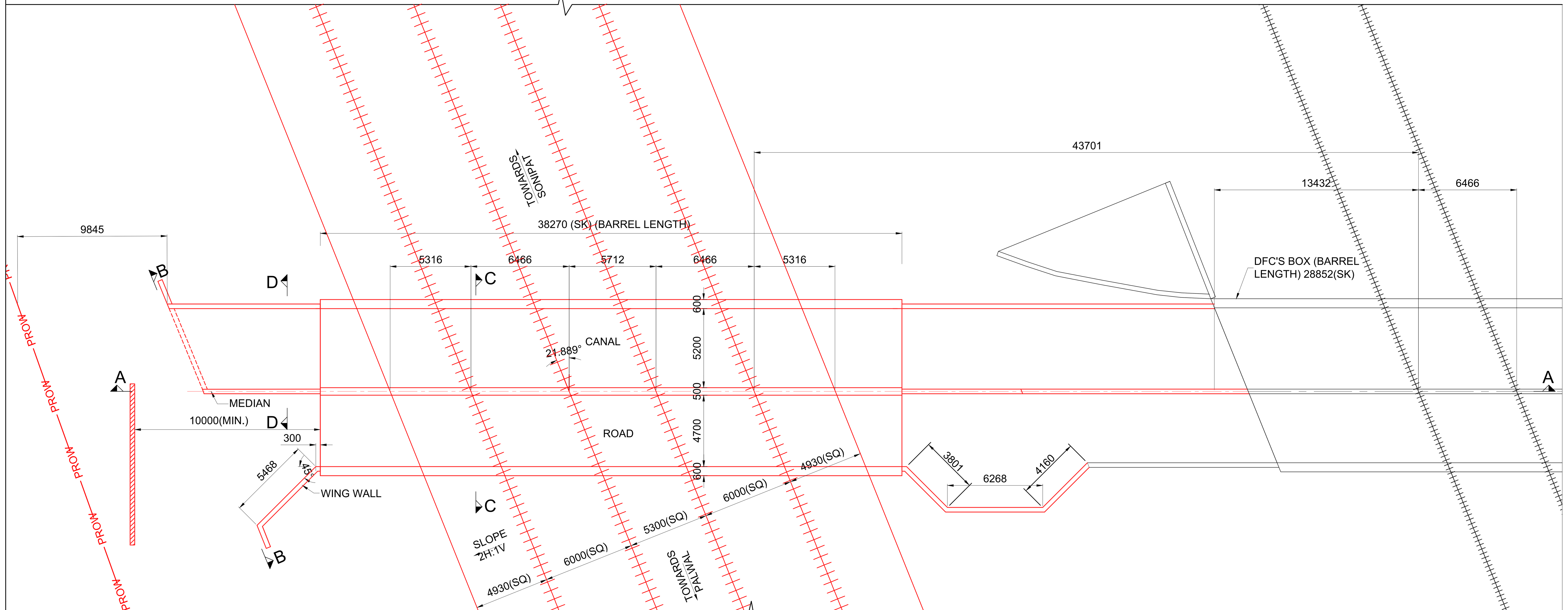
SPAN 1.0X4.6X4.15 RCC BOX AT CH: 139.953

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD-01009_A0	1 OF 1

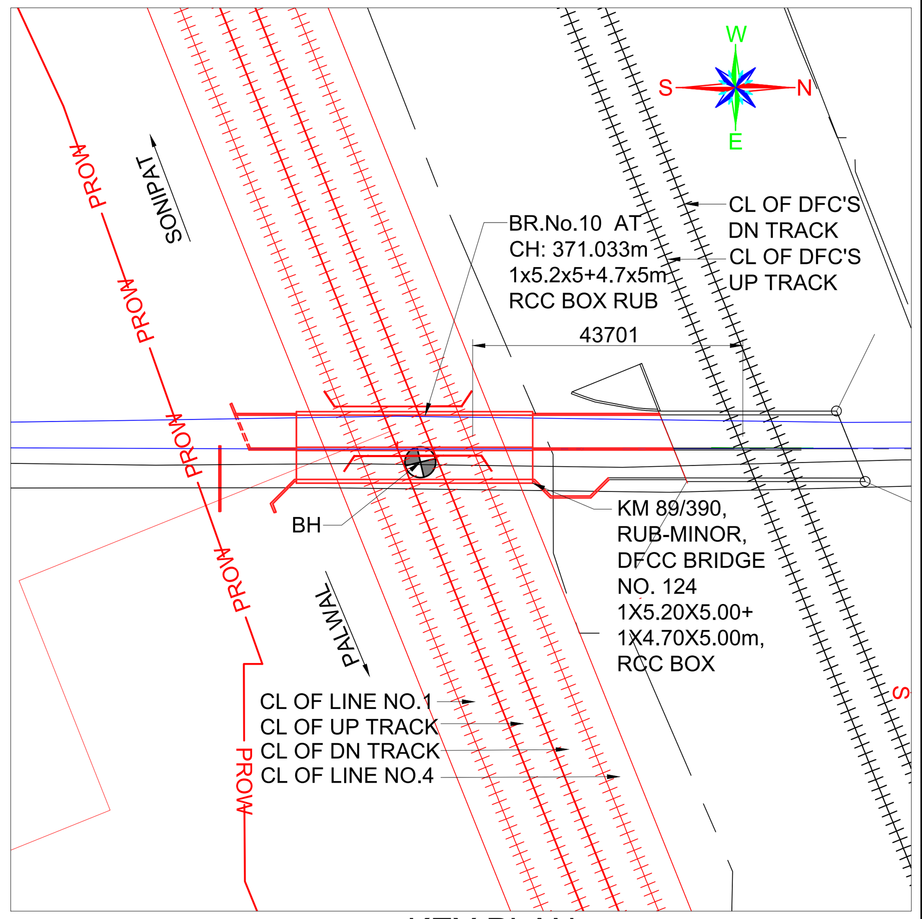
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



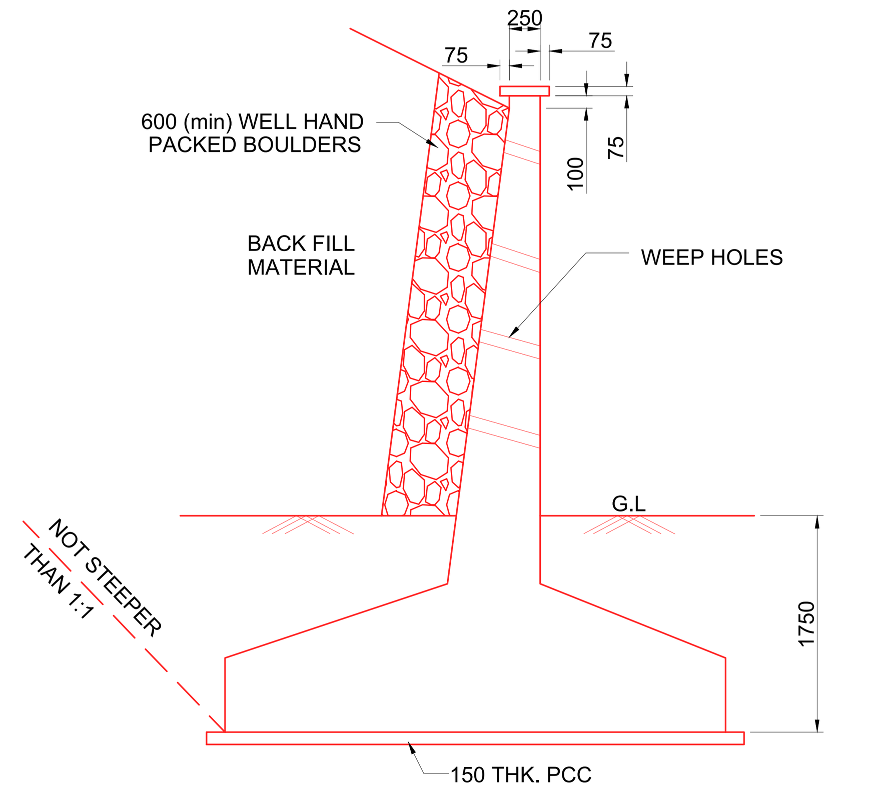
SECTIONAL ELEVATION AT A-A
SCALE 1:200



PLAN AT TOP
SCALE 1:200



KEY PLAN
SCALE NTS



TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50

NOTES :

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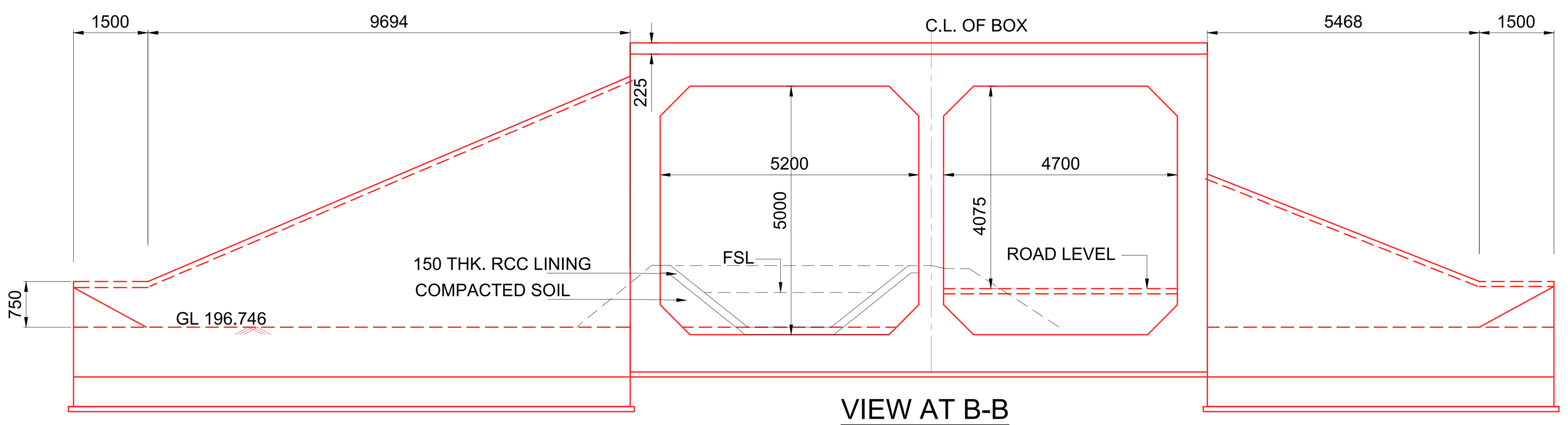
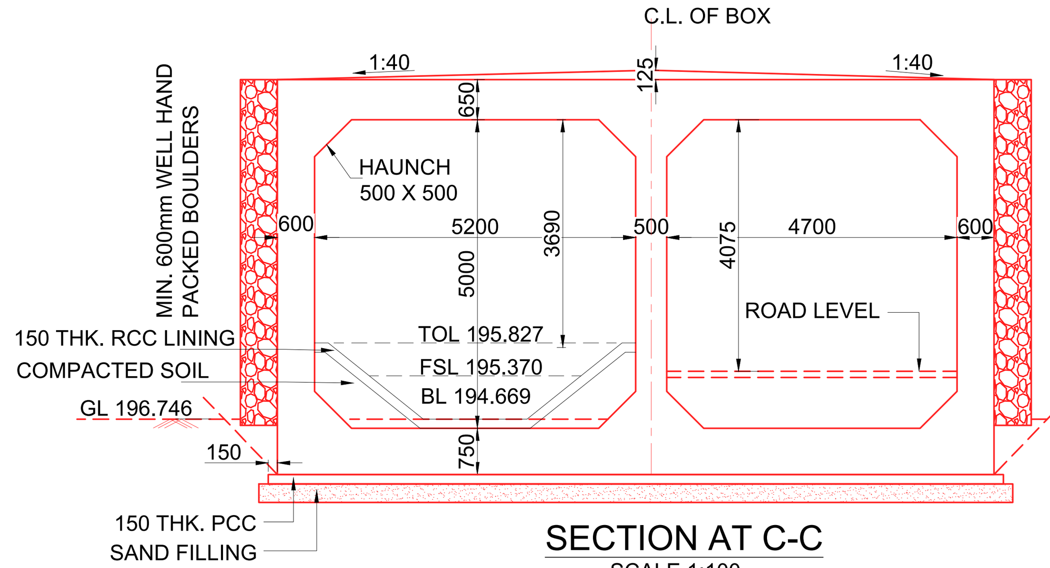
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.
3. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.
4. RCC LINING SHALL BE CONSTRUCTED FOR CANAL FROM ROW TO ROW OF HORC INCLUDING IN RCC BOX & U-TROUGH.
5. RCC LINING SHALL BE OF MIN 150 MM THICK AND HAVING AT LEAST MIN TEMP REINFORCEMENT.

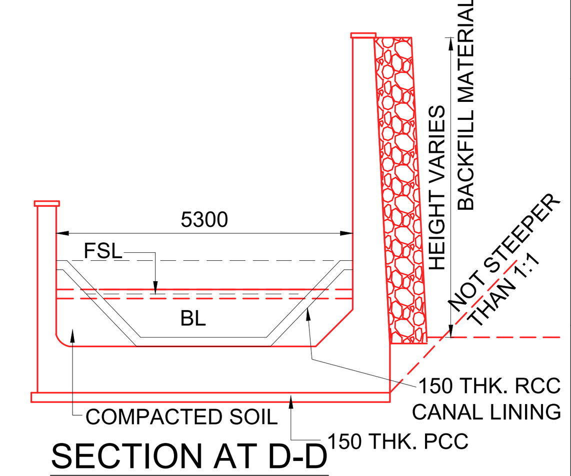
IMPORTANT NOTE:
TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.



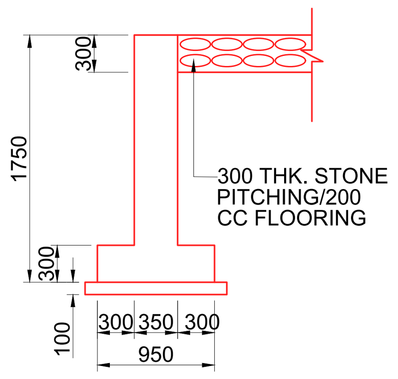
VIEW AT B-B
SCALE 1:100



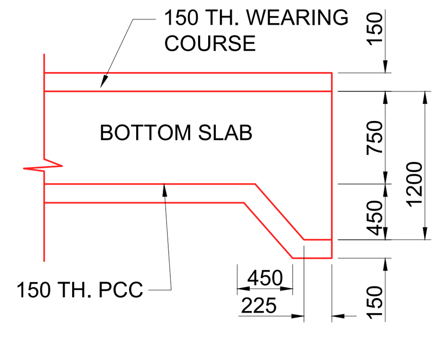
SECTION AT C-C
SCALE 1:100



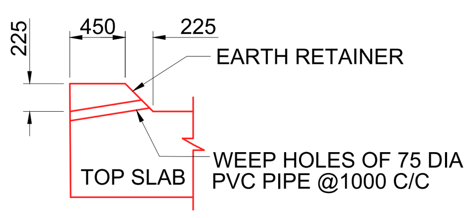
SECTION AT D-D
SCALE 1:100



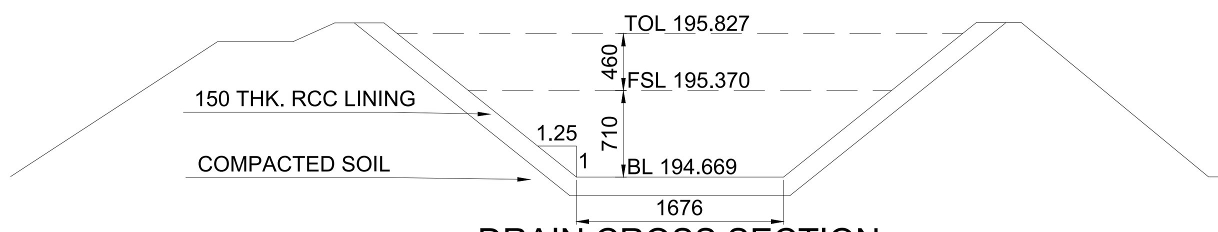
DROP/CURTAIN WALL DETAILS
SCALE 1:50



SHEAR KEY
SCALE 1:50



EARTH RETAINER
SCALE 1:50



DRAIN CROSS SECTION
(SCALE 1:50)

HYDRAULIC DATA OF DRAIN

1	NAME OF CANAL	DHATRI DISTY
2	RD	25000/371
3	BED LEVEL (BL)	194.670
4	FULL SUPPLY LEVEL(FSL)	195.370
5	TOP OF LINING(TOL)	195.830
6	DISCHARGE	35cs
7	FREE BOARD	195.830

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
VC	VERTICAL CLEARANCE
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

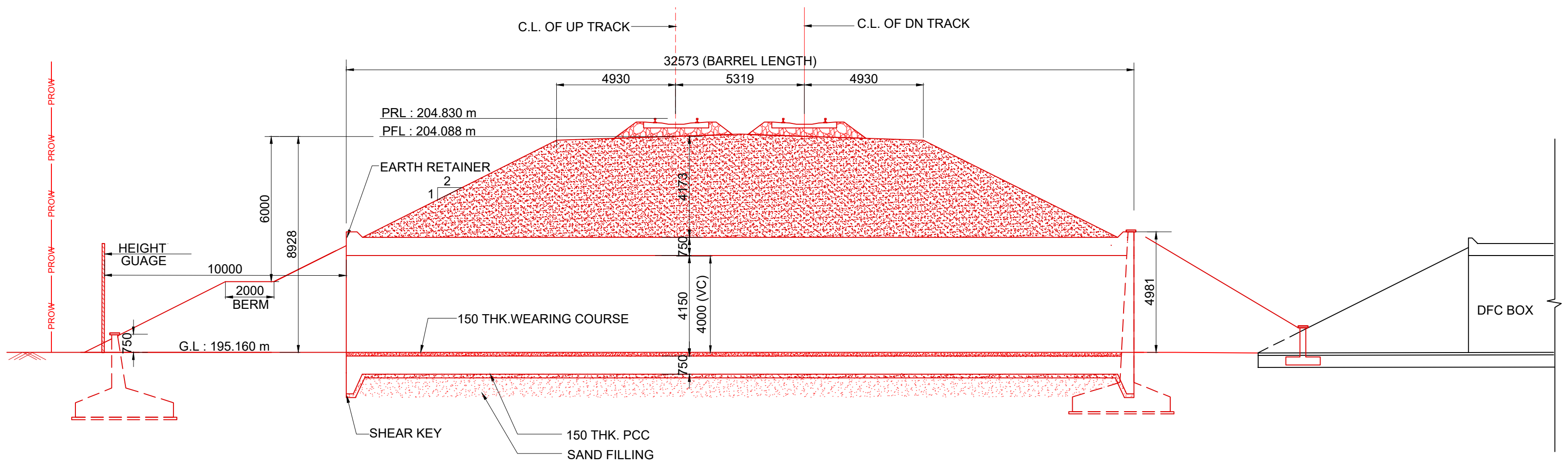
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR BALANCING CULVERT + RUB BRIDGE NO. 10 SPAN 1X5.2X5+1x4.7x5 RCC BOX AT CH: 371.033 (CANAL CROSSING DHATIR DISTRIBUTORY RD 25000)

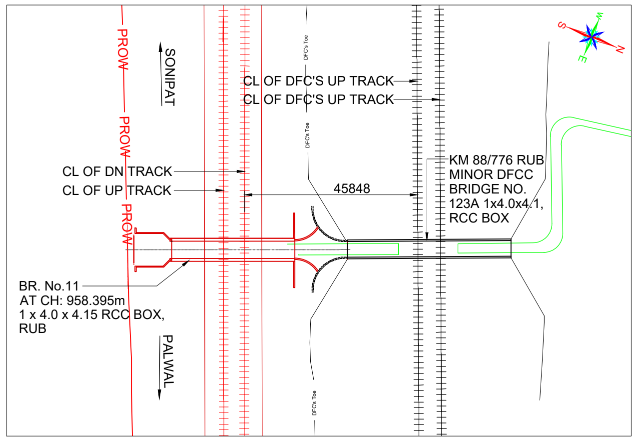
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_010010_A1	

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



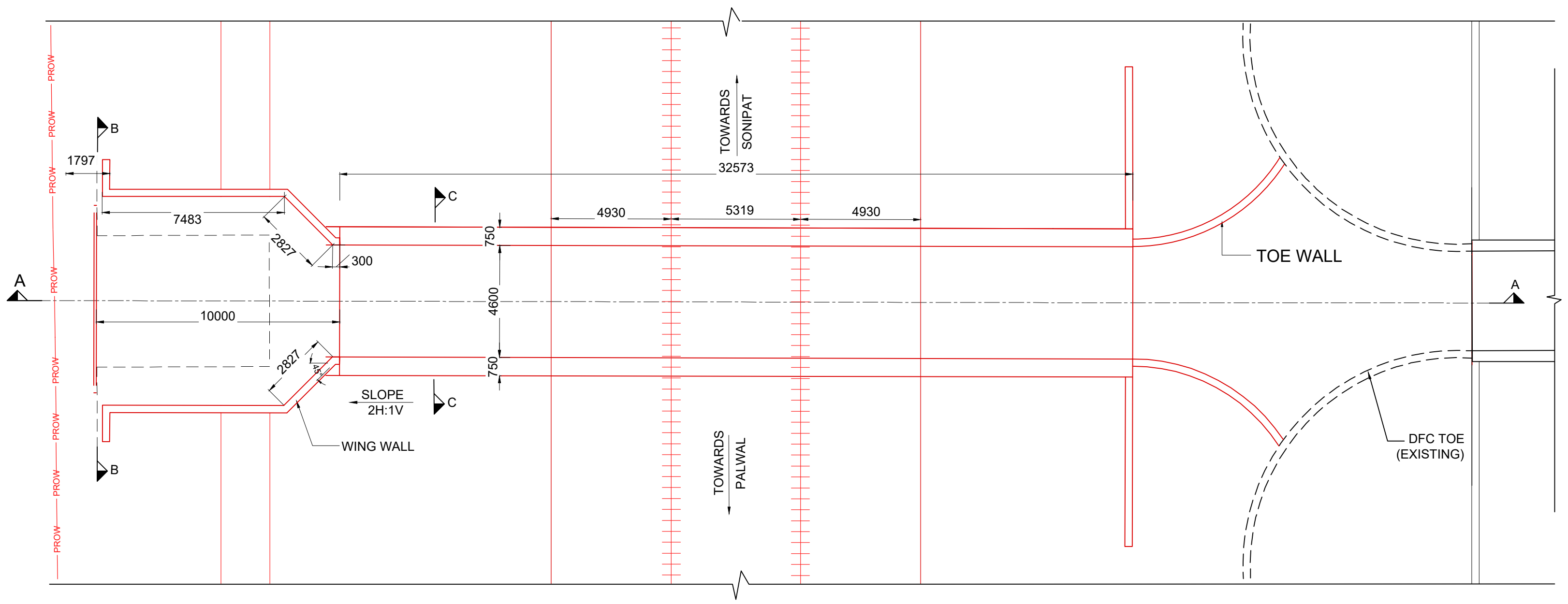
SECTIONAL ELEVATION AT A-A

SCALE 1:150



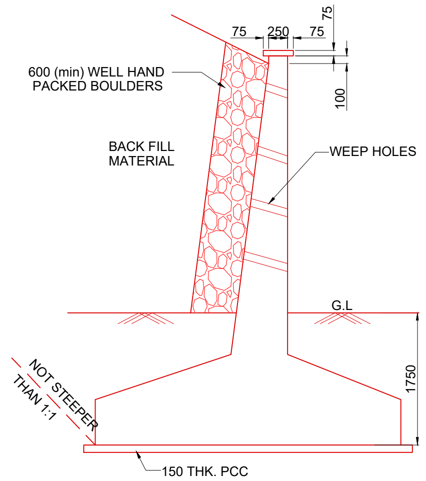
KEY PLAN

SCALE : NTS



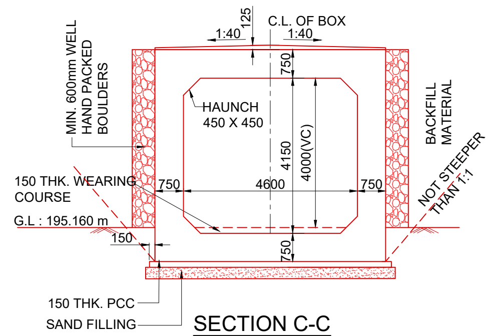
PLAN AT TOP

SCALE 1:150



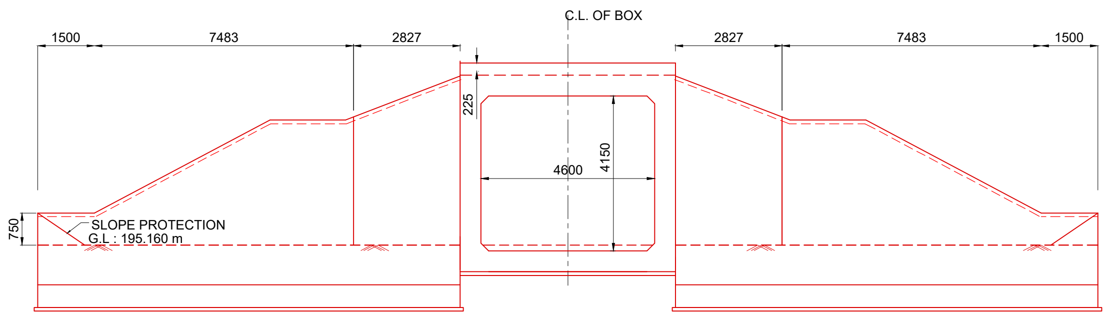
TYPICAL DETAIL OF RETURN WALL / WING WALL

SCALE 1:50



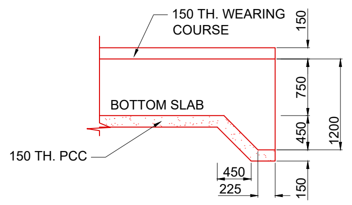
SECTION C-C

SCALE 1:100



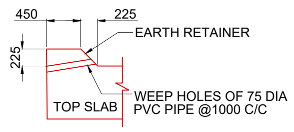
VIEW AT B-B

SCALE 1:100



SHEAR KEY

SCALE 1:50



EARTH RETAINER

SCALE 1:50

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL/ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD,

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.
17. DETAIL OF TOE WALL SHALL BE PROVIDED AS PER SKETCH NO. GC-HRIDC-SK-GEN-014_A1

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.

IMPORTANT NOTE:

TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

LEGEND

(red line)	PROPOSED
(black line)	EXISTING
(green dashed line)	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
VC	VERTICAL CLEARANCE
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

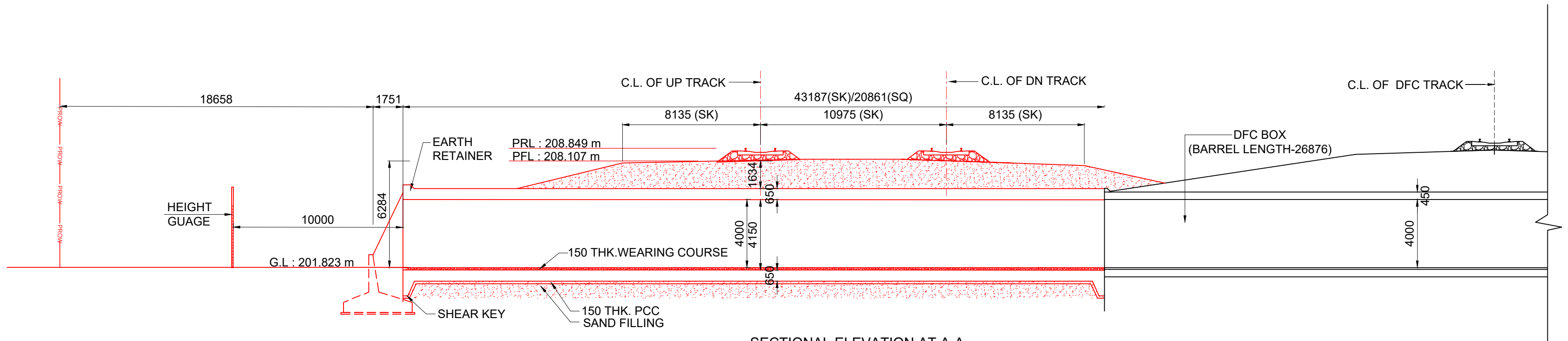
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

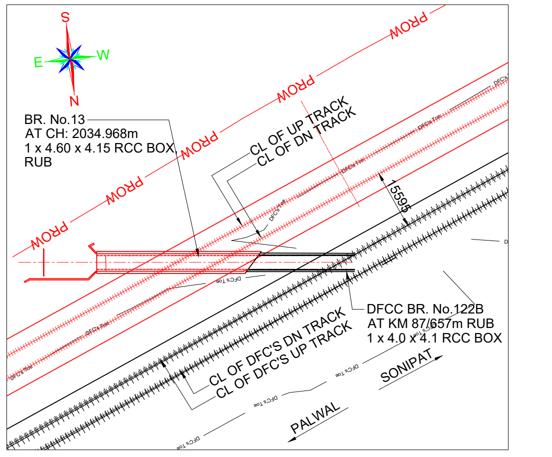
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO 11 SPAN 1X4.6X4.15 RCC BOX AT CH: 958.395

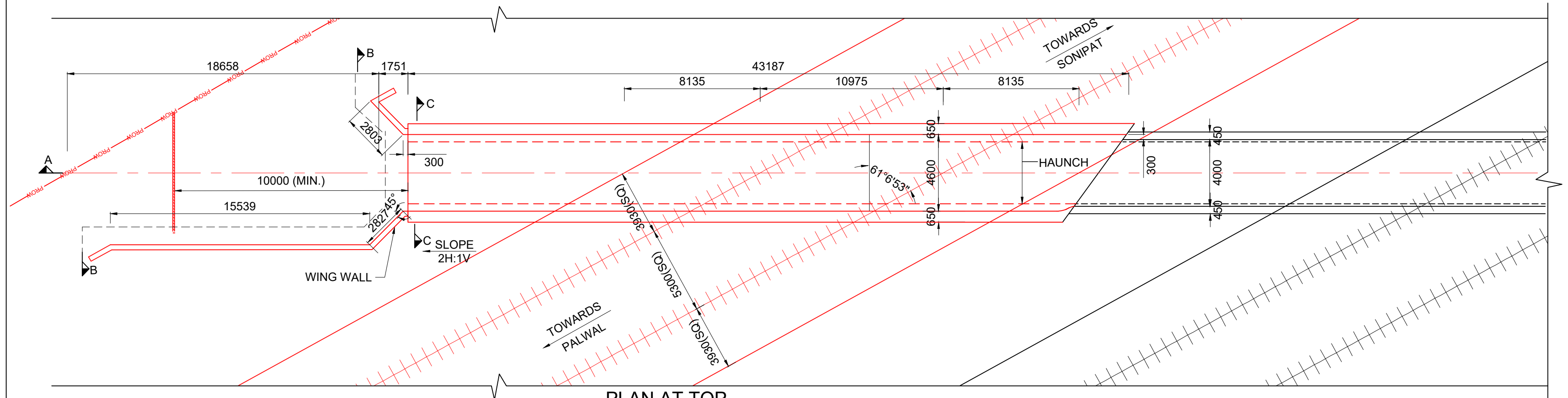
DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD-01011_A0		
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



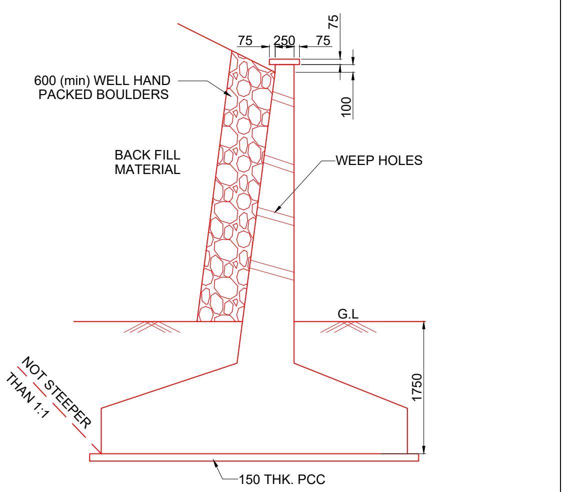
SECTIONAL ELEVATION AT A-A
SCALE 1:200



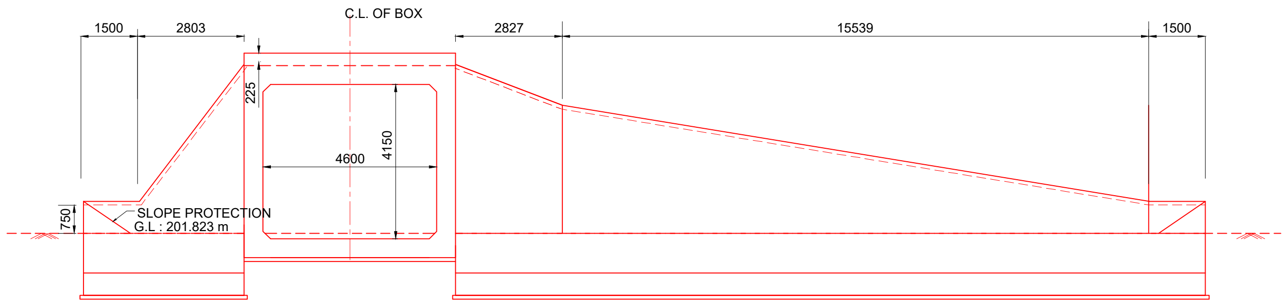
KEY PLAN
SCALE : NTS



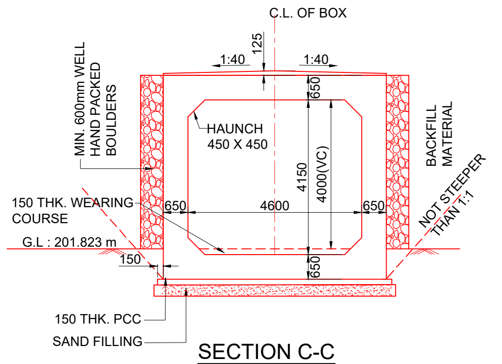
PLAN AT TOP
SCALE 1:200



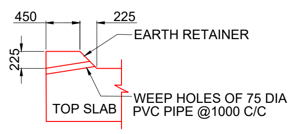
TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



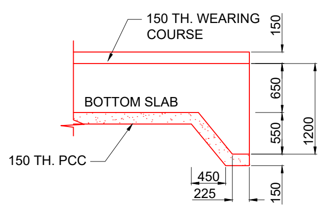
VIEW AT B-B
SCALE 1:100



SECTION C-C
SCALE 1:100



EARTH RETAINER
SCALE 1:50



SHEAR KEY
SCALE 1:50

LEGEND

——— (red)	PROPOSED
———	EXISTING
— — —	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
VC	VERTICAL CLEARANCE
PROW	PROPOSED HORC'S ROW

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL/ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.

IMPORTANT NOTE:

TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL. HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	Mohd
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

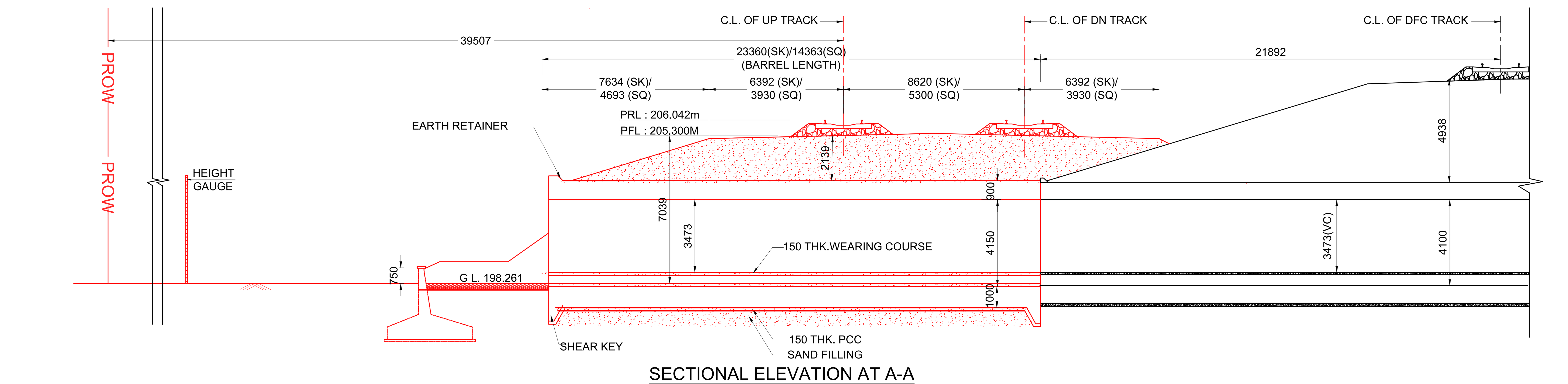
RITES THE INFRASTRUCTURE PEOPLE

SMEC

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO 13 SPAN 1X4.60X4.15, RCC BOX AT CH: 2034.968

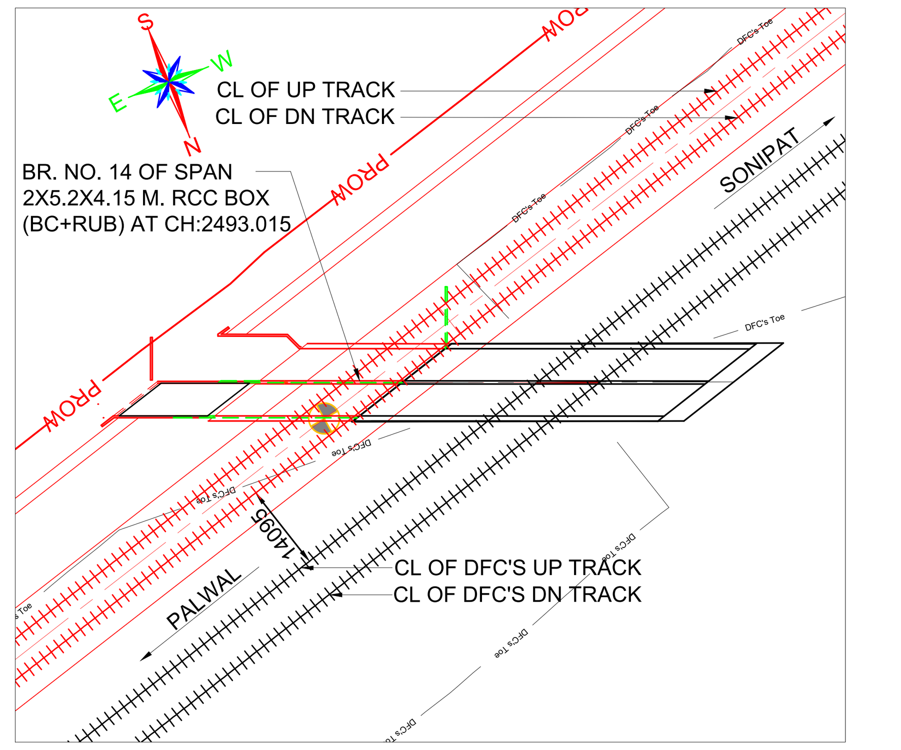
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD-01013_A0	

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



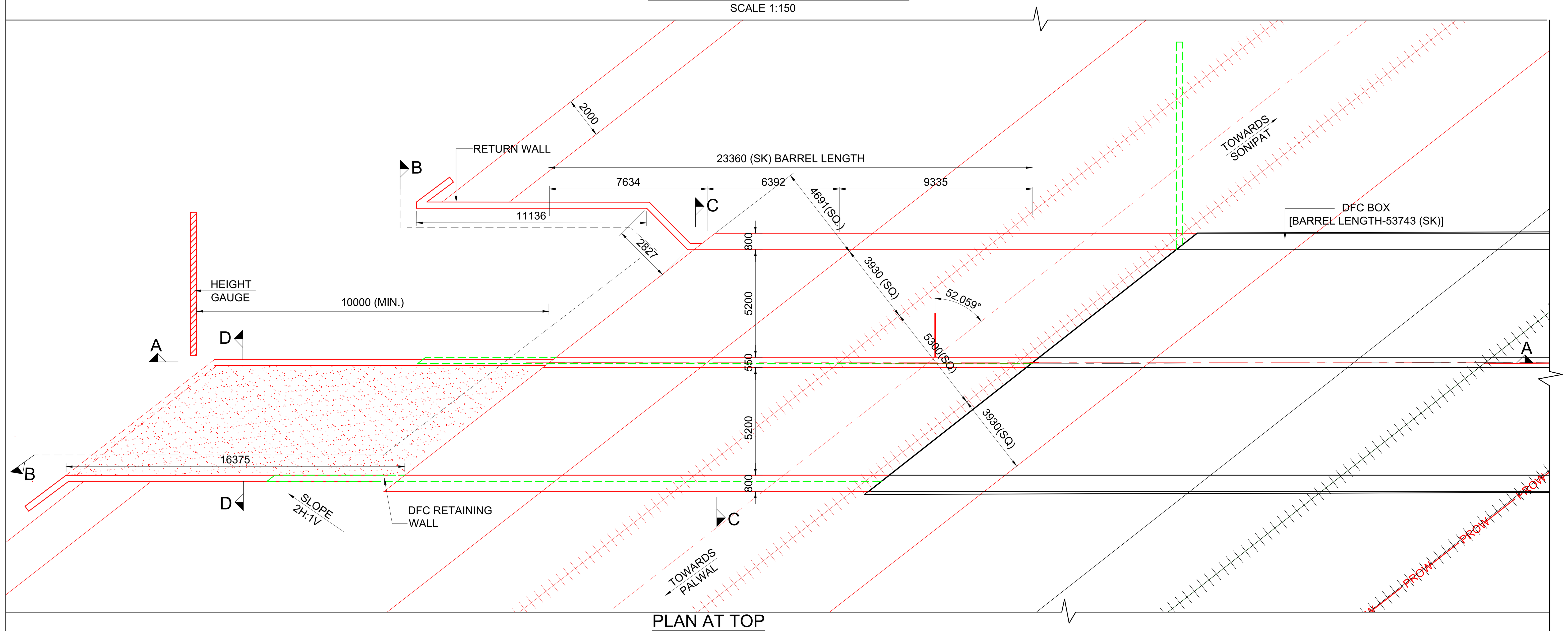
SECTIONAL ELEVATION AT A-A

SCALE 1:150



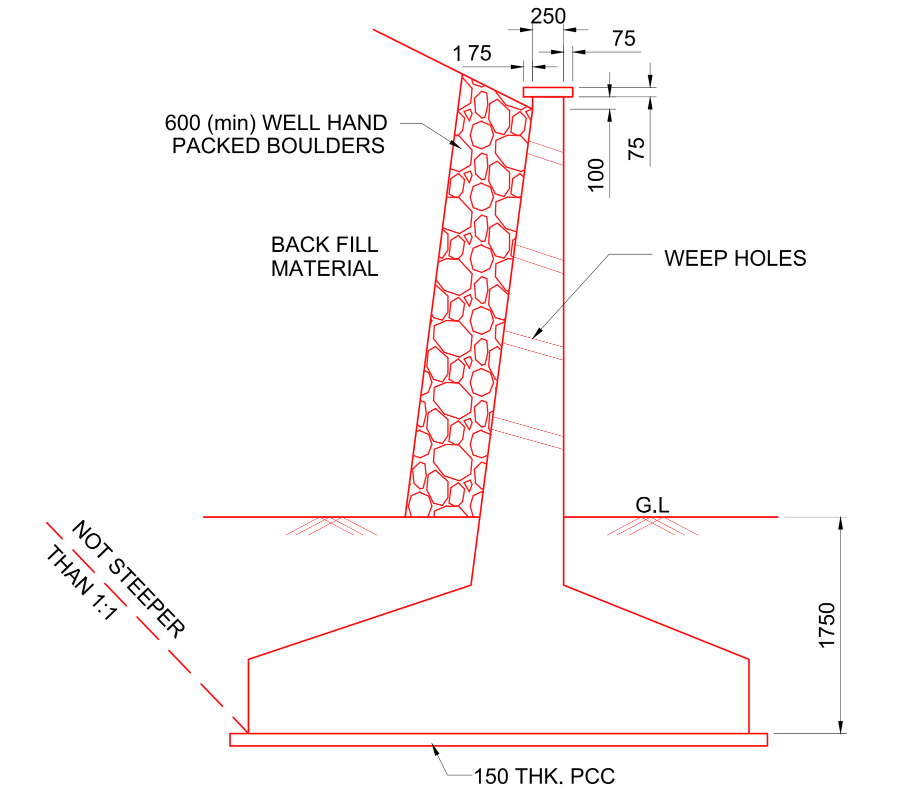
KEY PLAN

SCALE NTS



PLAN AT TOP

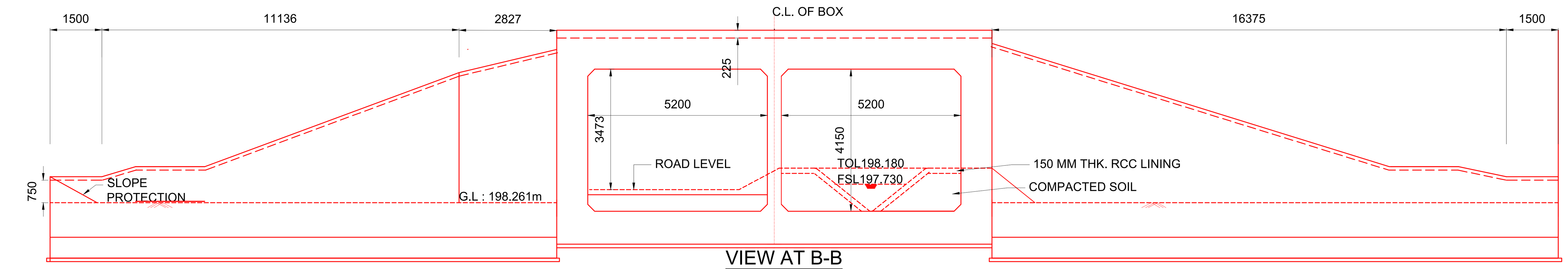
SCALE 1:150



TYPICAL DETAIL OF RETURN WALL / WING WALL

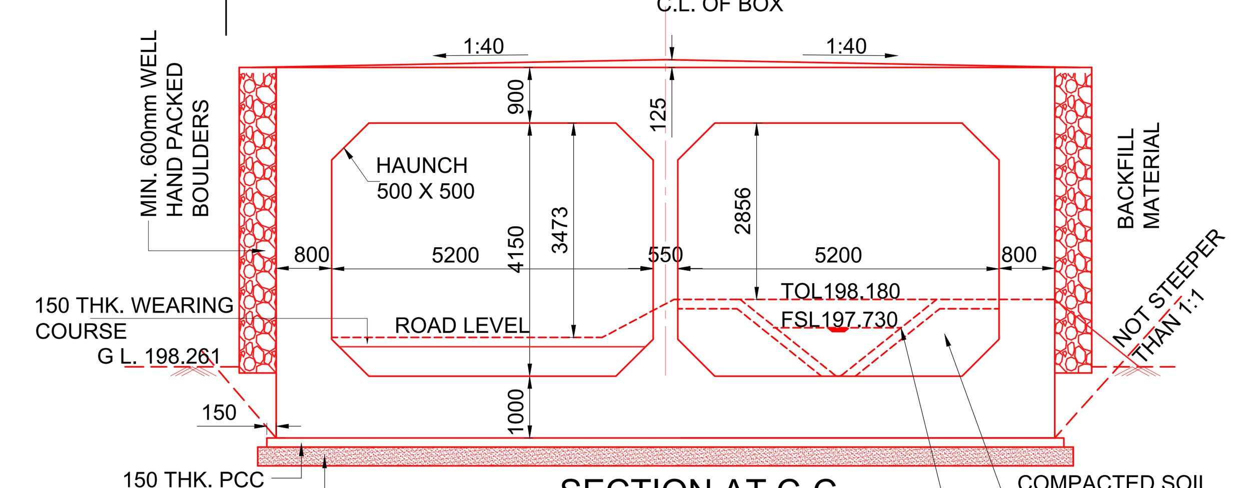
SCALE 1:50

HYDRAULIC DATA OF DRAIN		
1	NAME OF CANAL	CHANDPUR MINOR CANAL
2	RD	6500/2493.016
3	BED LEVEL(BL)	196.950
4	FULL SUPPLY LEVEL(FSL)	197.730
5	DISCHARGE	16.50CS
6	FREE BOARD	198.180
7	TOP OF LINING (T.O.L.)	198.180



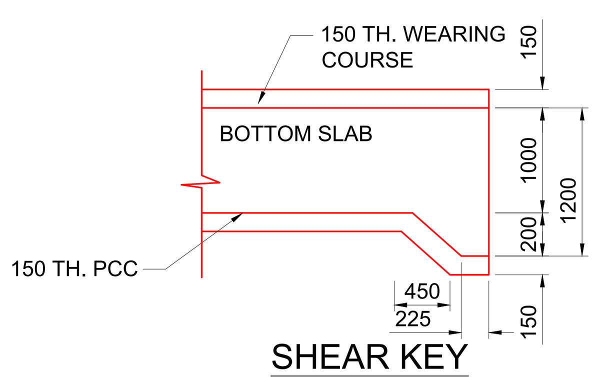
VIEW AT B-B

SCALE 1:50



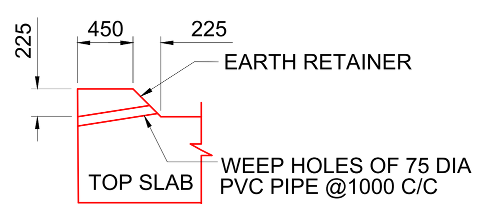
SECTION AT C-C

SCALE 1:100



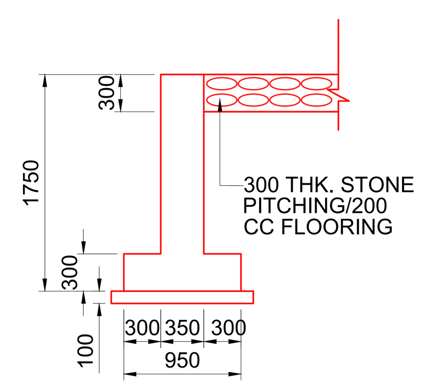
SHEAR KEY

SCALE 1:50



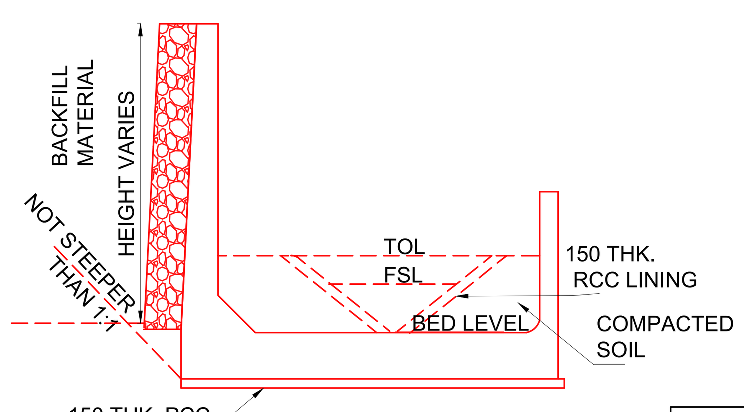
EARTH RETAINER

SCALE 1:50



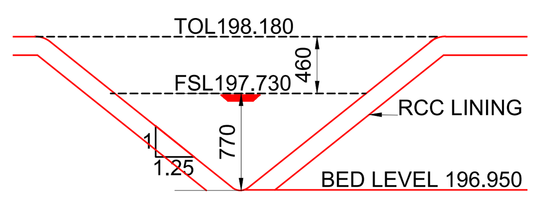
DROP WALL DETAILS

SCALE 1:50



SECTION AT D-D

SCALE 1:50



DRAIN CROSS SECTION

(SCALE 1:50)

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
VC	VERTICAL CLEARANCE
PROW	PROPOSED HORC'S ROW

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/Sig.NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.
3. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.
4. RCC LINING SHALL BE CONSTRUCTED FOR CANAL FROM ROW TO ROW OF HORC INCLUDING IN RCC BOX & U-TROUGH.
5. RCC LINING SHALL BE OF MIN 150 MM THICK AND HAVING AT LEAST MIN TEMP REINFORCEMENT.

IMPORTANT NOTE:

TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

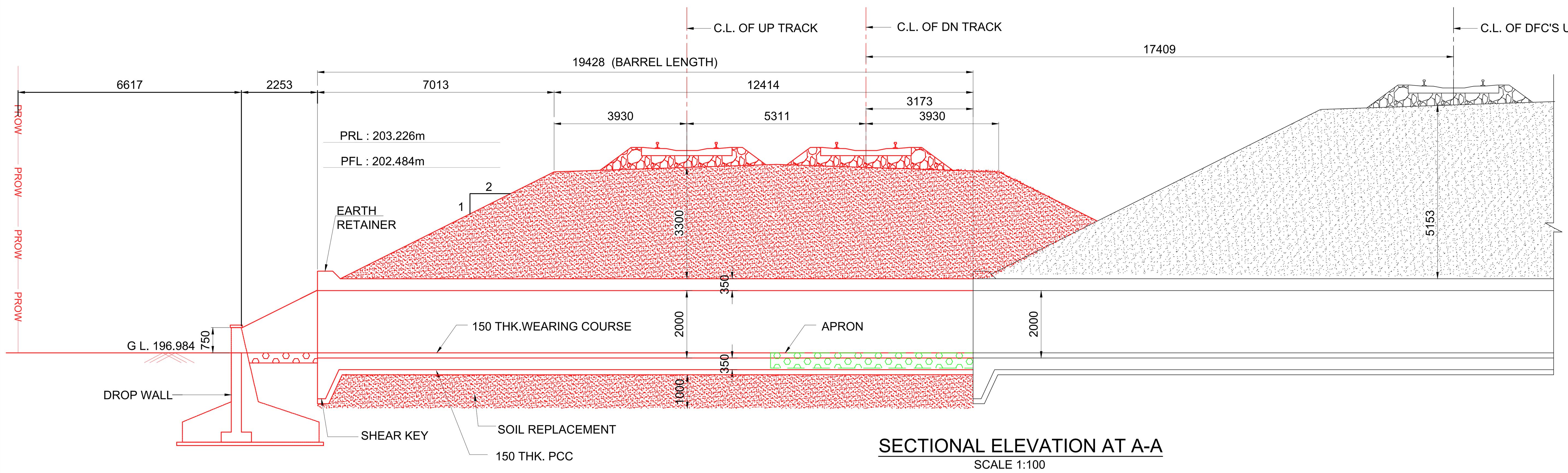
THE INFRASTRUCTURE PEOPLE

Member of the Surbana Jurong Group

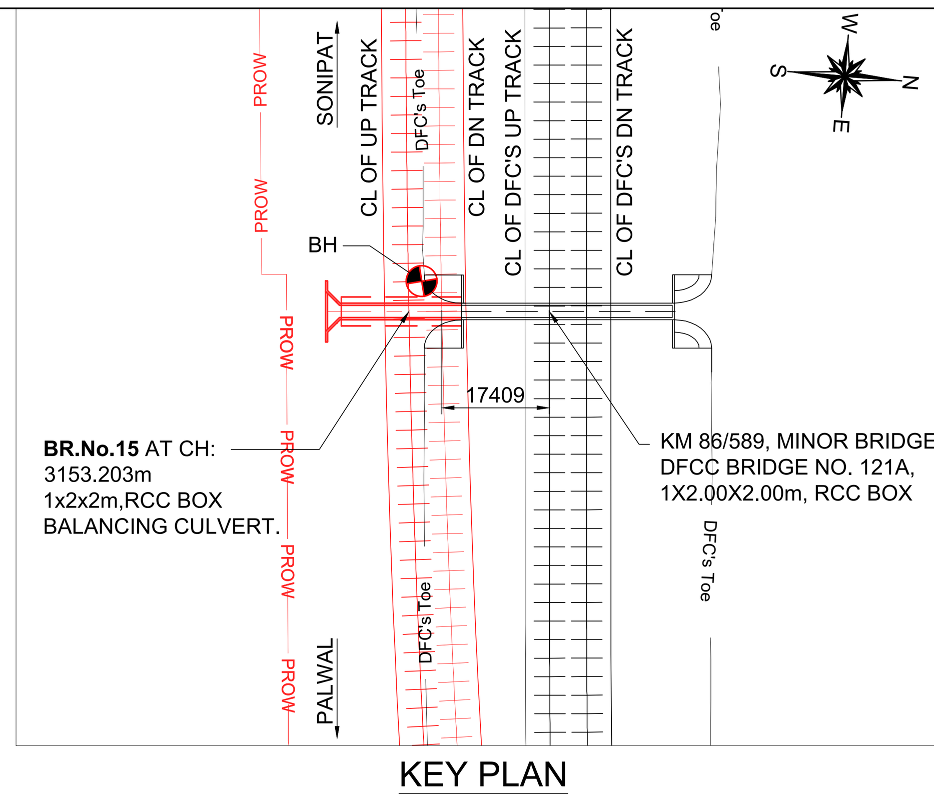
GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR RUB + BALANCING CULVERT BRIDGE NO. 14 SPAN 2X5.2X4.15 RCC BOX AT CH: 2493.015 (CANAL CROSSING CHANDPUR MINOR RD 6500)

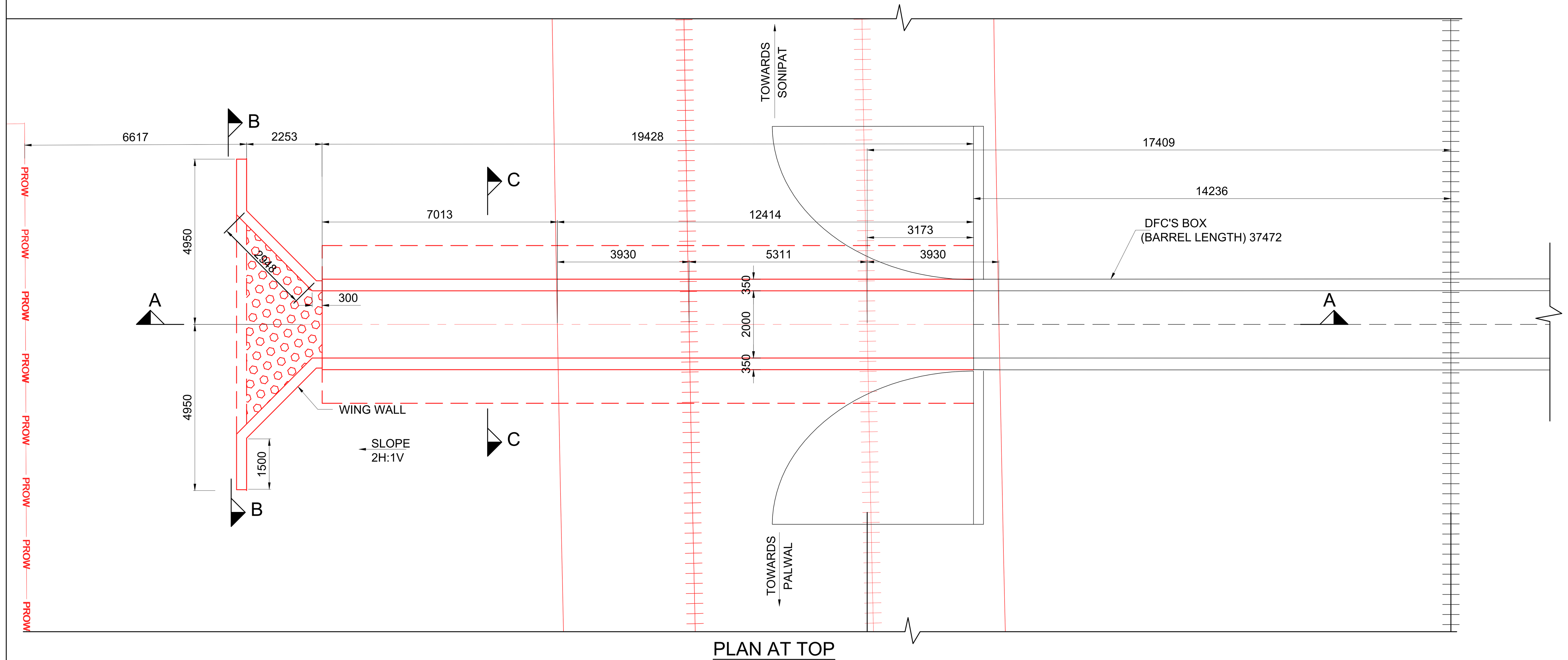
DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01014_A1		
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	06-12-2023



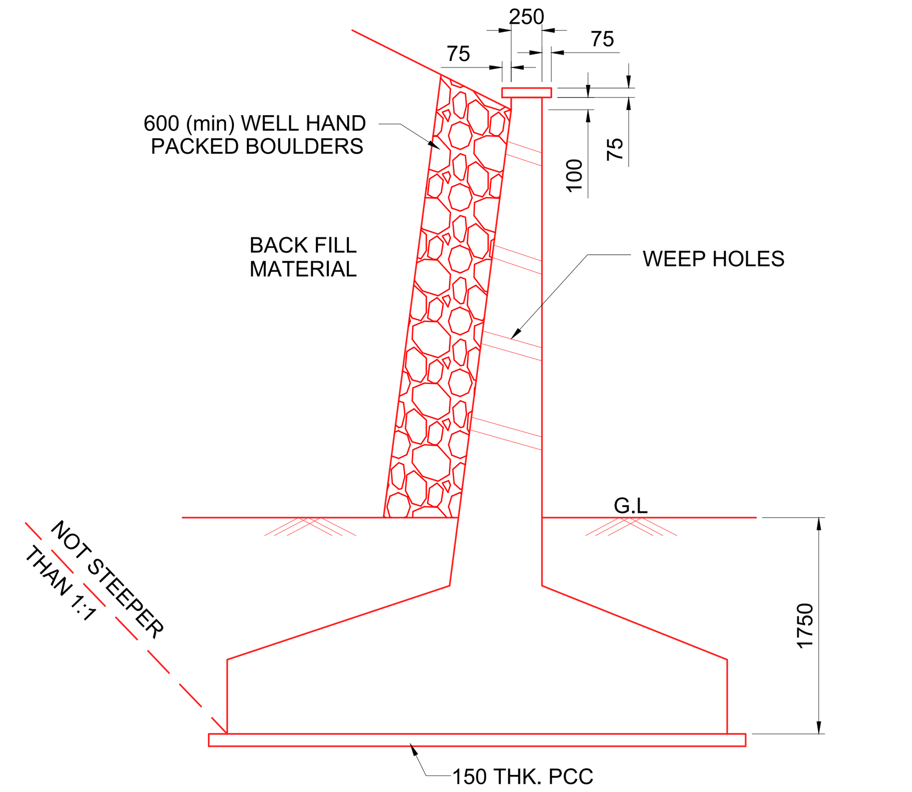
SECTIONAL ELEVATION AT A-A
SCALE 1:100



KEY PLAN
SCALE NTS



PLAN AT TOP
SCALE 1:150



TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50

NOTES :

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11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD,

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
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3. SEISMIC ZONE- IV
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5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
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8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
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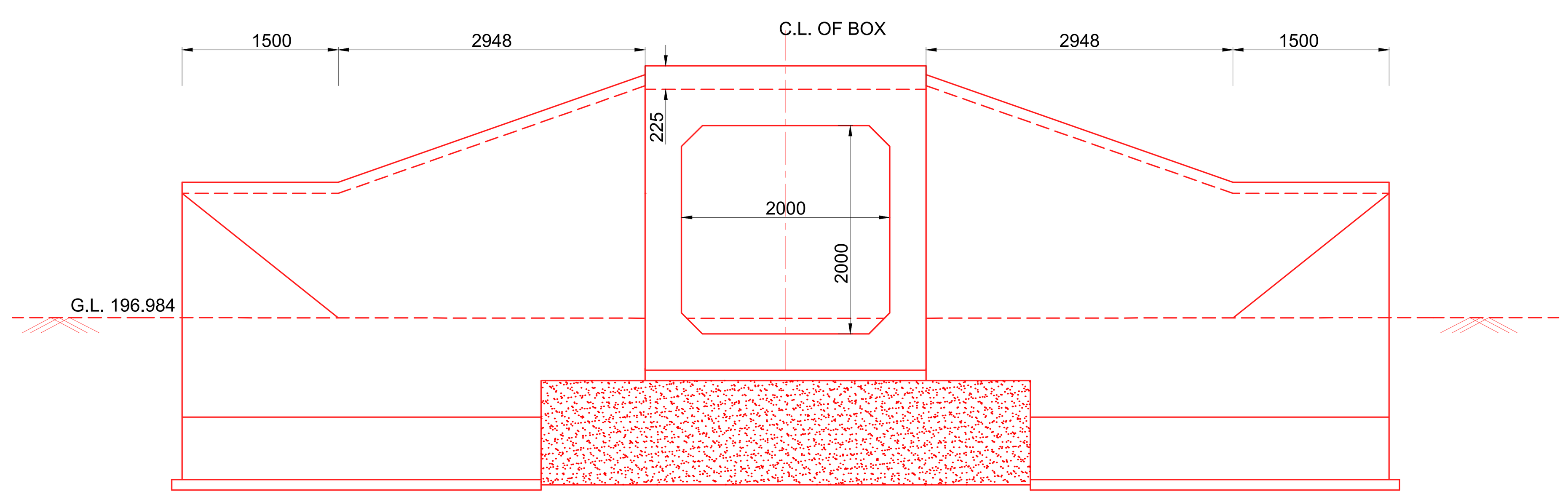
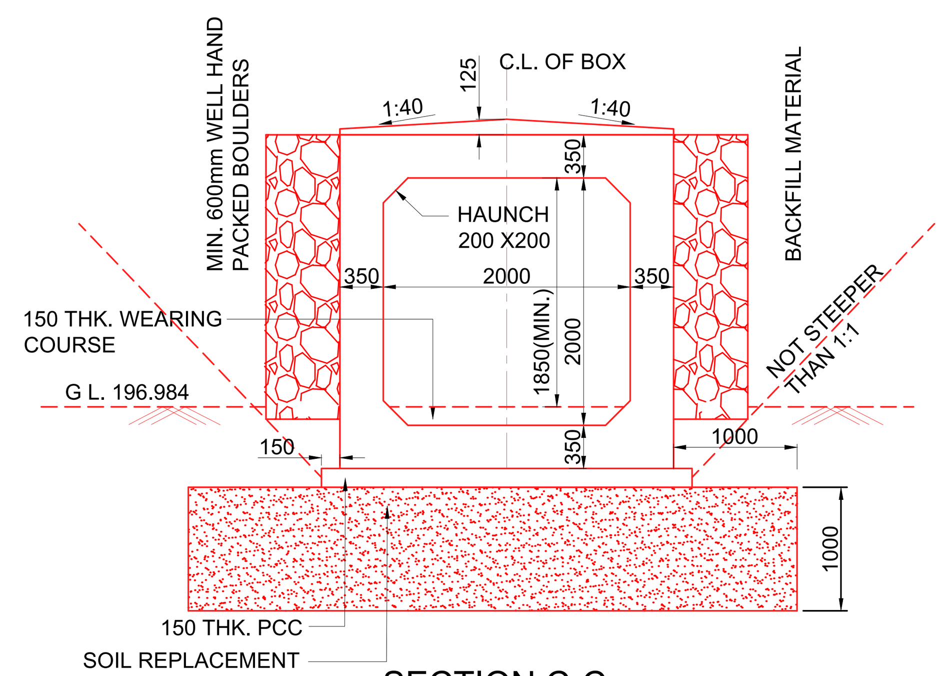
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.
2. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.



VIEW AT B-B
SCALE 1:50



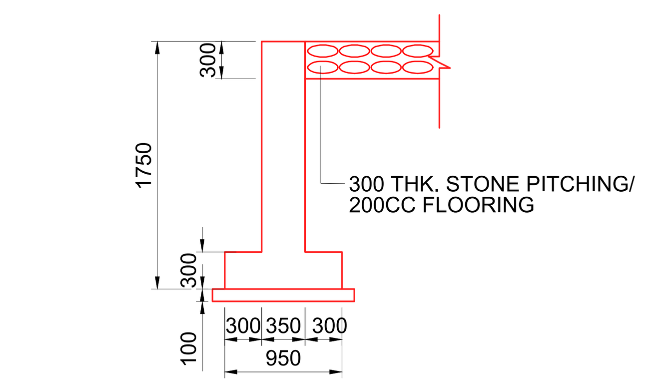
SECTION C-C
SCALE 1:50

LEGEND

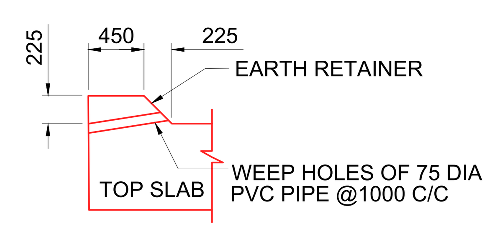
	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

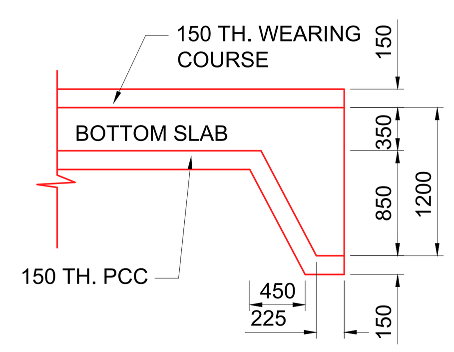
PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW



DROP / CURTAIN WALL DETAILS
SCALE 1:50



EARTH RETAINER
SCALE 1:50



SHEAR KEY
SCALE 1:50

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

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CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

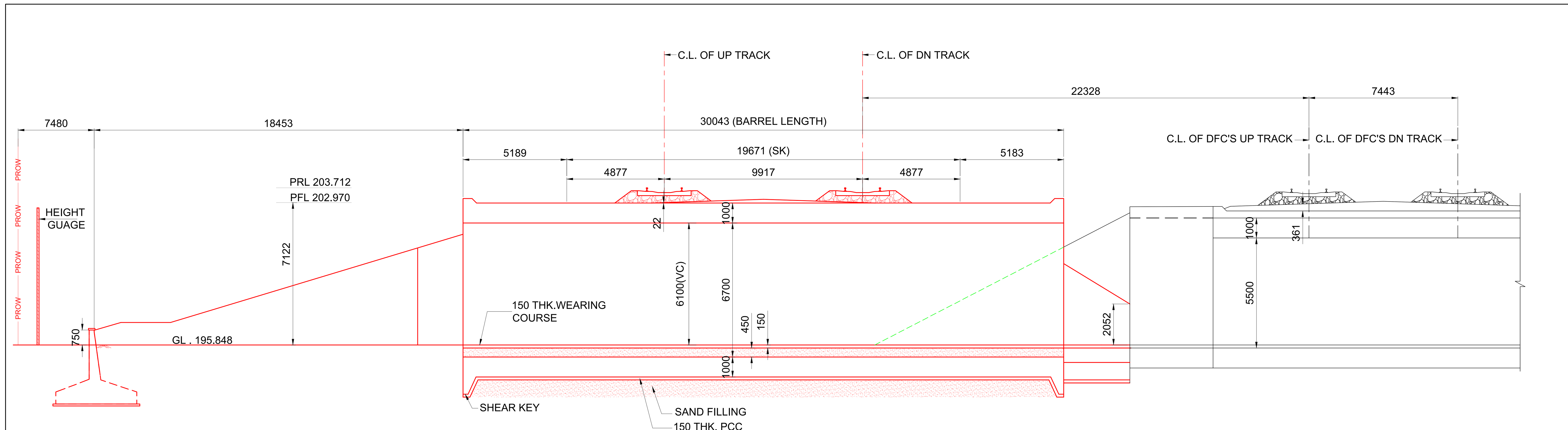
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

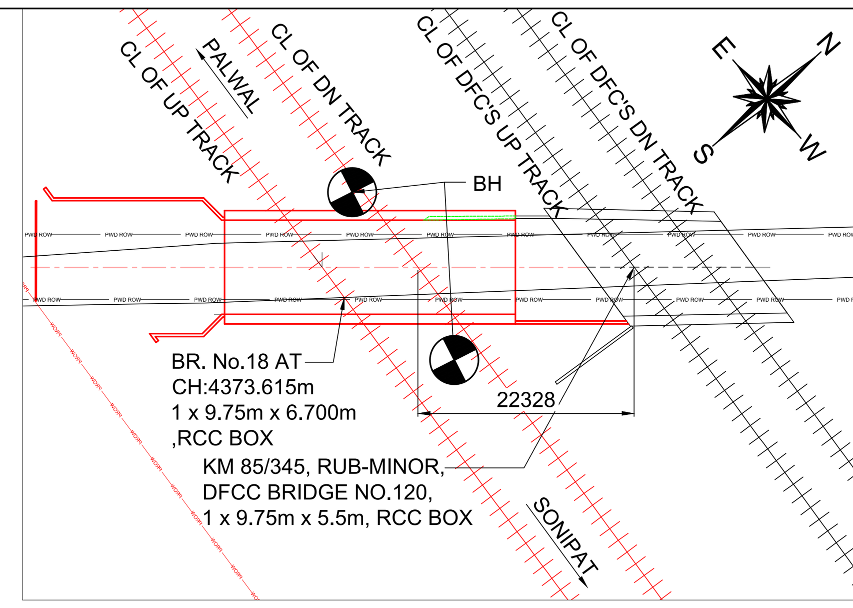
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR BALANCING CULVERT BRIDGE NO. 15 SPAN 1X2X2 RCC BOX AT CH: 3153.203

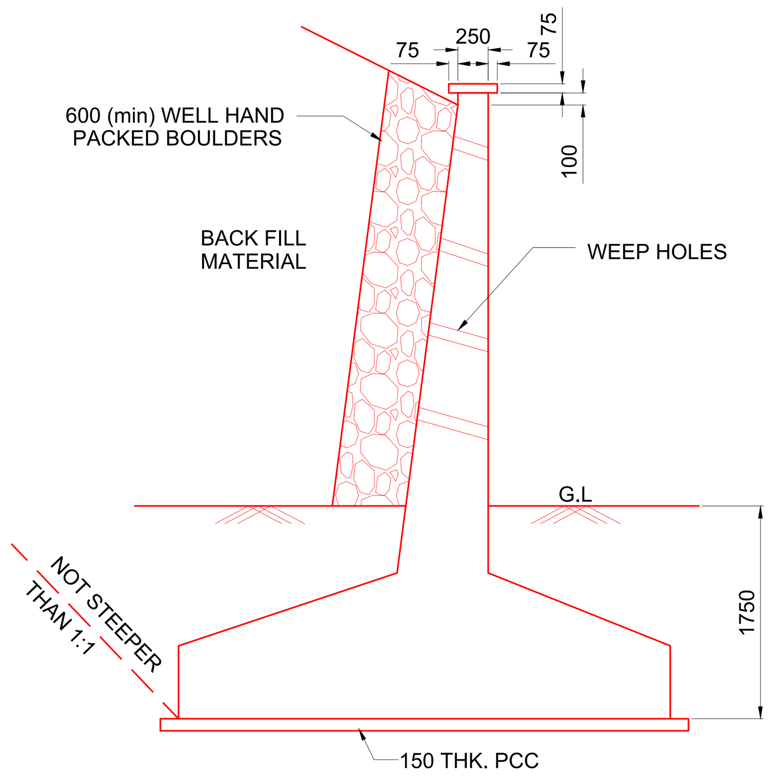
DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01015_A0		1 OF 1
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



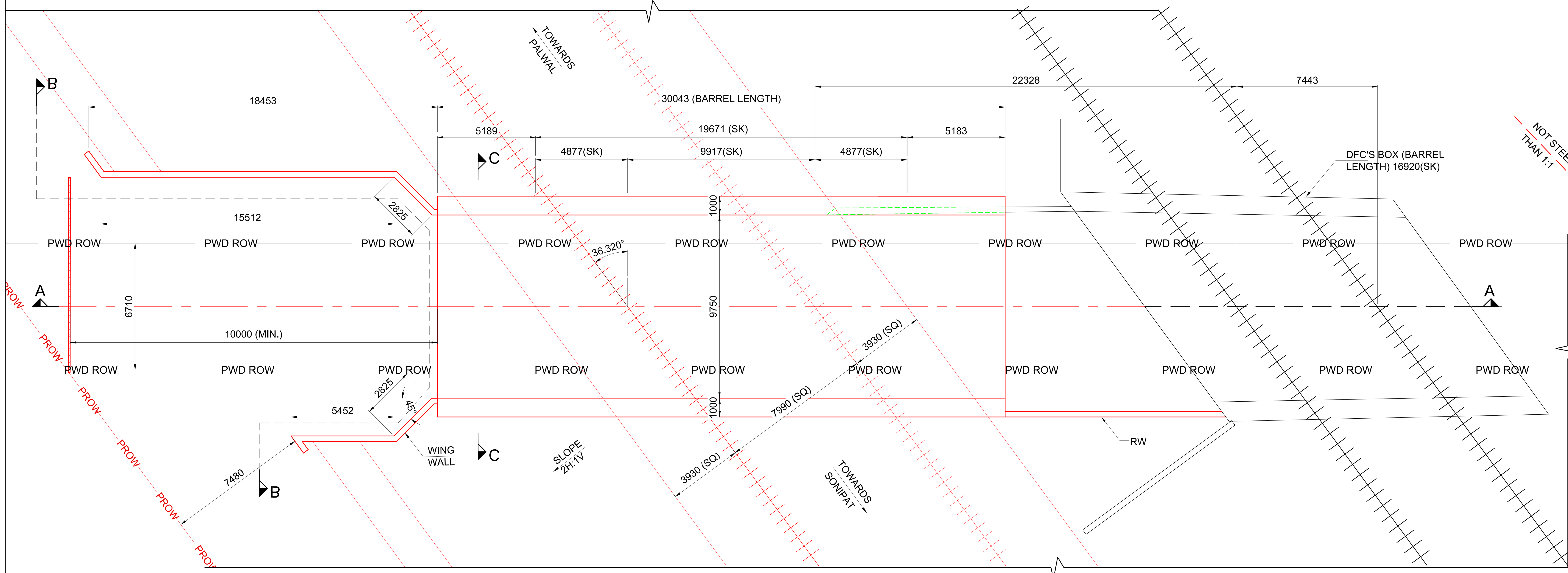
SECTIONAL ELEVATION AT A-A
SCALE 1:150



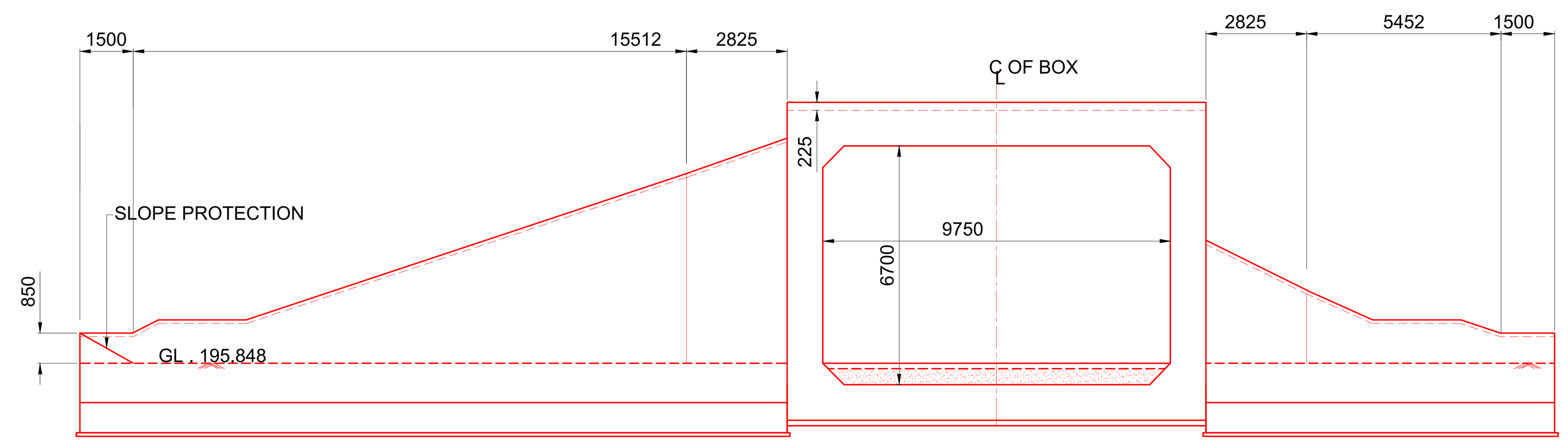
KEY PLAN
SCALE NTS



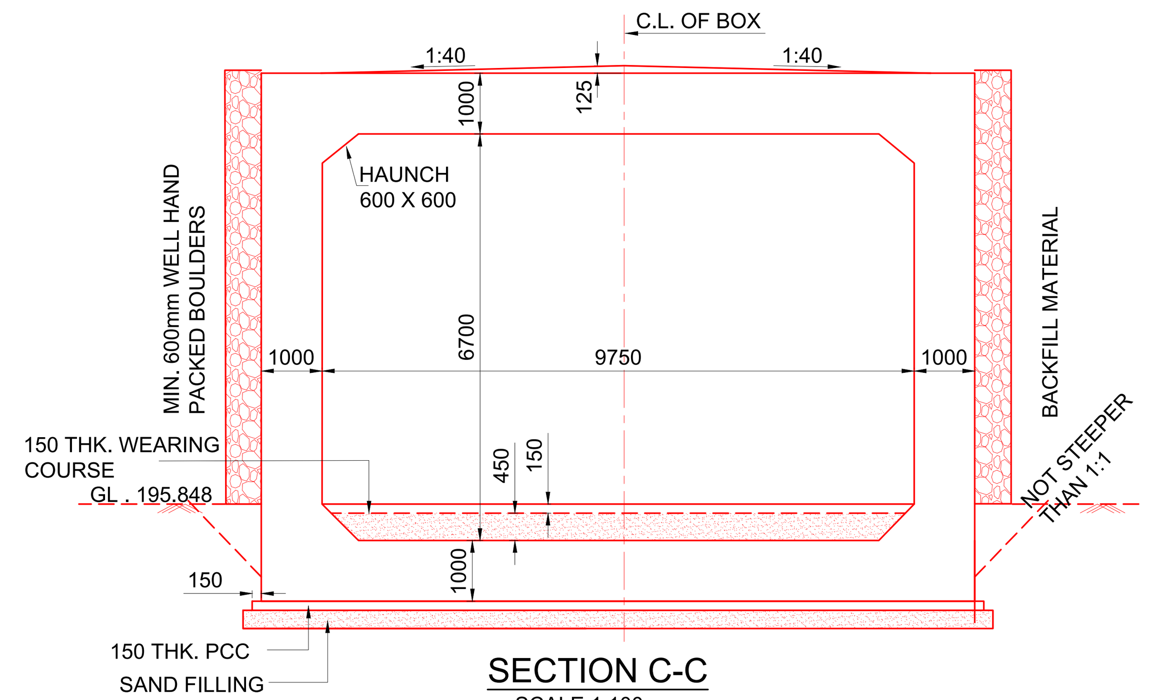
TYPICAL DETAIL OF RETAINING WALL(RW) / WING WALL
SCALE 1:50



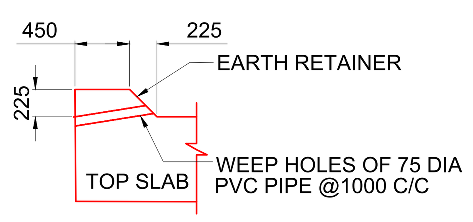
PLAN AT TOP
SCALE 1:150



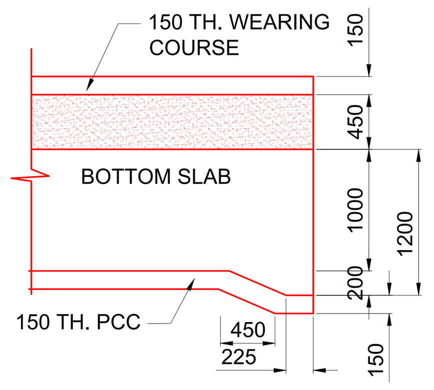
VIEW B-B
SCALE 1:150



SECTION C-C
SCALE 1:100



EARTH RETAINER
SCALE 1:50



SHEAR KEY
SCALE 1:50

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

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PFL	PROPOSED FORMATION LEVEL
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13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB-STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.
3. REGRADING OF APPROACH ROAD HAS TO BE DONE ON OPPOSITE SIDE O DFC.

IMPORTANT NOTE:
TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

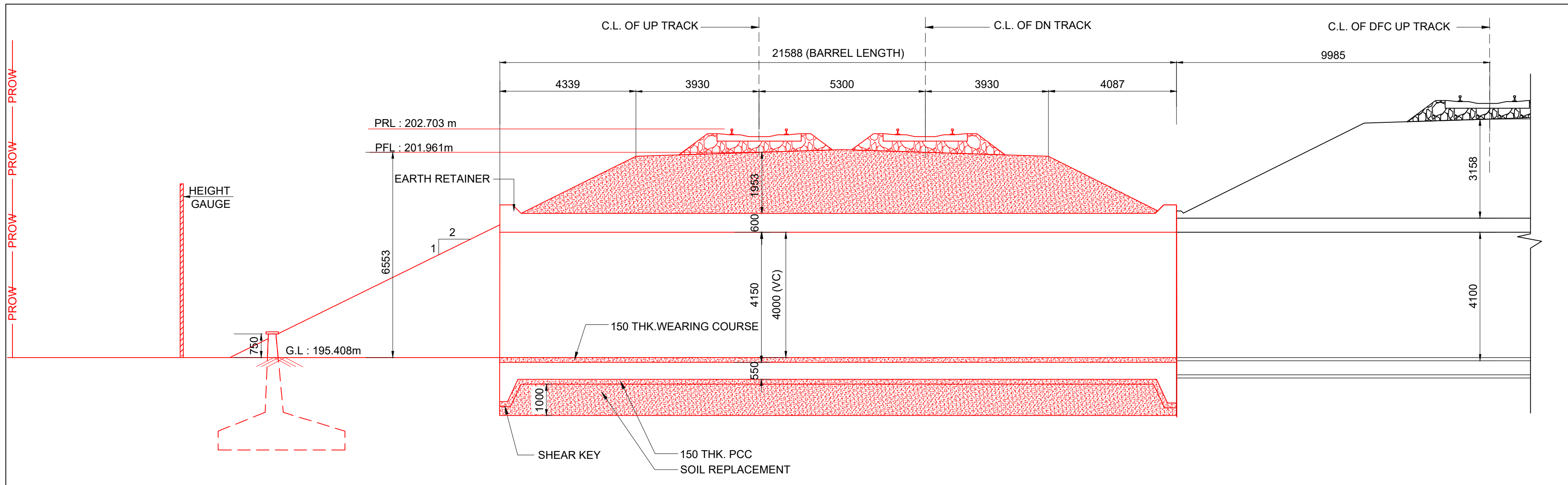
RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO. 18
1 x 9.75m x 6.70m RCC BOX AT CH.4373.615m

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01018_A0	1 OF 1

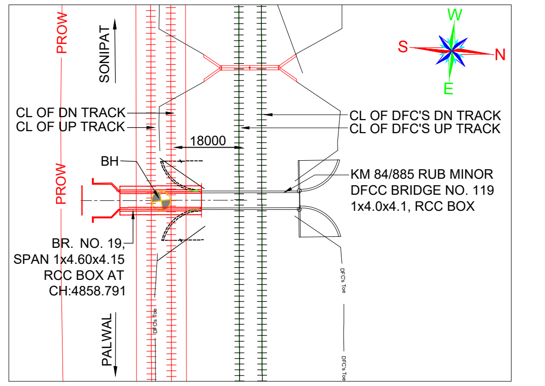
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	

OLD CH: 4858.699, NEW CH: 4856.791



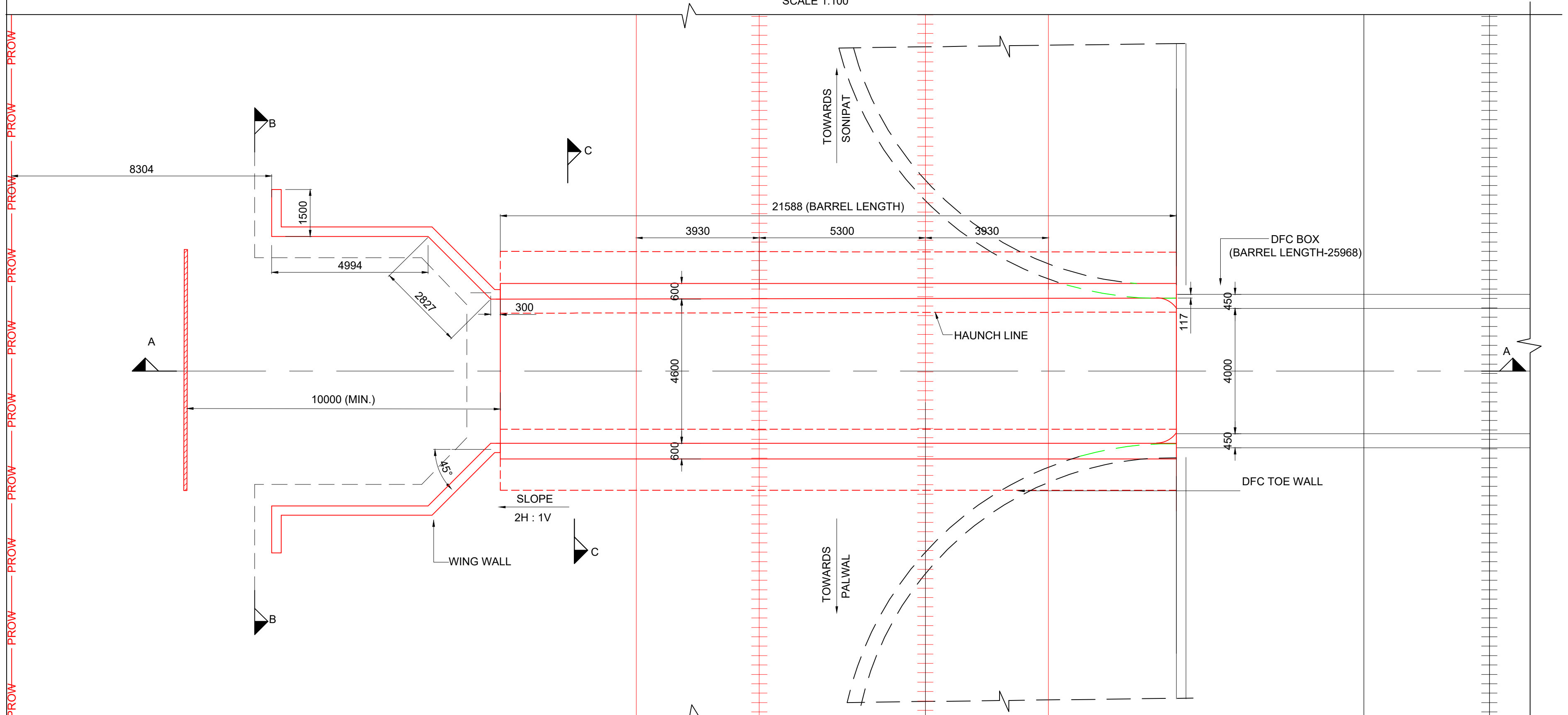
SECTIONAL ELEVATION AT A-A

SCALE 1:100



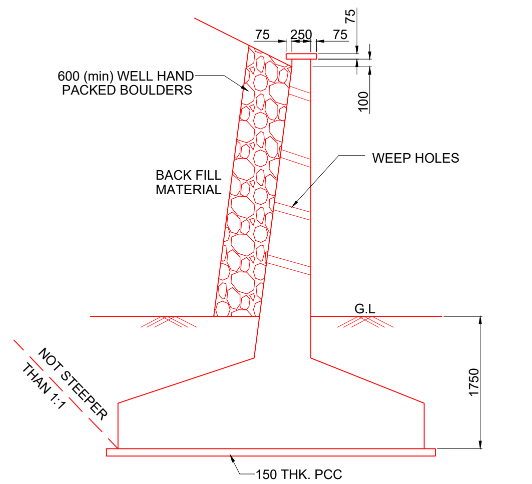
KEY PLAN

SCALE :NTS



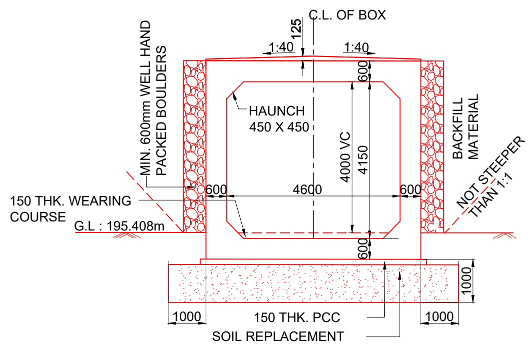
PLAN AT TOP

SCALE 1:100



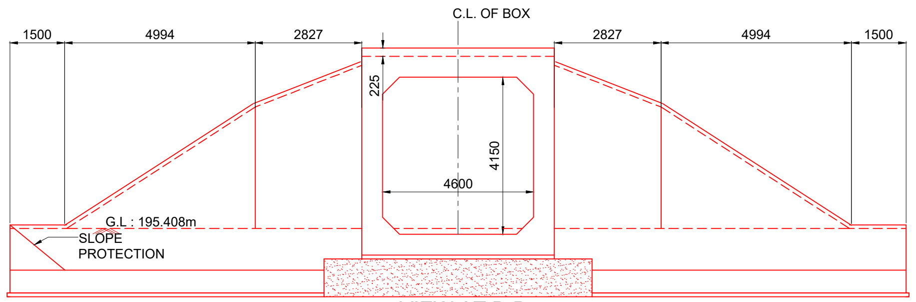
TYPICAL DETAIL OF RETURN WALL / WING WALL

SCALE 1:50



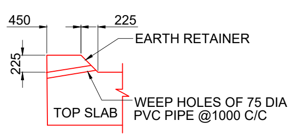
SECTION C-C

SCALE 1:100



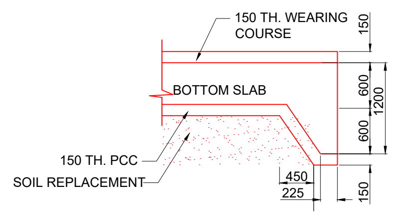
VIEW AT B-B

SCALE 1:100



EARTH RETAINER

SCALE 1:50



SHEAR KEY

SCALE 1:50

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig.)NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.
3. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.

IMPORTANT NOTE:

TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

LEGEND

(red line)	PROPOSED
(black line)	EXISTING
(green dashed line)	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
VC	VERTICAL CLEARANCE
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	(signature)
SUDHIR AGRAWAL DPD/CIVIL	(signature)	RAJU SOLANK DGM/CIVIL	(signature)
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	(signature)
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

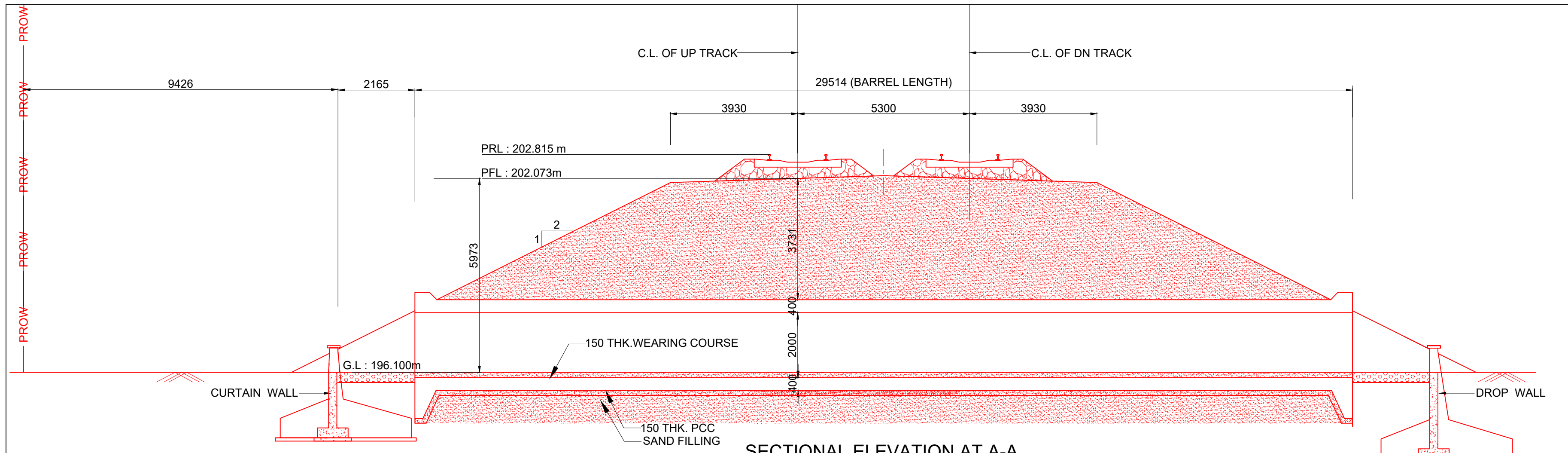
RITES THE INFRASTRUCTURE PEOPLE

SMEC Member of the Surbana Jurong Group

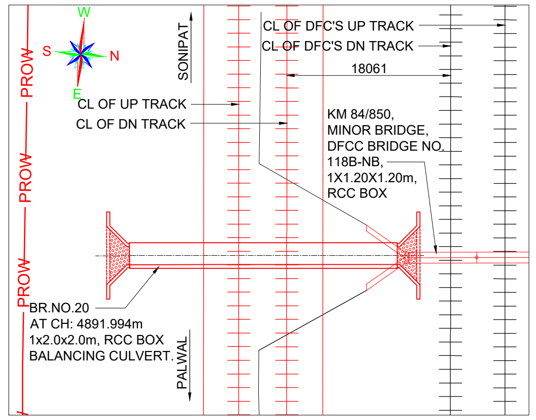
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO 19 SPAN 1.0X4.6X4.15 RCC BOX AT CH: 4858.791

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD-01019_A1	

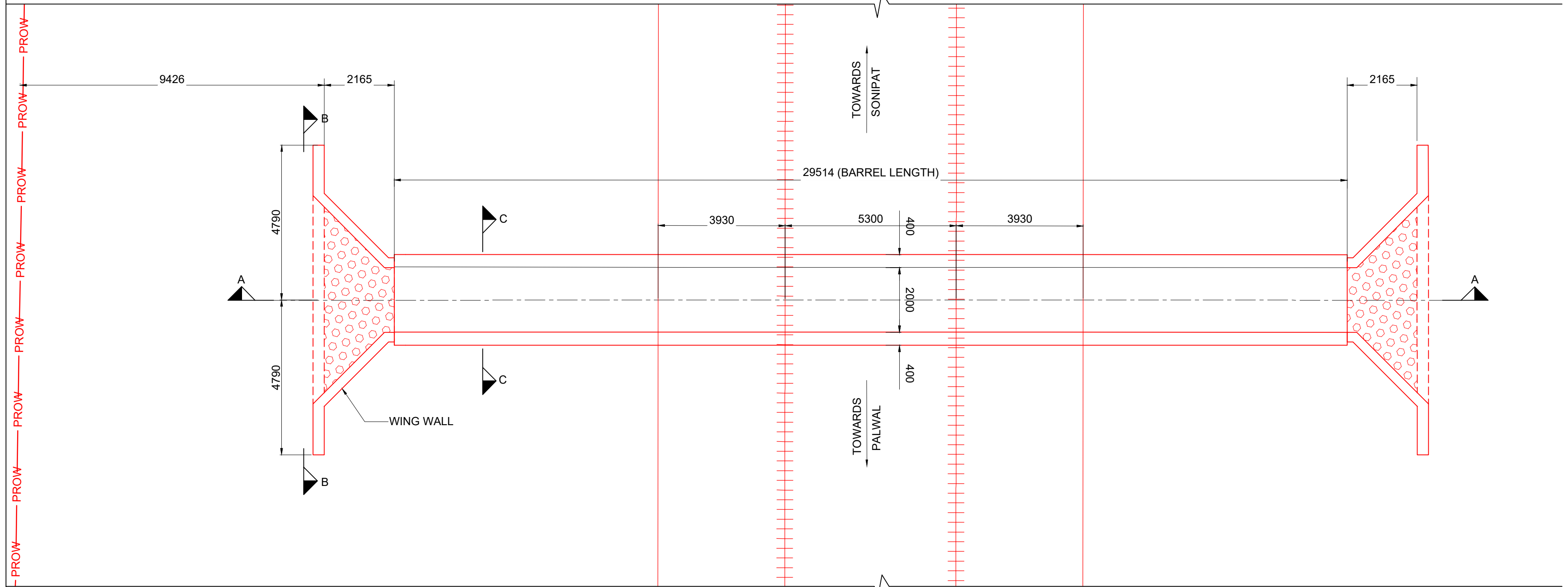
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



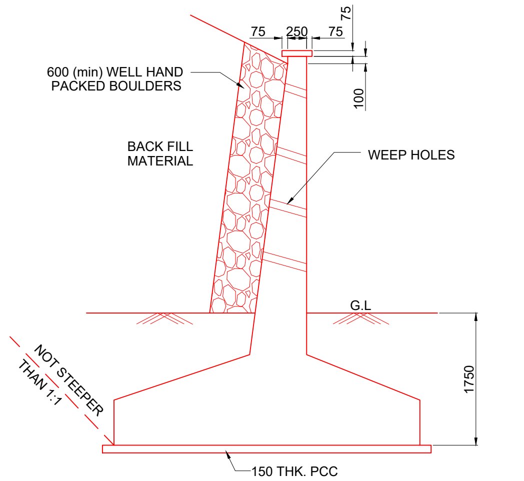
SECTIONAL ELEVATION AT A-A
SCALE 1:100



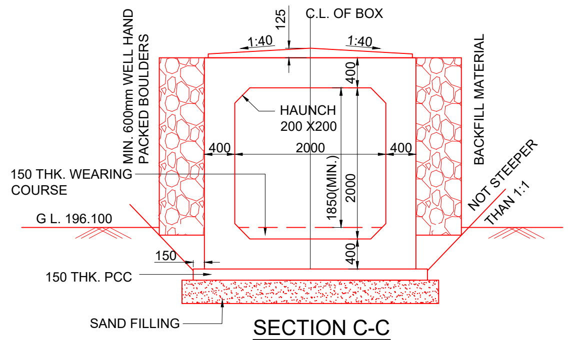
KEY PLAN
SCALE : NTS



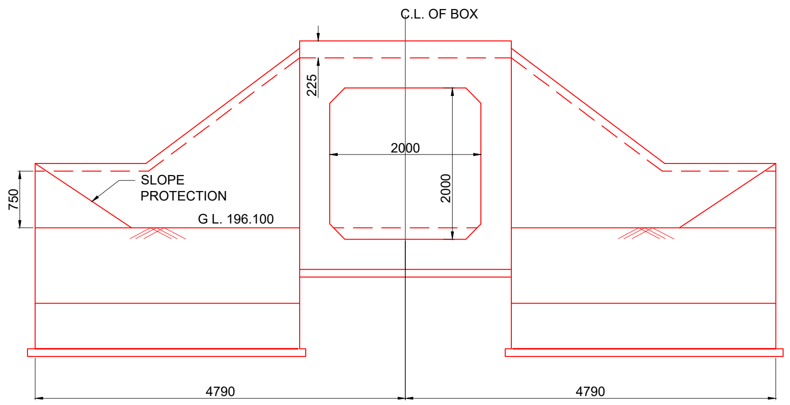
PLAN AT TOP
SCALE 1:150



TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



SECTION C-C
SCALE 1:50



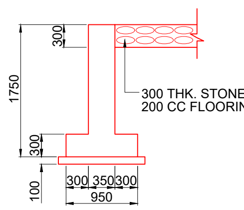
VIEW AT B-B
SCALE 1:50

LEGEND

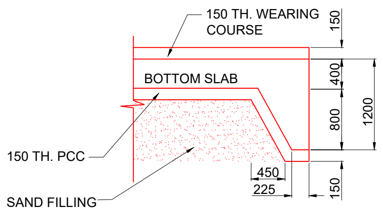
——	PROPOSED
——	EXISTING
— — —	DISMANTLE

ABBREVIATION

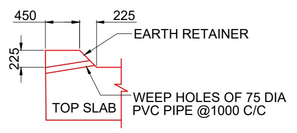
PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW



DROP / CURTAIN WALL DETAILS
SCALE 1:50



SHEAR KEY
SCALE 1:50



EARTH RETAINER
SCALE 1:50

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
(i) IRS BRIDGE RULE
(ii) IRS CONCRETE BRIDGE CODE
(iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
(i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
(ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

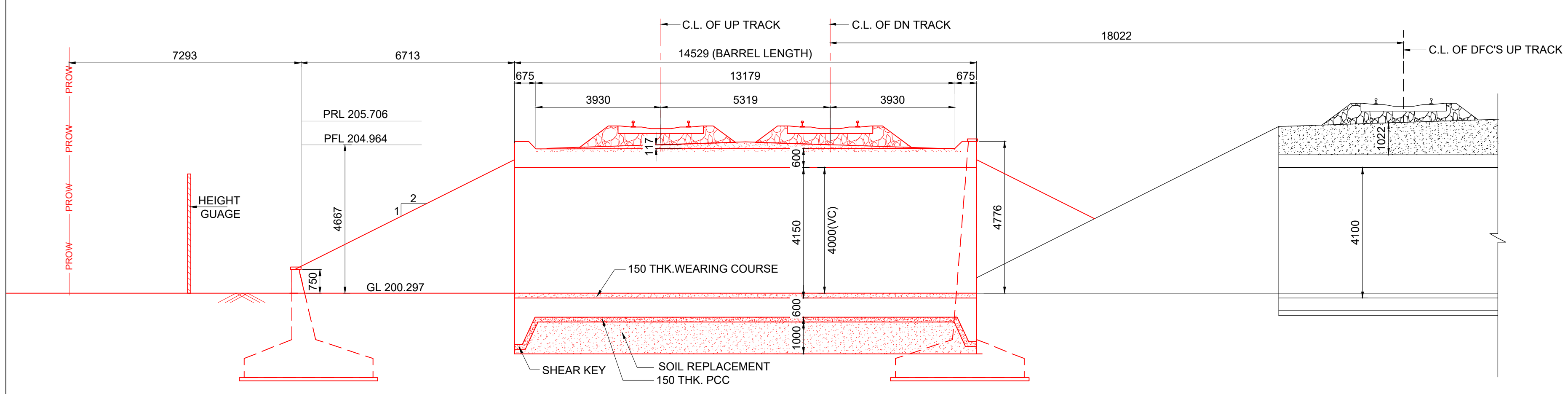
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.
THE INFRASTRUCTURE PEOPLE

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR BALANCING CULVERT BRIDGE NO. 20 SPAN 1X2.0X2.0 RCC BOX AT CH.4891.994

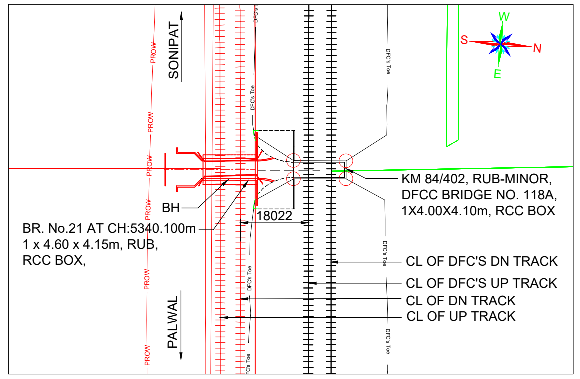
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD-01020_A1	1 OF 1

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



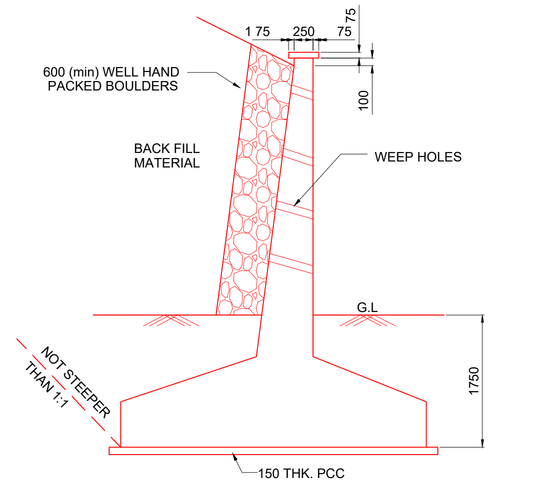
SECTIONAL ELEVATION AT A-A

SCALE 1:100



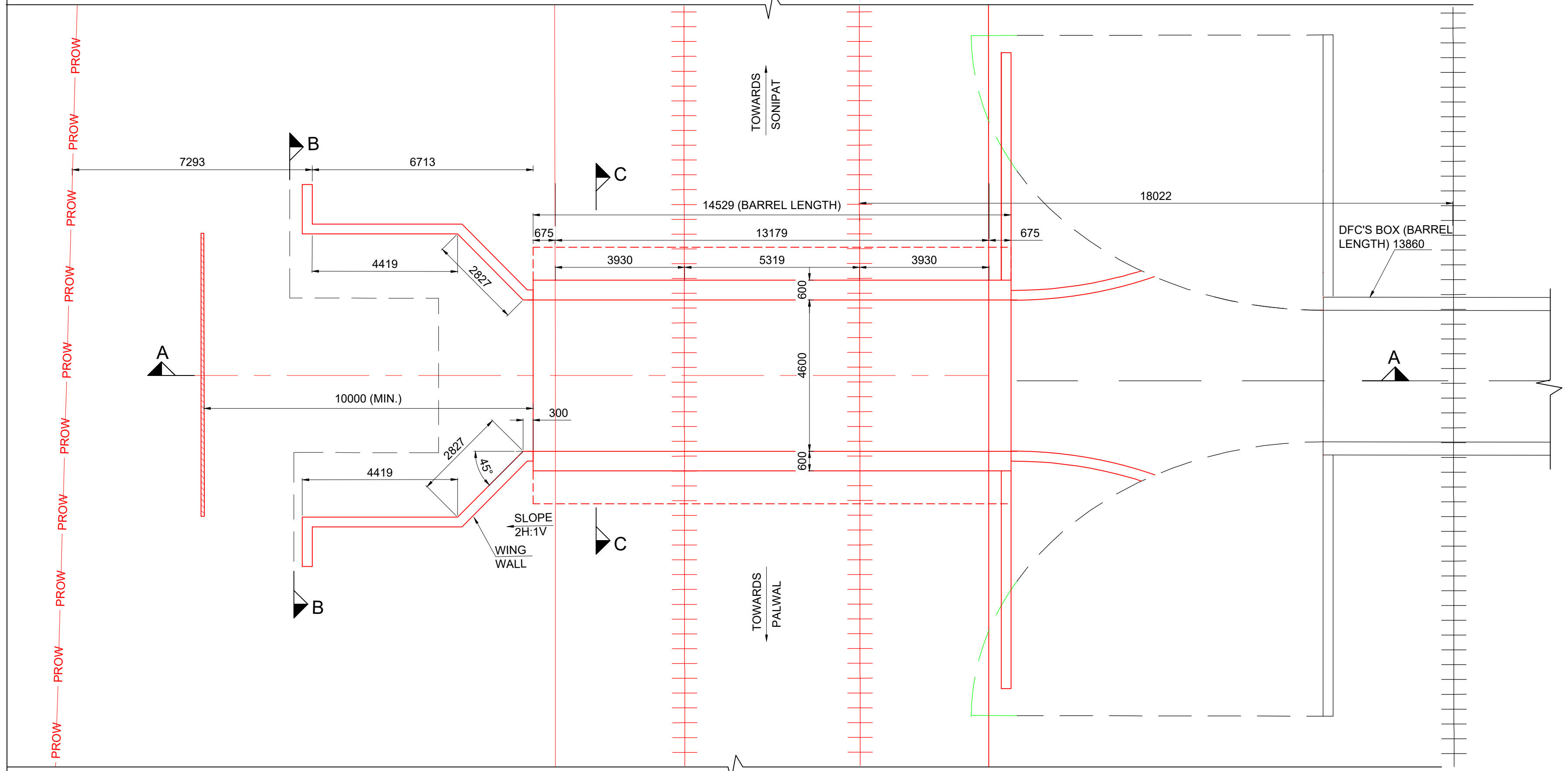
KEY PLAN

SCALE NTS



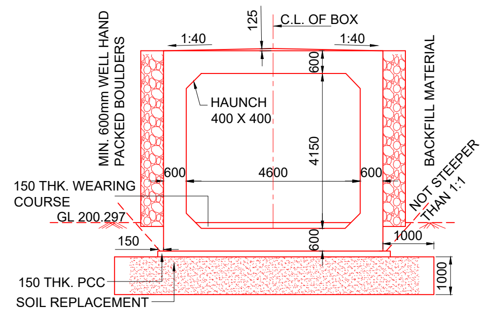
TYPICAL DETAIL OF RETURN WALL / WING WALL

SCALE 1:50



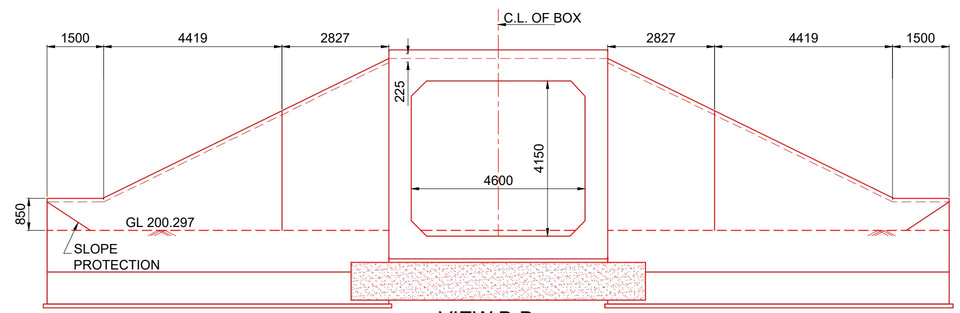
PLAN AT TOP

SCALE 1:100



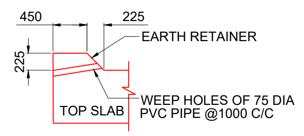
SECTION C-C

SCALE 1:100



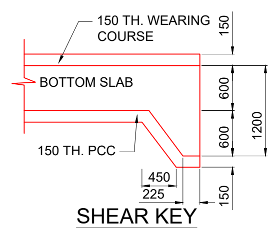
VIEW B-B

SCALE 1:100



EARTH RETAINER

SCALE 1:50



SHEAR KEY

SCALE 1:50

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
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5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL, BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST.
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE.
   GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.
3. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.

IMPORTANT NOTE:

TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

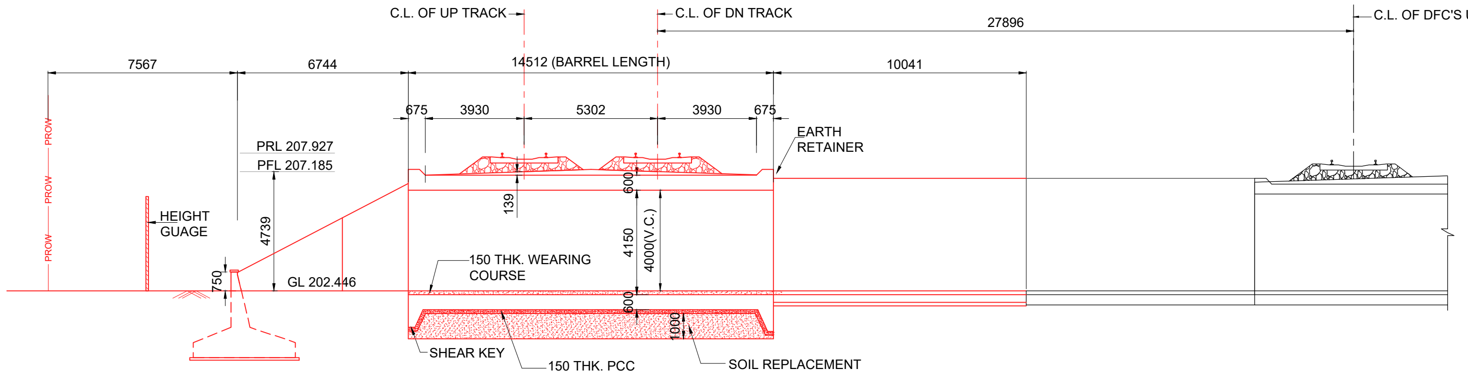
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

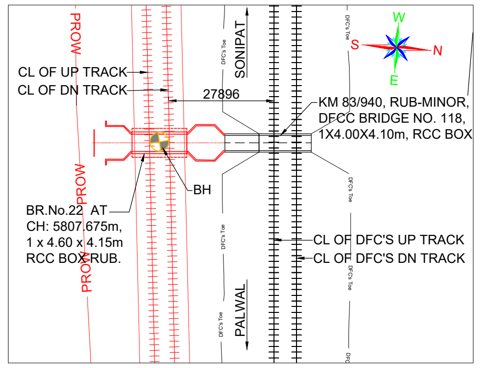
SMEC

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO. 21 1 x 4.60 x 4.15m RCC BOX AT CH.5340.10m

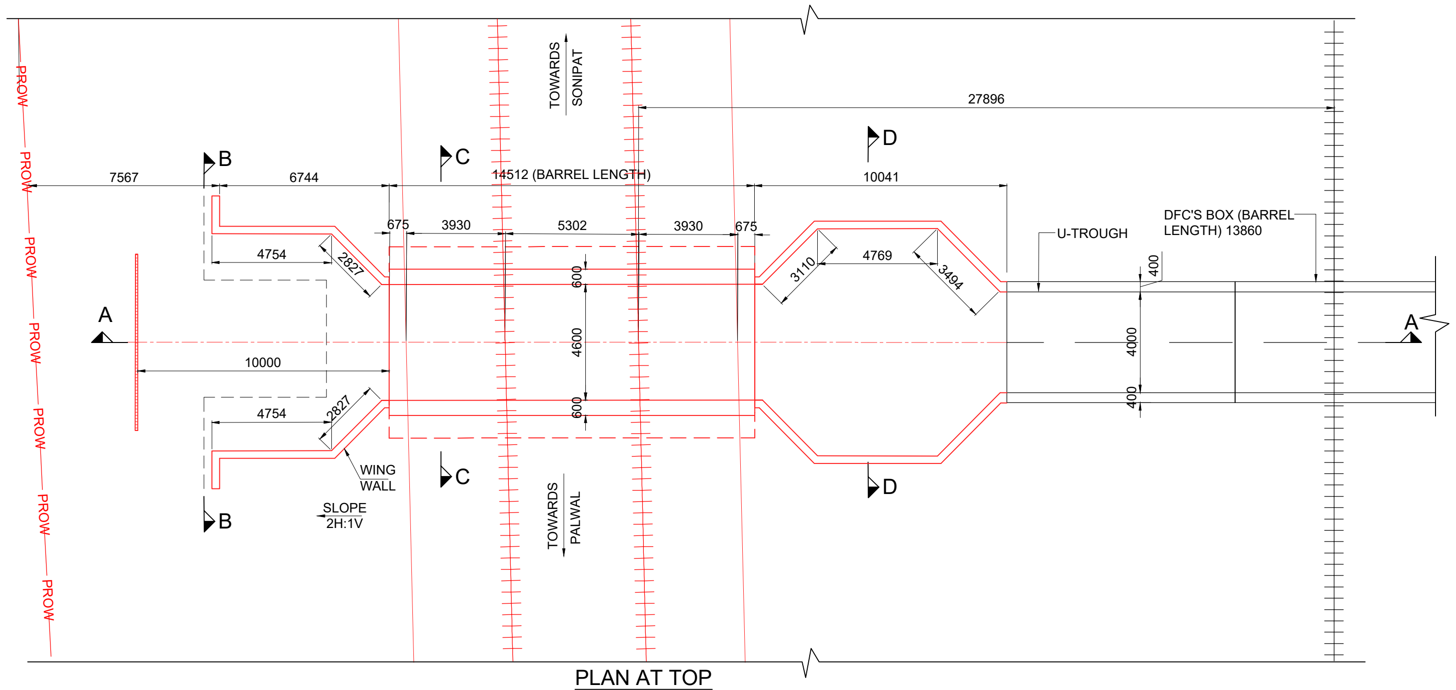
DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01021_A0		1 OF 1
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



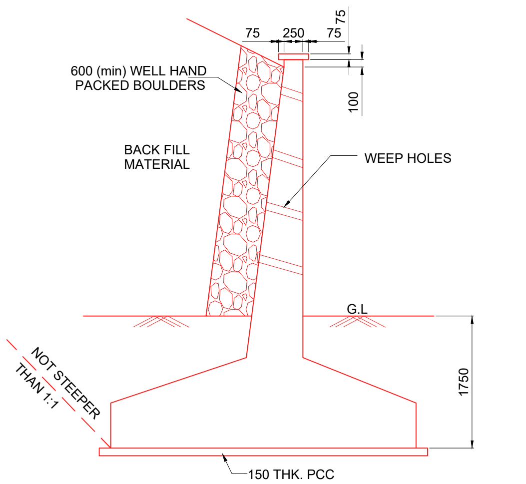
SECTIONAL ELEVATION AT A-A
SCALE 1:100



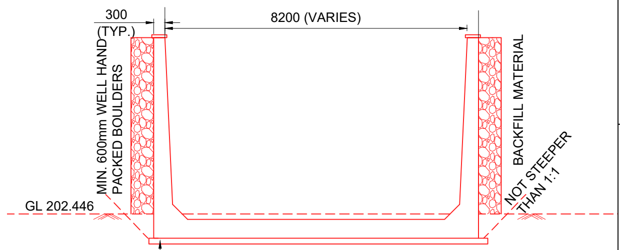
KEY PLAN
SCALE NTS



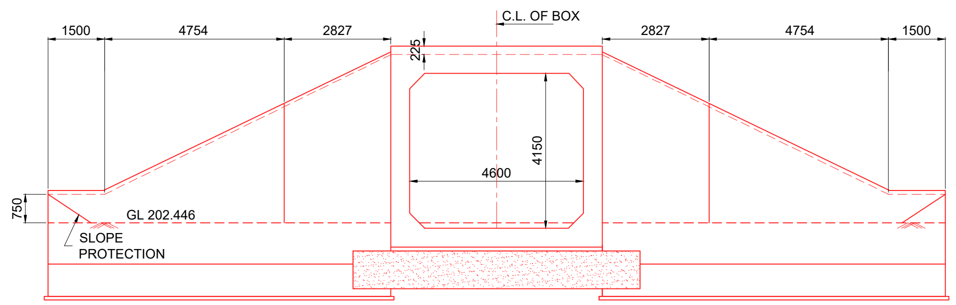
PLAN AT TOP
SCALE 1:150



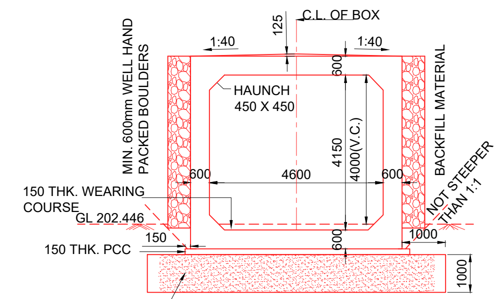
TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



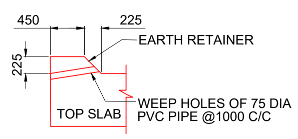
SECTION D-D
U-TROUGH
SCALE 1:100



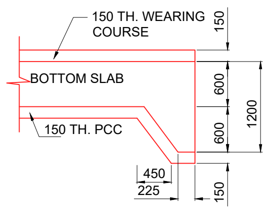
VIEW B-B
SCALE 1:100



SECTION C-C
SCALE 1:100



EARTH RETAINER
SCALE 1:50



SHEAR KEY
SCALE 1:50

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL, BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.
3. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.

IMPORTANT NOTE:

TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

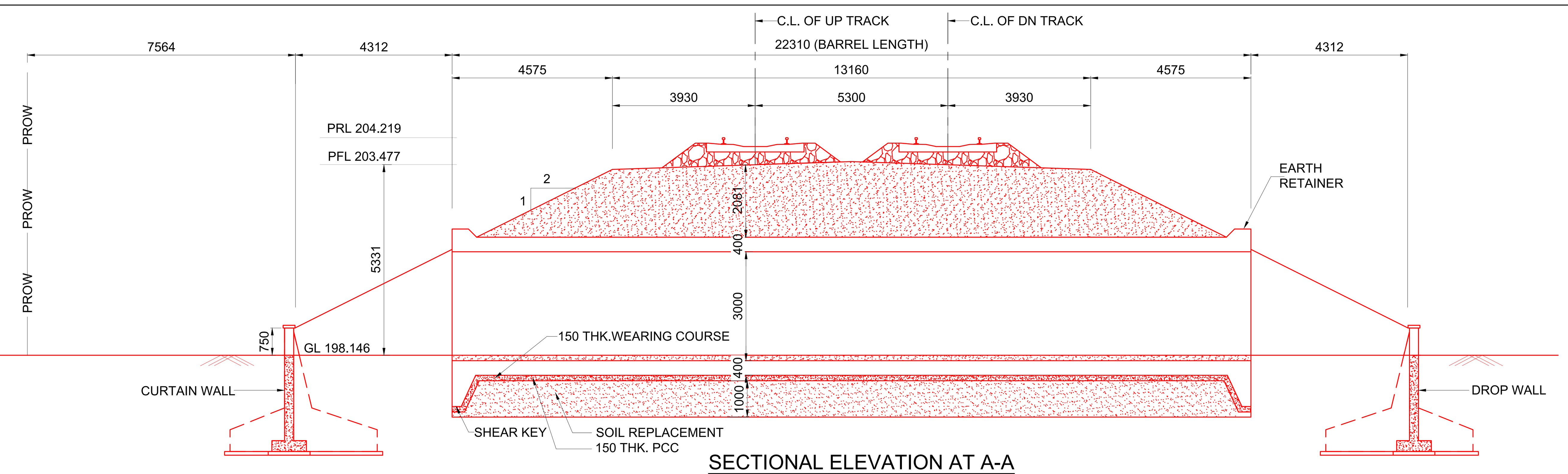
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

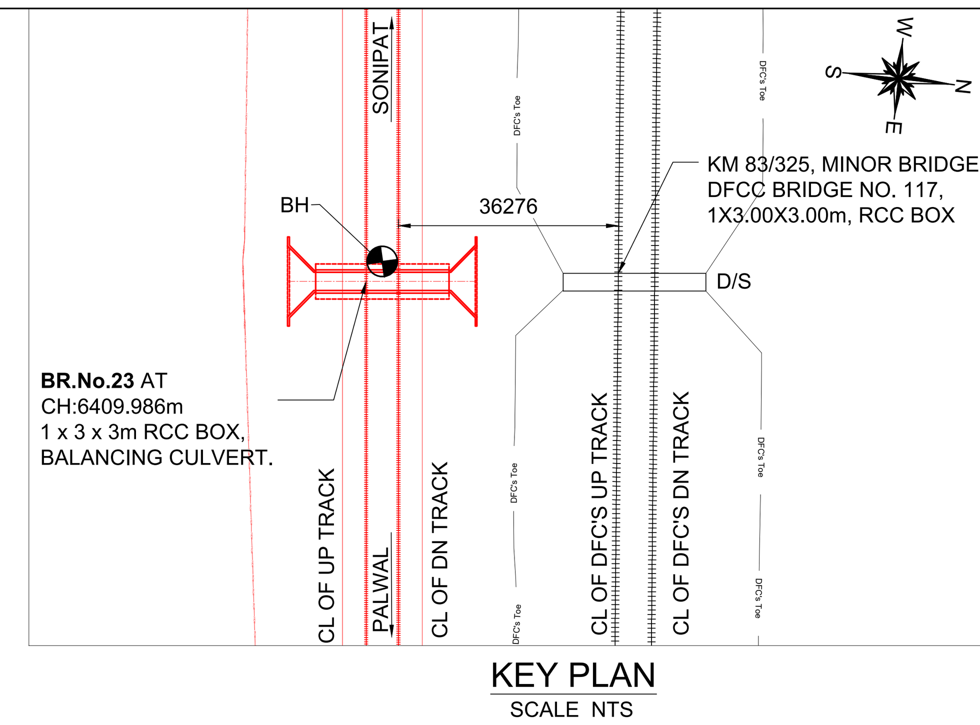
GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO. 22
1 x 4.60x 4.15m RCC BOX AT CH.5807.675m

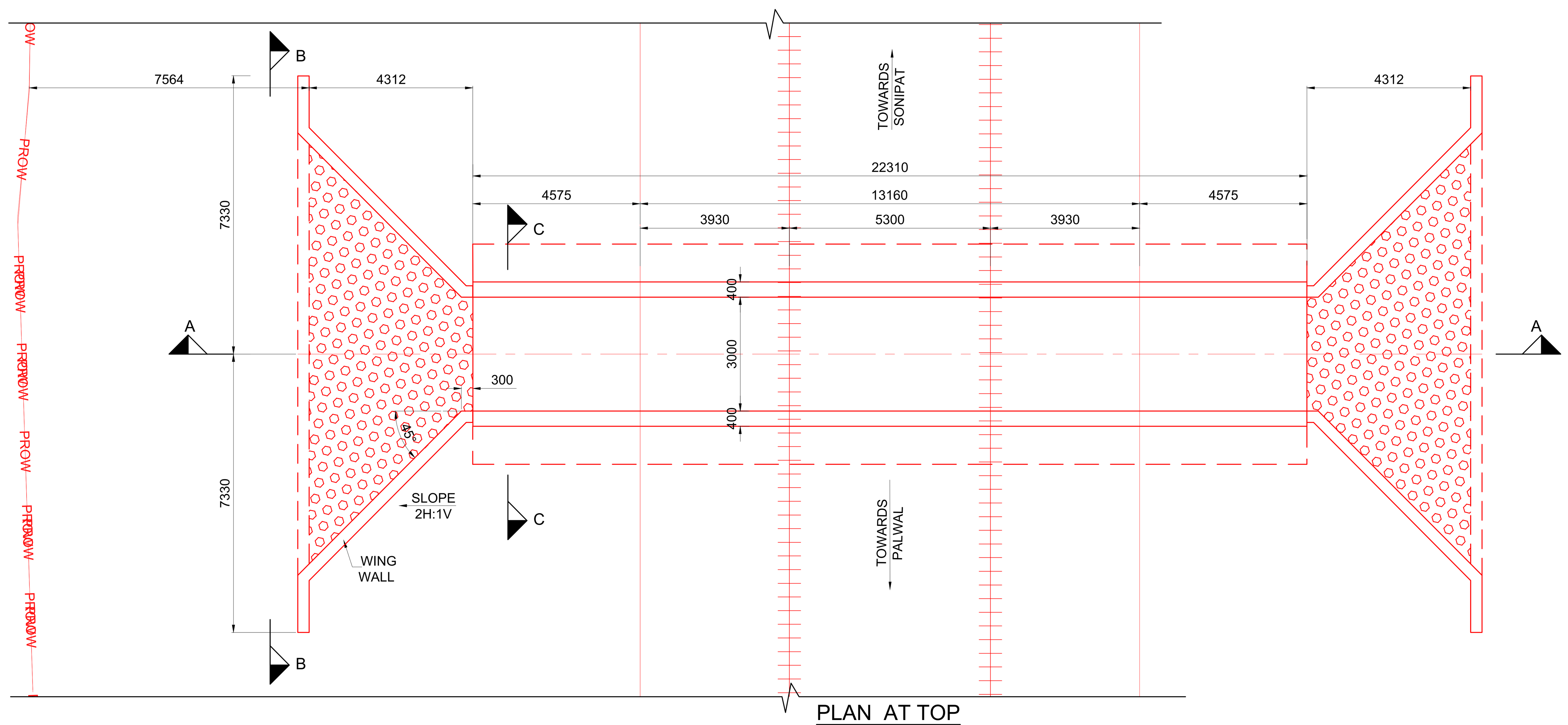
DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01022_A0		1 OF 1
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



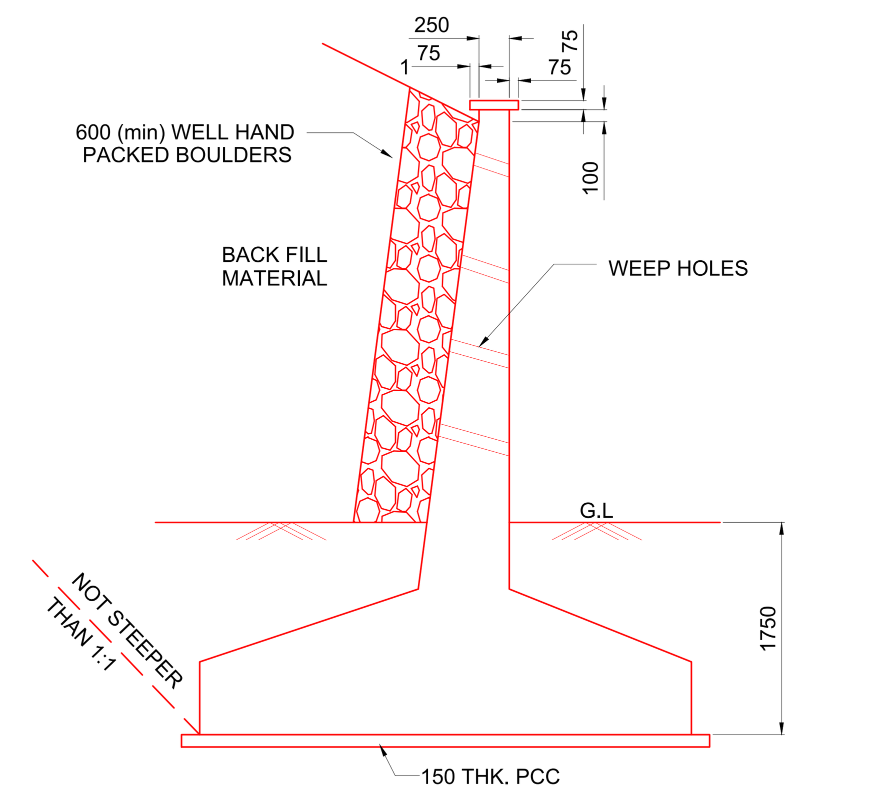
SECTIONAL ELEVATION AT A-A
SCALE 1:100



KEY PLAN
SCALE NTS



PLAN AT TOP
SCALE 1:150



TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/ (Sig.)/ NR, DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
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   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
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8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
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11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE. 13.THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
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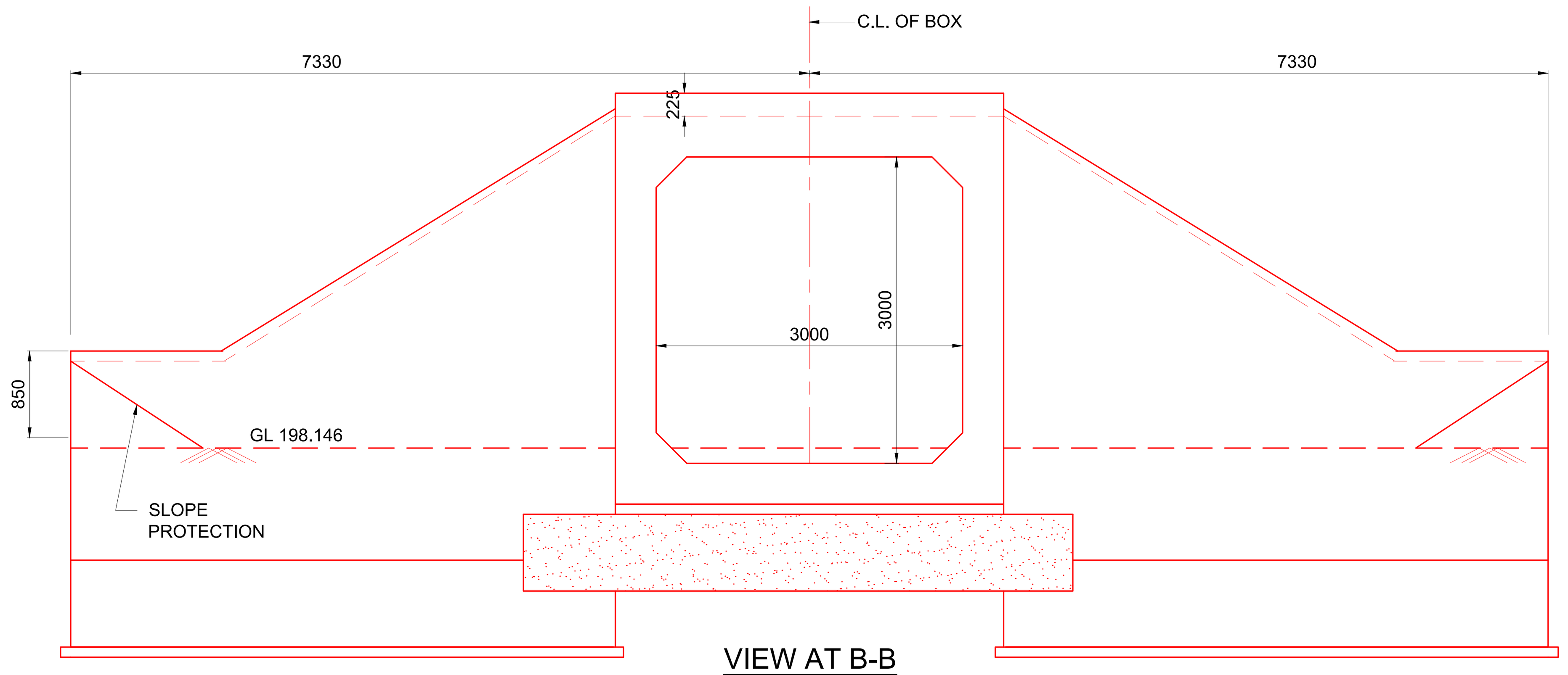
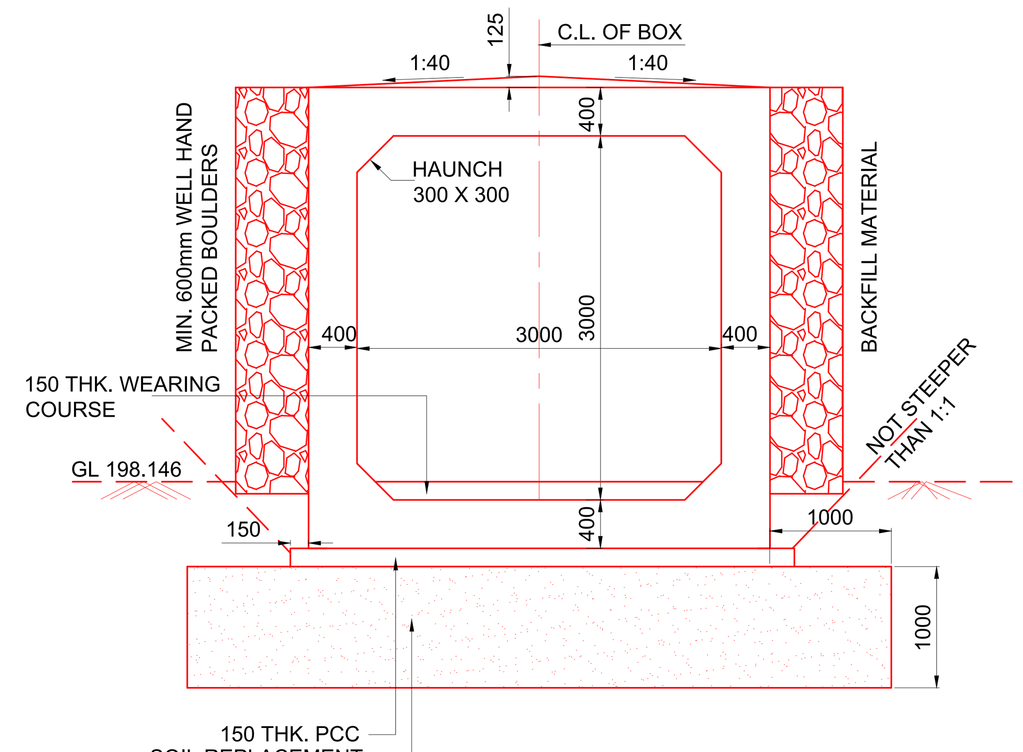
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.
2. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.



VIEW AT B-B
SCALE 1:50



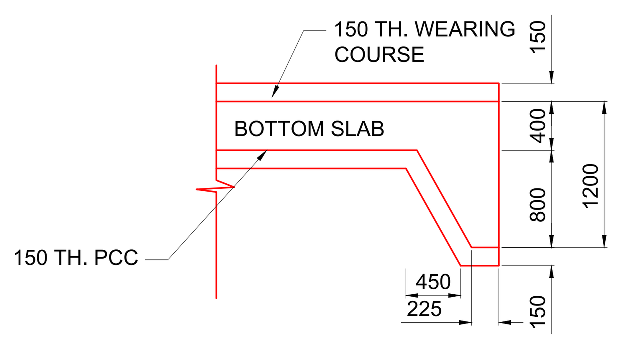
SECTION AT C-C
SCALE 1:50

LEGEND

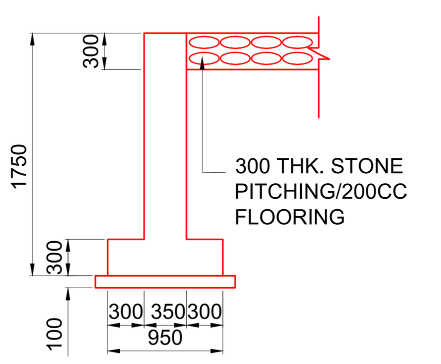
	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

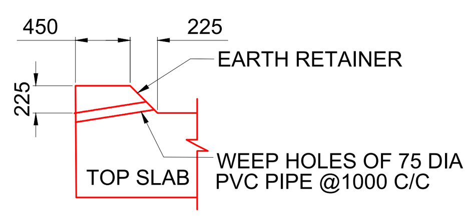
PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW



SHEAR KEY
SCALE 1:50



DROP / CURTAIN WALL DETAILS
SCALE 1:50



EARTH RETAINER
SCALE 1:50

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL		MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

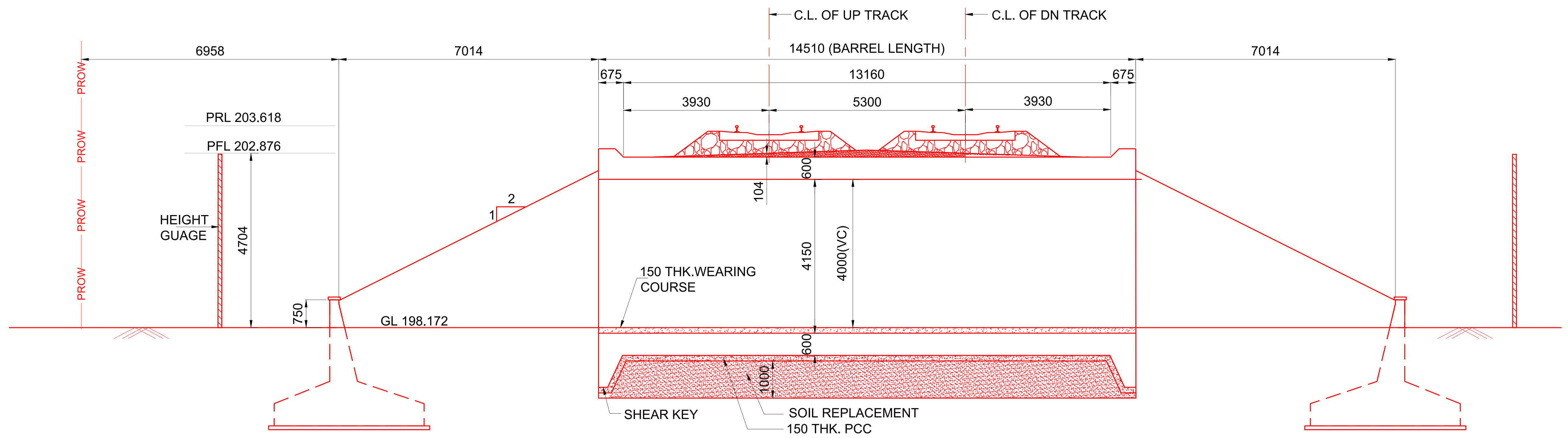
CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

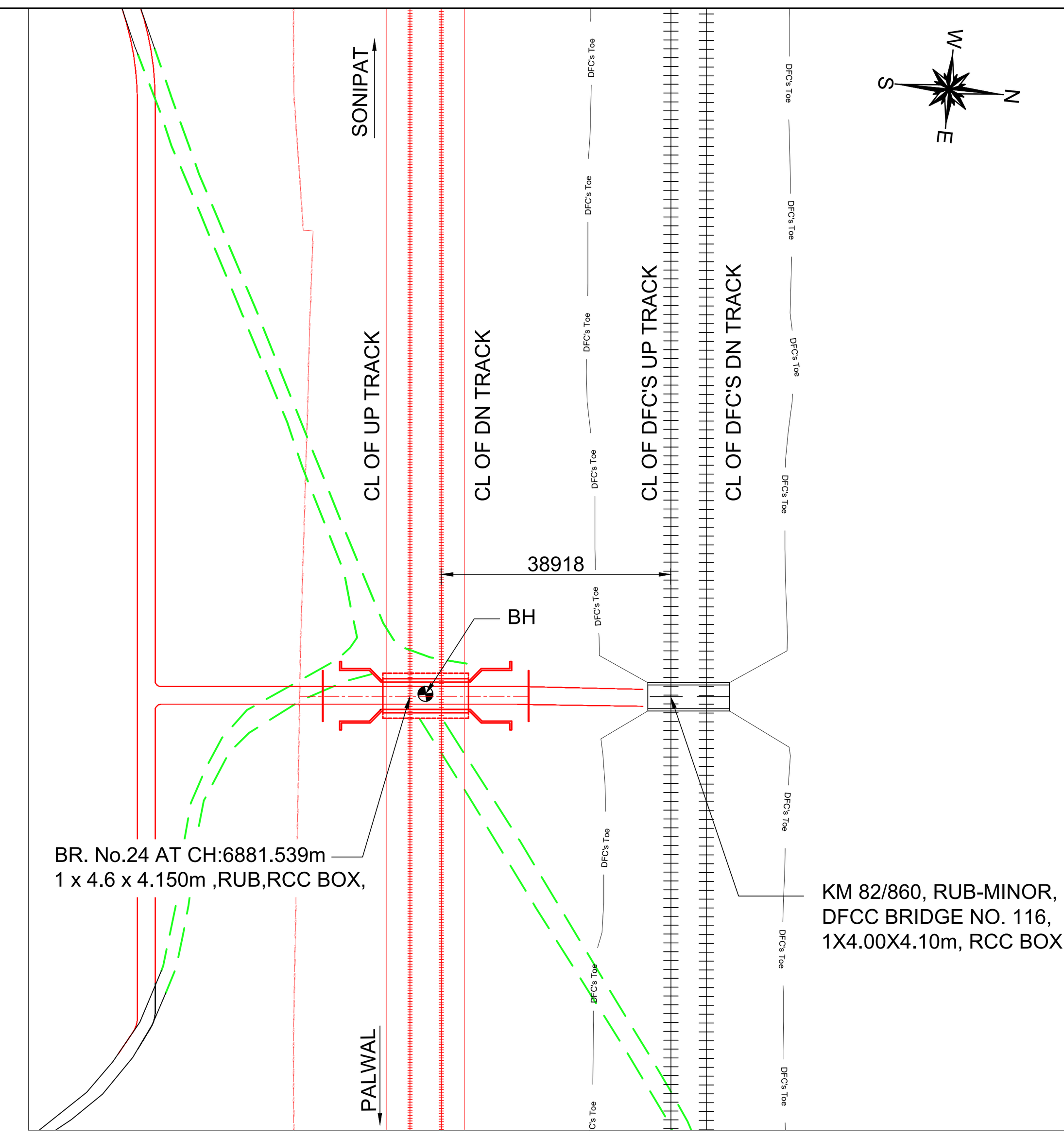
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR BALANCING CULVERT.BRIDGE NO. 23 1 x 3 x 3m RCC BOX AT CH.6409.986m

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_0023_A0	1 OF 1

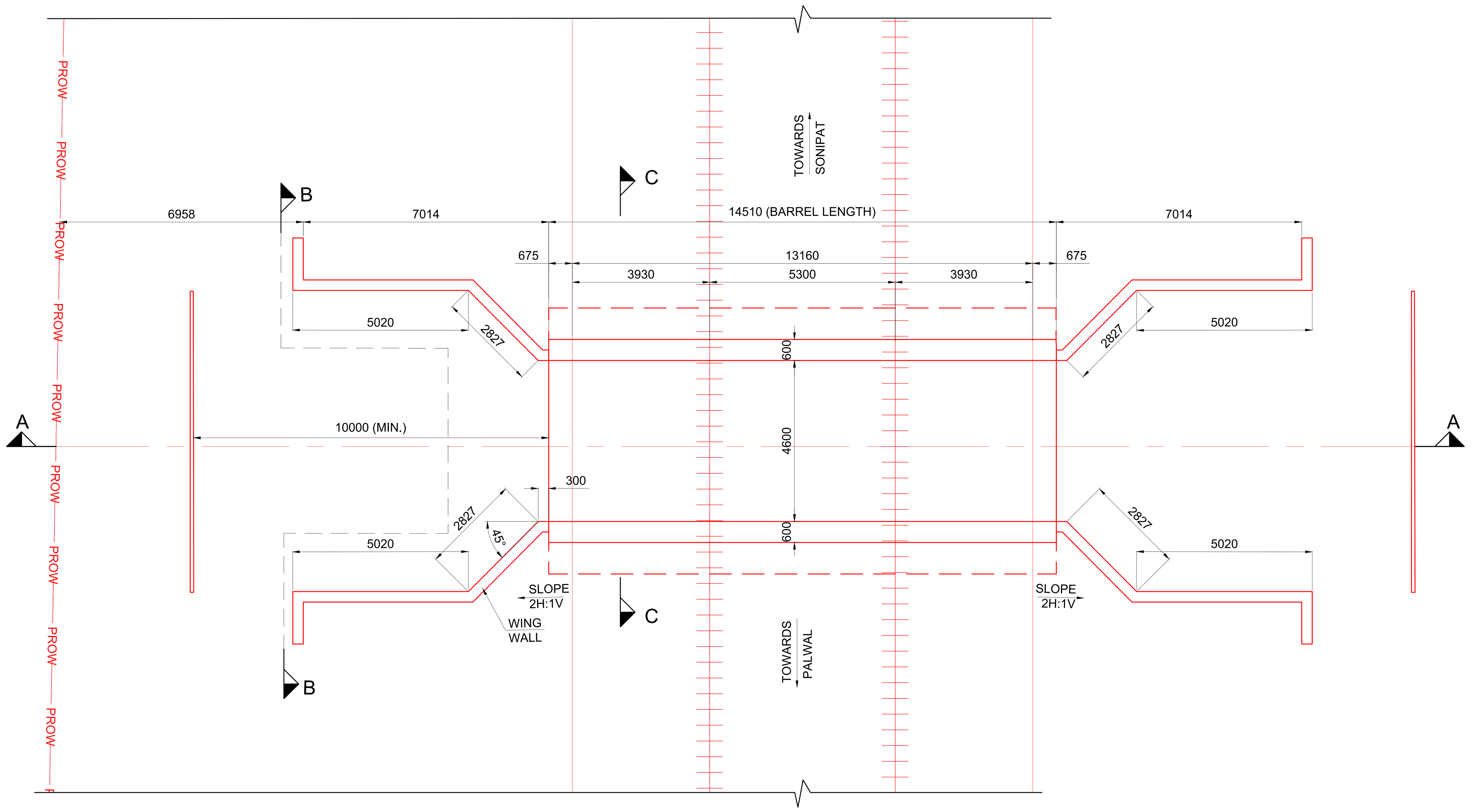
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



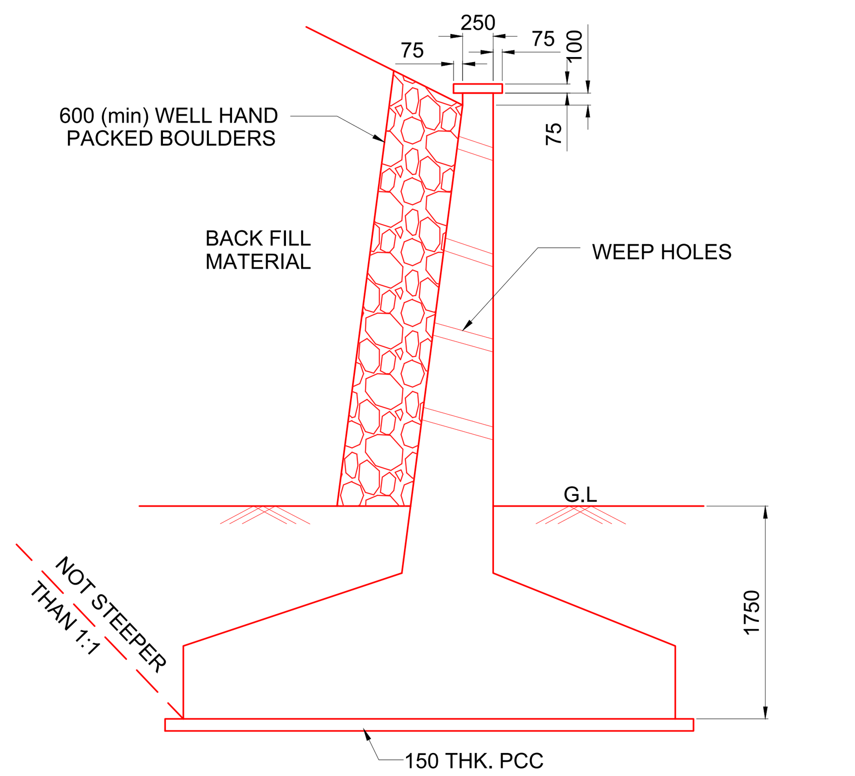
SECTIONAL ELEVATION AT A-A
SCALE 1:100



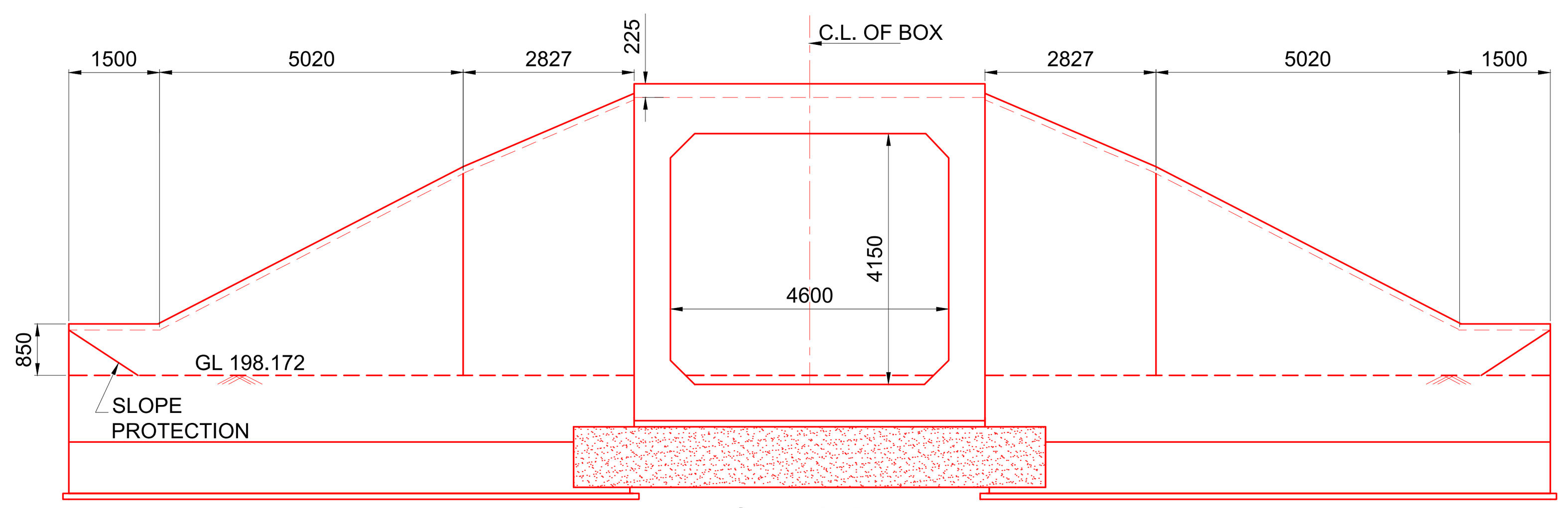
KEY PLAN
SCALE NTS



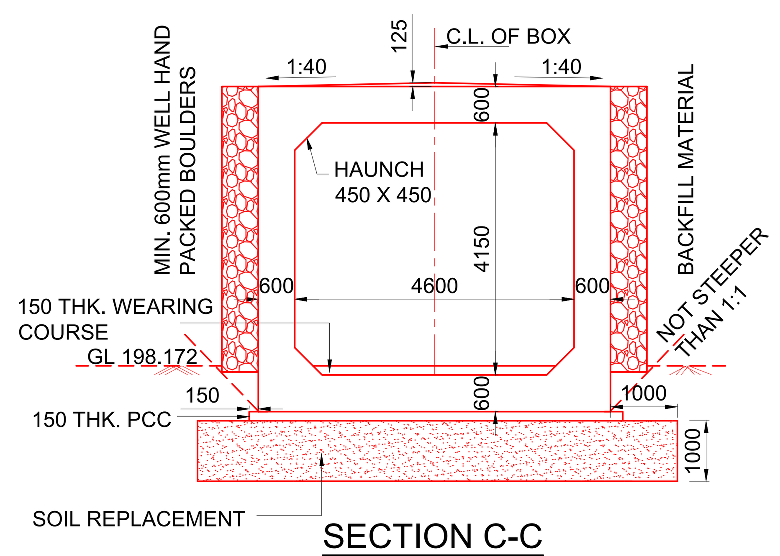
PLAN AT TOP
SCALE 1:100



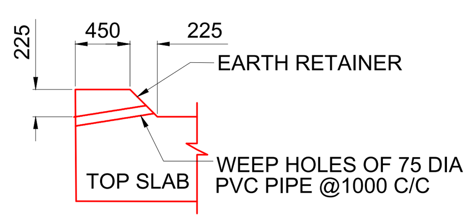
TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



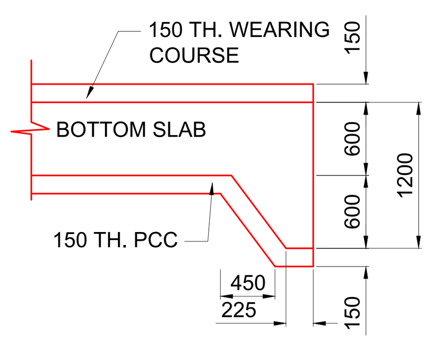
VIEW B-B
SCALE 1:100



SECTION C-C
SCALE 1:100



EARTH RETAINER
SCALE 1:50



SHEAR KEY
SCALE 1:50

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
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4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
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6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL, BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.
3. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.

IMPORTANT NOTE:
TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

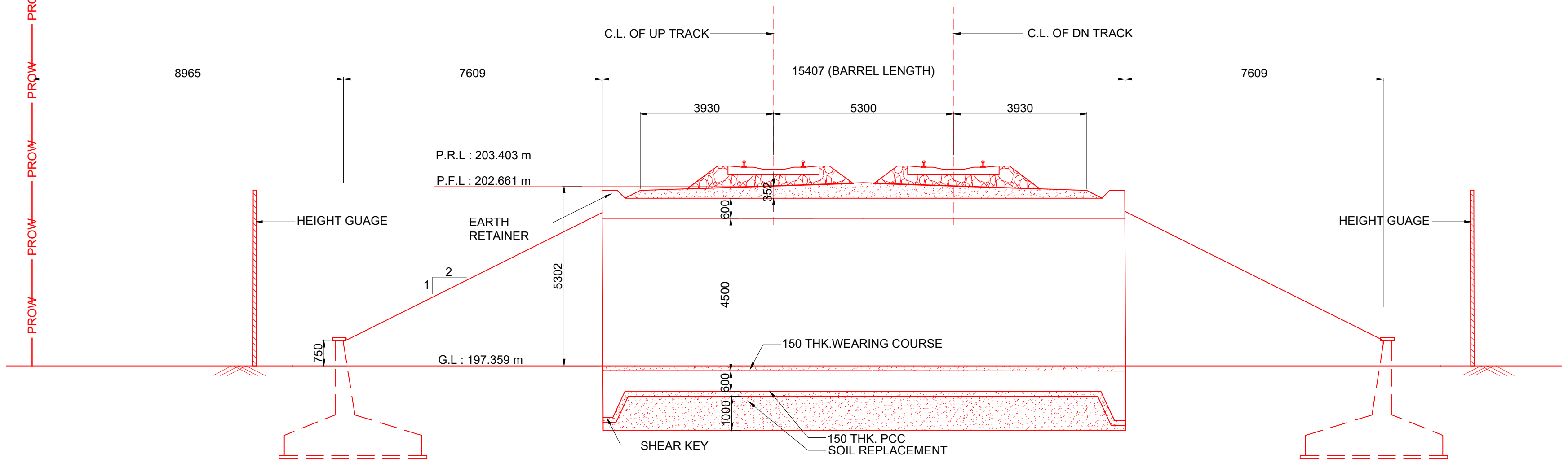
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.
THE INFRASTRUCTURE PEOPLE
Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL		MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

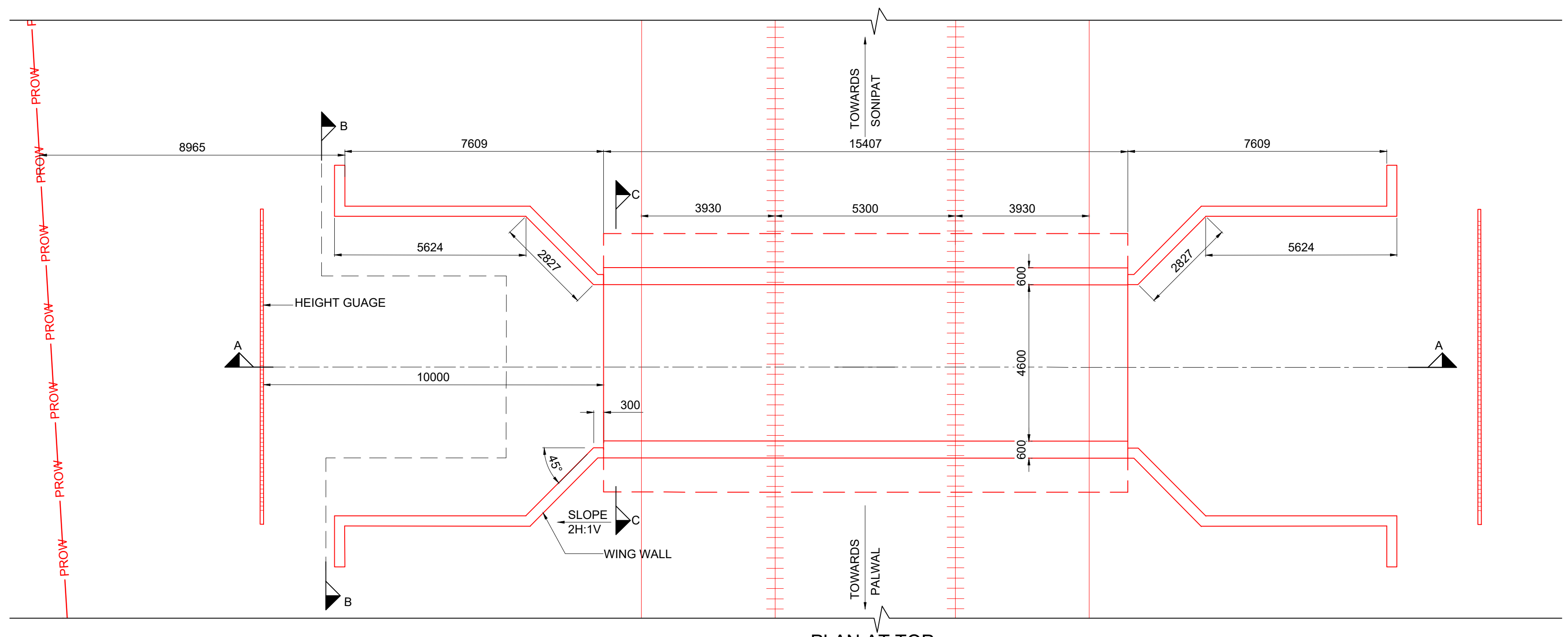
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO. 24
1 x 4.6 x 4.150m RCC BOX AT CH.6881.539m

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01024_A0	1 OF 1

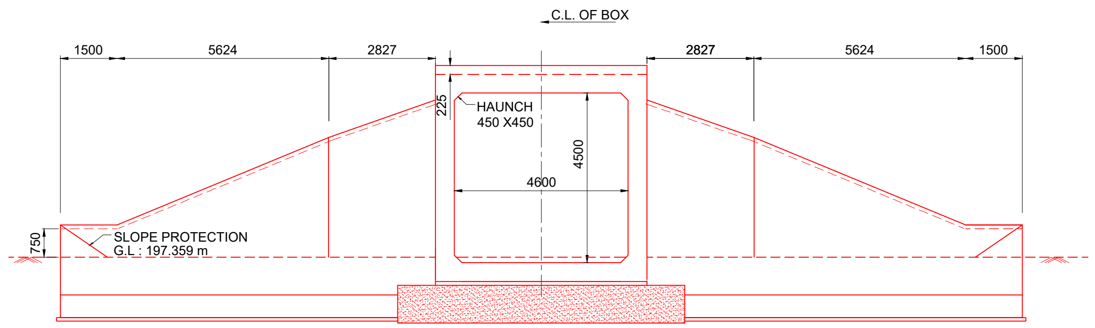
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



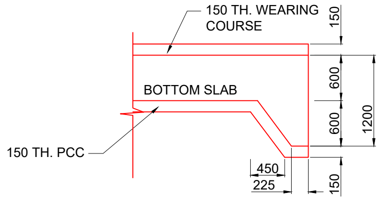
SECTIONAL ELEVATION AT A-A
SCALE 1:100



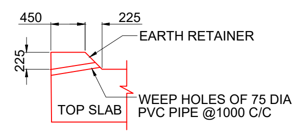
PLAN AT TOP
SCALE 1:100



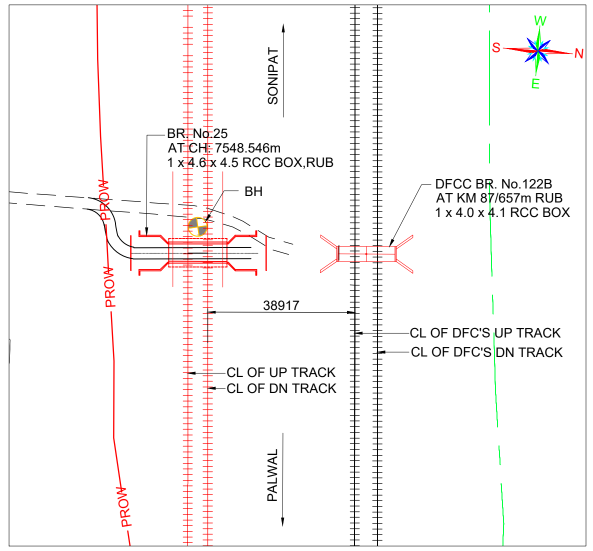
VIEW AT B-B
SCALE 1:100



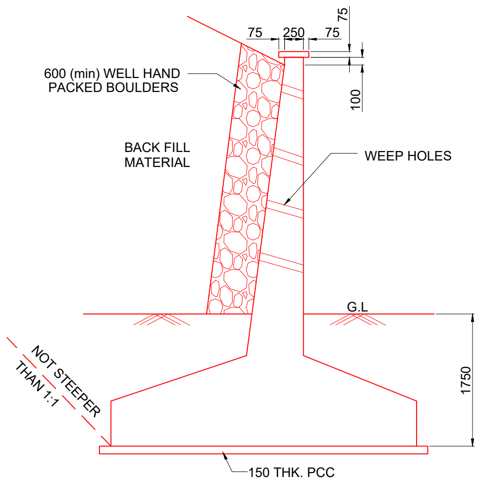
SHEAR KEY
SCALE 1:50



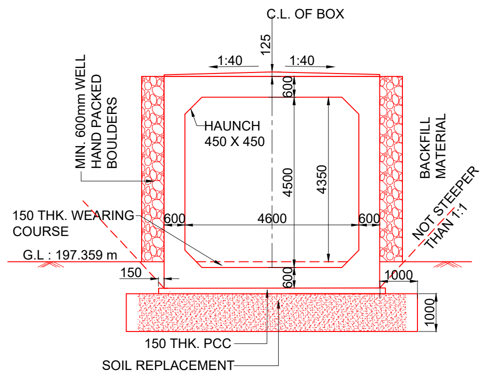
EARTH RETAINER
SCALE 1:50



KEY PLAN
SCALE : NTS



TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



SECTION C-C
SCALE 1:100

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
VC	VERTICAL CLEARANCE
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

NOTES :

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C) OTHER NOTES :

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PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

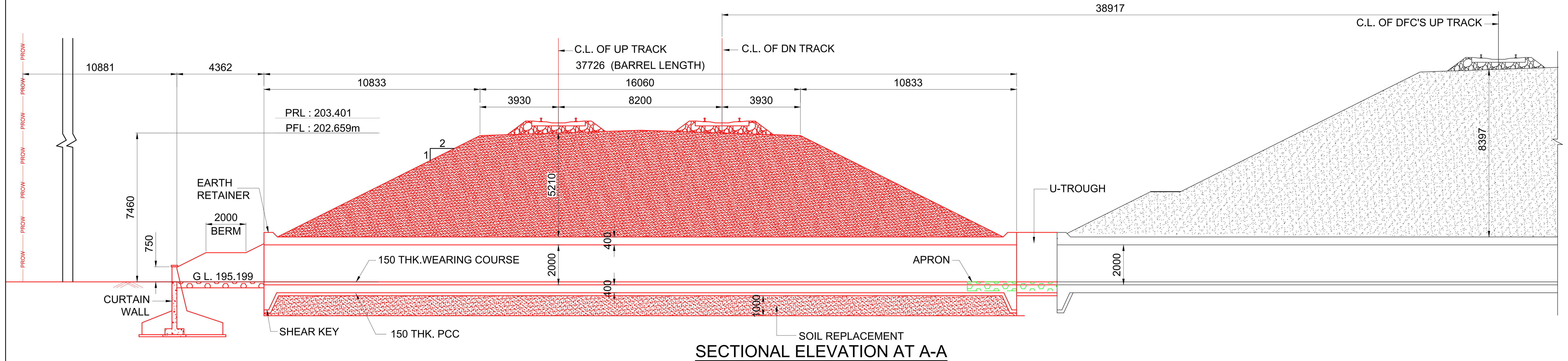
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

THE INFRASTRUCTURE PEOPLE

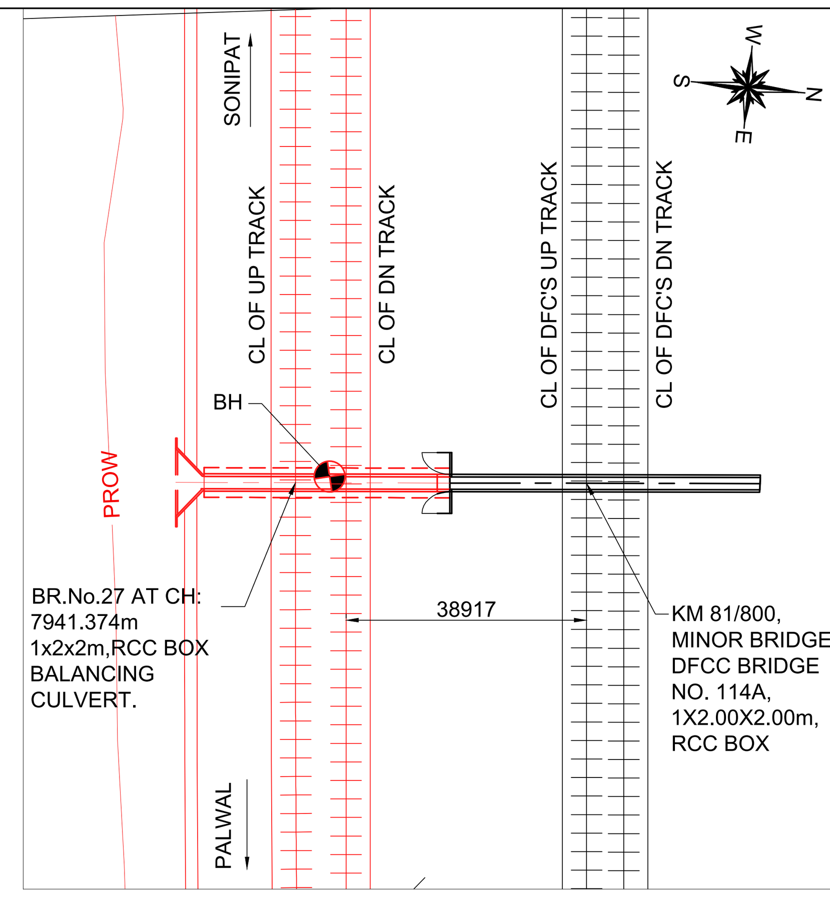
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO 25 SPAN 1.0X4.60X4.50 RCC BOX AT CH: 7548.737

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD-01025_A0	1 OF 1

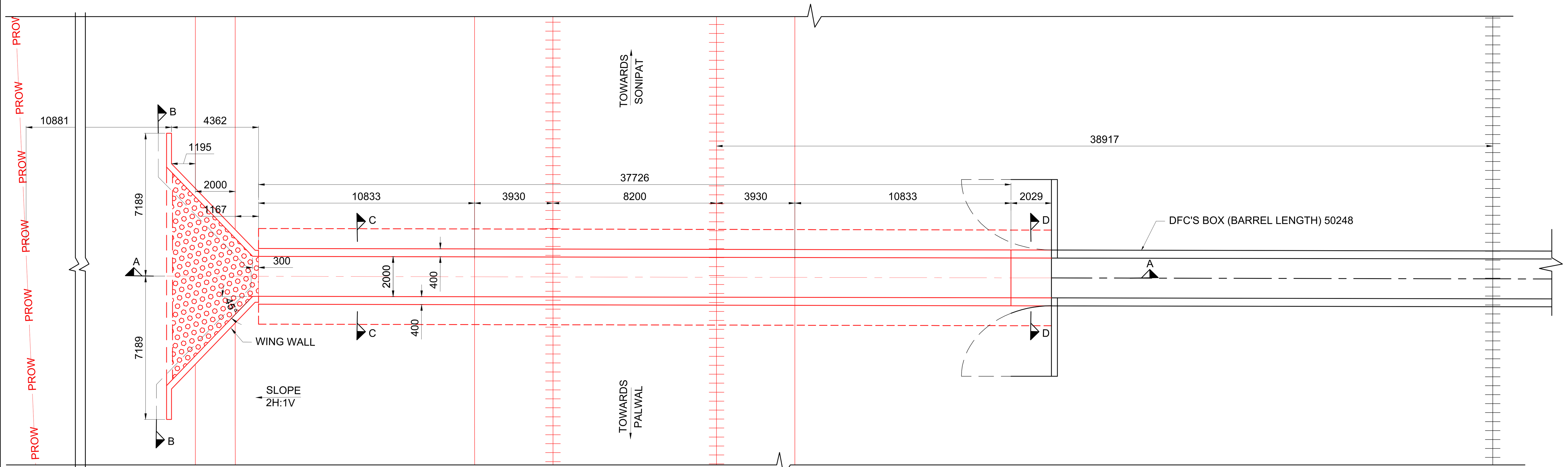
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



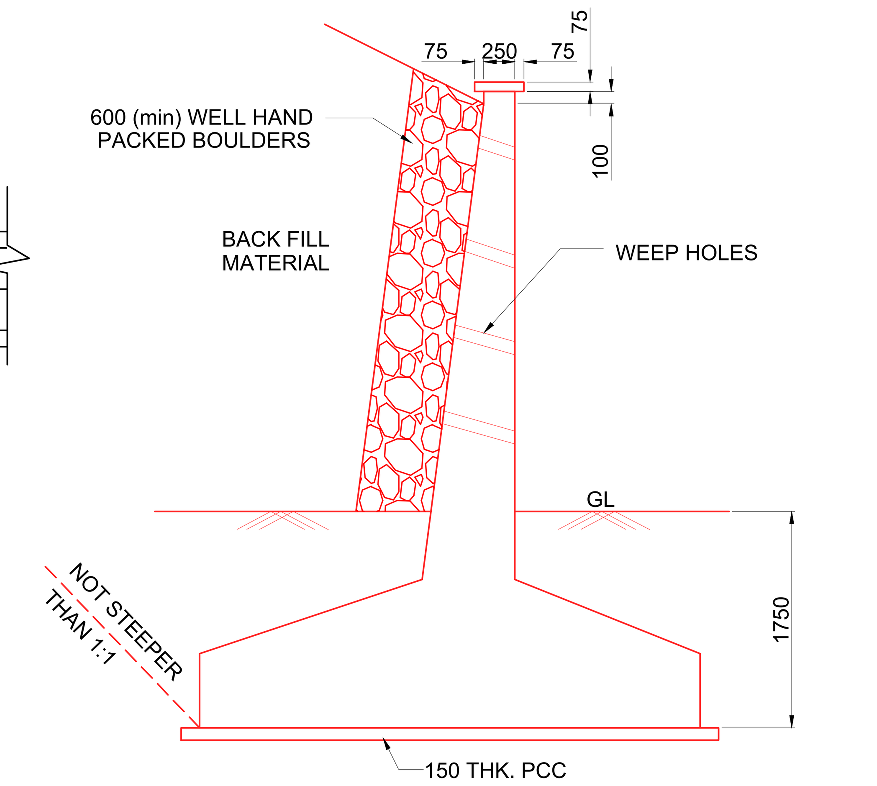
SECTIONAL ELEVATION AT A-A
SCALE 1:150



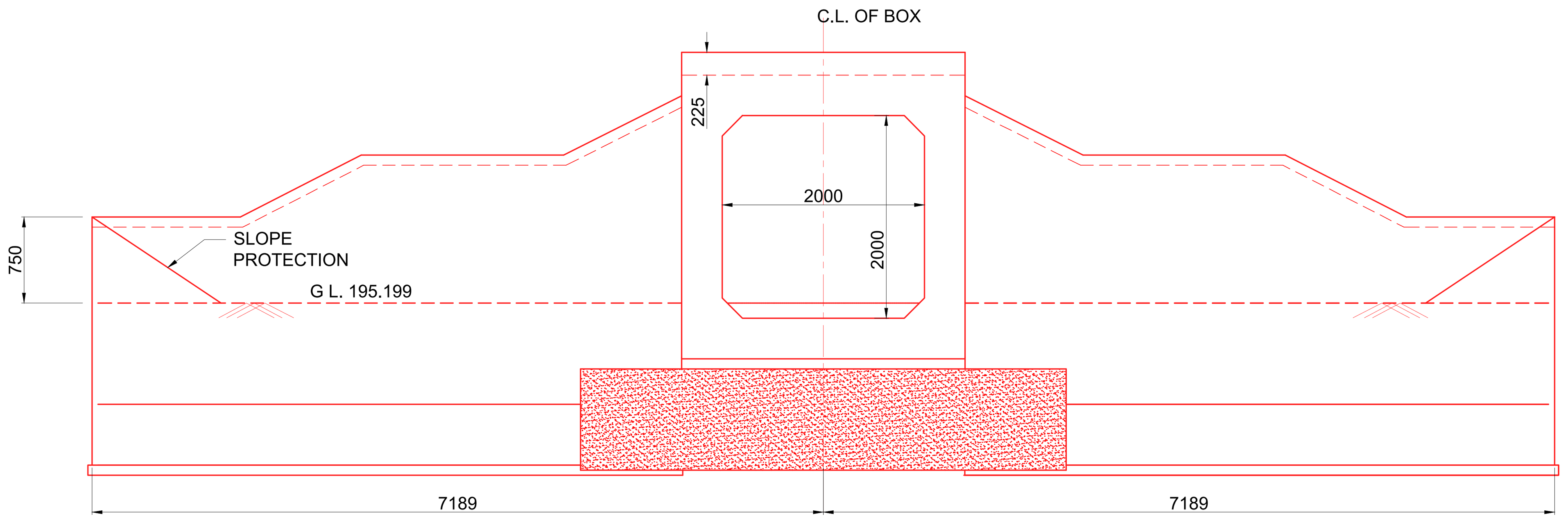
KEY PLAN
SCALE NTS



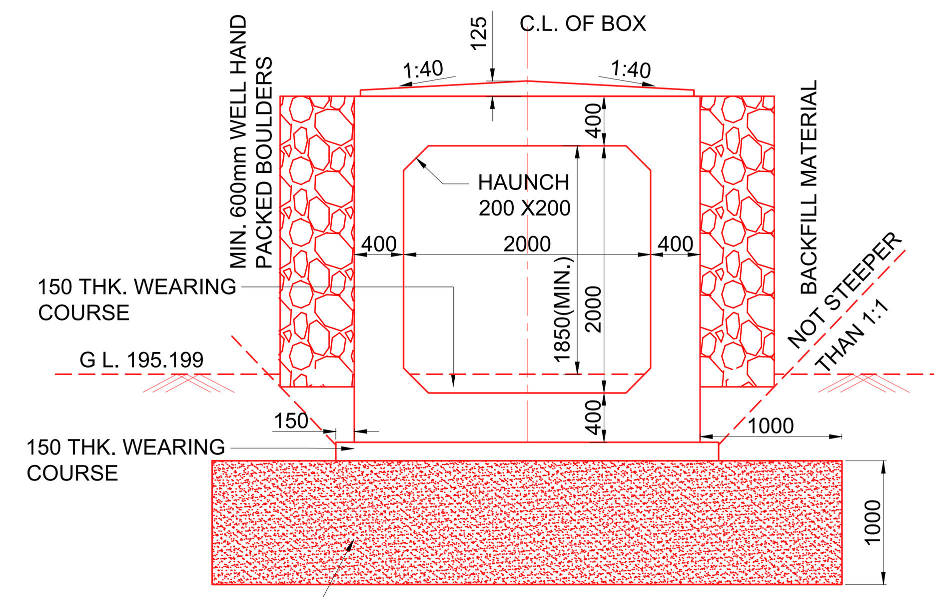
PLAN AT TOP
SCALE 1:150



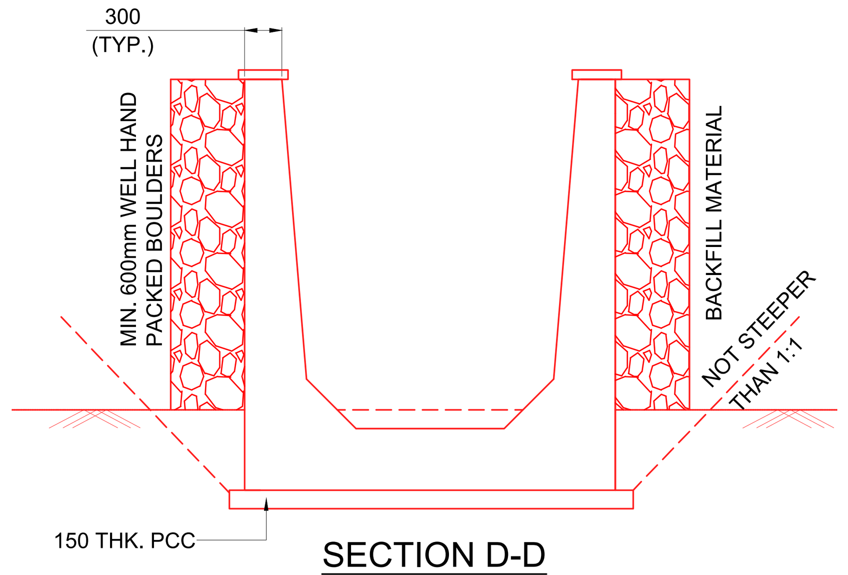
TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



VIEW AT B-B
SCALE 1:50



SECTION C-C
SCALE 1:50



SECTION D-D
U-TROUGH
SCALE 1:100

NOTES :

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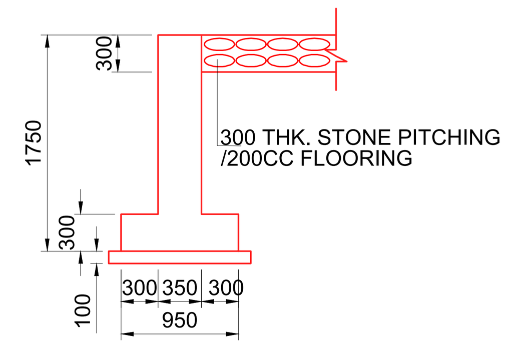
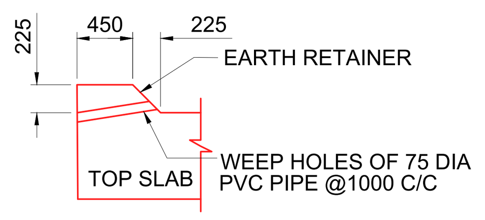
C) OTHER NOTES :

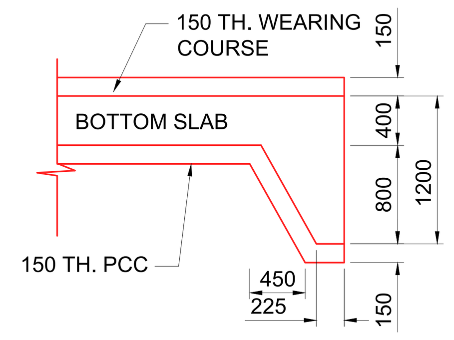
1. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.
2. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.



DROP / CURTAIN WALL DETAILS
SCALE 1:50



EARTH RETAINER
SCALE 1:50



SHEAR KEY
SCALE 1:50

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL		MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

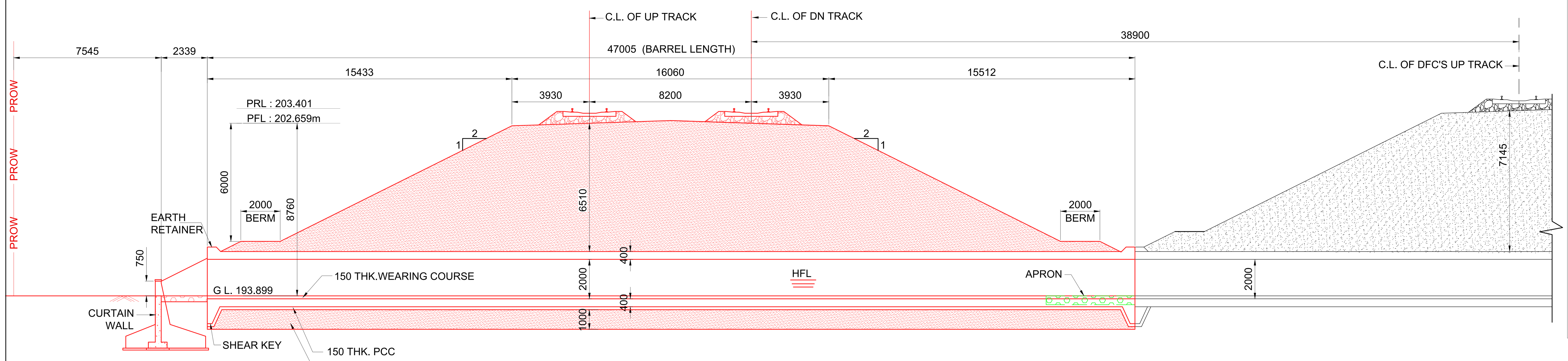
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR BALANCING CULVERT BRIDGE NO. 27 SPAN 1X2X2 RCC BOX AT CH: 7941.374

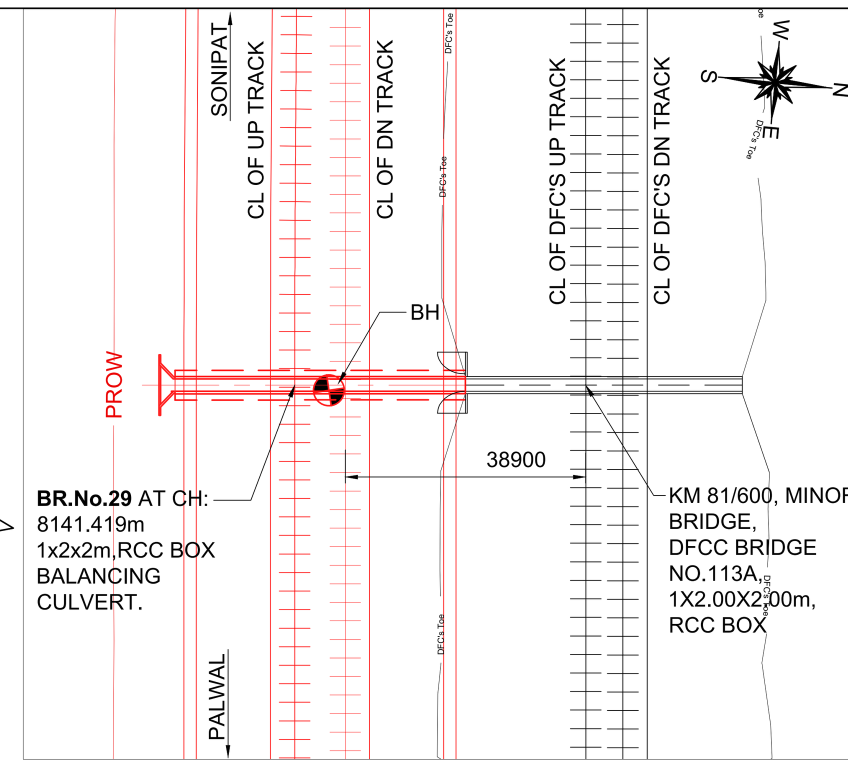
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01027_A0	1 OF 1

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



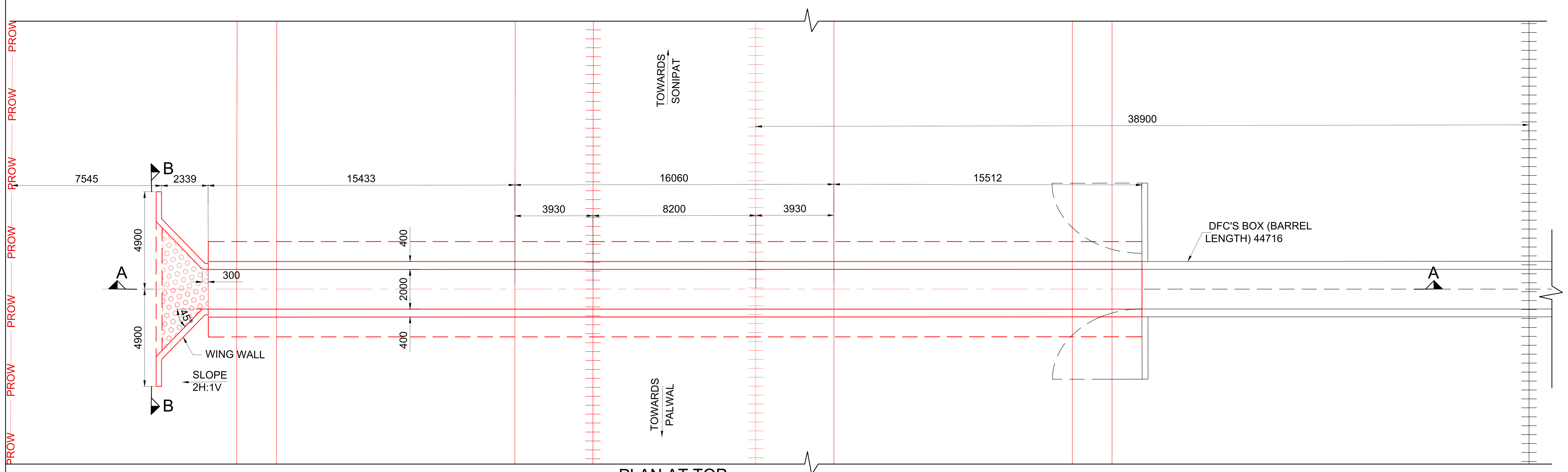
SECTIONAL ELEVATION AT A-A

SCALE 1:150



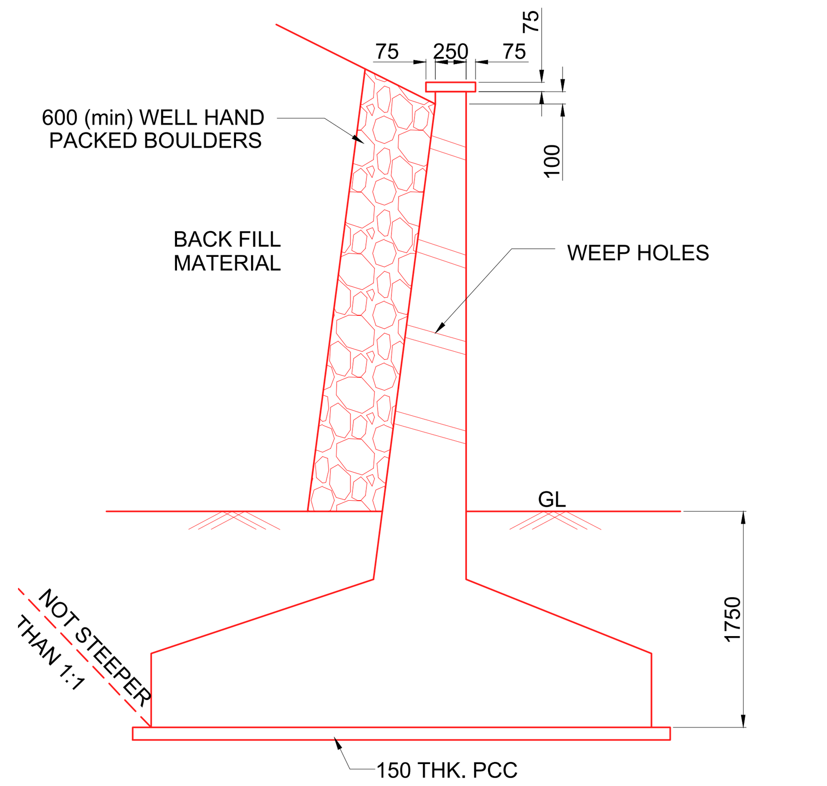
KEY PLAN

SCALE NTS



PLAN AT TOP

SCALE 1:150



TYPICAL DETAIL OF RETURN WALL / WING WALL

SCALE 1:50

NOTES :

A) GENERAL NOTES

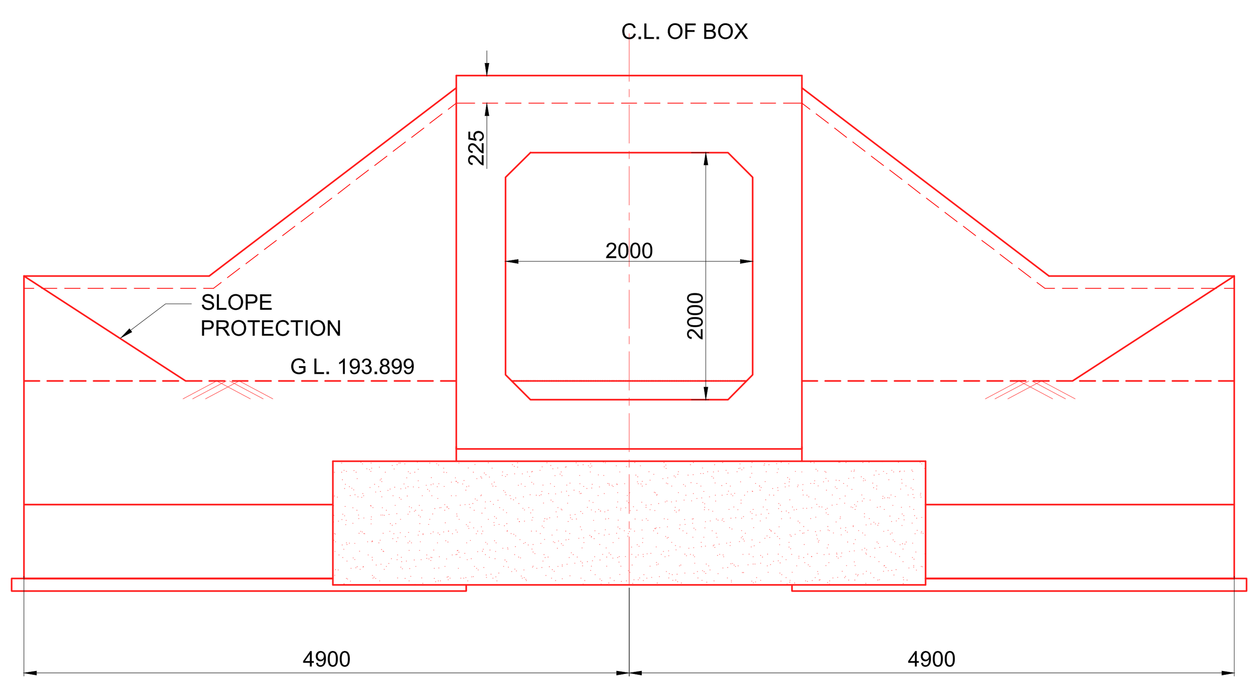
1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/ (Sig.)/ NR, DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST.
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD,

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

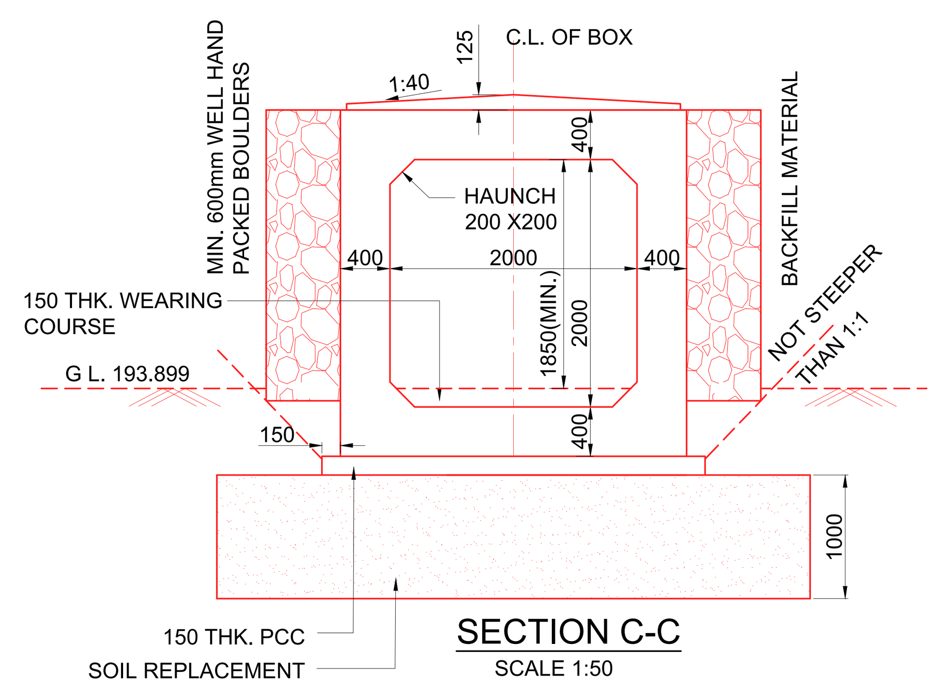
C) OTHER NOTES :

1. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.
2. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.



VIEW AT B-B

SCALE 1:50



SECTION C-C

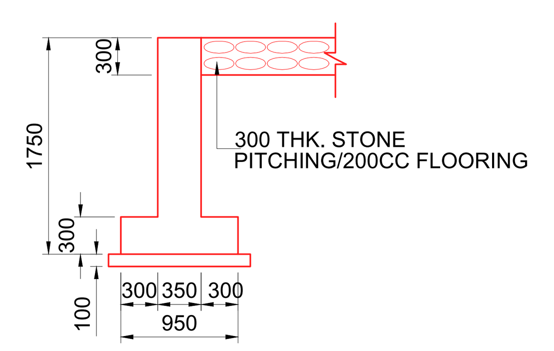
SCALE 1:50

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

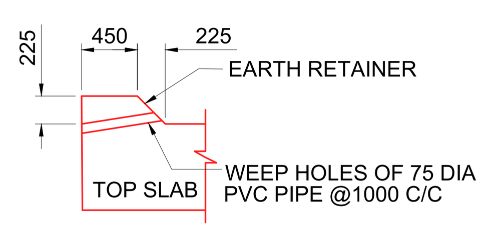
ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW



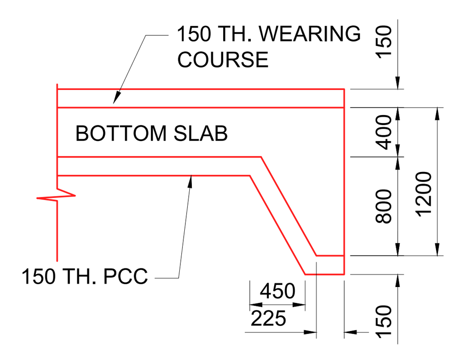
DROP / CURTAIN WALL DETAILS

SCALE 1:50



EARTH RETAINER

SCALE 1:50



SHEAR KEY

SCALE 1:50

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

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CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

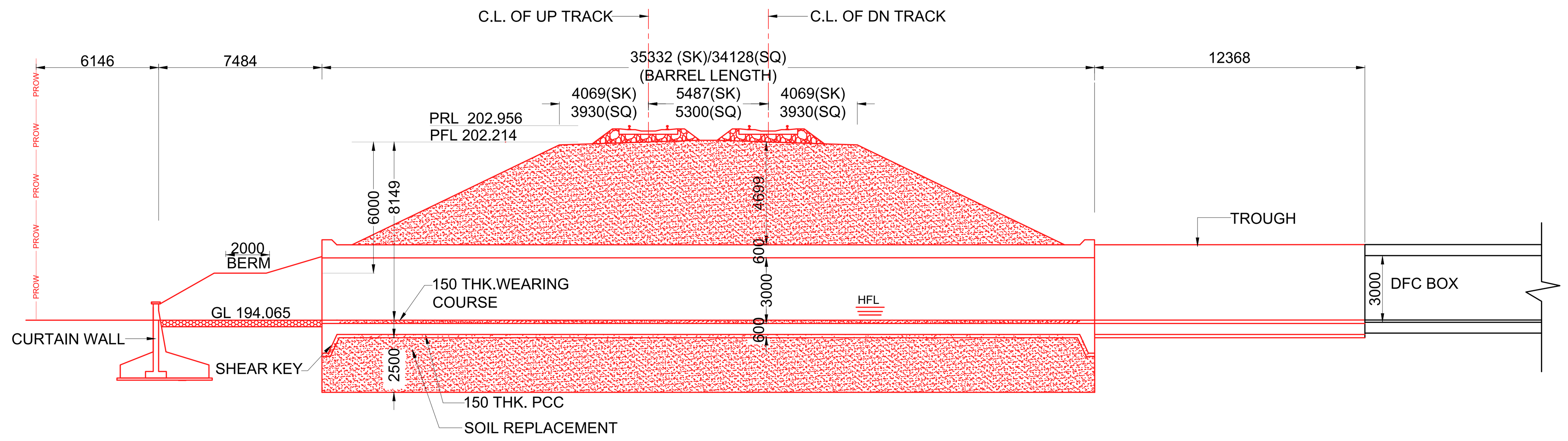
RITES THE INFRASTRUCTURE PEOPLE

SMEC Member of the Surbana Jurong Group

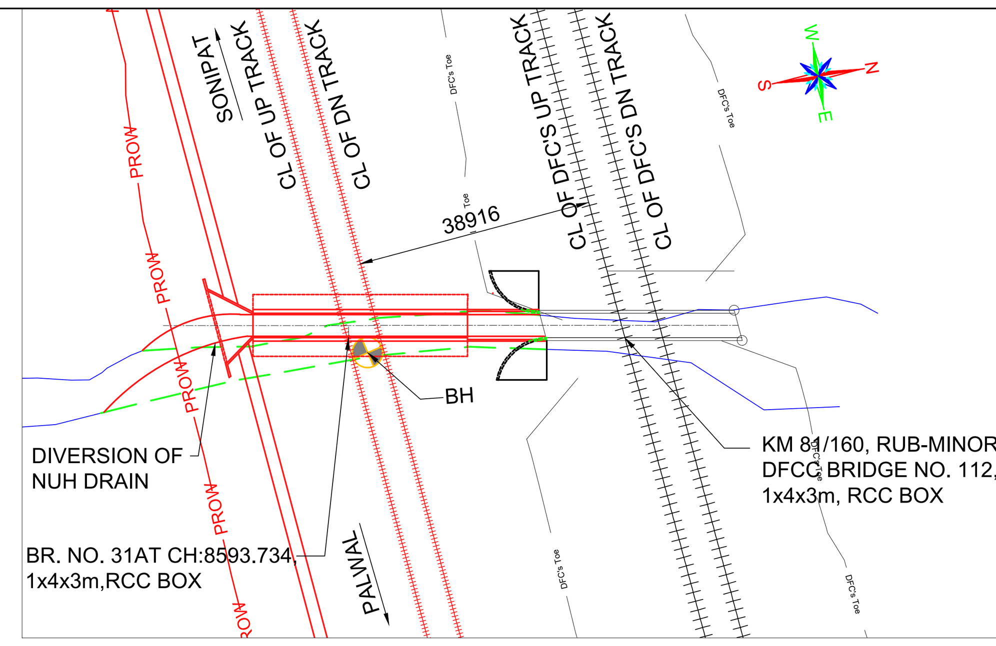
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR BALANCING CULVERT BRIDGE NO. 29 SPAN 1X2X2 RCC BOX AT CH: 8141.419

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01029_A0	1 OF 1

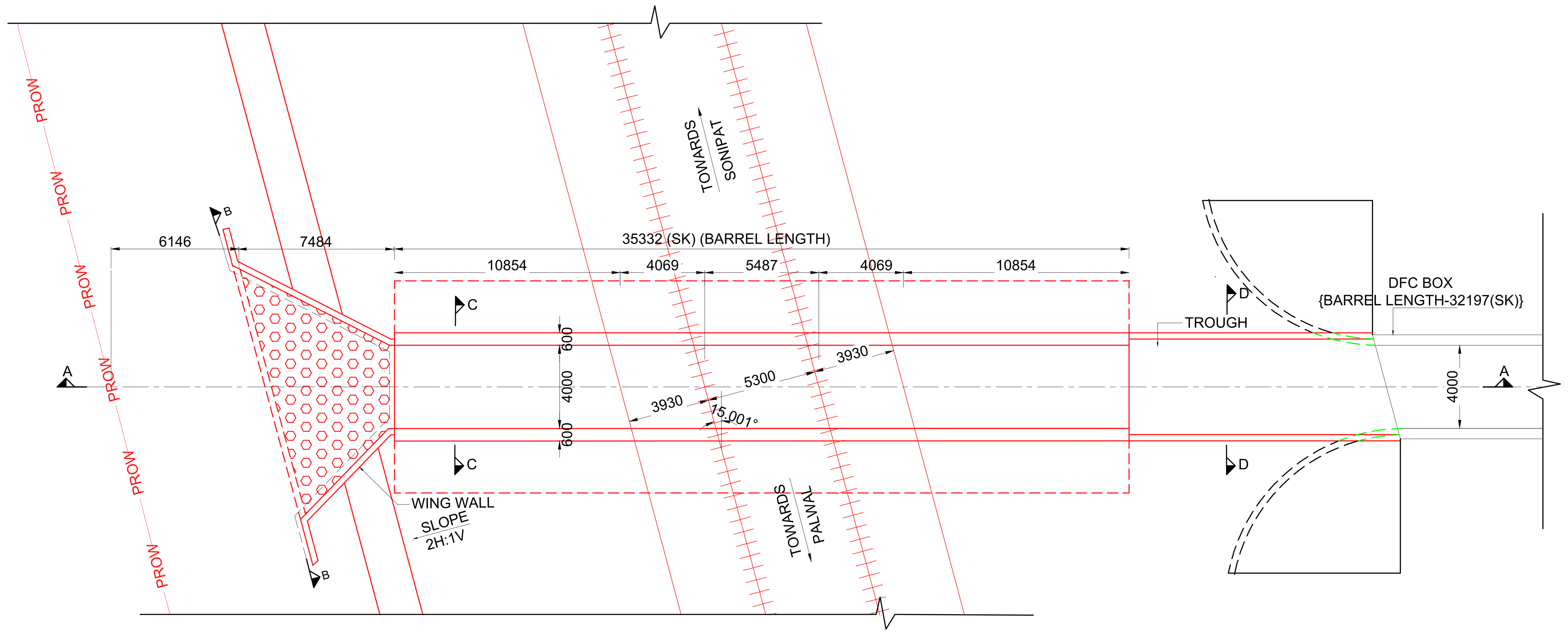
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



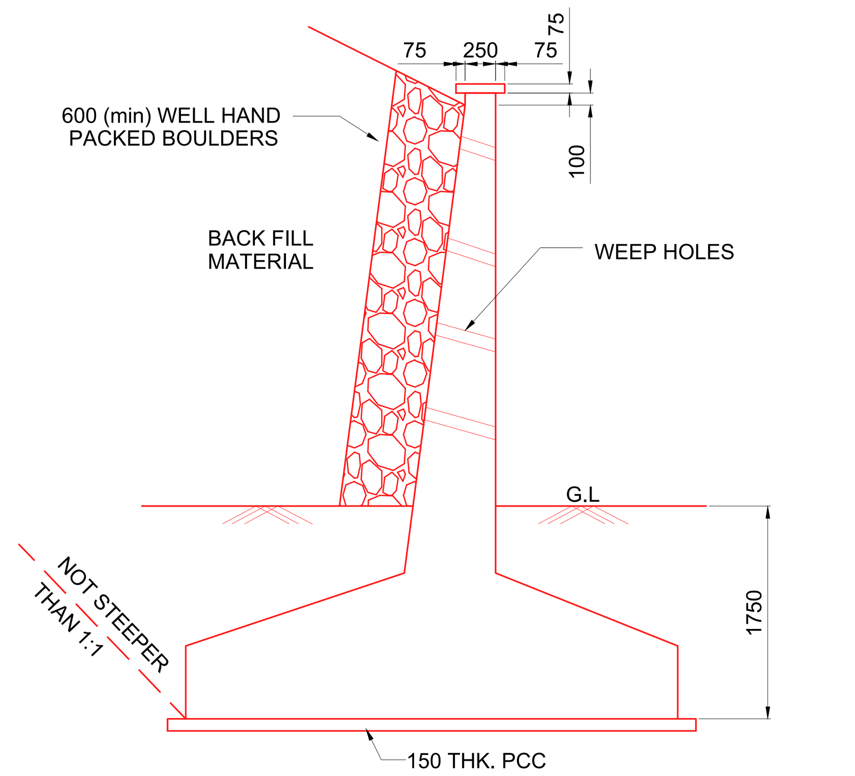
SECTIONAL ELEVATION AT A-A
SCALE 1:200



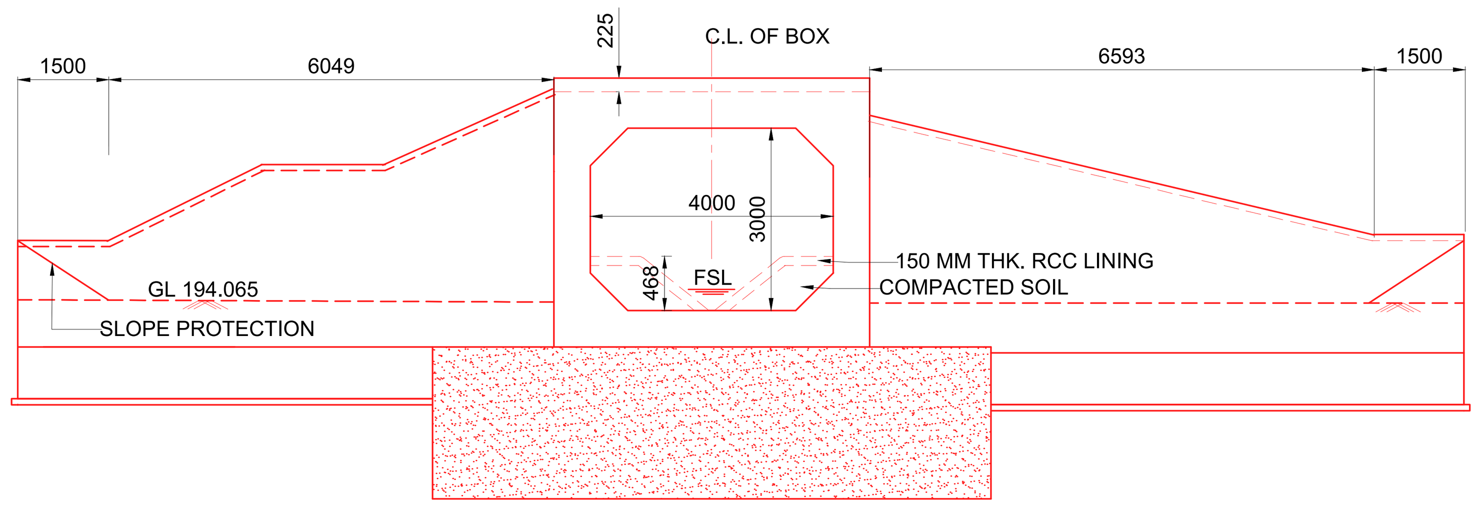
KEY PLAN
SCALE NTS



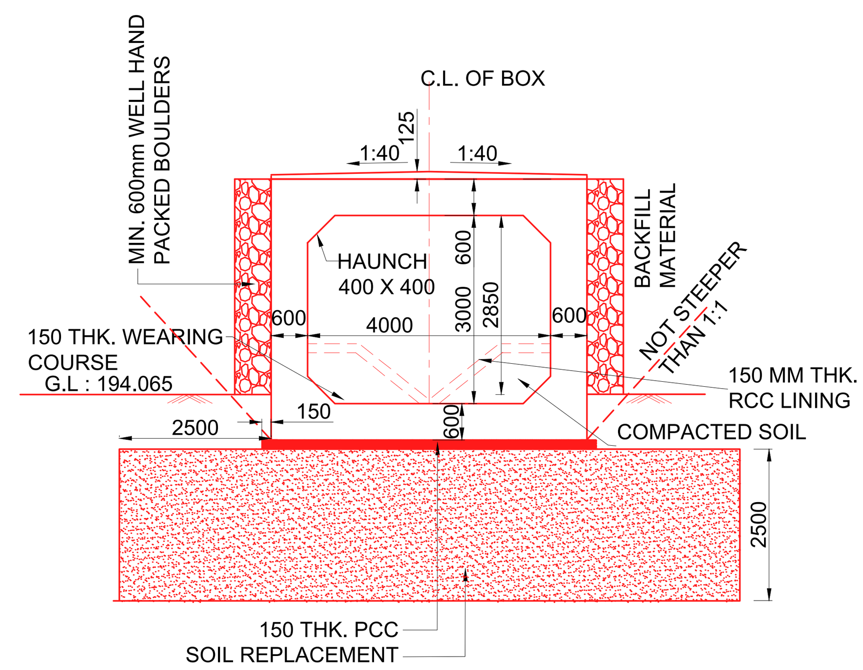
PLAN AT TOP
SCALE 1:200



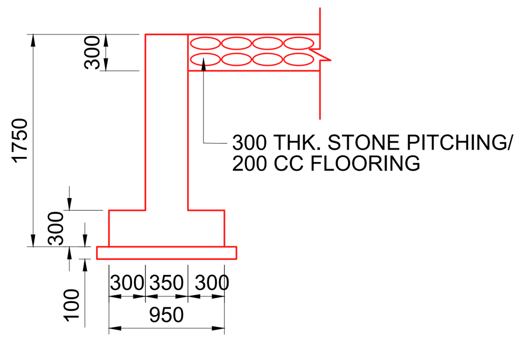
TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



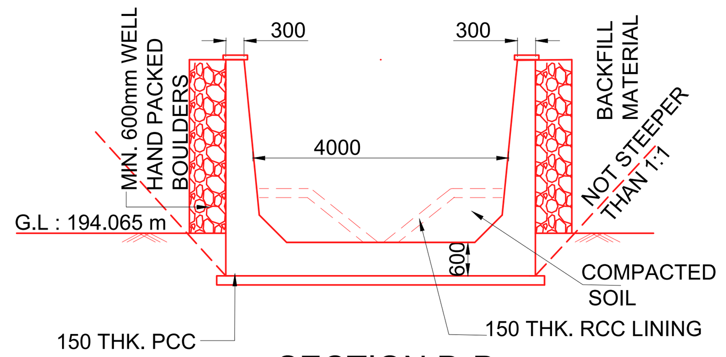
VIEW B-B
SCALE 1:100



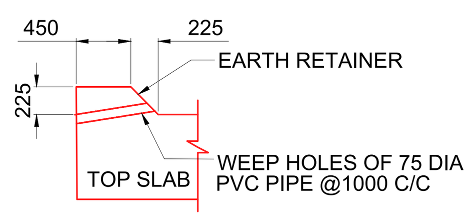
SECTION C-C
SCALE 1:100



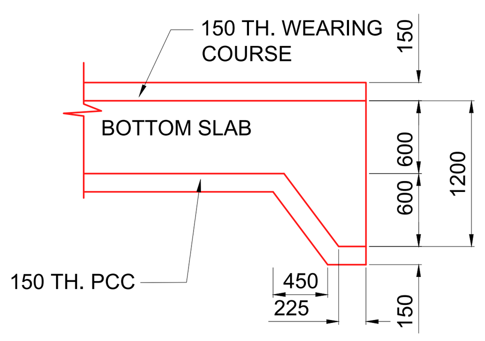
DROP / CURTAIN WALL DETAILS
SCALE 1:50



SECTION D-D
SCALE 1:100



EARTH RETAINER
SCALE 1:50



SHEAR KEY
SCALE 1:50

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
VC	VERTICAL CLEARANCE
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
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8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
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B) TECHNICAL NOTES :

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2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE.
   GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.
2. WEARING COURSE PROFILE IN HORC BOX SHALL BE MAINTAINED WITH THAT OF DFC BOX. FOUNDING LEVEL OF BOX SHALL BE ADJUSTED ACCORDINGLY.
3. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.
4. CANAL IN HORC PORTION SHALL BE LINED FROM ROW TO ROW OF HORC INCLUDING IN RCC BOX & U-TROUGH.
5. RCC LINING SHALL BE OF MIN 150 MM THICK AND HAVING AT LEAST MIN TEMP REINFORCEMENT.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

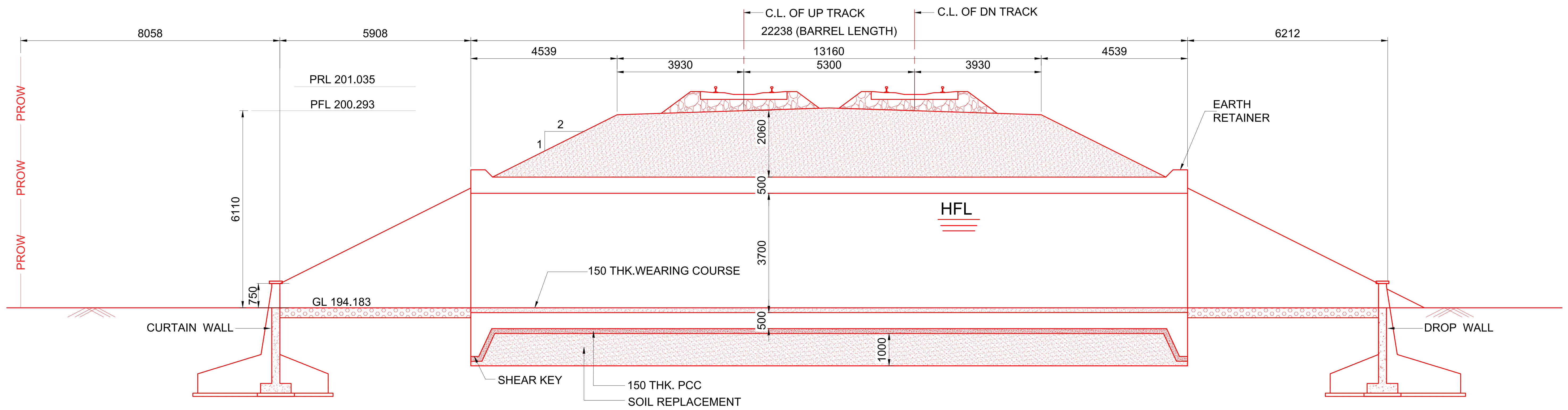
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

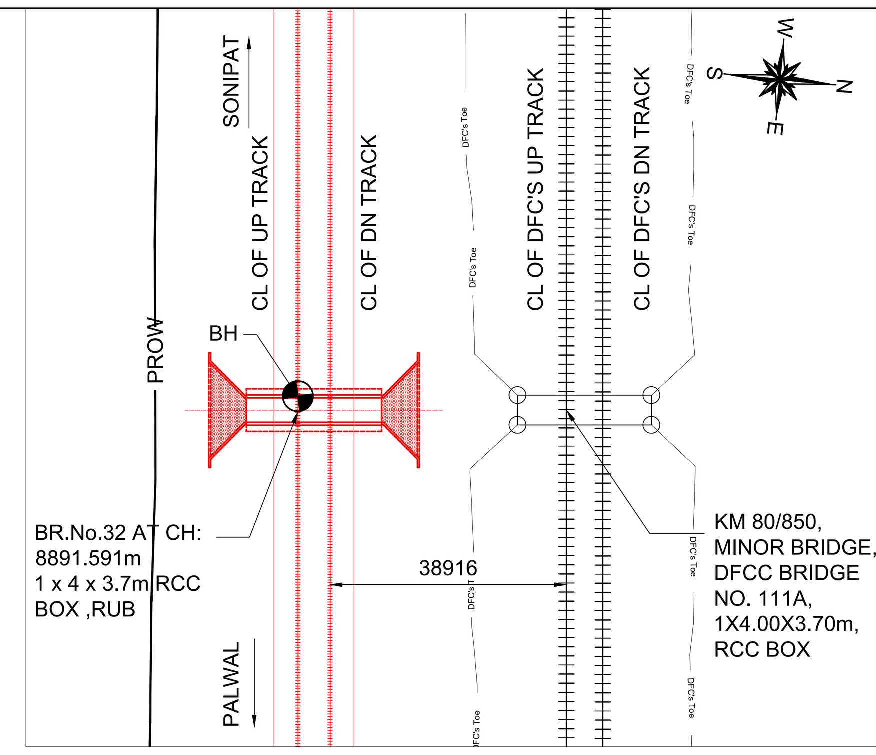
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR BALANCING CULVERT BRIDGE NO. 31
1 x 4 x 3.0m RCC BOX AT CH.8593.734m

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01031_A1	1 OF 1

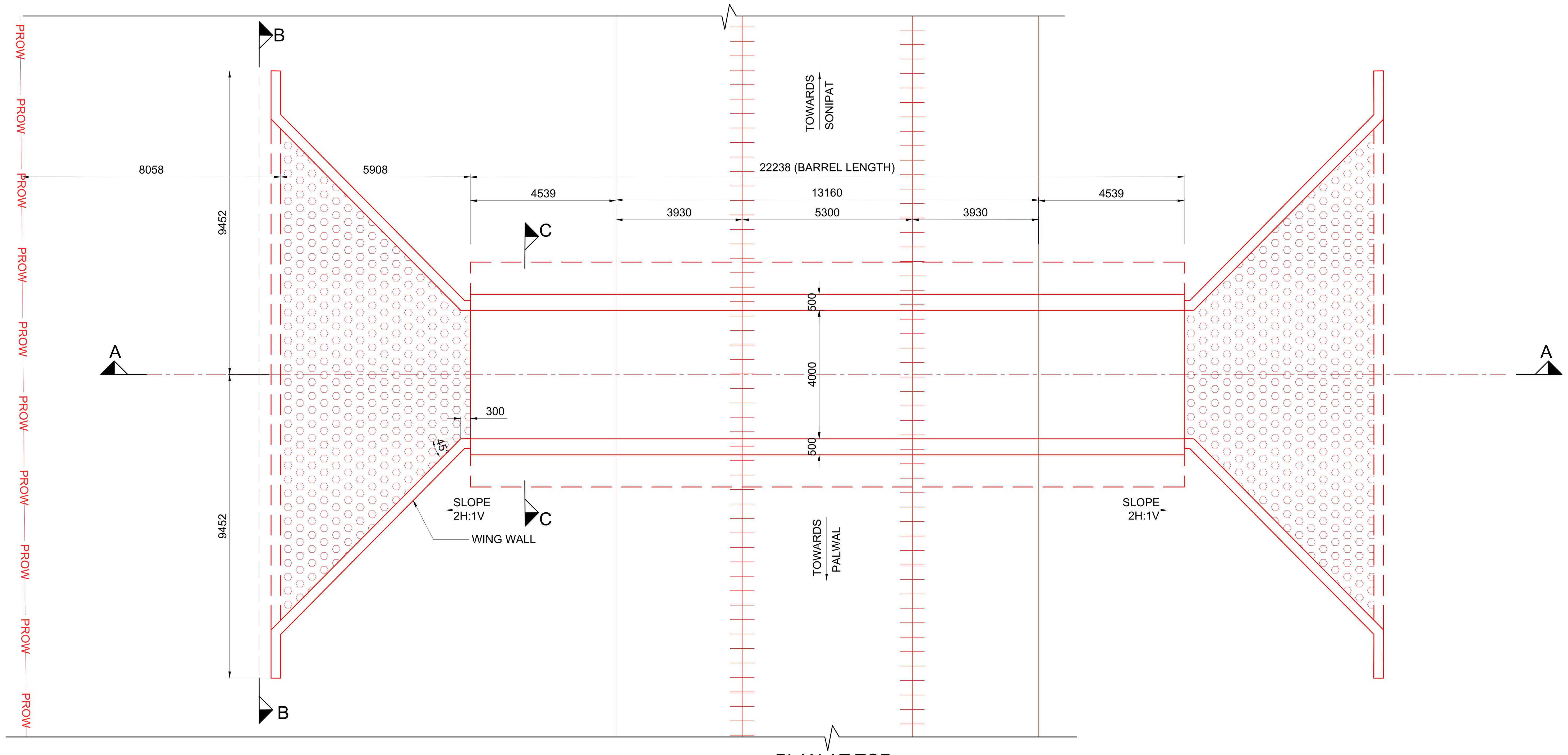
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	06-12-2023



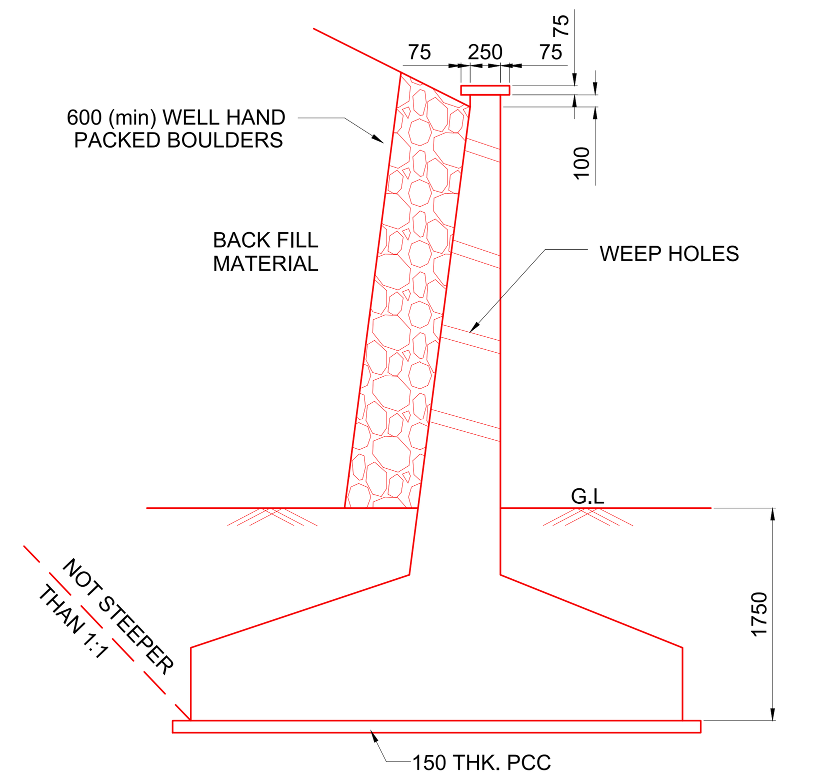
SECTIONAL ELEVATION AT A-A
SCALE 1:100



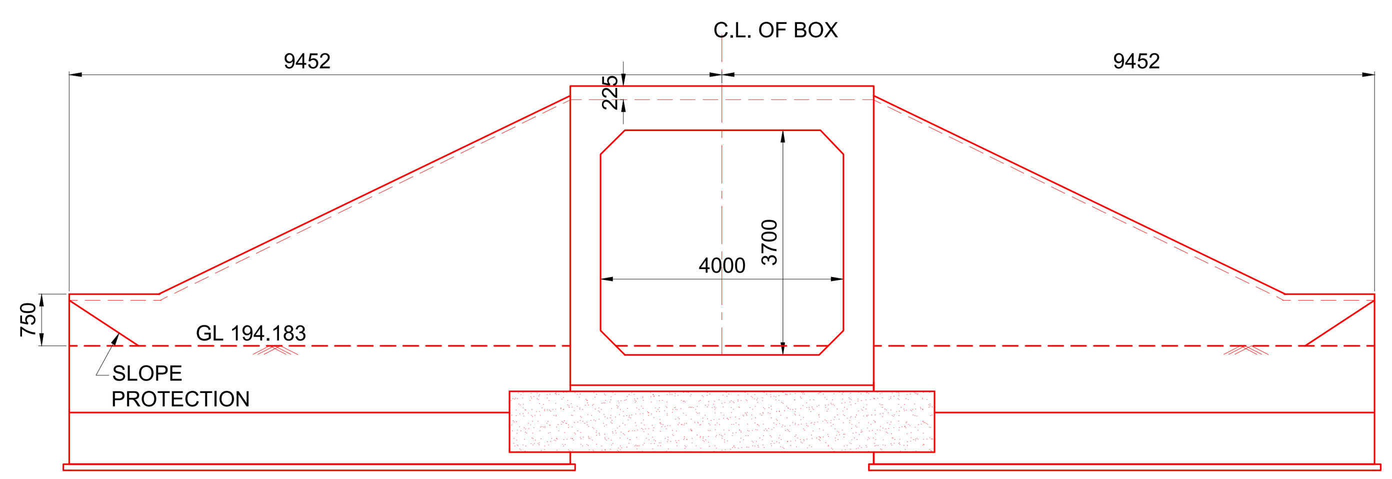
KEY PLAN
SCALE NTS



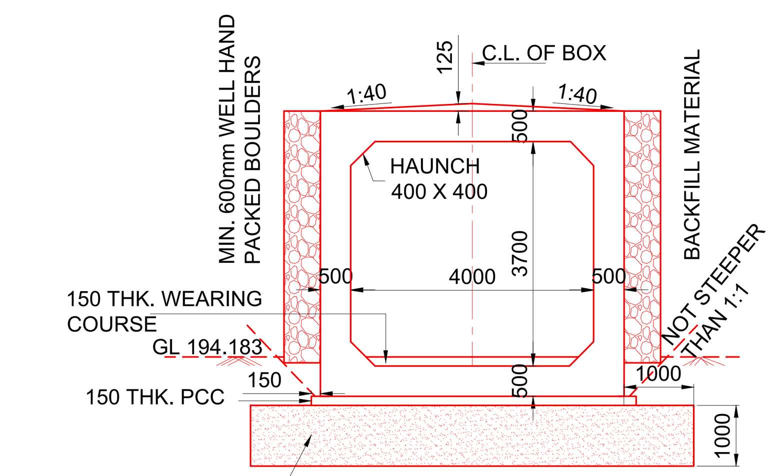
PLAN AT TOP
SCALE 1:100



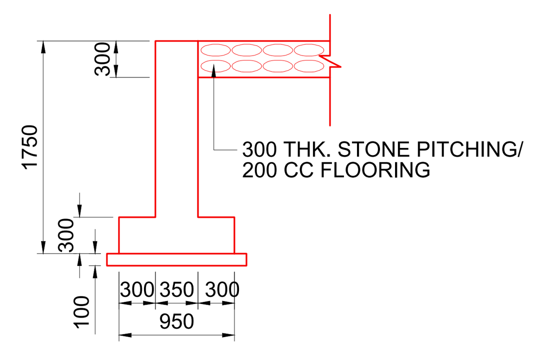
TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



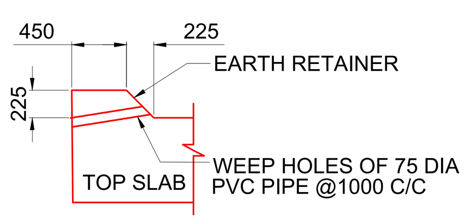
VIEW B-B
SCALE 1:100



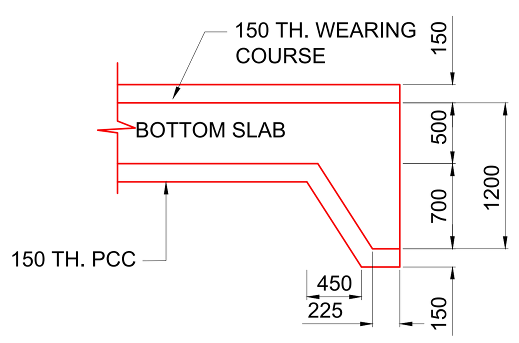
SECTION C-C
SCALE 1:100



DROP / CURTAIN WALL DETAILS
SCALE 1:50



EARTH RETAINER
SCALE 1:50



SHEAR KEY
SCALE 1:50

NOTES :

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12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE.
   GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.
2. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K.Singh		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

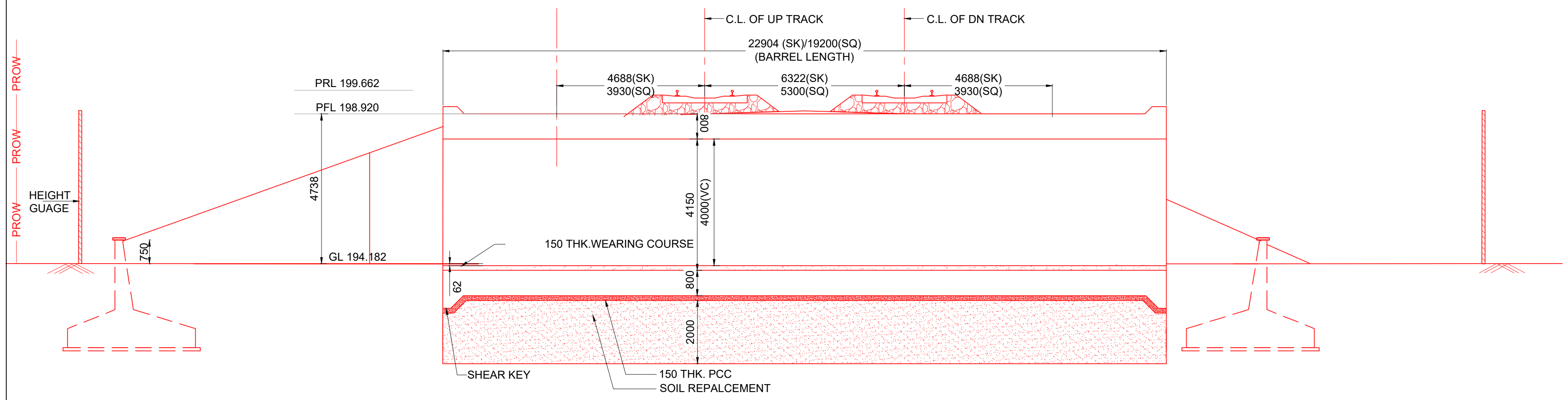
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR BALANCING CULVERT BRIDGE NO. 32 1X4.0X3.7m RCC BOX AT CH: 8891.591m

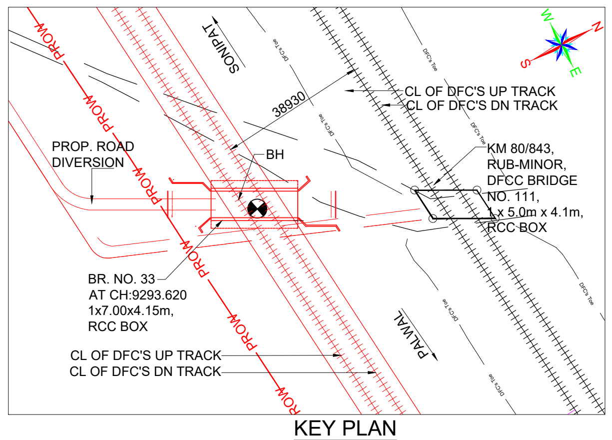
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01032_A0	1 OF 1

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



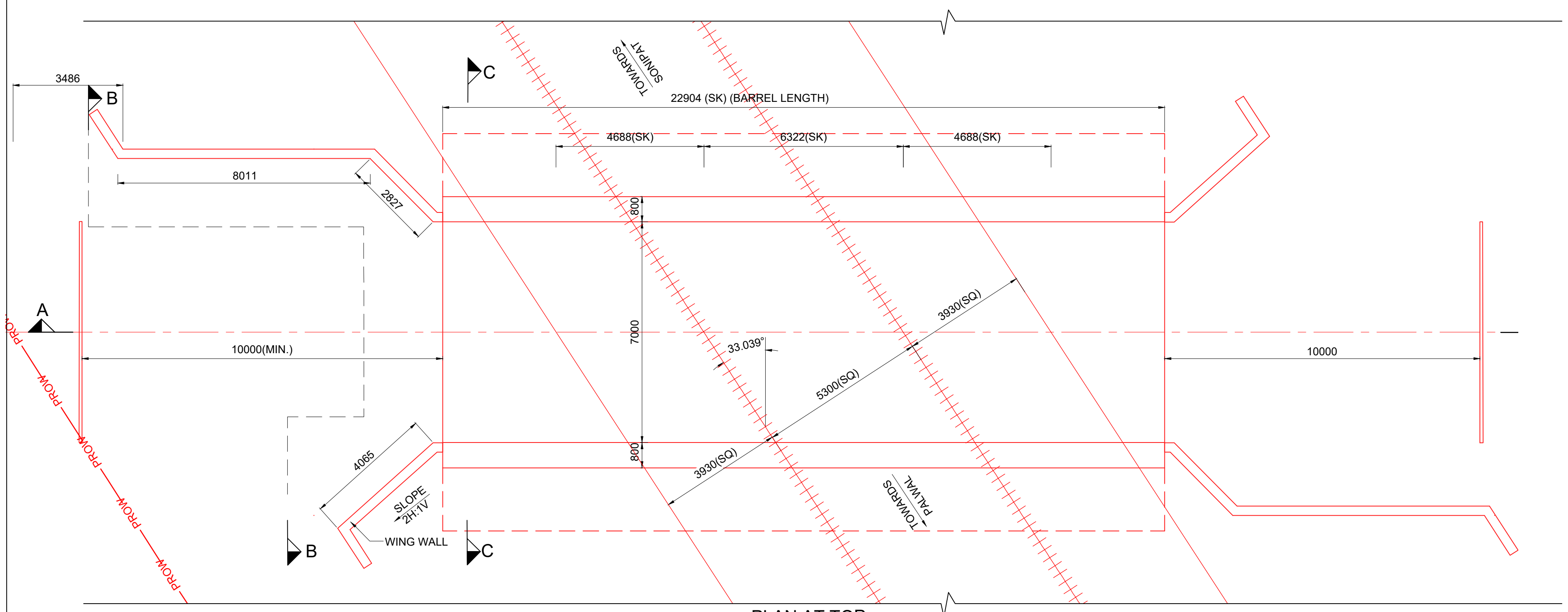
SECTIONAL ELEVATION AT A-A

SCALE 1:100



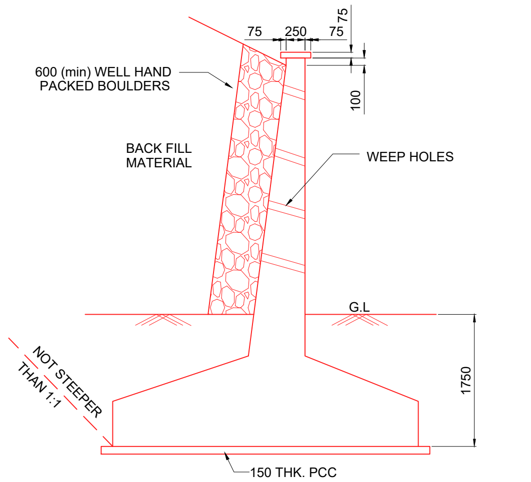
KEY PLAN

SCALE : NTS



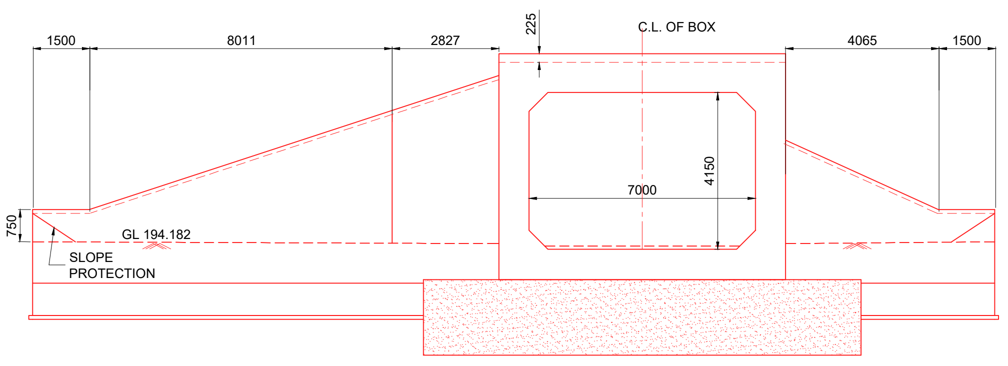
PLAN AT TOP

SCALE 1:100



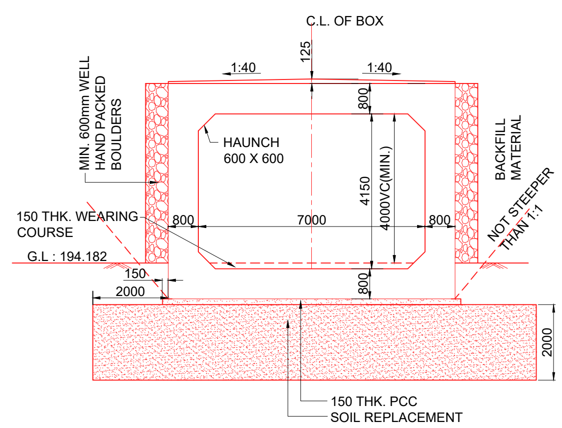
TYPICAL DETAIL OF RETURN WALL / WING WALL

SCALE 1:50



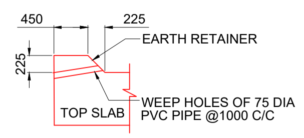
VIEW B-B

SCALE 1:100



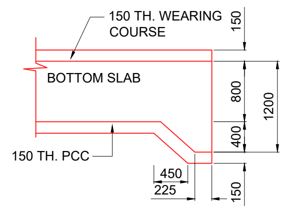
SECTION C-C

SCALE 1:100



EARTH RETAINER

SCALE 1:50



SHEAR KEY

SCALE 1:50

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

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6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
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16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.
3. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.

IMPORTANT NOTE:

TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL. HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

LEGEND

(red line)	PROPOSED
(grey line)	EXISTING
(green dashed line)	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
VC	VERTICAL CLEARANCE
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	(signature)
SUDHIR AGRAWAL DPD/CIVIL	(signature)	RAJU SOLANK DGM/CIVIL	(signature)
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	(signature)
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

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CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

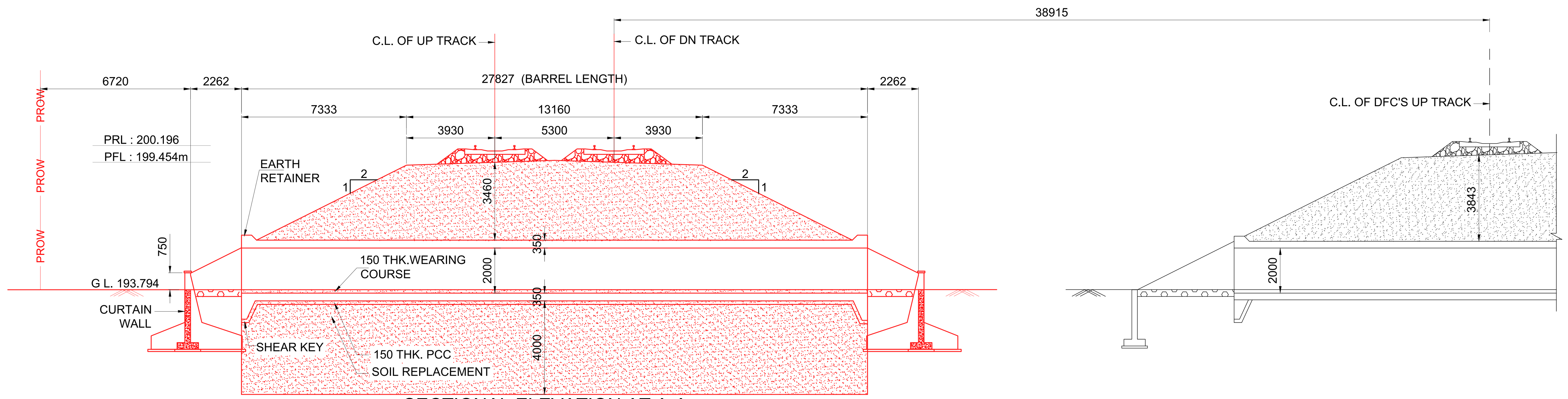
RITES THE INFRASTRUCTURE PEOPLE

SMEC

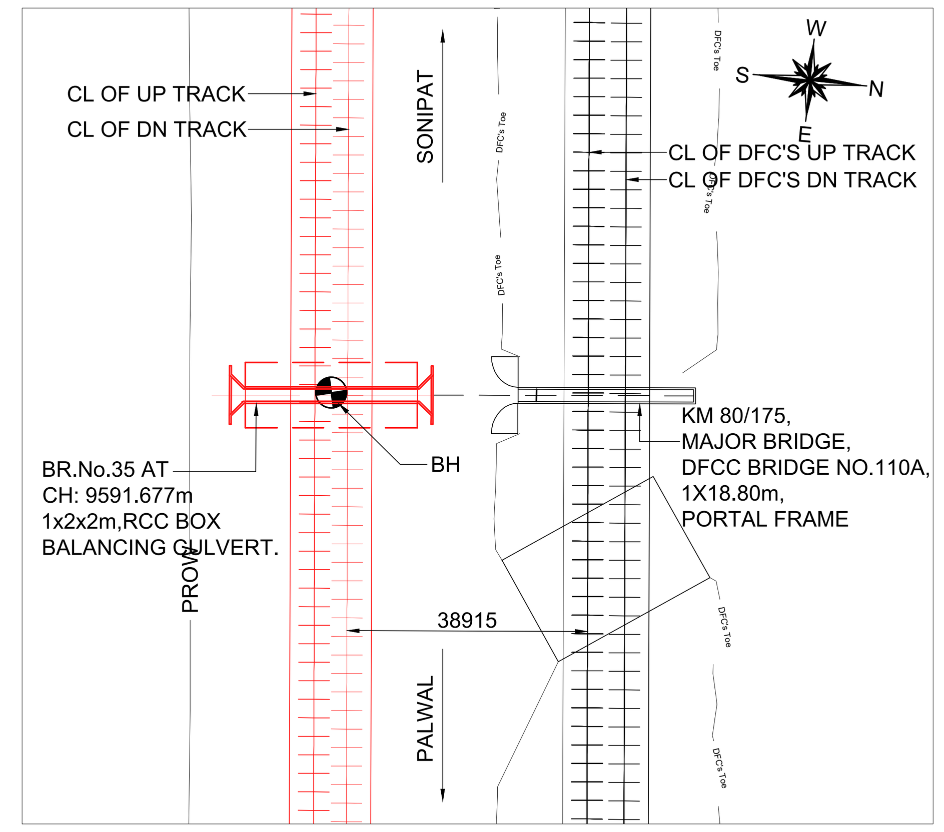
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO. 33 1 x 7.00 x 4.15m RCC BOX AT CH.9293.620m

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01033_A0	1 OF 1

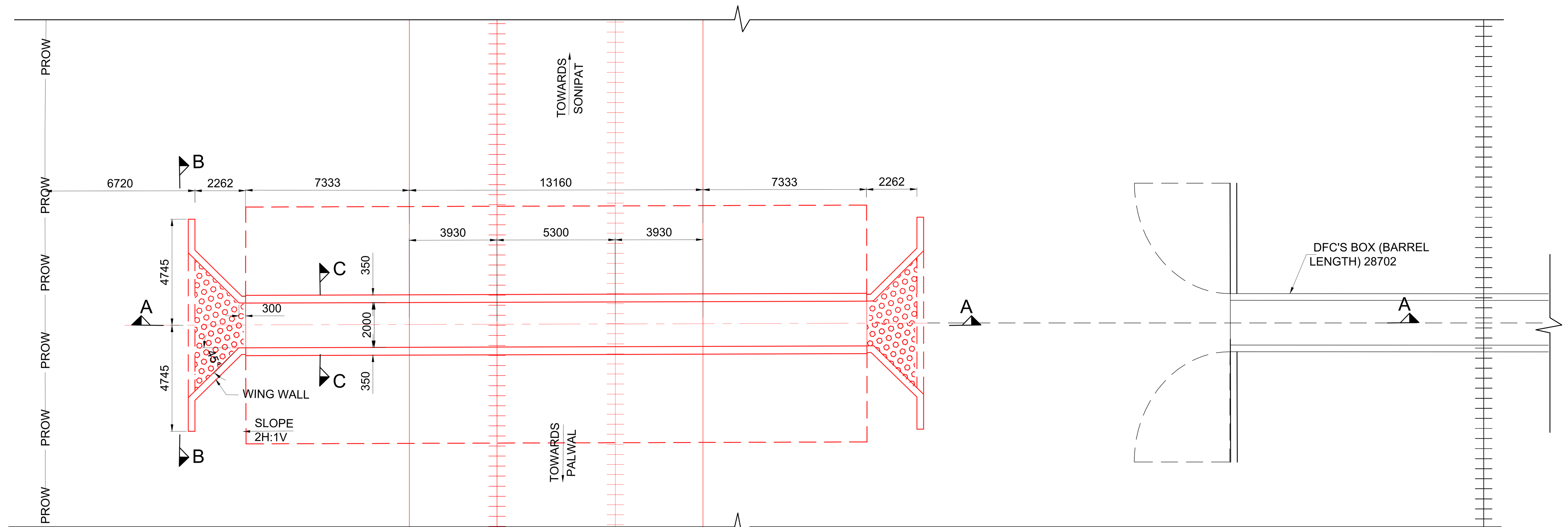
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



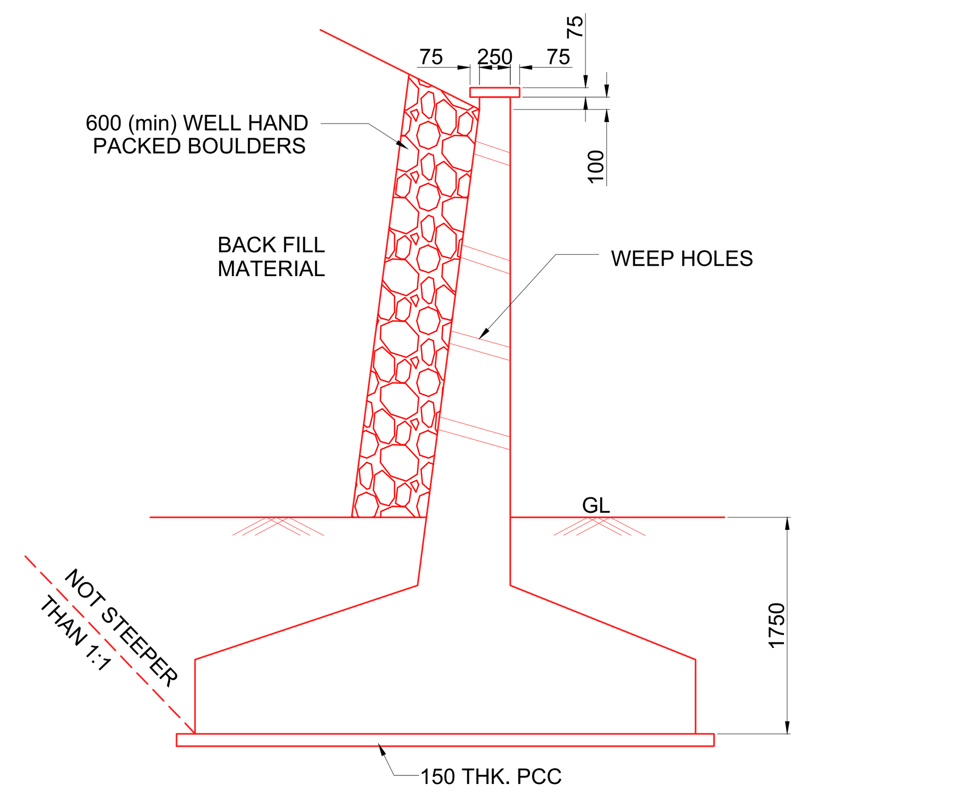
SECTIONAL ELEVATION AT A-A
SCALE 1:150



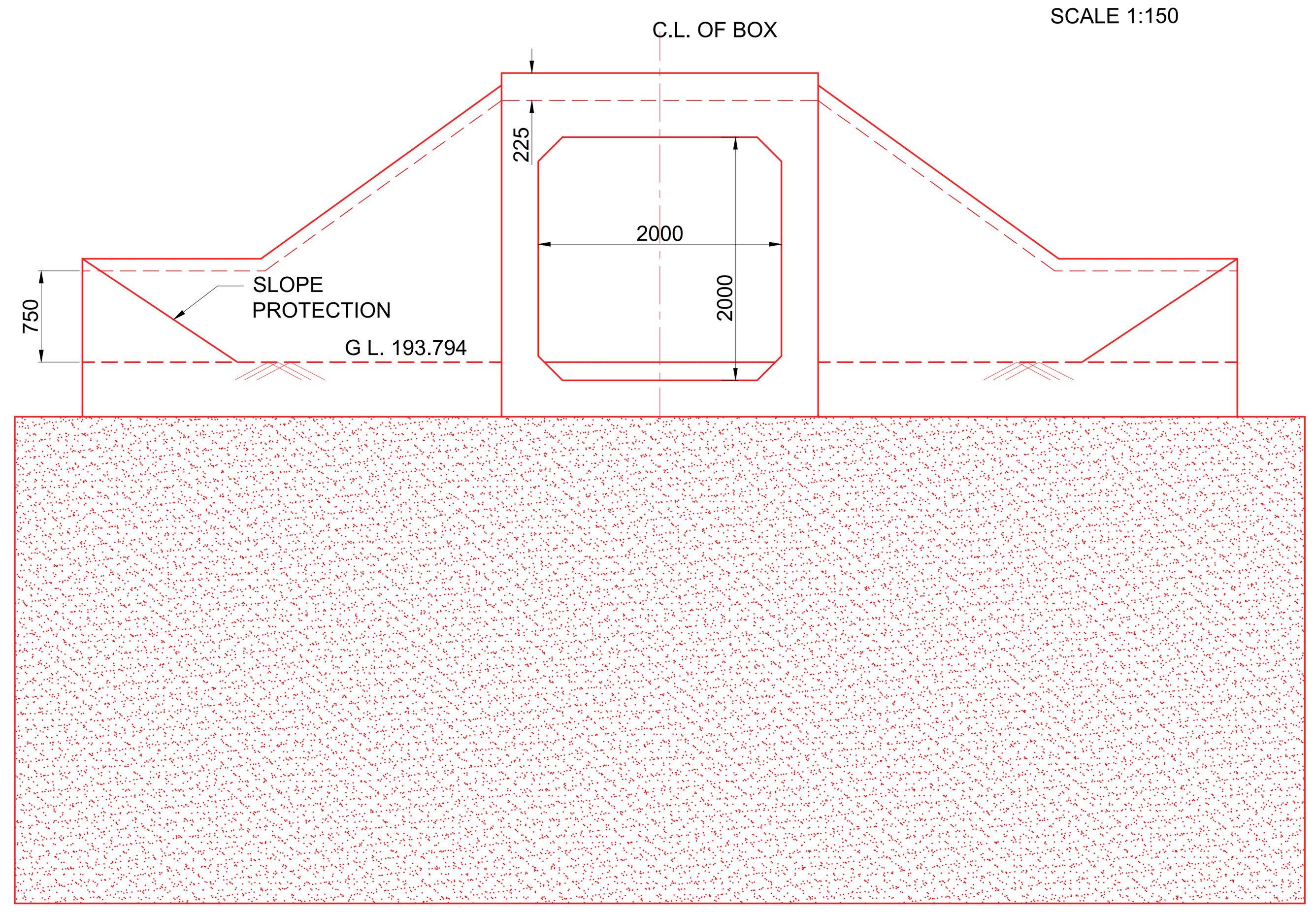
KEY PLAN
SCALE NTS



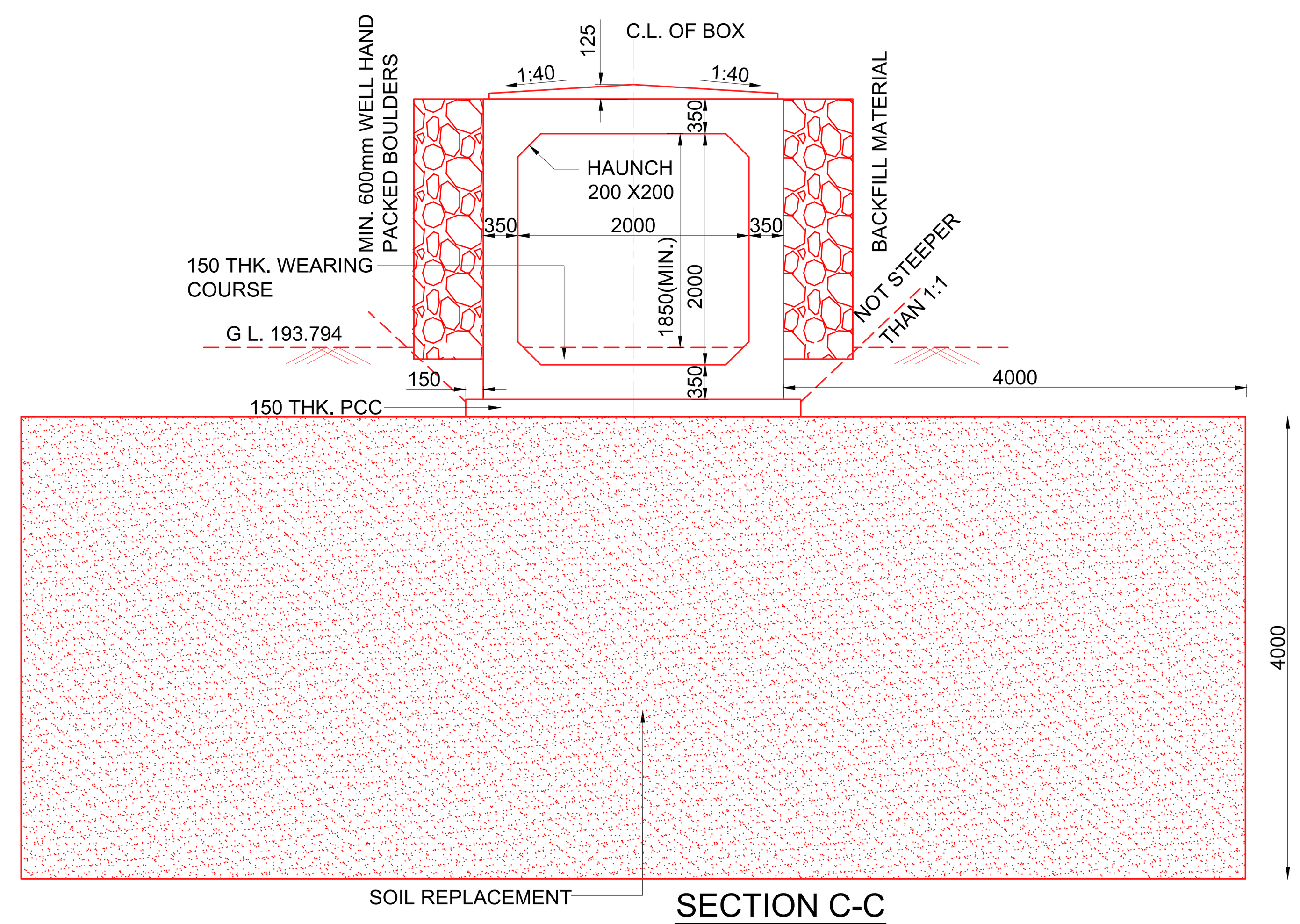
PLAN AT TOP
SCALE 1:150



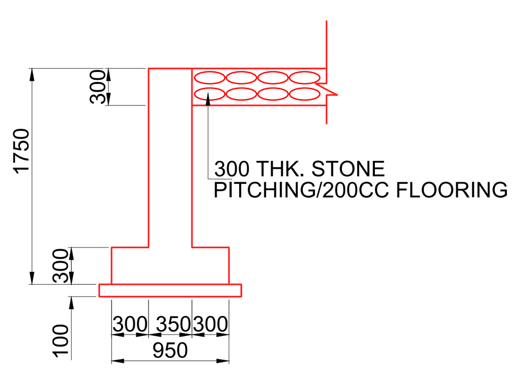
TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



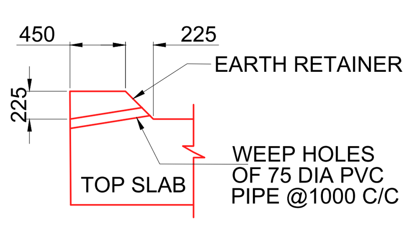
VIEW AT B-B
SCALE 1:50



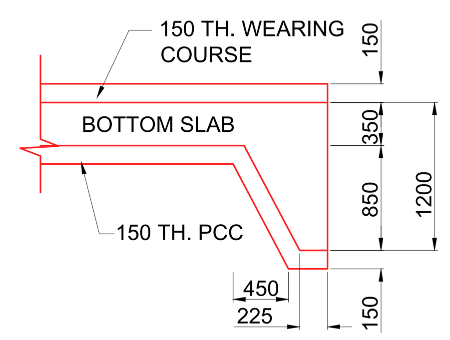
SECTION C-C
SCALE 1:50



DROP / CURTAIN WALL DETAILS
SCALE 1:50



EARTH RETAINER
SCALE 1:50



SHEAR KEY
SCALE 1:50

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

NOTES :

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PROJECT:
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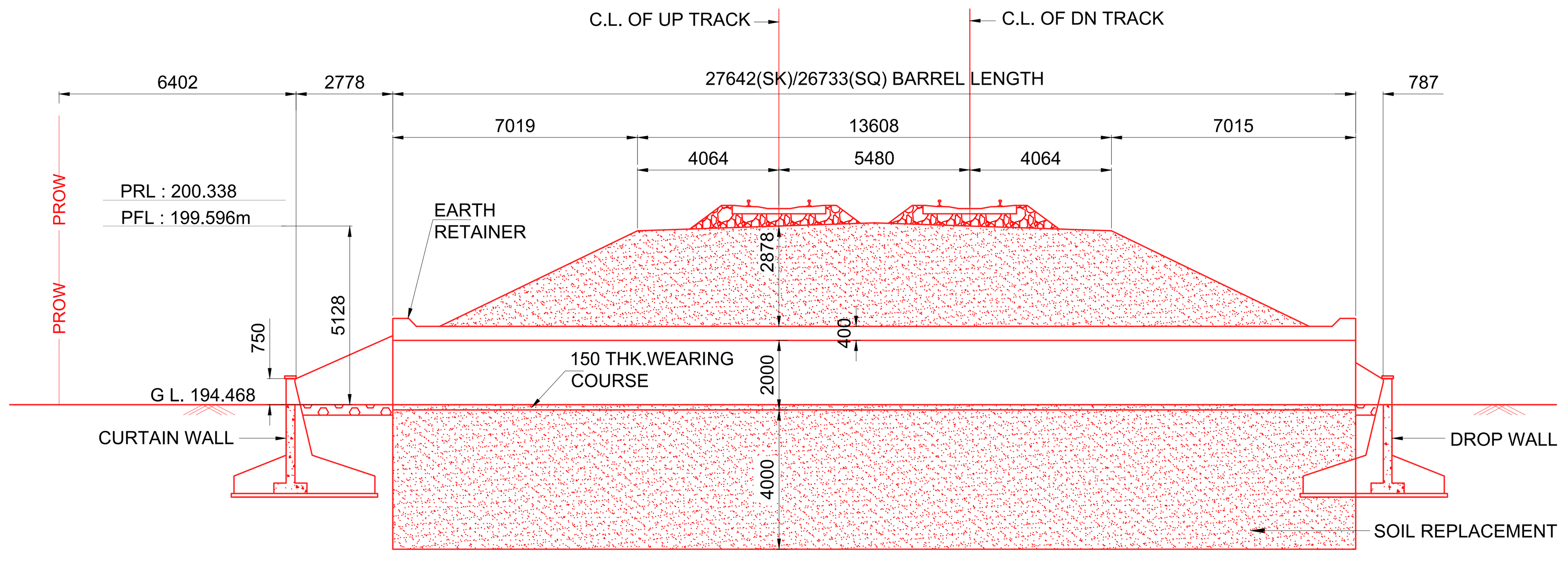
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

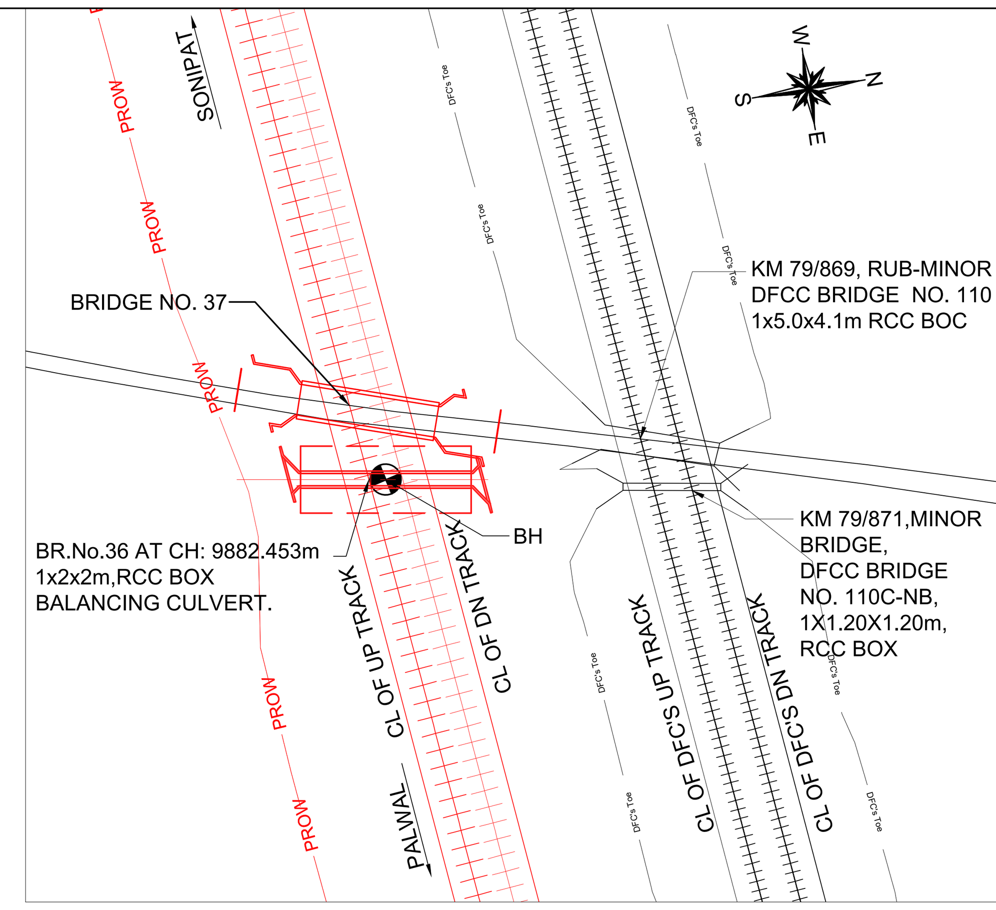
RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR BALANCING CULVERT BRIDGE NO. 35 SPAN 1X2X2 RCC BOX AT CH: 9591.677

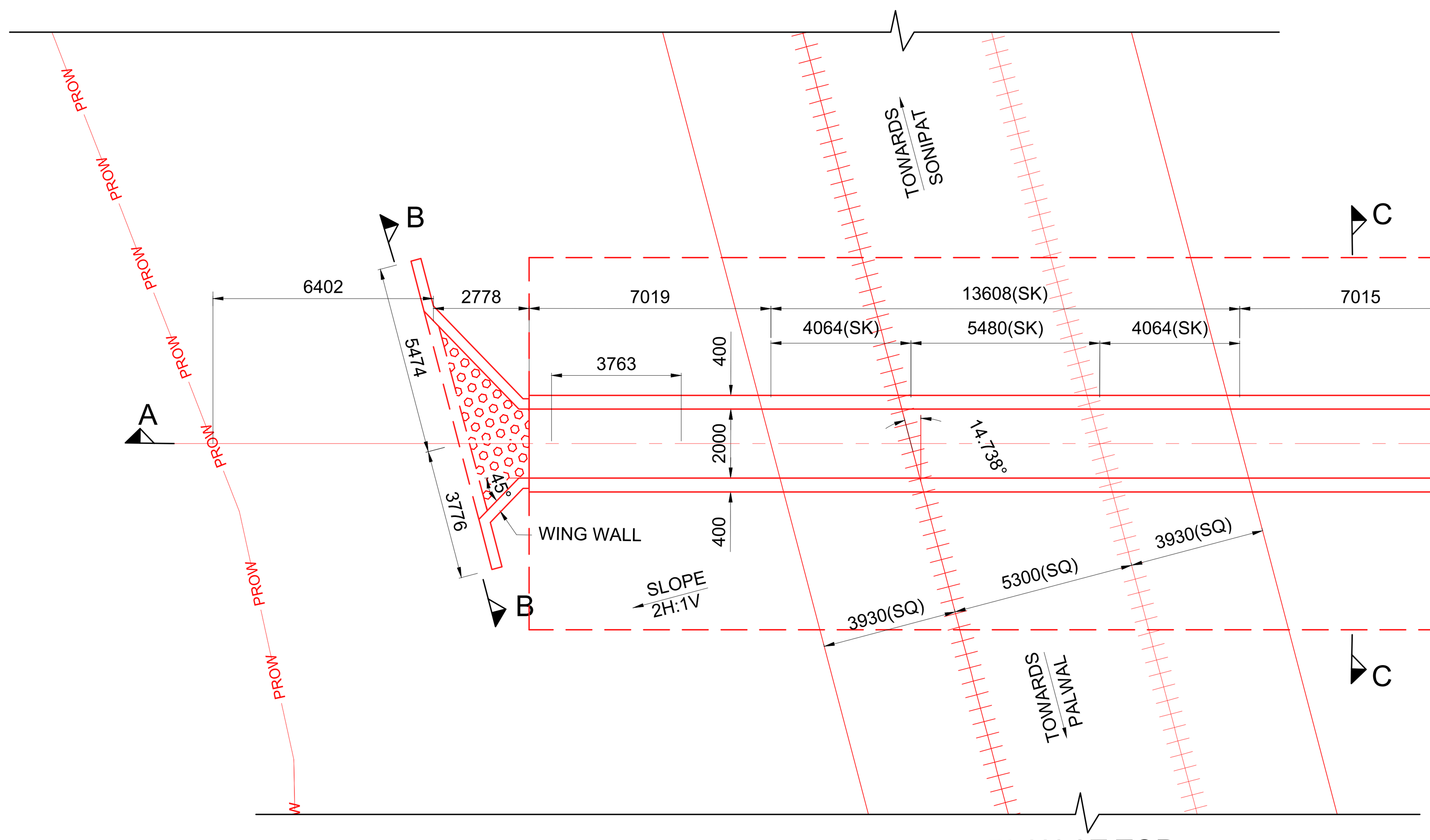
DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01035_A0		1 OF 1
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



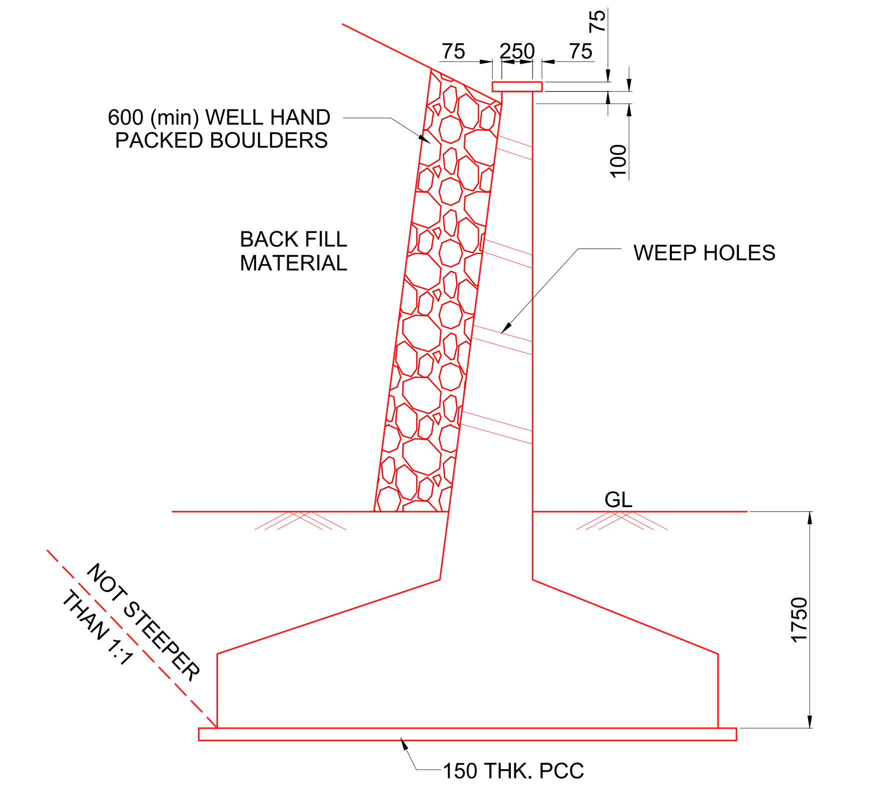
SECTIONAL ELEVATION AT A-A
SCALE 1:150



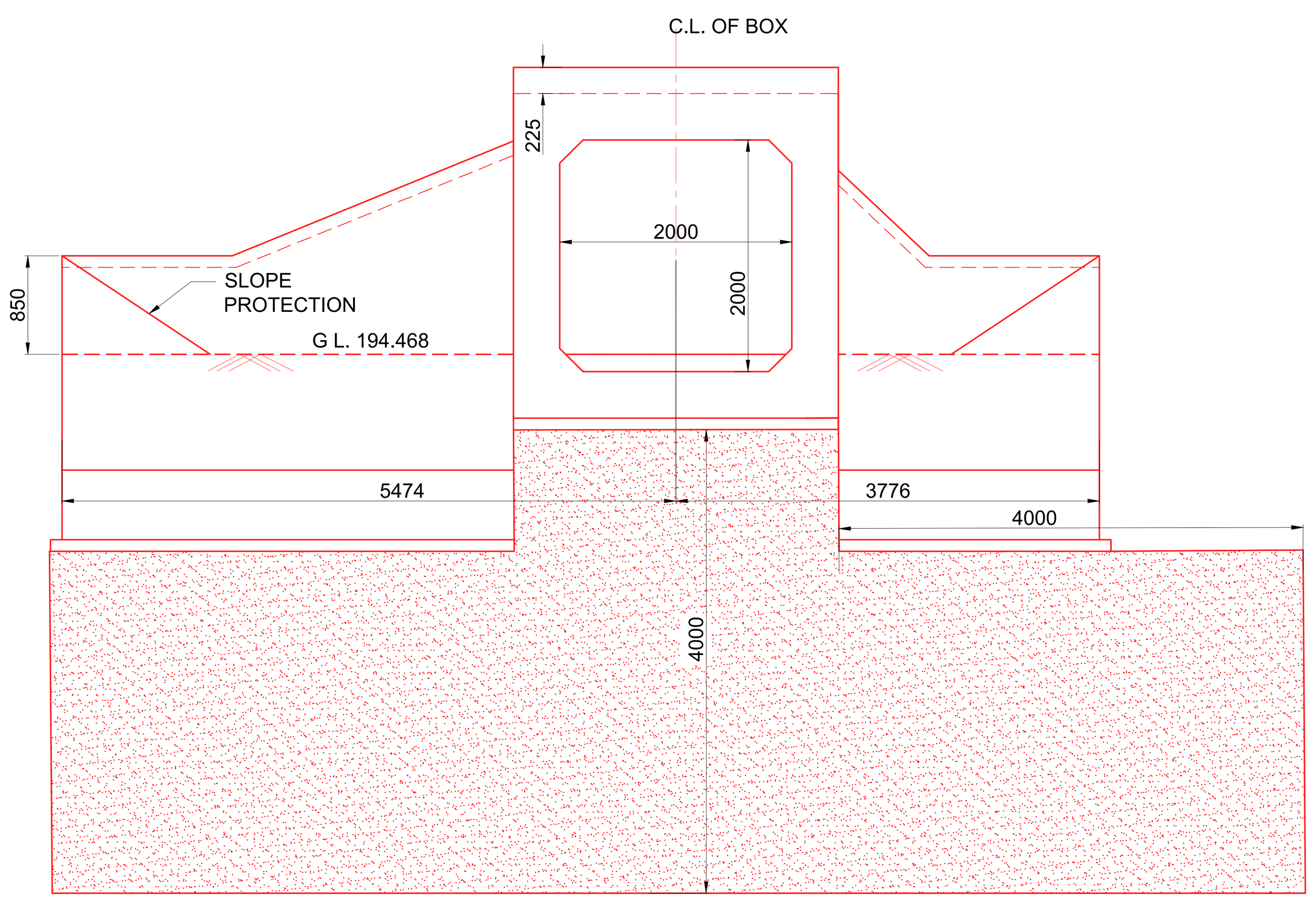
KEY PLAN
SCALE NTS



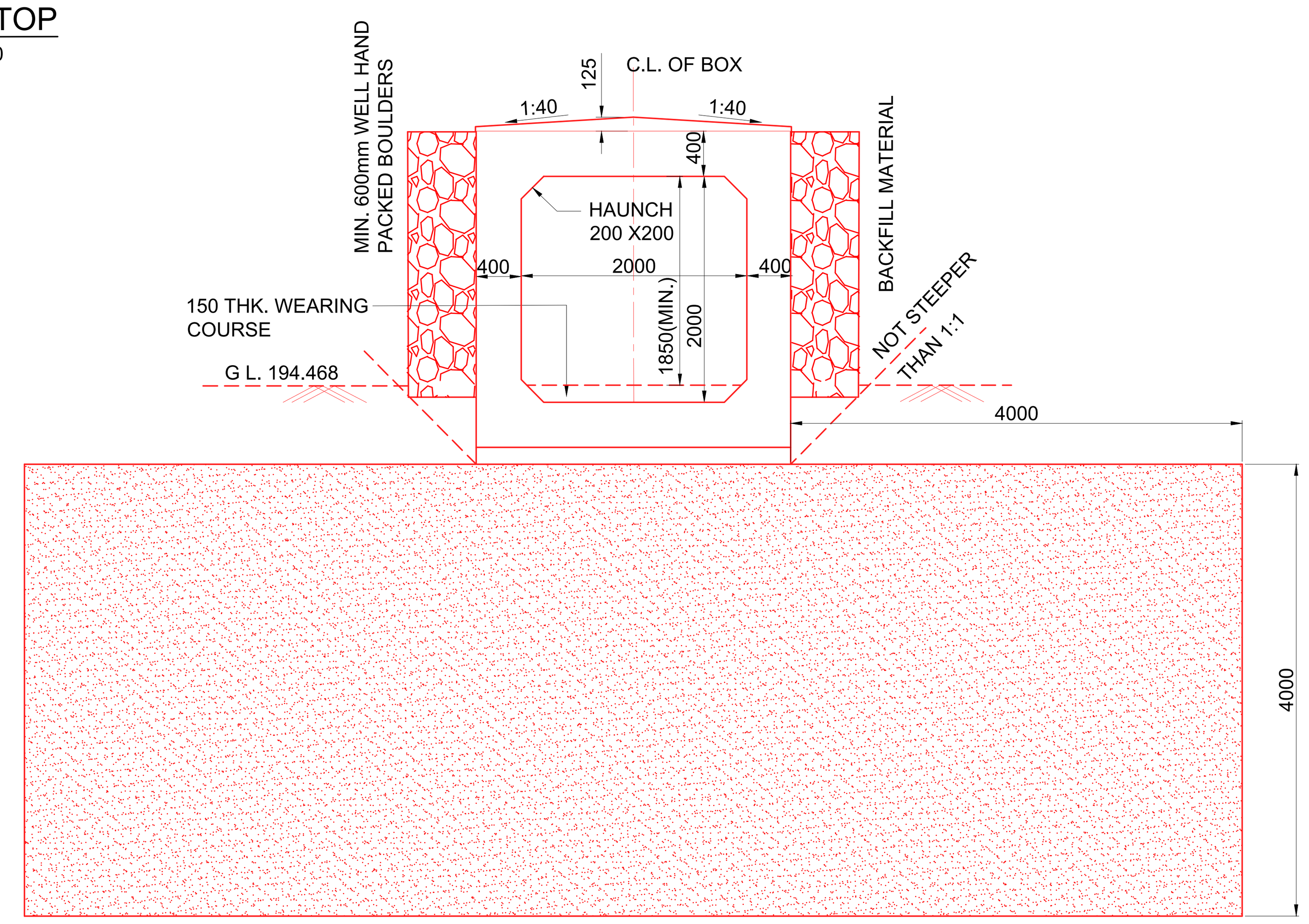
PLAN AT TOP
SCALE 1:150



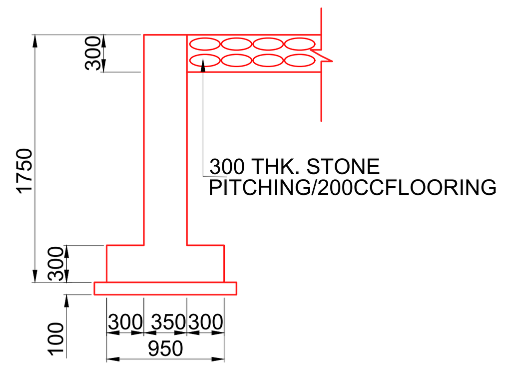
TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



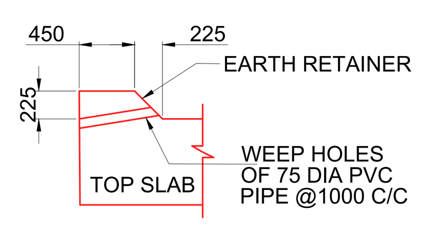
VIEW AT B-B
SCALE 1:50



SECTION C-C
SCALE 1:50



DROP / CURTAIN WALL DETAILS
SCALE 1:50



EARTH RETAINER
SCALE 1:50

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/ (Sig.)/ NR, DFCCI ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD,

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

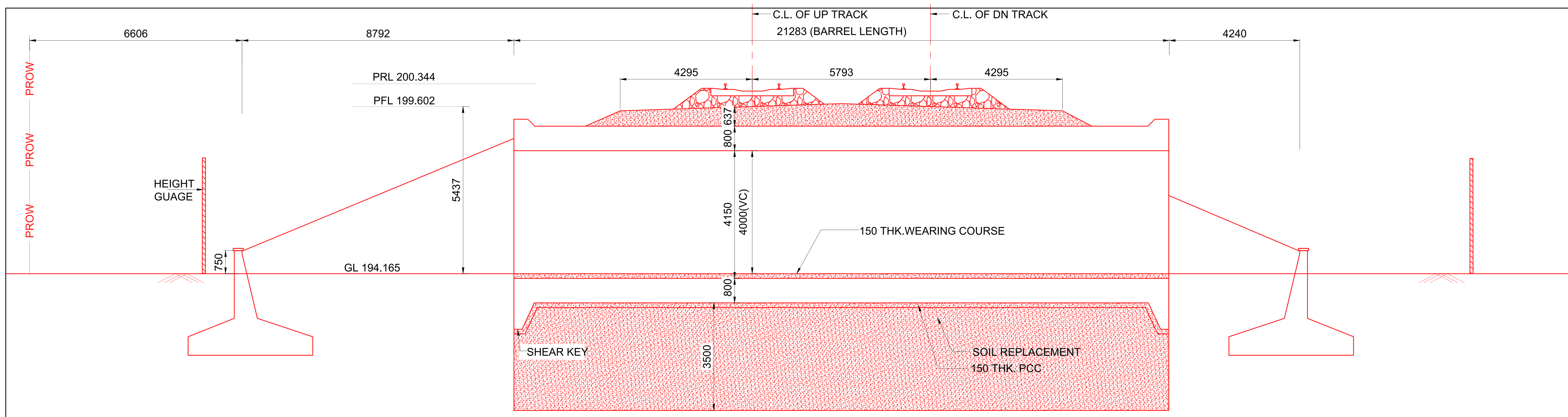
CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

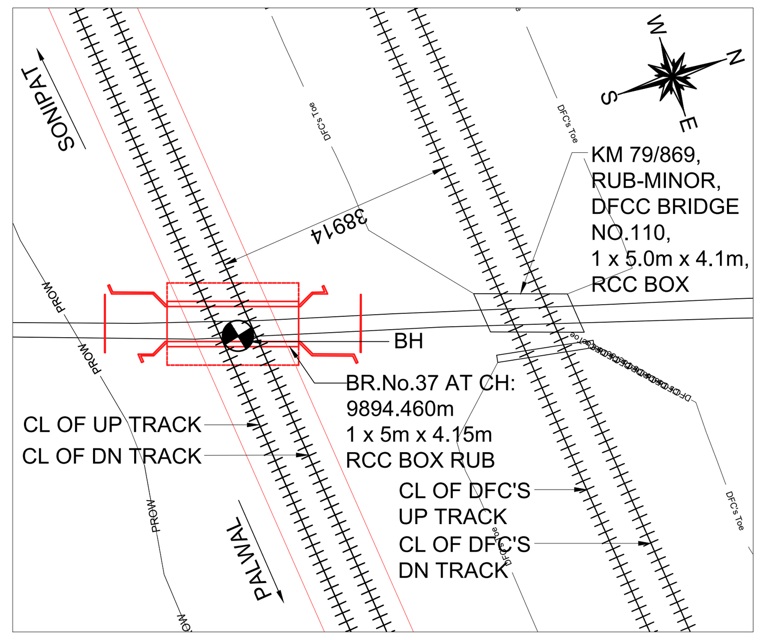
RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR BALANCING CULVERT BRIDGE NO. 36 SPAN 1X2X2 RCC BOX AT CH: 9882.453

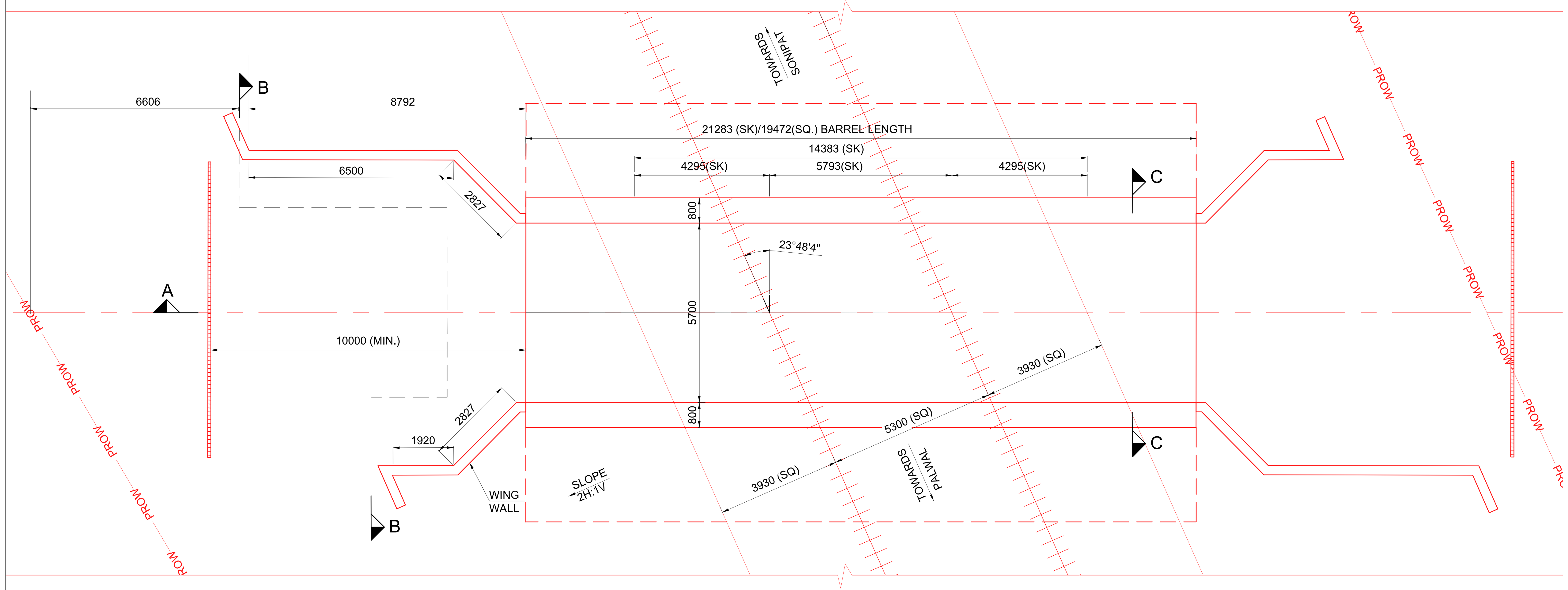
DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01036_A0		1 OF 1
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



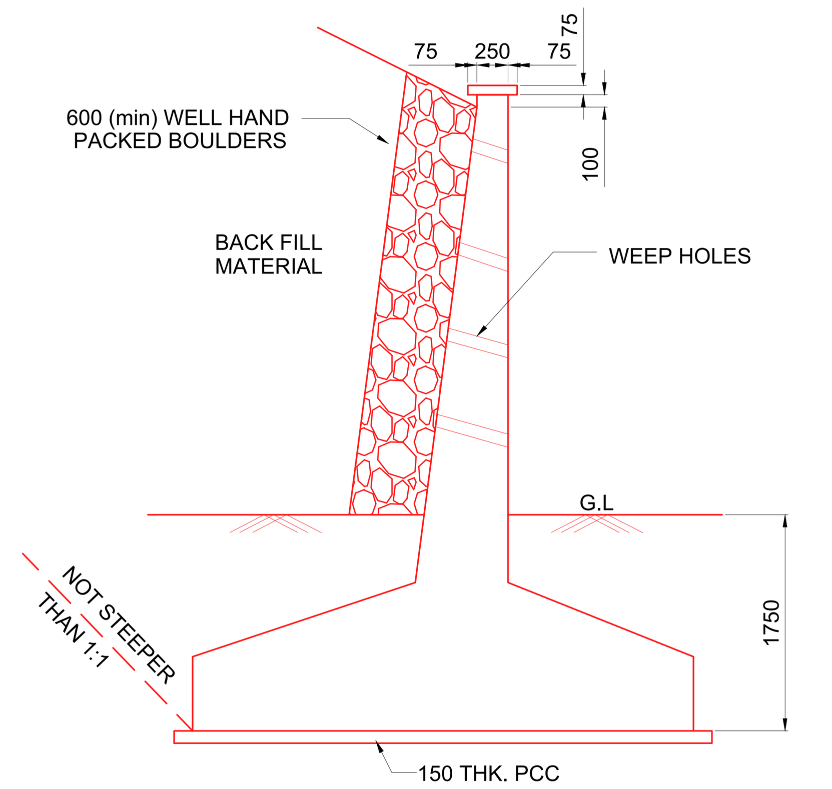
SECTIONAL ELEVATION AT A-A
SCALE 1:100



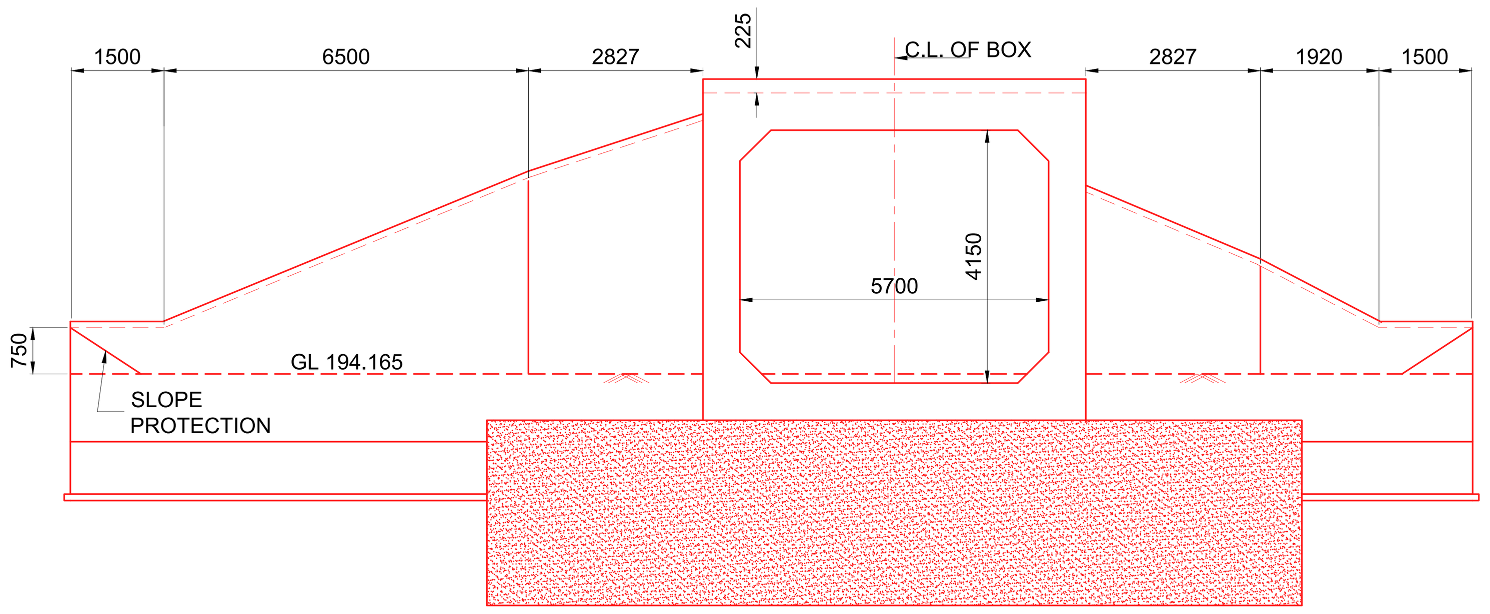
KEY PLAN
SCALE NTS



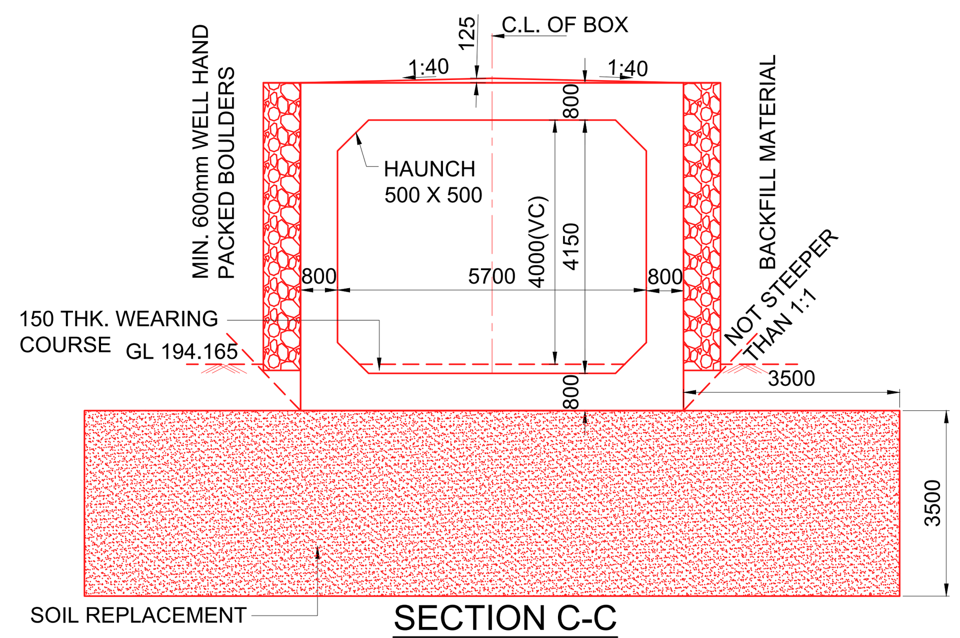
PLAN AT TOP
SCALE 1:100



TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



VIEW B-B
SCALE 1:100



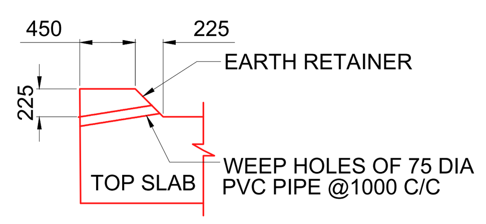
SECTION C-C
SCALE 1:100

LEGEND

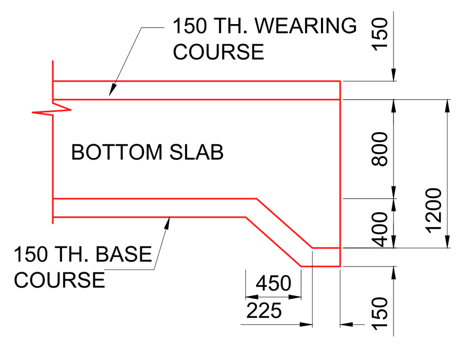
	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW



EARTH RETAINER
SCALE 1:50



SHEAR KEY
SCALE 1:50

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL		MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL			

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL, BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
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12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
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4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE.
   GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
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6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
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14 75MM DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
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16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.
3. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.

IMPORTANT NOTE:

TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

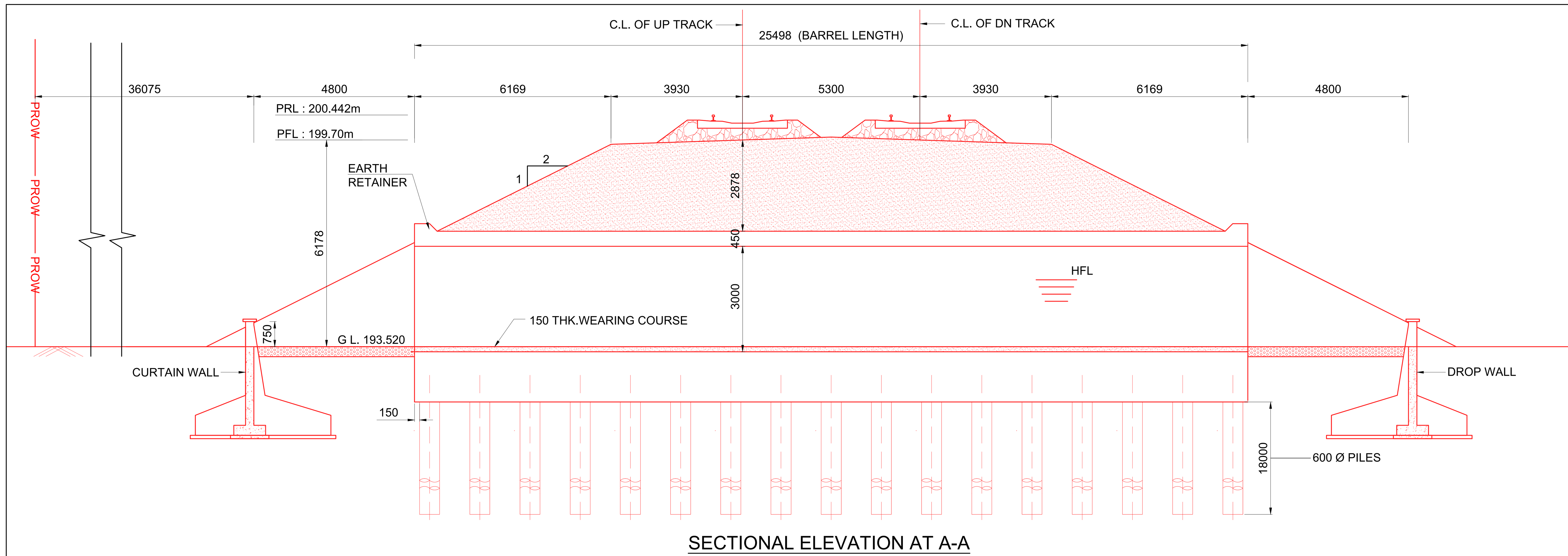
THE INFRASTRUCTURE PEOPLE

Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO. 37 1 x 5.70 x 4.15m RCC BOX AT CH.9894.460m

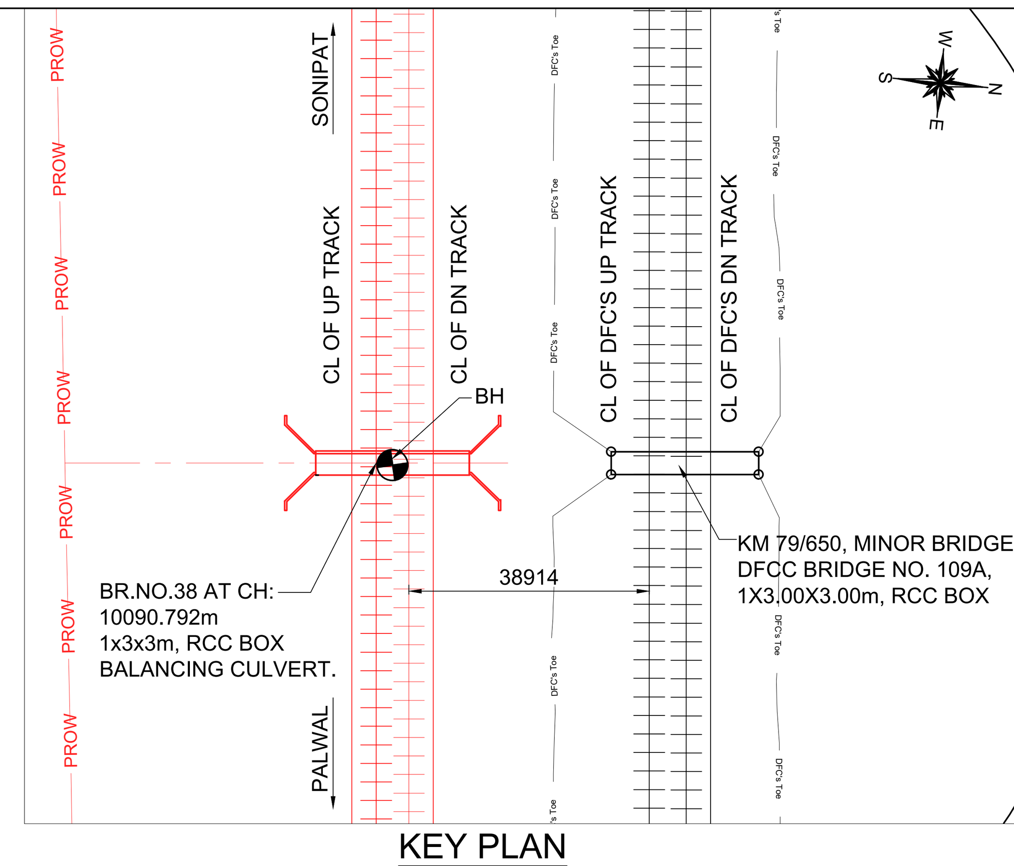
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01037_A0	1 OF 1

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



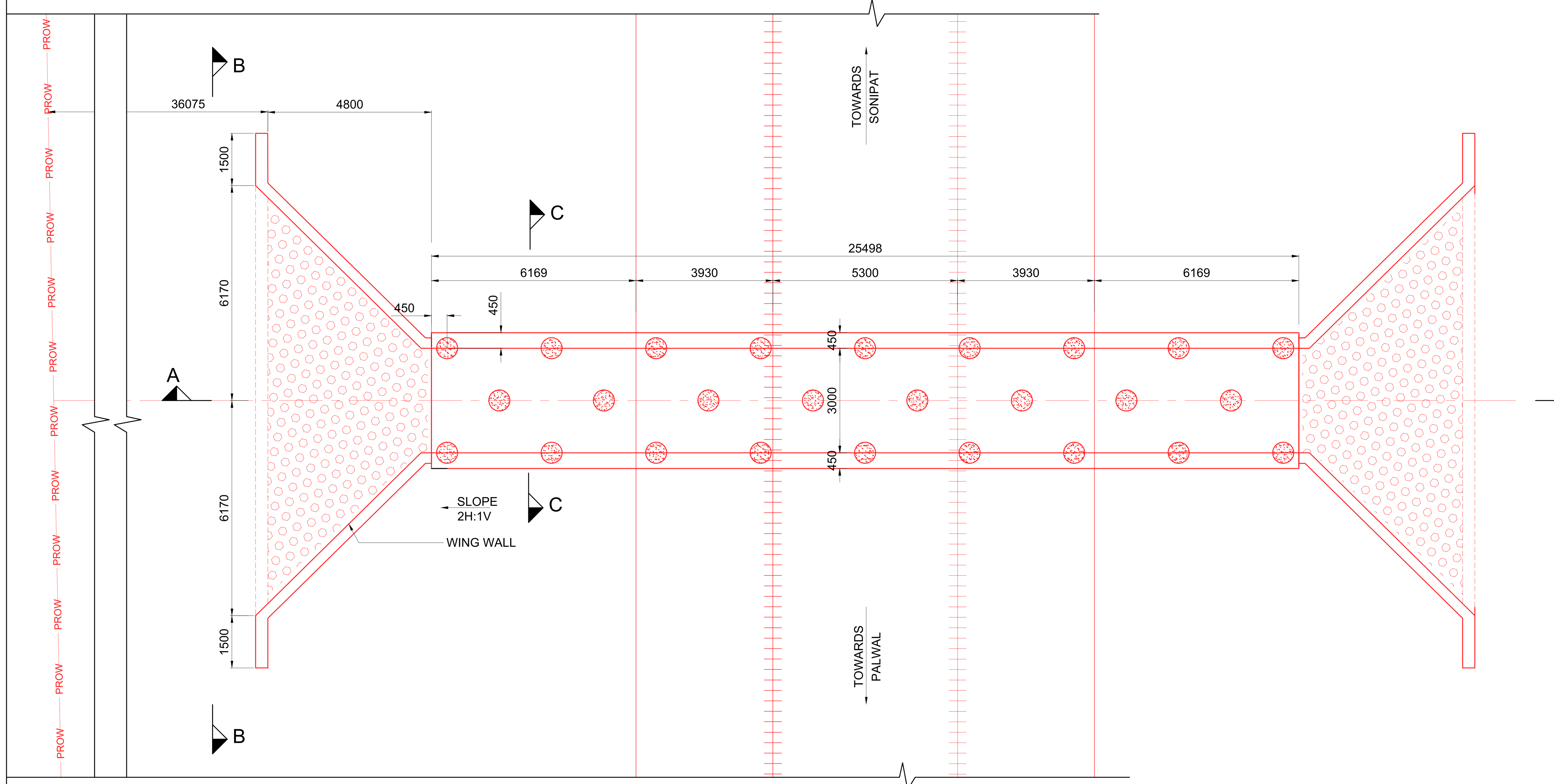
SECTIONAL ELEVATION AT A-A

SCALE 1:100



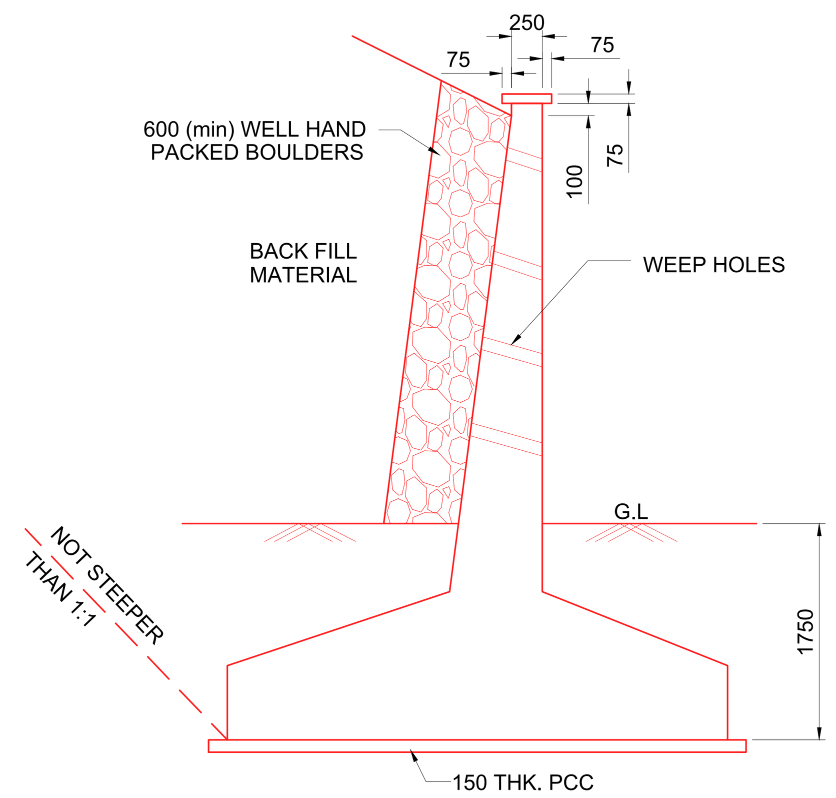
KEY PLAN

SCALE : NTS



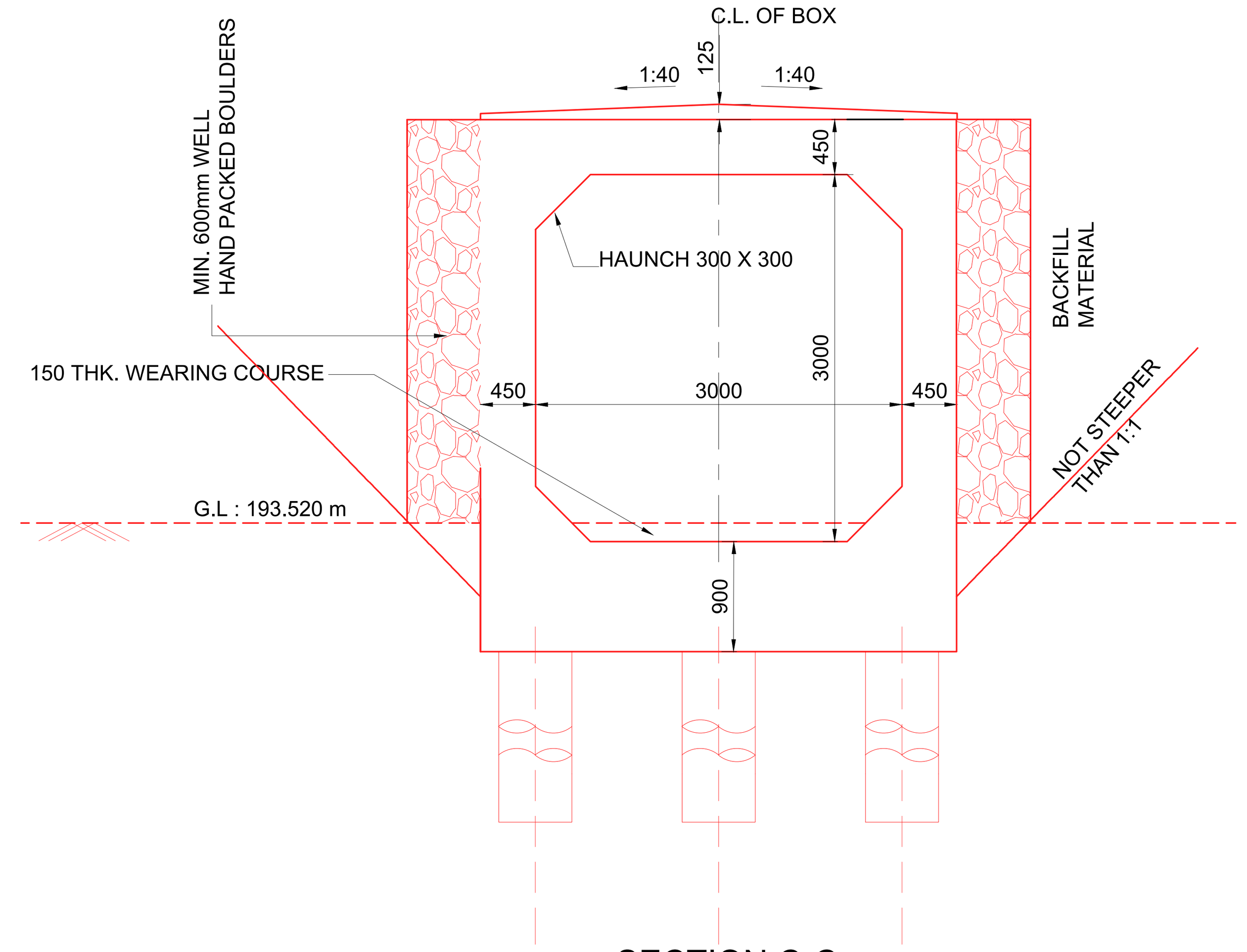
PLAN AT TOP

SCALE 1:100



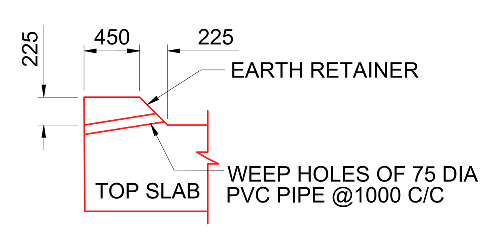
TYPICAL DETAIL OF RETURN WALL / WING WALL

SCALE 1:50



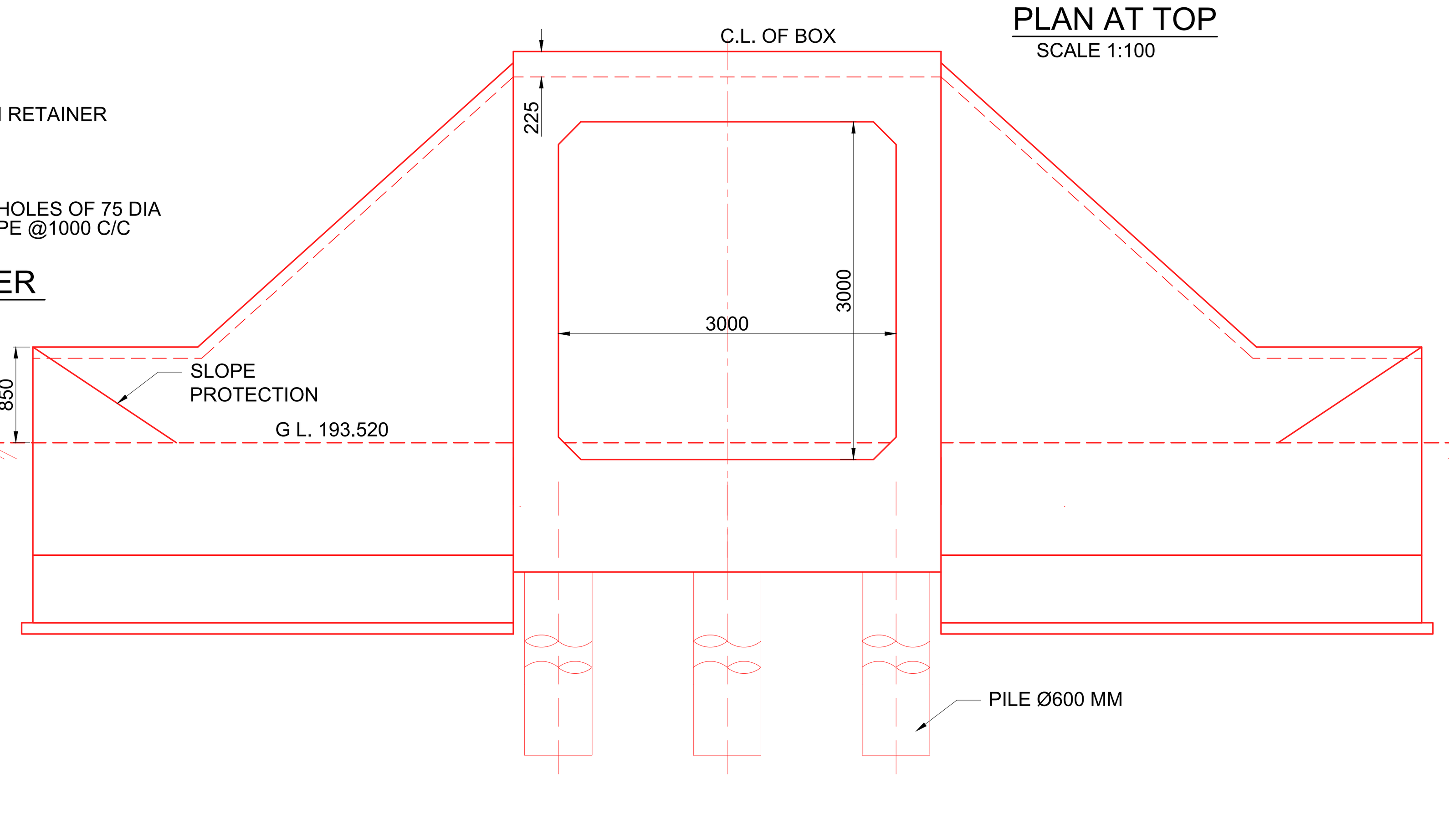
SECTION C-C

SCALE 1:100



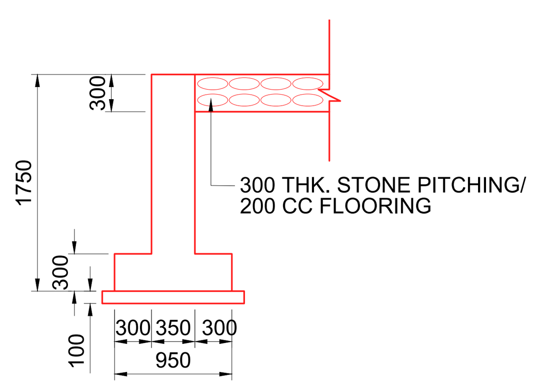
EARTH RETAINER

SCALE 1:50



VIEW AT B-B

SCALE 1:50



DROP / CURTAIN WALL DETAILS

SCALE 1:50

NOTES :

A) GENERAL NOTES

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B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
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   (i) IRS BRIDGE RULE
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C) OTHER NOTES :

1. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.

LEGEND

(red line)	PROPOSED
(black line)	EXISTING
(green dashed)	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANKI DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

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CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

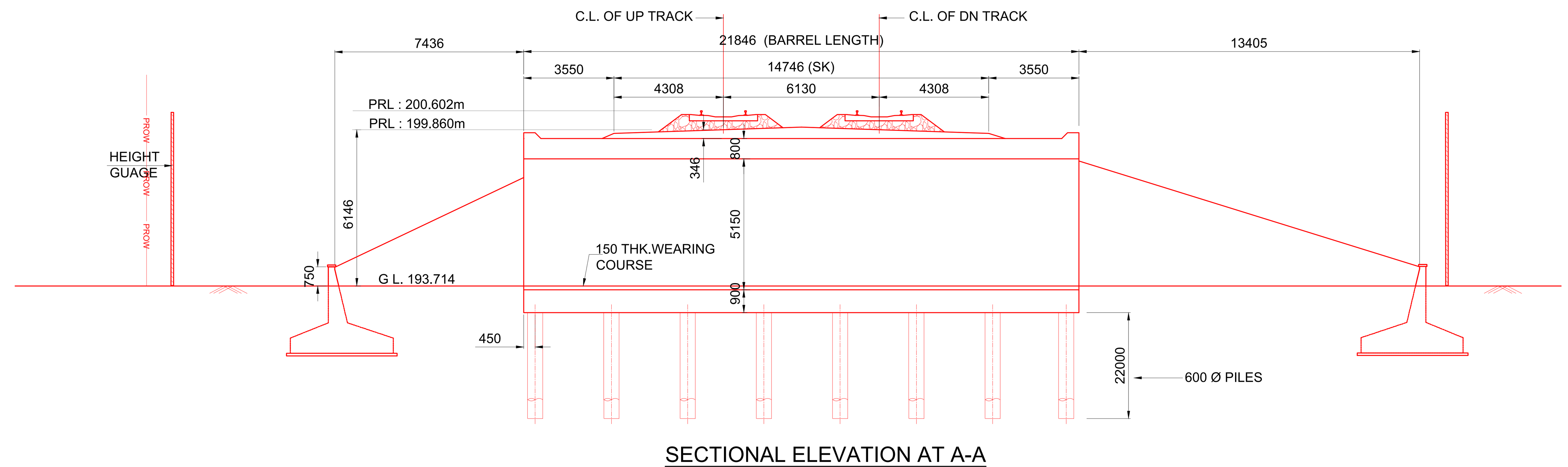
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

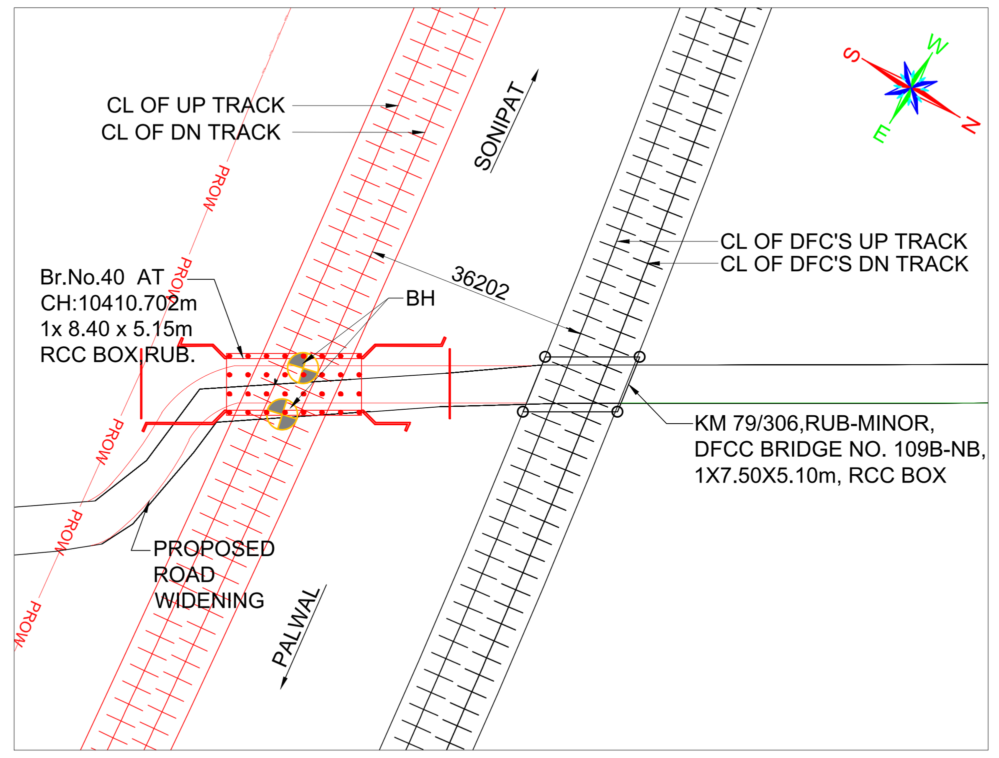
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR BALANCING CULVERT BRIDGE NO. 38 SPAN 1X3X3 RCC BOX AT CH: 10090.792

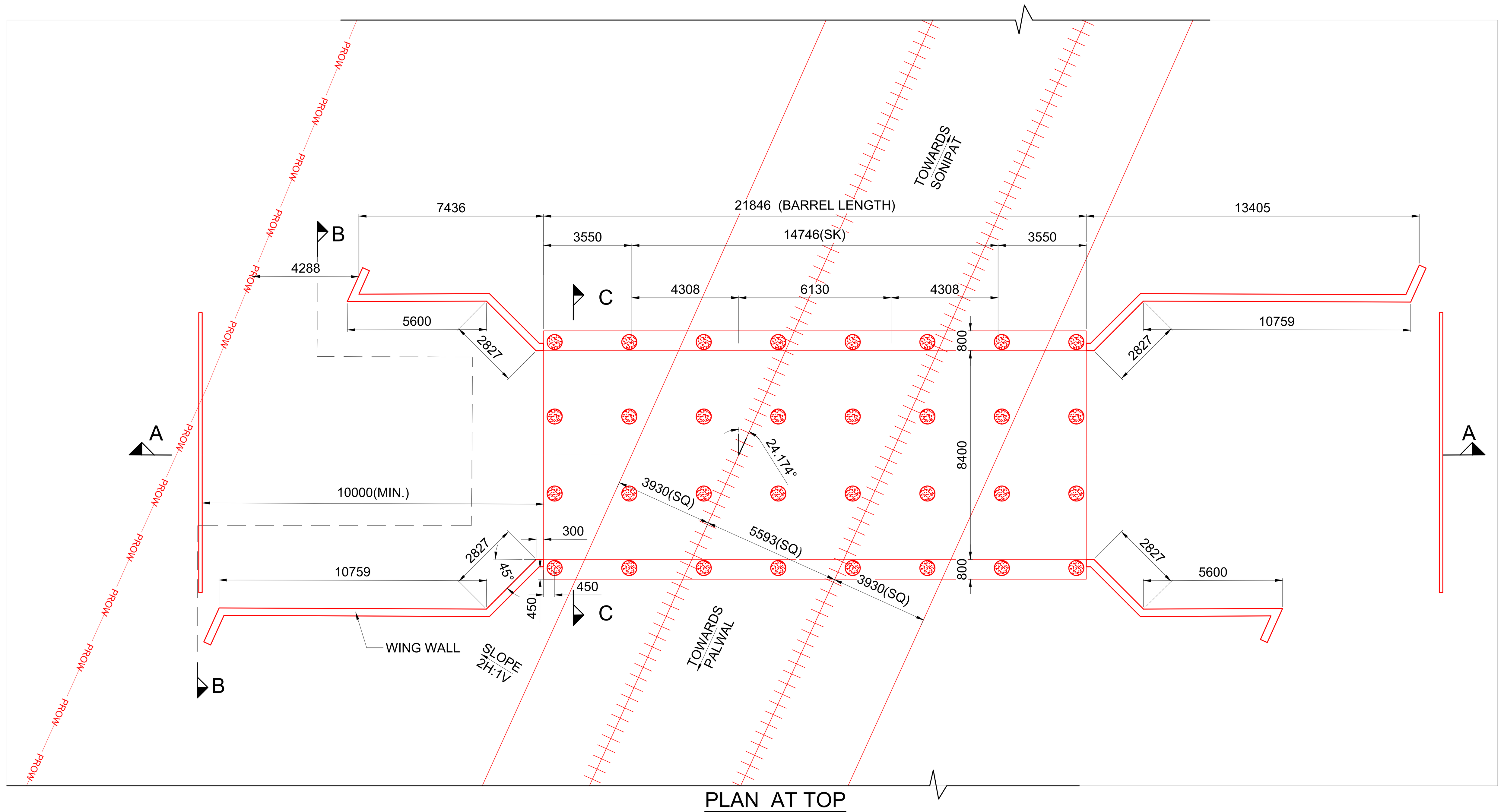
DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01038_A1		1 OF 1
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	19-12-2023



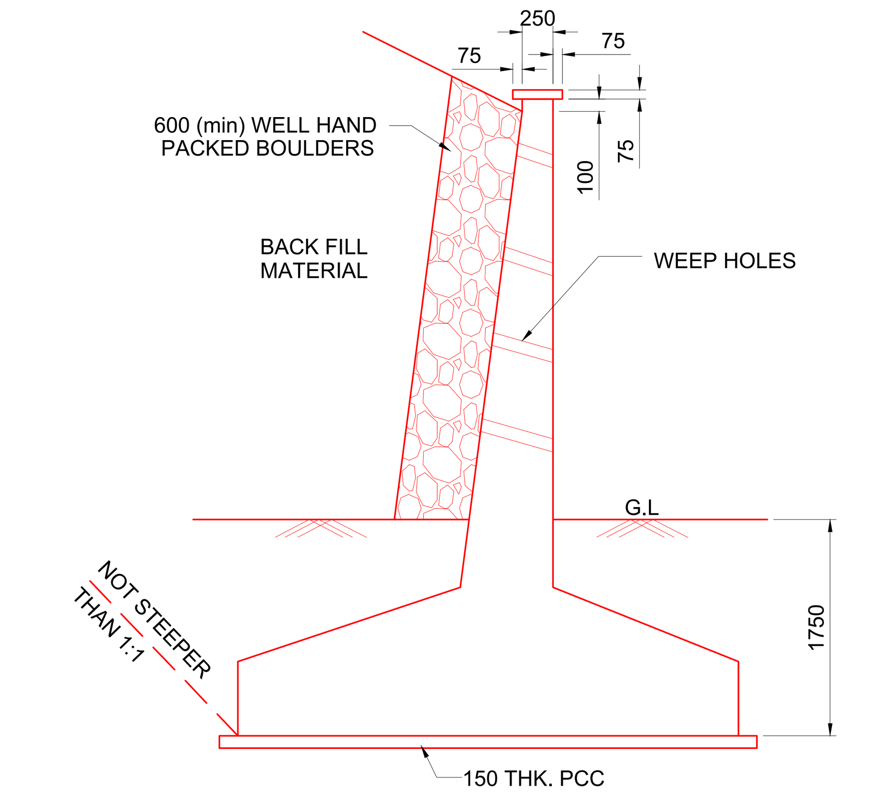
SECTIONAL ELEVATION AT A-A
SCALE 1:150



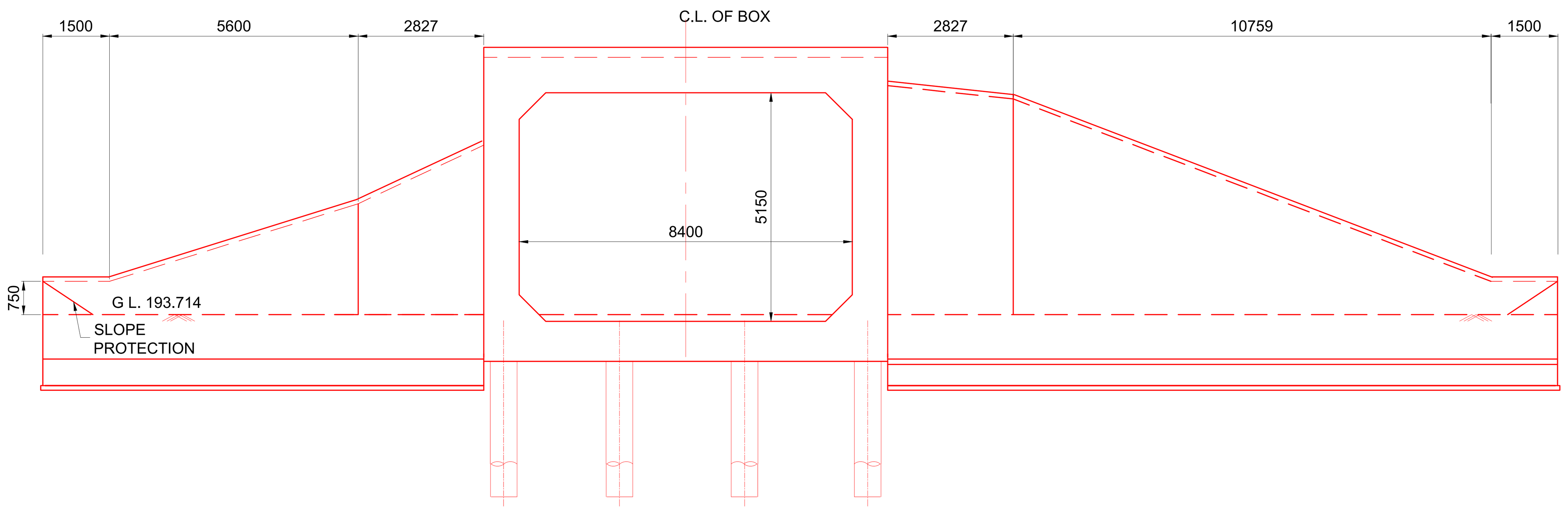
KEY PLAN
SCALE NTS



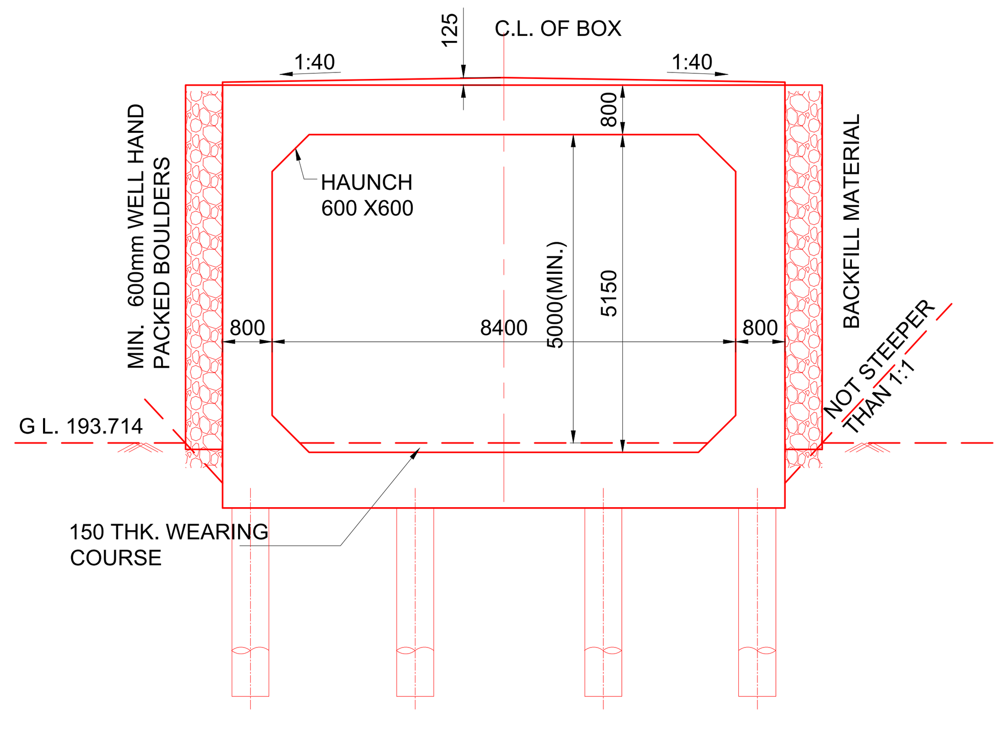
PLAN AT TOP
SCALE 1:150



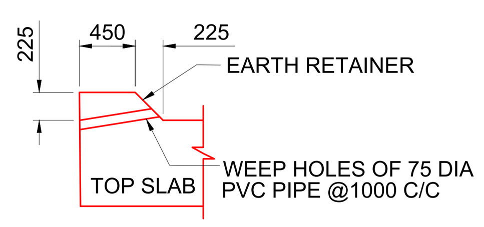
TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



VIEW AT B-B
SCALE 1:100



SECTION AT C-C
SCALE 1:100



EARTH RETAINER
SCALE 1:50

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL, BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.

IMPORTANT NOTE:
TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

LEGEND

——	PROPOSED
——	EXISTING
— — —	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

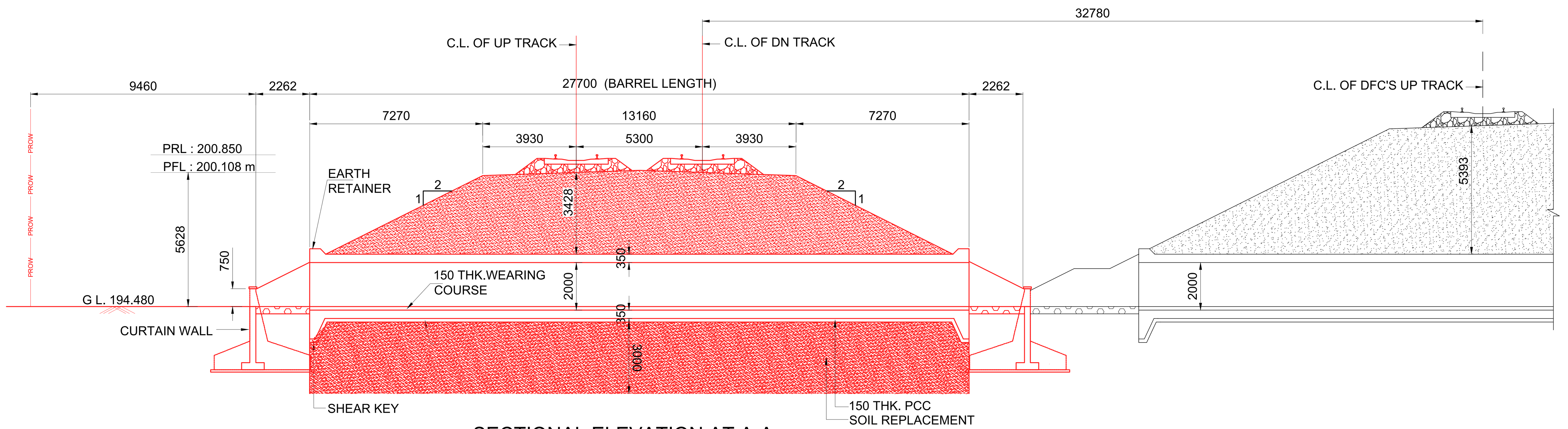
CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.
THE INFRASTRUCTURE PEOPLE
Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANKI DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

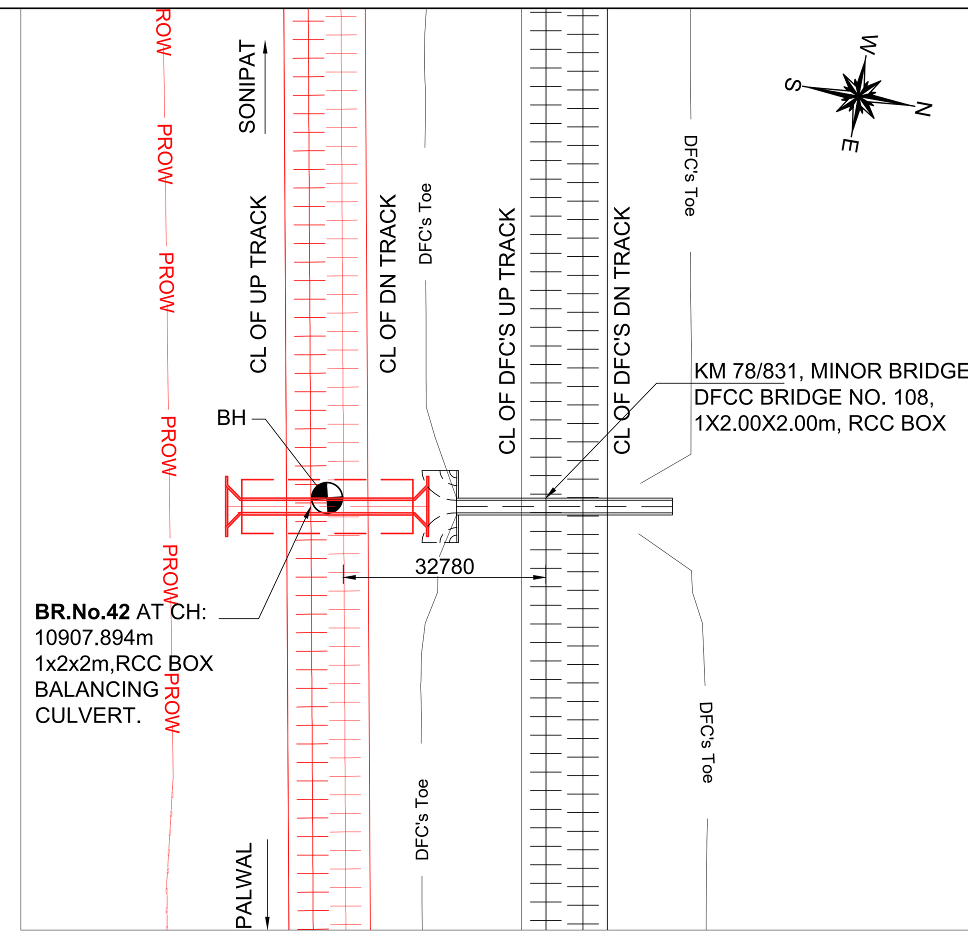
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO. 40 SPAN 1X8.40X5.15 RCC BOX AT CH: 10410.702

DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01040_A1		1 OF 1
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	19-12-2023



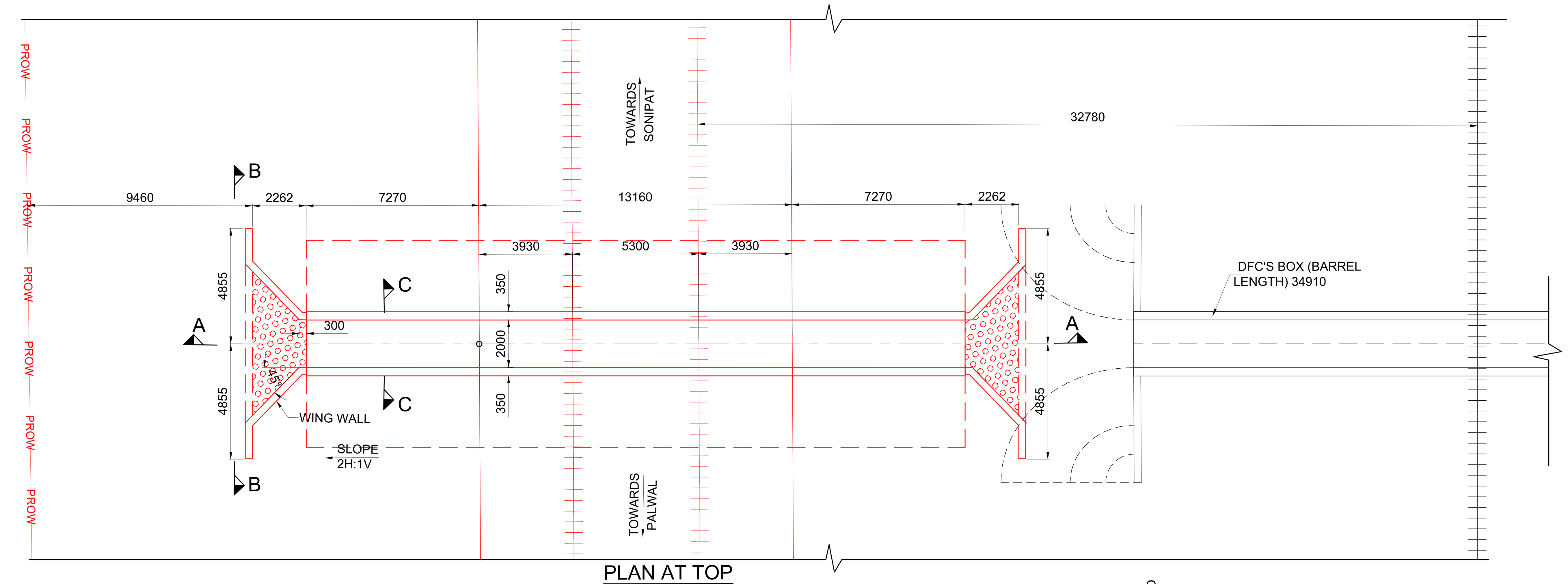
SECTIONAL ELEVATION AT A-A

SCALE 1:150



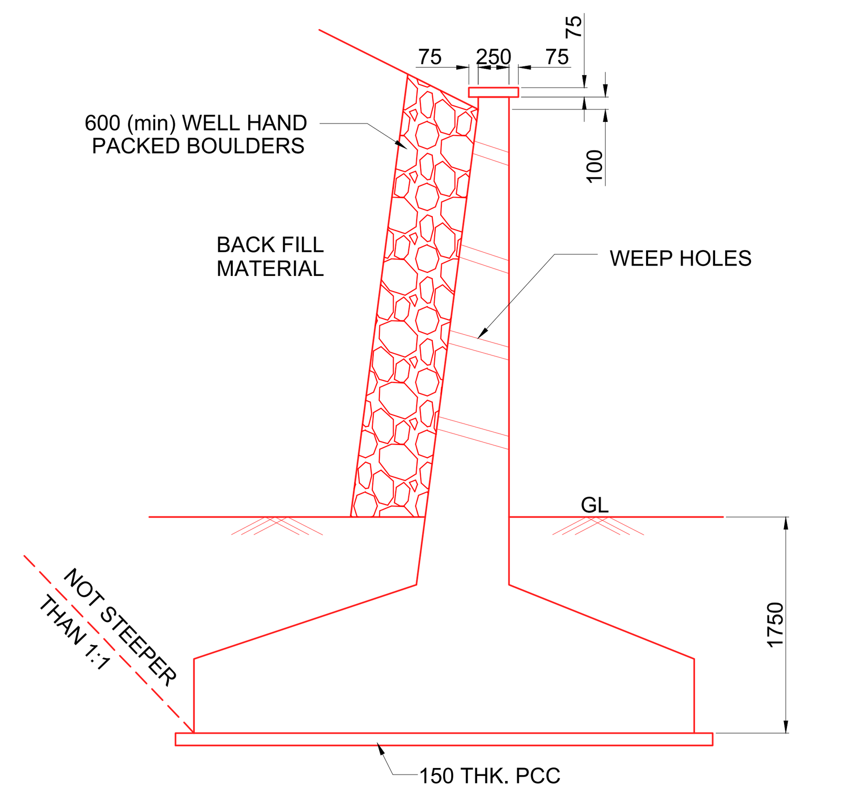
KEY PLAN

SCALE NTS



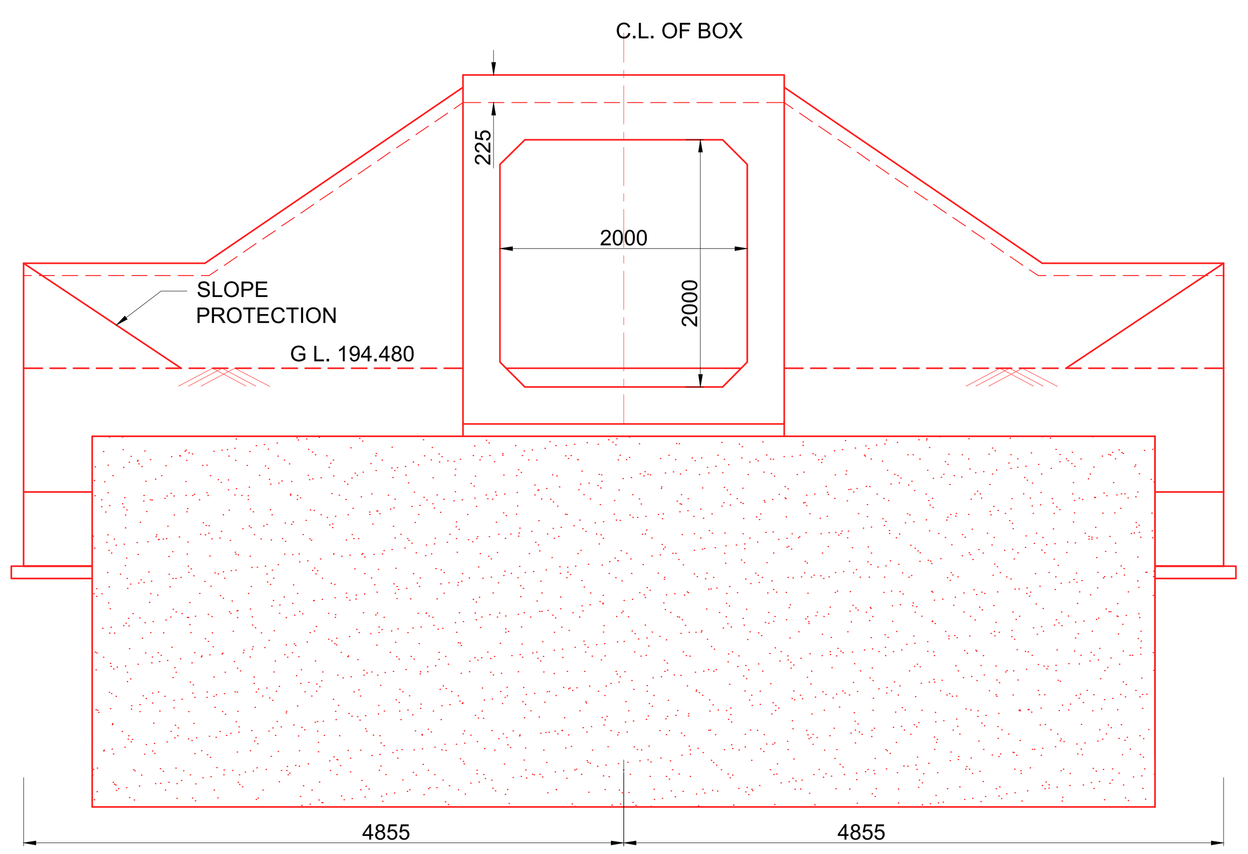
PLAN AT TOP

SCALE 1:150



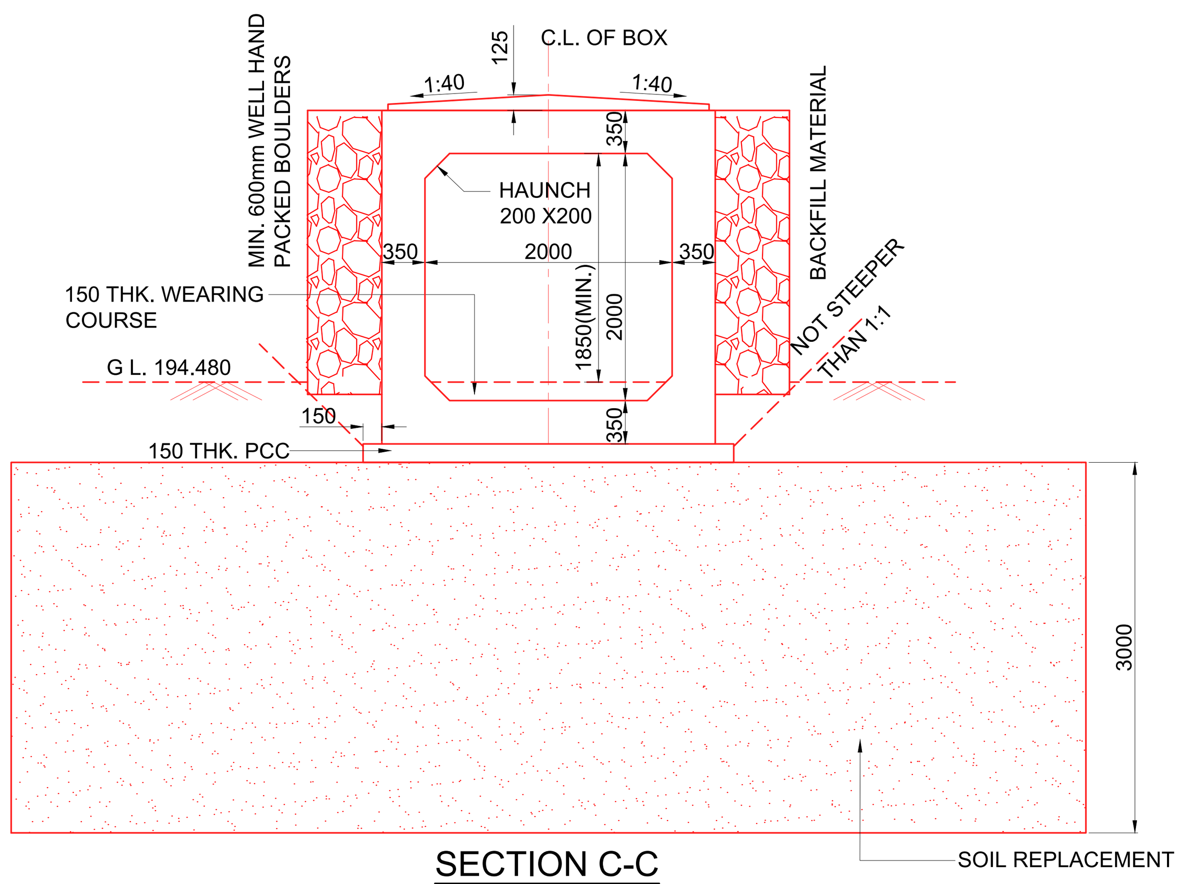
TYPICAL DETAIL OF RETURN WALL / WING WALL

SCALE 1:50



VIEW AT B-B

SCALE 1:50



SECTION C-C

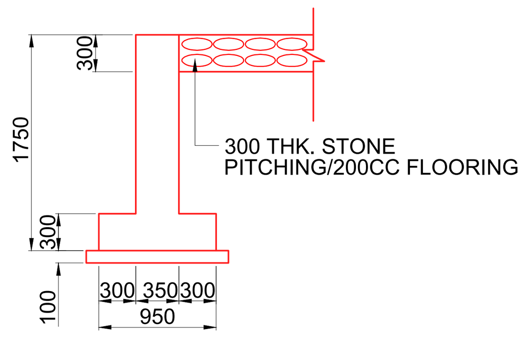
SCALE 1:50

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

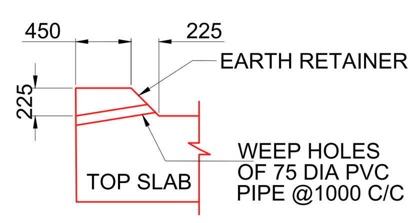
ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW



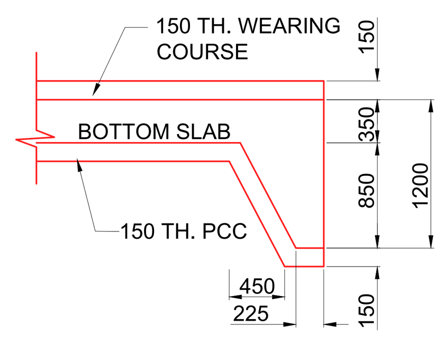
DROP / CURTAIN WALL DETAILS

SCALE 1:50



EARTH RETAINER

SCALE 1:50



SHEAR KEY

SCALE 1:50

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
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9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/ (Sig.)/ NR, DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
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12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD,

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   (ii) IRS CONCRETE BRIDGE CODE
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3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
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8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
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16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.
2. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

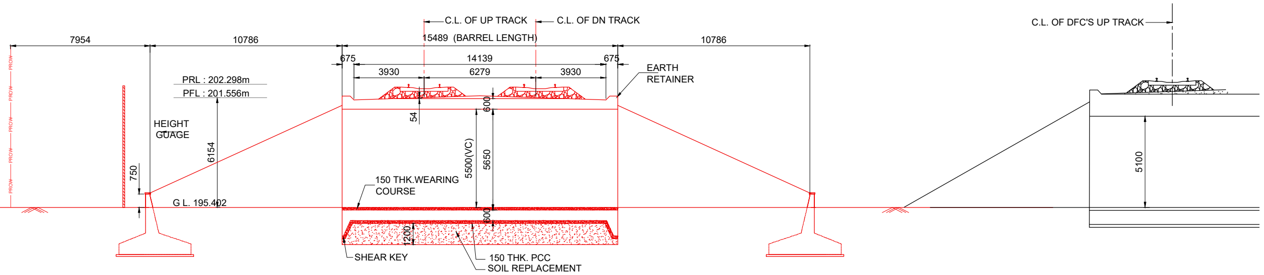
RITES THE INFRASTRUCTURE PEOPLE

SMEC Member of the Surbana Jurong Group

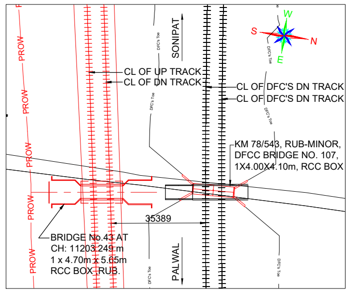
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR BALANCING CULVERT BRIDGE NO. 42 SPAN 1X2X2 RCC BOX AT CH: 10907.894

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01042_A0	1 OF 1

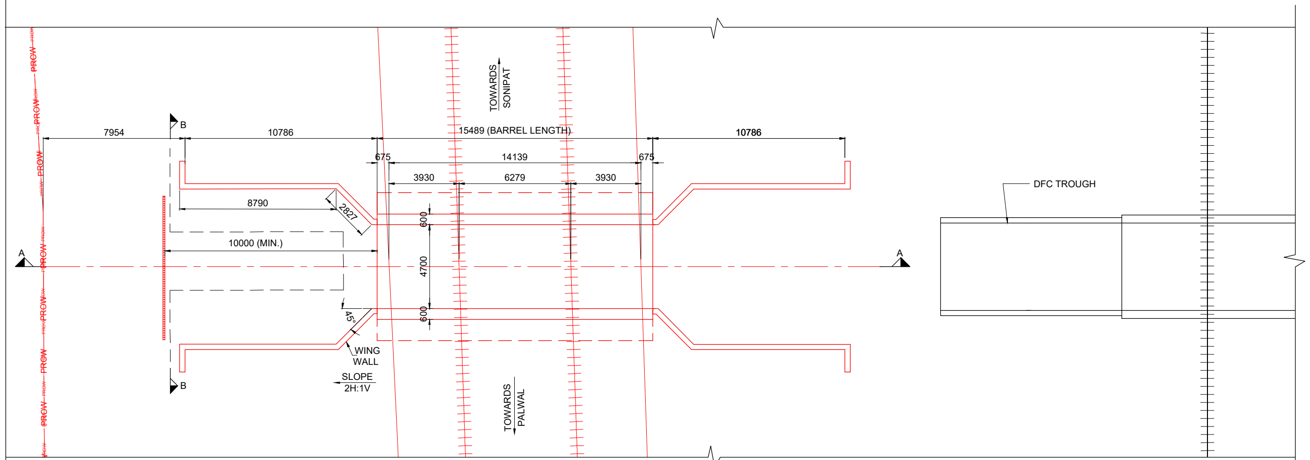
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



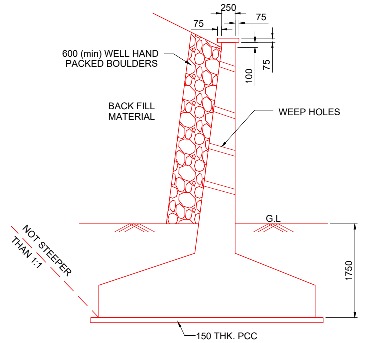
SECTIONAL ELEVATION AT A-A
SCALE 1:150



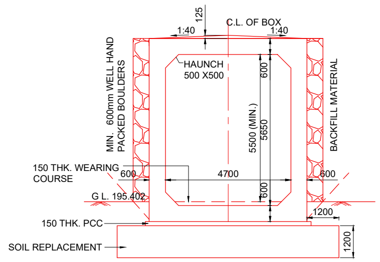
KEY PLAN
SCALE NTS



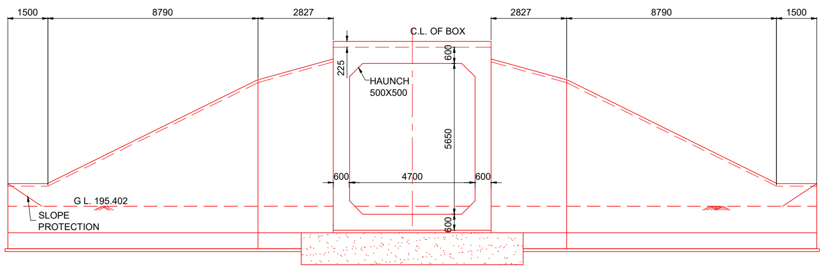
PLAN AT TOP
SCALE 1:150



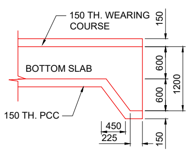
TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



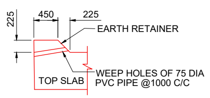
SECTION C-C
SCALE 1:50



VIEW AT B-B
SCALE 1:100



SHEAR KEY
SCALE 1:50



EARTH RETAINER
SCALE 1:50

NOTES :

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LEGEND

———	PROPOSED
———	EXISTING
— — —	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

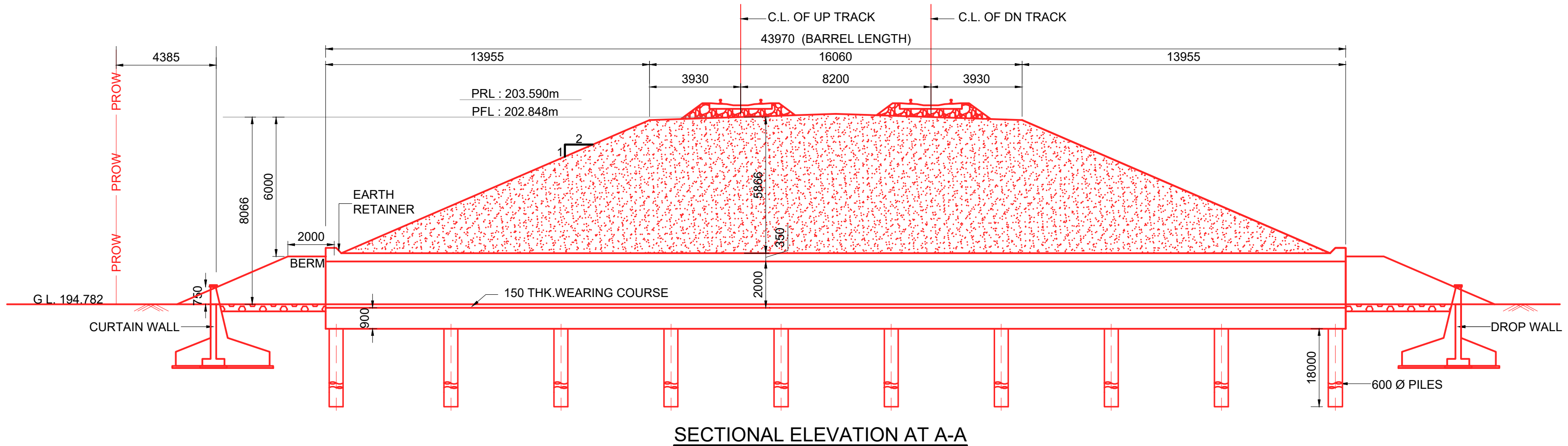
CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.
RITES THE INFRASTRUCTURE PEOPLE
SMEC

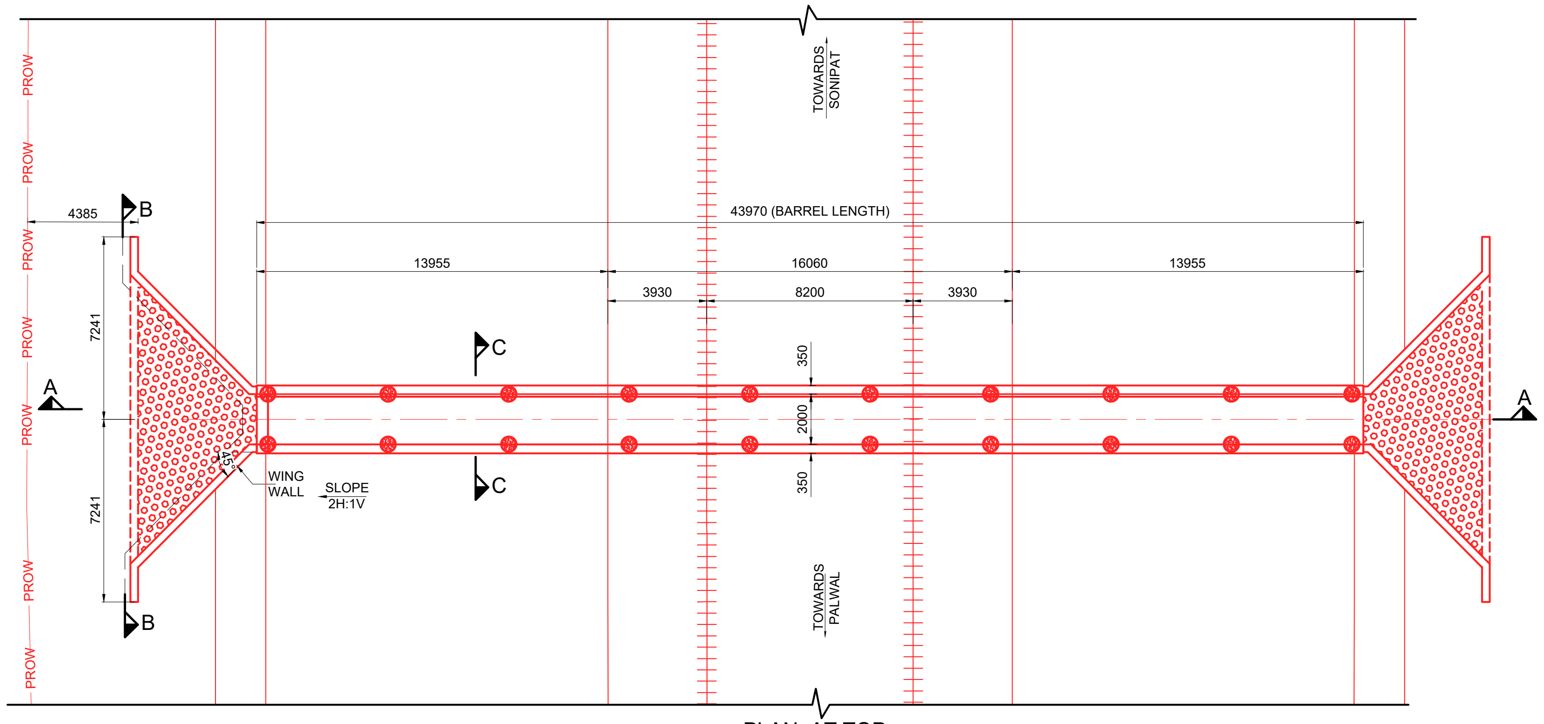
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO. 43 SPAN 1X4.70X5.65 RCC BOX AT CH: 11203.249

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01043_A0	1 OF 1

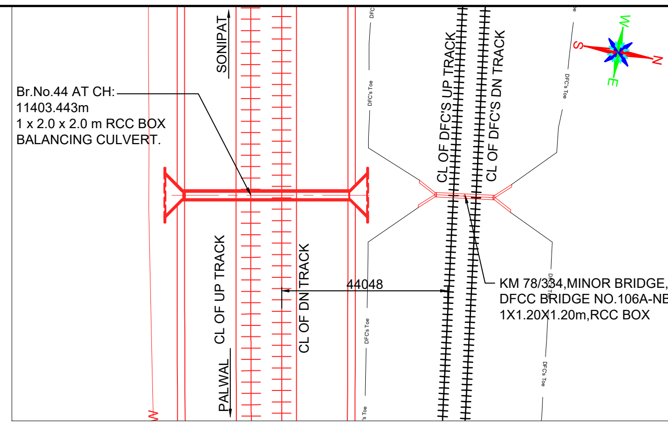
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



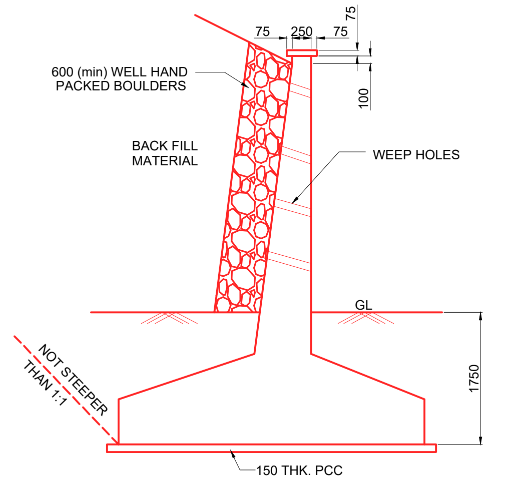
SECTIONAL ELEVATION AT A-A
SCALE 1:150



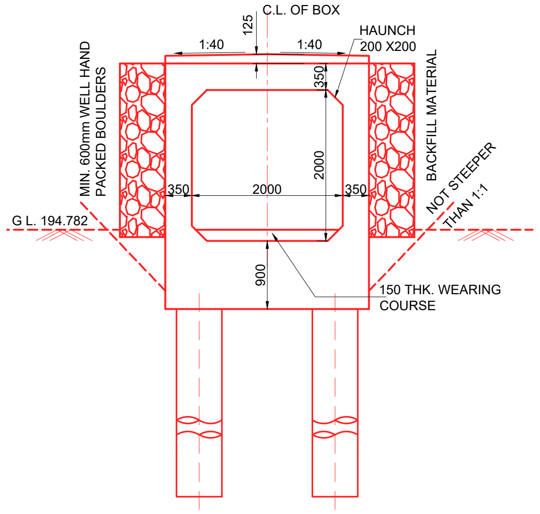
PLAN AT TOP
SCALE 1:150



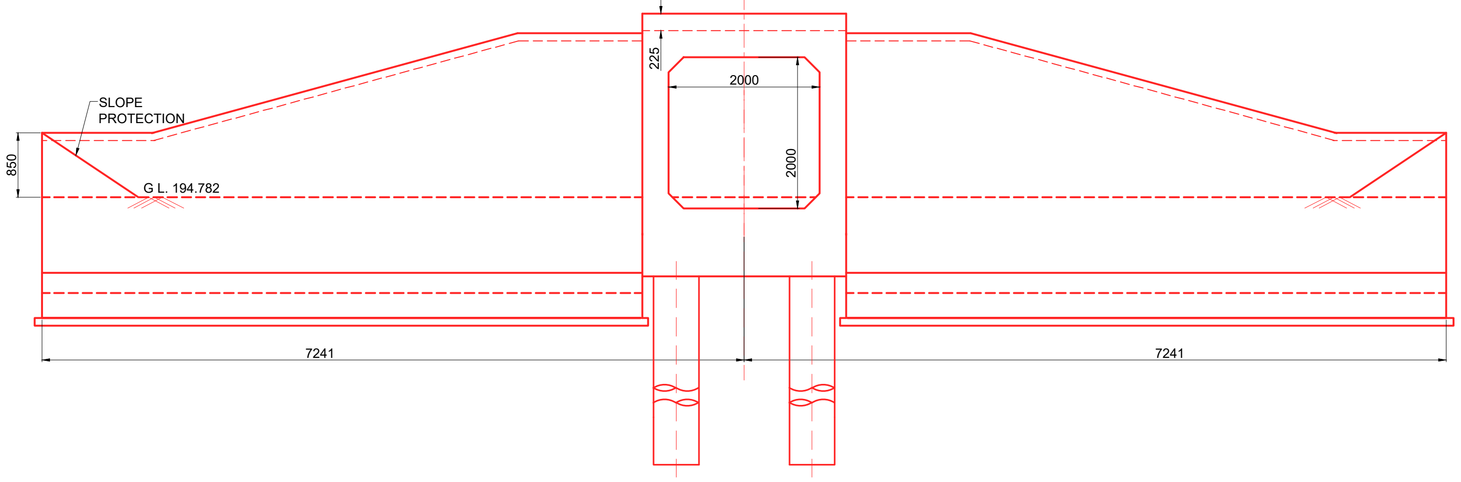
KEY PLAN
SCALE NTS



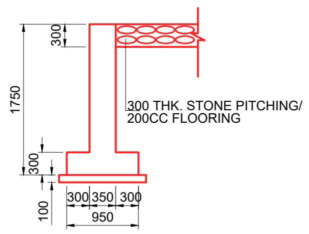
TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



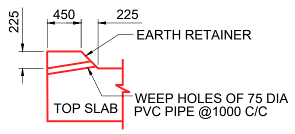
SECTION C-C
SCALE 1:50



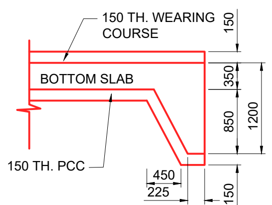
VIEW AT B-B
SCALE 1:50



DROP / CURTAIN WALL DETAILS
SCALE 1:50



EARTH RETAINER
SCALE 1:50



SHEAR KEY
SCALE 1:50

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/ (Sig.)/ NR, DFCCI ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD,

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

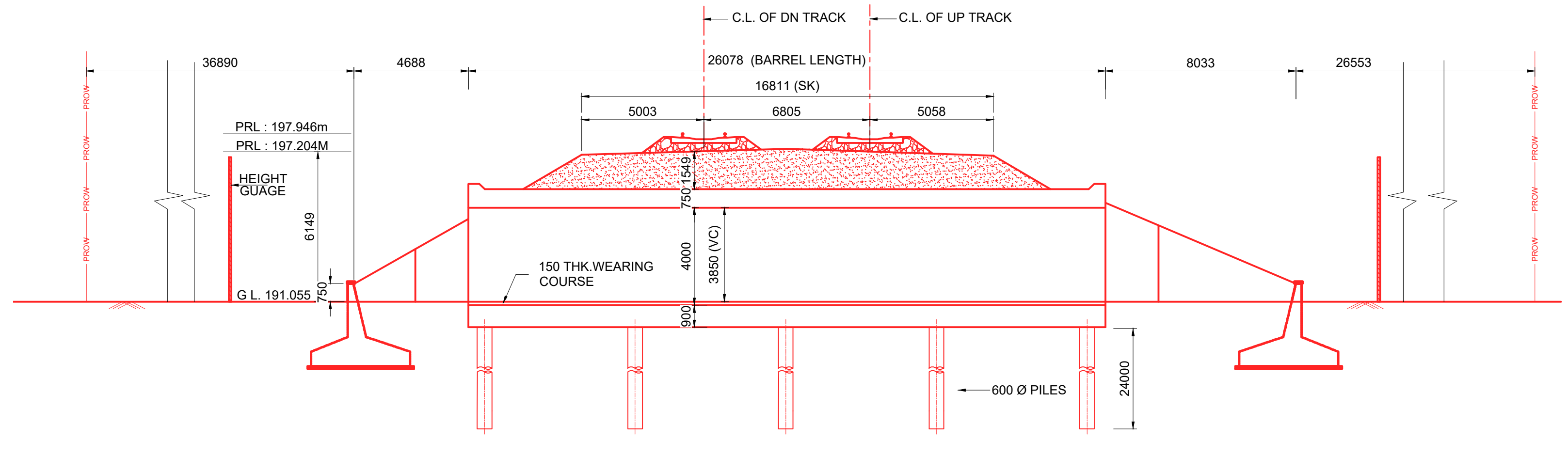
SMEC

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

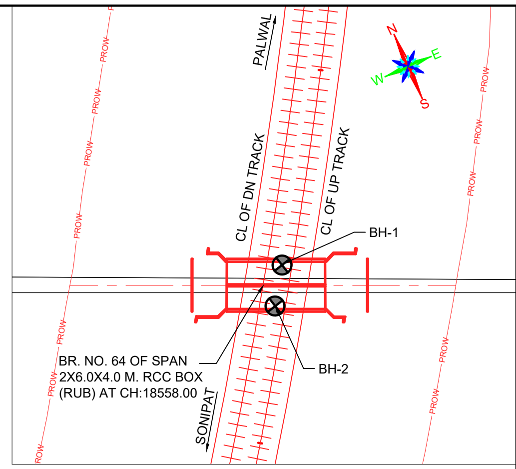
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR BALANCING CULVERT BRIDGE NO. 44 SPAN 1X2.0X2.0 RCC BOX AT CH: 11403.443

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01044_A1	1 OF 1

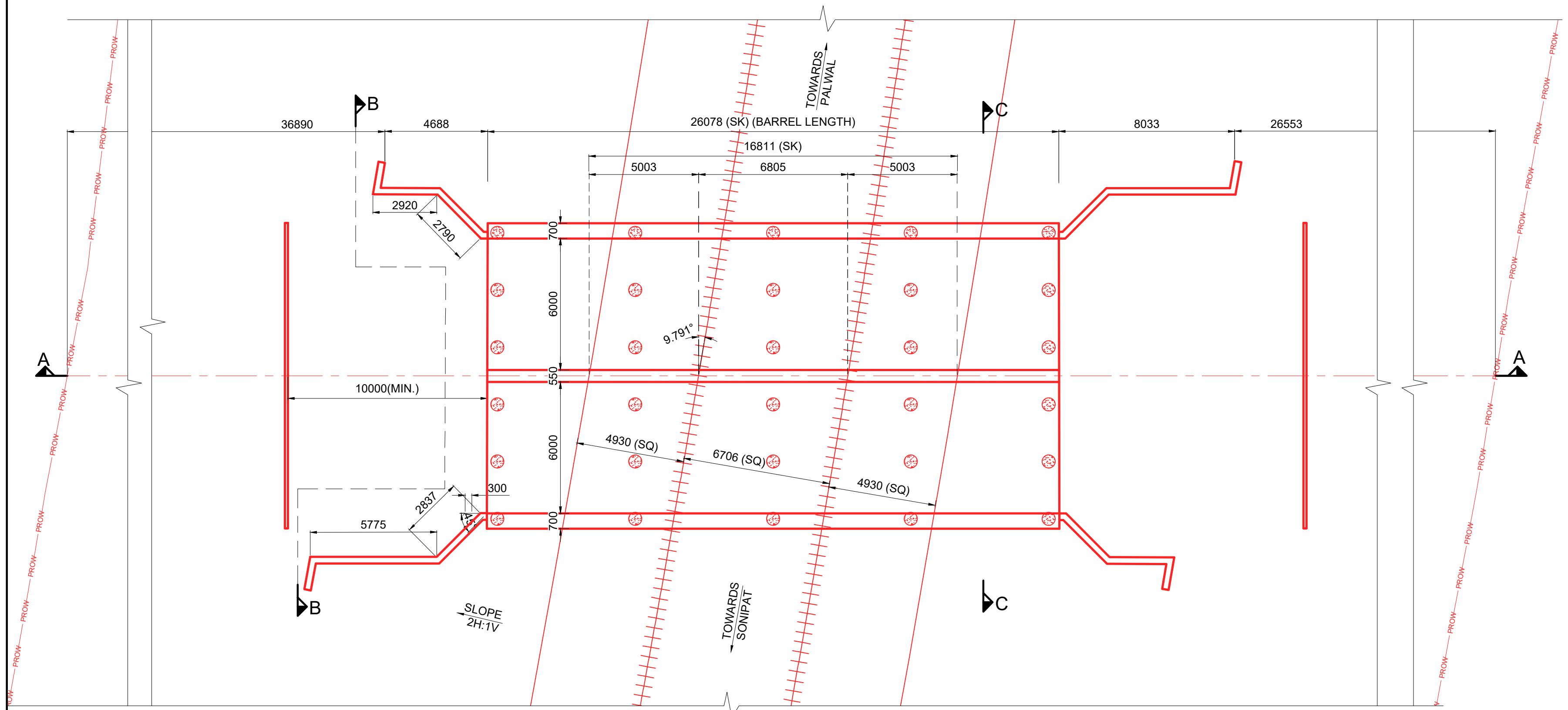
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	23-08-2023	19-12-2023



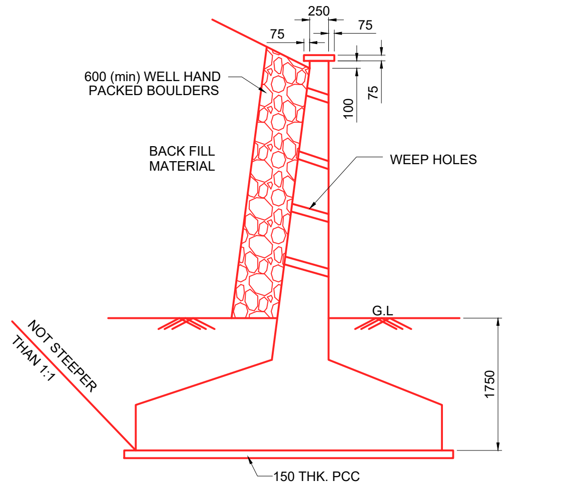
SECTIONAL ELEVATION AT A-A
SCALE 1:150



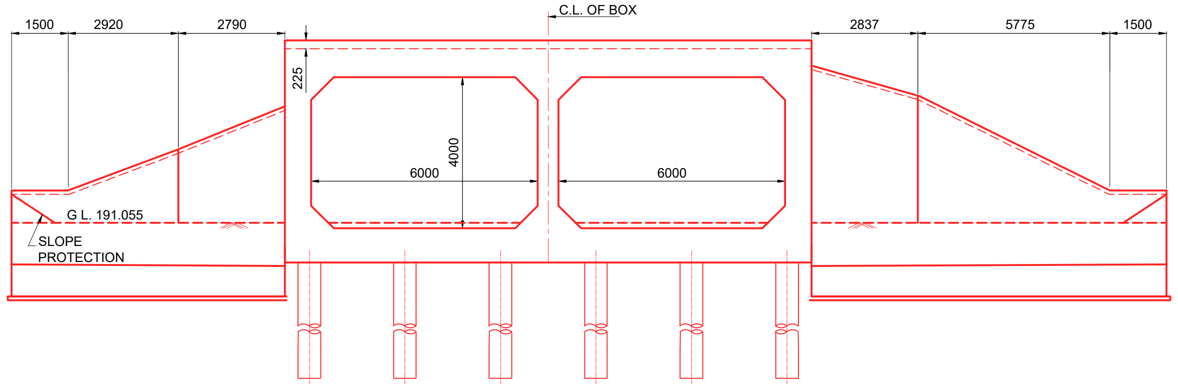
KEY PLAN
SCALE NTS



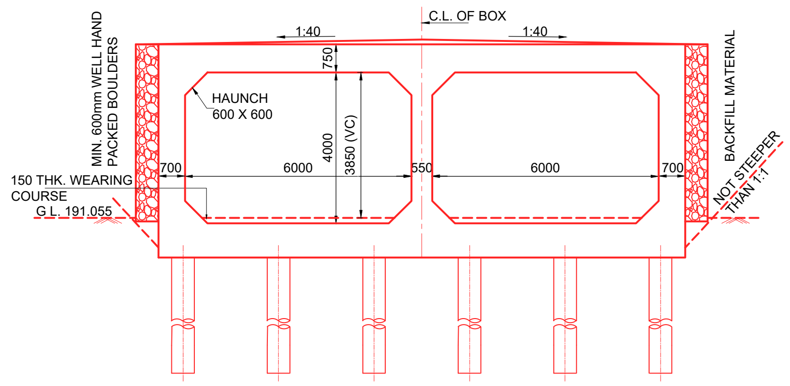
PLAN AT TOP
SCALE 1:100



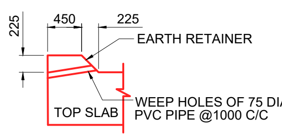
TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



VIEW B-B
SCALE 1:100



SECTION C-C
SCALE 1:100



EARTH RETAINER
SCALE 1:50

LEGEND

(red line)	PROPOSED
(black line)	EXISTING

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
VC	VERTICAL CLEARANCE
PROW	PROPOSED HORC'S ROW

NOTES :

A) GENERAL NOTES

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B) TECHNICAL NOTES :

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12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
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16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.

IMPORTANT NOTE:

TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

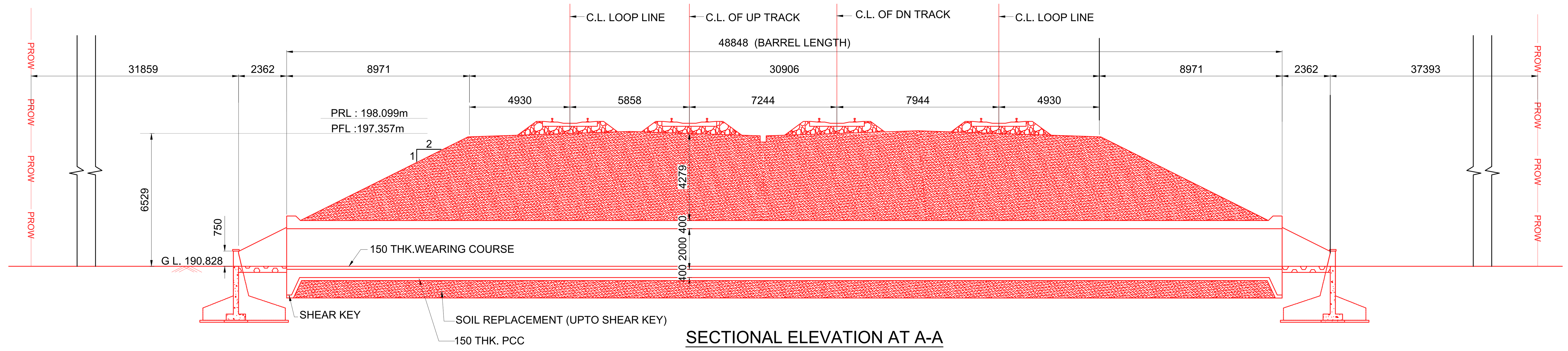
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.
RITES THE INFRASTRUCTURE PEOPLE
SMEC

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	(signature)
SUDHIR AGRAWAL DPD/CIVIL	(signature)	RAJU SOLANK DGM/CIVIL	(signature)
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	(signature)
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO. 64 SPAN 2X6.0X4.0 RCC BOX AT CH: 18558.00

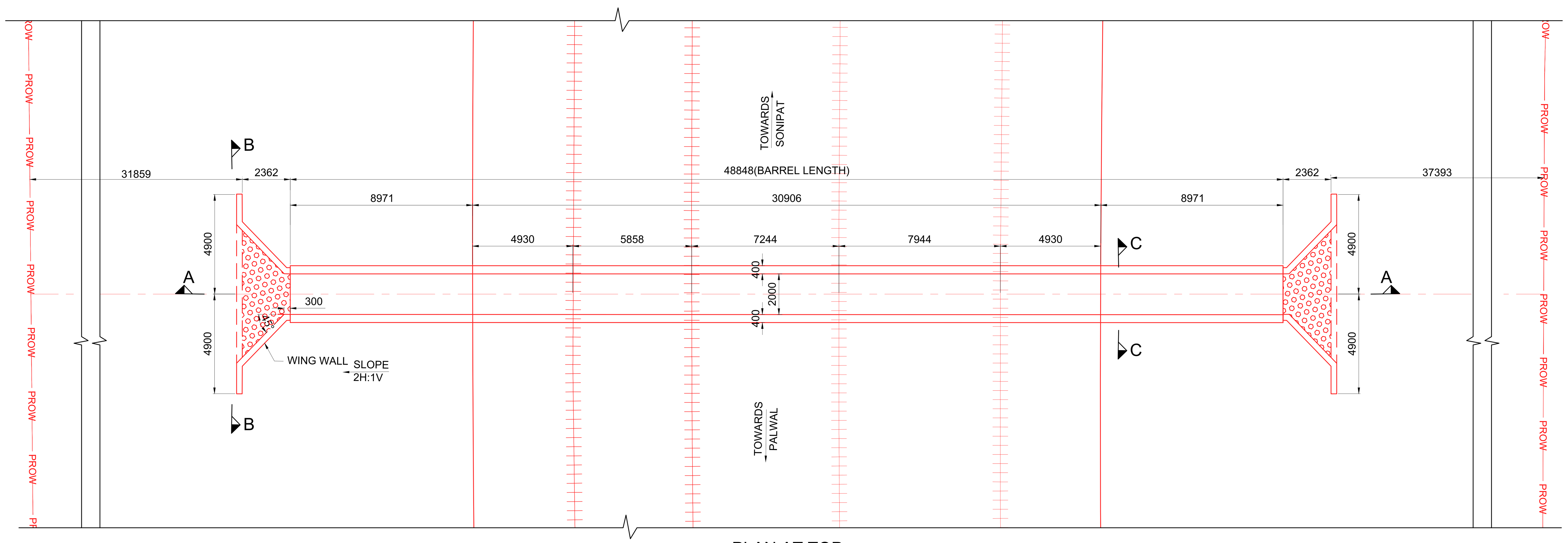
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01064_A1	1 OF 1

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	23-08-2023	19-12-2023



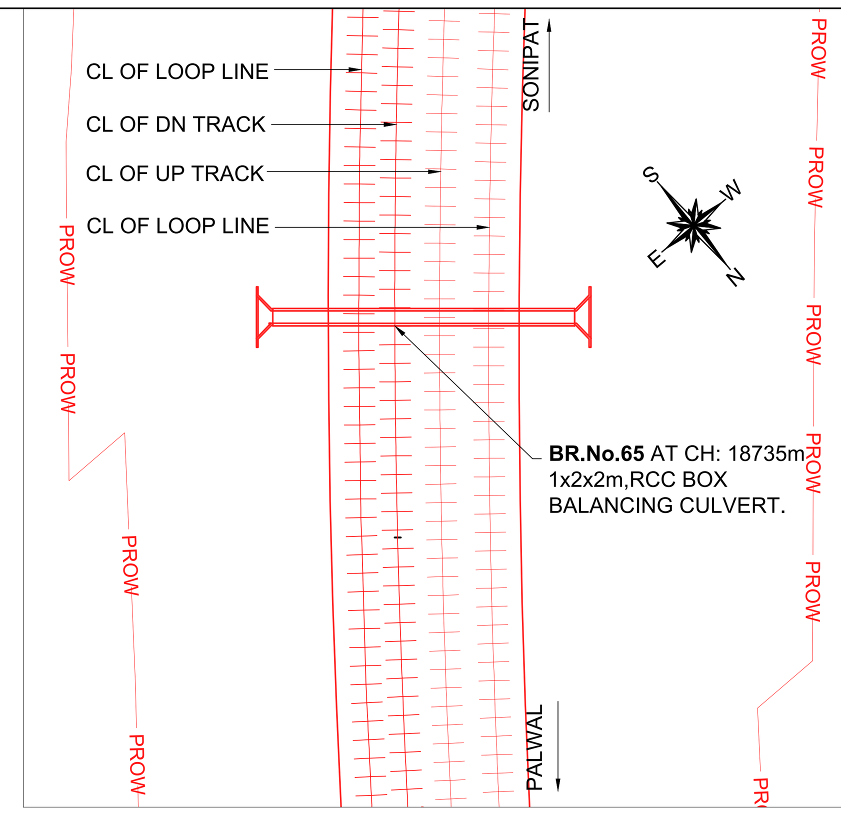
SECTIONAL ELEVATION AT A-A

SCALE 1:150



PLAN AT TOP

SCALE 1:150



KEY PLAN

SCALE NTS

NOTES :

A) GENERAL NOTES

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4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
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11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE.
   GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
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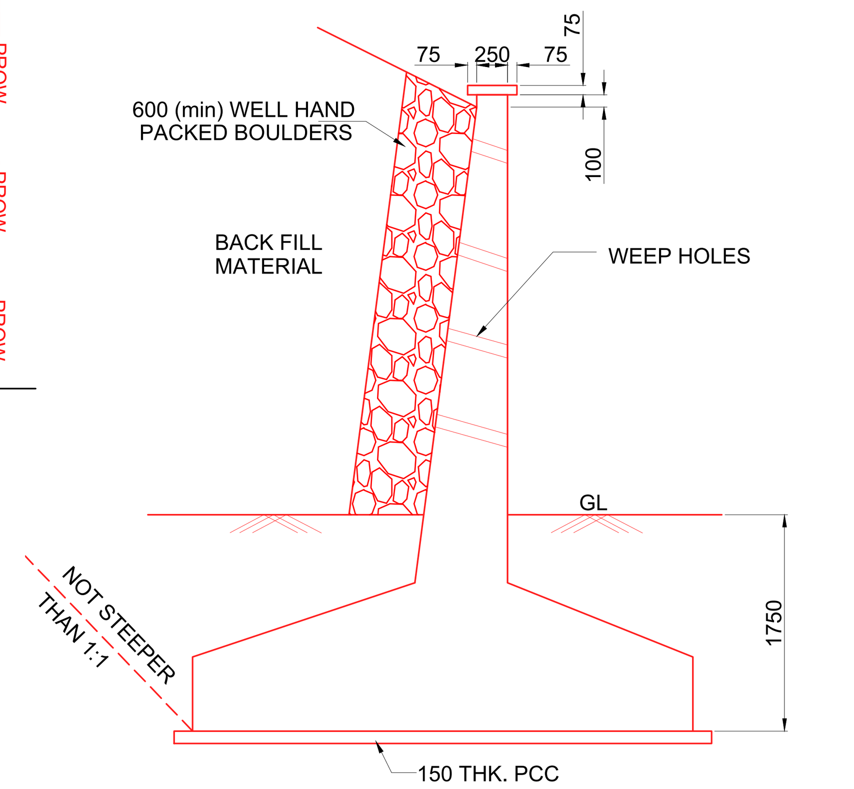
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

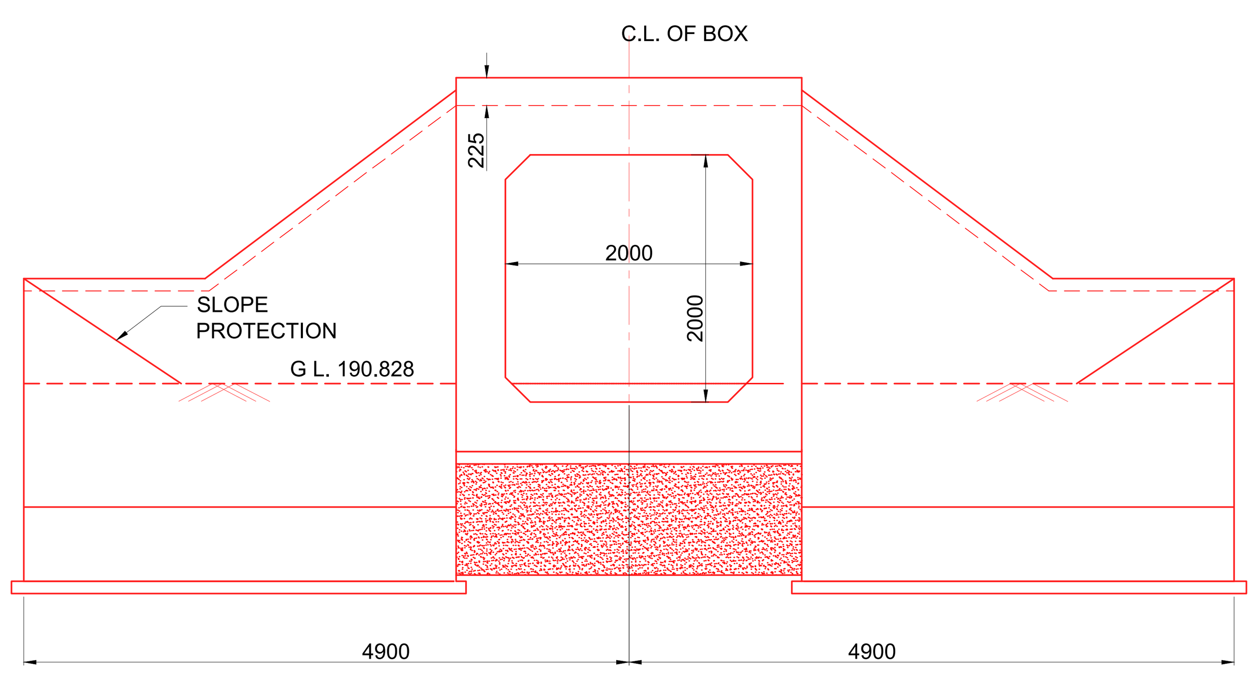
C) OTHER NOTES :

1. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.
2. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.



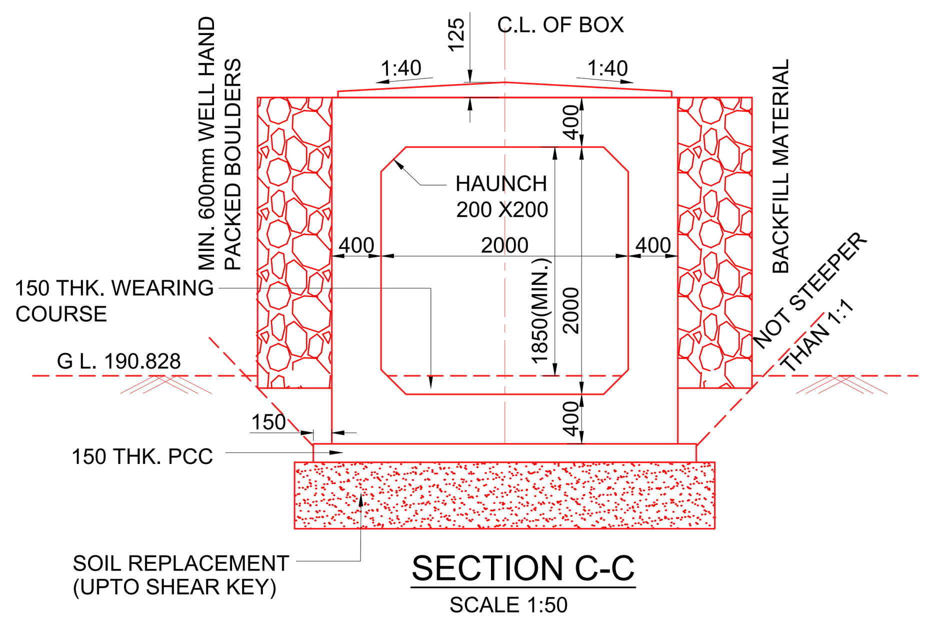
TYPICAL DETAIL OF RETURN WALL / WING WALL

SCALE 1:50



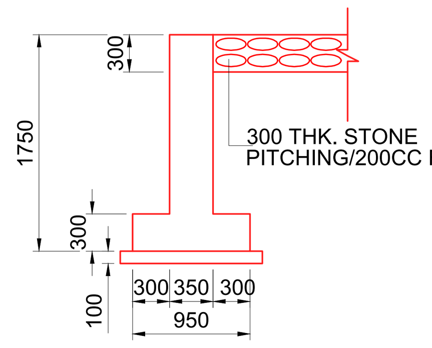
VIEW AT B-B

SCALE 1:50



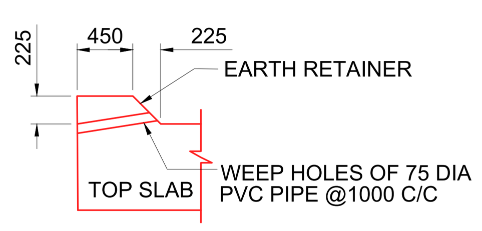
SECTION C-C

SCALE 1:50



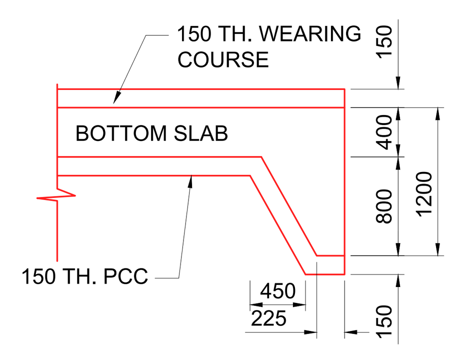
DROP / CURTAIN WALL DETAILS

SCALE 1:50



EARTH RETAINER

SCALE 1:50



SHEAR KEY

SCALE 1:50

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
VC	VERTICAL CLEARANCE
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

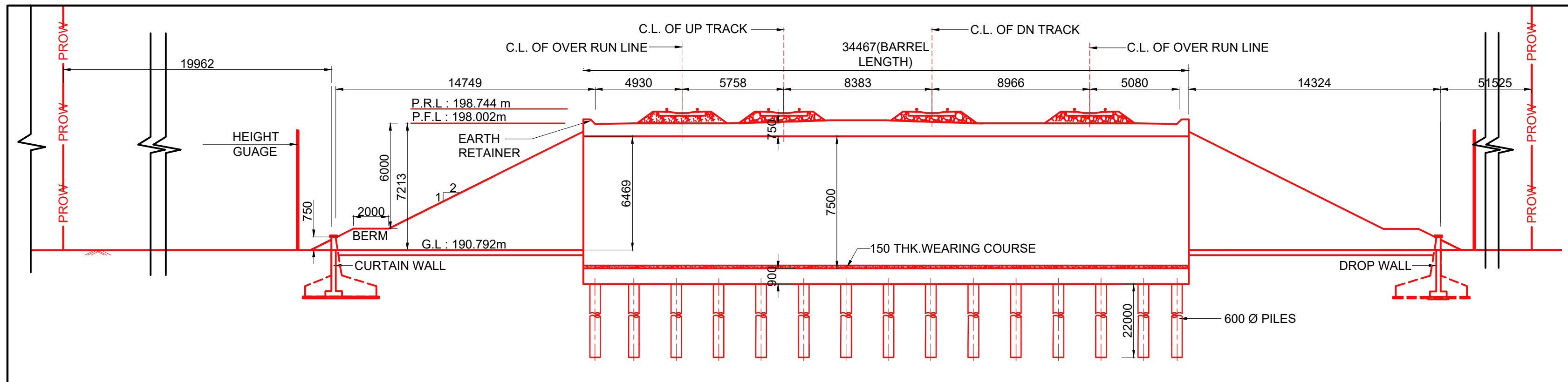
CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

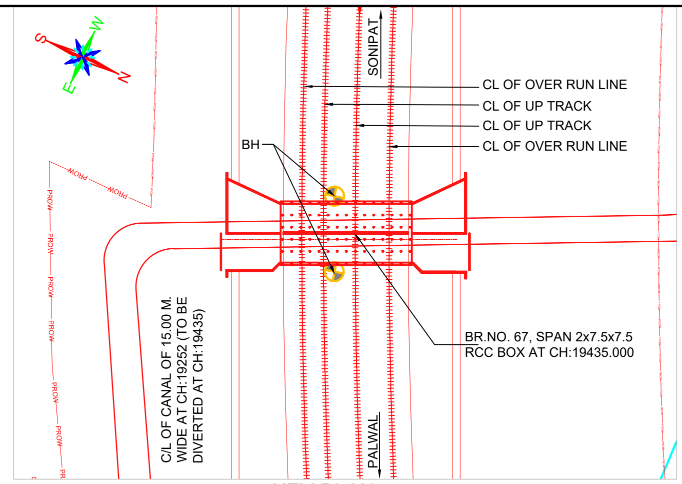
RITES Limited in consortium with SMEC International Pty. Ltd.

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR BALANCING CULVERT BRIDGE NO. 65 SPAN 1X2X2 RCC BOX AT CH: 18735.000

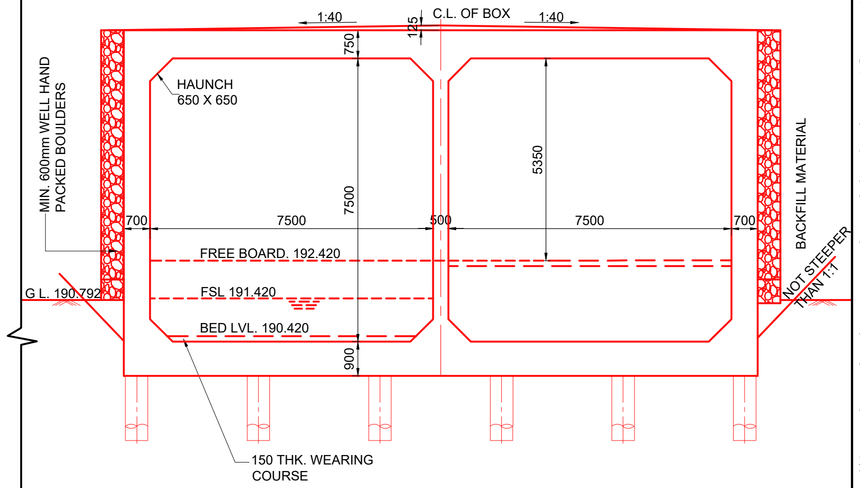
DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01065_A0		1 OF 1
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



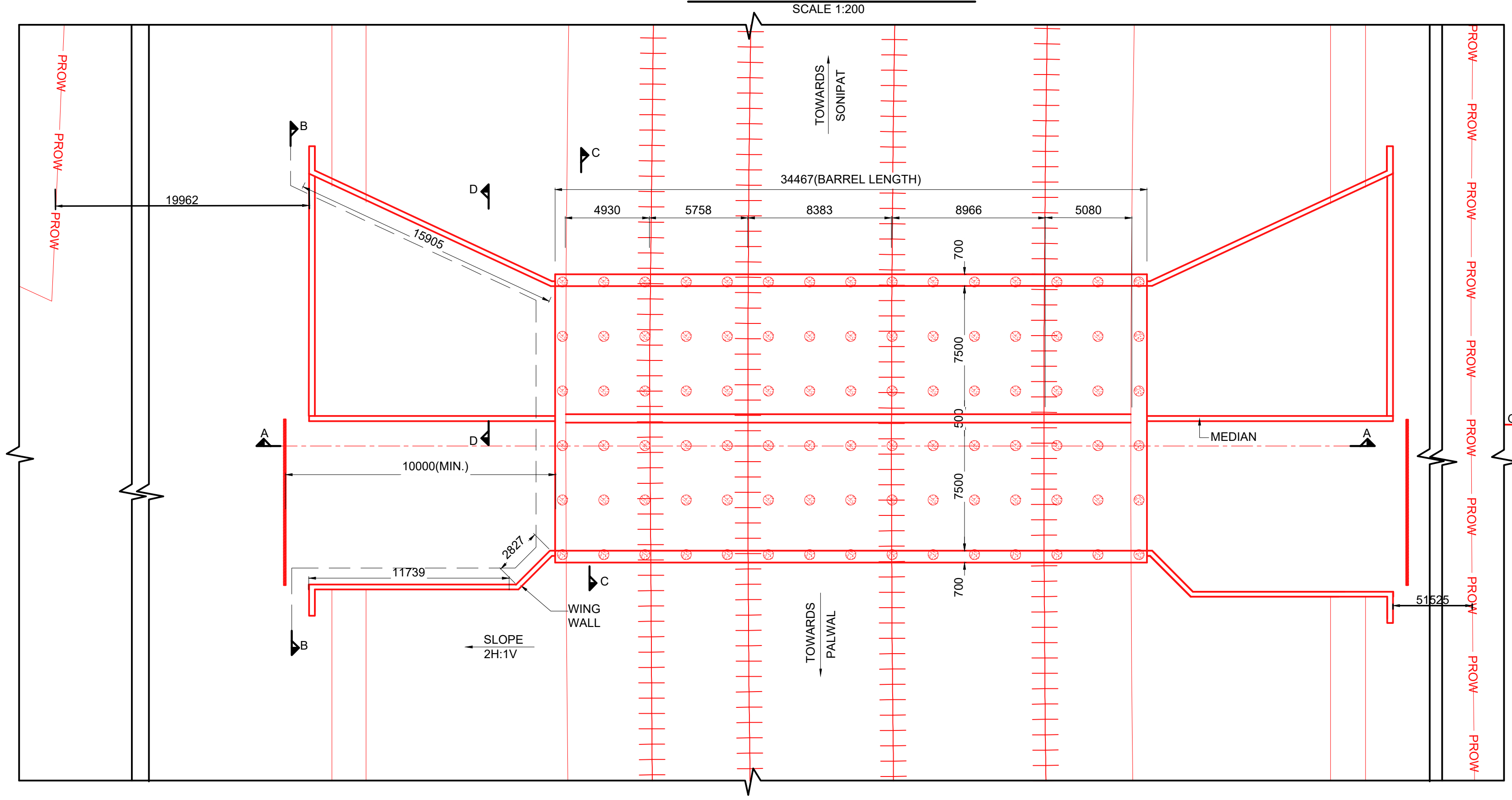
SECTIONAL ELEVATION AT A-A
SCALE 1:200



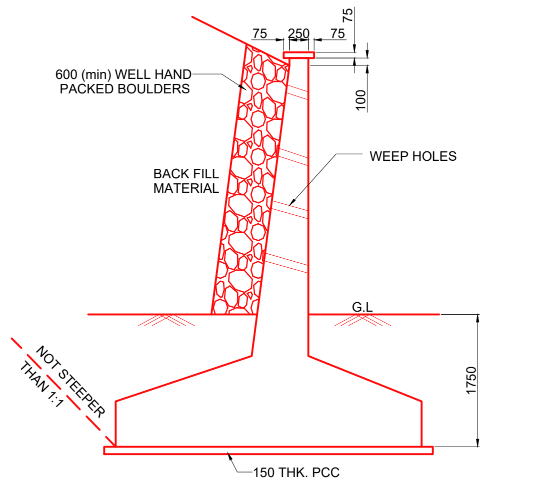
KEY PLAN
SCALE : NTS



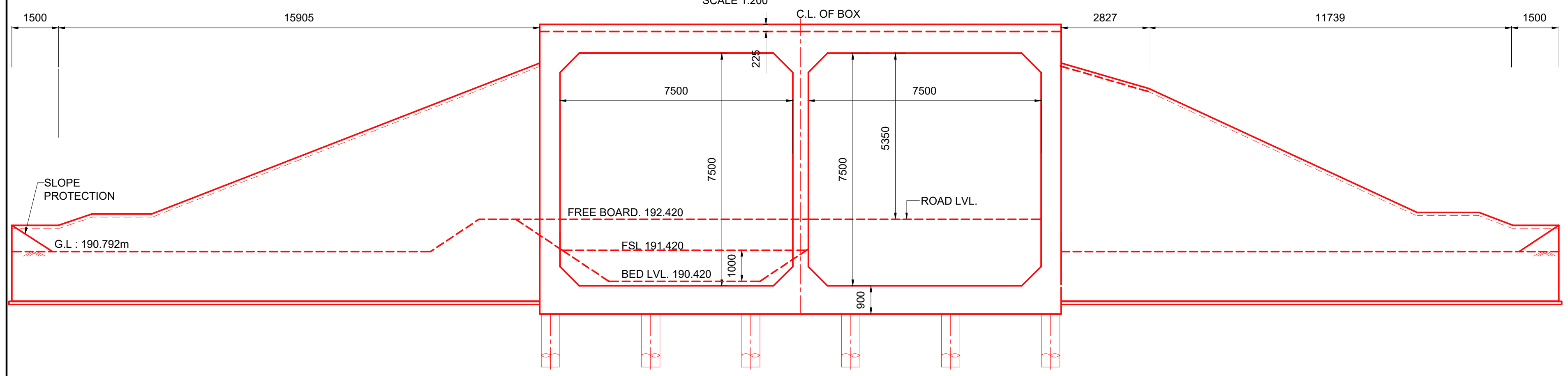
SECTION AT C-C
SCALE 1:100



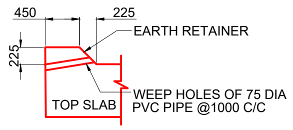
PLAN AT TOP
SCALE 1:200



TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



VIEW AT B-B
SCALE 1:50



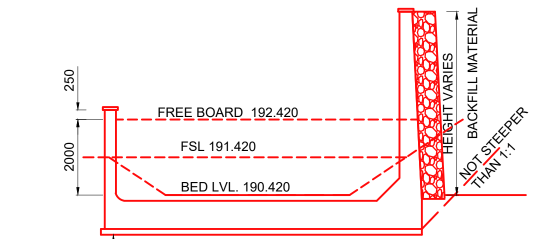
EARTH RETAINER
SCALE 1:50

LEGEND

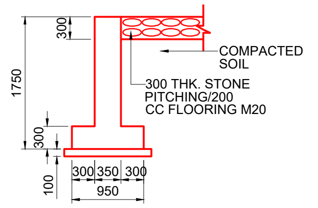
	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW



SECTION AT D-D
SCALE 1:100



CURTAIN/DROP WALL DETAILS
SCALE 1:50

HYDRAULIC DATA OF DRAIN		
1	NAME OF CANAL	REWASAN DRAIN
2	RD	19435/10350
3	BED LEVEL	190.420
4	FULL SUPPLY LEVEL	191.42
5	FREE BOARD	192.420
6	DISCHARGE	90 cusec
7	BED WIDTH	4.87
8	FSD	1.00
9	SIDE SLOPE	1.5:1
10	W S SLOPE	0.15%
11	VELOCITY	1.5ft/sec
12	ROW	49.5

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.
2. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
3. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.
4. RCC LINING SHALL BE CONSTRUCTED FOR CANAL UPTO ROW OF HORC.

IMPORTANT NOTE:

TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

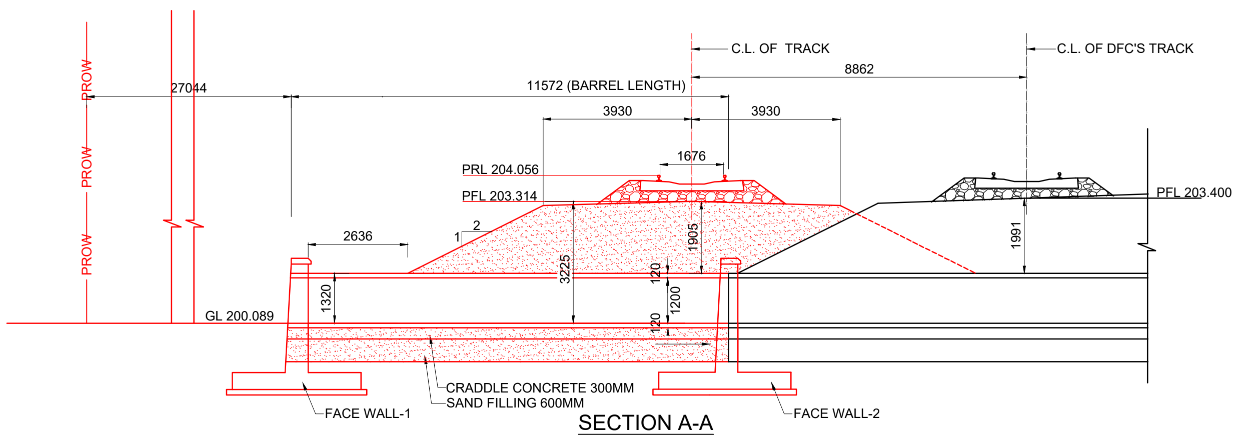
RITES THE INFRASTRUCTURE PEOPLE

SMEC

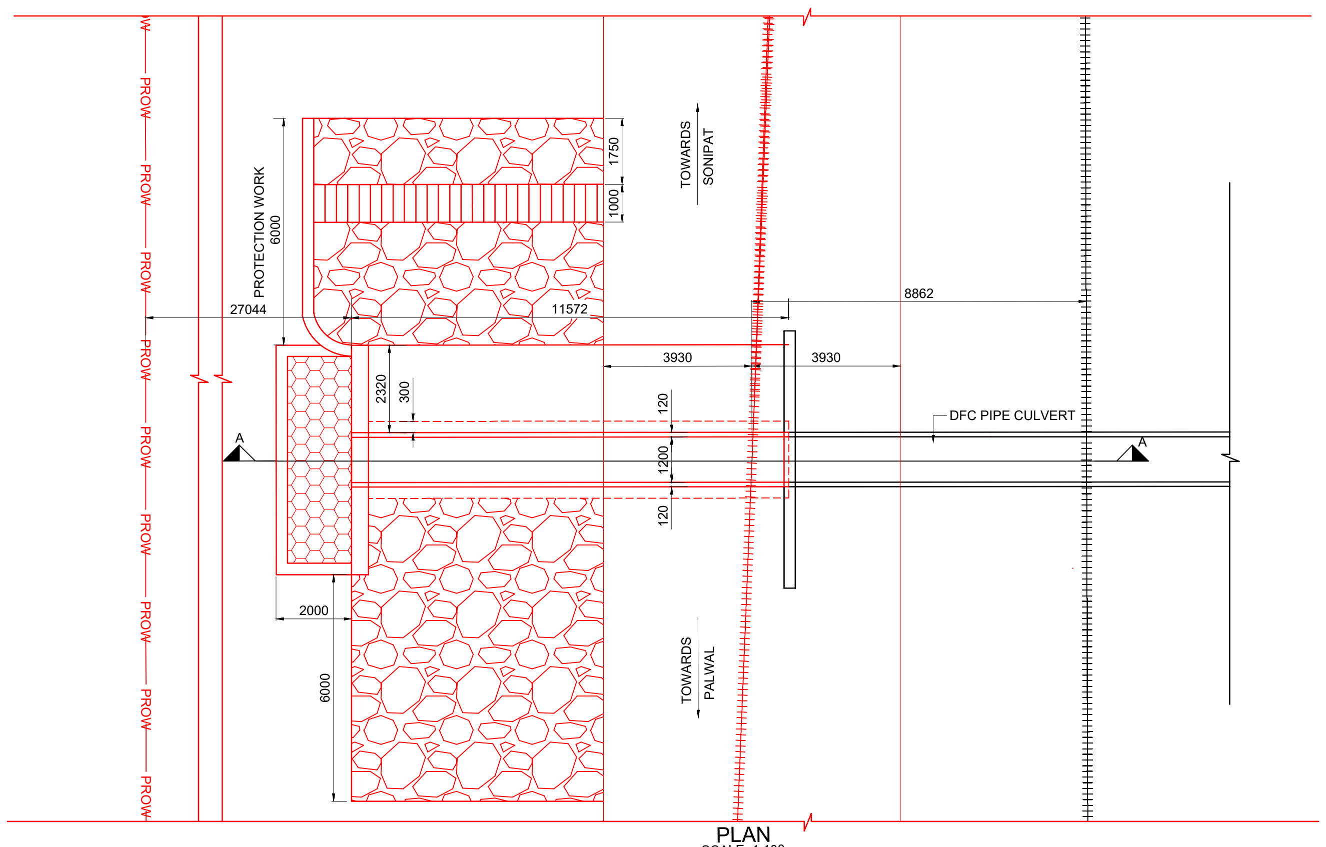
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD + BALANCING CULVERT BRIDGE NO. 67 SPAN 2.0X7.5X7.5 RCC BOX AT CH: 19435.000 (CANAL CROSSING REWASAN DRAIN RD 10350)

DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD-01067_A1		
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	23-08-2023	19-12-2023

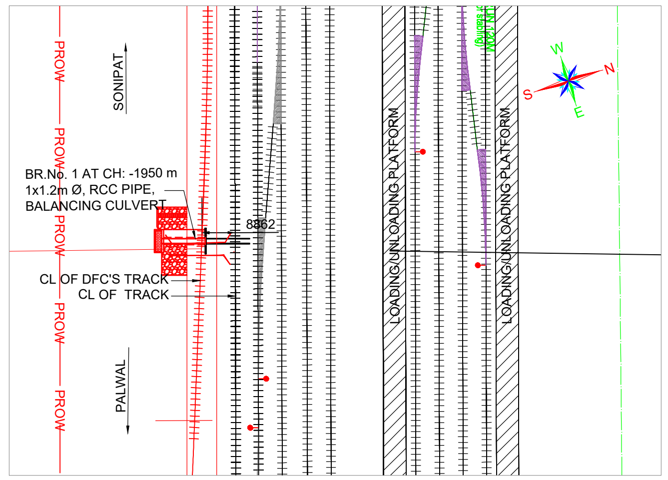
4.1.2 CONNECTING LINE



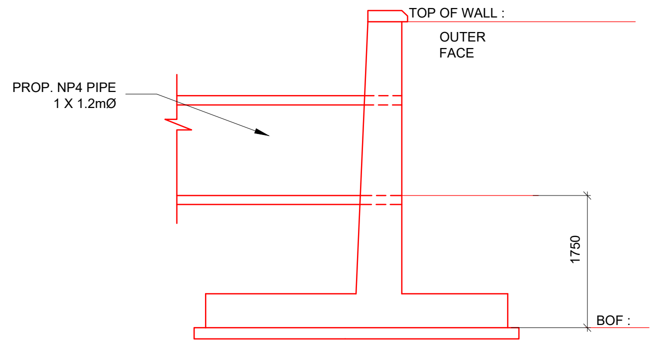
SECTION A-A
SCALE 1:100



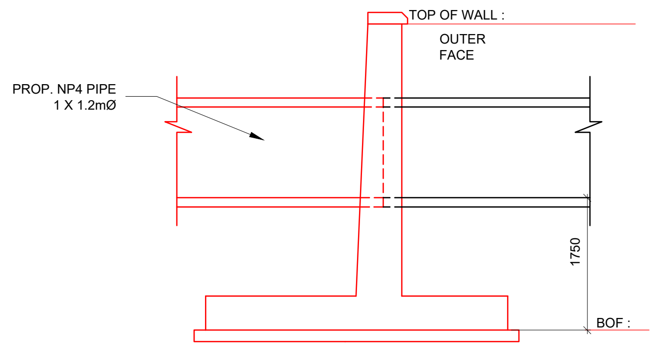
PLAN
SCALE: 1:100



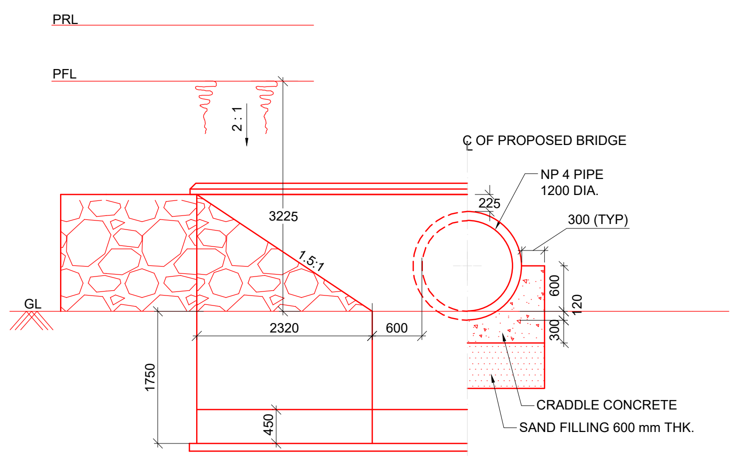
KEY PLAN
SCALE: NTS



TYPICAL DETAIL OF FACE WALL-1
(SCALE 1:75)



TYPICAL DETAIL OF FACE WALL-2
(SCALE 1:75)



HALF ELEVATION HALF SECTION
(SCALE 1:50)

LEGEND

(red line)	PROPOSED
(black line)	EXISTING
(green line)	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	(signed)	SHIV OM DWIVEDI CPM/SOUTH	(signed)
SUDHIR AGRAWAL DPD/CIVIL	(signed)	RAJU SOLANK DGM/CIVIL	(signed)
REETU PATIAL CDE/ CIVIL	(signed)	MOHD. ISHAK EXECUTIVE/CIVIL	(signed)
PUSHPENDRA KR.SINGH SDE/ CIVIL	(signed)		

NOTES :

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C) OTHER NOTES :

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PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

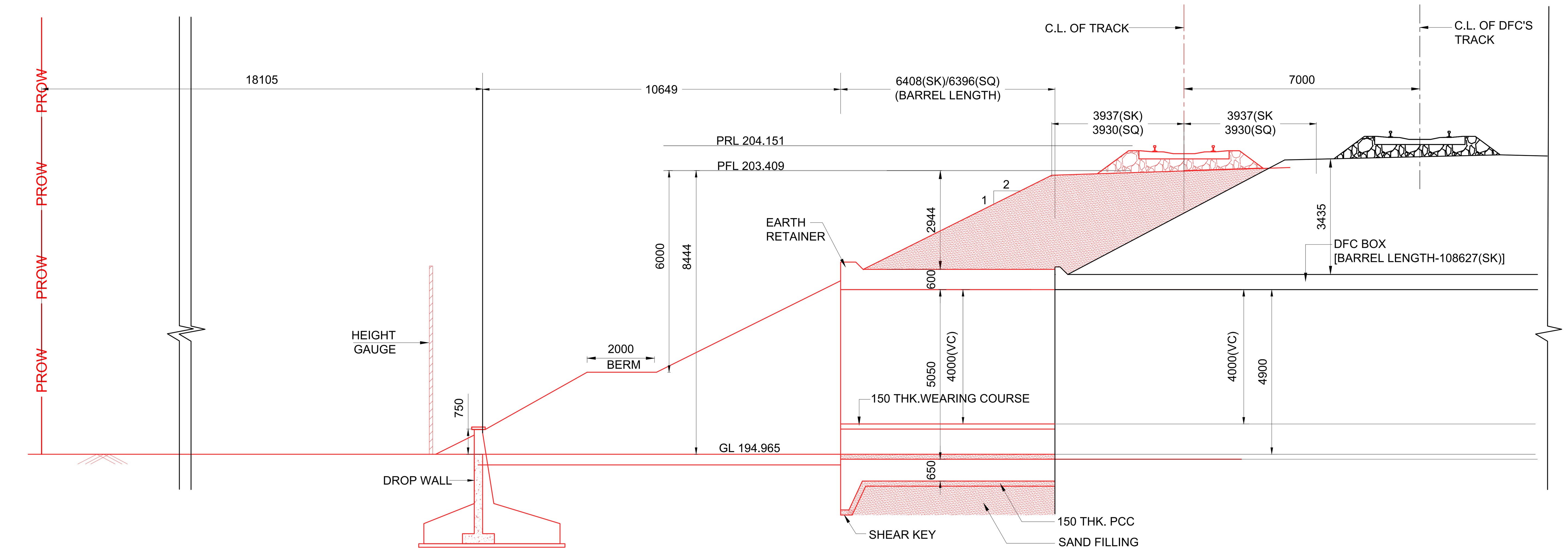
RITES THE INFRASTRUCTURE PEOPLE

SMEC Member of the Surbana Jurong Group

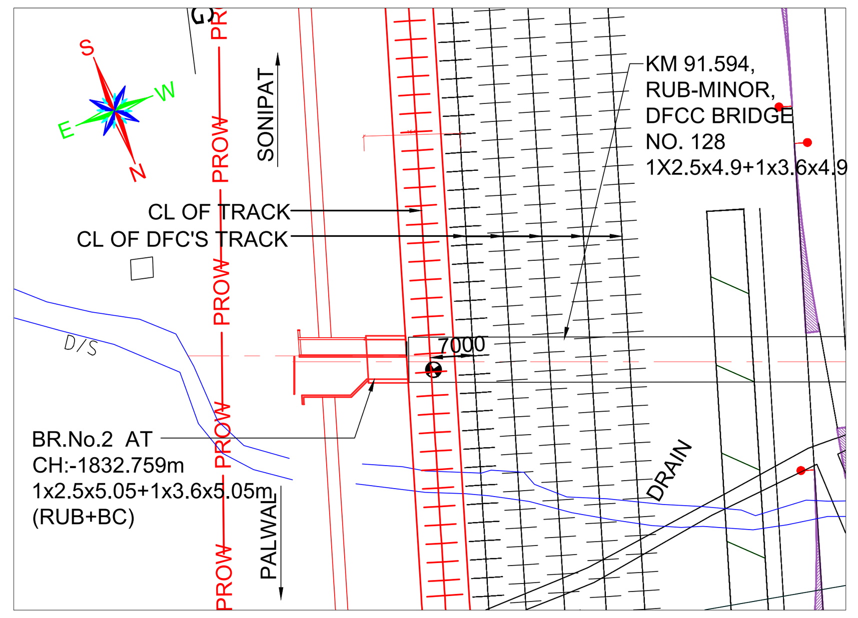
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR PIPE CULVERT BRIDGE NO. 1 1X1.2 Ø AT CH.-1950.00

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD-01001_A0	1 OF 1

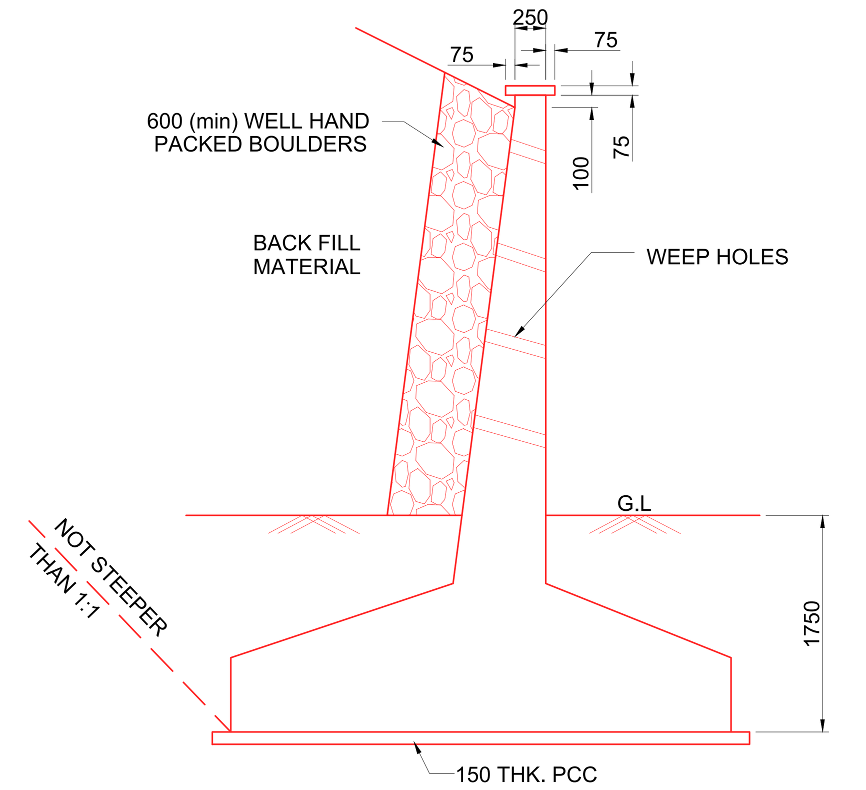
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



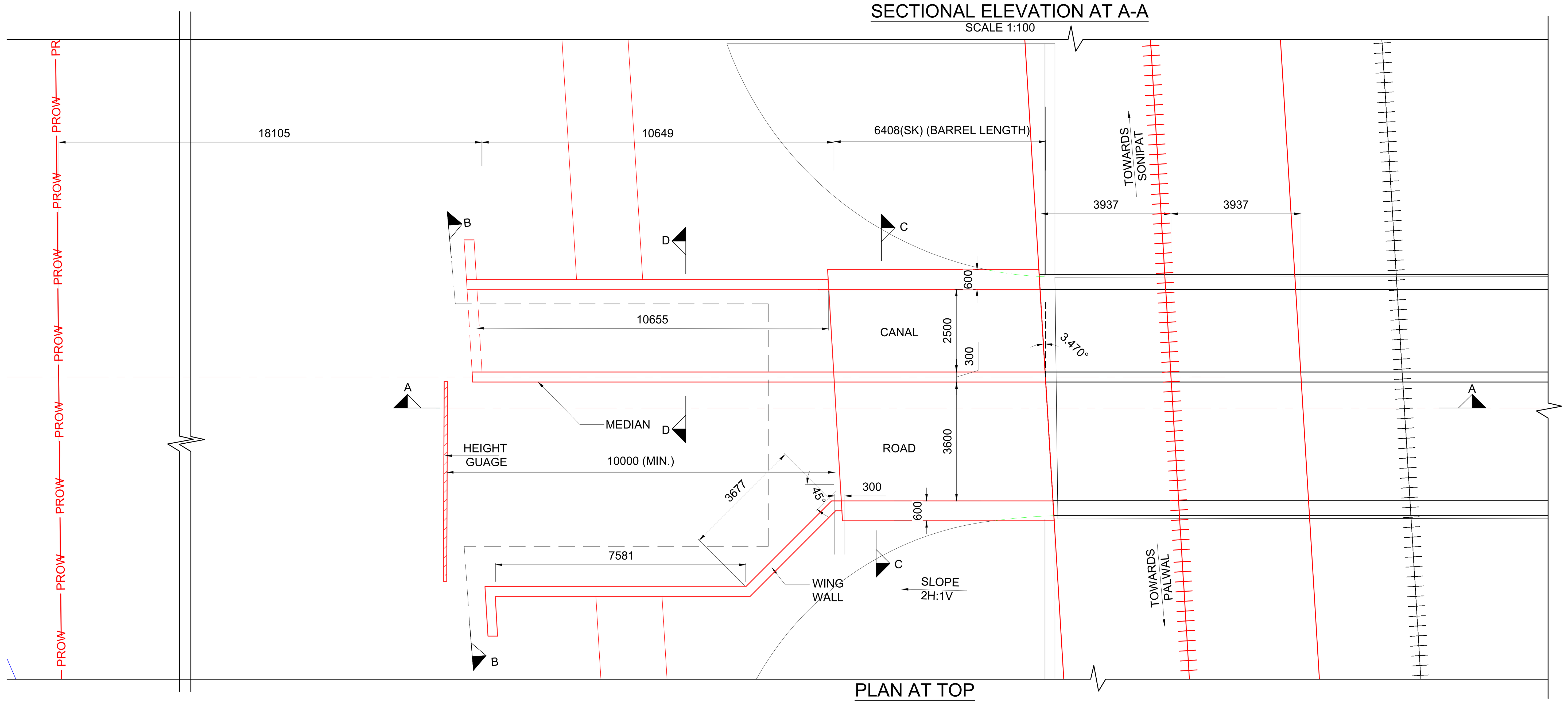
SECTIONAL ELEVATION AT A-A
SCALE 1:100



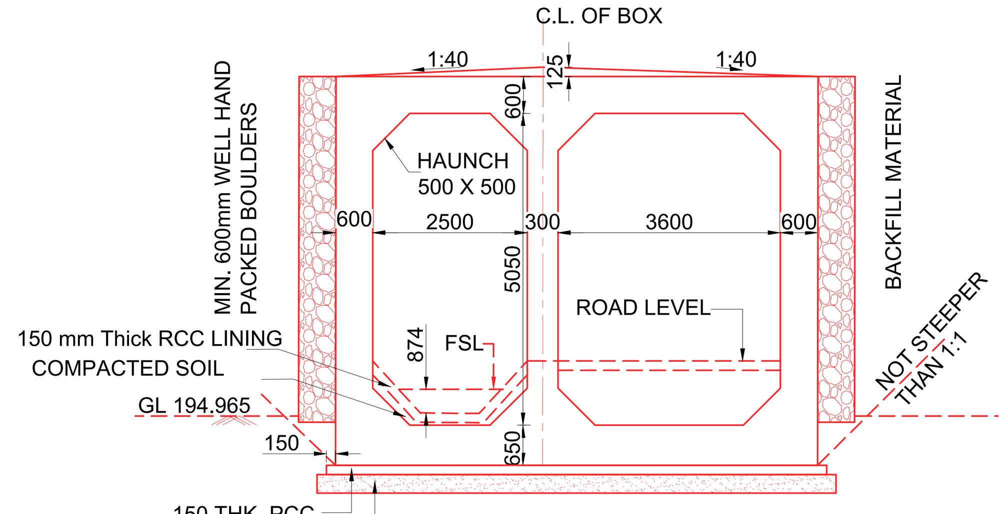
KEY PLAN
SCALE NTS



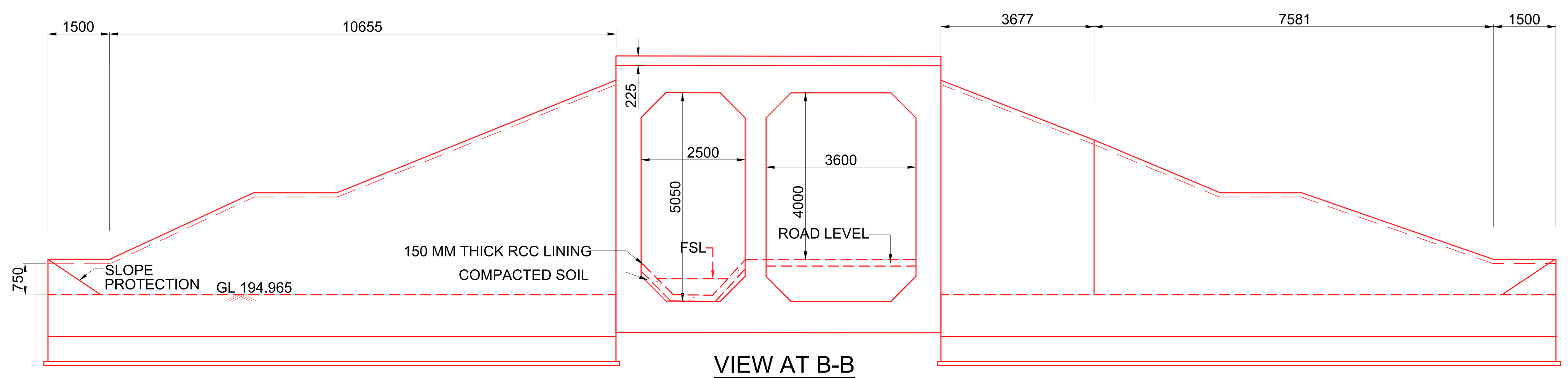
TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



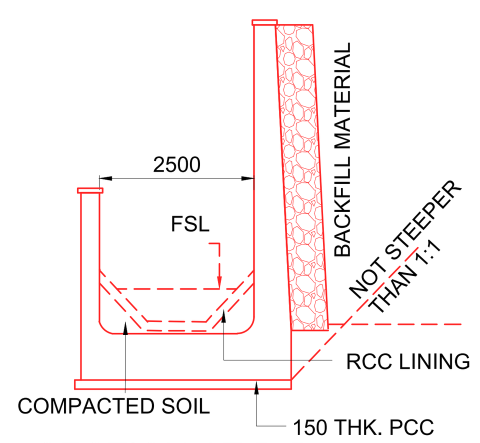
PLAN AT TOP
SCALE 1:100



SECTION AT C-C
SCALE 1:100



VIEW AT B-B
SCALE 1:100



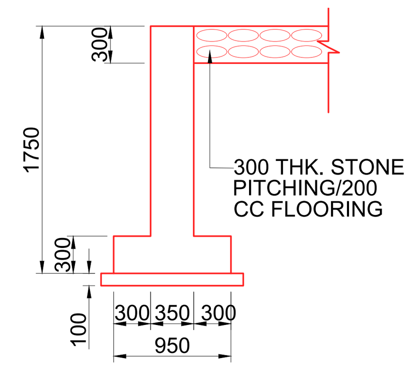
SECTION AT D-D
SCALE 1:100

LEGEND

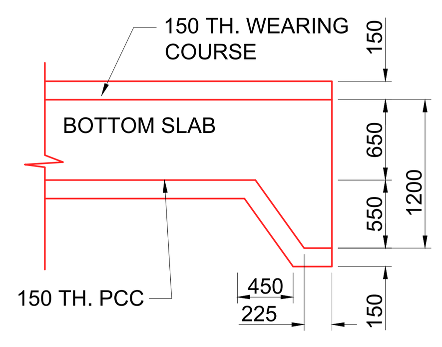
	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

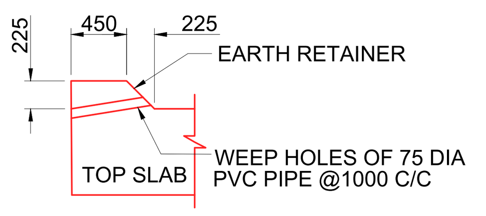
PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
VC	VERTICAL CLEARANCE
PROW	PROPOSED HORC'S ROW



DROP WALL DETAILS
SCALE 1:50



SHEAR KEY
SCALE 1:50



EARTH RETAINER
SCALE 1:50

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
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SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

NOTES :

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7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/Sig.NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.
3. ADEQUATE SLOPE IN BOTTOM SLAB OF RCC BOX TOWARDS DIRECTION OF FLOW SHALL BE PROVIDED.
4. RCC LINING SHALL BE CONSTRUCTED FOR CANAL FROM ROW TO ROW OF HORC INCLUDING IN RCC BOX & U-TROUGH.
5. RCC LINING SHALL BE OF MIN 150 MM THICK AND HAVING AT LEAST MIN TEMP REINFORCEMENT.

IMPORTANT NOTE:

TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

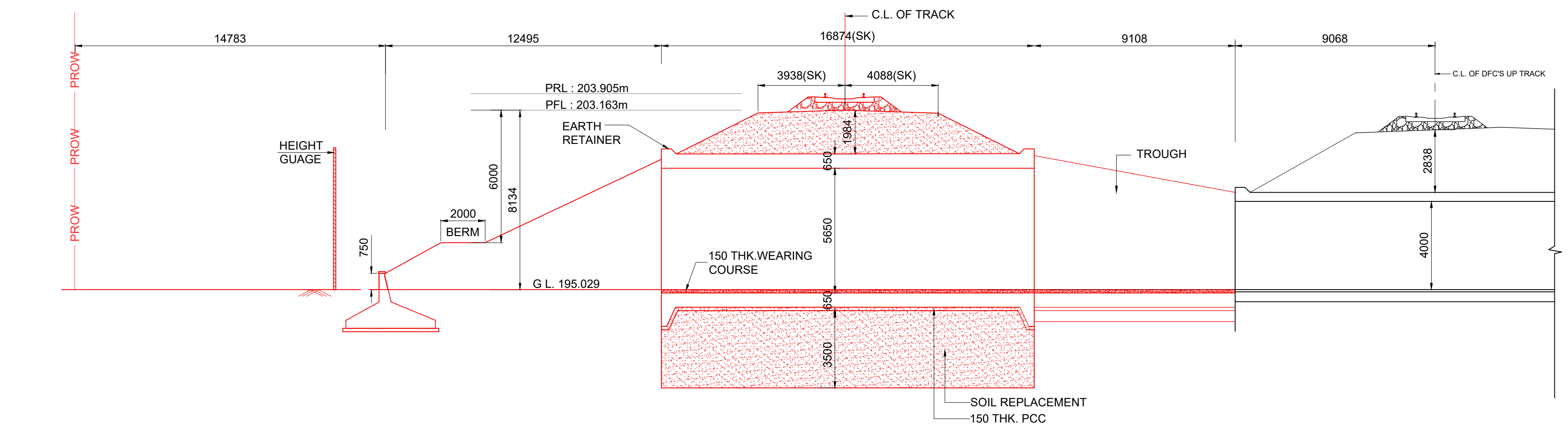
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

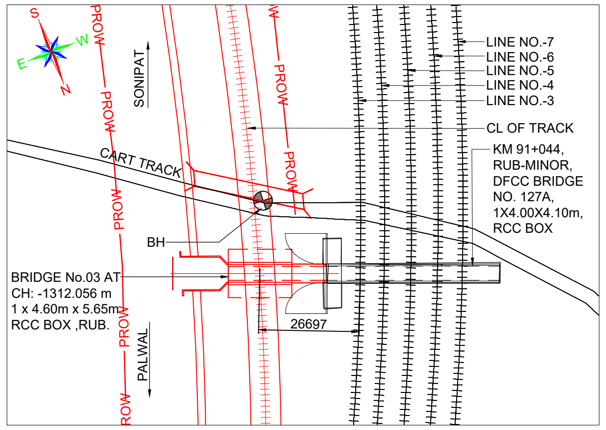
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR BALANCING CULVERT + RUB BRIDGE NO. 02 SPAN 1X2.5X5.05+1x3.6x5.05, RCC BOX, AT CH: -1832.759

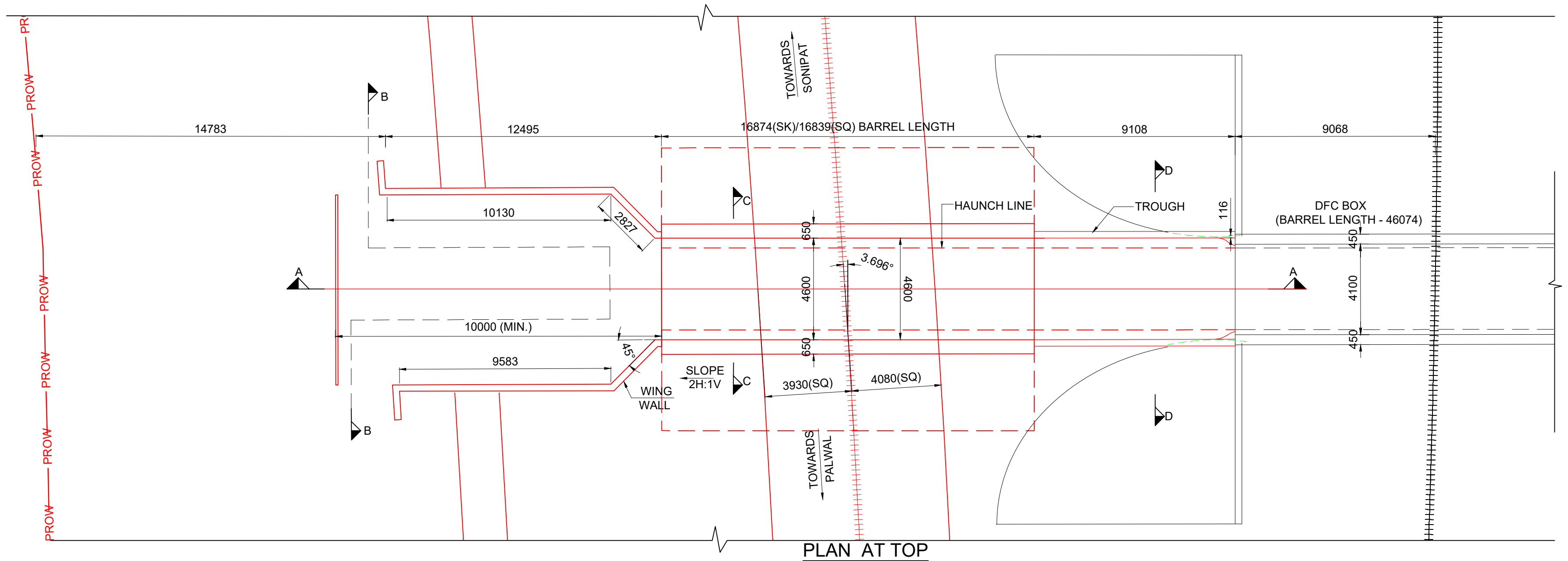
DRG. NO.			SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01002_A1			
SCALE :	ISSUE DATE	REVISED DATE	
AS SHOWN	10-10-2023	06-12-2023	



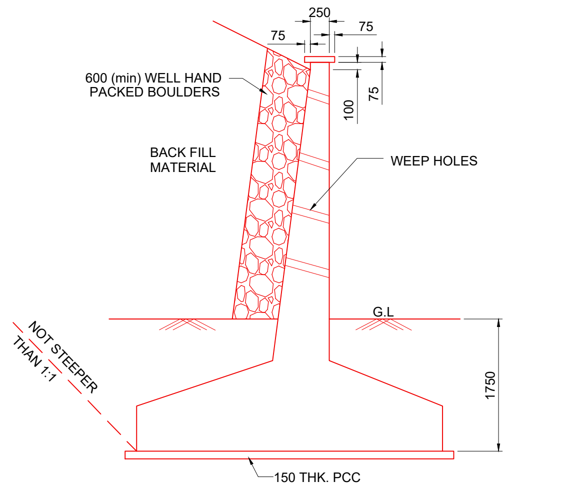
SECTIONAL ELEVATION AT A-A
SCALE 1:150



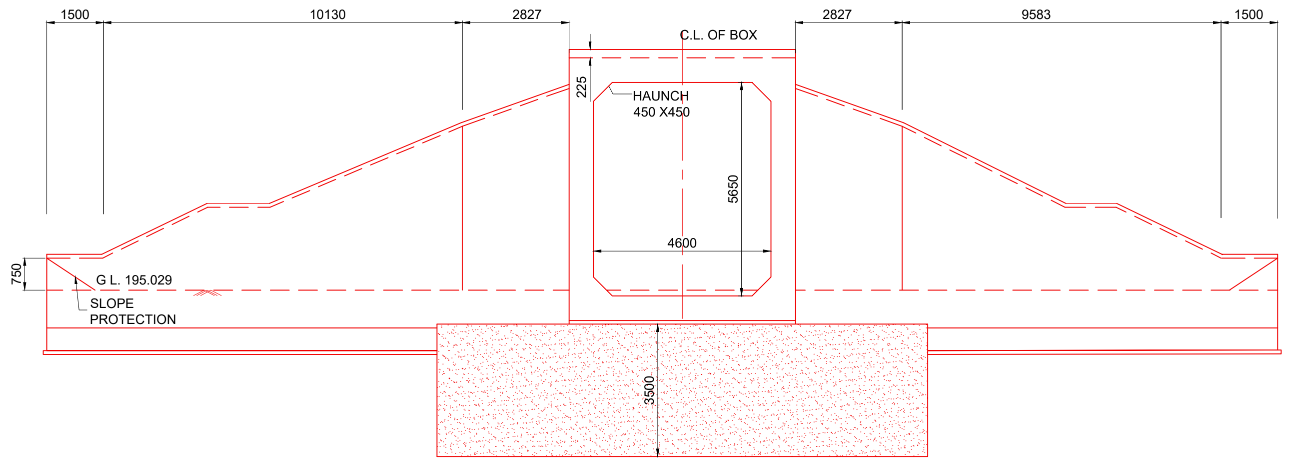
KEY PLAN
SCALE NTS



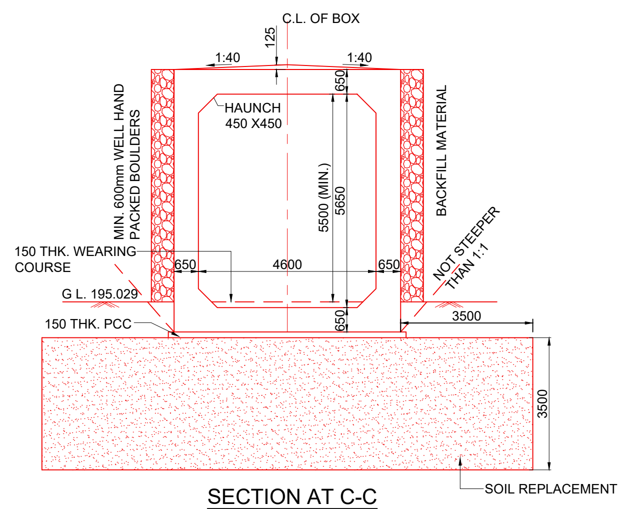
PLAN AT TOP
SCALE 1:150



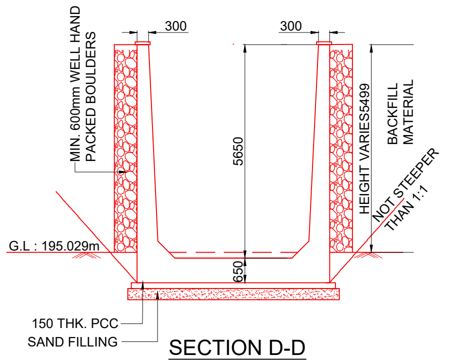
TYPICAL DETAIL OF RETURN WALL / WING WALL
SCALE 1:50



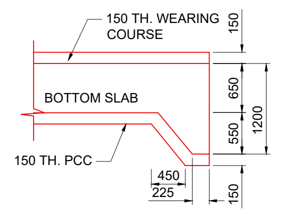
VIEW AT B-B
SCALE 1:100



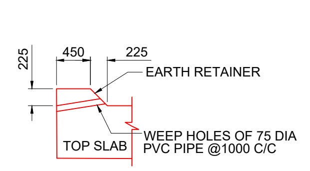
SECTION AT C-C
SCALE 1:100



SECTION D-D
SCALE 1:100



SHEAR KEY
SCALE 1:50



EARTH RETAINER
SCALE 1:50

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
VC	VERTICAL CLEARANCE
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL, BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD,

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.
3. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.

IMPORTANT NOTE:

TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

SMEC

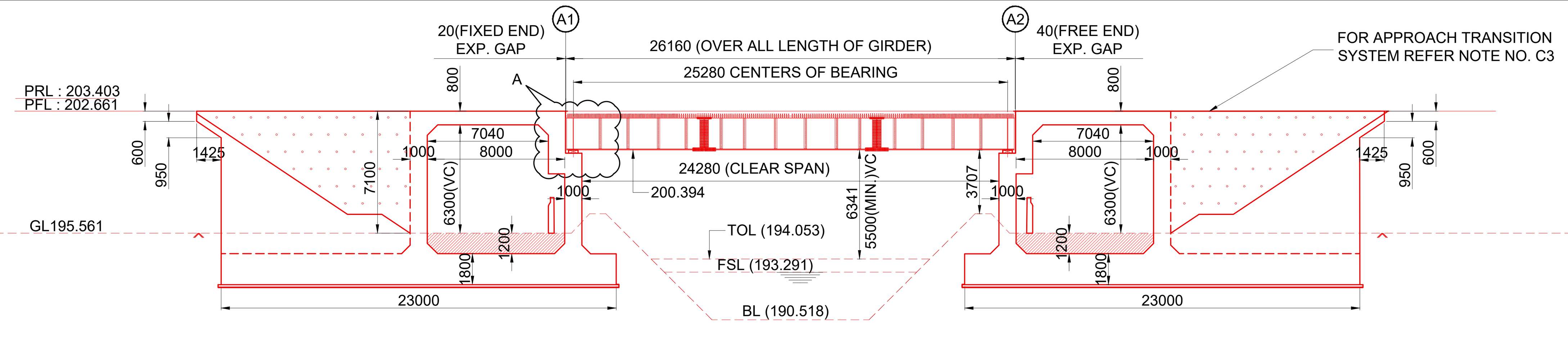
GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO. 03, SPAN 1X4.60X5.65 RCC BOX AT CH: -1312.056

DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01003_A0		1 OF 1
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	

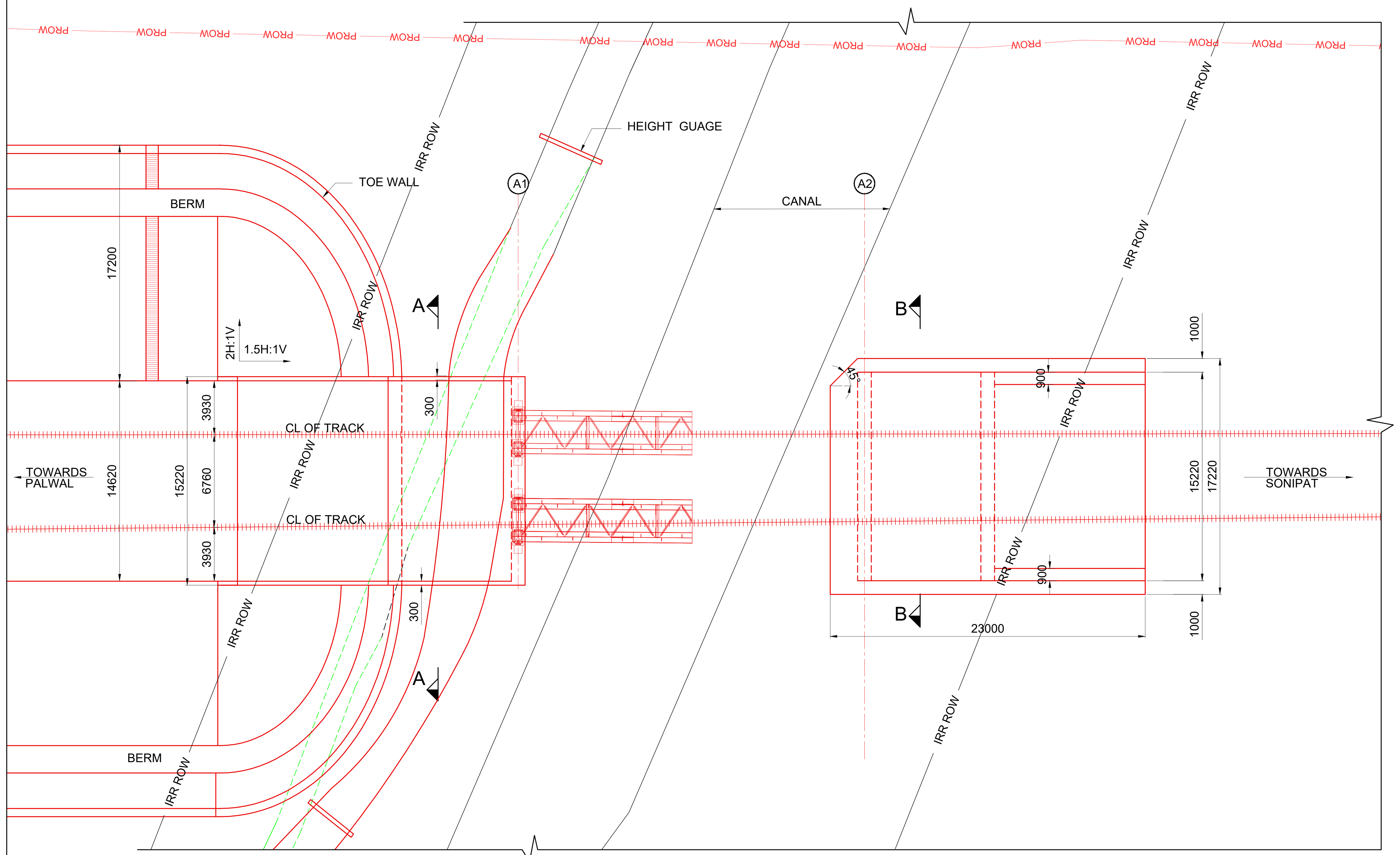
4.2 MAJOR BRIDGES

4.2.1 MAIN LINE



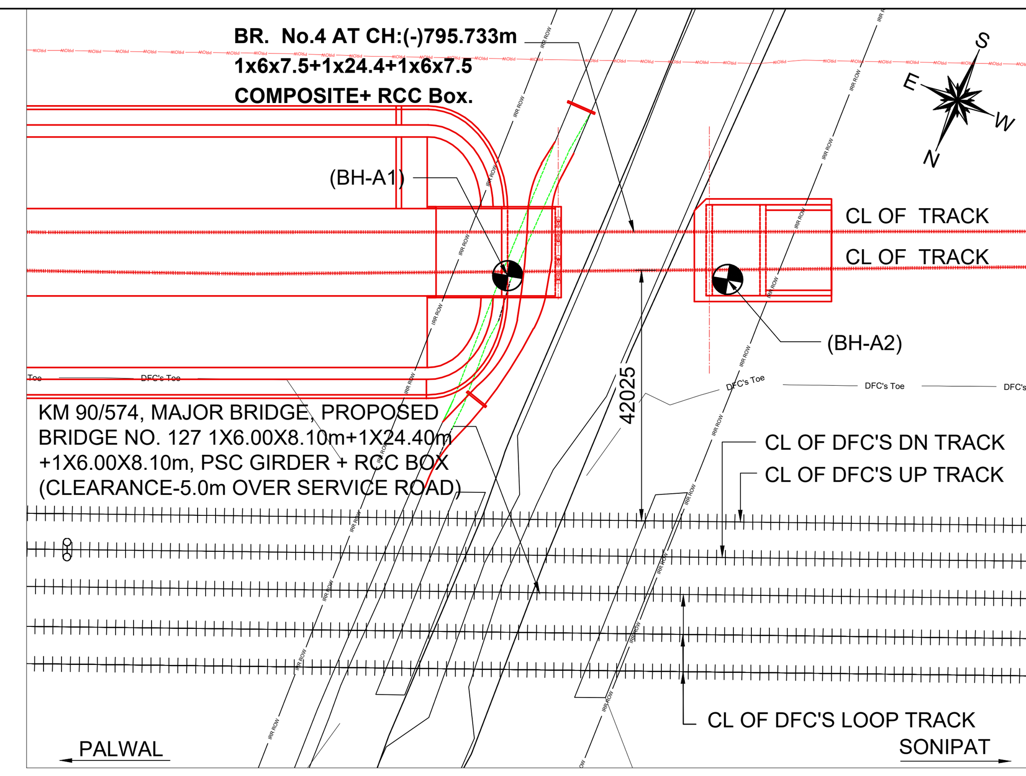
SECTIONAL ELEVATION

SCALE 1:250



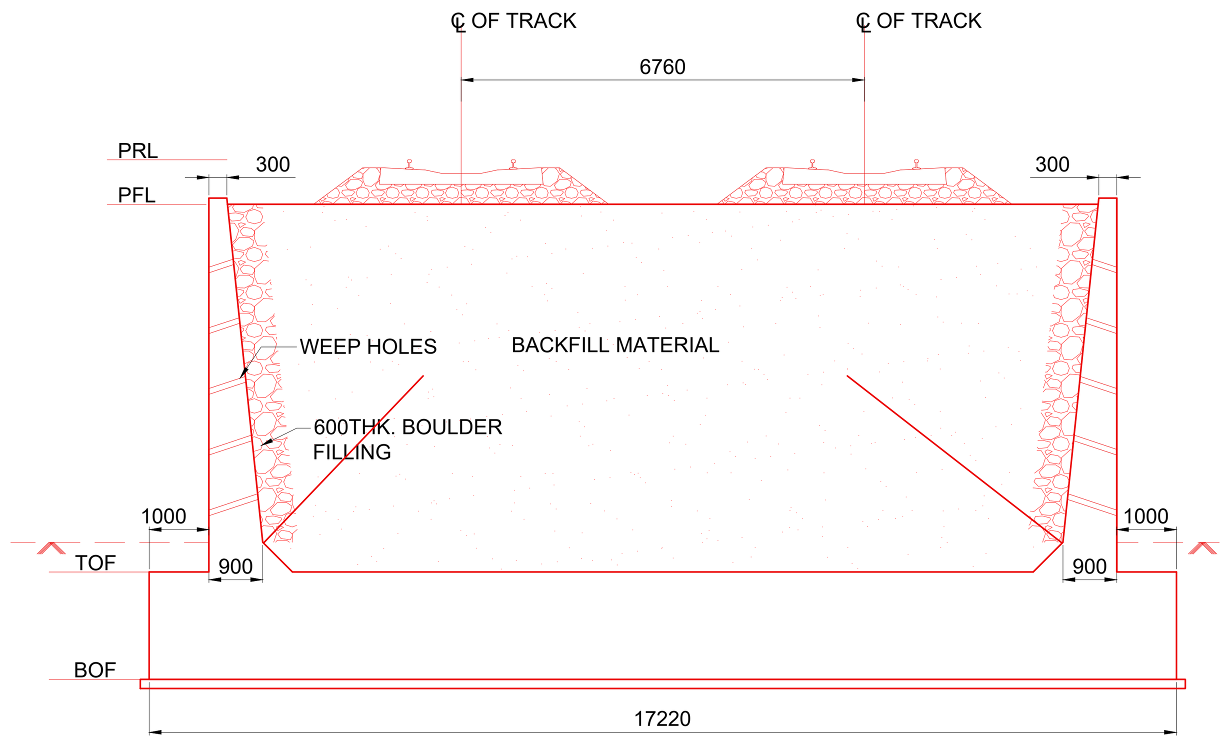
HALF PLAN AT TOP HALF PLAN AT BOTTOM

SCALE 1 : 250



KEY PLAN

SCALE NTS



SECTION B-B

SCALE 1:100

LEGEND

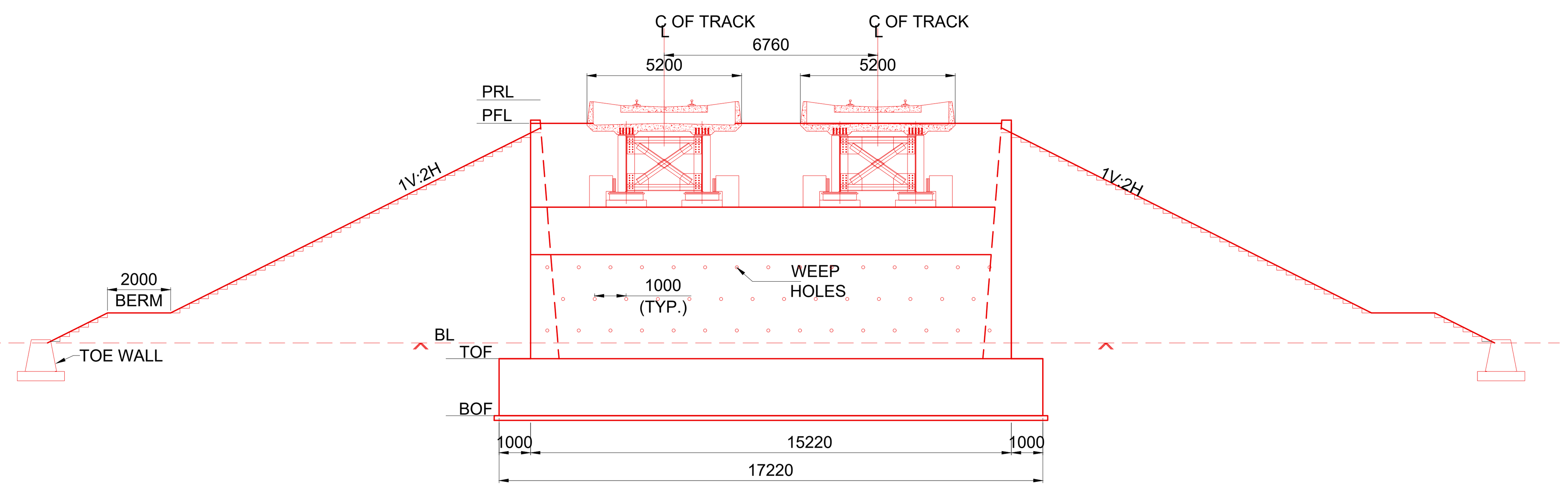
	PROPOSED
	EXISTING
	DISMANTEL

HYDRAULIC DATA OF DRAIN

1	NAME OF CANAL	GAUNCHI MAIN DRAIN
2	BED LEVEL(BL)	190.518
3	FULL SUPPLY LEVEL(FSL)	193.291
4	FREE BOARD/TOL	194.053
5	DISCHARGE	90Cs

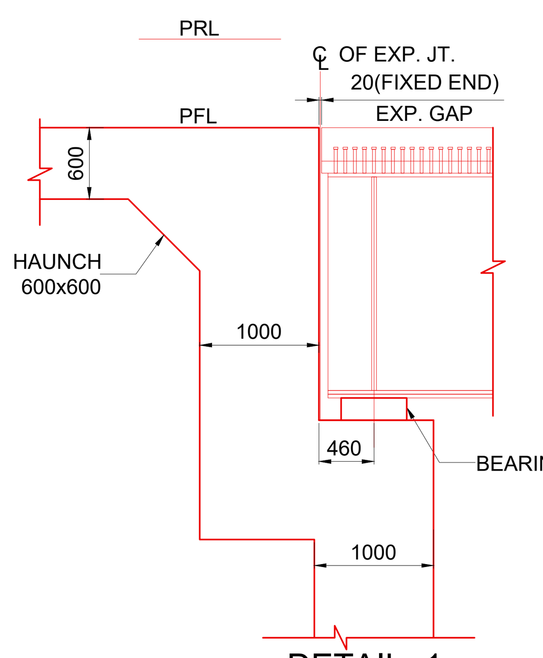
CONSTRUCTION DEPTH

	PROP. LINE
1) RAIL	172 mm
2) RUBBER PAD	10 mm
3) PSC SLEEPER	210 mm
4) BALLAST	350 mm
TOTAL	742 mm



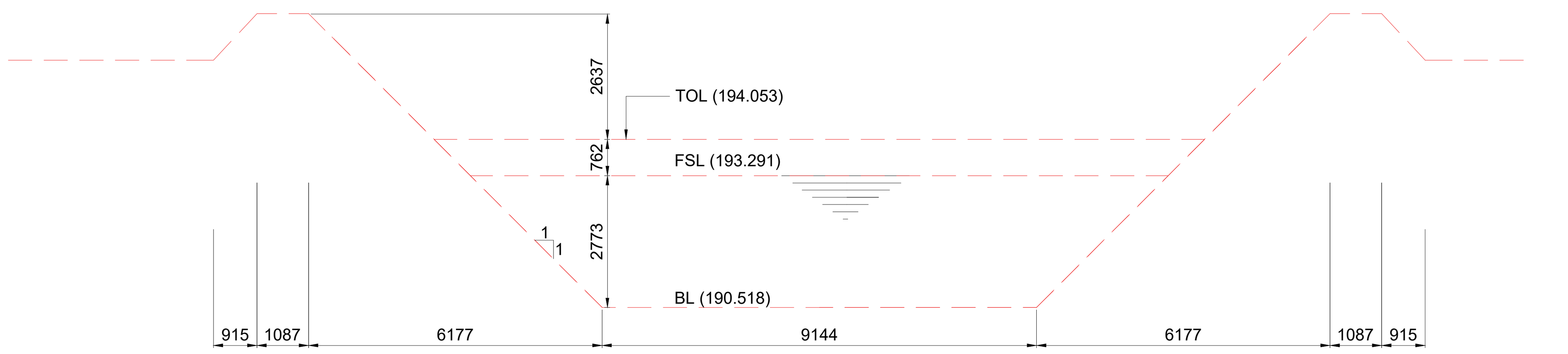
SECTION A-A

SCALE 1:150



DETAIL -1

SCALE 1:50



SECTION OF CANAL

(SCALE 1:100)

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
RD.L	ROAD LEVEL
TOF	TOP OF FOUNDATION
BOF	BOTTOM OF FOUNDATION
THK.	THICKNESS
EXP. GAP	EXPANSION GAP
CC	CEMENT CONCRETE
TYP.	TYPICAL
GL	GROUND LEVEL
PROW	PROPOSED HORC ROW
ROW	ROAD ROW

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
8. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE/OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/ (Sig.)/ NR, DFCCI ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
9. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
10. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
11. DETAILED GAD WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. STANDARD OF LOADING :- SUPER STRUCTURE-25.0 T (RDSO STANDARD CG),& SUB STRUCTURE-32.5T- 2008 LOADING..
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   a. IRS BRIDGE RULE
   b. IRS CONCRETE BRIDGE CODE
   c. IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
   d. IS 2911 PART-1 SECTION-2.
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE.
   GRADE OF CONCRETE :
   a. ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   b. LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 30M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BRIDGE AFTER PROTECTION WORK.
9. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
10. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
11. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
12. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB-STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
13. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
14. THE STRUCTURAL DIMENSIONS AND SIZES ARE INDICATIVE AND THESE MAY VARY DURING DETAIL DESIGN.
15. SIZE, TYPE OF FOUNDATION & GROUND IMPROVEMENT DETAILS SHOWN ARE TENTATIVE AND MAY CHANGE DURING DETAILED DESIGN.
16. SEISMIC ARRESTOR SHALL BE PROVIDED ON THE PIER/ABUTMENT CAP.
17. DETAIL OF TOE WALL SHALL BE PROVIDED AS PER SKETCH NO. GC-HRIDC-SK-GEN-014_A1
18. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
19. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.

IMPORTANT NOTE:

TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

C) OTHER NOTES :

1. FOR SUPERSTRUCTURE DETAIL FOLLOW RDSO/B-11751/R1 TO B-11751/8 (FOR CG)
2. ARRANGEMENT FOR PATHWAY SHALL BE PROVIDED AS PER RDSO DWG. NO. CBS-0046(FOR CG) .
3. TRANSITION SYSTEM TO BE ADOPTED ON BRIDGE APPROACHES SHALL BE AS PER RDSO REPORT NO. GE:R-50(TRANSITION SYSTEM ON APPROACHES OF BRIDGES). FOR DETAILS REFER SKETCH NO. GC-HRIDC-SK-GEN-019.
4. RCC LINING SHALL BE CONSTRUCTED FOR CANAL UPTO ROW OF HORC.

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

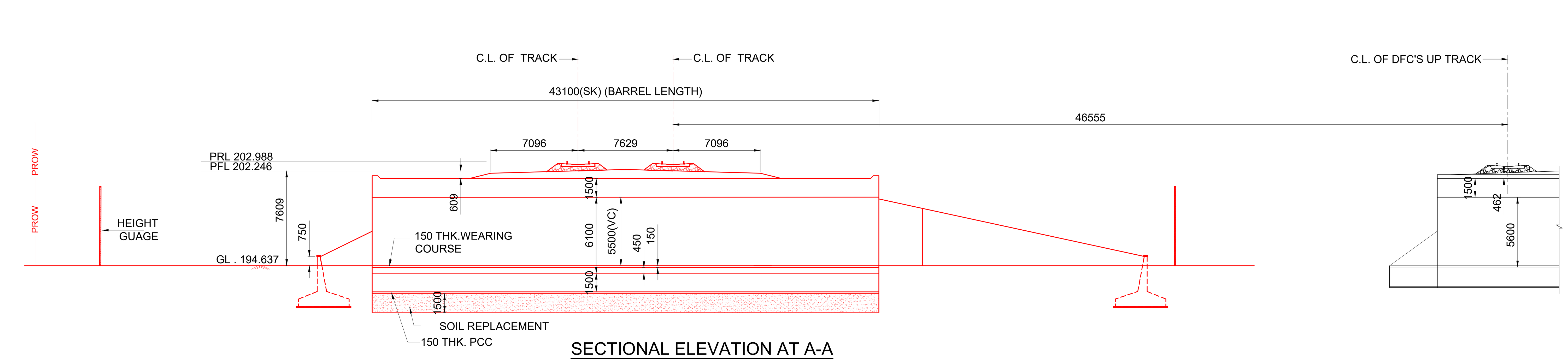
RITES Limited in consortium with SMEC International Pty. Ltd.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

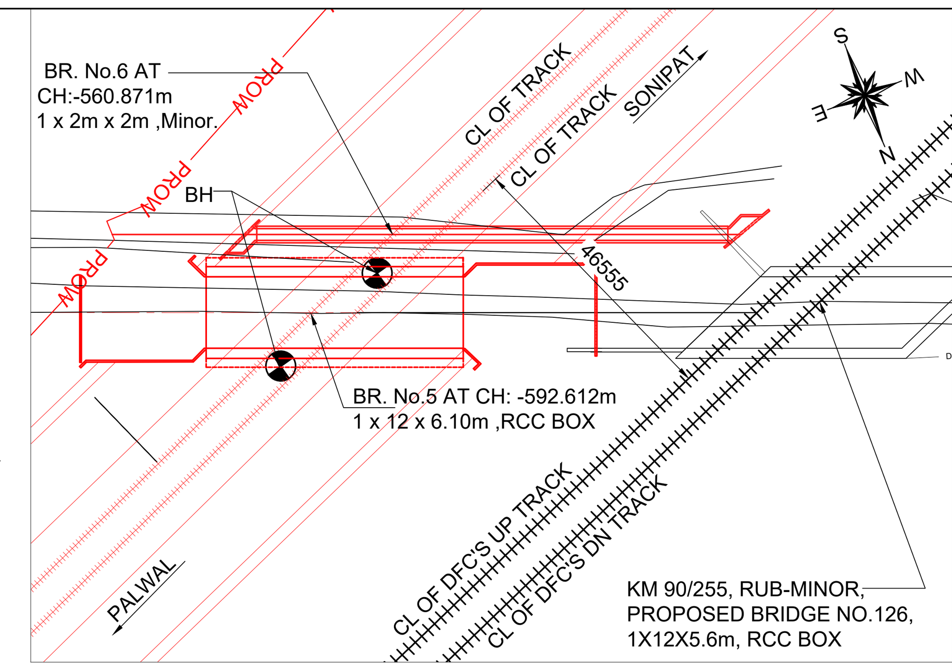
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR PROP. CANAL CROSSING BRIDGE No.4, 1x8x7.5+1x24.4+1x8x7.5 (CG+ RCC BOX) AT CH: (-)795.733m

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01004_A0	1 OF 1

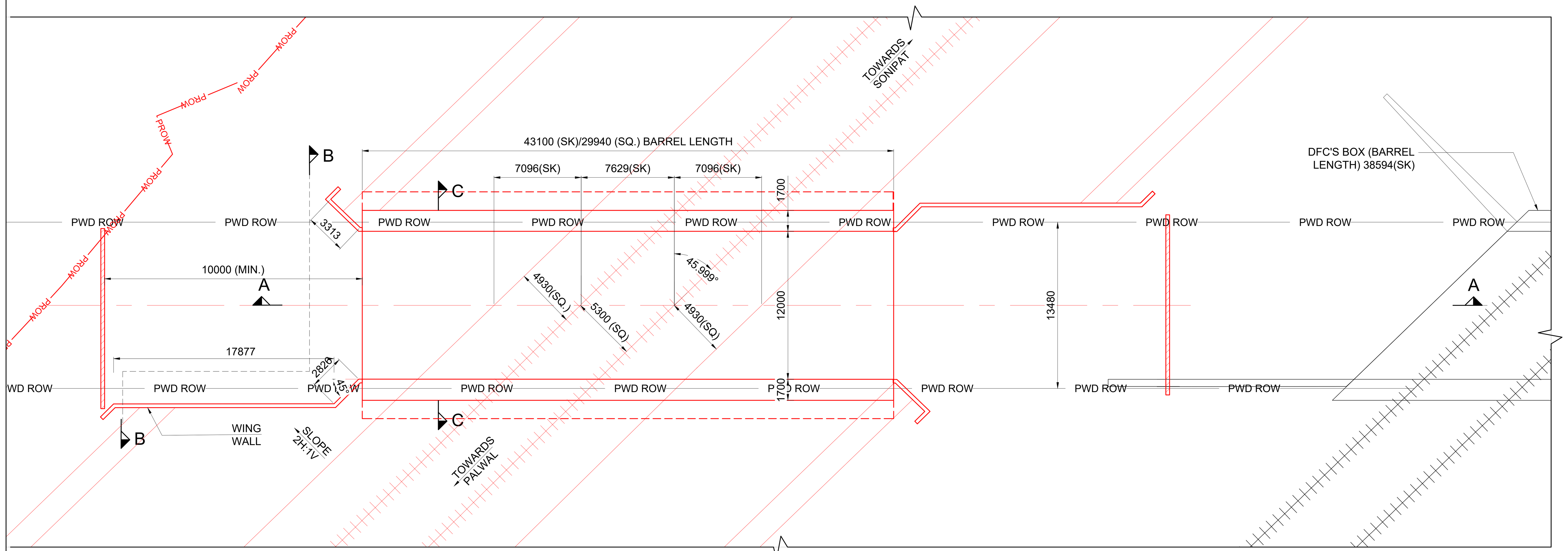
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



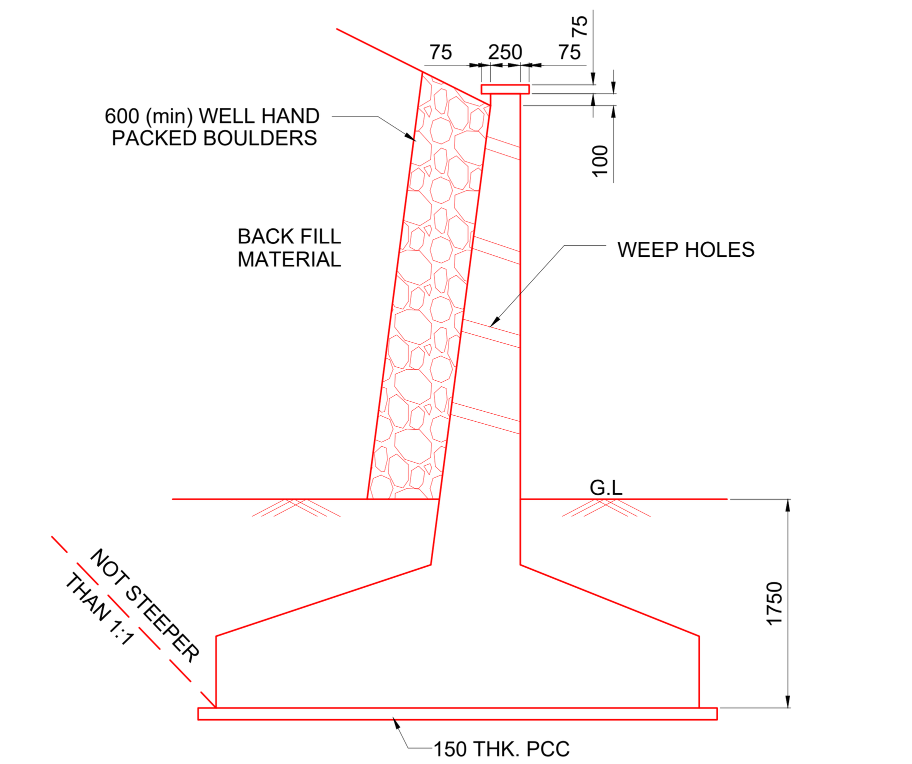
SECTIONAL ELEVATION AT A-A
SCALE 1:250



KEY PLAN
SCALE NTS



PLAN AT TOP
SCALE 1:250



TYPICAL DETAIL OF RETAINING WALL(RW) / WING WALL
SCALE 1:50

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL, BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

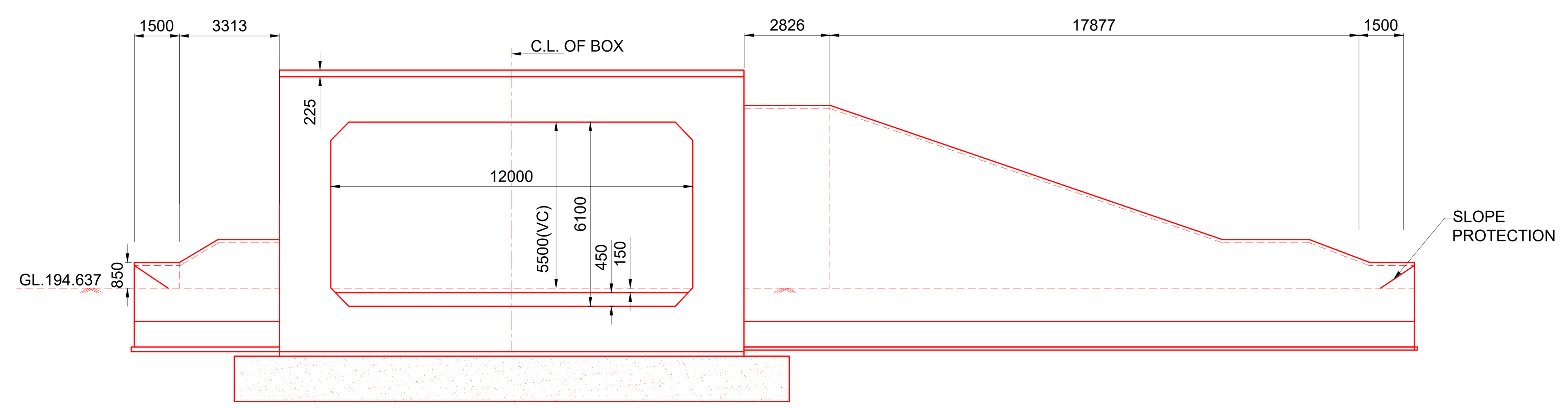
B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

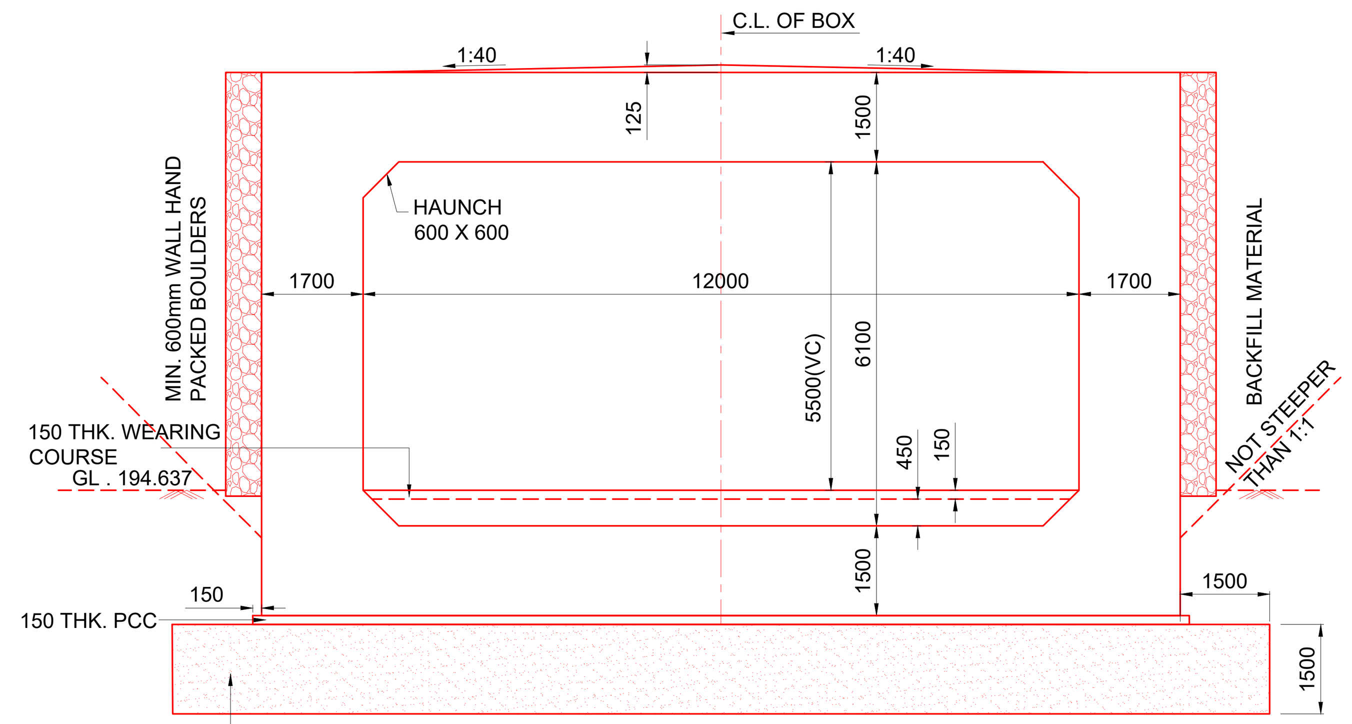
C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.
3. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.

IMPORTANT NOTE:
TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.



VIEW AT B-B
SCALE 1:150



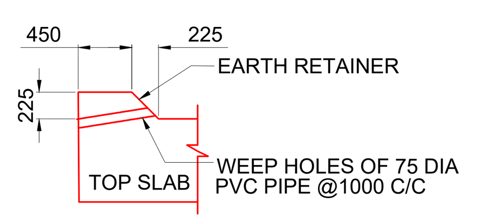
SECTION C-C
SCALE 1:100

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW



EARTH RETAINER
SCALE 1:50

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL		MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

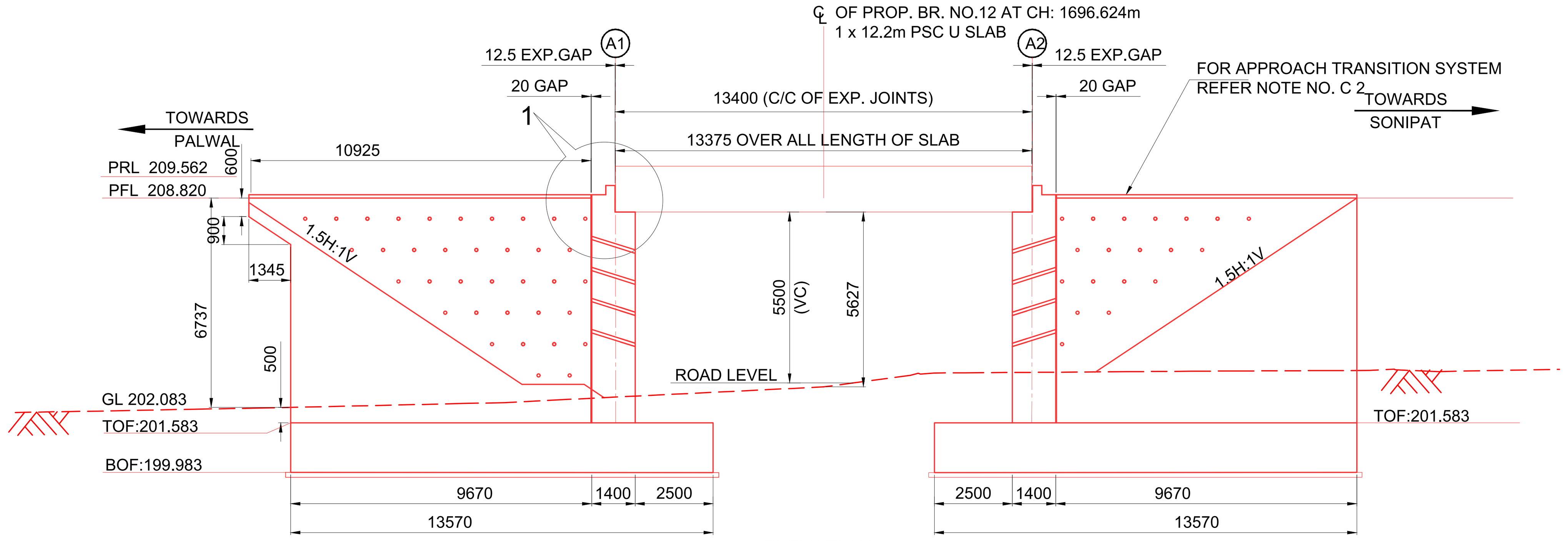
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

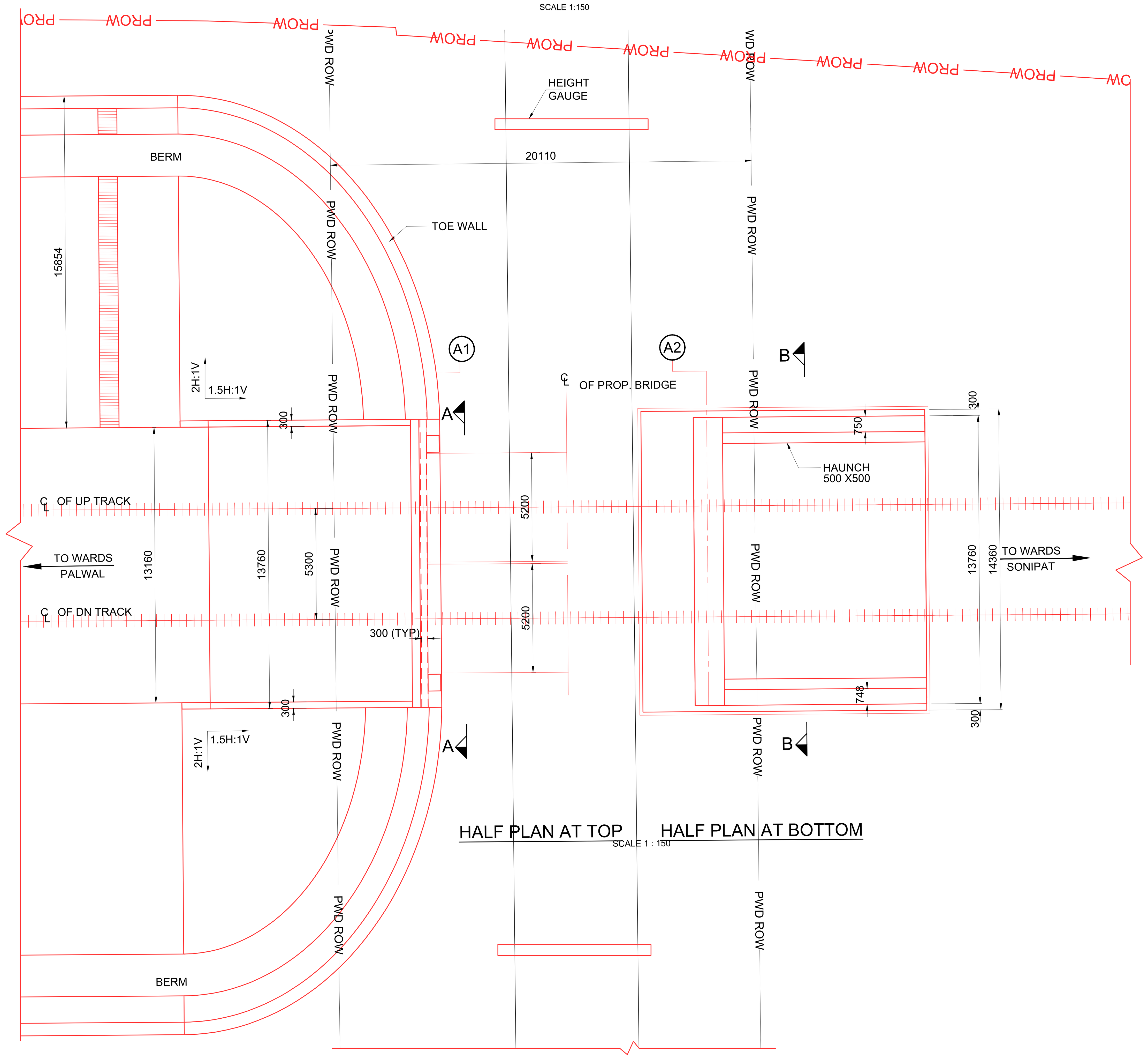
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO. 5
1x 12 x 6.10m RCC BOX AT CH. -592.612m

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01005_A0	1 OF 1

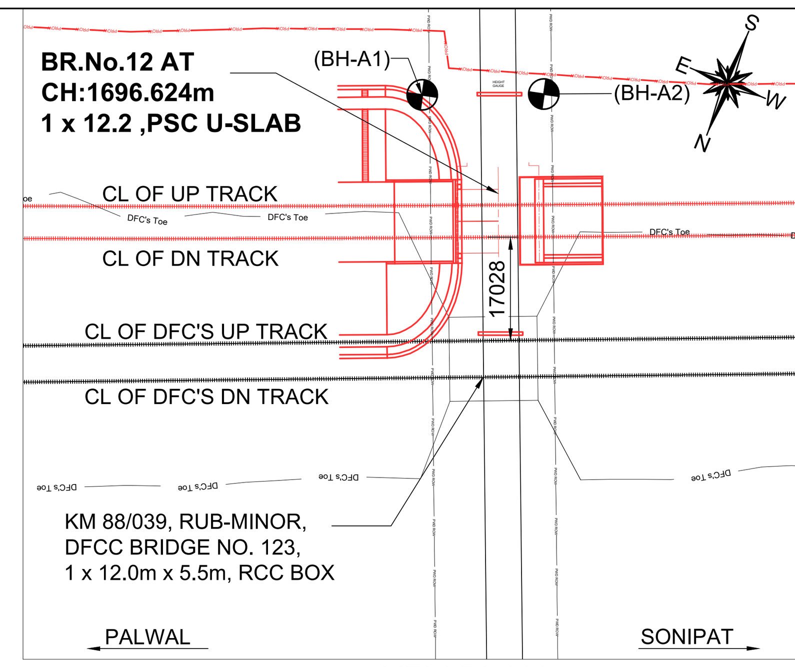
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



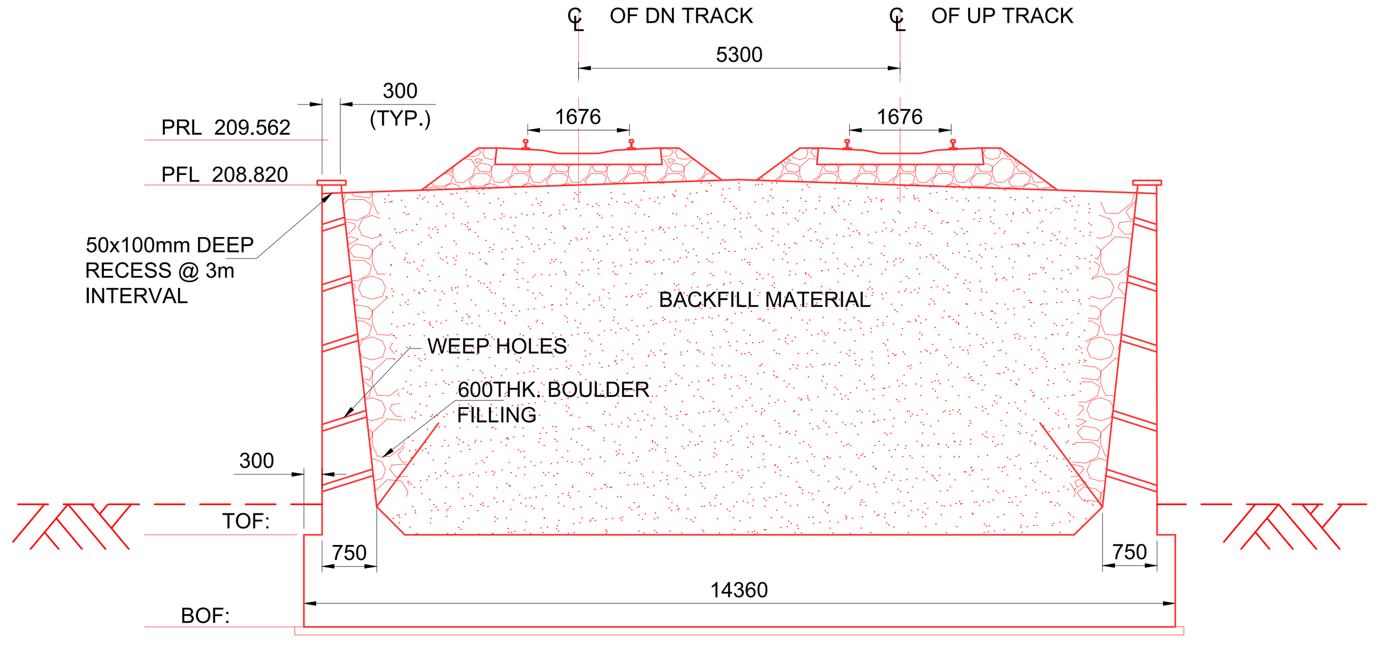
ELEVATION
SCALE 1:150



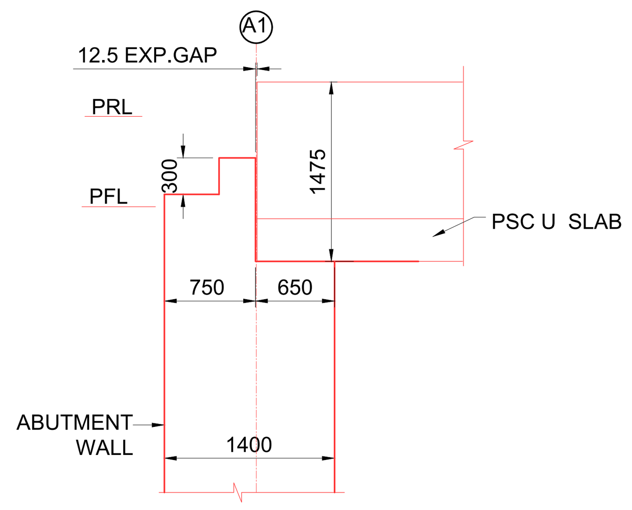
HALF PLAN AT TOP
HALF PLAN AT BOTTOM
SCALE 1 : 150



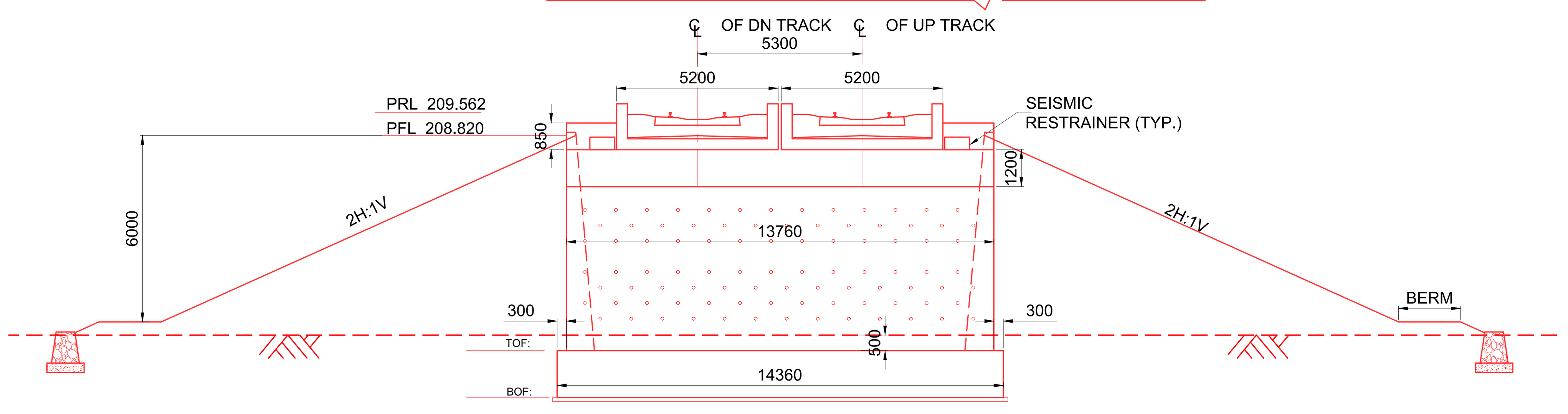
KEY PLAN
SCALE NTS



SECTION B-B
SCALE 1:100



DETAIL -1
SCALE 1:50



SECTION A-A
SCALE 1:150

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
8. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE/OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/ (Sig.)/ NR, DFCCI ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
9. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
10. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
11. DETAILED GAD WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. STANDARD OF LOADING :- SUPER STRUCTURE-25T (RDSO STANDARD PSC U SLAB),& SUB STRUCTURE-32.5T- LOADING..
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   a. IRS BRIDGE RULE
   b. IRS CONCRETE BRIDGE CODE
   c. IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
   d. IS 2911 PART-1 SECTION-2.
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   a. ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   b. LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 30M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BRIDGE AFTER PROTECTION WORK.
9. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
10. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
11. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB-STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
12. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
13. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
14. THE STRUCTURAL DIMENSIONS AND SIZES ARE INDICATIVE AND THESE MAY VARY DURING DETAIL DESIGN.
15. SIZE, TYPE OF FOUNDATION & GROUND IMPROVEMENT DETAILS SHOWN ARE TENTATIVE AND MAY CHANGE DURING DETAILED DESIGN.
16. SEISMIC ARRESTOR SHALL BE PROVIDED ON THE PIER/ABUTMENT CAP.
17. DETAIL OF TOE WALL SHALL BE PROVIDED AS PER SKETCH NO. GC-HRIDC-SK-GEN-014_A1

C) OTHER NOTES :

1. FOR SUPERSTRUCTURE DETAILS FOLLOW RDSO DRG.NO'S : RDSO 10281,10281/1 AND 10281/2.
2. TRANSITION SYSTEM TO BE ADOPTED ON BRIDGE APPROACHES SHALL BE AS PER RDSO REPORT NO. GE:R-50(TRANSITION SYSTEM ON APPROACHES OF BRIDEGES). FOR DETAILS REFER SKETCH NO. GC-HRIDC-SK-GEN-019.
3. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
4. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.

CONSTRUCTION DEPTH

1) RAIL (60kg)	172 mm
2) RUBBER PAD	10 mm
3) WIDER PSC SLEEPER HEIGHT AT RAIL SEAT	210 mm
4) MINIMUM BALLAST THK.	350 mm
TOTAL	742 mm

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
TOF	TOP OF FOUNDATION
BOF	BOTTOM OF FOUNDATION
PROW	PROPOSED HORC'S ROW

LEGEND

	PROPOSED
	EXISTING

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:
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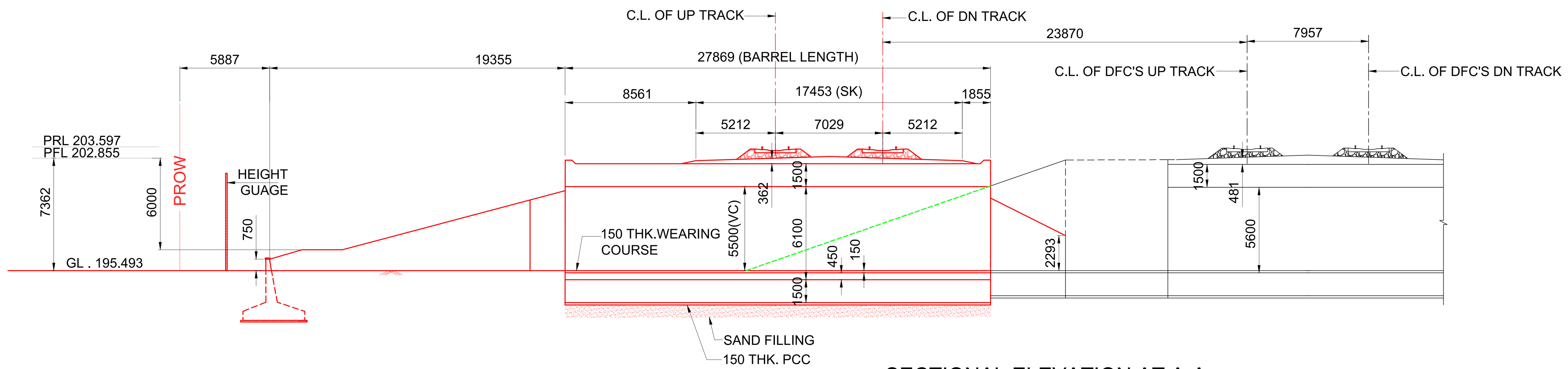
RITES Limited in consortium with SMEC International Pty. Ltd.
RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING
PROPOSED RUB BRIDGE NO. 12
1 x 12.2m PSC U SLAB CH: 1696.624

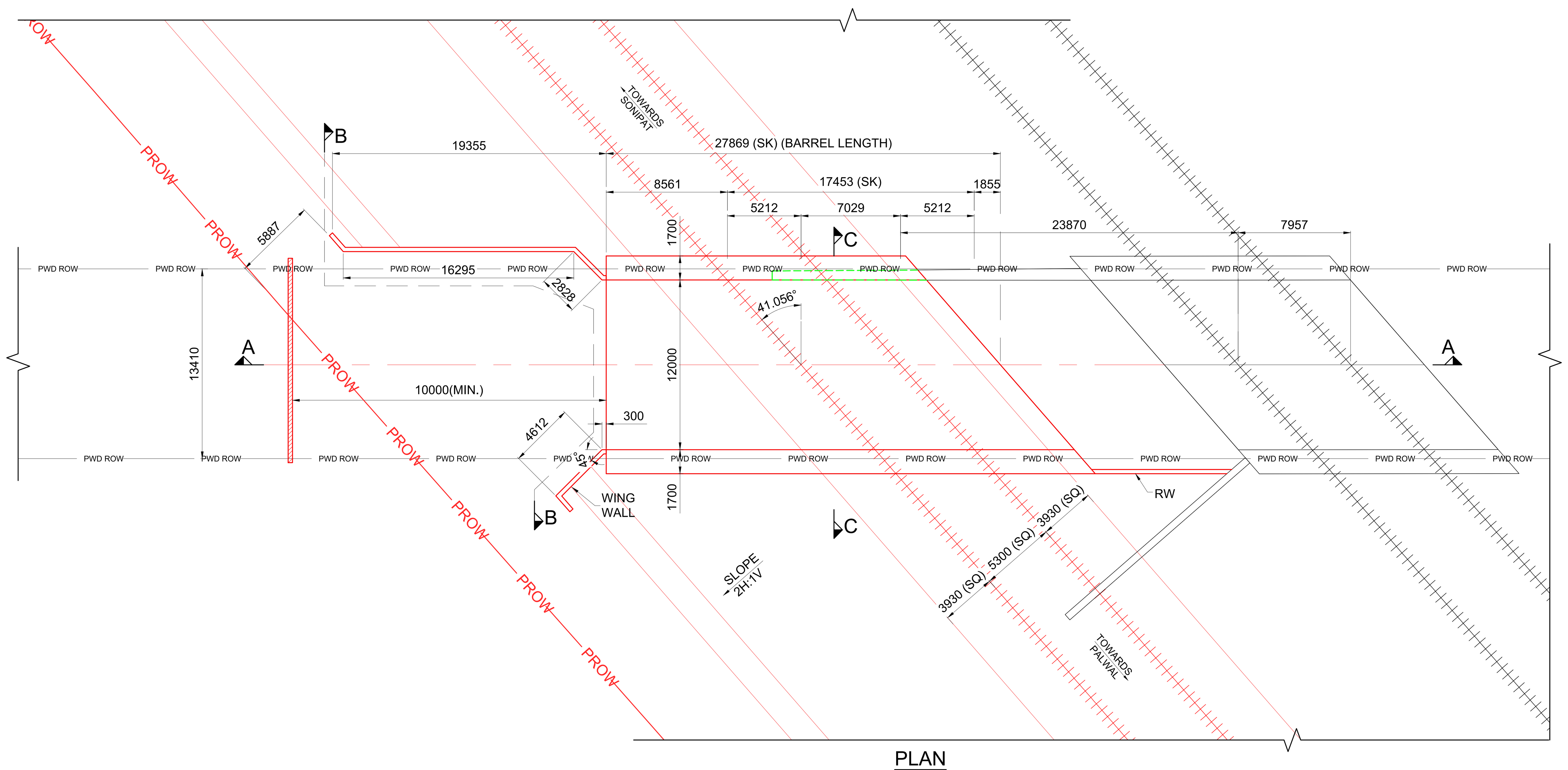
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD-01012_A0	1 OF 1

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



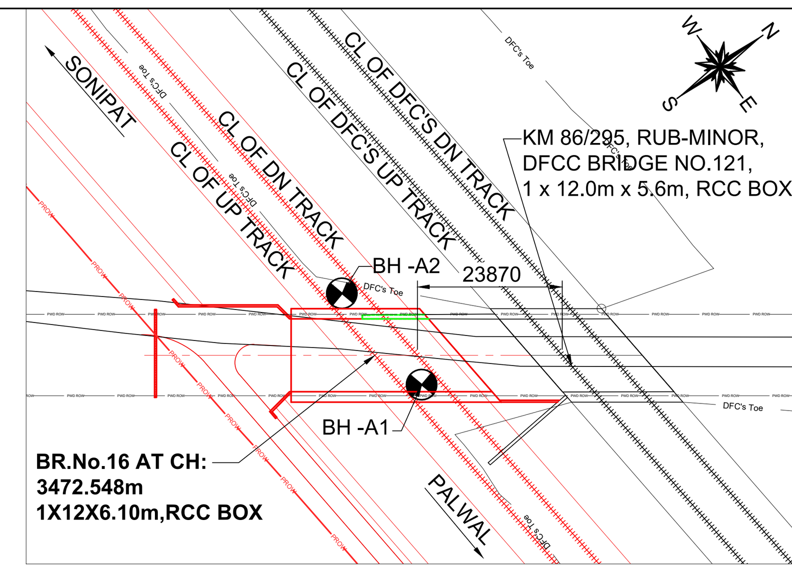
SECTIONAL ELEVATION AT A-A

SCALE 1:250



PLAN

SCALE 1:250



KEY PLAN

SCALE NTS

NOTES :

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   (i) IRS BRIDGE RULE
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   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
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16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

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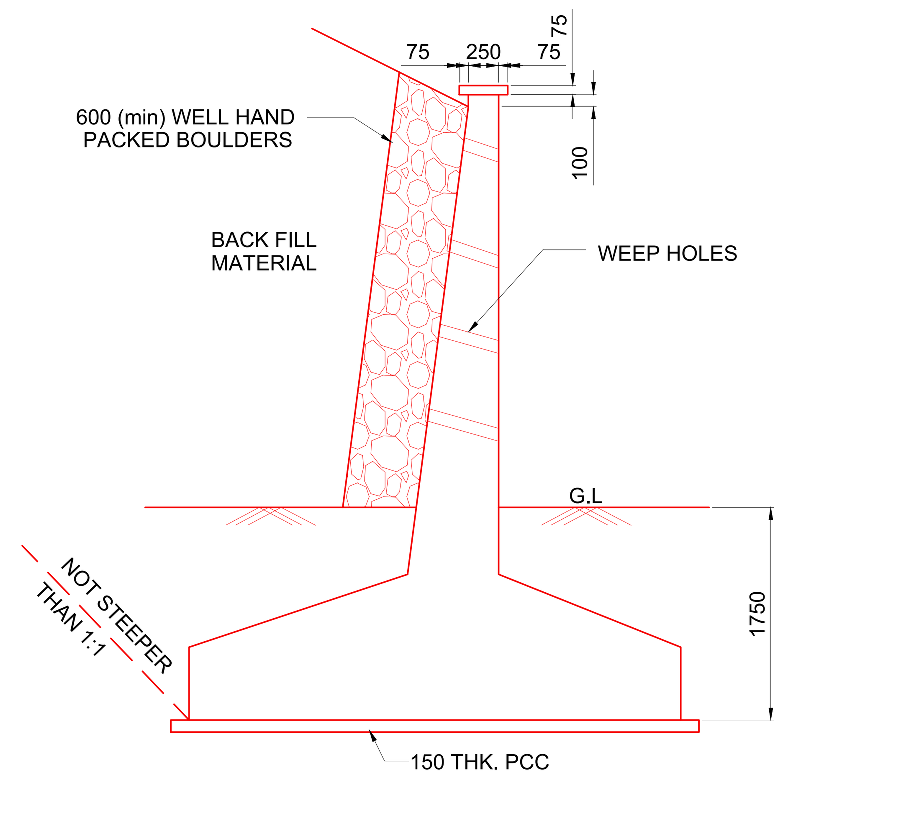
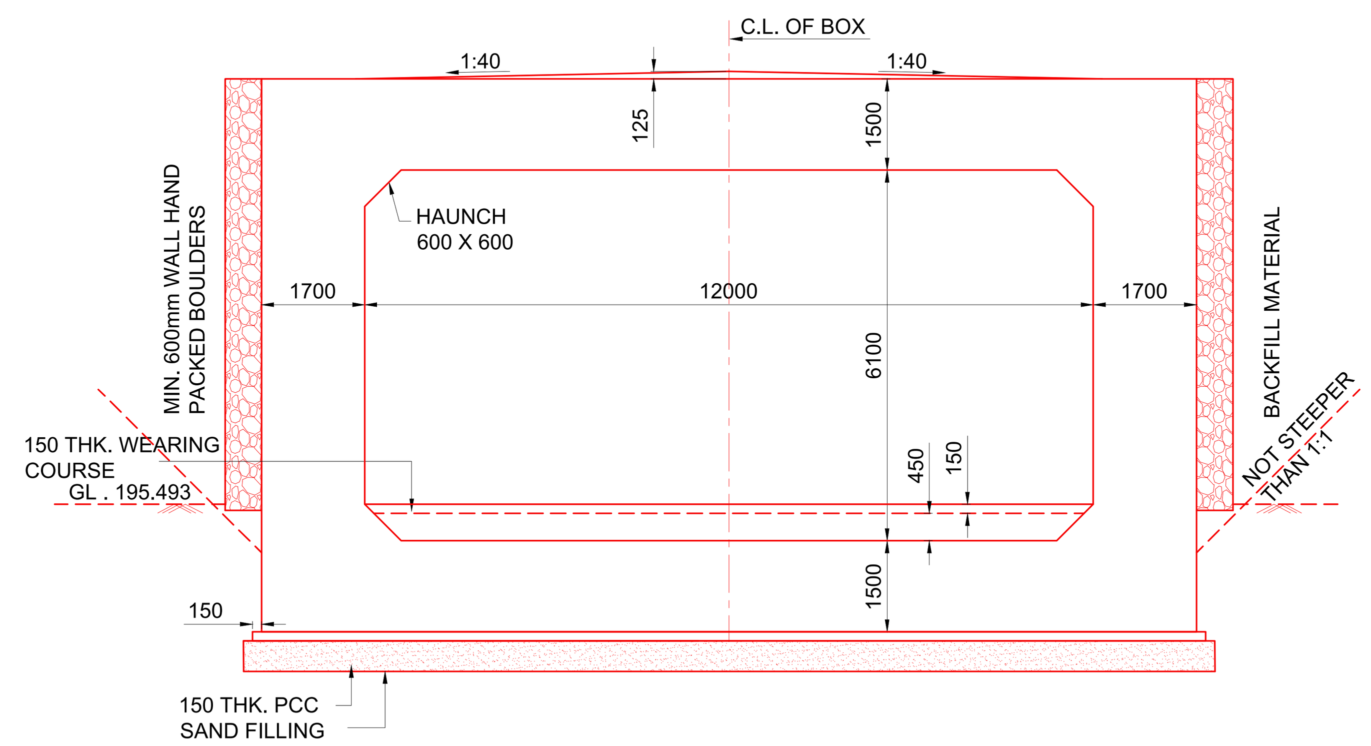


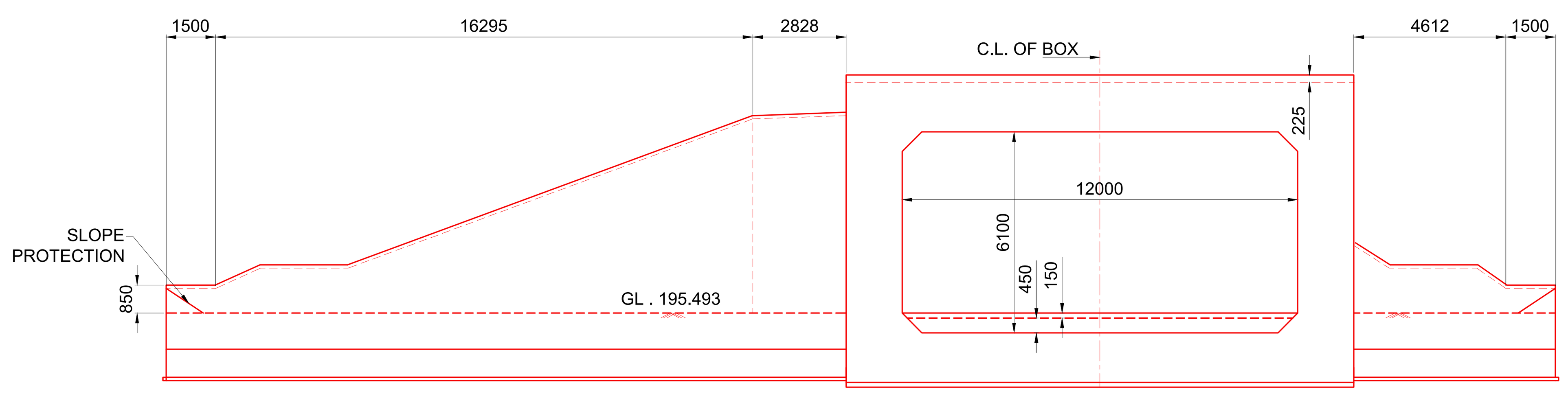
TYPICAL DETAIL OF RETAINING WALL(RW) / WING WALL

SCALE 1:50



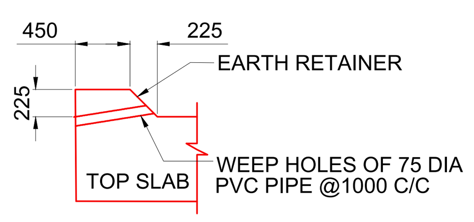
SECTION C-C

SCALE 1:100



SECTION B-B

SCALE 1:150



EARTH RETAINER

SCALE 1:50

LEGEND

(red line)	PROPOSED
(grey line)	EXISTING
(green dashed line)	DISMANTEL

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

SMEC Member of the Surbana Jurong Group

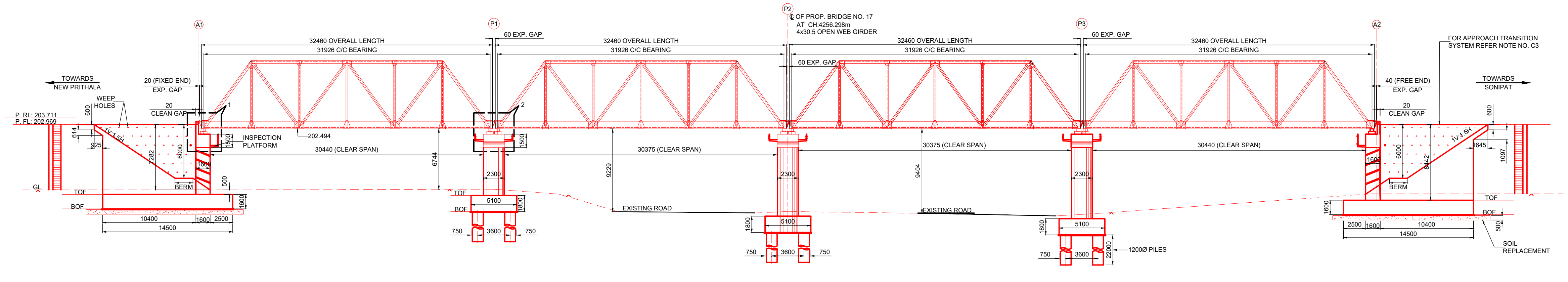
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING

PROPOSED MAJOR BRIDGE NO. 16

1X12X6.10 m,RCC BOX CH: 3472.548m

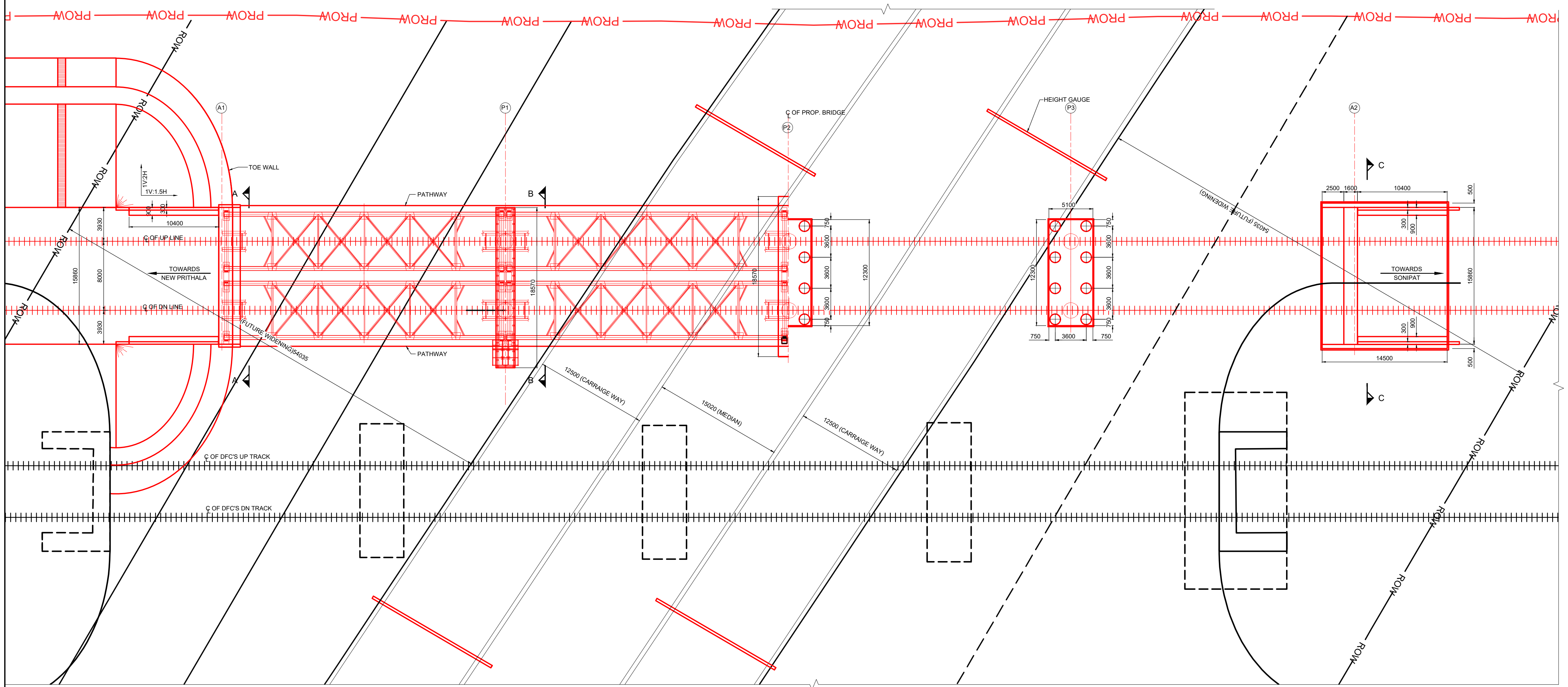
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01016_A0	1 OF 1

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	

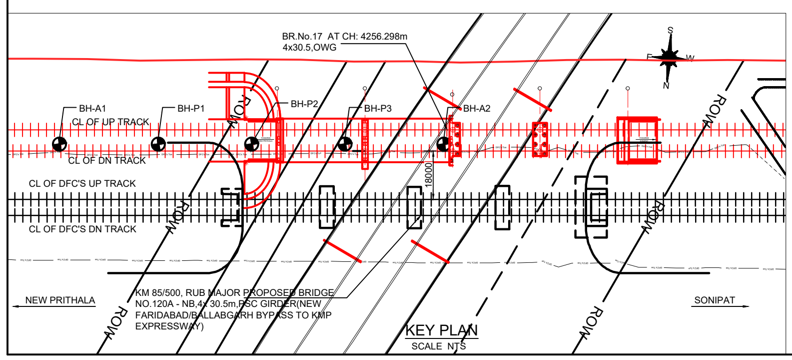


FORMATION LEVEL	202.969	202.969	202.969	202.969	202.969
GROUND LEVEL	195.685	195.765	193.280	192.950	195.262
CHAINAGE	4189.838	4223.298	4256.298	4289.298	4322.288

SECTIONAL ELEVATION
(SCALE 1:200)



HALF PLAN AT TOP HALF PLAN AT BOTTOM
SCALE 1 : 200



KEY PLAN
SCALE NTS

LEGEND

———	PROPOSED
———	EXISTING

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
RD.L	ROAD LEVEL
TOF	TOP OF FOUNDATION
BOF	BOTTOM OF FOUNDATION
THK.	THICKNESS
EXP. GAP	EXPANSION GAP
CC	CEMENT CONCRETE
TYP.	TYPICAL
GL	GROUND LEVEL
PROW	PROPOSED HORC ROW
ROW	ROAD ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	(signature)
SUDHIR AGRAWAL DPD/CIVIL	(signature)	RAJU SOLANK DGM/CIVIL	(signature)
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	(signature)
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
8. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE/OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig.)/ NR, DFCCI ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
9. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
10. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
11. DETAILED GAD WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. STANDARD OF LOADING :- SUPER STRUCTURE - 25.0T & SUB STRUCTURE - 32.5T- LOADING.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   a.IRS BRIDGE RULE
   b.IRS CONCRETE BRIDGE CODE
   c.IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
   d.IS 2911 PART-1 SECTION-2.
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   a. ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   b. LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 30M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BRIDGE AFTER PROTECTION WORK.
9. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
10. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
11. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
12. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
13. THE STRUCTURAL DIMENSIONS AND SIZES ARE INDICATIVE AND THESE MAY VARY DURING DETAIL DESIGN.
14. SIZE, TYPE OF FOUNDATION & GROUND IMPROVEMENT DETAILS SHOWN ARE TENTATIVE AND MAY CHANGE DURING DETAILED DESIGN.
15. SEISMIC ARRESTOR SHALL BE PROVIDED ON THE PIER/ABUTMENT CAP.
16. DETAIL OF TOE WALL SHALL BE PROVIDED AS PER SKETCH NO. GC-HRIDC-SK-GEN-014_A1
17. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
18. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.

C) OTHER NOTES :

1. THE CONTRACTOR SHALL DESIGN OWG (WITH SLAB) FOR 25t LOADING AS PER SKETCH NO. GC-HRIDC-SK-GEN-036.
2. PATHWAY SHALL BE PROVIDED AS PER ARRANGEMENT GIVEN IN RDSO DWG. NO. CBS-0045(FOR OWG) .
3. TRANSITION SYSTEM TO BE ADOPTED ON BRIDGE APPROACHES SHALL BE AS PER RDSO REPORT NO. GE:R-50(TRANSITION SYSTEM ON APPROACHES OF BRIDEGES). FOR DETAILS REFER SKETCH NO. GC-HRIDC-SK-GEN-019.
4. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.

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CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

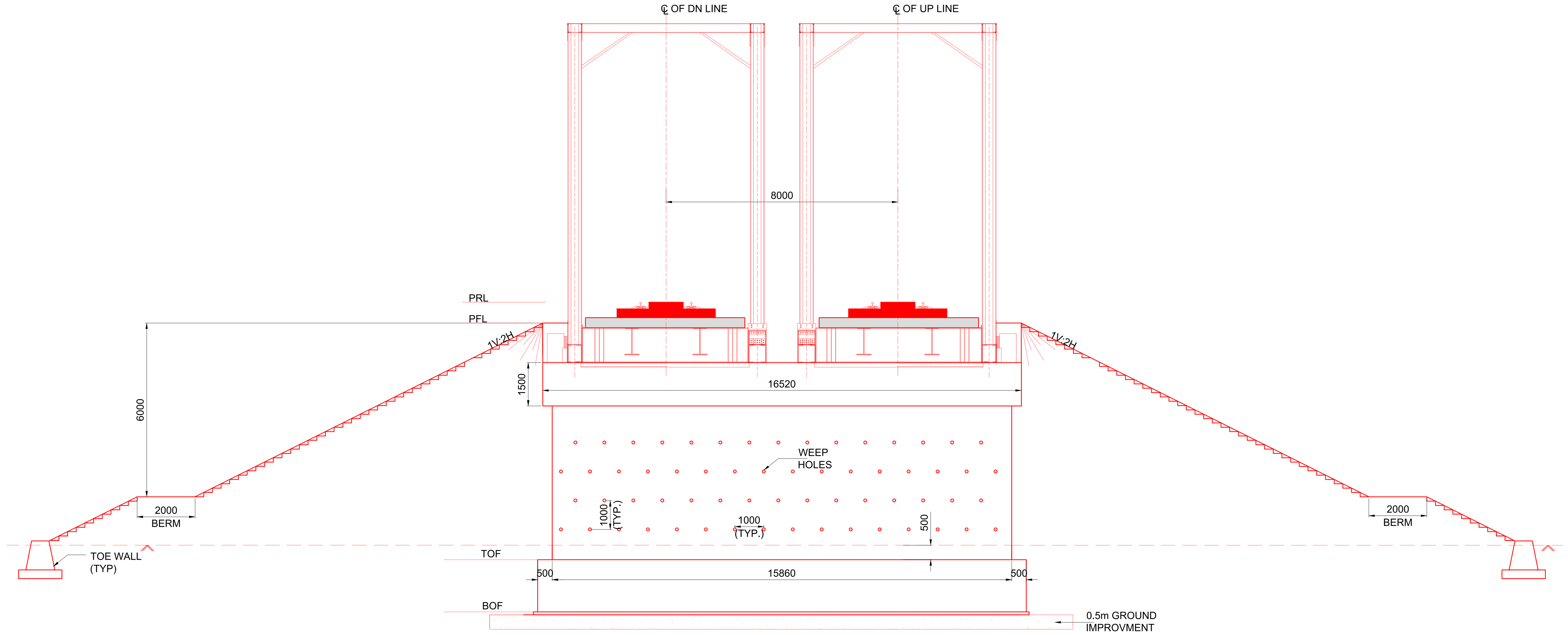
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC

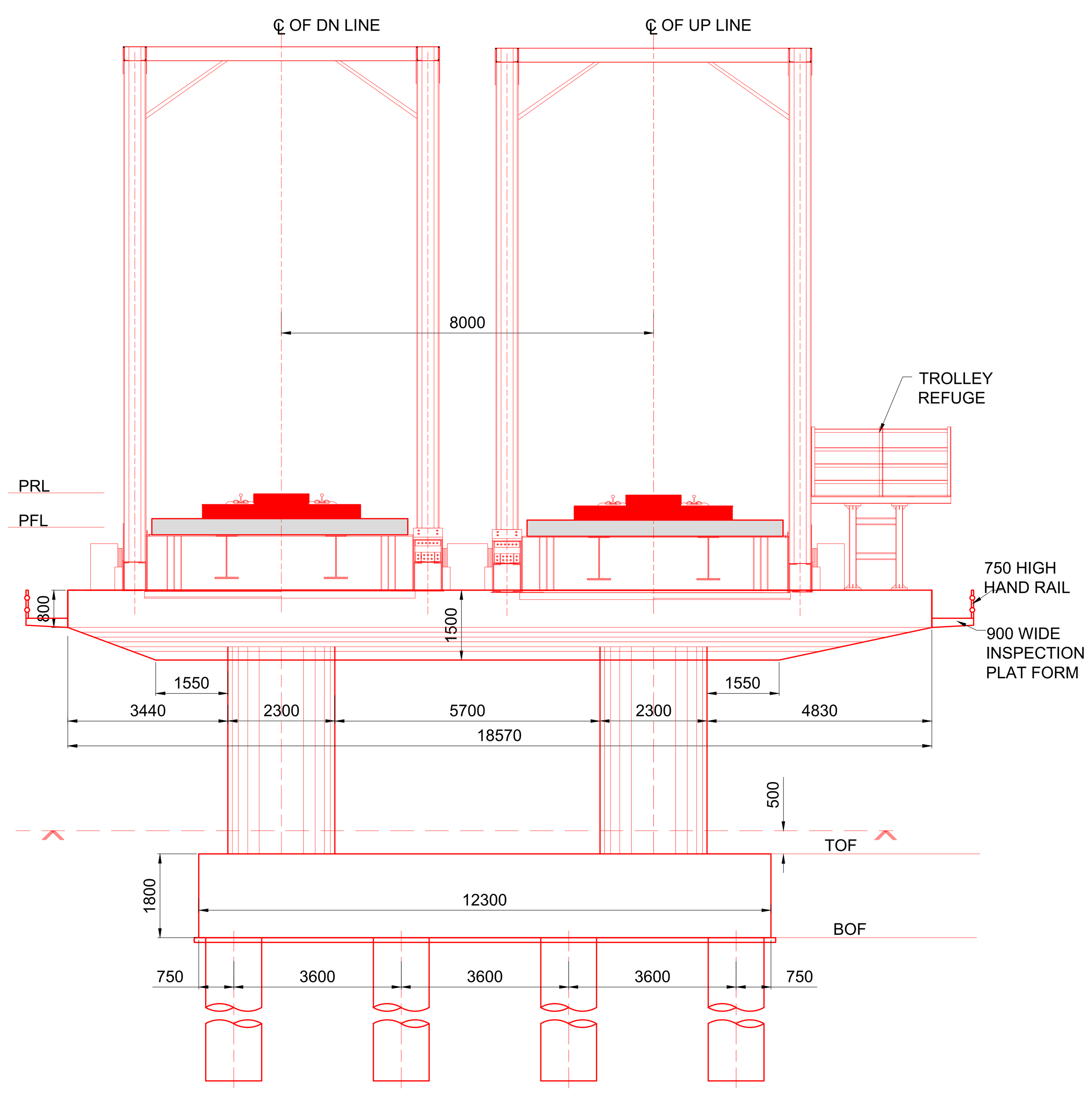
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR PROPOSED MAJOR RUB NO.17, 4X30.5 OPEN WEB GIRDER AT CH: 4256.298m. (NH-148A DND-2)

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-00017_A0	1 OF 2

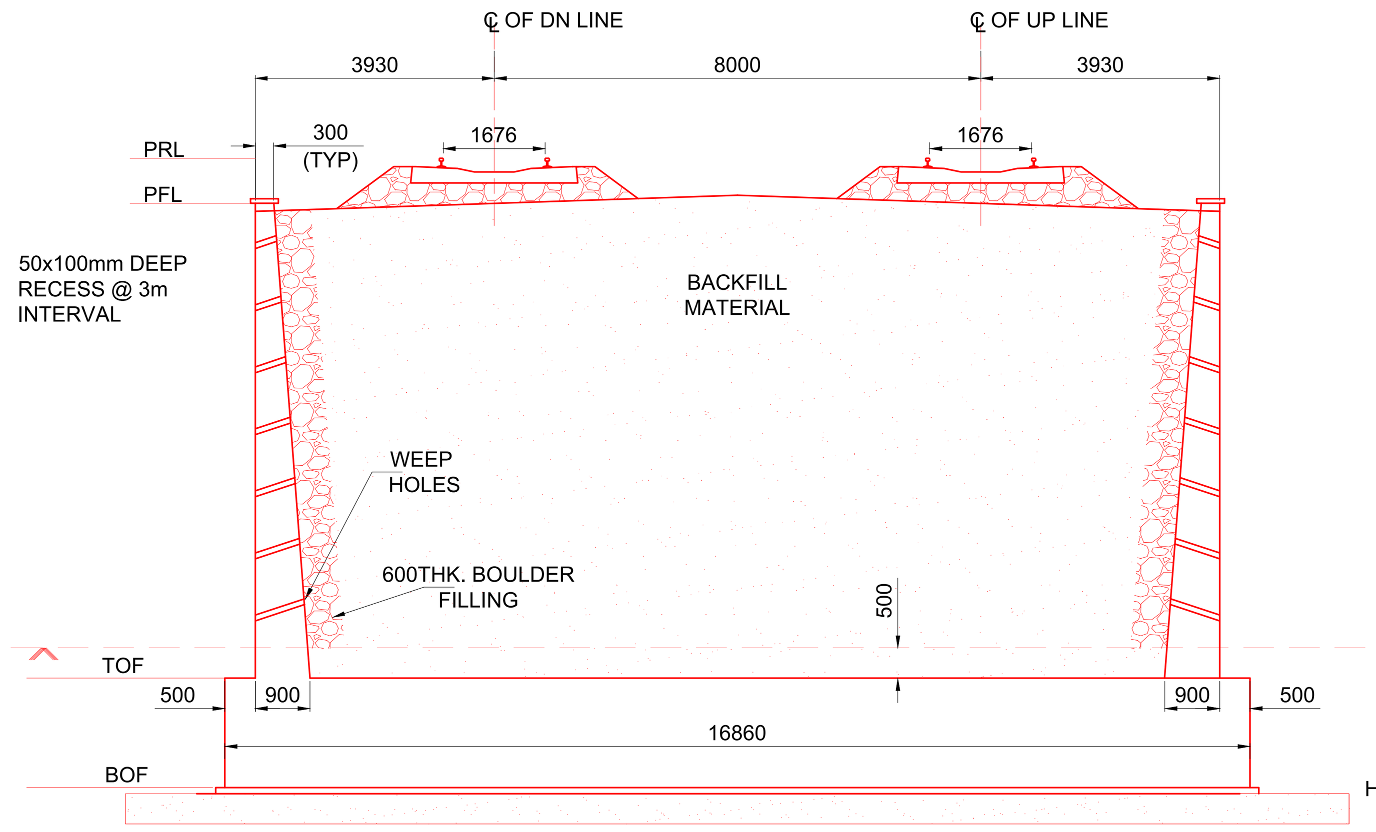
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



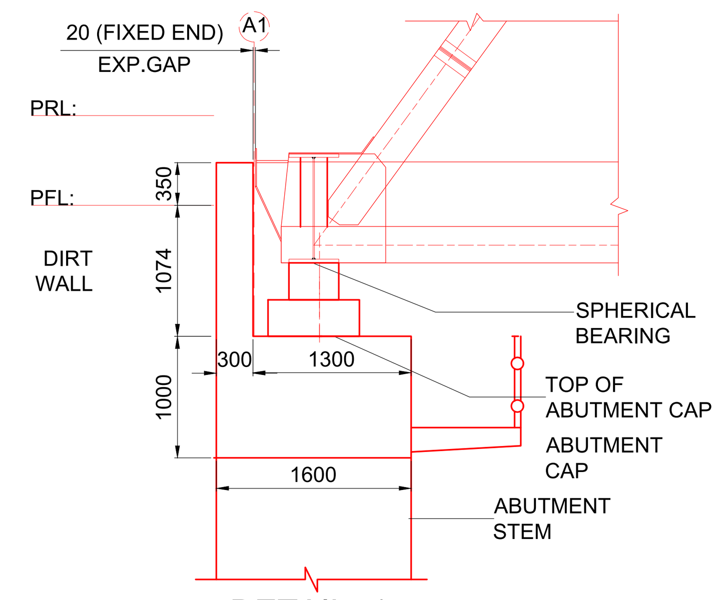
SECTION A-A
(SCALE 1:100)



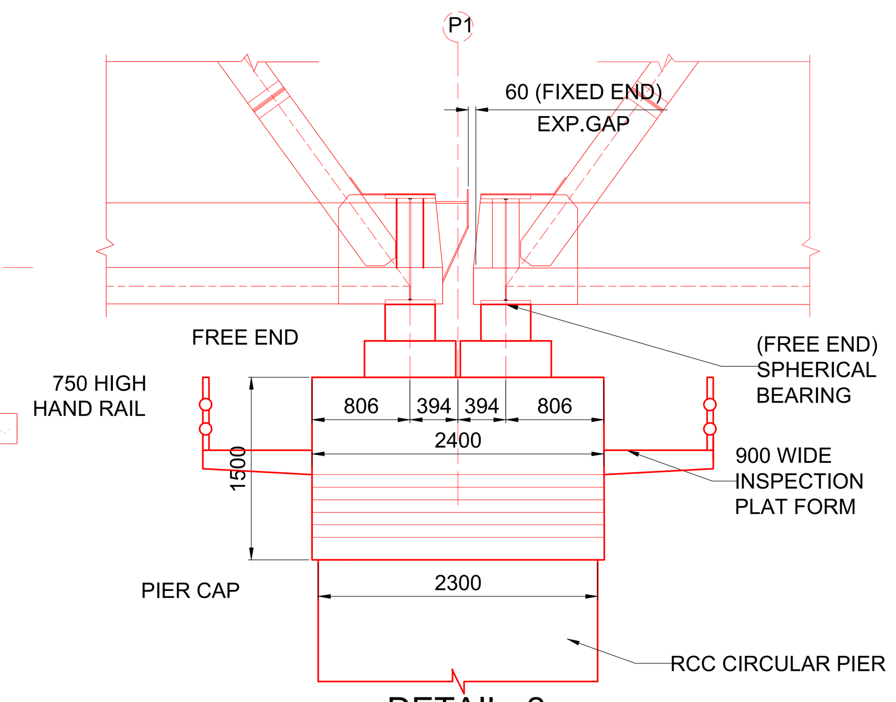
SECTION B-B
(SCALE 1:100)



SECTION C-C
(SCALE 1:100)



DETAIL -1
SCALE 1:50



DETAIL -2
SCALE 1:50

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

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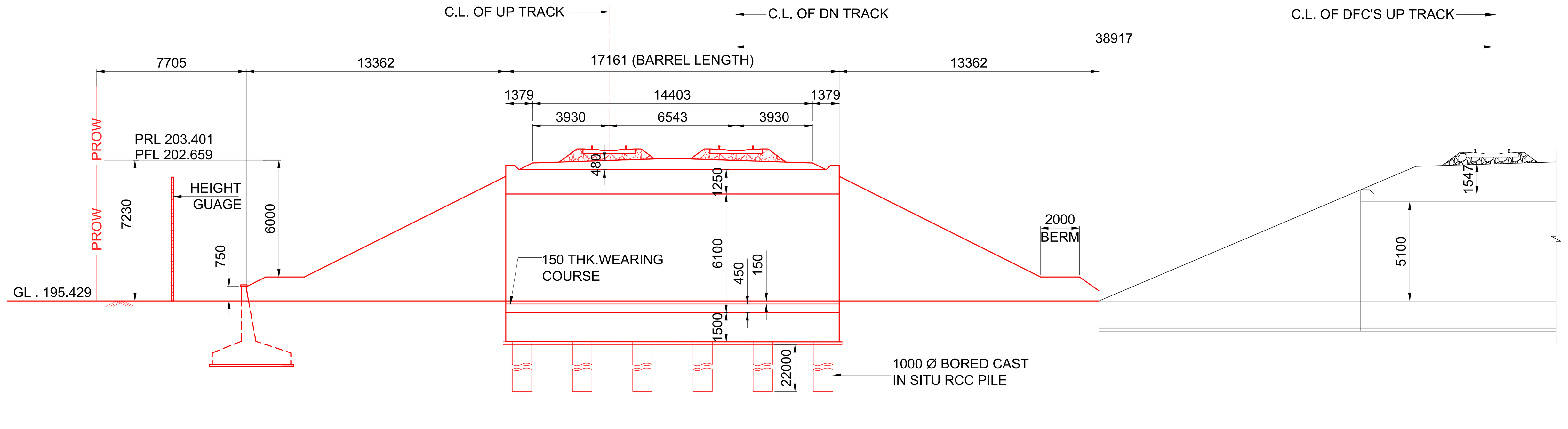
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR PROPOSED MAJOR RUB NO.17, 4X30.5 OPEN WEB GIRDER AT CH: 4256.298m. (NH-148A DND-2)

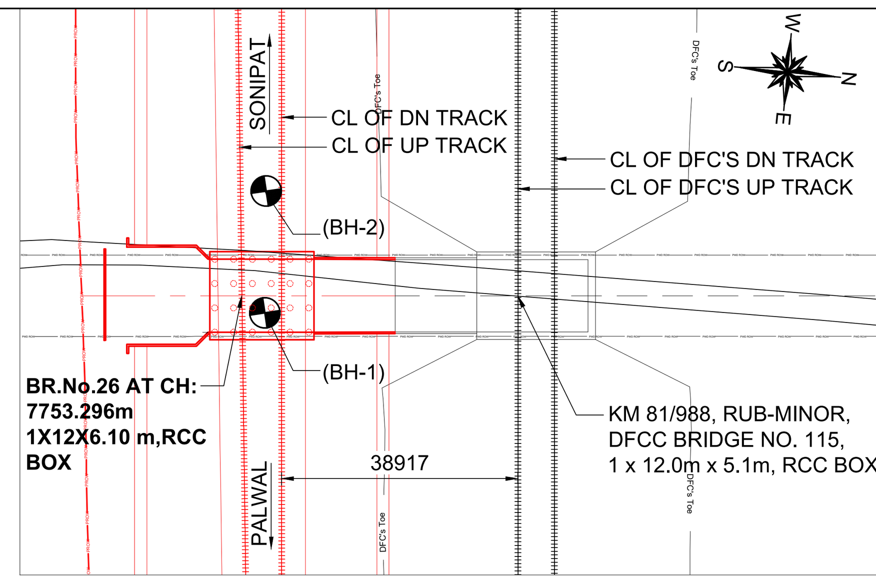
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-00017_A0	2 OF 2

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



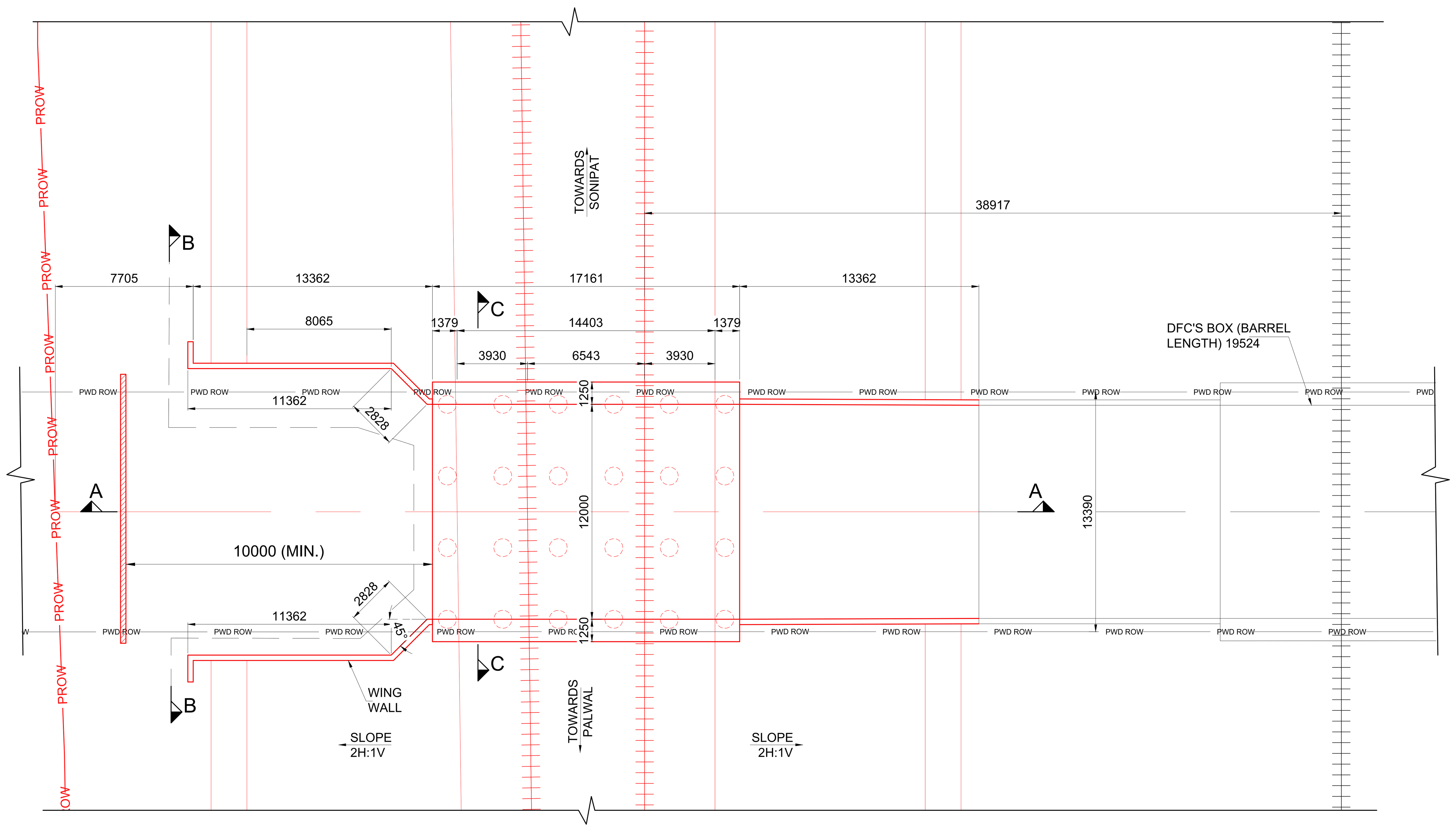
SECTIONAL ELEVATION AT A-A

SCALE 1:200



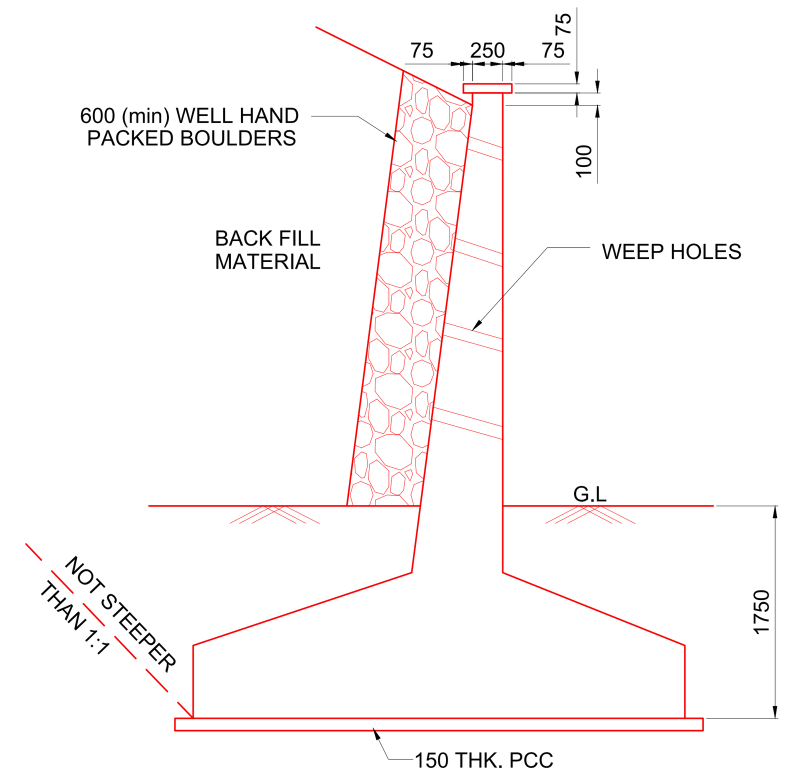
KEY PLAN

SCALE NTS



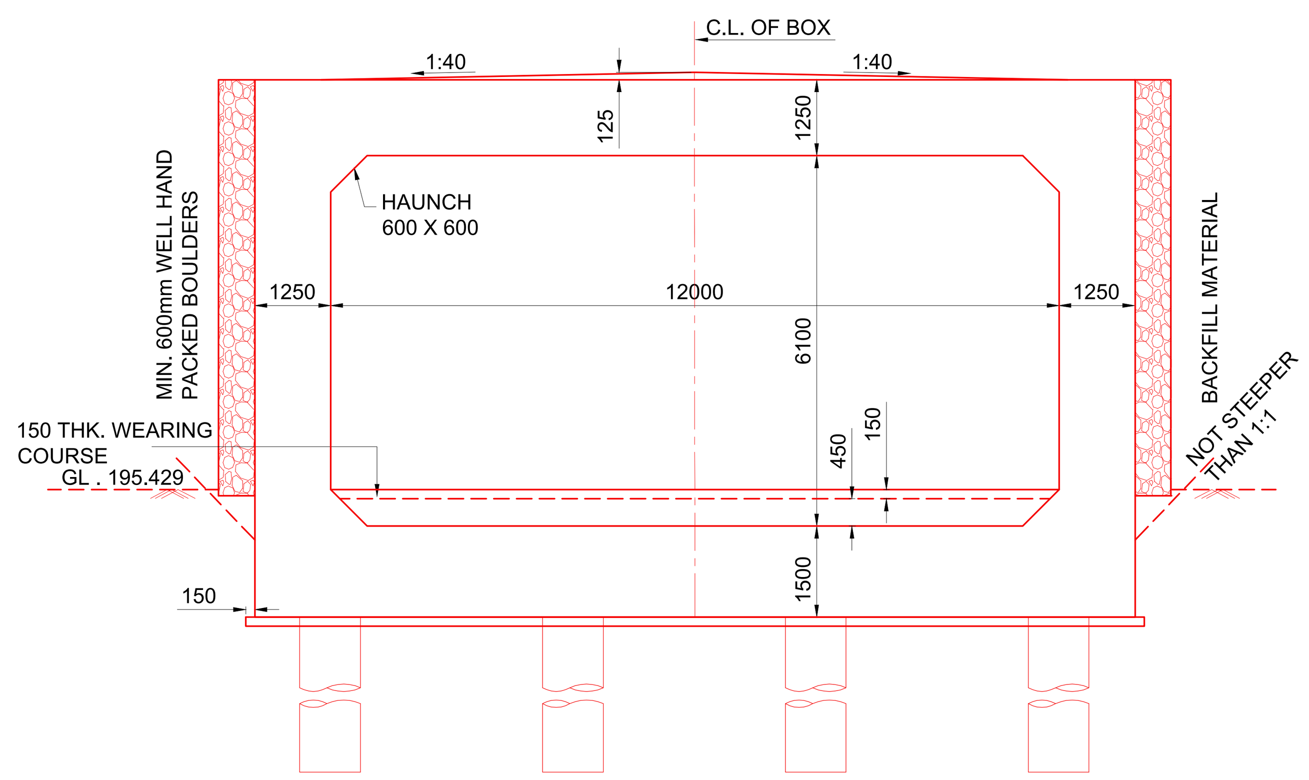
PLAN

SCALE 1:200



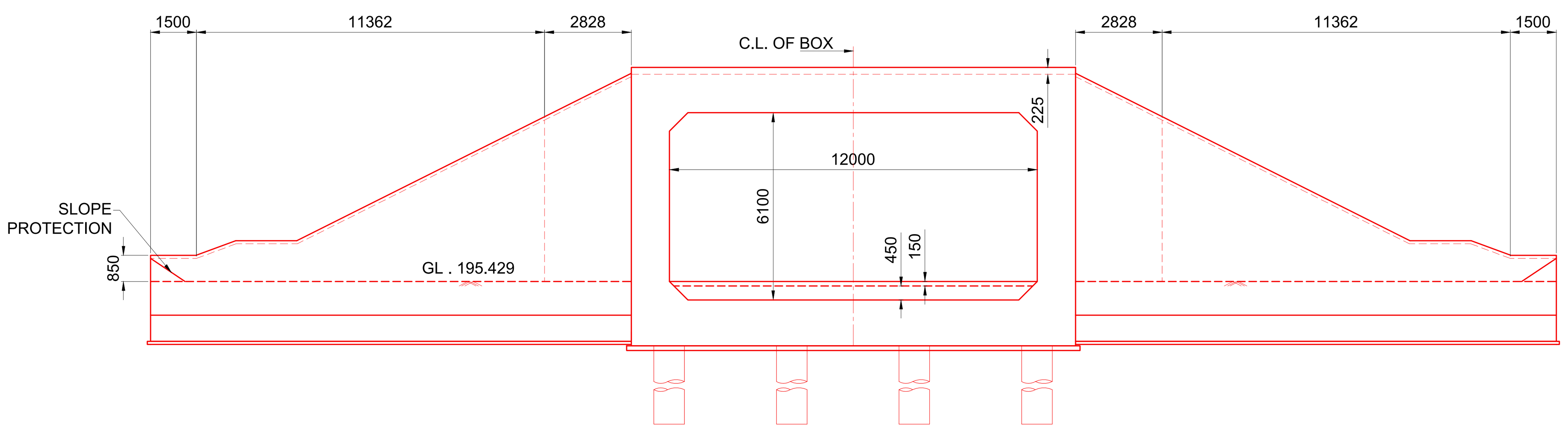
TYPICAL DETAIL OF RETAINING WALL(RW) / WING WALL

SCALE 1:50



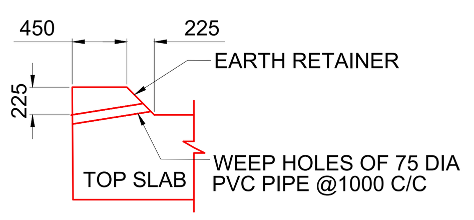
SECTION C-C

SCALE 1:100



SECTION B-B

SCALE 1:150



EARTH RETAINER

SCALE 1:50

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL, BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD,

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   (i) IRS BRIDGE RULE
   (ii) IRS CONCRETE BRIDGE CODE
   (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
14. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.

IMPORTANT NOTE:
TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PROW	PROPOSED HORC'S ROW

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

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CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

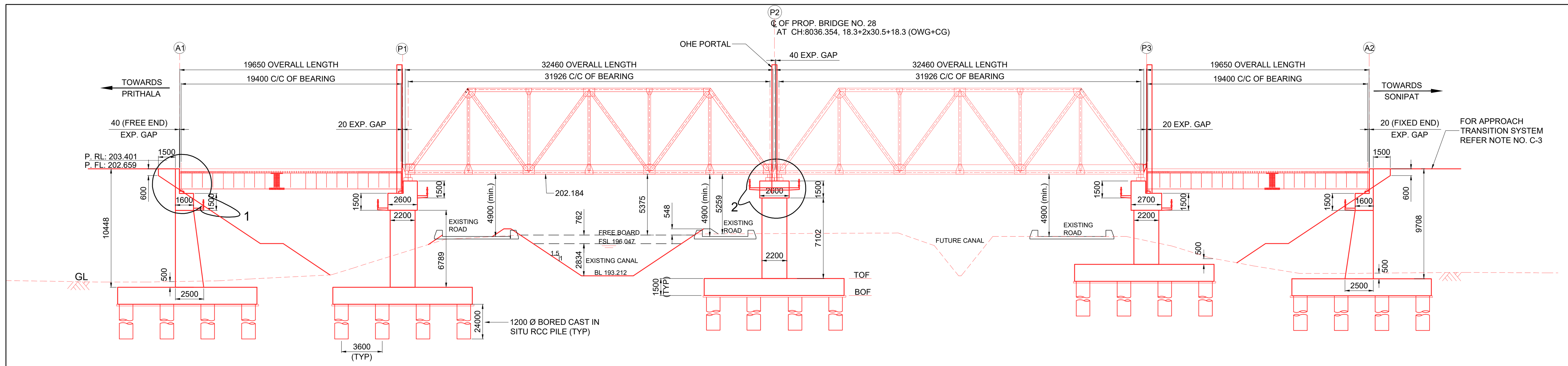
RITES THE INFRASTRUCTURE PEOPLE — SMEC Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING

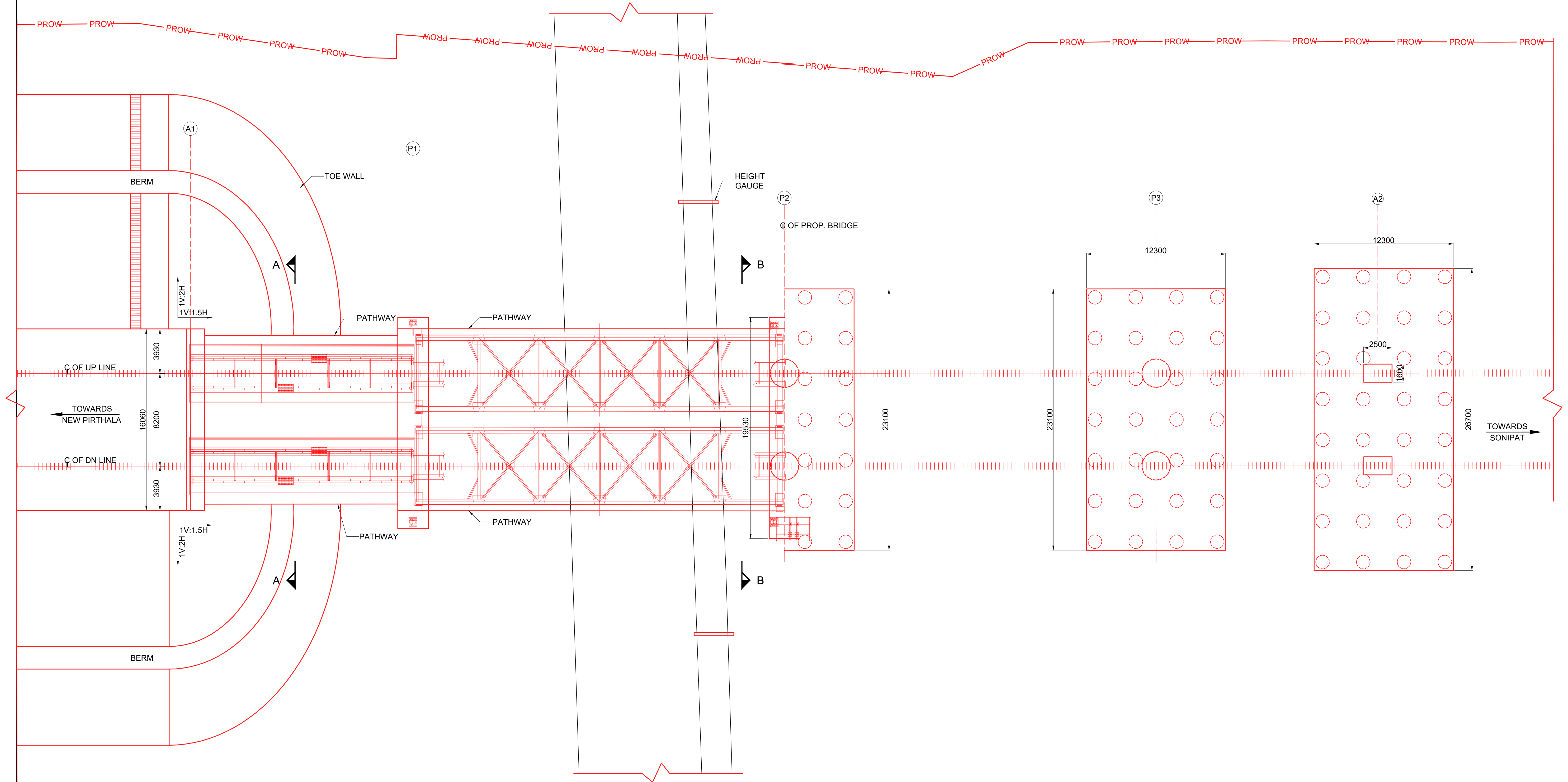
PROPOSED RUB BRIDGE NO. 26
1X12X6.10 RCC BOX CH: 7753.296m

DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01026_A0		1 OF 1
SCALE : AS SHOWN	ISSUE DATE 10-10-2023	REVISED DATE

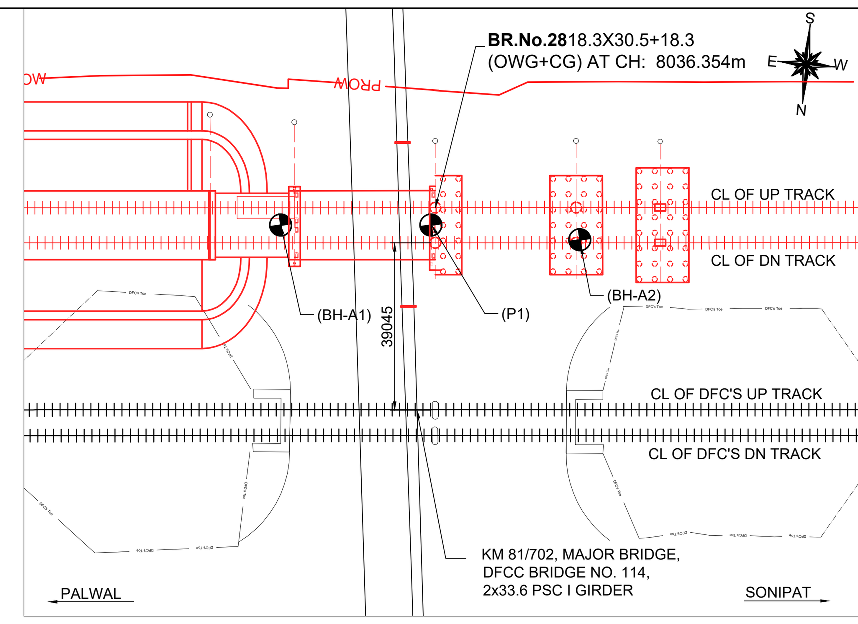


FORMATION LEVEL	202.659	202.659	202.659	202.659	202.659
GROUND LEVEL	192.717	195.423	196.721	193.479	193.446
CHAINAGE	7983.874	8003.544	8036.354	8068.164	8088.834

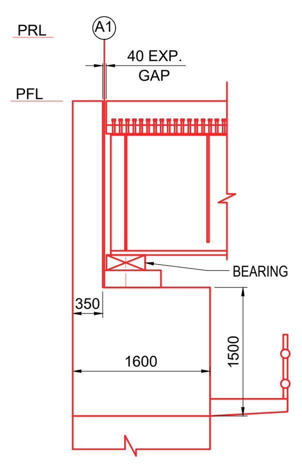
SECTIONAL ELEVATION
(SCALE 1:200)



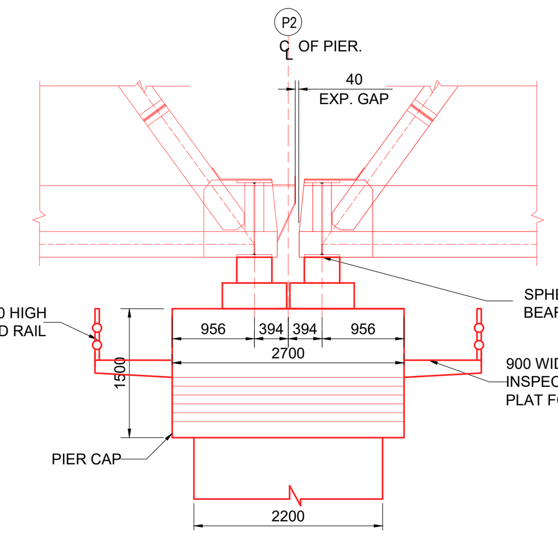
HALF PLAN AT TOP HALF PLAN AT BOTTOM
SCALE 1 : 200



KEY PLAN
SCALE NTS



DETAIL -1
SCALE 1:50



DETAIL -2
SCALE 1:50

LEGEND

(red line)	PROPOSED
(black line)	EXISTING

CONSTRUCTION DEPTH

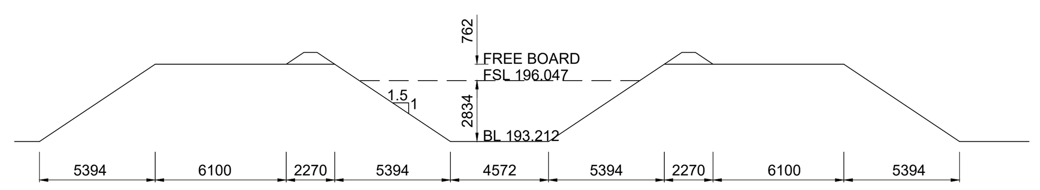
1) RAIL (60kg)	172 mm
2) RUBBER PAD	10 mm
3) WIDER PSC SLEEPER HEIGHT AT RAIL SEAT	210 mm
4) MINIMUM BALLAST THK.	350 mm
TOTAL	742 mm

ABBREVIATION

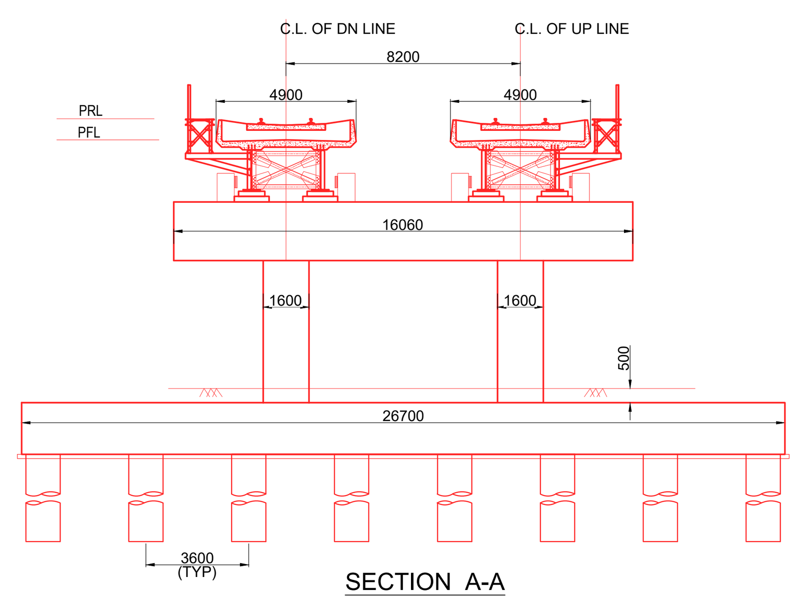
PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
RD.L	ROAD LEVEL
TOF	TOP OF FOUNDATION
BOF	BOTTOM OF FOUNDATION
THK.	THICKNESS
EXP. GAP	EXPANSION GAP
CC	CEMENT CONCRETE
TYP.	TYPICAL
GL	GROUND LEVEL
PROW	PROPOSED HORC ROW
ROW	ROAD ROW

HYDRAULIC DATA OF DRAIN

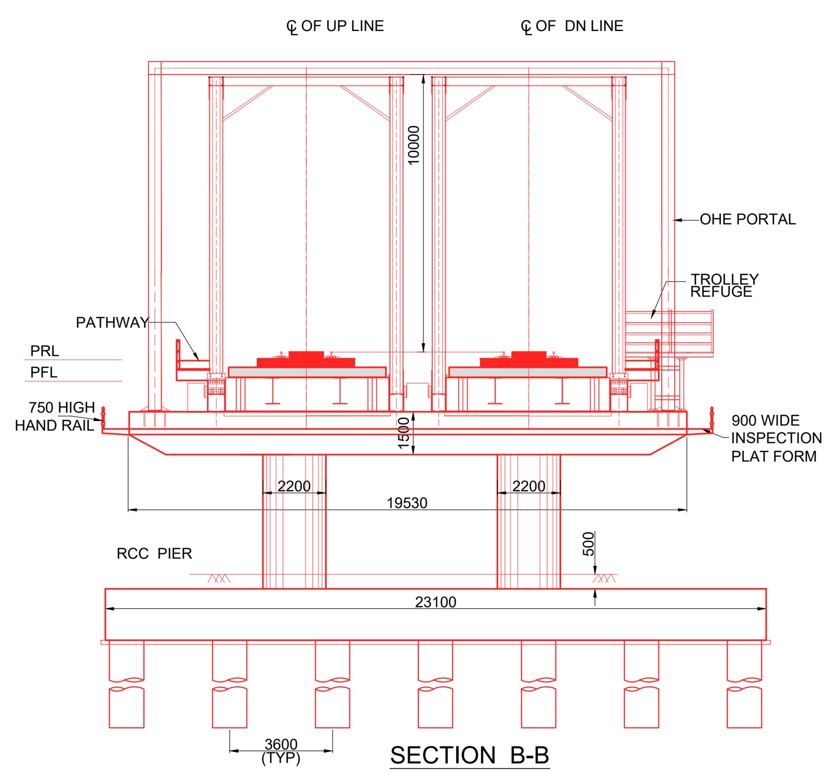
1	NAME OF CANAL	GURGAON CANAL
2	RD	8036.354/79150
3	BED LEVEL	193.212
4	FULL SUPPLY LEVEL	196.047
5	DISCHARGE	1057Cusec
6	W S SLOPE	0.15%
7	VELOCITY	3.25
8	FREE BOARD	0.762
9	SIDE SLOPE	1.5:1
10	BED WIDTH	4.572



CROSS SECTION OF CANAL
(SCALE 1:100)



SECTION A-A
SCALE 1:150



SECTION B-B
SCALE 1:150

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
8. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE/OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/ (Sig.)/ NR, DFCCI ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
9. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
10. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
11. DETAILED GAD WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. STANDARD OF LOADING :- SUPER STRUCTURE-32.5T (OWG) AND 25T (CG) SUB STRUCTURE-32.5T- LOADING..
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   a. IRS BRIDGE RULE
   b. IRS CONCRETE BRIDGE CODE
   c. IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
   d. IS 2911 PART-1 SECTION-2.
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE.
   GRADE OF CONCRETE :
   a. ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   b. LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 30M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BRIDGE AFTER PROTECTION WORK.
9. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
10. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
11. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB-STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
12. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT.
13. THE STRUCTURAL DIMENSIONS AND SIZES ARE INDICATIVE AND THESE MAY VARY DURING DETAIL DESIGN.
14. SIZE, TYPE OF FOUNDATION & GROUND IMPROVEMENT DETAILS SHOWN ARE TENTATIVE AND MAY CHANGE DURING DETAILED DESIGN.
15. SEISMIC ARRESTOR SHALL BE PROVIDED ON THE PIER/ABUTMENT CAP.
16. TROUGH MAY BE REQUIRED AT SERVICE ROAD CONNECTING DFC SERVICE ROAD WITH DFC BRIDGE UPTO HORC ROW WITH VERTICAL CLEARANCE OF MIN. 4.5m.
17. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
18. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.

C) OTHER NOTES :

1. THE CONTRACTOR SHALL DESIGN OWG (WITH SLAB) FOR 25t LOADING AS PER SKETCH NO. GC-HRIDC-SK-GEN-036 & 18.3m CG SUPERSTRUCTURE FOR 25t LOADING FOR BLT.
2. PATHWAY SHALL BE PROVIDED AS PER ARRANGEMENT GIVEN IN RDSO DWG. NO. CBS-0045(FOR OWG)& CBS-0046(FOR CG).
3. TRANSITION SYSTEM TO BE ADOPTED ON BRIDGE APPROACHES SHALL BE AS PER RDSO REPORT NO. GE:R-50(TRANSITION SYSTEM ON APPROACHES OF BRIDEGES). FOR DETAILS REFER SKETCH NO. GC-HRIDC-SK-GEN-019.
4. RCC LINING SHALL BE CONSTRUCTED FOR CANAL UPTO ROW OF HORC.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

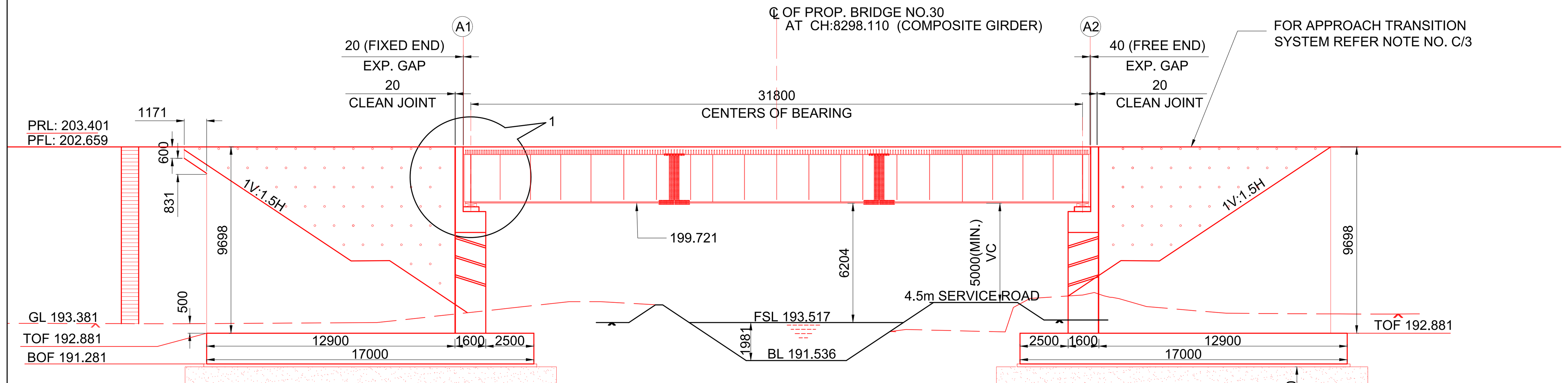
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.
THE INFRASTRUCTURE PEOPLE
Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	(signature)
SUDHIR AGRAWAL DPD/CIVIL	(signature)	RAJU SOLANK DGM/CIVIL	(signature)
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	(signature)
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

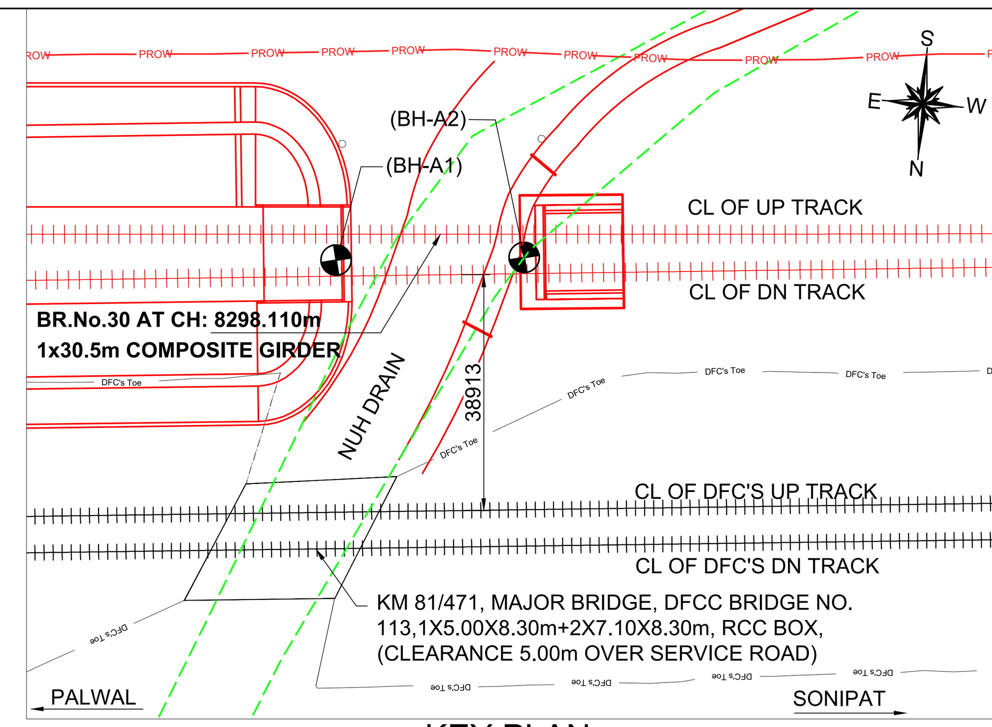
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR PROP. MAJOR BRIDGE NO.28 18.3X30.5+18.3(OWG+CG) AT CH: 8036.354m (CANAL CROSSING GURGAON CANAL RD 79150)

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01028_A0	1 OF1

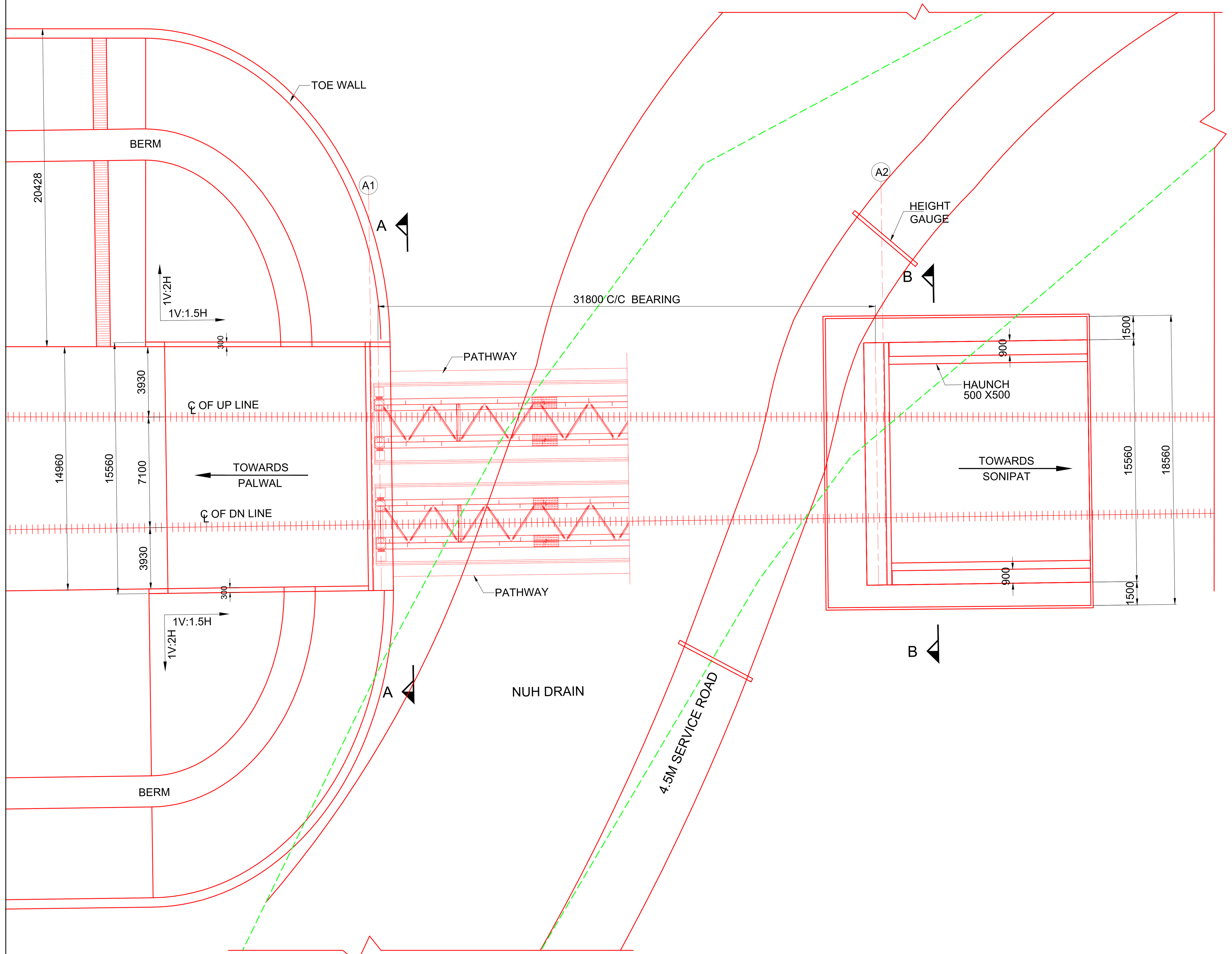
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



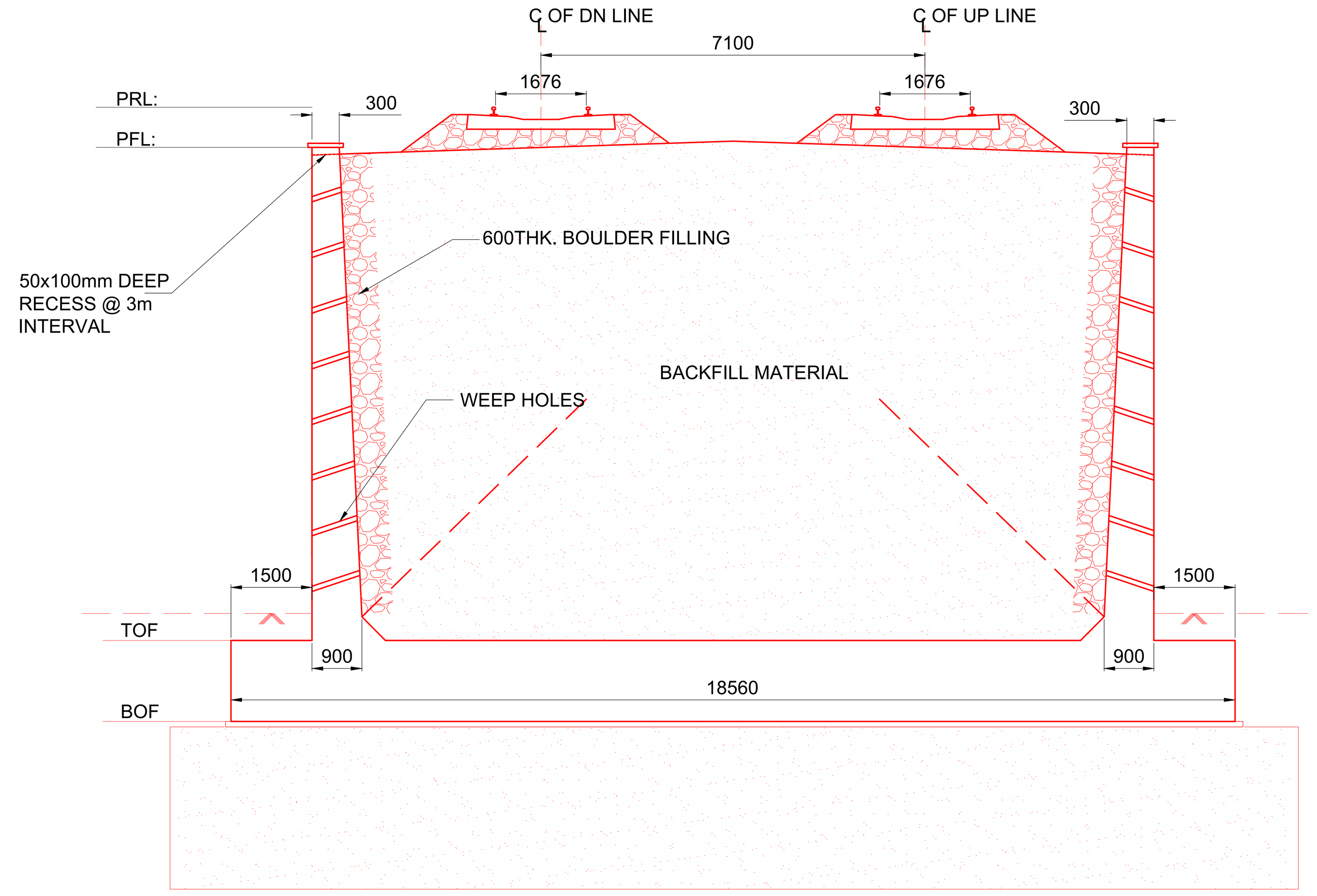
SECTIONAL ELEVATION
(SCALE 1:200)



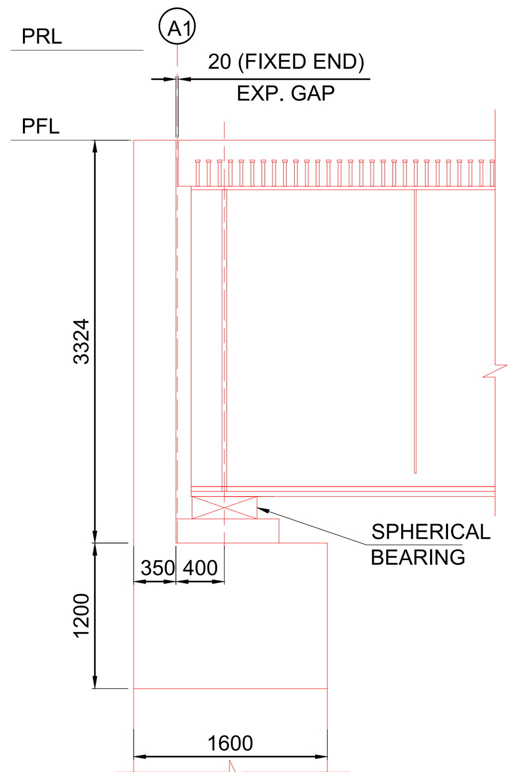
KEY PLAN
SCALE NTS



HALF PLAN AT TOP HALF PLAN AT BOTTOM
SCALE 1 : 200



SECTION B-B
SCALE 1:100



DETAIL- 1
SCALE 1:50

LEGEND

	PROPOSED
	EXISTING
	DISMANTEL

CONSTRUCTION DEPTH

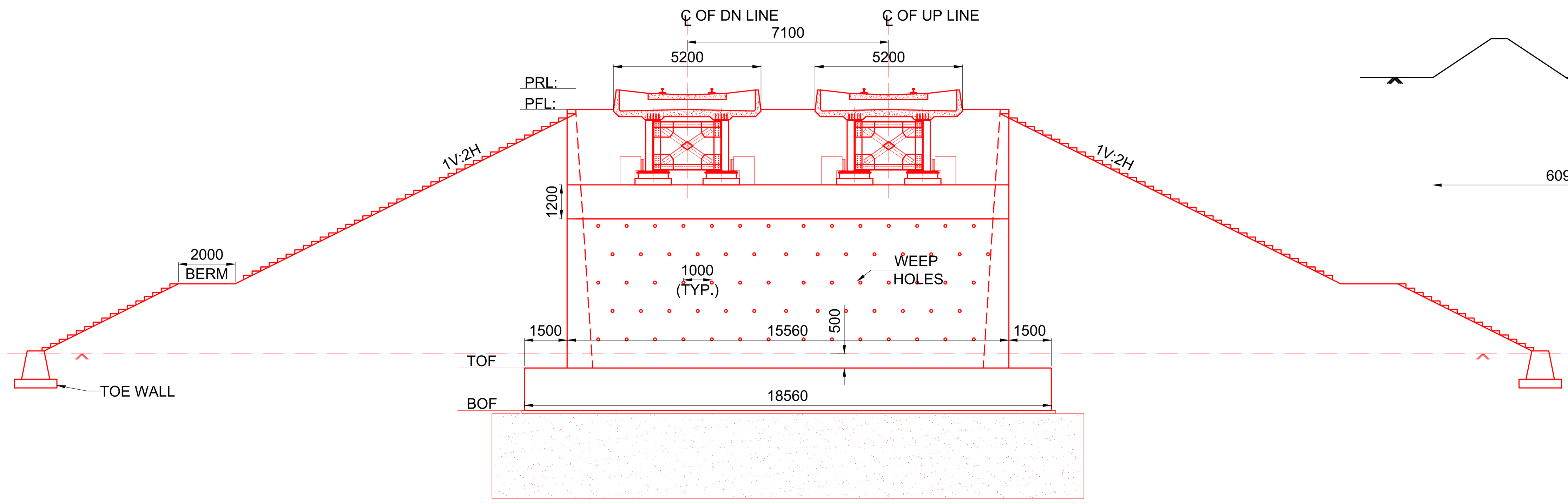
1) RAIL	172 mm
2) RUBBER PAD	10 mm
3) PSC SLEEPER	210 mm
4) BALLAST	350 mm
TOTAL	742 mm

HYDRAULIC DATA OF DRAIN

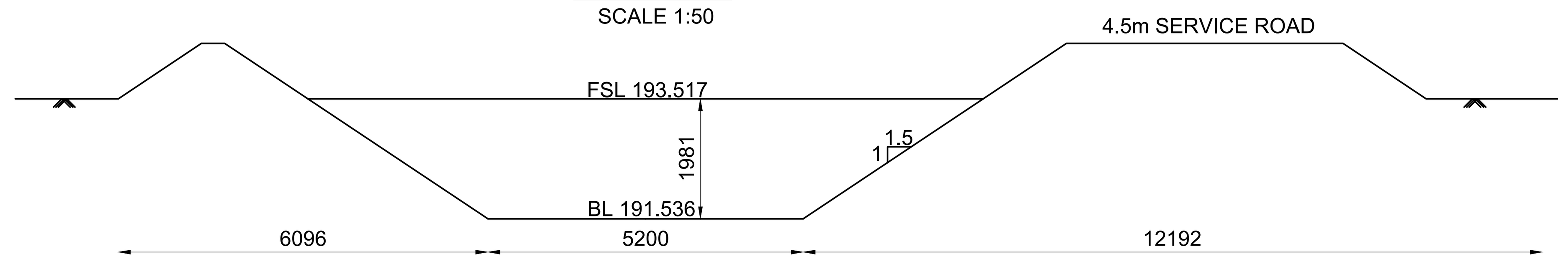
1	NAME OF CANAL	NUH DRAIN
2	RD	8298.110/87645
3	BED LEVEL (BL)	191.530m
4	FULL SUPPLY LEVEL (FSL)	193.510m
5	DISCHARGE	500Cusec
6	W S SLOPE	0.35%
7	VELOCITY	-

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
RD.L	ROAD LEVEL
TOF	TOP OF FOUNDATION
BOF	BOTTOM OF FOUNDATION
THK.	THICKNESS
EXP. GAP	EXPANSION GAP
CC	CEMENT CONCRETE
TYP.	TYPICAL
GL	GROUND LEVEL
PROW	PROPOSED HORC ROW
ROW	ROAD ROW



SECTION A-A
SCALE 1:150



CROSS SECTION OF DRAIN
(SCALE NTS)

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
8. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE/OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig.)/ NR, DFCCI ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
9. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
10. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
11. DETAILED GAD WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. STANDARD OF LOADING :- SUPER STRUCTURE-25.0T (RDSO STANDARD CG) & SUB STRUCTURE-32.5T- LOADING..
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   a. IRS BRIDGE RULE
   b. IRS CONCRETE BRIDGE CODE
   c. IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
   d. IS 2911 PART-1 SECTION-2.
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE.
   GRADE OF CONCRETE :
   a. ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   b. LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 30M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BRIDGE AFTER PROTECTION WORK.
9. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
10. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
11. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB- STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
12. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
13. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
14. THE STRUCTURAL DIMENSIONS AND SIZES ARE INDICATIVE AND THESE MAY VARY DURING DETAIL DESIGN.
15. SIZE, TYPE OF FOUNDATION & GROUND IMPROVEMENT DETAILS SHOWN ARE TENTATIVE AND MAY CHANGE DURING DETAILED DESIGN.
16. SEISMIC ARRESTOR SHALL BE PROVIDED ON THE PIER/ABUTMENT CAP.
17. DETAIL OF TOE WALL SHALL BE PROVIDED AS PER SKETCH NO. GC-HRIDC-SK-GEN-014_A1
18. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
19. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.

C) OTHER NOTES :

1. FOR SUPERSTRUCTURE DETAILS FOLLOW RDSO DWG. NO: RDSO/B-11754/R2 TO B-11754/6.
2. ARRANGEMENT FOR PATHWAY SHALL BE PROVIDED AS PER RDSO DWG. NO.CBS-0046(FOR CG) .
3. TRANSITION SYSTEM TO BE ADOPTED ON BRIDGE APPROACHES SHALL BE AS PER RDSO REPORT NO. GE:R-50(TRANSITION SYSTEM ON APPROACHES OF BRIDEGES). FOR DETAILS REFER SKETCH NO. GC-HRIDC-SK-GEN-019.
4. RCC LINING SHALL BE CONSTRUCTED FOR CANAL UPTO ROW OF HORC.
5. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

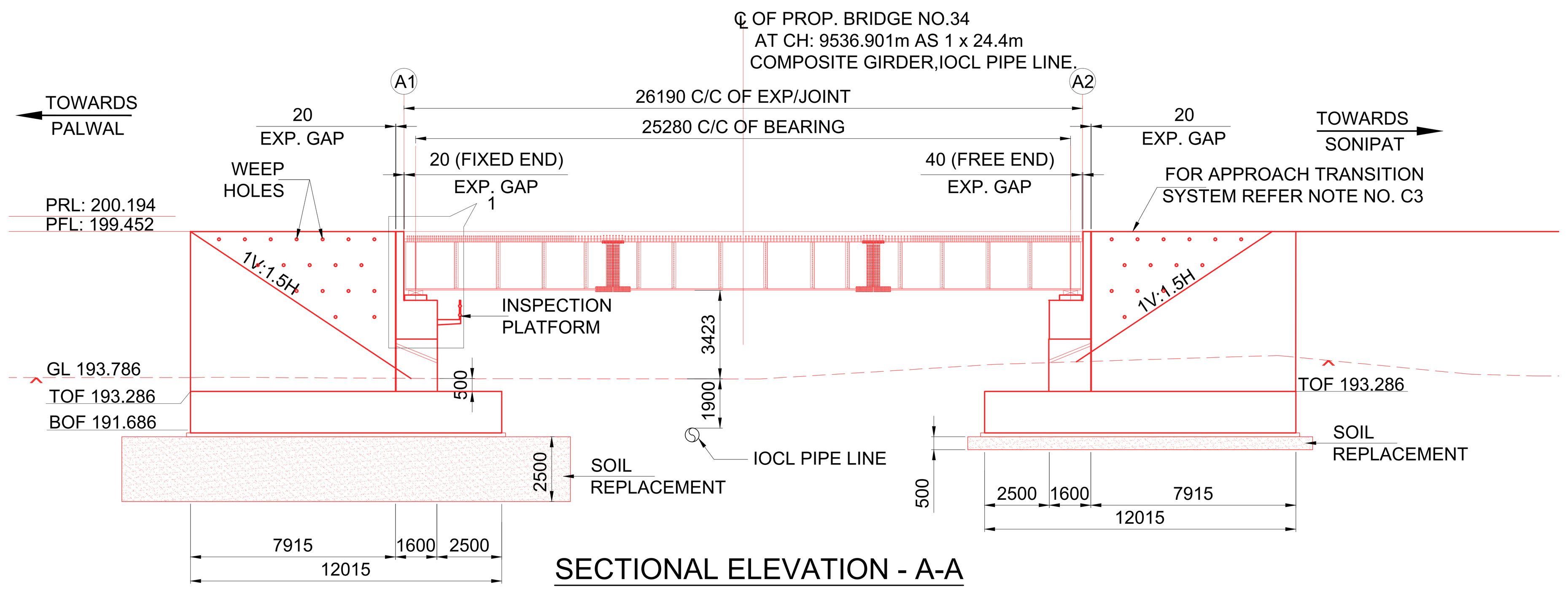
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.
RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING
FOR PROP. DRAIN CROSSING BRIDGE NO.30,
1X30.5 (COMPOSITE GIRDER) AT CH: 8298.110m
(CANAL CROSSING NUH DRAIN RD 87645)

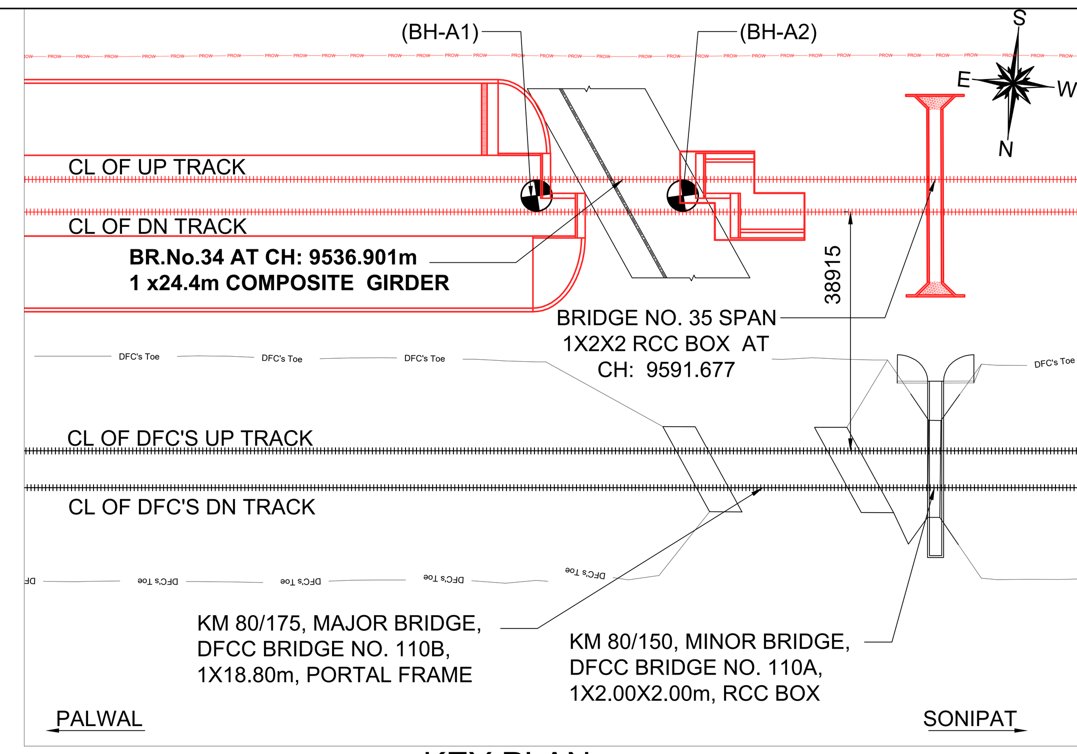
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01030_A0	1 OF1

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



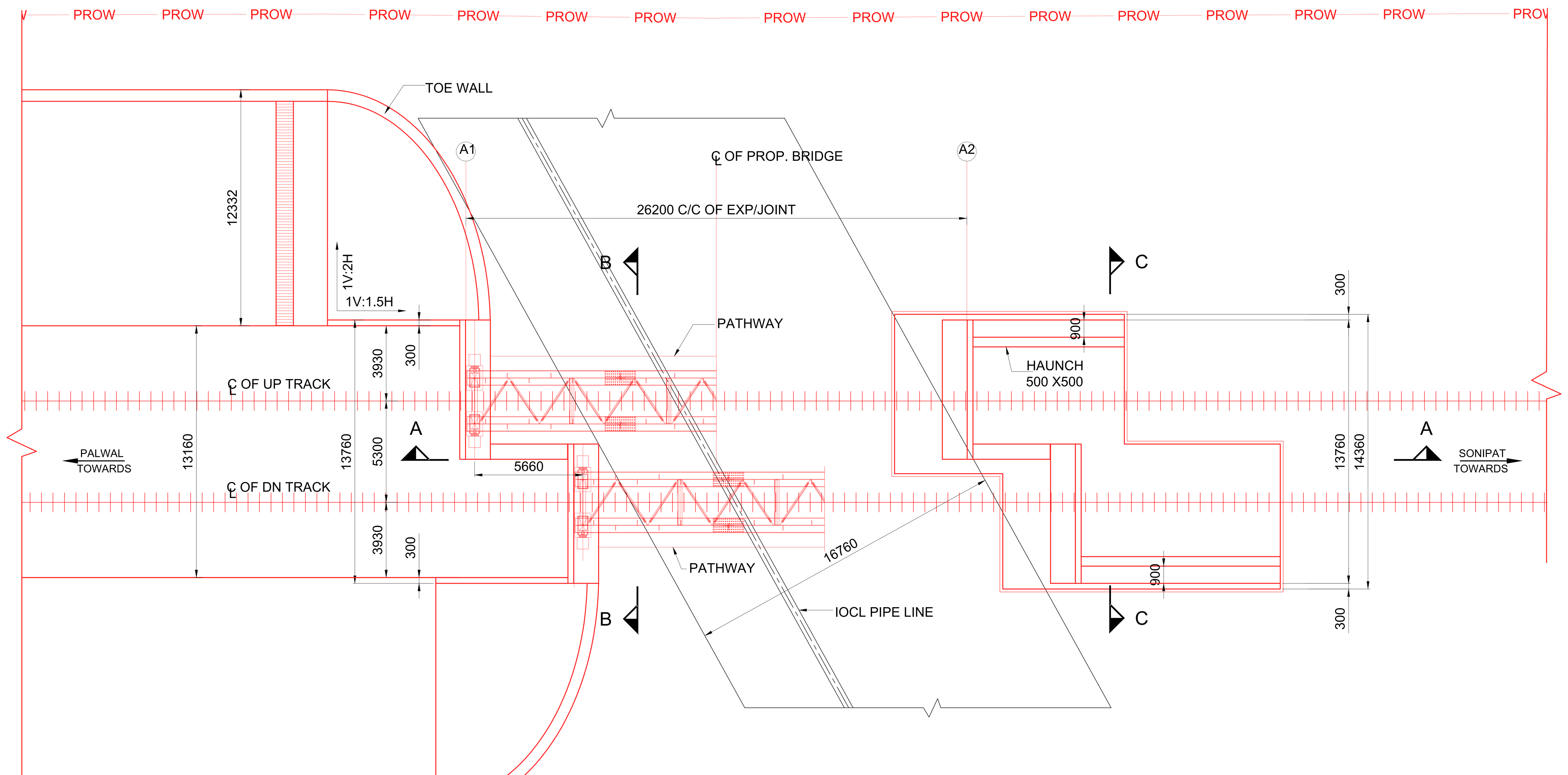
SECTIONAL ELEVATION - A-A

SCALE 1:200



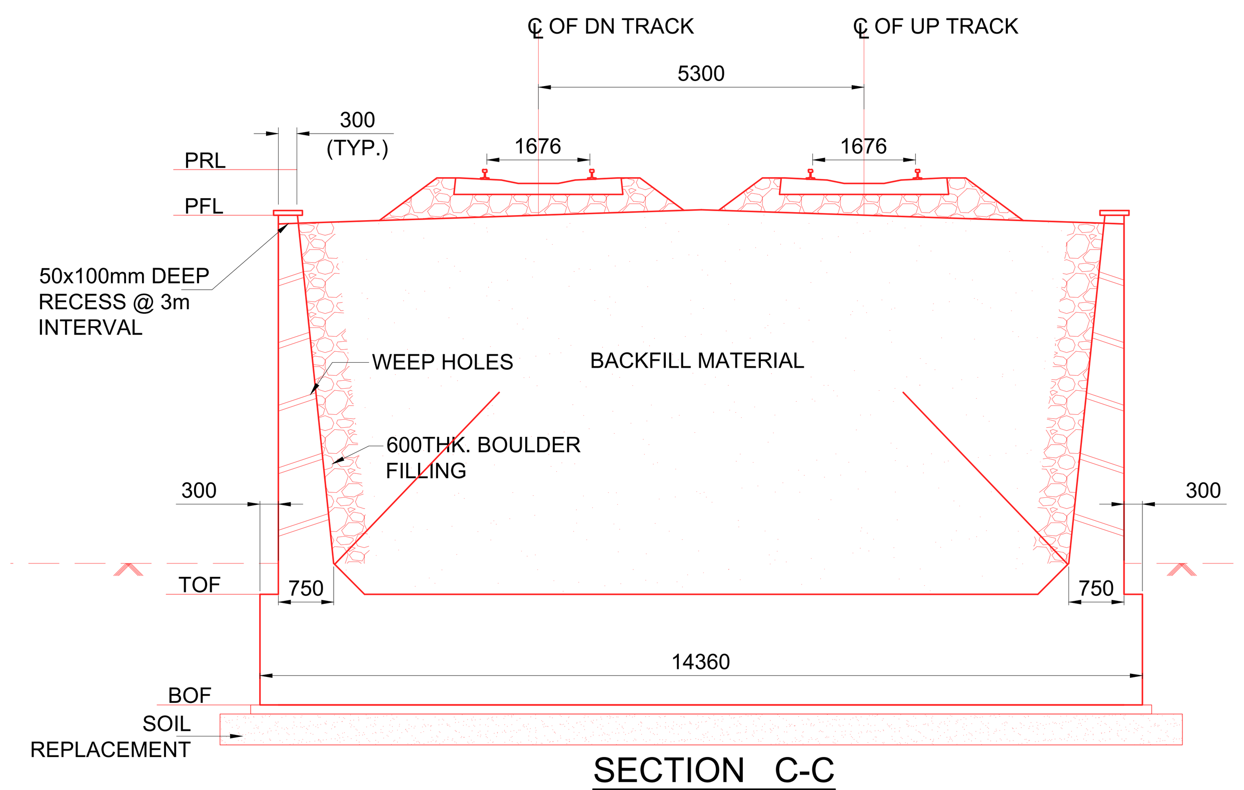
KEY PLAN

SCALE NTS



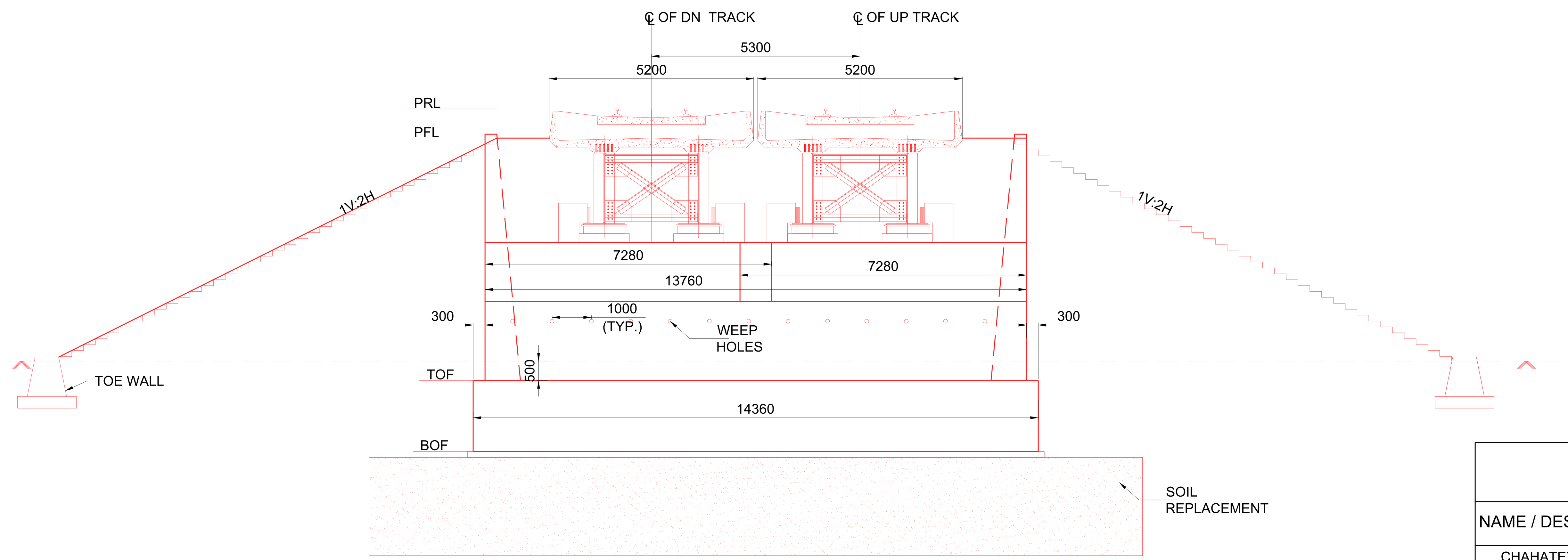
HALF PLAN AT TOP HALF PLAN AT BOTTOM

SCALE 1 : 200



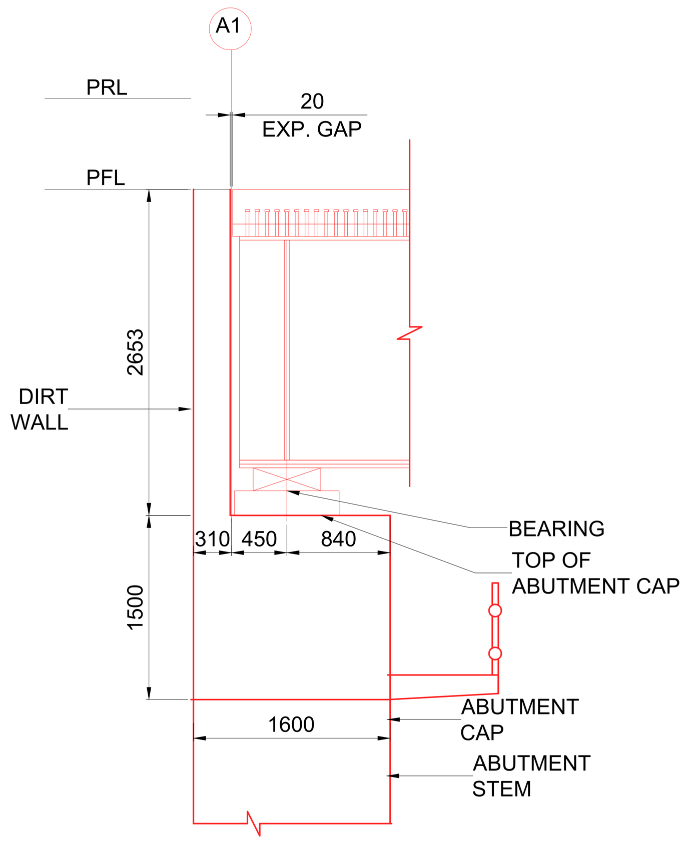
SECTION C-C

SCALE 1:100



SECTION B-B

SCALE 1:100



DETAIL -1

SCALE 1:50

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
8. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE/OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/ (Sig.)/ NR, DFCCI ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
9. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
10. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
11. DETAILED GAD WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. STANDARD OF LOADING :- SUPER STRUCTURE-25T (RDSO STANDARD CG),& SUB STRUCTURE-32.5T- LOADING.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   a.IRS BRIDGE RULE
   b.IRS CONCRETE BRIDGE CODE
   c.IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
   d.IS 2911 PART-1 SECTION-2.
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE.
   GRADE OF CONCRETE :
   a. ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   b.LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 30M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BRIDGE AFTER PROTECTION WORK.
9. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
10. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
11. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB-STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
12. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
13. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
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15. SIZE, TYPE OF FOUNDATION & GROUND IMPROVEMENT DETAILS SHOWN ARE TENTATIVE AND MAY CHANGE DURING DETAILED DESIGN.
16. SEISMIC ARRESTOR SHALL BE PROVIDED ON THE PIER/ABUTMENT CAP.
17. DETAIL OF TOE WALL SHALL BE PROVIDED AS PER SKETCH NO. GC-HRIDC-SK-GEN-014_A1

C) OTHER NOTES :

1. THE SPECIFICATIONS FOR THE SUPERSTRUCTURE REFER 24.4m COMPOSITE GIRDER RDSO/B-11754/R2 TO B-11754/6.
2. ARRANGEMENT FOR PATHWAY SHALL BE PROVIDED AS PER RDSO DWG. NO. CBS-0046(FOR CG) .
3. TRANSITION SYSTEM TO BE ADOPTED ON BRIDGE APPROACHES SHALL BE AS PER RDSO REPORT NO. GE:R-50(TRANSITION SYSTEM ON APPROACHES OF BRIDEGES). FOR DETAILS REFER SKETCH NO. GC-HRIDC-SK-GEN-019.
4. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.

LEGEND

(line)	PROPOSED
(line)	EXISTING

CONSTRUCTION DEPTH

1) RAIL	172 mm
2) RUBBER PAD	10 mm
3) PSC SLEEPER	210 mm
4) BALLAST	350 mm
TOTAL	742 mm

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
RD.L	ROAD LEVEL
TOF	TOP OF FOUNDATION
BOF	BOTTOM OF FOUNDATION
THK.	THICKNESS
EXP. GAP	EXPANSION GAP
CC	CEMENT CONCRETE
TYP.	TYPICAL
GL	GROUND LEVEL
PROW	PROPOSED HORC ROW
ROW	ROAD ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	(signature)
SUDHIR AGRAWAL DPD/CIVIL	(signature)	RAJU SOLANK DGM/CIVIL	(signature)
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	(signature)
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K.Singh		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

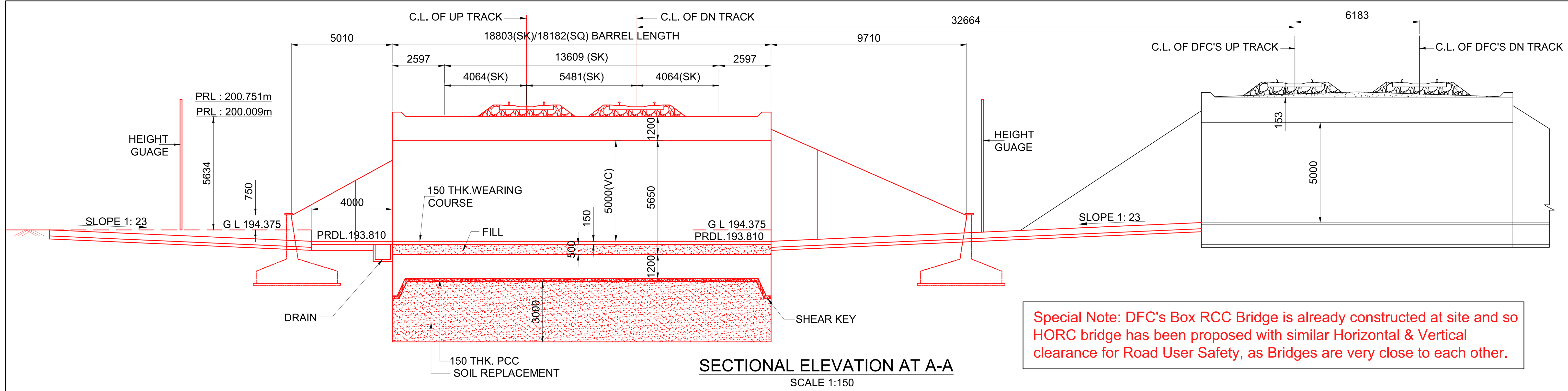
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING
PROPOSED IOCL CROSSING BRIDGE NO. 34
1 x24.4m (CG) AT CH.9536.901m

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01034_A0	1 OF 1

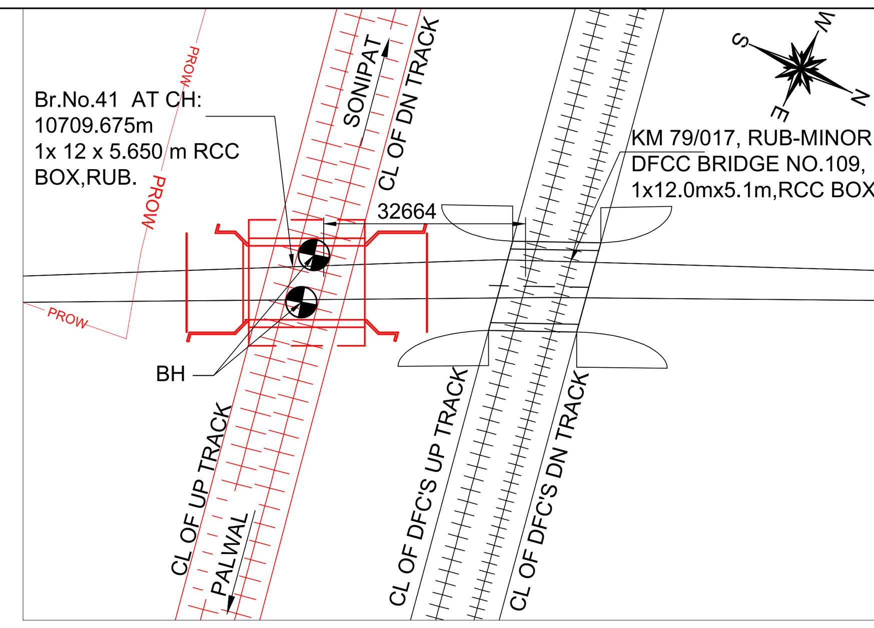
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



SECTIONAL ELEVATION AT A-A

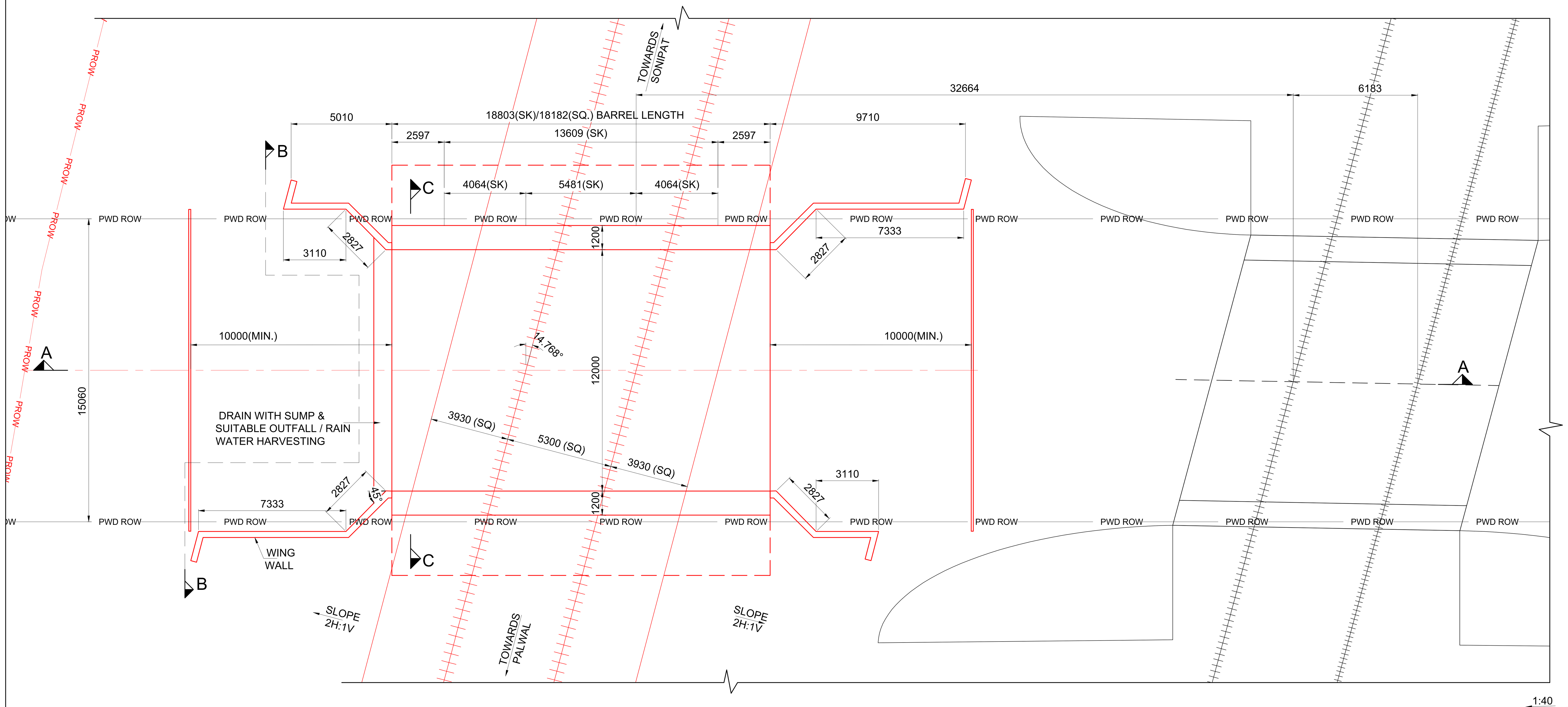
SCALE 1:150

Special Note: DFC's Box RCC Bridge is already constructed at site and so HORC bridge has been proposed with similar Horizontal & Vertical clearance for Road User Safety, as Bridges are very close to each other.



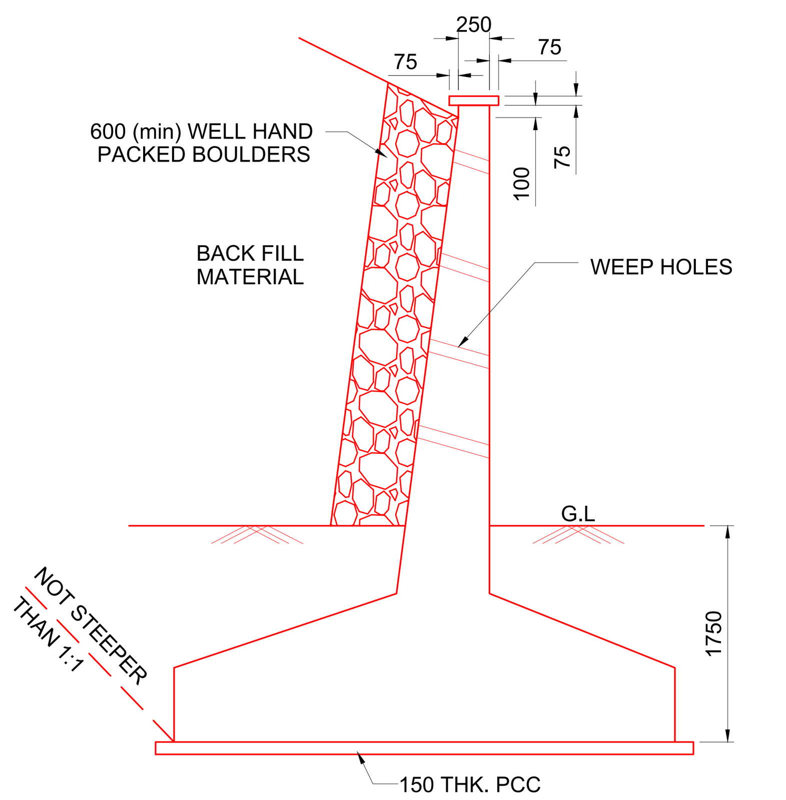
KEY PLAN

SCALE NTS



PLAN AT TOP

SCALE 1:150



TYPICAL DETAIL OF RETURN WALL(RW) / WING WALL

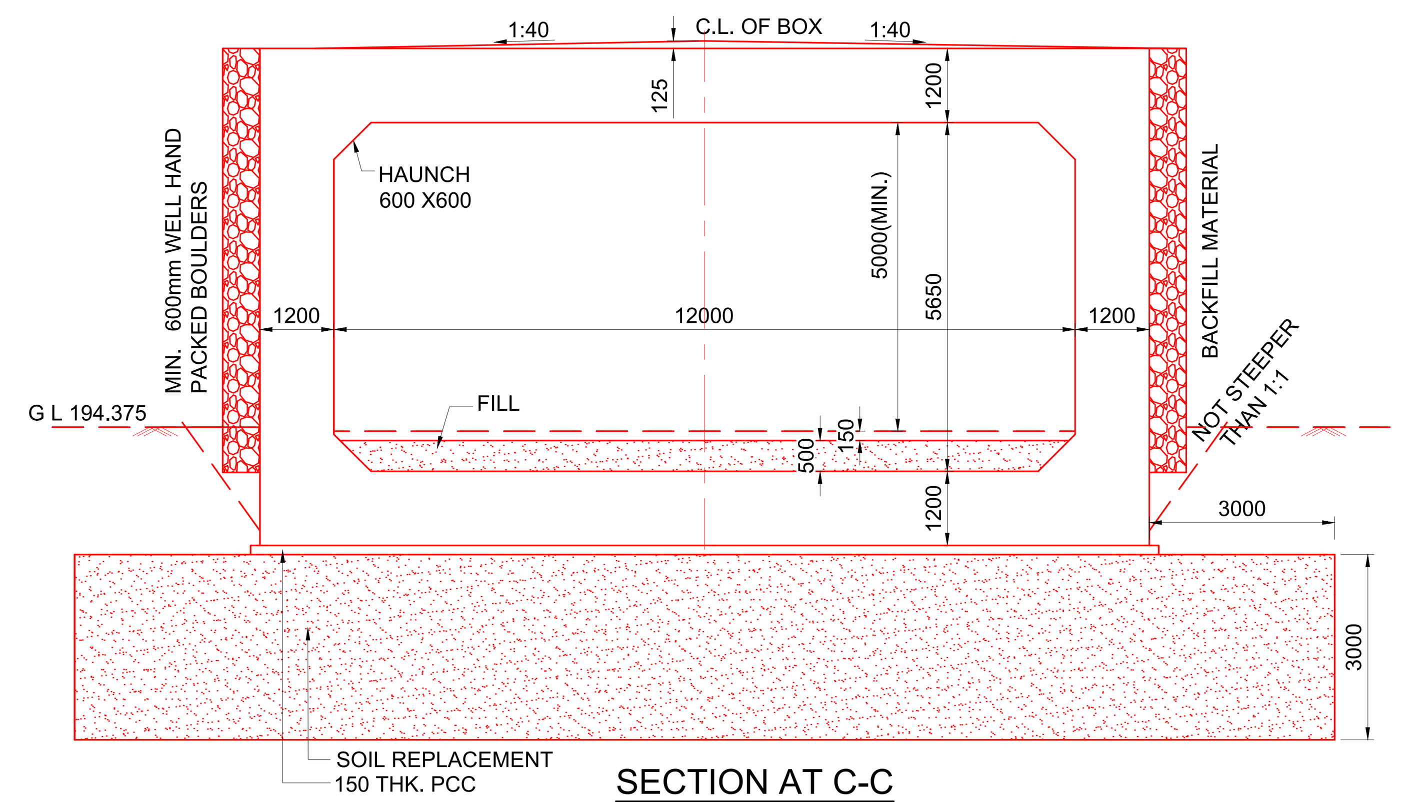
SCALE 1:50

LEGEND

	PROPOSED
	EXISTING
	DISMANTLE

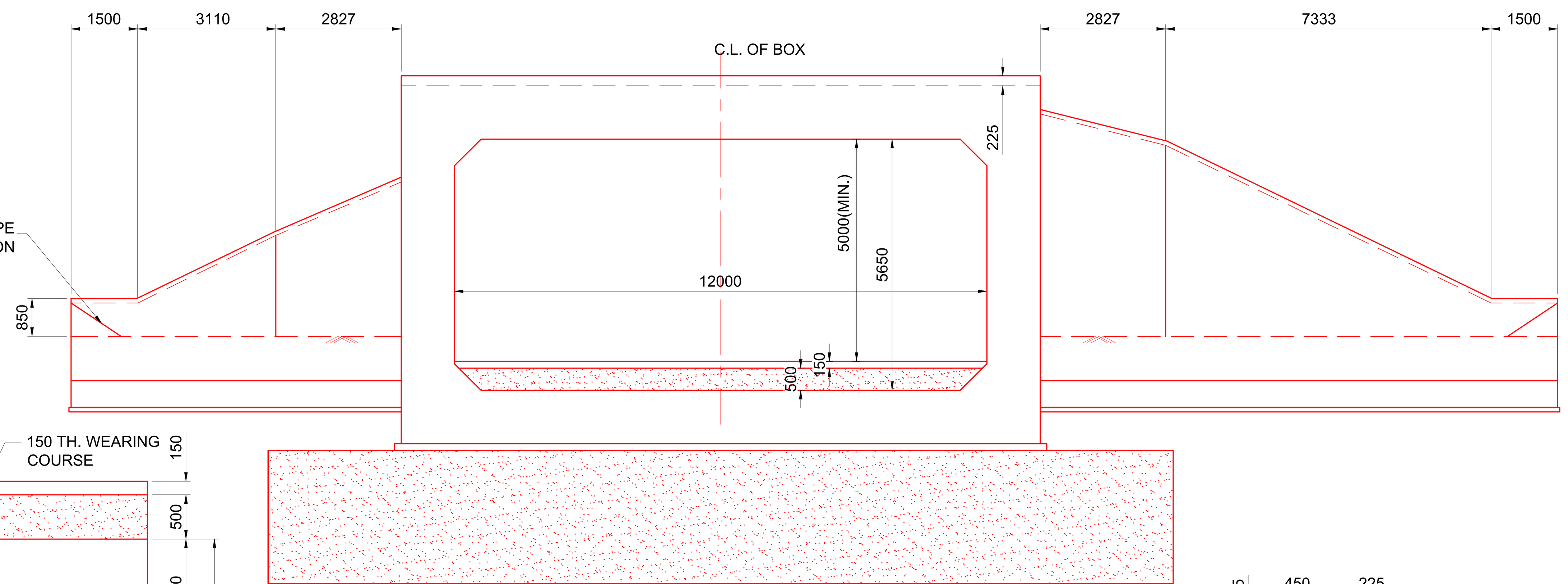
ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL
PRDL	PROPOSED ROAD LEVEL
PROW	PROPOSED HORC'S ROW



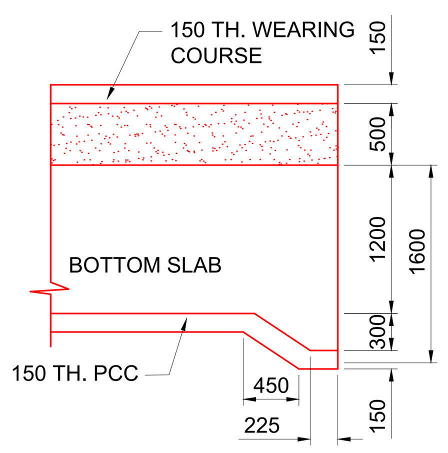
SECTION AT C-C

SCALE 1:100



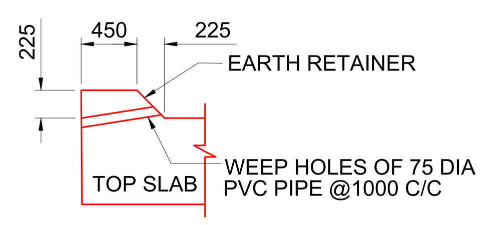
VIEW B-B

SCALE 1:100



SHEAR KEY

SCALE 1:50



EARTH RETAINER

SCALE 1:50

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL, BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. SUITABLE BED SLOPE SHALL BE PROVIDED AND ADJUSTED AS PER SITE CONDITIONS
8. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
9. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE /OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/(Sig)NR,DFCCIL ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
10. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
11. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
12. DETAILED DESIGN DRAWING WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. BOX BRIDGE IS TO BE DESIGNED FOR 32.5 T LOADING AS APPLICABLE.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   - (i) IRS BRIDGE RULE
   - (ii) IRS CONCRETE BRIDGE CODE
   - (iii) IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   - (i) ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   - (ii) LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 15M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BOX AFTER PROTECTION WORK.
9. FOR PROPER DRAINAGE OF WATER,SUITABLE SLOPE TO BE PROVIDED ON TOP OF BOX SLAB.
10. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL .
11. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
12. PLACEMENT LEVEL OF BOX AS SHOWN IN THIS GAD IS INDICATIVE AND MAY BE SUITABLY LOWERED/ELEVATED BASED UPON THE REQUIREMENT OF CLEARANCE, DRAINAGE &NATURAL GROUND PROFILE.
13. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB-STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °
14. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
15. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
16. THICKNESS OF STRUCTURAL MEMBERS ARE TENTATIVE AND WILL BE FINALISED AFTER DETAILED DESIGN.

C) OTHER NOTES :

1. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
2. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.
3. GROUND IMPROVEMENT DEPTH SHALL BE AS PER DETAILED GT INVESTIGATION AND DESIGN REQUIREMENTS.

IMPORTANT NOTE:

TOP OF BOTTOM SLAB OF RCC BOX SHALL NOT BE KEPT ABOVE THE NATURAL GROUND LEVEL.HOWEVER, ROAD LEVEL AND VERTICAL CLEARANCE ABOVE ROAD LEVEL SHALL BE MAINTAINED AS SHOWN IN THE DRAWING.OVERALL HEIGHT OF THE BOX MAY NEED MODIFICATION ACCORDINGLY.THE HEIGHT OF RCC BOX SHALL BE PROVIDED KEEPING ABOVE PROVISION IN VIEW.

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

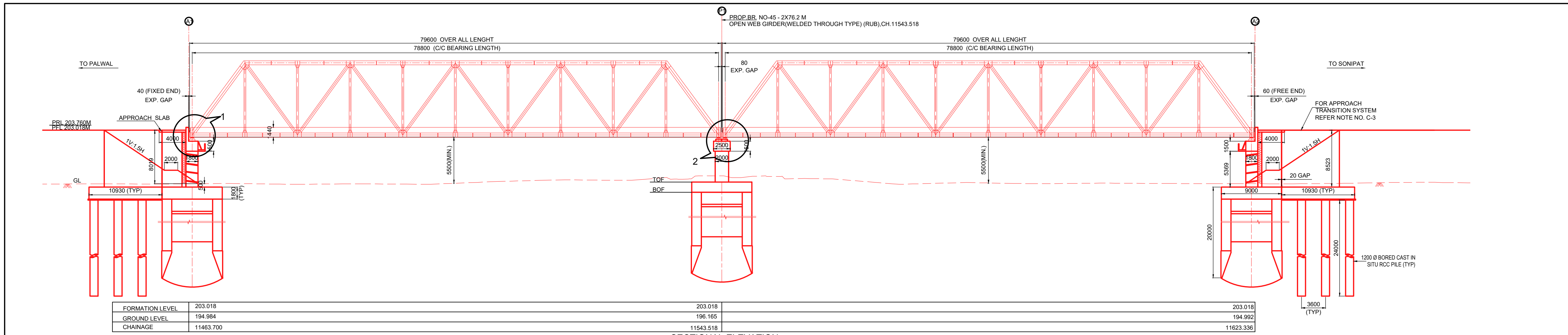
RITES THE INFRASTRUCTURE PEOPLE

SMEC Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

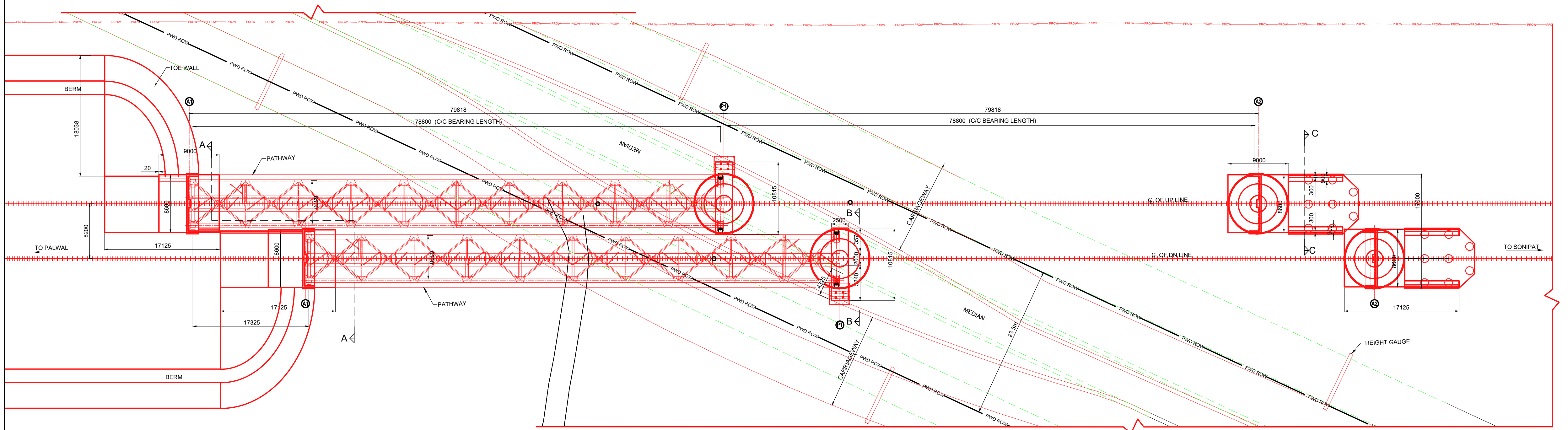
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR ROAD UNDER BRIDGE NO. 41 SPAN 1X12X5.650 RCC BOX AT CH: 10709.675

DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD_01041_A0		1 OF 1
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	

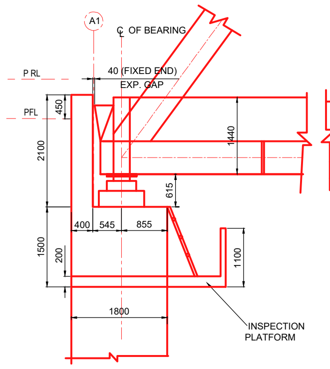


FORMATION LEVEL	203.018	203.018	203.018
GROUND LEVEL	194.984	196.165	194.992
CHAINAGE	11463.700	11543.518	11623.336

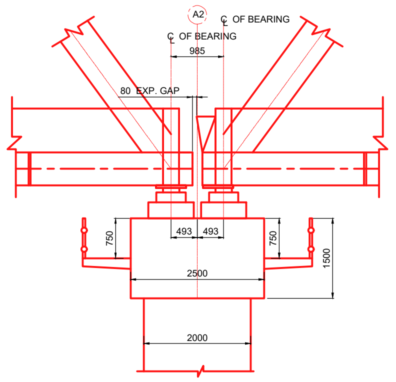
SECTIONAL ELEVATION
SCALE 1:250



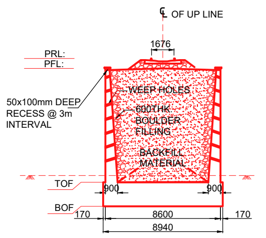
HALF PLAN AT TOP HALF PLAN AT BOTTOM
SCALE 1 : 250



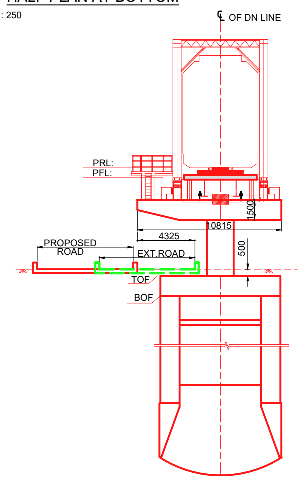
DETAILS -1
SCALE 1:50



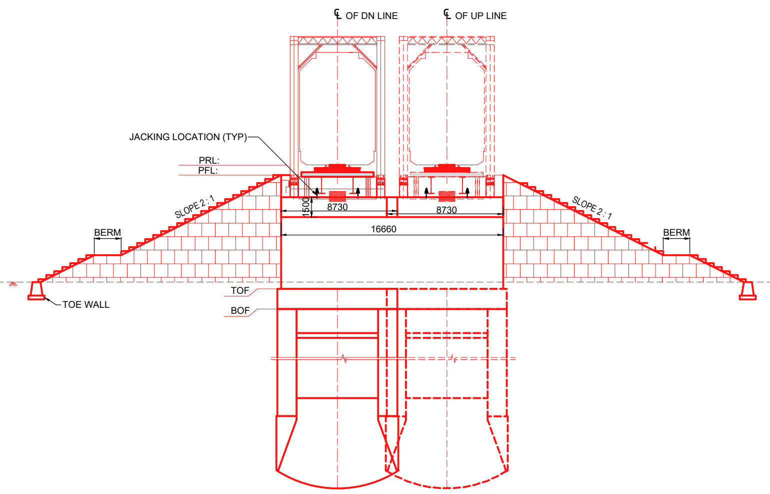
DETAILS -2
SCALE 1:50



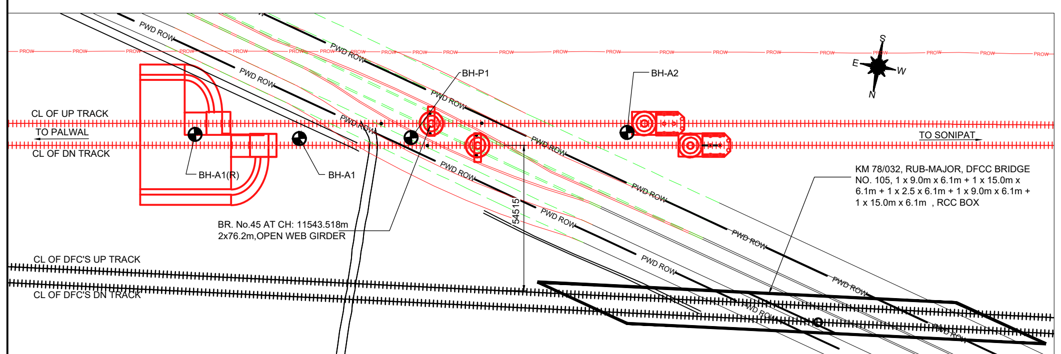
SECTION C-C
SCALE 1:200



SECTION B-B
SCALE 1:200



SECTION A-A (ABUTMENT)
SCALE 1:200



KEY PLAN
SCALE NTS

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
8. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE/OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/ (Sig.)/ NR, DFCCI ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
9. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
10. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
11. DETAILED GAD WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. STANDARD OF LOADING :- SUPER STRUCTURE-32.5T (RDSO STANDARD OWG) AND 25T (RDSO STANDARD PSC U SLAB), SUB STRUCTURE-32.5T- LOADING..
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   a.IRS BRIDGE RULE
   b.IRS CONCRETE BRIDGE CODE
   c.IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
   d.IS 2911 PART-1 SECTION-2.
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   a. ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   b.LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 30M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BRIDGE AFTER PROTECTION WORK.
9. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
10. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
11. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB-STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
12. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT.
13. THE STRUCTURAL DIMENSIONS AND SIZES ARE INDICATIVE AND THESE MAY VARY DURING DETAIL DESIGN.
14. SIZE, TYPE OF FOUNDATION & GROUND IMPROVEMENT DETAILS SHOWN ARE TENTATIVE AND MAY CHANGE DURING DETAILED DESIGN.
15. SEISMIC ARRESTOR SHALL BE PROVIDED ON THE PIER/ABUTMENT CAP.
16. DETAIL OF TOE WALL SHALL BE PROVIDED AS PER SKETCH NO. GC-HRIDC-SK-GEN-014_A1
17. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
18. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.

C) OTHER NOTES :

1. THE CONTRACTOR SHALL DESIGN OWG (WITH SLAB) FOR 25t LOADING AS PER SKETCH NO. GC-HRIDC-SK-GEN-036.
2. PATHWAY SHALL BE PROVIDED AS PER ARRANGEMENT GIVEN IN RDSO DWG. NO. CBS-0045(FOR OWG)
3. TRANSITION SYSTEM TO BE ADOPTED ON BRIDGE APPROACHES SHALL BE AS PER RDSO REPORT NO. GE:R-50(TRANSITION SYSTEM ON APPROACHES OF BRIDEGES). FOR DETAILS REFER SKETCH NO. GC-HRIDC-SK-GEN-019.

LEGEND

	PROPOSED
	EXISTING
	DISMANTEL

CONSTRUCTION DEPTH

1) RAIL (60kg)	172 mm
2) RUBBER PAD	10 mm
3) WIDER PSC SLEEPER HEIGHT AT RAIL SEAT	210 mm
4) MINIMUM BALLAST THK.	350 mm
TOTAL	742 mm

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
RD.L	ROAD LEVEL
TOF	TOP OF FOUNDATION
BOF	BOTTOM OF FOUNDATION
THK.	THICKNESS
EXP. GAP	EXPANSION GAP
CC	CEMENT CONCRETE
TYP.	TYPICAL
GL	GROUND LEVEL
PROW	PROPOSED HORC ROW
ROW	ROAD ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANK DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	[signature]
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

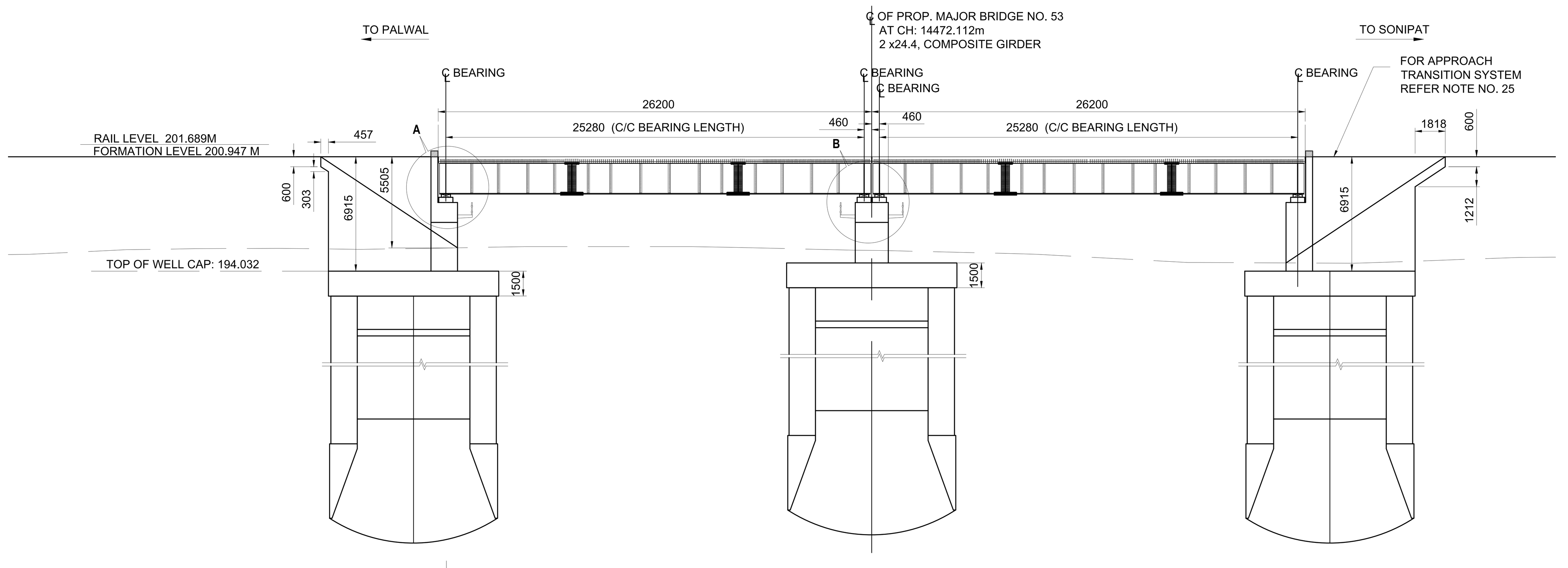
CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.
RITES THE INFRASTRUCTURE PEOPLE
SMEC

TITLE:- GENERAL ARRANGEMENT DRAWING
FOR PROP. MAJOR BRIDGE NO.045,
AT CH: 11543.518m 2X76.2 (OPEN WEB GIRDER)
(NH 919 PALWAL SOHNA ROAD)

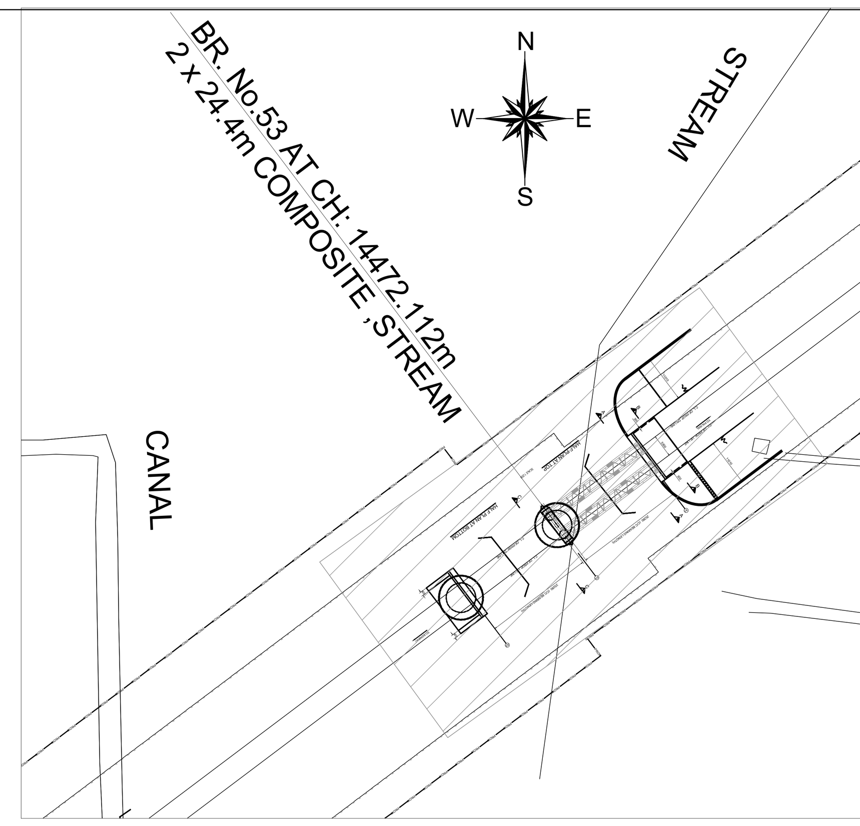
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01045_A0	1 OF1

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	23-08-2023	



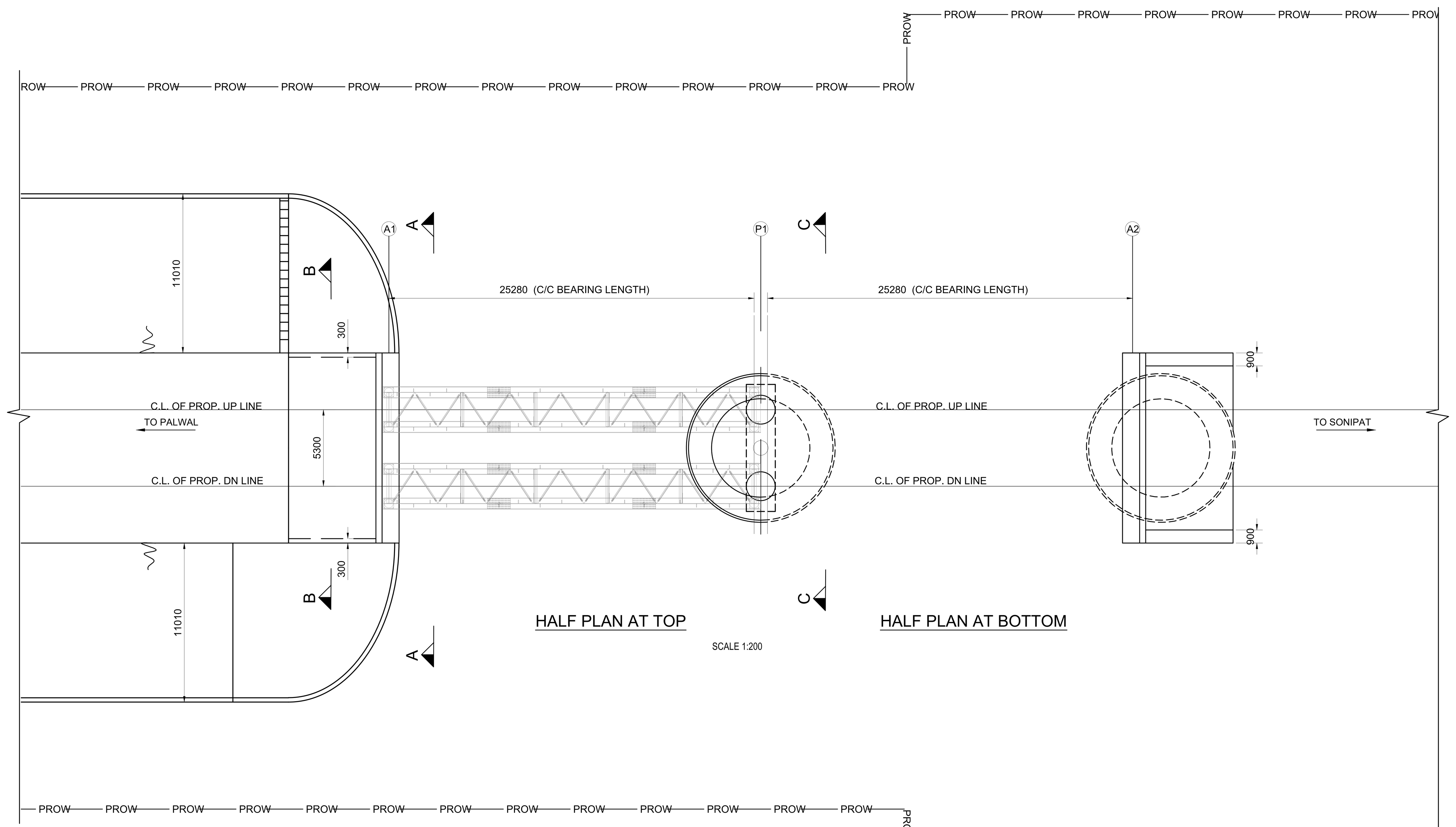
FORMATION LEVEL	200.947	200.947	200.947
GROUND LEVEL	195.402	195.520	194.915
CHAINAGE	14446.452	14472.112	14497.772

SECTIONAL ELEVATION
SCALE 1:200

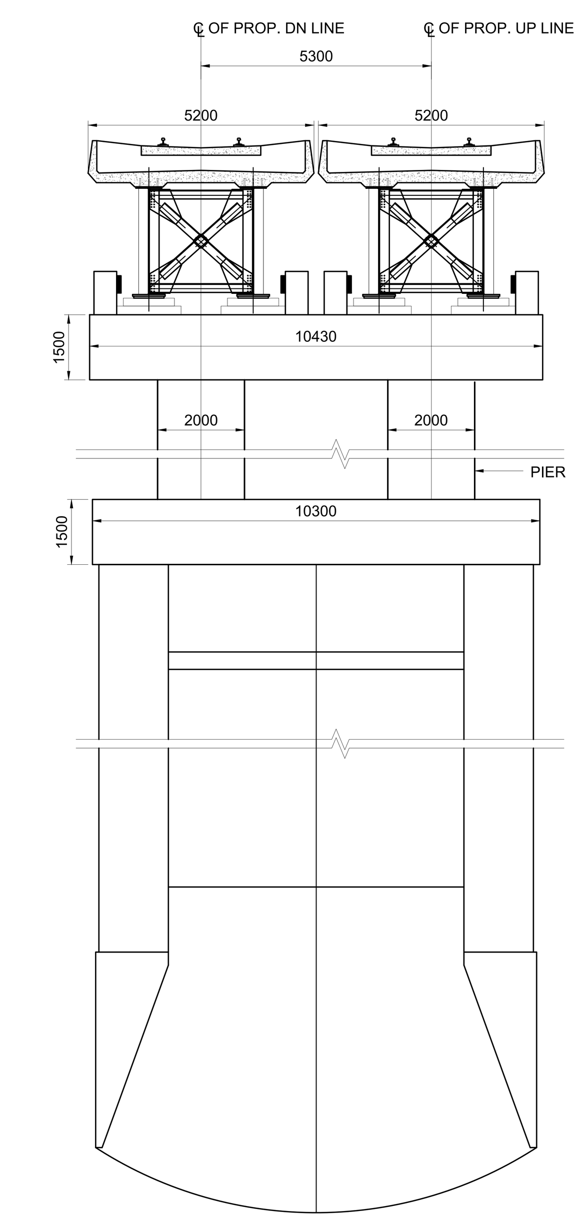


KEY PLAN
(NOT TO SCALE)

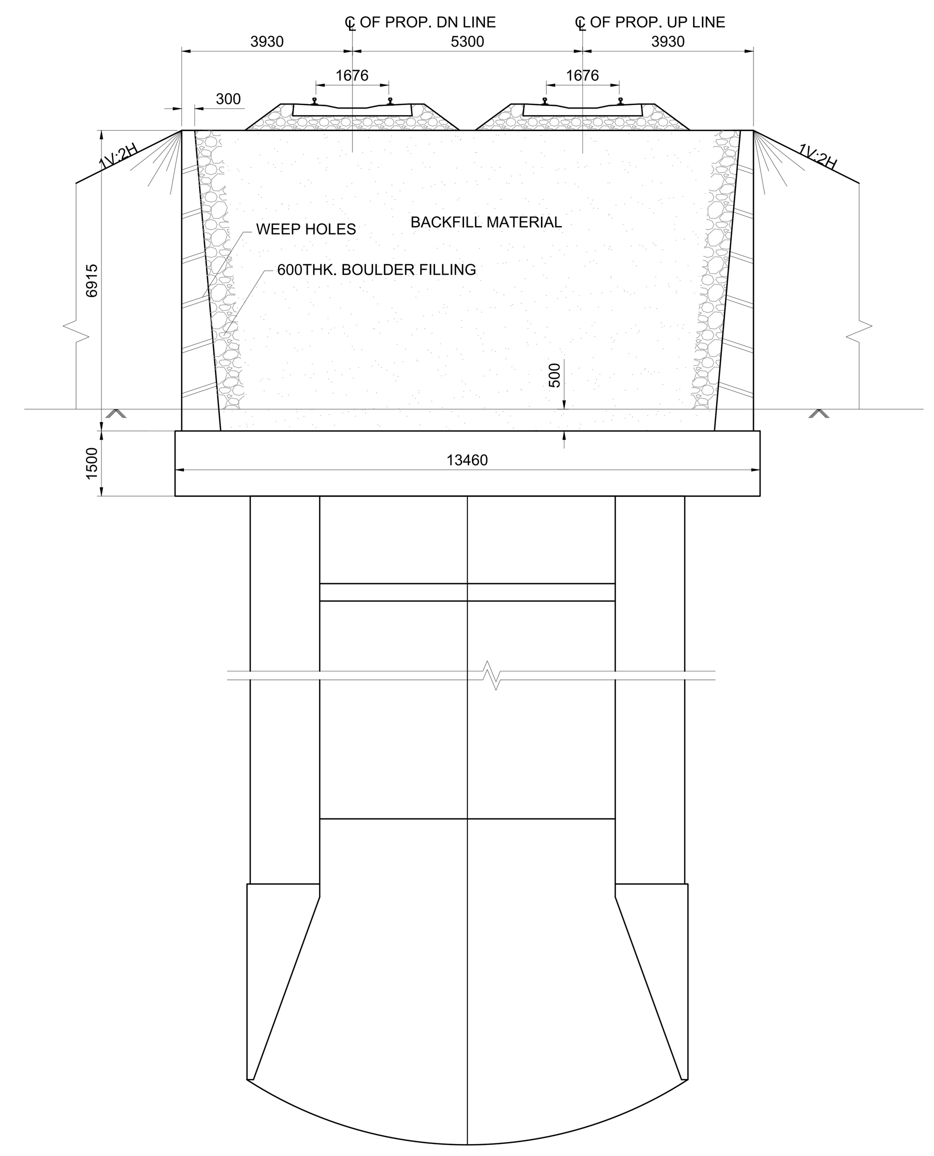
NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METER
2. DIMENSIONS ARE NOT TO BE SCALED ONLY WRITTEN DIMENSIONS TO BE FOLLOWED
3. DESIGN CRITERIA
   i) IRS BRIDGE SUBSTRUCTURE AND FOUNDATION CODE 2013.
   ii) IRS CONCRETE BRIDGE CODE 2014.
   iii) IRS BRIDGE RULES 2014.
   iv) IS 2911 PART-1 SECTION-2.
   v) EXPOSURE CONDITION - MODERATE.
   vi) SEISMIC ZONE - IV
   vii) STANDARD OF LOADING :- SUPER STRUCTURE-25T (RDSO STANDARD CG) & SUB STRUCTURE-32.5T- 2008 LOADING.
4. THE STRUCTURAL DIMENSIONS AND SIZES ARE INDICATIVE AND THESE MAY VARY DURING DETAIL DESIGN.
5. SIZE AND TYPE OF FOUNDATION SHOWN IS TENTATIVE AND MAY CHANGE DURING DETAILED DESIGN.
6. ALL RCC AND CC WORKS SHALL BE DONE IN ACCORDANCE WITH SPECIFICATION LAID DOWN IN IRS CONCRETE BRIDGE CODE.
7. THE GRADE OF CONCRETE
   i) FOR ABUTMENT,DIRT & RETURN WALLWEARING COURSE(WC)---------------M35
   ii) FOR FOUNDATION --M35
   iii) FOR LEVELING COURSE--M20
8. ALL CONCRETE WORK SHALL BE MECHANICALLY MIXED AND VIBRATED.
9. MIX DESIGN SHALL BE APPROVED BY ENGINEER - IN CHARGE.
10. HIGH YIELD STRENGTH DEFORMED BARS OF GRADE Fe-500D CONFORMING TO IS: 1786-2008 SHALL BE USED AS REINFORCEMENT.
11. BED LEVEL & ROAD LEVEL,FORMATION LEVEL AND RAIL LEVEL & ALIGNMENT SHALL BE VERIFIED BY THE ENGINEER AT SITE BEFORE EXECUTION OF WORK.
12. ANGLE OF INTERNAL FRICTION OF BACK FILL SHALL NOT BE LESS THAN 35.
13. PROTECTION WORK ON SLOPES OF BANK UP TO 30M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015.
14. BACK FILL BEHIND RETURN WALL/WING WALL SHALL BE AS PER CL.7.5 OF IRS BRIDGE SUBSTRUCTURE & FOUNDATION CODE 2013. BOULDER FILLING & BOULDER PACKING BEHIND RETURN WALL/WING WALL TO BE DONE AS PER IRS FOUNDATION & SUBSTRUCTURE CODE CL.7.5.2. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 KG/SQM.CONFORMING TO IS-3117.
15. CURING SHALL BE DONE AS PER CLAUSE NO 8.4 OF IRS CONCRETE BRIDGE CODE.
16. SAFETY & PROTECTION OF THE PROPOSED WORK IS TO BE ENSURED BY THE CONTRACTOR AS PER PARA 826 OF IRPWM WITH UPDATED CORRECTION SLIPS OF 2011-12.
17. THE SPECIFICATIONS FOR THE COMPOSITE GIRDER SHALL BE IN ACCORDANCE WITH RDSO DRG.NO'S : RDSO B-11751/R1 TO 11751/8.
18. CONCRETING SHALL BE DONE IN ACCORDANCE WITH IRS CONCRETE BRIDGE CODE WITH 20MM MAXIMUM SIZE AGGREGATE.
19. ALL DIMENSIONS AND LEVELS SHOULD BE VERIFIED AT SITE BEFORE EXECUTION.
20. BRIDGE DETAILS LIKE , DL, INSPECTION STEPS PAINTINGS ETC SHOULD BE FOLLOWED AS PER BRIDGE MANUAL, DURING CONSTRUCTION.
21. THIS DRAWING IS PROPERTY OF HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED (HRIDC) AND EXCLUSIVE USE OF HRIDC.
22. ARRANGEMENT FOR PATHWAY SHALL BE PROVIDED AS PER RDSO DWG. NO. CBS-0046 (FOR CG).
23. SEISMIC ARRESTOR SHALL BE PROVIDED ON THE PIER/ABUTMENT CAP.
24. TRANSITION SYSTEM TO BE ADOPTED ON BRIDGE APPROACHES SHALL BE AS PER RDSO REPORT NO. GE:R-50(TRANSITION SYSTEM ON APPROACHES OF BRIDEGES). FOR DETAILS REFER SKETCH NO. GC-HRIDC-SK-GEN-019.



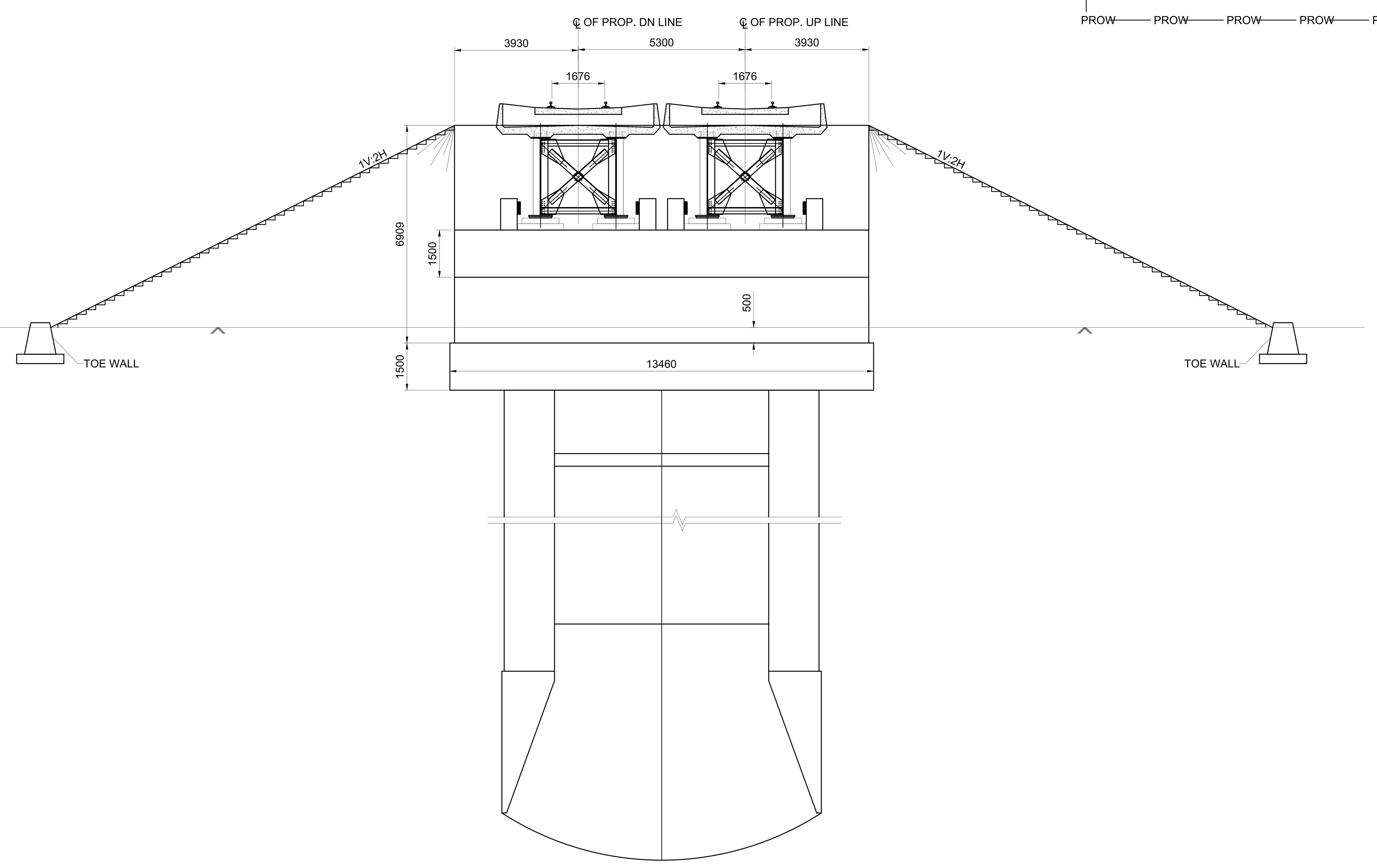
PLAN
SCALE 1:200



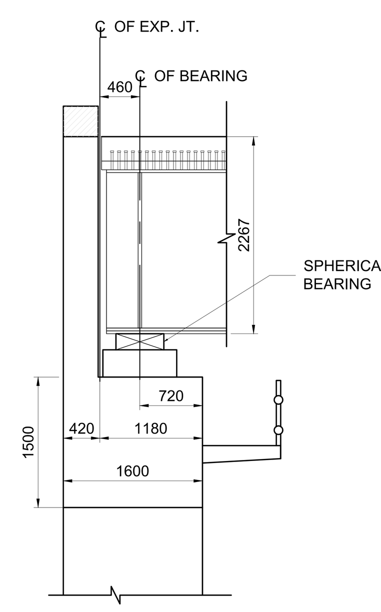
SECTION C-C
SCALE 1:100



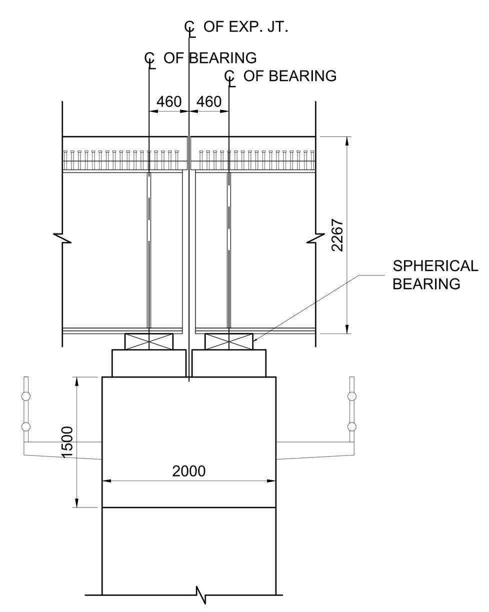
SECTION B-B
SCALE 1:100



SECTION A-A
SCALE 1:100



DETAILS AT "A"
SCALE 1:50



DETAILS AT "B"
SCALE 1:50

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	ChahateyRam	SHIV OM DWIVEDI CPM/HRIDC	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL/SOUTH	
REETU PATIAL CDE/ CIVIL			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

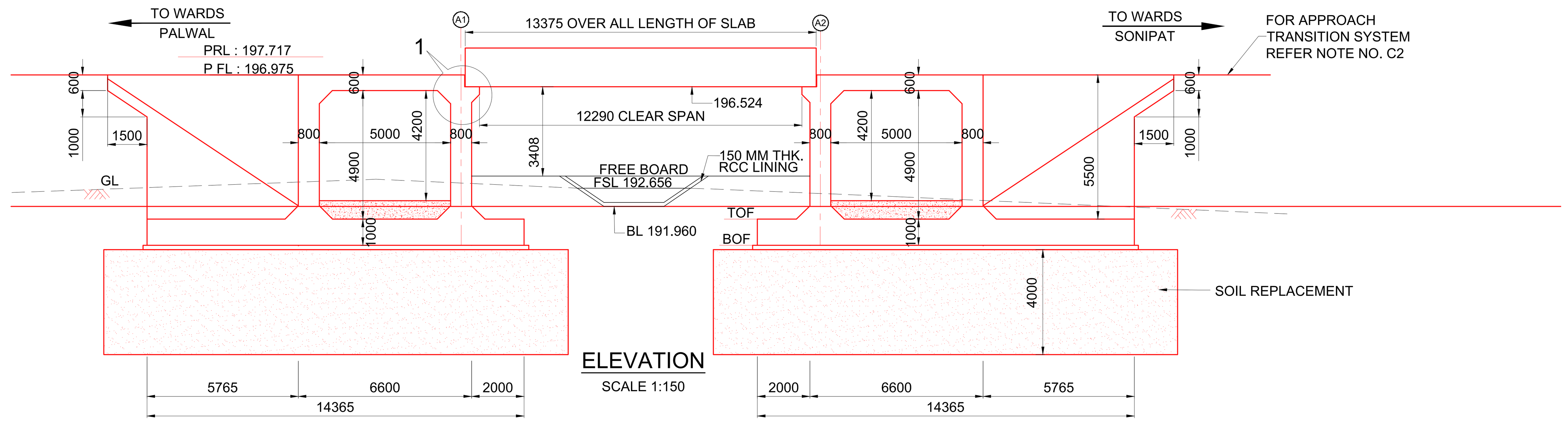
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES
THE INFRASTRUCTURE PEOPLE
SMEC
Member of the Surbana Jurong Group

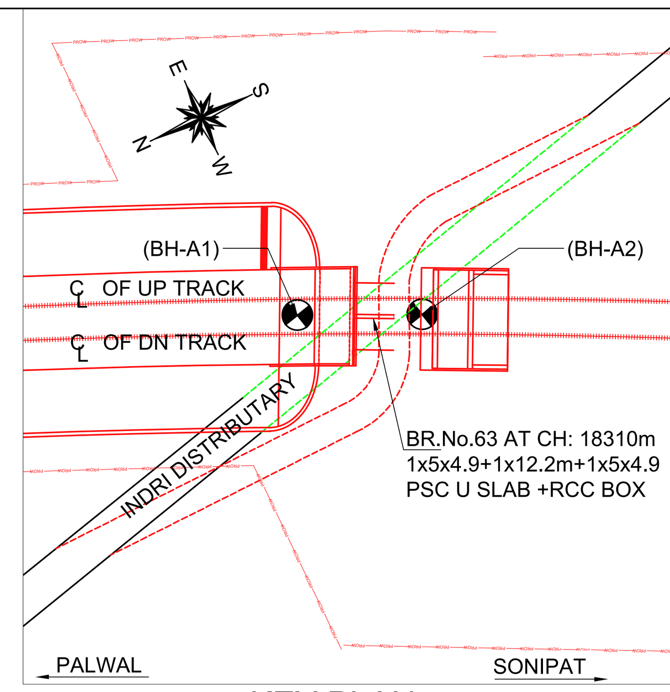
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING
FOR STREAM BRIDGE NO.53
2x24.4 CG AT CH: 14472.112m

DRG. NO.	SHEET NO.
GC-HRIDC-C4-DRW-BRD-GAD-01053_A2	1 OF 1

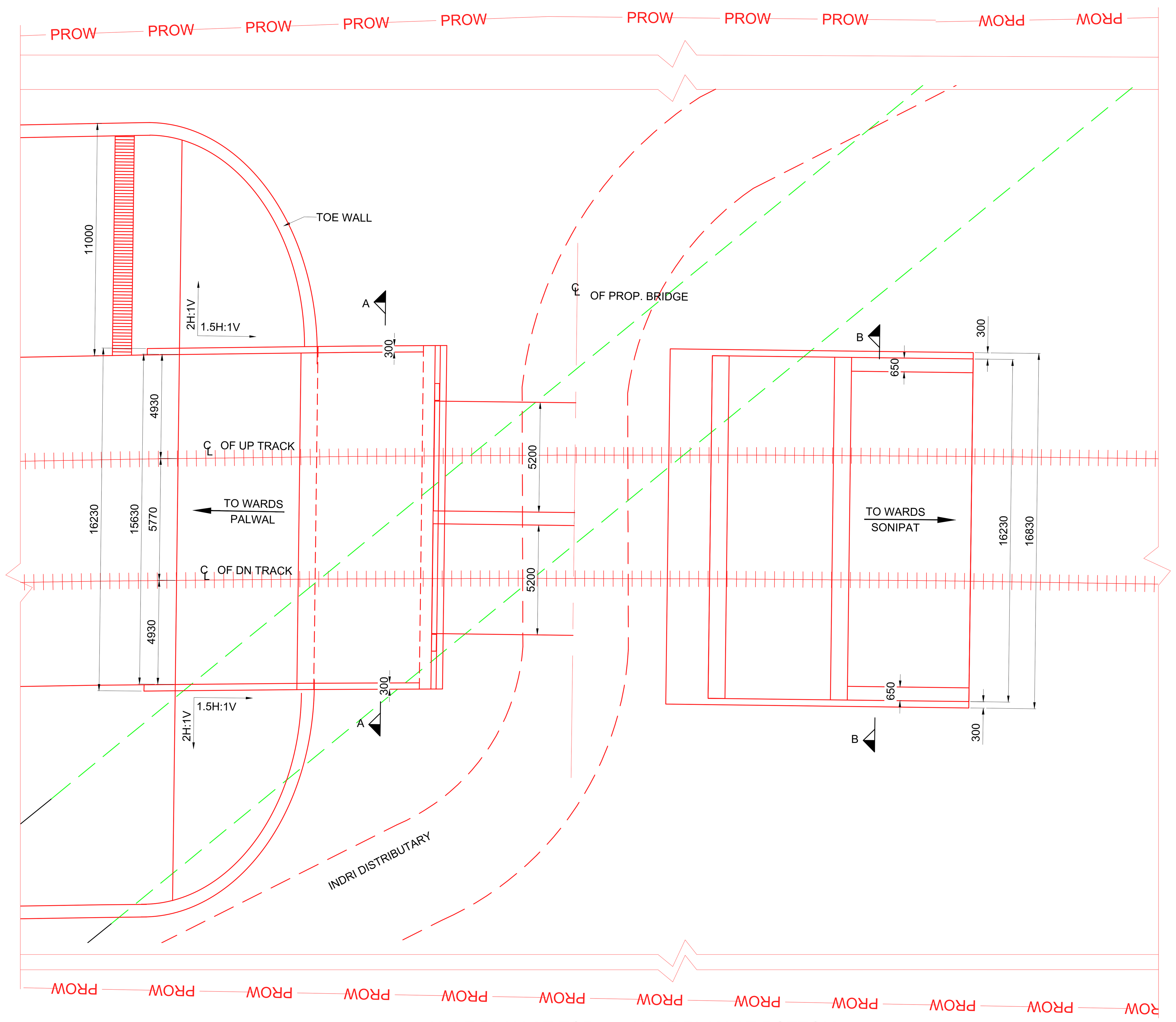
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	07-11-2022	10-01-2023



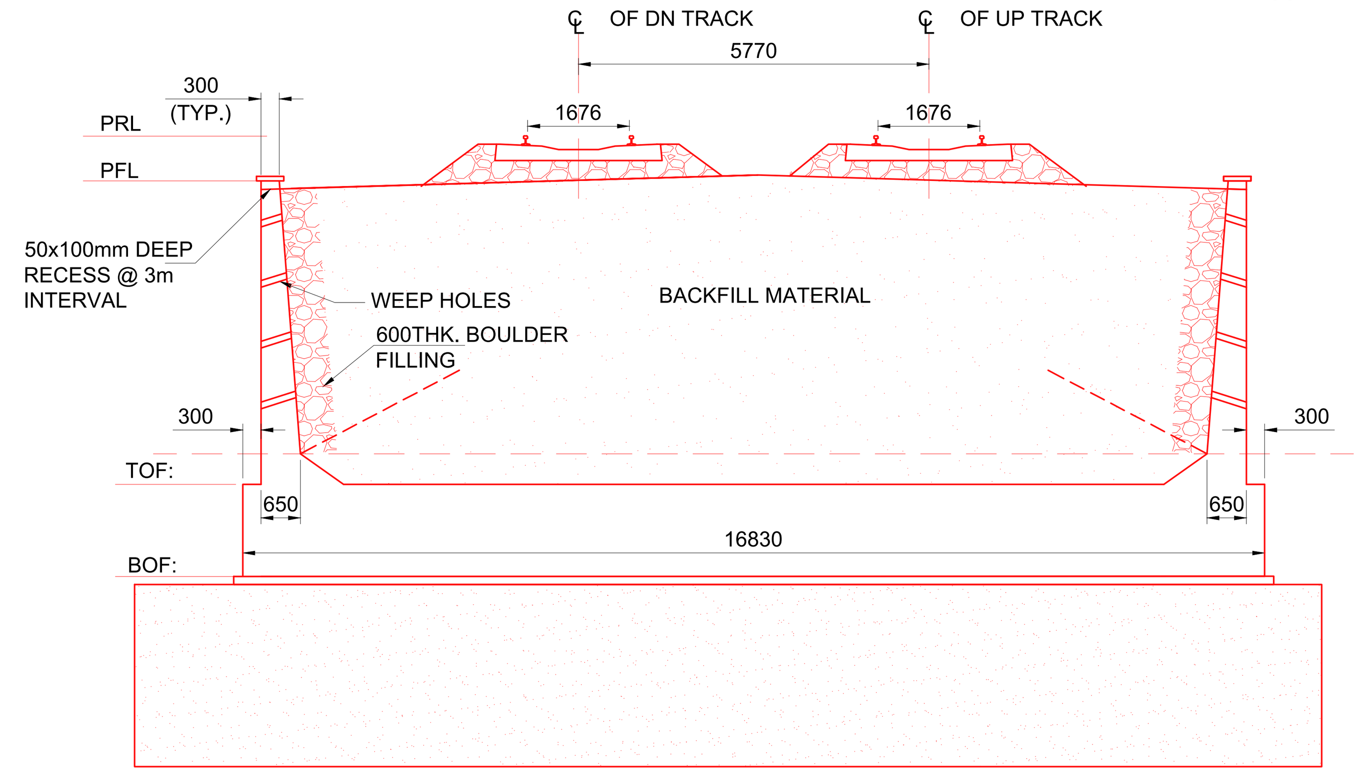
ELEVATION
SCALE 1:150



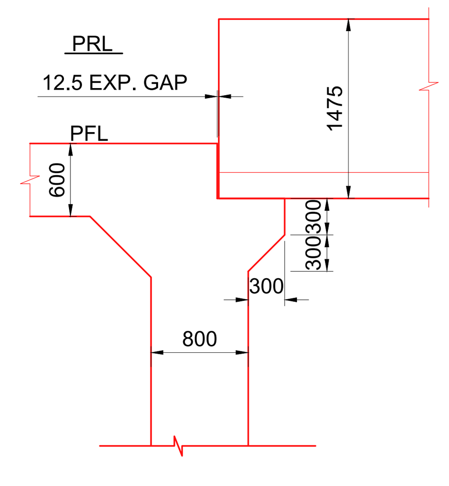
KEY PLAN
SCALE NTS



HALF PLAN AT TOP HALF PLAN AT BOTTOM
SCALE 1 : 150



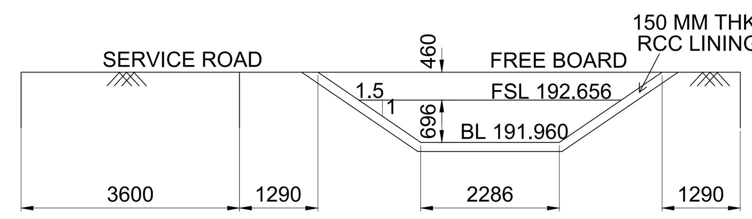
SECTION B-B
SCALE 1:100



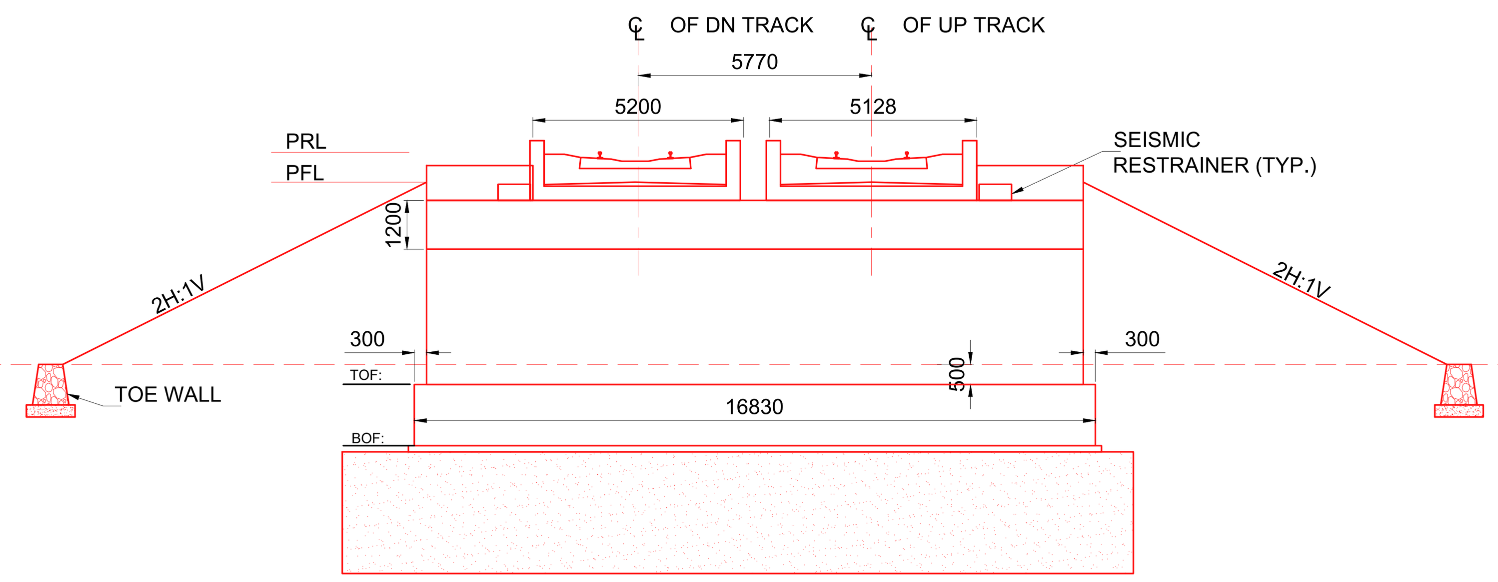
DETAIL -1
SCALE 1:50

HYDRAULIC DATA OF DRAIN

1	NAME OF CANAL	INDRI DISTRIBUTARY
2	RD	18310/11260
3	BED LEVEL (BL)	191.960m
4	FULL SUPPLY LEVEL (FSL)	192.656m
5	DISCHARGE	42.94 cusec
6	BED WIDTH	2.286m
7	FSD	1.143 m
8	SIDE SLOPE	1.5:1
9	W S SLOPE	0.20%
10	VELOCITY	0.338m/sec
11	ROW	49.5m
12	FREE BOARD	193.116



CROSS SECTION OF DRAIN
(SCALE NTS)



SECTION A-A
SCALE 1:150

LEGEND

(red dashed line)	PROPOSED
(grey line)	DISMANTEL
(green dashed line)	DISMANTEL

CONSTRUCTION DEPTH

1) RAIL	172 mm
2) RUBBER PAD	10 mm
3) PSC SLEEPER	210 mm
4) BALLAST	350 mm
TOTAL	742 mm

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
RD.L	ROAD LEVEL
TOF	TOP OF FOUNDATION
BOF	BOTTOM OF FOUNDATION
THK.	THICKNESS
EXP. GAP	EXPANSION GAP
CC	CEMENT CONCRETE
TYP.	TYPICAL
GL	GROUND LEVEL
PROW	PROPOSED HORC ROW
ROW	ROAD ROW

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
8. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE/OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/ (Sig.)/ NR, DFCCI ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
9. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
10. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
11. DETAILED GAD WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. STANDARD OF LOADING :- SUPER STRUCTURE-32.5T (RDSO STANDARD OWG),& SUB STRUCTURE-32.5T- LOADING,.
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   a.IRS BRIDGE RULE
   b.IRS CONCRETE BRIDGE CODE
   c.IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
   d.IS 2911 PART-1 SECTION-2.
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   a. ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   b.LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 30M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BRIDGE AFTER PROTECTION WORK.
9. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
10. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
11. 75mm DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORIZONTAL AND 1000 MM C/C VERTICALLY IN RETURN WALL & ABUTMENT THROUGHOUT.
12. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB-STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
13. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT. IF REQUIRED GROUND IMPROVEMENT MAY BE CARRIED OUT AND CONFIRMED THROUGH FIELD TESTING.
14. THE STRUCTURAL DIMENSIONS AND SIZES ARE INDICATIVE AND THESE MAY VARY DURING DETAIL DESIGN.
15. SIZE, TYPE OF FOUNDATION & GROUND IMPROVEMENT DETAILS SHOWN ARE TENTATIVE AND MAY CHANGE DURING DETAILED DESIGN.
16. SEISMIC ARRESTOR SHALL BE PROVIDED ON THE PIER/ABUTMENT CAP.
17. DETAIL OF TOE WALL SHALL BE PROVIDED AS PER SKETCH NO. GC-HRIDC-SK-GEN-014_A1

C) OTHER NOTES :

1. FOR SUPERSTRUCTURE DETAIL FOLLOW RDSO DRG.NO'S : RDSO 10281,10281/1 AND 10281/2.
2. TRANSITION SYSTEM TO BE ADOPTED ON BRIDGE APPROACHES SHALL BE AS PER RDSO REPORT NO. GE:R-50(TRANSITION SYSTEM ON APPROACHES OF BRIDEGES). FOR DETAILS REFER SKETCH NO. GC-HRIDC-SK-GEN-019.
3. RCC LINING SHALL BE CONSTRUCTED FOR CANAL FROM ROW TO ROW OF HORC .
4. RCC LINING SHALL BE OF MIN 150 MM THICK AND HAVING AT LEAST MIN TEMP REINFORCEMENT.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	(signature)
SUDHIR AGRAWAL DPD/CIVIL	(signature)	RAJU SOLANKI DGM/CIVIL	(signature)
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	(signature)
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

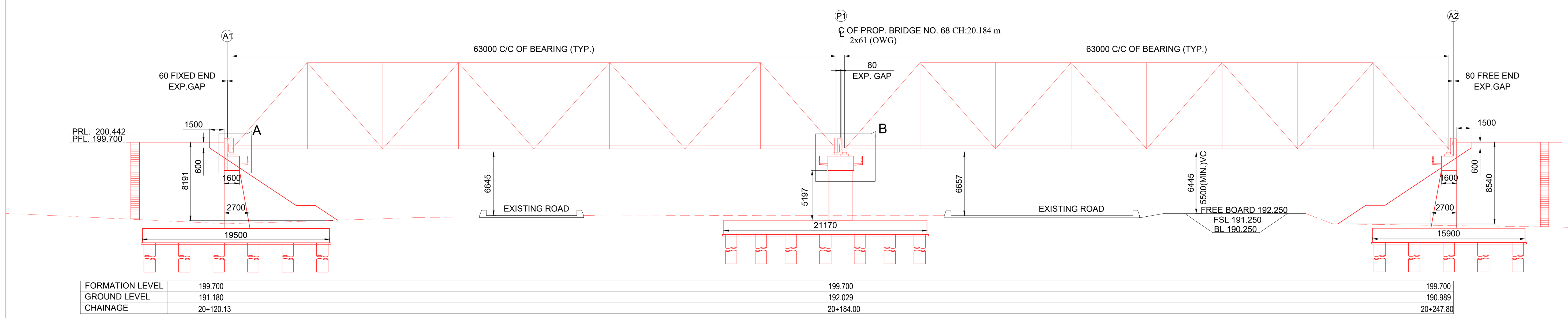
CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.
THE INFRASTRUCTURE PEOPLE
Member of the Surbana Jurong Group

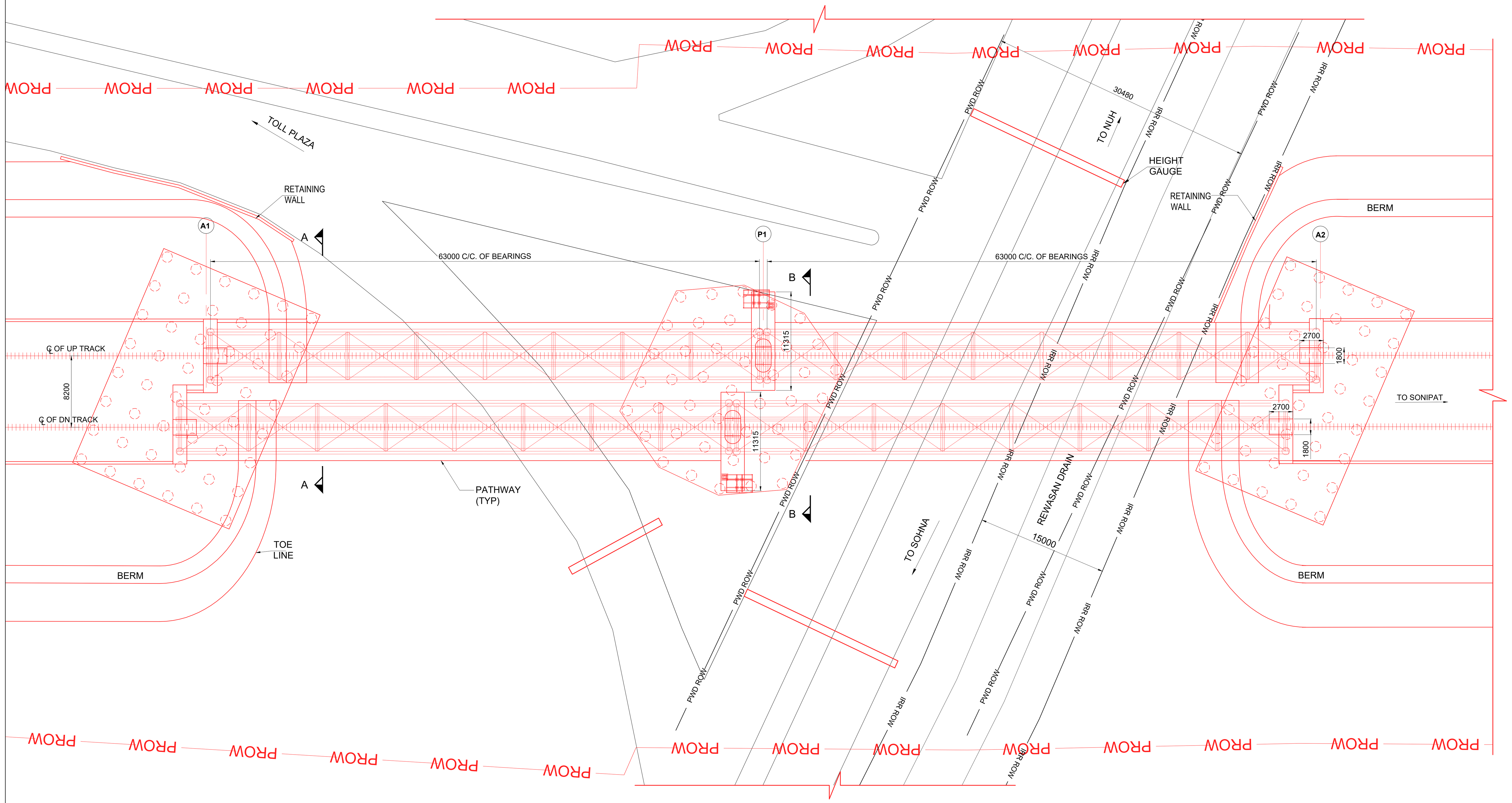
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR PROP. DRAIN CROSSING BRIDGE NO. 63
1x5x4.9+1x12.2m+1x5x4.9 (PSC U SLAB +RCC BOX) AT CH: 18310
(CANAL CROSSING INDRI DISTRIBUTARY RD 11260)

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-BRD-GAD-01063_A0	1 OF 1

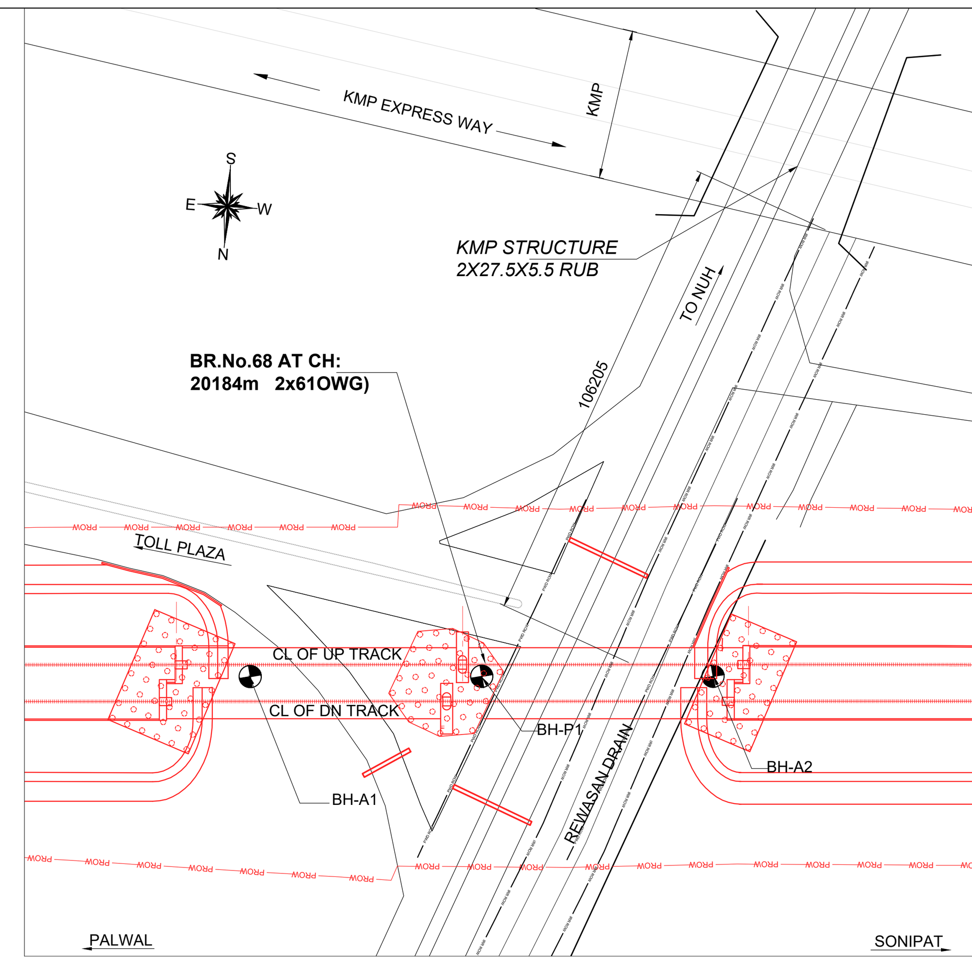
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	06-12-2023



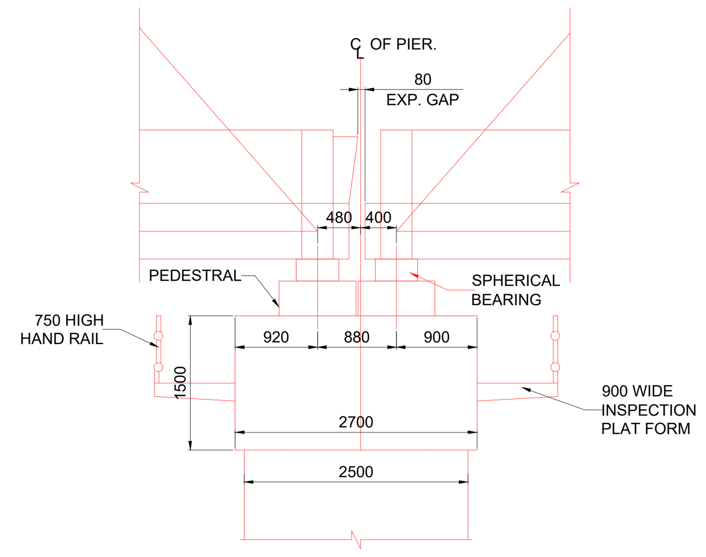
SECTIONAL ELEVATION
SCALE 1:250



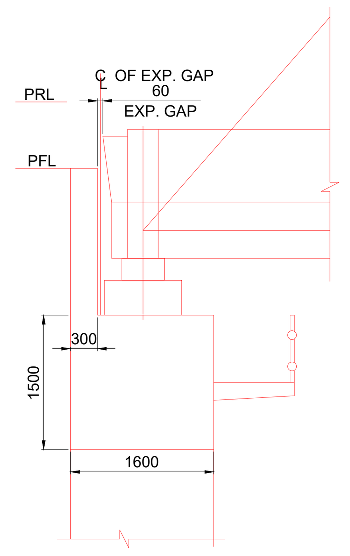
PLAN
SCALE 1:250



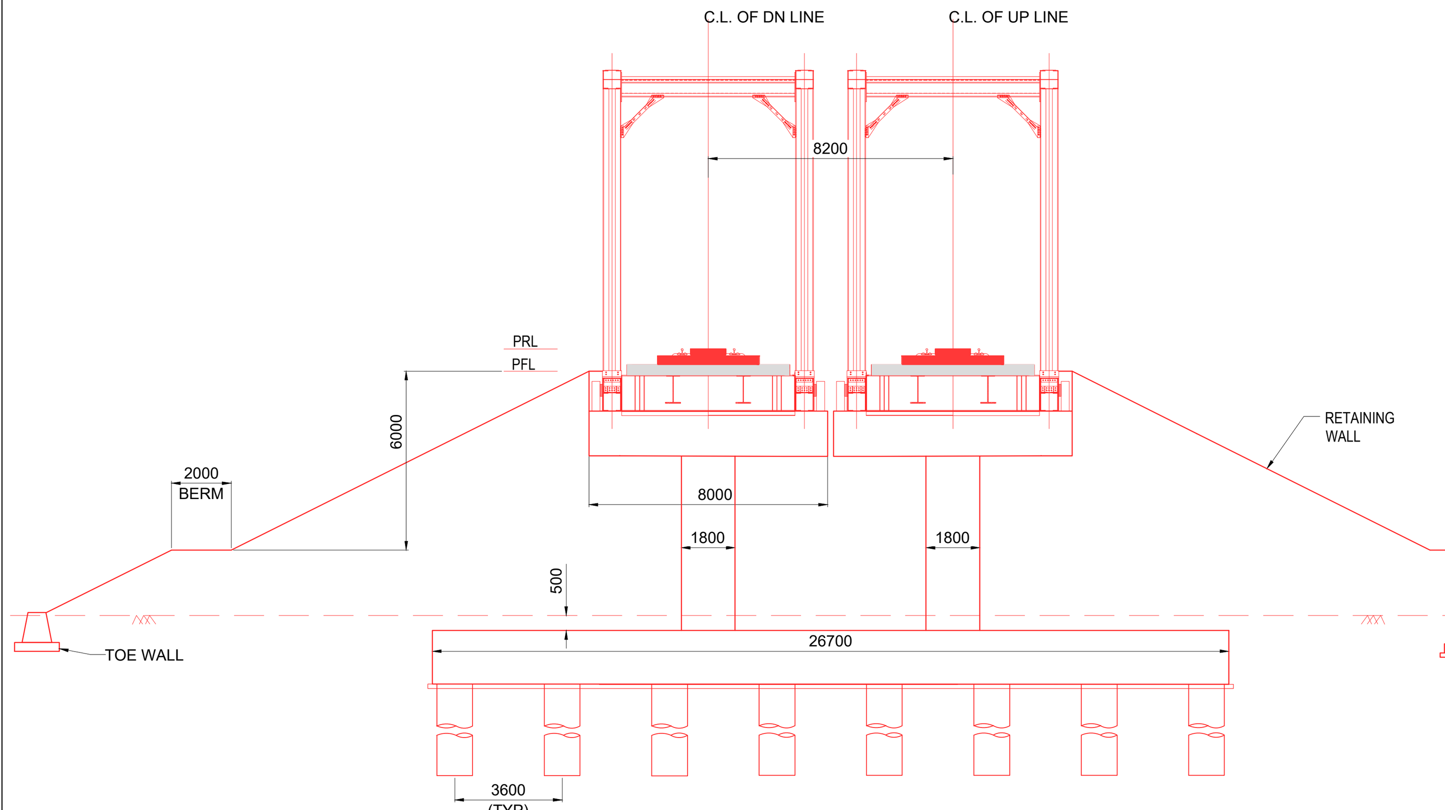
KEY PLAN
SCALE NTS



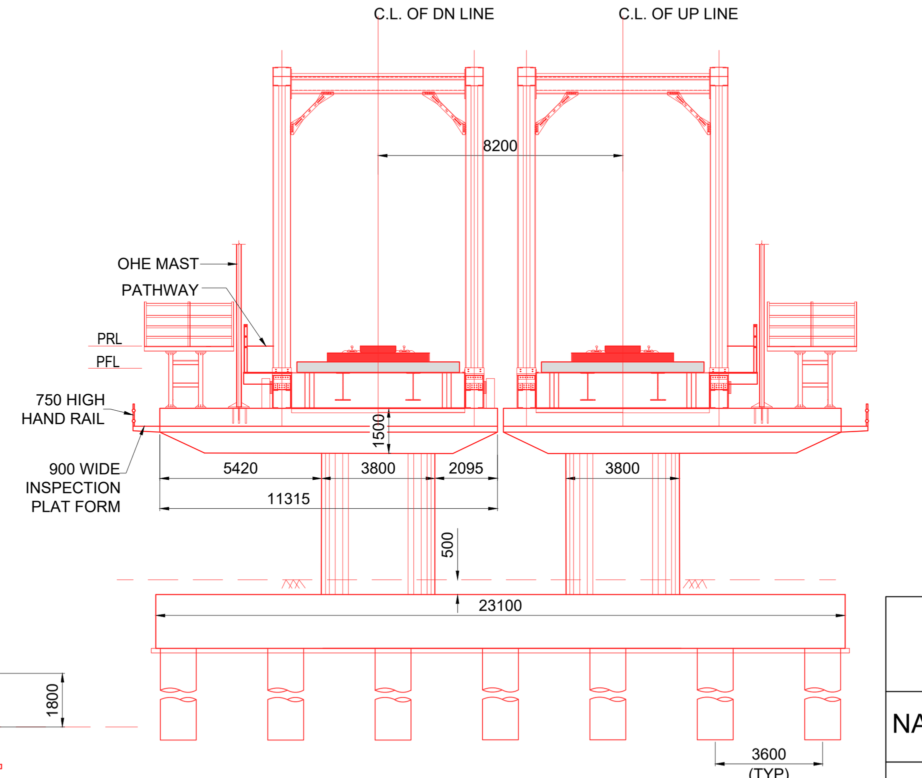
DETAIL-B
(SCALE 1:50)



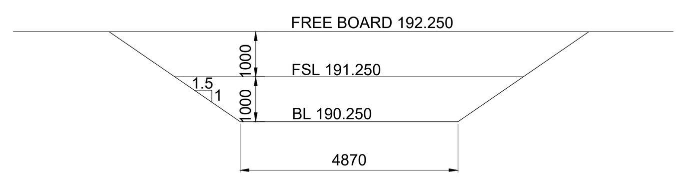
DETAIL-A
(SCALE 1:50)



SECTION AT A-A
SCALE 1:150



SECTION AT B-B
SCALE 1:150



CROSS SECTION OF DRAIN
(SCALE : 100)

LEGEND

(red line)	PROPOSED
(black line)	EXISTING

CONSTRUCTION DEPTH

1) RAIL (60kg)	172 mm
2) RUBBER PAD	10 mm
3) WIDER PSC SLEEPER HEIGHT AT RAIL SEAT	210 mm
4) MINIMUM BALLAST THK.	350 mm
TOTAL	742 mm

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
RD.L	ROAD LEVEL
TOF	TOP OF FOUNDATION
BOF	BOTTOM OF FOUNDATION
THK.	THICKNESS
EXP. GAP	EXPANSION GAP
CC	CEMENT CONCRETE
TYP.	TYPICAL
GL	GROUND LEVEL
PROW	PROPOSED HORC ROW
ROW	ROAD ROW

HYDRAULIC DATA OF DRAIN

1	NAME OF CANAL	REWASAN DRAIN
2	RD	20185/6670
3	BED LEVEL (BL)	190.250m
4	FULL SUPPLY LEVEL (FSL)	191.250m
5	FREE BOARD	192.250m
6	DISCHARGE	90 cusec
7	BED WIDTH	4.87m
8	FSD	1.00 m
9	SIDE SLOPE	1.5:1
10	W S SLOPE	0.15%
11	VELOCITY	0.048m/sec
12	ROW	49.5
13	FREE BOARD	192.25

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
8. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE/OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/ (Sig.)/ NR, DFCCI ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
9. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
10. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
11. DETAILED GAD WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. STANDARD OF LOADING :- SUPER STRUCTURE-32.5T (OWG) SUB STRUCTURE-32.5T- LOADING..
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   a.IRS BRIDGE RULE
   b.IRS CONCRETE BRIDGE CODE
   c.IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
   d.IS 2911 PART-1 SECTION-2.
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   a. ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   b. LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 30M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BRIDGE AFTER PROTECTION WORK.
9. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
10. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
11. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB-STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
12. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT.
13. THE STRUCTURAL DIMENSIONS AND SIZES ARE INDICATIVE AND THESE MAY VARY DURING DETAIL DESIGN.
14. SIZE, TYPE OF FOUNDATION & GROUND IMPROVEMENT DETAILS SHOWN ARE TENTATIVE AND MAY CHANGE DURING DETAILED DESIGN.
15. SEISMIC ARRESTOR SHALL BE PROVIDED ON THE PIER/ABUTMENT CAP.
16. DETAIL OF TOE WALL SHALL BE PROVIDED AS PER SKETCH NO. GC-HRIDC-SK-GEN-014_A1
17. HEIGHT GAUGE SHALL BE PROVIDE AS PER RDSO STANDARD DRAWING NO. RDSO/M0001.
18. SPEED BREAKER SHOULD BE PROVIDED ON EITHER APPROACH OF RUB AT A DISTANCE OF 20M FROM THE BRIDGE COVERING FULL WIDTH OF THE ROAD INCLUDE BERMS.

C) OTHER NOTES :

1. THE CONTRACTOR SHALL DESIGN OWG (WITH SLAB) FOR 25t LOADING AS PER SKETCH NO. GC-HRIDC-SK-GEN-036
2. PATHWAY SHALL BE PROVIDED AS PER ARRANGEMENT GIVEN IN RDSO DWG. NO. CBS-0045(FOR OWG) .
3. RCC LINING SHALL BE CONSTRUCTED FOR CANAL UPTO ROW OF HORC.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

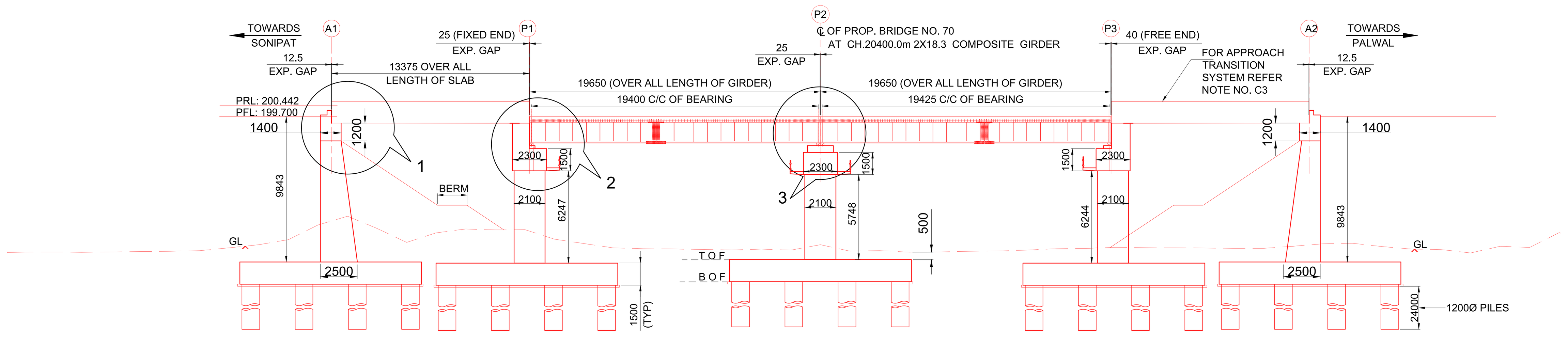
RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	(signature)
SUDHIR AGRAWAL DPD/CIVIL	(signature)	RAJU SOLANK DGM/CIVIL	(signature)
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	(signature)
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING
FOR PROP. MAJOR RUB NO.68
2x61 (OWG) AT CH: 20184m.
(CANAL CROSSING REWASAN DRAIN RD 6670) NH-248A

DRG. NO. GC-HRIDC-C5-DRG-BRD-GAD-01068_A0	SHEET NO. 1 OF 1

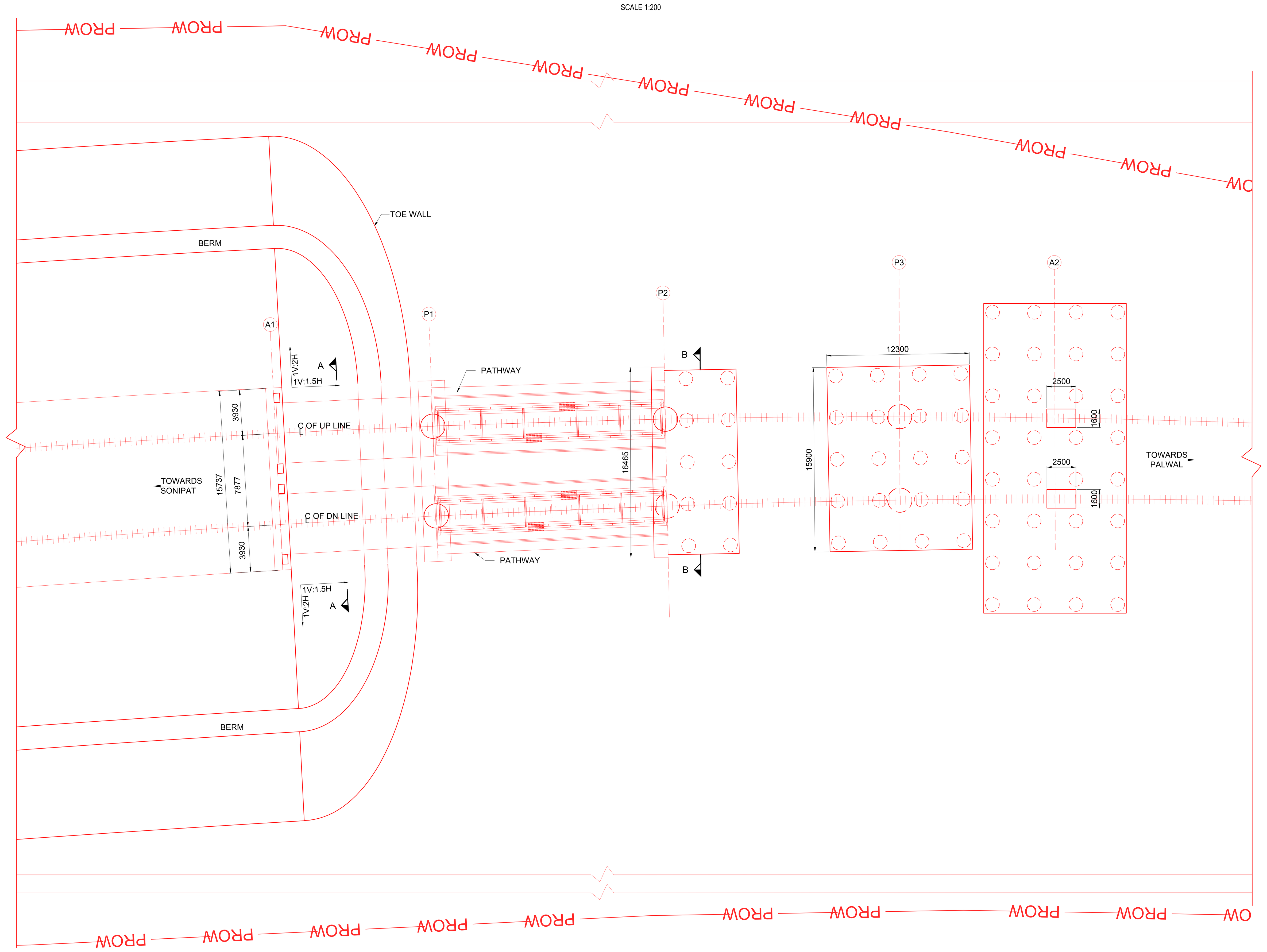
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



FORMATION LEVEL	199.700	199.700	199.700	199.700	199.700
GROUND LEVEL	198.857	190.657	191.025	190.586	190.456
CHAINAGE	20366.60	20380	20400	20420	20433.40

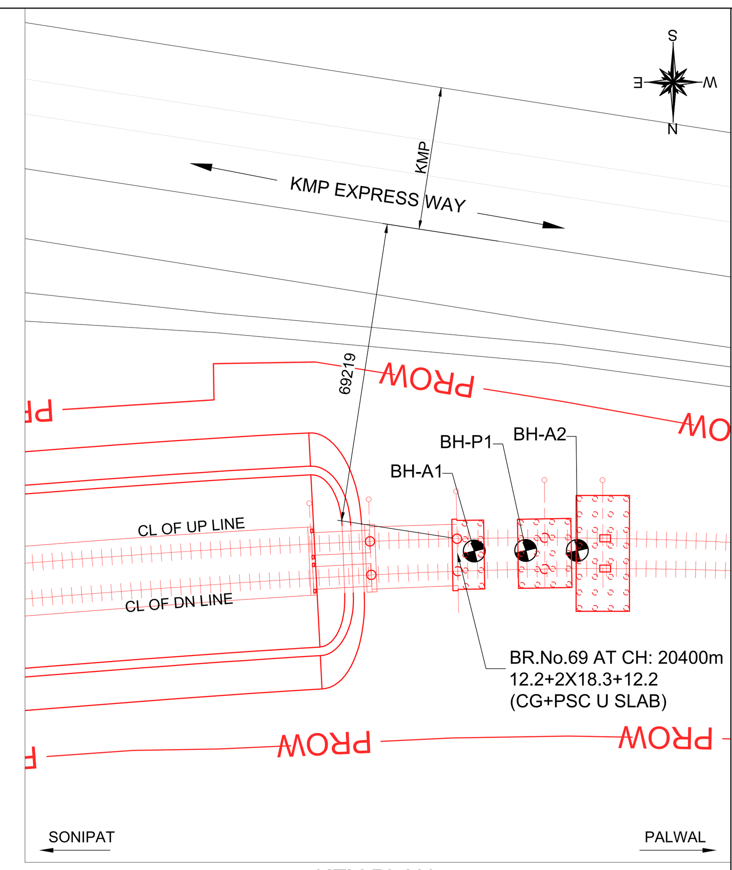
SECTIONAL ELEVATION

SCALE 1:200



HALF PLAN AT TOP HALF PLAN AT BOTTOM

SCALE 1 : 200



KEY PLAN

SCALE NTS

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONTRACTOR BEFORE EXECUTION.
6. ENGINEER IN CHARGE/ SITE ENGINEER SHOULD VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. ENGINEER IN CHARGE SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
8. ENGINEER IN CHARGE SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE/OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/ (Sig.)/ NR, DFCCI ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
9. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD IF ANY, REQUIRED IS TO BE DONE BY CONTRACTOR AT HIS COST
10. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
11. DETAILED GAD WILL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. STANDARD OF LOADING :- SUPER STRUCTURE-32.5T (RDSO STANDARD OWG) AND 25T (RDSO STANDARD PSC U SLAB), SUB STRUCTURE-32.5T- LOADING..
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   a. IRS BRIDGE RULE
   b. IRS CONCRETE BRIDGE CODE
   c. IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
   d. IS 2911 PART-1 SECTION-2.
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE. GRADE OF CONCRETE :
   a. ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   b. LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 30M,BOTH SIDES ON APPROACHES OF BRIDGE SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015
8. INSPECTION STEPS SHALL BE PROVIDED AT DIAGONALLY OPPOSITE SIDES ON BOTH ENDS OF THE BRIDGE AFTER PROTECTION WORK.
9. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
10. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFIRMING TO IS: 3117.
11. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB-STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
12. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT.
13. THE STRUCTURAL DIMENSIONS AND SIZES ARE INDICATIVE AND THESE MAY VARY DURING DETAIL DESIGN.
14. SIZE, TYPE OF FOUNDATION & GROUND IMPROVEMENT DETAILS SHOWN ARE TENTATIVE AND MAY CHANGE DURING DETAILED DESIGN.
15. SEISMIC ARRESTOR SHALL BE PROVIDED ON THE PIER/ABUTMENT CAP.

C) OTHER NOTES :

1. FOR SUPERSTRUCTURE DETAIL FOLLOW RDSO DWG. NO: RDSO/B-11753/R1 TO B-11753/7R1 (FOR CG) & RDSO 10281,10281/1 AND 10281/2(FOR PSC U SLAB).
2. ARRANGEMENT FOR PATHWAY SHALL BE PROVIDED AS PER RDSO DWG. NO. CBS-0045(FOR OWG) .
3. TRANSITION SYSTEM TO BE ADOPTED ON BRIDGE APPROACHES SHALL BE AS PER RDSO REPORT NO. GE:R-50(TRANSITION SYSTEM ON APPROACHES OF BRIDEGES). FOR DETAILS REFER SKETCH NO. GC-HRIDC-SK-GEN-019.

LEGEND

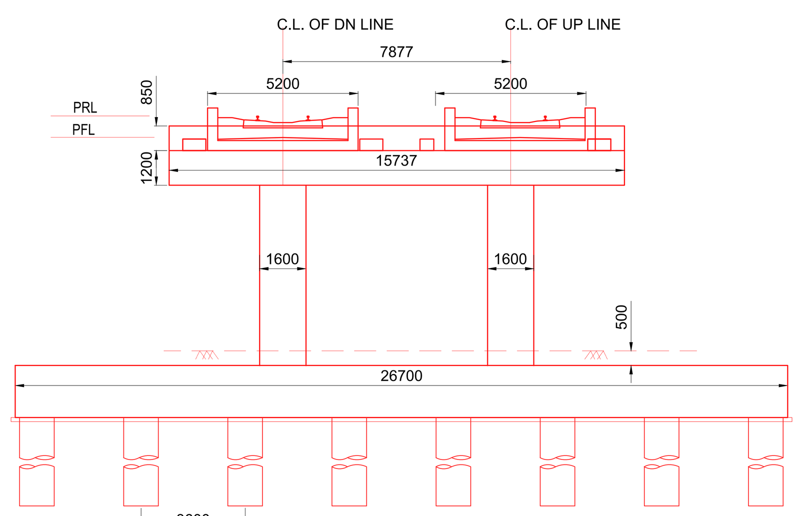
(red line)	PROPOSED
(black line)	DISMANTEL

CONSTRUCTION DEPTH

1) RAIL (60kg)	172 mm
2) RUBBER PAD	10 mm
3) WIDER PSC SLEEPER HEIGHT AT RAIL SEAT	210 mm
4) MINIMUM BALLAST THK.	350 mm
TOTAL	742 mm

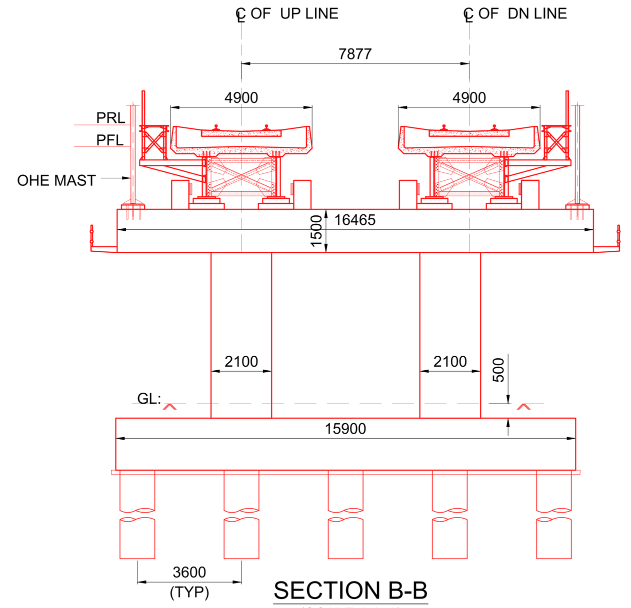
ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
RD.L	ROAD LEVEL
TOF	TOP OF FOUNDATION
BOF	BOTTOM OF FOUNDATION
THK.	THICKNESS
EXP. GAP	EXPANSION GAP
CC	CEMENT CONCRETE
TYP.	TYPICAL
GL	GROUND LEVEL
PROW	PROPOSED HORC ROW
ROW	ROAD ROW



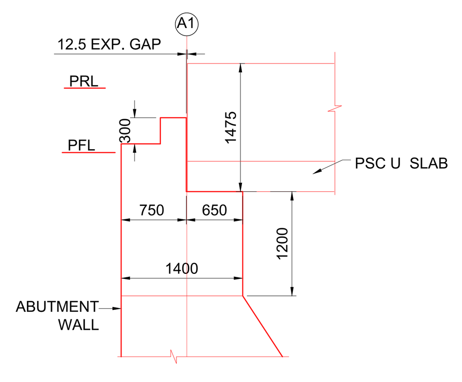
SECTION A-A

SCALE 1:150



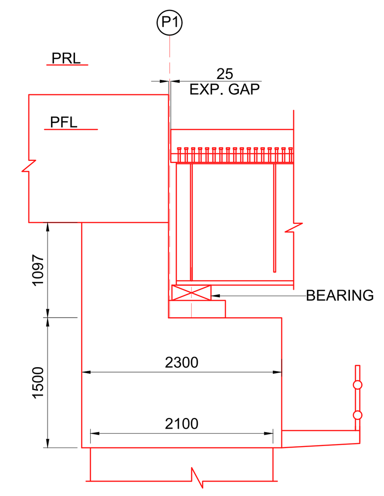
SECTION B-B

(SCALE 1:150)



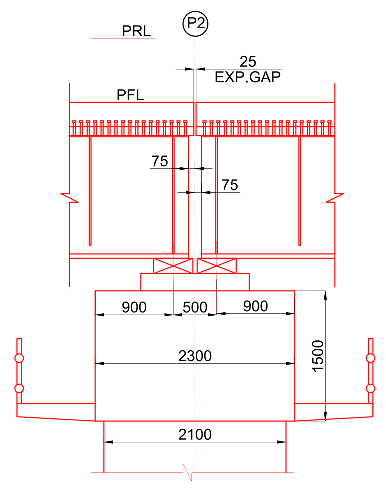
DETAIL -1

SCALE 1:50



DETAIL -2

SCALE 1:50



DETAIL -3

SCALE 1:50

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	(signature)
SUDHIR AGRAWAL DPD/CIVIL	(signature)	RAJU SOLANK DGM/CIVIL	(signature)
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	(signature)
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

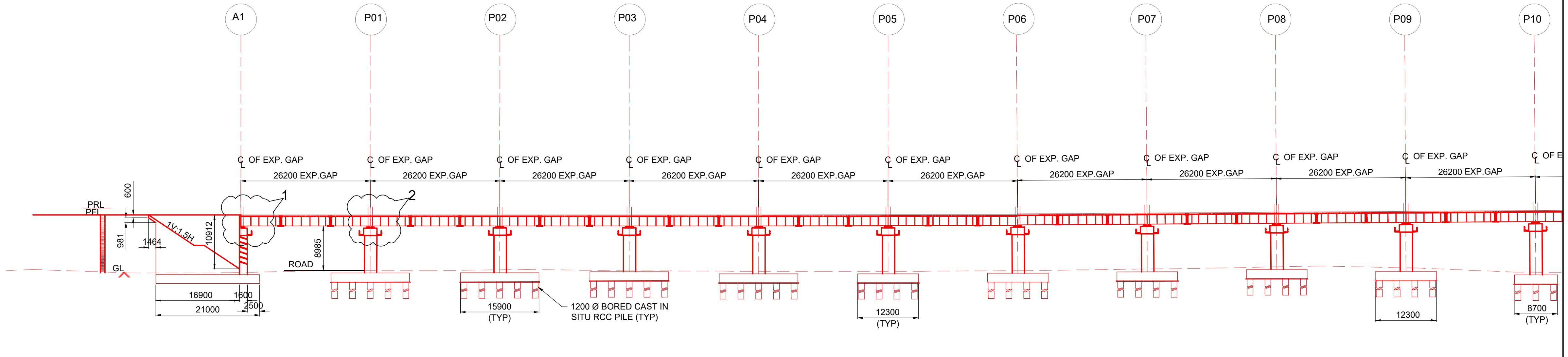
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

SMEC Member of the Surbana Jurong Group

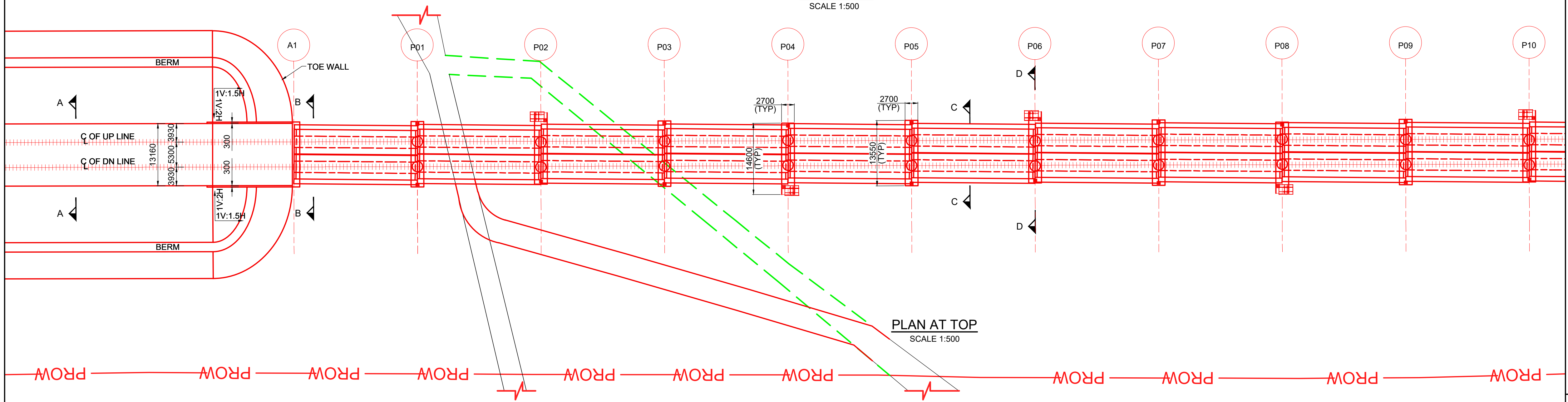
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR PROP. MAJOR BRIDGE NO.69 12.2+2X18.3+12.2 (CG+PSC U SLAB) AT CH: 20400m

DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01069_A0		1 OF1
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	

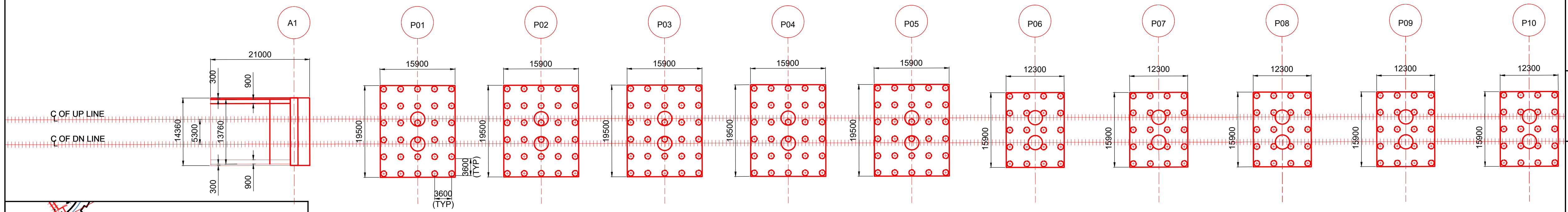


FORMATION LEVEL	202.557	202.557	202.557	202.557	202.557	202.645	202.817	202.989	203.161	203.334	203.506
GROUND LEVEL	191.203	191.606	191.757	191.551	191.466	191.458	191.584	191.825	192.364	192.156	191.258
CHAINAGE	20942.473	20968.673	20994.873	21021.073	21047.273	21073.473	21099.673	21125.873	21152.073	21178.273	21204.473

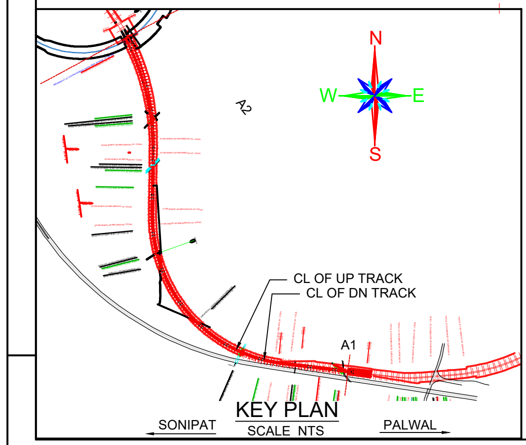
ELEVATION
SCALE 1:500



PLAN AT TOP
SCALE 1:500



PLAN AT BOTTOM
SCALE 1:500



KEY PLAN
SCALE NTS

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHALA STATION BUILDING TAKEN AS 0.00 M, WITH RESPECT TO UP MAIN LINE.
4. FOR RAIL LEVELS, FORMATION LEVEL, GRADES ETC. REFER L-SECTION.
5. THE EXISTING DETAILS ARE AS PER PRELIMINARY SITE SURVEY AND SHALL BE VERIFIED BY THE CONCTRACTOR BEFORE EXECUTION.
6. THE CONTRACTOR SHALL VERIFY THE RAIL LEVEL FORMATION LEVEL , BED LEVEL & TRACK CENTER AT SITE BEFORE COMMENCEMENT OF WORK.
7. THE CONTRACTOR SHALL ENSURE THE SAFETY OF DFC TRACK AND STRUCTURE DURING EXECUTION OF WORK.
8. THE CONTRACTOR SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT DAMAGE OF S&T CABLE/OFC DURING EXECUTION OF WORK. CONCERNED DEPT. SUCH AS BSNL/AIRTEL/SSE/ (Sig.)/ NR, DFCCI ETC. SHALL BE INFORMED WELL IN ADVANCE BEFORE EXECUTION OF WORK.
9. DURING CONSTRUCTION, IF REQUIRED, ROAD CLOSURE TO BE OBTAINED FROM CONCERNED ROAD/CIVIL AUTHORITIES. DIVERSION OF ROAD, IF ANY REQUIRED, IS TO BE DONE BY CONTRACTOR AT HIS COST.
10. THIS DRAWING IS THE PROPERTY OF HRIDC AND FOR EXCLUSIVE USE OF HORC.
11. DETAILED GAD SHALL BE PREPARED BASED ON THIS CONCEPTUAL APPROVED GAD.

B) TECHNICAL NOTES :

1. STANDARD OF LOADING :- SUPER STRUCTURE- 25T, SUB STRUCTURE-32.5T-LOADING..
2. DESIGN CRITERIA SHALL BE BASED ON FOLLOWING IRS CODES
   a. IRS BRIDGE RULE
   b. IRS CONCRETE BRIDGE CODE
   c. IRS BRIDGE SUB-STRUCTURE & FOUNDATION CODE
   d. IS 2911 PART-1 SECTION-2.
3. SEISMIC ZONE- IV
4. EXPOSURE CONDITION-MODERATE.
5. FOR CONCRETE SPECIFICATION REFER IRS CONCRETE BRIDGE CODE.
   GRADE OF CONCRETE :
   a. ALL RCC /WEARING COURSE : M:35/DETAILED DESIGN DRG.
   b. LEVELING COURSE/PCC : M:20/DETAILED DESIGN DRG.
6. REINFORCEMENT SHALL BE Fe 500D (TMT) CONFORMING TO IS 1786.
7. PROTECTION WORK ON SLOPES OF BANK UP TO 30M, ON APPROACHES OF VIADUCT ABUTMENT A1 SHALL BE DONE AS PER SKETCH NO. GC-HRIDC-SK-GEN-015.
8. INSPECTION STEPS SHALL BE PROVIDED ON BOTH SIDES OF ABUTMENT A1 OF THE VIADUCT.
9. ALL CLEAN/ EXPANSION JOINTS SHALL BE FILLED WITH THERMOCOL. .
10. ALL RCC SURFACES COMING IN CONTACT WITH SOIL SHOULD BE PAINTED WITH BITUMEN OR COAL TAR OF APPROVED QUALITY @ 1.464 K.G/SQM. CONFORMING TO IS: 3117.
11. THE BACK FILL MATERIAL SHALL BE CONFORMING TO CLAUSE 7.5 OF IRS SUB-STRUCTURE AND FOUNDATION CODE. ANGLE OF INTERNAL FRICTION OF BACKFILL SHALL NOT BE LESS THAN 33 °.
12. BEARING CAPACITY OF SOIL SHALL BE ENSURED AS PER DETAILED DESIGN REQUIREMENT.
13. THE STRUCTURAL DIMENSIONS AND SIZES SHOWN ARE INDICATIVE AND THESE MAY VARY DURING DETAIL DESIGN.
14. SEISMIC ARRESTOR SHALL BE PROVIDED ON THE PIER/ABUTMENT CAP.
15. VIADUCT SHALL BE PROVIDED WITH LWR & BLT AS PER DETAILED DESIGN.
16. C-4 CONTRACTOR SHALL CONSTRUCT ABUTMENT A-2 OF VIADUCT AND HANDOVER THE SITE TO C-5 CONTRACTOR FOR CONSTRUCTION OF SUPERSTRUCTURE. C-5 CONTRACTOR SHALL PROVIDE THE DESIGN PARAMETERS FOR CONSTRUCTION OF ABUTMENT OF A-2 TO C-4 CONTRACTOR.
17. SPAN ARRANGEMENT BETWEEN P149 AND ABUTMENT A2 ARE NON-STANDARD AND WILL BE FINALISED AFTER FINALISATION OF EXISTING ROCK PROFILE AND AVAILABILITY OF SEATING WIDTH FOR ABUTMENT A2.

LEGEND

	PROPOSED
	EXISTING
	DISMANTEL

CONSTRUCTION DEPTH

1) RAIL (60kg)	172 mm
2) RUBBER PAD	10 mm
3) WIDER PSC SLEEPER HEIGHT AT RAIL SEAT	210 mm
4) MINIMUM BALLAST THK.	350 mm
TOTAL	742 mm

ABBREVIATION

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
RD.L	ROAD LEVEL
TOF	TOP OF FOUNDATION
BOF	BOTTOM OF FOUNDATION
THK.	THICKNESS
EXP. GAP	EXPANSION GAP
CC	CEMENT CONCRETE
TYP.	TYPICAL
GL	GROUND LEVEL
PROW	PROPOSED HORC ROW
ROW	ROAD ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu		
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

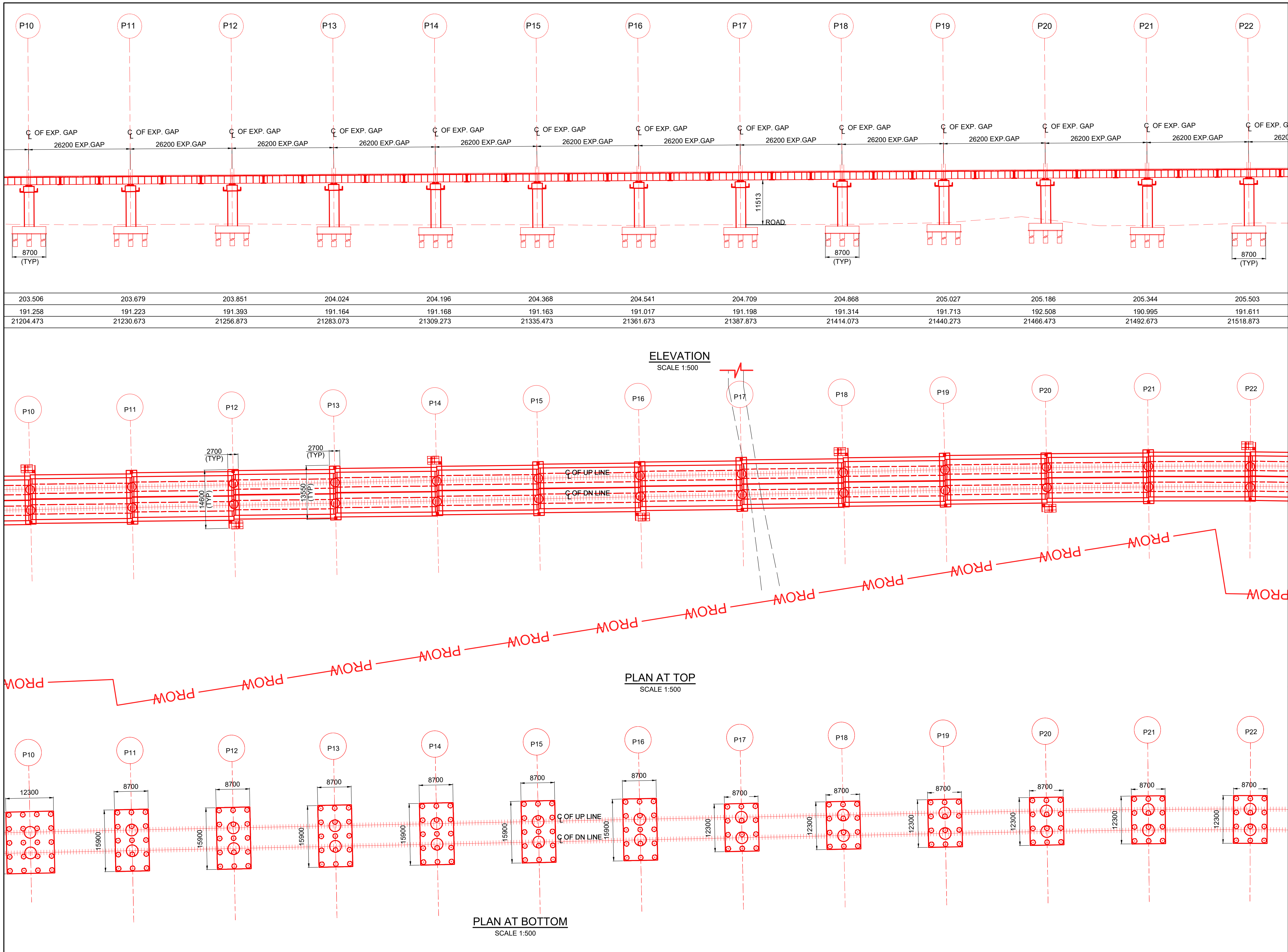
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

THE INFRASTRUCTURE PEOPLE

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR VIADUCT BR. NO.70,
SPAN: 105X24.4+1X30.5+41x24.4 +1x30+1x11.10
(COMPOSITE GIRDER) FROM CH: 20942.473M TO 24843.543M

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01070_A0	1 OF 15

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	12-10-2023	



NOTES :

A) **GENERAL NOTES**

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING NO. : GC-HRIDC-C5-DRG-BRD-GAD-01070_A0(1 OF 15).

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

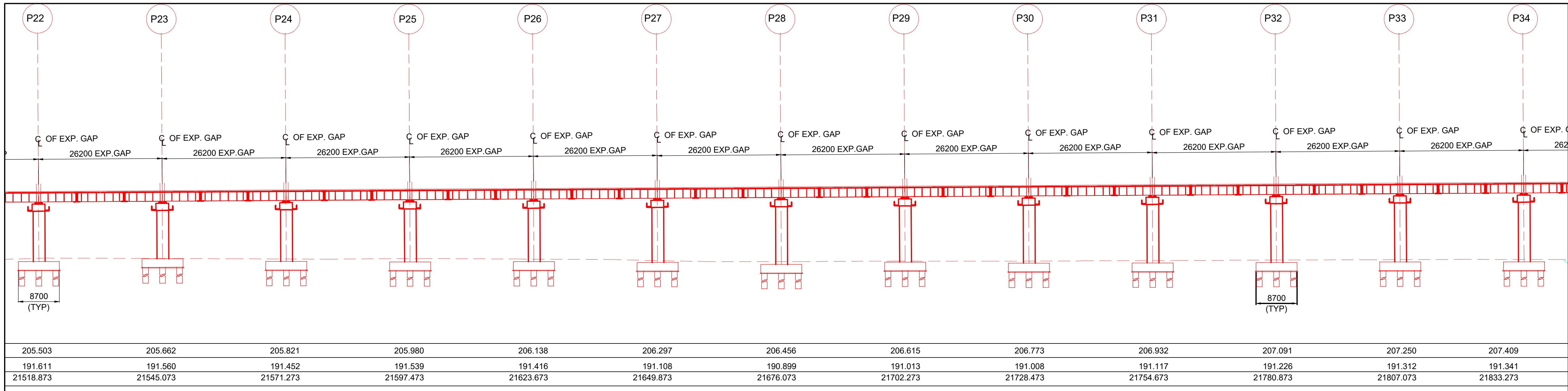
RITES THE INFRASTRUCTURE PEOPLE | SMEC

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANKI DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu		
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K.Singh		

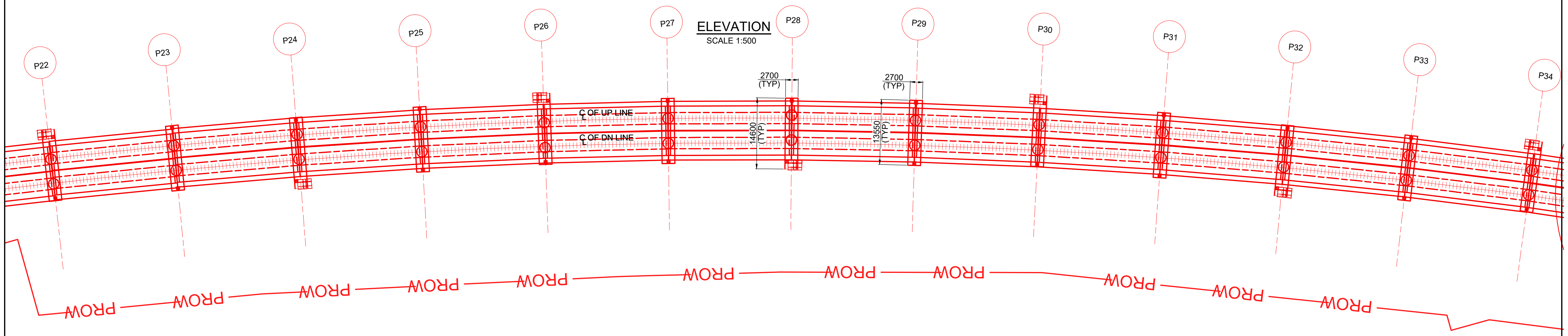
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR VIADUCT BR. NO.70, SPAN: 105X24.4+1X30.5+41x24.4 +1x30+1x11.10 (COMPOSITE GIRDER) FROM CH: 20942.473M TO 24843.543M

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01070_A0	2 OF 15

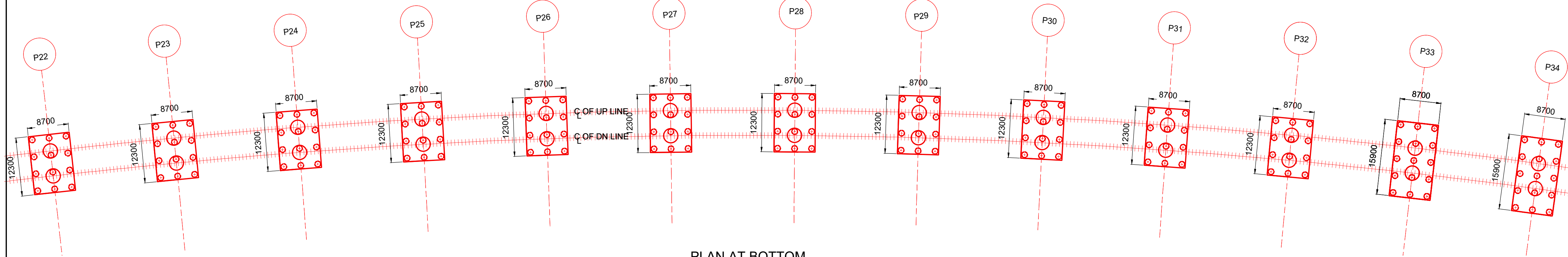
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	12-10-2023	



ELEVATION
SCALE 1:500



PLAN AT TOP
SCALE 1:500



PLAN AT BOTTOM
SCALE 1:500

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANKI DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu		
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K.Singh		

NOTES :

A) **GENERAL NOTES**

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING NO. : GC-HRIDC-C5-DRG-BRD-GAD-01070_A0(1 OF 15).

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

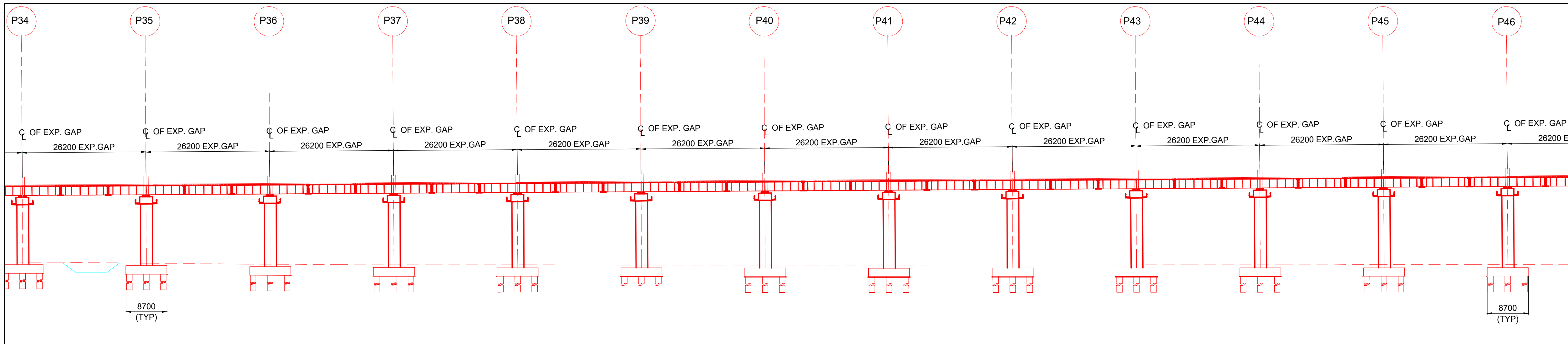
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR VIADUCT BR. NO.70, SPAN: 105X24.4+1X30.5+41x24.4 +1x30+1x11.10 (COMPOSITE GIRDER) FROM CH: 20942.473M TO 24843.543M

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01070_A0	3 OF 15

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	12-10-2023	



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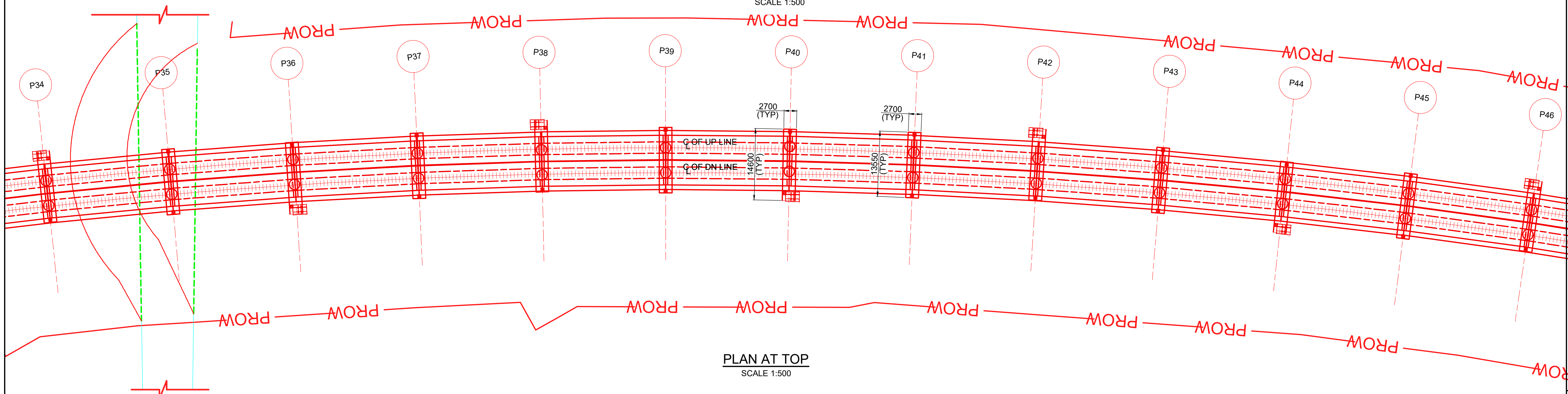
341	191.108	190.876	190.778	190.767	190.704	190.694	190.700	190.724	190.748	190.774	190.800	190.827
273	21859.473	21885.673	21911.873	21938.073	21964.273	21990.473	22016.673	22042.873	22069.073	22095.273	22121.473	22147.673

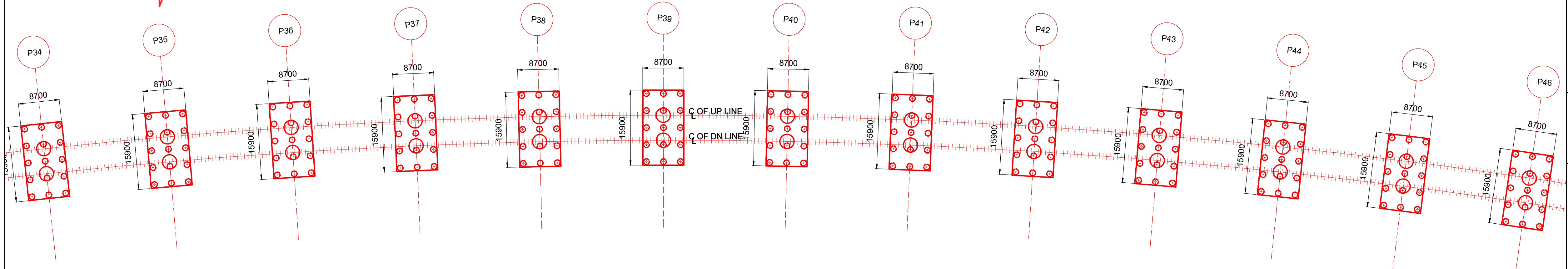
ELEVATION

SCALE 1:500



PLAN AT TOP

SCALE 1:500



PLAN AT BOTTOM

SCALE 1:500

NOTES :

A) GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING NO. : GC-HRIDC-C5-DRG-BRD-GAD-01070_A0(1 OF 15).

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu		
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

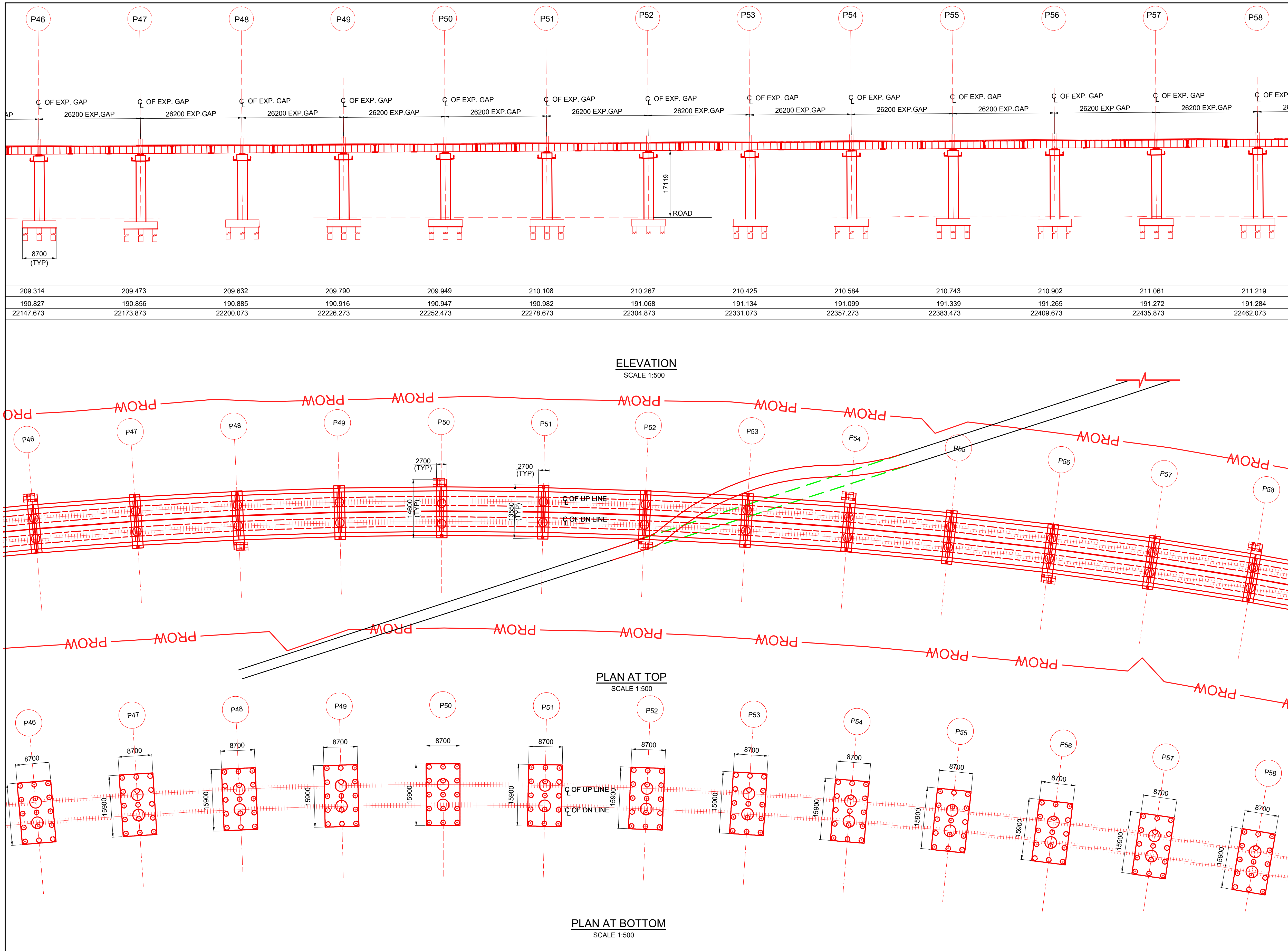
RITES THE INFRASTRUCTURE PEOPLE

SMEC

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR VIADUCT BR. NO.70,
SPAN: 105X24.4+1X30.5+41x24.4 +1x30+1x11.10
(COMPOSITE GIRDER) FROM CH: 20942.473M TO 24843.543M

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01070_A0	4 OF 15

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	12-10-2023	



ELEVATION
SCALE 1:500

PLAN AT TOP
SCALE 1:500

PLAN AT BOTTOM
SCALE 1:500

NOTES :

A) **GENERAL NOTES**

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
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3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING NO. : GC-HRIDC-C5-DRG-BRD-GAD-01070_A0(1 OF 15).

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	ChahateyRam	NEERAJ BHANDARI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu		
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K.Singh		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

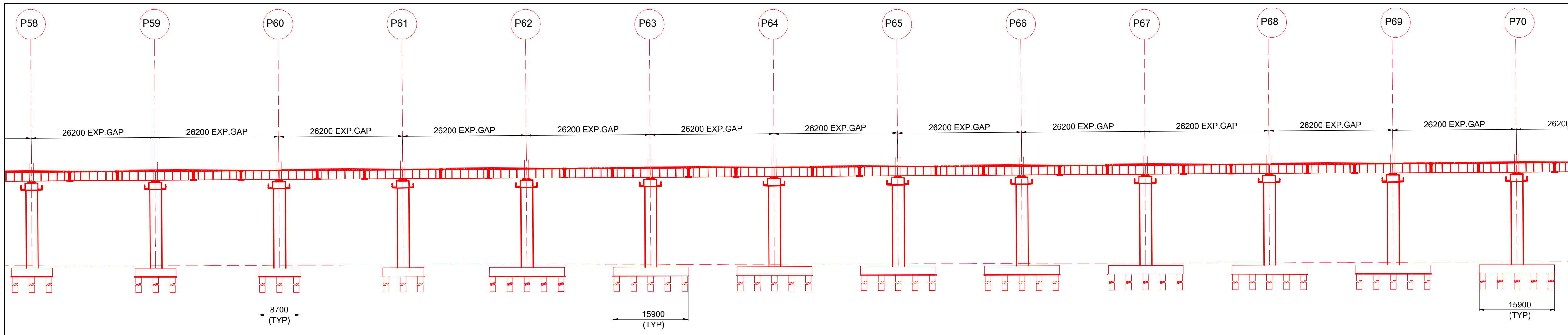
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC

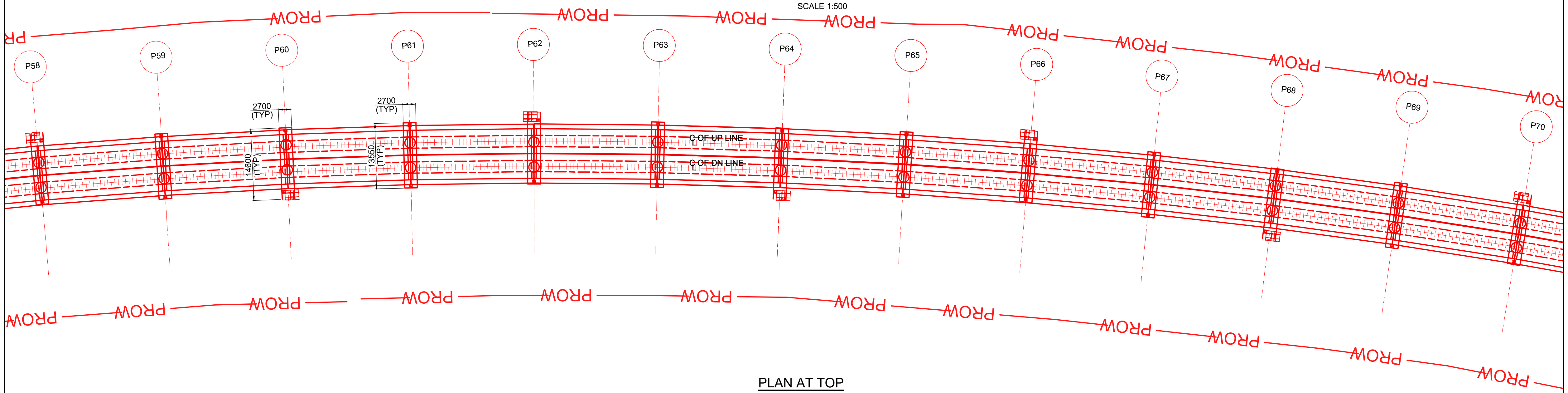
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING
FOR VIADUCT BR. NO.70,
SPAN: 105X24.4+1X30.5+41x24.4 +1x30+1x11.10
(COMPOSITE GIRDER) FROM CH: 20942.473M TO 24843.543M

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01070_A0	5 OF 15

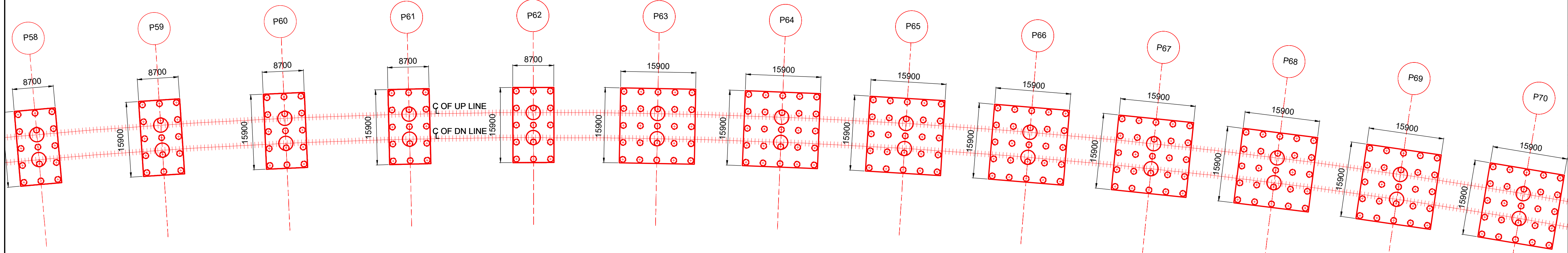
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	12-10-2023	



ELEVATION
SCALE 1:500



PLAN AT TOP
SCALE 1:500



PLAN AT BOTTOM
SCALE 1:500

NOTES :

A) **GENERAL NOTES**

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2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING NO. : GC-HRIDC-C5-DRG-BRD-GAD-01070_A0(1 OF 15).

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		NEERAJ BHANDARI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
REETU PATIAL CDE/ CIVIL			
PUSHPENDRA KR.SINGH SDE/ CIVIL			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

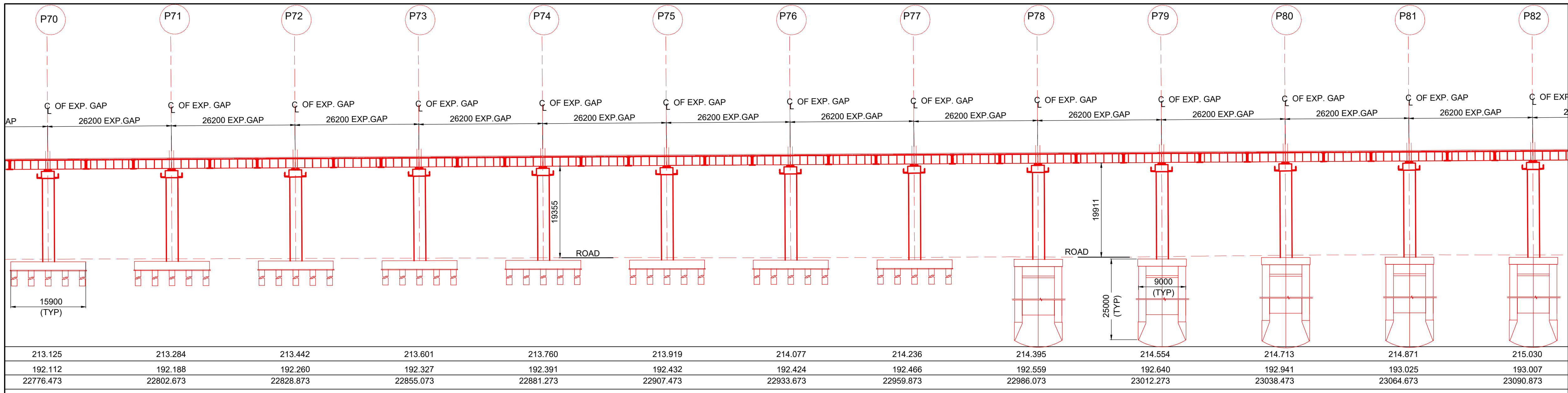
RITES THE INFRASTRUCTURE PEOPLE

SMEC

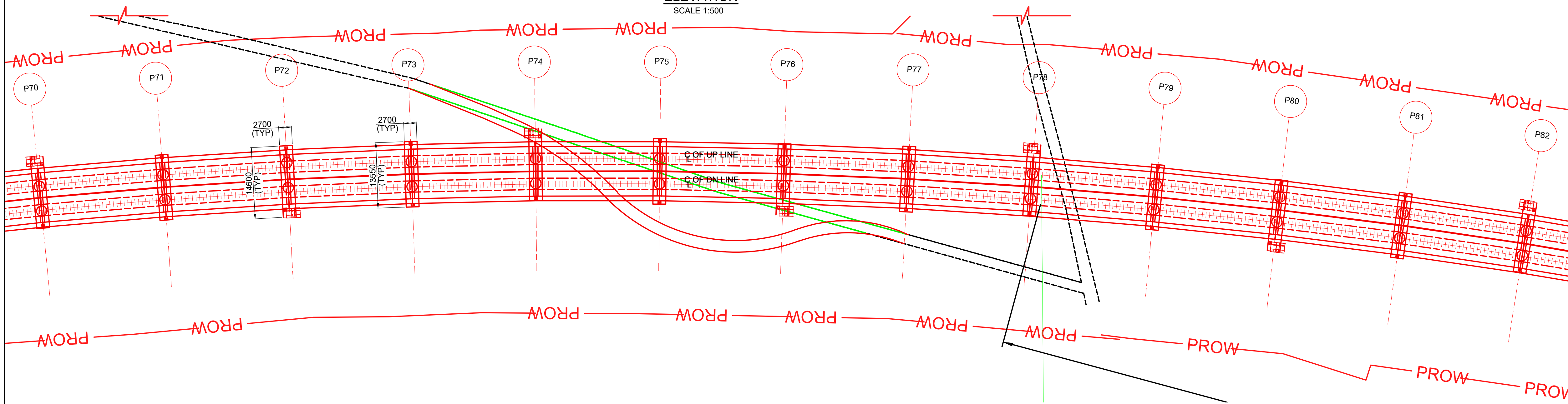
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING
FOR VIADUCT BR. NO.70,
SPAN: 105X24.4+1X30.5+41x24.4 +1x30+1x11.10
(COMPOSITE GIRDER) FROM CH: 20942.473M TO 24843.543M

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01070_A0	6 OF 15

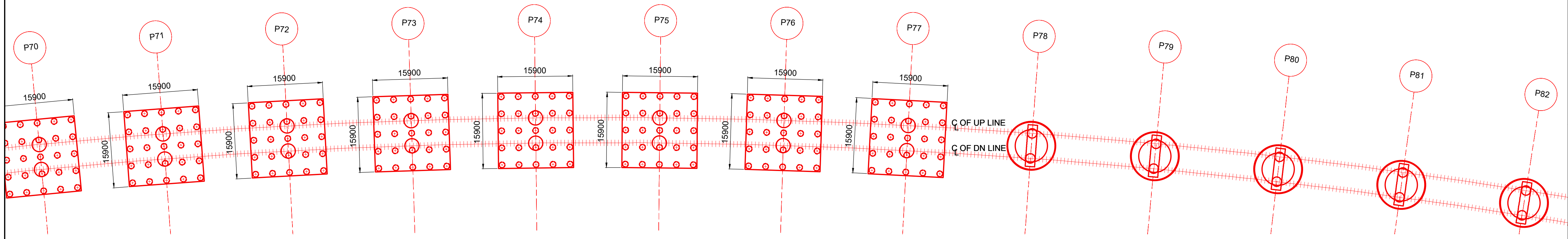
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	12-10-2023	



ELEVATION
SCALE 1:500



PLAN AT TOP
SCALE 1:500



PLAN AT BOTTOM
SCALE 1:500

NOTES :

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PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

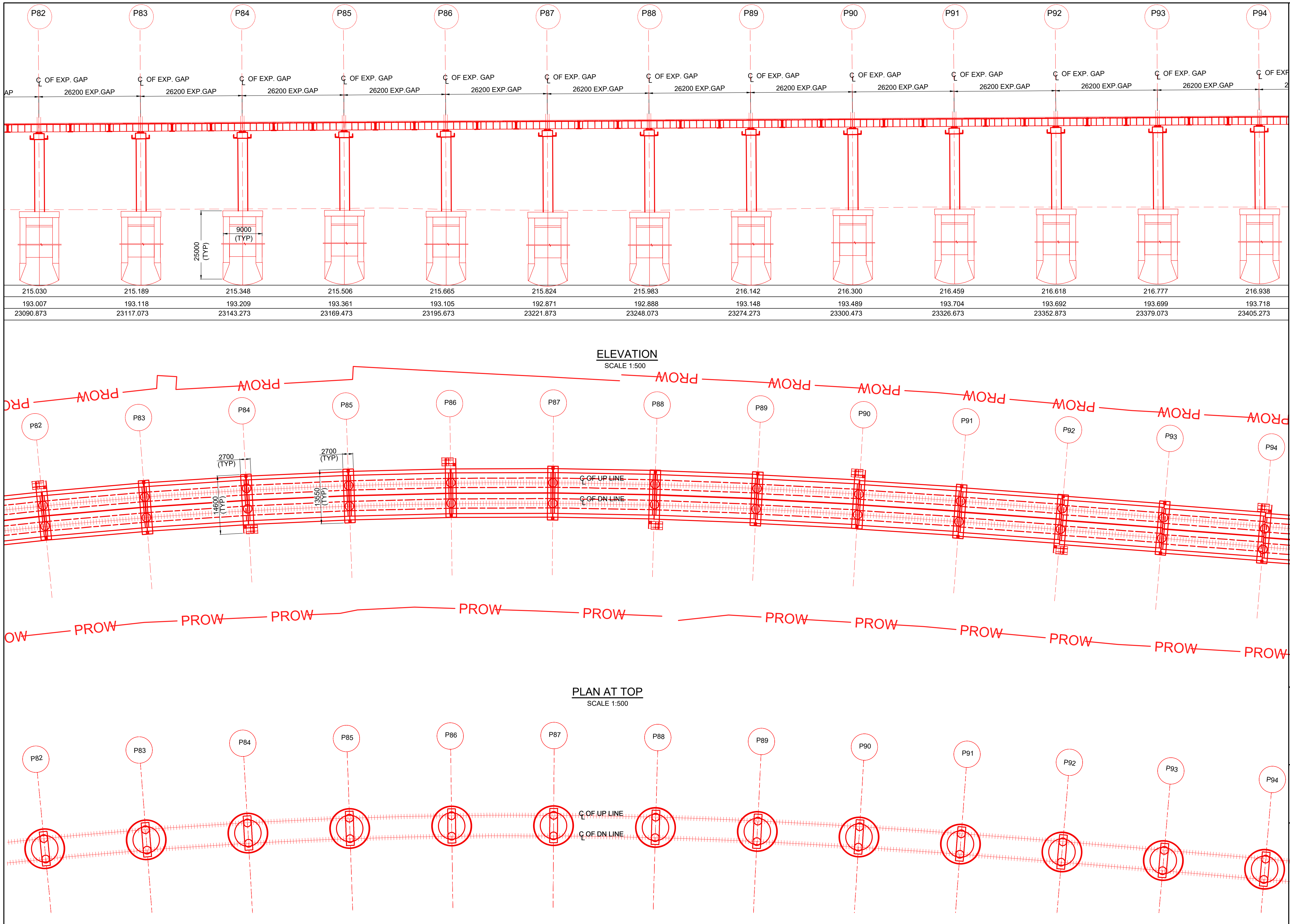
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANKI DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu		
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING
FOR VIADUCT BR. NO.70,
SPAN: 105X24.4+1X30.5+41x24.4 +1x30+1x11.10
(COMPOSITE GIRDER) FROM CH: 20942.473M TO 24843.543M

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01070_A0	7 OF 15

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	12-10-2023	



ELEVATION
SCALE 1:500

PLAN AT TOP
SCALE 1:500

PLAN AT BOTTOM
SCALE 1:500

NOTES :

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PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
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CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

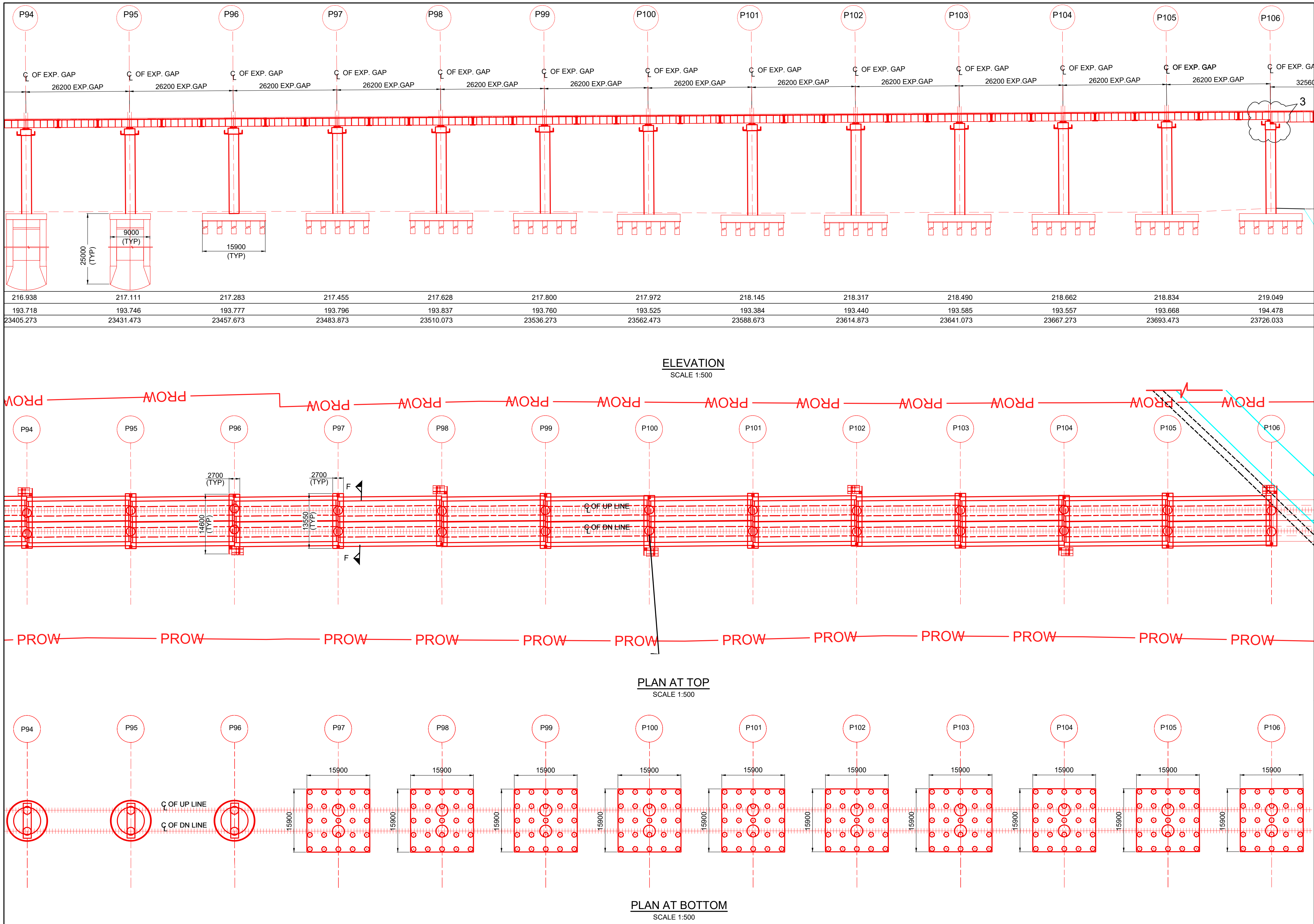
RITES THE INFRASTRUCTURE PEOPLE
SMEC

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANKI DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu		
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR VIADUCT BR. NO.70, SPAN: 105X24.4+1X30.5+41x24.4 +1x30+1x11.10 (COMPOSITE GIRDER) FROM CH: 20942.473M TO 24843.543M

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01070_A0	8 OF 15

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	12-10-2023	



ELEVATION
SCALE 1:500

PLAN AT TOP
SCALE 1:500

PLAN AT BOTTOM
SCALE 1:500

NOTES :

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NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANKI DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu		
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:
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CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

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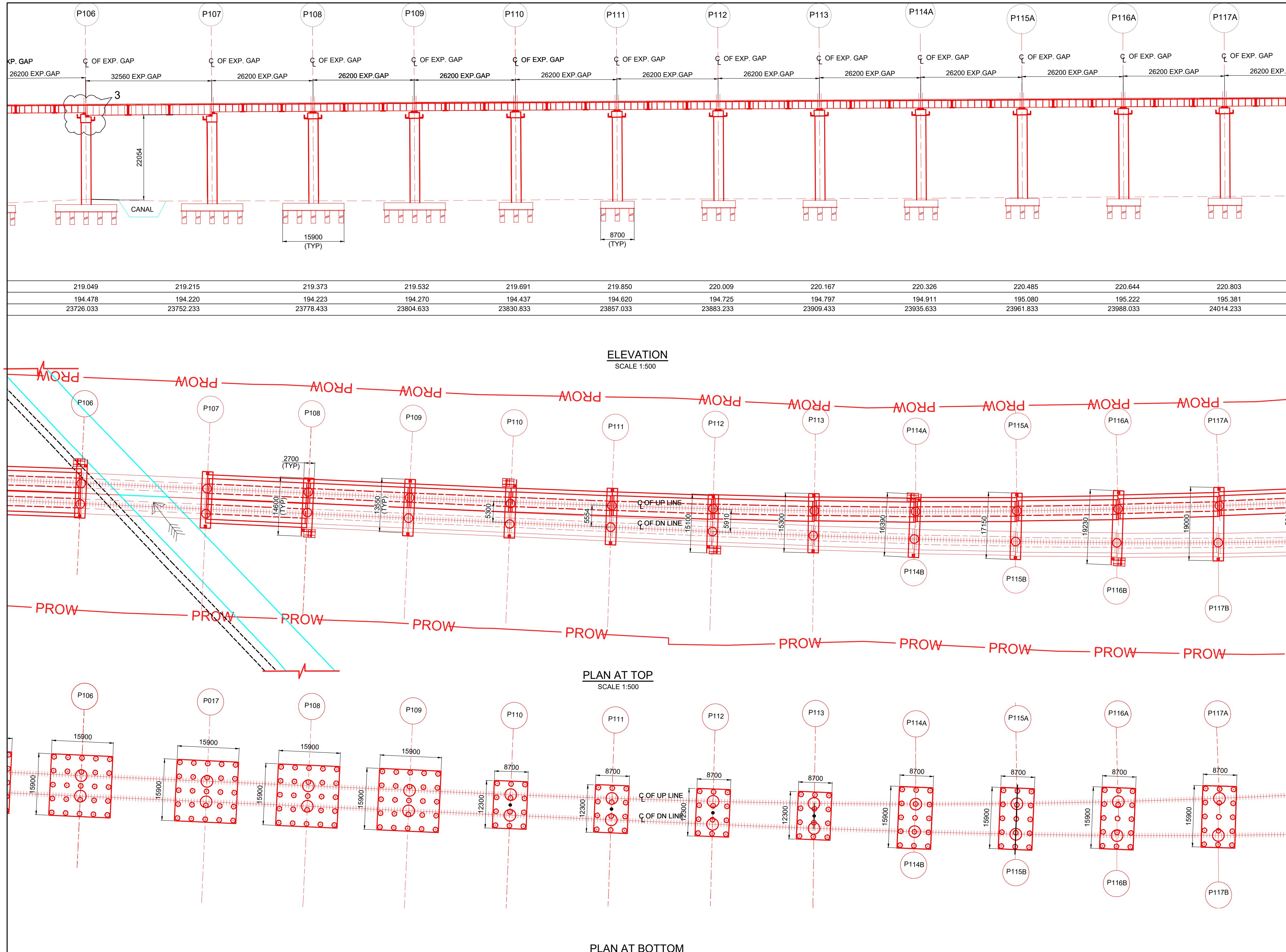
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE | SMEC

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING
FOR VIADUCT BR. NO.70,
SPAN: 105X24.4+1X30.5+41x24.4 +1x30+1x11.10
(COMPOSITE GIRDER) FROM CH: 20942.473M TO 24843.543M

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01070_A0	9 OF 15

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	12-10-2023	



NOTES :

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PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
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RITES THE INFRASTRUCTURE PEOPLE
SMEC

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	
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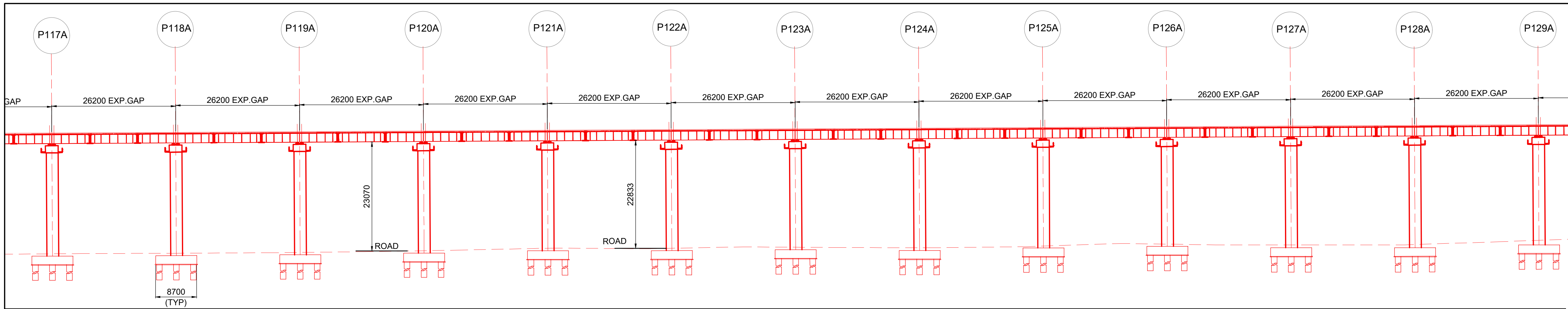
REETU PATIAL CDE/ CIVIL	Reetu		
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR VIADUCT BR. NO.70, SPAN: 105X24.4+1X30.5+41x24.4 +1x30+1x11.10 (COMPOSITE GIRDER) FROM CH: 20942.473M TO 24843.543M

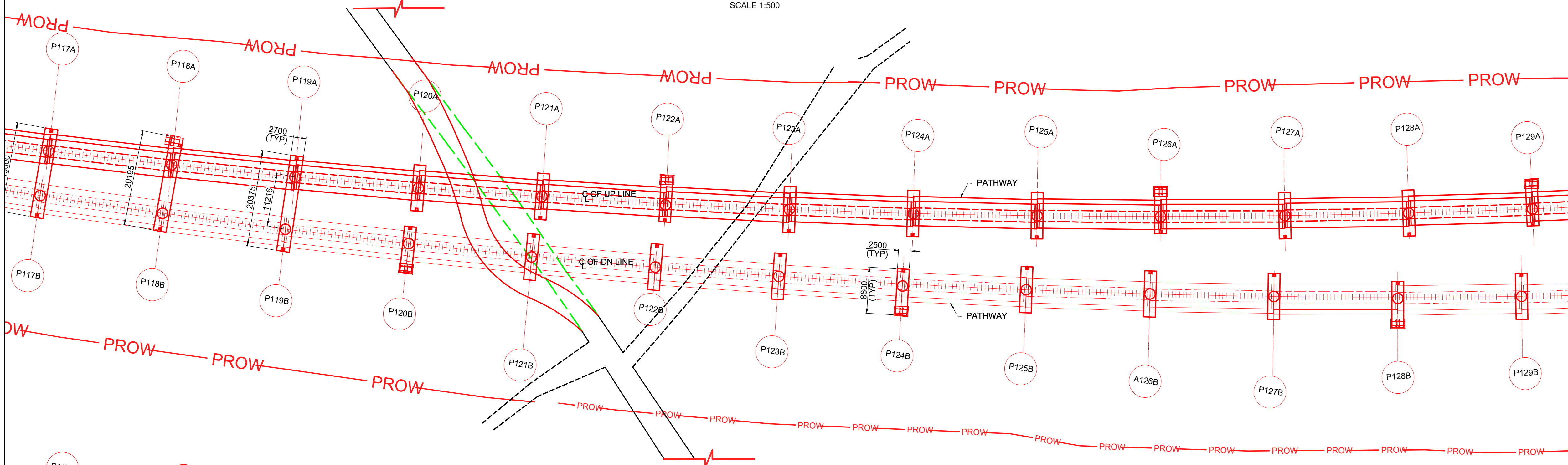
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01070_A0	10 OF 15

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	12-10-2023	

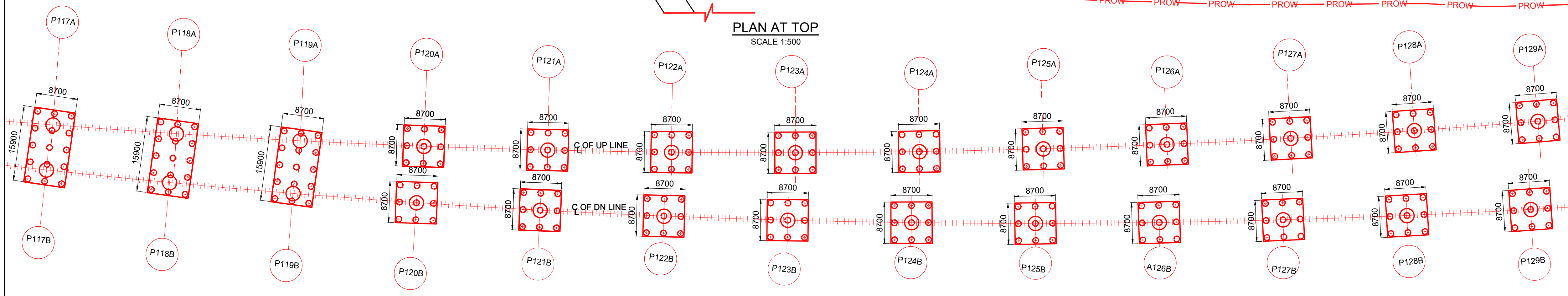


220.803	220.961	221.120	221.279	221.438	221.596	221.755	221.914	222.073	222.232	222.390	222.549	222.708
195.381	195.496	195.676	196.041	196.568	196.555	196.768	196.660	197.017	197.419	197.272	197.348	198.246
24014.233	24040.433	24066.633	24092.833	24119.033	24145.233	24171.433	24197.633	24223.833	24250.033	24276.233	24302.433	24328.633

ELEVATION
SCALE 1:500



PLAN AT TOP
SCALE 1:500



PLAN AT BOTTOM
SCALE 1:500

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GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANKI DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu		
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
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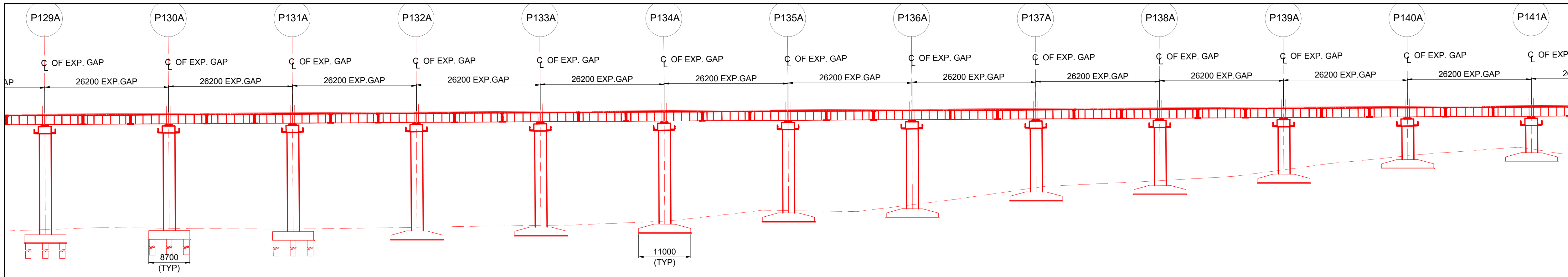
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING
FOR VIADUCT BR. NO.70,
SPAN: 105X24.4+1X30.5+41x24.4 +1x30+1x11.10
(COMPOSITE GIRDER) FROM CH: 20942.473M TO 24843.543M

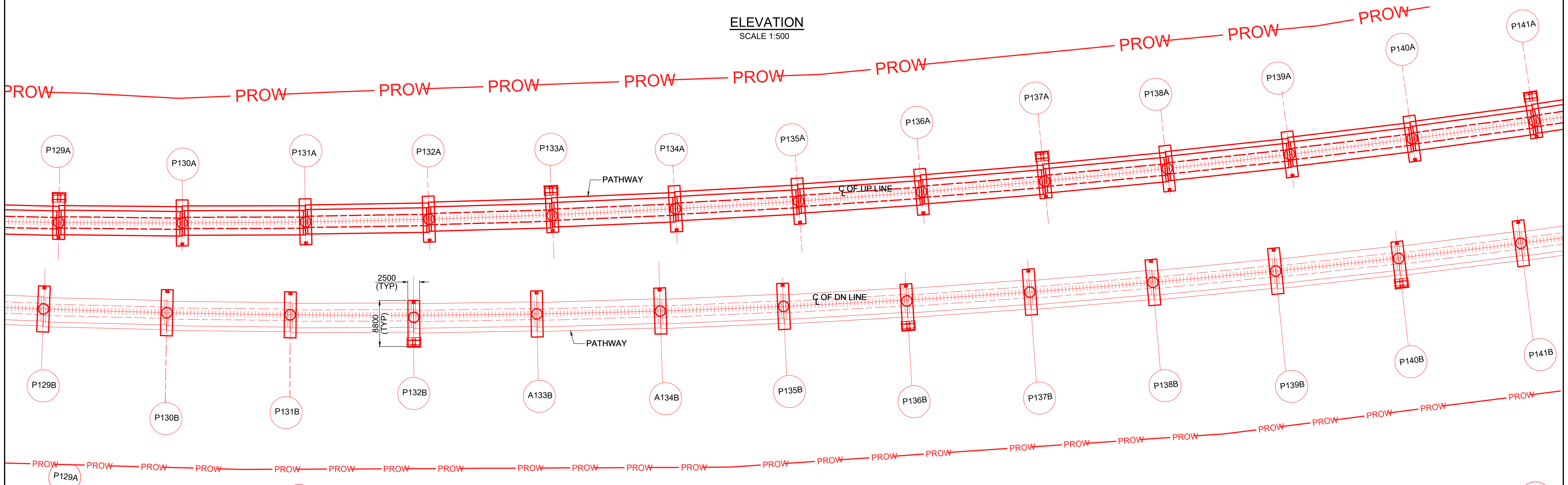
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01070_A0	11 OF 15

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	12-10-2023	

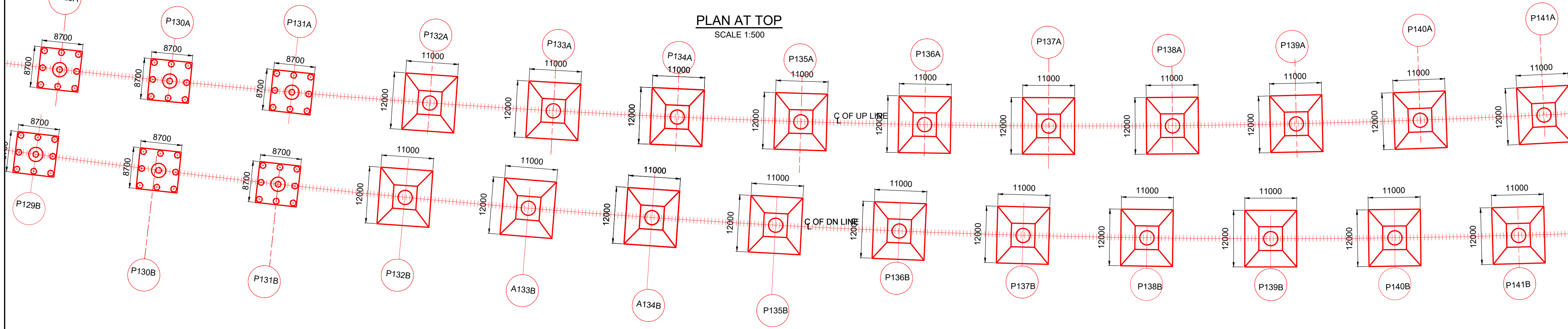


222.708	222.867	223.025	223.184	223.343	223.502	223.661	223.819	223.978	224.137	224.296	224.454	224.613
198.246	198.502	198.350	198.723	199.115	200.025	202.237	203.537	207.157	208.602	210.938	213.878	215.211
24328.633	24354.833	24381.033	24407.233	24433.433	24459.633	24485.833	24512.033	24538.233	24564.433	24590.633	24616.833	24643.033

ELEVATION
SCALE 1:500



PLAN AT TOP
SCALE 1:500



PLAN AT BOTTOM
SCALE 1:500

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GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANKI DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu		
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
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CONSULTANT:
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RITES THE INFRASTRUCTURE PEOPLE
SMEC

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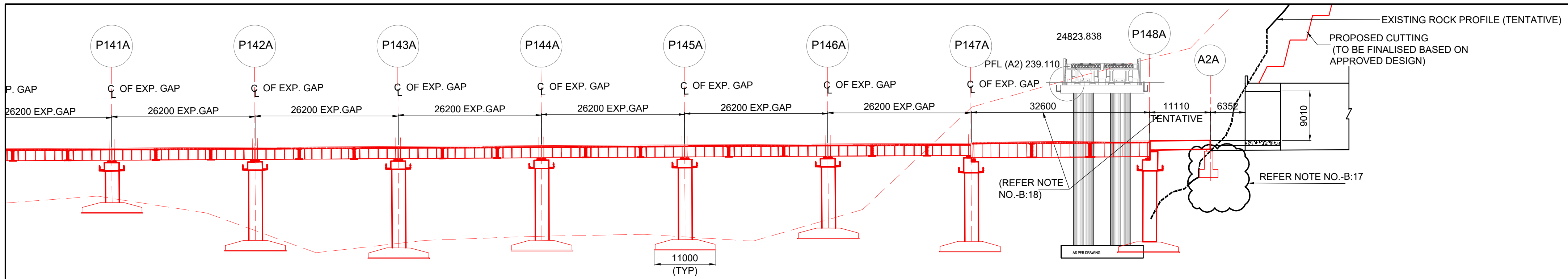
FOR VIADUCT BR. NO.70,
SPAN: 105X24.4+1X30.5+41x24.4 +1x30+1x11.10
(COMPOSITE GIRDER) FROM CH: 20942.473M TO 24843.543M

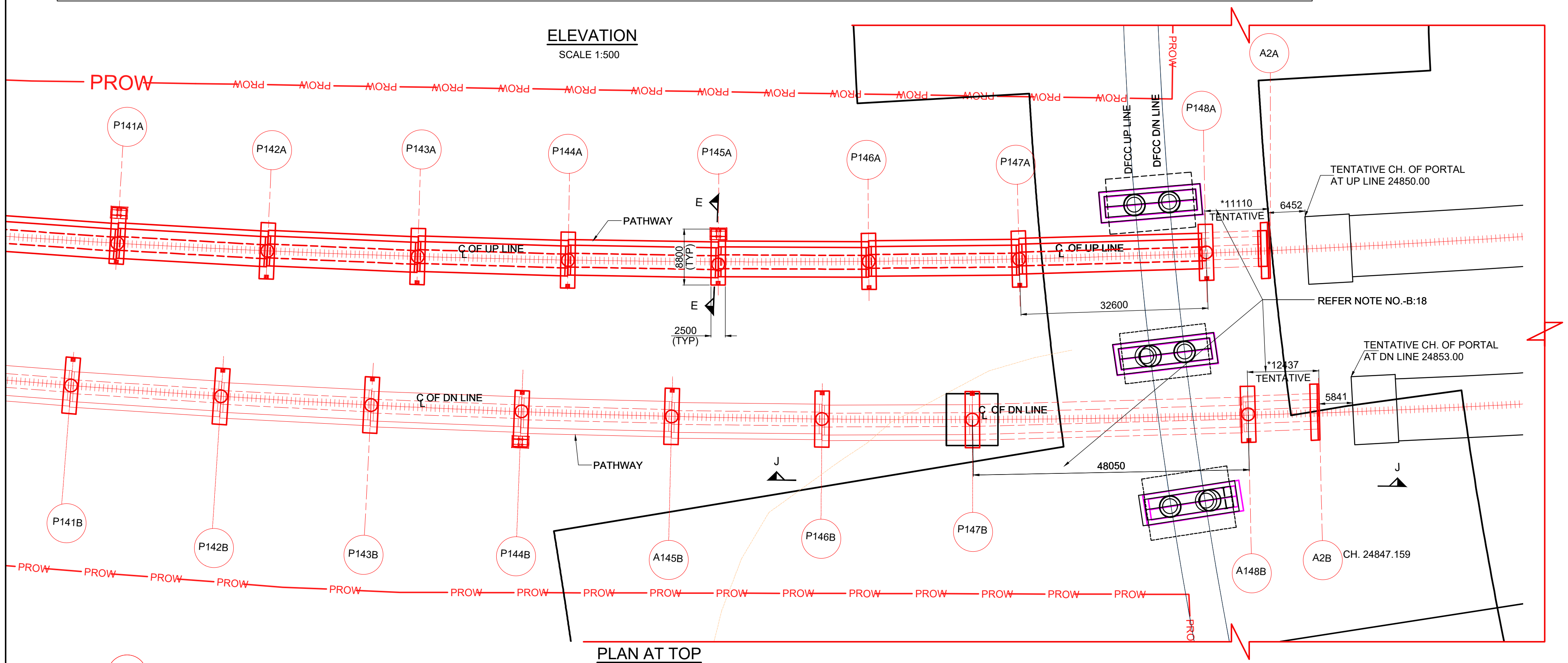
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01070_A0	12 OF 15

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	12-10-2023	

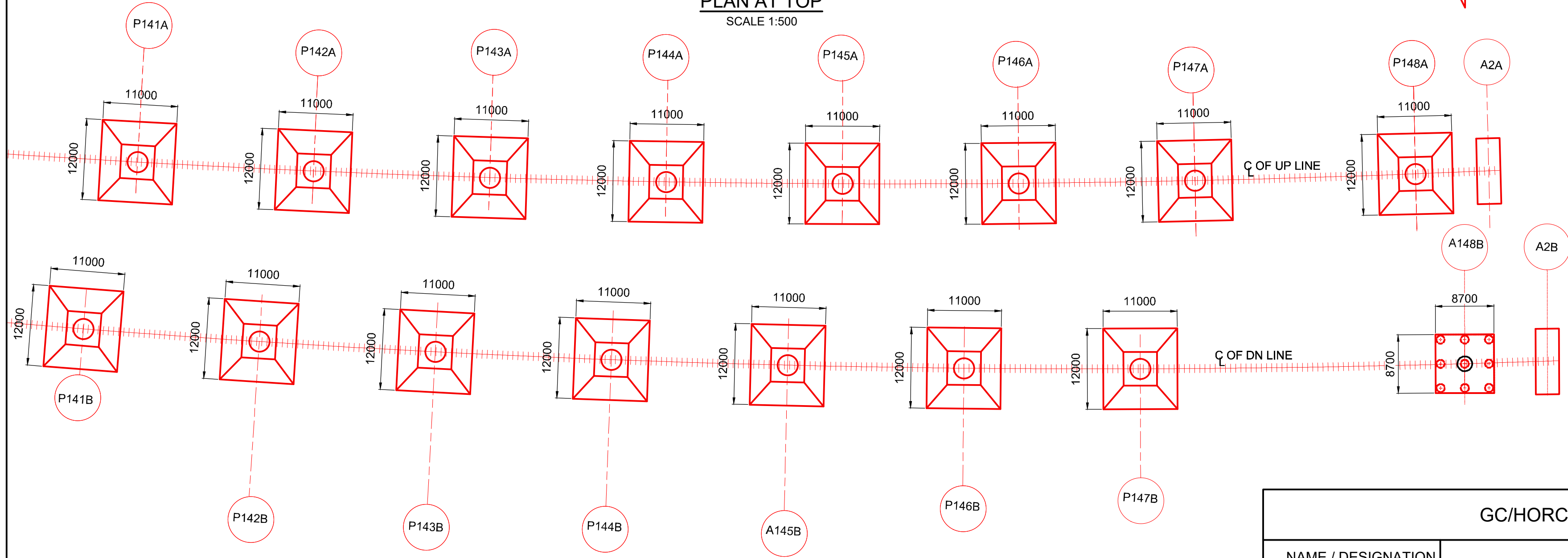


224.613	224.772	224.931	225.090	225.248	225.407	225.566	225.761	225.828
215.211	209.257	207.101	208.363	208.215	211.504	232.023	240.781	246.299
24643.033	24669.233	24695.433	24721.633	24747.833	24774.033	24800.233	24832.433	24843.548

ELEVATION
SCALE 1:500



PLAN AT TOP
SCALE 1:500



PLAN AT BOTTOM
SCALE 1:500

NOTES :

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GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	[signature]
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PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
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CONSULTANT:
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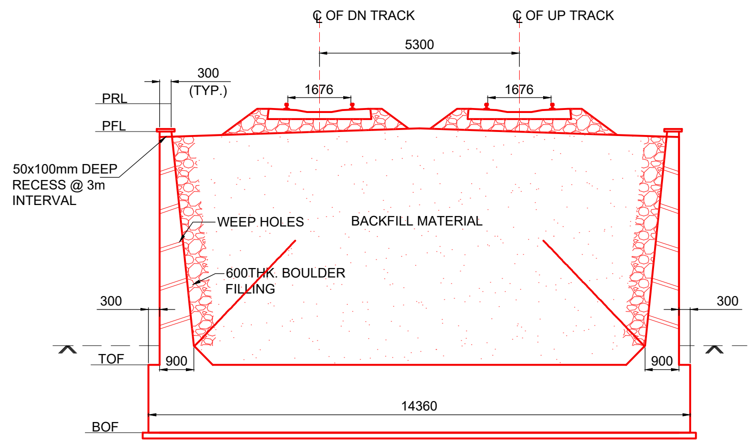
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE | SMEC

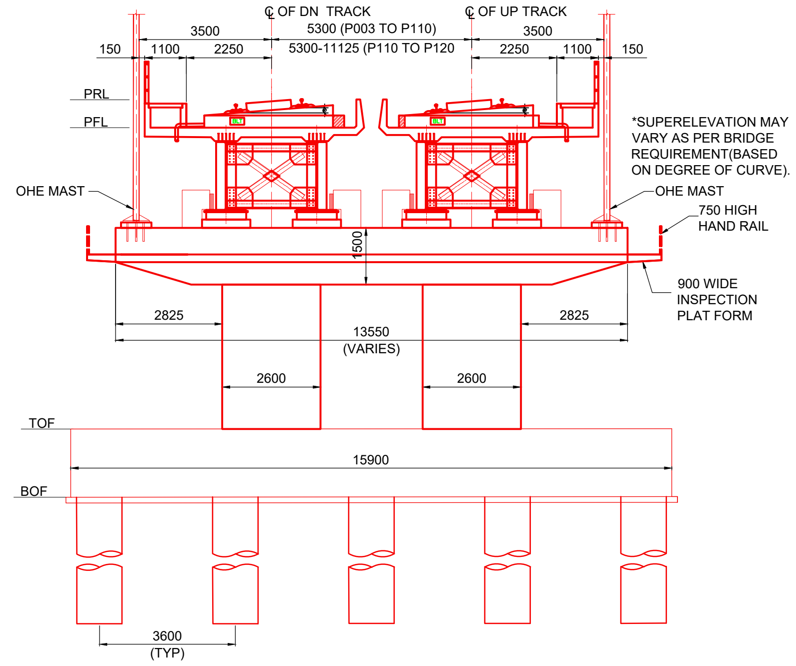
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING
FOR VIADUCT BR. NO.70,
SPAN: 105X24.4+1X30.5+41x24.4 +1x30+1x11.10
(COMPOSITE GIRDER) FROM CH: 20942.473M TO 24843.543M

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01070_A0	13 OF 15

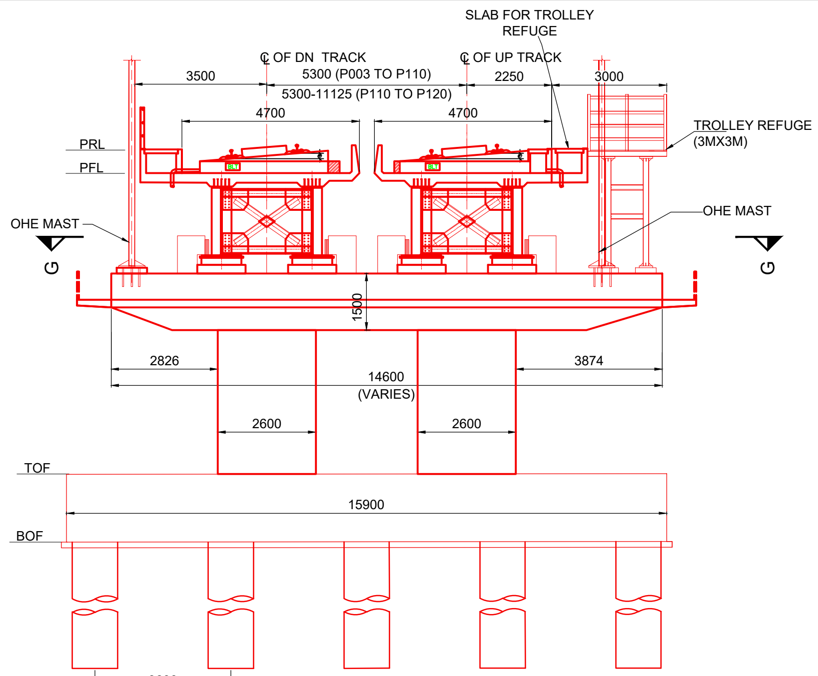
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	12-10-2023	



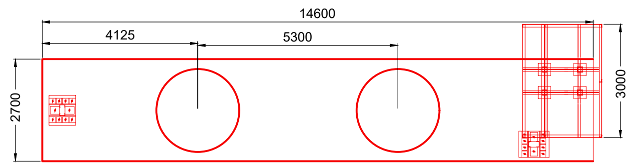
SECTION A-A
SCALE 1:100



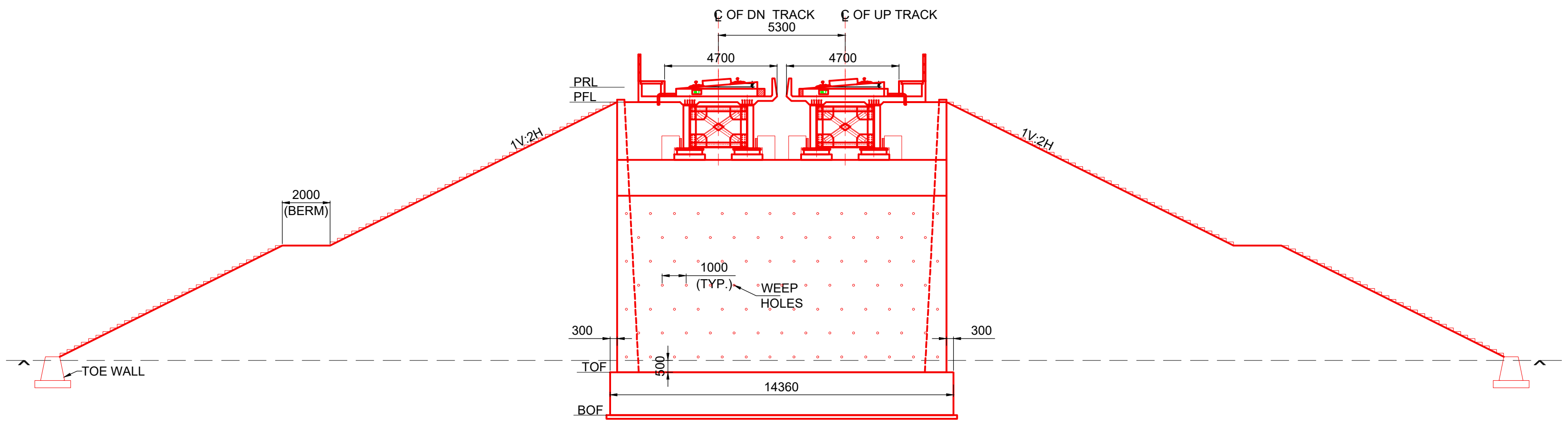
SECTION C-C
SCALE 1:100



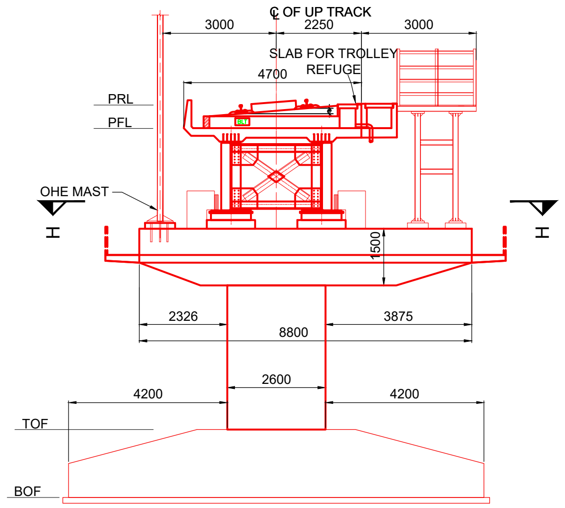
SECTION D-D
SCALE 1:100



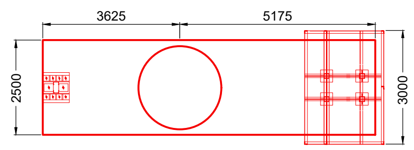
SECTION G-G
SCALE 1:100



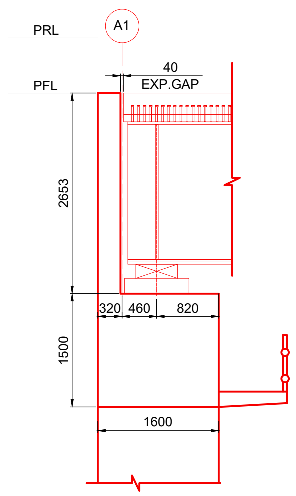
SECTION B-B
SCALE 1:150



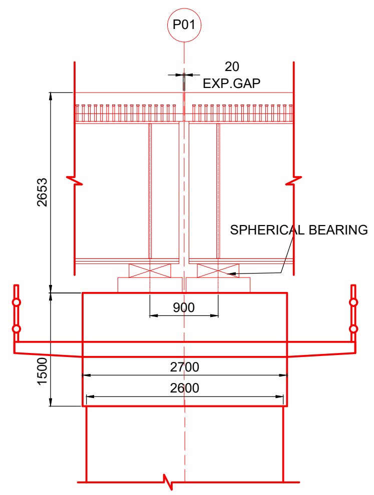
SECTION E-E
SCALE 1:100
(P121TO P150)



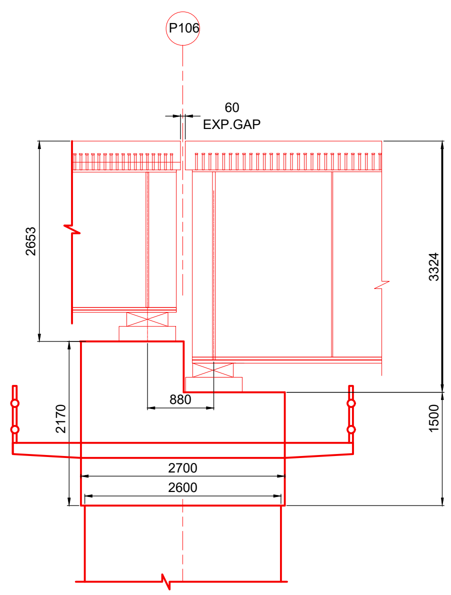
SECTION H-H
SCALE 1:100



DETAIL -1
SCALE 1:50



DETAIL -2
SCALE 1:50



DETAIL -3
SCALE 1:50

NOTES :

A) **GENERAL NOTES**

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING NO. : GC-HRIDC-C5-DRG-BRD-GAD-01070_A0(1 OF 15).

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

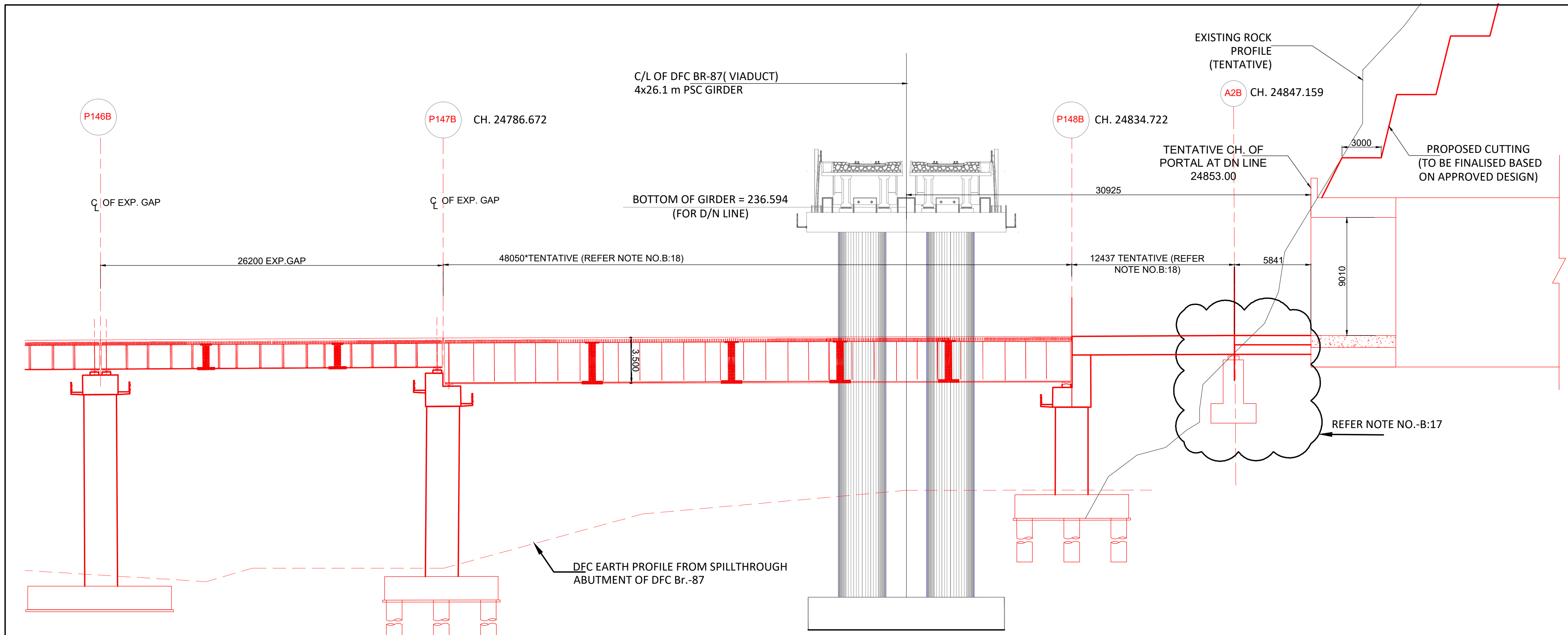
SMEC

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu		
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

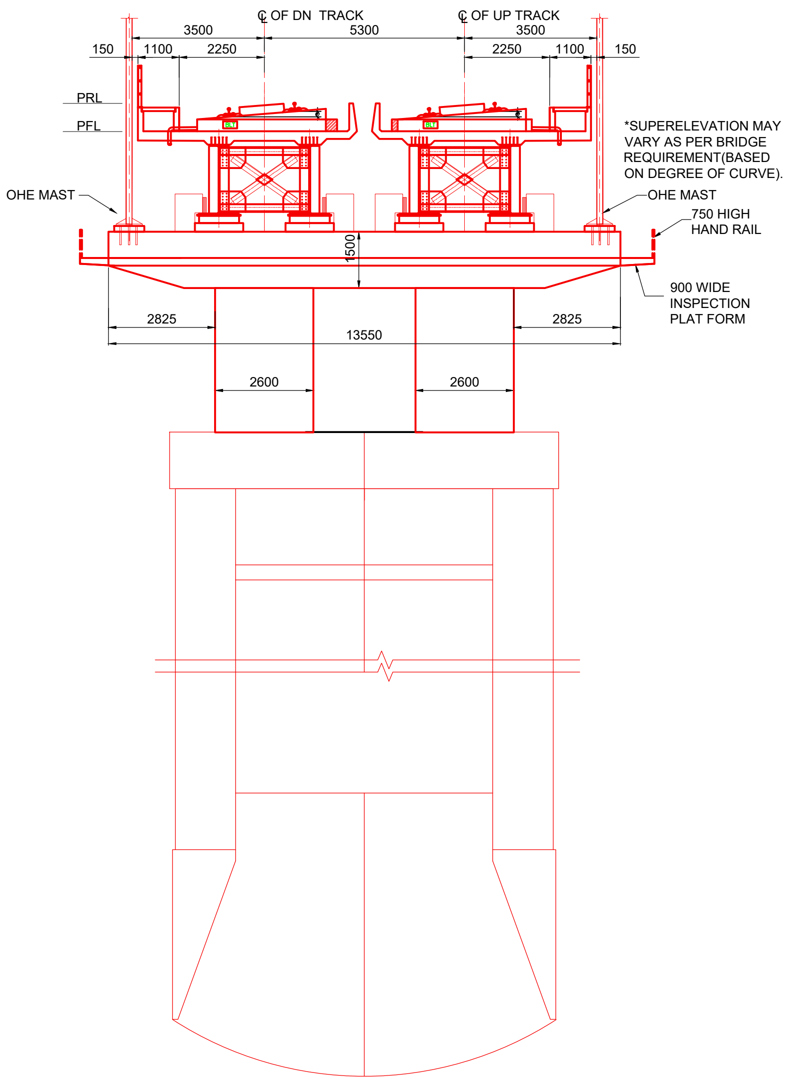
TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING FOR VIADUCT BR. NO.70, SPAN: 105X24.4+1X30.5+41x24.4 +1x30+1x11.10 (COMPOSITE GIRDER) FROM CH: 20942.473M TO 24843.543M

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01070_A0	14 OF 15

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	12-10-2023	



SECTION J-J
SCALE 1:100



SECTION F-F
SCALE 1:100

NOTES :

A) **GENERAL NOTES**

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING NO. : GC-HRIDC-C5-DRG-BRD-GAD-01070_A0(1 OF 15).

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

THE INFRASTRUCTURE PEOPLE

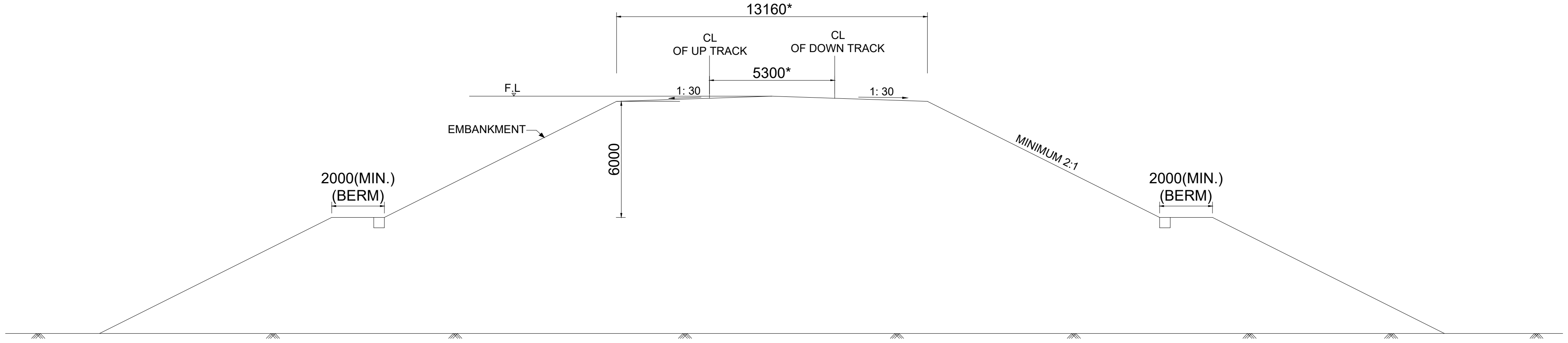
GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANKI DGM/CIVIL	[signature]
REETU PATIAL CDE/ CIVIL	Reetu		
PUSHPENDRA KR.SINGH SDE/ CIVIL	P.K. Singh		

TITLE:- CONCEPTUAL GENERAL ARRANGEMENT DRAWING
FOR VIADUCT BR. NO.70,
SPAN: 105X24.4+1X30.5+41x24.4 +1x30+1x11.10
(COMPOSITE GIRDER) FROM CH: 20942.473M TO 24843.543M

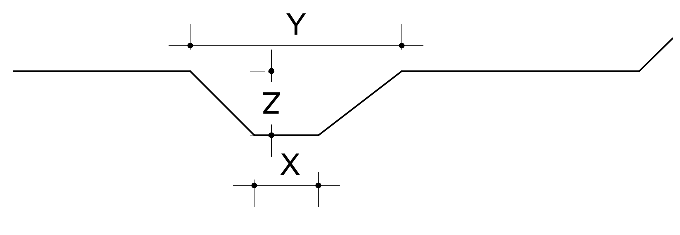
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRG-BRD-GAD-01070_A0	15 OF 15

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	12-10-2023	

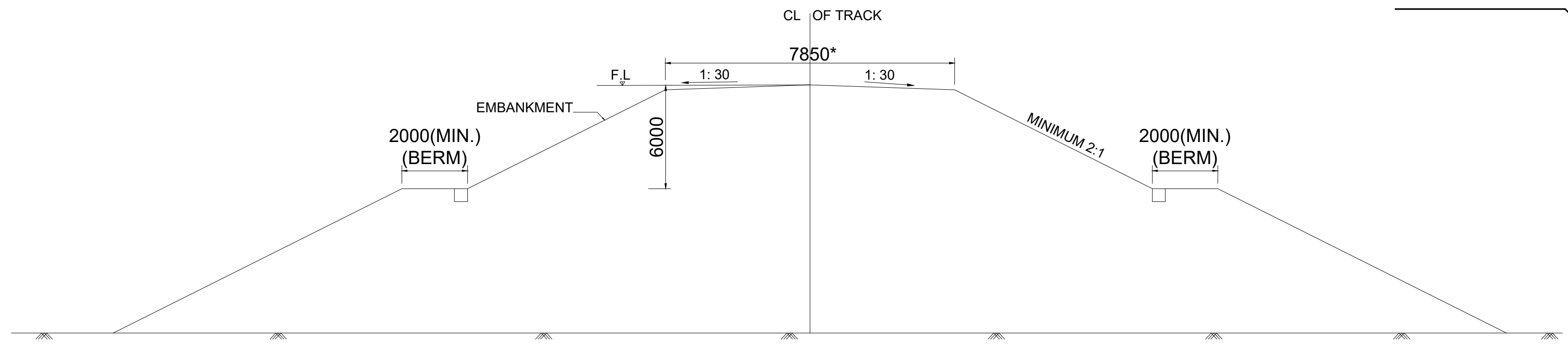
5. MISCELLANEOUS DRAWINGS (CONCEPTUAL PLANS)



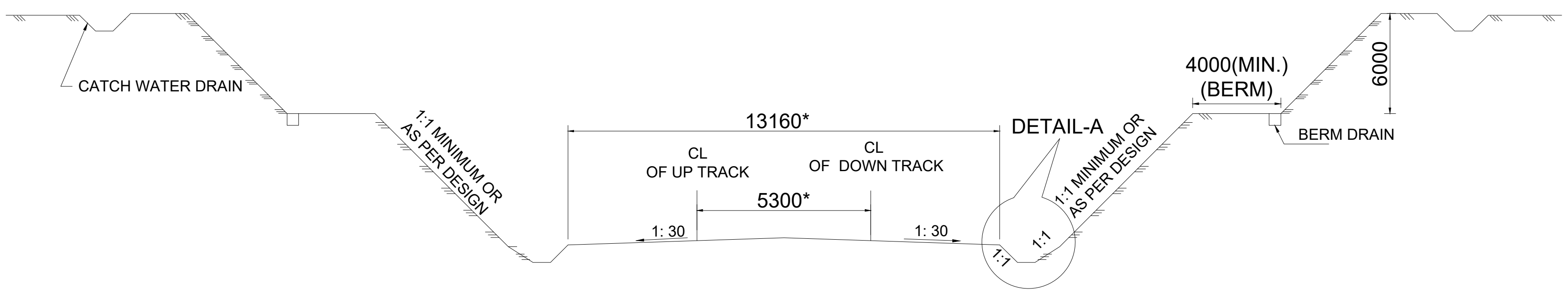
TYPICAL CROSS-SECTION OF EMBANKMENT (FOR DOUBLE TRACK)



DETAIL-A



TYPICAL CROSS-SECTION OF EMBANKMENT (FOR SINGLE TRACK)



TYPICAL CROSS-SECTION OF CUTTING (FOR DOUBLE TRACK)

NOTES:
1. ALL DIMENSION ARE IN MM.
2. DEPTH OF BALLAST CUSHION SHOULD BE PROVIDED AS PER PARA 212(2) OF IRPWM.
3. CROSS SLOPE OF 1IN 30 SHALL BE PROVIDED.
4. MINIMUM FORMATION WIDTH OF 13160 MM SHALL BE ENSURED FOR NEW WORKS IN BOTH EMBANKMENT AND IN CUTTING (EXCLUDING SIDE DRAIN)
5. * FORMATION WIDTH SHALL BE INCREASED BASED ON CURVE & SUPER ELEVATION AS PER IRSOD.
6. X, Y, Z DIMENSIONS SHALL BE AS PER DESIGN.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

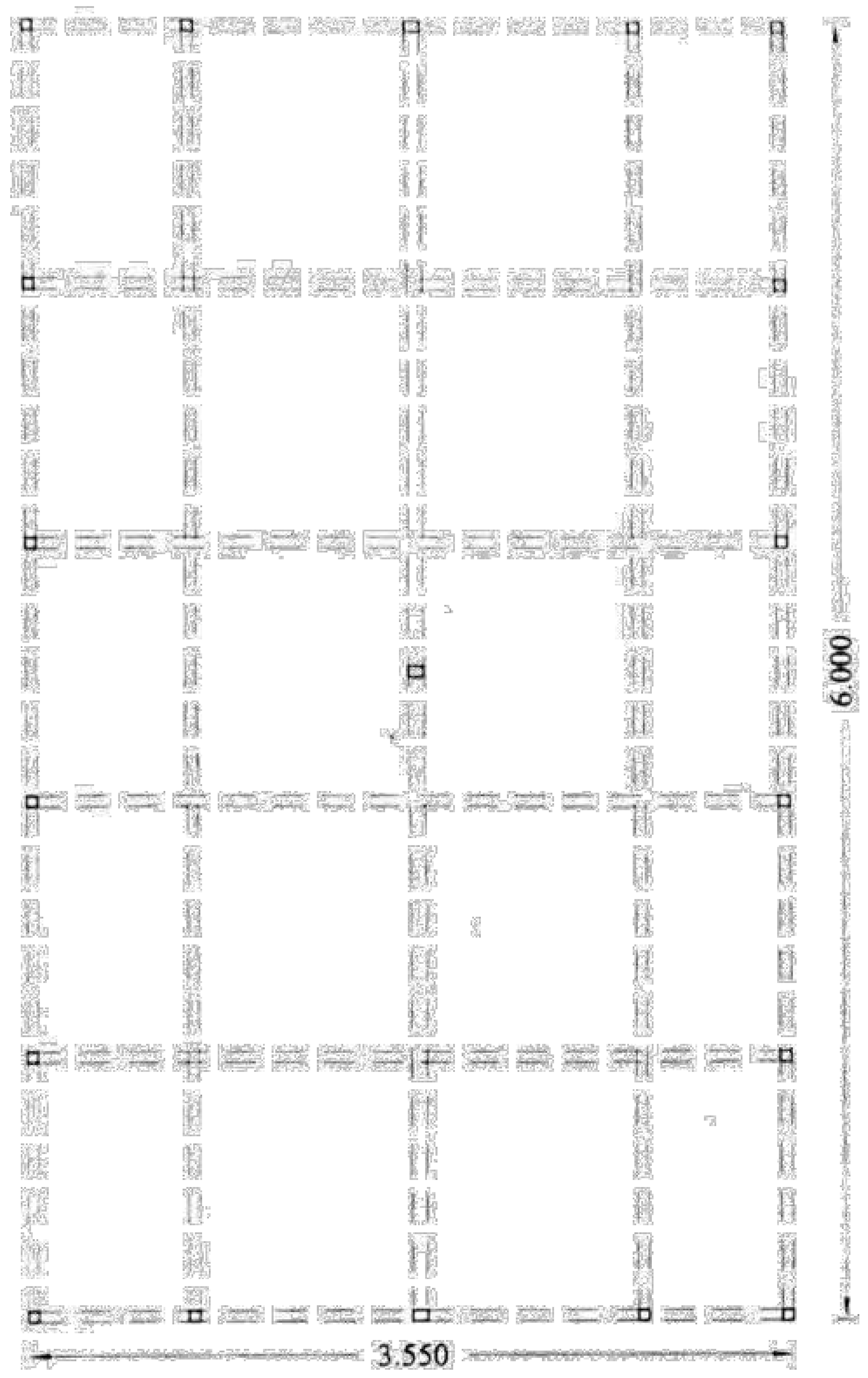
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

THE INFRASTRUCTURE PEOPLE

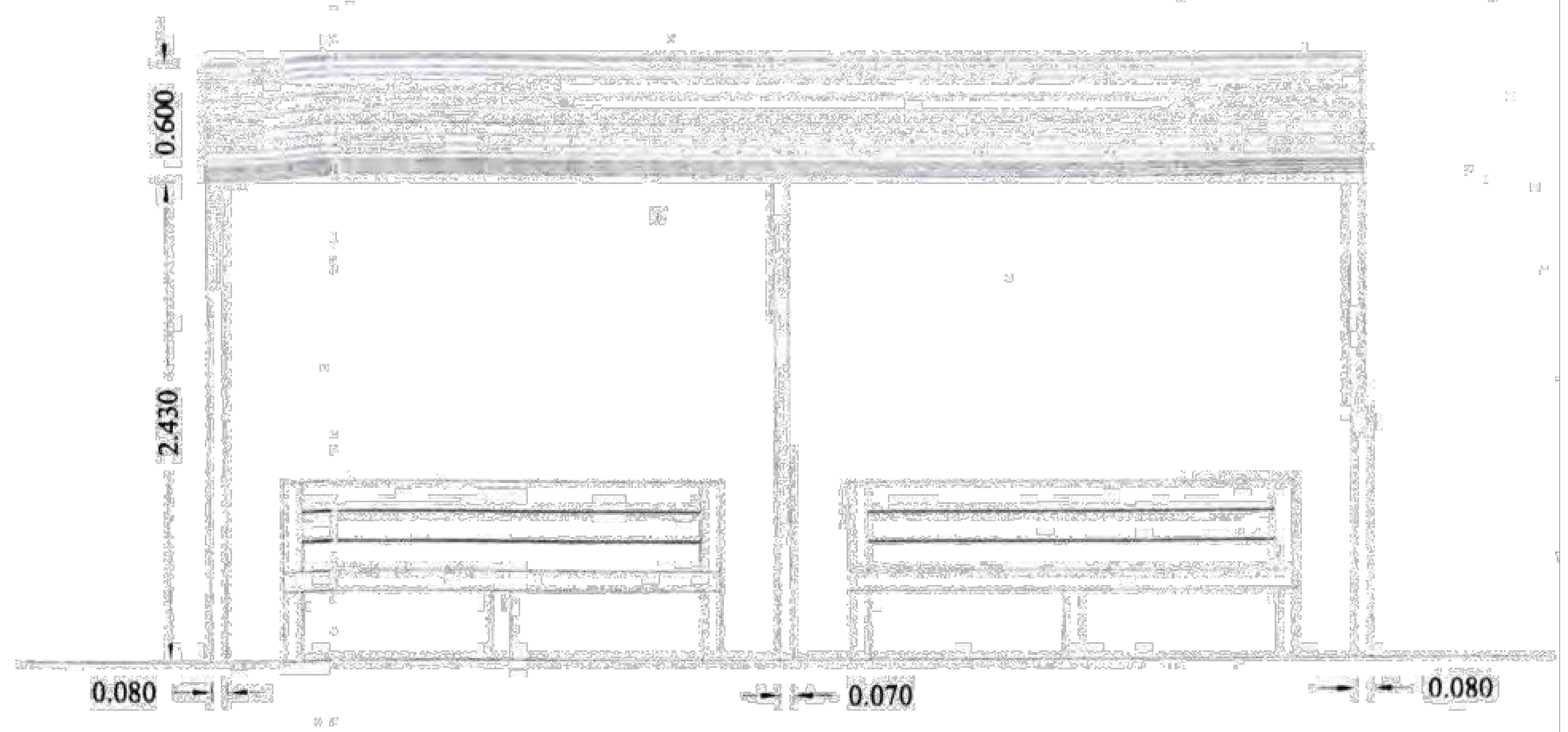
GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu		

TITLE:- CONCEPTUAL PLAN
TYPICAL EMBANKMENT/CUTTING PROFILE

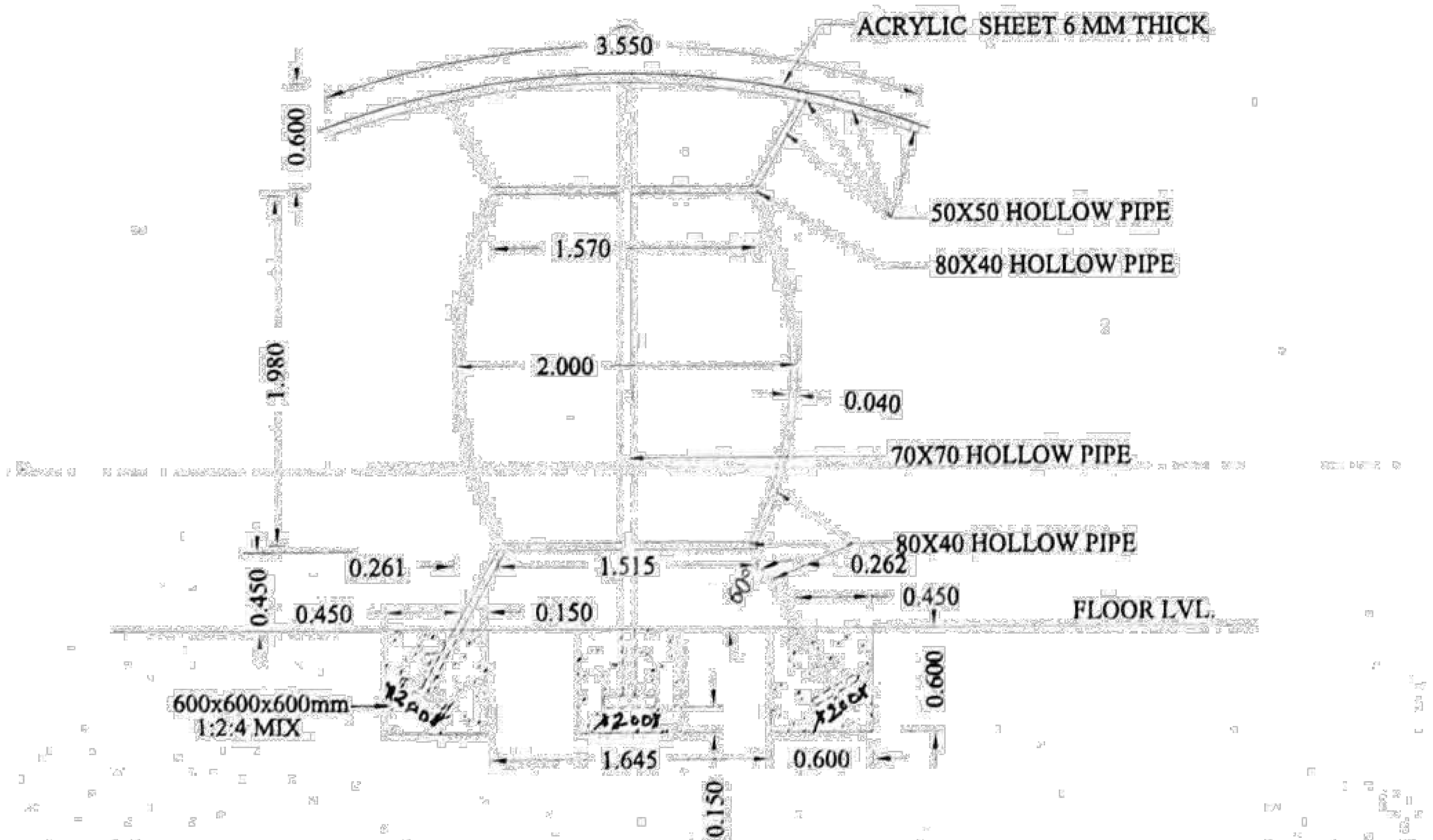
DRG. NO.	SHEET NO.		
GC-HRIDC-SK-GEN-001_A1			
SCALE :	ISSUE DATE	REVISED DATE	
AS SHOWN	10-10-2023		



PLAN



FRONT VIEW



CROSS SECTION

Note:-

1- All dimensions are in meter unless otherwise mentioned in the drawing.
2- 6mm thick Multi-wall Translucent Polycarbonate sheet both side UV Protected and in curved shape including Aluminum top and bottom profile with EPDM gasket,their fixing with S.S. Pipe purlins self tapping screw etc. on structure roof of shelter
3- This sketch is only for architectural purpose. Hollow Circular/ square/ rectangular sections of S.S. shall be used. Size mentioned in the drawing are tentative and shall be as per detailed design.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

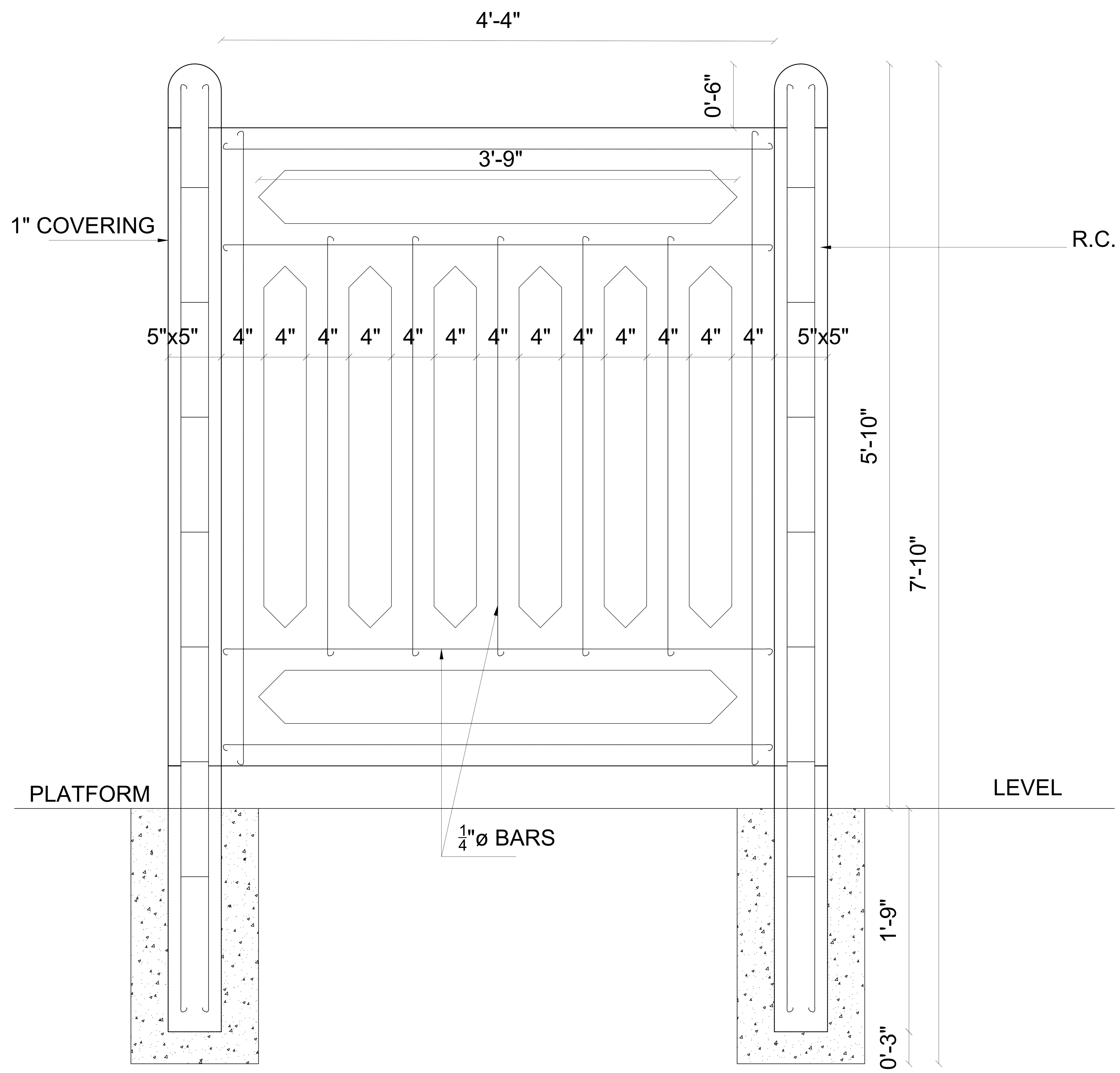
RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	ChahateyRam	R. R. KUMAR GM/ IP&P	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
REETU PATIAL CDE/ CIVIL			

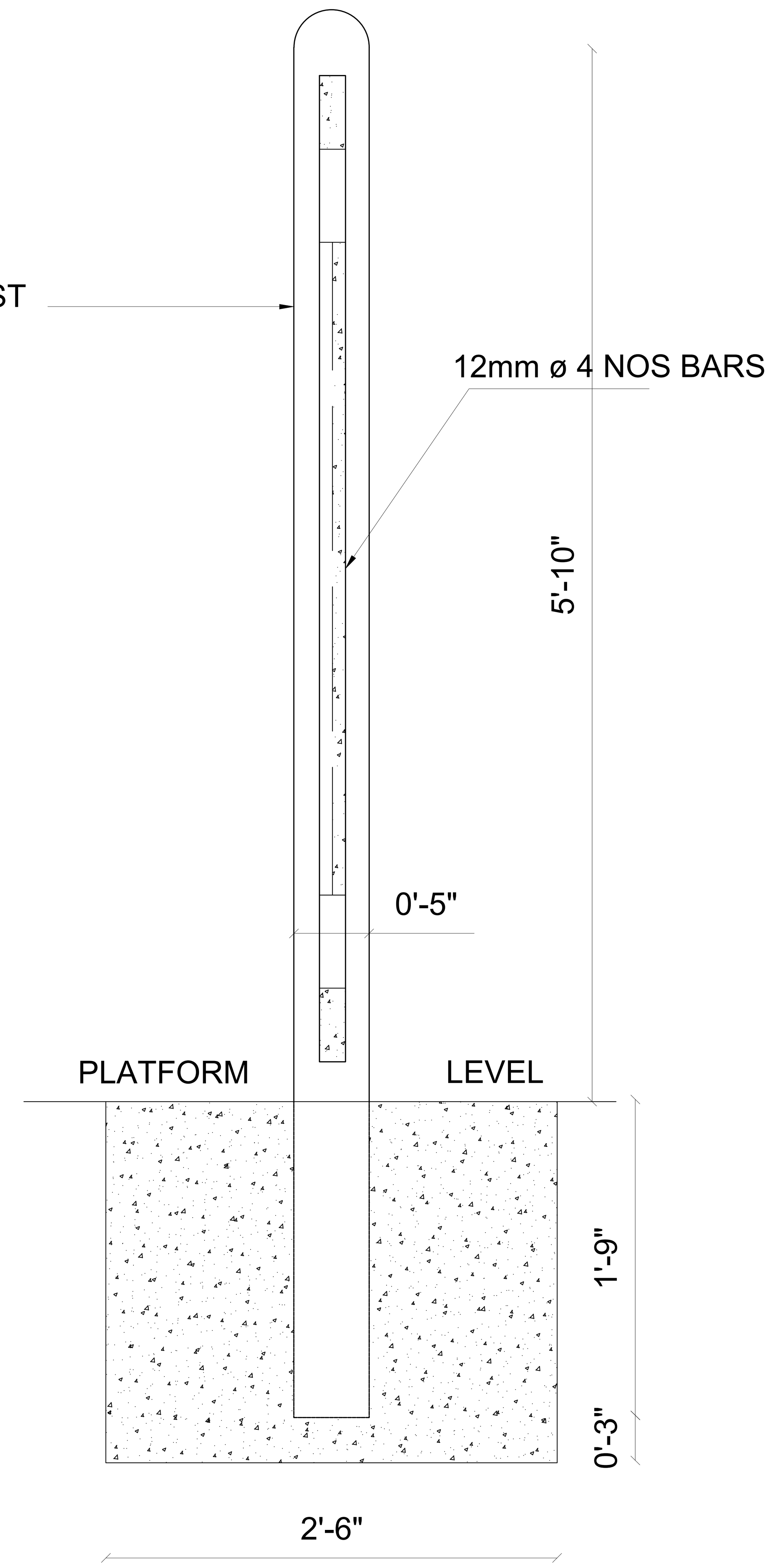
TITLE:- CONCEPTUAL PLAN MINI PLATFORM SHELTER

DRG. NO.	SHEET NO.
GC-HRIDC-SK-GEN-003	1 OF 1

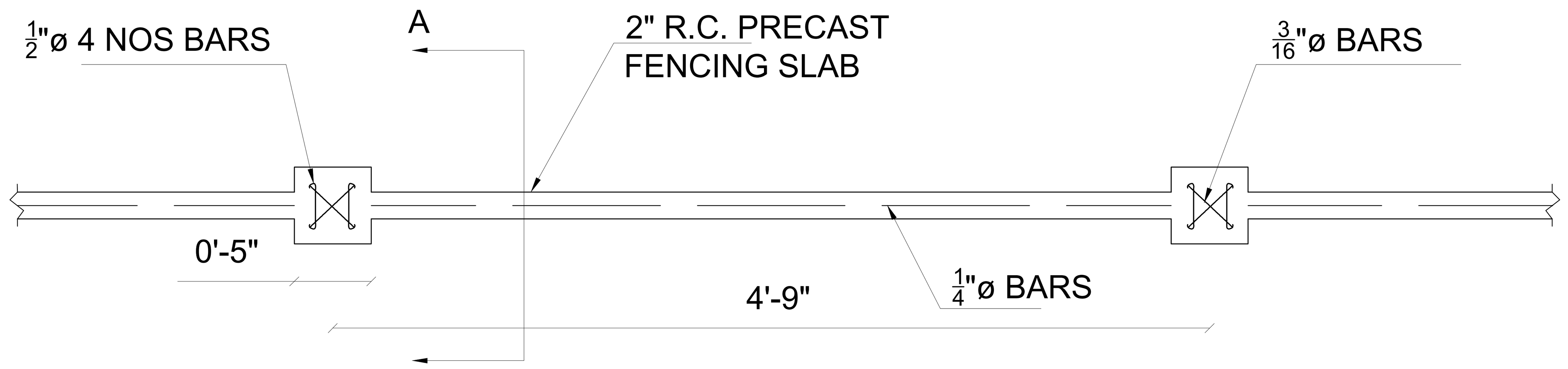
SCALE :	ISSUE DATE
AS SHOWN	28.12.2022



ELEVATION



SECTION AT A-A



PLAN

NOTES:
1. ALL DIMENSION ARE IN INCHES UNLESS OR OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		R. R. KUMAR GM/ IP&P	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
REETU PATIAL CDE/ CIVIL			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

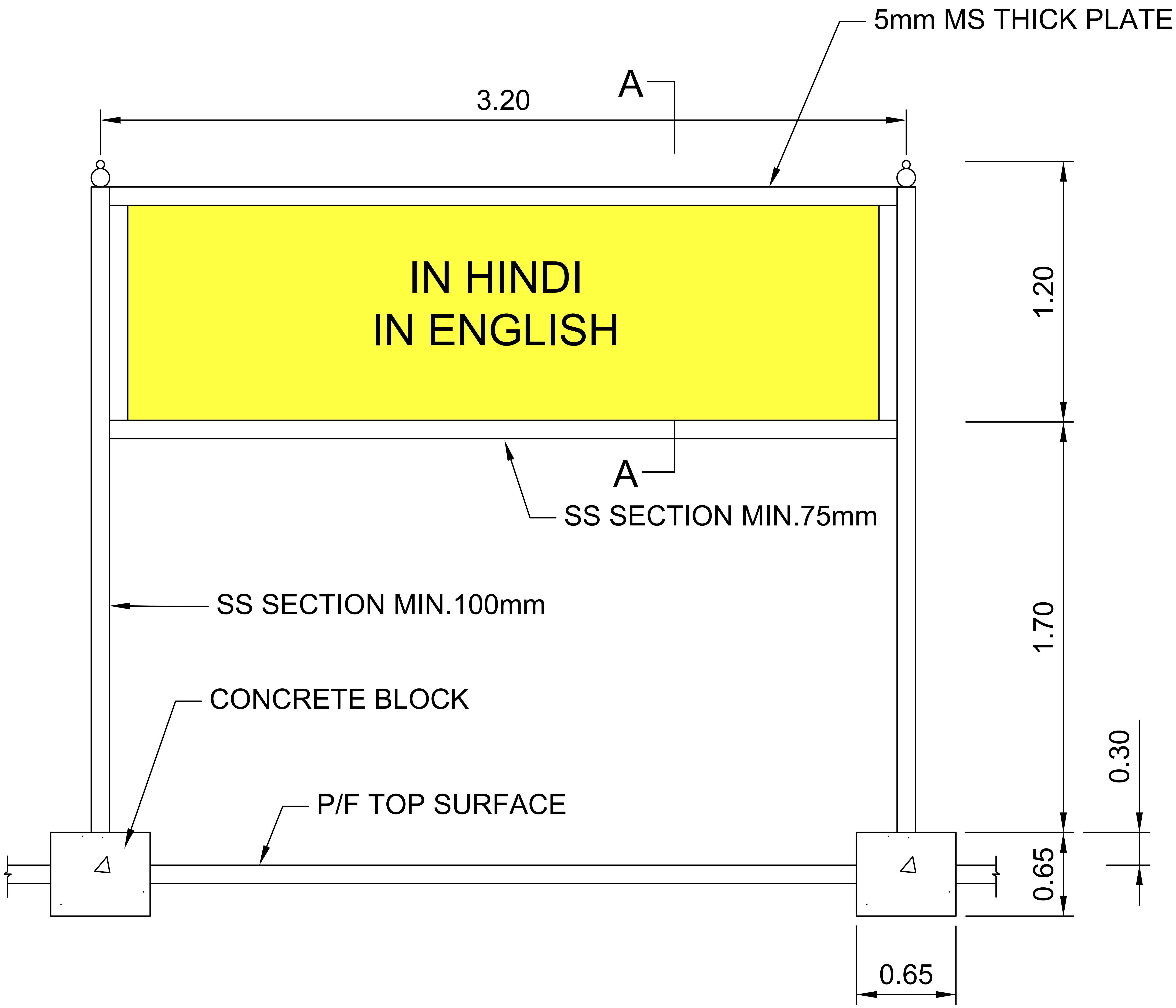
CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL PLAN
R.C. PRE-CAST FENCING FOR END PLATFORM

DRG. NO.	GC-HRIDC-SK-GEN-004	SHEET NO. 1 OF 1
SCALE : AS SHOWN	ISSUE DATE 28.12.2022	



Notes:

1. THE PRINCIPAL NAME BOARDS PAINTED ON BOTH FACES SHOULD BE FIXED AT BOTH THE ENDS OF THE PLATFORM AND GENERALLY ORIENTED AT RIGHT ANGLE TO THE TRACK.
2. THE ACTUAL ANGEL AT WHICH THE NAME BOARD ARE FACED SHOULD BE DETERMINED BY THE SITE CONDITIONS ENSURING THE CRITERIA THAT THE NAME BOARDS ARE CLEARLY VISIBLE FROM APPROACHING TRAINS.
3. BOARD TO BE PAINTED YELLOW WITH BLACK LETTERS.
4. THE STATION NAME SHALL BE EXHIBITED IN THE FOLLOWING ORDER: REGIONAL LANGUAGE, HINDI AND ENGLISH.
5. HEIGHT OF LETTERS SHALL BE 300 MM, THICKNESS IN PROPORTIONS TO THE STYLE OF THE SCRIPT.
6. THE LOWER EDGE OF THE PRINCIPAL BOARD SHOULD BE 2M ABOVE THE PLATFORM.
7. THE PAINTING WORK SHALL BE COMMENCE ONLY AFTER THE SATISFACTORY SURFACE PREPARATION INSPECTED AND APPROVED BY THE ENGINEER.
8. 2 COATS OF APPROVED BRAND YELLOW PAINT SHALL BE APPLIED OVER THE ONE COAT OF PRIMER.
9. THE APPLIED COAT OF PAINT SHALL BE UNIFORM AND FREE FROM BRUSH MARKS, SACK MARKS, BLEMISHES ETC.
10. SS SECTION SIZE TO BE ADOPTED SHALL BE BASED UPON DETAILED DESIGN. SIZE SHALL NOT BE LESS THAN THAT MENTION DRAWING (CIRCULAR /SQUARE/RECTANGLE).

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		R. R. KUMAR GM/ IP&P	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
REETU PATIAL CDE/ CIVIL			

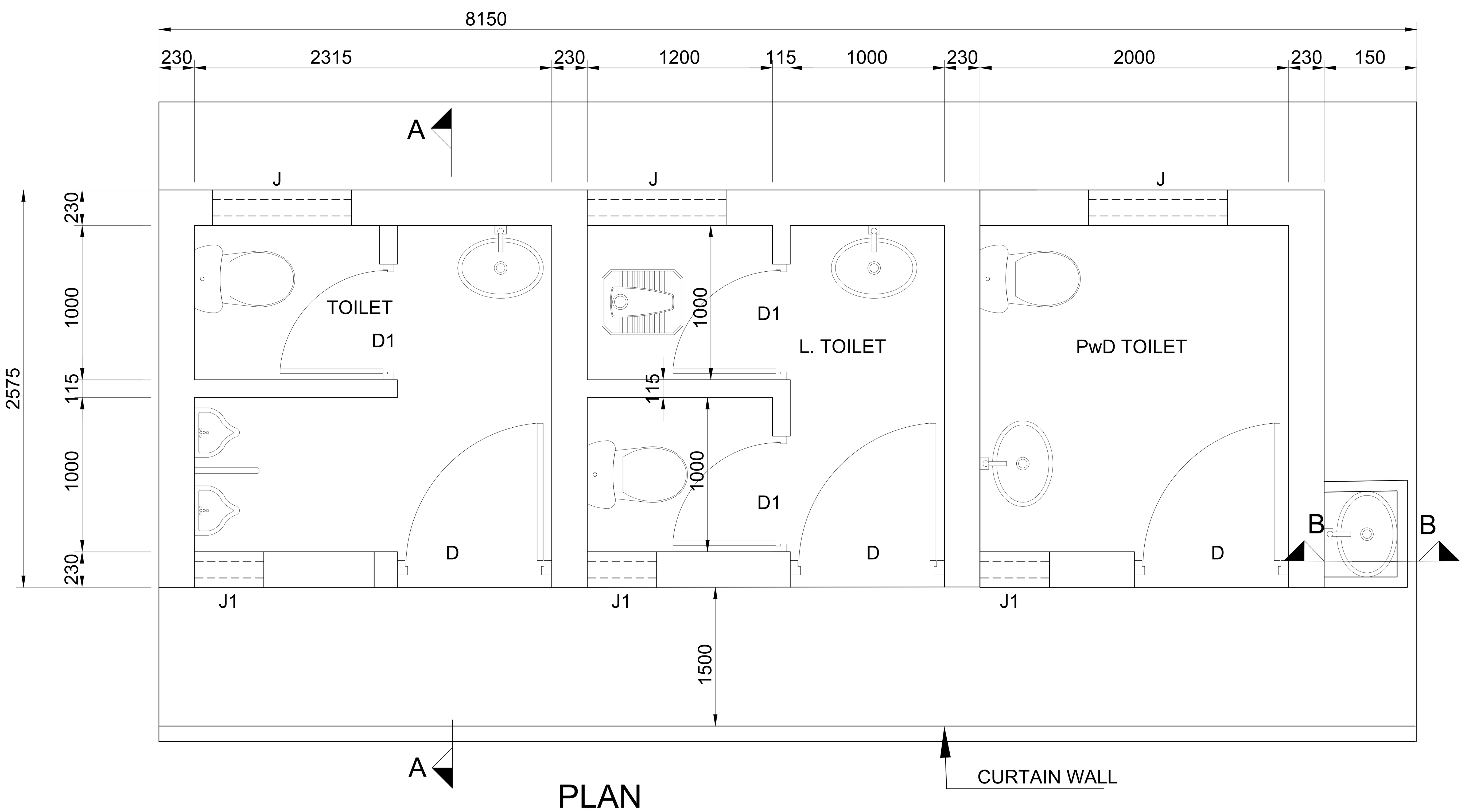
TITLE:- CONCEPTUAL PLAN STATION NAME BOARD

DRG. NO. GC-HRIDC-SK-GEN-005

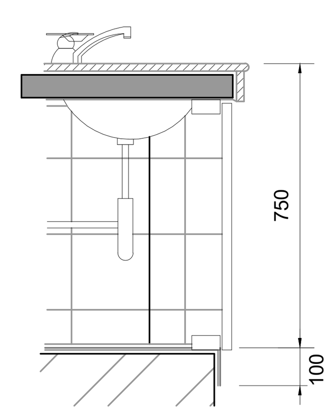
SHEET NO.

SCALE : AS SHOWN

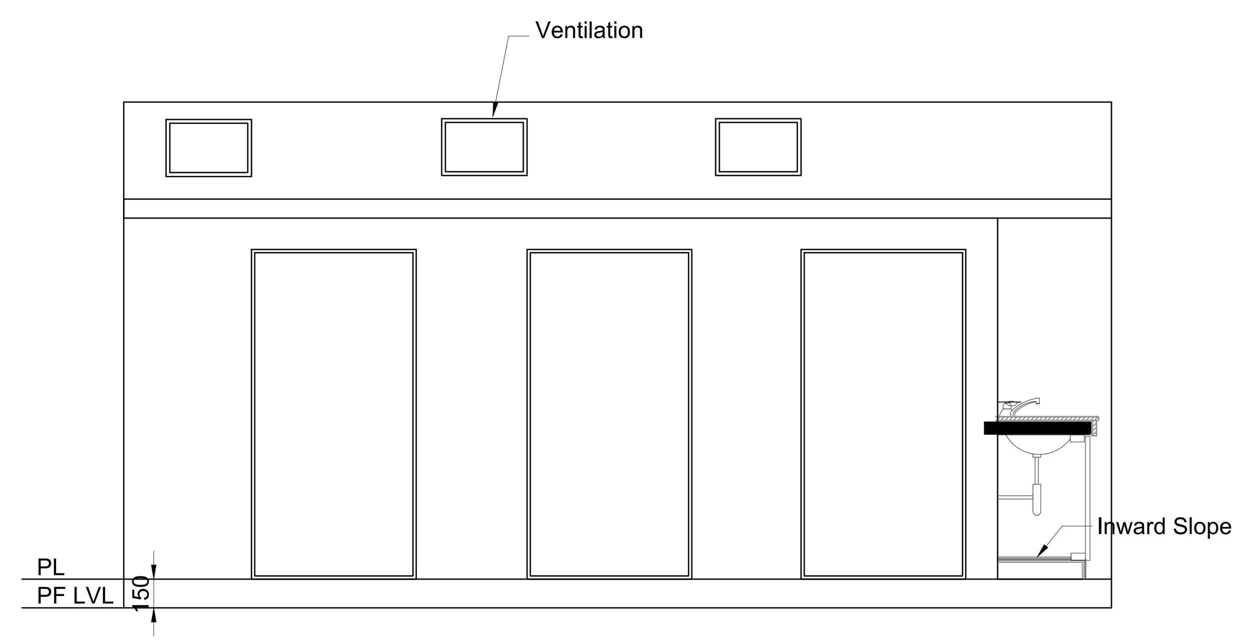
ISSUE DATE 11-11-2022 28.12.2022



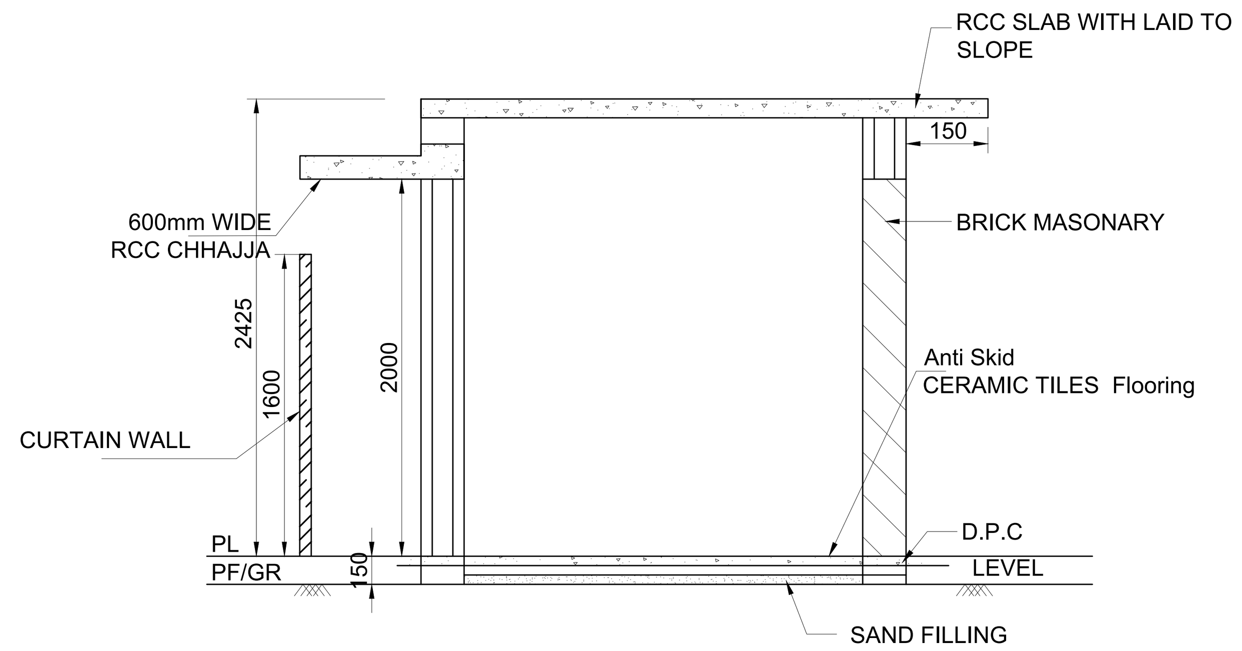
PLAN



SECTION B-B



FRONT ELEVATION



SECTION A-A

SCHEDULE OF JOINERY

REF.		SIZE
D	PVC DOOR	900x2000
J	RCC JALI (RAIN PROOF TYPE)	900x600
J1	RCC JALI (RAIN PROOF TYPE)	450x300

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. FLOORING WITH ANTISKID CERAMIC TILES TO BE PROVIDED.
3. INSIDE WALLS SHALL BE PROVIDED WITH GLAZED TILES OF APPROVED QUALITY UPTO CEILING.
4. WHITE GLAZED FLAT BACK LIPPED/ FRONT URINAL 430X260X350MM SIZE WITH PVC AUTOMATIC FLUSHING CISTERN.
5. VITREOUS CHINA SQUATTING TYPE URINAL OF SIZE 450X350X100MM TO CONFORM IS 771-1963 WITH AUTOMATIC FLUSHING CISTERN.
6. WASH BASIN OF SIZE 630MM X 450MM WITH CP BRASS PILLAR TAP OUTSIDE THE TOILET AND 550MM X 400MM WITH CP BRASS PILLAR TAP SHALL BE PROVIDED INSIDE THE TOILETS.
7. PLUMBING TO BE CONCEALED.
8. OVERHEAD TANK OF SUITABLE CAPACITY SHALL BE PROVIDED TO ENSURE UNINTERRUPTED WATER SUPPLY.
9. DRAINAGE IS TO BE CONNECTED TO SOAK PIT OF SUITABLE CAPACITY.
10. EFFLUENT TO BE DISCHARGE IN DRAINAGE SYSTEM (REFER SEPARATE DRAINAGE PLAN FOR DRAINAGE SYSTEM).

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	R. R. KUMAR GM/ IP&P	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
REETU PATIAL CDE/ CIVIL			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

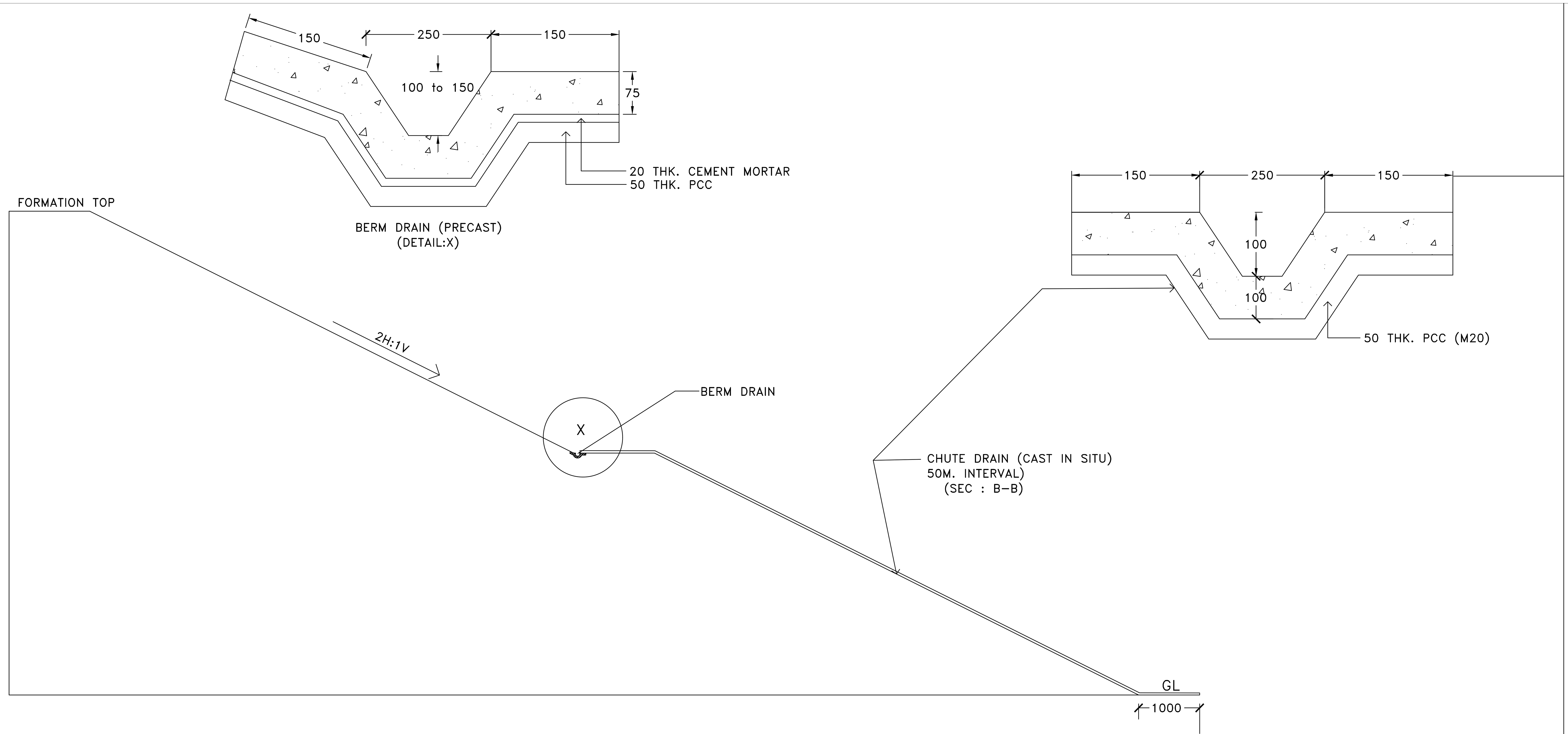
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

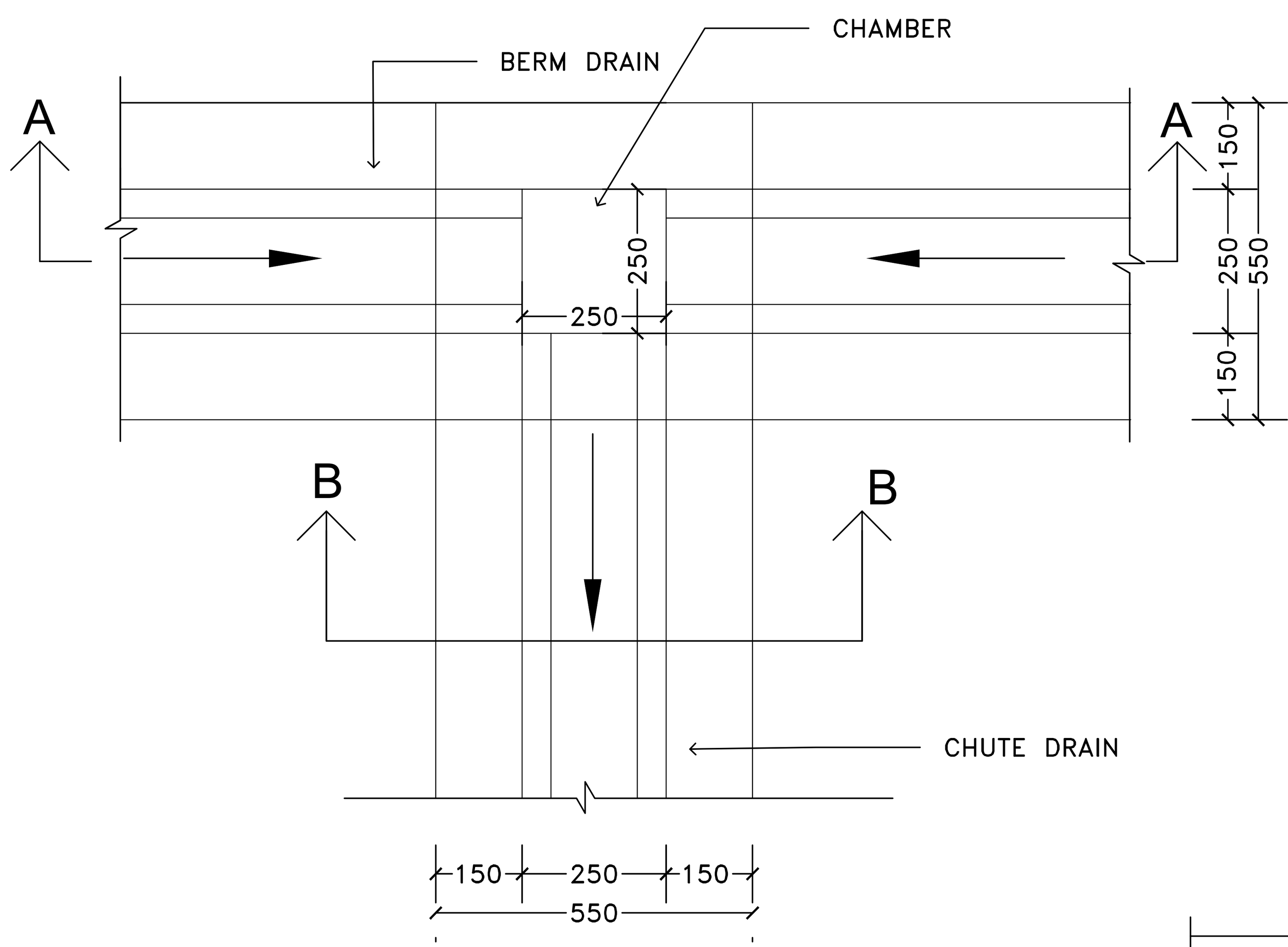
RITES THE INFRASTRUCTURE PEOPLE

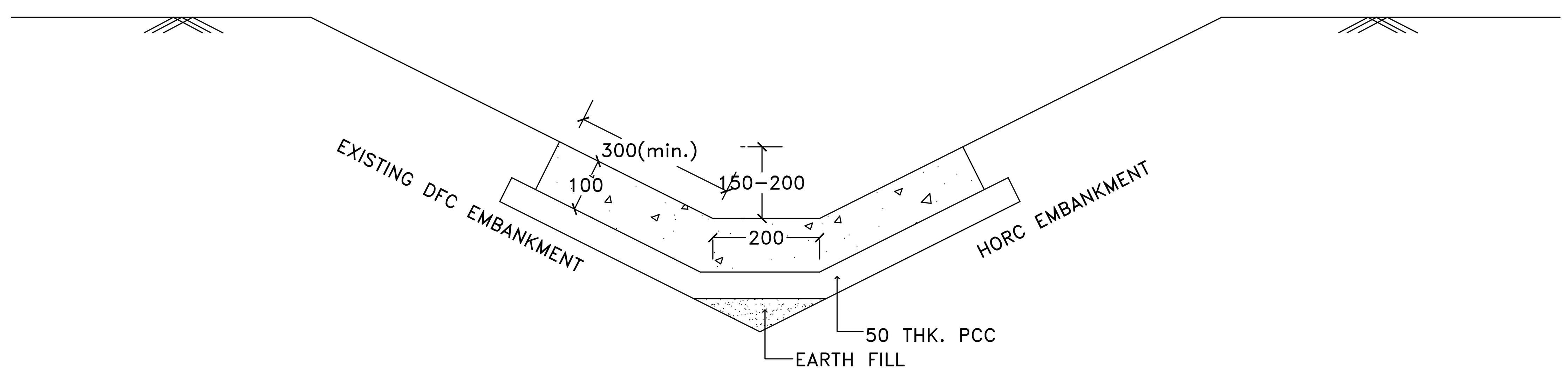
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL PLAN
PROPOSED TOILET BLOCK ON END PLATFORMS

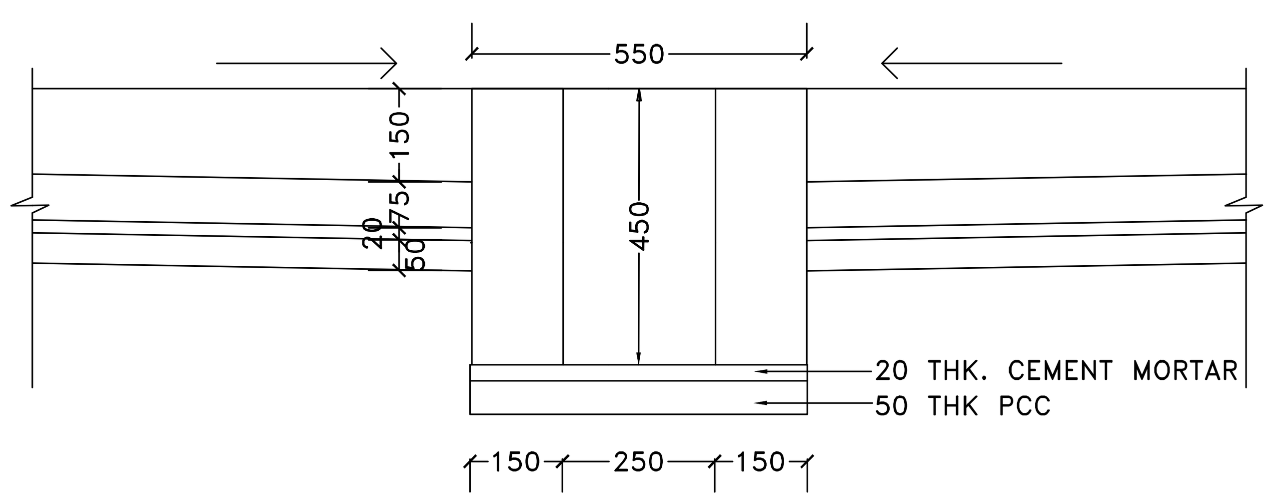
DRG. NO. GC-HRIDC-SK-GEN-007_A1	SHEET NO. 1 OF1
SCALE : AS SHOWN	ISSUE DATE 28.12.2022







DRAIN BETWEEN (CAST IN SITU)
HORC & DFC EMBANKMENT



(SEC:A-A)

NOTES :-
1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE SCALED FROM DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. MIN. GRADE OF CONCRETE
   A) PRECAST M35
   B) CAST IN SITU M25
   C) PCC M20

GC/HORC		HRIDC	
NAME / DEGINATION	SIGN	NAME / DEGINATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/HRIDC	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANKI DGM/C-SOUTH	[signature]
REETU PATIAL CDE/ CIVIL	Reetu		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

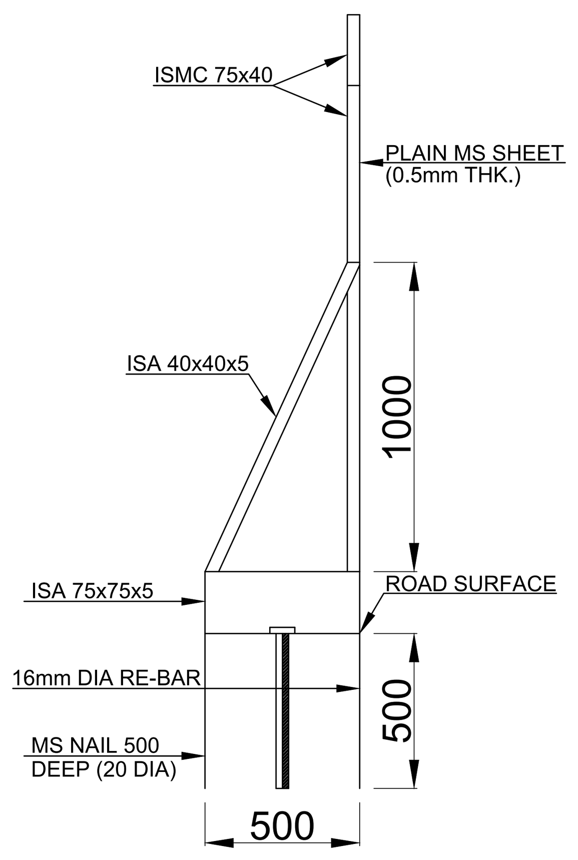
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

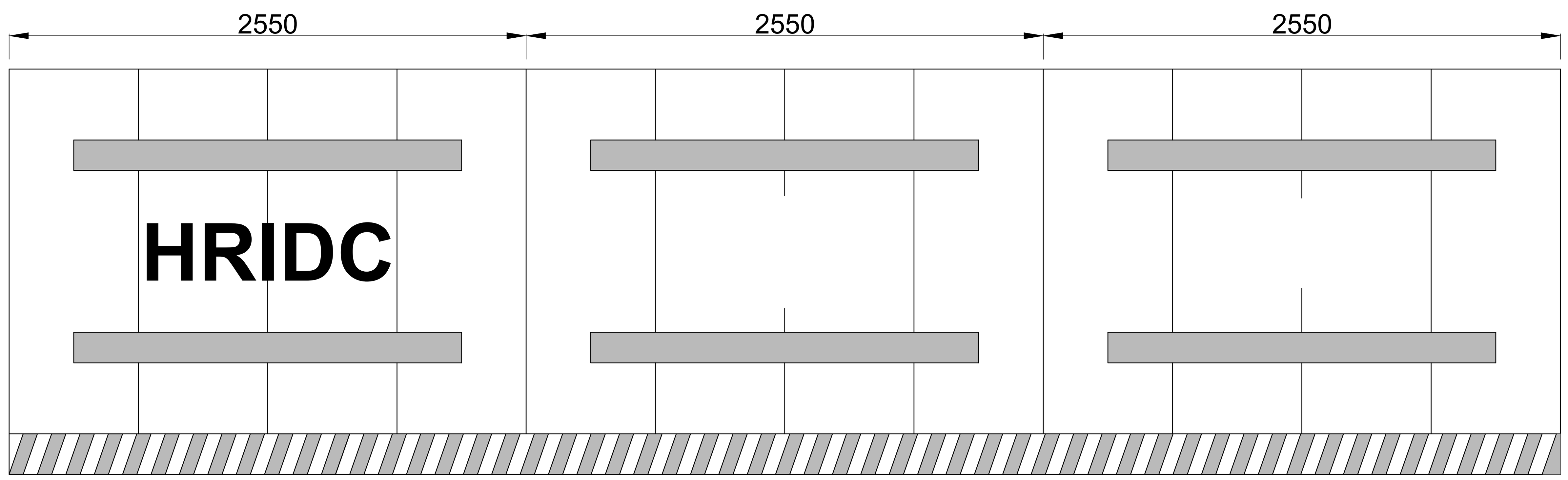
TITLE:-
CONCEPTUAL PLAN
DRAINS FOR EMBANKMENT

SKETCH NO. GC-HRIDC-SK-GEN-008_A1
SHEET NO. 1 OF 1

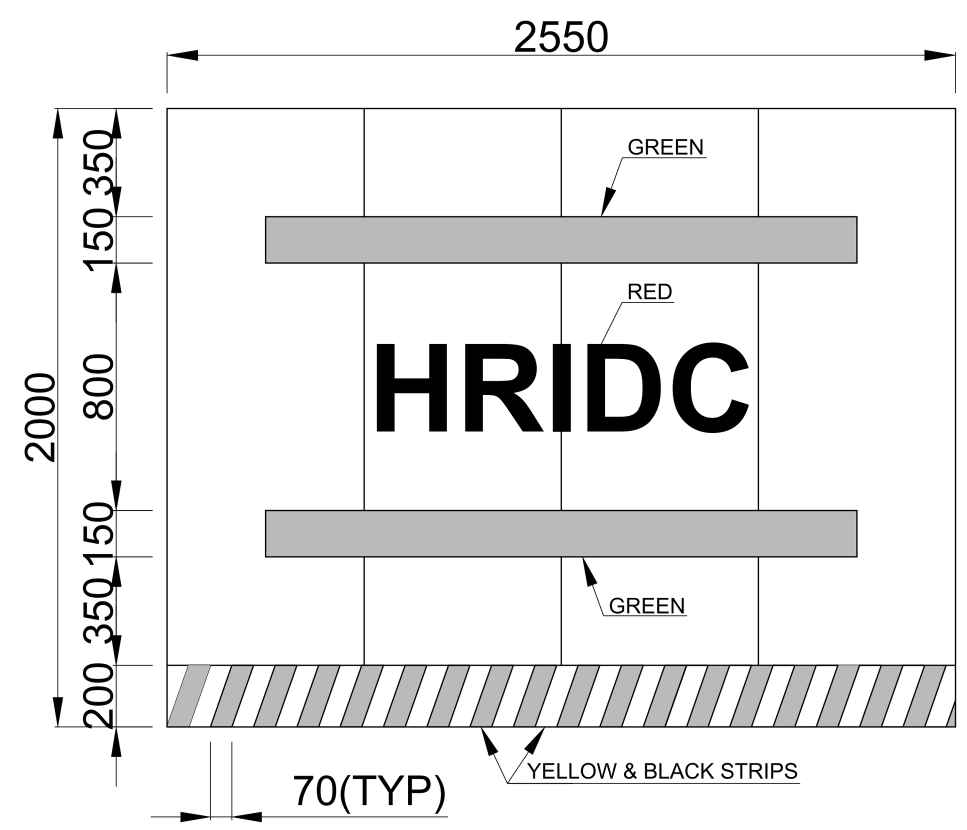
SCALE : AS SHOWN
ISSUE DATE 09.09.2023
REVISED DATE



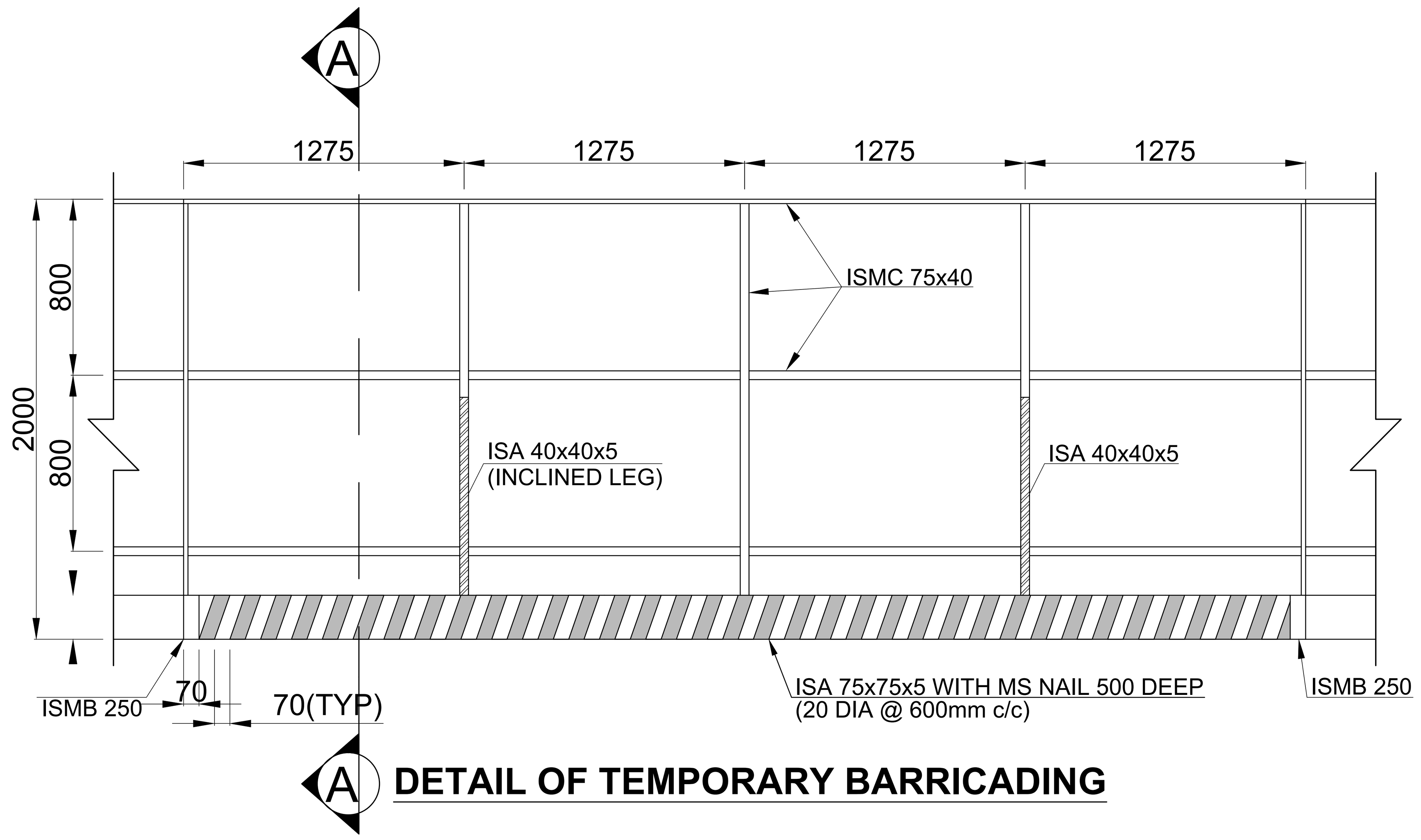
SECTION A-A



ELEVATION OF ONE UNIT OF TEMPORARY BARRICADING



ELEVATION OF ONE SET OF TEMPORARY BARRICADING



DETAIL OF TEMPORARY BARRICADING

NOTES:

1. ALL DIMENSIONS SHOWN ARE IN MILLIMETERS, UNLESS OTHERWISE MENTIONED.
2. THIS BARRICADING SHALL BE USED AT LOCATION OF ROAD AND PEDESTRIAN TRAFFIC.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	[signature]	R. R. KUMAR GM/ IP&P	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANKI DGM/C-SOUTH	[signature]
REETU PATIAL CDE/ CIVIL	[signature]		

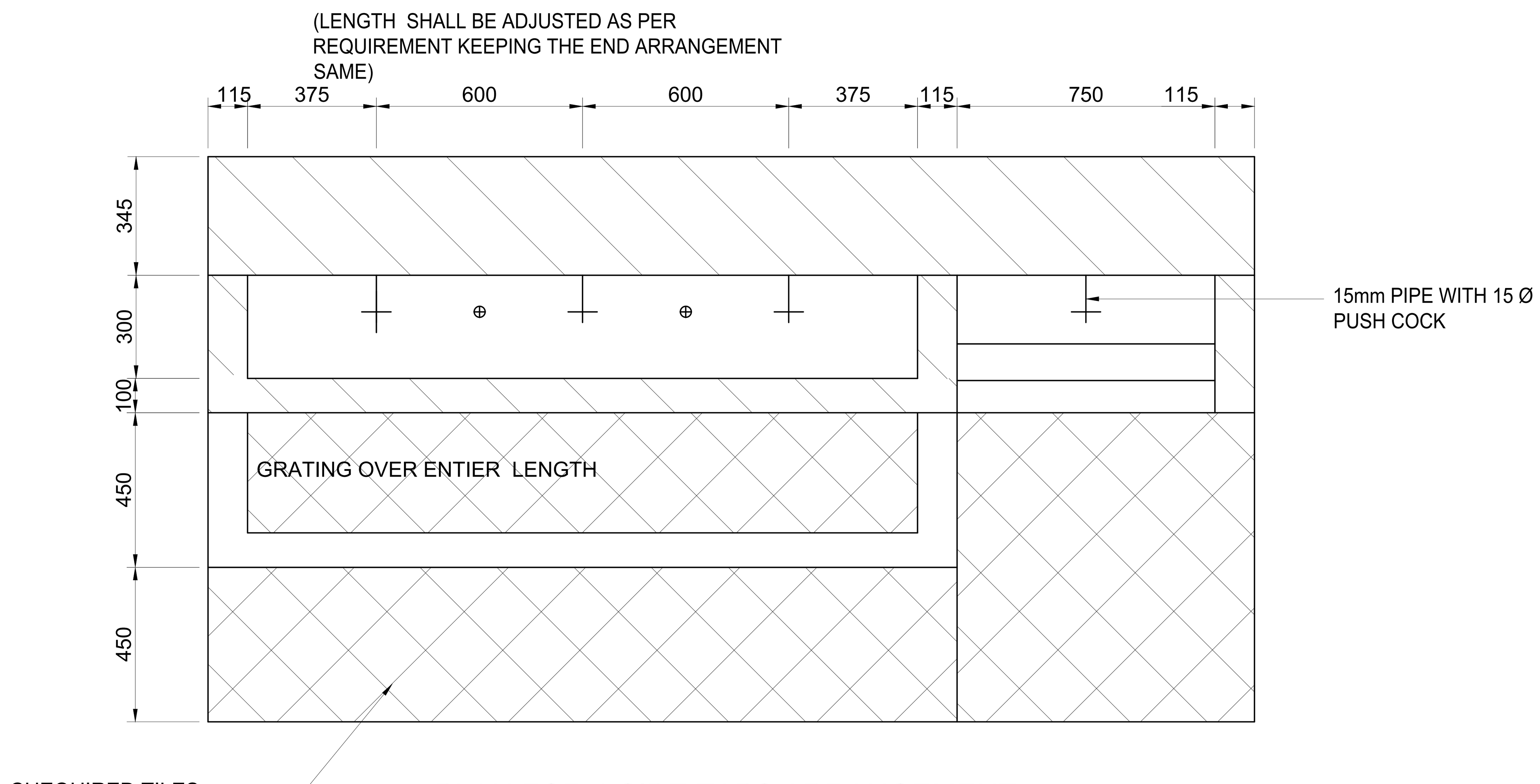
TITLE:- CONCEPTUAL PLAN
STEEL BARRICADE

DRG. NO. GC-HRIDC-SK-GEN-009

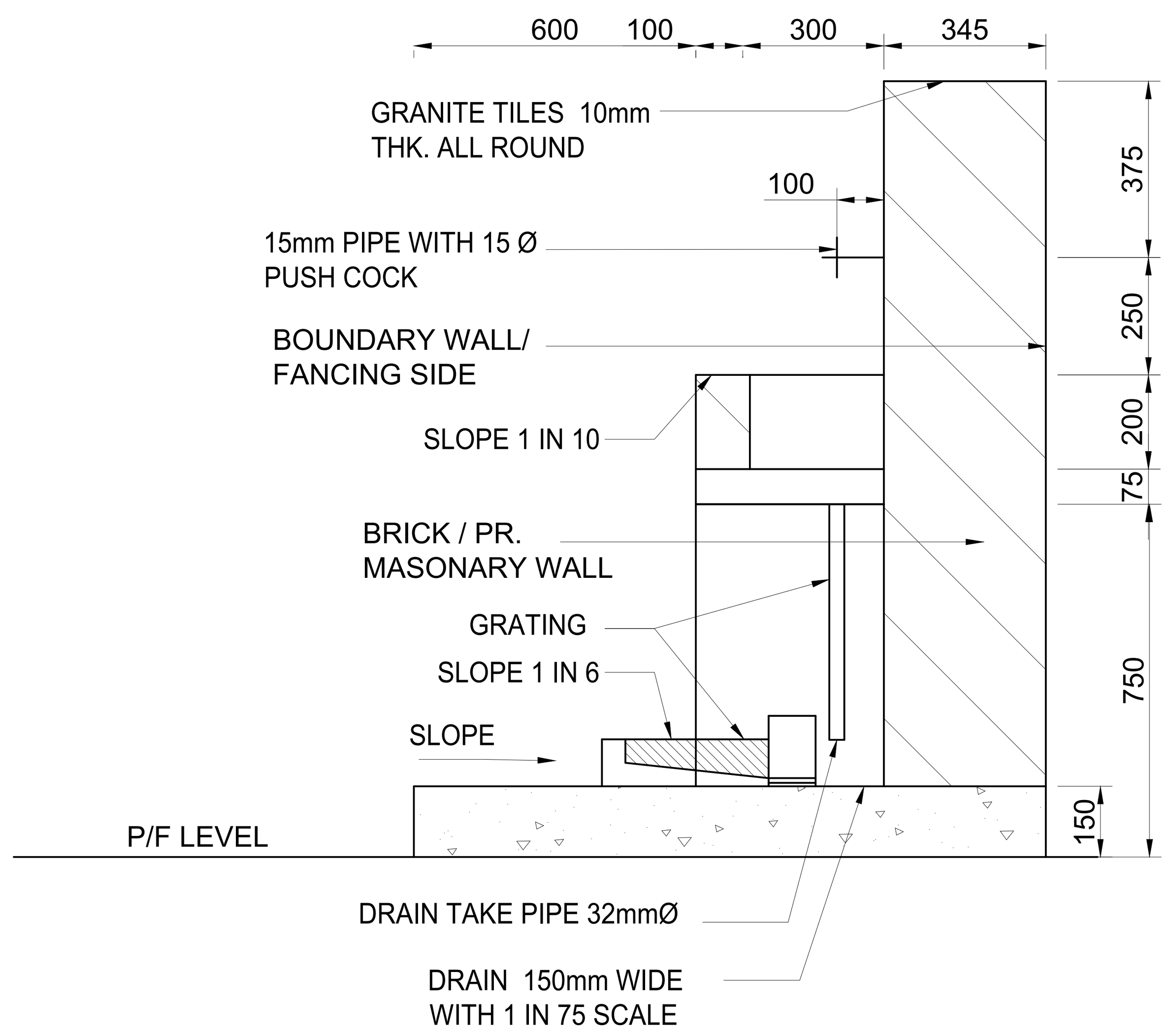
SHEET NO.

SCALE : AS SHOWN

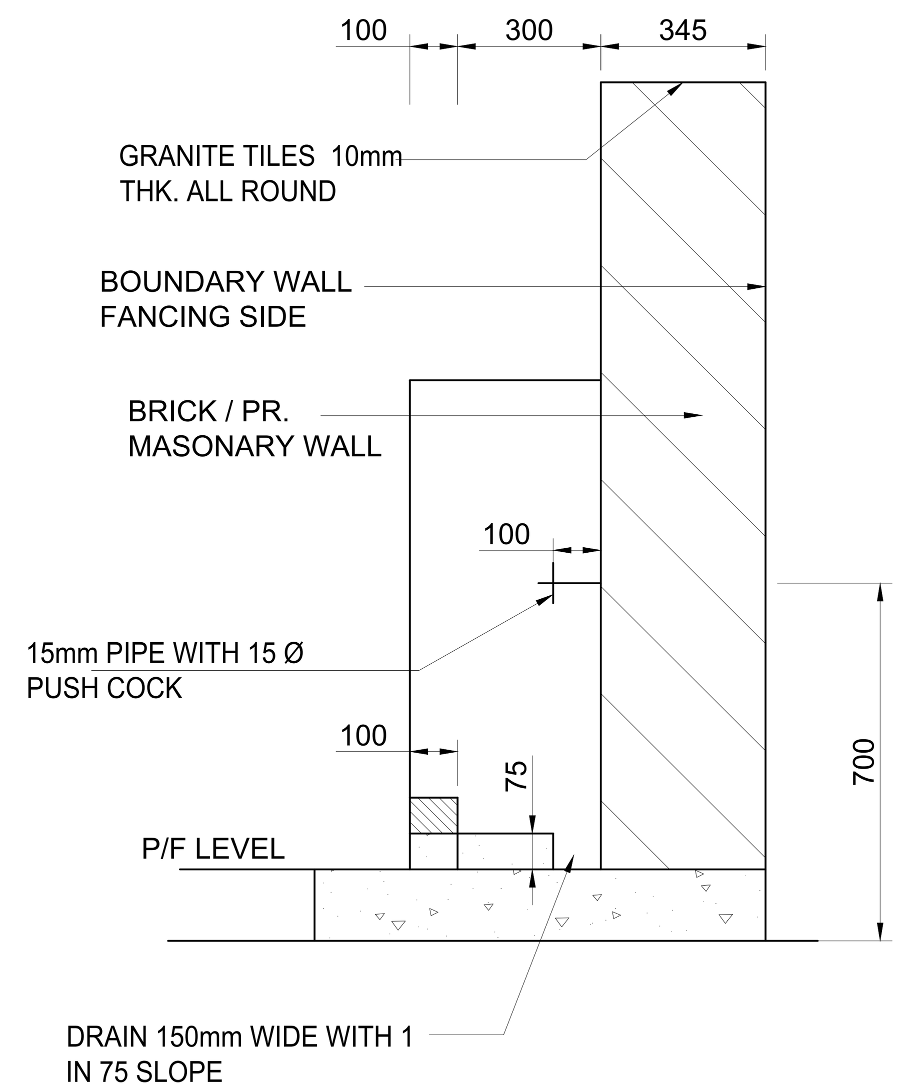
ISSUE DATE 28.12.2022



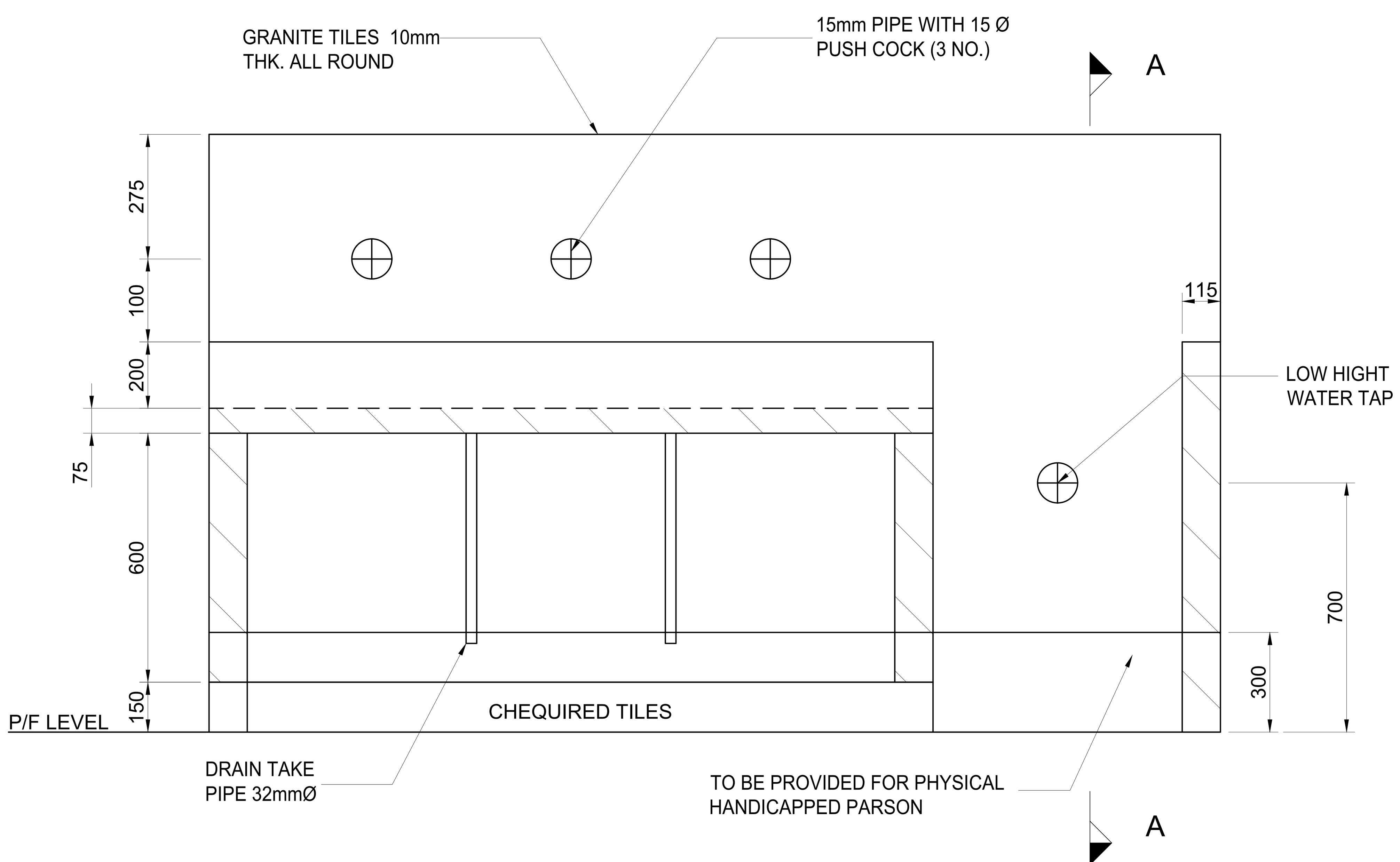
PLAN FOR 1 SIDE TAPS ARRANGEMENT



SECTION FOR ONE SIDE TAPS



SECTION AT A-A



FRONT ELEVATION

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETER
2. LENGTH SHALL BE ADJUSTED AS PER REQUIREMENT KEEPING THE END ARRANGEMENT SAME.
3. ALL EXPOSED SURFACES SHALL BE PROVIDE WITH GRANITE CLADDING.
4. CP BRASS TAPS WITH ANTI-SABOTAGE FITTINGS.
5. LOW HEIGHT WATER TAP TO BE PROVIDED FOR PHYSICALLY HANDICAPPED PERSONS.
6. ALL DIMENSIONS ARE TENTATIVE AND MAY VARY AS PER THE REQUIREMENT.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	ChahateyRam	R. R. KUMAR GM/ IP&P	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANKI DGM/C-SOUTH	[signature]
REETU PATIAL CDE/ CIVIL	[signature]		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

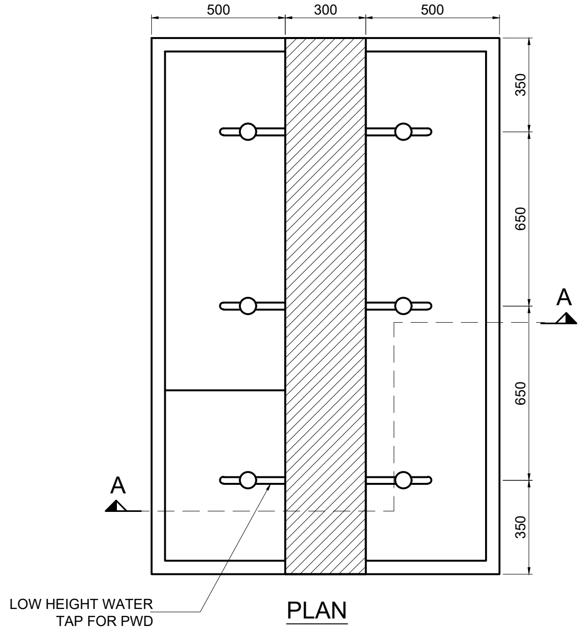
CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

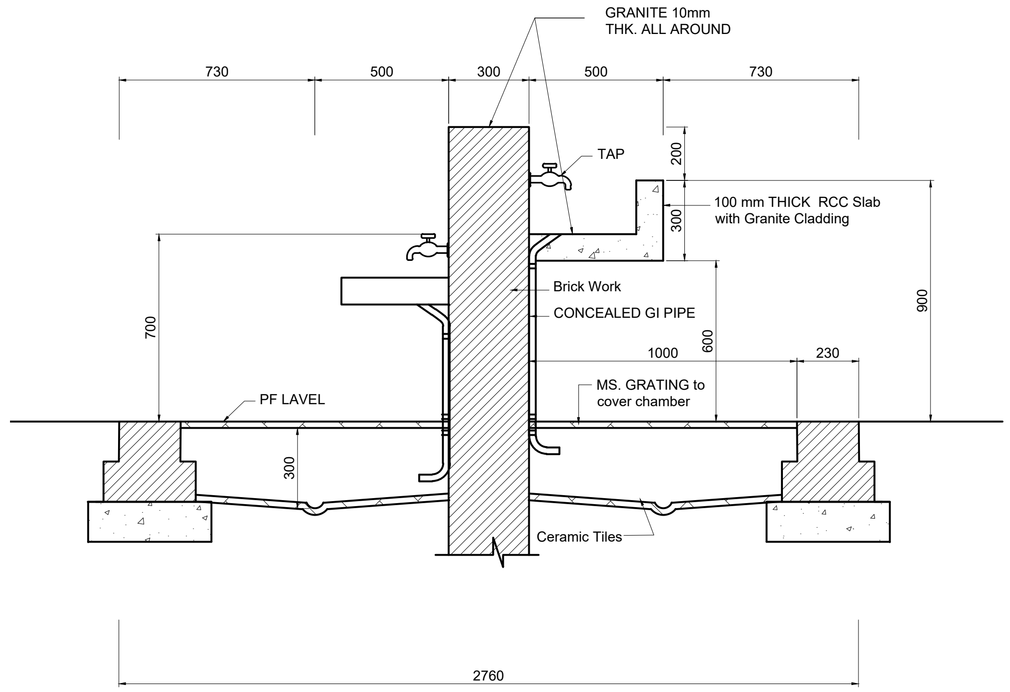
RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL PLAN
WATER BOOTH WITH ONE SIDE TAPS ARRANGEMENT (END PLATFORM)

DRG. NO.	SHEET NO.
GC-HRIDC-SK-GEN-010_A1	1 OF 1
SCALE :	ISSUE DATE
AS SHOWN	28.12.2022



PLAN



SECTION A-A

NOTES :

1. ALL DIMENSIONS ARE IN MM .
2. ALL EXPOSED SURFACE SHALL BE OF GRANITE CLADDING
3. CP BRASS TAPS WITH ANTY SABOTAGE FITTINGS.
4. SEPARATE DRAINAGE PLAN SHALL BE REFERRED FOR EFFLUENT DISCHARGE etc.
5. ALL DIMENSIONS ARE TENTATIVE AND MAY VARY AS PER THE REQUIREMENT.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

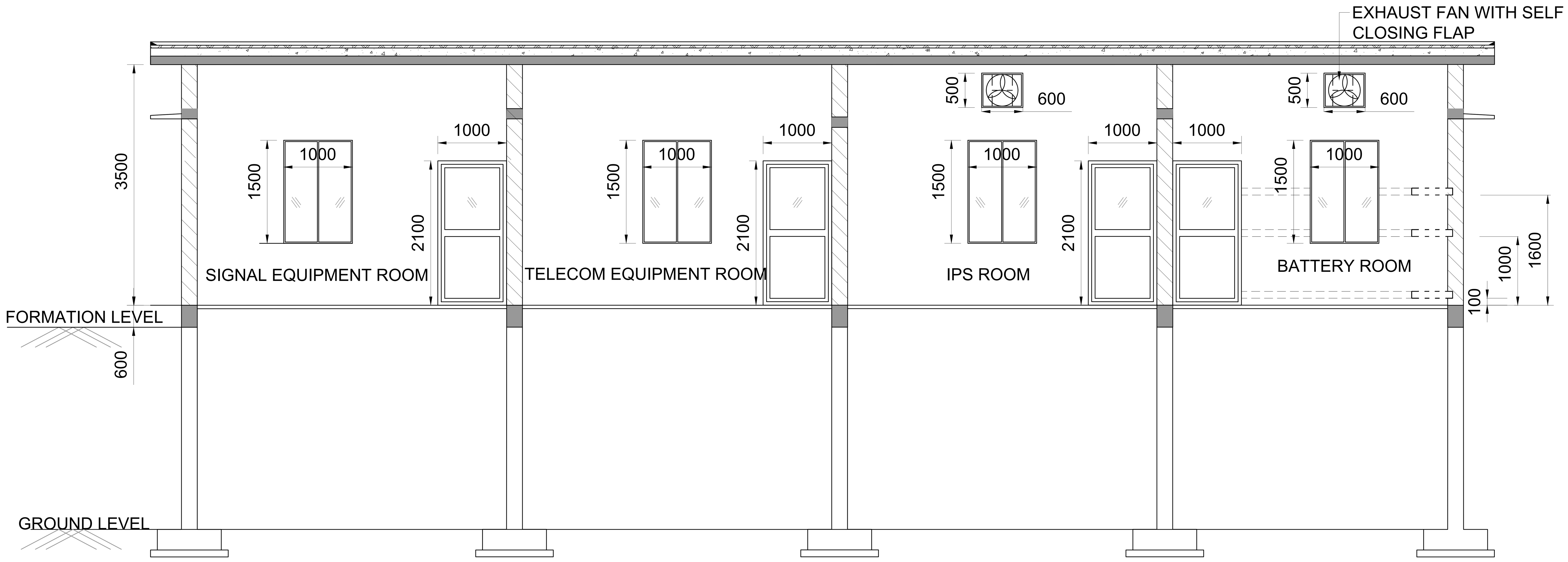
RITES THE INFRASTRUCTURE PEOPLE
SMEC

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		R. R. KUMAR GM/ IP&P	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
REETU PATIAL CDE/ CIVIL			

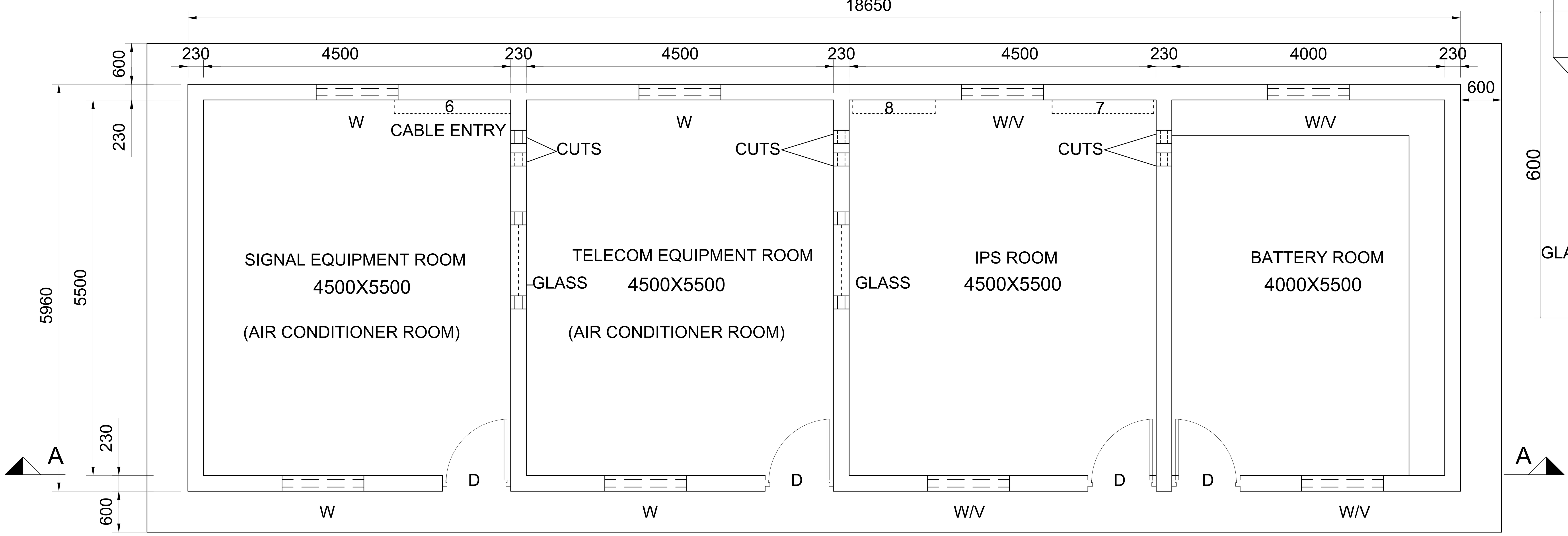
TITLE:- CONCEPTUAL PLAN
WATER BOOTH WITH BOTH SIDE TAPS ARRANGEMENT (ISLAND PLATFORM)

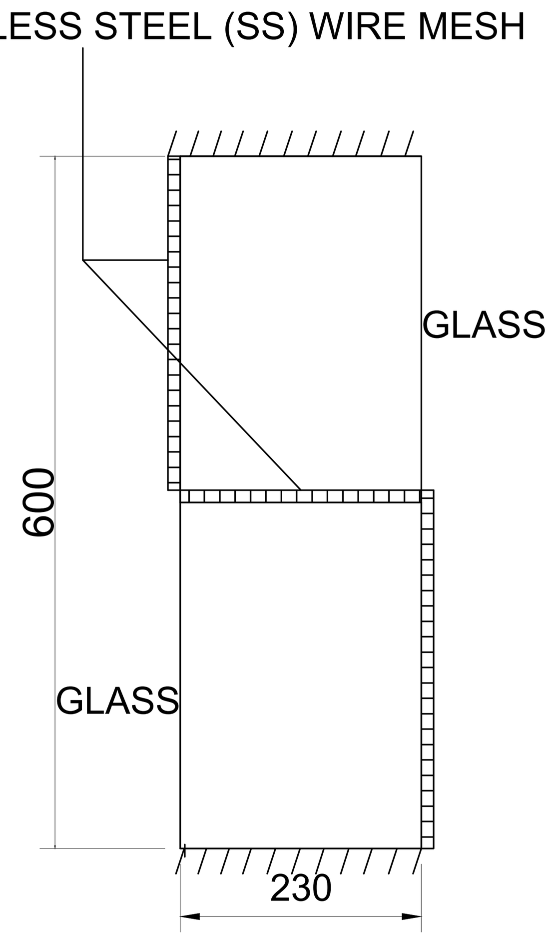
DRG. NO.	SHEET NO.
GC-HRIDC-SK-GEN-011_A1	

SCALE :	ISSUE DATE
AS SHOWN	28.12.2022



SECTION ELEVATION A-A
(SCALE 1:100)





VENTILATOR

SCHEDULE

DOOR	2100x1000
WINDOW	1000x1500
VENTILATOR	600x500

PLAN
(SCALE 1:100)

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. PLINTH LEVEL SHALL BE KEPT AT LEAST 300mm ABOVE FORMATION LEVEL.
3. HEAVY DUTY TWO RCC SHELF IN BATTERY ROOM ON TWO SIDES 750mm WIDE FOR BATTERIES, 100mm PLINTH SHALL BE MADE BELOW SHELF. FIRST SHELF AT 1000mm & SECOND SHELF AT 1600mm FROM GROUND LEVEL.
4. TWO OPENINGS 100mmX100mm AT 2500mm FROM FLOOR IN PARTITION WALLS.
5. OPENING DUCT FOR CABLE ENTRY IN FLOOR OF EQUIPMENT ROOM @ 1000mm(L)X 600mm(H)X 600mm DEEP.
6. POWER CABLE ENTRY 300mm(L)x300mm(H)x600mm DEEP IN POWER ROOM.
7. TELECOM/OFC CABLE ENTERY IN POWER ROOM 300mm(L)X300mm(H)X600mm DEEP.
8. MS STEEL GRILL ON WINDOWS & VENTILATORS.
9. EQUIPMENT ROOM TO BE PROTECTED FOR DUST.
10. 1000mmX600mm TOUGHENED GLASS IN THE PARTITION WALL BETWEEN EQUIPMENT ROOM & IPS ROOM.
11. OIL PAINT IN INTERIOR IN S & T EQUIPMENT ROOM.
12. HEAVY DUTY EXHAUST FAN IN IPS & BATTERY ROOM FRONT WALL WITH SELF CLOSING FLAP.
13. SIGNAL & TELECOME EQUIPMENT ROOM SHALL BE AIRCONDITIONED.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

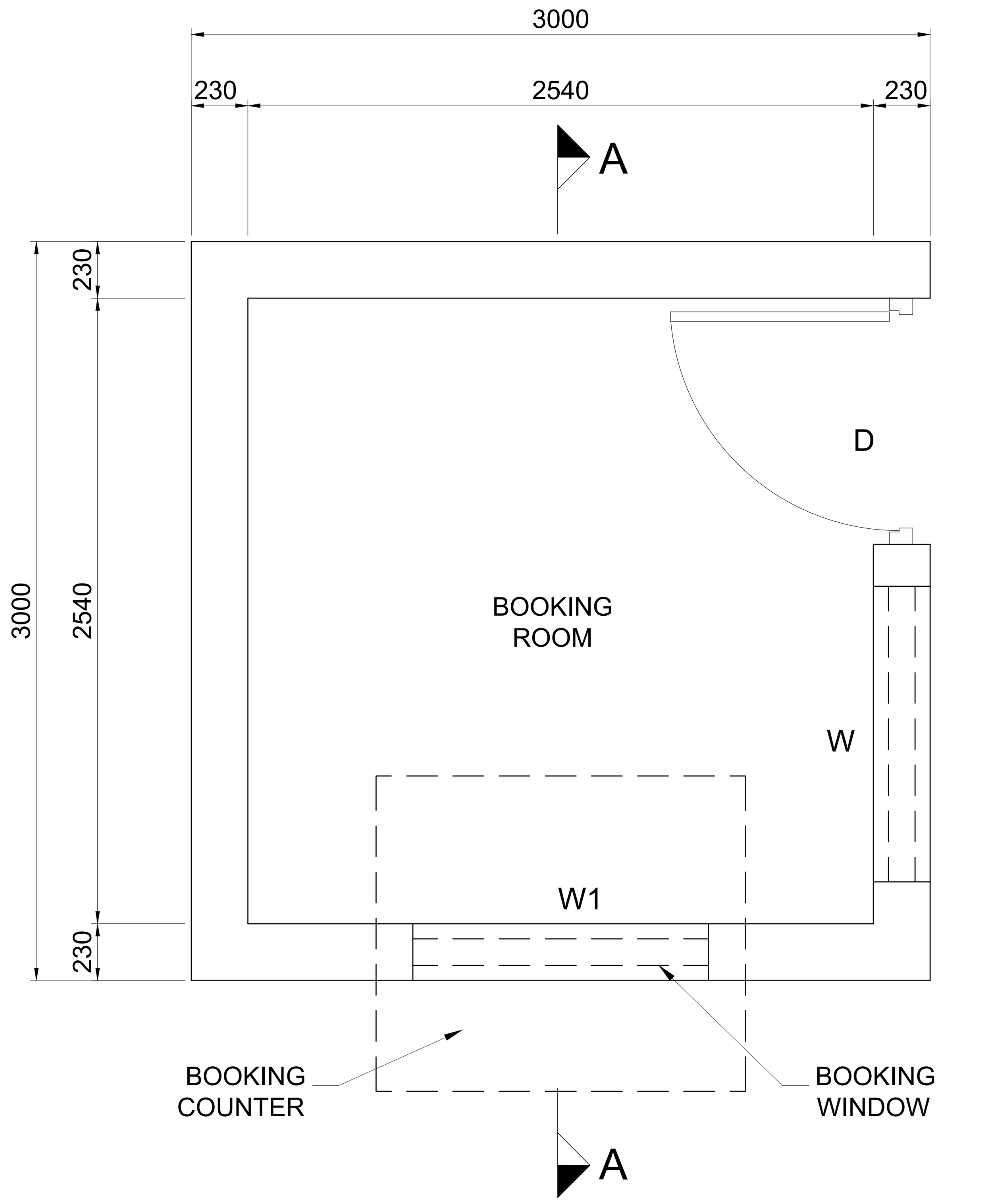
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

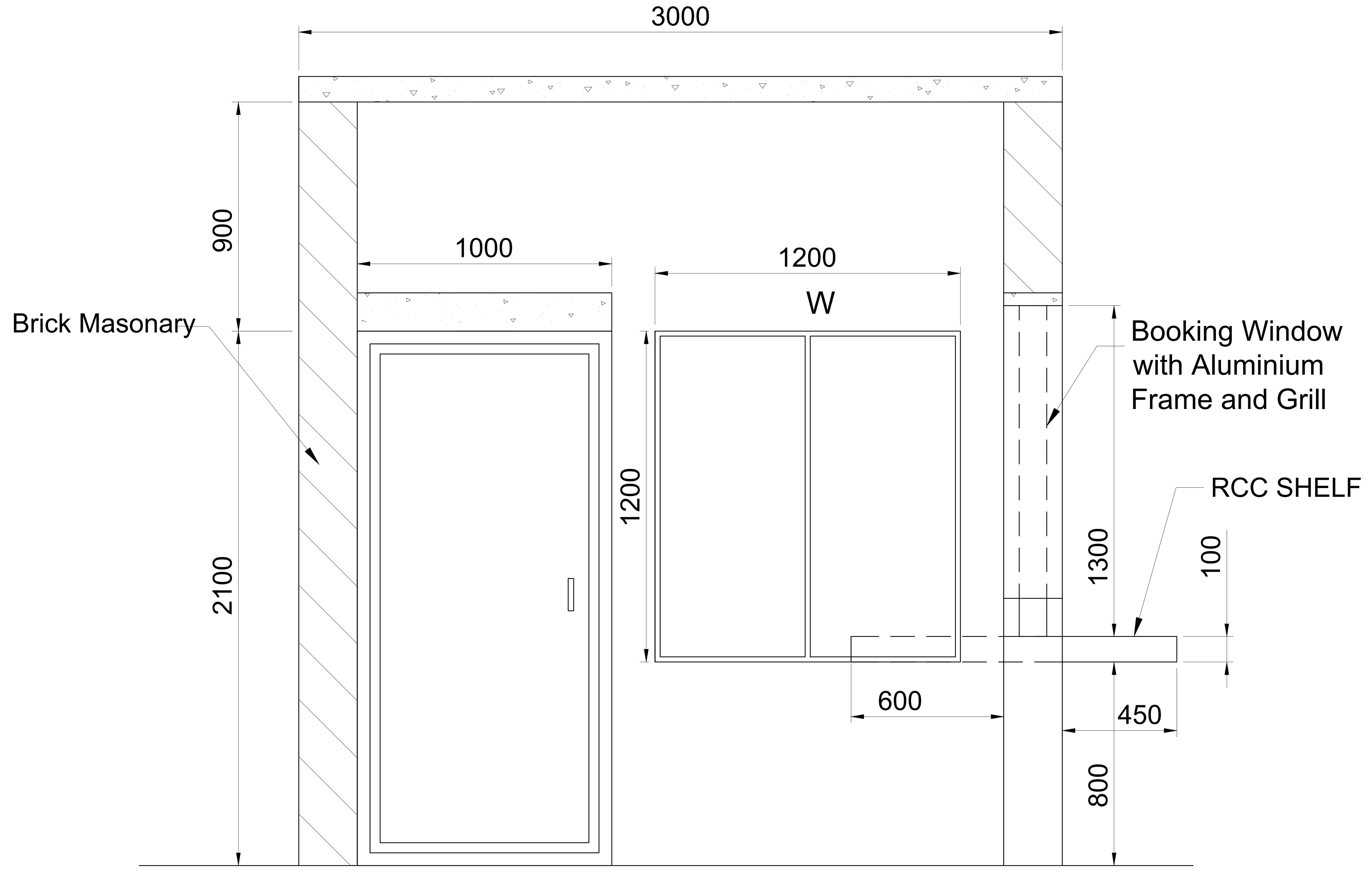
GC/HORC		HRIDC	
NAME / DEGINATION	SIGN	NAME / DEGINATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
RAJENDRA KR. BHAUGUNA DPD / EST	राजेन्द्र बहुगुणा		

TITLE:-
CONCEPTUAL PLAN OF AUTO LOCATION HUT (S & T)

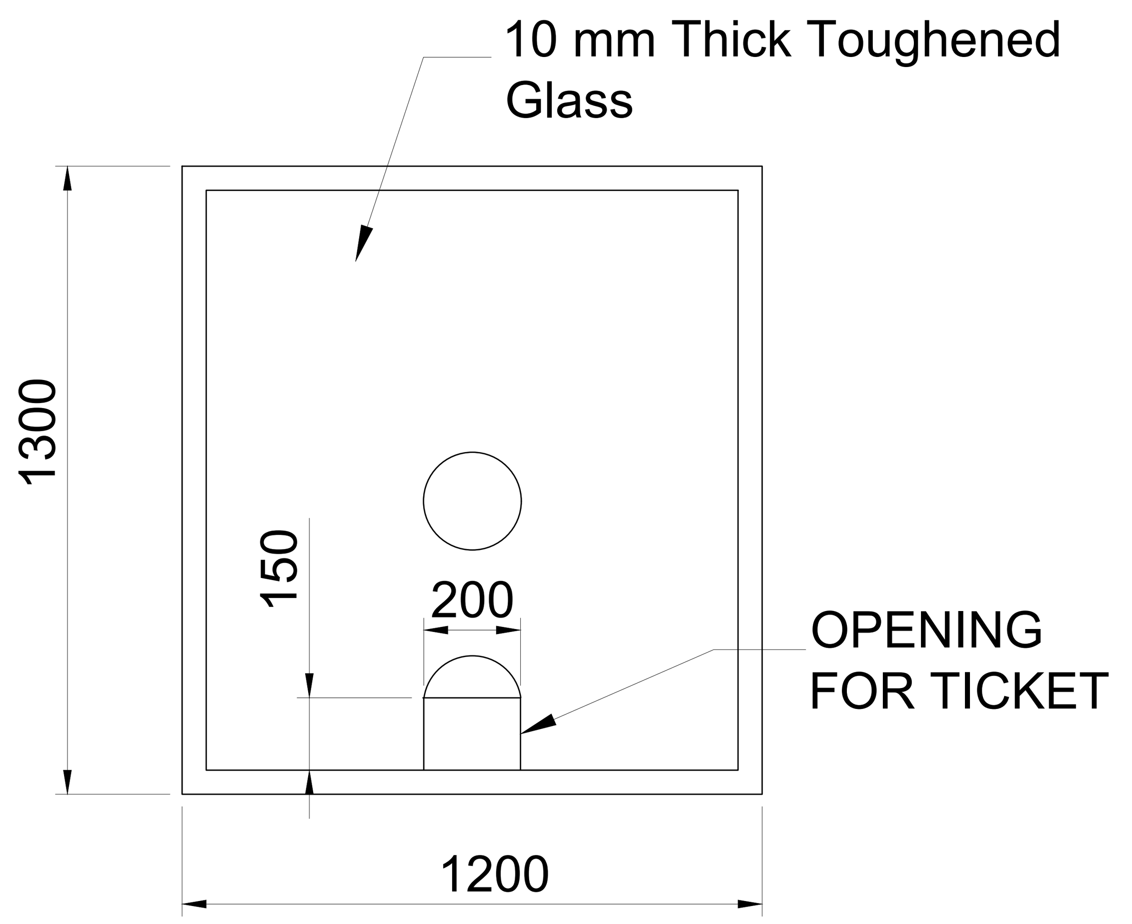
SKETCH NO.		SHEET NO.
GC-HRIDC-SK-GEN-012_A1		1 OF 1
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	31-08-2023	07-12-2023



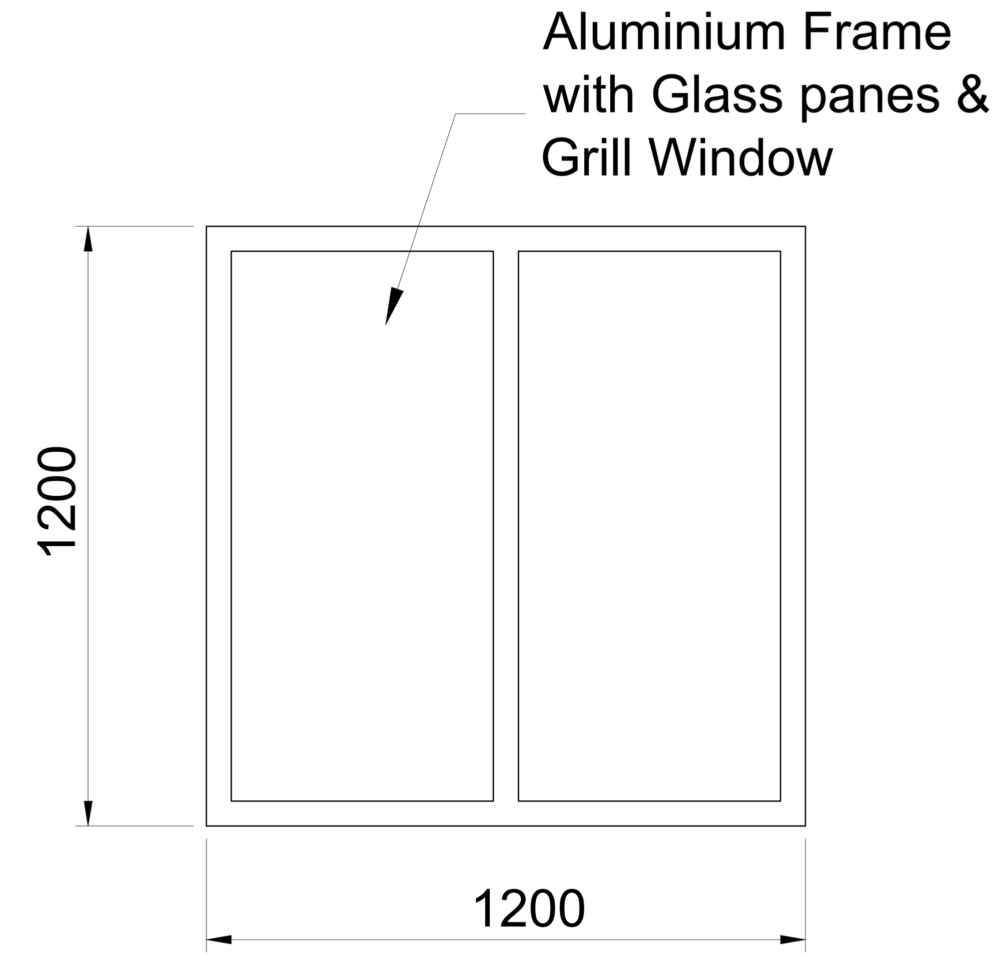
PLAN
(SCALE 1:50)



SECTION A-A
(SCALE 1:50)



DETAIL OF WINDOW (W1)
(SCALE 1:50)



DETAIL OF WINDOW (W)
(SCALE 1:50)

NOTES :
1. ALL DIMENSIONS ARE IN MILIMETERS.
2. DEPTH OF FOUNDATION TO BE DECIDED AS PER SITE CONDITION.
3. RCC SHELF WITH GRANITE TOP TO BE PROVIDED FOR BOOKING COUNTER.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

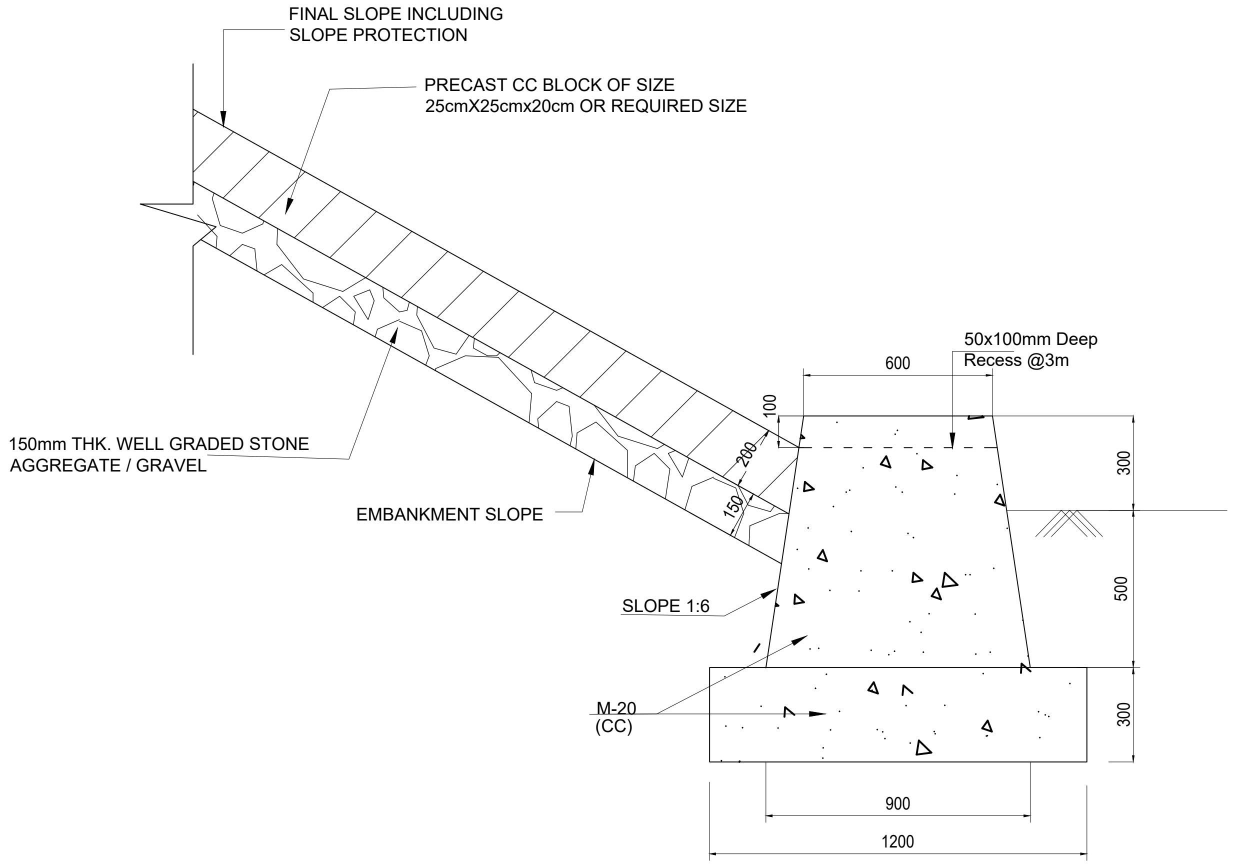
RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:-
CONCEPTUAL PLAN TICKET COUNTER

SKETCH NO.	SHEET NO.
GC-HRIDC-SK-GEN-013	1OF1

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	16-08-2023	

GC/HORC		HRIDC	
NAME / DEGINATION	SIGN	NAME / DEGINATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/HRIDC	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANKI DGM/C-SOUTH	[signature]
REETU PATIAL CDE / CIVIL	Reetu		



TOE WALL

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE MENTIONED.
2. M-20 GRADE CONCRETE SHALL BE USED FOR TOE WALL.
3. 25MM EXPANSION GAP SHALL BE PROVIDED AT 30m (MAX.) OF LENGTH OF WALL.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES
THE INFRASTRUCTURE PEOPLE

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		R. R. KUMAR GM/ IP&P	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
REETU PATIAL CDE/ CIVIL			

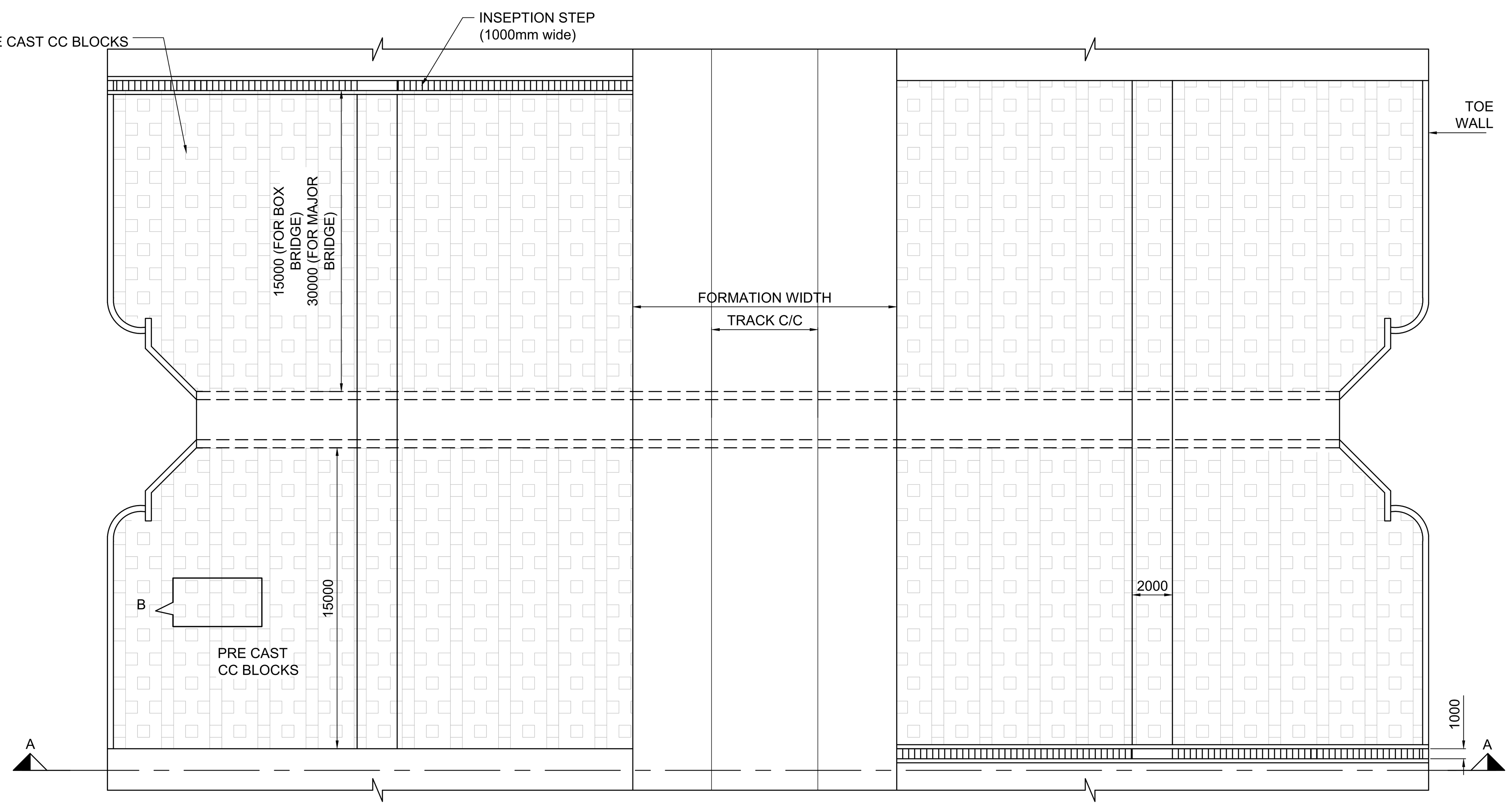
TITLE:- CONCEPTUAL PLAN CC TOE WALL

DRG. NO. GC-HRIDC-SK-GEN-014_A1

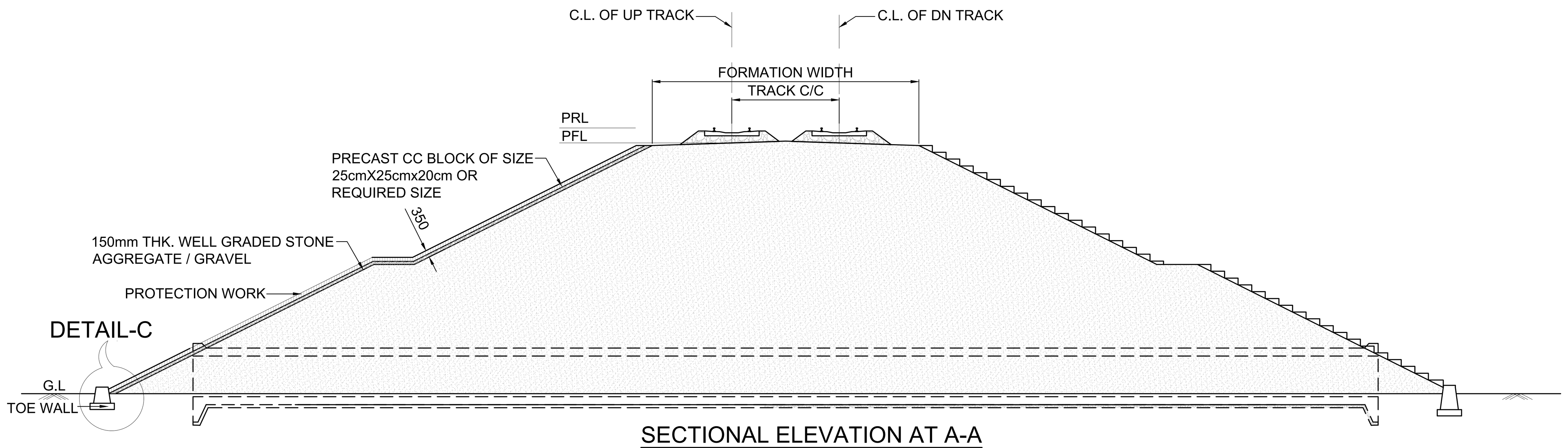
SHEET NO. 1 OF 1

SCALE : AS SHOWN

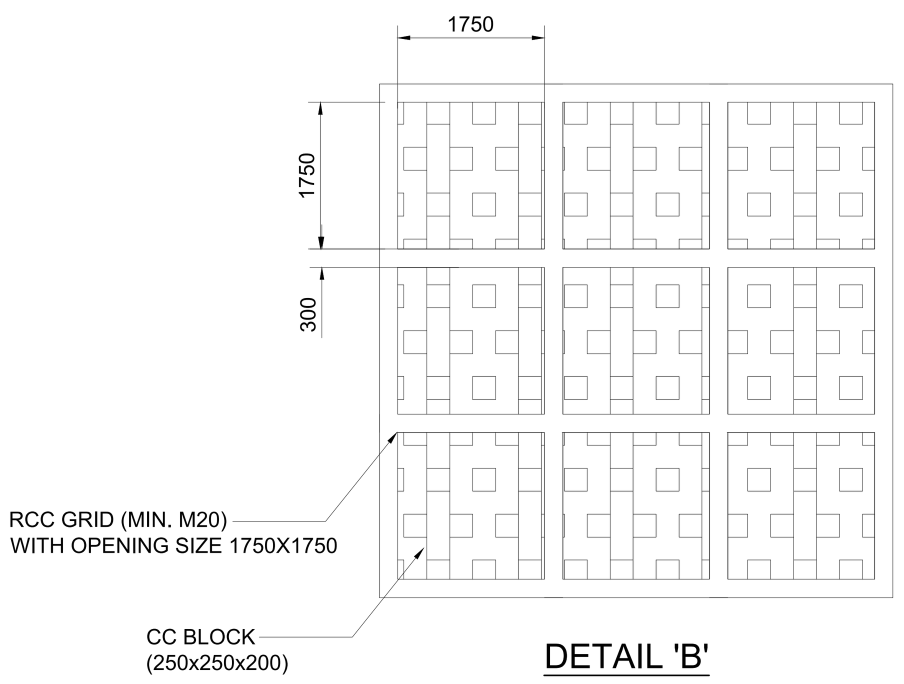
ISSUE DATE 28.12.2022



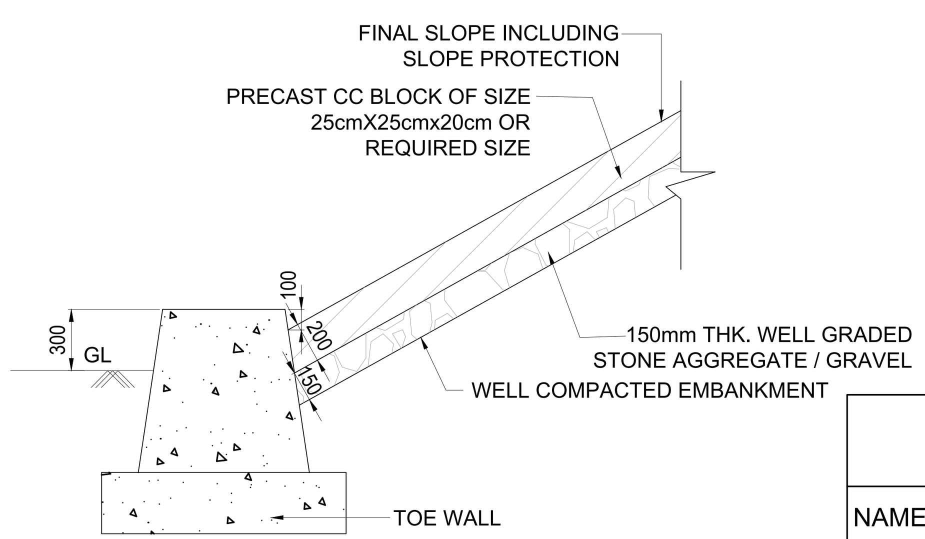
PLAN AT TOP
SCALE 1:100



SECTIONAL ELEVATION AT A-A
SCALE 1:100



DETAIL 'B'



DETAIL-C

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS, UNLESS OTHERWISE MENTIONED.
2. PROTECTION WORK WITH PRECAST CC BLOCK ON BOTH SIDES OF BRIDGES SHALL BE DONE FOR 15m LENGTH AND 30m LENGTH FOR MINOR BRIDGES & MAJOR BRIDGES RESPECTIVELY.
3. THIS DRAWING IS VALID FOR SINGLE/MULTIPLE NO. OF TRACKS. TRACKS SHOWN IN DRAWING ARE SYMBOLIC PRESENTATION ONLY.
4. THIS SKETCH SHALL BE READ ALONG WITH CONCEPTUAL PLAN CC TOE WALL NO. GC-HRIDC-SK-GEN-014-A1.

LEGEND

PRL	PROPOSED RAIL LEVEL
PFL	PROPOSED FORMATION LEVEL
GL	GROUND LEVEL

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	Shiv Om
SUDHIR AGRAWAL DPD/CIVIL	[illegible]	RAJU SOLANKI DGM/CIVIL	[illegible]
REETU PATIAL CDE/ CIVIL	Reetu		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL PLAN
TYPICAL DETAILS OF PROTECTION WORK OF BRIDGE

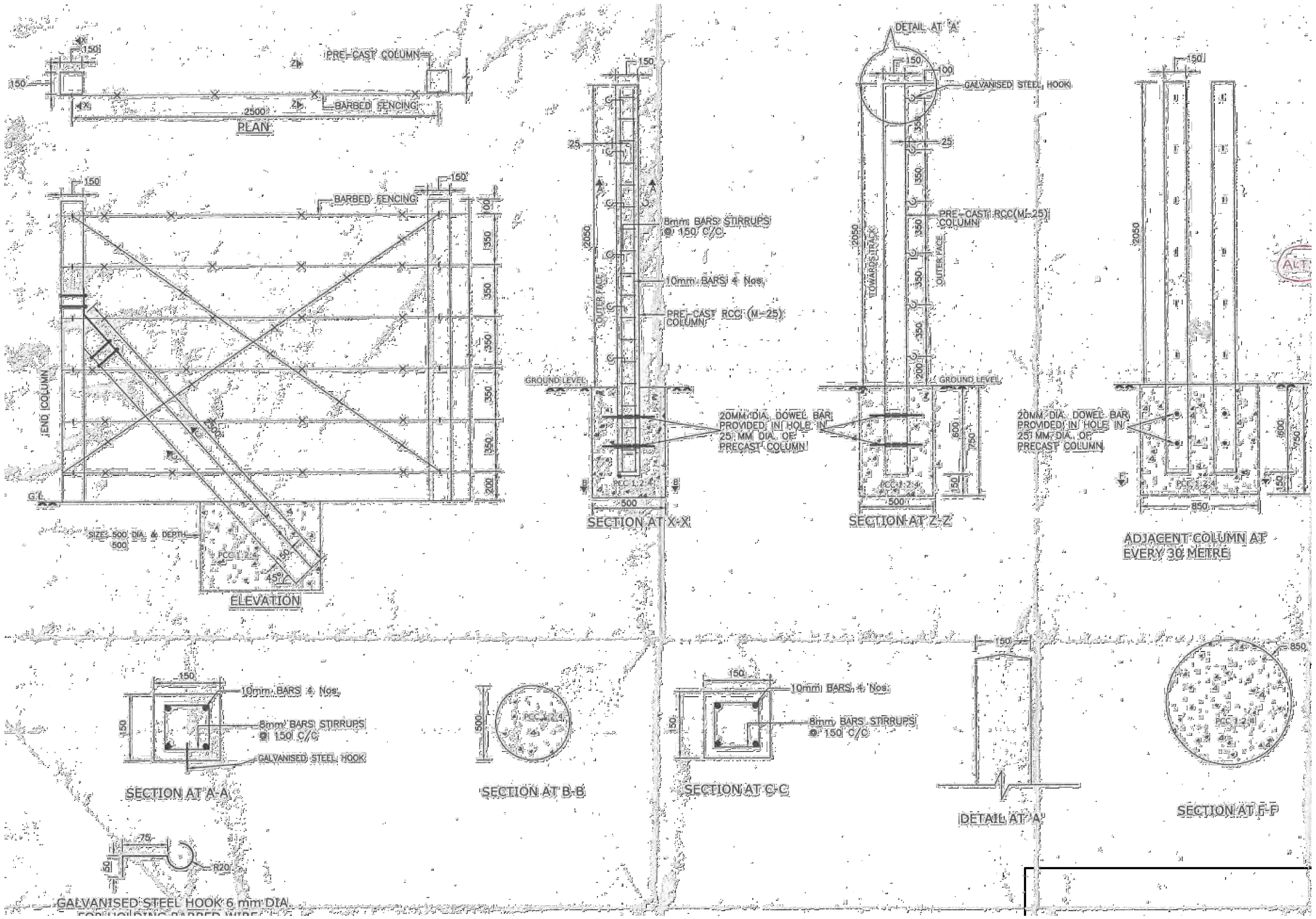
DRG. NO. GC-HRIDC-SK-GEN-015_A1

SHEET NO.

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	

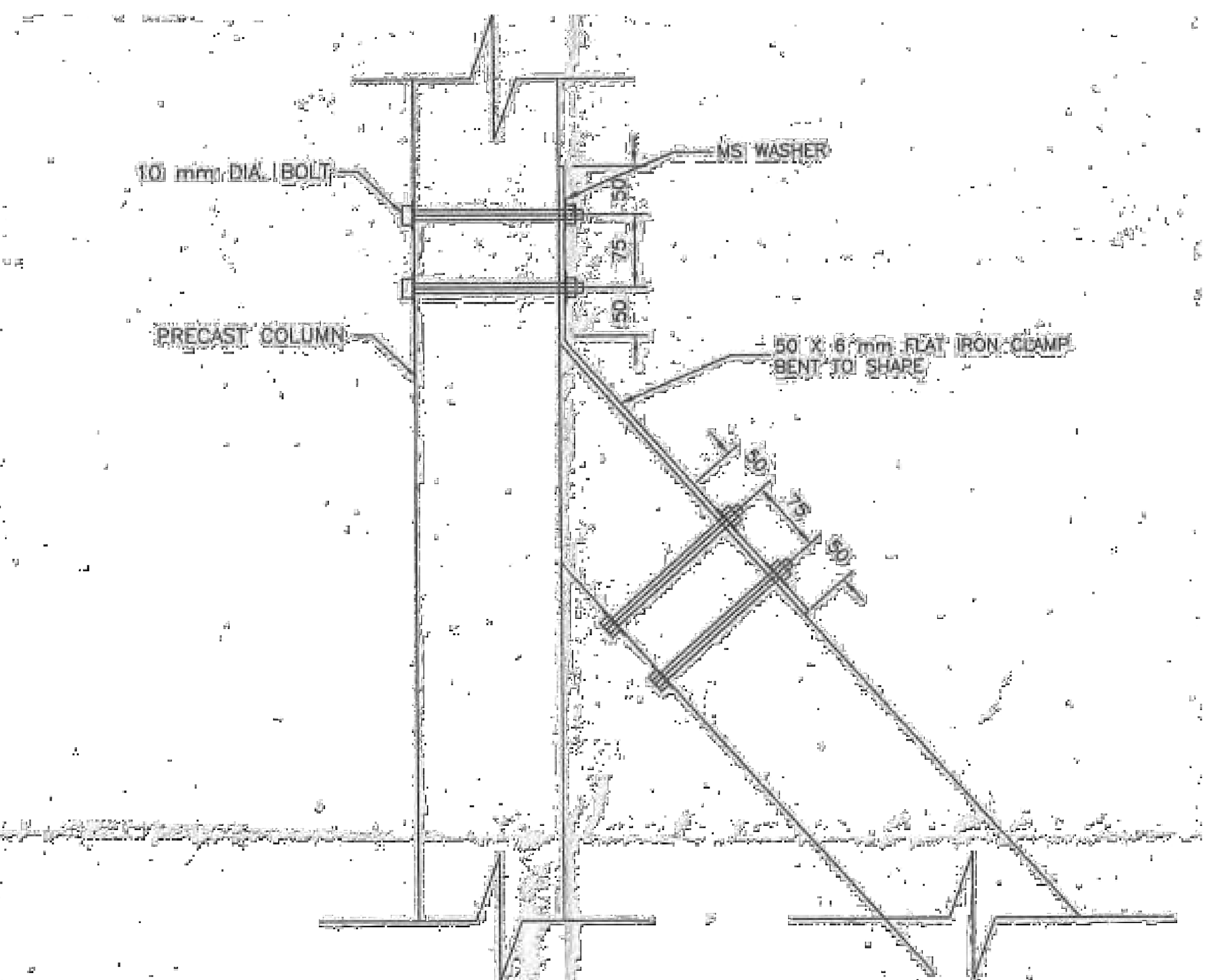
Notes:

1. THIS DRAWING IS BASED ON RDSO DRAWING NO. RDSO/WKS/2019/2.
2. GRADE OF CONCRETE M25.



NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.
2. BARBED FENCING SHALL BE MADE OF G.I. BARBED WIRES CONFIRMING TO IS: 278. THE WEIGHT OF G.I. BARBED WIRE SHALL BE AS PER SOR.
3. THE G.I BARBED WIRES SHALL BE FIXED TO THE COLUMNS WITH HOOKS MADE OF 6 mm DIA. GALVANIZED STEEL. ANOTHER END OF GALVANIZED STEEL HOOK SHALL BE PLACED BEHIND STIRRUPS AND TIED WITH STIRRUPS AS PER DRAWING TO PROVIDE STRENGTH.
4. FOR ERECTION OF WIRE FENCING, RECOMMENDATIONS GIVEN IN IS:4996-1984 SHALL BE FOLLOWED. FENCING WIRE SHALL BE TIED TO GALVANISED STEEL HOOKS WITH SHORT PIECE OF LIGHT WIRE.
5. M-25 GRADE CONCRETE SHALL BE USED IN PRECAST COLUMN/ STRUT. COLUMN/ STRUT SHALL BE CAST AT CENTRALIZED DEPOT UNDER CONTROLLED CONDITION AS PER IS :456-2000.
6. TMT BARS OF GRADE FE 415/ 500 OF SPECIFIED DIA. SHALL BE USED. TMT BAR SHALL BE CONFIRMING TO IS: 1786 (LATEST).
7. ZONAL RAILWAY MAY PAINT THEIR INITIALS (SUCH AS NR, SER etc.) ON COLUMN AND STRUT.
8. STRUT OR BRACE SHALL BE FIXED WITH END RCC COLUMN BY SUITABLE ARRANGEMENT AS DETAILED IN DRAWING. 50 X 6 mm MS FLAT SHALL BE USED TO CONNECT STRUT/BRACE TO RCC COLUMN. 10 mm DIA. MS BOLT BLACK HEXAGONAL HEAD ROUND NECK WITH HEXAGONAL NUTS AND TWO WASHER SHALL BE USED. AFTER TIGHTING NUT, END OF BOLT SHALL BE HAMMERED TO MAKE ANTITHEFT.
9. SUPPORTING STRUT SHALL BE PROVIDED AT FIRST / END COLUMN OR CHANGE OF DIRECTION.
10. 1:20 SLOPE SHALL BE PROVIDED ON TOP OF COLUMN AT THE TIME OF CASTING.
11. AT EVERY 30 METRE TWO COLUMN SHALL BE GROUTED SIDE BY SIDE.
12. IN UNDULATING AREA, COLUMN SHALL BE PLACED ACCORDINGLY SO THAT BARBED WIRE ARE ALIGNED HORIZONTAL. VERTICALITY OF COLUMN SHALL BE CHECKED DURING ERECTION.
13. FOUNDATION SHALL BE DUG USING AUGAR/ MECHANICAL BORING EARTH SHALL BE RAMMED PROPERLY AND 50 MM SAND SHALL BE PLACED BEFORE FOUNDATION CASTING. FOUNDATION SHALL BE CURED PROPERLY.
14. THIS CATLE FENCE SHALL BE PROVIDED AT RAILWAY BOUNDARY.
15. IS:456(LATEST) SHALL BE FOLLOWED IN ALL R.C.C & P.C.C WORKS.



DETAIL OF JUNCTION OF PRECAST COLUMN AND STRUT

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

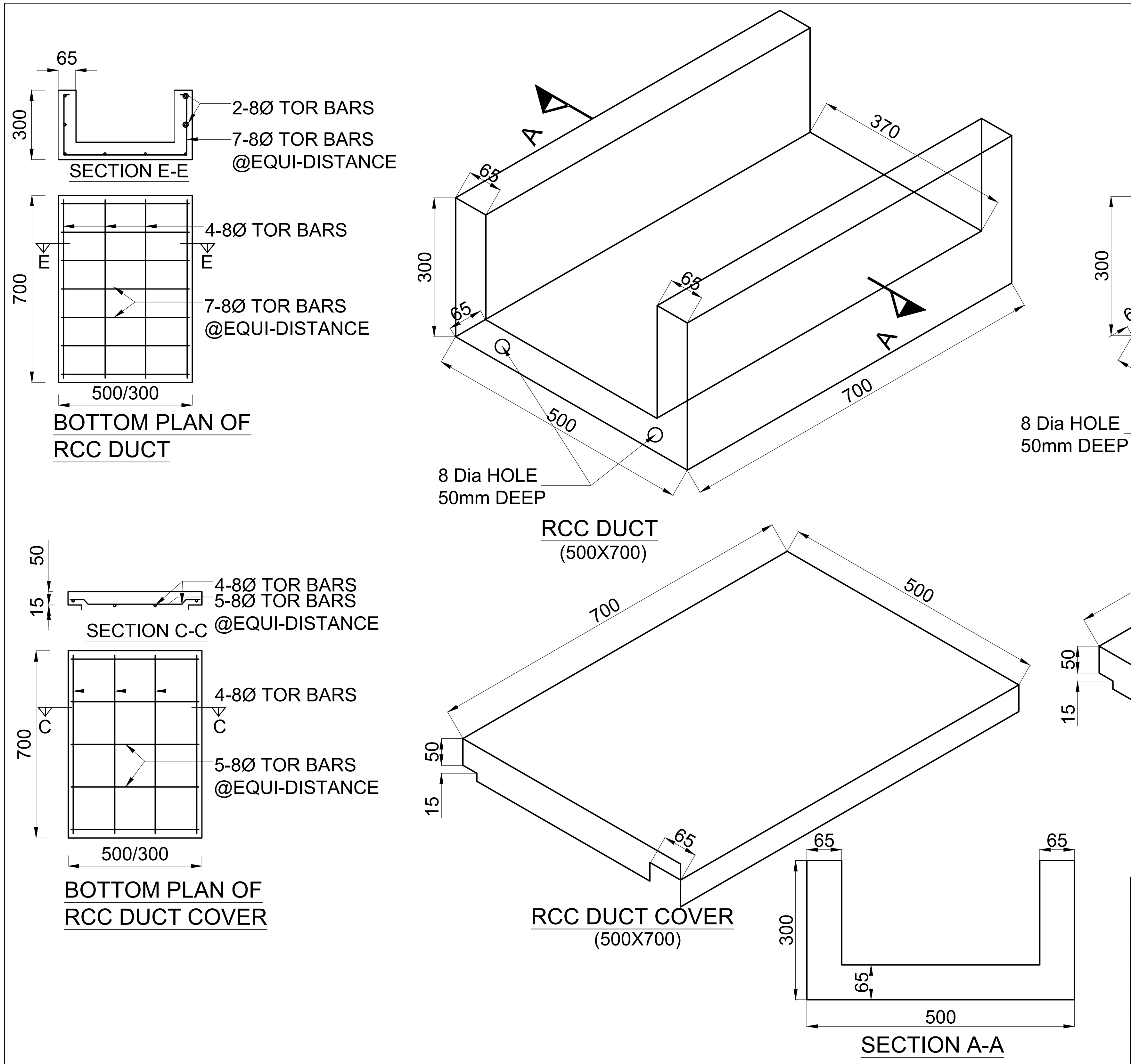
THE INFRASTRUCTURE PEOPLE

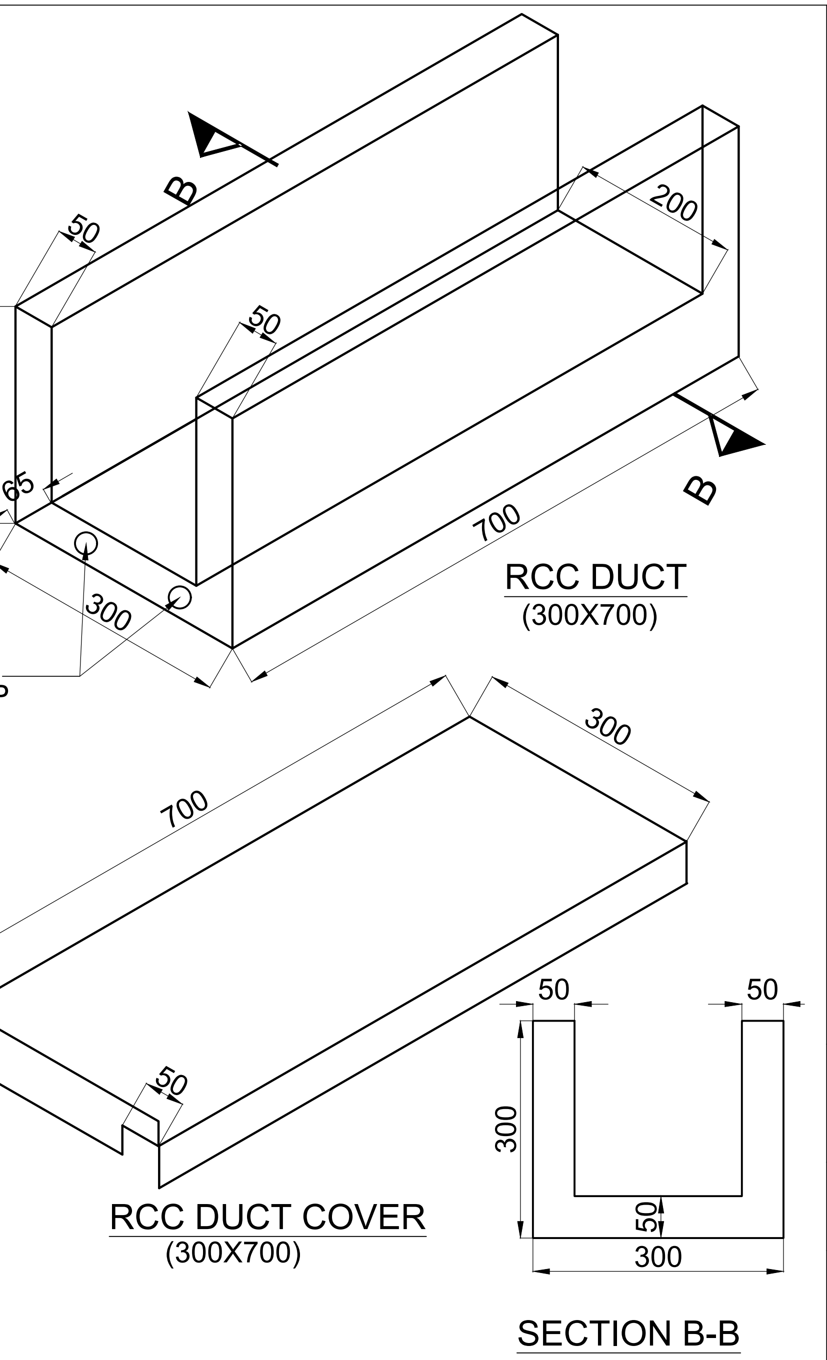
Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	R. R. KUMAR GM/ IP&P	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	RAJU SOLANKI DGM/C-SOUTH	[signature]
REETU PATIAL CDE/ CIVIL	[signature]		

TITLE:- CONCEPTUAL PLAN
BARBED WIRE FENCING

DRG. NO.	GC-HRIDC-SK-GEN-016_A1	SHEET NO. 1 OF 1
SCALE : AS SHOWN	ISSUE DATE 28.12.2022	





NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS .
2. RCC DUCT SHALL BE LAID AT A DEPTH SUCH THAT THE TOP OF RCC COVER IS AT THE DEPTH OF MINIMUM 690mm BELOW GROUND LEVEL.
3. THE TRUNKING OF SEGMENT TO BE DONE BY PUTTING MS RODS OF 8 mm DIA x 100mm LONG (AS PER IS:432 PART(i)-1982 IN THE TWO HOLES PROVIDED.
4. DUCT SHOULD BE RCC PRECAST (FACTORY MADE) OF M-35 GRADE.
5. THIS DRAWING IS DEVELOPMENT FOR INCIDENTAL VEHICLE LOAD OF 10KN/M² OVER AND ABOVE EARTH PRESSURE.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	VIKRAM YADAV GM/ A&IE/HRIDC	[signature]
RAJENDRA KR. BHAUGUNA DPD/E&T.	[signature]	JYOTI SANGWAN DGM/Elect.	Jyoti Sangwan
PRATIBHA KUMARI SRE/S&T	Pratibha		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

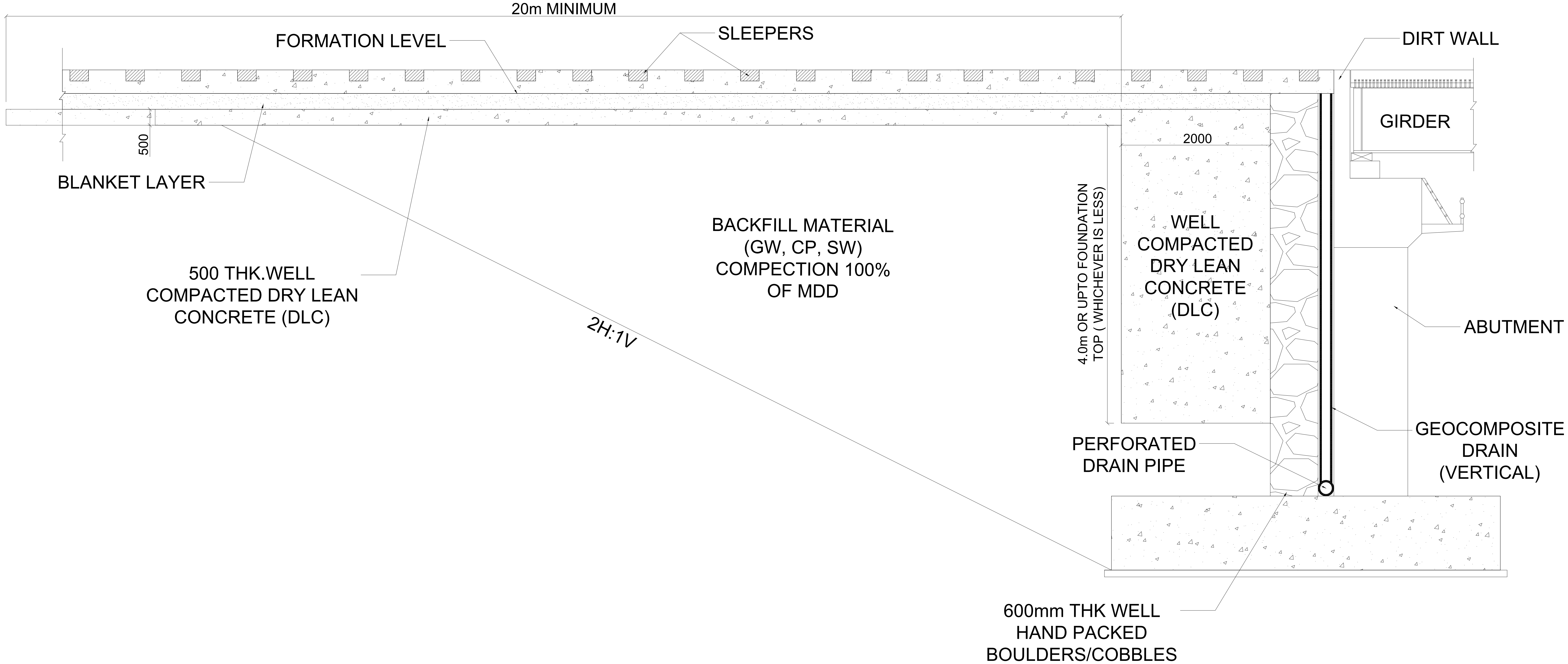
CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES
THE INFRASTRUCTURE PEOPLE
SMEC

TITLE:- CONCEPTUAL PLAN
RCC DUCT OF SIGNALLING CABLE

DRG. NO.	SHEET NO.
GC-HRIDC-SK-GEN-017	1 OF 1
SCALE : AS SHOWN	ISSUE DATE 09.09.2023



TRANSITION SYSTEM ON APPROACHES OF BRIDGES

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT STATED.
2. DO NOT SCALE THE DRAWING FOLLOW ONLY WRITTEN.
3. THIS DRAWING IS PREPARED BASED UPON REFER RDSO REPORT NO. GE:R-50 DATED JULY-2021 FOR DETAILS THIS REPORT SHALL BE FOLLOWED.
4. GEOCOMPOSITE DRAINS TO BE USED BEHIND BRIDGE ABUTMENT SHALL BE AS PER RDSO/2018/GE:IRS-006, MARCH-2019 AND COMPREHENSIVE GUIDELINE AND SPECIFICATIONS FOR RAILWAY FORMATION.
5. PROVISION IN RETURN WALL SHALL BE KEPT TO TAKE OUT THE DISCHARGE FROM PERFORATED DRAIN PIPE.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		R. R. KUMAR GM/ IP&P	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
REETU PATIAL CDE/ CIVIL			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

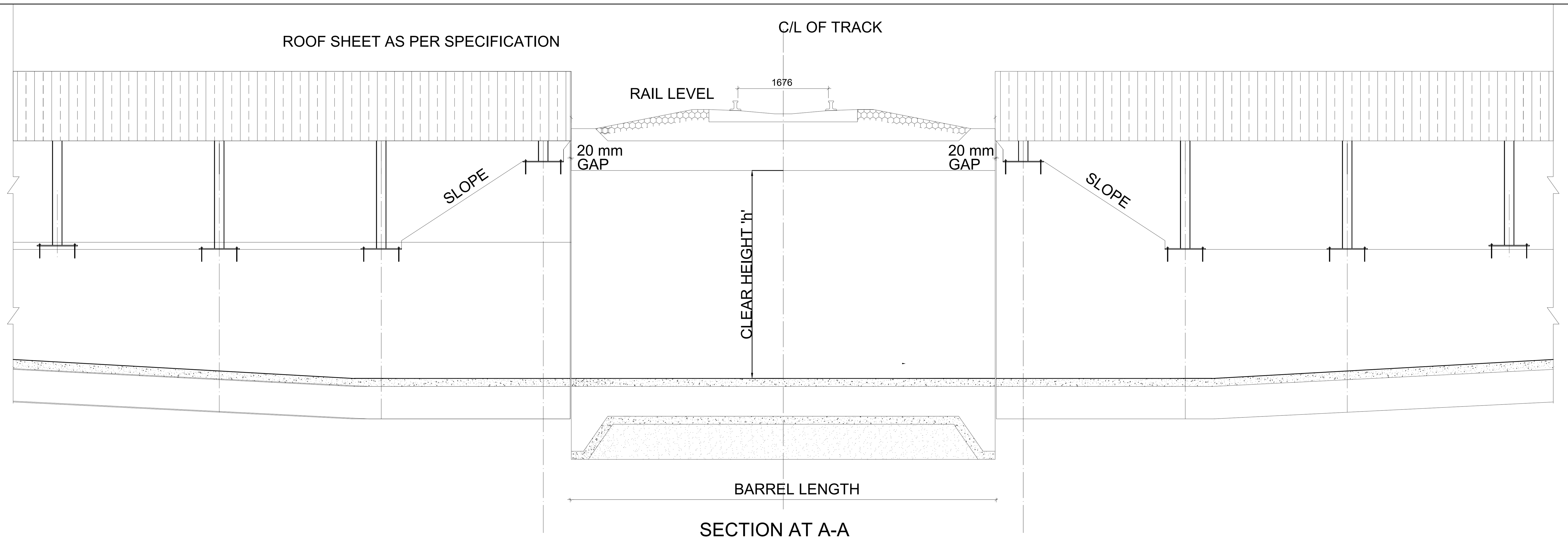
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

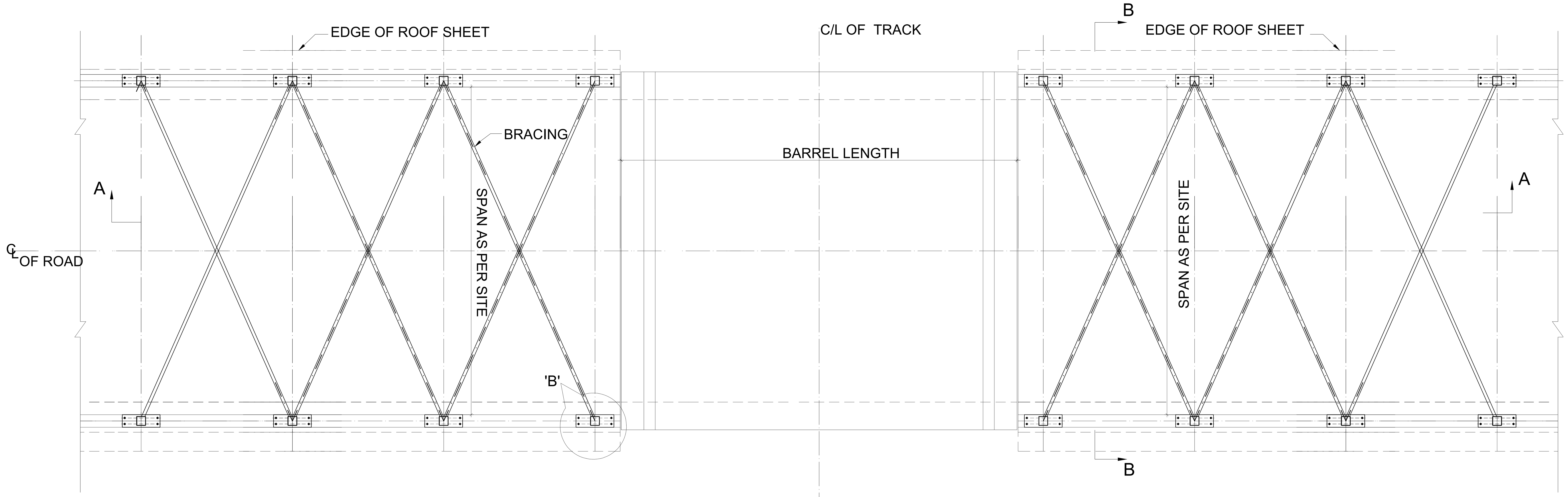
TITLE:-
CONCEPTUAL PLAN FOR
TRANSITION SYSTEM OF BRIDGE APPROACHES

DRG. NO.	SHEET NO.
GC-HRIDC-SK-GEN-019	1 OF 1

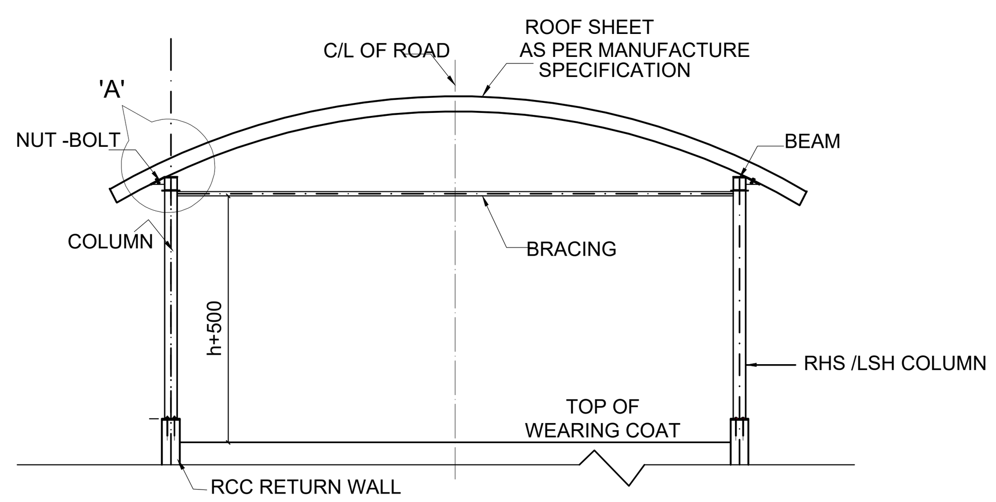
SCALE :	ISSUE DATE
AS SHOWN	28.12.2022



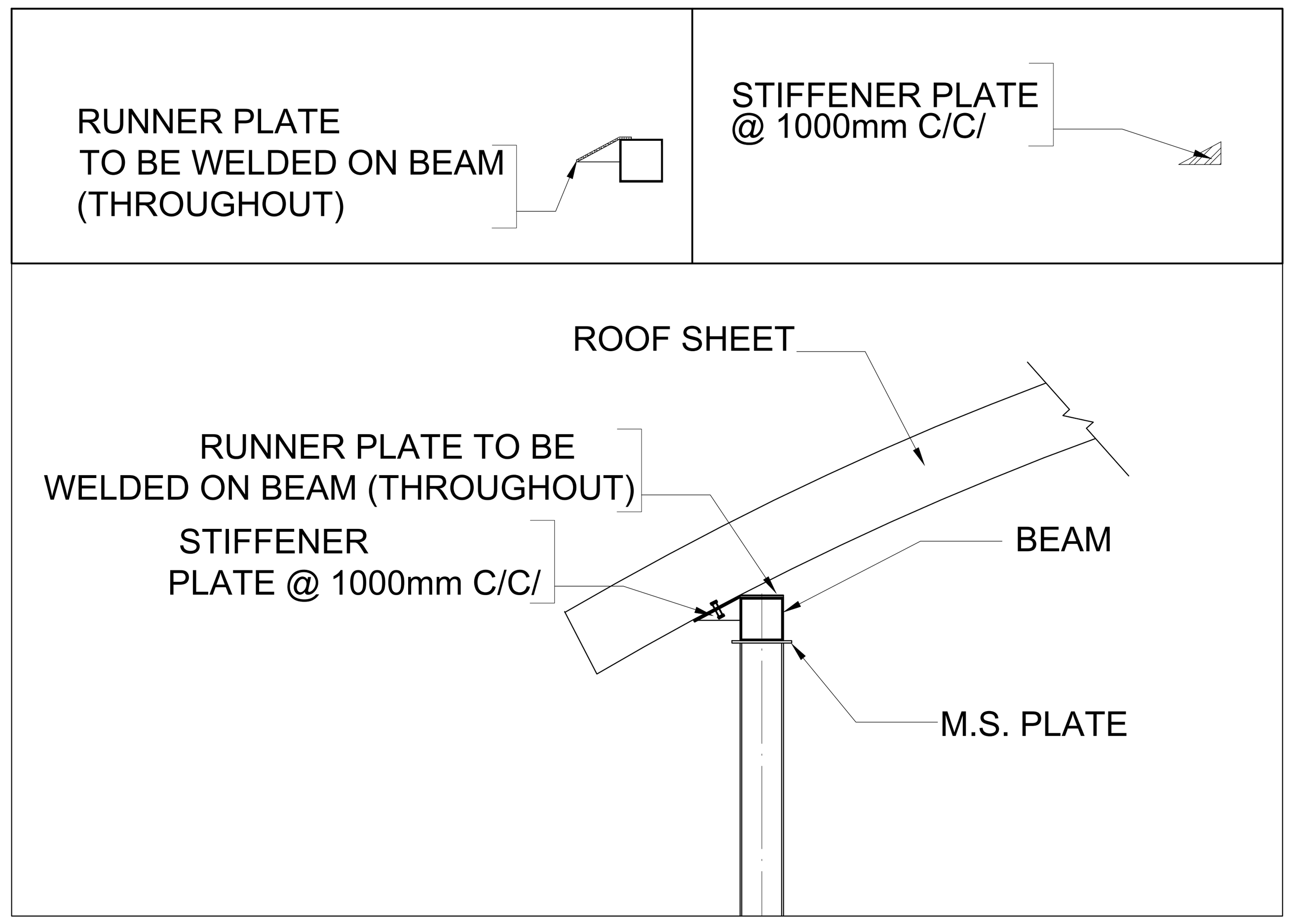
SECTION AT A-A



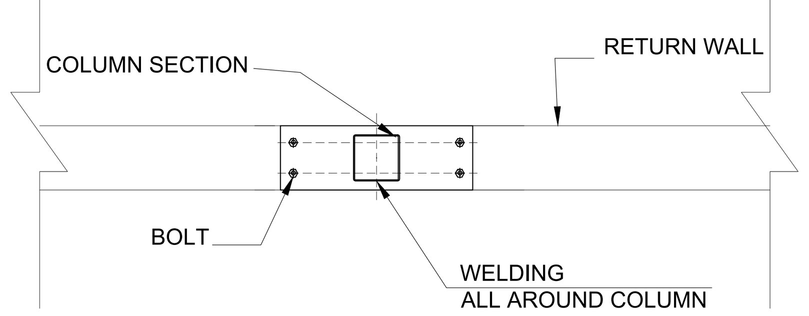
PLAN



SECTION AT B-B
DETAILS OF COVER SHED (COVER ON APPROACH ROAD)



DETAIL AT 'A'
NOT TO SCALE



DETAIL AT 'B'
NOT TO SCALE

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT STATED OTHERWISE.
2. DO NOT SCALE THE DRAWING FOLLOW ONLY WRITTEN DIMENSIONS.
3. VERIFY ALL SCHEDULE OF DIMENSION BEFORE EXECUTION OF WORK AT SITE. ENGINEER IN CHARGE SHOULD ENSURE THE SAFETY OF TRACK/EXISTING STRUCTURES BEFORE EXECUTION OF WORK.
4. STRUCTURAL STEEL SHALL CONFORM TO IS : 2062.
5. ALL WELD SHALL BE ALL AROUND CONTINUOUS UNLESS OTHERWISE MENTIONED.
6. SIZE AND SPACING OF STRUCTURAL MEMBERS SHALL BE FINALIZED AFTER DETAILED DESIGN.
7. RDSO REPORT NO. RDSO/WKS/2015/3 SHALL BE FOLLOWED FOR SELF-SUPPORTING ROOFING SYSTEM DETAILS, ITS INSTALLATION AND MATERIAL SPECIFICATION.
8. ROOF COVERING SHALL BE OF HIGH QUALITY, HIGH GRADE, PRE COATED GALVALUME SHEET OF MINIMUM THICKNESS 0.9mm.
9. PROFLEX ROOFING SYSTEM SHALL BE ADOPTED FOR SELF-SUPPORTING ROOFING.
10. ROOFING PANELS SHALL BE MECHANICALLY SEAMED (INTERLOCK) AND FREE FROM NOTES, NUT, BOLTS OVERLAPS AND SEALANTS.
13. AFTER ERECTION OF ROOFING, IT SHALL BE BOLTED WITH THE SUPPORTING STRUCTURE BY SELF-SPLITTING SCREWS.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

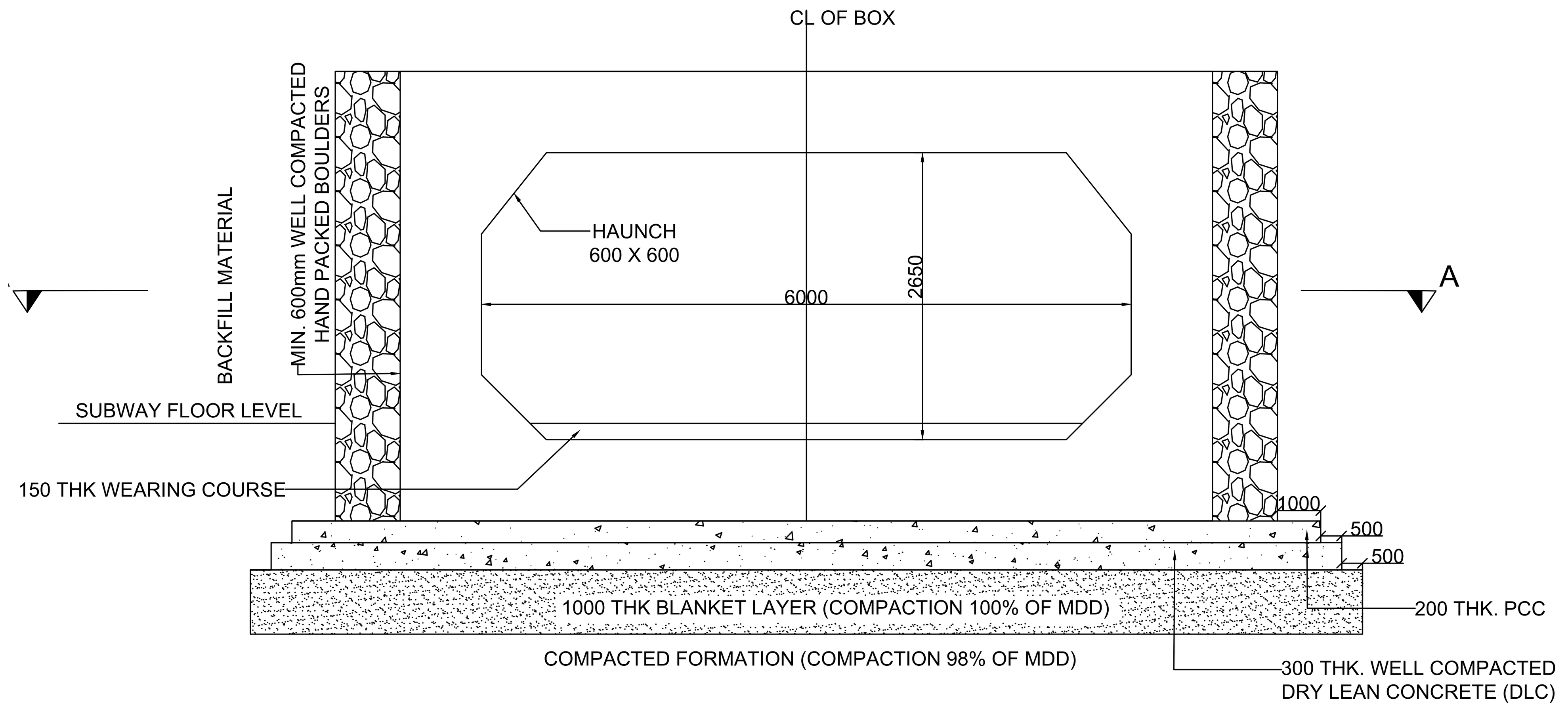
GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
REETU PATIAL CDE/ CIVIL			

TITLE:-
CONCEPTUAL PLAN FOR
SELF SUPPORTING ROOF COVERING SHED

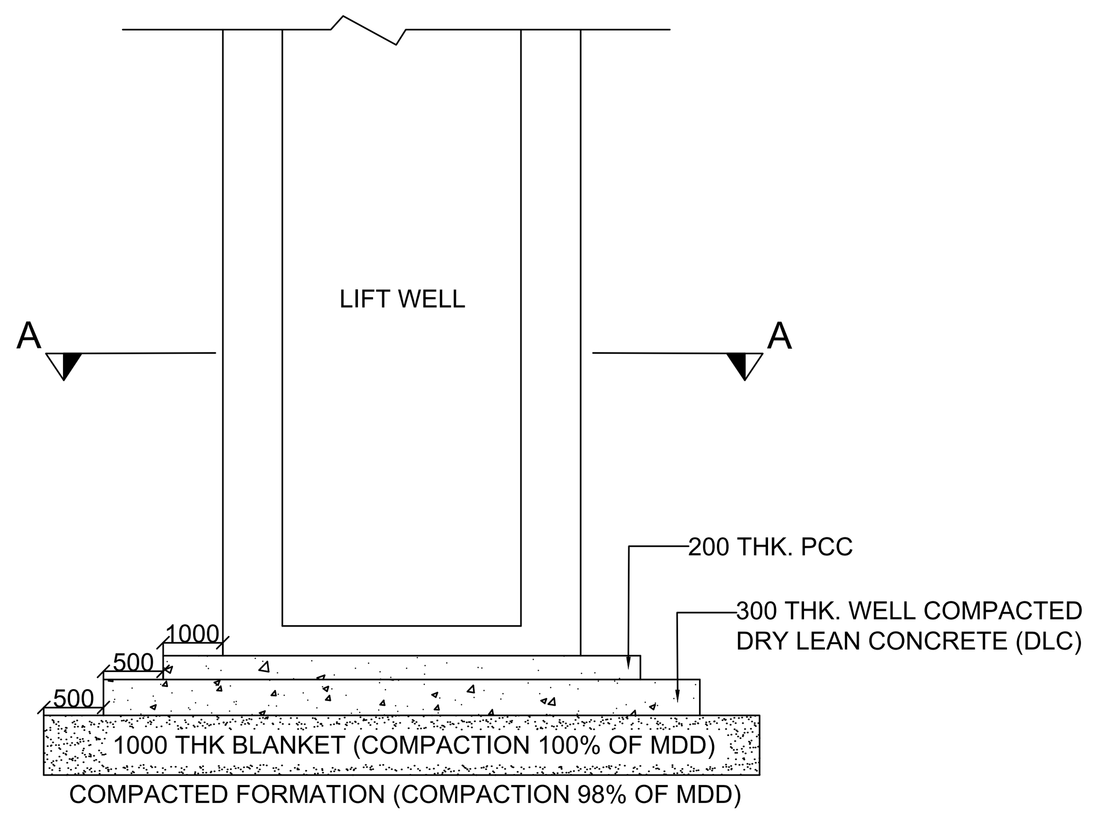
DRG. NO.	GC-HRIDC-SK-GEN-020	SHEET NO. 1 OF 1
SCALE : AS SHOWN	ISSUE DATE 10-10-2023	REVISED DATE

NOTES:

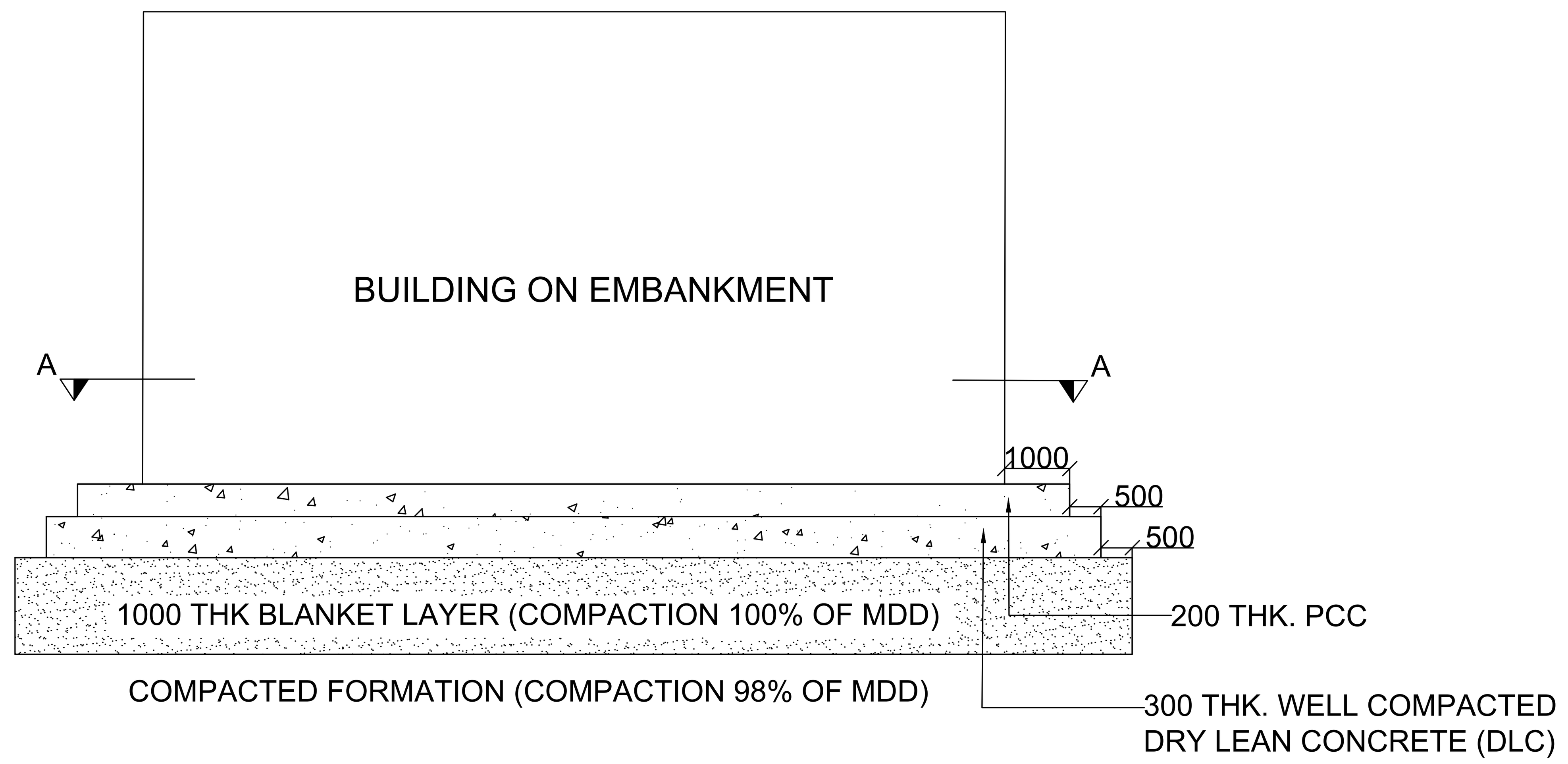
1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT STATED.
2. DO NOT SCALE THE DRAWING FOLLOW ONLY WRITTEN DIMENSIONS.
3. FOR BLANKET LAYER DETAILS FOLLOW RDSO SPECIFICATION NO.: RDSO82020/GR:IRS-004 (COMPREHENSIVE GUIDELINE AND SPECIFICATION FOR RAILWAY FORMATION).



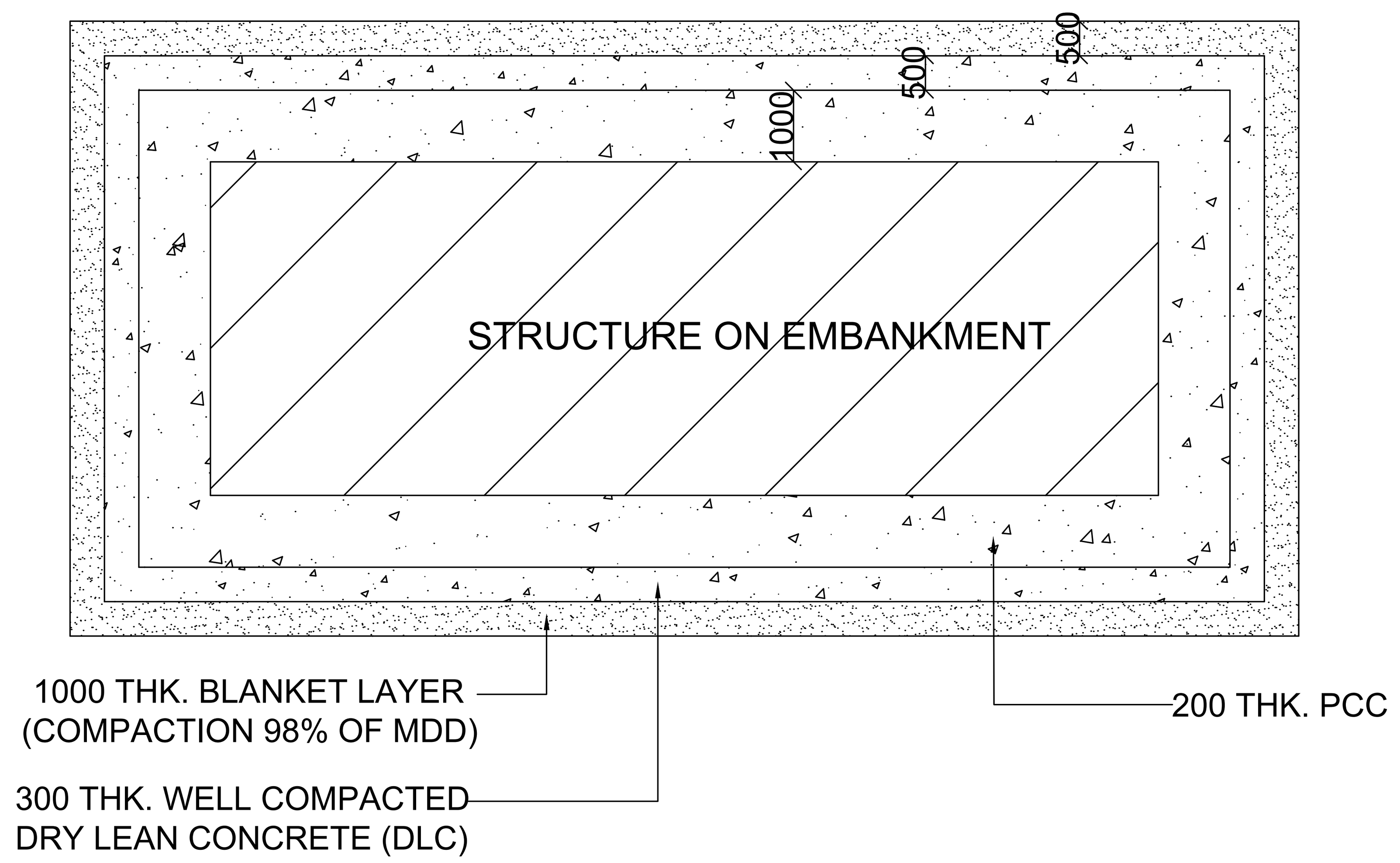
FORMATION DETAIL BELOW SUBWAY BOX



FORMATION DETAIL BELOW LIFT WELL



FORMATION DETAIL BUILDING



SECTION A-A
SCALE : NOT SCALE

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

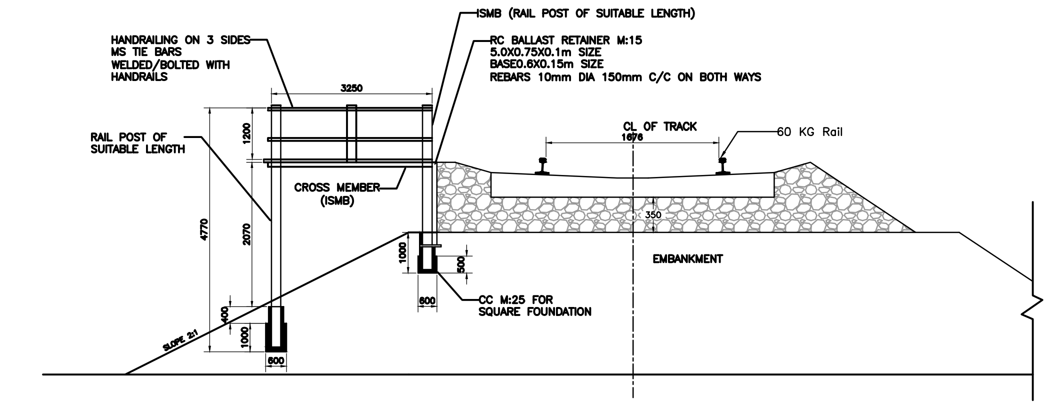
RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	R. R. KUMAR GM/ IP&P	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
REETU PATIAL CDE/ CIVIL			

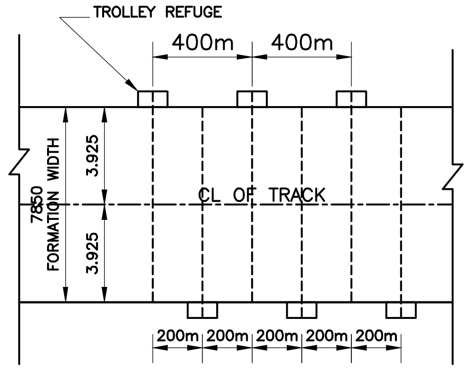
TITLE:- CONCEPTUAL PLAN FOR FORMATION DETAIL BELOW OF SUBWAY AND LIFT WELL

DRG. NO.	SHEET NO.
GC-HRIDC-SK-GEN-021	1 OF 1

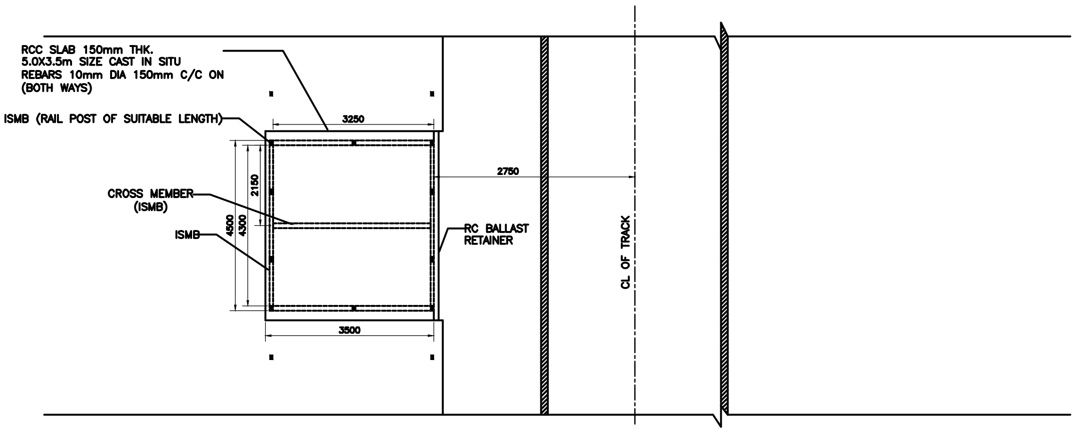
SCALE :	ISSUE DATE
AS SHOWN	28.12.2022



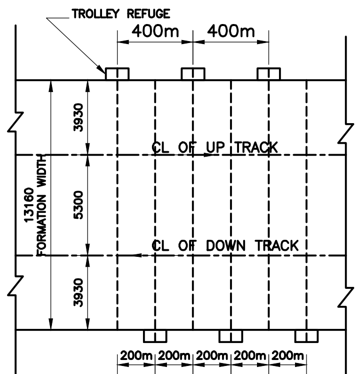
SECTIONAL ELEVATION



PLAN SHOWING TROLLEY REFUGE
SPACING FOR SINGLE TRACK



PLAN



PLAN SHOWING TROLLEY REFUGE
SPACING FOR DOUBLE TRACK

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT STATED.

2. DO NOT SCALE THE DRAWING FOLLOW ONLY WRITTEN DIMENSIONS.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		R. R. KUMAR GM/ IP&P	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
REETU PATIAL CDE/ CIVIL			

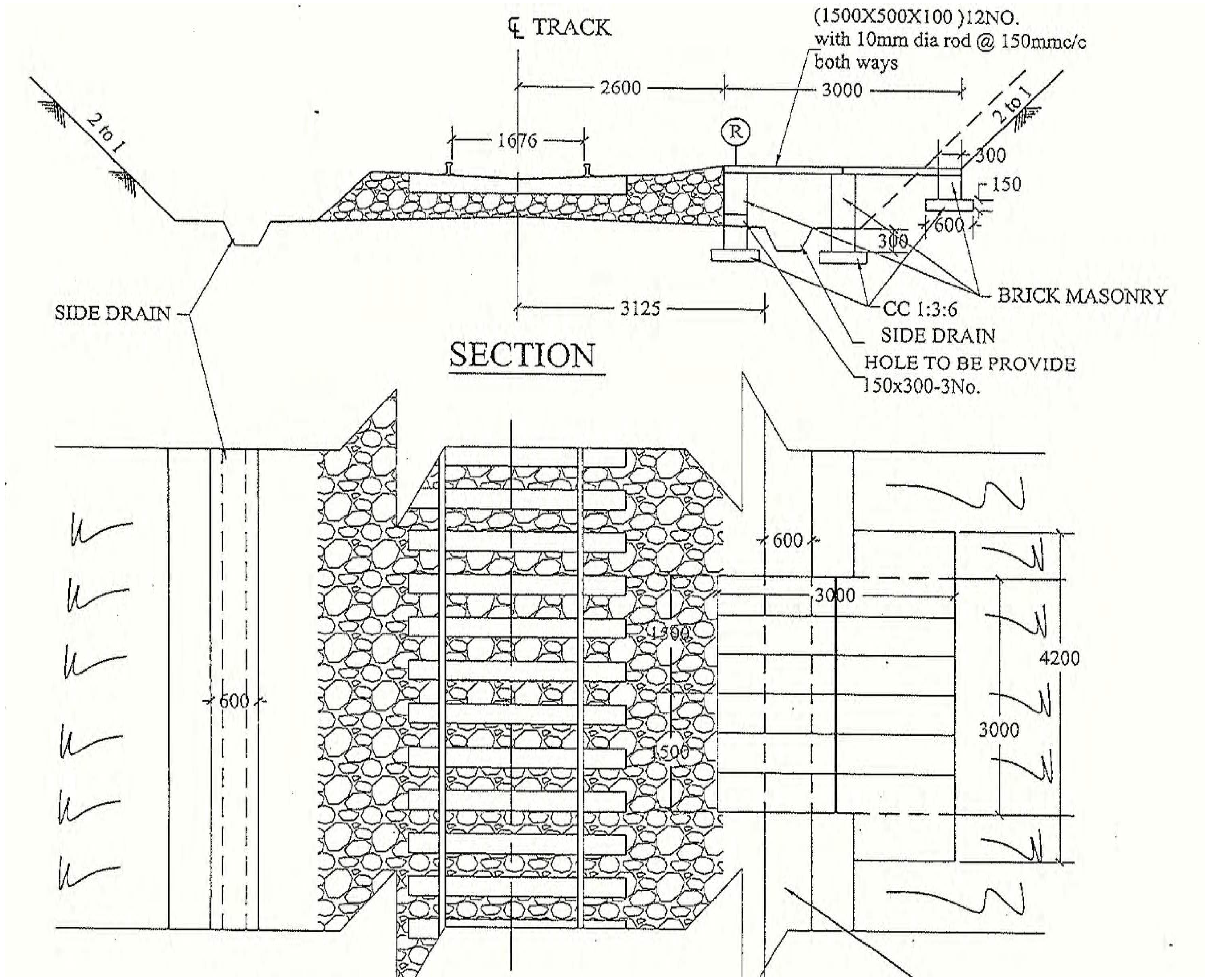
TITLE:- CONCEPTUAL PLAN FOR TROLLEY REFUGE IN EMBANKMENT

DRG. NO. GC-HRIDC-SK-GEN-022

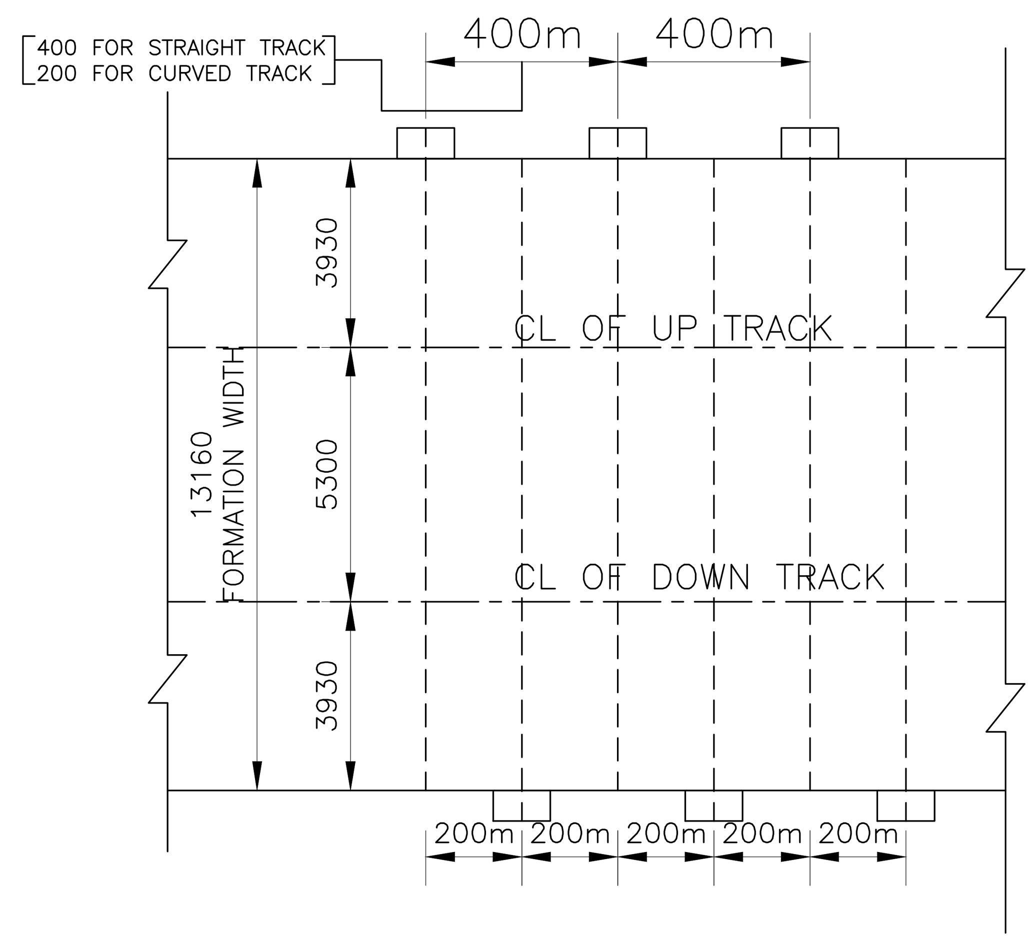
SHEET NO. 1 OF 1

SCALE : AS SHOWN

ISSUE DATE 28.12.2022



SECTION



PLAN SHOWING TROLLEY REFUGE
SPACING FOR DOUBLE TRACK

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT STATED.
2. DO NOT SCALE THE DRAWING FOLLOW ONLY WRITTEN DIMENSIONS.
3. RCC PRECAST SLAB M35 (1500X500X100)

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		R. R. KUMAR GM/ IP&P	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
REETU PATIAL CDE/ CIVIL			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

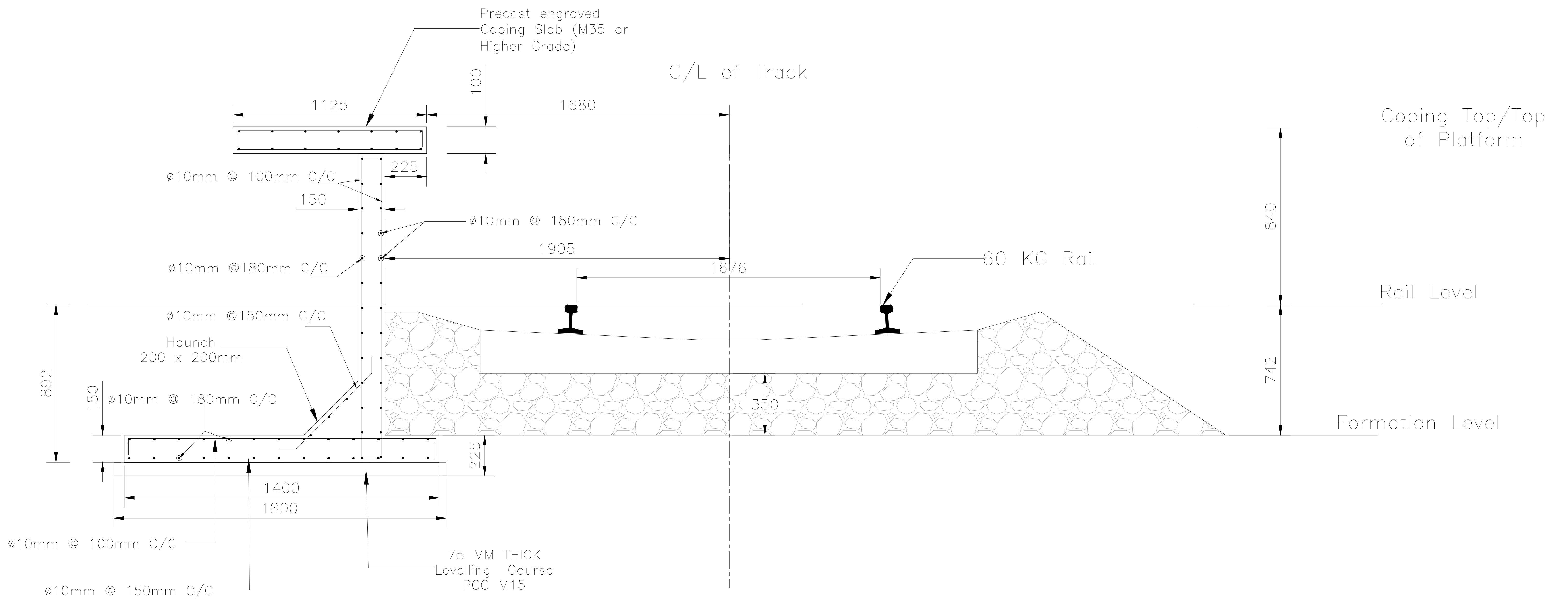
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL PLAN FOR TROLLEY REFUGE IN CUTTING

DRG. NO.	SHEET NO.
GC-HRIDC-SK-GEN-023	1 OF 1

SCALE :	ISSUE DATE
AS SHOWN	28.12.2022



SECTION FOR PLATFORM WALL

NOTES:
1. ALL DIMENSION ARE IN MILLIMETERS EXPECT LEVELS WHICH ARE IN METERS. NO DIMENSION SHALL BE SCALED FROM DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
2. 25MM CLEAR COVER SHALL BE PROVIDED TO ALL TYPES OF OUTERMOST REINFORCEMENT.
3. #INDICATES HIGH YIELD STRENGTH STEEL Fe-500 D(TMT) CONFORMING TO I.S. 2008.
4. ANCHORAGE SHALL BE 50 X DIA OF BARS & NOT MORE THAN 50% BARS SHALL BE LAPPED AT ONE SECTION. THE DISTANCE BETWEEN TWO LAPS SHALL BE MORE THAN 1.5 TIMES THE LAP LENGTH.
5. 50mm DIA. PVC PIPE AS WEEP HOLES ARE TO BE PROVIDED IN PLATFORM/TOE WALL @1000mm C/C HORIZONTALLY AND VERTICALLY STAGGERED. MINIMUM 50mm DISTANCE BETWEEN PIPE FACE & ALL STEEL MUST BE MAINTAINED.
6. THE BACK FILL IS TO BE PROVIDED CONFORMING TO CLAUSE 7.5 OF IRS SUB-STRUCTURE CODE. COMPACTION OF BACKFILL SHALL BE DONE AFTER COMPACTING THE SOIL GIVING PASSIVE PRESSURE FROM TRACK SIDE.
7. CONCRETE GRADE OF PLATFORM WALL SHALL BE M:35.
8. IT SHALL BE DESIGNED FOR SEISMIC ZONE IV.
9. COPING SLAB IS NOT MONOLITHICALLY CAST WITH WALL. IT SHALL BE PRESENT ON PLATFORM WALL TOP USING 1:3 CEMENT-SAND MORTAR COPING SHALL BE KEPT AFTER THE COMPACTION OF BACKFILL.
10. SIZE & REINFORCEMENT SHOWN IN DRAWING IS TENTATIVE AND DETAILED DESIGN SHALL TAKE CARE OF THE REQUIREMENT OF SEISMIC ZONE IV.
11. 25MM EXPANSION GAP SHALL BE PROVIDED AFTER EVERY 25m LENGTH.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	R. R. KUMAR GM/ IP&P	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
REETU PATIAL CDE/ CIVIL			

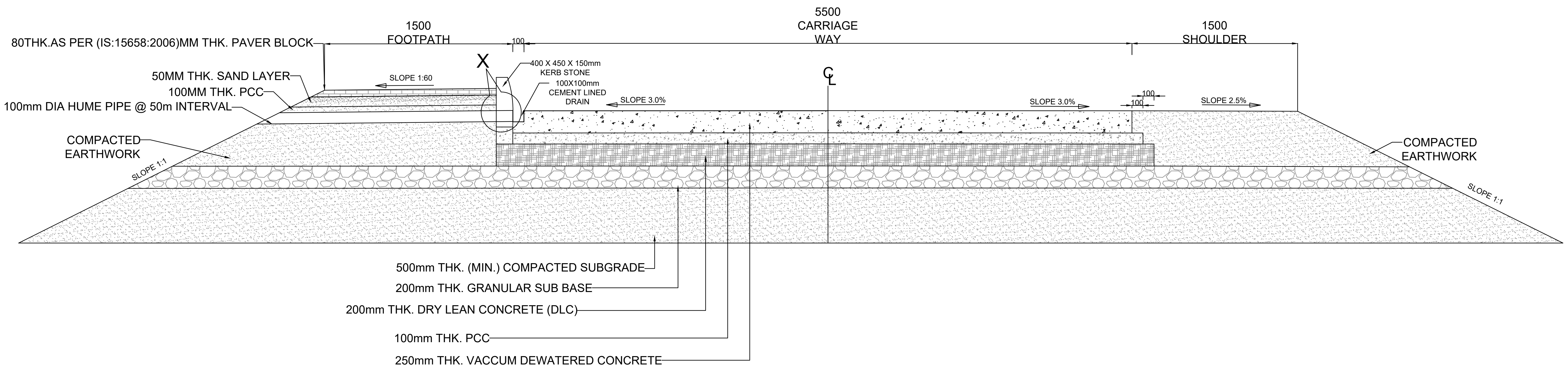
TITLE:- CONCEPTUAL SKETCH FOR RCC PLATFORM WALL

DRG. NO. GC-HRIDC-SK-GEN-024

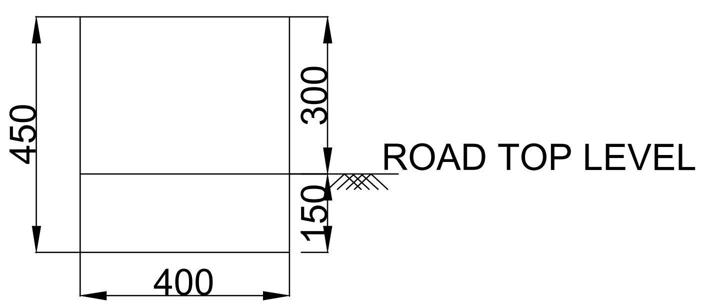
SHEET NO. 1 OF 1

SCALE : AS SHOWN

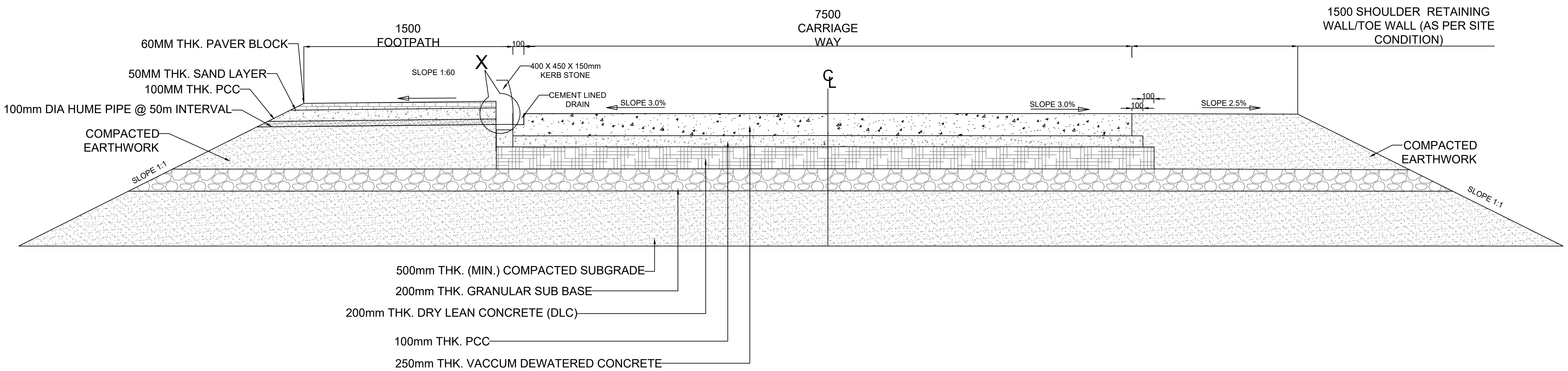
ISSUE DATE 28.12.2022



TYPICAL CROSS-SECTION OF SINGLE LANE ROAD



DETAIL OF X



TYPICAL CROSS-SECTION OF DOUBLE LANE ROAD

NOTES:
1. ALL DIMENSION ARE IN MILLIMETERS EXPECT LEVELS WHICH ARE IN METERS. NO DIMENSION SHALL BE SCALED FROM DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
2. ROAD SHALL BE CONSTRUCTED AS PER MORTH STANDARDS.
3. LAYING OF PAVE BLOCK SHALL BE AS PER IRC PROVISION.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		R. R. KUMAR GM/ IP&P	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
REETU PATIAL CDE/ CIVIL			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

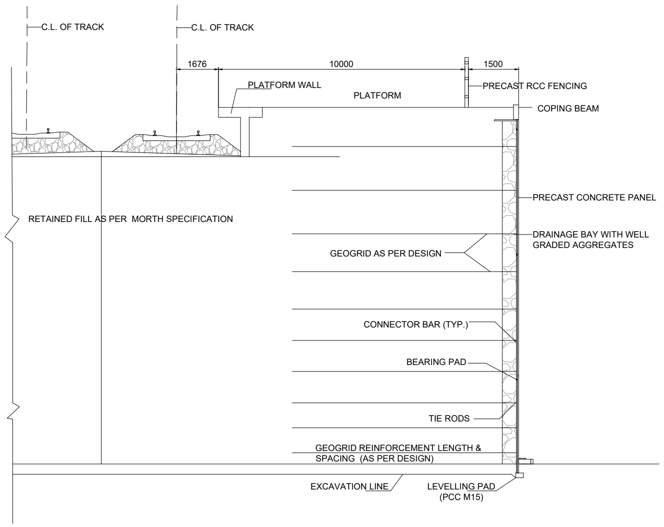
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

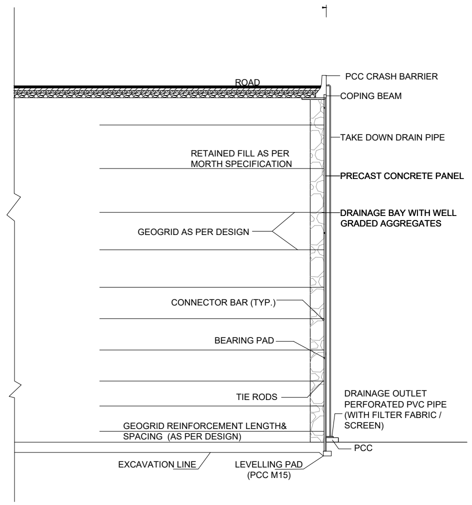
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL SKETCH FOR SINGLE & DOUBLE LANE ROAD

DRG. NO.	GC-HRIDC-SK-GEN-025	SHEET NO. 1 OF 1
SCALE : AS SHOWN		ISSUE DATE 28.12.2022



TYPICAL CROSS SECTION OF REINFORCED EARTH WALL WITH GEOGRID REINFORCEMENT AND PRECAST PANEL FACING FOR RAIL PLATFROM



TYPICAL CROSS SECTION OF REINFORCED EARTH WALL WITH GEOGRID REINFORCEMENT AND PRECAST PANEL FACING FOR ROAD

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT STATED OTHERWISE.
2. DO NOT SCALE THE DRAWING FOLLOW ONLY WRITTEN DIMENSIONS.
3. DESIGNS, DETAILING OF RE WALL SHALL BE AS PER MORTH SPECIFICATION.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

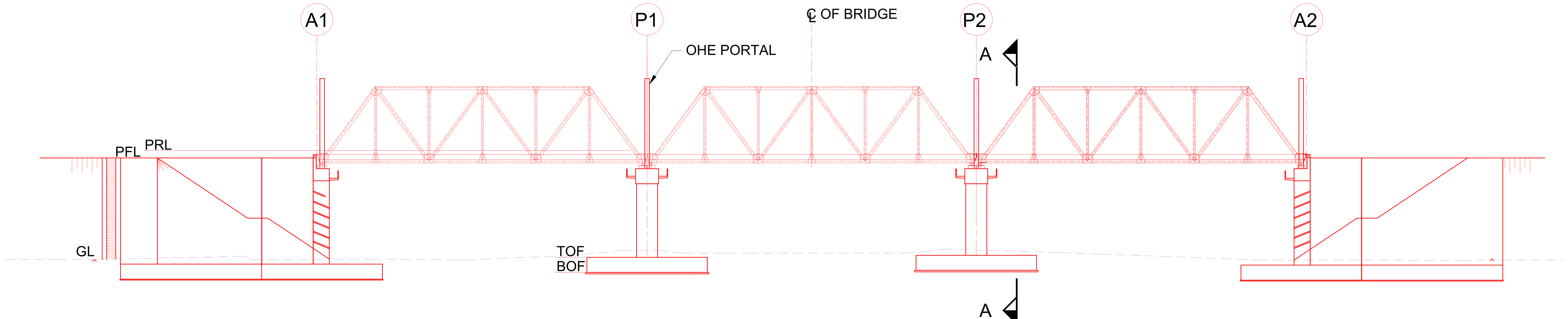
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES
THE INFRASTRUCTURE PEOPLE
SMEC

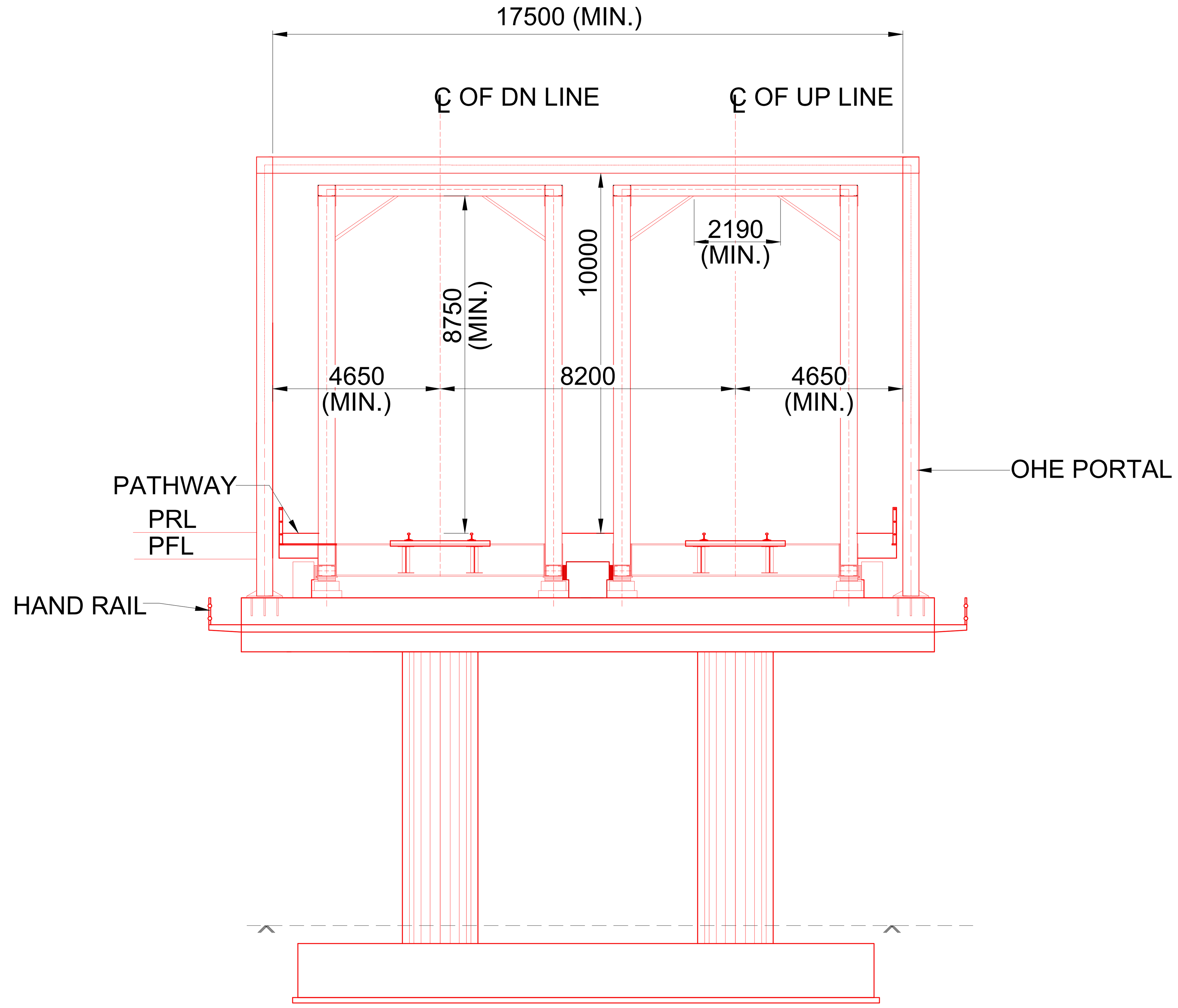
GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		R. R. KUMAR GM/ IP&P	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
REETU PATIAL CDE/ CIVIL			

TITLE:- CONCEPTUAL SKETCH FOR REINFORCED EARTH WALL WITH GEOGRID REINFORCEMENT

DRG. NO.	GC-HRIDC-SK-GEN-026	SHEET NO. 1 OF 1
SCALE : AS SHOWN	ISSUE DATE 28.12.2022	



SECTIONAL ELEVATION



SECTION A-A

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. EARTHING ARRANGEMENT SHALL BE MADE AT EACH OHE MAST LOCATION AS PER SKETCH NO. GC-HRIDC-C5-SK-GEN-38.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL PLAN
OHE PORTAL FOR OWG GIRDER

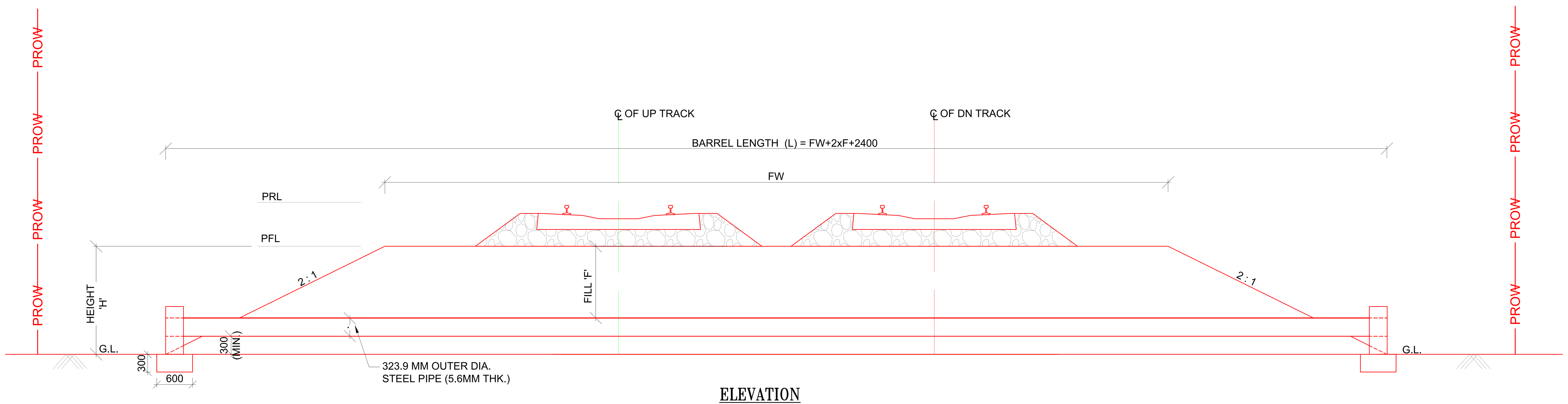
GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		VIKRAM YADAV GM/ A&IE/HRIDC	
A.S JANGHU CRE/ELECT.		JYOTI SANGWAN DGM/Elect.	Jyoti Sangwan
REETU PATIAL CDE/ CIVIL			

DRG. NO.	SHEET NO.
GC-HRIDC-SK-GEN-035	1 OF 1

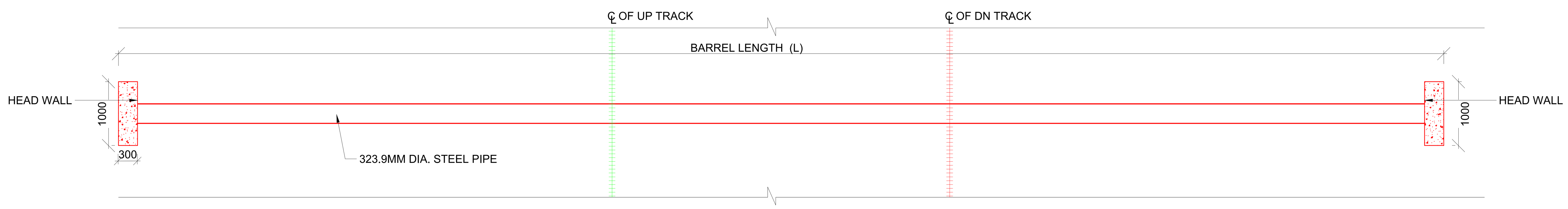
SCALE :	ISSUE DATE
AS SHOWN	09.09.2023

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
2. A MIN. CUSHION BELOW BOTTOM OF SLEEPER OF 600MM SHALL BE ENSURED FOR CASING PIPE.
3. THE PIPE SHOULD BE OF MILD STEEL FABRICATED AS PER IS: 3589 FROM STEEL PLATES CONFORMING TO IS : 2062.
4. PIPE SHALL BE LAID UNDER RAILWAY TRACK AS PER RDSO REPORT NO. BS-105.
5. JOINTING OF TWO PIPES SHALL BE DONE AS PER CLAUSE 17 OF IS : 3589.



ELEVATION
(SCALE 1:50)



PLAN
(SCALE 1:50)

LEGEND

PFL	FORMATION LEVEL
PRL	RAIL LEVEL
GL	GROUND LEVEL
FW	FORMATION WIDTH

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

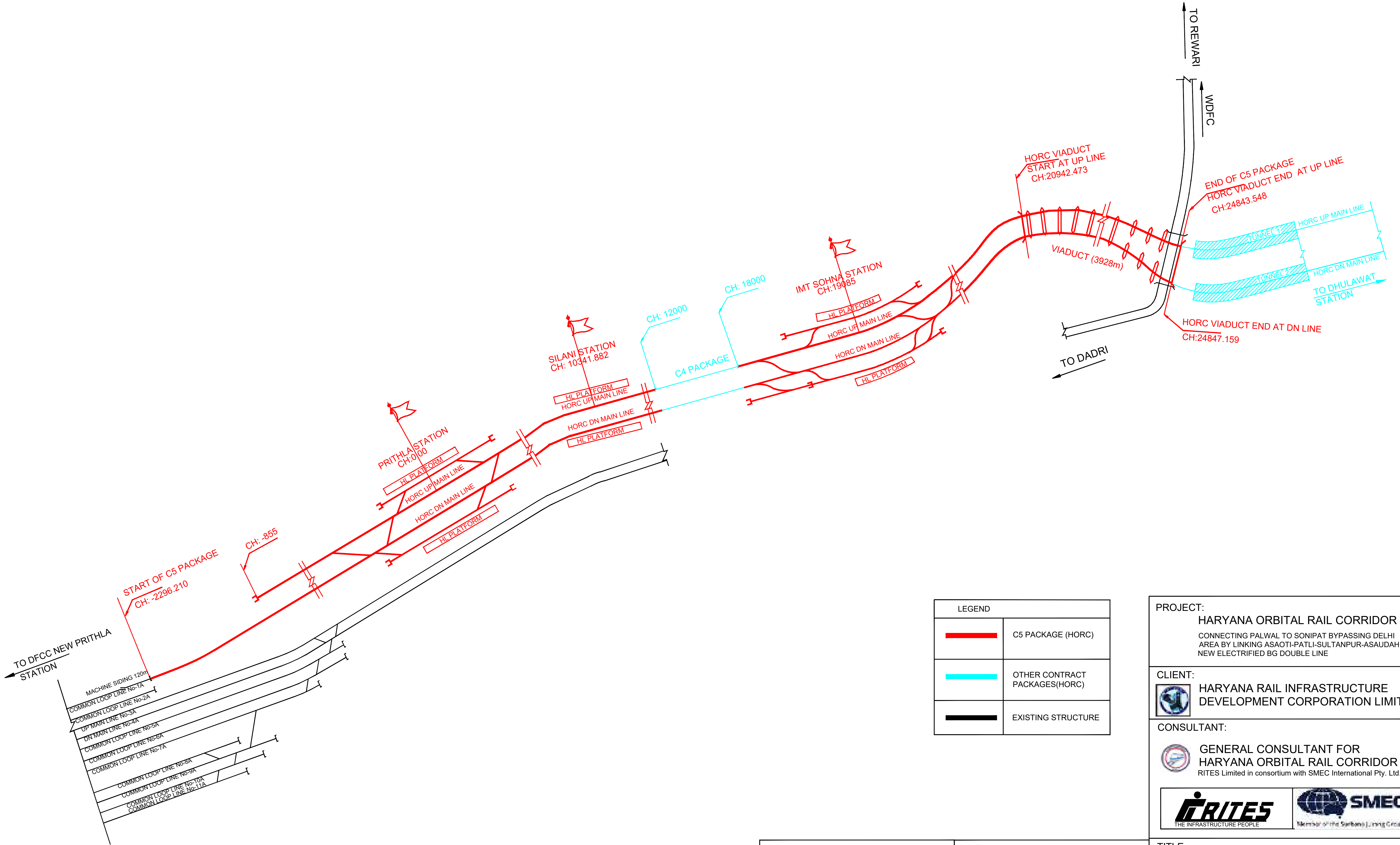
RITES THE INFRASTRUCTURE PEOPLE | SMEC Member of the Surbana Jurong Group

TITLE:-

CONCEPTUAL PLAN FOR MILD STEEL PIPE 323.9MM OUTER DIA FOR FUTURE UTILITIES

DRG. NO.	SHEET NO.
GC-HRIDC-SK-GEN-30	1 OF1

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	10-10-2023	



LEGEND	
(red line)	C5 PACKAGE (HORC)
(cyan line)	OTHER CONTRACT PACKAGES(HORC)
(black line)	EXISTING STRUCTURE

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/HRIDC	(signed)
SUDHIR AGRAWAL DPD/CIVIL	(signed)	RAJU SOLANKI DGM/CIVIL/SOUTH	(signed)
REETU PATIAL CDE/ CIVIL	Reetu		

TITLE:- JURISDICTIONAL SKETCH OF C-5 PACKAGE

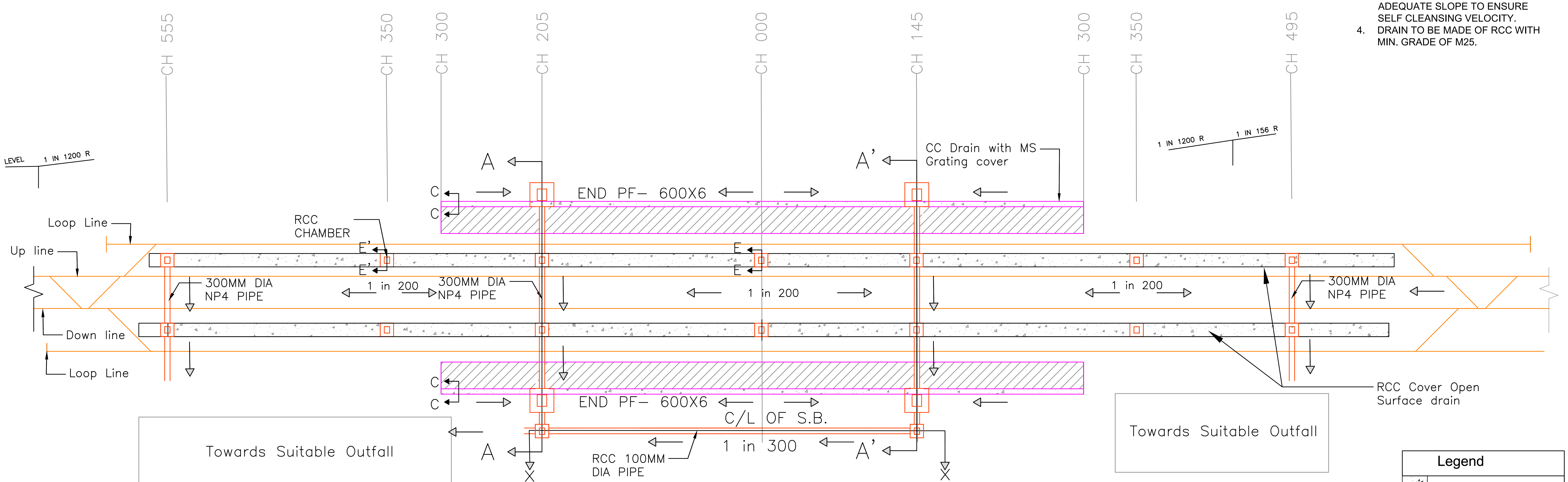
SKETCH NO.		SHEET NO.
GC-HRIDC-C5-SK-CIVIL-001_A0		
SCALE :	ISSUE DATE	REVISED DATE
NTS	09.09.2023	

NOTES:

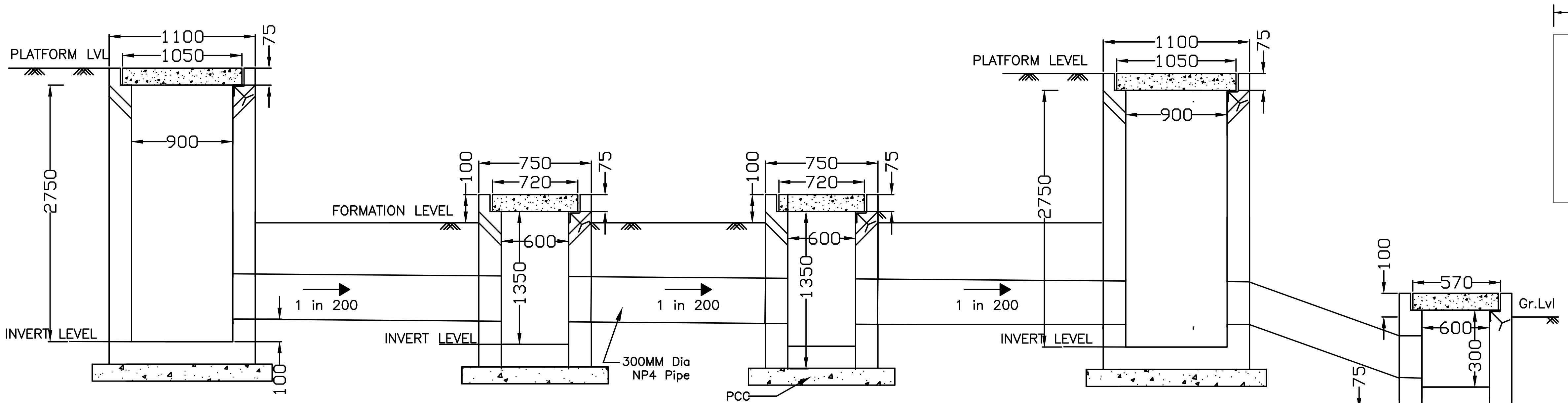
- JURISDICTION OF C5 PACKAGE SHOWN IN RED COLOUR.
- CHAINAGES SHOWN ARE RECKONED FROM C/L OF PRITHLA STATION TAKEN AS 0.00m, WITH RESPECT TO UP MAIN LINE.
- ALL CHAINAGES ARE MARKED IN METER. NO DIMENSION SHALL BE SCALED FROM THE DRAWING, ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.

DRAINAGE PLAN OF PRITHALA STATION

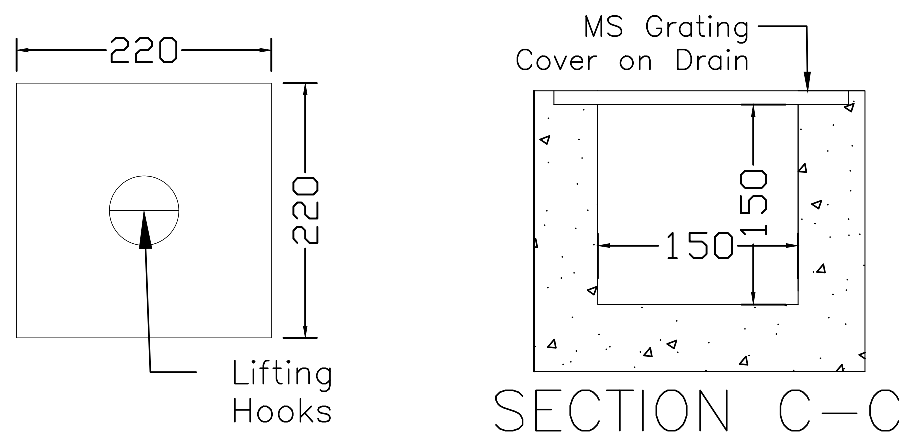
NOTE:-
1. ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. PRECAST RCC COVER TO BE PROVIDED AS PER DRAWING.
3. DRAIN TO BE PROVIDED WITH ADEQUATE SLOPE TO ENSURE SELF CLEANSING VELOCITY.
4. DRAIN TO BE MADE OF RCC WITH MIN. GRADE OF M25.



YARD AND PLATFORM DRAINAGE PLAN



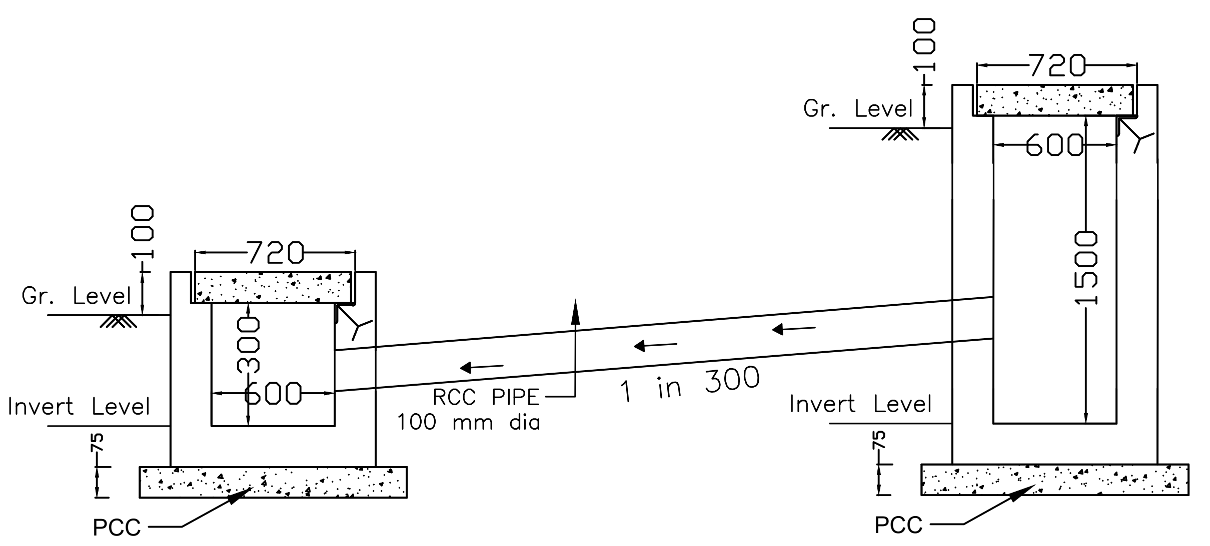
SECTION- A-A, A'-A',



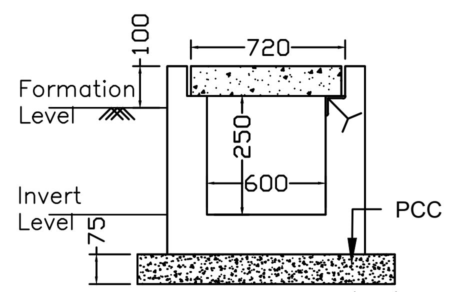
SECTION C-C

Platform Drain

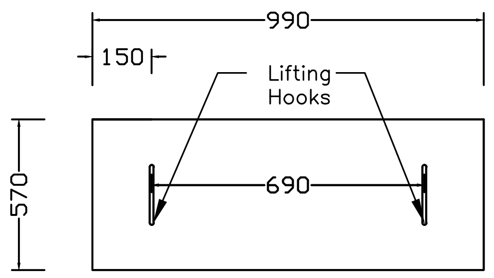
CHAINAGE	0	205	145
FR.	0	-171	131
DRAIN SLOPE	LEVEL	RISE 1 IN 200	FALL 1 IN 200
MIN DEPTH	-250	-250	-250
DEPTH DUE TO SLOPE	0	1025	725
TOTAL DEPTH	[illegible]	[illegible]	[illegible]



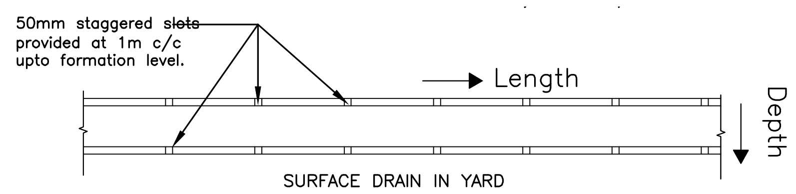
SECTION- X-X



SECTION- E-E, E'-E'



TYP. RCC drain cover with lifting arrangement



SURFACE DRAIN IN YARD

Legend

	RCC YARD DRAIN WITH COVER
	PLATFORM AREA
	PF DRAIN WITH MS GRATING
	RCC CHAMBER

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/ SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
REETU PATIAL CDE/CIVIL			

TITLE:- CONCEPTUAL PLAN DRAINAGE ARRANGEMENT (PRITHLA)

DRG. NO. GC-HRIDC-C5-SK-CIVIL-002-A1

SHEET NO. 1 OF 1

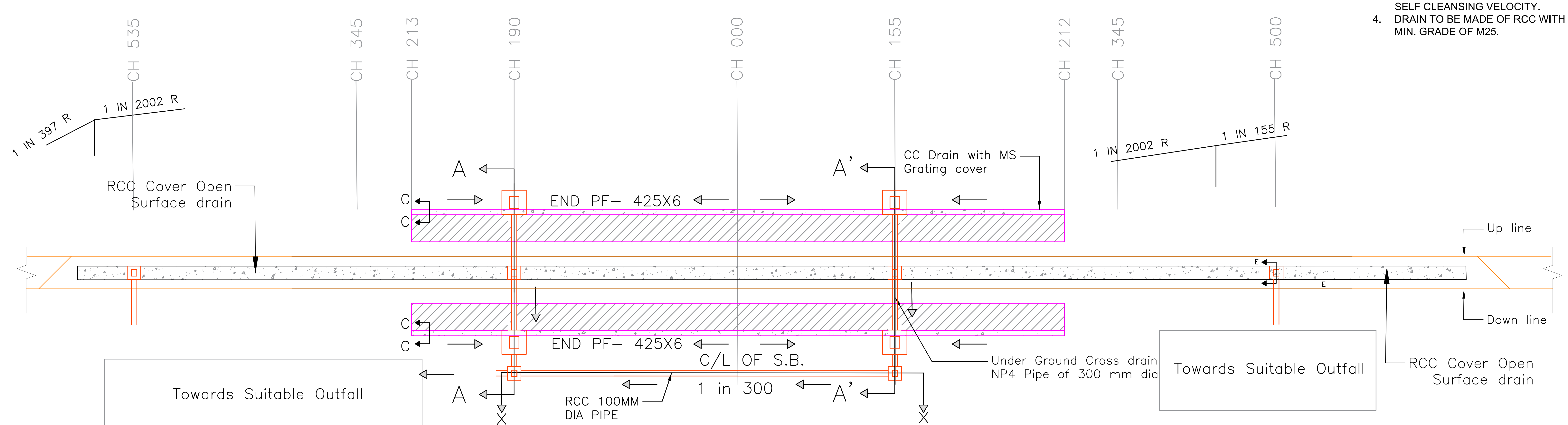
SCALE : AS SHOWN

ISSUE DATE 14-09-2023

REVISED DATE

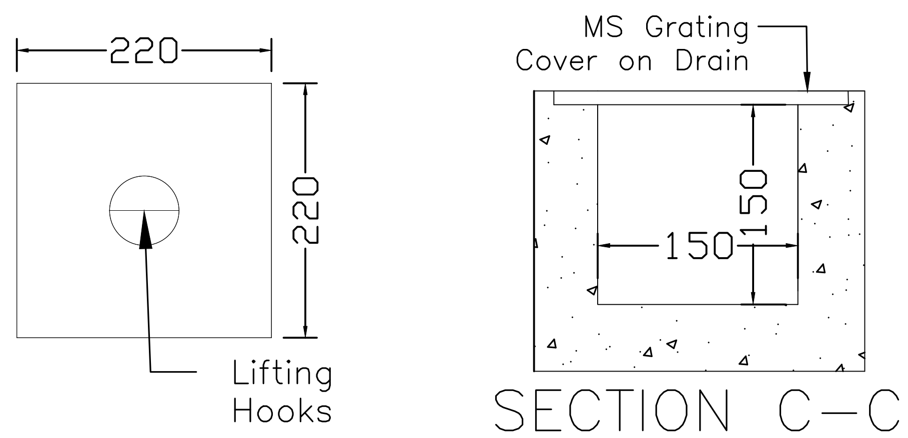
DRAINAGE PLAN OF SILANI STATION

NOTE:-
1. ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. PRECAST RCC COVER TO BE PROVIDED AS PER DRAWING.
3. DRAIN TO BE PROVIDED WITH ADEQUATE SLOPE TO ENSURE SELF CLEANSING VELOCITY.
4. DRAIN TO BE MADE OF RCC WITH MIN. GRADE OF M25.



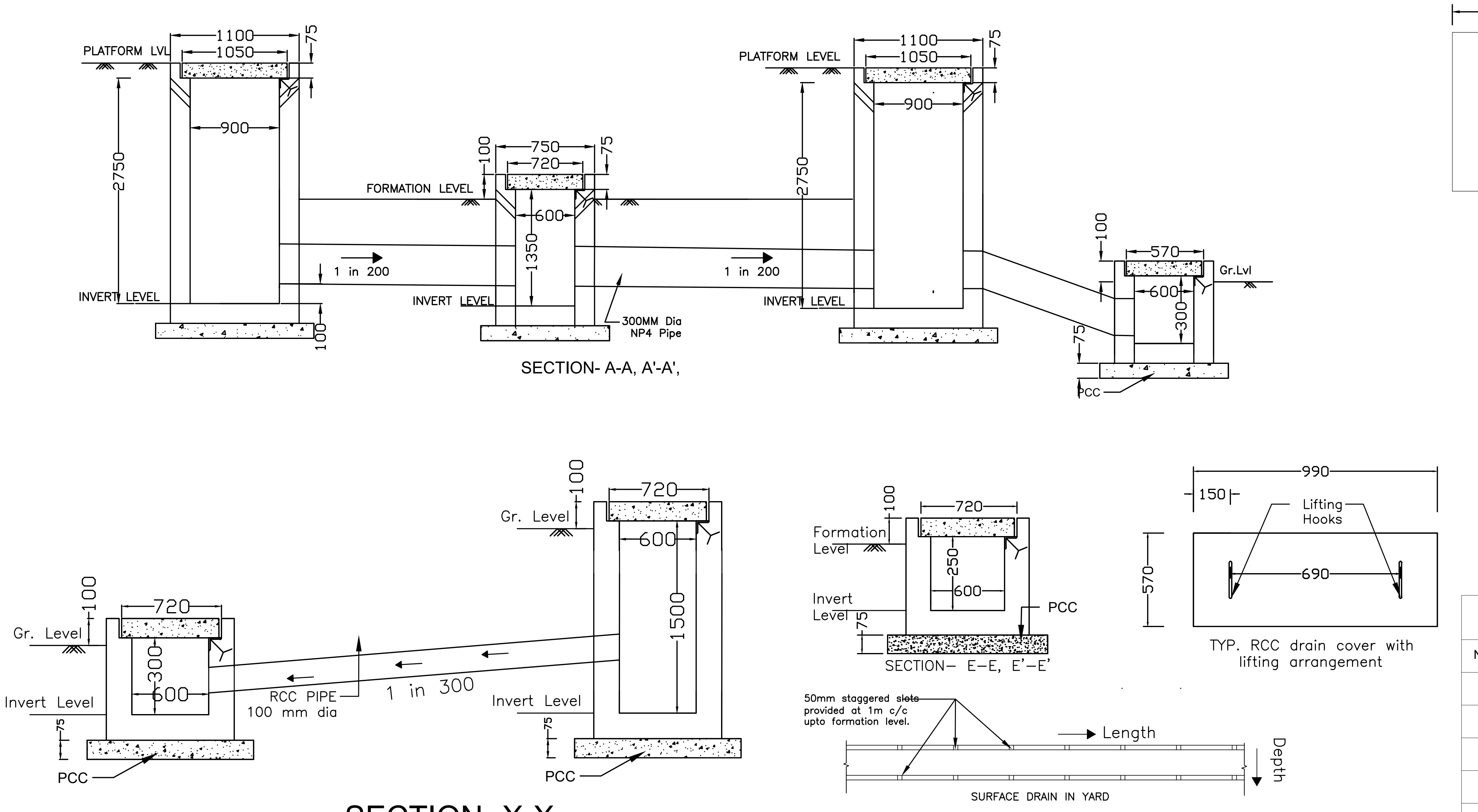
YARD AND PLATFORM DRAINAGE PLAN

Legend	
	RCC YARD DRAIN WITH COVER
	PLATFORM AREA
	PF DRAIN WITH MS GRATING
	RCC CHAMBER



SECTION C–C

Platform Drain



SECTION- X-X

CHAINAGE	0	-190	155
FRL	0	-95	77
DRAIN SLOPE	LEVEL	RISE 1 IN 200	FALL 1 IN 200
FIX DEPTH	-250	-250	-250
DEPTH DUE TO SLOPE	0	-950	-775
TOTAL DEPTH	-250.000	-1105.095	-1102.423

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/ SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
REETU PATIAL CDE/CIVIL			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

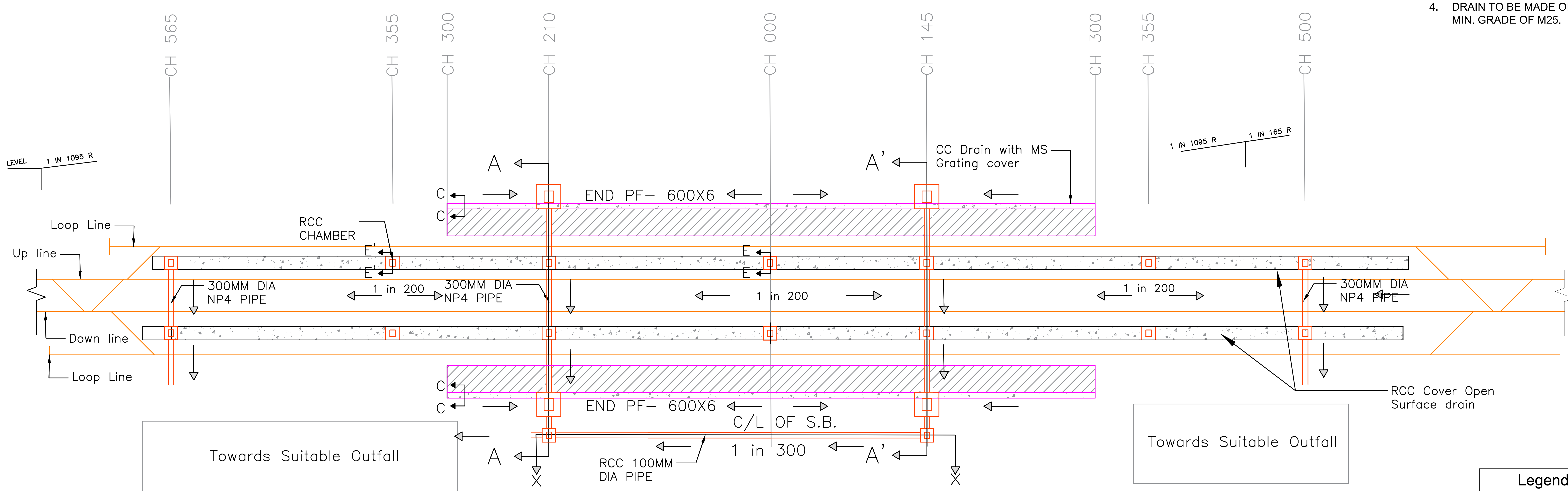
RITES THE INFRASTRUCTURE PEOPLE | SMEC Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL PLAN DRAINAGE ARRANGEMENT (SILANI)

DRG. NO.		SHEET NO.
GC-HRIDC-C5-SK-CIVIL-003-A1		1 OF 1
SCALE : AS SHOWN	ISSUE DATE 14-09-2023	REVISED DATE

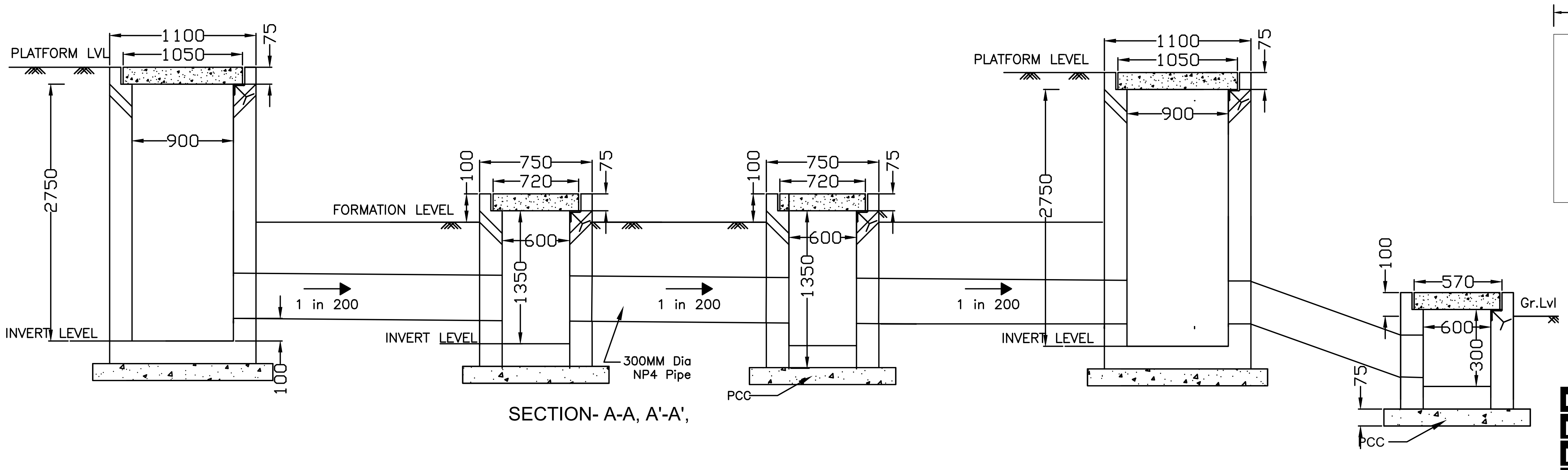
DRAINAGE PLAN OF IMT SOHNA STATION

NOTE:-
1. ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. PRECAST RCC COVER TO BE PROVIDED AS PER DRAWING.
3. DRAIN TO BE PROVIDED WITH ADEQUATE SLOPE TO ENSURE SELF CLEANSING VELOCITY.
4. DRAIN TO BE MADE OF RCC WITH MIN. GRADE OF M25.

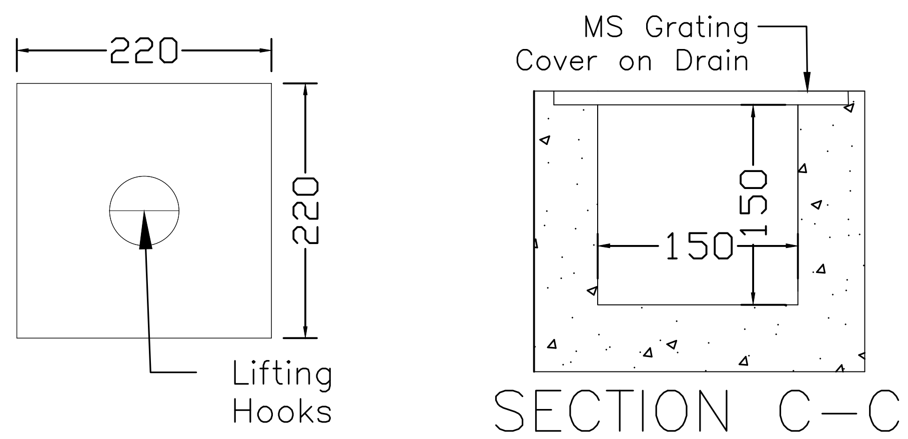


YARD AND PLATFORM DRAINAGE PLAN

Legend	
	RCC YARD DRAIN WITH COVER
	PLATFORM AREA
	PF DRAIN WITH MS GRATING
	RCC CHAMBER



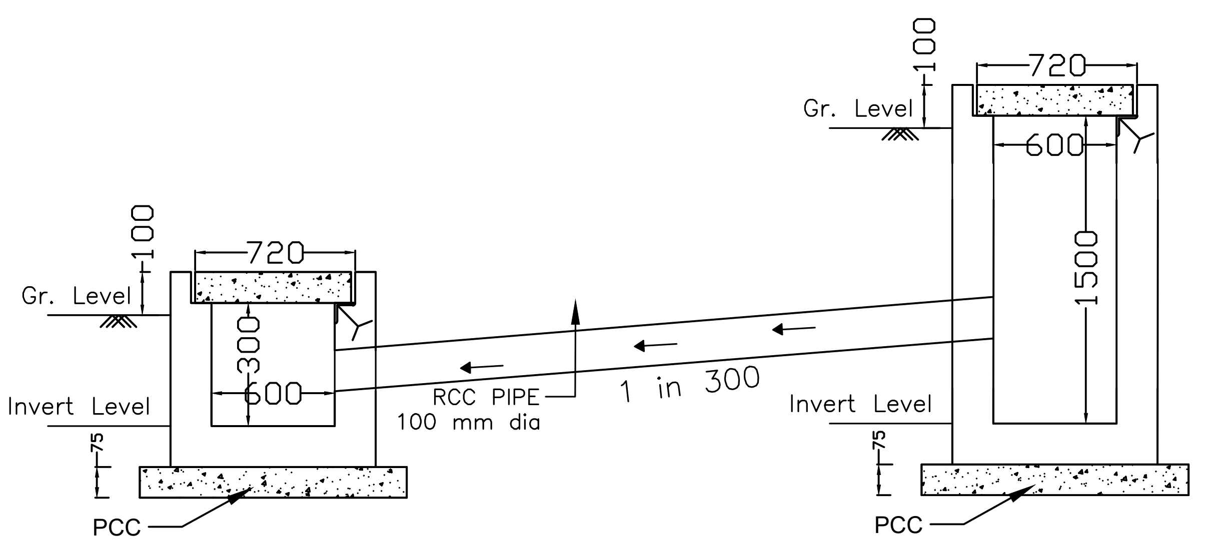
SECTION- A-A, A'-A',



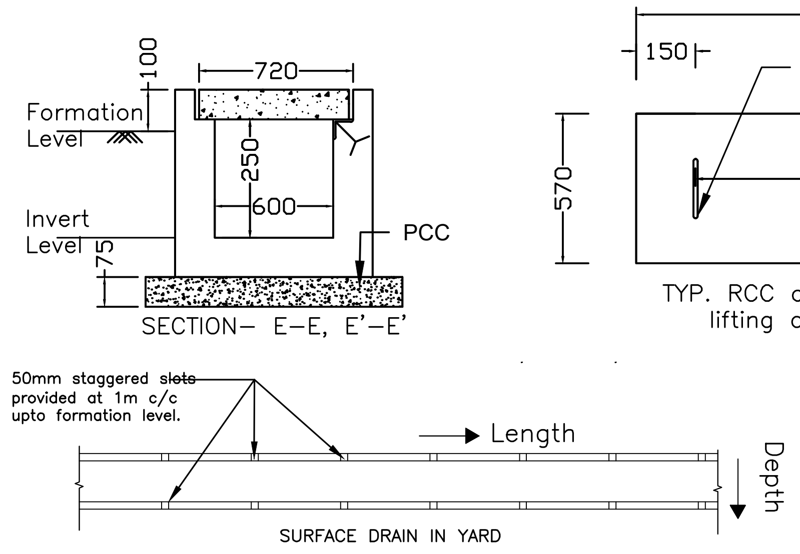
SECTION C–C

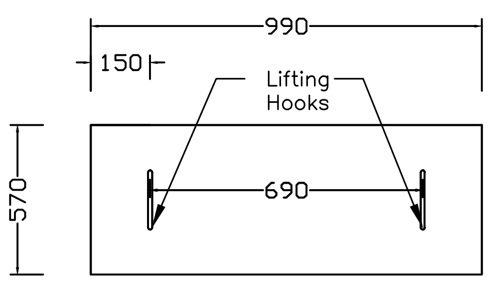
Platform Drain

CHAINAGE	0	-210	145
FRL	0	-192	132
DRAIN SLOPE	LEVEL	RISE 1 IN 200	FALL 1 IN 200
FIX DEPTH	-250	-250	-250
DEPTH DUE TO SLOPE	0	1050	725
TOTAL DEPTH	-250.000	-1108.219	-1107.420



SECTION- X-X





TYP. RCC drain cover with lifting arrangement

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/ SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
REETU PATIAL CDE/CIVIL	Reetu		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

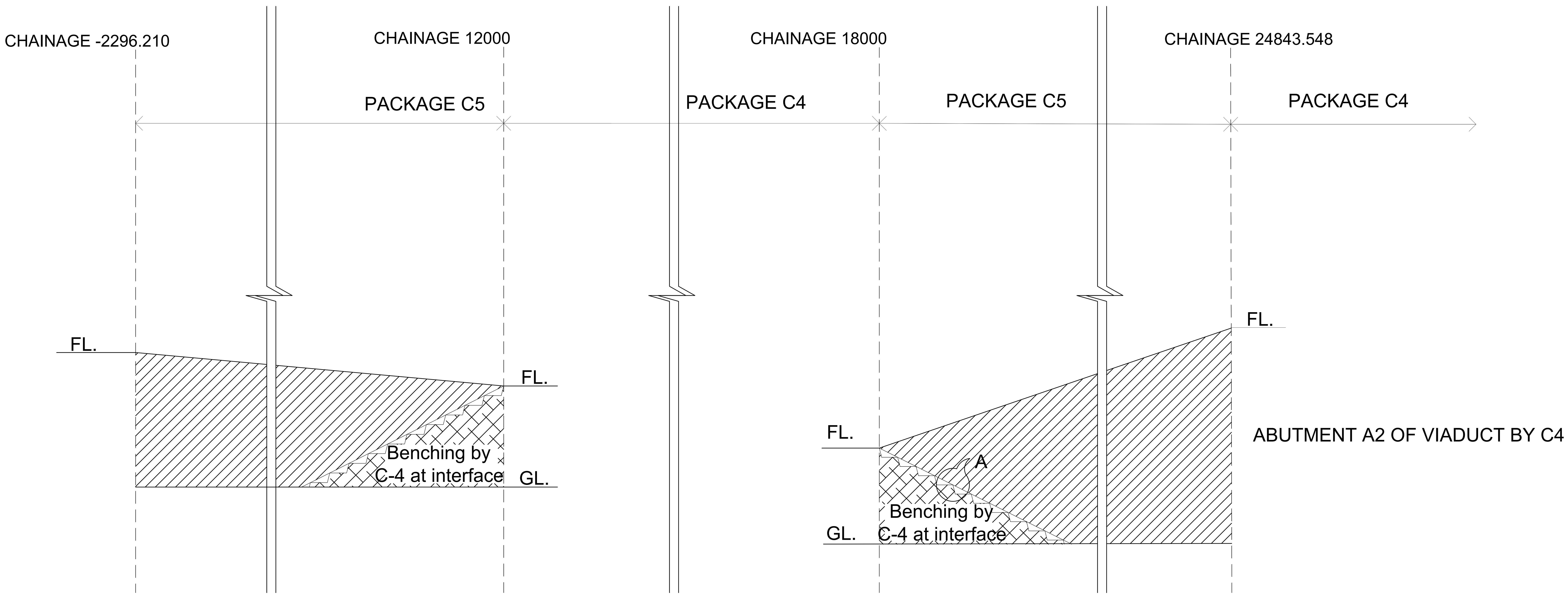
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

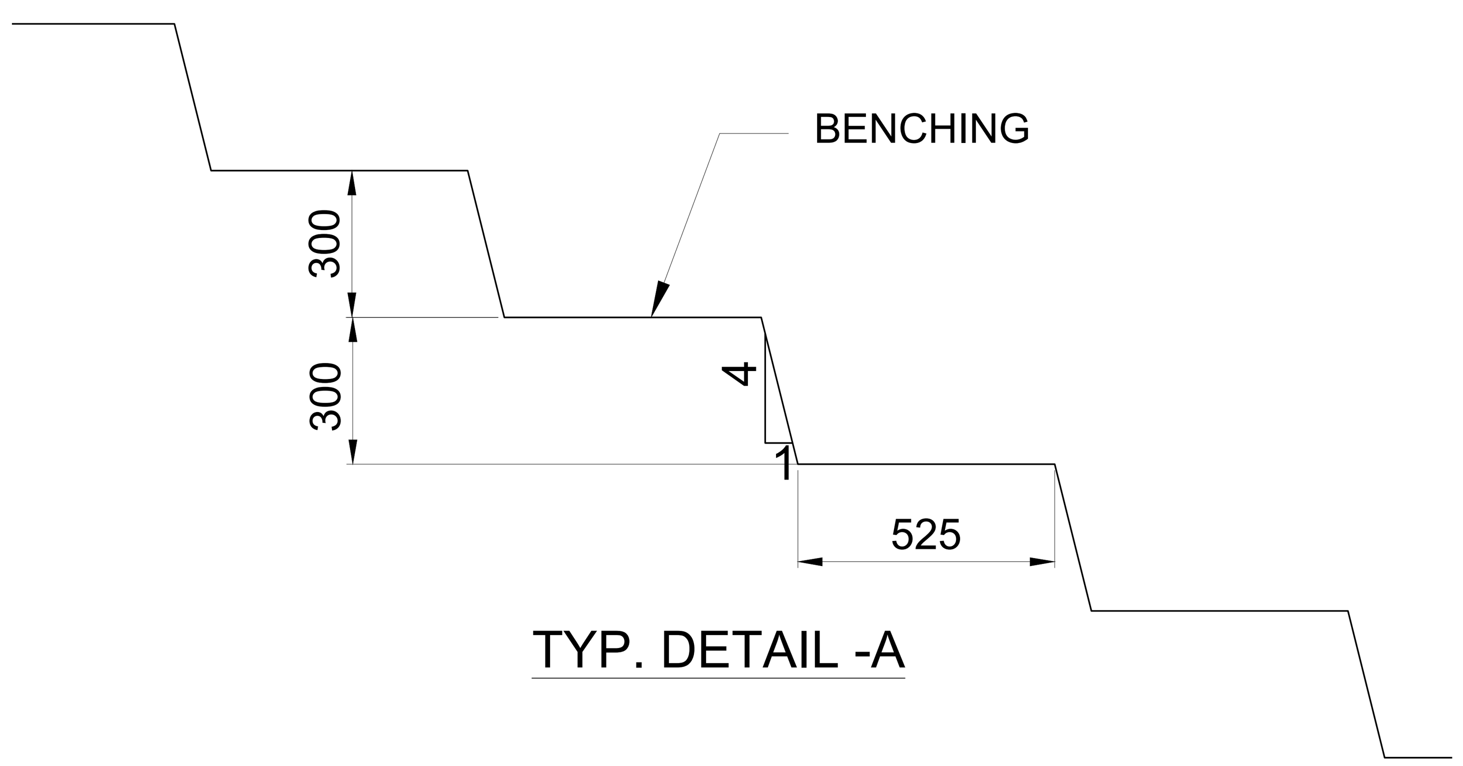
THE INFRASTRUCTURE PEOPLE
Member of the Surbana Jurong Group

TITLE:- CONCEPTUAL PLAN
DRAINAGE ARRANGEMENT (IMT SOHNA)

DRG. NO.	SHEET NO.
GC-HRIDC-C5-SK-CIVIL-004-A1	1 OF 1

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	14-09-2023	





TYP. DETAIL -A

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. FOR OTHER DETAILS REFER RDSO SPECIFICATION NO. RDSO/2020/GE:IRS-004 SEPTEMBER 2020 "COMPREHENSIVE GUIDELINES AND SPECIFICATIONS FOR RAILWAY FORMATION".
3. DETAILS OF HATCHED AS BELOW-
   - AREA IS IN THE SCOPE OF C5
   - AREA IS NOT IN THE SCOPE OF C5

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL	
REETU PATIAL CDE/ CIVIL			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:-
CONCEPTUAL PLAN BANK/CUTTING BENCHING AT INTERFACE LOCATION

DRG. NO.		SHEET NO.
GC-HRIDC-C5-SK-CIVIL-009_A0		
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	09.09.2023	

Northern Railway

Headquarters Office,
Baroda House,
New Delhi.

No. SD/TP/2021

Date: 22/11/2021

C.A.O./Const.
Northern Railway,
Kashmere Gate, Delhi.

C.A.O.-II/Const.,
Northern Railway,
Kashmere Gate, Delhi.

C.A.O./C/USBRL,
Northern Railway,
Jammu Tawi.

Divisional Railway Manager,
Northern Railway,
DLI, FZR, LKO, MB & UMB.

Sr. Divisional Engineer/Co-ord.,
Northern Railway,
DLI, FZR, LKO, MB & UMB.

Type Plan No. O-104/2021

Sub: Standard Type Plan of "Powder Toilet for Divyangjans"

In spite of the enabling policies and guidelines at national and state level regarding divyang toilet, there have been challenges faced by implementers and service providers because of lack of skills to deal with Divyang toilet due to in-adequate information.

In order to satiate the desire of Divyang Toilet, a Type Plan No. P-45/2019 (NRHQE Plan No. HQ/05/07-2019) of "Toilet & Ramp for Divyangs" has been already circulated earlier. In that, toilet enclosed both Water Closet & bathing facilities. A new Type Plan of "Powder Toilet for Divyangs" has been prepared, wherever, space is constrained. It encloses Water Closet with wash basin only. The layout plan conforms "Harmonised Guidelines and Space Standards for Barrier Free Built Environment for Person with Disability and Elderly Person (2016)" issued by MoUD, Govt. of India.

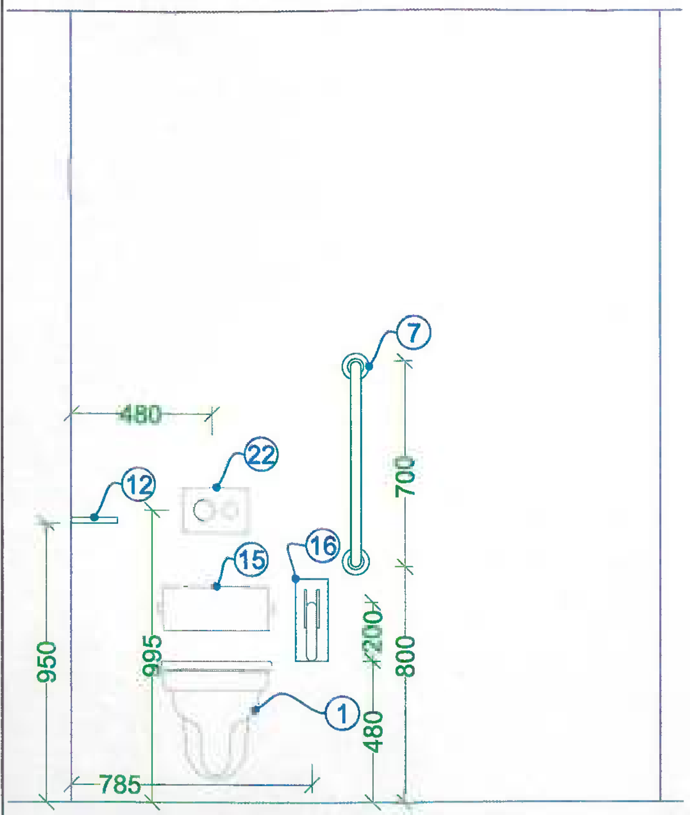
This Type Plan No. O-104/2021 (NRHQE No. HQ/20/11-2021) regarding **"Powder Toilet for Divyangs"** has been uploaded on Northern Railway website https://nr.indianrailways.gov.in/ and can be downloaded. This may be circulated to all concerned for implementation of instructions contained therein.

If any discrepancy found in above Type Plan, kindly inform this office. You may also send your comments/remarks/suggestions, if any to this office so that necessary improvements/ corrections may be incorporated.

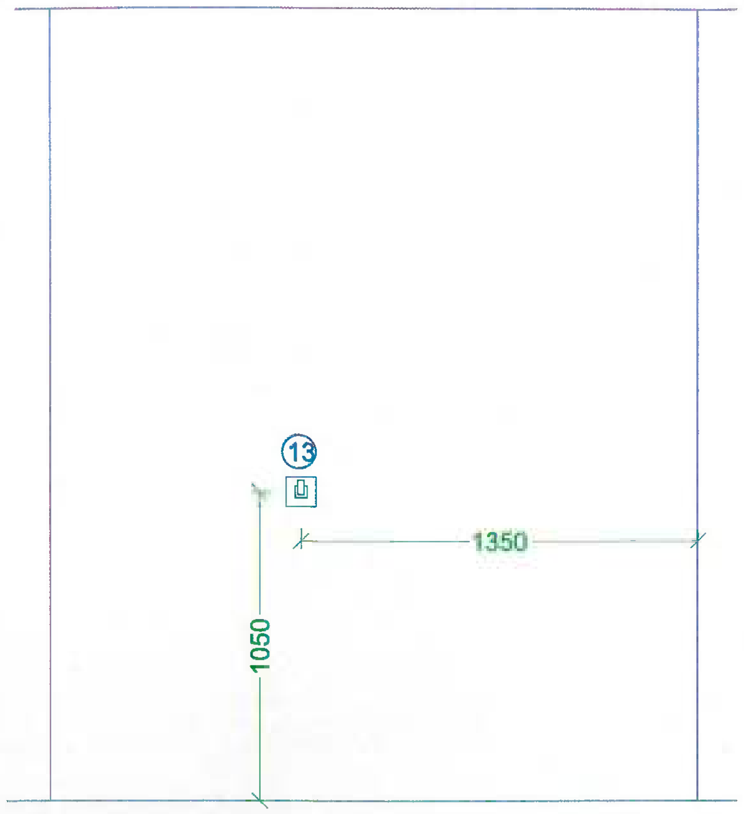
Encl. - as above

KK 22/11/21

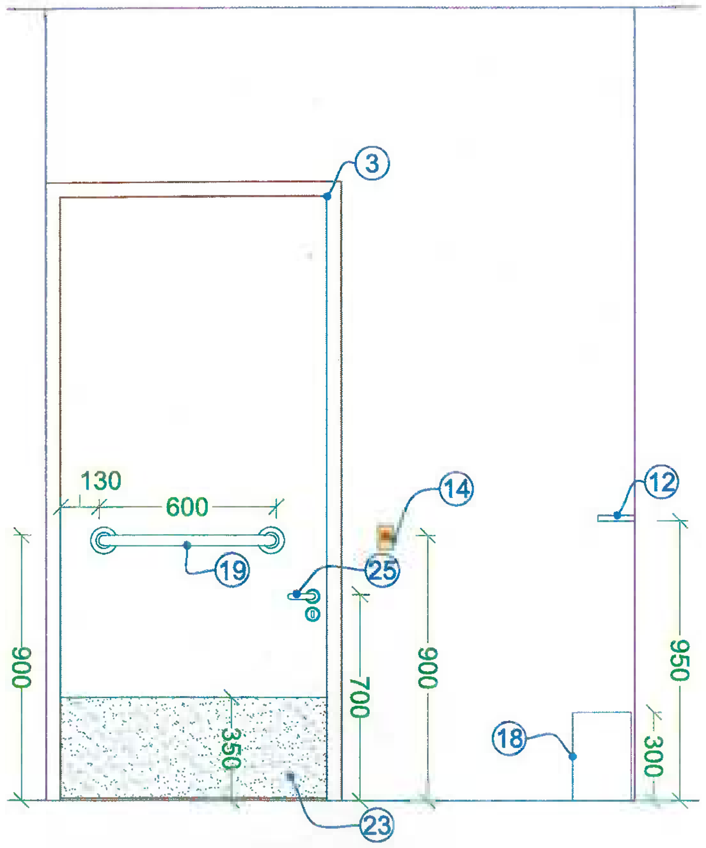
Name: (K.K. SHARMA)
Dy. Chief Engineer/ Stn.Dev.
For General Manager/Engg.



ELEVATION 'A'



ELEVATION 'B'



ELEVATION 'C'

Figure 1

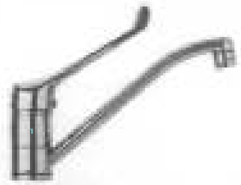
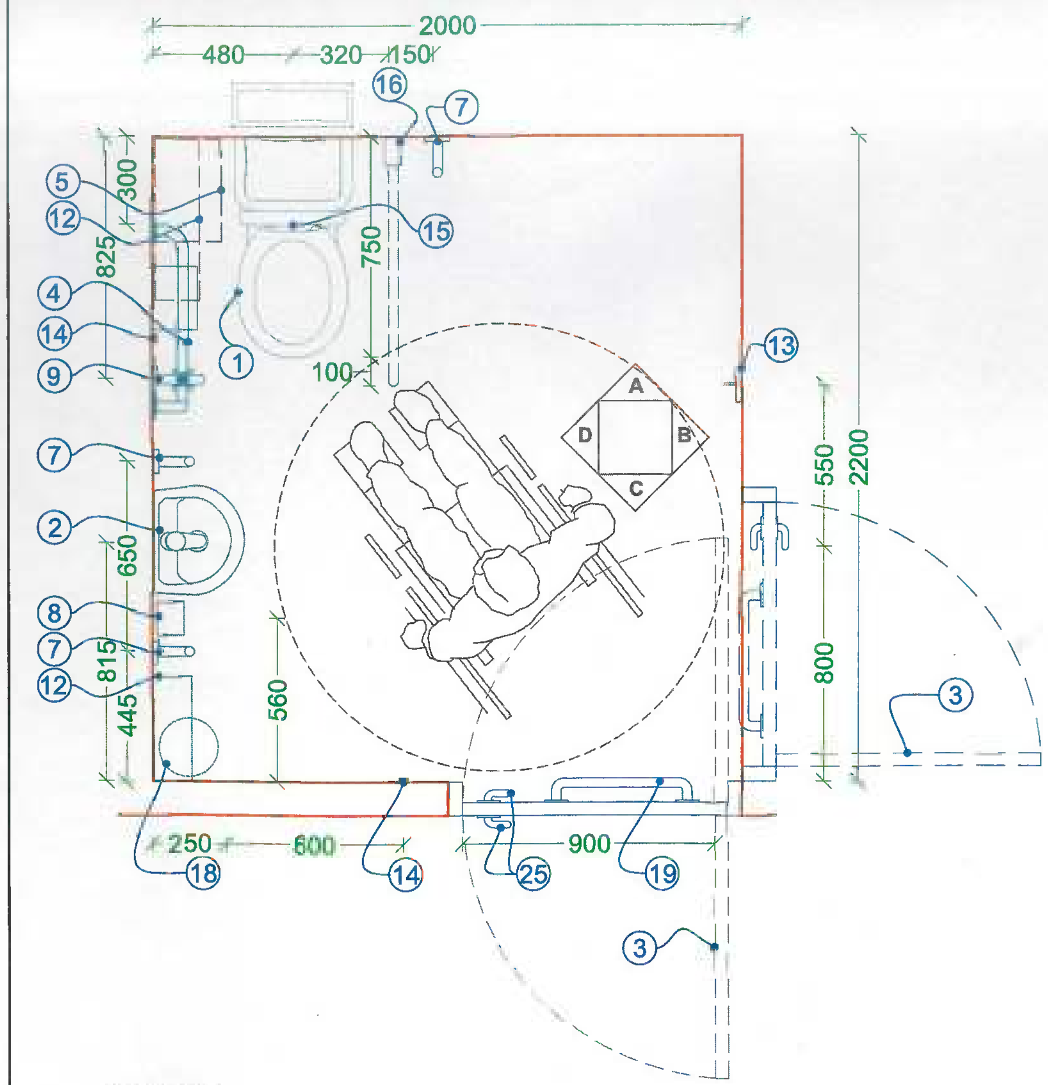
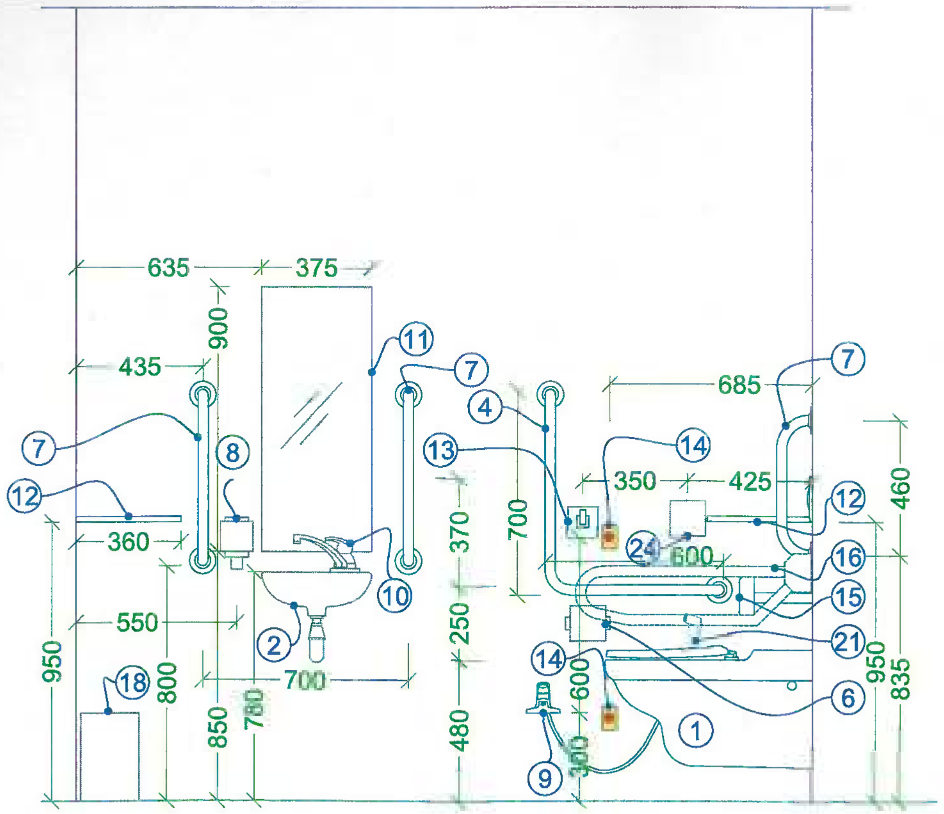


Figure 2

Figure 3



PLAN



ELEVATION 'D'

N.R.H.Q.E. PLAN NO.	: HQ/20/11-2021
TYPE PLAN NO.	: O-104/2021
CANCEL TYPE PLAN NO. :	......

NOTE:-

1. DO NOT SCALE THIS DRAWING.
2. THIS DRAWING IS TO BE READ WITH ALL RELATED INFORMATION.
3. ALL DIMENSIONS TO BE VERIFIED ON SITE BY MAIN CONTRACTOR BEFORE THE COMMENCEMENT OF ANY DRAWING OR WORK WHATSOEVER.
4. ALL DIMENSIONS ARE IN MILLIMETER UNLESS SHOWN OTHERWISE.
5. ALL GRAB RAIL SHOULD BE PROPERLY FIXED TO HANDLE THE MINIMUM LOAD OF 45 kg (100 lbs).
6. ANTI-SKID OR SLIP RESISTANT TILES SHOULD BE USED ON FLOORING.
7. MIRROR SHOULD BE TILTED AT AN ANGLE OF 30° FOR BETTER VISIBILITY OF WHEELCHAIR USER.
8. VENTILATOR (600mm x 600mm) TO BE PROVIDED ACCORDING TO SITE OPENING.
9. ACCESSIBLE TOILET SHOULD HAVE THE INTERNATIONAL SYMBOL OF ACCESSIBILITY (WITH BRAILLE SIGNAGE) DISPLAYED OUTSIDE FOR WHEELCHAIR ACCESS (Figure 1).
10. THERE SHOULD BE ADEQUATE COLOUR & TONAL CONTRAST BETWEEN THE FIXTURES, WALLS & FLOORING. THIS IS TO ENABLE EASY RECOGNITION BY PERSONS WITH VISUAL IMPAIRMENTS.
11. TOILET LEVEL SHOULD BE KEPT SAME AS LEVEL OF PLATFORM SO AS TO AVOID REQUIREMENT OF RAMP.
12. THIS DRAWING IS BASED ON RAILWAY BOARD'S LETTER NO. 2019/Stn.Dev.-I/03/06/Policy/PwDs dated 12.02.2020.

LEGENDS:-

ITEM NO.	PARTICULARS/ DESCRIPTION OF ITEM
1	WALL HUNG COMMODE
2	WASH BASIN
3	DOUBLE SWING DOOR POSITIONS
4	STAINLESS STEEL WALL MOUNTED L-SHAPE GRAB RAIL
5	STAINLESS STEEL SANITARY NAPKIN DISPOSAL
6	STAINLESS STEEL TISSUE HOLDER
7	STAINLESS STEEL VERTICAL GRAB RAIL
8	SOAP DISPENSER
9	TWO WAY BIB COCK
10	LEVER HANDLE TAP (Figure 2)
11	MIRROR
12	STAINLESS STEEL SHELF
13	SINGLE POST CLOTH HOOK
14	ALARM SWITCH
15	BACK REST (Figure 3)
16	STAINLESS STEEL DROP DOWN RAIL
17	SANITARY DISPOSAL UNIT
18	STAINLESS STEEL DISPOSAL BIN
19	STAINLESS STEEL PULL RAIL
20	ALARM RESET BUTTON
21	HAND JET SPRAY
22	FULL & HALF FLUSH BUTTON
23	KICK PLATE
24	ALARM RESET BUTTON
25	D-LEVER HANDLE

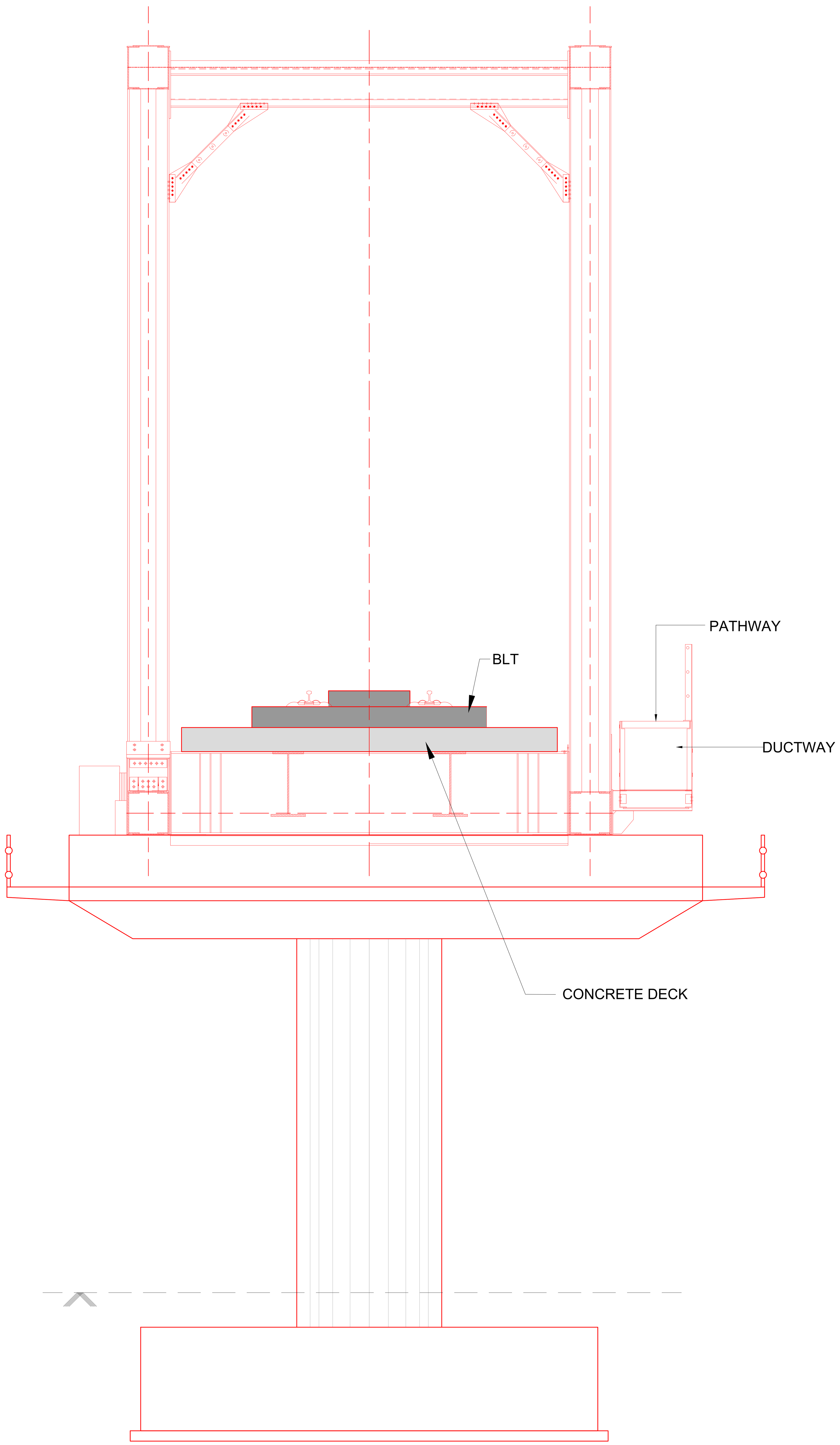
MONA SRIVASTAVA (CE/STN. DEV.)	24/11/21
K.K. SHARMA (DY.CE/STN. DEV.)	22/11/21
MOHD. SHARIF (PREPARED BY: SSE/ARCH.)	10 Nov 2021

NORTHERN RAILWAY

TYPE PLAN

POWDER TOILET FOR DIVYANGS

CASE NO. SD/TP/2021	CANCEL PLAN NO. : NIL
SCALE : 1:25@A3	SHEET NO.: 01 OF 01
N.R.H.Q.E. PLAN NO. :	HQ/20/11-2021



CROSS SECTION

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. OWG,SUPERSTRUCTURE SHALL BE DESIGN WITH CONCRETE DECK FOR BLT.
3. TROLLEY REFUGE,PATHWAY AND MAN REFUGE SHALL BE PROVIDED AS PER CBS-0045 OWG.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C SOUTH	
REETU PATIAL CDE/ CIVIL			

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

SMEC Member of the Surbana Jurong Group

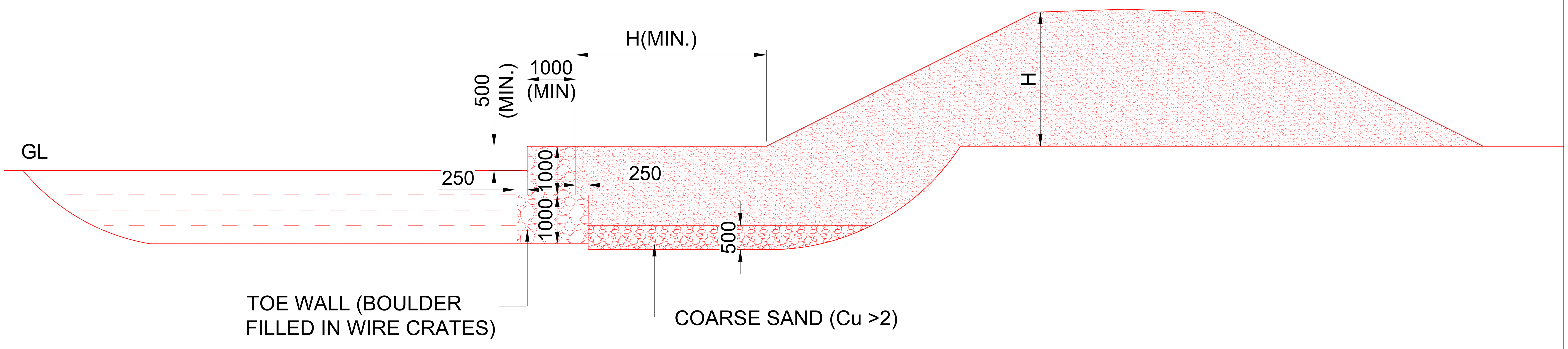
TITLE:- CONCEPTUAL PLAN

OWG WITH CONCRETE DECK FOR BLT

DRG. NO.	SHEET NO.
GC-HRIDC-SK-GEN-036	1 OF 1
SCALE :	ISSUE DATE
AS SHOWN	09.09.2023

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.



PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

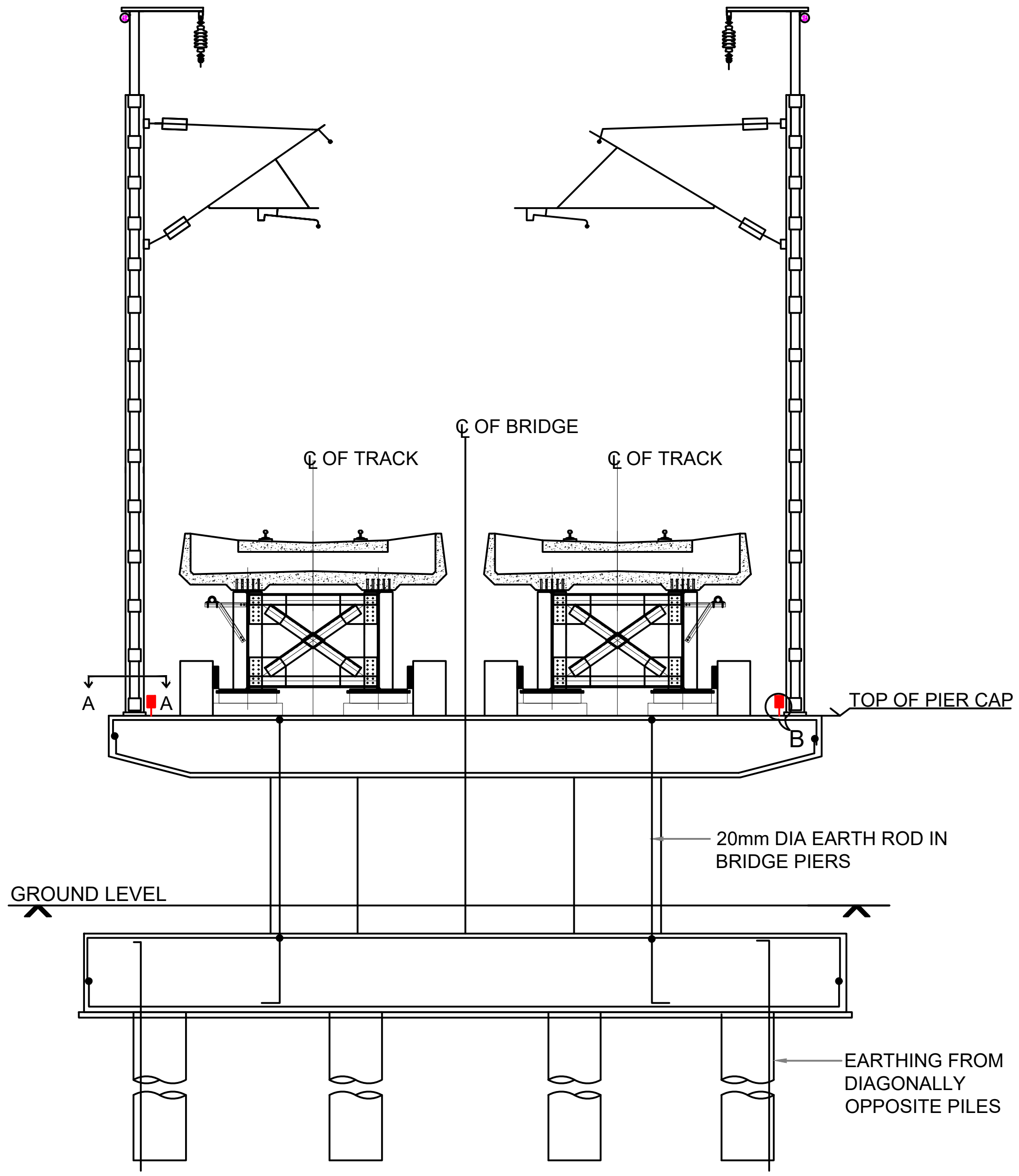
SMEC Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C SOUTH	
REETU PATIAL CDE/ CIVIL			

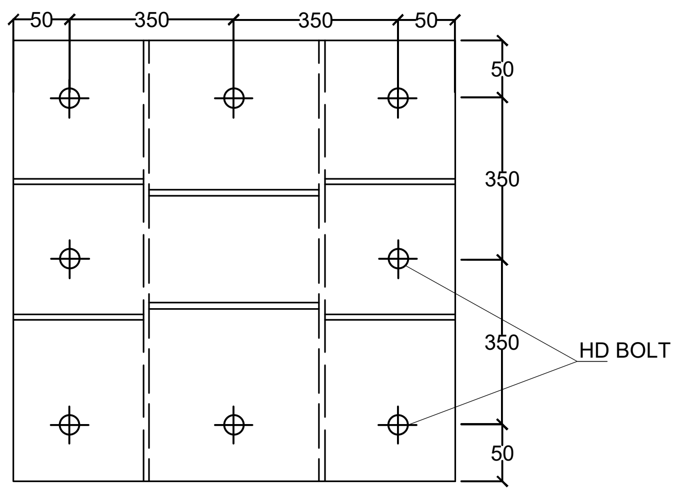
TITLE:- CONCEPTUAL PLAN

GROUND IMPROVEMENT FOR EMBANKMENT AT POND/WATER LOGED AREA

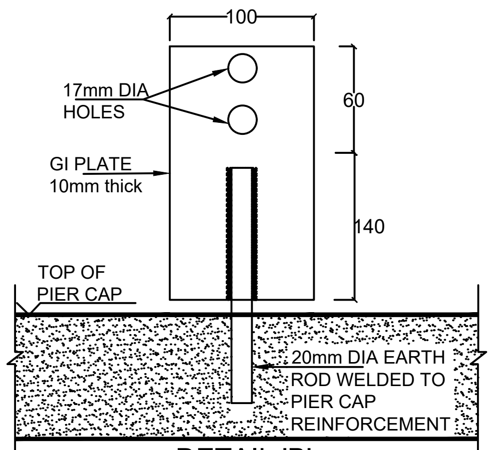
DRG. NO.	SHEET NO.
GC-HRIDC-SK-GEN-037	1 OF 1
SCALE :	**ISSUE DATE**
AS SHOWN	09.09.2023



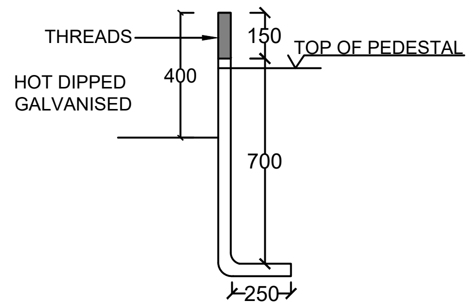
SECTION SHOWING LOCATIONS OF AEC, BEC AND THEIR INTER CONNECTIONS TO STEEL OHE MAST



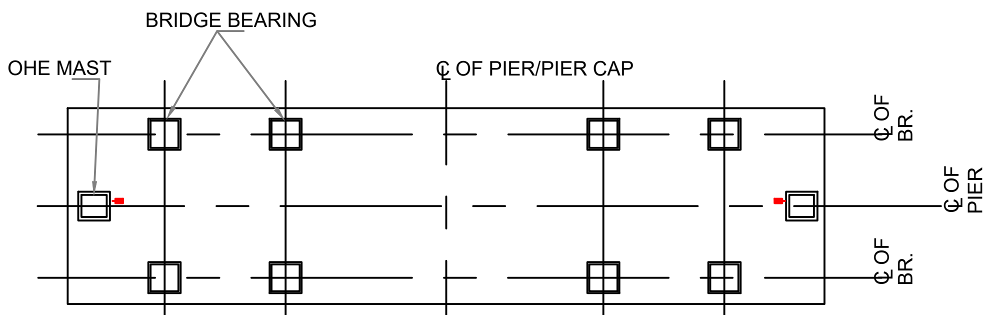
OHE STRUCTURE FIXING BOLTS AND BASE PLATE
SECTION AT A- A



DETAIL 'B'
EARTHING ARRANGEMENT



BOLT DETAIL



PLAN AT PIER CAP LEVEL WITH OHE MAST BASE

NOTES:
1. ALL DIMENSIONS ARE IN MILIMETERS.
2. DESIGN DETAILS OF TEMPLATE FOR HOLDING DOWN BOLT FOR OHE BASE PLATE AT PIER, DIA OF BOLT, LENGTH, SHAPE, MATERIAL AND LOCATION SHALL BE PROVIDED BY OHE CONTRACTOR TO CIVIL CONTRACTOR.
3. CIVIL CONTRACTOR SHALL SUPPLY HOT DIP GALVANISED HOLDING DOWN BOLTS WITH 5MM THICK TEMPLATE AND ERECT IN COORDINATION WITH OHE CONTRACTOR.
4. EARTHING GI PLATE SHALL BE PROVIDED BY CIVIL CONTRACTOR WELDED WITH 20MM DIA ROD FOR OHE EARTHING WITH PIER EARTHING.
5. GI PLATE SIZE 200X100X10MM HAVING TWO HOLES OF 17MM DIA EACH SHALL BE PROVIDED BY CIVIL CONTRACTOR.
6. 20MM DIA ROD SHALL BE 140MM OUTSIDE THE CONCRETE.
7. REINFORCEMENT OF TWO DIAGONALLY OPPOSITE PILES SHALL BE CONNECTED WITH PIER & PIER CAP BY MIN. 20MM DIA STEEL ROD FOR EARTHING.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/HRIDC	
SUDHIR AGRAWAL DPD/CIVIL		VIKRAM YADAV GM/ A&E/ HRIDC	
A.S.JANGHU CRE/ELECT.		JYOTI SANGWAN DGM/ Elect.	Jyoti Sangwan
REETU PATIAL CDE/CIVIL			
STIPHEN SAHOO SRE/Elect.			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

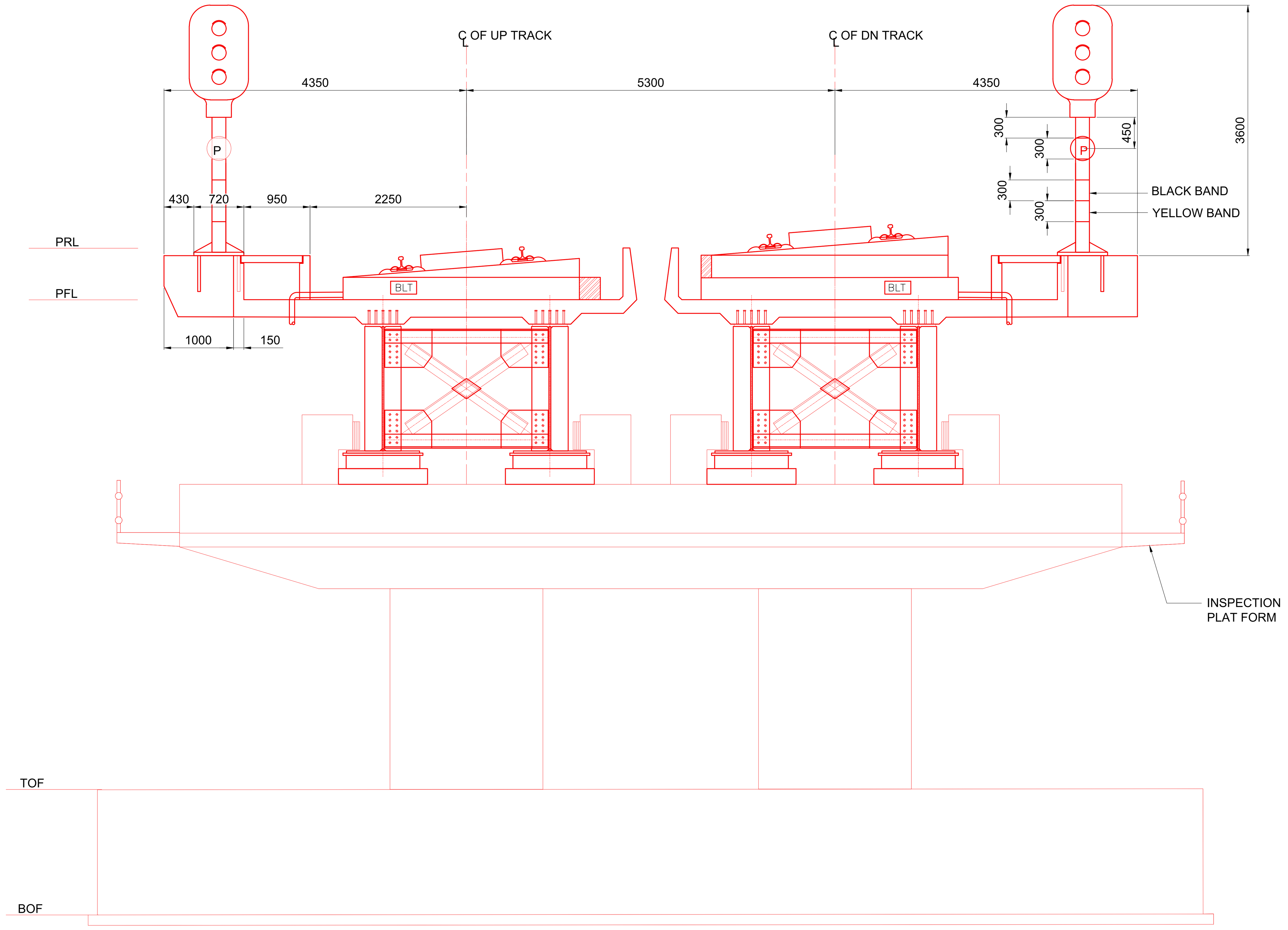
RITES THE INFRASTRUCTURE PEOPLE
SMEC

TITLE:- CONCEPTUAL PLAN FOR OHE EARTHING & OHE BOLT FIXING ARRANGEMENT ON BRIDGES

DRG. NO.			SHEET NO.
GC-HRIDC-C5-SK-GEN-38			
SCALE :	ISSUE DATE	REVISED DATE	
AS SHOWN	22.09.2023		

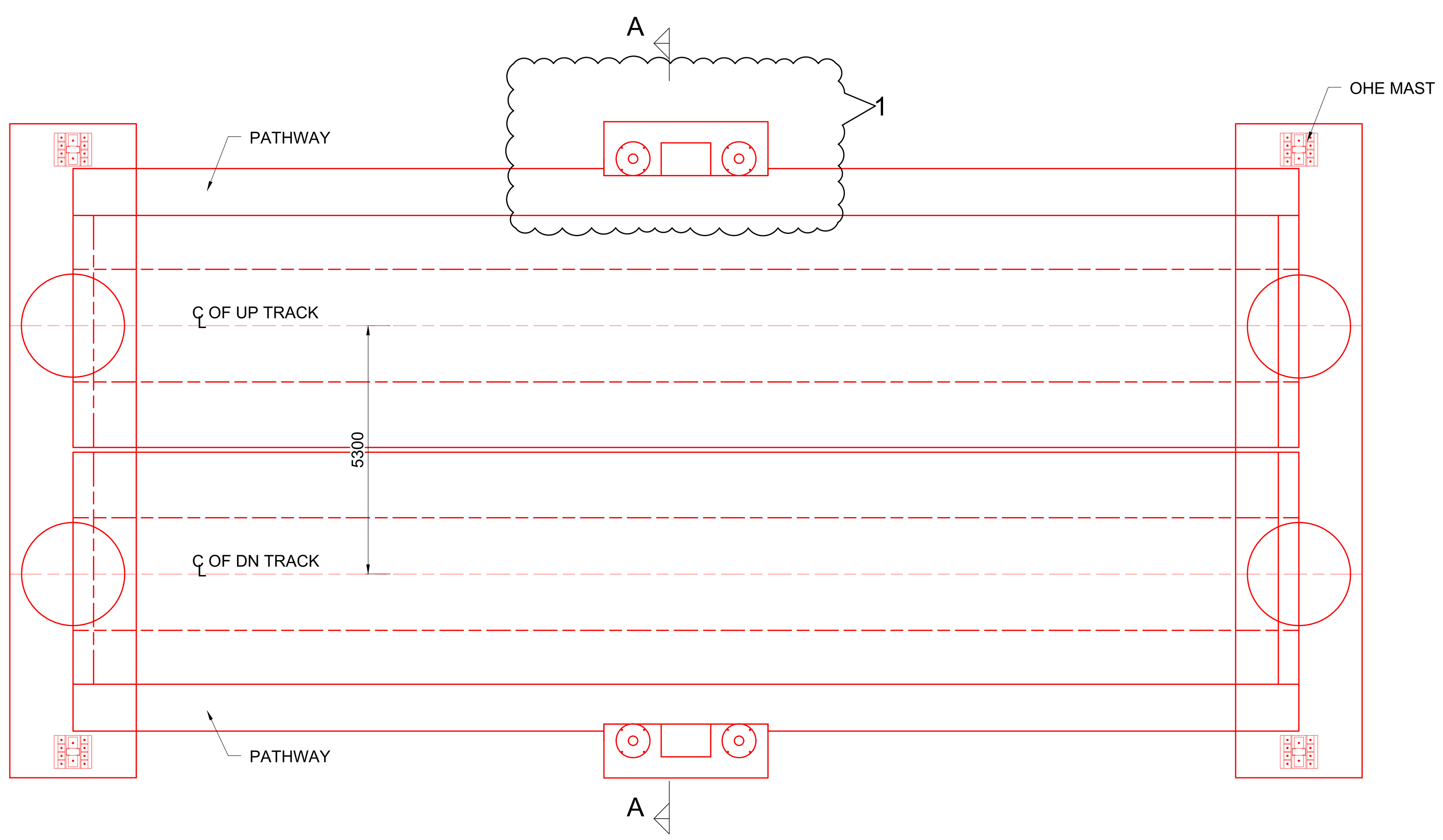
NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. SIGNAL POST SHALL BE INSTALLED AT CH. 21020.6872,22199.6872,23404.8872 & 24616.4472 ON BOTH SIDE OF VIADUCT.



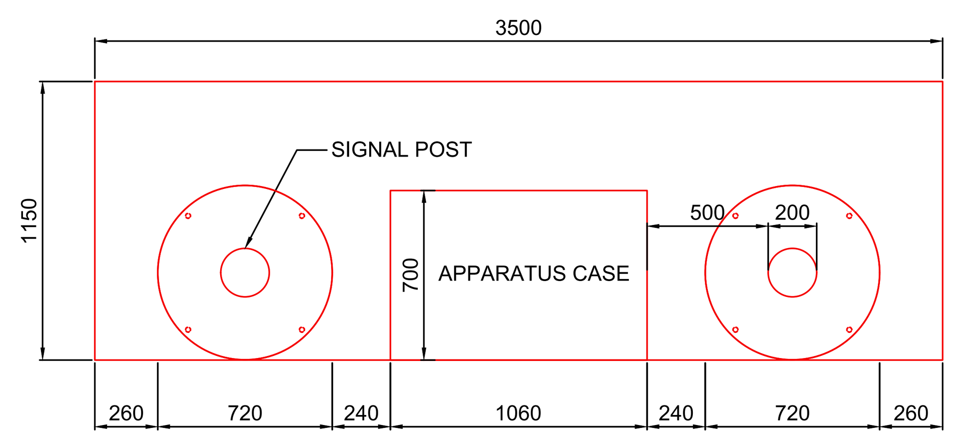
CROSS SECTION A-A

SCALE 1:50



PLAN

SCALE 1:100



DETAIL-1

SCALE 1:25

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		VIKRAM YADAV GM/ A&IE/HRIDC	
RAJENDRA KR. BHAUGUNA DPD/E&T.		JYOTI SANGWAN DGM/Elect.	Jyoti Sangwan
REETU PATIAL CDE/ CIVIL			

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

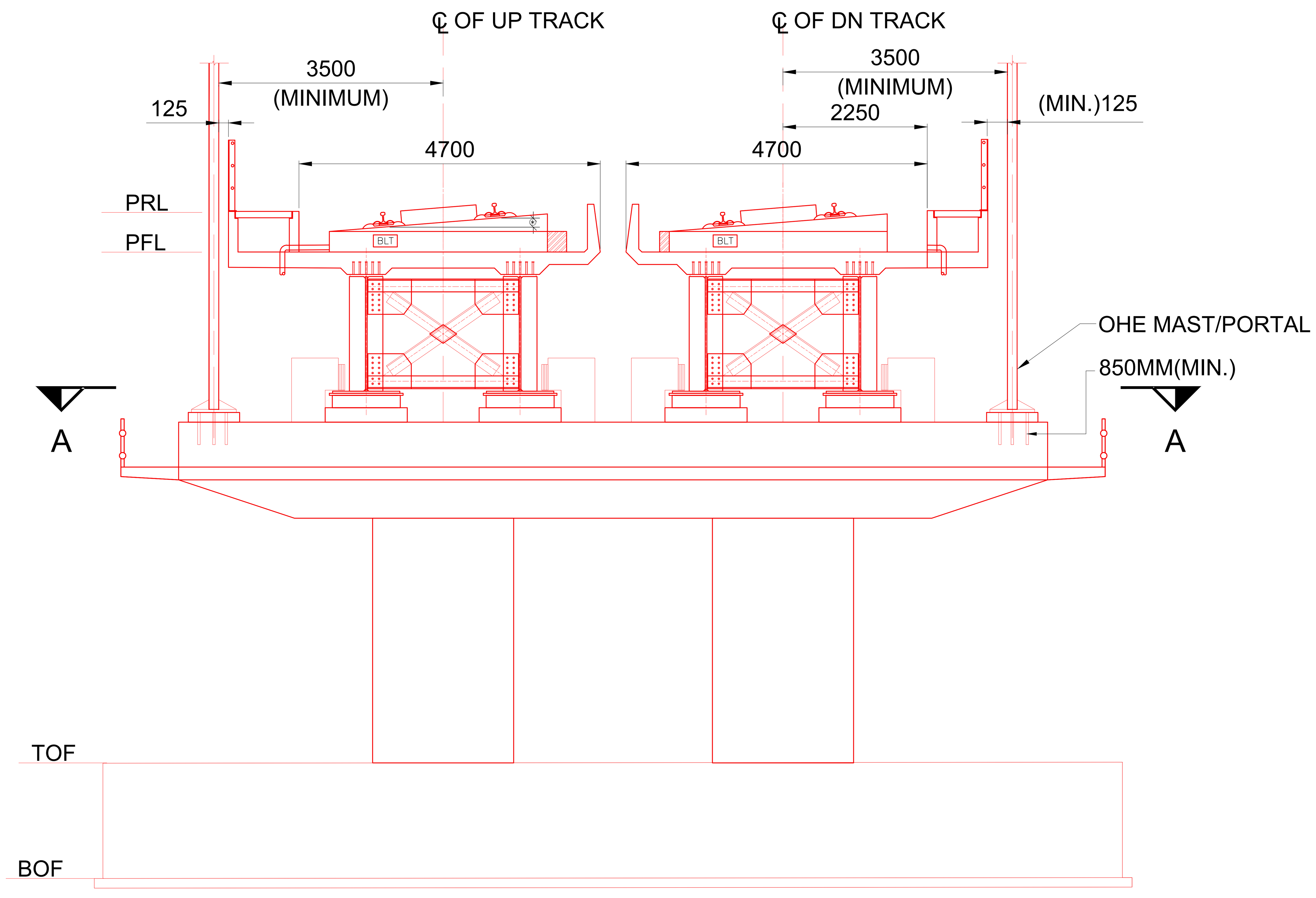
RITES THE INFRASTRUCTURE PEOPLE

SMEC Member of the Surbana Jurong Group

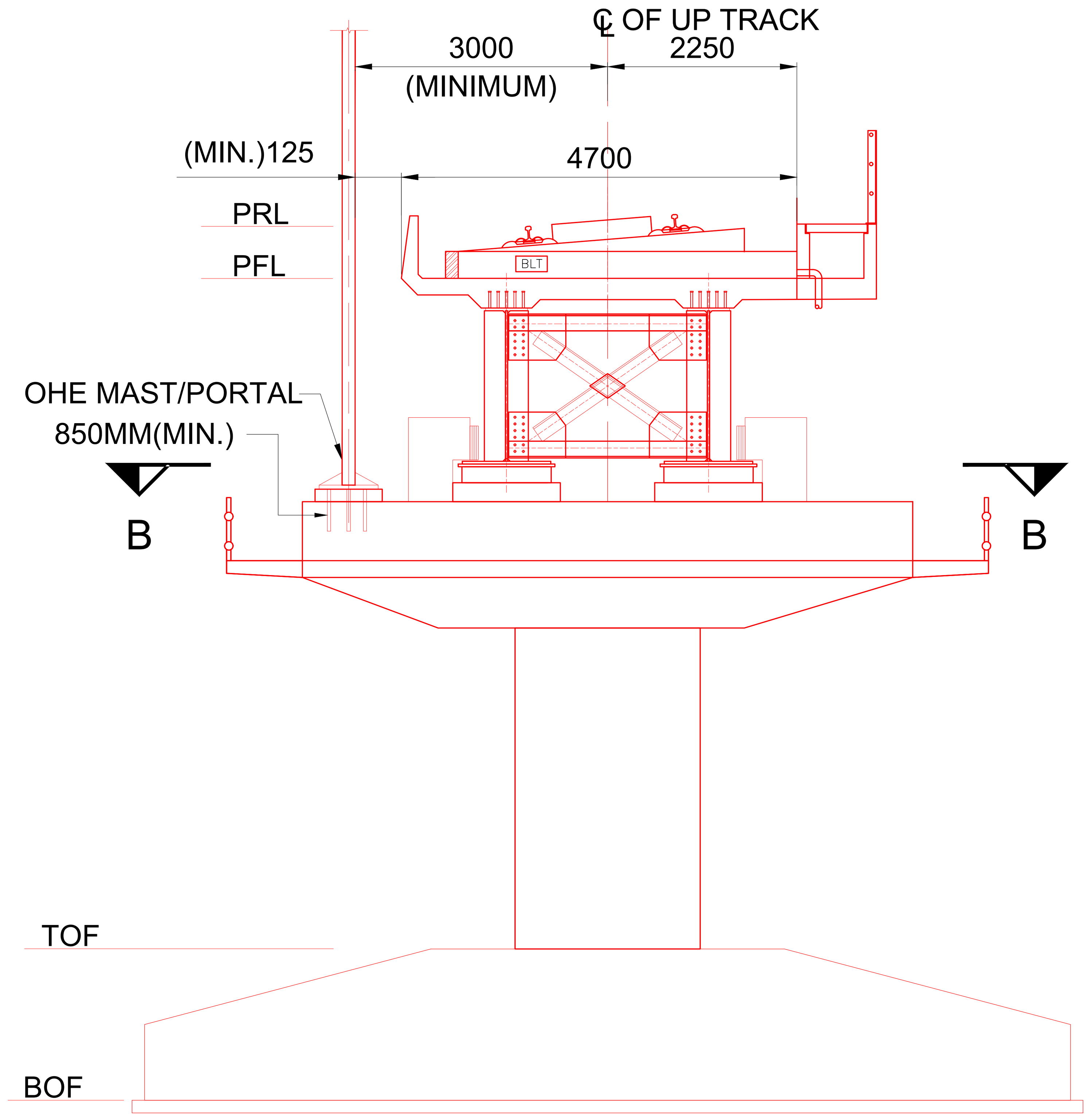
TITLE:- CONCEPTUAL PLAN

LOCATION OF SIGNAL POST FOR COMPOSITE GIRDER BRIDGES

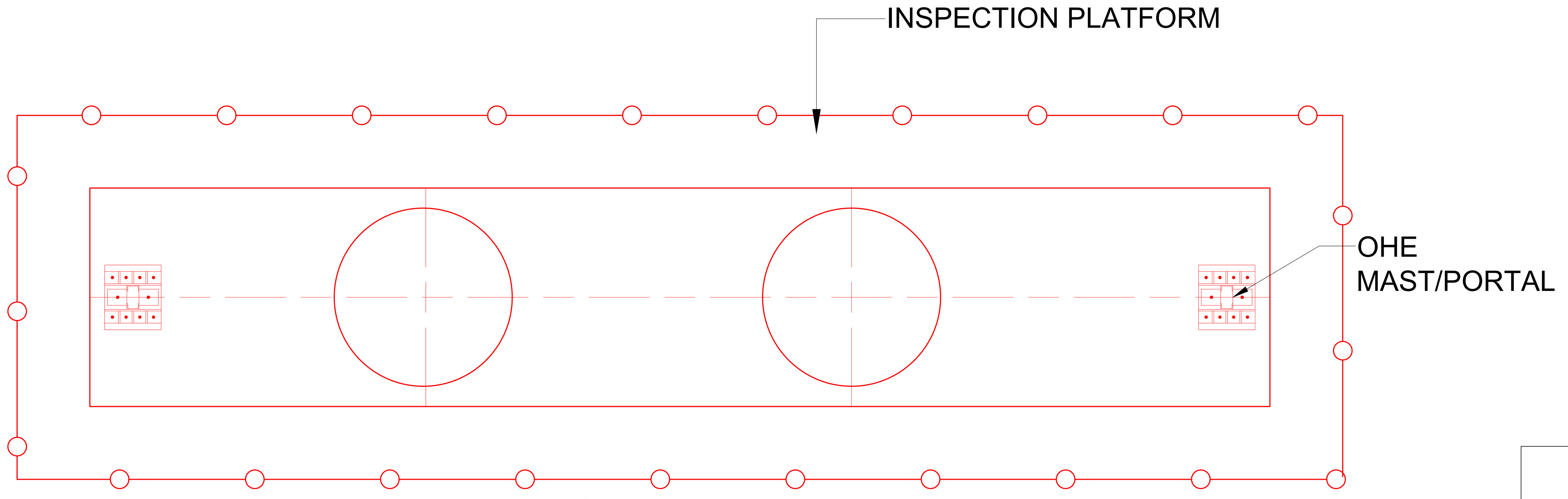
DRG. NO.	SHEET NO.
GC-HRIDC-SK-GEN-034	1 OF 1
SCALE :	ISSUE DATE
AS SHOWN	31.08.2023



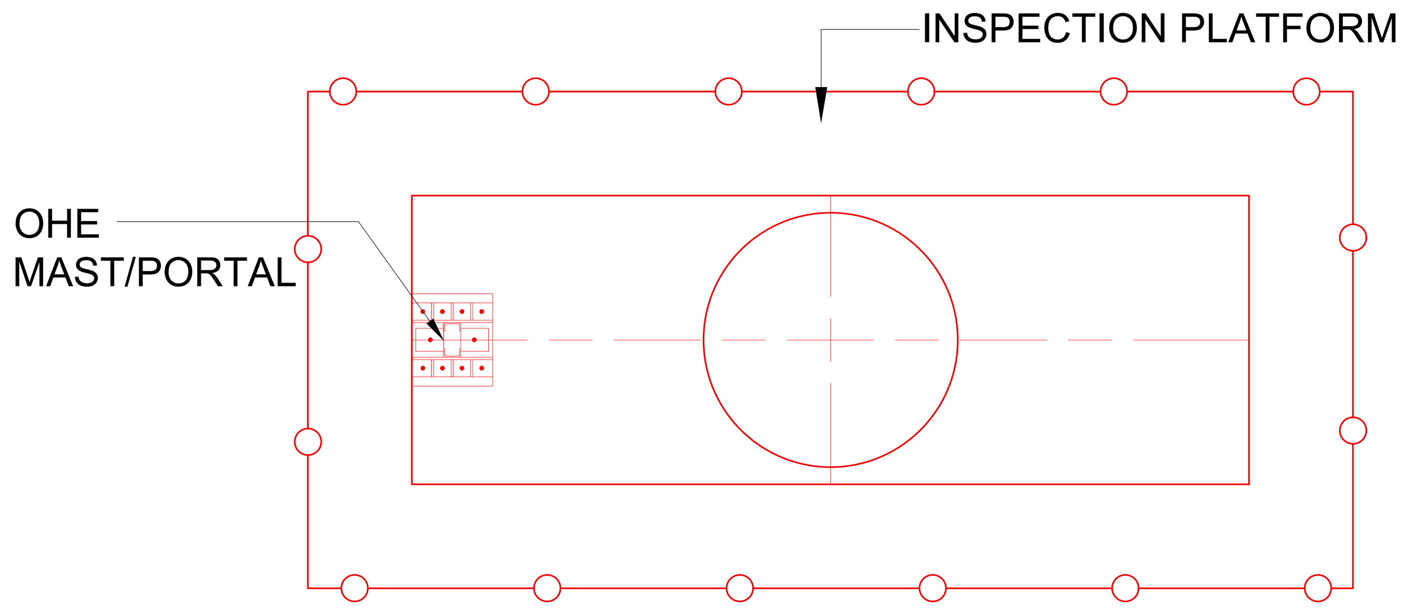
OHE LOCATION FROM CH. 20915 TO 24040



OHE LOCATION FROM CH. 24040 TO 24843



VIEW A-A



VIEW B-B

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. CHAINAGES SHOWN ARE TENTATIVE AND MAY CHANGE DURING EXECUTION.
4. THE EARTHING ARRANGEMENT, EARTHING PLATES HOLDING DOWN BOLTS, TEMPLATES ETC. SHALL BE PROVIDED BY CIVIL CONTRACTOR AS MENTIONED IN SKETCH NO. GC-HRIDC-C5-SK-GEN-38.
5. OHE CONTRACTOR SHALL PROVIDE DETAILS OF GUY ROD ANCHOR ARRANGEMENT ON VIADUCT & CIVIL CONTRACTOR SHALL PROVIDE THE SAME AS PER DRG. NO.GC-HRIDC-SYS4-DRW-ELE-007_A0.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[illegible]
SUDHIR AGRAWAL DPD/CIVIL	[illegible]	VIKRAM YADAV GM/ A&IE/HRIDC	[illegible]
A.S.JANGHU CRE/ELECT.	[illegible]	JYOTI SANGWAN DGM/Elect.	Jyoti Sangwan
REETU PATIAL CDE/ CIVIL	Reetu		

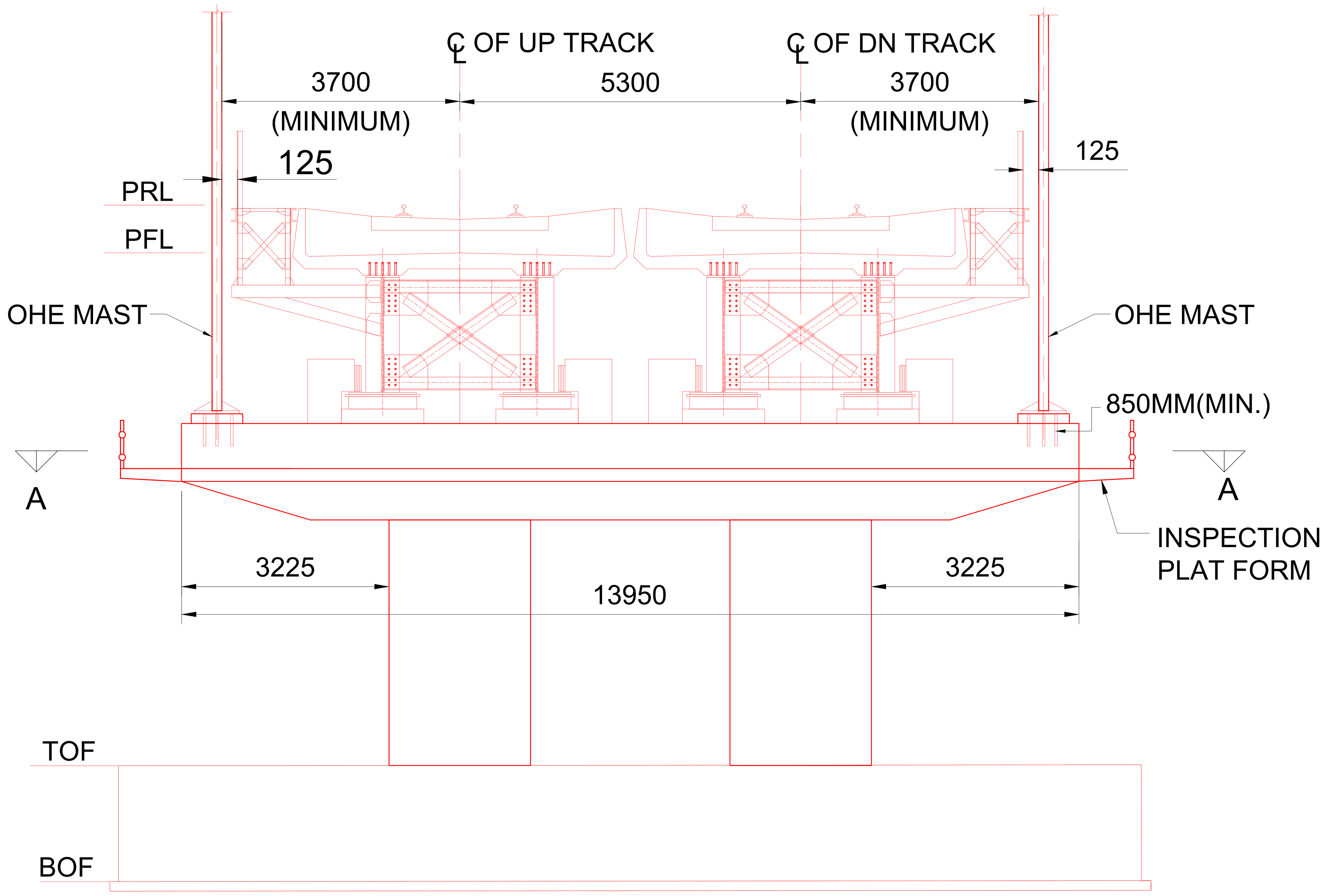
PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

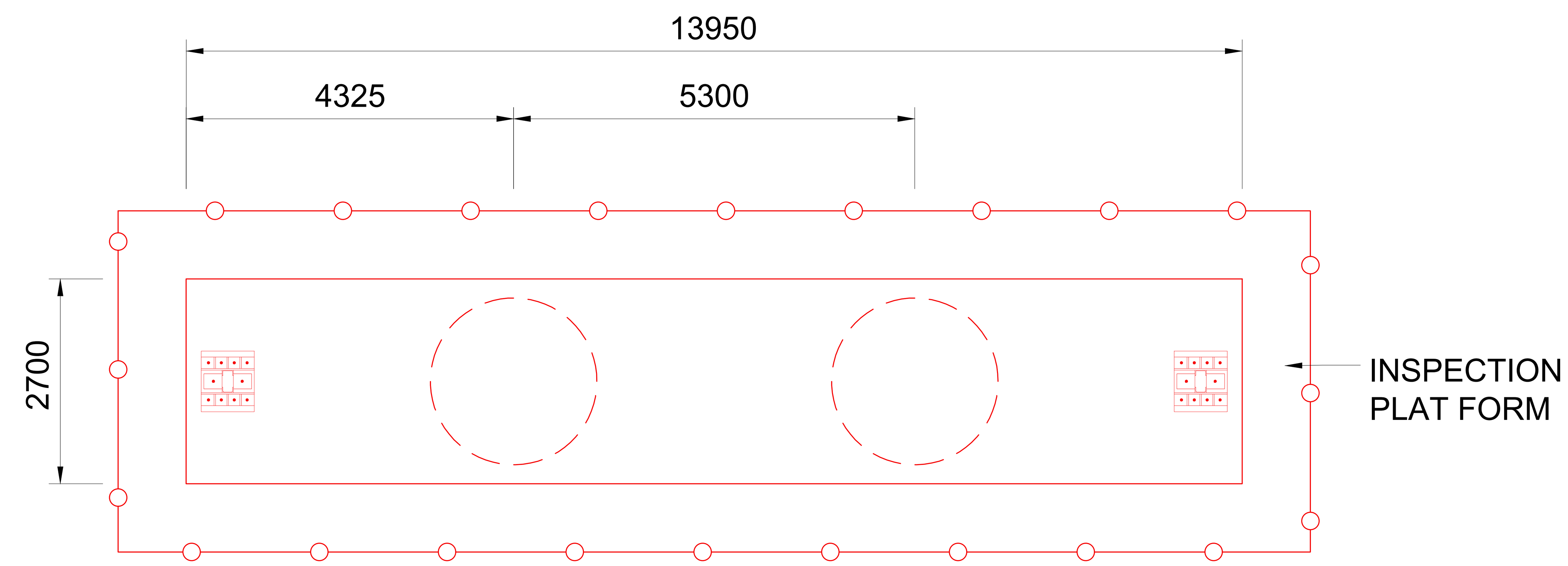
RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:-	CONCEPTUAL PLAN LOCATION OF OHE MAST IN VIADUCT
DRG. NO. GC-HRIDC-SK-GEN-032	SHEET NO. 1 OF 1
SCALE : AS SHOWN	ISSUE DATE 09.09.2023



PIER ELEVATION

SCALE 1:150



SECTION A-A

SCALE 1:150

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS WHICH ARE IN METER, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. THE EARTHING ARRANGEMENT, EARTHING PLATES HOLDING DOWN BOLTS, TEMPLATES ETC. SHALL BE PROVIDED BY CIVIL CONTRACTOR AS MENTIONED IN SKETCH NO. GC-HRIDC-C5-SK-GEN-38.
4. OHE CONTRACTOR SHALL PROVIDE DETAILS OF ANCHOR ARRANGEMENT ON BRIDGE & CIVIL CONTRACTOR SHALL PROVIDE THE SAME AS PER DRG. NO.GC-HRIDC-SYS4-DRW-ELE-007_A0.

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

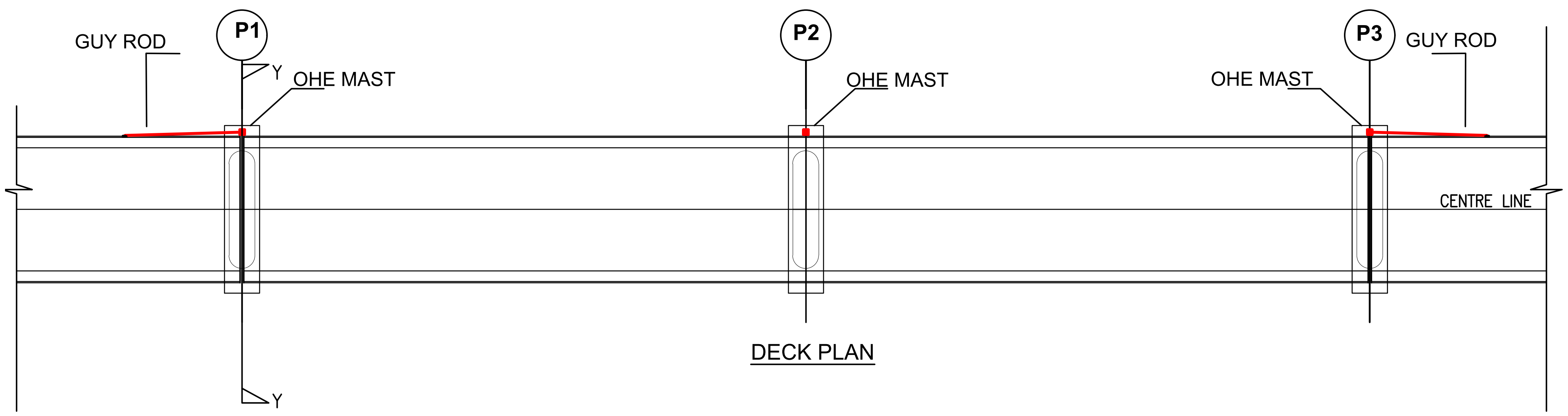
SMEC Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	VIKRAM YADAV GM/ A&IE/HRIDC	[signature]
A.S.JANGHU CRE/ELECT.	[signature]	JYOTI SANGWAN DGM/Elect.	Jyoti Sangwan
REETU PATIAL CDE/ CIVIL	Reetu		

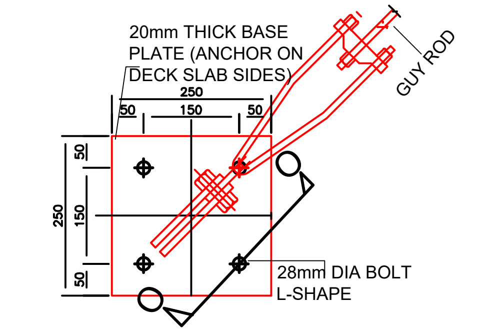
TITLE:- CONCEPTUAL PLAN

LOCATION OF OHE MAST FOR COMPOSITE GIRDER BRIDGES

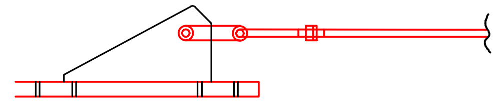
DRG. NO.	SHEET NO.
GC-HRIDC-SK-GEN-031	1 OF 1
SCALE :	ISSUE DATE
AS SHOWN	09.09.2023



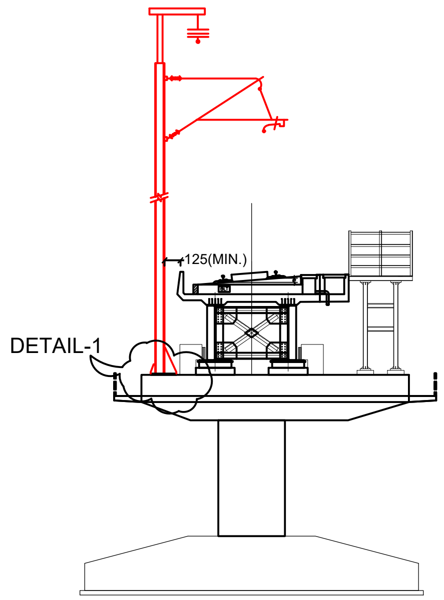
DECK PLAN



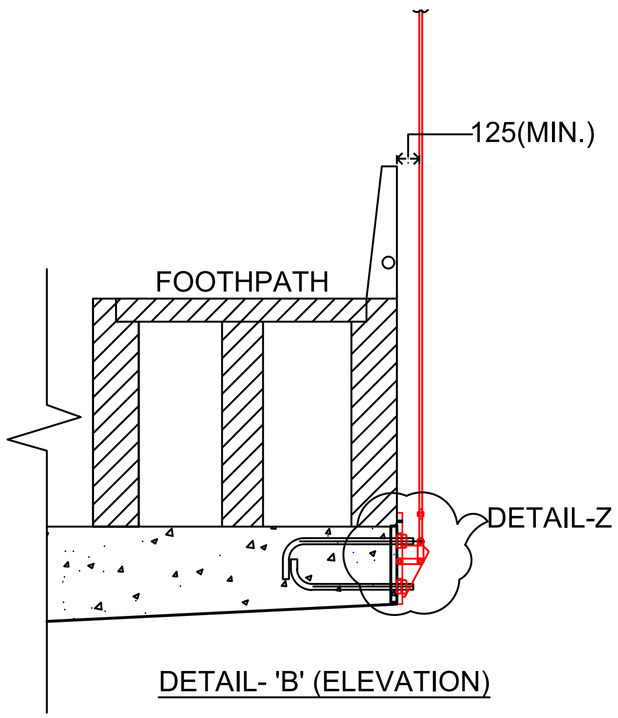
GUY ROD BASE PLATE
DETAIL -Z (PLAN)



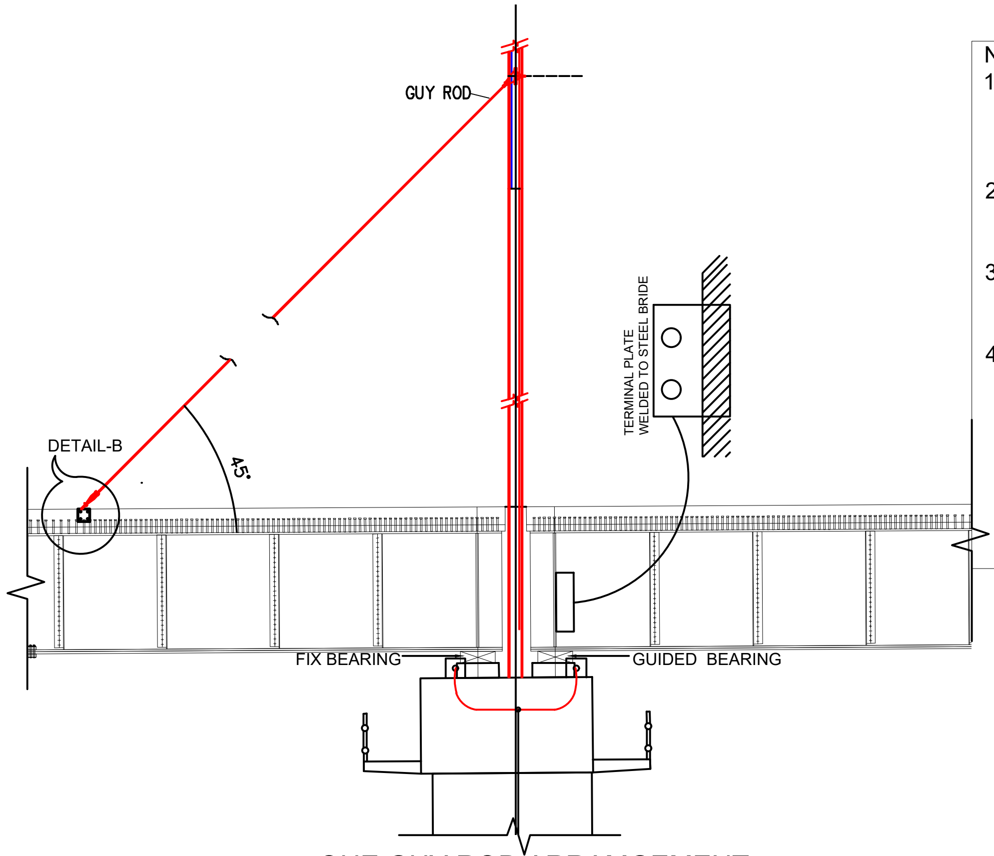
SECTION O-O



SECTION Y-Y



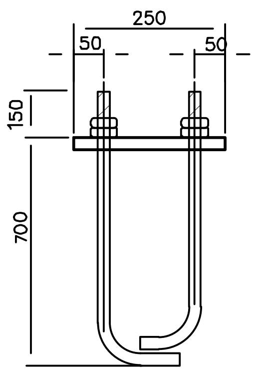
DETAIL- 'B' (ELEVATION)



OHE GUY ROD ARRAMGEMENT

NOTE :

1. SIZES ARE INDICATIVE AND MINIMUM, HOWEVER CONTRACTOR MAY BE REQUIRED TO PROVIDE HIGHER AS APPROVED BY THE ENGINEER.
2. APPROX. 12 NUMBER GUY ROD SHALL BE PROVIDED IN TRACK PER KM.
3. OHE CONTRACTOR SHALL PROVIDE GUY ROD LOCATION TO CIVIL CONTRACTOR.
4. OHE CONTRACTOR SHALL PROVIDE DESIGN DETAILS OF GUY ROD GI BOLTS AND METAL COMPOSITION TO CIVIL CONTRACTOR. CIVIL CONTRACTOR SHALL ARRANGE GUY ROD GI BOLTS AND ERECT THE SAME ON VIADUCT IN CORDINATION WITH OHE CONTRACTOR.



GI BOLT DETAIL

—	OHE SCOPE
—	CIVIL SCOPE

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		SHIV OM DWIVEDI CPM/HRIDC	
SUDHIR AGRAWAL DPD/CIVIL		VIKRAM YADAV GM/ A&IE/ HRIDC	
A.S.JANGHU CRE/ELECT.		JYOTI SANGWAN DGM/ Elect.	
REETU PATIAL CDE/CIVIL			
STIPHEN SAHOO SRE/Elect.			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

TITLE:- INDICATIVE OHE GUY ROD ARRANGEMENT ANCHOR ON VIADUCT

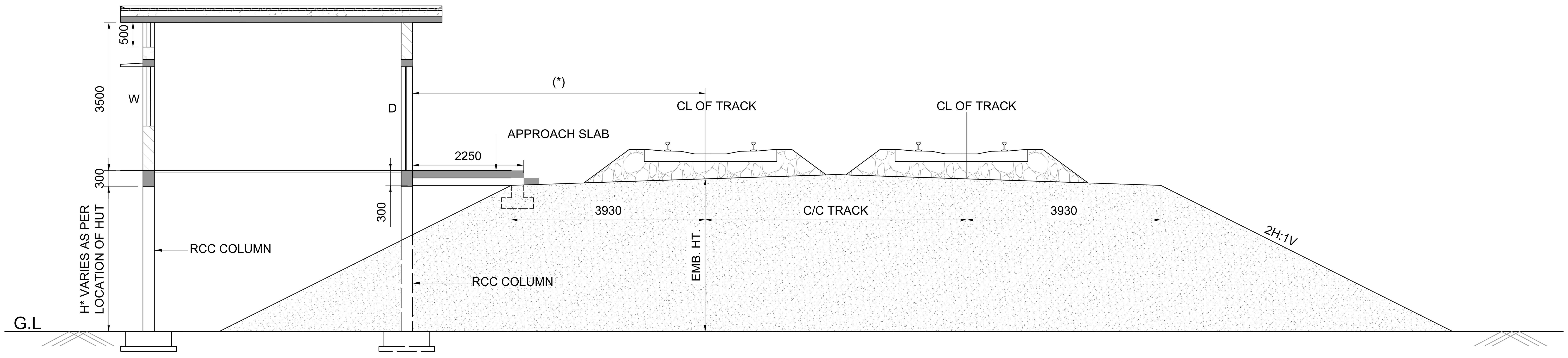
DRG. NO. GC-HRIDC-SYS1-DRW-ELE-007_A0

SHEET NO.

SCALE : AS SHOWN

ISSUE DATE 22.09.2023

REVISED DATE



TYPICAL CROSS-SECTIONAL SKETCH OF AUTO LOCATION HUT

(*)
BLOCK SECTION AREA - 6 M (min)
STATION YARD - 8 M (min)

NOTES :

1. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
2. REFER SKETCH NO. GC-HRIDC-SK-GEN-012_A0.
3. H* VARIES FROM 1.3 M TO 11.0 M.

GC/HORC		HRIDC	
NAME / DEGINATION	SIGN	NAME / DEGINATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
RAJENDRA KR. BHAUGUNA DPD / EST	राजेन्द्र बहुगुणा		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

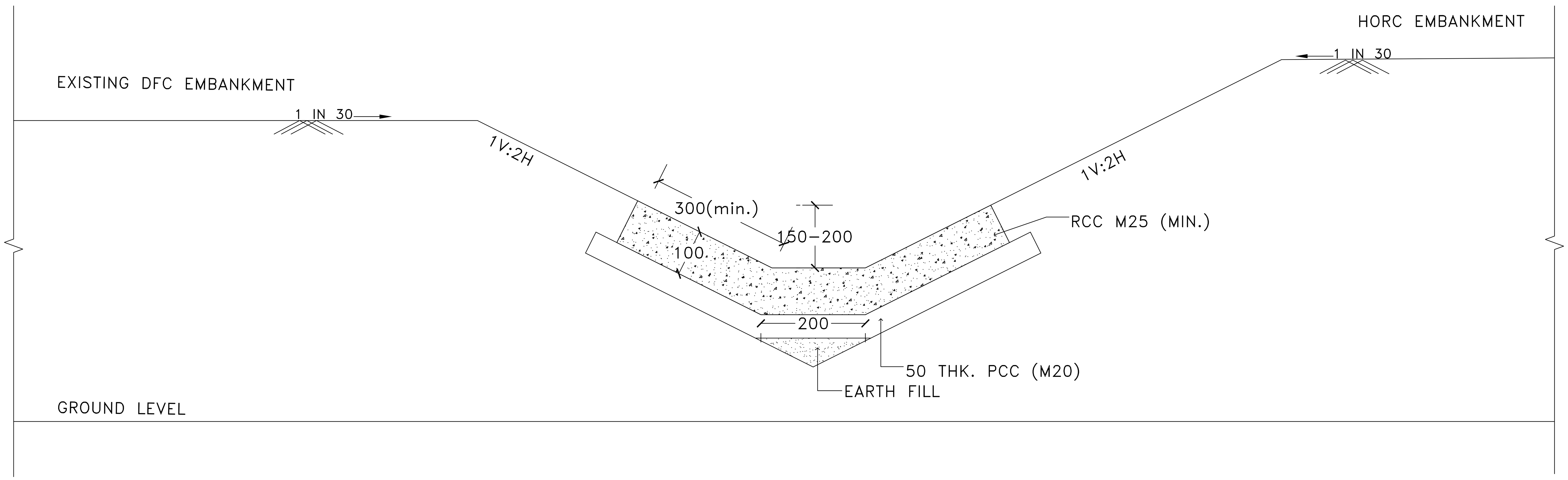
CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

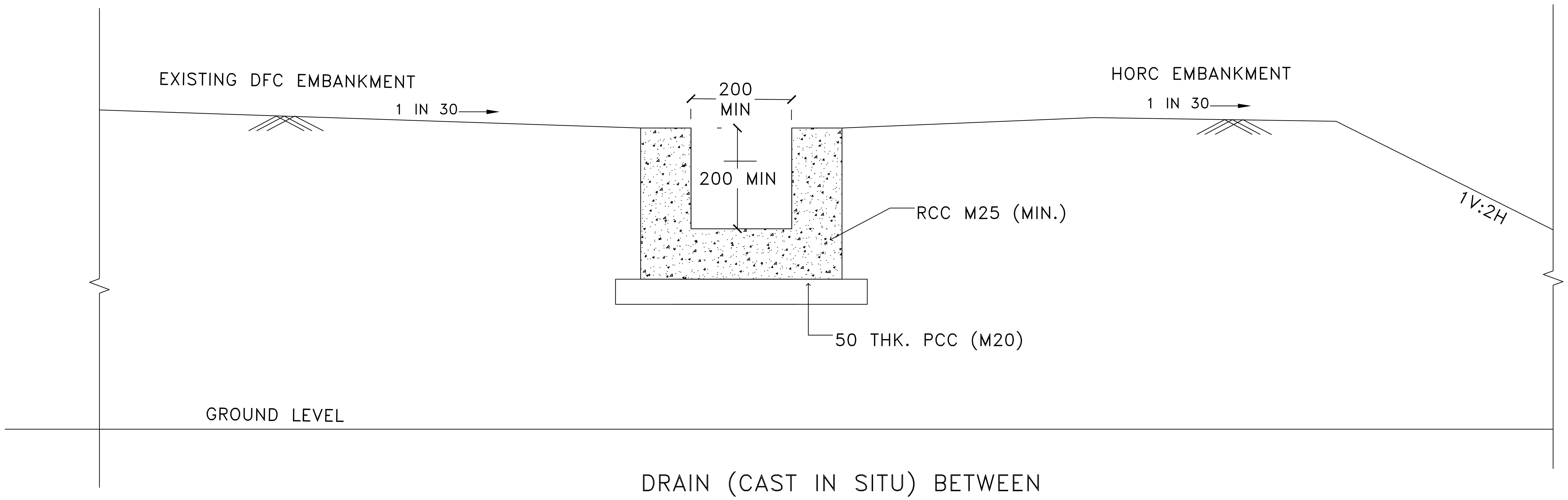
TITLE:-
CONCEPTUAL CROSS-SECTIONAL SKETCH OF ALH

SKETCH NO.		SHEET NO.
GC-HRIDC--SK-GEN-039_A0		1OF1
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	14-12-2023	



DRAIN (CAST IN SITU) BETWEEN
HORC & DFC EMBANKMENT

(CASE- I)



DRAIN (CAST IN SITU) BETWEEN
HORC & DFC EMBANKMENT (OVERLAPPING
OF BANK AT FORMATION LEVEL)

(CASE- II)

NOTES :-
1. ALL DIMENSION ARE IN MM.
2. NO DIMENSION SHALL BE SCALED FROM DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. MIN GRADE OF CONCRETE:
   A) CAST IN SITU - M25.
   B) PCC - M20.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

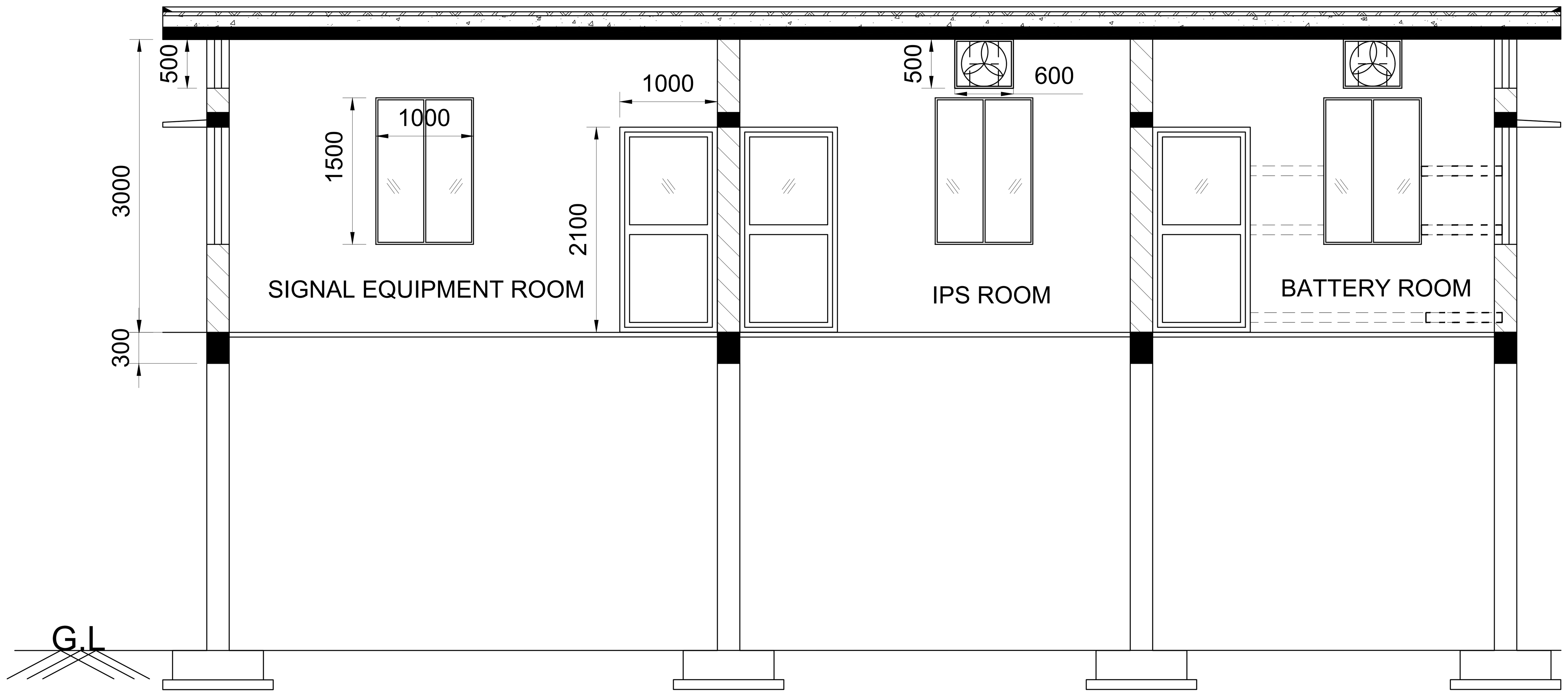
THE INFRASTRUCTURE PEOPLE

Member of the Surbana Jurong Group

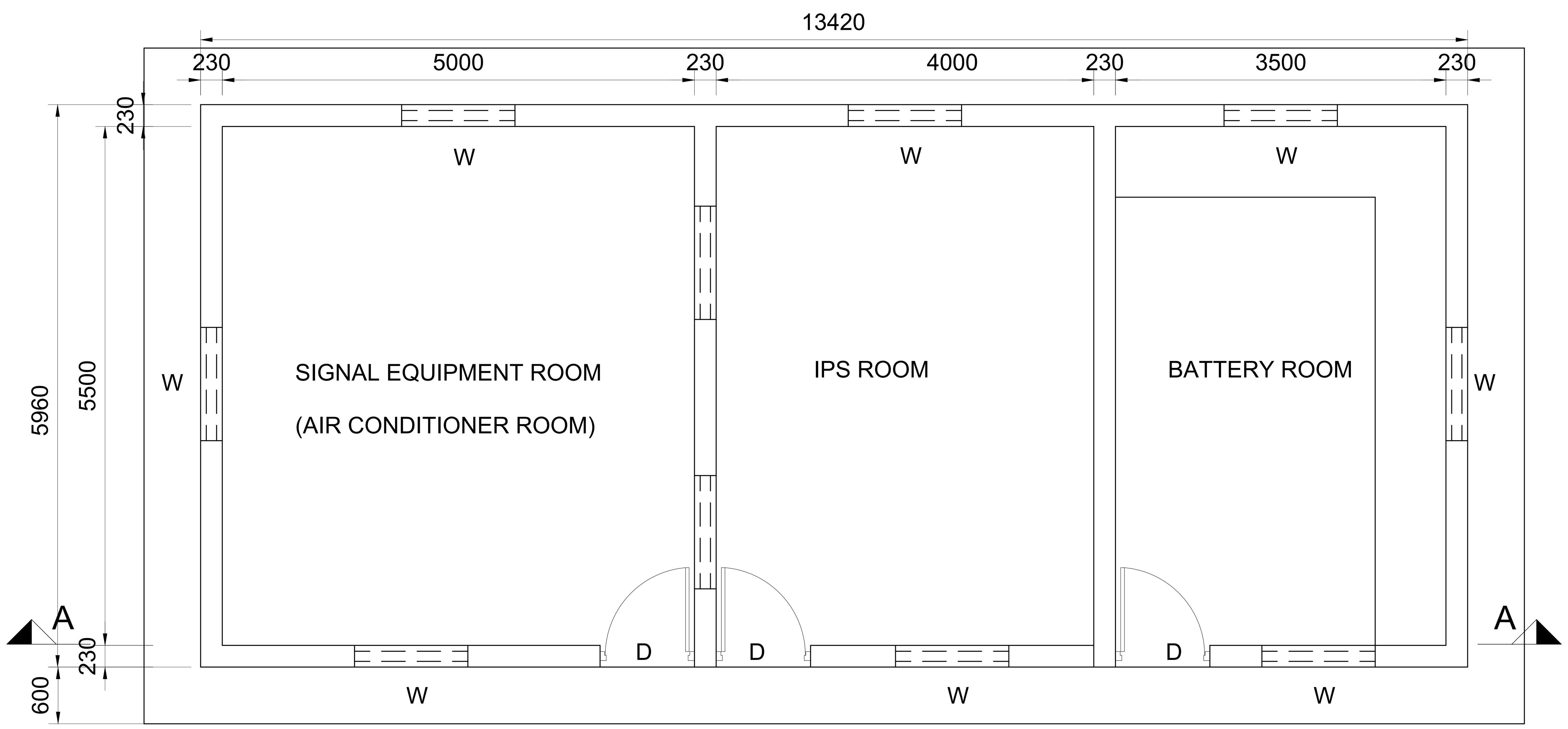
GC/HORC		HRIDC	
NAME / DEGINATION	SIGN	NAME / DEGINATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/HRIDC	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
REETU PATIAL CDE/ CIVIL	Reetu		
MEENAKSHI SHARMA SDE/ CIVIL			

TITLE:- CONCEPTUAL PLAN
DRAINS BETWEEN
HORC EMBANKMENT & DFC

SKETCH NO. GC-HRIDC-SK-GEN-041_A0		SHEET NO. 1 OF 1
SCALE : NTS	ISSUE DATE 14.12.2023	REVISED DATE



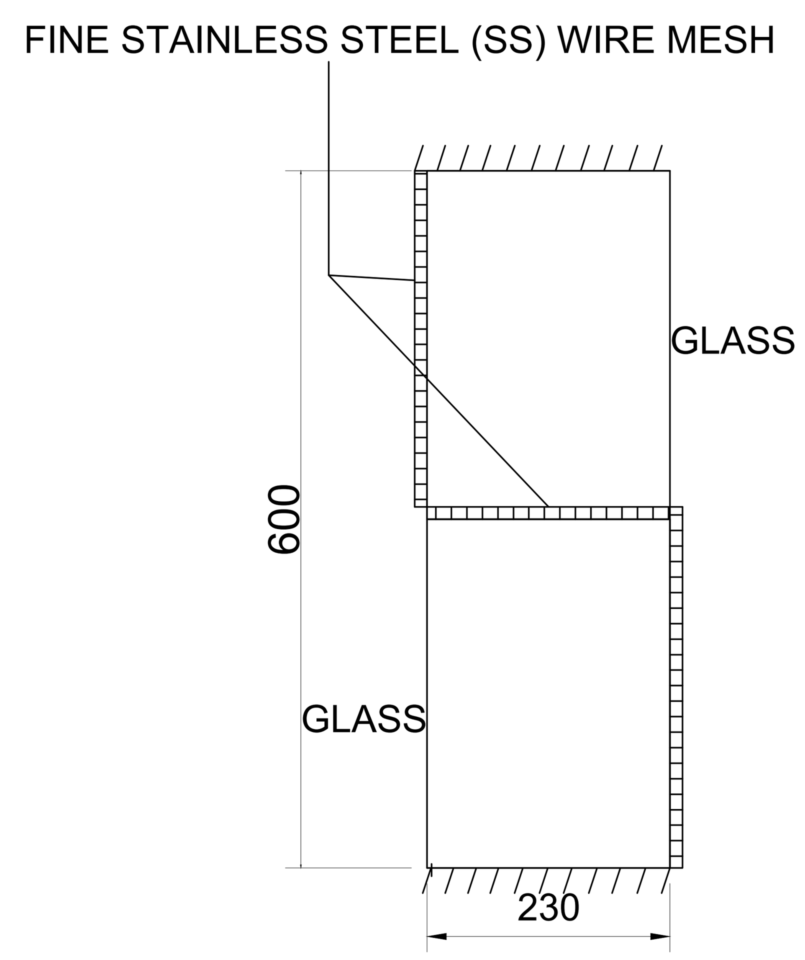
SECTIONAL ELEVATION A-A
(SCALE 1:100)



PLAN
(SCALE 1:100)

SCHEDULE

DOOR	2100x1000
WINDOW	1000x1500
VENTILATOR	600x500



VENTILATOR

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. PLINTH LEVEL SHALL BE KEPT AT LEAST 300mm ABOVE THE GROUND LEVEL.
3. DPC SHALL BE PROVIDED ABOVE PLINTH LEVEL.
4. FOUNDATION SHALL BE DESIGNED BY THE CONTRACTOR AND APPROVED BY THE ENGINEER.
5. DOOR SHUTTERS SHALL BE 35MM THICK FLUSH DOORS.
6. WINDOWS AND VENTILATORS SHALL BE AS PER RELEVANT IS CODES.
7. SIGNAL & TELECOM EQUIPMENT ROOM SHALL BE AIR CONTITIONED.
8. HEAVY DUTY TWO RCC SHELF IN BATTERY ROOM ON TWO SIDES 750mm WIDE FOR BATTERIES, 100mm PLINTH SHALL BE MADE BELOW SHELF. FIRST SHELF AT 1000mm & SECOND SHELF AT 1600mm FROM GROUND LEVEL.
9. TWO OPENINGS 100mmX100mm AT 2500mm FROM FLOOR IN PARTITION WALLS.
10. OPENING DUCT FOR CABLE ENTRY IN FLOOR OF EQUIPMENT ROOM @ 1000mm(L)X 600mm(H)X 600mm DEEP.
11. POWER CABLE ENTRY 300mm(L)x300mm(H)x600mm DEEP IN POWER ROOM.
12. TELECOM/OFC CABLE ENTERY IN POWER ROOM 300mm(L)X300mm(H)X600mm DEEP.
13. MS STEEL GRILL ON WINDOWS & VENTILATORS.
14. EQUIPMENT ROOM TO BE PROTECTED FOR DUST.
15. 1000mmX600mm TOUGHENED GLASS IN THE PARTITION WALL BETWEEN EQUIPMENT ROOM & IPS ROOM.
16. OIL PAINT IN INTERIOR IN S & T EQUIPMENT ROOM.
17. HEAVY DUTY EXHAUST FAN IN IPS & BATTERY ROOM FRONT WALL WITH SELF CLOSING FLAP.
18. SIGNAL & TELECOME EQUIPMENT ROOM SHALL BE AIRCONDITIONED.

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

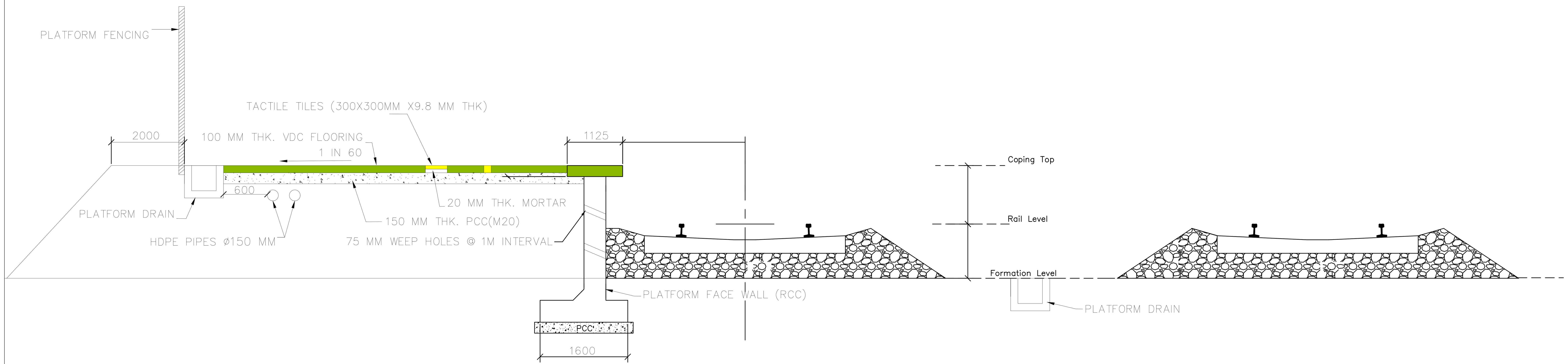
GC/HORC		HRIDC	
NAME / DEGINATION	SIGN	NAME / DEGINATION	SIGN
CHAHATEY RAM PD		NEERAJ BHANDARI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
RAJENDRA KR. BHAUGUNA DPD / EST			

TITLE:-

CONCEPTUAL PLAN S & T HUT

SKETCH NO.	SHEET NO.
GC-HRIDC--SK-GEN-002_A0	1OF1

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	07-12-2023	



NOTES :

1. ALL DIMENSION ARE IN MM.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
3. FOR DETAIL OF PLATFORM FACE WALL REFER SKETCH NO.GC-HRIDC-SK-GEN-024.
4. FOR PLATFORM DRAINS REFER SKETCH NO.

A) GC-HRIDC-C5-SK-CIVIL-002-A1 FOR PRITHLA STATION.
B) GC-HRIDC-C5-SK-CIVIL-003-A1 FOR SILANI STATION.
C) GC-HRIDC-C5-SK-CIVIL-004-A1 FOR IMT SOHNA STATION.

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

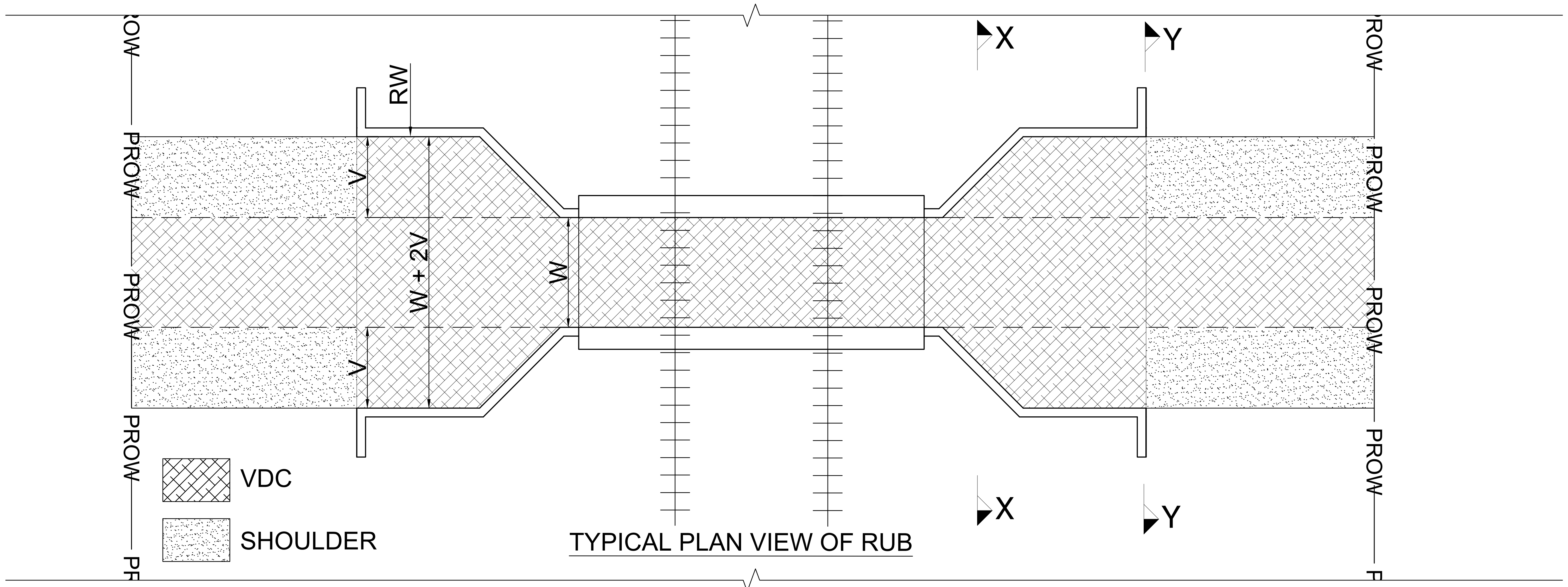
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE | SMEC Member of the Surbana Jurong Group

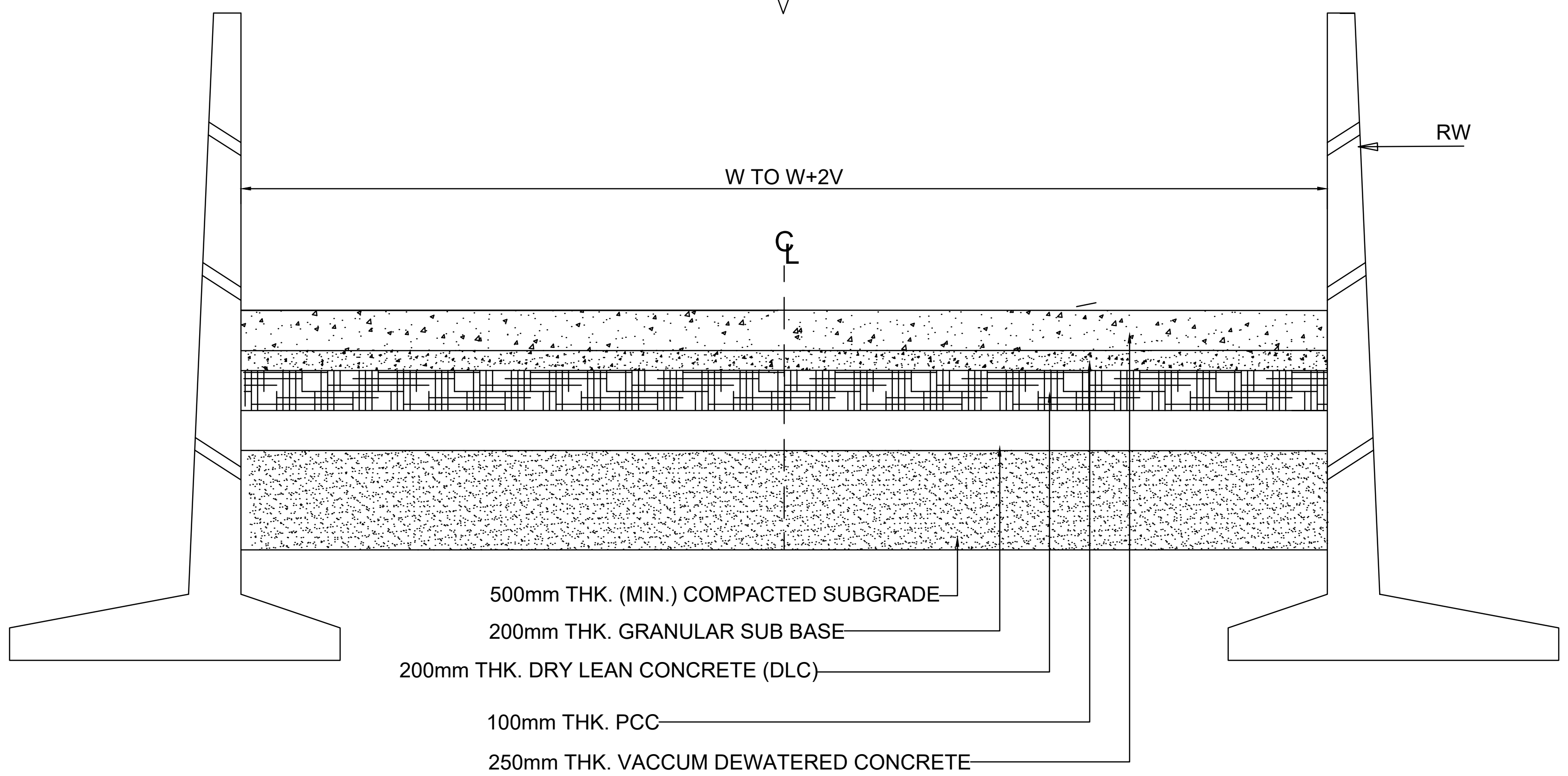
GC/HORC		HRIDC	
NAME / DEGINATION	SIGN	NAME / DEGINATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/C-SOUTH	
REETU PATIAL CDE / CIVIL			
MEENAKSHI SHARMA SDE / CIVIL			

TITLE:- TYPICAL CONCEPTUAL CROSS-SECTIONAL SKETCH OF PLATFORM

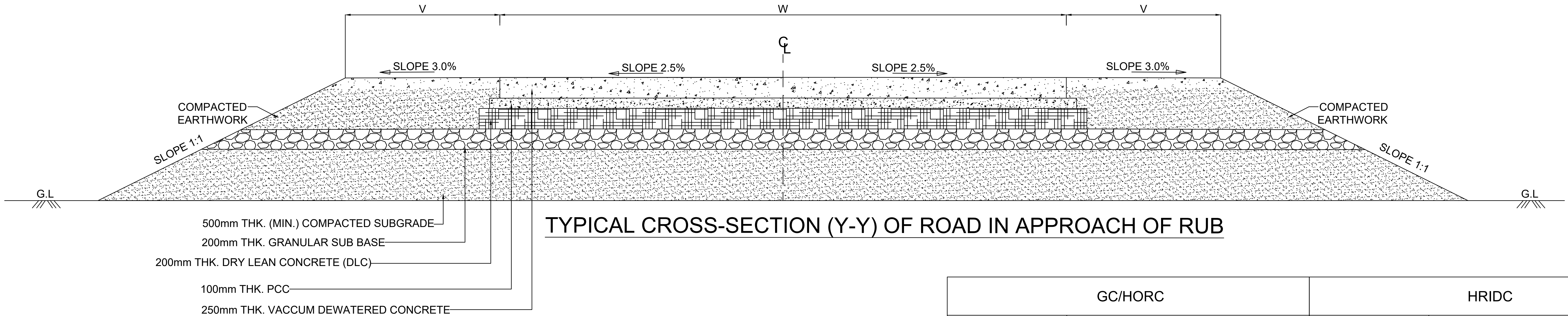
SKETCH NO.		SHEET NO.
GC-HRIDC--SK-GEN-042_A0		1OF1
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	14-12-2023	



TYPICAL PLAN VIEW OF RUB



TYPICAL CROSS-SECTION (X-X) OF ROAD IN APPROACH OF RUB



TYPICAL CROSS-SECTION (Y-Y) OF ROAD IN APPROACH OF RUB

NOTES:

1. ALL DIMENSION ARE IN MILLIMETERS EXPECT LEVELS WHICH ARE IN METERS. NO DIMENSION SHALL BE SCALED FROM DRAWING ONLY WRITTEN DIMENSION ARE TO BE FOLLOWED.
2. ROAD,CRASH BARRIER & MEDIAN SHALL BE CONSTRUCTED AS PER MORTH STANDARDS.
3. LAYING OF PAVE BLOCK SHALL BE AS PER IRC PROVISION.
4. IRC 58 SHALL BE FOLLOWED FOR DESIGN OF PLAIN JOINTED RIGID PAVEMENT.
5. IN DOUBLE CELL BOX, A MEDIAN SHALL BE PROVIDED (FROM ROW TO ROW) IN LINED WITH THE CENTRAL WALL OF THE BOX.

ABBREVIATION

RW	RETURN WALL
CL	CENTER LINE
W	WIDTH OF BOX
PROW	PROPOSED HORC'S ROW

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	NEERAJ BHANDARI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANK DGM/CIVIL	
REETU PATIAL CDE/ CIVIL	Reetu	MOHD. ISHAK EXECUTIVE/CIVIL	
MEENAKSHI SHARMA SDE/ CIVIL			

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

THE INFRASTRUCTURE PEOPLE

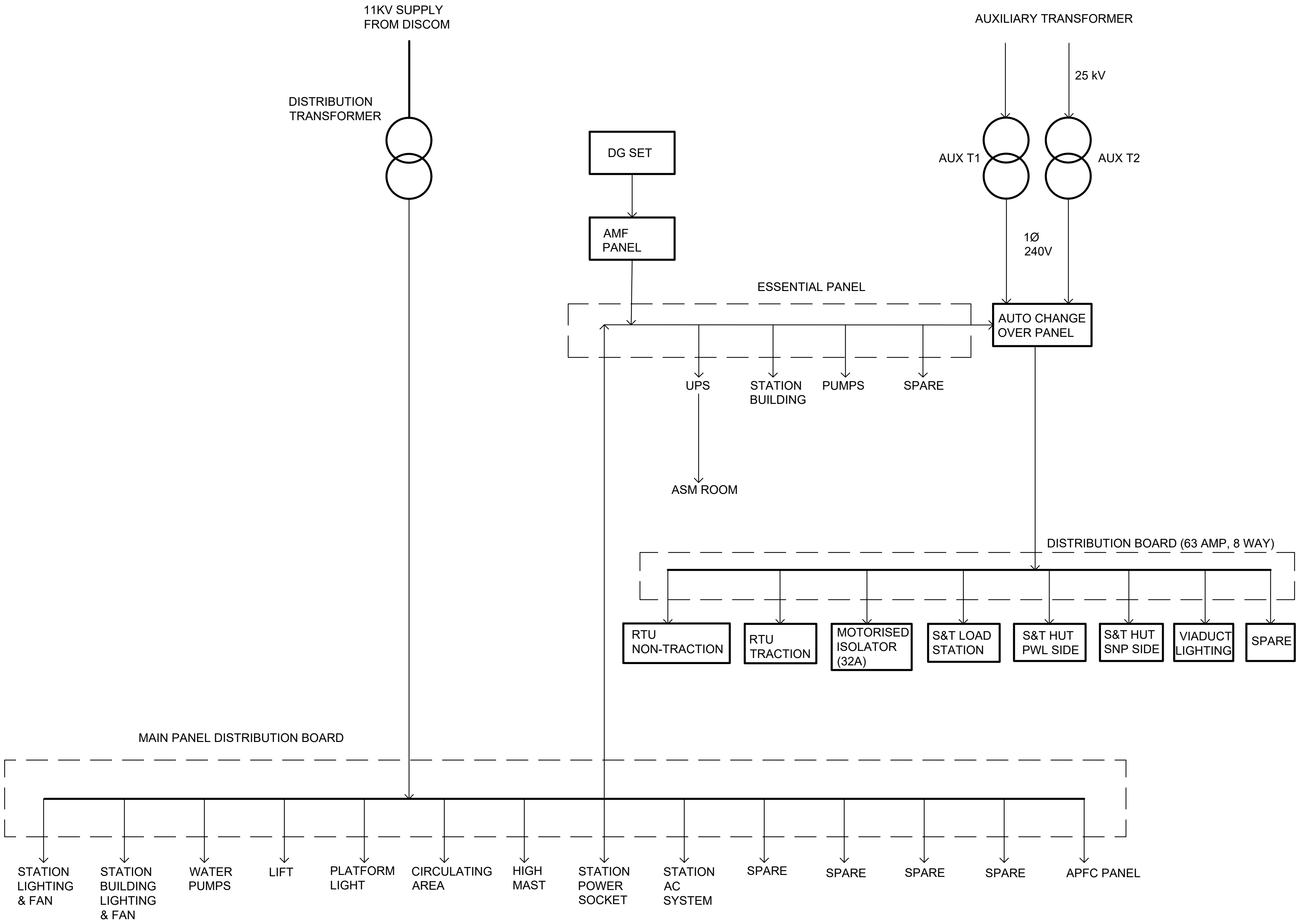
TITLE:- CONCEPTUAL SKETCH FOR ROAD IN APPROACH OF RUB

DRG. NO.	SHEET NO.
GC-HRIDC-SK-GEN-043_A0	1 OF 1

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	19-12-2023	

II. General Electrical Services Drawings

INDICATIVE LT SUPPLY SYSTEM WITH LOCAL, DG & AUXILIARY TRANSFORMER SUPPLY



GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		VIKRAM YADAV GM/ A&IE/HRIDC	
A.S.JANGHU CRE/ELECT.		JYOTI SANGWAN DGM/Elect.	
VIKAS KUMAR HARIT SRE/GEN/Elect.			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE | SMEC

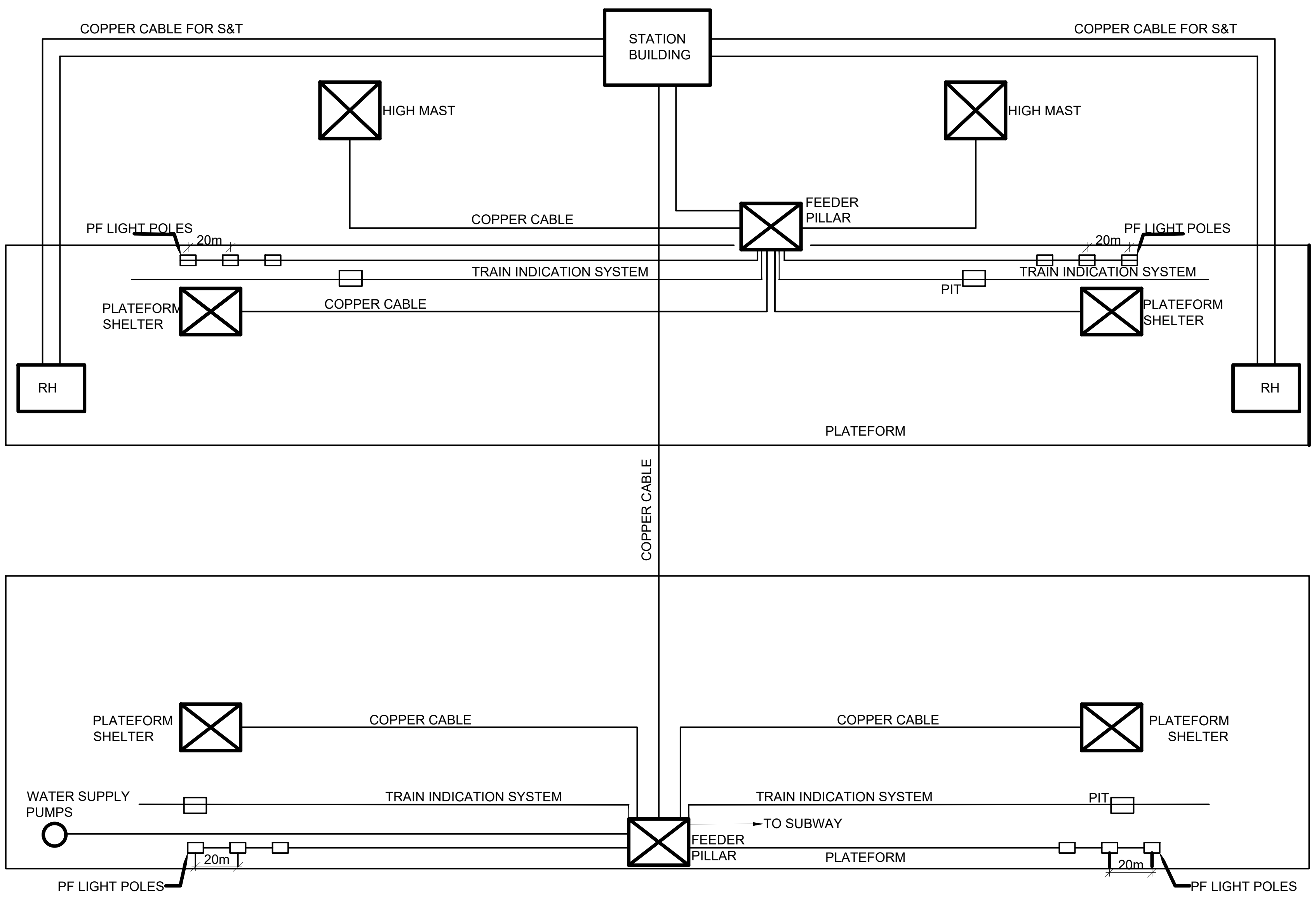
TITLE:-
INDICATIVE LT SUPPLY SYSTEM WITH LOCAL, DG & AUXILIARY TRANSFORMER SUPPLY

DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-ELE-001_A1		
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	08.07.2023	05.12.2023

NOTES:

1. FOR TRAIN INDICATION SYSTEM, THE PIT SHALL BE PROVIDED AT EVERY 50m.

INDICATIVE LT SUPPLY DISTRIBUTION DIAGRAM



GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	ChahateyRam	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL	[illegible]	VIKRAM YADAV GM/ A&IE/HRIDC	
A.S.JANGHU CRE/ELECT.	[illegible]	JYOTI SANGWAN DGM/Elect.	
VIKAS KUMAR HARIT SRE/GEN/Elect.	[illegible]		

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

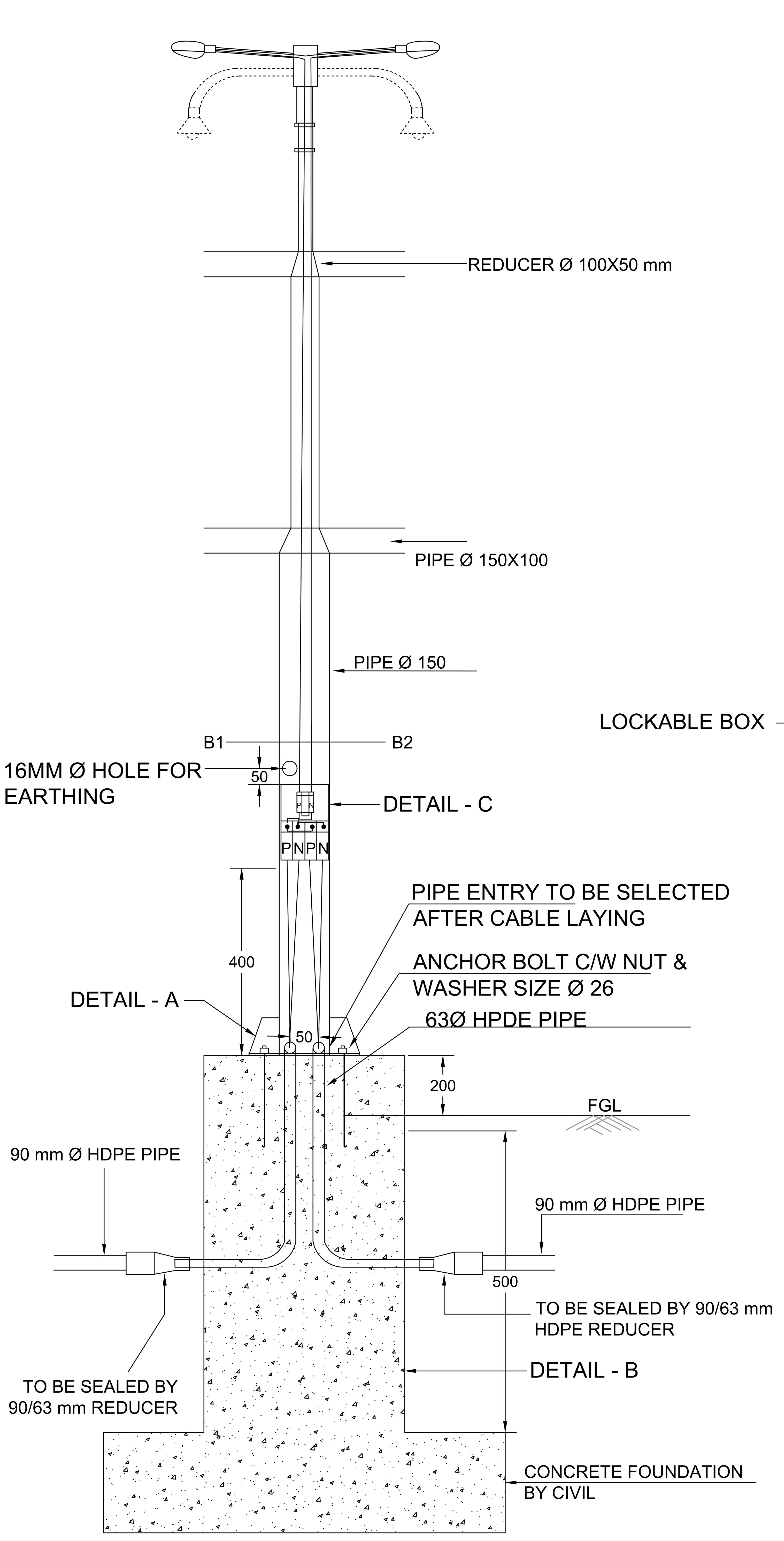
RITES THE INFRASTRUCTURE PEOPLE

SMEC

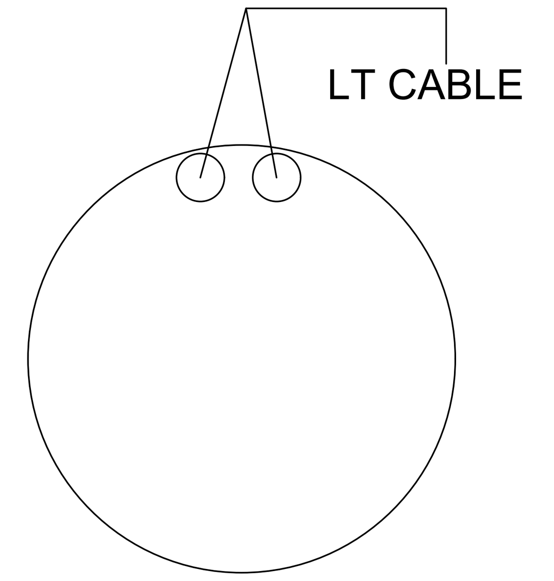
TITLE:-

INDICATIVE LT SUPPLY DISTRIBUTION DIAGRAM

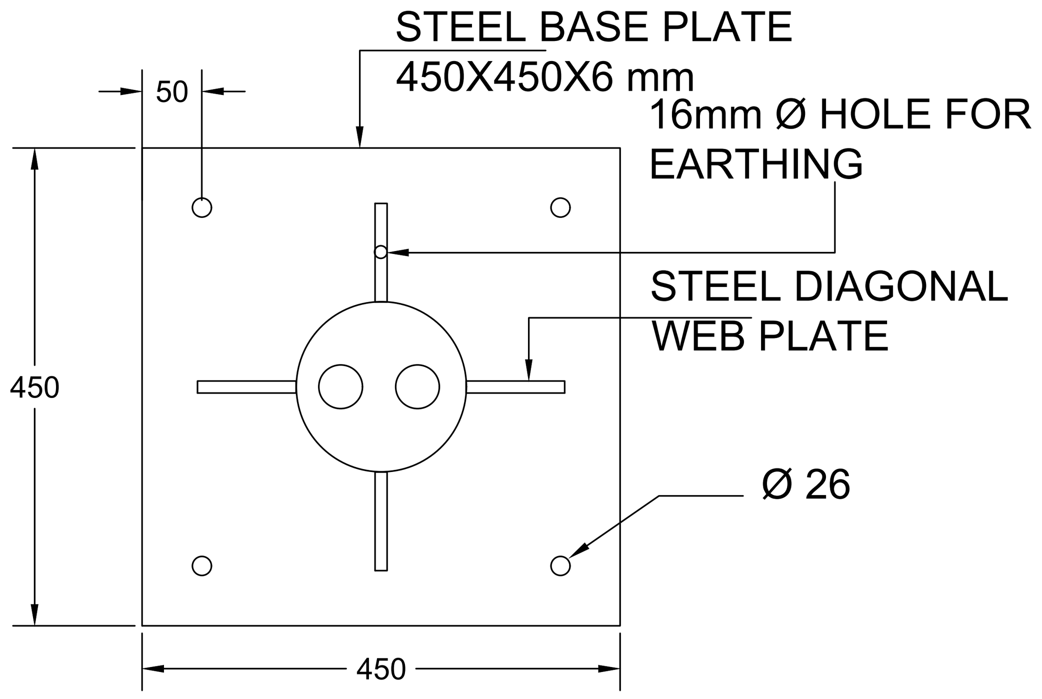
DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-ELE-002_A0		
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN		09.09.2023



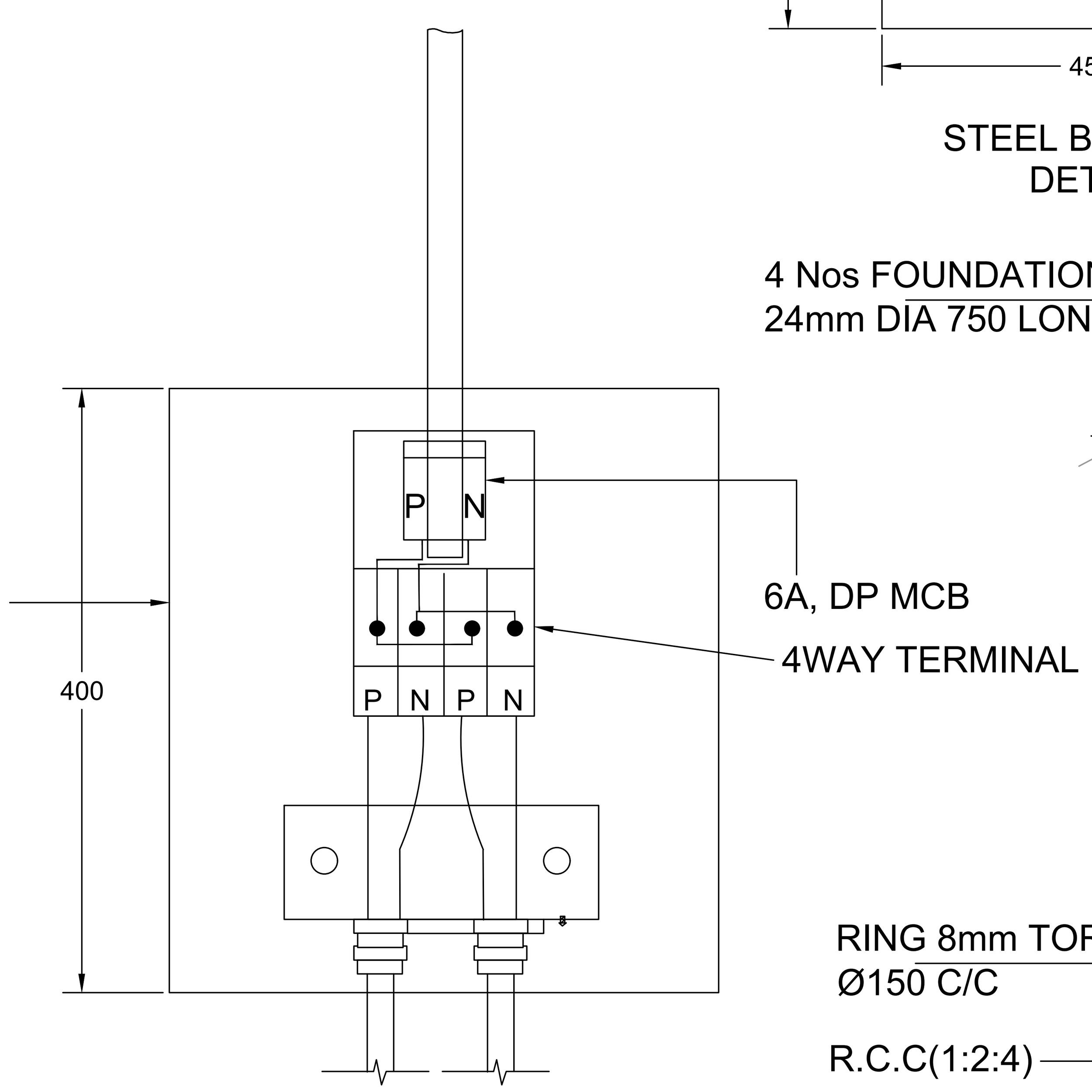
DECORATIVE LIGHT POLE DETAILS



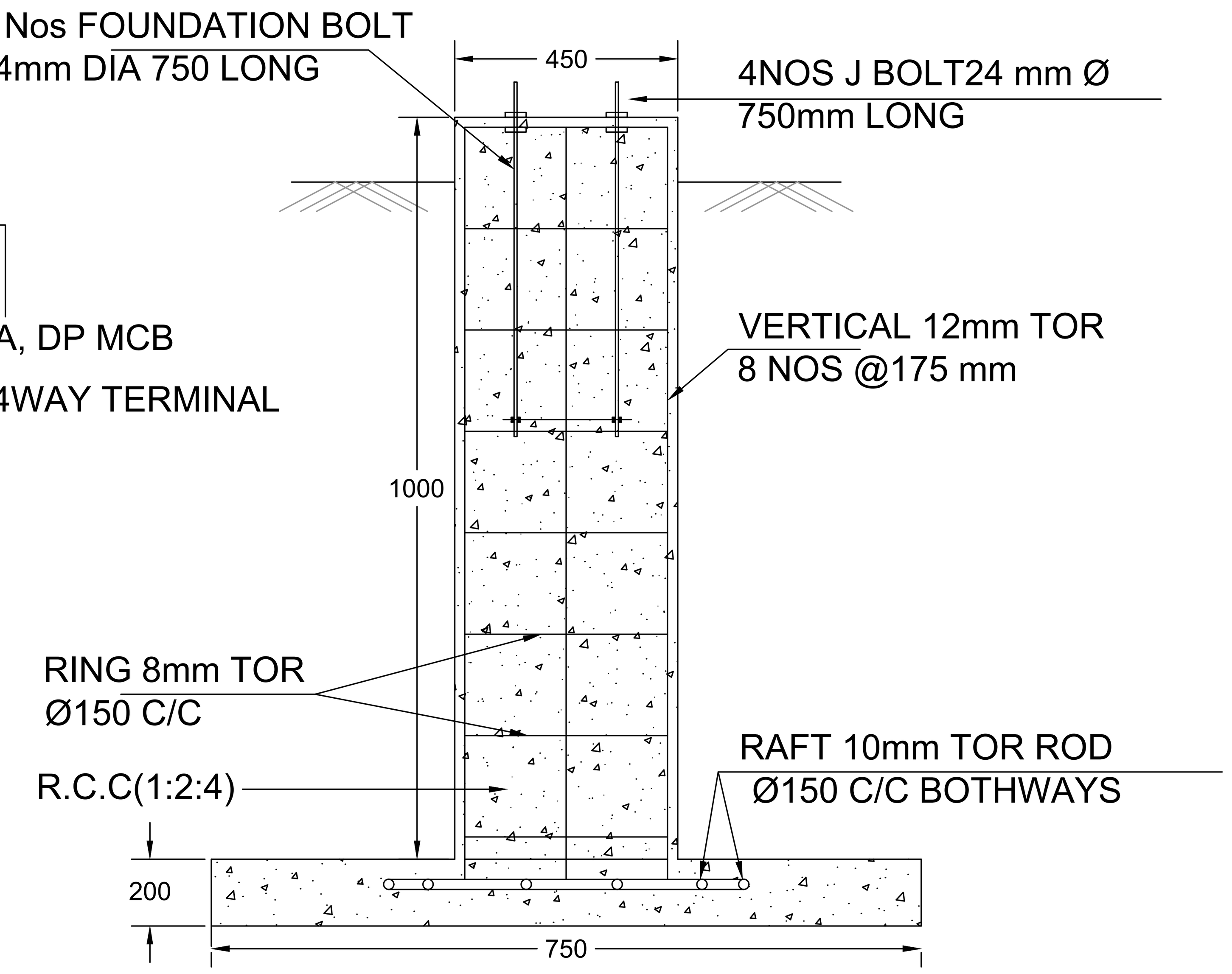
CROSS-SECTION OF B1 - B2
DETAIL-C



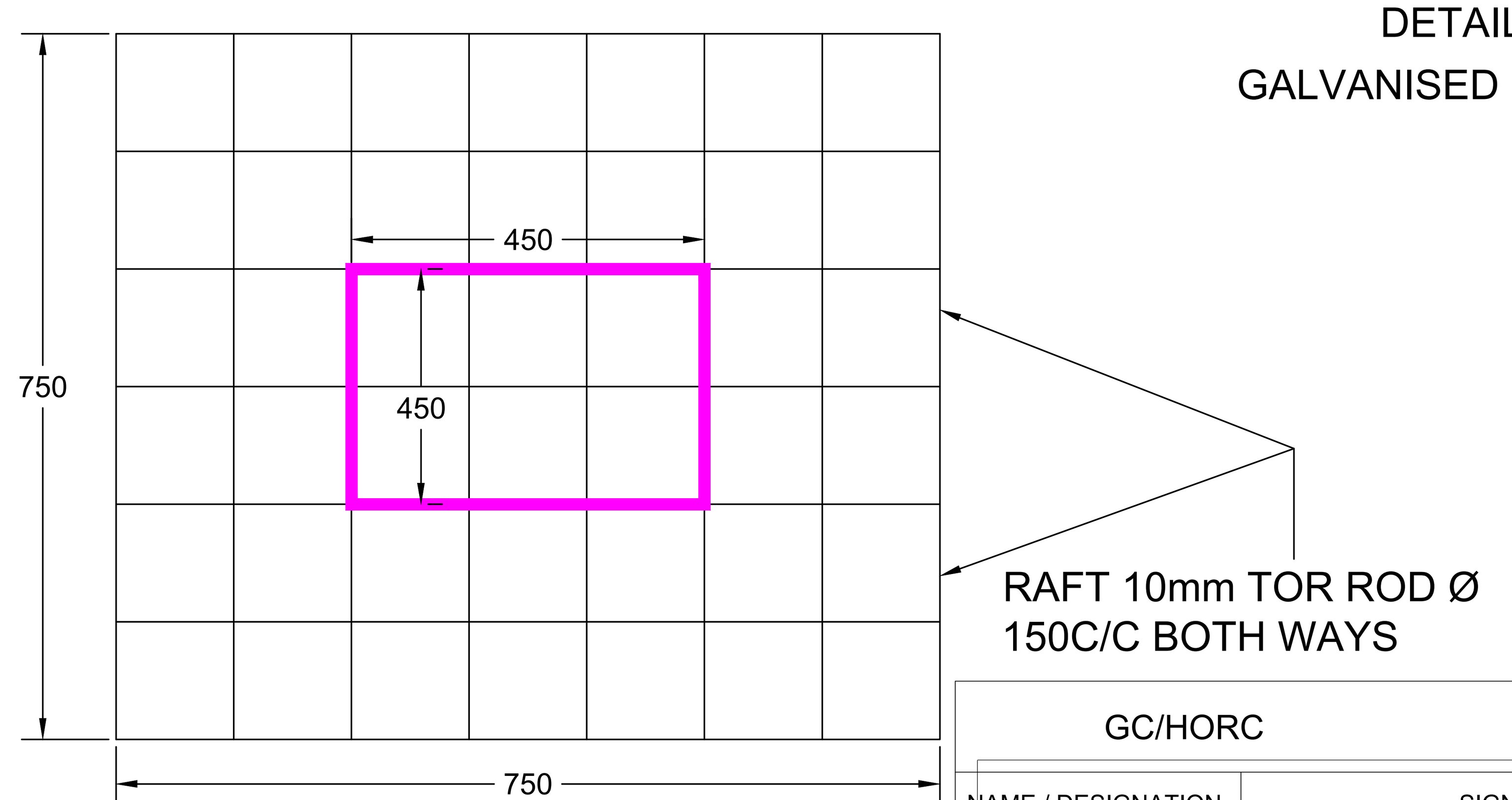
STEEL BASE PLATE
DETAIL - A



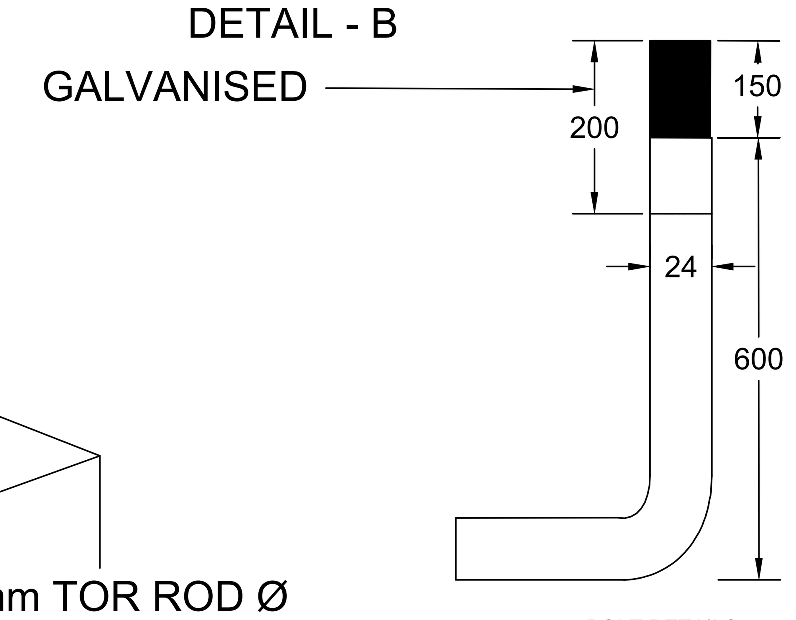
DETAIL - C



DETAIL - B



FOUNDATION DETAILS



BOLT DETAILS

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. ALL LOOSE WIRES SHOULD BE BOUND NEATLY BY CABLE TIES.
3. EARTH WIRE TO BE SEPERATELY RUN & CONNECTED TO THE COLUMN EARTHING TERMINAL.
4. TYPE OF INSTALLATION ARM (SINGLE /DOUBLE AND STRAIGHT/CURVED HANGING) OF LIGHT SHALL BE DECIDED BY ENGINEER .

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		VIKRAM YADAV GM/ A&IE/HRIDC	
A.S.JANGHU CRE/ELECT.		JYOTI SANGWAN DGM/Elect.	
VIKAS KUMAR HARIT SRE/GEN/Elect.			

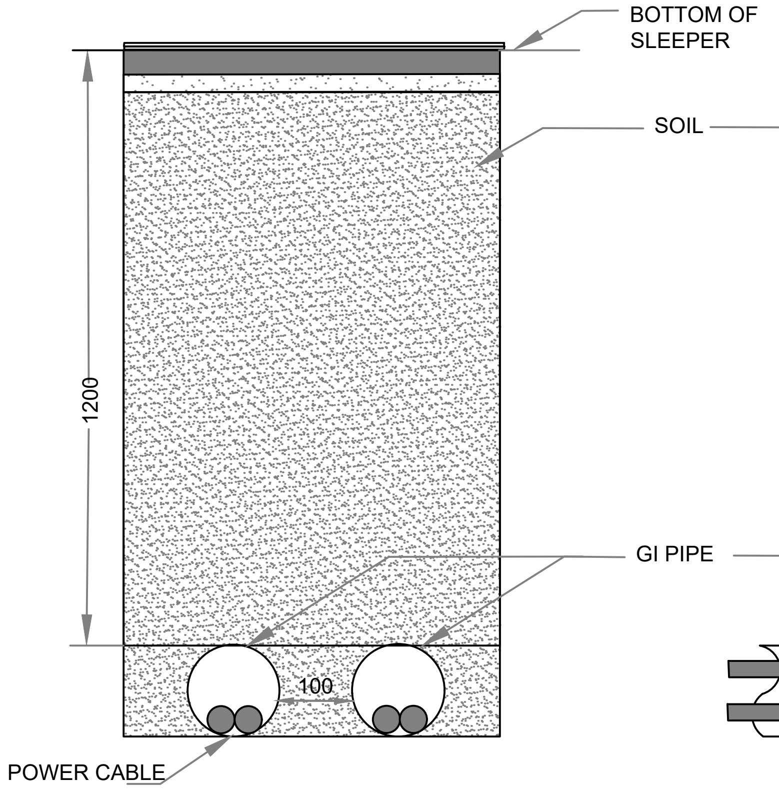
TITLE:-
INDICATIVE ARRANGEMENT OF DECORATIVE STREET LIGHT POLE AT STATION AND PLATFORM

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-ELE-03_A1	

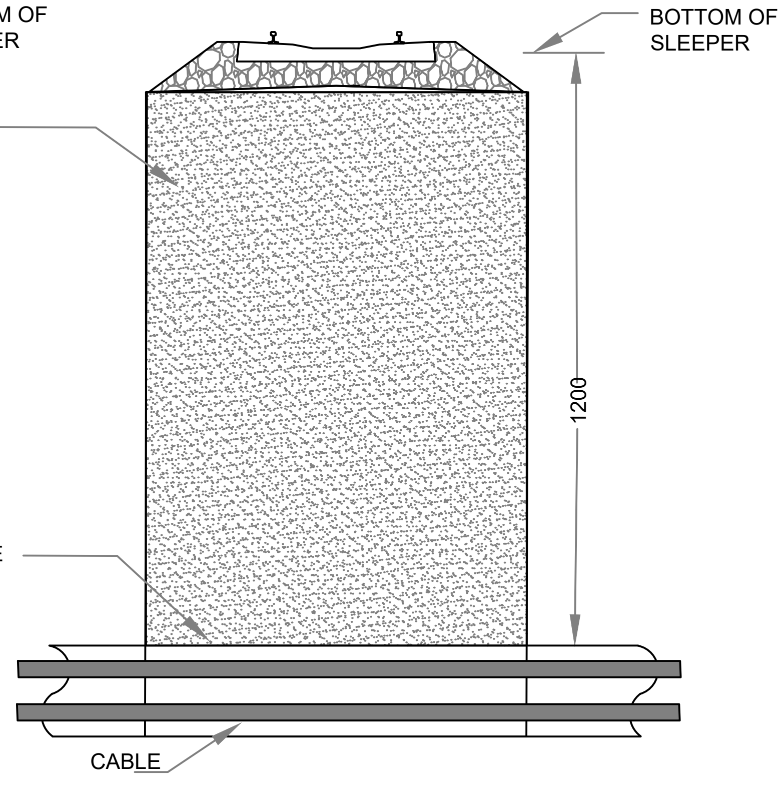
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	26.08.2023	05.12.2023

NOTE:

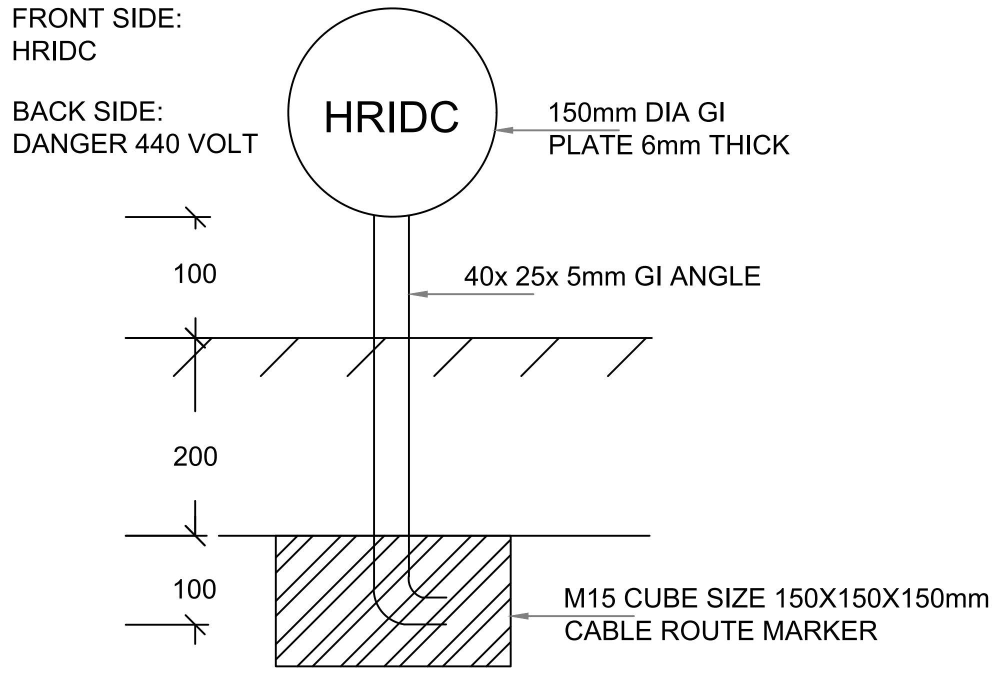
1. ALL DIMENSIONS ARE IN MILLIMETRE.
2. FOR TRACK CROSSING GI PIPE 125mm Ø SHALL BE PROVIDED.
3. ROUTE MARKER SHALL BE PROVIDED AT EVERY 100m AND ON CHANGE OF DIRECTION OF CABLE ROUTE.



ACROSS THE TRACK



ACROSS THE TRACK



GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL	[signature]	VIKRAM YADAV GM/ A&IE/HRIDC	
A.S.JANGHU CRE/ELECT.	[signature]	JYOTI SANGWAN DGM/Elect.	
VIKAS KUMAR HARIT SRE/GEN/Elect.	[signature]		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

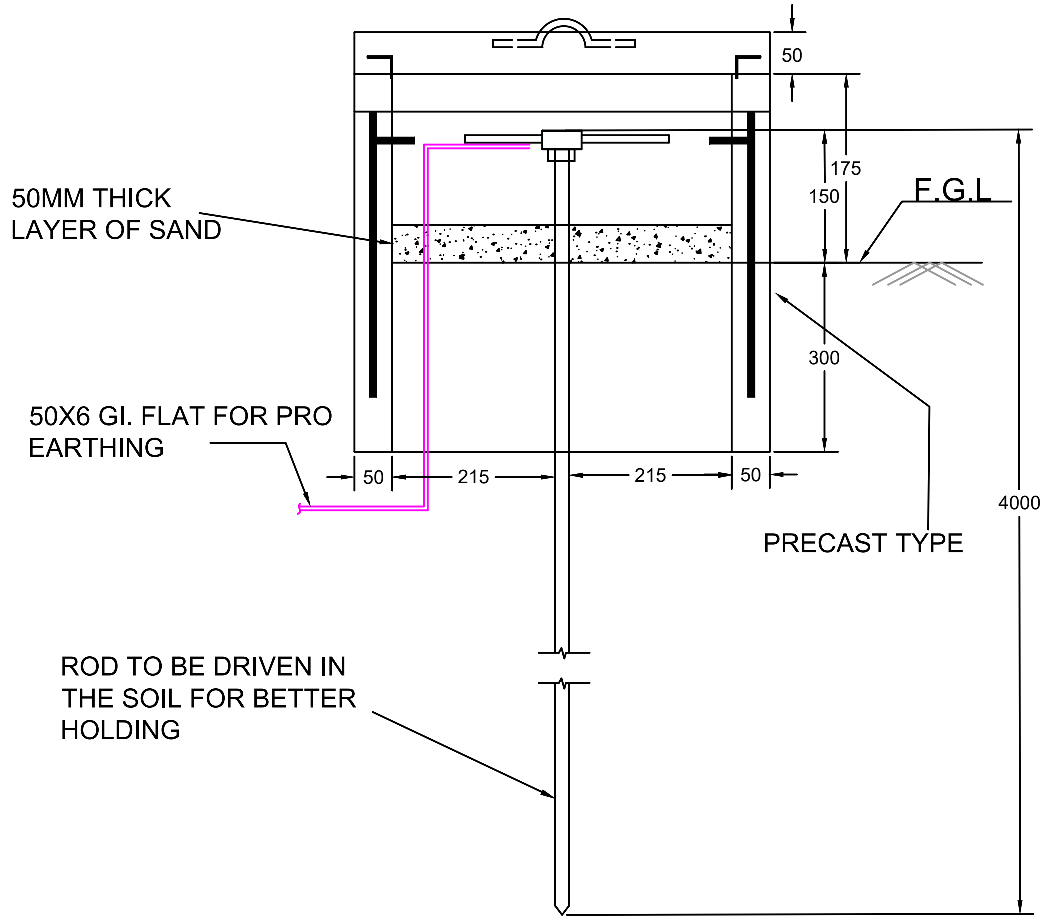
CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE | SMEC

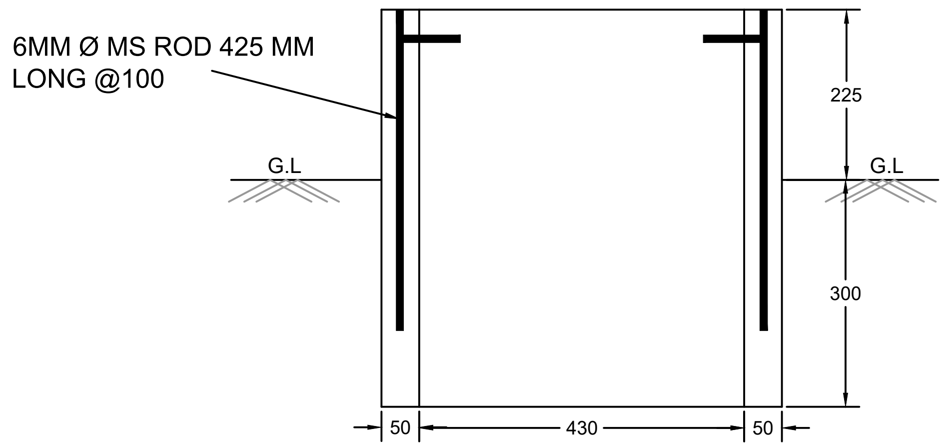
TITLE:-
INDICATIVE CABLE ROUTE PLAN FOR TRACK CROSSING OF POWER CABLE AND ROUTE MARKER

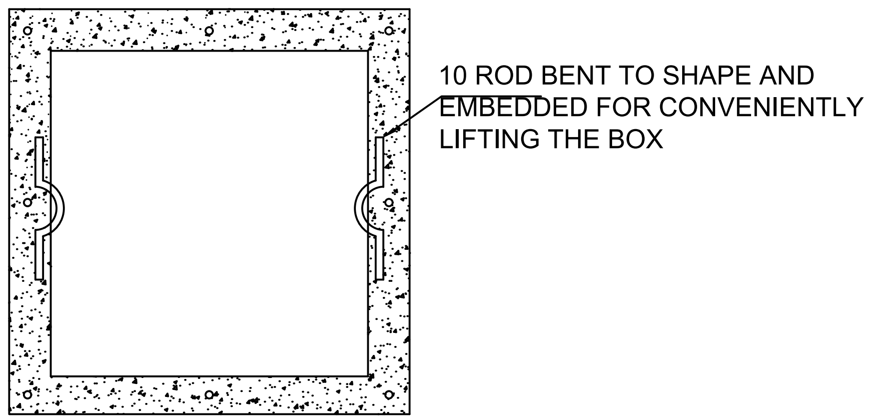
DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-ELE-04_A0		
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	21.09.2023	



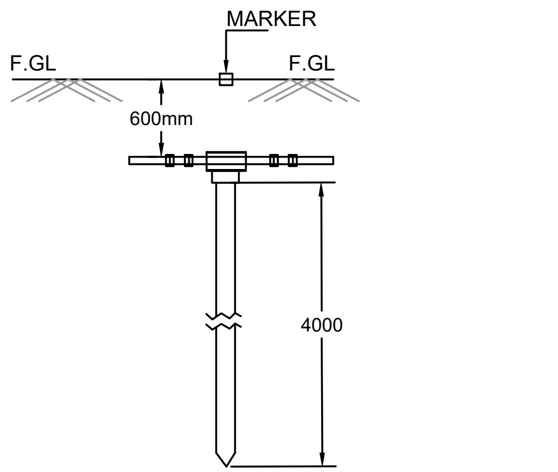
TYPICAL ARRANGEMENT OF EARTH ELECTRODE

DETAIL - 1



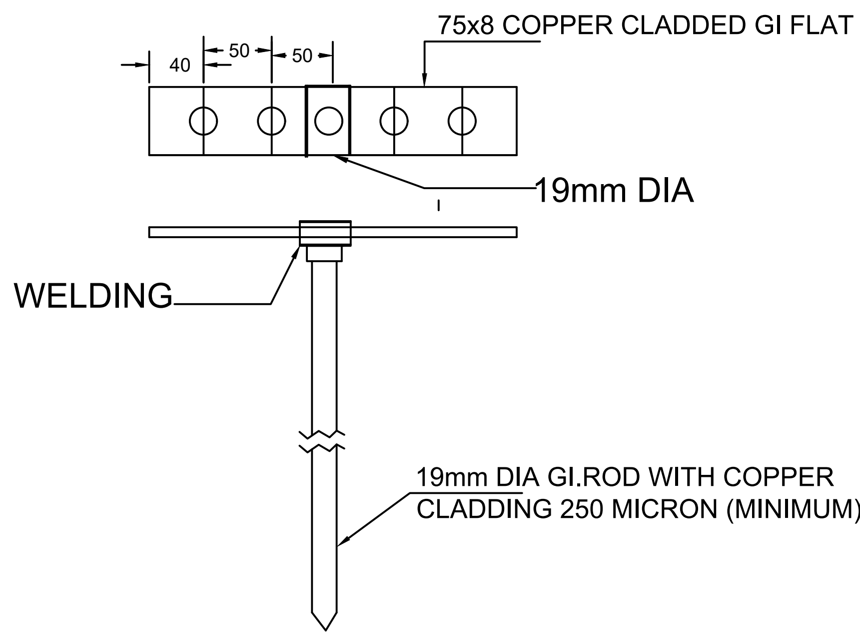


DETAIL - 2

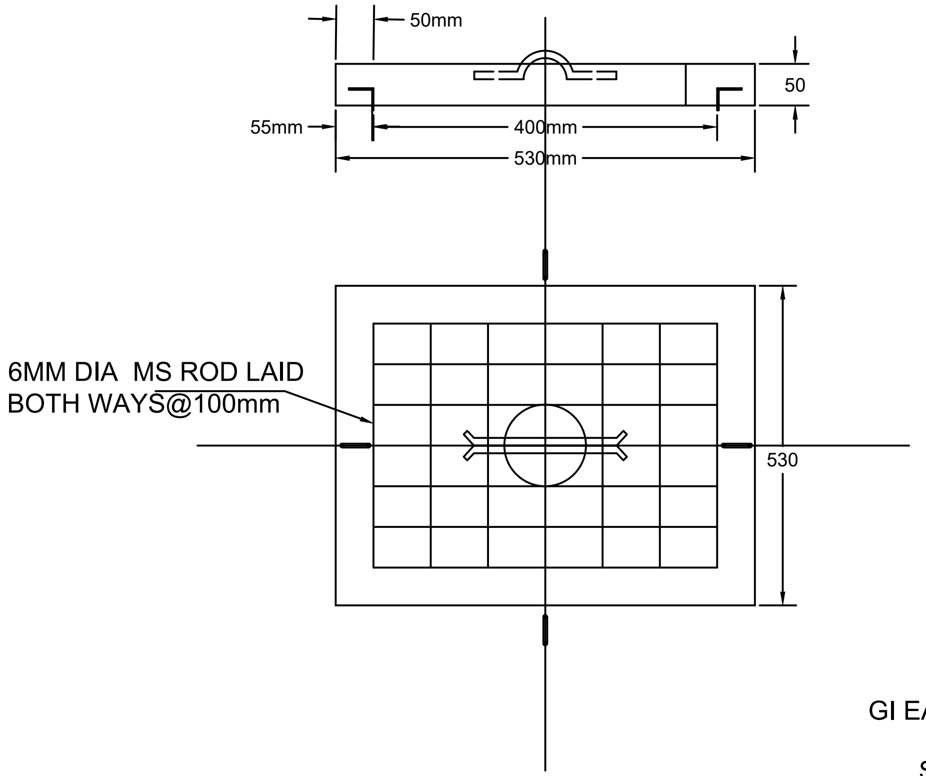


FABRICATION DETAILS OF EARTH ELECTRODE LENGTH OF 3M

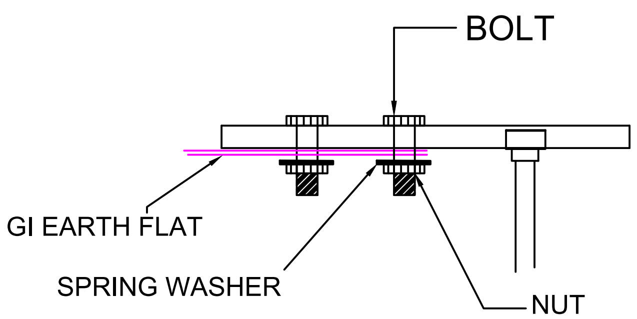
DETAIL - 4



DETAIL - 5



DETAIL - 3



DETAIL - 4A

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. THE CONCRETE BOX AND COVER SHALL BE CAST WITH RCC M25 GRADE CONCRETE.
3. 75X8 FLAT 280MM LONG SHALL BE WELDED WITH ROD BEFORE COPPER CLADDING.
4. EARTH GI BOLTSHALL BE PROVIDED WITH GI SPRING WASHER AND NUT.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	VIKRAM YADAV GM/ A&IE/ HRIDC	
SUDHIR AGRAWAL DPD/CIVIL		JYOTI SANGWAN DGM/ Elect.	
A.S. JANGHU CRE/Elect.			
VIKAS KUMAR HARIT SRE/GEN/Elect.			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

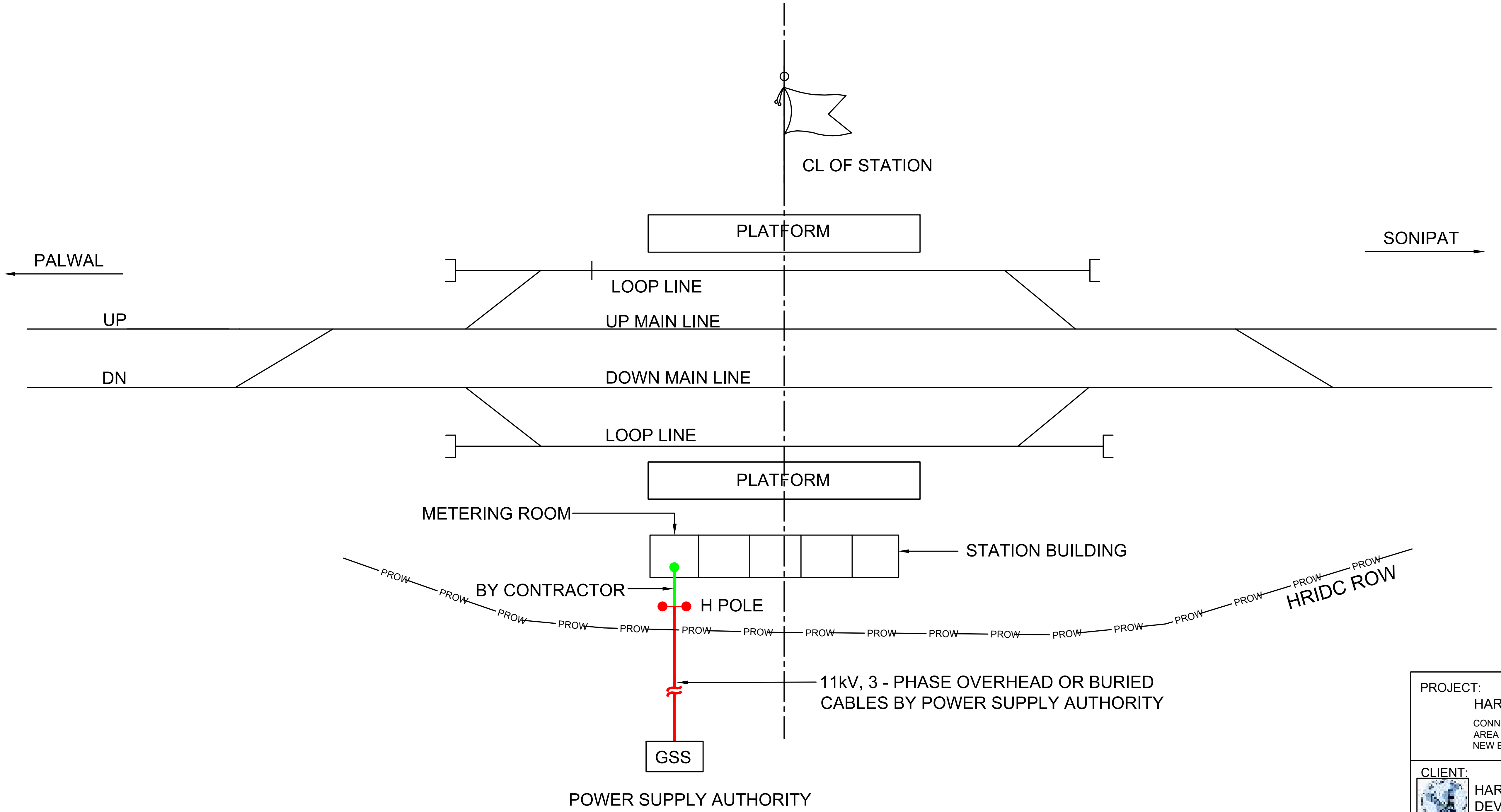
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE | SMEC

TITLE:- INDICATIVE EARTHING ARRANGEMENT OF ELECTRICAL SYSTEM BY COPPER CLADDED ELECTRODE

DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-ELE-05_A0		1
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	26.08.2023	

NOTES :
1. RED:- POWER SUPPLY AUTHORITY SCOPE
2. GREEN:- CONTRACTOR'S SCOPE



GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		VIKRAM YADAV GM/ A&IE/HRIDC	
A.S.JANGHU CRE/ELECT.		JYOTI SANGWAN DGM/Elect.	
VIKAS KUMAR HARIT SRE/GEN/Elect.			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

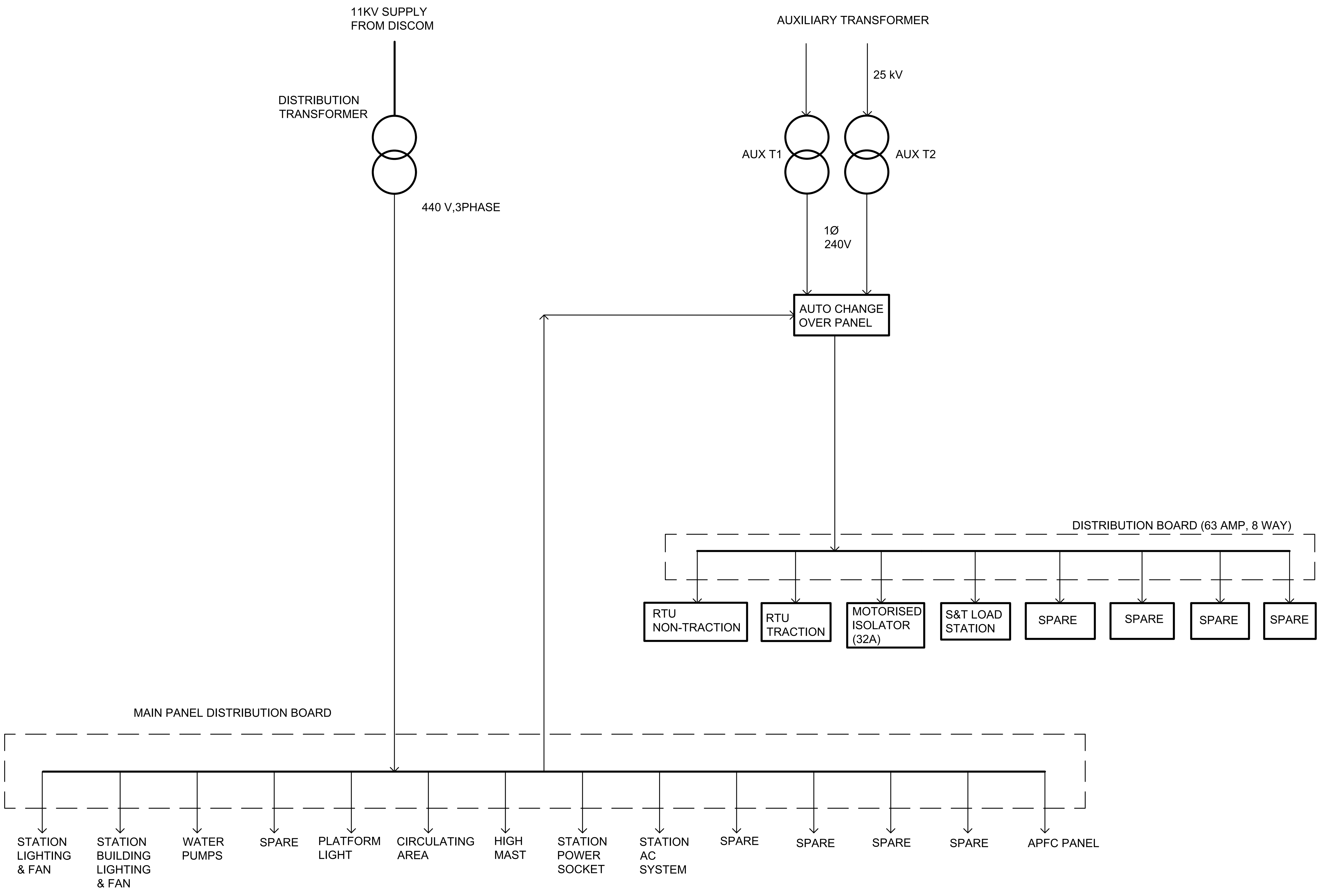
RITES THE INFRASTRUCTURE PEOPLE | SMEC

TITLE:- INDICATIVE SCHEMATIC DRAWING OF 11 KV POWER SUPPLY ARRANGEMENT.

DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-ELE-06_A0	

SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	29.08.2023	

INDICATIVE LT SUPPLY SYSTEM WITH LOCAL & AUXILIARY TRANSFORMER SUPPLY



GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	[signature]
SUDHIR AGRAWAL DPD/CIVIL	[signature]	VIKRAM YADAV GM/ A&IE/HRIDC	[signature]
A.S.JANGHU CRE/ELECT.	[signature]	JYOTI SANGWAN DGM/Elect.	
VIKAS KUMAR HARIT SRE/GEN/Elect.	[signature]		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

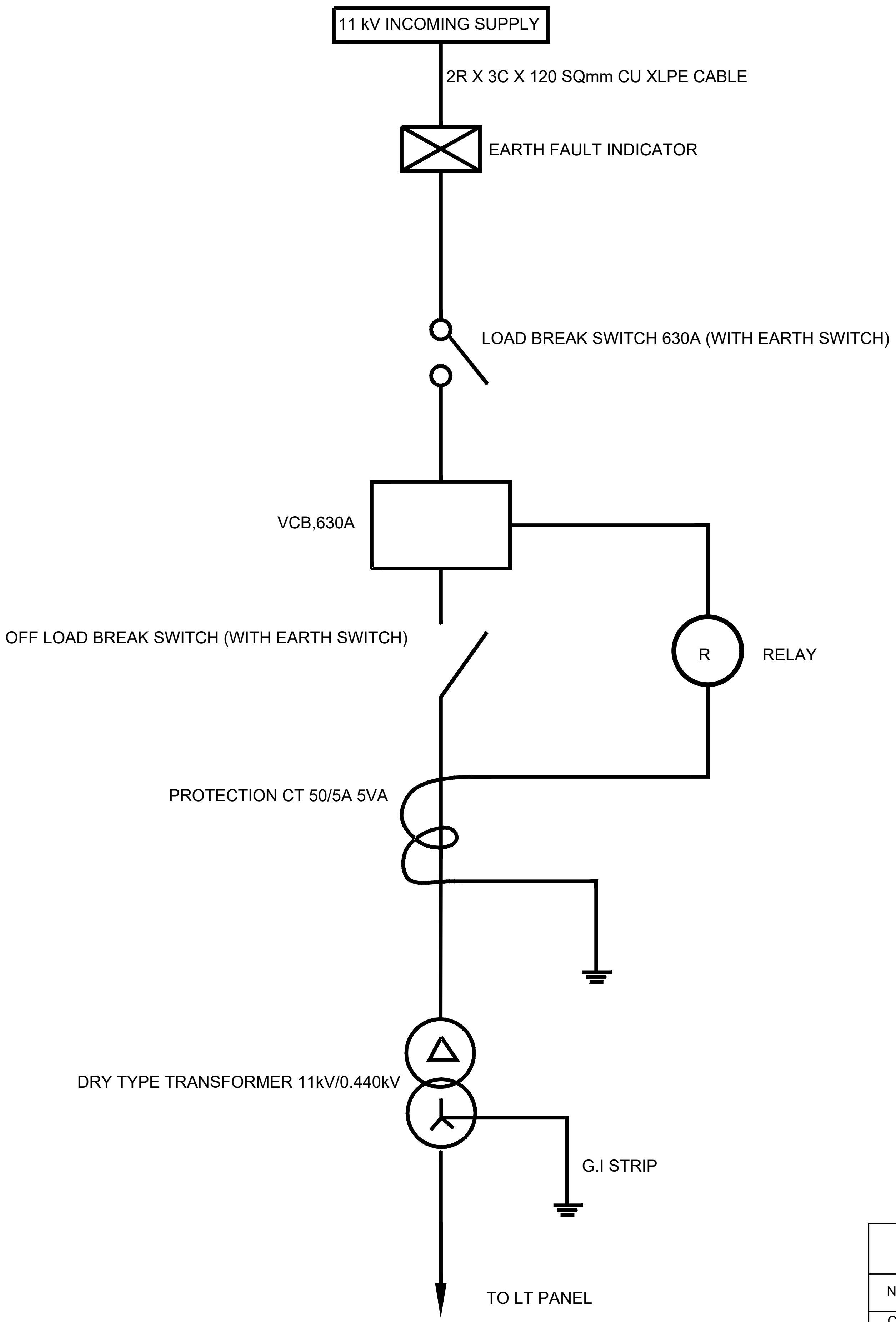
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC Member of the Surbana Jurong Group

TITLE:-
INDICATIVE LT SUPPLY SYSTEM WITH LOCAL & AUXILIARY TRANSFORMER SUPPLY

DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-ELE-007_A1		
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	22.09.2023	05.12.2023

COMPACT SUBSTATION SLD



GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD		SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL		VIKRAM YADAV GM/ A&IE/HRIDC	
A.S.JANGHU CRE/ELECT.		JYOTI SANGWAN DGM/Elect.	
VIKAS KUMAR HARIT SRE/GEN/Elect.			

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

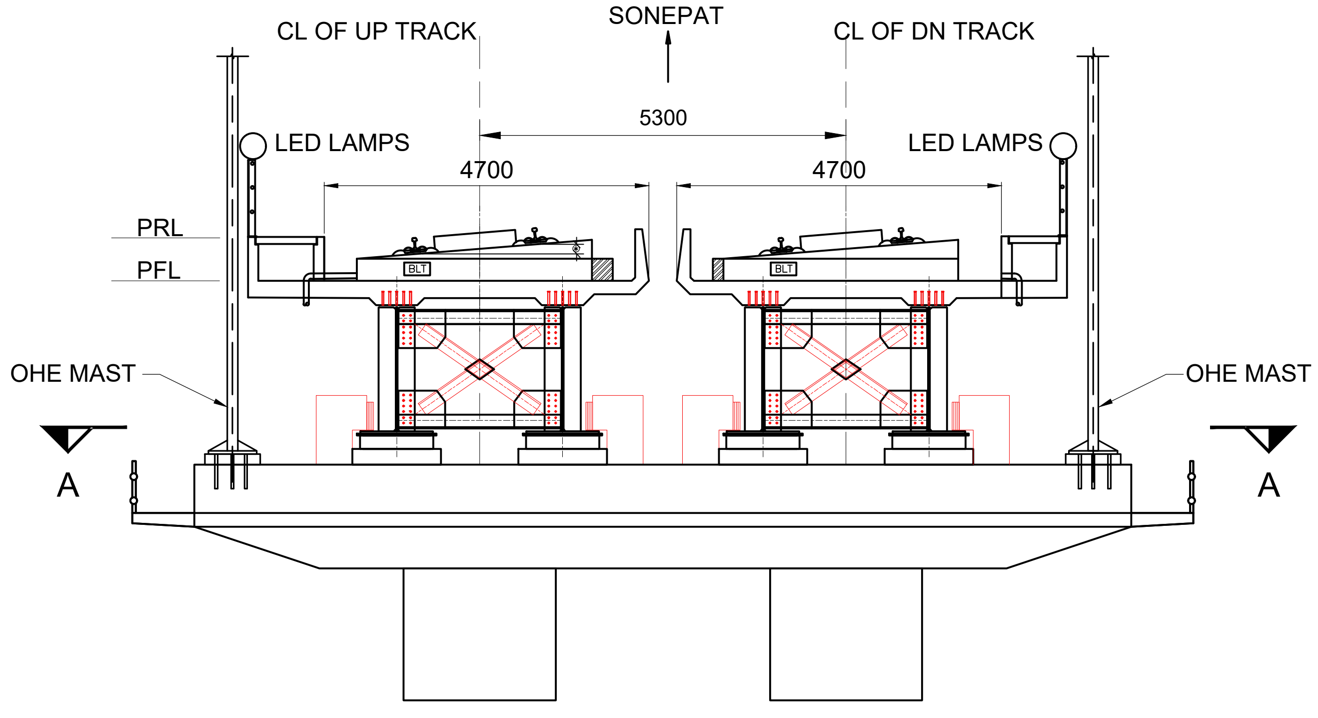
CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE

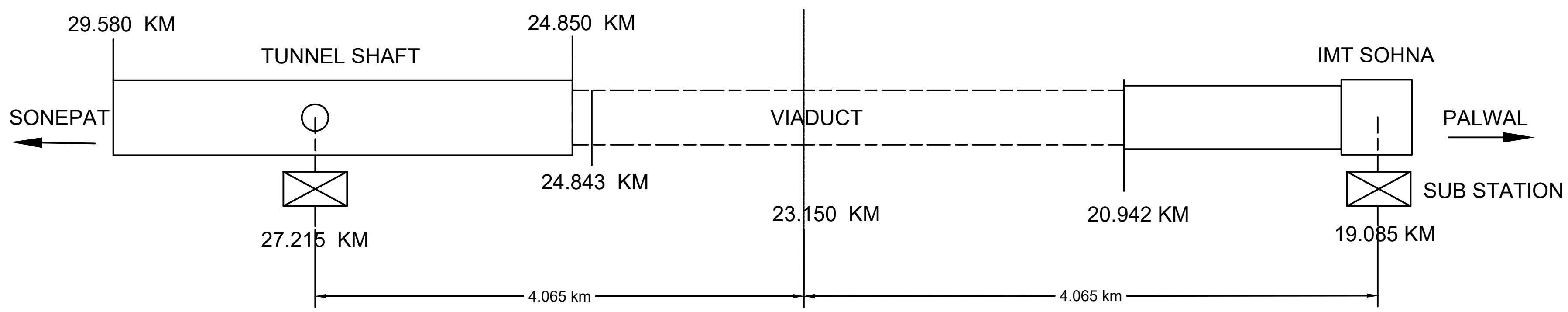
SMEC

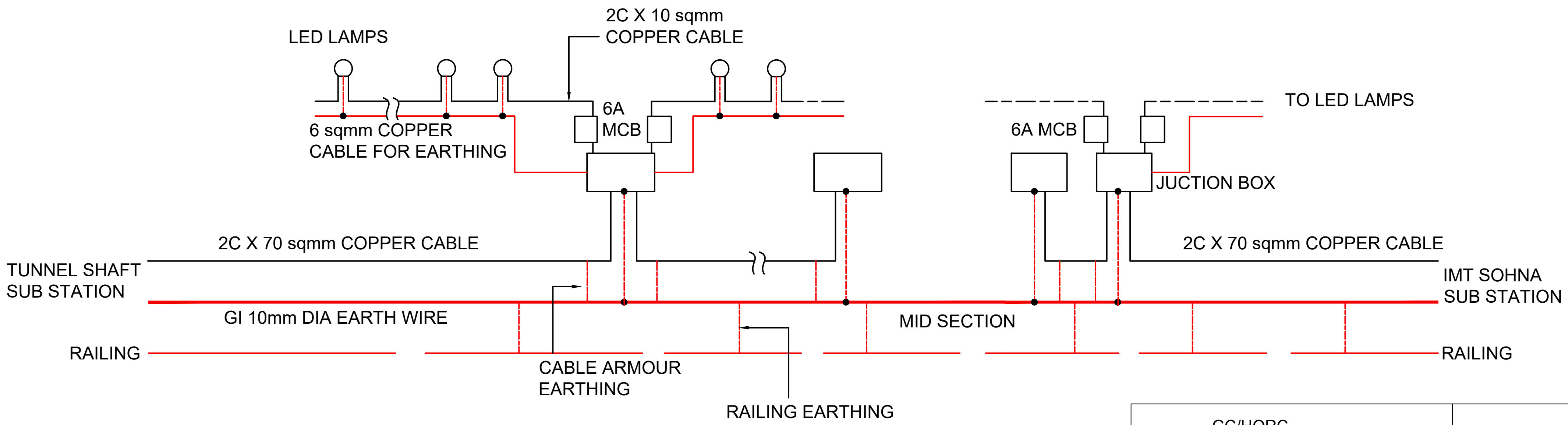
TITLE:- INDICATIVE COMPACT SUBSTATION (CSS) SINGLE LINE DIAGRAM

DRG. NO.		SHEET NO.
GC-HRIDC-C5-DRW-ELE-08_A0		
SCALE :	ISSUE DATE	REVISED DATE
AS SHOWN	22.09.2023	



VIADUCT TYPICAL SECTION





NOTES:

1. CIVIL CONTRACTOR SHALL PROVIDE VIADUCT RAILINGS IN LENGTHS NOT EXCEEDING 15m. THE DISTANCE BETWEEN TWO ADJACENT RAILINGS SHALL BE MINIMUM 50mm.
2. IF RAILING LENGTH IN ONE STRETCH EXCEEDS 15m, THAN BOTH RAILINGS SHALL BE EARTHED WITH 10mm DIA GI WIRE AT EVERY 20m.
3. THE 2C X 70 sqmm CABLE ARMOUR SHALL BE EARTHED AT EVERY END POINT OF CABLE WITH 10mm DIA GI WIRE.

GC/HORC		HRIDC	
NAME / DESIGNATION	SIGN	NAME / DESIGNATION	SIGN
CHAHATEY RAM PD	Chahatey Ram	SHIV OM DWIVEDI CPM/SOUTH	
SUDHIR AGRAWAL DPD/CIVIL	[illegible]	VIKRAM YADAV GM/ A&IE/HRIDC	
REETU PATIAL CDE/CIVIL	Reetu	JYOTI SANGWAN DGM/Elect.	
A.S.JANGHU CRE/ELECT.	[illegible]		
VIKAS KUMAR HARIT SRE/GEN/Elect.	[illegible]		

PROJECT:
HARYANA ORBITAL RAIL CORRIDOR
CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:
HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

CONSULTANT:
GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR
RITES Limited in consortium with SMEC International Pty. Ltd.

RITES THE INFRASTRUCTURE PEOPLE
SMEC

TITLE:- INDICATIVE VIADUCT LIGHTING AND RAILING EARTHING ARRANGEMENT

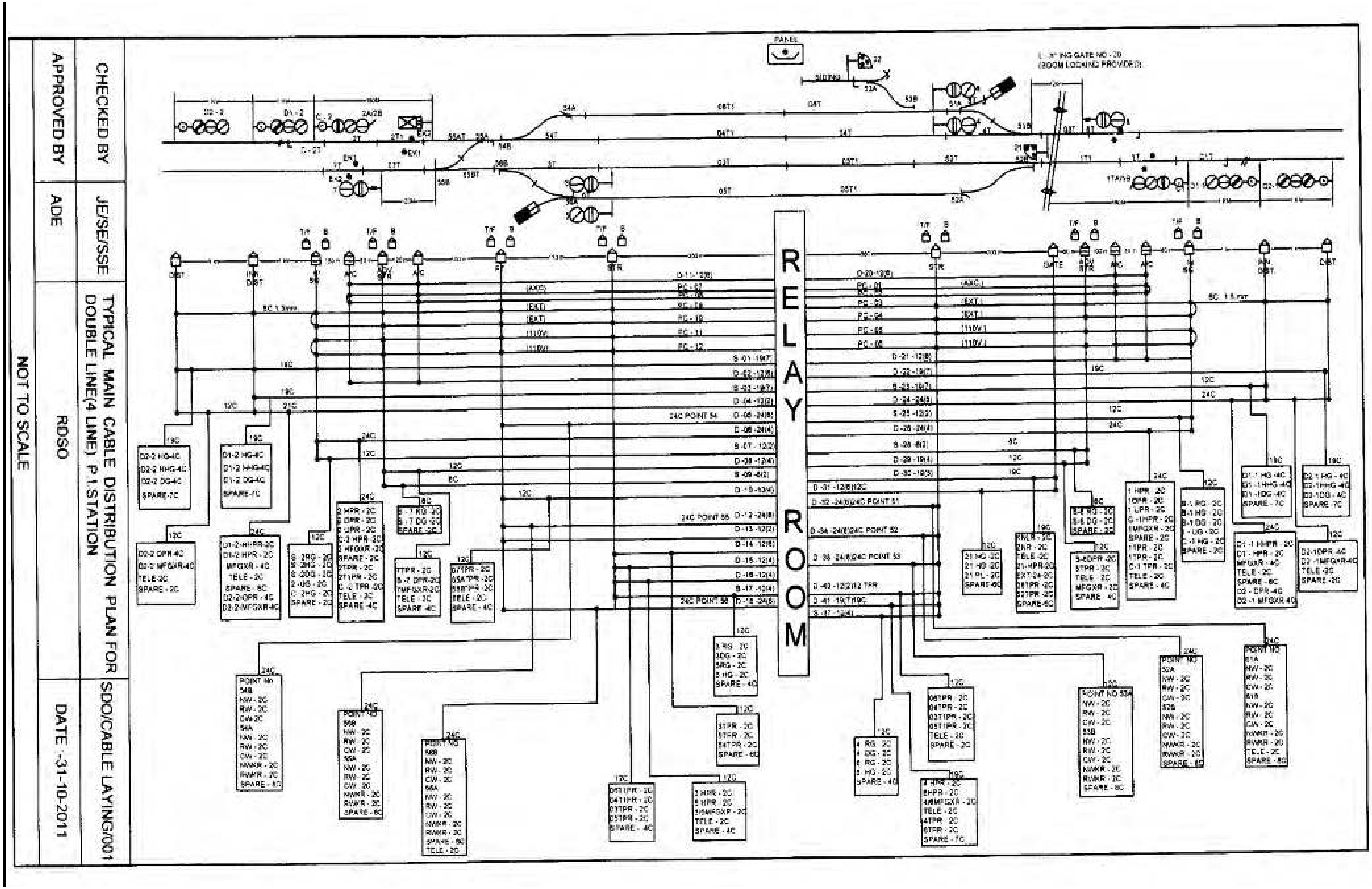
DRG. NO.	SHEET NO.
GC-HRIDC-C5-DRW-ELE-09_A0	1 OF 1

SCALE :	ISSUE DATE
AS SHOWN	12.10.2023

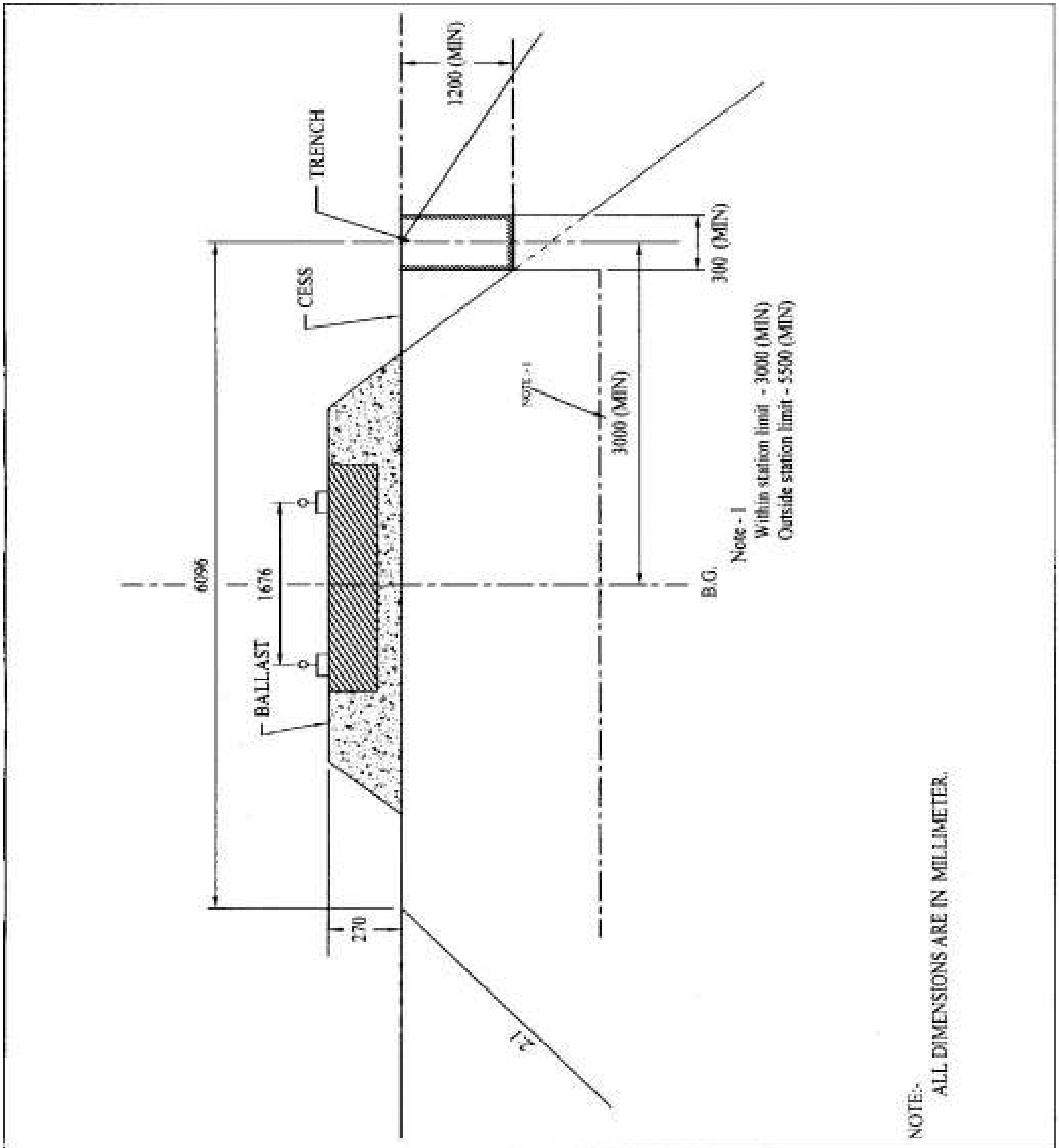
III. Signalling & Telecommunication Drawings

A

Annexure- 4

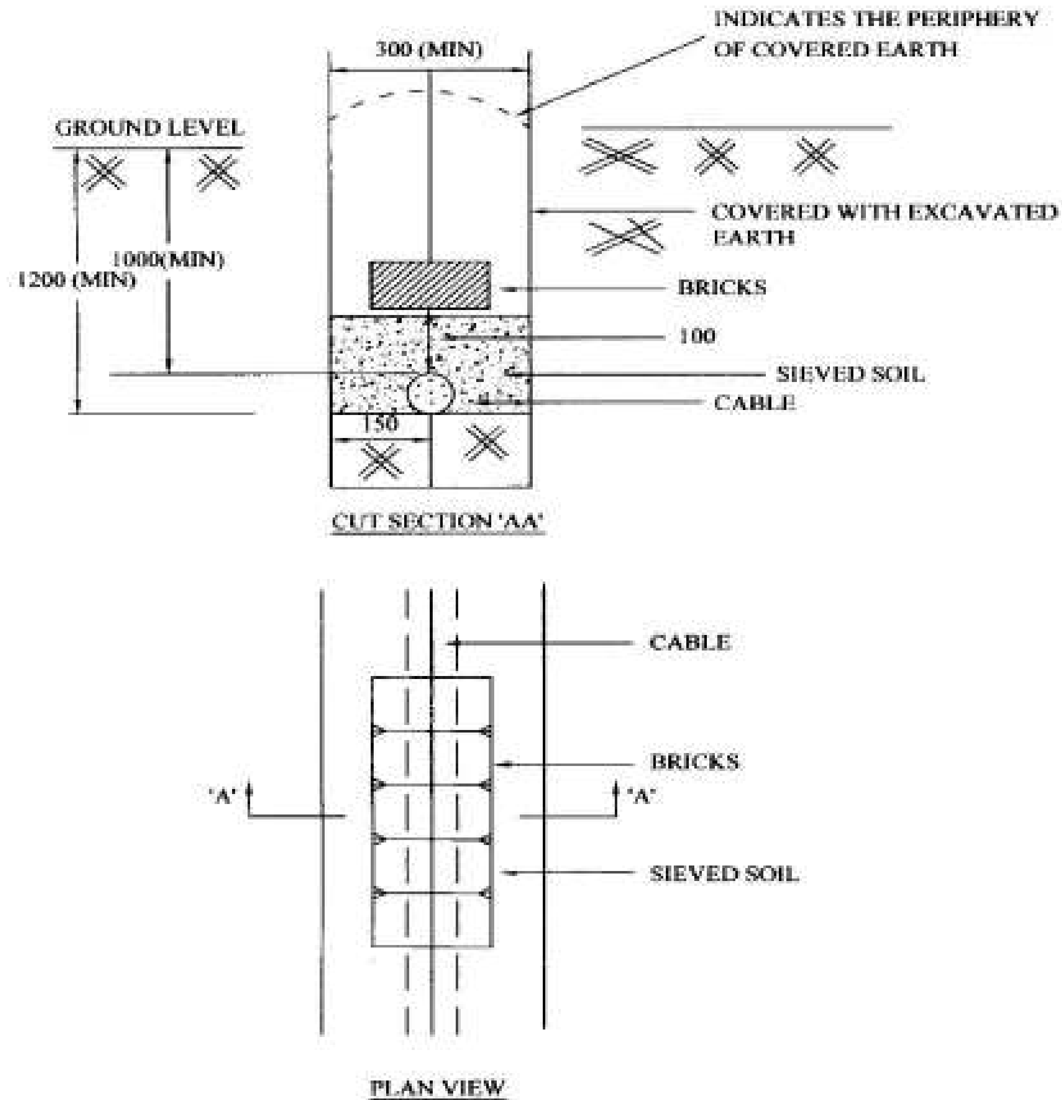

CHECKED BY
APPROVED BY
JE/SE/SSE
ADE
RDSO
TYPICAL MAIN CABLE DISTRIBUTION PLAN FOR DOUBLE LINE(4 LINE) P.I STATION
SDO/CABLE LAYING/001
DATE :-31-10-2011
NOT TO SCALE
RELAY ROOM

Annexure-6



CHECKED BY	JE/SE/SSE	POSITION OF TRENCHES FOR CABLE LAYING	SDO/CABLE LAYING /002
APPROVED BY	ADE	R D S O	DATE : 31-10-2011
NOT TO SCALE			

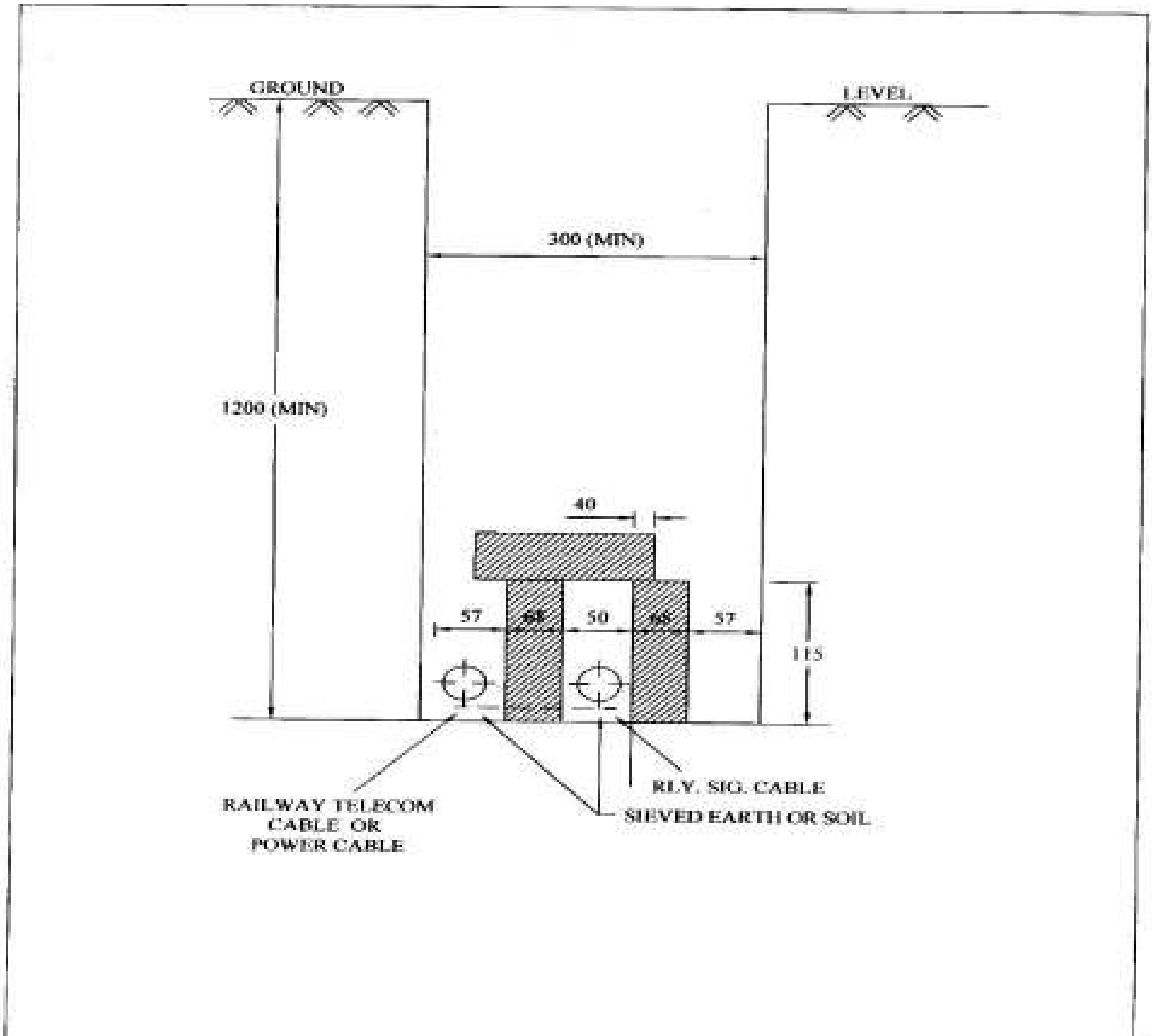
Annexure-7



NOTE :
1. ALL DIMENSIONS ARE IN MILLIMETER.

CHECKED BY	JE/SE/SSE	CABLE TRENCH	SDO/CABLE LAYING/003
APPROVED BY	ADE	R. D. S. O.	DATE : 31-10-2011
NOT TO SCALE			

Annexure-9



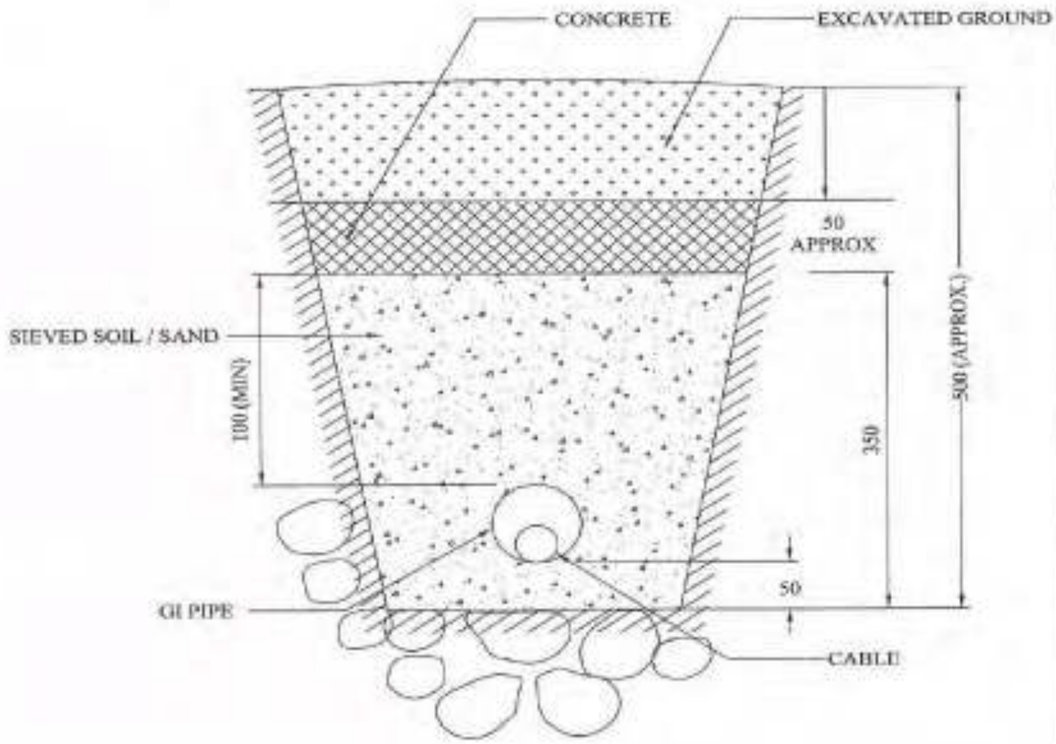
NOTE:

2. TELECOM CABLE/POWER CABLE TO BE LAID AWAY FROM THE TRACK
1. DIMENSIONS ARE IN MILLIMETRES

CHECKED BY	JE/SE/SSE	LAYING OF SIGNALLING CABLE & TELECOM/POWER CABLE IN SAME TRENCH	SDO/CABLE LAYING/004
APPROVED BY		R. D. S. O.	DATE :- 31-10-2011
NOT TO SCALE			

Annexure-11

ANNEXURE-11



NOTE:-

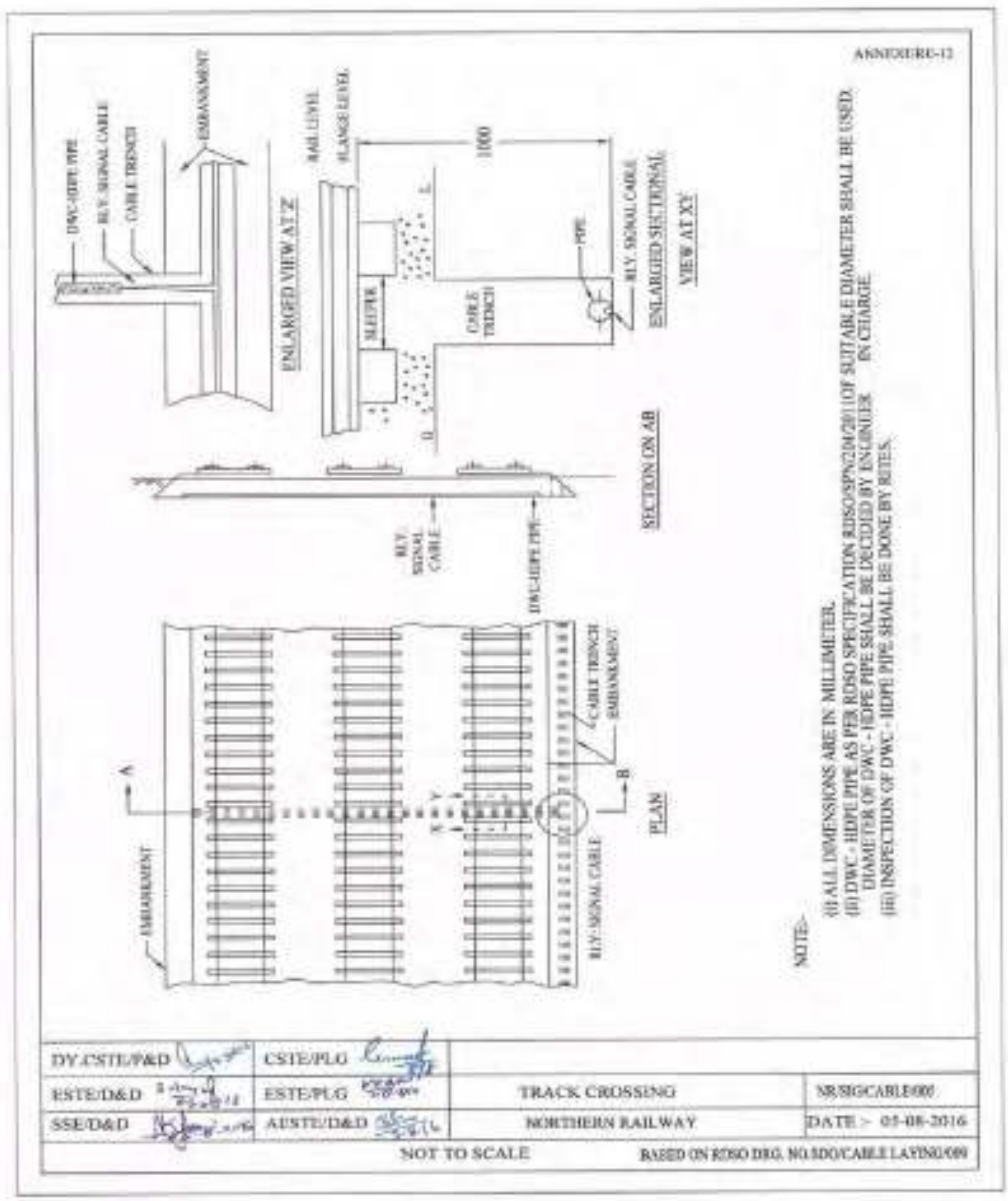
(i)ALL DIMENSIONS ARE IN MILLIMETER.

(ii) G.I PIPE OF MEDIUM GRADE OF ISI MARK AS PER IS:1239(PART-I) OF SUITABLE DIAMETER SHALL BE USED. DIAMETER OF G.I.PIPE SHALL BE DECIDED BY ENGINEER IN CHARGE.

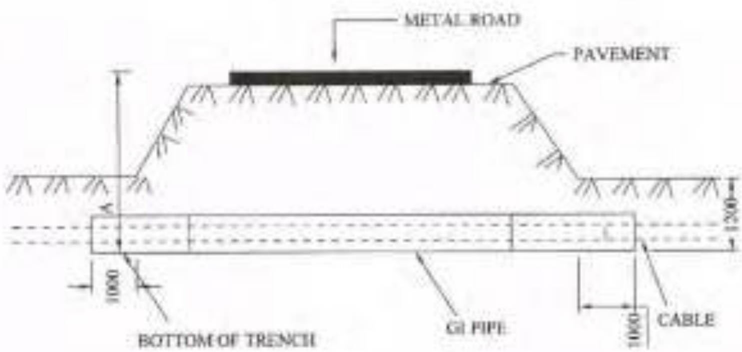
(iii) INSPECTION OF G.I PIPE SHALL BE DONE BY RITES.

DY.CSTE/P&D	CSTE/PLG		
ESTE/D&D	ESTE/PLG	LAYING OF CABLES IN ROCKY AREA	NR/SIG/CABLE/004
SSE/D&D	AESTE/D&D	NORTHERN RAILWAY	DATE :- 05-08-2016
	NOT TO SCALE		BASED ON RDSO DRG. NO.SDO/CABLE LAYING/008

Annexure-12


ANNEXURE-12
ENLARGED VIEW AT 'Z'
ENLARGED SECTIONAL VIEW AT XY
1000
SECTION ON AB
PLAN
NOTE-
(i) ALL DIMENSIONS ARE IN MILLIMETER.
(iii) INSPECTION OF DWC - HDPE PIPE SHALL BE DONE BY RITES.
DY.CSTE/P&D
CSTE/PLG
ESTE/D&D
ESTE/PLG
TRACK CROSSING
SSE/D&D
AESTE/D&D
NORTHERN RAILWAY
DATE :- 05-08-2016
NOT TO SCALE

ANNEXURE-13



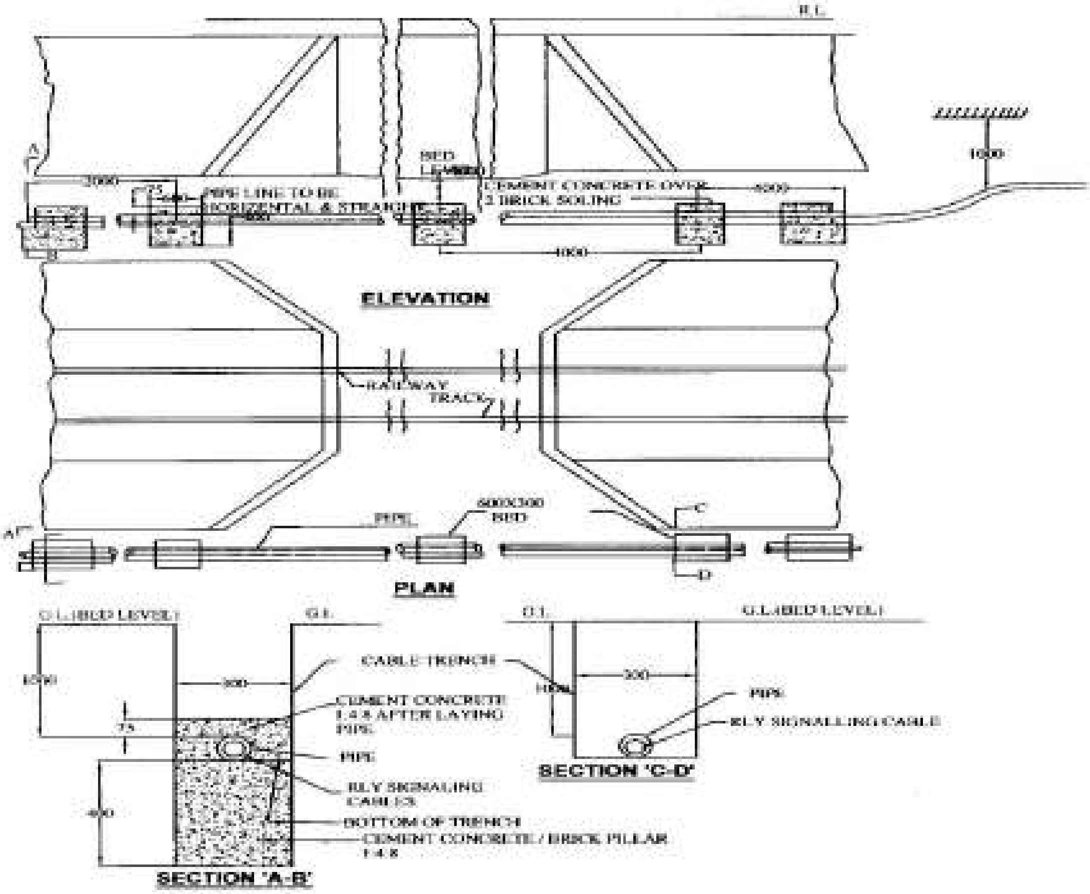
NOTE:-

(I) ALL DIMENSIONS ARE IN MILLIMETER.

(ii) G.I PIPE OF MEDIUM GRADE OF ISI MARK AS PER IS:1239(PART-I) OF SUITABLE DIAMETER SHALL BE USED. DIAMETER OF G.I.PIPE SHALL BE DECIDED BY ENGINEER IN CHARGE.

(iii) INSPECTION OF G.I.PIPE SHALL BE DONE BY RITES.

DY.CSTE/P&D	CSTE/PLG		
ESTE/D&D	ESTE/PLG	ROAD CROSSINGS	NR/SIG/CABLE/006
SSE/D&D	AESTE/D&D	NORTHERN RAILWAY	DATE :- 05-08-2016
	NOT TO SCALE	BASED ON RDSO DRG. NO.SDO/CABLE LAYING/018	



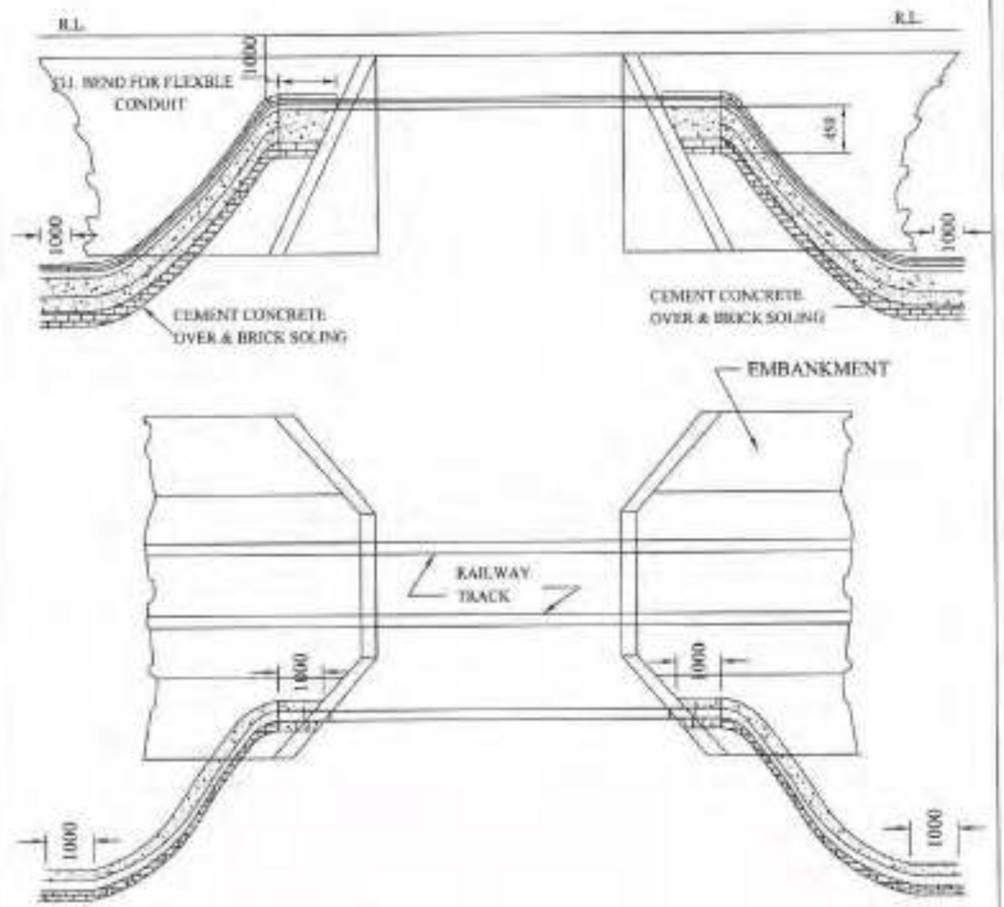
NOTE:-

ALL DIMENSIONS ARE IN MILLIMETER.

CHECKED BY	JE/SE/SSE	CABLE LAYING ON CULVERTS WITH LOW FLOOD LEVEL	SDO/CABLE LAYING/011
APPROVED BY	ADE	R.D.S.O	DATE :- 31-10-2011
NOT TO SCALE			

Annexure-15

ANNEXURE-15



NOTE:-

(i) ALL DIMENSIONS ARE IN MILLIMETER.

(ii) ON APPROACH OF CULVERTS, DWC- HDPE PIPE OF SUITABLE DIAMETERAS PER RDSO SPECIFICATION RDSO/SPN/204/2011 SHALL BE USED.DIAMETER OF DWC -HDPE PIPE SHALL BE DECIDED BY ENGINEER IN CHARGE.

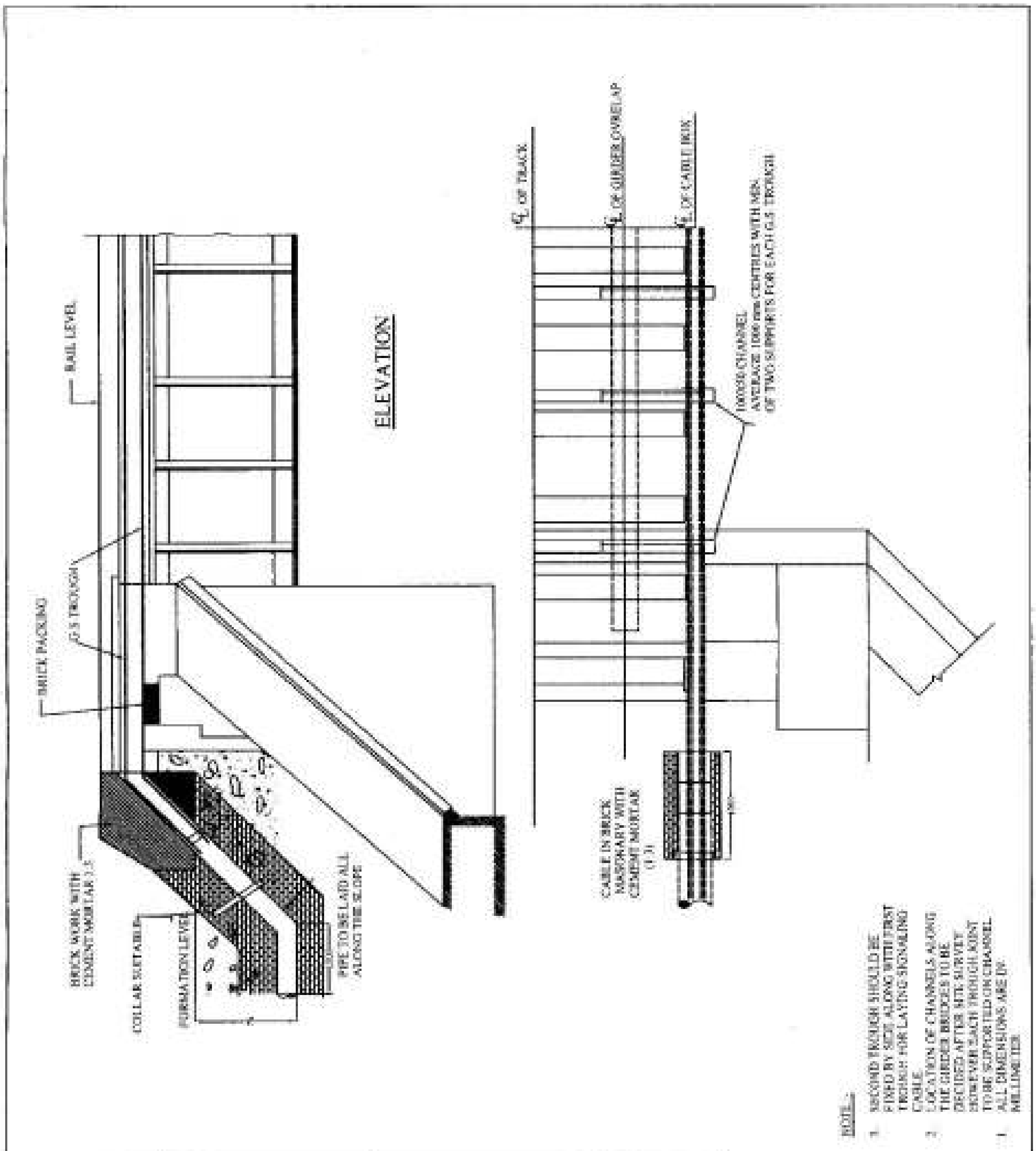
(iii) ON CULVERT PORTION, PERFORATED G.I PIPE OF MEDIUM GRADE OF ISI MARK AS PER IS:1239(PART-I) OF SUITABLE DIAMETER SHALL BE USED. DIAMETER OF G.I.PIPE SHALL BE DECIDED BY ENGINEER IN CHARGE.

(iv) AT JUNCTION POINT OF G.I AND DWC PIPE, A G.I.BEND OF 112.5 DEGREE,1 MTR. LENGTH AS PER IS-1239(Part-2) AND OVERLAPPING 250MM. WITH DWC PIPE SHALL BE USED.

(v) INSPECTION OF DWC-HDPE AND G.I. PIPE SHALL BE DONE BY RITES.

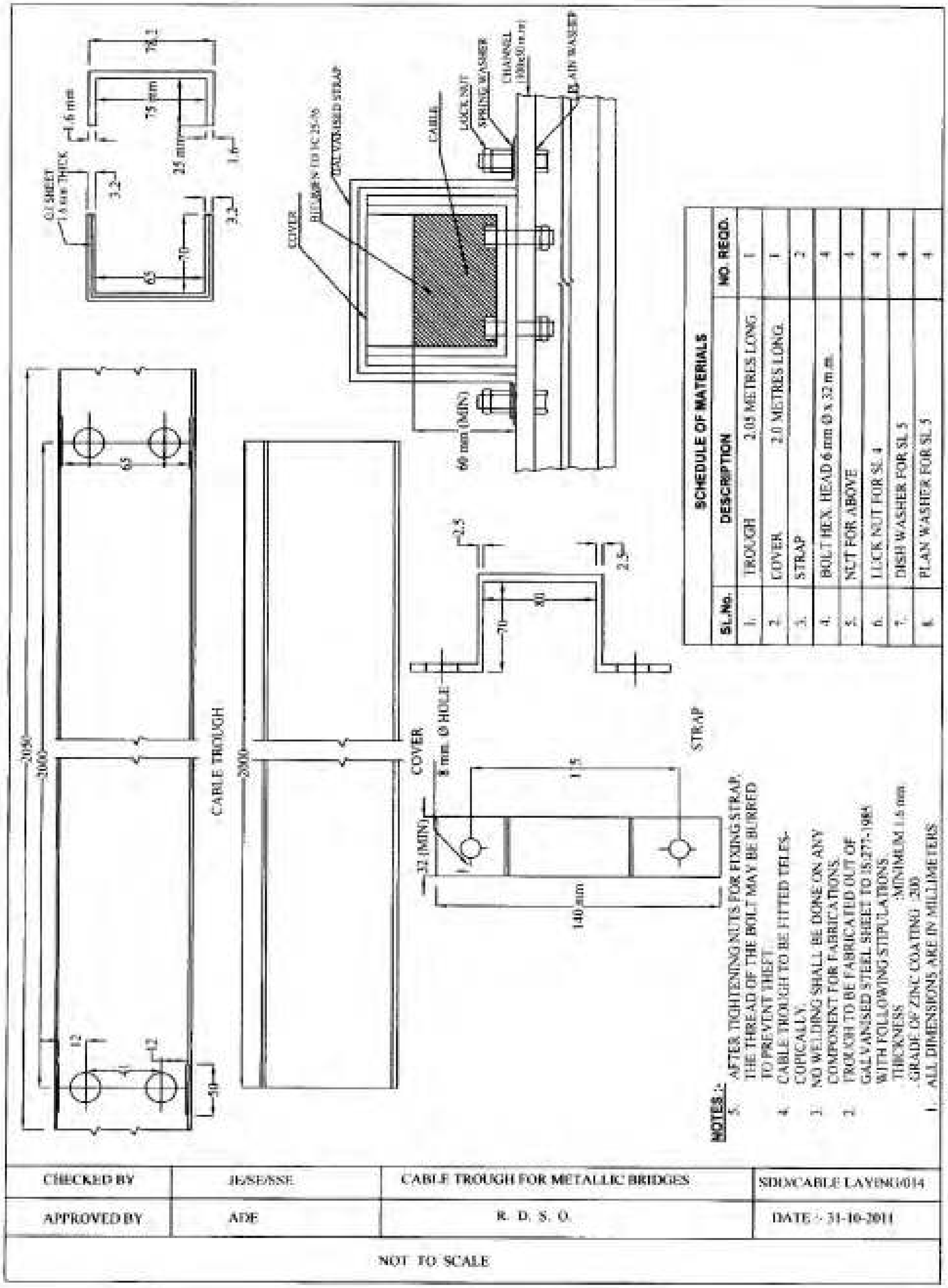
DY.CSTE/P&D	CSTE/PLG		
ESTE/D&D	ESTE/PLG	CABLE LAYING ON CULVERTS WITH HIGH FLOOD LEVEL	NR/SIG/CABLE/007
SSE/D&D	AESTE/D&D	NORTHERN RAILWAY	DATE :- 05-08-2016
		NOT TO SCALE	BASED ON RDSO DRG. NO.SDO/CABLE LAYING/012

Annexure-16

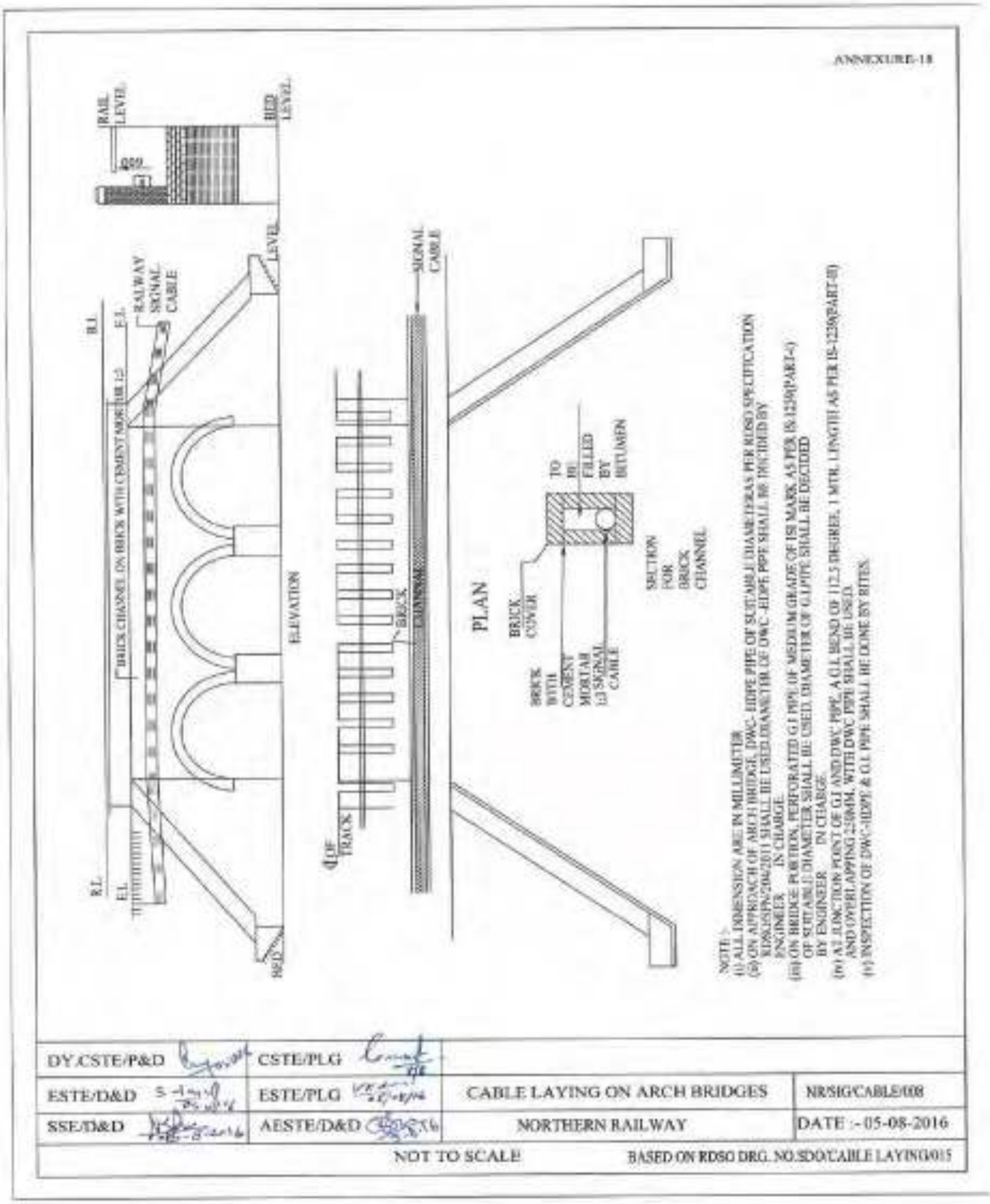


CHECKED BY	JE/SE/SSE	CABLE LAYING ON METALLIC BRIDGES	SDO/CABLE LAYING/013
APPROVED BY	ADE	R. D. S. O.	DATE :- 31-10-2011
NOT TO SCALE			

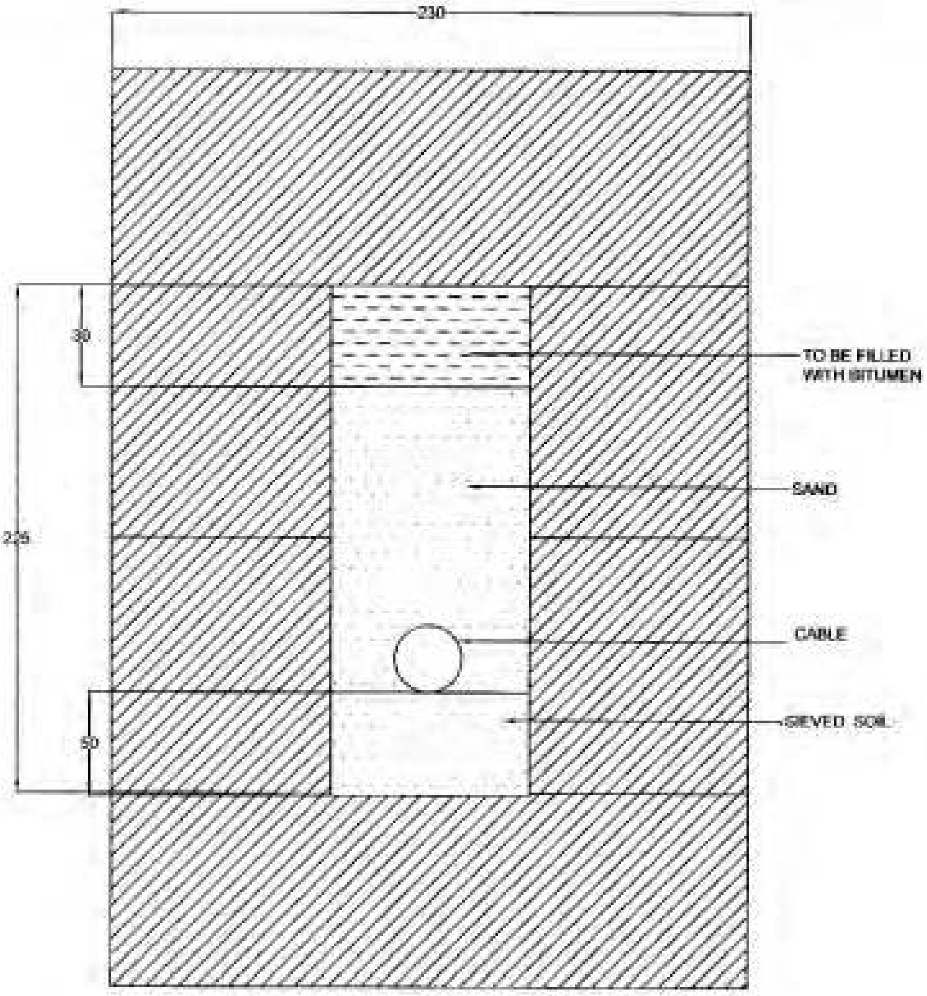
Annexure-17


GI SHEET 1.6 mm THICK
1.6 mm
75 mm
25 mm
78.1
COVER
GALVANISED STRAP
CABLE
LOCK NUT
SPRING WASHER
CHANNEL
PLAIN WASHER
60 mm (MIN)
CABLE TROUGH
COVER
STRAP
8 mm Ø HOLE
140 mm
SCHEDULE OF MATERIALS
SL.No. DESCRIPTION NO. REQD.
1. TROUGH 2.05 METRES LONG 1
2. COVER 2.0 METRES LONG 1
3. STRAP 2
4. BOLT HEX. HEAD 6 mm Ø x 32 m.m. 4
5. NUT FOR ABOVE 4
6. LOCK NUT FOR SL 4 4
7. DISH WASHER FOR SL 5 4
8. PLAN WASHER FOR SL 5 4
NOTES :-
5. AFTER TIGHTENING NUTS FOR FIXING STRAP, THE THREAD OF THE BOLT MAY BE BURRED TO PREVENT THEFT.
4. CABLE TROUGH TO BE FITTED TELES-COPICALLY.
3. NO WELDING SHALL BE DONE ON ANY COMPONENT FOR FABRICATIONS.
2. TROUGH TO BE FABRICATED OUT OF GALVANISED STEEL SHEET TO IS:277-1985 WITH FOLLOWING STIPULATIONS
THICKNESS :MINIMUM 1.6 mm
GRADE OF ZINC COATING :200
1. ALL DIMENSIONS ARE IN MILLIMETERS
CHECKED BY
JE/SE/SSE
CABLE TROUGH FOR METALLIC BRIDGES
SDO/CABLE LAYING/014
APPROVED BY
ADE
R. D. S. O.
DATE :- 31-10-2011
NOT TO SCALE

Annexure-18


ANNEXURE-18
DY.CSTE/P&D
CSTE/PLG
ESTE/D&D
ESTE/PLG
SSE/D&D
AESTE/D&D
CABLE LAYING ON ARCH BRIDGES
NR/SIG/CABLE/008
NORTHERN RAILWAY
DATE :- 05-08-2016
NOT TO SCALE
BASED ON RDSO DRG. NO.SDO/CABLE LAYING/015

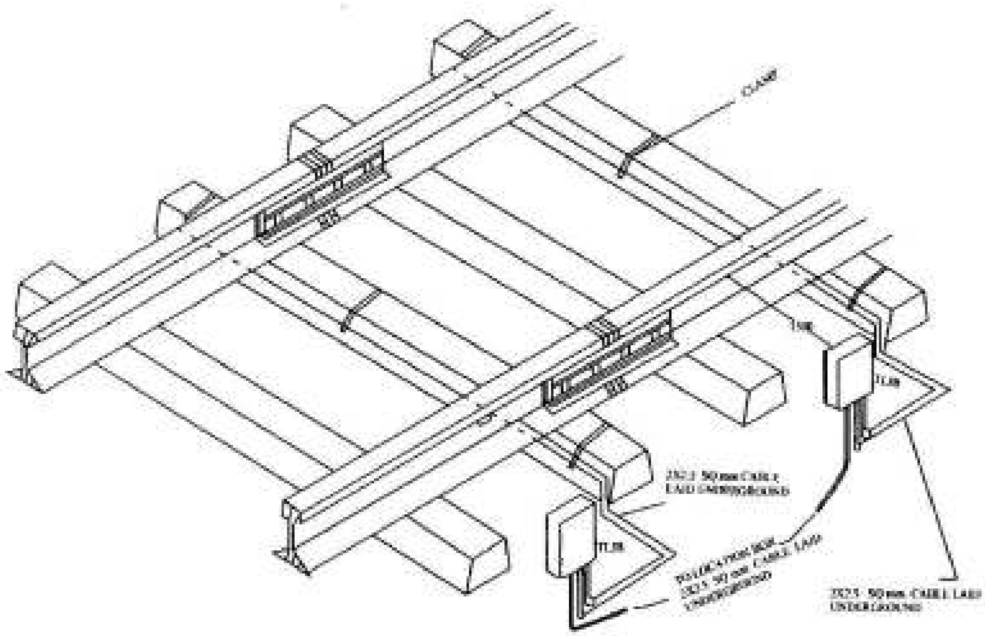
Annexure-19



NOTE :-
ALL DIMENTION ARE IN MILLIMETER.

CHECKED BY	JE/SE/SSE	BRICK MASONRY CHANNEL FOR ARCH BRIDGE	SDO/CABLE LAYING /016
APPROVED BY	ADE	R. D. S. O.	DATE :- 31-10-2011
NOT TO SCALE			

Annexure-20

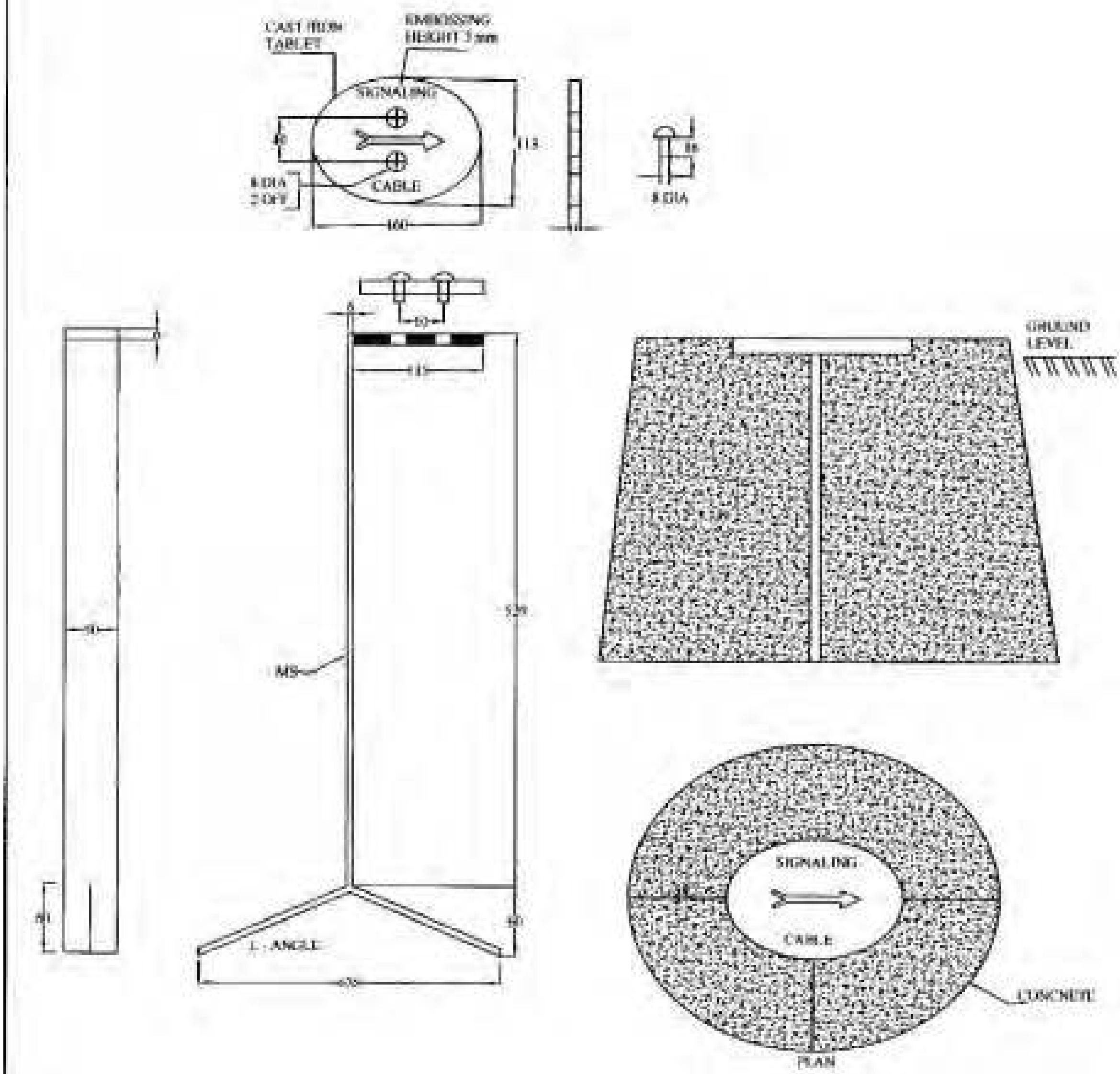


NOTE:-

ALL DIMENSIONS ARE IN MILLIMETER.

CHECKED BY	JE/SE/SSE	ARRANGMENT OF JUMPER CABLE	SDO/CABLE LAYING/017
APPROVED BY	ADE	R.D.S.O	DATE :- 31-10-2011
NOT TO SCALE			

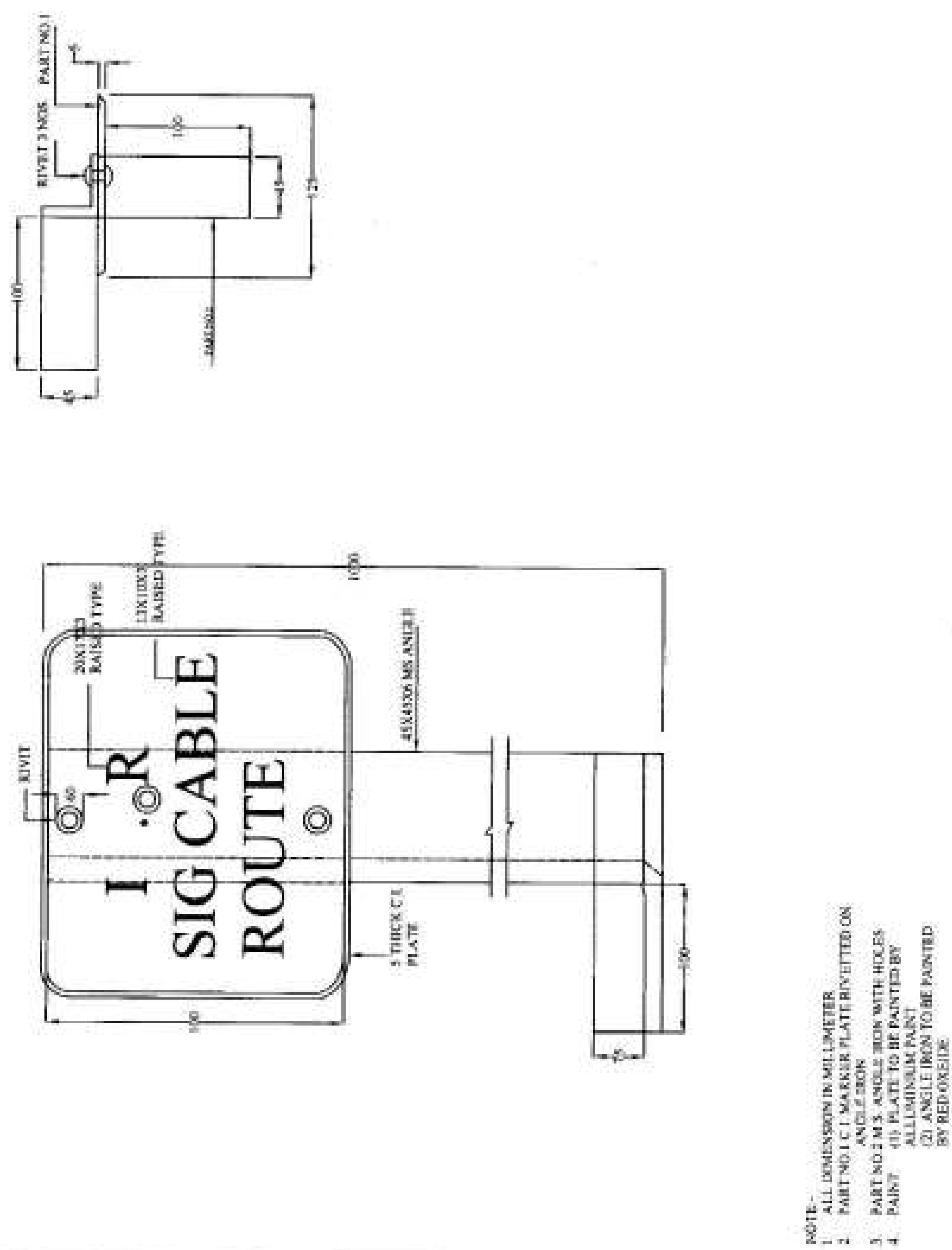
Annexure-21



NOTE :-
1 ALL DIMENSION ARE IN MM
2 CAST IRON TABLET IS TO BE REVETTED TO THE L - ANGLE ON THE 2 HOLES

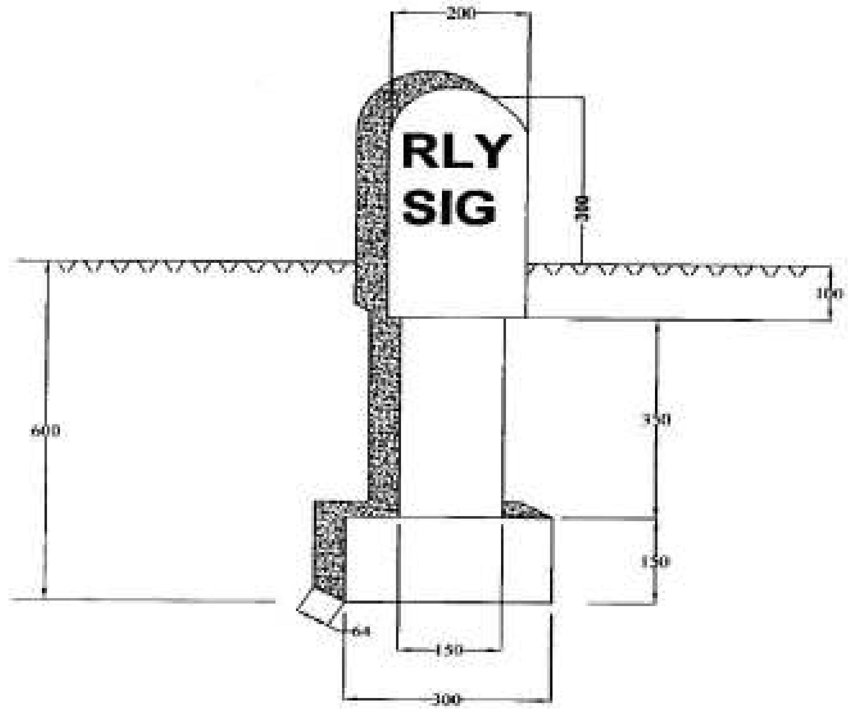
CHECKED BY	JE/SE/SSE	CI CABLE MARKER & CONCRETING	SDO/CABLE LAYING/018
APPROVED BY	ADE	R. D. S. O.	DATE :- 31-10-2011
NOT TO SCALE			

Annexure-22



CHECKED BY	JE/SE/SSE	CI CABLE MARKER	SDO/CABLE LAYING/019
APPROVED BY	ADE	R.D.S.O.	DATE :- 31-10-2011
NOT TO SCALE			

Annexure-23

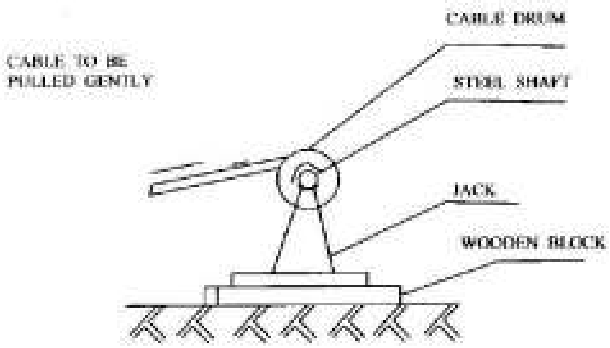


NOTE:-

1. ALL DIMENTIONS ARE IN MILLIMETER
2. PAINTED WHITE LETTERS ON RED BACKGROUND.
3. FOUNDATION CONCRETE OF 300 mm FROM THE BASE OF THE MARKER SHALL BE DONE AT SITE AT ALL PLACES WITH MIX 1:3:5.
4. COMPONENT CONCRETE SHALL BE OF M25 MIX AND WIRE MESH OF 1.5MM THICKMESS SHALL BE USED.
5. THE ENGRAVING OF "RLY" & "SIG" SHALL BE DONE ON BOTH SIDES OF THE MARKER.

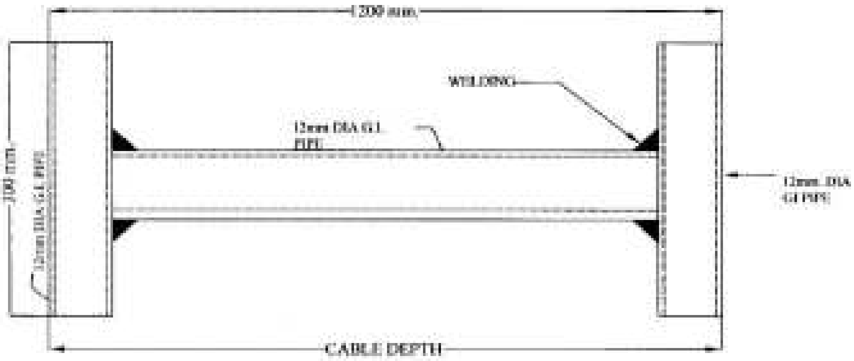
CHECKED BY	JE/SE/SSE	CONCRETE CABLE MARKER	SDO/CABLE LAYING/020
APPROVED BY	ADE	R.D.S.O.	DATE :- 31-10-2011
NOT TO SCALE			

Annexure-24



CHECKED BY	JE/SE/SSE	METHOD OF UNROLLING CABLE	SDO/CABLE LAYING /021
APPROVED BY	ADE	R.D.S.O.	DATE :- 31-10-2011
NOT TO SCALE			

Annexure-25



NOTE :-
ALL DIMENSION ARE IN MILLIMETER.

CHECKED BY	JE/SE/SSE	RULE MADE OF PIPE FOR MEASURING TRENCH DEPTH	SDO/CABLE LAYING/022
APPROVED BY	ADE	R. D. S. O.	DATE :- 31-10-2011
NOT TO SCALE			

Note: ALL the above sketches/Drawings/Diagram given are only indicative. The detailed drawings shall be proposed by the Contractor and approved by the Engineer.

(End of Appendix 2)

VII-8B : Documents

Section VII-8B
Documents

	Black colour shows Documents which have not been revised
	Blue colour shows Documents which have been revised
	Red colour shows New additional Documents

1. List of Curve and Gradients

1. List of Curve and Gradients

Horizontal Curve Detail's PKG-C5

S.No.	Curve No.	DEGREE	RADIUS	DEF.ANGLE (Delta)	CANT {SE) (mm)	TANGENT LENGTH	Circular Curve Length(CCL	TRANSITION LENGTH	Vmax	TPTC 1	TPCC 1	TPCC 2	TPTC 2	TOTAL LENGTH
MAIN LINE UP-LINE														
1	1	0.5833	3000.0m	3°12'01"	35mm	138.8m	57.5m	110.0m	160kmph	914.556	1024.556	1082.076	1192.076	277.52m
2	2	0.53	3300.0m	2°59'07"	35mm	136.0m	71.9m	100.0m	160kmph	1438.006	1538.006	1609.921	1709.921	271.915m
3	3	1.394	1255.3m	17°43'03"	165mm	300.1m	176.6m	210.0m	155kmph	2653.331	2863.331	3039.907	3249.907	596.576m
4	4	0.269	6500.0m	0°46'58"	20mm	69.4m	38.8m	50.0m	160kmph	3792.02	3842.02	3880.821	3930.821	138.801m
5	5	0.269	6500.0m	0°46'58"	20mm	69.4m	38.8m	50.0m	160kmph	3989.656	4039.656	4078.457	4128.457	138.801m
6	6	0.269	6500.0m	0°46'58"	20mm	69.4m	38.8m	50.0m	160kmph	4352.458	4402.458	4441.258	4491.258	138.8m
7	7	0.269	6500.0m	0°46'58"	20mm	69.4m	38.8m	50.0m	160kmph	4550.094	4600.094	4638.895	4688.895	138.094m
8	8	0.269	6500.0m	1°23'00"	15mm	108.5m	96.9m	60.0m	160kmph	5293.783	5353.783	5450.702	5510.702	216.783m
9	9	0.233	7500.0m	0°31'04"	15mm	58.9m	17.8m	50.0m	160kmph	6651.085	6701.085	6718.858	6768.858	117.773m
10	10	0.269	6500.0m	0°46'50"	15mm	74.3m	28.5m	60.0m	160kmph	7587.702	7647.702	7676.246	7736.246	148.544m
11	11	0.269	6500.0m	0°46'50"	15mm	74.3m	28.5m	60.0m	160kmph	7800.592	7860.592	7889.136	7949.136	148.544m

Horizontal Curve Detail's PKG-C5

S.No.	Curve No.	DEGREE	RADIUS	DEF.ANGLE (Delta)	CANT {SE} (mm)	TANGENT LENGTH	Circular Curve Length(CCL	TRANSITION LENGTH	Vmax	TPTC 1	TPCC 1	TPCC 2	TPTC 2	TOTAL LENGTH
12	12	0.269	6500.0m	0°46'50"	20mm	69.3m	38.5m	50.0m	160kmph	8118.271	8168.271	8206.816	8256.816	138.545m
13	13	0.269	6500.0m	0°46'50"	20mm	69.3m	38.5m	50.0m	160kmph	8331.16	8381.16	8419.705	8469.705	138.545m
14	14	0.437	4000.0m	4°53'31"	30mm	210.9m	261.5m	80.0m	160kmph	10283.73	10363.73	10625.24	10705.24	421.509m
15	15	0.269	6500.0m	0°46'50"	15mm	74.3m	28.5m	60.0m	160kmph	11050.05	11110.05	11138.59	11198.592	148.544m
16	16	0.269	6500.0m	0°46'50"	15mm	74.3m	28.5m	60.0m	160kmph	11262.93	11322.93	11351.48	11411.475	148.545m
17	17	0.269	6500.0m	0°51'14"	20mm	70.9m	51.9m	45.0m	160kmph	11685.34	11730.34	11782.21	11827.209	141.873m
18	18	0.269	6500.0m	0°51'14"	20mm	70.9m	51.9m	45.0m	160kmph	11879.92	11924.92	11976.79	12021.792	141.873m
19	19	0.831	2105.3m	26°30'21"	70mm	560.9m	843.8m	130.0m	160kmph	12070.03	12200.03	13043.84	13173.84	1103.807m
20	20	0.583	3000.0m	33°19'13"	35mm	952.8m	1634.6m	110.0m	160kmph	15569.58	15679.58	17314.18	17424.179	1854.602m
21	21	1.093	1600.0m	65°50'26"	125mm	1116.1m	1678.2m	160.0m	160kmph	18098.26	18258.26	19936.45	20096.446	1998.182m
22	22	2	875.0m	11°26'24"	130mm	152.3m	43.9m	130.0m	120kmph	20270.6	20400.6	20444.53	20574.531	303.929m
23	23	1.4	1250.0m	83°49'48"	120mm	1192.5m	1688.4m	140.0m	140kmph	21419.55	21559.55	23247.97	23387.965	1968.415m
MAIN LINE DOWN LINE														

Horizontal Curve Detail's PKG-C5

S.No.	Curve No.	DEGREE	RADIUS	DEF.ANGLE (Delta)	CANT {SE} (mm)	TANGENT LENGTH	Circular Curve Length(CCL	TRANSITION LENGTH	Vmax	TPTC 1	TPCC 1	TPCC 2	TPTC 2	TOTAL LENGTH
24	1	2.058	850.0m	40°11'22"	140 mm	380.08m	455.2m	140.0m	120kmph	-1610.95	-1470.95	-1015.76	-875.764	735.188m
25	1	0.53	3300.0m	3°12'01"	35mm	142.2m	84.3m	100.0m	160kmph	911.022	1011.022	1095.313	1195.313	284.291m
26	2	0.583	3000.0m	2°59'07"	35mm	133.2m	46.3m	110.0m	160kmph	1440.669	1550.669	1596.938	1706.938	266.269m
27	3	1.367	1280.0m	17°43'03"	160 mm	299.0m	194.5m	200.0m	155kmph	2653.518	2853.518	3048.006	3248.006	594.488m
28	4	0.35	5000.0m	1°23'00"	20mm	100.4m	40.7m	80.0m	160kmph	5300.34	5380.34	5421.054	5501.054	200.714m
29	5	0.145	12000.0m	0°31'04"	10mm	69.2m	78.5m	30.0m	160kmph	6639.112	6669.12	6747.575	6777.575	138.463m
30	6	0.5	3500.0m	4°53'31"	30mm	199.5m	198.8m	100.0m	160kmph	10293.65	10393.65	10592.45	10692.451	398.805m
31	7	0.836	2092.0m	26°30'21"	70mm	557.7m	837.7m	130.0m	160kmph	12073.18	12203.18	13040.83	13170.832	1097.653
32	8	0.585	2990.0m	33°19'13"	35mm	949.8m	1628.8m	110.0m	160kmph	15575.53	15685.53	17314.31	17424.314	1848.786m
33	9	1.093	1600.0m	65°50'26"	125 mm	1116.1m	1678.2m	160.0m	160kmph	18096.37	18256.37	19934.55	20094.551	1998.183
34	10	2	875.0m	11°26'24"	130 mm	152.3m	43.9m	130.0m	120kmph	20280.38	20410.38	20454.31	20584.305	303.929m
35	11	1.405	1244.7m	83°49'48"	120 mm	1187.7m	1680.7m	140.0m	140kmph	21414.17	21554.17	23234.83	23374.828	1960.656m

GRADIENT DETAIL'S OF PKG-C-5 (FROM CH:- -2.120 km to 12.00 km) - MAIN LINE							
S.NO	**CHAINAGE KM**		**LENGTH (MTR)**	**Formation LEVEL**		**GRADIENT**	**RISE/FALL**
	FROM	**TO**				**1 IN**	
1	-2115	-1795	320	203.181	203.439	1241	R
2	-1795	-1451	344	203.439	203.468	11862	R
3	-1451	-855	596	203.468	202.161	456	F
4	-855	-695	160	202.161	202.161	**LEVEL**	
5	-695	860	1555	202.161	203.494	1200	R
6	860	1769.999	909.999	203.494	209.290	156	R
7	1769.999	2089.999	320	209.290	207.868	225	F
8	2089.999	2409.999	320	207.868	205.803	155	F
9	2409.999	2984.869	574.87	205.803	202.318	165	F
10	2984.869	3404.782	419.913	202.318	202.731	1017	R
11	3404.782	3564.782	160	202.731	202.731	**LEVEL**	
12	3564.782	3964.782	400	202.731	202.969	1680	R
13	3964.782	4524.782	560	202.969	202.969	**LEVEL**	
14	4524.782	4814.742	289.96	202.969	201.575	208	F
15	4814.742	5684.782	870.04	201.575	207.188	155	R
16	5684.782	5824.782	140	207.188	207.188	**LEVEL**	
17	5824.782	6444.782	620	207.188	203.188	155	F
18	6444.782	6904.782	460	203.188	202.859	1398	F
19	6904.782	7564.782	660	202.859	202.659	3300	F
20	7564.782	8534.782	970	202.659	202.659	**LEVEL**	
21	8534.782	9164.782	630	202.659	198.53	155	F
22	9164.782	9484.782	320	198.53	199.452	347	R
23	9484.782	9594.782	110	199.452	199.452	**LEVEL**	

GRADIENT DETAIL'S OF PKG-C-5 (FROM CH:- -2.120 km to 12.00 km) - MAIN LINE							
S.NO	CHAINAGE KM		LENGTH (MTR)	Formation LEVEL		GRADIENT	RISE/FALL
	FROM	TO				1 IN	
24	9594.782	10984.782	1390	199.452	200.147	2002	R
25	10984.782	11429.782	445	200.147	203.018	155	R
26	11429.782	11759.782	330	203.018	203.018	**LEVEL**	
27	11759.782	12000	240.218	203.018	201.605	170	F
		Total Lenth	**14115**				
GRADIENT DETAIL'S OF PKG-C-5 (FROM CH:-18 km To 24.86 km) - MAIN LINE							
28	18020	18280	260	196.948	196.948	**LEVEL**	
29	18280	19900	1620	196.948	198.427	1095	R
30	19900	20100	200	198.427	199.64	165	R
31	20100	20420	320	199.64	199.64	**LEVEL**	
32	20420	20920	500	199.64	202.557	175	R
33	20920	21060	140	202.557	202.557	**LEVEL**	
34	21060	21380	320	202.557	204.663	152	R
35	21380	23400	2020	204.663	216.905	165	R
36	23400	23740	340	216.905	219.142	152	R
37	23740	24860	1120	219.142	225.93	165	R
		Total Lenth	**6840**				

2. List of Control Points

2. List of Control Points

Project Name:-Field verification for land boundary and supplying, fixing of boundary pillars along HORC alignment and it's connectivities to existing IR/DFC networks, picking up of finalized land boundary and centre line coordinates using DGPS (RTK Method) by establishing control points in connection with Haryana Orbital Rail Corridor (HORC) from Palwal to Sonipat

GCP's DATA OF CH: -3.500 TO 0.0KM & 0.0KM TO 128 KM

Name	WGS84 Latitude	WGS84 Longitude	Grid Northing (m)	Grid Easting (m)	Elevation
SCP-001	28°13'36.4461"N	77°16'42.8520"E	3124429.076	723596.755	196.397
SCP-002	28°15'27.5135"N	77°15'58.4447"E	3127825.599	722321.902	195.689
SCP-003	28°13'05.4037"N	77°14'44.3063"E	3123413.047	720382.185	194.341
SCP-004	28°15'11.3415"N	77°13'48.5273"E	3127261.925	718789.760	196.687
SCP-005	28°12'41.9039"N	77°12'26.1222"E	3122620.349	716627.351	197.059
SCP-006	28°14'56.7268"N	77°11'37.2212"E	3126746.576	715218.645	196.359
SCP-007	28°12'24.6069"N	77°10'31.7830"E	3122031.472	713518.954	199.057
SCP-008	28°14'55.5514"N	77°09'48.9907"E	3126657.269	712268.960	201.987
SCP-009	28°12'25.3731"N	77°09'09.6978"E	3122015.079	711280.047	194.380
SCP-010	28°14'42.9312"N	77°08'00.6765"E	3126216.341	709323.220	199.402
SCP-011	28°11'39.2352"N	77°07'12.9607"E	3120538.658	708121.475	193.529
SCP-012	28°14'07.9269"N	77°06'12.5381"E	3125087.181	706394.085	199.346
SCP-013	28°10'47.0640"N	77°05'43.5348"E	3118890.253	705710.322	193.408
SCP-014	28°13'39.4318"N	77°03'49.0236"E	3124142.674	702496.512	206.820
SCP-015	28°10'54.2284"N	77°01'21.9949"E	3118989.664	698572.831	195.675
SCP-016	28°14'24.9297"N	77°00'38.4942"E	3125455.819	697278.697	293.012
SCP-017	28°12'09.7271"N	76°59'49.0726"E	3121271.671	696000.073	285.465
SCP-018	28°15'19.2876"N	76°59'11.9851"E	3127090.138	694892.969	273.709
SCP-019	28°12'36.4995"N	76°58'28.9449"E	3122059.974	693801.589	267.623
SCP-020	28°16'14.8549"N	76°57'40.0201"E	3128759.717	692358.624	265.112
SCP-021	28°13'47.9549"N	76°57'05.9422"E	3124222.828	691502.865	255.562
SCP-022	28°16'55.1346"N	76°56'08.4654"E	3129959.400	689843.726	263.025
SCP-023	28°15'13.5971"N	76°54'58.7895"E	3126803.659	687994.658	251.916
SCP-024	28°18'24.4724"N	76°55'12.5797"E	3132685.086	688277.200	269.222
SCP-025	28°17'16.6389"N	76°52'57.2887"E	3130539.057	684624.084	247.585
SCP-026	28°19'55.3848"N	76°54'39.3566"E	3135469.180	687327.824	274.734
SCP-027	28°18'49.3740"N	76°52'18.0110"E	3133376.943	683509.660	248.185
SCP-028	28°21'34.0782"N	76°54'03.4730"E	3138491.703	686302.627	280.255
SCP-029	28°20'24.3860"N	76°51'42.8468"E	3136286.731	682506.665	247.017
SCP-030	28°23'07.8703"N	76°53'32.8386"E	3141365.673	685423.154	233.634
SCP-031	28°22'08.1544"N	76°51'03.7859"E	3139464.494	681393.875	237.072
SCP-032	28°24'51.7879"N	76°53'24.9249"E	3144561.072	685157.516	220.622
SCP-033	28°23'51.2766"N	76°50'47.9712"E	3142632.139	680914.651	225.660
SCP-034	28°26'27.1660"N	76°53'03.9408"E	3147488.043	684540.453	215.911
SCP-035	28°25'30.7392"N	76°50'25.8913"E	3145684.543	680266.856	219.896
SCP-036	28°28'09.7293"N	76°52'43.6735"E	3150636.520	683939.677	213.146
SCP-037	28°27'18.7550"N	76°50'07.4498"E	3149001.770	679714.292	220.146
SCP-038	28°29'42.9174"N	76°52'07.7145"E	3153489.785	682916.938	214.025
SCP-039	28°28'50.9803"N	76°49'32.4323"E	3151826.102	678718.550	213.476
SCP-040	28°31'23.0046"N	76°51'19.5862"E	3156550.370	681560.510	215.268
SCP-041	28°30'47.1215"N	76°48'49.0457"E	3155383.233	677484.549	215.147
SCP-042	28°32'46.8437"N	76°50'59.1405"E	3159122.525	680964.848	212.394
SCP-043	28°32'23.6956"N	76°48'04.3887"E	3158337.646	676225.734	213.962

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GCP's DATA OF CH: -3.500 TO 0.0KM & 0.0KM TO 128 KM

Name	WGS84 Latitude	WGS84 Longitude	Grid Northing (m)	Grid Easting (m)	Elevation
SCP-044	28°34'35.6181"N	76°50'37.4479"E	3162461.747	680323.698	213.780
SCP-045	28°33'59.7877"N	76°48'05.0133"E	3161295.776	676198.247	213.144
SCP-046	28°35'59.9513"N	76°50'17.9686"E	3165049.567	679754.523	212.869
SCP-047	28°35'44.1280"N	76°47'29.6425"E	3164493.133	675188.989	214.385
SCP-048	28°37'43.7974"N	76°50'11.8125"E	3168243.616	679538.194	211.365
SCP-049	28°37'20.8988"N	76°47'30.9108"E	3167472.431	675178.822	214.849
SCP-050	28°39'17.6896"N	76°50'15.5662"E	3171135.407	679595.691	212.758
SCP-051	28°39'06.0639"N	76°47'27.7904"E	3170708.346	675045.557	214.564
SCP-052	28°40'55.5996"N	76°50'43.3817"E	3174160.974	680304.367	213.623
SCP-053	28°40'49.6516"N	76°48'01.1468"E	3173910.611	675903.203	215.232
SCP-054	28°42'14.8135"N	76°51'48.0932"E	3176626.699	682022.913	214.380
SCP-055	28°42'36.2269"N	76°48'38.2909"E	3177206.504	676861.708	216.294
SCP-056	28°43'50.5868"N	76°52'20.9630"E	3179588.863	682868.688	216.674
SCP-057	28°44'05.2133"N	76°49'30.4444"E	3179967.314	678235.110	217.989
SCP-058	28°45'20.6187"N	76°53'09.2286"E	3182380.992	684134.409	216.402
SCP-059	28°45'45.9842"N	76°50'09.3199"E	3183085.533	679242.048	216.272
SCP-060	28°46'41.4775"N	76°53'43.0935"E	3184884.691	685013.417	217.596
SCP-061	28°47'17.3471"N	76°51'03.6355"E	3185920.779	680671.588	217.009
SCP-062	28°48'07.7837"N	76°54'55.8970"E	3187573.140	686945.141	217.856
SCP-063	28°48'29.7793"N	76°51'48.2328"E	3188169.362	681846.040	217.275
SCP-064	28°48'51.5460"N	76°56'05.6169"E	3188950.935	688813.677	217.838
SCP-065	28°49'53.1214"N	76°52'53.7324"E	3190762.903	683581.309	219.203
SCP-066	28°50'11.2445"N	76°57'23.3871"E	3191438.920	690881.786	217.762
SCP-067	28°51'04.7927"N	76°54'23.5000"E	3193008.027	685979.239	221.407
SCP-068	28°51'14.1166"N	76°59'07.3306"E	3193421.178	693666.978	218.767
SCP-069	28°52'08.4648"N	76°55'34.7382"E	3194999.290	687878.141	220.724
SCP-070	28°52'28.2557"N	77°00'09.4122"E	3195731.814	695311.007	219.719
SCP-071	28°54'15.4471"N	76°58'21.5709"E	3198982.696	692333.931	220.614
SCP-072	28°52'56.4202"N	77°01'58.7477"E	3196649.269	698258.826	220.958
SCP-073	28°54'57.9790"N	77°00'31.7987"E	3200351.313	695839.495	221.410
SCP-074	28°53'49.8545"N	77°03'38.7018"E	3198341.028	700938.526	215.376
SCP-075	28°56'16.5033"N	77°00'52.0494"E	3202778.020	696346.884	219.178
SCP-076	28°56'07.1033"N	77°03'46.4922"E	3202570.002	701075.991	215.765
SCP-077	28°57'23.3942"N	77°01'26.8948"E	3204853.384	697255.295	216.508
SCP-078	28°57'31.0430"N	77°03'10.5149"E	3205137.209	700056.830	216.240
TCP-001	28°14'21.4725"N	77°17'04.9615"E	3125826.599	724173.443	195.708
TCP-002	28°14'24.3916"N	77°17'03.1045"E	3125915.511	724121.117	195.491
TCP-003	28°14'31.8093"N	77°16'32.4011"E	3126128.097	723279.756	195.881
TCP-004	28°14'34.4997"N	77°16'30.6949"E	3126210.050	723231.685	195.720
TCP-005	28°14'41.6562"N	77°15'50.0713"E	3126409.594	722120.073	196.165
TCP-006	28°14'44.7644"N	77°15'51.4560"E	3126505.985	722156.031	195.677
TCP-007	28°14'39.5700"N	77°15'27.8578"E	3126334.055	721515.695	196.141
TCP-008	28°14'40.9972"N	77°15'23.4000"E	3126375.726	721393.349	Not Found

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GCP's DATA OF CH: -3.500 TO 0.0KM & 0.0KM TO 128 KM					
Name	WGS84 Latitude	WGS84 Longitude	Grid Northing (m)	Grid Easting (m)	Elevation
TCP-009	28°14'22.8380"N	77°14'47.5059"E	3125798.484	720425.198	193.702
TCP-010	28°14'24.9307"N	77°14'44.4561"E	3125861.366	720340.856	196.727
TCP-011	28°14'12.4058"N	77°14'14.8903"E	3125460.859	719541.942	199.405
TCP-012	28°14'13.5342"N	77°14'12.0740"E	3125494.176	719464.519	201.634
TCP-013	28°13'59.2918"N	77°13'39.5906"E	3125039.395	718586.984	198.195
TCP-014	28°14'01.9557"N	77°13'39.2400"E	3125121.226	718575.914	198.430
TCP-015	28°13'55.9121"N	77°13'06.5504"E	3124918.807	717688.075	197.517
TCP-016	28°13'58.7470"N	77°13'08.8851"E	3125007.247	717750.128	197.410
TCP-017	28°13'53.0806"N	77°12'22.8038"E	3124809.844	716496.941	196.123
TCP-018	28°13'51.4889"N	77°12'19.9521"E	3124759.428	716420.082	195.463
TCP-019	28°13'49.7602"N	77°11'42.0994"E	3124687.455	715389.010	203.244
TCP-020	28°13'53.9024"N	77°11'42.2949"E	3124815.066	715392.031	202.674
TCP-021	28°13'46.4748"N	77°11'07.7481"E	3124569.371	714454.265	199.417
TCP-022	28°13'49.4997"N	77°11'10.4701"E	3124663.830	714526.798	198.613
TCP-023	28°13'43.8074"N	77°10'30.7988"E	3124469.114	713448.329	196.569
TCP-024	28°13'46.6952"N	77°10'30.9754"E	3124558.100	713451.546	196.610
TCP-025	28°13'40.8173"N	77°09'55.9613"E	3124360.042	712500.137	194.890
TCP-026	28°13'44.4734"N	77°09'55.7117"E	3124472.471	712491.318	195.313
TCP-027	28°13'38.8686"N	77°09'11.9039"E	3124278.630	711299.984	195.052
TCP-028	28°13'41.2280"N	77°09'13.0688"E	3124351.827	711330.452	195.221
TCP-029	28°13'36.4332"N	77°08'44.0730"E	3124190.186	710542.504	195.381
TCP-030	28°13'38.5058"N	77°08'41.1399"E	3124252.574	710461.405	195.885
TCP-031	28°13'32.7210"N	77°08'15.0757"E	3124061.929	709753.912	196.424
TCP-032	28°13'34.4235"N	77°08'10.2582"E	3124112.021	709621.637	196.726
TCP-033	28°13'24.1071"N	77°07'33.5187"E	3123776.815	708625.507	195.883
TCP-034	28°13'26.0676"N	77°07'28.5870"E	3123834.806	708489.981	195.888
TCP-035	28°13'06.1224"N	77°07'04.0268"E	3123209.091	707831.072	196.092
TCP-036	28°13'08.4893"N	77°07'01.1748"E	3123280.594	707752.032	196.182
TCP-037	28°12'46.0137"N	77°06'30.9154"E	3122574.323	706939.003	196.105
TCP-038	28°12'48.2184"N	77°06'28.5920"E	3122641.090	706874.466	195.849
TCP-039	28°12'26.9901"N	77°06'02.1892"E	3121975.106	706165.842	195.179
TCP-040	28°12'28.5366"N	77°06'00.3063"E	3122021.822	706113.673	195.220
TCP-041	28°12'02.1341"N	77°05'38.0417"E	3121198.560	705520.574	194.986
TCP-042	28°12'05.5195"N	77°05'35.9737"E	3121301.798	705462.378	194.676
TCP-043	28°11'41.1865"N	77°05'25.8750"E	3120547.998	705199.897	196.170
TCP-044	28°11'42.7878"N	77°05'22.1513"E	3120595.539	705097.490	194.453
TCP-045	28°11'09.1126"N	77°05'11.8430"E	3119554.071	704834.200	192.723
TCP-046	28°11'10.7340"N	77°05'08.4153"E	3119602.374	704739.851	192.474
TCP-047	28°10'44.0971"N	77°04'38.8322"E	3118768.558	703947.028	194.012
TCP-049	28°10'45.7448"N	77°04'04.6722"E	3118803.354	703014.397	196.986
TCP-050	28°10'47.3044"N	77°04'04.1586"E	3118851.126	702999.570	191.383
TCP-051	28°10'51.3667"N	77°03'23.5326"E	3118957.332	701889.325	195.797
TCP-052	28°10'53.9021"N	77°03'25.6299"E	3119036.346	701945.208	191.911

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GCP's DATA OF CH: -3.500 TO 0.0KM & 0.0KM TO 128 KM					
Name	WGS84 Latitude	WGS84 Longitude	Grid Northing (m)	Grid Easting (m)	Elevation
TCP-053	28°11'01.6934"N	77°02'51.9934"E	3119260.655	701023.701	195.171
TCP-054	28°11'03.8249"N	77°02'56.0714"E	3119328.149	701133.819	191.919
TCP-055	28°11'23.8532"N	77°02'22.5241"E	3119929.247	700208.451	204.928
TCP-056	28°11'24.8968"N	77°02'26.9602"E	3119963.405	700328.898	196.307
TCP-057	28°12'01.8109"N	77°02'33.8636"E	3121102.891	700498.028	211.829
TCP-058	28°11'57.1647"N	77°02'37.9469"E	3120961.745	700611.793	205.087
TCP-059	28°12'28.9448"N	77°02'37.3175"E	3121939.734	700578.131	293.483
TCP-060	28°12'31.5563"N	77°02'39.7458"E	3122021.241	700642.990	293.567
TCP-061	28°12'49.2444"N	77°02'09.6693"E	3122551.915	699813.695	279.754
TCP-062	28°12'53.1437"N	77°02'12.1593"E	3122673.087	699879.573	280.937
TCP-063	28°13'03.6003"N	77°01'33.0531"E	3122977.089	698807.880	274.423
TCP-064	28°13'07.3919"N	77°01'35.4993"E	3123094.921	698872.627	274.485
TCP-065	28°13'03.9204"N	77°01'07.3722"E	3122975.253	698107.496	273.065
TCP-066	28°13'06.7684"N	77°01'04.6873"E	3123061.702	698032.829	272.484
TCP-067	28°13'06.4061"N	77°00'21.6871"E	3123031.074	696860.575	271.034
TCP-068	28°13'10.1973"N	77°00'24.0409"E	3123148.838	696922.820	267.933
TCP-069	28°13'18.2988"N	76°59'48.3517"E	3123382.138	695945.625	266.631
TCP-070	28°13'19.9142"N	76°59'51.8013"E	3123433.416	696038.857	267.836
TCP-071	28°13'30.9119"N	76°59'07.9414"E	3123752.284	694837.477	268.041
TCP-072	28°13'34.8089"N	76°59'10.8492"E	3123873.541	694914.788	265.898
TCP-073	28°13'52.9970"N	76°58'45.2818"E	3124421.995	694208.575	268.496
TCP-074	28°13'56.2575"N	76°58'46.5997"E	3124522.949	694242.866	265.104
TCP-075	28°14'13.3161"N	76°58'21.1823"E	3125036.739	693541.378	264.634
TCP-076	28°14'16.1903"N	76°58'23.6378"E	3125126.302	693606.877	263.697
TCP-077	28°14'37.2068"N	76°57'55.7443"E	3125760.863	692835.976	265.078
TCP-078	28°14'39.8343"N	76°57'57.5805"E	3125842.554	692884.717	261.528
TCP-079	28°14'57.9545"N	76°57'26.5372"E	3126386.614	692029.490	267.744
TCP-080	28°15'01.0976"N	76°57'26.4793"E	3126483.340	692026.347	263.061
TCP-081	28°15'15.1912"N	76°56'53.7368"E	3126902.765	691126.892	262.110
TCP-082	28°15'18.2916"N	76°56'54.8506"E	3126998.690	691155.712	260.056
TCP-083	28°15'32.5066"N	76°56'21.7602"E	3127421.762	690246.788	259.226
TCP-084	28°15'34.3650"N	76°56'24.1917"E	3127480.027	690312.141	257.216
TCP-085	28°15'52.5120"N	76°55'53.0335"E	3128025.036	689454.013	259.620
TCP-086	28°15'55.2536"N	76°55'55.6864"E	3128110.581	689524.965	258.329
TCP-087	28°16'11.0478"N	76°55'26.5575"E	3128584.097	688723.376	258.667
TCP-088	28°16'13.5955"N	76°55'27.8330"E	3128663.075	688756.888	257.003
TCP-089	28°16'33.0663"N	76°54'57.7123"E	3129249.383	687926.545	256.936
TCP-090	28°16'35.3419"N	76°54'59.4766"E	3129320.192	687973.514	252.996
TCP-091	28°16'58.1919"N	76°54'38.4368"E	3130014.477	687389.057	256.735
TCP-092	28°16'59.1606"N	76°54'42.0278"E	3130045.843	687486.435	254.180
TCP-093	28°17'27.8720"N	76°54'20.4598"E	3130920.345	686884.805	255.939
TCP-094	28°17'29.7514"N	76°54'21.8008"E	3130978.772	686920.431	256.329
TCP-095	28°17'57.4427"N	76°54'00.7114"E	3131822.106	686332.417	263.020

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GCP's DATA OF CH: -3.500 TO 0.0KM & 0.0KM TO 128 KM

Name	WGS84 Latitude	WGS84 Longitude	Grid Northing (m)	Grid Easting (m)	Elevation
TCP-096	28°17'59.4644"N	76°54'04.6478"E	3131886.023	686438.683	258.503
TCP-097	28°18'28.6195"N	76°53'47.4042"E	3132776.079	685954.805	253.132
TCP-098	28°18'29.6459"N	76°53'49.6679"E	3132808.641	686015.977	252.571
TCP-099	28°19'00.8854"N	76°53'42.2393"E	3133767.067	685798.517	267.264
TCP-100	28°19'01.2164"N	76°53'44.2060"E	3133778.095	685851.931	264.187
TCP-101	28°19'36.3274"N	76°53'25.5125"E	3134850.886	685325.802	258.351
TCP-102	28°19'39.8222"N	76°53'26.5136"E	3134958.888	685351.382	258.279
TCP-103	28°20'00.9454"N	76°53'07.5761"E	3135601.025	684825.425	255.750
TCP-104	28°20'01.9312"N	76°53'09.9570"E	3135632.384	684889.796	256.456
TCP-105	28°20'26.6062"N	76°52'58.9299"E	3136387.228	684577.617	254.448
TCP-106	28°20'26.6381"N	76°53'00.7694"E	3136388.992	684627.698	254.540
TCP-107	28°21'02.7798"N	76°52'53.2526"E	3137498.297	684405.637	259.513
TCP-108	28°21'05.0330"N	76°52'55.7444"E	3137568.714	684472.409	260.368
TCP-109	28°21'33.4984"N	76°52'42.2721"E	3138439.205	684091.900	250.940
TCP-110	28°21'33.7066"N	76°52'45.7096"E	3138447.074	684185.399	251.315
TCP-111	28°22'02.9073"N	76°52'34.6907"E	3139341.245	683871.380	241.589
TCP-112	28°22'00.6212"N	76°52'31.1157"E	3139269.359	683775.137	242.421
TCP-113	28°22'32.3873"N	76°52'22.6854"E	3140243.606	683530.415	236.713
TCP-114	28°22'32.8678"N	76°52'26.6861"E	3140260.089	683639.103	236.489
TCP-115	28°23'07.6321"N	76°52'09.8221"E	3141323.059	683163.386	234.031
TCP-116	28°23'09.1365"N	76°52'10.2919"E	3141369.565	683175.457	232.909
TCP-117	28°23'34.0880"N	76°52'06.0418"E	3142135.820	683047.847	229.442
TCP-118	28°23'33.2265"N	76°52'11.0570"E	3142111.419	683184.774	229.522
TCP-119	28°24'06.5670"N	76°52'07.5751"E	3143136.224	683074.072	224.365
TCP-120	28°24'08.5433"N	76°52'07.5499"E	3143197.047	683072.441	223.715
TCP-121	28°24'44.9666"N	76°52'05.2477"E	3144317.248	682992.383	219.192
TCP-122	28°24'43.9123"N	76°52'08.2088"E	3144286.044	683073.473	218.608
TCP-123	28°25'12.0360"N	76°51'58.2550"E	3145147.538	682789.158	216.629
TCP-124	28°25'12.2561"N	76°52'01.6202"E	3145155.733	682880.630	216.485
TCP-125	28°25'44.3761"N	76°51'51.2001"E	3146140.046	682581.747	215.537
TCP-126	28°25'44.5441"N	76°51'55.0849"E	3146146.859	682687.377	215.975
TCP-127	28°26'14.6158"N	76°51'43.6273"E	3147067.689	682361.278	217.239
TCP-128	28°26'12.3380"N	76°51'47.4057"E	3146999.166	682465.168	218.938
TCP-129	28°26'52.0371"N	76°51'34.8424"E	3148215.885	682104.440	214.765
TCP-130	28°26'53.6477"N	76°51'38.0460"E	3148266.810	682190.830	213.613
TCP-131	28°27'22.0923"N	76°51'27.8475"E	3149138.096	681899.839	213.026
TCP-132	28°27'23.6537"N	76°51'29.6618"E	3149186.920	681948.452	212.382
TCP-133	28°27'36.8392"N	76°51'38.4657"E	3149596.499	682181.669	213.633
TCP-134	28°27'37.9196"N	76°51'45.7131"E	3149632.812	682378.301	213.769
TCP-135	28°27'59.5240"N	76°51'23.4804"E	3150288.477	681763.240	212.754
TCP-136	28°27'58.2345"N	76°51'26.5012"E	3150250.052	681846.023	213.531
TCP-137	28°28'36.0083"N	76°51'16.7447"E	3151408.700	681562.683	212.211
TCP-138	28°28'35.7799"N	76°51'20.2138"E	3151403.127	681657.146	212.179

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GCP's DATA OF CH: -3.500 TO 0.0KM & 0.0KM TO 128 KM					
Name	WGS84 Latitude	WGS84 Longitude	Grid Northing (m)	Grid Easting (m)	Elevation
TCP-139	28°28'57.6830"N	76°51'05.8799"E	3152071.330	681256.893	212.880
TCP-140	28°28'57.1481"N	76°51'10.2363"E	3152056.693	681375.628	212.816
TCP-141	28°29'18.8721"N	76°50'53.4692"E	3152718.372	680909.323	212.975
TCP-142	28°29'19.3493"N	76°50'57.6049"E	3152734.791	681021.569	212.681
TCP-143	28°29'54.7526"N	76°50'31.4879"E	3153813.651	680294.586	214.680
TCP-144	28°29'57.1221"N	76°50'30.5123"E	3153886.183	680266.936	214.588
TCP-145	28°30'22.3772"N	76°50'20.6217"E	3154659.458	679986.076	214.211
TCP-146	28°30'22.6226"N	76°50'23.7880"E	3154668.329	680072.053	214.134
TCP-147	28°30'53.1741"N	76°50'08.1171"E	3155602.235	679631.563	213.177
TCP-148	28°30'54.2896"N	76°50'11.2711"E	3155637.887	679716.790	212.908
TCP-149	28°31'22.3387"N	76°49'56.0802"E	3156494.973	679290.586	213.433
TCP-150	28°31'25.2632"N	76°49'57.6593"E	3156585.651	679332.140	213.002
TCP-151	28°31'59.1200"N	76°49'43.5444"E	3157621.968	678932.518	212.454
TCP-152	28°31'59.1272"N	76°49'46.9756"E	3157623.614	679025.787	212.229
TCP-153	28°32'26.7740"N	76°49'35.6755"E	3158469.951	678705.642	213.086
TCP-154	28°32'26.4983"N	76°49'39.8166"E	3158463.179	678818.333	Not Found
TCP-155	28°32'53.9751"N	76°49'28.0246"E	3159304.084	678484.932	213.040
TCP-156	28°32'53.1025"N	76°49'30.9652"E	3159278.440	678565.266	212.970
TCP-157	28°33'37.0758"N	76°49'21.9955"E	3160628.310	678300.880	214.384
TCP-158	28°33'34.0657"N	76°49'24.3878"E	3160536.643	678367.307	Not Found
TCP-159	28°34'06.2658"N	76°49'23.8031"E	3161527.582	678336.328	215.035
TCP-160	28°34'06.5116"N	76°49'27.5806"E	3161536.712	678438.865	215.232
TCP-161	28°34'44.1302"N	76°49'21.6178"E	3162692.219	678259.204	215.717
TCP-162	28°34'44.0011"N	76°49'24.6126"E	3162689.483	678340.641	215.278
TCP-163	28°35'09.5370"N	76°49'13.4355"E	3163470.908	678024.983	214.889
TCP-164	28°35'07.6456"N	76°49'17.6162"E	3163414.415	678139.459	214.612
TCP-165	28°35'49.0434"N	76°49'01.9172"E	3164682.237	677693.567	215.457
TCP-166	28°35'47.6889"N	76°49'04.9767"E	3164641.806	677777.317	215.564
TCP-167	28°36'14.8728"N	76°48'53.1968"E	3165473.723	677444.596	216.920
TCP-168	28°36'17.7457"N	76°48'53.0803"E	3165562.109	677440.090	216.659
TCP-169	28°36'53.6286"N	76°48'52.3007"E	3166666.338	677402.156	212.887
TCP-170	28°36'53.5674"N	76°48'55.5844"E	3166665.807	677491.379	213.297
TCP-171	28°37'16.7159"N	76°48'48.6339"E	3167375.501	677291.779	215.681
TCP-172	28°37'17.3314"N	76°48'51.6175"E	3167395.675	677372.528	214.707
TCP-173	28°37'46.6093"N	76°48'43.5742"E	3168293.597	677140.405	214.187
TCP-174	28°37'47.1935"N	76°48'46.5660"E	3168312.814	677221.386	213.926
TCP-175	28°38'15.6349"N	76°48'45.4960"E	3169187.860	677179.049	213.600
TCP-176	28°38'15.2158"N	76°48'48.5079"E	3169176.200	677261.038	213.400
TCP-177	28°38'52.6530"N	76°48'49.2286"E	3170328.894	677263.120	212.775
TCP-178	28°38'50.3688"N	76°48'51.5203"E	3170259.526	677326.417	212.786
TCP-179	28°39'32.7743"N	76°48'58.6038"E	3171567.785	677498.914	212.932
TCP-180	28°39'34.3510"N	76°49'01.8370"E	3171617.653	677585.962	213.008
TCP-181	28°39'57.4882"N	76°49'07.1922"E	3172332.083	677720.515	214.640

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GCP's DATA OF CH: -3.500 TO 0.0KM & 0.0KM TO 128 KM

Name	WGS84 Latitude	WGS84 Longitude	Grid Northing (m)	Grid Easting (m)	Elevation
TCP-182	28°39'59.9709"N	76°49'08.1020"E	3172408.883	677744.052	214.623
TCP-183	28°40'33.8436"N	76°49'17.1206"E	3173455.299	677972.991	Not Found
TCP-184	28°40'31.5333"N	76°49'19.8702"E	3173385.319	678048.720	212.801
TCP-185	28°41'04.4049"N	76°49'27.2132"E	3174400.233	678232.594	213.359
TCP-186	28°41'04.2513"N	76°49'30.3003"E	3174396.785	678316.466	213.092
TCP-187	28°41'29.5545"N	76°49'39.7592"E	3175179.610	678561.293	213.916
TCP-188	28°41'27.5136"N	76°49'42.9392"E	3175118.110	678648.570	213.692
TCP-189	28°41'53.0101"N	76°49'49.7887"E	3175905.806	678822.443	Not Found
TCP-190	28°41'51.8793"N	76°49'52.7202"E	3175872.217	678902.544	Not Found
TBM-8	-	-	-	-	216.022
TBM-8A	-	-	-	-	217.141
TCP-191	28°42'19.5156"N	76°50'08.3889"E	3176729.472	679314.720	Not Found
TCP-192	28°42'20.5735"N	76°50'13.0258"E	3176763.975	679440.061	215.715
TCP-195	28°43'19.8012"N	76°50'45.7135"E	3178600.869	680298.954	216.671
TCP-196	28°43'22.2933"N	76°50'47.7586"E	3178678.441	680353.259	216.732
TCP-200	28°44'11.8367"N	76°50'57.1896"E	3180207.496	680585.502	215.863
TCP-201	28°44'13.7696"N	76°50'54.5753"E	3180265.895	680513.649	220.736
TCP 202	28°44'47.4517"N	76°51'13.3781"E	3181310.657	681007.658	215.773
TCP-203	28°44'47.5267"N	76°51'10.5601"E	3181311.774	680931.172	219.196
TCP-204	28°45'15.6253"N	76°51'28.8014"E	3182184.445	681412.544	216.728
TCP-205	28°45'16.6182"N	76°51'26.4624"E	3182214.019	681348.618	Not Found
TCP-206	28°45'43.3746"N	76°51'47.4539"E	3183046.560	681905.163	216.724
TCP-207	28°45'44.3337"N	76°51'45.3902"E	3183075.208	681848.723	217.837
TCP-208	28°46'12.1697"N	76°52'07.8621"E	3183941.643	682444.818	217.157
TCP-209	28°46'14.1830"N	76°52'04.6579"E	3184002.256	682356.937	224.242
TCP-210	28°46'41.2891"N	76°52'23.5045"E	3184844.706	682854.974	216.705
TCP-211	28°46'41.6254"N	76°52'19.6773"E	3184853.423	682751.014	221.517
TCP-212	28°47'06.9931"N	76°52'37.2627"E	3185641.839	683215.626	217.137
TCP-213	28°47'09.6905"N	76°52'34.8052"E	3185723.824	683147.670	217.713
TCP-215	28°47'41.2724"N	76°52'50.8038"E	3186702.875	683566.159	218.645
TCP-216	28°48'06.7675"N	76°53'11.9801"E	3187496.799	684127.937	217.848
TCP-217	28°48'09.9565"N	76°53'10.7518"E	3187594.440	684093.076	220.428
TCP-220	28°48'57.1791"N	76°54'00.9431"E	3189069.798	685430.755	218.322
TCP-221	28°48'57.2345"N	76°53'58.0967"E	3189070.271	685353.560	218.610
TCP-222	28°49'22.3693"N	76°54'27.4414"E	3189856.759	686136.712	218.018
TCP-223	28°49'22.3876"N	76°54'23.7163"E	3189855.699	686035.717	217.864
TCP-224	28°49'43.8176"N	76°54'51.4390"E	3190527.485	686776.639	218.273
TCP-225	28°49'45.4980"N	76°54'49.0279"E	3190578.160	686710.444	221.500
TCP-226	28°50'05.7997"N	76°55'18.5617"E	3191216.053	687500.936	217.993
TCP-227	28°50'08.2738"N	76°55'16.9260"E	3191291.499	687455.364	224.763
TCP-228	28°50'28.8356"N	76°55'45.1844"E	3191936.893	688211.065	218.895
TCP-229	28°50'29.7194"N	76°55'43.2143"E	3191963.232	688157.225	221.779
TCP-230	28°50'50.6845"N	76°56'12.8509"E	3192621.702	688949.996	219.059

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GCP's DATA OF CH: -3.500 TO 0.0KM & 0.0KM TO 128 KM

Name	WGS84 Latitude	WGS84 Longitude	Grid Northing (m)	Grid Easting (m)	Elevation
TCP-231	28°50'51.5664"N	76°56'11.1237"E	3192648.087	688902.738	219.080
TCP 232	28°51'12.4342"N	76°56'39.3405"E	3193302.986	689656.989	218.126
TCP 233	28°51'13.0106"N	76°56'36.5176"E	3193319.479	689580.191	218.099
TCP-234	28°51'35.5539"N	76°57'05.4444"E	3194026.323	690352.753	218.728
TCP-235	28°51'37.3748"N	76°57'03.2061"E	3194081.380	690291.173	218.866
TCP-236	28°51'58.9139"N	76°57'33.2424"E	3194757.862	691094.216	217.924
TCP-237	28°51'59.5617"N	76°57'29.5754"E	3194776.164	690994.517	217.805
TCP-238	28°52'20.6429"N	76°57'58.0973"E	3195437.924	691756.669	220.381
TCP-239	28°52'21.9951"N	76°57'55.1679"E	3195478.233	691676.601	220.347
TCP-240	28°52'43.2460"N	76°58'23.3823"E	3196145.129	692430.245	219.634
TCP-241	28°52'44.8674"N	76°58'22.4457"E	3196194.621	692404.039	219.585
TCP-242	28°53'04.5385"N	76°58'49.6071"E	3196812.457	693129.879	Not Found
TCP-243	28°53'06.7052"N	76°58'48.4196"E	3196878.622	693096.591	219.843
TCP-244	28°53'27.6906"N	76°59'15.9857"E	3197537.151	693832.638	219.331
TCP-245	28°53'29.6655"N	76°59'15.8042"E	3197597.866	693826.699	219.700
TCP-246	28°53'39.0276"N	76°59'52.7637"E	3197902.911	694823.168	219.418
TCP-247	28°53'41.4429"N	76°59'52.7141"E	3197977.243	694820.573	219.356
TCP-248	28°53'48.1373"N	77°00'41.0308"E	3198205.471	696126.059	220.279
TCP-249	28°53'50.0922"N	77°00'40.7153"E	3198265.508	696116.491	219.686
TCP-250	28°53'51.8361"N	77°01'02.9349"E	3198329.424	696717.533	219.796
TCP-251	28°53'53.8396"N	77°01'02.9790"E	3198391.123	696717.677	219.670
TCP-252	28°53'59.0604"N	77°01'41.7943"E	3198569.796	697766.474	220.626
TCP-253	28°54'01.1271"N	77°01'40.0906"E	3198632.632	697719.231	Not Found
TCP-254	28°54'05.4704"N	77°02'14.8846"E	3198782.507	698659.522	222.576
TCP-255	28°54'07.7889"N	77°02'14.9287"E	3198853.906	698659.488	222.387
TCP-256	28°54'11.9954"N	77°02'47.9907"E	3198998.839	699552.910	Not Found
TCP-257	28°54'13.9564"N	77°02'47.9454"E	3199059.188	699550.640	220.173
TCP-258	28°54'35.6726"N	77°03'19.9205"E	3199742.728	700405.242	213.919
TCP-259	28°54'35.6407"N	77°03'17.6883"E	3199740.697	700344.791	Not Found
TCP 260	28°55'07.1089"N	77°03'06.5866"E	3200704.252	700027.285	213.548
TCP-261	28°55'06.6600"N	77°03'04.1751"E	3200689.301	699962.205	213.333
TCP-262	28°55'37.0488"N	77°02'52.3390"E	3201619.289	699625.434	215.014
TCP-263	28°55'36.4479"N	77°02'50.5823"E	3201599.968	699578.176	215.152
TCP-264	28°56'07.9988"N	77°02'36.2805"E	3202564.591	699174.062	216.020
TCP-265	28°56'06.3488"N	77°02'33.4393"E	3202512.464	699097.997	215.420
TCP-266	28°56'37.4916"N	77°02'22.9390"E	3203466.311	698797.109	215.340
TCP-267	28°56'36.0575"N	77°02'20.2303"E	3203420.898	698724.520	215.133

MNEC CONSULTANTS PVT. LTD. NAGPUR

3. List of Charted Utilities

3. List of Charted Utilities

Ref. Sub-Clause 10.45 & 10.46, Appendix 10, Section VII-9: Appendices, Part 2- Employer's Requirements

3.1.1 Overground Electrical Crossings

a) Overhead Electrical Crossings: LT and HT (up to 33 KV)

S. No.	Type of crossings	Chainage No.
1	11kV HT Parallel	(-) 0+880 to (-)1+470
2	11kV HT Crossing	(-880)
3	11kV HT Crossing	(-1470)
4	11kV HT Crossing	(-) 1+390
5	11kV HT Parallel	(-) 1+055 to (-) 1+390
6	11kV HT Parallel	(-724 to -319)
7	11kV HT Crossing	(-724)
8	11kV HT Crossing	(-319)
9	11kV HT Crossing	0+429
10	11kV HT Crossing	0+860
11	11kV HT Crossing	1+642
12	11kV HT Parallel	1+600 to 1696
13	11kV HT Crossing	1+651
14	11kV HT Crossing	2+863
15	11kV HT Crossing	3+106
16	11kV HT Crossing	3+513
17	11kV HT Crossing	4+123
18	11kV HT Crossing	4+294
19	11kV HT Crossing	4+805
20	11kV HT Crossing	4+826
21	11kV HT Crossing	5+805
22	11kV HT Crossing	6+954
23	11kV HT Parallel	7+289 to 7+300
24	11kV HT Crossing	7+289
25	11kV HT Parallel	7+289+100
26	11kV HT Crossing	7+657
27	11kV HT Crossing	7+807
28	11kV HT Crossing	9+226
29	11kV HT Crossing	11+879
30	11kV HT Parallel	11+879 TO 12+070
31	11kV HT Crossing	12+070
32	11kV HT Crossing	20+045
33	33 kV HT Parallel	20+058 to 21+880
34	11kV HT Crossing	20+206
35	11kV HT Crossing	21+668
36	33 kV HT Crossing	20+400
37	33 kV HT Crossing	20+400

S. No.	Type of crossings	Chainage No.
38	33 kV HT Crossing	20+403
39	33 kV HT Crossing	20+403
40	33 kV HT Crossing	20+407
41	33 kV HT Crossing	20+407
42	33 kV HT Crossing	20+260
43	33 kV HT Crossing	20+104
44	33 kV HT Crossing	20+260
45	33 kV HT Crossing	20+261
46	11kV HT Crossing	23+041
47	11 kV HT Parallel	23+536
48	11 kV HT Parallel	23+746

b) EHT (above 33 KV)

S. No.	Type of crossings (Voltage Level)	Owner	Feeder name	Chainage (m)	Remarks
1	EHT Crossing (220 kV)	HVPNL	BTPS - Alwar Line	00+815	Not Required to be modified
2	EHT Crossing (400 kV)	GPTL	Prithla - Kaderpur Line	03+070	Not Required to be modified
3	EHT Crossing (400 kV)	PGCIL	Ballabhgarh - Agra Line	05+676	Not Required to be modified
4	EHT Crossing (220 kV)	HVPNL	Sec-72- Rangala Rajpur LILO Line (IMT Sohna)	19+950	Modification work is in progress
5	EHT crossing (66 kV)	HVPNL	Sohna-Nuh Nagina Line	20+500	Modification work Completed

4. Indicative List of Existing Structures to be Dismantled /to be filled (Tube Wells, Bore Wells and Wells)

4. Indicative List of Existing Structures to be Dismantled /*to be filled (Tube Wells, Bore Wells and Wells*

(Ref. Sub-Clause 10.14, Appendix 10, Section VII-9: Appendices, Part 2 – Employer's Requirements)

Structures in Main Line							
S. No.	**Type of Structure**	**Chainage (in m)**	**District**	**Sub Division**	**Length of Obstruction to be considered (in m)**	**Chainage**	
						From	**To**
1	Tubewell with one room	-1015	Palwal	Palwal	20		
2	Water Pipe Line	-821	Palwal	Palwal	20		
3	Boundary wall	-730	Palwal	Palwal	140	-730	-640
4	Bore well	-555	Palwal	Palwal	20		
5	Bore Well	-530	Palwal	Palwal	20		
6	Bore Well	-250	Palwal	Palwal	20		
7	Bore Well	-225	Palwal	Palwal	20		
8	Open Well	-215	Palwal	Palwal	20		
9	Shamshan Ghat/Boundary wall	-90	Palwal	Palwal	100	-174	-90
10	Bore well	0	Palwal	Palwal	20		
11	Bore well	140	Palwal	Palwal	20		
12	Tubewell with one room	800	Palwal	Palwal	20		
13	Tubewell with one room	1585	Palwal	Palwal	20		
14	Village Habitation at Mandpuri Village	1640 to 1800	Palwal	Palwal	160		
15	Bore well	4450	Palwal	Palwal	20		
16	House/Structure	4535	Palwal	Palwal	60		
17	Tubewell with one room	6485	Gurugram	Sohna	20		
18	Bore well	6595	Gurugram	Sohna	20		
19	Hand Pump	6681	Gurugram	Sohna			
20	Bore well	7265	Gurugram	Sohna	20		
21	Bore well	7280	Gurugram	Sohna	20		
22	Bore well	7570	Gurugram	Sohna	20		
23	Bore well	7630	Gurugram	Sohna	20		

Structures in Main Line							
S. No.	**Type of Structure**	**Chainage (in m)**	**District**	**Sub Division**	**Length of Obstructio n to be considered (in m)**	**Chainage**	
						From	**To**
24	Bore well with Room	7715	Gurugram	Sohna	20		
25	Bore well	9230	Gurugram	Sohna	20		
26	*Deleted*						
27	Open well	11135	Gurugram	Sohna	20		
28	Structure/Room	11165	Gurugram	Sohna	40		
29	Structure/Bhumiya	11215	Gurugram	Sohna	20		
30	Boundary wall,Farm house	11615	Gurugram	Sohna	185	11615	11800
31	Structue/Room	18310	Nuh	Indri	40		
32	Bore well	18900	Nuh	Indri	20		
33	Water tank and Room	20985	Nuh	Indri	40		
34	Water *Pipe* Line	20985	Nuh	Indri	675	20985	21660
35	Kabristan/Boundary wall	21420	Nuh	Indri	140	21420	21560
36	Small Hut	21580	Nuh	Indri	10		
37	Bore well/Handpump	24120	Nuh	Indri	20		
38	Structure/Teen shed Factory	24180	Nuh	Indri	60		
32	Small Hut	24280	Nuh	Indri	20		

5. Approved Manufactures/Suppliers List

5. Approved Manufactures/Suppliers List

All materials and products shall conform to the Outline Construction Specification (OCS), BIS codes and other relevant codes etc. and shall be of make as approved by the Engineer.

The list of approved makes for products and materials is given below. Other equivalent manufacturers may also be considered with prior approval of the Engineer, if found conforming to all standards. Such requests should be made with all documents to the Engineer at least 45 days before the material is required and any order shall be placed only after receiving the written approval of the Engineer.

S. No.	Details of Materials/ Products	Manufacturer's Name
1.	Cement	ACC, Ultratech, Ambuja Cements, JK Lakshmi, JSW, JK Cement, Lafarge, Shree Cement, Birla Cement, Grasim
2.	Reinforcement Bars	SAIL, JSW STEEL, TATASTEEL, RINL, JSPL
3.	Epoxy	FOSROC, SIKA QUALCRETE, BASF, CICO, MC–BAUCHEMIE, MAPEI, CHRYSO, Huntsman Advanced Materials
4.	Expansion Joints for Viaduct	Prequalified Manufacturers as per RDSO's latest approved list
5.	Admixtures	FOSROC, SIKA, MC-BAUCHEMIE, CHRYSO, MAPEI, CICO
6.	Pile Integrity Testing	CIMEC, Geodynamics, AIMIL, CBRI, Pile Dynamic, CEGTH, FUGRO
7.	*Anchor Fastener	HILTI, FISHER, BOSCH, (Please note that ETA Certification is mandatory for using/supplying fasteners for load bearing structural members)
8.	Structural Steel	TATA, SAIL, ESSAR, JSPL, JSW
9.	Pre- stressing Strand (LRPC)	TATA SSL Ltd, USHA MARTIN
10.	*Pot/Elastomeric /Spherical Bearings	Prequalified Manufactures as per RDSO's latest approved list.
11.	HDPE Sheathing	Rex Polyextrusion, Gwalior Poly Pipes Ltd, Dynamic Prestress, JK Prestressing
12.	Formwork Release Agent	FOSROC, MC BAUCHEMIE, CICO, MAPEI, SIKA, CHRYSO
13.	*Prestressing System	Freyssinet, BBR, VSL, Dynamic, Killick Nixon, Tensacciai (India Ltd.), JK Prestressing, Usha Martin, VSIL

S. No.	Details of Materials/ Products	Manufacturer's Name
14.	*Reinforcement Couplers	DEXTRA, , SANFIELD, SPLICETECH COUPLERS
15.	Hollow Sections, Pipes	Surya Pipes, Hi-Tech Pipes, JSW, JSPL, TATA.
16.	Drainage Pipes	Tirupati Plastomatics, Duraline, REX, STIPL
17.	Acrylic Textured Coatings	Spectrum, Surfa Nova, Jotun, Asian Paints, Berger, Hempel, DULUX
18.	Non Shrink Grout	FOSROC, Fairmate, SIKA, CICO, MC-Bauchemie, CHRYSO
19.	Bonding Coat	CICO, FOSROC, BASF, SIKA, MAPEI, MC-BAUCHEMIE, CHRYSO
20.	Polysuphide Sealant	CICO, PIDILITE, FOSROC, SIKA, CHRYSO
21.	*Steel Structural Fasteners	Sundram Fasteners, Nelson, Dextra India, Panchsheel, Pooja Forge (Please note that ETA Certification is mandatory for using/supplying fasteners for load bearing structural members)
22.	*Corrosion Protection Paints	Berger, Jenson and Nicholson, Nerolac, Asian Paints, Akzo Nobel, Jotun
23.	Fire Resistant Paint	Akzo Nobel, PPG, Jotun
24.	Water stopper/ Bar	Greenstreak, Duron, Maruti, Kanta Rubber
25.	*Liquid Polymer membrane waterproofing	SIKA, MAPEI , NINA, CICO, MYK Schomburg, Geo-Constech
26.	Curing Compound	FOSROC, CHRYSO, CICO, MC- BAUCHEMIE, MAPEI, SIKA.
27.	*Polycarbonate Sheets	Gallina Acroplus, Coxwell, Poly U, Fabic, Lexan, (SABIC Innovative Plastics), DANPALON, GE Plastics, VMI Plastics, Power Chem Plast
28.	Fly Ash	Thermal Plants, Ashcrete, Ultra Pozz, Star Pozz, Ashtech
29.	*Pre-Coated Profiled Metal Sheetings	TATA Blue Scope, Multicolor, Essar Steel, Bhushan Steel, Ispat Profile India
30.	Fly Ash Block/ AAC Block	Siporex, Ascolite, J.K. Laxmi, Ashtech
31.	Rock Bolts/Swellex Bolts	Geo Constech, DSI, Atlas Copco, FIREP International, Minova
32.	Soft eye GFRP	Dextra, FIREP International, Minova, Hughes Brothers, Geo Constech
33.	Polymer	WALLGRIP, TRISHUL, Shubham Minerals, Goldy Minerals, GeoPolymer

S. No.	Details of Materials/ Products	Manufacturer's Name
34.	Welding electrodes	Ador welding Ltd.(Advani-Oerlikon),ESAB, D&H Welding Electrodes, Modi Arc
35.	Aluminium Sheets	Hindustan Aluminium, Jindal, Balco
36.	Vitrified Tiles	Asian Tiles, Somany, Johnson, Bell Ceramics, Kajaria, Simpolo
37.	Ceramic Tiles	NITCO, Orient, Regency Ceramics
38.	Wall Putty	JK White, Birla
39.	Flush Doors	Samrat, Kanchan, Prima Swastik, Kutty, Diamond
40.	Adhesives	Pidilite, Araldite, Toyo Ferrous Crete
41.	Plywood	Duroply, Century Plywood, Green Plywood, Kitply
42.	Veneers	Green Plywood, Century Plywood, Kitply
43.	FloatGlass/Toughened Glass/Insulated Glass/Laminated Glass	Saint Gobain, Modiguard, Tata Float, Asahi Glass Ltd.
44.	Heavy Duty Chequered Tiles	NITCO. Hindustan Tiles, Super Tiles & Marbles Pvt.Ltd.
45.	Heavy Duty Vitrified Tiles	Kajaria World
46.	Emulsion Paint	Asian Paints, Berger, Nerolac, Jenson & Nicholson, Dulux, ICI
47.	Synthetic Enamel	Asian Paints, Berger, Nerolac, Jenson & Nicholson, Dulux, ICI
48.	Paver Blocks	As approved by the Engineer
49.	Sanitary & Bath Fittings	Hindware, Parryware, Jaquar, HR & Johnson, Cera, , Somany, Asian Granito
50.	Aluminium doors & windows	Sehgal & Sehgal Industries
51.	Yellow Tactile Tiles	Pelican
52.	SS Railing	The Cavalier, D Line India, DOORMAT, Panchal Enterprises, SS Enterprises
53.	Glass Mosaic Tiles	Mridul Enterprises, Italia, Bissazza, Kenzai, Opio
54.	Granite Slabs & Tiles	As approved by the Engineer.

NOTE: For the categories marked as *, the enclosed undertaking performa should be duly filled and signed by authorized representatives of concerned agencies.

UNDERTAKING

Name of Contract:	**Date of start of work:**
Category of work:	**Date of completion of work:**

This is to certify that work of ………………… (Category to be mentioned) at ………………… (Location) of the contract .... (Name of contract) has been executed/completed in accordance with the manufacturer's/supplier's specifications and as per the approved method statement.

The work has been jointly inspected by authorised representative of ……………(Manufacturer/supplier), …………………… (Executing agency) &…………………………….. (Contractor) during its execution and all non-conformities observed during inspection have been complied to achieve the best industry standards.

The undersigned take full responsibility of the overall adequacy, accuracy, effectiveness & warranty (upto design life) of the completed work as per the provision of the contract……………………. (Contract number) and Outline Construction Specifications of the Part 2- Employer's Requirements.

(Stamp and Signature)	**(Stamp and Signature)**	**(Stamp and Signature)**
Manufacturer Representative	**Executing agency Representative**	**Contractor Representative**

6. DFC Letter – Approval of GAD of HORC alignment crossing under DFC bridge 87

डेडीकेटेड फ्रेट कॉरीडोर कार्पोरेशन ऑफ इंडिया लि.
भारत सरकार (रेल मंत्रालय) का उपक्रम
Dedicated Freight Corridor Corporation of India Ltd.
A Govt. of India (Ministry of Railways) Enterprise

डेडीकेटेड फ्रेट कॉरीडोर

No: DFCC/Noida Unit/DMIC/HRIDC/ 8228 Dated: 03-06-2023

Chief Project Manager/HRIDC
Plot No. 143, 5th Floor, Rail Tel Tower
Sec-44, Gurugram, Haryana-122003

Sub: - Approval of GAD of HORC alignment crossing under DFC bridge 87.

Ref: -

i. Your Letter No. HRIDC/GGN/DFCCIL/2021/1637 dated 10-02-2022.
ii. This office letter no. DFCC/Noida Unit/DMIC/HRIDC/7726 dated 04.03.2023.
iii. Presentation made by HRIDC before director Infra at prithala on 09.05.2023.
iv. your office letter no. HRIDC/GGN/DFCCIL/2021/1914 dated 19.05.2023.

Under the above reference in principal approval for crossing HORC alignment under DFC bridge no. 87 is granted subject to fulfilment of following conditions.

(i) HORC track will be placed clear-off DFC Bridge structure as per SSOD of DFCC/HORC.
(ii) Drawings of DFC Bridge no. 87 are attached herewith for further planning at the end of HRIDC.
(iii) The HORC structural components (viz. Sub-structure, super-structure and foundations) shall be planned/executed at-least 2.0 m clear distance (in plan) from DFC Bridge structural components (viz. sub-structure and foundation).
(iv) HORC Bridge pile/open foundations will be designed duly accounting base pressure below DFC bridge open foundations.
(v) HORC UP-line Bridge foundation is shown adjacent to DFC Bridge foundation. This indicates that there will be overlap of pressure bulb of adjacent foundations. It will be ensured that sufficient bearing capacity is available against the super-imposed base pressure of DFC bridge foundation and HORC bridge foundation.
(vi) Since it is proposed to carry out tunnelling works from Sonipat end, rock/boulders may hit DFC Bridge components while opening of tunnel on DFC Bridge side. HRIDC will submit and obtain DFCCIL approval for the protection arrangement/scheme for DFC works prior to opening of tunnel.
(vii) HRIDC will submit the detailed safety plans for the approval of DFCCIL before start of any execution work near to DFCCIL track.
(viii) HRIDC will submit, analysis of safety, stability and protection measures (temporary and permanent) duly proof checked by IIT/NIT for the DFCC works.
(ix) Sub-structure and foundation of HORC will not infringe with the toe of the buttress wall.
(x) Adequate protection (temporary/permanent) arrangements will be made for DFC Bridge structure, embankment and rock surface during construction of HORC bridge structure and tunnel works.
(xi) Existing drainage works will be re-instated to their original condition. In case, HORC drainage plan is affecting existing drainage scheme, drainage works shall be designed and executed by HRIDC duly accounting DFC drainage requirement, with prior approval of DFCCIL at the cost of HRIDC.
(xii) Duly proof checked (from IIT/NIT) detailed GAD, Design/Drawings of pier/abutment, super-structure and rock slope stability shall be submitted to DFCCIL for his review and approval start of any execution work the vicinity of DFCCIL ROW.
(xiii) HRIDC will be required to submit the construction programmer before the actual start of the work.

03/6/23

(xiv) Whenever necessary/required, HRIDC will seek permission for issuance of **Traffic Work Order** (TOW) from DFCCIL for the activities which may affect train operations and safety of the DFC works.

(xv) HRIDC or its Contractor will interface with DFCCIL Contractor for the planning and execution of HORCL works in DFC ROW.

(xvi) DFCCIL reserves the right of cancellation of approval on violation of any of the condition and may impose any other condition to ensure the safety of DFC bridge structure and DFC train operation.

(xvii)HRIDC will indemnify DFCCIL regarding any damage during construction of HORC line and any damage to DFC works shall be reinstated to its original condition by the HRIDC at his own cost..

HRIDC will indemnify, defend and hold DFCCIL harmless against any and all proceedings, action and third-party claims for any loss, damage, cost and expenses arising out of any action of HRIDC or its Contractor under this work.

01
03/6/23

R.K.Gupta
CGM/Noida

Copy to:

(i) Director/Infra/DFCCIL New Delhi for kind information please.
(ii) ED/Assets/Management/DFCCIL for kind information please.

7. Geotechnical Investigation Reports

CONTENTS

7.1 Report No: SMC – 2050 - Viaduct Report

GEOTECHNICAL INVESTIGATION REPORT
FOR
VIADUCT

EXPLORING ALTERNATE ALIGNMENTS, FINAL LOCATION SURVEY, GEOLOGICAL MAPPING, GEO-TECHNICAL INVESTIGATION, DETAIL DESIGN OF TUNNEL & ITS APPROACHES INCLUDING VIADUCT IF ANY AND OTHER ANCILLARY WORK IN SOHNA-MANESAR SECTION OF HORC PROJECT.

Client:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

Prepared By:

S.M. CONSULTANTS,
S.M.TOWER, PLOT NO.-130,
MANCHESWAR INDUSTRIAL ESTATE,
RASULGARH, BHUBANESWAR-751010, ODISHA

GEOTECHNICAL INVESTIGATION REPORT
FOR
VIADUCT

EXPLORING ALTERNATE ALIGNMENTS, FINAL LOCATION SURVEY, GEOLOGICAL MAPPING, GEO-TECHNICAL INVESTIGATION, DETAIL DESIGN OF TUNNEL & ITS APPROACHES INCLUDING VIADUCT IF ANY AND OTHER ANCILLARY WORK IN SOHNA-MANESAR SECTION OF HORC PROJECT.

VIADUCT REPORT

Prepared & Submitted By		
M/s. S. M. Consultants		
Prepared By	Geotechnical Engineer	Shreesta
Approved By	Sr. Consultant	Virendravarma

Client:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

Prepared By:

S.M. CONSULTANTS,
S.M.TOWER, PLOT NO.-130,
MANCHESWAR INDUSTRIAL ESTATE,
RASULGARH, BHUBANESWAR-751010,
ODISHA

CONTENTS

LIST OF TABLES

ANNEXURES

EXECUTIVE SUMMARY

General Objectives of Investigation: The scope of work was to complete **"Exploring alternate alignments, final location survey, geological mapping, geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project."** This report presents the results of the Site Investigation and Geotechnical recommendations related to the Project.

Fieldwork and Laboratory Testing: Twelve nos. of borehole at location **Abutment(BH NO -2), Pier(BH NO-3, BH NO-4,BH NO-5,BH NO-6,BH NO-7,BH NO-8,BH NO-9,BH-10,BH-11,BH-11A,BH NO-12)** were drilled. Field-testing of subsoil was conducted and soil samples at various depths were collected during drilling. Geotechnical laboratory tests on collected soil samples were conducted at our laboratory (NABL accredited) at New Delhi. These tests include Grain Size Distributions, Hydrometer Analysis, Atterberg's Limits, Density, Moisture Content, Specific Gravity, Shear Strength Parameters, Void Ratio and Consolidation Test and of soil samples.

Report on Foundation System: A general description of the strata encountered during boring, the soil properties, details of field Test, Laboratory Test and groundwater levels are provided in this report. Recommendations for Foundations based on Geotechnical Engineering parameters related to the proposed structure **(Viaduct)** have been given in this report. The design of Pile Foundations is based on parameters derived from Geotechnical Investigations. The calculation of safe load carrying capacity of pile foundation was carried out as per the relevant clauses of IRC 78 and IS Codes.

1.0.INTRODUCTION

This report presents results of sub-soil Exploration work for **"Exploring alternate alignments, final location survey, geological mapping, geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project." Abutment(BH NO -2), Pier(BH NO-3, BH NO-4,BH NO-5,BH NO-6,BH NO-7,BH NO-8,BH NO-9,BH-10,BH-11,BH-11A,BH NO-12).** This work was performed by **M/s. S. M. Consultants, Bhubaneswar** under **Haryana Rail Infrastructure Development Corporation Ltd.**

2.0.PURPOSE AND SCOPE OF SERVICES

The purpose of the current geotechnical investigation was to explore and determine the existing sub-strata conditions such as stratification, denseness or hardness of the strata, position of ground water table etc. at the location and to evaluate shear strength parameters for determination of safe bearing capacity and foundation system of proposed structure (**Viaduct**) using procedures as provided in the relevant IS codes. The goal of our investigation was to identify the key geotechnical issues that could potentially affect the proposed project and to develop geotechnical recommendations for design and construction of foundation of related structures.

Our scope of services included the following tasks:

- Field marking of boring locations.
- Drilling of **twelve** numbers of boreholes up to the required depth below the existing ground level in order to know the sub surface stratification, conducting necessary field tests and collection of sub-strata samples for laboratory testing.
- Testing of soil samples in the laboratory to determine its physical and engineering properties and analyzing all field and laboratory data to evaluate bearing capacity of the sub-strata for given foundation sizes.
- Preparation of this report containing our findings and recommendations including:
  a) Brief description of the proposed project;
  b) Description of the field exploration and laboratory testing programs;
  c) Discussion on the site surface and subsurface conditions.
  d) Preliminary geotechnical parameters for design of foundations for structural support.

3.0. PROJECT DESCRIPTION

Proposed site is located at Sohna, Haryana.

3.1. Location And Topography of Haryana

3.1.1. Geography

Haryana is in north India and has a total area of 44212 square kilometres. Haryana surrounds the country's capital Delhi on three sides (north, west and south). Haryana is a landlocked state in northern India. It is between 27°39' to 30°35' N latitude and between 74°28' and 77°36' E longitude. The total geographical area of the state is 4.42 m ha, which is 1.4% of the geographical area of the country. The altitude of Haryana varies between 700 and 3600 ft (200 metres to 1200 metres) above sea level.

3.1.2. Climate

Haryana is extremely hot in summer at around 45 °C (113 °F) and mild in winter. The hottest months are May and June and the coldest December and January.[83] The climate is arid to semi-arid with average rainfall of 354.5 mm. Around 29% of rainfall is received during the months from July to September, and the remaining rainfall is received during the period from December to February.

3.1.3. Rainfall

Haryana gets highest rainfall (33%) of south west monsoon rainfall in August month while the July month get 32% of the south west monsoon rainfall. June and September receive 14% and 21% of south west 5 monsoon rainfall. Also more than 82% of annual rainfall receives during the southwest monsoon season only. The variability of monsoon or annual rainfall is 31% and 27% respectively.

3.1.4. Seismic zone

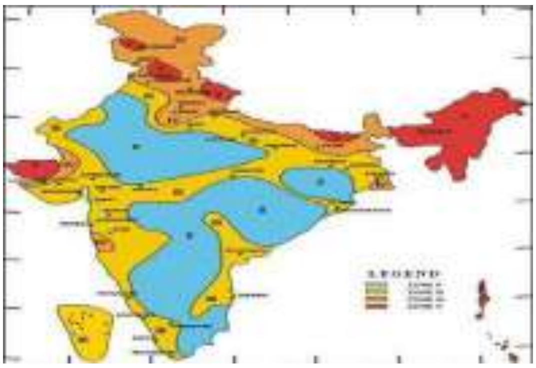


Figure 1. Seismic zone of India

Haryana falls under seismic zones IV. zone IV is considered a high-damage risk zone.

4.0. FIELD INVESTIGATION PROGRAM

Field investigation work was in accordance with IS 1892 -1979.

Field works include:

- Boring in the sub-strata by Rotary Boring Method.
- Collection of disturbed & undisturbed samples from bore holes.
- Conducting SPT in soil as per IS: 2131-1981(Reaffirmed 2016) and collection of SPT samples.

4.1. Present Site Location:

Present site is located at Sohna . Boreholes were conducted for a proposed structure i.e. **(Viaduct).**

4.2. Methodology of Investigation:

By using Rotary Boring, the borehole was progressed up to desired depth. Rotary Boring method of boring is most widely used method of advancing a boreholes. This method along with use of drilling mud to stabilize the side of the borehole is likely to give the least disturbance to soils beneath the base of the borehole and permit taking near to truly undisturbed samples. Diameter of boreholes was 150mm. Where caving of boreholes occurred, casings were used to keep the boreholes stable.

Standard Penetration Tests (SPT) was conducted in the boreholes alternate to UDS. By connecting a split spoon sampler to ‘A’ rods and driving it by 45cm using a 63.5 kg hammer falling freely from a height of 75cm. The tests were conducted in accordance with IS: 2131-1981(Reaffirmed 2016).

Number of blows required for each 15cm penetration of the split spoon sampler was recorded. First 15cm penetration is ignored. The cumulative no. of blows required to penetrate the rest 30cm of the 45cm sampling interval is reported as the SPT value (N value).

Bore logs showing field data of each borehole has been attached in this report **(ANNEXURE-A).**

4.3. Logging and Sample collection:

During exploration for each borehole log of borings showing details about the exploration were prepared. Bore logs were presented in this report under **Annexure-A.**

Disturbed samples were collected from the split spoon sampler after conducting SPT. The samples were preserved in transparent polythene bags with proper identification mark.

In case of undisturbed samples, tubes were sealed with wax at both the ends. Then samplers were wrapped with moist jute bags to prevent loss of moisture.

4.4. Summary of fieldwork:

The table below shows the numbers of boreholes with max-explored depth and depth of water table encountered.

Table - 1

BH Reference	Chainage Reference in m	Ground Level RL in m.	Max depth of exploration in m.	Ground water table below E.G.L in m.
A-(BH NO-02)	21305	191.135	32.0	1.5
PIER- (BH NO-03)	21805	191.220	32.0	2.5
PIER- (BH NO-04)	22265	191.013	32.0	2.0
PIER- (BH NO-05)	22160	192.226	32.0	3.0
PIER- (BH NO-06)	22660	194.594	32.0	Not Found
PIER- (BH NO-07)	23160	196.146	32.0	Not Found
PIER- (BH NO-08)	23660	200.069	20.0	Not Found
PIER- (BH NO-09)	22705	191.897	40.0	1.90
PIER- (BH NO-10)	23205	193.009	40.0	2.40
PIER- (BH NO-11)	23705	193.717	40.0	1.80
PIER- (BH NO-11A)	24205	196.637	40.0	6.50
PIER- (BH NO-12)	24700	203.485	20.0	Not Found

Note: - This Report is for Alternative Alignment 2A.For BH No. 05, 06, 07 & 08 chainages are as per the old alignment-2.

5.0. LABORATORY TESTING

Laboratory methods in accordance with relevant standard codes of practices are adopted to ascertain the different essential characteristics of sub-soil using field samples obtained in during field investigations. The tests as under have been conducted to ascertain the parameters indicated in the test. The finding of these test are required for use in relevant engineering designs.

The table below shows the laboratory tests with concerned IS codes followed.

Table – 2

Sl. No.	Laboratory tests	IS Codes
1	Preparation of soil sample	IS: 2720(part-1)-1983 (Reaffirmed 2015)
2	Moisture Content	IS: 2720(part-2)-1973 (Reaffirmed 2015)
3	Specific Gravity	IS: 2720(part-3)(sec-1)-1980 (Reaffirmed 2016)
4	Grain Size Analysis	IS: 2720(part-4)-1985 (Reaffirmed 2015)
5	Atterberg's Limits	IS: 2720(part-5)-1985 (Reaffirmed 2015)
6	Bulk Density	----
7	Triaxial Shear Strength	IS: 2720(part-11)-1993 (Reaffirmed 2016)
8	Direct Shear Strength	IS: 2720(part-13)-1986 (Reaffirmed 2016)
9	Consolidation Test	IS: 2720(part-15)-1986 (Reaffirmed 2016)

The result sheets of the tests are presented in the subsequent pages.

6.0. DISCUSSION ON THE ENGINEERING PROPERTIES OF THE SUB-STRATA AT THE PROJECT SITE

Abutment (BH NO- 02, CH-21305 m)

1. From N.G.L to 1.5 m depth, a non-plastic, non-expansive Silty sand stratum exists from which one DS was collected at 0.5 m depth.
2. From 1.50 m to 32.0 m (max. explored) depth, medium-plastic, stiff to hard consistency silt & clay with low compressibility stratum exist from which six UDS samples were collected at 3.0 m,6.0 m,12.0 m,18.0 m,24.0 m & 30.0 m depth. The field SPT N values were found to be 11,15,22,28,48,54 & 66 at 1.50 m,4.5 m,9.0 m,15.0 m,21.0 m,27.0 m & 32.0 m depth respectively.

Pier - (BH NO- 03, CH-21805 m)

1. From N.G.L to 1.5 m depth, a non-plastic, Silty sand stratum exists from which one DS was collected at 0.5 m depth.
2. From 1.50 m to 9.0 m depth, medium-plastic, stiff to very stiff consistency silt & clay with low compressibility stratum exist from which two UDS sample were collected at 3.0 m & 6.0 m depth. The field SPT N values were found to be 12 & 17 at 1.50 m & 4.5 m depth respectively.
3. From 9.0 m to 12.0 m depth, a non-plastic, medium compacted Silty sand stratum exists. The field SPT N value was found to be 24 at 9.0 m depth respectively.
4. From 12.0 m to 21.0 m depth, medium-plastic, hard consistency silt & clay with low compressibility stratum exist from which two UDS sample were collected at 12.0 m & 18.0 m depth. The field SPT N value was found to be 32 at 15.0 m depth respectively.
5. From 21.0 m to 24.0 m depth, a non-plastic, very dense compacted clayey silts with none to low plasticity stratum exists. The field SPT N value was found to be 59 at 21.0 m depth respectively.
6. From 24.0 m to 32.0 m (max. explored) depth, non-plastic, very dense compacted Silty sand stratum exist. The field SPT N values were found to be 68 & 77 at 27.0 m & 32.0 m depth respectively.

Pier - (BH NO- 04, CH-21580 m)

1. From N.G.L to 3.0 m depth, a non-plastic, medium compacted clayey silts with none to low plasticity stratum exists from which one DS was collected at 0.5 m depth. The field SPT N value was found to be 16 at 1.50 m depth respectively.
2. From 3.0 m to 12.0 m depth, non-plastic, medium to dense compacted Silty sand stratum exist from which two UDS sample were collected at 3.0 m & 6.0 m depth. The field SPT N values were found to be 18 & 36 at 4.50 m & 9.0 m depth respectively.
3. From 12.0 m to 21.0 m depth, a medium-plastic, hard consistency Silt & clay with low compressibility stratum exists from which two UDS were collected at 12.0 m & 18.0 m depth. The field SPT N value was found to be 52 at 15.0 m depth respectively.
4. From 21.0 m to 32.0 m (max. explored) depth, non-plastic, very dense compacted Silty sand stratum exist. The field SPT N values were found to be 65,76 & 85 at 21.0 m, 27.0 m & 32.0 m depth respectively.

Pier - (BH NO- 05, CH-22160 m)

1. From N.G.L to 3.0 m depth, a non-plastic, medium compacted clayey silts with none to low plasticity stratum exists from which one DS was collected at 0.5 m depth. The field SPT N value was found to be 15 at 1.50 m depth respectively.
2. From 3.0 m to 4.50 m depth, medium-plastic, Clayey sand stratum exist from which one UDS sample was collected at 3.0 m depth.
3. From 4.50 m to 6.0 m depth, non-plastic, clayey silts with none to low plasticity stratum exist. The field SPT N value was found to be 23 at 4.50 m.
4. From 6.0 m to 18.0 m depth, a medium-plastic, medium to dense compacted clayey sand stratum exists from which two UDS were collected at 6.0 m & 12.0 m depth. The field SPT N value were found to be 28 & 50 at 9.0 m & 15.0 m depth respectively.
5. From 18.0 m to 30.0 m depth, a medium-plastic, hard consistency silt and clay with low compressibility stratum exists from which two UDS were collected at 18.0 m & 24.0 m depth. The field SPT N value were found to be 61 & 70 at 21.0 m & 27.0 m depth respectively.

6. From 30.0 m to 32.0 m (max. explored) depth, medium-plastic, very dense compacted clayey sand stratum exist from which one UDS sample was collected at 30.0 m depth. The field SPT N values was found to be 73 at 32.0 m depth respectively.

Pier - (BH NO- 06, CH-22660 m)

1. From N.G.L to 6.0 m depth, a non-plastic, medium compacted clayey silts with none to low plasticity stratum exists from which one DS and one UDS was collected at 0.5 m & 3.0 m depth. The field SPT N value was found to be 15 & 25 at 1.50 m & 4.5 m depth.
2. From 6.0 m to 15.0 m depth, non-plastic, dense compacted Silty sand stratum exist from which two UDS sample were collected at 6.0 m & 12.0 m depth. The Field SPT N value was found to be 39 at 9.0 m Depth,
3. From 15.0 m to 24.0 m depth, non-plastic, dense to very dense clayey silts with none to low plasticity stratum exist from which one UDS was collected at 18.0 m depth. The field SPT N value were found to be 47 & 60 at 15.0 m & 21.0 m depth
4. From 24.0 m to 32.0 m (max. explored) depth, non-plastic, very dense compacted Silty sand stratum exist from which two UDS sample were collected at 24.0 m & 30.0 m depth. The field SPT N values were found to be 71 & 83 at 27.0 m & 32.0 m depth respectively.

Pier - (BH NO- 07, CH-23160 m)

1. From N.G.L to 1.50 m depth, a non-plastic, Silty sand stratum exists from which one DS was collected at 0.5 m depth.
2. From 1.50 m to 3.0 m depth, a non-plastic, medium compacted poorly graded silty sand stratum exists. The field SPT N value was found to be 18 at 1.50 m depth
3. From 3.0 m to 4.50 m depth, a non-plastic, Silty sand stratum exists from which one UDS was collected at 3.0 m depth.
4. From 4.50 m to 6.0 m depth, a non-plastic, dense compacted poorly graded sand stratum exists. The field SPT N value was found to be 36 at 4.50 m depth
5. From 6.0 m to 9.0 m depth, a non-plastic, Silty sand stratum exists from which one UDS was collected at 6.0 m depth.

6. From 9.0 m to 18.0 m depth, medium-plastic, hard consistency Silt & clay with low compressibility stratum exist. The Field SPT N values were found to be 50 & 54 at 9.0 m & 15.0 m Depth.
7. From 18.0 m to 21.0 m depth, a non-plastic, poorly graded Silty sand stratum exists from which one UDS was collected at 18.0 m depth.
8. From 21.0 m to 27.0 m depth, medium-plastic, hard consistency Silt & clay with low compressibility stratum exist from which one UDS sample was collected at 24.0 m depth. The Field SPT N value was found to be 68 at 21.0 m Depth.
9. From 27.0 m to 32.0 m (max. explored) depth, non-plastic, very dense compacted Silty sand stratum exist from which one UDS sample was collected at 30.0 m depth. The field SPT N values were found to be 79 & 88 at 27.0 m & 32.0 m depth respectively.

Pier - (BH NO- 08, CH-23660 m)

1. From N.G.L m to 15.0 m depth, non-plastic, dense to very dense compacted clayey silts with none to low plasticity stratum exist from which one DS & three UDS sample were collected at 0.5 m, 3.0 m, 6.0 m & 12.0 m depth. The Field SPT N values were found to be 50, 51 & 59 at 1.50 m, 4.50 m & 9.0 m Depth.
2. From 15.0 m to 20.0 m (max. explored) depth, medium-plastic, medium to dense compacted clayey sand stratum exist from which one UDS sample was collected at 18.0 m depth. The field SPT N values were found to be 33 & 25 at 15.0 m & 20.0 m depth respectively.

Pier - (BH NO- 09, CH-22705 m)

1. From N.G.L to 3.0 m depth, a non-plastic, loose compacted Clayey silts with none to low plasticity stratum exists from which one DS was collected at 0.5 m depth. The field SPT N value was found to be 5 at 1.50 m depth
2. From 3.0 m to 4.50 m depth, a low-plastic, stiff consistency, inorganic silty clayey soil stratum exists. The field SPT N value was found to be 13 at 3.0 m depth
3. From 4.50 m to 6.0 m depth, a non-plastic, Clayey silts with none to low plasticity stratum exists from which one UDS was collected at 4.50 m depth.
4. From 6.0 m to 9.0 m depth, a non-plastic, medium compacted silty sand stratum exists. The field SPT N value was found to be 19 at 6.0 m depth

5. From 9.0 m to 15.0 m depth, medium-plastic, very stiff consistency Silt & clay with low compressibility stratum exist from which one UDS was collected at 9.0 m depth. The Field SPT N value was found to be 17 at 12.0 m Depth.
6. From 15.0 m to 27.0 m depth, a non-plastic, medium compacted Clayey silts with none to low plasticity stratum exists from which two UDS were collected at 15.0 m & 21.0 m depth. The Field SPT N values were found to be 25 & 29 at 18.0 m & 24.0 m Depth.
7. From 27.0 m to 40.0 m (max. explored) depth, non-plastic, very dense compacted Silty sand stratum exist from which one UDS sample was collected at 27.0 m depth. The field SPT N values were found to be 61,77 & greater than 50 at 30.0 m,33.0 m,36.0 m,39.0 m & 40.0 m depth respectively.

Pier - (BH NO- 10, CH-23205 m)

1. From N.G.L to 12.0 m depth, a non-plastic, loose to medium compacted Silty sand stratum exists from which one DS was collected at 0.5 m depth and three UDS were collected at 1.50 m,4.5 m,9.0 m depth. The field SPT N values were found to be 5 & 11 at 3.0 m & 6.0 m depth
2. From 12.0 m to 15.0 m depth, a low-plastic, stiff consistency, inorganic silty clayey soil stratum exists. The field SPT N value was found to be 13 at 12.0 m depth
3. From 15.0 m to 18.0 m depth, a medium-plastic, silt and clay with low compressibility stratum exists from which one UDS was collected at 15.0 m depth.
4. From 18.0 m to 40.0 m (max. explored) depth, non-plastic, medium to very dense compacted Silty sand stratum exist from which two UDS sample were collected at 21.0 m & 27.0 m depth. The field SPT N values were found to be 17,30,64,77,84 & greater than 50 at 18.0 m,24.0 m,30.0 m,33.0 m,36.0 m,39.0 m & 40.0 m depth respectively.

Pier - (BH NO- 11, CH-23705 m)

1. From N.G.L to 9.0 m depth, a non-plastic, loose to medium compacted Silty sand stratum exists from which one DS was collected at 0.5 m depth and two UDS were collected at 1.50 m & 4.5 m depth. The field SPT N values were found to be 9 & 18 at 3.0 m & 6.0 m depth
2. From 9.0 m to 15.0 m depth, a medium-plastic, very stiff consistency silt and clay with low compressibility stratum exists from which one UDS was collected at 9.0 m depth. The field SPT N value was found to be 26 at 12.0 m depth.

3. From 15.0 m to 40.0 m (max. explored) depth, non-plastic, dense to very dense compacted Silty sand stratum exist from which three UDS sample were collected at 15.0 m,21.0 m & 27.0 m depth. The field SPT N values were found to be 32,37,85 & greater than 50 at 18.0 m,24.0 m,30.0 m,33.0 m,36.0 m,39.0 m & 40.0 m depth respectively.

Pier - (BH NO- 11A, CH-24205 m)

1. From N.G.L to 6.0 m depth, a non-plastic, loose compacted Silty sand stratum exists from which one DS was collected at 0.5 m depth and two UDS were collected at 1.50 m & 4.5 m depth. The field SPT N values were found to be 5 at 3.0 m depth.
2. From 6.0 m to 15.0 m depth, a medium-plastic, stiff consistency silt and clay with low compressibility stratum exists from which one UDS was collected at 9.0 m depth. The field SPT N values were found to be 10 & 12 at 6.0 m & 12.0 m depth.
3. From 15.0 m to 18.0 m depth, a non-plastic, Clayey silts with none to low plasticity stratum exists from which one UDS was collected at 15.0 m depth.
4. From 18.0 m to 36.0 m depth, non-plastic, very dense compacted Silty sand stratum exist. The field SPT N values were found to be 56,67,74 & greater than 50 at 18.0 m,21.0 m,24.0 m,27.0 m,30.0 m & 33.0 m depth respectively.
5. From 36.0 m to 40.0 m (max. explored) depth, very dense compacted Pebble pieces' stratum encountered. The field SPT N values were found to be greater than 50 at 36.0 m,39.0 m & 40.0 m depth respectively.

Pier - (BH NO- 12, CH-24700 m)

1. From N.G.L to 4.5 m depth, a non-plastic, medium to very dense compacted clayey silts with none to low plasticity stratum exists. The field SPT N values were found to be 17,24 & greater than 50 at 1.50 m,3.0 m & 4.50 m depth.
2. From 4.50 m to 6.0 m depth, a Boulder stratum encountered.
3. From 6.0 m to 20.0 m (max. explored) depth, rock stratum encountered. The field SPT N values were found to be greater than 50 at 36.0 m,39.0 m & 40.0 m depth respectively. Core Recovery varies from 16.66 % to 36.66 % and R.Q.D varies from zero to 24.95 %.

7. ABSTRACTOF BEARING/LOAD CARRYING CAPACITY

Table-3

7.1 Load Carrying Capacity of Bored Cast-In-Situ Pile

Location	Dia of pile in (m)	Length of Pile in (m)	Safe Load Carrying Capacity in (Ton)	Recommended safe load carrying capacity in (Ton)	Safe Horizontal Load Carrying Capacity in (Ton)	Recommended Safe Horizontal Load Carrying Capacity in (Ton)
Abutment (BH-2)	1.20	23	265	260	52	50
		25	292	285	52	50
Pier (BH-3)	1.20	20	251	245	52	50
		23	307	300	52	50
Pier (BH-4)	1.20	20	228	220	31	30
		23	280	275	31	30
		25	314	310	31	30
Pier (BH-5)	1.20	25	257	250	30	30
		28	284	280	30	30
Pier (BH-6)	1.20	20	271	270	34	30
		23	324	320	34	30
Pier (BH-7)	1.20	20	262	255	36	35
		23	289	280	36	35
Pier (BH-8)	1.20	18	202	195	36	35
Pier (BH-9)	1.20	25	232	230	23	20
		28	302	300	23	20
Pier (BH-10)	1.20	34	353	350	5	5
		36	385	380	5	5
		38	418	400	5	5
Pier (BH-11)	1.20	23	340	320	24	20
		25	376	370	24	20
		27	427	400	24	20

Location	Dia of pile in (m)	Length of Pile in (m)	Safe Load Carrying Capacity in (Ton)	Recommended safe load carrying capacity in (Ton)	Safe Horizontal Load Carrying Capacity in (Ton)	Recommended Safe Horizontal Load Carrying Capacity in (Ton)
Pier (BH-11A)	1.20	23	291	290	52	50
		25	323	320	52	50
		27	356	350	52	50

Table-4

7.2 Abstract of Safe Load Carrying Capacity of Socketed Pile

Location	Dia of pile in (m)	Length of Pile above Rock (m)	Length of Socket in to rock in m	Safe Load Carrying Capacity in (Ton)	Recommended safe load carrying capacity in (Ton)	Safe Horizontal Load Carrying Capacity in (Ton)	Recommended Safe Horizontal Load Carrying Capacity in (Ton)
Pier (BH-12)	1.2	9.7	0.3	473	450	36	36

7.3 Abstract of Safe Bearing Pressure of Soil

Table-5

Location	Depth in m.	Net Safe Bearing Capacity in T/m^2	Settlement in mm	Safe Bearing Pressure in T/m^2	Safe Bearing Pressure in T/m^2
				25 mm settlement	50 mm settlement
Abutment (BH-02)	2.0	9	102	2	4
	3.0	10	96	3	5
	4.0	11	91	3	6
Pier (BH-03)	2.0	12	109	3	6
	3.0	13	100	3	7
	4.0	14	91	4	8
Pier (BH-04)	2.0	13	42	8	13
	3.0	15	47	8	15
	4.0	16	52	8	15
Pier (BH-05)	2.0	10	27	9	10
	3.0	12	30	10	12
	4.0	14	29	12	14
Pier (BH-06)	2.0	9	19	9	9
	3.0	11	18	11	11
	4.0	13	18	13	13
Pier (BH-07)	2.0	13	38	9	13
	3.0	17	39	11	17
	4.0	22	51	11	22

Location	Depth in m.	Net Safe Bearing Capacity in T/m^2	Settlement in mm	Safe Bearing Pressure in T/m^2	Safe Bearing Pressure in T/m^2
				25 mm settlement	50 mm settlement
Pier (BH-08)	2.0	11	10	11	11
	3.0	12	11	12	12
	4.0	14	14	14	14
Pier (BH-09)	3.0	13	70	5	9
	4.0	14	79	4	9
Pier (BH-11)	2.0	11	63	4	9
	3.0	14	84	4	8
	4.0	18	107	4	8
Pier (BH-11A)	2.0	12	312	1	2
	3.0	14	354	1	2
	4.0	16	395	1	2
Pier (BH-12)	2.0	79	120	16	33
	3.0	230	261	22	44
	4.0	281	305	23	46

Note*

1. **The actual load carrying capacity of piles depends upon many factors such as the quality of construction of piles, disturbance to sub-soil during construction etc. The influence of these factors is not amenable to theoretical computation. It is therefore, a usual practice to confirm theoretical estimated pile capacity by conducting pile load test on prototype piles-in-situ.**
2. **It is therefore, recommended that few initial load tests be conducted on piles at the site as per Indian standard (IS: 2911, Part IV, 2013) by subjecting the pile to a load level of 2.5 times of the safe load carrying capacity of the pile. It is also advisable to conduct few routine load tests on piles as per (IS: 2911, Part IV, 2013).**
3. **The allowable bearing pressure determined from various B.I.S Codes have been reduced due to likely variation and uncertainties in properties of sub soil determined based on available limited test result.**
4. **Foundation suitable for design may be considered for BH-12.**
5. **SBP has calculated considering the squire footing with size of L=10.0 m& B=8.0 m.**

8.0 Liquefaction Potential

The assessment for liquefaction of soil has been made as per Annexure D. It was revealed that the subsoil from BH-02 to BH-08 & BH-12, is not prone to liquefaction. Further subsoil in BH-9, BH-10 in different stretch of depth is prone to liquefaction hence pile lengths have been increased suitably to account for loss in frictional component of pile capacity.

ANNEXURE -A
BORE LOGS

Consultant:	Geotechnical Investigation Report		Client :
S.M. CONSULTANTS BHUBANESWAR	Job No:830	Report No. SMC-2050	Haryana Rail Infrastructure Development Corporation Ltd

Name of Consultants : M/s S.M Consultants , Bhubaneswar
Name of the client : Haryana Rail Infrastructure Development Corporation Ltd.
Name of Work : Exploring alternate alignments,final location survey,geological mapping, geo-technical investigation, detail design of tunnel & its approaches including viaduct if any and other ancillary work in Sohana-Manesar section of HORC project

Ground surface level : [RL(+) 191.135m]
Type of boring : Rotary Boring
Diameter of boring : 150mm
Inclination : Vertical
Ground water table : 1.50 m below the E.G.L

Abutment(BH NO:02)
Location:Rozaxan toll Naka
CH NO: 21305m
Date of boring started:05.02.2021
Date of boring completed:06.02.2021

Sl. No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		191.135		0.0									
01	1.5	190.635		0.5	Silty Sand	---	DS	---	---	---	---	---	DS was colected
02		189.635		1.5		---	SPT	02	04	07	11	0.45	
03	13.5	188.135		3.0	Silt and Clay with Low Compressibility	---	UDS	---	---	---	---	---	UDS was colected
04		186.635		4.5		---	SPT	06	07	08	15	0.45	
05		185.135		6.0		---	UDS	---	---	---	---	---	UDS was colected
06		182.135		9.0		---	SPT	07	10	12	22	0.45	
07		179.135		12.0		---	UDS	---	---	---	---	---	UDS was colected
08		176.135		15.0		---	SPT	11	13	15	28	0.45	

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

Cont... Abutment(BH NO:02)

Sl. No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		176.135		15.0									
09	17.0	173.135		18.0	Silt and Clay with Low Compressibility	---	UDS	---	---	---	---	---	UDS was collected
10		170.135		21.0		---	SPT	10	22	26	48	0.45	
11		167.135		24.0		---	UDS	---	---	---	---	---	UDS was collected
12		164.135		27.0		---	SPT	19	25	29	54	0.45	
13		161.135		30.0		---	UDS	---	---	---	---	---	UDS was collected
14		159.135		32.0		---	SPT	25	32	34	66	0.45	

Name of Consultants : M/s S.M.Consultants , Bhubaneswar.
Name of the client : Haryana Rail Infrastructure Development Corporation Ltd.
Name of work : Exploring alternate alignments,final location survey,geological mapping, geo-technical investigation, detail design of tunnel & its approaches including viaduct if any and other ancillary work in Sohna Manesar section of HORC project
Ground surface level : [RL(+) 191.220m]
Type of boring : Rotary Boring
Diameter of boring : 150mm
Inclination : Vertical
Ground watertable : 2.5 m below the E.G.L

Pier(BH NO:03)
Location:Rewasan toll Naka
CH NO: 21805m
Date of boring started:07.02.2021
Date of boring completed:08.02.2021

Sl. No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		191.220		0.0									
01	1.5	190.720		0.5	Silty Sand	—	DS	—	—	—	—	—	DS was collected
02		189.720		1.5		—	SPT	03	05	07	12	0.45	
03	7.5	188.220		3.0	Silt and Clay with Low Compressibility	---	UDS	—	—	—	—	—	UDS was collected
04		186.720		4.5		—	SPT	03	07	10	17	0.45	
05		185.220		6.0		—	UDS	---	---	---	---	---	UDS was collected
06		182.220		9.0		—	SPT	07	10	14	24	0.45	
07	3.0	179.220		12.0	Silty Sand	—	UDS	---	---	---	---	—	UDS was collected
08	3.0	176.220		15.0	Silt and Clay with Low Compressibility	---	SPT	09	13	19	32	0.45	

Cont...Pier(BH NO:03)

Sl. No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		176.220		15.0									
09	6.0	173.220		18.0	Silt and Clay with Low Compressibility	---	UDS	---	---	---	---	---	UDS was collected
10		170.220		21.0		---	SPT	21	28	31	59	0.45	
11	3.0	167.220		24.0	Clayey silts with moderate low plasticity	---	DS	---	---	---	---	---	
12		164.220		27.0		---	SPT	28	31	37	68	0.45	
13	8.0	161.220		30.0	Silty Sand	---	DS	---	---	---	---	---	
14		159.220		32.0		---	SPT	31	36	41	77	0.45	

Name of Consultants : M/s S.M.Consultants , Bhubaneswar.
Name of the client : Haryana Rail Infrastructure Development Corporation Ltd.
Name of Work : Exploring alternate alignments,final location survey,geological mapping, geo-technical investigation, detail design of tunnel & its approaches including viaduct if any and other ancillary work in Sohna-Manesar section of HORC project.
Ground surface level : (RL(+) 191.013m)
Type of boring : Rotary Boring
Diameter of boring : 150mm
Inclination : Vertical
Ground water table : 2.0 m below the E.G.L

Pier(BH NO:04)
Location:Kheri-Kankar Village
CH NO: 22265m
Date of boring started:09.02.2021
Date of boring completed:10.02.2021

Sl. No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		191.013		0.0									
01	3.0	190.513		0.5	Clayey Silts with none to Low Plasticity	---	DS	---	---	---	---	---	DS was collected
02		189.513		1.5		---	SPT	04	05	11	16	0.45	
03		188.013		3.0		---	UDS	---	---	---	---	---	UDS was collected
04	9.0	186.513		4.5	Silty Sand	---	SPT	06	08	10	18	0.45	
05		185.013		6.0		---	UDS	---	---	---	---	---	UDS was collected
06		182.013		9.0		---	SPT	10	14	22	36	0.45	
07		179.013		12.0		---	UDS	---	---	---	---	---	UDS was collected
08	3.0	176.013		15.0	Silt and Clay with Low Compressibility	---	SPT	22	24	28	52	0.45	

Cont...Pier(BH NO:04)

Sl. No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		176.013		15.0									
09	6.0	173.013		18.0	Silt and clay with Low Compressibility	---	UDS	---	---	---	---	---	UDS was collected
10		170.013		21.0		---	SPT	29	32	33	65	0.45	
11		167.013		24.0		---	DS	---	---	---	---	---	
12	11.0	164.013		27.0	Silty Sand	---	SPT	32	37	39	76	0.45	
13		161.013		30.0		---	DS	---	---	---	---	---	
14		159.013		32.0		---	SPT	30	39	46	85	0.45	

Name of Consultants : M/s S.M.Consultants , Bhubaneswar.
Name of the client : Haryana Rail Infrastructure Development Corporation Ltd.
Name of Work : Exploring alternate alignments,final location survey,geological mapping, geo-technical investigation, detail design of tunnel & its approaches including viaduct if any and other ancillary work in Sohna-Manesar section of HORC project
Ground surface level : (RL(+) 192.226m)
Type of boring : Rotary Boring
Diameter of boring : 150mm
Inclination : Vertical
Ground water table : 3.0 m below the E.G.L

Pier(BH NO:05)
Location:Khori-Kankar Village
CH NO: 22180m
Date of boring started:10.02.2021
Date of boring completed:11.02.2021

SL No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		192.226		0.0									
01	3.0	191.726		0.5	Clayey Silts with nonplastic Low Plasticity	---	DS	---	---	---	---	---	DS was collected
02		190.726		1.5		---	SPT	04	06	09	15	0.45	
03		189.226		3.0		---	UDS	---	---	---	---	---	UDS was collected
04	1.5	187.726		4.5	Clayey Sand	---	SPT	07	08	15	23	0.45	
05	1.5	186.226		6.0	Clayey Silts with nonplastic Low Plasticity	---	UDS	---	---	---	---	---	UDS was collected
06	9.0	183.226		9.0	Clayey Sand	---	SPT	10	12	16	28	0.45	
07		180.226		12.0		---	UDS	---	---	---	---	---	UDS was collected
08		177.226		15.0		---	SPT	25	29	31	50	0.45	

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

Cont...Pier(BH NO:05)

Sl. No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		177.226		15.0									
09	3.0	174.226		18.0	Clayey Sand	—	UDS	—	—	—	—	—	UDS was collected
10	12.0	171.226		21.0	Silt and Clay with Low Compressibility	—	SPT	28	30	31	61	0.45	
11		168.226		24.0		—	UDS	—	—	—	—	—	UDS was collected
12		165.226		27.0		—	SPT	25	33	37	70	0.45	
13		162.226		30.0		—	UDS	—	—	—	—	—	UDS was collected
14	2.0	160.226		32.0	Clayey Sand	—	SPT	28	34	39	73	0.45	

Name of Consultants : M/s S.M.Consultants , Bhubaneswar.
Name of the client : Haryana Rail Infrastructure Development Corporation Ltd
Name of Work : Exploring alternate alignments,final location survey,geological mapping,geotechnical investigation, detail design of tunnel & its approaches including viaduct if any and other ancillary work in Sohna-Manesar section of HORC project
Ground surface level : [RL(+) 194.594m]
Type of boring : Rotary Boring
Diameter of boring : 150mm
Inclination : Vertical
Ground water table : Not Found

Pier(BH NO:05)
Location:Kherli-Kankar Village
CH NO: 22660m
Date of boring started: 11.02.2021
Date of boring completed: 13.02.2021

Sl. No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 = N	Penetration of soil strata in m.	Remarks
		194.594		0.0									
01	6.0	194.094		0.5	Clayey Silts with some to Low Plasticity	---	DS	---	---	---	---	---	DS was collected
02		193.094		1.5		---	SPT	05	07	08	15	0.45	
03		191.594		3.0		---	UDS	---	---	---	---	---	UDS was collected
04		190.094		4.5		---	SPT	09	11	14	25	0.45	
05		188.594		6.0		---	UDS	---	---	---	---	---	UDS was collected
06	9.0	185.594		9.0	Silt+Sand	---	SPT	15	18	21	39	0.46	
07		182.594		12.0		---	UDS	---	---	---	---	---	UDS was collected
08		179.594		15.0		---	SPT	20	22	23	47	0.45	

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

Cont...Pier(BH NO:08)

SL NO.	Thickness of soil strata in m.	R.L. in m.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		179.594		15.0									
09		176.594		18.0		---	UDS	---	---	---	---	---	UDS was collected
10	9.0	173.594		21.0	Clayey Silt with nodule Low Plasticity	---	SPT	26	29	31	60	0.45	
11		170.594		24.0		---	UDS	---	---	---	---	---	UDS was collected
12		167.594		27.0		---	SPT	31	33	38	71	0.45	
13	8.0	164.594		30.0	Silty Sand	---	UDS	---	---	---	---	---	UDS was collected
14		162.594		32.0		---	SPT	38	40	43	83	0.45	

Name of Consultants : M/s S.M.Consultants, Bhubaneswar.
Name of the client : Haryana Rail Infrastructure Development Corporation Ltd.
Name of Work : Exploring alternate alignments, final location survey, geological mapping, geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohana-Manesar section of HORC project
Ground surface level : [RL(+) 196.146m]
Type of boring : Rotary Boring
Diameter of boring : 150mm
Inclination : Vertical
Ground water table : Not Found

Pier(BM NO:07)
Location: Khor Basai Village
CH NO: 23160m
Date of boring started: 14.02.2021
Date of boring completed: 15.02.2021

SL No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 = N	Penetration of soil strata in m.	Remarks
		196.146		0.0									
01	1.5	195.646		0.5	Silty Sand	---	DS	---	---	---	---	---	DS was collected
02		194.646		1.5		---	SPT	05	07	11	18	0.45	
03	1.5	193.146		3.0	Poorly graded Silty Sand	---	UDS	---	---	---	---	---	UDS was collected
04	1.5	191.646		4.5	Silty Sand	---	SPT	11	16	20	36	0.45	
05	1.5	190.146		6.0	Poorly graded Sand	---	UDS	---	---	---	---	---	UDS was collected
06	3.0	187.146		9.0	Silty Sand	---	SPT	21	23	27	50	0.45	
07	6.0	184.146		12.0	Silt and Clay with low compressibility	---	DS	---	---	---	---	---	
08		181.146		15.0		---	SPT	22	25	29	54	0.45	

Cont...Pier(BH NO:07)

Sl. No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		181.146		15.0									
09	3.0	178.146		18.0	Silt and Clay with Low Compressibility	---	UDS	---	---	---	---	---	UDS was collected
10	3.0	175.146		21.0	Poorly graded Silty Sand	---	SPT	30	33	35	68	0.45	
11	6.0	172.146		24.0	Silt and Clay with Low Compressibility	---	UDS	---	---	---	---	---	UDS was collected
12		169.146		27.0		---	SPT	38	39	40	79	0.45	
13	5.0	166.146		30.0	Silty Sand	---	UDS	---	---	---	---	---	UDS was collected
14		164.146		32.0		---	SPT	41	43	45	88	0.45	

Name of Consultants : M/s S.M Consultants , Bhubaneswar
Name of the client : Haryana Rail Infrastructure Development Corporation Ltd
Name of Work : Exploring alternate alignments,final location survey,geological mapping, geo-technical investigation, detail design of tunnel & its approaches including viaduct if any and other ancillary work in Sohana-Manesar section of HORC project
Ground surface level : (RL(+) 200.069m)
Type of boring : Rotary Boring
Diameter of boring : 150mm
Inclination : Vertical
Ground water table : Not Found

Pier(BH NO:06)
Location:Khor-Baser Village
CH NO: 23660m
Date of boring started:18.02.2021
Date of boring completed:20.02.2021

Sl. No.	Thickness of soil strata in mt.	R.L. in mt. 200.069	Graphical representation of soil strata	Depth from ground level in m. 0.0	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
01	15.0	199.569		0.5	Clayey silts with [illegible] Low Plasticity	---	DS	---	---	---	---	---	DS was collected
02		198.569		1.5		---	SPT	08	26	29	50	0.45	
03		197.069		3.0		---	UDS	---	---	---	---	---	UDS was collected
04		195.569		4.5		---	SPT	15	26	27	51	0.45	
05		194.069		6.0		---	UDS	---	---	---	---	---	UDS was collected
06		191.069		9.0		---	SPT	13	24	33	99	0.45	
07		188.069		12.0		---	UDS	---	---	---	---	---	UDS was collected
08		185.069		15.0		---	SPT	09	14	19	32	0.45	

Cont...Pier(BH NO:08)

SL No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		185.069		15.0									
09	5.0	182.069		18.0	Clayey Sand	---	UDS	---	---	---	---	---	UDS was collected
10		180.069		20.0		---	SPT	11	12	13	25	0.45	

Name of Consultants : M/s S.M.Consultants , Bhubaneswar.
Name of the client : Haryana Rail Infrastructure Development Corporation Ltd.
Name of Work : Exploring alternate alignments,final location survey,geological mapping, geo-technical investigation, detail design of tunnel & its approaches including viaduct if any and other ancillary work in Sohna-Manesar section of HORC project
Ground surface level : [RL(+) 191.897m]
Type of boring : Rotary Boring
Diameter of boring : 150mm
Inclination : Vertical
Ground water table : 1.90 m below the E.G.L.

Pier(BH NO:09)
Location: Dhudhaulka
CH NO : 22705m
Date of boring started: 27.11.2021
Date of boring completed: 29.11.2021

Sl. No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 = N	Penetration of soil strata in m.	Remarks
		191.897		0.0									
01	3.0	191.397		0.5	Clayey silt with Non to Low Plasticity	---	DS	---	---	---	---	---	DS was collected
02		190.397		1.5		---	SPT	02	03	03	06	0.45	
03		188.897		3.0		---	SPT	04	06	07	13	0.45	
04	1.5	187.397		4.5	Inorganic Silt Clayey Soil	---	UDS	---	---	---	---	---	UDS was collected
05	1.5	185.897		6.0	Clayey silt with Non to Low Plasticity	---	SPT	07	08	11	19	0.45	
06	3.0	182.897		9.0	Silty Sand	---	UDS	---	---	---	---	---	UDS was collected
07	6.0	179.897		12.0	Silt and Clay with Low Compressibility	---	SPT	05	07	10	17	0.45	
08		176.897		15.0		---	UDS	---	---	---	---	---	UDS was collected
09	3.0	173.897		18.0	Clayey silt with Non to Low Plasticity	---	SPT	08	11	14	25	0.45	

Cont...Pier(BH NO:09)

Sl. No.	Thickness of soil strata in mt.	R.L. In mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		173.897		18.0									
10		170.897		21.0		---	UDS	---	---	---	---	---	UDS was collected
	9.0				Clayey silt with Pockets Low Plasticity								
11		167.897		24.0		---	SPT	09	11	18	29	0.45	
12		164.897		27.0		---	UDS	---	---	---	---	---	UDS was collected
13		161.897		30.0		—	SPT	20	29	32	61	0.46	
14		158.897		33.0		—	SPT	23	30	41	77	0.45	
	13.0				Silty Sand								
15		155.897		36.0		—	SPT	26	40	>50	>50	0.36	
16		152.897		39.0		—	SPT	27	43	>50	>50	0.31	
17		151.897		40.0		—	SPT	36	>50	>50	>50	0.16	

Name of Consultants : M/s S.M.Consultants , Bhubaneswar.
Name of the client : Haryana Rail Infrastructure Development Corporation Ltd.
Name of Work : Exploring alternate alignments,final location survey,geological mapping, geo-technical investigation, detail design of tunnel & its approaches including viaduct if any and other ancillary work in Sohna-Manesar section of HORC project.
Ground surface level : [RL(+) 193.009m]
Type of boring : Rotary Boring
Diameter of boring : 150mm
Inclination : Vertical
Ground water table : 2.4 m below the E.G.L.

Pier(BH NO:10)
Location:Dhirdhaunka
CH NO:- 23205m
Date of boring started: 30.11.2021
Date of boring completed: 02.12.2021

Sl. No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		193.009		0.0									
01	12.0	192.509		0.5	Silty Sand	---	DS	---	---	---	---	---	DS was collected
02		191.509		1.5		---	UDS	---	---	---	---	---	UDS was collected
03		190.009		3.0		---	SPT	02	02	03	05	0.45	
04		188.509		4.5		---	UDS	---	---	---	---	---	UDS was collected
05		187.009		6.0		---	SPT	03	04	07	11	0.45	
06		184.009		9.0		---	UDS	---	---	---	---	---	UDS was collected
07		181.009		12.0		---	SPT	04	06	07	13	0.45	
08	6.0	178.009		15.0	Inorganic Silty Clayey Soil	---	UDS	---	---	---	---	---	UDS was collected
09		175.009		18.0	Silt and Clay with Low Compressibility	---	SPT	05	07	10	17	0.45	

Cont...Pier(BH NO: 10)

Sl. No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		175.009		18.0									
10	15.0	172.009		21.0	Silty Sand	---	UDS	---	---	---	---	---	UDS was collected
11		169.009		24.0		---	SPT	08	13	17	30	0.45	
12		166.009		27.0		---	UDS	---	---	---	---	---	UDS was collected
13		163.009		30.0		---	SPT	11	28	36	64	0.45	
14		160.009		33.0		---	SPT	16	32	45	77	0.45	
15	3.0	157.009		36.0	Clayey silt with Gravels Low Plastic	---	SPT	18	36	48	84	0.45	
16	4.0	154.009		39.0	Silty Sand	---	SPT	26	45	>50	>50	0.32	
17		153.009		40.0		---	SPT	30	49	>50	>50	0.30	

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

Name of Consultants : M/S S.M.Consultants , Bhubaneswar.
Name of the client : Haryana Rail Infrastructure Development Corporation Ltd.
Name of Work : Exploring alternate alignments,final location survey,geological mapping, geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohana-Manesar section of HORC project.
Ground surface level : [RL(+) 193.717m]
Type of boring : Rotary Boring
Diameter of boring : 150mm
Inclination : Vertical
Ground water table : 1.80 m below the E.G.L.

Pier(BH NO:11)
Location: Maraula
CH NO: 23706m
Date of boring started:03.12.2021
Date of boring completed:04.12.2021

Sl. No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		193.717		0.0									
01	9.0	193.217		0.5	Silty Sand	---	DS	---	---	---	---	---	DS was collected
02		192.217		1.5		---	UDS	---	---	---	---	---	UDS was collected
03		190.717		3.0		---	SPT	03	04	05	09	0.45	
04		189.217		4.5		---	UDS	---	---	---	---	---	UDS was collected
05		187.717		6.0		---	SPT	06	08	10	18	0.45	
06		184.717		9.0		---	UDS	---	---	---	---	---	UDS was collected
07	6.0	181.717		12.0	Silt and Clay with Low Compressibility	---	SPT	08	11	15	26	0.45	
08		178.717		15.0		---	UDS	---	---	---	---	---	UDS was collected
09	3.0	175.717		18.0	Silty Sand	---	SPT	11	14	18	32	0.45	

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

Cont...Pier(BH NO:11)

Sl. No.	Thickness of soil strata in mt.	R.L in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		175.717		18.0									
10		172.717		21.0		---	UDS	---	---	---	---	---	UDS was collected
11		169.717		24.0		---	SPT	13	16	21	37	0.45	
12		166.717		27.0		---	UDS	---	---	---	---	---	UDS was collected
13	22.0	163.717		30.0	Silty Sand	---	SPT	25	36	49	85	0.45	
14		160.717		33.0		---	SPT	>50	---	---	>50	0.15	DS was collected
15		157.717		36.0		---	SPT	>50	---	---	>50	0.06	DS was collected
16		154.717		39.0		---	SPT	>50	---	---	>50	0.06	DS was collected
17		153.717		40.0		---	SPT	>50	---	---	>50	0.06	DS was collected

Name of Consultants : M/s S.M.Consultants , Bhubaneswar.
Name of the client : Haryana Rail Infrastructure Development Corporation Ltd.
Name of Work : Exploring alternate alignments, final location survey, geological mapping, geo-technical investigation, detail design of tunnel & its approaches including viaduct if any and other ancillary work in Sohana-Manesar section of HORC project
Ground surface level : [RL(+) 196.637m]
Type of boring : Rotary Boring
Diameter of boring : 150mm
Inclination : Vertical
Ground water table : 6.50 m below the E.G.L

Pier(BH NO:11-A)
Location [illegible]
CH NO: 24205m
Date of boring started:05.12.2021
Date of boring completed:06.12.2021

Sl. No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		196.637		0.0									
01	6.0	196.137		0.5	Silty Soil	---	DS	---	---	---	---	---	DS was collected
02		195.137		1.5		---	UDS	---	---	---	---	---	UDS was collected
03		193.637		3.0		---	SPT	02	02	03	05	0.45	
04		192.137		4.5		---	UDS	---	---	---	---	---	UDS was collected
05		190.637		6.0		---	SPT	03	04	06	10	0.45	
06	9.0	187.637		9.0	Silt and Clay with Low Compressibility	---	UDS	---	---	---	---	---	UDS was collected
07		184.637		12.0		---	SPT	04	05	07	12	0.45	
08		181.637		15.0		---	UDS	---	---	---	---	---	UDS was collected
09	3.0	178.637		18.0	[illegible]	---	SPT	18	26	30	56	0.45	

Consultant:	Geotechnical Investigation Report		Client :
S.M. CONSULTANTS BHUBANESWAR	Job No:830	Report No. SMC-2050	Haryana Rail Infrastructure Development Corporation Ltd

Cont... Pier(BH NO:11-A)

Sl. No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		178.637		18.0									
10		175.637		21.0		---	SPT	21	31	36	67	0.45	
11		172.637		24.0		---	SPT	23	34	40	74	0.45	
12	18.0	169.637		27.0	[illegible]	---	SPT	>50	---	---	>50	0.07	DS was collected
13		166.637		30.0		---	SPT	>50	---	---	>50	0.07	DS was collected
14		163.637		33.0		---	SPT	>50	---	---	>50	0.06	DS was collected
15		160.637		36.0		---	SPT	>50	---	---	>50	0.06	DS was collected
16	4.0	157.637		39.0	[illegible]	---	SPT	>50	---	---	>50	0.05	DS was collected
17		156.637		40.0		---	SPT	>50	---	---	>50	0.04	DS was collected

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

Name of Consultants : M/s S.M.Consultants , Bhubaneswar.
Name of the client : Haryana Rail Infrastructure Development Corporation Ltd.
Name of Work : Exploring alternate alignments,final location survey,geological mapping, geo-technical investigation, detail design of tunnel & its approaches including viaduct if any and other ancillary work in Sohna-Manesar section of HORC project
Ground surface level : (RL(+) 203.485m)
Type of boring : Rotary Boring
Diameter of boring : 150mm
Inclination : Vertical
Ground water table : Not Found

Pier(SH NO:12)
Location:Maraula
CH NO: 24700m
Date of boring started:27.02.2022
Date of boring completed:03.03.2022

Sl. No.	Thickness of soil strata in mt.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Colour of boring water	Type of sampling	No. of blows for 1st 15 cm penetration(1)	No. of blows for 2nd 15 cm penetration(2)	No. of blows for 3rd 15 cm penetration(3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
		203.485		0.0									
02	6.0	201.985		1.5	[illegible]	BROWN	SPT	04	06	11	17	0.45	
03		200.485		3.0		BROWN	SPT	06	08	16	24	0.45	
04		198.985		4.5		BROWN	SPT	10	29	>50	>50	0.33	
05		197.485		6.0		BROWN	BOULDER	---	---	---	---	---	Core Recovery=18.66 % R.Q.D=Nil
06	1.5	195.985		7.5	Boulder	BROWN	ROCK	---	---	---	---	---	Core Recovery=18.66 % R.Q.D=Nil
07	12.5	194.485		9.0	Rock	BROWN	ROCK	---	---	---	---	---	Core Recovery=20.66 % R.Q.D=Nil
08		192.985		10.5		BROWN	ROCK	---	---	---	---	---	Core Recovery=22.66 % R.Q.D=7 %
09		191.485		12.0		BROWN	ROCK	---	---	---	---	---	Core Recovery=38 % R.Q.D=16.66 %
10		189.985		13.5		BROWN	ROCK	---	---	---	---	---	Core Recovery=22.66 % R.Q.D=7.33 %
11		188.485		15.0		BROWN	ROCK	---	---	---	---	---	Core Recovery=28.66 % R.Q.D=14.46 %
12		186.985		16.5		BROWN	ROCK	---	---	---	---	---	Core Recovery=36.66 % R.Q.D=22.46 %
13		185.485		18.0		BROWN	ROCK	---	---	---	---	---	Core Recovery=24.66 % R.Q.D=8.67
14		183.485		20.0		BROWN	ROCK	---	---	---	---	---	Core Recovery=38 % R.Q.D=24.26 %

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

ANNEXURE -B
LABORATORY TEST RESULT

Consultant:	Geotechnical Investigation Report		Client :
S.M. CONSULTANTS BHUBANESWAR	Job No:- 830	Report No:- SMC-2050	Haryana Rail Infrastructure Development Corporation Ltd

ABUTMENT (BH-02, CH-21305 m)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII& Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis				Hydrometer Analysis		Atterberg's Limit			Field Moisture Content in %	Natural density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To 0.075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
1	**At 0.5 m depth**	DS	---	0	0	3.28	48.51	48.21	0.00	21	---	NP	---	---	---	---	---	---	2.63	---	---	SM
2	**At 1.5 m depth**	SPT	11	0.13	0.92	1.82	16.06	64.57	16.50	31	18	13	---	---	---	---	---	---	2.71	---	---	CL
3	**At 3.0 m depth**	UDS	---	0	0.65	2.31	15.64	64.80	16.60	32	19	13	11.28	1.762	1.583	0.31	10	UU	2.71	0.71	0.132	CL
4	**At 4.5 m depth**	SPT	15	0	0.82	1.98	18.21	63.29	15.70	30	18	12	---	---	---	---	---	---	2.70	---	---	CL
5	**At 6.0 m depth**	UDS	---	0.32	1.08	1.26	16.24	64.50	16.60	31	17	14	12.64	1.792	1.591	0.29	11	UU	2.71	0.70	0.129	CL
6	**At 9.0 m depth**	SPT	22	8.88	1.55	1.11	23.71	49.65	15.10	29	17	12	---	---	---	---	---	---	2.70	---	---	CL
7	**At 12.0 m depth**	UDS	---	0	0	0	40.22	45.58	14.20	28	18	10	13.56	1.816	1.599	0.28	10	UU	2.70	0.69	0.126	CL
8	**At 15.0 m depth**	SPT	28	0.62	0.24	1.24	29.52	52.88	15.50	30	17	13	---	---	---	---	---	---	2.70	---	---	CL

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

Contd… ABUTMENT (BH-02, CH-21305 m)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII & Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis				Hydrometer Analysis		Atterberg's Limit			Field Moisture Content in %	Natural density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To 0.075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
9	**At 18.0 m depth**	UDS	---	0	0	1.45	27.43	55.32	15.80	32	18	14	14.28	1.845	1.614	0.30	9	UU	2.71	0.68	0.125	CL
10	**At 21.0 m depth**	SPT	48	23.64	2.87	6.92	3.82	48.05	14.70	30	17	13	---	---	---	---	---	---	2.70	---	---	CL
11	**At 24.0 m depth**	UDS	---	14.62	3.85	8.24	3.62	54.57	15.10	31	18	13	15.47	1.887	1.634	0.28	15	UU	2.71	0.66	0.119	CL
12	**At 27.00 m depth**	SPT	54	17.11	2.86	6.31	5.24	53.48	15.00	30	18	12	---	---	---	---	---	---	2.70	---	---	CL
13	**At 30.00 m depth**	UDS	---	17.64	3.24	5.84	3.26	54.22	15.80	31	19	12	16.38	1.926	1.655	0.29	16	UU	2.71	0.64	0.117	CL
14	**At 32.00 m depth**	SPT	66	19.56	6.45	6.38	2.53	50.48	14.60	30	17	13	---	---	---	---	---	---	2.70	---	---	CL

Consultant:	Geotechnical Investigation Report		Client :
S.M. CONSULTANTS BHUBANESWAR	Job No:- 830	Report No:- SMC-2050	Haryana Rail Infrastructure Development Corporation Ltd

PIER (BH-03, CH-21805 m)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII& Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis				Hydrometer Analysis		Atterberg's Limit			Field Moisture Content in %	Natural density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To 0.075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
1	**At 0.5 m depth**	DS	---	0	0	0	73.31	26.69	0.00	21	---	NP	---	---	---	---	---	---	2.63	---	---	SM
2	**At 1.5 m depth**	SPT	12	0	0	6.26	7.24	69.20	17.30	32	20	12	---	---	---	---	---	---	2.71	---	---	CL
3	**At 3.0 m depth**	UDS	---	15.74	8.53	6.18	8.45	46.60	14.50	30	20	10	11.87	1.762	1.575	0.30	13	UU	2.70	0.71	0.129	CL
4	**At 4.5 m depth**	SPT	17	0	0	0	39.15	46.65	14.20	29	19	10	---	---	---	---	---	---	2.69	---	---	CL
5	**At 6.0 m depth**	UDS	---	13.78	5.45	9.03	8.43	48.21	15.10	30	18	12	12.32	1.804	1.606	0.31	12	UU	2.70	0.68	0.124	CL
6	**At 9.0 m depth**	SPT	24	0.14	0	0.14	60.77	38.95	0.00	21	---	NP	---	---	---	---	---	---	2.62	---	---	SM
7	**At 12.0 m depth**	UDS	---	15.33	7.25	11.48	13.99	38.75	13.20	28	16	12	13.54	1.826	1.608	0.29	14	UU	2.69	0.67	0.120	CL
8	**At 15.0 m depth**	SPT	32	6.59	1.2	3.59	15.31	57.11	16.20	32	19	13	---	---	---	---	---	---	2.72	---	---	CL

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

Contd… PIER (BH-03, CH-21805 m)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII & Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis				Hydrometer Analysis		Atterberg's Limit			Field Moisture Content in %	Natural density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To 0.075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
9	**At 18.0 m depth**	UDS	---	15.58	3.53	2.43	21.20	43.06	14.20	30	18	12	14.18	1.871	1.639	0.28	15	UU	2.69	0.64	0.118	CL
10	**At 21.0 m depth**	SPT	59	0.45	0.16	3.54	33.68	54.67	7.50	27	---	NP	---	---	---	---	---	---	2.67	---	---	ML
11	**At 24.0 m depth**	DS	---	0.11	0	0.36	66.48	33.05	0.00	21	---	NP	---	---	---	---	---	---	2.64	---	---	SM
12	**At 27.00 m depth**	SPT	68	0	0	1.62	71.26	27.12	0.00	19	---	NP	---	---	---	---	---	---	2.63	---	---	SM
13	**At 30.00 m depth**	DS	---	0	0	0.84	68.64	30.52	0.00	20	---	NP	---	---	---	---	---	---	2.64	---	---	SM
14	**At 32.00 m depth**	SPT	77	0	0	1.08	64.37	34.55	0.00	21	---	NP	---	---	---	---	---	---	2.65	---	---	SM

PIER (BH-04, CH-22265 m)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII& Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis				Hydrometer Analysis		Atterberg's Limit			Field Moisture Content in %	Natural density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To 0.075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
1	**At 0.5 m depth**	DS	---	15.58	3.53	2.43	21.20	51.96	5.30	26	---	NP	---	---	---	---	---	---	2.66	---	---	ML
2	**At 1.5 m depth**	SPT	16	0.45	0.16	3.54	33.68	54.97	7.20	27	---	NP	---	---	---	---	---	---	2.67	---	---	ML
3	**At 3.0 m depth**	UDS	---	0.11	0	0.36	66.48	33.05	0.00	19	---	NP	11.54	1.768	1.585	0.03	26	DS	2.65	0.67	---	SM
4	**At 4.5 m depth**	SPT	18	0	0	1.62	71.26	27.12	0.00	18	---	NP	---	---	---	---	---	---	2.63	---	---	SM
5	**At 6.0 m depth**	UDS	---	0	0	0.84	68.64	30.52	0.00	20	---	NP	11.96	1.795	1.603	0.05	24	DS	2.64	0.65	---	SM
6	**At 9.0 m depth**	SPT	36	0	0	1.08	64.37	34.55	0.00	20	---	NP	---	---	---	---	---	---	2.64	---	---	SM
7	**At 12.0 m depth**	UDS	---	15.58	3.53	2.43	21.20	44.06	13.20	31	18	13	12.21	1.844	1.643	0.28	14	UU	2.70	0.64	0.111	CL
8	**At 15.0 m depth**	SPT	52	0.45	0.16	3.54	33.68	48.07	14.10	32	18	13	---	---	---	---	---	---	2.71	---	---	CL

Contd… PIER (BH-04, CH-22265 m)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII & Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis				Hydrometer Analysis		Atterberg's Limit			Field Moisture Content in %	Natural density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To 0.075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
9	**At 18.0 m depth**	UDS	---	6.57	1.22	2.22	7.92	64.67	17.40	33	20	13	13.58	1.893	1.667	0.31	11	UU	2.72	0.63	0.109	CL
10	**At 21.0 m depth**	SPT	65	0.21	0.13	2.31	58.34	39.01	0.00	20	---	NP	---	---	---	---	---	---	2.63	---	---	SM
11	**At 24.0 m depth**	DS	---	0.36	0	0.48	60.34	38.82	0.00	20	---	NP	---	---	---	---	---	---	2.63	---	---	SM
12	**At 27.00 m depth**	SPT	76	0	0	0.21	58.62	41.17	0.00	21	---	NP	---	---	---	---	---	---	2.64	---	---	SM
13	**At 30.00 m depth**	DS	---	0	0	0.17	62.56	37.27	0.00	20	---	NP	---	---	---	---	---	---	2.63	---	---	SM
14	**At 32.00 m depth**	SPT	85	0	0	0.08	63.69	36.23	0.00	20	---	NP	---	---	---	---	---	---	2.64	---	---	SM

PIER (BH-05, CH-22160 m)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII& Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis				Hydrometer Analysis		Atterberg's Limit			Field Moisture Content in %	Natural density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To 0.075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
1	**At 0.5 m depth**	DS	---	0	0	8.62	21.56	62.22	7.60	27	---	NP	---	---	---	---	---	---	2.67	---	---	ML
2	**At 1.5 m depth**	SPT	15	0	0	5.36	25.83	62.01	6.80	25	---	NP	---	---	---	---	---	---	2.66	---	---	ML
3	**At 3.0 m depth**	UDS	---	7.54	1.86	2.89	41.63	34.88	11.20	28	19	9	11.82	1.763	1.577	0.10	19	DS	2.68	0.70	0.118	SC
4	**At 4.5 m depth**	SPT	23	0	0	5.23	41.23	48.34	5.20	25	---	NP	---	---	---	---	---	---	2.66	---	---	ML
5	**At 6.0 m depth**	UDS	---	24.25	17.67	15.73	9.46	22.69	10.20	26	18	8	12.45	1.784	1.586	0.08	21	DS	2.65	0.67	0.116	SC
6	**At 9.0 m depth**	SPT	28	4.67	3.84	11.26	33.89	34.64	11.70	29	19	10	---	---	---	---	---	---	2.67	---	---	SC
7	**At 12.0 m depth**	UDS	---	8.62	1.06	1.79	41.23	35.00	12.30	29	18	11	12.94	1.826	1.617	0.10	20	DS	2.67	0.65	0.110	SC
8	**At 15.0 m depth**	SPT	50	7.23	1.34	2.13	40.82	35.98	12.50	27	17	10	---	---	---	---	---	---	2.66	---	---	SC

Consultant:	Geotechnical Investigation Report		Client :
S.M. CONSULTANTS BHUBANESWAR	Job No:- 830	Report No:- SMC-2050	Haryana Rail Infrastructure Development Corporation Ltd

Contd… PIER (BH-05, CH-22160 m)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII & Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis				Hydrometer Analysis		Atterberg's Limit			Field Moisture Content in %	Natural density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To 0.075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
9	**At 18.0 m depth**	UDS	---	0	0.64	2.34	41.12	41.30	14.60	31	18	13	13.65	1.875	1.650	0.30	10	UU	2.69	0.63	0.115	CL
10	**At 21.0 m depth**	SPT	61	0	0.84	3.26	44.62	37.08	14.20	30	19	11	---	---	---	---	---	---	2.68	---	---	CL
11	**At 24.0 m depth**	UDS	---	0	0.51	2.29	23.88	56.52	16.80	33	20	13	14.85	1.926	1.677	0.32	8	UU	2.71	0.62	0.109	CL
12	**At 27.00 m depth**	SPT	70	0	0	2.47	26.84	55.09	15.60	32	19	13	---	---	---	---	---	---	2.70	---	---	CL
13	**At 30.00 m depth**	UDS	---	6.62	0.53	1.53	44.52	35.00	11.80	27	19	8	15.34	1.934	1.677	0.11	18	DS	2.67	0.59	0.105	SC
14	**At 32.00 m depth**	SPT	73	7.63	0.82	1.69	43.23	35.23	11.40	27	18	9	---	---	---	---	---	---	2.66	---	---	SC

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

PIER (BH-06, CH-22660 m)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII & Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis				Hydrometer Analysis		Atterberg's Limit			Field Moisture Content in %	Natural density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To 0.075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
1	**At 0.5 m depth**	DS	---	0	0	2.56	39.89	51.15	6.40	25	---	NP	---	---	---	---	---	---	2.66	---	---	ML
2	**At 1.5 m depth**	SPT	15	0	0	2.89	35.62	54.19	7.30	26	---	NP	---	---	---	---	---	---	2.67	---	---	ML
3	**At 3.0 m depth**	UDS	---	0	0	1.56	39.65	52.29	6.50	25	---	NP	11.54	1.758	1.576	0.12	17	DS	2.66	0.69	0.111	ML
4	**At 4.5 m depth**	SPT	25	0	0.45	2.36	38.62	52.17	6.40	25	---	NP	---	---	---	---	---	---	2.66	---	---	ML
5	**At 6.0 m depth**	UDS	---	1.87	9.02	22.25	30.46	36.40	0.00	20	---	NP	12.62	1.794	1.593	0.03	26	DS	2.64	0.66	---	SM
6	**At 9.0 m depth**	SPT	39	1.23	7.56	20.38	31.64	39.19	0.00	21	---	NP	---	---	---	---	---	---	2.64	---	---	SM
7	**At 12.0 m depth**	UDS	---	1.84	1.39	3.93	48.41	44.43	0.00	21	---	NP	13.24	1.816	1.604	0.04	24	DS	2.65	0.65	---	SM
8	**At 15.0 m depth**	SPT	47	0	0.45	3.45	34.26	54.44	7.40	26	---	NP	---	---	---	---	---	---	2.67	---	---	ML

Contd… PIER (BH-06, CH-22660 m)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII & Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis				Hydrometer Analysis		Atterberg's Limit			Field Moisture Content in %	Natural density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm²	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To 0.075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
9	**At 18.0 m depth**	UDS	---	0	0.28	2.87	36.24	53.51	7.10	26	---	NP	14.45	1.863	1.628	0.13	18	DS	2.66	0.63	0.108	ML
10	**At 21.0 m depth**	SPT	60	0	1.23	2.63	39.87	50.17	6.10	24	---	NP	---	---	---	---	---	---	2.66	---	---	ML
11	**At 24.0 m depth**	UDS	---	2.63	1.85	5.36	48.69	41.47	0.00	21	---	NP	15.28	1.895	1.644	0.04	26	DS	2.65	0.61	---	SM
12	**At 27.00 m depth**	SPT	71	2.15	1.63	4.82	47.32	44.08	0.00	21	---	NP	---	---	---	---	---	---	2.65	---	---	SM
13	**At 30.00 m depth**	UDS	---	4.15	2.88	6.3	51.13	35.54	0.00	20	---	NP	16.21	1.943	1.672	0.03	28	DS	2.64	0.58	---	SM
14	**At 32.00 m depth**	SPT	83	2.46	1.85	4.36	53.47	37.86	0.00	20	---	NP	---	---	---	---	---	---	2.64	---	---	SM

PIER (BH-07, CH-23160 m)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII, & Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis				Hydrometer Analysis		Atterberg's Limit			Field Moisture Content in %	Natural density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To .075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
1	**At 0.5 m depth**	DS	---	0	0	0.24	50.16	49.60	0.00	21	---	NP	---	---	---	---	---	---	2.64	---	---	SM
2	**At 1.5 m depth**	SPT	18	0	0	0	89.62	10.38	0.00	18	---	NP	---	---	---	---	---	---	2.62	---	---	SP-SM
3	**At 3.0 m depth**	UDS	---	0	0.02	1.09	74.84	24.05	0.00	19	---	NP	12.32	1.772	1.578	0.02	26	DS	2.63	0.67	---	SM
4	**At 4.5 m depth**	SPT	36	0	0	0.34	98.85	0.81	0.00	18	---	NP	---	---	---	---	---	---	2.62	---	---	SP
5	**At 6.0 m depth**	UDS	---	0	0	0.63	70.26	29.11	0.00	19	---	NP	13.26	1.794	1.584	0.04	25	DS	2.63	0.66	---	SM
6	**At 9.0 m depth**	SPT	50	17.10	6.16	4.70	16.62	40.22	15.20	32	18	14	---	---	---	---	---	---	2.70	---	---	CL
7	**At 12.0 m depth**	DS	---	2.65	5.82	6.21	19.64	49.28	16.40	33	18	13	---	---	---	---	---	---	2.71	---	---	CL
8	**At 15.0 m depth**	SPT	54	6.91	6.62	6.55	21.99	42.13	15.80	31	17	14	---	---	---	---	---	---	2.70	---	---	CL

Contd… PIER (BH-07, CH-23160 m)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII & Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis				Hydrometer Analysis		Atterberg's Limit			Field Moisture Content in %	Natural density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To .075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
9	**At 18.0 m depth**	UDS	---	0	0	0.62	92.44	6.94	0.00	18	---	NP	15.36	1.894	1.642	0.06	25	DS	2.62	0.60	---	SP-SM
10	**At 21.0 m depth**	SPT	68	2.54	0.33	1.24	41.11	40.18	14.60	30	18	12	---	---	---	---	---	---	2.70	---	---	CL
11	**At 24.0 m depth**	UDS	---	2.76	1.95	0.28	6.91	70.90	17.20	34	20	14	15.45	1.973	1.709	0.32	10	UU	2.72	0.59	0.108	CL
12	**At 27.00 m depth**	SPT	79	1.32	0.34	19.36	32.64	46.34	0.00	20	---	NP	---	---	---	---	---	---	2.65	---	---	SM
13	**At 30.00 m depth**	UDS	---	2.55	3.04	29.05	18.69	46.67	0.00	21	---	NP	16.24	1.992	1.714	0.04	27	DS	2.64	0.54	---	SM
14	**At 32.00 m depth**	SPT	88	1.46	0.55	1.25	48.29	48.45	0.00	21	---	NP	---	---	---	---	---	---	2.65	---	---	SM

PIER (BH-08, CH-23660 m)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII, & Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis				Hydrometer Analysis		Atterberg's Limit			Field Moisture Content in %	Natural density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To 0.075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
1	**At 0.5 m depth**	DS	---	0	0	3.65	42.23	46.92	7.20	26	---	NP	---	---	---	---	---	---	2.67	---	---	ML
2	**At 1.5 m depth**	SPT	50	0	0	1.86	45.32	46.62	6.20	25	---	NP	---	---	---	---	---	---	2.66	---	---	ML
3	**At 3.0 m depth**	UDS	---	0	0	3.18	44.21	46.51	6.10	25	---	NP	10.63	1.758	1.589	0.12	19	DS	2.65	0.67	0.102	ML
4	**At 4.5 m depth**	SPT	51	0	0	2.14	38.56	51.10	8.20	27	---	NP	---	---	---	---	---	---	2.68	---	---	ML
5	**At 6.0 m depth**	UDS	---	0	0	4.54	41.62	46.94	6.90	26	---	NP	12.15	1.812	1.616	0.13	17	DS	2.66	0.65	0.105	ML
6	**At 9.0 m depth**	SPT	59	0	0	1.47	43.56	47.57	7.40	26	---	NP	---	---	---	---	---	---	2.66	---	---	ML
7	**At 12.0 m depth**	UDS	---	0	0	2.38	35.12	54.40	8.10	27	---	NP	13.56	1.863	1.641	0.15	17	DS	2.68	0.63	0.110	ML
8	**At 15.0 m depth**	SPT	33	0	0.23	1.89	48.56	37.02	12.30	28	19	9	---	---	---	---	---	---	2.66	---	---	SC

Contd… PIER(BH-08, CH-23660 m)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII & Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis				Hydrometer Analysis		Atterberg's Limit			Field Moisture Content in %	Natural density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To 0.075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
9	**At 18.0 m depth**	UDS	---	0	0.45	3.41	51.28	33.66	11.20	27	18	9	14.28	1.895	1.658	0.09	19	DS	2.66	0.60	0.106	SC
10	**At 20.0 m depth**	SPT	25	0	0.63	2.69	54.62	31.06	11.00	26	19	7	---	---	---	---	---	---	2.65	---	---	SC

Consultant:	Geotechnical Investigation Report		Client :
S.M. CONSULTANTS BHUBANESWAR	Job No:- 830	Report No:- SMC-2050	Haryana Rail Infrastructure Development Corporation Ltd

PIER(BH-09, CH-22705)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII,& Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S. P.T N Value	Grain size analysis						Atterberg's Limit			Field Moisture Content in %	Bulk density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To .075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
1	**At 0.5 m depth**	DS	---	0	0.16	0.18	46.38	43.92	9.36	25	---	NP	---	---	---	---	---	---	2.66	---	---	ML
2	**At 1.5 m depth**	SPT	5	0.57	0.25	1.22	39.73	46.99	11.24	26	---	NP	---	---	---	---	---	---	2.67	---	---	ML
3	**At 3.0 m depth**	SPT	13	4.37	4.36	4.53	9.49	60.56	16.69	26	20	6	---	---	---	---	---	---	2.69	---	---	ML-CL
4	**At 4.5 m depth**	UDS	---	0	0	0.73	40.7	46.93	11.64	25	---	NP	11.54	1.755	1.573	0.15	18	UU	2.66	0.69	0.116	ML
5	**At 6.0 m depth**	SPT	19	0	0	9.64	43.56	46.80	0.00	20	---	NP	---	---	---	---	---	---	2.66	---	---	SM
6	**At 9.0 m depth**	UDS	---	10.7	6.7	5.93	8.46	47.65	20.56	30	18	12	12.87	1.832	1.623	0.25	12	UU	2.72	0.68	0.123	CL
7	**At 12.0 m depth**	SPT	17	0.3	0.28	0.98	4.42	69.17	24.85	32	19	13	---	---	---	---	---	---	2.72	---	---	CL
8	**At 15.0 m depth**	UDS	---	0	0.56	2.14	16.07	70.68	10.55	27	---	NP	14.46	1.878	1.641	0.18	14	UU	2.72	0.66	0.114	ML

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

Contd… PIER(BH-09,CH-22705)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII & Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis: Fine Gravel in % (20mm To 4.75mm)	Grain size analysis: Coarse Sand in % (4.75mm To 2.00 mm)	Grain size analysis: Medium Sand in % (2.0mm To 0.425mm)	Grain size analysis: Fine Sand in % (0.425mm To .075mm)	Grain size analysis: Silt in %	Grain size analysis: Clay in %	Atterberg's Limit: Liquid Limit In %	Atterberg's Limit: Plastic Limit In %	Atterberg's Limit: Plasticity Index in %	Field Moisture Content in %	Bulk density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
9	**At 18.0 m depth**	SPT	25	0.18	0.19	1.32	28.34	59.11	10.86	25	---	NP	---	---	---	---	---	---	2.67	---	---	ML
10	**At 21.0 m depth**	UDS	---	0.36	2.59	9.7	36.26	41.40	9.69	24	---	NP	15.96	1.923	1.658	0.15	14	UU	2.72	0.64	0.106	ML
11	**At 24.0 m depth**	SPT	29	10.1	3.74	4.15	8.43	62.52	11.06	26	---	NP	---	---	---	---	---	---	2.72	---	---	ML
12	**At 27.00 m depth**	UDS	---	12.58	2.36	1.24	42.91	40.91	0.00	19	---	NP	16.12	1.929	1.661	0.03	27	DS	2.64	0.59	---	SM
13	**At 30.00 m depth**	SPT	61	28.48	2.95	2.17	20.06	46.34	0.00	20	---	NP	---	---	---	---	---	---	2.66	---	---	SM
14	**At 33.00 m depth**	SPT	77	8.79	0.06	2.54	40.04	48.57	0.00	21	---	NP	---	---	---	---	---	---	2.66	---	---	SM
15	**At 36.00 m depth**	SPT	>50	12.85	0.04	2.87	42.2	42.04	0.00	20	---	NP	---	---	---	---	---	---	2.65	---	---	SM
16	**At 39.00 m depth**	SPT	>50	8.05	0.43	3.72	53.93	33.87	0.00	19	---	NP	---	---	---	---	---	---	2.63	---	---	SM
17	**At 40.00 m depth**	SPT	>50	10.46	2.03	2.98	39.52	45.01	0.00	20	---	NP	---	---	---	---	---	---	2.65	---	---	SM

PIER (BH-10, CH-23205)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII,& Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S. P.T N Value	Grain size analysis						Atterberg's Limit			Field Moisture Content in %	Bulk density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To .075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
1	**At 0.5 m depth**	DS	---	0	0	0.82	68.39	30.79	0.00	18	---	NP	---	---	---	---	---	---	2.65	---	---	SM
2	**At 1.5 m depth**	UDS	---	0	0	0.77	56.52	42.71	0.00	21	---	NP	11.26	1.759	1.581	0.02	25	DS	2.66	0.68	---	SM
3	**At 3.0 m depth**	SPT	5	10.5	3.3	3.87	44.19	38.14	0.00	20	---	NP	---	---	---	---	---	---	2.65	---	---	SM
4	**At 4.5 m depth**	UDS	---	0.21	0	0.68	62.17	36.94	0.00	19	---	NP	11.76	1.789	1.601	0.03	26	DS	2.65	0.66	---	SM
5	**At 6.0 m depth**	SPT	11	0	1.01	0.54	62.16	36.29	0.00	19	---	NP	---	---	---	---	---	---	2.65	---	---	SM
6	**At 9.0 m depth**	UDS	---	0	0	0.8	63.86	35.34	0.00	19	---	NP	12.86	1.813	1.606	0.01	25	DS	2.64	0.64	---	SM
7	**At 12.0 m depth**	SPT	13	2.68	1.01	1.01	5.83	72.58	16.89	27	21	6	---	---	---	---	---	---	2.69	---	---	ML-CL
8	**At 15.0 m depth**	UDS	---	2.05	1.03	1.58	7.14	63.99	24.21	32	19	13	13.26	1.881	1.661	0.27	11	UU	2.7	0.63	0.114	CL

Contd… PIER (BH-10,CH-23205)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII & Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis						Atterberg's Limit			Field Moisture Content in %	Bulk density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To .075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
9	**At 18.0 m depth**	SPT	17	2.04	0.16	1	54.52	42.28	0.00	21	---	NP	---	---	---	---	---	---	2.65	---	---	SM
10	**At 21.0 m depth**	UDS	---	0	0.23	3.35	68.23	28.19	0.00	18	---	NP	15.63	1.896	1.640	0.03	25	DS	2.64	0.61	---	SM
11	**At 24.0 m depth**	SPT	30	0	0	5.13	58.88	35.99	0.00	19	---	NP	---	---	---	---	---	---	2.65	---	---	SM
12	**At 27.00 m depth**	UDS	---	0	0.28	5.38	59.25	35.09	0.00	19	---	NP	17.26	1.943	1.657	0.04	24	DS	2.65	0.60	---	SM
13	**At 30.00 m depth**	SPT	64	0	0	3.72	58.83	37.45	0.00	20	---	NP	---	---	---	---	---	---	2.66	---	---	SM
14	**At 33.00 m depth**	SPT	77	4.36	2	2.65	24.74	55.39	10.86	27	---	NP	---	---	---	---	---	---	2.68	---	---	ML
15	**At 36.00 m depth**	SPT	84	7.24	0	7.67	51.71	33.38	0.00	19	---	NP	---	---	---	---	---	---	2.65	---	---	SM
16	**At 39.00 m depth**	SPT	>50	5.84	0	2.21	56.72	35.23	0.00	20	---	NP	---	---	---	---	---	---	2.65	---	---	SM
17	**At 40.00 m depth**	SPT	>50	5.28	0	1.74	47.84	45.14	0.00	21	---	NP	---	---	---	---	---	---	2.66	---	---	SM

Consultant:	Geotechnical Investigation Report		Client :
S.M. CONSULTANTS BHUBANESWAR	Job No:- 830	Report No:- SMC-2050	Haryana Rail Infrastructure Development Corporation Ltd

PIER (BH-11,CH-23705)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII& Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S. P.T N Value	Grain size analysis						Atterberg's Limit			Field Moisture Content in %	Bulk density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To .075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
1	**At 0.5 m depth**	DS	---	0	0	0	55.05	44.95	0.00	21	---	NP	---	---	---	---	---	---	2.65	---	---	SM
2	**At 1.5 m depth**	UDS	---	0	0	0.51	50.28	49.21	0.00	22	---	NP	10.56	1.754	1.586	0.04	23	DS	2.66	0.68	---	SM
3	**At 3.0 m depth**	SPT	9	0	0	4.56	53.61	41.83	0.00	20	---	NP	---	---	---	---	---	---	2.65	---	---	SM
4	**At 4.5 m depth**	UDS	---	1.15	0	0.51	48.76	49.58	0.00	22	---	NP	12.56	1.796	1.596	0.04	25	DS	2.66	0.67	---	SM
5	**At 6.0 m depth**	SPT	18	9.85	2.57	1.6	70.34	15.64	0.00	19	---	NP	---	---	---	---	---	---	2.63	---	---	SM
6	**At 9.0 m depth**	UDS	---	5.19	2.12	1.44	9.61	55.77	25.87	32	19	13	14.26	1.863	1.630	0.26	13	UU	2.71	0.66	0.117	CL
7	**At 12.0 m depth**	SPT	26	11.46	2.67	1.85	9.55	51.02	23.45	30	18	12	---	---	---	---	---	---	2.70	---	---	CL
8	**At 15.0 m depth**	UDS	---	5.16	3.12	0.5	61.29	29.93	0.00	19	---	NP	15.78	1.886	1.629	0.02	27	DS	2.64	0.62	---	SM

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

Contd… PIER (BH-11, CH-23705)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII & Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis						Atterberg's Limit			Field Moisture Content in %	Bulk density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To .075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
9	**At 18.0 m depth**	SPT	32	7.09	3.55	1.1	52.97	35.29	0.00	20	---	NP	---	---	---	---	---	---	2.64	---	---	SM
10	**At 21.0 m depth**	UDS	---	3.49	3.42	1.25	56.54	35.30	0.00	20	---	NP	16.93	1.918	1.640	0.02	26	DS	2.64	0.61	---	SM
11	**At 24.0 m depth**	SPT	37	10.4	5.24	2.52	40.13	41.71	0.00	21	---	NP	---	---	---	---	---	---	2.65	---	---	SM
12	**At 27.00 m depth**	UDS	---	7.77	3.46	1.81	51.02	35.94	0.00	20	---	NP	17.64	1.956	1.663	0.03	27	DS	2.65	0.59	---	SM
13	**At 30.00 m depth**	SPT	85	11.85	5.5	38.58	29.07	15.00	0.00	18	---	NP	---	---	---	---	---	---	2.63	---	---	SM
14	**At 33.00 m depth**	SPT	>50	16.43	9.27	30.06	27.07	17.17	0.00	19	---	NP	---	---	---	---	---	---	2.63	---	---	SM
15	**At 36.00 m depth**	SPT	>50	12.91	6.82	33.11	30.9	16.26	0.00	19	---	NP	---	---	---	---	---	---	2.63	---	---	SM
16	**At 39.00 m depth**	SPT	>50	9.55	5.13	37.91	31.44	15.97	0.00	18	---	NP	---	---	---	---	---	---	2.64	---	---	SM
17	**At 40.00 m depth**	SPT	>50	15.13	13.01	46.89	11.59	13.38	0.00	18	---	NP	---	---	---	---	---	---	2.63	---	---	SM

Consultant:	Geotechnical Investigation Report		Client :
S.M. CONSULTANTS BHUBANESWAR	Job No:- 830	Report No:- SMC-2050	Haryana Rail Infrastructure Development Corporation Ltd

PIER (BH-11A,CH-24205)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII,& Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S. P.T N Value	Grain size analysis						Atterberg's Limit			Field Moisture Content in %	Bulk density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To .075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
1	**At 0.5 m depth**	DS	---	0	0	0	69.72	30.28	0.00	19	---	NP	---	---	---	---	---	---	2.65	---	---	SM
2	**At 1.5 m depth**	UDS	---	0	0	0.94	60.7	38.36	0.00	20	---	NP	11.45	1.776	1.594	0.04	25	DS	2.66	0.67	---	SM
3	**At 3.0 m depth**	SPT	5	2.13	0.9	2.36	70.19	24.42	0.00	19	---	NP	---	---	---	---	---	---	2.64	---	---	SM
4	**At 4.5 m depth**	UDS	---	0	0	0.53	85.64	13.83	0.00	18	---	NP	12.63	1.802	1.600	0.02	26	DS	2.64	0.65	---	SM
5	**At 6.0 m depth**	SPT	10	8.54	1.99	3.21	9.87	52.63	23.76	33	20	13	---	---	---	---	---	---	2.72	---	---	CL
6	**At 9.0 m depth**	UDS	---	14.78	2.2	2.32	9.39	49.91	21.40	31	19	12	13.47	1.876	1.653	0.25	14	UU	2.71	0.64	0.111	CL
7	**At 12.0 m depth**	SPT	12	2.03	0.78	3.35	18.84	51.54	23.46	32	19	13	---	---	---	---	---	---	2.72	---	---	CL
8	**At 15.0 m depth**	UDS	---	18.5	6.49	9.25	13.48	42.66	9.62	25	---	NP	14.26	1.903	1.665	0.16	19	UU	2.70	0.62	0.108	ML

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

Contd… PIER (BH-11A,CH-24205)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII & Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis: Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To .075mm)	Silt in %	Clay in %	Atterberg's Limit: Liquid Limit In %	Plastic Limit In %	Plasticity Index in %	Field Moisture Content in %	Bulk density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
9	**At 18.0 m depth**	SPT	56	16.94	2.05	2.3	48.93	29.78	0.00	21	---	NP	---	---	---	---	---	---	2.65	---	---	SM
10	**At 21.0 m depth**	SPT	67	18.69	3.42	2.86	52.65	22.38	0.00	20	---	NP	---	---	---	---	---	---	2.64	---	---	SM
11	**At 24.0 m depth**	SPT	74	21.42	5.82	3.12	48.39	21.25	0.00	19	---	NP	---	---	---	---	---	---	2.64	---	---	SM
12	**At 27.00 m depth**	SPT	>50	20.48	2.96	1.66	51.47	23.43	0.00	21	---	NP	---	---	---	---	---	---	2.63	---	---	SM
13	**At 30.00 m depth**	SPT	>50	22.65	3.85	2.46	49.53	21.51	0.00	20	---	NP	---	---	---	---	---	---	2.64	---	---	SM
14	**At 33.00 m depth**	SPT	>50	26.19	2.48	3.21	50.69	17.43	0.00	19	---	NP	---	---	---	---	---	---	2.63	---	---	SM
15	**At 36.00 m depth**	SPT	>50	Pebble Pieces Were Collected																		
16	**At 39.00 m depth**	SPT	>50	Pebble Pieces Were Collected																		
17	**At 40.00 m depth**	SPT	>50	Pebble Pieces Were Collected																		

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

PIER (BH-12,CH-24700)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII,& Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S. P.T N Value	Grain size analysis						Atterberg's Limit			Field Moisture Content in %	Bulk density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To .075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
1	**At 0.5 m to 1.5 m depth**	SPT	17	4.21	0.86	0.47	42.56	45.66	6.24	20	---	NP	---	---	---	---	---	---	2.67	---	**---**	ML
2	**At 1.5 m to 3.0 m depth**	SPT	24	0	1.38	0.52	47.36	46.58	4.16	19	---	NP	---	---	---	---	---	---	2.66	---	**---**	ML
3	**At 3.0 m to 4.5 m depth**	SPT	>50	3.64	0.27	0.21	45.52	46.24	4.12	20	---	NP	---	---	---	---	---	---	2.67	---	**---**	ML
4	**At 4.5 m to 6.0 m depth**	BOULDER	---	CORE RECOVERY=16.66% & R.Q.D=NIL																		
5	**At 6.0 m to 7.5 m depth**	ROCK	---	CORE RECOVERY=18.66% & R.Q.D=NIL																		
6	**At 7.5 m to 9.0 m depth**	ROCK	---	CORE RECOVERY=20.66% & R.Q.D=NIL																		
7	**At 9.0 m to 10.5 m depth**	ROCK	---	CORE RECOVERY=22.66% & R.Q.D=7%																		
8	**At 10.5 m to 12.0 m depth**	ROCK	---	CORE RECOVERY=36% & R.Q.D=16.66%																		

Contd… PIER (BH-12,CH-24700)

TEST CONDUCTED AS PER IS: 2720 (Pt. II, Pt. III, Pt. IV, Pt. V, Pt. X, Pt. XI / Pt. XIII & Pt. XV) AND IS: 1498 – 1970

Sl. No.	Sample Collected at	Type of soil collected	S.P.T N Value	Grain size analysis						Atterberg's Limit			Field Moisture Content in %	Bulk density in gm/cc.	Dry density in gm/cc	Cohesion (C) Kgf/cm^2	Angle of shearing resistance (ϕ) in degree	Type of shear test Triaxial test (UU) Direct shear test (DS)	Specific gravity	Void ratio	Consolidation test (Compression Index, Cc)	Group of soil
				Fine Gravel in % (20mm To 4.75mm)	Coarse Sand in % (4.75mm To 2.00 mm)	Medium Sand in % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To .075mm)	Silt in %	Clay in %	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %										
9	**At 12.0 m to 13.5 m depth**	ROCK	---	CORE RECOVERY=22.66% & R.Q.D=7.33%																		
10	**At 13.5 m to 15.0 m depth**	ROCK	---	CORE RECOVERY=26.66% & R.Q.D=14.46%																		
11	**At 15.0 m to 16.5 m depth**	ROCK	---	CORE RECOVERY=36.66% & R.Q.D=22.46%																		
12	**At 16.5 m to 18.0 m depth**	ROCK	---	CORE RECOVERY=24.66% & R.Q.D=8.67%																		
13	**At 18.0 m to 20.0 m depth**	ROCK	---	CORE RECOVERY=35% & R.Q.D=24.95%																		

BH NO.	Depth	Sample Number	Weight Density	Specific Gravity	Water Absorption	Tensile Strength Test	UCS Test	Modulas of Elasticity	Poisson's Ratio	Point load index	Triaxial		Hardness Test	Abrasiveness Test
			(kN/m³)		(%)	(Mpa)	(Mpa)	(Mpa)		(Mpa)	c (Mpa)	(φ°)		
BH NO-12	7.50	BH12/0322/R/01	---	---	---	---	37.79	40.3	0.15	---	---	---	---	---
		BH12/0322/R/02	---	---	---	---	---	---	---	11.49	---	---	---	---
	9.00	BH12/0322/R/03	---	---	---	---	---	---	---	---	---	---	---	---
		BH12/0322/R/04	25.4	2.58	0.34	---	---	---	---	---	---	---	---	---
		BH12/0322/R/05	---	---	---	---	---	---	---	14.81	---	---	---	---
		BH12/0322/R/06	---	---	---	14.93	---	---	---	---	---	---	---	---
	10.50	BH12/0322/R/07	---	---	---	---	---	---	---	---	---	---	33.8	2.7
		BH12/0322/R/08	---	---	---	---	33.91	44	0.11	---	---	---	---	---
		BH12/0322/R/09	25.74	2.61	0.49	---	---	---	---	---	---	---	---	---
	12.00	BH12/0322/R/10	---	---	---	---	40.18	41	0.13	---	---	---	---	---
		BH12/0322/R/11	---	---	---	---	---	---	---	---	---	---	---	2.86
		BH12/0322/R/12	---	---	---	---	---	---	---	13.67	---	---	---	---
		BH12/0322/R/13	25.57	2.59	0.46	---	---	---	---	---	---	---	---	---
	13.50	BH12/0322/R/14	---	---	---	---	---	---	---	---	---	---	---	---
		BH12/0322/R/15	---	---	---	---	---	---	---	---	---	---	---	---
		BH12/0322/R/16	---	---	---	---	34.78	38.6	0.13	---	---	---	---	---
		BH12/0322/R/17	---	---	---	---	---	---	---	---	---	---	35.2	2.9
	15.00	BH12/0322/R/18	25.06	2.55	0.37	---	---	---	---	---	---	---	---	---
		BH12/0322/R/19	---	---	---	13.78	---	---	---	---	---	---	---	---
		BH12/0322/R/20	---	---	---	---	37.22	40.7	0.14	---	---	---	---	---
	16.50	BH12/0322/R/21	---	---	---	16.33	---	---	---	---	---	---	---	---
		BH12/0322/R/22	---	---	---	---	---	---	---	---	---	---	31.2	3.11
		BH12/0322/R/23	---	---	---	---	38.63	42.3	0.15	---	---	---	---	---
		BH12/0322/R/24	---	---	---	---	---	---	---	---	---	---	---	---
		BH12/0322/R/25	25.43	2.58	0.38	---	---	---	---	---	---	---	---	---
	18.00	BH12/0322/R/26	---	---	---	---	---	---	---	---	---	---	---	---
		BH12/0322/R/27	---	---	---	---	42.3	39	0.17		---	---	---	---
		BH12/0322/R/28	---	---	---	---	---	---	---	---	---	---	---	---
		BH12/0322/R/29	---	---	---	---	---	---	---	---	---	---	---	---
	20.00	BH12/0322/R/30	---	---	---	---	---	---	---	---	---	---	27.3	2.66
		BH12/0322/R/31	---	---	---	---	37.12	48.1	0.16	---	---	---	---	---
		BH12/0322/R/32	24.98	2.54	0.46	14.41	---	---	---	---			---	---
		BH12/0322/R/33	---	---	---	---	---	---	---	---	15.77	63.37	---	---
		BH12/0322/R/34	---	---	---	---	---	---	---	---			---	---

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

ANNEXURE -C
CALCULATION OF LOAD CARRYING CAPACITY OF PILE

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering Abutment (BH NO-02)

Dia = 1.2 m

Length = 23.00 m From Bottom of the Pile Cap

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$\mathbf{Q_u} = \mathbf{R_u} + \mathbf{R_f}$

Where, $\mathbf{R_u}$ = Ultimate Base Resistance

$\mathbf{R_f}$ = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$\mathbf{R_u} = \mathbf{A_p N_c c_p + Ap (0.5 D\gamma N_\gamma + P_D Nq)}$

$= \mathbf{X' + Y'}$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p (0.5 D\gamma N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$\mathbf{R_f} = \mathbf{\Sigma^n_{i=1} \alpha_i c_i A_{si} + \Sigma K P_{Di} \tan \delta_i A_{si}}$

$= \mathbf{X + Y}$ where; $X = \Sigma^n_{i=1} \alpha_i c_i A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1} K_i P_{Di} \tan \delta_i A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -02

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t / m^3	kg / cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
6.000		2	4.00	4.00	15	1.762	0.31	10	X
12.000	**2.000**	3	6.00	10.00	22	1.792	0.29	11	X
18.000		4	6.00	16.00	28	1.816	0.28	10	X
22.000		5	4.00	20.00	48	1.845	0.30	9	X
25.000		6	3.00	23.00	---	1.887	0.28	15	X

Design Parameters

Pile Diameter = 1.200 m

K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t/m^3	t/m^2	t/m^2	t/m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
4.00		4.00	1.000	4.000	4.000	2.00
10.00		6.00	1.000	6.000	10.000	7.00
16.00		6.00	1.000	6.000	16.000	13.00
20.00		4.00	1.000	4.000	18.000	17.00
23.00		3.00	1.000	3.000	18.000	18.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Compo nent (X or	Depth	A_{si}	α	X	Y	$Q_u = X + Y$	Factor of Safety	Q_{safe}
		(m)	(m^2)		$\alpha C' A_s$	$K P_{Di} \tan\delta A_{si}$	t		t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**527.233**	**2.500**	**210.893**
Zone II	X	4.00	15.08	1.0	46.8	7.977			
Zone III	X	6.00	22.62	1.0	65.6	46.166			
Zone IV	X	6.00	22.62	1.0	63.3	77.774			
Zone V	X	4.00	15.08	1.0	45.2	60.904			
Zone VI	X	3.00	11.31	1.0	31.7	81.822			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level

For c-ϕ Soil

$\mathbf{A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)}$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$A_p N_c C_p$		
Ap	=	1.131
Nc	=	9.000
Cp	=	2.80
B.Capacity	=	**28.50**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
$Ap (0.5D\gamma N_\gamma + P_d N_q)$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	15.00
N_q	=	10.00
N_γ	=	2.65
B.Capacity	=	**205.37**

ϕ		Nγ
15		2.65
20		5.39

Hence, B. Capacity = 233.87

Q_{safe} = **93.550** t

Total Q_{safe} = 210.9 + 93.55

= **304.44** t

1. Density of concrete = ***2.50*** ***t/m^3***
2. Salfe weight of pile (Buoyant) = ***39.02*** ***t***
3. Net bearing capacity of pile = ***265.42*** ***t***

say ***265.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **265 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1.	Pile Diameter	=	1.200	m	
2.	Concrete design mix strength	=	35	Mpa	(Assume)
3.	Modulus of elasticity of Concrete (E_c)	=	5000 x sqrt (35)		
		=	295804.0	kg / cm^2	
4.	Moment of Inertia (I)	=	$\Pi d^4 / 64$		
		=	0.10179	m^4	
		=	10178760	cm^4	
5.	Embeded Length of Pile (L_e)	=	23.00	m	> 4T 12.79237763 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.90 kg/cm^3

T = 319.81 cm
= 3.198 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.199
= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 3.199
= **7.04** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q (L_1 + L_f)^3}{3 E I}$$

Fixed Head Piles

$$Y = \frac{Q (L_1 + L_f)^3}{12 E I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top; $$Q = \frac{12 EI Y}{(L_1 + L_f)^3}$$

= 51869.05 kg
= **52** t

Hence, the horizontal Load carrying capacity of the pile is taken as **52 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.
In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4)\times D^2\times L\times(2.5-1)$ gm

Frictional resistance = 527.23 T

W_p = 39.024 T

so Q_{tu} = 390.512 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

130.17 T

SAY 130.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Abutment (BH NO-02)

Dia = 1.2 m

Length = 25.00 m **From Bottom of the Pile Cap**

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$Q_u = R_u + R_f$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$R_u = A_p N_c c_p + Ap (0.5\ D\gamma\ N_\gamma + P_D Nq)$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p (0.5\ D\gamma\ N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$R_f = \Sigma^n_{i=1}\ \alpha_i\ c_i\ A_{si} + \Sigma\ K\ P_{Di}\ \tan\delta_i\ A_{si}$

$= X + Y$ where; $X = \Sigma^n_{i=1} \alpha_i\ c_i\ A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1}\ K_i\ P_{Di}\ \tan\delta_i\ A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -02

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
6.000		2	4.00	4.00	15	1.762	0.31	10	X
12.000	2.000	3	6.00	10.00	22	1.792	0.29	11	X
18.000		4	6.00	16.00	28	1.816	0.28	10	X
22.000		5	4.00	20.00	48	1.845	0.30	9	X
27.000		6	5.00	25.00	---	1.887	0.28	15	X

Design Parameters

Pile Diameter	=	1.200	m
K	=	1.50	

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t/m^3	t/m^2	t/m^2	t/m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
4.00		4.00	1.000	4.000	4.000	2.00
10.00		6.00	1.000	6.000	10.000	7.00
16.00		6.00	1.000	6.000	16.000	13.00
20.00		4.00	1.000	4.000	18.000	17.00
25.00		5.00	1.000	5.000	18.000	18.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Component (X or Y)	Depth	A_{si}	α	X	Y	$Q_u = X + Y$	Factor of Safety	Q_{safe}
		(m)	(m^2)		$\alpha\, C'\, A_s$	$K\, P_{Di} \tan\delta\, A_{si}$	t		t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**602.891**	**2.500**	**241.156**
Zone II	X	4.00	15.08	1.0	46.8	7.977			
Zone III	X	6.00	22.62	1.0	65.6	46.166			
Zone IV	X	6.00	22.62	1.0	63.3	77.774			
Zone V	X	4.00	15.08	1.0	45.2	60.904			
Zone VI	X	5.00	18.85	1.0	52.8	136.370			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$\mathbf{A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)}$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$\mathbf{A_p N_c C_p}$		
Ap	=	1.131
Nc	=	9.000
Cp	=	2.80
B.Capacity	=	**28.50**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
$\mathbf{Ap\,(0.5D\gamma N_\gamma + P_d N_q)}$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	15.00
N_q	=	10.00
N_γ	=	2.65
B.Capacity	=	**205.37**

ϕ		$N\gamma$
15		2.65
20		5.39

Hence, B. Capacity = 233.87

Q_{safe} = **93.550** t

Total Q_{safe} = 241.16 + 93.55
= **334.71** t

1. Density of concrete = ***2.50*** ***t/m^3***
2. Salfe weight of pile (Buoyant) = ***42.41 t***
3. Net bearing capacity of pile = ***292.29 t***

say ***292.00 t***

Hence, the vertical Load carrying capacity of the pile is taken as **292 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1.	Pile Diameter	=	1.200	m	
2.	Concrete design mix strength	=	35	Mpa	(Assume)
3.	Modulus of elasticity of Concrete (E_c)	=	5000 x sqrt (35)		
		=	295804.0	kg / cm^2	
4.	Moment of Inertia (I)	=	$\Pi\ d^4 / 64$		
		=	0.10179	m^4	
		=	10178760	cm^4	
5.	Embeded Length of Pile (L_e)	=	25.00	m	> 4T
					12.79237763 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get	n_h	=	0.90	kg/cm^3
	T	=	319.81	cm
		=	3.198	m
Free Length of pile (L_1)		=	Pile cap bottom Level - Scour Level	
	L_1	=	**0.000**	m
Hence;	L_1 / T	=	0 / 3.199	
		=	0.00	

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

	L_f / T	=	2.20	for pile in sand
Hence;				
Equivalent Cantilever Length	L_f	=	2.2 x 3.199	
		=	**7.04**	m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{3\,E\,I}$$

Fixed Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{12\,E\,I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top;

$$Q = \frac{12\,EI\,Y}{(L_1 + L_f)^3}$$

= 51869.05 kg

= **52** t

Hence, the horizontal Load carrying capacity of the pile is taken as **52 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.
In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4)\times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 602.89 T

W_p = 42.417 T

so Q_{tu} = 444.344 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

148.11 T

SAY 148.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier(BH NO-03)

Dia = 1.2 m

Length = 20.00 m From Bottom of the Pile Cap

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$Q_u = R_u + R_f$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$R_u = A_p N_c c_p + Ap\,(0.5\, D\gamma\, N_\gamma + P_D Nq)$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p (0.5\, D\gamma\, N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$R_f = \Sigma^n_{i=1}\, \alpha_i\, c_i\, A_{si} + \Sigma\, K\, P_{Di} \tan \delta_i\, A_{si}$

$= X + Y$ where; $X = \Sigma^n_{i=1} \alpha_i\, c_i\, A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1}\, K_i\, P_{Di} \tan \delta_i\, A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -03

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t / m^3	kg / cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
9.000		2	7.00	7.00	17	1.783	0.30	12	X
12.000	**2.000**	3	3.00	10.00	24	---	0.05	25	Y
18.000		4	6.00	16.00	32	1.826	0.29	14	X
21.000		5	3.00	19.00	---	1.871	0.28	15	X
22.000		6	1.00	20.00	59	---	0.11	18	Y

Note*

The values of c and ϕ, strength parameters, where ever not evaluated by testing have been assumed and as available elsewhere in the literature.

Design Parameters

Pile Diameter	=	1.200	m
K	=	1.50	

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t / m^3	t / m^2	t / m^2	t / m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
7.00		7.00	1.000	7.000	7.000	3.50
10.00		3.00	1.000	3.000	10.000	8.50
16.00		6.00	1.000	6.000	16.000	13.00
19.00		3.00	1.000	3.000	18.000	17.00
20.00		1.00	1.000	1.000	18.000	18.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Component (X or Y)	Depth (m)	A_{si} (m^2)	α	X α C' A_s	Y K P_{Di} tanδ A_{si}	Q_u = X + Y t	Factor of Safety	Q_{safe} t
Zone I	0	0.00	0.00	0.0	0.0	0.000	493.452	2.500	197.381
Zone II	X	7.00	26.39	1.0	79.2	29.448			
Zone III	Y	3.00	11.31	0.0	0.0	67.241			
Zone IV	X	6.00	22.62	1.0	65.6	109.973			
Zone V	X	3.00	11.31	1.0	31.7	77.276			
Zone VI	Y	1.00	3.77	0.0	0.0	33.073			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$\mathbf{A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)}$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$A_p N_c C_p$		
Ap	=	1.131
Nc	=	9.000
Cp	=	1.10
B.Capacity	=	**11.20**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
Ap $(0.5 D\gamma N_\gamma + P_d N_q)$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	18.00
N_q	=	10.00
N_γ	=	4.29
B.Capacity	=	**206.49**

ϕ		$N\gamma$
15		2.65
20		5.39

Hence, B. Capacity = 217.69

Q_{safe} = **87.074** t

Total Q_{safe} = 197.39 + 87.08
= **284.46** t

1. Density of concrete = ***2.50*** ***t/m*** ^{3}
2. Salfe weight of pile (Buoyant) = ***33.93*** ***t***
3. Net bearing capacity of pile = ***250.53*** ***t***
say ***251.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **251 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1. Pile Diameter = 1.200 m
2. Concrete design mix strength = 35 Mpa (Assume)
3. Modulus of elasticity of Concrete (E_c) = 5000 x sqrt (35)
   = 295804.0 kg / cm^2
4. Moment of Inertia (I) = $\Pi\ d^4 / 64$
   = 0.10179 m^4
   = 10178760.2 cm^4
5. Embeded Length of Pile (L_e) = 20.00 m > 4T
   12.79237763 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.90 kg/cm^3

T = 319.81 cm
= 3.198 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level
L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.199
= 0.00

Therefore from the graph we read the corresponding value of " **L_f / T** ".

L_f / T = 2.20 for pile in sand

Hence;
Equivalent Cantilever Length L_f = 2.2 x 3.199
= **7.04** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{3\ E\ I}$$

Fixed Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{12\ E\ I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top;
$$Q = \frac{12\ EI\ Y}{(L_1 + L_f)^3}$$

= 51869.05 kg
= **52** t

Hence, the horizontal Load carrying capacity of the pile is taken as **52 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.

In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4)\times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 493.45 T

W_p = 33.934 T

so Q_{tu} = 362.902 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

120.97 T

SAY 121.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier(BH NO-03)

Dia = 1.2 m

Length = 23.00 m From Bottom of the Pile Cap

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$Q_u = R_u + R_f$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$R_u = A_p N_c c_p + Ap (0.5 D\gamma N_\gamma + P_D Nq)$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p (0.5 D\gamma N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$R_f = \Sigma^n_{i=1} \alpha_i c_i A_{si} + \Sigma K P_{Di} \tan \delta_i A_{si}$

$= X + Y$ where; $X = \Sigma^n_{i=1} \alpha_i c_i A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1} K_i P_{Di} \tan \delta_i A_{si}$ *For Granular Soil*

Where;

A_p = cross sectional area of pile tip, in m^2

N_c = bearing capacity factor, may be taken as " 9 "

c_p = average cohesion at pile tip, in kN/m^2

α_i = adhesion factor for the ith layer depending on the consistency of soil

c_i = average cohesion for the ith layer, in kN/m^2

A_p = cross sectional area of pile tip, in m^2

D = diameter of the pile shaft, in m

γ = effective unit weight of the soil at pile tip, in kN/m^2

P_D = effective overburden pressure at pile tip, in kN/m^2

$\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.

N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.

K_i = coefficient of Earth pressure applicable for the ith layer.

P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2

δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).

A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -03

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t / m^3	kg / cm^2	(degrees)	
2.000	2.000	1	0.00	0.00	---	---	0.00	0	
9.000		2	7.00	7.00	17	1.783	0.30	12	X
12.000		3	3.00	10.00	24	---	0.05	25	Y
18.000		4	6.00	16.00	32	1.826	0.29	14	X
21.000		5	3.00	19.00	---	1.871	0.28	15	X
25.000		6	4.00	23.00	59	---	0.04	25	Y

Note*

The values of c and ϕ, strength parameters, where ever not evaluated by testing have been assumed and as available elsewhere in the literature.

Design Parameters

Pile Diameter = 1.200 m
K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t/m^3	t/m^2	t/m^2	t/m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
7.00		7.00	1.000	7.000	7.000	3.50
10.00		3.00	1.000	3.000	10.000	8.50
16.00		6.00	1.000	6.000	16.000	13.00
19.00		3.00	1.000	3.000	18.000	17.00
23.00		4.00	1.000	4.000	18.000	18.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Component (X or Y)	Depth (m)	A_{si} (m^2)	α	X ($\alpha\, C'\, A_s$)	Y ($K\, P_{Di}\, \tan\delta\, A_{si}$)	$Q_u = X + Y$ (t)	Factor of Safety	Q_{safe} (t)
Zone I	0	0.00	0.00	0.0	0.0	0.000	**650.237**	**2.500**	**260.095**
Zone II	X	7.00	26.39	1.0	79.2	29.448			
Zone III	Y	3.00	11.31	0.0	0.0	67.241			
Zone IV	X	6.00	22.62	1.0	65.6	109.973			
Zone V	X	3.00	11.31	1.0	31.7	77.276			
Zone VI	Y	4.00	15.08	0.0	0.0	189.857			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$A_p N_c C_p + A_p\,(0.5\,D\,\gamma\,N_\gamma + P_d N_q)$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$A_p N_c C_p$		
Ap	=	1.131
Nc	=	9.000
Cp	=	0.40
B.Capacity	=	**4.07**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
$A_p\,(0.5D\gamma N_\gamma + P_d N_q)$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	25.00
N_q	=	10.00
N_γ	=	10.88
B.Capacity	=	**210.96**

ϕ		N_γ
25		10.88
30		22.40

Hence, B. Capacity = 215.03

Q_{safe} = **86.012** t

Total Q_{safe} = 260.1 + 86.02
= **346.11** t

1. Density of concrete = ***2.50*** ***t/m³***
2. Salfe weight of pile (Buoyant) = ***39.02*** ***t***
3. Net bearing capacity of pile = ***307.09*** ***t***
say ***307.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **307 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1. Pile Diameter = 1.200 m
2. Concrete design mix strength = 35 Mpa (Assume)
3. Modulus of elasticity of Concrete (E_c) = 5000 x sqrt (35)
   = 295804.0 kg / cm^2
4. Moment of Inertia (I) = $\Pi\ d^4 / 64$
   = 0.10179 m^4
   = 10178760 cm^4
5. Embeded Length of Pile (L_e) = 23.00 m > 4T
   12.79237763 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.90 kg/cm^3

T = 319.81 cm
= 3.198 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.199
= 0.00

Therefore from the graph we read the corresponding value of " **L_f / T** ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 3.199
= **7.04** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{3\,E\,I}$$

Fixed Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{12\,E\,I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top; $$Q = \frac{12\,EI\,Y}{(L_1 + L_f)^3}$$

= 51869.05 kg
= **52** t

Hence, the horizontal Load carrying capacity of the pile is taken as **52 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.

In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4)\times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 650.24 T

W_p = 39.024 T

so Q_{tu} = 472.515 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

157.50 T

SAY 158.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-04)

Dia = 1.2 m

Length = 20.00 m **From Bottom of the Pile Cap**

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$\mathbf{Q_u} = \mathbf{R_u} + \mathbf{R_f}$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$R_u = A_p N_c c_p + A_p (0.5 D\gamma N_\gamma + P_D N_q)$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p (0.5 D\gamma N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$R_f = \Sigma^n_{i=1} \alpha_i c_i A_{si} + \Sigma K P_{Di} \tan \delta_i A_{si}$

$= X + Y$ where; $X = \Sigma^n_{i=1} \alpha_i c_i A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1} K_i P_{Di} \tan \delta_i A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -04

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
6.000		2	4.00	4.00	17	1.768	0.03	26	Y
12.000	2.000	3	6.00	10.00	36	1.795	0.05	24	Y
18.000		4	6.00	16.00	52	1.844	0.28	14	X
21.000		5	3.00	19.00	---	1.893	0.31	11	X
22.000		6	1.00	20.00	65	---	0.04	25	Y

Note*

The values of c and ϕ, strength parameters, where ever not evaluated by testing have been assumed and as available elsewhere in the literature.

Design Parameters

Pile Diameter = 1.200 m
K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t / m^3	t / m^2	t / m^2	t / m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
4.00		4.00	1.000	4.000	4.000	2.00
10.00		6.00	1.000	6.000	10.000	7.00
16.00		6.00	1.000	6.000	16.000	13.00
19.00		3.00	1.000	3.000	18.000	17.00
20.00		1.00	1.000	1.000	18.000	18.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Component (X or Y)	Depth (m)	A_{si} (m^2)	α	X α C' A_s	Y K P_{Di} tanδ A_{si}	Q_u = X + Y t	Factor of Safety	Q_{safe} t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**439.695**	**2.500**	**175.878**
Zone II	Y	4.00	15.08	0.0	0.0	22.065			
Zone III	Y	6.00	22.62	0.0	0.0	105.744			
Zone IV	X	6.00	22.62	1.0	63.3	109.973			
Zone V	X	3.00	11.31	1.0	35.1	56.059			
Zone VI	Y	1.00	3.77	0.0	0.0	47.464			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$A_p N_c C_p$		
Ap	=	1.131
Nc	=	9.000
Cp	=	0.40
B.Capacity	=	**4.07**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
Ap (0.5DγN$_\gamma$+P$_d$N$_q$)		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	25.00
N_q	=	10.00
N_γ	=	10.88
B.Capacity	=	**210.96**

ϕ		Nγ
25		10.88
30		22.40

Hence, B. Capacity = 215.03

Q_{safe} = **86.012** t

Total Q_{safe} = 175.88 + 86.02
= **261.89** t

1. Density of concrete = ***2.50*** ***t/m^3***
2. Salfe weight of pile (Buoyant) = ***33.93*** ***t***
3. Net bearing capacity of pile = ***227.96*** ***t***
say ***228.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **228 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1. Pile Diameter = 1.200 m
2. Concrete design mix strength = 35 Mpa (Assume)
3. Modulus of elasticity of Concrete (E_c) = 5000 x sqrt (35)
   = 295804.0 kg / cm^2
4. Moment of Inertia (I) = $\Pi d^4 / 64$
   = 0.10179 m^4
   = 10178760.2 cm^4
5. Embeded Length of Pile (L_e) = 20.00 m > 4T
   15.19998131 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.38 kg/cm^3

T = 380.00 cm
= 3.800 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.8
= 0.00

Therefore from the graph we read the corresponding value of " **L_f / T** ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 3.8
= **8.36** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q (L_1 + L_f)^3}{3 E I}$$

Fixed Head Piles

$$Y = \frac{Q (L_1 + L_f)^3}{12 E I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top; $Q = \frac{12 EI Y}{(L_1 + L_f)^3}$

= 30919.53 kg
= **31** t

Hence, the horizontal Load carrying capacity of the pile is taken as **31 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.
In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$\mathbf{Q_{tu} = (2/3)\ rd\ of\ frictional\ resistance + W_p}$$

where W_p = Submerged weight of pile = $(3.141/4)\times D^2\times L\times(2.5-1)$ gm

Frictional resistance = 439.70 T

W_p = 33.934 T

so Q_{tu} = 327.064 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

109.02 T

SAY 109.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-04)

Dia = 1.2 m

Length = 23.00 m From Bottom of the Pile Cap

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$\mathbf{Q_u} = \mathbf{R_u} + \mathbf{R_f}$

Where, $\mathbf{R_u}$ = Ultimate Base Resistance

$\mathbf{R_f}$ = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$\mathbf{R_u} = \mathbf{A_p N_c c_p + Ap\,(0.5\,D\gamma\,N_\gamma + P_D Nq)}$

$= \mathbf{X' + Y'}$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p\,(0.5\,D\gamma\,N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$\mathbf{R_f} = \mathbf{\Sigma^n_{i=1}\,\alpha_i\,c_i\,A_{si} + \Sigma\,K\,P_{Di}\,\tan\delta_i\,A_{si}}$

$= \mathbf{X + Y}$ where; $X = \Sigma^n_{i=1}\alpha_i\,c_i\,A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1}\,K_i\,P_{Di}\,\tan\delta_i\,A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -04

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
6.000		2	4.00	4.00	17	1.768	0.03	26	Y
12.000	**2.000**	3	6.00	10.00	36	1.795	0.05	24	Y
18.000		4	6.00	16.00	52	1.844	0.28	14	X
21.000		5	3.00	19.00	---	1.893	0.31	11	X
25.000		6	4.00	23.00	65	---	0.04	25	Y

Note*

The values of c and ϕ, strength parameters, where ever not evaluated by testing have been assumed and as available elsewhere in the literature.

Design Parameters

Pile Diameter = 1.200 m
K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t / m^3	t / m^2	t / m^2	t / m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
4.00		4.00	1.000	4.000	4.000	2.00
10.00		6.00	1.000	6.000	10.000	7.00
16.00		6.00	1.000	6.000	16.000	13.00
19.00		3.00	1.000	3.000	18.000	17.00
23.00		4.00	1.000	4.000	18.000	18.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Component (X or Y)	Depth (m)	A_{si} (m^2)	α	X $\alpha C' A_s$	Y $K P_{Di} \tan\delta A_{si}$	$Q_u = X + Y$ t	Factor of Safety	Q_{safe} t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**582.088**	**2.500**	**232.835**
Zone II	Y	4.00	15.08	0.0	0.0	22.065			
Zone III	Y	6.00	22.62	0.0	0.0	105.744			
Zone IV	X	6.00	22.62	1.0	63.3	109.973			
Zone V	X	3.00	11.31	1.0	35.1	56.059			
Zone VI	Y	4.00	15.08	0.0	0.0	189.857			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$\mathbf{A_p N_c C_p + A_p (0.5\, D\, \gamma\, N_\gamma + P_d N_q)}$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$\mathbf{A_p N_c C_p}$		
Ap	=	1.131
Nc	=	9.000
Cp	=	0.40
B.Capacity	=	**4.07**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
$\mathbf{Ap\,(0.5D\gamma N_\gamma + P_d N_q)}$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	25.00
N_q	=	10.00
N_γ	=	10.88
B.Capacity	=	**210.96**

ϕ		Nγ
25		10.88
30		22.40

Hence, B. Capacity = 215.03

Q_{safe} = **86.012** t

Total Q_{safe} = 232.84 + 86.02
= **318.85** t

1. Density of concrete = ***2.50*** ***t/m***^{3}
2. Salfe weight of pile (Buoyant) = ***39.02*** ***t***
3. Net bearing capacity of pile = ***279.83*** ***t***
say ***280.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **280 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1. Pile Diameter = 1.200 m
2. Concrete design mix strength = 35 Mpa (Assume)
3. Modulus of elasticity of Concrete (E_c) = 5000 x sqrt (35)
   = 295804.0 kg / cm^2
4. Moment of Inertia (I) = $\Pi\ d^4 / 64$
   = 0.10179 m^4
   = 10178760.2 cm^4
5. Embeded Length of Pile (L_e) = 23.00 m > 4T
   15.19998131 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.38 kg/cm^3

T = 380.00 cm
= 3.800 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.8
= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 3.8
= **8.36** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{3\,E\,I}$$

Fixed Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{12\,E\,I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top;

$$Q = \frac{12\,EI\,Y}{(L_1 + L_f)^3}$$

= 30919.53 kg
= **31** t

Hence, the horizontal Load carrying capacity of the pile is taken as **31 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.
In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

Q_{tu} = (2/3) rd of frictional resistance + W_p

where W_p = Submerged weight of pile = $(3.141/4)\times D^2\times L\times(2.5-1)$ gm

Frictional resistance = 582.09 T

W_p = 39.024 T

so Q_{tu} = 427.082 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

142.36 T

SAY 142.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-04)

Dia = 1.2 m

Length = 25.00 m From Bottom of the Pile Cap

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$\mathbf{Q_u} = \mathbf{R_u} + \mathbf{R_f}$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$\mathbf{R_u} = \mathbf{A_p N_c c_p + Ap\,(0.5\, D\gamma N_\gamma + P_D Nq)}$

$= \mathbf{X' + Y'}$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p\,(0.5\,D\gamma\,N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$\mathbf{R_f} = \mathbf{\Sigma^n_{i=1}\, \alpha_i\, c_i\, A_{si} + \Sigma\, K\, P_{Di}\, \tan\delta_i\, A_{si}}$

$= \mathbf{X + Y}$ where; $X = \Sigma^n_{i=1} \alpha_i\, c_i\, A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1}\, K_i\, P_{Di} \tan\delta_i\, A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -04

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000	**2.000**	1	0.00	0.00	---	---	0.00	0	
6.000		2	4.00	4.00	17	1.768	0.03	26	Y
12.000		3	6.00	10.00	36	1.795	0.05	24	Y
18.000		4	6.00	16.00	52	1.844	0.28	14	X
21.000		5	3.00	19.00	---	1.893	0.31	11	X
27.000		6	6.00	25.00	65	---	0.04	25	Y

Note*

The values of c and ϕ, strength parameters, where ever not evaluated by testing have been assumed and as available elsewhere in the literature.

Design Parameters

Pile Diameter = 1.200 m
K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t / m^3	t / m^2	t / m^2	t / m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
4.00		4.00	1.000	4.000	4.000	2.00
10.00		6.00	1.000	6.000	10.000	7.00
16.00		6.00	1.000	6.000	16.000	13.00
19.00		3.00	1.000	3.000	18.000	17.00
25.00		6.00	1.000	6.000	18.000	18.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Component (X or Y)	Depth	A_{si}	α	X	Y	$Q_u = X + Y$	Factor of Safety	Q_{safe}
		(m)	(m^2)		$\alpha C' A_s$	$K P_{Di} \tan\delta A_{si}$	t		t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**677.017**	**2.500**	**270.807**
Zone II	Y	4.00	15.08	0.0	0.0	22.065			
Zone III	Y	6.00	22.62	0.0	0.0	105.744			
Zone IV	X	6.00	22.62	1.0	63.3	109.973			
Zone V	X	3.00	11.31	1.0	35.1	56.059			
Zone VI	Y	6.00	22.62	0.0	0.0	284.786			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$\mathbf{A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)}$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$A_p N_c C_p$		
Ap	=	1.131
Nc	=	9.000
Cp	=	0.40
B.Capacity	=	**4.07**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
Ap ($0.5D\gamma N_\gamma + P_d N_q$)		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	25.00
N_q	=	10.00
N_γ	=	10.88
B.Capacity	=	**210.96**

ϕ		Nγ
25		10.88
30		22.40

Hence, B. Capacity = 215.03

Q_{safe} = **86.012** t

Total Q_{safe} = 270.81 + 86.02
= **356.82** t

1. Density of concrete = ***2.50*** ***t/m^3***
2. Salfe weight of pile (Buoyant) = ***42.41*** ***t***
3. Net bearing capacity of pile = ***314.41*** ***t***
say ***314.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **314 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1.	Pile Diameter	=	1.200	m	
2.	Concrete design mix strength	=	35	Mpa	(Assume)
3.	Modulus of elasticity of Concrete (E_c)	=	5000 x sqrt (35)		
		=	295804.0	kg / cm^2	
4.	Moment of Inertia (I)	=	Π d^4 / 64		
		=	0.10179	m^4	
		=	10178760.2	cm^4	
5.	Embeded Length of Pile (L_e)	=	25.00	m	> 4T
					15.19998131 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.38 kg/cm^3

T = 380.00 cm
= 3.800 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.8
= 0.00

Therefore from the graph we read the corresponding value of " **L_f / T** ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 3.8
= **8.36** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q (L_1 + L_f)^3}{3 E I}$$

Fixed Head Piles

$$Y = \frac{Q (L_1 + L_f)^3}{12 E I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top;

$$Q = \frac{12 EI Y}{(L_1 + L_f)^3}$$

= 30919.53 kg
= **31** t

Hence, the horizontal Load carrying capacity of the pile is taken as **31 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.

In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4) \times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 677.02 T

W_p = 42.417 T

so Q_{tu} = 493.761 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

164.59 T

SAY 165.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-05)

Dia = 1.2 m

Length = 25.00 m From Bottom of the Pile Cap

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$Q_u = R_u + R_f$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$R_u = A_p N_c c_p + Ap\,(0.5\, D\gamma\, N_\gamma + P_D N q)$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p\,(0.5\, D\gamma\, N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$R_f = \Sigma^n{}_{i=1}\, \alpha_i\, c_i\, A_{si} + \Sigma\, K\, P_{Di} \tan \delta_i\, A_{si}$

$= X + Y$ where; $X = \Sigma^n{}_{i=1} \alpha_i\, c_i\, A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n{}_{i=1}\, K_i\, P_{Di} \tan \delta_i\, A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n{}_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -05

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
3.000		2	1.00	1.00	15	---	0.11	17	Y
9.000	2.000	3	6.00	7.00	23	1.773	0.09	20	Y
15.000		4	6.00	13.00	28	1.826	0.10	20	Y
18.000		5	3.00	16.00	50	---	0.10	20	Y
24.000		6	6.00	22.00	61	1.875	0.30	10	X
27.000		7	3.00	25.00	---	1.926	0.32	8	X

Note*

The values of c and ϕ, strength parameters, where ever not evaluated by testing have been assumed and as available elsewhere in the literature.

Design Parameters

Pile Diameter = 1.200 m
K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t/m^3	t/m^2	t/m^2	t/m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
1.00		1.00	1.000	1.000	1.000	0.50
7.00		6.00	1.000	6.000	7.000	4.00
13.00		6.00	1.000	6.000	13.000	10.00
16.00		3.00	1.000	3.000	16.000	14.50
22.00		6.00	1.000	6.000	18.000	17.00
25.00		3.00	1.000	3.000	18.000	18.00

No. of Zones Considered ***7***

Q_{safe} due friction

Zone	Component (X or Y)	Depth (m)	A_{si} (m^2)	α	X $\alpha\, C'\, A_s$	Y $K\, P_{Di} \tan\delta\, A_{si}$	$Q_u = X + Y$ t	Factor of Safety	Q_{safe} t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**511.956**	**2.500**	**204.782**
Zone II	Y	1.00	3.77	0.0	0.0	0.864			
Zone III	Y	6.00	22.62	0.0	0.0	49.397			
Zone IV	Y	6.00	22.62	0.0	0.0	123.492			
Zone V	Y	3.00	11.31	0.0	0.0	89.532			
Zone VI	X	6.00	22.62	1.0	67.9	101.705			
Zone VII	X	3.00	11.31	1.0	36.2	42.916			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$\mathbf{A_p\, N_c\, C_p + A_p\, (\, 0.5\, D\, \gamma\, N_\gamma + P_d\, N_q\,)}$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$\mathbf{A_p\, N_c\, C_p}$		
Ap	=	1.131
Nc	=	9.000
Cp	=	3.20
B.Capacity	=	**32.57**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
$\mathbf{Ap\, (0.5D\gamma N_\gamma + P_d N_q)}$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	8.00
N_q	=	10.00
N_γ	=	0.91
B.Capacity	=	**204.19**

ϕ		$N\gamma$
5		0.45
10		1.22

Hence, B. Capacity = 236.77

Q_{safe} = **94.706** t

Total Q_{safe} = 204.79 + 94.71
= **299.49** t

1. Density of concrete = ***2.50*** ***t/m^3***
2. Salfe weight of pile (Buoyant) = ***42.41 t***
3. Net bearing capacity of pile = ***257.08 t***
say ***257.00 t***

Hence, the vertical Load carrying capacity of the pile is taken as **257 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1. Pile Diameter = 1.200 m
2. Concrete design mix strength = 35 Mpa (Assume)
3. Modulus of elasticity of Concrete (E_c) = 5000 x sqrt (35)
   = 295804.0 kg / cm^2
4. Moment of Inertia (I) = $\Pi\ d^4 / 64$
   = 0.10179 m^4
   = 10178760.2 cm^4
5. Embeded Length of Pile (L_e) = 25.00 m > 4T
   15.36523734 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.36 kg/cm^3

T = 384.13 cm
= 3.841 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.842
= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 3.842
= **8.45** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{3\,E\,I}$$

Fixed Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{12\,E\,I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top;

$$Q = \frac{12\,EI\,Y}{(L_1 + L_f)^3}$$

= 29932.59 kg
= **30** t

Hence, the horizontal Load carrying capacity of the pile is taken as **30 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.

In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

Q_{tu} = (2/3) rd of frictional resistance + W_p

where W_p = Submerged weight of pile = $(3.141/4)\times D^2\times L\times(2.5\text{-}1)$ gm

Frictional resistance = 511.96 T

W_p = 42.417 T

so Q_{tu} = 383.721 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

127.91 T

SAY 128.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-05)

Dia = 1.2 m

Length = 28.00 m From Bottom of the Pile Cap

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$Q_u = R_u + R_f$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$R_u = A_p N_c c_p + Ap (0.5 D\gamma N_\gamma + P_D Nq)$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p (0.5 D\gamma N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$R_f = \Sigma^n_{i=1} \alpha_i c_i A_{si} + \Sigma K P_{Di} \tan \delta_i A_{si}$

$= X + Y$ where; $X = \Sigma^n_{i=1} \alpha_i c_i A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1} K_i P_{Di} \tan \delta_i A_{si}$ *For Granular Soil*

Where;

A_p	=	cross sectional area of pile tip, in m^2
N_c	=	bearing capacity factor, may be taken as " 9 "
c_p	=	average cohesion at pile tip, in kN/m^2
α_i	=	adhesion factor for the ith layer depending on the consistency of soil
c_i	=	average cohesion for the ith layer, in kN/m^2
A_p	=	cross sectional area of pile tip, in m^2
D	=	diameter of the pile shaft, in m
γ	=	effective unit weight of the soil at pile tip, in kN/m^2
P_D	=	effective overburden pressure at pile tip, in kN/m^2
$\Sigma^n_{i=1}$	=	summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
N_γ & N_q	=	bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
K_i	=	coefficient of Earth pressure applicable for the ith layer.
P_{Di}	=	effective overburden pressure for the " i^{th} " layer, in kN/m^2
δ	=	angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
A_{si}	=	surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -05

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000	2.000	1	0.00	0.00	---	---	0.00	0	
3.000		2	1.00	1.00	15	---	0.11	17	Y
9.000		3	6.00	7.00	23	1.773	0.09	20	Y
15.000		4	6.00	13.00	28	1.826	0.10	20	Y
18.000		5	3.00	16.00	50	---	0.10	20	Y
24.000		6	6.00	22.00	61	1.875	0.30	10	X
30.000		7	6.00	28.00	70	1.926	0.32	8	X

Note*

The values of c and ϕ, strength parameters, where ever not evaluated by testing have been assumed and as available elsewhere in the literature.

Design Parameters

Pile Diameter = 1.200 m
K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t/m^3	t/m^2	t/m^2	t/m^2
0.00		0.00	0.000	0.000	0.000	0.00
1.00		1.00	1.000	1.000	1.000	0.50
7.00		6.00	1.000	6.000	7.000	4.00
13.00	2.000	6.00	1.000	6.000	13.000	10.00
16.00		3.00	1.000	3.000	16.000	14.50
22.00		6.00	1.000	6.000	18.000	17.00
28.00		6.00	1.000	6.000	18.000	18.00

No. of Zones Considered 7

Q_{safe} due friction

Zone	Component (X or Y)	Depth (m)	A_{si} (m^2)	α	X $\alpha C' A_s$	Y $K P_{Di} \tan\delta A_{si}$	$Q_u = X + Y$ t	Factor of Safety	Q_{safe} t
Zone I	0	0.00	0.00	0.0	0.0	0.000			
Zone II	Y	1.00	3.77	0.0	0.0	0.864			
Zone III	Y	6.00	22.62	0.0	0.0	49.397			
Zone IV	Y	6.00	22.62	0.0	0.0	123.492	**591.062**	**2.500**	**236.425**
Zone V	Y	3.00	11.31	0.0	0.0	89.532			
Zone VI	X	6.00	22.62	1.0	67.9	101.705			
Zone VII	X	6.00	22.62	1.0	72.4	85.832			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$A_p N_c C_p$		
Ap	=	1.131
Nc	=	9.000
Cp	=	3.20
B.Capacity	=	**32.57**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
Ap $(0.5D\gamma N_\gamma + P_d N_q)$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	8.00
N_q	=	10.00
N_γ	=	0.91
B.Capacity	=	**204.19**

ϕ		$N\gamma$
5		0.45
10		1.22

Hence, B. Capacity = 236.77

Q_{safe} = **94.706** t

Total Q_{safe} = 236.43 + 94.71
= **331.13** t

1. Density of concrete = ***2.50*** ***t/m^3***
2. Salfe weight of pile (Buoyant) = ***47.50*** ***t***
3. Net bearing capacity of pile = ***283.63*** ***t***
say ***284.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **284 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1.	Pile Diameter	=	1.200	m	
2.	Concrete design mix strength	=	35	Mpa	(Assume)
3.	Modulus of elasticity of Concrete (E_c)	=	5000 x sqrt (35)		
		=	295804.0	kg / cm^2	
4.	Moment of Inertia (I)	=	$\Pi\ d^4 / 64$		
		=	0.10179	m^4	
		=	10178760.2	cm^4	
5.	Embeded Length of Pile (L_e)	=	28.00	m	> 4T
					15.36523734 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.36 kg/cm^3

T = 384.13 cm

= 3.841 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.842

= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 3.842

= **8.45** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{3\ E\ I}$$

Fixed Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{12\ E\ I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top;

$$Q = \frac{12\ EI\ Y}{(L_1 + L_f)^3}$$

= 29932.59 kg

= **30** t

Hence, the horizontal Load carrying capacity of the pile is taken as **30 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.
In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4)\times D^2\times L\times(2.5-1)$ gm

Frictional resistance = 591.06 T

W_p = 47.507 T

so Q_{tu} = 441.548 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

147.18 T

SAY 147.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-06)

Dia = **1.2** **m**

Length = **20.00** **m** **From Bottom of the Pile Cap**

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$Q_u = R_u + R_f$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$R_u = A_p N_c c_p + Ap\,(0.5\,D\gamma\,N_\gamma + P_D N_q)$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p\,(0.5\,D\gamma\,N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$R_f = \Sigma^n_{i=1}\,\alpha_i\,c_i\,A_{si} + \Sigma\,K\,P_{Di}\tan\delta_i\,A_{si}$

$= X + Y$ where; $X = \Sigma^n_{i=1}\alpha_i\,c_i\,A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1}\,K_i\,P_{Di}\tan\delta_i\,A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -06

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t / m^3	kg / cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
6.000		2	4.00	4.00	20	1.758	0.12	17	Y
12.000	**2.000**	3	6.00	10.00	39	1.794	0.03	26	Y
15.000		4	3.00	13.00	---	1.816	0.04	24	Y
18.000		5	3.00	16.00	47	---	0.13	18	Y
22.000		6	4.00	20.00	60	1.863	0.13	18	Y

Note*

The values of c and ϕ, strength parameters, where ever not evaluated by testing have been assumed and as available elsewhere in the literature.

Design Parameters

Pile Diameter = 1.200 m
K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Bulk Density γ_b	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t / m^3	t / m^2	t / m^2	t / m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
4.00		4.00	1.758	7.032	7.032	3.52
10.00		6.00	1.794	10.764	17.796	12.41
13.00		3.00	1.816	5.448	18.000	17.90
16.00		3.00	1.816	5.448	18.000	18.00
20.00		4.00	1.863	7.452	18.000	18.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Component (X or Y)	Depth (m)	A_{si} (m^2)	α	X α C' A_s	Y K P_{Di} tanδ A_{si}	$Q_u = X + Y$ t	Factor of Safety	Q_{safe} t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**596.442**	**2.500**	**238.577**
Zone II	Y	4.00	15.08	0.0	0.0	24.315			
Zone III	Y	6.00	22.62	0.0	0.0	205.432			
Zone IV	Y	3.00	11.31	0.0	0.0	135.186			
Zone V	Y	3.00	11.31	0.0	0.0	99.218			
Zone VI	Y	4.00	15.08	0.0	0.0	132.291			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$\mathbf{A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)}$

Where

End Bearing Capacity of pile at founding level For Cohesive Soil $A_p N_c C_p$		
Ap	=	1.131
Nc	=	9.000
Cp	=	1.30
B.Capacity	=	**13.23**

and

End Bearing Capacity of pile at founding level For Granular Soil $Ap (0.5D\gamma N_\gamma + P_d N_q)$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.86
ϕ	=	18.00
N_q	=	10.00
N_γ	=	4.29
B.Capacity	=	**209.00**

ϕ		$N\gamma$
15		2.65
20		5.39

Hence, B. Capacity = 222.24

Q_{safe} = **88.894** t

Total Q_{safe} = 238.58 + 88.9
= **327.47** t

1. Density of concrete = ***2.50*** ***t/m³***
2. Salfe weight of pile = ***56.55*** ***t***
3. Net bearing capacity of pile = ***270.92*** ***t***
say ***271.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **271 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1. Pile Diameter = 1.200 m
2. Concrete design mix strength = 35 Mpa (Assume)
3. Modulus of elasticity of Concrete (E_c) = 5000 x sqrt (35)
   = 295804.0 kg / cm^2
4. Moment of Inertia (I) = $\Pi\ d^4 / 64$
   = 0.10179 m^4
   = 10178760.2 cm^4
5. Embeded Length of Pile (L_e) = 20.00 m > 4T
   14.69458314 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.45 kg/cm^3

T = 367.36 cm
= 3.674 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.674
= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 3.674
= **8.08** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{3\ E\ I}$$

Fixed Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{12\ E\ I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top;

$$Q = \frac{12\ EI\ Y}{(L_1 + L_f)^3}$$

= 34220.81 kg
= **34** t

Hence, the horizontal Load carrying capacity of the pile is taken as **34 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.

In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4) \times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 596.44 T

W_p = 33.934 T

so Q_{tu} = 431.561 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

143.85 T

SAY 144.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-06)

Dia = **1.2** **m**

Length = **23.00** **m** **From Bottom of the Pile Cap**

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

Q_u = R_u + R_f

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

R_u = $A_p N_c c_p + Ap\,(0.5\,D\gamma\,N_\gamma + P_D Nq)$

= X' + Y' where; X' = $A_p N_c c_p$ *For Cohesive Soil*

Y' = $A_p\,(0.5\,D\gamma\,N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

R_f = $\Sigma^n_{i=1}\,\alpha_i\,c_i\,A_{si} + \Sigma\,K\,P_{Di}\tan\delta_i\,A_{si}$

= X + Y where; X = $\Sigma^n_{i=1}\alpha_i\,c_i\,A_{si}$ *For Cohesive Soil*

Y = $\Sigma^n_{i=1}\,K_i\,P_{Di}\tan\delta_i\,A_{si}$ *For Granular Soil*

Where;

A_p	=	cross sectional area of pile tip, in m^2
N_c	=	bearing capacity factor, may be taken as " 9 "
c_p	=	average cohesion at pile tip, in kN/m^2
α_i	=	adhesion factor for the ith layer depending on the consistency of soil
c_i	=	average cohesion for the ith layer, in kN/m^2
A_p	=	cross sectional area of pile tip, in m^2
D	=	diameter of the pile shaft, in m
γ	=	effective unit weight of the soil at pile tip, in kN/m^2
P_D	=	effective overburden pressure at pile tip, in kN/m^2
$\Sigma^n_{i=1}$	=	summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
N_γ & N_q	=	bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
K_i	=	coefficient of Earth pressure applicable for the ith layer.
P_{Di}	=	effective overburden pressure for the " i^{th} " layer, in kN/m^2
δ	=	angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
A_{si}	=	surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -06

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
6.000		2	4.00	4.00	20	1.758	0.12	17	Y
12.000	**2.000**	3	6.00	10.00	39	1.794	0.03	26	Y
15.000		4	3.00	13.00	---	1.816	0.04	24	Y
18.000		5	3.00	16.00	47	---	0.13	18	Y
25.000		6	7.00	23.00	60	1.879	0.08	22	Y

Note*

The values of c and ϕ, strength parameters, where ever not evaluated by testing have been assumed and as available elsewhere in the literature.

The values of c and ϕ, strength parameters, where ever not evaluated by testing have been assumed and as available elsewhere in the literature.

Design Parameters

Pile Diameter = 1.200 m
K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Bulk Density γ_b	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t/m^3	t/m^2	t/m^2	t/m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
4.00		4.00	1.758	7.032	7.032	3.52
10.00		6.00	1.794	10.764	17.796	12.41
13.00		3.00	1.816	5.448	18.000	17.90
16.00		3.00	1.816	5.448	18.000	18.00
23.00		7.00	1.879	13.153	18.000	18.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Component (X or Y)	Depth (m)	A_{si} (m^2)	α	X ($\alpha C' A_s$)	Y ($K P_{Di} \tan\delta A_{si}$)	$Q_u = X + Y$ (t)	Factor of Safety	Q_{safe} (t)
Zone I	0	0.00	0.00	0.0	0.0	0.000	**752.025**	**2.500**	**300.810**
Zone II	Y	4.00	15.08	0.0	0.0	24.315			
Zone III	Y	6.00	22.62	0.0	0.0	205.432			
Zone IV	Y	3.00	11.31	0.0	0.0	135.186			
Zone V	Y	3.00	11.31	0.0	0.0	99.218			
Zone VI	Y	7.00	26.39	0.0	0.0	287.874			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$\mathbf{A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)}$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$A_p N_c C_p$		
Ap	=	1.131
Nc	=	9.000
Cp	=	0.80
B.Capacity	=	**8.14**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
$Ap (0.5D\gamma N_\gamma + P_d N_q)$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.88
ϕ	=	22.00
N_q	=	10.00
N_γ	=	7.59
B.Capacity	=	**213.25**

ϕ		Nγ
20		5.39
25		10.88

Hence, B. Capacity = 221.39

Q_{safe} = **88.556** t

Total Q_{safe} = 300.81 + 88.56
= **389.37** t

1. Density of concrete = ***2.50*** ***t/m***[3]
2. Salfe weight of pile = ***65.03 t***
3. Net bearing capacity of pile = ***324.34 t***
say ***324.00 t***

Hence, the vertical Load carrying capacity of the pile is taken as **324 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1.	Pile Diameter	=	1.200	m	
2.	Concrete design mix strength	=	35	Mpa	(Assume)
3.	Modulus of elasticity of Concrete (E_c)	=	5000 x sqrt (35)		
		=	295804.0	kg / cm^2	
4.	Moment of Inertia (I)	=	$\Pi\ d^4 / 64$		
		=	0.10179	m^4	
		=	10178760.2	cm^4	
5.	Embeded Length of Pile (L_e)	=	23.00	m	> 4T 14.69458314 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.45 kg/cm^3

T = 367.36 cm
= 3.674 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.674
= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 3.674
= **8.08** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{3\,E\,I}$$

Fixed Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{12\,E\,I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top;

$$Q = \frac{12\,EI\,Y}{(L_1 + L_f)^3}$$

= 34220.81 kg
= **34** t

Hence, the horizontal Load carrying capacity of the pile is taken as **34 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.
In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4) \times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 752.02 T

W_p = 39.024 T

so Q_{tu} = 540.373 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

180.12 T

SAY 180.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-07)

Dia = 1.2 m

Length = 20.00 m From Bottom of the Pile Cap

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$$Q_u = R_u + R_f$$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$$R_u = A_p N_c c_p + Ap\,(0.5\, D\gamma\, N_\gamma + P_D Nq)$$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p\,(0.5\, D\gamma\, N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$$R_f = \Sigma^n_{i=1}\, \alpha_i\, c_i\, A_{si} + \Sigma\, K\, P_{Di} \tan\delta_i\, A_{si}$$

$= X + Y$ where; $X = \Sigma^n_{i=1} \alpha_i\, c_i\, A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1}\, K_i\, P_{Di} \tan\delta_i\, A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -07

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t / m^3	kg / cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
9.000		2	7.00	7.00	27	1.783	0.03	25	Y
15.000	2.000	3	6.00	13.00	50	1.872	0.28	12	X
18.000		4	3.00	16.00	54	---	0.28	12	X
21.000		5	3.00	19.00	---	1.894	0.06	25	Y
22.000		6	1.00	20.00	68	1.933	0.32	10	X

Note*

The values of c and ϕ, strength parameters, where ever not evaluated by testing have been assumed and as available elsewhere in the literature.

Design Parameters

Pile Diameter = 1.200 m
K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Bulk Density γ_b	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t/m^3	t/m^2	t/m^2	t/m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
7.00		7.00	1.783	12.481	12.481	6.24
13.00		6.00	1.872	11.232	18.000	15.24
16.00		3.00	1.872	5.616	18.000	18.00
19.00		3.00	1.894	5.682	18.000	18.00
20.00		1.00	1.933	1.933	18.000	18.00

No. of Zones Considered ***5***

Q_{safe} due friction

Zone	Component (X or Y)	Depth (m)	A_{si} (m^2)	α	X ($\alpha C' A_s$)	Y ($K P_{Di} \tan\delta A_{si}$)	$Q_u = X + Y$ (t)	Factor of Safety	Q_{safe} (t)
Zone I	0	0.00	0.00	0.0	0.0	0.000	**557.410**	**2.500**	**222.964**
Zone II	Y	7.00	26.39	0.0	0.0	115.189			
Zone III	X	6.00	22.62	1.0	63.3	109.913			
Zone IV	X	3.00	11.31	1.0	31.7	64.907			
Zone V	Y	3.00	11.31	0.0	0.0	142.393			
Zone V1	X	1.00	3.77	1.0	12.1	17.948			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$\mathbf{A_p N_c C_p + A_p (0.5\, D\, \gamma\, N_\gamma + P_d N_q)}$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$\mathbf{A_p N_c C_p}$		
Ap	=	1.131
Nc	=	9.000
Cp	=	3.20
B.Capacity	=	**32.57**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
$\mathbf{Ap\,(0.5 D\gamma N_\gamma + P_d N_q)}$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.93
ϕ	=	10.00
N_q	=	10.00
N_γ	=	1.22
B.Capacity	=	**205.18**

ϕ		Nγ
10		1.22
15		2.65

Hence, B. Capacity = 237.75

Q_{safe} = **95.099** t

Total Q_{safe} = 222.97 + 95.1
= **318.06** t

1. Density of concrete = ***2.50*** ***t/m***^{3}
2. Salfe weight of pile = ***56.55*** ***t***
3. Net bearing capacity of pile = ***261.51*** ***t***
say ***262.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **262 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1. Pile Diameter = 1.200 m
2. Concrete design mix strength = 35 Mpa (Assume)
3. Modulus of elasticity of Concrete (E_c) = 5000 x sqrt (35)
   = 295804.0 kg / cm^2
4. Moment of Inertia (I) = Π d^4 / 64
   = 0.10179 m^4
   = 10178760.2 cm^4
5. Embeded Length of Pile (L_e) = 20.00 m > 4T
   14.38817702 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.50 kg/cm^3

T = 359.70 cm
= 3.597 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level
L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.598
= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;
Equivalent Cantilever Length L_f = 2.2 x 3.598
= **7.91** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{3\,E\,I}$$

Fixed Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{12\,E\,I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top;

$$Q = \frac{12\,EI\,Y}{(L_1 + L_f)^3}$$

= 36453.97 kg
= **36** t

Hence, the horizontal Load carrying capacity of the pile is taken as **36 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.

In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4) \times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 557.41 T

W_p = 33.934 T

so Q_{tu} = 405.540 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

135.18 T

SAY 135.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-07)

Dia = **1.2** **m**

Length = **23.00** **m** **From Bottom of the Pile Cap**

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$\mathbf{Q_u} = \mathbf{R_u} + \mathbf{R_f}$

Where, $\mathbf{R_u}$ = Ultimate Base Resistance

$\mathbf{R_f}$ = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$\mathbf{R_u} = \mathbf{A_p N_c c_p + Ap (0.5 D\gamma N_\gamma + P_D Nq)}$

$= \mathbf{X' + Y'}$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p (0.5 D\gamma N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$\mathbf{R_f} = \mathbf{\Sigma^n_{i=1} \alpha_i c_i A_{si} + \Sigma K P_{Di} \tan \delta_i A_{si}}$

$= \mathbf{X + Y}$ where; $X = \Sigma^n_{i=1} \alpha_i c_i A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1} K_i P_{Di} \tan \delta_i A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -07

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
9.000		2	7.00	7.00	27	1.783	0.03	25	Y
15.000	**2.000**	3	6.00	13.00	50	1.872	0.28	12	X
18.000		4	3.00	16.00	54	---	0.28	12	X
21.000		5	3.00	19.00	---	1.894	0.06	25	Y
25.000		6	4.00	23.00	68	1.933	0.32	10	X

Note*

The values of c and ϕ, strength parameters, where ever not evaluated by testing have been assumed and as available elsewhere in the literature.

Design Parameters

Pile Diameter = 1.200 m
K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Bulk Density γ_b	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t/m^3	t/m^2	t/m^2	t/m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
7.00		7.00	1.783	12.481	12.481	6.24
13.00		6.00	1.872	11.232	18.000	15.24
16.00		3.00	1.872	5.616	18.000	18.00
19.00		3.00	1.894	5.682	18.000	18.00
23.00		4.00	1.933	7.732	18.000	18.00

No. of Zones Considered *5*

Q_{safe} due friction

Zone	Component (X or Y)	Depth	A_{si}	α	X	Y	$Q_u = X + Y$	Factor of Safety	Q_{safe}
		(m)	(m^2)		$\alpha C' A_s$	$K P_{Di} \tan\delta A_{si}$	t		t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**647.443**	**2.500**	**258.977**
Zone II	Y	7.00	26.39	0.0	0.0	115.189			
Zone III	X	6.00	22.62	1.0	63.3	109.913			
Zone IV	X	3.00	11.31	1.0	31.7	64.907			
Zone V	Y	3.00	11.31	0.0	0.0	142.393			
Zone V1	X	4.00	15.08	1.0	48.3	71.792			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$\mathbf{A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)}$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$\mathbf{A_p N_c C_p}$		
Ap	=	1.131
Nc	=	9.000
Cp	=	3.20
B.Capacity	=	**32.57**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
Ap $(0.5 D\gamma N_\gamma + P_d N_q)$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.93
ϕ	=	10.00
N_q	=	10.00
N_γ	=	1.22
B.Capacity	=	**205.18**

ϕ		$N\gamma$
10		1.22
15		2.65

Hence, B. Capacity = 237.75

Q_{safe} = **95.099** t

Total Q_{safe} = 258.98 + 95.1
= **354.08** t

1. Density of concrete = ***2.50*** ***t/m*** ^{3}
2. Salfe weight of pile = ***65.03 t***
3. Net bearing capacity of pile = ***289.05 t***
say ***289.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **289 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1.	Pile Diameter	=	1.200	m	
2.	Concrete design mix strength	=	35	Mpa	(Assume)
3.	Modulus of elasticity of Concrete (E_c)	=	5000 x sqrt (35)		
		=	295804.0	kg / cm^2	
4.	Moment of Inertia (I)	=	$\Pi\ d^4 / 64$		
		=	0.10179	m^4	
		=	10178760.2	cm^4	
5.	Embeded Length of Pile (L_e)	=	23.00	m	> 4T 14.38817702 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.50 kg/cm^3

T = 359.70 cm

= 3.597 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.598

= 0.00

Therefore from the graph we read the corresponding value of " **L_f / T** ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 3.598

= **7.91** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{3\ E\ I}$$

Fixed Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{12\ E\ I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top;

$$Q = \frac{12\ EI\ Y}{(L_1 + L_f)^3}$$

= 36453.97 kg

= **36** t

Hence, the horizontal Load carrying capacity of the pile is taken as **36 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.
In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$\mathbf{Q_{tu} = (2/3)\text{ rd of frictional resistance} + W_p}$$

where W_p = Submerged weight of pile = $(3.141/4)\times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 647.44 T

W_p = 39.024 T

so Q_{tu} = 470.653 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

156.88 T

SAY 157.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-08)

Dia = 1.2 m

Length = 18.00 m From Bottom of the Pile Cap

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$Q_u = R_u + R_f$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$R_u = A_p N_c c_p + Ap (0.5 D\gamma N_\gamma + P_D Nq)$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p (0.5 D\gamma N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$R_f = \Sigma^n_{i=1} \alpha_i c_i A_{si} + \Sigma K P_{Di} \tan \delta_i A_{si}$

$= X + Y$ where; $X = \Sigma^n_{i=1} \alpha_i c_i A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1} K_i P_{Di} \tan \delta_i A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -08

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t / m^3	kg / cm^2	(degrees)	
2.000	2.000	1	0.00	0.00	---	---	0.00	0	
9.000		2	7.00	7.00	50	1.785	0.12	18	Y
15.000		3	6.00	13.00	59	1.863	0.15	17	Y
20.000		5	5.00	18.00	33	1.895	0.09	19	Y

Design Parameters

Pile Diameter = 1.200 m
K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Bulk Density γ_b	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t / m^3	t / m^2	t / m^2	t / m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
7.00		7.00	1.785	12.495	12.495	6.25
13.00		6.00	1.863	11.178	18.000	15.25
18.00		5.00	1.895	9.475	18.000	18.00

No. of Zones Considered ***4***

Q_{safe} due friction

Zone	Component (X or Y)	Depth (m)	A_{si} (m^2)	α	X α C' A_s	Y K P_{Di} tanδ A_{si}	Q_u = X + Y t	Factor of Safety	Q_{safe} t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**413.760**	**2.500**	**165.504**
Zone II	Y	7.00	26.39	0.0	0.0	80.353			
Zone III	Y	6.00	22.62	0.0	0.0	158.165			
Zone IV	Y	5.00	18.85	0.0	0.0	175.241			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$A_p N_c C_p$		
Ap	=	1.131
Nc	=	9.000
Cp	=	0.90
B.Capacity	=	**9.16**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
Ap ($0.5D\gamma N_\gamma + P_d N_q$)		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.90
ϕ	=	19.00
N_q	=	10.00
N_γ	=	4.84
B.Capacity	=	**209.80**

ϕ		$N\gamma$
15		2.65
20		5.39

Hence, B. Capacity = 218.96

Q_{safe} = **87.585** t

Total Q_{safe} = 165.51 + 87.59
= **253.09** t

1. Density of concrete = ***2.50*** ***t/m***^{3}
2. Salfe weight of pile = ***50.89 t***
3. Net bearing capacity of pile = ***202.20 t***
say ***202.00 t***

Hence, the vertical Load carrying capacity of the pile is taken as **202 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1. Pile Diameter = 1.200 m
2. Concrete design mix strength = 35 Mpa (Assume)
3. Modulus of elasticity of Concrete (E_c) = 5000 x sqrt (35)
   = 295804.0 kg / cm^2
4. Moment of Inertia (I) = $\Pi\ d^4 / 64$
   = 0.10179 m^4
   = 10178760.2 cm^4
5. Embeded Length of Pile (L_e) = 18.00 m > 4T
   14.38817702 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.50 kg/cm^3

T = 359.70 cm
= 3.597 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.598
= 0.00

Therefore from the graph we read the corresponding value of " **L_f / T** ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 3.598
= **7.91** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{3\ E\ I}$$

Fixed Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{12\ E\ I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top;

$$Q = \frac{12\ EI\ Y}{(L_1 + L_f)^3}$$

= 36453.97 kg
= **36** t

Hence, the horizontal Load carrying capacity of the pile is taken as **36 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.

In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$\mathbf{Q_{tu} = (2/3)\ rd\ of\ frictional\ resistance + W_p}$$

where W_p = Submerged weight of pile = $(3.141/4) \times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 413.76 T

W_p = 30.540 T

so Q_{tu} = 306.380 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

102.13 T

SAY 102.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-09)

Dia = 1.2 m

Length = 25.00 m From Bottom of the Pile Cap

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$Q_u = R_u + R_f$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$R_u = A_p N_c c_p + Ap\,(0.5\,D\gamma\,N_\gamma + P_D Nq)$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p\,(0.5\,D\gamma\,N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$R_f = \Sigma^n{}_{i=1}\,\alpha_i\,c_i\,A_{si} + \Sigma\,K\,P_{Di}\,\tan\delta_i\,A_{si}$

$= X + Y$ where; $X = \Sigma^n{}_{i=1}\alpha_i\,c_i\,A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n{}_{i=1}\,K_i\,P_{Di}\,\tan\delta_i\,A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n{}_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -09

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000	2.000		(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
3.000		2	1.00	1.00	---	---	0.15	18	Y
4.500		3	1.50	2.50	13	---	0.19	12	X
9.000		4	4.50	7.00	19	1.755	0.15	18	Y
15.000		5	6.00	13.00	17	1.832	0.25	12	X
21.000		6	6.00	19.00	25	1.878	0.18	14	Y
27.000		7	6.00	25.00	29	1.923	0.15	14	Y

Design Parameters

Pile Diameter = 1.200 m

K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t / m^3	t / m^2	t / m^2	t / m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
1.00		1.00	1.000	1.000	1.000	0.50
2.50		1.50	1.000	1.500	2.500	1.75
7.00		4.50	1.000	4.500	7.000	4.75
13.00		6.00	1.000	6.000	13.000	10.00
19.00		6.00	1.000	6.000	18.000	15.50
25.00		6.00	1.000	6.000	18.000	18.00

No. of Zones Considered 7

Q $_{safe}$ due friction

Zone	Component (X or	Depth	A_{si}	α	X	Y	$Q_u = X + Y$	Factor of Safety	Q_{safe}
		(m)	(m^2)		α C' A_s	K P_{Di} tanδ A_{si}	t		t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**466.150**	**2.500**	**186.460**
Zone II	Y	1.00	3.77	0.0	0.0	0.919			
Zone III	X	1.50	5.65	1.0	10.7	3.155			
Zone IV	Y	4.50	16.96	0.0	0.0	39.274			
Zone V	X	6.00	22.62	1.0	56.6	72.119			
Zone VI	Y	6.00	22.62	0.0	0.0	131.122			
Zone VII	Y	6.00	22.62	0.0	0.0	152.271			

Q $_{safe}$ due to end bearing

End Bearing Capacity of pile at founding level

For c-ϕ Soil

$\mathbf{A_p\ N_c\ C_p + A_p\ (0.5\ D\ \gamma\ N_\gamma + P_d\ N_q)}$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$\mathbf{A_p\ N_c\ C_p}$		
Ap	=	1.131
Nc	=	9.000
Cp	=	1.50
B.Capacity	=	**15.27**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
$\mathbf{Ap\ (0.5D\gamma N_\gamma + P_d N_q)}$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	14.00
N_q	=	10.00
N_γ	=	2.36
B.Capacity	=	**205.18**

ϕ		Nγ
10		1.22
15		2.65

Hence, B. Capacity = 220.45

Q_{safe} = **88.179** t

Total Q_{safe} = 186.46 + 88.18

= **274.64** t

1. Density of concrete = ***2.50*** ***t/m*** ^{3}
2. Salfe weight of pile (Buoyant) = ***42.41*** ***t***
3. Net bearing capacity of pile = ***232.23*** ***t***

say ***232.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **232 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1.	Pile Diameter	=	1.200	m	
2.	Concrete design mix strength	=	35	Mpa	(Assume)
3.	Modulus of elasticity of Concrete (E_c)	=	5000 x sqrt (35)		
		=	295804.0	kg / cm^2	
4.	Moment of Inertia (I)	=	$\Pi d^4 / 64$		
		=	0.10179	m^4	
		=	10178760.2	cm^4	
5.	Embeded Length of Pile (L_e)	=	25.00	m	> 4T
					16.8056071 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.23 kg/cm^3

T = 420.14 cm

= 4.201 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 4.202

= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 4.202

= **9.24** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q (L_1 + L_f)^3}{3 E I}$$

Fixed Head Piles

$$Y = \frac{Q (L_1 + L_f)^3}{12 E I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top;
$$Q = \frac{12 EI Y}{(L_1 + L_f)^3}$$

= 22877.02 kg

= **23** t

Hence, the horizontal Load carrying capacity of the pile is taken as **23 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.

In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4)\times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 466.15 T

W_p = 42.417 T

so Q_{tu} = 353.184 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

117.73 T

SAY 118.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-09)

Dia = 1.2 m

Length = 28.00 m **From Bottom of the Pile Cap**

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$Q_u = R_u + R_f$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$R_u = A_p N_c c_p + Ap (0.5 D\gamma N_\gamma + P_D Nq)$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p (0.5 D\gamma N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$R_f = \Sigma^n_{i=1} \alpha_i c_i A_{si} + \Sigma K P_{Di} \tan \delta_i A_{si}$

$= X + Y$ where; $X = \Sigma^n_{i=1} \alpha_i c_i A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1} K_i P_{Di} \tan \delta_i A_{si}$ *For Granular Soil*

Where;

A_p = cross sectional area of pile tip, in m^2

N_c = bearing capacity factor, may be taken as " 9 "

c_p = average cohesion at pile tip, in kN/m^2

α_i = adhesion factor for the ith layer depending on the consistency of soil

c_i = average cohesion for the ith layer, in kN/m^2

A_p = cross sectional area of pile tip, in m^2

D = diameter of the pile shaft, in m

γ = effective unit weight of the soil at pile tip, in kN/m^2

P_D = effective overburden pressure at pile tip, in kN/m^2

$\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.

N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.

K_i = coefficient of Earth pressure applicable for the ith layer.

P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2

δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).

A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -09

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t / m³	kg / cm²	(degrees)	
2.000	**2.000**	1	0.00	0.00	---	---	0.00	0	
3.000		2	1.00	1.00	---	---	0.15	18	Y
4.500		3	1.50	2.50	13	---	0.19	12	X
9.000		4	4.50	7.00	19	1.755	0.15	18	Y
15.000		5	6.00	13.00	17	1.832	0.25	12	X
21.000		6	6.00	19.00	25	1.878	0.18	14	Y
27.000		7	6.00	25.00	29	1.923	0.15	14	Y
30.000		8	3.00	28.00	---	1.929	0.03	27	Y

Design Parameters

Pile Diameter = 1.200 m
K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t / m^3	t / m^2	t / m^2	t / m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
1.00		1.00	1.000	1.000	1.000	0.50
2.50		1.50	1.000	1.500	2.500	1.75
7.00		4.50	1.000	4.500	7.000	4.75
13.00		6.00	1.000	6.000	13.000	10.00
19.00		6.00	1.000	6.000	18.000	15.50
25.00		6.00	1.000	6.000	18.000	18.00
28.00		3.00	1.000	3.000	18.000	18.00

No. of Zones Considered *8*

Q_{safe} due friction

Zone	Compo nent (X or	Depth (m)	A_{si} (m^2)	α	X $\alpha C' A_s$	Y $K P_{Di} \tan\delta A_{si}$	$Q_u = X + Y$ t	Factor of Safety	Q_{safe} t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**655.670**	**2.500**	**262.268**
Zone II	Y	1.00	3.77	0.0	0.0	0.919			
Zone III	X	1.50	5.65	1.0	10.7	3.155			
Zone IV	Y	4.50	16.96	0.0	0.0	39.274			
Zone V	X	6.00	22.62	1.0	56.6	72.119			
Zone VI	Y	6.00	22.62	0.0	0.0	131.122			
Zone VII	Y	6.00	22.62	1.0	33.9	152.271			
Zone VIII	Y	3.00	11.31	0.0	0.0	155.590			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$\mathbf{A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)}$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$\mathbf{A_p N_c C_p}$		
Ap	=	1.131
Nc	=	9.000
Cp	=	0.30
B.Capacity	=	**3.05**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
$\mathbf{Ap (0.5D\gamma N_\gamma + P_d N_q)}$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	27.00
N_q	=	10.00
N_γ	=	15.49
B.Capacity	=	**214.09**

ϕ		Nγ
25		10.88
30		22.40

Hence, B. Capacity = 217.14

Q_{safe} = **86.855** t

Total Q_{safe} = 262.27 + 86.86
= **349.12** t

1. Density of concrete = *2.50* *t/m^3*
2. Salfe weight of pile (Buoyant) = *47.50 t*
3. Net bearing capacity of pile = *301.62 t*
say *302.00 t*

Hence, the vertical Load carrying capacity of the pile is taken as **302 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1.	Pile Diameter	=	1.200	m	
2.	Concrete design mix strength	=	35	Mpa	(Assume)
3.	Modulus of elasticity of Concrete (E_c)	=	5000 x sqrt (35)		
		=	295804.0	kg / cm^2	
4.	Moment of Inertia (I)	=	$\Pi\ d^4 / 64$		
		=	0.10179	m^4	
		=	10178760.2	cm^4	
5.	Embeded Length of Pile (L_e)	=	28.00	m	> 4T 16.8056071 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.23 kg/cm^3

T = 420.14 cm
= 4.201 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 4.202
= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 4.202
= **9.24** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{3\ E\ I}$$

Fixed Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{12\ E\ I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top;

$$Q = \frac{12\ EI\ Y}{(L_1 + L_f)^3}$$

= 22877.02 kg
= **23** t

Hence, the horizontal Load carrying capacity of the pile is taken as **23 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.

In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4) \times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 655.67 T

W_p = 47.507 T

so Q_{tu} = 484.620 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

161.54 T

SAY 162.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-10)

Dia = 1.2 m

Length = 34.00 m From Bottom of the Pile Cap

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$Q_u = R_u + R_f$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$R_u = A_p N_c c_p + Ap\,(0.5\,D\gamma\,N_\gamma + P_D Nq)$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p\,(0.5\,D\gamma\,N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$R_f = \Sigma^n{}_{i=1}\,\alpha_i\,c_i\,A_{si} + \Sigma\,K\,P_{Di}\tan\delta_i\,A_{si}$

$= X + Y$ where; $X = \Sigma^n{}_{i=1}\alpha_i\,c_i\,A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n{}_{i=1}\,K_i\,P_{Di}\tan\delta_i\,A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n{}_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -10

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
12.000		2	10.00	10.00	8	1.801	0.02	25	Y
18.000	**2.000**	3	6.00	16.00	13	1.881	0.27	11	X
27.000		4	9.00	25.00	23	1.896	0.03	25	Y
33.000		5	6.00	31.00	64	1.943	0.04	24	Y
36.000		6	3.00	34.00	77	1.943	0.04	24	Y

Design Parameters

Pile Diameter = 1.200 m
K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t / m^3	t / m^2	t / m^2	t / m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
10.00		10.00	1.000	10.000	10.000	5.00
16.00		6.00	1.000	6.000	16.000	13.00
25.00		9.00	1.000	9.000	18.000	17.00
31.00		6.00	1.000	6.000	18.000	18.00
34.00		3.00	1.000	3.000	18.000	18.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Component (X or	Depth	A_{si}	α	X	Y	Q_u = X + Y	Factor of Safety	Q_{safe}
		(m)	(m^2)		α C' A_s	K P_{Di} tanδ A_{si}	t		t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**811.316**	**2.500**	**324.526**
Zone II	Y	10.00	37.70	0.0	0.0	0.000			
Zone III	X	6.00	22.62	1.0	0.0	0.000			
Zone IV	Y	9.00	33.93	0.0	0.0	403.447			
Zone V	Y	6.00	22.62	0.0	0.0	271.913			
Zone VI	Y	3.00	11.31	0.0	0.0	135.956			

Due to liquefaction upto 18.0 m, Ultimate load capacity due to friction up to a depth of 18.0 m has not been considered.

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$A_p N_c C_p + A_p$ (0.5 D γ N_γ + P_d N_q)

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$A_p N_c C_p$		
Ap	=	1.131
Nc	=	9.000
Cp	=	0.40
B.Capacity	=	**4.07**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
Ap (0.5D$\gamma$$N_\gamma$+$P_d$$N_q$)		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	24.00
N_q	=	10.00
N_γ	=	9.78
B.Capacity	=	**210.21**

ϕ		Nγ
20		5.39
25		10.88

Hence, B. Capacity = 214.28

Q_{safe} = **85.714** t

Total Q_{safe} = 324.53 + 85.72
= **410.24** t

1. Density of concrete = ***2.50*** ***t/m^3***
2. Salfe weight of pile (Buoyant) = ***57.68*** ***t***
3. Net bearing capacity of pile = ***352.56*** ***t***
say ***353.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **353 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1.	Pile Diameter	=	1.200	m	
2.	Concrete design mix strength	=	35	Mpa	(Assume)
3.	Modulus of elasticity of Concrete (E_c)	=	5000 x sqrt (35)		
		=	295804.0	kg / cm^2	
4.	Moment of Inertia (I)	=	$\Pi\ d^4 / 64$		
		=	0.10179	m^4	
		=	10178760.2	cm^4	
5.	Embeded Length of Pile (L_e)	=	34.00	m	> 4T 27.39010985 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.02 kg/cm^3

T = 684.75 cm
= 6.848 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 6.848
= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 6.848
= **15.06** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{3\ E\ I}$$

Fixed Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{12\ E\ I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top;
$$Q = \frac{12\ EI\ Y}{(L_1 + L_f)^3}$$

= 5284.22 kg
= **5** t

Hence, the horizontal Load carrying capacity of the pile is taken as **5 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.
In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4)\times D^2\times L\times(2.5-1)$ gm

Frictional resistance = 811.32 T

W_p = 57.687 T

so Q_{tu} = 598.564 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

199.52 T

SAY 200.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-10)

Dia = 1.2 m

Length = 36.00 m **From Bottom of the Pile Cap**

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$\mathbf{Q_u} = \mathbf{R_u} + \mathbf{R_f}$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$\mathbf{R_u} = \mathbf{A_p N_c c_p + Ap\,(0.5\,D\gamma N_\gamma + P_D Nq)}$

$= \mathbf{X' + Y'}$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p\,(0.5\,D\gamma N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$\mathbf{R_f} = \mathbf{\Sigma^n_{i=1}\,\alpha_i c_i A_{si} + \Sigma K P_{Di} \tan\delta_i A_{si}}$

$= \mathbf{X + Y}$ where; $X = \Sigma^n_{i=1}\alpha_i c_i A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1} K_i P_{Di} \tan\delta_i A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -10

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
12.000		2	10.00	10.00	8	1.801	0.02	25	Y
18.000	**2.000**	3	6.00	16.00	13	1.881	0.27	11	X
27.000		4	9.00	25.00	23	1.896	0.03	25	Y
33.000		5	6.00	31.00	64	1.943	0.04	24	Y
38.000		6	5.00	36.00	77	1.943	0.04	24	Y

Design Parameters

Pile Diameter	=	1.200	m
K	=	1.50	

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t / m^3	t / m^2	t / m^2	t / m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
10.00		10.00	1.000	10.000	10.000	5.00
16.00		6.00	1.000	6.000	16.000	13.00
25.00		9.00	1.000	9.000	18.000	17.00
31.00		6.00	1.000	6.000	18.000	18.00
36.00		5.00	1.000	5.000	18.000	18.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Component (X or	Depth (m)	A_{si} (m^2)	α	X α C' A_s	Y K P_{Di} tanδ A_{si}	Q_u = X + Y t	Factor of Safety	Q_{safe} t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**901.953**	**2.500**	**360.781**
Zone II	Y	10.00	37.70	0.0	0.0	0.000			
Zone III	X	6.00	22.62	1.0	0.0	0.000			
Zone IV	Y	9.00	33.93	0.0	0.0	403.447			
Zone V	Y	6.00	22.62	0.0	0.0	271.913			
Zone VI	Y	5.00	18.85	0.0	0.0	226.594			

Due to liquefaction upto 18.0 m, Ultimate load capacity due to friction up to a depth of 18.0 m has not been considered.

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$A_p N_c C_p$		
Ap	=	1.131
Nc	=	9.000
Cp	=	0.40
B.Capacity	=	**4.07**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
Ap (0.5DγN_γ+$P_d N_q$)		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	24.00
N_q	=	10.00
N_γ	=	9.78
B.Capacity	=	**210.21**

ϕ		$N\gamma$
20		5.39
25		10.88

Hence, B. Capacity = 214.28

Q_{safe} = **85.714** t

Total Q_{safe} = 360.79 + 85.72
= **446.50** t

1. Density of concrete = ***2.50*** ***t/m³***
2. Salfe weight of pile (Buoyant) = ***61.07*** ***t***
3. Net bearing capacity of pile = ***385.42*** ***t***
say ***385.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **385 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1. Pile Diameter = 1.200 m
2. Concrete design mix strength = 35 Mpa (Assume)
3. Modulus of elasticity of Concrete (E_c) = 5000 x sqrt (35)
   = 295804.0 kg / cm^2
4. Moment of Inertia (I) = $\Pi\ d^4 / 64$
   = 0.10179 m^4
   = 10178760.2 cm^4
5. Embeded Length of Pile (L_e) = 36.00 m > 4T
   27.39010985 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.02 kg/cm^3

T = 684.75 cm
= 6.848 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 6.848
= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 6.848
= **15.06** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{3\,E\,I}$$

Fixed Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{12\,E\,I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top;

$$Q = \frac{12\,EI\,Y}{(L_1 + L_f)^3}$$

= 5284.22 kg
= **5** t

Hence, the horizontal Load carrying capacity of the pile is taken as **5 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.

In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4) \times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 901.95 T

W_p = 61.080 T

so Q_{tu} = 662.383 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

220.79 T

SAY 221.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-10)

Dia = 1.2 m

Length = 38.00 m **From Bottom of the Pile Cap**

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$Q_u = R_u + R_f$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$R_u = A_p N_c c_p + Ap\ (0.5\ D\gamma\ N_\gamma + P_D Nq)$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p\ (0.5\ D\gamma\ N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$R_f = \Sigma^n_{i=1}\ \alpha_i\ c_i\ A_{si} + \Sigma\ K\ P_{Di}\ \tan\delta_i\ A_{si}$

$= X + Y$ where; $X = \Sigma^n_{i=1} \alpha_i\ c_i\ A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1}\ K_i\ P_{Di}\ \tan\delta_i\ A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -10

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
12.000		2	10.00	10.00	8	1.801	0.02	25	Y
18.000	2.000	3	6.00	16.00	13	1.881	0.27	11	X
27.000		4	9.00	25.00	23	1.896	0.03	25	Y
33.000		5	6.00	31.00	64	1.943	0.04	24	Y
40.000		6	7.00	38.00	77	1.943	0.04	24	Y

Design Parameters

Pile Diameter = 1.200 m

K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t / m^3	t / m^2	t / m^2	t / m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
10.00		10.00	1.000	10.000	10.000	5.00
16.00		6.00	1.000	6.000	16.000	13.00
25.00		9.00	1.000	9.000	18.000	17.00
31.00		6.00	1.000	6.000	18.000	18.00
38.00		7.00	1.000	7.000	18.000	18.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Component (X or	Depth	A_{si}	α	X	Y	$Q_u = X + Y$	Factor of Safety	Q_{safe}
		(m)	(m^2)		α C' A_s	K P_{Di} tanδ A_{si}	t		t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**992.591**	**2.500**	**397.036**
Zone II	Y	10.00	37.70	0.0	0.0	0.000			
Zone III	X	6.00	22.62	1.0	0.0	0.000			
Zone IV	Y	9.00	33.93	0.0	0.0	403.447			
Zone V	Y	6.00	22.62	0.0	0.0	271.913			
Zone VI	Y	7.00	26.39	0.0	0.0	317.231			

Due to liquefaction upto 18.0 m, Ultimate load capacity due to friction up to a depth of 18.0 m has not been considered.

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level

For c-ϕ Soil

$\mathbf{A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)}$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$\mathbf{A_p N_c C_p}$		
Ap	=	1.131
Nc	=	9.000
Cp	=	0.40
B.Capacity	=	**4.07**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
Ap (0.5DγN$_\gamma$+P$_d$N$_q$)		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	24.00
N_q	=	10.00
N_γ	=	9.78
B.Capacity	=	**210.21**

ϕ		Nγ
20		5.39
25		10.88

Hence, B. Capacity = 214.28

Q_{safe} = **85.714** t

Total Q_{safe} = 397.04 + 85.72

= **482.75** t

1. Density of concrete = ***2.50*** ***t/m^3***
2. Salfe weight of pile (Buoyant) = ***64.47*** ***t***
3. Net bearing capacity of pile = ***418.28*** ***t***

say ***418.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **418 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1. Pile Diameter = 1.200 m
2. Concrete design mix strength = 35 Mpa (Assume)
3. Modulus of elasticity of Concrete (E_c) = 5000 x sqrt (35)
   = 295804.0 kg / cm^2
4. Moment of Inertia (I) = $\Pi d^4 / 64$
   = 0.10179 m^4
   = 10178760.2 cm^4
5. Embeded Length of Pile (L_e) = 38.00 m > 4T
   27.39010985 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.02 kg/cm^3

T = 684.75 cm
= 6.848 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level
L_1 = **0.000** m

Hence; L_1 / T = 0 / 6.848
= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;
Equivalent Cantilever Length L_f = 2.2 x 6.848
= **15.06** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q (L_1 + L_f)^3}{3 E I}$$

Fixed Head Piles

$$Y = \frac{Q (L_1 + L_f)^3}{12 E I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top; $$Q = \frac{12 EI Y}{(L_1 + L_f)^3}$$

= 5284.22 kg
= **5** t

Hence, the horizontal Load carrying capacity of the pile is taken as **5 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.

In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4) \times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 992.59 T

W_p = 64.474 T

so Q_{tu} = 726.201 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

242.07 T

SAY 242.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-11)

Dia = 1.2 m

Length = 23.00 m **From Bottom of the Pile Cap**

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$Q_u = R_u + R_f$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$R_u = A_p N_c c_p + Ap (0.5 D\gamma N_\gamma + P_D Nq)$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p (0.5 D\gamma N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$R_f = \Sigma^n{}_{i=1} \alpha_i c_i A_{si} + \Sigma K P_{Di} \tan \delta_i A_{si}$

$= X + Y$ where; $X = \Sigma^n{}_{i=1} \alpha_i c_i A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n{}_{i=1} K_i P_{Di} \tan \delta_i A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n{}_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -11

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
3.000		2	1.00	1.00	---	1.754	0.04	23	Y
9.000	**2.000**	3	6.00	7.00	14	1.796	0.04	25	Y
15.000		4	6.00	13.00	26	1.863	0.26	13	X
20.000		5	5.00	18.00	32	1.886	0.02	27	Y
25.000		6	5.00	23.00	37	1.918	0.02	26	Y

Design Parameters

Pile Diameter = 1.200 m

K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t / m^3	t / m^2	t / m^2	t / m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
1.00		1.00	1.000	1.000	1.000	0.50
7.00		6.00	1.000	6.000	7.000	4.00
13.00		6.00	1.000	6.000	13.000	10.00
18.00		5.00	1.000	5.000	18.000	15.50
23.00		5.00	1.000	5.000	18.000	18.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Component (X or	Depth (m)	A_{si} (m^2)	α	X α C' A_s	Y K P_{Di} tanδ A_{si}	$Q_u = X + Y$ t	Factor of Safety	Q_{safe} t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**671.954**	**2.500**	**268.782**
Zone II	Y	1.00	3.77	0.0	0.0	0.000			
Zone III	Y	6.00	22.62	0.0	0.0	63.286			
Zone IV	X	6.00	22.62	1.0	58.8	78.332			
Zone V	Y	5.00	18.85	0.0	0.0	223.301			
Zone VI	Y	5.00	18.85	0.0	0.0	248.226			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level

For c-ϕ Soil

$\mathbf{A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)}$

Where

End Bearing Capacity of pile at founding level For Cohesive Soil		
$A_p N_c C_p$		
Ap	=	1.131
Nc	=	9.000
Cp	=	0.20
B.Capacity	=	**2.04**

and

End Bearing Capacity of pile at founding level For Granular Soil		
Ap ($0.5D\gamma N_\gamma + P_d N_q$)		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	26.00
N_q	=	13.00
N_γ	=	13.18
B.Capacity	=	**273.59**

ϕ		$N\gamma$
25		10.88
30		22.40

Hence, B. Capacity = 275.63

Q_{safe} = **110.252** t

Total Q_{safe} = 268.79 + 110.26

= **379.03** t

1. Density of concrete = ***2.50*** ***t/m*** ***3***
2. Salfe weight of pile (Buoyant) = ***39.02*** ***t***
3. Net bearing capacity of pile = ***340.01*** ***t***

say ***340.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **340 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1. Pile Diameter = 1.200 m
2. Concrete design mix strength = 35 Mpa (Assume)
3. Modulus of elasticity of Concrete (E_c) = 5000 x sqrt (35)
   = 295804.0 kg / cm^2
4. Moment of Inertia (I) = $\Pi\ d^4 / 64$
   = 0.10179 m^4
   = 10178760.2 cm^4
5. Embeded Length of Pile (L_e) = 23.00 m > 4T
   16.52767527 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.25 kg/cm^3

T = 413.19 cm
= 4.132 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 4.132
= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 4.132
= **9.09** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{3\ E\ I}$$

Fixed Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{12\ E\ I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top; $$Q = \frac{12\ EI\ Y}{(L_1 + L_f)^3}$$

= 24050.65 kg
= **24** t

Hence, the horizontal Load carrying capacity of the pile is taken as **24 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.

In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4)\times D^2\times L\times(2.5-1)$ gm

Frictional resistance = 671.95 T

W_p = 39.024 T

so Q_{tu} = 486.993 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

162.33 T

SAY 162.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-11)

Dia = 1.2 m

Length = 25.00 m From Bottom of the Pile Cap

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$\mathbf{Q_u} = \mathbf{R_u} + \mathbf{R_f}$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$\mathbf{R_u} = \mathbf{A_p N_c c_p + Ap (0.5 D\gamma N_\gamma + P_D Nq)}$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p (0.5 D\gamma N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$\mathbf{R_f} = \mathbf{\Sigma^n_{i=1} \alpha_i c_i A_{si} + \Sigma K P_{Di} \tan \delta_i A_{si}}$

$= X + Y$ where; $X = \Sigma^n_{i=1} \alpha_i c_i A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1} K_i P_{Di} \tan \delta_i A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -11

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
3.000		2	1.00	1.00	---	1.754	0.04	23	Y
9.000	2.000	3	6.00	7.00	14	1.796	0.04	25	Y
15.000		4	6.00	13.00	26	1.863	0.26	13	X
20.000		5	5.00	18.00	32	1.886	0.02	27	Y
27.000		6	7.00	25.00	37	1.918	0.02	26	Y

Design Parameters

Pile Diameter	=	1.200	m
K	=	1.50	

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t / m^3	t / m^2	t / m^2	t / m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
1.00		1.00	1.000	1.000	1.000	0.50
7.00		6.00	1.000	6.000	7.000	4.00
13.00		6.00	1.000	6.000	13.000	10.00
18.00		5.00	1.000	5.000	18.000	15.50
25.00		7.00	1.000	7.000	18.000	18.00

No. of Zones Considered 6

Q_{safe} due friction

Zone	Component (X or	Depth	A_{si}	α	X	Y	$Q_u = X + Y$	Factor of Safety	Q_{safe}
		(m)	(m^2)		α C' A_s	K P_{Di} tanδ A_{si}	t		t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**771.244**	**2.500**	**308.498**
Zone II	Y	1.00	3.77	0.0	0.0	0.000			
Zone III	Y	6.00	22.62	0.0	0.0	63.286			
Zone IV	X	6.00	22.62	1.0	58.8	78.332			
Zone V	Y	5.00	18.85	0.0	0.0	223.301			
Zone VI	Y	7.00	26.39	0.0	0.0	347.516			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$\mathbf{A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)}$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$A_p N_c C_p$		
Ap	=	1.131
Nc	=	9.000
Cp	=	0.20
B.Capacity	=	**2.04**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
Ap $(0.5D\gamma N_\gamma + P_d N_q)$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	26.00
N_q	=	13.00
N_γ	=	13.18
B.Capacity	=	**273.59**

ϕ		Nγ
25		10.88
30		22.40

Hence, B. Capacity = 275.63

Q_{safe} = **110.252** t

Total Q_{safe} = 308.5 + 110.26
= **418.75** t

1. Density of concrete = ***2.50*** ***t/m*** ^{3}
2. Salfe weight of pile (Buoyant) = ***42.41 t***
3. Net bearing capacity of pile = ***376.34 t***
   say ***376.00 t***

Hence, the vertical Load carrying capacity of the pile is taken as **376 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1.	Pile Diameter	=	1.200	m	
2.	Concrete design mix strength	=	35	Mpa	(Assume)
3.	Modulus of elasticity of Concrete (E_c)	=	5000 x sqrt (35)		
		=	295804.0	kg / cm^2	
4.	Moment of Inertia (I)	=	$\Pi\ d^4 / 64$		
		=	0.10179	m^4	
		=	10178760.2	cm^4	
5.	Embeded Length of Pile (L_e)	=	25.00	m	> 4T
					16.52767527 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.25 kg/cm^3

T = 413.19 cm
= 4.132 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level
L_1 = **0.000** m

Hence; L_1 / T = 0 / 4.132
= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;
Equivalent Cantilever Length L_f = 2.2 x 4.132
= **9.09** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{3\ E\ I}$$

Fixed Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{12\ E\ I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top;

$$Q = \frac{12\ EI\ Y}{(L_1 + L_f)^3}$$

= 24050.65 kg
= **24** t

Hence, the horizontal Load carrying capacity of the pile is taken as **24 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.
In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4) \times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 771.24 T

W_p = 42.417 T

so Q_{tu} = 556.580 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

185.53 T

SAY 186.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-11)

Dia = 1.2 m

Length = 27.00 m From Bottom of the Pile Cap

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$\mathbf{Q_u} = \mathbf{R_u} + \mathbf{R_f}$

Where, $\mathbf{R_u}$ = Ultimate Base Resistance

$\mathbf{R_f}$ = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$\mathbf{R_u} = A_p N_c c_p + Ap\,(0.5\,D\gamma\,N_\gamma + P_D Nq)$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p\,(0.5\,D\gamma\,N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$\mathbf{R_f} = \Sigma^n_{i=1}\,\alpha_i\,c_i\,A_{si} + \Sigma\,K\,P_{Di}\tan\delta_i\,A_{si}$

$= X + Y$ where; $X = \Sigma^n_{i=1}\alpha_i\,c_i\,A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1}\,K_i\,P_{Di}\tan\delta_i\,A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -11

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
3.000		2	1.00	1.00	---	1.754	0.04	23	Y
9.000	2.000	3	6.00	7.00	14	1.796	0.04	25	Y
15.000		4	6.00	13.00	26	1.863	0.26	13	X
21.000		5	6.00	19.00	32	1.886	0.02	27	Y
29.000		6	8.00	27.00	37	1.937	0.03	27	Y

Design Parameters

Pile Diameter = 1.200 m

K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t/m^3	t/m^2	t/m^2	t/m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
1.00		1.00	1.000	1.000	1.000	0.50
7.00		6.00	1.000	6.000	7.000	4.00
13.00		6.00	1.000	6.000	13.000	10.00
19.00		6.00	1.000	6.000	18.000	15.50
27.00		8.00	1.000	8.000	18.000	18.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Component (X or	Depth	A_{si}	α	X	Y	$Q_u = X + Y$	Factor of Safety	Q_{safe}
		(m)	(m^2)		$\alpha C' A_s$	$K P_{Di} \tan\delta A_{si}$	t		t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**883.295**	**2.500**	**353.318**
Zone II	Y	1.00	3.77	0.0	0.0	0.000			
Zone III	Y	6.00	22.62	0.0	0.0	63.286			
Zone IV	X	6.00	22.62	1.0	58.8	78.332			
Zone V	Y	6.00	22.62	0.0	0.0	267.961			
Zone VI	Y	8.00	30.16	0.0	0.0	414.907			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level

For c-ϕ Soil

$\mathbf{A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)}$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$\mathbf{A_p N_c C_p}$		
Ap	=	1.131
Nc	=	9.000
Cp	=	0.30
B.Capacity	=	**3.05**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
Ap $(0.5D\gamma N_\gamma + P_d N_q)$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	27.00
N_q	=	14.00
N_γ	=	15.49
B.Capacity	=	**295.52**

ϕ		N_γ
25		10.88
30		22.40

Hence, B. Capacity = 298.57

Q_{safe} = **119.428** t

Total Q_{safe} = 353.32 + 119.43

= **472.75** t

1. Density of concrete = ***2.50*** ***t/m*** [3]
2. Salfe weight of pile (Buoyant) = ***45.80*** ***t***
3. Net bearing capacity of pile = ***426.94*** ***t***

say ***427.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **427 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1.	Pile Diameter	=	1.200	m	
2.	Concrete design mix strength	=	35	Mpa	(Assume)
3.	Modulus of elasticity of Concrete (E_c)	=	5000 x sqrt (35)		
		=	295804.0	kg / cm^2	
4.	Moment of Inertia (I)	=	$\Pi d^4 / 64$		
		=	0.10179	m^4	
		=	10178760.2	cm^4	
5.	Embeded Length of Pile (L_e)	=	27.00	m	> 4T 16.52767527 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.25 kg/cm^3

T = 413.19 cm
= 4.132 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level
L_1 = **0.000** m

Hence; L_1 / T = 0 / 4.132
= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;
Equivalent Cantilever Length L_f = 2.2 x 4.132
= **9.09** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q (L_1 + L_f)^3}{3 E I}$$

Fixed Head Piles

$$Y = \frac{Q (L_1 + L_f)^3}{12 E I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top; $$Q = \frac{12 EI Y}{(L_1 + L_f)^3}$$

= 24050.65 kg
= **24** t

Hence, the horizontal Load carrying capacity of the pile is taken as **24 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.

In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4) \times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 883.30 T

W_p = 45.810 T

so Q_{tu} = 634.674 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

211.56 T

SAY 212.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-11A)

Dia = 1.2 m

Length = 23.00 m From Bottom of the Pile Cap

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$\mathbf{Q_u} = \mathbf{R_u} + \mathbf{R_f}$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$\mathbf{R_u} = \mathbf{A_p N_c c_p + Ap (0.5 D\gamma N_\gamma + P_D Nq)}$

$= \mathbf{X' + Y'}$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p (0.5 D\gamma N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$\mathbf{R_f} = \mathbf{\Sigma^n_{i=1} \alpha_i c_i A_{si} + \Sigma K P_{Di} \tan \delta_i A_{si}}$

$= \mathbf{X + Y}$ where; $X = \Sigma^n_{i=1} \alpha_i c_i A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n_{i=1} K_i P_{Di} \tan \delta_i A_{si}$ *For Granular Soil*

Where;

A_p	=	cross sectional area of pile tip, in m^2
N_c	=	bearing capacity factor, may be taken as " 9 "
c_p	=	average cohesion at pile tip, in kN/m^2
α_i	=	adhesion factor for the ith layer depending on the consistency of soil
c_i	=	average cohesion for the ith layer, in kN/m^2
A_p	=	cross sectional area of pile tip, in m^2
D	=	diameter of the pile shaft, in m
γ	=	effective unit weight of the soil at pile tip, in kN/m^2
P_D	=	effective overburden pressure at pile tip, in kN/m^2
$\Sigma^n_{i=1}$	=	summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
N_γ & N_q	=	bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
K_i	=	coefficient of Earth pressure applicable for the ith layer.
P_{Di}	=	effective overburden pressure for the " i^{th} " layer, in kN/m^2
δ	=	angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
A_{si}	=	surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -11A

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
3.000		2	1.00	1.00	---	1.776	0.04	25	Y
6.000	**2.000**	3	3.00	4.00	5	1.802	0.02	26	Y
15.000		4	9.00	13.00	11	1.876	0.25	14	X
18.000		5	3.00	16.00	56	1.903	0.16	19	Y
25.000		6	7.00	23.00	66	---	0.02	25	Y

The values of c and ϕ, strength parameters, where ever not evaluated by testing have been assumed based on our experience and as available elsewhere in the literature.

Design Parameters

Pile Diameter = 1.200 m
K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t / m^3	t / m^2	t / m^2	t / m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
1.00		1.00	1.000	1.000	1.000	0.50
4.00		3.00	1.000	3.000	4.000	2.50
13.00		9.00	1.000	9.000	13.000	8.50
16.00		3.00	1.000	3.000	16.000	14.50
23.00		7.00	1.000	7.000	18.000	17.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Component (X or	Depth	A_{si}	α	X	Y	$Q_u = X + Y$	Factor of Safety	Q_{safe}
		(m)	(m^2)		α C' A_s	K P_{Di} tanδ A_{si}	t		t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**611.856**	**2.500**	**244.742**
Zone II	Y	1.00	3.77	0.0	0.0	0.000			
Zone III	Y	3.00	11.31	0.0	0.0	20.685			
Zone IV	X	9.00	33.93	1.0	84.8	107.859			
Zone V	Y	3.00	11.31	0.0	0.0	84.700			
Zone VI	Y	7.00	26.39	0.0	0.0	313.792			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$A_p N_c C_p$		
Ap	=	1.131
Nc	=	9.000
Cp	=	0.20
B.Capacity	=	**2.04**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
Ap $(0.5D\gamma N_{\gamma+} P_d N_q)$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	25.00
N_q	=	10.00
N_γ	=	10.88
B.Capacity	=	**210.96**

ϕ		Nγ
25		10.88
30		22.40

Hence, B. Capacity = 212.99

Q_{safe} = **85.198** t

Total Q_{safe} = 244.75 + 85.2
= **329.94** t

1. Density of concrete = ***2.50*** ***t/m^3***
2. Salfe weight of pile (Buoyant) = ***39.02*** ***t***
3. Net bearing capacity of pile = ***290.92*** ***t***

say ***291.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **291 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1.	Pile Diameter	=	1.200	m	
2.	Concrete design mix strength	=	35	Mpa	(Assume)
3.	Modulus of elasticity of Concrete (E_c)	=	5000 x sqrt (35)		
		=	295804.0	kg / cm^2	
4.	Moment of Inertia (I)	=	$\Pi d^4 / 64$		
		=	0.10179	m^4	
		=	10178760.2	cm^4	
5.	Embeded Length of Pile (L_e)	=	23.00	m	> 4T
					12.79237763 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.90 kg/cm^3

T = 319.81 cm
= 3.198 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level
L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.199
= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;
Equivalent Cantilever Length L_f = 2.2 x 3.199
= **7.04** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q (L_1 + L_f)^3}{3 E I}$$

Fixed Head Piles

$$Y = \frac{Q (L_1 + L_f)^3}{12 E I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top; $$Q = \frac{12 EI Y}{(L_1 + L_f)^3}$$

= 51869.05 kg
= **52** t

Hence, the horizontal Load carrying capacity of the pile is taken as **52 ton for the design**

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.
In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4)\times D^2\times L\times(2.5-1)$ gm

Frictional resistance = 611.86 T

W_p = 39.024 T

so Q_{tu} = 446.928 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

148.98 T

SAY 149.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-11A)

Dia = 1.2 m

Length = 25.00 m From Bottom of the Pile Cap

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

Q_u = R_u + R_f

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

R_u = $A_p N_c c_p + Ap\,(0.5\,D\gamma\,N_\gamma + P_D Nq)$

= X' + Y' where; X' = $A_p N_c c_p$ *For Cohesive Soil*

Y' = $A_p\,(0.5\,D\gamma\,N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

R_f = $\Sigma^n_{i=1}\,\alpha_i\,c_i\,A_{si} + \Sigma\,K\,P_{Di}\,\tan\delta_i\,A_{si}$

= X + Y where; X = $\Sigma^n_{i=1}\alpha_i\,c_i\,A_{si}$ *For Cohesive Soil*

Y = $\Sigma^n_{i=1}\,K_i\,P_{Di}\,\tan\delta_i\,A_{si}$ *For Granular Soil*

Where; A_p = cross sectional area of pile tip, in m^2

N_c = bearing capacity factor, may be taken as " 9 "

c_p = average cohesion at pile tip, in kN/m^2

α_i = adhesion factor for the ith layer depending on the consistency of soil

c_i = average cohesion for the ith layer, in kN/m^2

A_p = cross sectional area of pile tip, in m^2

D = diameter of the pile shaft, in m

γ = effective unit weight of the soil at pile tip, in kN/m^2

P_D = effective overburden pressure at pile tip, in kN/m^2

$\Sigma^n_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.

N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.

K_i = coefficient of Earth pressure applicable for the ith layer.

P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2

δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).

A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -11A

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t/m^3	kg/cm^2	(degrees)	
2.000		1	0.00	0.00	---	---	0.00	0	
3.000		2	1.00	1.00	---	1.776	0.04	25	Y
6.000	**2.000**	3	3.00	4.00	5	1.802	0.02	26	Y
15.000		4	9.00	13.00	11	1.876	0.25	14	X
18.000		5	3.00	16.00	56	1.903	0.16	19	Y
27.000		6	9.00	25.00	66	---	0.02	25	Y

The values of c and ϕ, strength parameters, where ever not evaluated by testing have been assumed based on our experience and as available elsewhere in the literature.

Design Parameters

Pile Diameter = 1.200 m
K = 1.50

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t/m^3	t/m^2	t/m^2	t/m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
1.00		1.00	1.000	1.000	1.000	0.50
4.00		3.00	1.000	3.000	4.000	2.50
13.00		9.00	1.000	9.000	13.000	8.50
16.00		3.00	1.000	3.000	16.000	14.50
25.00		9.00	1.000	9.000	18.000	17.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Component (X or	Depth (m)	A_{si} (m^2)	α	X $\alpha C' A_s$	Y $K P_{Di} \tan\delta A_{si}$	$Q_u = X + Y$ t	Factor of Safety	Q_{safe} t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**701.511**	**2.500**	**280.604**
Zone II	Y	1.00	3.77	0.0	0.0	0.000			
Zone III	Y	3.00	11.31	0.0	0.0	20.685			
Zone IV	X	9.00	33.93	1.0	84.8	107.859			
Zone V	Y	3.00	11.31	0.0	0.0	84.700			
Zone VI	Y	9.00	33.93	0.0	0.0	403.447			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$A_p N_c C_p + A_p (0.5 D \gamma N_\gamma + P_d N_q)$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$A_p N_c C_p$		
Ap	=	1.131
Nc	=	9.000
Cp	=	0.20
B.Capacity	=	**2.04**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
$Ap\ (0.5 D\gamma N_\gamma + P_d N_q)$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	25.00
N_q	=	10.00
N_γ	=	10.88
B.Capacity	=	**210.96**

ϕ		$N\gamma$
25		10.88
30		22.40

Hence, B. Capacity = 212.99

Q_{safe} = **85.198** t

Total Q_{safe} = 280.61 + 85.2
= **365.80** t

1. Density of concrete = ***2.50*** ***t/m^3***
2. Salfe weight of pile (Buoyant) = ***42.41*** ***t***
3. Net bearing capacity of pile = ***323.39*** ***t***
say ***323.00*** ***t***

Hence, the vertical Load carrying capacity of the pile is taken as **323 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1. Pile Diameter = 1.200 m
2. Concrete design mix strength = 35 Mpa (Assume)
3. Modulus of elasticity of Concrete (E_c) = 5000 x sqrt (35)
   = 295804.0 kg / cm^2
4. Moment of Inertia (I) = $\Pi\ d^4 / 64$
   = 0.10179 m^4
   = 10178760.2 cm^4
5. Embeded Length of Pile (L_e) = 25.00 m > 4T
   12.79237763 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.90 kg/cm^3

T = 319.81 cm
= 3.198 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.199
= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 3.199
= **7.04** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{3\ E\ I}$$

Fixed Head Piles

$$Y = \frac{Q\ (L_1 + L_f)^3}{12\ E\ I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top; $$Q = \frac{12\ EI\ Y}{(L_1 + L_f)^3}$$

= 51869.05 kg
= **52** t

Hence, the horizontal Load carrying capacity of the pile is taken as **52 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.

In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4)\times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 701.51 T

W_p = 42.417 T

so Q_{tu} = 510.091 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

170.03 T

SAY 170.00 T

CALCULATION OF LOAD CARRYING CAPACITY OF PILE

Calculation of load carrying capacity of bored cast in-situ pile considering

Pier (BH NO-11A)

Dia = 1.2 m

Length = 27.00 m From Bottom of the Pile Cap

Vertical Load Carrying Capacity

As per IRC:78-2014 (Appendix-5) & IS : 2911 Part I / Sec 2 - 2010 (Appendix B)

Axial Capacity of Piles in Soil - Static Formula

Ultimate Load Carrying Capacity (Qu) of a Pile is given by :

$Q_u = R_u + R_f$

Where, R_u = Ultimate Base Resistance

R_f = Ultimate Shaft Resistance

The Ultimate Base Resistance of Pile is as follows:

$R_u = A_p N_c c_p + Ap\,(0.5\,D\gamma\,N_\gamma + P_D Nq)$

$= X' + Y'$ where; $X' = A_p N_c c_p$ *For Cohesive Soil*

$Y' = A_p\,(0.5\,D\gamma\,N_\gamma + P_D N_q)$ *For Granular Soil*

The Ultimate Side Resistance of Pile due to friction is as follows:

$R_f = \Sigma^n{}_{i=1}\,\alpha_i\,c_i\,A_{si} + \Sigma\,K\,P_{Di}\tan\delta_i\,A_{si}$

$= X + Y$ where; $X = \Sigma^n{}_{i=1}\alpha_i\,c_i\,A_{si}$ *For Cohesive Soil*

$Y = \Sigma^n{}_{i=1}\,K_i\,P_{Di}\tan\delta_i\,A_{si}$ *For Granular Soil*

Where;
- A_p = cross sectional area of pile tip, in m^2
- N_c = bearing capacity factor, may be taken as " 9 "
- c_p = average cohesion at pile tip, in kN/m^2
- α_i = adhesion factor for the ith layer depending on the consistency of soil
- c_i = average cohesion for the ith layer, in kN/m^2
- A_p = cross sectional area of pile tip, in m^2
- D = diameter of the pile shaft, in m
- γ = effective unit weight of the soil at pile tip, in kN/m^2
- P_D = effective overburden pressure at pile tip, in kN/m^2
- $\Sigma^n{}_{i=1}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction.
- N_γ & N_q = bearing capacity factors depending upon the angle of internal friction "ϕ" at pile tip.
- K_i = coefficient of Earth pressure applicable for the ith layer.
- P_{Di} = effective overburden pressure for the " i^{th} " layer, in kN/m^2
- δ = angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ).
- A_{si} = surface area of pile shaft in the ith layer, in m^2

Presented below is in tabular form the various soil parameters as encountered through the Bore hole

Bore hole Location -11A

Levels		Layer	Thickness of the strata	Depth from Bed	Average SPT N value	Bulk Density γ_b	c	ϕ	Compnent (X or Y)
0.000			(m)	(m)		t / m³	kg / cm²	(degrees)	
2.000	2.000	1	0.00	0.00	---	---	0.00	0	
3.000		2	1.00	1.00	---	1.776	0.04	25	Y
6.000		3	3.00	4.00	5	1.802	0.02	26	Y
15.000		4	9.00	13.00	11	1.876	0.25	14	X
18.000		5	3.00	16.00	56	1.903	0.16	19	Y
29.000		6	11.00	27.00	---	---	0.02	25	Y

The values of c and ϕ, strength parameters, where ever not evaluated by testing have been assumed based on our experience and as available elsewhere in the literature.

Design Parameters

Pile Diameter	=	1.200	m
K	=	1.50	

Calculated below is the Avg. Overburden pressure at different layers.

Depth from Bed	Scour Level from Bed	Depth of Strata	Submerged Density γ_{sub}	Overburden Pressure of thickness of the strata	Cumulative Overburden Pressure	Avg. Overburden Pressure of ith layer (thickness of the strata)
(m)	(m)	(m)	t/m^3	t/m^2	t/m^2	t/m^2
0.00	2.000	0.00	0.000	0.000	0.000	0.00
1.00		1.00	1.000	1.000	1.000	0.50
4.00		3.00	1.000	3.000	4.000	2.50
13.00		9.00	1.000	9.000	13.000	8.50
16.00		3.00	1.000	3.000	16.000	14.50
27.00		11.00	1.000	11.000	18.000	17.00

No. of Zones Considered ***6***

Q_{safe} due friction

Zone	Component (X or	Depth	A_{si}	α	X	Y	$Q_u = X + Y$	Factor of Safety	Q_{safe}
		(m)	(m^2)		$\alpha\, C'\, A_s$	$K\, P_{Di}\, \tan\delta\, A_{si}$	t		t
Zone I	0	0.00	0.00	0.0	0.0	0.000	**791.166**	**2.500**	**316.466**
Zone II	Y	1.00	3.77	0.0	0.0	0.000			
Zone III	Y	3.00	11.31	0.0	0.0	20.685			
Zone IV	X	9.00	33.93	1.0	84.8	107.859			
Zone V	Y	3.00	11.31	0.0	0.0	84.700			
Zone VI	Y	11.00	41.47	0.0	0.0	493.102			

Q_{safe} due to end bearing

End Bearing Capacity of pile at founding level
For c-ϕ Soil
$A_p\, N_c\, C_p + A_p\, (\,0.5\, D\, \gamma\, N_\gamma + P_d\, N_q\,)$

Where

End Bearing Capacity of pile at founding level		
For Cohesive Soil		
$A_p\, N_c\, C_p$		
Ap	=	1.131
Nc	=	9.000
Cp	=	0.20
B.Capacity	=	**2.04**

and

End Bearing Capacity of pile at founding level		
For Granular Soil		
Ap $(0.5D\gamma N_\gamma + P_d N_q)$		
Ap	=	1.131
D	=	1.200
Pd	=	18.00
γ	=	1.00
ϕ	=	25.00
N_q	=	10.00
N_γ	=	10.88
B.Capacity	=	**210.96**

ϕ		$N\gamma$
25		10.88
30		22.40

Hence, B. Capacity = 212.99

Q_{safe} = **85.198** t

Total Q_{safe} = 316.47 + 85.2
= **401.66** t

1. Density of concrete = ***2.50*** ***t/m^3***
2. Salfe weight of pile (Buoyant) = ***45.80 t***
3. Net bearing capacity of pile = ***355.86 t***

say ***356.00 t***

Hence, the vertical Load carrying capacity of the pile is taken as **356 ton in the design**

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1.	Pile Diameter	=	1.200	m	
2.	Concrete design mix strength	=	35	Mpa	(Assume)
3.	Modulus of elasticity of Concrete (E_c)	=	5000 x sqrt (35)		
		=	295804.0	kg / cm^2	
4.	Moment of Inertia (I)	=	$\Pi\ d^4 / 64$		
		=	0.10179	m^4	
		=	10178760.2	cm^4	
5.	Embeded Length of Pile (L_e)	=	27.00	m	> 4T 12.79237763 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.90 kg/cm^3

T = 319.81 cm
= 3.198 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.199
= 0.00

Therefore from the graph we read the corresponding value of " $\mathbf{L_f / T}$ ".

L_f / T = 2.20 for pile in sand

Hence;

Equivalent Cantilever Length L_f = 2.2 x 3.199
= **7.04** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{3\,E\,I}$$

Fixed Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{12\,E\,I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top; $Q = \dfrac{12\ EI\ Y}{(L_1 + L_f)^3}$

= 51869.05 kg
= **52** t

Hence, the horizontal Load carrying capacity of the pile is taken as **52 ton for the design**

ESTIMATION OF UP-LIFT CAPACITY

In the worst case of submergance the first part of the expression representing end bearing resistance is neglected, and in its place submerged weight of the pile is taken to add towards the ultimate capacity of pile.

In the instant case therefore the ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = (2/3) \text{ rd of frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4) \times D^2 \times L \times (2.5-1)$ gm

Frictional resistance = 791.17 T

W_p = 45.810 T

so Q_{tu} = 573.254 T

safe Up Lift capacity with a factor of safety of 3 = $Q_{tu}/3$

191.08 T

SAY 191.00 T

PILE LOAD CALCULATION BY FORMULA
(As per Method-1 of IRC: 78 - 2014)
Pier (BH No- 12)
Length of pile=12.00 m and Dia. = 1.2 m

Pile Dia (D)=		**1200** mm
Ksp = Empirical Co-efficient (0.3 to 1.2)		**0.3**
qc = Ave. Compressive strength of rock core =		**36.00** N/mm^2
		As per IRC-78 Appendix-5 (709.3.1)
d = Dia of socket =		1200.00 mm
l = length of socket as per IRC:78-2014		300.00 mm
d_f = Depth factor = 1 + 0.4 (length of socket / dia of socket) =		1.1
Ab = Cross-sectional area of pile at base =	0.785 x D^2 =	1130400.00 mm^2
As = Surface area of socket =	3.142 x d x l =	1131120.00 mm^2
C_{us} = Ultimate shear along the socket of normal rock = 0.225 X $(q_c)^{0.5}$		**1.35** N/mm^2
Re = Ultimate end bearing = Ksp.qc.df.Ab =		13429152
Raf = Ultimate side socket shear = As.Cus =		1527012

Qa = Ultimate load carrying capacity of pile = Re + R_{af} = Ksp.q_c.d_f.A_b + A_s.q_s = 14956164 Newton

Considering factor of safety as per Clause 709.3.2 of IRC:78-2014

Safe load carrying capacity of pile = Qs = Re/3 + Raf/6= Ksp.qc.df.Ab/3 + As.qs/6

Qs = 4730886 Newton

= 473.09 Ton

SAY = 473 Ton

Horizontal Load Carrying Capacity

As per IS : 2911 Part I / Sec 2 - 1979 (Appendix C)

1.	Pile Diameter	=	1.200	m	
2.	Concrete design mix strength	=	35	Mpa	(Assumed)
3.	Modulus of elasticity of Concrete (E_c)	=	5000 x sqrt (35)		
		=	295804.0	kg / cm^2	
4.	Moment of Inertia (I)	=	Π d^4 / 64		
		=	0.10179	m^4	
		=	10178760.2	cm^4	
5.	Embeded Length of Pile (L_e)	=	19.955	m	> 4T 14.39 m

The depth of fixity is determined from the codal provisions and the graph given there.

From Table we get n_h = 0.50 kg/cm^3 (Assumed)

T = 359.70 cm
= 3.597 m

Free Length of pile (L_1) = Pile cap bottom Level - Scour Level

L_1 = **0.000** m

Hence; L_1 / T = 0 / 3.598
= 0.00

Therefore from the graph we read the corresponding value of " **L_f / T** ".

L_f / T = 2.20

Hence;

Equivalent Cantilever Length L_f = 2.2 x 3.598
= **7.91** m

The pile head deflection is calculated by " **Y** "

Free Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{3\,E\,I}$$

Fixed Head Piles

$$Y = \frac{Q\,(L_1 + L_f)^3}{12\,E\,I}$$

In our case the piles are considered to be Fixed Head piles

Considering an allowable deflection of 0.5 cm (say) at Scour Level

Lateral Load at Pile top; $$Q = \frac{12\,EI\,Y}{(L_1 + L_f)^3}$$

= 36453.97 kg
= **36** t

Hence, the horizontal Load carrying capacity of the pile is taken as **36 ton for the design**

ESTIMATION OF UPLIFT LOAD CARRYING CAPACITY

Frictional Resistance

d = Dia of socket =		1200.00 mm	
l = length of pile from bottom of the pile cap		10.00 m	
l = length of socket as per IRC:78-2014		300.00 mm	As per IRC-78 clause 709.3.6.2
As = Surface area of socket =	3.142 x d x l =	1131120.00 mm^2	
qc = Ave. Compressive strength of rock core =		**36.00** N/mm^2	As per IRC-78 Appendix-5 (709.3.1)
C_{us} = Ultimate shear along the socket of normal rock =	$0.225 \times (q_c)^{0.5}$	**1.35** N/mm^2	
Raf = Ultimate side socket shear = As.Cus =		1527012 N	
		152.7012 T	
Factor of safety		3.5	
Safe Frictional resistsnce with factor of safety		43.63 T	

ultimate uplift capacity of pile (Q_{tu}) shall be given by

$$Q_{tu} = \text{frictional resistance} + W_p$$

where W_p = Submerged weight of pile = $(3.141/4)\times d^2 \times L \times (2.5-1)$ T

W_p = 26.51 T

Frictional resistance = 43.63 T

So Q_{tu} = 70.136 T

say 70 T

Hence, the uplift load carrying capacity of the pile is **70 ton for the design**

Before execution of the construction work initial load test on pile shall be conducted as per IS:2911(Part-4)

ANNEXURE-D
CALCULATION OF SAFE BEARING CAPACITY

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 2.0 m DEPTH OF ABUTMENT (BH No-02)

Bh No		2	
Depth of Foundation =		2	m
Cohesion C =		0.28	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		10	Degree
ϕ' =		7	Degree
Void ratio	e =	0.7	Medium
Specific Gravity	Gs =	2.7	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.2	Kg/cm^2
Bγ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'
10	8.35	2.47	1.22
7	7.234	1.93	0.758

Sc = 1.16 **Sq =** 1.16 **Sγ =** 0.68

Nϕ 1.420

Depth Factors

dc = 1.06 **d_q=** 1.00 **d_γ =** 1.00

Inclination Factors

i_c=i_q 1.0

i_γ 1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 2.875 + 0.334 + 0.163

= 3.372 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 1.660 + 0.228 + 0.109

= 1.997 Kg/cm^2

from interpolation Qd = 2.341

Factor of Safety for Soil 2.5

Net Safe Bearing Capacity (NSBC)= 9 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 3.0 m DEPTH OF ABUTMENT (BH No-02)

Bh No		2	
Depth of Foundation =		3	m
Cohesion C =		0.28	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		10	Degree
ϕ' =		7	Degree
Void ratio	e =	0.7	Medium
Specific Gravity	Gs =	2.7	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.3	Kg/cm^2
Bγ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'
10	8.35	2.47	1.22
7	7.234	1.93	0.758

Sc = 1.16 **Sq =** 1.16 **Sγ =** 0.68

Nϕ 1.420

		Depth Factors				**Inclination Factors**	
dc =	1.089	**d_q=**	1.00	**d_γ** =	1.00	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure			Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'			
	=	2.953	+	0.501	+	0.163
	=	3.617	Kg/cm^2			
For local shear failure			Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'			
	=	1.706	+	0.341	+	0.109
	=	2.156	Kg/cm^2			
from interpolation Qd =			2.521			
Factor of Safety for			Soil	2.5		

Net Safe Bearing Capacity (NSBC)= 10 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 4.0 m DEPTH OF ABUTMENT (BH No-02)

Bh No		2	
Depth of Foundation =		4	m
Cohesion C =		0.28	Kg/cm^2
Inclination of load to the vertical	α	0	$^\circ$
Angle of shearing resistance ϕ=		10	Degree
ϕ' =		7	Degree
Void ratio	e =	0.7	Medium
Specific Gravity	Gs =	2.7	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.4	Kg/cm^2
Bγ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'		
10	8.35	2.47	1.22		
7	7.234	1.93	0.758		
Sc =	1.16	**Sq =**	1.16	**Sγ =**	0.68
Nϕ	1.420				

Depth Factors / **Inclination Factors**

dc =	1.119	**d_q=**	1.00	d_γ =	1.00	i_c=i_q	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 3.035 + 0.668 + 0.163

= 3.866 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 1.753 + 0.454 + 0.109

= 2.316 Kg/cm^2

from interpolation Qd = 2.704

Factor of Safety for Soil 2.5

Net Safe Bearing Capacity (NSBC)= 11 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 2.0 m DEPTH OF PIER (BH-03)

Bh No		3	
Depth of Foundation =		2	m
Cohesion C =		0.3	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		13	Degree
ϕ' =		9	Degree
Void ratio	e =	0.69	Medium
Specific Gravity	Gs =	2.68	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.2	Kg/cm^2
Bγ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'
13	9.928	3.352	2.078
9	7.606	2.11	0.912

Sc = 1.16 **Sq =** 1.16 **Sγ =** 0.68

Nϕ 1.580

Depth Factors

dc = 1.063 **d_q=** 1.03 **d_γ =** 1.03

Inclination Factors

i_c=i_q 1.0

i_γ 1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 3.673 + 0.551 + 0.286

= 4.510 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 1.876 + 0.28 + 0.135

= 2.291 Kg/cm^2

from interpolation Qd = 2.957

Factor of Safety for Soil 2.5

Net Safe Bearing Capacity (NSBC)= **12 T/m^2**

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 3.0 m DEPTH OF PIER (BH-03)

Bh No		3	
Depth of Foundation =		3	m
Cohesion C =		0.3	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		13	Degree
ϕ' =		9	Degree
Void ratio	e =	0.69	Medium
Specific Gravity	Gs =	2.68	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.3	Kg/cm^2
Bγ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'		
13	9.928	3.352	2.078		
9	7.606	2.11	0.912		
Sc =	1.16	**Sq =**	1.16	**Sγ =**	0.68
Nϕ	1.580				

		Depth Factors				**Inclination Factors**	
dc =	1.094	**d_q=**	1.05	**d_γ =**	1.05	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure		Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'				
=	3.780	+	0.84	+	0.29	
=	4.910	Kg/cm^2				
For local shear failure		Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'				
=	1.930	+	0.426	+	0.137	
=	2.493	Kg/cm^2				
from interpolation Qd =		3.218				
Factor of Safety for		Soil	2.5			

Net Safe Bearing Capacity (NSBC)= **13 T/m^2**

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 4.0 m DEPTH OF PIER (BH-03)

Bh No		3	
Depth of Foundation =		4	m
Cohesion C =		0.3	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		13	Degree
ϕ' =		9	Degree
Void ratio	e =	0.69	Medium
Specific Gravity	Gs =	2.68	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.4	Kg/cm^2
Bγ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'		
13	9.928	3.352	2.078		
9	7.606	2.11	0.912		
Sc =	1.16	**Sq =**	1.16	**Sγ =**	0.68
Nϕ	1.580				

Depth Factors | **Inclination Factors**

dc =	1.126	**d_q=**	1.06	**d_γ =**	1.06	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure		Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'			
=	3.890	+	1.137	+	0.294
=	5.321	Kg/cm^2			
For local shear failure		Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'			
=	1.987	+	0.576	+	0.139
=	2.702	Kg/cm^2			
from interpolation Qd =		3.488			
Factor of Safety for		Soil	2.5		

Net Safe Bearing Capacity (NSBC)= 14 T/m²

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 2.0 m DEPTH OF PIER (BH NO-4)

Bh No		4	
Depth of Foundation =		2	m
Cohesion C =		0.28	Kg/cm^2
Inclination of load to the vertical	α	0	^{o}
Angle of shearing resistance ϕ=		14	Degree
ϕ' =		9	Degree
Void ratio	e =	0.65	Medium
Specific Gravity	Gs =	2.65	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.2	Kg/cm^2
Bγ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'		
14	10.454	3.646	2.364		
9	7.606	2.11	0.912		
Sc =	1.16	**Sq =**	1.16	**Sγ =**	0.68
Nϕ	1.638				

Depth Factors | **Inclination Factors**

dc =	1.064	**d_q=**	1.03	**d_γ** =	1.03	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 3.613 + 0.621 + 0.325

= 4.559 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 1.752 + 0.28 + 0.135

= 2.167 Kg/cm^2

from interpolation Qd = 3.363

Factor of Safety for Sand 2.5

Net Safe Bearing Capacity (NSBC)= 13 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 3.0 m DEPTH OF PIER (BH NO-4)

Bh No		4	
Depth of Foundation =		3	m
Cohesion C =		0.28	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		14	Degree
ϕ' =		9	Degree
Void ratio	e =	0.65	Medium
Specific Gravity	Gs =	2.65	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.3	Kg/cm^2
Bγ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'		
14	10.454	3.646	2.364		
9	7.606	2.11	0.912		
Sc =	1.16	**Sq =**	1.16	**Sγ =**	0.68
Nϕ	1.638				

Depth Factors | **Inclination Factors**

dc =	1.096	**d_q=**	1.05	**d_γ =**	1.05	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 3.721 + 0.946 + 0.33

= 4.997 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 1.805 + 0.426 + 0.137

= 2.368 Kg/cm^2

from interpolation Qd = 3.683

Factor of Safety for Sand 2.5

Net Safe Bearing Capacity (NSBC)= 15 T/m^2

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 4.0 m DEPTH OF PIER (BH NO-4)

Bh No		4	
Depth of Foundation =		4	m
Cohesion C =		0.28	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		14	Degree
ϕ' =		9	Degree
Void ratio	e =	0.65	Medium
Specific Gravity	Gs =	2.65	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.4	Kg/cm^2
Bγ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'		
14	10.454	3.646	2.364		
9	7.606	2.11	0.912		
Sc =	1.16	**Sq =**	1.16	**Sγ =**	0.68
Nϕ	1.638				

Depth Factors | **Inclination Factors**

dc =	1.128	**d_q=**	1.06	**d_γ =**	1.06	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 3.830 + 1.28 + 0.335

= 5.445 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 1.858 + 0.577 + 0.139

= 2.574 Kg/cm^2

from interpolation Qd = 4.010

Factor of Safety for Sand 2.5

Net Safe Bearing Capacity (NSBC)= 16 T/m^2

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 2.0 m DEPTH OF PIER (BH NO-5)

Bh No		5	
Depth of Foundation =		2	m
Cohesion C =		0.1	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		19	Degree
ϕ' =		13	Degree
Void ratio	e =	0.67	Medium
Specific Gravity	Gs =	2.67	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.2	Kg/cm^2
Bγ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'		
19	14.06	5.908	4.842		
13	9.928	3.352	2.078		
Sc =	1.16	**Sq =**	1.16	**Sγ =**	0.68
Nϕ	1.965				

Depth Factors **Inclination Factors**

dc =	1.07	**d_q=**	1.04	**d_γ =**	1.04	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 1.745 + 1.155 + 0.668

= 3.568 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 0.822 + 0.596 + 0.308

= 1.726 Kg/cm^2

from interpolation Qd = 2.463

Factor of Safety for Sand 2.5

Net Safe Bearing Capacity (NSBC)= 10 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 3.0 m DEPTH OF PIER (BH NO-5)

Bh No		5	
Depth of Foundation =		3	m
Cohesion C =		0.1	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		19	Degree
ϕ' =		13	Degree
Void ratio	e =	0.67	Medium
Specific Gravity	Gs =	2.67	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.3	Kg/cm^2
$B\gamma$ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	$N\gamma$ & $N\gamma'$		
19	14.06	5.908	4.842		
13	9.928	3.352	2.078		
Sc =	1.16	**Sq =**	1.16	**$S\gamma$ =**	0.68
$N\phi$	1.965				

Depth Factors | **Inclination Factors**

dc =	1.105	**d_q=**	1.05	**d_γ =**	1.05	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure		Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'				
=	1.802	+	1.763	+	0.68	
=	4.245	Kg/cm^2				
For local shear failure		Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'				
=	0.848	+	0.908	+	0.314	
=	2.070	Kg/cm^2				
from interpolation Qd =		2.940				
Factor of Safety for		Sand	2.5			

Net Safe Bearing Capacity (NSBC)= **12 T/m^2**

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 4.0 m DEPTH OF PIER (BH NO-5)

Bh No		5	
Depth of Foundation =		4	m
Cohesion C =		0.1	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		19	Degree
ϕ' =		13	Degree
Void ratio	e =	0.67	Medium
Specific Gravity	Gs =	2.67	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.4	Kg/cm^2
$B\gamma$ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	$N\gamma$ & $N\gamma'$
19	14.06	5.908	4.842
13	9.928	3.352	2.078

Sc = 1.16 **Sq =** 1.16 **Sγ =** 0.68

$N\phi$ 1.965

Depth Factors

dc = 1.14 **d_q=** 1.07 **d_γ =** 1.07

Inclination Factors

i_c=i_q 1.0

i_γ 1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 1.859 + 2.388 + 0.691

= 4.938 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 0.875 + 1.229 + 0.319

= 2.423 Kg/cm^2

from interpolation Qd = 3.429

Factor of Safety for Sand 2.5

Net Safe Bearing Capacity (NSBC)= 14 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 2.0 m DEPTH OF PIER (BH NO-6)

Bh No		6	
Depth of Foundation =		2	m
Cohesion C =		0.12	Kg/cm^2
Inclination of load to the vertical	α	0	o
Angle of shearing resistance ϕ=		17	Degree
ϕ' =		12	Degree
Void ratio	e =	0.67	Medium
Specific Gravity	Gs =	2.65	
Bulk density γ_b =		0.01791	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_b) / 10		0.004	Kg/cm^2
Bγ = (B x γ_b) / 10		0.014	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'		
17	12.52	4.924	3.746		
12	9.402	3.058	1.792		
Sc =	1.16	**Sq =**	1.16	**Sγ =**	0.68
Nϕ	1.826				

Depth Factors / **Inclination Factors**

dc =	1.068	**d_q=**	1.03	**d_γ =**	1.03	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure: Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 1.861 + 0.922 + 0.516

= 3.299 Kg/cm^2

For local shear failure: Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 0.932 + 0.521 + 0.266

= 1.719 Kg/cm^2

from interpolation Qd = 2.351

Factor of Safety for Sand 2.5

Net Safe Bearing Capacity (NSBC)= 9 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 3.0 m DEPTH OF PIER (BH NO-6)

Bh No		6	
Depth of Foundation =		3	m
Cohesion C =		0.12	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		17	Degree
ϕ' =		12	Degree
Void ratio	e =	0.67	Medium
Specific Gravity	Gs =	2.65	
Bulk density γ_b =		0.01791	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_b) / 10		0.005	Kg/cm^2
Bγ = (B x γ_b) / 10		0.014	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'		
17	12.52	4.924	3.746		
12	9.402	3.058	1.792		
Sc =	1.16	**Sq =**	1.16	**Sγ =**	0.68
Nϕ	1.826				

Depth Factors | **Inclination Factors**

dc =	1.101	**d_q=**	1.05	**d_γ =**	1.05	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 1.919 + 1.406 + 0.525

= 3.850 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 0.961 + 0.793 + 0.27

= 2.024 Kg/cm^2

from interpolation Qd = 2.754

Factor of Safety for Sand 2.5

Net Safe Bearing Capacity (NSBC)= 11 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 4.0 m DEPTH OF PIER (BH NO-6)

Bh No		6	
Depth of Foundation =		4	m
Cohesion C =		0.12	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		17	Degree
ϕ' =		12	Degree
Void ratio	e =	0.67	Medium
Specific Gravity	Gs =	2.65	
Bulk density γ_b =		0.001807	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_b) / 10		0.001	Kg/cm^2
Bγ = (B x γ_b) / 10		0.001	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'		
17	12.52	4.924	3.746		
12	9.402	3.058	1.792		
Sc =	1.16	**Sq =**	1.16	**Sγ =**	0.68
Nϕ	1.826				

Depth Factors						**Inclination Factors**	
dc =	1.135	**d_q=**	1.07	**d_γ** =	1.07	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure		Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'				
=	1.978		+	1.906	+	0.533
=	4.417	Kg/cm^2				
For local shear failure		Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'				
=	0.990		+	1.073	+	0.274
=	2.337	Kg/cm^2				
from interpolation Qd =			3.169			
Factor of Safety for			Soil	2.5		

Net Safe Bearing Capacity (NSBC)= 13 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 2.0 m DEPTH OF PIER (BH NO-7)

Bh No		7	
Depth of Foundation =		2	m
Cohesion C =		0.02	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		26	Degree
ϕ' =		18	Degree
Void ratio	e =	0.66	Medium
Specific Gravity	Gs =	2.65	
Bulk density γ_b =		0.001789	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_b) / 10		0	Kg/cm^2
Bγ = (B x γ_b) / 10		0.001	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'
26	22.604	12.208	13.184
18	13.29	5.416	4.294

Sc = 1.16 Sq = 1.16 Sγ = 0.68

Nϕ 2.561

Depth Factors

dc = 1.08 d_q= 1.04 d_γ = 1.04

Inclination Factors

i_c=i_q 1.0

i_γ 1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 0.566 + 2.65 + 1.827

= 5.043 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 0.222 + 1.124 + 0.64

= 1.986 Kg/cm^2

from interpolation Qd = 3.362

Factor of Safety for Sand 2.5

Net Safe Bearing Capacity (NSBC)= 13 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 3.0 m DEPTH OF PIER (BH NO-7)

Bh No		7	
Depth of Foundation =		3	m
Cohesion C =		0.02	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		26	Degree
ϕ' =		18	Degree
Void ratio	e =	0.66	Medium
Specific Gravity	Gs =	2.65	
Bulk density γ_b =		0.001789	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_b) / 10		0.001	Kg/cm^2
Bγ = (B x γ_b) / 10		0.001	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'		
26	22.604	12.208	13.184		
18	13.29	5.416	4.294		
Sc =	1.16	Sq =	1.16	Sγ =	0.68
Nϕ	2.561				

Depth Factors | **Inclination Factors**

dc =	1.12	**d_q=**	1.06	**d_γ** =	1.06	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure			Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'			
	=	0.587	+	4.052	+	1.863
	=	6.502	Kg/cm^2			
For local shear failure			Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'			
	=	0.230	+	1.716	+	0.652
	=	2.598	Kg/cm^2			
from interpolation Qd =			4.355			
Factor of Safety for			Sand	2.5		

Net Safe Bearing Capacity (NSBC)= **17 T/m^2**

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 4.0 m DEPTH OF PIER (BH NO-7)

Bh No		7	
Depth of Foundation =		4	m
Cohesion C =		0.02	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		26	Degree
ϕ' =		18	Degree
Void ratio	e =	0.66	Medium
Specific Gravity	Gs =	2.65	
Bulk density γ_b =		0.001807	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_b) / 10		0.001	Kg/cm^2
Bγ = (B x γ_b) / 10		0.001	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'		
26	22.604	12.208	13.184		
18	13.29	5.416	4.294		
Sc =	1.16	**Sq =**	1.16	**Sγ =**	0.68
Nϕ	2.561				

Depth Factors / **Inclination Factors**

dc =	1.16	**d_q=**	1.08	**d_γ =**	1.08	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 0.608 + 5.504 + 1.898

= 8.010 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 0.238 + 2.329 + 0.665

= 3.232 Kg/cm^2

from interpolation Qd = 5.382

Factor of Safety for Sand 2.5

Net Safe Bearing Capacity (NSBC)= 22 T/m²

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 2.0 m DEPTH OF PIER (BH NO-8)

Bh No		8	
Depth of Foundation =		2	m
Cohesion C =		0.13	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		17	Degree
ϕ' =		12	Degree
Void ratio	e =	0.65	Medium
Specific Gravity	Gs =	2.67	
Bulk density γ_b =		0.001811	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0	Kg/cm^2
$B\gamma$ = (B x γ_{sub}) / 10		0.001	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	$N\gamma$ & $N\gamma'$
17	12.52	4.924	3.746
12	9.402	3.058	1.792

Sc = 1.16 **Sq =** 1.16 **Sγ =** 0.68

$N\phi$ 1.826

Depth Factors

dc = 1.068 **d_q=** 1.03 **d_γ =** 1.03

Inclination Factors

i_c=i_q 1.0

i_γ 1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 2.016 + 0.922 + 0.516

= 3.454 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 1.009 + 0.521 + 0.266

= 1.796 Kg/cm^2

from interpolation Qd = 2.625

Factor of Safety for Sand 2.5

Net Safe Bearing Capacity (NSBC)= 11 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 3.0 m DEPTH OF PIER (BH NO-8)

Bh No		8	
Depth of Foundation =		3	m
Cohesion C =		0.13	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		17	Degree
ϕ' =		12	Degree
Void ratio	e =	0.65	Medium
Specific Gravity	Gs =	2.67	
Bulk density γ_b =		0.001811	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.001	Kg/cm^2
Bγ = (B x γ_{sub}) / 10		0.001	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'
17	12.52	4.924	3.746
12	9.402	3.058	1.792

Sc = 1.16 **Sq =** 1.16 **Sγ =** 0.68

Nϕ 1.826

Depth Factors

dc = 1.101 **d_q=** 1.05 **d_γ =** 1.05

Inclination Factors

i_c=i_q 1.0

i_γ 1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 2.079 + 1.406 + 0.525

= 4.010 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 1.041 + 0.793 + 0.27

= 2.104 Kg/cm^2

from interpolation Qd = 3.057

Factor of Safety for Sand 2.5

Net Safe Bearing Capacity (NSBC)= **12 T/m²**

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 4.0 m DEPTH OF PIER (BH NO-8)

Bh No		8	
Depth of Foundation =		4	m
Cohesion C =		0.13	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		17	Degree
ϕ' =		12	Degree
Void ratio	e =	0.65	Medium
Specific Gravity	Gs =	2.67	
Bulk density γ_b =		0.001834	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.001	Kg/cm^2
Bγ = (B x γ_{sub}) / 10		0.001	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'
17	12.52	4.924	3.746
12	9.402	3.058	1.792

Sc = 1.16 **Sq =** 1.16 **Sγ =** 0.68

Nϕ 1.826

Depth Factors

dc = 1.135 **d_q=** 1.07 **d_γ =** 1.07

Inclination Factors

i_c=i_q 1.0

i_γ 1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 2.143 + 1.906 + 0.533

= 4.582 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 1.073 + 1.073 + 0.274

= 2.420 Kg/cm^2

from interpolation Qd = 3.501

Factor of Safety for Soil 2.5

Net Safe Bearing Capacity (NSBC)= 14 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 3.0 m DEPTH OF PIER (BH NO-9)

Bh No		9	
Depth of Foundation =		3	m
Cohesion C =		0.15	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		18	Degree
ϕ' =		12	Degree
Void ratio	e =	0.68	Medium
Specific Gravity	Gs =	2.69	
Submerged density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.3	Kg/cm^2
Bγ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'
18	13.29	5.416	4.294
12	9.402	3.058	1.792

Sc = 1.16 **Sq =** 1.16 **Sγ =** 0.68

Nϕ 1.894

Depth Factors

dc = 1.103 **d_q=** 1.05 **d_γ =** 1.05

Inclination Factors

i_c=i_q 1.0

i_γ 1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 2.551 + 1.584 + 0.602

= 4.737 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 1.203 + 0.794 + 0.27

= 2.267 Kg/cm^2

from interpolation Qd = 3.132

Factor of Safety for Soil 2.5

Net Safe Bearing Capacity (NSBC)= **13 T/m^2**

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 4.0 m DEPTH OF PIER (BH NO-9)

Bh No		9	
Depth of Foundation =		4	m
Cohesion C =		0.15	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		18	Degree
ϕ' =		12	Degree
Void ratio	e =	0.68	Medium
Specific Gravity	Gs =	2.69	
Submerged density γ_{sub}=		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.4	Kg/cm^2
$B\gamma$ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	$N\gamma$ & $N\gamma'$
18	13.29	5.416	4.294
12	9.402	3.058	1.792

Sc = 1.16 **Sq =** 1.16 **Sγ =** 0.68

$N\phi$ 1.894

		Depth Factors				**Inclination Factors**	
dc =	1.138	**d_q=**	1.07	d_γ =	1.07	i_c=i_q	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure		Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'				
=	2.632	+	2.147	+	0.612	
=	5.391	Kg/cm^2				
For local shear failure		Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'				
=	1.241	+	1.074	+	0.275	
=	2.590	Kg/cm^2				

from interpolation Qd = 3.570

Factor of Safety for Soil 2.5

Net Safe Bearing Capacity (NSBC)= 14 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 2.0 m DEPTH OF PIER (BH NO-11)

Bh No		11	
Depth of Foundation =		2	m
Cohesion C =		0.04	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		23	Degree
ϕ' =		16	Degree
Void ratio	e =	0.67	Medium
Specific Gravity	Gs =	2.67	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.2	Kg/cm^2
Bγ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'		
23	18.364	8.956	8.684		
16	11.75	4.432	3.198		
Sc =	1.16	**Sq =**	1.16	**Sγ =**	0.68
Nϕ	2.283				

Depth Factors

dc = 1.076 **d_q=** 1.04 **d_γ =** 1.04

Inclination Factors

i_c=i_q 1.0

i_γ 1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 0.917 + 1.878 + 1.201

= 3.996 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 0.391 + 0.872 + 0.476

= 1.739 Kg/cm^2

from interpolation Qd = 2.642

Factor of Safety for Sand 2.5

Net Safe Bearing Capacity (NSBC)= 11 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 3.0 m DEPTH OF PIER (BH NO-11)

Bh No		11	
Depth of Foundation =		3	m
Cohesion C =		0.04	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		23	Degree
ϕ' =		16	Degree
Void ratio	e =	0.66	Medium
Specific Gravity	Gs =	2.67	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.3	Kg/cm^2
Bγ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'		
23	18.364	8.956	8.684		
16	11.75	4.432	3.198		
Sc =	1.16	**Sq =**	1.16	**Sγ =**	0.68
Nϕ	2.283				

Depth Factors | **Inclination Factors**

dc =	1.113	**d_q=**	1.06	**d_γ =**	1.06	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 0.948 + 2.868 + 1.223

= 5.039 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 0.405 + 1.33 + 0.484

= 2.219 Kg/cm^2

from interpolation Qd = 3.488

Factor of Safety for Sand 2.5

Net Safe Bearing Capacity (NSBC)= 14 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 4.0 m DEPTH OF PIER (BH NO-11)

Bh No		11	
Depth of Foundation =		4	m
Cohesion C =		0.04	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		23	Degree
ϕ' =		16	Degree
Void ratio	e =	0.65	Medium
Specific Gravity	Gs =	2.67	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.4	Kg/cm^2
$B\gamma$ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	$N\gamma$ & $N\gamma'$
23	18.364	8.956	8.684
16	11.75	4.432	3.198

Sc = 1.16 **Sq =** 1.16 **Sγ =** 0.68

$N\phi$ 2.283

Depth Factors						Inclination Factors	
dc =	1.151	**d_q=**	1.08	**d_γ =**	1.08	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 0.981 + 3.893 + 1.245

= 6.119 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 0.418 + 1.803 + 0.493

= 2.714 Kg/cm^2

from interpolation Qd = 4.417

Factor of Safety for Sand 2.5

Net Safe Bearing Capacity (NSBC)= 18 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 2.0 m DEPTH OF PIER (BH-11A)

Bh No		11A	
Depth of Foundation =		2	m
Cohesion C =		0.25	Kg/cm^2
Inclination of load to the vertical	α	0	^{o}
Angle of shearing resistance ϕ=		14	Degree
ϕ' =		9	Degree
Void ratio	e =	0.65	Medium
Specific Gravity	Gs =	2.68	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.2	Kg/cm^2
$B\gamma$ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	$N\gamma$ & $N\gamma'$		
14	10.454	3.646	2.364		
9	7.606	2.11	0.912		
Sc =	1.16	**Sq =**	1.16	**Sγ =**	0.68
$N\phi$	1.638				

Depth Factors | **Inclination Factors**

dc =	1.064	**d_q=**	1.03	**d_γ** =	1.03	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 3.226 + 0.621 + 0.325

= 4.172 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 1.565 + 0.28 + 0.135

= 1.980 Kg/cm^2

from interpolation Qd = 3.076

Factor of Safety for Sand 2.5

Net Safe Bearing Capacity (NSBC)= 12 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 3.0 m DEPTH OF PIER (BH-11A)

Bh No		11A	
Depth of Foundation =		3	m
Cohesion C =		0.25	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		14	Degree
ϕ' =		9	Degree
Void ratio	e =	0.64	Medium
Specific Gravity	Gs =	2.68	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.3	Kg/cm^2
$B\gamma$ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	$N\gamma$ & $N\gamma'$		
14	10.454	3.646	2.364		
9	7.606	2.11	0.912		
Sc =	1.16	**Sq =**	1.16	**Sγ =**	0.68
$N\phi$	1.638				

Depth Factors						Inclination Factors	
dc =	1.096	**d_q=**	1.05	**d_γ** =	1.05	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'

= 3.323 + 0.946 + 0.33

= 4.599 Kg/cm^2

For local shear failure Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'

= 1.612 + 0.426 + 0.137

= 2.175 Kg/cm^2

from interpolation Qd = 3.508

Factor of Safety for Sand 2.5

Net Safe Bearing Capacity (NSBC)= 14 T/m^2

CALCULATION OF SAFE BEARING CAPACITY

NET SAFE BEARING CAPACITY FROM STRENGTH PARAMETERS AT 4.0 m DEPTH OF PIER (BH-11A)

Bh No		11A	
Depth of Foundation =		4	m
Cohesion C =		0.25	Kg/cm^2
Inclination of load to the vertical	α	0	°
Angle of shearing resistance ϕ=		14	Degree
ϕ' =		9	Degree
Void ratio	e =	0.63	Medium
Specific Gravity	Gs =	2.68	
Submerdeg density γ_{sub} =		1.000	g/cc
Type of footing		Rectangle	
Length of footing (L) =		10.00	m
Width of footing B =		8.00	m
Over burden pressure			
q = (Df x γ_{sub}) / 10		0.4	Kg/cm^2
Bγ = (B x γ_{sub}) / 10		0.8	Kg/cm^2

Bearing capacity factors

ϕ & ϕ'	Nc & Nc'	Nq & Nq'	Nγ & Nγ'		
14	10.454	3.646	2.364		
9	7.606	2.11	0.912		
Sc =	1.16	**Sq =**	1.16	**Sγ =**	0.68
Nϕ	1.638				

		Depth Factors				**Inclination Factors**	
dc =	1.128	**d_q=**	1.06	**d_γ** =	1.06	**i_c=i_q**	1.0
						i_γ	1.0

Effect of Water Table = **W'** 0.500 (Considering worst condition)

For General shear failure		Qd = CNcscdcic + q(Nq -1)sqdqiq + 0.5BγNγsγdγiγW'				
=	3.420	+	1.28	+	0.335	
=	5.035	Kg/cm^2				
For local shear failure		Qd = 2/3CNc'sc'dc'ic' + q(Nq' -1)sq'dq'iq' + 0.5BγNγ'sγ'dγ'iγ'W'				
=	1.659	+	0.577	+	0.139	
=	2.375	Kg/cm^2				
from interpolation Qd =		3.971				
Factor of Safety for		Sand	2.5			

Net Safe Bearing Capacity (NSBC)= **16 T/m^2**

CALCULATION OF SAFE BEARING CAPACITY

Calculation of Safe Bearing Capacity from Standard Penetration Test of PIER(BH NO-12) at 2.0 m Depth

Soil Investigation Data

Site Information

1	BH No		12	
2	Depth of Sample Collection	D_f	2.0	m
3	Inclination of load to the vertical	α	0	°

Laboratory Investigations

a)	Avg. corrected N value	**N**	30.00		
1	Angle of Internal Friction	ϕ	36.0	°	*Ref: Fig.1 of IS 6403: 1981*
2	Specific Gravity of Soil	G	2.66		
3	Submerged Density of Soil	γ'	0.001	kg/cm^3	

Assumptions

1	Width of Foundation	B	800	cm
2	Depth of Foundation	D_f	200	cm
3	Length of Foundation	L	1000	cm
4	Shape of Base		Square	
	Effect of Water Table	W'	0.500	Worst condition
5	Factor of Safety for	Sand	2.5	

Calculations

6	Submerged Density of Soil	γ'	0.001	kg/cm^3
		ϕ	36	°
		$N\phi$	3.852	

Surcharge Intensity = q = γ' D　　0.20 kg/cm^2

Bearing Capacity Factors for ϕ	36 °		Shape Factors		Depth Factors		Inclination Factors	
N_q	39.480		s_q	1.200	d_q	1.0490	i_q	1.0000
$N\gamma$	60.306		s_γ	0.800	d_γ	1.0490	i_γ	1.0000

Angle of Internal Friction Φ' = **26**

N_q　12.208

$N\gamma$　13.184

Difference in N_q　27.272　　Difference in N_y　47.1220

From interpolation the required values of Nq & Ny are =

N_q =　39.480

N_y =　60.306

Ultimate Net Bearing Capacity q_d = $q\,(N_q - 1)\, s_q\, d_q\, i_q + ½\, B\gamma\, N_\gamma\, s_\gamma\, d_\gamma\, i_\gamma\, W'$

= 0.200 x (39.480 - 1) x 1.200 x 1.049 x 1.000

+ ½ x 800.0 x 0.001 x 60.306 x 0.800 x 1.049 x 1.000 x 0.500 / 1000

= 9.6877 + 10.12

Ultimate Net Bearing Capacity q_d = **19.8095** kg/cm^2

Net Safe Bearing Capacity (NSBC)= 79 T/m^2

Calculation of Safe Bearing Capacity

Safe Bearing Capacity from Standard Penetration Test of Pier (BH NO-12) at 3.0 m Depth

Site Information

1	BH No		12	
2	Depth of foundation below Ground level	D_f	3.00	m
3	Inclination of load to the vertical	α	0	°

Laboratory Investigations

	a) Due to Dilatancy	**N**	37.00		
1	Angle of Internal Friction	ϕ	37.6	°	*Ref: Fig.1 of IS 6403: 1981*
2	Submerged Density	γ'	0.001768	kg/cm^3	

Assumptions

1	Width of Foundation	B	800	cm
2	Depth of foundation below Ground level	D_f	300	cm
3	Length of Foundation	L	1000	cm
4	Shape of Base		Square	
5	***Effect of Water Table***	W'	0.500	Worst condition
6	Factor of Safety for	Sand	2.5	

Calculations

Submerged Density	γ'	0.001768	kg/cm^3
	ϕ	37.6	°
	$N\phi$	4.130	

Surcharge Intensity = q = γ' D 0.53 kg/cm^2

Bearing Capacity Factors for ϕ	37.6 °	Shape Factors		Depth Factors		Inclination Factors	
N_q	49.368	s_q	1.200	d_q	1.0760	i_q	1.0000
N_γ	79.948	s_γ	0.800	d_γ	1.0760	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q\,(N_q - 1)\, s_q\, d_q\, i_q + ½\, B\gamma\, N_\gamma\, s_\gamma\, d_\gamma\, i_\gamma\, W'$

= 0.530 x (49.368 - 1) x 1.200 x 1.076 x 1.000
+ ½ x 800.0 x 0.002 x 79.948 x 0.800 x 1.076 x 1.000 x 0.500
= 33.1249 + 24.33

Ultimate Net Bearing Capacity q_d = **57.4594** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **230** T/m^2

Calculation of Safe Bearing Capacity
Safe Bearing Capacity from Standard Penetration Test of Pier (BH NO-12) at 4.0 m Depth

Site Information

1	BH No		12	
2	Depth of foundation below Ground level	D_f	4.00	m
3	Inclination of load to the vertical	α	0	°

Laboratory Investigations

	a) Due to Dilatancy	**N**	37.00		
1	Angle of Internal Friction	ϕ	37.6	°	*Ref: Fig.1 of IS 6403: 1981*
2	Submerged Density	γ'	0.001768	kg/cm^3	

Assumptions

1	Width of Foundation	B	800	cm
2	Depth of foundation below Ground level	D_f	400	cm
3	Length of Foundation	L	1000	cm
4	Shape of Base		Square	
5	***Effect of Water Table***	W'	0.500	Worst condition
6	Factor of Safety for	Sand	2.5	

Calculations

Submerged Density	γ'	0.001768	kg/cm^3
	ϕ	37.6	°
	$N\phi$	4.130	

Surcharge Intensity = q = γ' D 0.71 kg/cm^2

Bearing Capacity Factors for ϕ	37.6 °	Shape Factors		Depth Factors		Inclination Factors	
N_q	49.368	s_q	1.200	d_q	1.1020	i_q	1.0000
N_γ	79.948	s_γ	0.800	d_γ	1.1020	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q\,(N_q - 1)\, s_q\, d_q\, i_q + ½\, B\gamma\, N_\gamma\, s_\gamma\, d_\gamma\, i_\gamma\, W'$

= 0.707 x (49.368 - 1) x 1.200 x 1.102 x 1.000
+ ½ x 800.0 x 0.002 x 79.948 x 0.800 x 1.102 x 1.000 x 0.500
= 45.2338 + 24.92

Ultimate Net Bearing Capacity q_d = **70.1563** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **281** **T/m^2**

ANNEXURE-E
CALCULATION OF SETTLEMENT FOOTING

CALCULATION OF SETTLEMENT OF FOUNDATION
AS PER IS:8009 (Part -I)-1976
ABUTMENT (BH NO-2) AT 2.0 M DEPTH

Depth of foundation :	2.00	m		
Influennce Zone= 1.5 X B	12	m (Below founding level)		
Size of foundation:	8.0 x 10.0	=> width B =	8.00	m
		Length L=	10.00	m

Due to imposed load	NSBC	**9.00**	t/m^2
Void ratio	e_0 =	0.7	
Submersible density =		1	g/cc
Height of Compressible layer (Ht) =		12.00	m

A **Settlement of Foundation due to consolidation (Sc)**

Compression Index (Cc) =	0.129	
Initial Pressure P_0 =	8.00	t/m^2
Area of footing =	80.00	m^2
Width of spread =	14.00	m
Length of spread =	16.00	m
Area of spread =	224.00	m^2
Pressure intensity (ΔP)=	3.21	t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

1 $$Sc = \frac{H_t}{(1+e_0)} X\ C_c\ [\log_{10} (P_0 + \Delta P)/P_0]$$

= 0.1336 m = 133.6 mm

B **Total Settlement Sc=** 134 mm

Depth factor =	0.95				
Sf= S total x Depth factor =	126.89	mm			
Rigidity factor =	0.8				
Final settlement (S) =	101.5	mm	(Say	102	mm)

Safe bearing capacity for 25mm settlement= 2.00 t/m^2

Safe bearing capacity for 50mm settlement= 4.00 t/m^2

CALCULATION OF SETTLEMENT OF FOUNDATION
AS PER IS:8009 (Part -I)-1976
ABUTMENT (BH NO-2) AT 3.0 M DEPTH

Depth of foundation :	3.00	m		
Influennce Zone= 1.5 X B	12	m	(Below founding level)	
Size of foundation:	8.0 x 10.0	=> width B =	8.00	m
		Length L=	10.00	m

Due to imposed load	NSBC	**10.00**	t/m^2
Void ratio	e_0 =	0.7	
Submersible density =		1	g/cc
Height of Compressible layer (Ht) =		12.00	m

A **Settlement of Foundation due to consolidation (Sc)**

Compression Index (Cc) =	0.129	
Initial Pressure P_0 =	9.00	t/m^2
Area of footing =	80.00	m^2
Width of spread =	14.00	m
Length of spread =	16.00	m
Area of spread =	224.00	m^2
Pressure intensity (ΔP)=	3.57	t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

1 $$Sc = \boxed{\frac{H_t}{(1+e_0)} \times C_c\,[\,\log_{10} (P_0 + \Delta P)/P_0]}$$

= 0.1322 m = 132.2 mm

B **Total Settlement Sc=** 132 mm

Depth factor =	0.91	
Sf= S total x Depth factor =	120.27	mm
Rigidity factor =	0.8	
Final settlement (S) =	96.2	mm (Say 96 mm)

Safe bearing capacity for 25mm settlement= 3.00 t/m^2

Safe bearing capacity for 50mm settlement= 5.00 t/m^2

CALCULATION OF SETTLEMENT OF FOUNDATION
AS PER IS:8009 (Part -I)-1976
ABUTMENT (BH NO-2) AT 4.0 M DEPTH

Depth of foundation :	4.00	m		
Influennce Zone= 1.5 X B	12	m (Below founding level)		
Size of foundation:	8.0 x 10.0	=> width B =	8.00	m
		Length L=	10.00	m

Due to imposed load	NSBC	**11.00**	t/m^2
Void ratio	e_0 =	0.7	
Submersible density =		1	g/cc
Height of Compressible layer (Ht) =		12.00	m

A **Settlement of Foundation due to consolidation (Sc)**

Compression Index (Cc) =	0.129	
Initial Pressure P_0 =	10.00	t/m^2
Area of footing =	80.00	m^2
Width of spread =	14.00	m
Length of spread =	16.00	m
Area of spread =	224.00	m^2
Pressure intensity (ΔP)=	3.93	t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

1 $$Sc = \boxed{\frac{H_t}{(1+e_0)} \times C_c \left[\log_{10} (P_0 + \Delta P)/P_0 \right]}$$

= 0.1310 m = 131.0 mm

B **Total Settlement Sc=** 131.0 mm

Depth factor =	0.87				
Sf= S total x Depth factor =	114.00	mm			
Rigidity factor =	0.8				
Final settlement (S) =	91.2	mm	(Say	91	mm)

Safe bearing capacity for 25mm settlement= 3.00 t/m^2

Safe bearing capacity for 50mm settlement= 6.00 t/m^2

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

CALCULATION OF SETTLEMENT OF FOUNDATION
AS PER IS:8009 (Part -I)-1976
PIER (BH NO-03) AT 2.0 M DEPTH

Depth of foundation :	2.00	m		
Influennce Zone= 1.5 X B	12.0	m	(Below founding level)	
Depth consider from the founding level =	14.00	m		
Size of foundation:	10.0 x 8.0	=> width B =	8.00	m
		Length L=	10.00	m

The total depth of compressible layer is divided in to 3 layers.

First layer =	Clay layer =	7.00	m
Second layer =	Sand layer =	3.00	m
Third layer =	Clay layer =	2.00	m

Calculation of settlement for first layer (Clay layer)

Imposed load at founding level =	NSBC	**12.000**	t/m^2
Void ratio	e_0 =	0.69	
Submerged unit weight of soil (γ_{sub}) =		1.000	g/cc
Height of Compressible layer (Ht) =		7.00	m

A **Settlement of Foundation due to consolidation (Sc)**

Compression Index (Cc) =	0.126	
Initial Pressure P_0 =	5.500	t/m^2 [Ref. cl.no.8.1.1 from IS:8009 (part-1)-1998]
Area of footing =	80.00	m^2
Width of spread =	11.500	m
Length of spread =	13.500	m
Area of spread =	155.25	m^2
Pressure intensity (ΔP)=	6.18	t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times Cc\ [\log_{10} (P_0 + \Delta P)/P_0]$$

= 0.1708 m = 170.8 mm

Due to clay layer resting on cohesionless soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 128.08 mm (Say 128 mm)

B Total Settlement Sc= 128 mm

Contd..

(For footing at 2.0 m depth)

Settlement of the cohesionless soil below the cohesive soil at 9.0 m depth upto 12.0 m depth.

Calculation of settlement for second layer (sand layer)

Depth of foundation	2.0	m	
Corrected average N Value	19.5		
Settelment from Fig No.9 of IS: 8009-1976	18	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	36.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976

Imposed load = **NSBC = 12.00** t/m^2 t/m^2

Imposed load = $\sigma_z = I_B\, P$ **= 0.178 X 30 = 2.14** t/m^2

(Derived using Boussinesq chart (fig.18) of IS:8009(part-1))

Settlement for imposed load (Sf) = 7.69 mm

Contd..

(For footing at 2.0 m depth)
Settlement of the cohesive soil below the cohesionless soil at 12.0 m depth upto 14.0 m depth.

Calculation of settlement for third layer (Clay layer)

Depth of foundation (D)	2.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
imposed load at F.L.(P)	12.00 T/m^2
Depth from the F.L.	10.00 m
Width of spread	19 m
Length of spread	21 m
Depth from the G.L	12.00 m
Thickness of clay layer	2.00 m

Calculation of settlement :

Compression Index (Cc) =	0.120
Initial void ratio (e_0) =	0.67
Thickness of layer =	2.00 m
Submerged unit weight of soil (γ_{sub}) =	1.00 g/cc
Initial Pressure P_0 =	13.00 t/m^2 [Ref. cl.no.8.1.1 from IS:8009 (part-1)-1998]
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	19.00 m
Length of spread =	21.00 m
Area of spread =	399.00 m^2
Pressure intensity (ΔP)=	2.41 t/m^2

A **Settlement of Foundation due to consolidation (Sc)**

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times Cc\ [\log_{10} (P_0 + \Delta P)/P_0]$$

Sf = 0.0106 m 10.6 mm

Due to clay layer resting on cohesionless soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 7.95 mm (Say 8 mm)

For footing at 2.0 m depth total calculated settlement in mm = 143.690 mm

Depth factor = 0.95 As per Fig No.12 of IS 8009(P-1)-1976

$S_{fd} = S_f$ x Depth factor = 136.51 mm

Rigidity factor = 0.8

Final settlement (S) in mm= 109.20 mm (say 109.00 mm)

For 25 mm settlement safe bearing pressure= 3.00 t/m^2

For 50 mm settlement safe bearing pressure= 6.00 t/m^2

CALCULATION OF SETTLEMENT OF FOUNDATION
AS PER IS:8009 (Part -I)-1976
PIER (BH NO-03) AT 3.0 M DEPTH

Depth of foundation :	3.00	m		
Influennce Zone= 1.5 X B	12.0	m (Below founding level)		
Depth consider from the founding level =	15.00	m		
Size of foundation:	10.0 x 8.0	=> width B =	8.00	m
		Length L=	10.00	m

The total depth of compressible layer is divided in to 3 layers.

First layer =	Clay layer =	6.00	m
Second layer =	Sand layer =	3.00	m
Third layer =	Clay layer =	3.00	m

Calculation of settlement for first layer (Clay layer)

Imposed load at founding level =	NSBC	**13.000**	t/m^2
Void ratio	e_0 =	0.69	
Submerged unit weight of soil (γ_{sub}) =		1.000	g/cc
Height of Compressible layer (Ht) =		6.00	m

A **Settlement of Foundation due to consolidation (Sc)**

Compression Index (Cc) =	0.126	
Initial Pressure P_0 =	6.000	t/m^2 [Ref. cl.no.8.1.1 from IS:8009 (part-1)-1998]
Area of footing =	80.00	m^2
Width of spread =	11.000	m
Length of spread =	13.000	m
Area of spread =	143.00	m^2
Pressure intensity (ΔP)=	7.27	t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times Cc\,[\log_{10}(P_0+\Delta P)/P_0]$$

= 0.1542 m = 154.2 mm

Due to clay layer resting on cohesionless soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 115.68 mm (Say 116 mm)

B Total Settlement Sc= 116 mm

Contd..

(For footing at 3.0 m depth)
Settlement of the cohesionless soil below the cohesive soil at 9.0 m depth upto 12.0 m depth.

Calculation of settlement for second layer (sand layer)

Depth of foundation	3.0	m	
Corrected average N Value	19.5		
Settelment from Fig No.9 of IS: 8009-1976	18	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	36.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976

Imposed load = **NSBC =** **13.00** t/m^2 t/m^2

Imposed load = $\sigma_z = I_B\, P$ **= 0.185 X 12 = 2.41** t/m^2

(Derived using Boussinesq chart (fig.18) of IS:8009(part-1))

Settlement for imposed load (Sf) = 8.66 mm

Contd..

(For footing at 3.0 m depth)

Settlement of the cohesive soil below the cohesionless soil at 12.0 m depth upto 15.0 m depth.

Calculation of settlement for third layer (Clay layer)

Depth of foundation (D)	3.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
imposed load at F.L.(P)	13.00 T/m^2
Depth from the F.L.	9.00 m
Width of spread	18.5 m
Length of spread	20.5 m
Depth from the G.L	12.00 m
Thickness of clay layer	3.00 m

Calculation of settlement :

Compression Index (Cc) =	0.120
Initial void ratio (e_0) =	0.67
Thickness of layer =	3.00 m
Submerged unit weight of soil (γ_{sub}) =	1.00 g/cc
Initial Pressure P_0 =	13.50 t/m^2 [Ref. cl.no.8.1.1 from IS:8009 (part-1)-1998]
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	18.50 m
Length of spread =	20.50 m
Area of spread =	379.25 m^2
Pressure intensity (ΔP)=	2.74 t/m^2

A **Settlement of Foundation due to consolidation (Sc)**

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times Cc\ [\log_{10} (P_0 + \Delta P)/P_0]$$

Sf = 0.0173 m 17.3 mm

Due to clay layer resting on cohesionless soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 12.98 mm (Say 13 mm)

For footing at 3.0 m depth total calculated settlement in mm = 137.658 mm

Depth factor = 0.91 As per Fig No.12 of IS 8009(P-1)-1976

$S_{fd} = S_f$ x Depth factor = 125.27 mm

Rigidity factor = 0.8

Final settlement (S) in mm= 100.22 mm (say 100.00 mm)

For 25 mm settlement safe bearing pressure= 3.00 t/m^2

For 50 mm settlement safe bearing pressure= 7.00 t/m^2

CALCULATION OF SETTLEMENT OF FOUNDATION
AS PER IS:8009 (Part -I)-1976
PIER (BH NO-03) AT 4.0 M DEPTH

Depth of foundation :	4.00	m			
Influennce Zone= 1.5 X B	12.0	m	(Below founding level)		
Depth consider from the founding level =	16.00	m			
Size of foundation:	10.0 x 8.0	=> width B =	8.00	m	
		Length L=	10.00	m	

The total depth of compressible layer is divided in to 3 layers.

First layer =	Clay layer =	5.00	m
Second layer =	Sand layer =	3.00	m
Third layer =	Clay layer =	4.00	m

Calculation of settlement for first layer (Clay layer)

Imposed load at founding level =	NSBC	**14.000**	t/m^2
Void ratio	e_0 =	0.69	
Submerged unit weight of soil (γ_{sub}) =		1.000	g/cc
Height of Compressible layer (Ht) =		5.00	m

A **Settlement of Foundation due to consolidation (Sc)**

Compression Index (Cc) =	0.126	
Initial Pressure P_0 =	6.500	t/m^2 [Ref. cl.no.8.1.1 from IS:8009 (part-1)-1998]
Area of footing =	80.00	m^2
Width of spread =	10.500	m
Length of spread =	12.500	m
Area of spread =	131.25	m^2
Pressure intensity (ΔP)=	8.53	t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \text{ X } Cc\,[\,\log_{10}(P_0 + \Delta P)/P_0]$$

= 0.1357 m = 135.7 mm

Due to clay layer resting on cohesionless soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 101.81 mm (Say 102 mm)

B Total Settlement Sc= 102 mm

Contd..

(For footing at 4.0 m depth)
Settlement of the cohesionless soil below the cohesive soil at 9.0 m depth upto 12.0 m depth.

Calculation of settlement for second layer (sand layer)

Depth of foundation	4.0	m	
Corrected average N Value	19.5		
Settelment from Fig No.9 of IS: 8009-1976	18	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	36.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976

Imposed load = **NSBC = 14.00** t/m^2 t/m^2

Imposed load = $\sigma_z = I_B P$ **= 0.204 X 13 = 2.86** t/m^2

(Derived using Boussinesq chart (fig.18) of IS:8009(part-1))

Settlement for imposed load (Sf) = 10.28 mm

Contd..

(For footing at 4.0 m depth)

Settlement of the cohesive soil below the cohesionless soil at 12.0 m depth upto 16.0 m depth.

Calculation of settlement for third layer (Clay layer)

Depth of foundation (D)	4.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
imposed load at F.L.(P)	14.00 T/m^2
Depth from the F.L.	8.00 m
Width of spread	18 m
Length of spread	20 m
Depth from the G.L	12.00 m
Thickness of clay layer	4.00 m

<u>Calculation of settlement :</u>

Compression Index (Cc) =	0.120
Initial void ratio (e_0) =	0.67
Thickness of layer =	4.00 m
Submerged unit weight of soil (γ_{sub}) =	1.00 g/cc
Initial Pressure P_0 =	14.00 t/m^2 [Ref. cl.no.8.1.1 from IS:8009 (part-1)-1998]
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	18.00 m
Length of spread =	20.00 m
Area of spread =	360.00 m^2
Pressure intensity (ΔP)=	3.11 t/m^2

A **Settlement of Foundation due to consolidation (Sc)**

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times Cc\ [\log_{10} (P_0 + \Delta P)/P_0]$$

Sf = 0.0250 m 25.0 mm

Due to clay layer resting on cohesionless soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 18.79 mm (Say 19 mm)

For footing at 3.0 m depth total calculated settlement in mm = 131.282 mm

Depth factor = 0.87 As per Fig No.12 of IS 8009(P-1)-1976

$S_{fd} = S_f$ x Depth factor = 114.21 mm

Rigidity factor = 0.8

Final settlement (S) in mm= 91.37 mm (say 91.00 mm)

For 25 mm settlement safe bearing pressure= 4.00 t/m^2

For 50 mm settlement safe bearing pressure= 8.00 t/m^2

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

PIER(BH NO-04) AT 2.0 M DEPTH

Depth of foundation (D) =	2.0	m	
Width of foundation (B) =	8.0	m	
Influence Zone to be extended up to	1.5 B.		
Depth of influence zone =	12.0	m depth below foundation level.	
Depth of end of influence zone from G.L	14.0	m	

a) Settlement due to cohesionless soil beneath foundation level

Cohesionless strata exist upto	10.0	m depth below foundation level	
Corrected N Value	19		
Settelment from Fig No.9 of IS: 8009-1976	18	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	36.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**13.00** t/m^2	
Settlement for imposed load (Sf) =	46.80	mm	

Due to the cohesionless soil settlement = S_1 = 46.80 mm

Contd…

(For footing at 2.0 m depth)

Settlement of the cohesive soil below the cohesionless soil at 12.0 m depth up to 14.0 m depth.

Depth of foundation (D)	2.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
Load intensity at FL (3.0m depth below existing G.L, NSBC)=	13.00 T/m^2
At the mid height of clay layer width of spread =	19.00 m
Depth of clay layer from G.L	12.00 m
Depth of clay strata from depth of consideration below FL to end of influence zone =	2.00 m

Calculation of settlement :

Compression Index (Cc) =	0.111
Initial void ratio (e_0) =	0.64
Thickness of layer =	2.00 m
Submersible density =	1.000 g/cc
Initial Pressure P_0 =	13.00 t/m^2
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	19.00 m
Length of spread =	21.00 m
Area of spread =	399.00 m^2
Pressure intensity (ΔP)=	2.61 t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \boxed{\frac{H_t}{(1+e_0)} \times C_c \left[\log_{10} (P_0 + \Delta P)/P_0 \right]}$$

Sf_1 = 0.0107 m

10.7 mm

2 Due to clay layer resting on cohesion less soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 8.06 mm (Say 8.00 mm)

Total settlemen in mm = S_1+S_c= 54.8 mm

Depth factor = 0.95 As per Fig No.12 of IS 8009(P-1)-1976

S_{fd} = S_f x Depth factor = 52.06 mm

Rigidity factor = 0.8

Final settlement= (Sfd x Rigidity Factor) 41.6 mm (Say 42mm)

For 25 mm settlement safe bearing pressure = 8.0 T/m2

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

PIER(BH NO-04) AT 3.0 M DEPTH

Depth of foundation (D) =	3.0	m	
Width of foundation (B) =	8.0	m	
Influence Zone to be extended up to	1.5 B.		
Depth of influence zone =	12.0	m depth below foundation level.	
Depth of end of influence zone from G.L	15.0	m	

a) Settlement due to cohesionless soil beneath foundation level

Cohesionless strata exist upto	9.0	m depth below foundation level	
Corrected N Value	21		
Settelment from Fig No.9 of IS: 8009-1976	17	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	34.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**		**15.00** t/m^2
Settlement for imposed load (Sf) =	51.00	mm	

Due to the cohesionless soil settlement = S_1 = 51.00 mm

Contd...

(For footing at 3.0 m depth)

Settlement of the cohesive soil below the cohesionless soil at 12.0 m depth up to 15.0 m depth.

Depth of foundation (D)	3.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
Load intensity at FL (3.0m depth below existing G.L, NSBC)=	15.00 T/m^2
At the mid height of clay layer width of spread =	18.50 m
Depth of clay layer from G.L	12.00 m
Depth of clay strata from depth of consideration below FL to end of influence zone =	3.00 m

Calculation of settlement :

Compression Index (Cc) =	0.111
Initial void ratio (e_0) =	0.64
Thickness of layer =	3.00 m
Submersible density =	1.000 g/cc
Initial Pressure P_0 =	13.50 t/m^2
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	18.50 m
Length of spread =	20.50 m
Area of spread =	379.25 m^2
Pressure intensity (ΔP)=	3.16 t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times C_c \left[\log_{10} (P_0 + \Delta P)/P_0 \right]$$

Sf_1 = 0.0186 m

18.6 mm

2 Due to clay layer resting on cohesion less soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 13.93 mm (Say 14.00 mm)

Total settlemen in mm = $S_1 + S_c$= 65.0 mm

Depth factor = 0.91 As per Fig No.12 of IS 8009(P-1)-1976

$S_{fd} = S_f$ x Depth factor = 59.15 mm

Rigidity factor = 0.8

Final settlement= (Sfd x Rigidity Factor) 47.3 mm (Say 47mm)

For 25 mm settlement safe bearing pressure = 8.0 T/m2

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

PIER(BH NO-04) AT 4.0 M DEPTH

Depth of foundation (D) =	4.0	m	
Width of foundation (B) =	8.0	m	
Influence Zone to be extended up to	1.5 B.		
Depth of influence zone =	12.0	m depth below foundation level.	
Depth of end of influence zone from G.L	16.0	m	

a) Settlement due to cohesionless soil beneath foundation level

Cohesionless strata exist upto	8.0	m depth below foundation level	
Corrected N Value	21		
Settelment from Fig No.9 of IS: 8009-1976	17	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	34.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**16.00** t/m^2	
Settlement for imposed load (Sf) =	54.40	mm	

Due to the cohesionless soil settlement = S_1 = 54.40 mm

Contd...

(For footing at 4.0 m depth)

Settlement of the cohesive soil below the cohesionless soil at 12.0 m depth up to 16.0 m depth.

Depth of foundation (D)	4.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
Load intensity at FL (3.0m depth below existing G.L, NSBC)=	16.00 T/m^2
At the mid height of clay layer width of spread =	18.00 m
Depth of clay layer from G.L	12.00 m
Depth of clay strata from depth of consideration below FL to end of influence zone =	4.00 m

Calculation of settlement :

Compression Index (Cc) =	0.111
Initial void ratio (e_0) =	0.64
Thickness of layer =	4.00 m
Submersible density =	1.000 g/cc
Initial Pressure P_0 =	14.00 t/m^2
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	18.00 m
Length of spread =	20.00 m
Area of spread =	360.00 m^2
Pressure intensity (ΔP)=	3.56 t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times C_c \left[\log_{10} (P_0 + \Delta P)/P_0 \right]$$

Sf_1 = 0.0266 m

26.6 mm

2 Due to clay layer resting on cohesion less soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 19.96 mm (Say 20.00 mm)

Total settlemen in mm = S_1+S_c= 74.4 mm

Depth factor = 0.87 As per Fig No.12 of IS 8009(P-1)-1976

S_{fd} = S_f x Depth factor = 64.73 mm

Rigidity factor = 0.8

Final settlement= (Sfd x Rigidity Factor) 51.8 mm (Say 52mm)

For 25 mm settlement safe bearing pressure = 8.0 T/m2

For 50 mm settlement safe bearing pressure = 15.0 T/m2

SETTLEMENT ANALYSIS

PIER (BH No-5) at 2.0 m depth

AS PER IS:8009 (Part -I)-1976

Depth of foundation	2.0	m	
Corrected N Value	18		
Settelment from Fig No.9 of IS: 8009-1976	18	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	36.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**10.00** t/m^2	
Settlement for imposed load (Sf) =	36.00	mm	
Depth factor =	0.95		As per IS 8009(P-1)-1976 of fig.12
$S_{fd} = S_f$ x Depth factor =	34.20	mm	
Rigidity factor =	0.8		
Final settlement (S) = (Sfd x Rigidity Factor)	27.4	mm	
say	27	mm	

For 25mm settlement safe bearing pressure = 9.00 t/m^2

SETTLEMENT ANALYSIS

PIER (BH No-5) at 3.0 m depth

AS PER IS:8009 (Part -I)-1976

Depth of foundation	3.0	m	
Corrected N Value	20		
Settelment from Fig No.9 of IS: 8009-1976	17	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	34.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**12.00** t/m^2	
Settlement for imposed load (Sf) =	40.80	mm	
Depth factor =	0.91		As per IS 8009(P-1)-1976 of fig.12
$S_{fd} = S_f$ x Depth factor =	37.13	mm	
Rigidity factor =	0.8		
Final settlement (S) = (Sfd x Rigidity Factor)	29.7	mm	
say	30	mm	
For 25mm settlement safe bearing pressure =		10.00 t/m^2	

SETTLEMENT ANALYSIS

PIER (BH No-5) at 4.0 m depth

AS PER IS:8009 (Part -I)-1976

Depth of foundation	4.0	m	
Corrected N Value	23		
Settelment from Fig No.9 of IS: 8009-1976	15	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	30.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**14.00**	t/m^2
Settlement for imposed load (Sf) =	42.00	mm	
Depth factor =	0.87		As per IS 8009(P-1)-1976 of fig.12
$S_{fd} = S_f$ x Depth factor =	36.54	mm	
Rigidity factor =	0.8		
Final settlement (S) = (Sfd x Rigidity Factor)	29.2	mm	
say	29	mm	
For 25mm settlement safe bearing pressure =	12.00	t/m^2	

SETTLEMENT ANALYSIS

PIER (BH No-6) at 2.0 m depth

AS PER IS:8009 (Part -I)-1976

Depth of foundation	2.0	m	
Corrected N Value	24		
Settelment from Fig No.9 of IS: 8009-1976	14	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	28.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**9.00**	t/m^2
Settlement for imposed load (Sf) =	25.20	mm	
Depth factor =	0.95		As per IS 8009(P-1)-1976 of fig.12
$S_{fd} = S_f$ x Depth factor =	23.94	mm	
Rigidity factor =	0.8		
Final settlement (S) = (Sfd x Rigidity Factor)	19.2	mm	
say	19	mm	

SETTLEMENT ANALYSIS

PIER (BH No-6) at 3.0 m depth

AS PER IS:8009 (Part -I)-1976

Depth of foundation	3.0	m	
Corrected N Value	29		
Settelment from Fig No.9 of IS: 8009-1976	11	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	22.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**11.00** t/m^2	
Settlement for imposed load (Sf) =	24.20	mm	
Depth factor =	0.91		As per IS 8009(P-1)-1976 of fig.12
S_{fd} = S_f x Depth factor =	22.02	mm	
Rigidity factor =	0.8		
Final settlement (S) = (Sfd x Rigidity Factor)	17.6	mm	
say	18	mm	

SETTLEMENT ANALYSIS

PIER (BH No-6) at 4.0 m depth

AS PER IS:8009 (Part -I)-1976

Depth of foundation	4.0	m	
Corrected N Value	30		
Settelment from Fig No.9 of IS: 8009-1976	10	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	20.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**13.00**	t/m^2
Settlement for imposed load (Sf) =	26.00	mm	
Depth factor =	0.87		As per IS 8009(P-1)-1976 of fig.12
$S_{fd} = S_f$ x Depth factor =	22.62	mm	
Rigidity factor =	0.8		
Final settlement (S) = (Sfd x Rigidity Factor)	18.1	mm	
say	18	mm	

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

PIER (BH NO-07) AT 2.0 M DEPTH

Depth of foundation (D) =	2.0	m	
Width of foundation (B) =	8.0	m	
Influence Zone to be extended up to	1.5 B.		
Depth of influence zone =	12.0	m depth below foundation level.	
Depth of end of influence zone from G.L	14.0	m	

a) Settlement due to cohesionless soil beneath foundation level

Cohesionless strata exist upto	7.0	m depth below foundation level	
Corrected N Value	27		
Settelment from Fig No.9 of IS: 8009-1976	13	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	26.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**13.00** t/m^2	
Settlement for imposed load (Sf) =	33.80	mm	

Due to the cohesionless soil settlement = S_1 = 33.80 mm

Contd…

(For footing at 2.0 m depth)

Settlement of the cohesive soil below the cohesionless soil at 9.0 m depth up to 14.0 m depth.

Depth of foundation (D)	2.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
Load intensity at FL (3.0m depth below existing G.L, NSBC)=	13.00 T/m^2
At the mid height of clay layer width of spread =	17.50 m
Depth of clay layer from G.L	9.00 m
Depth of clay strata from depth of consideration below FL to end of influence zone =	5.00 m

Calculation of settlement :

Compression Index (Cc) =	0.117
Initial void ratio (e_0) =	0.66
Thickness of layer =	5.00 m
Bulk density =	1.794 g/cc
Initial Pressure P_0 =	20.63 t/m^2
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	17.50 m
Length of spread =	19.50 m
Area of spread =	341.25 m^2
Pressure intensity (ΔP)=	3.05 t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times C_c \left[\log_{10}(P_0 + \Delta P)/P_0\right]$$

Sf_1 = 0.0211 m

21.1 mm

2 Due to clay layer resting on cohesion less soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 15.82 mm (Say 16.00 mm)

Total settlemen in mm = S_1+S_c= 49.8 mm

Depth factor = 0.95 As per Fig No.12 of IS 8009(P-1)-1976

S_{fd} = S_f x Depth factor = 47.31 mm

Rigidity factor = 0.8

Final settlement= (Sfd x Rigidity Factor) 37.8 mm (Say 38mm)

For 25 mm settlement safe bearing pressure = 9.0 T/m2

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

PIER (BH NO-07) AT 3.0 M DEPTH

Depth of foundation (D) =	3.0	m	
Width of foundation (B) =	8.0	m	
Influence Zone to be extended up to	1.5 B.		
Depth of influence zone =	12.0	m depth below foundation level.	
Depth of end of influence zone from G.L	15.0	m	

a) Settlement due to cohesionless soil beneath foundation level

Cohesionless strata exist upto	6.0	m depth below foundation level	
Corrected N Value	36		
Settelment from Fig No.9 of IS: 8009-1976	8.5	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	17.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**17.00** t/m^2	
Settlement for imposed load (Sf) =	28.90	mm	

Due to the cohesionless soil settlement = S_1 = 28.90 mm

Contd...

(For footing at 3.0 m depth)

Settlement of the cohesive soil below the cohesionless soil at 9.0 m depth up to 15.0 m depth.

Depth of foundation (D)	3.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
Load intensity at FL (3.0m depth below existing G.L, NSBC)=	17.00 T/m^2
At the mid height of clay layer width of spread =	17.00 m
Depth of clay layer from G.L	9.00 m
Depth of clay strata from depth of consideration below FL to end of influence zone =	6.00 m

Calculation of settlement :

Compression Index (Cc) =	0.117
Initial void ratio (e_0) =	0.66
Thickness of layer =	6.00 m
Bulk density =	1.794 g/cc
Initial Pressure P_0 =	21.53 t/m^2
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	17.00 m
Length of spread =	19.00 m
Area of spread =	323.00 m^2
Pressure intensity (ΔP)=	4.21 t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times C_c \left[\log_{10} (P_0 + \Delta P)/P_0 \right]$$

Sf_1 = 0.0328 m

32.8 mm

Due to clay layer resting on cohesion less soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 24.61 mm (Say 25.00 mm)

Total settlemen in mm = S_1+S_c= 53.9 mm

Depth factor = 0.91 As per Fig No.12 of IS 8009(P-1)-1976

$S_{fd} = S_f$ x Depth factor = 49.05 mm

Rigidity factor = 0.8

Final settlement= (Sfd x Rigidity Factor) 39.2 mm (Say 39mm)

For 25 mm settlement safe bearing pressure = 11.0 T/m2

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

PIER (BH NO-07) AT 4.0 M DEPTH

Depth of foundation (D) =	4.0	m	
Width of foundation (B) =	8.0	m	
Influence Zone to be extended up to	1.5 B.		
Depth of influence zone =	12.0	m depth below foundation level.	
Depth of end of influence zone from G.L	16.0	m	

a) Settlement due to cohesionless soil beneath foundation level

Cohesionless strata exist upto	5.0	m depth below foundation level	
Corrected N Value	36		
Settelment from Fig No.9 of IS: 8009-1976	8.5	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	17.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**22.00** t/m^2	
Settlement for imposed load (Sf) =	37.40	mm	

Due to the cohesionless soil settlement = S_1 = 37.40 mm

Contd...

(For footing at 4.0 m depth)

Settlement of the cohesive soil below the cohesionless soil at 9.0 m depth up to 16.0 m depth.

Depth of foundation (D)	4.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
Load intensity at FL (3.0m depth below existing G.L, NSBC)=	22.00 T/m^2
At the mid height of clay layer width of spread =	16.50 m
Depth of clay layer from G.L	9.00 m
Depth of clay strata from depth of consideration below FL to end of influence zone =	7.00 m

Calculation of settlement :

Compression Index (Cc) =	0.117
Initial void ratio (e_0) =	0.66
Thickness of layer =	7.00 m
Bulk density =	1.819 g/cc
Initial Pressure P_0 =	22.74 t/m^2
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	16.50 m
Length of spread =	18.50 m
Area of spread =	305.25 m^2
Pressure intensity (ΔP)=	5.77 t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times C_c \left[\log_{10} (P_0 + \Delta P)/P_0 \right]$$

Sf_1 = 0.0484 m

48.4 mm

Due to clay layer resting on cohesion less soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 36.32 mm (Say 36.00 mm)

Total settlemen in mm = S_1+S_c= 73.4 mm

Depth factor = 0.87 As per Fig No.12 of IS 8009(P-1)-1976

$S_{fd} = S_f$ x Depth factor = 63.86 mm

Rigidity factor = 0.8

Final settlement= (Sfd x Rigidity Factor) 51.1 mm (Say 51mm)

For 25 mm settlement safe bearing pressure = 11.0 T/m2

For 50 mm settlement safe bearing pressure = 22.0 T/m2

SETTLEMENT ANALYSIS

PIER (BH No-8) at 2.0 m depth

AS PER IS:8009 (Part -I)-1976

Depth of foundation	2.0	m	
Corrected N Value	47		
Settelment from Fig No.9 of IS: 8009-1976	6	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	12.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**11.00** t/m^2	
Settlement for imposed load (Sf) =	13.20	mm	
Depth factor =	0.95		As per IS 8009(P-1)-1976 of fig.12
$S_{fd} = S_f$ x Depth factor =	12.54	mm	
Rigidity factor =	0.8		
Final settlement (S) = (Sfd x Rigidity Factor)	10.0	mm	
say	10	mm	

SETTLEMENT ANALYSIS

PIER (BH No-8) at 3.0 m depth

AS PER IS:8009 (Part -I)-1976

Depth of foundation	3.0	m	
Corrected N Value	46		
Settelment from Fig No.9 of IS: 8009-1976	6.2	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	12.40	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**12.00** t/m^2	
Settlement for imposed load (Sf) =	14.88	mm	
Depth factor =	0.91		As per IS 8009(P-1)-1976 of fig.12
$S_{fd} = S_f$ x Depth factor =	13.54	mm	
Rigidity factor =	0.8		
Final settlement (S) = (Sfd x Rigidity Factor)	10.8	mm	
say	11	mm	

SETTLEMENT ANALYSIS

PIER (BH No-8) at 4.0 m depth

AS PER IS:8009 (Part -I)-1976

Depth of foundation	4.0	m	
Corrected N Value	39		
Settelment from Fig No.9 of IS: 8009-1976	7.2	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	14.40	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**14.00** t/m^2	
Settlement for imposed load (Sf) =	20.16	mm	
Depth factor =	0.87		As per IS 8009(P-1)-1976 of fig.12
$S_{fd} = S_f$ x Depth factor =	17.54	mm	
Rigidity factor =	0.8		
Final settlement (S) = (Sfd x Rigidity Factor)	14.0	mm	
say	14	mm	

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

PIER (BH NO-09) AT 3.0 M DEPTH

Depth of foundation (D) =	3.0	m	
Width of foundation (B) =	8.0	m	
Influence Zone to be extended up to	1.5 B.		
Depth of influence zone =	12.0	m depth below foundation level.	
Depth of end of influence zone from G.L	15.0	m	

a) Settlement due to cohesionless soil beneath foundation level

Cohesionless strata exist upto	6.0	m depth below foundation level	
Corrected N Value	15		
Settelment from Fig No.9 of IS: 8009-1976	24	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	48.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**13.00** t/m^2	
Settlement for imposed load (Sf) =	62.40	mm	

Due to the cohesionless soil settlement = S_1 = 62.40 mm

Contd...

(For footing at 3.0 m depth)

Settlement of the cohesive soil below the cohesionless soil at 9.0 m depth up to 15.0 m depth.

Depth of foundation (D)	3.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
Load intensity at FL (3.0m depth below existing G.L, NSBC)=	13.00 T/m^2
At the mid height of clay layer width of spread =	17.00 m
Depth of clay layer from G.L	9.00 m
Depth of clay strata from depth of consideration below FL to end of influence zone =	6.00 m

Calculation of settlement :

Compression Index (Cc) =	0.123
Initial void ratio (e_0) =	0.68
Thickness of layer =	6.00 m
Submerged density =	1.000 g/cc
Initial Pressure P_0 =	12.00 t/m^2
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	17.00 m
Length of spread =	19.00 m
Area of spread =	323.00 m^2
Pressure intensity (ΔP)=	3.22 t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times C_c \left[\log_{10} (P_0 + \Delta P)/P_0 \right]$$

Sf_1 = 0.0453 m

45.3 mm

Due to clay layer resting on cohesion less soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 34.01 mm (Say 34.00 mm)

Total settlemen in mm = S_1+S_c= 96.4 mm

Depth factor = 0.91 As per Fig No.12 of IS 8009(P-1)-1976

$S_{fd} = S_f$ x Depth factor = 87.72 mm

Rigidity factor = 0.8

Final settlement= (Sfd x Rigidity Factor) 70.2 mm (Say 70mm)

For 25 mm settlement safe bearing pressure = 5.0 T/m2

For 50 mm settlement safe bearing pressure = 9.0 T/m2

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

PIER (BH NO-09) AT 4.0 M DEPTH

Depth of foundation	(D) =	4.0	m	
Legth of foundation	(L) =	10.0	m	
Width of foundation	(B) =	8.0	m	
Influence Zone to be extended up to		1.5 B.		
Depth of influence zone =		12.0	m depth below foundation level.	
Depth of end of influence zone below the ground Level		16.0	m	

a) Settlement due to cohesionless soil beneath foundation level

Cohesionless strata exist upto	5.0	m depth below foundation level	
Average submerged Density for sand layer	1.000	g/cc	
Corrected N Value	15		
Settelment from Fig No.9 of IS: 8009-1976	24	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	48.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**14.00** t/m^2	
Settlement for imposed load (Sf) =	67.20	mm	

Due to the cohesionless soil settlement = S_1 = 67.00 mm

Contd…

(For footing at 4.0 m depth)

Settlement of the cohesive soil below the cohesionless soil at 9.0 m depth up to 15.0 m depth.

Depth of foundation (D)	4.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
Load intensity at FL (2.0 m depth below existing G.L, NSBC)=	14.00 T/m^2
At the mid height of clay layer width of spread =	16.00 m
Depth of clay layer from G.L	9.00 m
Thickness of clay layer	6.00 m

Calculation of settlement :

Compression Index (Cc) =	0.123
Initial void ratio (e_0) =	0.68
Thickness of layer =	6.00 m
Submerged density =	1.000 g/cc
Initial Pressure P_0 =	12.00 t/m^2
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	16.00 m
Length of spread =	18.00 m
Area of spread =	288.00 m^2
Pressure intensity (ΔP)=	3.89 t/m^2

a As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times C_c \left[\log_{10} (P_0 + \Delta P)/P_0 \right]$$

Sf_1 = 0.0536 m

53.6 mm

2 Due to clay layer resting on cohesion less soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 40.17 mm (Say 40.00 mm)

Contd..

(For footing at 4.0 m depth)

Settlement of the cohesionless soil below the cohesive soil at 15.0 m depth up to 16.0 m depth.

Depth of foundation	4.0	m	
Average submerged Density for sand	1.000	g/cc	
Cohesionless strata exist upto	1.0	m below	considering depth of influence zone
Corrected average N Value	18		
Settelment from Fig No.9 of IS: 8009-1976	18	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	36.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976

Imposed load = $\sigma_z = I_B$ P **= 0.148 X14= 2.07** t/m^2

(Derived using Boussinesq chart (fig.18) of IS:8009(part-1))

Settlement for imposed load S_3 (Sf) = 7.00 mm

For footing at 4.50 m depth total calculated settlement in mm = 114.00

Depth factor =	0.87		As per Fig No.12 of IS 8009(P-1)-1976
$S_{fd} = S_f$ x Depth factor =	99.18	mm	
Rigidity factor =	0.8		
Final settlement (S) in mm=	79	mm	

For 25 mm settlement safe bearing pressure = 4.0 t/m^2

For 50 mm settlement safe bearing pressure = 9.0 t/m^2

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

PIER (BH NO-11) AT 2.0 M DEPTH

Depth of foundation (D) =	2.0	m	
Width of foundation (B) =	8.0	m	
Influence Zone to be extended up to	1.5 B.		
Depth of influence zone =	12.0	m depth below foundation level.	
Depth of end of influence zone from G.L	14.0	m	

a) Settlement due to cohesionless soil beneath foundation level

Cohesionless strata exist upto	7.0	m depth below foundation level	
Corrected N Value	13		
Settelment from Fig No.9 of IS: 8009-1976	27	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	54.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**11.00** t/m^2	
Settlement for imposed load (Sf) =	59.40	mm	

Due to the cohesionless soil settlement = S_1 = 59.40 mm

Contd...

(For footing at 2.0 m depth)

Settlement of the cohesive soil below the cohesionless soil at 9.0 m depth up to 14.0 m depth.

Depth of foundation (D)	2.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
Load intensity at FL (3.0m depth below existing G.L, NSBC)=	11.00 T/m^2
At the mid height of clay layer width of spread =	17.50 m
Depth of clay layer from G.L	9.00 m
Depth of clay strata from depth of consideration below FL to end of influence zone =	5.00 m

Calculation of settlement :

Compression Index (Cc) =	0.117
Initial void ratio (e_0) =	0.66
Thickness of layer =	5.00 m
Submerged density =	1.000 g/cc
Initial Pressure P_0 =	11.50 t/m^2
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	17.50 m
Length of spread =	19.50 m
Area of spread =	341.25 m^2
Pressure intensity (ΔP)=	2.58 t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times C_c\,[\log_{10}(P_0 + \Delta P)/P_0]$$

Sf_1 = 0.0310 m

31.0 mm

2 Due to clay layer resting on cohesion less soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 23.22 mm (Say 23.00 mm)

Total settlemen in mm = S_1+S_c= 82.4 mm

Depth factor = 0.95 As per Fig No.12 of IS 8009(P-1)-1976

$S_{fd} = S_f$ x Depth factor = 78.28 mm

Rigidity factor = 0.8

Final settlement= (Sfd x Rigidity Factor) 62.6 mm (Say 63mm)

For 25 mm settlement safe bearing pressure = 4.0 T/m2

For 50 mm settlement safe bearing pressure = 9.0 T/m2

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

PIER (BH NO-11) AT 3.0 M DEPTH

Depth of foundation (D) =	3.0	m	
Width of foundation (B) =	8.0	m	
Influence Zone to be extended up to	1.5 B.		
Depth of influence zone =	12.0	m depth below foundation level.	
Depth of end of influence zone from G.L	15.0	m	

a) Settlement due to cohesionless soil beneath foundation level

Cohesionless strata exist upto	6.0	m depth below foundation level	
Corrected N Value	13		
Settelment from Fig No.9 of IS: 8009-1976	27	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	54.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**14.00** t/m^2	
Settlement for imposed load (Sf) =	75.60	mm	

Due to the cohesionless soil settlement = S_1 = 75.60 mm

Contd...

(For footing at 3.0 m depth)

Settlement of the cohesive soil below the cohesionless soil at 9.0 m depth up to 15.0 m depth.

Depth of foundation (D)	2.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
Load intensity at FL (3.0m depth below existing G.L, NSBC)=	14.00 T/m^2
At the mid height of clay layer width of spread =	17.00 m
Depth of clay layer from G.L	9.00 m
Depth of clay strata from depth of consideration below FL to end of influence zone =	6.00 m

Calculation of settlement :

Compression Index (Cc) =	0.117
Initial void ratio (e_0) =	0.66
Thickness of layer =	6.00 m
Submerged density =	1.000 g/cc
Initial Pressure P_0 =	12.00 t/m^2
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	17.00 m
Length of spread =	19.00 m
Area of spread =	323.00 m^2
Pressure intensity (ΔP)=	3.47 t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \boxed{\frac{H_t}{(1+e_0)} \times C_c \left[\log_{10} (P_0 + \Delta P)/P_0\right]}$$

Sf_1 = 0.0466 m
46.6 mm

2 Due to clay layer resting on cohesion less soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 34.96 mm (Say 35.00 mm)

Total settlemen in mm = S_1+S_c= 110.6 mm

Depth factor = 0.95 As per Fig No.12 of IS 8009(P-1)-1976

S_{fd} = S_f x Depth factor = 105.07 mm

Rigidity factor = 0.8

Final settlement= (Sfd x Rigidity Factor) 84.1 mm (Say 84mm)

For 25 mm settlement safe bearing pressure = 4.0 T/m2
For 50 mm settlement safe bearing pressure = 8.0 T/m2

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

PIER (BH NO-11) AT 4.0 M DEPTH

Depth of foundation	(D) =	4.0	m	
Legth of foundation	(L) =	10.0	m	
Width of foundation	(B) =	8.0	m	
Influence Zone to be extended up to		1.5 B.		
Depth of influence zone =		12.0	m depth below foundation level.	
Depth of end of influence zone below the ground Level		16.0	m	

a) Settlement due to cohesionless soil beneath foundation level

Cohesionless strata exist upto	5.0	m depth below foundation level	
Average submerged Density for sand layer	1.000	g/cc	
Corrected N Value	13		
Settelment from Fig No.9 of IS: 8009-1976	27	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	54.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**18.00** t/m^2	
Settlement for imposed load (Sf) =	97.20	mm	

Due to the cohesionless soil settlement = S_1 = 97.00 mm

Contd…

(For footing at 4.0 m depth)

Settlement of the cohesive soil below the cohesionless soil at 9.0 m depth up to 15.0 m depth.

Depth of foundation (D)	4.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
Load intensity at FL (2.0 m depth below existing G.L, NSBC)=	18.00 T/m^2
At the mid height of clay layer width of spread =	16.00 m
Depth of clay layer from G.L	9.00 m
Thickness of clay layer	6.00 m

Calculation of settlement :

Compression Index (Cc) =	0.117
Initial void ratio (e_0) =	0.66
Thickness of layer =	6.00 m
Submerged density =	1.000 g/cc
Initial Pressure P_0 =	12.00 t/m^2
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	16.00 m
Length of spread =	18.00 m
Area of spread =	288.00 m^2
Pressure intensity (ΔP)=	5.00 t/m^2

a As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times C_c \left[\log_{10} (P_0 + \Delta P)/P_0 \right]$$

Sf_1 = 0.0640 m

64.0 mm

2 Due to clay layer resting on cohesion less soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 47.98 mm (Say 48.00 mm)

Contd..

(For footing at 4.0 m depth)

Settlement of the cohesionless soil below the cohesive soil at 15.0 m depth up to 16.0 m depth.

Depth of foundation	4.0	m	
Average submerged Density for sand	1.000	g/cc	
Cohesionless strata exist upto	1.0	m below	considering depth of influence zone
Corrected average N Value	20		
Settelment from Fig No.9 of IS: 8009-1976	17	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	34.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976

Imposed load = $\sigma_z = I_B P$ **= 0.148 X18= 2.66** t/m^2

(Derived using Boussinesq chart (fig.18) of IS:8009(part-1))

Settlement for imposed load S_3 (Sf) =	9.00	mm	
For footing at 4.50 m depth total calculated settlement in mm =			154.00
Depth factor =	0.87		As per Fig No.12 of IS 8009(P-1)-1976
$S_{fd} = S_f$ x Depth factor =	133.98	mm	
Rigidity factor =	0.8		
Final settlement (S) in mm=	107	mm	
For 25 mm settlement safe bearing pressure =	4.0	t/m^2	
For 50 mm settlement safe bearing pressure =	8.0	t/m^2	

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

PIER (BH NO-11A) AT 2.0 M DEPTH

Depth of foundation (D) =	2.0	m	
Width of foundation (B) =	8.0	m	
Influence Zone to be extended up to	1.5 B.		
Depth of influence zone =	12.0	m depth below foundation level.	
Depth of end of influence zone from G.L	14.0	m	

a) Settlement due to cohesionless soil beneath foundation level

Cohesionless strata exist upto	4.0	m depth below foundation level	
Corrected N Value	7.5		
Settelment from Fig No.9 of IS: 8009-1976	150	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	300.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**12.00** t/m^2	
Settlement for imposed load (Sf) =	360.00	mm	

Due to the cohesionless soil settlement = S_1 = 360.00 mm

Contd...

(For footing at 2.0 m depth)

Settlement of the cohesive soil below the cohesionless soil at 6.0 m depth up to 14.0 m depth.

Depth of foundation (D)	2.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
Load intensity at FL (3.0m depth below existing G.L, NSBC)=	12.00 T/m^2
At the mid height of clay layer width of spread =	16.00 m
Depth of clay layer from G.L	6.00 m
Depth of clay strata from depth of consideration below FL to end of influence zone =	8.00 m

Calculation of settlement :

Compression Index (Cc) =	0.111
Initial void ratio (e_0) =	0.64
Thickness of layer =	8.00 m
Submerged density =	1.000 g/cc
Initial Pressure P_0 =	10.00 t/m^2
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	16.00 m
Length of spread =	18.00 m
Area of spread =	288.00 m^2
Pressure intensity (ΔP)=	3.33 t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times C_c\,[\log_{10}(P_0 + \Delta P)/P_0]$$

Sf_1 = 0.0676 m
67.6 mm

2 Due to clay layer resting on cohesion less soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 50.74 mm (Say 51.00 mm)

Total settlemen in mm = S_1+S_c= 411.0 mm

Depth factor = 0.95 As per Fig No.12 of IS 8009(P-1)-1976

$S_{fd} = S_f$ x Depth factor = 390.45 mm

Rigidity factor = 0.8

Final settlement= (Sfd x Rigidity Factor) 312.4 mm (Say 312mm)

For 25 mm settlement safe bearing pressure = 1.0 T/m2
For 50 mm settlement safe bearing pressure = 2.0 T/m2

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

PIER (BH NO-11A) AT 3.0 M DEPTH

Depth of foundation (D) =	3.0	m	
Width of foundation (B) =	8.0	m	
Influence Zone to be extended up to	1.5 B.		
Depth of influence zone =	12.0	m depth below foundation level.	
Depth of end of influence zone from G.L	15.0	m	

a) Settlement due to cohesionless soil beneath foundation level

Cohesionless strata exist upto	3.0	m depth below foundation level	
Corrected N Value	7.5		
Settelment from Fig No.9 of IS: 8009-1976	150	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	300.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**14.00** t/m^2	
Settlement for imposed load (Sf) =	420.00	mm	

Due to the cohesionless soil settlement = S_1 = 420.00 mm

Contd...

(For footing at 3.0 m depth)

Settlement of the cohesive soil below the cohesionless soil at 6.0 m depth up to 15.0 m depth.

Depth of foundation (D)	2.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
Load intensity at FL (3.0m depth below existing G.L, NSBC)=	14.00 T/m^2
At the mid height of clay layer width of spread =	15.50 m
Depth of clay layer from G.L	6.00 m
Depth of clay strata from depth of consideration below FL to end of influence zone =	9.00 m

Calculation of settlement :

Compression Index (Cc) =	0.111
Initial void ratio (e_0) =	0.64
Thickness of layer =	9.00 m
Submerged density =	1.000 g/cc
Initial Pressure P_0 =	10.50 t/m^2
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	15.50 m
Length of spread =	17.50 m
Area of spread =	271.25 m^2
Pressure intensity (ΔP)=	4.13 t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times C_c \left[\log_{10} (P_0 + \Delta P)/P_0 \right]$$

Sf_1 = 0.0877 m
87.7 mm

Due to clay layer resting on cohesion less soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 65.80 mm (Say 66.00 mm)

Total settlemen in mm = S_1+S_c= 486.0 mm

Depth factor = 0.91 As per Fig No.12 of IS 8009(P-1)-1976

$S_{fd} = S_f$ x Depth factor = 442.26 mm

Rigidity factor = 0.8

Final settlement= (Sfd x Rigidity Factor) 353.8 mm (Say 354mm)

For 25 mm settlement safe bearing pressure = 1.0 T/m2
For 50 mm settlement safe bearing pressure = 2.0 T/m2

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

PIER(BH NO-11A) AT 4.0 M DEPTH

Depth of foundation	(D) =	4.0	m	
Legth of foundation	(L) =	10.0	m	
Width of foundation	(B) =	8.0	m	
Influence Zone to be extended up to		1.5 B.		
Depth of influence zone =		12.0	m depth below foundation level.	
Depth of end of influence zone below the ground Level		16.0	m	

a) Settlement due to cohesionless soil beneath foundation level

Cohesionless strata exist upto	2.0	m depth below foundation level	
Average submerged Density for sand layer	1.000	g/cc	
Corrected N Value	7.5		
Setteltment from Fig No.9 of IS: 8009-1976	150	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	300.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**16.00** t/m^2	
Settlement for imposed load (Sf) =	480.00	mm	

Due to the cohesionless soil settlement = S_1 = 480.00 mm

Contd…

(For footing at 4.0 m depth)

Settlement of the cohesive soil below the cohesionless soil at 6.0 m depth up to 16.0 m depth.

Depth of foundation (D)	4.00 m
Length of foundation (L)	10.00 m
Width of foundation (B)	8.00 m
Load intensity at FL (2.0 m depth below existing G.L, NSBC)=	16.00 T/m^2
At the mid height of clay layer width of spread =	14.50 m
Depth of clay layer from G.L	6.00 m
Thickness of clay layer	9.00 m

Calculation of settlement :

Compression Index (Cc) =	0.111
Initial void ratio (e_0) =	0.64
Thickness of layer =	9.00 m
Submerged density =	1.000 g/cc
Initial Pressure P_0 =	10.50 t/m^2
Width of footing =	8.00 m
Length of footing =	10.00 m
Area of footing =	80.00 m^2
Width of spread =	14.50 m
Length of spread =	16.50 m
Area of spread =	239.25 m^2
Pressure intensity (ΔP)=	5.35 t/m^2

As per clause 9.2.2 of IS : 8009 (Part-I) -1976

$$S_f = \frac{H_t}{(1+e_0)} \times C_c \left[\log_{10} (P_0 + \Delta P)/P_0 \right]$$

Sf_1 = 0.1089 m

108.9 mm

Due to clay layer resting on cohesion less soil, value of λ = 0.75 As per tabel-1 of IS:8009(Pt-1)

Consolidated settlement (Sc) = Sfd x λ = 81.71 mm (Say 82.00 mm)

Contd..

(For footing at 4.0 m depth)

Settlement of the cohesionless soil below the cohesive soil at 15.0 m depth up to 16.0 m depth.

Depth of foundation	4.0	m	
Average submerged Density for sand	1.000	g/cc	
Cohesionless strata exist upto	1.0	m below	considering depth of influence zone
Corrected average N Value	28		
Settelment from Fig No.9 of IS: 8009-1976	10.4	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	20.80	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976

Imposed load = $\sigma_z = I_B P$ **= 0.148 X16=** **2.37** t/m^2

(Derived using Boussinesq chart (fig.18) of IS:8009(part-1))

Settlement for imposed load S_3 (Sf) =	5.00	mm	
For footing at 4.50 m depth total calculated settlement in mm =			567.00
Depth factor =	0.87		As per Fig No.12 of IS 8009(P-1)-1976
$S_{fd} = S_f$ x Depth factor =	493.29	mm	
Rigidity factor =	0.8		
Final settlement (S) in mm=	395	mm	
For 25 mm settlement safe bearing pressure =	1.0	t/m^2	
For 50 mm settlement safe bearing pressure =	2.0	t/m^2	

SETTLEMENT ANALYSIS

PIER (BH No-12) at 2.0 m depth

AS PER IS:8009 (Part -I)-1976

Depth of foundation	2.0	m	
Corrected N Value	30		
Settelment from Fig No.9 of IS: 8009-1976	10	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	20.00	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**79.00** t/m^2	
Settlement for imposed load (Sf) =	158.00	mm	
Depth factor =	0.95		As per IS 8009(P-1)-1976 of fig.12
$S_{fd} = S_f$ x Depth factor =	150.10	mm	
Rigidity factor =	0.8		
Final settlement (S) = (Sfd x Rigidity Factor)	120.1	mm	
say	120	mm	

For 25mm settlement safe bearing pressure = 16.00 t/m^2

For 50mm settlement safe bearing pressure = 33.00 t/m^2

SETTLEMENT ANALYSIS

PIER (BH No-12) at 3.0 m depth

AS PER IS:8009 (Part -I)-1976

Depth of foundation	3.0	m	
Corrected N Value	37		
Settelment from Fig No.9 of IS: 8009-1976	7.8	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	15.60	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**230.00** t/m^2	
Settlement for imposed load (Sf) =	358.80	mm	
Depth factor =	0.91		As per IS 8009(P-1)-1976 of fig.12
$S_{fd} = S_f$ x Depth factor =	326.51	mm	
Rigidity factor =	0.8		
Final settlement (S) = (Sfd x Rigidity Factor)	261.2	mm	
say	261	mm	

For 25mm settlement safe bearing pressure = 22.00 t/m^2

For 75mm settlement safe bearing pressure = 44.00 t/m^2

SETTLEMENT ANALYSIS

PIER (BH No-12) at 4.0 m depth

AS PER IS:8009 (Part -I)-1976

Depth of foundation	4.0	m	
Corrected N Value	37		
Settelment from Fig No.9 of IS: 8009-1976	7.8	mm	(For 10 T/m^2)
Effect of water table (W')	0.5		Insert fig of fig 9, IS:8009-1976
Corrected Settlement	15.60	mm	As per cl. No. 9.1.4 of IS 8009(P-1)-1976
Imposed load =	**NSBC =**	**281.00** t/m^2	
Settlement for imposed load (Sf) =	438.36	mm	
Depth factor =	0.87		As per IS 8009(P-1)-1976 of fig.12
$S_{fd} = S_f$ x Depth factor =	381.37	mm	
Rigidity factor =	0.8		
Final settlement (S) = (Sfd x Rigidity Factor)	305.1	mm	
say	305	mm	

For 25mm settlement safe bearing pressure = 23.00 t/m^2

For 75mm settlement safe bearing pressure = 46.00 t/m^2

ANNEXURE -F
LIQUEFACTION CALCULATION

Liquefaction Analysis Using SPT Data

Bore hole	BH 03	Water Table =	2.5 m
Sesmic Zone	IV	Magnitude (M_w) =	7
Reference Standard	IS 1893 (Part 1) : 2016		

Depth Below G.L (z) in m	Soil Classification	Observed SPT Value	Bulk Density (kN/m³)	Submerged Density (kN/m³)	Fine Content (%)	Total Vertical Overburden Stress_σ_{vo} (kPa)	Pore water Pressure (kPa)	Effective Vertical Overburden Stress_σ'_{vo} (kPa)	Stress Reduction Coefficient (rd)	Cyclic Stress Ratio (CSR)	Atmospheric Pressure_P_a (kPa)	Overburden Correction Factor (CN)	$(N_1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$	MSF	Relative Density_D_r	f	K_σ	K_α	CRR	FS	Condition
9.00	SM	24	18.15	8.15	38.95	163.350	63.765	99.585	0.931	0.238	101.41	1.009	24.219	0.500	1.200	29.56	0.44	1.19	NA	NA	1.00	1.00	0.52	2.20	Non Liquefiable
21.00	ML	50	19	9	62.17	391.350	181.485	209.865	0.613	0.178	101.56	0.696	34.783	0.500	1.200	42.24	---	---	---	---	---	---	---	---	Non Liquefiable
24.00	SM	50	19	9	33.05	448.350	210.915	237.435	0.560	0.165	101.60	0.654	32.707	4.884	1.180	43.48	---	---	---	---	---	---	---	---	Non Liquefiable
27.00	SM	50	19	9	27.12	505.350	240.345	265.005	0.560	0.167	101.64	0.619	30.965	4.489	1.131	39.52	---	---	---	---	---	---	---	---	Non Liquefiable
30.00	SM	50	19	9	30.52	562.350	269.775	292.575	0.560	0.168	101.68	0.590	29.475	4.740	1.159	38.89	---	---	---	---	---	---	---	---	Non Liquefiable
32.00	SM	50	19	9	34.55	600.350	289.395	310.955	0.560	0.169	101.70	0.572	28.594	4.957	1.193	39.07	---	---	---	---	---	---	---	---	Non Liquefiable

Since the value of (N1)60cs is graeter than equal to 30, so the soil are too densed to liquefy and are classed as nonliquefiable.

Liquefaction Analysis Using SPT Data

Bore hole	BH 04	Water Table =	2 m
Sesmic Zone	IV	Magnitude (M_w) =	7
Reference Standard	IS 1893 (Part 1) : 2016		

Depth Below G.L (z) in m	Soil Classification	Observed SPT Value	Bulk Density (kN/m³)	Submerged Density (kN/m³)	Fine Content (%)	Total Vertical Overburden Stress_σ_{vo} (kPa)	Pore water Pressure (kPa)	Effective Vertical Overburden Stress_σ'_{vo} (kPa)	Stress Reduction Coefficient (rd)	Cyclic Stress Ratio (CSR)	Atmospheric Pressure_P_a (kPa)	Overburden Correction Factor (CN)	$(N_1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$	MSF	Relative Density_D_r	f	K_σ	K_α	CRR	FS	Condition
1.50	ML	16	17.68	7.68	62.17	26.520	---	26.520	0.989	0.154	101.32	1.700	27.200	0.500	1.200	33.14	---	---	---	---	---	---	---	---	Non Liquefiable
3.00	ML	17	17.68	7.68	33.05	53.040	9.810	43.230	0.977	0.187	101.34	1.531	26.028	4.884	1.180	35.60	---	---	---	---	---	---	---	---	Non Liquefiable
4.50	SM	18	17.81	7.81	27.12	79.755	24.525	55.230	0.966	0.218	101.36	1.355	24.384	4.489	1.131	32.07	---	---	---	---	---	---	---	---	Non Liquefiable
6.00	SM	27	17.95	7.95	30.52	106.680	39.240	67.440	0.954	0.235	101.38	1.226	33.103	4.740	1.159	43.09	---	---	---	---	---	---	---	---	Non Liquefiable
9.00	SM	36	18.19	8.19	34.55	161.250	68.670	92.580	0.931	0.253	101.41	1.047	37.678	4.957	1.193	49.91	---	---	---	---	---	---	---	---	Non Liquefiable
21.00	SM	50	19	9	39.01	389.250	186.390	202.860	0.613	0.184	101.56	0.708	35.378	0.500	1.200	42.95	---	---	---	---	---	---	---	---	Non Liquefiable
24.00	SM	50	19	9	38.82	446.250	215.820	230.430	0.560	0.169	101.60	0.664	33.201	0.500	1.200	40.34	---	---	---	---	---	---	---	---	Non Liquefiable
27.00	SM	50	19	9	41.17	503.250	245.250	258.000	0.560	0.170	101.64	0.628	31.382	0.500	1.200	38.16	---	---	---	---	---	---	---	---	Non Liquefiable
30.00	SM	50	19	9	37.27	560.250	274.680	285.570	0.560	0.171	101.68	0.597	29.835	0.500	1.200	36.30	---	---	---	---	---	---	---	---	Non Liquefiable
32.00	SM	50	19	9	36.23	598.250	294.300	303.950	0.560	0.172	101.70	0.578	28.922	0.500	1.200	35.21	---	---	---	---	---	---	---	---	Non Liquefiable

Since the value of (N1)60cs is graeter than equal to 30, so the soil are too densed to liquefy and are classed as nonliquefiable.

Consultant:	Geotechnical Investigation Report		Client :
S.M. CONSULTANTS BHUBANESWAR	Job No:- 830	Report No:- SMC-2050	Haryana Rail Infrastructure Development Corporation Ltd

Liquefaction Analysis Using SPT Data

Bore hole: **BH 05** — Water Table = 3 m — Reference Standard: **IS 1893 (Part 1) : 2016**

Sesmic Zone: **IV** — Magnitude (M_w) = 7

Depth Below G.L (z) in m	Soil Classification	Observed SPT Value	Bulk Density (kN/m³)	Submerged Density (kN/m³)	Fine Content (%)	Total Vertical Overburden Stress_σ_{vo} (kPa)	Pore water Pressure (kPa)	Effective Vertical Overburden Stress_σ'_{vo} (kPa)	Stress Reduction Coefficient (rd)	Cyclic Stress Ratio (CSR)	Atmospheric Pressure_P_a (kPa)	Overburden Correction Factor (CN)	$(N_1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$	MSF	Relative Density_D_r	f	K_σ	K_α	CRR	FS	Condition
1.50	ML	15	17.63	7.63	68.81	26.445	---	26.445	0.989	0.154	101.32	1.700	25.500	0.500	1.200	31.10	---	---	---	---	---	---	---	---	Non Liquefiable
3.00	SC	19	17.63	7.63	46.08	52.890	0.000	52.890	0.977	0.152	101.34	1.384	26.300	0.500	1.200	32.06	---	---	---	---	---	---	---	---	Non Liquefiable
4.50	ML	23	17.74	7.74	53.54	79.500	14.715	64.785	0.966	0.185	101.36	1.251	28.768	0.500	1.200	35.02	---	---	---	---	---	---	---	---	Non Liquefiable
6.00	SC	25	17.84	7.84	32.89	106.260	29.430	76.830	0.954	0.206	101.38	1.149	28.717	4.876	1.179	38.72	---	---	---	---	---	---	---	---	Non Liquefiable
9.00	SC	28	18.05	8.05	46.34	160.410	58.860	101.550	0.931	0.229	101.41	0.999	27.981	0.500	1.200	34.08	---	---	---	---	---	---	---	---	Non Liquefiable
12.00	SC	39	18.26	8.26	47.3	215.190	88.290	126.900	0.854	0.226	101.45	0.894	34.871	0.500	1.200	42.34	---	---	---	---	---	---	---	---	Non Liquefiable
15.00	SC	50	18.51	8.51	48.48	270.720	117.720	153.000	0.774	0.214	101.49	0.814	40.722	0.500	1.200	49.37	---	---	---	---	---	---	---	---	Non Liquefiable
30.00	SC	50	19.34	9.34	46.8	560.820	264.870	295.950	0.560	0.166	101.68	0.586	29.307	0.500	1.200	35.67	---	---	---	---	---	---	---	---	Non Liquefiable
32.00	SC	50	19.34	9.34	46.63	599.500	284.490	315.010	0.560	0.166	101.70	0.568	28.410	0.500	1.200	34.59	---	---	---	---	---	---	---	---	Non Liquefiable

Since the value of (N1)60cs is graeter than equal to 30, so the soil are too densed to liquefy and are classed as nonliquefiable.

Liquefaction Analysis Using SPT Data

Bore hole: **BH 06** — Water Table = **Not Found** — Reference Standard: **IS 1893 (Part 1) : 2016**

Sesmic Zone: **IV** — Magnitude (M_w) = 7

Depth Below G.L (z) in m	Soil Classification	Observed SPT Value	Bulk Density (kN/m³)	Submerged Density (kN/m³)	Fine Content (%)	Total Vertical Overburden Stress_σ_{vo} (kPa)	Effective Vertical Overburden Stress_σ'_{vo} (kPa)	Stress Reduction Coefficient (rd)	Cyclic Stress Ratio (CSR)	Atmospheric Pressure_P_a (kPa)	Overburden Correction Factor (CN)	$(N_1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$	MSF	Relative Density_D_r	f	K_σ	K_α	CRR	FS	Condition
1.50	ML	15	17.58	7.58	61.49	26.370	26.370	0.989	0.154	101.32	1.700	25.500	0.500	1.200	31.10	---	---	---	---	---	---	---	---	Non Liquefiable
3.00	ML	20	17.58	7.58	58.79	52.740	52.740	0.977	0.152	101.34	1.386	27.723	0.500	1.200	33.77	---	---	---	---	---	---	---	---	Non Liquefiable
4.50	ML	25	17.76	7.76	58.57	79.380	79.380	0.966	0.151	101.36	1.130	28.249	0.500	1.200	34.40	---	---	---	---	---	---	---	---	Non Liquefiable
6.00	SM	32	17.94	7.94	36.4	106.830	106.830	0.954	0.149	101.38	0.974	31.172	0.500	1.200	37.91	---	---	---	---	---	---	---	---	Non Liquefiable
9.00	SM	39	18.05	8.05	39.19	161.790	161.790	0.931	0.145	101.41	0.792	30.877	0.500	1.200	37.55	---	---	---	---	---	---	---	---	Non Liquefiable
12.00	SM	43	18.16	8.16	44.43	216.930	216.930	0.854	0.133	101.45	0.684	29.406	0.500	1.200	35.79	---	---	---	---	---	---	---	---	Non Liquefiable
15.00	ML	47	18.40	8.395	61.84	273.105	273.105	0.774	0.121	101.49	0.610	28.651	0.500	1.200	34.88	---	---	---	---	---	---	---	---	Non Liquefiable
18.00	ML	50	18.63	8.63	60.61	331.815	331.815	0.693	0.108	101.53	0.553	27.657	0.500	1.200	33.69	---	---	---	---	---	---	---	---	Non Liquefiable
21.00	ML	50	18.79	8.79	56.27	391.710	391.710	0.613	0.096	101.56	0.509	25.460	0.500	1.200	31.05	---	---	---	---	---	---	---	---	Non Liquefiable
24.00	SM	50	18.95	8.95	41.47	451.440	451.440	0.560	0.087	101.60	0.474	23.720	0.500	1.200	28.96	0.41	1.19	NA	NA	1.00	1.00	0.49	5.58	Non Liquefiable
27.00	SM	50	19.19	9.19	44.08	512.370	512.370	0.560	0.087	101.64	0.445	22.269	0.500	1.200	27.22	0.34	1.19	NA	NA	1.00	1.00	0.41	4.71	Non Liquefiable
30.00	SM	50	19.43	9.43	35.54	576.420	576.420	0.560	0.087	101.68	0.420	20.999	0.500	1.200	25.70	0.31	1.19	NA	NA	1.00	1.00	0.37	4.18	Non Liquefiable
32.00	SM	50	19.43	9.43	37.86	621.760	621.760	0.560	0.087	101.70	0.404	20.222	0.500	1.200	24.77	0.29	1.19	NA	NA	1.00	1.00	0.34	3.92	Non Liquefiable

Since the value of (N1)60cs is graeter than equal to 30, so the soil are too densed to liquefy and are classed as nonliquefiable.

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

Liquefaction Analysis Using SPT Data

Bore hole: BH 07 | Water Table = Not Found | Reference Standard: IS 1893 (Part 1) : 2016

Sesmic Zone: IV | Magnitude (M_w) = 7

Depth Below G.L (z) in m	Soil Classification	Observed SPT Value	Bulk Density (kN/m³)	Submerged Density (kN/m³)	Fine Content (%)	Total Vertical Overburden Stress_σ_{vo} (kPa)	Effective Vertical Overburden Stress_σ'_{vo} (kPa)	Stress Reduction Coefficient (rd)	Cyclic Stress Ratio (CSR)	Atmospheric Pressure_P_a (kPa)	Overburden Correction Factor (C_N)	$(N_1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$	MSF	Relative Density_D_r	f	K_σ	K_α	CRR	FS	Condition
1.50	SP-SM	18	17.72	7.72	10.38	26.580	26.580	0.989	0.154	101.32	1.700	30.600	0.997	1.023	32.31	---	---	---	---	---	---	---	---	Non Liquefiable
3.00	SM	27	17.72	7.72	24.05	53.160	53.160	0.977	0.152	101.34	1.381	37.278	4.185	1.108	45.49	---	---	---	---	---	---	---	---	Non Liquefiable
4.50	SP	36	17.83	7.83	0.81	79.905	79.905	0.966	0.151	101.36	1.126	40.545	0.000	1.000	40.55	---	---	---	---	---	---	---	---	Non Liquefiable
6.00	SM	43	17.94	7.94	29.11	106.815	106.815	0.954	0.149	101.38	0.974	41.891	4.645	1.147	52.70	---	---	---	---	---	---	---	---	Non Liquefiable
18.00	SP-SM	50	18.94	8.94	6.94	334.095	334.095	0.693	0.108	101.53	0.551	27.563	0.112	1.008	27.90	0.37	1.19	NA	NA	1.00	1.00	0.44	4.04	Non Liquefiable
27.00	SM	50	19.82	9.82	46.34	512.475	512.475	0.560	0.087	101.64	0.445	22.267	0.500	1.200	27.22	0.34	1.19	NA	NA	1.00	1.00	0.41	4.71	Non Liquefiable
30.00	SM	50	19.92	9.92	46.67	572.235	572.235	0.560	0.087	101.68	0.422	21.076	0.500	1.200	25.79	0.31	1.19	NA	NA	1.00	1.00	0.37	4.21	Non Liquefiable
32.00	SM	50	19.92	9.92	48.45	612.075	612.075	0.560	0.087	101.70	0.408	20.381	0.500	1.200	24.96	0.29	1.19	NA	NA	1.00	1.00	0.35	3.97	Non Liquefiable

Since the value of (N1)60cs is graeter than equal to 30, so the soil are too densed to liquefy and are classed as nonliquefiable.

Liquefaction Analysis Using SPT Data

Bore hole: BH 08 | Water Table = Not Found | Reference Standard: IS 1893 (Part 1) : 2016

Sesmic Zone: IV | Magnitude (M_w) = 7

Depth Below G.L (z) in m	Soil Classification	Observed SPT Value	Bulk Density (kN/m³)	Submerged Density (kN/m³)	Fine Content (%)	Total Vertical Overburden Stress_σ_{vo} (kPa)	Effective Vertical Overburden Stress_σ'_{vo} (kPa)	Stress Reduction Coefficient (rd)	Cyclic Stress Ratio (CSR)	Atmospheric Pressure_P_a (kPa)	Overburden Correction Factor (C_N)	$(N_1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$	MSF	Relative Density_D_r	f	K_σ	K_α	CRR	FS	Condition
1.50	ML	50	17.58	7.58	52.82	26.370	26.370	0.989	0.154	101.32	1.700	85.000	0.500	1.200	102.50	---	---	---	---	---	---	---	---	Non Liquefiable
3.00	ML	50	17.58	7.58	52.61	52.740	52.740	0.977	0.152	101.34	1.386	69.308	0.500	1.200	83.67	---	---	---	---	---	---	---	---	Non Liquefiable
4.50	ML	50	17.85	7.85	59.3	79.515	79.515	0.966	0.151	101.36	1.129	56.451	0.500	1.200	68.24	---	---	---	---	---	---	---	---	Non Liquefiable
6.00	ML	50	18.12	8.12	53.84	106.695	106.695	0.954	0.149	101.38	0.975	48.738	0.500	1.200	58.99	---	---	---	---	---	---	---	---	Non Liquefiable
9.00	ML	50	18.37	8.37	54.97	161.805	161.805	0.931	0.145	101.41	0.792	39.584	0.500	1.200	48.00	---	---	---	---	---	---	---	---	Non Liquefiable
12.00	ML	50	18.63	8.63	62.5	217.695	217.695	0.854	0.133	101.45	0.683	34.133	0.500	1.200	41.46	---	---	---	---	---	---	---	---	Non Liquefiable
15.00	SC	50	18.79	8.79	49.32	274.065	274.065	0.774	0.121	101.49	0.609	30.426	0.500	1.200	37.01	---	---	---	---	---	---	---	---	Non Liquefiable
18.00	SC	50	18.95	8.95	44.86	330.915	330.915	0.693	0.108	101.53	0.554	27.695	0.500	1.200	33.73	---	---	---	---	---	---	---	---	Non Liquefiable
20.00	SC	50	18.95	8.95	42.06	368.815	368.815	0.640	0.100	101.55	0.525	26.236	0.500	1.200	31.98	---	---	---	---	---	---	---	---	Non Liquefiable

Since the value of (N1)60cs is graeter than equal to 30, so the soil are too densed to liquefy and are classed as nonliquefiable.

Liquefaction Analysis Using SPT Data

Bore hole: BH 09 — Water Table = 1.9 m — Reference Standard: IS 1893 (Part 1) : 2016

Sesmic Zone: IV — Magnitude (M_w) = 7

Depth Below G.L (z) in m	Soil Classification	Observed SPT Value	Bulk Density (kN/m³)	Submerged Density (kN/m³)	Fine Content (%)	Total Vertical Overburden Stress_σ_{vo} (kPa)	Pore water Pressure (kPa)	Effective Vertical Overburden Stress_σ'_{vo} (kPa)	Stress Reduction Coefficient (rd)	Cyclic Stress Ratio (CSR)	Atmospheric Pressure_P_a (kPa)	Overburden Correction Factor (CN)	$(N_1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$	MSF	Relative Density_D_r	f	K_σ	K_α	CRR	FS	Condition
1.50	ML	5	17.55	7.55	58.23	26.325	---	26.325	0.989	0.154	101.32	1.700	8.500	0.500	1.200	10.70	0.12	1.19	NA	NA	1.00	1.00	0.14	0.92	Liquefiable
6.00	SM	19	17.93	7.93	46.8	107.010	40.221	66.789	0.954	0.238	101.38	1.232	23.408	0.500	1.200	28.59	0.39	1.19	NA	NA	1.00	1.00	0.47	1.96	Non Liquefiable
18.00	ML	25	19	9	69.97	335.010	157.941	177.069	0.693	0.205	101.53	0.757	18.930	0.500	1.200	23.22	0.26	1.19	NA	NA	1.00	1.00	0.31	1.52	Non Liquefiable
24.00	ML	29	19.26	9.26	73.58	450.570	216.801	233.769	0.533	0.160	101.60	0.659	19.118	0.500	1.200	23.44	0.26	1.19	NA	NA	1.00	1.00	0.31	1.96	Non Liquefiable
30.00	SM	50	19.26	9.26	46.34	566.130	275.661	290.469	0.373	0.113	101.68	0.592	29.582	0.500	1.200	36.00	---	---	---	---	---	---	---	---	Non Liquefiable
33.00	SM	50	19.26	9.26	48.57	623.910	305.091	318.819	0.293	0.089	101.71	0.565	28.241	0.500	1.200	34.39	---	---	---	---	---	---	---	---	Non Liquefiable
36.00	SM	50	19.26	9.26	42.04	681.690	334.521	347.169	0.213	0.065	101.75	0.541	27.069	0.500	1.200	32.98	---	---	---	---	---	---	---	---	Non Liquefiable
39.00	SM	50	19.26	9.26	33.87	739.470	363.951	375.519	0.560	0.172	101.79	0.521	26.032	4.925	1.187	35.83	---	---	---	---	---	---	---	---	Non Liquefiable
40.00	SM	50	19.26	9.26	45.01	758.730	373.761	384.969	0.560	0.172	101.80	0.514	25.712	0.500	1.200	31.35	---	---	---	---	---	---	---	---	Non Liquefiable

Since the value of (N1)60cs is graeter than equal to 30, so the soil are too densed to liquefy and are classed as nonliquefiable.

Liquefaction Analysis Using SPT Data

Bore hole: BH 10 — Water Table = 2.4 m — Reference Standard: IS 1893 (Part 1) : 2016

Sesmic Zone: IV — Magnitude (M_w) = 7

Depth Below G.L (z) in m	Soil Classification	Observed SPT Value	Bulk Density (kN/m³)	Submerged Density (kN/m³)	Fine Content (%)	Total Vertical Overburden Stress_σ_{vo} (kPa)	Pore water Pressure (kPa)	Effective Vertical Overburden Stress_σ'_{vo} (kPa)	Stress Reduction Coefficient (rd)	Cyclic Stress Ratio (CSR)	Atmospheric Pressure_P_a (kPa)	Overburden Correction Factor (CN)	$(N_1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$	MSF	Relative Density_D_r	f	K_σ	K_α	CRR	FS	Condition
3.00	SM	5	17.74	7.74	38.14	53.220	5.886	47.334	0.977	0.171	101.34	1.463	7.316	0.500	1.200	9.28	0.11	1.19	NA	NA	1.00	1.00	0.13	0.74	Liquefiable
6.00	SM	11	18.01	8.01	36.29	107.250	35.316	71.934	0.954	0.222	101.38	1.187	13.058	0.500	1.200	16.17	0.17	1.19	NA	NA	1.00	1.00	0.21	0.92	Liquefiable
18.00	SM	17	18.88	8.88	42.28	333.810	153.036	180.774	0.693	0.200	101.53	0.749	12.740	0.500	1.200	15.79	0.17	1.19	NA	NA	1.00	1.00	0.20	1.00	Non Liquefiable
24.00	SM	30	19.19	9.19	35.99	448.950	211.896	237.054	0.533	0.158	101.60	0.655	19.640	0.500	1.200	24.07	0.27	1.19	NA	NA	1.00	1.00	0.33	2.08	Non Liquefiable
30.00	SM	50	19.43	9.43	37.45	565.530	270.756	294.774	0.373	0.112	101.68	0.587	29.365	0.500	1.200	35.74	---	---	---	---	---	---	---	---	Non Liquefiable
33.00	ML	50	19.43	9.43	66.25	623.820	300.186	323.634	0.293	0.088	101.71	0.561	28.030	0.500	1.200	34.14	---	---	---	---	---	---	---	---	Non Liquefiable
36.00	SM	50	19.43	9.43	33.38	682.110	329.616	352.494	0.213	0.064	101.75	0.537	26.863	4.901	1.183	36.68	---	---	---	---	---	---	---	---	Non Liquefiable
39.00	SM	50	19.43	9.43	35.23	740.400	359.046	381.354	0.560	0.170	101.79	0.517	25.832	0.500	1.200	31.50	---	---	---	---	---	---	---	---	Non Liquefiable
40.00	SM	50	19.43	9.43	45.14	759.830	368.856	390.974	0.560	0.170	101.80	0.510	25.513	0.500	1.200	31.12	---	---	---	---	---	---	---	---	Non Liquefiable

Since the value of (N1)60cs is graeter than equal to 30, so the soil are too densed to liquefy and are classed as nonliquefiable.

Liquefaction Analysis Using SPT Data

Bore hole: **BH 11** | Water Table = 1.8 m | Reference Standard: **IS 1893 (Part 1) : 2016**

Sesmic Zone: **IV** | Magnitude (M_w) = 7

Depth Below G.L (z) in m	Soil Classification	Observed SPT Value	Bulk Density (kN/m³)	Submerged Density (kN/m³)	Fine Content (%)	Total Vertical Overburden Stress_σ_{vo} (kPa)	Pore water Pressure (kPa)	Effective Vertical Overburden Stress_σ'_{vo} (kPa)	Stress Reduction Coefficient (rd)	Cyclic Stress Ratio (CSR)	Atmospheric Pressure_P_a (kPa)	Overburden Correction Factor (C_N)	$(N_1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$	MSF	Relative Density_D_r	f	K_σ	K_α	CRR	FS	Condition
3.00	SM	9	17.75	7.75	41.83	53.250	11.772	41.478	0.977	0.196	101.34	1.563	14.068	0.500	1.200	17.38	0.18	1.19	NA	NA	1.00	1.00	0.22	1.13	Non Liquefiable
6.00	SM	18	18.29	8.29	15.64	108.120	41.202	66.918	0.954	0.240	101.38	1.231	22.155	2.673	1.052	25.98	0.31	1.19	NA	NA	1.00	1.00	0.37	1.55	Non Liquefiable
18.00	SM	32	19.02	9.02	35.29	336.360	158.922	177.438	0.693	0.205	101.53	0.756	24.205	0.500	1.200	29.55	0.44	1.19	NA	NA	1.00	1.00	0.52	2.55	Non Liquefiable
24.00	SM	37	19.37	9.37	41.71	452.580	217.782	234.798	0.533	0.160	101.60	0.658	24.339	0.500	1.200	29.71	0.45	1.19	NA	NA	1.00	1.00	0.53	3.34	Non Liquefiable
30.00	SM	50	19.56	9.56	15	569.940	276.642	293.298	0.373	0.113	101.68	0.589	29.439	2.498	1.048	33.35	---	---	---	---	---	---	---	---	Non Liquefiable
33.00	SM	50	19.56	9.56	17.17	628.620	306.072	322.548	0.293	0.089	101.71	0.562	28.078	3.051	1.061	32.85	---	---	---	---	---	---	---	---	Non Liquefiable
36.00	SM	50	19.56	9.56	16.26	687.300	335.502	351.798	0.213	0.065	101.75	0.538	26.890	2.833	1.056	31.22	---	---	---	---	---	---	---	---	Non Liquefiable
39.00	SM	50	19.56	9.56	15.97	745.980	364.932	381.048	0.560	0.171	101.79	0.517	25.842	2.759	1.054	29.99	---	---	---	---	---	---	---	---	Non Liquefiable
40.00	SM	50	19.56	9.56	13.38	765.540	374.742	390.798	0.560	0.171	101.80	0.510	25.519	2.011	1.039	28.52	---	---	---	---	---	---	---	---	Non Liquefiable

Since the value of (N1)60cs is graeter than equal to 30, so the soil are too densed to liquefy and are classed as nonliquefiable.

Liquefaction Analysis Using SPT Data

Bore hole: **BH 11A** | Water Table = 6.5 m | Reference Standard: **IS 1893 (Part 1) : 2016**

Sesmic Zone: **IV** | Magnitude (M_w) = 7

Depth Below G.L (z) in m	Soil Classification	Observed SPT Value	Bulk Density (kN/m³)	Submerged Density (kN/m³)	Fine Content (%)	Total Vertical Overburden Stress_σ_{vo} (kPa)	Pore water Pressure (kPa)	Effective Vertical Overburden Stress_σ'_{vo} (kPa)	Stress Reduction Coefficient (rd)	Cyclic Stress Ratio (CSR)	Atmospheric Pressure_P_a (kPa)	Overburden Correction Factor (C_N)	$(N_1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$	MSF	Relative Density_D_r	f	K_σ	K_α	CRR	FS	Condition
3.00	SM	5	17.89	7.89	24.42	53.670	---	53.670	0.977	0.152	101.34	1.374	6.871	4.227	1.111	11.86	0.13	1.19	NA	NA	1.00	1.00	0.15	1.02	Non Liquefiable
18.00	SM	50	19.03	9.03	29.78	339.120	112.815	339.120	0.693	0.108	101.53	0.547	27.358	4.692	1.153	36.22	---	---	---	---	---	---	---	---	Non Liquefiable
21.00	SM	50	19.03	9.03	22.38	396.210	142.245	253.965	0.613	0.149	101.56	0.632	31.619	3.978	1.096	38.63	---	---	---	---	---	---	---	---	Non Liquefiable
24.00	SM	50	19.03	9.03	21.25	453.300	171.675	281.625	0.533	0.134	101.60	0.601	30.032	3.816	1.088	36.49	---	---	---	---	---	---	---	---	Non Liquefiable
27.00	SM	50	19.03	9.03	23.43	510.390	201.105	309.285	0.453	0.117	101.64	0.573	28.663	4.112	1.103	35.74	---	---	---	---	---	---	---	---	Non Liquefiable
30.00	SM	50	19.03	9.03	21.51	567.480	230.535	336.945	0.373	0.098	101.68	0.549	27.466	3.855	1.090	33.79	---	---	---	---	---	---	---	---	Non Liquefiable
33.00	SM	50	19.03	9.03	17.43	624.570	259.965	364.605	0.293	0.078	101.71	0.528	26.409	3.110	1.063	31.18	---	---	---	---	---	---	---	---	Non Liquefiable

Since the value of (N1)60cs is graeter than equal to 30, so the soil are too densed to liquefy and are classed as nonliquefiable.

Consultant:	Geotechnical Investigation Report		Client :
S.M. CONSULTANTS BHUBANESWAR	Job No:- 830	Report No:- SMC-2050	Haryana Rail Infrastructure Development Corporation Ltd

Bore hole	BH 12						Water Table =		Not Found									Reference Standard			IS 1893 (Part 1) : 2016				
Sesmic Zone	IV						Magnitude (M_w) =		7																
Depth Below G.L (z) in m	Soil Classification	Observed SPT Value	Bulk Density (kN/m³)	Submerged Density (kN/m³)	Fine Content (%)	Total Vertical Overburden Stress_σ_{vo} (kPa)	Effective Vertical Overburden Stress_σ'_{vo} (kPa)	Stress Reduction Coefficient (rd)	Cyclic Stress Ratio (CSR)	Atmospheric Pressure_P_a (kPa)	Overburden Correction Factor (C_N)	$(N_1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$	MSF	Relative Density_D_r	f	K_σ	K_α	CRR	FS	Condition	
0.50	ML	17	17.9	7.9	51.90	8.95	8.95	0.996	0.155	101.306	1.700	28.900	0.500	1.200	35.18	---	---	---	---	---	---	---	---	Non Liquefiable	
1.50	ML	24	17.9	7.9	50.74	26.85	26.85	0.989	0.154	101.319	1.700	40.800	0.500	1.200	49.46	---	---	---	---	---	---	---	---	Non Liquefiable	
3.00	ML	50	17.9	7.9	50.36	53.70	53.70	0.977	0.152	101.338	1.374	68.686	0.500	1.200	82.92	---	---	---	---	---	---	---	---	Non Liquefiable	

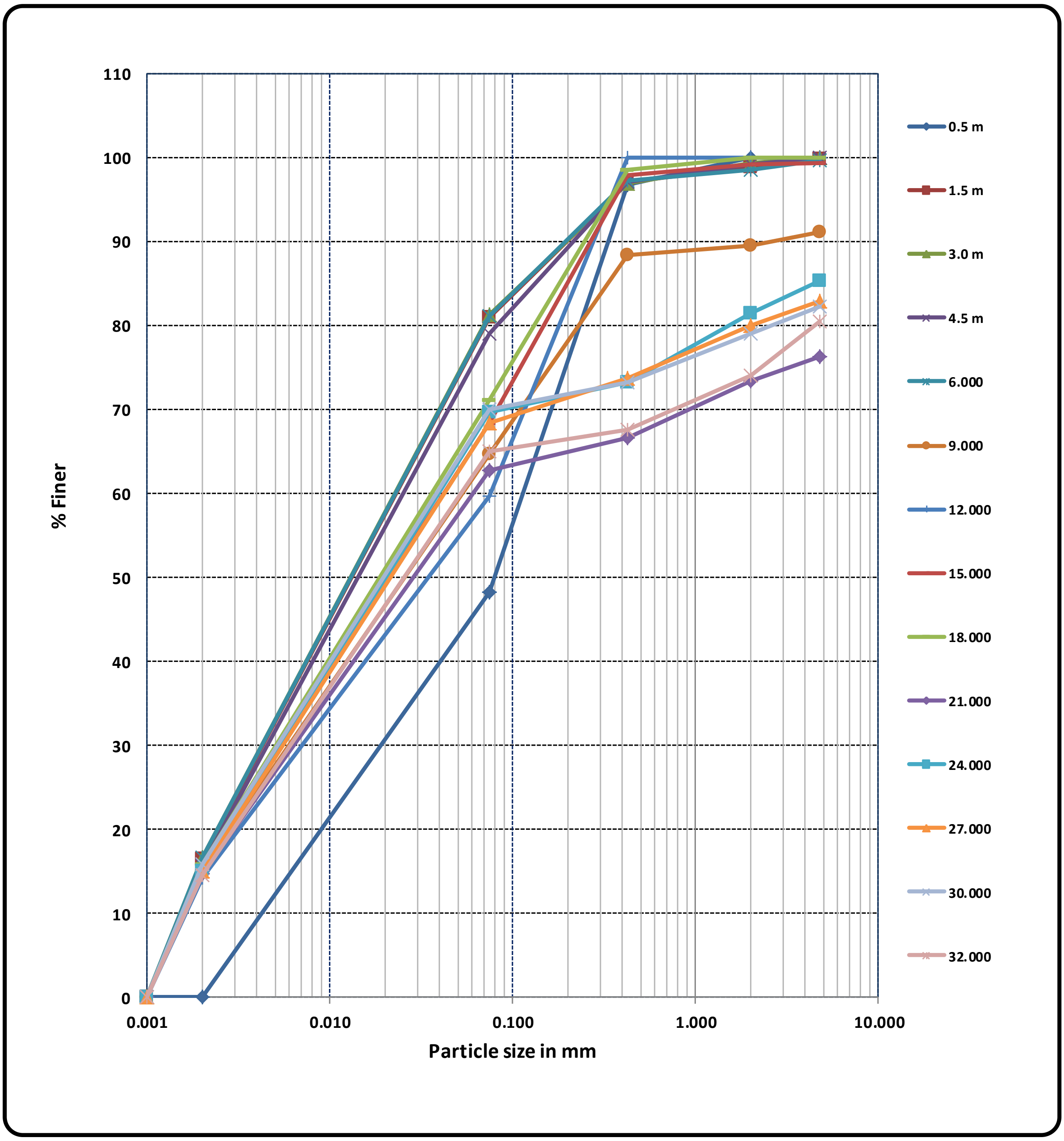
Since the value of (N1)60cs is graeter than equal to 30, so the soil are too densed to liquefy and are classed as nonliquefiable.

Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

ANNEXURE -G
GRAIN SIZE DISTRIBUTION CURVE

Consultant:	Geotechnical Investigation Report		Client :
S.M. CONSULTANTS BHUBANESWAR	Job No:830	Report No. SMC-2050	Haryana Rail Infrastructure Development Corporation Ltd

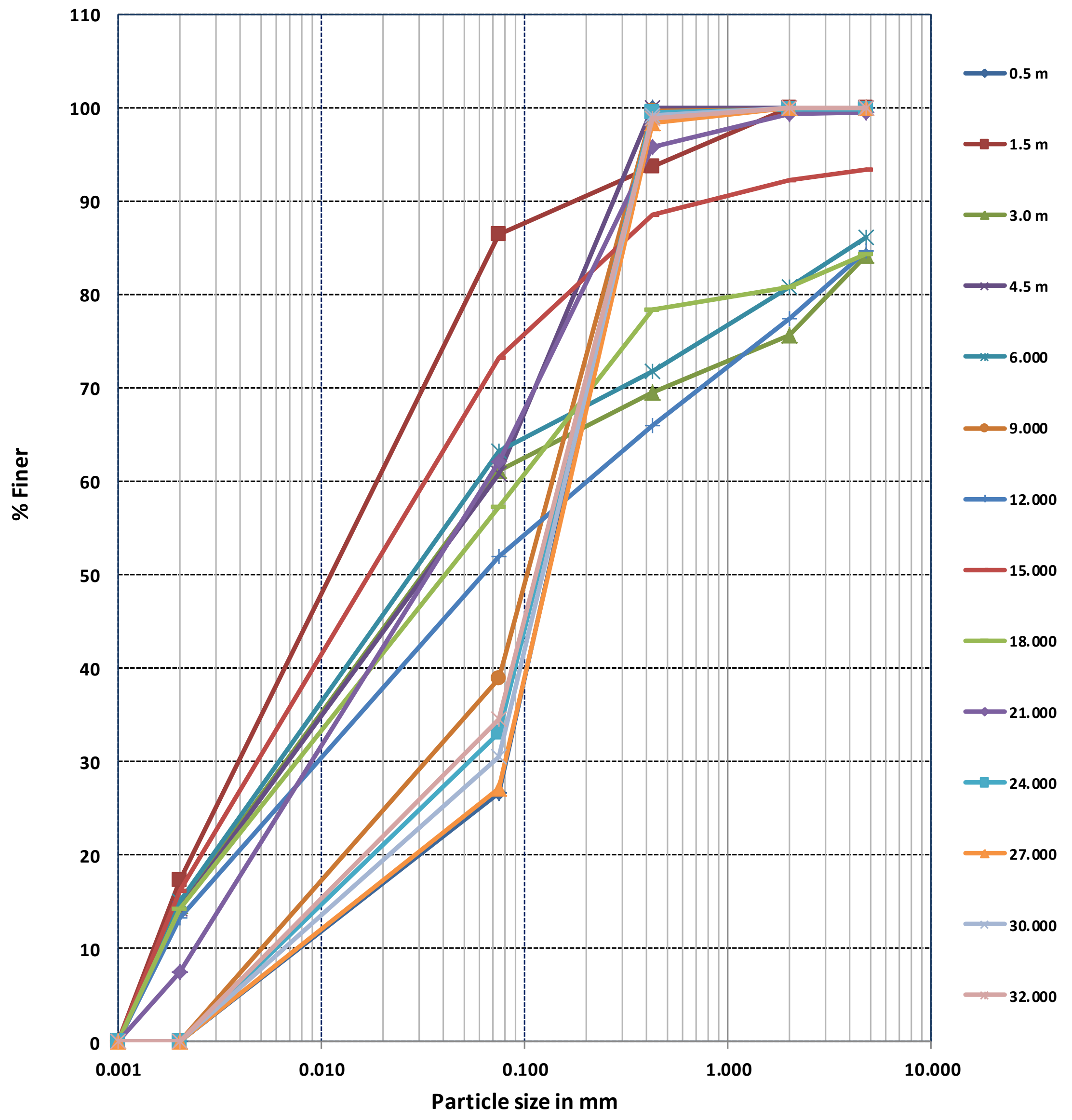
GRAIN SIZE DISTRIBUTION CURVE OF ABUTMENT (BH NO-2)



Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

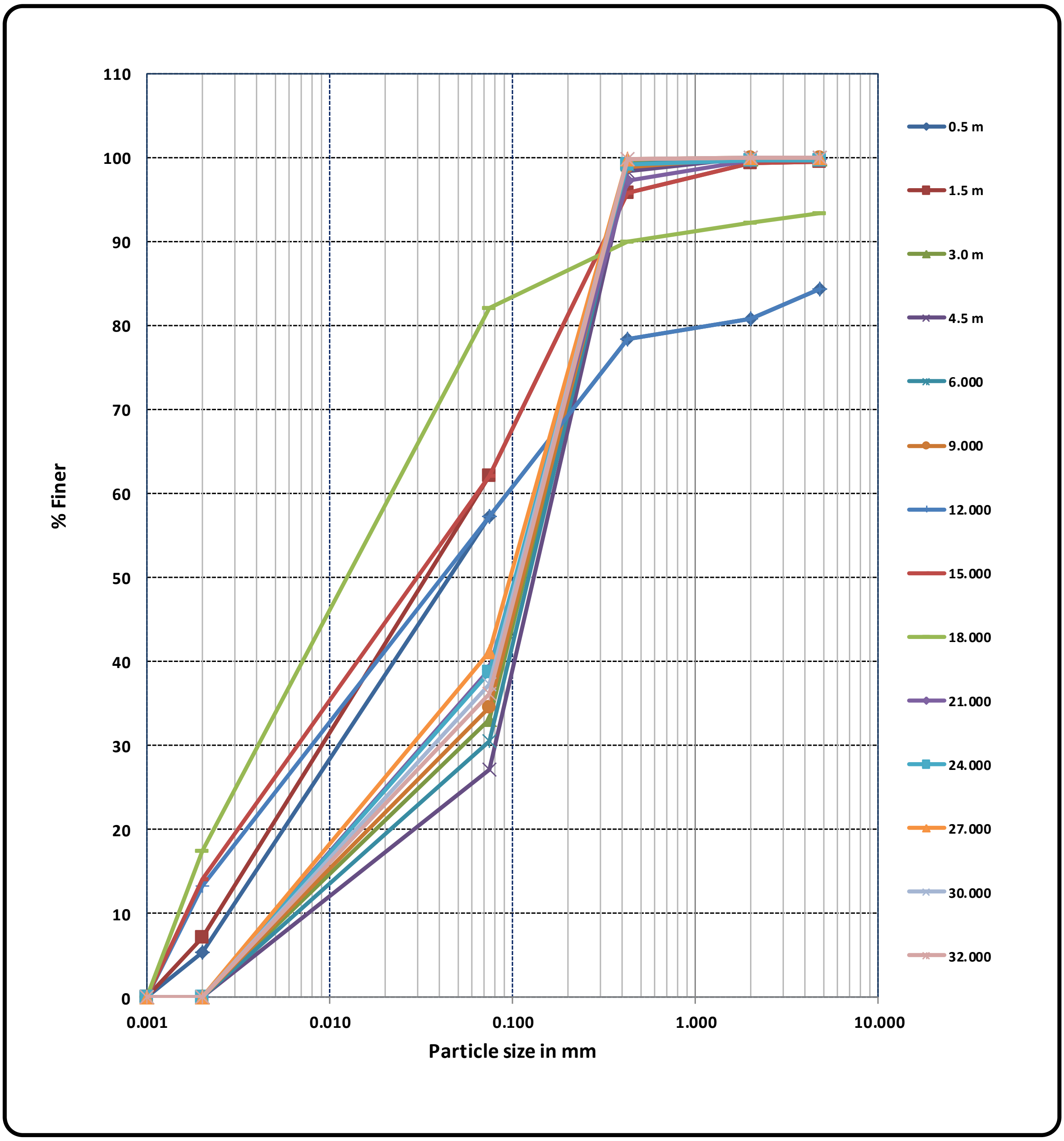
Consultant:	Geotechnical Investigation Report		Client :
S.M. CONSULTANTS BHUBANESWAR	Job No:830	Report No. SMC-2050	Haryana Rail Infrastructure Development Corporation Ltd

GRAIN SIZE DISTRIBUTION CURVE OF PIER (BH NO-3)



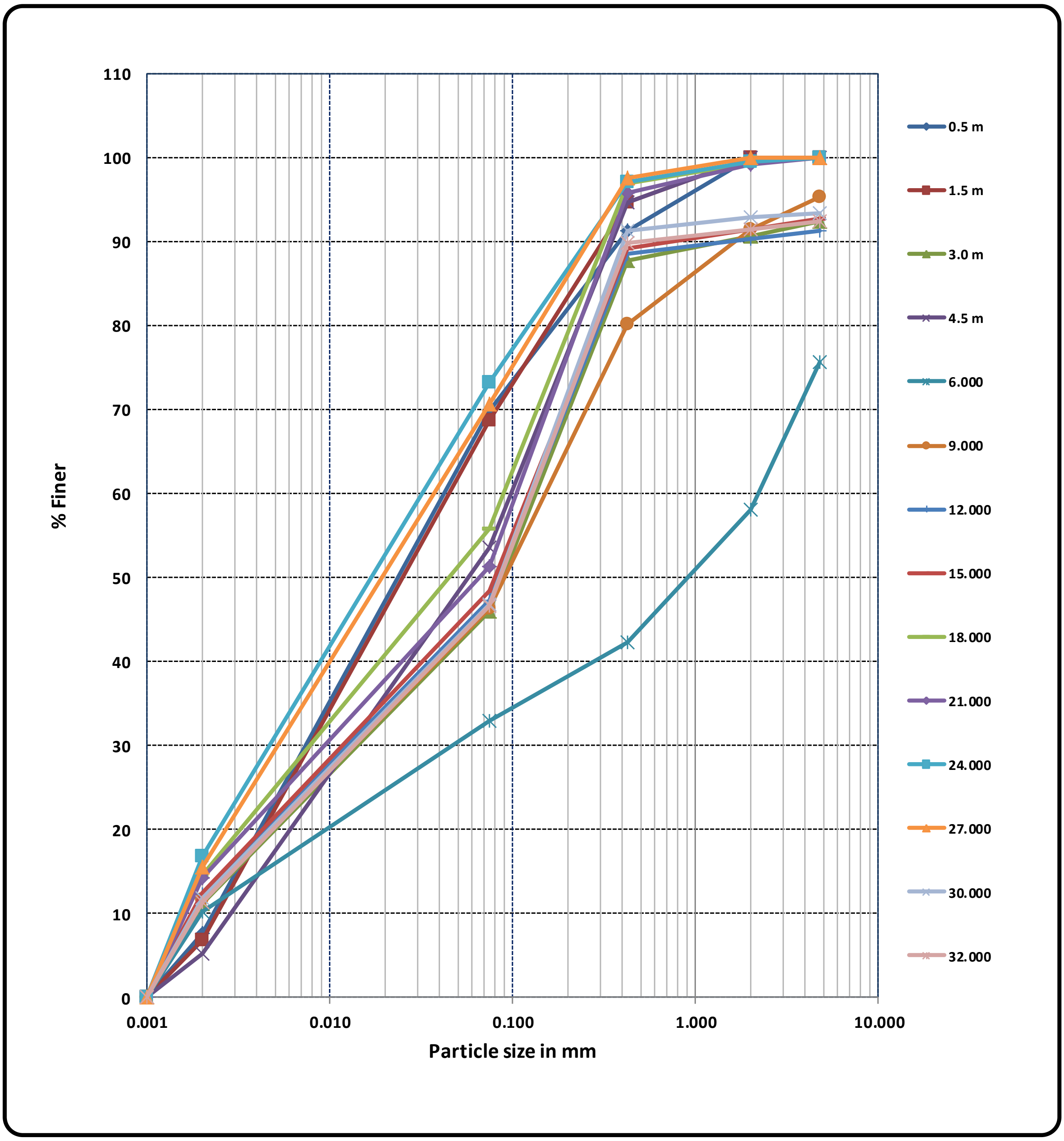
Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

GRAIN SIZE DISTRIBUTION CURVE OF PIER (BH NO-4)



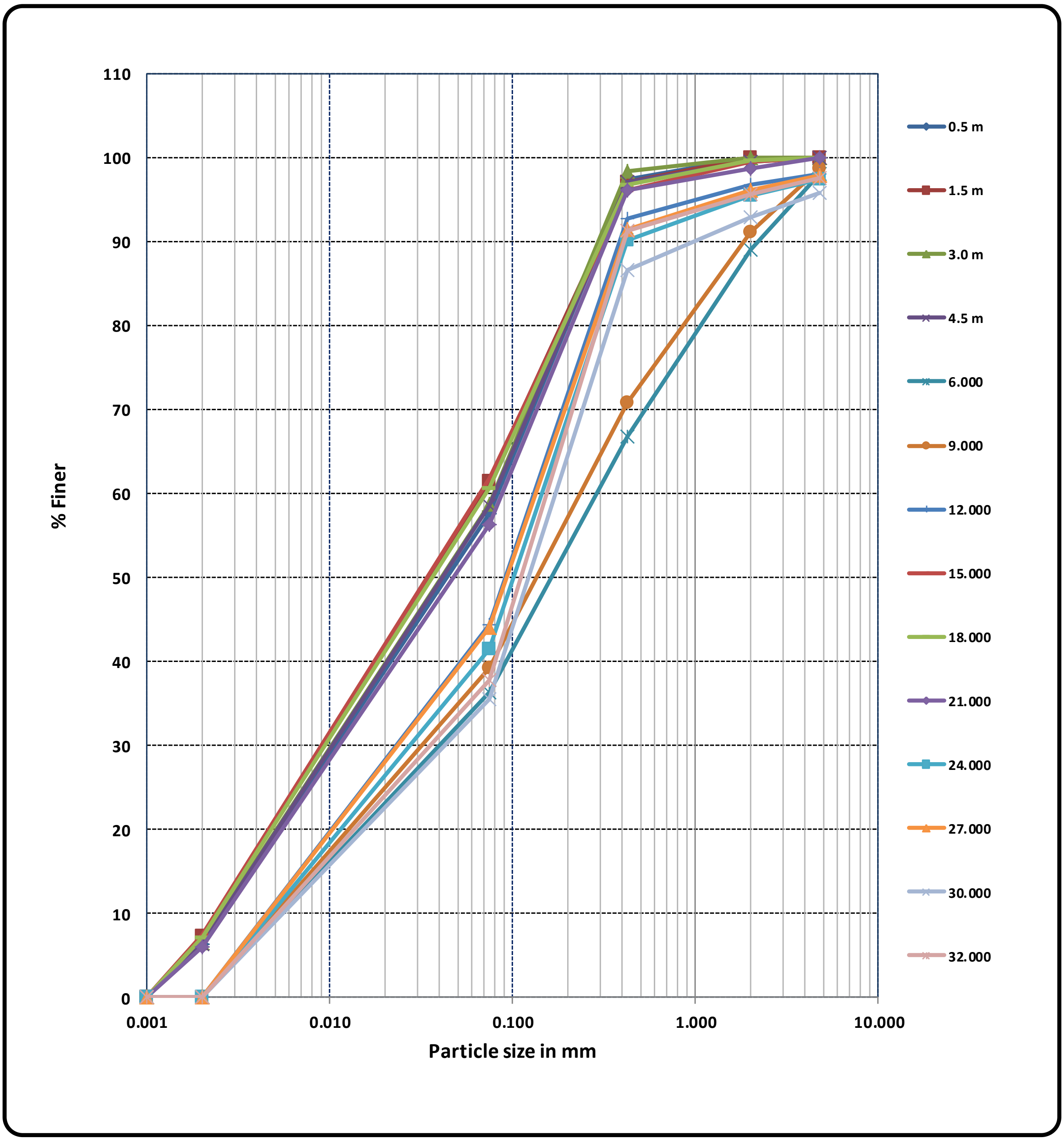
Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

GRAIN SIZE DISTRIBUTION CURVE OF PIER (BH NO-5)



Consultant:	Geotechnical Investigation Report		Client :
S.M. CONSULTANTS BHUBANESWAR	Job No:830	Report No. SMC-2050	Haryana Rail Infrastructure Development Corporation Ltd

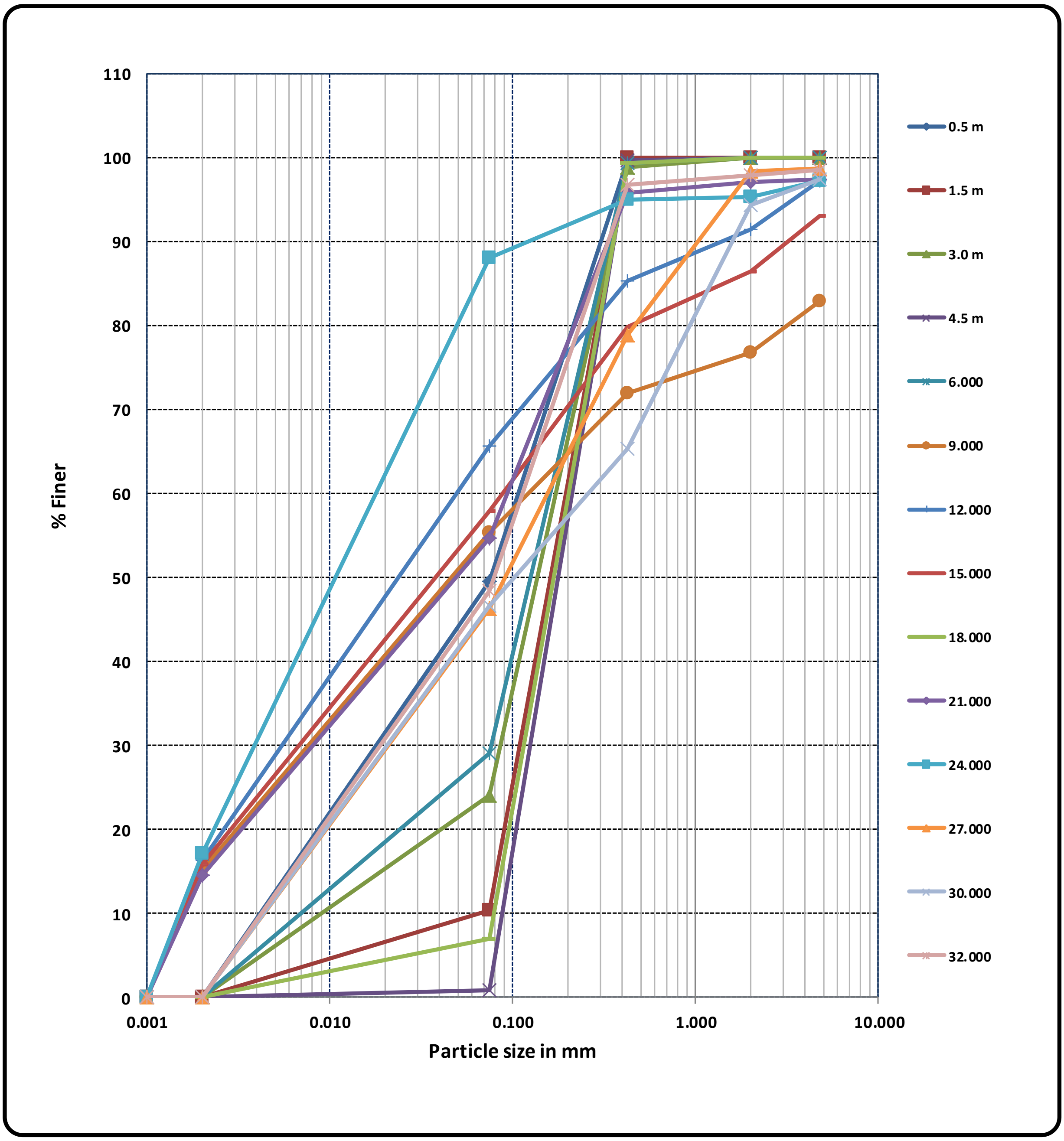
GRAIN SIZE DISTRIBUTION CURVE OF PIER (BH NO-6)



Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

Consultant:	Geotechnical Investigation Report		Client :
S.M. CONSULTANTS BHUBANESWAR	Job No:830	Report No. SMC-2050	Haryana Rail Infrastructure Development Corporation Ltd

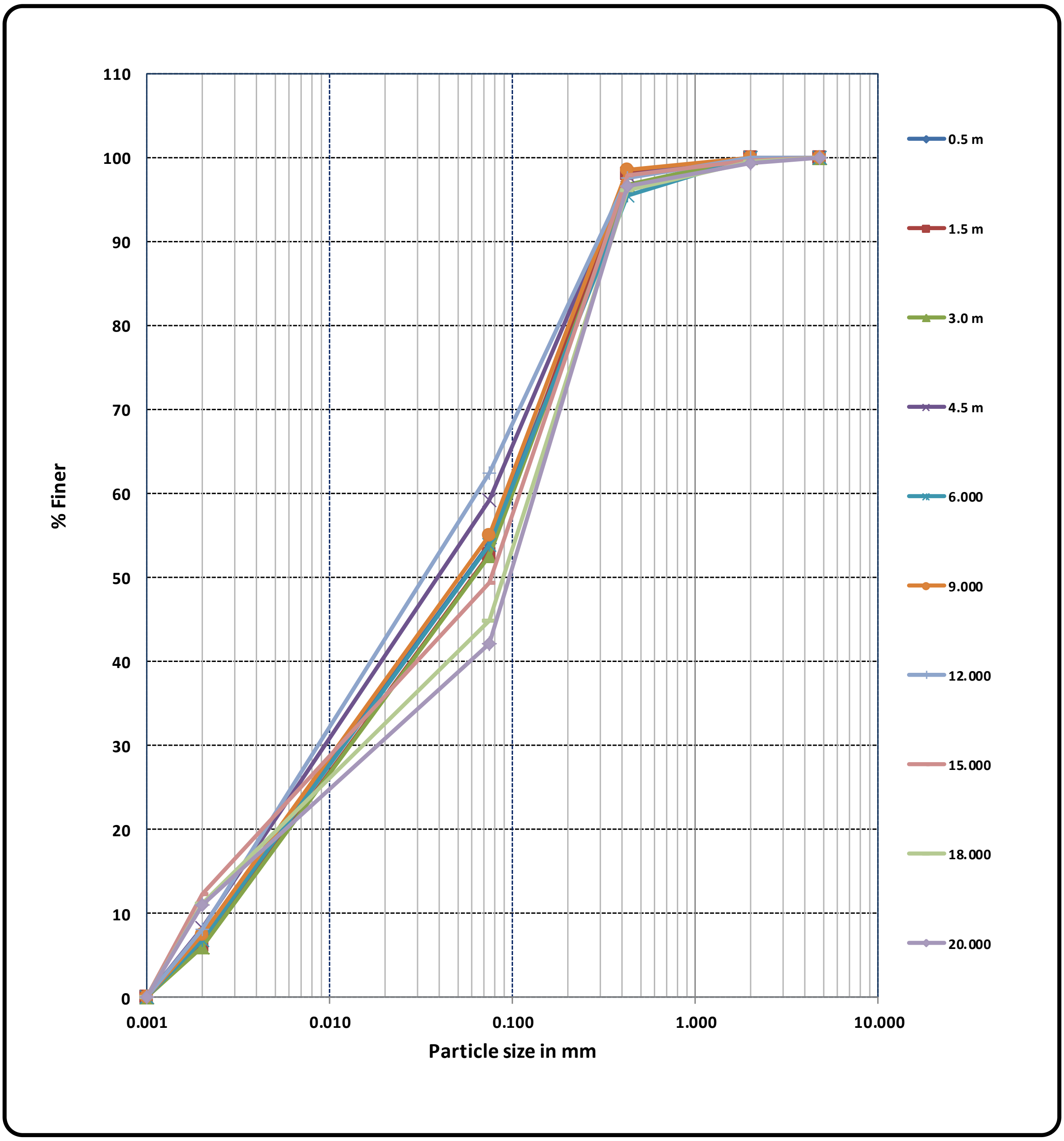
GRAIN SIZE DISTRIBUTION CURVE OF PIER (BH NO-7)



Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

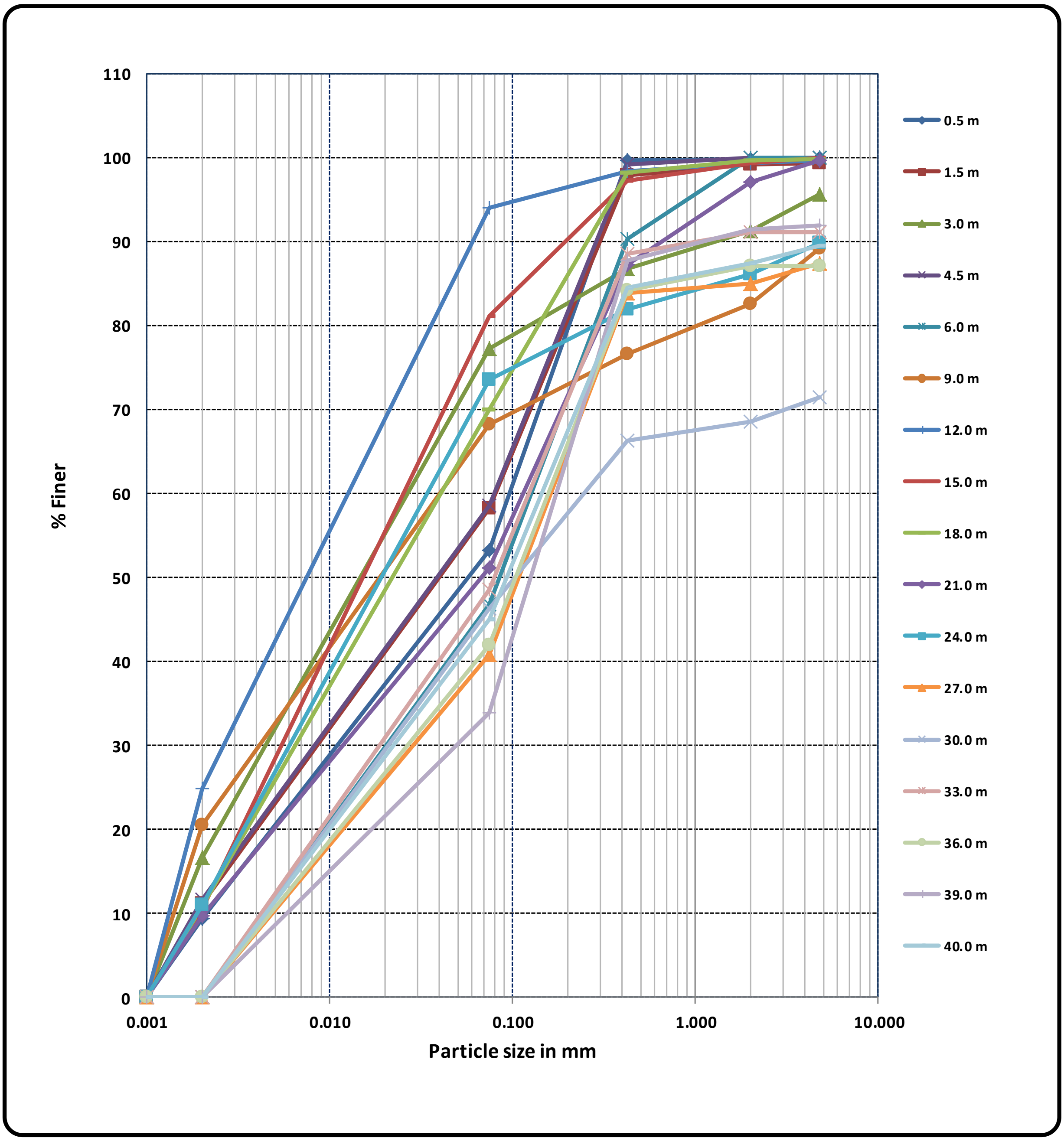
Consultant:	Geotechnical Investigation Report		Client :
S.M. CONSULTANTS BHUBANESWAR	Job No:830	Report No. SMC-2050	Haryana Rail Infrastructure Development Corporation Ltd

GRAIN SIZE DISTRIBUTION CURVE OF PIER (BH NO-8)

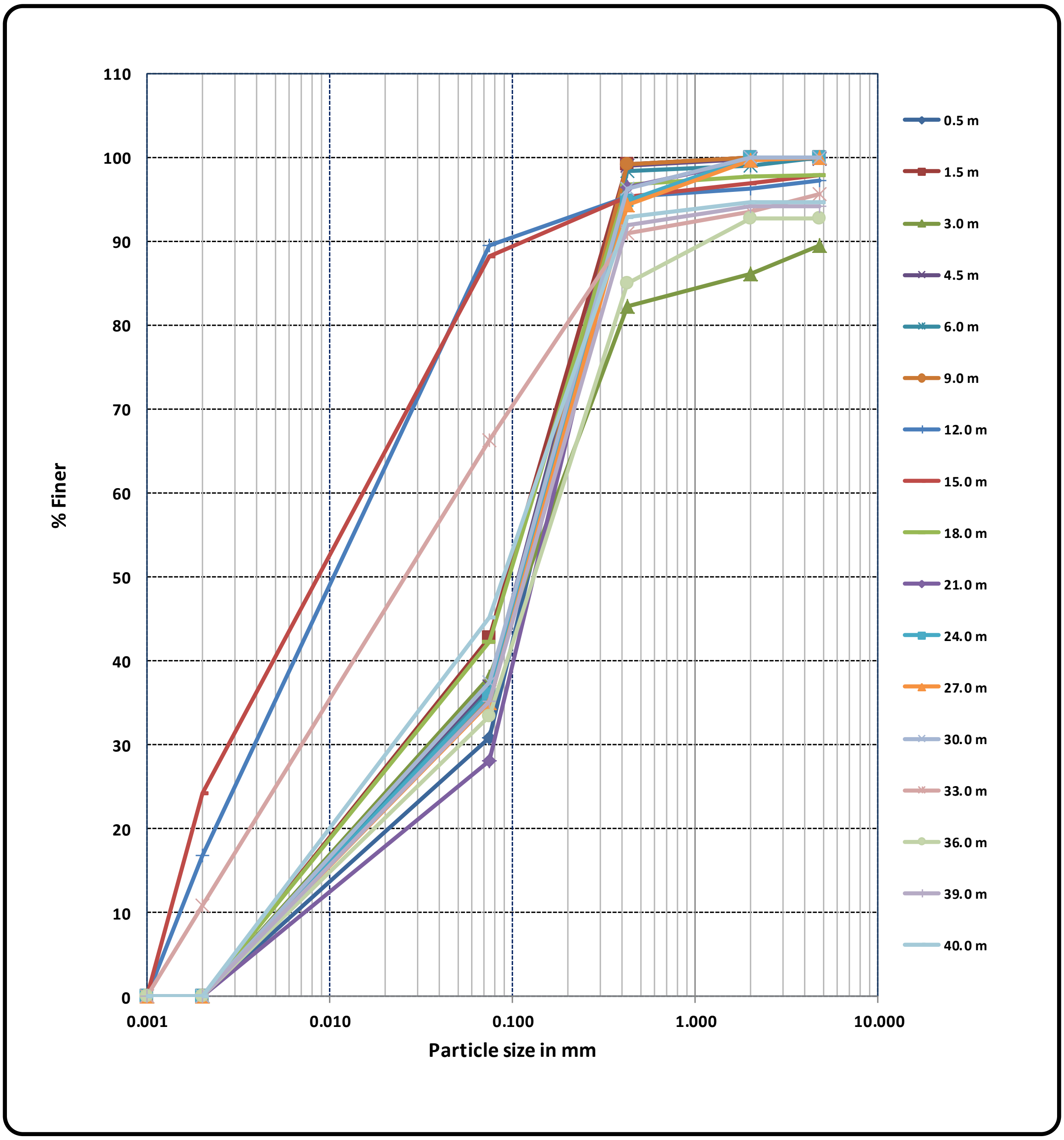


Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

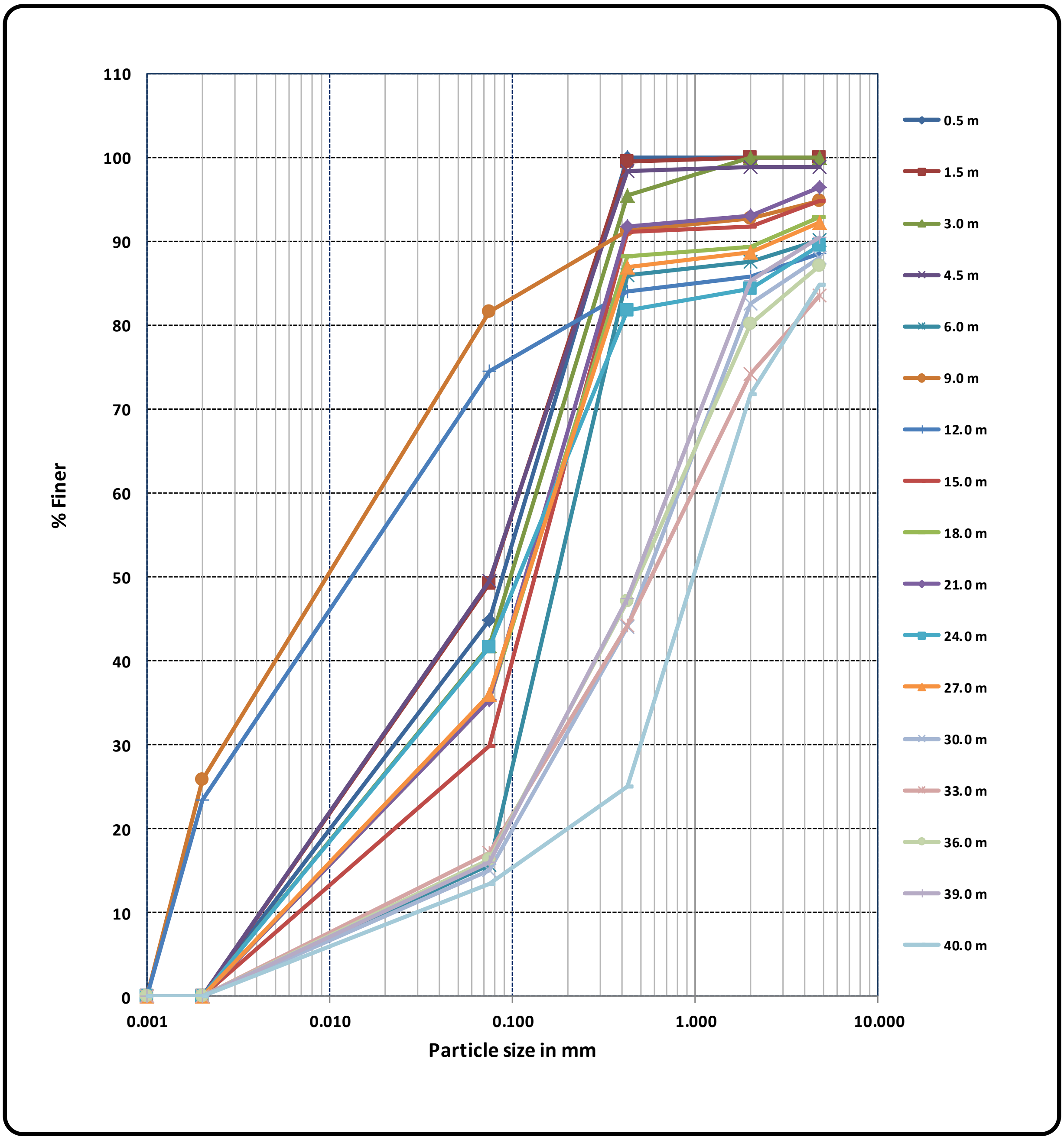
GRAIN SIZE DISTRIBUTION CURVE OF PIER (BH NO-9)



GRAIN SIZE DISTRIBUTION CURVE OF PIER (BH NO-10)

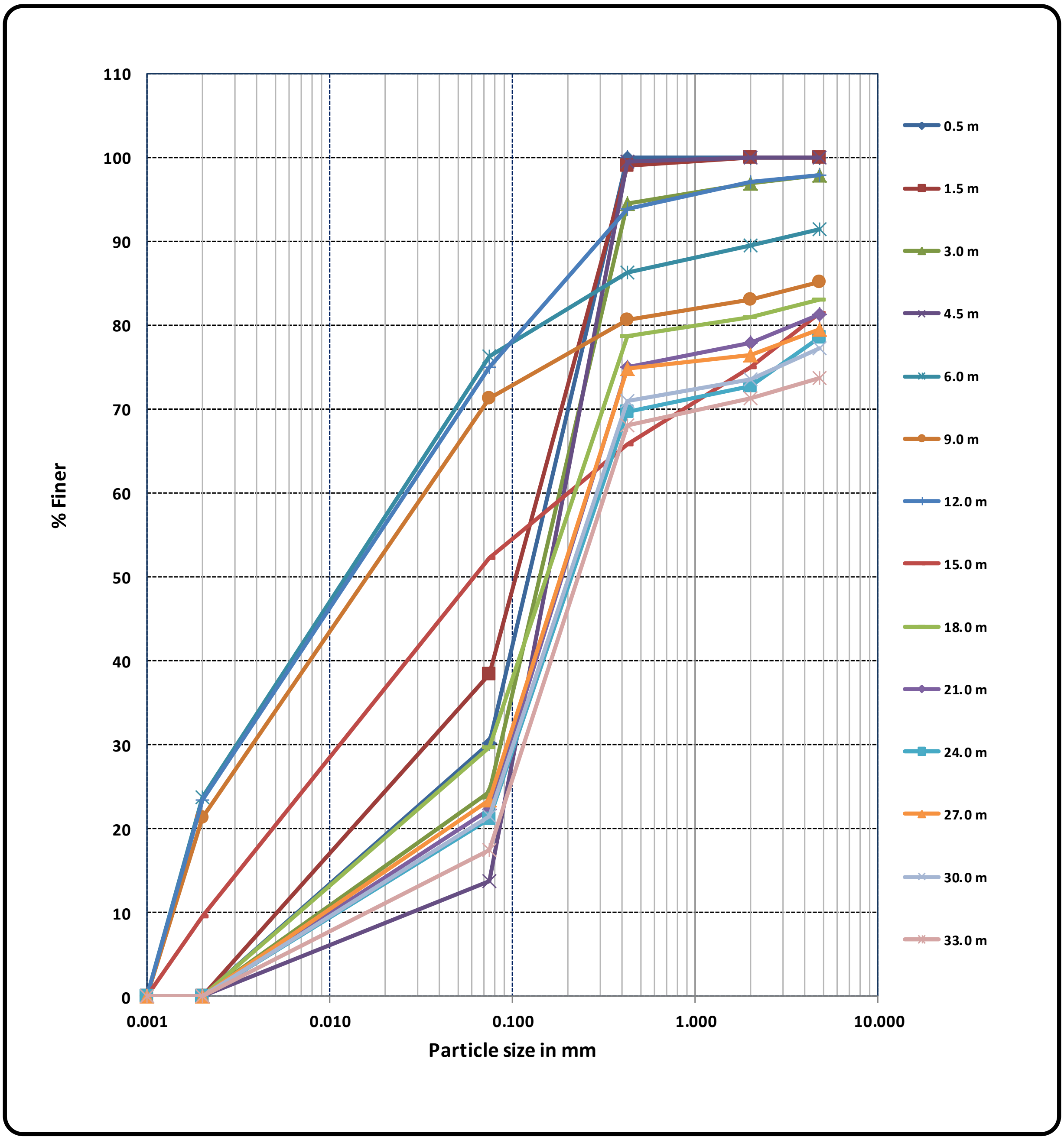


GRAIN SIZE DISTRIBUTION CURVE OF PIER (BH NO-11)



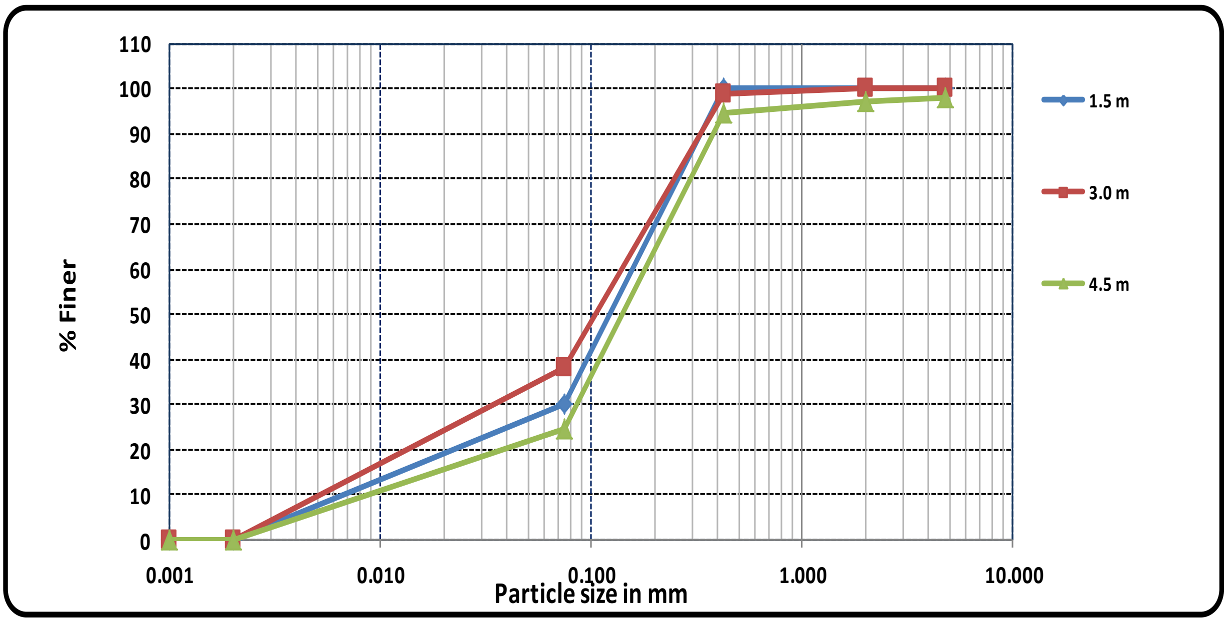
Consultant:	Geotechnical Investigation Report		Client :
S.M. CONSULTANTS BHUBANESWAR	Job No:830	Report No. SMC-2050	Haryana Rail Infrastructure Development Corporation Ltd

GRAIN SIZE DISTRIBUTION CURVE OF PIER (BH NO-11A)



Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

GRAIN SIZE DISTRIBUTION CURVE OF PIER (BH NO-12)



ANNEXURE -H
COMPUTATION OF CORRECTED N VALUE

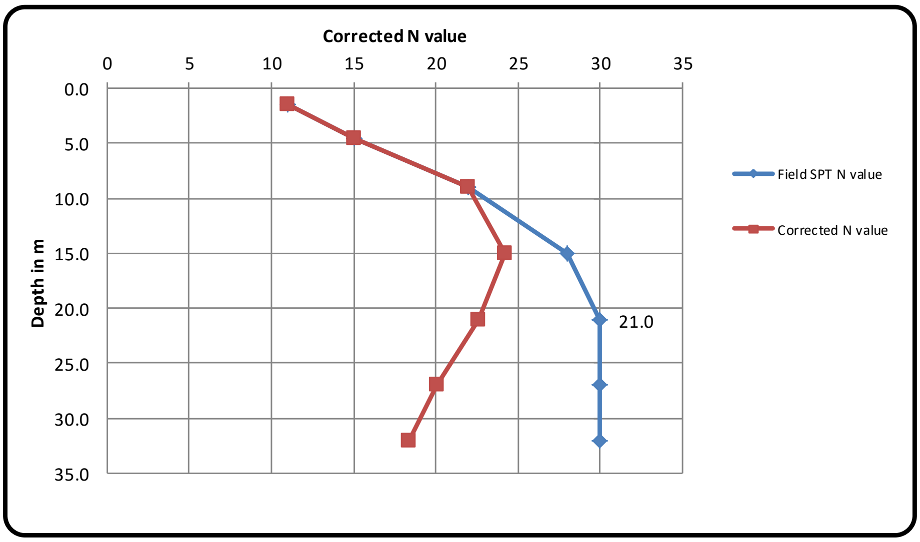
COMPUTATION OF SELECTED N VALUE)

Sl No.	Bridge No.	Depth from G.L in m.	Water table in m	Group of soil	Field SPT N value		Density gm/cm^3	overburden pressure in kg/cm^2	overburden correction factor	Corrected N value due to overburden	Corrected N value due to Dilatancy
1	ABUTMENT (BH-02)	1.5	1.5	CL	11		1.000	0.150	1.00	11.00	11.00
2		4.5		CL	15		1.000	0.450	1.00	15.00	15.00
3		9.0		CL	22		1.000	0.900	1.00	22.00	22.00
4		15.0		CL	28		1.000	1.500	0.87	24.25	24.25
5		21.0		CL	48	30	1.000	2.100	0.75	22.61	22.61
6		27.0		CL	54	30	1.000	2.700	0.67	20.09	20.09
7		32.0		CL	66	30	1.000	3.200	0.61	18.38	18.38

Note: Above Strength parameters (C& ϕ) are calculated theoritically from N value.

1. As per Terzaghi & Peck, in case of cohesive soil there is a relationship between N value & consistency.
   Where N is the corrected N value.
2. In case of cohesionless, for angle of shearing resistance (ϕ), fig - 1 of IS : 6403 was used.
3. In case of clay soil, if N>30 then it may be considered limited to 30.
4. Overburden correction factor is considered as1 whereever its value is greater than 1.

STANDARD PENETRATION TEST OF BH NO-02(ABUTMENT)



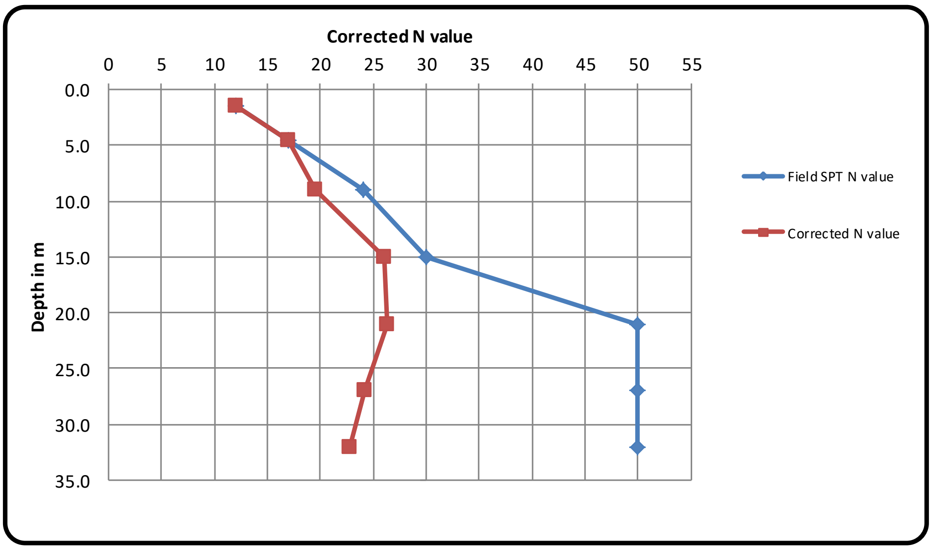
COMPUTATION OF SELECTED N VALUE)

Sl No.	Bridge No.	Depth from G.L in m.	Water table in m	Group of soil	Field SPT N value		Density gm/cm^3	overburden pressure in kg/cm^2	overburden correction factor	Corrected N value due to overburden	Corrected N value due to Dilatancy
1	PIER (BH-03)	1.5	2.5	CL	12		1.762	0.264	1.00	12.0	12.00
2		4.5		CL	17		1.000	0.450	1.00	17.0	17.00
3		9.0		SM	24		1.000	0.900	1.00	24.0	19.50
4		15.0		CL	32	30	1.000	1.500	0.87	26.0	25.99
5		21.0		ML	59	50	1.000	2.100	0.75	37.7	26.3
6		27.0		SM	68	50	1.000	2.700	0.67	33.5	24.2
7		32.0		SM	77	50	1.000	3.200	0.61	30.6	22.8

Note: Above Strength parameters (C& ϕ) are calculated theoritically from N value.

1. As per Terzaghi & Peck, in case of cohesive soil there is a relationship between N value & consistency.
   Where N is the corrected N value.
2. In case of cohesionless, for angle of shearing resistance (ϕ), fig - 1 of IS : 6403 was used.
3. In case of clay soil, if N>30 then it may be considered limited to 30.
4. Overburden correction factor is considered as1 whereever its value is greater than 1.

STANDARD PENETRATION TEST OF BH NO-03(PIER)



COMPUTATION OF SELECTED N VALUE)

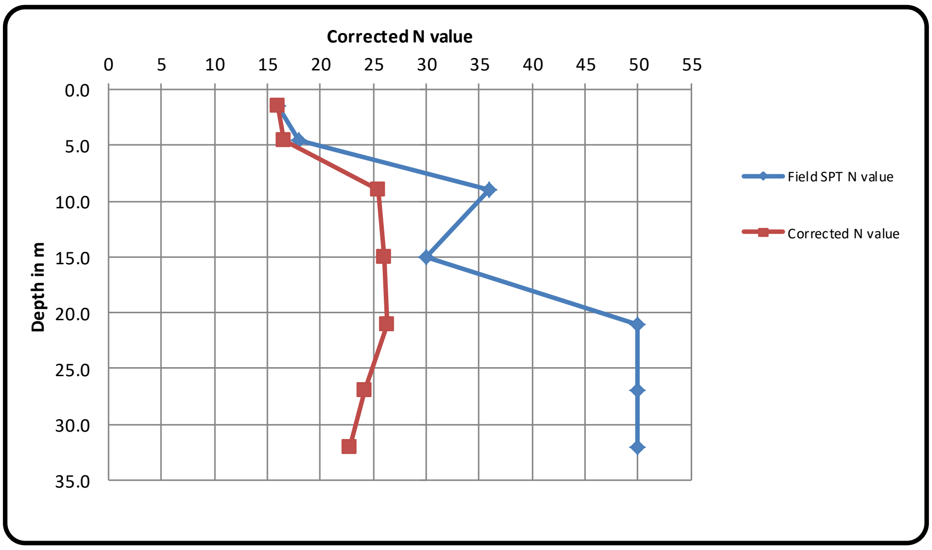
Sl No.	Bridge No.	Depth from G.L in m.	Water table in m	Group of soil	Field SPT N value		Density gm/cm³	overburden pressure in kg/cm²	overburden correction factor	Corrected N value due to overburden	Corrected N value due to Dilatancy
1	PIER (BH-04)	1.5	2.00	ML	16		1.768	0.265	1.00	16.0	16.0
2		4.5		SM	18		1.000	0.450	1.00	18.0	16.5
3		9.0		SM	36		1.000	0.900	1.00	36.0	25.5
4		15.0		CL	52	30	1.000	1.500	0.87	26.0	25.99
5		21.0		SM	65	50	1.000	2.100	0.75	37.7	26.3
6		27.0		SM	76	50	1.000	2.700	0.67	33.5	24.2
7		32.0		SM	85	50	1.000	3.200	0.61	30.6	22.8

Note: Above Strength parameters (C& ϕ) are calculated theoritically from N value.

1. As per Terzaghi & Peck, in case of cohesive soil there is a relationship between N value & consistency.

   Where N is the corrected N value.
2. In case of cohesionless, for angle of shearing resistance (ϕ), fig - 1 of IS : 6403 was used.
3. In case of clay soil, if N>30 then it may be considered limited to 30.
4. Overburden correction factor is considered as1 whereever its value is greater than 1.

STANDARD PENETRATION TEST OF BH NO- 04(PIER)



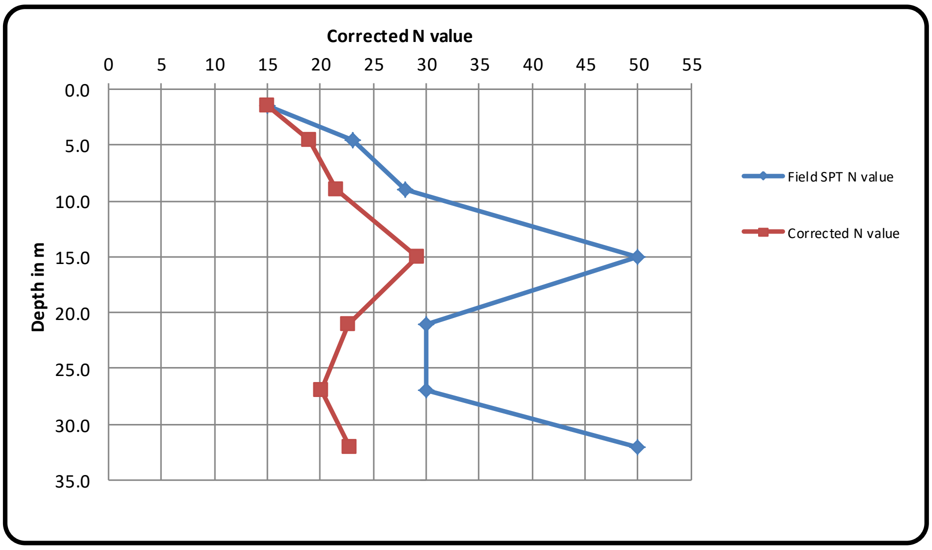
COMPUTATION OF SELECTED N VALUE)

Sl No.	Bridge No.	Depth from G.L in m.	Water table in m	Group of soil	Field SPT N value		Density gm/cm^3	overburden pressure in kg/cm^2	overburden correction factor	Corrected N value due to overburden	Corrected N value due to Dilatancy
1	PIER (BH-5)	1.5	3.00	ML	15		1.763	0.264	1.00	15.0	15.0
2		4.5		ML	23		1.000	0.450	1.00	23.0	19.0
3		9.0		SC	28		1.000	0.900	1.00	28.0	21.5
4		15.0		SC	50		1.000	1.500	0.87	43.3	29.2
5		21.0		CL	61	30	1.000	2.100	0.75	22.6	22.6
6		27.0		CL	70	30	1.000	2.700	0.67	20.1	20.1
7		32.0		SC	73	50	1.000	3.200	0.61	30.6	22.8

Note: Above Strength parameters (C& ϕ) are calculated theoritically from N value.

1. As per Terzaghi & Peck, in case of cohesive soil there is a relationship between N value & consistency.
   Where N is the corrected N value.
2. In case of cohesionless, for angle of shearing resistance (ϕ), fig - 1 of IS : 6403 was used.
3. In case of clay soil, if N>30 then it may be considered limited to 30.
4. Overburden correction factor is considered as1 whereever its value is greater than 1.

STANDARD PENETRATION TEST OF BH NO-5(PIER)



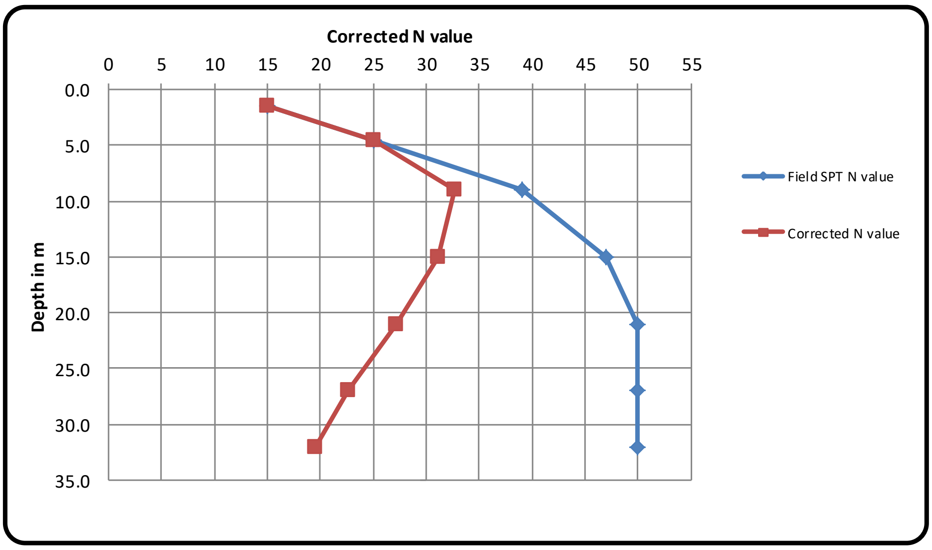
COMPUTATION OF SELECTED N VALUE)

Sl No.	Bridge No.	Depth from G.L in m.	Water table in m	Group of soil	Field SPT N value		Density gm/cm^3	overburden pressure in kg/cm^2	overburden correction factor	Corrected N value due to overburden	Corrected N value due to Dilatancy
1	PIER (BH-6)	1.5	NOT FOUND	ML	15		1.758	0.264	1.00	15.0	15.0
2		4.5		ML	25		1.776	0.799	1.00	25.0	25.0
3		9.0		SM	39		1.805	1.625	0.84	32.7	32.7
4		15.0		ML	47		1.840	2.759	0.66	31.1	31.1
5		21.0		ML	60	50	1.879	3.946	0.54	27.1	27.1
6		27.0		SM	71	50	1.919	5.181	0.45	22.6	22.6
7		32.0		SM	83	50	1.943	6.218	0.39	19.5	19.5

Note: Above Strength parameters (C& ϕ) are calculated theoritically from N value.

1. As per Terzaghi & Peck, in case of cohesive soil there is a relationship between N value & consistency.
   Where N is the corrected N value.
2. In case of cohesionless, for angle of shearing resistance (ϕ), fig - 1 of IS : 6403 was used.
3. In case of clay soil, if N>30 then it may be considered limited to 30.
4. Overburden correction factor is considered as1 whereever its value is greater than 1.

STANDARD PENETRATION TEST OF BH NO-6(PIER)



Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.

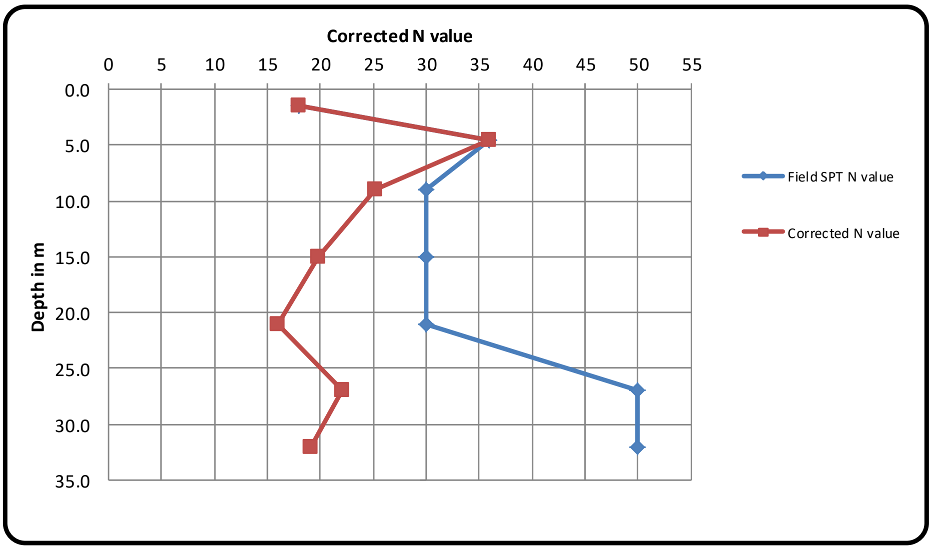
COMPUTATION OF SELECTED N VALUE)

Sl No.	Bridge No.	Depth from G.L in m.	Water table in m	Group of soil	Field SPT N value		Density gm/cm^3	overburden pressure in kg/cm^2	overburden correction factor	Corrected N value due to overburden	Corrected N value due to Dilatancy
1	PIER (BH-7)	1.5	NOT FOUND	SP-SM	18		1.772	0.266	1.00	18.0	18.0
2		4.5		SP	36		1.783	0.802	1.00	36.0	36.0
3		9.0		CL	50	30	1.794	1.615	0.84	25.2	25.2
4		15.0		CL	54	30	1.844	2.766	0.66	19.8	19.8
5		21.0		CL	68	30	1.934	4.060	0.53	16.0	16.0
6		27.0		SM	79	50	1.983	5.353	0.44	22.0	22.0
7		32.0		SM	88	50	1.992	6.374	0.38	19.1	19.1

Note: Above Strength parameters (C& ϕ) are calculated theoritically from N value.

1. As per Terzaghi & Peck, in case of cohesive soil there is a relationship between N value & consistency.
   Where N is the corrected N value.
2. In case of cohesionless, for angle of shearing resistance (ϕ), fig - 1 of IS : 6403 was used.
3. In case of clay soil, if N>30 then it may be considered limited to 30.
4. Overburden correction factor is considered as1 whereever its value is greater than 1.

STANDARD PENETRATION TEST OF BH NO-7(PIER)



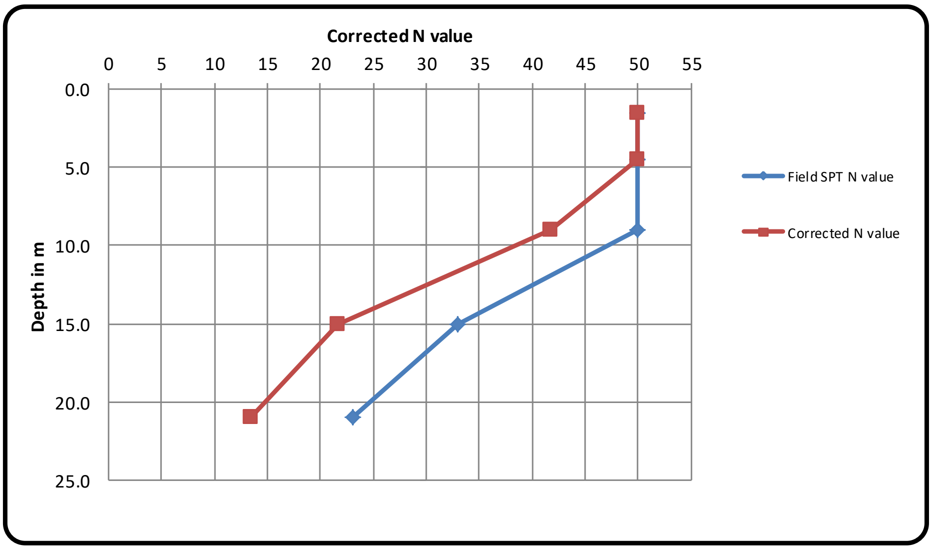
COMPUTATION OF SELECTED N VALUE)

Sl No.	Bridge No.	Depth from G.L in m.	Water table in m	Group of soil	Field SPT N value		Density gm/cm^3	overburden pressure in kg/cm^2	overburden correction factor	Corrected N value due to overburden	Corrected N value due to Dilatancy
1	PIER (BH-8)	1.5	NOT FOUND	ML	50		1.758	0.264	1.00	50.0	50.0
2		4.5		ML	51	50	1.785	0.803	1.00	50.0	50.0
3		9.0		ML	59	50	1.838	1.654	0.83	41.7	41.7
4		15.0		SC	33		1.879	2.819	0.66	21.6	21.6
5		21.0		SC	25		1.895	3.980	0.54	13.5	13.5

Note: Above Strength parameters (C& ϕ) are calculated theoritically from N value.

1. As per Terzaghi & Peck, in case of cohesive soil there is a relationship between N value & consistency.
   Where N is the corrected N value.
2. In case of cohesionless, for angle of shearing resistance (ϕ), fig - 1 of IS : 6403 was used.
3. In case of clay soil, if N>30 then it may be considered limited to 30.
4. Overburden correction factor is considered as1 whereever its value is greater than 1.

STANDARD PENETRATION TEST OF BH NO-8(PIER)



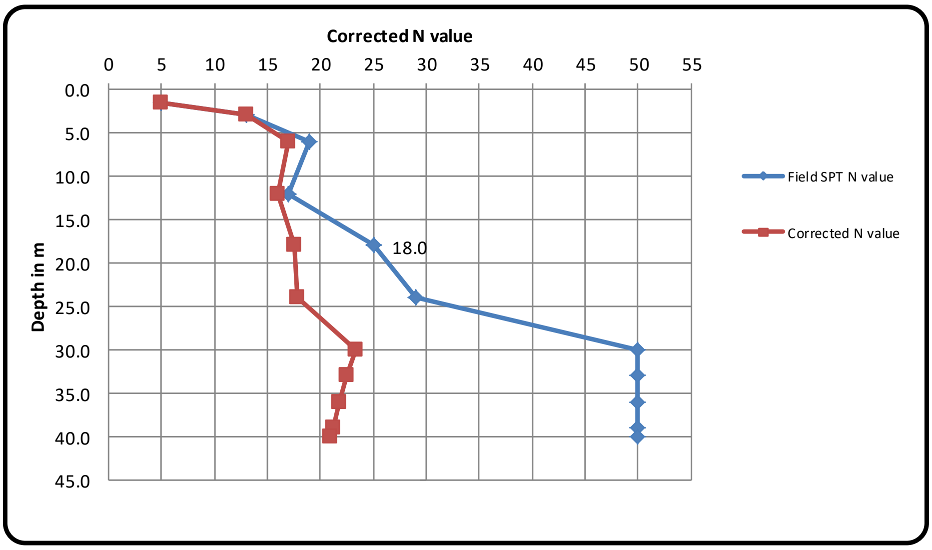
COMPUTATION OF SELECTED N VALUE)

Sl No.	Bridge No.	Depth from G.L in m.	Water table in m	Group of soil	Field SPT N value		Density gm/cm^3	overburden pressure in kg/cm^2	overburden correction factor	Corrected N value due to overburden	Corrected N value due to Dilatancy
1	PIER (BH-9)	1.5	1.9	ML	5		1.000	0.150	1.00	5.00	5
2		3.0		ML-CL	13		1.000	0.300	1.00	13.00	13
3		6.0		SM	19		1.000	0.600	1.00	19.00	17
4		12.0		CL	17		1.000	1.200	0.94	15.99	15.99
5		18.0		ML	25		1.000	1.800	0.81	20.13	18
6		24.0		ML	29		1.000	2.400	0.71	20.56	18
7		30.0		SM	61	50	1.000	3.000	0.63	31.72	23
8		33.0		SM	77	50	1.000	3.300	0.60	30.13	23
9		36.0		SM	>50	50	1.000	3.600	0.57	28.67	22
10		39.0		SM	>50	50	1.000	3.900	0.55	27.33	21
11		40.0		SM	>50	50	1.000	4.000	0.54	26.91	21

Note: Above Strength parameters (C& ϕ) are calculated theoritically from N value.

1. As per Terzaghi & Peck, in case of cohesive soil there is a relationship between N value & consistency.
   Where N is the corrected N value.
2. In case of cohesionless, for angle of shearing resistance (ϕ), fig - 1 of IS : 6403 was used.
3. In case of clay soil, if N>30 then it may be considered limited to 30.
4. Overburden correction factor is considered as1 whereever its value is greater than 1.

STANDARD PENETRATION TEST OF BH NO-9 (PIER)



COMPUTATION OF SELECTED N VALUE)

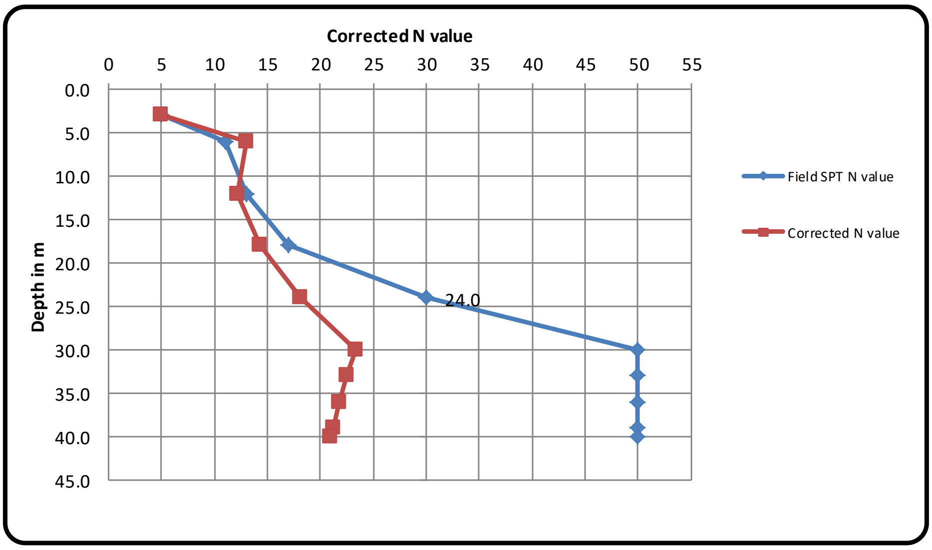
Sl No.	Bridge No.	Depth from G.L in m.	Water table in m	Group of soil	Field SPT N value		Density gm/cm³	overburden pressure in kg/cm²	overburden correction factor	Corrected N value due to overburden	Corrected N value due to Dilatancy
1	PIER (BH-10)	3.0	2.4	SM	5		1.000	0.300	1.00	5.00	5
2		6.0		SM	11		1.000	0.600	1.00	11.00	13
3		12.0		ML-CL	13		1.000	1.200	0.94	12.23	12.23
4		18.0		SM	17		1.000	1.800	0.81	13.69	14
5		24.0		SM	30		1.000	2.400	0.71	21.27	18
6		30.0		SM	64	50	1.000	3.000	0.63	31.72	23
7		33.0		ML	77	50	1.000	3.300	0.60	30.13	23
8		36.0		SM	84	50	1.000	3.600	0.57	28.67	22
9		39.0		SM	>50	50	1.000	3.900	0.55	27.33	21
10		40.0		SM	>50	50	1.000	4.000	0.54	26.91	21

Note: Above Strength parameters (C& ϕ) are calculated theoritically from N value.

1. As per Terzaghi & Peck, in case of cohesive soil there is a relationship between N value & consistency.

   Where N is the corrected N value.
2. In case of cohesionless, for angle of shearing resistance (ϕ), fig - 1 of IS : 6403 was used.
3. In case of clay soil, if N>30 then it may be considered limited to 30.
4. Overburden correction factor is considered as1 whereever its value is greater than 1.

STANDARD PENETRATION TEST OF BH NO-10(PIER)



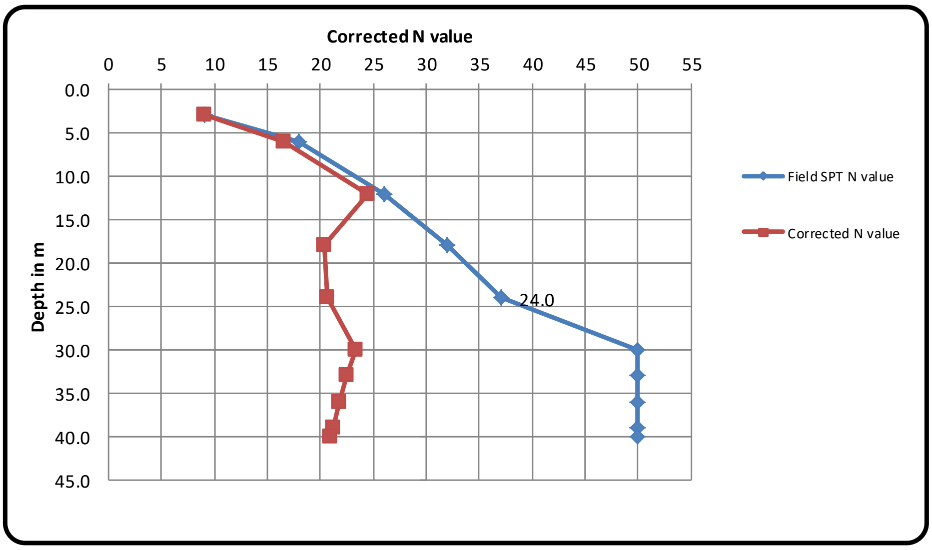
COMPUTATION OF SELECTED N VALUE)

Sl No.	Bridge No.	Depth from G.L in m.	Water table in m	Group of soil	Field SPT N value		Density gm/cm^3	overburden pressure in kg/cm^2	overburden correction factor	Corrected N value due to overburden	Corrected N value due to Dilatancy
1	PIER (BH-11)	3.0	1.8	SM	9		1.000	0.300	1.00	9.00	9
2		6.0		SM	18		1.000	0.600	1.00	18.00	17
3		12.0		CL	26		1.000	1.200	0.94	24.46	24.46
4		18.0		SM	32		1.000	1.800	0.81	25.77	20
5		24.0		SM	37		1.000	2.400	0.71	26.23	21
6		30.0		SM	85	50	1.000	3.000	0.63	31.72	23
7		33.0		SM	>50	50	1.000	3.300	0.60	30.13	23
8		36.0		SM	>50	50	1.000	3.600	0.57	28.67	22
9		39.0		SM	>50	50	1.000	3.900	0.55	27.33	21
10		40.0		SM	>50	50	1.000	4.000	0.54	26.91	21

Note: Above Strength parameters (C& ϕ) are calculated theoritically from N value.

1. As per Terzaghi & Peck, in case of cohesive soil there is a relationship between N value & consistency.
   Where N is the corrected N value.
2. In case of cohesionless, for angle of shearing resistance (ϕ), fig - 1 of IS : 6403 was used.
3. In case of clay soil, if N>30 then it may be considered limited to 30.
4. Overburden correction factor is considered as1 whereever its value is greater than 1.

STANDARD PENETRATION TEST OF BH NO-11 (PIER)



COMPUTATION OF SELECTED N VALUE)

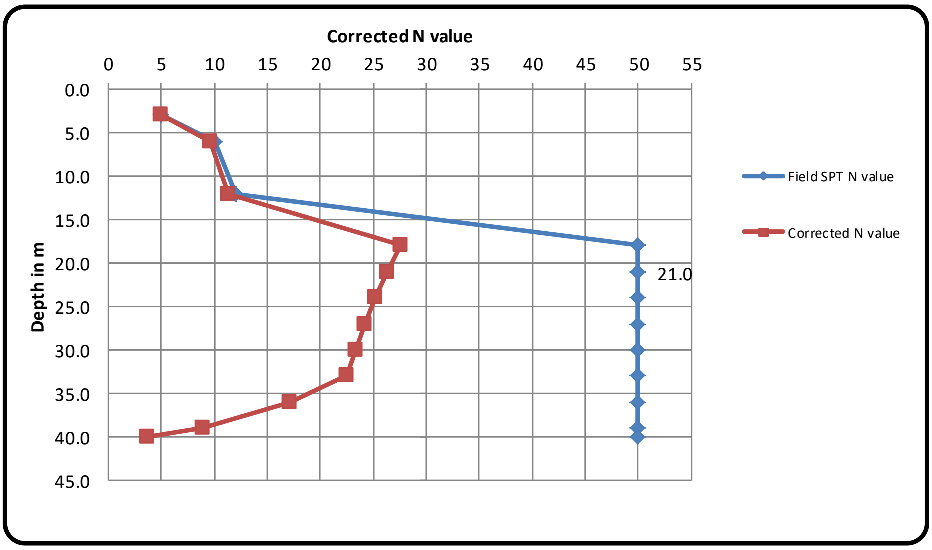
Sl No.	Bridge No.	Depth from G.L in m.	Water table in m	Group of soil	Field SPT N value		Density gm/cm^3	overburden pressure in kg/cm^2	overburden correction factor	Corrected N value due to overburden	Corrected N value due to Dilatancy
1	PIER (BH-11A)	3.0	6.5	SM	5		1.789	0.537	1.00	5.00	5
2		6.0		CL	10		1.839	1.103	0.97	9.69	10
3		12.0		CL	12		1.000	1.200	0.94	11.29	11
4		18.0		SM	56	50	1.000	1.800	0.81	40.26	28
5		21.0		SM	67	50	1.000	2.100	0.75	37.68	26
6		24.0		SM	74	50	1.000	2.400	0.71	35.45	25
7		27.0		SM	>50	50	1.000	2.700	0.67	33.48	24
8		30.0		SM	>50	50	1.000	3.000	0.63	31.72	23
9		33.0		SM	>50	50	1.000	3.300	0.60	30.13	23
10		36.0		Pebble	>50	50	2.000	7.200	0.34	17.08	17
11		39.0		Pebble	>50	50	3.000	11.700	0.18	8.96	8.96
12		40.0		Pebble	>50	50	4.000	16.000	0.07	3.73	3.73

Note: Above Strength parameters (C& ϕ) are calculated theoritically from N value.

1. As per Terzaghi & Peck, in case of cohesive soil there is a relationship between N value & consistency.

   Where N is the corrected N value.
2. In case of cohesionless, for angle of shearing resistance (ϕ), fig - 1 of IS : 6403 was used.
3. In case of clay soil, if N>30 then it may be considered limited to 30.
4. Overburden correction factor is considered as1 whereever its value is greater than 1.

STANDARD PENETRATION TEST OF BH NO-11A (PIER)



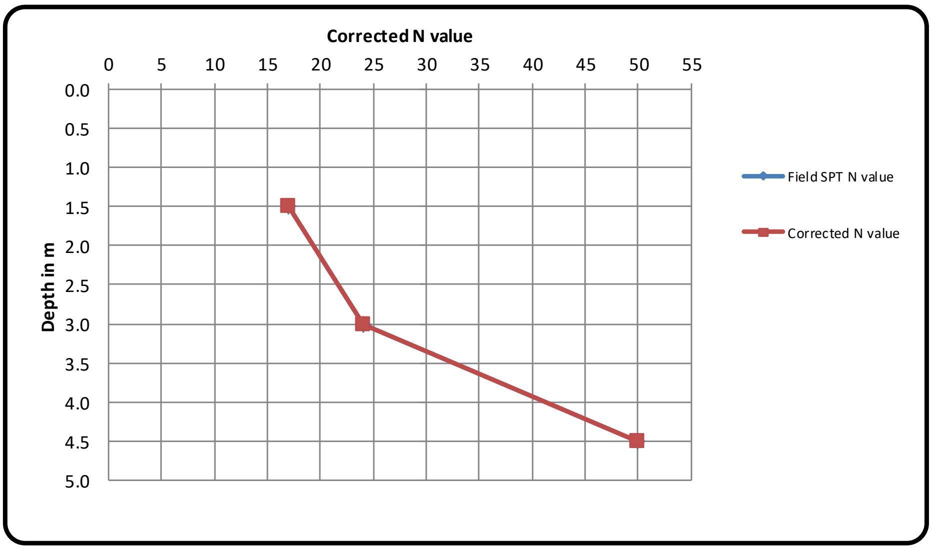
COMPUTATION OF SELECTED N VALUE)

Sl No.	Bridge No.	Depth from G.L in m.	Water table in m	Group of soil	Field SPT N value		Density gm/cm^3	overburden pressure in kg/cm^2	overburden correction factor	Corrected N value due to overburden	Corrected N value due to Dilatancy
1	PIER (BH-12)	1.5	NOT FOUND	SM	17		1.768	0.265	1.00	17.00	17
2		3.0		ML	24		1.768	0.530	1.00	24.00	24
3		4.5		ML	>50	50	1.768	0.796	1.00	50.00	50

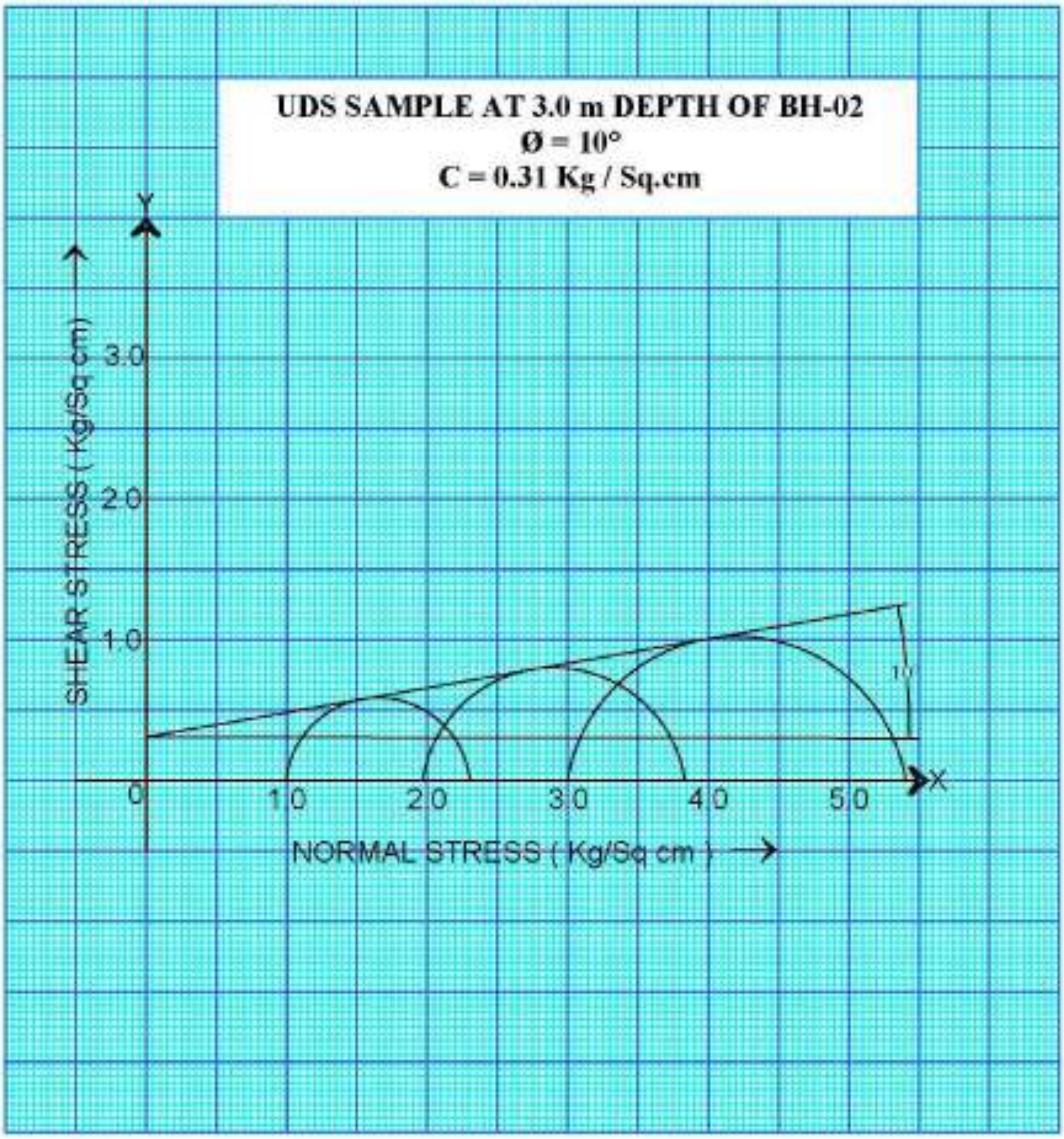
Note: Above Strength parameters (C& ϕ) are calculated theoritically from N value.

1. As per Terzaghi & Peck, in case of cohesive soil there is a relationship between N value & consistency.
   Where N is the corrected N value.
2. In case of cohesionless, for angle of shearing resistance (ϕ), fig - 1 of IS : 6403 was used.
3. In case of clay soil, if N>30 then it may be considered limited to 30.
4. Overburden correction factor is considered as1 whereever its value is greater than 1.

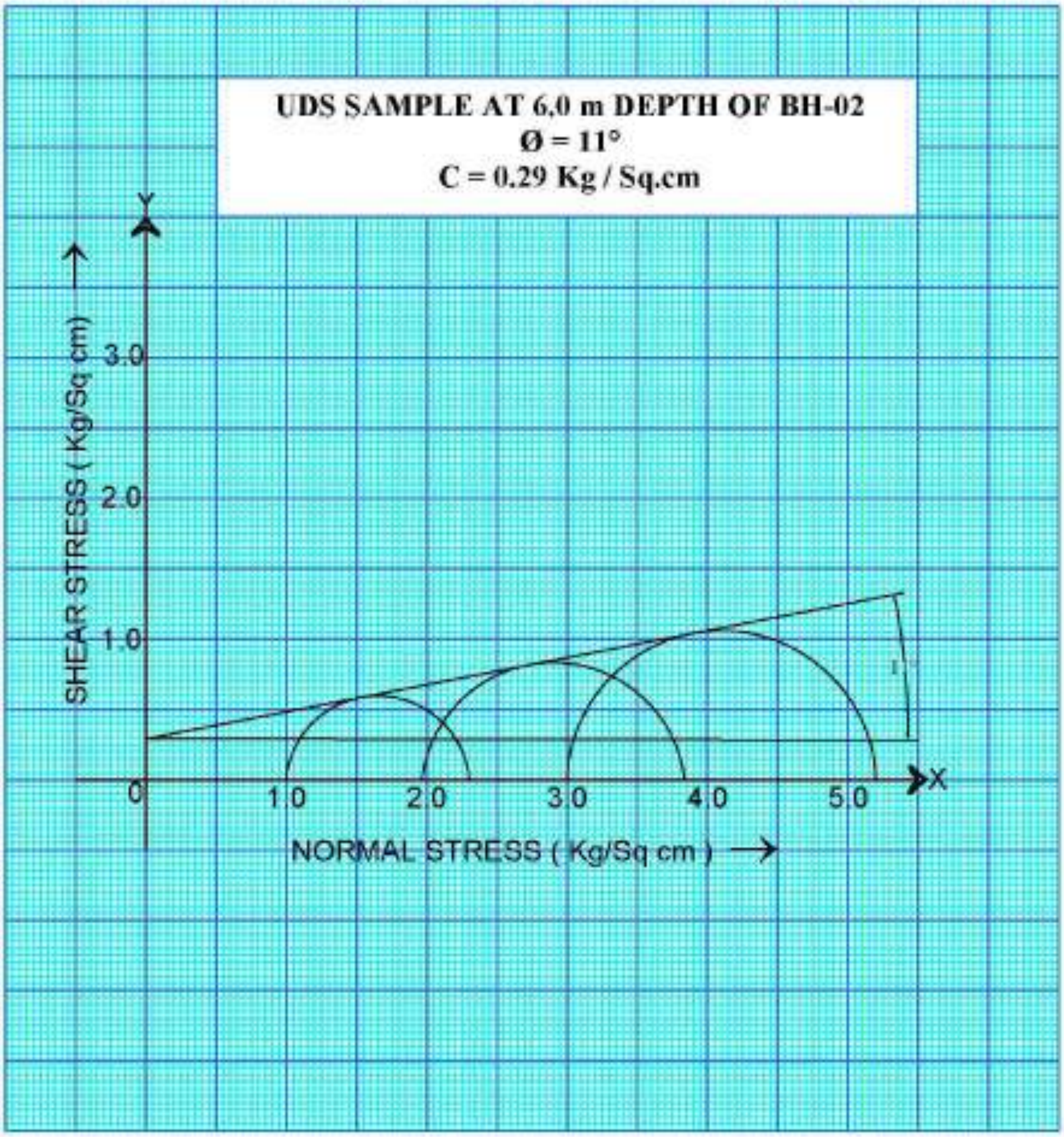
STANDARD PENETRATION TEST OF BH NO-12 (PIER)



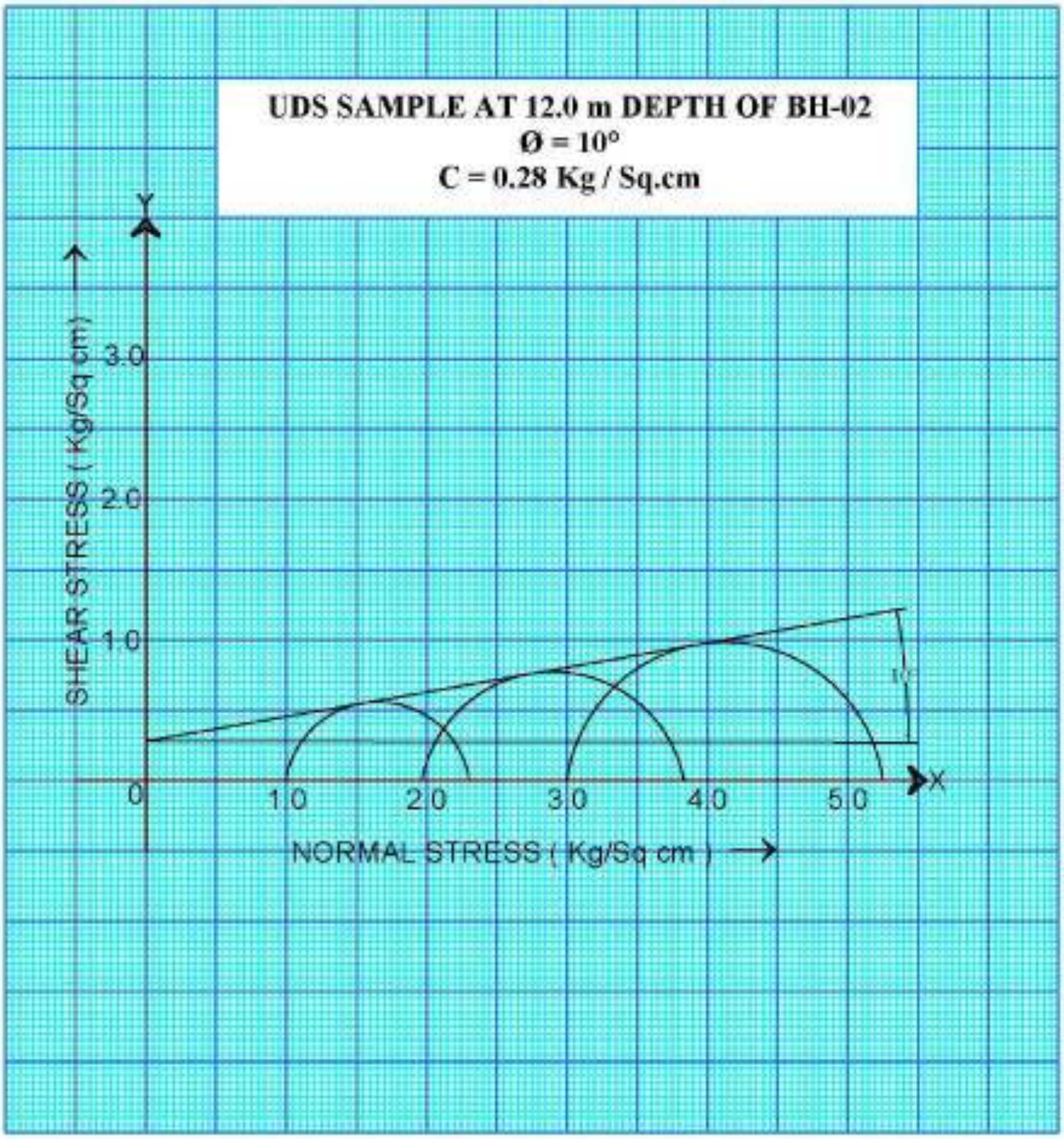
ANNEXURE -I
GRAPHICAL REPRESENTATION OF SHEAR STRENGTH PARAMETER



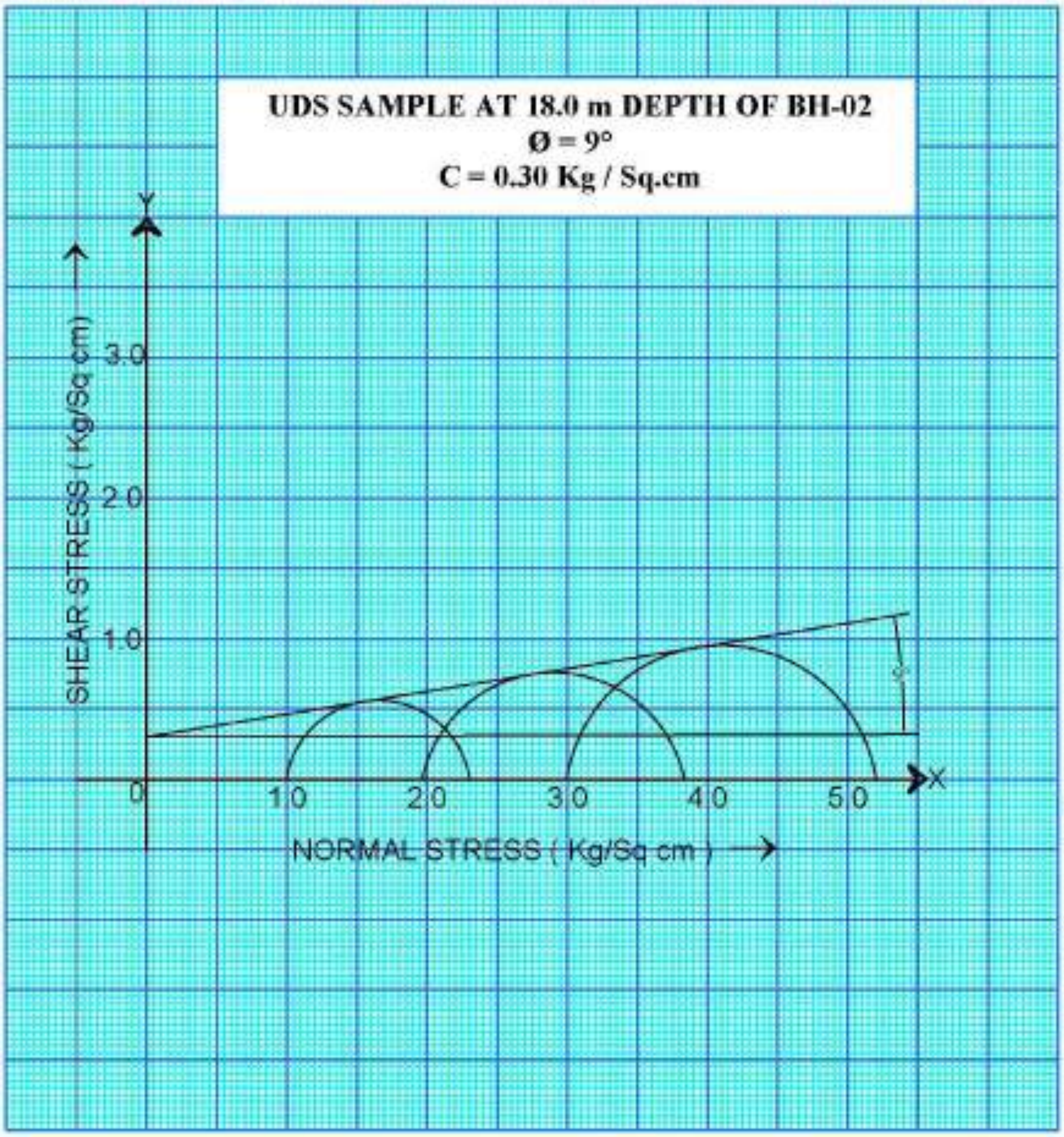
UDS SAMPLE AT 3.0 m DEPTH OF BH-02
Ø = 10°
C = 0.31 Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
X
NORMAL STRESS (Kg/Sq cm)



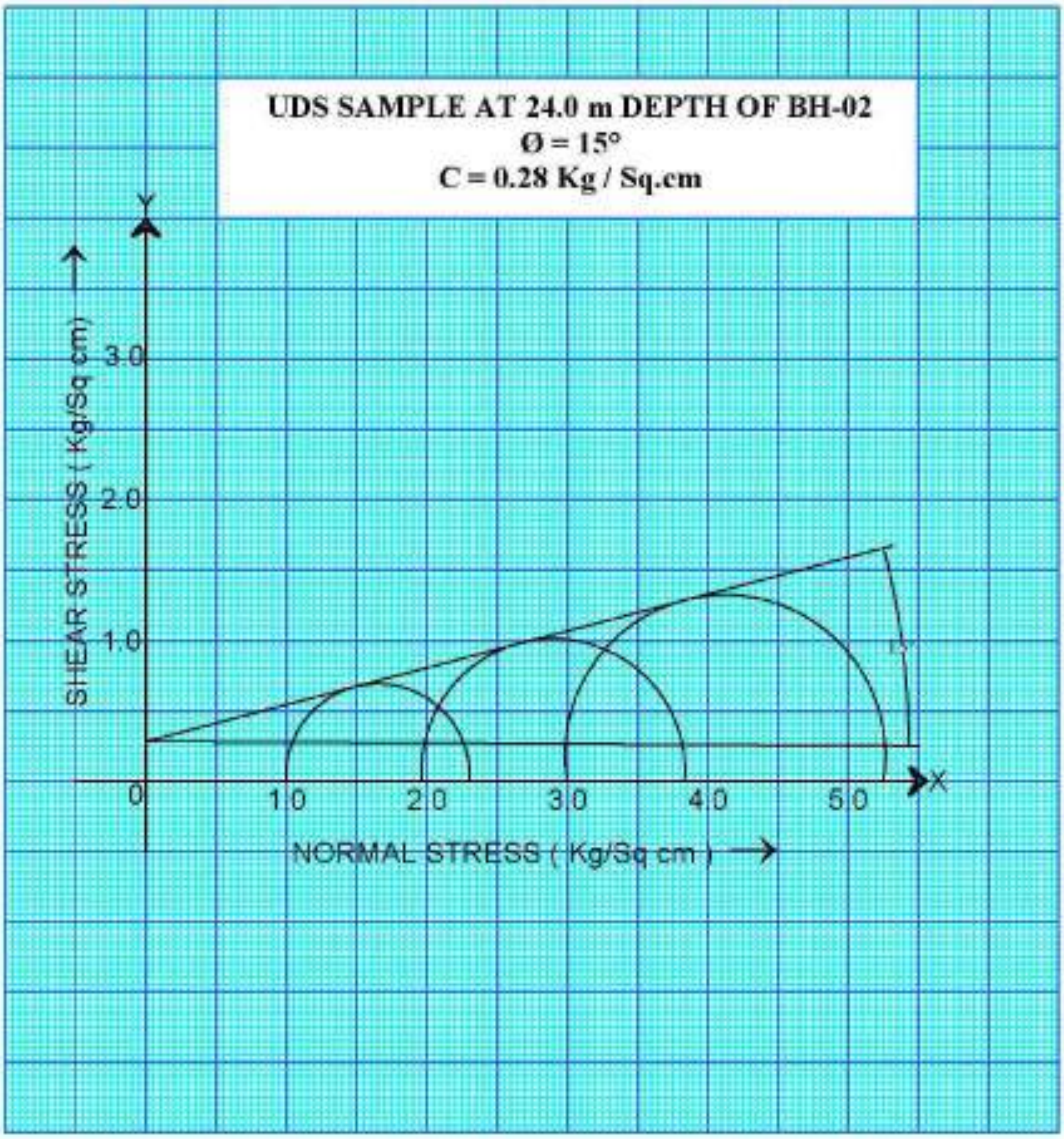
UDS SAMPLE AT 6.0 m DEPTH OF BH-02
Ø = 11°
C = 0.29 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
Y
X
NORMAL STRESS (Kg/Sq cm)



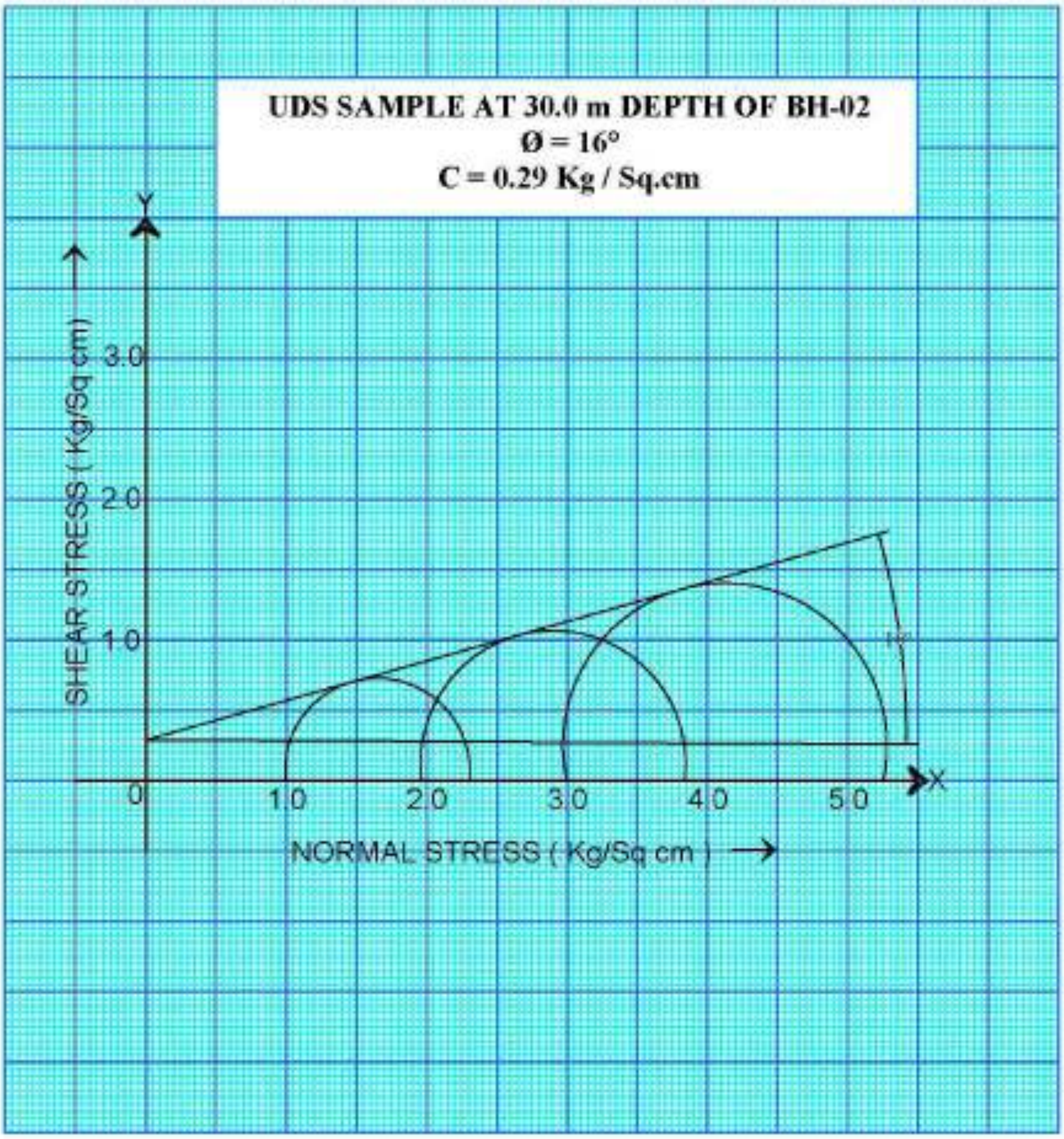
UDS SAMPLE AT 12.0 m DEPTH OF BH-02
Ø = 10°
C = 0.28 Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
X
NORMAL STRESS (Kg/Sq cm)



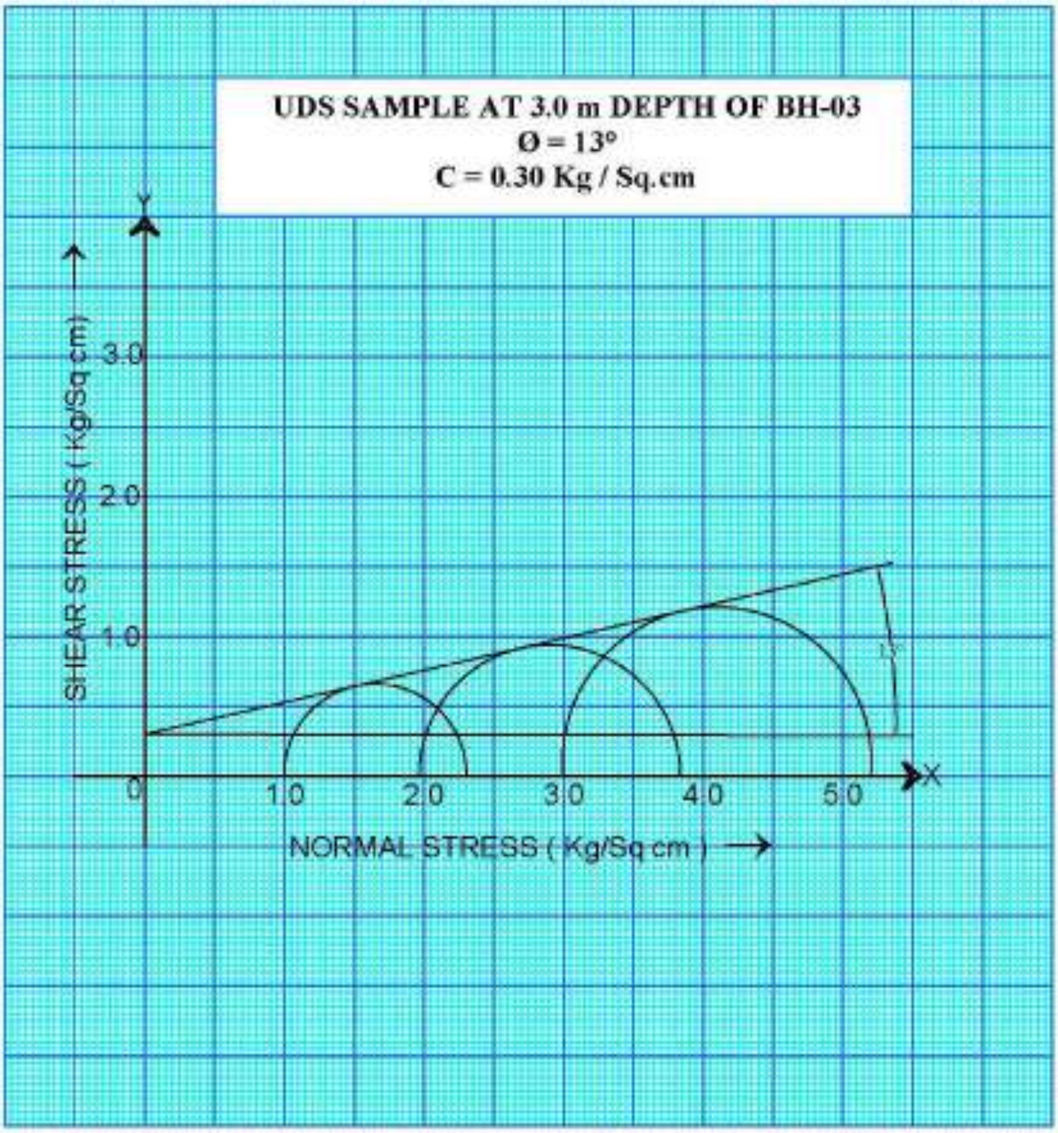
UDS SAMPLE AT 18.0 m DEPTH OF BH-02
Ø = 9°
C = 0.30 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
X
Y
NORMAL STRESS (Kg/Sq cm)



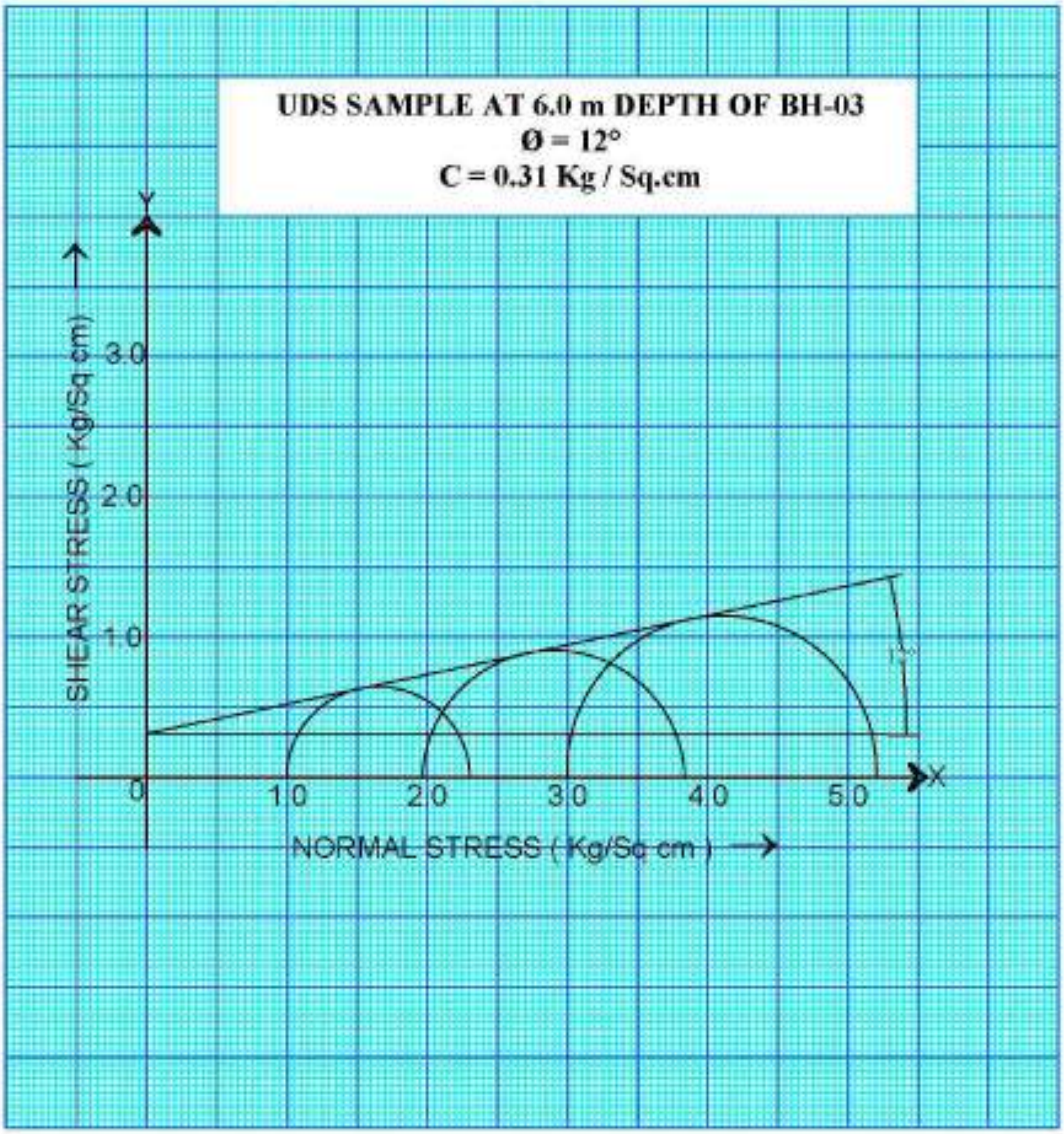
UDS SAMPLE AT 24.0 m DEPTH OF BH-02
Ø = 15°
C = 0.28 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
NORMAL STRESS (Kg/Sq cm)
Y
X
0
1.0
2.0
3.0
4.0
5.0



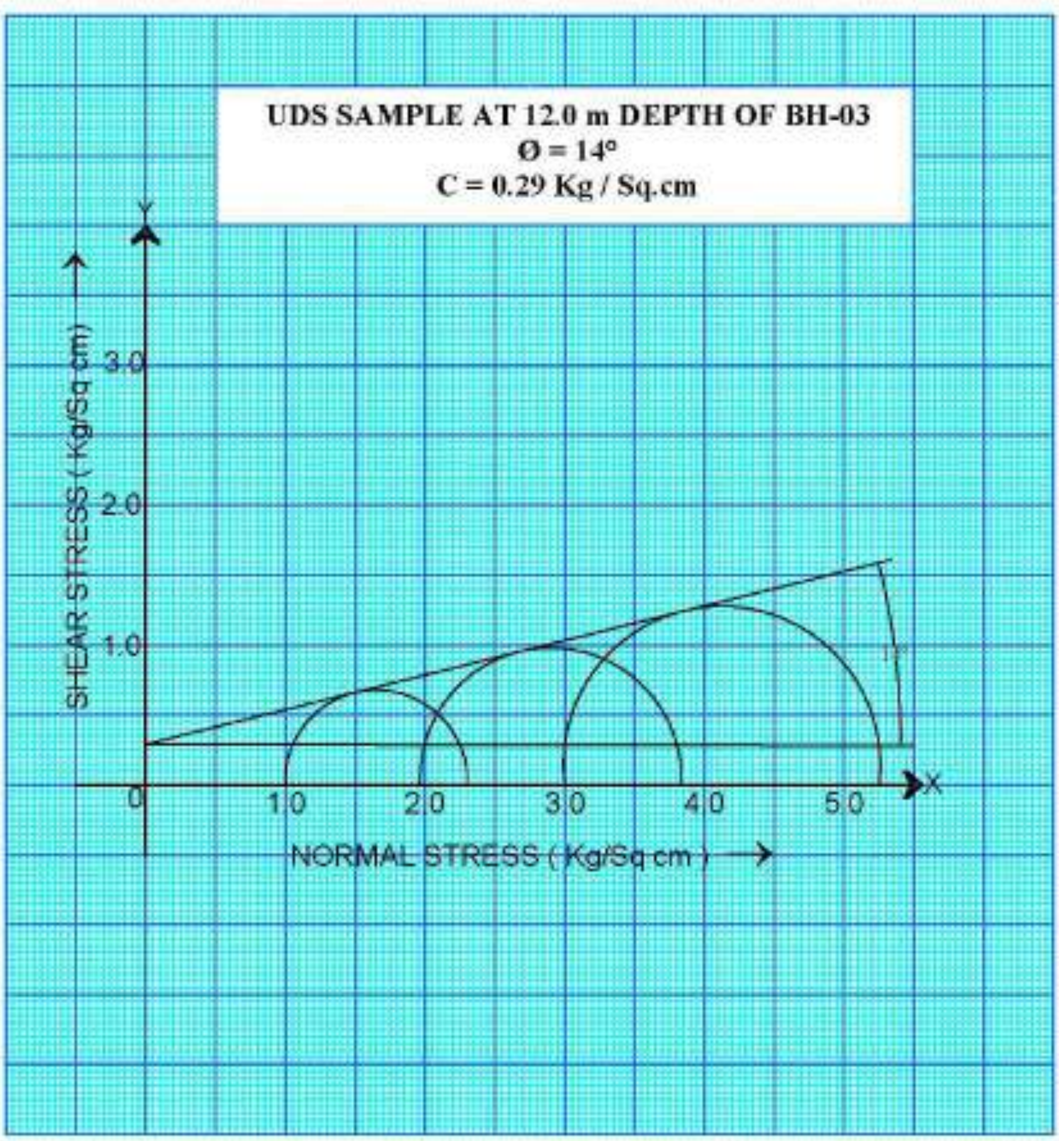
UDS SAMPLE AT 30.0 m DEPTH OF BH-02
Ø = 16°
C = 0.29 Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
X
NORMAL STRESS (Kg/Sq cm)



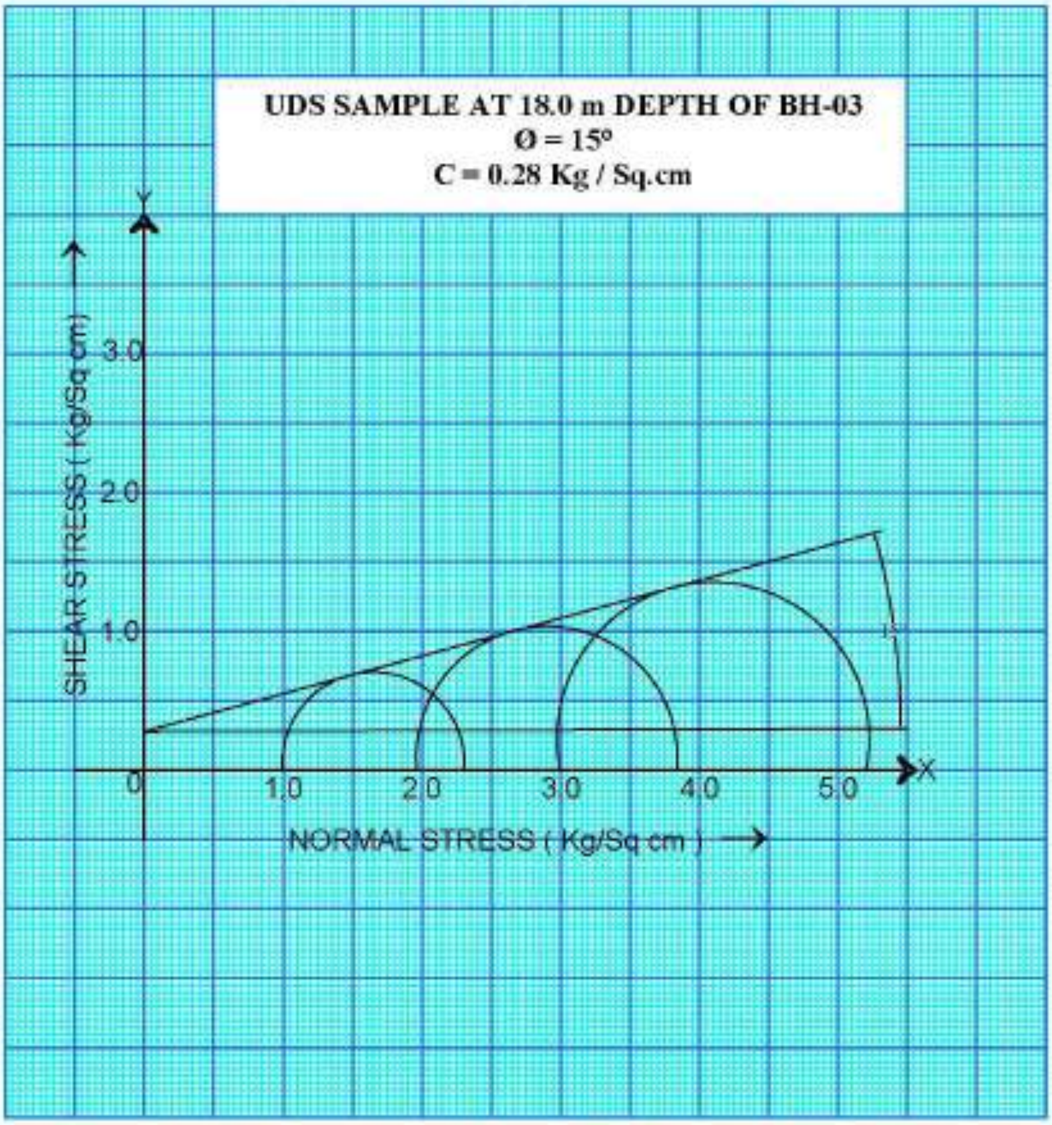
UDS SAMPLE AT 3.0 m DEPTH OF BH-03
Ø = 13°
C = 0.30 Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
X
NORMAL STRESS (Kg/Sq cm)



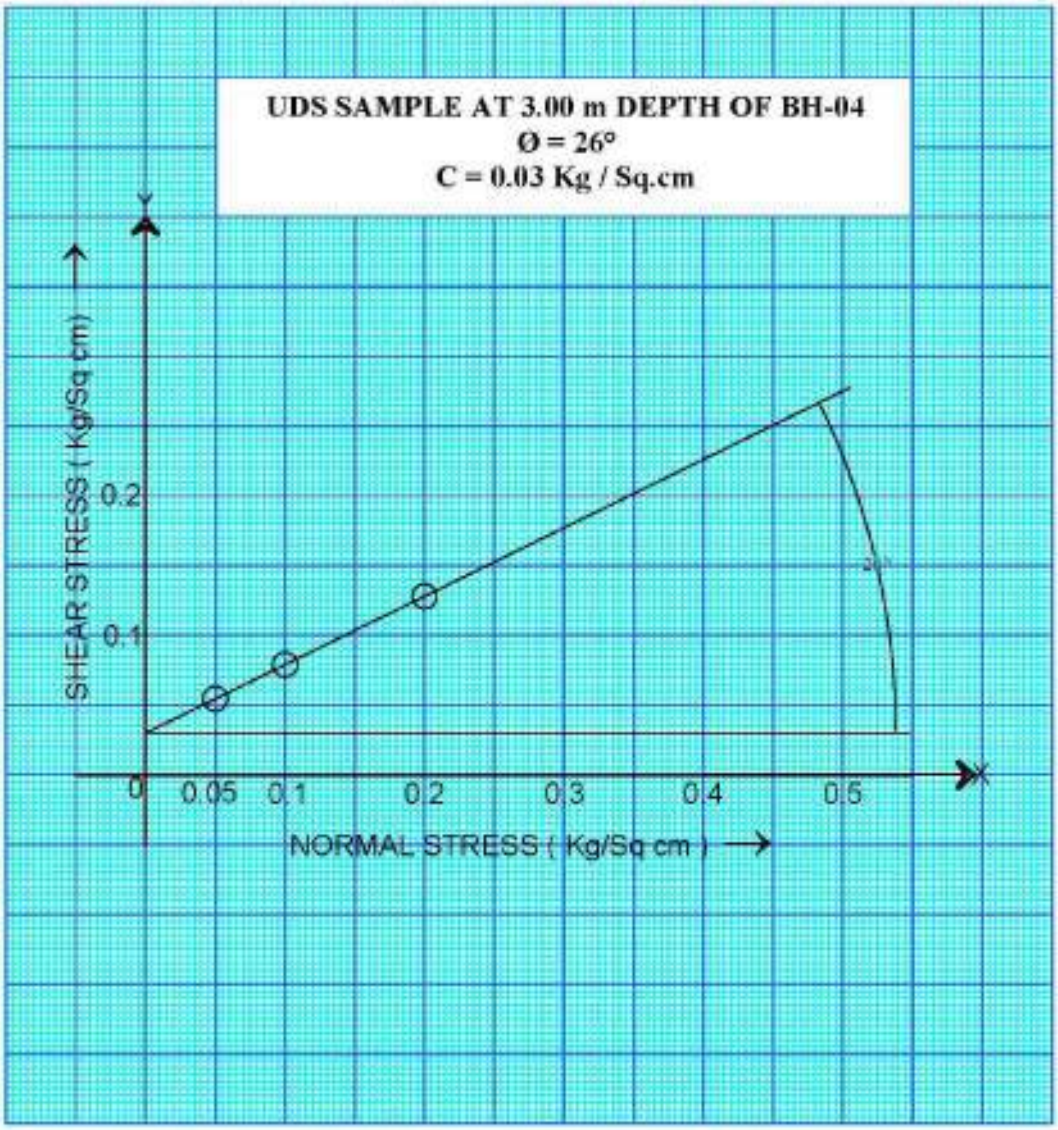
UDS SAMPLE AT 6.0 m DEPTH OF BH-03
Ø = 12°
C = 0.31 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
X
Y
NORMAL STRESS (Kg/Sq cm)



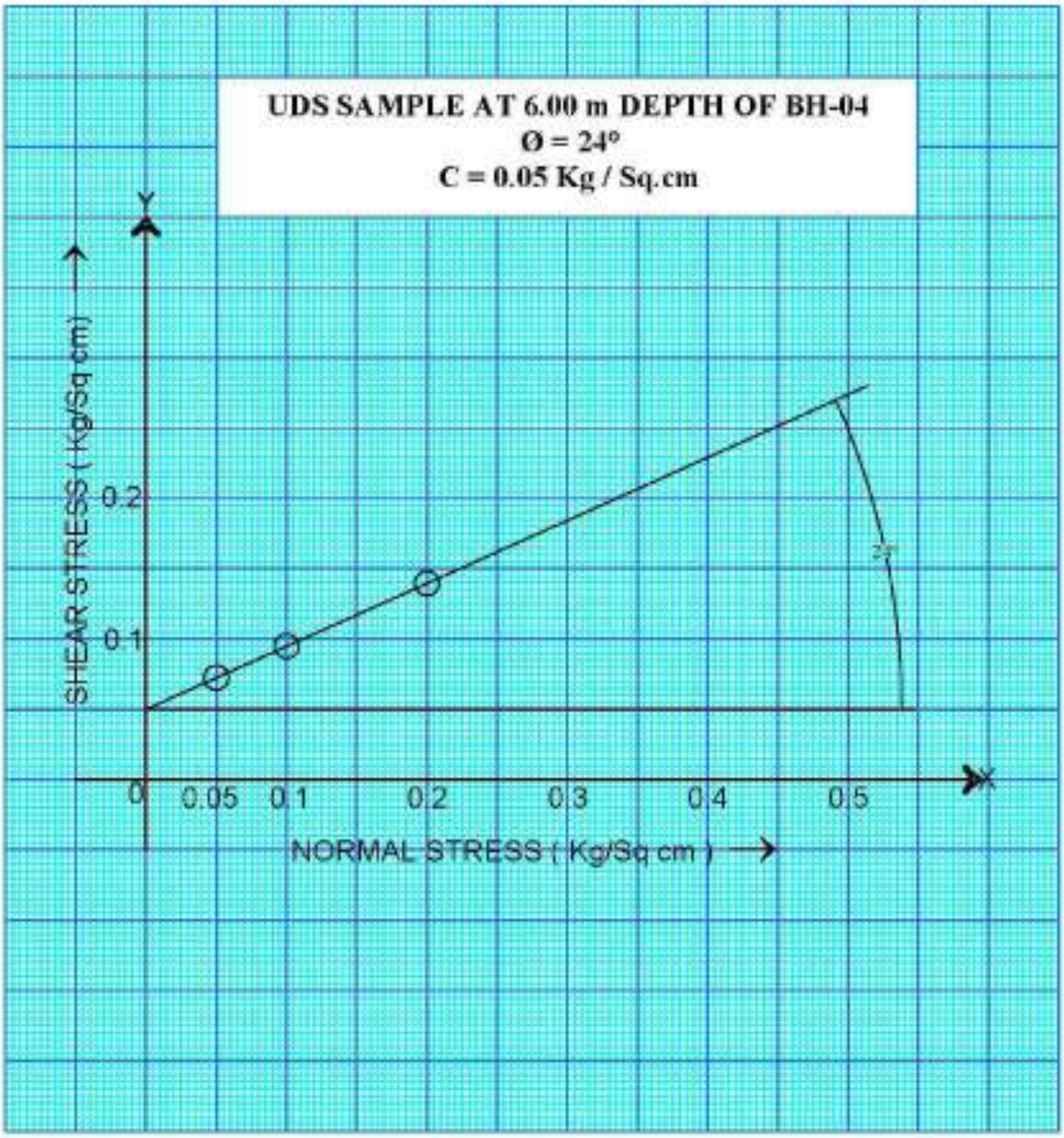
UDS SAMPLE AT 12.0 m DEPTH OF BH-03
Ø = 14°
C = 0.29 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
X
Y
NORMAL STRESS (Kg/Sq cm)

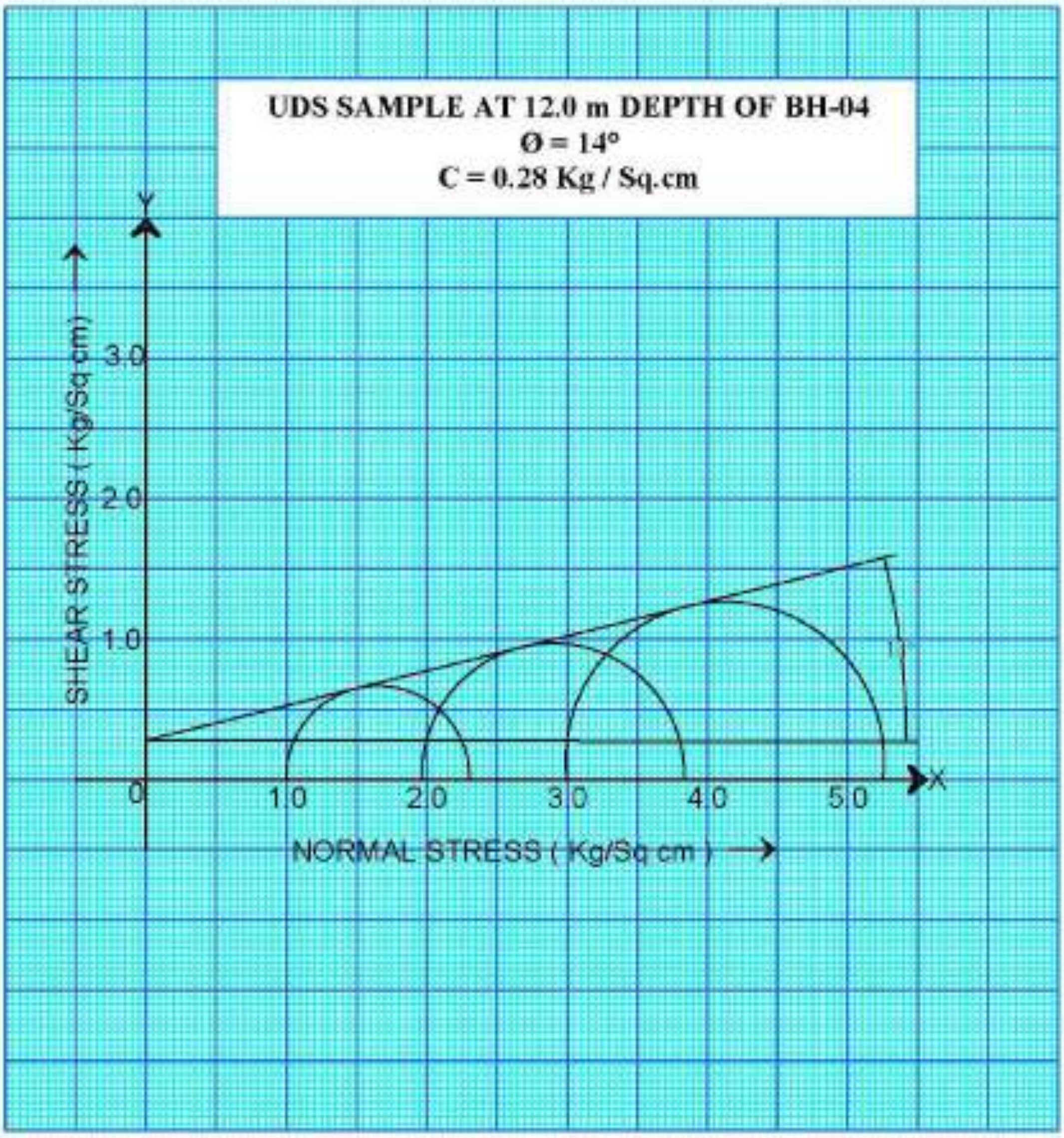


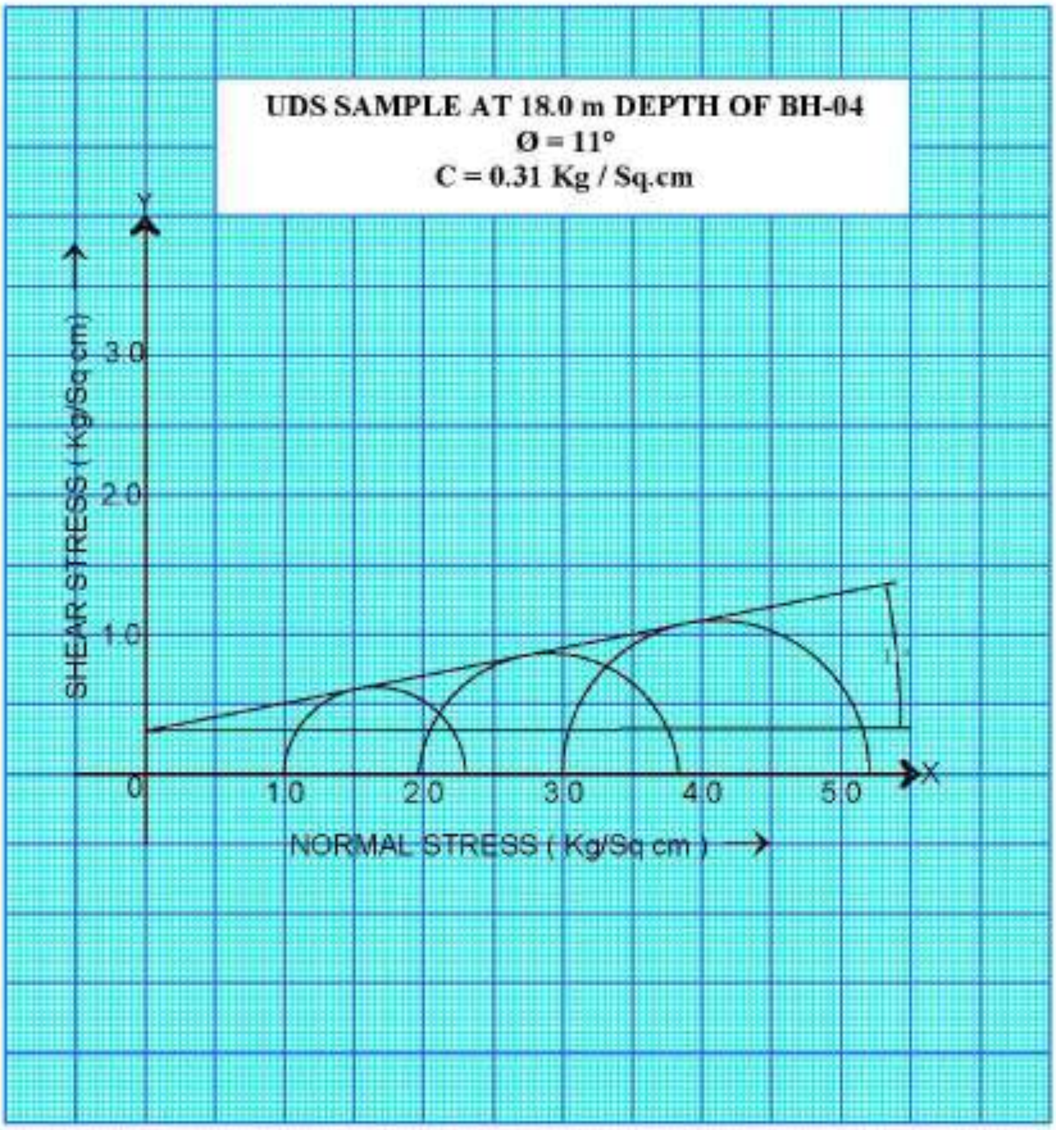
UDS SAMPLE AT 18.0 m DEPTH OF BH-03
Ø = 15°
C = 0.28 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
NORMAL STRESS (Kg/Sq cm)
X
Y



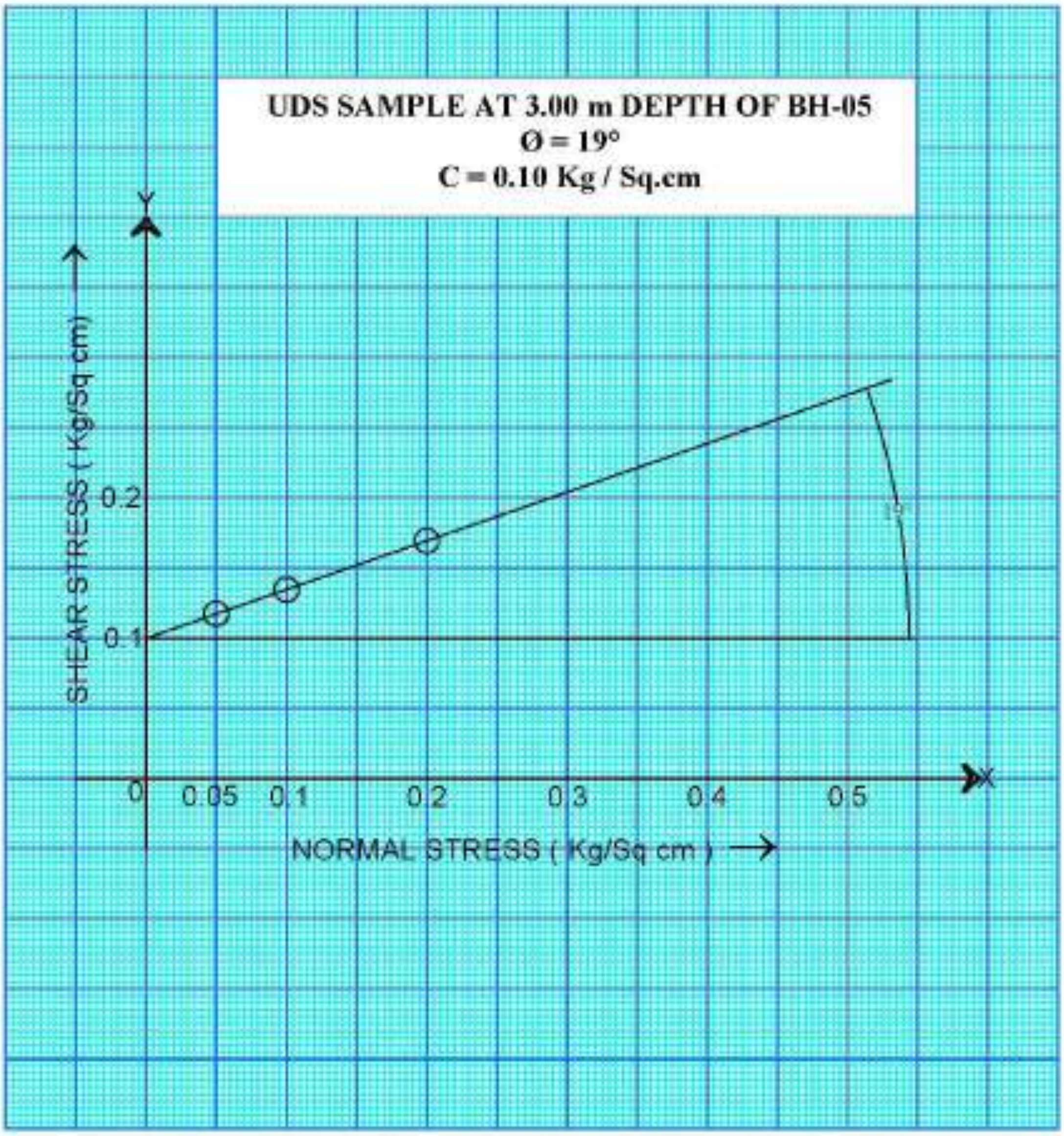
Name of Project:	Exploring alternate alignments, final location survey, geological mapping,geo-technical investigation, detail design of tunnel & its approaches including Viaduct if any and other ancillary work in Sohna-Manesar Section of HORC project.


UDS SAMPLE AT 6.00 m DEPTH OF BH-04
Ø = 24°
C = 0.05 Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
X
NORMAL STRESS (Kg/Sq cm)

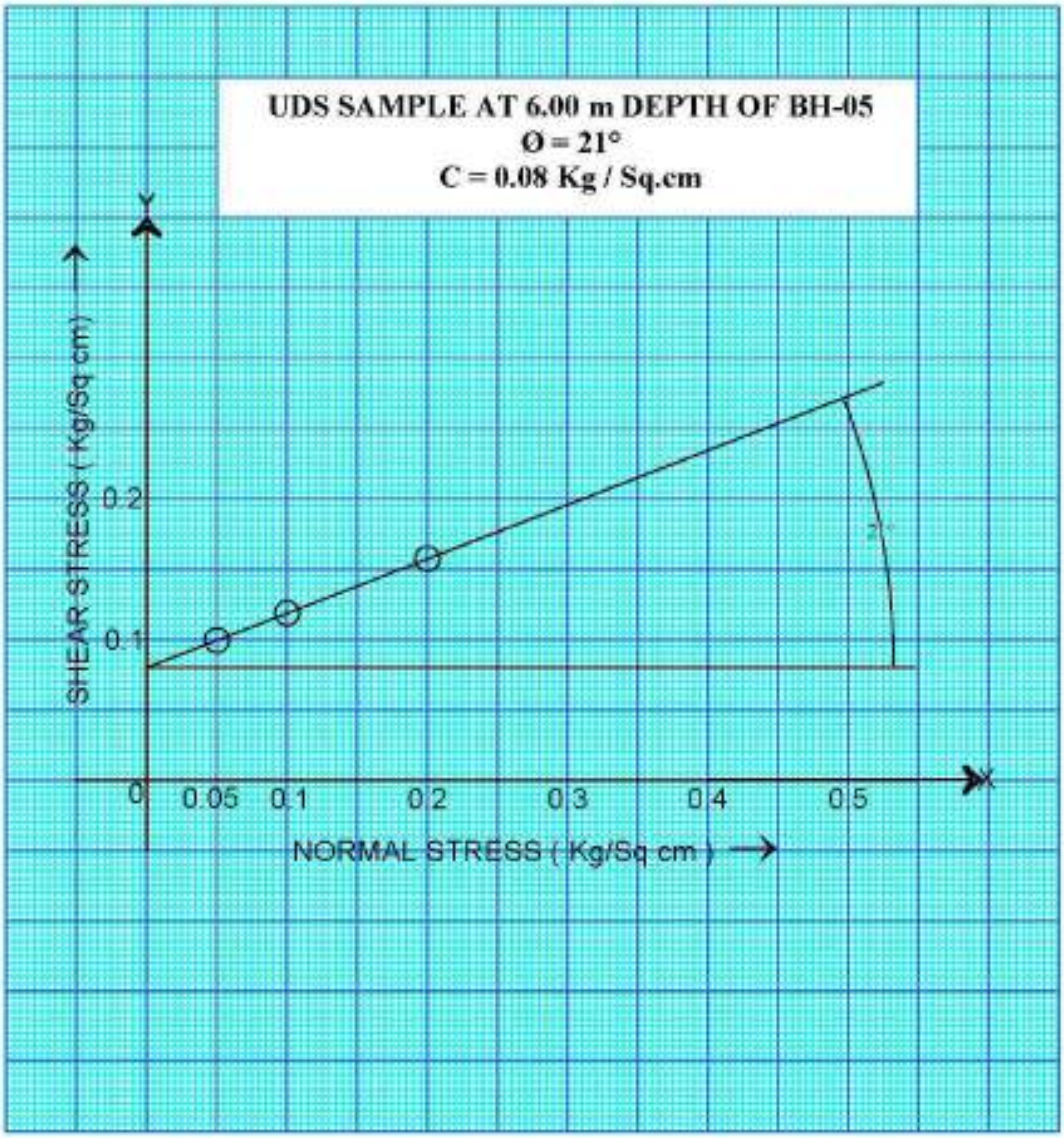

UDS SAMPLE AT 12.0 m DEPTH OF BH-04
Ø = 14°
C = 0.28 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
NORMAL STRESS (Kg/Sq cm)
X
Y



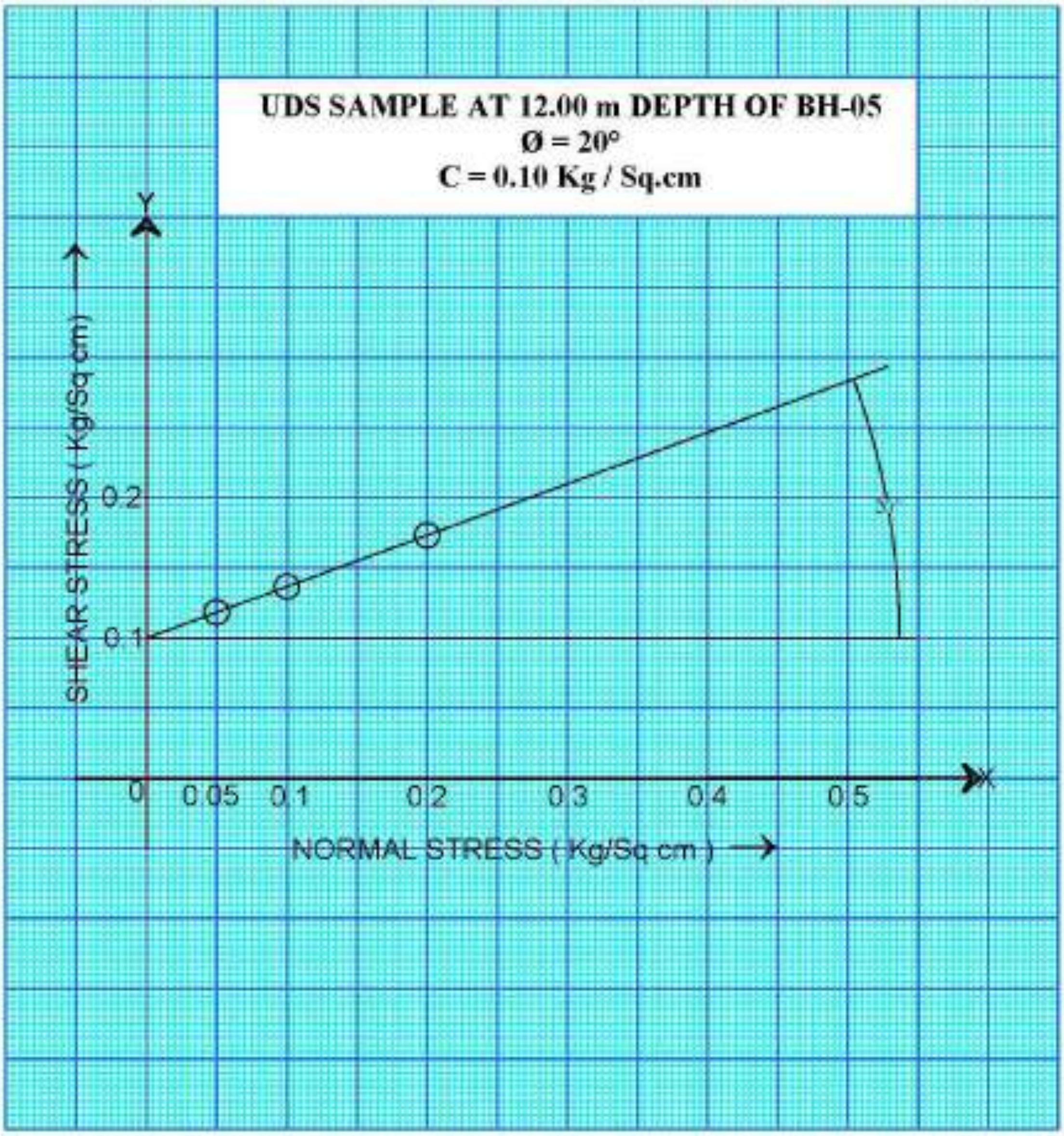
UDS SAMPLE AT 18.0 m DEPTH OF BH-04
Ø = 11°
C = 0.31 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
X
Y
NORMAL STRESS (Kg/Sq cm)

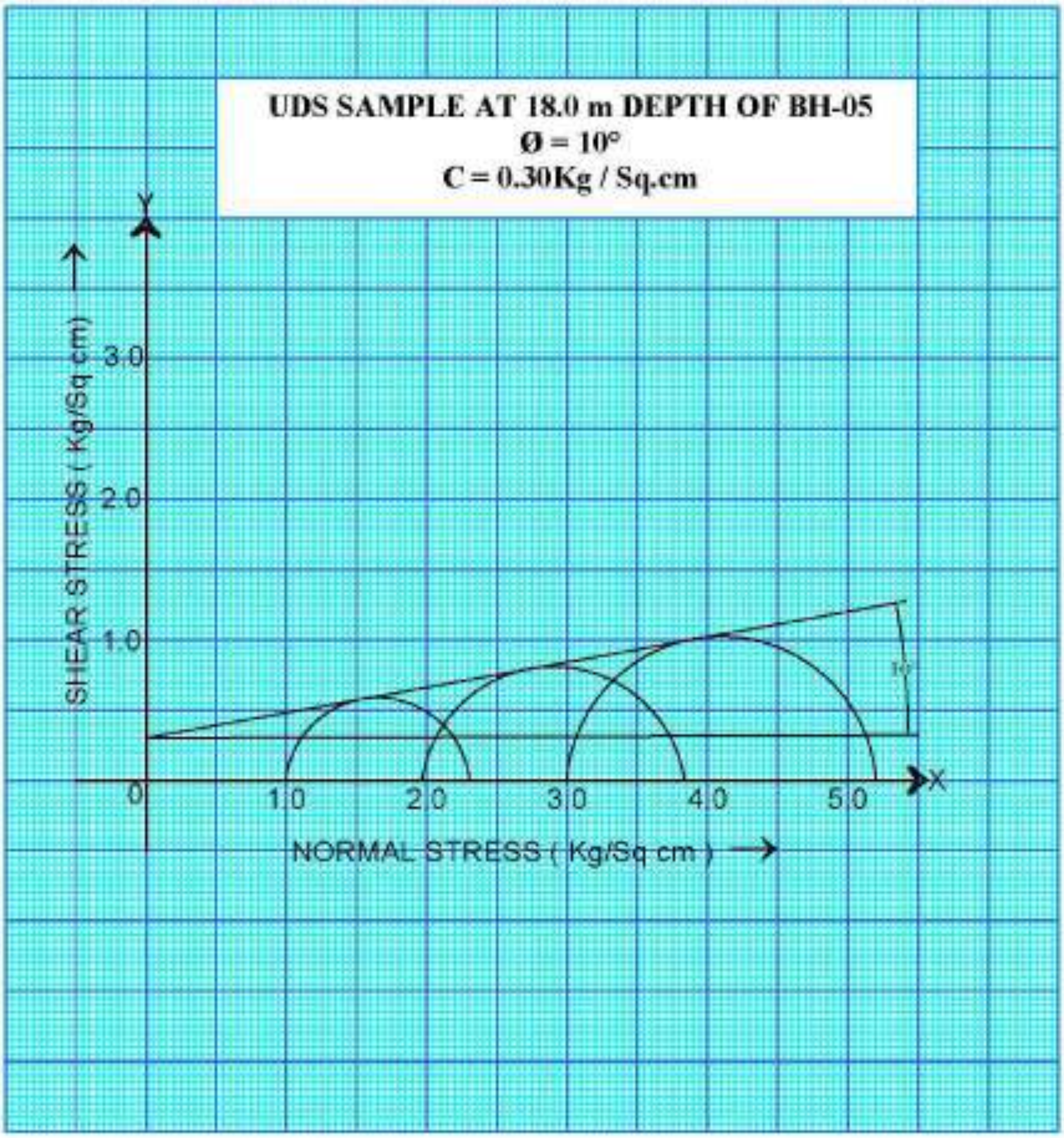


UDS SAMPLE AT 3.00 m DEPTH OF BH-05
Ø = 19°
C = 0.10 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq cm)
Y
X

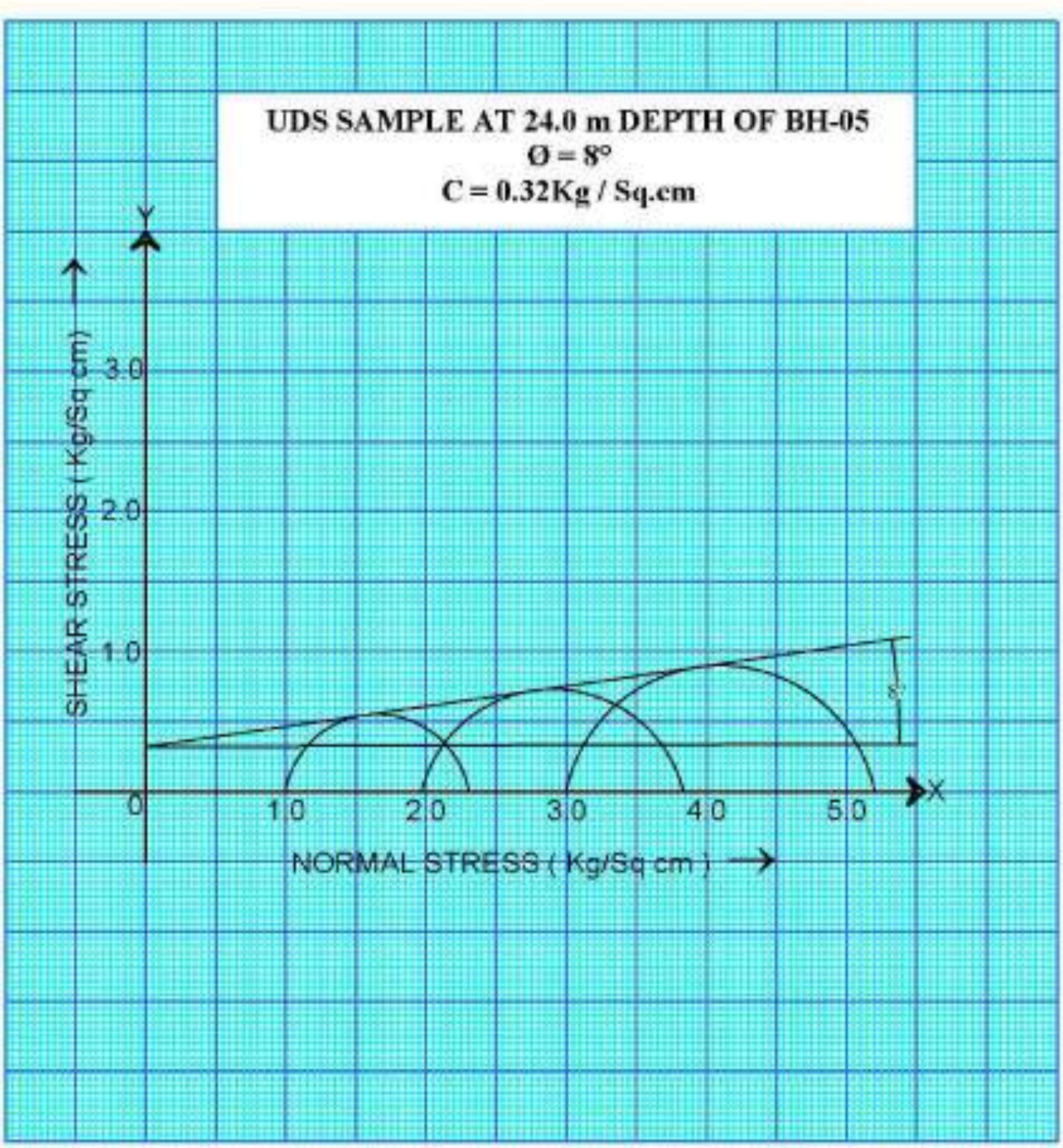


UDS SAMPLE AT 6.00 m DEPTH OF BH-05
Ø = 21°
C = 0.08 Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
X
NORMAL STRESS (Kg/Sq cm)

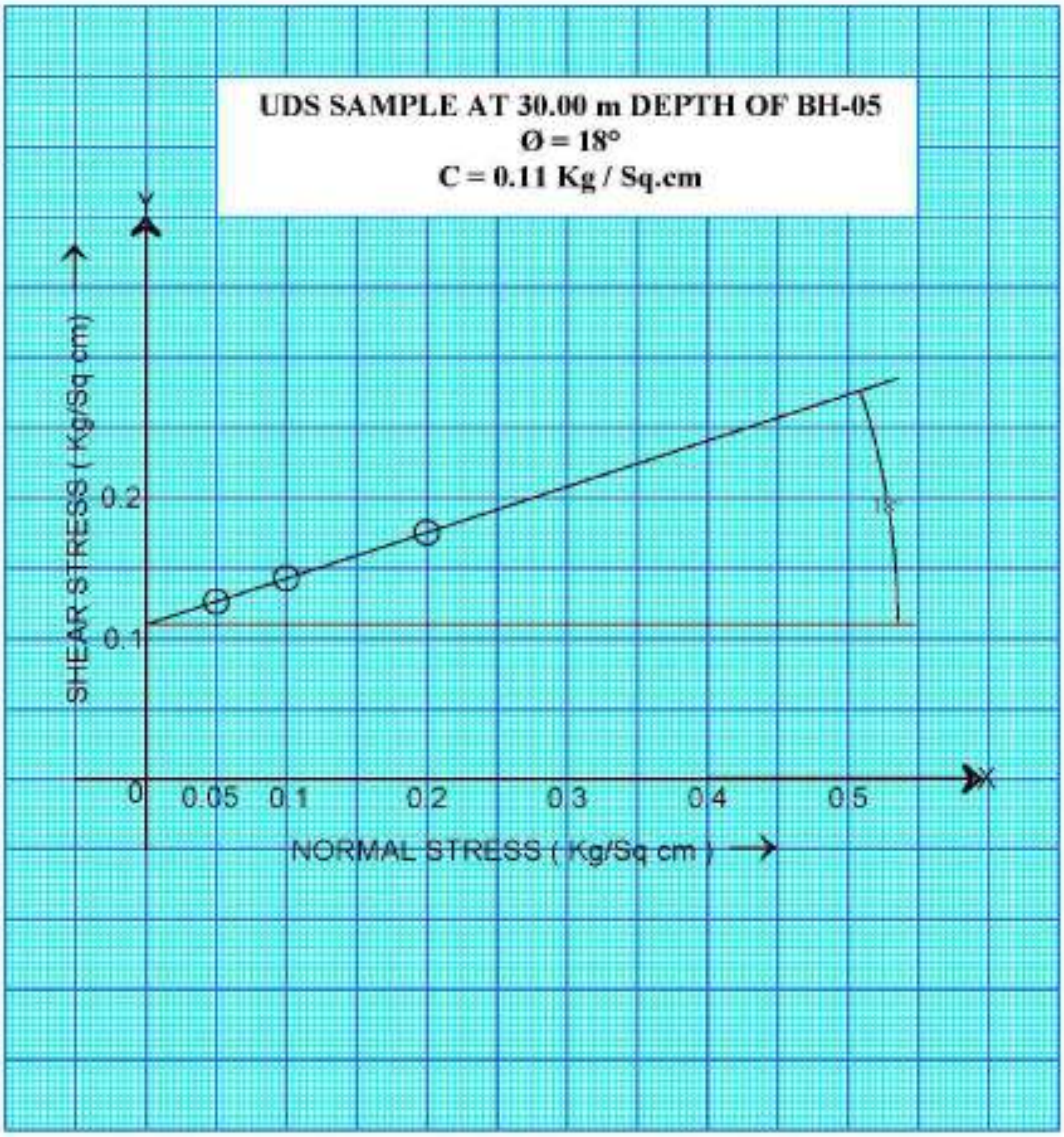

UDS SAMPLE AT 12.00 m DEPTH OF BH-05
Ø = 20°
C = 0.10 Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
X
NORMAL STRESS (Kg/Sq cm)

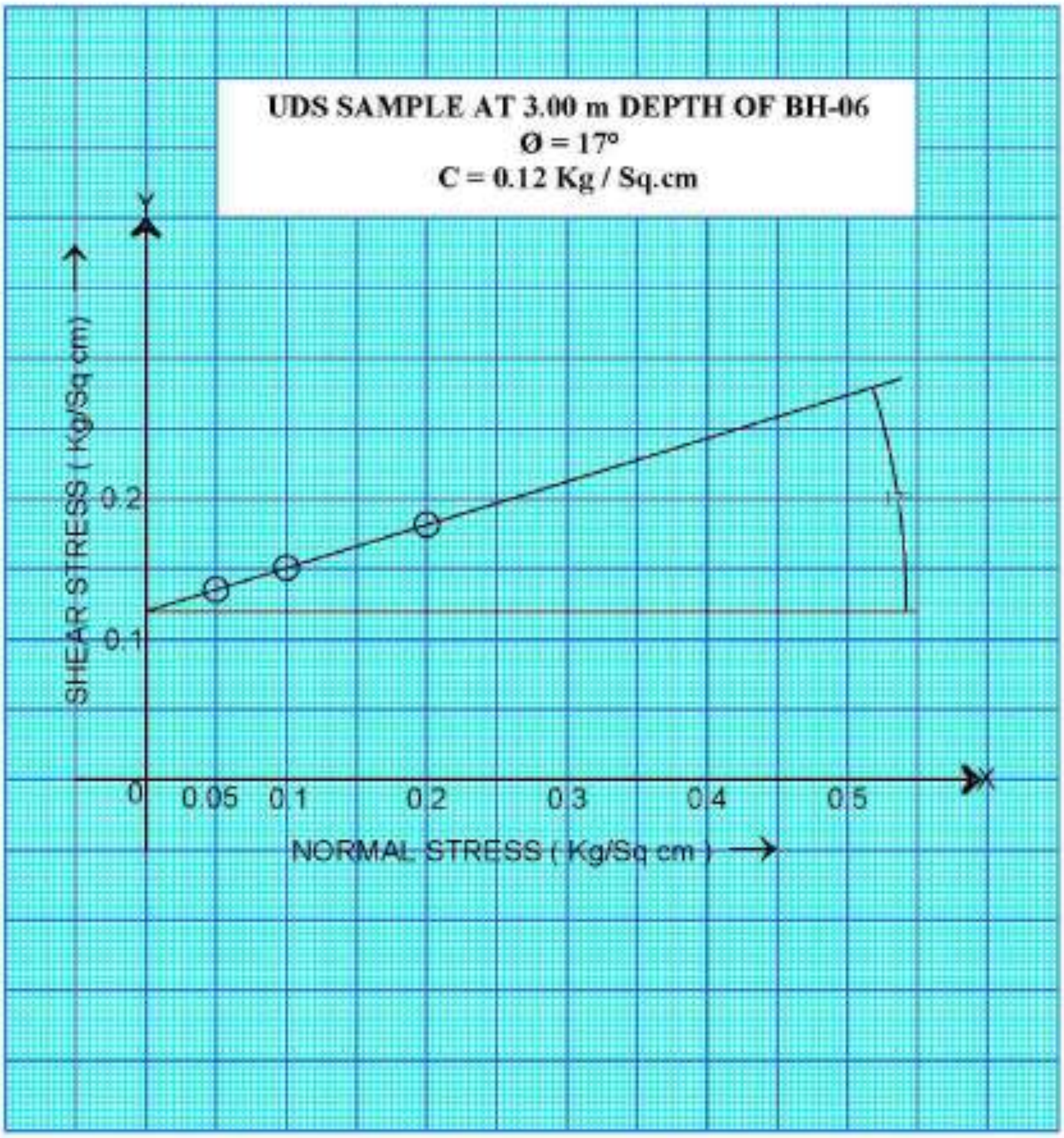


UDS SAMPLE AT 18.0 m DEPTH OF BH-05
Ø = 10°
C = 0.30Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
NORMAL STRESS (Kg/Sq cm)
Y
X

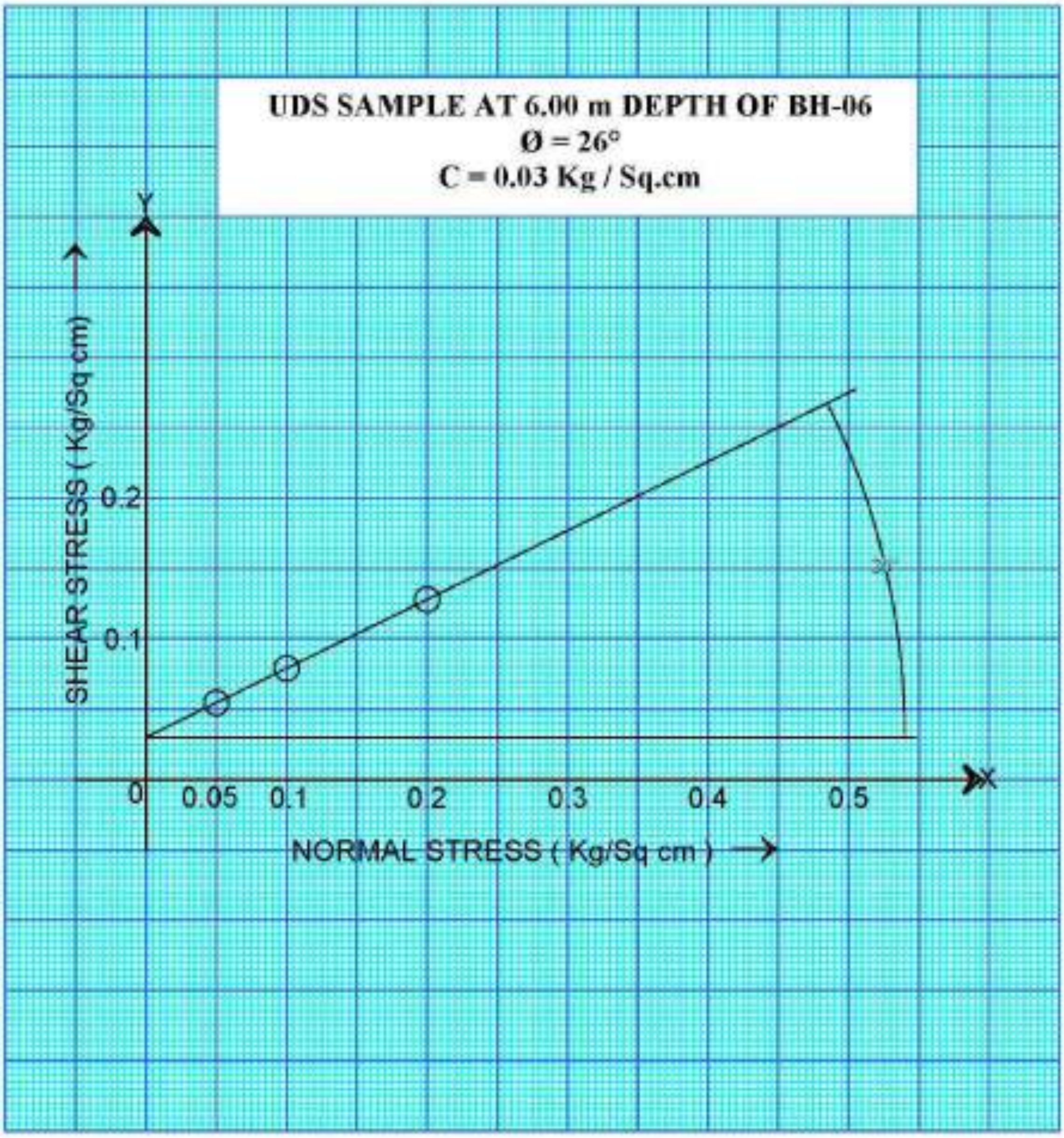


UDS SAMPLE AT 24.0 m DEPTH OF BH-05
Ø = 8°
C = 0.32Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
X
NORMAL STRESS (Kg/Sq cm)
8°

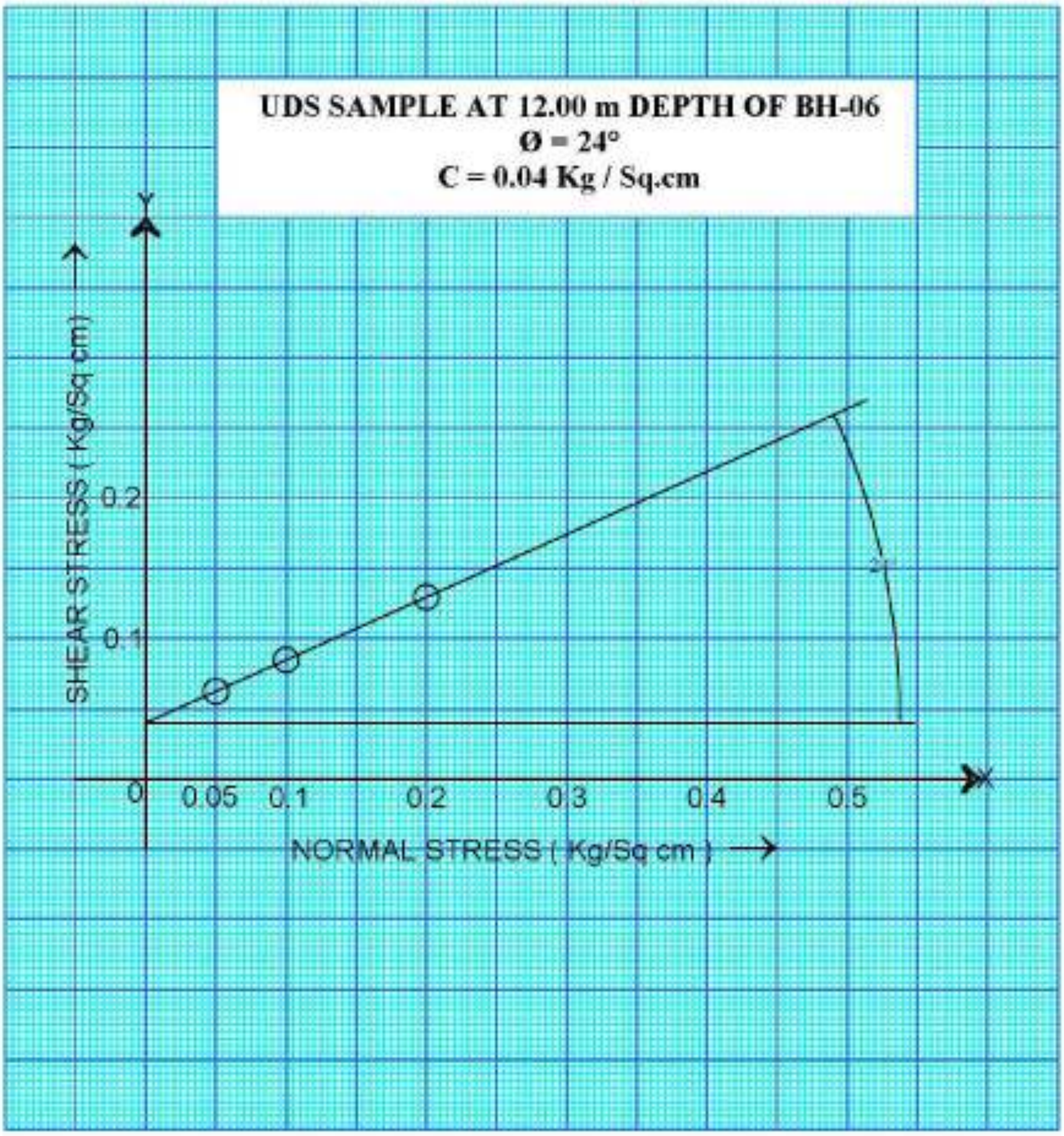

UDS SAMPLE AT 30.00 m DEPTH OF BH-05
Ø = 18°
C = 0.11 Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
X
NORMAL STRESS (Kg/Sq cm)

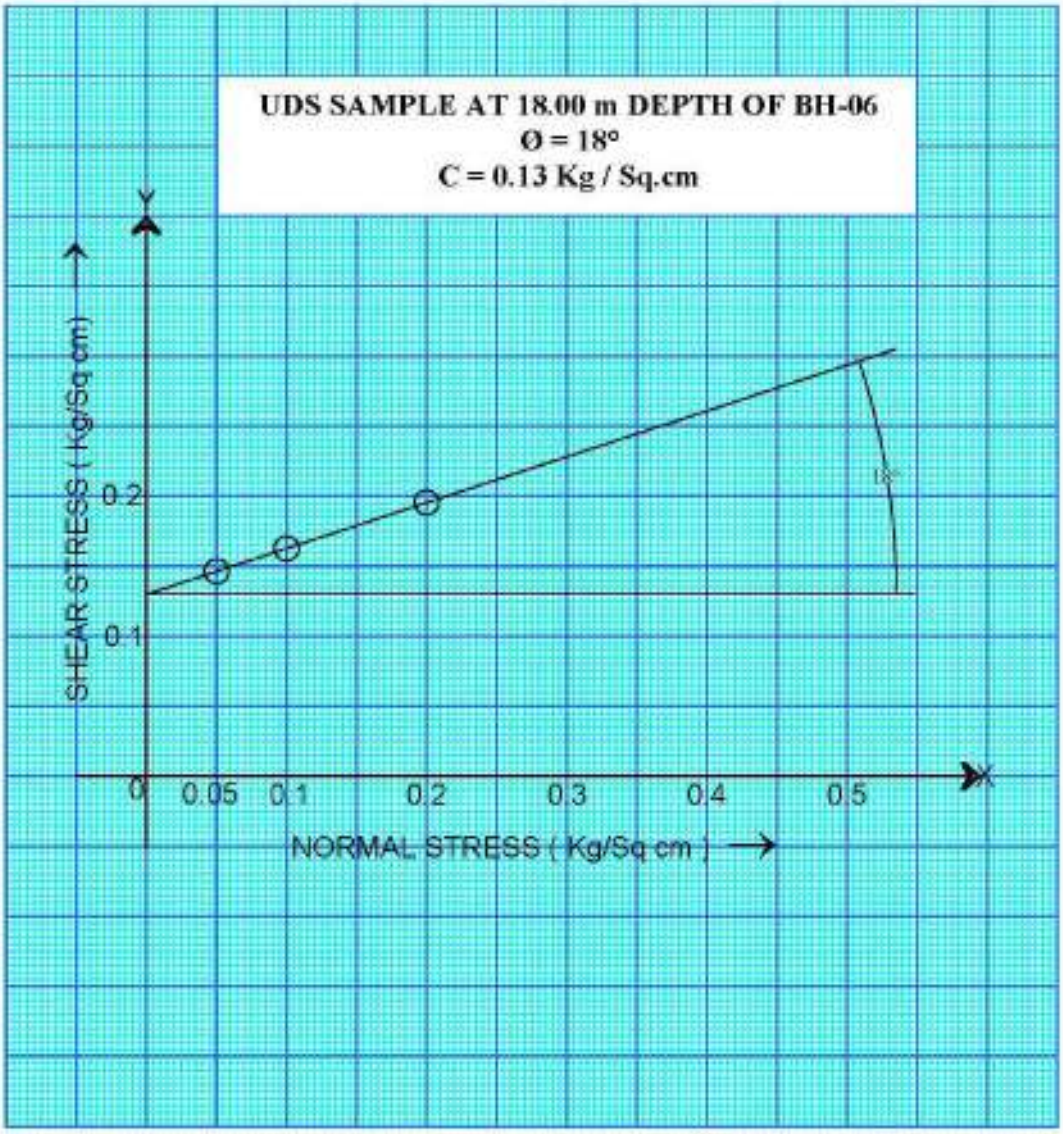


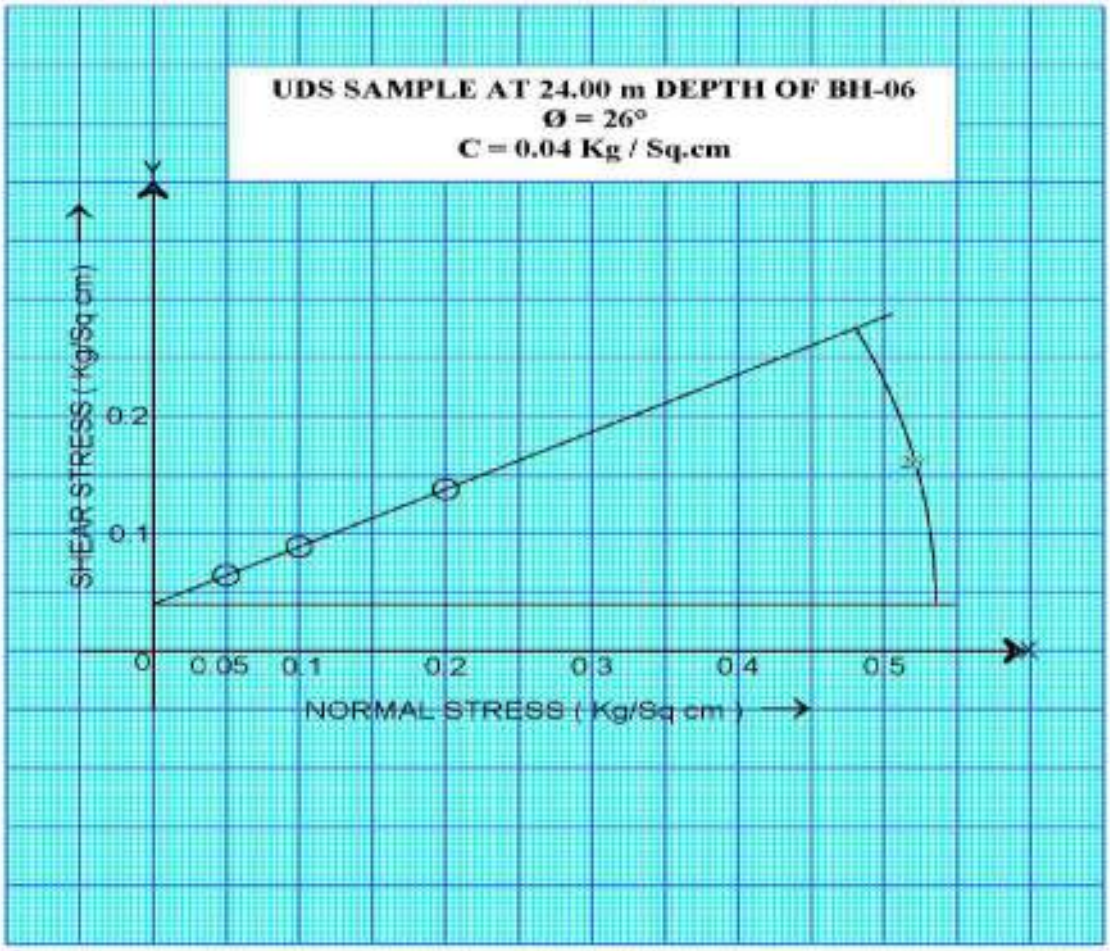
UDS SAMPLE AT 3.00 m DEPTH OF BH-06
Ø = 17°
C = 0.12 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq cm)



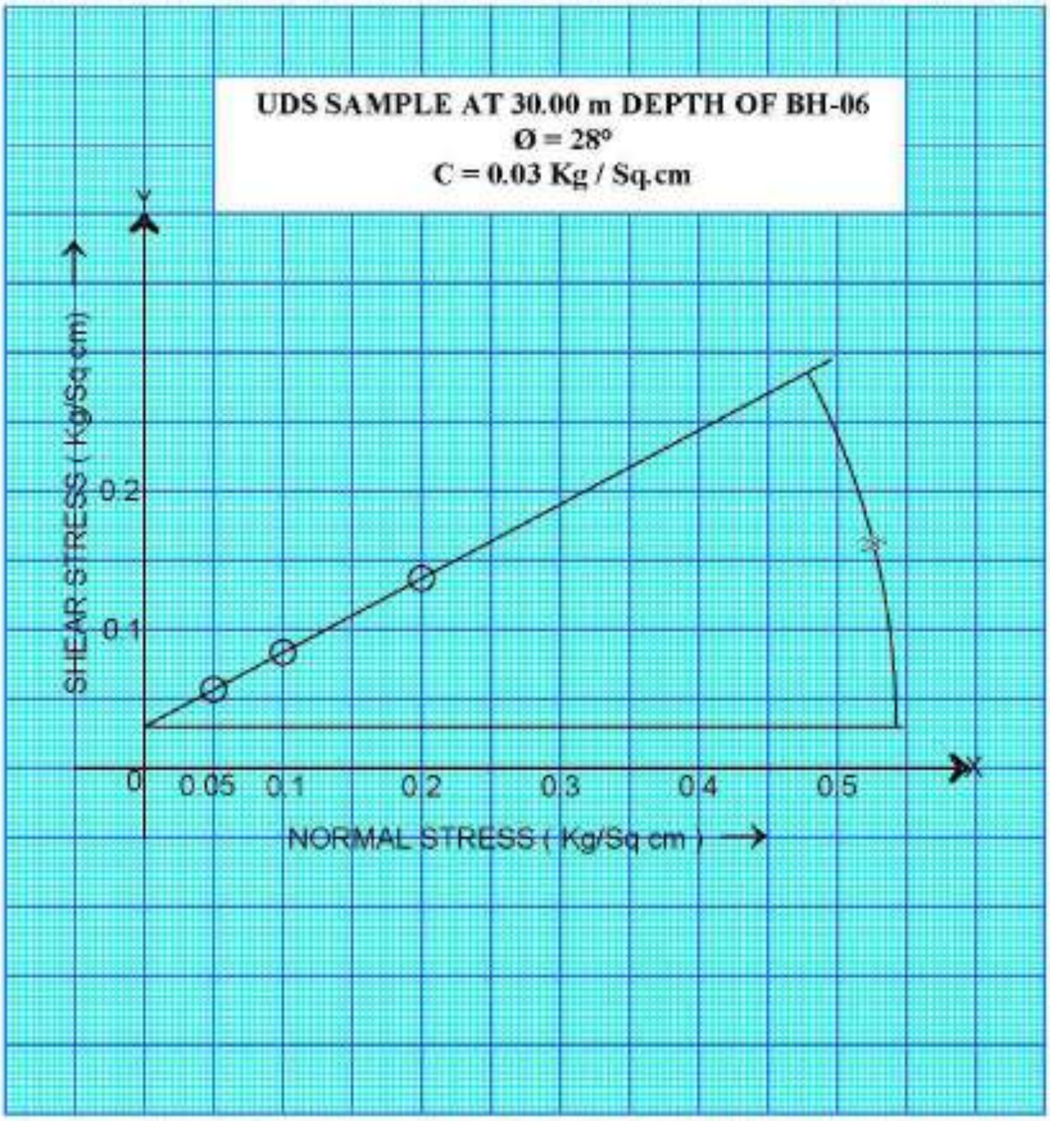
UDS SAMPLE AT 6.00 m DEPTH OF BH-06
Ø = 26°
C = 0.03 Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
X
NORMAL STRESS (Kg/Sq cm)

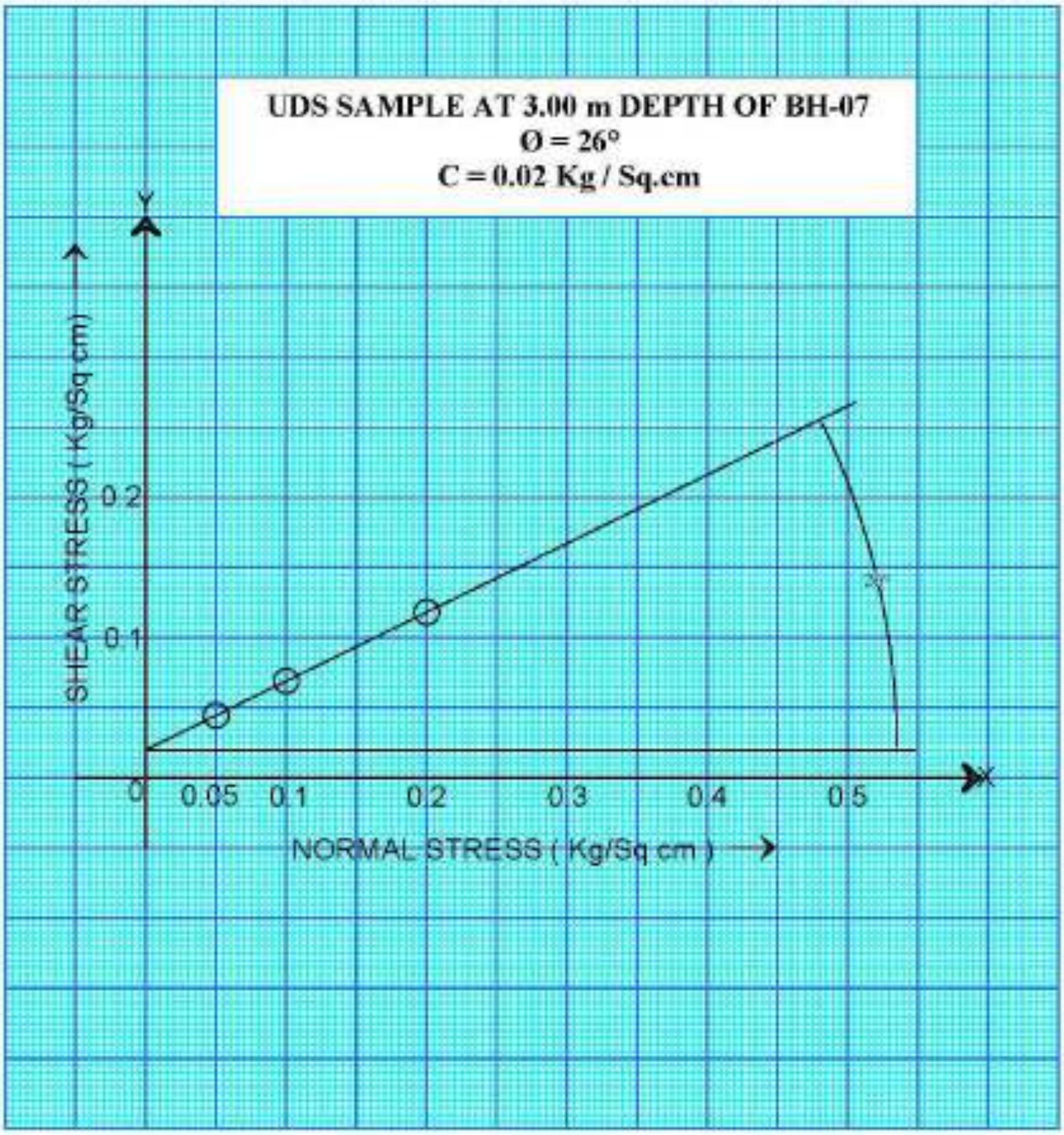

UDS SAMPLE AT 12.00 m DEPTH OF BH-06
Ø = 24°
C = 0.04 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq cm)
Y
X


UDS SAMPLE AT 18.00 m DEPTH OF BH-06
Ø = 18°
C = 0.13 Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
X
NORMAL STRESS (Kg/Sq cm)

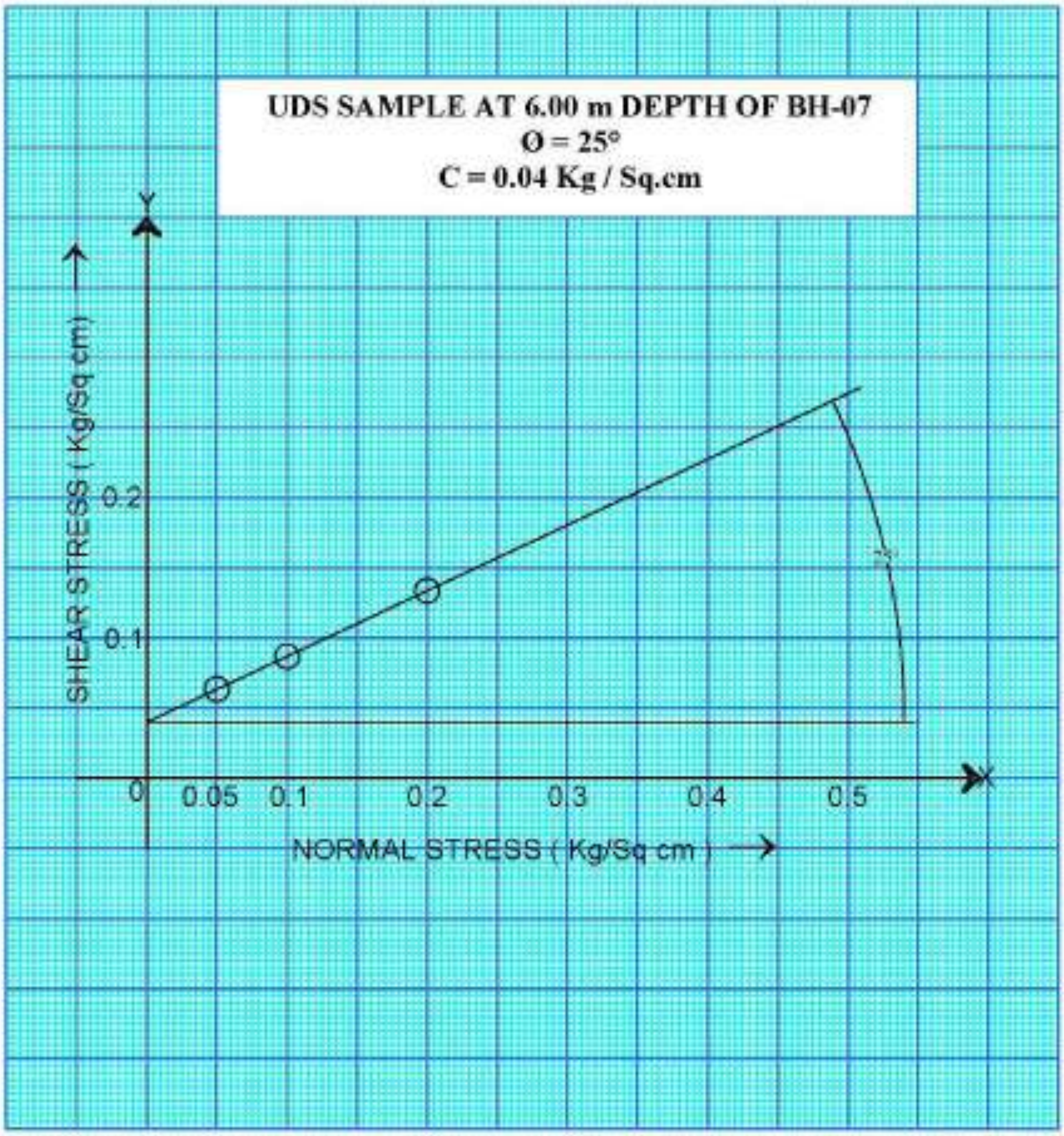


UDS SAMPLE AT 24.00 m DEPTH OF BH-06
Ø = 26°
C = 0.04 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq cm)

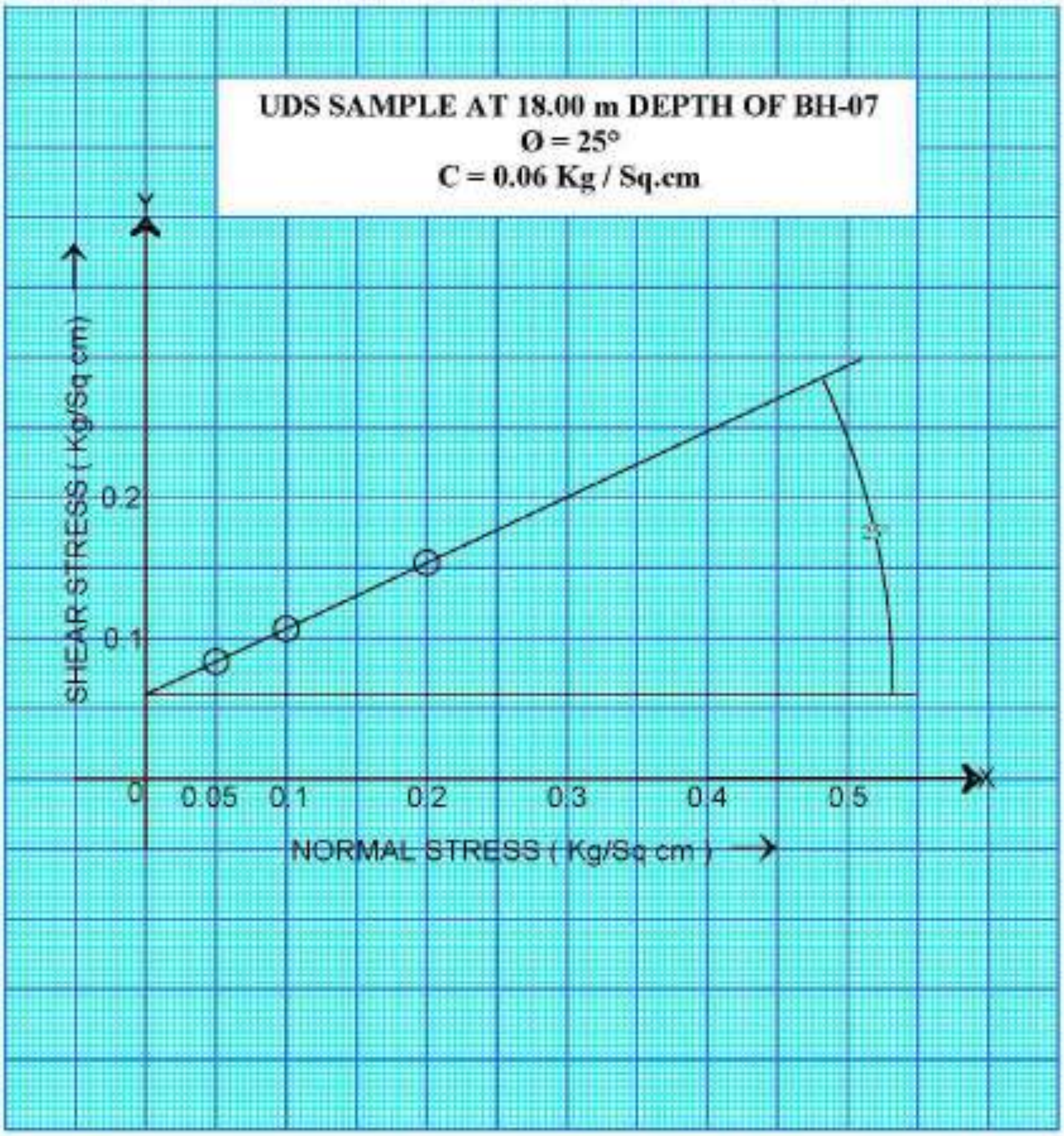

UDS SAMPLE AT 30.00 m DEPTH OF BH-06
Ø = 28°
C = 0.03 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
Y
X
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq cm)



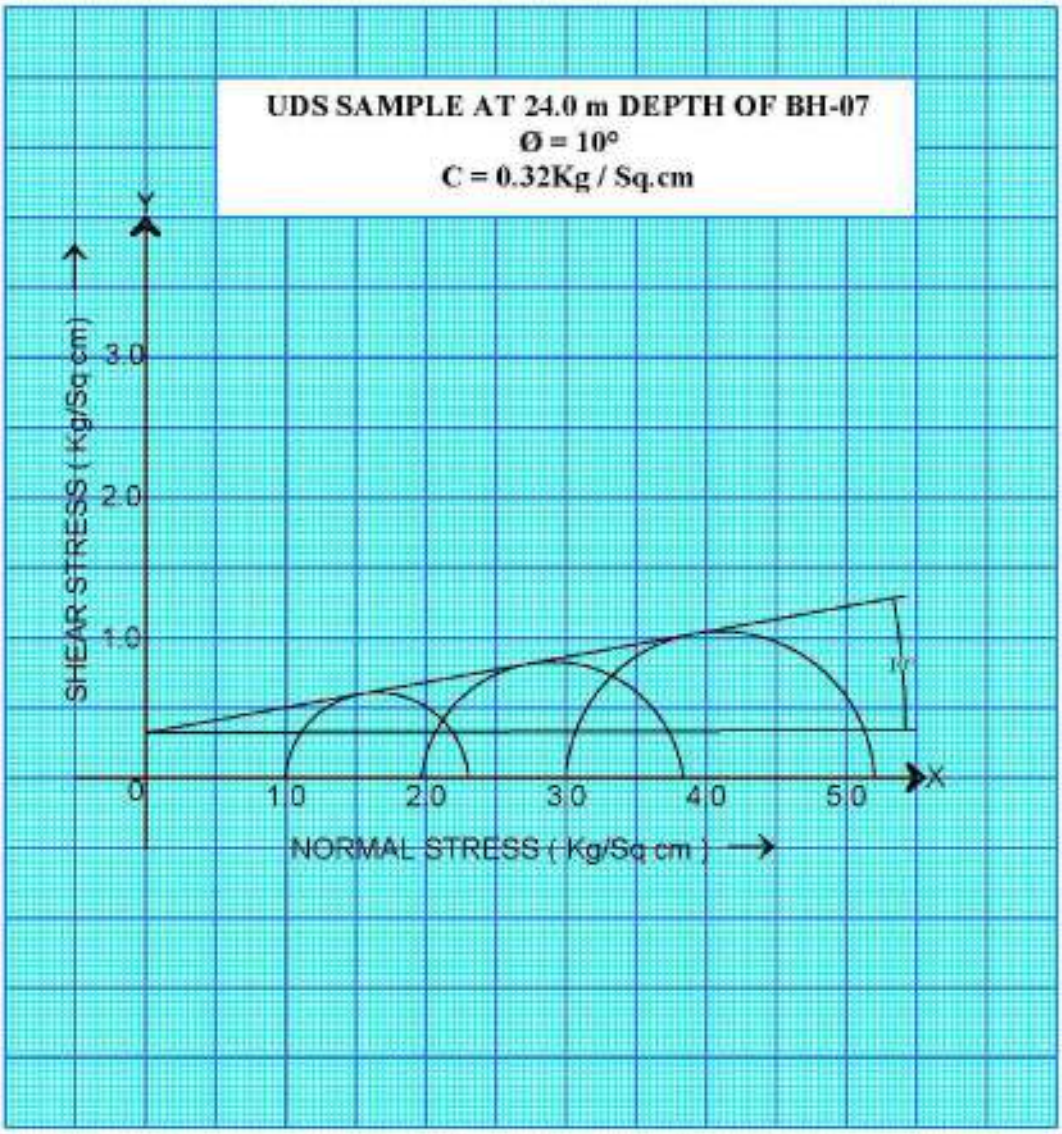
UDS SAMPLE AT 3.00 m DEPTH OF BH-07
Ø = 26°
C = 0.02 Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
X
NORMAL STRESS (Kg/Sq cm)

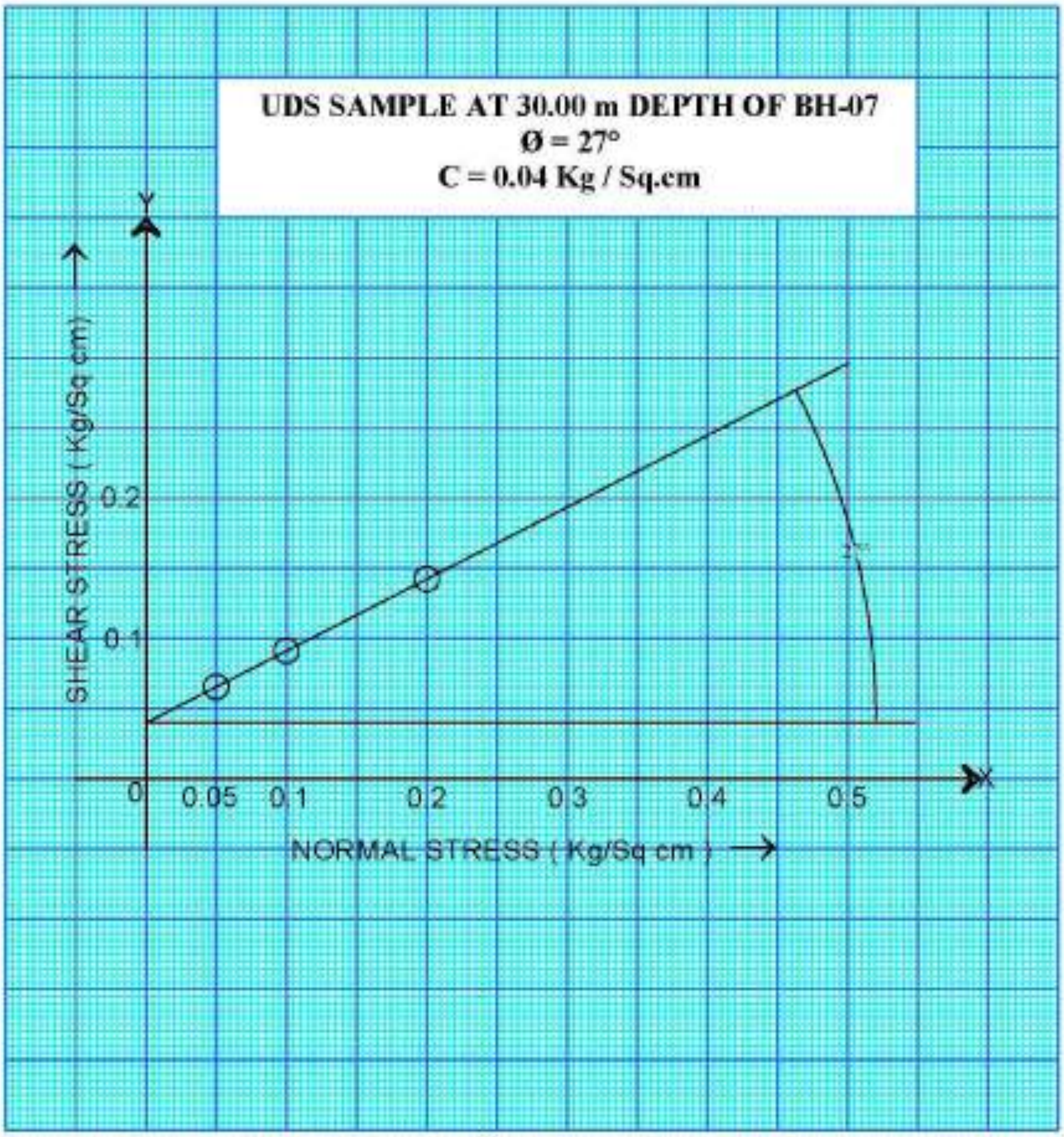


UDS SAMPLE AT 6.00 m DEPTH OF BH-07
Ø = 25°
C = 0.04 Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
X
NORMAL STRESS (Kg/Sq cm)

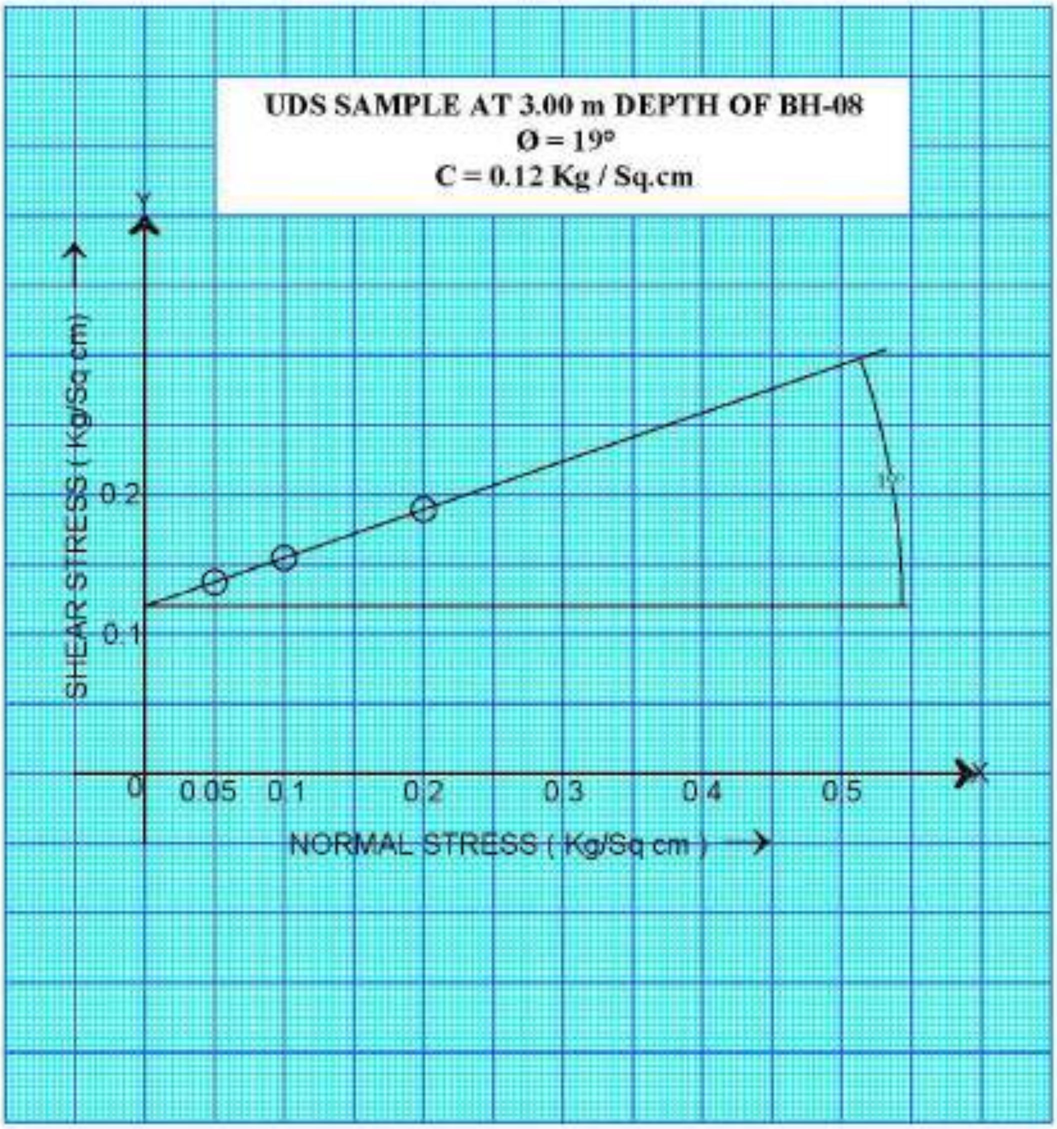


UDS SAMPLE AT 18.00 m DEPTH OF BH-07
Ø = 25°
C = 0.06 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq cm)
Y
X

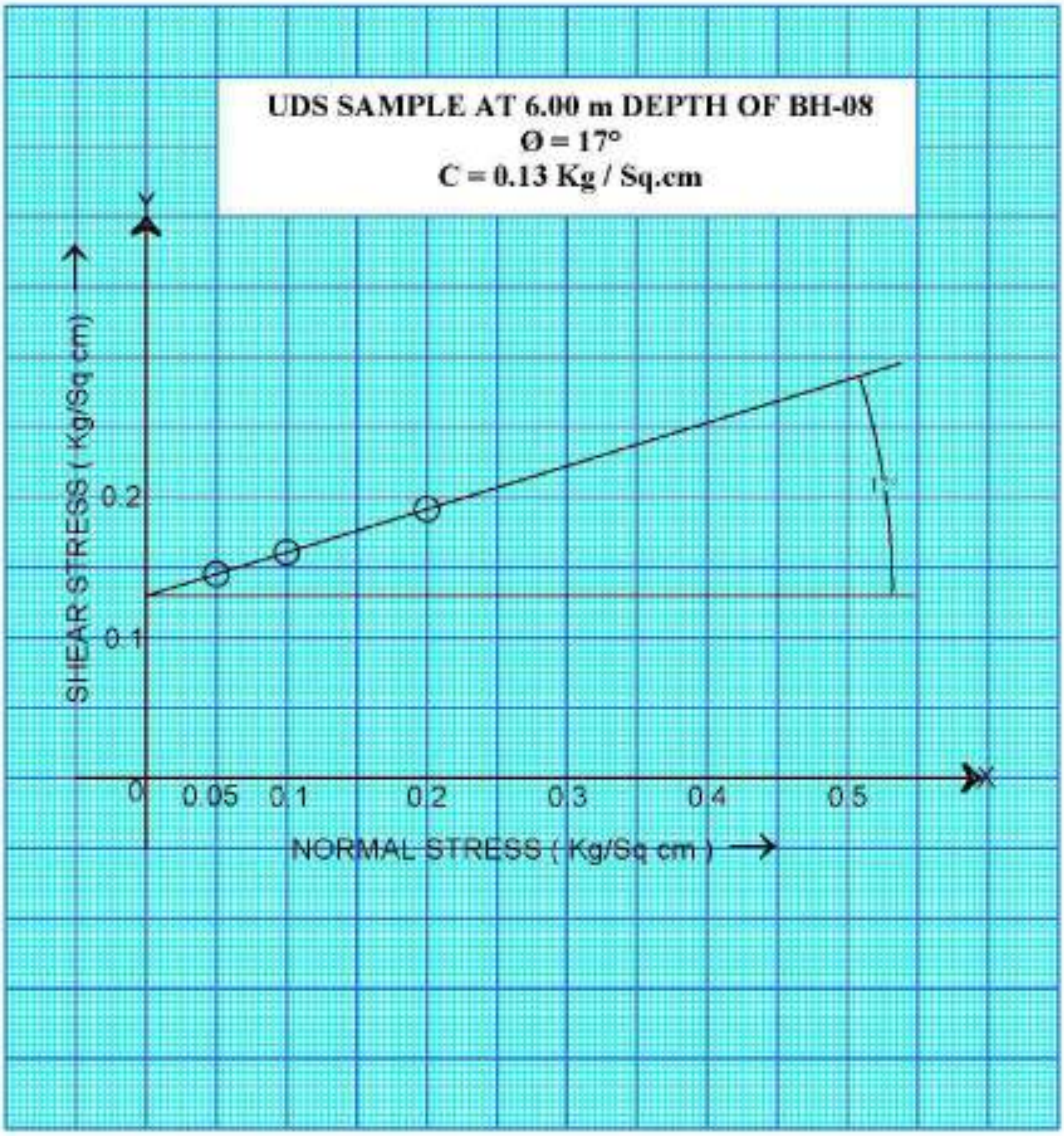

UDS SAMPLE AT 24.0 m DEPTH OF BH-07
Ø = 10°
C = 0.32Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
X
NORMAL STRESS (Kg/Sq cm)

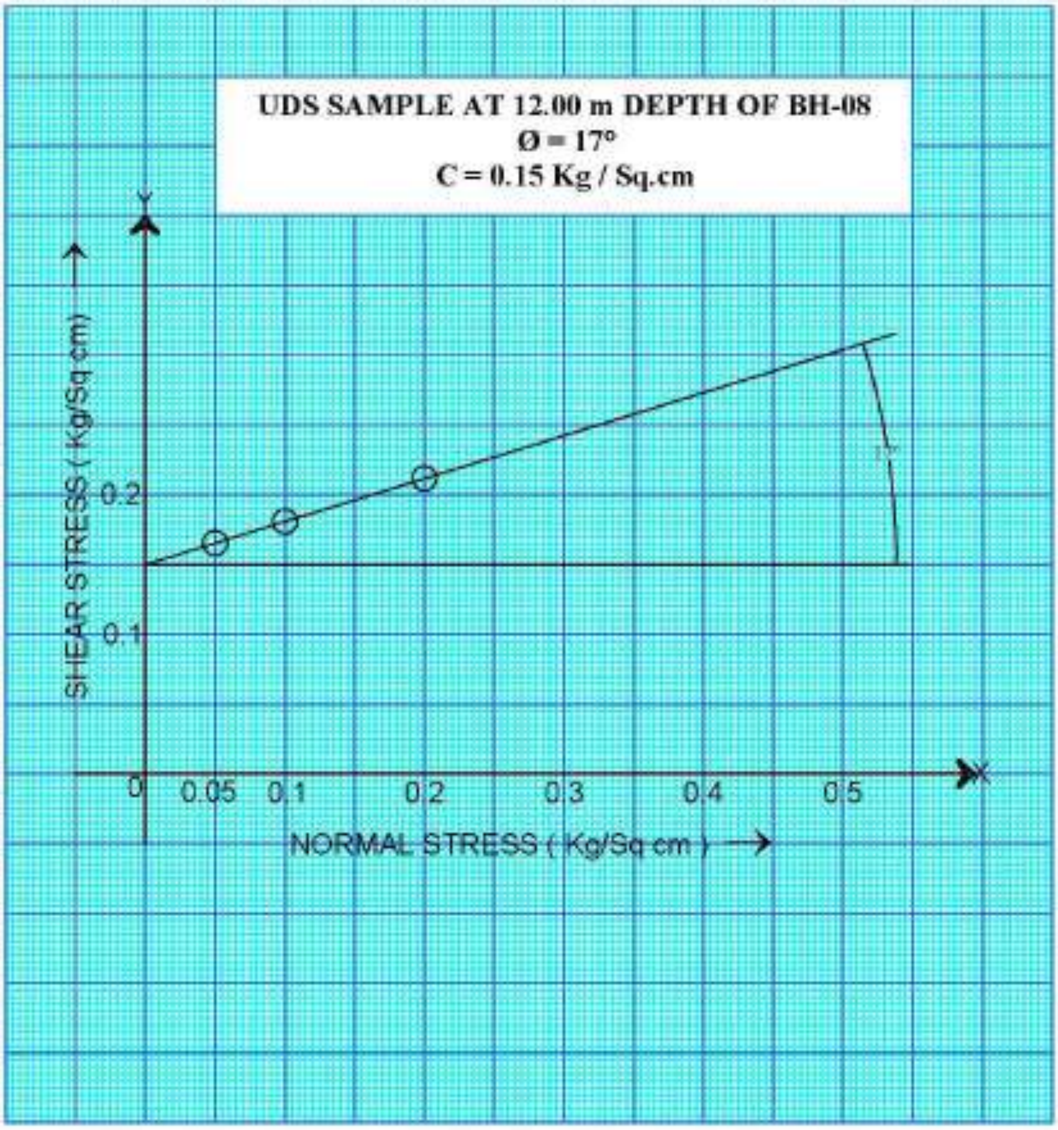


UDS SAMPLE AT 30.00 m DEPTH OF BH-07
Ø = 27°
C = 0.04 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq cm)
Y
X

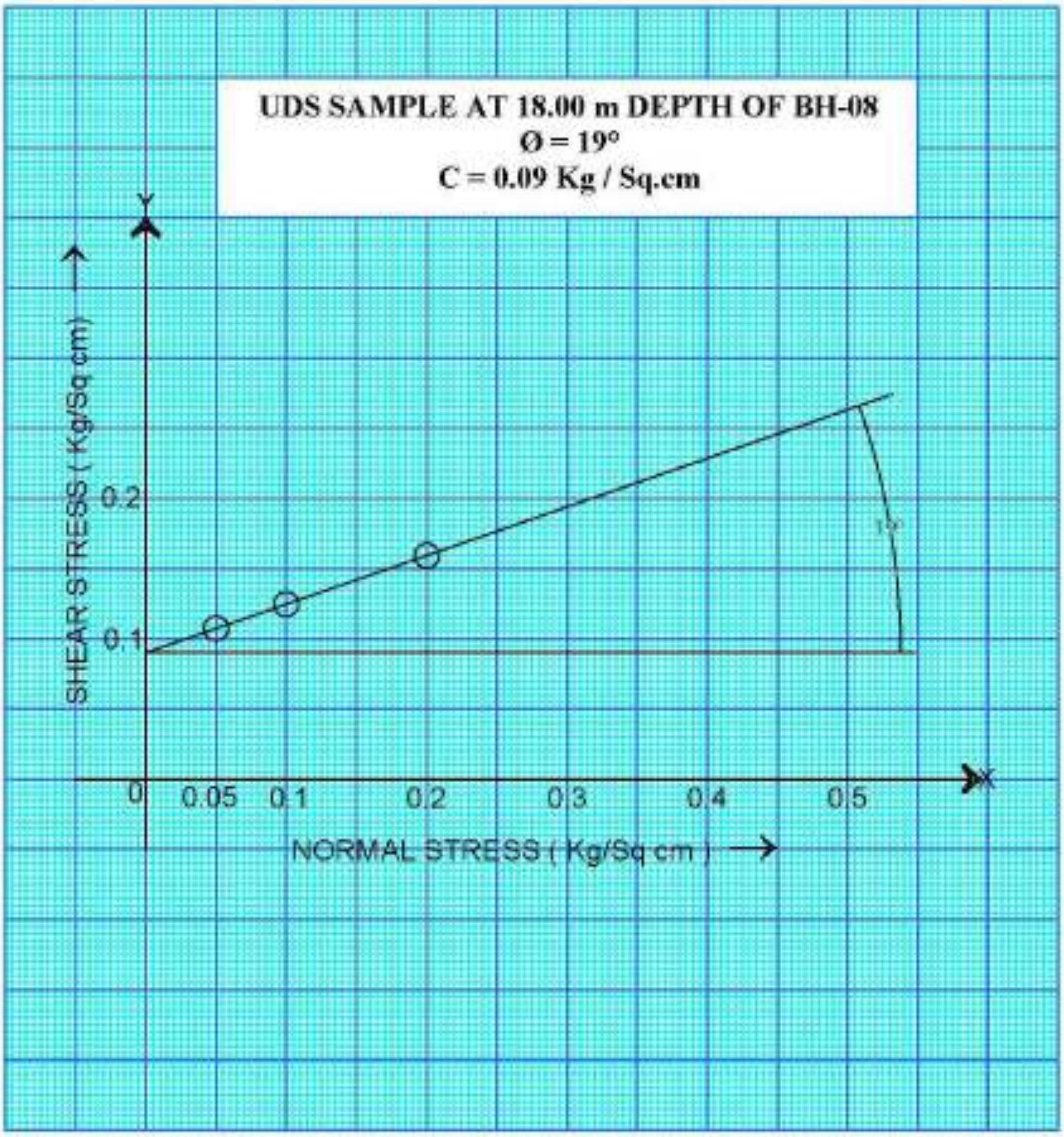


UDS SAMPLE AT 3.00 m DEPTH OF BH-08
Ø = 19°
C = 0.12 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq cm)
Y
X

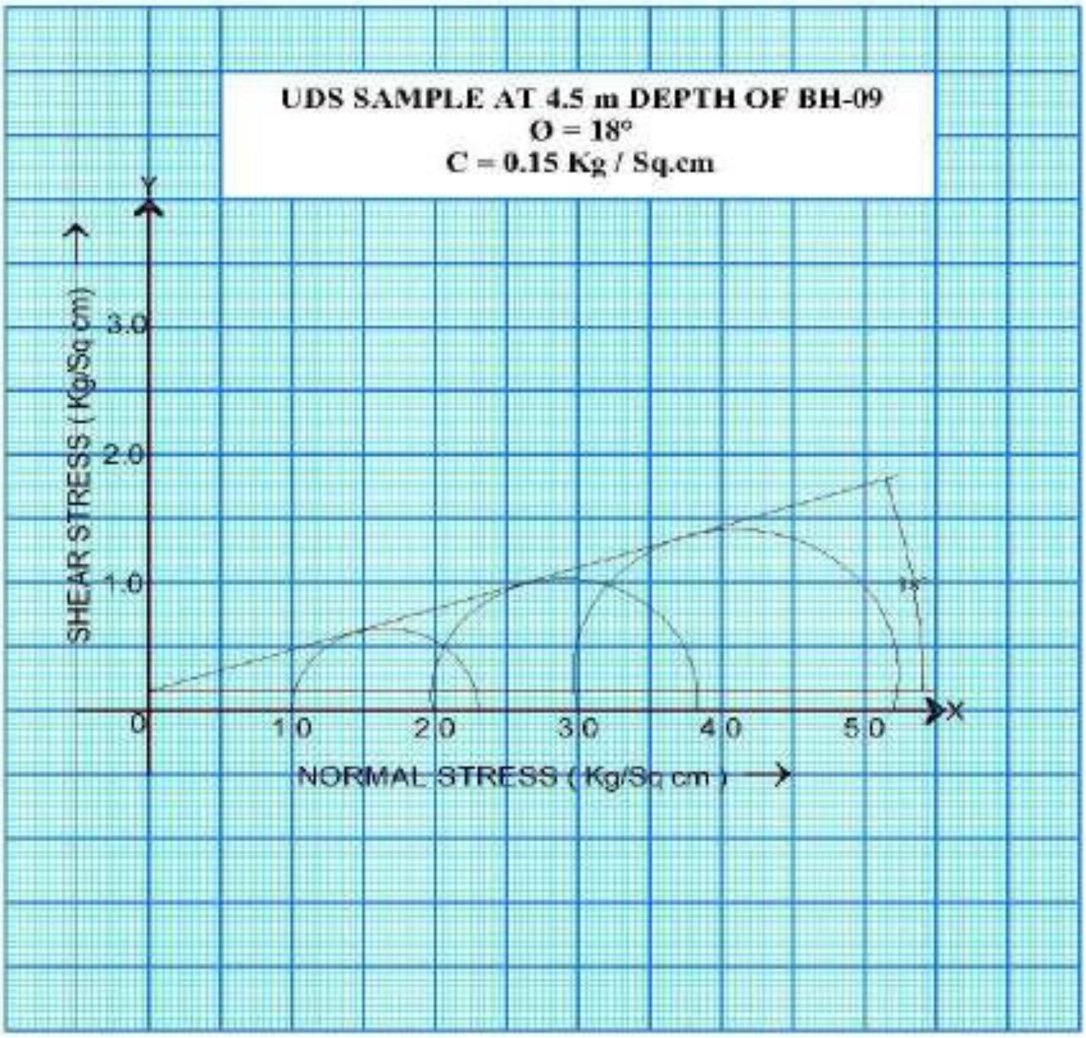

UDS SAMPLE AT 6.00 m DEPTH OF BH-08
Ø = 17°
C = 0.13 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
NORMAL STRESS (Kg/Sq cm)
0
0.05
0.1
0.2
0.3
0.4
0.5
0.1
0.2
Y
X



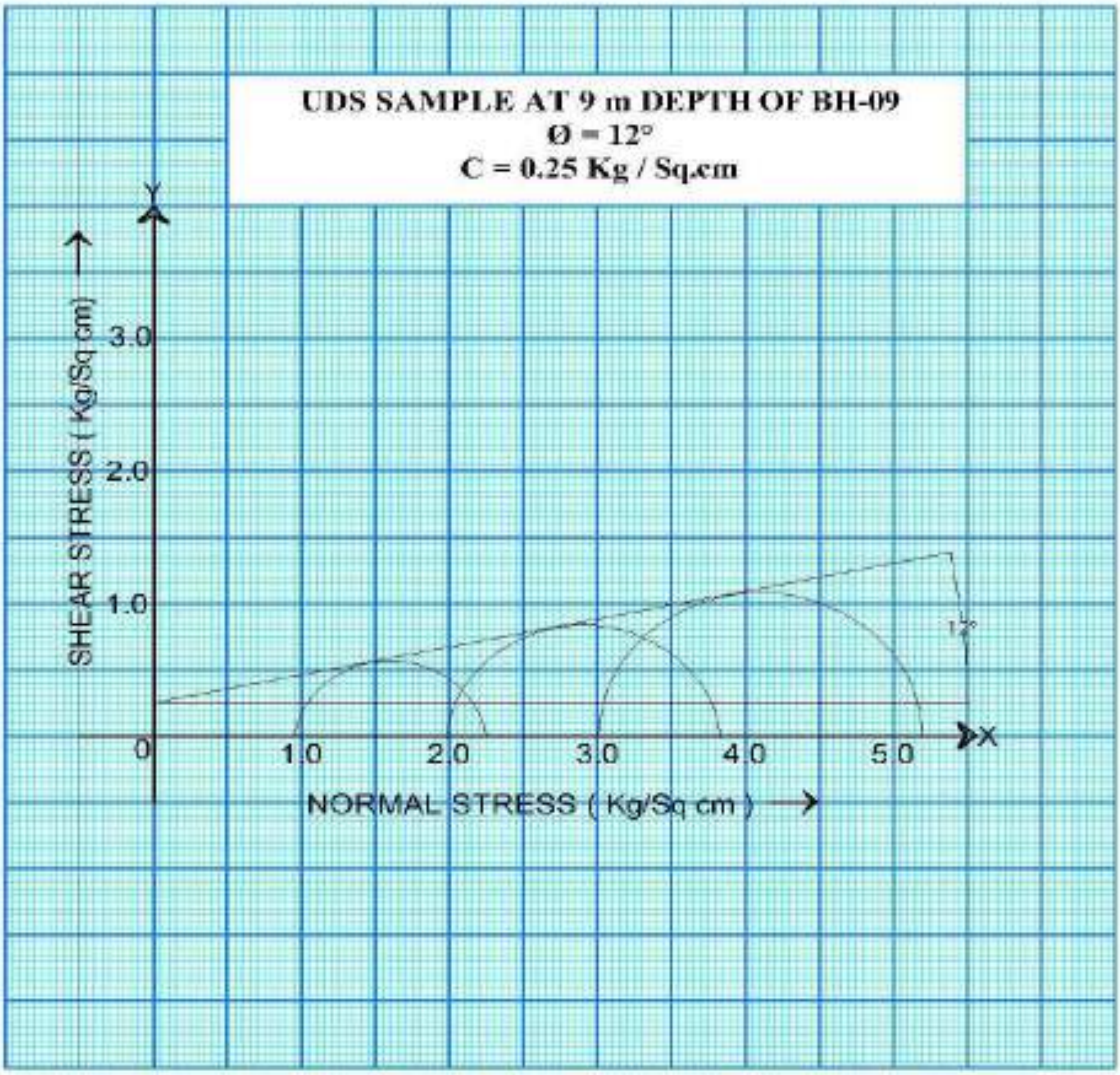
UDS SAMPLE AT 12.00 m DEPTH OF BH-08
Ø = 17°
C = 0.15 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq cm)



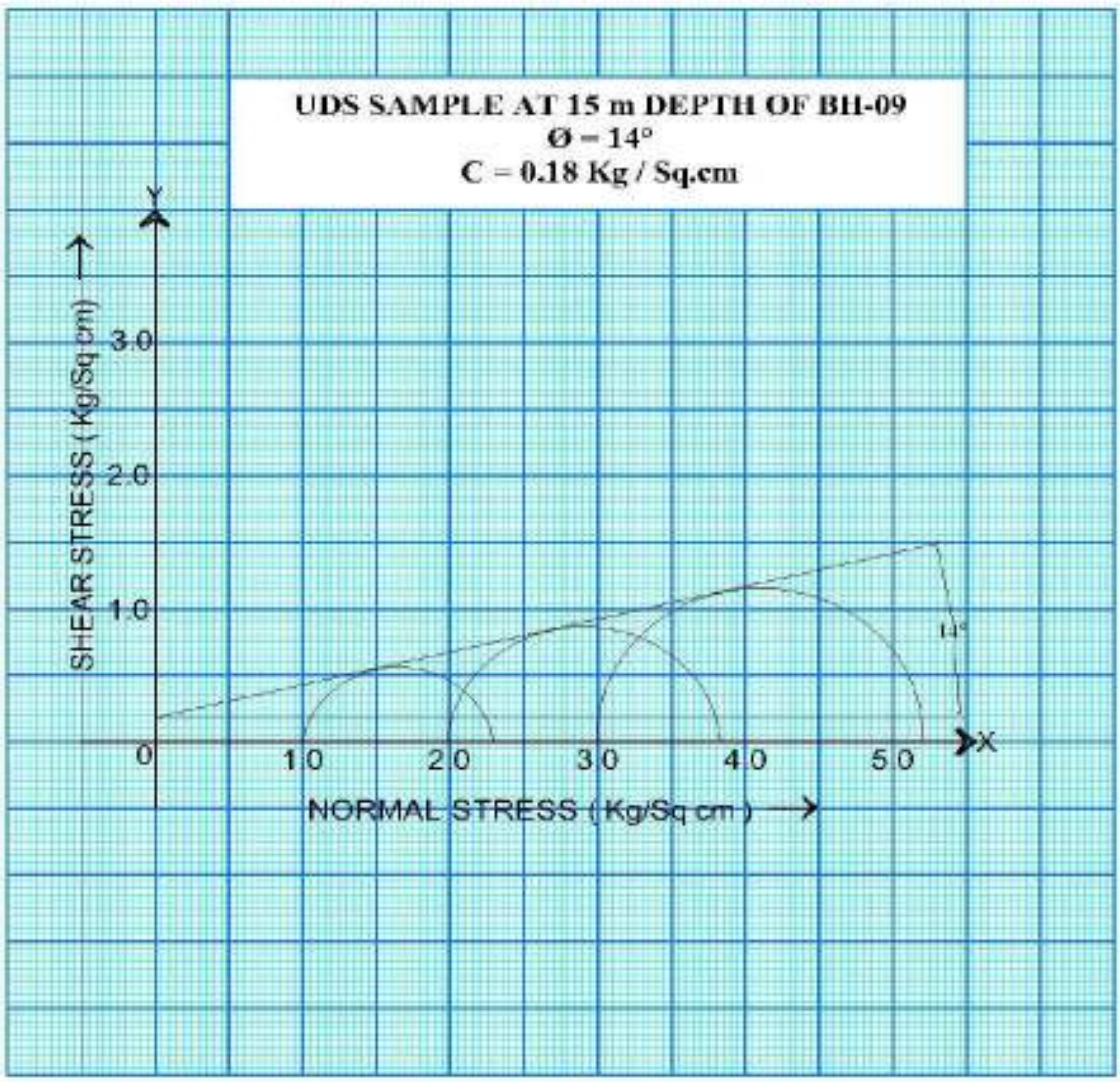
UDS SAMPLE AT 18.00 m DEPTH OF BH-08
Ø = 19°
C = 0.09 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
Y
X
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq cm)



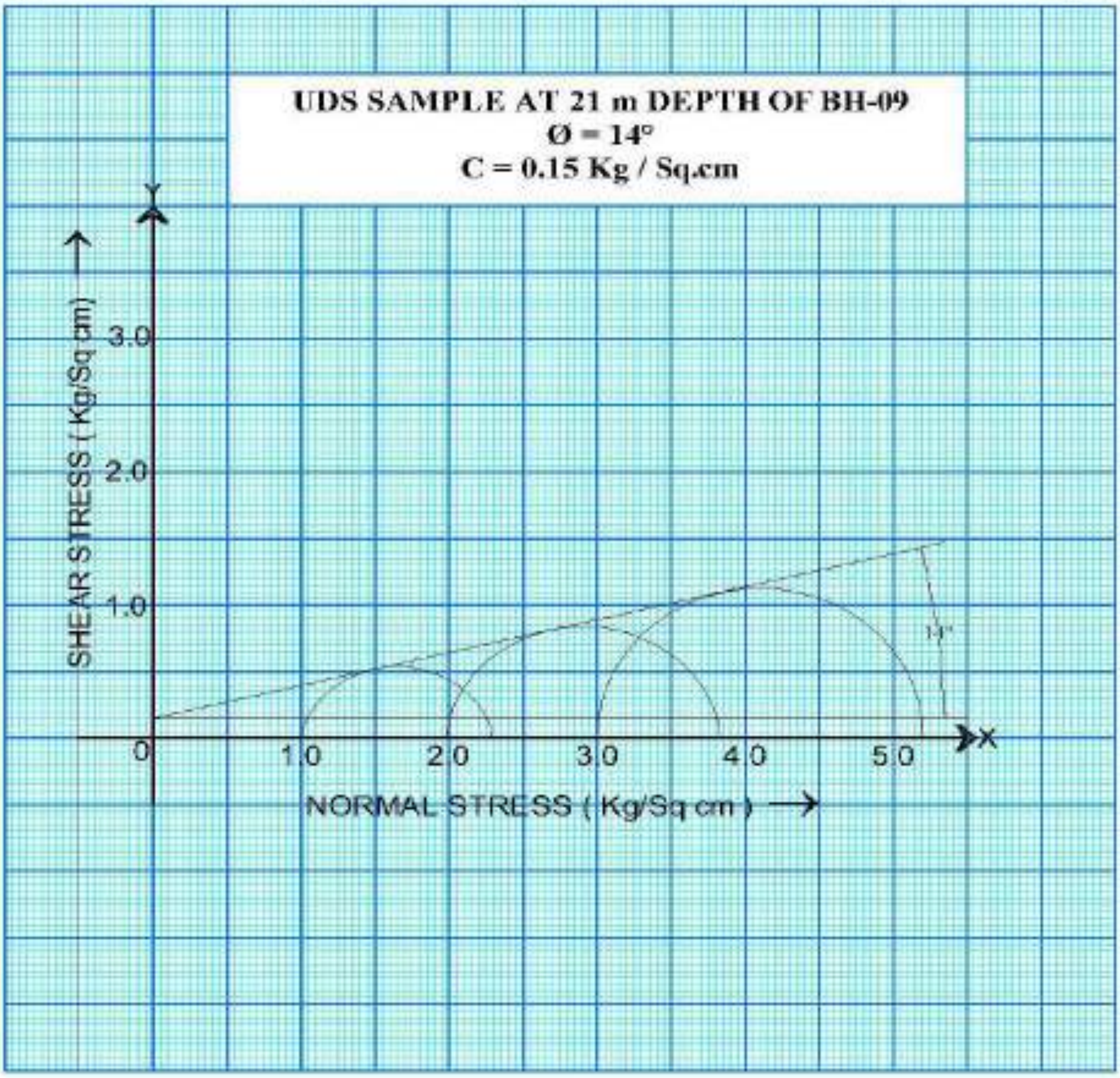
UDS SAMPLE AT 4.5 m DEPTH OF BH-09
Ø = 18°
C = 0.15 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
NORMAL STRESS (Kg/Sq cm)
0
1.0
2.0
3.0
4.0
5.0
Y
X

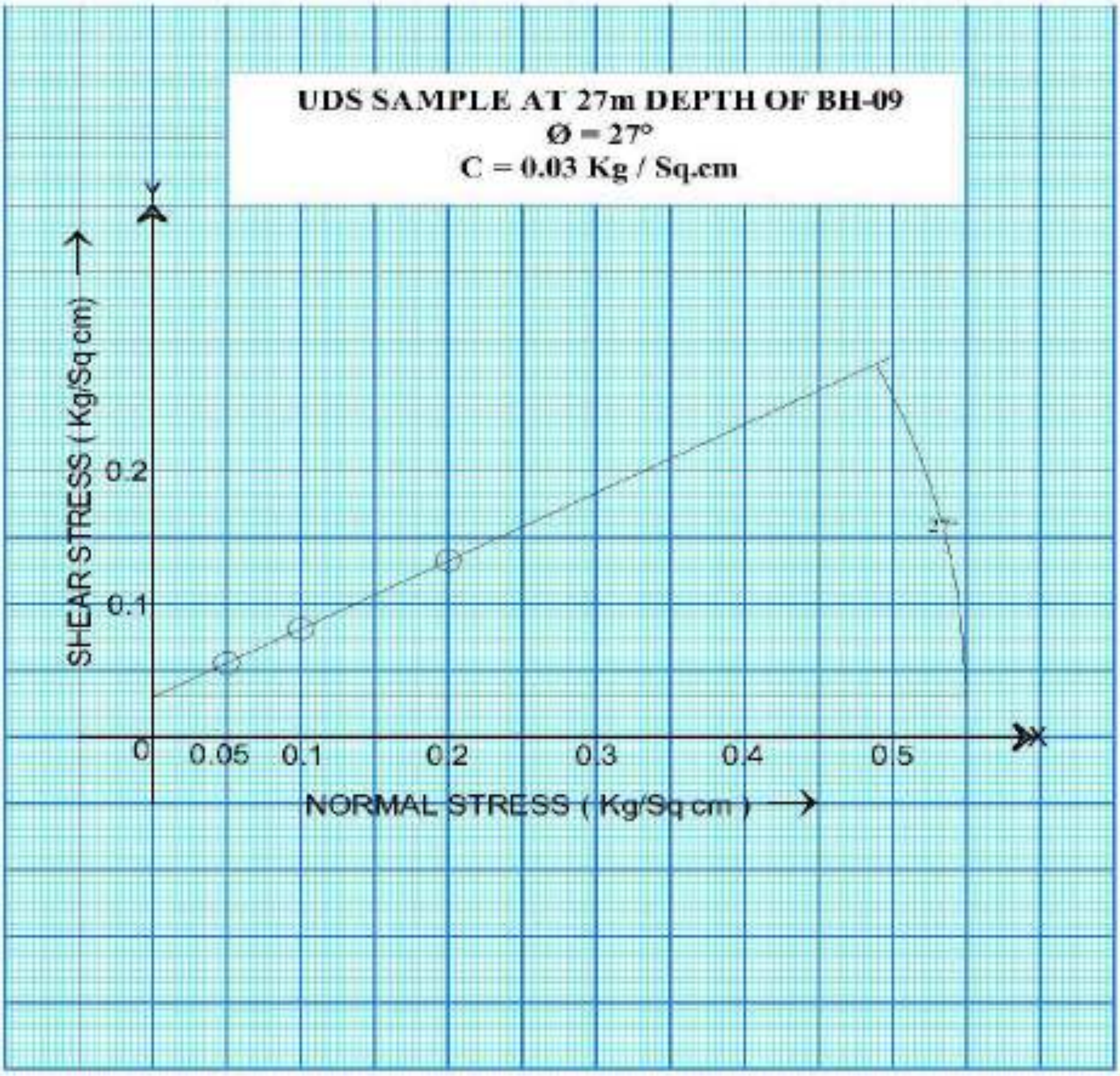


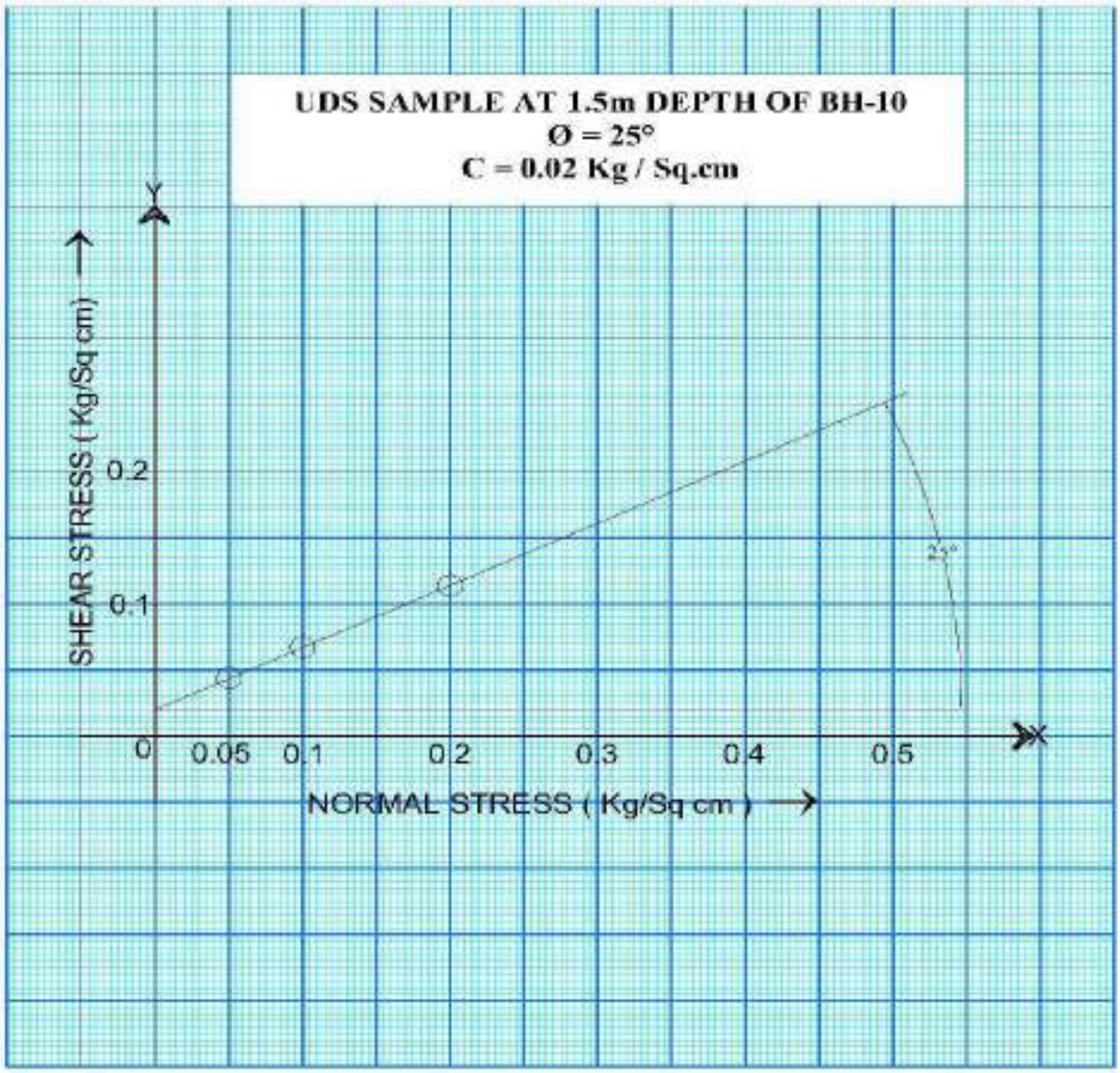
UDS SAMPLE AT 9 m DEPTH OF BH-09
Ø = 12°
C = 0.25 Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
X
12°
NORMAL STRESS (Kg/Sq cm)

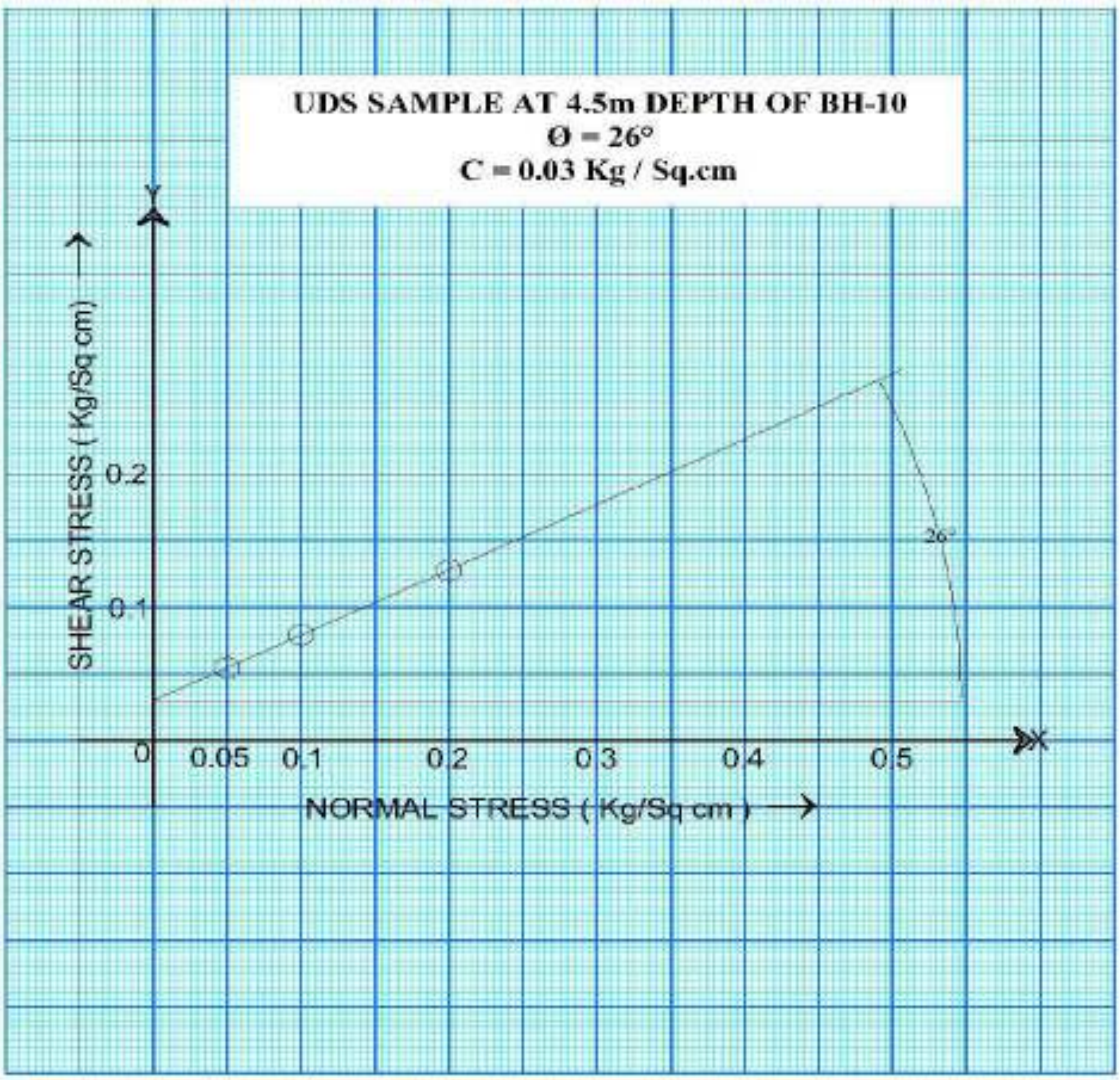


UDS SAMPLE AT 15 m DEPTH OF BH-09
Ø = 14°
C = 0.18 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
14°
X
Y
NORMAL STRESS (Kg/Sq cm)

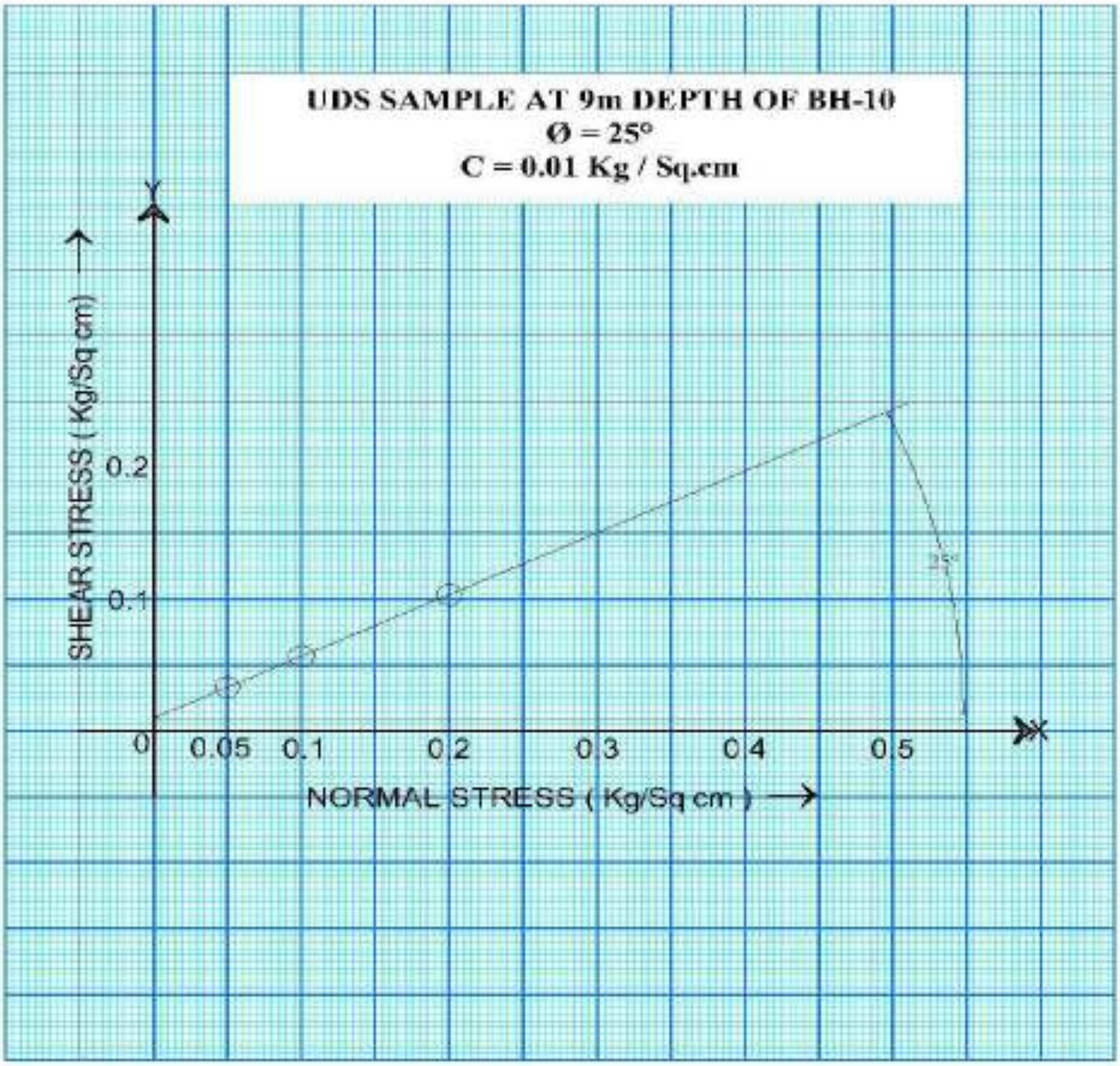

UDS SAMPLE AT 21 m DEPTH OF BH-09
Ø = 14°
C = 0.15 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
NORMAL STRESS (Kg/Sq cm)
Y
X


UDS SAMPLE AT 27m DEPTH OF BH-09
Ø = 27°
C = 0.03 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm) →
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq cm) →
X
Y

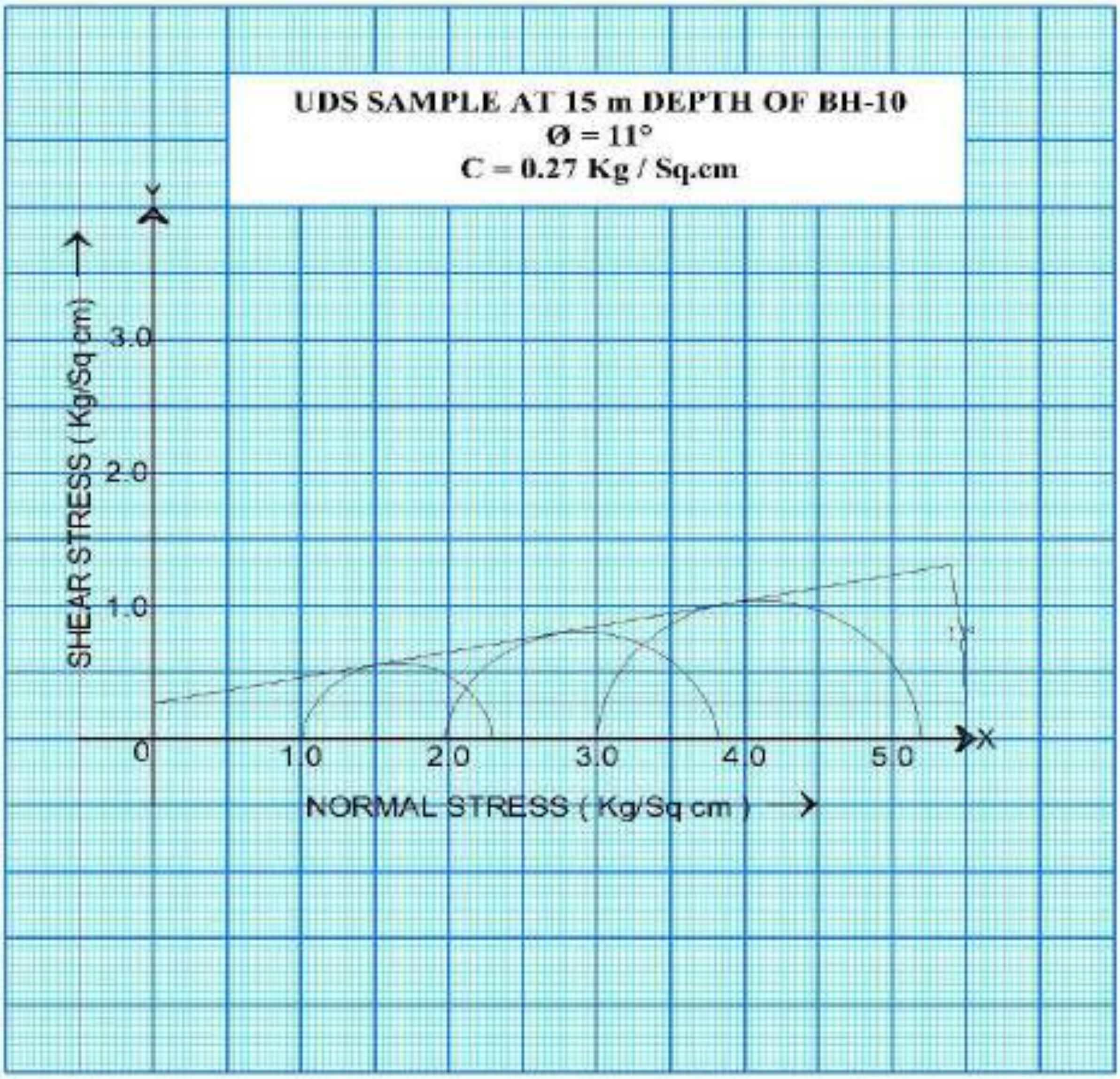

UDS SAMPLE AT 1.5m DEPTH OF BH-10
Ø = 25°
C = 0.02 Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
X
25°
NORMAL STRESS (Kg/Sq cm)



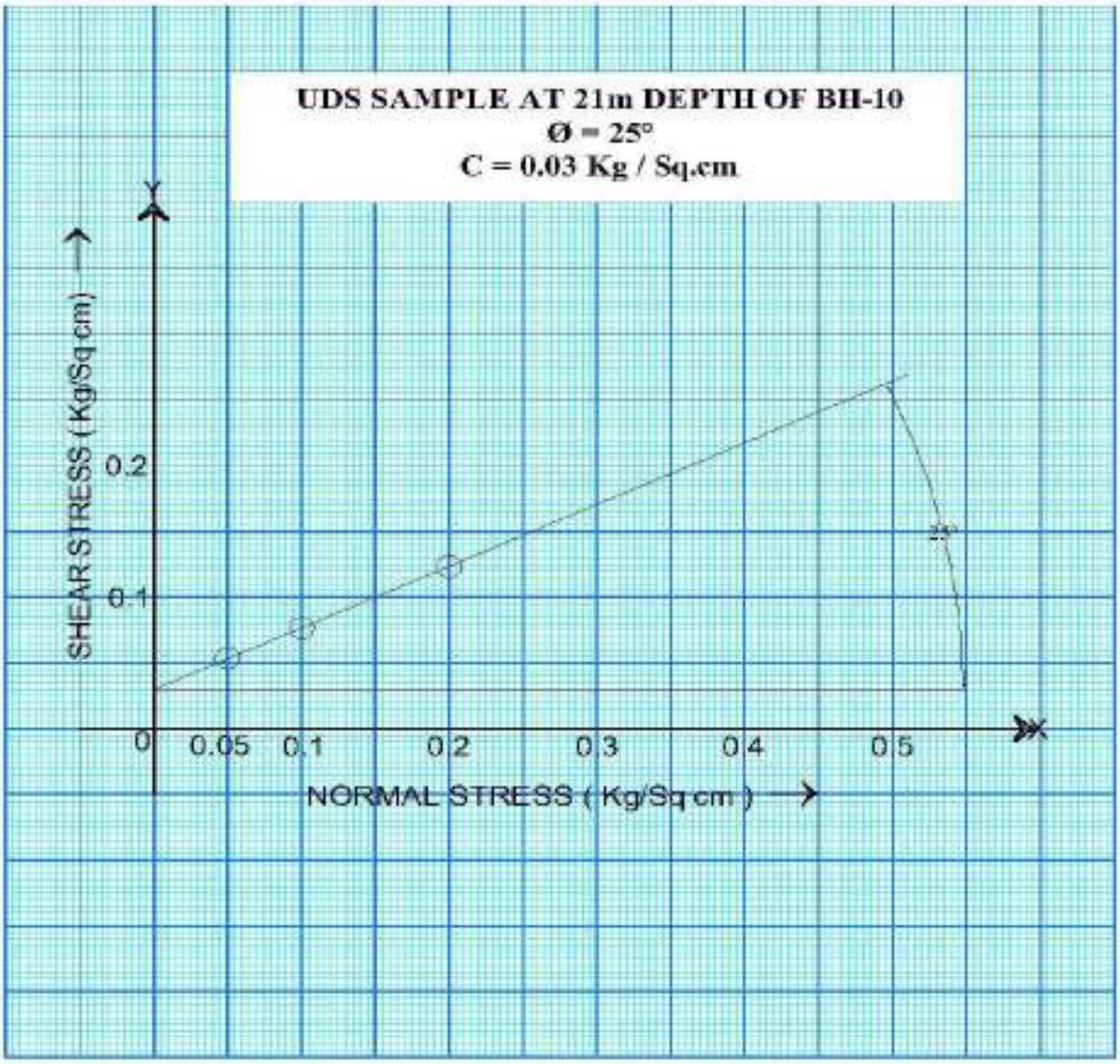
UDS SAMPLE AT 4.5m DEPTH OF BH-10
Ø = 26°
C = 0.03 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
26°
NORMAL STRESS (Kg/Sq cm)
Y
X



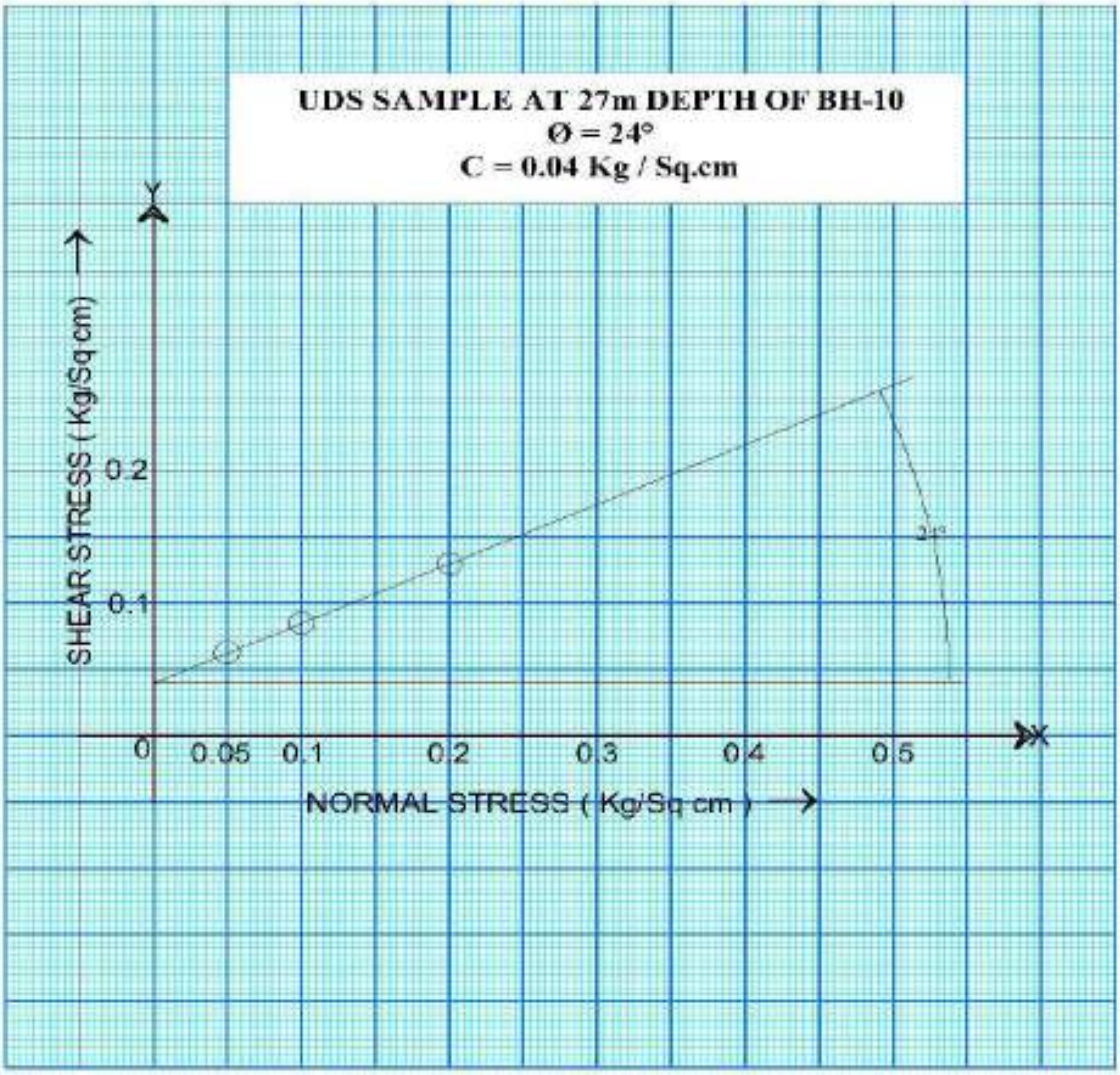
UDS SAMPLE AT 9m DEPTH OF BH-10
Ø = 25°
C = 0.01 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq cm)
25°

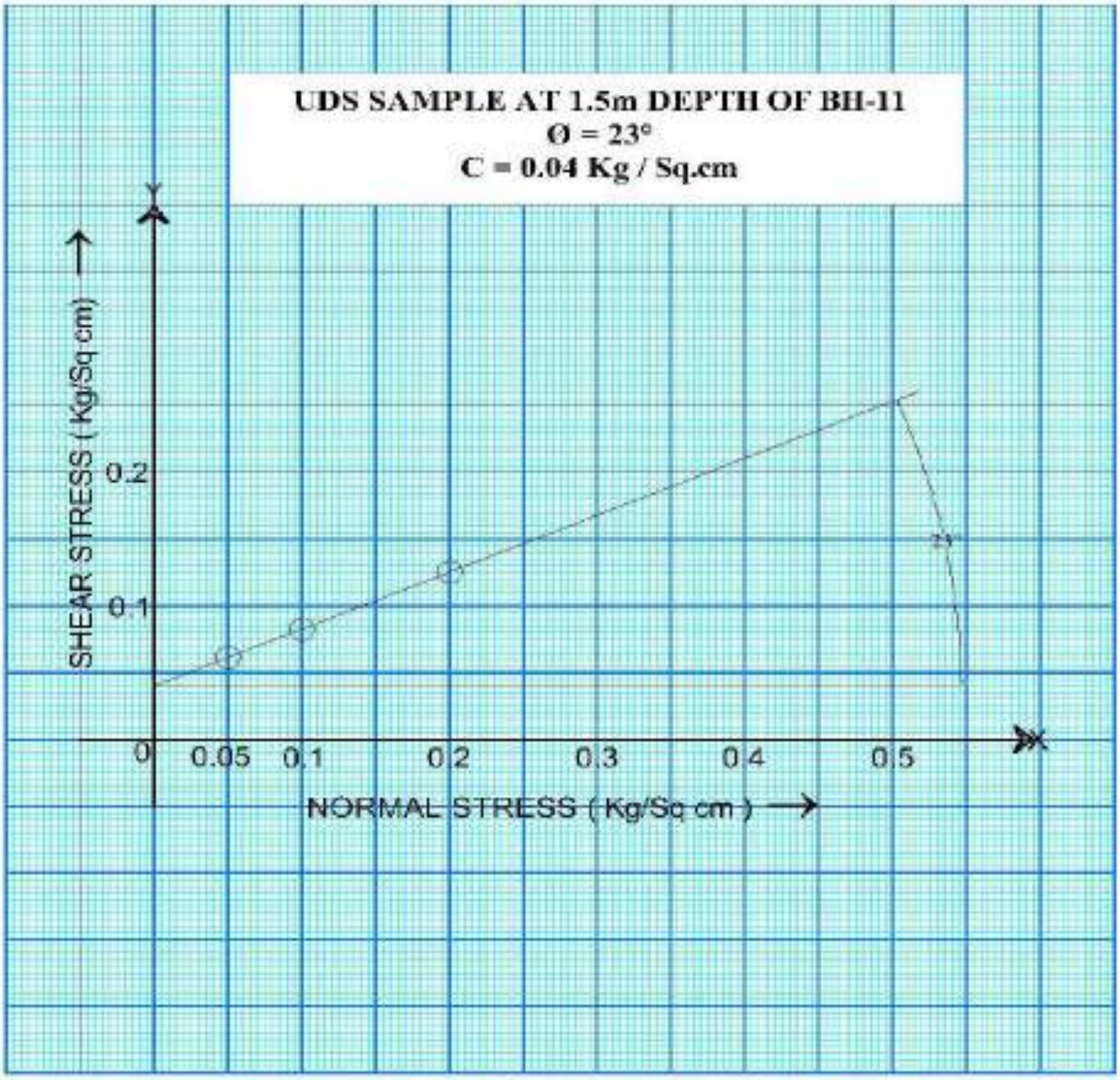


UDS SAMPLE AT 15 m DEPTH OF BH-10
Ø = 11°
C = 0.27 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
X
Y
NORMAL STRESS (Kg/Sq cm)

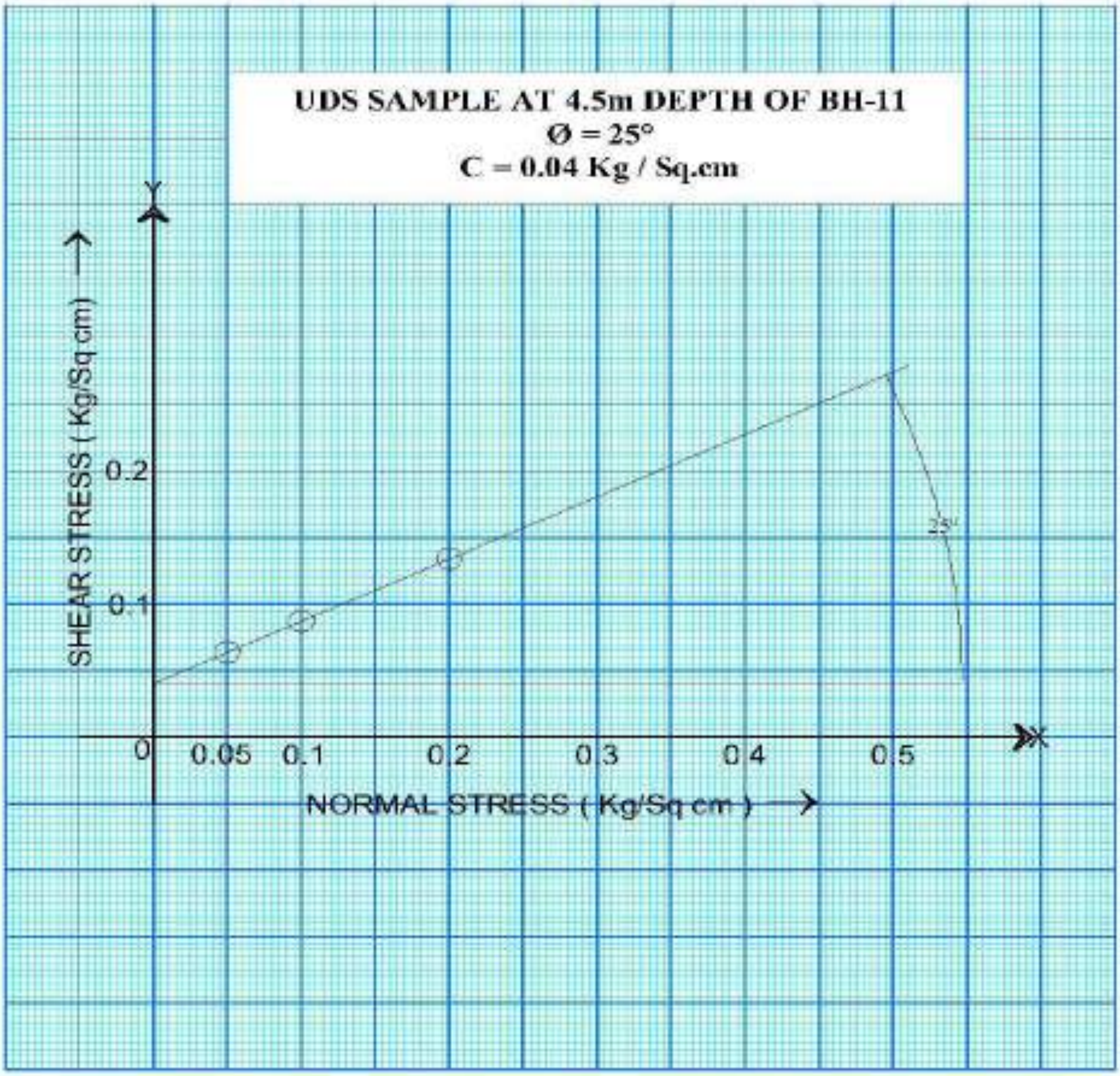


UDS SAMPLE AT 21m DEPTH OF BH-10
Ø = 25°
C = 0.03 Kg / Sq.cm
SHEAR STRESS (Kg/Sq.cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq.cm)
Y
X

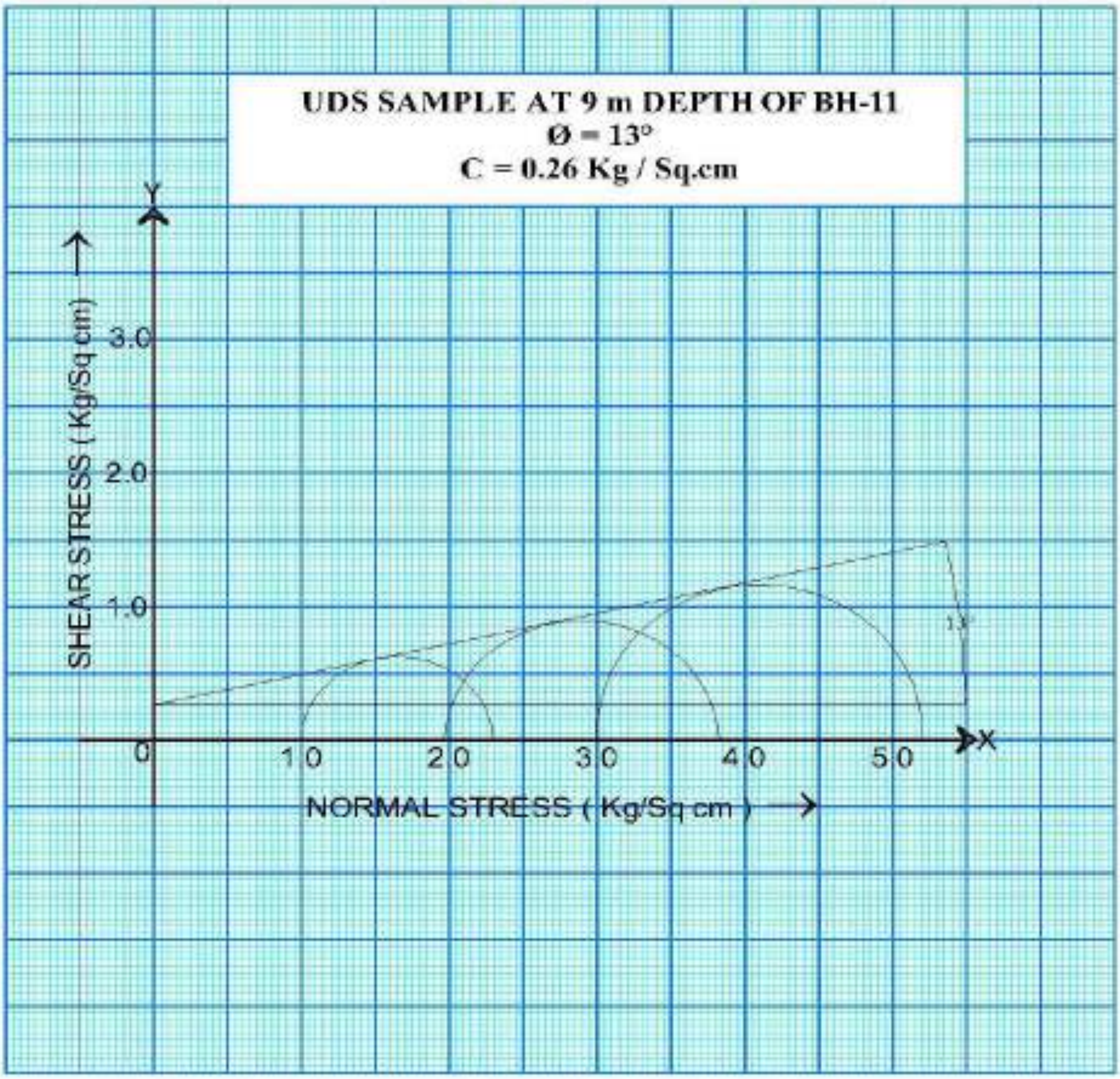

UDS SAMPLE AT 27m DEPTH OF BH-10
Ø = 24°
C = 0.04 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm) →
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq cm) →
Y
X
24°



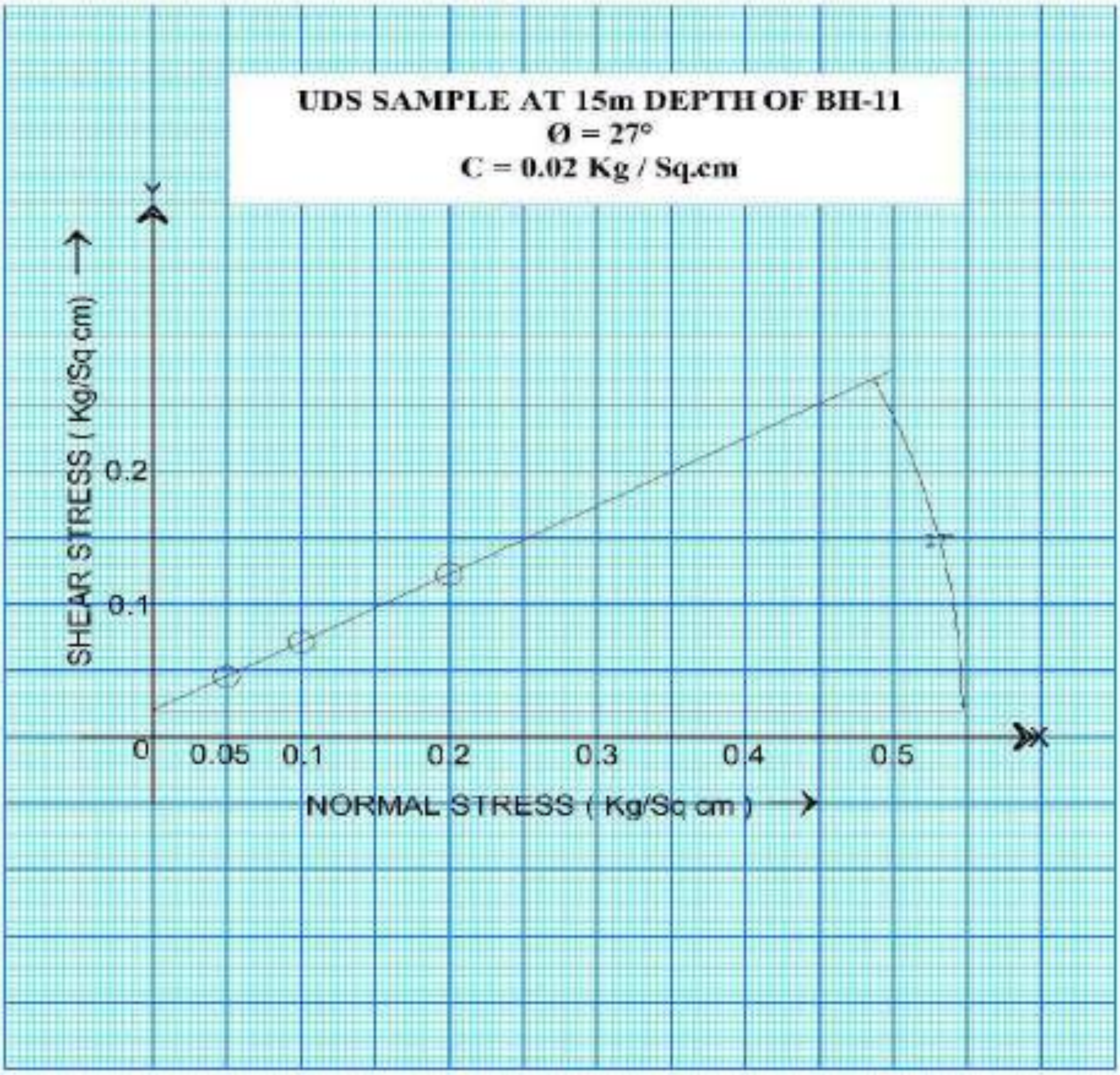
UDS SAMPLE AT 1.5m DEPTH OF BH-11
Ø = 23°
C = 0.04 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm) →
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq cm) →



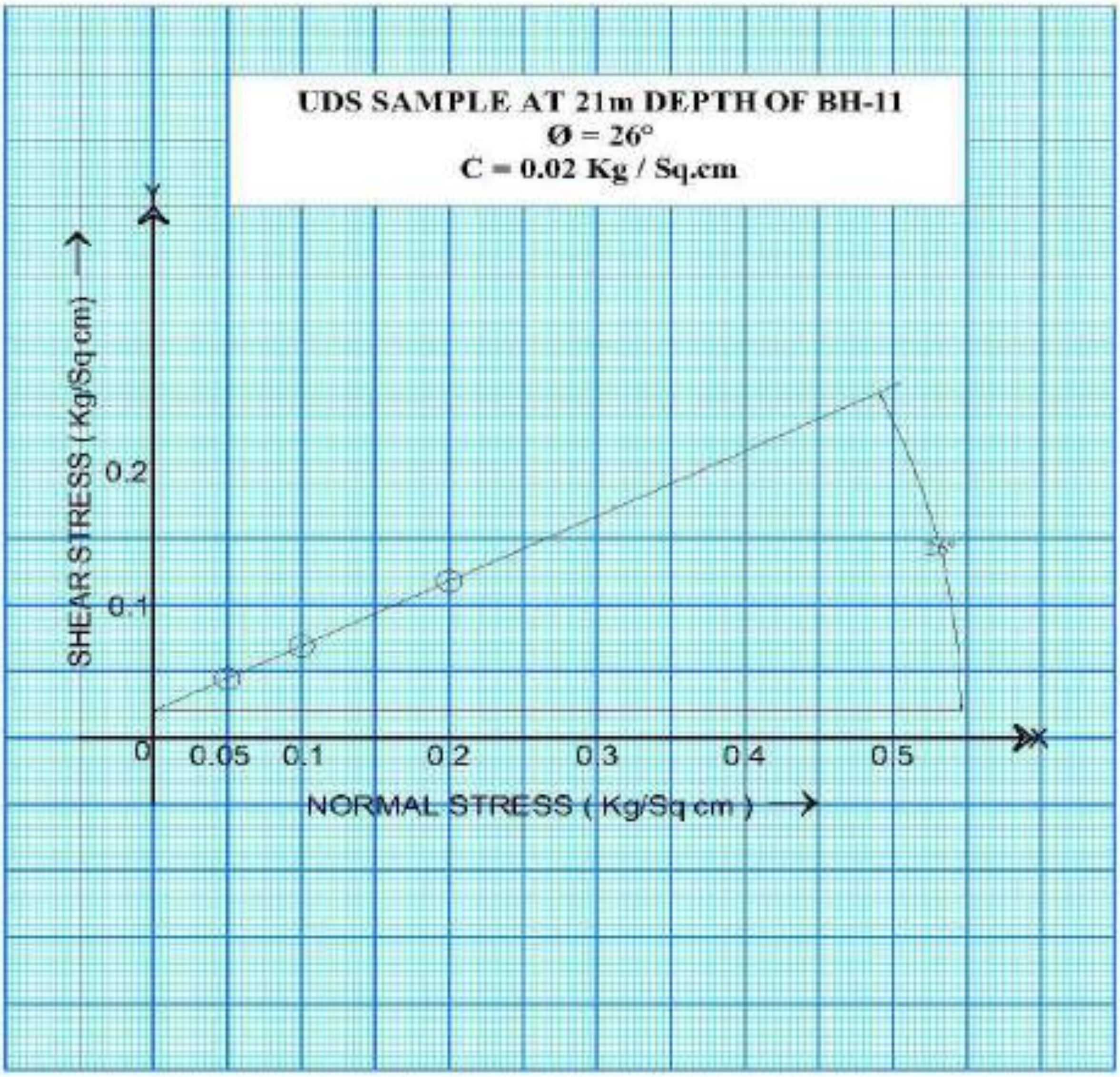
UDS SAMPLE AT 4.5m DEPTH OF BH-11
Ø = 25°
C = 0.04 Kg / Sq.cm
Y
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
X
NORMAL STRESS (Kg/Sq cm)
25°



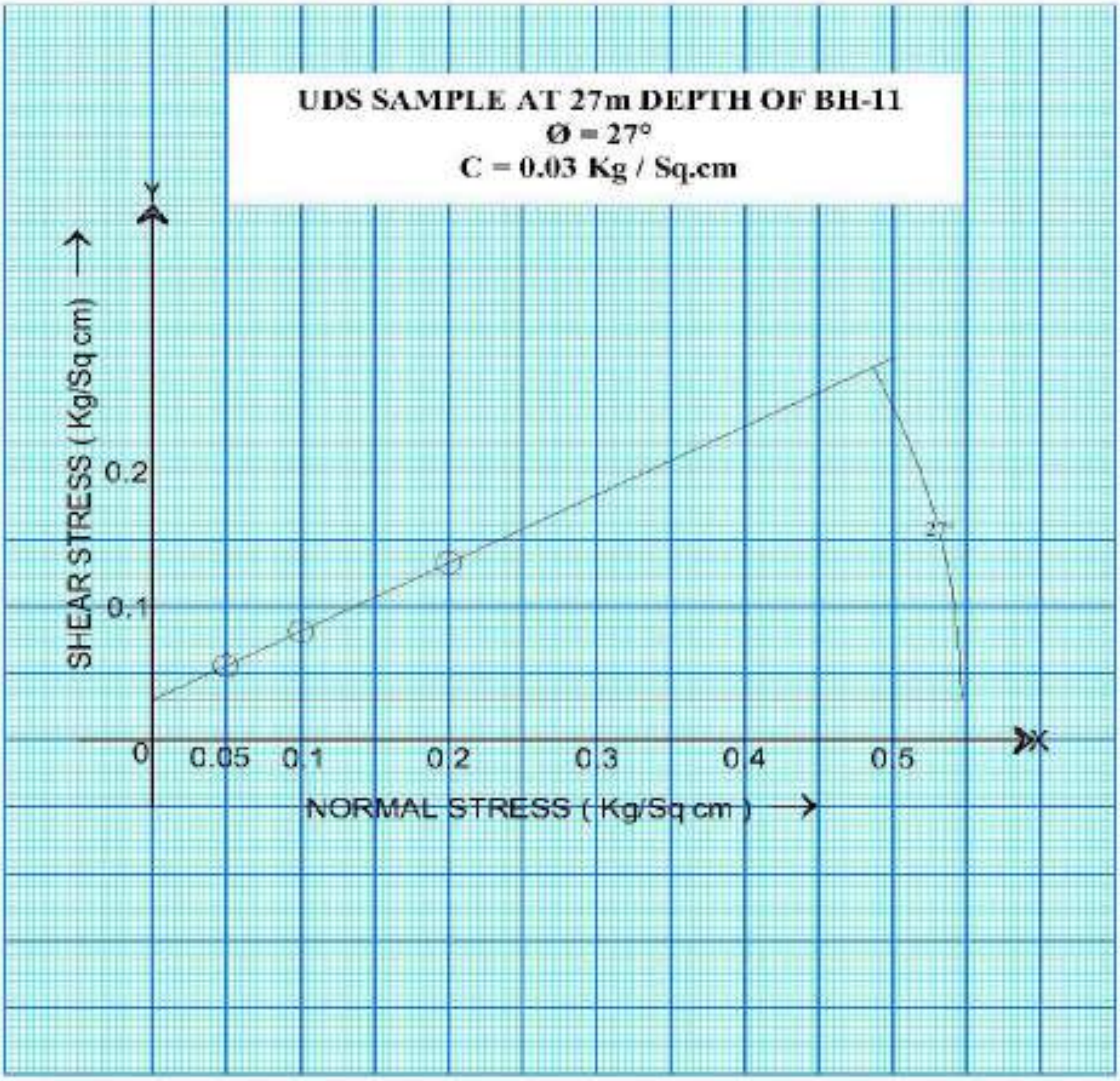
UDS SAMPLE AT 9 m DEPTH OF BH-11
Ø = 13°
C = 0.26 Kg / Sq.cm
Y
3.0
2.0
1.0
SHEAR STRESS (Kg/Sq.cm)
0
1.0
2.0
3.0
4.0
5.0
X
13°
NORMAL STRESS (Kg/Sq cm)



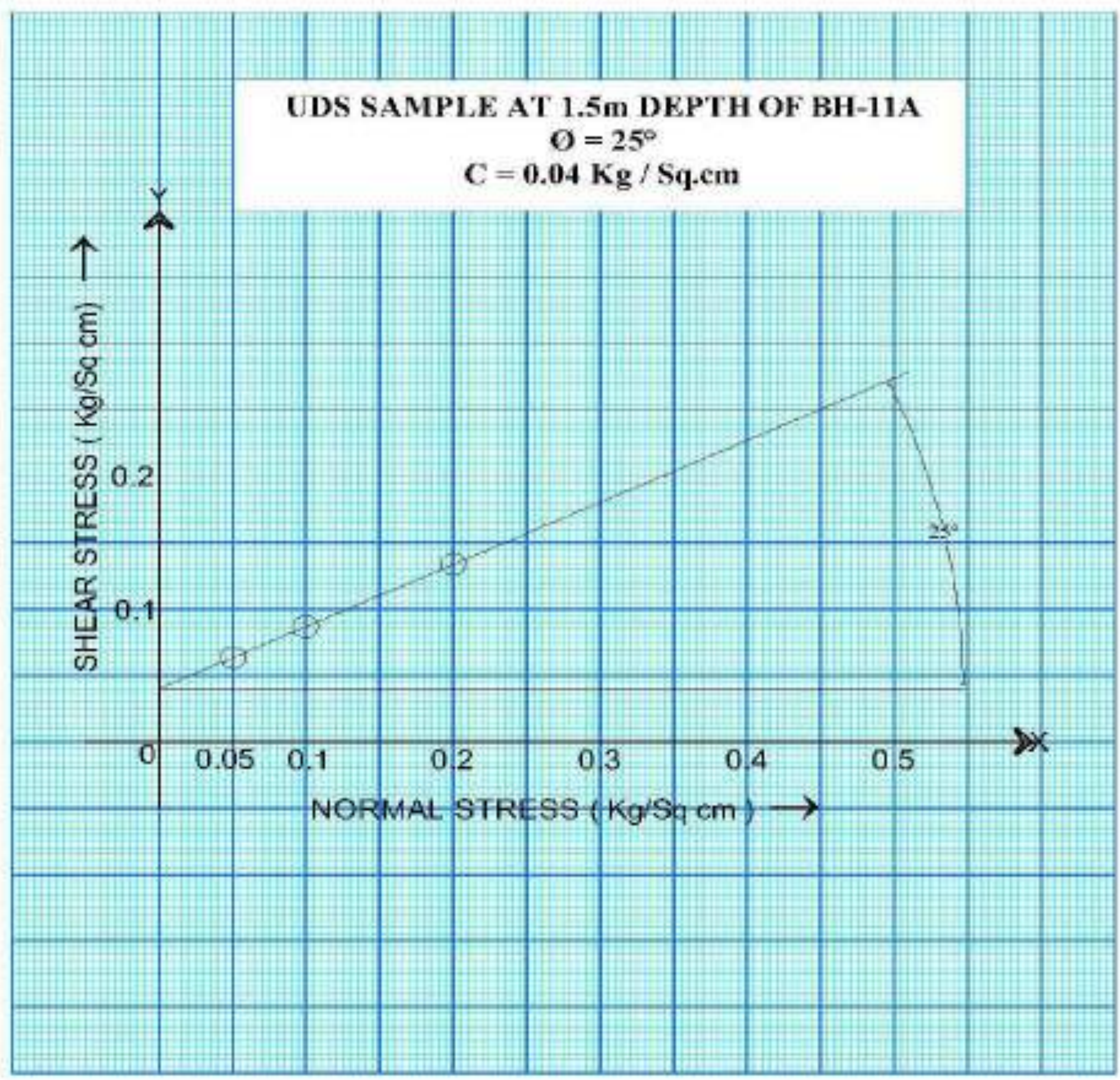
UDS SAMPLE AT 15m DEPTH OF BH-11
Ø = 27°
C = 0.02 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq cm)
27°

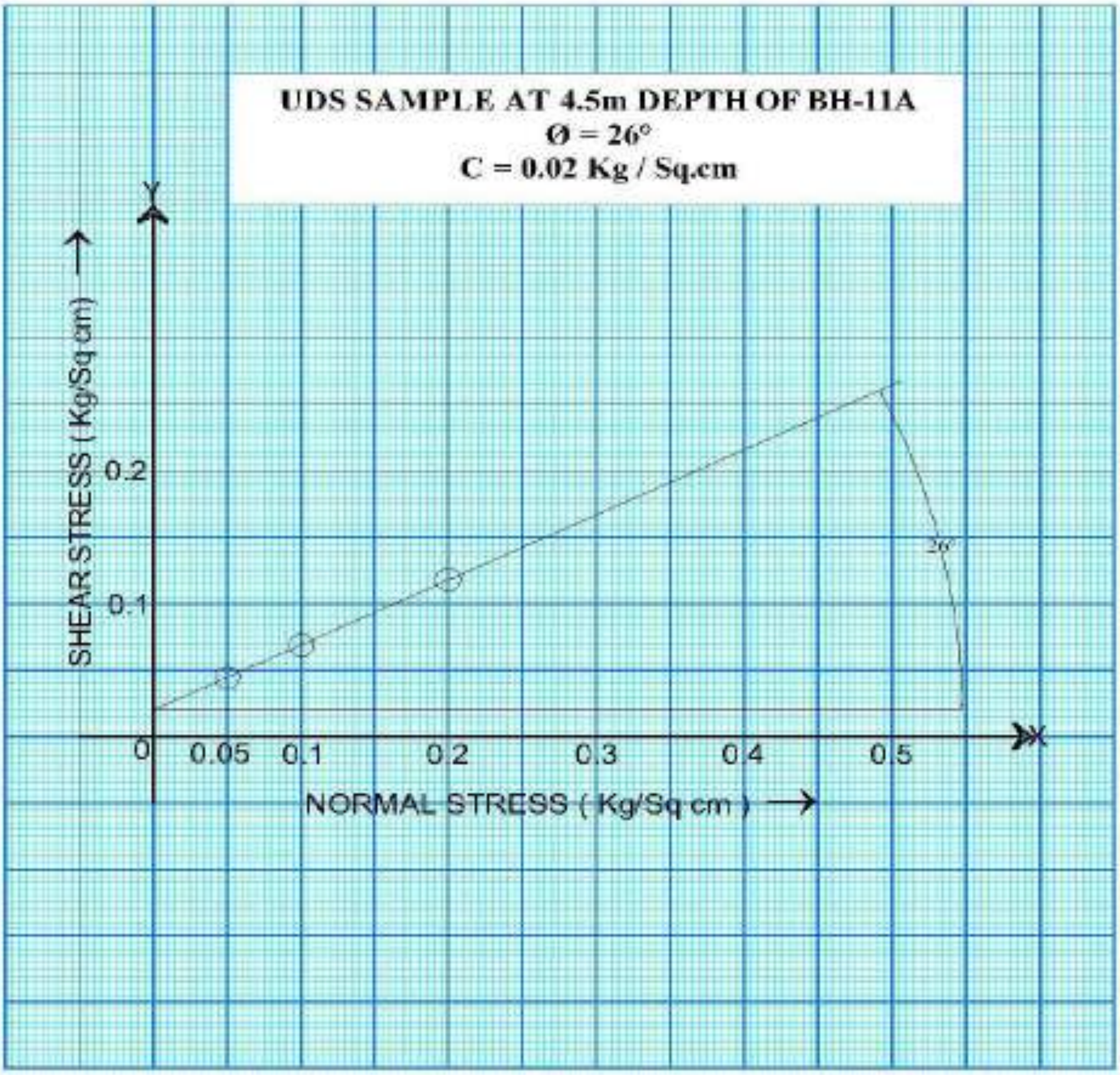


UDS SAMPLE AT 21m DEPTH OF BH-11
Ø = 26°
C = 0.02 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
26°
NORMAL STRESS (Kg/Sq cm)

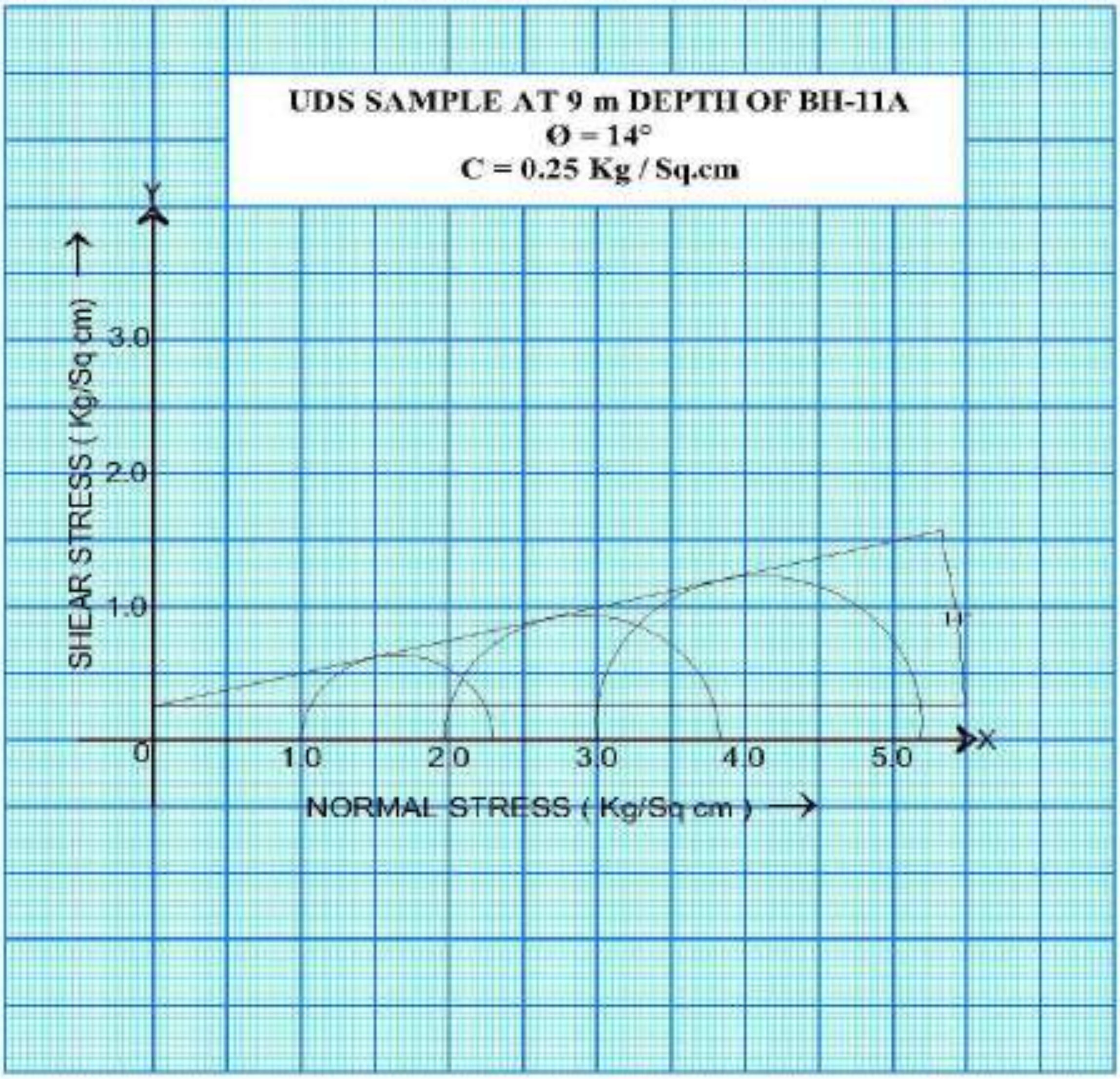


UDS SAMPLE AT 27m DEPTH OF BH-11
Ø = 27°
C = 0.03 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
NORMAL STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
27°
Y
X

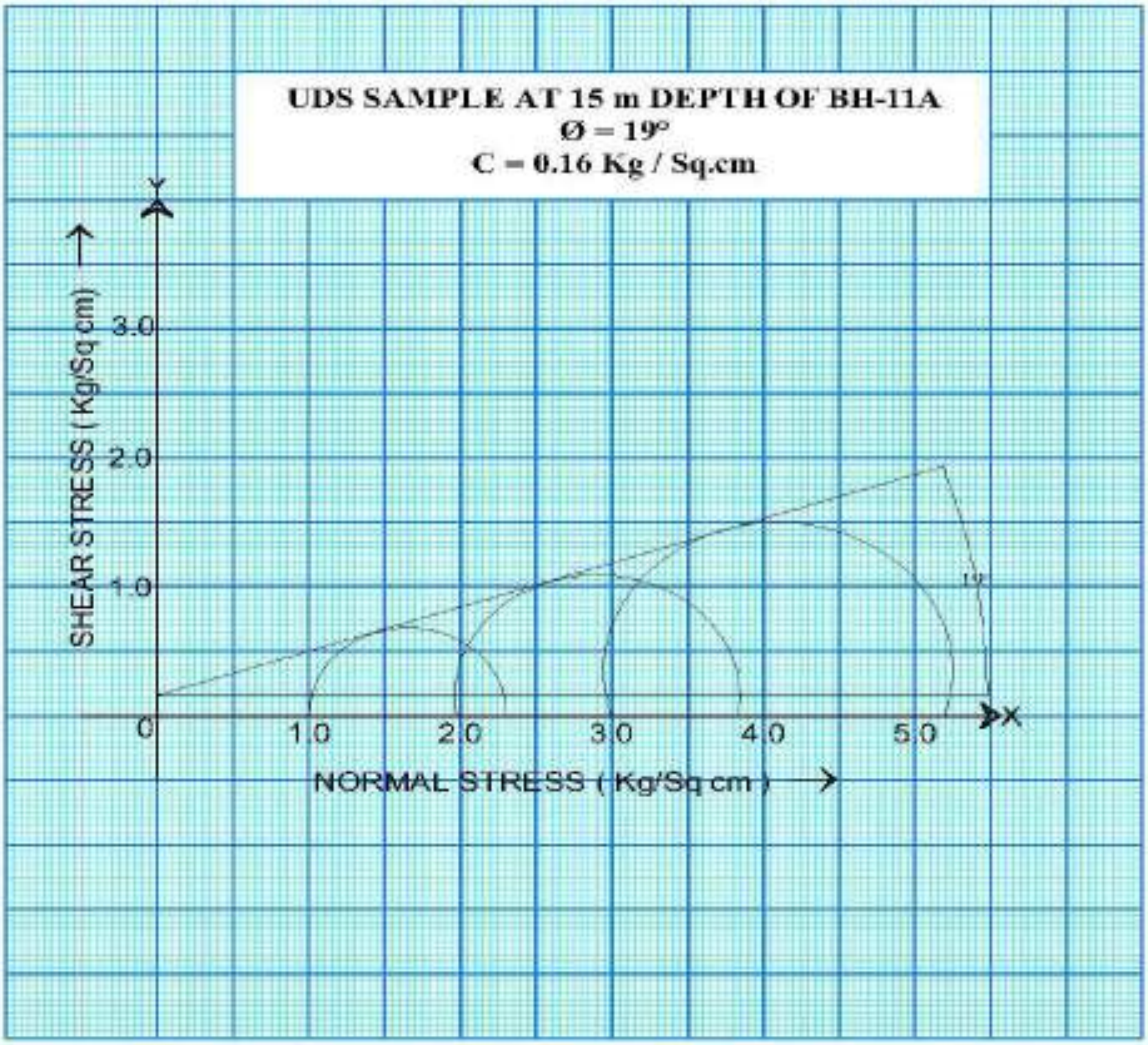

UDS SAMPLE AT 1.5m DEPTH OF BH-11A
Ø = 25°
C = 0.04 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
0.2
0.1
0
0.05
0.1
0.2
0.3
0.4
0.5
NORMAL STRESS (Kg/Sq cm)
25°
Y
X



UDS SAMPLE AT 4.5m DEPTH OF BH-11A
Ø = 26°
C = 0.02 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
NORMAL STRESS (Kg/Sq cm)
Y
X
0
0.05
0.1
0.2
0.3
0.4
0.5
26°



UDS SAMPLE AT 9 m DEPTH OF BH-11A
Ø = 14°
C = 0.25 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
X
Y
NORMAL STRESS (Kg/Sq cm)

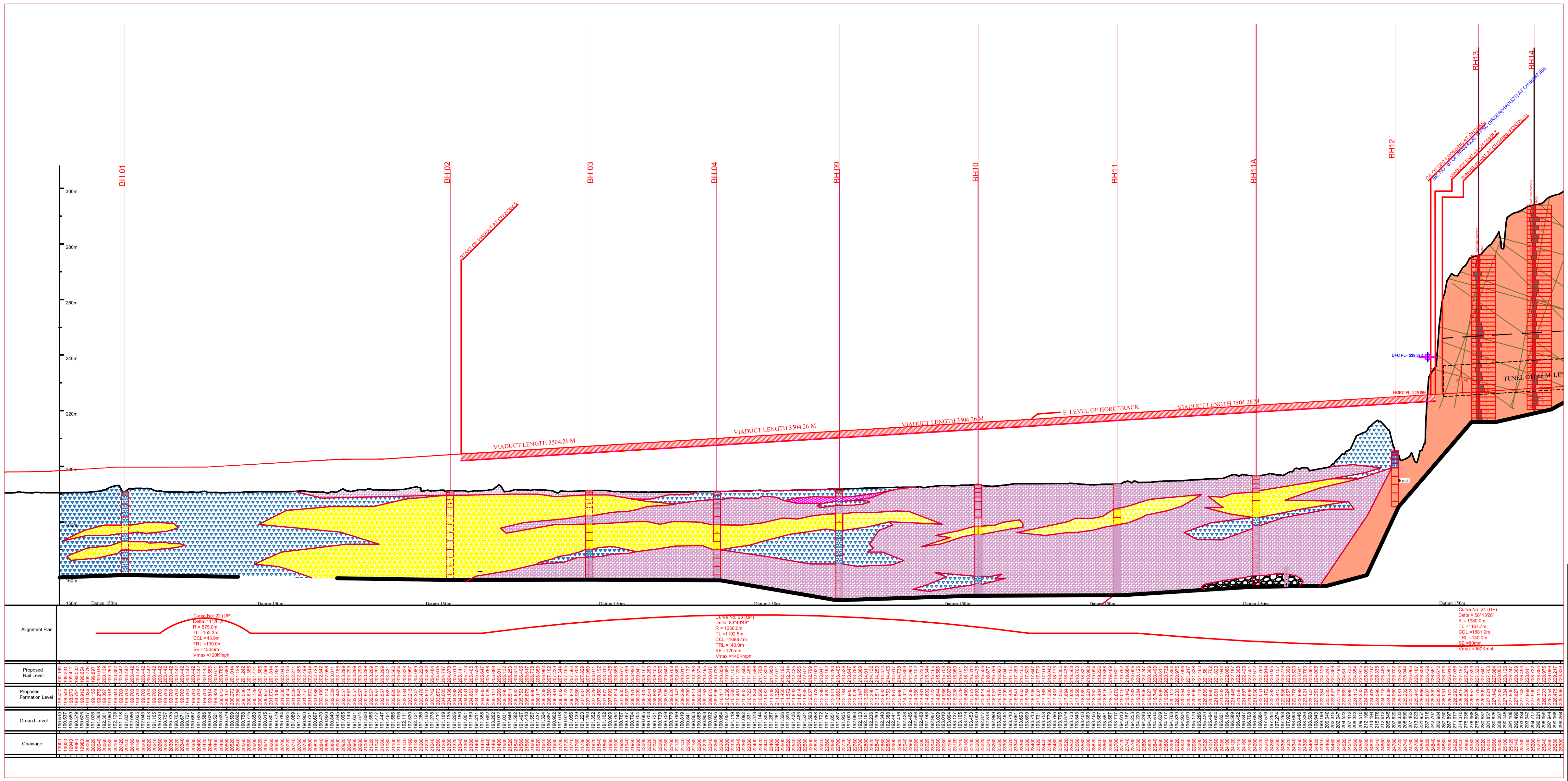


UDS SAMPLE AT 15 m DEPTH OF BH-11A
Ø = 19°
C = 0.16 Kg / Sq.cm
SHEAR STRESS (Kg/Sq cm)
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
X
Y
19°
NORMAL STRESS (Kg/Sq cm)

ANNEXURE -J
LOCATION MAP

BH-12
BH-11A
BH-11
BH-8
bh-10
BH-7
bh-9
BH-6
BH-5
BH-4
BH-2
BH-3

ANNEXURE -K
LITHOLOGICAL SECTION



Legend

- Phyllite
- Quarzite
- Joints
- Tunnel Line
- Inorganic Silty Soil (ML)
- Inorganic Clay rich Soil (CL)
- Silty Sand (SM)
- Kanker
- Clayey Sand (SC)
- Inorganic Silty Clayey Soil (ML-CL)

Rock Weathering & Fracturing Index

HW & HF	MW & HF	SW & HF
HW & MF	MW & MF	SW & MF
HW & SF	MW & SF	SW & SF

HW : Highly Weathered

MW: Moderately Weathered

SW: Slightly Weathered

HF: Highly Fractured

MF: Moderately Fractured

SF: Slightly Fractured

GC/HORC		HRIDC	
NAME / DEGINATION	SIGN	NAME / DEGINATION	SIGN
CHAHATEY RAM PD		SHIV OM DWIVEDI CPM/HRIDC	
SUDHIR AGRAWAL DPD/CIVIL		RAJU SOLANKI DGM/CIVIL/SOUTH	
AJAY VIJAYVARGIYA DPD/EST		DGM/S&T	
KRISHAN CHAND SAINSI CRE/CIVIL		DGM/Elect.	
AMARNATH SINGH CRE/S&T			

NORTHERN RAILWAY

DELHI DIVISION

PROJECT:

HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT:

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

GENERAL CONSULTANT:

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

SIGN

RITES THE INFRASTRUCTURE PEOPLE

GC/HORC DRG. NO:-

DRAWING NAME: LITHOLOGICAL SECTION OF VIDUCT

N.R.H.Q.E.(P) PLAN NO:

DIVISION PLAN NO :

SCALE: 0m Horizontal 500m; 0m VERTICAL 50m

SMC DRG. NO:- SMC/ HORC/TUN/GEO/2

CONSULTANT: S.M. CONSULTANTS An ISO 9001 Company Bhubaneswar / Balasore / Secunderabad / South Andaman / New Delhi Web : www.smcindia.com , E-Mail : support@smcindia.com

DRAWN: AVINASH | CHECKED: D.Bhattacharjee | A. A. SAMANT PROJECT INCHARGE

RELEASED FOR: ☐ PRELIMINARY FOR APPROVAL ☑ TENDER ☐ CONSTRUCTION

7.2 Report No : SR No.544_21-22

Geotechnical Investigation Report

PACKAGE-C5

PART-A (Connecting Line)	Old Ch. (-)2+514 to Old Ch. (-)0+934 [New Ch. (-)1+838 to (-)0+248]
PART-B (Main Line)	Old Ch. 17+625 to Old Ch. 20+300 (New Ch: 18+310 to 20+985)

SR NO. : 544_21-22

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA

CLIENT

M/S. HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LTD. (HRIDCL)

CEGTH
CEG TEST HOUSE
AND RESEARCH CENTRE PVT LTD

B-11(G), Malviya Industrial Area, Jaipur-302017
Tel. : 91-141-4046599, Fax : 91-141-2751806
E-mail : info@cegtesthouse.com., www.cegtesthouse.com

V
V
V
V
V
V

PART-A (Connecting Line)
Old Ch. (-)2+514 to Old Ch. (-)0+934
[New Ch. (-)1+838 to (-)0+248]

Geotechnical Investigation Report

PACKAGE-C5

New Ch. 0+000 to Old Ch. 10+859 (New Ch: 11+543) &
Old Ch. 17+625 to Old Ch. 20+300 (New Ch: 18+310 to 20+985) &
Connecting Line from Prithala to New Prithla

PART-A

Connecting Line from Prithala to New Prithla
Old Ch. (-)2+514 to Old Ch. (-)0+934 [New Ch. (-)1+838 to (-)0+248]

SR NO. : 544_21-22

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA

CLIENT

M/S. HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LTD. (HRIDCL)

PROGRAMME
FEBRUARY - 2023

SR. No.	Report No.	Revision No.	Date
544_21-22	CEGTH/HRIDCL/SR-544/2022-23/1625_(08 BHs)	01	17.03.2023
544_21-22	CEGTH/HRIDCL/SR-544/2022-23/1476_(87 BHs)	00	08.02.2023

CEGTH
CEG TEST HOUSE
AND RESEARCH CENTRE PVT LTD

B-11(G), Malviya Industrial Area, Jaipur-302017
Tel. : 91-141-4046599, Fax : 91-141-2751806
E-mail : info@cegtesthouse.com., www.cegtesthouse.com

CEGTH/HRIDCL/SR-544/2022-23/1625 Date:- 17.03.2023

To,

Haryana Rail Infrastructure Development Corporation Ltd. (HRIDCL)
SCO No.-17-19, 3rd & 4th Floor,
Sector - 17-A,
Chandigarh - 160017
Tele:- 0172-2715644
Email: hridc2017@gmail.com

Subject :- Geotechnical investigation work for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan in the state of Haryana.

Dear Sir,

We are pleased to submit this report of the subject work based on 08 boreholes carried out at Connecting Line from Prithala to New Prithla [Old Ch. (-)2+514 to Old Ch. (-)0+934 {New Ch. (-)1+838 to (-)0+248}] for the proposed project site.

The accompanying report presents results of various field tests and laboratory tests conducted on selected soil samples and their interpretation.

Should there be any clarifications regarding the contents please contact us at your most convenient time.

We value the opportunity to participate in this project and look forward a pleasant association on future projects.

Very truly yours,
CEG Test House & Research Centre Pvt. Ltd.

Prepared By:-

Nehal Jain
General Manager - Geotechnical
Authorized Signatory

Dr. Ankur Mudgal
Sr. Manager

Technical Advisor **Dr. Sarvesh Chandra**
(Geotechnical Expert)
Former Professor, IIT Kanpur

SR. No.	Report Ref. No.	Revision No.	Date
544_21-22	CEGTH/HRIDCL/SR-544/2022-23/1625_(08 BHs)	01	17.03.2023
544_21-22	CEGTH/HRIDCL/SR-544/2022-23/1476_(87 BHs)	00	08.02.2023

CONTENTS

LIST OF FIGURES / TABLES

CHAPTER 1 GENERAL

1.0 INTRODUCTION:

The work of conducting "**Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana"** was awarded to "**CEG Test House & Research Centre Pvt. Ltd., Jaipur" by M/S.** "**Haryana Rail Infrastructure Development Corporation Ltd. (HRIDCL)"** as per work order no. HRIDC/ HORC/ GT/ CEG/ 237/ 2021/ 577-M dated 29th July 2021.

Field work including drilling of boreholes, conducting field tests such as Electrical Resistivity Test, & Plate Load Test and sample collection was carried out in the presence of representative of Client. Laboratory tests were conducted on selected soil samples to determine the design parameters, confirming to relevant IS specifications and the guidelines received from time to time from representative of Client.

This report includes the details of Methodology of Investigation, collection of samples of soil, field test results, laboratory test results, analysis of results and recommendations for proposed structure carried out at Connecting Line from Prithala to New Prithla [Old Ch. (-)2+514 to Old Ch. (-)0+934 {New Ch (-)1+838 to (-)0+248}] based on soil sample collected from the locations of 08 boreholes.

2.0 SITE LOCATION & GENERAL GEOLOGICAL HISTORY:

The details of the site & test locations for the proposed project are shown in location plan attached vide **Appendix A-1**. The site of proposed project is located from Palwal to Harsana Kalan (Sonipat) in the State of Haryana falls in seismic zone – IV (Zone factor=0.24) of India.

Soil of the Haryana Sub-Region have been classified and described under the following major soil types as shown below:-

- Typic Ustochrepts : Soil of old alluvial plains
- Typic Ustipsamments : Soil of Aravali plains
- Typic Ustifluvents : Soil of recent alluvial plains and flood plains
- Typic Torripsamments : Soil of Aeofluvial plains
- Rocky Outcrops : Aravali rocky hills

The district wise details of soil characteristics are described below:-

Panipat: The soils are well drained, Sandy loam to clay loam/silty clay loam in plains and loam to clay loam/ silty/ loose clay loam in relic channels/depressions/basins.

Sonipat: The district comprises of recent flood plains, young meander plains, old meander plains and old alluvial plains. Recent flood plains occur along the Yamuna River and clearly show fluvial features. The soils are loamy sand to sandy loam on the surface and sandy loam to clay loam in the sub surface.

Rohtak: The district mainly comprises of old alluvial plains. The soils are loamy sand to sandy loam on the surface and sandy loam to clay loam in the sub surface. Old meander plains are almost flat with loamy sand to silty clay loam soils. Oldest among all the land forms are old alluvial plains, which cover major areas in the district. These soils are sand to loamy sand/sandy loam (surface) to silt loam/silty clay loam (sub-surface).

Jhajjar: The district mainly comprises of old alluvial plains and some parts of the district also have soil belonging to Aravali plains.

Rewari: The soils of the district fall under Entisols and Inceptisols orders. The surface soil texture varies from sand to fine loamy sand.

Gurgaon: The district comprises of sand dunes, sandy plains, alluvial plains, salt affected areas,

low lands, lakes, hills and pediments. The soil varies from sand to loamy sand in sand dunes and sandy plain areas, sandy loam to clay loam / silty clay loam in alluvial plains, calcareous, loamy sand to loam in salt affected plains, silty loam to loam in low lands and calcareous, loamy sand to loam in hills.

Mewat: The soils of the area are generally sandy loam to loam. In parts of the low-lying areas, they are clayey and saline. The upper hills are mostly barren.

Faridabad and Palwal: The district comprises of recent Yamuna flood plains, low lying plains, depressions, sand dunes and hills. The texture of the soil is sand to loamy sand in recent Yamuna flood plains, sandy loam in plains, sandy loam to clay loam in alluvial plains, sandy loam to loam

(surface), clay loam/silty clay (sub-surface) in low lying plains and depressions.

3.0 SCOPE OF WORK:

The stipulated scope of work involved carrying out the following operations:-

a) Mobilisation of necessary plant equipment, men and materials for the complete Geotechnical investigation work as per specifications, drawings and instructions of the Engineer and to complete the same within the stipulated time schedule and demobilisation after completion of field work.

b) Shifting of Equipments from one structure location to another including Ereaction, installation of rigs at site and dismantling of the same after completion of field work. Shifting of setup for each borehole location and associated preparation for borehole under water

c) Making 150 mm nominal diameter boreholes at various locations in all types of soils except hard rock and large boulders using suitable approved method of boring including chiselling, cleaning, providing casing pipe as required; performing Standard Penetration Test at every 3.0m interval and at change of strata; collection of water samples and disturbed soil samples, observation such as ground water, etc., collection of undisturbed soil samples at every 3.0 m interval and at change of strata; transportation of all the collected samples to the laboratory and back filling of boreholes on completion of the same, complete as per specification and instructions of the Engineer, for depths below natural ground level.

d) Conducting Electrical resistivity tests at various locations all complete as per specification and directions of the Engineer.

e) Conducting plate load test at various locations, all complete as per specification and directions of the Engineer.

f) Drilling of Nx size boreholes (75mm dia.) in all types of hard rock, collection of core samples, maintaining continuous record of core recovery/ RQD, keeping the cores in wooden core boxes, transporting to laboratory, backfilling on completion of the same, all complete as per specification and instructions of the EIC.

g) Conducting various laboratory tests on soil samples at an approved laboratory including preparation of soil samples to determine the following properties of soil, all complete as per specification.

On soil Samples

- Dry density test
- Bulk Density and Moisture Content.
- Sieve Analysis
- Hydrometer Analysis
- Liquid Limit and Plastic Limit
- Specific gravity
- Shrinkage Limit
- Free Swell Index
- Direct Shear Test
- Triaxial Shear Test
- One Dimensional consolidation test
- Chemical Analysis of soil samples (pH, chloride, Sulphate)

h) Conducting laboratory tests on rock samples including preparation of the samples to determine the following properties, all complete as per specification

On Rock Samples

- Moisture content, porosity & Density
- Specific gravity
- Hardness
- Unconfined compression test
- Point load strength index
- Modulus of Elasticity and Poission's Ratio
- Abrasion Test

i) Conducting chemical tests on water samples to determine the Sulphate, chloride and pH value all complete as per specification.

j) Submitting draft report in soft copy including all field records and laboratory test results, graphs, etc., all complete as per specifications.

k) Submitting final report in three hard copies in after the approval of the draft report including all field records and laboratory test results, graphs, etc., all complete as per specifications.

4.0 FIELD INVESTIGATION IN SOIL STRATA:

The investigation was planned to obtain the subsurface stratification in the proposed project site and collect soil / rock core samples for laboratory testing to determine the engineering properties such as shear strength, along with basic engineering classification of the subsurface stratum.

For geotechnical investigation work, required equipements along with rotary drilling rigs and manpower were mobilized at site to carry out various field activities as per the scope of work. These were shifted from one test location to another location during execution of field work and were demobilized on satisfactory completion of field work.

For conducting the field investigations the following practices were followed at site:

- The locations of 08 boreholes carried out at Connecting Line from Prithala to New Prithla **[**Old Ch. (-)2+514 to Old Ch. (-)0+934 {New Ch. (-)1+838 to (-)0+248}] were marked at site at specified locations. These locations are shown in **Appendix-A1** attached subsequently.

The details of various boreholes along with their coordinates are provided herein below:

Table 1.1: Details of Borehole Locations

S. No.	Chainage Old (km)	Chainage New (km)	Structure	BH.No.	Depth of Water Table below EGL (m)	Depth of Borehole below EGL (m)	Co-ordinates (m)		(+) R.L. (m)
							E	N	
1.	(-)2+514	(-)1+838	BH-CL	MNB	7.15	10.00	722701.988	3126414.281	195.721
2.	(-)1+969	(-)1+291	BH-CL	MNB	7.50	10.00	722173.198	3126541.073	195.326
3.	(-)1+500	(-)0+821	BH-A1	MJB	5.10	35.00	721737.910	3126432.416	195.309
4.			BH-A2	MJB	5.20	35.00	721703.826	3126418.378	195.429
5.	(-)1+269	(-)0+592	BH-A1	MJB	6.10	30.00	721528.877	3126336.130	194.566
6.			BH-A2	MJB	6.55	30.00	721508.138	3126327.463	195.172
7.	(-)1+241	(-)0+567	BH-CL	MNB	6.50	10.00	721494.114	3126321.741	194.789
8.	(-)0+934	(-)0+248	BH-CL	MNB	8.10	10.00	721203.669	3126250.134	196.343

***NE=Not Encountered**

- In soil, boreholes of 150mm dia. were drilled as per the standard procedure laid in IS: 1892.
- Borehole was properly cleaned before taking any sample in soil.
- Casing was used as per the prevailing soil conditions, to stabilize the borehole.
- Standard Penetration Tests were conducted in bore holes at regular intervals or at every change of strata as per Technical specification.
- Undisturbed were collected wherevery feasible as per the requirements and at specified depths. The same has been discussed in detail in soil characteristics sheets attached with the report.
- The Ground Water Table was met at depths of from 5.10m to 8.10m below EGL. The detailed procedure adopted for conducting various field tests is given here in below:

(i) Standard Penetration Test:

The Standard Penetration Test was conducted in boreholes as per IS 2131. The test was carried out using the standard split spoon sampler to measure the number of blows 'N'.

Standard split spoon sampler was attached to an 'A' rod. It was driven from borehole bottom to a distance of 45 cm using a standard hammer of 63.5 kg falling freely from a height of 75 cm to the required depth. While driving, the number of blows required to penetrate every 15 cm are recorded. The total number of blows required for the last 30 cm is taken as 'N' value at that particular depth of the borehole. Wherever the total penetration was less than 45cm, the no. of blows & the depth penetrated is recorded in the respective borelog.

SPT 'N' values were correlated with relative density of non-cohesive stratum and with consistency of cohesive stratum as given below:-

Table 1.2: Soil compactness as per SPT N values (cl. 9.7, table 9.3 & 9.4, page 330_text book of V.N.S. Murthy)

Correlation for Clay / Plastic silt		Correlation for Sand / Non-Plastic silt	
Consistency	**SPT "N" Value**	**Compactness**	**SPT "N" Value**
Very Soft	0 - 2	Very Loose	0 - 4
Soft	2 - 4	Loose	4 - 10
Medium	4 - 8	Medium	10 - 30
Stiff	8 - 15	Dense	30 - 50
Very Stiff	15 - 30	Very Dense	> 50
Hard	> 30		

The field SPT N values obtained were further corrected as per the guidelines given in IS: 2131 as follows:

(a) For overburden: - The N value for cohesionless soil is corrected with the help of fig. 1 given in IS-2131.

(b) Due to dilatancy :- Wherever N values observed below water table in fine sand, silty sand or silt was greater than 15, then corrected N values were corrected as under:

$$N' = 15 + \frac{1}{2}(N-15)$$

(ii) Undisturbed Sampling (Soil) in boreholes:

Undisturbed samples were collected using MS tubes of suitable diameter and length with Area ratio as per clause 4.1.1 (c) of IS: 1892 (latest) fitted to an adopter with ball and socket arrangement. Before taking any sample, sampling tube was properly greased. Immediately after taking on undisturbed sample in a tube, the adopter head was removed along with the disturbed material. The visible ends of the sample were trimmed off any wet disturbed soil. The ends were coated alternately with four layers of just molten wax. More molten wax was added to give a total thickness of min. 25 mm. The samples were carefully labeled and transported to the laboratory for testing. Undisturbed samples wherever slipped during lifting were duly marked in the field logs as well as in the soil profile.

5.0 LABORATORY TESTS ON SOIL SAMPLES:

The following laboratory tests were conducted on selected soil samples:

Table 1.3: Description of Tests

Description of Test	Reference	Undisturbed (UDS) Soil Samples	Disturbed (DS/SPT) Soil Samples
Grain Size Analysis / Hydrometer	IS: 2720 (Part - 4)	√	-

Description of Test	Reference	Undisturbed (UDS) Soil Samples	Disturbed (DS/SPT) Soil Samples
Natural Moisture Content / Bulk / Dry density	IS : 2720 (Part – 2)	√	-
Atterberg Limits • Liquid Limit • Plastic Limit	 IS: 2720 (Part - 5) IS: 2720 (Part - 5)	 √ √	 √ √
Specific Gravity	IS : 2720 (Part – 3)	√	-
Direct Shear Test	IS : 2720 (Part – 13)	√	-
Triaxial compressive shear test	IS : 2720 (Part – 11 & 12)	√	-
Chemical Analysis of Soil Samples	IS : 2720 (Part – 26, 27)	√	-

Note:- The detailed procedure adopted for conducting various laboratory tests is described in the following paragraphs:

5.1.1 Dry density and Bulk density

For determination of bulk density and dry density, a sample of known volume 'V' was extracted from the undisturbed sampling tube and it's bulk weight 'W' was noted down.Moisture content 'Wn' was determined by oven drying method.

The bulk density and dry density were determined by following equation-

Bulk density (γ_b) = W/V

Dry density (γ_d) = γ_b/ (1+Wn)

5.1.2 Natural water content

For this test, the soil sample of known quantity (Wm) was taken in a container.The container with soil sample was placed into an oven for drying at 105-110°c temperature for 16-24 hours. After drying, the dry sample was again weighted to determine the dry weight of sample (Wd).

The natural water content was computed by the following equation-

Wn = (Wm-Wd)*100/Wd

5.1.3 Grain Size Analysis (IS: 2720- Part-4)

Wet sieve analysis:

For determination of particle sizes finer than 75 micron, wet sieve analysis test was conducted. For this test, oven dried sample of known quantity was taken in a container and soaked with dispersing agent. The soaked soil sample was washed thoroughly over 75 micron IS sieve until the water passing sieve was substantially clean.

Fraction retained on 75 micron IS sieve was carefully collected in a container without any loss in material and placed into oven for drying.

Dry sieve analysis:

For this test, the oven dried soil sample after wet sieving was sieved through the set of IS sieves 20 mm, 10 mm, 4.75 mm, 2.0 mm, 1.0 m , 425 micron , 300 micron, 150 micron and 75micron. The amounts of soil retained on each sieve were noted down. The % retained, cumulative % retained and % passing were computed accordingly. Wherever the soil sample % passing 75 micron sieve was significant, Hydrometer method was used to find the percentage of silt and clay fraction.

Grain size analysis for the fraction passing 75 micron IS Sieve (Hydrometer method)

Calibration of Hydrometer

Hydrometer was calibrated to determine a relationship (an equation) between the effective depth H_R and corresponding hydrometer reading R_h (obtained during test).

50 to 100 gm of soil sample passing through 75 micron IS Sieve was taken. It was mixed with 100 ml of sodium hexametaphesphate solution and the mixture was warmed for about 10 minutes. It was then transferred to the cup of the mechanical mixer and the soil suspension was stirred for 15 minutes. The soil suspension was transferred into 1000 ml measuring cylinder and distilled water was added to make 1000ml solution. This solution was mixed vigorously. The measuring cylinder was then allowed to stand and the stopwatch was started. Hydrometer was immersed in the solution and reading were taken after half, one, two and four minutes. The hydrometer was then removed slowly and kept in distilled water at the same temperature as the soil suspension. Readings were taken after the periods of 8, 15 and 30 minutes, and one, two and four hours. Hydrometer was removed, rinsed and placed in the distilled water after each reading. After 4 hours reading was taken once or twice within 24 hours. Finally a reading was taken at the end of 24 hours. The temperature of the suspension was observed and recorded.

Calculations

Diameter of the particles (D):

$$D = \sqrt{\frac{30\mu}{980(G-1)}} \times \sqrt{\frac{H_R}{t}} = M\sqrt{\frac{H_R}{t}}$$

Where,

D = diameter of particle in suspension, in mm;

μ = co-efficient of viscosity of water at the temperature of the suspension at the time of taking the hydrometer reading, in poise;

G = specific gravity of the soil fraction used in the sedimentations analysis;

H_R = effective depth corresponding to R_n, in cm.

t = time elapsed between the beginning of sedimentation and taking of hydrometer reading in minutes

$M = \sqrt{\frac{30\mu}{980(G-1)}}$ = a constant factor for given values of μ and G at the temperature of the suspension.

Percentage finer than diameter D:

The percentage by mass (w) of particles smaller than corresponding equivalent particle diameters (D) was calculated from the formula:

$$w = \frac{100G_s}{W_b(G_s - 1)} \times R_h$$

Where

w = percentage finer

G_s = specific gravity of soil particle

W_b = weight of soil

R_h = Hydrometer reading

5.1.4 Specific Gravity (IS: 2720-Part-3 Sec-1)

The specific gravity of soil sample was determined by density bottle method. For this test 5-10g oven dried and cooled soil sample was taken in 50ml capacity density bottle and its weight was noted down as W_2 .The soil was covered with distilled water and left for sufficient period for suitable soaking. The entrapped air was removed by vacuum. The bottle with soil was filled fully with water and its weight was noted down (W_3). The mass of empty bottle and bottle filled with distilled water were noted down as W_1 and W_4 respectively.

The Specific Gravity was determined by using following equation :

$G=W_2-W_1/[(W_2-W_1)-(W_3-W_4)]$

5.1.5 Liquid Limit (IS: 2720- Part-5)

By Cone Penetrometer Method

The 'Cone Penetrometer Apparatus' is a variant of the fall-cone and consists of a cone with a smooth polished surface and angle of 30° ± 1/2°. The weight of the cone, together with its associated shaft is 80g ± 0.5g. A support assembly with an automatic cone release mechanism and cone height adjustment mechanism used to hold the cone vertically. The angle and weight of the cone were calibrated at regular intervals, and the sharpness of the cone tip was checked daily.

Distilled water was added and thoroughly mixed with the soil sample to produce a homogeneous paste. The paste was then placed in a cup with a diameter of at least 55mm and a depth of at least 40mm. The surface of the soil was smoothed off level and parallel to the base. The support assembly was used to position the tip of the cone so that it was just touching the top surface of the soil, and the automatic tripping mechanism was released. The cone was allowed to penetrate into the soil for a period of 5 (± 1) s, then the cone was locked off to stop further movement and the penetration was recorded. The cup was refilled and the test was repeated. The two recorded penetrations need to be within 0.5mm of each other, otherwise a third test is performed. when the three test vary by more than 1mm the test was repeated.

Further tests were conducted, at varying water contents, in order to produce a series of cone penetrations (usually 4) in the range 15mm to 25mm. The resulting cone penetrations were plotted verses the water content of the test specimens. The Liquid Limit (W_L) was read off the graph, being the water content at which the line of best fit through the test points crosses 20mm penetration.

5.1.6 Plastic Limit (IS: 2720-Part-5)

For this test, soil sample was prepared in the same way as for liquid limit test. A ball of soil sample weighed about 5 gm was formed. The ball was rolled between the fingers of one hand and the glass plate with pressure sufficient to reduce the mass into a thread of about 3 mm in 5 to 10 complete forward and back movements. When a diameter of 3 mm was reached, soil was again remolded into a ball. The process of rolling and remolding was repeated until the thread started just crumbing at a diameter of 3 mm. The crumbled thread was immediately transferred to an airtight container for determination of its moisture content by oven drying method.

This water content has been termed as plastic limit. (W_P)

5.1.7 Plasticity Index (IS: 2720-Part-5)

The plasticity index Ip was given by

$I_p=W_L-W_P$ (in percent)

5.1.8 Direct Shear Test (IS:2720-Part-13):

For this test shear box test apparatus was used. The prepared specimen from remolded/undisturbed sample was placed carefully in the box. The plain grid was kept on top of the specimen with its directions at right angles to the direction of shear. The upper porous stone was placed on the grid and loading pad on the stone. The box with specimen was gently placed in the container (water jacket). The specimen was submerged with water. The container was mounted with the shear box and the specimen inside, on the shearing machine. The upper part of the box was so adjusted that it touchéd the proving ring. The jack was brought forward to bear up against the box container. The proving ring dial gauge was set to read zero.

The steel ball was placed in the recess of the loading pad. The loading yoke was set in contact with the steel ball on the loading pad. Vertical displacement dial gauge to read zero in contact with the top of the yoke. The normal load was applied and any change in thickness of specimen was recorded. Shear displacement dial gauge was also set to read zero. The locking screw was now removed and two parts of the shear box were separated by advancing the spacing screws.

The specimen was sheared at constant rate of strain. The readings of the proving ring dial gauge were noted down every 15 seconds for the first one-minute and then every 30 seconds thereafter. The reading of change in the thickness dial gauge and shear displacement dial gauge were also recorded at the same time interval. The test was continued until the specimen fails. The specimen was assumed to fail when the proving ring dial gauge started receding or at shear displacement of approximately 15% of the length took place.

The soil was removed from the box and test was repeated on the identical specimen under increased normal load.

The rate of strain for conducting Direct Shear Test is kept as 0.25 mm/min as per codal/literature provision based on strata.

5.1.9 Triaxial Shear Test_UUT (IS: 2720-Part-11)

For this test, Triaxial Shear Test apparatus was used. The plain disc was placed on the pedestal of the triaxial cell. The specimen was placed centrally on the disc. A correct size rubber membrane was fitted inside the stretcher with ends of membrane folded over those of the stretcher. Vacuum was applied to stretch the membrane to the inside surface of the stretcher which was carefully slipped around the specimen kept on the pedestal. The vacuum on the membrane was released. Its bottom part was rolled down into the pedestal. plain disc was placed on the top of the specimen and then loading pad was placed. The top part of membrane was rolled on to the loading pad. Then the stretcher was removed and ends were sealed with ‘O’ rings. With the properly sealed specimen placed centrally on the pedestal, the cell was assembled, keeping the loading piston initially clear of the loading pad of the specimen, the assembly was placed in the loading frame.

For unconsolidated undrained test, the bottom drainage value (BDV) and top drainage value (TDV) of cell, was closed and air release valve (ARV) was opened. The cell was filled with water through the cell water value CWV. ARV was closed when water begins to escape through it. The cell pressure was raised to the desired value and kept constant till the end of the test.

When the cell pressure was applied, the load piston rises upward, the loading machine was operated at the anticipated rate to bring the load piston slightly above the loading pad of the specimen and the load measuring dial gauge on proving ring was set to zero.

The piston was brought just in contact with loading pad by hand operation of the machine. The axial compression dial gauge was mounted and set to read zero.

The axial loading was started at 1.25 mm/min rate of strain. Simultaneous readings on the load and compression dial gauges were noted down. The test was continued until a recession of the axial load is observed or 20% of strain.

After failure, the specimen was unloaded by reversing the loading machine, cell pressure was reduced and cell water was drained out through BRV. The cell was dismantled and the specimen was taken out, rubber membrane was removed and weight of the failed sample and its water content was determined. The test was repeated on two more identical specimens with increasing cell pressure.

The rate of strain for conducting UUT is kept as 1.25 mm/min as per codal/literature provision based on strata.

5.1.10 Chemical Testing

Chemical Testing was generally performed in accordance with IS: 2720, but the different parts of method as described below:

a) **Total Sulphate Content Of Soil**

Samples were tested according to IS 2720 (Part 27). The dried soil was extracted with a 10% solution of hydrochloric acid. The extract was adjusted to slightly alkaline pH with ammonia, and then barium chloride solution was added to precipitate the sulphate. The barium sulphate precipitate was collected by filtration, and it was washed, dried and weighed. The mass of barium sulphate recovered was used to calculate the sulphate content of the original soil.

b) **pH Value**

Samples were tested according to IS: 2720 (Part 26). The soil sample (30 ± 0.1g) was extracted with 75 ml of distilled water and the pH of the resulting suspension was measured with a calibrated (by means of Standard buffer solution) pH meter.

c) **Chloride Content**

For the water soluble content, soil samples were extracted with a volume of water equal to twice the mass of the soil. The extract was filtered and acidified with a small amount of nitric acid. Standardized silver nitrate solution was then added to precipitate the chloride as its silver salt. The amount of precipitated silver remaining in solution was then determined by titration.

An acid-soluble version of the test was also available, with the initial extraction being with nitric acid instead of water.

CHAPTER 2 ANALYSIS OF TEST RESULTS AND INTERPRETATION

6.0 STRATIFICATION

From the study of the borehole carried out at Connecting Line from Prithala to New Prithla **[**Old Ch. (-)2+514 to Old Ch. (-)0+934 **{**New Ch (-)1+838 to (-)0+248}], it is revealed that the substrata of all boreholes mainly consisit of Silty Clay of low plasticity (CL), sandy silt of low plasticity (ML-CL), Silty Sand with Clay (SM-SC), Silty Sand (SM).

6.1 GROUND WATER TABLE DEPTH

The Ground Water Table was met at depths of from 5.10m to 8.10m below EGL as given in Table 1.1, it may rise up during heavy rains / rainy season. Therefore, for the analysis of various foundations, the water table has been considered to rise by about 2 to 3.0m at the locations of boreholes.

6.2 RESULTS OF CHEMICAL ANALYSIS

Results of chemical analysis of soil samples (as per **Appendix – B2**) indicates that the soil sample falls under Class I for sulphates and chlorides concentration (As per IS 456-2000 and CIRIA Sp. Publication No. 31). The results are summarized here in below :-

Summary of chemical analysis of soil samples

Chemical Property	Findings (Min. to Max.)	Remarks (Required limits as per IS 456-2000)
pH	6.95 to 8.17	> 6.0
Sulphite as SO_3^{2-} (%)	0.0021 (%) to 0.0029 (%)	< 0.2% (Class I)
Chlorides as Cl^- (%)	0.0062 (%) to 0.0088 (%)	No limit specified in IS 456. However, a limit of 0.10% specified for class I in CIRIA Sp. Publication No. 31)

Note :- All the chemical contents are within permissible limit hence no special precautions are required.

6.3 COMPUTATION OF LIQUEFACTION POTENTIAL

Liquefaction is the sudden loss of shear strength of the sub soil strata due to earthquake-induced vibration under saturated conditions.

Assessment of liquefaction potential of foundation strata is made by simplified approach proposed as per IS: 1893 (Part-1)-2016, from the SPT data and peak ground acceleration likely to occur at the site. In this method, cyclic shear stress likely to be induced in the foundation strata by Design Basis Earthquake (DBE) is first evaluated.

Next threshold cyclic shear stress, which is good enough to cause liquefaction, is determined from SPT data and the empirical relations. Finally, comparison of these two stresses is used in the estimation of liquefaction susceptibility of the foundation strata.

Unsaturated soils are not subjected to liquefaction because vibratory forces from earthquakes do not cause any increase in pore water pressure in such soils.

The area of site from Palwal to Harsana Kalan (Sonipat) in the State of Haryana falls in seismic zone – IV of India as per IS: 1893. Further as per the provisions of IS: 1893 in soil deposits consisting of submerged loose sands & soils falling under classification of SP with standard penetration N value less than 15, the shaking caused by earthquake ground motion may cause liquefaction or excessive total and differential settlements.

For the analysis of liquefaction potential, following constant parameters are considered:

EQ Zone	IV
Earthquake Magnitude (Mw)	7.0
Peak Horizontal Ground Acceleration (amax /g)	0.24

The Ground Water Table was met at depths of from 5.10m to 8.10m below EGL as given in Table 1.1. For the analysis of liquefaction potential, the water table is generally considered to rise by about 2.0m to 3.0m at the location of all boreholes. The strata in the boreholes are not likely to liquefy as mentioned above and the same is tabulated below:-

Table 2.1: Liquefaction Analysis

S. No.	Chainage Old (km)	Chainage New (km)	Structure	BH.No.	Depth of Water Table below EGL (m)	Water table depth Considered for Liquefaction Analysis	Liquefiable Depth (m)
1.	(-)2+514	(-)1+838	MNB	BH-CL	7.15	3.15	Non Liquefiable
2.	(-)1+969	(-)1+291	MNB	BH-CL	7.50	4.50	Non Liquefiable
3.	(-)1+500	(-)0+821	MJB	BH-A1	5.10	2.00	Non Liquefiable
4.			MJB	BH-A2	5.20	2.00	Non Liquefiable
5.	(-)1+269	(-)0+592	MJB	BH-A1	6.10	3.00	Non Liquefiable
6.			MJB	BH-A2	6.55	3.00	Non Liquefiable
7.	(-)1+241	(-)0+567	MNB	BH-CL	6.50	3.00	Non Liquefiable
8.	(-)0+934	(-)0+248	MNB	BH-CL	8.10	5.10	Non Liquefiable

6.4 INTERPRETATION OF LAB TEST RESULTS

Grain Size Analysis

1. **Clay content:** It generally varies from 4 to 11%.
2. **Silt content:** It generally varies from 20 to 66%.
3. **Sand content:** It generally varies from 22 to 85%.
4. **Gravel content:** It generally varies from 1 to 10%.

Atterberg's Limit

5. **Liquid limit:** The test results of liquid limit of the soil samples reveal that it generally varies from 24 to 28% in ML-CL type of soil, 32 to 33% in CL type of soil.
6. **Plastic Limit:** The plastic limit of the soil sample varies from 20 to 21% in ML-CL type of soil, 20 to 23% in CL type of soil. However ML-CL type of soil is considered as non-plastic.
7. **Plasticity index:** The plasticity index of the soil samples generally varies from 5 to 6% in ML-CL type of soil, 9 to 11% in CL type of soil whereas ML-CL and SM/ SM-SC/ SC type of soil are non-plastic.

Natural moisture content & Bulk density

The bulk density of soil samples generally varies from 1.84 gm/cc to 1.97gm/cc whereas natural moisture content varies from 10% to 21%.

Direct shear tests:

Direct shear test under drained condition have been conducted in sandy silty (ML-CL) / sandy stratum (SM/ SM-SC/ SC) type of soil.

For Sandy strata (SM/ SM-SC/ SC), the value of angle of internal friction varies from 28^o to 32^o, whereas cohesion varies from 0.00 kg/cm^2 to 0.11 kg/cm^2.

For Silty strata (ML-CL), the value of angle of internal friction varies from 24^o to 27^o, whereas cohesion varies from 0.11 kg/cm^2 to 0.22 kg/cm^2.

Triaxial shear tests:

Triaxial shear test under undrained condition have been conducted in silty clay (CL) type of soil.

For silty clay (CL) strata, the value of angle of internal friction varies from 4^o to 5^o, whereas cohesion varies from 1.41kg/cm^2 to 2.22 kg/cm^2.

CHAPTER 3 TYPE AND DEPTH OF FOUNDATION WITH ANALYSIS

7.0 TYPE & DEPTH OF FOUNDATION:

Based on the nature & strength characteristics of the substrata and requirement of the project, the following type of foundation have been analyzed as given below:

Table 3.1 : Shallow Foundation

Type of foundation	Depth of Foundation below E.G.L. (m)	Size of Foundation (m x m)
Shallow Foundation	1.0, 2.0, 3.0	4.8 x 4.8
	2.0, 3.0, 4.0	7.2 x 7.2
	1.0, 1.5, 2.0	8.0 x 8.0

Table 3.2 : Pile Foundation

Type of foundation	Length of Pile below E.G.L. (m)	Dia. of Pile (m)
Normal Bored Cast in-situ RCC Pile	20.0, 22.0, 24.0, 26.0, 28.0 & 30.0	1.0 & 1.2

The details of foundation analysis are given in the subsequent paragraph.

7.1 ANALYSIS OF SHALLOW FOUNDATION

7.1.1 From Shear Failure Criteria

Net Safe Bearing capacity from Shear Failure consideration has been computed in accordance with IS: 6403-1981, which is based on, modified Terzaghi's classical approach. The weighted average of shear strength parameters for various strata upto depth equal to 0.5*B*Tan (45+Ø/2) (where B = Width of the Foundation, Ø = Angle of internal friction) is used in the analysis. A factor of safety of 2.5 to estimate the net safe bearing capacity from ultimate net bearing capacity.

For soils, containing both coarse grained (gravels & sands) and fine grained (clays), c and Φ are used to determine the soil strength. In case of predominantly fine grained soils, c and Φ are determined by the Triaxial Compression test as per IS: 2720 pt XI. For predominantly coarse grained soils, c and Φ are determined by Direct Shear test as per IS: 2720 pt XIII. These c and Φ values were used for determining the SBC of soil as per shear failure criteria.

The ultimate net bearing capacity in case of general shear failure is given by following expression,

$q_d = c\, N_c\, s_c\, d_c\, i_c + q\,(N_q-1)\, s_q\, d_q\, i_q + (1/2)\, B\, \gamma\, N_\gamma\, s_\gamma\, d_\gamma\, i_\gamma\, W'$

The ultimate net bearing capacity in case of local shear failure is given by following expression,

$q'_d = (2/3)\, c\, N'_c\, s_c\, d_c\, i_c + q\,(N'_q-1)\, s_q\, d_q\, i_q + (1/2)\, B\, \gamma\, N'_\gamma\, s_\gamma\, d_\gamma\, i_\gamma\, W'$

Where,

$d_c = 1+ 0.2\,(D_f/B)*SQRT(N_\phi)$

$d_q = d_\gamma = 1$ for $\phi < 10^o$

$d_q = d_\gamma = 1 + 0.1\ (D_f/B)*SQRT(N_\phi)$ for $\phi > 10^o$

$N_\phi = \tan^2(\pi/4 + \phi/2)$

ϕ' for local shear failure = $\tan^{-1}(0.67 \tan\phi)$

7.1.2 From Settlement Failure Criteria

Allowable Bearing Pressure from Settlement Failure consideration has been computed in accordance with IS: 8009 (Part-I). The magnitude of settlement, when foundation loads are applied, depends upon the compressibility of the underlying strata and rigidity of the substructure.

The total permissible settlement in cohesion-less soil is estimated using SPT value as per IS: 8009 (Part-I). While using this approach, the N value was corrected, wherever applicable, below the footing base to at least 1.5B below the base to account for the effects of energy ratio, adopted bearing pressure, dilation for submerged silty fine sands / fine sands as well as that due to the overburden pressure.

Further for settlement Calculation in cohesive soil the following equation has been used.

$S_t = \Delta P\ M_v\ H$

Where,

M_v = Coefficient of volume compressibility, cm^2/kg

ΔP = Pressure increment, kg/cm^2

H = Thickness of layers

Note: - Value of Coefficient of volume compressibility (Mv) has been calculated by using the following co-relation [Ref. Stroud and Butler, 1975] :-

Coefficient of Volume Compressibility derived from SPT N-Value (after Stroud and Butler, 1975)

Plasticity Index (%)	Conversion Factor (f_2)	m_v (10^{-3} kPa^{-1}) based on N-Value: $m_v = 1/(f_2N)$				
		N=10	N=20	N=30	N=40	N=50
10	800	0.12	0.06	0.04	0.03	0.02
20	525	0.19	0.09	0.06	0.05	0.04
30	475	0.21	0.10	0.07	0.05	0.04
40	450	0.22	0.11	0.07	0.06	0.04

$Mv = 1/(f_2 N_{corr.})$

Where f_2 = factor based on $N_{corr.}$ Value & plasticity index of soil

$N_{corr.}$ = corrected SPT 'N' value

For analysis of shallow foundation the total permissible settlement has been considered as 25mm, & 50mm as per IS 1904.

Zone of influence below foundation has been considered up to 1.5 times the width of the foundation.

For the determination of the SBC from settlement criteria, the corrected SPT N values within the influence zone are given in the table below.

NOTE:-

- Lower of the two values obtained from settlement and shear criteria is used in arriving at allowable bearing capacity of the soil.
- Structural foundations are designed based on the minimum of Safe Bearing Capacity obtained from Shear Failure Criteria and Allowable Bearing Pressure corresponding to the permissible settlement. The permissible Settlement that can be allowed for the foundation depends on the strata at the location and type of foundation (whether Isolated or Raft).

  Settlement occurs with the application of loads on foundations. It has two components, Immediate Settlement and Long Term Settlement. The immediate settlement takes place immediately as the loading is imposed on the structure and long term settlement arises due to the consolidation of the sub-soil with time under the load. Hence, the total settlement allowed for a foundation is the sum of the immediate and consolidation settlement that is expected to occur. The cohesionless strata (predominantly sandy) is primarily subjected to immediate settlement and cohesive strata (clayey) undergoes settlement in long time with the compression of the strata due to consolidation. Settlement of the foundation is determined from the relation provided in Indian standards (IS: 8009 (part-1) &/or various literatures (Bowles, BM Das, etc.).

From the Geotechnical investigation conducted on our site along with subsequent laboratory tests on soil samples, it is observed that predominantly the strata is silty with sand (SM/SC/SM-SC/ML-CL i.e. predominantly cohesionless) with the presence of small patches of silty clay of low plasticity (CL). Since the Settlement that takes place in cohesionless strata is mostly immediate, it takes place immediately after the imposing of load, initially during construction with the application of Dead Load and further during Live Load. The live load usually is many times lesser than the dead load, and correspondingly the post construction settlement is very less for live loads. As an example, if dead load is three times that of live load, then the settlement corresponding to live load (i.e. the post construction settlement) will be one-third of the settlement due to dead load which is comparatively lesser than 25mm for permissible settlement of 50mm.

According to the IS 1904, the permissible settlement for concrete structure having raft foundation is allowed upto 75mm, and the permissible settlement is 25mm post construction as per IRS code (Code of Practice for The Design of Sub-Structures and Foundations of Bridges). As discussed above, the settlement post construction is directly proportional to the allowable settlement. Therefore, given the importance of structure to be constructed and considering mostly cohesionless strata encountered at site, it is recommended that the maximum permissible settlement shall be restricted to 50mm for the design purpose on conservative side so that the post construction settlement can be constraint to lesser than 25mm.

As per IS- 8009 part 1 clause 9.2.2.1, If the clay layer is sandwitched between cohesionless soil layers, the immediate settlement is zero. Hence, even though the immediate settlement has been calculated during analysis, however it is ignored in the calculation of total settlement.

The sample calculations for computation of allowable bearing capacity of sub-strata for shallow foundation vide **Appendix – C-2.**

7.2 ANALYSIS OF PILE FOUNDATION

(A) DEEP FOUNDATION

The safe Load Carrying Capacity of normal bored cast in-situ RCC pile is determined in compression, uplift and lateral as per IS: 2911 (Part-1/sec-2) – 2010. The axial capacity of a pile depends upon the soil skin friction along the shaft and end bearing at it's tip.

Thus Axial load = Skin Friction + End-bearing

a) For piles in granular soils (using the static formula)

$$\mathbf{Q_u = (0.5*D*\gamma*N_\gamma + P_D*N_q)*A_p + (\Sigma K_i*P_{Di}*\tan\delta_i)*A_{si}}$$

Where,

Q_u = Ultimate load capacity of pile in KN

D = dia. of pile shaft in m

γ = effective unit weight of the soil at pile tip in kN/m^3

N_γ & N_q = bearing capacity factors depending upon the angle of internal friction Φ at pile tip (N_γ from IS 6403 for general shear failure case & N_q from Fig. 1, IS 2911)

P_D = effective overburden pressure at pile tip in kN/m^2 limited to 15-17 times diameter of pile (as per the Phi value at end bearing)

Σ = Summation for layers (1 to n) in which pile is installed and which contribute to (+ve) skin friction

K_i = coefficient of earth pressure applicable for the ith layer

P_{Di} = effective overburden pressure for the ith layer in kN/m^2 limited to 15-17 times diameter of pile (as per the Phi value at end bearing)

δ_i = angle of wall friction between pile and soil for ith layer, and

A_{si} = surface area of pile shaft in the ith layer in m^2

b) For piles in cohesive soils (using the static formula)

$$Q_u = cp*Nc*A_p + \Sigma\alpha_i*c_i*A_{si}$$

Where,

Q_u = Ultimate load capacity of pile in KN

A_p = cross-sectional area of pile tip in m^2

N_c = bearing capacity factor (= 9)

Σ = Summation for layers (1 to n) in which pile is installed and which contribute to (+ve) skin friction

α_i = adhesion factor for the i^{th} layer depending on the consistency of soil

c_i = average cohesion for i^{th} layer in kN/m^2

A_{si} = surface area for pile shaft in the i^{th} layer in m^2

c) For computation of safe load carrying capacity of pile in lateral, the following equation has been used:

i. **Fixed Head Condition**

$$Q = (12 * E * I * Y) / (L_1 + L_f)^3$$

ii. **Free Head Condition**

$$Q = (3 * E * I * Y) / (L_1 + L_f)^3$$

Where,

Q = Lateral Load (in kg)

Y = Permissible lateral deflection taken as 5mm

E = Modulus of Elasticity of concrete

I = Moment of Inertia of the pile cross-section

L_1 = Length of pile above cut-off level

L_f = Length of fixity

The effective length of the pile has been considered below the cut-off level taken as 2.0m below the EGL. Normal Bored cast in-situ RCC piles having stem diameter equal to 100cm & 120cm and of effective length varying from 20.0m to 30.0m were selected.

For the analysis of the pile foundations the soil parameters used for computation of safe load carrying capacity of pile is tabulated below:-

Table 3.3 : Design Soil Parameter

ChainageOld (km)	ChainageNew (km)	BH.No.	Layer depth below EGL(m)		Thicknessofstrata(m)	Stratadescription	SPT'N'		BulkDensity(gm/cc)	Cohesion(C)(kg/cm^2)	AngleofinternalFriction(Φ)(°)
			From	To			Observed	Corrected			
(-)2+514	(-)1+838	BH-CL	0.00	4.00	4.00	SandySilt	13	17	1.73	0.21	24
			4.00	7.00	3.00	SiltySand	28	28	1.80	0.00	29
			7.00	10.00	3.00	SiltySand	46	28	1.83	0.00	30
(-)1+969	(-)1+291	BH-C	0.00	4.00	4.00	SandySilt	9	14	1.70	0.18	26
			4.00	8.50	4.50	SiltyClay	22	22	1.82	0.75	5
			8.50	10.00	1.50	SandySilt	34	22	1.85	0.21	27
(-)1+500	(-)0+821	BH-A1	0.00	4.00	4.00	SandySilt	10	16	1.71	0.22	23
			4.00	8.50	4.50	SiltySand	26	23	1.77	0.00	29
			8.50	11.50	3.00	SiltySand	48	30	1.82	0.00	30
			11.50	19.00	7.50	SiltyClay	35	35	1.99	1.02	5
			19.00	25.00	6.00	SandySilt	96	43	1.95	0.21	27
			25.00	31.00	6.00	SiltyClay	70	70	2.02	2.01	4
			31.00	35.00	4.00	SiltySand	100	38	-	-	-
		BH-A2	0.00	4.00	4.00	SandySilt	13	17	1.78	0.19	24
			4.00	7.00	3.00	SiltyClay	36	36	1.94	1.23	5
			7.00	10.00	3.00	SiltyClay	43	43	2.00	1.35	5
			10.00	13.00	3.00	SiltyClay	36	36	1.99	1.35	5
			13.00	16.00	3.00	SiltyClay	41	41	2.00	1.35	5
			16.00	19.00	3.00	SiltyClay	50	50	2.00	1.64	4
			19.00	22.00	3.00	SandySilt	100	43	1.96	0.21	28
			22.00	25.00	3.00	SandySilt	100	41	1.96	0.21	28
			25.00	29.50	4.50	SiltyClay	50	50	2.01	1.66	4
			29.50	35.00	5.50	SiltySand	100	38	1.95	0.10	30
(-)1+269	(-)0+592	BH-A1	0.00	4.00	4.00	SandySilt	19	24	1.74	0.14	23
			4.00	7.00	3.00	SandySilt	18	18	1.75	0.15	23
			7.00	8.50	1.50	SandySilt	-	-	1.76	0.15	23
			8.50	13.00	4.50	SiltySand	27	20	1.75	0.00	30
			13.00	16.00	3.00	SandySilt	60	32	1.83	0.16	24
			16.00	19.00	3.00	SandySilt	60	31	1.85	0.16	24
			19.00	22.00	3.00	SandySilt	75	35	1.86	0.16	25
			22.00	25.00	3.00	SandySilt	73	33	1.86	0.16	25
			25.00	30.00	5.00	SandySilt	65	29	1.88	0.16	26
		BH-A2	0.00	5.50	5.50	SandySilt	18	24	1.73	0.13	22
			5.50	7.00	1.50	SandySilt	-	-	1.77	0.14	24
			7.00	11.50	4.50	SiltySand	43	28	1.78	0.00	30
			11.50	14.50	3.00	SandySilt	42	25	1.81	0.16	24
			14.50	17.50	3.00	SandySilt	47	26	1.81	0.16	24

ChainageOld (km)	ChainageNew (km)	BH.No.	Layer depth below EGL(m)		Thicknessofstrata(m)	Stratadescription	SPT'N'		BulkDensity(gm/cc)	Cohesion(C)(kg/cm^2)	AngleofinternalFriction(Φ)(°)
			From	To			Observed	Corrected			
(-)1+269	(-)0+592	BH-A2	17.50	19.00	1.50	SandySilt	-	-	1.81	0.16	24
			19.00	23.50	4.50	SiltySand	69	33	1.84	0.00	31
			23.50	26.50	3.00	SiltySand	72	32	1.86	0.00	31
			26.50	30.00	3.50	SiltySand	77	33	1.87	0.00	32
(-)1+241	(-)0+567	BH-CL	0.00	4.00	4.00	SiltySand	10	16	1.71	0.00	29
			4.00	7.00	3.00	SiltySand	23	26	1.80	0.00	30
			7.00	10.00	3.00	SiltySand	41	28	1.85	0.00	31
(-)0+934	(-)0+248	BH-CL	0.00	4.00	4.00	SiltySand	16	21	1.73	0.00	29
			4.00	7.00	3.00	SiltySand	39	39	1.82	0.00	31
			7.00	10.00	3.00	SiltySand	41	26	1.78	0.00	30

Design parameter have been obtain from the laboratory test results however various depth where the shear parameter seems on the lower side with respect to SPT ‘N’ values those shear parameter have been judicially improved based on the SPT ‘N’ for the analysis purpose.

The sample calculation for computation of safe load carrying capacity of normal bored cast-in-situ RCC pile in compression & uplift are attached vide **Appendix C-3.**

The sample calculation for computation of safe load carrying capacity of normal bored cast-in-situ RCC pile in lateral are attached vide **Appendix C-4.**

CHAPTER 4 FOUNDATION RECOMMENDATIONS

8.0 FOUNDATION RECOMMENDATIONS

- Based on the nature & strength characteristics of the substrata and requirement of the project, shallow foundation and normal bored cast in-situ RCC pile foundation have been analyzed.
- Based on the method of analysis & design parameters given under Para 7.1 above, the recommended net allowable bearing capacity values are given in Table 4.1 to 4.2.

Table 4.1: Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 25mm

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)
(-)2+514	(-)1+838	BH-CL	8.0 x 8.0	1.0	26.6	16.4	16.4
			8.0 x 8.0	2.0	31.4	16.4	16.4
			8.0 x 8.0	3.0	36.4	16.5	16.5
(-)1+969	(-)1+291	BH-CL	4.8 x 4.8	1.0	17.2	11.7	11.7
			4.8 x 4.8	2.0	21.2	13.9	13.9
			4.8 x 4.8	3.0	25.3	17.0	17.0
(-)1+500	(-)0+821	BH-A1	7.2 x 7.2	2.0	21.0	10.2	10.2
			7.2 x 7.2	3.0	23.3	10.8	10.8
			7.2 x 7.2	4.0	25.4	11.6	11.6
		BH-A2	7.2 x 7.2	2.0	35.6	12.9	12.9
			7.2 x 7.2	3.0	36.8	17.3	17.3
			7.2 x 7.2	4.0	38.0	26.2	26.2
(-)1+269	(-)0+592	BH-A1	7.2 x 7.2	2.0	21.7	14.9	14.9
			7.2 x 7.2	3.0	25.8	26.3	25.8
			7.2 x 7.2	4.0	28.3	27.8	27.8
		BH-A2	7.2 x 7.2	2.0	24.5	15.1	15.1
			7.2 x 7.2	3.0	29.2	26.3	26.3
			7.2 x 7.2	4.0	32.0	27.8	27.8
(-)1+241	(-)0+567	BH-CL	2.7 x 2.7	1.0	14.9	15.1	14.9
			2.7 x 2.7	2.0	22.6	18.7	18.7
			2.7 x 2.7	3.0	30.7	21.7	21.7
(-)0+934	(-)0+248	BH-CL	4.8 x 4.8	1.0	23.3	19.2	19.2
			4.8 x 4.8	2.0	31.7	20.7	20.7
			4.8 x 4.8	3.0	40.6	20.7	20.7

* The maximum value of recommended net allowable bearing capacity shall be restricted to 30 t/m^2.

Table 4.2: Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 50mm

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)
(-)2+514	(-)1+838	BH-CL	8.0 x 8.0	1.0	26.6	32.8	26.6
			8.0 x 8.0	2.0	31.4	32.8	31.4
			8.0 x 8.0	3.0	36.4	33.0	33.0
(-)1+969	(-)1+291	BH-CL	4.8 x 4.8	1.0	17.2	23.4	17.2
			4.8 x 4.8	2.0	21.2	27.9	21.2
			4.8 x 4.8	3.0	25.3	33.9	25.3
(-)1+500	(-)0+821	BH-A1	7.2 x 7.2	2.0	21.0	20.4	20.4
			7.2 x 7.2	3.0	23.3	21.5	21.5
			7.2 x 7.2	4.0	25.4	23.1	23.1
		BH-A2	7.2 x 7.2	2.0	35.6	25.8	25.8
			7.2 x 7.2	3.0	36.8	34.7	34.7
			7.2 x 7.2	4.0	38.0	52.3	38.0
(-)1+269	(-)0+592	BH-A1	7.2 x 7.2	2.0	21.7	29.7	21.7
			7.2 x 7.2	3.0	25.8	52.6	25.8
			7.2 x 7.2	4.0	28.3	55.5	28.3
		BH-A2	7.2 x 7.2	2.0	24.5	30.1	24.5
			7.2 x 7.2	3.0	29.2	52.6	29.2
			7.2 x 7.2	4.0	32.0	55.5	32.0
(-)1+241	(-)0+567	BH-CL	2.7 x 2.7	1.0	14.9	30.2	14.9
			2.7 x 2.7	2.0	22.6	37.4	22.6
			2.7 x 2.7	3.0	30.7	43.4	30.7
(-)0+934	(-)0+248	BH-CL	4.8 x 4.8	1.0	23.3	38.4	23.3
			4.8 x 4.8	2.0	31.7	41.4	31.7
			4.8 x 4.8	3.0	40.6	41.4	40.6

* The maximum value of recommended net allowable bearing capacity shall be restricted to 30 t/m^2.

- Based on the method of analysis given under Para 7.2 above, The values of Safe Load Carrying Capacity of piles in compression, uplift and lateral under static conditions have been tabulated below:-

Table 4.5: Safe Load Carrying Capacity of normal bored cast in-situ RCC Pile in Soil

Chainage Old (km)	Chainage New (km)	BH. No.	Diameter of Pile (m)	Length of piles below cut-off (m)	Cut-off level below EGL (m)	Safe load carrying capacity of single pile (T) In compression	In uplift	In Lateral Fixed Head
(-)1+500	(-)0+821	BH-A1	1.0	20.0	2.0	222.0	162.0	18.0
(-)1+500	(-)0+821	BH-A1	1.0	22.0	2.0	226.0	185.0	18.0
(-)1+500	(-)0+821	BH-A1	1.0	24.0	2.0	245.0	205.0	18.0
(-)1+500	(-)0+821	BH-A1	1.0	26.0	2.0	259.0	220.0	18.0
(-)1+500	(-)0+821	BH-A1	1.0	28.0	2.0	274.0	237.0	18.0
(-)1+500	(-)0+821	BH-A1	1.0	30.0	2.0	312.0	256.0	18.0
(-)1+500	(-)0+821	BH-A1	1.2	20.0	2.0	267.0	210.0	25.0
(-)1+500	(-)0+821	BH-A1	1.2	22.0	2.0	300.0	243.0	25.0
(-)1+500	(-)0+821	BH-A1	1.2	24.0	2.0	325.0	270.0	25.0
(-)1+500	(-)0+821	BH-A1	1.2	26.0	2.0	342.0	290.0	25.0
(-)1+500	(-)0+821	BH-A1	1.2	28.0	2.0	361.0	311.0	25.0
(-)1+500	(-)0+821	BH-A1	1.2	30.0	2.0	412.0	336.0	25.0
(-)1+500	(-)0+821	BH-A2	1.0	20.0	2.0	210.0	169.0	25.0
(-)1+500	(-)0+821	BH-A2	1.0	22.0	2.0	237.0	196.0	25.0
(-)1+500	(-)0+821	BH-A2	1.0	24.0	2.0	258.0	217.0	25.0
(-)1+500	(-)0+821	BH-A2	1.0	26.0	2.0	272.0	233.0	25.0
(-)1+500	(-)0+821	BH-A2	1.0	28.0	2.0	289.0	251.0	25.0
(-)1+500	(-)0+821	BH-A2	1.0	30.0	2.0	392.0	277.0	25.0
(-)1+500	(-)0+821	BH-A2	1.2	20.0	2.0	275.0	219.0	33.0
(-)1+500	(-)0+821	BH-A2	1.2	22.0	2.0	313.0	256.0	33.0
(-)1+500	(-)0+821	BH-A2	1.2	24.0	2.0	341.0	285.0	33.0
(-)1+500	(-)0+821	BH-A2	1.2	26.0	2.0	358.0	305.0	33.0
(-)1+500	(-)0+821	BH-A2	1.2	28.0	2.0	381.0	330.0	33.0
(-)1+500	(-)0+821	BH-A2	1.2	30.0	2.0	561.0	367.0	33.0
(-)1+269	(-)0+592	BH-A1	1.0	20.0	2.0	227.0	179.0	18.0
(-)1+269	(-)0+592	BH-A1	1.0	22.0	2.0	249.0	201.0	18.0
(-)1+269	(-)0+592	BH-A1	1.0	24.0	2.0	270.0	223.0	18.0
(-)1+269	(-)0+592	BH-A1	1.0	26.0	2.0	292.0	245.0	18.0
(-)1+269	(-)0+592	BH-A1	1.0	28.0	2.0	314.0	267.0	18.0
(-)1+269	(-)0+592	BH-A1	1.0	30.0	2.0	335.0	289.0	18.0
(-)1+269	(-)0+592	BH-A1	1.2	20.0	2.0	310.0	233.0	25.0
(-)1+269	(-)0+592	BH-A1	1.2	22.0	2.0	340.0	264.0	25.0
(-)1+269	(-)0+592	BH-A1	1.2	24.0	2.0	370.0	294.0	25.0
(-)1+269	(-)0+592	BH-A1	1.2	26.0	2.0	400.0	325.0	25.0
(-)1+269	(-)0+592	BH-A1	1.2	28.0	2.0	429.0	355.0	25.0
(-)1+269	(-)0+592	BH-A1	1.2	30.0	2.0	459.0	385.0	25.0

Chainage Old (km)	Chainage New (km)	BH. No.	Diameter of Pile (m)	Length of piles below cut-off (m)	Cut-off level below EGL (m)	Safe load carrying capacity of single pile (T)		
						In compression	In uplift	In Lateral Fixed Head
(-)1+269	(-)0+592	BH-A2	1.0	20.0	2.0	307.0	180.0	21.0
				22.0		330.0	203.0	
				24.0		353.0	226.0	
				26.0		376.0	249.0	
				28.0		399.0	272.0	
				30.0		422.0	295.0	
			1.2	20.0		447.0	235.0	28.0
				22.0		479.0	267.0	
				24.0		511.0	299.0	
				26.0		543.0	332.0	
				28.0		575.0	364.0	
				30.0		607.0	396.0	

Notes : -

1. Permissible lateral deflection has been taken as 5 mm.
2. The self weight of the pile has been taken into account while computing the Safe Load Carrying Capacity of Pile in uplift only and not considered for vertical load capacity in compression.
3. The safe load carrying capacity of piles have been worked out on the basis of IS: 2911 (Part-1/sec-2) – 2010 as per provisions / assumptions provided therein & are only an assessment based on characteristics of the sub-strata obtained at the locations of the above BHs. The safe load carrying capacities as tabulated above will further depend substantially on the piling technique adopted and equipment used for making the piles in the field. However, for the final designs & constructions, the safe/allowable load carrying capacities of these piles should be taken by conducting actual initial load tests on these piles by casting them in the respective areas.
4. While erecting normal bored cast in-situ pile, utmost care should be taken while flushing/cleaning the bottom of pile particularly prior to start of pouring of concrete so as o rest the pile in virgin soil only for obtaining full point bearing as while computing safe load carrying capacity of pile no bottom softening during erection of pile has been considered.
5. Further the pile should have necessary structural strength to transmit / sustain the design load.

All The above recommendations are based on the field and laboratory tests conducted on selected soil/ rock core samples and our experience in this regard. If the actual substrata conditions during excavation for the foundation differ from the observations reported here, the design experts/consultants should be referred for suggestion, further investigations.

REFERENCES

1. IS 2911: Part 1 : Sec 2 : 2010 (Reaffirmed Year : 2020) Design And construction Of pile foundations - Code Of Practice Part 1 Concrete Piles Section 2 Bored Cast In-situ Concrete Piles.
2. IS 2911 : Part 4 : 2013 (Reaffirmed Year : 2018) Design and construction of pile foundations - Code of practice : Part 4 Load test on piles .
3. IS 6403 : 1981 (Reaffirmed Year : 2016), Amd. 2 : 2018 Code of practice for determination of bearing capacity of shallow foundations.
4. IS 8009 : Part 1 : 1976 (Reaffirmed Year : 2018) Code of practice for calculation of settlements of foundations: Part 1 Shallow foundations subjected to symmetrical static vertical loads.
5. IS 8009 : Part 2 : 1980 (Reaffirmed Year : 2020) Code of practice for calculation of settlement of foundations: Part 2 Deep foundations subjected to symmetrical static vertical loading.
6. IS 1893 : Part 1 : 2016 (Reaffirmed Year : 2021) Criteria for Earthquake Resistant Design of Structures - Part 1 : General Provisions and Buildings.
7. IS 1904 : 2021 Draft Indian Standard for General requirements for design and construction of foundations in soils Code of practice third revision of IS 1904.
8. IS 456 : 2000 (Reaffirmed Year : 2021) Plain and Reinforced Concrete - Code of Practice (Including Amendment 1, 2, 3,& 4).
9. BS – 118 : 2015 Final Seismic Design of Bridges.
10. IS 2131 : 1981 (Reaffirmed Year : 2016) Method for standard penetration test for soils.
11. IS 2132 : 1986 (Reaffirmed Year : 2016) Code of practice for thin-walled tube sampling of soils.
12. IS 1892 : 1979 (Reaffirmed Year : 2016) Code of practice for subsurface investigation for foundations.
13. Bowles, J.E., 1982. Foundation design and analysis.
14. IS. 2720 (Part 3)-1980. Determination of Specific Gravity of Soil.
15. IS. 2720 (Part 4). 1985. Methods of Test for Soils: Grain Size Analysis.
16. IS. IS 2131, 1981. Method for standard penetration test for soils.
17. IS: 2720 (Part 11)–(1993). Determination of the shear strength parameters of a specimen tested in unconsolidated undrained triaxial compression without the measurement of pore water pressure.
18. IS: 2720 (Part 13) 1986 Method of test for soils, direct shear test. New Delhi, India.
19. IS: 2720 (Part 3/See 1)–(1980) Methods of test for soils, determination of specific gravity of soil. New Delhi, India.
20. IS: 2720 (Part 5) 1985 Methods of test for soils, determination of liquid and plastic limit of soils. New Delhi, India.

Abbreviations

BH	Borehole
ERT	Electrical Resistivity Test
EGL	Existing Ground Level
GWT	Ground Water Table
IS	Indian Standards
SPT	Standard Penetration Test
DS	Disturbed Soil
R.L.	Reduced Level
m	Metre
sp. gr.	Specific Gravity
%	Percentage
mg /l	Milligram per litre
mg /kg	Milligram per kilogram

APPENDIX – A (FIELD DATA RESULTS)

Appendix No.	ITEMS
A-1	LOCATION PLAN
A-2	FIELD BORE HOLE LOGS
A-3	SUB SOIL PROFILE DIAGRAM

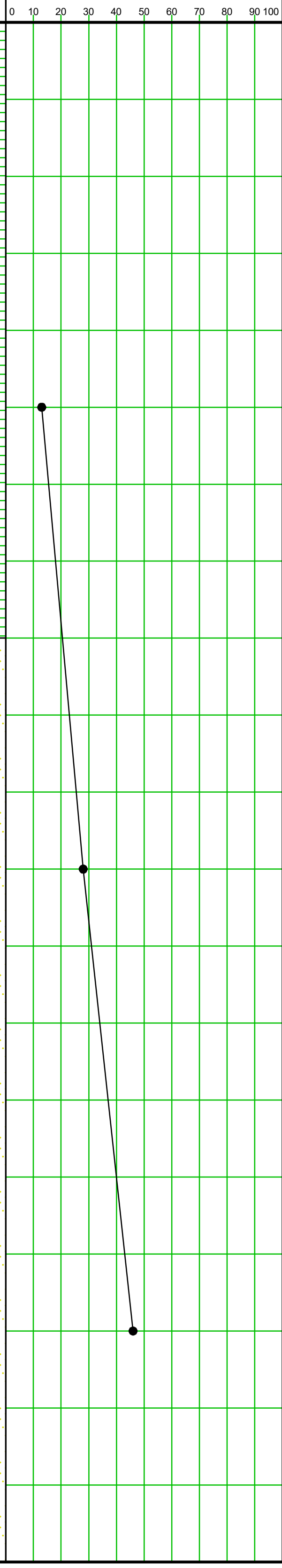

GHS Chhaprola
SLD College
BIRENDER GENERAL STORE
CH-(-)1+969_BH-CL
CH-(-)1+500_BH-A2
CH-(-)1+500_BH-A1
CH-(-)1+241_BH-CL
CH-(-)1+269_BH-A1
CH-(-)0+934_BH-CL
CH-(-)1+269_BH-A2
BHARDWAJ GENERAL STORE
CH-(-)2+514_BH-CL
Google Earth
N

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
BH Location/Chainage :(-)2+514 km	*Northing :*3126414.281 m	*Easting :*722701.988 m
Reduced Level (m):(+)195.721	*BH. No. :*BH-CL	*BH Termination Depth (m):*10
*Proposed / Existing Structure :*Minor Bridge	*Water Table (m):*7.15	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*12-10-2021	*Date of Completion :*12-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS								
0.5										
1.0	1	UDS-1								
1.5										
2.0							Brown, Medium dense, Sandy silt of low plasticity	ML-CL		
2.5	2.5	SPT-1	3	5	8	13				
3.0										
3.5										
4.0	4	UDS-2								
4.5										
5.0										
5.5	5.5	SPT-2	7	10	18	28				
6.0										
6.5										
7.0	7	UDS-3					Brown, Medium dense to dense, Silty sand with gravel	SM	7.15m	
7.5										
8.0										
8.5	8.5	SPT-3	7	19	27	46				
9.0										
9.5										
10.0	10	UDS-4								

(Depth v/s SPT N Value)

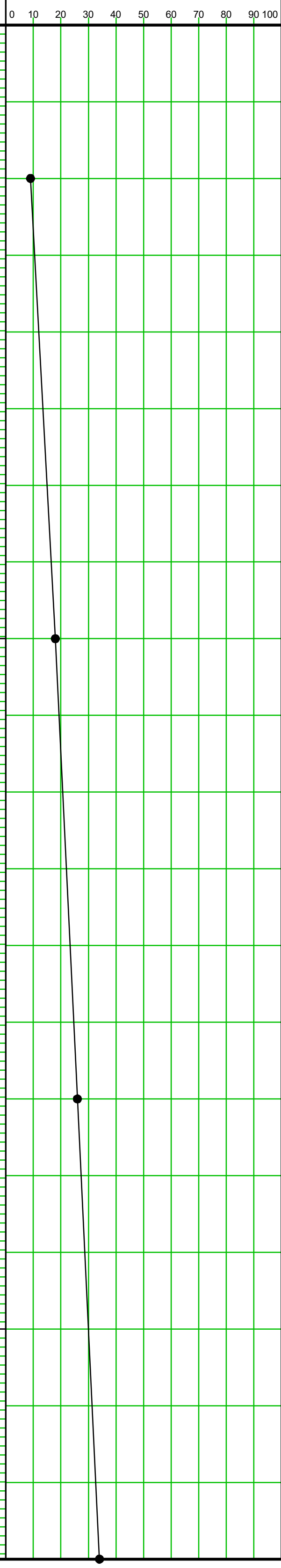


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
BH Location/Chainage :(-)1+969 km	*Northing :*3126541.073 m	*Easting :*722173.198 m
Reduced Level (m):(+)195.326	*BH. No. :*BH-CL	*BH Termination Depth (m):*10
*Proposed / Existing Structure :*Minor Bridge	*Water Table (m):*7.50	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*12-10-2021	*Date of Completion :*12-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Loose, Sandy silt of low plasticity (0.0–4.0)	ML-CL			
0.5											
1.0	1	SPT-1	3	4	5	9					
1.5											
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	5	8	10	18	Brown, Very stiff, Silty clay of low plasticity (4.0–8.75)	CL			
4.5											
5.0											
5.5	5.5	UDS-2									
6.0											
6.5											
7.0	7	SPT-3	10	12	14	26					
7.5									7.50m		
8.0											
8.5	8.5	UDS-3									
9.0							Brown, Dense, Sandy silt of low plasticity (8.75–10.0)	ML-CL			
9.5											
10.0	10	SPT-4	11	14	20	34					

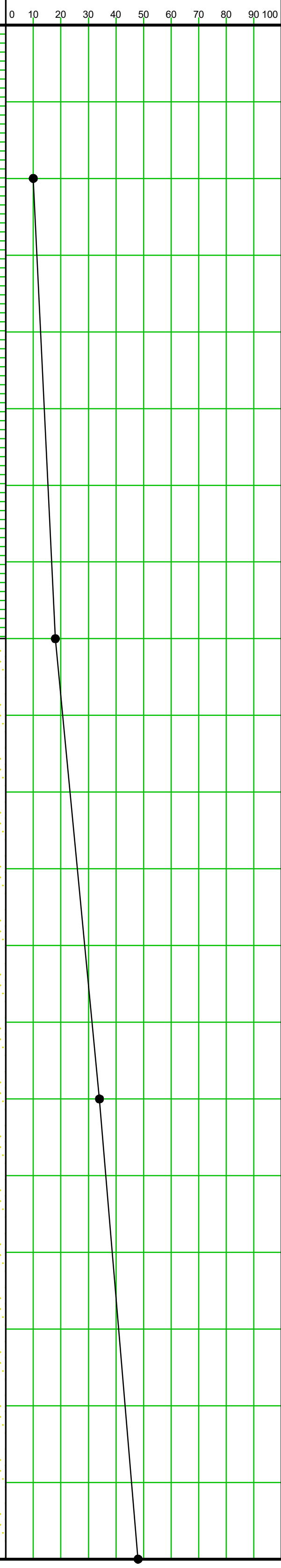


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :(-)1+500 km	*Northing* :3126432.416 m	*Easting* :721737.91 m
Reduced Level (m):(+)195.309	*BH. No.* :BH-A1	*BH Termination Depth (m)*:35
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:5.10	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :11-10-2021	*Date of Completion* :12-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Yellowish brown, Medium dense, Sandy silt of low plasticity	ML-CL			
0.5											
1.0	1	SPT-1	3	4	6	10					
1.5											
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	7	8	10	18	Yellowish brown, Medium dense to dense, Silty sand	SM			
4.5											
5.0									5.10m		
5.5	5.5	UDS-2									
6.0											
6.5											
7.0	7	SPT-3	12	15	19	34					
7.5											
8.0											
8.5	8.5	UDS-3									
9.0											
9.5											
10.0	10	SPT-4	14	21	27	48					

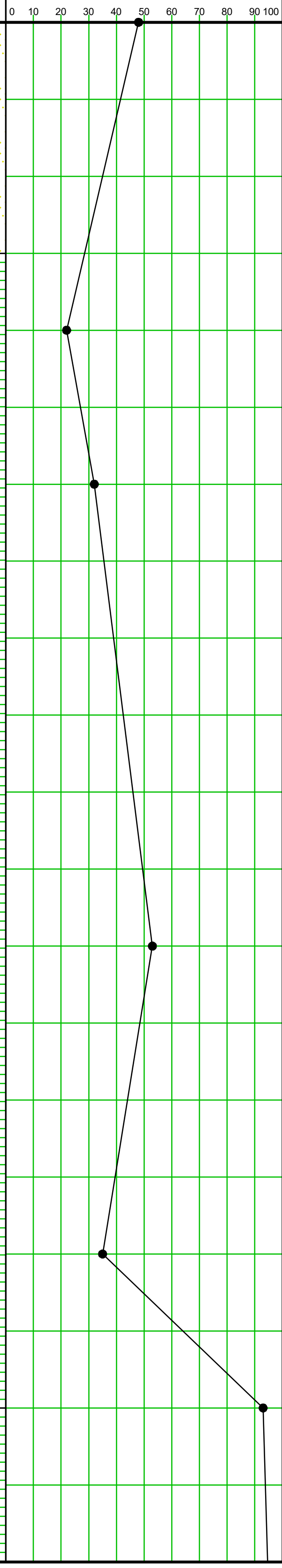


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :(-)1+500 km	*Northing* :3126432.416 m	*Easting* :721737.91 m
Reduced Level (m):(+)195.309	*BH. No.* :BH-A1	*BH Termination Depth (m)*:35
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:5.10	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :11-10-2021	*Date of Completion* :12-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5							Yellowish brown, Medium dense to dense, Silty sand	SM			
11.0											
11.5	11.5	UDS*									
12.0	12	SPT-5	7	9	13	22					
12.5											
13.0	13	SPT-6	9	12	20	32					
13.5											
14.0											
14.5	14.5	UDS-4									
15.0							Yellowish brown, Very stiff to hard, Silty clay of low plasticity with gravel	CL			
15.5											
16.0	16	SPT-7	14	23	30	53					
16.5											
17.0											
17.5	17.5	UDS*									
18.0	18	SPT-8	9	12	23	35					
18.5											
19.0	19	SPT-9	22	38	55	93					
19.5							Yellowish brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
20.0											

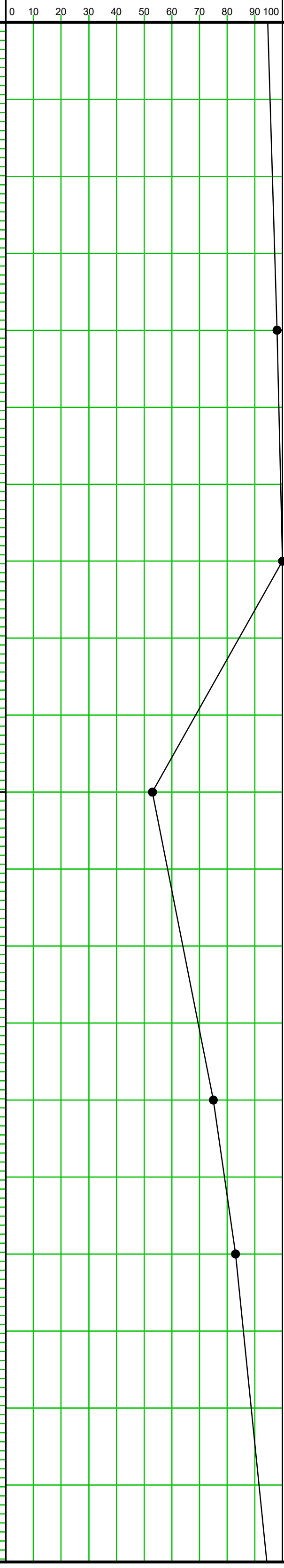


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :(-)1+500 km	*Northing* :3126432.416 m	*Easting* :721737.91 m
Reduced Level (m):(+)195.309	*BH. No.* :BH-A1	*BH Termination Depth (m)*:35
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:5.10	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :11-10-2021	*Date of Completion* :12-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	UDS*									
21.0											
21.5											
22.0	22	SPT-10	25	40	58	98					
22.5							Yellowish brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
23.0											
23.5	23.5	SPT-11	32	54	44 (5cm)	>100					
24.0											
24.5											
25.0	25	SPT-12	15	23	30	53					
25.5											
26.0											
26.5	26.5	UDS*									
27.0	27	SPT-13	20	30	45	75					
27.5							Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL			
28.0	28	SPT-14	24	33	50	83					
28.5											
29.0											
29.5	29.5	UDS-5									
30.0											

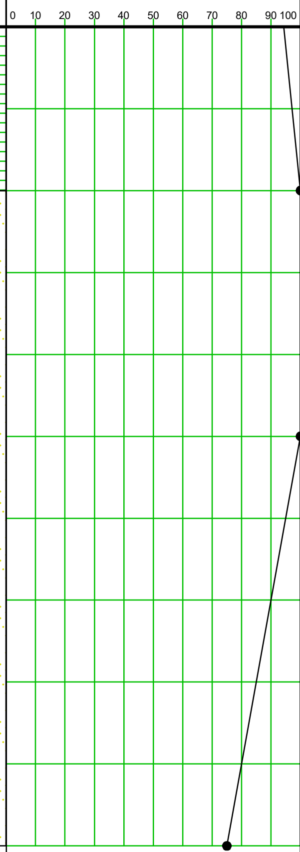


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :(-)1+500 km	*Northing* :3126432.416 m	*Easting* :721737.91 m
Reduced Level (m):(+)195.309	*BH. No.* :BH-A1	*BH Termination Depth (m)*:35
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:5.10	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :11-10-2021	*Date of Completion* :12-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0											
30.5							Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL			
31.0	31	SPT-15	33	70	30 (8cm)	>100					
31.5											
32.0											
32.5	32.5	SPT-16	52	100 (10cm)	-	>100					
33.0							Yellowish brown, Very dense, Silty sand with gravel	SM			
33.5											
34.0											
34.5											
35.0	35	SPT-17	62	100 (13cm)	-	75					

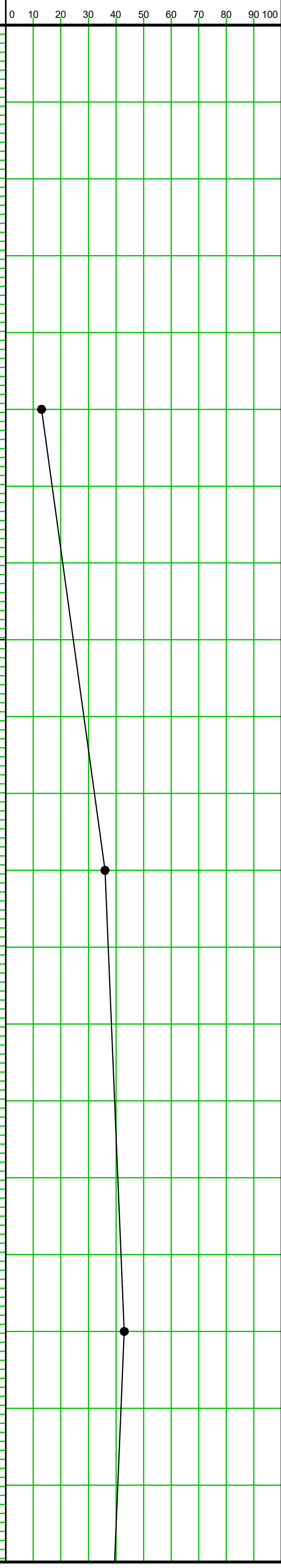


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
BH Location/Chainage :(-)1+500 km	*Northing :*3126418.378 m	*Easting :*721703.826 m
Reduced Level (m):(+)195.429	*BH. No. :*BH-A2	*BH Termination Depth (m):*35
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*5.20	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*11-10-2021	*Date of Completion :*12-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5											
1.0	1	UDS-1									
1.5											
2.0							Yellowish brown, Medium dense, Sandy silt of low plasticity	ML-CL			
2.5	2.5	SPT-1	5	5	8	13					
3.0											
3.5											
4.0	4	UDS-2									
4.5											
5.0									5.20m		
5.5	5.5	SPT-2	9	15	21	36					
6.0											
6.5											
7.0	7	UDS-3					Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL			
7.5											
8.0											
8.5	8.5	SPT-3	10	19	24	43					
9.0											
9.5											
10.0	10	UDS-4									

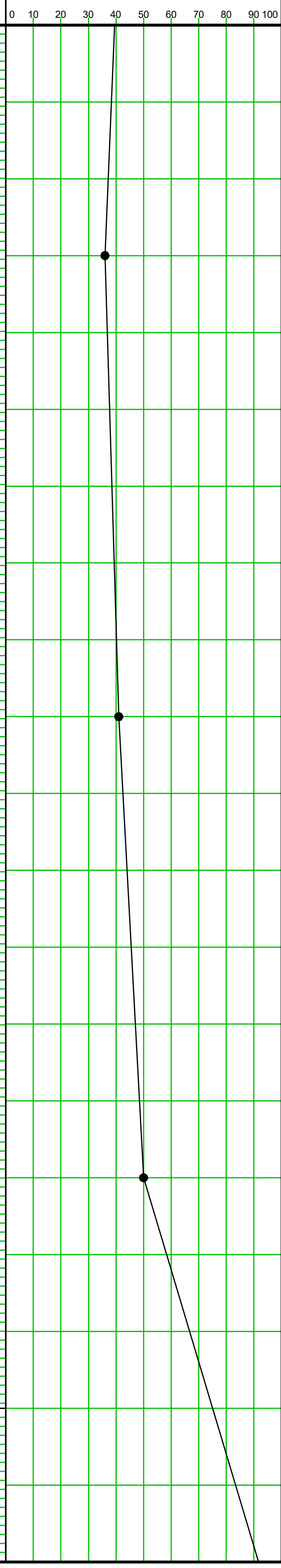


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
BH Location/Chainage :(-)1+500 km	*Northing :*3126418.378 m	*Easting :*721703.826 m
Reduced Level (m):(+)195.429	*BH. No. :*BH-A2	*BH Termination Depth (m):*35
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*5.20	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*11-10-2021	*Date of Completion :*12-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-4	9	14	22	36					
12.0											
12.5											
13.0	13	UDS-5									
13.5											
14.0											
14.5	14.5	SPT-5	13	17	24	41	Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL			
15.0											
15.5											
16.0	16	UDS-6									
16.5											
17.0											
17.5	17.5	SPT-6	14	22	28	50					
18.0											
18.5											
19.0	19	UDS-7									
19.5							Yellowish brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
20.0											

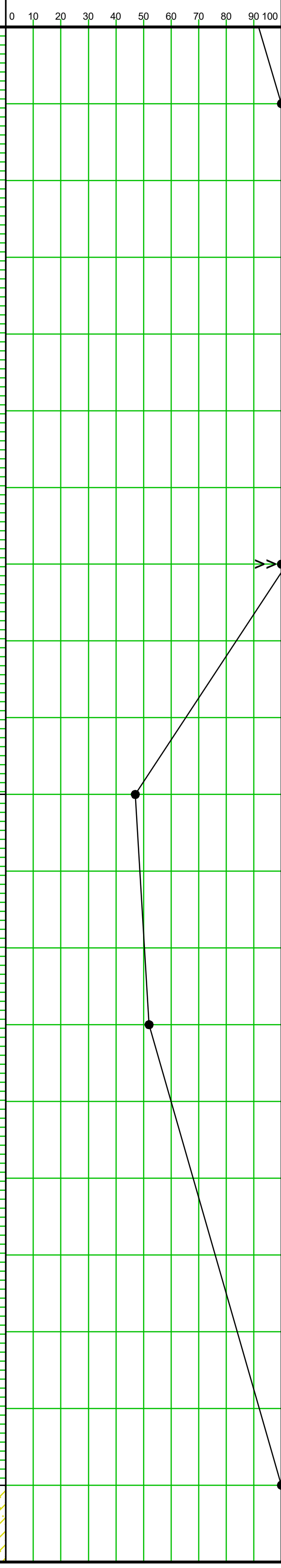


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :(-)1+500 km	*Northing* :3126418.378 m	*Easting* :721703.826 m
Reduced Level (m):(+)195.429	*BH. No.* :BH-A2	*BH Termination Depth (m)*:35
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:5.20	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :11-10-2021	*Date of Completion* :12-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-7	32	62	48 (8cm)	>100	Yellowish brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
21.0											
21.5											
22.0	22	UDS-8									
22.5											
23.0											
23.5	23.5	SPT-8	22	34	68	102					
24.0											
24.5											
25.0	25	SPT-9	12	19	28	47	Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL			
25.5											
26.0											
26.5	26.5	SPT-10	12	22	30	52					
27.0											
27.5											
28.0	28	UDS-9									
28.5											
29.0											
29.5	29.5	SPT-11	32	69	31 (5cm)	>100	Yellowish brown, Very dense, Silty sand with clay & gravel	SM-SC			
30.0											

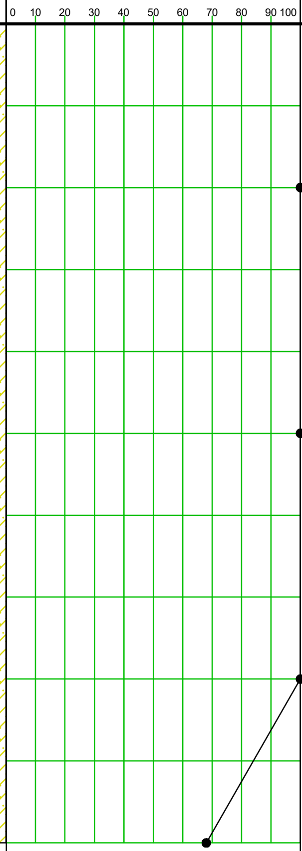


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
BH Location/Chainage :(-)1+500 km	*Northing :*3126418.378 m	*Easting :*721703.826 m
Reduced Level (m):(+)195.429	*BH. No. :*BH-A2	*BH Termination Depth (m):*35
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*5.20	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*11-10-2021	*Date of Completion :*12-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0											
30.5											
31.0	31	SPT-12	35	72	28 (3cm)	>100					
31.5											
32.0											
32.5	32.5	SPT-13	55	100 (5cm)	-	>100	Yellowish brown, Very dense, Silty sand with clay & gravel	SM-SC			
33.0											
33.5											
34.0	34	SPT-14	60	100 (10cm)	-	>100					
34.5											
35.0	35	SPT-15	19	28	40	68					



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :(-)1+269 km	*Northing* :3126336.13 m	*Easting* :721528.877 m
Reduced Level (m):(+)194.566	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:6.10	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :10-10-2021	*Date of Completion* :13-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Medium dense, Sandy silt of low plasticity (0.0–8.5)	ML-CL			
0.5											
1.0	1	UDS-1									
1.5											
2.0											
2.5	2.5	SPT-1	5	9	10	19					
3.0											
3.5											
4.0	4	UDS-2									
4.5											
5.0											
5.5	5.5	SPT-2	7	8	10	18					
6.0									6.10m		
6.5											
7.0	7	UDS-3									
7.5											
8.0											
8.5	8.5	SPT-3	8	10	14	24	Brown, Medium dense to dense, Silty sand with gravel (8.5–10.0)	SM			
9.0											
9.5											
10.0	10	UDS-4									

Chart axis (SPT N Value): 0 10 20 30 40 50 60 70 80 90 100

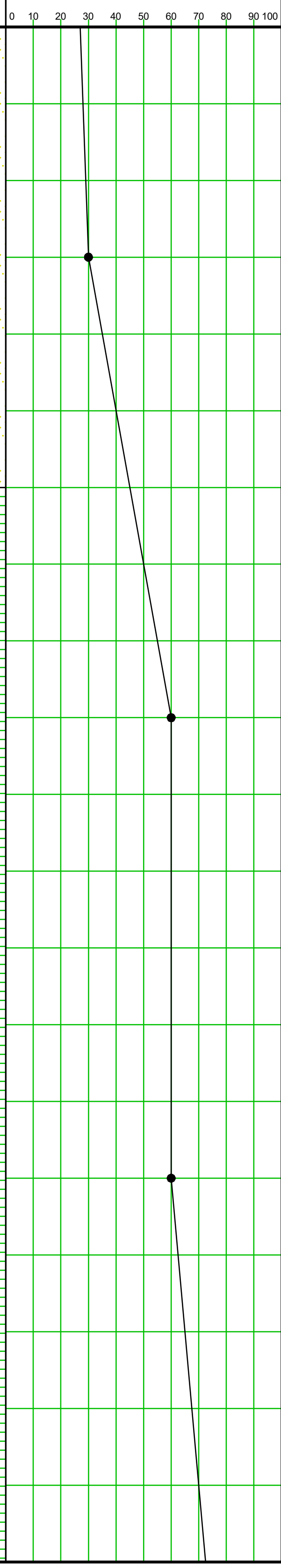
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :(-)1+269 km	*Northing* :3126336.13 m	*Easting* :721528.877 m
Reduced Level (m):(+)194.566	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:6.10	*Inclination :* Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :10-10-2021	*Date of Completion* :13-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
10.0							Brown, Medium dense to dense, Silty sand with gravel	SM		
10.5										
11.0										
11.5	11.5	SPT-4	10	12	18	30				
12.0										
12.5										
13.0	13	UDS-5					Brown, Very dense, Sandy silt of low plasticity	ML-CL		
13.5										
14.0										
14.5	14.5	SPT-5	17	25	35	60				
15.0										
15.5										
16.0	16	UDS-6								
16.5										
17.0										
17.5	17.5	SPT-6	16	26	34	60				
18.0										
18.5										
19.0	19	UDS-7								
19.5										
20.0										

(Depth v/s SPT N Value)

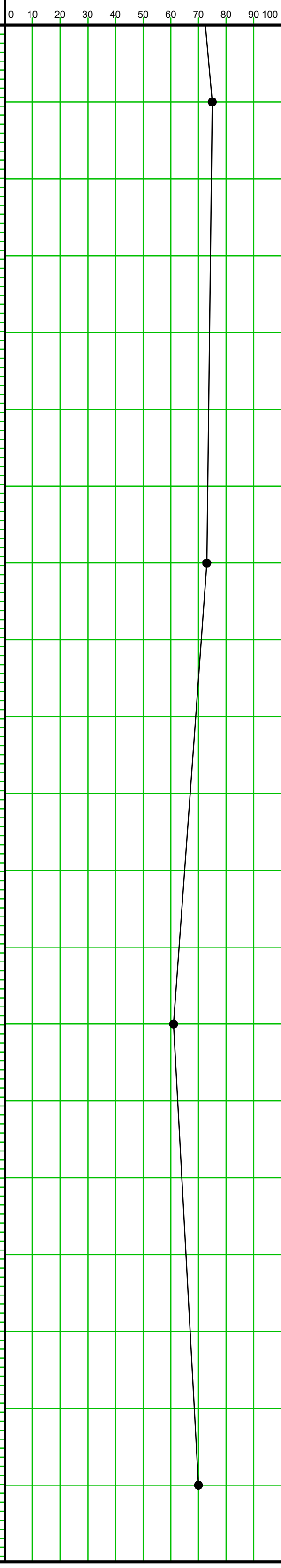


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
BH Location/Chainage :(-)1+269 km	*Northing :*3126336.13 m	*Easting :*721528.877 m
Reduced Level (m):(+)194.566	*BH. No. :*BH-A1	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*6.10	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*10-10-2021	*Date of Completion :*13-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-7	30	36	39	75					
21.0											
21.5											
22.0	22	UDS-8									
22.5											
23.0											
23.5	23.5	SPT-8	17	30	43	73					
24.0											
24.5											
25.0	25	UDS-9					Brown, Very dense, Sandy silt of low plasticity	ML-CL			
25.5											
26.0											
26.5	26.5	SPT-9	24	27	34	61					
27.0											
27.5											
28.0	28	UDS*									
28.5											
29.0											
29.5	29.5	SPT-10	28	30	40	70					
30.0	30	-									

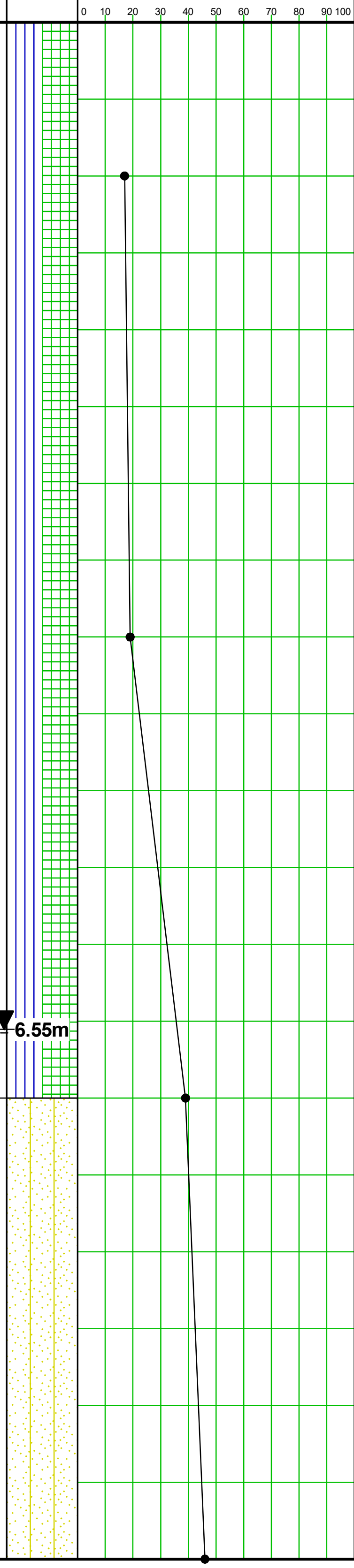


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :(-)1+269 km	*Northing* :3126327.463 m	*Easting* :721508.138 m
Reduced Level (m):(+)195.172	*BH. No.* :BH-A2	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:6.55	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :10-10-2021	*Date of Completion* :13-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5											
1.0	1	SPT-1	6	7	10	17					
1.5											
2.0											
2.5	2.5	UDS-1									
3.0											
3.5							Brown, Medium dense, Sandy silt of low plasticity	ML-CL			
4.0	4	SPT-2	5	7	12	19					
4.5											
5.0											
5.5	5.5	UDS-2									
6.0											
6.5									6.55m		
7.0	7	SPT-3	12	17	22	39					
7.5											
8.0											
8.5	8.5	UDS-3					Brown, Medium dense to dense, Silty sand with gravel	SM			
9.0											
9.5											
10.0	10	SPT-4	12	19	27	46					



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :(-)1+269 km	*Northing* :3126327.463 m	*Easting* :721508.138 m
Reduced Level (m):(+)195.172	*BH. No.* :BH-A2	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:6.55	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :10-10-2021	*Date of Completion* :13-10-2021	

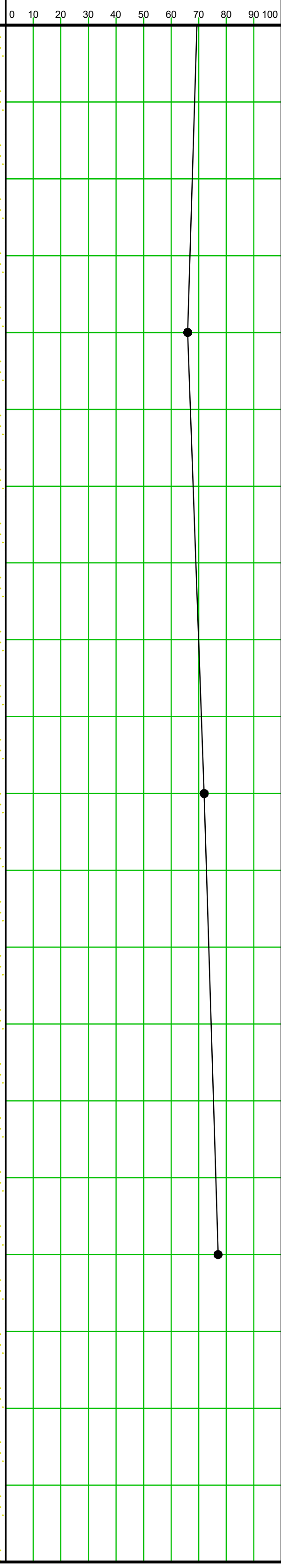
Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5							Brown, Medium dense to dense, Silty sand with gravel	SM			
11.0											
11.5	11.5	UDS-4									
12.0											
12.5											
13.0	13	SPT-5	11	17	25	42					
13.5											
14.0											
14.5	14.5	UDS-5									
15.0											
15.5							Brown, Medium dense, Sandy silt of low plasticity	ML-CL			
16.0	16	SPT-6	11	19	28	47					
16.5											
17.0											
17.5	17.5	UDS-6									
18.0											
18.5											
19.0	19	SPT-7	19	29	42	71					
19.5							Brown, Medium dense to dense, Silty sand with gravel	SM			
20.0											

UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
BH Location/Chainage :(-)1+269 km	*Northing :*3126327.463 m	*Easting :*721508.138 m
Reduced Level (m):(+)195.172	*BH. No. :*BH-A2	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*6.55	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*10-10-2021	*Date of Completion :*13-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	UDS-7									
21.0											
21.5											
22.0	22	SPT-8	21	27	39	66					
22.5											
23.0											
23.5	23.5	UDS-8									
24.0											
24.5											
25.0	25	SPT-9	24	31	41	72	Brown, Medium dense to dense, Silty sand with gravel	SM			
25.5											
26.0											
26.5	26.5	UDS-9									
27.0											
27.5											
28.0	28	SPT-10	16	32	45	77					
28.5											
29.0											
29.5	29.5	UDS*									
30.0	30	-									

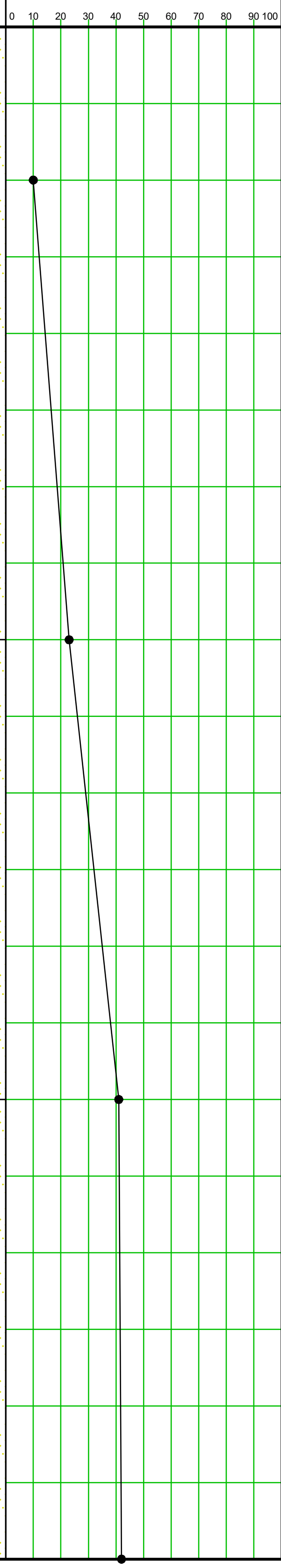


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
BH Location/Chainage :(-)1+241 km	*Northing :*3126321.741 m	*Easting :*721494.114 m
Reduced Level (m):(+)194.789	*BH. No. :*BH-CL	*BH Termination Depth (m):*10
*Proposed / Existing Structure :*Minor Bridge	*Water Table (m):*6.50	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*14-10-2021	*Date of Completion :*14-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Loose, Silty sand	SM			
0.5											
1.0	1	SPT-1	2	4	6	10					
1.5											
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	7	9	14	23	Brown, Medium dense, Silty sand	SM			
4.5											
5.0											
5.5	5.5	UDS-2									
6.0											
6.5									6.50m		
7.0	7	SPT-3	11	17	24	41	Brown, Dense, Silty sand with gravel	SM			
7.5											
8.0											
8.5	8.5	UDS-3									
9.0											
9.5											
10.0	10	SPT-4	9	16	26	42					

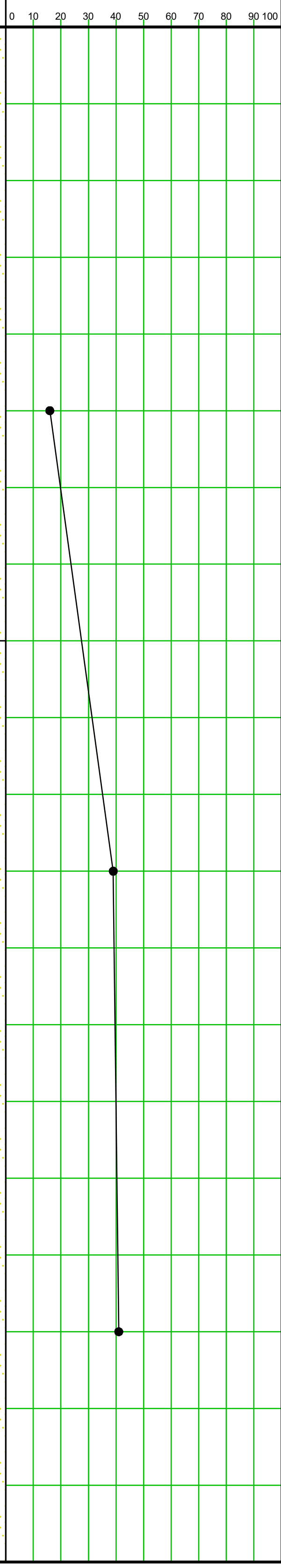


UDS*-UDS not recovered

FIELD BOREHOLE LOG

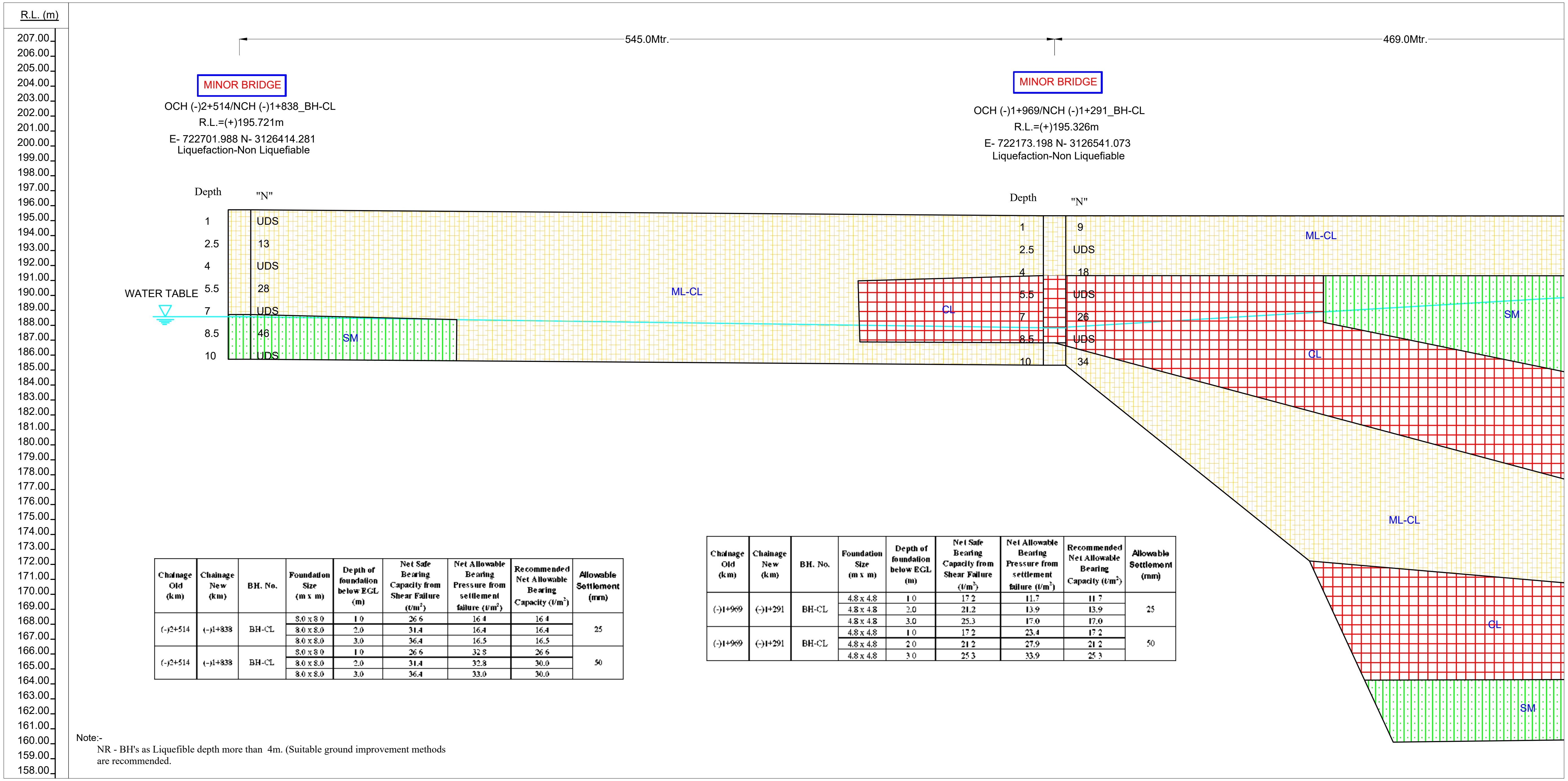
Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :(-)0+934 km	*Northing* :3126250.134 m	*Easting* :721203.669 m
Reduced Level (m):(+)196.343	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:8.10	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :14-10-2021	*Date of Completion* :14-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5											
1.0	1	UDS-1									
1.5											
2.0							Brown, Medium dense, Silty sand	SM			
2.5	2.5	SPT-1	5	6	10	16					
3.0											
3.5											
4.0	4	UDS-2									
4.5											
5.0											
5.5	5.5	SPT-2	17	16	23	39					
6.0											
6.5											
7.0	7	UDS-3					Brown, Dense, Silty sand with gravel	SM			
7.5											
8.0									8.10m		
8.5	8.5	SPT-3	11	17	24	41					
9.0											
9.5											
10.0	10	UDS-4									



UDS*-UDS not recovered

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
(-)2+514	(-)1+838	BH-CL	8.0 x 8.0	1.0	26.6	16.4	16.4	25
			8.0 x 8.0	2.0	31.4	16.4	16.4	
			8.0 x 8.0	3.0	36.4	16.5	16.5	
(-)2+514	(-)1+838	BH-CL	8.0 x 8.0	1.0	26.6	32.8	26.6	50
			8.0 x 8.0	2.0	31.4	32.8	30.0	
			8.0 x 8.0	3.0	36.4	33.0	30.0	

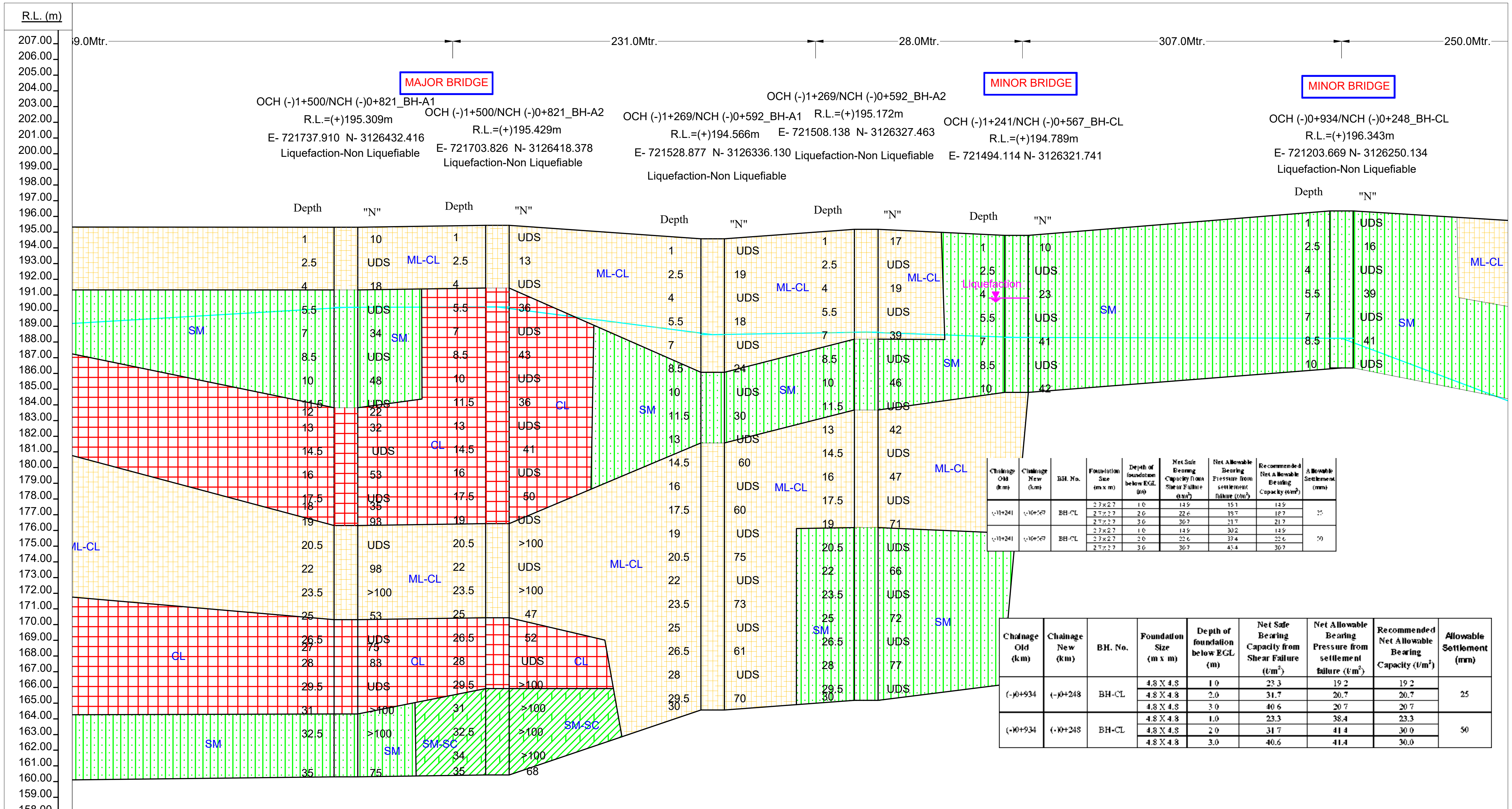
Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
(-)1+969	(-)1+291	BH-CL	4.8 x 4.8	1.0	17.2	11.7	11.7	25
			4.8 x 4.8	2.0	21.2	13.9	13.9	
			4.8 x 4.8	3.0	25.3	17.0	17.0	
(-)1+969	(-)1+291	BH-CL	4.8 x 4.8	1.0	17.2	23.4	17.2	50
			4.8 x 4.8	2.0	21.2	27.9	21.2	
			4.8 x 4.8	3.0	25.3	33.9	25.3	

Note:-
NR - BH's as Liquefible depth more than 4m. (Suitable ground improvement methods are recommended.

SYMBOL	DESCRIPTION
	SM- Silty Sand (Having fines Less Than 50% and no plasticity or below A-line)
	SM-SC -Clayey Sand (Having fines Less Than 50% and in the hatched zone (4<PI<7)
	ML-CL -Sandy with clay (Having fines greater than 50% and in the hatched zone (LL<35 & 4<PI<7)
	CL-Silty Clay of low plasticity (Above A-line, LL<35)
	CI- Clay of medium plasticity (Above A-line, 35≤LL<50) — LIQUEFACTION
	BOREHOLE REQUIRED — WATER TABLE

Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20) SCALE:- HOR:- 1:2850 SCALE:- VER:- 1:285

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
(-)1+241	(-)0+567	BH-CL	2.7x2.7	1.0	14.9	15.1	14.9	25
			2.7x2.7	2.0	22.6	18.7	18.7	
			2.7x2.7	3.0	30.7	21.7	21.7	
(-)1+241	(-)0+567	BH-CL	2.7x2.7	1.0	14.9	30.2	14.9	50
			2.7x2.7	2.0	22.6	37.4	22.6	
			2.7x2.7	3.0	30.7	43.4	30.7	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
(-)0+934	(-)0+248	BH-CL	4.8 X 4.8	1.0	23.3	19.2	19.2	25
			4.8 X 4.8	2.0	31.7	20.7	20.7	
			4.8 X 4.8	3.0	40.6	20.7	20.7	
(-)0+934	(-)0+248	BH-CL	4.8 X 4.8	1.0	23.3	38.4	23.3	50
			4.8 X 4.8	2.0	31.7	41.4	30.0	
			4.8 X 4.8	3.0	40.6	41.4	30.0	

Note:-
NR - BH's as Liquefible depth more than 4m. (Suitable ground improvement methods are recommended.

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
(-)1+500	(-)0+821	BH-A1	7.2 X 7.2	2.0	21.0	10.2	10.2	25
			7.2 X 7.2	3.0	23.3	10.8	10.8	
			7.2 X 7.2	4.0	25.4	11.6	11.6	
(-)1+500	(-)0+821	BH-A1	7.2 X 7.2	2.0	21.0	20.4	20.4	50
			7.2 X 7.2	3.0	23.3	21.5	21.5	
			7.2 X 7.2	4.0	25.4	23.1	23.1	
(-)1+500	(-)0+821	BH-A2	7.2 X 7.2	2.0	35.6	12.9	12.9	25
			7.2 X 7.2	3.0	36.8	17.3	17.3	
			7.2 X 7.2	4.0	38.0	26.2	26.2	
(-)1+500	(-)0+821	BH-A2	7.2 X 7.2	2.0	35.6	25.8	25.8	50
			7.2 X 7.2	3.0	36.8	34.7	30.0	
			7.2 X 7.2	4.0	38.0	52.3	30.0	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
(-)1+269	(-)0+592	BH-A1	7.2 X 7.2	2.0	21.7	14.9	14.9	25
			7.2 X 7.2	3.0	25.8	26.3	25.8	
			7.2 X 7.2	4.0	28.3	27.8	27.8	
(-)1+269	(-)0+592	BH-A1	7.2 X 7.2	2.0	21.7	29.7	21.7	50
			7.2 X 7.2	3.0	25.8	52.6	25.8	
			7.2 X 7.2	4.0	28.3	55.5	28.3	
(-)1+269	(-)0+592	BH-A2	7.2 X 7.2	2.0	24.5	15.1	15.1	25
			7.2 X 7.2	3.0	29.2	26.3	26.3	
			7.2 X 7.2	4.0	32.0	27.8	27.8	
(-)1+269	(-)0+592	BH-A2	7.2 X 7.2	2.0	24.5	30.1	24.5	50
			7.2 X 7.2	3.0	29.2	52.6	29.2	
			7.2 X 7.2	4.0	32.0	55.5	30.0	

SYMBOL	DESCRIPTION
	SM- Silty Sand (Having fines Less Than 50% and no plasticity or below A-line)
	SM-SC -Clayey Sand (Having fines Less Than 50% and in the hatched zone (4<PI<7)
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	CL-Silty Clay of low plasticity (Above A-line, LL<35)
	CI- Clay of medium plasticity (Above A-line, 35≤LL<50) — LIQUEFACTION
	BOREHOLE REQUIRED — WATER TABLE

Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20) SCALE:- HOR:- 1:2850 SCALE:- VER:- 1:285

APPENDIX – B (LAB TEST RESULTS)

Appendix No.	ITEMS
B-1	SOIL CHARACTERISTICS SHEETS
B-2	RESULT OF CHEMICAL ANALYSIS OF SOIL SAMPLES
B-3	RESULT OF CHEMICAL ANALYSIS OF WATER SAMPLES
B-4	GSD CURVES
B-5	SHEAR CURVE
B-6	CONSOLIDATION CURVE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	12-10-2021	to	12-10-2021	(-)2+514 Minor Bridge	BH-CL	7.15 m	10.00 m	722701.988 m	3126414.281 m	(+)195.721 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Medium dense, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		ML-CL		7	52	28	3	8	2	0	27	20	7	-	1.73	13.05	1.53	2.66	DST	0.21	24	-	-	-	-	-	-	-	-
SPT-1	2.50	13	17		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-	Brown, Medium dense to dense, Silty sand with gravel	SM		0	19	71	4	2	4	0	-	Nil	NP	-	1.80	13.22	1.59	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-2	5.50	28	28		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		SM		0	21	66	3	4	6	0	-	Nil	NP	-	1.83	15.10	1.59	2.63	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-3	8.50	46	28		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		SM		0	21	71	2	0	5	1	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	12-10-2021	to	12-10-2021	(-)1+969 Minor Bridge	BH-CL	7.50 m	10.00 m	722173.198 m	3126541.073 m	(+)195.326 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Loose, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	9	14		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		ML-CL		7	47	41	3	1	1	0	27	20	7	-	1.70	13.26	1.50	2.66	DST	0.18	24	-	-	-	-	-	-	-	-
SPT-2	4.00	18	18	Brown, Very stiff, Silty clay of low plasticity	CL		11	52	28	4	3	2	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		CL		12	52	26	5	2	3	0	33	22	11	-	1.82	16.74	1.56	2.67	UUT	0.75	5	-	-	-	-	-	-	-	-
SPT-3	7.00	26	26		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-	Brown, Dense, Sandy silt of low plasticity	ML-CL		8	46	37	3	1	5	0	28	21	7	-	1.85	18.65	1.56	2.66	DST	0.21	25	-	-	-	-	-	-	-	-
SPT-4	10.00	34	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		11-10-2021	to	12-10-2021	(-)1+500 Major Bridge	BH-A1	5.10 m	35.00 m	721737.910 m	3126432.416 m	(+)195.309 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	10	16	Yellowish brown, Medium dense, Sandy silt of low plasticity	ML-CL		6	52	32	5	3	2	0	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		ML-CL		7	52	30	4	3	4	0	27	20	7	-	1.71	12.40	1.52	2.66	DST	0.22	23	-	-	-	-	-	-	-	-
SPT-2	4.00	18	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		SM		0	31	59	4	3	3	0	-	Nil	NP	-	1.77	13.20	1.56	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-3	7.00	34	25	Yellowish brown, Medium dense to dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		SM		0	23	65	5	2	5	0	-	Nil	NP	-	1.82	13.76	1.60	2.62	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-4	10.00	48	30		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	11.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	12.00	22	22		CL		12	63	18	2	2	3	0	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	13.00	32	32		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	14.50	-	-	Yellowish brown, Very stiff to hard, Silty clay of low plasticity with gravel	CL		11	57	20	3	4	5	0	32	21	11	-	1.99	24.20	1.60	2.68	UUT	1.02	5	-	-	-	0.675	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	10.59 7.62 5.68 4.67	1.69 1.22 0.74 0.52	0.1100
SPT-7	16.00	53	53		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	17.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	18.00	35	35		CL		11	56	22	5	2	4	0	31	20	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	19.00	93	43		ML-CL		6	52	29	3	2	8	0	27	21	6	-	1.95	19.50	1.63	2.66	DST+	0.21	27	-	-	-	-	-	-	-	-
UDS*	20.50	-	-	Yellowish brown, Very dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	22.00	98	43		ML-CL		7	45	36	5	0	7	0	28	21	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	23.50	100 (20cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	11-10-2021	to	12-10-2021	(-)1+500 Major Bridge	BH-A1	5.10 m	35.00 m	721737.910 m	3126432.416 m	(+)195.309 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand Fine	Sand Medium	Sand Coarse	Gravel Fine	Gravel Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-12	25.00	53	53	Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL		11	57	20	5	1	6	0	32	21	11	-	2.01	22.50	1.64	2.67	UUT+	1.75	4	-	-	-	-	-	-	-	-
UDS*	26.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	27.00	75	75		CL		12	55	18	2	4	9	0	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	28.00	83	83		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	29.50	-	-		CL		11	50	21	7	2	6	3	32	22	10	-	2.04	21.14	1.68	2.68	UUT	2.46	4	-	-	-	-	-	-	-	-
SPT-15	31.00	100 (23cm)	-	Yellowish brown, Very dense, Silty sand with gravel	SM		0	15	68	4	2	9	2	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	32.50	100 (25cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-17	35.00	75	75	Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL		11	57	17	6	2	7	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	11-10-2021	to	12-10-2021	(-)1+500 Major Bridge	BH-A2	5.20 m	35.00 m	721703.826 m	3126418.378 m	(+)195.429 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-	Yellowish brown, Medium dense, Sandy silt of low plasticity	ML-CL		7	53	34	5	1	0	0	27	20	7	-	1.78	14.23	1.56	2.66	DST	0.19	24	-	-	-	-	-	-	-	-
SPT-1	2.50	13	17		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		CL		11	48	24	9	5	3	0	31	20	11	-	1.94	20.36	1.61	2.68	UUT	1.23	5	-	-	-	0.665	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	11.81 8.36 6.72 5.45	1.83 1.17 0.78 0.51	0.106
SPT-2	5.50	36	36		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		CL		12	55	23	4	1	5	0	33	22	11	-	2.00	23.44	1.62	2.68	UUT	1.35	5	-	-	-	0.654	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	11.95 11.75 9.70 8.93	1.83 1.17 0.78 0.51	0.106
SPT-3	8.50	43	43		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-	Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL		12	59	19	3	2	4	1	32	21	11	-	1.99	23.70	1.61	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	11.50	36	36		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-		CL		10	58	20	3	4	5	0	31	21	10	-	2.00	23.19	1.62	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	14.50	41	41		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	16.00	-	-		CL		11	54	25	2	1	6	1	32	21	11	-	2.00	22.16	1.64	2.67	UUT	1.64	4	-	-	-	-	-	-	-	-
SPT-6	17.50	50	50		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	19.00	-	-		ML-CL		8	49	27	3	4	9	0	28	21	7	-	1.96	18.11	1.66	2.66	DST	0.21	28	-	-	-	-	-	-	-	-
SPT-7	20.50	100 (23cm)	-	Yellowish brown, Very dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	22.00	-	-		ML-CL		6	51	30	4	2	7	0	27	21	6	-	1.96	18.20	1.66	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	23.50	102	42		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		11-10-2021	to	12-10-2021	(-)1+500 Major Bridge	BH-A2	5.20 m	35.00 m	721703.826 m	3126418.378 m	(+)195.429 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm³)	Natural Moisture Content (%)	Dry Density (g/cm³)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm²)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm²)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm²)	C_v x 10^{-4} (cm²/Sec)	M_v x 10^{-2} (cm²/Kg)	Compression Index (C_c)
SPT-9	25.00	47	47	Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL		11	57	20	4	3	5	0	31	20	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	26.50	52	52		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	28.00	-	-		CL		12	51	22	3	5	6	1	32	21	11	-	2.01	22.86	1.64	2.68	UUT	1.66	4	-	-	-	-	-	-	-	-
SPT-11	29.50	100 (20cm)	-	Yellowish brown, Very dense, Silty sand with clay & gravel	SM-SC		5	35	47	5	2	5	1	26	20	6	-	1.95	17.00	1.67	2.65	DST+	0.10	30	-	-	-	-	-	-	-	-
SPT-12	31.00	100 (18cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	32.50	>100	-		SM-SC		4	33	50	5	1	7	0	25	20	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	34.00	>100	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	35.00	68	68	Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL		12	54	18	6	2	6	2	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	10-10-2021	to	13-10-2021	(-)1+269 Major Bridge	BH-A1	6.10 m	30.00 m	721528.877 m	3126336.130 m	(+)194.566 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm³)	Natural Moisture Content (%)	Dry Density (g/cm³)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm²)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm²)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm²)	C_v x 10^{-4} (cm²/Sec)	M_v x 10^{-2} (cm²/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Medium dense, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		ML-CL		7	51	29	4	7	2	0	28	21	7	-	1.74	13.10	1.54	2.66	DST	0.14	23	-	-	-	-	-	-	-	-
SPT-1	2.50	19	24		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		ML-CL		8	50	29	4	7	2	0	26	20	6	-	1.75	13.40	1.54	2.66	DST	0.15	23	-	-	-	-	-	-	-	-
SPT-2	5.50	18	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		ML-CL		7	50	30	4	7	2	0	27	20	7	-	1.76	13.80	1.55	2.66	-	-	-	-	-	-	-	-	-	-	-
SPT-3	8.50	24	19	Brown, Medium dense to dense, Silty sand with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		SM		0	22	66	3	4	5	0	-	Nil	NP	-	1.75	12.40	1.56	2.63	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-4	11.50	30	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-	Brown, Very dense, Sandy silt of low plasticity	ML-CL		7	54	29	2	6	2	0	28	21	7	-	1.83	14.60	1.60	2.66	DST	0.16	24	-	-	-	-	-	-	-	-
SPT-5	14.50	60	32		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	16.00	-	-		ML-CL		8	51	30	3	6	2	0	27	20	7	-	1.85	14.70	1.61	2.66	-	-	-	-	-	-	-	-	-	-	-
SPT-6	17.50	60	31		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	19.00	-	-		ML-CL		7	51	31	4	5	2	0	25	20	5	-	1.86	14.80	1.62	2.66	DST	0.16	25	-	-	-	-	-	-	-	-
SPT-7	20.50	75	35		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	22.00	-	-		ML-CL		8	52	29	3	6	2	0	26	20	6	-	1.86	15.10	1.62	2.66	-	-	-	-	-	-	-	-	-	-	-
SPT-8	23.50	73	33		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	25.00	-	-		ML-CL		8	49	33	3	5	2	0	26	20	6	-	1.88	15.60	1.63	2.66	-	-	-	-	-	-	-	-	-	-	-
SPT-9	26.50	61	28		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	28.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		10-10-2021	to	13-10-2021	(-)1+269 Major Bridge	BH-A1	6.10 m	30.00 m	721528.877 m	3126336.130 m	(+)194.566 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-10	29.50	70	30	Brown, Very dense, Sandy silt of low plasticity	ML-CL		7	54	28	2	7	2	0	27	20	7	-	1.88	15.20	1.63	2.66	DST	0.16	26	-	-	-	-	-	-	-	-
-	30.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	10-10-2021	to	13-10-2021	(-)1+269 Major Bridge	BH-A2	6.55 m	30.00 m	721508.138 m	3126327.463 m	(+)195.172 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	17	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-	Brown, Medium dense, Sandy silt of low plasticity	ML-CL		8	49	30	4	7	2	0	27	20	7	-	1.73	13.10	1.53	2.66	DST	0.13	22	-	-	-	-	-	-	-	-
SPT-2	4.00	19	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		ML-CL		7	52	28	4	7	2	0	26	20	6	-	1.77	13.50	1.56	2.66	DST	0.14	23	-	-	-	-	-	-	-	-
SPT-3	7.00	39	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-	Brown, Medium dense to dense, Silty sand with gravel	SM		0	23	66	4	4	3	0	-	Nil	NP	-	1.78	12.60	1.58	2.63	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-4	10.00	46	28		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-		ML-CL		8	51	27	4	8	2	0	27	20	7	-	1.81	13.90	1.59	2.66	DST	0.16	24	-	-	-	-	-	-	-	-
SPT-5	13.00	42	25		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-	Brown, Medium dense, Sandy silt of low plasticity	ML-CL		7	52	28	4	7	2	0	26	20	6	-	1.81	14.10	1.59	2.66	-	-	-	-	-	-	-	-	-	-	-
SPT-6	16.00	47	26		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	17.50	-	-		ML-CL		8	55	25	4	6	2	0	27	20	7	-	1.81	14.12	1.59	2.66	-	-	-	-	-	-	-	-	-	-	-
SPT-7	19.00	71	35		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	20.50	-	-		SM		0	32	58	2	4	4	0	-	Nil	NP	-	1.84	13.60	1.62	2.63	DST	0.00	31	-	-	-	-	-	-	-	-
SPT-8	22.00	66	31		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	23.50	-	-	Brown, Medium dense to dense, Silty sand with gravel	SM		0	30	61	2	4	3	0	-	Nil	NP	-	1.86	13.90	1.63	2.63	-	-	-	-	-	-	-	-	-	-	-
SPT-9	25.00	72	32				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	26.50	-	-		SM		0	30	61	2	4	3	0	-	Nil	NP	-	1.87	14.00	1.64	2.63	DST	0.00	32.00	-	-	-	-	-	-	-	-
SPT-10	28.00	77	33		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		10-10-2021	to	13-10-2021	(-)1+269 Major Bridge	BH-A2	6.55 m	30.00 m	721508.138 m	3126327.463 m	(+)195.172 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
UDS*	29.50	-	-	Brown, Medium dense to dense, Silty sand with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	30.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		14-10-2021	to	14-10-2021	(-)1+241 Minor Bridge	BH-CL	6.50 m	10.00 m	721494.114 m	3126321.741 m	(+)194.789 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Loose, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	10	16		SM		0	27	70	2	1	0	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		SM		0	25	69	3	2	1	0	-	Nil	NP	-	1.71	12.44	1.52	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-2	4.00	23	26	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		SM		0	16	73	5	3	3	0	-	Nil	NP	-	1.80	14.20	1.58	2.63	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-3	7.00	41	28	Brown, Dense, Silty sand with gravel	SM		0	21	65	5	3	6	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		SM		0	21	67	3	2	5	2	-	Nil	NP	-	1.85	16.33	1.59	2.62	DST	0.00	31	-	-	-	-	-	-	-	-
SPT-4	10.00	42	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	14-10-2021	to	14-10-2021	(-)0+934 Minor Bridge	BH-CL	8.10 m	10.00 m	721203.669 m	3126250.134 m	(+)196.343 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		SM		0	15	77	2	4	2	0	-	Nil	NP	-	1.73	11.34	1.55	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-1	2.50	16	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-	Brown, Dense, Silty sand with gravel	SM		0	17	71	4	3	5	0	-	Nil	NP	-	1.82	12.04	1.62	2.63	DST	0.00	31	-	-	-	-	-	-	-	-
SPT-2	5.50	39	39		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		SM		0	19	67	6	2	4	2	-	Nil	NP	-	1.78	12.80	1.58	2.62	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-3	8.50	41	26		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		SM		0	20	71	2	1	6	0	-	Nil	NP	-	1.81	13.11	1.60	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

RESULT OF CHEMICAL ANALYSIS OF SOIL SAMPLES

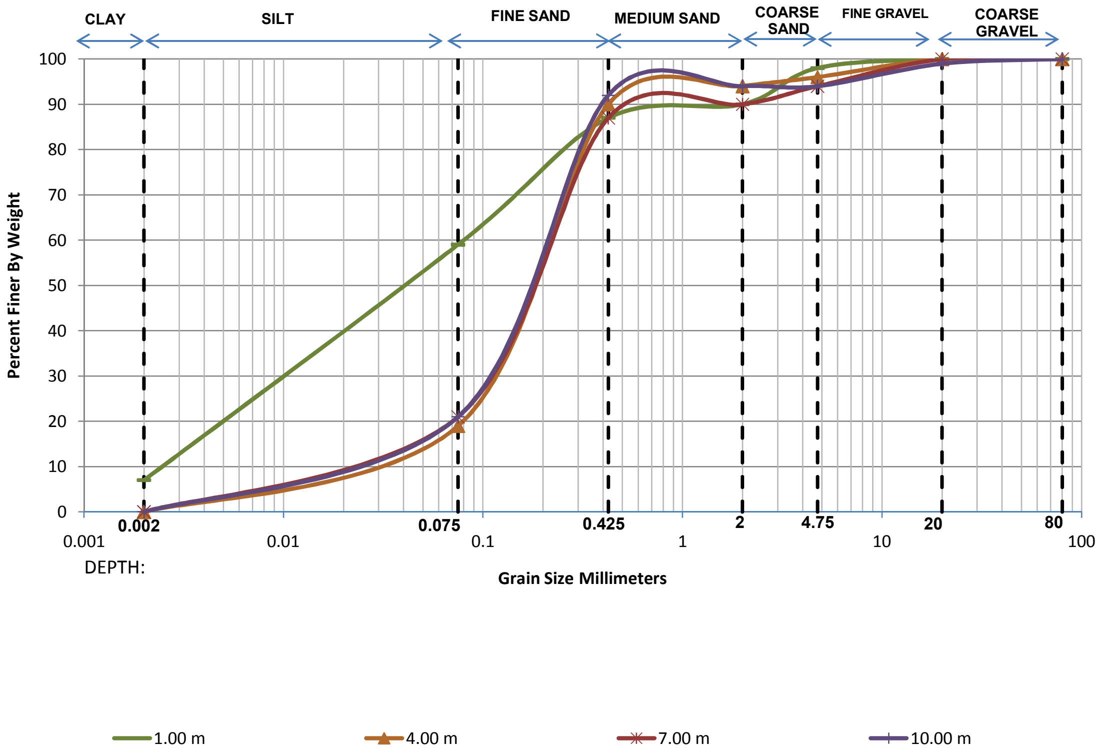
Sr. No	Chainage Old (km)	Chainage New (km)	BH No.	Depth of collected sample (m)	pH	Chlorides (Cl^-)		Sulphate (SO_3^{2-})	
						(mg/kg)	(%)	(mg/kg)	(%)
1.	(-)1+500	(-)0+821	BH-A1	2.50	8.17	84.31	0.0084	28.81	0.0029
2.			BH-A2	4.00	7.27	62.34	0.0062	20.78	0.0021
3.	(-)1+269	(-)0+592	BH-A1	23.50	7.55	87.64	0.0088	20.74	0.0021
4.			BH-A2	2.50	6.95	74.33	0.0074	26.81	0.0027

RESULT OF CHEMICAL ANALYSIS OF WATER SAMPLE

Sr. No	Chainage Old (km)	Chainage New (km)	BH No.	pH	Chlorides (Cl^-) (mg/l)	Sulphate (SO_3^{2-}) (mg/l)
1.	(-)1+500	(-)0+821	BH-A1	8.80	45.25	18.96
2.	(-)1+269	(-)0+592	BH-A2	8.52	58.84	33.81

GRAIN SIZE DISTRIBUTION CURVES

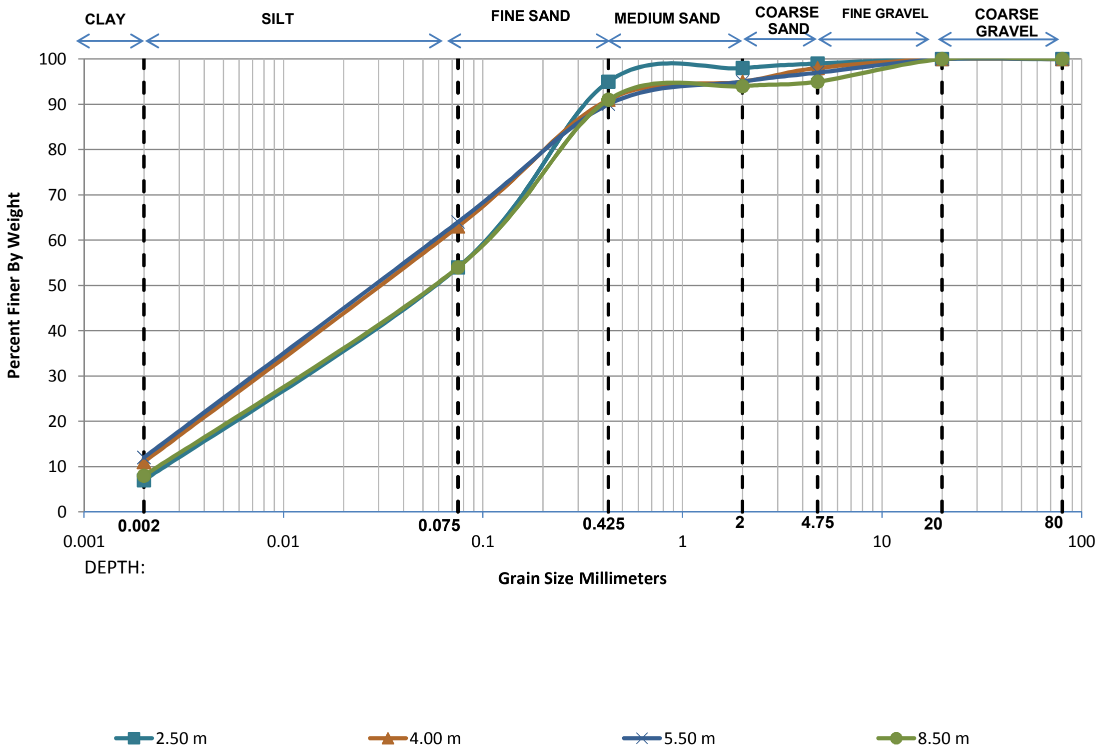
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	(-)2+514 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	7.00	52.00	28.00	3.00	8.00	2.00	0.00	0.0036	0.0213	0.0778	21.89	1.64
4.00 m	0.00	19.00	71.00	4.00	2.00	4.00	0.00	0.0306	0.1175	0.2245	7.33	2.01
7.00 m	0.00	21.00	66.00	3.00	4.00	6.00	0.00	0.0254	0.1098	0.2256	8.88	2.10
10.00 m	0.00	21.00	71.00	2.00	0.00	5.00	1.00	0.0257	0.1087	0.2135	8.30	2.15

GRAIN SIZE DISTRIBUTION CURVES

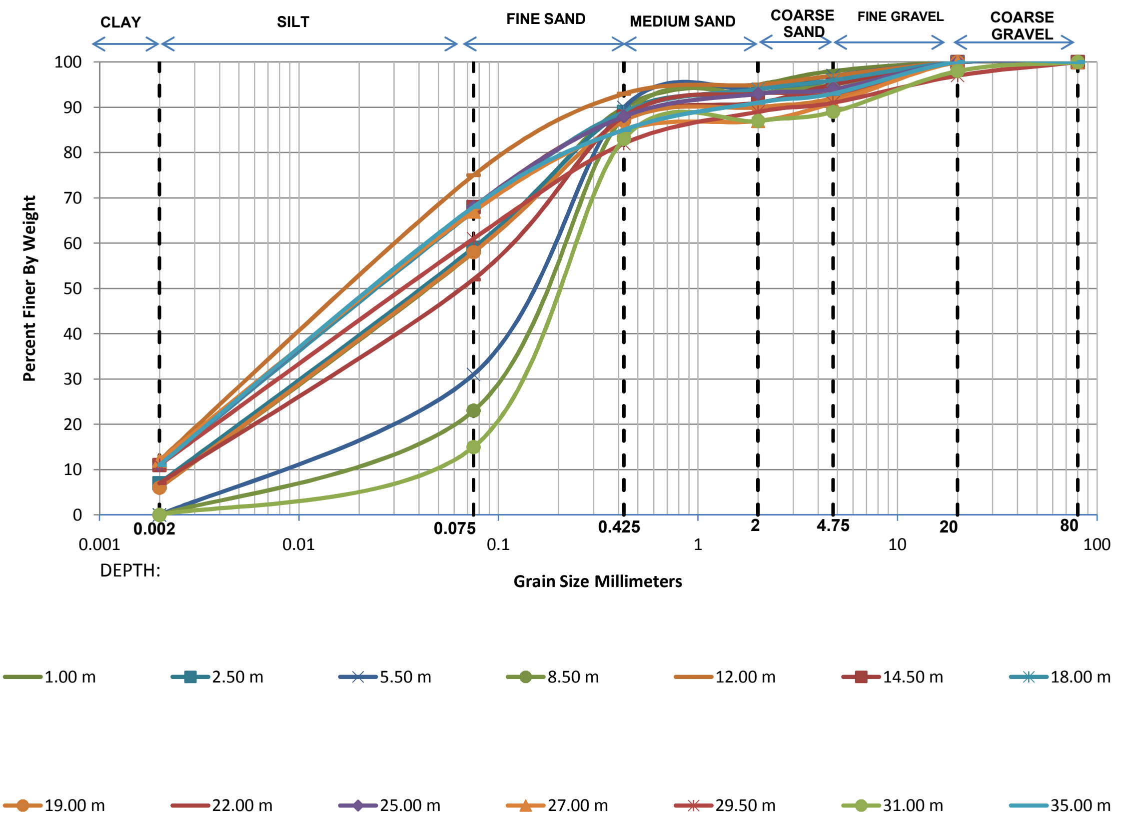
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	(-)1+969 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	7.00	47.00	41.00	3.00	1.00	1.00	0.00	0.0037	0.0251	0.0942	25.79	1.84
4.00 m	11.00	52.00	28.00	4.00	3.00	2.00	0.00	-	0.0155	0.0676	-	-
5.50 m	12.00	52.00	26.00	5.00	2.00	3.00	0.00	-	0.0141	0.0652	-	-
8.50 m	8.00	46.00	37.00	3.00	1.00	5.00	0.00	0.0030	0.0238	0.0959	32.34	1.99

GRAIN SIZE DISTRIBUTION CURVES

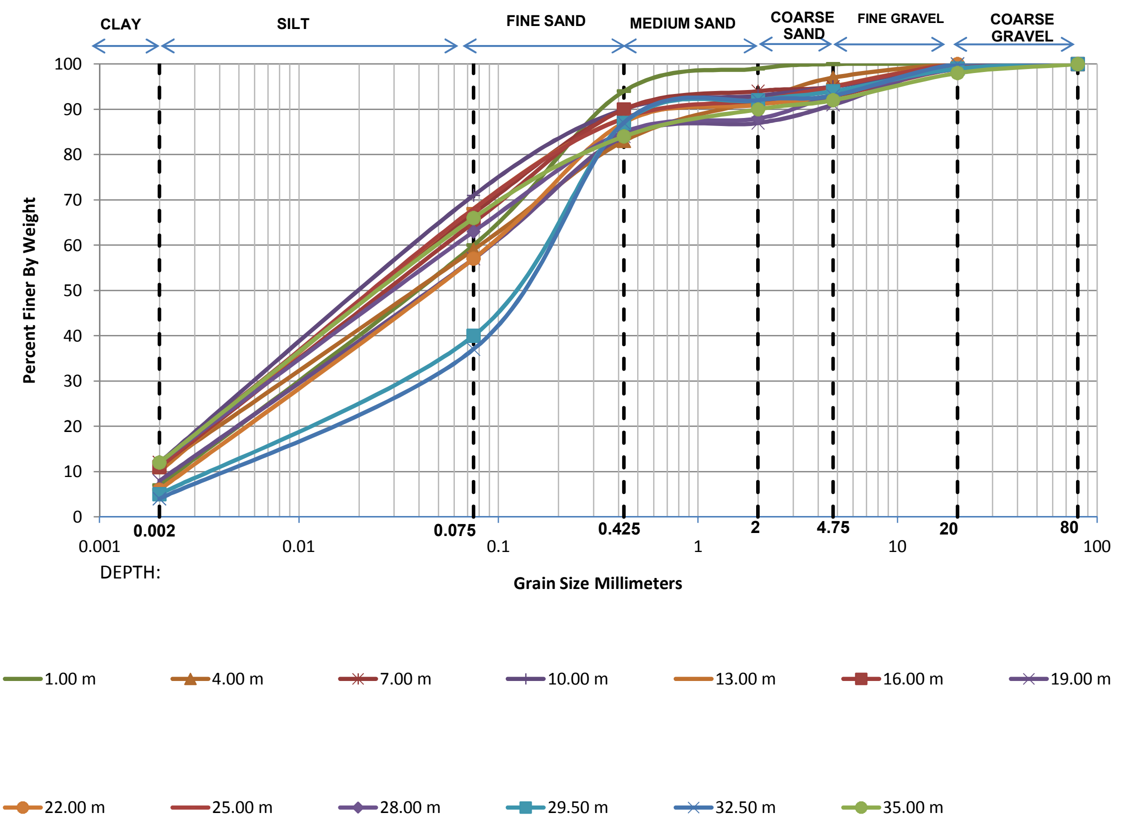
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	(-)1+500 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	6.00	52.00	32.00	5.00	3.00	2.00	0.00	0.0044	0.0232	0.0808	18.54	1.53
2.50 m	7.00	52.00	30.00	4.00	3.00	4.00	0.00	0.0036	0.0214	0.0778	21.86	1.65
5.50 m	0.00	31.00	59.00	4.00	3.00	3.00	0.00	0.0125	0.0716	0.1861	14.86	2.20
8.50 m	0.00	23.00	65.00	5.00	2.00	5.00	0.00	0.0216	0.1014	0.2175	10.08	2.19
12.00 m	12.00	63.00	18.00	2.00	2.00	3.00	0.00	-	0.0111	0.0463	-	-
14.50 m	11.00	57.00	20.00	3.00	4.00	5.00	0.00	-	0.0135	0.0573	-	-
18.00 m	11.00	56.00	22.00	5.00	2.00	4.00	0.00	-	0.0139	0.0592	-	-
19.00 m	6.00	52.00	29.00	3.00	2.00	8.00	0.00	0.0044	0.0230	0.0811	18.64	1.50
22.00 m	7.00	45.00	36.00	5.00	0.00	7.00	0.00	0.0037	0.0264	0.1065	28.95	1.78
25.00 m	11.00	57.00	20.00	5.00	1.00	6.00	0.00	-	0.0135	0.0573	-	-
27.00 m	12.00	55.00	18.00	2.00	4.00	9.00	0.00	-	0.0129	0.0587	-	-
29.50 m	11.00	50.00	21.00	7.00	2.00	6.00	3.00	-	0.0160	0.0723	-	-
31.00 m	0.00	15.00	68.00	4.00	2.00	9.00	2.00	0.0450	0.1380	0.2554	5.68	1.66
35.00 m	11.00	57.00	17.00	6.00	2.00	7.00	0.00	-	0.0134	0.0571	-	-

GRAIN SIZE DISTRIBUTION CURVES

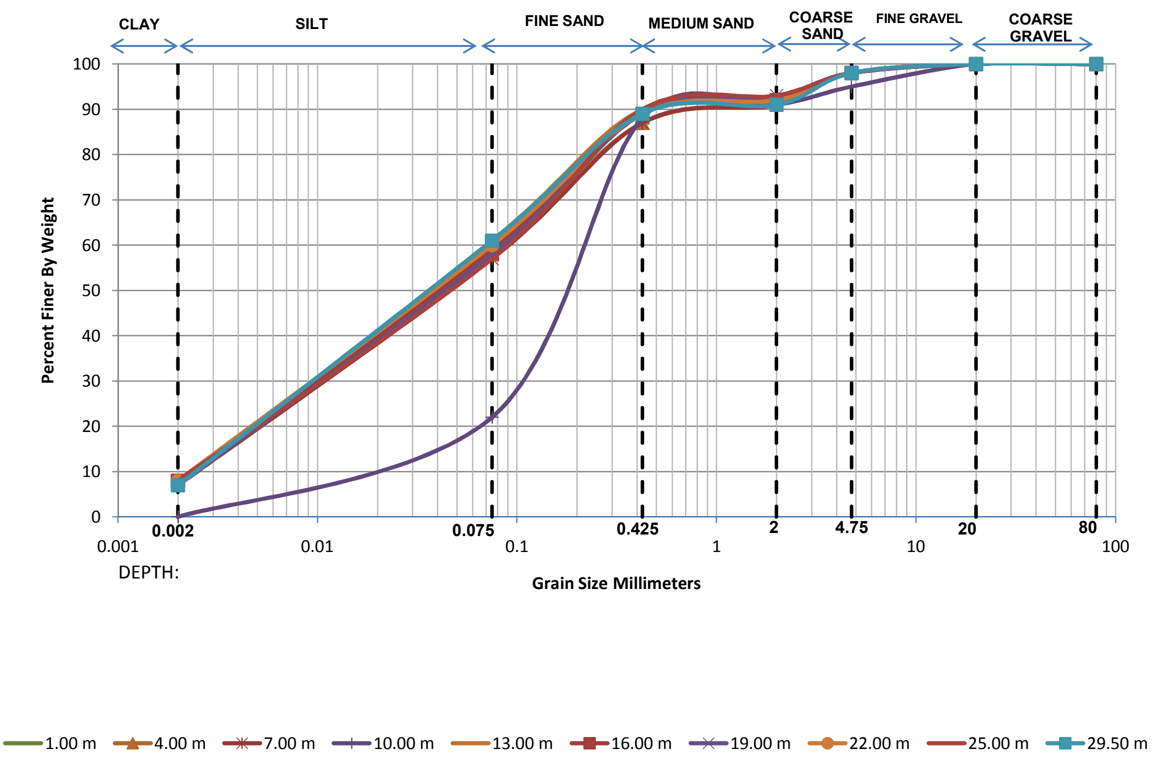
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	(-)1+500 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	7.00	53.00	34.00	5.00	1.00	0.00	0.00	0.0035	0.0211	0.0750	21.13	1.67
4.00 m	11.00	48.00	24.00	9.00	5.00	3.00	0.00	-	0.0170	0.0782	-	-
7.00 m	12.00	55.00	23.00	4.00	1.00	5.00	0.00	-	0.0131	0.0590	-	-
10.00 m	12.00	59.00	19.00	3.00	2.00	4.00	1.00	-	0.0119	0.0519	-	-
13.00 m	10.00	58.00	20.00	3.00	4.00	5.00	0.00	0.0020	0.0144	0.0576	28.79	1.80
16.00 m	11.00	54.00	25.00	2.00	1.00	6.00	1.00	-	0.0146	0.0632	-	-
19.00 m	8.00	49.00	27.00	3.00	4.00	9.00	0.00	0.0029	0.0212	0.0858	29.26	1.79
22.00 m	6.00	51.00	30.00	4.00	2.00	7.00	0.00	0.0044	0.0237	0.0849	19.39	1.51
25.00 m	11.00	57.00	20.00	4.00	3.00	5.00	0.00	-	0.0135	0.0573	-	-
28.00 m	12.00	51.00	22.00	3.00	5.00	6.00	1.00	-	0.0143	0.0673	-	-
29.50 m	5.00	35.00	47.00	5.00	2.00	5.00	1.00	0.0065	0.0453	0.1616	24.80	1.95
32.50 m	4.00	33.00	50.00	5.00	1.00	7.00	0.00	0.0086	0.0529	0.1733	20.07	1.87
35.00 m	12.00	54.00	18.00	6.00	2.00	6.00	2.00	-	0.0132	0.0607	-	-

GRAIN SIZE DISTRIBUTION CURVES

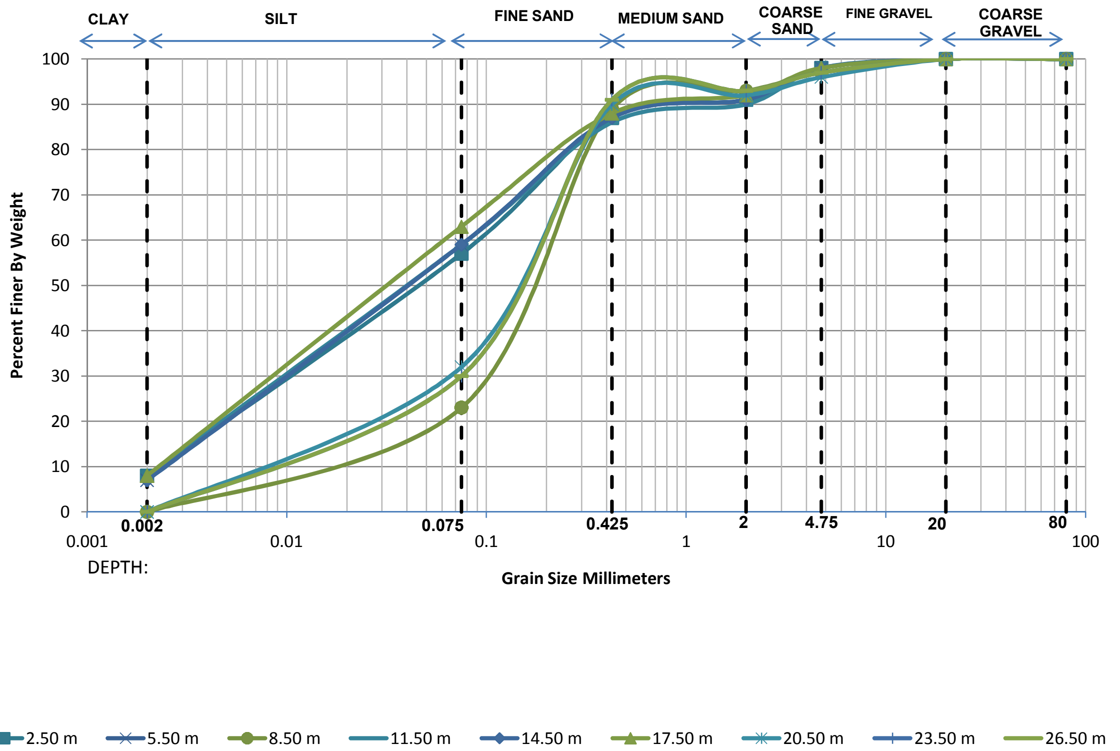
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	(-)1+269 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	7.00	51.00	29.00	4.00	7.00	2.00	0.00	0.0036	0.0219	0.0812	22.75	1.65
4.00 m	8.00	50.00	29.00	4.00	7.00	2.00	0.00	0.0029	0.0208	0.0813	27.76	1.82
7.00 m	7.00	50.00	30.00	4.00	7.00	2.00	0.00	0.0036	0.0225	0.0850	23.71	1.66
10.00 m	0.00	22.00	66.00	3.00	4.00	5.00	0.00	0.0234	0.1055	0.2199	9.39	2.16
13.00 m	7.00	54.00	29.00	2.00	6.00	2.00	0.00	0.0035	0.0204	0.0726	20.56	1.62
16.00 m	8.00	51.00	30.00	3.00	6.00	2.00	0.00	0.0029	0.0203	0.0778	26.62	1.81
19.00 m	7.00	51.00	31.00	4.00	5.00	2.00	0.00	0.0036	0.0220	0.0810	22.67	1.67
22.00 m	8.00	52.00	29.00	3.00	6.00	2.00	0.00	0.0029	0.0197	0.0750	25.73	1.78
25.00 m	8.00	49.00	33.00	3.00	5.00	2.00	0.00	0.0029	0.0216	0.0845	28.75	1.88
29.50 m	7.00	54.00	28.00	2.00	7.00	2.00	0.00	0.0035	0.0203	0.0726	20.57	1.61

GRAIN SIZE DISTRIBUTION CURVES

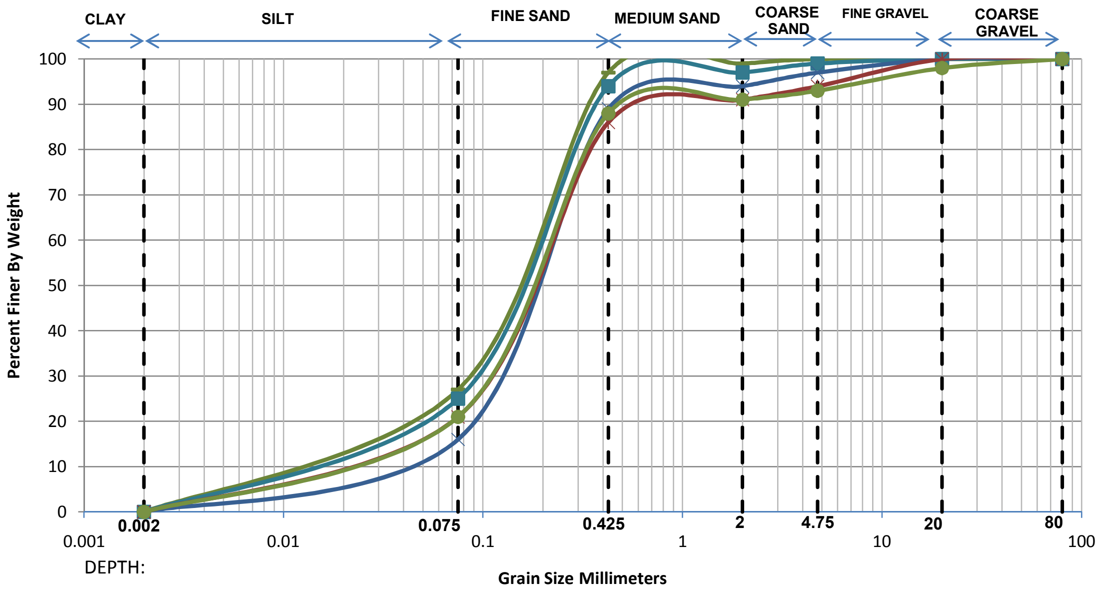
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	(-)1+269 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	8.00	49.00	30.00	4.00	7.00	2.00	0.00	0.0029	0.0214	0.0851	28.99	1.83
5.50 m	7.00	52.00	28.00	4.00	7.00	2.00	0.00	0.0036	0.0213	0.0778	21.90	1.64
8.50 m	0.00	23.00	66.00	4.00	4.00	3.00	0.00	0.0216	0.1012	0.2146	9.92	2.21
11.50 m	8.00	51.00	27.00	4.00	8.00	2.00	0.00	0.0029	0.0201	0.0779	26.68	1.78
14.50 m	7.00	52.00	28.00	4.00	7.00	2.00	0.00	0.0036	0.0213	0.0778	21.90	1.64
17.50 m	8.00	55.00	25.00	4.00	6.00	2.00	0.00	0.0029	0.0182	0.0679	23.47	1.69
20.50 m	0.00	32.00	58.00	2.00	4.00	4.00	0.00	0.0118	0.0684	0.1820	15.40	2.17
23.50 m	0.00	30.00	61.00	2.00	4.00	3.00	0.00	0.0133	0.0750	0.1868	14.01	2.26
26.50 m	0.00	30.00	61.00	2.00	4.00	3.00	0.00	0.0133	0.0750	0.1868	14.01	2.26

GRAIN SIZE DISTRIBUTION CURVES

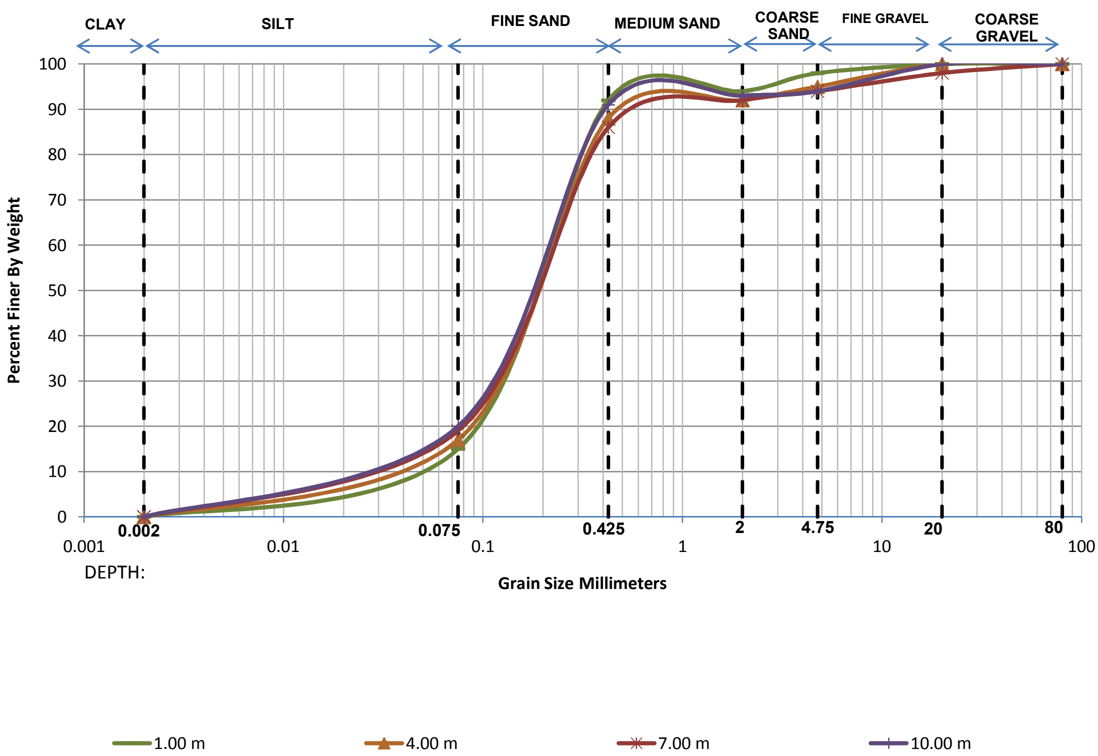
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	(-)1+241 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	27.00	70.00	2.00	1.00	0.00	0.00	0.0164	0.0853	0.1857	11.29	2.38
2.50 m	0.00	25.00	69.00	3.00	2.00	1.00	0.00	0.0188	0.0928	0.1974	10.50	2.32
5.50 m	0.00	16.00	73.00	5.00	3.00	3.00	0.00	0.0409	0.1309	0.2361	5.77	1.77
7.00 m	0.00	21.00	65.00	5.00	3.00	6.00	0.00	0.0254	0.1101	0.2291	9.03	2.09
8.50 m	0.00	21.00	67.00	3.00	2.00	5.00	2.00	0.0255	0.1096	0.2230	8.75	2.11

GRAIN SIZE DISTRIBUTION CURVES

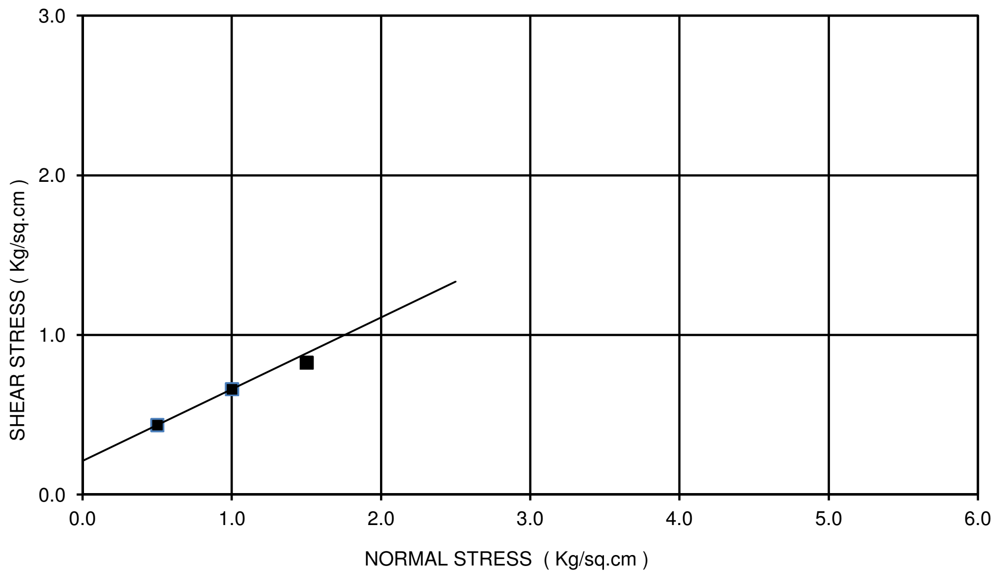
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	(-)0+934 Minor Bridge
B.H. No.	BH-CL

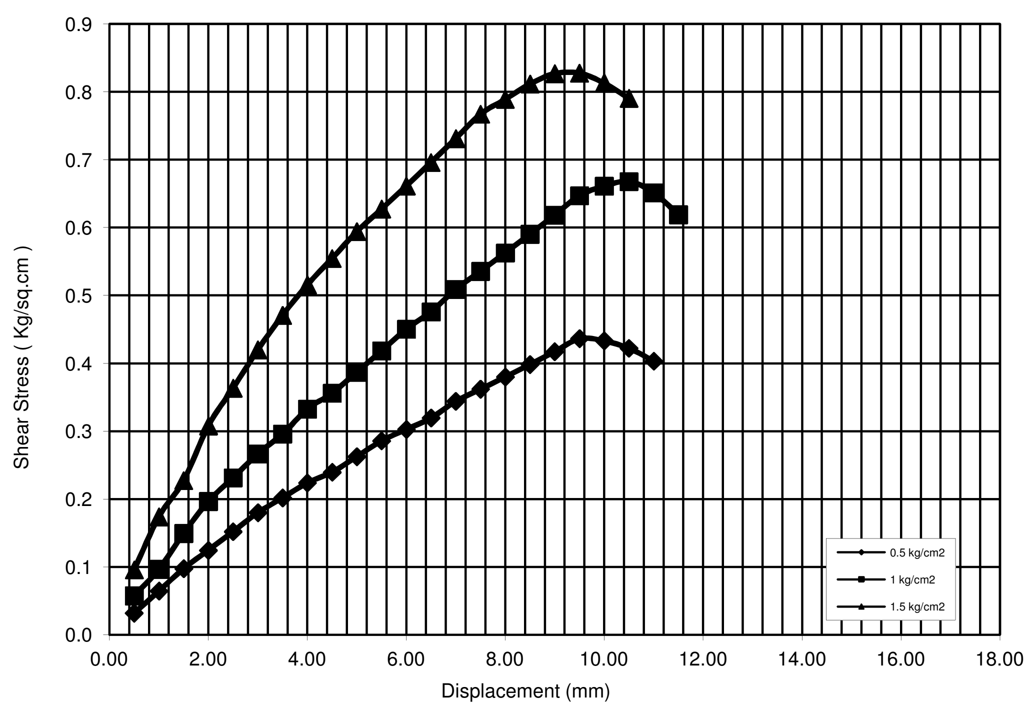


Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	15.00	77.00	2.00	4.00	2.00	0.00	0.0456	0.1341	0.2316	5.08	1.70
4.00 m	0.00	17.00	71.00	4.00	3.00	5.00	0.00	0.0369	0.1268	0.2353	6.37	1.85
7.00 m	0.00	19.00	67.00	6.00	2.00	4.00	2.00	0.0303	0.1188	0.2354	7.76	1.98
10.00 m	0.00	20.00	71.00	2.00	1.00	6.00	0.00	0.0280	0.1130	0.2187	7.81	2.08

BORE HOLE NO: BH-CL

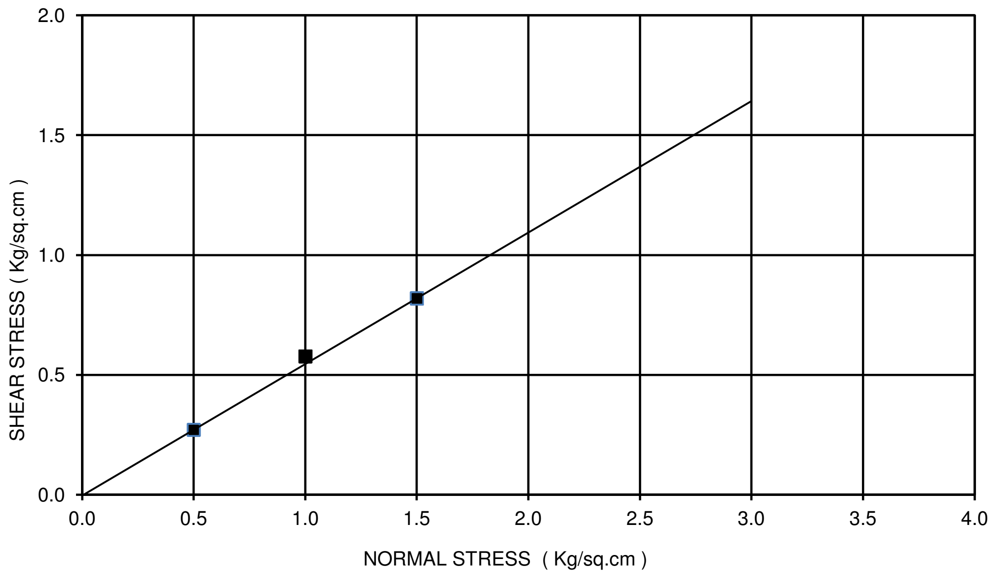
SAMPLE NO.: UDS-1
DEPTH: 1.00 m
COHESION(C)= 0.21 kg/sq.cm
ANGLE OF FRICTION(Phi): 24 deg
TYPE OF THE TEST: DST

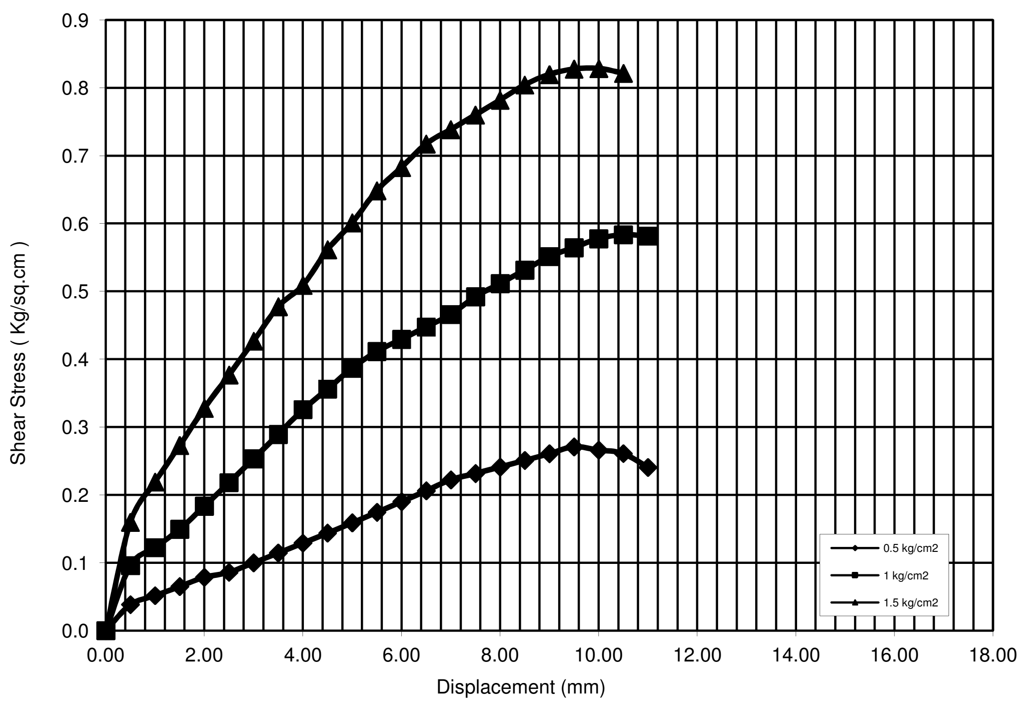




BORE HOLE NO: BH-CL

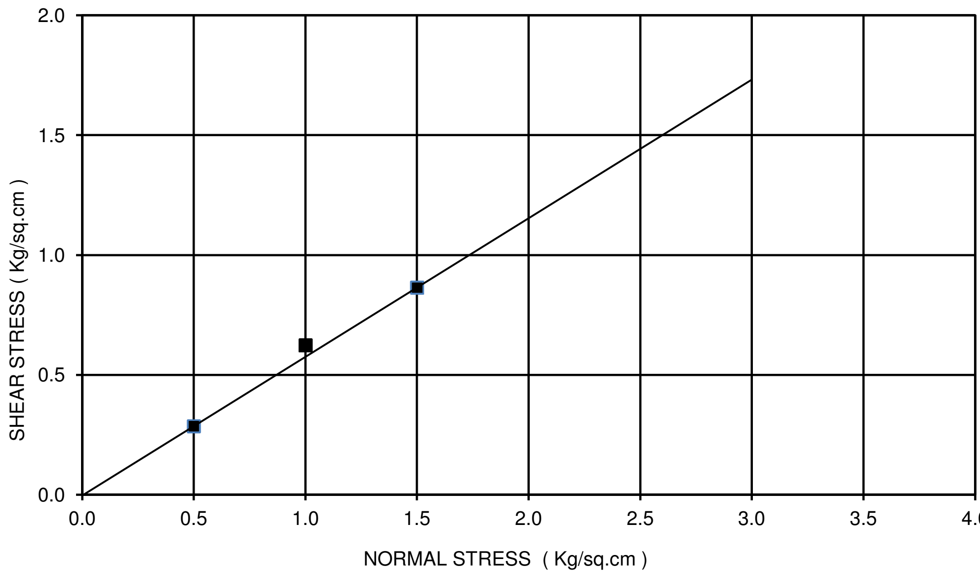
SAMPLE NO.: UDS-2
DEPTH: 4.00 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 29 deg
TYPE OF THE TEST: DST

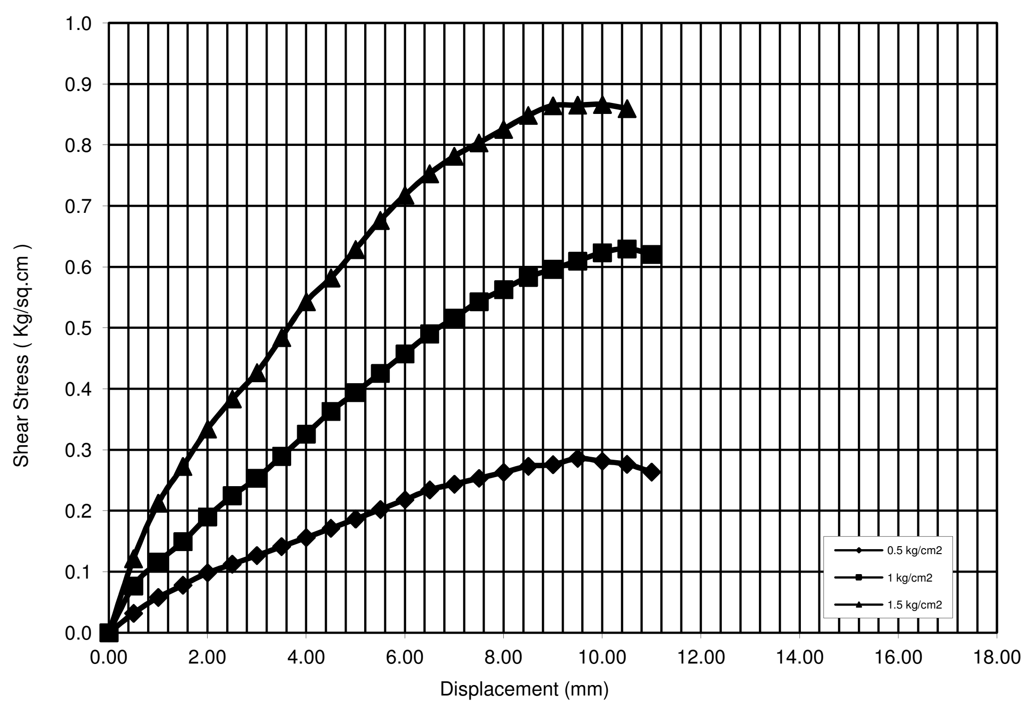




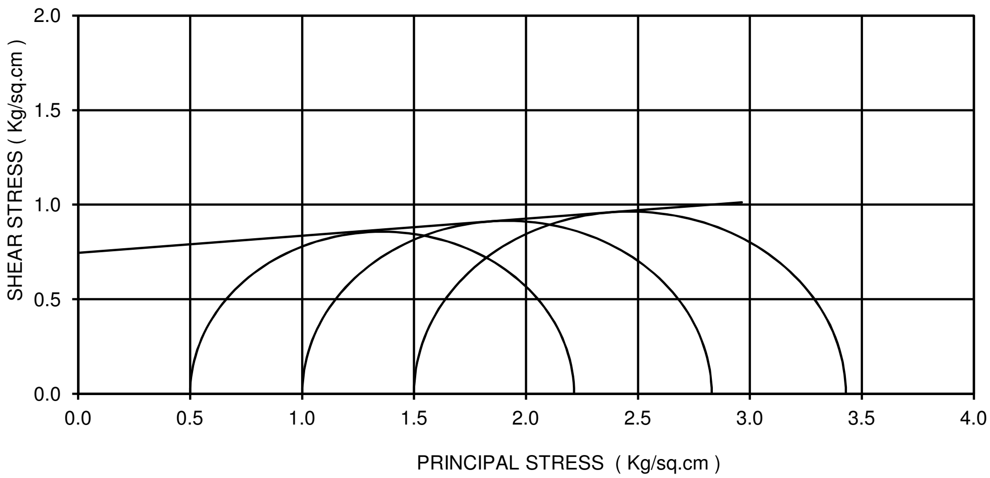
BORE HOLE NO: BH-CL

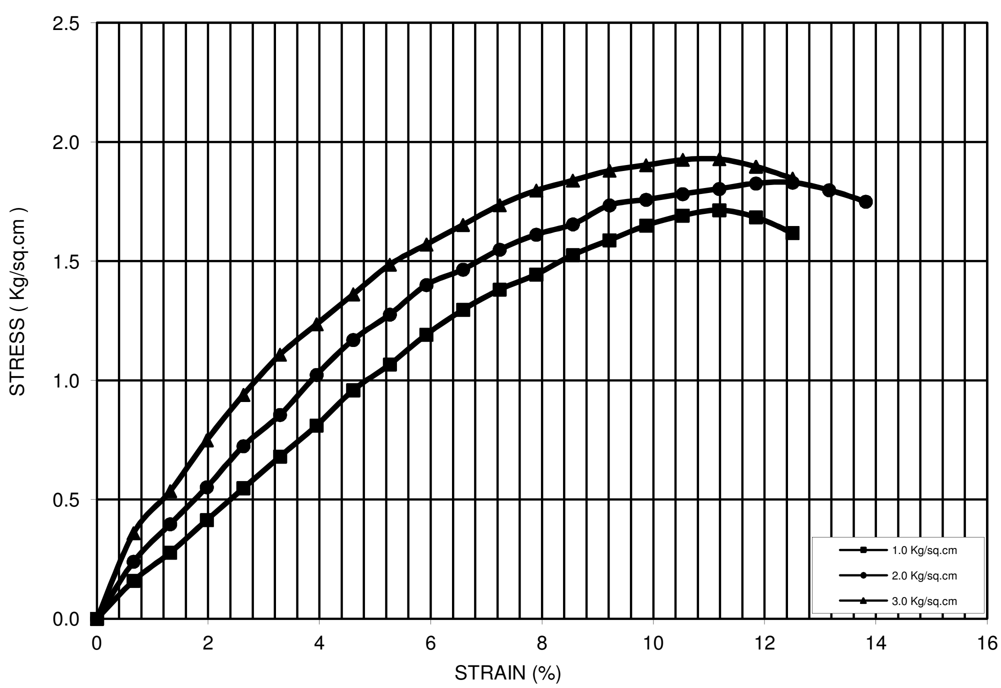
SAMPLE NO.: UDS-3
DEPTH: 7.00 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 30 deg
TYPE OF THE TEST: DST



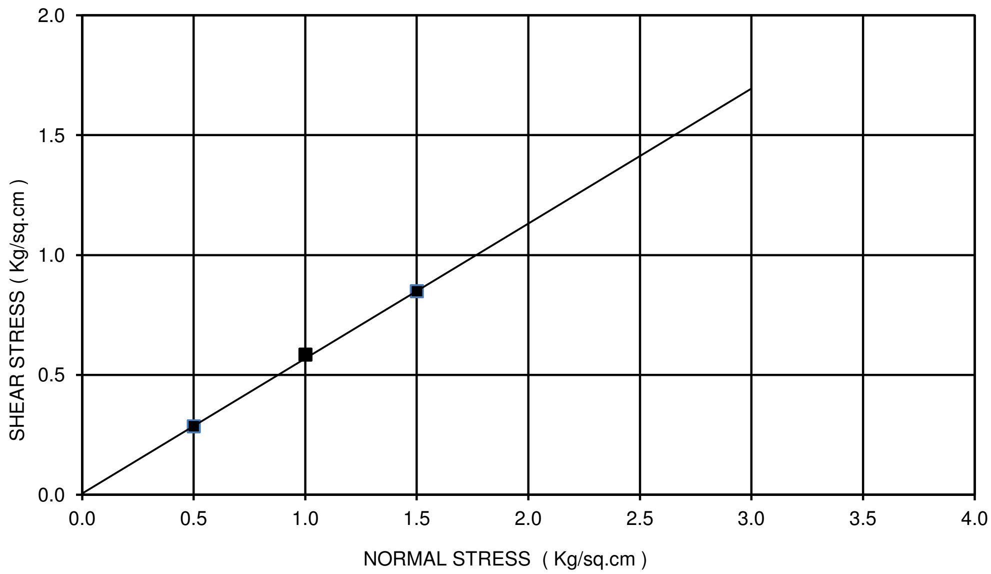


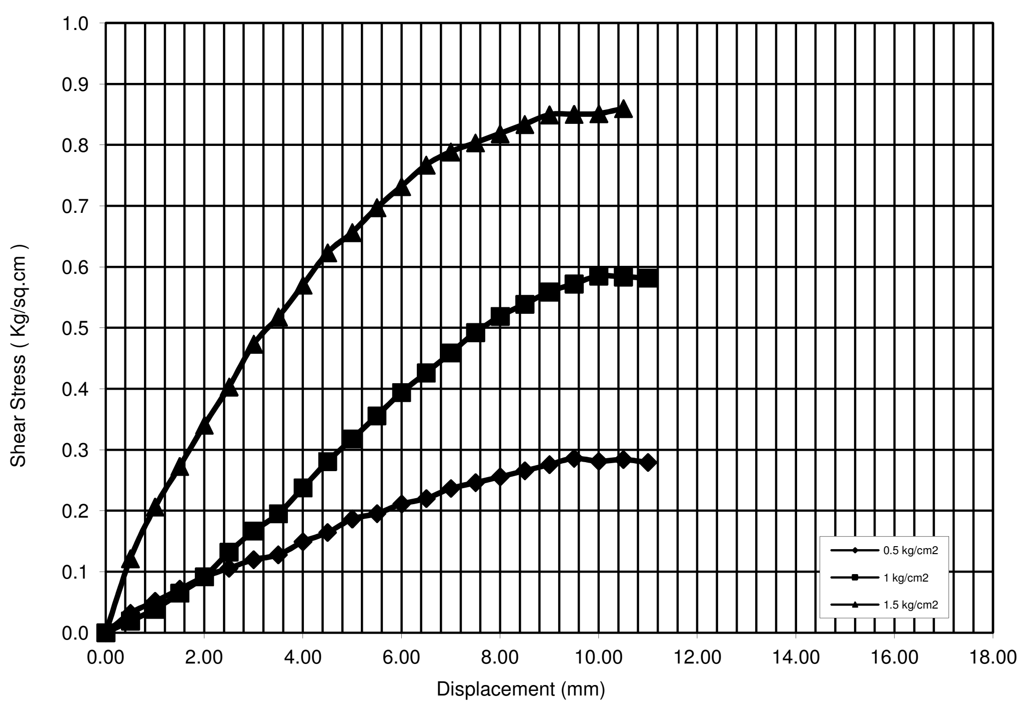
BORE HOLE NO: BH-CL
CH-1+969.2
SAMPLE NO.: UDS-2
DEPTH: 5.50 m
COHESION(C)= 0.75 kg/sq.cm
ANGLE OF FRICTION(Phi): 5 deg
TYPE OF THE TEST: UUT



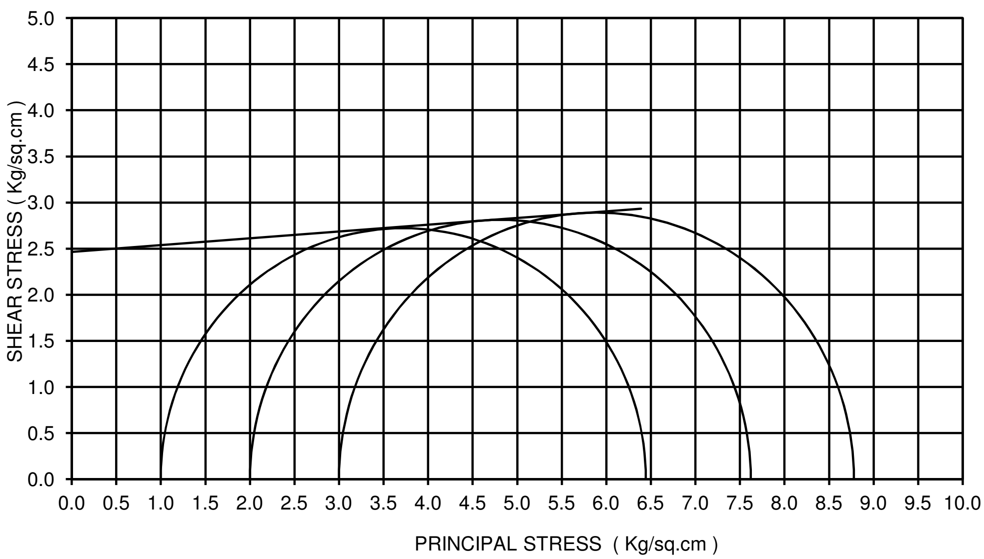


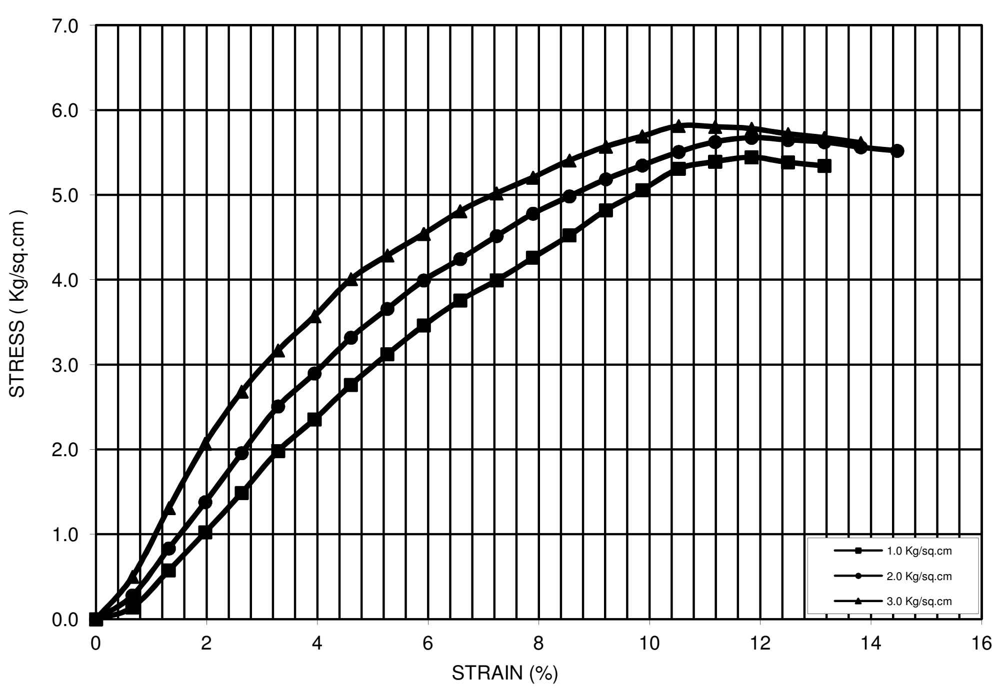
BORE HOLE NO: BH-A-1
CHAINAGE : 1+500
SAMPLE NO.: UDS-2
DEPTH: 5.50 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 29 deg
TYPE OF THE TEST: DST



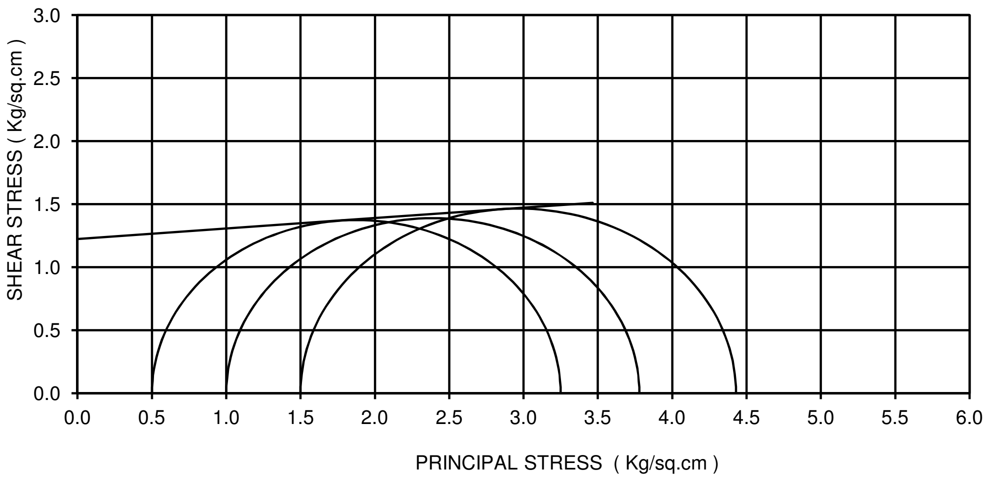


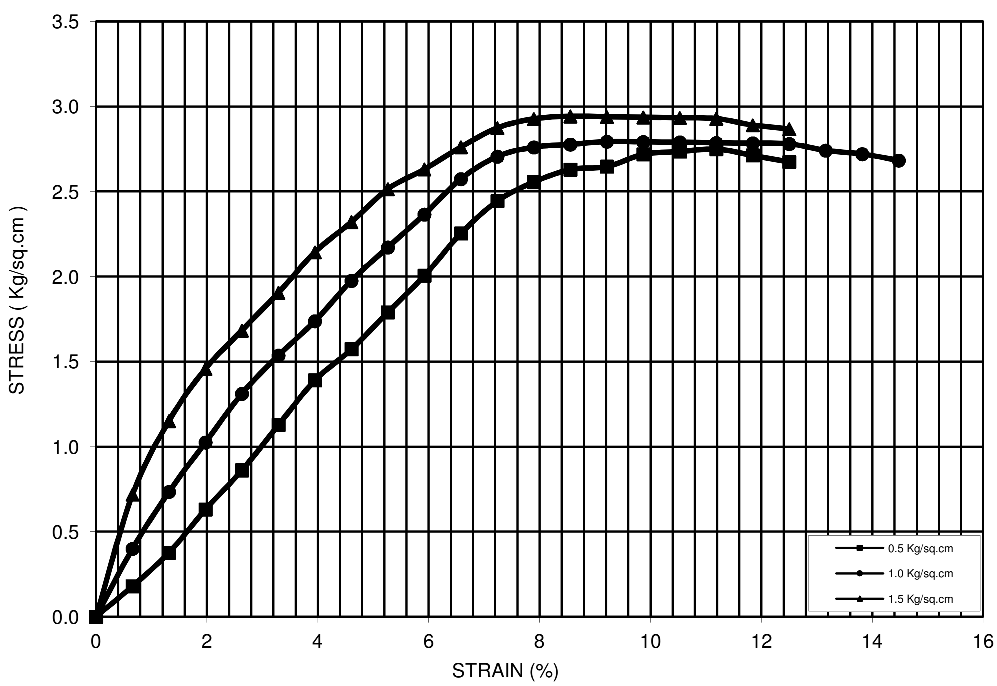
BORE HOLE NO: BH-A-1
CHAINAGE : 1+500
SAMPLE NO.: UDS-5
DEPTH: 29.50 m
COHESION(C)= 2.46 kg/sq.cm
ANGLE OF FRICTION(Phi): 4 deg
TYPE OF THE TEST: UUT



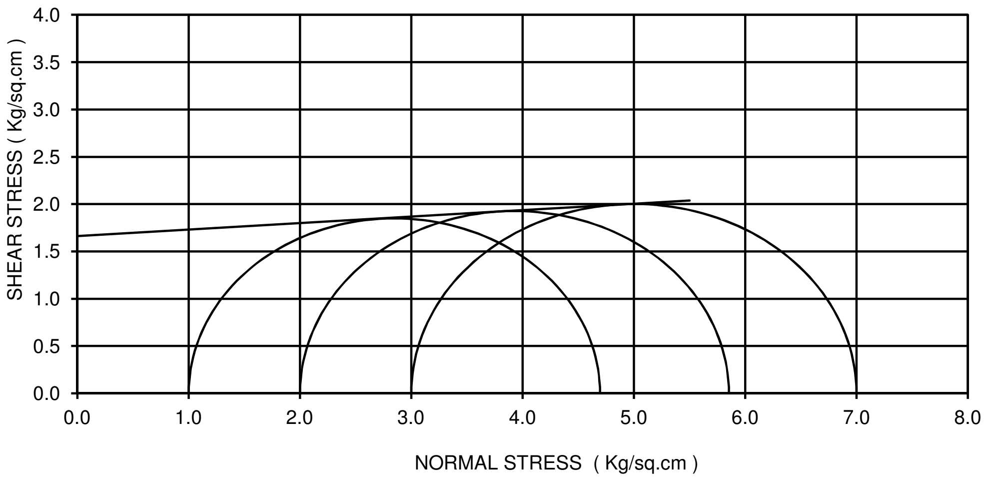


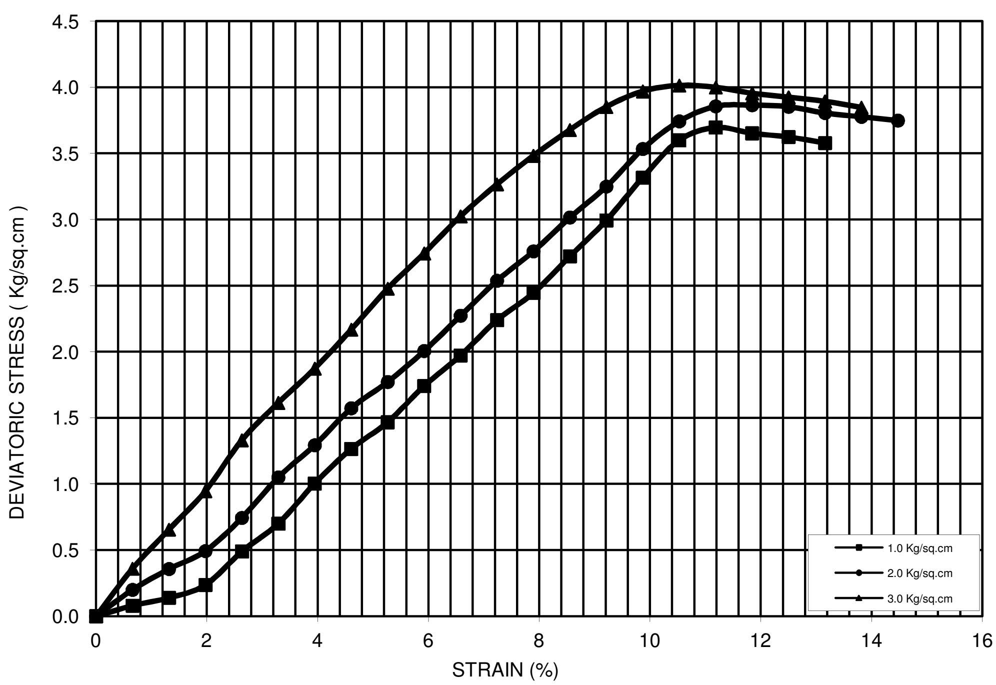
BORE HOLE NO: BH-A-2
CHAINAGE : 1+500
SAMPLE NO.: UDS-2
DEPTH: 4.00 m
COHESION(C)= 1.23 kg/sq.cm
ANGLE OF FRICTION(Phi): 5 deg
TYPE OF THE TEST: UUT





BORE HOLE NO: BH-A-2
CHAINAGE : 1+500
SAMPLE NO.: UDS-9
DEPTH: 28.00 m
COHESION(C)= 1.66 kg/sq.cm
ANGLE OF FRICTION(Phi): 4 deg
TYPE OF THE TEST: UUT

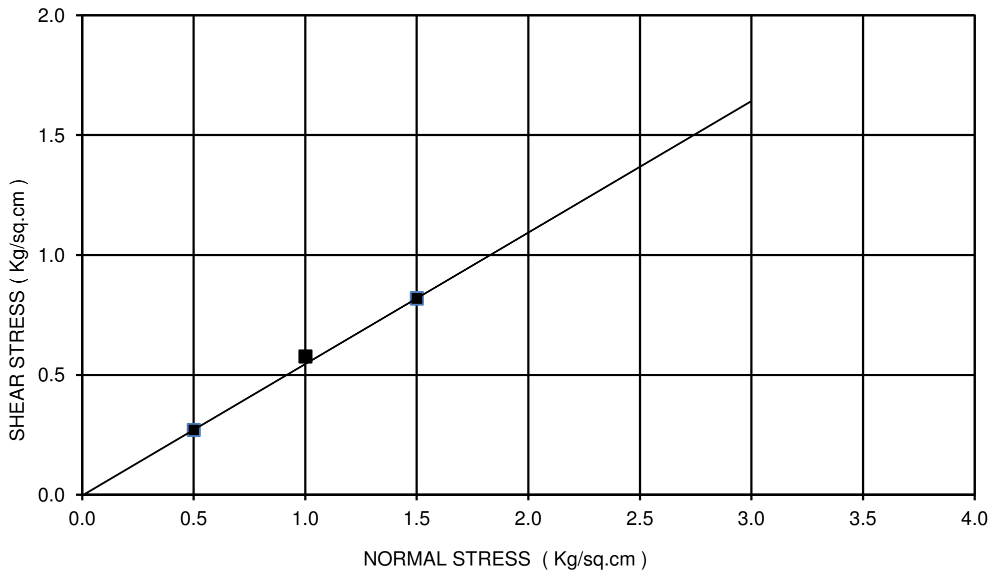


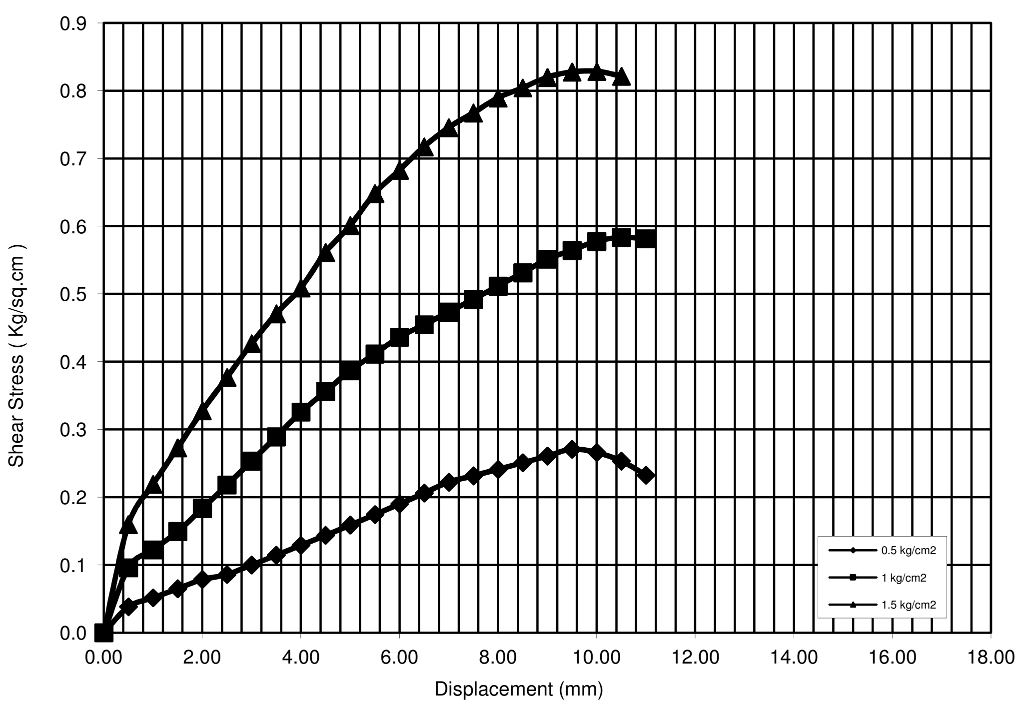


CEG Test House and Research Centre Pvt. Ltd.

BORE HOLE NO: BH-CL

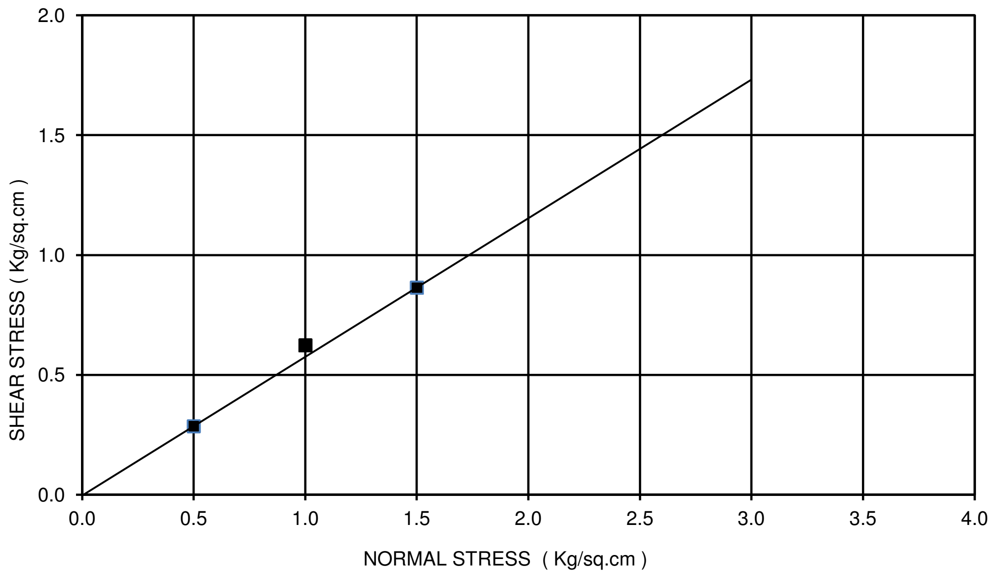
SAMPLE NO.: UDS-1
DEPTH: 2.50 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 29 deg
TYPE OF THE TEST: DST

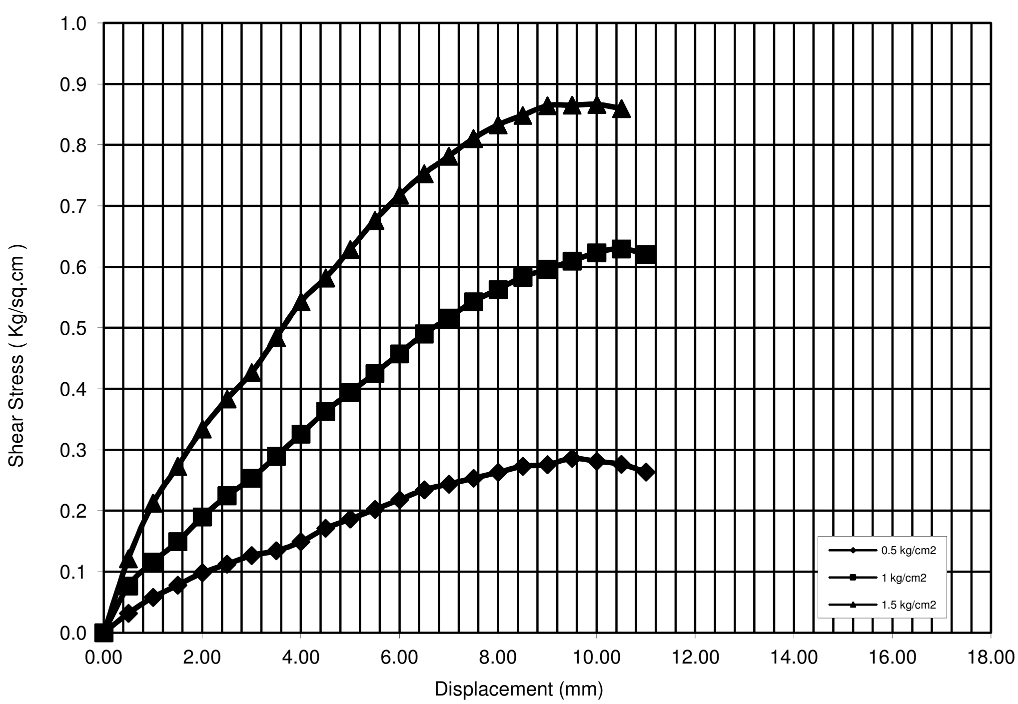




BORE HOLE NO: BH-CL

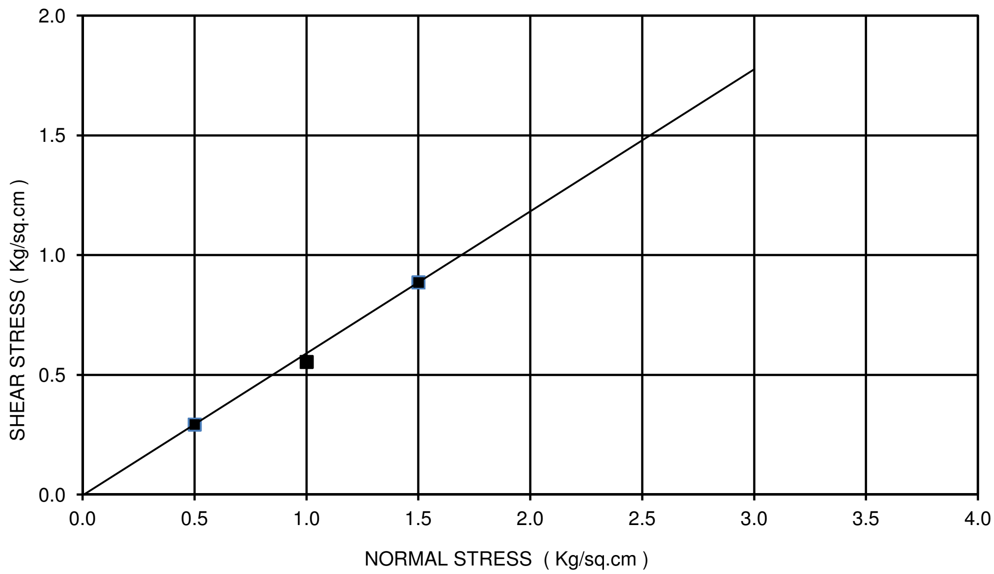
SAMPLE NO.: UDS-2
DEPTH: 5.50 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 30 deg
TYPE OF THE TEST: DST

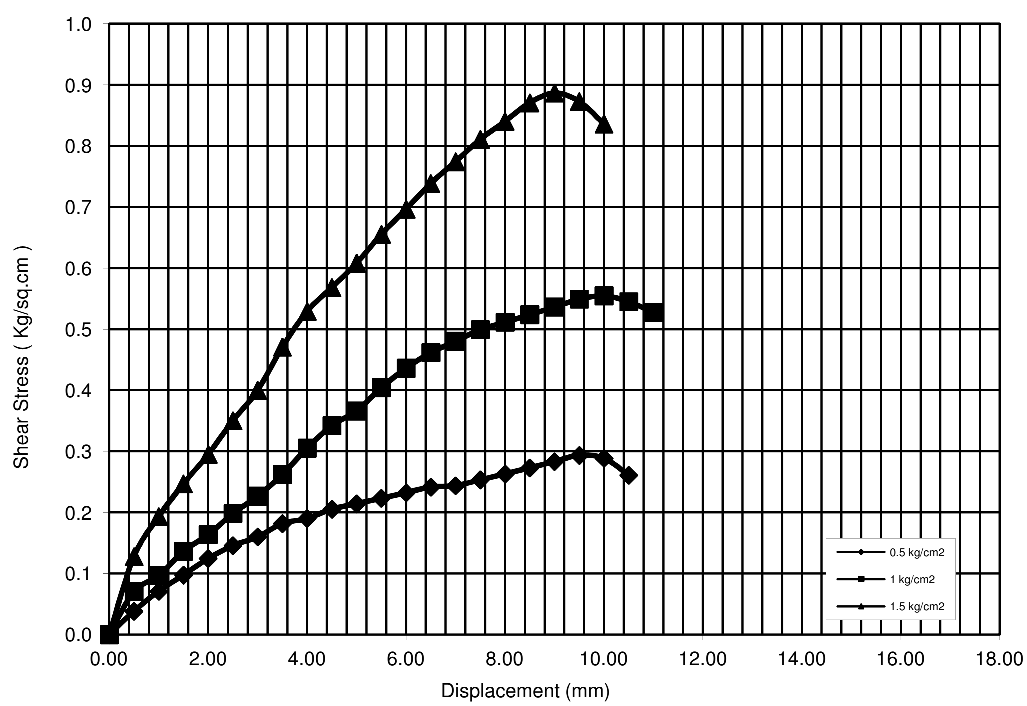




BORE HOLE NO: BH-CL

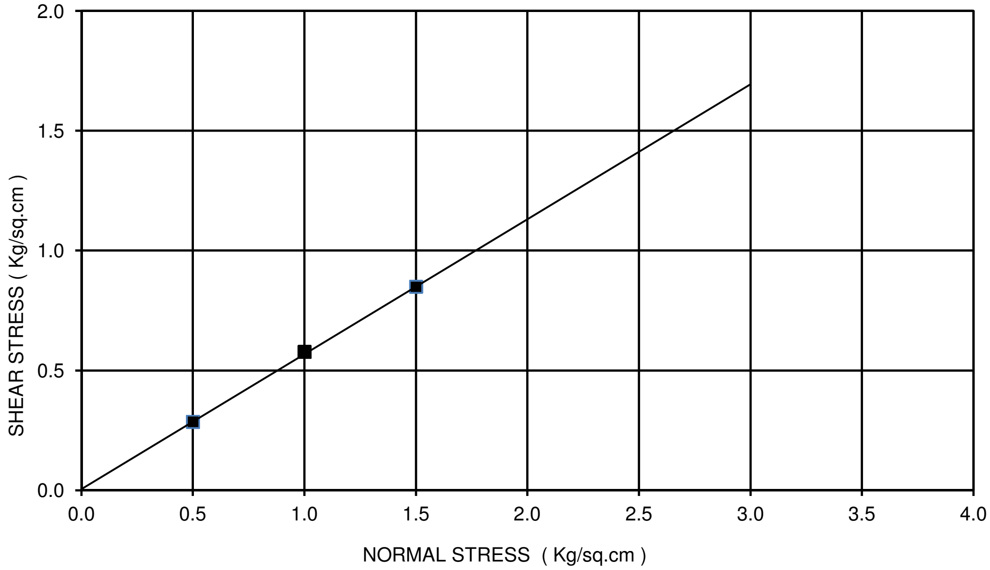
SAMPLE NO.: UDS-3
DEPTH: 8.50 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 31 deg
TYPE OF THE TEST: DST

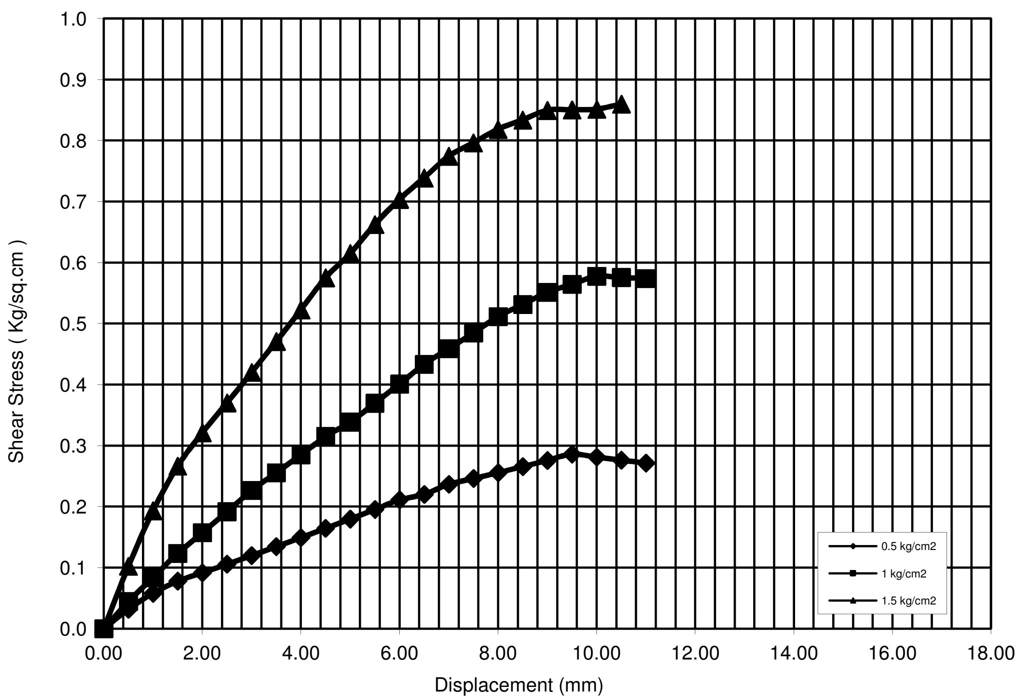




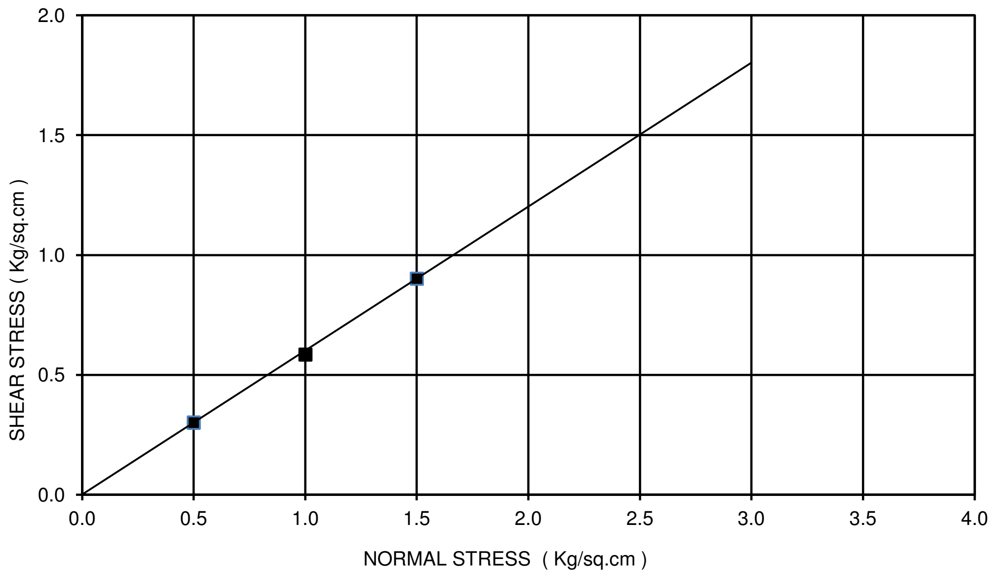
BORE HOLE NO: BH-CL

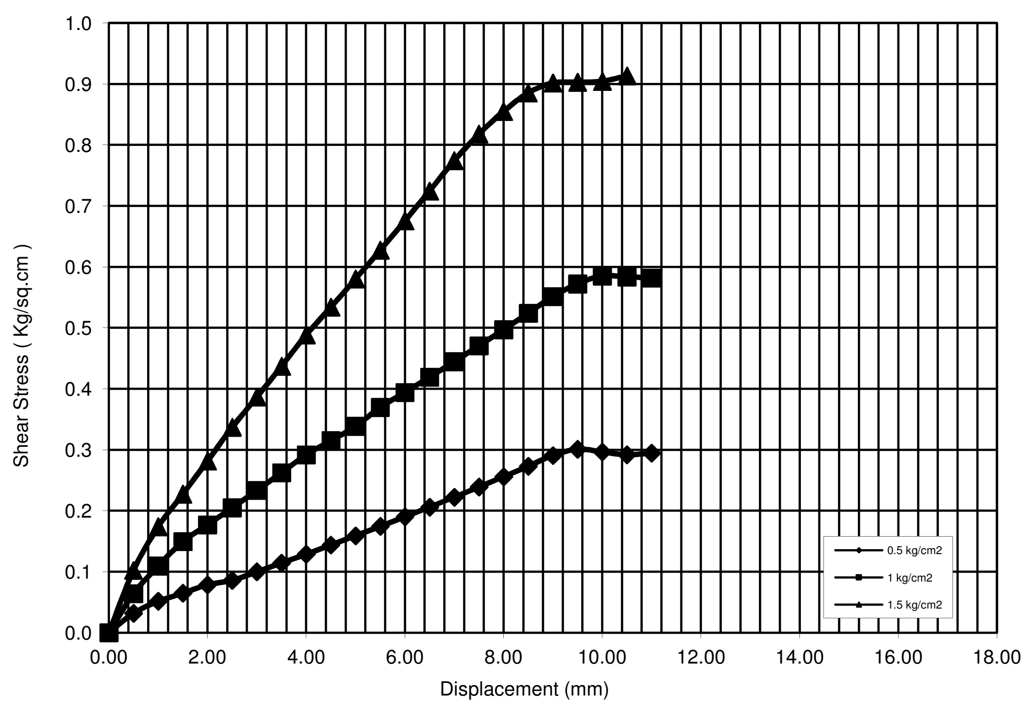
SAMPLE NO.: UDS-1
DEPTH: 1.00 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 29 deg
TYPE OF THE TEST: DST





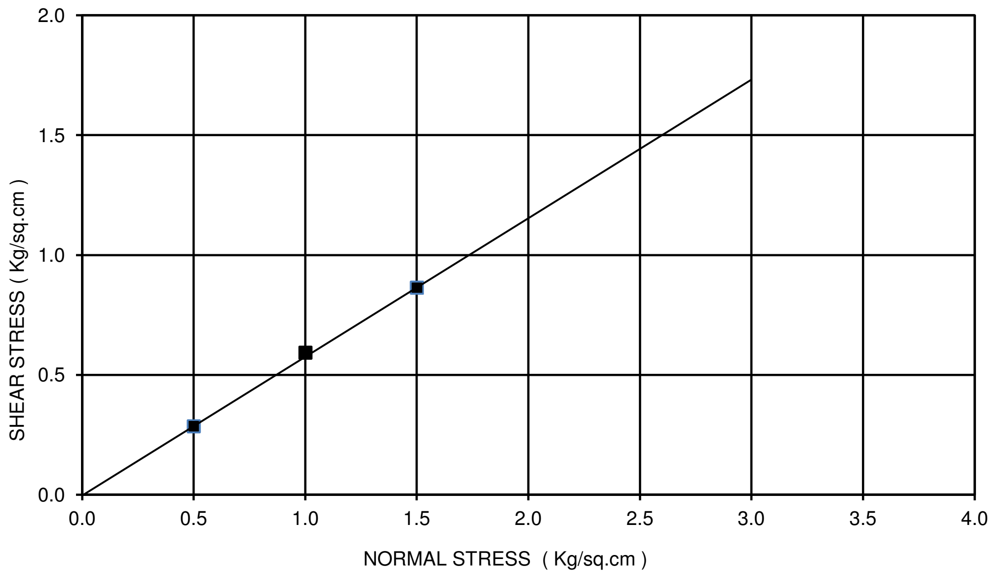
BORE HOLE NO: BH-CL
CHAINAGE : 0+934
SAMPLE NO.: UDS-2
DEPTH: 4.00 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 31 deg
TYPE OF THE TEST: DST

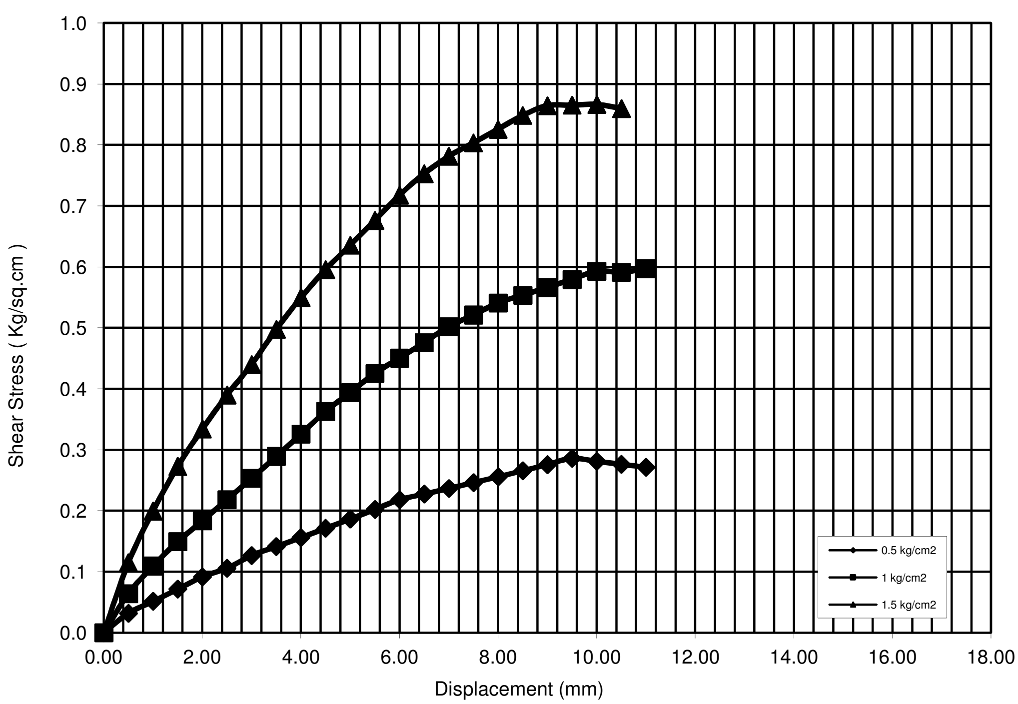


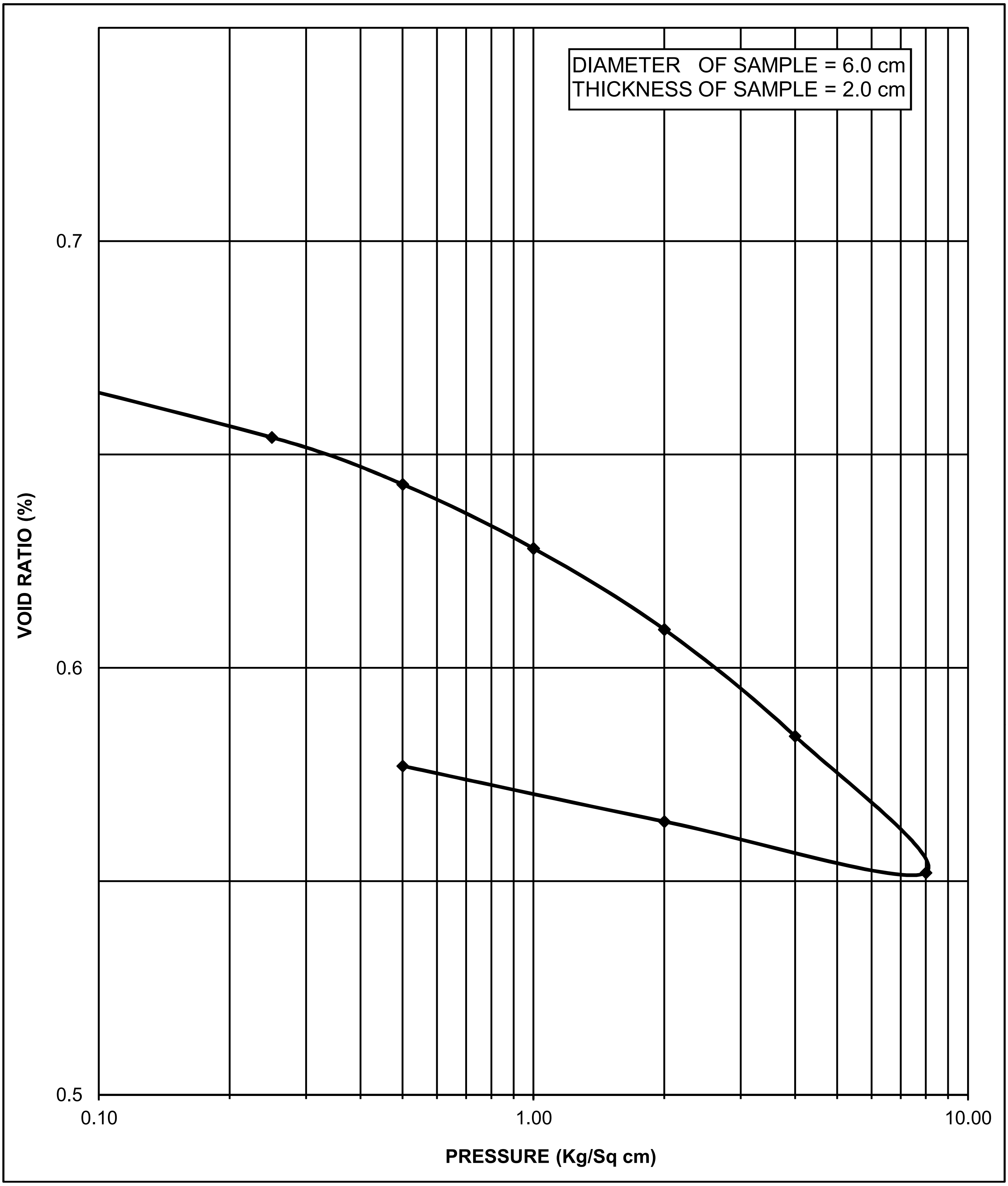


BORE HOLE NO: BH-CL

SAMPLE NO.: UDS-3
DEPTH: 7.00 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 30 deg
TYPE OF THE TEST: DST







BORE HOLE NO. = BH-A2

CHAINAGE = 1+500

SAMPLE NO. = UDS-02

DEPTH = 11.50 M

TYPY OF SOIL = CL

INITIAL WATER CONTENT = 20.36 %

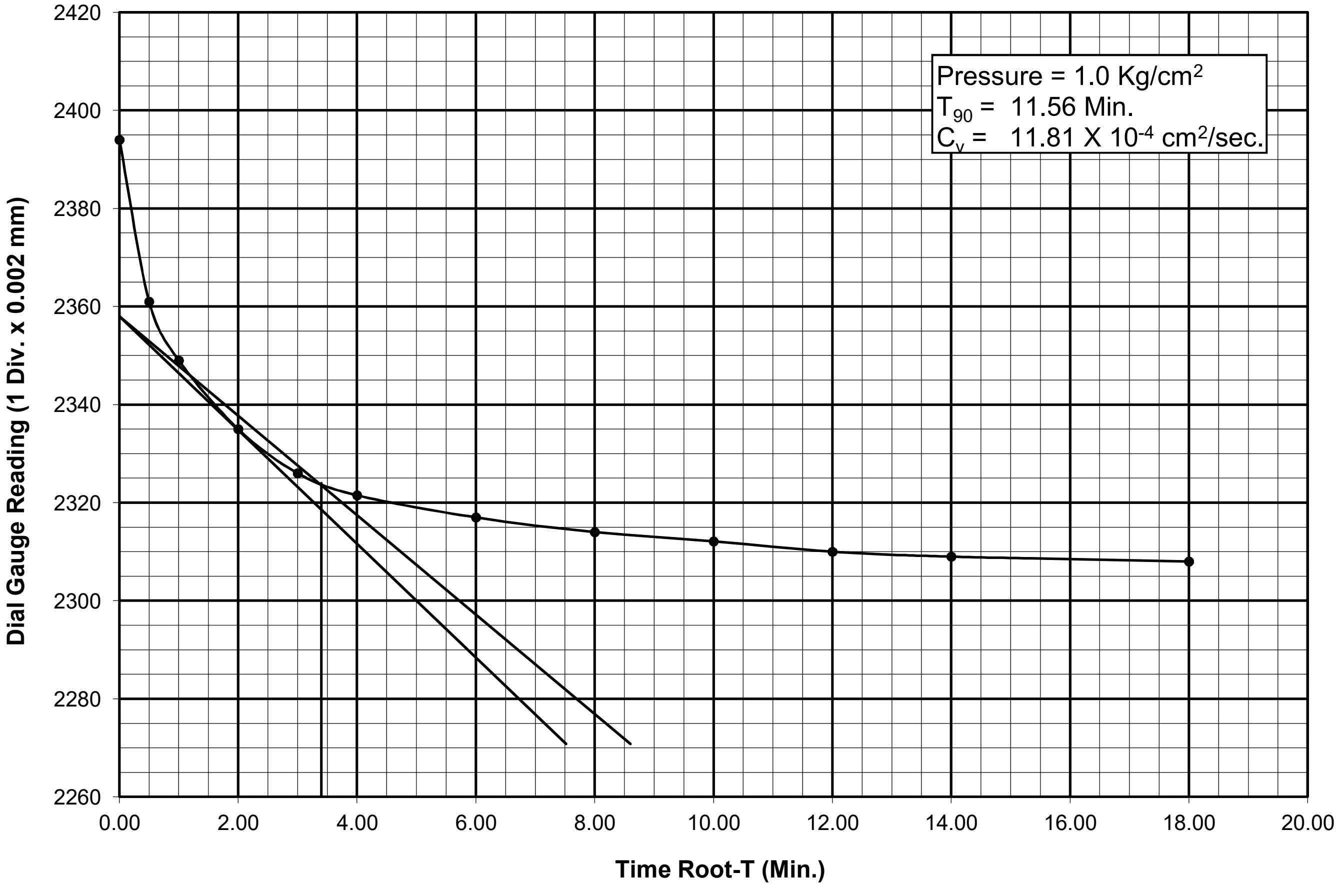
DRY DENSITY = 1.61 gm/cm^3

VOID RATIO (e_o) = 0.665

COMPRESIVE INDEX (C_c) = 0.106

FIGURE NO. PRESSURE Vs VOID RATIO CURVE (e-log p)

BORE HOLE NO. =	BH-A2
CHAINAGE =	1+500
SAMPLE NO. =	UDS-02
DEPTH =	4.00 M



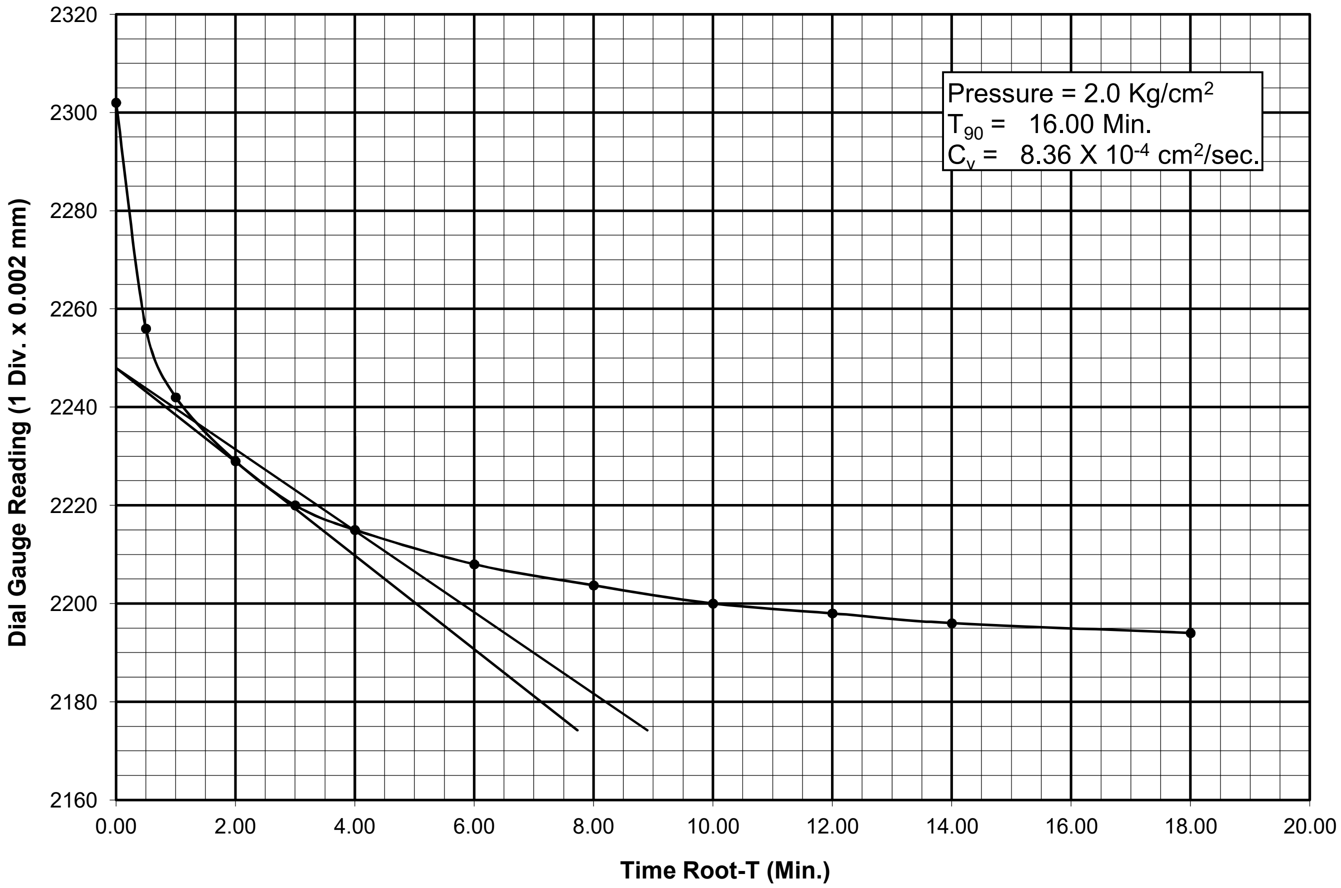
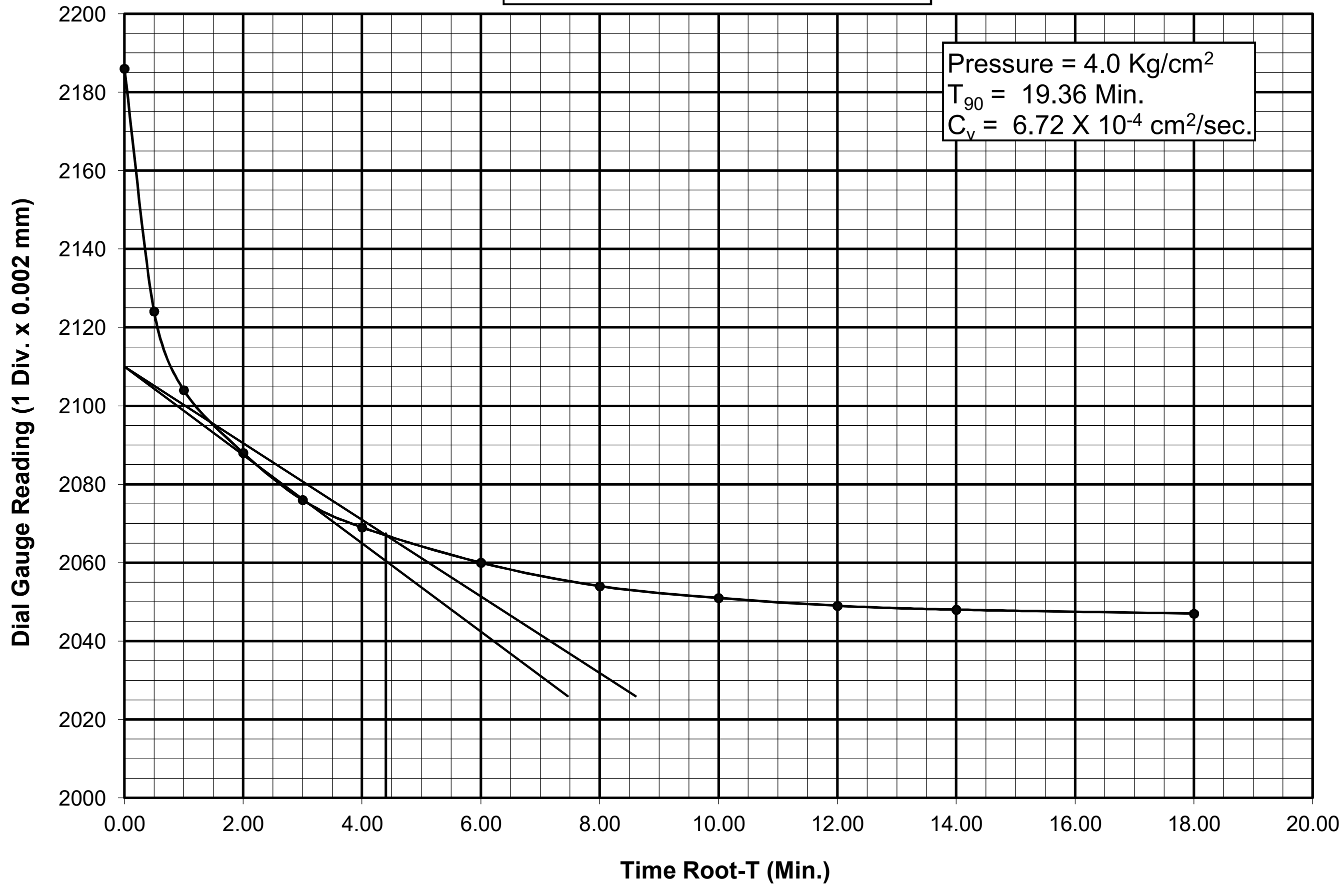


Figure No. -

BORE HOLE NO. = BH-A2
CHAINAGE = 1+500
SAMPLE NO. = UDS-02
DEPTH = 4.00 M



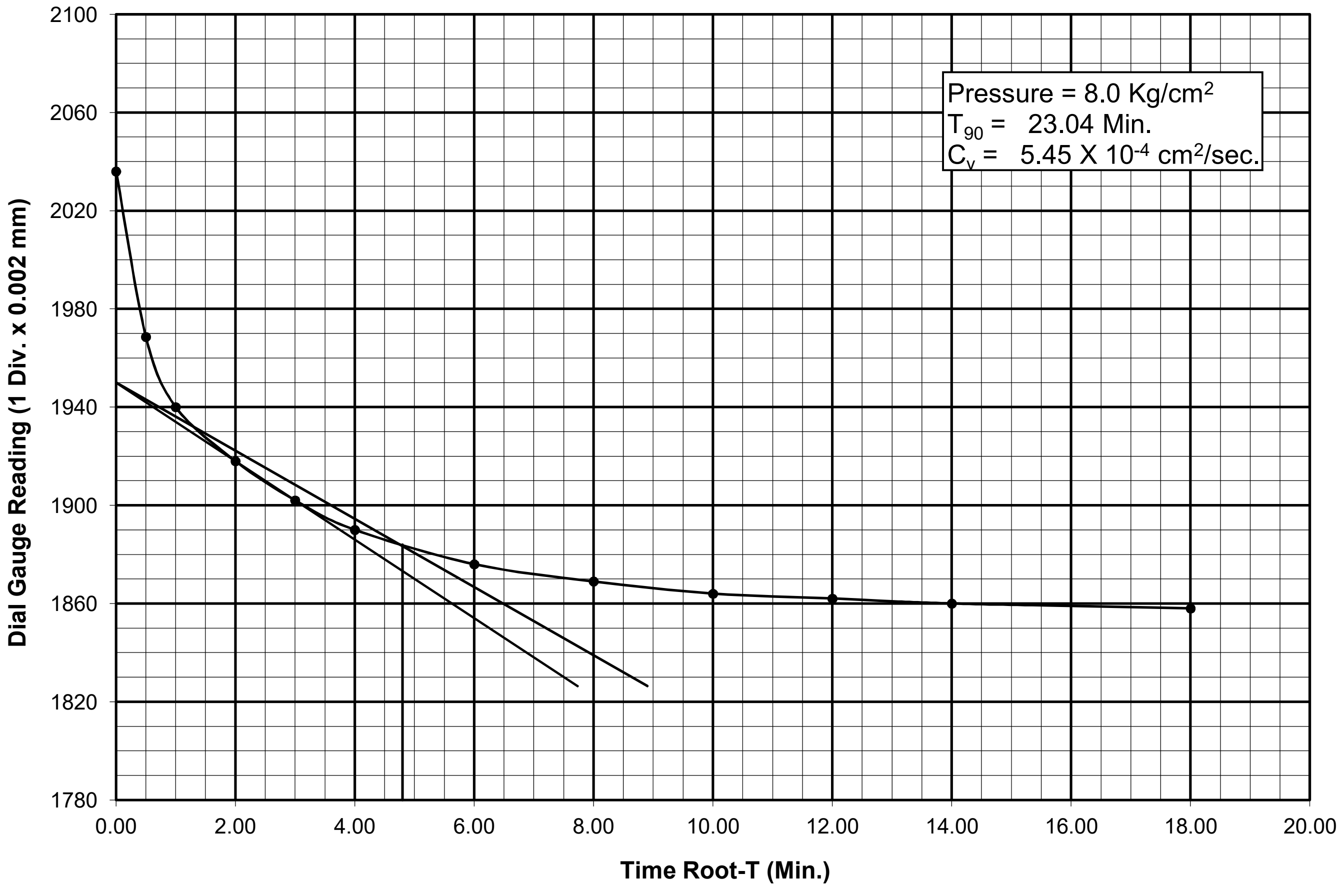
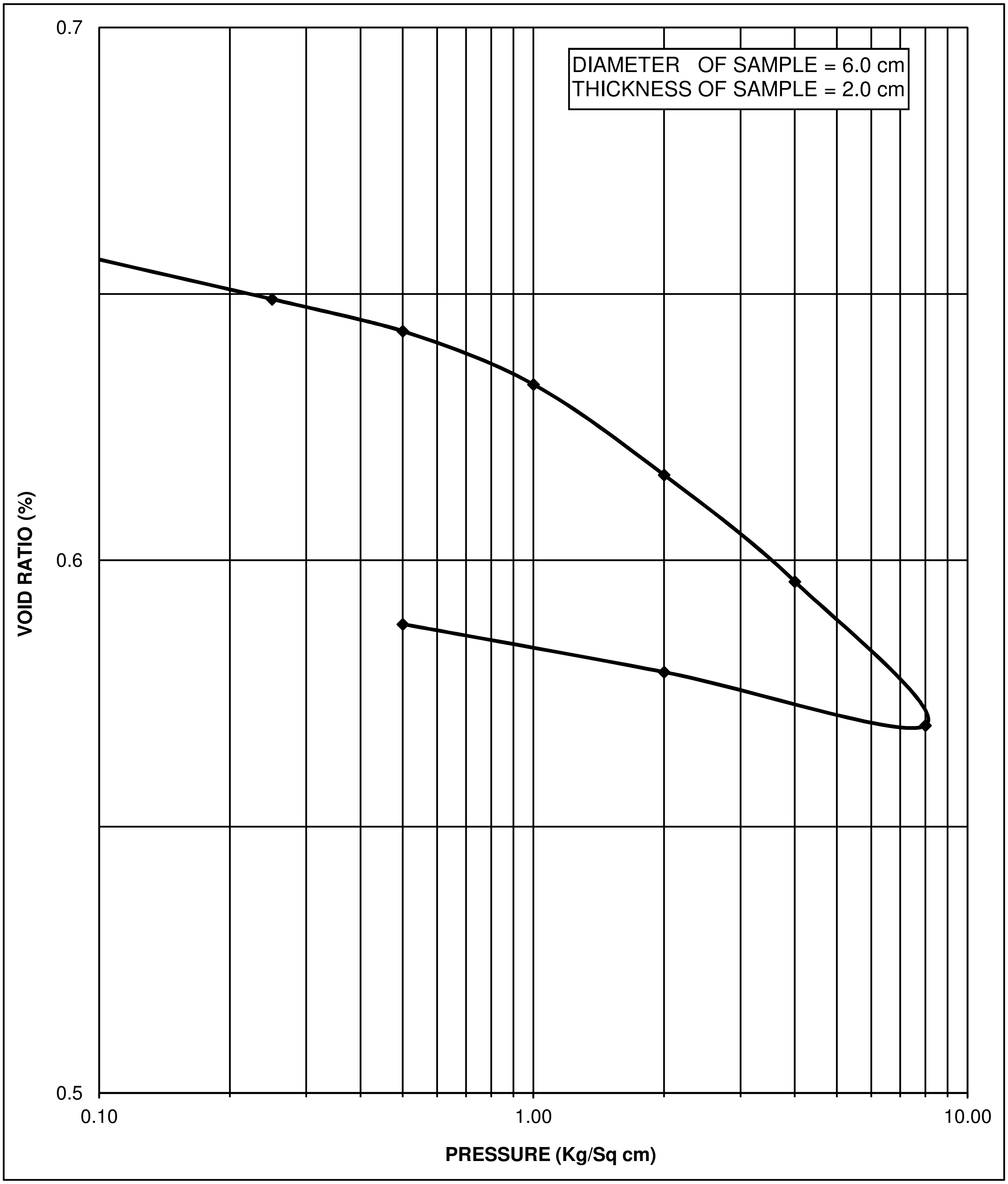


Figure No. -



BORE HOLE NO. = BH-A2

CHAINAGE = 1+500

SAMPLE NO. = UDS-03

DEPTH = 7.50 M

TYPY OF SOIL = CL

INITIAL WATER CONTENT = 23.44 %

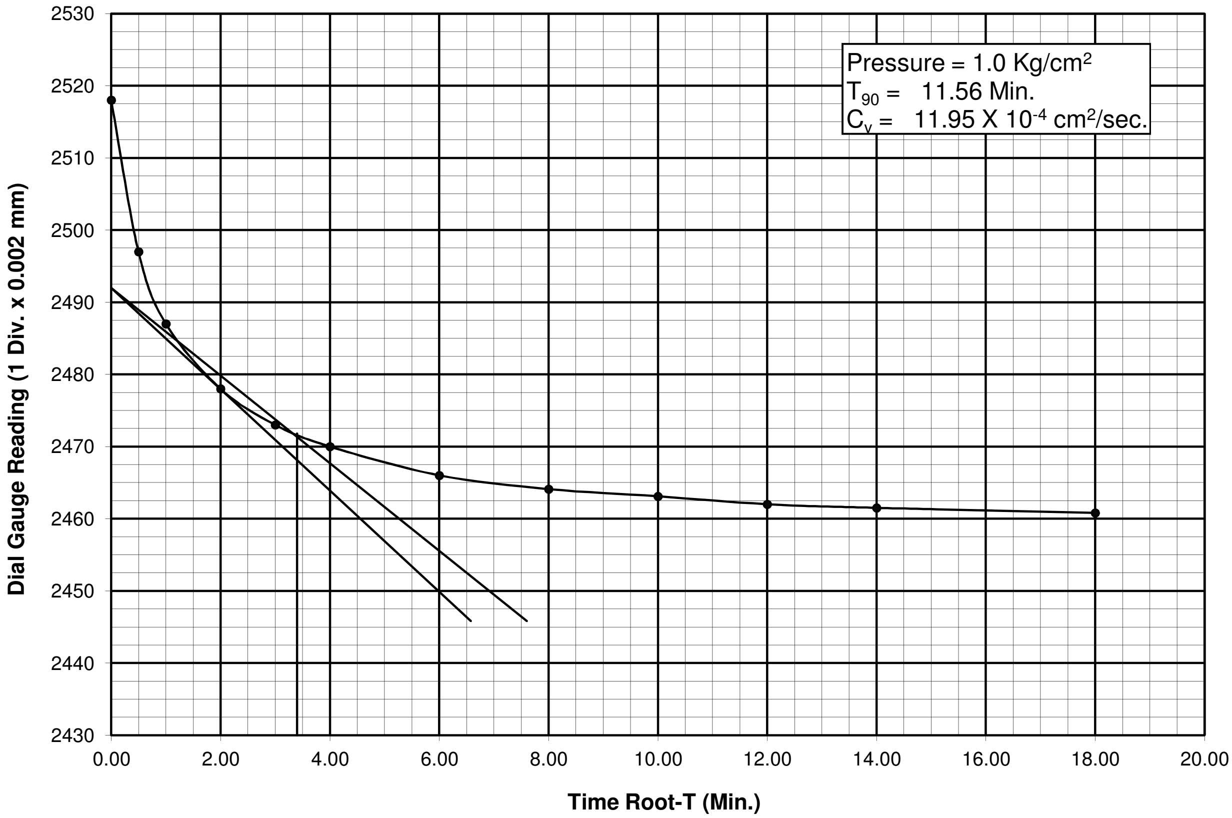
DRY DENSITY = 1.62 gm/cm^3

VOID RATIO (e_o) = 0.655

COMPRESIVE INDEX (C_c) = 0.090

FIGURE NO. PRESSURE Vs VOID RATIO CURVE (e-log p)

BORE HOLE NO.	=	BH-A2
CHAINAGE	=	1+500
SAMPLE NO.	=	UDS-2
DEPTH	=	7.00 M



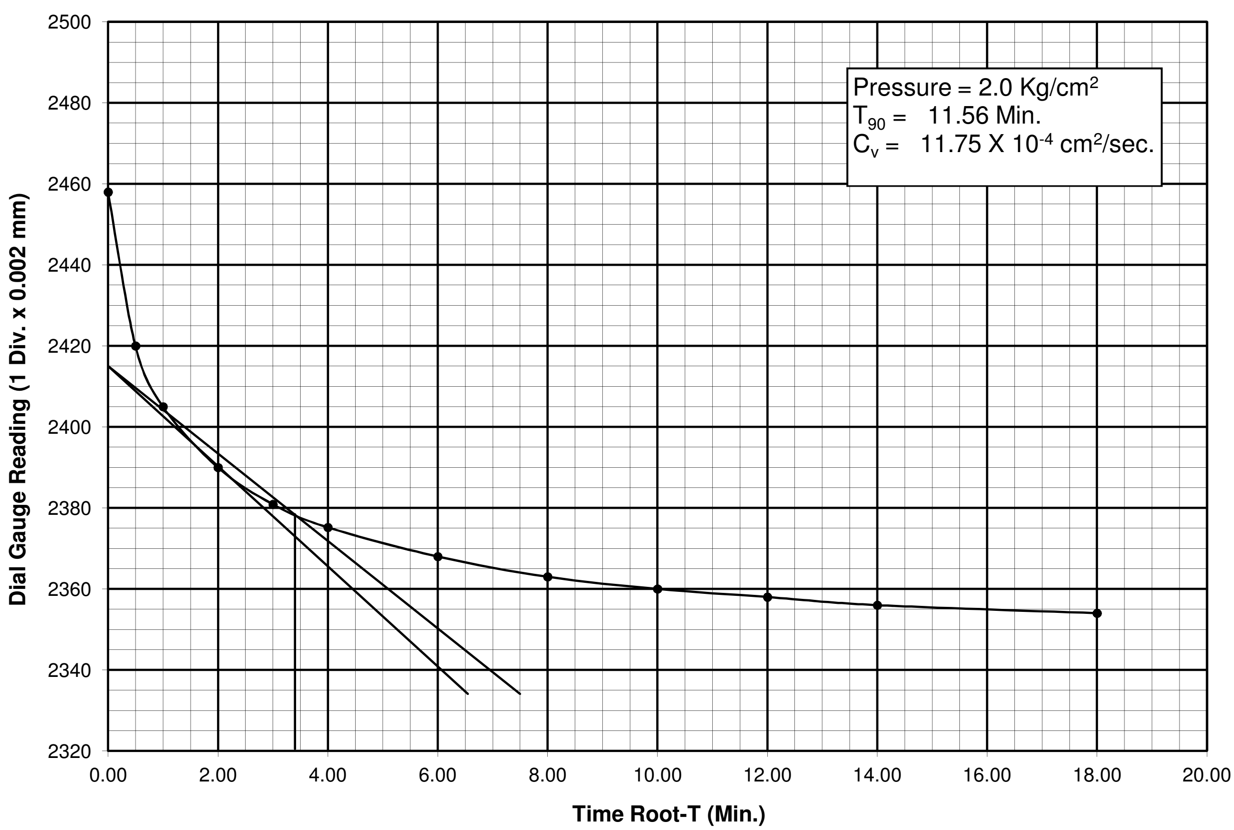
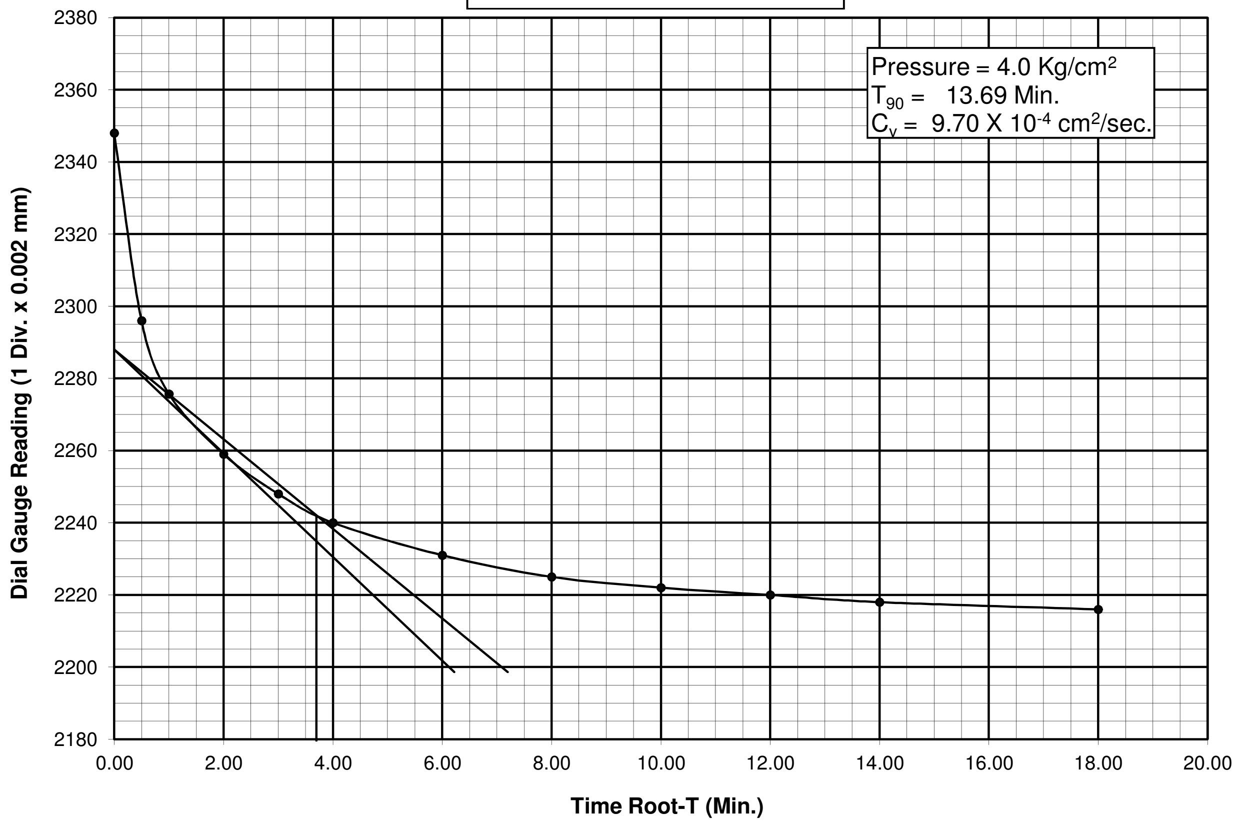


Figure No. -

BORE HOLE NO. = BH-A2
CHAINAGE = 1+500
SAMPLE NO. = UDS-2
DEPTH = 7.00 M



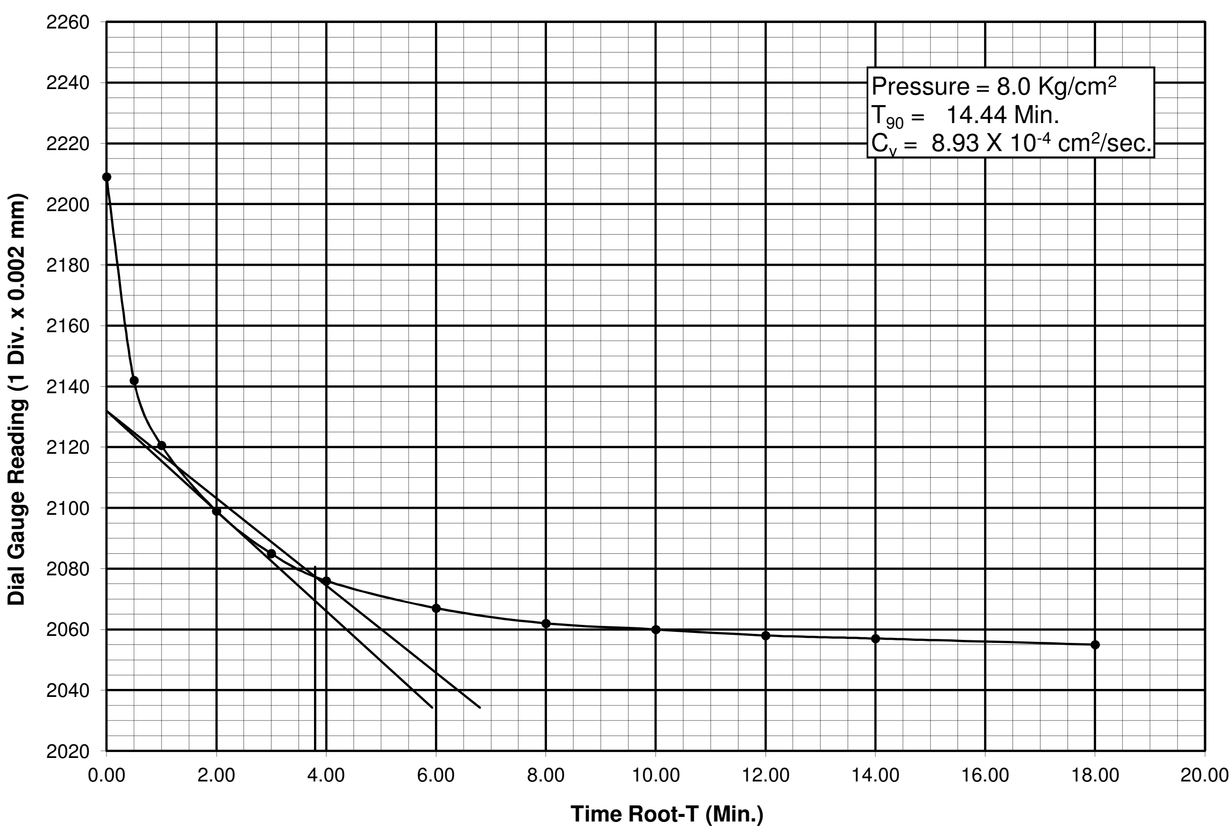


Figure No. -

APPENDIX – C
(ANALYSIS & RECOMENDATION)

Appendix No.	ITEMS
C-1	SAMPLE CALCULATION SHEET OF LIQUEFACTION ANALYSIS RESULTS
C-2	SAMPLE CALCULATIONS FOR COMPUTATION OF ALLOWABLE BEARING CAPACITY OF SUB-STRATA FOR SHALLOW FOUNDATION
C-3	SAMPLE CALCULATION FOR COMPUTATION OF SAFE LOAD CARRYING CAPACITY OF NORMAL BORED CAST-IN-SITU RCC PILE IN COMPRESSION & UPLIFT
C-4	SAMPLE CALCULATION FOR COMPUTATION OF SAFE LOAD CARRYING CAPACITY OF NORMAL BORED CAST-IN-SITU RCC PILE IN LATERAL

Liquefaction Analysis as per 2. IS code1893 Part I: 2016, IRC:75-2015 & RDSO BS-118

Chainage (Km)	(-)2+514	BH No.:-	BH-CL	Liquefiable upto=	NL		Water Table depth considered for analysis (m):-	0.00	

Depth Below G.L. (z) in m	Observed SPT Value	Saturated Density (t/m^3)	Submerged Density (t/m^3)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Moisture Content @ 100% saturation	Strata Type	Liquefaction Check for Cohesive Strata	Fine Content (%)	Stress Reduction Coefficient (rd)	Total Overburden Press (σ_o), t/m^2	Effective Overburden (σ'_o), t/m^2	Critical Stress Ratio (CSR)	C_{60}	Stress Normalization Factor(C_N)	SPT Corrected $(N1)_{60}$	α	β	$(N1)_{60CS}$	$CRR_{M=7.5}$	K_M	Kα	Kσ	CRR_{Mw}	FOS	Conclusion
2.50	13	1.95	1.95	27.00	20.00	7.00	27.77	Cohesive	Liquefiable	59	0.981	4.50	2.00	0.344	1.000	1.70	22.1	5.00	1.20	31.52	NA	1.19	1	1.00	NA	>1	Non Liquefiable
5.50	28	1.98	1.98					Cohesionless		19	0.958	10.36	7.86	0.197	1.000	1.12	31.3	3.43	1.07	36.97	NA	1.19	1	1.00	NA	>1	Non Liquefiable
10.00	46	1.99	0.99					Cohesionless		21	0.907	19.29	16.79	0.163	1.000	0.76	35.1	3.78	1.09	41.95	NA	1.19	1	1.00	NA	>1	Non Liquefiable

Calculation of SBC for shallow foundations as per IS : 6403 - 1981

INPUT DATA

CH. (KM) :- (-)1+969

BH NO. :- BH-CL

Type of footing

1 Continuous Strip
2 Rectangular
3 Square
4 Circular

Square **3**

Angle of internal friction (ϕ^o)	26.00
Cohesion (c in t/m^2)	1.80
Void ratio (e), $e = (G.\gamma_w/\gamma_d)-1$	0.77
Direction of load with vertical (^{o})	0.00
Density of foundation soil (t/m^3) γ_{bulk}	1.70
Depth of water table(m)	4.50
Factor of safety	2.50

S.no.	Depth (m) of footing (D_f) below EGL	Width (m)
1	1.00	4.80
2	2.00	4.80
3	3.00	4.80

SHEAR FAILURE CRITERIA

Assumptions and formula used in calculation as per IS:6403-1981 are given below -

NOTE: The type of failure used for bearing capacity analysis depends upon the value of void ratio (see IS 6403 : 1981, Page No. 9, Table No. 3).

The ultimate net bearing capacity in case of general shear failure is given by (from IS 6403 : 1981, page No. 8)

$$q_d = c\,N_c\,s_c\,d_c\,i_c + q\,(N_q-1)\,s_q\,d_q\,i_q + (1/2)\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$$

The ultimate net bearing capacity in case of local shear failure is given by (from IS 6403 : 1981, page No. 8)

$$q'_d = (2/3)\,c\,N'_c\,s_c\,d_c\,i_c + q\,(N'_q-1)\,s_q\,d_q\,i_q + (1/2)\,B\,\gamma\,N'_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$$

Where,

$d_c = 1+ 0.2\,(D_f/B)*SQRT(N_\phi)$

$d_q = d_\gamma = 1$ for $\phi < 10^o$

$d_q = d_\gamma = 1 + 0.1\,(D_f/B)*SQRT(N_\phi)$ for $\phi > 10^o$

$N_\phi = \tan^2(\pi/4 + \phi/2)$

(from IS 6403 : 1981, page No. 9)

ϕ' is friction angle for local shear failure = $\tan^{-1}(0.67 \tan\phi)$

OUTPUT

The computer aided results for shear failure criteria are tabulated below. The results are interpolated values of bearing capacity obtained from general and local shear failure criteria.

Bearing capacity factors : (from IS 6403 : 1981, page No. 8, Table No. 1)

ϕ	26.00	ϕ'	18.10
N_c	22.25	N'_c	13.18
N_q	11.85	N'_q	5.31
N_γ	12.54	N'_γ	4.12

Shape factors : (from IS 6403 : 1981, page No. 8, Table No. 2)

S.no.	Width(m)	S_c	S_q	S_γ
1	4.80	1.30	1.20	0.80
2	4.80	1.30	1.20	0.80
3	4.80	1.30	1.20	0.80
		1.30	1.20	0.80
		1.30	1.20	0.80
		1.30	1.20	0.80

Depth factors : (from IS 6403 : 1981, page No. 9)

S.no.	Depth(m)	Width(m)	dc	d_q	d_γ
1	1.00	4.80	1.07	1.03	1.03
2	2.00	4.80	1.13	1.07	1.07
3	3.00	4.80	1.20	1.10	1.10
			#VALUE!	#VALUE!	#VALUE!
			#VALUE!	#VALUE!	#VALUE!
			#VALUE!	#VALUE!	#VALUE!

Inclination factors : (from IS 6403 : 1981, page No. 9)

$i_c = (1-\alpha / 90)^2$	$i_q = (1-\alpha / 90)^2$	$i_\gamma = (1- \alpha / \phi)^2$
1.00	1.00	1.00

Water table factor : (from IS 6403 : 1981, page No. 9)

S.no.	Depth(m)	Width(m)	Z_w/B	W'
1	1.00	4.80	0.73	0.86
2	2.00	4.80	0.52	0.76
3	3.00	4.80	0.31	0.66
			#VALUE!	#VALUE!
			#VALUE!	#VALUE!
			#VALUE!	#VALUE!

Safe Bearing Capacity

S.no.	Depth(m)	Width(m)	SBC in (t/m^2)		
			General shear	Local shear	Recommended
1	1.00	4.80	45.98	17.21	17.21
2	2.00	4.80	55.76	21.18	21.18
3	3.00	4.80	66.02	25.34	25.34

SETTLEMENT CALCULATION AS PER 8009 Part-1 1976 | CH. (KM): (-)1+969 | BH NO. :- BH-CL

Layer	Depth below FGL (m)	From (m)	To (m)	Layer Thickness	Stress at Foundation level (Kg/Cm2)	Length (m)	Breadth (m)	Layer Thickness(m)	Dispersed Length (m)	Dispersed Breadth (m)	Stress Increment at top for cohesionless layer & at mid Depth for cohesive layer (kg/Cm2)	Average N-Value	Mvc (Cm^2/Kg)	Consolidation Settlement (mm)	Water Table Correction Factor	Modulus of Soil (Kg/Cm^2)	Poission's Ratio	Settlement (mm) for 10 t/m2 (from IS:8009 (Part I), Fig. 9, Page NO. 17)	Settlement in Non-Cohesive Soil Si (mm)	Total Settlement (mm)	Depth Factor	Rigidity Factor	Corrected Total Settlement (mm)
Layer 1		1.00	4.00	3.00				3.00	4.80	4.800	1.169	14			0.50	145	0.30	25.00	19.28	19.28			
Layer 2		4.00	8.20	4.20				4.20	9.900	9.900	0.275	22	0.0061	6.99	0.50	84	0.45			6.99			
	1.00				1.17	4.80	4.80														0.95	1.00	25.00
Layer 1		2.00	4.00	2.00				2.00	4.80	4.800	1.395	14			0.50	145	0.30	25.00	16.68	16.68			
Layer 2		4.00	8.50	4.50				4.50	9.050	9.050	0.392	22	0.0061	10.70	0.50	84	0.45			10.70			
Layer 3		8.50	9.20	0.70				0.70	11.300	11.300	0.252	22			0.50	92.5	0.30	13.80	0.56	1.02			
	2.00				1.39	4.80	4.80														0.88	1.00	25.00
Layer 1		3.00	4.00	1.00				1.00	4.80	4.800	1.697	14			0.50	145	0.30	25.00	10.96	10.96			
Layer 2		4.00	8.50	4.50				4.50	8.050	8.050	0.603	22	0.0061	16.45	0.50	84	0.45			16.45			
Layer 3		8.50	10.20	1.70				1.70	10.300	10.300	0.368	22			0.50	92.5	0.30	13.80	2.11	3.33			
	3.00				1.70	4.80	4.80														0.81	1.00	25.00

SETTLEMENT CALCULATION AS PER 8009 Part-1 1976														CH. (KM): (-)1+969						BH NO. :- BH-CL			
Layer	Depth below FGL (m)	From (m)	To (m)	Layer Thickness	Stress at Foundation level (Kg/Cm2)	Length (m)	Breadth (m)	Layer Thickness(m)	Dispersed Length (m)	Dispersed Breadth (m)	Stress Increment at top for cohesionless layer & at mid Depth for cohesive layer (kg/Cm2)	Average N-Value	Mvc (Cm^2/Kg)	Consolidation Settlement (mm)	Water Table Correction Factor	Modulus of Soil (Kg/Cm^2)	Poission's Ratio	Settlement (mm) for 10 t/m2 (from IS:8009 (Part I), Fig. 9, Page NO. 17)	Settlement in Non-Cohesive Soil Si (mm)	Total Settlement (mm)	Depth Factor	Rigidity Factor	Corrected Total Settlement (mm)
Layer 1	1.00	1.00	4.00	3.00	2.34	4.80	4.80	3.00	4.80	4.800	2.337	14			0.50	145	0.30	25.00	38.55	38.55	0.95	1.00	50.00
Layer 2		4.00	8.20	4.20				4.20	9.900	9.900	0.549	22	0.0061	13.99	0.50	84	0.45			13.99			
Layer 1	2.00	2.00	4.00	2.00	2.79	4.80	4.80	2.00	4.80	4.800	2.790	14			0.50	145	0.30	25.00	33.36	33.36	0.88	1.00	50.00
Layer 2		4.00	8.50	4.50				4.50	9.050	9.050	0.785	22	0.0061	21.40	0.50	84	0.45			21.40			
Layer 3		8.50	9.20	0.70				0.70	11.300	11.300	0.503	22			0.50	92.5	0.30	13.80	1.12	2.04			
Layer 1	3.00	3.00	4.00	1.00	3.39	4.80	4.80	1.00	4.80	4.800	3.393	14			0.50	145	0.30	25.00	21.93	21.93	0.81	1.00	50.00
Layer 2		4.00	8.50	4.50				4.50	8.050	8.050	1.206	22	0.0061	32.90	0.50	84	0.45			32.90			
Layer 3		8.50	10.20	1.70				1.70	10.300	10.300	0.737	22			0.50	92.5	0.30	13.80	4.23	6.66			

Calculation of SBC for shallow foundations as per IS : 6403 - 1981

INPUT DATA

CH. (KM) :- (-)1+969

BH NO. :- BH-CL

Type of footing

1 Continuous Strip
2 Rectangular
3 Square
4 Circular

Square **3**

Angle of internal friction (ϕ °)	26.00
Cohesion (c in t/m^2)	1.80
Void ratio (e), e = $(G.\gamma_w/\gamma_d)-1$	0.77
Direction of load with vertical (°)	0.00
Density of foundation soil (t/m^3) γ_{bulk}	1.70
Depth of water table(m)	4.50
Factor of safety	2.50

S.no.	Depth (m) of footing (D_f) below EGL	Width (m)
1	1.00	4.80
2	2.00	4.80
3	3.00	4.80

SHEAR FAILURE CRITERIA

Assumptions and formula used in calculation as per IS:6403-1981 are given below -

NOTE: The type of failure used for bearing capacity analysis depends upon the value of void ratio (see IS 6403 : 1981, Page No. 9, Table No. 3).

The ultimate net bearing capacity in case of general shear failure is given by (from IS 6403 : 1981, page No. 8)

$$q_d = c\, N_c\, s_c\, d_c\, i_c + q\,(N_q-1)\, s_q\, d_q\, i_q + (1/2)\, B\, \gamma\, N_\gamma\, s_\gamma\, d_\gamma\, i_\gamma\, W'$$

The ultimate net bearing capacity in case of local shear failure is given by (from IS 6403 : 1981, page No. 8)

$$q'_d = (2/3)\, c\, N'_c\, s_c\, d_c\, i_c + q\,(N'_q-1)\, s_q\, d_q\, i_q + (1/2)\, B\, \gamma\, N'_\gamma\, s_\gamma\, d_\gamma\, i_\gamma\, W'$$

Where,

$d_c = 1+ 0.2\,(D_f/B)*SQRT(N_\phi)$

$d_q = d_\gamma = 1$ for $\phi < 10^o$

$d_q = d_\gamma = 1 + 0.1\,(D_f/B)*SQRT(N_\phi)$ for $\phi > 10^o$

$N_\phi = \tan^2(\pi/4 + \phi/2)$

(from IS 6403 : 1981, page No. 9)

ϕ' is friction angle for local shear failure = $\tan^{-1}(0.67 \tan\phi)$

OUTPUT

The computer aided results for shear failure criteria are tabulated below. The results are interpolated values of bearing capacity obtained from general and local shear failure criteria.

Bearing capacity factors : (from IS 6403 : 1981, page No. 8, Table No. 1)

ϕ	26.00	ϕ'	18.10
N_c	22.25	N'_c	13.18
N_q	11.85	N'_q	5.31
N_γ	12.54	N'_γ	4.12

Shape factors : (from IS 6403 : 1981, page No. 8, Table No. 2)

S.no.	Width(m)	S_c	S_q	S_γ
1	4.80	1.30	1.20	0.80
2	4.80	1.30	1.20	0.80
3	4.80	1.30	1.20	0.80

Depth factors : (from IS 6403 : 1981, page No. 9)

S.no.	Depth(m)	Width(m)	dc	d_q	d_γ
1	1.00	4.80	1.07	1.03	1.03
2	2.00	4.80	1.13	1.07	1.07
3	3.00	4.80	1.20	1.10	1.10

Inclination factors : (from IS 6403 : 1981, page No. 9)

$i_c = (1-\alpha / 90)^2$	$i_q = (1-\alpha / 90)^2$	$i_\gamma = (1- \alpha / \phi)^2$
1.00	1.00	1.00

Water table factor : (from IS 6403 : 1981, page No. 9)

S.no.	Depth(m)	Width(m)	Z_w/B	W'
1	1.00	4.80	0.73	0.86
2	2.00	4.80	0.52	0.76
3	3.00	4.80	0.31	0.66

Safe Bearing Capacity

S.no.	Depth(m)	Width(m)	SBC in (t/m^2)		
			General shear	Local shear	Recommended
1	1.00	4.80	45.98	17.21	17.21
2	2.00	4.80	55.76	21.18	21.18
3	3.00	4.80	66.02	25.34	25.34

SETTLEMENT CALCULATION AS PER 8009 Part-1 1976														CH. (KM): (-)1+969						BH NO. :- BH-CL			
Layer	Depth below FGL (m)	From (m)	To (m)	Layer Thickness	Stress at Foundation level (Kg/Cm2)	Length (m)	Breadth (m)	Layer Thickness(m)	Dispersed Length (m)	Dispersed Breadth (m)	Stress Increment at top for cohesionless layer & at mid Depth for cohesive layer (kg/Cm2)	Average N-Value	Mvc (Cm^2/Kg)	Consolidation Settlement (mm)	Water Table Correction Factor	Modulus of Soil (Kg/Cm^2)	Poission's Ratio	Settlement (mm) for 10 t/m2 (from IS:8009 (Part I), Fig. 9, Page NO. 17)	Settlement in Non-Cohesive Soil Si (mm)	Total Settlement (mm)	Depth Factor	Rigidity Factor	Corrected Total Settlement (mm)
Layer 1	1.00	1.00	4.00	3.00	1.95	4.80	4.80	3.00	4.80	4.800	1.945	25			0.50	200	0.30	11.40	14.63	14.63	0.95	1.00	25.00
Layer 2		4.00	8.20	4.20				4.20	9.900	9.900	0.457	22	0.0061	11.64	0.50	84	0.45			11.64			
Layer 1	2.00	2.00	4.00	2.00	2.10	4.80	4.80	2.00	4.80	4.800	2.099	25			0.50	200	0.30	11.40	11.45	11.45	0.88	1.00	25.00
Layer 2		4.00	8.50	4.50				4.50	9.050	9.050	0.591	22	0.0061	16.11	0.50	84	0.45			16.11			
Layer 3		8.50	9.20	0.70				0.70	11.300	11.300	0.379	22			0.50	92.5	0.30	13.80	0.85	0.85			
Layer 1	3.00	3.00	4.00	1.00	2.21	4.80	4.80	1.00	4.80	4.800	2.214	25			0.50	200	0.30	11.40	6.52	6.52	0.81	1.00	25.00
Layer 2		4.00	8.50	4.50				4.50	8.050	8.050	0.787	22	0.0061	21.47	0.50	84	0.45			21.47			
Layer 3		8.50	10.20	1.70				1.70	10.300	10.300	0.481	22			0.50	92.5	0.30	13.80	2.76	2.76			

SETTLEMENT CALCULATION AS PER 8009 Part-1 1976														CH. (KM): (-)1+969						BH NO. :- BH-CL			
Layer	Depth below FGL (m)	From (m)	To (m)	Layer Thickness	Stress at Foundation level (Kg/Cm2)	Length (m)	Breadth (m)	Layer Thickness(m)	Dispersed Length (m)	Dispersed Breadth (m)	Stress Increment at top for cohesionless layer & at mid Depth for cohesive layer (kg/Cm2)	Average N-Value	Mvc (Cm^2/Kg)	Consolidation Settlement (mm)	Water Table Correction Factor	Modulus of Soil (Kg/Cm^2)	Poission's Ratio	Settlement (mm) for 10 t/m2 (from IS:8009 (Part I), Fig. 9, Page NO. 17)	Settlement in Non-Cohesive Soil Si (mm)	Total Settlement (mm)	Depth Factor	Rigidity Factor	Corrected Total Settlement (mm)
Layer 1	1.00	1.00	4.00	3.00	3.89	4.80	4.80	3.00	4.80	4.800	3.890	25			0.50	200	0.30	11.40	29.26	29.26	0.95	1.00	50.00
Layer 2		4.00	8.20	4.20				4.20	9.900	9.900	0.915	22	0.0061	23.28	0.50	84	0.45			23.28			
Layer 1	2.00	2.00	4.00	2.00	4.20	4.80	4.80	2.00	4.80	4.800	4.198	25			0.50	200	0.30	11.40	22.90	22.90	0.88	1.00	50.00
Layer 2		4.00	8.50	4.50				4.50	9.050	9.050	1.181	22	0.0061	32.21	0.50	84	0.45			32.21			
Layer 3		8.50	9.20	0.70				0.70	11.300	11.300	0.758	22			0.50	92.5	0.30	13.80	1.69	1.69			
Layer 1	3.00	3.00	4.00	1.00	4.43	4.80	4.80	1.00	4.80	4.800	4.427	25			0.50	200	0.30	11.40	13.05	13.05	0.81	1.00	50.00
Layer 2		4.00	8.50	4.50				4.50	8.050	8.050	1.574	22	0.0061	42.93	0.50	84	0.45			42.93			
Layer 3		8.50	10.20	1.70				1.70	10.300	10.300	0.962	22			0.50	92.5	0.30	13.80	5.52	5.52			

NAME OF PROJECT:- "GTI for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan in the state of Haryana".

Length of Pile below cut of level = 20.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** (-)1+500 **Dia of pile =** 1.00 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 2.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Nγ	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					1.71	200	0.17											
1.00		2.00	4.00	0.22	24	1.00	1.00	0.71	200	0.41								314.29		25.38	
1.00		4.00	8.50	0.00	30	1.00	1.00	0.77	450	0.66								314.29		53.57	
1.00		8.50	14.50	0.00	31	1.00	1.00	0.82	600	1.07								314.29		121.76	
1.00		14.50	15.00	1.02	5	1.00	0.43	0.99	50	1.34								314.29		8.75	
1.00		15.00	19.00	1.02	5	1.00	0.43	0.99	400	1.37								314.29		70.30	
1.00		19.00	22.00	0.21	28	1.00	1.00	0.95	300	1.37	1.37	0.95	0.21	28	9	15.50	16.72	314.29	7857.14	88.49	187.82
																				368.25	187.82

Qu,comp.= qs + Qp

Qa,comp.= (368.25 + 187.82) / 2.5

Qa,comp.= 222.43 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 368.25 / 3 + 39.27

Qa,uplift = 162.02 T

Say **Qa,comp.= 222.00 T** **Qa,uplift = 162.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

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NAME OF PROJECT:- "GTI for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan in the state of Haryana".

Length of Pile below cut of level = 22.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** (-)1+500 **Dia of pile =** 1.00 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 2.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					1.71	200	0.17											
1.00		2.00	4.00	0.22	24	1.00	1.00	0.71	200	0.41								314.29		25.38	
1.00		4.00	8.50	0.00	30	1.00	1.00	0.77	450	0.66								314.29		53.57	
1.00		8.50	14.50	0.00	31	1.00	1.00	0.82	600	1.07								314.29		121.76	
1.00		14.50	15.00	1.02	5	1.00	0.43	0.99	50	1.34								314.29		8.75	
1.00		15.00	19.00	1.02	5	1.00	0.43	0.99	400	1.37								314.29		70.30	
1.00		19.00	24.00	0.21	28	1.00	1.00	0.95	500	1.37	1.37	1.01	1.75	4	9	1.43	0.34	314.29	7857.14	147.48	139.30
																				427.24	139.30

Qu,comp.= qs + Qp

Qa,comp.= (427.24 + 139.3) / 2.5

Qa,comp.= 226.62 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 427.24 / 3 + 43.2

Qa,uplift = 185.61 T

Say **Qa,comp.= 226.00 T** **Qa,uplift = 185.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan in the state of Haryana".

Length of Pile below cut of level = 24.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** (-)1+500 **Dia of pile =** 1.00 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 2.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Nγ	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					1.71	200	0.17											
1.00		2.00	4.00	0.22	24	1.00	1.00	0.71	200	0.41								314.29		25.38	
1.00		4.00	8.50	0.00	30	1.00	1.00	0.77	450	0.66								314.29		53.57	
1.00		8.50	14.50	0.00	31	1.00	1.00	0.82	600	1.07								314.29		121.76	
1.00		14.50	15.00	1.02	5	1.00	0.43	0.99	50	1.34								314.29		8.75	
1.00		15.00	19.00	1.02	5	1.00	0.43	0.99	400	1.37								314.29		70.30	
1.00		19.00	25.00	0.21	28	1.00	1.00	0.95	600	1.37								314.29		176.98	
1.00		25.00	26.00	1.75	4	1.00	0.26	1.01	100	1.37	1.37	1.01	1.75	4	9	1.43	0.34	314.29	7857.14	17.31	139.30
																				474.05	139.30

Qu,comp.= qs + Qp

Qa,comp.= (474.05 + 139.3) / 2.5

Qa,comp.= 245.34 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 474.05 / 3 + 47.12

Qa,uplift = 205.14 T

Say **Qa,comp.= 245.00 T** **Qa,uplift = 205.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan in the state of Haryana".

Length of Pile below cut of level = 26.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** (-)1+500 **Dia of pile =** 1.00 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 2.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					1.71	200	0.17											
1.00		2.00	4.00	0.22	24	1.00	1.00	0.71	200	0.41								314.29		25.38	
1.00		4.00	8.50	0.00	30	1.00	1.00	0.77	450	0.66								314.29		53.57	
1.00		8.50	14.50	0.00	31	1.00	1.00	0.82	600	1.07								314.29		121.76	
1.00		14.50	15.00	1.02	5	1.00	0.43	0.99	50	1.34								314.29		8.75	
1.00		15.00	19.00	1.02	5	1.00	0.43	0.99	400	1.37								314.29		70.30	
1.00		19.00	25.00	0.21	28	1.00	1.00	0.95	600	1.37								314.29		176.98	
1.00		25.00	28.00	1.75	4	1.00	0.26	1.01	300	1.37	1.37	1.01	1.75	4	9	1.43	0.34	314.29	7857.14	51.93	139.30
																				508.67	139.30

Qu,comp.= qs + Qp

Qa,comp.= (508.67 + 139.3) / 2.5

Qa,comp.= 259.19 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 508.67 / 3 + 51.05

Qa,uplift = 220.61 T

Say **Qa,comp.= 259.00 T** **Qa,uplift = 220.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan in the state of Haryana".

Length of Pile below cut of level = 28.00 m		**Bore Hole No =** BH-A1	**Ch. (KM)** (-)1+500	**Dia of pile =** 1.00 m	**Cut-off Level =** 2.00 m below EGL	
Restricting PD to 15D	**Water Table depth considered for analysis =** 2.00 m		**Scour Depth =** Non-scourable		**Liquefaction Depth =** Non Liquefiable	

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Nγ	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					1.71	200	0.17											
1.00		2.00	4.00	0.22	24	1.00	1.00	0.71	200	0.41								314.29		25.38	
1.00		4.00	8.50	0.00	30	1.00	1.00	0.77	450	0.66								314.29		53.57	
1.00		8.50	14.50	0.00	31	1.00	1.00	0.82	600	1.07								314.29		121.76	
1.00		14.50	15.00	1.02	5	1.00	0.43	0.99	50	1.34								314.29		8.75	
1.00		15.00	19.00	1.02	5	1.00	0.43	0.99	400	1.37								314.29		70.30	
1.00		19.00	25.00	0.21	28	1.00	1.00	0.95	600	1.37								314.29		176.98	
1.00		25.00	29.50	1.75	4	1.00	0.26	1.01	450	1.37								314.29		77.90	
1.00		29.50	30.00	2.46	4	1.00	0.26	1.04	50	1.37	1.37	1.01	1.75	4	9	1.43	0.34	314.29	7857.14	11.56	139.30
																				546.20	139.30

Qu,comp.=	qs + Qp	Qu,uplift =	Safe Frictional Resistance + Weight of Pile
Qa,comp.=	(546.2 + 139.3) / 2.5	Qa,uplift =	546.2 / 3 + 54.98
Qa,comp.=	274.20 T	Qa,uplift =	237.04 T

Say **Qa,comp.= 274.00 T** **Qa,uplift = 237.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan in the state of Haryana".

Length of Pile below cut of level = 30.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** (-)1+500 **Dia of pile =** 1.00 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 2.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Nγ	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					1.71	200	0.17											
1.00		2.00	4.00	0.22	24	1.00	1.00	0.71	200	0.41								314.29		25.38	
1.00		4.00	8.50	0.00	30	1.00	1.00	0.77	450	0.66								314.29		53.57	
1.00		8.50	14.50	0.00	31	1.00	1.00	0.82	600	1.07								314.29		121.76	
1.00		14.50	15.00	1.02	5	1.00	0.43	0.99	50	1.34								314.29		8.75	
1.00		15.00	19.00	1.02	5	1.00	0.43	0.99	400	1.37								314.29		70.30	
1.00		19.00	25.00	0.21	28	1.00	1.00	0.95	600	1.37								314.29		176.98	
1.00		25.00	29.50	1.75	4	1.00	0.26	1.01	450	1.37								314.29		77.90	
1.00		29.50	32.00	2.46	4	1.00	0.26	1.04	250	1.37	1.37	1.04	2.46	4	9	1.43	0.34	314.29	7857.14	57.78	189.51
																				592.42	189.51

Qu,comp.= qs + Qp

Qa,comp.= (592.42 + 189.51) / 2.5

Qa,comp.= 312.77 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 592.42 / 3 + 58.9

Qa,uplift = 256.38 T

Say **Qa,comp.= 312.00 T** **Qa,uplift = 256.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan in the state of Haryana".

Length of Pile below cut of level = 20.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** (-)1+500 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 2.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					1.71	200	0.17											
1.20		2.00	4.00	0.22	24	1.00	1.00	0.71	200	0.41								377.14		30.46	
1.20		4.00	8.50	0.00	30	1.00	1.00	0.77	450	0.66								377.14		64.28	
1.20		8.50	14.50	0.00	31	1.00	1.00	0.82	600	1.07								377.14		146.11	
1.20		14.50	18.00	1.02	5	1.00	0.43	0.99	350	1.49								377.14		75.24	
1.20		18.00	19.00	1.02	5	1.00	0.43	0.99	100	1.67								377.14		22.07	
1.20		19.00	22.00	0.21	28	1.00	1.00	0.95	300	1.67	1.67	1.01	1.75	4	9	1.43	0.34	377.14	11314.29	124.01	205.43
																				462.17	205.43

Qu,comp.=	qs + Qp	Qu,uplift =	Safe Frictional Resistance + Weight of Pile
Qa,comp.=	(462.17 + 205.43) / 2.5	Qa,uplift =	462.17 / 3 + 56.55
Qa,comp.=	267.04 T	Qa,uplift =	210.61 T

Say **Qa,comp.= 267.00 T** **Qa,uplift = 210.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan in the state of Haryana".

Length of Pile below cut of level = 22.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** (-)1+500 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 2.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					1.71	200	0.17											
1.20		2.00	4.00	0.22	24	1.00	1.00	0.71	200	0.41								377.14		30.46	
1.20		4.00	8.50	0.00	30	1.00	1.00	0.77	450	0.66								377.14		64.28	
1.20		8.50	14.50	0.00	31	1.00	1.00	0.82	600	1.07								377.14		146.11	
1.20		14.50	18.00	1.02	5	1.00	0.43	0.99	350	1.49								377.14		75.24	
1.20		18.00	19.00	1.02	5	1.00	0.43	0.99	100	1.67								377.14		22.07	
1.20		19.00	24.00	0.21	28	1.00	1.00	0.95	500	1.67	1.67	1.01	1.75	4	9	1.43	0.34	377.14	11314.29	206.69	205.43
																				544.85	205.43

Qu,comp.= qs + Qp

Qa,comp.= (544.85 + 205.43) / 2.5

Qa,comp.= 300.11 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 544.85 / 3 + 62.2

Qa,uplift = 243.82 T

Say **Qa,comp.= 300.00 T** **Qa,uplift = 243.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan in the state of Haryana".

Length of Pile below cut of level = 24.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** (-)1+500 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 2.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm²	deg			gm/cc	cm	kg/cm²	kg/cm²	gm/cc	kg/cm²	deg				cm²	cm²	t	t
1.20	2.00	0.00	2.00					1.71	200	0.17											
1.20		2.00	4.00	0.22	24	1.00	1.00	0.71	200	0.41								377.14		30.46	
1.20		4.00	8.50	0.00	30	1.00	1.00	0.77	450	0.66								377.14		64.28	
1.20		8.50	14.50	0.00	31	1.00	1.00	0.82	600	1.07								377.14		146.11	
1.20		14.50	18.00	1.02	5	1.00	0.43	0.99	350	1.49								377.14		75.24	
1.20		18.00	19.00	1.02	5	1.00	0.43	0.99	100	1.67								377.14		22.07	
1.20		19.00	25.00	0.21	28	1.00	1.00	0.95	600	1.67								377.14		248.03	
1.20		25.00	26.00	1.75	4	1.00	0.26	1.01	100	1.67	1.67	1.01	1.75	4	9	1.43	0.34	377.14	11314.29	21.55	205.43
																				607.74	205.43

Qu,comp.= qs + Qp

Qa,comp.= (607.74 + 205.43) / 2.5

Qa,comp.= 325.27 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 607.74 / 3 + 67.86

Qa,uplift = 270.44 T

Say **Qa,comp.= 325.00 T** **Qa,uplift = 270.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan in the state of Haryana".

Length of Pile below cut of level = 26.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** (-)1+500 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 2.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					1.71	200	0.17											
1.20		2.00	4.00	0.22	24	1.00	1.00	0.71	200	0.41								377.14		30.46	
1.20		4.00	8.50	0.00	30	1.00	1.00	0.77	450	0.66								377.14		64.28	
1.20		8.50	14.50	0.00	31	1.00	1.00	0.82	600	1.07								377.14		146.11	
1.20		14.50	18.00	1.02	5	1.00	0.43	0.99	350	1.49								377.14		75.24	
1.20		18.00	19.00	1.02	5	1.00	0.43	0.99	100	1.67								377.14		22.07	
1.20		19.00	25.00	0.21	28	1.00	1.00	0.95	600	1.67								377.14		248.03	
1.20		25.00	28.00	1.75	4	1.00	0.26	1.01	300	1.67	1.67	1.01	1.75	4	9	1.43	0.34	377.14	11314.29	64.66	205.43
																				650.85	205.43

Qu,comp.= qs + Qp

Qa,comp.= (650.85 + 205.43) / 2.5

Qa,comp.= 342.51 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 650.85 / 3 + 73.51

Qa,uplift = 290.46 T

Say **Qa,comp.= 342.00 T** **Qa,uplift = 290.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan in the state of Haryana".

Length of Pile below cut of level = 28.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** (-)1+500 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 2.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Nγ	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					1.71	200	0.17											
1.20		2.00	4.00	0.22	24	1.00	1.00	0.71	200	0.41								377.14		30.46	
1.20		4.00	8.50	0.00	30	1.00	1.00	0.77	450	0.66								377.14		64.28	
1.20		8.50	14.50	0.00	31	1.00	1.00	0.82	600	1.07								377.14		146.11	
1.20		14.50	18.00	1.02	5	1.00	0.43	0.99	350	1.49								377.14		75.24	
1.20		18.00	19.00	1.02	5	1.00	0.43	0.99	100	1.67								377.14		22.07	
1.20		19.00	25.00	0.21	28	1.00	1.00	0.95	600	1.67								377.14		248.03	
1.20		25.00	29.50	1.75	4	1.00	0.26	1.01	450	1.67								377.14		97.00	
1.20		29.50	30.00	2.46	4	1.00	0.26	1.04	50	1.67	1.67	1.01	1.75	4	9	1.43	0.34	377.14	11314.29	14.26	205.43
																				697.44	205.43

Qu,comp.=	qs + Qp	Qu,uplift =	Safe Frictional Resistance + Weight of Pile
Qa,comp.=	(697.44 + 205.43) / 2.5	Qa,uplift =	697.44 / 3 + 79.17
Qa,comp.=	361.15 T	Qa,uplift =	311.65 T

Say **Qa,comp.= 361.00 T** **Qa,uplift = 311.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan in the state of Haryana".

Length of Pile below cut of level = 30.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** (-)1+500 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 2.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					1.71	200	0.17											
1.20		2.00	4.00	0.22	24	1.00	1.00	0.71	200	0.41								377.14		30.46	
1.20		4.00	8.50	0.00	30	1.00	1.00	0.77	450	0.66								377.14		64.28	
1.20		8.50	14.50	0.00	31	1.00	1.00	0.82	600	1.07								377.14		146.11	
1.20		14.50	18.00	1.02	5	1.00	0.43	0.99	350	1.49								377.14		75.24	
1.20		18.00	19.00	1.02	5	1.00	0.43	0.99	100	1.67								377.14		22.07	
1.20		19.00	25.00	0.21	28	1.00	1.00	0.95	600	1.67								377.14		248.03	
1.20		25.00	29.50	1.75	4	1.00	0.26	1.01	450	1.67								377.14		97.00	
1.20		29.50	32.00	2.46	4	1.00	0.26	1.04	250	1.67	1.67	1.04	2.46	4	9	1.43	0.34	377.14	11314.29	71.29	277.73
																				754.47	277.73

Qu,comp.= qs + Qp

Qa,comp.= (754.47 + 277.73) / 2.5

Qa,comp.= 412.88 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 754.47 / 3 + 84.82

Qa,uplift = 336.31 T

Say **Qa,comp.= 412.00 T** **Qa,uplift = 336.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

Lateral Load capacity of Pile

BH-A1

(-)1 +500

Type of Strata = Sandy

Le = Embedded Length of Pile in Meter = 20.000 m **Fck = 35.0 N/mm^2** **D = 100 cm**

Pile cap bottom level -2.0 m

Max. of Liquefaction & Scour Depth -2.0 m

E = Young's Modulus of Pile (Kg/cm^2) = $5000\sqrt{F_{ck}}$ N/mm^2 = 295803.99 Kg/cm^2

I = Moment of Inertia (cm^2) = $\pi x D^4/64$ = 4908738.5 cm^4

K_1 = Constant for Sandy / Normally Consolidated Clay (Kg/cm^3) = **0.284**

T, Relative stiffness factor in Sand

$$T = \sqrt[5]{\frac{EI}{K_1}}$$

= **348.1** cm

For Long Pile If L_e > 4T

L1 = = **0.000** cm

$\frac{L_1}{T}$ = 0.00

For Fixed Head Pile

$\frac{L_f}{T}$ = **2.219** From Fig. 4

Lf = 772.48 cm

Equivalent length of cantilever L= L1+LF: 0.00 + 772.48209 = **772.48** cm

Y = Pile Head Deflection (Cm) = $\frac{Q(L_1 + L_F)^3}{12\ EI}$ (for fixed Head pile)

Q = Lateral Load in Kg

Lateral Load For Pile Head Deflection .5 cm Q = 18899.92 Kg

= **18.90** **T**

Say **18.0** **T**

Lateral Load capacity of Pile

BH-A1

(-)1 +500

Type of Strata = Sandy

Le = Embedded Length of Pile in Meter = 20.000 m Fck = 35.0 N/mm^2 D = 120 cm

Pile cap bottom level -2.0 m

Max. of Liquefaction & Scour Depth -2.0 m

E	=	Young's Modulus of Pile (Kg/cm^2)	=	$5000\sqrt{F_{ck}}$ N/mm^2	=	295803.99 Kg/cm^2
I	=	Moment of Inertia (cm^2)	=	$\pi x D^4/64$	=	10178760.2 cm^4
K_1	=	Constant for Sandy / Normally Consolidated Clay		(Kg/cm^3)	=	**0.284**
T,		Relative stiffness factor in Sand	T =	$\sqrt[5]{\frac{EI}{K_1}}$	=	**402.8** cm

For Long Pile If $L_e > 4T$

L1 = ... = **0.000** cm

$\frac{L_1}{T}$ = 0.00

For Fixed Head Pile

$\frac{L_f}{T}$ = **2.219** From Fig. 4

Lf = 893.79 cm

Equivalent length of cantilever L= L1+L_F: 0.00 + 893.78573 = **893.79** cm

Y = Pile Head Deflection (Cm) = $\frac{Q(L_1 + L_F)^3}{12\ EI}$ (for fixed Head pile)

Q = Lateral Load in Kg

Lateral Load For Pile Head Deflection .5 cm Q = 25301.71 Kg

= **25.30 T**

Say 25.0 T

PART-B (Main Line)
Old Ch. 17+625 to Old Ch. 20+300
(New Ch: 18+310 to 20+985)

Geotechnical Investigation Report

PACKAGE-C5

New Ch. 0+000 to Old Ch. 10+859 (New Ch: 11+543) &
Old Ch. 17+625 to Old Ch. 20+300 (New Ch: 18+310 to 20+985) &
Connecting Line from Prithala to New Prithla

PART-B

New Ch. 0+000 to Old Ch. 10+859 (New Ch: 11+543) &
Old Ch. 17+625 to Old Ch. 20+300 (New Ch: 18+310 to 20+985)

SR NO. : 544_21-22

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA

CLIENT

M/S. HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LTD. (HRIDCL)

PROGRAMME

FEBRUARY - 2023

SR. No.	Report No.	Revision No.	Date
544_21-22	CEGTH/HRIDCL/SR-544/2022-23/1629_(76 BHs)	01	17.03.2023
544_21-22	CEGTH/HRIDCL/SR-544/2022-23/1476_(87 BHs)	00	08.02.2023

CEGTH
CEG TEST HOUSE
AND RESEARCH CENTRE PVT LTD

B-11(G), Malviya Industrial Area, Jaipur-302017
Tel. : 91-141-4046599, Fax : 91-141-2751806
E-mail : info@cegtesthouse.com., www.cegtesthouse.com

CEGTH/HRIDCL/SR-544/2022-23/1629 Date:- 17.03.2023

To,

Haryana Rail Infrastructure Development Corporation Ltd. (HRIDCL)
SCO No.-17-19, 3rd & 4th Floor,
Sector - 17-A,
Chandigarh - 160017
Tele:- 0172-2715644
Email: hridc2017@gmail.com

Subject :- Geotechnical investigation work for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan in the state of Haryana.

Dear Sir,

We are pleased to submit this report of the subject work based on 76 boreholes carried out at New Ch. 0+000 to Old Ch. 10+859 (New Ch: 11+543) & Old Ch. 17+625 to Old Ch. 20+300 (New Ch: 18+310 to 20+985) for the proposed project site.

The accompanying report presents results of various field tests and laboratory tests conducted on selected soil samples and their interpretation.

Should there be any clarifications regarding the contents please contact us at your most convenient time.

We value the opportunity to participate in this project and look forward a pleasant association on future projects.

Very truly yours,
CEG Test House & Research Centre Pvt. Ltd.

Prepared By:-

Nehal Jain
General Manager - Geotechnical
Authorized Signatory

Dr. Ankur Mudgal
Sr. Manager

Technical Advisor **Dr. Sarvesh Chandra**
(Geotechnical Expert)
Former Professor, IIT Kanpur

SR. No.	Report Ref. No.	Revision No.	Date
544_21-22	CEGTH/HRIDCL/SR-544/2022-23/1629_(76 BHs)	01	17.03.2023
544_21-22	CEGTH/HRIDCL/SR-544/2022-23/1476_(87 BHs)	00	08.02.2023

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LIST OF FIGURES / TABLES

CHAPTER 1 GENERAL

1.0 INTRODUCTION:

The work of conducting "**Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana"** was awarded to "**CEG Test House & Research Centre Pvt. Ltd., Jaipur" by M/S.** "**Haryana Rail Infrastructure Development Corporation Ltd. (HRIDCL)"** as per work order no. HRIDC/ HORC/ GT/ CEG/ 237/ 2021/ 577-M dated 29th July 2021.

Field work including drilling of boreholes, conducting field tests such as Electrical Resistivity Test, & Plate Load Test and sample collection was carried out in the presence of representative of Client. Laboratory tests were conducted on selected soil samples to determine the design parameters, confirming to relevant IS specifications and the guidelines received from time to time from representative of Client.

This report includes the details of Methodology of Investigation, collection of samples of soil, field test results, laboratory test results, analysis of results and recommendations for proposed structure carried out at New Ch. 0+000 to Old Ch. 10+859 (New Ch: 11+543) & Old Ch. 17+625 to Old Ch. 20+300 (New Ch: 18+310 to 20+985) based on soil sample collected from the locations of 76 boreholes.

2.0 SITE LOCATION & GENERAL GEOLOGICAL HISTORY:

The details of the site & test locations for the proposed project are shown in location plan attached vide **Appendix A-1**. The site of proposed project is located from Palwal to Harsana Kalan (Sonipat) in the State of Haryana falls in seismic zone – IV (Zone factor=0.24) of India.

Soil of the Haryana Sub-Region have been classified and described under the following major soil types as shown below:-

- Typic Ustochrepts : Soil of old alluvial plains
- Typic Ustipsamments : Soil of Aravali plains
- Typic Ustifluvents : Soil of recent alluvial plains and flood plains
- Typic Torripsamments : Soil of Aeofluvial plains
- Rocky Outcrops : Aravali rocky hills

The district wise details of soil characteristics are described below:-

Panipat: The soils are well drained, Sandy loam to clay loam/silty clay loam in plains and loam to clay loam/ silty/ loose clay loam in relic channels/depressions/basins.

Sonipat: The district comprises of recent flood plains, young meander plains, old meander plains and old alluvial plains. Recent flood plains occur along the Yamuna River and clearly show fluvial features. The soils are loamy sand to sandy loam on the surface and sandy loam to clay loam in the sub surface.

Rohtak: The district mainly comprises of old alluvial plains. The soils are loamy sand to sandy loam on the surface and sandy loam to clay loam in the sub surface. Old meander plains are almost flat with loamy sand to silty clay loam soils. Oldest among all the land forms are old alluvial plains, which cover major areas in the district. These soils are sand to loamy sand/sandy loam (surface) to silt loam/silty clay loam (sub-surface).

Jhajjar: The district mainly comprises of old alluvial plains and some parts of the district also have soil belonging to Aravali plains.

Rewari: The soils of the district fall under Entisols and Inceptisols orders. The surface soil texture varies from sand to fine loamy sand.

Gurgaon: The district comprises of sand dunes, sandy plains, alluvial plains, salt affected areas, low lands, lakes, hills and pediments. The soil varies from sand to loamy sand in sand dunes and sandy plain areas, sandy loam to clay loam / silty clay loam in alluvial plains, calcareous, loamy sand to loam in salt affected plains, silty loam to loam in low lands and calcareous, loamy sand to loam in hills.

Mewat: The soils of the area are generally sandy loam to loam. In parts of the low-lying areas, they are clayey and saline. The upper hills are mostly barren.

Faridabad and Palwal: The district comprises of recent Yamuna flood plains, low lying plains, depressions, sand dunes and hills. The texture of the soil is sand to loamy sand in recent Yamuna flood plains, sandy loam in plains, sandy loam to clay loam in alluvial plains, sandy loam to loam (surface), clay loam/silty clay (sub-surface) in low lying plains and depressions.

3.0 SCOPE OF WORK:

The stipulated scope of work involved carrying out the following operations:-

a) Mobilisation of necessary plant equipment, men and materials for the complete Geotechnical investigation work as per specifications, drawings and instructions of the Engineer and to complete the same within the stipulated time schedule and demobilisation after completion of field work.
b) Shifting of Equipments from one structure location to another including Ereaction, installation of rigs at site and dismantling of the same after completion of field work. Shifting of setup for each borehole location and associated preparation for borehole under water
c) Making 150 mm nominal diameter boreholes at various locations in all types of soils except hard rock and large boulders using suitable approved method of boring including chiselling, cleaning, providing casing pipe as required; performing Standard Penetration Test at every 3.0m interval and at change of strata; collection of water samples and disturbed soil samples, observation such as ground water, etc., collection of undisturbed soil samples at every 3.0 m interval and at change of strata; transportation of all the collected samples to the laboratory and back filling of boreholes on completion of the same, complete as per specification and instructions of the Engineer, for depths below natural ground level.
d) Conducting Electrical resistivity tests at various locations all complete as per specification and directions of the Engineer.
e) Conducting plate load test at various locations, all complete as per specification and directions of the Engineer.
f) Drilling of Nx size boreholes (75mm dia.) in all types of hard rock, collection of core samples, maintaining continuous record of core recovery/ RQD, keeping the cores in wooden core boxes, transporting to laboratory, backfilling on completion of the same, all complete as per specification and instructions of the EIC.
g) Conducting various laboratory tests on soil samples at an approved laboratory including preparation of soil samples to determine the following properties of soil, all complete as per specification.

<u>On soil Samples</u>

- Dry density test
- Bulk Density and Moisture Content.
- Sieve Analysis
- Hydrometer Analysis
- Liquid Limit and Plastic Limit
- Specific gravity
- Shrinkage Limit
- Free Swell Index
- Direct Shear Test
- Triaxial Shear Test

- One Dimensional consolidation test
- Chemical Analysis of soil samples (pH, chloride, Sulphate)

h) Conducting laboratory tests on rock samples including preparation of the samples to determine the following properties, all complete as per specification

On Rock Samples

- Moisture content, porosity & Density
- Specific gravity
- Hardness
- Unconfined compression test
- Point load strength index
- Modulus of Elasticity and Poission's Ratio
- Abrasion Test

i) Conducting chemical tests on water samples to determine the Sulphate, chloride and pH value all complete as per specification.

j) Submitting draft report in soft copy including all field records and laboratory test results, graphs, etc., all complete as per specifications.

k) Submitting final report in three hard copies in after the approval of the draft report including all field records and laboratory test results, graphs, etc., all complete as per specifications.

4.0 FIELD INVESTIGATION IN SOIL STRATA:

The investigation was planned to obtain the subsurface stratification in the proposed project site and collect soil / rock core samples for laboratory testing to determine the engineering properties such as shear strength, along with basic engineering classification of the subsurface stratum.

For geotechnical investigation work, required equipements along with rotary drilling rigs and manpower were mobilized at site to carry out various field activities as per the scope of work. These were shifted from one test location to another location during execution of field work and were demobilized on satisfactory completion of field work.

For conducting the field investigations the following practices were followed at site:

- The locations of 76 boreholes carried out at New Ch. 0+000 to Old Ch. 10+859 (New Ch: 11+543) & Old Ch. 17+625 to Old Ch. 20+300 (New Ch: 18+310 to 20+985) were marked at site at specified locations. These locations are shown in **Appendix-A1** attached subsequently.

The details of various boreholes along with their coordinates are provided herein below:

Table 1.1: Details of Borehole Locations

S. No.	Chainage Old (km)	Chainage New (km)	Structure	BH.No.	Depth of Water Table below EGL (m)	Depth of Borehole below EGL (m)	Co-ordinates (m)		(+) R.L. (m)
							E	N	
1.	-	0+000	BH-PLT-09	MNB	NE	12.00	720981.000	3126079.000	195.456
2.	(-)0+627	0+057	BH-CL	MNB	8.50	10.00	720920.890	3126081.947	196.408
3.	(-)0+529	0+158	BH-CL	MNB	8.15	10.00	720826.915	3126042.507	195.851
4.	(-)0+319	0+371	BH-CL	MNB	8.10	10.00	720635.657	3125962.572	197.352
5.	0+273	0+958	BH-CL	MNB	8.25	10.00	720089.535	3125734.325	195.008
6.	1+006	1+696	BH-A1	MJB	24.90	30.00	719415.302	3125461.869	202.730
7.			BH-A2	MJB	24.80	30.00	719396.820	3125454.226	203.271
8.	1+333	2+018	BH-CL	MNB	NE	10.00	719094.132	3125351.606	202.117
9.	1+811	2+493	BH-CL	MNB	9.10	10.00	718661.831	3125172.851	197.587
10.	2+472	3+160	BH-CL	MNB	7.50	10.00	718027.804	3124979.104	197.568
11.	2+788	3+476	BH-A1	MJB	18.24	30.00	717723.179	3124953.799	195.987
12.			BH-A2	MJB	17.68	30.00	717703.270	3124952.116	196.902
13.	3+497	4+242	BH-A1	MJB	16.25	40.00	717079.294	3124900.291	196.752
14.			BH-P1	MJB	15.32	40.00	717042.421	3124897.227	195.783
15.			BH-P2	MJB	15.30	40.00	717007.541	3124894.329	195.847
16.			BH-P3	MJB	15.31	40.00	716972.661	3124891.431	195.759
17.			BH-A2	MJB	15.30	40.00	716935.788	3124888.367	195.643
18.	3+691	4+376	BH-A1	MJB	15.40	30.00	716820.675	3124880.556	196.163
19.			BH-A2	MJB	15.25	30.00	716800.700	3124877.143	196.124
20.	4+174	4+858	BH-CL	MNB	NE	10.00	716335.062	3124838.454	196.256
21.	4+207	4+892	BH-CL	MNB	NE	10.00	716300.074	3124835.546	196.348
22.	4+655	5+340	BH-CL	MNB	NE	10.00	715855.211	3124798.666	200.573
23.	5+119	5+804	BH-CL	MNB	NE	10.00	715393.751	3124750.566	202.713
24.	5+730	6+415	BH-CL	MNB	NE	10.00	714786.103	3124685.263	198.287
25.	6+197	6+881	BH-CL	MNB	2.52	10.00	714320.102	3124636.752	198.287
26.	6+877	7+559	BH-CL	MNB	1.85	10.00	713641.709	3124570.057	196.702
27.	7+078	7+759	BH-A1	MJB	1.70	30.00	713455.570	3124551.638	195.221
28.			BH-A2	MJB	1.25	30.00	713435.595	3124549.896	194.815
29.	7+256	7+941	BH-CL	MNB	1.59	10.00	713264.533	3124532.969	193.947
30.	7+351	8+036	BH-A1	MJB	3.00	40.00	713206.080	3124525.765	194.037
31.			BH-P1	MJB	2.10	40.00	713171.257	3124522.342	196.827
32.	7+351	8+036	BH-A2	MJB	0.70	40.00	713136.399	3124522.342	193.680
33.	7+457	8+141	BH-CL	MNB	0.59	10.00	713067.448	3124513.592	193.671
34.	7+613	8+298	BH-A1	MJB	0.50	40.00	712928.250	3124499.906	195.453
35.			BH-A2	MJB	0.85	40.00	712897.399	3124496.873	193.923
36.	7+907	8+592	BH-CL	MNB	1.90	10.00	712620.430	3124469.642	193.872
37.	8+207	8+891	BH-CL	MNB	2.00	10.00	712317.987	3124437.243	193.686
38.	8+610	9+295	BH-CL	MNB	1.95	10.00	711923.004	3124401.078	194.123
39.	8+852	9+537	BH-A1	MJB	0.75	30.00	711688.170	3124377.983	193.689
40.			BH-A2	MJB	1.35	30.00	711664.484	3124375.655	194.209
41.	8+907	9+591	BH-CL	MNB	0.55	10.00	711623.253	3124371.601	193.708

S. No.	Chainage Old (km)	Chainage New (km)	Structure	BH.No.	Depth of Water Table below EGL (m)	Depth of Borehole below EGL (m)	Co-ordinates (m)		(+) R.L. (m)
							E	N	
42.	-	10+340	BH-PLT-08	MNB	4.03	12.00	711500.031	3124346.490	194.158
43.	9+200	9+882	BH-CL	MNB	1.25	10.00	711334.580	3124343.215	194.672
44.	9+211	9+894	BH-CL	MNB	1.36	10.00	711325.206	3124342.307	194.649
45.	9+407	10+091	BH-CL	MNB	0.60	10.00	711125.831	3124322.695	193.387
46.	9+726	10+410	BH-A1	MJB	0.85	30.00	710810.840	3124291.156	194.097
47.			BH-A2	MJB	0.29	30.00	710802.664	3124290.194	193.613
48.	9+772	10+457	BH-CL	MNB	0.60	12.00	710762.491	3124285.182	193.598
49.	10+025	10+709	BH-A1	MJB	1.34	30.00	710515.298	3124244.432	194.595
50.			BH-A2	MJB	1.22	30.00	710507.526	3124242.990	194.589
51.	10+223	10+908	BH-CL	MNB	3.50	10.00	710317.973	3124207.834	194.116
52.	10+519	11+203	BH-CL	MNB	4.50	10.00	710023.336	3124153.189	194.584
53.	10+658	11+340	BH-CL	MNB	3.20	10.00	709890.704	3124128.590	194.898
54.	10+718	11+403	BH-CL	MNB	2.50	10.00	709831.671	3124117.642	193.997
55.	10+749	11+434	BH-CL	MNB	2.60	10.00	709801.215	3124111.993	194.893
56.	10+859	11+543	BH-A1(R)	MJB	2.99	40.00	709761.805	3124103.149	195.206
57.			BH-A1	MJB	2.95	40.00	709723.114	3124097.508	194.772
58.			BH-P1	MJB	3.35	40.00	709681.945	3124089.603	195.316
59.			BH-A2	MJB	5.60	40.00	709602.681	3124072.923	195.247
60.	17+625	18+310	BH-A1	MJB	3.00	30.00	704882.319	3119823.851	191.597
61.			BH-A2	MJB	3.05	30.00	704873.896	3119805.101	191.814
62.	17+872	18+558	BH-A1	MJB	0.95	30.00	704759.612	3119597.349	191.318
63.			BH-A2	MJB	1.00	30.00	704753.576	3119588.153	191.150
64.	-	19+010	BH-PLT-07	MNB	0.60	12.00	704417.312	3119187.740	190.138
65.	18+750	19+435	BH-A1	MJB	1.22	30.00	704113.173	3119029.392	190.420
66.			BH-A2	MJB	1.50	30.00	704095.090	3119020.849	190.095
67.	19+500	20+185	BH-A1	MJB	0.60	40.00	703426.871	3118866.702	190.997
68.			BH-P1	MJB	1.85	40.00	703375.297	3118862.655	191.964
69.			BH-A2	MJB	1.60	40.00	703323.723	3118858.609	191.063
70.	19+715	20+400	BH-A1	MJB	0.85	30.00	703175.974	3118849.670	190.645
71.			BH-P1	MJB	0.80	30.00	703164.075	3118849.544	190.671
72.	19+715	20+400	BH-A2	MJB	0.45	30.00	703152.175	3118849.568	190.592
73.	20+300	20+985	BH-A1	MJB	1.00	40.00	702617.165	3118908.161	190.950
74.			BH-P1	MJB	2.10	40.00	702589.211	3118911.568	191.187
75.			BH-P2	MJB	2.25	40.00	702570.093	3118913.897	191.622
76.			BH-A2	MJB	2.55	40.00	702548.989	3118916.469	191.622

***NE=Not Encountered**

- In soil, boreholes of 150mm dia. were drilled as per the standard procedure laid in IS: 1892.
- Borehole was properly cleaned before taking any sample in soil.

- Casing was used as per the prevailing soil conditions, to stabilize the borehole.
- Standard Penetration Tests were conducted in bore holes at regular intervals or at every change of strata as per Technical specification.
- Undisturbed were collected wherevery feasible as per the requirements and at specified depths. The same has been discussed in detail in soil characteristics sheets attached with the report.
- The Ground Water Table was met at depths of from 0.29m to 24.90m below EGL. The detailed procedure adopted for conducting various field tests is given here in below:

(i) Standard Penetration Test:

The Standard Penetration Test was conducted in boreholes as per IS 2131. The test was carried out using the standard split spoon sampler to measure the number of blows 'N'.

Standard split spoon sampler was attached to an 'A' rod. It was driven from borehole bottom to a distance of 45 cm using a standard hammer of 63.5 kg falling freely from a height of 75 cm to the required depth. While driving, the number of blows required to penetrate every 15 cm are recorded. The total number of blows required for the last 30 cm is taken as 'N' value at that particular depth of the borehole. Wherever the total penetration was less than 45cm, the no. of blows & the depth penetrated is recorded in the respective borelog.

SPT 'N' values were correlated with relative density of non-cohesive stratum and with consistency of cohesive stratum as given below:-

Table 1.2: Soil compactness as per SPT N values (cl. 9.7, table 9.3 & 9.4, page 330_text book of V.N.S. Murthy)

Correlation for Clay / Plastic silt		Correlation for Sand / Non-Plastic silt	
Consistency	**SPT "N" Value**	**Compactness**	**SPT "N" Value**
Very Soft	0 - 2	Very Loose	0 - 4
Soft	2 - 4	Loose	4 - 10
Medium	4 - 8	Medium	10 - 30
Stiff	8 - 15	Dense	30 - 50
Very Stiff	15 - 30	Very Dense	> 50
Hard	> 30		

The field SPT N values obtained were further corrected as per the guidelines given in IS: 2131 as follows:

(a) For overburden: - The N value for cohesionless soil is corrected with the help of fig. 1 given in IS-2131.

(b) Due to dilatancy :- Wherever N values observed below water table in fine sand, silty sand or silt was greater than 15, then corrected N values were corrected as under:

$$N' = 15 + \frac{1}{2}(N-15)$$

(ii) Undisturbed Sampling (Soil) in boreholes:

Undisturbed samples were collected using MS tubes of suitable diameter and length with Area ratio as per clause 4.1.1 (c) of IS: 1892 (latest) fitted to an adopter with ball and socket arrangement. Before taking any sample, sampling tube was properly greased. Immediately after taking on undisturbed sample in a tube, the adopter head was removed along with the disturbed material. The visible ends of the sample were trimmed off any wet disturbed soil. The ends were coated alternately with four layers of just molten wax. More molten wax was added to give a total thickness of min. 25 mm. The samples were carefully labeled and transported to the laboratory for testing. Undisturbed samples wherever slipped during lifting were duly marked in the field logs as well as in the soil profile.

4.1 CONDUCTING PLATE LOAD TESTS

The reaction Load is applied on the test plate by reaction truss with a weight of several tonnes. The Plate Bearing Test is normally carried out at foundation level, either on the surface or in a shallow pit. The Size of Plate is 45 cm x 45 cm size (30mm thickness) and 60 cm x 60 cm size (30mm thickness) by the hydraulic jack. The test plate was placed over a horizontal sand layer of thickness 5 mm and leveled in a manner such that the center of the plate coincides with the center of application of load. The load was applied with hydraulic jack along with a pressure gauge. Settlement of the plate was measured by using two dial gauges, fixed to reference datum bars placed on firm ground, on either side of the plate. Desired seating pressure was applied on firmly seated test plate. Settlement was recorded for each increment of load. Loading was continued till a settlement of 25 mm occurred or up to desired loading intensity as per directions.

PLATE LOAD TEST LIMITATIONS

Plate load test, though useful in obtaining the necessary information about the soil with particular reference to design of foundation has some limitations:-

(a) The tests results reflect only the character of the soil located within a depth of less than twice the width of the bearing plate. Since the foundations are generally larger than the test plates, the settlement and shear resistance will depend on the properties of much thicker stratum. Moreover this method does not give the ultimate settlements particularly in case of cohesive soils. Thus the results of the test are likely to be misleading, if the character of the soil changes at shallow depths, which is not uncommon. A satisfactory load test should, therefore, include adequate soil exploration (see IS: 1892-1979) with due attention being paid to any weaker stratum below the level of the footing.

(b) Another limitation is the concerning of the effect of size of foundation. For clayey soils the bearing capacity (from shear consideration) for a larger foundation is almost the same as that for the smaller test plate. But in dense sandy soils the bearing capacity increases with the size of the foundation. Thus tests with smaller size plate tend to give conservative values in dense sandy soils. It may, therefore, be necessary to test with plates of at least three sizes and the bearing capacity results extrapolated for the size of the actual foundation (minimum dimensions in the case of rectangular footings).

(c) It has limited depth of influence. It could only give the bearing capacity of soils with depth up to two times the diameter of plate.

(d) It may not provide information on the potential for long term consolidation of foundation soils.

(e) There is scale effect as the size of test plate is smaller than actual foundation.

(f) To gain access to test position, excavation is carried out which causes significant ground disturbance. The change in ground stress leads to the change of soil properties which the test is planned to investigate.

Hence the interpretation of the test results & recommendation has been made in view of the above limitations.

The field record of applied load and respective average settlement obtained for plate load tests is being tabulated herein below :

Plate Load Test Data PLT-09 (New Ch. 0+000)

Applied Load (T)	Applied Pressure (T/m^2)	Cumulative Settlement (mm)
0.000	0.00	0.00
1.020	5.04	0.94
2.039	10.07	2.40
3.059	15.11	4.82
4.078	20.14	9.04
5.098	25.18	14.57
6.118	30.21	19.53
7.137	35.25	25.70

5.0 LABORATORY TESTS ON SOIL SAMPLES:

The following laboratory tests were conducted on selected soil samples:

Table 1.3: Description of Tests

Description of Test	Reference	Undisturbed (UDS) Soil Samples	Disturbed (DS/SPT) Soil Samples
Grain Size Analysis / Hydrometer	IS: 2720 (Part - 4)	√	-
Natural Moisture Content / Bulk / Dry density	IS : 2720 (Part – 2)	√	-
Atterberg Limits • Liquid Limit • Plastic Limit	 IS: 2720 (Part - 5) IS: 2720 (Part - 5)	 √ √	 √ √
Specific Gravity	IS : 2720 (Part – 3)	√	-
Direct Shear Test	IS : 2720 (Part – 13)	√	-
Triaxial compressive shear test	IS : 2720 (Part – 11 & 12)	√	-
Chemical Analysis of Soil Samples	IS : 2720 (Part – 26, 27)	√	-

Note:- The detailed procedure adopted for conducting various laboratory tests is described in the following paragraphs:

5.1.1 Dry density and Bulk density

For determination of bulk density and dry density, a sample of known volume ‘V’ was extracted from the undisturbed sampling tube and it’s bulk weight ‘W’ was noted down.Moisture content ‘Wn’ was determined by oven drying method.

The bulk density and dry density were determined by following equation-

Bulk density (γ_b) = W/V

Dry density (γ_d) = γ_b/ (1+Wn)

5.1.2 Natural water content

For this test, the soil sample of known quantity (Wm) was taken in a container.The container with soil sample was placed into an oven for drying at 105-110°c temperature for 16-24 hours. After drying, the dry sample was again weighted to determine the dry weight of sample (Wd).

The natural water content was computed by the following equation-

Wn = (Wm-Wd)*100/Wd

5.1.3 Grain Size Analysis (IS: 2720- Part-4)

Wet sieve analysis:

For determination of particle sizes finer than 75 micron, wet sieve analysis test was conducted. For this test, oven dried sample of known quantity was taken in a container and soaked with dispersing agent. The soaked soil sample was washed thoroughly over 75 micron IS sieve until the water passing sieve was substantially clean.

Fraction retained on 75 micron IS sieve was carefully collected in a container without any loss in material and placed into oven for drying.

Dry sieve analysis:

For this test, the oven dried soil sample after wet sieving was sieved through the set of IS sieves 20 mm, 10 mm, 4.75 mm, 2.0 mm, 1.0 m , 425 micron , 300 micron, 150 micron and 75micron. The amounts of soil retained on each sieve were noted down. The % retained, cumulative % retained and % passing were computed accordingly. Wherever the soil sample % passing 75 micron sieve was significant, Hydrometer method was used to find the percentage of silt and clay fraction.

Grain size analysis for the fraction passing 75 micron IS Sieve (Hydrometer method)

Calibration of Hydrometer

Hydrometer was calibrated to determine a relationship (an equation) between the effective depth H_R and corresponding hydrometer reading R_h (obtained during test).

50 to 100 gm of soil sample passing through 75 micron IS Sieve was taken. It was mixed with 100 ml of sodium hexametaphesphate solution and the mixture was warmed for about 10 minutes. It was then transferred to the cup of the mechanical mixer and the soil suspension was stirred for 15 minutes. The soil suspension was transferred into 1000 ml measuring cylinder and distilled water was added to make 1000ml solution. This solution was mixed vigorously. The measuring cylinder was then allowed to stand and the stopwatch was started. Hydrometer was immersed in the solution and reading were taken after half, one, two and four minutes. The hydrometer was then removed slowly and kept in distilled water at the same temperature as the soil suspension. Readings were taken after the periods of 8, 15 and 30 minutes, and one, two and four hours. Hydrometer was removed, rinsed and placed in the distilled water after each reading. After 4 hours reading was taken once or twice within 24 hours. Finally a reading was taken at the end of 24 hours. The temperature of the suspension was observed and recorded.

Calculations

Diameter of the particles (D):

$$D = \sqrt{\frac{30\mu}{980(G-1)}} \times \sqrt{\frac{H_R}{t}} = M\sqrt{\frac{H_R}{t}}$$

Where,

D = diameter of particle in suspension, in mm;

μ = co-efficient of viscosity of water at the temperature of the suspension at the time of taking the hydrometer reading, in poise;

G = specific gravity of the soil fraction used in the sedimentations analysis;

H_R = effective depth corresponding to R_n, in cm.

t = time elapsed between the beginning of sedimentation and taking of hydrometer reading in minutes

$M = \sqrt{\frac{30\mu}{980(G-1)}}$ = a constant factor for given values of μ and G at the temperature of the suspension.

Percentage finer than diameter D:

The percentage by mass (w) of particles smaller than corresponding equivalent particle diameters (D) was calculated from the formula:

$$w = \frac{100G_s}{W_b(G_s - 1)} \times R_h$$

Where

w = percentage finer

G_s = specific gravity of soil particle

W_b = weight of soil

R_h = Hydrometer reading

5.1.4 Specific Gravity (IS: 2720-Part-3 Sec-1)

The specific gravity of soil sample was determined by density bottle method. For this test 5-10g oven dried and cooled soil sample was taken in 50ml capacity density bottle and its weight was noted down as W_2 .The soil was covered with distilled water and left for sufficient period for suitable soaking. The entrapped air was removed by vacuum. The bottle with soil was filled fully with water and its weight was noted down (W_3). The mass of empty bottle and bottle filled with distilled water were noted down as W_1 and W_4 respectively.

The Specific Gravity was determined by using following equation :

$G=W_2-W_1/[(W_2-W_1)-(W_3-W_4)]$

5.1.5 Liquid Limit (IS: 2720- Part-5)

By Cone Penetrometer Method

The 'Cone Penetrometer Apparatus' is a variant of the fall-cone and consists of a cone with a smooth polished surface and angle of 30° ± 1/2°. The weight of the cone, together with its associated shaft is 80g ± 0.5g. A support assembly with an automatic cone release mechanism and cone height adjustment mechanism used to hold the cone vertically. The angle and weight of the cone were calibrated at regular intervals, and the sharpness of the cone tip was checked daily.

Distilled water was added and thoroughly mixed with the soil sample to produce a homogeneous paste. The paste was then placed in a cup with a diameter of at least 55mm and a depth of at least 40mm. The surface of the soil was smoothed off level and parallel to the base. The support assembly was used to position the tip of the cone so that it was just touching the top surface of the soil, and the automatic tripping mechanism was released. The cone was allowed to penetrate into the soil for a period of 5 (± 1) s, then the cone was locked off to stop further movement and the penetration was recorded. The cup was refilled and the test was repeated. The two recorded penetrations need to be within 0.5mm of each other, otherwise a third test is performed. when the three test vary by more than 1mm the test was repeated.

Further tests were conducted, at varying water contents, in order to produce a series of cone penetrations (usually 4) in the range 15mm to 25mm. The resulting cone penetrations were plotted verses the water content of the test specimens. The Liquid Limit (W_L) was read off the graph, being the water content at which the line of best fit through the test points crosses 20mm penetration.

5.1.6 Plastic Limit (IS: 2720-Part-5)

For this test, soil sample was prepared in the same way as for liquid limit test. A ball of soil sample weighed about 5 gm was formed. The ball was rolled between the fingers of one hand and the glass plate with pressure sufficient to reduce the mass into a thread of about 3 mm in 5 to 10 complete forward and back movements. When a diameter of 3 mm was reached, soil was again remolded into a ball. The process of rolling and remolding was repeated until the thread started just crumbing at a diameter of 3 mm. The crumbled thread was immediately transferred to an airtight container for determination of its moisture content by oven drying method.

This water content has been termed as plastic limit. (W_P)

5.1.7 Plasticity Index (IS: 2720-Part-5)

The plasticity index Ip was given by

$I_p=W_L-W_P$ (in percent)

5.1.8 Direct Shear Test (IS:2720-Part-13):

For this test shear box test apparatus was used. The prepared specimen from remolded/undisturbed sample was placed carefully in the box. The plain grid was kept on top of the specimen with its directions at right angles to the direction of shear. The upper porous stone was placed on the grid and loading pad on the stone. The box with specimen was gently placed in the container (water jacket). The specimen was submerged with water. The container was mounted with the shear box and the specimen inside, on the shearing machine. The upper part of the box was so adjusted that it touchéd the proving ring. The jack was brought forward to bear up against the box container. The proving ring dial gauge was set to read zero.

The steel ball was placed in the recess of the loading pad. The loading yoke was set in contact with the steel ball on the loading pad. Vertical displacement dial gauge to read zero in contact with the top of the yoke. The normal load was applied and any change in thickness of specimen was recorded. Shear displacement dial gauge was also set to read zero. The locking screw was now removed and two parts of the shear box were separated by advancing the spacing screws.

The specimen was sheared at constant rate of strain. The readings of the proving ring dial gauge were noted down every 15 seconds for the first one-minute and then every 30 seconds thereafter. The reading of change in the thickness dial gauge and shear displacement dial gauge were also recorded at the same time interval. The test was continued until the specimen fails. The specimen was assumed to fail when the proving ring dial gauge started receding or at shear displacement of approximately 15% of the length took place.

The soil was removed from the box and test was repeated on the identical specimen under increased normal load.

The rate of strain for conducting Direct Shear Test is kept as 0.25 mm/min as per codal/literature provision based on strata.

5.1.9 Triaxial Shear Test_UUT (IS: 2720-Part-11)

For this test, Triaxial Shear Test apparatus was used. The plain disc was placed on the pedestal of the triaxial cell. The specimen was placed centrally on the disc. A correct size rubber membrane was fitted inside the stretcher with ends of membrane folded over those of the stretcher. Vacuum was applied to stretch the membrane to the inside surface of the stretcher which was carefully slipped around the specimen kept on the pedestal. The vacuum on the membrane was released. Its bottom part was rolled down into the pedestal. plain disc was placed on the top of the specimen and then loading pad was placed. The top part of membrane was rolled on to the loading pad. Then the stretcher was removed and ends were sealed with ‘O’ rings. With the properly sealed specimen placed centrally on the pedestal, the cell was assembled, keeping the loading piston initially clear of the loading pad of the specimen, the assembly was placed in the loading frame.

For unconsolidated undrained test, the bottom drainage value (BDV) and top drainage value (TDV) of cell, was closed and air release valve (ARV) was opened. The cell was filled with water through the cell water value CWV. ARV was closed when water begins to escape through it. The cell pressure was raised to the desired value and kept constant till the end of the test.

When the cell pressure was applied, the load piston rises upward, the loading machine was operated at the anticipated rate to bring the load piston slightly above the loading pad of the specimen and the load measuring dial gauge on proving ring was set to zero.

The piston was brought just in contact with loading pad by hand operation of the machine. The axial compression dial gauge was mounted and set to read zero.

The axial loading was started at 1.25 mm/min rate of strain. Simultaneous readings on the load and compression dial gauges were noted down. The test was continued until a recession of the axial load is observed or 20% of strain.

After failure, the specimen was unloaded by reversing the loading machine, cell pressure was reduced and cell water was drained out through BRV. The cell was dismantled and the specimen was taken out, rubber membrane was removed and weight of the failed sample and its water content was determined. The test was repeated on two more identical specimens with increasing cell pressure.

The rate of strain for conducting UUT is kept as 1.25 mm/min as per codal/literature provision based on strata.

5.1.10 Chemical Testing

Chemical Testing was generally performed in accordance with IS: 2720, but the different parts of method as described below:

a) Total Sulphate Content Of Soil

Samples were tested according to IS 2720 (Part 27). The dried soil was extracted with a 10% solution of hydrochloric acid. The extract was adjusted to slightly alkaline pH with ammonia, and then barium chloride solution was added to precipitate the sulphate. The barium sulphate precipitate was collected by filtration, and it was washed, dried and weighed. The mass of barium sulphate recovered was used to calculate the sulphate content of the original soil.

b) pH Value

Samples were tested according to IS: 2720 (Part 26). The soil sample (30 ± 0.1g) was extracted with 75 ml of distilled water and the pH of the resulting suspension was measured with a calibrated (by means of Standard buffer solution) pH meter.

c) Chloride Content

For the water soluble content, soil samples were extracted with a volume of water equal to twice the mass of the soil. The extract was filtered and acidified with a small amount of nitric acid. Standardized silver nitrate solution was then added to precipitate the chloride as its silver salt. The amount of precipitated silver remaining in solution was then determined by titration.

An acid-soluble version of the test was also available, with the initial extraction being with nitric acid instead of water.

CHAPTER 2 ANALYSIS OF TEST RESULTS AND INTERPRETATION

6.0 STRATIFICATION

From the study of the borehole carried out at New Ch. 0+000 to Old Ch. 10+859 (New Ch: 11+543) & Old Ch. 17+625 to Old Ch. 20+300 (New Ch: 18+310 to 20+985), it is revealed that the substrata of all boreholes mainly consisit of Silty Clay of low plasticity (CL), sandy silt of low plasticity (ML-CL), Silty Sand with Clay (SM-SC), Silty Sand (SM).

6.1 GROUND WATER TABLE DEPTH

The Ground Water Table was met at depths of from 0.29m to 24.90m below EGL as given in Table 1.1, it may rise up during heavy rains / rainy season. Therefore, for the analysis of various foundations, the water table has been considered to rise by about 2.0 to 3.0m at the locations of boreholes.

6.2 RESULTS OF CHEMICAL ANALYSIS

Results of chemical analysis of soil samples (as per **Appendix – B2**) indicates that the soil sample falls under Class I for sulphates and chlorides concentration (As per IS 456-2000 and CIRIA Sp. Publication No. 31). The results are summarized here in below :-

Summary of chemical analysis of soil samples

Chemical Property	Findings (Min. to Max.)	Remarks (Required limits as per IS 456-2000)
pH	6.54 to 9.51	> 6.0
Sulphite as SO_3^{2-} (%)	0.0015 (%) to 0.0033 (%)	< 0.2% (Class I)
Chlorides as Cl^- (%)	0.0067 (%) to 0.0093 (%)	No limit specified in IS 456. However, a limit of 0.10% specified for class I in CIRIA Sp. Publication No. 31)

Note :- All the chemical contents are within permissible limit hence no special precautions are required.

6.3 COMPUTATION OF LIQUEFACTION POTENTIAL

Liquefaction is the sudden loss of shear strength of the sub soil strata due to earthquake-induced vibration under saturated conditions.

Assessment of liquefaction potential of foundation strata is made by simplified approach proposed as per IS: 1893 (Part-1)-2016, from the SPT data and peak ground acceleration likely to occur at the site. In this method, cyclic shear stress likely to be induced in the foundation strata by Design Basis Earthquake (DBE) is first evaluated.

Next threshold cyclic shear stress, which is good enough to cause liquefaction, is determined from SPT data and the empirical relations. Finally, comparison of these two stresses is used in the estimation of liquefaction susceptibility of the foundation strata.

Unsaturated soils are not subjected to liquefaction because vibratory forces from earthquakes do not cause any increase in pore water pressure in such soils.

The area of site from Palwal to Harsana Kalan (Sonipat) in the State of Haryana falls in seismic zone – IV of India as per IS: 1893. Further as per the provisions of IS: 1893 in soil deposits consisting of submerged loose sands & soils falling under classification of SP with standard penetration N value less than 15, the shaking caused by earthquake ground motion may cause liquefaction or excessive total and differential settlements.

For the analysis of liquefaction potential, following constant parameters are considered:

EQ Zone	IV
Earthquake Magnitude (Mw)	7.0
Peak Horizontal Ground Acceleration (amax /g)	0.24

The Ground Water Table was met at depths of from 0.29m to 24.90m below EGL as given in Table 1.1. For the analysis of liquefaction potential, the water table is generally considered to rise by about 3.0m at the location of all boreholes. The strata in the boreholes are not likely to liquefy as mentioned above and the same is tabulated below:-

Table 2.1: Liquefaction Analysis

S. No.	Chainage Old (km)	Chainage New (km)	Structure	BH.No.	Depth of Water Table below EGL (m)	Water table depth Considered for Liquefaction Analysis	Liquefiable Depth (m)
1.	-	0+000	MNB	BH-PLT-09	Not Encountered	Not Encountered	Non Liquefiable
2.	(-)0+627	0+057	MNB	BH-CL	8.50	5.50	Non Liquefiable
3.	(-)0+529	0+158	MNB	BH-CL	8.15	5.00	Non Liquefiable
4.	(-)0+319	0+371	MNB	BH-CL	8.10	5.10	Non Liquefiable
5.	0+273	0+958	MNB	BH-CL	8.25	5.25	Non Liquefiable
6.	1+006	1+696	MJB	BH-A1	24.90	20.00	Non Liquefiable
7.			MJB	BH-A2	24.80	20.00	Non Liquefiable
8.	1+333	2+018	MNB	BH-CL	Not Encountered	Not Encountered	Non Liquefiable
9.	1+811	2+493	MNB	BH-CL	9.10	6.00	Non Liquefiable
10.	2+472	3+160	MNB	BH-CL	7.50	4.50	Non Liquefiable

S. No.	Chainage Old (km)	Chainage New (km)	Structure	BH.No.	Depth of Water Table below EGL (m)	Water table depth Considered for Liquefaction Analysis	Liquefiable Depth (m)
11.	2+788	3+476	MJB	BH-A1	18.24	15.00	Non Liquefiable
12.			MJB	BH-A2	17.68	14.00	Non Liquefiable
13.	3+497	4+242	MJB	BH-A1	16.25	13.00	Non Liquefiable
14.			MJB	BH-P1	15.32	11.00	Non Liquefiable
15.			MJB	BH-P2	15.30	11.00	Non Liquefiable
16.			MJB	BH-P3	15.31	11.00	Non Liquefiable
17.			MJB	BH-A2	15.30	11.00	Non Liquefiable
18.	3+691	4+376	MJB	BH-A1	15.40	12.00	Non Liquefiable
19.			MJB	BH-A2	15.25	12.00	Non Liquefiable
20.	4+174	4+858	MNB	BH-CL	Not Encountered	Not Encountered	Non Liquefiable
21.	4+207	4+892	MNB	BH-CL	Not Encountered	Not Encountered	Non Liquefiable
22.	4+655	5+340	MNB	BH-CL	Not Encountered	Not Encountered	Non Liquefiable
23.	5+119	5+804	MNB	BH-CL	Not Encountered	Not Encountered	Non Liquefiable
24.	5+730	6+415	MNB	BH-CL	Not Encountered	Not Encountered	Non Liquefiable
25.	6+197	6+881	MNB	BH-CL	2.52	0.00	Non Liquefiable
26.	6+877	7+559	MNB	BH-CL	1.85	0.00	Non Liquefiable
27.	7+078	7+759	MJB	BH-A1	1.70	0.00	Non Liquefiable
28.			MJB	BH-A2	1.25	0.00	7.00
29.	7+256	7+941	MNB	BH-CL	1.59	0.00	Non Liquefiable
30.	7+351	8+036	MJB	BH-A1	3.00	0.00	4.00
31.			MJB	BH-P1	2.10	0.00	5.50
32.			MJB	BH-A2	0.70	0.00	7.00
33.	7+457	8+141	MNB	BH-CL	0.59	0.00	Non Liquefiable
34.	7+613	8+298	MJB	BH-A1	0.50	0.00	4.00
35.			MJB	BH-A2	0.85	0.00	Non Liquefiable
36.	7+907	8+592	MNB	BH-CL	1.90	0.00	Non Liquefiable
37.	8+207	8+891	MNB	BH-CL	2.00	0.00	Non Liquefiable
38.	8+610	9+295	MNB	BH-CL	1.95	0.00	Non Liquefiable
39.	8+852	9+537	MJB	BH-A1	0.75	0.00	Non Liquefiable
40.			MJB	BH-A2	1.35	0.00	Non Liquefiable
41.	8+907	9+591	MNB	BH-CL	0.55	0.00	4.00
42.	-	10+340	MNB	BH-PLT-08	4.03	0.00	3.75
43.	9+200	9+882	MNB	BH-CL	1.25	0.00	5.50
44.	9+211	9+894	MNB	BH-CL	1.36	0.00	4.00
45.	9+407	10+091	MNB	BH-CL	0.60	0.00	8.50

S. No.	Chainage Old (km)	Chainage New (km)	Structure	BH.No.	Depth of Water Table below EGL (m)	Water table depth Considered for Liquefaction Analysis	Liquefiable Depth (m)
46.	9+726	10+410	MJB	BH-A1	0.85	0.00	4.00
47.			MJB	BH-A2	0.29	0.00	4.50
48.	9+772	10+457	MNB	BH-CL	0.60	0.00	3.00
49.	10+025	10+709	MJB	BH-A1	1.34	0.00	Non Liquefiable
50.			MJB	BH-A2	1.22	0.00	Non Liquefiable
51.	10+223	10+908	MNB	BH-CL	3.50	0.00	3.00
52.	10+519	11+203	MNB	BH-CL	4.50	0.00	1.50
53.	10+658	11+340	MNB	BH-CL	3.20	0.00	3.00
54.	10+718	11+403	MNB	BH-CL	2.50	0.00	6.00
55.	10+749	11+434	MNB	BH-CL	2.60	0.00	Non Liquefiable
56.	10+859	11+543	MJB	BH-A1(R)	2.99	0.00	4.00
57.			MJB	BH-A1	2.95	0.00	4.50
58.			MJB	BH-P1	3.35	0.00	6.00
59.			MJB	BH-A2	5.60	0.00	8.50
60.	17+625	18+310	MJB	BH-A1	3.00	0.00	5.50
61.			MJB	BH-A2	3.05	0.00	4.00
62.	17+872	18+558	MJB	BH-A1	0.95	0.00	7.00
63.			MJB	BH-A2	1.00	0.00	Non Liquefiable
64.	-	19+010	MNB	BH-PLT-07	0.60	0.00	2.25
65.	18+750	19+435	MJB	BH-A1	1.22	0.00	4.00
66.			MJB	BH-A2	1.50	0.00	11.50
67.	19+500	20+185	MJB	BH-A1	0.60	0.00	4.50
68.			MJB	BH-P1	1.85	0.00	4.00
69.			MJB	BH-A2	1.60	0.00	11.50
70.	19+715	20+400	MJB	BH-A1	0.85	0.00	7.00
71.			MJB	BH-P1	0.80	0.00	11.50
72.			MJB	BH-A2	0.45	0.00	7.00
73.	20+300	20+985	MJB	BH-A1	1.00	0.00	Non Liquefiable
74.			MJB	BH-P1	2.10	0.00	5.50
75.			MJB	BH-P2	2.25	0.00	4.00
76.			MJB	BH-A2	2.55	0.00	Non Liquefiable

6.4 INTERPRETATION OF LAB TEST RESULTS

Grain Size Analysis

1. **Clay content:** It generally varies from 4 to 11%.
2. **Silt content:** It generally varies from 20 to 66%.
3. **Sand content:** It generally varies from 22 to 85%.

4. **Gravel content:** It generally varies from 1 to 10%.

Atterberg's Limit

5. **Liquid limit:** The test results of liquid limit of the soil samples reveal that it generally varies from 24 to 28% in ML-CL type of soil, 32 to 33% in CL type of soil.
6. **Plastic Limit:** The plastic limit of the soil sample varies from 20 to 21% in ML-CL type of soil, 20 to 23% in CL type of soil. However ML-CL type of soil is considered as non-plastic.
7. **Plasticity index:** The plasticity index of the soil samples generally varies from 5 to 6% in ML-CL type of soil, 9 to 11% in CL type of soil whereas ML-CL and SM/ SM-SC/ SC type of soil are non-plastic.

Natural moisture content & Bulk density

The bulk density of soil samples generally varies from 1.84 gm/cc to 1.97gm/cc whereas natural moisture content varies from 10% to 21%.

Direct shear tests:

Direct shear test under drained condition have been conducted in sandy silty (ML-CL) / sandy stratum (SM/ SM-SC/ SC) type of soil.

For Sandy strata (SM/ SM-SC/ SC), the value of angle of internal friction varies from 28^o to 32^o, whereas cohesion varies from 0.00 kg/cm^2 to 0.11 kg/cm^2.

For Silty strata (ML-CL), the value of angle of internal friction varies from 24^o to 27^o, whereas cohesion varies from 0.11 kg/cm^2 to 0.22 kg/cm^2.

Triaxial shear tests:

Triaxial shear test under undrained condition have been conducted in silty clay (CL) type of soil.

For silty clay (CL) strata, the value of angle of internal friction varies from 4^o to 5^o, whereas cohesion varies from 1.41kg/cm^2 to 2.22 kg/cm^2.

FROM THE STUDY OF PRESSURE-SETTLEMENT CURVE (ON ARITHMETIC SCALE) OF 01 PLATE LOAD TESTS AS PROVIDED VIDE APPENDIX A-4, IT IS REVEALED THAT

<u>For PLT-09 New Ch-0+000</u>

1. Ultimate bearing capacity and Safe bearing capacity of the sandy soil with respect to plate is found to be 17.05 t/m^2 and 6.82 t/m^2, respectively.
2. Safe bearing capacity of soil for 2.70 m foundation depth is found to be 22.75 t/m^2 at 25 mm settlement. As per shear failure criteria (Bowles, J.E., 1982. Foundation design and analysis), it is found to be 20.4 t/m^2.

Note:

The Safe bearing capacity of sandy soil as per shear failure criteria is computed by the following given relation (Bowles, J.E., 1982. Foundation design and analysis),

$$q_{Safe} = q_{safe\ (Plate)}\ X \left(\frac{B_{Foundation}}{B_{Plate}}\right)$$

J.E., 1982 recommended that the above equation is valid when the ratio lies between 3 to 6. However for better understanding the ratio is conservatively restricted to 3. The use of this equation is not recommended unless the ratio is not much more than about 3. When the ratio is more than 6 to 15 or more the extrapolation from a plate load test is little more than a guess that could be obtained at least as reliably using an SPT or CPT corerection.

CHAPTER 3 TYPE AND DEPTH OF FOUNDATION WITH ANALYSIS

7.0 TYPE & DEPTH OF FOUNDATION:

Based on the nature & strength characteristics of the substrata and requirement of the project, the following type of foundation have been analyzed as given below:

Table 3.1 : Shallow Foundation

Type of foundation	Depth of Foundation below E.G.L. (m)	Size of Foundation (m x m)
Shallow Foundation	1.0, 2.0, 3.0	1.5 x 1.5
	1.0, 2.0, 2.7, 3.0	2.0 x 2.0
	1.0, 2.0, 3.0	2.7 x 2.7
	1.0, 2.0, 3.0	3.7 x 3.7
	1.0, 2.0, 3.0	4.8 x 4.8
	1.0, 2.0, 3.0	5.5 x 5.5
	1.0, 2.0, 3.0	6.0 x 6.0
	1.0, 2.0, 3.0	7.2 x 7.2
	1.0, 2.0, 3.0	12.5 x 12.5

Table 3.2 : Pile Foundation

Type of foundation	Length of Pile below E.G.L. (m)	Dia. of Pile (m)
Normal Bored Cast in-situ RCC Pile	14.0, 16.0, 18.0, 20.0, 22.0, 24.0, 26.0, 28.0, 30.0 & 32.0	1.0 & 1.2

The details of foundation analysis are given in the subsequent paragraph.

7.1 ANALYSIS OF SHALLOW FOUNDATION

7.1.1 From Shear Failure Criteria

Net Safe Bearing capacity from Shear Failure consideration has been computed in accordance with IS: 6403-1981, which is based on, modified Terzaghi's classical approach. The weighted average of shear strength parameters for various strata upto depth equal to 0.5*B*Tan (45+Ø/2) (where B = Width of the Foundation, Ø = Angle of internal friction) is used in the analysis. A factor of safety of 2.5 to estimate the net safe bearing capacity from ultimate net bearing capacity.

For soils, containing both coarse grained (gravels & sands) and fine grained (clays), c and Φ are used to determine the soil strength. In case of predominantly fine grained soils, c and Φ are determined by the Triaxial Compression test as per IS: 2720 pt XI. For predominantly coarse grained soils, c and Φ are determined by Direct Shear test as per IS: 2720 pt XIII. These c and Φ values were used for determining the SBC of soil as per shear failure criteria.

The ultimate net bearing capacity in case of general shear failure is given by following expression,

$q_d = c\, N_c\, s_c\, d_c\, i_c + q\,(N_q-1)\, s_q\, d_q\, i_q + (1/2)\, B\, \gamma\, N_\gamma\, s_\gamma\, d_\gamma\, i_\gamma\, W'$

The ultimate net bearing capacity in case of local shear failure is given by following expression,

$q'_d = (2/3)\, c\, N'_c\, s_c\, d_c\, i_c + q\,(N'_q-1)\, s_q\, d_q\, i_q + (1/2)\, B\, \gamma\, N'_\gamma\, s_\gamma\, d_\gamma\, i_\gamma\, W'$

Where,

$d_c = 1+ 0.2\,(D_f/B)*SQRT(N_\phi)$

$d_q = d_\gamma = 1$ for $\phi < 10^o$

$d_q = d_\gamma = 1 + 0.1\,(D_f/B)*SQRT(N_\phi)$ for $\phi > 10^o$

$N_\phi = \tan^2(\pi/4 + \phi/2)$

ϕ' for local shear failure = $\tan^{-1}(0.67 \tan\phi)$

7.1.2 From Settlement Failure Criteria

Allowable Bearing Pressure from Settlement Failure consideration has been computed in accordance with IS: 8009 (Part-I). The magnitude of settlement, when foundation loads are applied, depends upon the compressibility of the underlying strata and rigidity of the substructure.

The total permissible settlement in cohesion-less soil is estimated using SPT value as per IS: 8009 (Part-I). While using this approach, the N value was corrected, wherever applicable, below the footing base to at least 1.5B below the base to account for the effects of energy ratio, adopted bearing pressure, dilation for submerged silty fine sands / fine sands as well as that due to the overburden pressure.

Further for settlement Calculation in cohesive soil the following equation has been used.

$S_t = \Delta P\, M_v\, H$

Where,

M_v = Coefficient of volume compressibility, cm^2/kg

ΔP = Pressure increment, kg/cm^2

H = Thickness of layers

Note: - Value of Coefficient of volume compressibility (Mv) has been calculated by using the following co-relation [Ref. Stroud and Butler, 1975] :-

Coefficient of Volume Compressibility derived from SPT N-Value (after Stroud and Butler, 1975)

Plasticity Index (%)	Conversion Factor (f_2)	m_v (10^{-3} kPa^{-1}) based on N-Value: $m_v = 1/(f_2 N)$				
		N=10	N=20	N=30	N=40	N=50
10	800	0.12	0.06	0.04	0.03	0.02
20	525	0.19	0.09	0.06	0.05	0.04

Plasticity Index (%)	**Conversion Factor (f_2)**	**m_v (10^{-3} kPa^{-1}) based on N-Value: $m_v = 1/(f_2N)$**				
		N=10	**N=20**	**N=30**	**N=40**	**N=50**
30	475	0.21	0.10	0.07	0.05	0.04
40	450	0.22	0.11	0.07	0.06	0.04

$Mv = 1/(f_2N_{corr.})$

Where f_2 = factor based on $N_{corr.}$ Value & plasticity index of soil

$N_{corr.}$ = corrected SPT 'N' value

For analysis of shallow foundation the total permissible settlement has been considered as 25mm, & 50mm as per IS 1904.

Zone of influence below foundation has been considered up to 1.5 times the width of the foundation.

For the determination of the SBC from settlement criteria, the corrected SPT N values within the influence zone are given in the table below.

NOTE:-

- Lower of the two values obtained from settlement and shear criteria is used in arriving at allowable bearing capacity of the soil.
- Structural foundations are designed based on the minimum of Safe Bearing Capacity obtained from Shear Failure Criteria and Allowable Bearing Pressure corresponding to the permissible settlement. The permissible Settlement that can be allowed for the foundation depends on the strata at the location and type of foundation (whether Isolated or Raft).

Settlement occurs with the application of loads on foundations. It has two components, Immediate Settlement and Long Term Settlement. The immediate settlement takes place immediately as the loading is imposed on the structure and long term settlement arises due to the consolidation of the sub-soil with time under the load. Hence, the total settlement allowed for a foundation is the sum of the immediate and consolidation settlement that is expected to occur. The cohesionless strata (predominantly sandy) is primarily subjected to immediate settlement and cohesive strata (clayey) undergoes settlement in long time with the compression of the strata due to consolidation. Settlement of the foundation is determined from the relation provided in Indian standards (IS: 8009 (part-1) &/or various literatures (Bowles, BM Das, etc.).

From the Geotechnical investigation conducted on our site along with subsequent laboratory tests on soil samples, it is observed that predominantly the strata is silty with sand (SM/SC/SM-SC/ML-CL i.e. predominantly cohesionless) with the presence of small patches of silty clay of low plasticity (CL). Since the Settlement that takes place in cohesionless strata is mostly immediate, it takes place immediately after the imposing of load, initially during construction with the application of Dead Load and further during Live Load. The live load usually is many times lesser than the dead load, and correspondingly the post construction settlement is very less for live loads. As an example, if dead load is three times that of live load, then the settlement corresponding to live load (i.e. the post construction settlement) will be one-third of the settlement due to dead load which is comparatively lesser than 25mm for permissible settlement of 50mm.

According to the IS 1904, the permissible settlement for concrete structure having raft foundation is allowed upto 75mm, and the permissible settlement is 25mm post construction as per IRS code (Code of Practice for The Design of Sub-Structures and Foundations of Bridges). As discussed above, the settlement post construction is directly proportional to the allowable settlement. Therefore, given the importance of structure to be constructed and considering mostly cohesionless strata encountered at site, it is recommended that the maximum permissible settlement shall be restricted to 50mm for the design purpose on conservative side so that the post construction settlement can be constraint to lesser than 25mm.

As per IS- 8009 part 1 clause 9.2.2.1, If the clay layer is sandwitched between cohesionless soil layers, the immediate settlement is zero. Hence, even though the immediate settlement has been calculated during analysis, however it is ignored in the calculation of total settlement.

The sample calculations for computation of allowable bearing capacity of sub-strata for shallow foundation vide **Appendix – C-2.**

7.2 ANALYSIS OF PILE FOUNDATION

(A) DEEP FOUNDATION

The safe Load Carrying Capacity of normal bored cast in-situ RCC pile is determined in compression, uplift and lateral as per IS: 2911 (Part-1/sec-2) – 2010. The axial capacity of a pile depends upon the soil skin friction along the shaft and end bearing at it's tip.

Thus Axial load = Skin Friction + End-bearing

a) For piles in granular soils (using the static formula)

$$\mathbf{Q_u = (0.5*D*\gamma*N_\gamma + P_D*N_q)*A_p + (\Sigma K_i*P_{Di}*\tan\delta_i)*A_{si}}$$

Where,

Q_u = Ultimate load capacity of pile in KN

D = dia. of pile shaft in m

γ = effective unit weight of the soil at pile tip in kN/m^3

N_γ & N_q = bearing capacity factors depending upon the angle of internal friction Φ at pile tip (N_γ from IS 6403 for general shear failure case & N_q from Fig. 1, IS 2911)

P_D = effective overburden pressure at pile tip in kN/m^2 limited to 15-17 times diameter of pile (as per the Phi value at end bearing)

Σ = Summation for layers (1 to n) in which pile is installed and which contribute to (+ve) skin friction

K_i = coefficient of earth pressure applicable for the i^{th} layer

P_{Di} = effective overburden pressure for the i^{th} layer in kN/m^2 limited to 15-17 times diameter of pile (as per the Phi value at end bearing)

δ_i = angle of wall friction between pile and soil for i^{th} layer, and

A_{si} = surface area of pile shaft in the i^{th} layer in m^2

b) For piles in cohesive soils (using the static formula)

$$\mathbf{Q_u = cp*Nc*A_p + \Sigma\alpha_i*c_i*A_{si}}$$

Where,

Q_u = Ultimate load capacity of pile in KN

A_p = cross-sectional area of pile tip in m^2

N_c = bearing capacity factor (= 9)

Σ = Summation for layers (1 to n) in which pile is installed and which contribute to (+ve) skin friction

α_i = adhesion factor for the i^{th} layer depending on the consistency of soil

c_i = average cohesion for i^{th} layer in kN/m^2

A_{si} = surface area for pile shaft in the i^{th} layer in m^2

c) For computation of safe load carrying capacity of pile in lateral, the following equation has been used:

i. **<u>Fixed Head Condition</u>**

$$\mathbf{Q = (12 * E * I * Y) / (L_1 + L_f)^3}$$

ii. **<u>Free Head Condition</u>**

$$\mathbf{Q = (3 * E * I * Y) / (L_1 + L_f)^3}$$

Where,

Q = Lateral Load (in kg)

Y = Permissible lateral deflection taken as 5mm

E = Modulus of Elasticity of concrete

I = Moment of Inertia of the pile cross-section

L_1 = Length of pile above cut-off level

L_f = Length of fixity

The effective length of the pile has been considered below the cut-off level taken as 2.0m below the EGL. Normal Bored cast in-situ RCC piles having stem diameter equal to 100cm & 120cm and of effective length varying from 16.0m to 32.0m were selected.

For the analysis of the pile foundations the soil parameters used for computation of safe load carrying capacity of pile is tabulated below:-

Table 3.3 : Design Soil Parameter

ChainageOld (km)	ChainageNew (km)	BH.No.	Layer depth below EGL(m)		Thicknessofstrata(m)	Stratadescription	SPT'N'		BulkDensity(gm/cc)	Cohesion(C)(kg/cm^2)	Angle of internal Friction (Φ) (°)
			From	To			Observed	Corrected			
-	0+000	BH-PLT-09	0.00	4.50	4.50	SandySilt	9	11	1.64	0.15	26
			4.50	6.00	1.50	SandySilt	-	-	1.67	0.18	27
			6.00	12.00	6.00	SiltySand	34	28	1.68	0.00	30
(-) 0+627	0+057	BH-CL	0.00	5.50	5.50	SiltySand	24	32	1.78	0.00	30
			5.50	10.00	4.50	SiltySand	46	34	1.85	0.00	31
(-) 0+529	0+158	BH-CL	0.00	4.00	4.00	SiltySand	18	23	1.74	0.00	29
			4.00	7.00	3.00	SiltySand	37	37	1.80	0.00	30
			7.00	10.00	3.00	SiltySand	43	27	1.85	0.00	31
(-) 0+319	0+371	BH-CL	0.00	5.50	5.50	SiltySand	27	34	1.79	0.00	30
			5.50	8.50	3.00	SiltyClay	23	23	1.86	0.79	5
			8.50	10.00	1.50	SiltySand	36	24	1.84	0.00	30
0+273	0+958	BH-CL	0.00	2.50	2.50	SiltySand	12	19	-	-	-
			2.50	8.50	6.00	SandySilt	31	32	1.82	0.21	25
			8.50	10.00	1.50	SiltySand	32	21	1.79	0.00	29
1+006	1+696	BH-A1	0.00	4.00	4.00	SiltySand	9	14	1.67	0.00	29
			4.00	7.00	3.00	SiltySand	22	25	1.76	0.00	30
			7.00	11.50	4.50	SiltySand	52	45	1.83	0.00	32
			11.50	14.50	3.00	SiltySand	69	50	1.84	0.00	32
			14.50	19.00	4.50	SiltySand	97	62	1.88	0.00	32
			19.00	23.50	4.50	SandySilt	56	31	1.88	0.18	27
			23.50	29.50	6.00	SandySilt	100	39	1.97	0.18	28
			29.50	30.00	0.50	SiltyClay	48	48	1.98	1.56	4
		BH-A2	0.00	4.00	4.00	SiltySand	7	9	1.62	0.00	28
			4.00	7.00	3.00	SiltySand	14	14	1.70	0.06	29
			7.00	10.00	3.00	SiltySand	20	18	1.74	0.09	30
			10.00	13.00	3.00	SiltySand	42	32	1.82	0.11	32
			13.00	19.00	6.00	SiltySand	84	56	1.92	0.10	32
			19.00	22.45	3.45	SiltySand	84	47	1.90	0.08	32
			22.45	25.00	2.55	SiltyClay	39	39	1.94	1.29	4
			25.00	29.50	4.50	SandySilt	65	24	1.92	0.22	26
			29.50	30.00	0.50	SiltyClay	64	64	2.02	2.05	4

Chainage Old (km)	Chainage New (km)	BH.No.	Layer depth below EGL(m) From	Layer depth below EGL(m) To	Thickness of strata(m)	Strata description	SPT'N' Observed	SPT'N' Corrected	Bulk Density(gm/cc)	Cohesion(C)(kg/cm^2)	Angle of internal Friction (Φ) (°)
1+333	2+018	BH-CL	0.00	4.00	4.00	SiltySand	35	44	1.80	0.00	32
			4.00	7.00	3.00	SiltySand	41	41	1.81	0.00	32
			7.00	10.00	3.00	Silty Clay	48	48	1.89	1.58	5
1+811	2+493	BH-CL	0.00	4.00	4.00	SiltySand	13	21	1.72	0.00	30
			4.00	7.00	3.00	SiltySand	33	37	1.82	0.00	31
			7.00	10.00	3.00	SandySilt	30	28	1.87	0.21	26
2+472	3+160	BH-CL	0.00	4.00	4.00	SiltySand	11	17	1.72	0.08	28
			4.00	10.00	6.00	SandySilt	32	32	1.91	0.18	27
2+788	3+476	BH-A1	0.00	5.50	5.50	SiltySand	15	19	1.71	0.00	30
			5.50	8.50	3.00	SiltySand	54	50	1.84	0.00	32
			8.50	11.50	3.00	SiltySand	84	68	1.87	0.00	32
			11.50	14.50	3.00	SiltySand	71	51	1.86	0.00	32
			14.50	20.50	6.00	SandySilt	40	22	1.80	0.20	26
			20.50	23.50	3.00	SandySilt	55	23	1.88	0.21	27
			23.50	26.50	3.00	SandySilt	48	21	1.88	0.21	27
			26.50	30.00	3.50	SandySilt	73	27	1.90	0.20	28
		BH-A2	0.00	4.00	4.00	SiltySand	22	28	1.79	0.00	31
			4.00	7.00	3.00	SiltySand	30	30	1.79	0.00	31
			7.00	10.00	3.00	SiltySand	59	51	1.86	0.00	32
			10.00	13.00	3.00	SiltySand	64	48	1.86	0.00	32
			13.00	16.00	3.00	SandySilt	33	22	1.82	0.18	27
			16.00	19.00	3.00	SandySilt	32	20	1.83	0.18	27
			19.00	22.00	3.00	SandySilt	36	18	1.84	0.18	27
			22.00	25.00	3.00	SandySilt	83	31	1.93	0.19	28
			25.00	30.00	5.00	SandySilt	75	28	1.93	0.19	28
3+497	4+242	BH-A1	0.00	4.00	4.00	Sandy Silt	5	8	1.64	0.21	23
			4.00	8.50	4.50	SiltyClay	26	26	1.82	0.85	4
			8.50	11.50	3.00	SiltySand	53	43	1.80	0.00	32
			11.50	14.50	3.00	SiltyClay	21	21	1.80	0.72	5
			14.50	17.50	3.00	SiltyClay	33	33	1.88	1.13	5
			17.50	20.50	3.00	SandySilt	61	26	1.89	0.22	28
			20.50	23.50	3.00	SandySilt	77	30	1.92	0.22	28
			23.50	26.50	3.00	SandySilt	57	24	1.90	0.22	28
			26.50	29.50	3.00	SandySilt	62	24	1.90	0.22	28
			29.50	32.50	3.00	SiltyClay	79	79	2.04	2.51	5
			32.50	40.00	7.50	SiltyClay	90	90	2.05	3.12	4
		BH-P1	0.00	4.00	4.00	SandySilt	45	57	1.82	0.22	27
			4.00	7.00	3.00	SandySilt	35	35	1.81	0.22	27

ChainageOld (km)	ChainageNew (km)	BH.No.	Layer depth below EGL(m)		Thicknessofstrata(m)	Stratadescription	SPT'N'		BulkDensity(gm/cc)	Cohesion(C)(kg/cm^2)	Angle of internal Friction (Φ) (°)
			From	To			Observed	Corrected			
3+497	4+242	BH-P1	7.00	10.00	3.00	SiltySand	55	47	1.80	0.00	31
			10.00	13.00	3.00	SiltySand	51	39	1.81	0.00	31
			13.00	17.50	4.50	SandySilt	40	27	1.83	0.20	27
			17.50	22.00	4.50	SiltySand	64	28	1.86	0.00	32
			22.00	25.00	3.00	SiltyClay	57	57	2.02	1.96	5
			25.00	28.00	3.00	SiltyClay	61	61	2.02	1.96	5
			28.00	31.00	3.00	SiltyClay	50	50	2.02	1.96	5
			31.00	34.00	3.00	SiltyClay	65	65	2.02	1.96	5
			34.00	40.00	6.00	SiltyClay	90	90	2.03	2.41	5
		BH-P2	0.00	4.00	4.00	SandySilt	7	11	1.66	0.18	24
			4.00	8.50	4.50	SiltySand	18	19	1.72	0.00	30
			8.50	11.50	3.00	SiltySand	23	19	1.73	0.00	30
			11.50	13.00	1.50	SiltySand	-	-	1.74	0.00	30
			13.00	17.50	4.50	SiltyClay	22	22	1.82	0.75	5
			17.50	20.50	3.00	SandySilt	60	27	1.87	0.21	26
			20.50	23.50	3.00	SandySilt	38	19	1.89	0.21	26
			23.50	26.50	3.00	SiltyClay	42	42	2.00	1.49	5
			26.50	28.00	1.50	SiltyClay	-	-	2.01	1.49	5
			28.00	34.00	6.00	SiltyClay	56	56	2.02	2.02	5
			34.00	40.00	6.00	SiltySand	94	31	1.95	0.10	32
		BH-P3	0.00	4.00	4.00	SiltySand	11	14	1.68	0.00	30
			4.00	7.00	3.00	SiltySand	22	22	1.75	0.00	31
			7.00	10.00	3.00	SiltySand	25	22	1.75	0.00	31
			10.00	13.00	3.00	SiltyClay	28	28	1.86	1.00	6
			13.00	16.00	3.00	SiltyClay	32	32	1.87	1.00	6
			16.00	19.00	3.00	SandySilt	56	26	1.91	0.21	28
			19.00	23.50	4.50	SandySilt	67	28	1.91	0.21	28
			23.50	28.00	4.50	SiltyClay	60	60	2.03	1.98	6
			28.00	31.50	3.50	SiltyClay	70	70	2.03	2.24	5
			31.50	40.00	8.50	SandySilt	85	29	-	-	-
		BH-A2	0.00	5.50	5.50	SandySilt	21	27	1.79	0.21	26
			5.50	8.50	3.00	SiltySand	47	43	1.82	0.00	33
			8.50	11.50	3.00	SiltySand	36	29	1.81	0.00	33
			11.50	14.50	3.00	SiltySand	60	43	1.83	0.00	33
			14.50	17.50	3.00	SandySilt	43	22	1.83	0.19	27
			17.50	23.50	6.00	SandySilt	83	34	1.94	0.20	31
			23.50	26.50	3.00	SiltyClay	58	58	2.01	1.82	6
			26.50	40.00	13.50	SiltyClay	63	63	2.05	3.15	6

ChainageOld (km)	ChainageNew (km)	BH.No.	Layer depth below EGL(m)		Thicknessofstrata(m)	Stratadescription	SPT'N'		BulkDensity(gm/cc)	Cohesion(C)(kg/cm^2)	Angle of internal Friction (Φ) (°)
			From	To			Observed	Corrected			
3+691	4+376	BH-A1	0.00	4.00	4.00	SiltySand	5	8	1.67	0.11	26
			4.00	8.50	4.50	SandySilt	23	24	1.79	0.18	26
			8.50	11.50	3.00	SandySilt	27	22	1.81	0.18	26
			11.50	14.50	3.00	SandySilt	22	16	1.81	0.18	26
			14.50	17.50	3.00	SiltyClay	40	40	1.94	1.36	4
			17.50	26.50	9.00	SandySilt	71	29	1.93	0.20	28
			26.50	30.00	3.50	SandySilt	87	31	-	-	-
		BH-A2	0.00	4.00	4.00	SiltyClay	12	12	1.70	0.43	4
			4.00	7.00	3.00	SandySilt	16	16	1.72	0.20	25
			7.00	10.00	3.00	SandySilt	20	17	1.74	0.20	25
			10.00	13.00	3.00	SandySilt	27	21	1.78	0.19	26
			13.00	16.00	3.00	SiltyClay	22	22	1.87	0.75	5
			16.00	19.00	3.00	SiltyClay	30	30	1.96	1.02	4
			19.00	25.00	6.00	SandySilt	48	22	1.88	0.22	27
			25.00	30.00	5.00	SandySilt	58	24	1.91	0.22	27
4+174	4+858	BH-CL	0.00	2.50	2.50	SiltySand	14	18	1.68	0.00	30
			2.50	5.50	3.00	SiltyClay	14	14	1.78	0.63	5
			5.50	10.00	4.50	SiltySand	42	39	1.82	0.00	32
4+207	4+892	BH-CL	0.00	5.50	5.50	SandySilt	21	27	1.78	0.18	26
			5.50	10.00	4.50	SiltySand	49	42	1.83	0.00	31
4+655	5+340	BH-CL	0.00	5.50	5.50	SiltySand	28	34	1.81	0.00	32
			5.50	10.00	4.50	SiltySand	58	50	1.84	0.00	33
5+119	5+804	BH-CL	0.00	4.00	4.00	SiltySand	10	13	1.66	0.00	29
			4.00	7.00	3.00	SiltySand	28	29	1.78	0.00	30
			7.00	10.00	3.00	SiltySand	33	29	1.79	0.00	31
5+730	6+415	BH-CL	0.00	5.50	5.50	SiltySand	12	15	1.69	0.00	28
			5.50	10.00	4.50	SiltySand	29	25	1.79	0.00	30
6+197	6+881	BH-CL	0.00	4.00	4.00	SandySilt	13	17	1.78	0.21	24
			4.00	7.00	3.00	SandySilt	21	19	1.84	0.21	24
			7.00	10.00	3.00	SiltySand	47	31	1.86	0.00	31
6+877	7+559	BH-CL	0.00	5.50	5.50	SiltySand	16	20	1.80	0.09	28
			5.50	10.00	4.50	SiltySand	36	27	1.84	0.00	31
7+078	7+759	BH-A1	0.00	10.00	10.00	SandySilt	17	18	1.80	0.18	24
			10.00	11.50	1.50	SandySilt	-	-	1.88	0.23	24
			11.50	16.00	4.50	SiltyClay	31	31	1.99	1.02	4
			16.00	23.50	7.50	SandySilt	83	41	1.94	0.22	27
			23.50	30.00	6.50	SiltyClay	74	74	2.03	2.40	4

ChainageOld (km)	ChainageNew (km)	BH.No.	Layer depth below EGL(m)		Thicknessofstrata(m)	Stratadescription	SPT'N'		BulkDensity(gm/cc)	Cohesion(C)(kg/cm^2)	Angle of internal Friction (Φ) (°)
			From	To			Observed	Corrected			
7+078	7+759	BH-A2	0.00	5.50	5.50	SiltyClay	6	6	1.88	0.24	5
			5.50	8.50	3.00	SiltyClay	8	8	1.88	0.24	5
			8.50	11.50	3.00	SandySilt	19	17	1.85	0.21	24
			11.50	14.50	3.00	SiltyClay	34	34	1.99	1.16	4
			14.50	17.50	3.00	SiltyClay	40	40	2.00	1.35	4
			17.50	20.50	3.00	SandySilt	92	45	1.94	0.22	27
			20.50	30.00	9.50	SiltyClay	67	67	2.03	2.15	4
7+256	7+941	BH-CL	0.00	4.00	4.00	SiltySand	16	25	1.82	0.00	30
			4.00	10.00	6.00	SandySilt	30	24	1.89	0.19	26
7+351	8+036	BH-A1	0.00	4.00	4.00	SandySilt	5	8	1.70	0.20	23
			4.00	8.50	4.50	SandySilt	24	22	1.86	0.19	25
			8.50	11.50	3.00	SiltyClay	20	20	1.95	0.70	4
			11.50	14.50	3.00	SandySilt	33	22	1.87	0.22	25
			14.50	17.50	3.00	SiltyClay	39	39	1.99	1.32	5
			17.50	23.50	6.00	SandySilt	67	32	1.93	0.20	28
			23.50	28.00	4.50	SandySilt	100	41	1.94	0.20	28
			28.00	32.50	4.50	SandySilt	49	23	1.89	0.21	27
			32.50	35.50	3.00	SiltyClay	71	71	2.03	2.28	5
			35.50	40.00	4.50	SiltyClay	100	100	2.05	3.15	5
		BH-P1	0.00	4.00	4.00	SandySilt	9	13	1.71	0.18	25
			4.00	7.00	3.00	SiltyClay	11	11	1.91	0.41	4
			7.00	10.00	3.00	SiltyClay	12	12	1.92	0.41	4
			10.00	13.00	3.00	SandySilt	45	29	1.93	0.21	27
			13.00	14.50	1.50	SandySilt	-	-	1.93	0.21	27
			14.50	19.00	4.50	SiltyClay	31	31	1.99	1.02	5
			19.00	25.00	6.00	SandySilt	56	29	1.92	0.22	27
			25.00	28.00	3.00	SandySilt	89	38	1.94	0.20	29
			28.00	31.00	3.00	SiltyClay	41	41	2.00	1.36	5
			31.00	34.00	3.00	SiltyClay	59	59	2.02	1.95	5
			34.00	40.00	6.00	SandySilt	95	35	1.96	0.20	30
		BH-A2	0.00	5.50	5.50	SiltySand	4	7	1.65	0.00	28
			5.50	8.50	3.00	SiltySand	8	10	1.66	0.00	28
			8.50	11.50	3.00	SiltySand	14	15	1.75	0.10	28
			11.50	14.50	3.00	SiltySand	22	19	1.79	0.11	29
			14.50	18.00	3.50	SandySilt	56	34	1.94	0.22	28
			18.00	25.00	7.00	SandySilt	78	40	1.96	0.19	29
			25.00	40.00	15.00	SandySilt	90	39	-	-	-

ChainageOld (km)	ChainageNew (km)	BH.No.	Layer depth below EGL(m)		Thicknessofstrata(m)	Stratadescription	SPT'N'		BulkDensity(gm/cc)	Cohesion(C)(kg/cm^2)	Angle of internal Friction (Φ) (°)
			From	To			Observed	Corrected			
7+457	8+141	BH-CL	0.00	4.00	4.00	SiltySand	12	19	1.78	0.00	29
			4.00	10.00	6.00	SandySilt	25	22	1.90	0.20	25
7+613	8+298	BH-A1	0.00	5.50	5.50	SiltySand	11	16	1.74	0.00	30
			5.50	8.50	3.00	SiltySand	21	20	1.81	0.09	30
			8.50	11.50	3.00	SiltySand	20	18	1.81	0.09	30
			11.50	14.50	3.00	SiltySand	29	22	1.83	0.09	30
			14.50	17.50	3.00	SiltyClay	100	100	2.00	3.15	5
			17.50	20.50	3.00	SiltySand	70	37	1.89	0.00	33
			20.50	23.50	3.00	SiltySand	55	29	1.88	0.00	32
			23.50	27.00	3.50	SiltyClay	72	72	2.04	2.41	5
			27.00	32.50	5.50	SiltyClay	81	81	2.04	2.64	5
			32.50	40.00	7.50	SiltySand	80	30	2.00	0.11	33
		BH-A2	0.00	4.00	4.00	SiltyClay	21	21	1.95	0.72	5
			4.00	7.00	3.00	SiltyClay	22	22	1.95	0.72	5
			7.00	10.00	3.00	SiltyClay	31	31	1.98	1.02	6
			10.00	13.00	3.00	SiltyClay	30	30	1.98	1.02	6
			13.00	16.00	3.00	SiltySand	60	34	1.89	0.11	31
			16.00	19.00	3.00	SiltySand	55	30	1.89	0.11	31
			19.00	22.00	3.00	SiltySand	81	39	1.89	0.00	33
			22.00	25.00	3.00	SiltySand	80	37	1.89	0.00	33
			25.00	28.00	3.00	SiltySand	82	36	1.89	0.00	33
			28.00	31.00	3.00	SiltyClay	56	56	1.98	1.85	4
			31.00	37.00	6.00	SiltyClay	100	100	2.01	3.13	4
			37.00	40.00	3.00	SandySilt	100	42	1.98	0.20	32
7+907	8+592	BH-CL	0.00	2.50	2.50	SiltySand	13	13	1.67	0.00	30
			2.50	8.50	4.50	SiltyClay	16	16	1.93	0.53	5
			8.50	10.0	2.50	SiltySand	39	28	1.86	0.00	30
8+207	8+891	BH-CL	0.00	5.50	5.50	SandySilt	17	21	1.83	0.20	26
			5.50	8.50	3.00	SandySilt	26	22	1.88	0.18	25
			8.50	10.00	1.50	SiltyClay	30	30	1.98	1.02	5
8+610	9+295	BH-CL	0.00	4.00	4.00	SiltySand	19	21	1.77	0.00	30
			4.00	7.00	3.00	SiltySand	17	18	1.80	0.10	29
			7.00	10.00	3.00	SiltySand	35	36	1.85	0.11	29
8+852	9+537	BH-A1	0.00	5.50	5.50	SiltySand	20	23	1.79	0.10	29
			5.50	8.50	3.00	SiltySand	25	22	1.80	0.09	30
			8.50	11.50	3.00	SiltyClay	49	49	2.00	1.49	6
			11.50	14.50	3.00	SiltyClay	41	41	1.99	1.49	6
			14.50	17.50	3.00	SiltyClay	46	46	2.00	1.49	6

ChainageOld (km)	ChainageNew (km)	BH.No.	Layer depth below EGL(m) From	Layer depth below EGL(m) To	Thicknessofstrata(m)	Stratadescription	SPT'N' Observed	SPT'N' Corrected	BulkDensity(gm/cc)	Cohesion(C)(kg/cm^2)	Angle of internal Friction (Φ) (°)
8+852	9+537	BH-A1	17.50	20.50	3.00	SandySilt	41	24	1.90	0.18	29
			20.50	25.00	4.50	SandySilt	43	24	1.90	0.18	29
			25.00	30.00	5.00	SiltyClay	53	53	2.01	1.65	6
		BH-A2	0.00	4.00	4.00	SiltySand	15	18	1.76	0.11	29
			4.00	7.00	3.00	SiltySand	14	16	1.77	0.11	29
			7.00	10.00	3.00	SiltySand	19	18	1.79	0.11	29
			10.00	13.00	3.00	SandySilt	39	27	1.90	0.21	27
			13.00	16.00	3.00	SiltyClay	57	57	2.02	1.88	5
			16.00	19.00	3.00	SiltyClay	40	40	2.00	1.35	6
			19.00	22.00	3.00	SandySilt	41	24	1.91	0.20	28
			22.00	25.00	3.00	SandySilt	56	28	1.90	0.19	29
			25.00	30.00	5.00	SiltyClay	54	54	2.01	1.72	6
8+907	9+591	BH-CL	0.00	5.50	5.50	SiltySand	11	15	1.70	0.00	29
			5.50	10.00	4.50	SiltySand	25	22	1.81	0.00	30
-	10+340	BH-PLT-08	0.00	4.50	4.50	SiltySand	7	9	1.79	0.15	25
			4.50	7.50	3.00	SiltySand	26	21	1.83	0.19	26
			7.50	12.00	4.50	SandySilt	49	30	1.88	0.21	26
9+200	9+882	BH-CL	0.00	4.00	4.00	SiltyClay	6	6	1.86	0.23	5
			4.00	10.00	6.00	SandySilt	20	19	1.86	0.22	25
9+211	9+894	BH-CL	0.00	4.00	4.00	SiltyClay	7	7	1.86	0.15	5
			4.00	10.00	6.00	SandySilt	21	19	1.88	0.20	26
9+407	10+091	BH-CL	0.00	4.00	4.00	SiltySand	7	11	1.70	0.00	29
			4.00	8.50	4.50	SiltySand	14	17	1.76	0.00	29
			8.50	10.00	1.50	SiltyClay	20	20	1.95	0.70	5
9+726	10+410	BH-A1	0.00	4.00	4.00	SiltySand	4	8	1.66	0.00	27
			4.00	8.50	4.50	SiltySand	21	22	1.79	0.11	27
			8.50	11.50	3.00	SandySilt	41	30	1.92	0.22	26
			11.50	14.50	3.00	SandySilt	48	31	1.92	0.22	26
			14.50	17.50	3.00	SandySilt	33	22	1.91	0.18	26
			17.50	20.50	3.00	SandySilt	33	21	1.91	0.18	26
			20.50	23.50	3.00	SiltyClay	39	39	2.00	1.32	5
			23.50	26.50	3.00	SiltyClay	47	47	2.01	1.55	5
			26.50	28.00	1.50	SiltyClay	100	100	2.00	1.55	5
			28.00	30.00	2.00	SiltySand	100	38	1.93	0.00	32
		BH-A2	0.00	4.50	4.50	SiltySand	5	8	-	-	-
			4.50	10.00	5.50	SiltySand	27	25	1.83	0	30
			10.00	13.00	3.00	SiltyClay	31	31	2.03	2.00	6

ChainageOld (km)	ChainageNew (km)	BH.No.	Layer depth below EGL(m)		Thicknessofstrata(m)	Stratadescription	SPT'N'		BulkDensity(gm/cc)	Cohesion(C)(kg/cm^2)	Angle of internal Friction (Φ) (°)
			From	To			Observed	Corrected			
9+726	10+410	BH-A2	13.00	16.00	3.00	SiltySand	37	25	1.87	0.11	29
			16.00	19.00	3.00	SiltySand	37	24	1.87	0.11	29
			19.00	22.00	3.00	SiltySand	40	24	1.87	0.11	29
			22.00	25.00	3.00	SiltySand	45	25	1.87	0.09	30
			25.00	26.50	1.50	SiltySand	-	-	1.89	0.09	30
			26.50	30.00	3.45	SiltyClay	64	64	2.03	2.00	6
9+772	10+457	BH-CL	0.00	2.25	2.25	SandySilt	5	8	1.74	0.21	22
			2.25	5.25	3.00	SandySilt	16	18	1.84	0.20	24
			5.25	8.25	3.00	SiltySand	22	20	1.84	0.10	27
			8.25	12.00	3.75	SiltySand	40	28	1.91	0.11	29
10+025	10+709	BH-A1	0.00	4.00	4.00	SandySilt	10	16	1.80	0.20	25
			4.00	8.50	4.50	SiltySand	20	20	1.82	0.10	29
			8.50	11.50	3.00	SandySilt	20	18	1.86	0.22	26
			11.50	14.50	3.00	SandySilt	27	20	1.86	0.22	26
			14.50	17.50	3.00	SandySilt	31	21	1.86	0.19	27
			17.50	20.50	3.00	SiltyClay	64	64	2.03	2.02	6
			20.50	26.50	6.00	SiltyClay	48	48	2.04	2.02	6
			26.50	30.00	3.50	SiltyClay	55	55	-	-	-
		BH-A2	0.00	4.00	4.00	SandySilt	13	17	1.73	0.22	26
			4.00	10.00	6.00	SiltySand	34	27	1.84	0.09	30
			10.00	13.00	3.00	SandySilt	55	35	1.91	0.23	28
			13.00	16.00	3.00	SandySilt	54	32	1.92	0.23	28
			16.00	19.00	3.00	SandySilt	59	32	1.92	0.23	28
			19.00	22.00	3.00	SiltyClay	62	62	2.03	2.05	5
			22.00	25.00	3.00	SiltyClay	67	67	2.03	2.05	5
			25.00	28.00	3.00	SiltyClay	63	63	2.03	2.05	5
			28.00	30.00	2.00	SiltyClay	72	72	2.03	2.31	5
10+223	10+908	BH-CL	0.00	2.25	2.25	SandySilt	6	9	1.65	0.18	25
			2.25	5.25	3.00	SandySilt	17	17	1.77	0.20	25
			5.25	8.25	3.00	SandySilt	25	21	1.85	0.19	26
			8.25	10.00	1.75	SiltySand	26	20	1.84	0.10	28
10+519	11+203	BH-CL	0.00	2.25	2.25	SandySilt	8	12	1.70	0.20	25
			2.25	4.50	2.25	SandySilt	18	22	1.78	0.21	25
			4.50	8.25	3.75	SiltySand	42	35	1.87	0.20	27
			8.25	10.00	1.75	SiltySand	51	33	1.88	0.19	28

ChainageOld (km)	ChainageNew (km)	BH.No.	Layer depth below EGL(m)		Thicknessofstrata(m)	Stratadescription	SPT'N'		BulkDensity(gm/cc)	Cohesion(C)(kg/cm^2)	Angle of internal Friction (Φ) (°)
			From	To			Observed	Corrected			
10+658	11+340	BH-CL	0.00	2.25	2.25	SandySilt	6	10	-	-	-
			2.25	3.00	0.75	SandySilt	-	-	1.74	0.19	24
			3.00	5.25	2.25	SiltyClay	13	13	1.80	0.37	5
			5.25	8.25	3.00	SiltySand	24	21	1.81	0.10	27
			8.25	10.00	1.75	SiltySand	33	24	1.81	0.00	30
10+718	11+403	BH-CL	0.00	2.25	2.25	SiltySand	20	32	1.75	0.00	30
			2.25	5.25	3.00	Silty Sand	8	10	1.72	0.10	27
			5.25	8.25	3.00	Silty Sand	23	21	1.83	0.11	28
			8.25	10.00	1.75	SandySilt	27	21	1.87	0.18	26
10+749	11+434	BH-CL	0.00	1.50	1.50	SiltySand	11	20	1.74	0.00	30
			1.50	5.25	3.75	SandySilt	18	21	1.79	0.21	25
			5.25	8.25	3.00	SiltySand	20	19	1.79	0.00	30
			8.25	10.00	1.75	SandySilt	23	19	1.86	0.20	26
10+859	11+543	BH-A1(R)	0.00	5.50	5.50	SiltySand	8	10	1.69	0.11	27
			5.50	11.50	6.00	SiltySand	16	16	1.77	0.09	28
			11.50	14.50	3.00	SiltyClay	31	31	1.98	1.06	6
			14.50	17.50	3.00	SiltyClay	36	36	1.99	1.23	6
			17.50	20.50	3.00	SiltyClay	49	49	2.01	1.62	5
			20.50	28.00	7.50	SiltyClay	77	77	-	-	-
			28.00	40.00	12.00	SandySilt	79	31	1.99	0.20	33
		BH-A1	0.00	4.50	4.50	SiltySand	9	12	1.69	0.00	29
			4.50	10.00	5.50	SiltySand	13	15	1.77	0.08	28
			10.00	16.00	6.00	SiltyClay	30	30	1.99	1.02	6
			16.00	19.00	3.00	SiltyClay	84	84	2.04	2.61	6
			19.00	25.00	6.00	SiltyClay	84	84	2.04	2.61	6
			25.00	31.00	9.00	SiltyClay	92	92	2.05	2.80	4
			31.00	40.00	9.00	SandySilt	93	36	1.97	0.18	31
		BH-P1	0.00	1.00	1.00	Filled up Strata	-	-	-	-	-
			1.00	11.50	10.50	SiltySand	20	22	1.74	0.00	30
			11.50	14.50	3.00	SiltyClay	31	31	1.99	1.06	6
			14.50	17.50	3.00	SiltyClay	32	32	1.99	1.06	6
			17.50	20.50	3.00	SiltyClay	34	34	1.99	1.16	6
			20.50	23.50	3.00	SiltyClay	49	49	2.01	1.65	5
			23.50	25.00	1.50	SiltyClay	100	100	2.01	1.65	5
			25.00	29.50	4.50	SiltyClay	48	48	2.00	1.34	6
			29.50	40.00	10.50	SandySilt	87	34	1.96	0.19	31
		BH-A2	0.00	4.00	4.00	SiltySand	8	10	1.67	0.00	29
			4.00	7.00	3.00	SiltySand	11	11	1.69	0.00	29

ChainageOld (km)	ChainageNew (km)	BH.No.	Layer depth below EGL(m) From	Layer depth below EGL(m) To	Thicknessofstrata(m)	Stratadescription	SPT'N' Observed	SPT'N' Corrected	BulkDensity(gm/cc)	Cohesion(C)(kg/cm^2)	Angle of internal Friction (Φ) (°)
10+859	11+543	BH-A2	7.00	10.00	3.00	SiltySand	14	13	1.71	0.00	30
			10.00	13.00	3.00	SiltySand	12	11	1.71	0.00	30
			13.00	16.00	3.00	SiltySand	21	16	1.79	0.11	28
			16.00	19.00	3.00	SiltyClay	57	57	2.01	1.88	6
			19.00	25.00	6.00	SiltyClay	55	55	2.01	1.88	6
			25.00	28.00	3.00	SiltyClay	72	72	2.03	2.29	6
			28.00	40.00	12.00	Sandy Silt	84	39	1.95	0.21	30
17+625	18+310	BH-A1	0.00	4.00	4.00	SandySilt	3	4	1.66	0.19	24
			4.00	7.00	3.00	SandySilt	12	14	1.79	0.20	25
			7.00	10.00	3.00	SandySilt	14	15	1.80	0.20	25
			10.00	13.00	3.00	SandySilt	13	12	1.80	0.20	25
			13.00	16.00	3.00	SandySilt	59	34	1.90	0.19	28
			16.00	19.00	3.00	SandySilt	52	29	1.90	0.19	28
			19.00	25.00	6.00	SiltyClay	76	76	2.04	2.41	5
			25.00	28.00	3.00	SiltyClay	55	55	2.02	1.76	6
			28.00	30.00	2.00	SiltyClay	100	100	2.04	2.05	5
		BH-A2	0.00	5.50	5.50	SandySilt	11	14	1.74	0.21	25
			5.50	8.50	3.00	SandySilt	20	18	1.83	0.22	27
			8.50	11.50	3.00	SandySilt	36	25	1.88	0.21	27
			11.50	14.50	3.00	SandySilt	45	28	1.90	0.21	28
			14.50	17.50	3.00	SandySilt	46	27	1.91	0.21	28
			17.50	20.50	3.00	SandySilt	52	28	1.91	0.18	29
			20.50	23.50	3.00	SandySilt	49	26	1.91	0.18	29
			23.50	26.50	3.00	SiltyClay	69	69	2.03	2.21	5
			26.50	30.00	3.50	SiltyClay	83	83	2.04	2.58	6
17+872	18+558	BH-A1	0.00	5.50	5.50	SiltyClay	7	7	1.87	0.26	5
			5.50	8.50	3.00	SandySilt	22	20	1.88	0.21	24
			8.50	11.50	3.00	SandySilt	30	23	1.89	0.21	24
			11.50	14.50	3.00	SandySilt	39	26	1.91	0.19	25
			14.50	17.50	3.00	SandySilt	42	26	1.92	0.19	25
			17.50	30.00	12.50	SiltyClay	100	100	2.06	3.16	4
		BH-A2	0.00	4.00	4.00	SiltyClay	16	16	1.92	0.56	5
			4.00	7.00	3.00	SiltyClay	22	22	1.96	0.75	4
			7.00	13.00	6.00	SandySilt	23	19	1.88	0.21	24
			13.00	16.00	3.00	SandySilt	38	25	1.91	0.22	25
			16.00	19.00	3.00	SiltyClay	63	63	2.03	2.02	5
			19.00	30.00	11.00	SiltyClay	100	100	2.05	3.15	4

ChainageOld (km)	ChainageNew (km)	BH.No.	Layer depth below EGL(m)		Thicknessofstrata(m)	Stratadescription	SPT'N'		BulkDensity(gm/cc)	Cohesion(C)(kg/cm^2)	Angle of internal Friction (Φ) (°)
			From	To			Observed	Corrected			
-	19+010	BH-PLT-07	0.00	3.00	3.00	SiltyClay	8	8	1.80	0.19	7
			3.00	7.50	4.50	SandySilt	23	23	1.82	0.12	23
			7.50	12.00	4.50	SandySilt	38	28	1.89	0.18	26
18+750	19+435	BH-A1	0.00	4.00	4.00	SiltyClay	7	7	1.88	0.25	5
			4.00	8.50	4.50	SiltySand	27	24	1.84	0.00	30
			8.50	13.00	5.50	SiltyClay	14	14	1.92	0.49	5
			13.00	14.50	3.00	SiltySand	66	38	-	-	-
			14.50	20.50	3.00	SiltyClay	36	36	1.98	1.15	6
			20.50	23.50	3.00	SiltyClay	46	46	1.99	1.52	5
			23.50	26.50	3.00	SiltyClay	65	65	2.01	2.03	6
			26.50	30.00	3.50	SiltyClay	78	78	2.03	2.52	5
		BH-A2	0.00	4.00	4.00	SiltyClay	13	13	1.91	0.45	5
			4.00	7.00	3.00	SiltyClay	17	17	1.93	0.45	5
			7.00	10.00	3.00	SiltyClay	11	11	1.91	0.45	5
			10.00	13.00	3.00	SiltyClay	20	20	1.95	0.69	5
			13.00	16.00	3.00	SiltyClay	32	32	1.98	1.03	6
			16.00	22.00	6.00	SiltyClay	49	49	2.00	1.36	5
			22.00	25.00	3.00	SiltyClay	52	52	2.02	1.75	5
			25.00	30.00	5.00	SiltyClay	67	67	2.04	2.20	6
19+500	20+185	BH-A1	0.00	4.00	4.00	SiltyClay	14	14	1.86	0.29	5
			4.00	10.00	6.00	SiltySand	17	17	1.78	0.00	30
			10.00	13.00	3.00	SiltyClay	20	20	1.95	0.70	5
			13.00	16.00	3.00	SiltyClay	21	21	1.95	0.70	5
			16.00	19.00	3.00	SiltyClay	33	33	1.99	1.12	4
			19.00	22.00	3.00	SiltyClay	48	48	2.01	1.58	5
			22.00	25.00	3.00	SiltyClay	63	63	2.02	2.02	4
			25.00	31.00	6.00	SiltyClay	84	84	2.03	2.58	4
			31.00	40.00	9.00	SiltySand	100	39	1.98	0.13	32
		BH-P1	0.00	4.00	4.00	SiltyClay	6	6	1.86	0.22	5
			4.00	8.50	4.50	SiltyClay	15	15	1.93	0.52	5
			8.50	11.50	3.00	SiltyClay	17	17	1.94	0.60	4
			11.50	14.50	3.00	SiltyClay	22	22	1.96	0.76	4
			14.50	17.50	3.00	SiltyClay	32	32	1.99	1.12	5
			17.50	20.50	3.00	SiltyClay	35	35	2.00	1.12	5
			20.50	23.50	3.00	SiltyClay	75	75	2.04	2.41	4
			23.50	29.50	6.00	SiltyClay	76	76	2.04	2.41	4
			29.50	32.50	3.00	SandySilt	100	40	1.96	0.18	30
			32.50	40.00	7.50	SiltyClay	75	75	2.04	2.52	4

ChainageOld (km)	ChainageNew (km)	BH.No.	Layer depth below EGL(m)		Thicknessofstrata(m)	Stratadescription	SPT'N'		BulkDensity(gm/cc)	Cohesion(C)(kg/cm^2)	Angle of internal Friction (Φ) (°)
			From	To			Observed	Corrected			
19+500	20+185	BH-A2	0.00	4.00	4.00	SiltyClay	18	18	1.95	0.63	5
			4.00	7.00	3.00	SiltyClay	19	19	1.95	0.63	5
			7.00	10.00	3.00	SiltyClay	8	8	1.87	0.30	5
			10.00	13.00	3.00	SiltyClay	58	58	2.02	1.85	4
			13.00	16.00	3.00	SiltyClay	56	56	2.02	1.85	4
			16.00	37.00	21.00	SiltyClay	86	76	2.03	3.12	4
			37.00	40.00	3.00	SiltyClay	100	100	2.03	3.12	4
19+715	20+400	BH-A1	0.00	5.50	5.50	SiltyClay	6	6	1.85	0.22	5
			5.50	9.00	3.50	SiltySand	18	18	1.76	0.00	30
			9.00	14.50	5.50	SiltyClay	22	22	1.96	0.75	5
			14.50	17.50	3.00	SiltyClay	27	27	1.97	0.92	5
			17.50	20.50	3.00	SandySilt	41	25	1.89	0.21	28
			20.50	25.00	4.50	SandySilt	57	30	1.91	0.19	29
			25.00	30.00	5.00	SiltyClay	84	84	2.04	2.59	6
		BH-P1	0.00	4.00	4.00	SiltyClay	5	5	1.85	0.18	5
			4.00	10.00	6.00	SiltySand	13	15	1.74	0.00	30
			10.00	14.50	4.50	SandySilt	36	25	1.89	0.22	27
			14.50	19.00	4.50	SandySilt	40	26	1.89	0.20	28
			19.00	26.50	7.50	SiltyClay	60	60	2.02	1.83	6
			26.50	30.00	3.50	SiltyClay	80	80	2.03	2.41	5
		BH-A2	0.00	5.50	5.50	SiltyClay	8	8	1.87	0.31	5
			5.50	8.50	3.00	SiltyClay	14	14	1.92	0.49	4
			8.50	12.00	3.50	SiltySand	25	21	1.81	0.00	31
			12.00	17.50	5.50	SandySilt	33	23	1.88	0.21	27
			17.50	20.50	3.00	SiltyClay	45	45	2.01	1.48	5
			20.50	23.50	3.00	SiltyClay	56	56	2.01	1.85	4
			23.50	30.00	6.50	SiltyClay	74	74	2.02	2.24	5
20+300	20+985	BH-A1	0.00	5.50	5.50	SandySilt	19	23	1.87	0.21	26
			5.50	8.50	3.00	SiltySand	38	30	1.87	0.11	30
			8.50	11.50	3.00	SiltyClay	46	46	2.00	1.52	5
			11.50	14.50	3.00	SiltyClay	53	53	2.02	1.70	6
			14.50	17.50	3.00	SiltyClay	53	53	2.02	1.70	6
			17.50	20.50	3.00	SiltyClay	54	54	2.02	1.70	6
			20.50	26.50	6.00	SiltyClay	63	63	2.02	1.97	5
			26.50	32.50	6.00	SiltyClay	61	61	2.02	1.97	5
			32.50	40.00	7.50	SiltyClay	75	75	2.03	2.35	6

ChainageOld (km)	ChainageNew (km)	BH.No.	Layer depth below EGL(m)		Thicknessofstrata(m)	Stratadescription	SPT'N'		BulkDensity(gm/cc)	Cohesion(C)(kg/cm^2)	Angle of internal Friction (Φ) (°)
			From	To			Observed	Corrected			
20+300	20+985	BH-P1	0.00	4.00	4.00	SiltyClay	8	8	1.87	0.30	5
			4.00	7.00	3.00	SandySilt	19	19	1.85	0.21	26
			7.00	10.00	3.00	SandySilt	22	19	1.85	0.21	26
			10.00	13.00	3.00	SandySilt	33	24	1.90	0.22	27
			13.00	17.50	4.50	SandySilt	40	25	1.91	0.22	27
			17.50	22.00	4.50	SiltyClay	53	53	2.01	1.65	4
			22.00	25.00	3.00	SiltyClay	68	68	2.02	2.18	5
			25.00	40.00	15.00	SiltyClay	100	100	2.05	3.14	4
		BH-P2	0.00	4.00	4.00	SiltyClay	8	8	1.87	0.29	5
			4.00	8.50	4.50	SandySilt	16	17	1.84	0.21	25
			8.50	11.50	3.00	SandySilt	24	20	1.86	0.20	26
			11.50	14.50	3.00	SandySilt	33	23	1.87	0.19	28
			14.50	19.00	4.50	SandySilt	45	27	1.89	0.20	28
			19.00	23.50	4.50	SiltyClay	57	57	2.02	1.82	5
			23.50	40.00	16.50	SiltyClay	100	100	2.08	3.14	4
		BH-A2	0.00	4.00	4.00	SiltyClay	10	10	1.88	0.37	5
			4.00	7.00	3.00	SiltyClay	18	18	1.94	0.70	4
			7.00	10.00	3.00	SiltyClay	21	21	1.94	0.70	4
			10.00	13.00	3.00	SiltyClay	28	28	1.98	0.95	5
			13.00	16.00	3.00	SiltyClay	32	32	1.98	1.16	5
			16.00	19.00	3.00	SiltyClay	36	36	1.98	1.16	5
			19.00	22.00	3.00	SandySilt	43	23	1.91	0.21	28
			22.00	28.00	6.00	SandySilt	59	27	1.91	0.21	28
			28.00	34.00	6.00	SandySilt	82	33	1.93	0.18	30
			34.00	40.00	6.00	SiltyClay	100	100	2.05	3.18	4
			0.00	5.50	5.50	SiltyClay	5	5	1.68	0.20	6
			5.50	8.50	3.00	SiltySand	11	13	1.67	0.00	28
			8.50	11.50	3.00	SiltySand	18	17	1.75	0.00	29

Design parameter have been obtain from the laboratory test results however various depth where the shear parameter seems on the lower side with respect to SPT 'N' values those shear parameter have been judicially improved based on the SPT 'N' for the analysis purpose.

The sample calculation for computation of safe load carrying capacity of normal bored cast-in-situ RCC pile in compression & uplift are attached vide **Appendix C-3.**

The sample calculation for computation of safe load carrying capacity of normal bored cast-in-situ RCC pile in lateral are attached vide **Appendix C-4.**

CHAPTER 4 FOUNDATION RECOMMENDATIONS

8.0 FOUNDATION RECOMMENDATIONS

- Based on the nature & strength characteristics of the substrata and requirement of the project, shallow foundation and normal bored cast in-situ RCC pile foundation have been analyzed.
- Based on the method of analysis & design parameters given under Para 7.1 above, the recommended net allowable bearing capacity values are given in Table 4.1 to 4.4.

Table 4.1: Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 25mm

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)
-	0+000	BH-PLT-09	2.0 x 2.0	1.0	16.1	10.3	10.3
			2.0 x 2.0	2.7	27.6	13.0	13.0
			2.0 x 2.0	3.0	29.8	13.3	13.3
-	0+000	PLT-09	2.0 x 2.0	2.7	20.4	22.8	20.4
(-)0+627	0+057	BH-CL	7.2 x 7.2	1.0	42.5	26.1	26.1
			7.2 x 7.2	2.0	53.4	25.9	25.9
			7.2 x 7.2	3.0	64.8	24.9	24.9
(-)0+529	0+158	BH-CL	4.8 x 4.8	1.0	24.0	25.2	24.0
			4.8 x 4.8	2.0	32.1	25.8	25.8
			4.8 x 4.8	3.0	40.7	26.1	26.1
(-)0+319	0+371	BH-CL	5.5 x 5.5	1.0	40.6	16.3	16.3
			5.5 x 5.5	2.0	52.5	14.7	14.7
			5.5 x 5.5	3.0	64.9	14.1	14.1
0+273	0+958	BH-CL	4.8 x 4.8	1.0	49.4	23.8	23.8
			4.8 x 4.8	2.0	61.4	25.8	25.8
			4.8 x 4.8	3.0	74.1	27.9	27.9
1+006	1+696	BH-A1	7.2 x 7.2	2.0	38.1	21.6	21.6
			7.2 x 7.2	3.0	47.2	25.3	25.3
			7.2 x 7.2	4.0	56.6	30.3	30.3
		BH-A2	7.2 x 7.2	2.0	43.2	11.1	11.1
			7.2 x 7.2	3.0	53.4	17.4	17.4
			7.2 x 7.2	4.0	63.9	38.9	38.9
1+333	2+018	BH-CL	4.8 x 4.8	1.0	50.2	40.7	40.7
			4.8 x 4.8	2.0	68.7	42.1	42.1
			4.8 x 4.8	3.0	88.4	44.3	44.3
1+811	2+493	BH-CL	12.5 x 12.5	1.0	41.8	28.9	28.9
			12.5 x 12.5	2.0	49.6	29.6	29.6
			12.5 x 12.5	3.0	57.6	30.2	30.2

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)
2+472	3+160	BH-CL	2.7 x 2.7	1.0	18.2	16.5	16.5
			2.7 x 2.7	2.0	25.9	22.1	22.1
			2.7 x 2.7	3.0	33.4	31.9	31.9
2+788	3+476	BH-A1	7.2 x 7.2	2.0	87.9	26.0	26.0
			7.2 x 7.2	3.0	107.3	29.9	29.9
			7.2 x 7.2	4.0	127.5	34.1	34.1
		BH-A2	7.2 x 7.2	2.0	88.7	21.6	21.6
			7.2 x 7.2	3.0	108.3	25.3	25.3
			7.2 x 7.2	4.0	128.7	30.3	30.3
3+497	4+242	BH-A1	7.2 x 7.2	2.0	22.1	7.2	7.2
			7.2 x 7.2	3.0	23.0	10.2	10.2
			7.2 x 7.2	4.0	23.9	17.3	17.3
		BH-P1	7.2 x 7.2	2.0	62.5	44.2	44.2
			7.2 x 7.2	3.0	73.0	45.7	45.7
			7.2 x 7.2	4.0	83.9	46.5	46.5
		BH-P2	7.2 x 7.2	2.0	41.5	14.1	14.1
			7.2 x 7.2	3.0	51.2	14.5	14.5
			7.2 x 7.2	4.0	61.4	14.8	14.8
		BH-P3	7.2 x 7.2	2.0	48.9	14.9	14.9
			7.2 x 7.2	3.0	60.2	15.6	15.6
			7.2 x 7.2	4.0	72.0	16.6	16.6
		BH-A2	7.2 x 7.2	2.0	71.1	29.0	29.0
			7.2 x 7.2	3.0	87.1	30.2	30.2
			7.2 x 7.2	4.0	103.7	31.6	31.6
3+691	4+376	BH-A1	7.2 x 7.2	2.0	41.7	15.9	15.9
			7.2 x 7.2	3.0	49.1	16.8	16.8
			7.2 x 7.2	4.0	56.8	17.5	17.5
		BH-A2	7.2 x 7.2	2.0	41.7	10.1	10.1
			7.2 x 7.2	3.0	49.1	12.5	12.5
			7.2 x 7.2	4.0	56.8	15.9	15.9
4+174	4+858	BH-CL	4.8 x 4.8	1.0	15.1	16.2	15.1
			4.8 x 4.8	2.0	16.0	17.2	16.0
			4.8 x 4.8	3.0	17.0	21.2	17.0
4+207	4+892	BH-CL	1.5 x 1.5	1.0	26.6	47.1	26.6
			1.5 x 1.5	2.0	38.0	55.8	38.0
			1.5 x 1.5	3.0	50.7	60.6	50.7
4+655	5+340	BH-CL	4.8 x 4.8	1.0	15.1	16.2	15.1
			4.8 x 4.8	2.0	16.0	17.2	16.0
			4.8 x 4.8	3.0	17.0	21.2	17.0

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)
5+119	5+804	BH-CL	4.8 x 4.8	1.0	14.0	21.7	14.0
			4.8 x 4.8	2.0	19.9	23.5	19.9
			4.8 x 4.8	3.0	26.2	25.4	25.4
5+730	6+415	BH-CL	3.7 x 3.7	1.0	15.3	17.5	15.3
			3.7 x 3.7	2.0	22.8	19.4	19.4
			3.7 x 3.7	3.0	30.8	21.3	21.3
6+197	6+881	BH-CL	4.8 x 4.8	1.0	16.2	9.5	9.5
			4.8 x 4.8	2.0	18.9	10.3	10.3
			4.8 x 4.8	3.0	21.8	11.1	11.1
6+877	7+559	BH-CL	4.8 x 4.8	1.0	16.0	10.2	10.2
			4.8 x 4.8	2.0	19.9	11.0	11.0
			4.8 x 4.8	3.0	24.0	11.9	11.9
7+078	7+759	BH-A1	7.2 x 7.2	2.0	16.9	7.4	7.4
			7.2 x 7.2	3.0	19.1	7.9	7.9
			7.2 x 7.2	4.0	21.5	8.5	8.5
		BH-A2	7.2 x 7.2	2.0	23.5	4.3	NR
			7.2 x 7.2	3.0	26.7	4.7	NR
			7.2 x 7.2	4.0	29.9	5.3	NR
7+256	7+941	BH-CL	2.7 x 2.7	1.0	11.9	13.5	11.9
			2.7 x 2.7	2.0	18.3	15.5	15.5
			2.7 x 2.7	3.0	25.4	17.1	17.1
7+351	8+036	BH-A1	7.2 x 7.2	2.0	19.5	7.3	NR*
			7.2 x 7.2	3.0	22.1	8.1	NR*
			7.2 x 7.2	4.0	24.9	9.1	NR*
		BH-P1	7.2 x 7.2	2.0	9.3	6.2	NR
			7.2 x 7.2	3.0	11.4	7.2	NR
			7.2 x 7.2	4.0	13.6	8.4	NR
		BH-A2	7.2 x 7.2	2.0	9.3	12.8	NR
			7.2 x 7.2	3.0	11.4	13.5	NR
			7.2 x 7.2	4.0	13.6	14.3	NR
7+457	8+141	BH-CL	2.7 x 2.7	1.0	17.6	10.8	10.8
			2.7 x 2.7	2.0	21.3	12.3	12.3
			2.7 x 2.7	3.0	25.4	13.7	13.7
7+613	8+298	BH-A1	7.2 x 7.2	2.0	16.4	7.5	NR*
			7.2 x 7.2	3.0	20.0	7.9	NR*
			7.2 x 7.2	4.0	23.8	8.4	NR*
		BH-A2	7.2 x 7.2	2.0	18.2	14.9	14.9
			7.2 x 7.2	3.0	18.8	15.7	15.7
			7.2 x 7.2	4.0	19.5	16.7	16.7

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)
7+907	8+592	BH-CL	4.8 x 4.8	1.0	11.9	7.2	7.2
			4.8 x 4.8	2.0	12.5	7.8	7.8
			4.8 x 4.8	3.0	13.2	8.4	8.4
8+207	8+891	BH-CL	4.8 x 4.8	1.0	18.5	9.2	9.2
			4.8 x 4.8	2.0	21.8	9.9	9.9
			4.8 x 4.8	3.0	25.3	10.6	10.6
8+610	9+295	BH-CL	7.2 x 7.2	1.0	17.3	9.3	9.3
			7.2 x 7.2	2.0	21.8	9.7	9.7
			7.2 x 7.2	3.0	26.5	10.2	10.2
8+852	9+537	BH-A1	7.2 x 7.2	2.0	21.7	10.5	10.5
			7.2 x 7.2	3.0	25.3	13.1	13.1
			7.2 x 7.2	4.0	29.1	15.1	15.1
		BH-A2	7.2 x 7.2	2.0	11.7	6.9	6.9
			7.2 x 7.2	3.0	14.2	8.1	8.1
			7.2 x 7.2	4.0	16.9	9.2	9.2
8+907	9+591	BH-CL	2.7 x 2.7	1.0	4.0	8.3	NR*
			2.7 x 2.7	2.0	6.2	9.6	NR*
			2.7 x 2.7	3.0	8.7	10.6	NR*
-	10+340	BH-PLT-08	4.8 x 4.8	1.0	15.8	3.3	NR*
			4.8 x 4.8	2.0	18.8	4.7	NR*
			4.8 x 4.8	3.0	22.0	7.9	NR*
9+200	9+882	BH-CL	2.7 x 2.7	1.0	4.0	8.3	NR
			2.7 x 2.7	2.0	6.2	9.6	NR
			2.7 x 2.7	3.0	8.7	10.6	NR
9+211	9+894	BH-CL	6.0 x 6.0	1.0	3.6	3.5	NR*
			6.0 x 6.0	2.0	3.9	4.5	NR*
			6.0 x 6.0	3.0	4.1	6.0	NR*
9+407	10+091	BH-CL	3.7 x 3.7	1.0	3.6	5.6	NR
			3.7 x 3.7	2.0	3.9	6.2	NR
			3.7 x 3.7	3.0	4.3	6.7	NR
9+726	10+410	BH-A1	7.2 x 7.2	2.0	24.6	7.6	NR*
			7.2 x 7.2	3.0	30.0	8.6	NR*
			7.2 x 7.2	4.0	35.6	9.8	NR*
		BH-A2	7.2 x 7.2	2.0	21.6	7.3	NR
			7.2 x 7.2	3.0	26.4	8.0	NR
			7.2 x 7.2	4.0	31.5	9.0	NR
9+772	10+457	BH-CL	7.2 x 7.2	1.0	18.8	4.9	NR*
			7.2 x 7.2	2.0	21.5	8.5	NR*
			7.2 x 7.2	3.0	24.4	10.9	NR*

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)
10+025	10+709	BH-A1	7.2 x 7.2	2.0	14.5	8.0	8.0
			7.2 x 7.2	3.0	16.3	8.4	8.4
			7.2 x 7.2	4.0	18.2	8.9	8.9
		BH-A2	7.2 x 7.2	2.0	17.5	12.8	12.8
			7.2 x 7.2	3.0	19.5	13.5	13.5
			7.2 x 7.2	4.0	21.6	14.3	14.3
10+223	10+908	BH-CL	2.7 x 2.7	1.0	13.1	4.4	NR*
			2.7 x 2.7	2.0	15.9	8.4	NR*
			2.7 x 2.7	3.0	18.8	11.3	NR*
10+519	11+203	BH-CL	4.8 x 4.8	1.0	18.8	7.8	NR*
			4.8 x 4.8	2.0	21.8	8.5	NR*
			4.8 x 4.8	3.0	25.0	9.2	NR*
10+658	11+340	BH-CL	2.7 x 2.7	1.0	12.2	5.0	NR*
			2.7 x 2.7	2.0	14.9	8.4	NR*
			2.7 x 2.7	3.0	17.7	13.4	NR*
10+718	11+403	BH-CL	4.8 x 4.8	1.0	9.9	8.9	NR
			4.8 x 4.8	2.0	12.1	9.6	NR
			4.8 x 4.8	3.0	14.5	10.4	NR
10+749	11+434	BH-CL	2.7 x 2.7	1.0	16.8	9.5	9.5
			2.7 x 2.7	2.0	20.4	10.9	10.9
			2.7 x 2.7	3.0	24.2	12.0	12.0
10+859	11+543	BH-A1(R)	7.2 x 7.2	2.0	11.7	5.4	NR*
			7.2 x 7.2	3.0	13.4	5.8	NR*
			7.2 x 7.2	4.0	15.2	6.3	NR*
		BH-A1	7.2 x 7.2	2.0	9.1	10.7	NR
			7.2 x 7.2	3.0	11.2	11.5	NR
			7.2 x 7.2	4.0	13.3	12.7	NR
		BH-P1	7.2 x 7.2	2.0	9.1	7.0	NR
			7.2 x 7.2	3.0	11.3	7.3	NR
			7.2 x 7.2	4.0	13.4	7.6	NR
		BH-A2	7.2 x 7.2	2.0	9.7	3.8	NR
			7.2 x 7.2	3.0	12.0	3.9	NR
			7.2 x 7.2	4.0	14.3	4.1	NR
17+625	18+310	BH-A1	7.2 x 7.2	2.0	17.8	7.5	NR
			7.2 x 7.2	3.0	20.1	7.9	NR
			7.2 x 7.2	4.0	22.5	8.4	NR
		BH-A2	7.2 x 7.2	2.0	16.8	10.4	NR*
			7.2 x 7.2	3.0	18.8	10.9	NR*
			7.2 x 7.2	4.0	20.9	11.5	NR*

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)
17+872	18+558	BH-A1	7.2 x 7.2	2.0	6.3	6.4	NR
17+872	18+558	BH-A1	7.2 x 7.2	3.0	6.6	8.2	NR
17+872	18+558	BH-A1	7.2 x 7.2	4.0	6.9	12.3	NR
17+872	18+558	BH-A2	7.2 x 7.2	2.0	18.4	11.8	11.8
17+872	18+558	BH-A2	7.2 x 7.2	3.0	19.0	10.9	10.9
17+872	18+558	BH-A2	7.2 x 7.2	4.0	19.7	10.6	10.6
-	19+010	BH-PLT-07	4.8 x 4.8	1.0	4.9	6.3	NR*
-	19+010	BH-PLT-07	4.8 x 4.8	2.0	5.3	8.9	NR*
-	19+010	BH-PLT-07	4.8 x 4.8	3.0	5.7	14.0	NR*
18+750	19+435	BH-A1	7.2 x 7.2	2.0	6.3	9.4	NR*
18+750	19+435	BH-A1	7.2 x 7.2	3.0	6.6	15.5	NR*
18+750	19+435	BH-A1	7.2 x 7.2	4.0	6.9	18.3	NR*
18+750	19+435	BH-A2	7.2 x 7.2	2.0	10.5	8.9	NR
18+750	19+435	BH-A2	7.2 x 7.2	3.0	11.0	8.4	NR
18+750	19+435	BH-A2	7.2 x 7.2	4.0	11.4	9.3	NR
19+500	20+185	BH-A1	7.2 x 7.2	2.0	7.0	6.8	NR
19+500	20+185	BH-A1	7.2 x 7.2	3.0	7.3	8.4	NR
19+500	20+185	BH-A1	7.2 x 7.2	4.0	7.6	11.0	NR
19+500	20+185	BH-P1	7.2 x 7.2	2.0	5.4	5.4	NR*
19+500	20+185	BH-P1	7.2 x 7.2	3.0	5.7	5.7	NR*
19+500	20+185	BH-P1	7.2 x 7.2	4.0	6.0	6.1	NR*
19+500	20+185	BH-A2	7.2 x 7.2	2.0	15.0	30.9	NR
19+500	20+185	BH-A2	7.2 x 7.2	3.0	15.5	32.6	NR
19+500	20+185	BH-A2	7.2 x 7.2	4.0	16.1	34.4	NR
19+715	20+400	BH-A1	7.2 x 7.2	2.0	17.8	4.5	NR
19+715	20+400	BH-A1	7.2 x 7.2	3.0	21.7	5.3	NR
19+715	20+400	BH-A1	7.2 x 7.2	4.0	25.8	6.6	NR
19+715	20+400	BH-P1	7.2 x 7.2	2.0	13.0	4.7	NR
19+715	20+400	BH-P1	7.2 x 7.2	3.0	16.0	6.3	NR
19+715	20+400	BH-P1	7.2 x 7.2	4.0	19.0	10.1	NR
19+715	20+400	BH-A2	7.2 x 7.2	2.0	10.9	6.1	NR
19+715	20+400	BH-A2	7.2 x 7.2	3.0	11.4	6.7	NR
19+715	20+400	BH-A2	7.2 x 7.2	4.0	11.8	7.3	NR
20+300	20+985	BH-A1	7.2 x 7.2	2.0	28.1	15.1	15.1
20+300	20+985	BH-A1	7.2 x 7.2	3.0	31.9	17.4	17.4
20+300	20+985	BH-A1	7.2 x 7.2	4.0	35.7	20.7	20.7
20+300	20+985	BH-P1	7.2 x 7.2	2.0	22.3	8.5	NR
20+300	20+985	BH-P1	7.2 x 7.2	3.0	25.2	10.2	NR
20+300	20+985	BH-P1	7.2 x 7.2	4.0	28.2	10.8	NR

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)
20+300	20+985	BH-P2	7.2 x 7.2	2.0	7.0	7.2	NR*
			7.2 x 7.2	3.0	7.3	9.2	NR*
			7.2 x 7.2	4.0	7.6	13.5	NR*
		BH-A2	7.2 x 7.2	2.0	16.4	13.8	13.8
			7.2 x 7.2	3.0	17.0	14.5	14.5
			7.2 x 7.2	4.0	17.6	15.3	15.3

* The maximum value of recommended net allowable bearing capacity shall be restricted to 30 t/m^2.

Note:-

- NR* - BH's as Liquefible depth less than or equal to 4m (SBC is recommended after replacement/compaction).
- NR - BH's as Liquefible depth more than 4m. (Suitable ground improvement methods are recommended.

Table 4.2: Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 50mm

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)
-	0+000	BH-PLT-09	2.0 x 2.0	1.0	16.1	20.6	16.1
			2.0 x 2.0	2.7	27.6	26.0	26.0
			2.0 x 2.0	3.0	29.8	26.6	26.6
(-)0+627	0+057	BH-CL	7.2 x 7.2	1.0	42.5	52.2	42.5
			7.2 x 7.2	2.0	53.4	51.8	51.8
			7.2 x 7.2	3.0	64.8	49.8	49.8
(-)0+529	0+158	BH-CL	4.8 x 4.8	1.0	24.0	50.4	24.0
			4.8 x 4.8	2.0	32.1	51.6	32.1
			4.8 x 4.8	3.0	40.7	52.3	40.7
(-)0+319	0+371	BH-CL	5.5 x 5.5	1.0	40.6	32.6	32.6
			5.5 x 5.5	2.0	52.5	29.4	29.4
			5.5 x 5.5	3.0	64.9	28.3	28.3
0+273	0+958	BH-CL	4.8 x 4.8	1.0	49.4	47.7	47.7
			4.8 x 4.8	2.0	61.4	51.5	51.5
			4.8 x 4.8	3.0	74.1	55.8	55.8
1+006	1+696	BH-A1	7.2 x 7.2	2.0	38.1	43.2	38.1
			7.2 x 7.2	3.0	47.2	50.6	47.2
			7.2 x 7.2	4.0	56.6	60.7	56.6

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)
1+006	1+696	BH-A2	7.2 x 7.2	2.0	43.2	22.2	22.2
			7.2 x 7.2	3.0	53.4	34.9	34.9
			7.2 x 7.2	4.0	63.9	77.9	63.9
1+333	2+018	BH-CL	4.8 x 4.8	1.0	50.2	81.3	50.2
			4.8 x 4.8	2.0	68.7	84.2	68.7
			4.8 x 4.8	3.0	88.4	88.5	88.4
1+811	2+493	BH-CL	12.5 x 12.5	1.0	41.8	57.8	41.8
			12.5 x 12.5	2.0	49.6	59.3	49.6
			12.5 x 12.5	3.0	57.6	60.5	57.6
2+472	3+160	BH-CL	2.7 x 2.7	1.0	18.2	32.9	18.2
			2.7 x 2.7	2.0	25.9	44.1	25.9
			2.7 x 2.7	3.0	33.4	63.8	33.4
2+788	3+476	BH-A1	7.2 x 7.2	2.0	87.9	52.0	52.0
			7.2 x 7.2	3.0	107.3	59.9	59.9
			7.2 x 7.2	4.0	127.5	68.2	68.2
		BH-A2	7.2 x 7.2	2.0	88.7	43.2	43.2
			7.2 x 7.2	3.0	108.3	50.6	50.6
			7.2 x 7.2	4.0	128.7	60.7	60.7
3+497	4+242	BH-A1	7.2 x 7.2	2.0	22.1	14.3	14.3
			7.2 x 7.2	3.0	23.0	20.5	20.5
			7.2 x 7.2	4.0	23.9	34.6	23.9
		BH-P1	7.2 x 7.2	2.0	62.5	88.3	62.5
			7.2 x 7.2	3.0	73.0	91.4	73.0
			7.2 x 7.2	4.0	83.9	93.0	83.9
		BH-P2	7.2 x 7.2	2.0	41.5	28.2	28.2
			7.2 x 7.2	3.0	51.2	29.0	29.0
			7.2 x 7.2	4.0	61.4	29.5	29.5
		BH-P3	7.2 x 7.2	2.0	48.9	29.8	29.8
			7.2 x 7.2	3.0	60.2	31.2	31.2
			7.2 x 7.2	4.0	72.0	33.1	33.1
		BH-A2	7.2 x 7.2	2.0	71.1	58.0	58.0
			7.2 x 7.2	3.0	87.1	60.3	60.3
			7.2 x 7.2	4.0	103.7	63.3	63.3
3+691	4+376	BH-A1	7.2 x 7.2	2.0	41.7	31.9	31.9
			7.2 x 7.2	3.0	49.1	33.6	33.6
			7.2 x 7.2	4.0	56.8	35.0	35.0
		BH-A2	7.2 x 7.2	2.0	41.7	20.2	20.2
			7.2 x 7.2	3.0	49.1	25.1	25.1
			7.2 x 7.2	4.0	56.8	31.7	31.7
4+174	4+858	BH-CL	4.8 x 4.8	1.0	15.1	32.4	15.1
			4.8 x 4.8	2.0	16.0	34.4	16.0
			4.8 x 4.8	3.0	17.0	42.4	17.0

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)
4+207	4+892	BH-CL	1.5 x 1.5	1.0	26.6	94.2	26.6
			1.5 x 1.5	2.0	38.0	111.7	38.0
			1.5 x 1.5	3.0	50.7	121.1	50.7
4+655	5+340	BH-CL	4.8 x 4.8	1.0	15.1	32.4	15.1
			4.8 x 4.8	2.0	16.0	34.4	16.0
			4.8 x 4.8	3.0	17.0	42.4	17.0
5+119	5+804	BH-CL	4.8 x 4.8	1.0	14.0	43.4	14.0
			4.8 x 4.8	2.0	19.9	46.9	19.9
			4.8 x 4.8	3.0	26.2	50.8	26.2
5+730	6+415	BH-CL	3.7 x 3.7	1.0	15.3	35.0	15.3
			3.7 x 3.7	2.0	22.8	38.9	22.8
			3.7 x 3.7	3.0	30.8	42.5	30.8
6+197	6+881	BH-CL	4.8 x 4.8	1.0	16.2	19.0	16.2
			4.8 x 4.8	2.0	18.9	20.6	18.9
			4.8 x 4.8	3.0	21.8	22.3	21.8
6+877	7+559	BH-CL	4.8 x 4.8	1.0	16.0	20.4	16.0
			4.8 x 4.8	2.0	19.9	22.0	19.9
			4.8 x 4.8	3.0	24.0	23.8	23.8
7+078	7+759	BH-A1	7.2 x 7.2	2.0	16.9	14.9	14.9
			7.2 x 7.2	3.0	19.1	15.8	15.8
			7.2 x 7.2	4.0	21.5	17.0	17.0
		BH-A2	7.2 x 7.2	2.0	23.5	8.6	NR
			7.2 x 7.2	3.0	26.7	9.5	NR
			7.2 x 7.2	4.0	29.9	10.6	NR
7+256	7+941	BH-CL	2.7 x 2.7	1.0	11.9	26.9	11.9
			2.7 x 2.7	2.0	18.3	30.9	18.3
			2.7 x 2.7	3.0	25.4	34.2	25.4
7+351	8+036	BH-A1	7.2 x 7.2	2.0	19.5	14.5	NR*
			7.2 x 7.2	3.0	22.1	16.1	NR*
			7.2 x 7.2	4.0	24.9	18.2	NR*
		BH-P1	7.2 x 7.2	2.0	9.3	12.3	NR
			7.2 x 7.2	3.0	11.4	14.4	NR
			7.2 x 7.2	4.0	13.6	16.7	NR
		BH-A2	7.2 x 7.2	2.0	9.3	25.7	NR
			7.2 x 7.2	3.0	11.4	27.0	NR
			7.2 x 7.2	4.0	13.6	28.6	NR
7+457	8+141	BH-CL	2.7 x 2.7	1.0	17.6	21.5	17.6
			2.7 x 2.7	2.0	21.3	24.7	21.3
			2.7 x 2.7	3.0	25.4	27.3	25.4
7+613	8+298	BH-A1	7.2 x 7.2	2.0	16.4	15.0	NR*
			7.2 x 7.2	3.0	20.0	15.9	NR*
			7.2 x 7.2	4.0	23.8	16.8	NR*

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)
7+613	8+298	BH-A2	7.2 x 7.2	2.0	18.2	29.8	18.2
			7.2 x 7.2	3.0	18.8	31.5	18.8
			7.2 x 7.2	4.0	19.5	33.4	19.5
7+907	8+592	BH-CL	4.8 x 4.8	1.0	11.9	14.4	11.9
			4.8 x 4.8	2.0	12.5	15.5	12.5
			4.8 x 4.8	3.0	13.2	16.8	13.2
8+207	8+891	BH-CL	4.8 x 4.8	1.0	18.5	18.3	18.3
			4.8 x 4.8	2.0	21.8	19.7	19.7
			4.8 x 4.8	3.0	25.3	21.3	21.3
8+610	9+295	BH-CL	7.2 x 7.2	1.0	17.3	18.5	17.3
			7.2 x 7.2	2.0	21.8	19.4	19.4
			7.2 x 7.2	3.0	26.5	20.4	20.4
8+852	9+537	BH-A1	7.2 x 7.2	2.0	21.7	23.3	21.7
			7.2 x 7.2	3.0	25.3	26.3	25.3
			7.2 x 7.2	4.0	29.1	30.2	29.1
		BH-A2	7.2 x 7.2	2.0	11.7	14.7	11.7
			7.2 x 7.2	3.0	14.2	16.2	14.2
			7.2 x 7.2	4.0	16.9	18.3	16.9
8+907	9+591	BH-CL	2.7 x 2.7	1.0	4.0	16.7	NR*
			2.7 x 2.7	2.0	6.2	19.2	NR*
			2.7 x 2.7	3.0	8.7	21.2	NR*
-	10+340	BH-PLT-08	4.8 x 4.8	1.0	15.8	6.6	NR*
			4.8 x 4.8	2.0	18.8	9.4	NR*
			4.8 x 4.8	3.0	22.0	15.9	NR*
9+200	9+882	BH-CL	2.7 x 2.7	1.0	4.0	16.7	NR
			2.7 x 2.7	2.0	6.2	19.2	NR
			2.7 x 2.7	3.0	8.7	21.2	NR
9+211	9+894	BH-CL	6.0 x 6.0	1.0	3.6	7.0	NR*
			6.0 x 6.0	2.0	3.9	9.0	NR*
			6.0 x 6.0	3.0	4.1	12.0	NR*
9+407	10+091	BH-CL	3.7 x 3.7	1.0	3.6	11.1	NR
			3.7 x 3.7	2.0	3.9	12.4	NR
			3.7 x 3.7	3.0	4.3	13.4	NR
9+726	10+410	BH-A1	7.2 x 7.2	2.0	24.6	15.9	NR*
			7.2 x 7.2	3.0	30.0	15.9	NR*
			7.2 x 7.2	4.0	35.6	16.8	NR*
		BH-A2	7.2 x 7.2	2.0	21.6	15.1	NR
			7.2 x 7.2	3.0	26.4	15.9	NR
			7.2 x 7.2	4.0	31.5	16.8	NR
9+772	10+457	BH-CL	7.2 x 7.2	1.0	18.8	12.7	NR*
			7.2 x 7.2	2.0	21.5	38.5	NR*
			7.2 x 7.2	3.0	24.4	21.8	NR*

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)
10+025	10+709	BH-A1	7.2 x 7.2	2.0	14.5	15.9	14.5
			7.2 x 7.2	3.0	16.3	16.8	16.3
			7.2 x 7.2	4.0	18.2	17.7	17.7
		BH-A2	7.2 x 7.2	2.0	17.5	25.7	17.5
			7.2 x 7.2	3.0	19.5	27.0	19.5
			7.2 x 7.2	4.0	21.6	28.6	21.6
10+223	10+908	BH-CL	2.7 x 2.7	1.0	13.1	8.7	NR*
			2.7 x 2.7	2.0	15.9	16.8	NR*
			2.7 x 2.7	3.0	18.8	22.5	NR*
10+519	11+203	BH-CL	4.8 x 4.8	1.0	18.8	15.6	NR*
			4.8 x 4.8	2.0	21.8	16.9	NR*
			4.8 x 4.8	3.0	25.0	18.3	NR*
10+658	11+340	BH-CL	2.7 x 2.7	1.0	12.2	9.6	NR*
			2.7 x 2.7	2.0	14.9	14.9	NR*
			2.7 x 2.7	3.0	17.7	26.9	NR*
10+718	11+403	BH-CL	4.8 x 4.8	1.0	9.9	17.7	NR
			4.8 x 4.8	2.0	12.1	19.2	NR
			4.8 x 4.8	3.0	14.5	20.8	NR
10+749	11+434	BH-CL	2.7 x 2.7	1.0	16.8	19.0	16.8
			2.7 x 2.7	2.0	20.4	21.8	20.4
			2.7 x 2.7	3.0	24.2	24.1	24.1
10+859	11+543	BH-A1(R)	7.2 x 7.2	2.0	11.7	10.7	NR*
			7.2 x 7.2	3.0	13.4	11.5	NR*
			7.2 x 7.2	4.0	15.2	12.7	NR*
		BH-A1	7.2 x 7.2	2.0	11.7	10.7	NR
			7.2 x 7.2	3.0	13.4	11.5	NR
			7.2 x 7.2	4.0	15.2	12.7	NR
		BH-P1	7.2 x 7.2	2.0	9.1	14.0	NR
			7.2 x 7.2	3.0	11.3	15.0	NR
			7.2 x 7.2	4.0	13.4	16.3	NR
		BH-A2	7.2 x 7.2	2.0	9.7	7.6	NR
			7.2 x 7.2	3.0	12.0	8.0	NR
			7.2 x 7.2	4.0	14.3	8.4	NR
17+625	18+310	BH-A1	7.2 x 7.2	2.0	17.8	15.0	NR
			7.2 x 7.2	3.0	20.1	15.9	NR
			7.2 x 7.2	4.0	22.5	16.8	NR
		BH-A2	7.2 x 7.2	2.0	16.8	20.7	NR*
			7.2 x 7.2	3.0	18.8	21.8	NR*
			7.2 x 7.2	4.0	20.9	23.1	NR*
17+872	18+558	BH-A1	7.2 x 7.2	2.0	6.3	12.7	NR
			7.2 x 7.2	3.0	6.6	16.4	NR
			7.2 x 7.2	4.0	6.9	24.6	NR

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)
17+872	18+558	BH-A2	7.2 x 7.2	2.0	18.4	21.2	18.4
			7.2 x 7.2	3.0	19.0	21.7	19.0
			7.2 x 7.2	4.0	19.7	22.1	19.7
-	19+010	BH-PLT-07	4.8 x 4.8	1.0	4.9	12.7	NR*
			4.8 x 4.8	2.0	5.3	17.7	NR*
			4.8 x 4.8	3.0	5.7	27.9	NR*
18+750	19+435	BH-A1	7.2 x 7.2	2.0	6.3	18.8	NR*
			7.2 x 7.2	3.0	6.6	31.1	NR*
			7.2 x 7.2	4.0	6.9	36.5	NR*
		BH-A2	7.2 x 7.2	2.0	10.5	15.5	NR
			7.2 x 7.2	3.0	11.0	16.8	NR
			7.2 x 7.2	4.0	11.4	18.6	NR
19+500	20+185	BH-A1	7.2 x 7.2	2.0	7.0	13.5	NR
			7.2 x 7.2	3.0	7.3	16.8	NR
			7.2 x 7.2	4.0	7.6	22.0	NR
		BH-P1	7.2 x 7.2	2.0	5.4	10.9	NR*
			7.2 x 7.2	3.0	5.7	11.5	NR*
			7.2 x 7.2	4.0	6.0	12.1	NR*
		BH-A2	7.2 x 7.2	2.0	15.0	61.9	NR
			7.2 x 7.2	3.0	15.5	65.2	NR
			7.2 x 7.2	4.0	16.1	68.9	NR
19+715	20+400	BH-A1	7.2 x 7.2	2.0	17.8	8.9	NR
			7.2 x 7.2	3.0	21.7	10.5	NR
			7.2 x 7.2	4.0	25.8	13.2	NR
		BH-P1	7.2 x 7.2	2.0	13.0	9.5	NR
			7.2 x 7.2	3.0	16.0	12.5	NR
			7.2 x 7.2	4.0	19.0	20.1	NR
		BH-A2	7.2 x 7.2	2.0	10.9	12.2	NR
			7.2 x 7.2	3.0	11.4	13.3	NR
			7.2 x 7.2	4.0	11.8	14.6	NR
20+300	20+985	BH-A1	7.2 x 7.2	2.0	28.1	30.2	28.1
			7.2 x 7.2	3.0	31.9	34.9	31.9
			7.2 x 7.2	4.0	35.7	41.4	35.7
		BH-P1	7.2 x 7.2	2.0	22.3	16.9	NR
			7.2 x 7.2	3.0	25.2	20.4	NR
			7.2 x 7.2	4.0	28.2	21.6	NR
		BH-P2	7.2 x 7.2	2.0	7.0	14.4	NR*
			7.2 x 7.2	3.0	7.3	18.3	NR*
			7.2 x 7.2	4.0	7.6	27.0	NR*
		BH-A2	7.2 x 7.2	2.0	16.4	27.5	16.4
			7.2 x 7.2	3.0	17.0	29.0	17.0
			7.2 x 7.2	4.0	17.6	30.6	17.6

* The maximum value of recommended net allowable bearing capacity shall be restricted to 30 t/m^2.

Note:-

- NR* - BH's as Liquefible depth less than or equal to 4m (SBC is recommended after replacement/compaction).
- NR - BH's as Liquefible depth more than 4m. (Suitable ground improvement methods are recommended.

Table 4.3: Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 25mm (Replaced or Compacted Soil)

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	*Recommended Net Allowable Bearing Capacity (t/m^2)
7+351	8+036	BH-A1	7.2 x 7.2	2.0	16.1	13.6	13.6
			7.2 x 7.2	3.0	17.6	14.2	14.2
			7.2 x 7.2	4.0	19.1	14.0	14.0
7+613	8+298	BH-A1	7.2 x 7.2	2.0	22.3	11.0	11.0
			7.2 x 7.2	3.0	26.5	10.6	10.6
			7.2 x 7.2	4.0	30.7	9.9	9.9
8+907	9+591	BH-CL	2.7 x 2.7	1.0	8.8	13.4	8.8
			2.7 x 2.7	2.0	13.6	16.0	13.6
			2.7 x 2.7	3.0	18.9	17.1	17.1
-	10+340	BH-PLT-08	4.8 x 4.8	1.0	28.5	11.9	11.9
			4.8 x 4.8	2.0	34.3	12.9	12.9
			4.8 x 4.8	3.0	40.5	14.0	14.0
9+211	9+894	BH-CL	6.0 x 6.0	1.0	22.6	9.3	9.3
			6.0 x 6.0	2.0	26.5	9.9	9.9
			6.0 x 6.0	3.0	30.5	10.6	10.6
9+726	10+410	BH-A1	7.2 x 7.2	2.0	36.1	11.7	11.7
			7.2 x 7.2	3.0	41.9	12.3	12.3
			7.2 x 7.2	4.0	48.0	13.0	13.0
9+772	10+457	BH-CL	7.2 x 7.2	1.0	17.7	10.5	10.5
			7.2 x 7.2	2.0	20.4	11.0	11.0
			7.2 x 7.2	3.0	23.2	11.6	11.6
10+223	10+908	BH-CL	2.7 x 2.7	1.0	14.2	10.8	10.8
			2.7 x 2.7	2.0	17.6	12.3	12.3
			2.7 x 2.7	3.0	21.2	13.7	13.7
10+519	11+203	BH-CL	4.8 x 4.8	1.0	22.6	12.3	12.3
			4.8 x 4.8	2.0	27.0	13.2	13.2
			4.8 x 4.8	3.0	31.5	14.3	14.3
10+658	11+340	BH-CL	2.7 x 2.7	1.0	10.6	13.9	10.6
			2.7 x 2.7	2.0	13.6	18.7	13.6
			2.7 x 2.7	3.0	16.9	23.9	16.9
10+859	11+543	BH-A1(R)	7.2 x 7.2	2.0	15.8	8.4	8.4
			7.2 x 7.2	3.0	18.5	9.0	9.0
			7.2 x 7.2	4.0	21.2	9.8	9.8

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	*Recommended Net Allowable Bearing Capacity (t/m^2)
17+625	18+310	BH-A2	7.2 x 7.2	2.0	37.1	13.5	13.5
			7.2 x 7.2	3.0	42.7	13.5	13.5
			7.2 x 7.2	4.0	48.6	13.0	13.0
-	19+010	BH-PLT-07	4.8 x 4.8	1.0	11.2	11.5	11.2
			4.8 x 4.8	2.0	12.3	12.5	12.3
			4.8 x 4.8	3.0	13.4	13.5	13.4
18+750	19+435	BH-A1	7.2 x 7.2	2.0	17.8	23.5	17.8
			7.2 x 7.2	3.0	21.2	24.8	21.2
			7.2 x 7.2	4.0	24.8	26.2	24.8
19+500	20+185	BH-P1	7.2 x 7.2	2.0	21.7	7.0	7.0
			7.2 x 7.2	3.0	23.8	6.9	6.9
			7.2 x 7.2	4.0	26.1	6.9	6.9
20+300	20+985	BH-P2	7.2 x 7.2	2.0	17.1	13.9	13.9
			7.2 x 7.2	3.0	19.2	14.5	14.5
			7.2 x 7.2	4.0	21.5	14.7	14.7

Table 4.4: Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 50mm (Replaced or Compacted Soil)

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	*Recommended Net Allowable Bearing Capacity (t/m^2)
7+351	8+036	BH-A1	7.2 x 7.2	2.0	16.1	27.2	16.1
			7.2 x 7.2	3.0	17.6	28.4	17.6
			7.2 x 7.2	4.0	19.1	28.0	19.1
7+613	8+298	BH-A1	7.2 x 7.2	2.0	22.3	21.9	21.9
			7.2 x 7.2	3.0	26.5	21.2	21.2
			7.2 x 7.2	4.0	30.7	19.8	19.8
8+907	9+591	BH-CL	2.7 x 2.7	1.0	8.8	26.9	8.8
			2.7 x 2.7	2.0	13.6	32.1	13.6
			2.7 x 2.7	3.0	18.9	34.2	18.9
-	10+340	BH-PLT-08	4.8 x 4.8	1.0	28.5	23.8	23.8
			4.8 x 4.8	2.0	34.3	25.8	25.8
			4.8 x 4.8	3.0	40.5	27.9	27.9
9+211	9+894	BH-CL	6.0 x 6.0	1.0	22.6	18.7	18.7
			6.0 x 6.0	2.0	26.5	19.8	19.8
			6.0 x 6.0	3.0	30.5	21.2	21.2

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	*Recommended Net Allowable Bearing Capacity (t/m^2)
9+726	10+410	BH-A1	7.2 x 7.2	2.0	36.1	23.4	23.4
			7.2 x 7.2	3.0	41.9	24.7	24.7
			7.2 x 7.2	4.0	48.0	26.1	26.1
9+772	10+457	BH-CL	7.2 x 7.2	1.0	17.7	21.1	17.7
			7.2 x 7.2	2.0	20.4	22.1	20.4
			7.2 x 7.2	3.0	23.2	23.3	23.2
10+223	10+908	BH-CL	2.7 x 2.7	1.0	14.2	21.5	14.2
			2.7 x 2.7	2.0	17.6	24.7	17.6
			2.7 x 2.7	3.0	21.2	27.3	21.2
10+519	11+203	BH-CL	4.8 x 4.8	1.0	22.6	24.5	22.6
			4.8 x 4.8	2.0	27.0	26.5	26.5
			4.8 x 4.8	3.0	31.5	28.7	28.7
10+658	11+340	BH-CL	2.7 x 2.7	1.0	10.6	25.0	10.6
			2.7 x 2.7	2.0	13.6	28.9	13.6
			2.7 x 2.7	3.0	16.9	26.9	16.9
10+859	11+543	BH-A1(R)	7.2 x 7.2	2.0	15.8	16.8	15.8
			7.2 x 7.2	3.0	18.5	18.0	18.0
			7.2 x 7.2	4.0	21.2	19.7	19.7
17+625	18+310	BH-A2	7.2 x 7.2	2.0	37.1	27.0	27.0
			7.2 x 7.2	3.0	42.7	27.0	27.0
			7.2 x 7.2	4.0	48.6	26.1	26.1
-	19+010	BH-PLT-07	4.8 x 4.8	1.0	11.2	23.0	11.2
			4.8 x 4.8	2.0	12.3	24.9	12.3
			4.8 x 4.8	3.0	13.4	27.0	13.4
18+750	19+435	BH-A1	7.2 x 7.2	2.0	17.8	47.0	17.8
			7.2 x 7.2	3.0	21.2	49.5	21.2
			7.2 x 7.2	4.0	24.8	52.3	24.8
19+500	20+185	BH-P1	7.2 x 7.2	2.0	21.7	14.0	14.0
			7.2 x 7.2	3.0	23.8	13.9	13.9
			7.2 x 7.2	4.0	26.1	13.7	13.7
20+300	20+985	BH-P2	7.2 x 7.2	2.0	17.1	27.8	17.1
			7.2 x 7.2	3.0	19.2	29.1	19.2
			7.2 x 7.2	4.0	21.5	29.3	21.5

Note:- Table 4.1& 4.2 Show that most of the boreholes are liquefiable up to certain depth. Therefore before laying the open foundation it is recommended to replace & compact the soil up to liquefaction depth, Replaced/ Compacted SBC are presented in Table 4.3 & 4.4. For the strata liquefying for more than 4m depth from EGL, Ground Improvement Techniques such as Dynamic Compaction or Vibro Compaction are recommended.

Note:-

- The maximum value of recommended net allowable bearing capacity shall be restricted to 30 t/m^2.
- As per the Morth guidelines the gradation of fill soil shall be as per following limits. The effective angle of friction not less than 30º. The gradation of fill soil shall be as per following limits.

Sieve Size	Percentage Passing
75 mm	100%
425 micron	0-60%
75 micron	less than 15 %
PI	≤6

1. *The density of backfill soil should be more than 95% of proctor density. The replaced /compacted soil should be lay down layer wise for each 300mm.*
2. *The design parameters considered for replaced/compacted Soil for calculating the SBC from shear criteria are as follows;*

C=0, Phi = 32 degree, Sp. Gravity= 2.63 Moisture content= 8%, bulk density= 1.84 g/cc, N = 25.

- Based on the method of analysis given under Para 7.2 above, The values of Safe Load Carrying Capacity of piles in compression, uplift and lateral under static conditions have been tabulated below:-

Table 4.5: Safe Load Carrying Capacity of normal bored cast in-situ RCC Pile in Soil

Chainage Old (km)	Chainage New (km)	BH. No.	Diameter of Pile (m)	Length of piles below cut-off (m)	Cut-off level below EGL (m)	Safe load carrying capacity of single pile (T)		
						In compression	In uplift	In Lateral Fixed Head
1+006	1+696	BH-A1	1.0	18.0	2.0	365.0	240.0	22.0
				20.0		404.0	276.0	
				22.0		443.0	313.0	
				24.0		501.0	350.0	
				26.0		460.0	388.0	
				28.0		494.0	420.0	

Chainage Old (km)	Chainage New (km)	BH. No.	Diameter of Pile (m)	Length of piles below cut-off (m)	Cut-off level below EGL (m)	Safe load carrying capacity of single pile (T) In compression	In uplift	In Lateral Fixed Head
1+006	1+696	BH-A1	1.2	18.0	2.0	519.0	311.0	30.0
				20.0		574.0	363.0	
				22.0		630.0	415.0	
				24.0		719.0	468.0	
				26.0		623.0	522.0	
				28.0		671.0	567.0	
		BH-A2	1.0	18.0	2.0	305.0	249.0	15.0
				20.0		348.0	289.0	
				22.0		370.0	311.0	
				24.0		397.0	337.0	
				26.0		456.0	373.0	
				28.0		488.0	404.0	
			1.2	18.0		400.0	323.0	20.0
				20.0		462.0	381.0	
				22.0		492.0	411.0	
				24.0		529.0	448.0	
				26.0		614.0	498.0	
				28.0		660.0	542.0	
2+788	3+476	BH-A1	1.0	18.0	2.0	331.0	234.0	24.0
				20.0		368.0	269.0	
				22.0		406.0	304.0	
				24.0		443.0	339.0	
				26.0		482.0	375.0	
				28.0		551.0	412.0	
			1.2	18.0		431.0	295.0	32.0
				20.0		485.0	340.0	
				22.0		533.0	386.0	
				24.0		581.0	431.0	
				26.0		631.0	479.0	
				28.0		729.0	527.0	
		BH-A2	1.0	18.0	2.0	326.0	232.0	24.0
				20.0		361.0	266.0	
				22.0		428.0	302.0	
				24.0		467.0	338.0	
				26.0		505.0	374.0	
				28.0		544.0	410.0	
			1.2	18.0		430.0	292.0	32.0
				20.0		476.0	336.0	
				22.0		526.0	384.0	
				24.0		622.0	431.0	
				26.0		672.0	478.0	
				28.0		722.0	526.0	

Chainage Old (km)	Chainage New (km)	BH. No.	Diameter of Pile (m)	Length of piles below cut-off (m)	Cut-off level below EGL (m)	Safe load carrying capacity of single pile (T) In compression	In uplift	In Lateral Fixed Head
3+497	4+242	BH-A1	1.0	22.0	2.0	338.0	255.0	28.0
				24.0		376.0	291.0	
				26.0		414.0	327.0	
				28.0		436.0	349.0	
				30.0		458.0	371.0	
				32.0		482.0	395.0	
			1.2	22.0		441.0	329.0	38.0
				24.0		492.0	376.0	
				26.0		542.0	424.0	
				28.0		569.0	452.0	
				30.0		596.0	480.0	
				32.0		625.0	510.0	
		BH-P1	1.0	20.0	2.0	351.0	276.0	41.0
				22.0		369.0	295.0	
				24.0		387.0	314.0	
				26.0		405.0	332.0	
				28.0		423.0	351.0	
				30.0		441.0	370.0	
			1.2	20.0		451.0	351.0	55.0
				22.0		474.0	375.0	
				24.0		496.0	399.0	
				26.0		518.0	423.0	
				28.0		540.0	447.0	
				30.0		562.0	471.0	
		BH-P2	1.0	20.0	2.0	277.0	226.0	22.0
				22.0		307.0	255.0	
				24.0		324.0	273.0	
				26.0		340.0	290.0	
				28.0		357.0	308.0	
				30.0		390.0	327.0	
			1.2	20.0		356.0	288.0	30.0
				22.0		396.0	327.0	
				24.0		417.0	350.0	
				26.0		437.0	373.0	
				28.0		458.0	395.0	
				30.0		502.0	420.0	
		BH-P3	1.0	22.0	2.0	317.0	250.0	24.0
				24.0		336.0	270.0	
				26.0		354.0	289.0	
				28.0		373.0	309.0	

Chainage Old (km)	Chainage New (km)	BH. No.	Diameter of Pile (m)	Length of piles below cut-off (m)	Cut-off level below EGL (m)	Safe load carrying capacity of single pile (T) In compression	In uplift	In Lateral Fixed Head
3+497	4+242	BH-P3	1.0	30.0	2.0	392.0	329.0	24.0
				32.0		411.0	348.0	
			1.2	22.0		414.0	323.0	32.0
				24.0		437.0	348.0	
				26.0		461.0	374.0	
				28.0		484.0	399.0	
				30.0		508.0	424.0	
				32.0		531.0	449.0	
		BH-A2	1.0	22.0	2.0	391.0	315.0	32.0
				24.0		409.0	334.0	
				26.0		433.0	359.0	
				28.0		497.0	385.0	
				30.0		524.0	411.0	
				32.0		551.0	437.0	
			1.2	22.0		502.0	402.0	43.0
				24.0		525.0	426.0	
				26.0		555.0	457.0	
				28.0		642.0	490.0	
				30.0		675.0	523.0	
				32.0		708.0	556.0	
3+691	4+376	BH-A1	1.0	20.0	2.0	391.0	247.0	26.0
				22.0		429.0	283.0	
				24.0		467.0	318.0	
				26.0		505.0	354.0	
				28.0		543.0	390.0	
				30.0		581.0	425.0	
			1.2	20.0		538.0	315.0	35.0
				22.0		588.0	363.0	
				24.0		639.0	410.0	
				26.0		689.0	458.0	
				28.0		739.0	505.0	
				30.0		789.0	553.0	
		BH-A2	1.0	22.0	2.0	379.0	257.0	21.0
				24.0		416.0	292.0	
				26.0		452.0	326.0	
				28.0		489.0	361.0	
				30.0		526.0	395.0	
				32.0		562.0	430.0	
			1.2	22.0		516.0	329.0	28.0
				24.0		565.0	375.0	
				26.0		614.0	422.0	
				28.0		662.0	468.0	
				30.0		710.0	514.0	
				32.0		759.0	560.0	

Chainage Old (km)	Chainage New (km)	BH. No.	Diameter of Pile (m)	Length of piles below cut-off (m)	Cut-off level below EGL (m)	Safe load carrying capacity of single pile (T)		
						In compression	In uplift	In Lateral Fixed Head
7+078	7+759	BH-A1	1.0	22.0	2.0	254.0	189.0	17.0
				24.0		267.0	212.0	
				26.0		290.0	234.0	
				28.0		312.0	257.0	
				30.0		334.0	279.0	
				32.0		353.0	299.0	
			1.2	22.0		365.0	251.0	23.0
				24.0		380.0	283.0	
				26.0		412.0	315.0	
				28.0		443.0	347.0	
				30.0		458.0	379.0	
				32.0		483.0	405.0	
		BH-A2	1.0	22.0	2.0	220.0	162.0	8.0
				24.0		239.0	182.0	
				26.0		259.0	202.0	
				28.0		278.0	222.0	
				30.0		297.0	242.0	
				32.0		316.0	262.0	
			1.2	22.0		328.0	220.0	12.0
				24.0		356.0	249.0	
				26.0		384.0	278.0	
				28.0		412.0	307.0	
				30.0		440.0	336.0	
				32.0		468.0	365.0	
7+351	8+036	BH-A1	1.0	22.0	2.0	247.0	183.0	13.0
				24.0		260.0	205.0	
				26.0		282.0	228.0	
				28.0		305.0	251.0	
				30.0		327.0	273.0	
				32.0		346.0	293.0	
			1.2	22.0		357.0	243.0	18.0
				24.0		371.0	276.0	
				26.0		403.0	308.0	
				28.0		435.0	340.0	
				30.0		449.0	371.0	
				32.0		474.0	398.0	
		BH-P1	1.0	22.0	2.0	204.0	175.0	9.0
				24.0		228.0	199.0	
				26.0		251.0	223.0	
				28.0		267.0	239.0	
				30.0		282.0	256.0	
				32.0		315.0	273.0	

Chainage Old (km)	Chainage New (km)	BH. No.	Diameter of Pile (m)	Length of piles below cut-off (m)	Cut-off level below EGL (m)	Safe load carrying capacity of single pile (T) In compression	In uplift	In Lateral Fixed Head
7+351	8+036	BH-P1	1.2	22.0	2.0	271.0	232.0	13.0
				24.0		304.0	265.0	
				26.0		338.0	299.0	
				28.0		357.0	320.0	
				30.0		377.0	342.0	
				32.0		421.0	365.0	
		BH-A2	1.0	22.0	2.0	220.0	162.0	8.0
				24.0		239.0	182.0	
				26.0		259.0	202.0	
				28.0		278.0	222.0	
				30.0		297.0	242.0	
				32.0		316.0	262.0	
			1.2	22.0		328.0	220.0	12.0
				24.0		356.0	249.0	
				26.0		384.0	278.0	
				28.0		412.0	307.0	
				30.0		440.0	336.0	
				32.0		468.0	365.0	
7+613	8+298	BH-A1	1.0	22.0	2.0	241.0	182.0	11.0
				24.0		260.0	201.0	
				26.0		280.0	222.0	
				28.0		306.0	243.0	
				30.0		327.0	264.0	
				32.0		349.0	286.0	
			1.2	22.0		328.0	244.0	16.0
				24.0		351.0	269.0	
				26.0		376.0	295.0	
				28.0		411.0	322.0	
				30.0		436.0	349.0	
				32.0		468.0	381.0	
		BH-A2	1.0	22.0	2.0	268.0	217.0	18.0
				24.0		292.0	241.0	
				26.0		316.0	265.0	
				28.0		331.0	282.0	
				30.0		351.0	302.0	
				32.0		411.0	325.0	
			1.2	22.0		357.0	287.0	21.0
				24.0		392.0	321.0	
				26.0		426.0	356.0	
				28.0		445.0	377.0	
				30.0		469.0	403.0	
				32.0		551.0	433.0	

Chainage Old (km)	Chainage New (km)	BH. No.	Diameter of Pile (m)	Length of piles below cut-off (m)	Cut-off level below EGL (m)	Safe load carrying capacity of single pile (T)		
						In compression	In uplift	In Lateral Fixed Head
8+852	9+537	BH-A1	1.0	20.0	2.0	197.0	159.0	25.0
				22.0		220.0	182.0	
				24.0		239.0	201.0	
				26.0		254.0	218.0	
				28.0		269.0	234.0	
				30.0		283.0	250.0	
			1.2	20.0		264.0	209.0	33.0
				22.0		296.0	242.0	
				24.0		322.0	269.0	
				26.0		340.0	290.0	
				28.0		359.0	312.0	
				30.0		378.0	333.0	
		BH-A2	1.0	20.0	2.0	194.0	155.0	18.0
				22.0		216.0	177.0	
				24.0		235.0	196.0	
				26.0		249.0	212.0	
				28.0		264.0	229.0	
				30.0		278.0	245.0	
			1.2	20.0		257.0	202.0	21.0
				22.0		289.0	234.0	
				24.0		314.0	261.0	
				26.0		332.0	282.0	
				28.0		351.0	303.0	
				30.0		369.0	324.0	
9+726	10+410	BH-A1	1.0	20.0	2.0	180.0	153.0	14.0
				22.0		195.0	169.0	
				24.0		215.0	185.0	
				26.0		229.0	200.0	
				28.0		316.0	220.0	
				30.0		335.0	240.0	
			1.2	20.0		237.0	201.0	20.0
				22.0		255.0	221.0	
				24.0		282.0	241.0	
				26.0		300.0	262.0	
				28.0		328.0	291.0	
				30.0		488.0	320.0	
		BH-A2	1.0	20.0	2.0	189.0	152.0	13.0
				22.0		213.0	176.0	
				24.0		232.0	196.0	
				26.0		246.0	212.0	
				28.0		262.0	229.0	
				30.0		348.0	253.0	

Chainage Old (km)	Chainage New (km)	BH. No.	Diameter of Pile (m)	Length of piles below cut-off (m)	Cut-off level below EGL (m)	Safe load carrying capacity of single pile (T)		
						In compression	In uplift	In Lateral Fixed Head
9+726	10+410	BH-A2	1.2	20.0	2.0	249.0	199.0	18.0
				22.0		284.0	233.0	
				24.0		310.0	261.0	
				26.0		327.0	280.0	
				28.0		348.0	304.0	
				30.0		504.0	338.0	
10+025	10+709	BH-A1	1.0	20.0	2.0	212.0	163.0	18.0
				22.0		229.0	180.0	
				24.0		245.0	198.0	
				26.0		262.0	216.0	
				28.0		278.0	233.0	
				30.0		295.0	251.0	
			1.2	20.0		276.0	208.0	24.0
				22.0		297.0	231.0	
				24.0		317.0	254.0	
				26.0		338.0	277.0	
				28.0		359.0	299.0	
				30.0		379.0	322.0	
		BH-A2	1.0	20.0	2.0	220.0	169.0	23.0
				22.0		237.0	187.0	
				24.0		253.0	204.0	
				26.0		270.0	223.0	
				28.0		295.0	241.0	
				30.0		313.0	260.0	
			1.2	20.0		289.0	218.0	31.0
				22.0		309.0	241.0	
				24.0		329.0	263.0	
				26.0		351.0	287.0	
				28.0		383.0	311.0	
				30.0		405.0	335.0	
10+859	11+543	BH-A1(R)	1.0	20.0	2.0	161.0	130.0	11.0
				22.0		175.0	146.0	
				24.0		189.0	161.0	
				26.0		203.0	177.0	
				28.0		317.0	201.0	
				30.0		341.0	225.0	
			1.2	20.0		210.0	168.0	15.0
				22.0		228.0	188.0	
				24.0		245.0	208.0	
				26.0		262.0	228.0	
				28.0		297.0	263.0	
				30.0		509.0	298.0	

Chainage Old (km)	Chainage New (km)	BH. No.	Diameter of Pile (m)	Length of piles below cut-off (m)	Cut-off level below EGL (m)	Safe load carrying capacity of single pile (T) In compression	In uplift	In Lateral Fixed Head
10+859	11+543	BH-A1	1.0	22.0	2.0	227.0	165.0	10.0
				24.0		248.0	186.0	
				26.0		268.0	207.0	
				28.0		288.0	228.0	
				30.0		309.0	249.0	
				32.0		329.0	270.0	
			1.2	22.0		298.0	212.0	14.0
				24.0		324.0	239.0	
				26.0		349.0	266.0	
				28.0		374.0	292.0	
				30.0		400.0	319.0	
				32.0		425.0	346.0	
		BH-P1	1.0	20.0	2.0	141.0	124.0	9.0
				22.0		160.0	139.0	
				24.0		175.0	155.0	
				26.0		190.0	172.0	
				28.0		207.0	190.0	
				30.0		292.0	213.0	
			1.2	20.0		184.0	160.0	13.0
				22.0		209.0	180.0	
				24.0		227.0	201.0	
				26.0		246.0	223.0	
				28.0		268.0	247.0	
				30.0		422.0	281.0	
		BH-A2	1.0	22.0	2.0	167.0	133.0	5.0
				24.0		184.0	151.0	
				26.0		213.0	170.0	
				28.0		241.0	191.0	
				30.0		262.0	212.0	
				32.0		283.0	233.0	
			1.2	22.0		221.0	173.0	8.0
				24.0		241.0	196.0	
				26.0		280.0	220.0	
				28.0		310.0	251.0	
				30.0		376.0	281.0	
				32.0		406.0	312.0	
17+625	18+310	BH-A1	1.0	18.0	2.0	181.0	133.0	12.0
				20.0		209.0	152.0	
				22.0		210.0	171.0	
				24.0		226.0	189.0	
				26.0		241.0	205.0	
				28.0		264.0	222.0	

Chainage Old (km)	Chainage New (km)	BH. No.	Diameter of Pile (m)	Length of piles below cut-off (m)	Cut-off level below EGL (m)	Safe load carrying capacity of single pile (T) In compression	In uplift	In Lateral Fixed Head
17+625	18+310	BH-A1	1.2	18.0	2.0	255.0	173.0	18.0
				20.0		277.0	197.0	
				22.0		275.0	222.0	
				24.0		295.0	245.0	
				26.0		313.0	266.0	
				28.0		333.0	288.0	
		BH-A2	1.0	18.0	2.0	206.0	150.0	14.0
				20.0		228.0	172.0	
				22.0		248.0	193.0	
				24.0		265.0	211.0	
				26.0		285.0	231.0	
				28.0		316.0	252.0	
			1.2	18.0		274.0	195.0	20.0
				20.0		304.0	226.0	
				22.0		333.0	255.0	
				24.0		354.0	279.0	
				26.0		378.0	304.0	
				28.0		419.0	331.0	
17+872	18+558	BH-A1	1.0	14.0	2.0	123.0	89.0	9.0
				16.0		144.0	111.0	
				18.0		214.0	134.0	
				20.0		237.0	157.0	
				22.0		260.0	180.0	
				24.0		283.0	203.0	
			1.2	14.0		164.0	114.0	13.0
				16.0		200.0	142.0	
				18.0		284.0	172.0	
				20.0		312.0	201.0	
				22.0		341.0	230.0	
				24.0		369.0	259.0	
		BH-A2	1.0	14.0	2.0	159.0	117.0	18.0
				16.0		188.0	135.0	
				18.0		208.0	155.0	
				20.0		262.0	178.0	
				22.0		285.0	201.0	
				24.0		308.0	224.0	
			1.2	14.0		208.0	148.0	24.0
				16.0		237.0	170.0	
				18.0		268.0	196.0	
				20.0		342.0	225.0	
				22.0		370.0	254.0	
				24.0		398.0	283.0	

Chainage Old (km)	Chainage New (km)	BH. No.	Diameter of Pile (m)	Length of piles below cut-off (m)	Cut-off level below EGL (m)	Safe load carrying capacity of single pile (T) In compression	In uplift	In Lateral Fixed Head
18+750	19+435	BH-A1	1.0	18.0	2.0	137.0	117.0	9.0
				20.0		152.0	133.0	
				22.0		177.0	149.0	
				24.0		209.0	167.0	
				26.0		227.0	187.0	
				28.0		260.0	207.0	
			1.2	18.0		179.0	150.0	11.0
				20.0		197.0	171.0	
				22.0		229.0	192.0	
				24.0		273.0	215.0	
				26.0		296.0	240.0	
				28.0		339.0	266.0	
		BH-A2	1.0	18.0	2.0	107.0	86.0	8.0
				20.0		121.0	103.0	
				22.0		147.0	119.0	
				24.0		163.0	136.0	
				26.0		195.0	155.0	
				28.0		213.0	174.0	
			1.2	18.0		143.0	113.0	11.0
				20.0		161.0	134.0	
				22.0		179.0	155.0	
				24.0		216.0	178.0	
				26.0		258.0	202.0	
				28.0		280.0	227.0	
19+500	20+185	BH-A1	1.0	18.0	2.0	132.0	114.0	11.0
				20.0		160.0	130.0	
				22.0		188.0	147.0	
				24.0		205.0	165.0	
				26.0		240.0	185.0	
				28.0		259.0	205.0	
			1.2	18.0		171.0	147.0	13.0
				20.0		209.0	167.0	
				22.0		228.0	189.0	
				24.0		266.0	212.0	
				26.0		313.0	238.0	
				28.0		336.0	263.0	
		BH-P1	1.0	18.0	2.0	145.0	124.0	10.0
				20.0		162.0	142.0	
				22.0		216.0	161.0	
				24.0		234.0	180.0	
				26.0		252.0	199.0	
				28.0		272.0	219.0	

Chainage Old (km)	Chainage New (km)	BH. No.	Diameter of Pile (m)	Length of piles below cut-off (m)	Cut-off level below EGL (m)	Safe load carrying capacity of single pile (T) In compression	In uplift	In Lateral Fixed Head
19+500	20+185	BH-P1	1.2	18.0	2.0	186.0	158.0	13.0
				20.0		208.0	181.0	
				22.0		282.0	206.0	
				24.0		304.0	230.0	
				26.0		326.0	255.0	
				28.0		352.0	281.0	
		BH-A2	1.0	18.0	2.0	172.0	100.0	11.0
				20.0		195.0	123.0	
				22.0		218.0	146.0	
				24.0		241.0	169.0	
				26.0		264.0	192.0	
				28.0		287.0	215.0	
			1.2	18.0		233.0	130.0	15.0
				20.0		261.0	159.0	
				22.0		289.0	188.0	
				24.0		317.0	217.0	
				26.0		346.0	246.0	
				28.0		374.0	275.0	
19+715	20+400	BH-A1	1.0	18.0	2.0	168.0	115.0	8.0
				20.0		191.0	139.0	
				22.0		223.0	162.0	
				24.0		244.0	184.0	
				26.0		265.0	205.0	
				28.0		285.0	226.0	
			1.2	18.0		246.0	152.0	12.0
				20.0		279.0	185.0	
				22.0		304.0	217.0	
				24.0		333.0	247.0	
				26.0		359.0	274.0	
				28.0		384.0	301.0	
		BH-P1	1.0	18.0	2.0	142.0	105.0	6.0
				20.0		158.0	122.0	
				22.0		173.0	138.0	
				24.0		188.0	155.0	
				26.0		206.0	174.0	
				28.0		240.0	193.0	
			1.2	18.0		193.0	140.0	9.0
				20.0		212.0	161.0	
				22.0		231.0	183.0	
				24.0		250.0	204.0	
				26.0		272.0	228.0	
				28.0		318.0	253.0	

Chainage Old (km)	Chainage New (km)	BH. No.	Diameter of Pile (m)	Length of piles below cut-off (m)	Cut-off level below EGL (m)	Safe load carrying capacity of single pile (T) In compression	In uplift	In Lateral Fixed Head
19+715	20+400	BH-A2	1.0	18.0	2.0	157.0	125.0	9.0
				20.0		171.0	141.0	
				22.0		196.0	158.0	
				24.0		225.0	176.0	
				26.0		243.0	195.0	
				28.0		260.0	213.0	
			1.2	18.0		205.0	162.0	13.0
				20.0		222.0	182.0	
				22.0		255.0	203.0	
				24.0		294.0	227.0	
				26.0		316.0	251.0	
				28.0		337.0	275.0	
20+300	20+985	BH-A1	1.0	18.0	2.0	173.0	133.0	21.0
				20.0		189.0	150.0	
				22.0		212.0	168.0	
				24.0		228.0	185.0	
				26.0		244.0	202.0	
				28.0		260.0	219.0	
			1.2	18.0		226.0	170.0	26.0
				20.0		245.0	192.0	
				22.0		275.0	214.0	
				24.0		295.0	237.0	
				26.0		315.0	259.0	
				28.0		335.0	281.0	
		BH-P1	1.0	18.0	2.0	176.0	138.0	9.0
				20.0		190.0	153.0	
				22.0		222.0	172.0	
				24.0		242.0	192.0	
				26.0		292.0	215.0	
				28.0		315.0	238.0	
			1.2	18.0		229.0	177.0	14.0
				20.0		246.0	196.0	
				22.0		267.0	220.0	
				24.0		314.0	246.0	
				26.0		380.0	275.0	
				28.0		408.0	304.0	
		BH-P2	1.0	18.0	2.0	194.0	148.0	12.0
				20.0		209.0	165.0	
				22.0		225.0	183.0	
				24.0		285.0	205.0	
				26.0		308.0	228.0	
				28.0		330.0	251.0	

Chainage Old (km)	Chainage New (km)	BH. No.	Diameter of Pile (m)	Length of piles below cut-off (m)	Cut-off level below EGL (m)	Safe load carrying capacity of single pile (T)		
						In compression	In uplift	In Lateral Fixed Head
20+300	20+985	BH-P2	1.2	18.0	2.0	254.0	192.0	17.0
				20.0		273.0	213.0	
				22.0		293.0	235.0	
				24.0		374.0	264.0	
				26.0		402.0	293.0	
				28.0		430.0	322.0	
		BH-A2	1.0	18.0	2.0	162.0	137.0	15.0
				20.0		223.0	161.0	
				22.0		248.0	185.0	
				24.0		272.0	209.0	
				26.0		296.0	233.0	
				28.0		248.0	258.0	
			1.2	18.0		210.0	176.0	18.0
				20.0		316.0	210.0	
				22.0		350.0	243.0	
				24.0		384.0	277.0	
				26.0		417.0	311.0	
				28.0		328.0	346.0	

Notes : -

1. Permissible lateral deflection has been taken as 5 mm.
2. The self weight of the pile has been taken into account while computing the Safe Load Carrying Capacity of Pile in uplift only and not considered for vertical load capacity in compression.
3. The safe load carrying capacity of piles have been worked out on the basis of IS: 2911 (Part-1/sec-2) – 2010 as per provisions / assumptions provided therein & are only an assessment based on characteristics of the sub-strata obtained at the locations of the above BHs. The safe load carrying capacities as tabulated above will further depend substantially on the piling technique adopted and equipment used for making the piles in the field. However, for the final designs & constructions, the safe/allowable load carrying capacities of these piles should be taken by conducting actual initial load tests on these piles by casting them in the respective areas.
4. While erecting normal bored cast in-situ pile, utmost care should be taken while flushing/cleaning the bottom of pile particularly prior to start of pouring of concrete so as o rest

the pile in virgin soil only for obtaining full point bearing as while computing safe load carrying capacity of pile no bottom softening during erection of pile has been considered.

5. Further the pile should have necessary structural strength to transmit / sustain the design load.

All The above recommendations are based on the field and laboratory tests conducted on selected soil/ rock core samples and our experience in this regard. If the actual substrata conditions during excavation for the foundation differ from the observations reported here, the design experts/consultants should be referred for suggestion, further investigations.

REFERENCES

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4. IS 8009 : Part 1 : 1976 (Reaffirmed Year : 2018) Code of practice for calculation of settlements of foundations: Part 1 Shallow foundations subjected to symmetrical static vertical loads.
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6. IS 1893 : Part 1 : 2016 (Reaffirmed Year : 2021) Criteria for Earthquake Resistant Design of Structures - Part 1 : General Provisions and Buildings.
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8. IS 456 : 2000 (Reaffirmed Year : 2021) Plain and Reinforced Concrete - Code of Practice (Including Amendment 1, 2, 3,& 4).
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10. IS 2131 : 1981 (Reaffirmed Year : 2016) Method for standard penetration test for soils.
11. IS 2132 : 1986 (Reaffirmed Year : 2016) Code of practice for thin-walled tube sampling of soils.
12. IS 1892 : 1979 (Reaffirmed Year : 2016) Code of practice for subsurface investigation for foundations.
13. Bowles, J.E., 1982. Foundation design and analysis.
14. IS. 2720 (Part 3)-1980. Determination of Specific Gravity of Soil.
15. IS. 2720 (Part 4). 1985. Methods of Test for Soils: Grain Size Analysis.
16. IS. IS 2131, 1981. Method for standard penetration test for soils.
17. IS: 2720 (Part 11)–(1993). Determination of the shear strength parameters of a specimen tested in unconsolidated undrained triaxial compression without the measurement of pore water pressure.
18. IS: 2720 (Part 13) 1986 Method of test for soils, direct shear test. New Delhi, India.
19. IS: 2720 (Part 3/See 1)–(1980) Methods of test for soils, determination of specific gravity of soil. New Delhi, India.
20. IS: 2720 (Part 5) 1985 Methods of test for soils, determination of liquid and plastic limit of soils. New Delhi, India.

Abbreviations

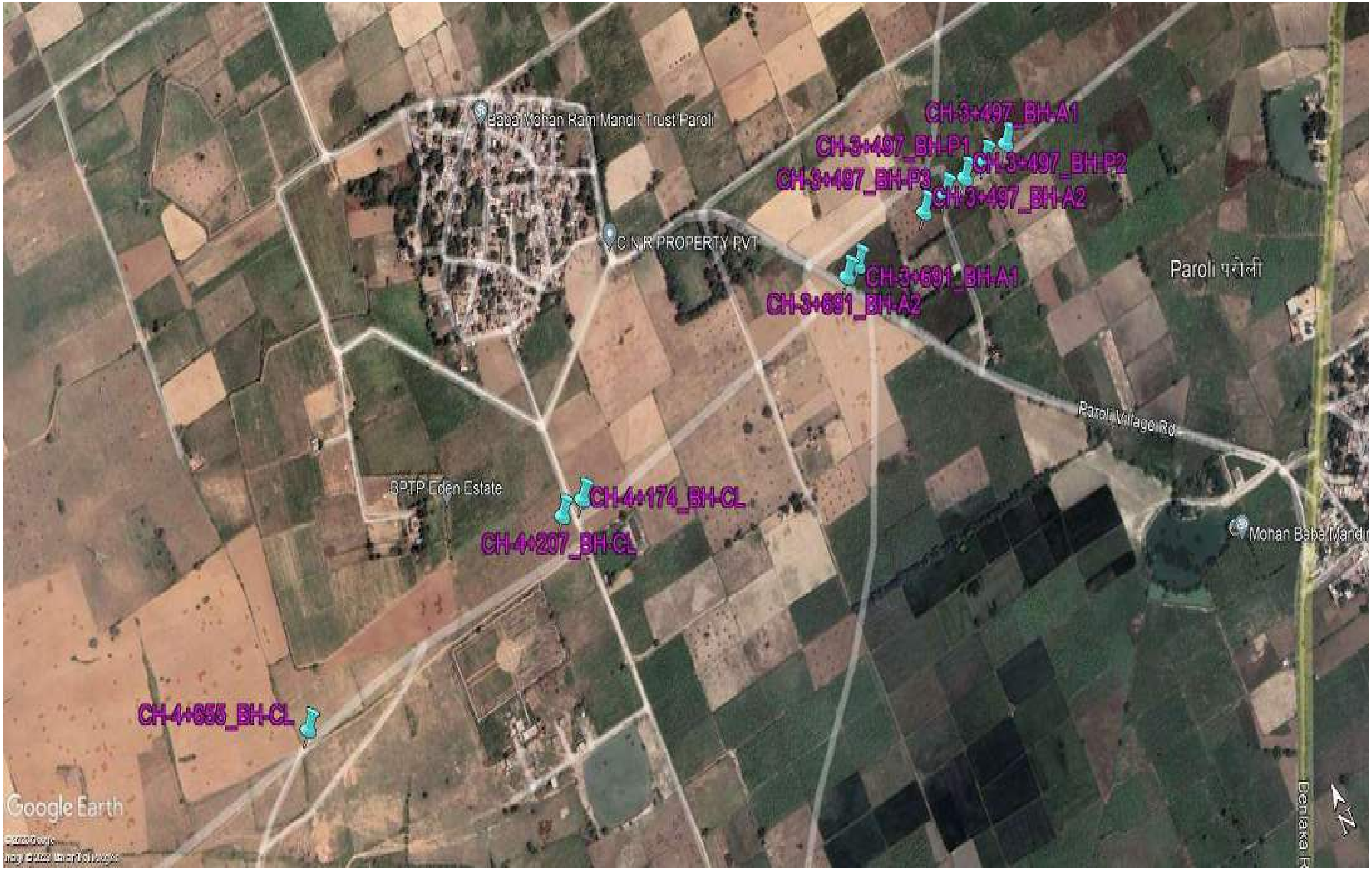
BH	Borehole
ERT	Electrical Resistivity Test
EGL	Existing Ground Level
GWT	Ground Water Table
IS	Indian Standards
SPT	Standard Penetration Test
DS	Disturbed Soil
R.L.	Reduced Level
m	Metre
sp. gr.	Specific Gravity
%	Percentage
mg /l	Milligram per litre
mg /kg	Milligram per kilogram

APPENDIX – A (FIELD DATA RESULTS)

Appendix No.	ITEMS
A-1	LOCATION PLAN
A-2	FIELD BORE HOLE LOGS
A-3	SUB SOIL PROFILE DIAGRAM
A-4	PLT TEST CURVE

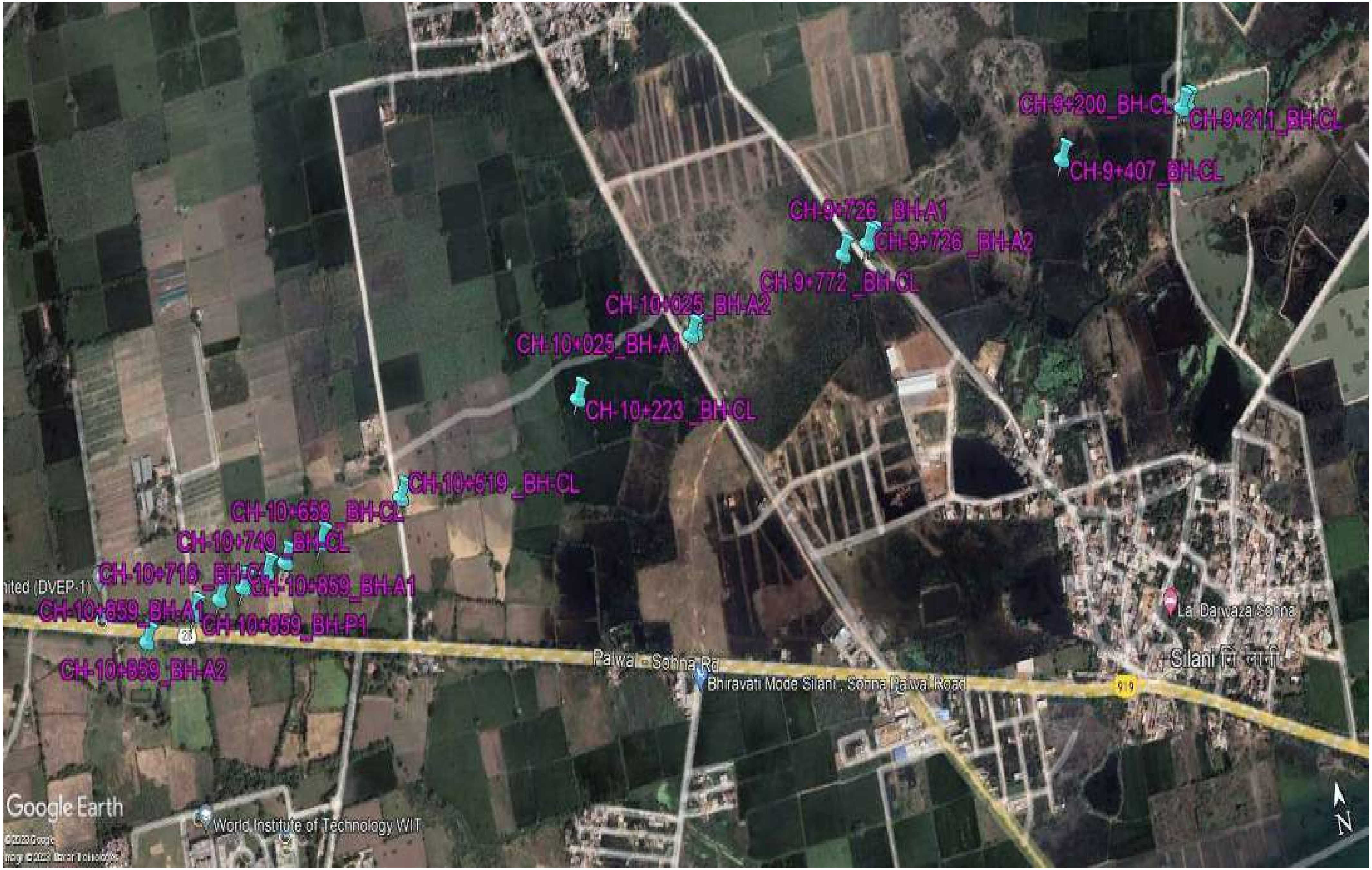

CH-(-)0+627_BH-CL
NCH-0+000_BH-PLT-09
CH-(-)0+529_BH-CL
CH-(-)0+319_BH-CL
CH-0+273_BH-CL
Chhaprola
Chhavi garment
CH-1+006_BH-A1
CH-1+006 _BH-A2
Google Earth
N


CH-1+333_BH-CL
CH-1+811_BH-CL
Chaudhary Poultry Farm
CH-2+788_BH-A1
CH-2+788_BH-A2
CH-2+472_BH-CL
Google Earth
N


Baba Mohan Ram Mandir Trust Paroli
C N R PROPERTY PVT
CH-3+497_BH-A1
CH-3+497_BH-P1
CH-3+497_BH-P2
CH-3+497_BH-P3
CH-3+497_BH-A2
CH-3+691_BH-A1
CH-3+691_BH-A2
Paroli परोली
Paroli Village Rd
BPTP Eden Estate
CH-4+174_BH-CL
CH-4+207_BH-CL
CH-4+655_BH-CL
Google Earth


CH-5+119_BH-CL
CH-5+730_BH-CL
CH-6+197_BH-CL
CH-6+877_BH-CL
CH-7+078_BH-A1
CH-7+256_BH-CL
CH-7+078_BH-A2
CH-7+351_BH-P1
CH-7+351_BH-A2
CH-7+351_BH-A1
KHOONTPURI
Government school
Ratika Noabad
Google Earth

CH-7+457_BH-CL
CH-7+613_BH-A1
CH-7+613_BH-A2
CH-7+907_BH-A1
HARENDER POSWAL
Aranyak farm
Ahara Farms
CH-8+207_BH-CL
CH-8+610_BH-CL
CH-8+852_BH-A1
CH-8+852_BH-A2
CH-8+907_BH-CL
Google Earth
NCH-10+840_BH-PLT-08
33KV Substation Silani
N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CH-9+211_BH-CL
CH-9+407_BH-CL
CH-9+726_BH-A1
CH-9+726_BH-A2
CH-9+772_BH-CL
CH-10+025_BH-A2
CH-10+025_BH-A1
CH-10+223_BH-CL
CH-10+519_BH-CL
CH-10+658_BH-CL
CH-10+749_BH-CL
CH-10+718_BH-CL
CH-10+859_BH-A1
CH-10+859_BH-A1
CH-10+859_BH-P1
CH-10+859_BH-A2
Palwal - Sohna Rd
Bhiravati Mode Silani , Sohna Palwal Road
Lal Darwaza Sohna
Silani
World Institute of Technology WIT
Google Earth
N


Mughal Food
Fly time India
HSK CONCRETE
CH-17+625_BH-A2
CH-17+625_BH-A1
Indari इन्दरी
CH-17+872_BH-A2
CH-17+872_BH-A1
NDER KIRAN...
NCH-19+010_BH-PLT-07
248A
CH-18+750_BH-A2
CH-18+750_BH-A1
Google Earth
N

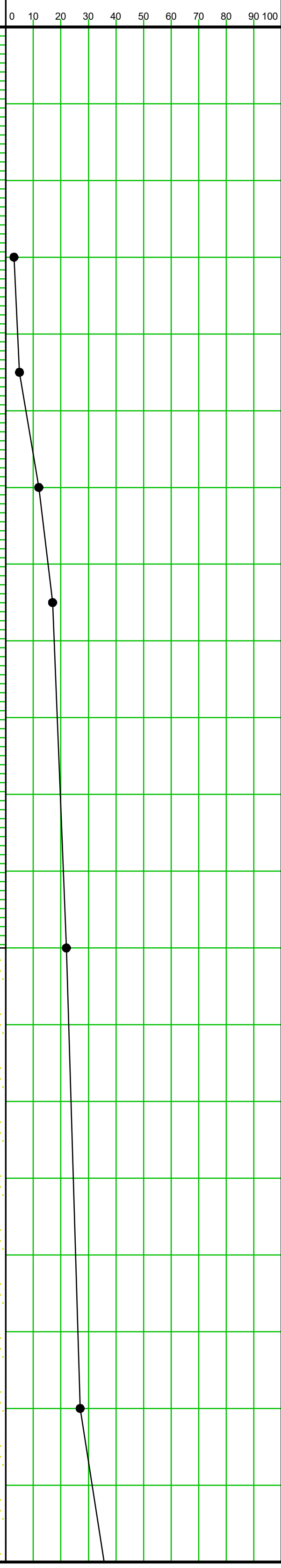

CH-20+300_BH-P2
CH-20+300_BH-A2
CH-20+300_BH-A
CH-20+300_BH-P1
Sorel Fast Food
Junaid General Store
220kV Substation Rojka Meo
CH-19+715_BH-P1
CH-19+715_BH-A2
CH-19+715_BH-A
CH-19+500_BH-A2
CH-19+500_BH-A1
CH-19+500_BH-P1
S K Hard Were
Western Peripheral Expy
Peripheral Expy
Nizam Kirana Store
Google Earth
N

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :New Ch. 0+000 km_Prithla Station	*Northing* :3126079 m	*Easting* :720981 m
Reduced Level (m):(+)195.456	*BH. No.* :BH-PLT-09	*BH Termination Depth (m)*:12
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:Not Encountered	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :23-12-2021	*Date of Completion* :23-12-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Special Observations
0.0		DS					Brownish, Medium dnese, Sandy Silt	ML-CL	
0.5	0.75	UDS-1							
1.0									
1.5	1.5	SPT-1	1	1	2	3			
2.0	2.25	SPT-2	1	2	3	5			
2.5									
3.0	3	SPT-3	3	5	7	12			
3.5	3.75	SPT-4	5	7	10	17			
4.0									
4.5	4.5	UDS-2							
5.0									
5.5									
6.0	6	SPT-5	7	10	12	22	Brownish, Medium dense to Dense, Silty Sand	SM	
6.5									
7.0									
7.5	7.5	UDS-3							
8.0									
8.5									
9.0	9	SPT-6	10	12	15	27			
9.5									
10.0									

(Depth v/s SPT N Value)

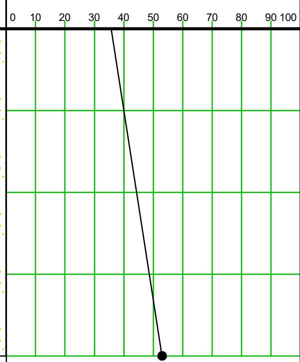


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :New Ch. 0+000 km_Prithla Station	*Northing* :3126079 m	*Easting* :720981 m
Reduced Level (m):(+)195.456	*BH. No.* :BH-PLT-09	*BH Termination Depth (m)*:12
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:Not Encountered	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :23-12-2021	*Date of Completion* :23-12-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5	10.5	UDS-4					Brownish, Medium dense to Dense, Silty Sand	SM			
11.0											
11.5											
12.0	12	SPT-7	18	24	29	53					

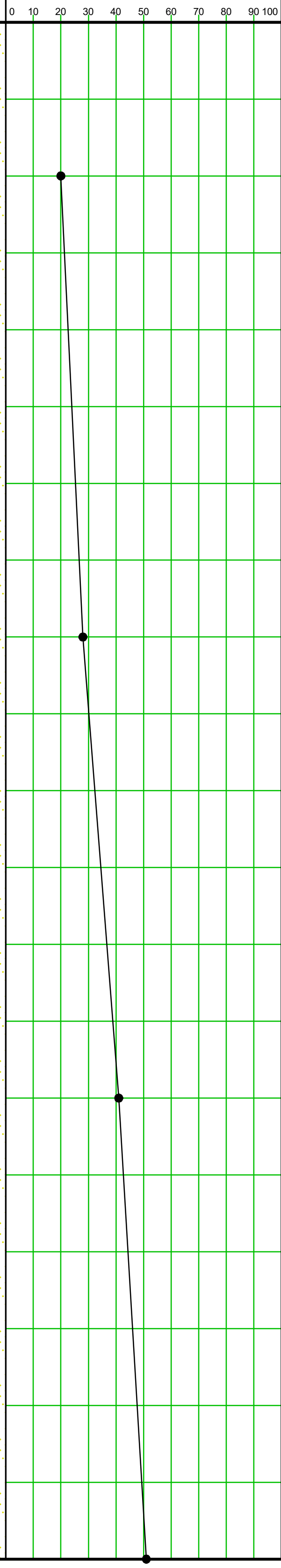


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
BH Location/Chainage :(-)0+627 km	*Northing :*3126081.947 m	*Easting :*720920.89 m
Reduced Level (m):(+)196.408	*BH. No. :*BH-CL	*BH Termination Depth (m):*10
*Proposed / Existing Structure :*Minor Bridge	*Water Table (m):*8.50	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*14-10-2021	*Date of Completion :*14-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Medium dense to very dense, Silty sand	SM			
0.5											
1.0	1	SPT-1	7	8	12	20					
1.5											
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	9	11	17	28					
4.5											
5.0											
5.5	5.5	UDS-2									
6.0											
6.5											
7.0	7	SPT-3	12	17	24	41					
7.5											
8.0											
8.5	8.5	UDS-3							8.50m		
9.0											
9.5											
10.0	10	SPT-4	16	22	29	51					

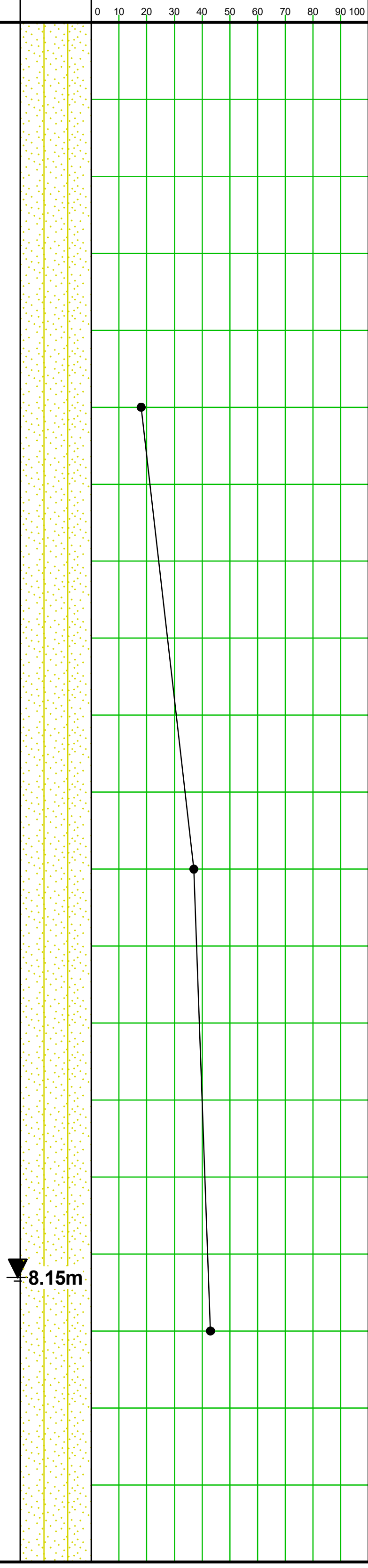


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage :(-)0+529 km	*Northing :* 3126042.507 m	*Easting :* 720826.915 m
Reduced Level (m):(+)195.851	*BH. No. :* BH-CL	*BH Termination Depth (m):* 10
Proposed / Existing Structure : Minor Bridge	*Water Table (m):* 8.15	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 14-10-2021	*Date of Completion :* 14-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5											
1.0	1	UDS-1									
1.5											
2.0											
2.5	2.5	SPT-1	6	7	11	18					
3.0											
3.5											
4.0	4	UDS-2									
4.5											
5.0							Brown, Medium dense to dense, Silty sand with gravel	SM			
5.5	5.5	SPT-2	7	15	22	37					
6.0											
6.5											
7.0	7	UDS-3									
7.5											
8.0											
8.5	8.5	SPT-3	10	18	25	43					
9.0											
9.5											
10.0	10	UDS-4									



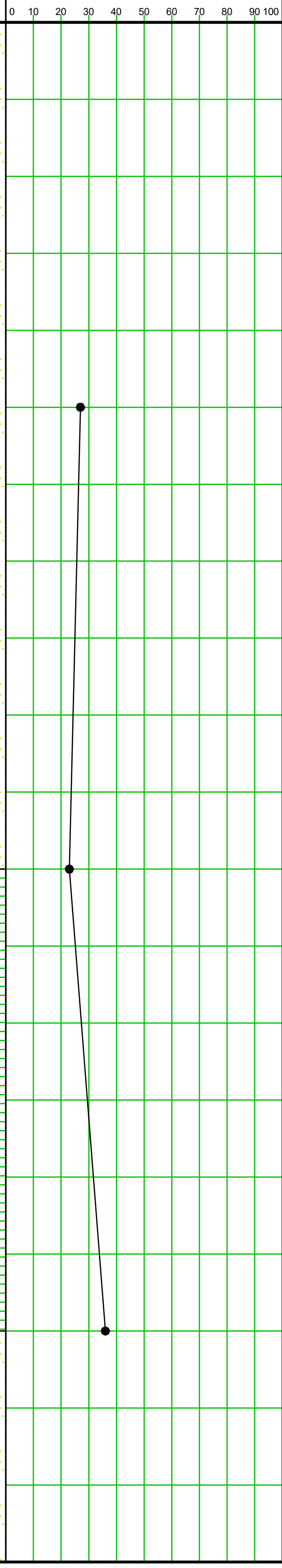
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : (-)0+319 km	*Northing :* 3125962.572 m	*Easting :* 720635.657 m
Reduced Level (m): (+)197.352	*BH. No. :* BH-CL	*BH Termination Depth (m):* 10
Proposed / Existing Structure : Minor Bridge	*Water Table (m):* 8.10	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 15-10-2021	*Date of Completion :* 15-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Special Observations
0.0		DS					Brown, Medium dense, Silty sand (0.0–5.5)	SM	
0.5									
1.0	1	UDS-1							
1.5									
2.0									
2.5	2.5	SPT-1	7	12	15	27			
3.0									
3.5									
4.0	4	UDS-2							
4.5									
5.0									
5.5	5.5	SPT-2	5	9	14	23	Brown, Very stiff, Silty clay of low plasticity with gravel (5.5–8.5)	CL	
6.0									
6.5									
7.0	7	UDS-3							
7.5									
8.0									8.10m
8.5	8.5	SPT-3	8	14	22	36	Brown, Dense, Silty sand with gravel (8.5–10.0)	SM	
9.0									
9.5									
10.0	10	UDS-4							

(Depth v/s SPT N Value)

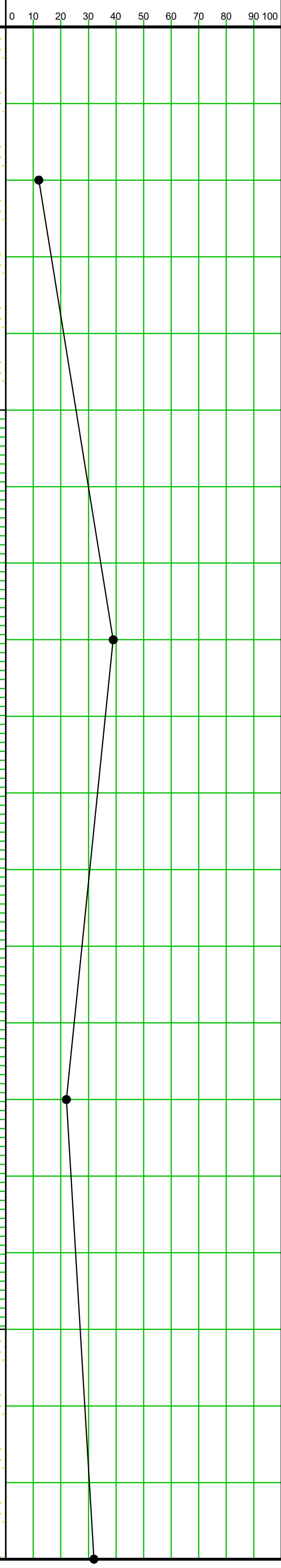


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*0+273 km	*Northing :*3125734.325 m	*Easting :*720089.535 m
Reduced Level (m):(+)195.008	*BH. No. :*BH-CL	*BH Termination Depth (m):*10
*Proposed / Existing Structure :*Minor Bridge	*Water Table (m):*8.25	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*14-10-2021	*Date of Completion :*14-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Medium dense, Silty sand (0.0–2.5 m)	SM			
0.5											
1.0	1	SPT-1	4	5	7	12					
1.5											
2.0											
2.5	2.5	UDS-1					Brown, Medium dense to dense, Sandy silt of low with gravel (2.5–8.5 m)	ML-CL			
3.0											
3.5											
4.0	4	SPT-2	15	16	23	39					
4.5											
5.0											
5.5	5.5	UDS-2									
6.0											
6.5											
7.0	7	SPT-3	6	9	13	22					
7.5											
8.0									8.25m		
8.5	8.5	UDS-3					Brown, Dense, Silty sand with gravel (8.5–10.0 m)	SM			
9.0											
9.5											
10.0	10	SPT-4	7	12	20	32					

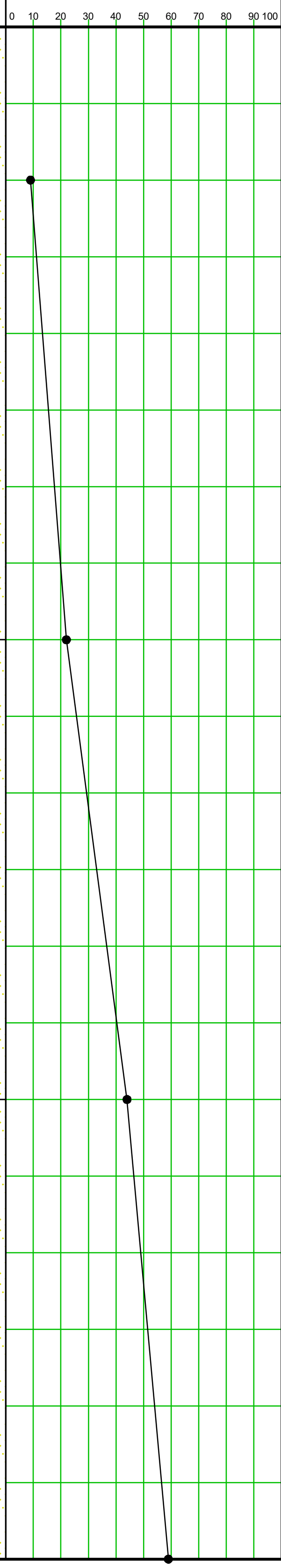


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :1+006 km	*Northing* :3125461.869 m	*Easting* :719415.302 m
Reduced Level (m):(+)202.730	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:24.90	*Inclination :* Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :04-10-2021	*Date of Completion* :05-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5											
1.0	1	SPT-1	3	4	5	9					
1.5											
2.0							Brown, Loose, Silty sand	SM			
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	7	10	12	22					
4.5											
5.0											
5.5	5.5	UDS-2					Brown, Medium dense, Silty sand	SM			
6.0											
6.5											
7.0	7	SPT-3	12	18	26	44					
7.5											
8.0											
8.5	8.5	UDS-3					Brown, Dense to very dense, Silty sand with gravel	SM			
9.0											
9.5											
10.0	10	SPT-4	14	27	32	59					

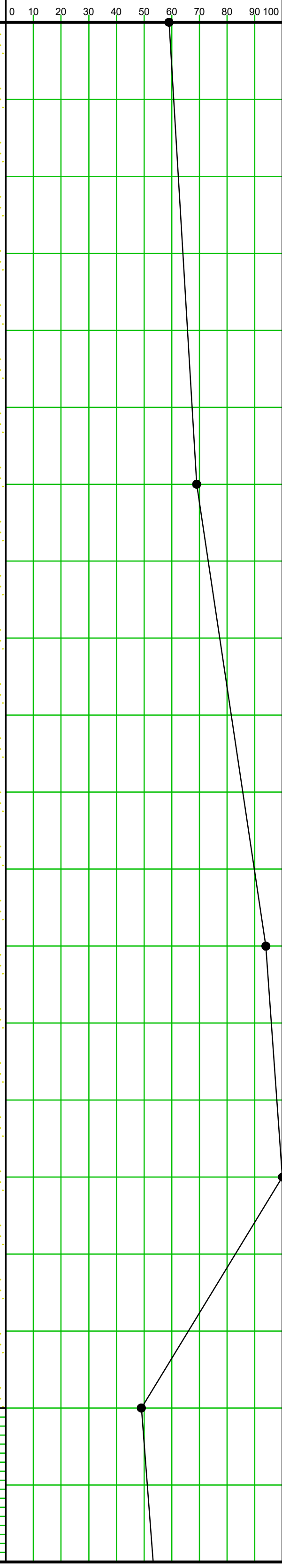


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :1+006 km	*Northing* :3125461.869 m	*Easting* :719415.302 m
Reduced Level (m):(+)202.730	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:24.90	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :04-10-2021	*Date of Completion* :05-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0							Brown, Dense to very dense, Silty sand with gravel (10.0–19.0)	SM			
10.5											
11.0											
11.5	11.5	UDS-4									
12.0											
12.5											
13.0	13	SPT-5	18	30	39	69					
13.5											
14.0											
14.5	14.5	UDS-5									
15.0											
15.5											
16.0	16	SPT-6	26	34	60	94					
16.5											
17.0											
17.5	17.5	SPT-7	17	36	64	100					
18.0											
18.5											
19.0	19	SPT-8	18	22	27	49					
19.5							Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
20.0											



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 1+006 km	*Northing :* 3125461.869 m	*Easting :* 719415.302 m
Reduced Level (m): (+)202.730	*BH. No. :* BH-A1	*BH Termination Depth (m):* 30
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 24.90	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 04-10-2021	*Date of Completion :* 05-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
20.0										
20.5	20.5	UDS-6								
21.0										
21.5										
22.0	22	SPT-9	20	28	34	62				
22.5										
23.0										
23.5	23.5	UDS-7								
24.0										
24.5										
25.0	25	SPT-10	36	76	24 (2cm)	>100	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL	24.90m	
25.5										
26.0										
26.5	26.5	SPT-11	22	45	55 (11cm)	>100				
27.0										
27.5										
28.0	28	SPT-12	26	62	38 (5cm)	>100				
28.5										
29.0										
29.5	29.5	SPT-13	16	20	28	48				
30.0	30	DS-2					Brown, Hard, Silty clay of low plasticity with gravel	CL		

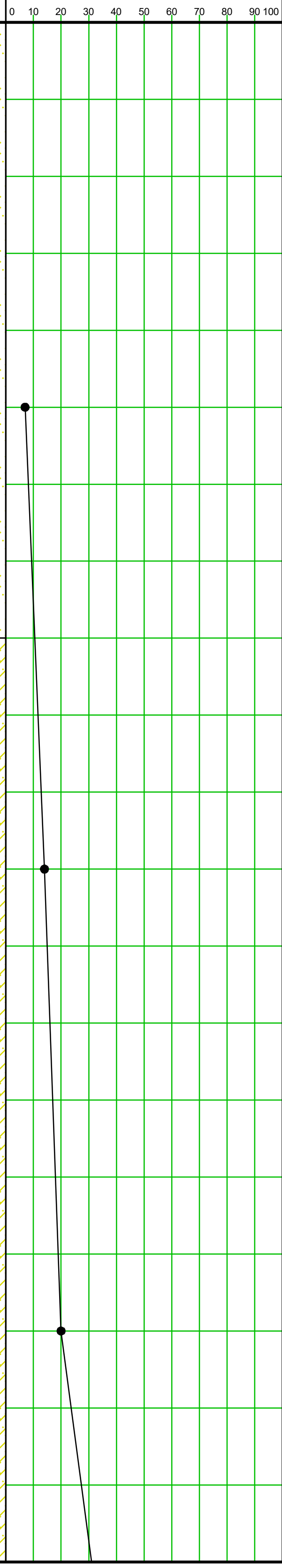
(Depth v/s SPT N Value)

UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*1+006 km	*Northing :*3125454.226 m	*Easting :*719396.82 m
Reduced Level (m):(+)203.271	*BH. No. :*BH-A2	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*24.80	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*04-10-2021	*Date of Completion :*04-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5											
1.0	1	UDS-1									
1.5											
2.0							Brown, Loose, Silty sand	SM			
2.5	2.5	SPT-1	2	3	4	7					
3.0											
3.5											
4.0	4	UDS-2									
4.5											
5.0											
5.5	5.5	SPT-2	4	6	8	14					
6.0											
6.5											
7.0	7	UDS-3					Brown, Medium dense, Silty sand with clay	SM-SC			
7.5											
8.0											
8.5	8.5	SPT-3	5	9	11	20					
9.0											
9.5											
10.0	10	UDS-4									

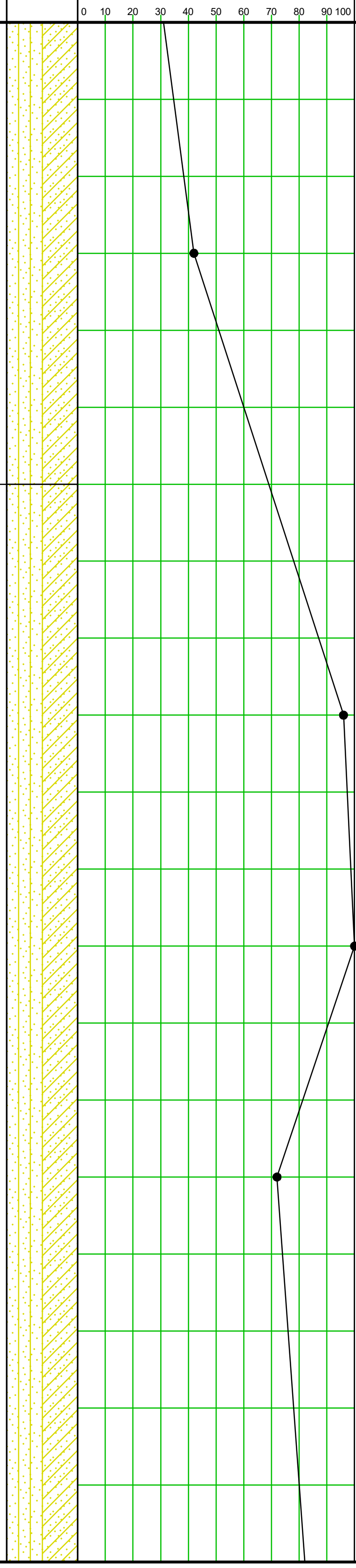


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*1+006 km	*Northing :*3125454.226 m	*Easting :*719396.82 m
Reduced Level (m):(+)203.271	*BH. No. :*BH-A2	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*24.80	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*04-10-2021	*Date of Completion :*04-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-4	12	19	23	42	Brown, Dense, Silty sand with clay	SM-SC			
12.0											
12.5											
13.0	13	UDS-5									
13.5											
14.0											
14.5	14.5	SPT-5	23	36	60	96					
15.0											
15.5											
16.0	16	SPT-6	23	37	63	100					
16.5							Brown, Very dense, Silty sand with clay with gravel	SM-SC			
17.0											
17.5	17.5	SPT-7	17	29	43	72					
18.0											
18.5											
19.0	19	UDS-6									
19.5											
20.0											



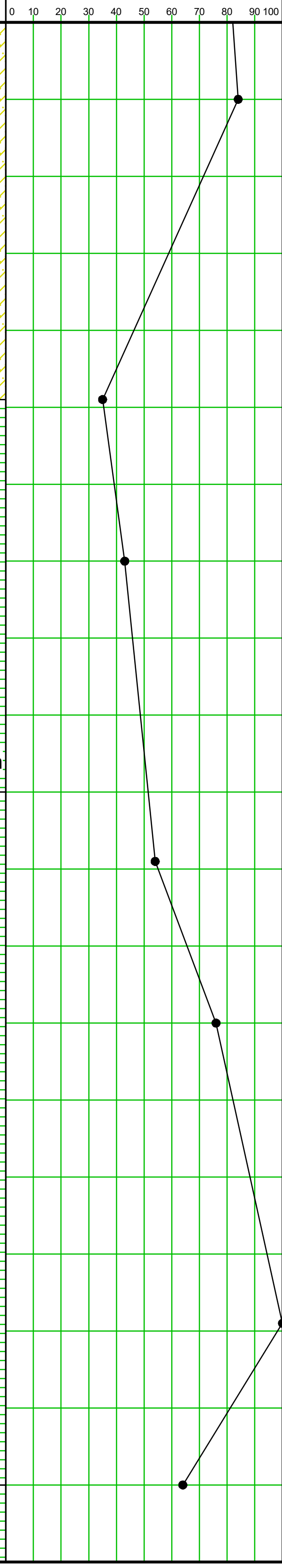
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 1+006 km	*Northing :* 3125454.226 m	*Easting :* 719396.82 m
Reduced Level (m): (+)203.271	*BH. No. :* BH-A2	*BH Termination Depth (m):* 30
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 24.80	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 04-10-2021	*Date of Completion :* 04-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
20.0										
20.5	20.5	SPT-8	14	30	54	84				
21.0										
21.5							Brown, Very dense, Silty sand with clay with gravel	SM-SC		
22.0	22	UDS*								
22.5	22.45	SPT-9	10	13	22	35				
23.0										
23.5	23.5	SPT-10	12	16	27	43	Brown, Hard, Silty clay of low plasticity with gravel	CL		
24.0										
24.5									24.80m	
25.0	25	UDS*								
25.5	25.45	SPT-11	15	21	33	54				
26.0										
26.5	26.5	SPT-12	16	26	50	76				
27.0										
27.5							Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		
28.0	28	UDS*								
28.5	28.45	SPT-13	20	45	55 (12cm)	>100				
29.0										
29.5	29.5	SPT-14	17	28	36	64				
30.0	30	DS-2					Brown, Hard, Silty clay of low plasticity with gravel	CL		

(Depth v/s SPT N Value)

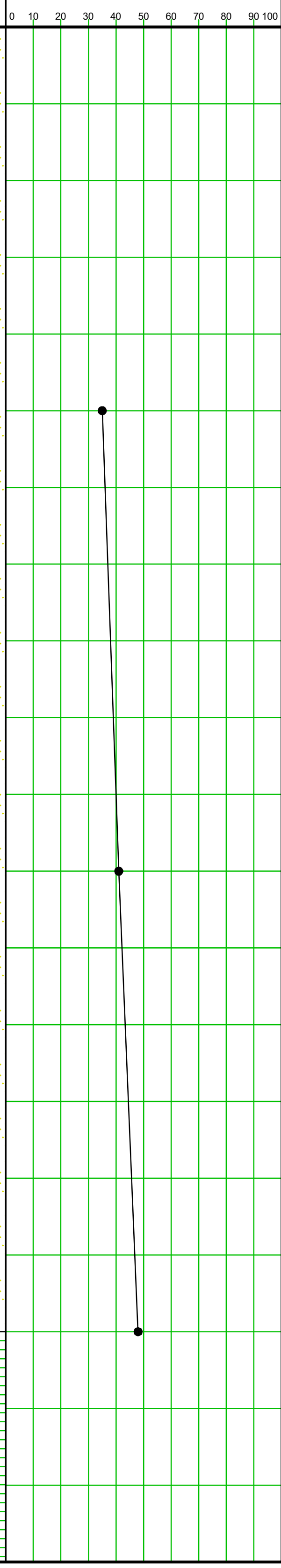


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*1+333 km	*Northing :*3125351.606 m	*Easting :*719094.132 m
Reduced Level (m):(+)202.117	*BH. No. :*BH-CL	*BH Termination Depth (m):*10
*Proposed / Existing Structure :*Minor Bridge	*Water Table (m):*Not Encountered	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*15-10-2021	*Date of Completion :*15-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5											
1.0	1	UDS-1									
1.5											
2.0											
2.5	2.5	SPT-1	12	14	21	35					
3.0											
3.5											
4.0	4	UDS-2					Brown, Dense, Silty sand with gravel	SM			
4.5											
5.0											
5.5	5.5	SPT-2	10	17	24	41					
6.0											
6.5											
7.0	7	UDS-3									
7.5											
8.0											
8.5	8.5	SPT-3	13	19	29	48					
9.0											
9.5							Brown, Hard, Silty clay of low plasticity with gravel	CL			
10.0	10	UDS-4									

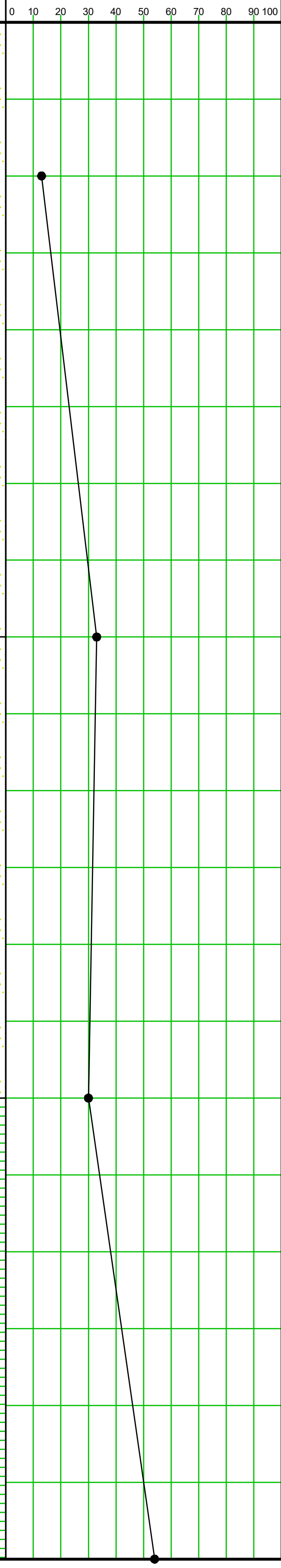


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :1+811 km	*Northing* :3125172.851 m	*Easting* :718661.831 m
Reduced Level (m):(+)197.587	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:9.10	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :15-10-2021	*Date of Completion* :15-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Medium dense, Silty sand	SM			
0.5											
1.0	1	SPT-1	4	6	7	13					
1.5											
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	9	15	18	33					
4.5							Brown, Dense, Silty sand with gravel	SM			
5.0											
5.5	5.5	UDS-2									
6.0											
6.5											
7.0	7	SPT-3	7	10	20	30					
7.5							Brown, Medium dense, Sandy silt of low plasticity with gravel	ML-CL			
8.0											
8.5	8.5	UDS-3									
9.0									9.10m		
9.5											
10.0	10	SPT-4	13	25	29	54					



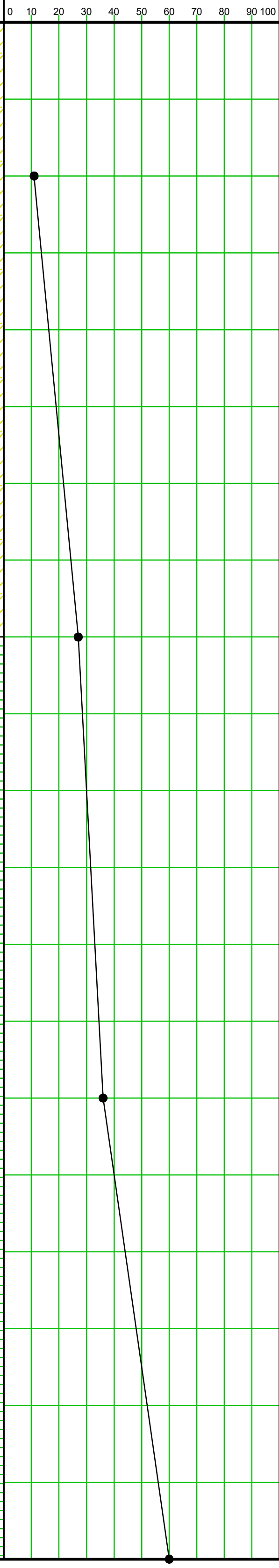
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :2+472 km	*Northing* :3124979.104 m	*Easting* :718027.804 m
Reduced Level (m):(+)197.568	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:7.50	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :16-10-2021	*Date of Completion* :16-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS								
0.5										
1.0	1	SPT-1	4	5	6	11				
1.5										
2.0							Brown, Medium dense, Silty sand with clay	SM-SC		
2.5	2.5	UDS-1								
3.0										
3.5										
4.0	4	SPT-2	9	12	15	27				
4.5										
5.0										
5.5	5.5	UDS-2								
6.0										
6.5										
7.0	7	SPT-3	11	16	20	36	Brown, Medium dense to dense, Sandy silt of low plasticity with gravel	ML-CL		
7.5									7.50m	
8.0										
8.5	8.5	UDS-3								
9.0										
9.5										
10.0	10	SPT-4	12	27	33	60				

(Depth v/s SPT N Value)

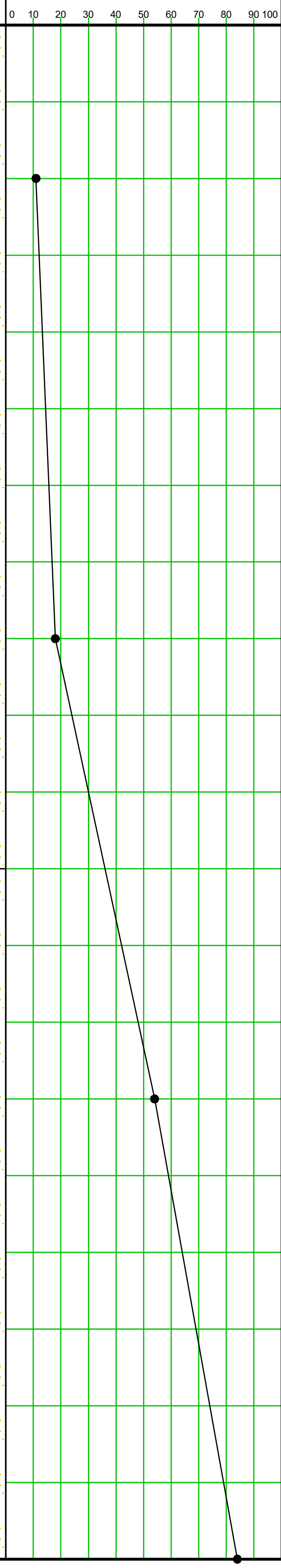


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :2+788 km	*Northing* :3124953.799 m	*Easting* :717723.179 m
Reduced Level (m):(+)195.987	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:18.24	*Inclination :* Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :03-10-2021	*Date of Completion* :04-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Medium dense, Silty sand	SM			
0.5											
1.0	1	SPT-1	4	5	6	11					
1.5											
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	6	8	10	18					
4.5											
5.0											
5.5	5.5	UDS-2					Brown, Very dense, Silty sand with gravel	SM			
6.0											
6.5											
7.0	7	SPT-3	15	24	30	54					
7.5											
8.0											
8.5	8.5	UDS-3									
9.0											
9.5											
10.0	10	SPT-4	25	40	44	84					



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :2+788 km	*Northing* :3124953.799 m	*Easting* :717723.179 m
Reduced Level (m):(+)195.987	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:18.24	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :03-10-2021	*Date of Completion* :04-10-2021	

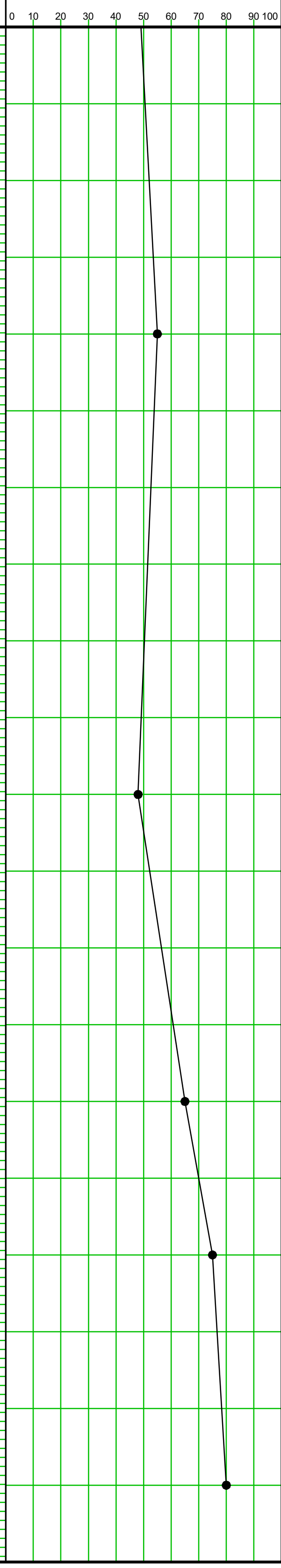
Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	UDS-4									
12.0											
12.5							Brown, Very dense, Silty sand with gravel	SM			
13.0	13	SPT-5	17	33	38	71					
13.5											
14.0											
14.5	14.5	UDS-5									
15.0											
15.5											
16.0	16	SPT-6	12	14	17	31					
16.5											
17.0											
17.5	17.5	UDS*					Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL			
18.0	18	SPT-7	17	20	23	43					
18.5									18.24m		
19.0	19	SPT-8	19	21	25	46					
19.5											
20.0											

UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*2+788 km	*Northing :*3124953.799 m	*Easting :*717723.179 m
Reduced Level (m):(+)195.987	*BH. No. :*BH-A1	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*18.24	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*03-10-2021	*Date of Completion :*04-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	UDS-6									
21.0											
21.5											
22.0	22	SPT-9	20	25	30	55					
22.5											
23.0											
23.5	23.5	UDS-7									
24.0											
24.5											
25.0	25	SPT-10	18	21	27	48	Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL			
25.5											
26.0											
26.5	26.5	UDS-8									
27.0	27	SPT-11	16	25	40	65					
27.5											
28.0	28	SPT-12	22	34	41	75					
28.5											
29.0											
29.5	29.5	SPT-13	20	35	45	80					
30.0	30	-									

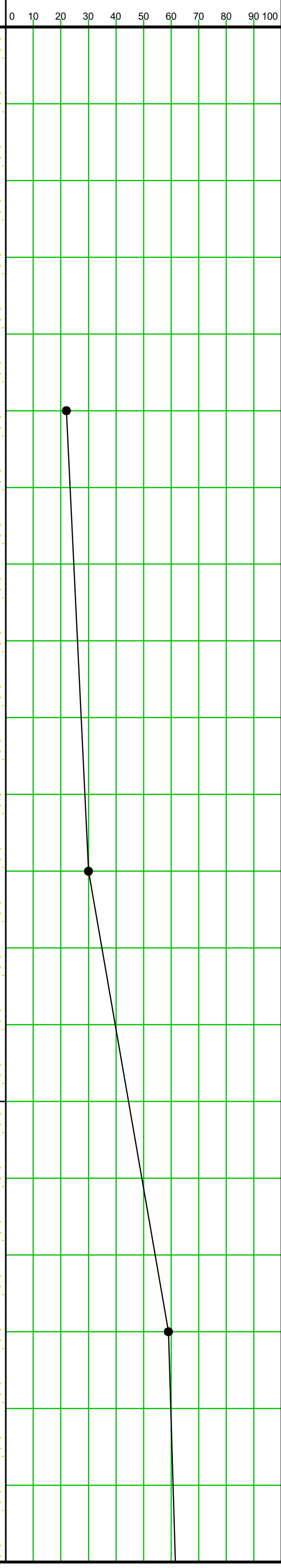


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :2+788 km	*Northing* :3124952.116 m	*Easting* :717703.27 m
Reduced Level (m):(+)196.902	*BH. No.* :BH-A2	*BH Termination Depth (m):*30
Proposed / Existing Structure :Major Bridge	*Water Table (m):*17.68	*Inclination :* Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :03-10-2021	*Date of Completion* :04-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Medium dense, Silty sand (0.0–7.0)	SM			
0.5											
1.0	1	UDS-1									
1.5											
2.0											
2.5	2.5	SPT-1	6	9	13	22					
3.0											
3.5											
4.0	4	UDS-2									
4.5											
5.0											
5.5	5.5	SPT-2	7	13	17	30					
6.0											
6.5											
7.0	7	UDS-3					Brown, Very dense, Silty sand with gravel (7.0–10.0)	SM			
7.5											
8.0											
8.5	8.5	SPT-3	14	25	34	59					
9.0											
9.5											
10.0	10	UDS-4									

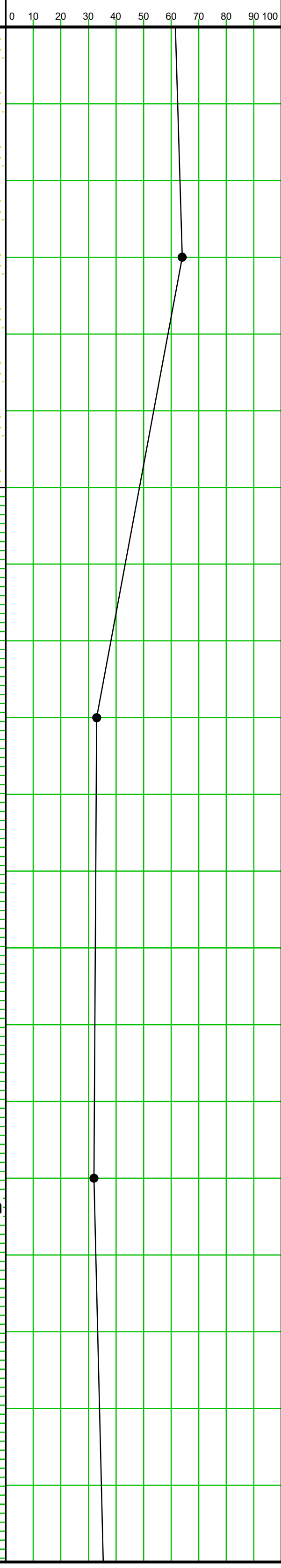


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :2+788 km	*Northing* :3124952.116 m	*Easting* :717703.27 m
Reduced Level (m):(+)196.902	*BH. No.* :BH-A2	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:17.68	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :03-10-2021	*Date of Completion* :04-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-4	16	26	38	64	Brown, Very dense, Silty sand with gravel	SM			
12.0											
12.5											
13.0	13	UDS-5									
13.5											
14.0											
14.5	14.5	SPT-5	12	14	19	33					
15.0											
15.5											
16.0	16	UDS-6									
16.5							Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL			
17.0											
17.5	17.5	SPT-6	12	14	18	32			17.68m		
18.0											
18.5											
19.0	19	UDS-7									
19.5											
20.0											

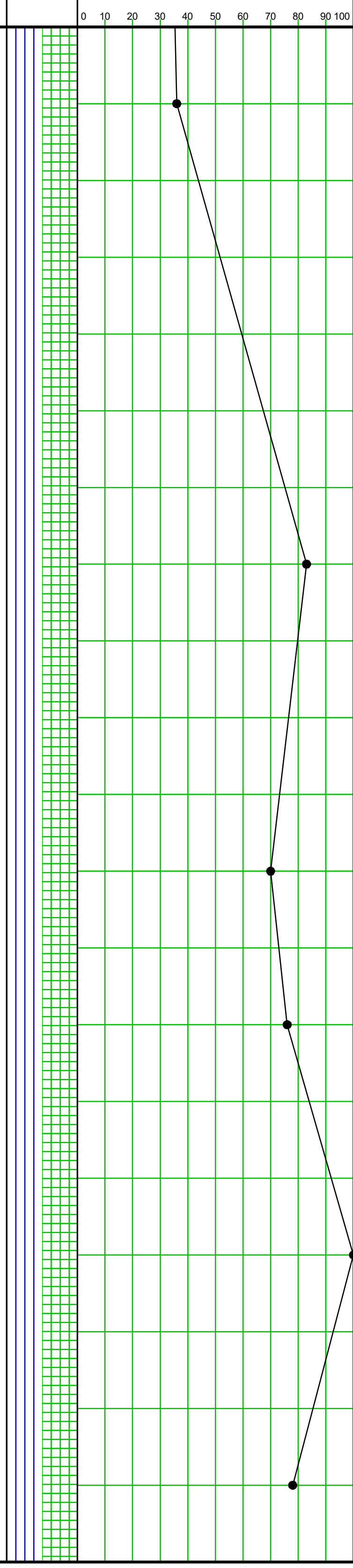


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*2+788 km	*Northing :*3124952.116 m	*Easting :*717703.27 m
Reduced Level (m):(+)196.902	*BH. No. :*BH-A2	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*17.68	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*03-10-2021	*Date of Completion :*04-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-7	14	17	19	36					
21.0											
21.5											
22.0	22	UDS-8									
22.5											
23.0											
23.5	23.5	SPT-8	35	40	43	83					
24.0											
24.5											
25.0	25	UDS-9					Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL			
25.5	25.5	SPT-9	22	33	37	70					
26.0											
26.5	26.5	SPT-10	24	36	40	76					
27.0											
27.5											
28.0	28	SPT-11	32	45	55 (12cm)	>100					
28.5											
29.0											
29.5	29.5	SPT-12	29	36	42	78					
30.0	29.95	-									

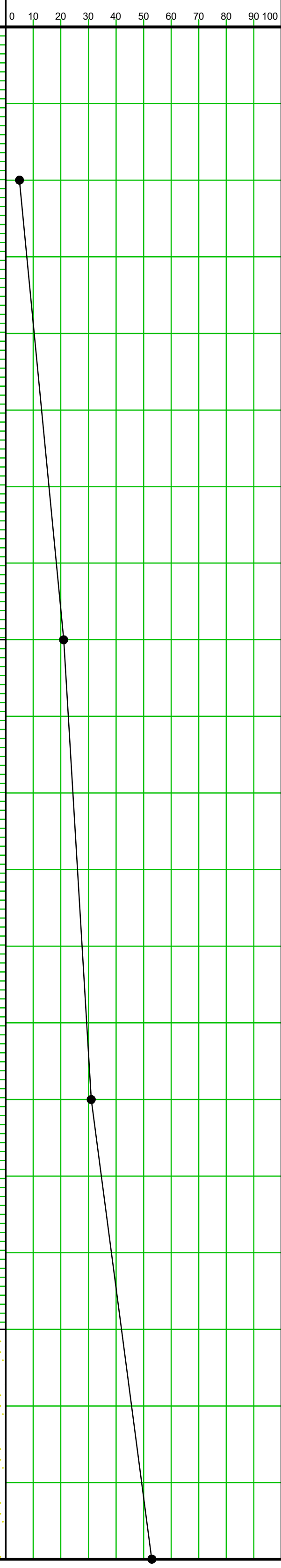


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+497 km	*Northing* :3124900.291 m	*Easting* :717079.294 m
Reduced Level (m):(+)196.752	*BH. No.* :BH-A1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:16.25	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :20-10-2021	*Date of Completion* :22-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5											
1.0	1	SPT-1	2	2	3	5					
1.5											
2.0							Brown, Loose, Sandy silt of low plasticity	ML-CL			
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	8	10	11	21					
4.5											
5.0											
5.5	5.5	UDS-2									
6.0											
6.5							Brown, Very stiff to hard, Silty clay of low plasticity	CL			
7.0	7	SPT-3	8	14	17	31					
7.5											
8.0											
8.5	8.5	UDS-3									
9.0											
9.5							Brown, Very dense, Silty sand with gravel	SM			
10.0	10	SPT-4	12	25	28	53					

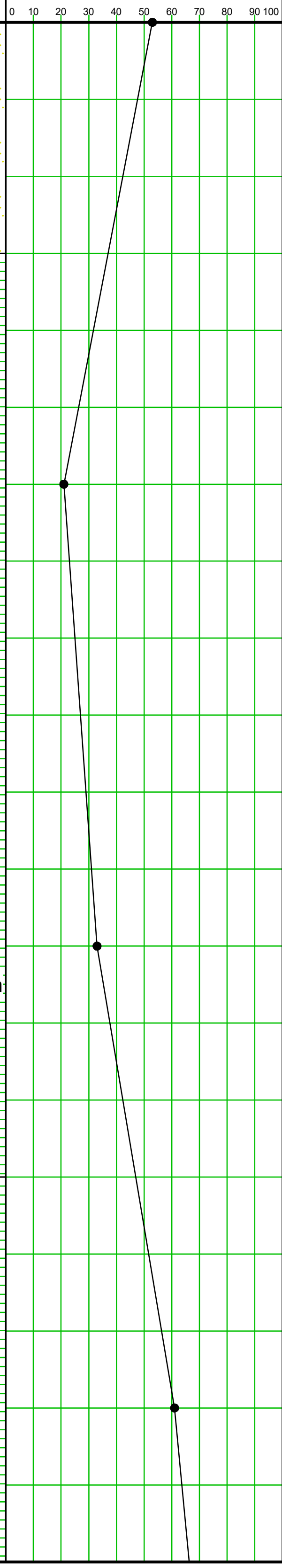


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+497 km	*Northing* :3124900.291 m	*Easting* :717079.294 m
Reduced Level (m):(+)196.752	*BH. No.* :BH-A1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:16.25	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :20-10-2021	*Date of Completion* :22-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5							Brown, Very dense, Silty sand with gravel	SM			
11.0											
11.5	11.5	UDS-4									
12.0											
12.5											
13.0	13	SPT-5	8	9	12	21					
13.5											
14.0											
14.5	14.5	UDS-5					Brown, Very stiff to hard, Silty clay of low plasticity	CL			
15.0											
15.5											
16.0	16	SPT-6	12	14	19	33			16.25m		
16.5											
17.0											
17.5	17.5	UDS-6									
18.0											
18.5											
19.0	19	SPT-7	21	27	34	61	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
19.5											
20.0											

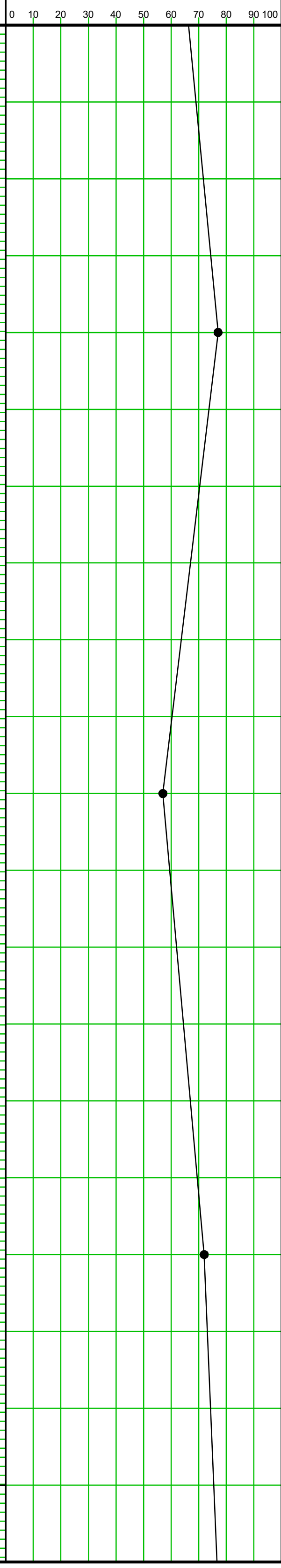


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 3+497 km	*Northing :* 3124900.291 m	*Easting :* 717079.294 m
Reduced Level (m): (+)196.752	*BH. No. :* BH-A1	*BH Termination Depth (m):* 40
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 16.25	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 20-10-2021	*Date of Completion :* 22-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	UDS-7									
21.0											
21.5											
22.0	22	SPT-8	19	34	43	77					
22.5											
23.0											
23.5	23.5	UDS-8									
24.0											
24.5							Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
25.0	25	SPT-9	13	24	33	57					
25.5											
26.0											
26.5	26.5	UDS-9									
27.0											
27.5											
28.0	28	SPT-10	18	29	43	72					
28.5											
29.0											
29.5	29.5	UDS-10									
30.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			

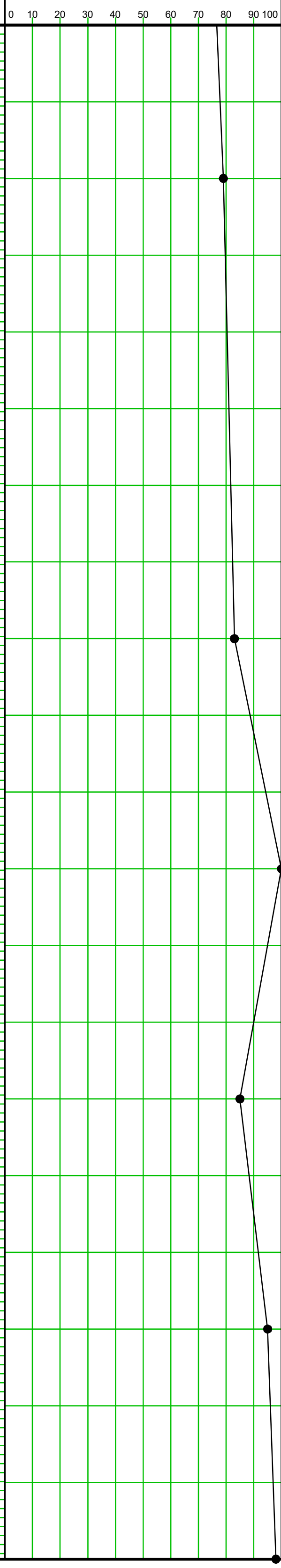


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*3+497 km	*Northing :*3124900.291 m	*Easting :*717079.294 m
Reduced Level (m):(+)196.752	*BH. No. :*BH-A1	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*16.25	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*20-10-2021	*Date of Completion :*22-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0											
30.5											
31.0	31	SPT-11	19	34	45	79					
31.5											
32.0											
32.5	32.5	UDS-11									
33.0											
33.5											
34.0	34	SPT-12	17	36	47	83					
34.5											
35.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
35.5	35.5	SPT-13	65	35 (6cm)	-	>100					
36.0											
36.5											
37.0	37	SPT-14	24	38	47	85					
37.5											
38.0											
38.5	38.5	SPT-15	27	40	55	95					
39.0											
39.5											
40.0	40	SPT-16	23	45	53	98					

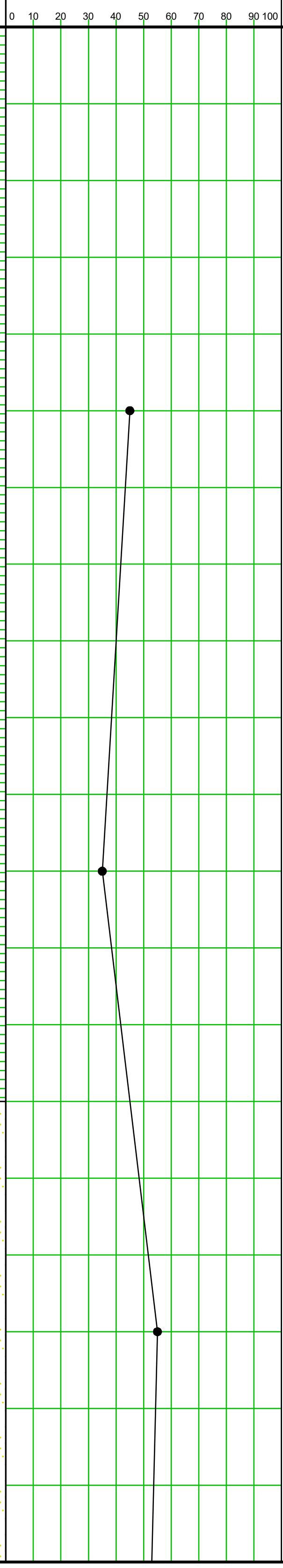


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+497 km	*Northing* :3124897.227 m	*Easting* :717042.421 m
Reduced Level (m):(+)195.783	*BH. No.* :BH-P1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:15.32	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :20-10-2021	*Date of Completion* :22-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Dense, Sandy silt of low plasticity with gravel	ML-CL			
0.5											
1.0	1	UDS-1									
1.5											
2.0											
2.5	2.5	SPT-1	7	22	23	45					
3.0											
3.5											
4.0	4	UDS-2									
4.5											
5.0											
5.5	5.5	SPT-2	7	15	20	35					
6.0											
6.5											
7.0	7	UDS-3					Brown, Very dense, Silty sand with gravel	SM			
7.5											
8.0											
8.5	8.5	SPT-3	20	25	30	55					
9.0											
9.5											
10.0	10	UDS-4									

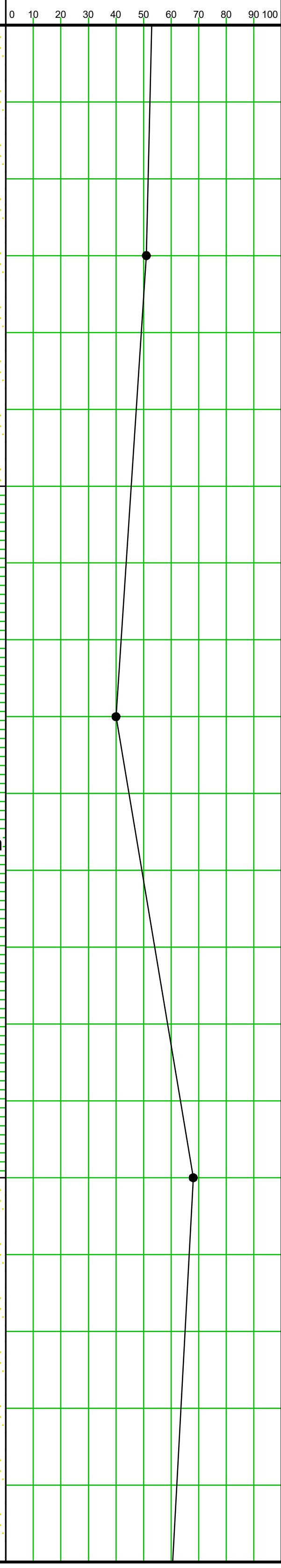


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+497 km	*Northing* :3124897.227 m	*Easting* :717042.421 m
Reduced Level (m):(+)195.783	*BH. No.* :BH-P1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:15.32	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :20-10-2021	*Date of Completion* :22-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-4	12	21	30	51	Brown, Very dense, Silty sand with gravel	SM			
12.0											
12.5											
13.0	13	UDS-5									
13.5											
14.0											
14.5	14.5	SPT-5	10	16	24	40					
15.0											
15.5							Brown, Dense, Sandy silt of low plasticity with gravel	ML-CL	15.32m		
16.0											
16.5	16.5	UDS*									
17.0											
17.5	17.5	SPT-6	10	28	40	68					
18.0											
18.5											
19.0	19	UDS-6					Brown, Very dense, Silty sand with gravel	SM			
19.5											
20.0											

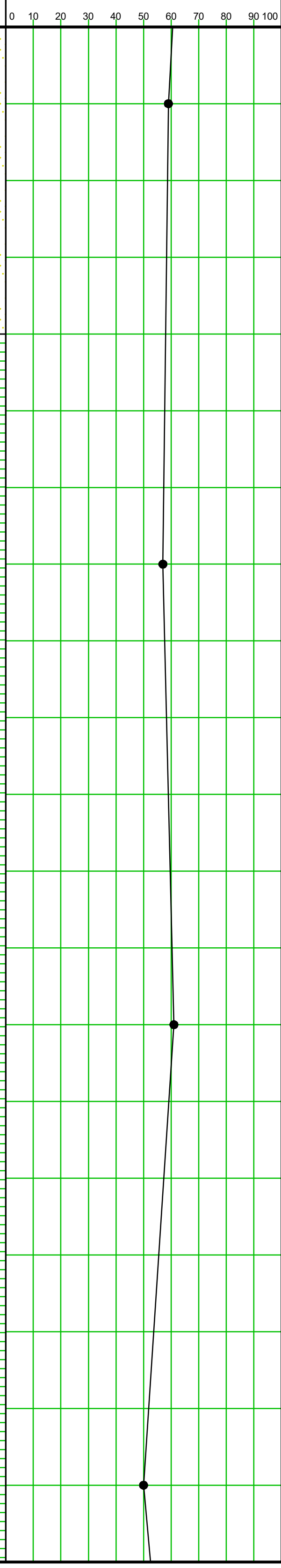


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+497 km	*Northing* :3124897.227 m	*Easting* :717042.421 m
Reduced Level (m):(+)195.783	*BH. No.* :BH-P1	*BH Termination Depth (m):*40
Proposed / Existing Structure :Major Bridge	*Water Table (m):*15.32	*Inclination :* Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :20-10-2021	*Date of Completion* :22-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-7	22	27	32	59	Brown, Very dense, Silty sand with gravel	SM			
21.0											
21.5											
22.0	22	UDS-7									
22.5							Brown, Hard, Silty clay of low plasticity with gravel	CL			
23.0											
23.5	23.5	SPT-8	19	26	31	57					
24.0											
24.5											
25.0	25	UDS-8									
25.5											
26.0											
26.5	26.5	SPT-9	19	27	34	61					
27.0											
27.5											
28.0	28	UDS-9									
28.5											
29.0											
29.5	29.5	SPT-10	17	24	26	50					
30.0											

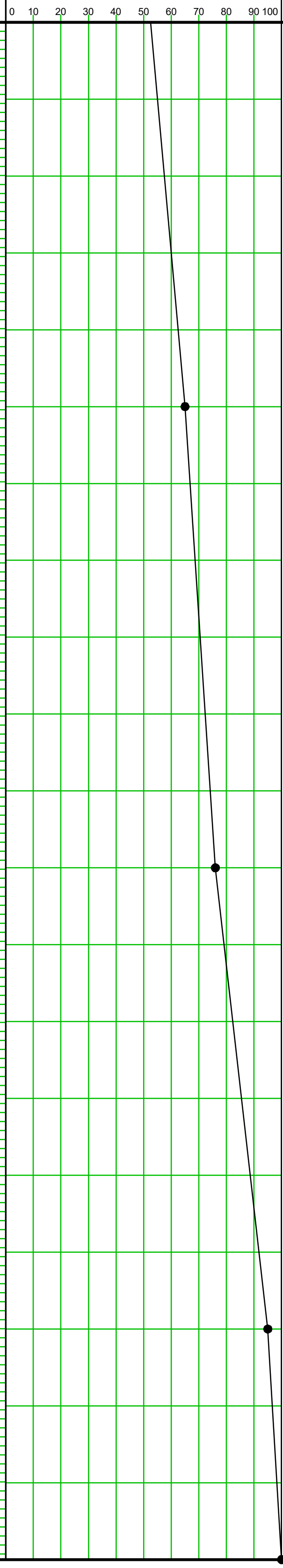


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 3+497 km	*Northing :* 3124897.227 m	*Easting :* 717042.421 m
Reduced Level (m): (+)195.783	*BH. No. :* BH-P1	*BH Termination Depth (m):* 40
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 15.32	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 20-10-2021	*Date of Completion :* 22-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0											
30.5											
31.0	31	UDS-10									
31.5											
32.0											
32.5	32.5	SPT-11	25	30	35	65					
33.0											
33.5											
34.0	34	UDS-11									
34.5											
35.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
35.5	35.5	SPT-12	18	33	43	76					
36.0											
36.5											
37.0	37	UDS*									
37.5											
38.0											
38.5	38.5	SPT-13	25	40	55	95					
39.0											
39.5											
40.0	40	SPT-14	35	49	51	100					

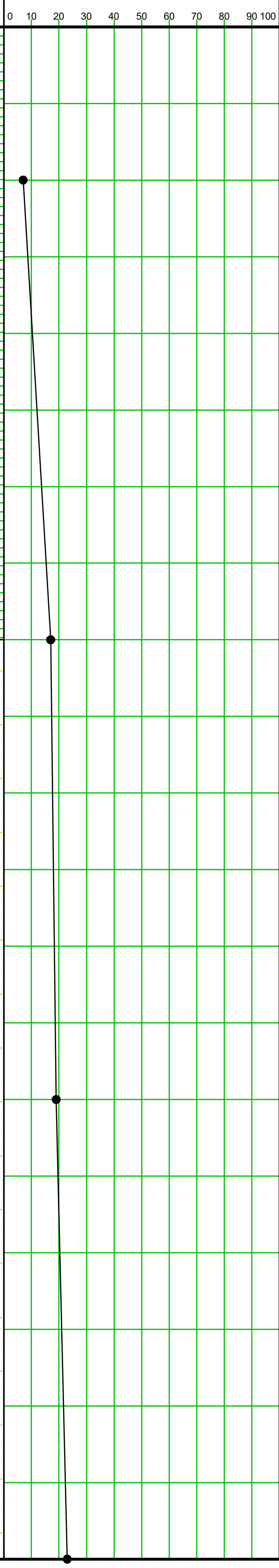


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*3+497 km	*Northing :*3124894.329 m	*Easting :*717007.541 m
Reduced Level (m):(+)195.847	*BH. No. :*BH-P2	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*15.30	*Inclination :* Vertical
*Boring type :*Shell & Auger	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*20-10-2021	*Date of Completion :*22-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Loose, Sandy silt of low plasticity (0.0–4.0)	ML-CL			
0.5											
1.0	1	SPT-1	2	3	4	7					
1.5											
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	6	8	9	17	Brown, Medium dense, Silty sand (4.0–10.0)	SM			
4.5											
5.0											
5.5	5.5	UDS-2									
6.0											
6.5											
7.0	7	SPT-3	7	9	10	19					
7.5											
8.0											
8.5	8.5	UDS-3									
9.0											
9.5											
10.0	10	SPT-4	7	10	13	23					

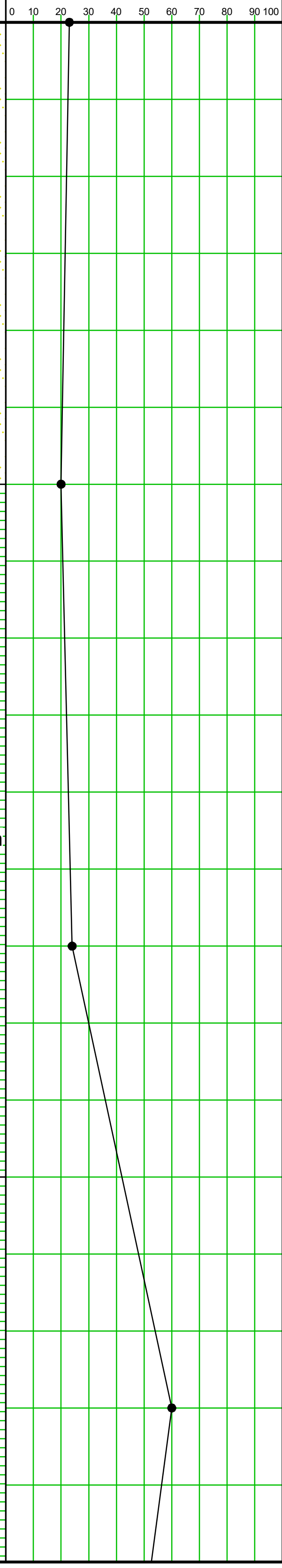


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+497 km	*Northing* :3124894.329 m	*Easting* :717007.541 m
Reduced Level (m):(+)195.847	*BH. No.* :BH-P2	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:15.30	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :20-10-2021	*Date of Completion* :22-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	UDS-4					Brown, Medium dense, Silty sand	SM			
12.0											
12.5											
13.0	13	SPT-5	5	9	11	20					
13.5											
14.0											
14.5	14.5	UDS-5									
15.0											
15.5							Brown, Very stiff, Silty clay of low plasticity	CL	15.30m		
16.0	16	SPT-6	6	11	13	24					
16.5											
17.0											
17.5	17.5	UDS-6									
18.0											
18.5											
19.0	19	SPT-7	22	25	35	60	Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL			
19.5											
20.0											

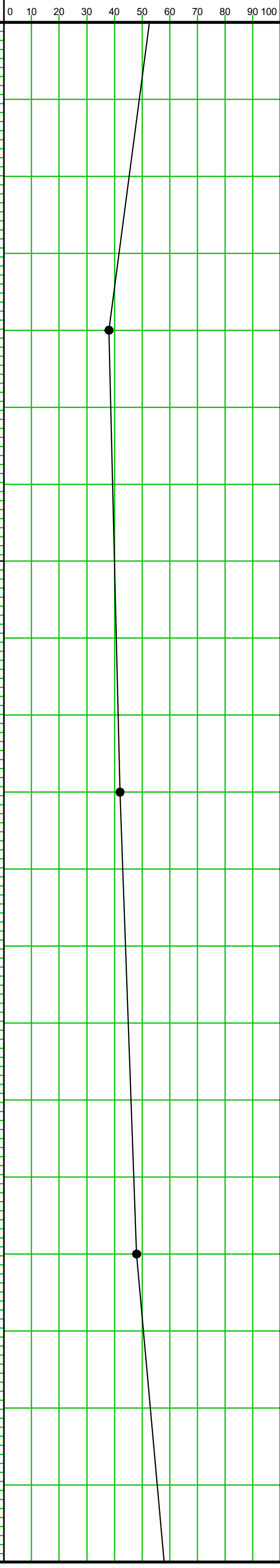


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*3+497 km	*Northing :*3124894.329 m	*Easting :*717007.541 m
Reduced Level (m):(+)195.847	*BH. No. :*BH-P2	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*15.30	*Inclination :* Vertical
*Boring type :*Shell & Auger	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*20-10-2021	*Date of Completion :*22-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	UDS-7					Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL			
21.0											
21.5											
22.0	22	SPT-8	10	17	21	38					
22.5											
23.0											
23.5	23.5	UDS-8									
24.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
24.5											
25.0	25	SPT-9	9	17	25	42					
25.5											
26.0											
26.5	26.5	UDS-9									
27.0											
27.5											
28.0	28	SPT-10	10	20	28	48					
28.5											
29.0											
29.5	29.5	UDS-10									
30.0											

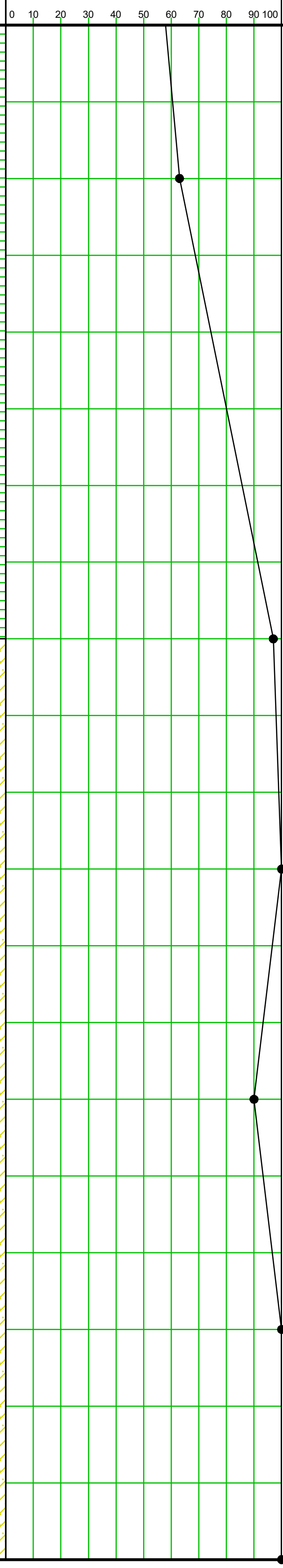


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+497 km	*Northing* :3124894.329 m	*Easting* :717007.541 m
Reduced Level (m):(+)195.847	*BH. No.* :BH-P2	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:15.30	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :20-10-2021	*Date of Completion* :22-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
30.5											
31.0	31	SPT-11	15	29	34	63					
31.5											
32.0											
32.5	32.5	UDS-11									
33.0											
33.5											
34.0	34	SPT-12	24	42	55	97					
34.5							Brown, Very dense, Silty sand with clay & gravel	SM-SC			
35.0											
35.5	35.5	SPT-13	40	100 (13cm)	-	>100					
36.0											
36.5											
37.0	37	SPT-14	20	38	52	90					
37.5											
38.0											
38.5	38.5	SPT-15	40	60	40 (7cm)	>100					
39.0											
39.5											
40.0	40	SPT-16	38	68	32 (5cm)	>100					

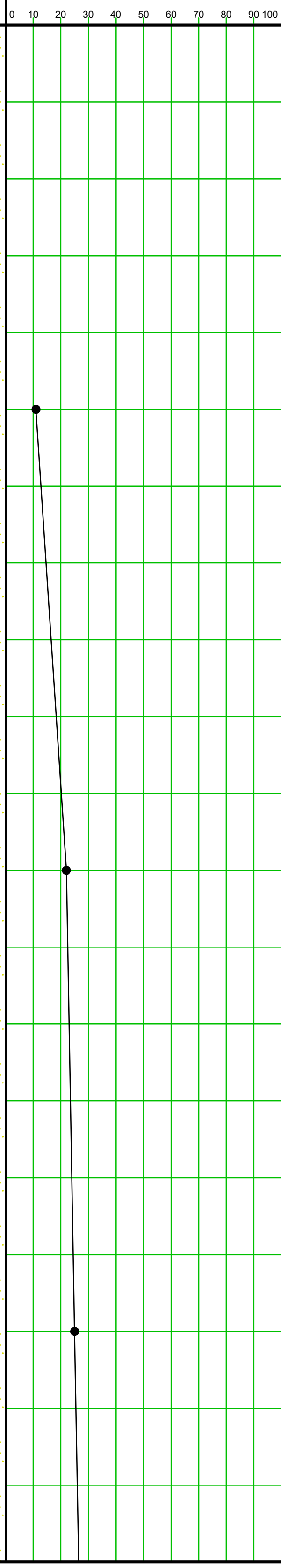


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 3+497 km	*Northing :* 3124891.431 m	*Easting :* 716972.661 m
Reduced Level (m): (+)195.759	*BH. No. :* BH-P3	*BH Termination Depth (m):* 40
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 15.31	*Inclination :* Vertical
Boring type : Shell & Auger	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 20-10-2021	*Date of Completion :* 22-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5											
1.0	1	UDS-1									
1.5											
2.0											
2.5	2.5	SPT-1	4	5	6	11					
3.0											
3.5											
4.0	4	UDS-2									
4.5											
5.0							Brown, Medium dense, Silty sand	SM			
5.5	5.5	SPT-2	7	10	12	22					
6.0											
6.5											
7.0	7	UDS-3									
7.5											
8.0											
8.5	8.5	SPT-3	8	11	14	25					
9.0											
9.5											
10.0	10	UDS-4									



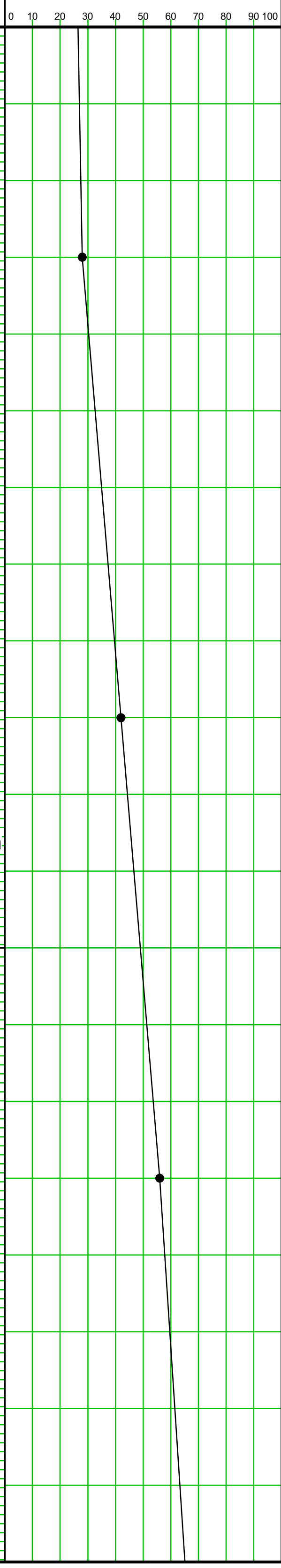
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+497 km	*Northing* :3124891.431 m	*Easting* :716972.661 m
Reduced Level (m):(+)195.759	*BH. No.* :BH-P3	*BH Termination Depth (m):*40
Proposed / Existing Structure :Major Bridge	*Water Table (m):*15.31	*Inclination :* Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :20-10-2021	*Date of Completion* :22-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
10.0										
10.5										
11.0										
11.5	11.5	SPT-4	9	12	16	28				
12.0										
12.5										
13.0	13	UDS-5					Brown, Very stiff to hard, Silty clay of low plasticity	CL		
13.5										
14.0										
14.5	14.5	SPT-5	10	17	25	42				
15.0										
15.5									15.31m	
16.0	16	UDS-6								
16.5										
17.0										
17.5	17.5	SPT-6	12	25	31	56				
18.0							Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		
18.5										
19.0	19	UDS-7								
19.5										
20.0										

(Depth v/s SPT N Value)

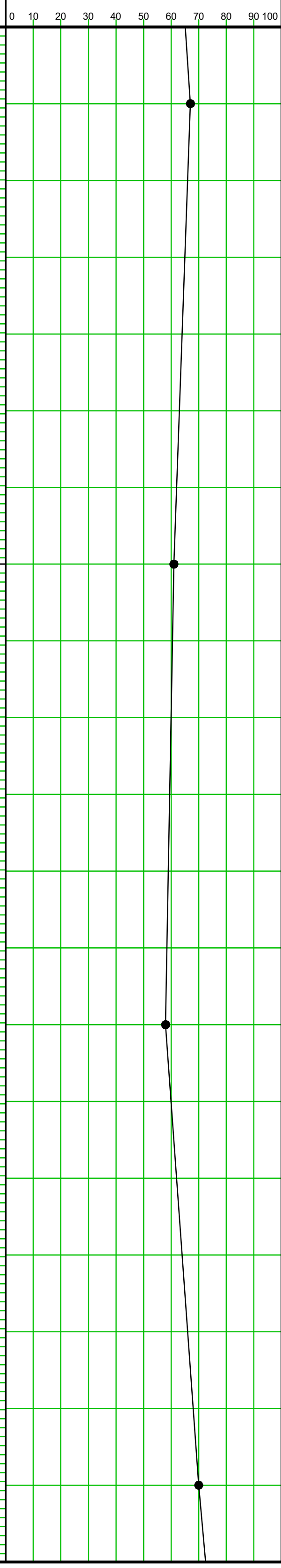


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+497 km	*Northing* :3124891.431 m	*Easting* :716972.661 m
Reduced Level (m):(+)195.759	*BH. No.* :BH-P3	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:15.31	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :20-10-2021	*Date of Completion* :22-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0							Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
20.5	20.5	SPT-7	14	28	39	67					
21.0											
21.5											
22.0	22	UDS-8									
22.5											
23.0											
23.5	23.5	SPT-8	11	26	35	61					
24.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
24.5											
25.0	25	UDS-9									
25.5											
26.0											
26.5	26.5	SPT-9	16	25	33	58					
27.0											
27.5											
28.0	28	UDS-10									
28.5											
29.0											
29.5	29.5	SPT-10	19	31	39	70					
30.0											

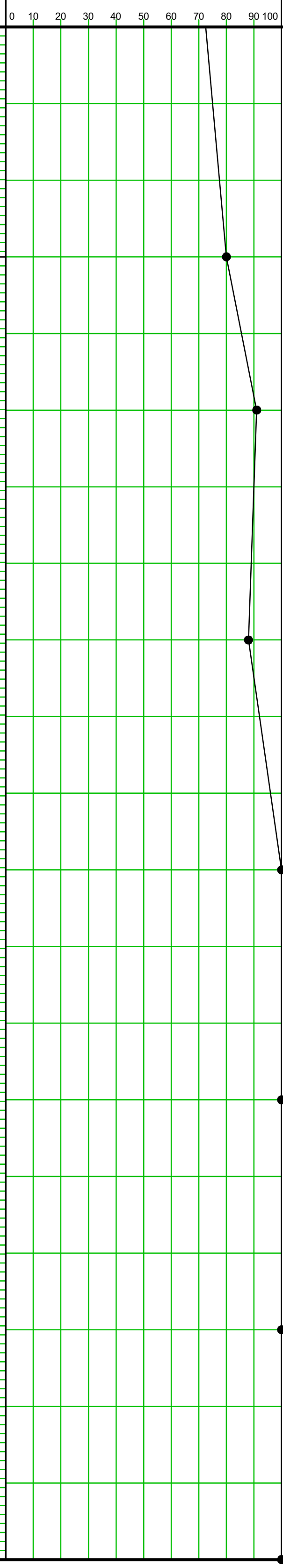


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+497 km	*Northing* :3124891.431 m	*Easting* :716972.661 m
Reduced Level (m):(+)195.759	*BH. No.* :BH-P3	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:15.31	*Inclination :* Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :20-10-2021	*Date of Completion* :22-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0											
30.5											
31.0	31	UDS*					Brown, Hard, Silty clay of low plasticity with gravel	CL			
31.5	31.5	SPT-11	22	36	44	80					
32.0											
32.5	32.5	SPT-12	25	42	49	91					
33.0											
33.5											
34.0	34	SPT-13	22	38	50	88					
34.5											
35.0											
35.5	35.5	SPT-14	35	100 (14cm)	-	>100	Brown, Very Dense, Sandy silt of low plasticity with gravel	ML-CL			
36.0											
36.5											
37.0	37	SPT-15	33	88	12 (5cm)	>100					
37.5											
38.0											
38.5	38.5	SPT-16	40	100 (15cm)	-	>100					
39.0											
39.5											
40.0	40	SPT-17	42	60	40 (5cm)	>100					



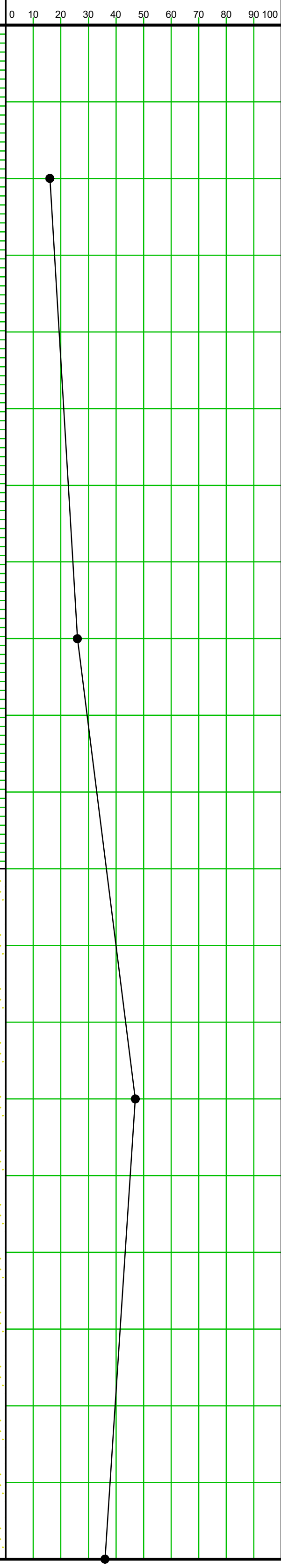
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+497 km	*Northing* :3124888.367 m	*Easting* :716935.788 m
Reduced Level (m):(+)195.643	*BH. No.* :BH-A2	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:15.30	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :21-10-2021	*Date of Completion* :23-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS					Brown, Medium dense, Sandy silt of low plasticity	ML-CL		
0.5										
1.0	1	SPT-1	6	8	8	16				
1.5										
2.0										
2.5	2.5	UDS-1								
3.0										
3.5										
4.0	4	SPT-2	9	12	14	26				
4.5										
5.0										
5.5	5.5	UDS-2					Brown, Dense to Very dense, Silty sand with gravel	SM		
6.0										
6.5										
7.0	7	SPT-3	17	21	26	47				
7.5										
8.0										
8.5	8.5	UDS-3								
9.0										
9.5										
10.0	10	SPT-4	10	16	20	36				

(Depth v/s SPT N Value)



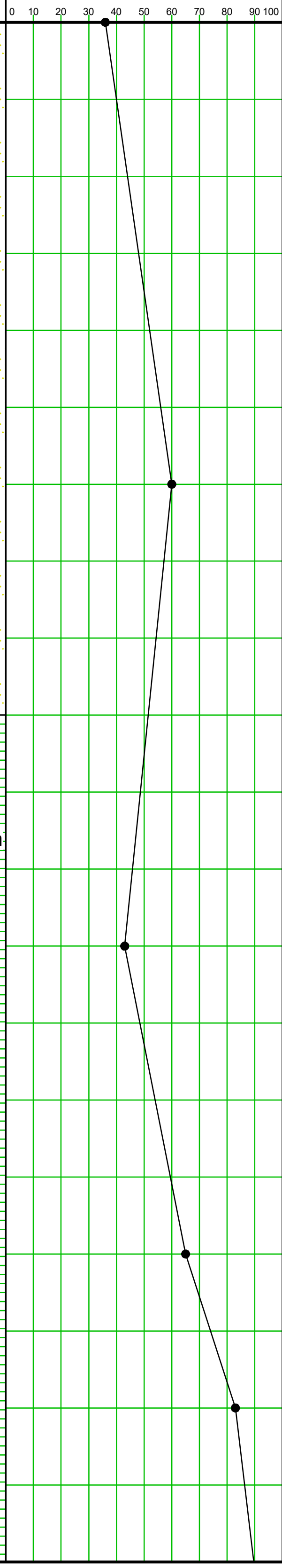
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+497 km	*Northing* :3124888.367 m	*Easting* :716935.788 m
Reduced Level (m):(+)195.643	*BH. No.* :BH-A2	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:15.30	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :21-10-2021	*Date of Completion* :23-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
10.0										
10.5										
11.0										
11.5	11.5	UDS-4								
12.0										
12.5							Brown, Dense to Very dense, Silty sand with gravel	SM		
13.0	13	SPT-5	18	24	36	60				
13.5										
14.0										
14.5	14.5	UDS-5								
15.0										
15.5									15.30m	
16.0	16	SPT-6	12	19	24	43				
16.5										
17.0										
17.5	17.5	UDS-6					Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL		
18.0	18	SPT-7	18	25	40	65				
18.5										
19.0	19	SPT-8	12	33	50	83				
19.5										
20.0										

(Depth v/s SPT N Value)

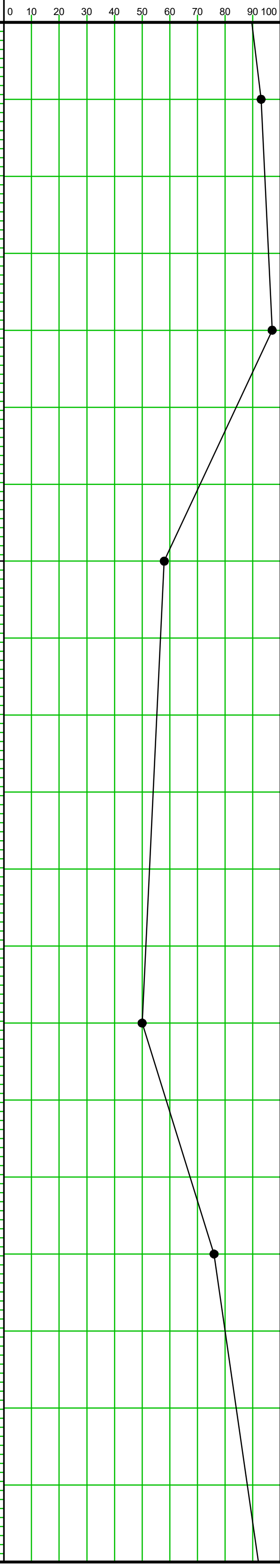


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+497 km	*Northing* :3124888.367 m	*Easting* :716935.788 m
Reduced Level (m):(+)195.643	*BH. No.* :BH-A2	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:15.30	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :21-10-2021	*Date of Completion* :23-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-9	20	38	55	93	Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL			
21.0											
21.5											
22.0	22	SPT-10	25	40	57	97					
22.5											
23.0											
23.5	23.5	SPT-11	22	25	33	58					
24.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
24.5											
25.0	25	UDS-7									
25.5											
26.0											
26.5	26.5	SPT-12	21	23	27	50					
27.0											
27.5											
28.0	28	SPT-13	24	31	45	76					
28.5											
29.0											
29.5	29.5	UDS-8									
30.0											



UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*3+497 km	*Northing :*3124888.367 m	*Easting :*716935.788 m
Reduced Level (m):(+)195.643	*BH. No. :*BH-A2	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*15.30	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*21-10-2021	*Date of Completion :*23-10-2021	

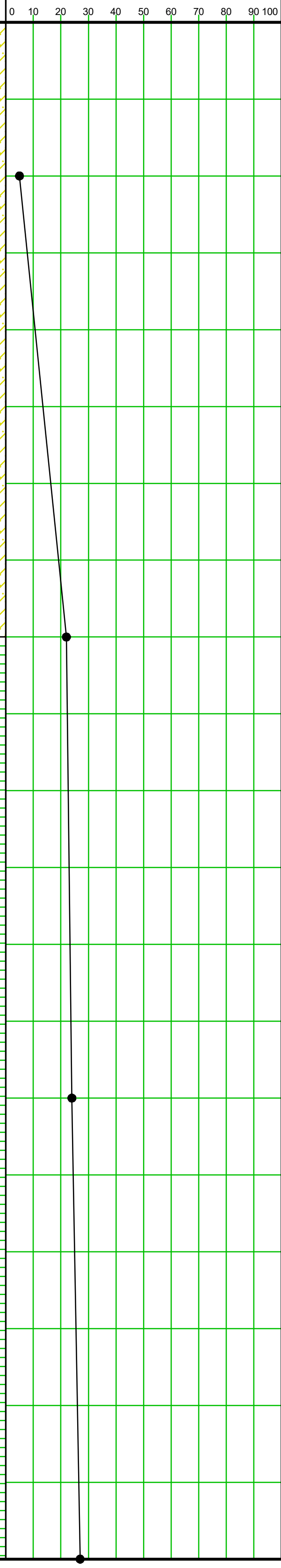
Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0											
30.5											
31.0	31	SPT-14	42	100 (9cm)	-	>100					
31.5											
32.0											
32.5	32.5	SPT-15	41	72	28 (10cm)	>100					
33.0											
33.5											
34.0	34	SPT-16	38	80	20 (5cm)	>100					
34.5											
35.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
35.5	35.5	SPT-17	46	75	25 (5cm)	>100					
36.0											
36.5											
37.0	37	SPT-18	36	82	18 (2cm)	>100					
37.5											
38.0											
38.5	38.5	SPT-19	48	100 (8cm)	-	>100					
39.0											
39.5											
40.0	40	SPT-20	27	67	33 (9cm)	>100					

UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+691 km	*Northing* :3124880.556 m	*Easting* :716820.675 m
Reduced Level (m):(+)196.163	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:15.40	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :23-10-2021	*Date of Completion* :25-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS-1					Brown, Loose, Silty sand with clay (0.0–4.0)	SM-SC			
0.5											
1.0	1	SPT-1	2	2	3	5					
1.5											
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	7	10	12	22	Brown, Medium dense, Sandy silt of low plasticity (4.0–10.0)	ML-CL			
4.5											
5.0											
5.5	5.5	UDS-2									
6.0											
6.5											
7.0	7	SPT-3	8	11	13	24					
7.5											
8.0											
8.5	8.5	UDS-3									
9.0											
9.5											
10.0	10	SPT-4	9	12	15	27					

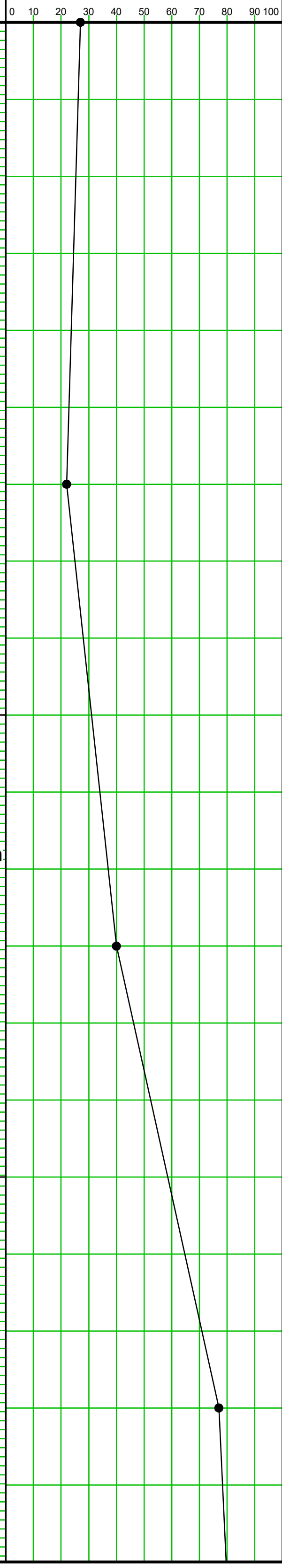


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 3+691 km	*Northing :* 3124880.556 m	*Easting :* 716820.675 m
Reduced Level (m): (+)196.163	*BH. No. :* BH-A1	*BH Termination Depth (m):* 30
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 15.40	*Inclination :* Vertical
Boring type : Shell & Auger	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 23-10-2021	*Date of Completion :* 25-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0							Brown, Medium dense, Sandy silt of low plasticity	ML-CL			
10.5											
11.0											
11.5	11.5	UDS-4									
12.0											
12.5											
13.0	13	SPT-5	7	10	12	22					
13.5											
14.0											
14.5	14.5	UDS-5					Brown, Hard, Silty clay of low plasticity with gravel	CL			
15.0											
15.5									15.40m		
16.0	16	SPT-6	10	18	22	40					
16.5											
17.0											
17.5	17.5	UDS-6					Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
18.0											
18.5											
19.0	19	SPT-7	17	31	46	77					
19.5											
20.0											



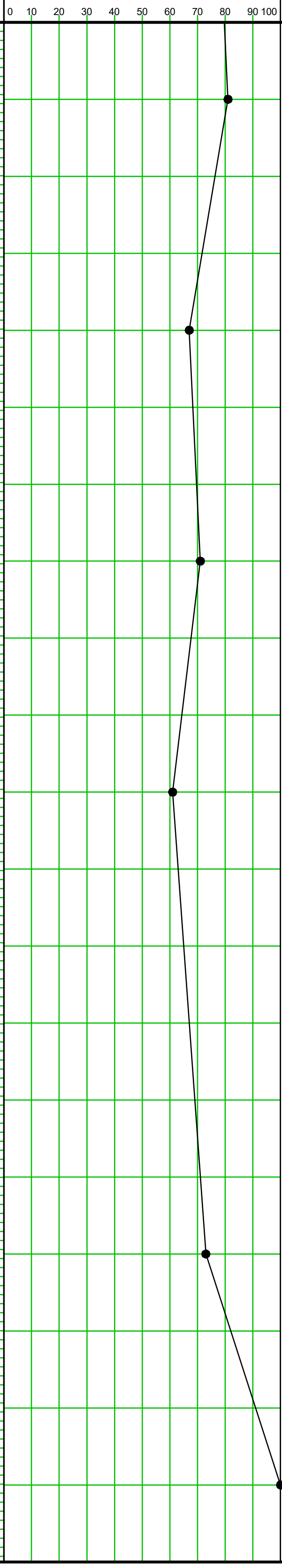
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+691 km	*Northing* :3124880.556 m	*Easting* :716820.675 m
Reduced Level (m):(+)196.163	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:15.40	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :23-10-2021	*Date of Completion* :25-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
20.0										
20.5	20.5	SPT-8	18	33	48	81				
21.0										
21.5										
22.0	22	SPT-9	13	28	39	67				
22.5										
23.0										
23.5	23.5	SPT-10	15	31	40	71				
24.0										
24.5										
25.0	25	SPT-11	12	24	37	61	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		
25.5										
26.0										
26.5	26.5	UDS-7								
27.0										
27.5										
28.0	28	SPT-12	17	32	41	73				
28.5										
29.0										
29.5	29.5	SPT-13	21	43	57	100				
30.0	29.95	DS-2								

(Depth v/s SPT N Value)

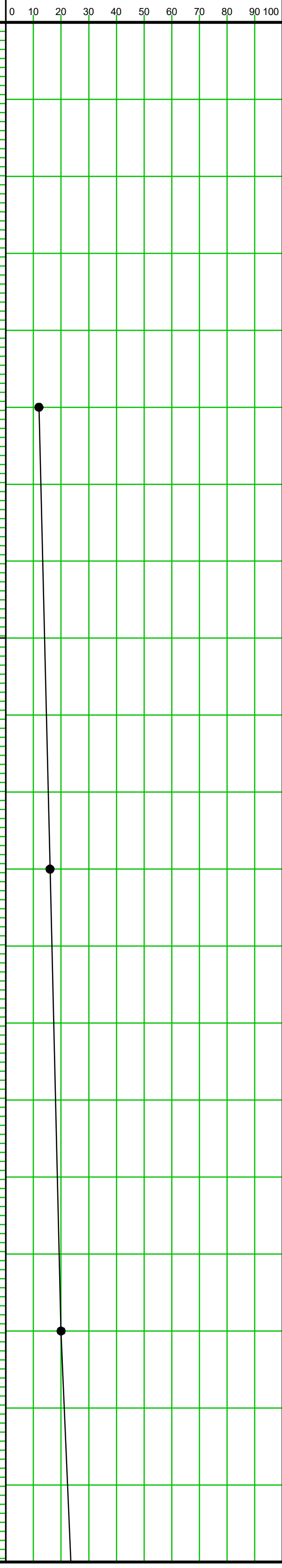


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+691 km	*Northing* :3124877.143 m	*Easting* :716800.7 m
Reduced Level (m):(+)196.124	*BH. No.* :BH-A2	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:15.25	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :23-10-2021	*Date of Completion* :25-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS-1					Brown, Very stiff, Silty clay of low plasticity (0.0–4.0)	CL			
0.5											
1.0	1	UDS-1									
1.5											
2.0											
2.5	2.5	SPT-1	3	5	7	12					
3.0											
3.5											
4.0	4	UDS-2					Brown, Medium dense, Sandy silt of low plasticity (4.0–10.0)	ML-CL			
4.5											
5.0											
5.5	5.5	SPT-2	4	7	9	16					
6.0											
6.5											
7.0	7	UDS-3									
7.5											
8.0											
8.5	8.5	SPT-3	7	9	11	20					
9.0											
9.5											
10.0	10	UDS-4									

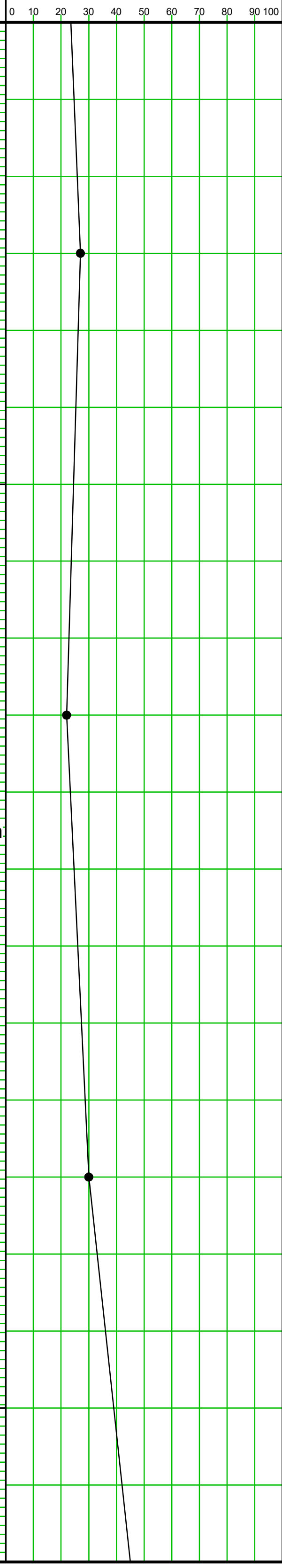


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :3+691 km	*Northing* :3124877.143 m	*Easting* :716800.7 m
Reduced Level (m):(+)196.124	*BH. No.* :BH-A2	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:15.25	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :23-10-2021	*Date of Completion* :25-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-4	9	12	15	27	Brown, Medium dense, Sandy silt of low plasticity	ML-CL			
12.0											
12.5											
13.0	13	UDS-5									
13.5											
14.0											
14.5	14.5	SPT-5	6	9	13	22					
15.0											
15.5									15.25m		
16.0	16	UDS-6					Brown, Very stiff, Silty clay of low plasticity with gravel	CL			
16.5											
17.0											
17.5	17.5	SPT-6	9	13	17	30					
18.0											
18.5											
19.0	19	UDS-7									
19.5							Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL			
20.0											

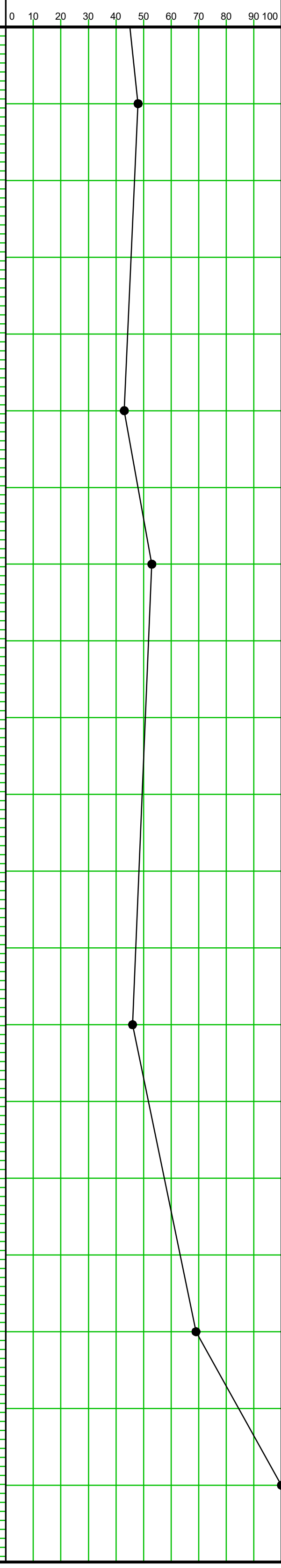


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 3+691 km	*Northing :* 3124877.143 m	*Easting :* 716800.7 m
Reduced Level (m): (+)196.124	*BH. No. :* BH-A2	*BH Termination Depth (m):* 30
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 15.25	*Inclination :* Vertical
Boring type : Shell & Auger	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 23-10-2021	*Date of Completion :* 25-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-7	15	21	27	48					
21.0											
21.5											
22.0	22	UDS*									
22.5	22.5	SPT-8	14	19	24	43					
23.0											
23.5	23.5	SPT-9	16	22	31	53					
24.0											
24.5											
25.0	25	UDS-8					Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL			
25.5											
26.0											
26.5	26.5	SPT-10	19	21	25	46					
27.0											
27.5											
28.0	28	UDS*									
28.5	28.5	SPT-11	18	31	38	69					
29.0											
29.5	29.5	SPT-12	20	42	58 (7cm)	>100					
30.0	29.95	DS-2									

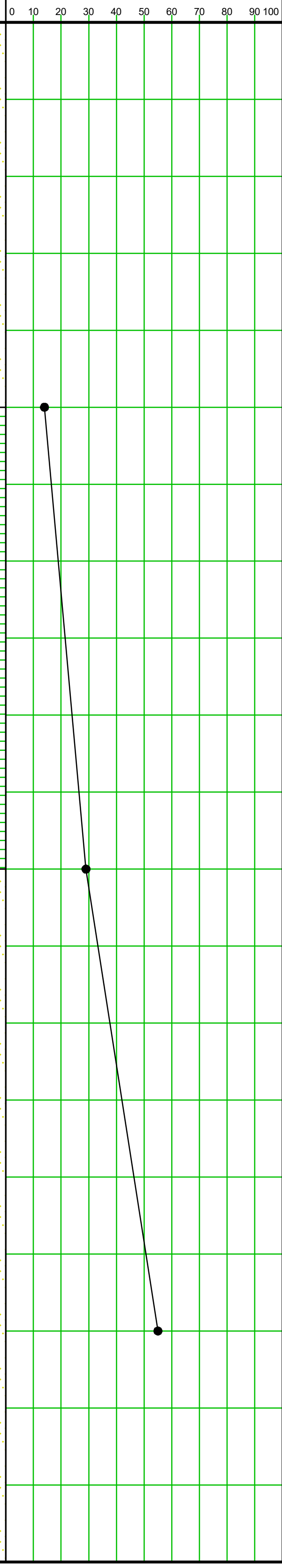


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :4+174 km	*Northing* :3124838.454 m	*Easting* :716335.062 m
Reduced Level (m):(+)196.256	*BH. No.* :BH-CL	*BH Termination Depth (m):*10
Proposed / Existing Structure :Minor Bridge	*Water Table (m):*Not Encountered	*Inclination :* Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :16-10-2021	*Date of Completion* :16-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Silty sand	SM			
0.5											
1.0	1	UDS-1									
1.5											
2.0											
2.5	2.5	SPT-1	5	6	8	14					
3.0							Brown, Very stiff, Silty clay of low plasticity	CL			
3.5											
4.0	4	UDS-2									
4.5											
5.0											
5.5	5.5	SPT-2	8	12	17	29					
6.0							Brown, Medium dense to very dense, Silty sand with gravel	SM			
6.5											
7.0	7	UDS-3									
7.5											
8.0											
8.5	8.5	SPT-3	17	24	31	55					
9.0											
9.5											
10.0	10	UDS-4									

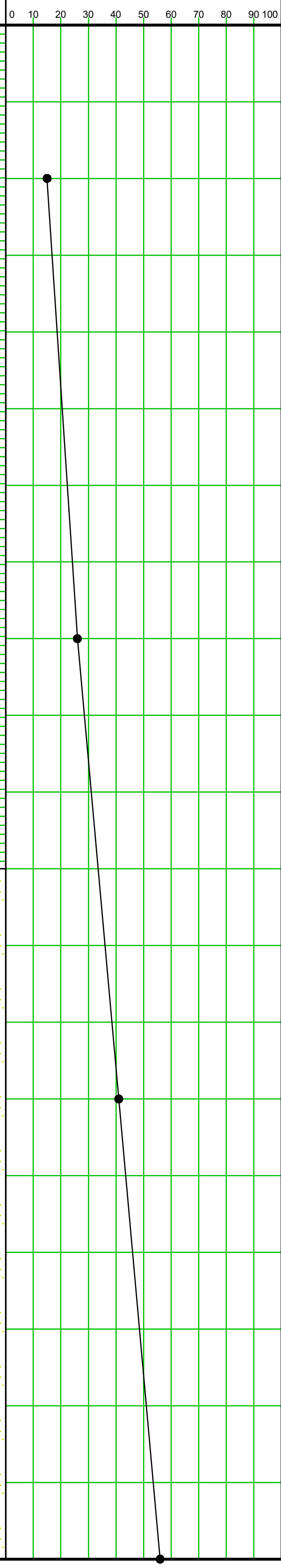


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :4+207 km	*Northing* :3124835.546 m	*Easting* :716300.074 m
Reduced Level (m):(+)196.348	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:Not Encountered	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :16-10-2021	*Date of Completion* :16-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Medium dense, Sandy silt of low plasticity (0.0–5.5 m)	ML-CL			
0.5											
1.0	1	SPT-1	4	6	9	15					
1.5											
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	9	12	14	26					
4.5											
5.0											
5.5	5.5	UDS-2					Brown, Dense to very dense, Silty sand with gravel (5.5–10.0 m)	SM			
6.0											
6.5											
7.0	7	SPT-3	11	17	24	41					
7.5											
8.0											
8.5	8.5	UDS-3									
9.0											
9.5											
10.0	10	SPT-4	17	24	32	56					

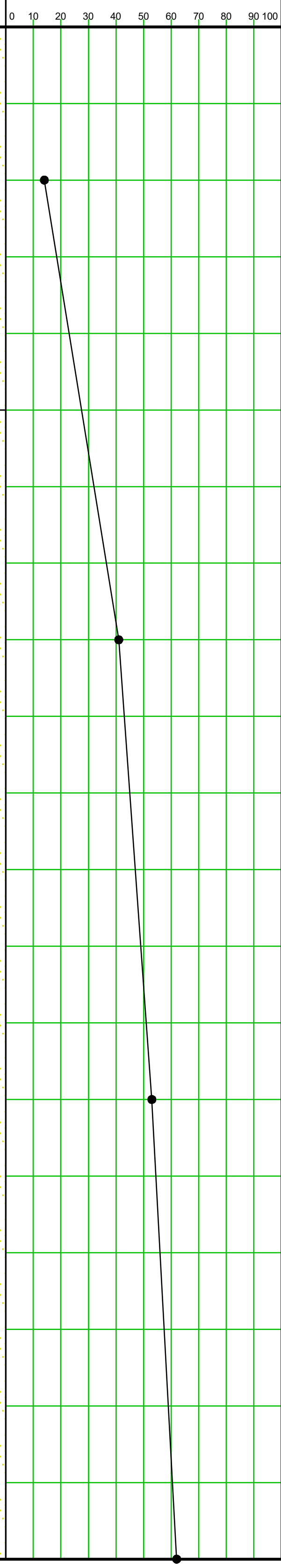


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*4+655 km	*Northing :*3124798.666 m	*Easting :*715855.211 m
Reduced Level (m):(+)200.573	*BH. No. :*BH-CL	*BH Termination Depth (m):*10
*Proposed / Existing Structure :*Minor Bridge	*Water Table (m):*Not Encountered	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*16-10-2021	*Date of Completion :*16-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5											
1.0	1	SPT-1	4	6	8	14	Brown, Medium dense, Silty sand	SM			
1.5											
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	11	17	24	41					
4.5											
5.0											
5.5	5.5	UDS-2									
6.0											
6.5							Brown, Dense to very dense, Silty sand with gravel	SM			
7.0	7	SPT-3	14	23	30	53					
7.5											
8.0											
8.5	8.5	UDS-3									
9.0											
9.5											
10.0	10	SPT-4	16	26	36	62					

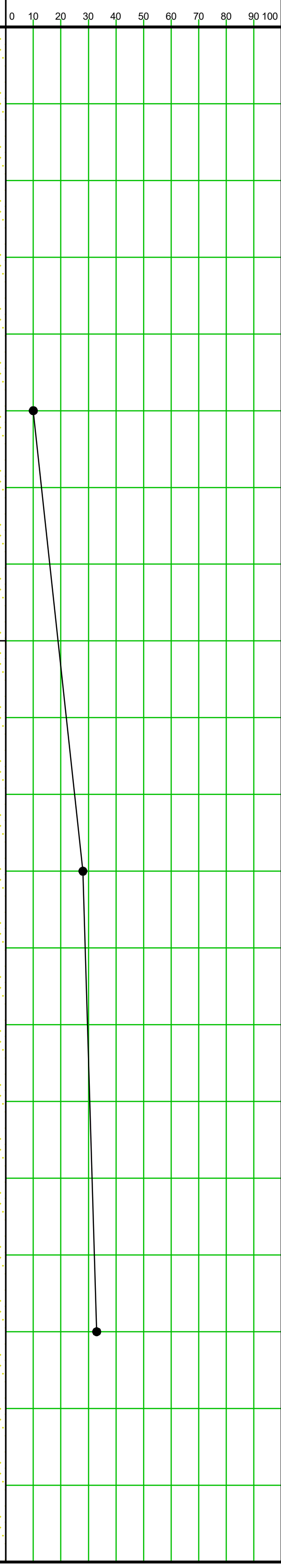


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 5+119 km	*Northing :* 3124750.566 m	*Easting :* 715393.751 m
Reduced Level (m): (+)202.713	*BH. No. :* BH-CL	*BH Termination Depth (m):* 10
Proposed / Existing Structure : Minor Bridge	*Water Table (m):* Not Encountered	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 16-10-2021	*Date of Completion :* 16-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5											
1.0	1	UDS-1									
1.5											
2.0							Brown, Loose, Silty sand	SM			
2.5	2.5	SPT-1	4	4	6	10					
3.0											
3.5											
4.0	4	UDS-2									
4.5											
5.0											
5.5	5.5	SPT-2	7	12	16	28					
6.0											
6.5											
7.0	7	UDS-3					Brown, Medium dense to dense, Silty sand with gravel	SM			
7.5											
8.0											
8.5	8.5	SPT-3	12	14	19	33					
9.0											
9.5											
10.0	10	UDS-4									

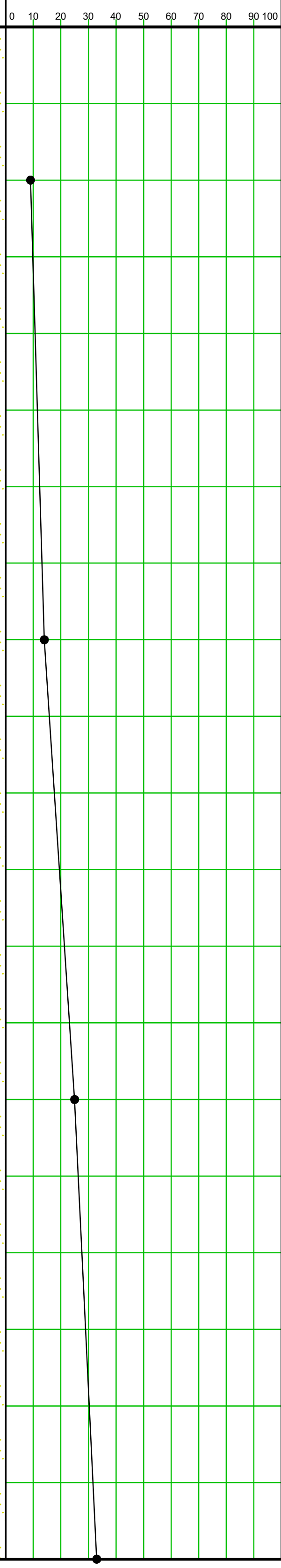


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :5+730 km	*Northing* :3124685.263 m	*Easting* :714786.103 m
Reduced Level (m):(+)198.287	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:Not Encountered	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :17-10-2021	*Date of Completion* :17-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5											
1.0	1	SPT-1	3	3	6	9					
1.5											
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	4	5	9	14					
4.5											
5.0							Brown, Loose to dense, Silty sand	SM			
5.5	5.5	UDS-2									
6.0											
6.5											
7.0	7	SPT-3	7	9	16	25					
7.5											
8.0											
8.5	8.5	UDS-3									
9.0											
9.5											
10.0	10	SPT-4	12	14	19	33					



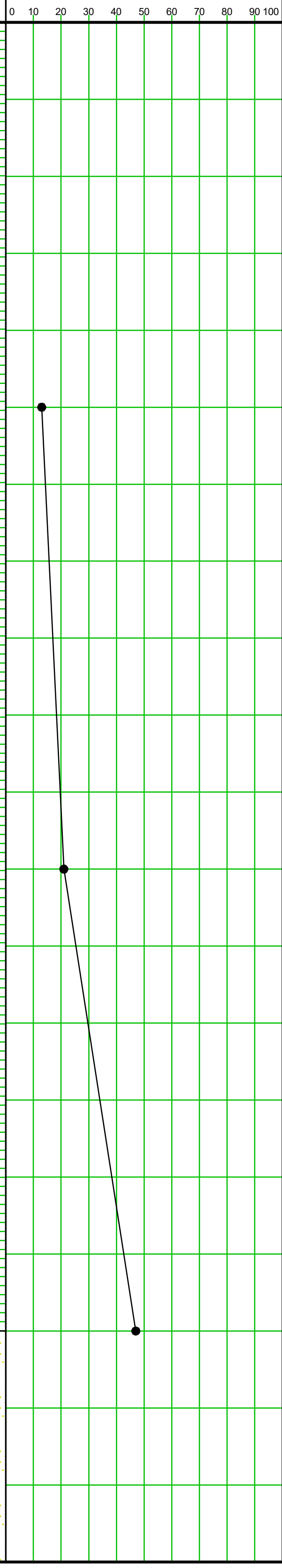
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :6+197 km	*Northing* :3124636.752 m	*Easting* :714320.102 m
Reduced Level (m):(+)198.287	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:2.52	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :17-10-2021	*Date of Completion* :17-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS					Brown, Medium dense, Sandy silt of low plasticity	ML-CL		
0.5										
1.0	1	UDS-1								
1.5										
2.0										
2.5	2.5	SPT-1	4	5	8	13			2.52m	
3.0										
3.5										
4.0	4	UDS-2								
4.5										
5.0										
5.5	5.5	SPT-2	7	9	12	21				
6.0										
6.5										
7.0	7	UDS-3								
7.5										
8.0										
8.5	8.5	SPT-3	15	19	28	47				
9.0							Brown, Dense, Silty sand with gravel	SM		
9.5										
10.0	10	UDS-4								

(Depth v/s SPT N Value)



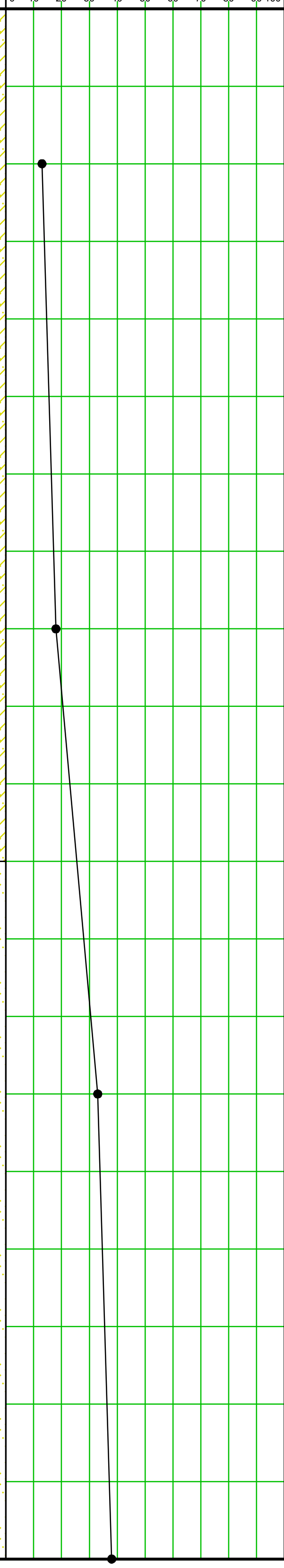
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :6+877 km	*Northing* :3124570.057 m	*Easting* :713641.709 m
Reduced Level (m):(+)196.702	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:1.85	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :17-10-2021	*Date of Completion* :17-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS					Brown, Medium dense, Silty sand with clay	SM-SC		
0.5										
1.0	1	SPT-1	6	6	7	13				
1.5										
2.0									1.85m	
2.5	2.5	UDS-1								
3.0										
3.5										
4.0	4	SPT-2	7	8	10	18				
4.5										
5.0										
5.5	5.5	UDS-2								
6.0							Brown, Dense, Silty sand	SM		
6.5										
7.0	7	SPT-3	8	12	21	33				
7.5										
8.0										
8.5	8.5	UDS-3								
9.0										
9.5										
10.0	10	SPT-4	12	14	24	38				

(Depth v/s SPT N Value)

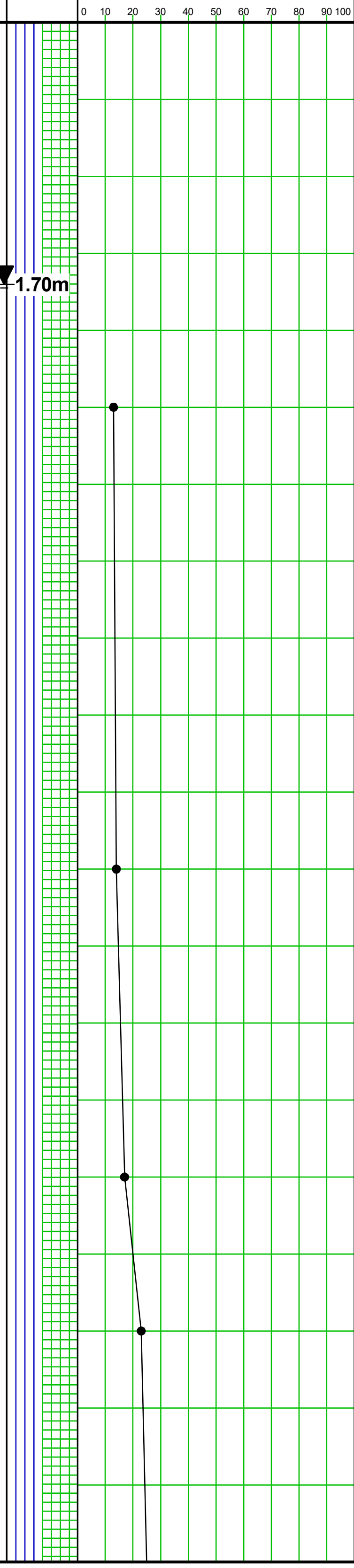


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :7+078 km	*Northing* :3124551.638 m	*Easting* :713455.57 m
Reduced Level (m):(+)195.221	*BH. No.* :BH-A1	*BH Termination Depth (m):*30
Proposed / Existing Structure :Major Bridge	*Water Table (m):*1.70	*Inclination :* Vertical
Boring type :Shell & Augar	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not-used
Date of Start :03-10-2021	*Date of Completion* :05-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5											
1.0	1	UDS-1									
1.5									1.70m		
2.0											
2.5	2.5	SPT-1	4	5	8	13					
3.0											
3.5											
4.0	4	UDS-2									
4.5											
5.0							Brown, Medium dense, Sandy silt of low plasticity	ML-CL			
5.5	5.5	SPT-2	4	5	9	14					
6.0											
6.5											
7.0	7	UDS*									
7.5	7.5	SPT-3	6	8	9	17					
8.0											
8.5	8.5	SPT-4	9	11	12	23					
9.0											
9.5											
10.0	10	UDS-3									

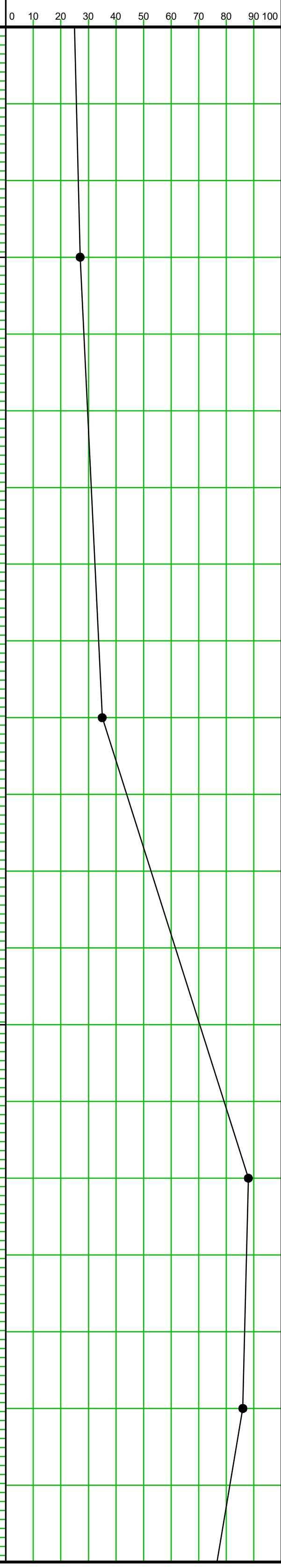


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*7+078 km	*Northing :*3124551.638 m	*Easting :*713455.57 m
Reduced Level (m):(+)195.221	*BH. No. :*BH-A1	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*1.70	*Inclination :* Vertical
*Boring type :*Shell & Augar	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not-used
*Date of Start :*03-10-2021	*Date of Completion :*05-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0							Brown, Medium dense, Sandy silt of low plasticity	ML-CL			
11.5	11.5	SPT-5	7	11	16	27					
12.0											
12.5											
13.0	13	UDS-4									
13.5											
14.0							Brown, Very stiff to hard, Silty clay of low plasticity	CL			
14.5	14.5	SPT-6	9	14	21	35					
15.0											
15.5											
16.0	16	UDS-5									
16.5											
17.0											
17.5	17.5	SPT-7	18	41	47	88					
18.0											
18.5							Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
19.0	19	SPT-8	20	36	50	86					
19.5											
20.0											

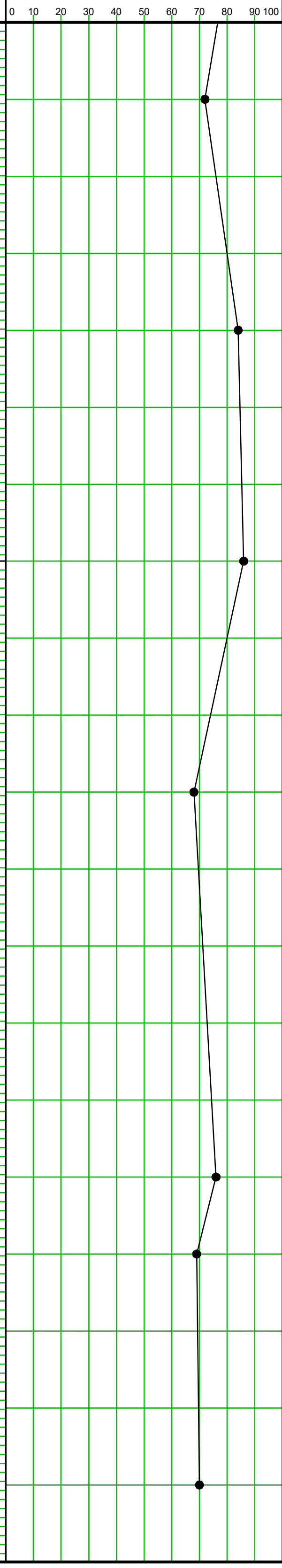


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*7+078 km	*Northing :*3124551.638 m	*Easting :*713455.57 m
Reduced Level (m):(+)195.221	*BH. No. :*BH-A1	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*1.70	*Inclination :* Vertical
*Boring type :*Shell & Augar	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not-used
*Date of Start :*03-10-2021	*Date of Completion :*05-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-9	22	32	40	72	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
21.0											
21.5											
22.0	22	SPT-10	20	34	50	84					
22.5											
23.0											
23.5	23.5	SPT-11	18	33	53	86					
24.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
24.5											
25.0	25	SPT-12	21	33	35	68					
25.5											
26.0											
26.5											
27.0											
27.5	27.5	SPT-13	15	28	48	76					
28.0	28	SPT-14	16	24	45	69					
28.5											
29.0											
29.5	29.5	SPT-15	15	22	48	70					
30.0	29.95	DS-2									

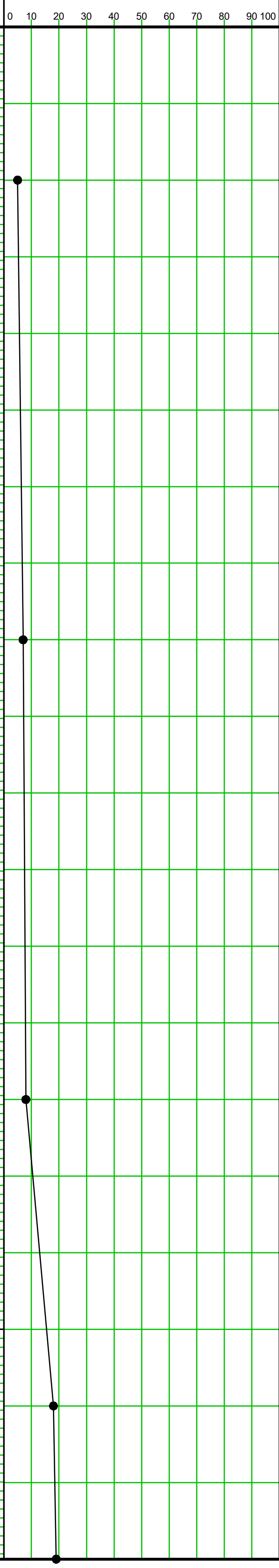


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*7+078 km	*Northing :*3124549.896 m	*Easting :*713435.595 m
Reduced Level (m):(+)194.815	*BH. No. :*BH-A2	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*1.25	*Inclination :* Vertical
*Boring type :*Shell & Augar	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not-used
*Date of Start :*03-10-2021	*Date of Completion :*04-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Medium stiff, Silty clay of low plasticity	CL			
0.5											
1.0	1	SPT-1	1	2	3	5					
1.5									1.25m		
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	2	3	4	7					
4.5											
5.0											
5.5	5.5	UDS-2									
6.0											
6.5											
7.0	7	SPT-3	3	3	5	8					
7.5											
8.0											
8.5	8.5	UDS*					Brown, Medium dense, Sandy silt of low plasticity	ML-CL			
9.0	9	SPT-4	6	8	10	18					
9.5											
10.0	10	SPT-5	5	7	12	19					



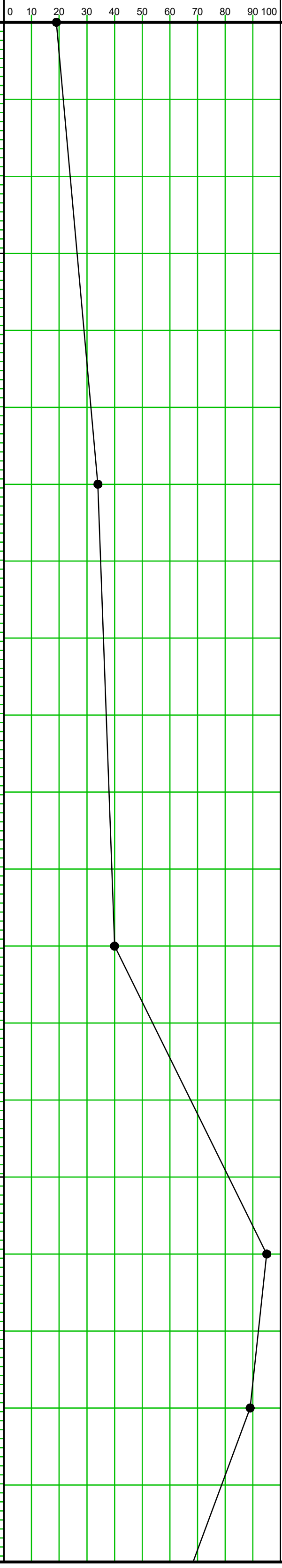
UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*7+078 km	*Northing :*3124549.896 m	*Easting :*713435.595 m
Reduced Level (m):(+)194.815	*BH. No. :*BH-A2	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*1.25	*Inclination :* Vertical
*Boring type :*Shell & Augar	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not-used
*Date of Start :*03-10-2021	*Date of Completion :*04-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
10.0							Brown, Medium dense, Sandy silt of low plasticity (10.0–11.5)	ML-CL		
10.5										
11.0										
11.5	11.5	UDS-3								
12.0							Brown, Hard, Silty clay of low plasticity with gravel (11.5–17.5)	CL		
12.5										
13.0	13	SPT-6	12	15	19	34				
13.5										
14.0										
14.5	14.5	UDS-4								
15.0										
15.5										
16.0	16	SPT-7	13	18	22	40				
16.5										
17.0										
17.5	17.5	UDS*								
18.0	18	SPT-8	30	45	50	95	Brown, Very dense, Sandy silt of low plasticity with gravel (17.5–20.0)	ML-CL		
18.5										
19.0	19	SPT-9	18	34	55	89				
19.5										
20.0										

(Depth v/s SPT N Value)

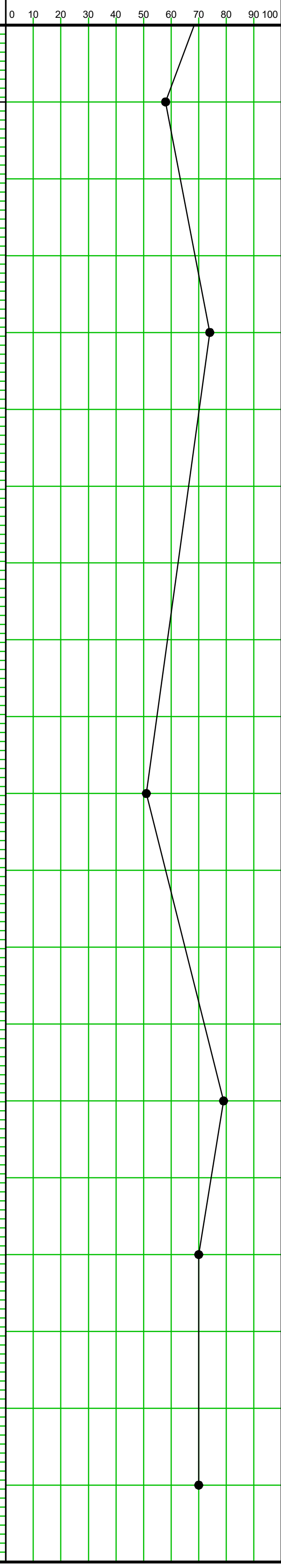


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*7+078 km	*Northing :*3124549.896 m	*Easting :*713435.595 m
Reduced Level (m):(+)194.815	*BH. No. :*BH-A2	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*1.25	*Inclination :* Vertical
*Boring type :*Shell & Augar	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not-used
*Date of Start :*03-10-2021	*Date of Completion :*04-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0							Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
20.5	20.5	SPT-10	21	28	30	58					
21.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
21.5											
22.0	22	SPT-11	18	35	39	74					
22.5											
23.0											
23.5	23.5	UDS-5									
24.0											
24.5											
25.0	25	SPT-12	10	19	32	51					
25.5											
26.0	26	UDS*									
26.5											
27.0	27	SPT-13	15	29	50	79					
27.5											
28.0	28	SPT-14	15	24	46	70					
28.5											
29.0											
29.5	29.5	SPT-15	14	25	45	70					
30.0	29.95	DS-2									



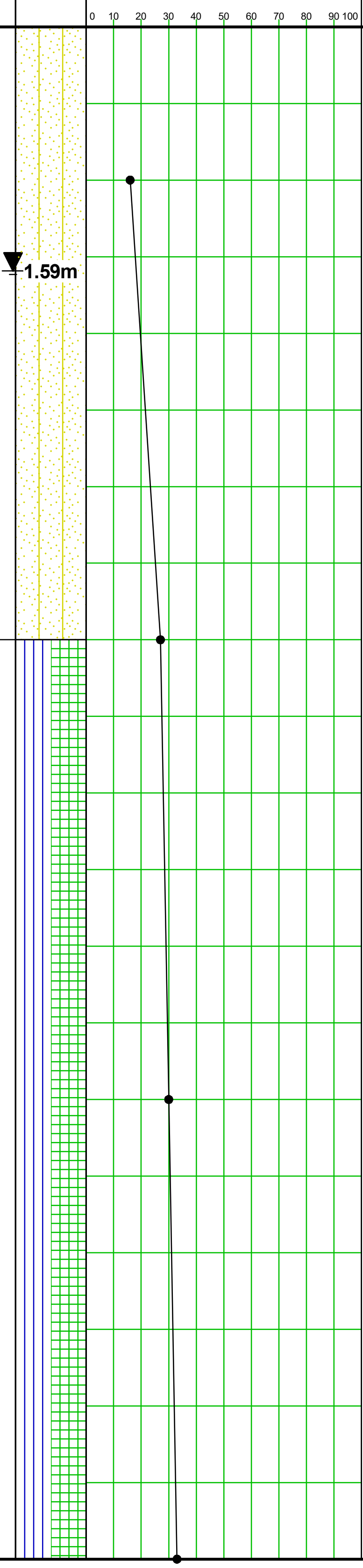
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :7+256 km	*Northing* :3124532.969 m	*Easting* :713264.533 m
Reduced Level (m):(+)193.947	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:1.59	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :28-10-2021	*Date of Completion* :28-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Special Observations
0.0		DS					Brown, Medium dense, Silty sand	SM	
0.5									
1.0	1	SPT-1	4	7	9	16			
1.5									
2.0									
2.5	2.5	UDS-1							
3.0									
3.5									
4.0	4	SPT-2	9	11	16	27	Brown, Medium dense to dense, Sandy silt of low plasticity with gravel	ML-CL	
4.5									
5.0									
5.5	5.5	UDS-2							
6.0									
6.5									
7.0	7	SPT-3	7	12	18	30			
7.5									
8.0									
8.5	8.5	UDS-3							
9.0									
9.5									
10.0	10	SPT-4	10	13	20	33			

Graphic Log / (Depth v/s SPT N Value)

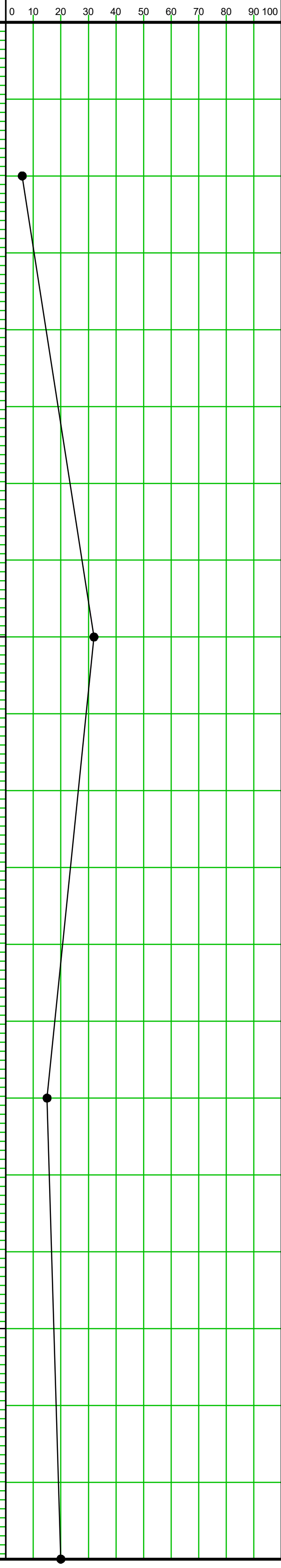


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :7+351 km	*Northing* :3124525.765 m	*Easting* :713206.08 m
Reduced Level (m):(+)194.037	*BH. No.* :BH-A1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:3.00	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :24-10-2021	*Date of Completion* :26-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Loose, Sandy silt of low plasticity	ML-CL			
0.5											
1.0	1	SPT-1	2	3	3	6					
1.5											
2.0											
2.5	2.5	UDS-1									
3.0									3.00m		
3.5											
4.0	4	SPT-2	10	14	18	32	Brown, Medium dense to dense, Sandy silt of low plasticity	ML-CL			
4.5											
5.0											
5.5	5.5	UDS-2									
6.0											
6.5											
7.0	7	SPT-3	5	7	8	15					
7.5											
8.0											
8.5	8.5	UDS-3					Brown, Very stiff, Silty clay of low plasticity	CL			
9.0											
9.5											
10.0	10	SPT-4	7	9	11	20					

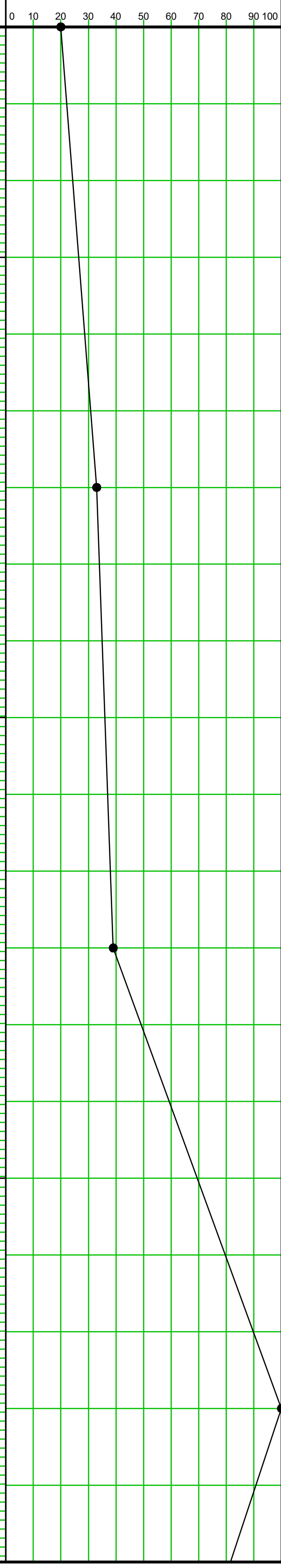


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :7+351 km	*Northing* :3124525.765 m	*Easting* :713206.08 m
Reduced Level (m):(+)194.037	*BH. No.* :BH-A1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:3.00	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :24-10-2021	*Date of Completion* :26-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5							Brown, Very stiff, Silty clay of low plasticity	CL			
11.0											
11.5	11.5	UDS-4									
12.0											
12.5											
13.0	13	SPT-5	10	14	19	33	Brown, Dense, Sandy silt of low plasticity with gravel	ML-CL			
13.5											
14.0											
14.5	14.5	UDS-5									
15.0											
15.5											
16.0	16	SPT-6	13	18	21	39	Brown, Hard, Silty clay of low plasticity with gravel	CL			
16.5											
17.0											
17.5	17.5	UDS-6									
18.0											
18.5											
19.0	19	SPT-7	35	65	35 (11cm)	>100	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
19.5											
20.0											

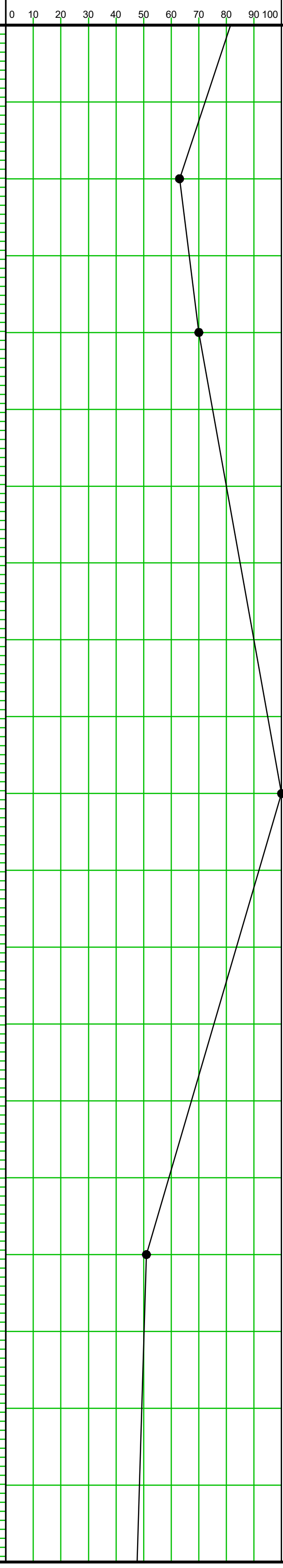


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 7+351 km	*Northing :* 3124525.765 m	*Easting :* 713206.08 m
Reduced Level (m): (+)194.037	*BH. No. :* BH-A1	*BH Termination Depth (m):* 40
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 3.00	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 24-10-2021	*Date of Completion :* 26-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5											
21.0	21	SPT-8	20	29	34	63					
21.5											
22.0	22	SPT-9	23	33	37	70					
22.5											
23.0											
23.5	23.5	UDS-7									
24.0											
24.5											
25.0	25	SPT-10	27	66	34 (12cm)	>100	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
25.5											
26.0											
26.5	26.5	UDS*									
27.0											
27.5											
28.0	28	SPT-11	20	24	27	51					
28.5											
29.0											
29.5	29.5	UDS-8									
30.0											



UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*7+351 km	*Northing :*3124525.765 m	*Easting :*713206.08 m
Reduced Level (m):(+)194.037	*BH. No. :*BH-A1	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*3.00	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*24-10-2021	*Date of Completion :*26-10-2021	

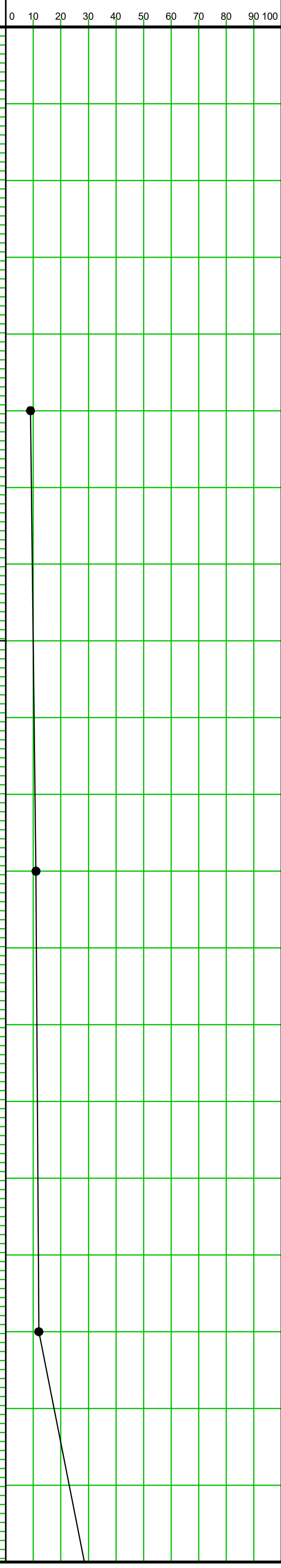
Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0											
30.5											
31.0	31	SPT-12	18	21	25	46	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
31.5											
32.0											
32.5	32.5	UDS-9									
33.0											
33.5											
34.0	34	SPT-13	22	32	39	71					
34.5											
35.0											
35.5	35.5	UDS-10									
36.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
36.5											
37.0	37	SPT-14	32	58	42 (8cm)	>100					
37.5											
38.0											
38.5	38.5	SPT-15	45	70	30 (13cm)	>100					
39.0											
39.5											
40.0	40	SPT-16	40	54	46 (5cm)	>100					

UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :7+351 km	*Northing* :3124522.342 m	*Easting* :713171.257 m
Reduced Level (m):(+)196.827	*BH. No.* :BH-P1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:2.10	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :23-10-2021	*Date of Completion* :25-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Loose, Sandy silt of low plasticity (0.0–4.0)	ML-CL	2.10m		
0.5											
1.0	1	UDS-1									
1.5											
2.0											
2.5	2.5	SPT-1	3	4	5	9					
3.0											
3.5											
4.0	4	UDS-2					Brown, Very stiff, Silty clay of low plasticity (4.0–10.0)	CL			
4.5											
5.0											
5.5	5.5	SPT-2	3	4	7	11					
6.0											
6.5											
7.0	7	UDS-3									
7.5											
8.0											
8.5	8.5	SPT-3	5	5	7	12					
9.0											
9.5											
10.0	10	UDS-4									

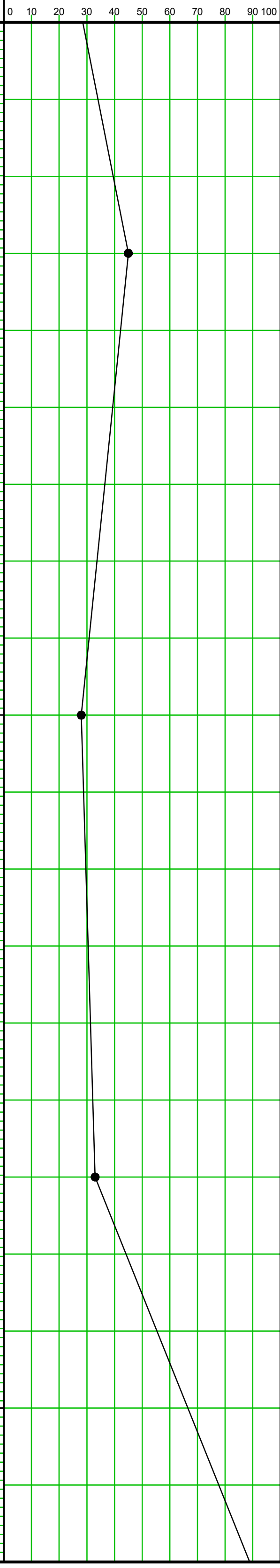


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*7+351 km	*Northing :*3124522.342 m	*Easting :*713171.257 m
Reduced Level (m):(+)196.827	*BH. No. :*BH-P1	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*2.10	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*23-10-2021	*Date of Completion :*25-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0							Brown, Dense, Sandy silt of low plasticity with gravel	ML-CL			
10.5											
11.0											
11.5	11.5	SPT-4	10	17	28	45					
12.0											
12.5											
13.0	13	UDS-5									
13.5											
14.0											
14.5	14.5	SPT-5	9	12	16	28					
15.0							Brown, Very stiff to hard, Silty clay of low plasticity with gravel	CL			
15.5											
16.0	16	UDS-6									
16.5											
17.0											
17.5	17.5	SPT-6	9	14	19	33					
18.0											
18.5											
19.0	19	UDS-7									
19.5							Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
20.0											

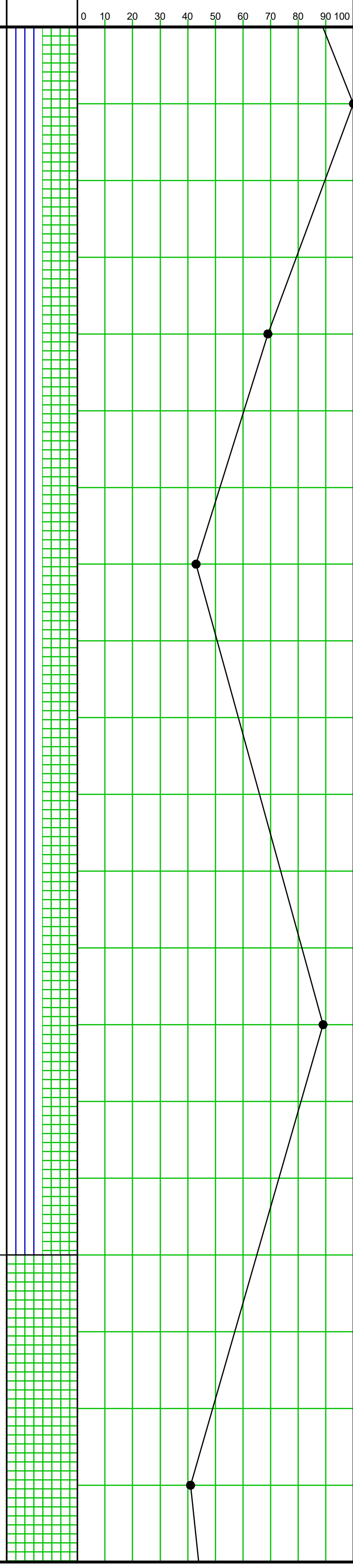


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :7+351 km	*Northing* :3124522.342 m	*Easting* :713171.257 m
Reduced Level (m):(+)196.827	*BH. No.* :BH-P1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:2.10	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :23-10-2021	*Date of Completion* :25-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-7	19	43	57 (8cm)	>100	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
21.0											
21.5											
22.0	22	SPT-8	18	30	39	69					
22.5											
23.0											
23.5	23.5	SPT-9	11	19	24	43					
24.0											
24.5											
25.0	25	UDS-8									
25.5											
26.0											
26.5	26.5	SPT-10	18	38	51	89					
27.0											
27.5											
28.0	28	UDS-9					Brown, Hard, Silty clay of low plasticity with gravel	CL			
28.5											
29.0											
29.5	29.5	SPT-11	12	18	23	41					
30.0											

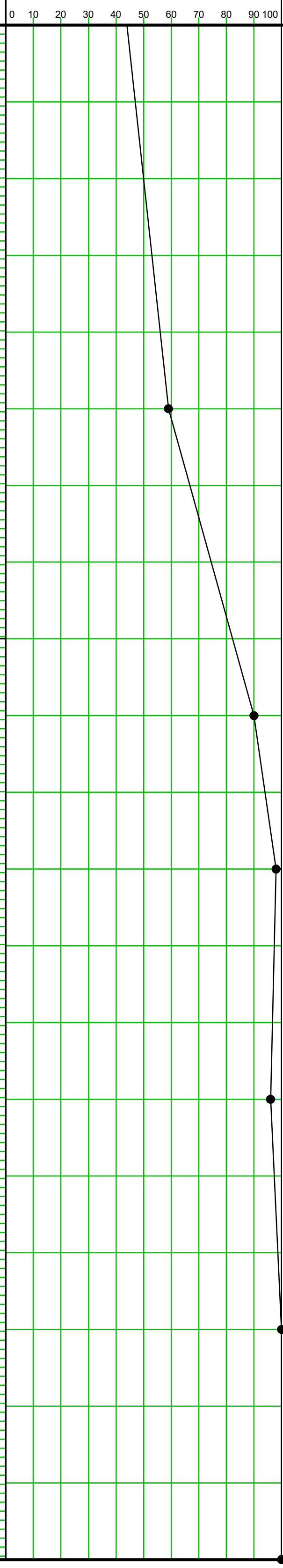


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :7+351 km	*Northing* :3124522.342 m	*Easting* :713171.257 m
Reduced Level (m):(+)196.827	*BH. No.* :BH-P1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:2.10	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :23-10-2021	*Date of Completion* :25-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0											
30.5											
31.0	31	UDS-10					Brown, Hard, Silty clay of low plasticity with gravel	CL			
31.5											
32.0											
32.5	32.5	SPT-12	18	27	32	59					
33.0											
33.5											
34.0	34	UDS*									
34.5	34.5	SPT-13	19	35	55	90	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
35.0											
35.5	35.5	SPT-14	20	38	60	98					
36.0											
36.5											
37.0	37	SPT-15	26	39	57	96					
37.5											
38.0											
38.5	38.5	SPT-16	31	45	55 (12cm)	>100					
39.0											
39.5											
40.0	40	SPT-17	35	50	50 (4cm)	>100					



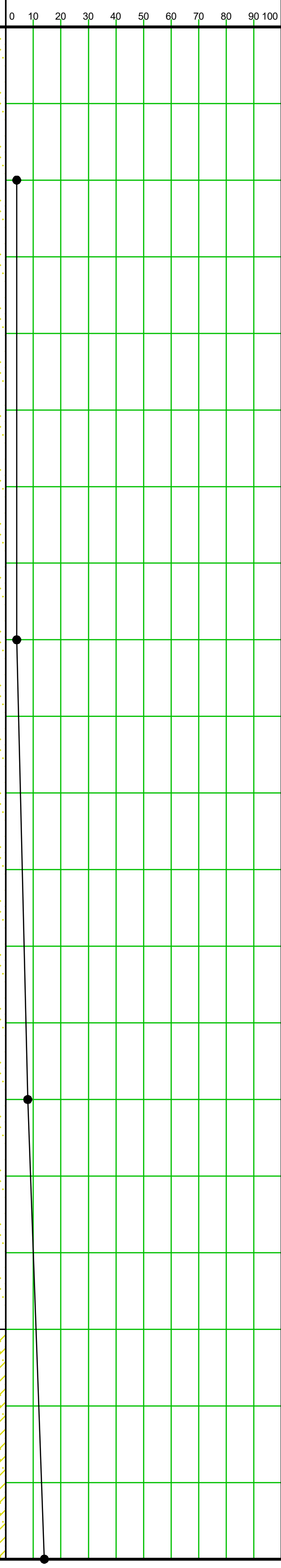
UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*7+351 km	*Northing :*3124522.342 m	*Easting :*713136.399 m
Reduced Level (m):(+)193.680	*BH. No. :*BH-A2	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*0.70	*Inclination :* Vertical
*Boring type :*Shell & Auger	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*27-10-2021	*Date of Completion :*28-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS					Brown, Loose, Silty sand	SM	0.70m	
0.5										
1.0	1	SPT-1	1	2	2	4				
1.5										
2.0										
2.5	2.5	UDS-1								
3.0										
3.5										
4.0	4	SPT-2	2	2	2	4				
4.5										
5.0										
5.5	5.5	UDS-2								
6.0										
6.5										
7.0	7	SPT-3	2	3	5	8				
7.5										
8.0										
8.5	8.5	UDS-3					Brown, Medium dense, Silty sand with clay	SM-SC		
9.0										
9.5										
10.0	10	SPT-4	4	6	8	14				

(Depth v/s SPT N Value)

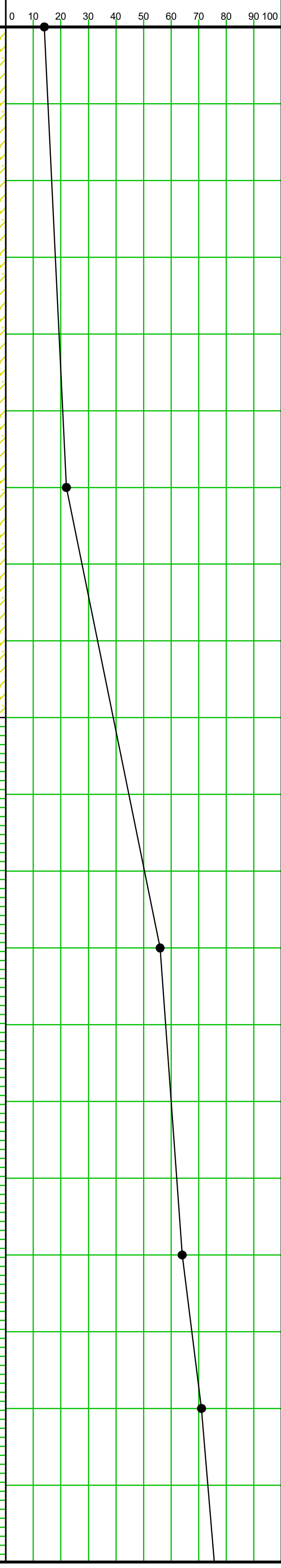


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :7+351 km	*Northing* :3124522.342 m	*Easting* :713136.399 m
Reduced Level (m):(+)193.680	*BH. No.* :BH-A2	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.70	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :27-10-2021	*Date of Completion* :28-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	UDS-4									
12.0											
12.5							Brown, Medium dense, Silty sand with clay	SM-SC			
13.0	13	SPT-5	7	9	13	22					
13.5											
14.0											
14.5	14.5	UDS-5									
15.0											
15.5											
16.0	16	SPT-6	13	25	31	56					
16.5											
17.0											
17.5	17.5	UDS*					Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
18.0	18	SPT-7	16	29	35	64					
18.5											
19.0	19	SPT-8	19	32	39	71					
19.5											
20.0											

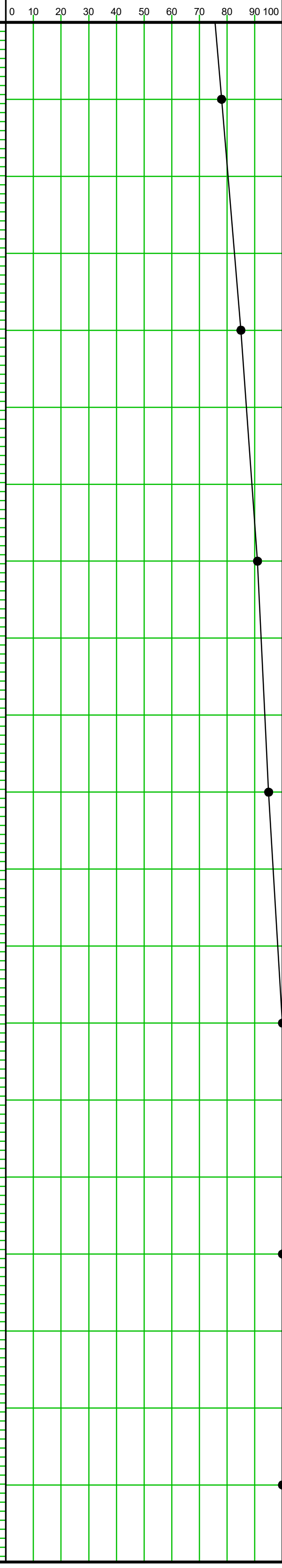


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*7+351 km	*Northing :*3124522.342 m	*Easting :*713136.399 m
Reduced Level (m):(+)193.680	*BH. No. :*BH-A2	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*0.70	*Inclination :* Vertical
*Boring type :*Shell & Auger	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*27-10-2021	*Date of Completion :*28-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-9	23	36	42	78					
21.0											
21.5											
22.0	22	SPT-10	25	39	46	85					
22.5											
23.0											
23.5	23.5	SPT-11	27	42	49	91					
24.0											
24.5											
25.0	25	SPT-12	29	45	50	95	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
25.5											
26.0											
26.5	26.5	SPT-13	32	55	45 (12cm)	>100					
27.0											
27.5											
28.0	28	SPT-14	35	61	39 (7cm)	>100					
28.5											
29.0											
29.5	29.5	SPT-15	33	58	42 (9cm)	>100					
30.0											



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :7+351 km	*Northing* :3124522.342 m	*Easting* :713136.399 m
Reduced Level (m):(+)193.680	*BH. No.* :BH-A2	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.70	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :27-10-2021	*Date of Completion* :28-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0											
30.5											
31.0	31	SPT-16	37	70	30 (5cm)	>100					
31.5											
32.0											
32.5	32.5	SPT-17	15	38	47	85					
33.0											
33.5											
34.0	34	SPT-18	19	41	50	91					
34.5											
35.0							Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
35.5	35.5	SPT-19	27	60	40 (13cm)	>100					
36.0											
36.5											
37.0	37	SPT-20	30	64	36 (9cm)	>100					
37.5											
38.0											
38.5	38.5	SPT-21	32	62	38 (7cm)	>100					
39.0											
39.5											
40.0	40	SPT-22	34	69	31 (5cm)	>100					

Chart axis: 0 10 20 30 40 50 60 70 80 90 100

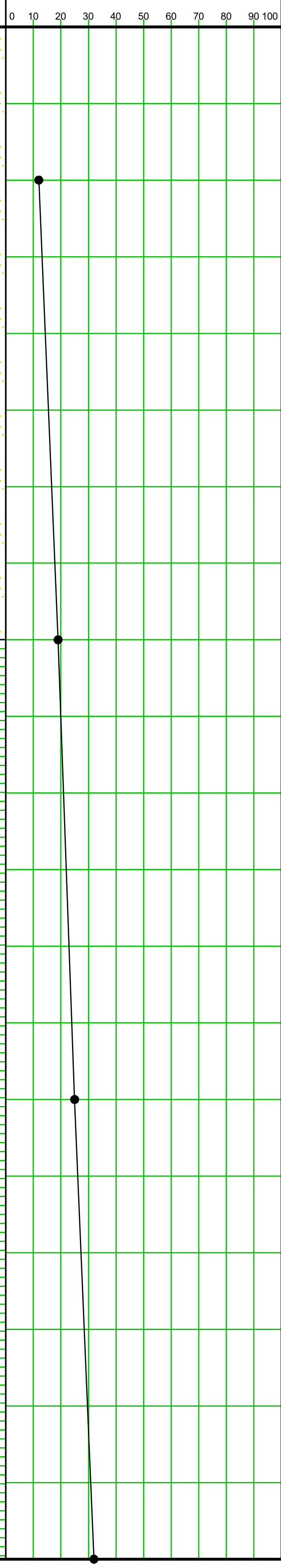
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :7+457 km	*Northing* :3124513.592 m	*Easting* :713067.448 m
Reduced Level (m):(+)193.671	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:0.59	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :24-10-2021	*Date of Completion* :24-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS					Brown, Medium dense, Silty sand	SM		
0.5									0.59m	
1.0	1	SPT-1	4	5	7	12				
1.5										
2.0										
2.5	2.5	UDS-1								
3.0										
3.5										
4.0	4	SPT-2	5	7	12	19				
4.5							Brown, Medium dense to dense, Sandy silt of low plasticity with gravel	ML-CL		
5.0										
5.5	5.5	UDS-2								
6.0										
6.5										
7.0	7	SPT-3	7	10	15	25				
7.5										
8.0										
8.5	8.5	UDS-3								
9.0										
9.5										
10.0	10	SPT-4	12	14	18	32				

(Depth v/s SPT N Value)

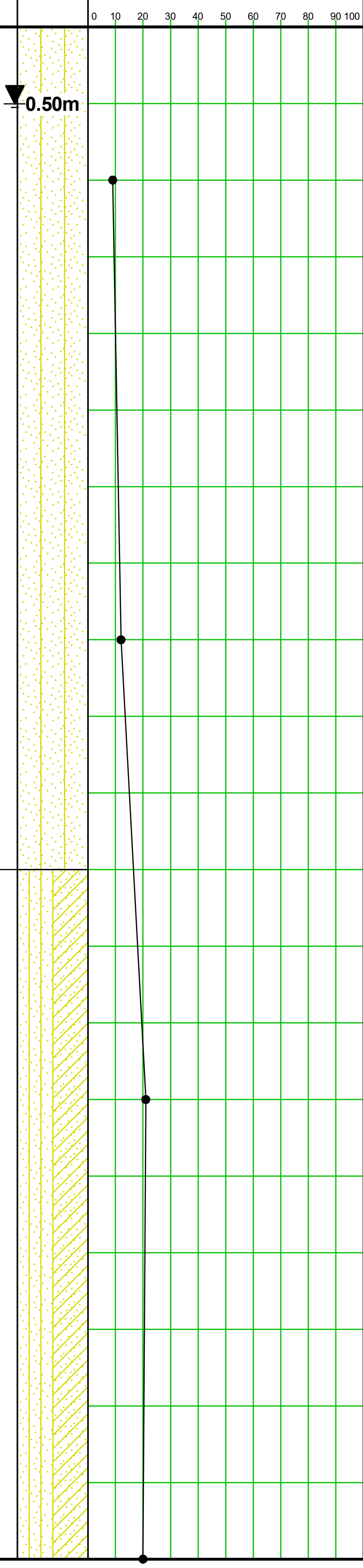


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :7+613 km	*Northing* :3124499.906 m	*Easting* :712928.25 m
Reduced Level (m):(+)195.453	*BH. No.* :BH-A1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.50	*Inclination :* Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :26-10-2021	*Date of Completion* :27-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Loose to medium dense, Silty sand	SM			
0.5											
1.0	1	SPT-1	4	4	5	9					
1.5											
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	4	5	7	12					
4.5											
5.0											
5.5	5.5	UDS-2					Brown, Medium dense, Silty sand with clay	SM-SC			
6.0											
6.5											
7.0	7	SPT-3	7	10	11	21					
7.5											
8.0											
8.5	8.5	UDS-3									
9.0											
9.5											
10.0	10	SPT-4	8	10	10	20					

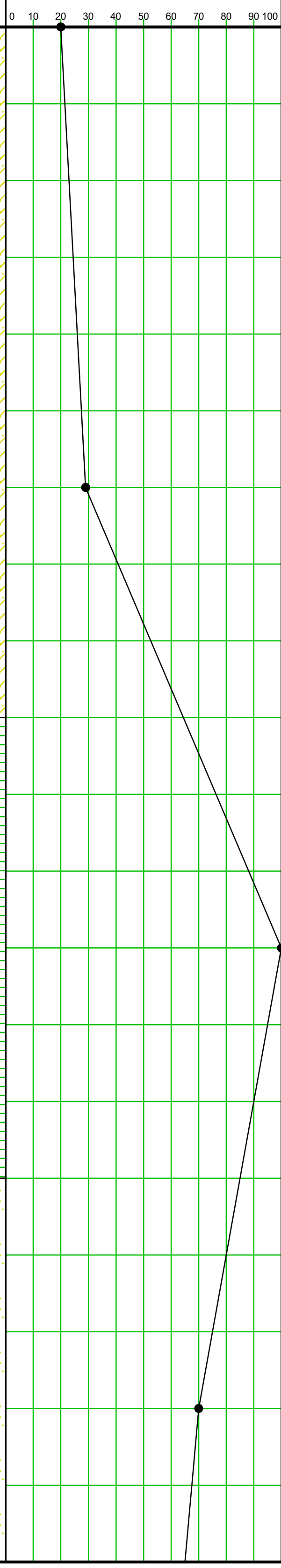


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :7+613 km	*Northing* :3124499.906 m	*Easting* :712928.25 m
Reduced Level (m):(+)195.453	*BH. No.* :BH-A1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.50	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :26-10-2021	*Date of Completion* :27-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	UDS-4									
12.0											
12.5							Brown, Medium dense, Silty sand with clay	SM-SC			
13.0	13	SPT-5	9	13	16	29					
13.5											
14.0											
14.5	14.5	UDS-5									
15.0											
15.5											
16.0	16	SPT-6	26	62	38 (7cm)	>100	Brown, Hard, Silty clay of low plasticity with gravel	CL			
16.5											
17.0											
17.5	17.5	UDS-6									
18.0											
18.5											
19.0	19	SPT-7	14	28	42	70	Brown, Very dense, Silty sand with gravel	SM			
19.5											
20.0											



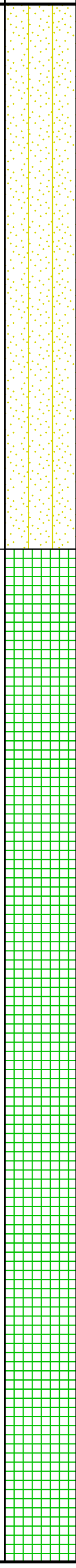
UDS*-UDS not recovered

FIELD BOREHOLE LOG

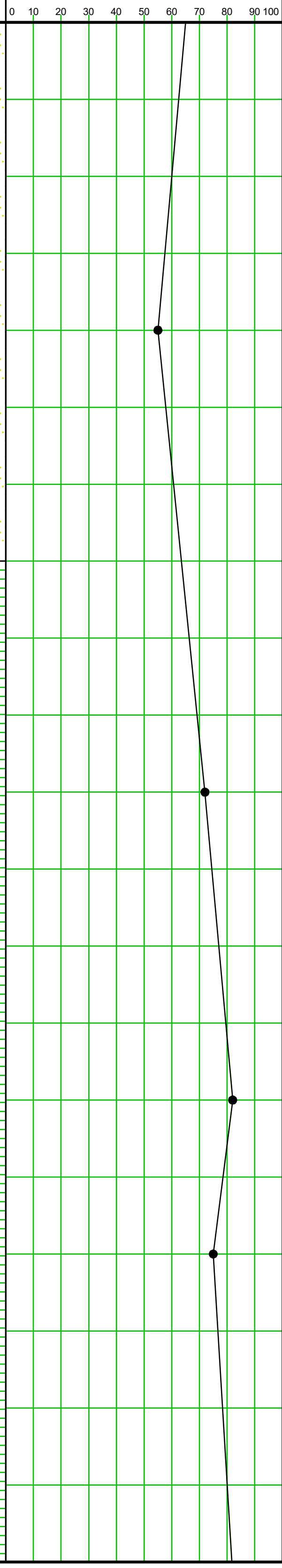
Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :7+613 km	*Northing* :3124499.906 m	*Easting* :712928.25 m
Reduced Level (m):(+)195.453	*BH. No.* :BH-A1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.50	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :26-10-2021	*Date of Completion* :27-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Special Observations
20.0							Brown, Very dense, Silty sand with gravel	SM	
20.5	20.5	UDS-7							
21.0									
21.5									
22.0	22	SPT-8	12	23	32	55			
22.5									
23.0									
23.5	23.5	UDS-8					Brown, Hard, Silty clay of low plasticity with gravel	CL	
24.0									
24.5									
25.0	25	SPT-9	12	30	42	72			
25.5									
26.0									
26.5	26.5	UDS*							
27.0	27	SPT-10	19	35	47	82			
27.5									
28.0	28	SPT-11	16	32	43	75			
28.5									
29.0									
29.5	29.5	UDS-9							
30.0									

Graphic Log



(Depth v/s SPT N Value)

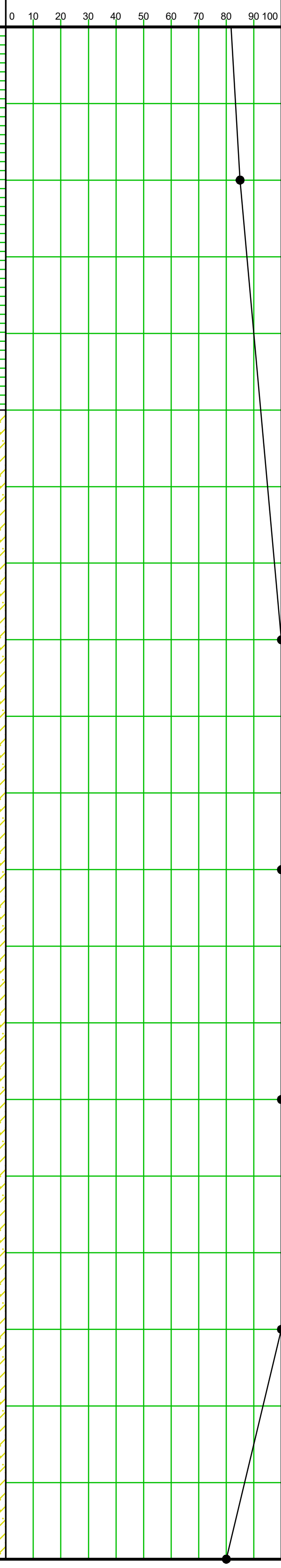


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*7+613 km	*Northing :*3124499.906 m	*Easting :*712928.25 m
Reduced Level (m):(+)195.453	*BH. No. :*BH-A1	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*0.50	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*26-10-2021	*Date of Completion :*27-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
30.5											
31.0	31	SPT-12	22	37	48	85					
31.5											
32.0											
32.5	32.5	UDS-10									
33.0							Brown, Very dense, Silty sand with clay & gravel	SM-SC			
33.5											
34.0	34	SPT-13	24	57	43 (8cm)	>100					
34.5											
35.0											
35.5	35.5	SPT-14	22	63	37 (6cm)	>100					
36.0											
36.5											
37.0	37	SPT-15	26	67	33 (5cm)	>100					
37.5											
38.0											
38.5	38.5	SPT-16	28	72	28 (3cm)	>100					
39.0											
39.5											
40.0	40	SPT-17	24	38	42	80					



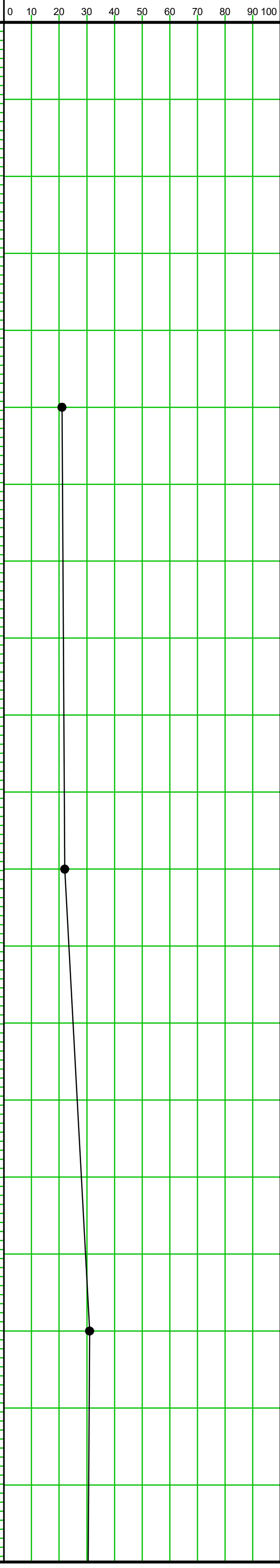
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 7+613 km	*Northing :* 3124496.873 m	*Easting :* 712897.399 m
Reduced Level (m): (+)193.923	*BH. No. :* BH-A2	*BH Termination Depth (m):* 40
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 0.85	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 27-10-2021	*Date of Completion :* 28-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS								
0.5										
1.0	1	UDS-1							0.85m	
1.5										
2.0										
2.5	2.5	SPT-1	5	6	15	21				
3.0										
3.5										
4.0	4	UDS-2								
4.5										
5.0							Brown, Very stiff, Silty clay of low plasticity	CL		
5.5	5.5	SPT-2	6	9	13	22				
6.0										
6.5										
7.0	7	UDS-3								
7.5										
8.0										
8.5	8.5	SPT-3	8	14	17	31				
9.0										
9.5										
10.0	10	UDS-4								

(Depth v/s SPT N Value)

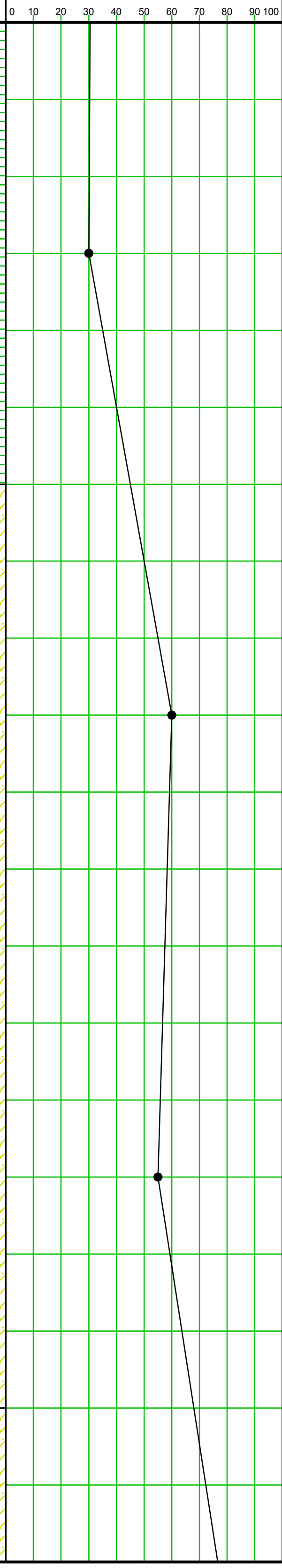


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :7+613 km	*Northing* :3124496.873 m	*Easting* :712897.399 m
Reduced Level (m):(+)193.923	*BH. No.* :BH-A2	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.85	*Inclination :* Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :27-10-2021	*Date of Completion* :28-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-4	10	12	18	30	Brown, Very stiff, Silty clay of low plasticity	CL			
12.0											
12.5											
13.0	13	UDS-5									
13.5											
14.0											
14.5	14.5	SPT-5	13	22	38	60					
15.0											
15.5											
16.0	16	UDS-6					Brown, Very dense, Silty sand with clay & gravel	SM-SC			
16.5											
17.0											
17.5	17.5	SPT-6	10	25	30	55					
18.0											
18.5											
19.0	19	UDS-7									
19.5							Brown, Very dense, Silty sand with gravel	SM-SC			
20.0											

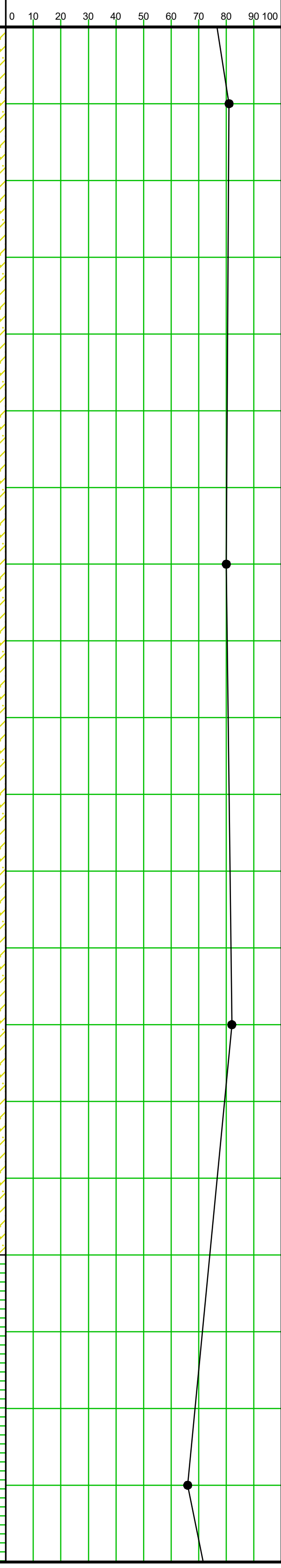


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 7+613 km	*Northing :* 3124496.873 m	*Easting :* 712897.399 m
Reduced Level (m): (+)193.923	*BH. No. :* BH-A2	*BH Termination Depth (m):* 40
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 0.85	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 27-10-2021	*Date of Completion :* 28-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0							Brown, Very dense, Silty sand with gravel (20.0–28.0)	SM-SC			
20.5	20.5	SPT-7	17	35	46	81					
21.0											
21.5											
22.0	22	UDS-8									
22.5											
23.0											
23.5	23.5	SPT-8	16	36	44	80					
24.0											
24.5											
25.0	25	UDS-9									
25.5											
26.0											
26.5	26.5	SPT-9	18	34	48	82					
27.0											
27.5											
28.0	28	UDS-10					Brown, Hard, Silty clay of low plasticity with gravel (28.0–30.0)	CL			
28.5											
29.0											
29.5	29.5	SPT-10	14	28	38	66					
30.0											



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :7+613 km	*Northing* :3124496.873 m	*Easting* :712897.399 m
Reduced Level (m):(+)193.923	*BH. No.* :BH-A2	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.85	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :27-10-2021	*Date of Completion* :28-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0							Brown, Hard, Silty clay of low plasticity with gravel (30.0–37.0)	CL			
30.5											
31.0	31	UDS-11									
31.5											
32.0											
32.5	32.5	SPT-11	22	57	43 (8cm)	>100					
33.0											
33.5											
34.0	34	SPT-12	23	55	45 (11cm)	>100					
34.5											
35.0											
35.5	35.5	SPT-13	21	56	44 (5cm)	>100					
36.0											
36.5											
37.0	37	SPT-14	27	70	30 (5cm)	>100	Brown, Very dense, Sandy silt of low plasticity with gravel (37.0–40.0)	ML-CL			
37.5											
38.0											
38.5	38.5	SPT-15	29	69	31 (6cm)	>100					
39.0											
39.5											
40.0	40	SPT-16	23	42	51 (10cm)	>100					

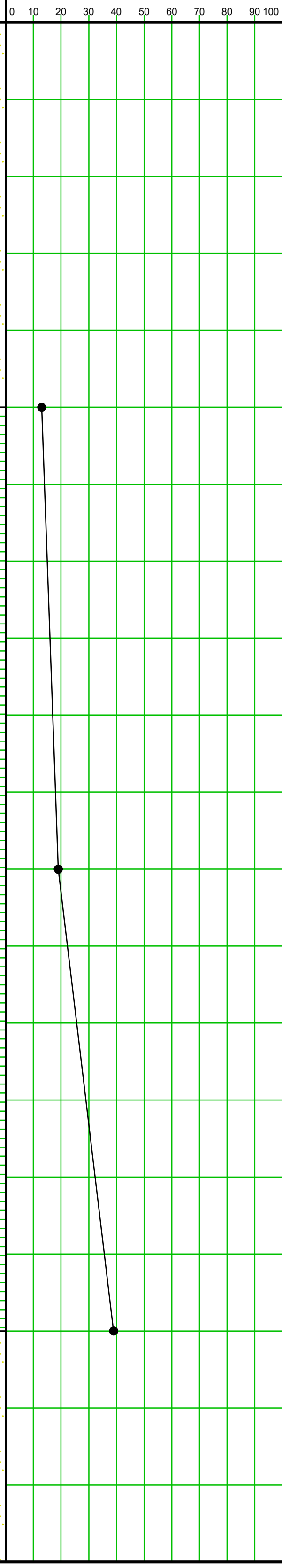
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :7+907 km	*Northing* :3124469.642 m	*Easting* :712620.43 m
Reduced Level (m):(+)193.872	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:1.90	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :26-10-2021	*Date of Completion* :26-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS					Brown, Silty sand	SM		
0.5										
1.0	1	UDS-1								
1.5										
2.0									1.90m	
2.5	2.5	SPT-1	4	6	7	13				
3.0							Brown, Very stiff, Silty clay of low plasticity	CL		
3.5										
4.0	4	UDS-2								
4.5										
5.0										
5.5	5.5	SPT-2	6	8	11	19				
6.0										
6.5										
7.0	7	UDS-3								
7.5										
8.0										
8.5	8.5	SPT-3	8	14	25	39				
9.0							Brown, Dense, Silty sand with gravel	SM		
9.5										
10.0	10	UDS-4								

(Depth v/s SPT N Value)



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :8+207 km	*Northing* :3124437.243 m	*Easting* :712317.987 m
Reduced Level (m):(+)193.686	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:2.00	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :26-10-2021	*Date of Completion* :26-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brownish grey, Medium dense, Sandy silt of low plasticity	ML-CL			
0.5											
1.0	1	SPT-1	4	5	7	12					
1.5											
2.0									2.00m		
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	5	8	14	22					
4.5											
5.0											
5.5	5.5	UDS-2									
6.0											
6.5											
7.0	7	SPT-3	7	10	16	26					
7.5											
8.0											
8.5	8.5	UDS-3					Brown, Hard, Silty clay of medium plasticity	CI			
9.0											
9.5											
10.0	10	SPT-4	6	12	18	30					

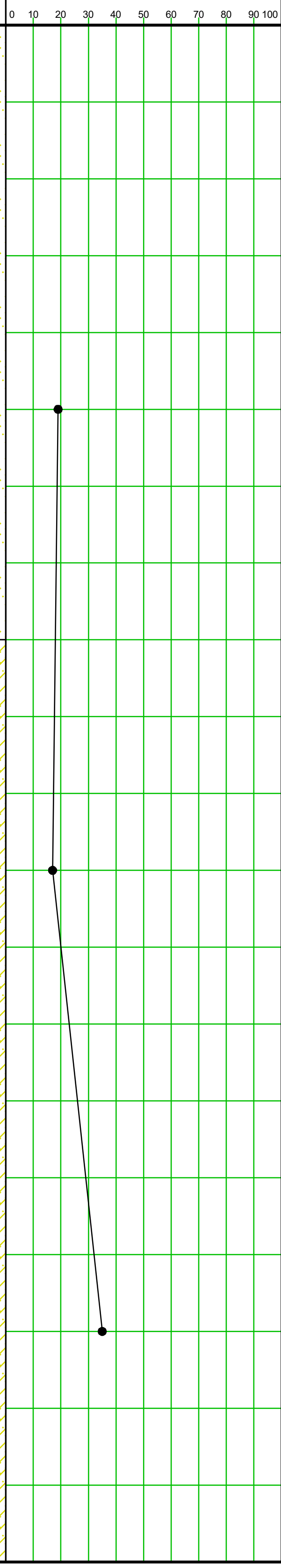
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :8+610 km	*Northing* :3124401.078 m	*Easting* :711923.004 m
Reduced Level (m):(+)194.123	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:1.95	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :20-10-2021	*Date of Completion* :20-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS					Brown, Medium dense, Silty sand	SM		
1.0	1	UDS-1								
1.95									1.95m	
2.5	2.5	SPT-1	5	7	12	19				
4.0	4	UDS-2					Brown, Medium dense to dense, Silty sand with clay	SM-SC		
5.5	5.5	SPT-2	6	7	10	17				
7.0	7	UDS-3								
8.5	8.5	SPT-3	8	15	20	35				
10.0	10	UDS-4								

(Depth v/s SPT N Value)



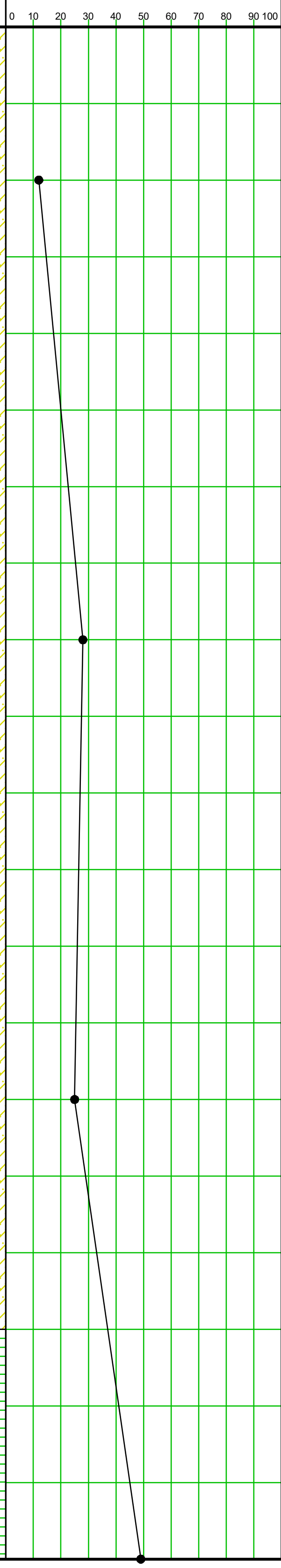
UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*8+852 km	*Northing :*3124377.983 m	*Easting :*711688.17 m
Reduced Level (m):(+)193.689	*BH. No. :*BH-A1	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*0.75	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not-used
*Date of Start :*18-10-2021	*Date of Completion :*19-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS-1					Brown, Medium dense, Silty sand with clay (0.0–8.5 m)	SM-SC		
0.5										
1.0	1	SPT-1	4	5	7	12			0.75m	
1.5										
2.0										
2.5	2.5	UDS-1								
3.0										
3.5										
4.0	4	SPT-2	5	12	16	28				
4.5										
5.0										
5.5	5.5	UDS-2								
6.0										
6.5										
7.0	7	SPT-3	11	10	15	25				
7.5										
8.0										
8.5	8.5	UDS-3					Brown, Hard, Silty clay of low plasticity with gravel (8.5–10.0 m)	CL		
9.0										
9.5										
10.0	10	SPT-4	12	19	30	49				

(Depth v/s SPT N Value)

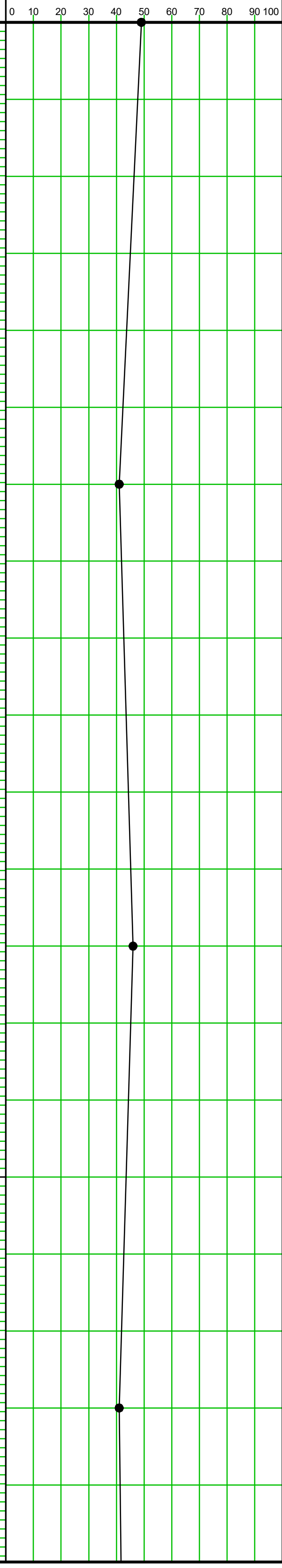


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :8+852 km	*Northing* :3124377.983 m	*Easting* :711688.17 m
Reduced Level (m):(+)193.689	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.75	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not-used
Date of Start :18-10-2021	*Date of Completion* :19-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0							Brown, Hard, Silty clay of low plasticity with gravel (10.0–17.5)	CL			
10.5											
11.0											
11.5	11.5	UDS-4									
12.0											
12.5											
13.0	13	SPT-5	14	17	24	41					
13.5											
14.0											
14.5	14.5	UDS-5									
15.0											
15.5											
16.0	16	SPT-6	14	19	27	46					
16.5											
17.0											
17.5	17.5	UDS-6					Brown, Dense, Sandy silt of low plasticity with gravel (17.5–20.0)	ML-CL			
18.0											
18.5											
19.0	19	SPT-7	13	17	24	41					
19.5											
20.0											



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :8+852 km	*Northing* :3124377.983 m	*Easting* :711688.17 m
Reduced Level (m):(+)193.689	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.75	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not-used
Date of Start :18-10-2021	*Date of Completion* :19-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	UDS-7					Brown, Dense, Sandy silt of low plasticity with gravel	ML-CL			
21.0											
21.5											
22.0	22	SPT-8	14	18	25	43					
22.5											
23.0											
23.5	23.5	UDS*									
24.0											
24.5											
25.0	25	SPT-9	13	19	28	47					
25.5							Brown, Hard, Silty clay of low plasticity with gravel	CL			
26.0											
26.5	26.5	UDS-8									
27.0											
27.5											
28.0	28	SPT-10	16	24	35	59					
28.5											
29.0											
29.5	29.5	UDS-9									
30.0	30	DS-2									

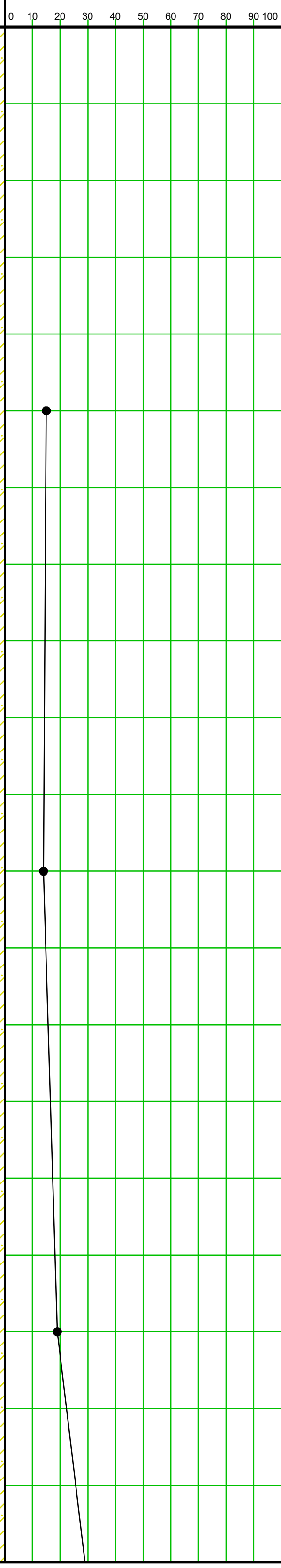
Chart axis: 0 10 20 30 40 50 60 70 80 90 100

UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*8+852 km	*Northing :*3124375.655 m	*Easting :*711664.484 m
Reduced Level (m):(+)194.209	*BH. No. :*BH-A2	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*1.35	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not-used
*Date of Start :*18-10-2021	*Date of Completion :*19-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS-1					Brown, Medium dense, Silty sand with clay	SM-SC	1.35m		
0.5											
1.0	1	UDS-1									
1.5											
2.0											
2.5	2.5	SPT-1	4	7	8	15					
3.0											
3.5											
4.0	4	UDS-2									
4.5											
5.0											
5.5	5.5	SPT-2	4	7	7	14					
6.0											
6.5											
7.0	7	UDS-3									
7.5											
8.0											
8.5	8.5	SPT-3	5	8	11	19					
9.0											
9.5											
10.0	10	UDS-4									

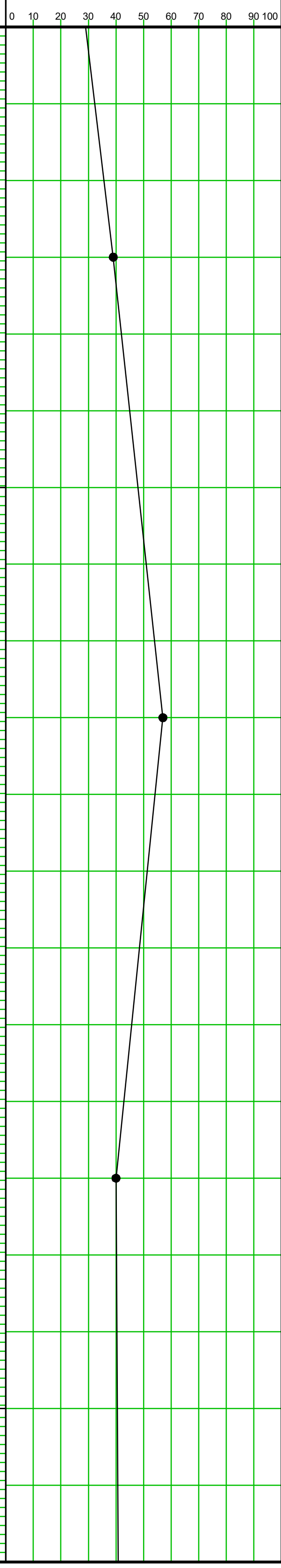


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*8+852 km	*Northing :*3124375.655 m	*Easting :*711664.484 m
Reduced Level (m):(+)194.209	*BH. No. :*BH-A2	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*1.35	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not-used
*Date of Start :*18-10-2021	*Date of Completion :*19-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-4	10	17	22	39	Brown, Dense, Sandy silt of low plasticity with gravel	ML-CL			
12.0											
12.5											
13.0	13	UDS-5									
13.5											
14.0											
14.5	14.5	SPT-5	13	24	33	57					
15.0											
15.5											
16.0	16	UDS-6					Brown, Hard, Silty clay of low plasticity with gravel	CL			
16.5											
17.0											
17.5	17.5	SPT-6	11	17	23	40					
18.0											
18.5											
19.0	19	UDS-7									
19.5							Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL			
20.0											



UDS*-UDS not recovered

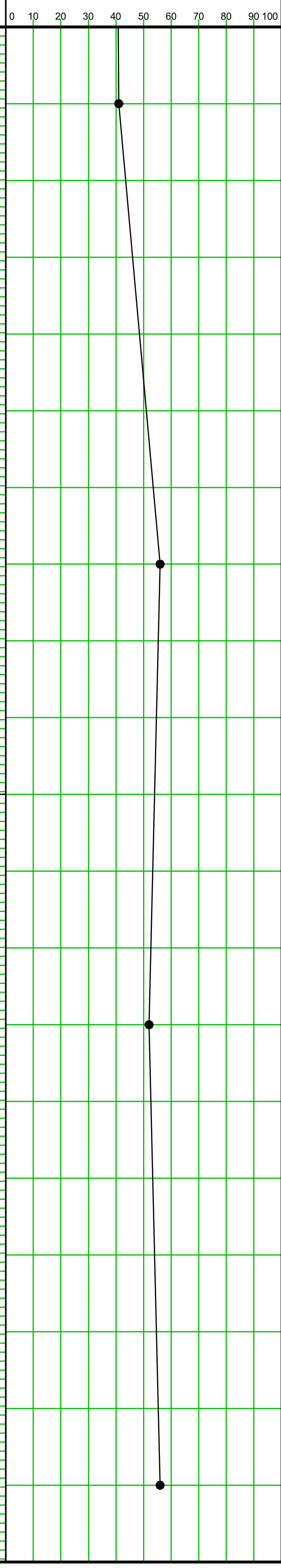
FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 8+852 km	*Northing :* 3124375.655 m	*Easting :* 711664.484 m
Reduced Level (m): (+)194.209	*BH. No. :* BH-A2	*BH Termination Depth (m):* 30
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 1.35	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not-used
Date of Start : 18-10-2021	*Date of Completion :* 19-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value
20.0						
20.5	20.5	SPT-7	12	19	22	41
21.0						
21.5						
22.0	22	UDS-8				
22.5						
23.0						
23.5	23.5	SPT-8	17	24	32	56
24.0						
24.5						
25.0	25	UDS-9				
25.5						
26.0						
26.5	26.5	SPT-9	14	22	30	52
27.0						
27.5						
28.0	28	UDS-10				
28.5						
29.0						
29.5	29.5	SPT-10	16	21	35	56
30.0	29.95	DS-2				

Depth range (m)	Strata Description	IS Classification
20.0 – 25.0	Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL
25.0 – 30.0	Brown, Hard, Silty clay of low plasticity with gravel	CL

Graphic Log | (Depth v/s SPT N Value) | Special Observations

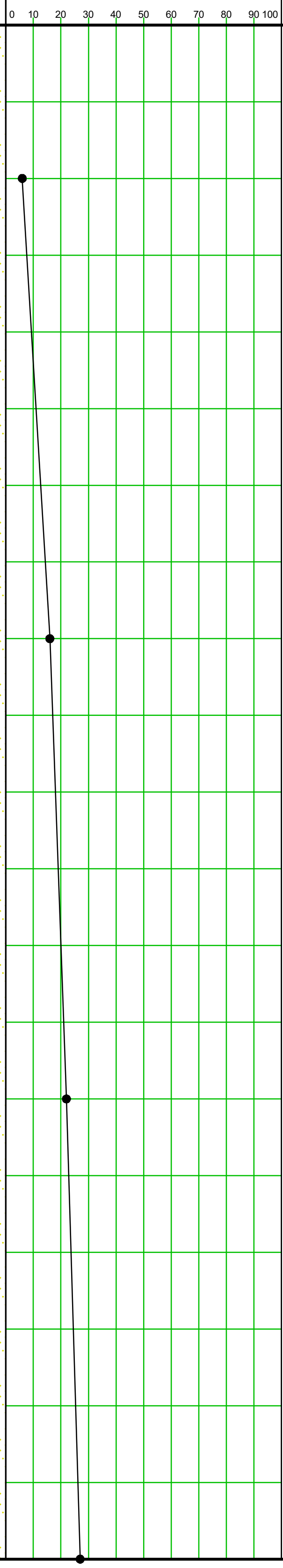


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :8+907 km	*Northing* :3124371.601 m	*Easting* :711623.253 m
Reduced Level (m):(+)193.708	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:0.55	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :26-10-2021	*Date of Completion* :26-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5									0.55m		
1.0	1	SPT-1	2	3	3	6					
1.5											
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	5	7	9	16					
4.5											
5.0							Brown, Loose to medium dense, Silty sand	SM			
5.5	5.5	UDS-2									
6.0											
6.5											
7.0	7	SPT-3	8	10	12	22					
7.5											
8.0											
8.5	8.5	UDS-3									
9.0											
9.5											
10.0	10	SPT-4	9	12	15	27					

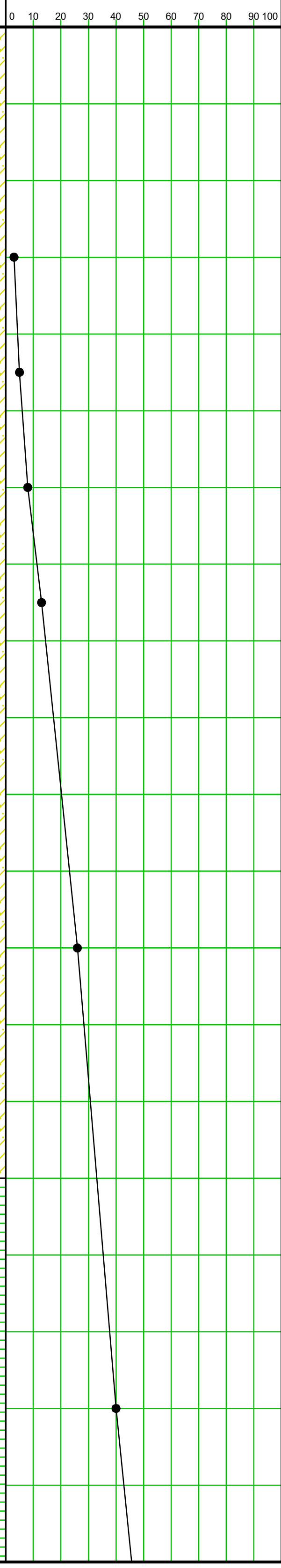


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :New Ch. 10+340 km_Silani Station	*Northing* :3124346.49 m	*Easting* :711500.031 m
Reduced Level (m):(+)194.158	*BH. No.* :BH-PLT-08	*BH Termination Depth (m)*:12
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:4.03	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :21-12-2021	*Date of Completion* :21-12-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Loose/Very loose, Silty sand with gravles	SM-SC			
0.5	0.75	UDS-1									
1.0											
1.5	1.5	SPT-1	1	1	2	3					
2.0											
2.5	2.25	SPT-2	1	2	3	5					
3.0	3	SPT-3	2	3	5	8					
3.5	3.75	SPT-4	3	5	8	13					
4.0									4.03m		
4.5	4.5	UDS-2									
5.0											
5.5											
6.0	6	SPT-5	9	12	14	26					
6.5											
7.0											
7.5	7.5	UDS-3					Brown, Medium dense, Sandy silt with clay	ML-CL			
8.0											
8.5											
9.0	9	SPT-6	14	19	21	40					
9.5											
10.0											



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : New Ch. 10+340 km_Silani Station	*Northing :* 3124346.49 m	*Easting :* 711500.031 m
Reduced Level (m): (+)194.158	*BH. No. :* BH-PLT-08	*BH Termination Depth (m):* 12
Proposed / Existing Structure : Minor Bridge	*Water Table (m):* 4.03	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 21-12-2021	*Date of Completion :* 21-12-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0							Brown, Medium dense, Sandy silt with clay	ML-CL			
10.5	10.5	UDS-4									
11.0											
11.5											
12.0	12	SPT-7	23	27	30	57					

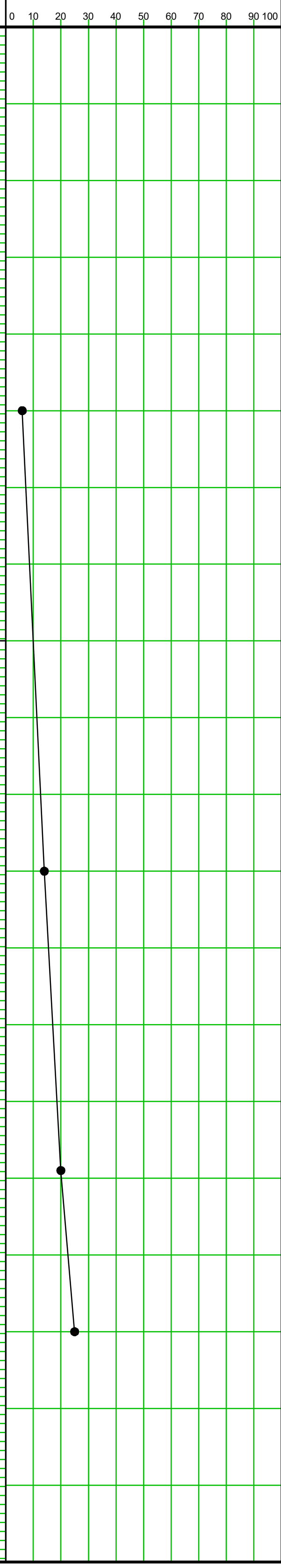
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :9+200 km	*Northing* :3124343.215 m	*Easting* :711334.58 m
Reduced Level (m):(+)194.672	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:1.25	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :05-10-2021	*Date of Completion* :05-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS					Grey, Medium stiff, Silty clay of low plasticity	CL		
0.5										
1.0	1	UDS-1							1.25m	
1.5										
2.0										
2.5	2.5	SPT-1	2	3	3	6				
3.0										
3.5										
4.0	4	UDS-2					Brown, Medium dense, Sandy silt of low plasticity	ML-CL		
4.5										
5.0										
5.5	5.5	SPT-2	4	6	8	14				
6.0										
6.5										
7.0	7	UDS*								
7.5	7.45	SPT-3	5	9	11	20				
8.0										
8.5	8.5	SPT-4	8	11	14	25				
9.0										
9.5										
10.0	10	UDS-3								

(Depth v/s SPT N Value)

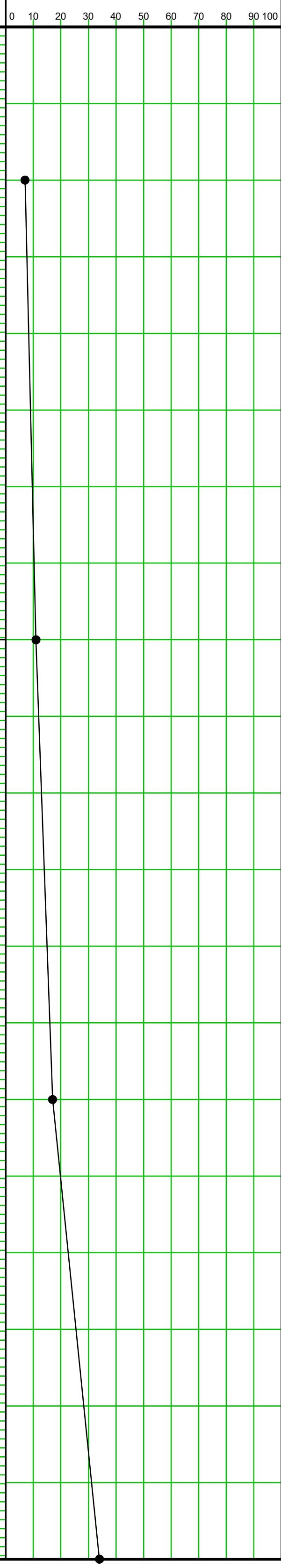


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 9+211 km	*Northing :* 3124342.307 m	*Easting :* 711325.206 m
Reduced Level (m): (+)194.649	*BH. No. :* BH-CL	*BH Termination Depth (m):* 10
Proposed / Existing Structure : Minor Bridge	*Water Table (m):* 1.36	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 06-10-2021	*Date of Completion :* 06-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Soft, Silty clay of low plasticity (0.0–4.0 m)	CL			
0.5											
1.0	1	SPT-1	2	3	4	7					
1.5									1.36m		
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	6	6	5	11					
4.5							Brown, Medium dense to dense, Sandy silt of low plasticity (4.0–10.0 m)	ML-CL			
5.0											
5.5	5.5	UDS-2									
6.0											
6.5											
7.0	7	SPT-3	5	8	9	17					
7.5											
8.0											
8.5	8.5	UDS-3									
9.0											
9.5											
10.0	10	SPT-4	9	12	22	34					



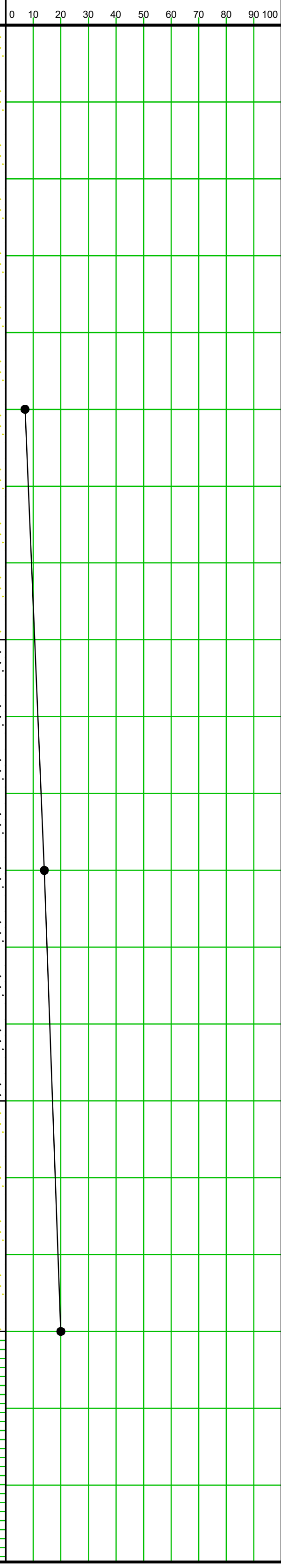
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :9+407 km	*Northing* :3124322.695 m	*Easting* :711125.831 m
Reduced Level (m):(+)193.387	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:0.60	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :27-10-2021	*Date of Completion* :27-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS					Brown, Loose to medium dense, Silty sand	SM	0.60m	
1.0	1	UDS-1								
2.5	2.5	SPT-1	2	3	4	7				
4.0	4	UDS-2					Brown, Loose to medium dense, Silty sand	SP-SM		
5.5	5.5	SPT-2	4	6	8	14				
7.0	7	UDS-3					Brown, Loose to medium dense, Silty sand	SM		
8.5	8.5	SPT-3	7	9	11	20	Brown, Very stiff, Silty clay of low plasticity	CL		
10.0	10	UDS-4								

(Depth v/s SPT N Value)

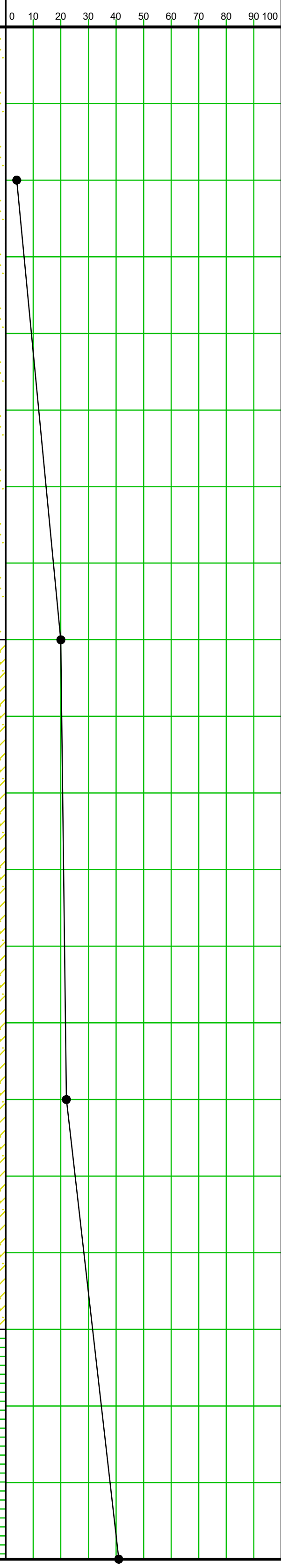


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :9+726 km	*Northing* :3124291.156 m	*Easting* :710810.84 m
Reduced Level (m):(+)194.097	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.85	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :07-10-2021	*Date of Completion* :08-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5											
1.0	1	SPT-1	2	2	2	4			0.85m		
1.5											
2.0							Yellowish brown, Loose, Silty sand	SM			
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	5	8	12	20					
4.5											
5.0											
5.5	5.5	UDS-2									
6.0											
6.5							Brown, Medium dense, Silty sand with clay	SM-SC			
7.0	7	SPT-3	6	10	12	22					
7.5											
8.0											
8.5	8.5	UDS-3									
9.0							Brown, Dense, Sandy silt of low plasticity with gravel	ML-CL			
9.5											
10.0	10	SPT-4	14	18	23	41					



UDS*-UDS not recovered

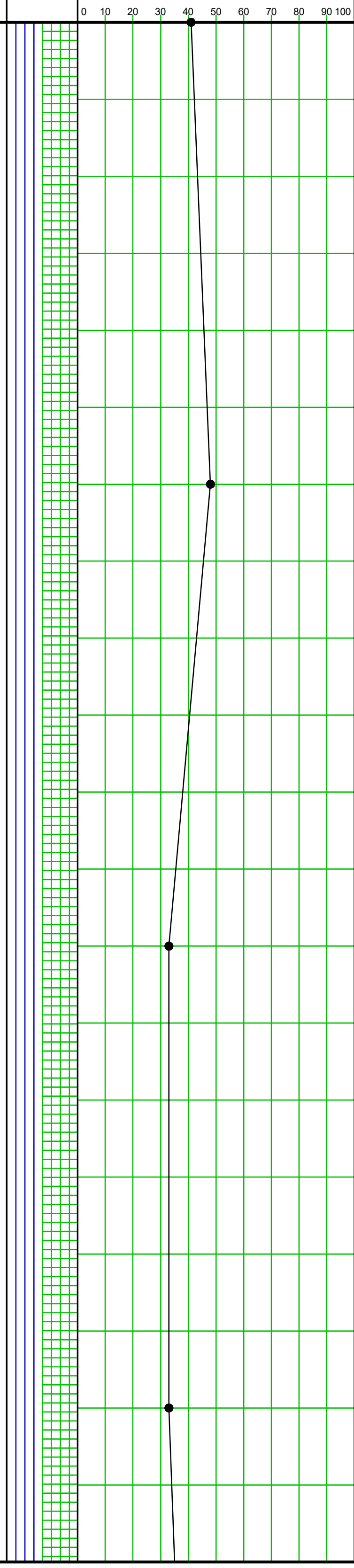
FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 9+726 km	*Northing :* 3124291.156 m	*Easting :* 710810.84 m
Reduced Level (m): (+)194.097	*BH. No. :* BH-A1	*BH Termination Depth (m):* 30
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 0.85	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 07-10-2021	*Date of Completion :* 08-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Special Observations
10.0									
10.5									
11.0									
11.5	11.5	UDS-4							
12.0									
12.5									
13.0	13	SPT-5	13	16	32	48			
13.5									
14.0									
14.5	14.5	UDS-5							
15.0							Brown, Dense, Sandy silt of low plasticity with gravel	ML-CL	
15.5									
16.0	16	SPT-6	11	14	19	33			
16.5									
17.0									
17.5	17.5	UDS-6							
18.0									
18.5									
19.0	19	SPT-7	14	15	18	33			
19.5									
20.0									

Graphic Log

(Depth v/s SPT N Value)



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 9+726 km	*Northing :* 3124291.156 m	*Easting :* 710810.84 m
Reduced Level (m): (+)194.097	*BH. No. :* BH-A1	*BH Termination Depth (m):* 30
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 0.85	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 07-10-2021	*Date of Completion :* 08-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0							Brown, Dense, Sandy silt of low plasticity with gravel	ML-CL			
20.5	20.5	UDS-7									
21.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
21.5											
22.0	22	SPT-8	10	18	21	39					
22.5											
23.0											
23.5	23.5	UDS-8									
24.0											
24.5											
25.0	25	SPT-9	12	21	26	47					
25.5											
26.0											
26.5	26.5	UDS-9									
27.0											
27.5											
28.0	28	SPT-10	48	100 (7cm)	-	>100					
28.5							Brown, Very dense, Silty sand with gravel	SM			
29.0											
29.5	29.5	SPT-11	36	62	38 (6cm)	>100					
30.0	30	DS-2									

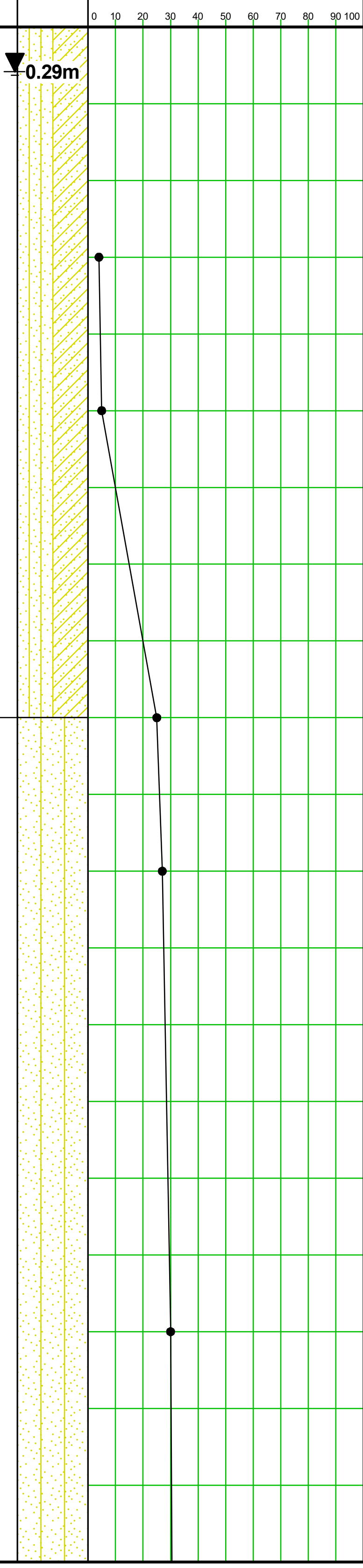
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :9+726 km	*Northing* :3124290.194 m	*Easting* :710802.664 m
Reduced Level (m):(+)193.613	*BH. No.* :BH-A2	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.29	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :28-10-2021	*Date of Completion* :29-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Special Observations
0.0		DS-1					Brown, Loose, Silty sand with clay	SM-SC	
0.5									
1.0	1	UDS*							
1.5	1.5	SPT-1	1	2	2	4			
2.0									
2.5	2.5	SPT-2	2	2	3	5			
3.0									
3.5									
4.0	4	UDS*							
4.5	4.5	SPT-3	8	11	14	25	Brown, Medium dense, Silty sand with gravel	SM	
5.0									
5.5	5.5	SPT-4	9	12	15	27			
6.0									
6.5									
7.0	7	UDS-1							
7.5									
8.0									
8.5	8.5	SPT-5	7	12	18	30			
9.0									
9.5									
10.0	10	UDS-2							

Graphic Log / (Depth v/s SPT N Value)

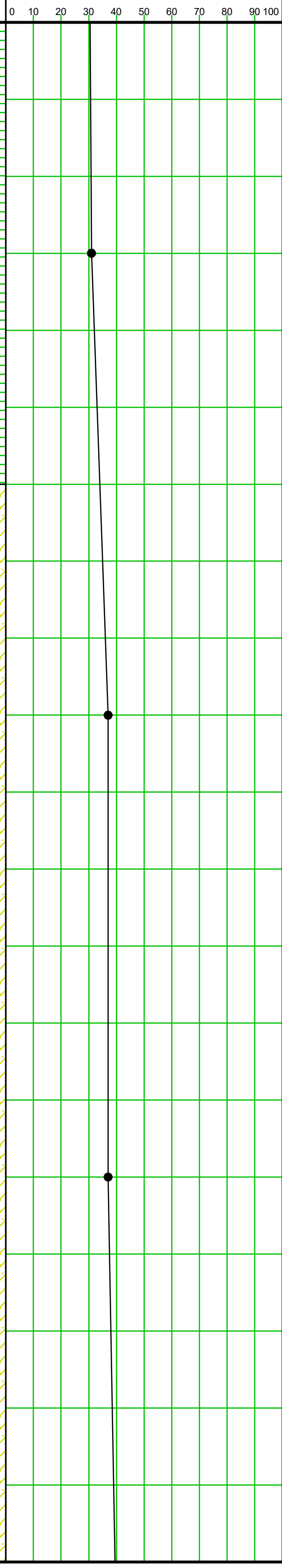


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 9+726 km	*Northing :* 3124290.194 m	*Easting :* 710802.664 m
Reduced Level (m): (+)193.613	*BH. No. :* BH-A2	*BH Termination Depth (m):* 30
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 0.29	*Inclination :* Vertical
Boring type : Shell & Auger	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 28-10-2021	*Date of Completion :* 29-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
10.5											
11.0											
11.5	11.5	SPT-6	9	13	18	31					
12.0											
12.5											
13.0	13	UDS-3					Brown, Dense, Silty sand with clay & gravel	SM-SC			
13.5											
14.0											
14.5	14.5	SPT-7	11	16	21	37					
15.0											
15.5											
16.0	16	UDS-4									
16.5											
17.0											
17.5	17.5	SPT-8	12	15	22	37					
18.0											
18.5											
19.0	19	UDS-5									
19.5											
20.0											



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :9+726 km	*Northing* :3124290.194 m	*Easting* :710802.664 m
Reduced Level (m):(+)193.613	*BH. No.* :BH-A2	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.29	*Inclination :* Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :28-10-2021	*Date of Completion* :29-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-9	13	16	24	40	Brown, Dense, Silty sand with clay & gravel	SM-SC			
21.0											
21.5											
22.0	22	UDS-6									
22.5											
23.0											
23.5	23.5	SPT-10	14	18	27	45					
24.0											
24.5											
25.0	25	UDS-7									
25.5											
26.0											
26.5	26.5	SPT-11	16	22	36	58					
27.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
27.5											
28.0	28	UDS-8									
28.5											
29.0											
29.5	29.5	SPT-12	21	30	39	69					
30.0	29.95	DS-2									

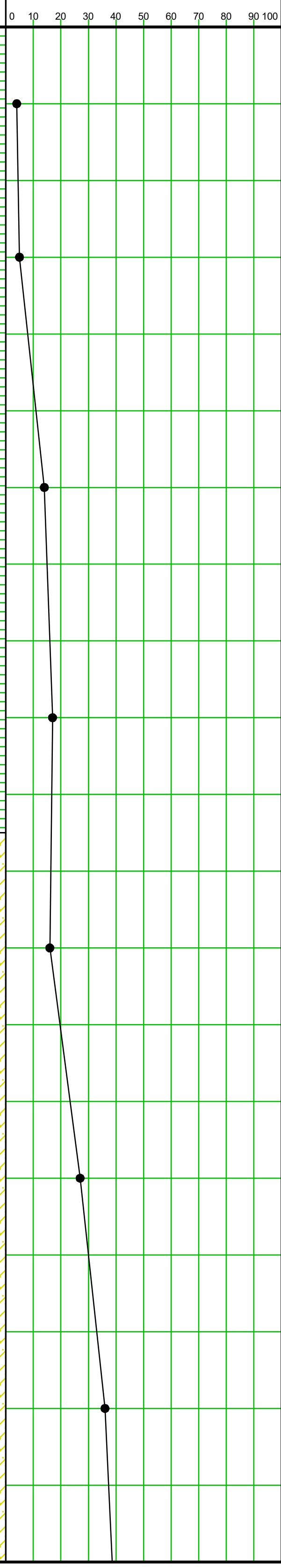
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 9+772 km	*Northing :* 3124285.182 m	*Easting :* 710762.491 m
Reduced Level (m): (+)193.598	*BH. No. :* BH-CL	*BH Termination Depth (m):* 12
Proposed / Existing Structure : Minor Bridge	*Water Table (m):* 0.60	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 10-11-2021	*Date of Completion :* 10-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS					Brown, Loose to medium dense, Sandy silt of low plasticity	ML-CL		
0.5	0.5	SPT-1	1	2	2	4			0.60m	
1.0										
1.5	1.5	SPT-2	2	2	3	5				
2.0										
	2.25	UDS-1								
2.5										
3.0	3	SPT-3	4	6	8	14				
3.5										
4.0										
4.5	4.5	SPT-4	3	7	10	17				
5.0										
	5.25	UDS-2								
5.5							Brown, Medium dense to dense, Silty sand with clay & gravel	SM-SC		
6.0	6	SPT-5	5	7	9	16				
6.5										
7.0										
7.5	7.5	SPT-6	8	12	15	27				
8.0										
	8.25	UDS-3								
8.5										
9.0	9	SPT-7	12	16	20	36				
9.5										
10.0										

(Depth v/s SPT N Value)

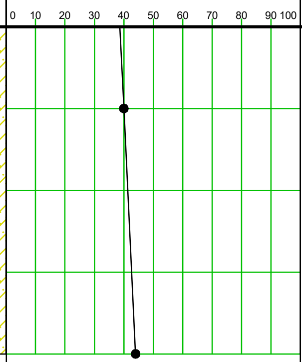


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :9+772 km	*Northing* :3124285.182 m	*Easting* :710762.491 m
Reduced Level (m):(+)193.598	*BH. No.* :BH-CL	*BH Termination Depth (m)*:12
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:0.60	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :10-11-2021	*Date of Completion* :10-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5	10.5	SPT-8	14	18	22	40	Brown, Medium dense to dense, Silty sand with clay & gravel	SM-SC			
11.0											
	11.25	UDS-4									
11.5											
12.0	12	SPT-9	16	20	24	44					

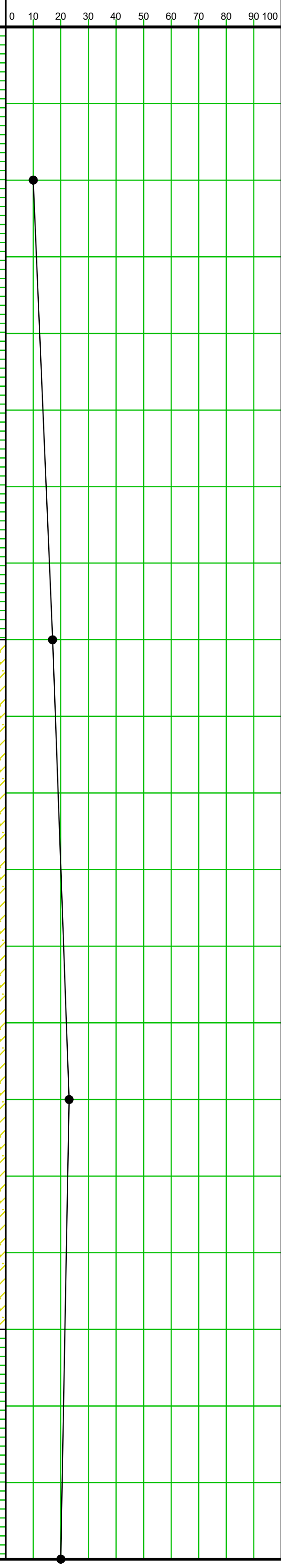


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*10+025 km	*Northing :*3124244.432 m	*Easting :*710515.298 m
Reduced Level (m):(+)194.595	*BH. No. :*BH-A1	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*1.34	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*05-10-2021	*Date of Completion :*06-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Yellowish brown, Loose, Sandy silt of low plasticity	ML-CL			
0.5											
1.0	1	SPT-1	2	3	7	10					
1.5									1.34m		
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	5	6	11	17					
4.5							Yellowish brown, Medium dense, Silty sand with clay & gravel	SM-SC			
5.0											
5.5	5.5	UDS-2									
6.0											
6.5											
7.0	7	SPT-3	7	10	13	23					
7.5											
8.0											
8.5	8.5	UDS-3									
9.0							Yellowish brown, Medium dense, Sandy silt of low plasticity	ML-CL			
9.5											
10.0	10	SPT-4	6	9	11	20					

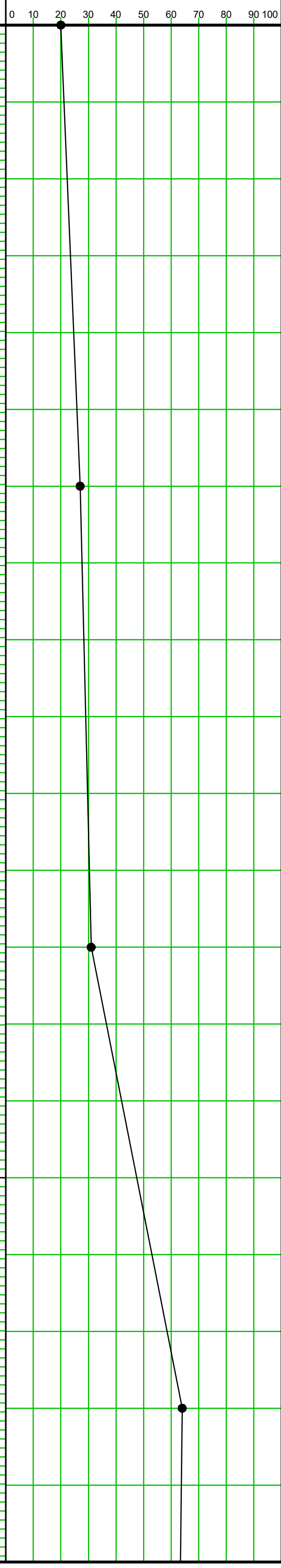


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+025 km	*Northing* :3124244.432 m	*Easting* :710515.298 m
Reduced Level (m):(+)194.595	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:1.34	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :05-10-2021	*Date of Completion* :06-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	UDS-4									
12.0											
12.5											
13.0	13	SPT-5	8	12	15	27					
13.5											
14.0							Yellowish brown, Medium dense, Sandy silt of low plasticity	ML-CL			
14.5	14.5	UDS-5									
15.0											
15.5											
16.0	16	SPT-6	9	14	17	31					
16.5											
17.0											
17.5	17.5	UDS-6									
18.0											
18.5											
19.0	19	SPT-7	13	30	34	64	Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL			
19.5											
20.0											

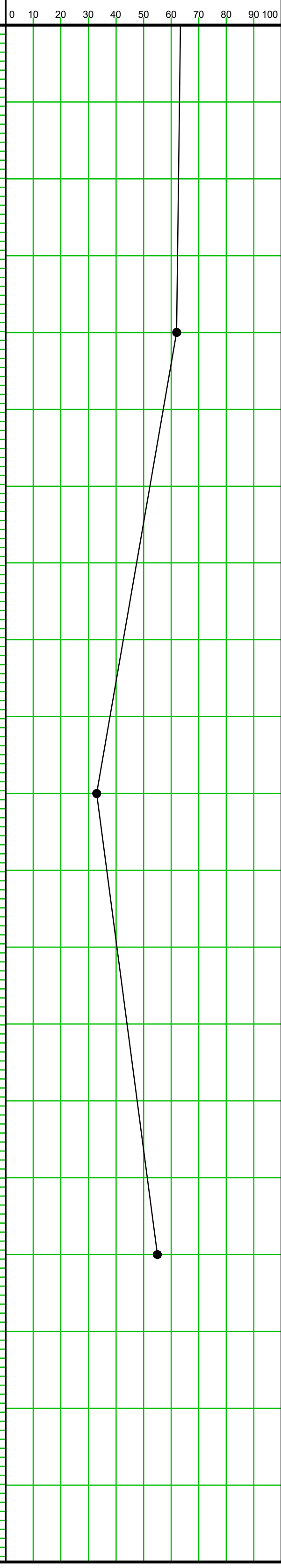


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+025 km	*Northing* :3124244.432 m	*Easting* :710515.298 m
Reduced Level (m):(+)194.595	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:1.34	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :05-10-2021	*Date of Completion* :06-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	UDS-7									
21.0											
21.5											
22.0	22	SPT-8	14	25	37	62					
22.5											
23.0											
23.5	23.5	UDS-8									
24.0											
24.5											
25.0	25	SPT-9	12	14	19	33	Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL			
25.5											
26.0											
26.5	26.5	UDS-9									
27.0											
27.5											
28.0	28	SPT-10	15	25	30	55					
28.5											
29.0											
29.5	29.5	UDS-10									
30.0	29.95	DS-2									



UDS*-UDS not recovered

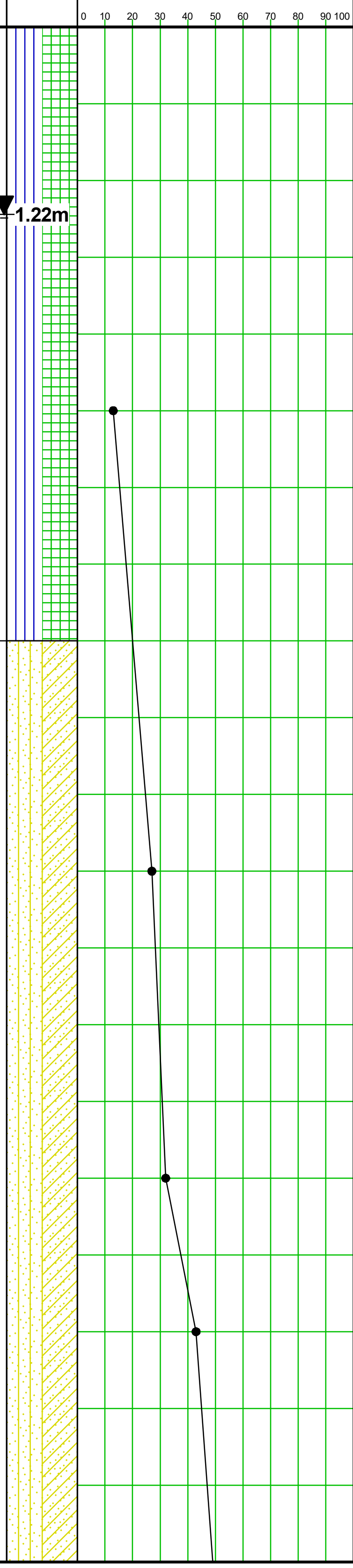
FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 10+025 km	*Northing :* 3124242.99 m	*Easting :* 710507.526 m
Reduced Level (m): (+)194.589	*BH. No. :* BH-A2	*BH Termination Depth (m):* 30
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 1.22	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 05-10-2021	*Date of Completion :* 06-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Special Observations
0.0		DS-1					Yellowish brown, Medium dense, Sandy silt of low plasticity	ML-CL	
1.0	1	UDS-1							
2.5	2.5	SPT-1	4	6	7	13			
4.0	4	UDS-2					Yellowish brown, Medium dense to dense, Silty sand with clay & gravel	SM-SC	
5.5	5.5	SPT-2	9	12	15	27			
7.0	7	UDS*							
7.5	7.5	SPT-3	10	15	17	32			
8.5	8.5	SPT-4	15	18	25	43			
10.0	10	UDS-3							

Water table: 1.22m

(Depth v/s SPT N Value)



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+025 km	*Northing* :3124242.99 m	*Easting* :710507.526 m
Reduced Level (m):(+)194.589	*BH. No.* :BH-A2	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:1.22	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :05-10-2021	*Date of Completion* :06-10-2021	

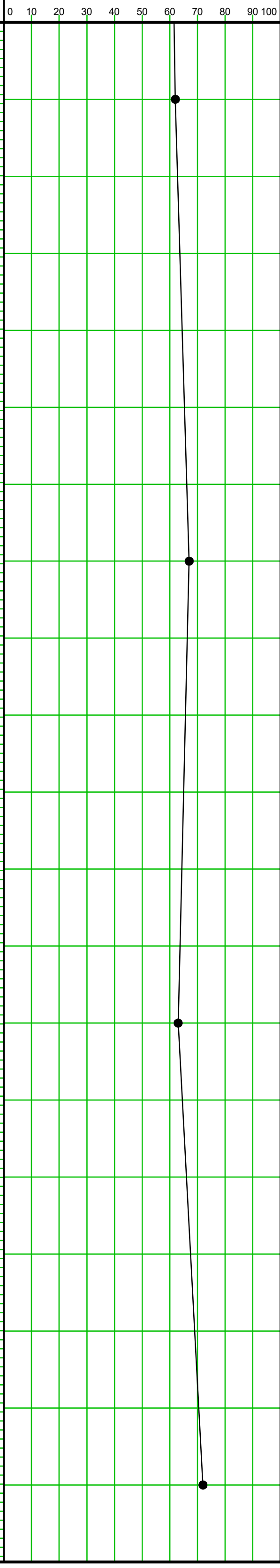
Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-5	14	25	30	55					
12.0											
12.5											
13.0	13	UDS-4									
13.5											
14.0											
14.5	14.5	SPT-6	13	23	31	54	Yellowish brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
15.0											
15.5											
16.0	16	UDS-5									
16.5											
17.0											
17.5	17.5	SPT-7	15	24	35	59					
18.0											
18.5											
19.0	19	UDS-6									
19.5							Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL			
20.0											

UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+025 km	*Northing* :3124242.99 m	*Easting* :710507.526 m
Reduced Level (m):(+)194.589	*BH. No.* :BH-A2	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:1.22	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :05-10-2021	*Date of Completion* :06-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-8	17	25	37	62					
21.0											
21.5											
22.0	22	UDS-7									
22.5											
23.0											
23.5	23.5	SPT-9	18	27	40	67					
24.0											
24.5											
25.0	25	UDS-8					Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL			
25.5											
26.0											
26.5	26.5	SPT-10	20	27	36	63					
27.0											
27.5											
28.0	28	UDS-9									
28.5											
29.0											
29.5	29.5	SPT-11	25	32	40	72					
30.0	29.95	DS-2									

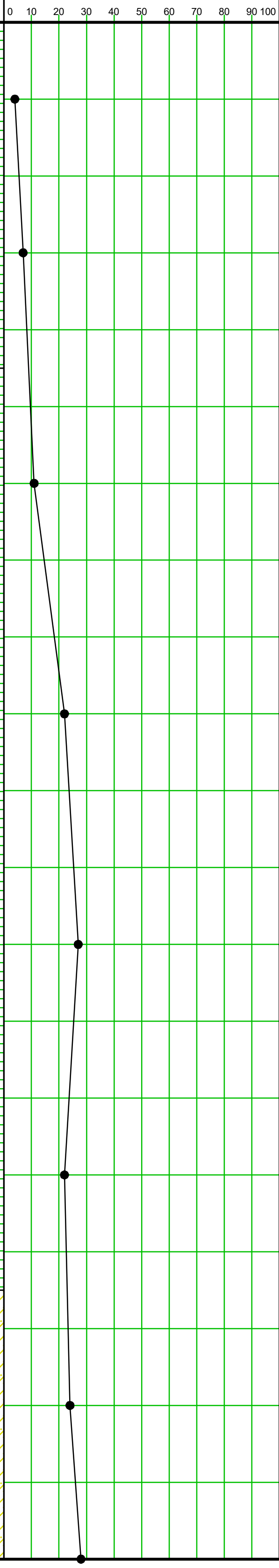


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*10+223 km	*Northing :*3124207.834 m	*Easting :*710317.973 m
Reduced Level (m):(+)194.116	*BH. No. :*BH-CL	*BH Termination Depth (m):*10
*Proposed / Existing Structure :*Minor Bridge	*Water Table (m):*3.50	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*29-10-2021	*Date of Completion :*29-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Loose, Sandy silt of low plasticity	ML-CL			
0.5	0.5	SPT-1	2	2	2	4					
1.0											
1.5	1.5	SPT-2	2	3	4	7					
2.0											
	2.25	UDS-1					Brown, Medium dense, Sandy silt of low plasticity	ML-CL			
2.5											
3.0	3	SPT-3	3	5	6	11					
3.5									3.50m		
4.0											
4.5	4.5	SPT-4	8	10	12	22					
5.0											
	5.25	UDS-2									
5.5											
6.0	6	SPT-5	10	12	15	27					
6.5											
7.0											
7.5	7.5	SPT-6	7	10	12	22					
8.0											
	8.25	UDS-3					Brown, Medium dense, Silty sand with clay	SM-SC			
8.5											
9.0	9	SPT-7	8	11	13	24					
9.5											
10.0	10	SPT-8	10	12	16	28					



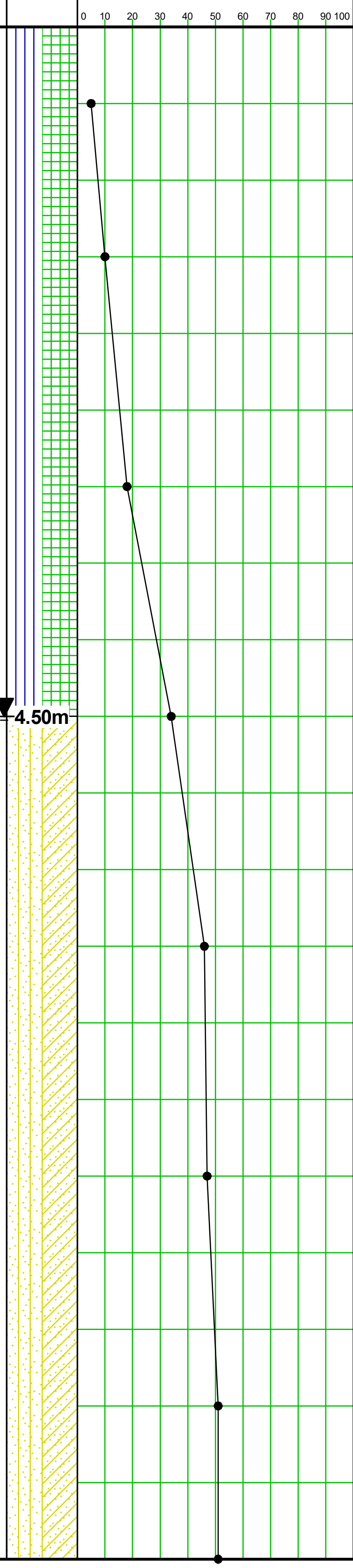
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+519 km	*Northing* :3124153.189 m	*Easting* :710023.336 m
Reduced Level (m):(+)194.584	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:4.50	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :29-10-2021	*Date of Completion* :29-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Special Observations
0.0		DS					Brown, Loose to medium dense, Sandy silt of low plasticity	ML-CL	
0.5	0.5	SPT-1	2	2	3	5			
1.0									
1.5	1.5	SPT-2	3	4	6	10			
2.0									
	2.25	UDS-1							
2.5									
3.0	3	SPT-3	5	6	12	18			
3.5									
4.0									
4.5	4.5	SPT-4	7	12	22	34	Brown, Dense to very dense, Silty sand with clay & gravel	SM-SC	
5.0									
	5.25	UDS-2							
5.5									
6.0	6	SPT-5	12	20	26	46			
6.5									
7.0									
7.5	7.5	SPT-6	14	22	25	47			
8.0									
	8.25	UDS-3							
8.5									
9.0	9	SPT-7	12	23	28	51			
9.5									
10.0	10	SPT-8	13	24	27	51			

Graphic Log / (Depth v/s SPT N Value)



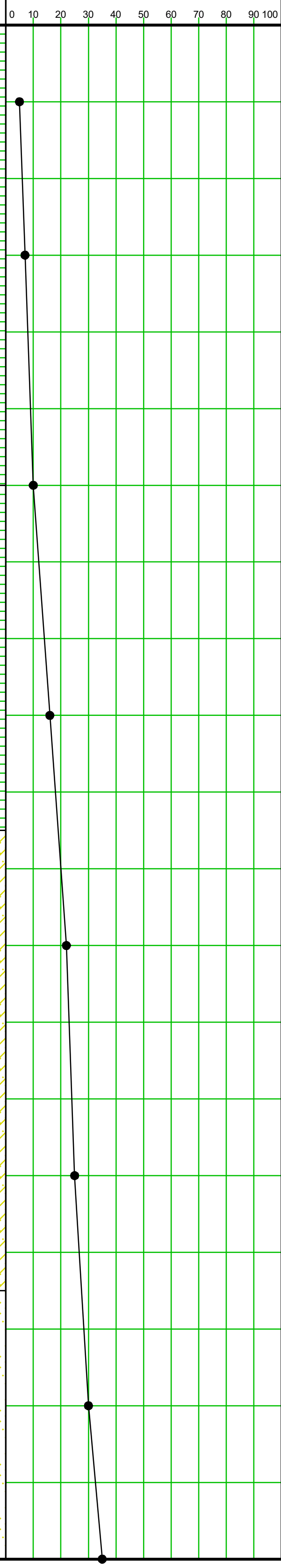
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+658 km	*Northing* :3124128.59 m	*Easting* :709890.704 m
Reduced Level (m):(+)194.898	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:3.20	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :29-10-2021	*Date of Completion* :29-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS					Brown, Loose, Sandy silt of low plasticity	ML-CL		
0.5	0.5	SPT-1	2	2	3	5				
1.0										
1.5	1.5	SPT-2	2	3	4	7				
2.0										
	2.25	UDS-1								
2.5										
3.0	3	SPT-3	3	4	6	10				
3.5							Brown, Stiff to very stiff, Silty clay of low plasticity	CL	3.20m	
4.0										
4.5	4.5	SPT-4	5	7	9	16				
5.0										
	5.25	UDS-2								
5.5							Brown, Medium dense, Silty sand with clay	SM-SC		
6.0	6	SPT-5	8	10	12	22				
6.5										
7.0										
7.5	7.5	SPT-6	10	11	14	25				
8.0										
	8.25	UDS-3								
8.5							Brown, Dense, Silty sand	SM		
9.0	9	SPT-7	12	14	16	30				
9.5										
10.0	10	SPT-8	13	17	18	35				

(Depth v/s SPT N Value)

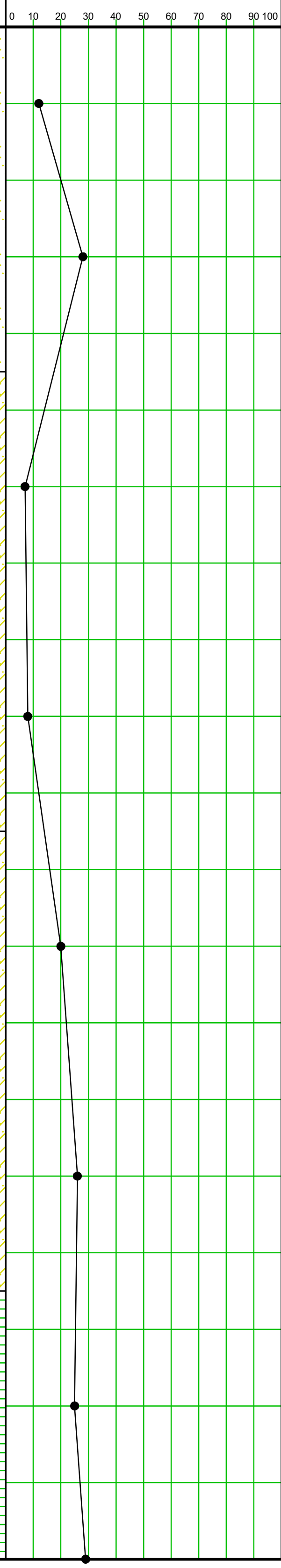


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+718 km	*Northing* :3124117.642 m	*Easting* :709831.671 m
Reduced Level (m):(+)193.997	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:2.50	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :29-10-2021	*Date of Completion* :29-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Medium dense, Silty sand	SM			
0.5	0.5	SPT-1	4	4	8	12					
1.0											
1.5	1.5	SPT-2	6	13	15	28					
2.0											
	2.25	UDS-1					Brown, Loose, Silty sand with clay	SM-SC			
2.5									2.50m		
3.0	3	SPT-3	2	3	4	7					
3.5											
4.0											
4.5	4.5	SPT-4	3	3	5	8					
5.0											
	5.25	UDS-2					Brown, Medium dense, Silty sand with clay	SM-SC			
5.5											
6.0	6	SPT-5	4	8	12	20					
6.5											
7.0											
7.5	7.5	SPT-6	5	10	16	26					
8.0											
	8.25	UDS-3					Brown, Medium dense, Sandy silt of low plasticity	ML-CL			
8.5											
9.0	9	SPT-7	7	11	14	25					
9.5											
10.0	10	SPT-8	6	13	16	29					

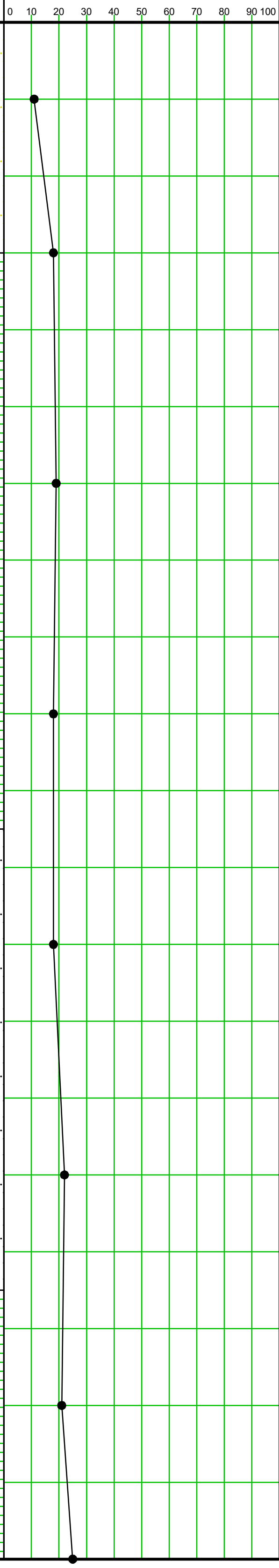


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+749 km	*Northing* :3124111.993 m	*Easting* :709801.215 m
Reduced Level (m):(+)194.893	*BH. No.* :BH-CL	*BH Termination Depth (m)*:10
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:2.60	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :29-10-2021	*Date of Completion* :29-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Medium dense, Silty sand (0.0–1.5 m)	SM			
0.5	0.5	SPT-1	4	5	6	11					
1.0											
1.5	1.5	SPT-2	5	8	10	18	Brown, Medium dense, Sandy silt of low plasticity (1.5–5.25 m)	ML-CL			
2.0											
	2.25	UDS-1									
2.5									2.60m		
3.0	3	SPT-3	4	8	11	19					
3.5											
4.0											
4.5	4.5	SPT-4	5	8	10	18					
5.0											
	5.25	UDS-2					Brown, Medium dense, Silty sand (5.25–8.25 m)	SP-SM			
5.5											
6.0	6	SPT-5	4	7	11	18					
6.5											
7.0											
7.5	7.5	SPT-6	4	8	14	22					
8.0											
	8.25	UDS-3					Brown, Medium dense, Sandy silt of low plasticity (8.25–10.0 m)	ML-CL			
8.5											
9.0	9	SPT-7	6	9	12	21					
9.5											
10.0	10	SPT-8	7	11	14	25					



UDS*-UDS not recovered

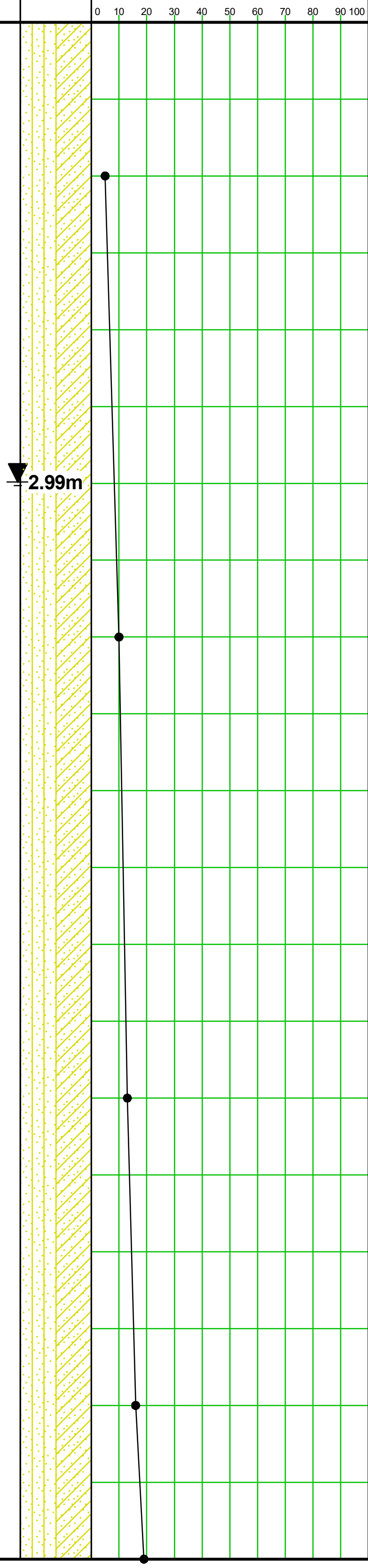
FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+859 km	*Northing* :3124103.149 m	*Easting* :709761.805 m
Reduced Level (m):(+)195.206	*BH. No.* :BH-A1(R)	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:2.99	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :08-10-2021	*Date of Completion* :10-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Special Observations
0.0		DS							
0.5									
1.0	1	SPT-1	2	2	3	5			
1.5									
2.0									
2.5	2.5	UDS-1							
3.0									
3.5									
4.0	4	SPT-2	3	4	6	10			
4.5									
5.0							Brown, Loose to medium dense, Silty sand with clay	SM-SC	
5.5	5.5	UDS-2							
6.0									
6.5									
7.0	7	SPT-3	4	6	7	13			
7.5									
8.0									
8.5	8.5	UDS*							
9.0	9	SPT-4	5	7	9	16			
9.5									
10.0	10	SPT-5	6	8	11	19			

Graphic Log

(Depth v/s SPT N Value)

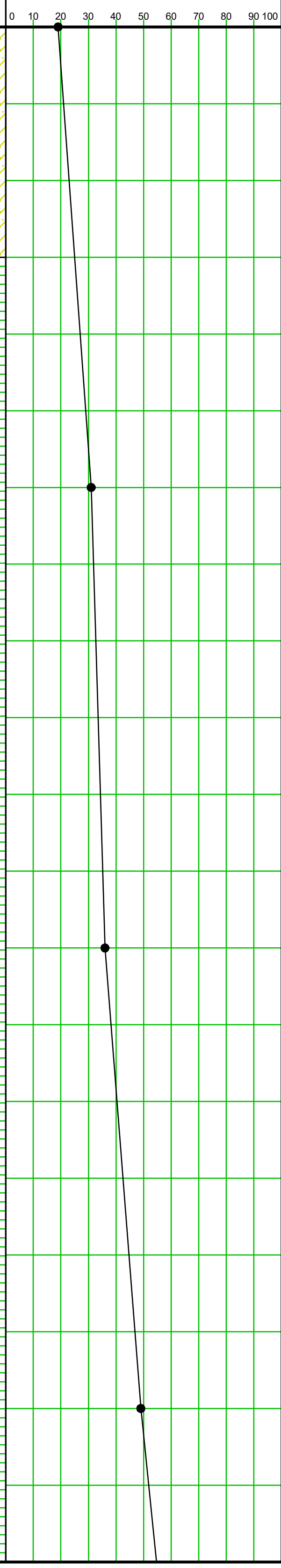


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+859 km	*Northing* :3124103.149 m	*Easting* :709761.805 m
Reduced Level (m):(+)195.206	*BH. No.* :BH-A1(R)	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:2.99	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :08-10-2021	*Date of Completion* :10-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5							Brown, Loose to medium dense, Silty sand with clay	SM-SC			
11.0											
11.5	11.5	UDS-3									
12.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
12.5											
13.0	13	SPT-6	8	12	19	31					
13.5											
14.0											
14.5	14.5	UDS-4									
15.0											
15.5											
16.0	16	SPT-7	9	16	20	36					
16.5											
17.0											
17.5	17.5	UDS-5									
18.0											
18.5											
19.0	19	SPT-8	13	21	28	49					
19.5											
20.0											

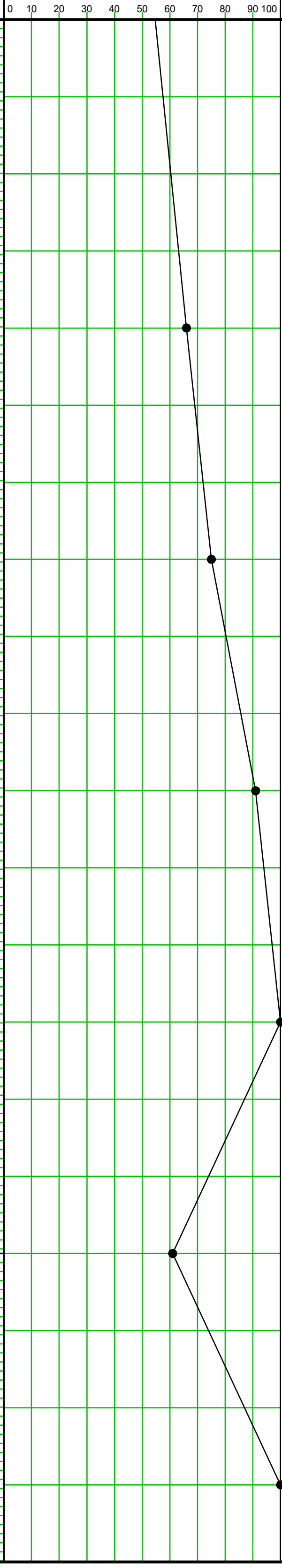


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 10+859 km	*Northing :* 3124103.149 m	*Easting :* 709761.805 m
Reduced Level (m): (+)195.206	*BH. No. :* BH-A1(R)	*BH Termination Depth (m):* 40
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 2.99	*Inclination :* Vertical
Boring type : Shell & Auger	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 08-10-2021	*Date of Completion :* 10-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	UDS-6					Brown, Hard, Silty clay of low plasticity with gravel	CL			
21.0											
21.5											
22.0	22	SPT-9	16	29	37	66					
22.5											
23.0											
23.5	23.5	SPT-10	19	34	41	75					
24.0											
24.5											
25.0	25	SPT-11	31	43	48	91					
25.5											
26.0											
26.5	26.5	SPT-12	33	54	46 (8cm)	>100					
27.0											
27.5											
28.0	28	SPT-13	16	28	33	61					
28.5							Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
29.0											
29.5	29.5	SPT-14	35	61	39 (11cm)	>100					
30.0											

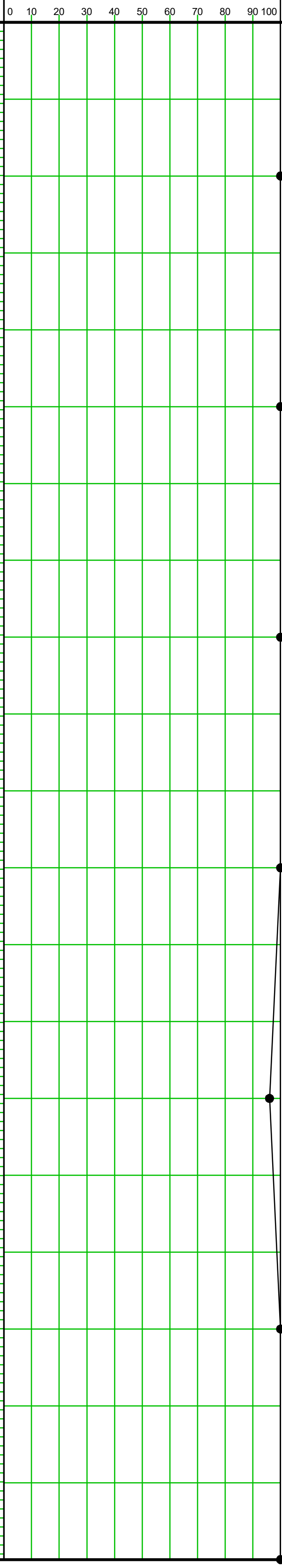


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+859 km	*Northing* :3124103.149 m	*Easting* :709761.805 m
Reduced Level (m):(+)195.206	*BH. No.* :BH-A1(R)	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:2.99	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :08-10-2021	*Date of Completion* :10-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0											
30.5											
31.0	31	SPT-15	30	46	54 (14cm)	>100					
31.5											
32.0											
32.5	32.5	SPT-16	34	50	50 (10cm)	>100					
33.0											
33.5											
34.0	34	SPT-17	37	60	40 (7cm)	>100					
34.5											
35.0							Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
35.5	35.5	SPT-18	32	66	34 (5cm)	>100					
36.0											
36.5											
37.0	37	SPT-19	25	41	55	96					
37.5											
38.0											
38.5	38.5	SPT-20	31	49	51 (5cm)	>100					
39.0											
39.5											
40.0	40	SPT-21	32	54	46 (8cm)	>100					



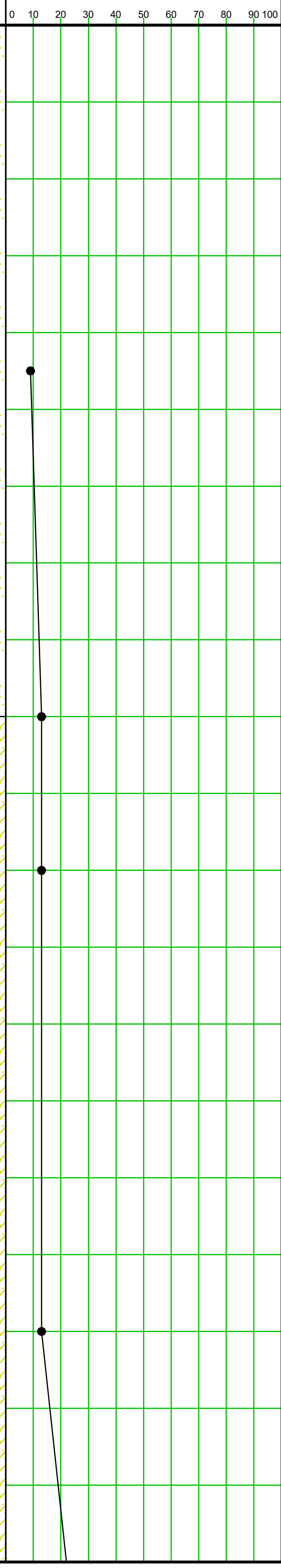
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+859 km	*Northing* :3124097.508 m	*Easting* :709723.114 m
Reduced Level (m):(+)194.772	*BH. No.* :BH-A1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:2.95	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :06-10-2021	*Date of Completion* :07-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS					Brown, Loose, Silty sand (0.0–4.5)	SM		
0.5										
1.0	1	UDS-1								
1.5										
2.0										
	2.25	SPT-1	3	4	5	9				
2.5										
3.0									2.95m	
3.5										
4.0	4	UDS*								
4.5	4.5	SPT-2	4	5	8	13	Brown, Medium dense, Silty sand with clay (4.5–10.0)	SM-SC		
5.0										
5.5	5.5	SPT-3	6	6	7	13				
6.0										
6.5										
7.0	7	UDS-2								
7.5										
8.0										
8.5	8.5	SPT-4	4	5	8	13				
9.0										
9.5										
10.0	10	UDS-3								

(Depth v/s SPT N Value)

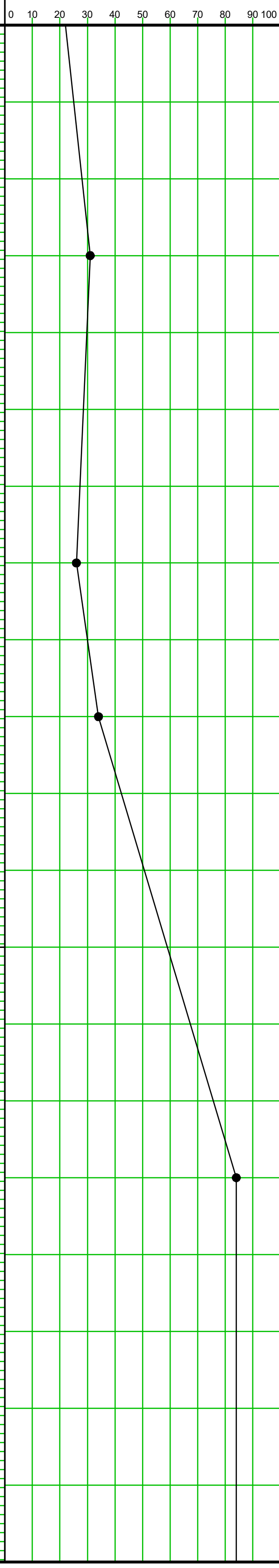


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+859 km	*Northing* :3124097.508 m	*Easting* :709723.114 m
Reduced Level (m):(+)194.772	*BH. No.* :BH-A1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:2.95	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :06-10-2021	*Date of Completion* :07-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-5	11	13	18	31					
12.0											
12.5											
13.0	13	UDS*					Brown, Very stiff to hard, Silty clay of low plasticity with gravel	CL			
13.5	13.5	SPT-6	7	10	16	26					
14.0											
14.5	14.5	SPT-7	8	14	20	34					
15.0											
15.5											
16.0	16	UDS-4									
16.5											
17.0											
17.5	17.5	SPT-8	26	35	49	84					
18.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
18.5											
19.0	19	UDS-5									
19.5											
20.0											

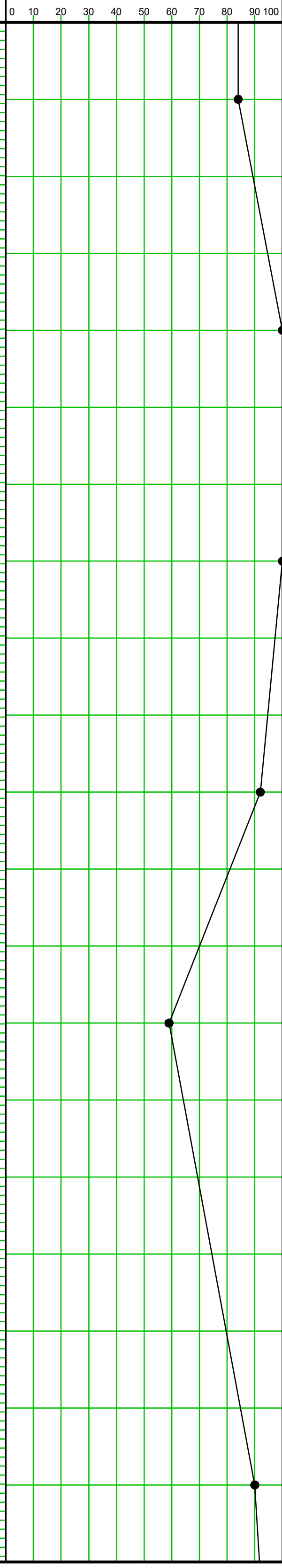


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+859 km	*Northing* :3124097.508 m	*Easting* :709723.114 m
Reduced Level (m):(+)194.772	*BH. No.* :BH-A1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:2.95	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :06-10-2021	*Date of Completion* :07-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-9	16	35	49	84					
21.0											
21.5											
22.0	22	SPT-10	41	72	28 (5cm)	>100					
22.5											
23.0											
23.5	23.5	SPT-11	35	48	52 (12cm)	>100					
24.0											
24.5											
25.0	25	SPT-12	30	40	52	92	Brown, Hard, Silty clay of low plasticity with gravel	CL			
25.5											
26.0											
26.5	26.5	SPT-13	15	26	33	59					
27.0											
27.5											
28.0	28	UDS-6									
28.5											
29.0											
29.5	29.5	SPT-14	22	52	38	90					
30.0											

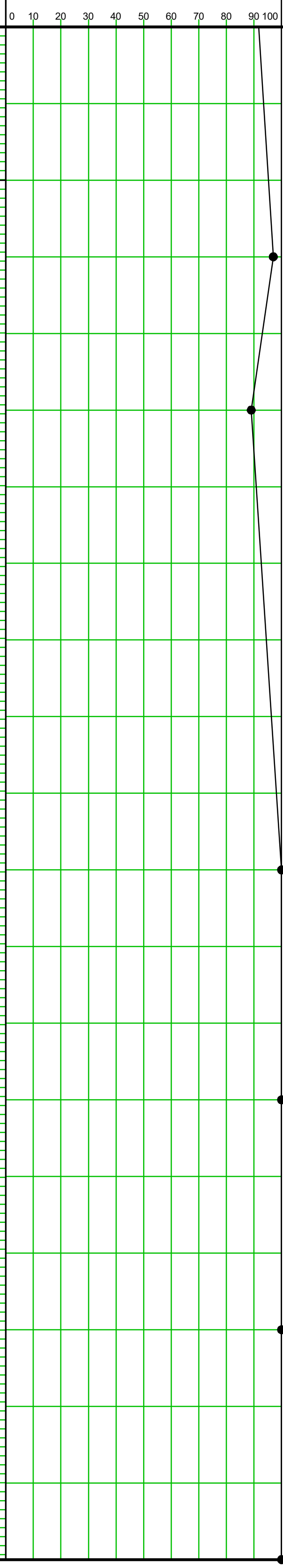


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+859 km	*Northing* :3124097.508 m	*Easting* :709723.114 m
Reduced Level (m):(+)194.772	*BH. No.* :BH-A1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:2.95	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :06-10-2021	*Date of Completion* :07-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0											
30.5							Brown, Hard, Silty clay of low plasticity with gravel	CL			
31.0	31	UDS*									
31.5	31.5	SPT-15	24	45	52	97					
32.0											
32.5	32.5	SPT-16	22	41	48	89					
33.0											
33.5											
34.0	34	UDS-7									
34.5											
35.0											
35.5	35.5	SPT-17	26	48	52 (13cm)	>100	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
36.0											
36.5											
37.0	37	SPT-18	30	56	44 (9cm)	>100					
37.5											
38.0											
38.5	38.5	SPT-19	28	43	52 (8cm)	>100					
39.0											
39.5											
40.0	40	SPT-20	32	58	47 (6cm)	>100					

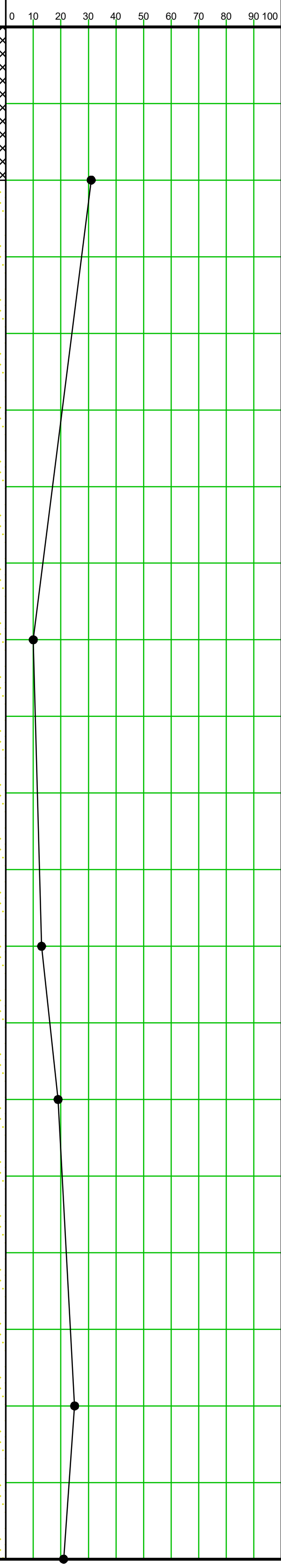


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+859 km	*Northing* :3124089.603 m	*Easting* :709681.945 m
Reduced Level (m):(+)195.316	*BH. No.* :BH-P1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:3.35	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :06-10-2021	*Date of Completion* :09-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5							Filled up strata	FILL			
1.0	1	SPT-1	10	14	17	31					
1.5											
2.0											
2.5	2.5	UDS-1									
3.0											
3.5									3.35m		
4.0	4	SPT-2	3	4	6	10					
4.5											
5.0											
5.5	5.5	UDS*					Brown, Loose to medium dense, Silty sand	SM			
6.0	6	SPT-3	4	5	8	13					
6.5											
7.0	7	SPT-4	6	8	11	19					
7.5											
8.0											
8.5	8.5	UDS*									
9.0	9	SPT-5	6	11	14	25					
9.5											
10.0	10	SPT-6	7	9	12	21					

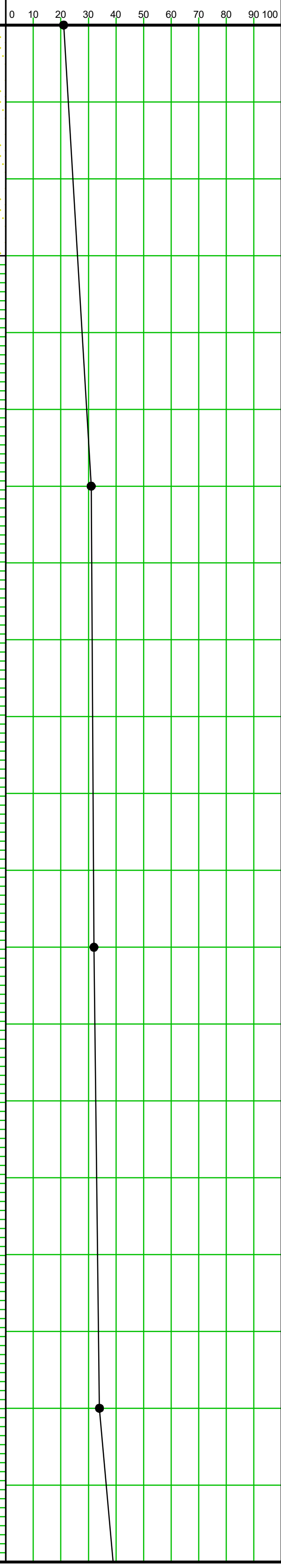


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+859 km	*Northing* :3124089.603 m	*Easting* :709681.945 m
Reduced Level (m):(+)195.316	*BH. No.* :BH-P1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:3.35	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :06-10-2021	*Date of Completion* :09-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0							Brown, Loose to medium dense, Silty sand	SM			
10.5											
11.0											
11.5	11.5	UDS-2									
12.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
12.5											
13.0	13	SPT-7	8	14	17	31					
13.5											
14.0											
14.5	14.5	UDS-3									
15.0											
15.5											
16.0	16	SPT-8	10	14	18	32					
16.5											
17.0											
17.5	17.5	UDS-4									
18.0											
18.5											
19.0	19	SPT-9	10	15	19	34					
19.5											
20.0											

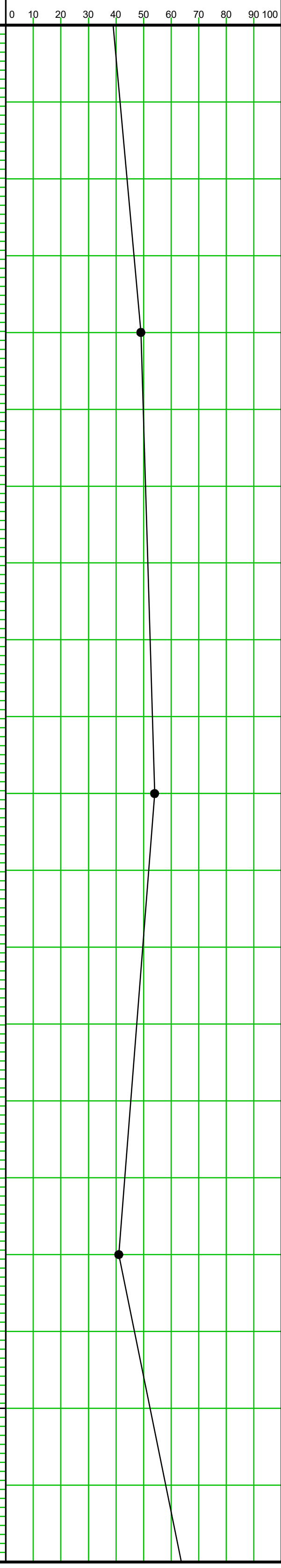


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*10+859 km	*Northing :*3124089.603 m	*Easting :*709681.945 m
Reduced Level (m):(+)195.316	*BH. No. :*BH-P1	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*3.35	*Inclination :* Vertical
*Boring type :*Shell & Auger	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*06-10-2021	*Date of Completion :*09-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	UDS-5					Brown, Hard, Silty clay of low plasticity with gravel	CL			
21.0											
21.5											
22.0	22	SPT-10	14	19	30	49					
22.5											
23.0											
23.5	23.5	UDS-6									
24.0											
24.5											
25.0	25	SPT-11	15	21	33	54					
25.5											
26.0											
26.5	26.5	UDS-7									
27.0											
27.5											
28.0	28	SPT-12	11	17	24	41					
28.5											
29.0											
29.5	29.5	UDS-8					Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
30.0											

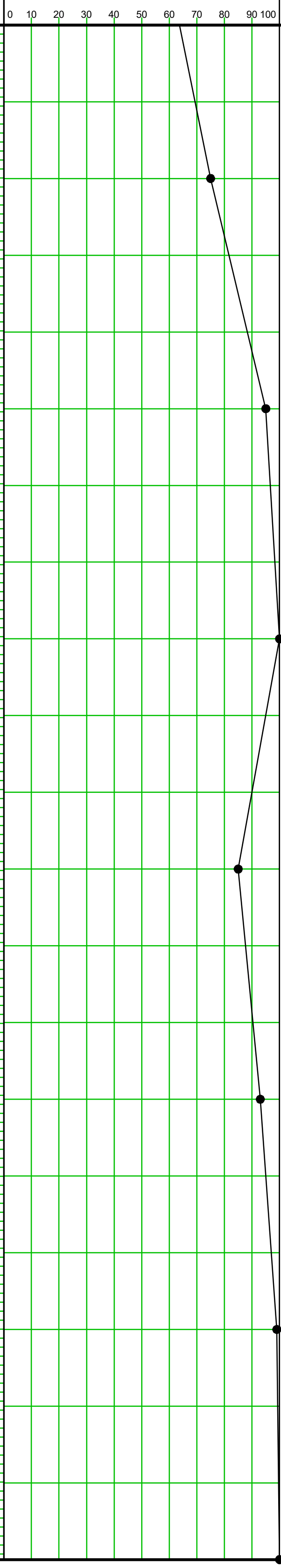


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+859 km	*Northing* :3124089.603 m	*Easting* :709681.945 m
Reduced Level (m):(+)195.316	*BH. No.* :BH-P1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:3.35	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :06-10-2021	*Date of Completion* :09-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0											
30.5											
31.0	31	SPT-13	22	35	40	75					
31.5											
32.0											
32.5	32.5	SPT-14	34	43	52	95					
33.0											
33.5											
34.0	34	SPT-15	38	58	42 (6cm)	>100					
34.5											
35.0							Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
35.5	35.5	SPT-16	25	30	55	85					
36.0											
36.5											
37.0	37	SPT-17	23	41	52	93					
37.5											
38.0											
38.5	38.5	SPT-18	28	44	55	99					
39.0											
39.5											
40.0	40	SPT-19	33	60	40 (10cm)	>100					

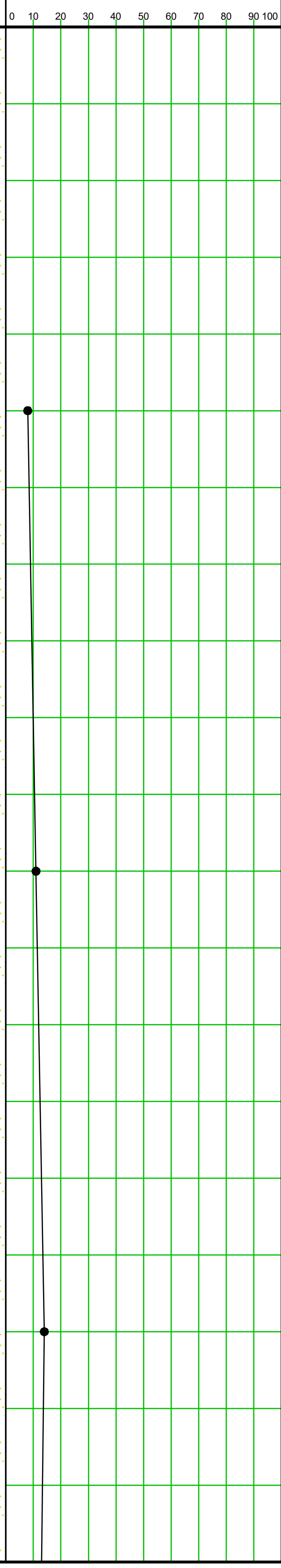


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*10+859 km	*Northing :*3124072.923 m	*Easting :*709602.681 m
Reduced Level (m):(+)195.247	*BH. No. :*BH-A2	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*5.60	*Inclination :* Vertical
*Boring type :*Shell & Auger	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*18-11-2021	*Date of Completion :*21-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5											
1.0	1	UDS-1									
1.5											
2.0											
2.5	2.5	SPT-1	2	3	5	8					
3.0											
3.5											
4.0	4	UDS-2									
4.5											
5.0							Brown, Loose to medium dense, Silty sand	SM			
5.5	5.5	SPT-2	3	4	7	11			5.60m		
6.0											
6.5											
7.0	7	UDS-3									
7.5											
8.0											
8.5	8.5	SPT-3	4	6	8	14					
9.0											
9.5											
10.0	10	UDS-4									



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+859 km	*Northing* :3124072.923 m	*Easting* :709602.681 m
Reduced Level (m):(+)195.247	*BH. No.* :BH-A2	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:5.60	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :18-11-2021	*Date of Completion* :21-11-2021	

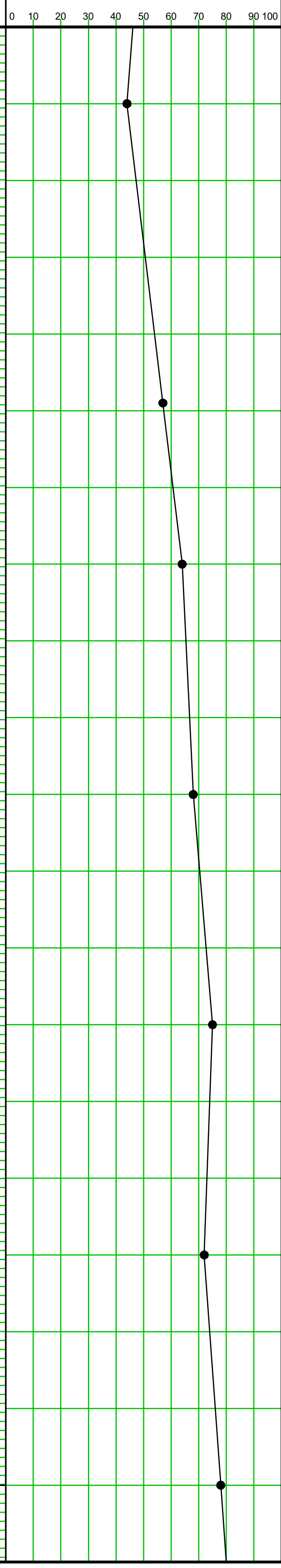
Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-4	4	5	7	12	Brown, Loose to medium dense, Silty sand	SM			
12.0											
12.5											
13.0	13	UDS-5									
13.5											
14.0											
14.5	14.5	SPT-5	7	9	12	21	Brown, Medium dense, Silty sand with clay	SM-SC			
15.0											
15.5											
16.0	16	UDS-6									
16.5											
17.0											
17.5	17.5	SPT-6	18	23	34	57					
18.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
18.5											
19.0	19	UDS-7									
19.5											
20.0											

UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 10+859 km	*Northing :* 3124072.923 m	*Easting :* 709602.681 m
Reduced Level (m): (+)195.247	*BH. No. :* BH-A2	*BH Termination Depth (m):* 40
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 5.60	*Inclination :* Vertical
Boring type : Shell & Auger	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 18-11-2021	*Date of Completion :* 21-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-7	15	20	24	44	Brown, Hard, Silty clay of low plasticity with gravel	CL			
21.0											
21.5											
22.0	22	UDS*									
22.5	22.45	SPT-8	18	23	34	57					
23.0											
23.5	23.5	SPT-9	20	26	38	64					
24.0											
24.5											
25.0	25	SPT-10	21	28	40	68					
25.5											
26.0											
26.5	26.5	SPT-11	17	33	42	75					
27.0											
27.5											
28.0	28	SPT-12	24	34	38	72					
28.5											
29.0											
29.5	29.5	SPT-13	31	37	41	78					
30.0							Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			

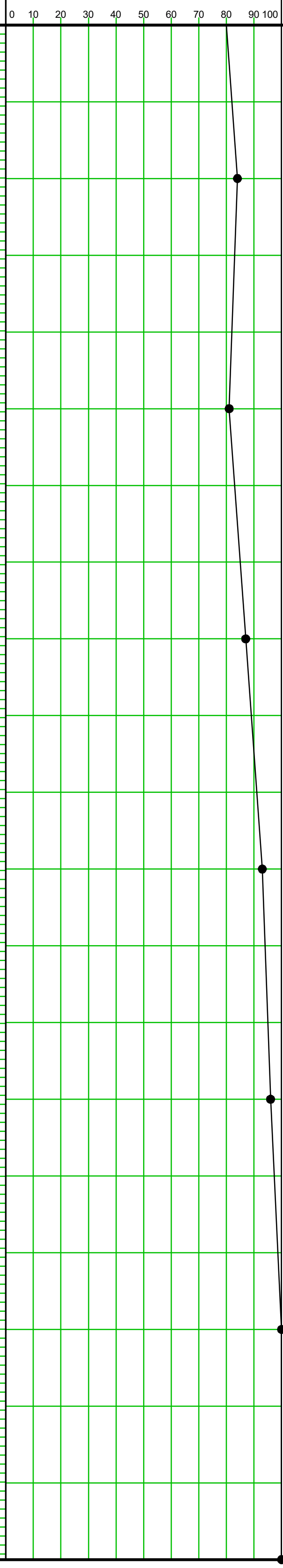


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :10+859 km	*Northing* :3124072.923 m	*Easting* :709602.681 m
Reduced Level (m):(+)195.247	*BH. No.* :BH-A2	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:5.60	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :18-11-2021	*Date of Completion* :21-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0											
30.5											
31.0	31	SPT-14	28	40	44	84					
31.5											
32.0											
32.5	32.5	SPT-15	26	38	43	81					
33.0											
33.5											
34.0	34	SPT-16	30	41	46	87					
34.5											
35.0							Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
35.5	35.5	SPT-17	28	44	49	93					
36.0											
36.5											
37.0	37	SPT-18	26	46	50	96					
37.5											
38.0											
38.5	38.5	SPT-19	34	50	50	100					
39.0											
39.5											
40.0	40	SPT-20	37	56	44 (13cm)	>100					

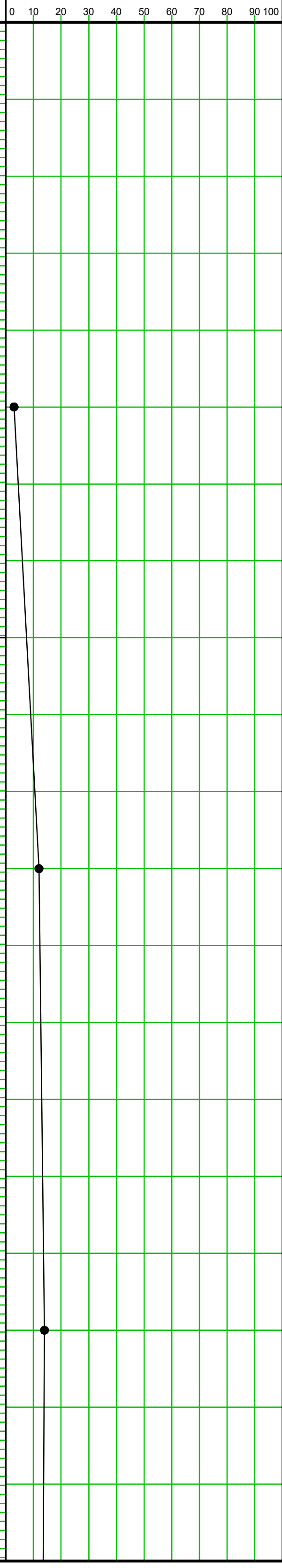


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :17+625 km	*Northing* :3119823.851 m	*Easting* :704882.319 m
Reduced Level (m):(+)191.597	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:3.00	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :13-11-2021	*Date of Completion* :13-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS-1					Yellowish brown, Very loose, Sandy silt of low plasticity (0.0–4.0 m)	ML-CL			
0.5											
1.0	1	UDS-1									
1.5											
2.0											
2.5	2.5	SPT-1	1	1	2	3					
3.0									3.00m		
3.5											
4.0	4	UDS-2					Yellowish brown, Medium, Sandy silt of low plasticity (4.0–10.0 m)	ML-CL			
4.5											
5.0											
5.5	5.5	SPT-2	3	4	8	12					
6.0											
6.5											
7.0	7	UDS-3									
7.5											
8.0											
8.5	8.5	SPT-3	6	6	8	14					
9.0											
9.5											
10.0	10	UDS-4									

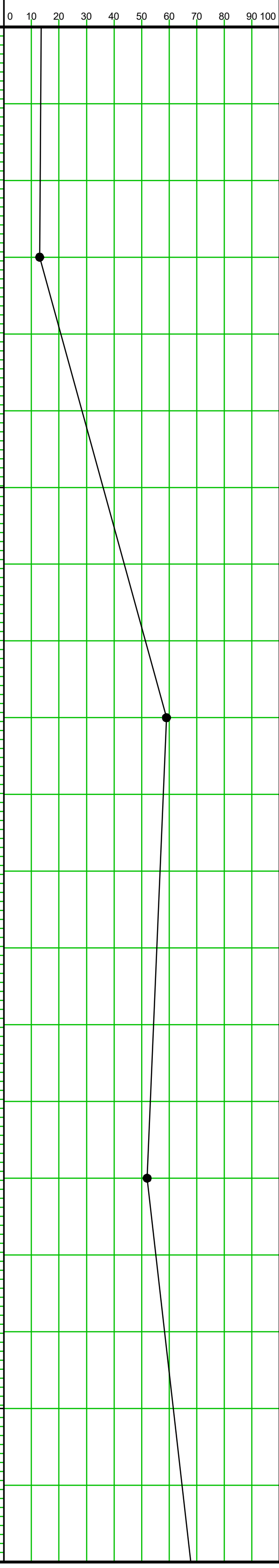


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :17+625 km	*Northing* :3119823.851 m	*Easting* :704882.319 m
Reduced Level (m):(+)191.597	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:3.00	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :13-11-2021	*Date of Completion* :13-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-4	4	5	8	13	Yellowish brown, Medium, Sandy silt of low plasticity	ML-CL			
12.0											
12.5											
13.0	13	UDS-5									
13.5											
14.0											
14.5	14.5	SPT-5	13	25	34	59					
15.0											
15.5											
16.0	16	UDS-6					Yellowish brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
16.5											
17.0											
17.5	17.5	SPT-6	12	22	30	52					
18.0											
18.5											
19.0	19	UDS-7									
19.5							Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL			
20.0											

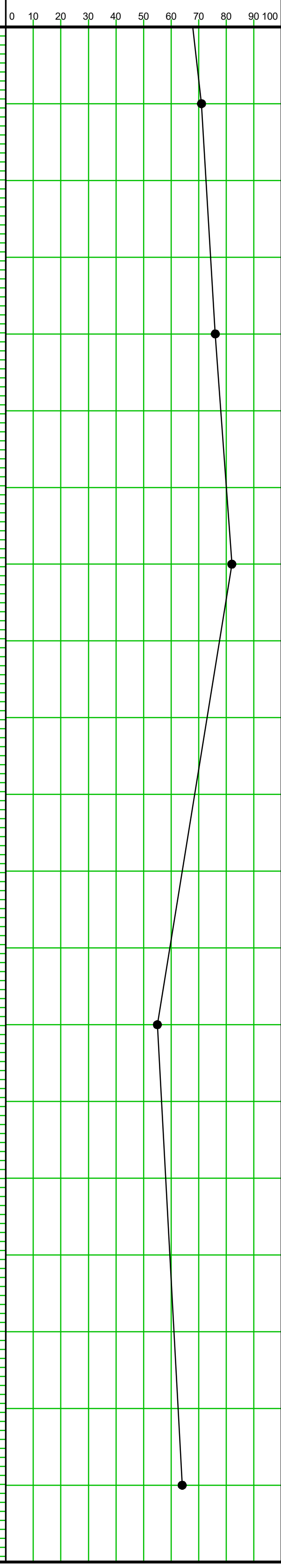


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*17+625 km	*Northing :*3119823.851 m	*Easting :*704882.319 m
Reduced Level (m):(+)191.597	*BH. No. :*BH-A1	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*3.00	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*13-11-2021	*Date of Completion :*13-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-7	12	30	41	71					
21.0											
21.5											
22.0	22	SPT-8	14	28	48	76					
22.5											
23.0											
23.5	23.5	SPT-9	13	32	50	82					
24.0											
24.5											
25.0	25	UDS-8					Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL			
25.5											
26.0											
26.5	26.5	SPT-10	12	20	35	55					
27.0											
27.5											
28.0	28	UDS-9									
28.5											
29.0											
29.5	29.5	SPT-11	14	24	40	64					
30.0	30	DS-2									



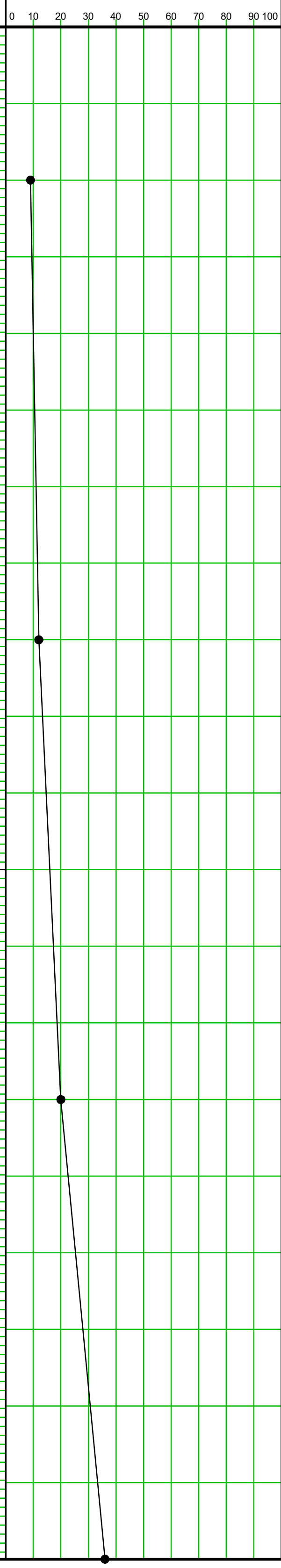
UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*17+625 km	*Northing :*3119805.101 m	*Easting :*704873.896 m
Reduced Level (m):(+)191.814	*BH. No. :*BH-A2	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*3.05	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*13-11-2021	*Date of Completion :*14-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS-1					Yellowish brown, Loose to medium dense, Sandy silt of low plasticity	ML-CL		
0.5										
1.0	1	SPT-1	3	4	5	9				
1.5										
2.0										
2.5	2.5	UDS-1								
3.0									3.05m	
3.5										
4.0	4	SPT-2	4	5	7	12				
4.5										
5.0										
5.5	5.5	UDS-2					Yellowish brown, Medium dense to very dense, Sandy silt of low plasticity with gravel	ML-CL		
6.0										
6.5										
7.0	7	SPT-3	7	8	12	20				
7.5										
8.0										
8.5	8.5	UDS-3								
9.0										
9.5										
10.0	10	SPT-4	10	13	23	36				

(Depth v/s SPT N Value)

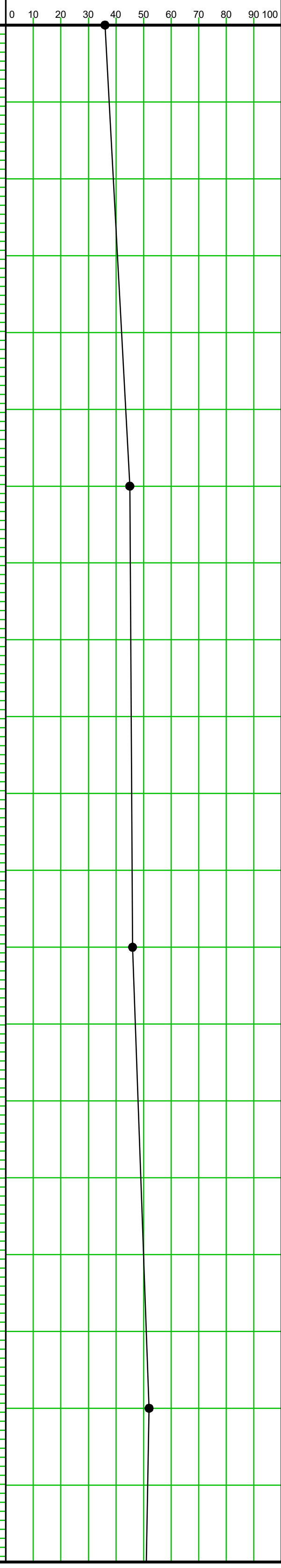


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 17+625 km	*Northing :* 3119805.101 m	*Easting :* 704873.896 m
Reduced Level (m): (+)191.814	*BH. No. :* BH-A2	*BH Termination Depth (m):* 30
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 3.05	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 13-11-2021	*Date of Completion :* 14-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	UDS-4									
12.0											
12.5											
13.0	13	SPT-5	12	20	25	45					
13.5											
14.0											
14.5	14.5	UDS-5									
15.0							Yellowish brown, Medium dense to very dense, Sandy silt of low plasticity with gravel	ML-CL			
15.5											
16.0	16	SPT-6	14	19	27	46					
16.5											
17.0											
17.5	17.5	UDS-6									
18.0											
18.5											
19.0	19	SPT-7	12	22	30	52					
19.5											
20.0											

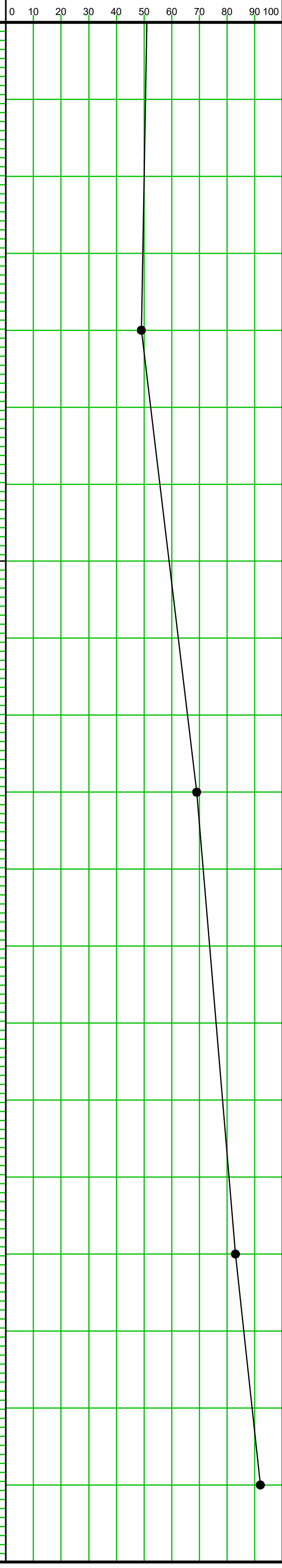


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :17+625 km	*Northing* :3119805.101 m	*Easting* :704873.896 m
Reduced Level (m):(+)191.814	*BH. No.* :BH-A2	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:3.05	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :13-11-2021	*Date of Completion* :14-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	UDS-7					Yellowish brown, Medium dense to very dense, Sandy silt of low plasticity with gravel	ML-CL			
21.0											
21.5											
22.0	22	SPT-8	11	20	29	49					
22.5											
23.0											
23.5	23.5	UDS-8									
24.0							Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL			
24.5											
25.0	25	SPT-9	18	29	40	69					
25.5											
26.0											
26.5	26.5	UDS-9									
27.0											
27.5											
28.0	28	SPT-10	17	38	45	83					
28.5											
29.0											
29.5	29.5	SPT-11	19	42	50	92					
30.0	30	DS-2									



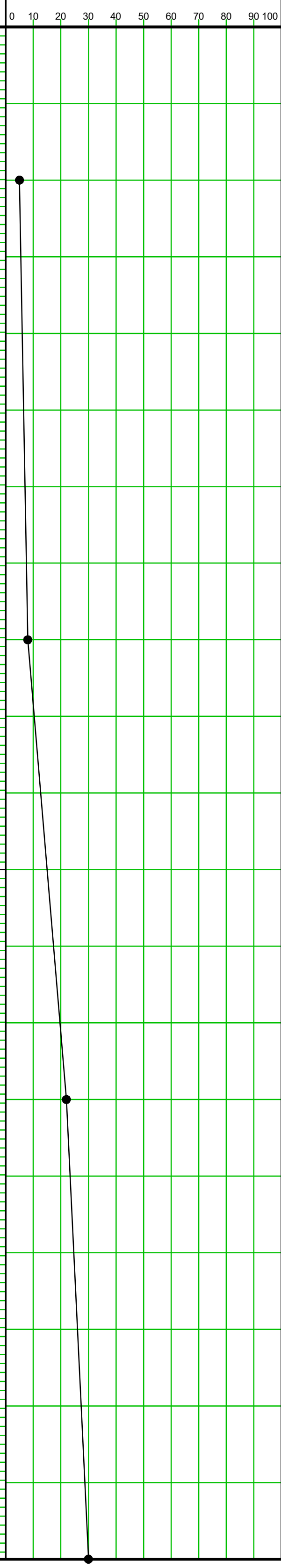
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :17+872 km	*Northing* :3119597.349 m	*Easting* :704759.612 m
Reduced Level (m):(+)191.318	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.95	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :08-10-2021	*Date of Completion* :09-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS-1								
0.5										
1.0	1	SPT-1	2	2	3	5			0.95m	
1.5										
2.0										
2.5	2.5	UDS-1					Brownish grey, Medium stiff, Silty clay of low plasticity	CL		
3.0										
3.5										
4.0	4	SPT-2	2	3	5	8				
4.5										
5.0										
5.5	5.5	UDS-2								
6.0										
6.5										
7.0	7	SPT-3	9	10	12	22				
7.5										
8.0							Brownish grey, Medium dense to dense, Sandy silt of low plasticity with gravel	ML-CL		
8.5	8.5	UDS-3								
9.0										
9.5										
10.0	10	SPT-4	11	14	16	30				

(Depth v/s SPT N Value)

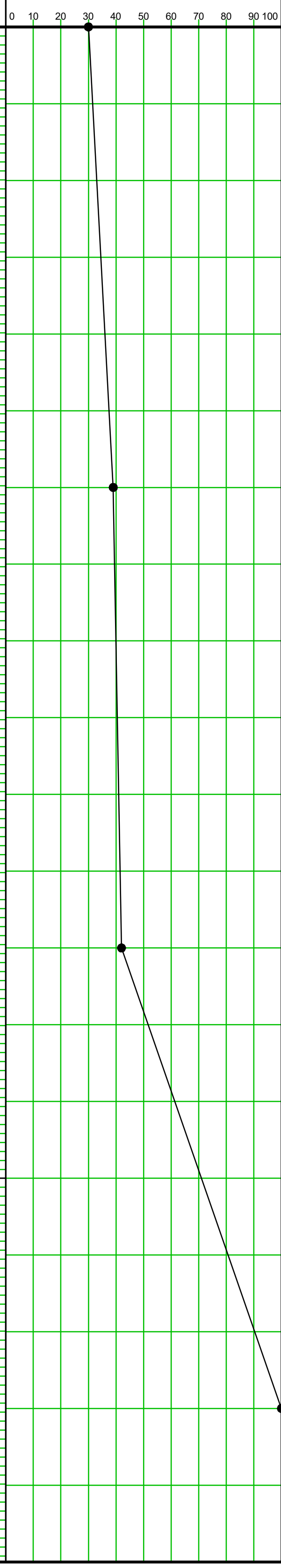


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :17+872 km	*Northing* :3119597.349 m	*Easting* :704759.612 m
Reduced Level (m):(+)191.318	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.95	*Inclination :* Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :08-10-2021	*Date of Completion* :09-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	UDS-4									
12.0											
12.5											
13.0	13	SPT-5	15	18	21	39					
13.5							Brownish grey, Medium dense to dense, Sandy silt of low plasticity with gravel	ML-CL			
14.0											
14.5	14.5	UDS-5									
15.0											
15.5											
16.0	16	SPT-6	18	20	22	42					
16.5											
17.0											
17.5	17.5	UDS-6									
18.0											
18.5											
19.0	19	SPT-7	30	48	52 (8cm)	>100	Brownish grey, Hard, Silty clay of low plasticity with gravel	CL			
19.5											
20.0											

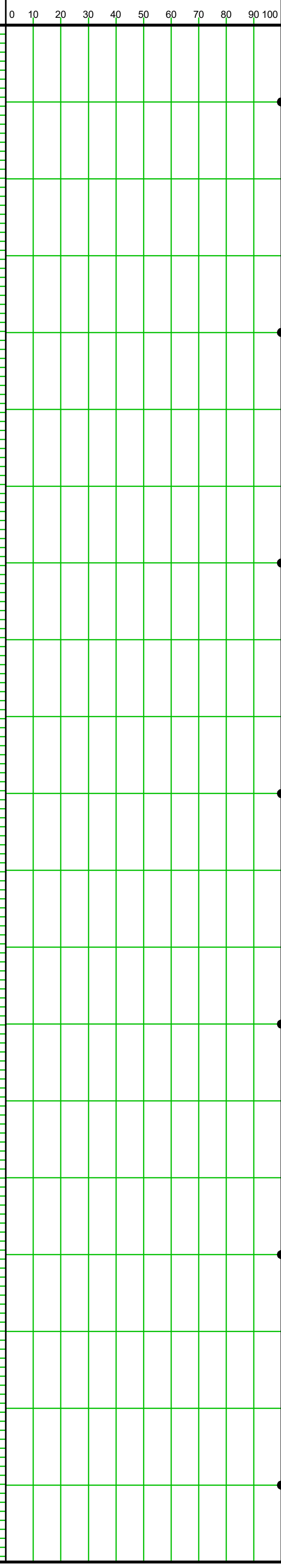


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :17+872 km	*Northing* :3119597.349 m	*Easting* :704759.612 m
Reduced Level (m):(+)191.318	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.95	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :08-10-2021	*Date of Completion* :09-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-8	35	52	48 (6cm)	>100					
21.0											
21.5											
22.0	22	SPT-9	40	61	39 (5cm)	>100					
22.5											
23.0											
23.5	23.5	SPT-10	35	63	37 (11cm)	>100					
24.0											
24.5											
25.0	25	SPT-11	40	60	40 (9cm)	>100	Brownish grey, Hard, Silty clay of low plasticity with gravel	CL			
25.5											
26.0											
26.5	26.5	SPT-12	45	65	35 (13cm)	>100					
27.0											
27.5											
28.0	28	SPT-13	47	70	30 (11cm)	>100					
28.5											
29.0											
29.5	29.5	SPT-14	40	100 (15cm)	-	>100					
	29.8	DS-2									
30.0	30										

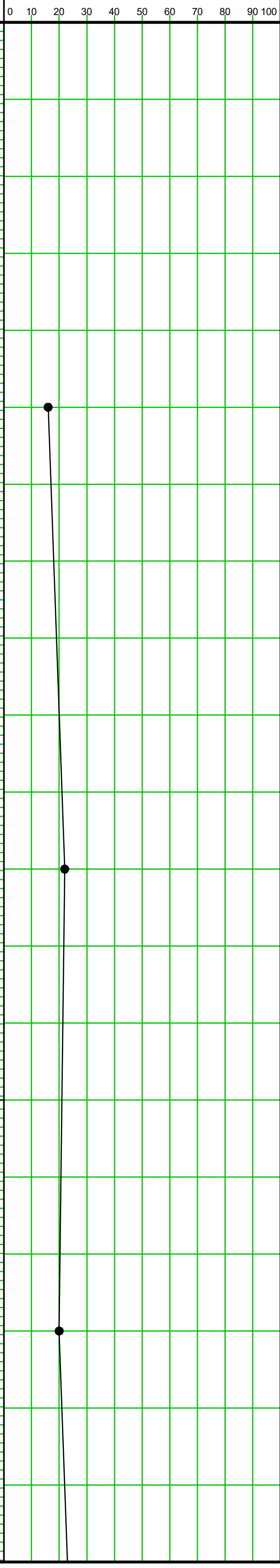


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :17+872 km	*Northing* :3119588.153 m	*Easting* :704753.576 m
Reduced Level (m):(+)191.150	*BH. No.* :BH-A2	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:1.00	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :08-10-2021	*Date of Completion* :09-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS-1					Brownish grey, Very stiff, Silty clay of low plasticity	CL			
0.5											
1.0	1	UDS-1							1.00m		
1.5											
2.0											
2.5	2.5	SPT-1	3	8	8	16					
3.0											
3.5											
4.0	4	UDS-2									
4.5											
5.0											
5.5	5.5	SPT-2	6	8	14	22					
6.0											
6.5											
7.0	7	UDS-3					Brownish grey, Medium dense to dense, Sandy silt of low plasticity with gravel	ML-CL			
7.5											
8.0											
8.5	8.5	SPT-3	4	8	12	20					
9.0											
9.5											
10.0	10	UDS-4									

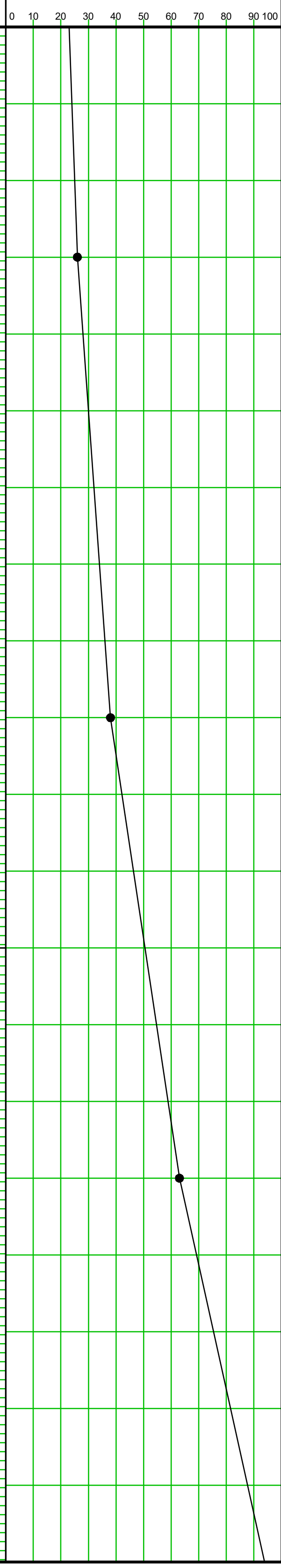


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 17+872 km	*Northing :* 3119588.153 m	*Easting :* 704753.576 m
Reduced Level (m): (+)191.150	*BH. No. :* BH-A2	*BH Termination Depth (m):* 30
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 1.00	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 08-10-2021	*Date of Completion :* 09-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-4	8	11	15	26					
12.0											
12.5											
13.0	13	UDS-5					Brownish grey, Medium dense to dense, Sandy silt of low plasticity with gravel	ML-CL			
13.5											
14.0											
14.5	14.5	SPT-5	14	17	21	38					
15.0											
15.5											
16.0	16	UDS-6									
16.5											
17.0											
17.5	17.5	SPT-6	16	28	35	63					
18.0							Brownish grey, Hard, Silty clay of low plasticity with gravel	CL			
18.5											
19.0	19	UDS-7									
19.5											
20.0											

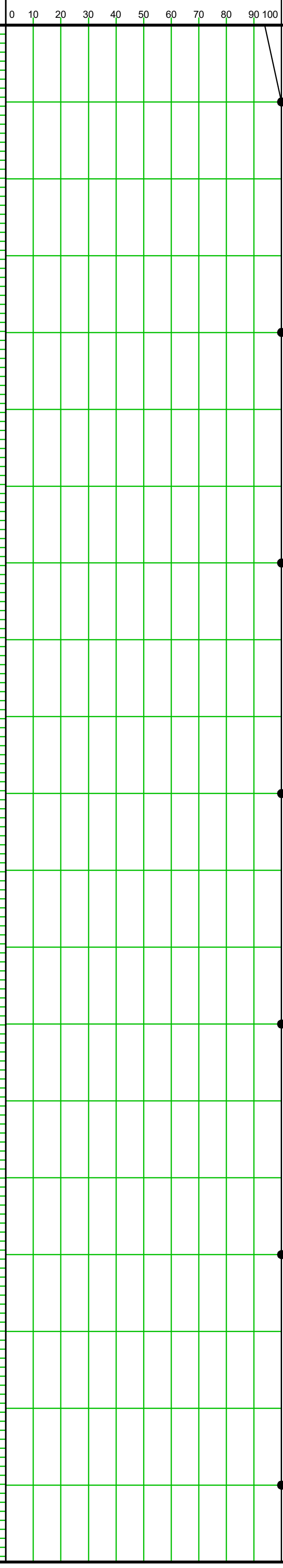


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 17+872 km	*Northing :* 3119588.153 m	*Easting :* 704753.576 m
Reduced Level (m): (+)191.150	*BH. No. :* BH-A2	*BH Termination Depth (m):* 30
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 1.00	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 08-10-2021	*Date of Completion :* 09-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-7	29	43	57	100					
21.0											
21.5											
22.0	22	SPT-8	32	48	52 (8cm)	>100					
22.5											
23.0											
23.5	23.5	SPT-9	28	40	60 (5cm)	>100					
24.0											
24.5											
25.0	25	SPT-10	24	48	52 (11cm)	>100	Brownish grey, Hard, Silty clay of low plasticity with gravel	CL			
25.5											
26.0											
26.5	26.5	SPT-11	28	58	42 (10cm)	>100					
27.0											
27.5											
28.0	28	SPT-12	28	65	35 (9cm)	>100					
28.5											
29.0											
29.5	29.5	SPT-13	33	70	30 (12cm)	>100					
30.0	29.92	DS-2									

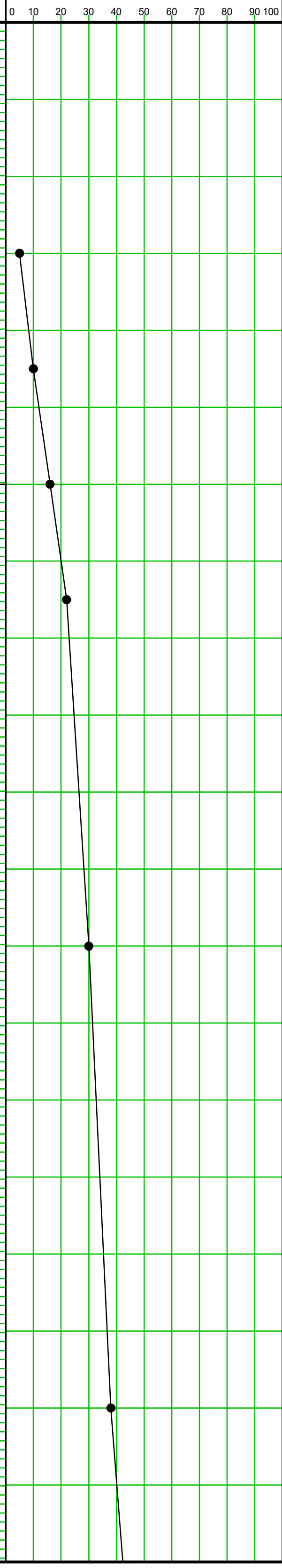


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :New Ch. 19+010 km_IMT Sohna Station	*Northing* :3119187.74 m	*Easting* :704417.312 m
Reduced Level (m):(+)190.138	*BH. No.* :BH-PLT-07	*BH Termination Depth (m)*:12
Proposed / Existing Structure :Minor Bridge	*Water Table (m)*:0.60	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :20-12-2021	*Date of Completion* :20-12-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Medium, Blackish, Silty clay with low Plasticity	CL			
0.5									0.60m		
	0.75	UDS-1									
1.0											
1.5	1.5	SPT-1	1	2	3	5					
2.0											
	2.25	SPT-2	2	4	6	10					
2.5											
3.0	3	SPT-3	4	7	9	16	Medium Dense, Brownish Sandy Silt	ML-CL			
3.5											
	3.75	SPT-4	9	10	12	22					
4.0											
4.5	4.5	UDS-2									
5.0											
5.5											
6.0	6	SPT-5	10	14	16	30					
6.5											
7.0											
7.5	7.5	UDS-3									
8.0											
8.5											
9.0	9	SPT-6	15	17	21	38					
9.5											
10.0											

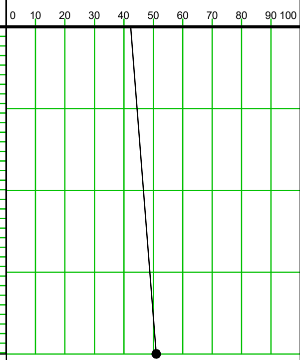


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*New Ch. 19+010 km_IMT Sohna Station	*Northing :*3119187.74 m	*Easting :*704417.312 m
Reduced Level (m):(+)190.138	*BH. No. :*BH-PLT-07	*BH Termination Depth (m):*12
*Proposed / Existing Structure :*Minor Bridge	*Water Table (m):*0.60	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*20-12-2021	*Date of Completion :*20-12-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5	10.5	UDS-4					Medium Dense, Brownish Sandy Silt	ML-CL			
11.0											
11.5											
12.0	12	SPT-7	18	24	27	51					

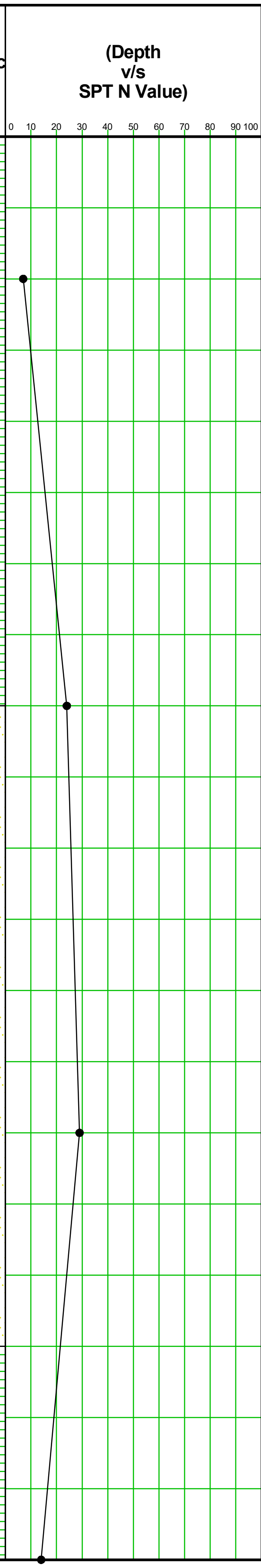


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 18+750 km	*Northing :* 3119029.392 m	*Easting :* 704113.173 m
Reduced Level (m): (+)190.420	*BH. No. :* BH-A1	*BH Termination Depth (m):* 30
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 1.22	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 14-11-2021	*Date of Completion :* 15-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS-1					Yellowish brown, Medium stiff, Silty clay of low plasticity (0.0–4.0 m)	CL		
0.5										
1.0	1	SPT-1	2	3	4	7			1.22m	
1.5										
2.0										
2.5	2.5	UDS-1								
3.0										
3.5										
4.0	4	SPT-2	6	10	14	24	Yellowish brown, Medium dense, Silty sand (4.0–8.5 m)	SM		
4.5										
5.0										
5.5	5.5	UDS-2								
6.0										
6.5										
7.0	7	SPT-3	6	12	17	29				
7.5										
8.0										
8.5	8.5	UDS-3					Yellowish brown, Stiff, Silty clay of low plasticity (8.5–10.0 m)	CL		
9.0										
9.5										
10.0	10	SPT-4	4	6	8	14				



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :18+750 km	*Northing* :3119029.392 m	*Easting* :704113.173 m
Reduced Level (m):(+)190.420	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:1.22	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :14-11-2021	*Date of Completion* :15-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value) 0 10 20 30 40 50 60 70 80 90 100	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	UDS-4					Yellowish brown, Stiff, Silty clay of low plasticity	CL			
12.0											
12.5											
13.0	13	SPT-5	14	27	39	66					
13.5											
14.0							Yellowish brown, Very dense, Silty sand with clay	SM-SC			
14.5	14.5	UDS-5									
15.0											
15.5											
16.0	16	SPT-6	10	13	22	35					
16.5											
17.0											
17.5	17.5	UDS-6					Yellowish brown, Very stiff to hard, Silty clay of low plasticity with gravel	CL			
18.0											
18.5											
19.0	19	SPT-7	10	16	21	37					
19.5											
20.0											

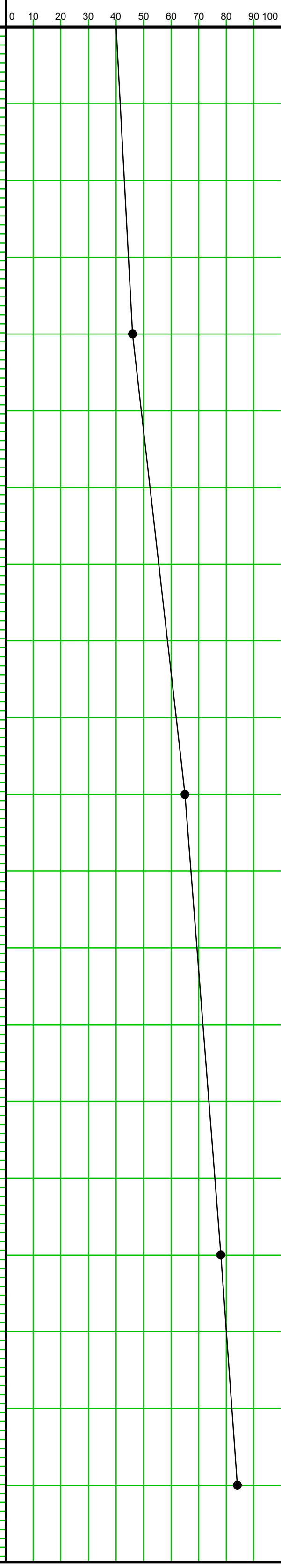
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 18+750 km	*Northing :* 3119029.392 m	*Easting :* 704113.173 m
Reduced Level (m): (+)190.420	*BH. No. :* BH-A1	*BH Termination Depth (m):* 30
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 1.22	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 14-11-2021	*Date of Completion :* 15-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
20.0										
20.5	20.5	UDS-7								
21.0										
21.5										
22.0	22	SPT-8	12	19	27	46				
22.5										
23.0										
23.5	23.5	UDS-8								
24.0										
24.5										
25.0	25	SPT-9	14	28	37	65	Yellowish brown, Very stiff to hard, Silty clay of low plasticity with gravel	CL		
25.5										
26.0										
26.5	26.5	UDS-9								
27.0										
27.5										
28.0	28	SPT-10	17	35	43	78				
28.5										
29.0										
29.5	29.5	SPT-11	19	37	47	84				
30.0	30	DS-2								

(Depth v/s SPT N Value)



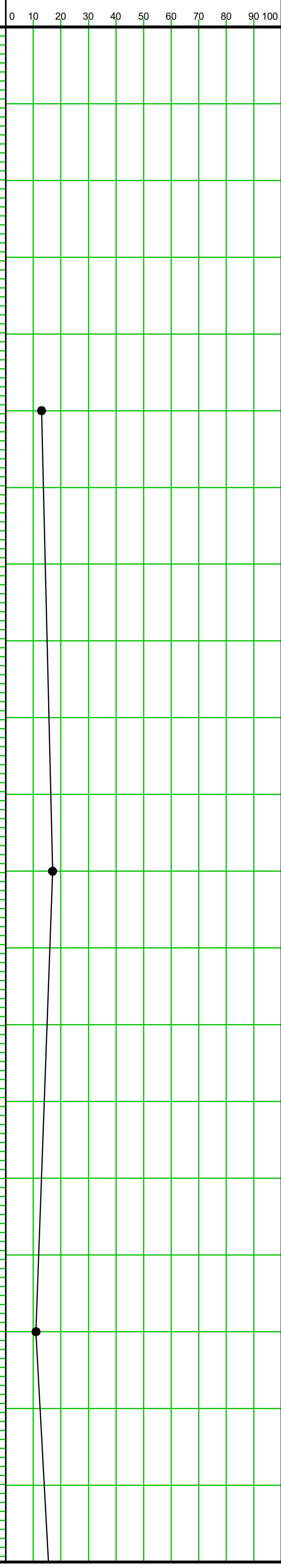
UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*18+750 km	*Northing :*3119020.849 m	*Easting :*704095.09 m
Reduced Level (m):(+)190.095	*BH. No. :*BH-A2	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*1.50	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*14-11-2021	*Date of Completion :*15-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS-1								
0.5										
1.0	1	UDS-1								
1.5									1.50m	
2.0										
2.5	2.5	SPT-1	4	5	8	13				
3.0										
3.5										
4.0	4	UDS-2								
4.5										
5.0							Yellowish brown, Stiff to very stiff, Silty clay of low plasticity	CL		
5.5	5.5	SPT-2	4	7	10	17				
6.0										
6.5										
7.0	7	UDS-3								
7.5										
8.0										
8.5	8.5	SPT-3	3	4	7	11				
9.0										
9.5										
10.0	10	UDS-4								

(Depth v/s SPT N Value)

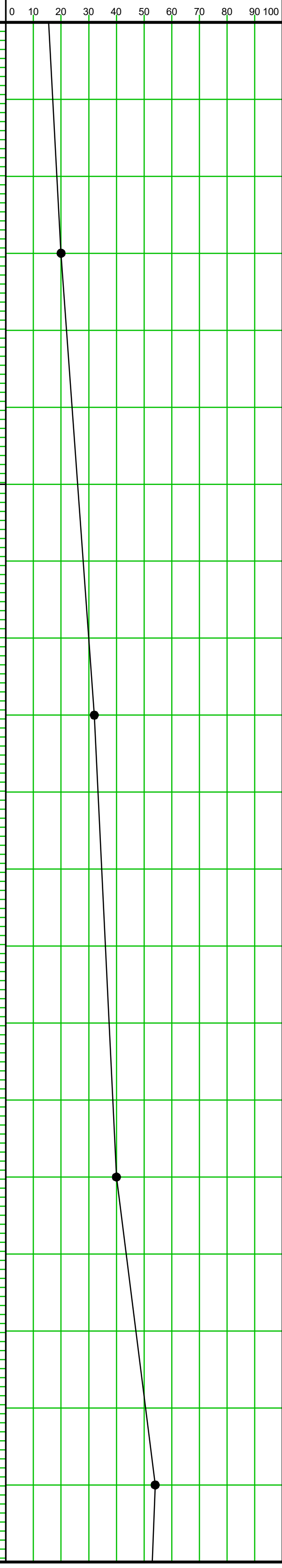


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :18+750 km	*Northing* :3119020.849 m	*Easting* :704095.09 m
Reduced Level (m):(+)190.095	*BH. No.* :BH-A2	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:1.50	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :14-11-2021	*Date of Completion* :15-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-4	5	8	12	20	Yellowish brown, Stiff to very stiff, Silty clay of low plasticity	CL			
12.0											
12.5											
13.0	13	UDS-5									
13.5											
14.0											
14.5	14.5	SPT-5	9	14	18	32					
15.0											
15.5											
16.0	16	UDS-6									
16.5							Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL			
17.0											
17.5	17.5	SPT-6	10	18	22	40					
18.0											
18.5											
19.0	19	UDS*									
19.5	19.5	SPT-7	11	20	34	54					
20.0											

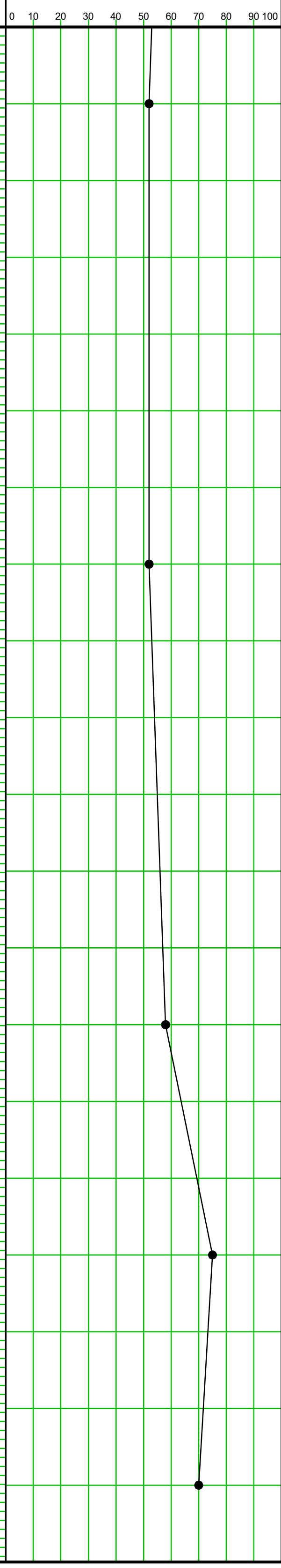


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 18+750 km	*Northing :* 3119020.849 m	*Easting :* 704095.09 m
Reduced Level (m): (+)190.095	*BH. No. :* BH-A2	*BH Termination Depth (m):* 30
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 1.50	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 14-11-2021	*Date of Completion :* 15-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-8	12	22	30	52					
21.0											
21.5											
22.0	22	UDS-7									
22.5											
23.0											
23.5	23.5	SPT-9				52					
24.0											
24.5											
25.0	25	UDS-8					Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL			
25.5											
26.0											
26.5	26.5	SPT-10				58					
27.0											
27.5											
28.0	28	SPT-11				75					
28.5											
29.0											
29.5	29.5	SPT-12				70					
30.0	30	DS-2									



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :19+500 km	*Northing* :3118866.702 m	*Easting* :703426.871 m
Reduced Level (m):(+)190.997	*BH. No.* :BH-A1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.60	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :14-11-2021	*Date of Completion* :15-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Stiff, Silty clay of low plasticity	CL	0.60m		
0.5											
1.0	1	UDS-1									
1.5											
2.0											
2.5	2.5	SPT-1	2	3	5	8					
3.0											
3.5											
4.0	4	UDS*									
4.5	4.5	SPT-2	4	6	10	16	Brown, Medium dense, Silty sand	SM			
5.0											
5.5	5.5	SPT-3	6	8	11	19					
6.0											
6.5											
7.0	7	UDS-2									
7.5											
8.0											
8.5	8.5	SPT-4	4	7	10	17					
9.0											
9.5											
10.0	10	UDS-3									

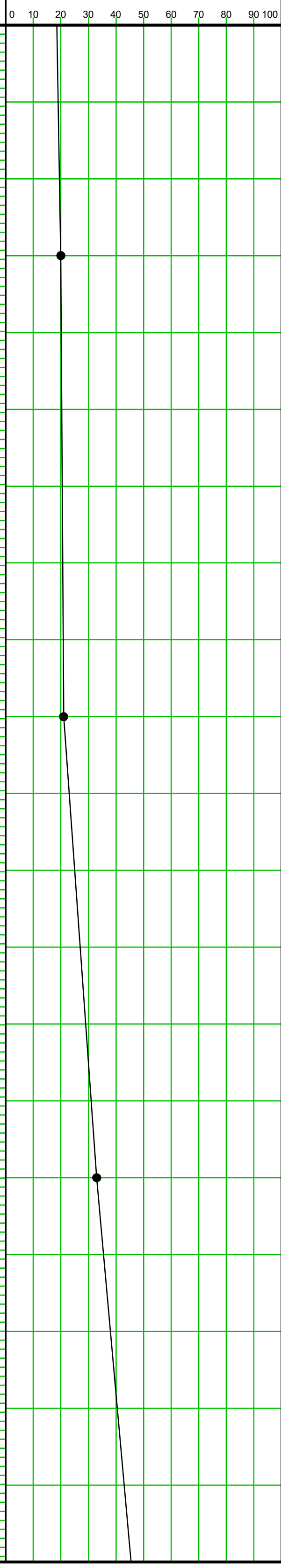
Chart scale: 0 10 20 30 40 50 60 70 80 90 100

UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*19+500 km	*Northing :*3118866.702 m	*Easting :*703426.871 m
Reduced Level (m):(+)190.997	*BH. No. :*BH-A1	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*0.60	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*14-11-2021	*Date of Completion :*15-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-5	6	8	12	20					
12.0											
12.5											
13.0	13	UDS-4									
13.5											
14.0											
14.5	14.5	SPT-6	7	9	12	21					
15.0							Brown, Very stiff to hard, Silty clay of low plasticity with gravel	CL			
15.5											
16.0	16	UDS-5									
16.5											
17.0											
17.5	17.5	SPT-7	10	14	19	33					
18.0											
18.5											
19.0	19	UDS-6									
19.5											
20.0											

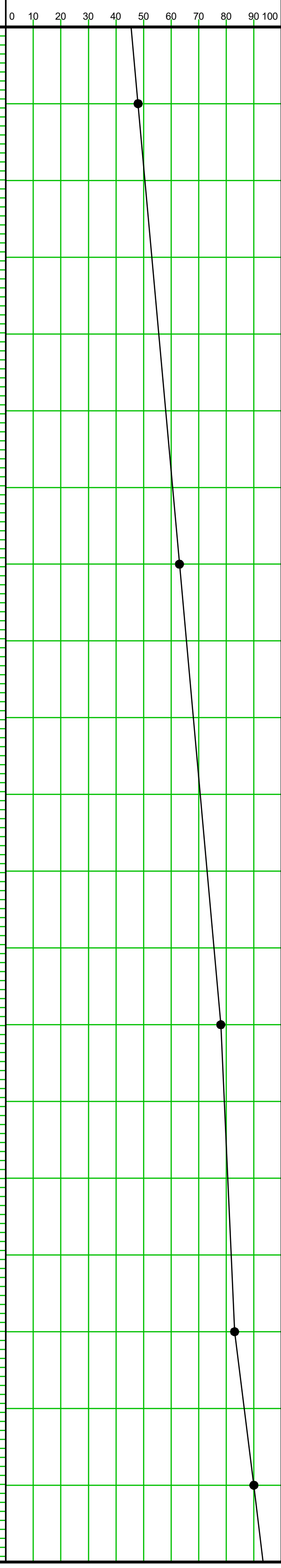


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :19+500 km	*Northing* :3118866.702 m	*Easting* :703426.871 m
Reduced Level (m):(+)190.997	*BH. No.* :BH-A1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.60	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :14-11-2021	*Date of Completion* :15-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-8	14	20	28	48					
21.0											
21.5											
22.0	22	UDS-7									
22.5											
23.0											
23.5	23.5	SPT-9	17	29	34	63					
24.0											
24.5											
25.0	25	UDS-8					Brown, Very stiff to hard, Silty clay of low plasticity with gravel	CL			
25.5											
26.0											
26.5	26.5	SPT-10	20	33	45	78					
27.0											
27.5											
28.0	28	UDS*									
28.5	28.5	SPT-11	23	36	47	83					
29.0											
29.5	29.5	SPT-12	28	40	50	90					
30.0											



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 19+500 km	*Northing :* 3118866.702 m	*Easting :* 703426.871 m
Reduced Level (m): (+)190.997	*BH. No. :* BH-A1	*BH Termination Depth (m):* 40
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 0.60	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 14-11-2021	*Date of Completion :* 15-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0							Brown, Very stiff to hard, Silty clay of low plasticity with gravel	CL			
30.5											
31.0	31	SPT-13	30	44	56 (14cm)	>100					
31.5							Brown, Very dense, Silty sand with gravel	SM-SC			
32.0											
32.5	32.5	SPT-14	28	46	54 (7cm)	>100					
33.0											
33.5											
34.0	34	SPT-15	31	48	52 (10cm)	>100					
34.5											
35.0											
35.5	35.5	SPT-16	32	51	49 (8cm)	>100					
36.0											
36.5											
37.0	37	SPT-17	29	49	51 (11cm)	>100					
37.5											
38.0											
38.5	38.5	SPT-18	31	57	43 (9cm)	>100					
39.0											
39.5											
40.0	40	SPT-19	34	65	35 (7cm)	>100					

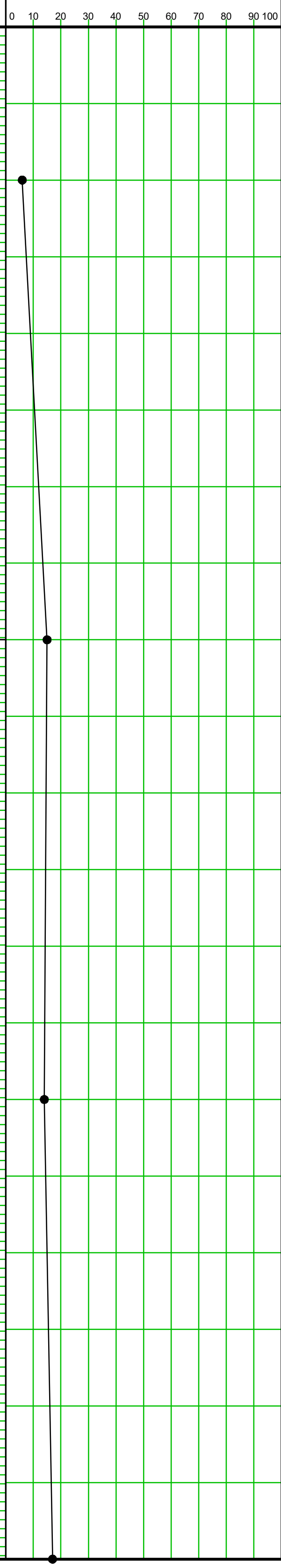
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :19+500 km	*Northing* :3118862.655 m	*Easting* :703375.297 m
Reduced Level (m):(+)191.964	*BH. No.* :BH-P1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:1.85	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :08-10-2021	*Date of Completion* :10-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS					Brown, Medium stiff, Silty clay of low plasticity	CL		
0.5										
1.0	1	SPT-1	2	3	3	6				
1.5										
2.0									1.85m	
2.5	2.5	UDS-1								
3.0										
3.5										
4.0	4	SPT-2	5	6	9	15	Brown, Stiff to very stiff, Silty clay of low plasticity	CL		
4.5										
5.0										
5.5	5.5	UDS-2								
6.0										
6.5										
7.0	7	SPT-3	4	5	9	14				
7.5										
8.0										
8.5	8.5	UDS-3								
9.0										
9.5										
10.0	10	SPT-4	3	6	11	17				

(Depth v/s SPT N Value)

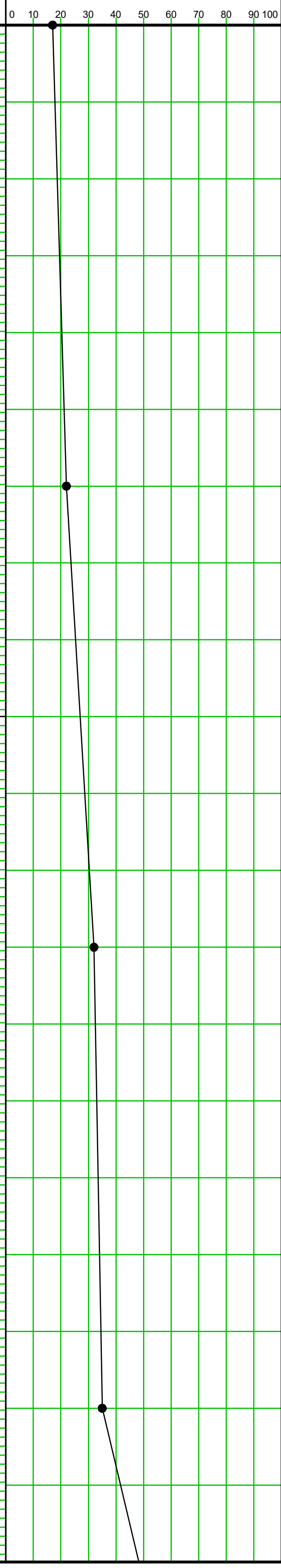


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :19+500 km	*Northing* :3118862.655 m	*Easting* :703375.297 m
Reduced Level (m):(+)191.964	*BH. No.* :BH-P1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:1.85	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :08-10-2021	*Date of Completion* :10-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0							Brown, Stiff to very stiff, Silty clay of low plasticity	CL			
10.5											
11.0											
11.5	11.5	UDS-4									
12.0											
12.5											
13.0	13	SPT-5	7	10	12	22					
13.5											
14.0											
14.5	14.5	UDS-5					Brown, Hard, Silty clay of low plasticity with gravel	CL			
15.0											
15.5											
16.0	16	SPT-6	8	14	18	32					
16.5											
17.0											
17.5	17.5	UDS-6									
18.0											
18.5											
19.0	19	SPT-7	10	16	19	35					
19.5											
20.0											

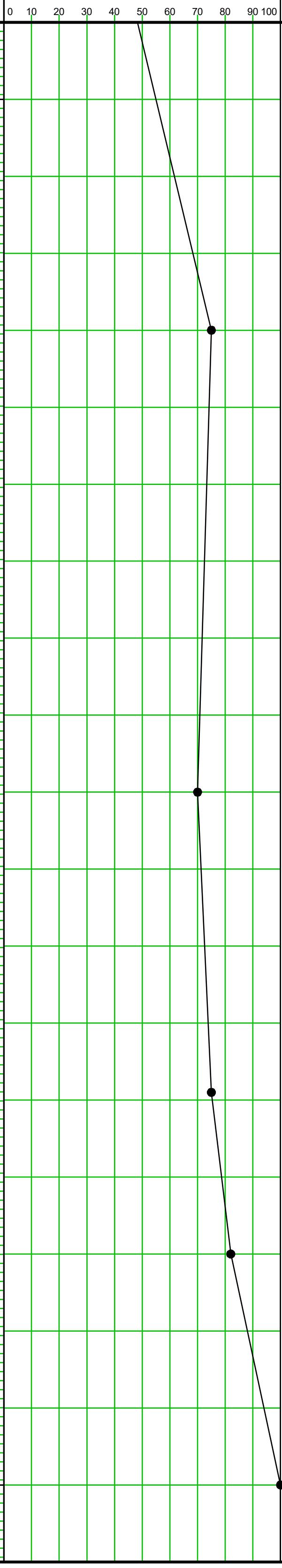


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 19+500 km	*Northing :* 3118862.655 m	*Easting :* 703375.297 m
Reduced Level (m): (+)191.964	*BH. No. :* BH-P1	*BH Termination Depth (m):* 40
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 1.85	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 08-10-2021	*Date of Completion :* 10-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
20.5	20.5	UDS-7									
21.0											
21.5											
22.0	22	SPT-8	24	33	42	75					
22.5											
23.0											
23.5	23.5	UDS-8									
24.0											
24.5											
25.0	25	SPT-9	19	29	41	70	Brown, Hard, Silty clay of low plasticity with gravel	CL			
25.5											
26.0											
26.5	26.5	UDS*									
27.0	26.95	SPT-10	22	32	43	75					
27.5											
28.0	28	SPT-11	26	36	46	82					
28.5											
29.0											
29.5	29.5	SPT-12	36	66	34 (7cm)	>100	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL			
30.0											



UDS*-UDS not recovered

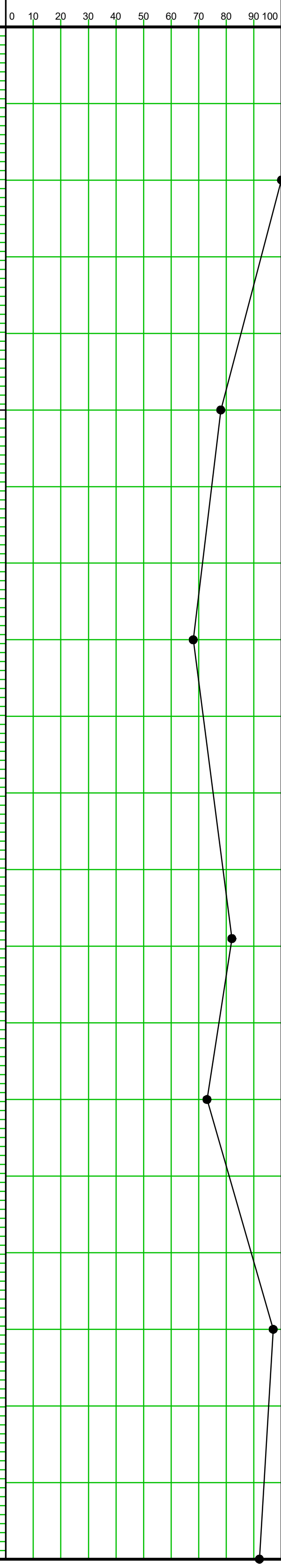
FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*19+500 km	*Northing :*3118862.655 m	*Easting :*703375.297 m
Reduced Level (m):(+)191.964	*BH. No. :*BH-P1	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*1.85	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*08-10-2021	*Date of Completion :*10-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Special Observations
30.0									
30.5									
31.0	31	SPT-13	32	53	47 (11cm)	>100	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL	
31.5									
32.0									
32.5	32.5	SPT-14	25	34	44	78			
33.0							Brown, Hard, Silty clay of low plasticity with gravel	CL	
33.5									
34.0	34	SPT-15	18	30	38	68			
34.5									
35.0									
35.5	35.5	UDS*							
36.0	35.95	SPT-16	26	38	44	82			
36.5									
37.0	37	SPT-17	22	33	40	73			
37.5									
38.0									
38.5	38.5	SPT-18	27	48	49	97			
39.0									
39.5									
40.0	40	SPT-19	31	41	51	92			

Depth range (m)	Strata Description	IS Classification
30.0 – 32.5	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL
32.5 – 40.0	Brown, Hard, Silty clay of low plasticity with gravel	CL

(Depth v/s SPT N Value)



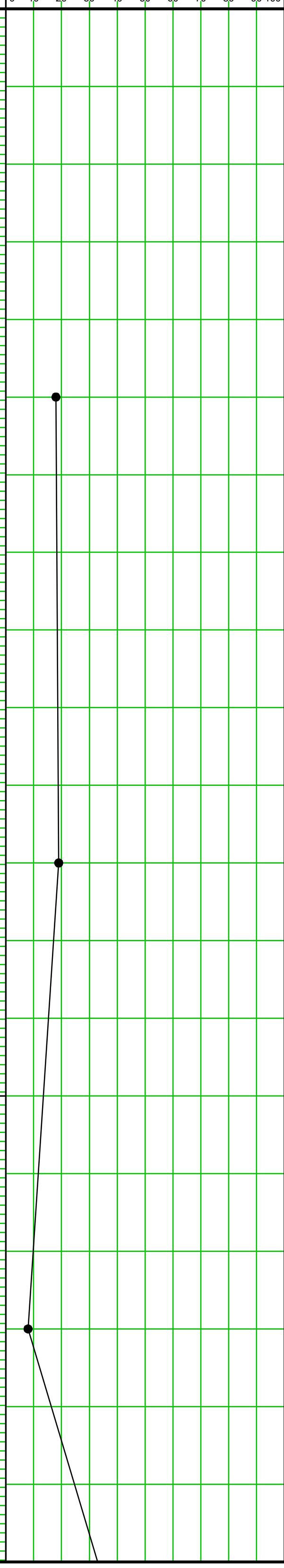
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :19+500 km	*Northing* :3118858.609 m	*Easting* :703323.723 m
Reduced Level (m):(+)191.063	*BH. No.* :BH-A2	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:1.60	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :09-10-2021	*Date of Completion* :10-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS					Brown, Very stiff, Silty clay of low plasticity (0.0–7.0 m)	CL		
0.5										
1.0	1	UDS-1								
1.5									1.60m	
2.0										
2.5	2.5	SPT-1	5	8	10	18				
3.0										
3.5										
4.0	4	UDS-2								
4.5										
5.0										
5.5	5.5	SPT-2	4	8	11	19				
6.0										
6.5										
7.0	7	UDS-3					Brown, Medium stiff, Silty clay of low plasticity (7.0–10.0 m)	CL		
7.5										
8.0										
8.5	8.5	SPT-3	3	4	4	8				
9.0										
9.5										
10.0	10	UDS-4								

(Depth v/s SPT N Value)

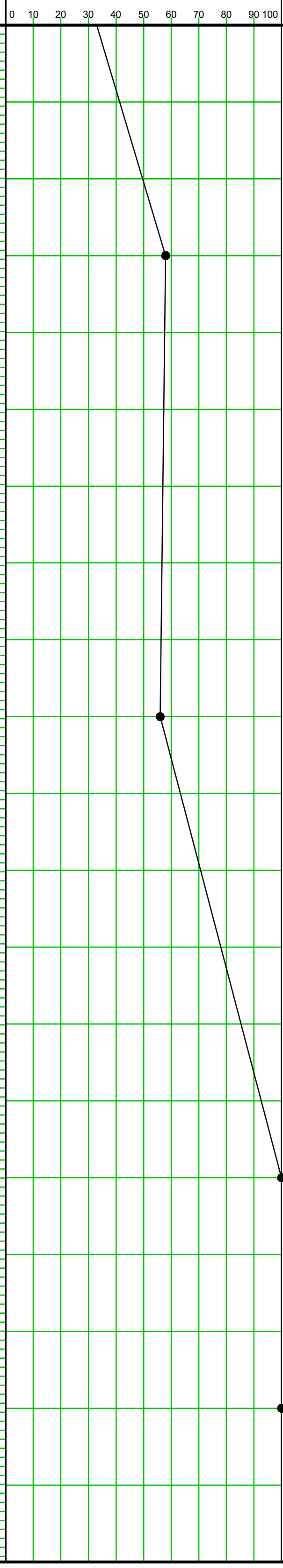


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 19+500 km	*Northing :* 3118858.609 m	*Easting :* 703323.723 m
Reduced Level (m): (+)191.063	*BH. No. :* BH-A2	*BH Termination Depth (m):* 40
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 1.60	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 09-10-2021	*Date of Completion :* 10-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-4	14	25	33	58					
12.0											
12.5											
13.0	13	UDS-5									
13.5											
14.0											
14.5	14.5	SPT-5	13	21	35	56					
15.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
15.5											
16.0	16	UDS-6									
16.5											
17.0											
17.5	17.5	SPT-6	29	50	50 (10cm)	>100					
18.0											
18.5											
19.0	19	SPT-7	36	79	21 (3cm)	>100					
19.5											
20.0											



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :19+500 km	*Northing* :3118858.609 m	*Easting* :703323.723 m
Reduced Level (m):(+)191.063	*BH. No.* :BH-A2	*BH Termination Depth (m):*40
Proposed / Existing Structure :Major Bridge	*Water Table (m):*1.60	*Inclination :* Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :09-10-2021	*Date of Completion* :10-10-2021	

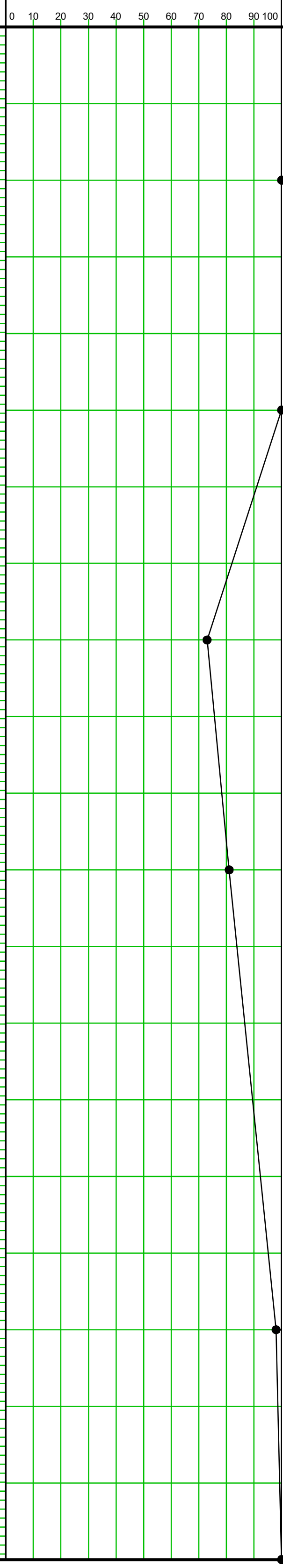
Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm			SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
			N1	N2	N3					0 10 20 30 40 50 60 70 80 90 100	
20.0											
20.5	20.5	SPT-8	40	100 (15cm)	-	>100					
21.0											
21.5											
22.0	22	SPT-9	34	34	41	75					
22.5											
23.0											
23.5	23.5	SPT-10	36	70	30 (4cm)	>100					
24.0											
24.5											
25.0	25	SPT-11	24	49	51 (10cm)	>100	Brown, Hard, Silty clay of low plasticity with gravel	CL			
25.5											
26.0											
26.5	26.5	SPT-12	28	48	52 (8cm)	>100					
27.0											
27.5											
28.0	28	SPT-13	38	54	46 (8cm)	>100					
28.5											
29.0											
29.5	29.5	SPT-14	49	64	36 (8cm)	>100					
30.0											

UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 19+500 km	*Northing :* 3118858.609 m	*Easting :* 703323.723 m
Reduced Level (m): (+)191.063	*BH. No. :* BH-A2	*BH Termination Depth (m):* 40
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 1.60	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 09-10-2021	*Date of Completion :* 10-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0											
30.5											
31.0	31	SPT-15	42	100 (15cm)	-	>100					
31.5											
32.0											
32.5	32.5	SPT-16	32	56	44 (7cm)	>100					
33.0											
33.5											
34.0	34	SPT-17	21	30	43	73					
34.5											
35.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
35.5	35.5	SPT-18	18	33	48	81					
36.0											
36.5											
37.0	37	UDS-7									
37.5											
38.0											
38.5	38.5	SPT-19	28	46	52	98					
39.0											
39.5											
40.0	40	SPT-20	45	59	41 (4cm)	>100					



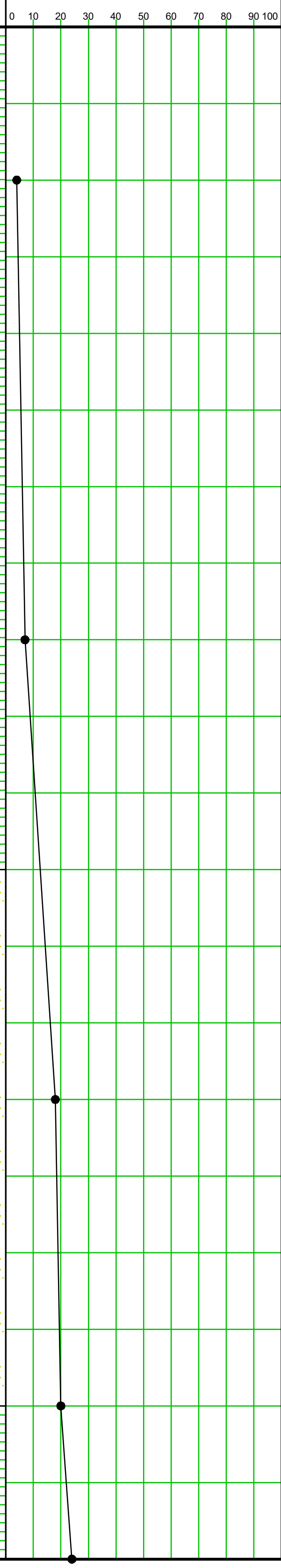
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :19+715 km	*Northing* :3118849.67 m	*Easting* :703175.974 m
Reduced Level (m):(+)190.645	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.85	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :12-11-2021	*Date of Completion* :12-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS-1								
0.5										
1.0	1	SPT-1	1	2	2	4			0.85m	
1.5										
2.0										
2.5	2.5	UDS-1								
3.0							Greyish brown, Soft to medium stiff, Silty clay of low plasticity	CL		
3.5										
4.0	4	SPT-2	2	3	4	7				
4.5										
5.0										
5.5	5.5	UDS-2								
6.0										
6.5										
7.0	7	SPT-3	5	8	10	18				
7.5							Greyish brown, Medium dense, Silty sand	SM		
8.0										
8.5	8.5	UDS*								
9.0	9	SPT-4	4	9	11	20				
9.5							Greyish brown, Very stiff, Silty clay of low plasticity	CL		
10.0	10	SPT-5	6	11	13	24				

(Depth v/s SPT N Value)

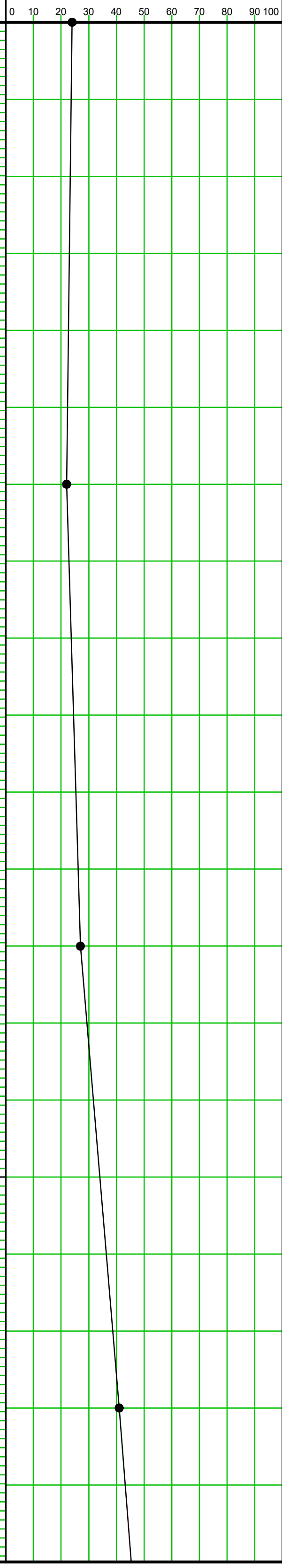


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :19+715 km	*Northing* :3118849.67 m	*Easting* :703175.974 m
Reduced Level (m):(+)190.645	*BH. No.* :BH-A1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.85	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :12-11-2021	*Date of Completion* :12-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	UDS-3									
12.0											
12.5											
13.0	13	SPT-6	7	10	12	22					
13.5							Greyish brown, Very stiff, Silty clay of low plasticity	CL			
14.0											
14.5	14.5	UDS-4									
15.0											
15.5											
16.0	16	SPT-7	8	12	15	27					
16.5											
17.0											
17.5	17.5	UDS-5									
18.0											
18.5											
19.0	19	SPT-8	13	18	23	41	Greyish brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL			
19.5											
20.0											

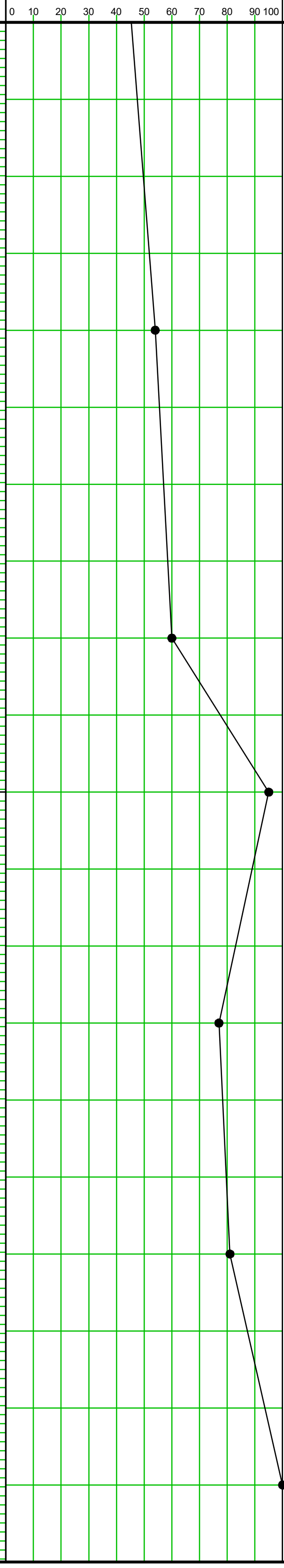


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*19+715 km	*Northing :*3118849.67 m	*Easting :*703175.974 m
Reduced Level (m):(+)190.645	*BH. No. :*BH-A1	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*0.85	*Inclination :* Vertical
*Boring type :*Shell & Auger	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*12-11-2021	*Date of Completion :*12-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	UDS-6					Greyish brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL			
21.0											
21.5											
22.0	22	SPT-9	15	24	30	54					
22.5											
23.0											
23.5	23.5	UDS*									
24.0	24	SPT-10	18	28	32	60					
24.5											
25.0	25	SPT-11	25	42	53	95					
25.5							Greyish brown, Hard, Silty clay of low plasticity with gravel	CL			
26.0											
26.5	26.5	SPT-12	21	34	43	77					
27.0											
27.5											
28.0	28	SPT-13	24	36	45	81					
28.5											
29.0											
29.5	29.5	SPT-14	42	69	31 (5cm)	>100					
30.0	30	DS-2									

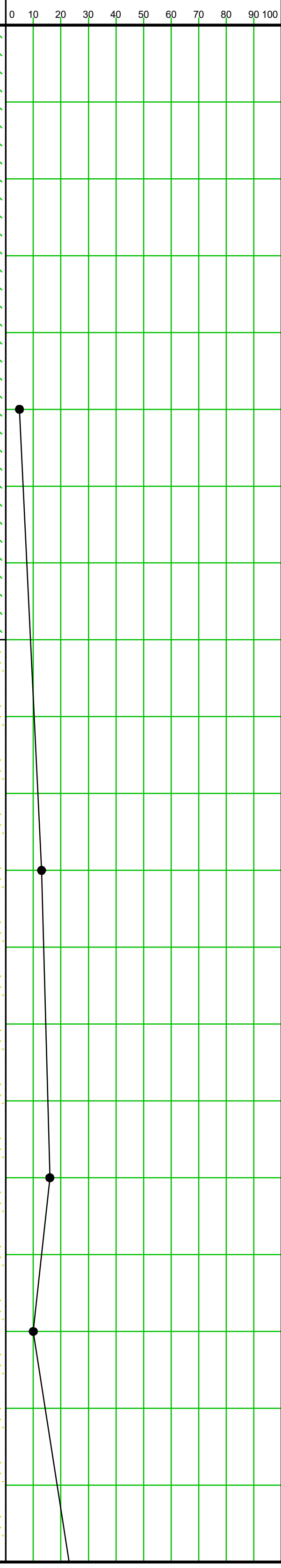


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*19+715 km	*Northing :*3118849.544 m	*Easting :*703164.075 m
Reduced Level (m):(+)190.671	*BH. No. :*BH-P1	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*0.80	*Inclination :* Vertical
*Boring type :*Shell & Auger	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*13-11-2021	*Date of Completion :*14-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS-1					Greyish brown, Medium stiff, Silty clay of high plasticity	CI	0.80m		
0.5											
1.0	1	UDS-1									
1.5											
2.0											
2.5	2.5	SPT-1	2	2	3	5					
3.0											
3.5											
4.0	4	UDS-2					Greyish brown, Medium dense, Silty sand	SM			
4.5											
5.0											
5.5	5.5	SPT-2	4	6	7	13					
6.0											
6.5											
7.0	7	UDS*									
7.5	7.5	SPT-3	5	7	9	16					
8.0											
8.5	8.5	SPT-4	3	4	6	10					
9.0											
9.5											
10.0	10	UDS-3									



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :19+715 km	*Northing* :3118849.544 m	*Easting* :703164.075 m
Reduced Level (m):(+)190.671	*BH. No.* :BH-P1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.80	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :13-11-2021	*Date of Completion* :14-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-5	8	15	21	36					
12.0											
12.5											
13.0	13	UDS*									
13.5	13.5	SPT-6	8	16	19	35					
14.0											
14.5	14.5	SPT-7	7	18	22	40	Greyish brown, Dense, Sandy silt of low plasticity with gravel	ML-CL			
15.0											
15.5											
16.0	16	UDS-4									
16.5											
17.0											
17.5	17.5	SPT-8	10	17	23	40					
18.0											
18.5											
19.0	19	UDS-5									
19.5							Greyish brown, Hard, Silty clay of low plasticity with gravel	CL			
20.0											

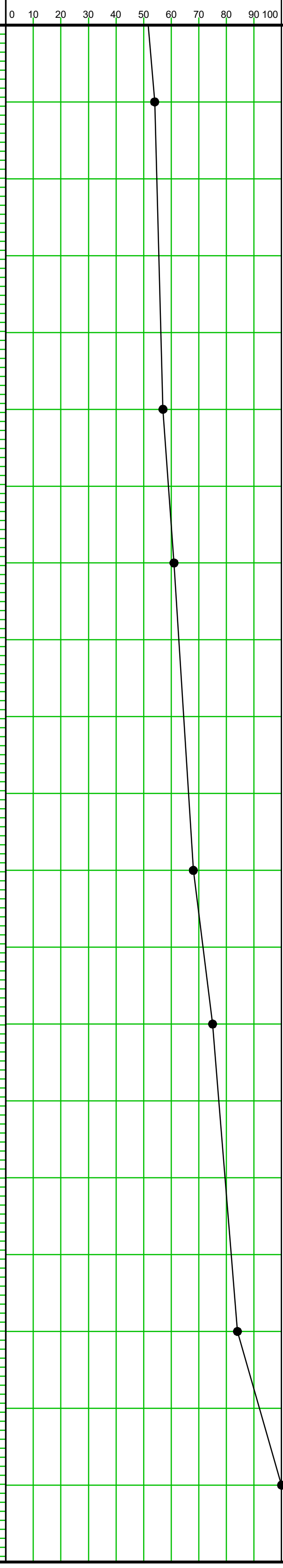
Chart axis (SPT N Value): 0 10 20 30 40 50 60 70 80 90 100

UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :19+715 km	*Northing* :3118849.544 m	*Easting* :703164.075 m
Reduced Level (m):(+)190.671	*BH. No.* :BH-P1	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.80	*Inclination* : Vertical
Boring type :Shell & Auger	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :13-11-2021	*Date of Completion* :14-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-9	14	23	31	54					
21.0											
21.5											
22.0	22	UDS*									
22.5	22.5	SPT-10	12	23	34	57					
23.0											
23.5	23.5	SPT-11	15	25	36	61					
24.0											
24.5											
25.0	25	UDS*					Greyish brown, Hard, Silty clay of low plasticity with gravel	CL			
25.5	25.5	SPT-12	18	29	39	68					
26.0											
26.5	26.5	SPT-13	21	34	41	75					
27.0											
27.5											
28.0	28	UDS*									
28.5	28.5	SPT-14	25	38	46	84					
29.0											
29.5	29.5	SPT-15	38	48	52 (7cm)	>100					
30.0	30	DS-2									

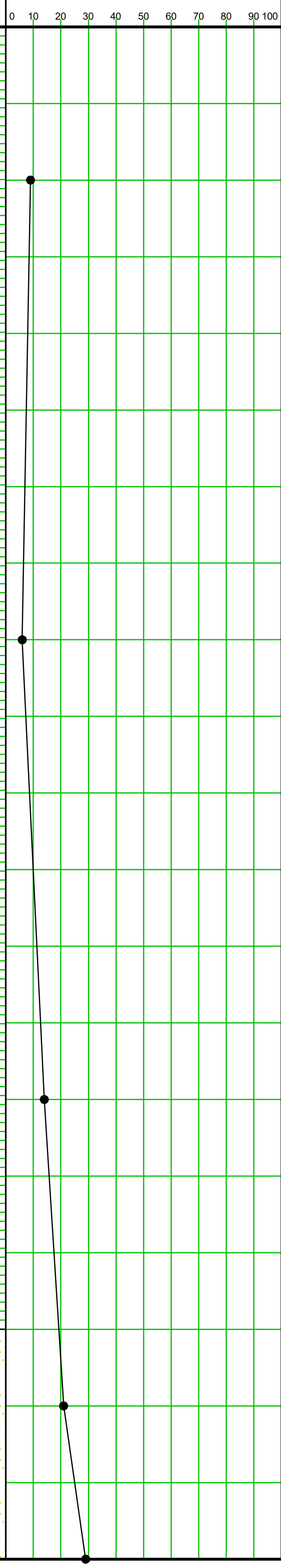


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :19+715 km	*Northing* :3118849.568 m	*Easting* :703152.175 m
Reduced Level (m):(+)190.592	*BH. No.* :BH-A2	*BH Termination Depth (m)*:30
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:0.45	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :14-11-2021	*Date of Completion* :16-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS									
0.5									0.45m		
1.0	1	SPT-1	2	4	5	9					
1.5											
2.0											
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	2	3	3	6	Greyish brown, Stiff, Silty clay of low plasticity	CL			
4.5											
5.0											
5.5	5.5	UDS-2									
6.0											
6.5											
7.0	7	SPT-3	4	6	8	14					
7.5											
8.0											
8.5	8.5	UDS*									
9.0	9	SPT-4	6	9	12	21	Greyish brown, Medium dense, Silty sand	SM			
9.5											
10.0	10	SPT-5	8	13	16	29					

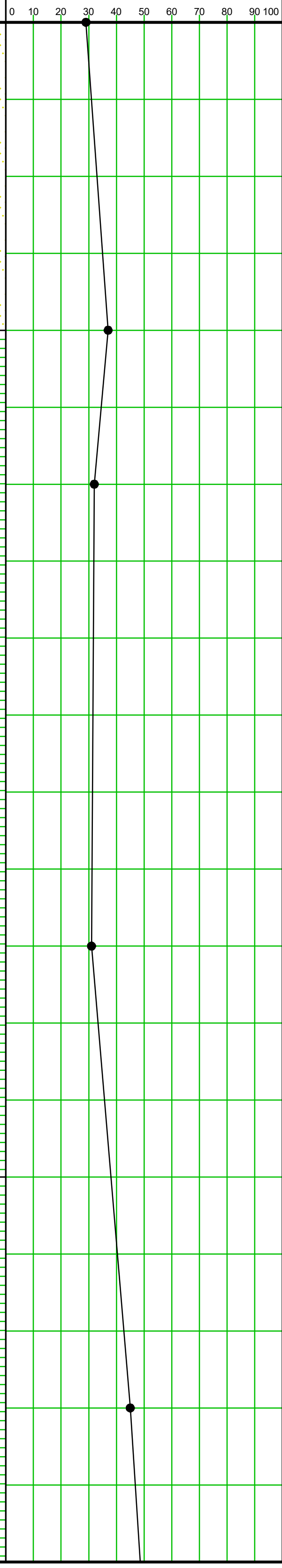


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 19+715 km	*Northing :* 3118849.568 m	*Easting :* 703152.175 m
Reduced Level (m): (+)190.592	*BH. No. :* BH-A2	*BH Termination Depth (m):* 30
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 0.45	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 14-11-2021	*Date of Completion :* 16-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0							Greyish brown, Medium dense, Silty sand	SM			
11.5	11.5	UDS*									
12.0	12	SPT-6	11	17	20	37					
12.5											
13.0	13	SPT-7	9	14	18	32					
13.5											
14.0											
14.5	14.5	UDS-3					Greyish brown, Dense, Sandy silt of low plasticity with gravel	ML-CL			
15.0											
15.5											
16.0	16	SPT-8	11	14	17	31					
16.5											
17.0											
17.5	17.5	UDS-4									
18.0											
18.5											
19.0	19	SPT-9	13	19	26	45	Greyish brown, Hard, Silty clay of low plasticity with gravel	CL			
19.5											
20.0											

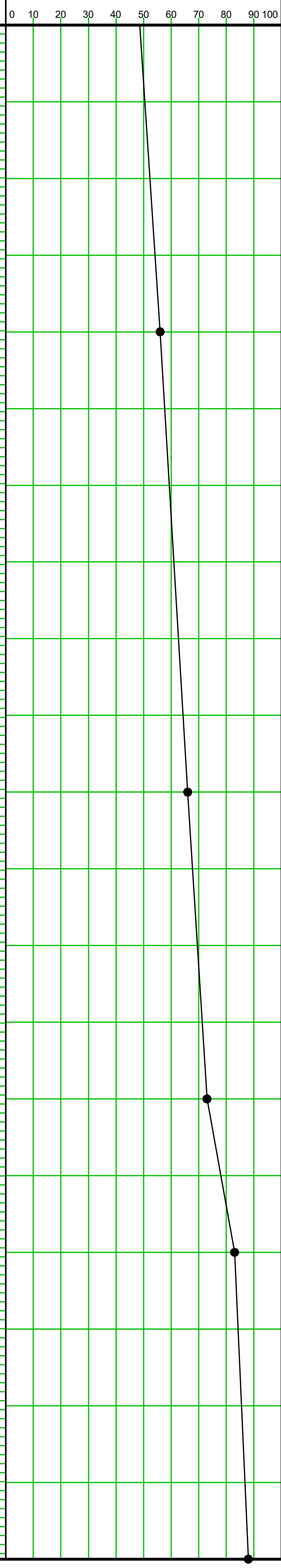


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*19+715 km	*Northing :*3118849.568 m	*Easting :*703152.175 m
Reduced Level (m):(+)190.592	*BH. No. :*BH-A2	*BH Termination Depth (m):*30
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*0.45	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*14-11-2021	*Date of Completion :*16-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	UDS-5									
21.0											
21.5											
22.0	22	SPT-10	16	25	31	56					
22.5											
23.0											
23.5	23.5	UDS-6									
24.0											
24.5											
25.0	25	SPT-11	19	29	37	66	Greyish brown, Hard, Silty clay of low plasticity with gravel	CL			
25.5											
26.0											
26.5	26.5	UDS*									
27.0	27	SPT-12	20	33	40	73					
27.5											
28.0	28	SPT-13	22	39	44	83					
28.5											
29.0											
29.5	29.5	UDS*									
30.0	30	SPT-14	24	41	47	88					



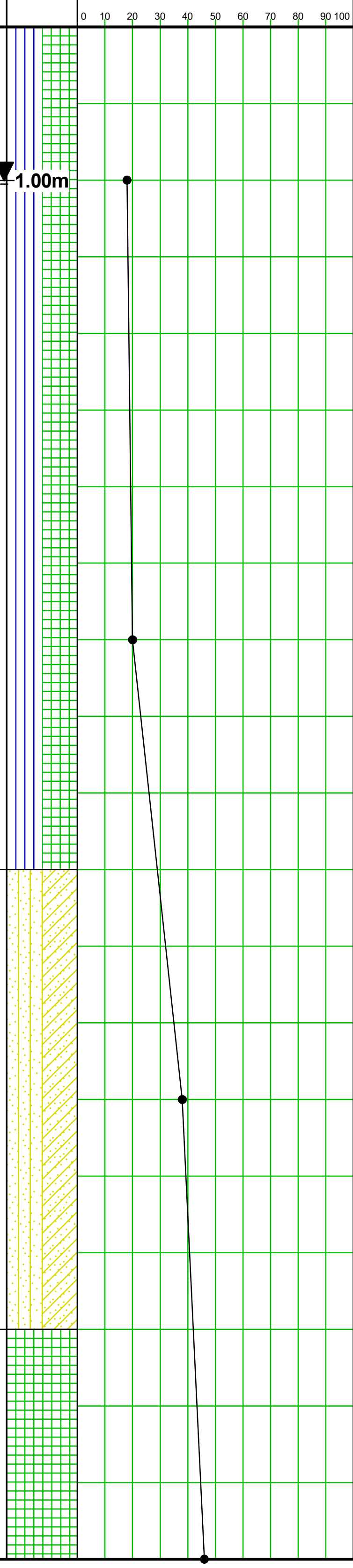
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :20+300 km	*Northing* :3118908.161 m	*Easting* :702617.165 m
Reduced Level (m):(+)190.950	*BH. No.* :BH-A1	*BH Termination Depth (m):*40
Proposed / Existing Structure :Major Bridge	*Water Table (m):*1.00	*Inclination :* Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :13-11-2021	*Date of Completion* :14-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Special Observations
0.0		DS					Brown, Medium dense, Sandy silt of low plasticity	ML-CL	
1.0	1	SPT-1	6	8	10	18			
2.5	2.5	UDS-1							
4.0	4	SPT-2	6	9	11	20			
5.5	5.5	UDS-2					Brown, Dense, Silty sand with clay & gravel	SM-SC	
7.0	7	SPT-3	13	16	22	38			
8.5	8.5	UDS-3					Brown, Hard with gravel Silty clay of low plasticity	CL	
10.0	10	SPT-4	14	18	28	46			

Graphic Log / (Depth v/s SPT N Value)

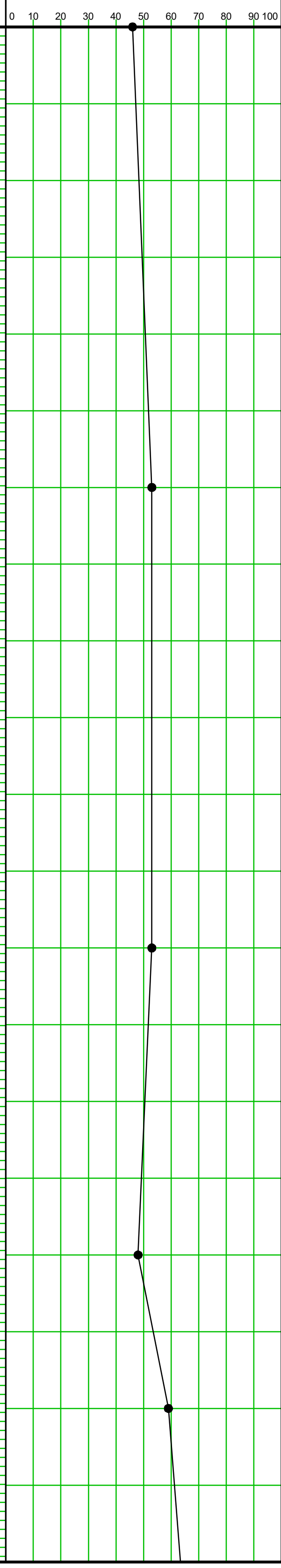


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :20+300 km	*Northing* :3118908.161 m	*Easting* :702617.165 m
Reduced Level (m):(+)190.950	*BH. No.* :BH-A1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:1.00	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :13-11-2021	*Date of Completion* :14-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	UDS-4									
12.0											
12.5											
13.0	13	SPT-5	16	23	30	53					
13.5											
14.0											
14.5	14.5	UDS-5									
15.0							Brown, Hard with gravel Silty clay of low plasticity	CL			
15.5											
16.0	16	SPT-6	20	24	29	53					
16.5											
17.0											
17.5	17.5	UDS-6									
18.0	18	SPT-7	19	23	25	48					
18.5											
19.0	19	SPT-8	21	27	32	59					
19.5											
20.0											

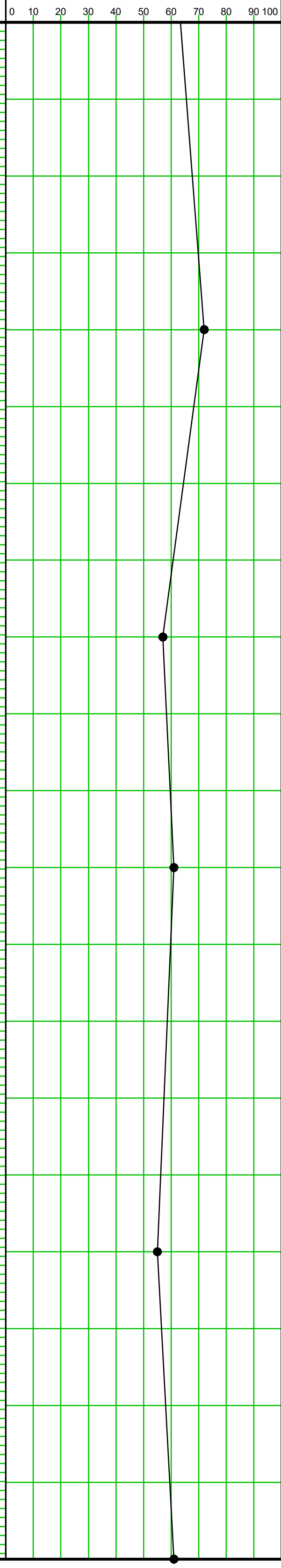


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*20+300 km	*Northing :*3118908.161 m	*Easting :*702617.165 m
Reduced Level (m):(+)190.950	*BH. No. :*BH-A1	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*1.00	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*13-11-2021	*Date of Completion :*14-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	UDS-7									
21.0											
21.5											
22.0	22	SPT-9	28	34	38	72					
22.5											
23.0											
23.5	23.5	UDS*									
24.0	24	SPT-10	25	28	29	57					
24.5											
25.0							Brown, Hard with gravel Silty clay of low plasticity	CL			
25.5	25.5	SPT-11	21	28	33	61					
26.0											
26.5	26.5	UDS-8									
27.0											
27.5											
28.0	28	SPT-12	20	25	30	55					
28.5											
29.0											
29.5	29.5	UDS*									
30.0	30	SPT-13	22	26	35	61					

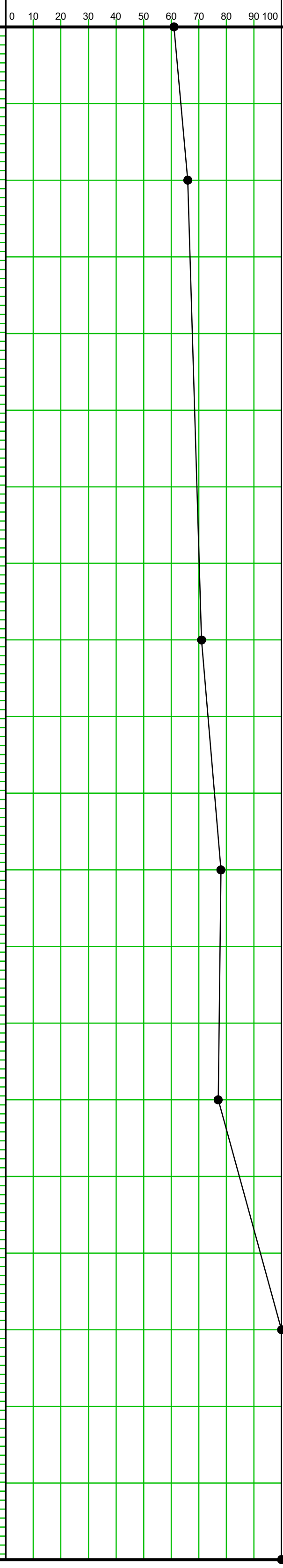


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :20+300 km	*Northing* :3118908.161 m	*Easting* :702617.165 m
Reduced Level (m):(+)190.950	*BH. No.* :BH-A1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:1.00	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :13-11-2021	*Date of Completion* :14-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0											
30.5											
31.0	31	SPT-14	20	28	38	66					
31.5											
32.0											
32.5	32.5	UDS-9									
33.0											
33.5											
34.0	34	SPT-15	27	32	39	71					
34.5											
35.0							Brown, Hard with gravel Silty clay of low plasticity	CL			
35.5	35.5	SPT-16	29	38	40	78					
36.0											
36.5											
37.0	37	SPT-17	29	35	42	77					
37.5											
38.0											
38.5	38.5	SPT-18	42	54	46 (10cm)	>100					
39.0											
39.5											
40.0	40	SPT-19	33	48	52 (7cm)	>100					

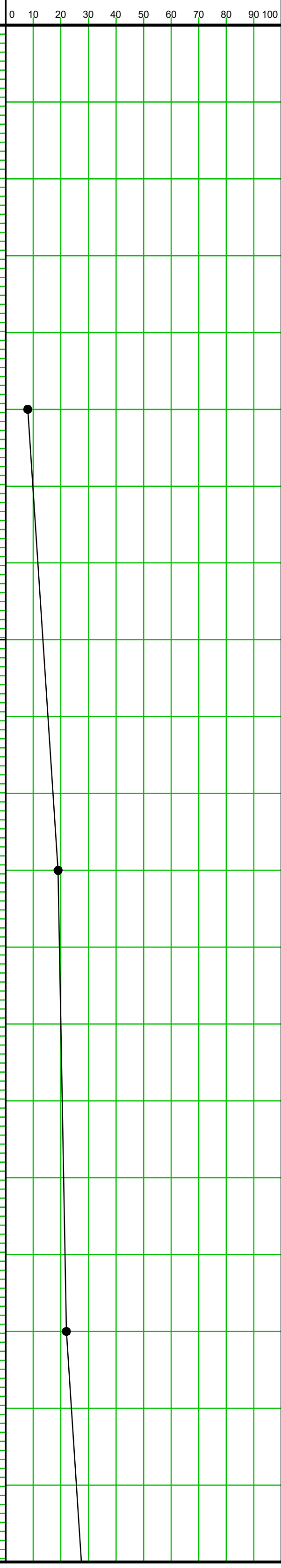


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :20+300 km	*Northing* :3118911.568 m	*Easting* :702589.211 m
Reduced Level (m):(+)191.187	*BH. No.* :BH-P1	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:2.10	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :09-10-2021	*Date of Completion* :11-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Medium stiff, Silty clay of low plasticity (0.0–4.0)	CL			
0.5											
1.0	1	UDS-1									
1.5											
2.0									2.10m		
2.5	2.5	SPT-1	2	3	5	8					
3.0											
3.5											
4.0	4	UDS-2					Brown, Medium dense to dense, Sandy silt of low plasticity with gravel (4.0–10.0)	ML-CL			
4.5											
5.0											
5.5	5.5	SPT-2	4	7	12	19					
6.0											
6.5											
7.0	7	UDS-3									
7.5											
8.0											
8.5	8.5	SPT-3	7	9	13	22					
9.0											
9.5											
10.0	10	UDS-4									

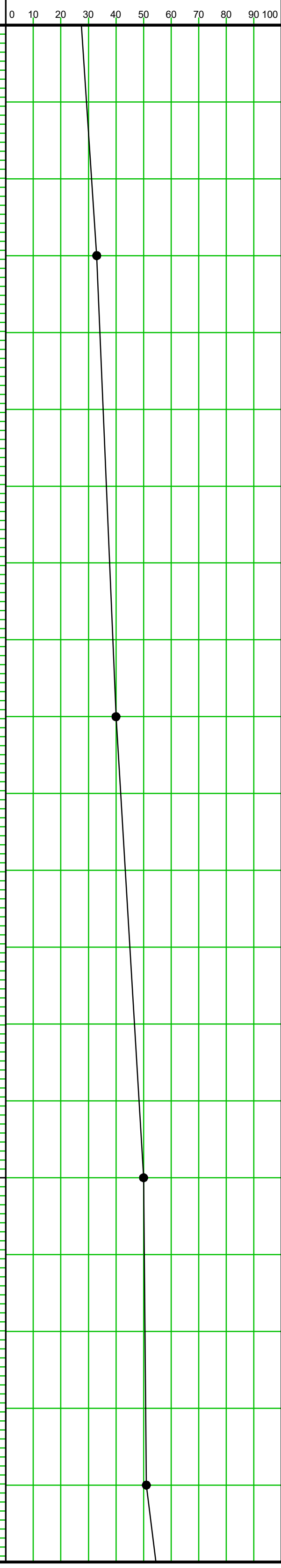


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 20+300 km	*Northing :* 3118911.568 m	*Easting :* 702589.211 m
Reduced Level (m): (+)191.187	*BH. No. :* BH-P1	*BH Termination Depth (m):* 40
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 2.10	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 09-10-2021	*Date of Completion :* 11-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0							Brown, Medium dense to dense, Sandy silt of low plasticity with gravel	ML-CL			
10.5											
11.0											
11.5	11.5	SPT-4	10	14	19	33					
12.0											
12.5											
13.0	13	UDS-5									
13.5											
14.0											
14.5	14.5	SPT-5	14	17	23	40					
15.0											
15.5											
16.0	16	UDS-6									
16.5											
17.0											
17.5	17.5	SPT-6	18	25	25	50					
18.0							Brown, Hard with gravel Silty clay of low plasticity	CL			
18.5											
19.0	19	UDS-7									
19.5	19.5	SPT-7	22	23	28	51					
20.0											

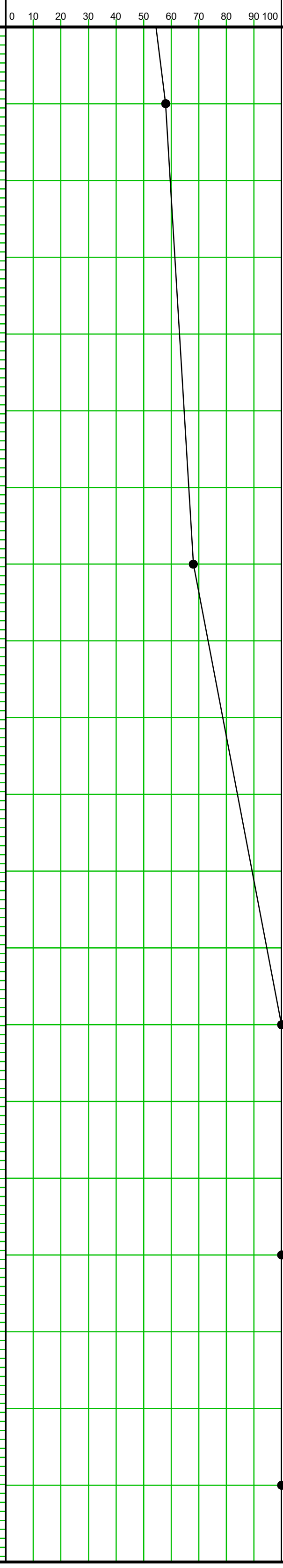


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*20+300 km	*Northing :*3118911.568 m	*Easting :*702589.211 m
Reduced Level (m):(+)191.187	*BH. No. :*BH-P1	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*2.10	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*09-10-2021	*Date of Completion :*11-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0							Brown, Hard with gravel Silty clay of low plasticity	CL			
20.5	20.5	SPT-8	25	27	31	58					
21.0											
21.5											
22.0	22	UDS-8									
22.5											
23.0											
23.5	23.5	SPT-9	29	32	36	68					
24.0											
24.5											
25.0	25	UDS-9									
25.5											
26.0											
26.5	26.5	SPT-10	30	45	55 (5cm)	>100					
27.0											
27.5											
28.0	28	SPT-11	30	52	48 (4cm)	>100					
28.5											
29.0											
29.5	29.5	SPT-12	35	45	55 (7cm)	>100					
30.0											

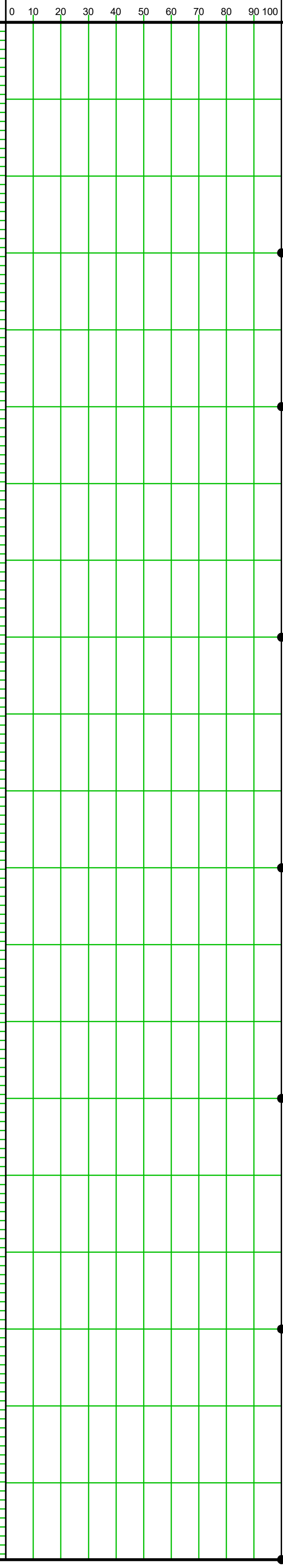


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 20+300 km	*Northing :* 3118911.568 m	*Easting :* 702589.211 m
Reduced Level (m): (+)191.187	*BH. No. :* BH-P1	*BH Termination Depth (m):* 40
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 2.10	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 09-10-2021	*Date of Completion :* 11-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
30.0											
30.5											
31.0											
31.5	31.5	SPT-13	37	40	60 (6cm)	>100					
32.0											
32.5	32.5	SPT-14	42	48	52 (6cm)	>100					
33.0											
33.5											
34.0	34	SPT-15	47	58	42 (5cm)	>100					
34.5											
35.0							Brown, Hard with gravel Silty clay of low plasticity	CL			
35.5	35.5	SPT-16	35	50	50 (4cm)	>100					
36.0											
36.5											
37.0	37	SPT-17	30	57	43 (4cm)	>100					
37.5											
38.0											
38.5	38.5	SPT-18	31	60	40 (8cm)	>100					
39.0											
39.5											
40.0	40	SPT-19	25	55	45 (10cm)	>100					

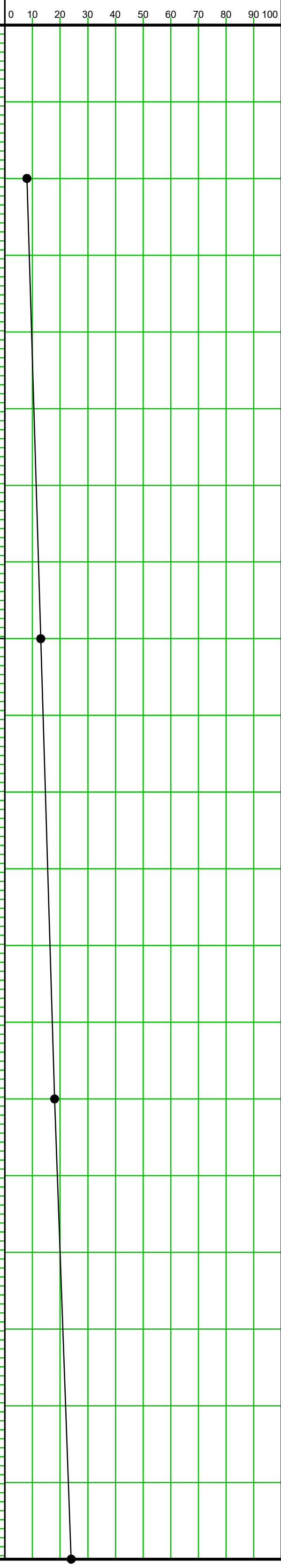


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 20+300 km	*Northing :* 3118913.897 m	*Easting :* 702570.093 m
Reduced Level (m): (+)191.622	*BH. No. :* BH-P2	*BH Termination Depth (m):* 40
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 2.25	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 09-10-2021	*Date of Completion :* 11-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
0.0		DS					Brown, Medium stiff, Silty clay of low plasticity	CL			
0.5											
1.0	1	SPT-1	3	3	5	8					
1.5											
2.0									2.25m		
2.5	2.5	UDS-1									
3.0											
3.5											
4.0	4	SPT-2	4	6	7	13	Brown, Medium dense to dense, Sandy silt of low plasticity with gravel	ML-CL			
4.5											
5.0											
5.5	5.5	UDS-2									
6.0											
6.5											
7.0	7	SPT-3	5	9	9	18					
7.5											
8.0											
8.5	8.5	UDS-3									
9.0											
9.5											
10.0	10	SPT-4	7	11	13	24					

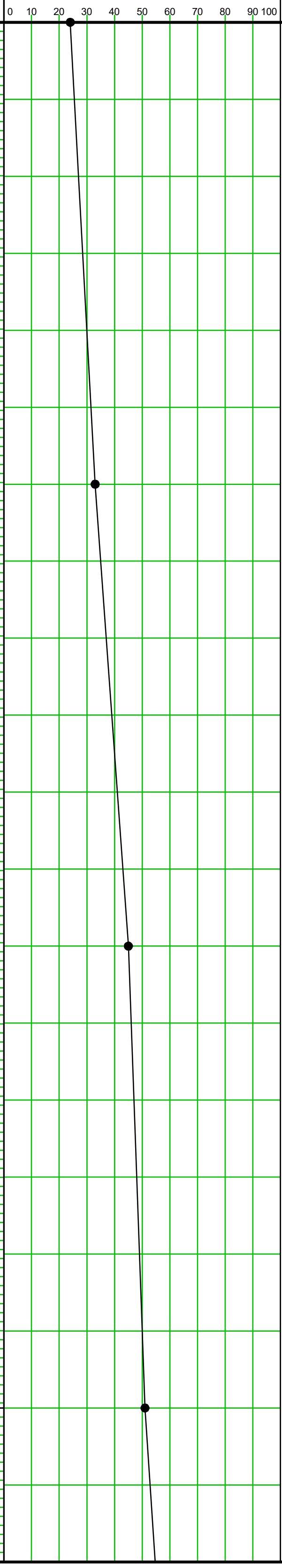


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :20+300 km	*Northing* :3118913.897 m	*Easting* :702570.093 m
Reduced Level (m):(+)191.622	*BH. No.* :BH-P2	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:2.25	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :09-10-2021	*Date of Completion* :11-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0							Brown, Medium dense to dense, Sandy silt of low plasticity with gravel	ML-CL			
10.5											
11.0											
11.5	11.5	UDS-4									
12.0											
12.5											
13.0	13	SPT-5	9	15	18	33					
13.5											
14.0											
14.5	14.5	UDS-5									
15.0											
15.5											
16.0	16	SPT-6	12	19	26	45					
16.5											
17.0											
17.5	17.5	UDS-6									
18.0											
18.5											
19.0	19	SPT-7	14	22	29	51					
19.5							Brown, Hard, Silty clay of low plasticity with gravel	CL			
20.0											

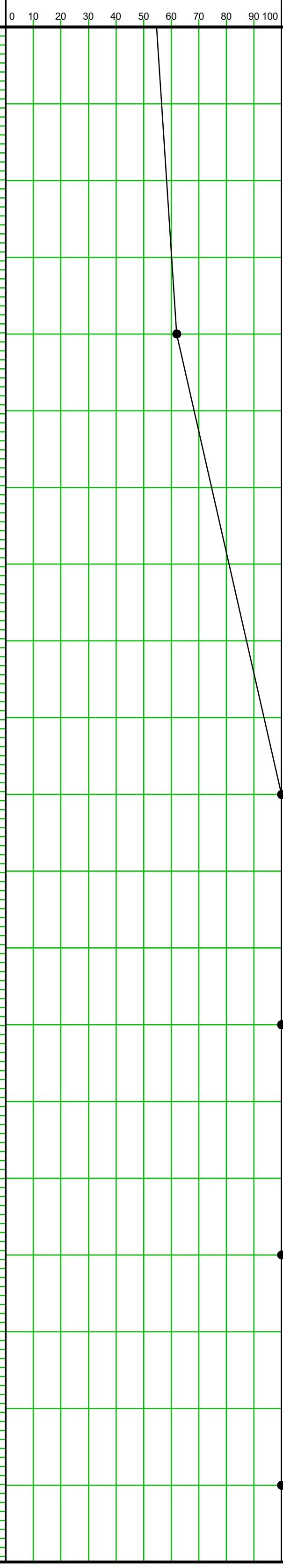


UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*20+300 km	*Northing :*3118913.897 m	*Easting :*702570.093 m
Reduced Level (m):(+)191.622	*BH. No. :*BH-P2	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*2.25	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*09-10-2021	*Date of Completion :*11-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	UDS-7									
21.0											
21.5											
22.0	22	SPT-8	19	28	34	62					
22.5											
23.0											
23.5	23.5	UDS-8									
24.0											
24.5											
25.0	25	SPT-9	28	45	55 (10cm)	>100	Brown, Hard, Silty clay of low plasticity with gravel	CL			
25.5											
26.0											
26.5	26.5	SPT-10	32	52	48 (7cm)	>100					
27.0											
27.5											
28.0	28	SPT-11	34	57	43 (6cm)	>100					
28.5											
29.0											
29.5	29.5	SPT-12	47	100 (10cm)	-	>100					
30.0											



UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :20+300 km	*Northing* :3118913.897 m	*Easting* :702570.093 m
Reduced Level (m):(+)191.622	*BH. No.* :BH-P2	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:2.25	*Inclination :* Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :09-10-2021	*Date of Completion* :11-10-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value) 0 10 20 30 40 50 60 70 80 90 100	Special Observations
30.0											
30.5											
31.0	31	SPT-13	30	41	59 (7cm)	>100					
31.5											
32.0											
32.5	32.5	SPT-14	39	49	51 (5cm)	>100					
33.0											
33.5											
34.0	34	SPT-15	41	77	23 (10cm)	>100					
34.5											
35.0							Brown, Hard, Silty clay of low plasticity with gravel	CL			
35.5	35.5	SPT-16	44	100 (6cm)	-	>100					
36.0											
36.5											
37.0	37	SPT-17	45	80	20 (12cm)	>100					
37.5											
38.0											
38.5	38.5	SPT-18	47	77	23 (9cm)	>100					
39.0											
39.5											
40.0	40	SPT-19	52	100 (6cm)	-	>100					

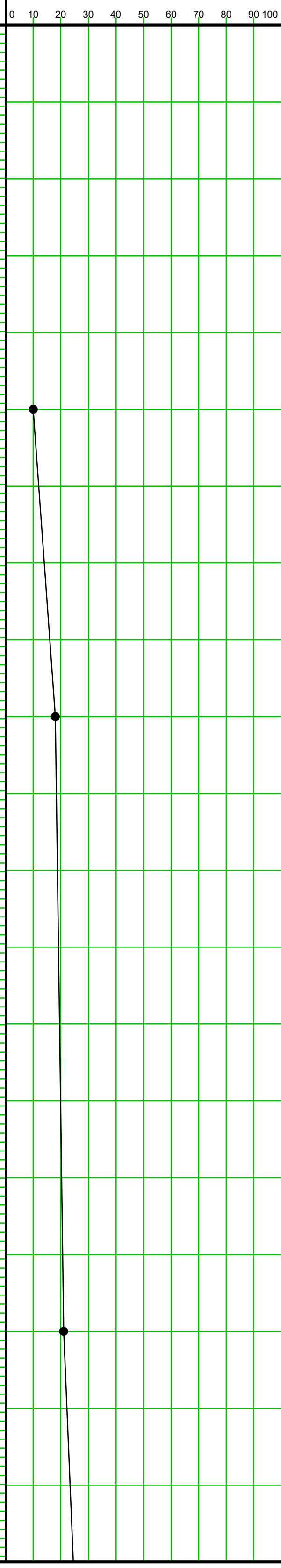
UDS*-UDS not recovered

FIELD BOREHOLE LOG

*Project Name :*GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :*HRIDCL
*BH Location/Chainage :*20+300 km	*Northing :*3118916.469 m	*Easting :*702548.989 m
Reduced Level (m):(+)191.622	*BH. No. :*BH-A2	*BH Termination Depth (m):*40
*Proposed / Existing Structure :*Major Bridge	*Water Table (m):*2.55	*Inclination :* Vertical
*Boring type :*Rotary	*Dia. of Boring :*150 mm	*Depth of Casing (m) :*Not Used
*Date of Start :*15-11-2021	*Date of Completion :*17-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	Special Observations
0.0		DS								
0.5										
1.0	1	UDS-1								
1.5										
2.0										
2.5	2.5	SPT-1	4	4	6	10			2.55m	
3.0										
3.5										
4.0	4	UDS-2								
4.5	4.5	SPT-2	6	8	10	18				
5.0							Brown, Stiff to very stiff, Silty clay of low plasticity with gravel	CL		
5.5										
6.0										
6.5										
7.0	7	UDS-3								
7.5										
8.0										
8.5	8.5	SPT-3	7	9	12	21				
9.0										
9.5										
10.0	10	UDS-4								

(Depth v/s SPT N Value)

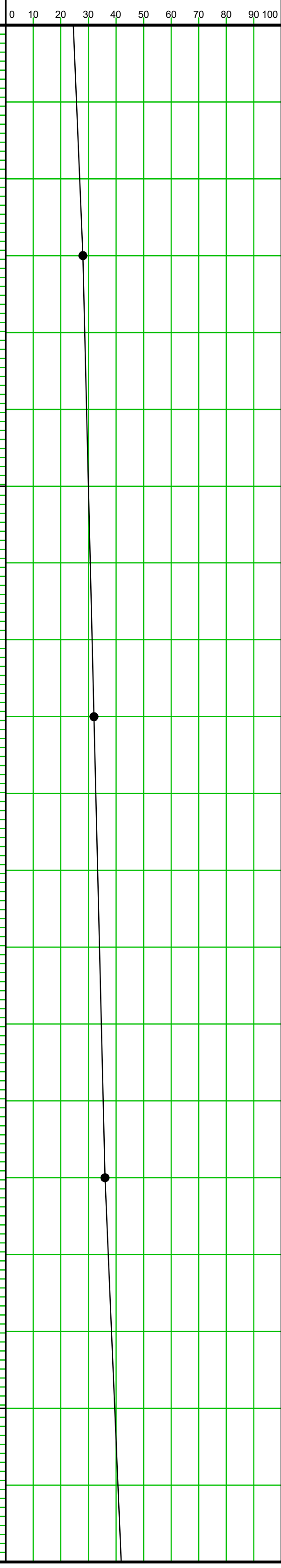


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :20+300 km	*Northing* :3118916.469 m	*Easting* :702548.989 m
Reduced Level (m):(+)191.622	*BH. No.* :BH-A2	*BH Termination Depth (m):*40
Proposed / Existing Structure :Major Bridge	*Water Table (m):*2.55	*Inclination :* Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :15-11-2021	*Date of Completion* :17-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
10.0											
10.5											
11.0											
11.5	11.5	SPT-4	9	12	16	28	Brown, Stiff to very stiff, Silty clay of low plasticity with gravel	CL			
12.0											
12.5											
13.0	13	UDS-5									
13.5											
14.0											
14.5	14.5	SPT-5	11	14	18	32					
15.0											
15.5											
16.0	16	UDS-6					Brown, Hard, Silty clay of low plasticity with gravel	CL			
16.5											
17.0											
17.5	17.5	SPT-6	11	16	20	36					
18.0											
18.5											
19.0	19	UDS-7									
19.5							Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL			
20.0											

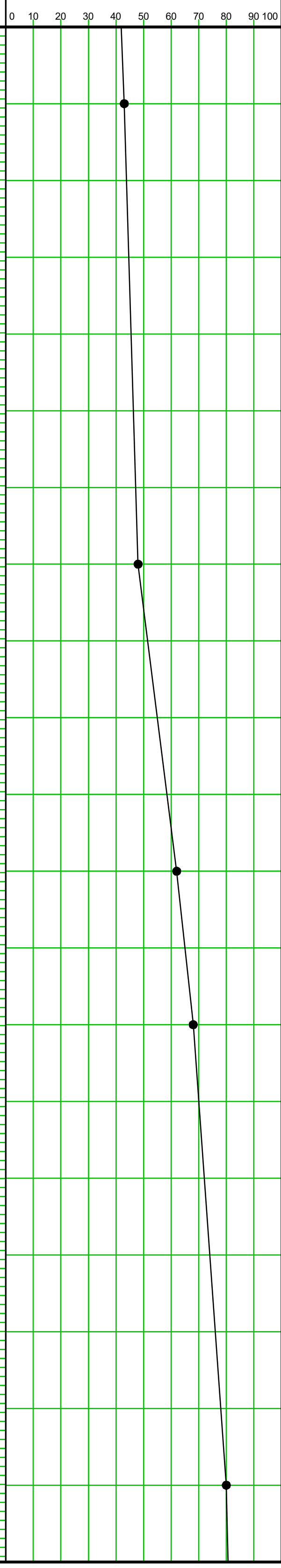


UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name :GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client* :HRIDCL
BH Location/Chainage :20+300 km	*Northing* :3118916.469 m	*Easting* :702548.989 m
Reduced Level (m):(+)191.622	*BH. No.* :BH-A2	*BH Termination Depth (m)*:40
Proposed / Existing Structure :Major Bridge	*Water Table (m)*:2.55	*Inclination* : Vertical
Boring type :Rotary	*Dia. of Boring* :150 mm	*Depth of Casing (m)* :Not Used
Date of Start :15-11-2021	*Date of Completion* :17-11-2021	

Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Graphic Log	(Depth v/s SPT N Value)	Special Observations
20.0											
20.5	20.5	SPT-7	13	18	25	43					
21.0											
21.5											
22.0	22	UDS-8									
22.5											
23.0											
23.5	23.5	SPT-8	14	20	28	48					
24.0											
24.5											
25.0	25	UDS*					Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL			
25.5	25.5	SPT-9	21	28	34	62					
26.0											
26.5	26.5	SPT-10	18	31	37	68					
27.0											
27.5											
28.0	28	UDS-9									
28.5											
29.0											
29.5	29.5	SPT-11	25	38	42	80					
30.0											



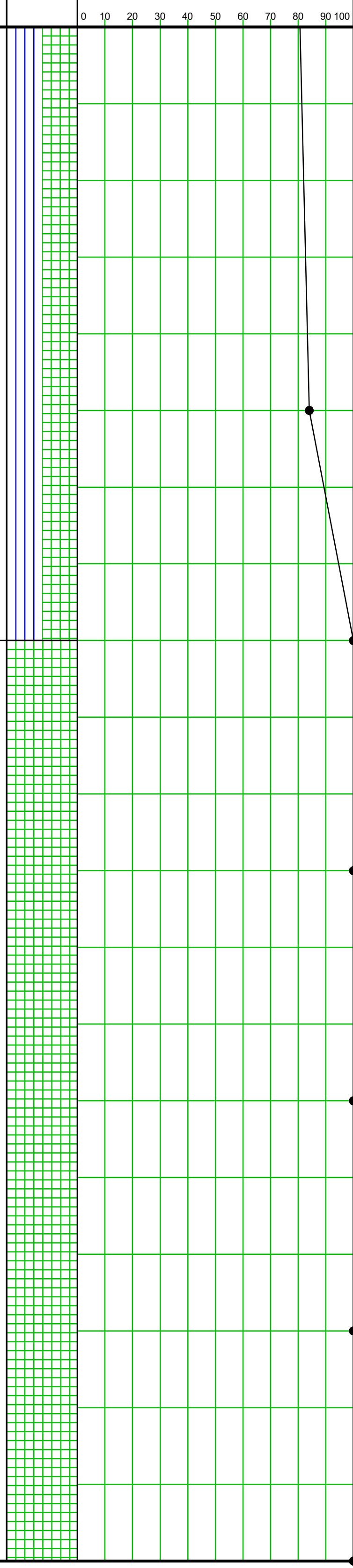
UDS*-UDS not recovered

FIELD BOREHOLE LOG

Project Name : GTI for (HORC) project from Palwal to Harsana Kalan in the state of Haryana.		*Client :* HRIDCL
BH Location/Chainage : 20+300 km	*Northing :* 3118916.469 m	*Easting :* 702548.989 m
Reduced Level (m): (+)191.622	*BH. No. :* BH-A2	*BH Termination Depth (m):* 40
Proposed / Existing Structure : Major Bridge	*Water Table (m):* 2.55	*Inclination :* Vertical
Boring type : Rotary	*Dia. of Boring :* 150 mm	*Depth of Casing (m) :* Not Used
Date of Start : 15-11-2021	*Date of Completion :* 17-11-2021	

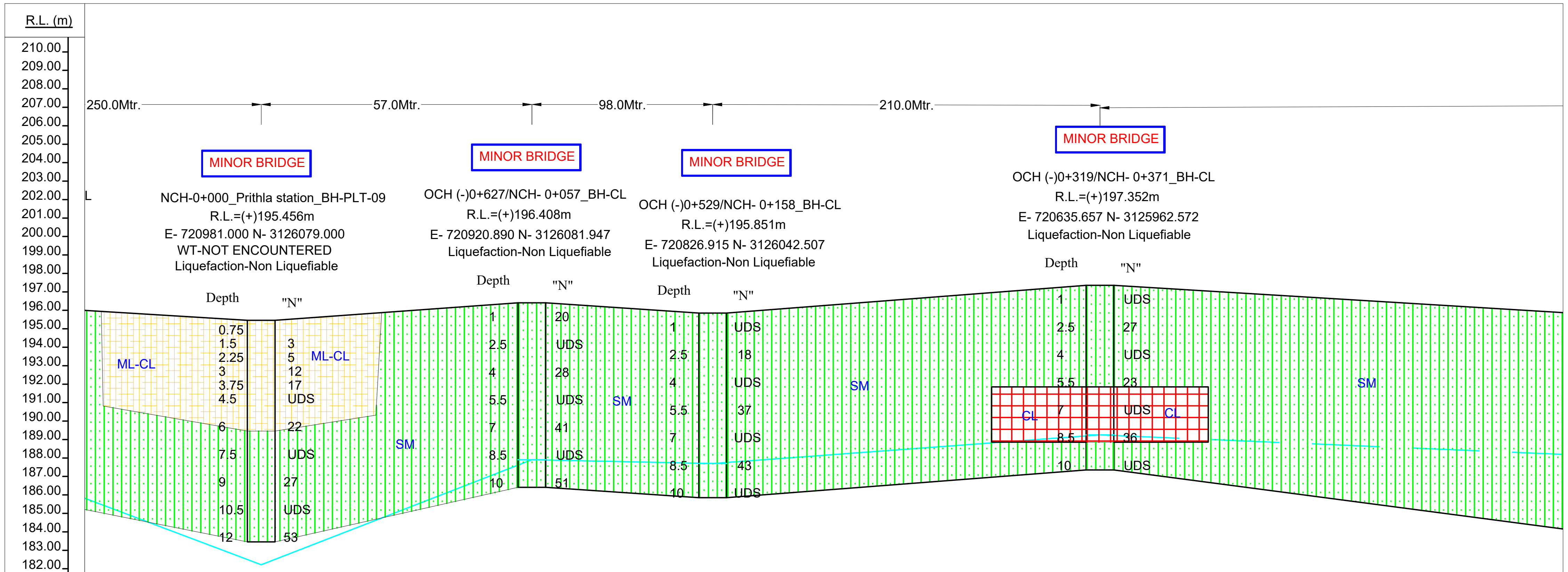
Depth (m)	In-Situ Sample Depth (m)	Sample Type	Blow counts per 15cm N1	N2	N3	SPT N Value	Strata Description	IS Classification	Special Observations
30.0							Brown, Dense to very dense, Sandy silt of low plasticity with gravel (30.0–34.0)	ML-CL	
30.5									
31.0	31	UDS-10							
31.5									
32.0									
32.5	32.5	SPT-12	28	36	48	84			
33.0									
33.5									
34.0	34	SPT-13	24	48	52 (15cm)	>100			
34.5							Brown, Hard, Silty clay of low plasticity with gravel (34.0–40.0)	CL	
35.0									
35.5	35.5	SPT-14	32	44	56 (12cm)	>100			
36.0									
36.5									
37.0	37	SPT-15	34	50	50 (8cm)	>100			
37.5									
38.0									
38.5	38.5	SPT-16	29	55	45 (7cm)	>100			
39.0									
39.5									
40.0	40	SPT-17	42	59	41 (6cm)	>100			

Graphic Log / (Depth v/s SPT N Value)



UDS*-UDS not recovered

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
-	0+000	BH-PLT-09	2.0 x 2.0	1.0	16.1	10.3	10.3	25
			2.0 x 2.0	2.7	27.6	13.0	13.0	
			2.0 x 2.0	3.0	29.8	13.3	13.3	
-	0+000	BH-PLT-09	2.0 x 2.0	1.0	16.1	20.6	16.1	50
			2.0 x 2.0	2.7	27.6	26.0	26.0	
			2.0 x 2.0	3.0	29.8	26.0	26.0	
-	0+000	PLT-09	2.0 x 2.0	2.7	20.4	22.8	20.4	25

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
(-)0+319	0+371	BH-CL	5.5 X 5.5	1.0	40.6	16.3	16.3	25
			5.5 X 5.5	2.0	52.5	14.7	14.7	
			5.5 X 5.5	3.0	64.9	14.1	14.1	
(-)0+319	0+371	BH-CL	5.5 X 5.5	1.0	40.6	32.6	30.0	50
			5.5 X 5.5	2.0	52.5	29.4	29.4	
			5.5 X 5.5	3.0	64.9	28.3	28.3	

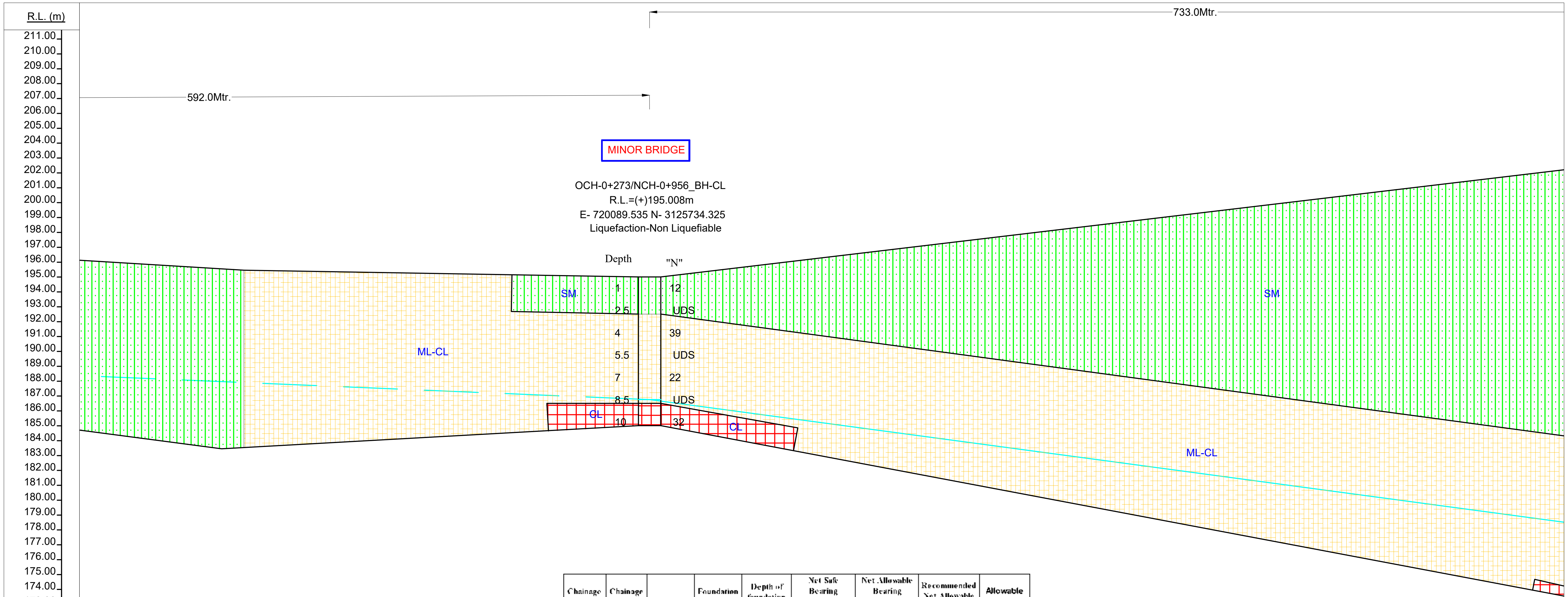
Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
(-)0+627	0+057	BH-CL	7.2 X 7.2	1.0	42.5	26.1	26.1	25
			7.2 X 7.2	2.0	53.4	25.9	25.9	
			7.2 X 7.2	3.0	64.8	24.9	24.9	
(-)0+627	0+057	BH-CL	7.2 X 7.2	1.0	42.5	52.2	30.0	50
			7.2 X 7.2	2.0	53.4	51.8	30.0	
			7.2 X 7.2	3.0	61.8	49.8	30.0	
(-)0+529	0+158	BH-CL	4.8 x 4.8	1.0	24.0	25.2	24.0	25
			4.8 x 4.8	2.0	32.1	25.8	25.8	
			4.8 x 4.8	3.0	40.7	26.1	26.1	
(-)0+529	0+158	BH-CL	4.8 x 4.8	1.0	24.0	50.4	24.0	50
			4.8 x 4.8	2.0	32.1	51.6	30.0	
			4.8 x 4.8	3.0	40.7	52.3	30.0	

Note:-
NR - BH's as Liquefible depth more than 4m. (Suitable ground improvement methods are recommended.

SYMBOL	DESCRIPTION
	SM- Silty Sand (Having fines Less Than 50% and no plasticity or below A-line)
	SM-SC -Clayey Sand (Having fines Less Than 50% and in the hatched zone (4<PI<7)
	ML-CL -Sandy with clay (Having fines greater than 50% and in the hatched zone (LL<35 & 4<PI<7)
	CL-Silty Clay of low plasticity (Above A-line, LL<35)
	CI- Clay of medium plasticity (Above A-line, 35≤LL<50) / LIQUEFACTION
BOREHOLE REQUIRED	WATER TABLE

Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20) SCALE:- HOR:- 1:2850 SCALE:- VER:- 1:285

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
0+273	0+958	BH-CL	4.8 X 4.8	1.0	49.4	23.8	23.8	25
			4.8 X 4.8	2.0	61.4	25.8	25.8	
			4.8 X 4.8	3.0	74.1	27.9	27.9	
0+273	0+958	BH-CL	4.8 X 4.8	1.0	49.4	47.7	30.0	50
			4.8 X 4.8	2.0	61.4	51.5	30.0	
			4.8 X 4.8	3.0	74.1	55.8	30.0	

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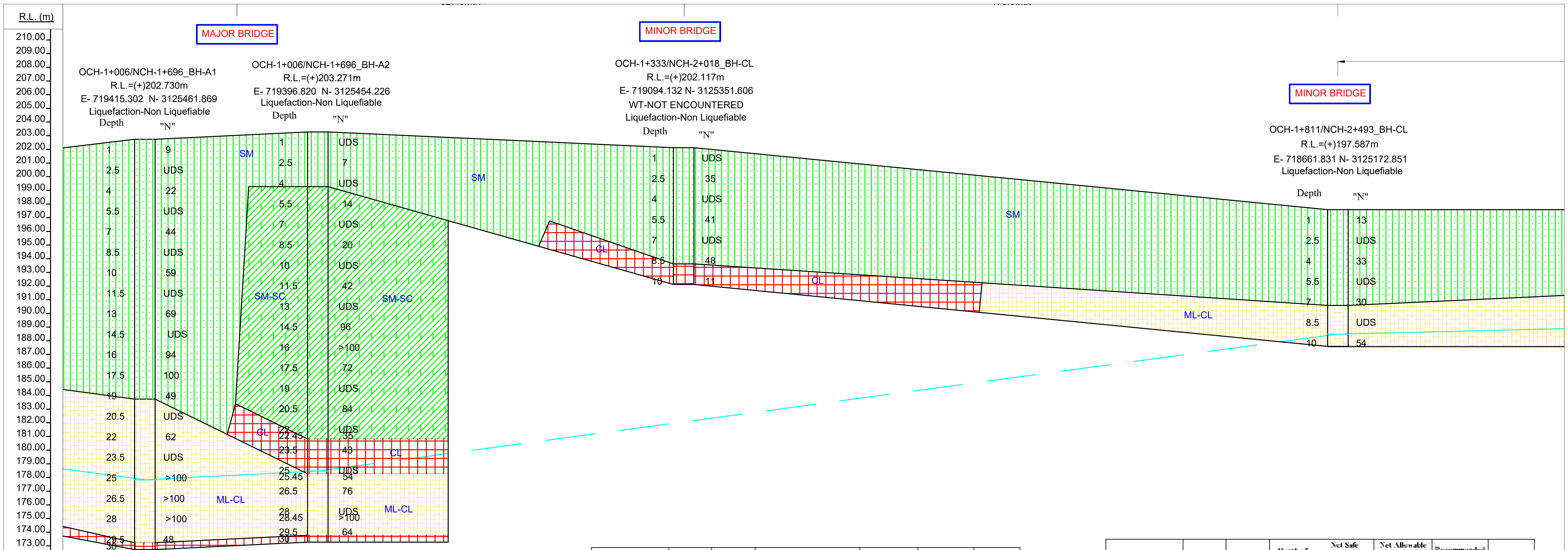
SYMBOL	DESCRIPTION		
	SM- Silty Sand (Having fines Less Than 50% and no plasticity or below A-line)		
	SM-SC -Clayey Sand (Having fines Less Than 50% and in the hatched zone (4<PI<7)		
	ML-CL -Sandy with clay (Having fines greater than 50% and in the hatched zone (LL<35 & 4<PI<7)		
	CL-Silty Clay of low plasticity (Above A-line, LL<35)		
	CI- Clay of medium plasticity (Above A-line, 35≤LL<50)		LIQUEFACTION
	BOREHOLE REQUIRED		WATER TABLE
Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20)	SCALE:- HOR:- 1:2850	SCALE:- VER:- 1:285	

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
1+006	1+696	BH-A1	7.2 X 7.2	2.0	38.1	21.6	21.6	25
			7.2 X 7.2	3.0	47.2	25.3	25.3	
			7.2 X 7.2	4.0	56.6	30.3	30.0	
1+006	1+696	BH-A1	7.2 X 7.2	2.0	38.1	43.2	30.0	50
			7.2 X 7.2	3.0	47.2	50.6	30.0	
			7.2 X 7.2	4.0	56.6	60.7	30.0	
1+006	1+696	BH-A2	7.2 X 7.2	2.0	43.2	11.1	11.1	25
			7.2 X 7.2	3.0	53.4	17.4	17.4	
			7.2 X 7.2	4.0	63.9	38.9	30.0	
1+006	1+696	BH-A2	7.2 X 7.2	2.0	43.2	22.2	22.2	50
			7.2 X 7.2	3.0	53.4	34.9	30.0	
			7.2 X 7.2	4.0	63.9	77.9	30.0	

Note:-
NR - BH's as Liquefible depth more than 4m. (Suitable ground improvement methods are recommended.

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
1+333	2+018	BH-CL	4.8 X 4.8	1.0	50.2	40.7	30.0	25
			4.8 X 4.8	2.0	68.7	42.1	30.0	
			4.8 X 4.8	3.0	88.4	44.5	30.0	
1+333	2+018	BH-CL	4.8 X 4.8	1.0	50.2	81.3	30.0	50
			4.8 X 4.8	2.0	68.7	84.2	30.0	
			4.8 X 4.8	3.0	88.4	88.5	30.0	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
1+811	2+493	BH-CL	12.5 X 12.5	1.0	41.8	28.9	28.9	25
			12.5 X 12.5	2.0	49.6	29.6	29.6	
			12.5 X 12.5	3.0	57.6	30.2	30.0	
1+811	2+493	BH-CL	12.5 X 12.5	1.0	41.8	57.8	30.0	50
			12.5 X 12.5	2.0	49.6	59.3	30.0	
			12.5 X 12.5	3.0	57.6	60.5	30.0	

SYMBOL	DESCRIPTION
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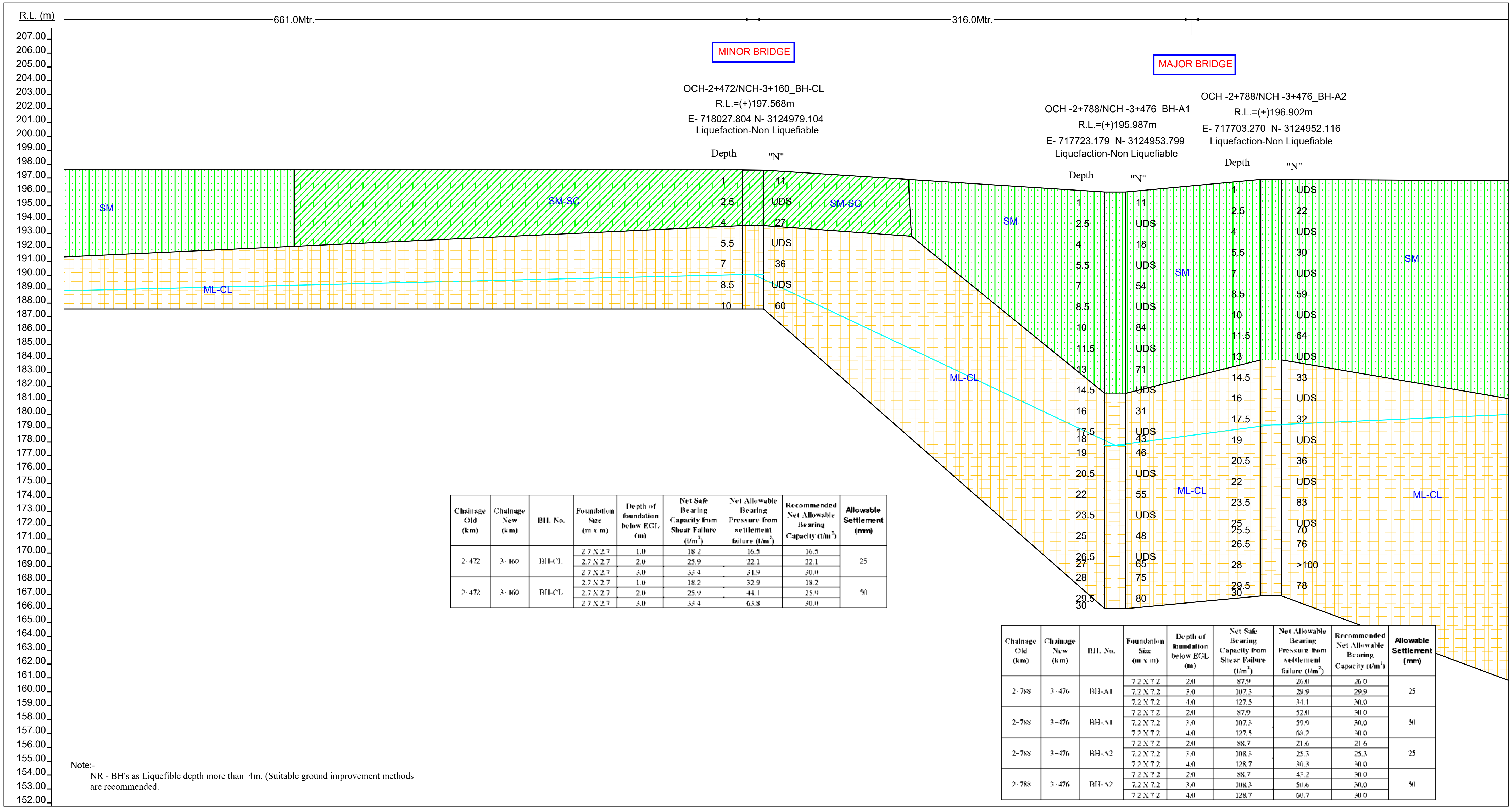
	BOREHOLE REQUIRED · WATER TABLE

Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20) SCALE:- HOR:- 1:2850 SCALE:- VER:- 1:285

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
2+472	3+160	BH-CL	2.7 X 2.7	1.0	18.2	16.5	16.5	25
			2.7 X 2.7	2.0	25.9	22.1	22.1	
			2.7 X 2.7	3.0	33.4	31.9	30.0	
2+472	3+160	BH-CL	2.7 X 2.7	1.0	18.2	32.9	18.2	50
			2.7 X 2.7	2.0	25.9	44.1	25.9	
			2.7 X 2.7	3.0	33.4	63.8	30.0	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
2+788	3+476	BH-A1	7.2 X 7.2	2.0	87.9	26.0	26.0	25
			7.2 X 7.2	3.0	107.3	29.9	29.9	
			7.2 X 7.2	4.0	127.5	34.1	30.0	
2+788	3+476	BH-A1	7.2 X 7.2	2.0	87.9	52.0	30.0	50
			7.2 X 7.2	3.0	107.3	59.9	30.0	
			7.2 X 7.2	4.0	127.5	68.2	30.0	
2+788	3+476	BH-A2	7.2 X 7.2	2.0	88.7	21.6	21.6	25
			7.2 X 7.2	3.0	108.3	25.3	25.3	
			7.2 X 7.2	4.0	128.7	30.3	30.0	
2+788	3+476	BH-A2	7.2 X 7.2	2.0	88.7	43.2	30.0	50
			7.2 X 7.2	3.0	108.3	50.6	30.0	
			7.2 X 7.2	4.0	128.7	60.7	30.0	

Note:-
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	LIQUEFACTION
	BOREHOLE REQUIRED
	WATER TABLE

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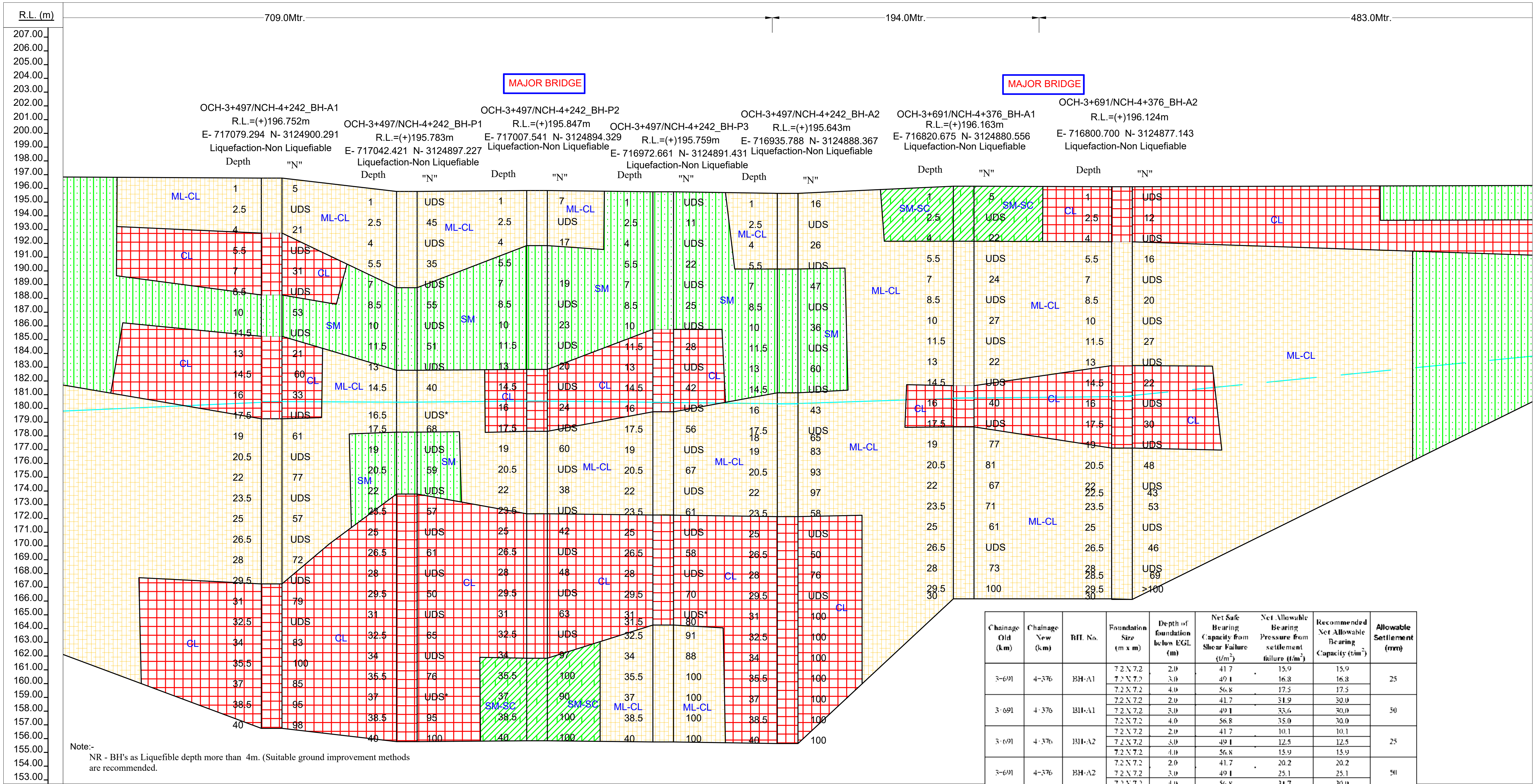
SCALE:- HOR:- 1:2850
SCALE:- VER:- 1:285

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
3+691	4+376	BH-A1	7.2 X 7.2	2.0	41.7	15.9	15.9	25
			7.2 X 7.2	3.0	49.1	16.8	16.8	
			7.2 X 7.2	4.0	56.8	17.5	17.5	
3+691	4+376	BH-A1	7.2 X 7.2	2.0	41.7	31.9	30.0	50
			7.2 X 7.2	3.0	49.1	33.6	30.0	
			7.2 X 7.2	4.0	56.8	35.0	30.0	
3+691	4+376	BH-A2	7.2 X 7.2	2.0	41.7	10.1	10.1	25
			7.2 X 7.2	3.0	49.1	12.5	12.5	
			7.2 X 7.2	4.0	56.8	15.9	15.9	
3+691	4+376	BH-A2	7.2 X 7.2	2.0	41.7	20.2	20.2	50
			7.2 X 7.2	3.0	49.1	25.1	25.1	
			7.2 X 7.2	4.0	56.8	31.7	30.0	

Note:-

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Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
3+497	4+242	BH-A1	7.2 X 7.2	2.0	22.1	7.2	7.2	25
			7.2 X 7.2	3.0	23.0	10.2	10.2	
			7.2 X 7.2	4.0	23.9	17.3	17.3	
3+497	4+242	BH-A1	7.2 X 7.2	2.0	22.1	14.3	14.3	50
			7.2 X 7.2	3.0	23.0	20.5	20.5	
			7.2 X 7.2	4.0	23.9	34.6	23.9	
3+497	4+242	BH-P1	7.2 X 7.2	2.0	62.5	44.2	30.0	25
			7.2 X 7.2	3.0	73.0	45.7	30.0	
			7.2 X 7.2	4.0	83.9	46.5	30.0	
3+497	4+242	BH-P1	7.2 X 7.2	2.0	62.5	88.3	30.0	50
			7.2 X 7.2	3.0	73.0	91.4	30.0	
			7.2 X 7.2	4.0	83.9	93.0	30.0	
3+497	4+242	BH-P2	7.2 X 7.2	2.0	41.5	14.1	14.1	25
			7.2 X 7.2	3.0	51.2	14.5	14.5	
			7.2 X 7.2	4.0	61.4	14.8	14.8	
3+497	4+242	BH-P2	7.2 X 7.2	2.0	41.5	28.2	28.2	50
			7.2 X 7.2	3.0	51.2	29.0	29.0	
			7.2 X 7.2	4.0	61.4	29.5	29.5	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
3+497	4+242	BH-P3	7.2 X 7.2	2.0	48.9	14.9	14.9	25
			7.2 X 7.2	3.0	60.2	15.6	15.6	
			7.2 X 7.2	4.0	72.0	16.6	16.6	
3+497	4+242	BH-P3	7.2 X 7.2	2.0	48.9	29.8	29.8	50
			7.2 X 7.2	3.0	60.2	31.2	30.0	
			7.2 X 7.2	4.0	72.0	33.1	30.0	
3+497	4+242	BH-A2	7.2 X 7.2	2.0	71.1	29.0	29.0	25
			7.2 X 7.2	3.0	87.1	30.2	30.0	
			7.2 X 7.2	4.0	103.7	31.6	30.0	
3+497	4+242	BH-A2	7.2 X 7.2	2.0	71.1	58.0	30.0	50
			7.2 X 7.2	3.0	87.1	60.3	30.0	
			7.2 X 7.2	4.0	103.7	63.3	30.0	

SYMBOL	DESCRIPTION
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	ML-CL -Sandy with clay (Having fines greater than 50% and in the hatched zone (LL<35 & 4<PI<7)
	CL-Silty Clay of low plasticity (Above A-line, LL<35)
	CI- Clay of medium plasticity (Above A-line, 35≤LL<50) — LIQUEFACTION
BOREHOLE REQUIRED	WATER TABLE

Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20) SCALE:- HOR:- 1:2850 SCALE:- VER:- 1:285

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT
IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN
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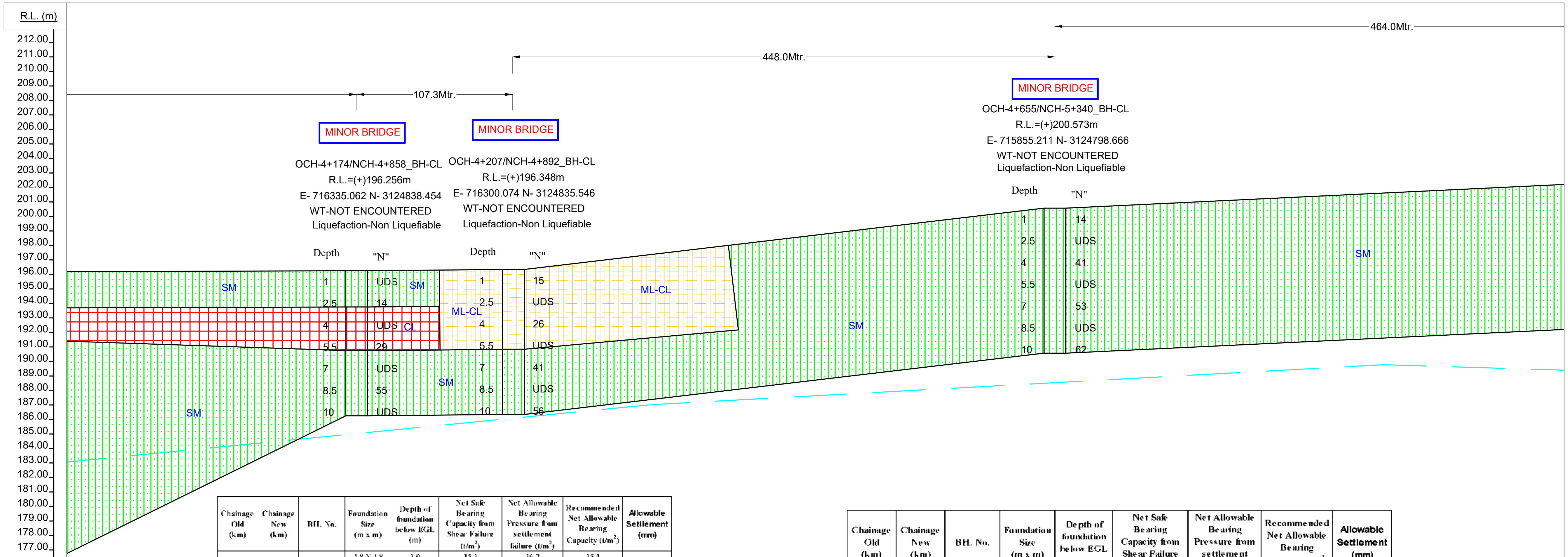

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Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
4+174	4+858	BH-CL	4.8 X 4.8	1.0	15.1	16.2	15.1	25
			4.8 X 4.8	2.0	16.0	17.2	16.0	
			4.8 X 4.8	3.0	17.0	21.2	17.0	
4+174	4+858	BH-CL	4.8 X 4.8	1.0	15.1	32.4	15.1	50
			4.8 X 4.8	2.0	16.0	34.4	16.0	
			4.8 X 4.8	3.0	17.0	42.4	17.0	
4+207	4+892	BH-CL	1.5 X 1.5	1.0	26.6	47.1	26.6	25
			1.5 X 1.5	2.0	38.0	55.8	30.0	
			1.5 X 1.5	3.0	50.7	60.6	30.0	
4+207	4+892	BH-CL	1.5 X 1.5	1.0	26.6	94.2	26.6	50
			1.5 X 1.5	2.0	38.0	111.7	30.0	
			1.5 X 1.5	3.0	50.7	121.1	30.0	

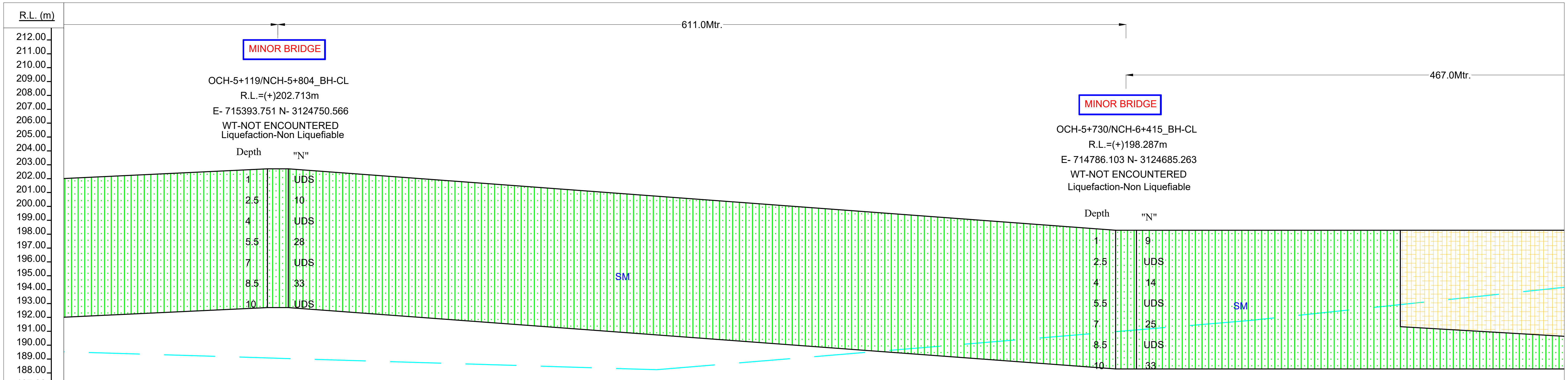
Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
4+655	5+340	BH-CL	4.8 x 4.8	1.0	15.1	16.2	15.1	25
			4.8 x 4.8	2.0	16.0	17.2	16.0	
			4.8 x 4.8	3.0	17.0	21.2	17.0	
4+655	5+340	BH-CL	4.8 x 4.8	1.0	15.1	32.4	15.1	50
			4.8 x 4.8	2.0	16.0	34.4	16.0	
			4.8 x 4.8	3.0	17.0	42.4	17.0	

Note:-
NR - BH's as Liquefible depth more than 4m. (Suitable ground improvement methods are recommended.

SYMBOL	DESCRIPTION
	SM- Silty Sand (Having fines Less Than 50% and no plasticity or below A-line)
	SM-SC -Clayey Sand (Having fines Less Than 50% and in the hatched zone (4<PI<7)
	ML-CL -Sandy with clay (Having fines greater than 50% and in the hatched zone (LL<35 & 4<PI<7)
	CL-Silty Clay of low plasticity (Above A-line, LL<35)
	CI- Clay of medium plasticity (Above A-line, 35≤LL<50) — LIQUEFACTION
	BOREHOLE REQUIRED — WATER TABLE

Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20)   SCALE:- HOR:- 1:2850   SCALE:- VER:- 1:285

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



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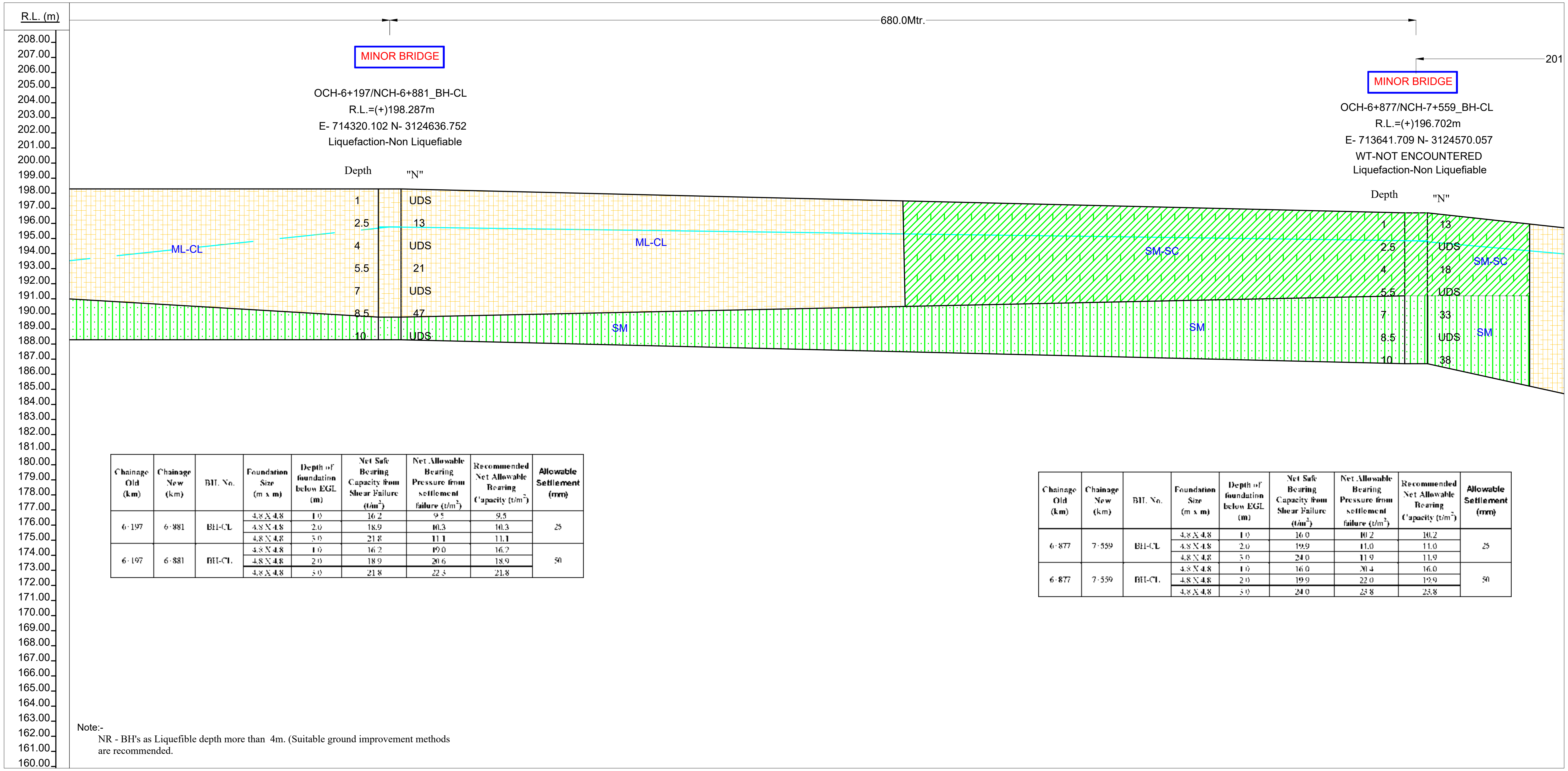
Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
5+119	5+804	BH-CL	4.8 X 4.8	1.0	14.0	21.7	14.0	25
			4.8 X 4.8	2.0	19.9	23.5	19.9	
			4.8 X 4.8	3.0	26.2	25.4	25.4	
5+119	5+804	BH-CL	4.8 X 4.8	1.0	14.0	43.4	14.0	50
			4.8 X 4.8	2.0	19.9	46.9	19.9	
			4.8 X 4.8	3.0	26.2	50.8	26.2	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
5+730	6+415	BH-CL	3.7 X 3.7	1.0	15.3	17.5	15.3	25
			3.7 X 3.7	2.0	22.8	19.4	19.4	
			3.7 X 3.7	3.0	30.8	21.3	21.3	
5+730	6+415	BH-CL	3.7 X 3.7	1.0	15.3	35.0	15.3	50
			3.7 X 3.7	2.0	22.8	38.9	22.8	
			3.7 X 3.7	3.0	30.8	42.5	30.0	

Note:-
NR - BH's as Liquefible depth more than 4m. (Suitable ground improvement methods are recommended.

SYMBOL	DESCRIPTION		
	SM- Silty Sand (Having fines Less Than 50% and no plasticity or below A-line)		
	SM-SC -Clayey Sand (Having fines Less Than 50% and in the hatched zone (4<PI<7)		
	ML-CL -Sandy with clay (Having fines greater than 50% and in the hatched zone (LL<35 & 4<PI<7)		
	CL-Silty Clay of low plasticity (Above A-line, LL<35)		
	CI- Clay of medium plasticity (Above A-line, 35≤LL<50)		LIQUEFACTION
	BOREHOLE REQUIRED		WATER TABLE
Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20)	SCALE:- HOR:- 1:2850	SCALE:- VER:- 1:285	

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
6+197	6+881	BH-CL	4.8 X 4.8	1.0	16.2	9.5	9.5	25
			4.8 X 4.8	2.0	18.9	10.3	10.3	
			4.8 X 4.8	3.0	21.8	11.1	11.1	
6+197	6+881	BH-CL	4.8 X 4.8	1.0	16.2	19.0	16.2	50
			4.8 X 4.8	2.0	18.9	20.6	18.9	
			4.8 X 4.8	3.0	21.8	22.3	21.8	

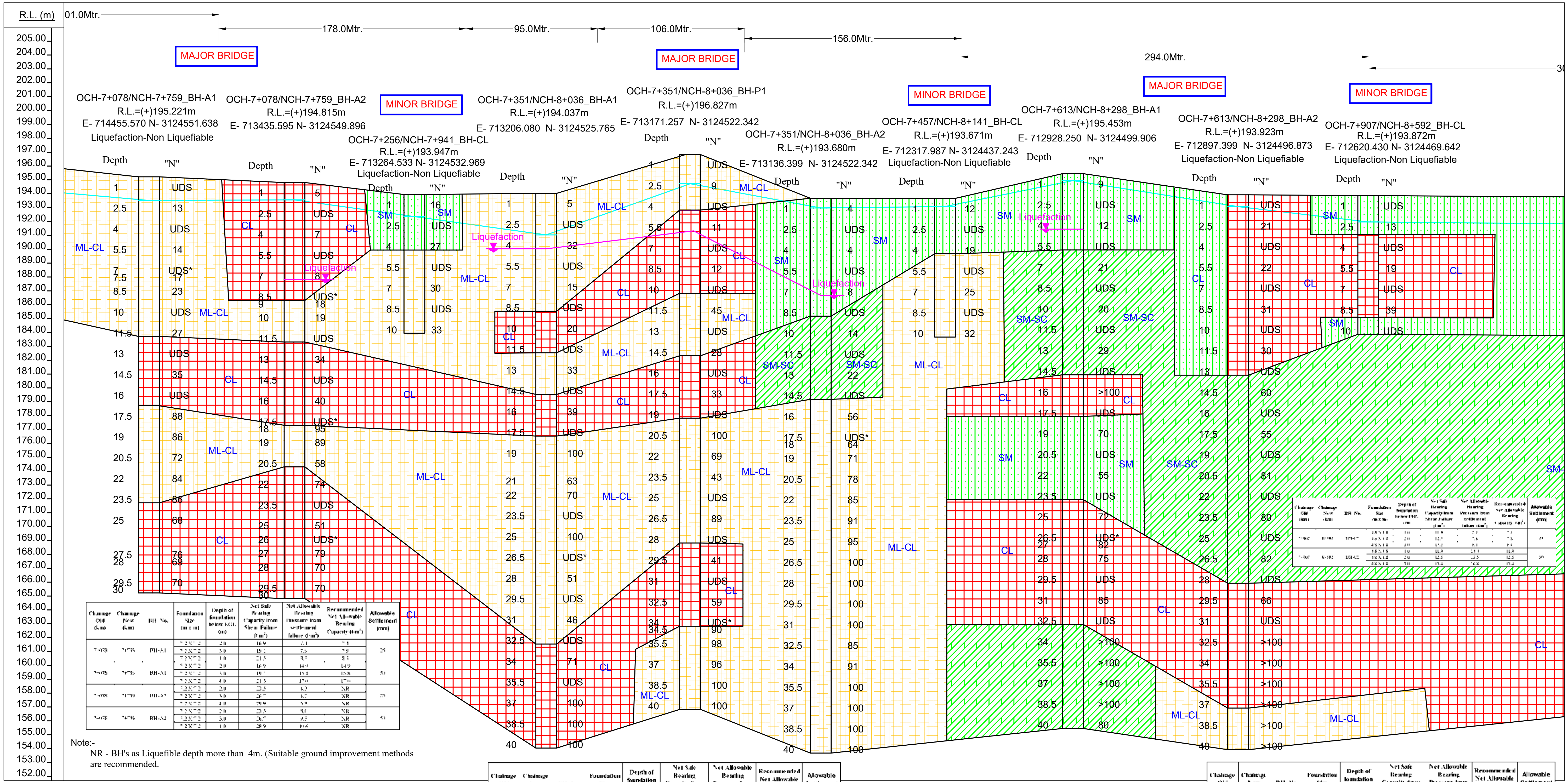
Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
6+877	7+559	BH-CL	4.8 X 4.8	1.0	16.0	10.2	10.2	25
			4.8 X 4.8	2.0	19.9	11.0	11.0	
			4.8 X 4.8	3.0	24.0	11.9	11.9	
6+877	7+559	BH-CL	4.8 X 4.8	1.0	16.0	20.4	16.0	50
			4.8 X 4.8	2.0	19.9	22.0	19.9	
			4.8 X 4.8	3.0	24.0	23.8	23.8	

Note:-
NR - BH's as Liquefible depth more than 4m. (Suitable ground improvement methods are recommended.

SYMBOL	DESCRIPTION
	SM- Silty Sand (Having fines Less Than 50% and no plasticity or below A-line)
	SM-SC -Clayey Sand (Having fines Less Than 50% and in the hatched zone (4<PI<7)
	ML-CL -Sandy with clay (Having fines greater than 50% and in the hatched zone (LL<35 & 4<PI<7)
	CL-Silty Clay of low plasticity (Above A-line, LL<35)
	CI- Clay of medium plasticity (Above A-line, 35≤LL<50) — LIQUEFACTION
	BOREHOLE REQUIRED — WATER TABLE

Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20) | SCALE:- HOR:- 1:2850 | SCALE:- VER:- 1:285

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
7+078	7+759	BH-A1	7.2X7.2	2.0	16.9	7.1	7.1	25
			7.2X7.2	3.0	19.1	7.5	7.9	
			7.2X7.2	4.0	21.5	8.5	8.5	
7+078	7+759	BH-A1	7.2X7.2	2.0	16.9	14.9	14.9	50
			7.2X7.2	3.0	19.1	15.8	15.8	
			7.2X7.2	4.0	21.5	17.0	17.0	
7+078	7+759	BH-A2	7.2X7.2	2.0	23.5	4.3	NR	25
			7.2X7.2	3.0	26.7	4.7	NR	
			7.2X7.2	4.0	29.9	5.3	NR	
7+078	7+759	BH-A2	7.2X7.2	2.0	23.5	8.0	NR	50
			7.2X7.2	3.0	26.7	9.5	NR	
			7.2X7.2	4.0	29.9	10.6	NR	

Note:-
NR - BH's as Liquefible depth more than 4m. (Suitable ground improvement methods are recommended.

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
7+351	8+036	BH-P1	7.2 X 7.2	2.0	9.3	6.2	NR	25
			7.2 X 7.2	3.0	11.4	7.2	NR	
			7.2 X 7.2	4.0	13.6	8.4	NR	
7+351	8+036	BH-P1	7.2 X 7.2	2.0	9.3	12.3	NR	50
			7.2 X 7.2	3.0	11.4	14.1	NR	
			7.2 X 7.2	4.0	13.6	15.7	NR	
7+351	8+036	BH-A2	7.2 X 7.2	2.0	9.3	12.8	NR	25
			7.2 X 7.2	3.0	11.4	13.5	NR	
			7.2 X 7.2	4.0	13.6	14.3	NR	
7+351	8+036	BH-A2	7.2 X 7.2	2.0	9.3	25.7	NR	50
			7.2 X 7.2	3.0	11.4	27.0	NR	
			7.2 X 7.2	4.0	13.6	28.6	NR	

Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 25mm & 50mm (Replaced / Compacted Soil)

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
7+351	8+036	BH-A2	7.2 X 7.2	2.0	16.1	13.6	13.6	25
			7.2 X 7.2	3.0	17.6	14.2	14.2	
			7.2 X 7.2	4.0	19.1	14.0	14.0	
7+351	8+036	BH-A2	7.2 X 7.2	2.0	16.1	27.2	16.1	50
			7.2 X 7.2	3.0	17.6	28.4	17.6	
			7.2 X 7.2	4.0	19.1	28.6	19.1	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
7+256	7+941	BH-CL	2.7 X 2.7	1.0	11.9	13.5	11.9	25
			2.7 X 2.7	2.0	18.3	15.5	15.5	
			2.7 X 2.7	3.0	25.1	17.1	17.1	
7+256	7+941	BH-CL	2.7 X 2.7	1.0	11.9	26.9	11.9	50
			2.7 X 2.7	2.0	18.3	29.9	18.3	
			2.7 X 2.7	3.0	25.1	34.2	25.1	
7+457	8+141	BH-CL	2.7 X 2.7	1.0	17.6	10.8	10.8	25
			2.7 X 2.7	2.0	21.3	12.3	12.3	
			2.7 X 2.7	3.0	25.4	13.7	13.7	
7+457	8+141	BH-CL	2.7 X 2.7	1.0	17.6	21.5	17.6	50
			2.7 X 2.7	2.0	21.3	24.7	21.3	
			2.7 X 2.7	3.0	25.1	27.3	25.1	

Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 25mm & 50mm (Replaced / Compacted Soil)

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
7+613	8+298	BH-A1	7.2 x 7.2	2.0	22.3	11.0	11.0	25
			7.2 x 7.2	3.0	26.5	10.6	10.6	
			7.2 x 7.2	4.0	30.7	9.9	9.9	
7+613	8+298	BH-A1	7.2 x 7.2	2.0	22.3	21.9	21.9	50
			7.2 x 7.2	3.0	26.5	21.2	21.2	
			7.2 x 7.2	4.0	30.7	19.8	19.8	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
7+613	8+298	BH-A2	7.2 X 7.2	2.0	18.2	14.9	14.9	25
			7.2 X 7.2	3.0	18.8	15.7	15.7	
			7.2 X 7.2	4.0	19.5	16.7	16.7	
7+613	8+298	BH-A2	7.2 X 7.2	2.0	18.2	29.8	18.2	50
			7.2 X 7.2	3.0	18.8	31.5	18.8	
			7.2 X 7.2	4.0	19.5	33.4	19.5	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
7+907	8+592	BH-CL	4.8 X 4.8	1.0	11.9	7.2	7.2	25
			4.8 X 4.8	2.0	12.5	7.6	7.6	
			4.8 X 4.8	3.0	15.2	8.1	8.1	
7+907	8+592	BH-CL	4.8 X 4.8	1.0	11.9	14.4	11.9	50
			4.8 X 4.8	2.0	12.5	15.5	12.5	
			4.8 X 4.8	3.0	15.2	16.8	15.2	

SYMBOL	DESCRIPTION
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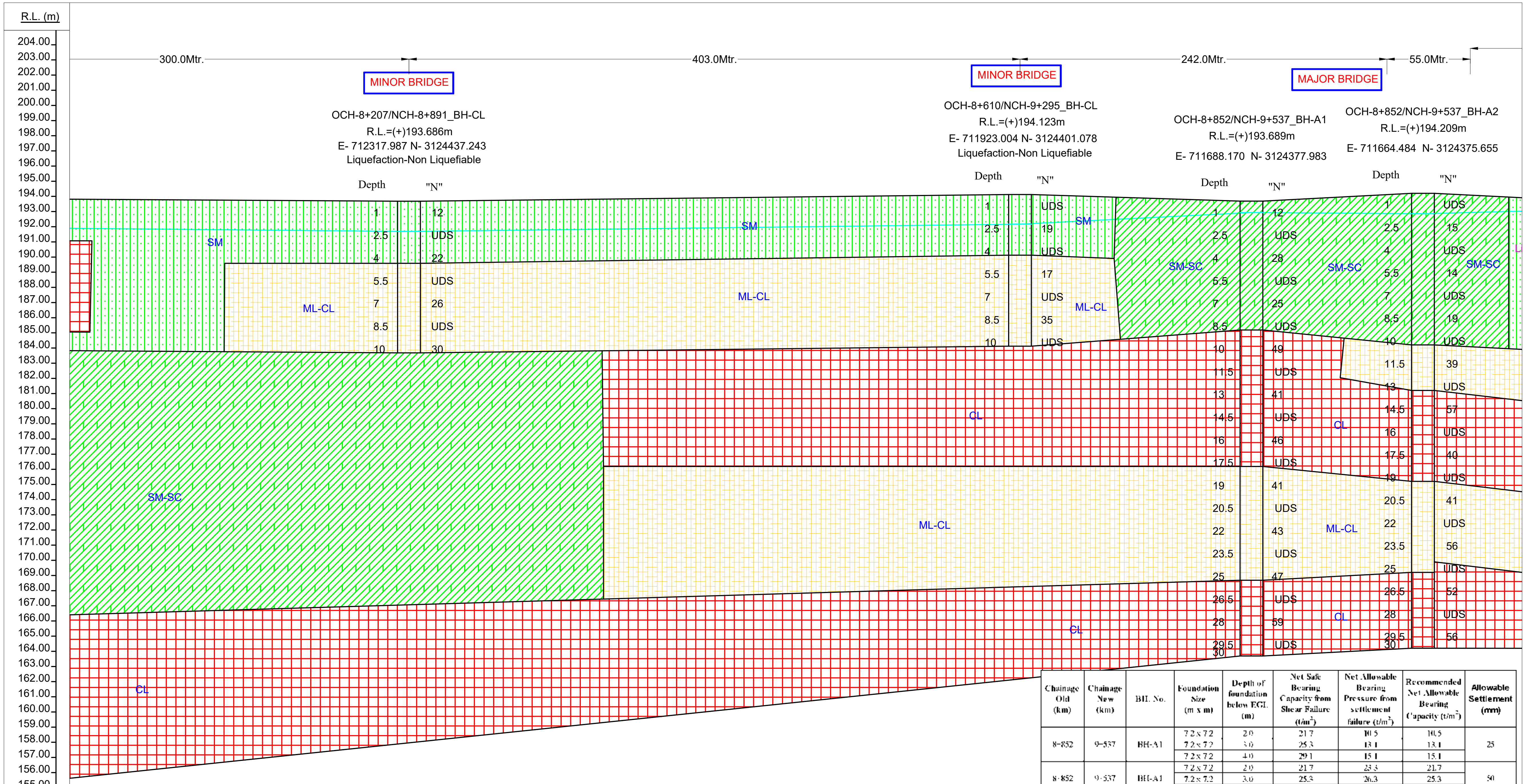
	ML-CL -Sandy with clay (Having fines greater than 50% and in the hatched zone (LL<35 & 4<PI<7)
	CL-Silty Clay of low plasticity (Above A-line, LL<35)
	CI- Clay of medium plasticity (Above A-line, 35≤LL<50)
	LIQUEFACTION
	BOREHOLE REQUIRED
	WATER TABLE

Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20) SCALE:- HOR:- 1:2850 SCALE:- VER:- 1:285

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



Note:-
NR - BH's as Liquefible depth more than 4m. (Suitable ground improvement methods are recommended.

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
8+207	8+891	BH-CL	4.8 X 4.8	1.0	18.5	9.2	9.2	25
			4.8 X 4.8	2.0	21.8	9.9	9.9	
			4.8 X 4.8	3.0	25.3	10.6	10.6	
8+207	8+891	BH-CL	4.8 X 4.8	1.0	18.5	18.3	18.3	50
			4.8 X 4.8	2.0	21.8	19.7	19.7	
			4.8 X 4.8	3.0	25.3	21.3	21.3	
8+610	9+295	BH-CL	7.2 X 7.2	1.0	17.3	9.3	9.3	25
			7.2 X 7.2	2.0	21.8	9.7	9.7	
			7.2 X 7.2	3.0	26.5	10.2	10.2	
8+610	9+295	BH-CL	7.2 X 7.2	1.0	17.3	18.5	17.3	50
			7.2 X 7.2	2.0	21.8	19.4	19.4	
			7.2 X 7.2	3.0	26.5	20.4	20.4	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
8+852	9+537	BH-A1	7.2 x 7.2	2.0	21.7	10.5	10.5	25
			7.2 x 7.2	3.0	25.3	13.1	13.1	
			7.2 x 7.2	4.0	29.1	15.1	15.1	
8+852	9+537	BH-A1	7.2 x 7.2	2.0	21.7	23.3	21.7	50
			7.2 x 7.2	3.0	25.3	26.3	25.3	
			7.2 x 7.2	4.0	29.1	30.2	29.1	
8+852	9+537	BH-A2	7.2 X 7.2	2.0	11.7	6.9	6.9	25
			7.2 X 7.2	3.0	14.2	8.1	8.1	
			7.2 X 7.2	4.0	16.9	9.2	9.2	
8+852	9+537	BH-A2	7.2 x 7.2	2.0	11.7	14.7	11.7	50
			7.2 x 7.2	3.0	14.2	16.2	14.2	
			7.2 x 7.2	4.0	16.9	18.3	16.9	

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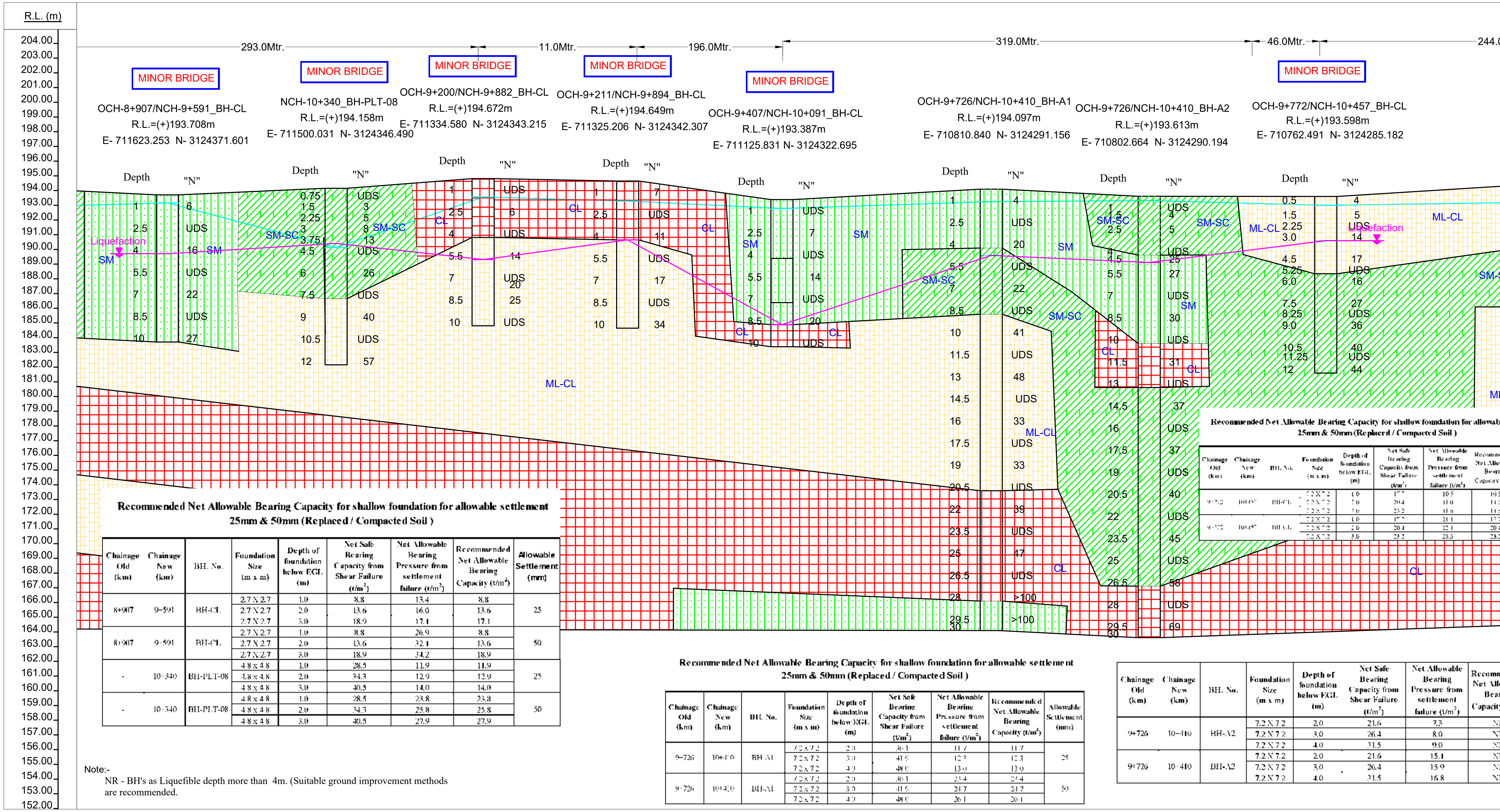
	CL-Silty Clay of low plasticity (Above A-line, LL<35)
	CI- Clay of medium plasticity (Above A-line, 35≤LL<50) — LIQUEFACTION
BOREHOLE REQUIRED	WATER TABLE

Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20) SCALE:- HOR:- 1:2850 SCALE:- VER:- 1:285

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 25mm & 50mm (Replaced / Compacted Soil)

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
8+907	9+591	BH-CL	2.7 X 2.7	1.0	8.8	13.4	8.8	25
			2.7 X 2.7	2.0	13.6	16.0	13.6	
			2.7 X 2.7	3.0	18.9	17.1	17.1	
8+907	9+591	BH-CL	2.7 X 2.7	1.0	8.8	26.9	8.8	50
			2.7 X 2.7	2.0	13.6	32.1	13.6	
			2.7 X 2.7	3.0	18.9	34.2	18.9	
-	10+340	BH-PLT-08	4.8 x 4.8	1.0	28.5	11.9	11.9	25
			4.8 x 4.8	2.0	34.3	12.9	12.9	
			4.8 x 4.8	3.0	40.5	14.0	14.0	
-	10+340	BH-PLT-08	4.8 x 4.8	1.0	28.5	23.8	23.8	50
			4.8 x 4.8	2.0	34.3	25.8	25.8	
			4.8 x 4.8	3.0	40.5	27.9	27.9	

Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 25mm & 50mm (Replaced / Compacted Soil)

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
9+772	10+457	BH-CL	7.2 X 7.2	1.0	17.7	10.5	10.5	25
			7.2 X 7.2	2.0	20.4	11.0	[illegible]	
			7.2 X 7.2	3.0	23.2	11.6	[illegible]	
9+772	10+457	BH-CL	7.2 X 7.2	1.0	17.7	21.1	17.7	50
			7.2 X 7.2	2.0	20.4	22.1	20.4	
			7.2 X 7.2	3.0	23.2	23.3	23.2	

Note:-
NR - BH's as Liquefible depth more than 4m. (Suitable ground improvement methods are recommended.

Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 25mm & 50mm (Replaced / Compacted Soil)

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
9+726	10+410	BH-A1	7.2 x 7.2	2.0	36.1	11.7	11.7	25
			7.2 x 7.2	3.0	41.9	12.3	12.3	
			7.2 x 7.2	4.0	48.0	13.0	13.0	
9+726	10+410	BH-A1	7.2 x 7.2	2.0	36.1	23.4	23.4	50
			7.2 x 7.2	3.0	41.9	21.7	21.7	
			7.2 x 7.2	4.0	48.0	26.1	26.1	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
9+726	10+410	BH-A2	7.2 X 7.2	2.0	21.6	7.3	NR	25
			7.2 X 7.2	3.0	26.4	8.0	NR	
			7.2 X 7.2	4.0	31.5	9.0	NR	
9+726	10+410	BH-A2	7.2 X 7.2	2.0	21.6	15.1	NR	50
			7.2 X 7.2	3.0	26.4	15.9	NR	
			7.2 X 7.2	4.0	31.5	16.8	NR	

Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 25mm & 50mm (Replaced / Compacted Soil)

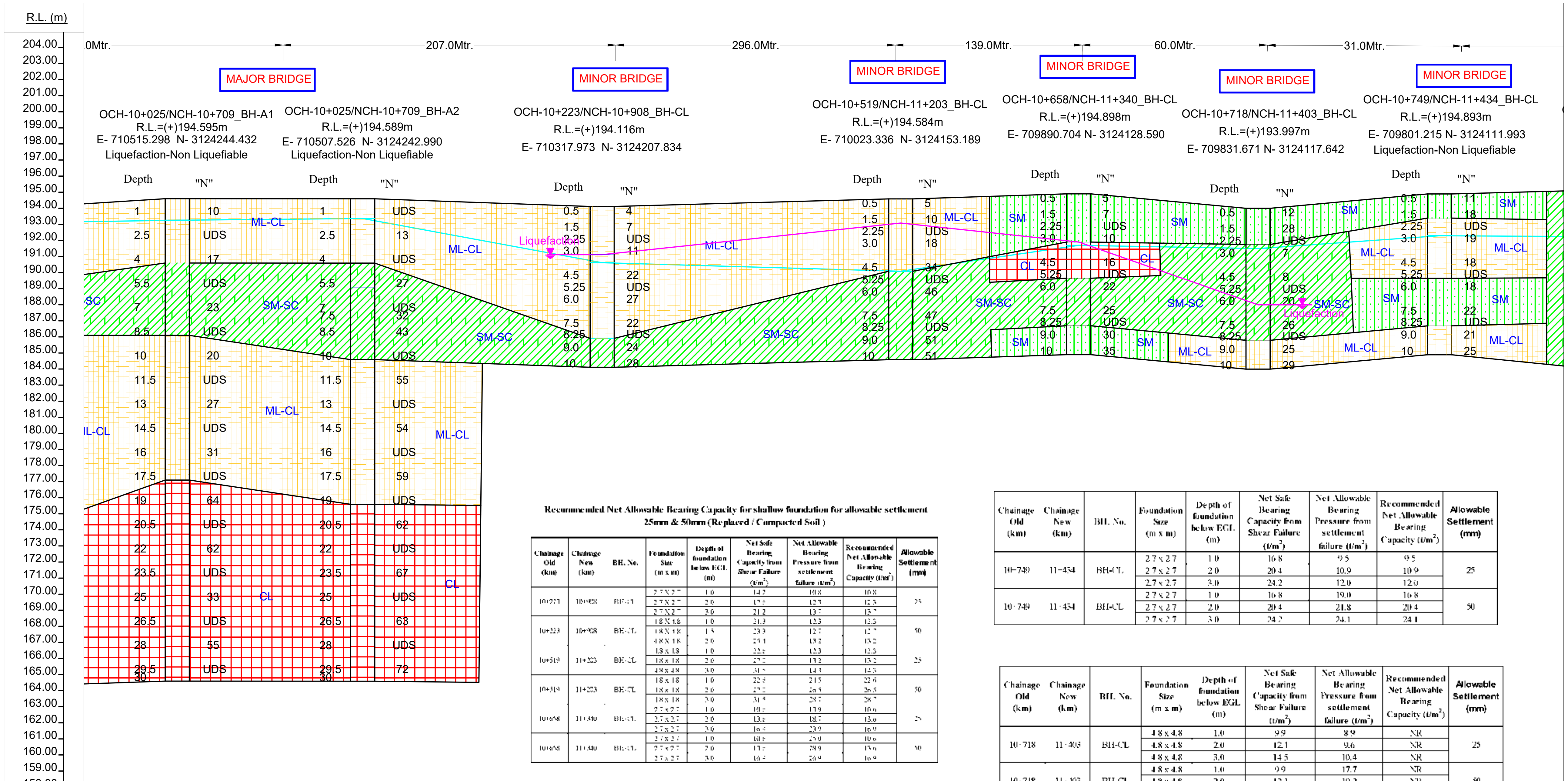
Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
9+211	9+894	BH-CL	6.0 x 6.0	1.0	22.6	9.3	9.3	25
			6.0 x 6.0	2.0	26.5	9.9	9.9	
			6.0 x 6.0	3.0	30.5	10.6	10.6	
9+211	9+894	BH-CL	6.0 x 6.0	1.0	22.6	18.7	18.7	50
			6.0 x 6.0	2.0	26.5	19.8	19.8	
			6.0 x 6.0	3.0	30.5	21.2	21.2	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
9+200	9+882	BH-CL	2.7 X 2.7	1.0	4.0	8.3	NR	25
			2.7 X 2.7	2.0	6.2	9.6	NR	
			2.7 X 2.7	3.0	8.7	10.6	NR	
9+200	9+882	BH-CL	2.7 X 2.7	1.0	4.0	16.7	NR	50
			2.7 X 2.7	2.0	6.2	19.2	NR	
			2.7 X 2.7	3.0	8.7	21.2	NR	
9+407	10+091	BH-CL	3.7 X 3.7	1.0	3.6	5.6	NR	25
			3.7 X 3.7	2.0	3.9	6.2	NR	
			3.7 X 3.7	3.0	4.3	6.7	NR	
9+407	10+091	BH-CL	3.7 X 3.7	1.0	3.6	11.1	NR	50
			3.7 X 3.7	2.0	3.9	12.4	NR	
			3.7 X 3.7	3.0	4.3	13.4	NR	

SYMBOL	DESCRIPTION
	SM- Silty Sand (Having fines Less Than 50% and no plasticity or below A-line)
	SM-SC -Clayey Sand (Having fines Less Than 50% and in the hatched zone (4<PI<7)
	ML-CL -Sandy with clay (Having fines greater than 50% and in the hatched zone (LL<35 & 4<PI<7)
	CL-Silty Clay of low plasticity (Above A-line, LL<35)
	CI- Clay of medium plasticity (Above A-line, 35≤LL<50) — LIQUEFACTION
BOREHOLE REQUIRED	WATER TABLE

Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20) SCALE:- HOR:- 1:2850 SCALE:- VER:- 1:285

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



Note:-
NR - BH's as Liquefible depth more than 4m. (Suitable ground improvement methods are recommended.

Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 25mm & 50mm (Replaced / Compacted Soil)

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
10+223	10+908	BH-CL	2.7 X 2.7	1.0	14.2	10.8	10.8	25
			2.7 X 2.7	2.0	17.6	12.3	12.3	
			2.7 X 2.7	3.0	21.2	13.7	13.7	
10+223	10+908	BH-CL	1.8 X 1.8	1.0	21.3	12.3	12.3	50
			1.8 X 1.8	1.5	23.3	12.7	12.7	
			4.8 X 1.8	2.0	25.1	13.2	13.2	
10+519	11+203	BH-CL	1.8 x 1.8	1.0	22.6	12.3	12.3	25
			1.8 x 1.8	2.0	27.2	13.2	13.2	
			4.8 x 4.8	3.0	31.5	14.3	14.3	
10+519	11+203	BH-CL	1.8 x 1.8	1.0	22.8	21.5	22.6	50
			1.8 x 1.8	2.0	27.2	26.5	26.5	
			1.8 x 1.8	3.0	31.5	28.7	28.7	
10+658	11+340	BH-CL	2.7 x 2.7	1.0	10.6	13.9	10.6	25
			2.7 x 2.7	2.0	13.6	18.7	13.6	
			2.7 x 2.7	3.0	16.9	23.9	16.9	
10+658	11+340	BH-CL	2.7 x 2.7	1.0	10.6	25.0	10.6	50
			2.7 x 2.7	2.0	13.6	28.9	13.6	
			2.7 x 2.7	3.0	16.9	26.9	16.9	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
10+749	11+434	BH-CL	2.7 x 2.7	1.0	16.8	9.5	9.5	25
			2.7 x 2.7	2.0	20.4	10.9	10.9	
			2.7 x 2.7	3.0	24.2	12.0	12.0	
10+749	11+434	BH-CL	2.7 x 2.7	1.0	16.8	19.0	16.8	50
			2.7 x 2.7	2.0	20.4	21.8	20.4	
			2.7 x 2.7	3.0	24.2	24.1	24.1	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
10+718	11+403	BH-CL	4.8 x 4.8	1.0	9.9	8.9	NR	25
			4.8 x 4.8	2.0	12.1	9.6	NR	
			4.8 x 4.8	3.0	14.5	10.4	NR	
10+718	11+403	BH-CL	4.8 x 4.8	1.0	9.9	17.7	NR	50
			4.8 x 4.8	2.0	12.1	19.2	NR	
			4.8 x 4.8	3.0	14.5	20.8	NR	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
10+025	10+709	BH-A1	7.2 X 7.2	2.0	14.5	8.0	8.0	25
			7.2 X 7.2	3.0	16.3	8.4	8.1	
			7.2 X 7.2	4.0	18.2	8.9	8.9	
10+025	10+709	BH-A1	7.2 X 7.2	2.0	14.5	15.9	14.5	50
			7.2 X 7.2	3.0	16.3	16.8	16.3	
			7.2 X 7.2	4.0	18.2	17.7	17.7	
10+025	10+709	BH-A2	7.2 X 7.2	2.0	17.5	12.8	12.8	25
			7.2 X 7.2	3.0	19.5	13.5	13.5	
			7.2 X 7.2	4.0	21.6	14.3	14.3	
10+025	10+709	BH-A2	7.2 X 7.2	2.0	17.5	25.7	17.5	50
			7.2 X 7.2	3.0	19.5	27.0	19.5	
			7.2 X 7.2	4.0	21.6	28.6	21.6	

SYMBOL	DESCRIPTION
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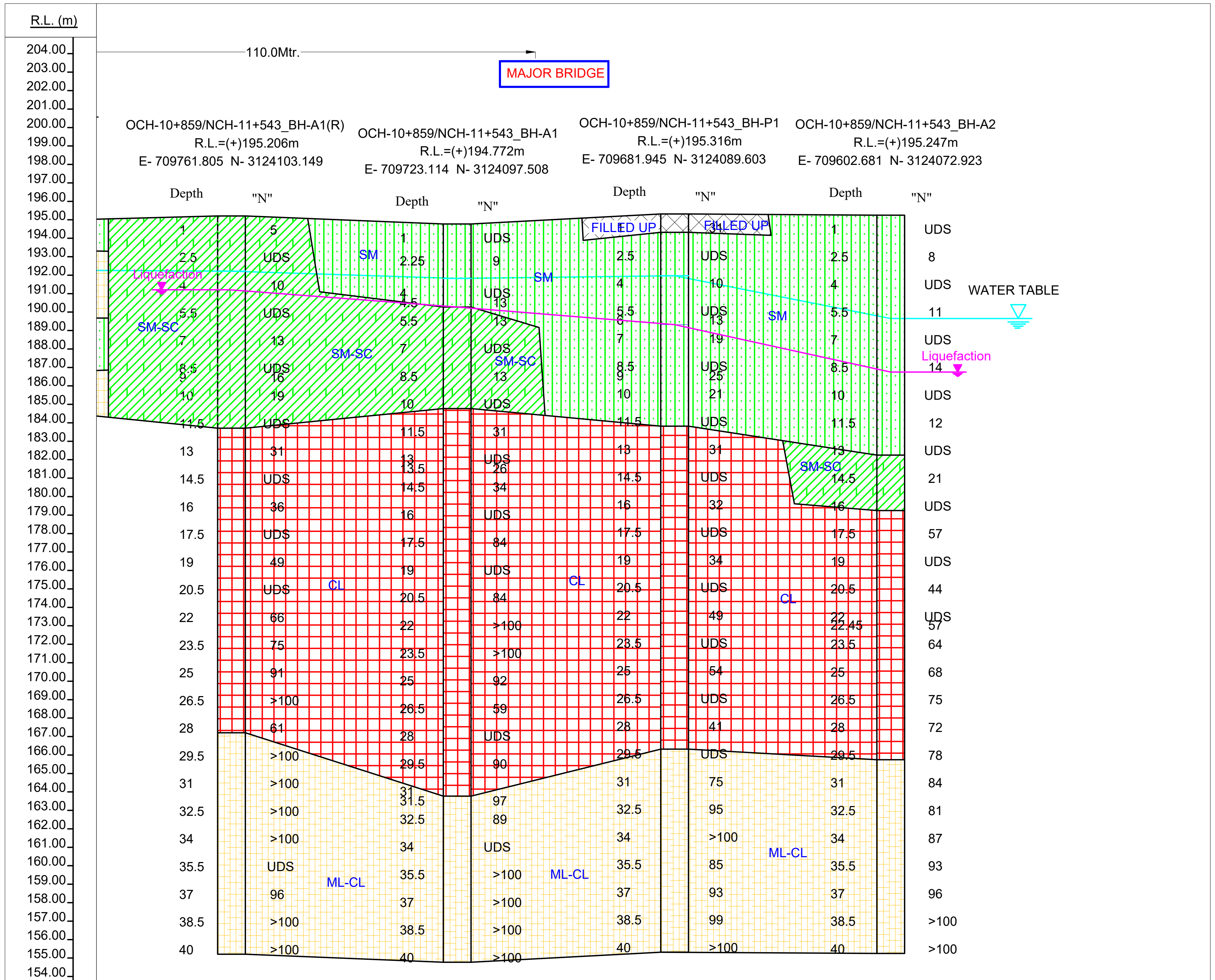
	CL-Silty Clay of low plasticity (Above A-line, LL<35)
	Cl- Clay of medium plasticity (Above A-line, 35≤LL<50)
	LIQUEFACTION
	BOREHOLE REQUIRED
	WATER TABLE

Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20)

SCALE:- HOR:- 1:2850

SCALE:- VER:- 1:285

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



Note:-
NR - BH's as Liquefible depth more than 4m. (Suitable ground improvement methods are recommended.

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
10+859	11+543	BH-A1	7.2 X 7.2	2.0	9.1	10.7	NR	25
			7.2 X 7.2	3.0	11.2	11.5	NR	
			7.2 X 7.2	4.0	13.3	12.7	NR	
10+859	11+543	BH-A1	7.2 X 7.2	2.0	11.7	10.7	NR	50
			7.2 X 7.2	3.0	13.4	11.5	NR	
			7.2 X 7.2	4.0	15.2	12.7	NR	
10+859	11+543	BH-P1	7.2 X 7.2	2.0	9.1	7.0	NR	25
			7.2 X 7.2	3.0	11.3	7.3	NR	
			7.2 X 7.2	4.0	13.4	7.6	NR	
10+859	11+543	BH-P1	7.2 X 7.2	2.0	9.1	14.0	NR	50
			7.2 X 7.2	3.0	11.3	15.0	NR	
			7.2 X 7.2	4.0	13.4	16.3	NR	
10+859	11+543	BH-A2	7.2 X 7.2	2.0	9.7	3.8	NR	25
			7.2 X 7.2	3.0	12.0	3.9	NR	
			7.2 X 7.2	4.0	14.3	4.1	NR	
10+859	11+543	BH-A2	7.2 X 7.2	2.0	9.7	7.6	NR	50
			7.2 X 7.2	3.0	12.0	8.0	NR	
			7.2 X 7.2	4.0	14.3	8.4	NR	

Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 25mm & 50mm (Replaced / Compacted Soil)

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
10+859	11+543	BH-A1(R)	7.2 x 7.2	2.0	15.8	8.4	8.4	25
			7.2 x 7.2	3.0	18.5	9.0	9.0	
			7.2 x 7.2	4.0	21.2	9.8	9.8	
10+859	11+543	BH-A1(R)	7.2 x 7.2	2.0	15.8	16.8	15.8	50
			7.2 x 7.2	3.0	18.5	18.0	18.0	
			7.2 x 7.2	4.0	21.2	19.7	19.7	

SYMBOL	DESCRIPTION
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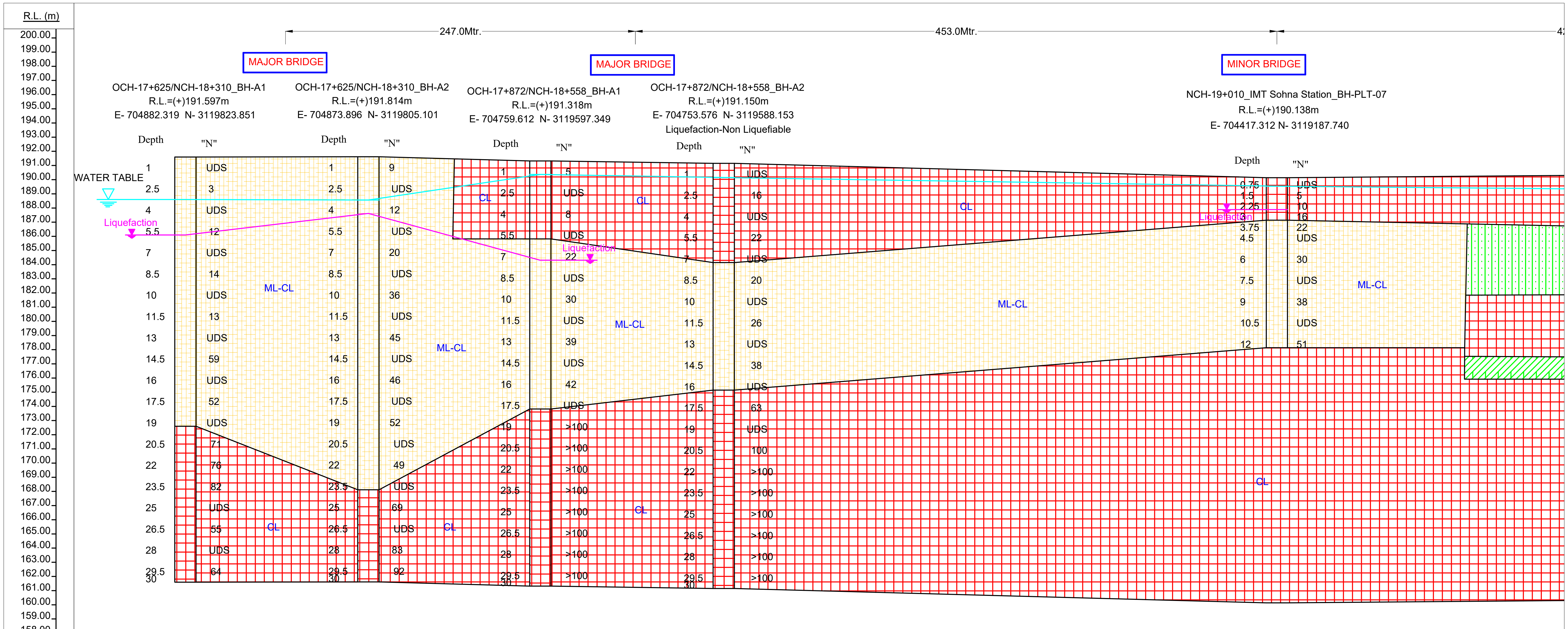
	CL-Silty Clay of low plasticity (Above A-line, LL<35)
	CI- Clay of medium plasticity (Above A-line, 35≤LL<50) — LIQUEFACTION
	BOREHOLE REQUIRED — WATER TABLE

Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20) SCALE:- HOR:- 1:2850 SCALE:- VER:- 1:285

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



Note:-

NR - BH's as Liquefible depth more than 4m. (Suitable ground improvement methods are recommended.

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
17-625	18-310	BH-A1	7.2 X 7.2	2.0	17.8	7.5	NR	25
			7.2 X 7.2	3.0	20.1	7.9	NR	
			7.2 X 7.2	4.0	22.5	8.4	NR	
17-625	18-310	BH-A1	7.2 X 7.2	2.0	17.8	15.0	NR	50
			7.2 X 7.2	3.0	20.1	15.9	NR	
			7.2 X 7.2	4.0	22.5	16.8	NR	

Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 25mm & 50mm (Replaced / Compacted Soil)

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
17-625	18-310	BH-A2	7.2 x 7.2	2.0	37.1	13.5	13.5	25
			7.2 x 7.2	3.0	42.7	13.5	13.5	
			7.2 x 7.2	4.0	48.6	13.0	13.0	
17-625	18-310	BH-A2	7.2 x 7.2	2.0	37.1	27.0	27.0	50
			7.2 x 7.2	3.0	42.7	27.0	27.0	
			7.2 x 7.2	4.0	48.6	26.1	26.1	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
17-872	18-558	BH-A1	7.2 X 7.2	2.0	6.3	6.4	NR	25
			7.2 X 7.2	3.0	6.6	8.2	NR	
			7.2 X 7.2	4.0	6.9	12.3	NR	
17-872	18-558	BH-A1	7.2 X 7.2	2.0	6.3	12.7	NR	50
			7.2 X 7.2	3.0	6.6	16.4	NR	
			7.2 X 7.2	4.0	6.9	24.6	NR	
17-872	18-558	BH-A2	7.2 X 7.2	2.0	18.4	11.8	11.8	25
			7.2 X 7.2	3.0	19.0	10.9	10.9	
			7.2 X 7.2	4.0	19.7	10.6	10.6	
17-872	18-558	BH-A2	7.2 X 7.2	2.0	18.4	21.2	18.4	50
			7.2 X 7.2	3.0	19.0	21.7	19.0	
			7.2 X 7.2	4.0	19.7	22.1	19.7	

Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 25mm & 50mm (Replaced / Compacted Soil)

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
-	19-010	BH-PLT-07	4.8 x 4.8	1.0	11.2	11.5	11.2	25
			4.8 x 4.8	2.0	12.3	12.5	12.3	
			4.8 x 4.8	3.0	13.4	13.5	13.4	
-	19-010	BH-PLT-07	4.8 x 4.8	1.0	11.2	23.0	11.2	50
			4.8 x 4.8	2.0	12.3	24.9	12.3	
			4.8 x 4.8	3.0	13.4	27.0	13.4	

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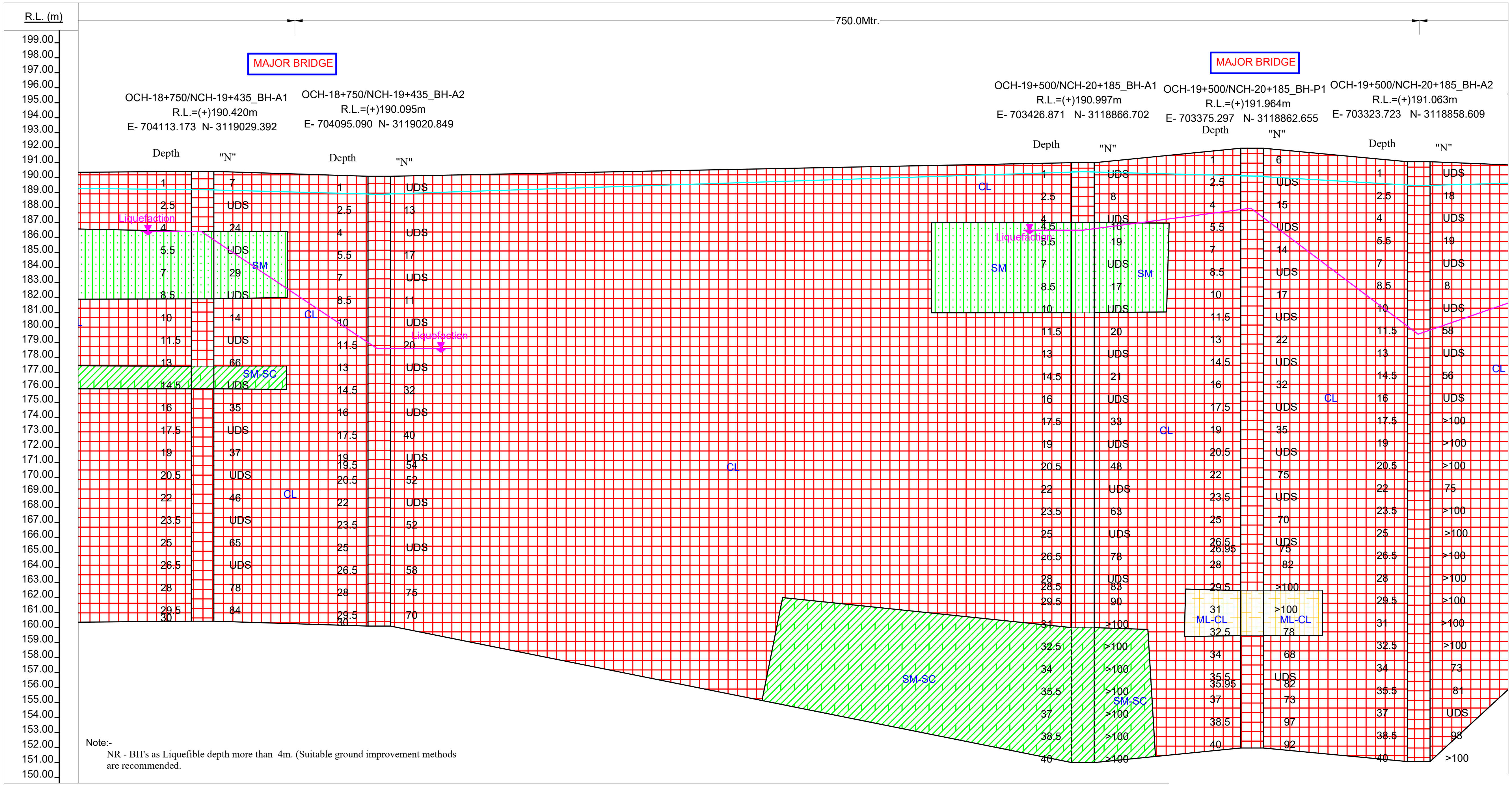
	CL-Silty Clay of low plasticity (Above A-line, LL<35)
	CI- Clay of medium plasticity (Above A-line, 35≤LL<50)
	LIQUEFACTION
	BOREHOLE REQUIRED
	WATER TABLE

Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20) SCALE:- HOR:- 1:2850 SCALE:- VER:- 1:285

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 25mm & 50mm (Replaced / Compacted Soil)

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
18·750	19·435	BH-A1	7.2 x 7.2	2.0	17.8	23.5	17.8	25
			7.2 x 7.2	3.0	21.2	24.8	21.2	
			7.2 x 7.2	4.0	24.8	26.2	24.8	
18·750	19·435	BH-A1	7.2 x 7.2	2.0	17.8	47.0	17.8	50
			7.2 x 7.2	3.0	21.2	49.5	21.2	
			7.2 x 7.2	4.0	24.8	52.3	24.8	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
18−750	19−435	BH-A2	7.2 X 7.2	2.0	10.5	8.9	NR	25
			7.2 X 7.2	3.0	11.0	8.4	NR	
			7.2 X 7.2	4.0	11.4	9.3	NR	
18·750	19·435	BH-A2	7.2 X 7.2	2.0	10.5	15.5	NR	50
			7.2 X 7.2	3.0	11.0	16.8	NR	
			7.2 X 7.2	4.0	11.4	18.6	NR	

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
19·500	20·185	BH-A1	7.2 X 7.2	2.0	7.0	6.8	NR	25
			7.2 X 7.2	3.0	7.3	8.4	NR	
			7.2 X 7.2	4.0	7.6	11.0	NR	
19·500	20·185	BH-A1	7.2 X 7.2	2.0	7.0	13.5	NR	50
			7.2 X 7.2	3.0	7.3	16.8	NR	
			7.2 X 7.2	4.0	7.6	22.0	NR	
19·500	20·185	BH-A2	7.2 X 7.2	2.0	15.0	30.9	NR	25
			7.2 X 7.2	3.0	15.5	32.6	NR	
			7.2 X 7.2	4.0	16.1	34.4	NR	
19·500	20·185	BH-A2	7.2 X 7.2	2.0	15.0	61.9	NR	50
			7.2 X 7.2	3.0	15.5	65.2	NR	
			7.2 X 7.2	4.0	16.1	68.9	NR	

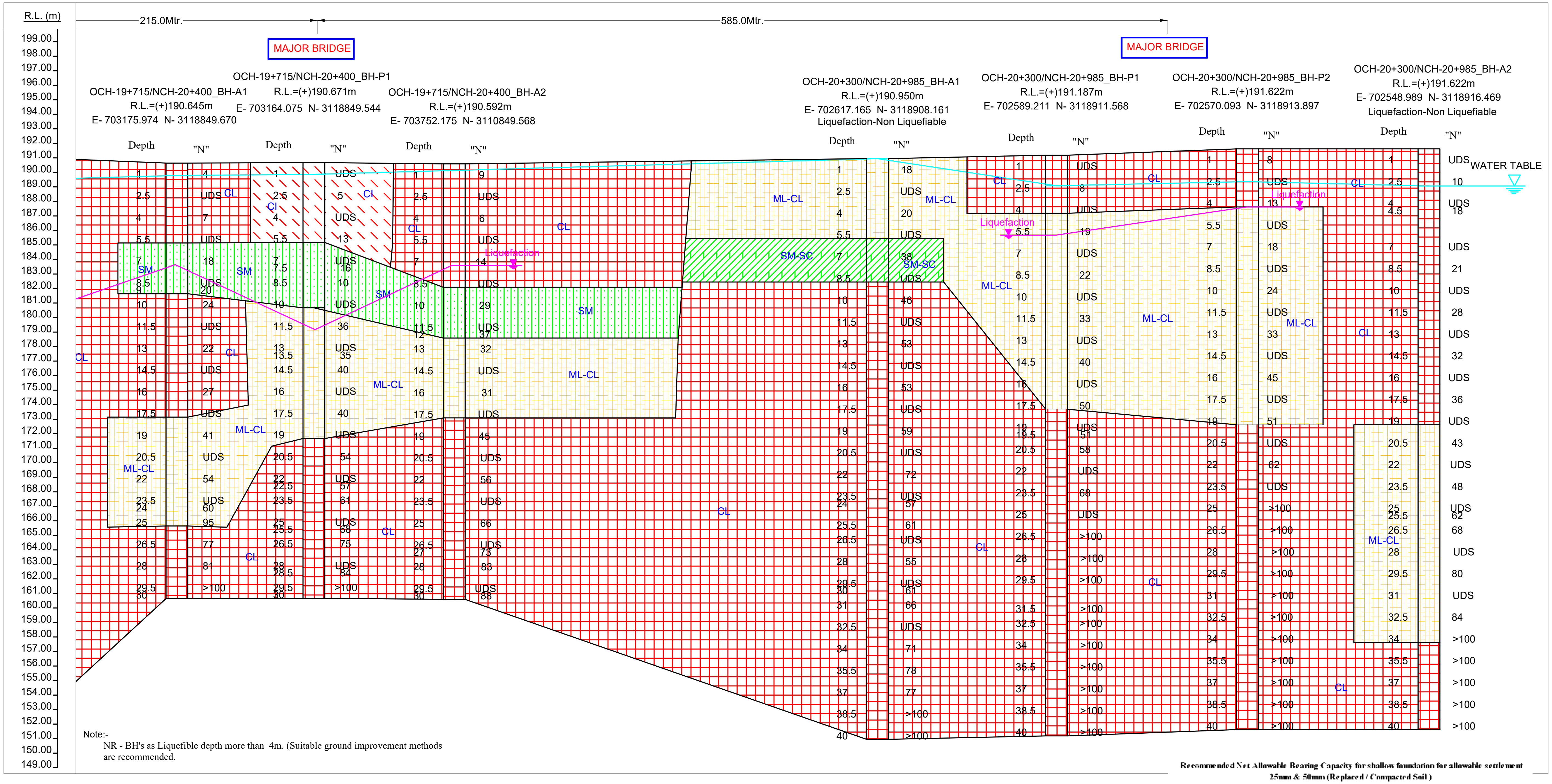
Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 25mm & 50mm (Replaced / Compacted Soil)

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m²)	Net Allowable Bearing Pressure from settlement failure (t/m²)	Recommended Net Allowable Bearing Capacity (t/m²)	Allowable Settlement (mm)
19−500	20−185	BH-P1	7.2 X 7.2	2.0	21.7	7.0	7.0	25
			7.2 X 7.2	3.0	23.5	6.9	6.9	
			7.2 X 7.2	4.0	26.1	6.9	6.9	
19−500	20−185	BH-P1	7.2 X 7.2	2.0	21.7	14.0	14.0	50
			7.2 X 7.2	3.0	23.5	13.9	13.9	
			7.2 X 7.2	4.0	26.1	13.7	13.7	

SYMBOL	DESCRIPTION		
	SM- Silty Sand (Having fines Less Than 50% and no plasticity or below A-line)		
	SM-SC -Clayey Sand (Having fines Less Than 50% and in the hatched zone (4<PI<7)		
	ML-CL -Sandy with clay (Having fines greater than 50% and in the hatched zone (LL<35 & 4<PI<7)		
	CL-Silty Clay of low plasticity (Above A-line, LL<35)		
	Cl- Clay of medium plasticity (Above A-line, 35≤LL<50)		LIQUEFACTION
	BOREHOLE REQUIRED		WATER TABLE

Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20) SCALE:- HOR:- 1:2850 SCALE:- VER:- 1:285

CONDUCTING GEOTECHNICAL INVESTIGATION, PREPARATION OF GEOTECHNICAL REPORT FOR DESIGNING OF BRIDGES AND FOR EMBANKMENT IN CONNECTION WITH CONSTRUCTION OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT FROM PALWAL TO HARSANA KALAN INCLUDING CONNECTIVITY TO EXISTING IR NETWORK IN THE STATE OF HARYANA.



Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
19-715	20-400	BH-A1	7.2 X 7.2	2.0	17.8	4.5	NR	25
			7.2 X 7.2	3.0	21.7	5.3	NR	
			7.2 X 7.2	4.0	25.8	6.6	NR	
19-715	20-400	BH-A1	7.2 X 7.2	2.0	17.8	8.9	NR	50
			7.2 X 7.2	3.0	21.7	10.5	NR	
			7.2 X 7.2	4.0	25.8	13.2	NR	
19-715	20-400	BH-P1	7.2 X 7.2	2.0	13.0	4.7	NR	25
			7.2 X 7.2	3.0	16.0	6.3	NR	
			7.2 X 7.2	4.0	19.0	10.1	NR	
19-715	20-400	BH-P1	7.2 X 7.2	2.0	13.0	9.5	NR	50
			7.2 X 7.2	3.0	16.0	12.5	NR	
			7.2 X 7.2	4.0	19.0	20.1	NR	
19-715	20-400	BH-A2	7.2 X 7.2	2.0	10.9	6.1	NR	25
			7.2 X 7.2	3.0	11.4	6.7	NR	
			7.2 X 7.2	4.0	11.8	7.3	NR	
19-715	20-400	BH-A2	7.2 X 7.2	2.0	10.9	12.2	NR	50
			7.2 X 7.2	3.0	11.4	13.3	NR	
			7.2 X 7.2	4.0	11.8	14.6	NR	

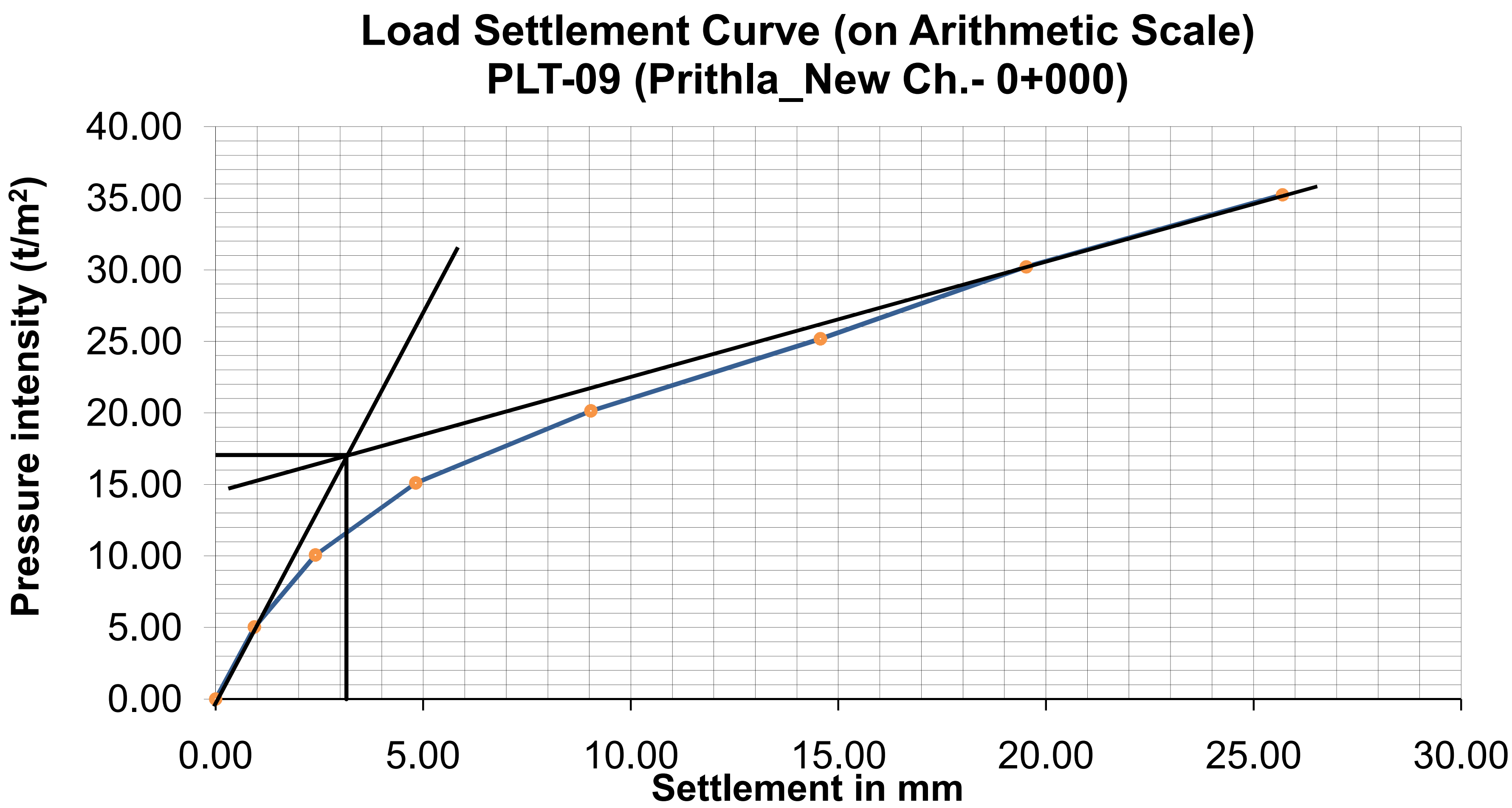
Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
20-300	20-985	BH-A1	7.2 X 7.2	2.0	28.1	15.1	15.1	25
			7.2 X 7.2	3.0	31.9	17.4	17.4	
			7.2 X 7.2	4.0	35.7	20.7	20.7	
20-300	20-985	BH-A1	7.2 X 7.2	2.0	28.1	30.2	28.1	50
			7.2 X 7.2	3.0	31.9	34.9	30.0	
			7.2 X 7.2	4.0	35.7	41.4	30.0	
20-300	20-985	BH-P1	7.2 X 7.2	2.0	22.3	8.5	NR	25
			7.2 X 7.2	3.0	25.2	10.2	NR	
			7.2 X 7.2	4.0	28.2	10.8	NR	
20-300	20-985	BH-P1	7.2 X 7.2	2.0	22.3	16.9	NR	50
			7.2 X 7.2	3.0	25.2	20.4	NR	
			7.2 X 7.2	4.0	28.2	21.6	NR	
20-300	20-985	BH-A2	7.2 X 7.2	2.0	16.4	15.8	15.8	25
			7.2 X 7.2	3.0	17.0	14.5	14.5	
			7.2 X 7.2	4.0	17.6	15.3	15.3	
20-300	20-985	BH-A2	7.2 X 7.2	2.0	16.4	27.5	16.4	50
			7.2 X 7.2	3.0	17.0	29.0	17.0	
			7.2 X 7.2	4.0	17.6	30.6	17.6	

Recommended Net Allowable Bearing Capacity for shallow foundation for allowable settlement 25mm & 50mm (Replaced / Compacted Soil)

Chainage Old (km)	Chainage New (km)	BH. No.	Foundation Size (m x m)	Depth of foundation below EGL (m)	Net Safe Bearing Capacity from Shear Failure (t/m^2)	Net Allowable Bearing Pressure from settlement failure (t/m^2)	Recommended Net Allowable Bearing Capacity (t/m^2)	Allowable Settlement (mm)
20-300	20-985	BH-P2	7.2 X 7.2	2.0	17.1	13.9	13.9	25
			7.2 X 7.2	3.0	19.2	14.5	14.5	
			7.2 X 7.2	4.0	21.5	14.7	14.7	
20-300	20-985	BH-P2	7.2 X 7.2	2.0	17.1	27.8	17.1	50
			7.2 X 7.2	3.0	19.2	29.1	19.2	
			7.2 X 7.2	4.0	21.5	29.3	21.5	

SYMBOL	DESCRIPTION
	SM- Silty Sand (Having fines Less Than 50% and no plasticity or below A-line)
	SM-SC -Clayey Sand (Having fines Less Than 50% and in the hatched zone (4<PI<7)
	ML-CL -Sandy with clay (Having fines greater than 50% and in the hatched zone (LL<35 & 4<PI<7)
	CL-Silty Clay of low plasticity (Above A-line, LL<35)
	CI- Clay of medium plasticity (Above A-line, 35≤LL<50) — LIQUEFACTION
	BOREHOLE REQUIRED — WATER TABLE

Note:- Fines= Percentage of Silty + Clay A-line=.73(wl-20)   SCALE:- HOR:- 1:2850   SCALE:- VER:- 1:285



Test Depth = 2.70m below NGL

Size of Plate = 450mm x 450mm, Thickness of Plate = 25mm

Ultimate Bearing Capacity of Soil = 17.05t/m^2 w.r.t. settlement of 3.15mm from the graph

Net Safe Bearing Capacity of Soil = 17.05/2.5 = 6.82 t/m^2

APPENDIX – B (LAB TEST RESULTS)

Appendix No.	ITEMS
B-1	SOIL CHARACTERISTICS SHEETS
B-2	RESULT OF CHEMICAL ANALYSIS OF SOIL SAMPLES
B-3	RESULT OF CHEMICAL ANALYSIS OF WATER SAMPLES
B-4	GSD CURVES
B-5	SHEAR CURVE
B-6	CONSOLIDATION CURVE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	23-12-2021	to	23-12-2021	New Ch. 0+000 Prithla Station	BH-PLT-09	Not Encountered	12.00 m	720981.000 m	3126079.000 m	(+)195.456 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brownish, Medium dnese, Sandy Silt	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	0.75	-	-		ML-CL		6	50	38	5	1	0	0	26	19	7	-	1.64	10.80	1.48	2.62	DST	0.15	26	-	-	-	-	-	-	-	-
SPT-1	1.50	3	4		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	2.25	5	7		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	3.00	12	14		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	3.75	17	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.50	-	-		ML-CL		6	51	37	5	1	0	0	26	19	7	-	1.67	11.20	1.50	2.62	DST	0.18	27	-	-	-	-	-	-	-	-
SPT-5	6.00	22	21	Brownish, Medium dense to Dense, Silty Sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.50	-	-		SM		0	21	71	5	2	1	0	-	Nil	NP	-	1.67	10.40	1.51	2.63	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-6	9.00	27	23		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.50	-	-		SM		0	20	71	4	2	2	0	-	Nil	NP	-	1.70	11.60	1.52	2.63	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-7	12.00	53	39		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project		Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	14-10-2021	to	14-10-2021	(-)0+627 Minor Bridge	BH-CL	8.50 m	10.00 m	720920.890 m	3126081.947 m	(+)196.408 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Medium dense to very dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	20	32		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		SM		0	14	80	2	1	3	0	-	Nil	NP	-	1.78	11.20	1.60	2.62	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-2	4.00	28	31		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		SM		0	18	70	5	3	4	0	-	Nil	NP	-	1.84	13.40	1.62	2.63	DST	0.00	31	-	-	-	-	-	-	-	-
SPT-3	7.00	41	38		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		SM		0	15	72	3	4	6	0	-	Nil	NP	-	1.85	15.64	1.60	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	10.00	51	29		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	14-10-2021	to	14-10-2021	(-)0+529 Minor Bridge	BH-CL	8.15 m	10.00 m	720826.915 m	3126042.507 m	(+)195.851 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		SM		0	19	70	6	2	3	0	-	Nil	NP	-	1.74	11.36	1.56	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-1	2.50	18	23		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-	Brown, Medium dense to dense, Silty sand with gravel	SM		0	20	68	4	3	5	0	-	Nil	NP	-	1.80	12.43	1.60	2.63	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-2	5.50	37	37		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		SM		0	17	72	2	3	5	1	-	Nil	NP	-	1.83	14.26	1.60	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	8.50	43	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		SM		0	14	71	6	2	7	0	-	NIL	NP	-	1.86	16.11	1.60	2.62	DST	0.00	31	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	15-10-2021	to	15-10-2021	(-)0+319 Minor Bridge	BH-CL	8.10 m	10.00 m	720635.657 m	3125962.572 m	(+)197.352 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %			
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit
									Fine	Medium	Coarse	Fine	Coarse				
DS	0.00	-	-	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		SM		0	26	72	1	1	0	0	-	Nil	NP	-
SPT-1	2.50	27	34		-		-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		SM		0	24	68	4	2	2	0	-	Nil	NP	-
SPT-2	5.50	23	23	Brown, Very stiff, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		CL		10	55	25	3	2	4	1	32	21	11	-
SPT-3	8.50	36	24	Brown, Dense, Silty sand with gravel	-		-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		SM		0	19	61	9	5	5	1	-	Nil	NP	-

Sample Type	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.79	11.26	1.61	2.62	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	1.86	18.38	1.57	2.67	UUT	0.79	5	-	-	-	-	-	-	-	-
SPT-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	1.84	16.47	1.58	2.63	DST	0.00	30	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	14-10-2021	to	14-10-2021	0+273 Minor Bridge	BH-CL	8.25 m	10.00 m	720089.535 m	3125734.325 m	(+)195.008 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	12	19		SM		0	20	73	2	3	2	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-	Brown, Medium dense to dense, Sandy silt of low with gravel	ML-CL		7	45	31	6	3	8	0	28	21	7	-	1.85	13.43	1.63	2.66	DST	0.21	26	-	-	-	-	-	-	-	-
SPT-2	4.00	39	43		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		ML-CL		7	50	30	3	5	5	0	27	20	7	-	1.79	15.30	1.55	2.66	DST	0.20	24	-	-	-	-	-	-	-	-
SPT-3	7.00	22	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-	Brown, Dense, Silty sand with gravel	SM		0	18	70	4	2	6	0	-	Nil	NP	-	1.79	15.60	1.55	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-4	10.00	32	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project		Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	04-10-2021	to	05-10-2021	1+006 Major Bridge	BH-A1	24.90 m	30.00 m	719415.302 m	3125461.869 m	(+)202.730 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Loose, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	9	14		SM		0	46	48	4	2	0	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		SM		0	42	51	4	2	1	0	-	Nil	NP	-	1.67	10.60	1.51	2.62	DST	0.00	28	-	-	-	-	-	-	-	-
SPT-2	4.00	22	25	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		SM		0	44	48	4	2	2	0	-	Nil	NP	-	1.76	11.22	1.58	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-3	7.00	44	41	Brown, Dense to very dense, Silty sand with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		SM		0	32	58	2	2	6	0	-	Nil	NP	-	1.83	12.37	1.63	2.63	DST	0.00	31	-	-	-	-	-	-	-	-
SPT-4	10.00	59	48		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-		SM		0	23	62	5	3	7	0	-	Nil	NP	-	1.84	12.89	1.63	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	13.00	69	50		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-		SM		0	26	61	3	2	6	2	-	Nil	NP	-	1.88	13.24	1.66	2.62	DST	0.00	32	-	-	-	-	-	-	-	-
SPT-6	16.00	94	61		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	17.50	100	62		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	19.00	49	29	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		7	52	32	2	2	5	0	27	21	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	20.50	-	-		ML-CL		8	50	30	3	2	7	0	28	21	7	-	1.88	17.46	1.60	2.66	DST	0.18	27	-	-	-	-	-	-	-	-
SPT-9	22.00	62	33		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	23.50	-	-		ML-CL		6	48	29	5	3	8	1	26	20	6	-	1.97	19.10	1.65	2.66	DST	0.18	28	-	-	-	-	-	-	-	-
SPT-10	25.00	100 (17cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	26.50	100 (26cm)	-		ML-CL		7	48	30	3	2	10	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		04-10-2021	to	05-10-2021	1+006 Major Bridge	BH-A1	24.90 m	30.00 m	719415.302 m	3125461.869 m	(+)202.730 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-12	28.00	100 (20cm)	-	Brown, Very dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	29.50	48	48	Brown, Hard, Silty clay of low plasticity with gravel	CL		11	57	21	4	1	6	0	30	20	10	-	1.98	21.00	1.64	2.68	UUT+	1.56	4	-	-	-	-	-	-	-	-
DS-2	30.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	04-10-2021	to	04-10-2021	1+006 Major Bridge	BH-A2	24.80 m	30.00 m	719396.820 m	3125454.226 m	(+)203.271 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Loose, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		SM		0	46	52	2	0	0	0	-	Nil	NP	-	1.62	10.24	1.47	2.62	DST	0.00	27	-	-	-	-	-	-	-	-
SPT-1	2.50	7	9		SM		0	48	51	0	1	0	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-	Brown, Medium dense, Silty sand with clay	SM-SC		5	43	50	2	0	0	0	26	20	6	-	1.70	12.07	1.52	2.64	DST	0.06	28	-	-	-	-	-	-	-	-
SPT-2	5.50	14	14		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		SM-SC		6	40	49	2	2	1	0	25	19	6	-	1.74	12.84	1.54	2.65	DST	0.09	29	-	-	-	-	-	-	-	-
SPT-3	8.50	20	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-	Brown, Dense, Silty sand with clay	SM-SC		5	43	43	3	2	4	0	26	21	5	-	1.82	13.74	1.60	2.65	DST	0.11	31	-	-	-	-	-	-	-	-
SPT-4	11.50	42	32		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-	Brown, Very dense, Silty sand with clay with gravel	SM-SC		5	38	45	6	1	5	0	26	20	6	-	1.92	14.69	1.67	2.66	DST	0.10	32	-	-	-	-	-	-	-	-
SPT-5	14.50	96	66		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	16.00	100 (29cm)	-		SM-SC		7	40	40	4	1	8	0	27	21	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	17.50	72	45		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	19.00	-	-		SM-SC		6	38	46	3	1	6	0	26	20	6	-	1.90	15.72	1.64	2.65	DST	0.08	32	-	-	-	-	-	-	-	-
SPT-8	20.50	84	47		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	22.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	22.45	35	35	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	54	23	5	2	4	0	33	22	11	-	1.94	19.50	1.62	2.68	UUT+	1.29	4	-	-	-	-	-	-	-	-
SPT-10	23.50	43	43		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	25.00	-	-	Brown, Very dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	25.45	54	21		ML-CL		8	44	37	3	1	7	0	28	21	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	04-10-2021	to	04-10-2021	1+006 Major Bridge	BH-A2	24.80 m	30.00 m	719396.820 m	3125454.226 m	(+)203.271 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand Fine	Sand Medium	Sand Coarse	Gravel Fine	Gravel Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-12	26.50	76	27	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		7	47	32	4	2	6	2	27	20	7	-	1.92	20.00	1.60	2.66	DST+	0.22	26	-	-	-	-	-	-	-	-
UDS*	28.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	28.45	100 (27cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	29.50	64	64	Brown, Hard, Silty clay of low plasticity with gravel	CL		10	60	21	3	1	5	0	30	20	10	-	2.02	21.00	1.67	2.67	UUT+	2.05	4	-	-	-	-	-	-	-	-
DS-2	30.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	15-10-2021	to	15-10-2021	1+333 Minor Bridge	BH-CL	Not Encountered	10.00 m	719094.132 m	3125351.606 m	(+)202.117 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Dense, Silty sand with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		SM		0	20	73	2	1	4	0	-	Nil	NP	-	1.80	10.43	1.63	2.62	DST	0.00	31	-	-	-	-	-	-	-	-
SPT-1	2.50	35	44		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		SM		0	19	68	4	3	5	1	-	Nil	NP	-	1.81	11.56	1.62	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	5.50	41	41		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		SM		0	17	70	5	2	4	2	-	Nil	NP	-	1.82	12.40	1.62	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	8.50	48	48	Brown, Hard, Silty clay of low plasticity with gravel	CL		10	53	26	3	4	4	0	31	21	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		CL		11	47	28	5	3	5	1	32	21	11	-	1.89	16.22	1.63	2.67	UUT	1.58	5	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	15-10-2021	to	15-10-2021	1+811 Minor Bridge	BH-CL	9.10 m	10.00 m	718661.831 m	3125172.851 m	(+)197.587 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	13	21	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-	Brown, Medium dense, Silty sand	SM		0	18	71	6	3	2	0	-	Nil	NP	-	1.72	11.26	1.55	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-2	4.00	33	37	Brown, Dense, Silty sand with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-	Brown, Dense, Silty sand with gravel	SM		0	13	76	4	2	5	0	-	Nil	NP	-	1.82	13.19	1.61	2.63	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-3	7.00	30	28	Brown, Medium dense, Sandy silt of low plasticity with gravel	ML-CL		7	47	35	4	2	5	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-	Brown, Medium dense, Sandy silt of low plasticity with gravel	ML-CL		6	49	31	5	3	4	2	26	20	6	-	1.87	17.14	1.60	2.66	DST	0.21	25	-	-	-	-	-	-	-	-
SPT-4	10.00	54	30	Brown, Very dense, Silty sand with gravel	SM		0	17	70	2	3	8	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	16-10-2021	to	16-10-2021	2+472 Minor Bridge	BH-CL	7.50 m	10.00 m	718027.804 m	3124979.104 m	(+)197.568 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand Fine	Sand Medium	Sand Coarse	Gravel Fine	Gravel Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Medium dense, Silty sand with clay	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	11	17		SM-SC		5	32	51	10	2	0	0	25	20	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		SM-SC		4	35	47	9	4	1	0	25	20	5	-	1.72	11.60	1.54	2.65	DST	0.08	27	-	-	-	-	-	-	-	-
SPT-2	4.00	27	30	Brown, Medium dense to dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		ML-CL		6	49	35	4	2	4	0	27	20	7	-	1.83	14.49	1.60	2.66	DST	0.20	25	-	-	-	-	-	-	-	-
SPT-3	7.00	36	34		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		ML-CL		7	52	29	5	2	5	0	27	20	7	-	1.91	18.60	1.61	2.66	DST	0.18	26	-	-	-	-	-	-	-	-
SPT-4	10.00	60	33	Brown, Very dense, Silty sand with gravel	SM		0	22	69	2	1	6	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	03-10-2021	to	04-10-2021	2+788 Major Bridge	BH-A1	18.24 m	30.00 m	717723.179 m	3124953.799 m	(+)195.987 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	11	18		SM		0	38	60	2	0	0	0	0	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		SM		0	37	62	1	0	0	0	-	Nil	NP	-	1.71	11.36	1.54	2.62	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-2	4.00	18	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-	Brown, Very dense, Silty sand with gravel	SM		0	28	64	2	1	5	0	0	Nil	NP	-	1.84	12.40	1.64	2.63	DST	0.00	32	-	-	-	-	-	-	-	-
SPT-3	7.00	54	50		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		SM		0	27	60	3	2	8	0	0	Nil	NP	-	1.87	12.85	1.66	2.62	DST	0.00	32	-	-	-	-	-	-	-	-
SPT-4	10.00	84	68		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-		SM		0	30	58	4	2	6	0	0	Nil	NP	-	1.86	13.45	1.64	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	13.00	71	51		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-	Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL		6	46	42	2	1	3	0	26	20	6	-	1.80	16.30	1.55	2.66	DST	0.20	26	-	-	-	-	-	-	-	-
SPT-6	16.00	31	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	17.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	18.00	43	26		ML-CL		7	64	21	3	1	4	0	27	21	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	19.00	46	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	20.50	-	-		ML-CL		7	59	26	2	1	4	1	27	20	7	-	1.88	19.63	1.57	2.66	DST	0.21	27	-	-	-	-	-	-	-	-
SPT-9	22.00	55	23		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	23.50	-	-		ML-CL		8	55	23	6	2	6	0	28	21	7	-	1.88	20.30	1.56	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	25.00	48	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		03-10-2021	to	04-10-2021	2+788 Major Bridge	BH-A1	18.24 m	30.00 m	717723.179 m	3124953.799 m	(+)195.987 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
UDS-8	26.50	-	-	Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL		7	55	26	4	3	5	0	26	19	7	-	1.90	19.80	1.59	2.67	DST	0.20	28	-	-	-	-	-	-	-	-
SPT-11	27.00	65	25		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	28.00	75	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	29.50	80	28		ML-CL		7	55	28	2	2	6	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	30.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		03-10-2021	to	04-10-2021	2+788 Major Bridge	BH-A2	17.68 m	30.00 m	717703.270 m	3124952.116 m	(+)196.902 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm³)	Natural Moisture Content (%)	Dry Density (g/cm³)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm²)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm²)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm²)	C_v x 10^{-4} (cm²/Sec)	M_v x 10^{-2} (cm²/Kg)	Compression Index (C_c)
DS	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		SM		0	41	52	4	1	2	0	0	Nil	NP	-	1.79	11.60	1.60	2.62	DST	0.00	31	-	-	-	-	-	-	-	-
SPT-1	2.50	22	28	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		SM		0	25	67	4	1	2	1	0	Nil	NP	-	1.79	12.10	1.60	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	5.50	30	30		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		SM		0	27	60	5	2	6	0	0	Nil	NP	-	1.86	13.44	1.64	2.63	DST	0.00	32	-	-	-	-	-	-	-	-
SPT-3	8.50	59	51	Brown, Very dense, Silty sand with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		SM		0	34	56	3	2	5	0	0	Nil	NP	-	1.86	13.60	1.64	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	11.50	64	48		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-		ML-CL		7	50	32	4	3	3	1	27	20	7	-	1.82	16.48	1.56	2.66	DST	0.18	27	-	-	-	-	-	-	-	-
SPT-5	14.50	33	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	16.00	-	-		ML-CL		7	53	33	2	1	4	0	26	20	6	-	1.83	17.34	1.56	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	17.50	32	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	19.00	-	-	Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL		8	52	30	5	2	3	0	28	21	7	-	1.84	19.70	1.54	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	20.50	36	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	22.00	-	-		ML-CL		6	52	31	3	1	7	0	25	19	6	-	1.93	20.04	1.61	2.66	DST	0.19	28	-	-	-	-	-	-	-	-
SPT-8	23.50	83	31		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	25.00	-	-		ML-CL		7	46	28	4	5	10	0	26	20	6	-	1.93	19.88	1.61	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	25.50	70	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	03-10-2021	to	04-10-2021	2+788 Major Bridge	BH-A2	17.68 m	30.00 m	717703.270 m	3124952.116 m	(+)196.902 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand Fine	Sand Medium	Sand Coarse	Gravel Fine	Gravel Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-10	26.50	76	28	Brown, Dense to very dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	28.00	100 (17cm)	-		ML-CL		7	46	34	3	1	9	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	29.50	78	28		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	29.95	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	20-10-2021	to	22-10-2021	3+497 Major Bridge	BH-A1	16.25 m	40.00 m	717079.294 m	3124900.291 m	(+)196.752 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Loose, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	5	8		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		ML-CL		6	49	29	13	3	0	0	28	21	7	-	1.64	12.10	1.46	2.66	DST	0.21	22	-	-	-	-	-	-	-	-
SPT-2	4.00	21	21	Brown, Very stiff to hard, Silty clay of low plasticity	CL		11	62	17	5	3	2	0	31	20	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		CL		9	61	19	6	2	3	0	30	20	10	-	1.82	15.26	1.58	2.68	UUT	0.85	4	-	-	-	-	-	-	-	-
SPT-3	7.00	31	31		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-	Brown, Very dense, Silty sand with gravel	SM		0	28	57	10	1	4	0	-	Nil	NP	-	1.80	11.24	1.62	2.62	DST	0.00	31	-	-	-	-	-	-	-	-
SPT-4	10.00	53	43		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-	Brown, Very stiff to hard, Silty clay of low plasticity	CL		9	59	21	7	1	3	0	31	21	10	-	1.80	16.37	1.55	2.67	UUT	0.72	5	-	-	-	0.725	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	8.51 6.02 5.13 4.52	1.76 1.54 1.05 0.65	0.140
SPT-5	13.00	21	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-		CL		11	60	17	6	2	4	0	32	21	11	-	1.88	17.46	1.60	2.67	UUT	1.13	5	-	-	-	-	-	-	-	-
SPT-6	16.00	33	33		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	17.50	-	-	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		7	50	27	4	3	9	0	27	20	7	-	1.89	19.93	1.58	2.66	DST	0.22	27	-	-	-	-	-	-	-	-
SPT-7	19.00	61	26		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	20.50	-	-		ML-CL		6	50	30	6	2	6	0	26	20	6	-	1.92	20.04	1.60	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	22.00	77	30		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	23.50	-	-		ML-CL		7	45	32	5	4	5	2	27	20	7	-	1.90	20.10	1.58	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	25.00	57	24		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	26.50	-	-		ML-CL		8	52	27	3	4	6	0	28	21	7	-	1.90	20.20	1.58	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	20-10-2021	to	22-10-2021	3+497 Major Bridge	BH-A1	16.25 m	40.00 m	717079.294 m	3124900.291 m	(+)196.752 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand Fine	Sand Medium	Sand Coarse	Gravel Fine	Gravel Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-10	28.00	62	24	Brown, Very dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-10	29.50	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	52	16	7	5	8	0	33	22	11	-	2.04	20.74	1.69	2.68	UUT	2.51	5	-	-	-	-	-	-	-	-
SPT-11	31.00	79	79		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-11	32.50	-	-		CL		10	44	18	12	9	7	0	30	20	10	-	2.05	20.60	1.70	2.67	UUT	3.12	4	-	-	-	-	-	-	-	-
SPT-12	34.00	83	83		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	35.50	100 (21cm)	100 (21cm)		CL		11	49	16	13	3	6	2	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	37.00	85	85		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	38.50	95	95		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	40.00	98	98		CL		12	46	19	7	4	10	2	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		20-10-2021	to	22-10-2021	3+497 Major Bridge	BH-P1	15.32 m	40.00 m	717042.421 m	3124897.227 m	(+)195.783 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		ML-CL		7	45	28	9	6	5	0	27	20	7	-	1.82	12.04	1.62	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	2.50	45	57		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		ML-CL		6	52	30	4	3	4	1	26	20	6	-	1.81	12.49	1.61	2.66	DST	0.22	26	-	-	-	-	-	-	-	-
SPT-2	5.50	35	35		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-	Brown, Very dense, Silty sand with gravel	SM		0	13	58	14	8	7	0	-	Nil	NP	-	1.80	11.41	1.62	2.63	DST	0.00	31	-	-	-	-	-	-	-	-
SPT-3	8.50	55	47		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		SM		0	22	64	6	2	6	0	-	Nil	NP	-	1.81	11.80	1.62	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	11.50	51	39		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-	Brown, Dense, Sandy silt of low plasticity with gravel	ML-CL		8	55	23	9	5	0	0	28	21	7	-	1.83	15.26	1.59	2.66	DST	0.20	26	-	-	-	-	-	-	-	-
SPT-5	14.50	40	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	16.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	17.50	68	30	Brown, Very dense, Silty sand with gravel	SM		0	21	61	7	2	7	2	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	19.00	-	-		SM		0	37	50	4	1	8	0	-	Nil	NP	-	1.86	16.03	1.60	2.62	DST	0.00	31	-	-	-	-	-	-	-	-
SPT-7	20.50	59	26		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	22.00	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		13	45	16	8	8	10	0	34	23	11	-	2.02	21.98	1.66	2.68	UUT	1.96	5	-	-	-	-	-	-	-	-
SPT-8	23.50	57	57		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	25.00	-	-		CL		11	53	18	6	3	7	2	32	21	11	-	2.02	21.70	1.66	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	26.50	61	61		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		20-10-2021	to	22-10-2021	3+497 Major Bridge	BH-P1	15.32 m	40.00 m	717042.421 m	3124897.227 m	(+)195.783 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
UDS-9	28.00	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	47	15	11	3	12	0	33	22	11	-	2.02	22.14	1.65	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	29.50	50	50		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-10	31.00	-	-		CL		13	53	19	4	2	9	0	34	23	11	-	2.02	20.97	1.67	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	32.50	65	65		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-11	34.00	-	-		CL		12	56	13	8	2	9	0	33	22	11	-	2.03	20.86	1.68	2.67	UUT	2.41	5	-	-	-	-	-	-	-	-
SPT-12	35.50	76	76		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	37.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	38.50	95	95		CL		11	54	17	6	4	8	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	40.00	100	100		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		20-10-2021	to	22-10-2021	3+497 Major Bridge	BH-P2	15.30 m	40.00 m	717007.541 m	3124894.329 m	(+)195.847 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ^o)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	7	11	Brown, Loose, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		ML-CL		7	44	37	11	1	0	0	27	21	6	-	1.66	12.06	1.48	2.66	DST	0.18	23	-	-	-	-	-	-	-	-
SPT-2	4.00	17	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		SM		0	29	49	18	1	3	0	-	Nil	NP	-	1.72	11.87	1.54	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-3	7.00	19	18	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		SM		0	32	57	7	2	2	0	-	Nil	NP	-	1.73	12.10	1.54	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	10.00	23	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-		SM		0	26	64	3	4	3	0	-	Nil	NP	-	1.74	12.31	1.55	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	13.00	20	20		CL		11	62	17	4	3	3	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-	Brown, Very stiff, Silty clay of low plasticity	CL		10	59	19	6	2	4	0	31	20	11	-	1.82	16.74	1.56	2.67	UUT	0.75	5	-	-	-	0.715	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	7.71 6.26 5.54 4.50	2.25 1.55 1.03 0.67	0.1430
SPT-6	16.00	24	24		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	17.50	-	-		ML-CL		7	46	26	10	3	7	1	27	21	6	-	1.87	19.40	1.57	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	19.00	60	27	Brown, Dense to very dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	20.50	-	-		ML-CL		6	54	29	3	4	4	0	26	20	6	-	1.89	21.04	1.56	2.66	DST	0.21	25	-	-	-	-	-	-	-	-
SPT-8	22.00	38	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	23.50	-	-		CL		11	59	11	7	4	8	0	32	21	11	-	2.00	23.30	1.62	2.68	UUT	1.49	5	-	-	-	-	-	-	-	-
SPT-9	25.00	42	42	Brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	26.50	-	-		CL		12	58	16	3	5	6	0	33	22	11	-	2.01	23.17	1.63	-	-	-	-	-	-	-	-	-	-	-	-

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		20-10-2021	to	22-10-2021	3+497 Major Bridge	BH-P2	15.30 m	40.00 m	717007.541 m	3124894.329 m	(+)195.847 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ^o)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
SPT-10	28.00	48	48	Brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-10	29.50	-	-		CL		11	55	19	7	2	4	2	31	20	11	-	2.02	21.79	1.66	2.67	UUT	2.02	5	-	-	-	-	-	-	-	-
SPT-11	31.00	63	63		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-11	32.50	-	-		CL		10	53	22	3	4	8	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	34.00	97	32	Brown, Very dense, Silty sand with clay & gravel	SM-SC		4	35	40	10	11	0	0	25	20	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	35.50	>100	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	37.00	90	29		SM-SC		5	40	42	3	8	2	0	25	20	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	38.50	100 (22cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	40.00	100 (20cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		20-10-2021	to	22-10-2021	3+497 Major Bridge	BH-P3	15.31 m	40.00 m	716972.661 m	3124891.431 m	(+)195.759 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		SM		0	28	64	8	0	0	0	-	Nil	NP	-	1.68	11.46	1.51	2.63	DST	0.00	28	-	-	-	-	-	-	-	-
SPT-1	2.50	11	14		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		SM		0	22	70	4	2	2	0	-	Nil	NP	-	1.75	12.06	1.56	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-2	5.50	22	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		SM		0	18	68	7	4	2	1	-	Nil	NP	-	1.75	12.20	1.56	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	8.50	25	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-	Brown, Very stiff to hard, Silty clay of low plasticity	CL		12	57	20	5	2	4	0	33	22	11	-	1.86	16.24	1.60	2.67	UUT	1.00	5	-	-	-	-	-	-	-	-
SPT-4	11.50	28	28		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-		CL		11	59	18	7	1	4	0	32	21	11	-	1.87	17.10	1.60	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	14.50	32	32		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	16.00	-	-	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		8	50	27	6	2	6	1	28	21	7	-	1.91	20.74	1.58	2.66	DST	0.21	26	-	-	-	-	-	-	-	-
SPT-6	17.50	56	26		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	19.00	-	-		ML-CL		7	52	30	3	1	7	0	27	20	7	-	1.91	21.19	1.58	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	20.50	67	28		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	22.00	-	-		ML-CL		7	52	27	3	5	4	2	26	19	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	23.50	61	61	Brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	25.00	-	-		CL		12	52	16	9	2	9	0	33	22	11	-	2.03	22.10	1.66	2.67	UUT	1.98	5	-	-	-	-	-	-	-	-
SPT-9	26.50	58	58		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Date of Boring	20-10-2021 to 22-10-2021
Chainage (km.)/Location	3+497 Major Bridge
B.H. No.	BH-P3
Depth of Water Table	15.31 m
Termination Depth	40.00 m
Cordinates (E,N)	716972.661 m, 3124891.431 m
R.L.	(+)195.759 m
Ref. Code	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm³)	Natural Moisture Content (%)	Dry Density (g/cm³)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm²)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm²)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm²)	C_v x 10^{-4} (cm²/Sec)	M_v x 10^{-2} (cm²/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
UDS-10	28.00	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		11	55	19	4	3	7	1	32	21	11	-	2.03	21.48	1.67	2.68	UUT	2.24	5	-	-	-	-	-	-	-	-
SPT-10	29.50	70	70		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	31.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	31.50	80	28	Brown, Very Dense, Sandy silt of low plasticity with gravel	ML-CL		7	49	29	2	2	11	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	32.50	91	31		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	34.00	85	29		ML-CL		8	50	26	1	1	14	0	28	21	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	35.50	>100	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	37.00	100 (20cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	38.50	>100	-		ML-CL		7	48	28	3	2	10	2	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-17	40.00	100 (20cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	21-10-2021	to	23-10-2021	3+497 Major Bridge	BH-A2	15.30 m	40.00 m	716935.788 m	3124888.367 m	(+)195.643 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	16	25	Brown, Medium dense, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		ML-CL		7	44	38	10	1	0	0	28	21	7	-	1.79	13.10	1.58	2.66	DST	0.21	24	-	-	-	-	-	-	-	-
SPT-2	4.00	26	29		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		SM		0	25	61	8	2	4	0	-	Nil	NP	-	1.82	12.16	1.62	2.62	DST	0.00	31	-	-	-	-	-	-	-	-
SPT-3	7.00	47	43		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-	Brown, Dense to Very dense, Silty sand with gravel	SM		0	24	65	4	3	3	1	-	Nil	NP	-	1.81	12.40	1.61	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	10.00	36	29		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-		SM		0	26	60	7	2	5	0	-	Nil	NP	-	1.83	13.27	1.62	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	13.00	60	43		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-		ML-CL		7	49	24	12	1	7	0	27	20	7	-	1.83	16.79	1.57	2.66	DST	0.19	25	-	-	-	-	-	-	-	-
SPT-6	16.00	43	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	17.50	-	-		ML-CL		6	49	27	6	3	8	1	26	20	6	-	1.94	18.95	1.63	2.66	DST	0.20	29	-	-	-	-	-	-	-	-
SPT-7	18.00	65	28	Brown, Dense to very dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	19.00	83	34		ML-CL		7	48	23	11	5	6	0	28	21	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	20.50	88	35		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	22.00	97	37		ML-CL		7	51	27	4	3	8	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	23.50	58	58	Brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	25.00	-	-		CL		11	51	24	3	3	8	0	30	20	10	-	2.01	22.10	1.65	2.67	UUT	1.82	5	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	21-10-2021	to	23-10-2021	3+497 Major Bridge	BH-A2	15.30 m	40.00 m	716935.788 m	3124888.367 m	(+)195.643 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
SPT-12	26.50	50	50	Brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	28.00	76	76		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	29.50	-	-		CL		12	49	21	8	1	9	0	33	22	11	-	2.05	20.46	1.70	2.68	UUT	3.15	5	-	-	-	-	-	-	-	-
SPT-14	31.00	>100	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	32.50	100 (25cm)	100 (25cm)		CL		11	48	19	8	3	11	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	34.00	100 (20cm)	100 (20cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-17	35.50	100 (20cm)	100 (20cm)		CL		10	47	22	6	4	9	2	31	20	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-18	37.00	100 (17cm)	100 (17cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-19	38.50	>100	-		CL		11	50	18	7	4	7	3	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-20	40.00	100 (24cm)	100 (24cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		23-10-2021	to	25-10-2021	3+691 Major Bridge	BH-A1	15.40 m	30.00 m	716820.675 m	3124880.556 m	(+)196.163 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS-1	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	5	8	Brown, Loose, Silty sand with clay	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		SM-SC		5	41	50	1	2	1	0	25	20	5	-	1.67	11.64	1.50	2.65	DST	0.11	25	-	-	-	-	-	-	-	-
SPT-2	4.00	22	25		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		ML-CL		7	58	29	3	1	2	0	27	20	7	-	1.79	14.26	1.57	2.66	DST	0.18	25	-	-	-	-	-	-	-	-
SPT-3	7.00	24	23		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-	Brown, Medium dense, Sandy silt of low plasticity	ML-CL		8	56	25	6	2	3	0	28	21	7	-	1.81	15.24	1.57	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	10.00	27	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-		ML-CL		7	54	27	7	3	2	0	26	19	7	-	1.81	16.33	1.56	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	13.00	22	16		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		10	57	24	3	1	5	0	31	21	10	-	1.94	19.72	1.62	2.68	UUT	1.36	4	-	-	-	0.655	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	10.09 8.47 7.12 5.76	1.58 1.16 0.81 0.47	0.100
SPT-6	16.00	40	40		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	17.50	-	-		ML-CL		8	49	21	11	6	5	0	28	21	7	-	1.93	20.40	1.60	2.66	DST	0.20	27	-	-	-	-	-	-	-	-
SPT-7	19.00	77	32		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	20.50	81	33		ML-CL		6	51	26	6	3	8	0	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	22.00	67	28	Brown, Very dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	23.50	71	28		ML-CL		7	50	23	9	4	7	0	26	19	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	25.00	61	25				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	26.50	-	-		ML-CL		6	54	25	4	2	6	3	26	19	7	-	1.94	20.34	1.61	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		23-10-2021	to	25-10-2021	3+691 Major Bridge	BH-A1	15.40 m	30.00 m	716820.675 m	3124880.556 m	(+)196.163 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
SPT-12	28.00	73	28	Brown, Very dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	29.50	100	34		ML-CL		7	50	23	5	4	10	1	28	21	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	29.95	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project		Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	23-10-2021	to	25-10-2021	3+691 Major Bridge	BH-A2	15.25 m	30.00 m	716800.700 m	3124877.143 m	(+)196.124 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand Fine	Sand Medium	Sand Coarse	Gravel Fine	Gravel Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS-1	0.00	-	-	Brown, Very stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		CL		12	57	18	10	3	0	0	32	21	11	-	1.70	13.20	1.50	2.67	UUT	0.43	4	-	-	-	-	-	-	-	-
SPT-1	2.50	12	12		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-	Brown, Medium dense, Sandy silt of low plasticity	ML-CL		8	48	26	13	3	2	0	28	21	7	-	1.72	12.46	1.53	2.66	DST	0.20	24	-	-	-	-	-	-	-	-
SPT-2	5.50	16	16		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		ML-CL		7	54	27	7	2	2	1	27	20	7	-	1.74	13.04	1.54	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	8.50	20	17		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		ML-CL		7	52	28	6	4	3	0	26	19	7	-	1.78	14.60	1.55	2.66	DST	0.19	25	-	-	-	-	-	-	-	-
SPT-4	11.50	27	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-	Brown, Very stiff, Silty clay of low plasticity with gravel	CL		12	51	16	13	4	4	0	33	22	11	-	1.87	20.13	1.56	2.68	UUT	0.75	5	-	-	-	-	-	-	-	-
SPT-5	14.50	22	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	16.00	-	-		CL		11	60	20	3	2	4	0	32	21	11	-	1.96	22.64	1.60	2.67	UUT	1.02	4	-	-	-	-	-	-	-	-
SPT-6	17.50	30	30		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	19.00	-	-	Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL		7	44	25	16	2	6	0	27	20	7	-	1.88	20.71	1.56	2.66	DST	0.22	26	-	-	-	-	-	-	-	-
SPT-7	20.50	48	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	22.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	22.50	43	20		ML-CL		6	53	30	2	3	5	1	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	23.50	53	23		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	25.00	-	-		ML-CL		7	52	26	6	2	7	0	26	19	7	-	1.91	21.60	1.57	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project		Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	23-10-2021	to	25-10-2021	3+691 Major Bridge	BH-A2	15.25 m	30.00 m	716800.700 m	3124877.143 m	(+)196.124 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
SPT-10	26.50	46	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	28.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	28.50	69	27	Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL		8	46	24	9	4	9	0	28	21	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	29.50	100 (22cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	29.95	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	16-10-2021	to	16-10-2021	4+174 Minor Bridge	BH-CL	Not Encountered	10.00 m	716335.062 m	3124838.454 m	(+)196.256 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand Fine	Sand Medium	Sand Coarse	Gravel Fine	Gravel Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		SM		0	20	72	5	2	1	0	-	Nil	NP	-	1.68	10.23	1.52	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-1	2.50	14	18	Brown, Very stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		CL		9	50	28	7	4	2	0	30	20	10	-	1.78	15.26	1.54	2.67	UUT	0.63	5	-	-	-	0.735	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	10.01 7.96 6.11 4.96	2.10 1.41 0.95 0.59	0.130
SPT-2	5.50	29	30	Brown, Medium dense to very dense, Silty sand with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		SM		0	22	67	4	3	3	1	-	Nil	NP	-	1.82	13.24	1.61	2.62	DST	0.00	31	-	-	-	-	-	-	-	-
SPT-3	8.50	55	48		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		SM		0	20	70	3	1	6	0	-	Nil	NP	-	1.87	14.16	1.64	2.63	DST	0.00	32	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project		Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	16-10-2021	to	16-10-2021	4+207 Minor Bridge	BH-CL	Not Encountered	10.00 m	716300.074 m	3124835.546 m	(+)196.348 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Medium dense, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	15	24		ML-CL		7	46	33	11	2	1	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		ML-CL		6	52	31	6	3	2	0	26	19	7	-	1.78	12.46	1.58	2.66	DST	0.18	25	-	-	-	-	-	-	-	-
SPT-2	4.00	26	29		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-	Brown, Dense to very dense, Silty sand with gravel	SM		0	17	72	3	2	6	0	-	Nil	NP	-	1.81	11.47	1.62	2.62	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-3	7.00	41	38		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		SM		0	14	70	4	4	8	0	-	Nil	NP	-	1.83	12.23	1.63	2.63	DST	0.00	31	-	-	-	-	-	-	-	-
SPT-4	10.00	56	45		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	16-10-2021	to	16-10-2021	4+655 Minor Bridge	BH-CL	Not Encountered	10.00 m	715855.211 m	3124798.666 m	(+)200.573 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	14	22		SM		0	13	81	2	3	1	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-	Brown, Dense to very dense, Silty sand with gravel	SM		0	20	68	4	3	5	0	-	Nil	NP	-	1.81	11.34	1.63	2.63	DST	0.00	31	-	-	-	-	-	-	-	-
SPT-2	4.00	41	46		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		SM		0	15	71	5	2	7	0	-	Nil	NP	-	1.84	12.06	1.64	2.62	DST	0.00	32	-	-	-	-	-	-	-	-
SPT-3	7.00	53	49		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		SM		0	16	72	3	1	6	2	-	Nil	NP	-	1.84	12.46	1.64	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	10.00	62	50		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		16-10-2021	to	16-10-2021	5+119 Minor Bridge	BH-CL	Not Encountered	10.00 m	715393.751 m	3124750.566 m	(+)202.713 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm³)	Natural Moisture Content (%)	Dry Density (g/cm³)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm²)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm²)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm²)	C_v x 10^{-4} (cm²/Sec)	M_v x 10^{-2} (cm²/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-	Brown, Loose, Silty sand	SM		0	23	70	4	2	1	0	-	Nil	NP	-	1.66	10.74	1.50	2.62	DST	0.00	28	-	-	-	-	-	-	-	-
SPT-1	2.50	10	13		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		SM		0	16	73	5	3	3	0	-	Nil	NP	-	1.78	11.43	1.60	2.63	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-2	5.50	28	29		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-	Brown, Medium dense to dense, Silty sand with gravel	SM		0	19	69	4	3	5	0	-	Nil	NP	-	1.79	12.16	1.60	2.62	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-3	8.50	33	29		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		SM		0	13	75	6	2	4	0	-	Nil	NP	-	1.81	13.24	1.60	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	17-10-2021	to	17-10-2021	5+730 Minor Bridge	BH-CL	Not Encountered	10.00 m	714786.103 m	3124685.263 m	(+)198.287 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Loose to dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	9	14		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		SM		0	26	62	10	2	0	0	-	Nil	NP	-	1.69	11.06	1.52	2.62	DST	0.00	28	-	-	-	-	-	-	-	-
SPT-2	4.00	14	16		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		SM		0	19	75	1	2	3	0	-	Nil	NP	-	1.77	11.76	1.58	2.63	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-3	7.00	25	23		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		SM		0	14	72	9	1	4	0	-	Nil	NP	-	1.79	12.40	1.59	2.62	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-4	10.00	33	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	17-10-2021	to	17-10-2021	6+197 Minor Bridge	BH-CL	2.52 m	10.00 m	714320.102 m	3124636.752 m	(+)198.287 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm³)	Natural Moisture Content (%)	Dry Density (g/cm³)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm²)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm²)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm²)	$C_v \times 10^{-4}$ (cm²/Sec)	$M_v \times 10^{-2}$ (cm²/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Medium dense, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		ML-CL		6	50	29	13	2	0	0	26	20	6	-	1.78	16.26	1.53	2.66	DST	0.14	22	-	-	-	-	-	-	-	-
SPT-1	2.50	13	17		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		ML-CL		7	46	31	10	4	2	0	27	20	7	-	1.84	19.46	1.54	2.63	DST	0.15	24	-	-	-	-	-	-	-	-
SPT-2	5.50	21	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		ML-CL		6	46	30	9	5	3	1	26	19	7	-	1.87	20.87	1.55	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	8.50	47	31	Brown, Dense, Silty sand with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		SM		0	23	70	1	1	5	0	-	Nil	NP	-	1.86	16.20	1.60	2.62	DST	0.00	31	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	17-10-2021	to	17-10-2021	6+877 Minor Bridge	BH-CL	1.85 m	10.00 m	713641.709 m	3124570.057 m	(+)196.702 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand Fine	Sand Medium	Sand Coarse	Gravel Fine	Gravel Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Medium dense, Silty sand with clay	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	13	20		SM-SC		4	45	41	7	3	0	0	25	20	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		SM-SC		5	42	39	13	1	0	0	26	21	5	-	1.80	16.43	1.55	2.65	DST	0.09	27	-	-	-	-	-	-	-	-
SPT-2	4.00	18	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-	Brown, Dense, Silty sand	SM		0	26	55	19	0	0	0	-	Nil	NP	-	1.84	16.14	1.58	2.62	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-3	7.00	33	26		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		SM		0	18	66	15	1	0	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	10.00	38	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	03-10-2021	to	05-10-2021	7+078 Major Bridge	BH-A1	1.70 m	30.00 m	713455.570 m	3124551.638 m	(+)195.221 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		ML-CL		6	63	26	4	1	0	0	26	19	7	-	1.80	18.23	1.52	2.66	DST	0.18	24	-	-	-	-	-	-	-	-
SPT-1	2.50	13	17		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		ML-CL		5	60	28	4	2	1	0	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	5.50	14	16	Brown, Medium dense, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	7.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	7.50	17	17		ML-CL		6	54	32	5	2	1	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	8.50	23	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	10.00	-	-		ML-CL		7	54	30	3	4	2	0	27	20	7	-	1.88	21.14	1.55	2.67	DST	0.23	24	-	-	-	-	-	-	-	-
SPT-5	11.50	27	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	13.00	-	-	Brown, Very stiff to hard, Silty clay of low plasticity	CL		11	67	16	2	1	2	1	32	21	11	-	1.99	24.10	1.60	2.68	UUT	1.02	4	25.0	-	-	-	-	-	-	-
SPT-6	14.50	35	35		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	16.00	-	-		ML-CL		8	53	23	6	3	7	0	28	21	7	-	1.94	19.64	1.62	2.66	DST	0.22	27	-	-	-	-	-	-	-	-
SPT-7	17.50	88	44		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	19.00	86	42	Brown, Very dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	20.50	72	36		ML-CL		7	48	28	7	1	9	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	22.00	84	40		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	23.50	86	86	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	61	16	3	1	7	0	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	25.00	68	68		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		03-10-2021	to	05-10-2021	7+078 Major Bridge	BH-A1	1.70 m	30.00 m	713455.570 m	3124551.638 m	(+)195.221 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-13	27.50	76	76	Brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	28.00	69	69		CL		11	58	18	5	2	6	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	29.50	70	70		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	29.95	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		03-10-2021	to	04-10-2021	7+078 Major Bridge	BH-A2	1.25 m	30.00 m	713435.595 m	3124549.896 m	(+)194.815 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Medium stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	5	5		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		CL		11	71	13	3	2	0	0	33	22	11	-	1.88	29.10	1.46	2.68	UUT	0.24	5	-	-	-	0.835	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	7.69 6.21 5.03 4.23	2.55 1.85 1.28 0.75	0.169
SPT-2	4.00	7	7		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		CL		12	69	11	4	3	1	0	32	21	11	-	1.88	28.96	1.46	-	-	-	-	28.0	-	-	-	-	-	-	-
SPT-3	7.00	8	8		CL		10	70	16	1	2	1	0	31	20	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	8.50	-	-	Brown, Medium dense, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	9.00	18	17		ML-CL		7	60	27	3	2	1	0	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	10.00	19	17		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	11.50	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	60	19	5	1	3	0	32	21	11	-	1.99	23.67	1.61	2.68	UUT	1.16	4	-	-	-	-	-	-	-	-
SPT-6	13.00	34	34		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	14.50	-	-		CL		13	58	17	4	3	5	0	33	22	11	-	2.00	23.19	1.62	2.67	UUT	1.35	4	24.0	-	-	-	-	-	-	-
SPT-7	16.00	40	40		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	17.50	-	-	Brown, Very dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	18.00	95	46		ML-CL		6	45	35	4	2	8	0	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	19.00	89	43		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	20.50	58	58	Brown, Hard, Silty clay of low plasticity with gravel	CL		10	56	23	3	2	6	0	31	21	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	22.00	74	74				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	23.50	-	-		CL		12	55	20	5	3	5	0	32	21	11	-	2.03	21.60	1.67	2.68	UUT	2.15	4	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	03-10-2021	to	04-10-2021	7+078 Major Bridge	BH-A2	1.25 m	30.00 m	713435.595 m	3124549.896 m	(+)194.815 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-12	25.00	51	51	Brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	26.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	27.00	79	79		CL		11	56	22	2	2	7	0	31	20	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	28.00	70	70		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	29.50	70	70		CL		10	52	25	4	2	6	1	30	20	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	29.95	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	28-10-2021	to	28-10-2021	7+256 Minor Bridge	BH-CL	1.59 m	10.00 m	713264.533 m	3124532.969 m	(+)193.947 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	16	25		SM		0	32	58	9	1	0	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		SM		0	30	62	3	4	1	0	-	Nil	NP	-	1.82	15.36	1.58	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-2	4.00	27	25	Brown, Medium dense to dense, Sandy silt of low plasticity with gravel	ML-CL		7	51	30	8	1	3	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		ML-CL		6	49	32	6	2	4	1	26	20	6	-	1.89	19.46	1.58	2.66	DST	0.19	25	-	-	-	-	-	-	-	-
SPT-3	7.00	30	24		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		ML-CL		8	49	26	8	4	5	0	28	21	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	10.00	33	24		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		24-10-2021	to	26-10-2021	7+351 Major Bridge	BH-A1	3.00 m	40.00 m	713206.080 m	3124525.765 m	(+)194.037 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Loose, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	5	8		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		ML-CL		6	47	30	12	5	0	0	26	20	6	-	1.70	16.23	1.46	2.66	DST	0.20	22	-	-	-	-	-	-	-	-
SPT-2	4.00	32	27	Brown, Medium dense to dense, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		ML-CL		7	49	28	11	3	2	0	27	20	7	-	1.86	21.46	1.53	2.66	DST	0.19	24	-	-	-	-	-	-	-	-
SPT-3	7.00	15	16		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-	Brown, Very stiff, Silty clay of low plasticity	CL		12	65	11	8	3	1	0	33	22	11	-	1.95	26.10	1.55	2.67	UUT	0.70	4	-	-	-	0.725	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	7.77 5.35 4.41 4.21	1.87 1.54 1.11 0.63	0.1360
SPT-4	10.00	20	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-	Brown, Dense, Sandy silt of low plasticity with gravel	ML-CL		7	46	29	10	3	5	0	28	21	7	-	1.87	20.18	1.56	2.65	DST	0.22	24	-	-	-	-	-	-	-	-
SPT-5	13.00	33	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	55	16	10	1	6	0	33	22	11	-	1.99	22.83	1.62	2.67	UUT	1.32	5	-	-	-	-	-	-	-	-
SPT-6	16.00	39	39		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	17.50	-	-	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		6	46	27	11	0	10	0	26	20	6	-	1.93	19.70	1.61	2.66	DST	0.20	27	-	-	-	-	-	-	-	-
SPT-7	19.00	100 (26cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	21.00	63	31		ML-CL		7	51	30	4	2	6	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	22.00	70	33		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	23.50	-	-		ML-CL		8	45	25	10	1	9	2	28	21	7	-	1.94	20.04	1.62	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	25.00	100 (27cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	26.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		24-10-2021	to	26-10-2021	7+351 Major Bridge	BH-A1	3.00 m	40.00 m	713206.080 m	3124525.765 m	(+)194.037 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-11	28.00	51	24	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		7	51	30	2	3	7	0	26	19	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	29.50	-	-		ML-CL		6	49	28	7	2	6	2	26	20	6	-	1.89	19.87	1.58	2.66	DST	0.21	26	-	-	-	-	-	-	-	-
SPT-12	31.00	46	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	32.50	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	48	16	12	4	8	0	33	22	11	-	2.03	21.60	1.67	2.68	UUT	2.28	5	-	-	-	-	-	-	-	-
SPT-13	34.00	71	71		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-10	35.50	-	-		CL		10	50	13	10	6	11	0	31	20	11	-	2.05	20.40	1.70	2.67	UUT	3.15	5	-	-	-	-	-	-	-	-
SPT-14	37.00	100 (23cm)	100 (23cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	38.50	100 (28cm)	100 (28cm)		CL		11	50	18	6	3	12	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	40.00	100 (20cm)	100 (20cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	23-10-2021	to	25-10-2021	7+351 Major Bridge	BH-P1	2.10 m	40.00 m	713171.257 m	3124522.342 m	(+)196.827 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Loose, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		ML-CL		6	49	27	13	5	0	0	27	21	6	-	1.71	14.26	1.50	2.66	DST	0.18	24	-	-	-	-	-	-	-	-
SPT-1	2.50	9	13		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-	Brown, Very stiff, Silty clay of low plasticity	CL		12	60	16	10	1	1	0	33	22	11	-	1.91	27.41	1.50	2.67	UUT	0.41	4	-	-	-	0.780	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	8.54 7.53 6.03 5.26	2.16 1.72 1.11 0.72	0.159
SPT-2	5.50	11	11		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		CL		11	63	19	3	2	2	0	32	21	11	-	1.92	27.80	1.50	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	8.50	12	12		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-	Brown, Dense, Sandy silt of low plasticity with gravel	ML-CL		8	53	27	3	4	5	0	28	21	7	-	1.93	20.36	1.60	2.66	DST	0.21	26	-	-	-	-	-	-	-	-
SPT-4	11.50	45	29		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-		ML-CL		7	47	30	9	2	5	0	27	20	7	-	1.93	20.40	1.60	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	14.50	28	28	Brown, Very stiff to hard, Silty clay of low plasticity with gravel	CL		11	61	20	3	2	3	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	16.00	-	-		CL		10	59	14	8	5	4	0	31	20	11	-	1.99	24.10	1.60	2.68	UUT	1.02	5	-	-	-	-	-	-	-	-
SPT-6	17.50	33	33		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	19.00	-	-	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		8	45	26	10	2	9	0	28	21	7	-	1.92	20.30	1.60	2.66	DST	0.22	26	-	-	-	-	-	-	-	-
SPT-7	20.50	100 (23cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	22.00	69	34		ML-CL		6	55	30	2	1	6	0	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	23.50	43	23		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	25.00	-	-		ML-CL		7	49	28	6	2	8	0	27	20	7	-	1.94	19.89	1.62	2.66	DST	0.20	28.00	-	-	-	-	-	-	-	-
SPT-10	26.50	89	38		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		23-10-2021	to	25-10-2021	7+351 Major Bridge	BH-P1	2.10 m	40.00 m	713171.257 m	3124522.342 m	(+)196.827 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
UDS-9	28.00	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		11	55	15	11	2	6	0	32	21	11	-	2.00	23.48	1.62	2.68	UUT	1.36	5	-	-	-	-	-	-	-	-
SPT-11	29.50	41	41		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-10	31.00	-	-		CL		12	52	19	8	1	7	1	33	22	11	-	2.02	21.90	1.66	2.67	UUT	1.95	5	-	-	-	-	-	-	-	-
SPT-12	32.50	59	59		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	34.00	-	-	Brown, Very dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	34.50	90	34		ML-CL		7	46	23	12	1	11	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	35.50	98	36		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	37.00	96	35		ML-CL		8	46	25	8	3	9	1	28	21	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	38.50	100 (27cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-17	40.00	100 (19cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	27-10-2021	to	28-10-2021	7+351 Major Bridge	BH-A2	0.70 m	40.00 m	713136.399 m	3124522.342 m	(+)193.680 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Loose, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	4	8		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		SM		0	17	76	6	1	0	0	-	Nil	NP	-	1.65	12.80	1.46	2.62	DST	0.00	27	-	-	-	-	-	-	-	-
SPT-2	4.00	4	6		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		SM		0	19	71	8	2	0	0	-	Nil	NP	-	1.66	13.24	1.47	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	7.00	8	10		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-	Brown, Medium dense, Silty sand with clay	SM-SC		5	34	53	6	1	1	0	25	20	5	-	1.75	15.32	1.52	2.65	DST	0.10	27	-	-	-	-	-	-	-	-
SPT-4	10.00	14	15		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-		SM-SC		6	34	51	5	2	2	0	26	20	6	-	1.79	16.29	1.54	2.66	DST	0.11	28.00	-	-	-	-	-	-	-	-
SPT-5	13.00	22	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		7	49	28	5	3	8	0	27	20	7	-	1.94	19.46	1.62	2.66	DST	0.22	27	-	-	-	-	-	-	-	-
SPT-6	16.00	56	34		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	17.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	18.00	64	36		ML-CL		8	48	27	6	1	10	0	28	21	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	19.00	71	38		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	20.50	78	40		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	22.00	85	42		ML-CL		7	45	31	5	2	9	1	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	23.50	91	43		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	25.00	95	44		ML-CL		8	53	25	6	1	7	0	28	21	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		27-10-2021	to	28-10-2021	7+351 Major Bridge	BH-A2	0.70 m	40.00 m	713136.399 m	3124522.342 m	(+)193.680 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-13	26.50	100 (27cm)	-	Brown, Very dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	28.00	100 (22cm)	-		ML-CL		6	48	27	6	1	12	0	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	29.50	100 (24cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	31.00	100 (20cm)	-		ML-CL		7	46	25	9	3	10	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-17	32.50	85	36		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-18	34.00	91	37		ML-CL		6	49	28	6	2	8	1	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-19	35.50	100 (28cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-20	37.00	100 (24cm)	-		ML-CL		7	50	25	6	1	11	0	26	19	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-21	38.50	100 (22cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-22	40.00	100 (20cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		24-10-2021	to	24-10-2021	7+457 Minor Bridge	BH-CL	0.59 m	10.00 m	713067.448 m	3124513.592 m	(+)193.671 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	12	19		SM		0	31	59	9	1	0	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		SM		0	26	64	6	3	1	0	-	Nil	NP	-	1.78	15.46	1.54	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-2	4.00	19	21	Brown, Medium dense to dense, Sandy silt of low plasticity with gravel	ML-CL		7	47	30	11	2	2	1	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		ML-CL		8	49	29	7	4	3	0	28	21	7	-	1.87	19.74	1.56	2.66	DST	0.22	24	-	-	-	-	-	-	-	-
SPT-3	7.00	25	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		ML-CL		7	48	26	10	5	4	0	26	19	7	-	1.90	20.14	1.58	2.66	DST	0.20	25	-	-	-	-	-	-	-	-
SPT-4	10.00	32	24		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	26-10-2021	to	27-10-2021	7+613 Major Bridge	BH-A1	0.50 m	40.00 m	712928.250 m	3124499.906 m	(+)195.453 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Loose to medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	9	16		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		SM		0	19	68	6	1	6	0	-	Nil	NP	-	1.74	14.63	1.52	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-2	4.00	12	16		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-	Brown, Medium dense, Silty sand with clay	SM-SC		6	43	43	4	2	2	0	26	20	6	-	1.81	16.89	1.55	2.65	DST	0.09	29	-	-	-	-	-	-	-	-
SPT-3	7.00	21	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		SM-SC		5	34	50	7	1	3	0	25	20	5	-	1.81	17.46	1.54	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	10.00	20	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-		SM-SC		6	35	49	4	3	3	0	26	20	6	-	1.83	17.98	1.55	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	13.00	29	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		10	52	30	6	1	1	0	31	21	10	-	2.00	23.16	1.62	2.68	UUT	3.15	5	-	-	-	-	-	-	-	-
SPT-6	16.00	100 (22cm)	100 (22cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	17.50	-	-	Brown, Very dense, Silty sand with gravel	SM		0	16	69	7	1	7	0	-	Nil	NP	-	1.89	16.46	1.62	2.63	DST	0.00	32	-	-	-	-	-	-	-	-
SPT-7	19.00	70	37		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	20.50	-	-		SM		0	17	70	3	2	8	0	-	Nil	NP	-	1.88	17.21	1.60	2.62	DST	0.00	31	-	-	-	-	-	-	-	-
SPT-8	22.00	55	29		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	23.50	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		11	55	20	5	1	8	0	32	21	11	-	2.04	21.19	1.68	2.68	UUT	2.41	5	-	-	-	0.595	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	8.63 7.71 6.29 5.18	1.39 0.89 0.61 0.39	0.080
SPT-9	25.00	72	72		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	26.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		26-10-2021	to	27-10-2021	7+613 Major Bridge	BH-A1	0.50 m	40.00 m	712928.250 m	3124499.906 m	(+)195.453 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-10	27.00	82	82	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	49	22	7	1	7	2	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	28.00	75	75		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	29.50	-	-		CL		11	50	24	3	2	10	0	31	20	11	-	2.04	20.70	1.69	2.67	UUT	2.64	5	-	-	-	-	-	-	-	-
SPT-12	31.00	85	85		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-10	32.50	-	-	Brown, Very dense, Silty sand with clay & gravel	SM-SC		6	38	40	6	1	9	0	26	20	6	-	2.00	17.60	1.70	2.65	DST	0.11	32	-	-	-	-	-	-	-	-
SPT-13	34.00	100 (23cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	35.50	100 (21cm)	-		SM-SC		5	38	38	7	1	11	0	25	20	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	37.00	100 (20cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	38.50	100 (18cm)	-		SM-SC		5	32	43	6	2	12	0	25	20	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-17	40.00	80	30		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		27-10-2021	to	28-10-2021	7+613 Major Bridge	BH-A2	0.85 m	40.00 m	7128973992.000 m	3124496.873 m	(+)193.923 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Very stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		CL		11	50	30	6	1	2	0	32	21	11	-	1.95	25.14	1.56	2.68	UUT	0.72	5	-	-	-	-	-	-	-	-
SPT-1	2.50	21	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		CL		10	55	25	4	3	2	1	30	20	10	-	1.95	24.80	1.56	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	5.50	22	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		CL		11	52	24	7	2	4	0	31	20	11	-	1.98	23.79	1.60	2.67	UUT	1.02	6	-	-	-	-	-	-	-	-
SPT-3	8.50	31	31		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		CL		12	54	21	6	2	5	0	33	22	11	-	1.98	23.70	1.60	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	11.50	30	30		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-	Brown, Very dense, Silty sand with clay & gravel	SM-SC		6	38	41	5	1	9	0	26	20	6	-	1.89	17.26	1.61	2.65	DST	0.11	30	-	-	-	-	-	-	-	-
SPT-5	14.50	60	34		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	16.00	-	-		SM-SC		5	35	43	8	2	7	0	25	20	5	-	1.89	17.40	1.61	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	17.50	55	30		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	19.00	-	-	Brown, Very dense, Silty sand with gravel	SM		0	16	66	6	1	11	0	-	Nil	NP	-	1.89	16.88	1.62	2.62	DST	0.00	32	-	-	-	-	-	-	-	-
SPT-7	20.50	81	39		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	22.00	-	-		SM		0	20	65	5	2	7	1	-	Nil	NP	-	1.89	17.10	1.61	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	23.50	80	37		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	25.00	-	-		SM		0	14	68	7	1	8	2	-	Nil	NP	-	1.89	16.90	1.62	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	26.50	82	36		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project		Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	27-10-2021	to	28-10-2021	7+613 Major Bridge	BH-A2	0.85 m	40.00 m	7128973992.000 m	3124496.873 m	(+)193.923 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
UDS-10	28.00	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		11	51	25	3	4	6	0	32	21	11	-	1.98	24.06	1.60	2.67	UUT	1.85	4	-	-	-	-	-	-	-	-
SPT-10	29.50	56	56		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-11	31.00	-	-		CL		12	49	23	5	1	10	0	33	22	11	-	2.01	22.67	1.64	2.68	UUT	3.13	4	-	-	-	-	-	-	-	-
SPT-11	32.50	100 (23cm)	100 (23cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	34.00	100 (26cm)	100 (26cm)		CL		10	45	26	3	4	12	0	30	20	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	35.50	100 (20cm)	100 (20cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	37.00	100 (20cm)	-	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		7	47	30	6	1	9	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	38.50	100 (21cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	40.00	100 (25cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
26-10-2021	to	26-10-2021	7+907 Minor Bridge	BH-CL	1.90 m	10.00 m	712620.430 m	3124469.642 m	(+)193.872 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		SM		0	19	72	6	2	1	0	-	Nil	NP	-	1.67	13.11	1.48	2.62	DST	0.00	28	-	-	-	-	-	-	-	-
SPT-1	2.50	13	13	Brown, Very stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		CL		10	52	28	6	2	2	0	31	20	11	-	1.93	26.73	1.52	2.67	UUT	0.53	5	-	-	-	-	-	-	-	-
SPT-2	5.50	19	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		CL		12	51	27	5	2	3	0	32	21	11	-	1.96	26.18	1.55	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	8.50	39	28	Brown, Dense, Silty sand with gravel	SM		0	16	75	7	1	1	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		SM		0	17	65	11	2	5	0	-	Nil	NP	-	1.86	16.23	1.60	2.63	DST	0.00	30	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	26-10-2021	to	26-10-2021	8+207 Minor Bridge	BH-CL	2.00 m	10.00 m	712317.987 m	3124437.243 m	(+)193.686 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brownish grey, Medium dense, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	12	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		ML-CL		7	54	30	6	1	2	0	27	20	7	-	1.83	18.23	1.55	2.66	DST	0.20	24	-	-	-	-	-	-	-	-
SPT-2	4.00	22	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		ML-CL		8	50	31	7	1	3	0	28	21	7	-	1.88	20.34	1.56	2.66	DST	0.18	25	-	-	-	-	-	-	-	-
SPT-3	7.00	26	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-	Brown, Hard, Silty clay of medium plasticity	CI		15	62	13	5	1	4	0	36	24	12	-	1.98	23.86	1.60	2.68	UUT	1.02	5	-	-	-	-	-	-	-	-
SPT-4	10.00	30	30		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		20-10-2021	to	20-10-2021	8+610 Minor Bridge	BH-CL	1.95 m	10.00 m	711923.004 m	3124401.078 m	(+)194.123 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-	Brown, Medium dense, Silty sand	SM		0	19	64	16	1	0	0	-	Nil	NP	-	1.77	14.20	1.55	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-1	2.50	19	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		SM-SC		5	41	44	6	2	2	0	26	21	5	-	1.80	17.16	1.54	2.65	DST	0.10	27	-	-	-	-	-	-	-	-
SPT-2	5.50	17	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-	Brown, Medium dense to dense, Silty sand with clay	SM-SC		4	40	40	9	3	4	0	25	20	5	-	1.85	17.30	1.58	2.65	DST	0.11	28	-	-	-	-	-	-	-	-
SPT-3	8.50	35	26		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		18-10-2021	to	19-10-2021	8+852 Major Bridge	BH-A1	0.75 m	30.00 m	711688.170 m	3124377.983 m	(+)193.689 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS-1	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	12	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-	Brown, Medium dense, Silty sand with clay	SM-SC		5	36	55	1	2	1	0	25	20	5	-	1.79	14.26	1.57	2.65	DST	0.10	27	-	-	-	-	-	-	-	-
SPT-2	4.00	28	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		SM-SC		6	38	49	3	2	2	0	26	21	5	-	1.80	15.13	1.56	2.65	DST	0.09	28	-	-	-	-	-	-	-	-
SPT-3	7.00	25	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		CL		10	54	21	10	1	4	0	30	20	10	-	2.00	22.84	1.63	2.68	UUT	1.49	5	-	-	-	-	-	-	-	-
SPT-4	10.00	49	49		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	55	20	6	2	4	1	33	22	11	-	1.99	23.10	1.62	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	13.00	41	41		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-		CL		11	51	19	12	2	5	0	32	21	11	-	2.00	22.96	1.63	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	16.00	46	46		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	17.50	-	-		ML-CL		7	50	20	13	4	6	0	27	20	7	-	1.90	20.10	1.58	2.66	DST	0.18	27	-	-	-	-	-	-	-	-
SPT-7	19.00	41	24		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	20.50	-	-	Brown, Dense, Sandy silt of low plasticity with gravel	ML-CL		6	55	26	6	2	5	0	26	20	6	-	1.90	20.21	1.58	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	22.00	43	24		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	23.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project		Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	18-10-2021	to	19-10-2021	8+852 Major Bridge	BH-A1	0.75 m	30.00 m	711688.170 m	3124377.983 m	(+)193.689 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-9	25.00	47	47	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	57	20	3	2	6	0	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	26.50	-	-		CL		13	58	15	6	1	7	0	34	23	11	-	2.01	22.49	1.64	2.68	UUT	1.65	5	-	-	-	-	-	-	-	-
SPT-10	28.00	59	59		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	29.50	-	-		CL		11	55	17	5	3	9	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	30.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		18-10-2021	to	19-10-2021	8+852 Major Bridge	BH-A2	1.35 m	30.00 m	711664.484 m	3124375.655 m	(+)194.209 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ^0)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS-1	0.00	-	-	Brown, Medium dense, Silty sand with clay	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		SM-SC		4	32	54	10	0	0	0	25	20	5	-	1.76	14.26	1.54	2.64	DST	0.11	27	-	-	-	-	-	-	-	-
SPT-1	2.50	15	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		SM-SC		5	42	47	2	2	2	0	25	19	6	-	1.77	15.74	1.53	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	5.50	14	16		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		SM-SC		5	32	50	7	3	3	0	26	20	6	-	1.79	16.12	1.54	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	8.50	19	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-	Brown, Dense, Sandy silt of low plasticity with gravel	ML-CL		7	57	26	4	2	4	0	27	20	7	-	1.90	19.46	1.59	2.66	DST	0.21	25	-	-	-	-	-	-	-	-
SPT-4	11.50	39	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		10	54	17	11	1	7	0	31	21	10	-	2.02	22.67	1.65	2.68	UUT	1.88	4	-	-	-	0.625	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	9.58 7.71 6.27 5.58	1.36 1.00 0.73 0.43	0.090
SPT-5	14.50	57	57		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	16.00	-	-		CL		11	54	20	6	3	5	1	32	21	11	-	2.00	23.49	1.62	2.67	UUT	1.35	5	-	-	-	-	-	-	-	-
SPT-6	17.50	40	40		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	19.00	-	-	Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL		7	47	30	3	2	11	0	27	20	7	-	1.91	20.66	1.58	2.66	DST	0.20	26	-	-	-	-	-	-	-	-
SPT-7	20.50	41	24		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	22.00	-	-		ML-CL		8	48	28	5	3	8	0	28	21	7	-	1.90	19.47	1.59	2.66	DST	0.19	27	-	-	-	-	-	-	-	-
SPT-8	23.50	56	28		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project		Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	18-10-2021	to	19-10-2021	8+852 Major Bridge	BH-A2	1.35 m	30.00 m	711664.484 m	3124375.655 m	(+)194.209 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
UDS-9	25.00	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	58	20	2	2	6	0	33	22	11	-	2.01	22.47	1.64	2.67	UUT	1.72	5	-	-	-	-	-	-	-	-
SPT-9	26.50	52	52		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-10	28.00	-	-		CL		11	54	18	6	3	7	1	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	29.50	56	56		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	29.95	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	26-10-2021	to	26-10-2021	8+907 Minor Bridge	BH-CL	0.55 m	10.00 m	711623.253 m	3124371.601 m	(+)193.708 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Loose to medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	6	11		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		SM		0	36	58	6	0	0	0	-	Nil	NP	-	1.70	13.46	1.50	2.62	DST	0.00	28	-	-	-	-	-	-	-	-
SPT-2	4.00	16	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		SM		0	29	63	7	1	0	0	-	Nil	NP	-	1.81	15.74	1.56	2.63	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-3	7.00	22	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		SM		0	24	68	6	1	1	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	10.00	27	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	21-12-2021	to	21-12-2021	New Ch. 10+340 Silani Station	BH-PLT-08	4.03 m	12.00 m	711500.031 m	3124346.490 m	(+)194.158 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Loose/Very loose, Silty sand with gravles	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	0.75	-	-		SM-SC		5	40	42	11	2	0	0	26	19	7	-	1.79	15.66	1.55	2.63	DST	0.15	25	-	-	-	-	-	-	-	-
SPT-1	1.50	3	4		SM-SC		4	29	53	6	3	5	0	25	19	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	2.25	5	7		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	3.00	8	10		SM-SC		5	26	51	10	2	6	0	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	3.75	13	15		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.50	-	-		SM-SC		6	13	62	8	5	6	0	25	19	6	-	1.83	17.22	1.56	2.63	DST	0.19	26	-	-	-	-	-	-	-	-
SPT-5	6.00	26	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.50	-	-	Brown, Medium dense, Sandy silt with clay	ML-CL		5	47	19	22	5	2	0	24	18	6	-	1.88	17.96	1.59	2.64	DST	0.21	26	-	-	-	-	-	-	-	-
SPT-6	9.00	40	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	12.00	57	33		SM-SC		5	25	45	12	11	2	0	25	19	6	-	1.93	18.96	1.62	2.65	DST	0.22	27	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project		Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	05-10-2021	to	05-10-2021	9+200 Minor Bridge	BH-CL	1.25 m	10.00 m	711334.580 m	3124343.215 m	(+)194.672 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm³)	Natural Moisture Content (%)	Dry Density (g/cm³)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm²)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm²)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm²)	C_v x 10^{-4} (cm²/Sec)	M_v x 10^{-2} (cm²/Kg)	Compression Index (C_c)
DS	0.00	-	-	Grey, Medium stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		CL		12	64	18	2	3	1	0	33	22	11	-	1.86	28.41	1.45	2.68	UUT	0.23	5	-	-	-	-	-	-	-	-
SPT-1	2.50	6	6		CL		11	71	15	1	1	1	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-	Brown, Medium dense, Sandy silt of low plasticity	ML-CL		6	56	32	3	2	1	0	26	20	6	-	1.86	21.65	1.53	2.66	DST	0.22	23	-	-	-	-	-	-	-	-
SPT-2	5.50	14	16		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	7.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	7.45	20	19		ML-CL		7	61	23	4	3	2	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	8.50	25	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	10.00	-	-		ML-CL		6	59	24	6	2	3	0	26	19	7	-	1.87	20.78	1.55	2.66	DST	0.21	24	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	06-10-2021	to	06-10-2021	9+211 Minor Bridge	BH-CL	1.36 m	10.00 m	711325.206 m	3124342.307 m	(+)194.649 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Soft, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	7	7		CL		10	64	18	6	2	0	0	31	20	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		CL		11	65	16	4	3	1	0	32	21	11	-	1.86	29.10	1.44	2.68	UUT	0.15	5	-	-	-	-	-	-	-	-
SPT-2	4.00	11	14	Brown, Medium dense to dense, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		ML-CL		6	60	27	5	1	1	0	26	20	6	-	1.83	20.30	1.52	2.66	DST	0.21	23	-	-	-	-	-	-	-	-
SPT-3	7.00	17	17		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		ML-CL		7	54	30	6	2	1	0	27	20	7	-	1.88	19.24	1.58	2.66	DST	0.20	24	-	-	-	-	-	-	-	-
SPT-4	10.00	34	25		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		27-10-2021	to	27-10-2021	9+407 Minor Bridge	BH-CL	0.60 m	10.00 m	711125.831 m	3124322.695 m	(+)193.387 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Loose to medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		SM		0	14	78	7	1	0	0	-	Nil	NP	-	1.70	14.15	1.49	2.62	DST	0.00	28	-	-	-	-	-	-	-	-
SPT-1	2.50	7	11		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		SP-SM		0	12	80	6	1	1	0	-	Nil	NP	-	1.76	15.26	1.53	2.63	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-2	5.50	14	17		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		SM		0	17	72	6	3	2	0	-	Nil	NP	-	1.80	16.10	1.55	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	8.50	20	20	Brown, Very stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		CL		11	55	25	5	1	3	0	31	21	10	-	1.95	25.63	1.55	2.67	UUT	0.70	5	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	07-10-2021	to	08-10-2021	9+726 Major Bridge	BH-A1	0.85 m	30.00 m	710810.840 m	3124291.156 m	(+)194.097 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm³)	Natural Moisture Content (%)	Dry Density (g/cm³)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm²)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm²)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm²)	C_v x 10^{-4} (cm²/Sec)	M_v x 10^{-2} (cm²/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	4	8	Yellowish brown, Loose, Silty sand	SM		0	34	58	6	2	0	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		SM		0	28	65	5	1	1	0	-	Nil	NP	-	1.66	13.67	1.46	2.62	DST	0.00	27	-	-	-	-	-	-	-	-
SPT-2	4.00	20	22	Brown, Medium dense, Silty sand with clay	SM-SC		5	41	40	8	3	3	0	26	21	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		SM-SC		4	40	43	9	1	2	1	25	20	5	-	1.79	15.57	1.55	2.65	DST	0.11	27	-	-	-	-	-	-	-	-
SPT-3	7.00	22	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-	Brown, Dense, Sandy silt of low plasticity with gravel	ML-CL		7	55	25	6	2	5	0	27	20	7	-	1.92	19.74	1.60	2.66	DST	0.22	26	-	-	-	-	-	-	-	-
SPT-4	10.00	41	30		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-		ML-CL		6	52	27	3	4	7	1	26	20	6	-	1.92	20.10	1.60	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	13.00	48	31		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-		ML-CL		7	50	28	5	3	5	2	26	19	7	-	1.91	20.63	1.58	2.66	DST	0.18	26	-	-	-	-	-	-	-	-
SPT-6	16.00	33	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	17.50	-	-		ML-CL		8	51	29	5	1	6	0	28	21	7	-	1.91	20.80	1.58	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	19.00	33	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	20.50	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	52	20	7	3	6	0	33	22	11	-	2.00	23.40	1.62	2.68	UUT	1.32	5	-	-	-	0.655	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	7.75 6.33 5.65 5.01	1.71 1.23 0.84 0.54	0.113
SPT-8	22.00	39	39		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	23.50	-	-		CL		11	56	18	5	3	5	2	32	21	11	-	2.01	23.11	1.63	2.67	UUT	1.55	5	-	-	-	-	-	-	-	-
SPT-9	25.00	47	47		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	26.50	-	-		CL		12	51	22	6	2	7	0	34	23	11	-	2.00	22.90	1.63	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		07-10-2021	to	08-10-2021	9+726 Major Bridge	BH-A1	0.85 m	30.00 m	710810.840 m	3124291.156 m	(+)194.097 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-10	28.00	>100	-	Brown, Very dense, Silty sand with gravel	SM		0	32	57	8	2	1	0	-	Nil	NP	-	1.93	16.50	1.66	2.63	DST+	0.00	32	-	-	-	-	-	-	-	-
SPT-11	29.50	100 (21cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	30.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	28-10-2021	to	29-10-2021	9+726 Major Bridge	BH-A2	0.29 m	30.00 m	710802.664 m	3124290.194 m	(+)193.613 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS-1	0.00	-	-	Brown, Loose, Silty sand with clay	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	1.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.50	4	7		SM-SC		5	35	55	3	2	0	0	25	20	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	2.50	5	8		SM-SC		6	35	51	6	1	1	0	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	4.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	4.50	25	25	Brown, Medium dense, Silty sand with gravel	SM		0	14	75	7	1	3	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	5.50	27	25		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	7.00	-	-		SM		0	20	67	6	3	4	0	-	Nil	NP	-	1.83	15.80	1.58	2.62	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-5	8.50	30	25		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	10.00	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		11	53	25	5	1	5	0	32	21	11	-	1.98	23.76	1.60	2.67	UUT	1.06	6	-	-	-	-	-	-	-	-
SPT-6	11.50	31	31		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	13.00	-	-	Brown, Dense, Silty sand with clay & gravel	SM-SC		5	28	47	11	3	6	0	25	20	5	-	1.87	18.04	1.58	2.65	DST	0.11	29	-	-	-	-	-	-	-	-
SPT-7	14.50	37	25		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	16.00	-	-		SM-SC		5	30	51	7	1	5	1	26	19	7	-	1.87	18.10	1.58	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	17.50	37	24		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	19.00	-	-		SM-SC		4	33	48	6	2	7	0	25	20	5	-	1.87	17.90	1.59	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	20.50	40	24		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	22.00	-	-		SM-SC		6	30	51	6	2	5	0	26	20	6	-	1.87	17.87	1.59	2.65	DST	0.09	30	-	-	-	-	-	-	-	-
SPT-10	23.50	45	25		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	25.00	-	-		SM-SC		6	24	55	5	3	7	0	26	20	6	-	1.89	18.10	1.60	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		28-10-2021	to	29-10-2021	9+726 Major Bridge	BH-A2	0.29 m	30.00 m	710802.664 m	3124290.194 m	(+)193.613 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
SPT-11	26.50	58	58	Brown, Hard, Silty clay of low plasticity with gravel	CL		10	44	26	9	2	9	0	30	20	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	28.00	-	-		CL		11	49	21	7	1	11	0	32	22	10	-	2.03	22.06	1.66	2.68	UUT	2.00	6	-	-	-	-	-	-	-	-
SPT-12	29.50	69	69		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	29.95	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	10-11-2021	to	10-11-2021	9+772 Minor Bridge	BH-CL	0.60 m	12.00 m	710762.491 m	3124285.182 m	(+)193.598 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ^0)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Loose to medium dense, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	0.50	4	7		ML-CL		7	55	30	6	1	1	0	27	20	7	-	1.74	19.00	1.46	2.66	DST+	0.21	22	-	-	-	-	-	-	-	-
SPT-2	1.50	5	8		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.25	-	-		ML-CL		6	46	33	6	1	8	0	26	20	6	-	1.84	19.23	1.54	2.66	DST	0.20	24	-	-	-	-	-	-	-	-
SPT-3	3.00	14	17		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	4.50	17	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.25	-	-	Brown, Medium dense to dense, Silty sand with clay & gravel	SM-SC		5	33	51	6	2	3	0	25	20	5	-	1.84	18.52	1.55	2.65	DST	0.10	27	-	-	-	-	-	-	-	-
SPT-5	6.00	16	17		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	7.50	27	23		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.25	-	-		SM-SC		6	32	50	5	2	5	0	26	20	6	-	1.89	19.03	1.59	2.65	DST	0.09	28	-	-	-	-	-	-	-	-
SPT-7	9.00	36	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	10.50	40	28		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.25	-	-		SM-SC		6	30	48	6	4	6	0	26	20	6	-	1.91	19.20	1.60	2.66	DST	0.11	29	-	-	-	-	-	-	-	-
SPT-9	12.00	44	29		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		05-10-2021	to	06-10-2021	10+025 Minor Bridge	BH-A1	1.34 m	30.00 m	710515.298 m	3124244.432 m	(+)194.595 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	10	16	Yellowish brown, Loose, Sandy silt of low plasticity	ML-CL		7	55	33	3	2	0	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		ML-CL		6	55	32	4	2	1	0	26	20	6	-	1.80	18.34	1.52	2.66	DST	0.20	25	-	-	-	-	-	-	-	-
SPT-2	4.00	17	18		SM-SC		5	16	74	3	1	1	0	25	20	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-	Yellowish brown, Medium dense, Silty sand with clay & gravel	SM-SC		4	24	65	3	2	2	0	25	20	5	-	1.82	17.10	1.55	2.65	DST	0.10	28	-	-	-	-	-	-	-	-
SPT-3	7.00	23	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		ML-CL		6	48	37	6	1	2	0	26	20	6	-	1.86	19.70	1.55	2.66	DST	0.22	26	-	-	-	-	-	-	-	-
SPT-4	10.00	20	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-	Yellowish brown, Medium dense, Sandy silt of low plasticity	ML-CL		8	49	32	7	2	2	0	28	21	7	-	1.86	20.10	1.55	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	13.00	27	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-		ML-CL		7	51	31	5	3	3	0	27	20	7	-	1.86	20.16	1.55	2.66	DST	0.19	27	-	-	-	-	-	-	-	-
SPT-6	16.00	31	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	17.50	-	-		CL		10	56	22	6	1	5	0	31	21	10	-	2.03	22.36	1.66	2.68	UUT	2.02	5	-	-	-	0.615	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	8.65 5.67 4.93 4.28	1.25 0.94 0.60 0.42	0.086
SPT-7	19.00	64	64		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	20.50	-	-		CL		11	54	20	5	4	6	0	32	21	11	-	2.04	22.60	1.66	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	22.00	62	62	Yellowish brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	23.50	-	-		CL		12	49	26	5	1	7	0	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	25.00	33	33		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	26.50	-	-		CL		11	54	21	6	1	5	2	31	20	11	-	2.03	23.16	1.65	2.67	UUT	1.82	5	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project		Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	05-10-2021	to	06-10-2021	10+025 Minor Bridge	BH-A1	1.34 m	30.00 m	710515.298 m	3124244.432 m	(+)194.595 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand Fine	Sand Medium	Sand Coarse	Gravel Fine	Gravel Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-10	28.00	55	55	Yellowish brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-10	29.50	-	-		CL		10	53	23	3	5	6	0	30	20	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	29.95	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		05-10-2021	to	06-10-2021	10+025 Minor Bridge	BH-A2	1.22 m	30.00 m	710507.526 m	3124242.990 m	(+)194.589 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS-1	0.00	-	-	Yellowish brown, Medium dense, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		ML-CL		7	53	32	4	3	1	0	27	20	7	-	1.73	13.26	1.53	2.66	DST	0.22	26	-	-	-	-	-	-	-	-
SPT-1	2.50	13	17		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-	Yellowish brown, Medium dense to dense, Silty sand with clay & gravel	SM-SC		5	19	65	6	2	3	0	26	21	5	-	1.84	16.23	1.58	2.65	DST	0.09	29	-	-	-	-	-	-	-	-
SPT-2	5.50	27	24		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	7.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	7.50	32	25		SM-SC		4	26	63	2	1	4	0	25	20	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	8.50	43	31		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	10.00	-	-	Yellowish brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		7	51	30	2	3	7	0	27	20	7	-	1.91	19.63	1.60	2.66	DST	0.23	27	-	-	-	-	-	-	-	-
SPT-5	11.50	55	35		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	13.00	-	-		ML-CL		6	49	31	5	3	6	0	26	20	6	-	1.92	20.10	1.60	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	14.50	54	32		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	16.00	-	-		ML-CL		8	51	28	3	4	5	1	28	21	7	-	1.92	19.80	1.60	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	17.50	59	32		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	19.00	-	-	Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL		11	57	20	4	1	7	0	31	21	10	-	2.03	21.41	1.67	2.68	UUT	2.05	4	-	-	-	-	-	-	-	-
SPT-8	20.50	62	62		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	22.00	-	-		CL		12	53	19	5	3	8	0	33	22	11	-	2.03	21.60	1.67	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	23.50	67	67				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	25.00	-	-		CL		11	49	22	7	3	6	2	32	21	11	-	2.03	21.62	1.67	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	05-10-2021	to	06-10-2021	10+025 Minor Bridge	BH-A2	1.22 m	30.00 m	710507.526 m	3124242.990 m	(+)194.589 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
SPT-10	26.50	63	63	Yellowish brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	28.00	-	-		CL		11	53	21	6	4	5	0	34	22	12	-	2.03	21.13	1.68	2.68	UUT	2.31	4	-	-	-	-	-	-	-	-
SPT-11	29.50	72	72		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	29.95	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	29-10-2021	to	29-10-2021	10+223 Minor Bridge	BH-CL	3.50 m	10.00 m	710317.973 m	3124207.834 m	(+)194.116 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Loose, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	0.50	4	7		ML-CL		6	52	35	6	1	0	0	26	20	6	-	1.65	12.50	1.47	2.66	DST+	0.18	23	-	-	-	-	-	-	-	-
SPT-2	1.50	7	10		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.25	-	-	Brown, Medium dense, Sandy silt of low plasticity	ML-CL		7	54	31	4	3	1	0	27	20	7	-	1.77	15.64	1.53	2.66	DST	0.20	24	-	-	-	-	-	-	-	-
SPT-3	3.00	11	13		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	4.50	22	20		ML-CL		8	55	28	6	1	2	0	28	21	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.25	-	-		ML-CL		7	51	30	7	2	3	0	27	20	7	-	1.85	19.40	1.55	2.66	DST	0.19	25	-	-	-	-	-	-	-	-
SPT-5	6.00	27	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	7.50	22	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.25	-	-	Brown, Medium dense, Silty sand with clay	SM-SC		5	35	50	6	1	3	0	25	20	5	-	1.84	18.46	1.55	2.65	DST	0.10	27	-	-	-	-	-	-	-	-
SPT-7	9.00	24	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	10.00	28	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		29-10-2021	to	29-10-2021	10+519 Minor Bridge	BH-CL	4.50 m	10.00 m	710023.336 m	3124153.189 m	(+)194.584 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	0.50	5	9		ML-CL		5	50	38	6	1	0	0	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	1.50	10	15	Brown, Loose to medium dense, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.25	-	-		ML-CL		6	54	32	4	2	2	0	26	20	6	-	1.78	14.16	1.56	2.66	DST	0.21	24	-	-	-	-	-	-	-	-
SPT-3	3.00	18	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	4.50	34	39		SM-SC		6	30	53	7	1	3	0	25	19	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.25	-	-		SM-SC		4	22	62	6	2	4	0	25	20	5	-	1.87	16.12	1.61	2.65	DST	0.20	26	-	-	-	-	-	-	-	-
SPT-5	6.00	46	33		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	7.50	47	32	Brown, Dense to very dense, Silty sand with clay & gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.25	-	-		SM-SC		5	18	60	9	3	5	0	26	21	5	-	1.88	16.80	1.61	2.65	DST	0.19	27	-	-	-	-	-	-	-	-
SPT-7	9.00	51	33		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	10.00	51	32		SM-SC		5	16	65	7	1	6	0	25	20	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	29-10-2021	to	29-10-2021	10+658 Minor Bridge	BH-CL	3.20 m	10.00 m	709890.704 m	3124128.590 m	(+)194.898 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand Fine	Sand Medium	Sand Coarse	Gravel Fine	Gravel Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Loose, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	0.50	5	9		ML-CL		7	55	30	7	1	0	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	1.50	7	10		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.25	-	-		ML-CL		8	53	31	5	2	1	0	28	21	7	-	1.74	17.40	1.48	2.66	DST	0.19	24	-	-	-	-	-	-	-	-
SPT-3	3.00	10	10	Brown, Stiff to very stiff, Silty clay of low plasticity	CL		10	53	29	6	1	1	0	31	21	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	4.50	16	16		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.25	-	-	Brown, Medium dense, Silty sand with clay	SM-SC		5	33	53	4	2	3	0	25	20	5	-	1.81	16.85	1.55	2.65	DST	0.10	27	-	-	-	-	-	-	-	-
SPT-5	6.00	22	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	7.50	25	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.25	-	-	Brown, Dense, Silty sand	SM		0	21	68	6	1	4	0	-	Nil	NP	-	1.81	16.13	1.56	2.62	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-7	9.00	30	23		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	10.00	35	25		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	29-10-2021	to	29-10-2021	10+718 Minor Bridge	BH-CL	2.50 m	10.00 m	709831.671 m	3124117.642 m	(+)193.997 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand Fine	Sand Medium	Sand Coarse	Gravel Fine	Gravel Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	0.50	12	22		SM		0	18	76	6	0	0	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	1.50	28	41		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.25	-	-	Brown, Loose, Silty sand with clay	SM-SC		5	36	50	7	1	1	0	25	20	5	-	1.72	16.23	1.48	2.65	DST	0.10	26	-	-	-	-	-	-	-	-
SPT-3	3.00	7	9		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	4.50	8	10		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.25	-	-	Brown, Medium dense, Silty sand with clay	SM-SC		6	32	51	6	2	3	0	26	20	6	-	1.83	18.10	1.55	2.65	DST	0.11	27	-	-	-	-	-	-	-	-
SPT-5	6.00	20	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	7.50	26	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.25	-	-	Brown, Medium dense, Sandy silt of low plasticity	ML-CL		8	52	30	5	2	3	0	28	21	7	-	1.87	20.64	1.55	2.66	DST	0.18	25	-	-	-	-	-	-	-	-
SPT-7	9.00	25	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	10.00	29	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	29-10-2021	to	29-10-2021	10+749 Minor Bridge	BH-CL	2.60 m	10.00 m	709801.215 m	3124111.993 m	(+)194.893 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	0.50	11	20		SM		0	16	76	7	1	0	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	1.50	18	26	Brown, Medium dense, Sandy silt of low plasticity	ML-CL		7	53	33	4	2	1	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.25	-	-		ML-CL		8	53	30	6	1	2	0	28	21	7	-	1.79	15.41	1.55	2.66	DST	0.21	24	-	-	-	-	-	-	-	-
SPT-3	3.00	19	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	4.50	18	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.25	-	-	Brown, Medium dense, Silty sand	SP-SM		0	12	78	6	1	2	1	-	Nil	NP	-	1.79	16.20	1.54	2.63	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-5	6.00	18	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	7.50	22	19		SM		0	22	68	4	3	3	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.25	-	-	Brown, Medium dense, Sandy silt of low plasticity	ML-CL		6	51	31	7	1	4	0	26	20	6	-	1.86	19.74	1.55	2.66	DST	0.20	25	-	-	-	-	-	-	-	-
SPT-7	9.00	21	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	10.00	25	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		08-10-2021	to	10-10-2021	10+859 Major Bridge	BH-A1_(R)	2.99 m	40.00 m	709761.805 m	3124103.149 m	(+)195.206 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm³)	Natural Moisture Content (%)	Dry Density (g/cm³)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm²)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm²)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm²)	C_v x 10^{-4} (cm²/Sec)	M_v x 10^{-2} (cm²/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Loose to medium dense, Silty sand with clay	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	5	8		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		SM-SC		4	43	44	5	2	2	0	25	20	5	-	1.69	14.11	1.48	2.65	DST	0.11	25	-	-	-	-	-	-	-	-
SPT-2	4.00	10	12		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		SM-SC		5	32	50	9	3	1	0	26	21	5	-	1.77	16.24	1.52	2.64	DST	0.09	26	-	-	-	-	-	-	-	-
SPT-3	7.00	13	14		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	8.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	9.00	16	16		SM-SC		5	32	54	4	3	2	0	25	20	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	10.00	19	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	11.50	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	55	19	9	2	3	0	33	22	11	-	1.98	23.77	1.60	2.68	UUT	1.06	5	-	-	-	0.675	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	9.49 7.58 6.11 4.58	2.05 1.40 0.96 0.58	0.123
SPT-6	13.00	31	31		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	14.50	-	-		CL		10	66	19	1	2	2	0	30	20	10	-	1.99	23.48	1.61	2.67	UUT	1.23	5	-	-	-	-	-	-	-	-
SPT-7	16.00	36	36		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	17.50	-	-		CL		11	55	21	5	3	4	1	32	21	11	-	2.01	22.69	1.64	2.68	UUT	1.62	4	-	-	-	-	-	-	-	-
SPT-8	19.00	49	49		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	20.50	-	-		CL		11	56	22	4	2	5	0	31	20	11	-	2.03	21.07	1.68	2.67	UUT	2.40	4	-	-	-	-	-	-	-	-
SPT-9	22.00	66	66		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	23.50	75	75		CL		12	54	18	5	4	7	0	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	25.00	91	91		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	08-10-2021	to	10-10-2021	10+859 Major Bridge	BH-A1_(R)	2.99 m	40.00 m	709761.805 m	3124103.149 m	(+)195.206 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm³)	Natural Moisture Content (%)	Dry Density (g/cm³)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm²)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm²)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm²)	C_v x 10^{-4} (cm²/Sec)	M_v x 10^{-2} (cm²/Kg)	Compression Index (C_c)
SPT-12	26.50	100 (23cm)	100 (23cm)	Brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	28.00	61	28	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		8	49	31	5	1	6	0	28	21	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	29.50	100 (26cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	31.00	100 (29cm)	-		ML-CL		6	51	29	4	4	6	0	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	32.50	100 (25cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-17	34.00	100 (22cm)	-		ML-CL		7	48	30	5	3	7	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-18	35.50	100 (20cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-19	37.00	96	34		ML-CL		7	48	27	7	2	9	0	26	19	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-20	38.50	100 (20cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-21	40.00	100 (23cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		06-10-2021	to	07-10-2021	10+859 Major Bridge	BH-A1	2.95 m	40.00 m	709723.114 m	3124097.508 m	(+)194.772 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Loose, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		SM		0	19	73	6	2	0	0	-	Nil	NP	-	1.69	12.84	1.50	2.62	DST	0.00	28	-	-	-	-	-	-	-	-
SPT-1	2.25	9	12		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	4.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	4.50	13	15	Brown, Medium dense, Silty sand with clay	SM-SC		4	36	53	4	2	1	0	25	20	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	5.50	13	15		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	7.00	-	-		SM-SC		5	37	56	2	0	0	0	26	21	5	-	1.77	16.38	1.52	2.65	DST	0.08	27	-	-	-	-	-	-	-	-
SPT-4	8.50	13	14		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	10.00	-	-	Brown, Very stiff to hard, Silty clay of low plasticity with gravel	CL		11	57	21	4	3	4	0	31	20	11	-	1.99	24.11	1.60	2.68	UUT	1.02	5	-	-	-	-	-	-	-	-
SPT-5	11.50	31	31		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	13.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	13.50	26	26		CL		10	58	23	5	1	3	0	30	20	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	14.50	34	34		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	16.00	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		11	52	24	7	0	6	0	33	22	11	-	2.04	20.84	1.69	2.68	UUT	2.61	5	-	-	-	0.585	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	15.37 9.45 6.93 5.25	1.27 0.83 0.45 0.33	0.066
SPT-8	17.50	84	84		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	19.00	-	-		CL		12	50	22	4	3	9	0	34	23	11	-	2.04	20.90	1.69	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	20.50	84	84		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	22.00	100 (20cm)	100 (20cm)		CL		10	50	26	5	2	7	0	31	20	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	23.50	100 (27cm)	100 (27cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		06-10-2021	to	07-10-2021	10+859 Major Bridge	BH-A1	2.95 m	40.00 m	709723.114 m	3124097.508 m	(+)194.772 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-12	25.00	92	92	Brown, Hard, Silty clay of low plasticity with gravel	CL		11	51	21	3	4	8	2	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	26.50	59	59		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	28.00	-	-		CL		11	49	19	7	3	11	0	31	20	11	-	2.05	20.38	1.70	2.67	UUT	2.80	4	-	-	-	-	-	-	-	-
SPT-14	29.50	90	90		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	31.00	-	-	Brown, Very dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	31.50	97	37		ML-CL		7	49	33	2	0	9	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	32.50	89	34		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	34.00	-	-		ML-CL		6	51	30	4	2	7	0	26	20	6	-	1.97	19.24	1.65	2.66	DST	0.18	30	-	-	-	-	-	-	-	-
SPT-17	35.50	100 (28cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-18	37.00	100 (24cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-19	38.50	95 (23cm)	-		ML-CL		7	47	26	5	4	11	0	28	21	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-20	40.00	100 (21cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	06-10-2021	to	09-10-2021	10+859 Major Bridge	BH-P1	3.35 m	40.00 m	709681.945 m	3124089.603 m	(+)195.316 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	$C_v \times 10^{-4}$ (cm^2/Sec)	$M_v \times 10^{-2}$ (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Filled up strata	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	31	49		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		SM		0	22	75	2	1	0	0	-	Nil	NP	-	1.70	13.34	1.50	2.62	DST	0.00	28	-	-	-	-	-	-	-	-
SPT-2	4.00	10	12		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	5.50	-	-		SM		0	24	68	4	3	1	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	6.00	13	15	Brown, Loose to medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	7.00	19	18		SM		0	23	65	6	4	2	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	8.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	9.00	25	21		SM		0	23	70	3	2	2	0	0	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	10.00	21	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	11.50	-	-		CL		11	59	18	5	2	5	0	32	21	11	-	1.99	24.15	1.60	2.68	UUT	1.06	5	-	-	-	-	-	-	-	-
SPT-7	13.00	31	31		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	14.50	-	-		CL		12	55	22	3	4	3	1	33	22	11	-	1.99	24.40	1.60	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	16.00	32	32		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	17.50	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		10	53	26	4	3	4	0	30	20	10	-	1.99	23.74	1.61	2.67	UUT	1.16	5	-	-	-	-	-	-	-	-
SPT-9	19.00	34	34		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	20.50	-	-		CL		11	54	20	7	2	6	0	32	21	11	-	2.01	22.61	1.64	2.68	UUT	1.65	4	-	-	-	-	-	-	-	-
SPT-10	22.00	49	49		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	23.50	-	-		CL		12	52	22	6	1	4	3	33	22	11	-	2.01	22.44	1.64	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	06-10-2021	to	09-10-2021	10+859 Major Bridge	BH-P1	3.35 m	40.00 m	709681.945 m	3124089.603 m	(+)195.316 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-11	25.00	54	54	Brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	26.50	-	-		CL		11	50	24	7	3	4	1	33	22	11	-	2.00	23.40	1.62	2.68	UUT	1.34	5	-	-	-	-	-	-	-	-
SPT-12	28.00	41	41		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	29.50	-	-	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		8	49	28	5	2	8	0	28	21	7	-	1.96	19.26	1.64	2.66	DST	0.19	29	-	-	-	-	-	-	-	-
SPT-13	31.00	75	31		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	32.50	95	37		ML-CL		6	49	30	7	1	7	0	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	34.00	100 (21cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	35.50	85	32		ML-CL		7	49	27	4	3	10	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-17	37.00	93	34		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-18	38.50	99	35		ML-CL		7	49	29	3	4	7	1	26	19	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-19	40.00	100 (25cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Date of Boring	18-11-2021 to 21-11-2021
Chainage (km.)/Location	10+859 Major Bridge
B.H. No.	BH-A2
Depth of Water Table	5.60 m
Termination Depth	40.00 m
Cordinates (E,N)	709602.681 m, 3124072.923 m
R.L.	(+)195.247 m
Ref. Code	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		SM		0	19	78	2	1	0	0	-	Nil	NP	-	1.67	12.60	1.48	2.62	DST	0.00	28	-	-	-	-	-	-	-	-
SPT-1	2.50	8	10		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		SM		0	18	75	4	2	1	0	-	Nil	NP	-	1.69	12.96	1.50	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	5.50	11	11	Brown, Loose to medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		SM		0	16	75	6	1	2	0	-	Nil	NP	-	1.71	13.74	1.50	2.63	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-3	8.50	14	13		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		SM		0	20	73	4	2	1	0	-	Nil	NP	-	1.71	14.60	1.49	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	11.50	12	11		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-	Brown, Medium dense, Silty sand with clay	SM-SC		4	36	50	5	3	2	0	25	20	5	-	1.79	17.69	1.52	2.65	DST	0.11	27	-	-	-	-	-	-	-	-
SPT-5	14.50	21	16		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	16.00	-	-		CL		12	54	21	4	3	6	0	33	22	11	-	2.01	22.10	1.65	2.67	UUT	1.88	5	-	-	-	-	-	-	-	-
SPT-6	17.50	57	57		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	19.00	-	-		CL		11	59	19	3	2	5	1	32	21	11	-	2.01	22.60	1.64	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	20.50	44	44		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	22.00	-	-	Brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	22.45	57	57		CL		12	53	23	3	2	7	0	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	23.50	64	64		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	25.00	68	68		CL		13	48	22	5	3	9	0	34	23	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	26.50	75	75		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	18-11-2021	to	21-11-2021	10+859 Major Bridge	BH-A2	5.60 m	40.00 m	709602.681 m	3124072.923 m	(+)195.247 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-12	28.00	72	72	Brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	29.50	78	32	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		8	49	28	5	2	8	0	28	21	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	31.00	84	33		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	32.50	81	31		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	34.00	87	33		ML-CL		8	44	31	4	3	10	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-17	35.50	93	34		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-18	37.00	96	34		ML-CL		7	45	30	5	4	8	1	26	19	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-19	38.50	100	34		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-20	40.00	100 (28cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		13-11-2021	to	13-11-2021	17+625 Major Bridge	BH-A1	3.00 m	30.00 m	704882.319 m	3119823.851 m	(+)191.597 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS-1	0.00	-	-	Yellowish brown, Very loose, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		ML-CL		6	48	38	6	1	1	0	26	20	6	-	1.66	15.11	1.44	2.66	DST	0.19	24	-	-	-	-	-	-	-	-
SPT-1	2.50	3	4		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-	Yellowish brown, Medium, Sandy silt of low plasticity	ML-CL		7	53	32	5	1	2	0	26	20	6	-	1.79	18.40	1.51	2.67	DST	0.20	25	-	-	-	-	-	-	-	-
SPT-2	5.50	12	14		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		ML-CL		7	54	30	6	2	1	0	27	20	7	-	1.80	19.10	1.51	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	8.50	14	15		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		ML-CL		6	49	31	9	3	2	0	26	20	6	-	1.80	19.18	1.51	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	11.50	13	12		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-	Yellowish brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		6	53	28	5	1	7	0	26	20	6	-	1.90	18.79	1.60	2.66	DST	0.19	28	-	-	-	-	-	-	-	-
SPT-5	14.50	59	34		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	16.00	-	-		ML-CL		7	45	29	8	3	6	2	27	20	7	-	1.90	18.95	1.60	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	17.50	52	29		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	19.00	-	-	Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL		10	51	23	6	1	9	0	32	21	11	-	2.04	21.46	1.68	2.68	UUT	2.41	5	-	-	-	0.595	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	8.66 7.05 5.34 4.14	1.26 0.95 0.58 0.41	0.0830
SPT-7	20.50	71	71		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	22.00	76	76		CL		12	43	25	4	6	8	2	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	23.50	82	82		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	25.00	-	-		CL		11	45	26	5	2	11	0	32	21	11	-	2.02	22.57	1.65	2.67	UUT	1.76	6	-	-	-	-	-	-	-	-
SPT-10	26.50	55	55		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	13-11-2021	to	13-11-2021	17+625 Major Bridge	BH-A1	3.00 m	30.00 m	704882.319 m	3119823.851 m	(+)191.597 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
UDS-9	28.00	-	-	Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL		12	44	25	8	1	10	0	33	22	11	-	2.04	22.41	1.67	2.68	UUT	2.05	5	-	-	-	-	-	-	-	-
SPT-11	29.50	64	64		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	30.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	13-11-2021	to	14-11-2021	17+625 Major Bridge	BH-A2	3.05 m	30.00 m	704873.896 m	3119805.101 m	(+)191.814 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm³)	Natural Moisture Content (%)	Dry Density (g/cm³)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm²)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm²)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm²)	C_v x 10^{-4} (cm²/Sec)	M_v x 10^{-2} (cm²/Kg)	Compression Index (C_c)
DS-1	0.00	-	-	Yellowish brown, Loose to medium dense, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	9	14		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		ML-CL		6	53	33	6	1	1	0	27	20	7	-	1.74	15.37	1.51	2.66	DST	0.21	25	-	-	-	-	-	-	-	-
SPT-2	4.00	12	14		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-	Yellowish brown, Medium dense to very dense, Sandy silt of low plasticity with gravel	ML-CL		8	48	33	6	2	3	0	28	21	7	-	1.83	18.64	1.54	2.67	DST	0.22	27	-	-	-	-	-	-	-	-
SPT-3	7.00	20	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		ML-CL		7	51	30	4	3	5	0	27	20	7	-	1.88	19.10	1.58	2.66	DST	0.21	27	-	-	-	-	-	-	-	-
SPT-4	10.00	36	25		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-		ML-CL		7	45	31	6	4	7	0	27	21	6	-	1.90	19.78	1.59	2.66	DST	0.21	28	-	-	-	-	-	-	-	-
SPT-5	13.00	45	28		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-		ML-CL		6	48	27	11	1	6	1	26	20	6	-	1.91	19.60	1.60	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	16.00	46	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	17.50	-	-		ML-CL		7	48	28	9	1	7	0	26	19	7	-	1.91	19.14	1.60	2.67	DST	0.18	29	-	-	-	-	-	-	-	-
SPT-7	19.00	52	28		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	20.50	-	-		ML-CL		8	47	27	7	3	8	0	28	21	7	-	1.91	19.30	1.60	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	22.00	49	26		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	23.50	-	-	Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL		10	51	24	6	1	8	0	30	20	10	-	2.03	21.74	1.67	2.68	UUT	2.21	5	-	-	-	-	-	-	-	-
SPT-9	25.00	69	69		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	26.50	-	-		CL		12	42	26	5	3	12	0	32	21	11	-	2.04	20.80	1.69	2.67	UUT	2.58	6	-	-	-	-	-	-	-	-
SPT-10	28.00	83	83		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		13-11-2021	to	14-11-2021	17+625 Major Bridge	BH-A2	3.05 m	30.00 m	704873.896 m	3119805.101 m	(+)191.814 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
SPT-11	29.50	92	92	Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL		11	45	25	7	2	10	0	31	20	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	30.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		08-10-2021	to	09-10-2021	17+872 Major Bridge	BH-A1	0.95 m	30.00 m	704759.612 m	3119597.349 m	(+)191.318 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS-1	0.00	-	-	Brownish grey, Medium stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	5	5		CL		12	64	18	3	2	1	0	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		CL		11	70	15	2	1	1	0	32	21	11	-	1.87	28.13	1.46	2.68	UUT	0.26	5	-	-	-	0.835	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	7.01 5.71 5.04 4.40	2.54 1.90 1.20 0.78	0.1760
SPT-2	4.00	8	8		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-	Brownish grey, Medium dense to dense, Sandy silt of low plasticity with gravel	ML-CL		7	52	33	5	2	1	0	26	19	7	-	1.88	21.40	1.55	2.66	DST	0.21	25	-	-	-	-	-	-	-	-
SPT-3	7.00	22	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		ML-CL		6	55	30	5	1	2	1	27	21	6	-	1.89	21.28	1.56	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	10.00	30	23		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-		ML-CL		7	54	28	3	4	4	0	27	20	7	-	1.91	20.98	1.58	2.66	DST	0.19	26	-	-	-	-	-	-	-	-
SPT-5	13.00	39	26		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-		ML-CL		8	50	31	4	2	5	0	28	21	7	-	1.92	20.56	1.59	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	16.00	42	26		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	17.50	-	-	Brownish grey, Hard, Silty clay of low plasticity with gravel	CL		12	56	15	6	4	7	0	33	22	11	-	2.06	21.30	1.70	2.67	UUT	3.16	4	-	-	-	-	-	-	-	-
SPT-7	19.00	100 (23cm)	100 (23cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	20.50	100 (21cm)	100 (21cm)		CL		11	53	20	3	4	9	0	31	21	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	22.00	100 (20cm)	100 (20cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	23.50	100 (26cm)	100 (26cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	25.00	100 (24cm)	100 (24cm)		CL		12	56	17	4	3	6	2	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	26.50	100 (28cm)	100 (28cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project		Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	08-10-2021	to	09-10-2021	17+872 Major Bridge	BH-A1	0.95 m	30.00 m	704759.612 m	3119597.349 m	(+)191.318 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
SPT-13	28.00	100 (26cm)	100 (26cm)	Brownish grey, Hard, Silty clay of low plasticity with gravel	CL		10	51	19	7	3	10	0	30	20	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	29.50	>100	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	29.80	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		08-10-2021	to	09-10-2021	17+872 Major Bridge	BH-A2	1.00 m	30.00 m	704753.576 m	3119588.153 m	(+)191.150 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS-1	0.00	-	-	Brownish grey, Very stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		CL		14	61	18	4	1	1	1	34	23	11	-	1.92	26.43	1.52	2.68	UUT	0.56	5	-	-	-	-	-	-	-	-
SPT-1	2.50	16	16		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		CL		12	56	22	5	2	3	0	33	22	11	-	1.96	25.38	1.56	2.67	UUT	0.75	4	-	-	-	-	-	-	-	-
SPT-2	5.50	22	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-	Brownish grey, Medium dense to dense, Sandy silt of low plasticity with gravel	ML-CL		8	50	30	2	8	2	0	28	21	7	-	1.88	21.34	1.55	2.66	DST	0.21	25	-	-	-	-	-	-	-	-
SPT-3	8.50	20	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		ML-CL		7	55	24	2	9	3	0	27	20	7	-	1.88	21.25	1.55	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	11.50	26	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-		ML-CL		8	54	28	4	2	4	0	28	21	7	-	1.91	20.76	1.58	2.66	DST	0.22	26	-	-	-	-	-	-	-	-
SPT-5	14.50	38	25		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	16.00	-	-	Brownish grey, Hard, Silty clay of low plasticity with gravel	CL		11	56	21	5	1	6	0	32	21	11	-	2.03	22.16	1.66	2.68	UUT	2.02	5	-	-	-	-	-	-	-	-
SPT-6	17.50	63	63		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	19.00	-	-		CL		13	46	20	7	4	10	0	34	23	11	-	2.05	20.60	1.70	2.68	UUT	3.15	4	-	-	-	-	-	-	-	-
SPT-7	20.50	100 (30cm)	100 (30cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	22.00	100 (23cm)	100 (23cm)		CL		12	59	19	2	0	8	0	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	23.50	100 (20cm)	100 (20cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	25.00	100 (26cm)	100 (26cm)		CL		11	52	21	2	5	7	2	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	26.50	100 (25cm)	100 (25cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	08-10-2021	to	09-10-2021	17+872 Major Bridge	BH-A2	1.00 m	30.00 m	704753.576 m	3119588.153 m	(+)191.150 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-12	28.00	100 (24cm)	100 (24cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	29.50	100 (27cm)	100 (27cm)	Brownish grey, Hard, Silty clay of low plasticity with gravel	CL		12	50	23	3	2	10	0	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	29.92	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	20-12-2021	to	20-12-2021	New Ch. 19+010 IMT Sohna Station	BH-PLT-07	0.60 m	12.00 m	704417.312 m	3119187.740 m	(+)190.138 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Medium, Blackish, Silty clay with low Plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	0.75	-	-		CL		8	64	19	6	3	0	0	32	21	11	-	1.80	21.42	1.48	2.68	UUT	0.19	7	-	-	-	-	-	-	-	-
SPT-1	1.50	5	5		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	2.25	10	15		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	3.00	16	19	Medium Dense, Brownish Sandy Silt	ML-CL		6	59	19	12	4	0	0	25	19	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	3.75	22	23		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.50	-	-		ML-CL		7	51	19	15	8	0	0	25	19	6	-	1.82	17.25	1.55	2.65	DST	0.12	23	-	-	-	-	-	-	-	-
SPT-5	6.00	30	26		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.50	-	-		ML-CL		8	67	14	11	0	0	0	24	18	6	-	1.85	18.45	1.56	2.65	DST	0.16	24	-	-	-	-	-	-	-	-
SPT-6	9.00	38	28		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.50	-	-		ML-CL		6	46	19	22	5	2	0	23	18	5	-	1.89	19.68	1.58	2.65	DST	0.18	26	-	-	-	-	-	-	-	-
SPT-7	12.00	51	33		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		14-11-2021	to	15-11-2021	18+750 Major Bridge	BH-A1	1.22 m	30.00 m	704113.173 m	3119029.392 m	(+)190.420 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS-1	0.00	-	-	Yellowish brown, Medium stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	7	7		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		CL		12	62	20	5	1	0	0	33	22	11	-	1.88	28.76	1.46	2.68	UUT	0.25	5	-	-	-	-	-	-	-	-
SPT-2	4.00	24	23	Yellowish brown, Medium dense, Silty sand	SM		0	25	68	3	2	2	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		SM		0	23	66	7	1	2	1	-	Nil	NP	-	1.84	16.34	1.58	2.62	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-3	7.00	29	24		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-	Yellowish brown, Stiff, Silty clay of low plasticity	CL		12	49	28	8	1	2	0	33	22	11	-	1.92	26.22	1.52	2.67	UUT	0.49	5	-	-	-	-	-	-	-	-
SPT-4	10.00	14	14		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-		CL		10	50	27	6	4	3	0	30	20	10	-	1.92	26.14	1.52	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	13.00	66	38	Yellowish brown, Very dense, Silty sand with clay	SM-SC		5	36	47	5	3	4	0	25	20	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-	Yellowish brown, Very stiff to hard, Silty clay of low plasticity with gravel	CL		11	51	25	3	5	5	0	31	20	11	-	1.98	23.16	1.61	2.68	UUT	1.15	6	-	-	-	-	-	-	-	-
SPT-6	16.00	35	35		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	17.50	-	-		CL		11	53	23	6	1	6	0	31	21	10	-	1.98	22.89	1.61	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	19.00	37	37		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	20.50	-	-		CL		12	47	24	3	6	6	2	32	21	11	-	1.99	21.78	1.63	2.67	UUT	1.52	5	-	-	-	-	-	-	-	-
SPT-8	22.00	46	46		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	23.50	-	-		CL		10	51	25	4	2	8	0	31	21	10	-	2.01	20.46	1.67	2.68	UUT	2.03	6	-	-	-	0.605	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	8.60 6.39 5.27 4.07	1.64 0.95 0.77 0.42	0.0860
SPT-9	25.00	65	65		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	26.50	-	-		CL		12	46	26	4	1	11	0	32	21	11	-	2.03	20.10	1.69	2.69	UUT	2.52	5	-	-	-	-	-	-	-	-
SPT-10	28.00	78	78		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		14-11-2021	to	15-11-2021	18+750 Major Bridge	BH-A1	1.22 m	30.00 m	704113.173 m	3119029.392 m	(+)190.420 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
SPT-11	29.50	84	84	Yellowish brown, Very stiff to hard, Silty clay of low plasticity with gravel	CL		11	45	24	8	2	10	0	31	20	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	30.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	14-11-2021	to	15-11-2021	18+750 Major Bridge	BH-A2	1.50 m	30.00 m	704095.090 m	3119020.849 m	(+)190.095 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS-1	0.00	-	-	Yellowish brown, Stiff to very stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		CL		11	53	30	5	1	0	0	31	21	10	-	1.91	26.40	1.51	2.68	UUT	0.45	5	-	-	-	-	-	-	-	-
SPT-1	2.50	13	13		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		CL		10	52	26	7	3	2	0	31	20	11	-	1.93	26.19	1.53	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	5.50	17	17		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		CL		12	52	28	6	1	1	0	33	22	11	-	1.91	27.10	1.50	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	8.50	11	11		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		CL		11	54	27	3	2	3	0	32	21	11	-	1.95	25.76	1.55	2.67	UUT	0.69	5	-	-	-	-	-	-	-	-
SPT-4	11.50	20	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-	Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL		10	53	26	5	2	4	0	30	21	9	-	1.98	23.89	1.60	2.68	UUT	1.03	6	-	-	-	-	-	-	-	-
SPT-5	14.50	32	32		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	16.00	-	-		CL		12	47	23	9	3	6	0	33	22	11	-	2.00	23.27	1.62	2.67	UUT	1.36	5	-	-	-	-	-	-	-	-
SPT-6	17.50	40	40		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	19.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	19.50	54	54		CL		11	51	24	4	2	8	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	20.50	52	52		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	22.00	-	-		CL		13	39	28	3	7	10	0	34	23	11	-	2.02	22.40	1.65	2.68	UUT	1.75	5	-	-	-	-	-	-	-	-
SPT-9	23.50	52	52		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	25.00	-	-		CL		12	47	26	6	1	8	0	33	22	11	-	2.04	22.04	1.67	2.68	UUT	2.20	6	-	-	-	-	-	-	-	-
SPT-10	26.50	58	58		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		14-11-2021	to	15-11-2021	18+750 Major Bridge	BH-A2	1.50 m	30.00 m	704095.090 m	3119020.849 m	(+)190.095 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-11	28.00	75	75		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	29.50	70	70	Yellowish brown, Hard, Silty clay of low plasticity with gravel	CL		11	47	20	7	4	11	0	31	21	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	30.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		14-11-2021	to	15-11-2021	19+500 Major Bridge	BH-A1	0.60 m	40.00 m	703426.871 m	3118866.702 m	(+)190.997 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ^0)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-	Brown, Stiff, Silty clay of low plasticity	CL		13	70	11	5	1	0	0	34	23	11	-	1.86	27.56	1.46	2.67	UUT	0.29	5	-	-	-	-	-	-	-	-
SPT-1	2.50	8	8		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	4.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	4.50	16	18		SM		0	18	72	5	3	2	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	5.50	19	19	Brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	7.00	-	-		SM		0	24	68	6	1	1	0	-	Nil	NP	-	1.78	16.32	1.53	2.62	DST	0.00	30	-	-	-	-	-	-	-	-
SPT-4	8.50	17	17		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	10.00	-	-		CL		12	51	26	7	2	2	0	33	22	11	-	1.95	25.74	1.55	2.68	UUT	0.70	5	-	-	-	-	-	-	-	-
SPT-5	11.50	20	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	13.00	-	-		CL		10	54	28	6	1	1	0	31	21	10	-	1.95	25.60	1.55	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	14.50	21	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	16.00	-	-		CL		11	46	32	4	3	4	0	32	21	11	-	1.99	23.80	1.61	2.67	UUT	1.12	4	-	-	-	-	-	-	-	-
SPT-7	17.50	33	33	Brown, Very stiff to hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	19.00	-	-		CL		13	50	24	5	3	5	0	34	23	11	-	2.01	22.64	1.64	2.67	UUT	1.58	5	-	-	-	-	-	-	-	-
SPT-8	20.50	48	48		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	22.00	-	-		CL		12	45	30	5	1	7	0	33	22	11	-	2.02	21.96	1.66	2.68	UUT	2.02	4	-	-	-	-	-	-	-	-
SPT-9	23.50	63	63		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	25.00	-	-		CL		11	47	28	6	2	6	0	31	20	11	-	2.03	20.30	1.69	2.67	UUT	2.58	4	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	14-11-2021	to	15-11-2021	19+500 Major Bridge	BH-A1	0.60 m	40.00 m	703426.871 m	3118866.702 m	(+)190.997 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-10	26.50	78	78	Brown, Very stiff to hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	28.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	28.50	83	83		CL		10	50	28	5	2	5	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	29.50	90	90		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	31.00	100 (29cm)	-	Brown, Very dense, Silty sand with gravel	SM-SC		6	32	51	7	1	3	0	25	19	6	-	1.98	18.50	1.67	2.65	DST+	0.13	32	-	-	-	-	-	-	-	-
SPT-14	32.50	100 (27cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	34.00	100 (25cm)	-		SM-SC		5	36	50	6	2	1	0	25	20	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	35.50	100 (23cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-17	37.00	100 (26cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-18	38.50	100 (24cm)	-		SM-SC		6	34	51	6	2	1	0	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-19	40.00	100 (22cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		08-10-2021	to	10-10-2021	19+500 Major Bridge	BH-P1	1.85 m	40.00 m	703375.297 m	3118862.655 m	(+)191.964 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand Fine	Sand Medium	Sand Coarse	Gravel Fine	Gravel Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Medium stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	6	6		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		CL		11	56	28	3	1	1	0	32	22	10	-	1.86	28.11	1.45	2.68	UUT	0.22	5	-	-	-	-	-	-	-	-
SPT-2	4.00	15	15	Brown, Stiff to very stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		CL		12	59	24	2	1	2	0	34	23	11	-	1.93	27.13	1.52	2.67	UUT	0.52	5	-	-	-	-	-	-	-	-
SPT-3	7.00	14	14		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		CL		10	57	23	4	3	3	0	31	20	11	-	1.94	26.85	1.53	2.68	UUT	0.60	4	-	-	-	0.750	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	7.04 6.84 5.53 4.84	2.31 1.64 1.13 0.68	0.150
SPT-4	10.00	17	17		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-		CL		11	57	20	6	2	4	0	33	22	11	-	1.96	25.54	1.56	2.68	UUT	0.76	4	-	-	-	-	-	-	-	-
SPT-5	13.00	22	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	53	23	5	3	4	0	33	22	11	-	1.99	24.16	1.60	2.67	UUT	1.12	5	-	-	-	-	-	-	-	-
SPT-6	16.00	32	32		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	17.50	-	-		CL		11	55	21	4	4	5	0	32	21	11	-	2.00	24.10	1.61	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	19.00	35	35		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	20.50	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	53	20	6	2	7	0	33	22	11	-	2.04	21.24	1.68	2.69	UUT	2.41	4	-	-	-	-	-	-	-	-
SPT-8	22.00	75	75		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	23.50	-	-		CL		13	53	19	4	3	6	2	34	23	11	-	2.04	21.38	1.68	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	25.00	70	70		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	26.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		08-10-2021	to	10-10-2021	19+500 Major Bridge	BH-P1	1.85 m	40.00 m	703375.297 m	3118862.655 m	(+)191.964 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
SPT-10	26.95	75	75	Brown, Hard, Silty clay of low plasticity with gravel	CL		10	51	23	3	3	10	0	31	21	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	28.00	82	82		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	29.50	100 (22cm)	-	Brown, Very dense, Sandy silt of low plasticity with gravel	ML-CL		8	44	34	5	3	6	0	28	21	7	-	1.96	18.50	1.65	2.66	DST+	0.18	30	-	-	-	-	-	-	-	-
SPT-13	31.00	100 (26cm)	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	32.50	78	78	Brown, Hard, Silty clay of low plasticity with gravel	CL		10	55	20	5	1	9	0	31	21	10	-	2.04	21.00	1.69	2.68	UUT+	2.52	4	-	-	-	-	-	-	-	-
SPT-15	34.00	68	68		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	35.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	35.95	82	82		CL		11	53	22	5	1	7	1	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-17	37.00	73	73		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-18	38.50	97	97		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-19	40.00	92	92		CL		11	51	21	6	3	8	0	31	20	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	09-10-2021	to	10-10-2021	19+500 Major Bridge	BH-A2	1.60 m	40.00 m	703323.723 m	3118858.609 m	(+)191.063 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Very stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		CL		11	59	19	5	4	2	0	32	21	11	-	1.95	26.70	1.54	2.68	UUT	0.63	5	-	-	-	-	-	-	-	-
SPT-1	2.50	18	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		CL		12	61	16	7	1	3	0	34	23	11	-	1.95	26.55	1.54	-	-	-	-	-	-	-	-	-	-	-	-
SPT-2	5.50	19	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-	Brown, Medium stiff, Silty clay of low plasticity	CL		12	61	20	4	3	0	0	33	22	11	-	1.87	28.13	1.46	2.69	UUT	0.30	5	-	-	-	-	-	-	-	-
SPT-3	8.50	8	8		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		13	56	19	3	3	6	0	34	22	12	-	2.02	22.20	1.65	2.68	UUT	1.85	4	-	-	-	-	-	-	-	-
SPT-4	11.50	58	58		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-		CL		12	52	21	6	2	5	2	33	22	11	-	2.02	22.16	1.65	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	14.50	56	56		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	16.00	-	-		CL		15	52	17	5	3	8	0	34	23	11	-	2.04	21.15	1.68	2.67	UUT	3.12	4	-	-	-	-	-	-	-	-
SPT-6	17.50	100 (25cm)	100 (25cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	19.00	100 (18cm)	100 (18cm)		CL		11	57	20	5	2	5	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	20.50	>100	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	22.00	75	75		CL		12	51	23	4	3	6	1	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	23.50	100 (19cm)	100 (19cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	25.00	100 (25cm)	100 (25cm)		CL		10	51	22	5	2	10	0	31	21	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	26.50	100 (23cm)	100 (23cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	09-10-2021	to	10-10-2021	19+500 Major Bridge	BH-A2	1.60 m	40.00 m	703323.723 m	3118858.609 m	(+)191.063 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand Fine	Sand Medium	Sand Coarse	Gravel Fine	Gravel Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-13	28.00	100 (23cm)	100 (23cm)		CL		9	53	26	2	3	7	0	30	20	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	29.50	100 (23cm)	100 (23cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	31.00	>100	-		CL		12	54	23	3	2	6	0	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	32.50	100 (22cm)	100 (22cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-17	34.00	73	73	Brown, Hard, Silty clay of low plasticity with gravel	CL		11	47	26	5	3	8	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-18	35.50	81	81		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	37.00	-	-		CL		14	47	24	5	2	5	3	34	23	11	-	2.03	21.60	1.67	2.68	-	-	-	-	-	-	-	-	-	-	-
SPT-19	38.50	98	98		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-20	40.00	100 (19cm)	100 (19cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	12-11-2021	to	12-11-2021	19+715 Major Bridge	BH-A1	0.85 m	30.00 m	703175.974 m	3118849.670 m	(+)190.645 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS-1	0.00	-	-	Greyish brown, Soft to medium stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	4	4		CL		12	64	14	8	2	0	0	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		CL		13	62	18	5	1	1	0	34	23	11	-	1.85	27.60	1.45	2.67	UUT	0.22	5	-	-	-	-	-	-	-	-
SPT-2	4.00	7	7		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-	Greyish brown, Medium dense, Silty sand	SM		0	20	71	6	1	2	0	-	Nil	NP	-	1.76	14.61	1.54	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-3	7.00	18	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	8.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	9.00	20	20	Greyish brown, Very stiff, Silty clay of low plasticity	CL		10	50	27	8	3	2	0	30	20	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	10.00	24	24		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	11.50	-	-		CL		11	52	28	5	1	3	0	32	21	11	-	1.96	25.51	1.56	2.67	UUT	0.75	5	-	-	-	-	-	-	-	-
SPT-6	13.00	22	22		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	14.50	-	-		CL		12	51	25	3	5	4	0	33	22	11	-	1.97	24.82	1.58	2.68	UUT	0.92	5	-	-	-	-	-	-	-	-
SPT-7	16.00	27	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	17.50	-	-	Greyish brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL		7	51	31	3	2	6	0	27	20	7	-	1.89	19.40	1.58	2.66	DST	0.21	27	-	-	-	-	-	-	-	-
SPT-8	19.00	41	25		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	20.50	-	-		ML-CL		6	49	30	6	1	8	0	26	20	6	-	1.91	19.12	1.60	2.67	DST	0.19	28	-	-	-	-	-	-	-	-
SPT-9	22.00	54	29		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	23.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	24.00	60	30		ML-CL		8	48	29	3	4	7	1	28	21	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		12-11-2021	to	12-11-2021	19+715 Major Bridge	BH-A1	0.85 m	30.00 m	703175.974 m	3118849.670 m	(+)190.645 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-11	25.00	95	95		CL		11	47	25	6	1	10	0	31	21	10	-	2.04	21.00	1.69	2.68	UUT+	2.59	6	-	-	-	-	-	-	-	-
SPT-12	26.50	77	77		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	28.00	81	81	Greyish brown, Hard, Silty clay of low plasticity with gravel	CL		12	46	23	4	3	12	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	29.50	100 (20cm)	100 (20cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	30.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	13-11-2021	to	14-11-2021	19+715 Major Bridge	BH-P1	0.80 m	30.00 m	703164.075 m	3118849.544 m	(+)190.671 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS-1	0.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-	Greyish brown, Medium stiff, Silty clay of high plasticity	CI		16	65	13	5	1	0	0	38	24	14	-	1.85	28.70	1.44	2.70	UUT	0.18	5	-	-	-	-	-	-	-	-
SPT-1	2.50	5	5		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		SM		0	25	67	5	2	1	0	-	Nil	NP	-	1.74	14.60	1.52	2.62	DST	0.00	29	-	-	-	-	-	-	-	-
SPT-2	5.50	13	16		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	7.00	-	-	Greyish brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	7.50	16	17		SM		0	19	71	7	1	2	0	-	Nil	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	8.50	10	11		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	10.00	-	-		ML-CL		7	49	32	5	3	4	0	27	20	7	-	1.89	19.40	1.58	2.66	DST	0.22	26	-	-	-	-	-	-	-	-
SPT-5	11.50	36	26		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	13.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	13.50	35	24	Greyish brown, Dense, Sandy silt of low plasticity with gravel	ML-CL		6	50	31	3	4	4	2	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	14.50	40	26		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	16.00	-	-		ML-CL		8	47	30	8	2	5	0	28	21	7	-	1.89	19.14	1.59	2.66	DST	0.20	27	-	-	-	-	-	-	-	-
SPT-8	17.50	40	25		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	19.00	-	-		CL		12	53	20	5	2	8	0	33	22	11	-	2.02	22.36	1.65	2.68	UUT	1.83	6	-	-	-	-	-	-	-	-
SPT-9	20.50	54	54	Greyish brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	22.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	22.50	57	57		CL		11	44	26	7	3	7	2	31	20	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		13-11-2021	to	14-11-2021	19+715 Major Bridge	BH-P1	0.80 m	30.00 m	703164.075 m	3118849.544 m	(+)190.671 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm³)	Natural Moisture Content (%)	Dry Density (g/cm³)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm²)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm²)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm²)	C_v x 10^{-4} (cm²/Sec)	M_v x 10^{-2} (cm²/Kg)	Compression Index (C_c)
SPT-11	23.50	61	61		CL		13	48	20	6	2	11	0	34	23	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	25.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	25.50	68	68		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	26.50	75	75	Greyish brown, Hard, Silty clay of low plasticity with gravel	CL		12	45	25	2	6	10	0	33	22	11	-	2.03	21.00	1.68	2.68	UUT+	2.41	5	-	-	-	-	-	-	-	-
UDS*	28.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	28.50	84	84		CL		11	49	23	3	2	12	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	29.50	100 (22cm)	100 (22cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DS-2	30.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	14-11-2021	to	16-11-2021	19+715 Major Bridge	BH-A2	0.45 m	30.00 m	703152.175 m	3118849.568 m	(+)190.592 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Greyish brown, Stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	9	9		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		CL		13	60	18	7	1	1	0	34	23	11	-	1.87	28.16	1.46	2.67	UUT	0.31	5	-	-	-	0.825	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	8.52 7.50 6.86 5.68	2.45 1.86 1.18 0.75	0.1730
SPT-2	4.00	6	6		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		CL		12	53	23	10	2	0	0	33	22	11	-	1.92	27.35	1.51	2.68	UUT	0.49	4	-	-	-	-	-	-	-	-
SPT-3	7.00	14	14		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	8.50	-	-	Greyish brown, Medium dense, Silty sand	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-4	9.00	21	19		SM		0	25	68	7	0	0	0	-	Nil	NP	-	1.81	16.50	1.55	2.62	DST+	0.00	30	-	-	-	-	-	-	-	-
SPT-5	10.00	29	23		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	11.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	12.00	37	26	Greyish brown, Dense, Sandy silt of low plasticity with gravel	ML-CL		7	48	26	12	3	4	0	26	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	13.00	32	23		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	14.50	-	-		ML-CL		8	46	31	11	0	4	0	28	21	7	-	1.88	19.78	1.57	2.66	DST	0.21	26	-	-	-	-	-	-	-	-
SPT-8	16.00	31	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	17.50	-	-	Greyish brown, Hard, Silty clay of low plasticity with gravel	CL		13	57	16	6	2	6	0	34	23	11	-	2.01	23.06	1.63	2.67	UUT	1.48	5	-	-	-	-	-	-	-	-
SPT-9	19.00	45	45		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	20.50	-	-		CL		11	52	20	7	4	6	0	31	20	11	-	2.01	22.10	1.65	2.68	UUT	1.85	4	-	-	-	-	-	-	-	-
SPT-10	22.00	56	56		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	23.50	-	-		CL		11	44	25	10	2	8	0	32	21	11	-	2.02	21.16	1.67	2.67	UUT	2.24	5	-	-	-	-	-	-	-	-
SPT-11	25.00	66	66		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	14-11-2021	to	16-11-2021	19+715 Major Bridge	BH-A2	0.45 m	30.00 m	703152.175 m	3118849.568 m	(+)190.592 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
UDS*	26.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	27.00	73	73		CL		12	49	19	6	3	11	0	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	28.00	83	83	Greyish brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	29.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	30.00	88	58		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
		13-11-2021	to	14-11-2021	20+300 Major Bridge	BH-A1	1.00 m	40.00 m	702617.165 m	3118908.161 m	(+)190.950 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained: Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Atterberg Limits %: Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength: Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)	Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters: Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Medium dense, Sandy silt of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	18	33		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		ML-CL		6	51	31	9	2	1	0	27	20	7	-	1.87	19.78	1.56	2.66	DST	0.21	26	-	-	-	-	-	-	-	-
SPT-2	4.00	20	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-	Brown, Dense, Silty sand with clay & gravel	SM-SC		5	34	48	5	3	5	0	25	20	5	-	1.87	17.16	1.60	2.65	DST	0.11	30	-	-	-	-	-	-	-	-
SPT-3	7.00	38	30		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-	Brown, Hard with gravel Silty clay of low plasticity	CL		11	51	22	8	2	5	1	32	21	11	-	2.00	22.90	1.63	2.67	UUT	1.52	5	-	-	-	-	-	-	-	-
SPT-4	10.00	46	46		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-		CL		12	51	23	6	2	6	0	33	22	11	-	2.02	22.14	1.65	2.68	UUT	1.70	6	-	-	-	-	-	-	-	-
SPT-5	13.00	53	53		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-		CL		12	53	22	3	2	8	0	32	21	11	-	2.02	22.20	1.65	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	16.00	53	53		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	17.50	-	-		CL		13	54	20	5	1	7	0	34	23	11	-	2.02	22.22	1.65	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	18.00	48	48		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	19.00	59	59		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	20.50	-	-		CL		11	48	21	8	3	9	0	32	21	11	-	2.02	21.66	1.66	2.68	UUT	1.97	5	-	-	-	-	-	-	-	-
SPT-9	22.00	72	72		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	23.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	24.00	57	57		CL		10	53	24	4	1	6	2	30	20	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	25.50	61	61		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	13-11-2021	to	14-11-2021	20+300 Major Bridge	BH-A1	1.00 m	40.00 m	702617.165 m	3118908.161 m	(+)190.950 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
UDS-8	26.50	-	-	Brown, Hard with gravel Silty clay of low plasticity	CL		13	48	23	5	3	8	0	34	23	11	-	2.02	21.80	1.66	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	28.00	55	55		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	29.50	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	30.00	61	61		CL		12	54	21	3	2	7	1	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	31.00	66	66		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	32.50	-	-		CL		11	52	20	6	2	9	0	31	20	11	-	2.03	21.05	1.68	2.67	UUT	2.35	6	-	-	-	-	-	-	-	-
SPT-15	34.00	71	71		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	35.50	78	78		CL		12	52	19	4	1	12	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-17	37.00	77	77		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-18	38.50	100 (25cm)	100 (25cm)		CL		11	47	22	8	2	10	0	31	21	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-19	40.00	100 (22cm)	100 (22cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	09-10-2021	to	11-10-2021	20+300 Major Bridge	BH-P1	2.10 m	40.00 m	702589.211 m	3118911.568 m	(+)191.187 m	SR-544_21-22

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Medium stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		CL		11	61	20	3	4	1	0	31	21	10	-	1.87	28.13	1.46	2.68	UUT	0.30	5	-	-	-	-	-	-	-	-
SPT-1	2.50	8	8		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-	Brown, Medium dense to dense, Sandy silt of low plasticity with gravel	ML-CL		8	54	31	3	2	2	0	28	21	7	-	1.85	20.45	1.54	2.66	DST	0.21	26	-	-	-	-	-	-	-	-
SPT-2	5.50	19	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		ML-CL		7	55	29	6	1	2	0	27	20	7	-	1.85	20.30	1.54	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	8.50	22	19		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		ML-CL		7	54	27	5	4	3	0	26	19	7	-	1.90	20.30	1.58	2.66	DST	0.22	27	-	-	-	-	-	-	-	-
SPT-4	11.50	33	24		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-		ML-CL		6	54	28	4	3	5	0	26	20	6	-	1.91	20.65	1.58	-	-	-	-	-	-	-	-	-	-	-	-
SPT-5	14.50	40	25		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	16.00	-	-		ML-CL		8	49	29	6	2	4	2	27	20	7	-	1.90	20.47	1.58	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	17.50	50	50	Brown, Hard with gravel Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	19.00	-	-		CL		9	53	28	4	1	5	0	30	20	10	-	2.01	22.67	1.64	2.68	UUT	1.65	4	-	-	-	-	-	-	-	-
SPT-7	19.50	51	51		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	20.50	58	58		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	22.00	-	-		CL		11	54	22	4	2	7	0	33	21	12	-	2.02	21.18	1.67	2.67	UUT	2.18	5	-	-	-	-	-	-	-	-
SPT-9	23.50	68	68		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	25.00	-	-		CL		12	53	20	3	2	10	0	33	22	11	-	2.05	20.40	1.70	2.68	UUT	3.14	4	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	09-10-2021	to	11-10-2021	20+300 Major Bridge	BH-P1	2.10 m	40.00 m	702589.211 m	3118911.568 m	(+)191.187 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-10	26.50	100 (20cm)	100 (20cm)	Brown, Hard with gravel Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-11	28.00	100 (19cm)	100 (19cm)		CL		11	50	22	4	3	8	2	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	29.50	100 (22cm)	100 (22cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	31.50	100 (21cm)	100 (21cm)		CL		11	44	20	4	8	13	0	31	21	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	32.50	100 (21cm)	100 (21cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	34.00	100 (20cm)	100 (20cm)		CL		12	56	18	3	2	9	0	33	22	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	35.50	100 (19cm)	100 (19cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-17	37.00	100 (19cm)	100 (19cm)		CL		12	48	19	5	3	12	1	34	23	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-18	38.50	100 (23cm)	100 (23cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-19	40.00	100 (25cm)	100 (25cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	09-10-2021	to	11-10-2021	20+300 Major Bridge	BH-P2	2.25 m	40.00 m	702570.093 m	3118913.897 m	(+)191.622 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand: Fine	Sand: Medium	Sand: Coarse	Gravel: Fine	Gravel: Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
DS	0.00	-	-	Brown, Medium stiff, Silty clay of low plasticity	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-1	1.00	8	8		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	2.50	-	-		CL		10	58	25	4	2	1	0	30	20	10	-	1.87	28.13	1.46	2.68	UUT	0.29	5	-	-	-	0.835	0.5-1.0 1.0-2.0 2.0-4.0 4.0-8.0	9.39 7.44 6.48 5.14	2.54 1.90 1.31 0.76	0.173
SPT-2	4.00	13	16	Brown, Medium dense to dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	5.50	-	-		ML-CL		7	56	30	3	2	2	0	27	20	7	-	1.84	20.30	1.53	2.66	DST	0.21	25	-	-	-	-	-	-	-	-
SPT-3	7.00	18	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	8.50	-	-		ML-CL		8	53	28	5	3	2	1	28	21	7	-	1.86	20.14	1.55	2.66	DST	0.20	26	-	-	-	-	-	-	-	-
SPT-4	10.00	24	20		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	11.50	-	-		ML-CL		6	53	30	4	3	4	0	26	20	6	-	1.87	19.88	1.56	2.65	DST	0.19	28	-	-	-	-	-	-	-	-
SPT-5	13.00	33	23		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	14.50	-	-		ML-CL		7	53	27	6	2	5	0	27	20	7	-	1.89	19.80	1.58	2.66	DST	0.20	28	-	-	-	-	-	-	-	-
SPT-6	16.00	45	27		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	17.50	-	-		ML-CL		7	45	30	8	4	4	2	28	21	7	-	1.89	19.64	1.58	-	-	-	-	-	-	-	-	-	-	-	-
SPT-7	19.00	51	51	Brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	20.50	-	-		CL		10	55	21	4	3	7	0	30	20	10	-	2.02	22.14	1.65	2.68	UUT	1.82	5	-	-	-	-	-	-	-	-
SPT-8	22.00	62	62		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	23.50	-	-		CL		12	51	18	6	2	11	0	33	22	11	-	2.08	22.10	1.70	2.67	UUT	3.14	4	-	-	-	-	-	-	-	-
SPT-9	25.00	100 (25cm)	100 (25cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-10	26.50	100 (22cm)	100 (22cm)		CL		11	49	22	5	3	9	1	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Triaxial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project		Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Project	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	09-10-2021	to	11-10-2021	20+300 Major Bridge	BH-P2	2.25 m	40.00 m	702570.093 m	3118913.897 m	(+)191.622 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
									Sand			Gravel																				
							Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
SPT-11	28.00	100 (21cm)	100 (21cm)	Brown, Hard, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	29.50	>100	-		CL		10	51	23	5	4	7	0	31	20	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	31.00	100 (22cm)	100 (22cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-14	32.50	100 (20cm)	100 (20cm)		CL		10	50	20	6	3	8	3	30	20	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	34.00	100 (25cm)	100 (25cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	35.50	>100	-		CL		12	49	16	9	2	12	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-17	37.00	100 (27cm)	100 (27cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-18	38.50	100 (24cm)	100 (24cm)		CL		11	49	17	11	4	8	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-19	40.00	>100	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	15-11-2021	to	17-11-2021	20+300 Major Bridge	BH-A2	2.55 m	40.00 m	702548.989 m	3118916.469 m	(+)191.622 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ^0)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
DS	0.00	-	-	Brown, Stiff to very stiff, Silty clay of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-1	1.00	-	-		CL		11	53	30	5	1	0	0	31	21	10	-	1.88	27.36	1.48	2.67	UUT	0.37	5	-	-	-	-	-	-	-	-
SPT-1	2.50	10	10		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-2	4.00	-	-		CL		12	52	27	4	3	2	0	32	21	11	-	1.94	25.41	1.55	2.68	UUT	0.70	4	-	-	-	-	-	-	-	-
SPT-2	4.50	18	18		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-3	7.00	-	-		CL		11	50	30	6	2	1	0	31	21	10	-	1.94	25.29	1.55	-	-	-	-	-	-	-	-	-	-	-	-
SPT-3	8.50	21	21		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-4	10.00	-	-		CL		13	52	24	5	3	3	0	34	23	11	-	1.98	24.49	1.59	2.67	UUT	0.95	5	-	-	-	-	-	-	-	-
SPT-4	11.50	28	28		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-5	13.00	-	-	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	52	25	6	1	4	0	33	22	11	-	1.98	23.29	1.61	2.67	UUT	1.16	5	-	-	-	-	-	-	-	-
SPT-5	14.50	32	32		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-6	16.00	-	-		CL		10	49	28	7	2	4	0	30	20	10	-	1.98	23.10	1.61	-	-	-	-	-	-	-	-	-	-	-	-
SPT-6	17.50	36	36		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-7	19.00	-	-	Brown, Dense to very dense, Sandy silt of low plasticity with gravel	ML-CL		8	43	38	4	2	5	0	28	21	7	-	1.91	19.56	1.60	2.66	DST	0.21	28	-	-	-	-	-	-	-	-
SPT-7	20.50	43	23		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-8	22.00	-	-		ML-CL		6	47	31	7	2	7	0	26	20	6	-	1.91	19.27	1.60	-	-	-	-	-	-	-	-	-	-	-	-
SPT-8	23.50	48	24		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS*	25.00	-	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-9	25.50	62	28		ML-CL		7	47	33	4	3	6	0	27	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri-axial Test on Remoulded Sample.

CEG TEST HOUSE

SOIL CHARACTERISTICS

Project	Date of Boring			Chainage (km.)/Location	B.H. No.	Depth of Water Table	Termination Depth	Cordinates (E,N)		R.L.	Ref. Code
Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.	15-11-2021	to	17-11-2021	20+300 Major Bridge	BH-A2	2.55 m	40.00 m	702548.989 m	3118916.469 m	(+)191.622 m	**SR-544_21-22**

Sample Type	Depth from G.L. (m)	Observed SPT Value (N)	Corrected SPT Value (N_c)	Soil Description	IS Classification	IS Symbol	Grain Size Distribution % wt retained							Atterberg Limits %				Bulk Density (g/cm^3)	Natural Moisture Content (%)	Dry Density (g/cm^3)	Specific Gravity	Shear Strength			Free Swell Index (%)	Swelling Pressure (kg/cm^2)	Permeability (cm/sec)	Consolidation Parameters				
							Clay	Silt	Sand			Gravel		Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit					Type of Test	Cohesion C (kg/cm^2)	Angle of Friction (φ°)				Void Ratio (e_0)	Pressure (kg/cm^2)	C_v x 10^{-4} (cm^2/Sec)	M_v x 10^{-2} (cm^2/Kg)	Compression Index (C_c)
									Fine	Medium	Coarse	Fine	Coarse																			
SPT-10	26.50	68	30	Brown, Dense to very dense, Sandy silt of low plasticity with gravel	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-9	28.00	-	-		ML-CL		6	46	35	3	2	8	0	26	20	6	-	1.93	18.96	1.62	2.66	DST	0.18	30	-	-	-	-	-	-	-	-
SPT-11	29.50	80	33		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UDS-10	31.00	-	-		ML-CL		7	47	32	4	3	7	0	26	19	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-12	32.50	84	33		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-13	34.00	100 (30cm)	100 (30cm)	Brown, Hard, Silty clay of low plasticity with gravel	CL		12	41	29	6	1	11	0	33	22	11	-	2.05	20.50	1.70	2.68	UUT+	3.18	4	-	-	-	-	-	-	-	-
SPT-14	35.50	100 (27cm)	100 (27cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-15	37.00	100 (23cm)	100 (23cm)		CL		11	46	28	5	1	9	0	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-16	38.50	100 (22cm)	100 (22cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPT-17	40.00	100 (21cm)	100 (21cm)		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abbreviations:-
DS-Disturbed Sample, SPT-Standard Penetration Test, UDS-Undisturbed Sample, UDS*-UDS not recovered, DST-Direct Shear Test, UUT-Unconsolidated Undrained Triaxial Shear Test, DST+ - Direct Shear Test on Remoulded Sample, UUT+ - Unconsolidated Undrained Tri axial Test on Remoulded Sample.

RESULT OF CHEMICAL ANALYSIS OF SOIL SAMPLES

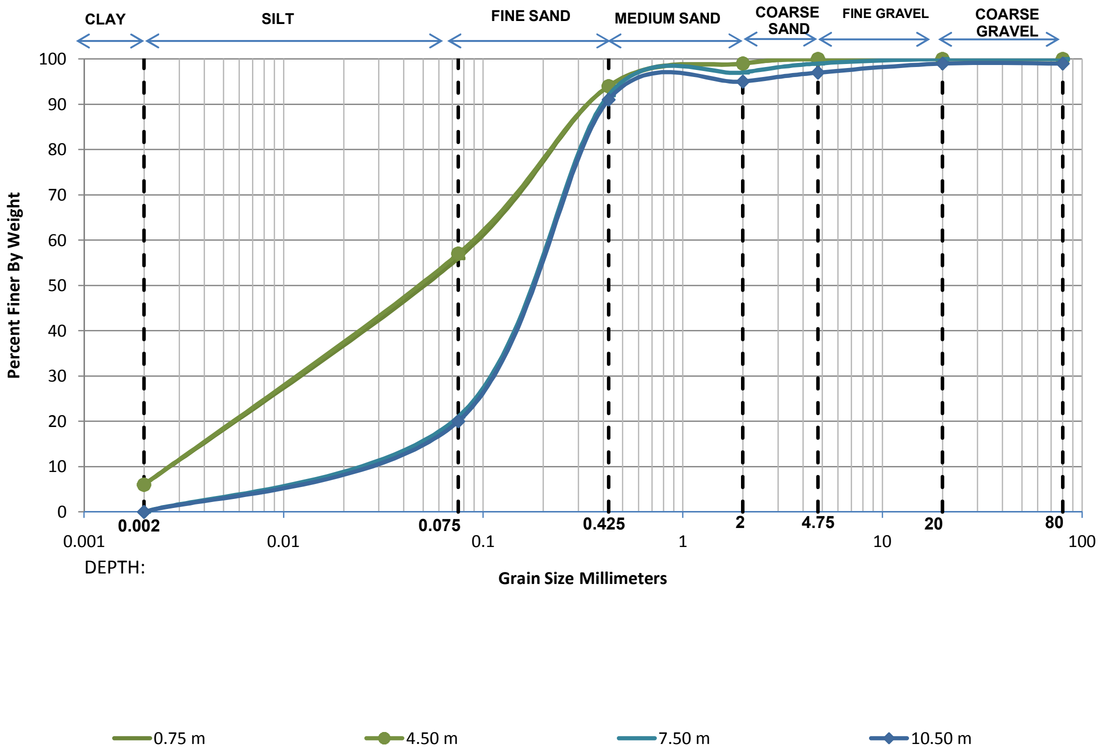
Sr. No	Chainage Old (km)	Chainage New (km)	BH No.	Depth of collected sample (m)	pH	Chlorides (Cl^-)		Sulphate (SO_3^{2-})	
						(mg/kg)	(%)	(mg/kg)	(%)
1.	1+006	1+696	BH-A1	2.50	7.19	80.65	0.0081	29.84	0.0030
2.			BH-A2	23.50	8.23	76.55	0.0076	24.87	0.0025
3.	2+788	3+476	BH-A1	2.50	7.34	74.81	0.0075	29.52	0.0030
4.			BH-A2	23.50	6.54	70.05	0.0070	30.34	0.0030
5.	3+497	4+242	BH-A1	4.00	8.26	66.53	0.0067	31.10	0.0031
6.			BH-P1	23.50	9.30	88.42	0.0088	32.67	0.0033
7.	3+691	4+376	BH-A1	2.50	7.12	80.55	0.0081	20.58	0.0021
8.			BH-A2	19.00	7.50	82.54	0.0083	22.57	0.0023
9.	7+078	7+759	BH-A1	4.00	7.35	71.61	0.0072	28.51	0.0029
10.			BH-A2	20.50	7.54	70.55	0.0071	31.52	0.0032
11.	7+351	8+036	BH-A1	2.50	8.56	73.83	0.0074	32.51	0.0033
12.			BH-A2	19.00	8.65	74.58	0.0075	24.29	0.0025
13.	7+613	8+298	BH-A1	2.50	7.30	74.58	0.0075	21.55	0.0022
14.			BH-A2	19.00	7.56	84.55	0.0085	26.68	0.0027
15.	8+852	9+537	BH-A1	2.50	9.51	88.96	0.0089	29.51	0.0030
16.			BH-A2	22.00	7.20	78.59	0.0079	19.20	0.0019
17.	9+726	10+410	BH-A1	1.00	7.64	84.55	0.0085	24.52	0.0025
18.			BH-A2	26.50	7.13	91.44	0.0090	27.64	0.0028
19.	10+025	10+709	BH-A1	1.00	7.57	78.64	0.0079	19.68	0.0020
20.			BH-A2	17.50	7.15	66.51	0.0067	22.53	0.0023
21.	10+859	11+543	BH-A1	2.50	7.67	89.56	0.0090	28.68	0.0029
22.			BH-A2	25.00	7.83	74.52	0.0075	31.65	0.0032
23.	18+750	19+435	BH-A1	1.00	7.21	88.86	0.0089	22.44	0.0022
24.			BH-A2	25.00	7.65	89.55	0.0090	20.51	0.0021
25.	19+500	20+185	BH-A1	2.50	8.88	78.65	0.0079	14.51	0.0015
26.			BH-A2	25.00	7.68	92.65	0.0093	17.70	0.0018
27.	19+715	20+400	BH-A1	1.00	7.51	90.52	0.0091	19.54	0.0020
28.			BH-A2	35.30	8.20	89.85	0.0090	21.80	0.0022
29.	20+300	20+985	BH-A1	2.50	8.34	84.55	0.0085	24.64	0.0025
30.			BH-A2	25.00	7.65	85.40	0.0085	25.88	0.0026

RESULT OF CHEMICAL ANALYSIS OF WATER SAMPLE

Sr. No	Chainage Old (km)	Chainage New (km)	BH No.	pH	Chlorides (Cl^-) (mg/l)	Sulphate (SO_3^{2-}) (mg/l)
1.	1+006	1+696	BH-P2	8.69	52.81	23.09
2.	2+788	3+476	BH-A1	8.11	39.36	33.21
3.	3+497	4+242	BH-A1	8.85	57.55	24.60
4.	3+691	4+376	BH-A1	8.14	51.00	30.11
5.	7+078	7+759	BH-A2	7.41	32.12	25.77
6.	7+351	8+036	BH-A1	7.91	51.31	28.07
7.	7+613	8+298	BH-A2	7.02	87.21	15.14
8.	8+852	9+537	BH-A2	8.47	70.12	26.45
9.	9+726	10+410	BH-A2	9.44	42.69	26.65
10.	10+025	10+709	BH-A1	8.77	54.10	15.55
11.	10+859	11+543	BH-A2	7.47	59.12	14.65
12.	17+625	18+310	BH-A1	7.11	61.45	18.32
13.	17+872	18+558	BH-A2	7.65	65.27	19.67
14.	18+750	19+435	BH-A1	7.45	66.44	21.74
15.	19+500	20+185	BH-A2	7.49	78.45	22.56
16.	19+715	20+400	BH-A2	6.84	79.44	18.77
17.	20+300	20+985	BH-A1	6.74	81.54	24.77

GRAIN SIZE DISTRIBUTION CURVES

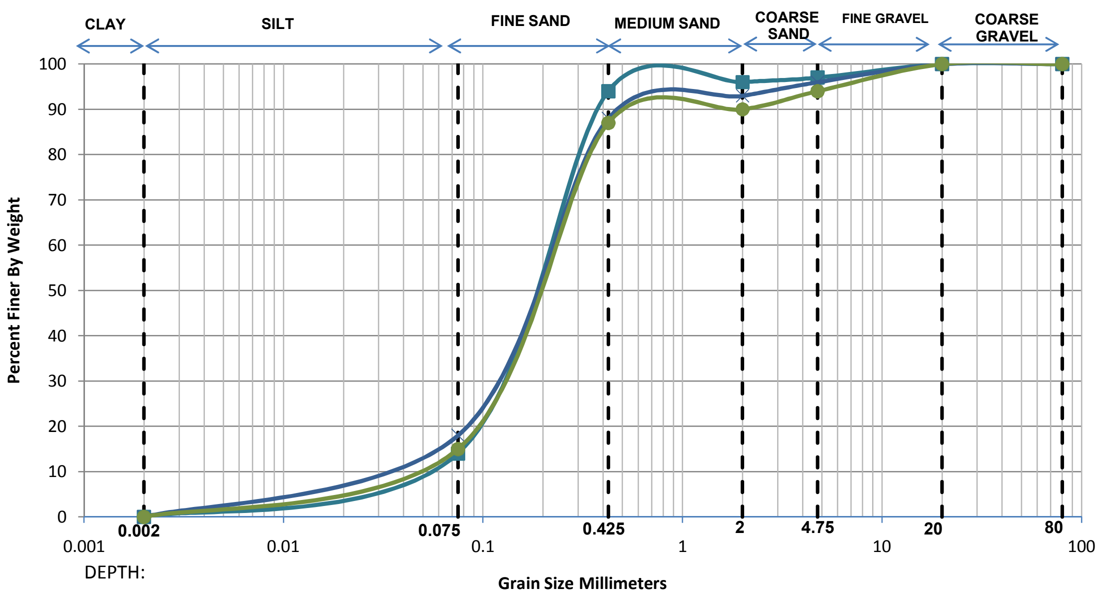
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	New Ch. 0+000 Prithla Station
B.H. No.	BH-PLT-09



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
0.75 m	6.00	50.00	38.00	5.00	1.00	0.00	0.00	0.0044	0.0247	0.0871	19.71	1.59
4.50 m	6.00	51.00	37.00	5.00	1.00	0.00	0.00	0.0044	0.0241	0.0837	19.05	1.57
7.50 m	0.00	21.00	71.00	5.00	2.00	1.00	0.00	0.0257	0.1088	0.2144	8.33	2.14
10.50 m	0.00	20.00	71.00	4.00	2.00	2.00	0.00	0.0280	0.1131	0.2193	7.83	2.08

GRAIN SIZE DISTRIBUTION CURVES

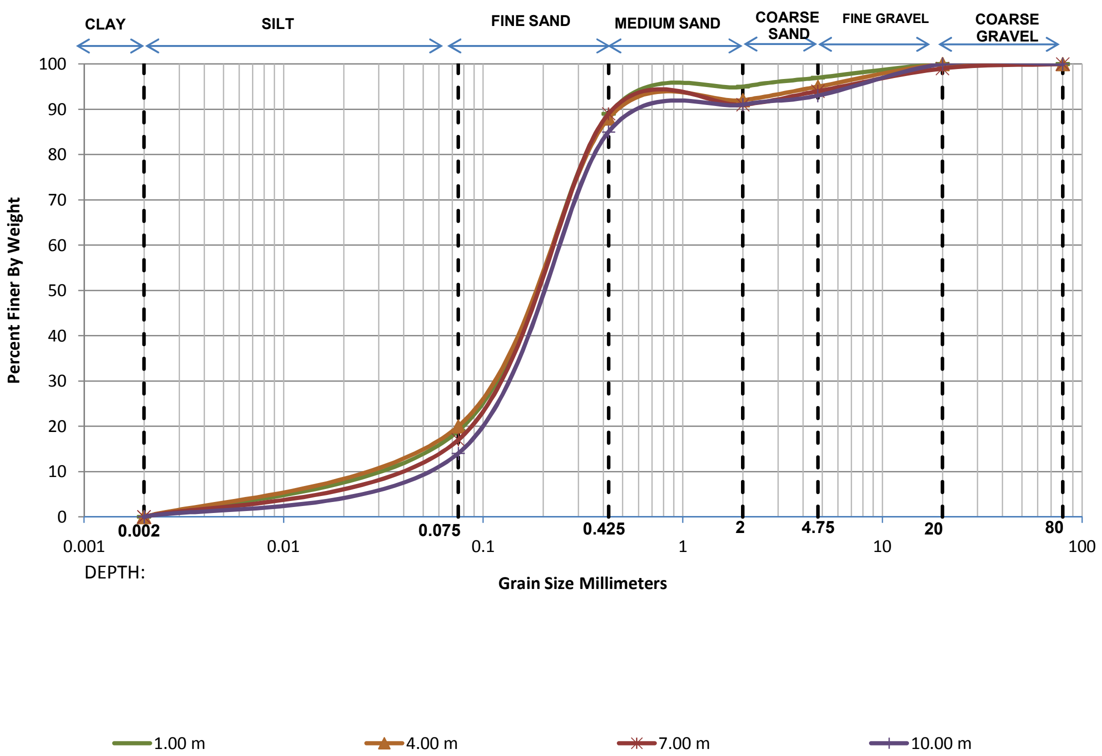
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	(-)0+627 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	0.00	14.00	80.00	2.00	1.00	3.00	0.00	0.0508	0.1378	0.2308	4.54	1.62
5.50 m	0.00	18.00	70.00	5.00	3.00	4.00	0.00	0.0335	0.1224	0.2327	6.95	1.92
8.50 m	0.00	15.00	72.00	3.00	4.00	6.00	0.00	0.0453	0.1361	0.2434	5.38	1.68

GRAIN SIZE DISTRIBUTION CURVES

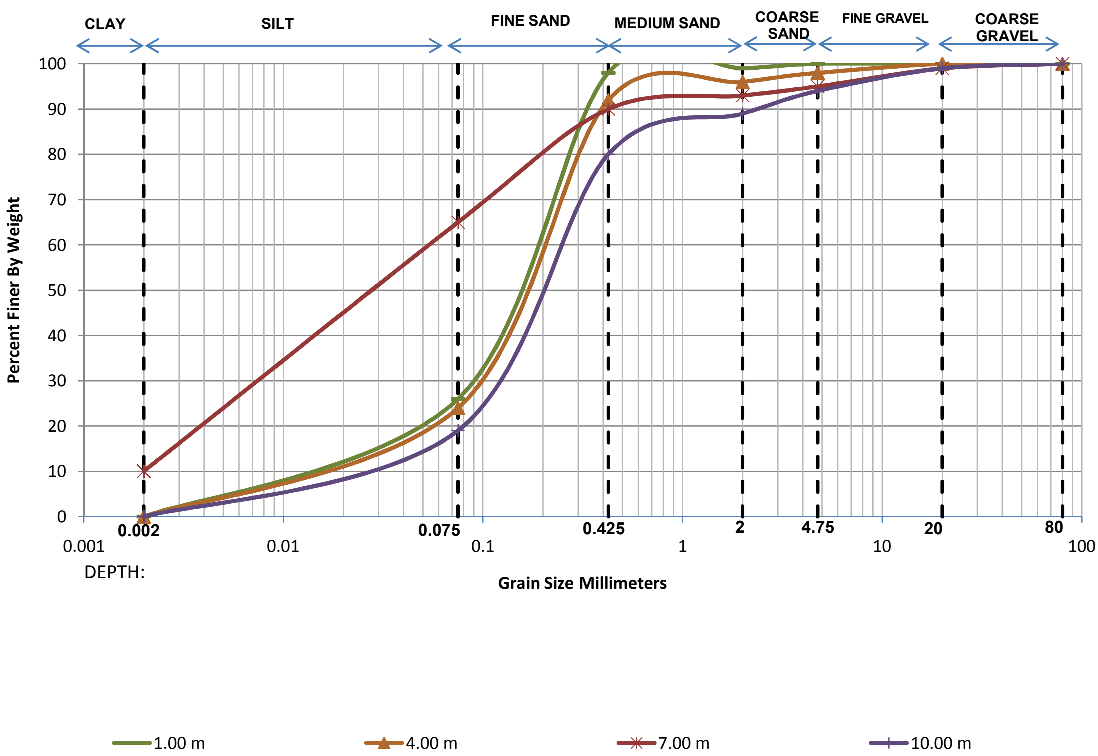
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	(-)0+529 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	19.00	70.00	6.00	2.00	3.00	0.00	0.0305	0.1179	0.2275	7.45	2.00
4.00 m	0.00	20.00	68.00	4.00	3.00	5.00	0.00	0.0278	0.1138	0.2264	8.14	2.06
7.00 m	0.00	17.00	72.00	2.00	3.00	5.00	1.00	0.0370	0.1263	0.2323	6.27	1.86
10.00 m	0.00	14.00	71.00	6.00	2.00	7.00	0.00	0.0502	0.1419	0.2527	5.04	1.59

GRAIN SIZE DISTRIBUTION CURVES

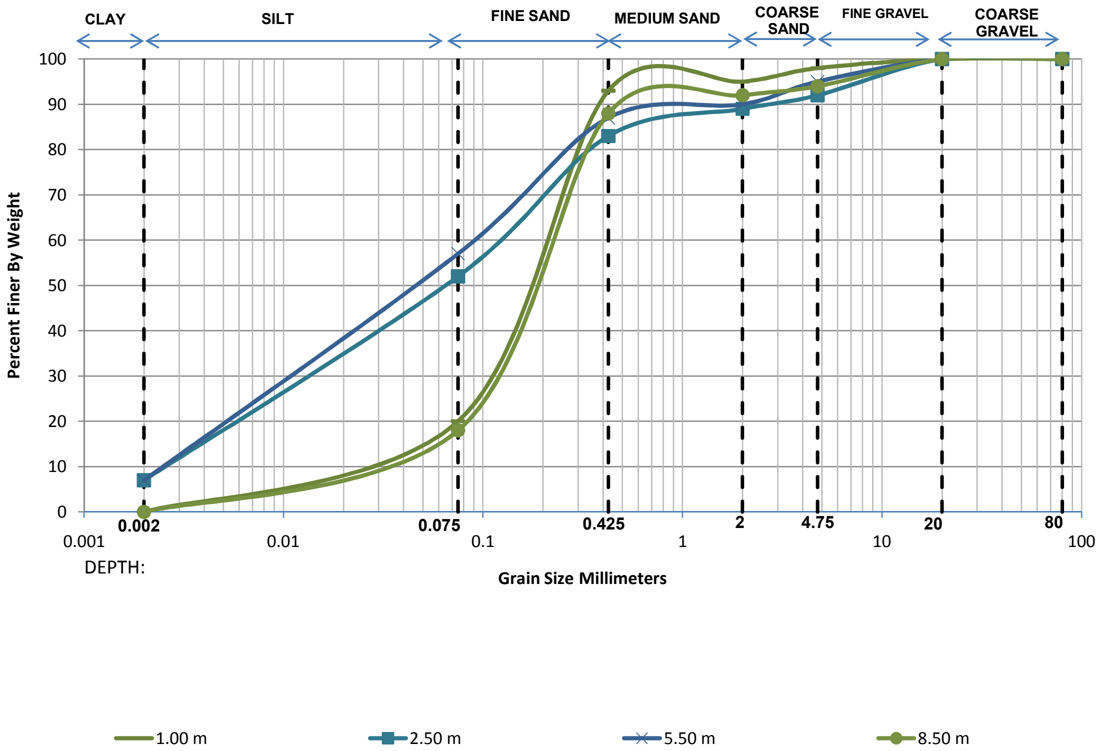
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	(-)0+319 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	26.00	72.00	1.00	1.00	0.00	0.00	0.0177	0.0888	0.1870	10.59	2.39
4.00 m	0.00	24.00	68.00	4.00	2.00	2.00	0.00	0.0202	0.0969	0.2048	10.15	2.27
7.00 m	10.00	55.00	25.00	3.00	2.00	4.00	1.00	0.0020	0.0155	0.0634	31.71	1.90
10.00 m	0.00	19.00	61.00	9.00	5.00	5.00	1.00	0.0299	0.1210	0.2567	8.58	1.91

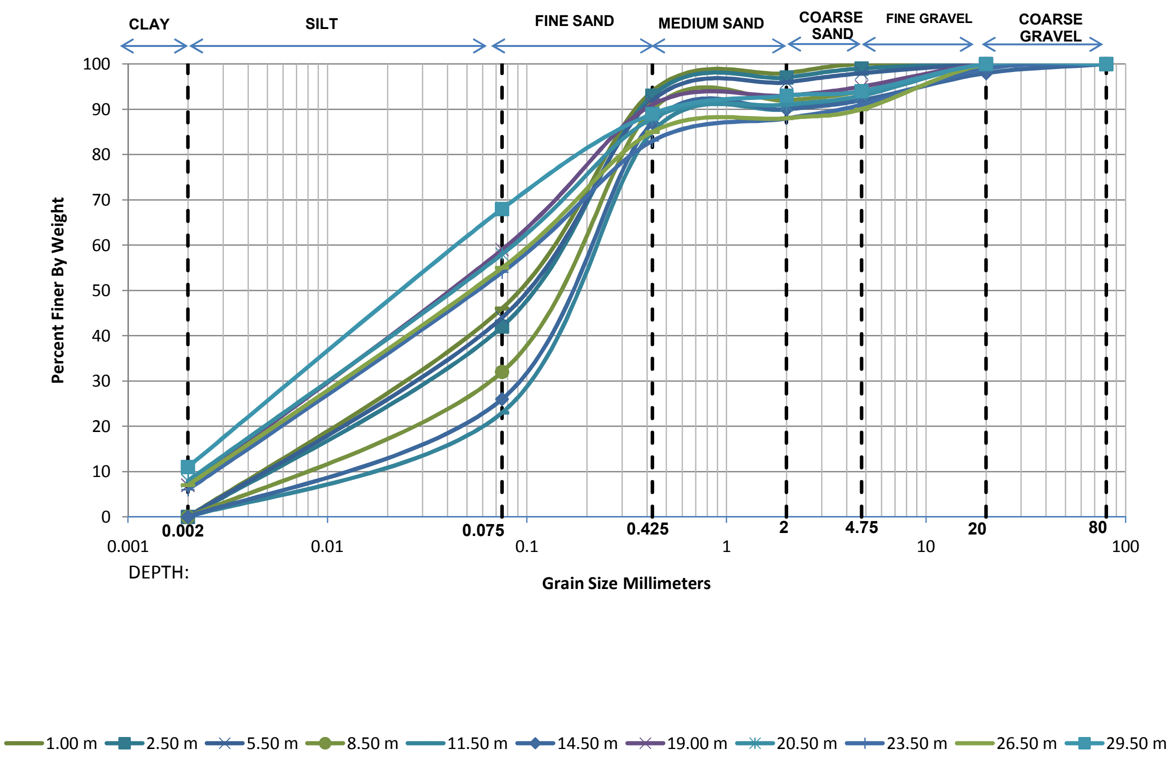
GRAIN SIZE DISTRIBUTION CURVES

Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	0+273 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	20.00	73.00	2.00	3.00	2.00	0.00	0.0281	0.1125	0.2145	7.62	2.10
2.50 m	7.00	45.00	31.00	6.00	3.00	8.00	0.00	0.0037	0.0261	0.1122	30.58	1.65
5.50 m	7.00	50.00	30.00	3.00	5.00	5.00	0.00	0.0036	0.0225	0.0849	23.70	1.66
8.50 m	0.00	18.00	70.00	4.00	2.00	6.00	0.00	0.0335	0.1224	0.2324	6.94	1.92

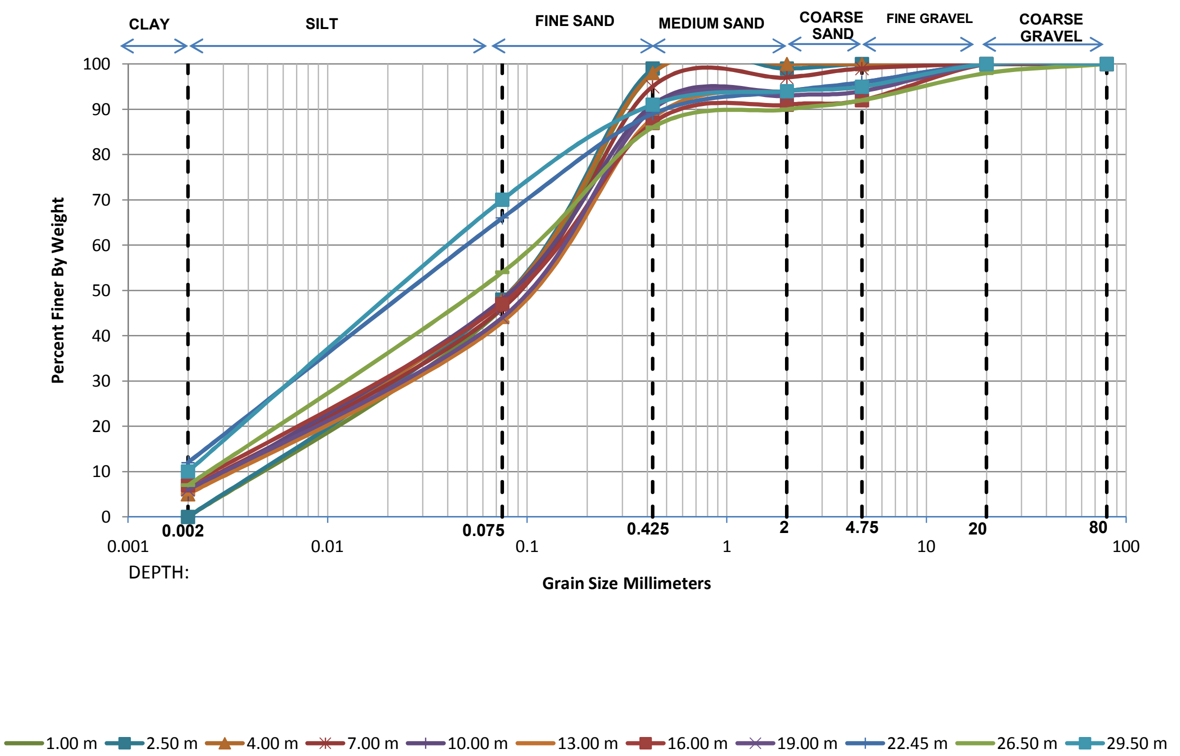
GRAIN SIZE DISTRIBUTION CURVES	
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	1+006 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	46.00	48.00	4.00	2.00	0.00	0.00	0.0064	0.0369	0.1239	19.31	1.71
2.50 m	0.00	42.00	51.00	4.00	2.00	1.00	0.00	0.0074	0.0435	0.1405	18.95	1.82
5.50 m	0.00	44.00	48.00	4.00	2.00	2.00	0.00	0.0069	0.0399	0.1341	19.57	1.74
8.50 m	0.00	32.00	58.00	2.00	2.00	6.00	0.00	0.0118	0.0684	0.1820	15.40	2.17
11.50 m	0.00	23.00	62.00	5.00	3.00	7.00	0.00	0.0214	0.1020	0.2259	10.55	2.15
14.50 m	0.00	26.00	61.00	3.00	2.00	6.00	2.00	0.0172	0.0897	0.2099	12.23	2.23
19.00 m	7.00	52.00	32.00	2.00	2.00	5.00	0.00	0.0036	0.0215	0.0777	21.82	1.67
20.50 m	8.00	50.00	30.00	3.00	2.00	7.00	0.00	0.0029	0.0208	0.0811	27.71	1.83
23.50 m	6.00	48.00	29.00	5.00	3.00	8.00	1.00	0.0044	0.0256	0.1011	22.71	1.45
26.50 m	7.00	48.00	30.00	3.00	2.00	10.00	0.00	0.0036	0.0238	0.0944	26.12	1.66
29.50 m	11.00	57.00	21.00	4.00	1.00	6.00	0.00	-	0.0136	0.0573	-	-

GRAIN SIZE DISTRIBUTION CURVES

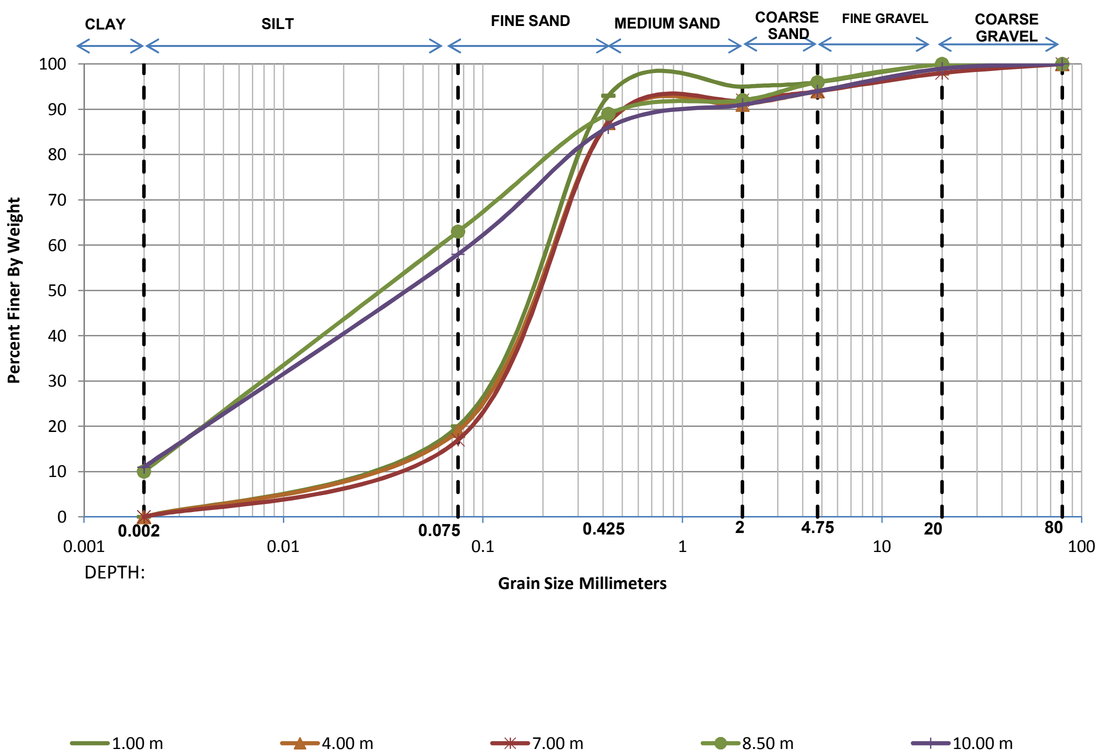
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	1+006 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	46.00	52.00	2.00	0.00	0.00	0.00	0.0065	0.0372	0.1199	18.50	1.78
2.50 m	0.00	48.00	51.00	0.00	1.00	0.00	0.00	0.0061	0.0344	0.1415	23.28	1.38
4.00 m	5.00	43.00	50.00	2.00	0.00	0.00	0.00	0.0059	0.0335	0.1144	19.53	1.68
7.00 m	6.00	40.00	49.00	2.00	2.00	1.00	0.00	0.0048	0.0347	0.1247	25.85	2.00
10.00 m	5.00	43.00	43.00	3.00	2.00	4.00	0.00	0.0058	0.0331	0.1204	20.70	1.56
13.00 m	5.00	38.00	45.00	6.00	1.00	5.00	0.00	0.0062	0.0398	0.1470	23.73	1.74
16.00 m	7.00	40.00	40.00	4.00	1.00	8.00	0.00	0.0038	0.0317	0.1309	34.37	2.02
19.00 m	6.00	38.00	46.00	3.00	1.00	6.00	0.00	0.0049	0.0373	0.1390	28.25	2.03
22.45 m	12.00	54.00	23.00	5.00	2.00	4.00	0.00	-	0.0134	0.0609	-	-
26.50 m	7.00	47.00	32.00	4.00	2.00	6.00	2.00	0.0036	0.0246	0.0986	27.13	1.69
29.50 m	10.00	60.00	21.00	3.00	1.00	5.00	0.00	0.0020	0.0139	0.0543	27.16	1.78

GRAIN SIZE DISTRIBUTION CURVES

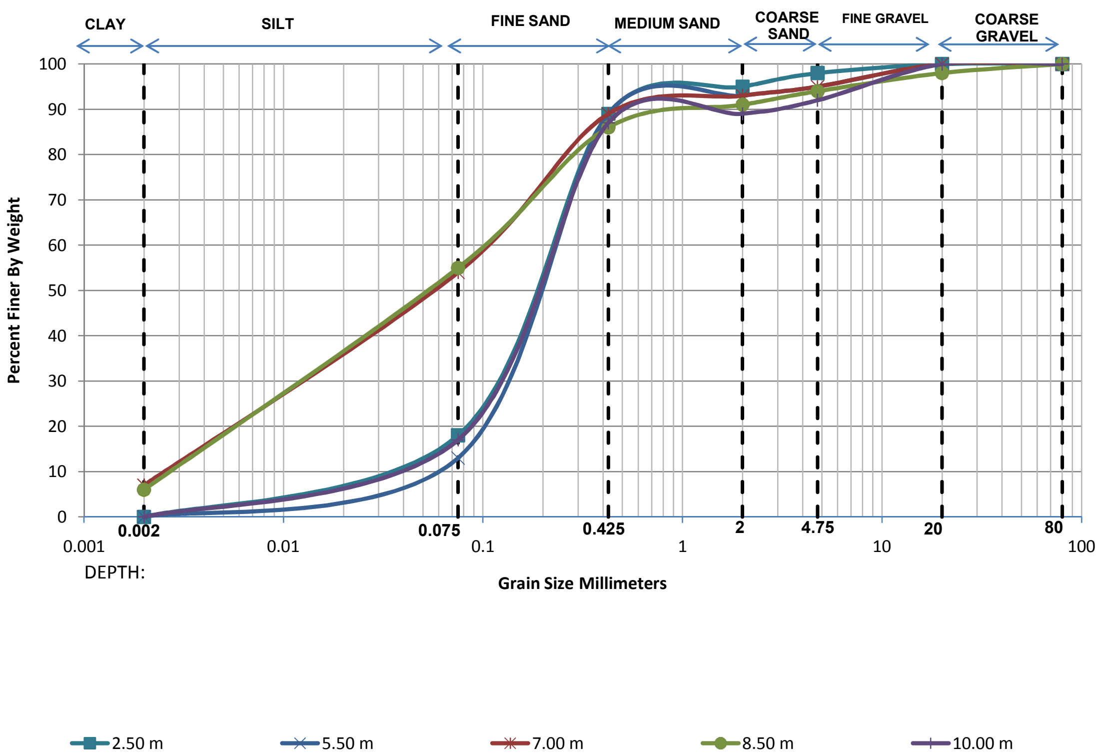
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	1+333 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	20.00	73.00	2.00	1.00	4.00	0.00	0.0281	0.1125	0.2145	7.62	2.10
4.00 m	0.00	19.00	68.00	4.00	3.00	5.00	1.00	0.0304	0.1184	0.2320	7.63	1.99
7.00 m	0.00	17.00	70.00	5.00	2.00	4.00	2.00	0.0369	0.1272	0.2382	6.46	1.84
8.50 m	10.00	53.00	26.00	3.00	4.00	4.00	0.00	0.0020	0.0163	0.0677	33.85	1.96
10.00 m	11.00	47.00	28.00	5.00	3.00	5.00	1.00	-	0.0177	0.0817	-	-

GRAIN SIZE DISTRIBUTION CURVES

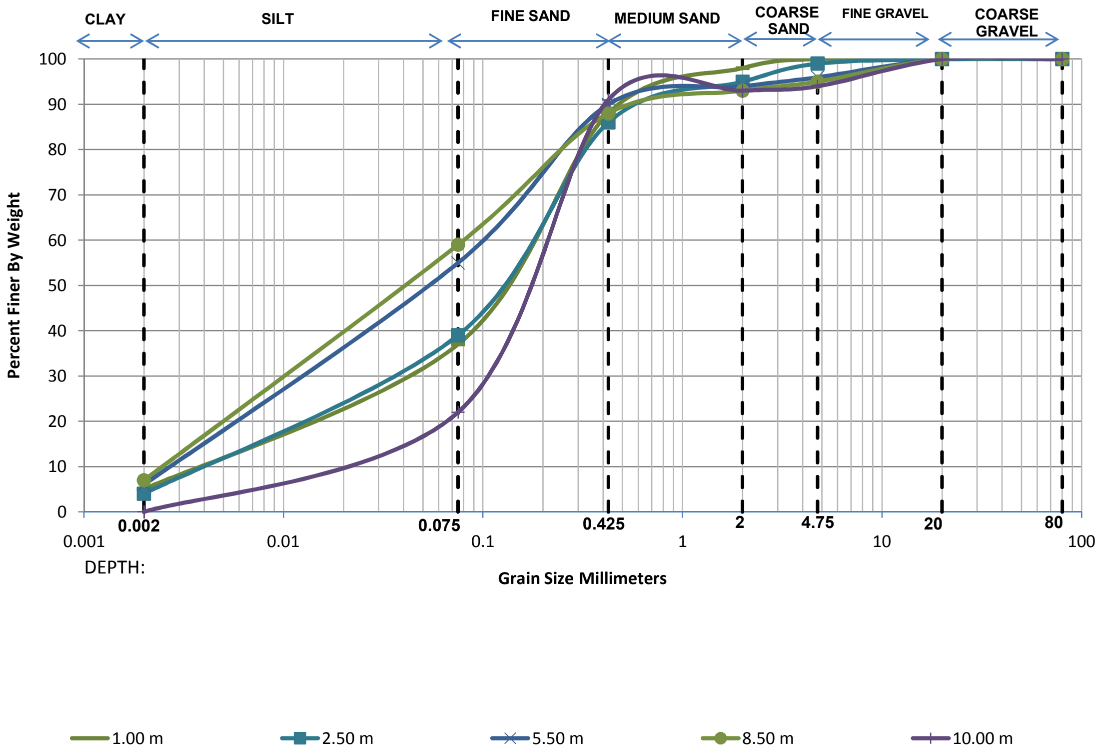
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	1+811 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	0.00	18.00	71.00	6.00	3.00	2.00	0.00	0.0336	0.1222	0.2305	6.87	1.93
5.50 m	0.00	13.00	76.00	4.00	2.00	5.00	0.00	0.0561	0.1447	0.2447	4.36	1.52
7.00 m	7.00	47.00	35.00	4.00	2.00	5.00	0.00	0.0036	0.0248	0.0968	26.58	1.74
8.50 m	6.00	49.00	31.00	5.00	3.00	4.00	2.00	0.0044	0.0250	0.0939	21.20	1.50
10.00 m	0.00	17.00	70.00	2.00	3.00	8.00	0.00	0.0369	0.1270	0.2373	6.44	1.84

GRAIN SIZE DISTRIBUTION CURVES

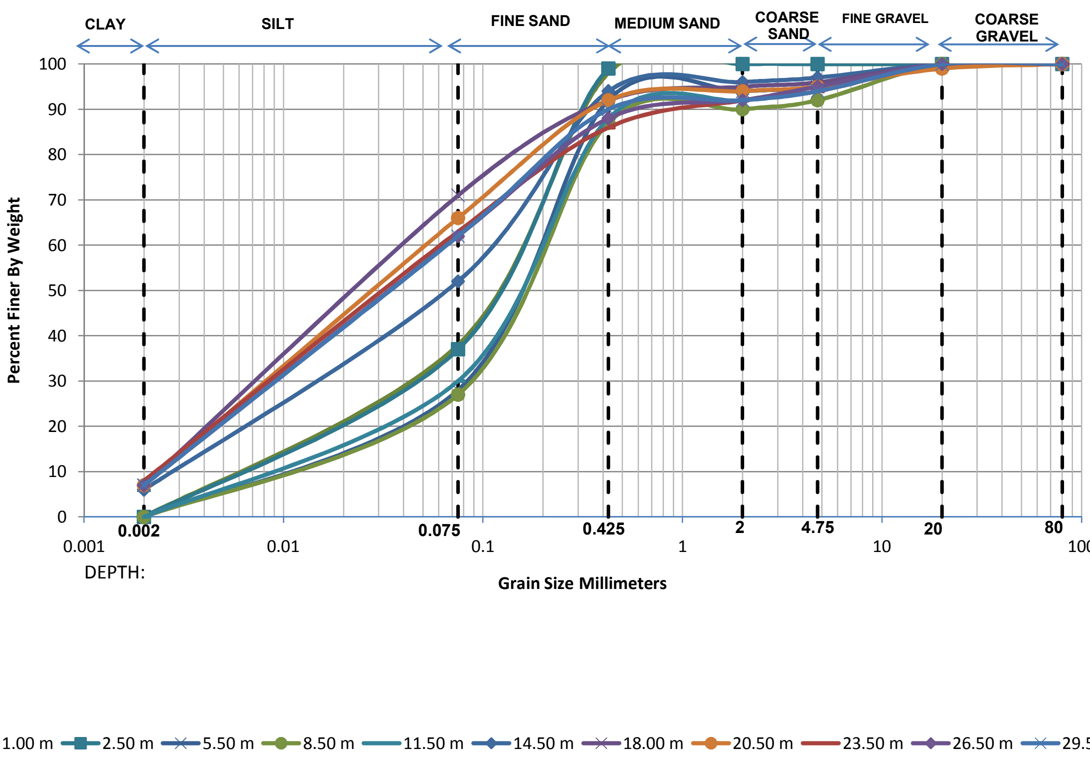
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	2+472 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	5.00	32.00	51.00	10.00	2.00	0.00	0.00	0.0070	0.0522	0.1732	24.90	2.26
2.50 m	4.00	35.00	47.00	9.00	4.00	1.00	0.00	0.0082	0.0482	0.1690	20.49	1.67
5.50 m	6.00	49.00	35.00	4.00	2.00	4.00	0.00	0.0044	0.0252	0.0920	20.71	1.56
8.50 m	7.00	52.00	29.00	5.00	2.00	5.00	0.00	0.0036	0.0213	0.0778	21.88	1.65
10.00 m	0.00	22.00	69.00	2.00	1.00	6.00	0.00	0.0236	0.1048	0.2125	9.01	2.19

GRAIN SIZE DISTRIBUTION CURVES

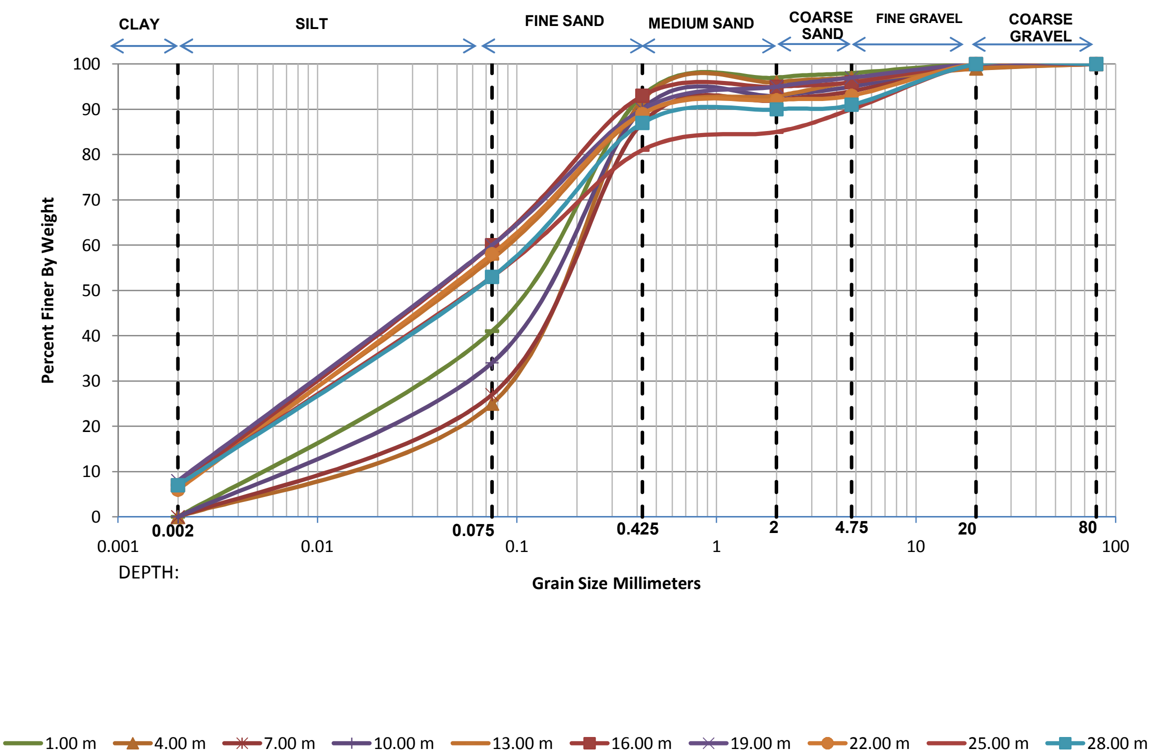
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	2+788 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	38.00	60.00	2.00	0.00	0.00	0.00	0.0089	0.0522	0.1480	16.63	2.07
2.50 m	0.00	37.00	62.00	1.00	0.00	0.00	0.00	0.0093	0.0547	0.1500	16.05	2.13
5.50 m	0.00	28.00	64.00	2.00	1.00	5.00	0.00	0.0152	0.0820	0.1914	12.61	2.31
8.50 m	0.00	27.00	60.00	3.00	2.00	8.00	0.00	0.0160	0.0859	0.2066	12.91	2.23
11.50 m	0.00	30.00	58.00	4.00	2.00	6.00	0.00	0.0132	0.0750	0.1943	14.70	2.19
14.50 m	6.00	46.00	42.00	2.00	1.00	3.00	0.00	0.0046	0.0279	0.1019	22.39	1.68
18.00 m	7.00	64.00	21.00	3.00	1.00	4.00	0.00	0.0034	0.0165	0.0539	15.73	1.48
20.50 m	7.00	59.00	26.00	2.00	1.00	4.00	1.00	0.0035	0.0182	0.0622	17.90	1.54
23.50 m	8.00	55.00	23.00	6.00	2.00	6.00	0.00	0.0029	0.0181	0.0679	23.47	1.67
26.50 m	7.00	55.00	26.00	4.00	3.00	5.00	0.00	0.0035	0.0198	0.0703	19.99	1.58
29.50 m	7.00	55.00	28.00	2.00	2.00	6.00	0.00	0.0035	0.0199	0.0703	19.98	1.59

GRAIN SIZE DISTRIBUTION CURVES

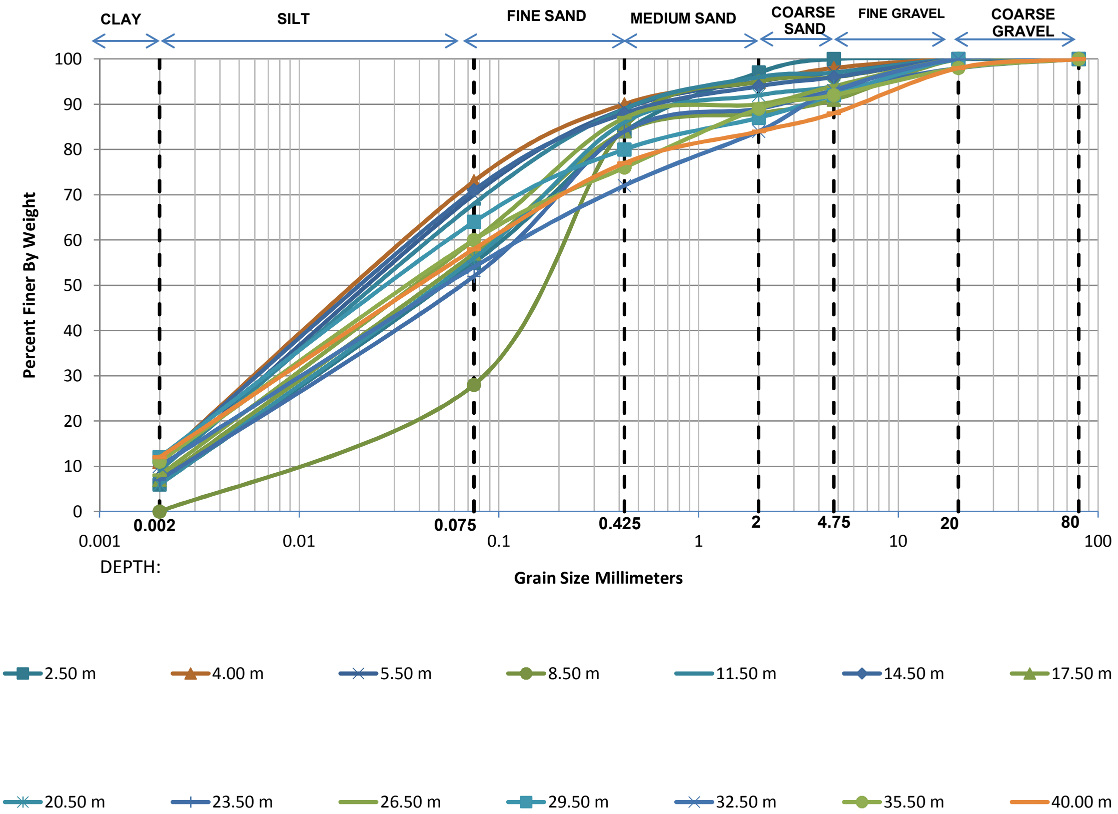
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	2+788 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	41.00	52.00	4.00	1.00	2.00	0.00	0.0077	0.0455	0.1443	18.70	1.86
4.00 m	0.00	25.00	67.00	4.00	1.00	2.00	1.00	0.0187	0.0930	0.2016	10.78	2.30
7.00 m	0.00	27.00	60.00	5.00	2.00	6.00	0.00	0.0160	0.0859	0.2073	12.95	2.22
10.00 m	0.00	34.00	56.00	3.00	2.00	5.00	0.00	0.0106	0.0623	0.1752	16.54	2.09
13.00 m	7.00	50.00	32.00	4.00	3.00	3.00	1.00	0.0036	0.0226	0.0846	23.57	1.69
16.00 m	7.00	53.00	33.00	2.00	1.00	4.00	0.00	0.0035	0.0210	0.0750	21.14	1.66
19.00 m	8.00	52.00	30.00	5.00	2.00	3.00	0.00	0.0029	0.0198	0.0750	25.73	1.79
22.00 m	6.00	52.00	31.00	3.00	1.00	7.00	0.00	0.0044	0.0232	0.0809	18.57	1.52
25.00 m	7.00	46.00	28.00	4.00	5.00	10.00	0.00	0.0036	0.0251	0.1090	29.89	1.58
28.00 m	7.00	46.00	34.00	3.00	1.00	9.00	0.00	0.0037	0.0255	0.1024	28.01	1.73

GRAIN SIZE DISTRIBUTION CURVES

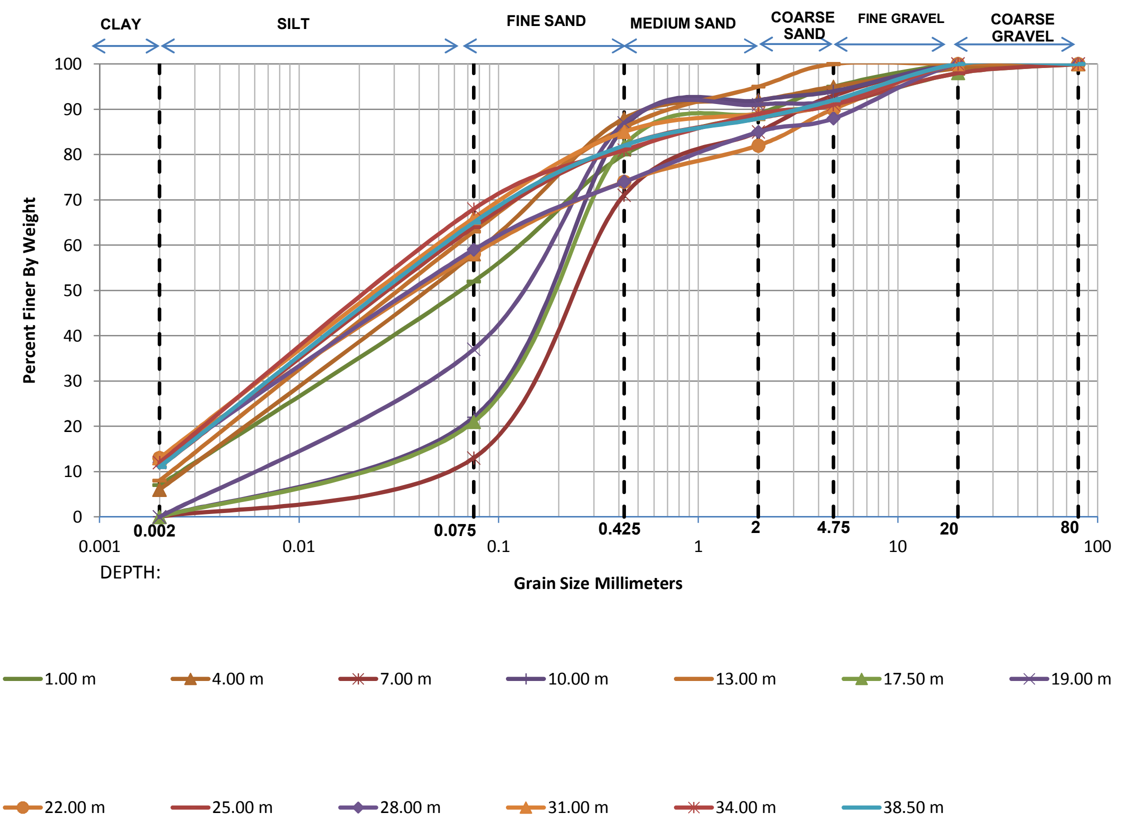
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	3+497 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	6.00	49.00	29.00	13.00	3.00	0.00	0.00	0.0044	0.0249	0.0960	21.72	1.46
4.00 m	11.00	62.00	17.00	5.00	3.00	2.00	0.00	-	0.0122	0.0493	-	-
5.50 m	9.00	61.00	19.00	6.00	2.00	3.00	0.00	0.0024	0.0147	0.0546	22.88	1.67
8.50 m	0.00	28.00	57.00	10.00	1.00	4.00	0.00	0.0149	0.0823	0.2115	14.21	2.15
11.50 m	9.00	59.00	21.00	7.00	1.00	3.00	0.00	0.0024	0.0154	0.0579	24.26	1.70
14.50 m	11.00	60.00	17.00	6.00	2.00	4.00	0.00	-	0.0127	0.0522	-	-
17.50 m	7.00	50.00	27.00	4.00	3.00	9.00	0.00	0.0036	0.0223	0.0858	23.97	1.63
20.50 m	6.00	50.00	30.00	6.00	2.00	6.00	0.00	0.0044	0.0243	0.0895	20.33	1.50
23.50 m	7.00	45.00	32.00	5.00	4.00	5.00	2.00	0.0037	0.0261	0.1107	30.14	1.68
26.50 m	8.00	52.00	27.00	3.00	4.00	6.00	0.00	0.0029	0.0196	0.0750	25.75	1.77
29.50 m	12.00	52.00	16.00	7.00	5.00	8.00	0.00	-	0.0137	0.0649	-	-
32.50 m	10.00	44.00	18.00	12.00	9.00	7.00	0.00	0.0020	0.0205	0.1287	64.37	1.63
35.50 m	11.00	49.00	16.00	13.00	3.00	6.00	2.00	-	0.0161	0.0750	-	-
40.00 m	12.00	46.00	19.00	7.00	4.00	10.00	2.00	-	0.0163	0.0841	-	-

GRAIN SIZE DISTRIBUTION CURVES

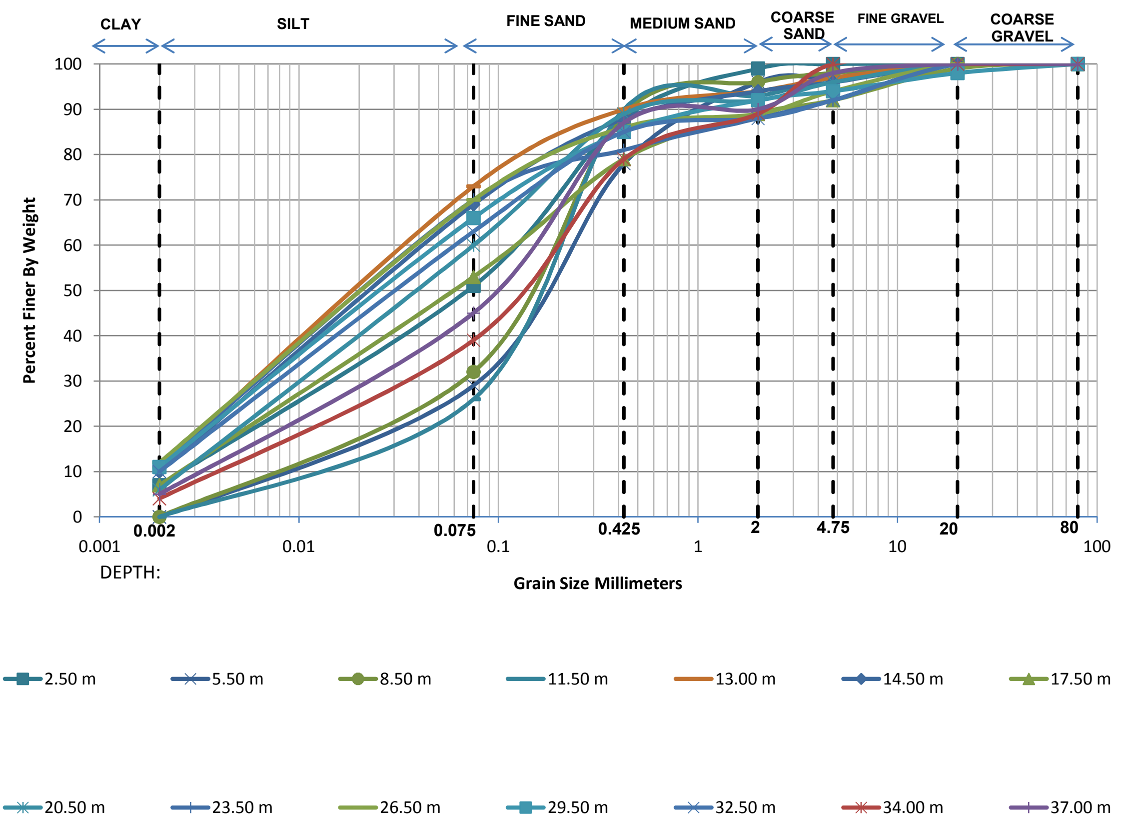
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	3+497 Major Bridge
B.H. No.	BH-P1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	7.00	45.00	28.00	9.00	6.00	5.00	0.00	0.0037	0.0259	0.1180	32.21	1.55
4.00 m	6.00	52.00	30.00	4.00	3.00	4.00	1.00	0.0044	0.0231	0.0810	18.61	1.51
7.00 m	0.00	13.00	58.00	14.00	8.00	7.00	0.00	0.0548	0.1567	0.3191	5.82	1.40
10.00 m	0.00	22.00	64.00	6.00	2.00	6.00	0.00	0.0233	0.1060	0.2263	9.72	2.13
13.00 m	8.00	55.00	23.00	9.00	5.00	0.00	0.00	0.0029	0.0181	0.0679	23.47	1.67
17.50 m	0.00	21.00	61.00	7.00	2.00	7.00	2.00	0.0251	0.1113	0.2426	9.67	2.03
19.00 m	0.00	37.00	50.00	4.00	1.00	8.00	0.00	0.0090	0.0540	0.1711	18.92	1.88
22.00 m	13.00	45.00	16.00	8.00	8.00	10.00	0.00	-	0.0152	0.0861	-	-
25.00 m	11.00	53.00	18.00	6.00	3.00	7.00	2.00	-	0.0147	0.0651	-	-
28.00 m	12.00	47.00	15.00	11.00	3.00	12.00	0.00	-	0.0156	0.0795	-	-
31.00 m	13.00	53.00	19.00	4.00	2.00	9.00	0.00	-	0.0124	0.0605	-	-
34.00 m	12.00	56.00	13.00	8.00	2.00	9.00	0.00	-	0.0125	0.0566	-	-
38.50 m	11.00	54.00	17.00	6.00	4.00	8.00	0.00	-	0.0143	0.0629	-	-

GRAIN SIZE DISTRIBUTION CURVES

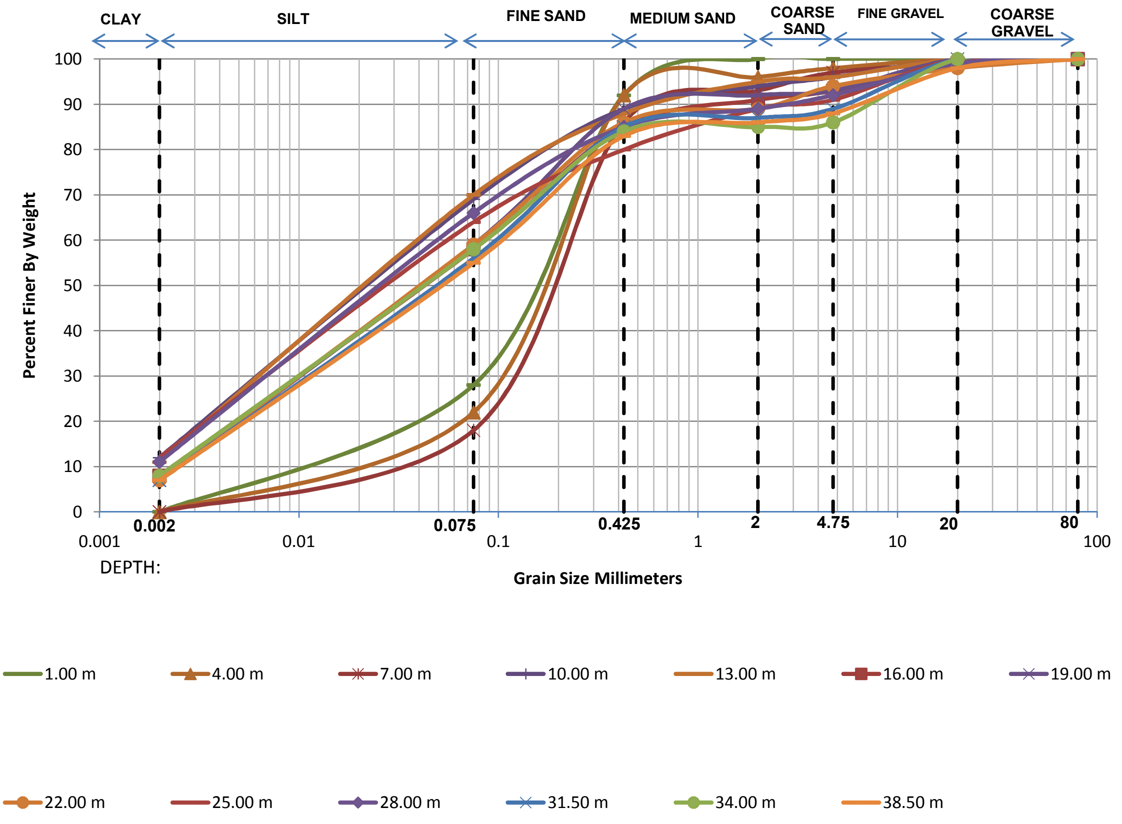
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	3+497 Major Bridge
B.H. No.	BH-P2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	7.00	44.00	37.00	11.00	1.00	0.00	0.00	0.0037	0.0273	0.1122	30.30	1.80
5.50 m	0.00	29.00	49.00	18.00	1.00	3.00	0.00	0.0136	0.0787	0.2384	17.47	1.91
8.50 m	0.00	32.00	57.00	7.00	2.00	2.00	0.00	0.0118	0.0683	0.1859	15.77	2.13
11.50 m	0.00	26.00	64.00	3.00	4.00	3.00	0.00	0.0173	0.0894	0.2025	11.70	2.28
13.00 m	11.00	62.00	17.00	4.00	3.00	3.00	0.00	-	0.0122	0.0493	-	-
14.50 m	10.00	59.00	19.00	6.00	2.00	4.00	0.00	0.0020	0.0141	0.0558	27.92	1.78
17.50 m	7.00	46.00	26.00	10.00	3.00	7.00	1.00	0.0036	0.0250	0.1139	31.28	1.50
20.50 m	6.00	54.00	29.00	3.00	4.00	4.00	0.00	0.0043	0.0220	0.0750	17.40	1.50
23.50 m	11.00	59.00	11.00	7.00	4.00	8.00	0.00	-	0.0127	0.0534	-	-
26.50 m	12.00	58.00	16.00	3.00	5.00	6.00	0.00	-	0.0121	0.0534	-	-
29.50 m	11.00	55.00	19.00	7.00	2.00	4.00	2.00	-	0.0141	0.0610	-	-
32.50 m	10.00	53.00	22.00	3.00	4.00	8.00	0.00	0.0020	0.0161	0.0676	33.81	1.93
34.00 m	4.00	35.00	40.00	10.00	11.00	0.00	0.00	0.0082	0.0477	0.1923	23.58	1.45
37.00 m	5.00	40.00	42.00	3.00	8.00	2.00	0.00	0.0060	0.0367	0.1391	23.14	1.61

GRAIN SIZE DISTRIBUTION CURVES

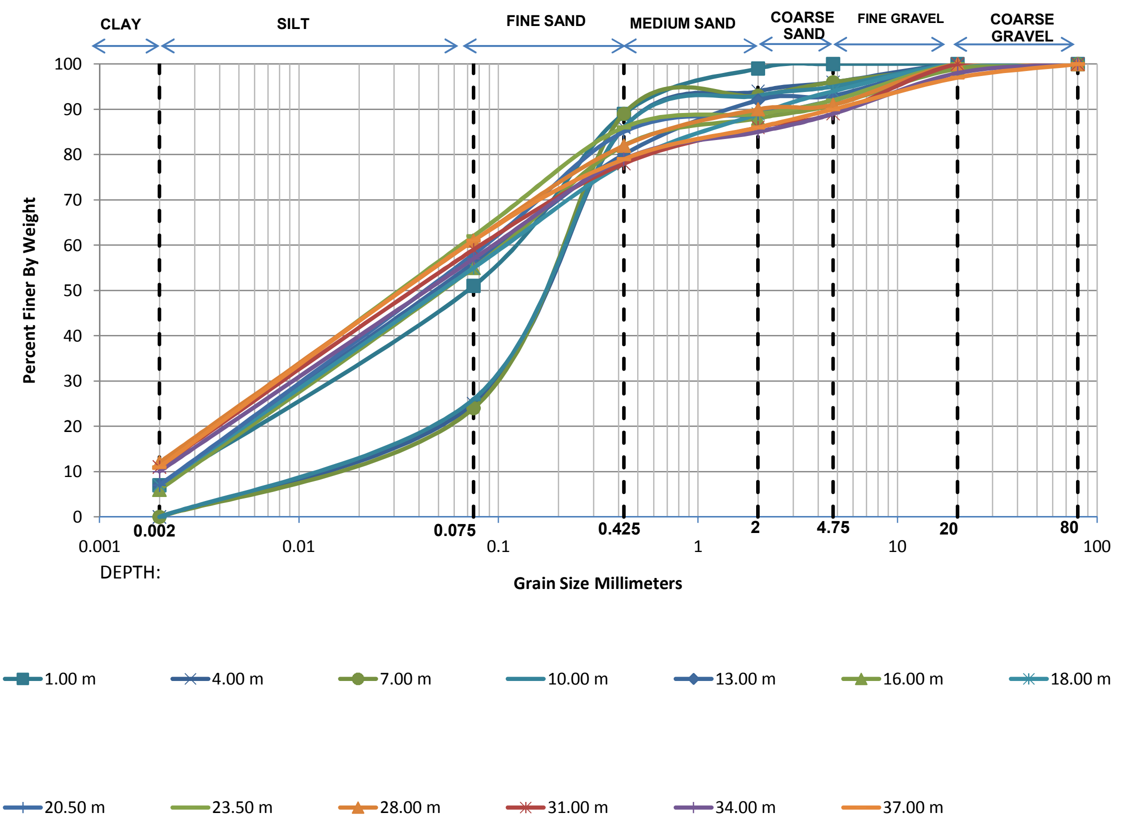
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	3+497 Major Bridge
B.H. No.	BH-P3



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	28.00	64.00	8.00	0.00	0.00	0.00	0.0152	0.0820	0.1931	12.72	2.29
4.00 m	0.00	22.00	70.00	4.00	2.00	2.00	0.00	0.0236	0.1047	0.2110	8.92	2.20
7.00 m	0.00	18.00	68.00	7.00	4.00	2.00	1.00	0.0334	0.1232	0.2387	7.15	1.91
10.00 m	12.00	57.00	20.00	5.00	2.00	4.00	0.00	-	0.0124	0.0552	-	-
13.00 m	11.00	59.00	18.00	7.00	1.00	4.00	0.00	-	0.0130	0.0538	-	-
16.00 m	8.00	50.00	27.00	6.00	2.00	6.00	1.00	0.0029	0.0207	0.0816	27.88	1.79
19.00 m	7.00	52.00	30.00	3.00	1.00	7.00	0.00	0.0036	0.0214	0.0777	21.86	1.65
22.00 m	7.00	52.00	27.00	3.00	5.00	4.00	2.00	0.0036	0.0212	0.0779	21.91	1.63
25.00 m	12.00	52.00	16.00	9.00	2.00	9.00	0.00	-	0.0137	0.0649	-	-
28.00 m	11.00	55.00	19.00	4.00	3.00	7.00	1.00	-	0.0141	0.0610	-	-
31.50 m	7.00	49.00	29.00	2.00	2.00	11.00	0.00	0.0036	0.0231	0.0897	24.94	1.65
34.00 m	8.00	50.00	26.00	1.00	1.00	14.00	0.00	0.0029	0.0206	0.0816	27.89	1.78
38.50 m	7.00	48.00	28.00	3.00	2.00	10.00	2.00	0.0036	0.0237	0.0957	26.51	1.62

GRAIN SIZE DISTRIBUTION CURVES

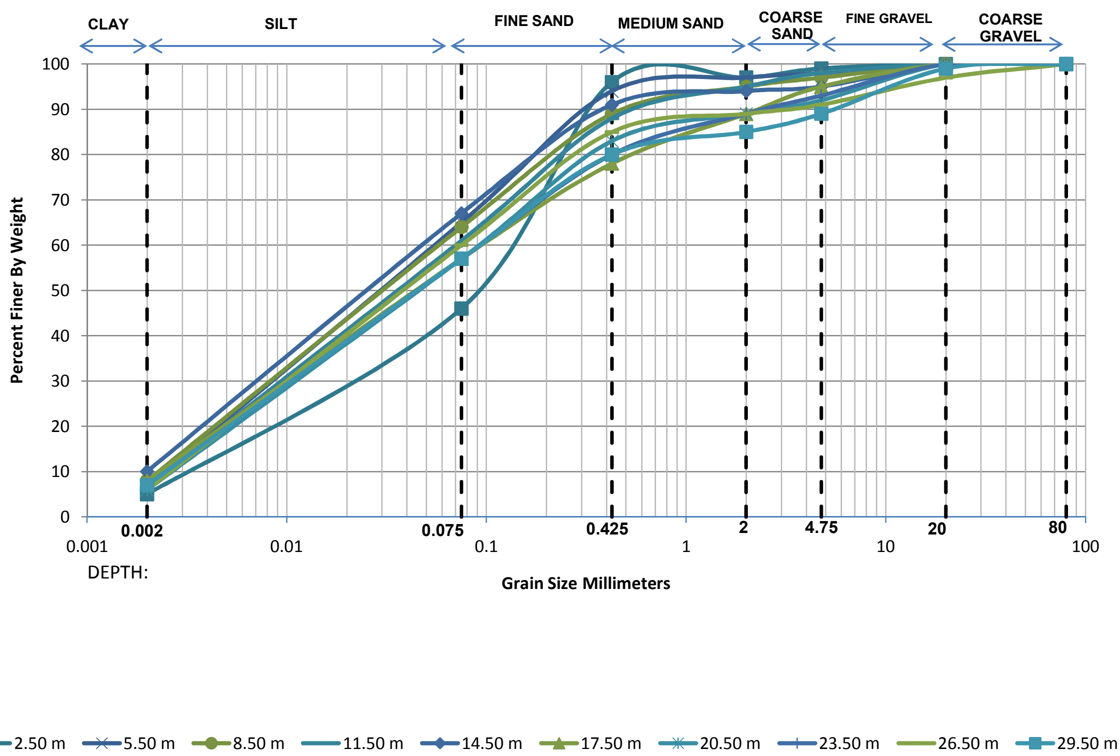
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	3+497 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	7.00	44.00	38.00	10.00	1.00	0.00	0.00	0.0037	0.0274	0.1110	29.96	1.83
4.00 m	0.00	25.00	61.00	8.00	2.00	4.00	0.00	0.0184	0.0938	0.2176	11.82	2.20
7.00 m	0.00	24.00	65.00	4.00	3.00	3.00	1.00	0.0200	0.0973	0.2115	10.57	2.24
10.00 m	0.00	26.00	60.00	7.00	2.00	5.00	0.00	0.0171	0.0898	0.2141	12.50	2.20
13.00 m	7.00	49.00	24.00	12.00	1.00	7.00	0.00	0.0036	0.0228	0.0939	26.15	1.54
16.00 m	6.00	49.00	27.00	6.00	3.00	8.00	1.00	0.0044	0.0248	0.0968	21.92	1.43
18.00 m	7.00	48.00	23.00	11.00	5.00	6.00	0.00	0.0036	0.0233	0.1025	28.45	1.48
20.50 m	7.00	51.00	27.00	4.00	3.00	8.00	0.00	0.0036	0.0218	0.0815	22.84	1.63
23.50 m	11.00	51.00	24.00	3.00	3.00	8.00	0.00	-	0.0157	0.0699	-	-
28.00 m	12.00	49.00	21.00	8.00	1.00	9.00	0.00	-	0.0150	0.0723	-	-
31.00 m	11.00	48.00	19.00	8.00	3.00	11.00	0.00	-	0.0167	0.0786	-	-
34.00 m	10.00	47.00	22.00	6.00	4.00	9.00	2.00	0.0020	0.0189	0.0885	44.24	2.02
37.00 m	11.00	50.00	18.00	7.00	4.00	7.00	3.00	-	0.0158	0.0723	-	-

GRAIN SIZE DISTRIBUTION CURVES

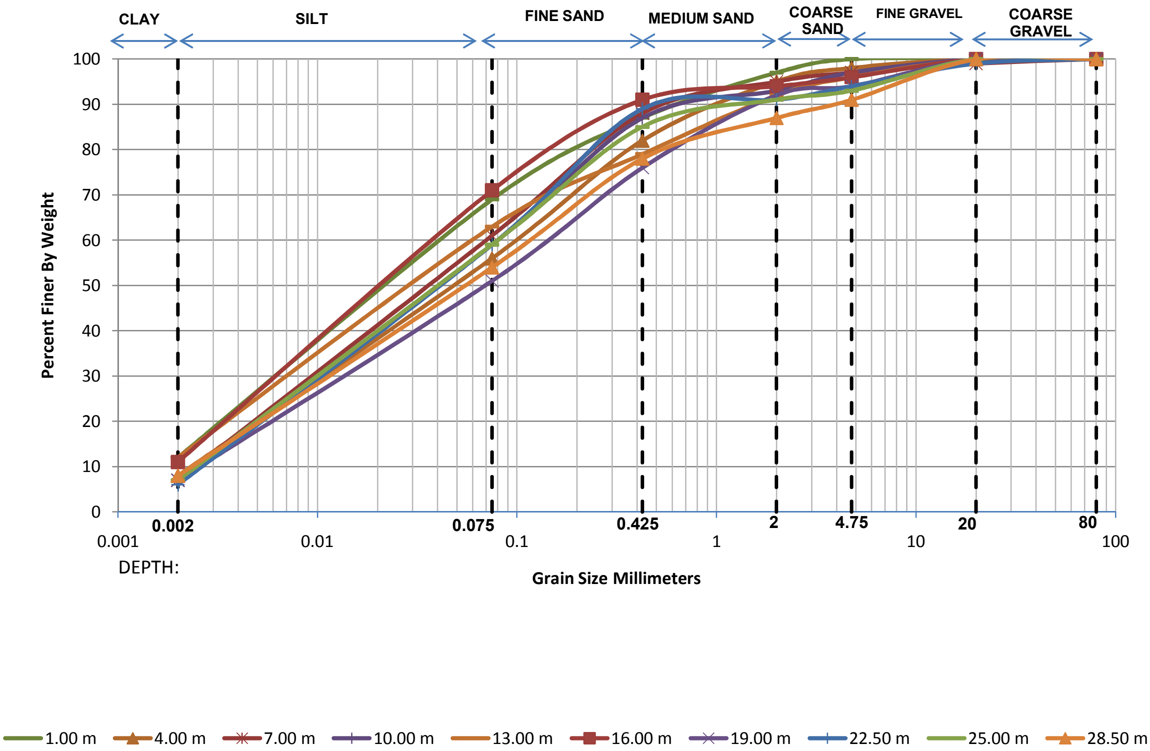
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	3+691 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	5.00	41.00	50.00	1.00	2.00	1.00	0.00	0.0060	0.0359	0.1232	20.57	1.75
5.50 m	7.00	58.00	29.00	3.00	1.00	2.00	0.00	0.0035	0.0187	0.0641	18.39	1.56
8.50 m	8.00	56.00	25.00	6.00	2.00	3.00	0.00	0.0029	0.0178	0.0658	22.79	1.67
11.50 m	7.00	54.00	27.00	7.00	3.00	2.00	0.00	0.0035	0.0203	0.0726	20.57	1.60
14.50 m	10.00	57.00	24.00	3.00	1.00	5.00	0.00	0.0020	0.0148	0.0595	29.77	1.85
17.50 m	8.00	49.00	21.00	11.00	6.00	5.00	0.00	0.0029	0.0209	0.0894	30.54	1.67
20.50 m	6.00	51.00	26.00	6.00	3.00	8.00	0.00	0.0044	0.0234	0.0861	19.73	1.46
23.50 m	7.00	50.00	23.00	9.00	4.00	7.00	0.00	0.0036	0.0221	0.0878	24.58	1.56
26.50 m	6.00	54.00	25.00	4.00	2.00	6.00	3.00	0.0043	0.0218	0.0750	17.44	1.47
29.50 m	7.00	50.00	23.00	5.00	4.00	10.00	1.00	0.0036	0.0221	0.0875	24.48	1.56

GRAIN SIZE DISTRIBUTION CURVES

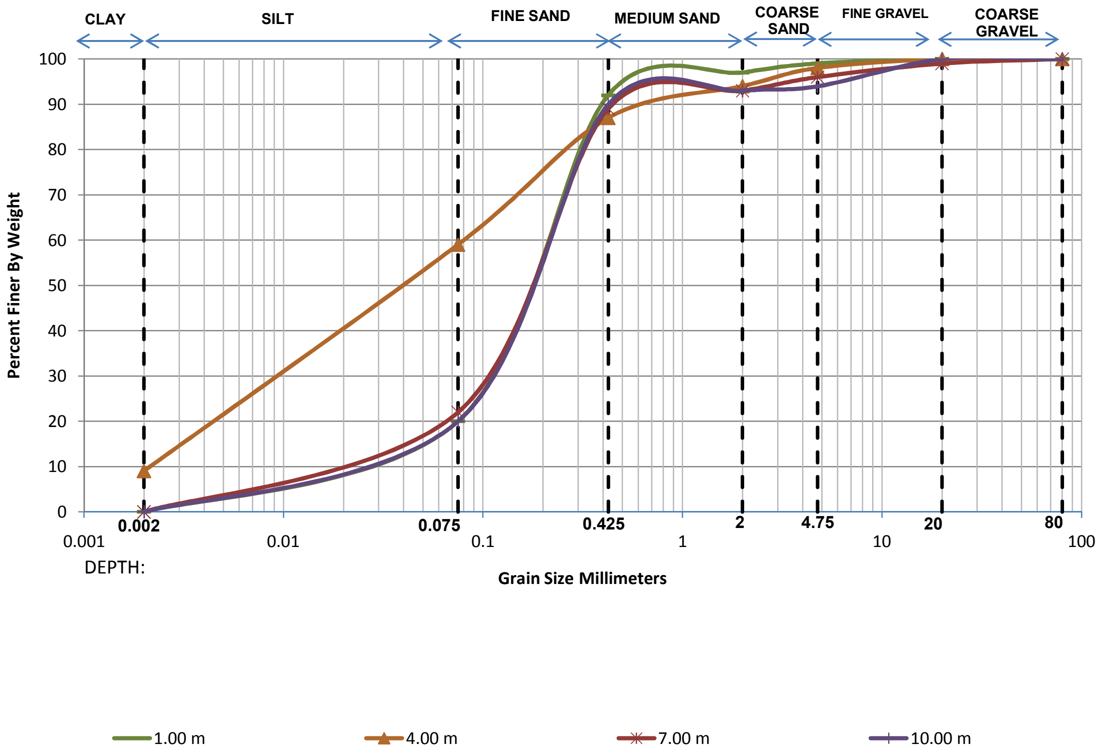
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	3+691 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	12.00	57.00	18.00	10.00	3.00	0.00	0.00	-	0.0124	0.0551	-	-
4.00 m	8.00	48.00	26.00	13.00	3.00	2.00	0.00	0.0029	0.0218	0.0925	31.47	1.75
7.00 m	7.00	54.00	27.00	7.00	2.00	2.00	1.00	0.0035	0.0203	0.0726	20.57	1.60
10.00 m	7.00	52.00	28.00	6.00	4.00	3.00	0.00	0.0036	0.0213	0.0778	21.90	1.64
13.00 m	12.00	51.00	16.00	13.00	4.00	4.00	0.00	-	0.0141	0.0672	-	-
16.00 m	11.00	60.00	20.00	3.00	2.00	4.00	0.00	-	0.0128	0.0524	-	-
19.00 m	7.00	44.00	25.00	16.00	2.00	6.00	0.00	0.0037	0.0265	0.1385	37.68	1.38
22.50 m	6.00	53.00	30.00	2.00	3.00	5.00	1.00	0.0043	0.0226	0.0777	17.94	1.51
25.00 m	7.00	52.00	26.00	6.00	2.00	7.00	0.00	0.0036	0.0212	0.0779	21.94	1.62
28.50 m	8.00	46.00	24.00	9.00	4.00	9.00	0.00	0.0030	0.0230	0.1091	36.92	1.64

GRAIN SIZE DISTRIBUTION CURVES

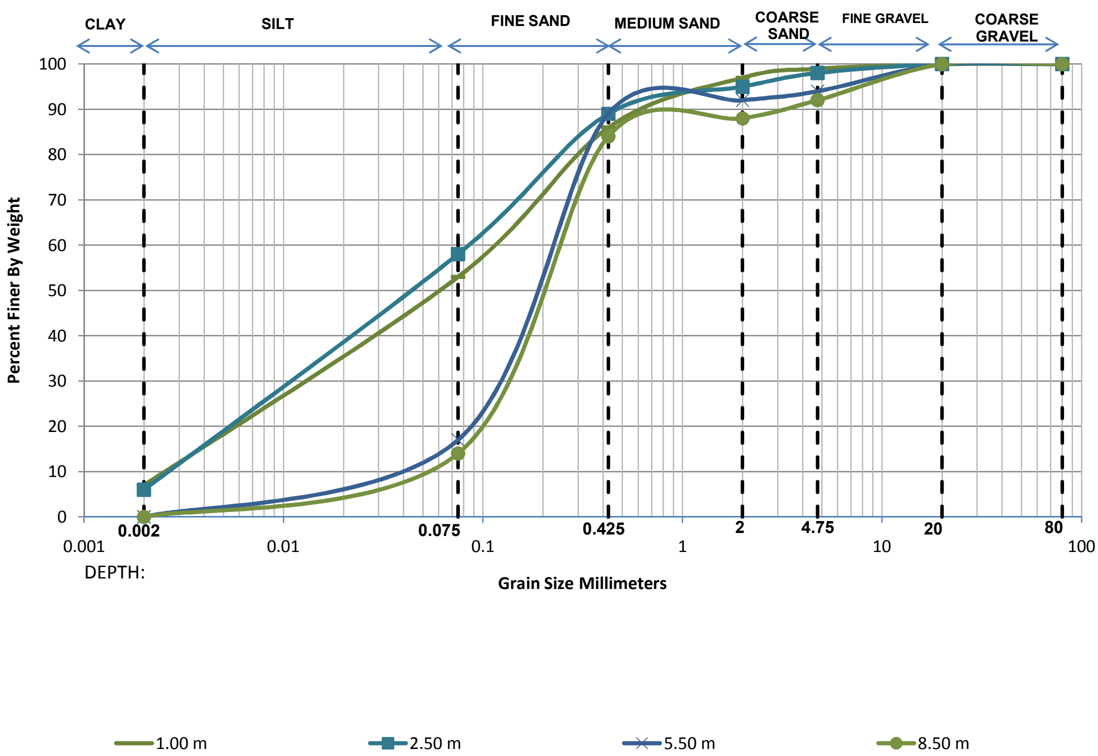
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	4+174 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	20.00	72.00	5.00	2.00	1.00	0.00	0.0281	0.1128	0.2174	7.74	2.09
4.00 m	9.00	50.00	28.00	7.00	4.00	2.00	0.00	0.0024	0.0192	0.0779	32.39	1.96
7.00 m	0.00	22.00	67.00	4.00	3.00	3.00	1.00	0.0235	0.1053	0.2178	9.28	2.17
10.00 m	0.00	20.00	70.00	3.00	1.00	6.00	0.00	0.0280	0.1133	0.2212	7.91	2.07

GRAIN SIZE DISTRIBUTION CURVES

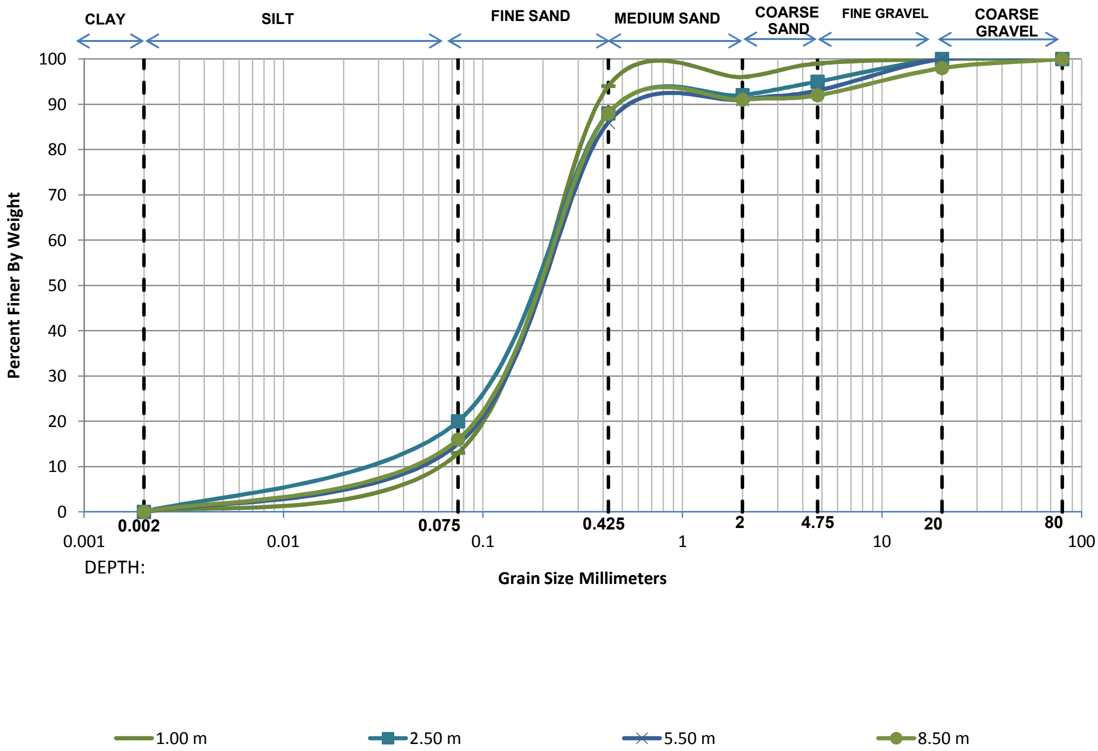
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	4+207 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	7.00	46.00	33.00	11.00	2.00	1.00	0.00	0.0037	0.0254	0.1045	28.58	1.69
2.50 m	6.00	52.00	31.00	6.00	3.00	2.00	0.00	0.0044	0.0232	0.0809	18.58	1.52
5.50 m	0.00	17.00	72.00	3.00	2.00	6.00	0.00	0.0370	0.1264	0.2326	6.28	1.86
8.50 m	0.00	14.00	70.00	4.00	4.00	8.00	0.00	0.0501	0.1422	0.2550	5.09	1.58

GRAIN SIZE DISTRIBUTION CURVES

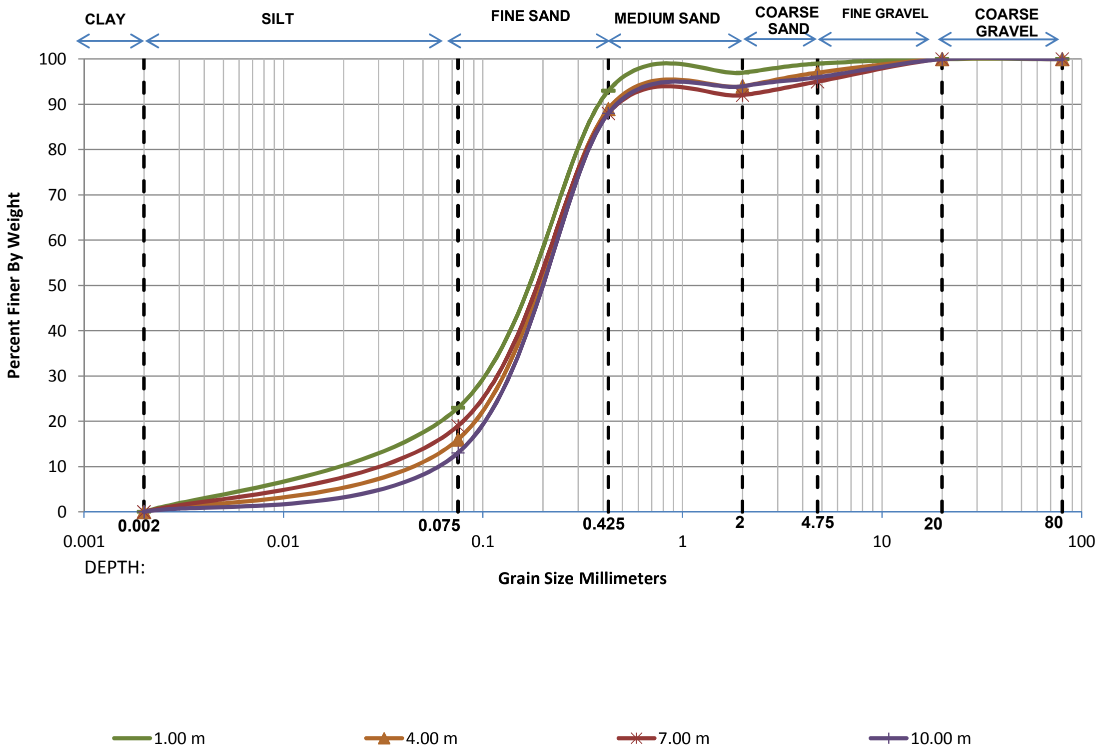
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	4+655 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	13.00	81.00	2.00	3.00	1.00	0.00	0.0565	0.1424	0.2338	4.14	1.54
2.50 m	0.00	20.00	68.00	4.00	3.00	5.00	0.00	0.0278	0.1138	0.2264	8.14	2.06
5.50 m	0.00	15.00	71.00	5.00	2.00	7.00	0.00	0.0452	0.1367	0.2467	5.46	1.68
8.50 m	0.00	16.00	72.00	3.00	1.00	6.00	2.00	0.0409	0.1312	0.2380	5.82	1.77

GRAIN SIZE DISTRIBUTION CURVES

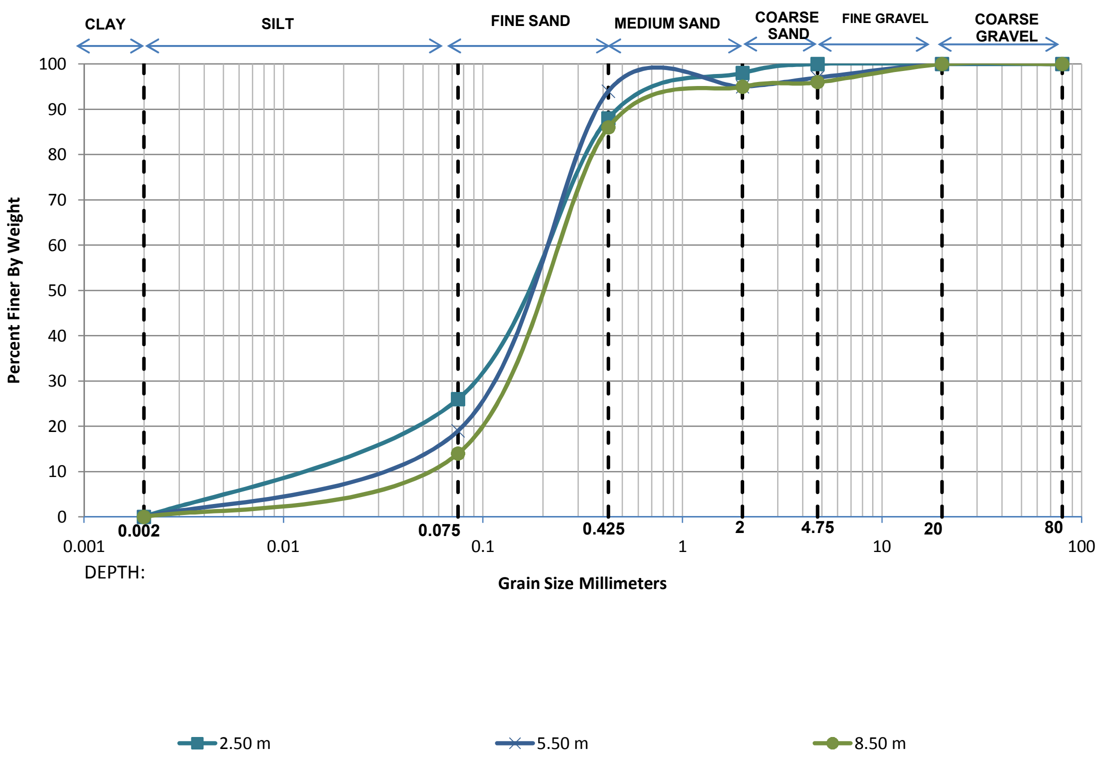
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	5+119 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	23.00	70.00	4.00	2.00	1.00	0.00	0.0219	0.1006	0.2059	9.42	2.25
4.00 m	0.00	16.00	73.00	5.00	3.00	3.00	0.00	0.0409	0.1309	0.2361	5.77	1.77
7.00 m	0.00	19.00	69.00	4.00	3.00	5.00	0.00	0.0305	0.1181	0.2294	7.53	1.99
10.00 m	0.00	13.00	75.00	6.00	2.00	4.00	0.00	0.0561	0.1453	0.2476	4.42	1.52

GRAIN SIZE DISTRIBUTION CURVES

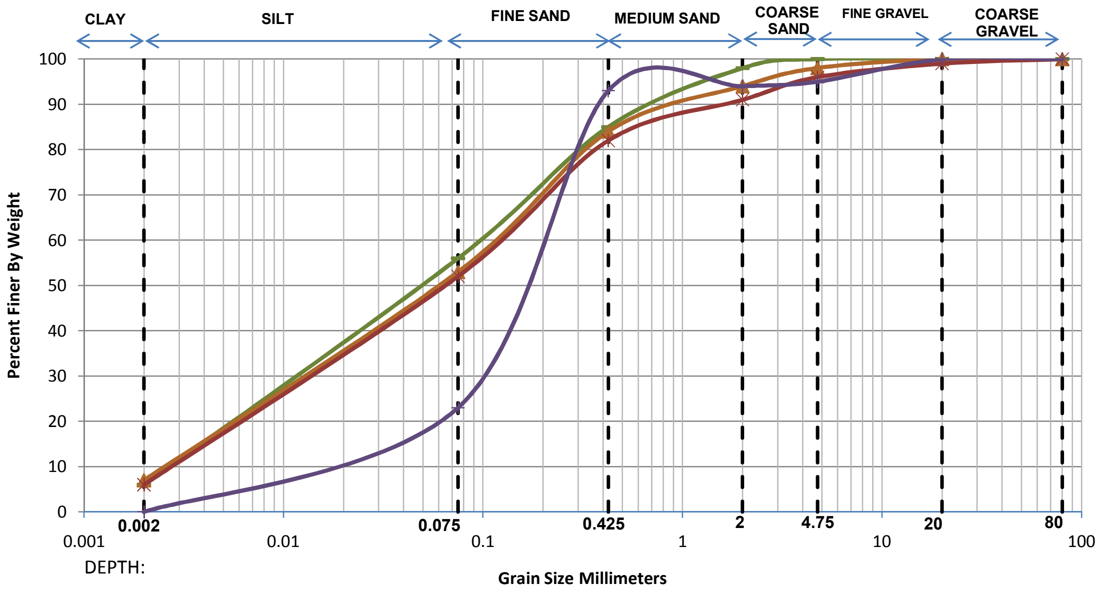
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	5+730 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	0.00	26.00	62.00	10.00	2.00	0.00	0.00	0.0172	0.0897	0.2095	12.17	2.23
5.50 m	0.00	19.00	75.00	1.00	2.00	3.00	0.00	0.0309	0.1163	0.2154	6.98	2.03
8.50 m	0.00	14.00	72.00	9.00	1.00	4.00	0.00	0.0503	0.1417	0.2508	4.99	1.59

GRAIN SIZE DISTRIBUTION CURVES

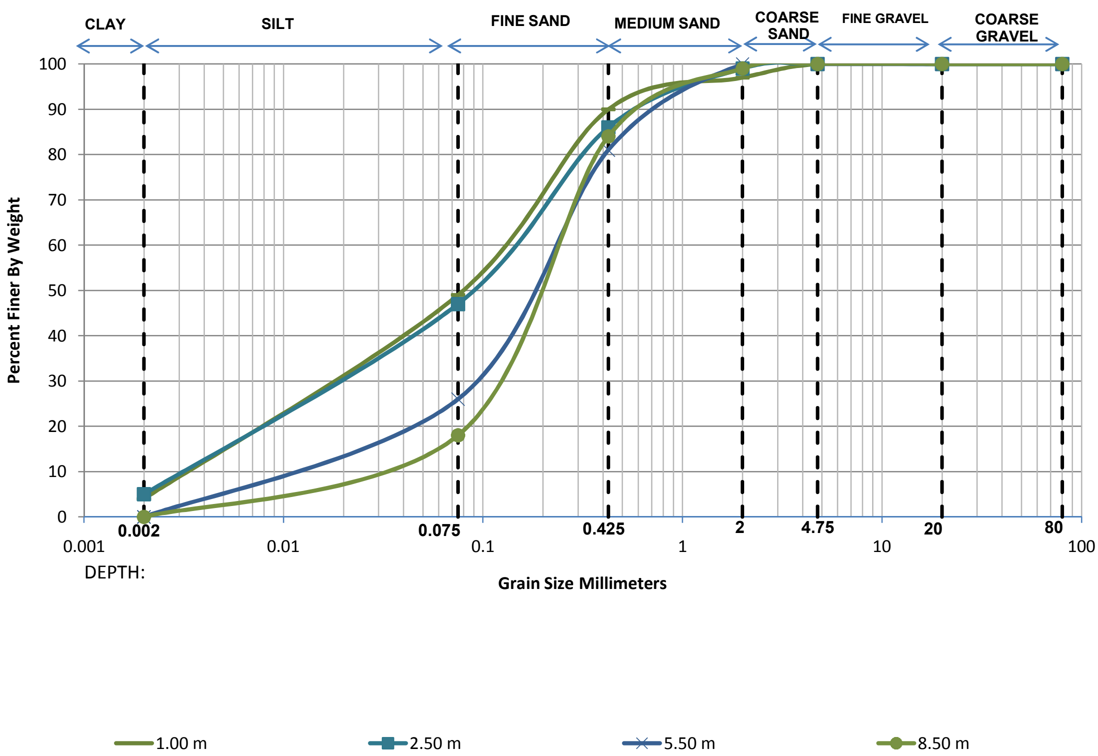
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	6+197 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	6.00	50.00	29.00	13.00	2.00	0.00	0.00	0.0044	0.0242	0.0904	20.57	1.48
4.00 m	7.00	46.00	31.00	10.00	4.00	2.00	0.00	0.0037	0.0253	0.1064	29.13	1.65
7.00 m	6.00	46.00	30.00	9.00	5.00	3.00	1.00	0.0045	0.0272	0.1142	25.32	1.43
10.00 m	0.00	23.00	70.00	1.00	1.00	5.00	0.00	0.0219	0.1005	0.2050	9.38	2.26

GRAIN SIZE DISTRIBUTION CURVES

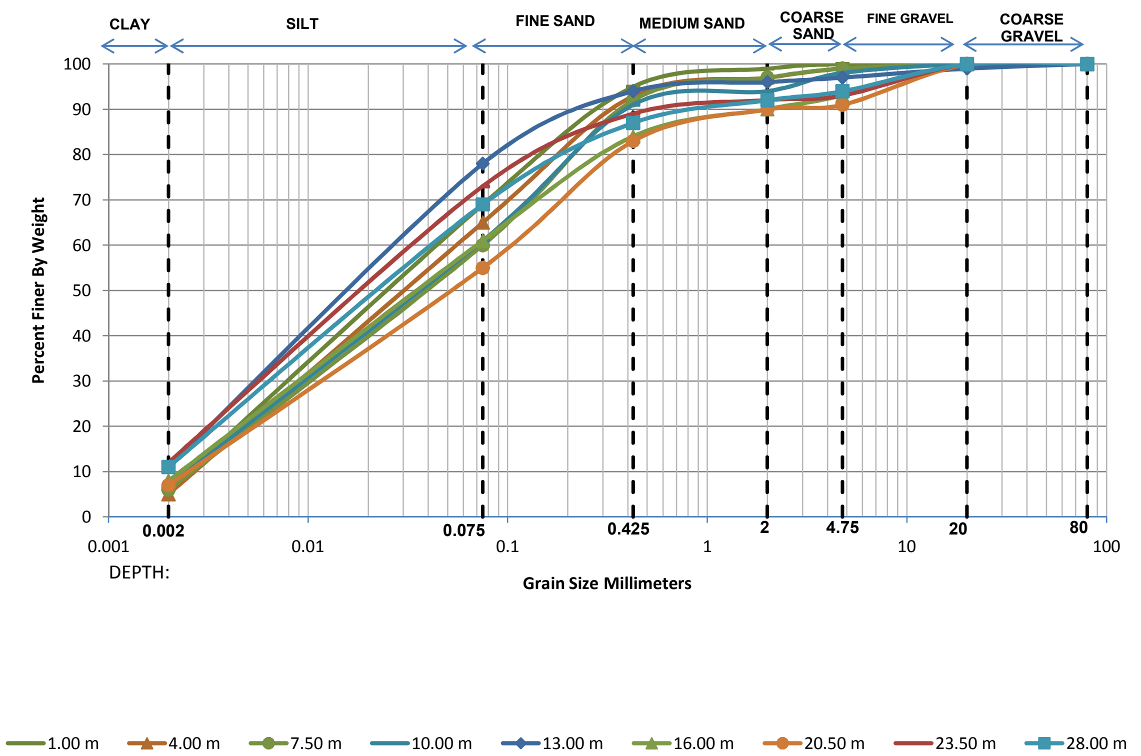
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	6+877 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	4.00	45.00	41.00	7.00	3.00	0.00	0.00	0.0071	0.0332	0.1176	16.56	1.32
2.50 m	5.00	42.00	39.00	13.00	1.00	0.00	0.00	0.0059	0.0339	0.1343	22.94	1.46
5.50 m	0.00	26.00	55.00	19.00	0.00	0.00	0.00	0.0169	0.0905	0.2353	13.95	2.06
8.50 m	0.00	18.00	66.00	15.00	1.00	0.00	0.00	0.0332	0.1244	0.2472	7.44	1.88

GRAIN SIZE DISTRIBUTION CURVES

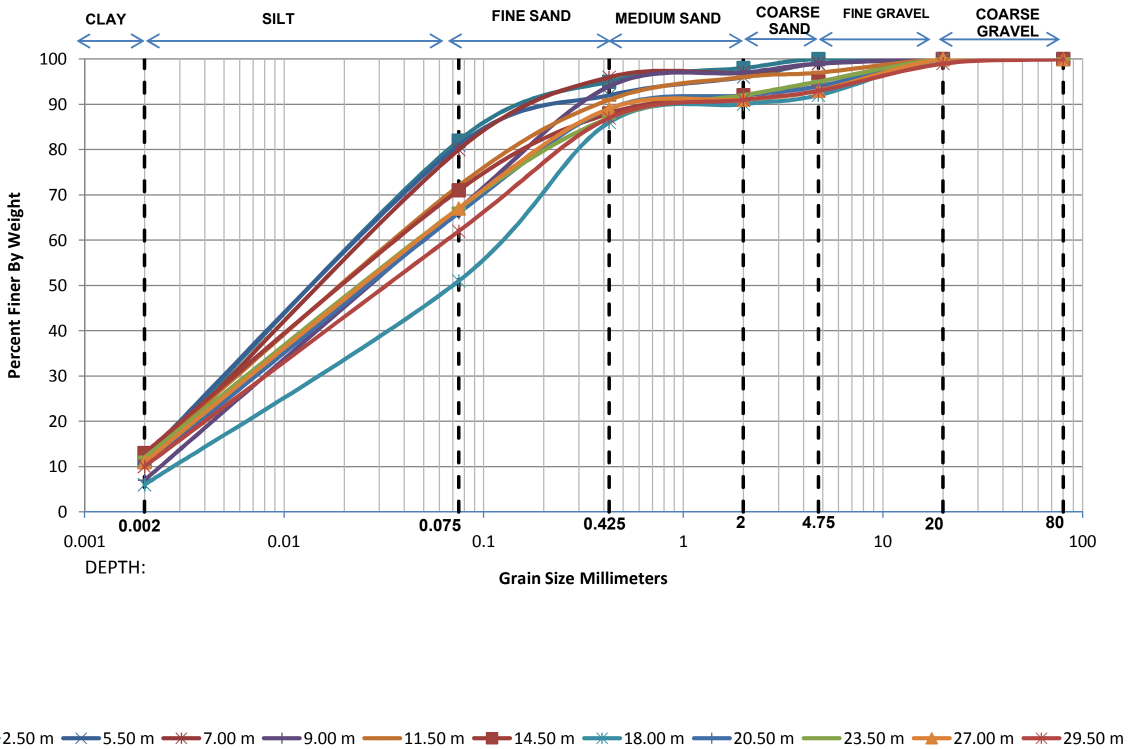
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	7+078 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	6.00	63.00	26.00	4.00	1.00	0.00	0.00	0.0042	0.0184	0.0574	13.82	1.42
4.00 m	5.00	60.00	28.00	4.00	2.00	1.00	0.00	0.0051	0.0211	0.0645	12.60	1.35
7.50 m	6.00	54.00	32.00	5.00	2.00	1.00	0.00	0.0043	0.0221	0.0750	17.38	1.51
10.00 m	7.00	54.00	30.00	3.00	4.00	2.00	0.00	0.0035	0.0204	0.0726	20.56	1.62
13.00 m	11.00	67.00	16.00	2.00	1.00	2.00	1.00	-	0.0113	0.0431	-	-
16.00 m	8.00	53.00	23.00	6.00	3.00	7.00	0.00	0.0029	0.0190	0.0725	24.96	1.71
20.50 m	7.00	48.00	28.00	7.00	1.00	9.00	0.00	0.0036	0.0237	0.0963	26.66	1.61
23.50 m	12.00	61.00	16.00	3.00	1.00	7.00	0.00	-	0.0114	0.0488	-	-
28.00 m	11.00	58.00	18.00	5.00	2.00	6.00	0.00	-	0.0132	0.0555	-	-

GRAIN SIZE DISTRIBUTION CURVES

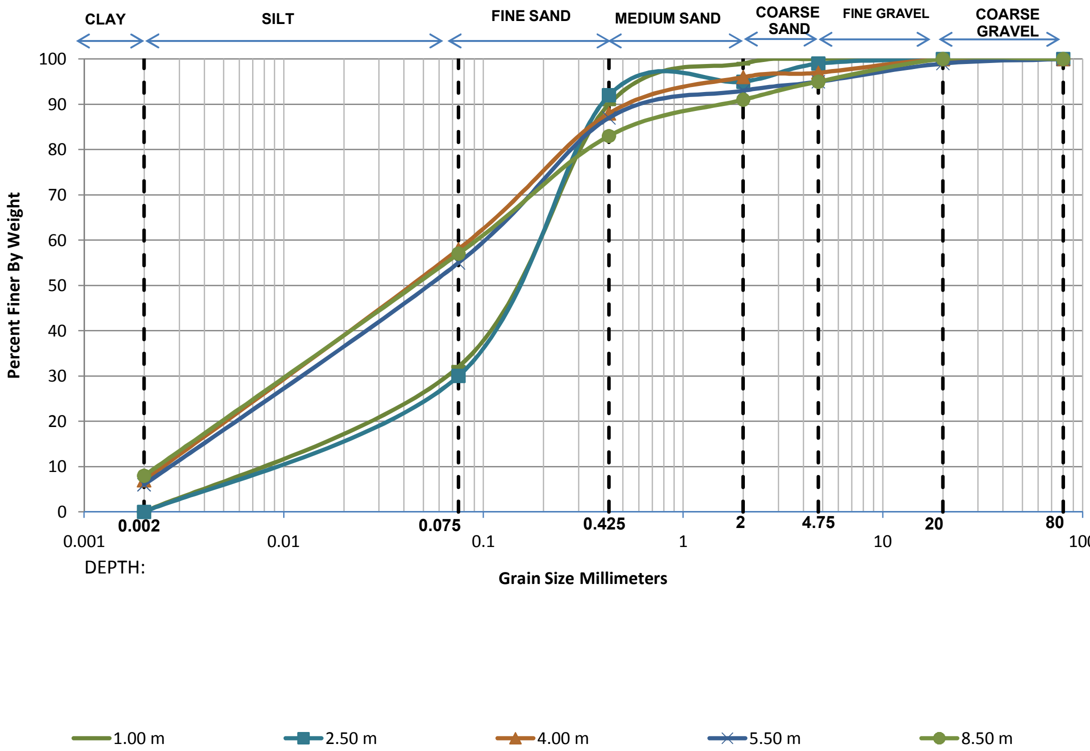
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	7+078 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	11.00	71.00	13.00	3.00	2.00	0.00	0.00	-	0.0107	0.0390	-	-
5.50 m	12.00	69.00	11.00	4.00	3.00	1.00	0.00	-	0.0100	0.0393	-	-
7.00 m	10.00	70.00	16.00	1.00	2.00	1.00	0.00	0.0020	0.0118	0.0416	20.79	1.67
9.00 m	7.00	60.00	27.00	3.00	2.00	1.00	0.00	0.0035	0.0179	0.0604	17.44	1.53
11.50 m	12.00	60.00	19.00	5.00	1.00	3.00	0.00	-	0.0117	0.0504	-	-
14.50 m	13.00	58.00	17.00	4.00	3.00	5.00	0.00	-	0.0111	0.0514	-	-
18.00 m	6.00	45.00	35.00	4.00	2.00	8.00	0.00	0.0046	0.0284	0.1129	24.75	1.56
20.50 m	10.00	56.00	23.00	3.00	2.00	6.00	0.00	0.0020	0.0151	0.0614	30.69	1.86
23.50 m	12.00	55.00	20.00	5.00	3.00	5.00	0.00	-	0.0130	0.0588	-	-
27.00 m	11.00	56.00	22.00	2.00	2.00	7.00	0.00	-	0.0139	0.0592	-	-
29.50 m	10.00	52.00	25.00	4.00	2.00	6.00	1.00	0.0020	0.0167	0.0700	35.00	1.98

GRAIN SIZE DISTRIBUTION CURVES

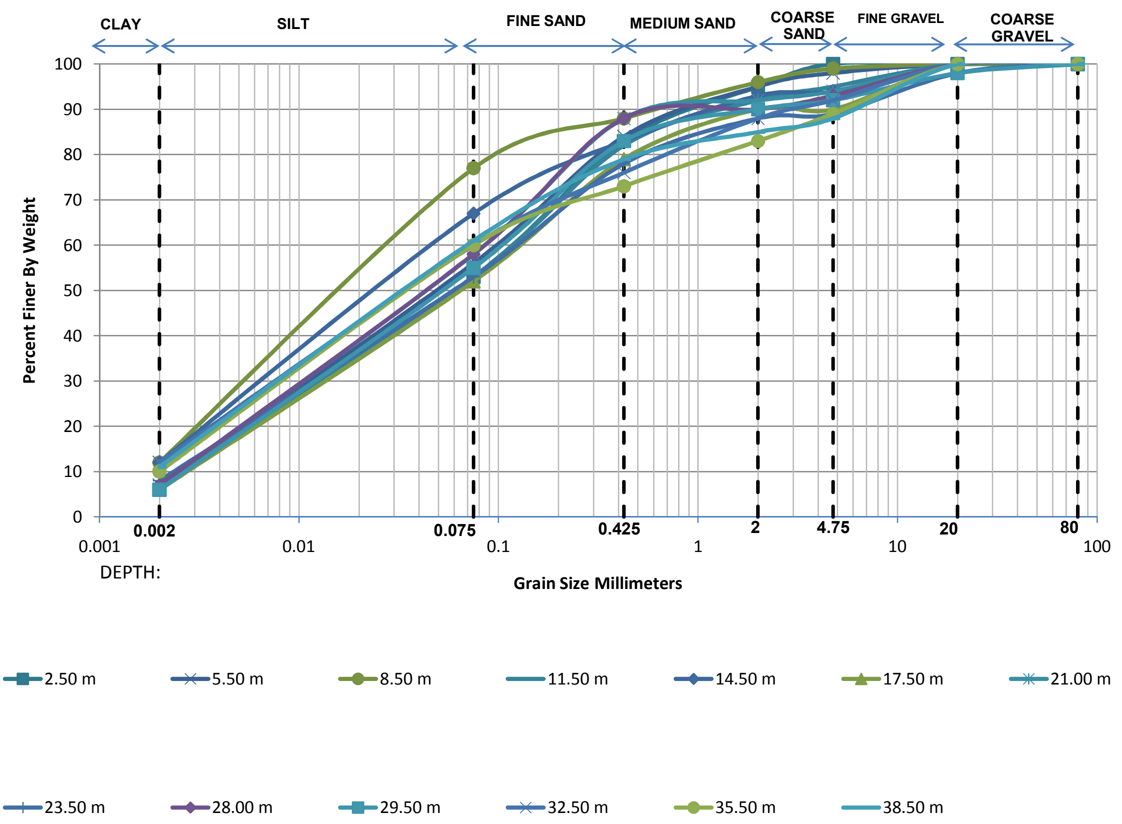
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	7+256 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	32.00	58.00	9.00	1.00	0.00	0.00	0.0118	0.0684	0.1842	15.59	2.15
2.50 m	0.00	30.00	62.00	3.00	4.00	1.00	0.00	0.0134	0.0750	0.1850	13.84	2.27
4.00 m	7.00	51.00	30.00	8.00	1.00	3.00	0.00	0.0036	0.0219	0.0812	22.73	1.66
5.50 m	6.00	49.00	32.00	6.00	2.00	4.00	1.00	0.0044	0.0251	0.0935	21.09	1.52
8.50 m	8.00	49.00	26.00	8.00	4.00	5.00	0.00	0.0029	0.0212	0.0865	29.49	1.77

GRAIN SIZE DISTRIBUTION CURVES

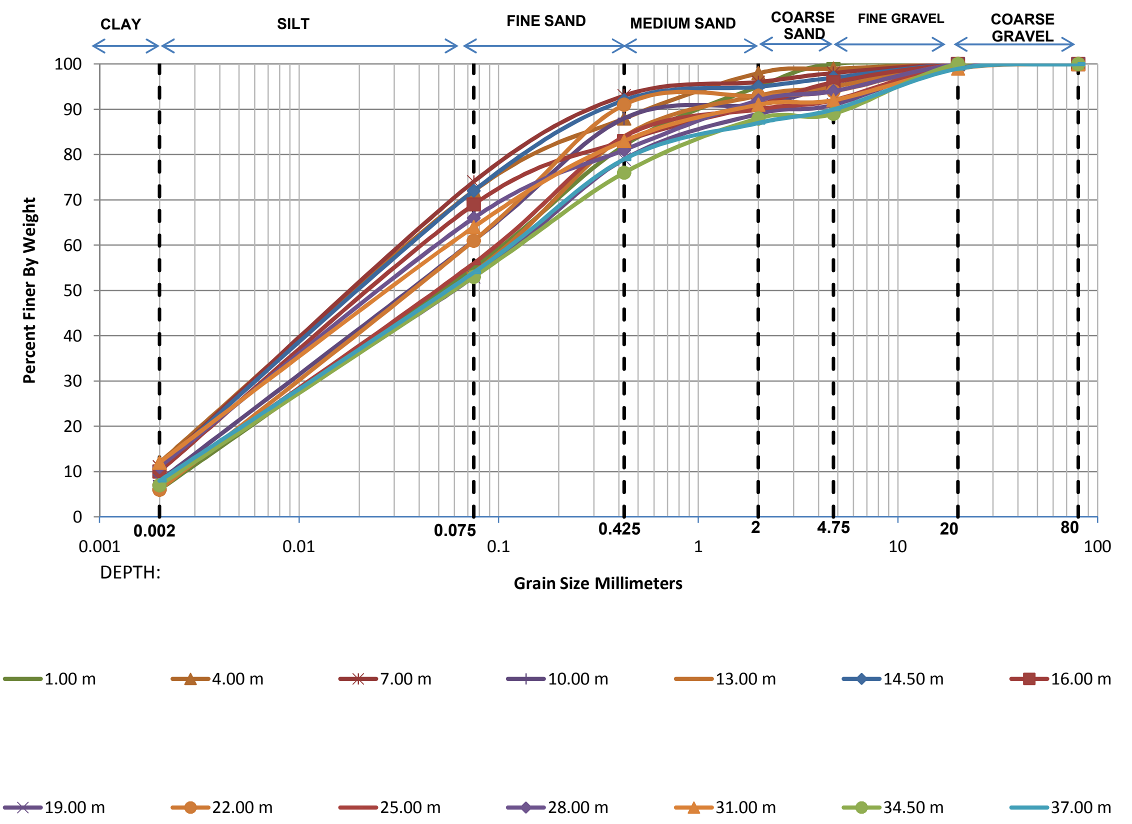
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	7+351 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	6.00	47.00	30.00	12.00	5.00	0.00	0.00	0.0045	0.0264	0.1077	24.04	1.44
5.50 m	7.00	49.00	28.00	11.00	3.00	2.00	0.00	0.0036	0.0230	0.0909	25.29	1.62
8.50 m	12.00	65.00	11.00	8.00	3.00	1.00	0.00	-	0.0106	0.0435	-	-
11.50 m	7.00	46.00	29.00	10.00	3.00	5.00	0.00	0.0036	0.0252	0.1089	29.86	1.59
14.50 m	12.00	55.00	16.00	10.00	1.00	6.00	0.00	-	0.0128	0.0586	-	-
17.50 m	6.00	46.00	27.00	11.00	0.00	10.00	0.00	0.0045	0.0270	0.1205	26.79	1.34
21.00 m	7.00	51.00	30.00	4.00	2.00	6.00	0.00	0.0036	0.0219	0.0811	22.71	1.66
23.50 m	8.00	45.00	25.00	10.00	1.00	9.00	2.00	0.0030	0.0238	0.1162	39.21	1.64
28.00 m	7.00	51.00	30.00	2.00	3.00	7.00	0.00	0.0036	0.0219	0.0810	22.70	1.66
29.50 m	6.00	49.00	28.00	7.00	2.00	6.00	2.00	0.0044	0.0248	0.0961	21.75	1.45
32.50 m	12.00	48.00	16.00	12.00	4.00	8.00	0.00	-	0.0152	0.0750	-	-
35.50 m	10.00	50.00	13.00	10.00	6.00	11.00	0.00	0.0020	0.0169	0.0750	37.50	1.91
38.50 m	11.00	50.00	18.00	6.00	3.00	12.00	0.00	-	0.0158	0.0723	-	-

GRAIN SIZE DISTRIBUTION CURVES

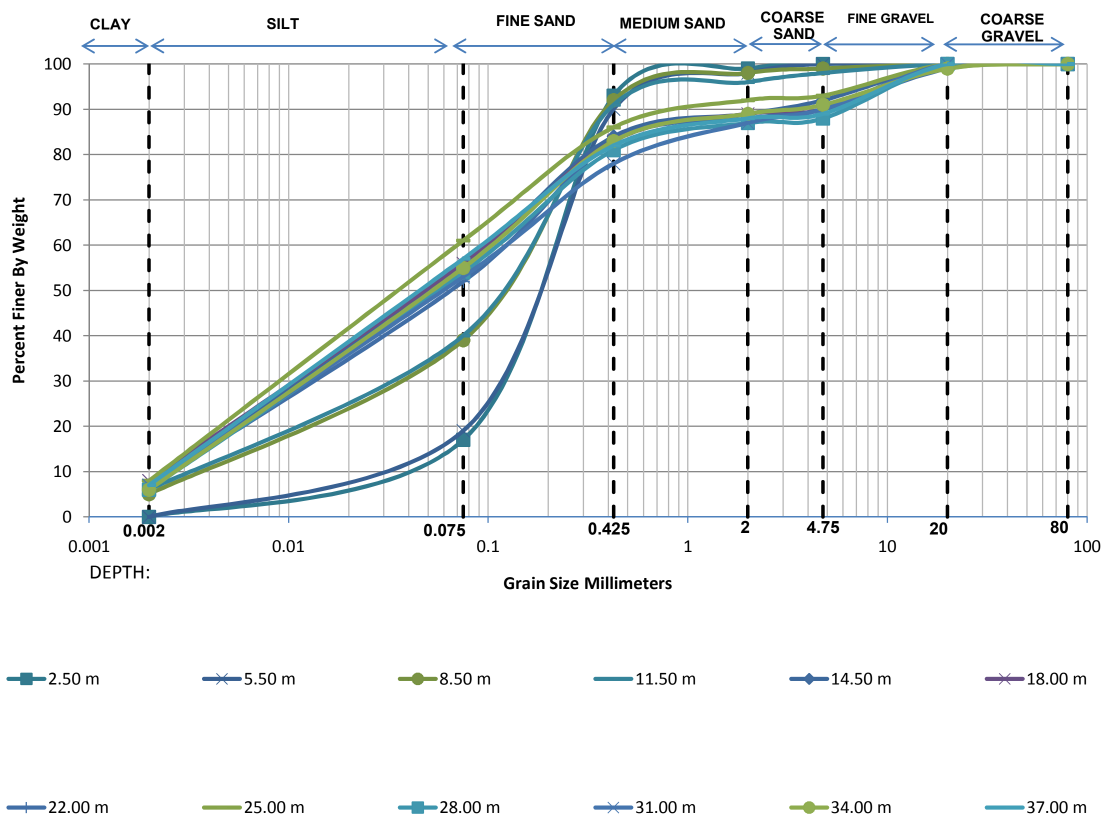
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	7+351 Major Bridge
B.H. No.	BH-P1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	6.00	49.00	27.00	13.00	5.00	0.00	0.00	0.0044	0.0248	0.0978	22.14	1.42
4.00 m	12.00	60.00	16.00	10.00	1.00	1.00	0.00	-	0.0116	0.0503	-	-
7.00 m	11.00	63.00	19.00	3.00	2.00	2.00	0.00	-	0.0121	0.0481	-	-
10.00 m	8.00	53.00	27.00	3.00	4.00	5.00	0.00	0.0029	0.0192	0.0725	24.95	1.74
13.00 m	7.00	47.00	30.00	9.00	2.00	5.00	0.00	0.0036	0.0245	0.1009	27.79	1.63
14.50 m	11.00	61.00	20.00	3.00	2.00	3.00	0.00	-	0.0125	0.0509	-	-
16.00 m	10.00	59.00	14.00	8.00	5.00	4.00	0.00	0.0020	0.0139	0.0556	27.79	1.74
19.00 m	8.00	45.00	26.00	10.00	2.00	9.00	0.00	0.0030	0.0239	0.1141	38.49	1.68
22.00 m	6.00	55.00	30.00	2.00	1.00	6.00	0.00	0.0043	0.0216	0.0726	16.93	1.49
25.00 m	7.00	49.00	28.00	6.00	2.00	8.00	0.00	0.0036	0.0230	0.0905	25.17	1.63
28.00 m	11.00	55.00	15.00	11.00	2.00	6.00	0.00	-	0.0139	0.0608	-	-
31.00 m	12.00	52.00	19.00	8.00	1.00	7.00	1.00	-	0.0138	0.0650	-	-
34.50 m	7.00	46.00	23.00	12.00	1.00	11.00	0.00	0.0036	0.0248	0.1218	33.52	1.38
37.00 m	8.00	46.00	25.00	8.00	3.00	9.00	1.00	0.0030	0.0231	0.1071	36.23	1.68

GRAIN SIZE DISTRIBUTION CURVES

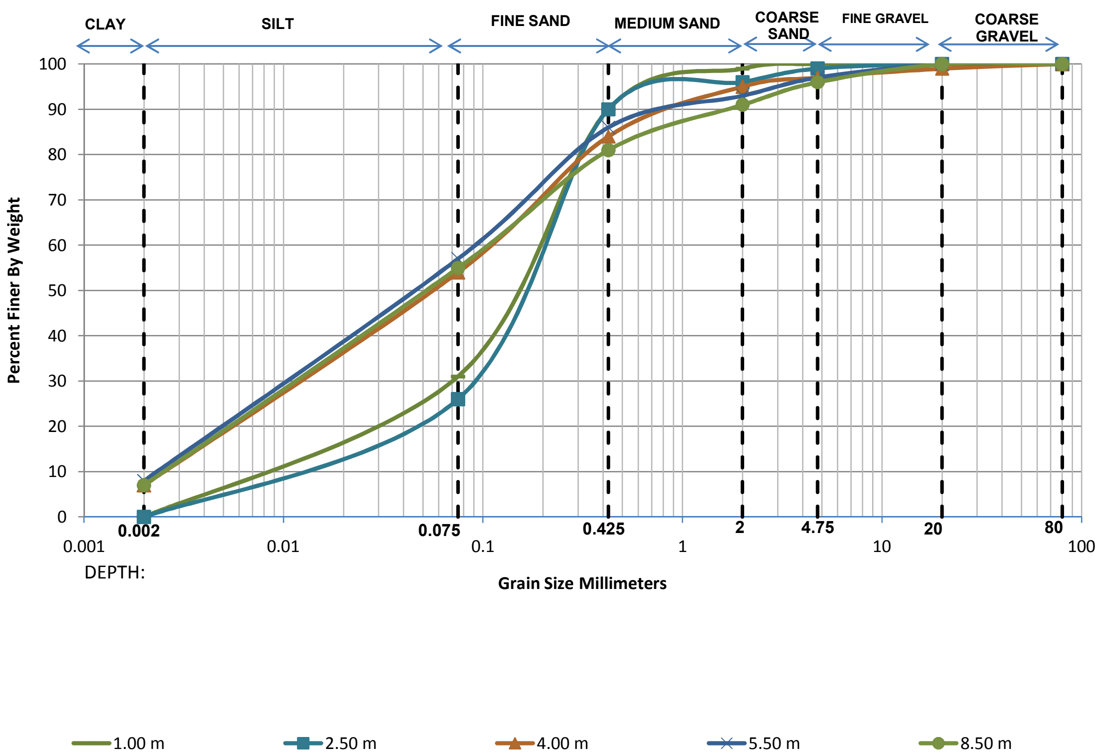
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	7+351 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	0.00	17.00	76.00	6.00	1.00	0.00	0.00	0.0373	0.1252	0.2247	6.03	1.87
5.50 m	0.00	19.00	71.00	8.00	2.00	0.00	0.00	0.0306	0.1177	0.2257	7.37	2.00
8.50 m	5.00	34.00	53.00	6.00	1.00	1.00	0.00	0.0067	0.0478	0.1564	23.37	2.18
11.50 m	6.00	34.00	51.00	5.00	2.00	2.00	0.00	0.0052	0.0447	0.1544	29.51	2.47
14.50 m	7.00	49.00	28.00	5.00	3.00	8.00	0.00	0.0036	0.0230	0.0904	25.15	1.63
18.00 m	8.00	48.00	27.00	6.00	1.00	10.00	0.00	0.0029	0.0219	0.0912	31.01	1.78
22.00 m	7.00	45.00	31.00	5.00	2.00	9.00	1.00	0.0037	0.0261	0.1120	30.52	1.66
25.00 m	8.00	53.00	25.00	6.00	1.00	7.00	0.00	0.0029	0.0191	0.0725	24.96	1.73
28.00 m	6.00	48.00	27.00	6.00	1.00	12.00	0.00	0.0044	0.0254	0.1034	23.28	1.41
31.00 m	7.00	46.00	25.00	9.00	3.00	10.00	0.00	0.0036	0.0249	0.1157	31.80	1.47
34.00 m	6.00	49.00	28.00	6.00	2.00	8.00	1.00	0.0044	0.0248	0.0960	21.72	1.45
37.00 m	7.00	50.00	25.00	6.00	1.00	11.00	0.00	0.0036	0.0222	0.0866	24.22	1.59

GRAIN SIZE DISTRIBUTION CURVES

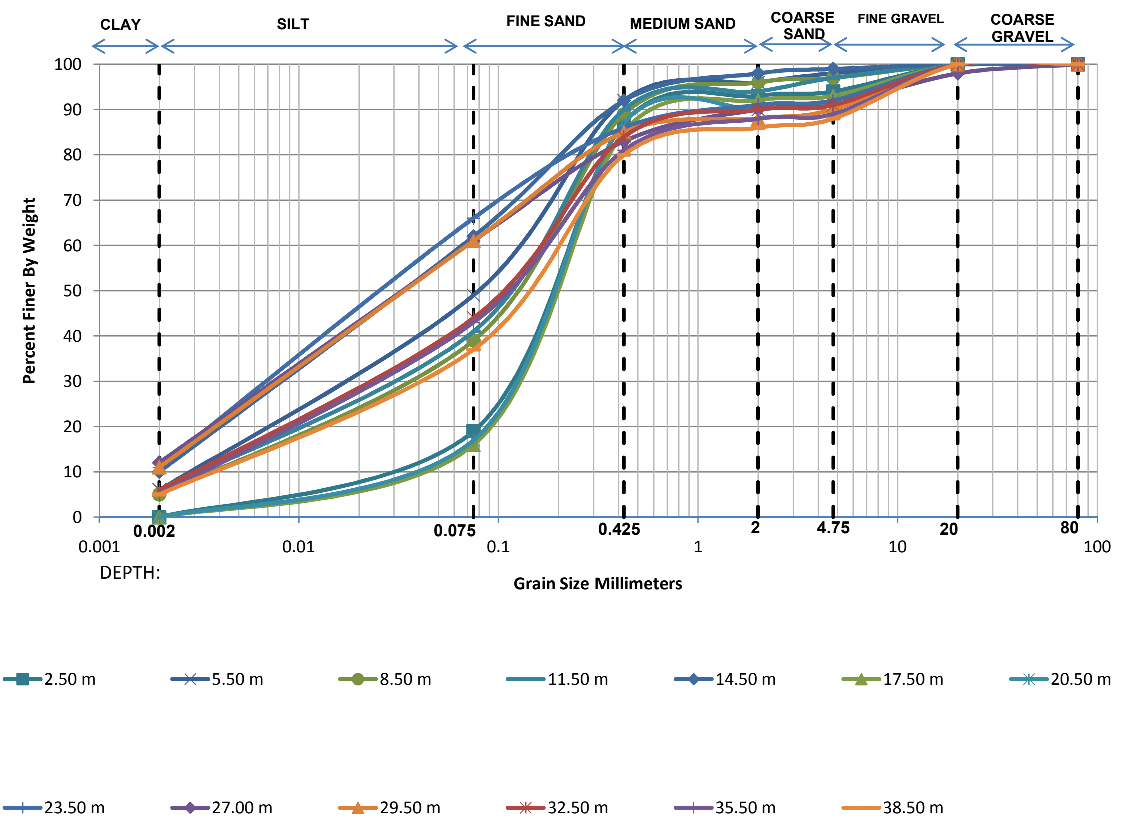
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	7+457 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	31.00	59.00	9.00	1.00	0.00	0.00	0.0125	0.0716	0.1877	14.99	2.18
2.50 m	0.00	26.00	64.00	6.00	3.00	1.00	0.00	0.0173	0.0895	0.2034	11.75	2.27
4.00 m	7.00	47.00	30.00	11.00	2.00	2.00	1.00	0.0036	0.0245	0.1012	27.87	1.63
5.50 m	8.00	49.00	29.00	7.00	4.00	3.00	0.00	0.0029	0.0214	0.0855	29.12	1.82
8.50 m	7.00	48.00	26.00	10.00	5.00	4.00	0.00	0.0036	0.0235	0.0985	27.30	1.56

GRAIN SIZE DISTRIBUTION CURVES

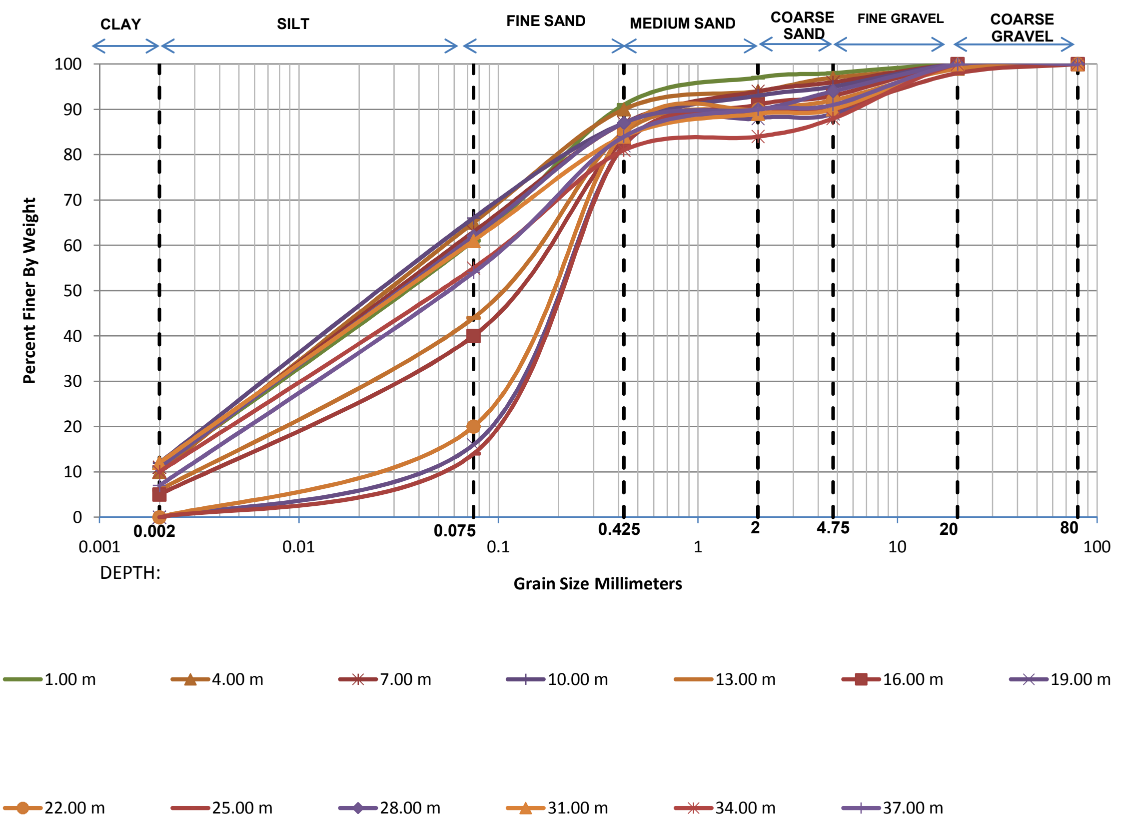
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	7+613 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	0.00	19.00	68.00	6.00	1.00	6.00	0.00	0.0304	0.1185	0.2326	7.65	1.98
5.50 m	6.00	43.00	43.00	4.00	2.00	2.00	0.00	0.0047	0.0308	0.1157	24.81	1.76
8.50 m	5.00	34.00	50.00	7.00	1.00	3.00	0.00	0.0067	0.0476	0.1621	24.33	2.09
11.50 m	6.00	35.00	49.00	4.00	3.00	3.00	0.00	0.0051	0.0426	0.1518	29.53	2.32
14.50 m	10.00	52.00	30.00	6.00	1.00	1.00	0.00	0.0020	0.0169	0.0701	35.04	2.03
17.50 m	0.00	16.00	69.00	7.00	1.00	7.00	0.00	0.0406	0.1326	0.2473	6.09	1.75
20.50 m	0.00	17.00	70.00	3.00	2.00	8.00	0.00	0.0369	0.1271	0.2376	6.44	1.84
23.50 m	11.00	55.00	20.00	5.00	1.00	8.00	0.00	-	0.0141	0.0610	-	-
27.00 m	12.00	49.00	22.00	7.00	1.00	7.00	2.00	-	0.0151	0.0723	-	-
29.50 m	11.00	50.00	24.00	3.00	2.00	10.00	0.00	-	0.0161	0.0724	-	-
32.50 m	6.00	38.00	40.00	6.00	1.00	9.00	0.00	0.0049	0.0368	0.1513	30.95	1.83
35.50 m	5.00	38.00	38.00	7.00	1.00	11.00	0.00	0.0061	0.0393	0.1646	26.81	1.53
38.50 m	5.00	32.00	43.00	6.00	2.00	12.00	0.00	0.0069	0.0516	0.1957	28.51	1.99

GRAIN SIZE DISTRIBUTION CURVES

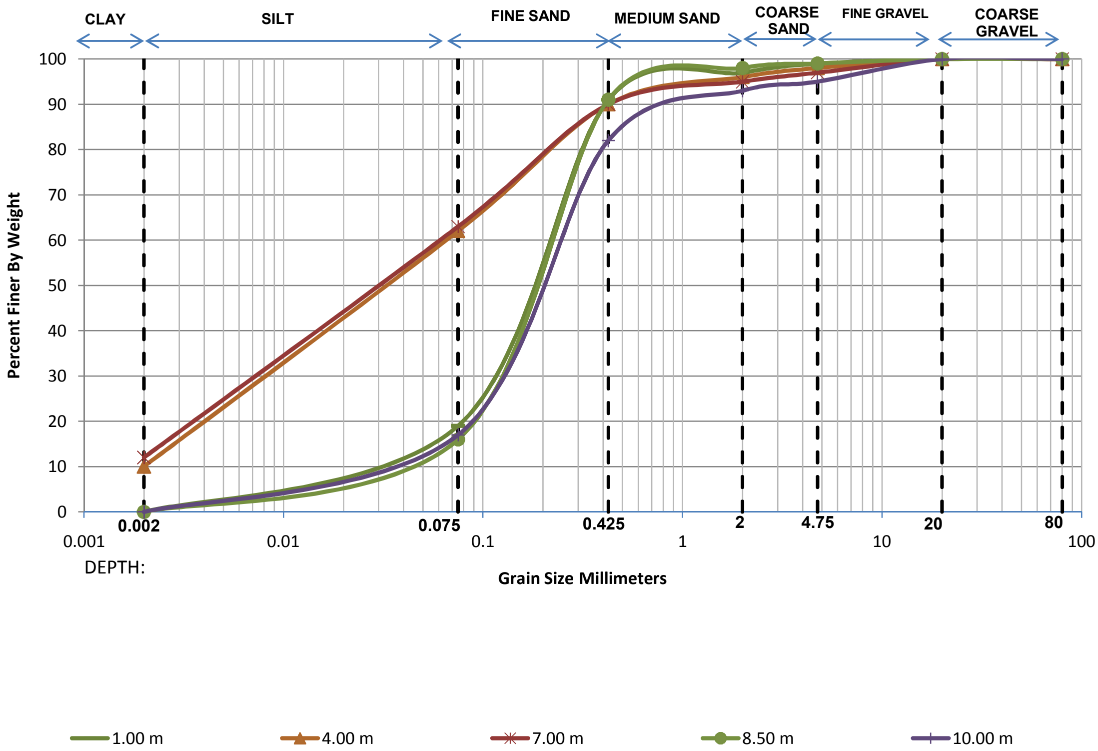
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	7+613 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	11.00	50.00	30.00	6.00	1.00	2.00	0.00	-	0.0164	0.0724	-	-
4.00 m	10.00	55.00	25.00	4.00	3.00	2.00	1.00	0.0020	0.0155	0.0634	31.71	1.90
7.00 m	11.00	52.00	24.00	7.00	2.00	4.00	0.00	-	0.0153	0.0675	-	-
10.00 m	12.00	54.00	21.00	6.00	2.00	5.00	0.00	-	0.0133	0.0608	-	-
13.00 m	6.00	38.00	41.00	5.00	1.00	9.00	0.00	0.0049	0.0369	0.1487	30.38	1.87
16.00 m	5.00	35.00	43.00	8.00	2.00	7.00	0.00	0.0065	0.0450	0.1729	26.70	1.80
19.00 m	0.00	16.00	66.00	6.00	1.00	11.00	0.00	0.0404	0.1339	0.2566	6.35	1.73
22.00 m	0.00	20.00	65.00	5.00	2.00	7.00	1.00	0.0276	0.1147	0.2350	8.51	2.03
25.00 m	0.00	14.00	68.00	7.00	1.00	8.00	2.00	0.0500	0.1435	0.2624	5.25	1.57
28.00 m	11.00	51.00	25.00	3.00	4.00	6.00	0.00	-	0.0157	0.0699	-	-
31.00 m	12.00	49.00	23.00	5.00	1.00	10.00	0.00	-	0.0151	0.0723	-	-
34.00 m	10.00	45.00	26.00	3.00	4.00	12.00	0.00	0.0020	0.0203	0.0979	48.96	2.11
37.00 m	7.00	47.00	30.00	6.00	1.00	9.00	0.00	0.0036	0.0245	0.1005	27.67	1.64

GRAIN SIZE DISTRIBUTION CURVES

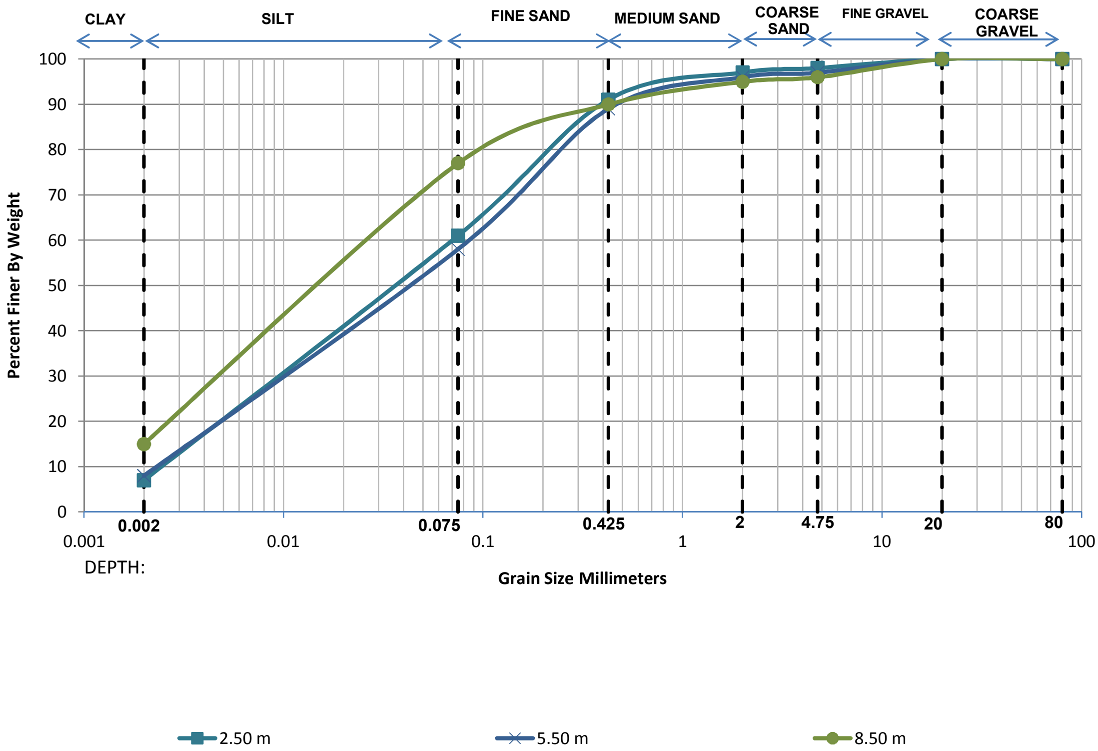
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	7+907 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	19.00	72.00	6.00	2.00	1.00	0.00	0.0307	0.1173	0.2229	7.27	2.01
4.00 m	10.00	52.00	28.00	6.00	2.00	2.00	0.00	0.0020	0.0168	0.0700	35.02	2.01
7.00 m	12.00	51.00	27.00	5.00	2.00	3.00	0.00	-	0.0145	0.0675	-	-
8.50 m	0.00	16.00	75.00	7.00	1.00	1.00	0.00	0.0411	0.1303	0.2322	5.65	1.78
10.00 m	0.00	17.00	65.00	11.00	2.00	5.00	0.00	0.0365	0.1296	0.2555	7.00	1.80

GRAIN SIZE DISTRIBUTION CURVES

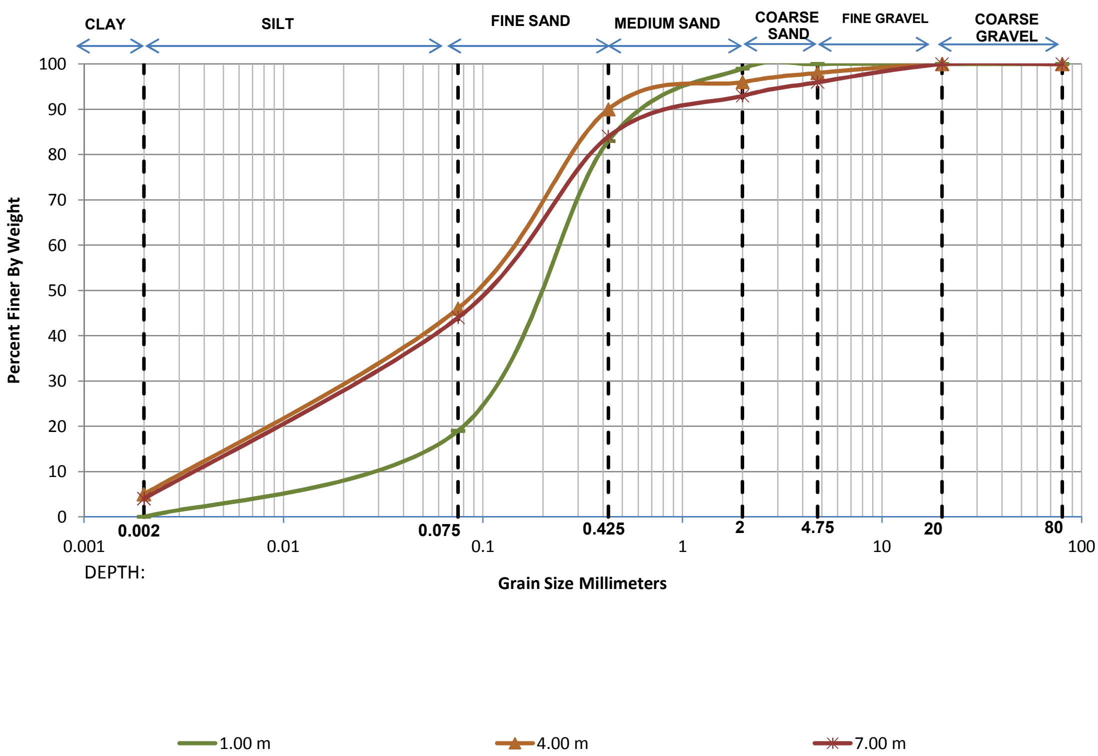
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	8+207 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	7.00	54.00	30.00	6.00	1.00	2.00	0.00	0.0035	0.0204	0.0726	20.56	1.62
5.50 m	8.00	50.00	31.00	7.00	1.00	3.00	0.00	0.0029	0.0209	0.0811	27.69	1.84
8.50 m	15.00	62.00	13.00	5.00	1.00	4.00	0.00	-	0.0086	0.0422	-	-

GRAIN SIZE DISTRIBUTION CURVES

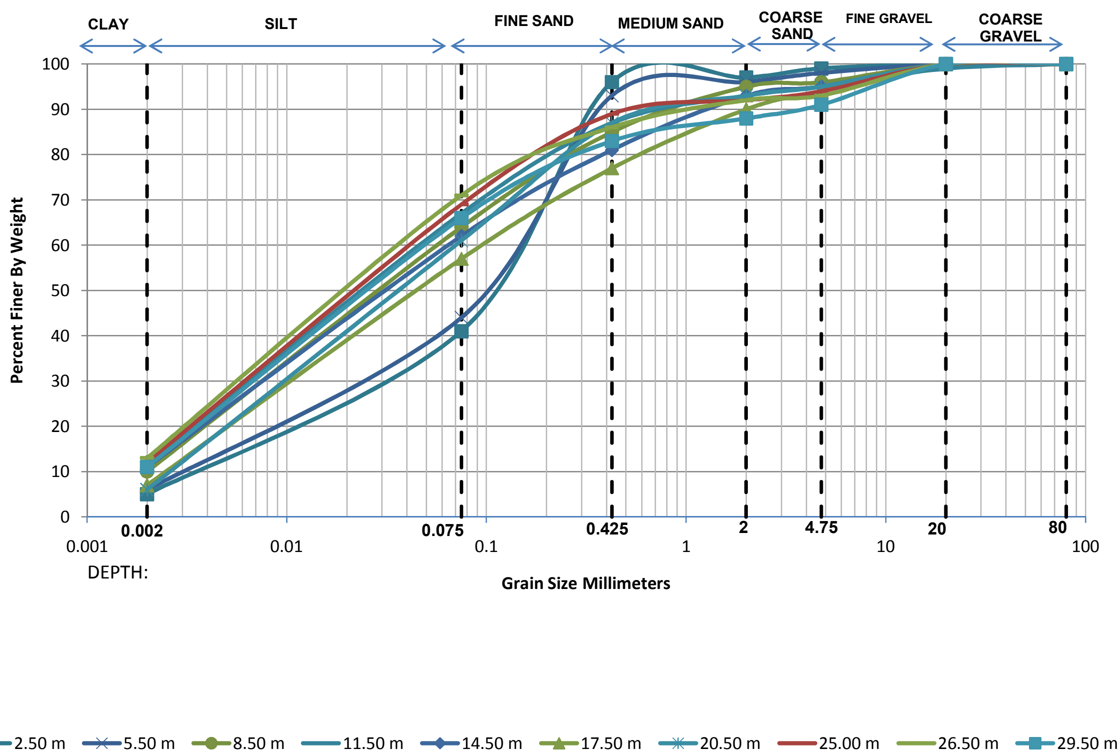
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	8+610 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	19.00	64.00	16.00	1.00	0.00	0.00	0.0301	0.1203	0.2480	8.23	1.94
4.00 m	5.00	41.00	44.00	6.00	2.00	2.00	0.00	0.0060	0.0355	0.1308	21.97	1.62
7.00 m	4.00	40.00	40.00	9.00	3.00	4.00	0.00	0.0075	0.0391	0.1516	20.14	1.34

GRAIN SIZE DISTRIBUTION CURVES

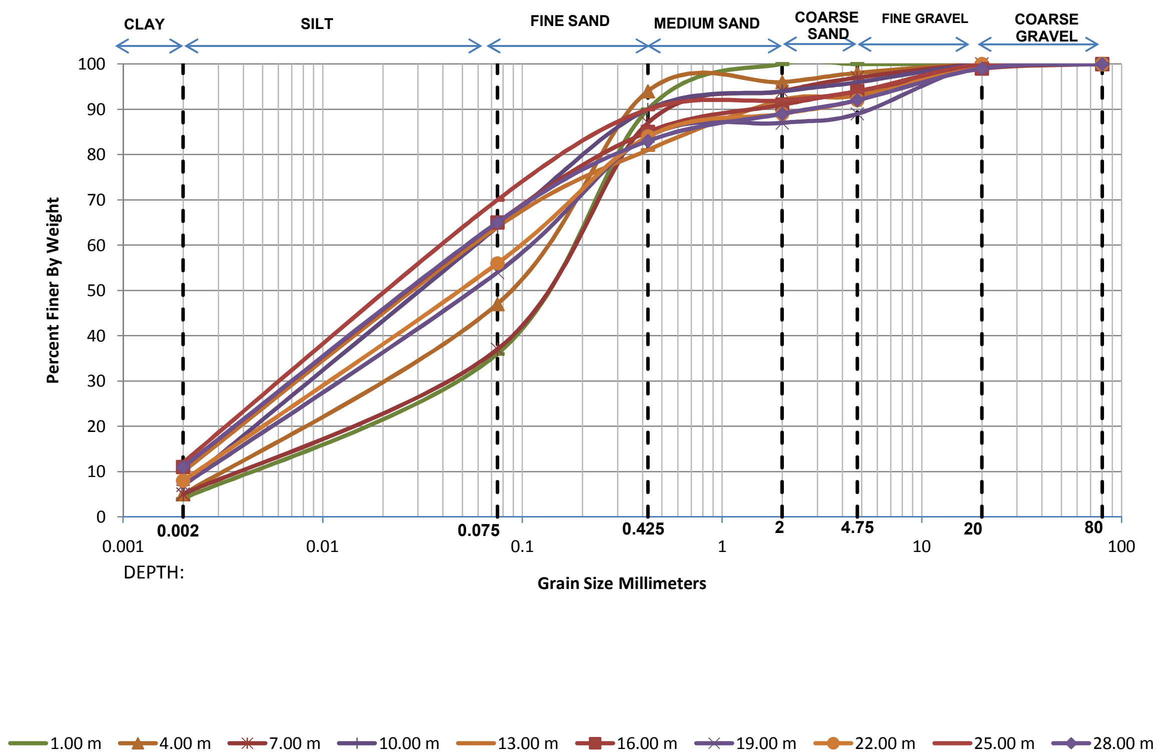
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	8+852 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	5.00	36.00	55.00	1.00	2.00	1.00	0.00	0.0065	0.0440	0.1420	21.95	2.10
5.50 m	6.00	38.00	49.00	3.00	2.00	2.00	0.00	0.0049	0.0375	0.1350	27.35	2.11
8.50 m	10.00	54.00	21.00	10.00	1.00	4.00	0.00	0.0020	0.0157	0.0654	32.69	1.89
11.50 m	12.00	55.00	20.00	6.00	2.00	4.00	1.00	-	0.0130	0.0588	-	-
14.50 m	11.00	51.00	19.00	12.00	2.00	5.00	0.00	-	0.0155	0.0698	-	-
17.50 m	7.00	50.00	20.00	13.00	4.00	6.00	0.00	0.0036	0.0219	0.0904	25.34	1.49
20.50 m	6.00	55.00	26.00	6.00	2.00	5.00	0.00	0.0043	0.0214	0.0726	16.95	1.47
25.00 m	12.00	57.00	20.00	3.00	2.00	6.00	0.00	-	0.0124	0.0552	-	-
26.50 m	13.00	58.00	15.00	6.00	1.00	7.00	0.00	-	0.0111	0.0513	-	-
29.50 m	11.00	55.00	17.00	5.00	3.00	9.00	0.00	-	0.0140	0.0609	-	-

GRAIN SIZE DISTRIBUTION CURVES

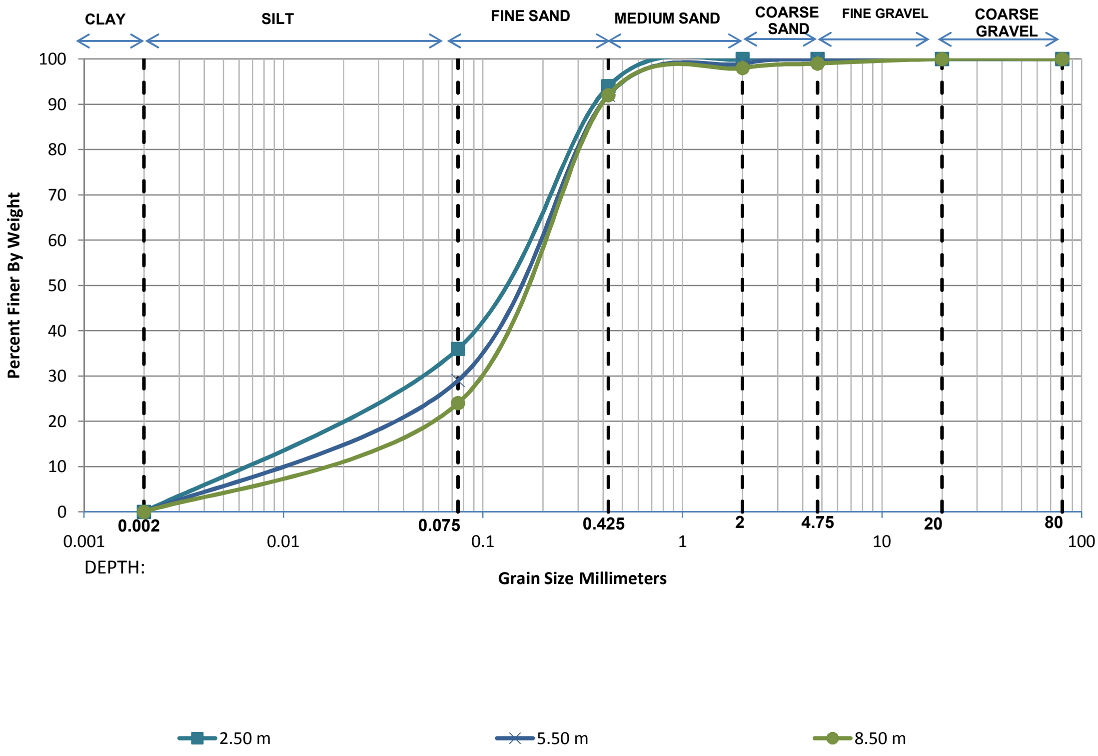
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	8+852 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	4.00	32.00	54.00	10.00	0.00	0.00	0.00	0.0089	0.0556	0.1722	19.34	2.02
4.00 m	5.00	42.00	47.00	2.00	2.00	2.00	0.00	0.0059	0.0345	0.1213	20.55	1.66
7.00 m	5.00	32.00	50.00	7.00	3.00	3.00	0.00	0.0069	0.0522	0.1746	25.14	2.24
10.00 m	7.00	57.00	26.00	4.00	2.00	4.00	0.00	0.0035	0.0189	0.0660	18.89	1.56
13.00 m	10.00	54.00	17.00	11.00	1.00	7.00	0.00	0.0020	0.0156	0.0653	32.63	1.85
16.00 m	11.00	54.00	20.00	6.00	3.00	5.00	1.00	-	0.0144	0.0630	-	-
19.00 m	7.00	47.00	30.00	3.00	2.00	11.00	0.00	0.0036	0.0245	0.1000	27.54	1.65
22.00 m	8.00	48.00	28.00	5.00	3.00	8.00	0.00	0.0029	0.0219	0.0906	30.79	1.80
25.00 m	12.00	58.00	20.00	2.00	2.00	6.00	0.00	-	0.0122	0.0536	-	-
28.00 m	11.00	54.00	18.00	6.00	3.00	7.00	1.00	-	0.0144	0.0630	-	-

GRAIN SIZE DISTRIBUTION CURVES

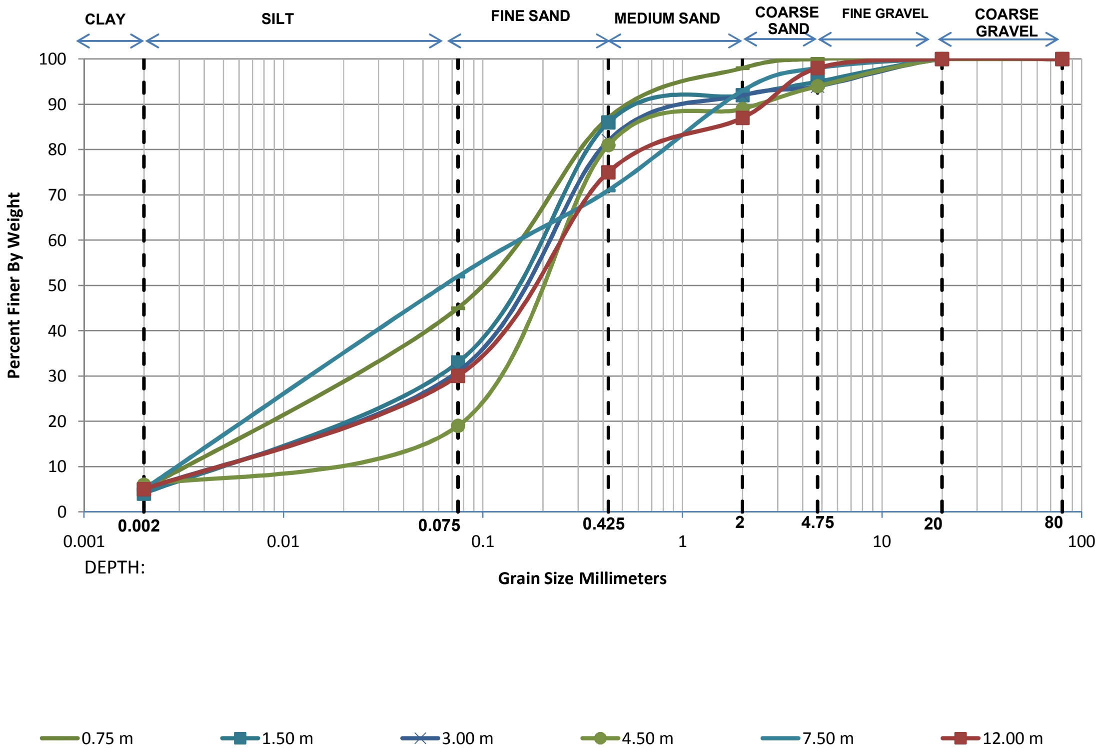
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	8+907 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	0.00	36.00	58.00	6.00	0.00	0.00	0.00	0.0097	0.0569	0.1615	16.69	2.07
5.50 m	0.00	29.00	63.00	7.00	1.00	0.00	0.00	0.0142	0.0784	0.1895	13.32	2.28
8.50 m	0.00	24.00	68.00	6.00	1.00	1.00	0.00	0.0202	0.0969	0.2054	10.18	2.27

GRAIN SIZE DISTRIBUTION CURVES

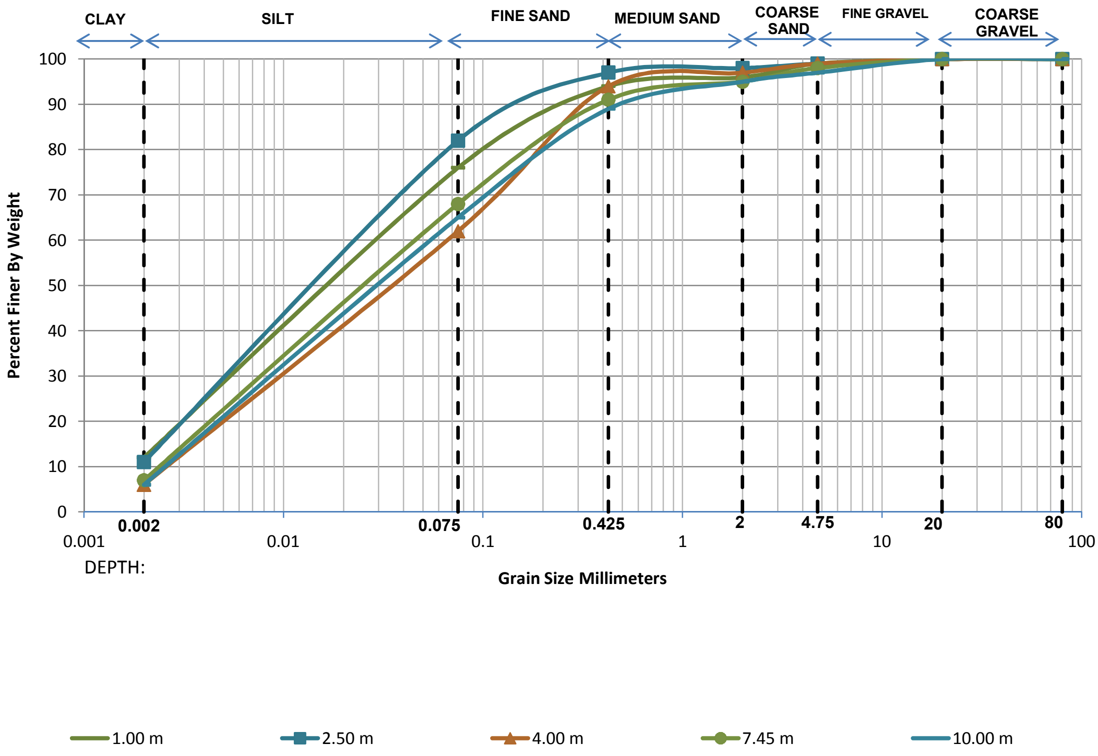
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	New Ch. 10+340 Silani Station
B.H. No.	BH-PLT-08



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
0.75 m	5.00	40.00	42.00	11.00	2.00	0.00	0.00	0.0060	0.0367	0.1414	23.52	1.58
1.50 m	4.00	29.00	53.00	6.00	3.00	5.00	0.00	0.0096	0.0643	0.1917	19.88	2.23
3.00 m	5.00	26.00	51.00	10.00	2.00	6.00	0.00	0.0082	0.0710	0.2137	25.91	2.86
4.50 m	6.00	13.00	62.00	8.00	5.00	6.00	0.00	0.0149	0.1284	0.2574	17.29	4.30
7.50 m	5.00	47.00	19.00	22.00	5.00	2.00	0.00	0.0055	0.0276	0.1594	29.09	0.87
12.00 m	5.00	25.00	45.00	12.00	11.00	2.00	0.00	0.0084	0.0750	0.2505	29.66	2.66

GRAIN SIZE DISTRIBUTION CURVES

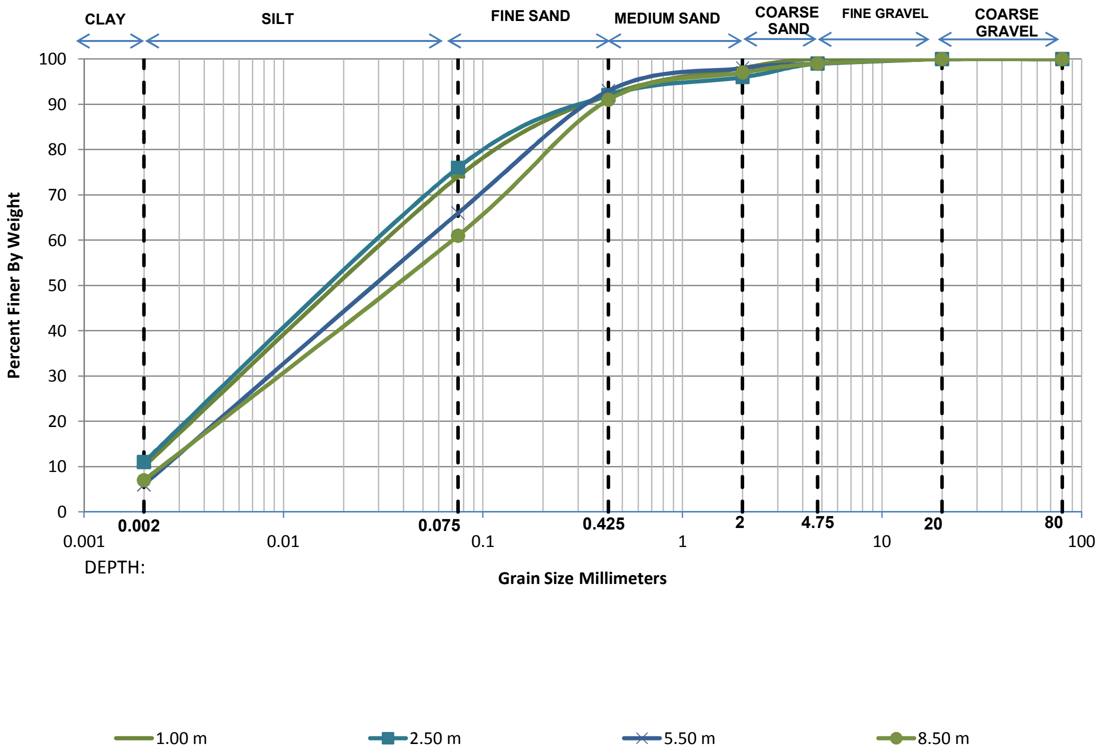
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	9+200 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	12.00	64.00	18.00	2.00	3.00	1.00	0.00	-	0.0109	0.0451	-	-
2.50 m	11.00	71.00	15.00	1.00	1.00	1.00	0.00	-	0.0107	0.0391	-	-
4.00 m	6.00	56.00	32.00	3.00	2.00	1.00	0.00	0.0043	0.0212	0.0704	16.47	1.49
7.45 m	7.00	61.00	23.00	4.00	3.00	2.00	0.00	0.0035	0.0174	0.0586	16.97	1.50
10.00 m	6.00	59.00	24.00	6.00	2.00	3.00	0.00	0.0042	0.0196	0.0642	15.24	1.43

GRAIN SIZE DISTRIBUTION CURVES

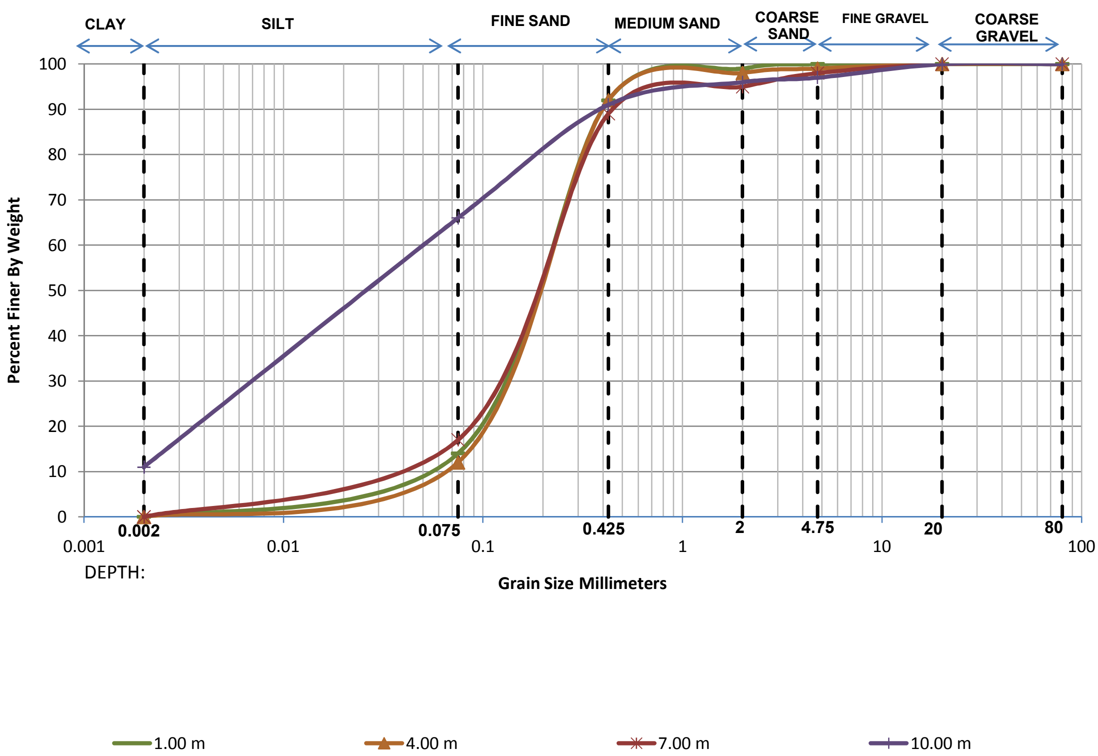
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	9+211 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	10.00	64.00	18.00	6.00	2.00	0.00	0.00	0.0020	0.0129	0.0485	24.23	1.71
2.50 m	11.00	65.00	16.00	4.00	3.00	1.00	0.00	-	0.0116	0.0454	-	-
5.50 m	6.00	60.00	27.00	5.00	1.00	1.00	0.00	0.0042	0.0194	0.0624	14.86	1.44
8.50 m	7.00	54.00	30.00	6.00	2.00	1.00	0.00	0.0035	0.0204	0.0726	20.56	1.62

GRAIN SIZE DISTRIBUTION CURVES

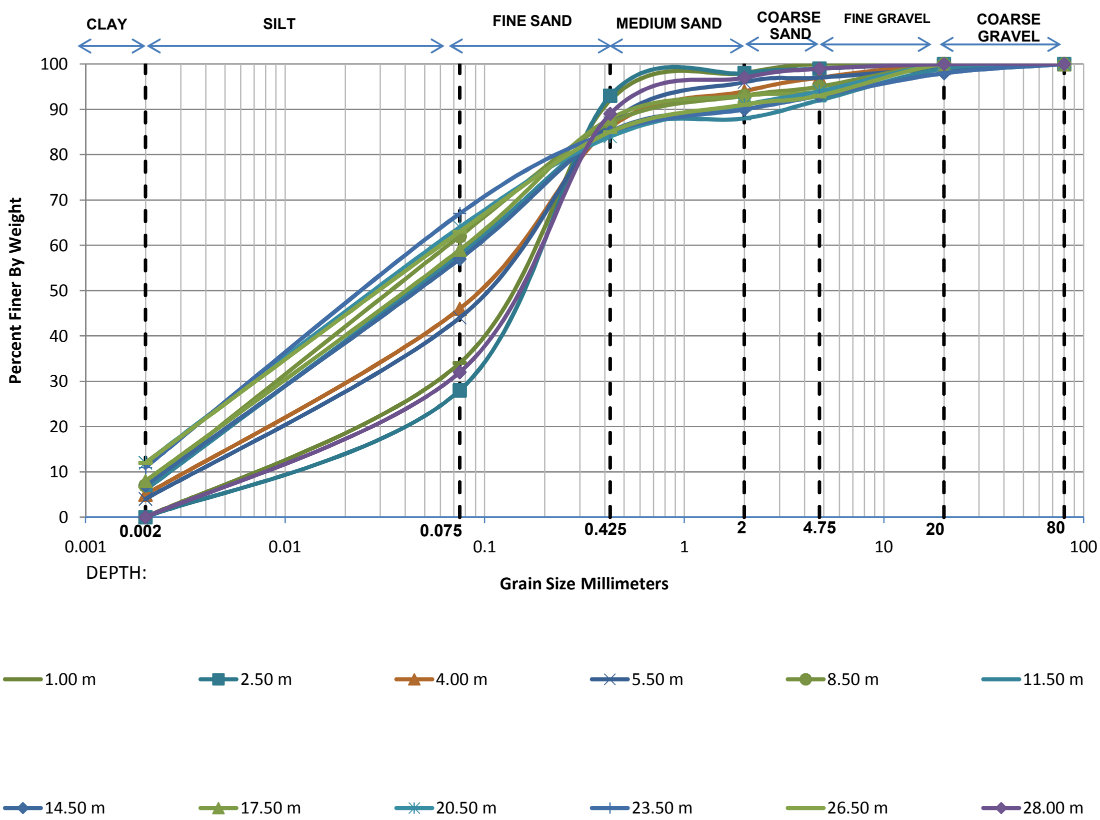
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	9+407 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	14.00	78.00	7.00	1.00	0.00	0.00	0.0507	0.1389	0.2360	4.66	1.61
4.00 m	0.00	12.00	80.00	6.00	1.00	1.00	0.00	0.0625	0.1482	0.2417	3.87	1.45
7.00 m	0.00	17.00	72.00	6.00	3.00	2.00	0.00	0.0370	0.1266	0.2335	6.31	1.85
10.00 m	11.00	55.00	25.00	5.00	1.00	3.00	0.00	-	0.0143	0.0612	-	-

GRAIN SIZE DISTRIBUTION CURVES

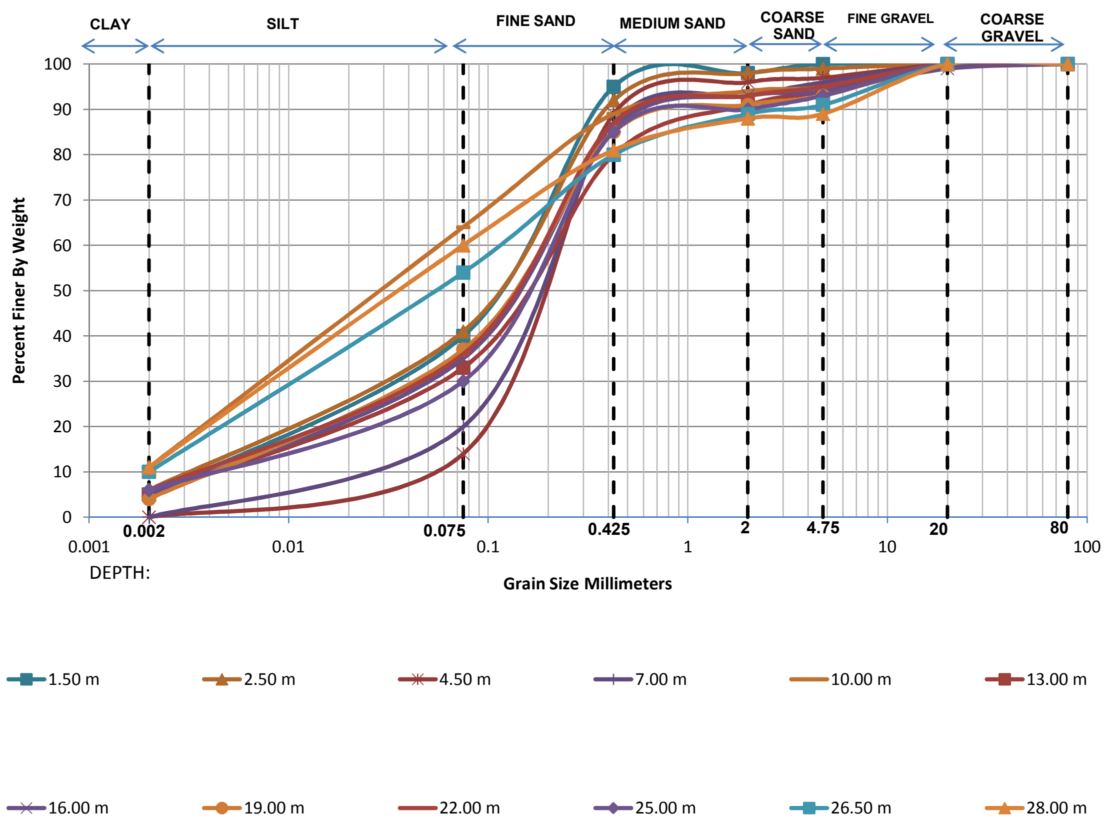
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	9+726 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	34.00	58.00	6.00	2.00	0.00	0.00	0.0107	0.0623	0.1721	16.16	2.12
2.50 m	0.00	28.00	65.00	5.00	1.00	1.00	0.00	0.0152	0.0819	0.1903	12.50	2.32
4.00 m	5.00	41.00	40.00	8.00	3.00	3.00	0.00	0.0059	0.0352	0.1377	23.24	1.52
5.50 m	4.00	40.00	43.00	9.00	1.00	2.00	1.00	0.0076	0.0393	0.1450	19.18	1.41
8.50 m	7.00	55.00	25.00	6.00	2.00	5.00	0.00	0.0035	0.0197	0.0702	19.99	1.57
11.50 m	6.00	52.00	27.00	3.00	4.00	7.00	1.00	0.0043	0.0229	0.0813	18.72	1.49
14.50 m	7.00	50.00	28.00	5.00	3.00	5.00	2.00	0.0036	0.0224	0.0855	23.89	1.64
17.50 m	8.00	51.00	29.00	5.00	1.00	6.00	0.00	0.0029	0.0202	0.0778	26.65	1.80
20.50 m	12.00	52.00	20.00	7.00	3.00	6.00	0.00	-	0.0139	0.0650	-	-
23.50 m	11.00	56.00	18.00	5.00	3.00	5.00	2.00	-	0.0137	0.0590	-	-
26.50 m	12.00	51.00	22.00	6.00	2.00	7.00	0.00	-	0.0143	0.0673	-	-
28.00 m	0.00	32.00	57.00	8.00	2.00	1.00	0.00	0.0118	0.0683	0.1862	15.80	2.13

GRAIN SIZE DISTRIBUTION CURVES

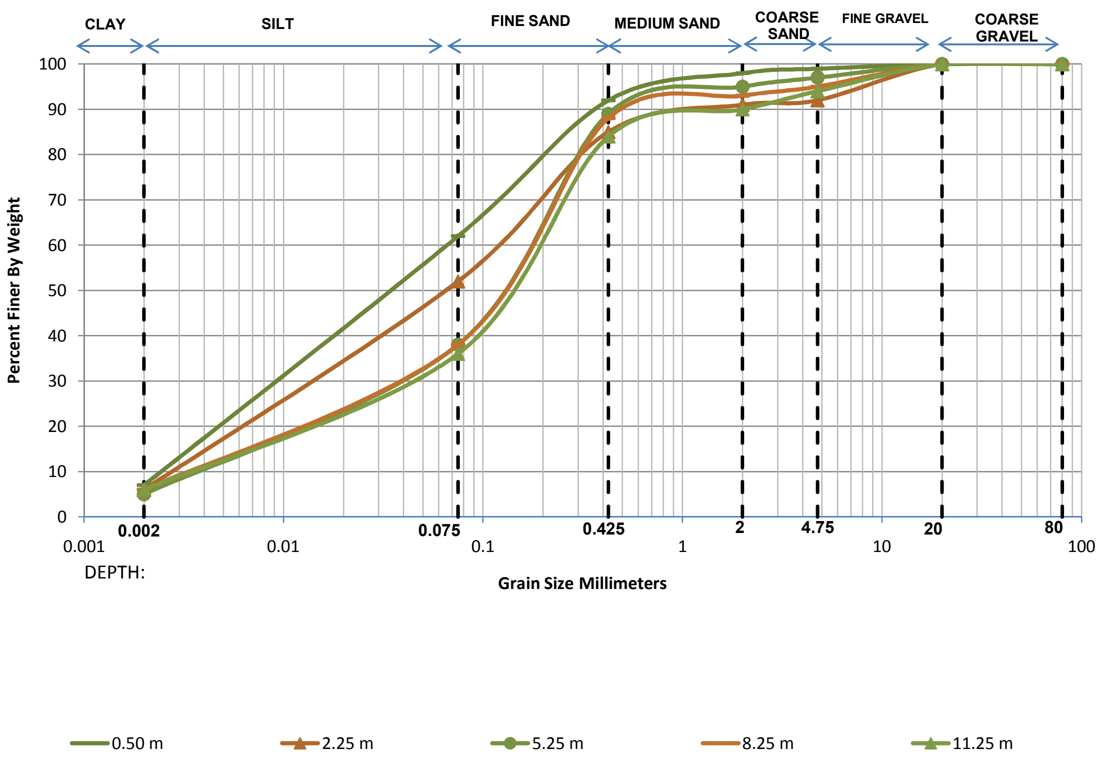
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	9+726 Major Bridge
B.H. No.	BH-A2



Depth	**Grain Size Distribution % wt retained**							**D10**	**D30**	**D60**	**Cu**	**Cc**
	Clay	**Silt**	**Sand**			**Gravel**						
			Fine	**Medium**	**Coarse**	**Fine**	**Coarse**					
1.50 m	5.00	35.00	55.00	3.00	2.00	0.00	0.00	0.0066	0.0459	0.1474	22.39	2.17
2.50 m	6.00	35.00	51.00	6.00	1.00	1.00	0.00	0.0052	0.0427	0.1491	28.94	2.38
4.50 m	0.00	14.00	75.00	7.00	1.00	3.00	0.00	0.0505	0.1402	0.2426	4.81	1.61
7.00 m	0.00	20.00	67.00	6.00	3.00	4.00	0.00	0.0278	0.1142	0.2296	8.27	2.04
10.00 m	11.00	53.00	25.00	5.00	1.00	5.00	0.00	-	0.0150	0.0653	-	-
13.00 m	5.00	28.00	47.00	11.00	3.00	6.00	0.00	0.0077	0.0636	0.2142	27.97	2.47
16.00 m	5.00	30.00	51.00	7.00	1.00	5.00	1.00	0.0073	0.0576	0.1850	25.35	2.46
19.00 m	4.00	33.00	48.00	6.00	2.00	7.00	0.00	0.0086	0.0527	0.1788	20.77	1.81
22.00 m	6.00	30.00	51.00	6.00	2.00	5.00	0.00	0.0056	0.0542	0.1788	31.65	2.91
25.00 m	6.00	24.00	55.00	5.00	3.00	7.00	0.00	0.0068	0.0750	0.2065	30.42	4.01
26.50 m	10.00	44.00	26.00	9.00	2.00	9.00	0.00	0.0020	0.0210	0.1062	53.09	2.08
28.00 m	11.00	49.00	21.00	7.00	1.00	11.00	0.00	-	0.0164	0.0750	-	-

GRAIN SIZE DISTRIBUTION CURVES

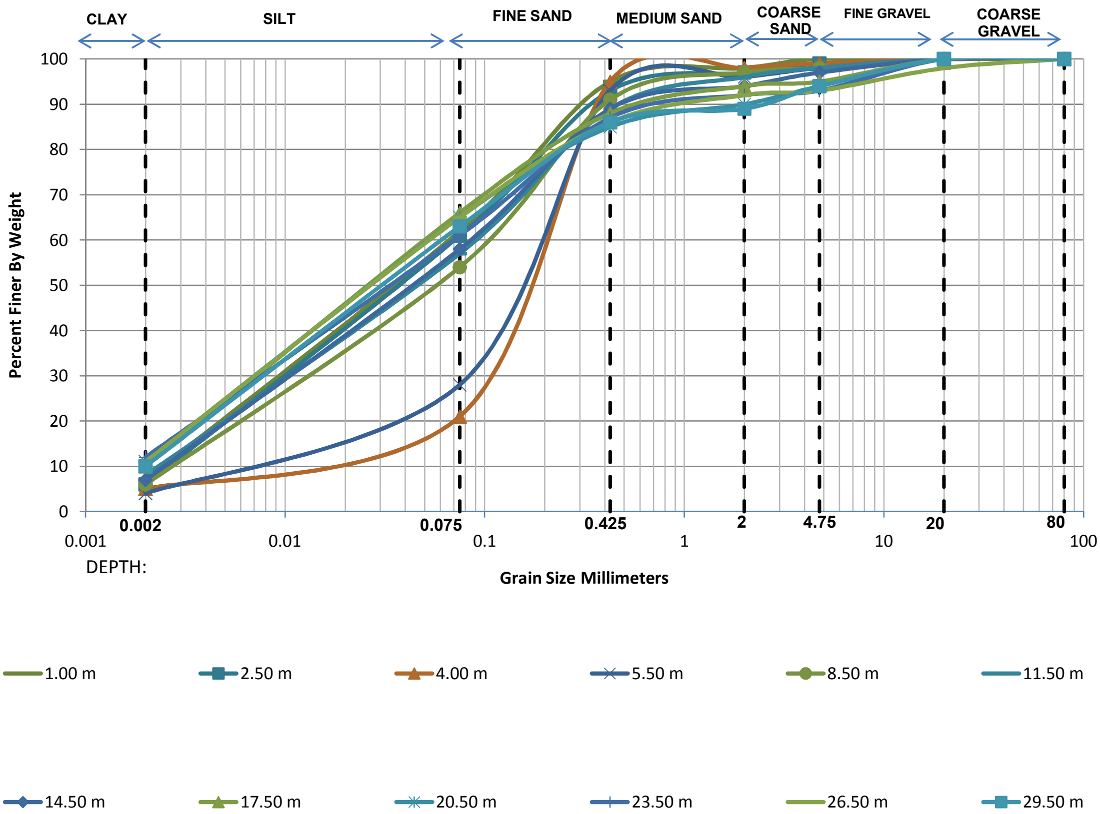
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	9+772 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
0.50 m	7.00	55.00	30.00	6.00	1.00	1.00	0.00	0.0035	0.0199	0.0703	19.98	1.61
2.25 m	6.00	46.00	33.00	6.00	1.00	8.00	0.00	0.0045	0.0274	0.1095	24.21	1.51
5.25 m	5.00	33.00	51.00	6.00	2.00	3.00	0.00	0.0068	0.0498	0.1658	24.36	2.20
8.25 m	6.00	32.00	50.00	5.00	2.00	5.00	0.00	0.0054	0.0490	0.1682	31.07	2.64
11.25 m	6.00	30.00	48.00	6.00	4.00	6.00	0.00	0.0056	0.0540	0.1868	33.22	2.77

GRAIN SIZE DISTRIBUTION CURVES

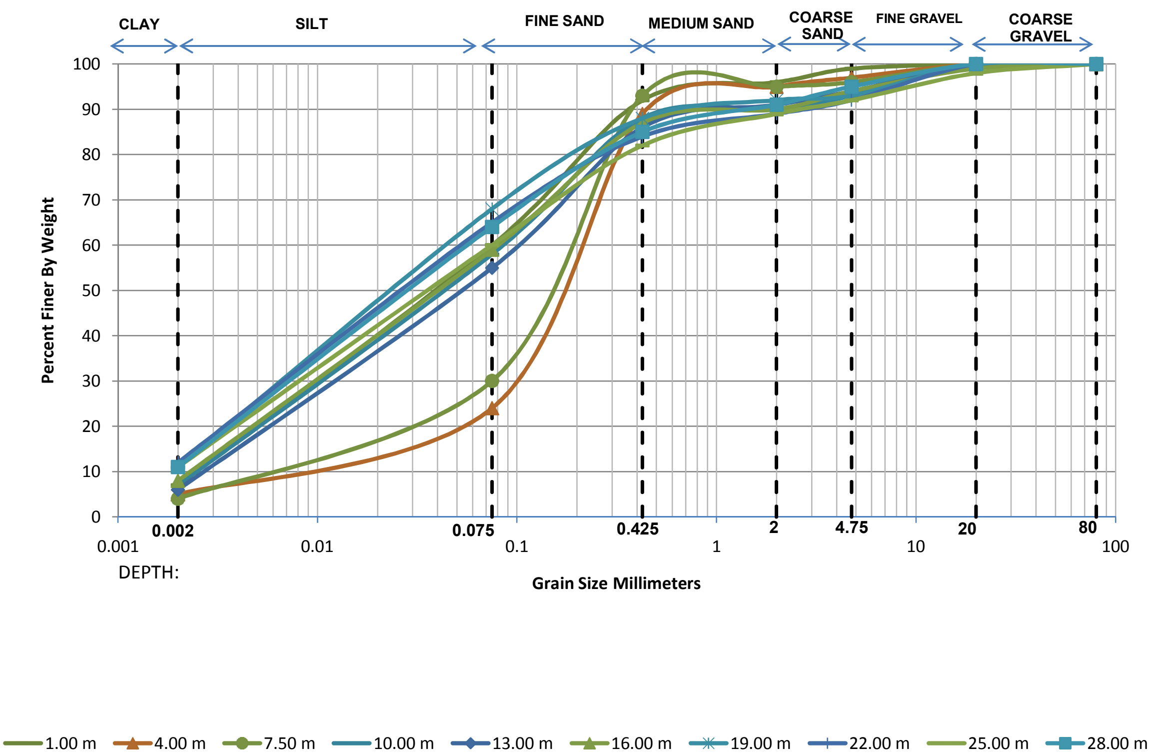
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	10+025 Minor Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	7.00	55.00	33.00	3.00	2.00	0.00	0.00	0.0035	0.0201	0.0704	19.97	1.63
2.50 m	6.00	55.00	32.00	4.00	2.00	1.00	0.00	0.0043	0.0217	0.0727	16.91	1.50
4.00 m	5.00	16.00	74.00	3.00	1.00	1.00	0.00	0.0157	0.1125	0.2136	13.62	3.78
5.50 m	4.00	24.00	65.00	3.00	2.00	2.00	0.00	0.0119	0.0826	0.1928	16.16	2.97
8.50 m	6.00	48.00	37.00	6.00	1.00	2.00	0.00	0.0045	0.0261	0.0958	21.41	1.58
11.50 m	8.00	49.00	32.00	7.00	2.00	2.00	0.00	0.0029	0.0215	0.0848	28.87	1.86
14.50 m	7.00	51.00	31.00	5.00	3.00	3.00	0.00	0.0036	0.0220	0.0810	22.68	1.67
17.50 m	10.00	56.00	22.00	6.00	1.00	5.00	0.00	0.0020	0.0151	0.0613	30.67	1.85
20.50 m	11.00	54.00	20.00	5.00	4.00	6.00	0.00	-	0.0144	0.0630	-	-
23.50 m	12.00	49.00	26.00	5.00	1.00	7.00	0.00	-	0.0153	0.0723	-	-
26.50 m	11.00	54.00	21.00	6.00	1.00	5.00	2.00	-	0.0145	0.0631	-	-
29.50 m	10.00	53.00	23.00	3.00	5.00	6.00	0.00	0.0020	0.0162	0.0676	33.82	1.93

GRAIN SIZE DISTRIBUTION CURVES

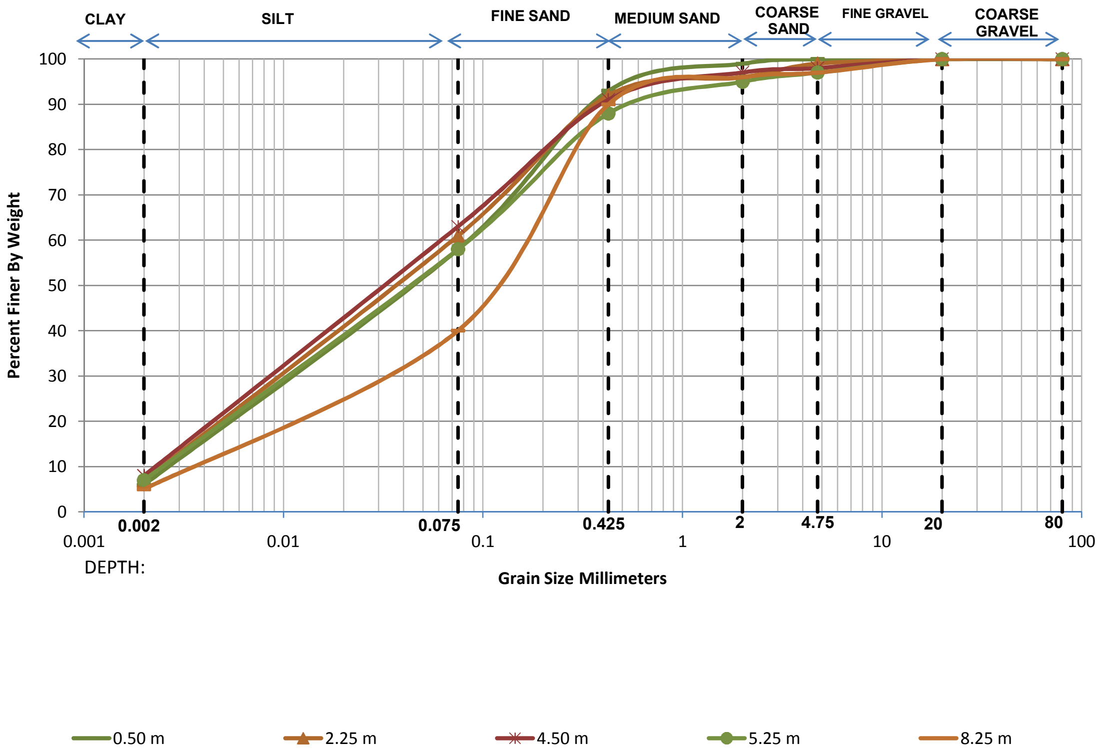
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	10+025 Minor Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	7.00	53.00	32.00	4.00	3.00	1.00	0.00	0.0035	0.0210	0.0750	21.15	1.65
4.00 m	5.00	19.00	65.00	6.00	2.00	3.00	0.00	0.0121	0.1003	0.2164	17.85	3.83
7.50 m	4.00	26.00	63.00	2.00	1.00	4.00	0.00	0.0109	0.0750	0.1857	17.02	2.78
10.00 m	7.00	51.00	30.00	2.00	3.00	7.00	0.00	0.0036	0.0219	0.0810	22.70	1.66
13.00 m	6.00	49.00	31.00	5.00	3.00	6.00	0.00	0.0044	0.0250	0.0939	21.20	1.50
16.00 m	8.00	51.00	28.00	3.00	4.00	5.00	1.00	0.0029	0.0202	0.0779	26.66	1.79
19.00 m	11.00	57.00	20.00	4.00	1.00	7.00	0.00	-	0.0135	0.0573	-	-
22.00 m	12.00	53.00	19.00	5.00	3.00	8.00	0.00	-	0.0135	0.0628	-	-
25.00 m	11.00	49.00	22.00	7.00	3.00	6.00	2.00	-	0.0164	0.0750	-	-
28.00 m	11.00	53.00	21.00	6.00	4.00	5.00	0.00	-	0.0148	0.0652	-	-

GRAIN SIZE DISTRIBUTION CURVES

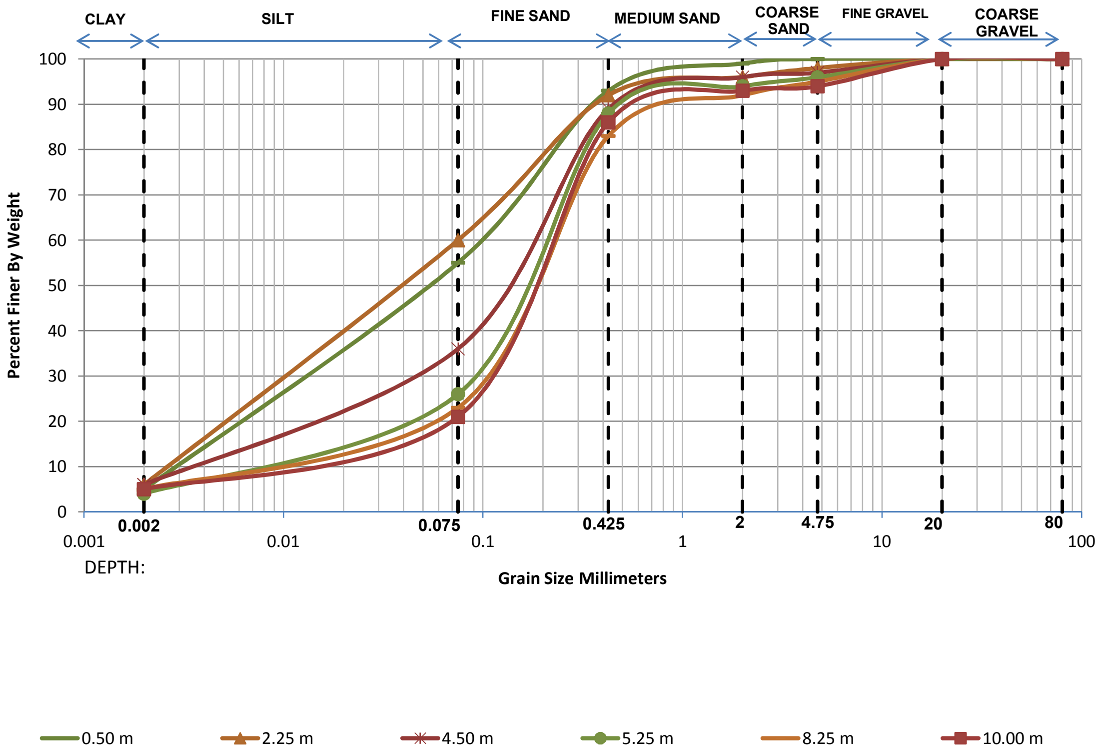
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	10+223 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
0.50 m	6.00	52.00	35.00	6.00	1.00	0.00	0.00	0.0044	0.0234	0.0806	18.46	1.55
2.25 m	7.00	54.00	31.00	4.00	3.00	1.00	0.00	0.0035	0.0204	0.0726	20.55	1.63
4.50 m	8.00	55.00	28.00	6.00	1.00	2.00	0.00	0.0029	0.0184	0.0680	23.48	1.71
5.25 m	7.00	51.00	30.00	7.00	2.00	3.00	0.00	0.0036	0.0219	0.0811	22.73	1.66
8.25 m	5.00	35.00	50.00	6.00	1.00	3.00	0.00	0.0065	0.0455	0.1559	23.83	2.03

GRAIN SIZE DISTRIBUTION CURVES

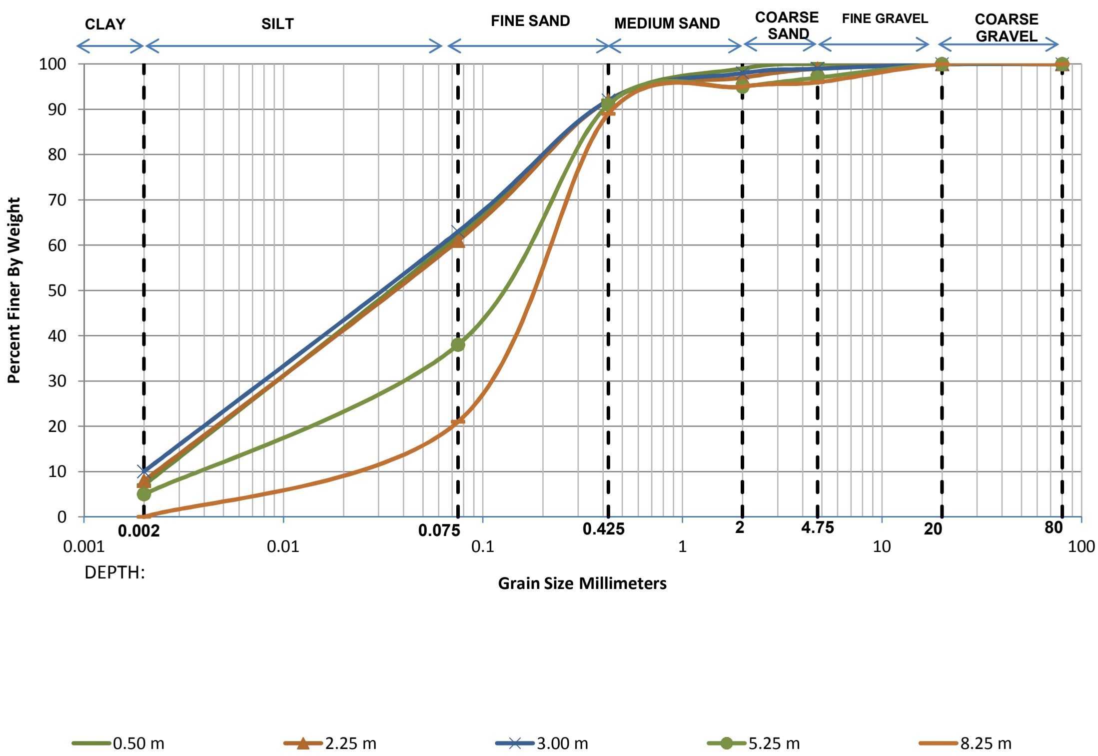
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	10+519 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
0.50 m	5.00	50.00	38.00	6.00	1.00	0.00	0.00	0.0055	0.0267	0.0909	16.67	1.43
2.25 m	6.00	54.00	32.00	4.00	2.00	2.00	0.00	0.0043	0.0221	0.0750	17.38	1.51
4.50 m	6.00	30.00	53.00	7.00	1.00	3.00	0.00	0.0057	0.0543	0.1746	30.81	2.98
5.25 m	4.00	22.00	62.00	6.00	2.00	4.00	0.00	0.0131	0.0911	0.2112	16.11	3.00
8.25 m	5.00	18.00	60.00	9.00	3.00	5.00	0.00	0.0129	0.1062	0.2374	18.45	3.69
10.00 m	5.00	16.00	65.00	7.00	1.00	6.00	0.00	0.0154	0.1150	0.2342	15.24	3.67

GRAIN SIZE DISTRIBUTION CURVES

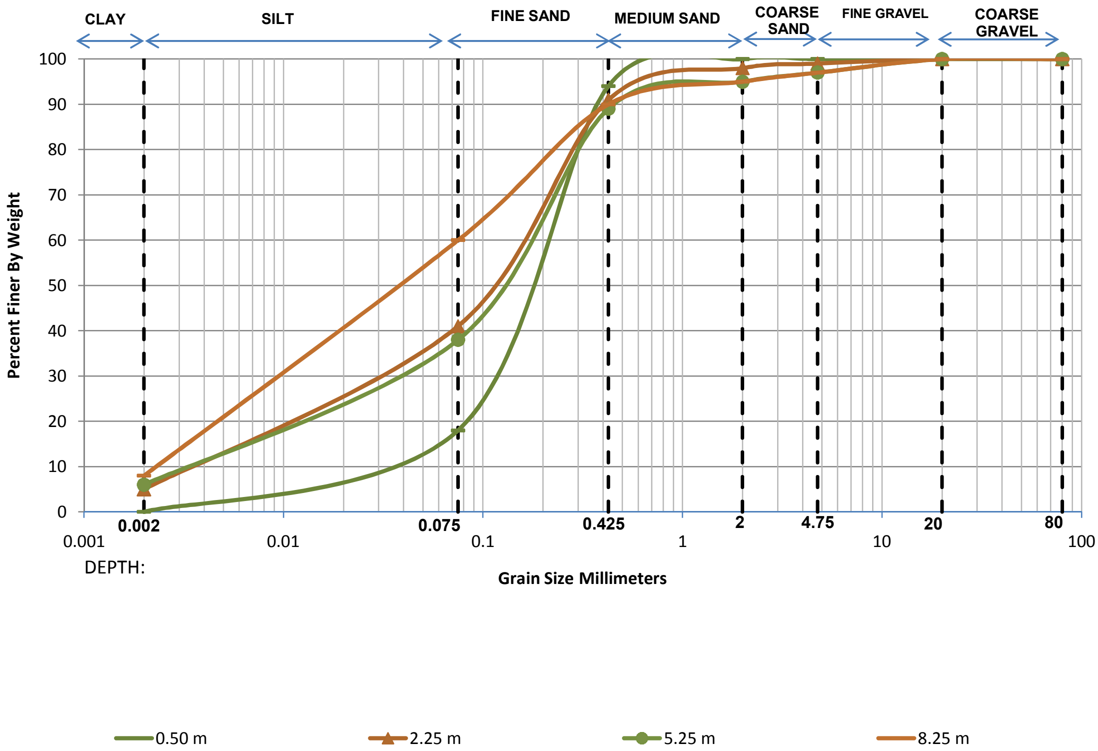
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	10+658 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
0.50 m	7.00	55.00	30.00	7.00	1.00	0.00	0.00	0.0035	0.0199	0.0703	19.98	1.61
2.25 m	8.00	53.00	31.00	5.00	2.00	1.00	0.00	0.0029	0.0194	0.0726	24.94	1.78
3.00 m	10.00	53.00	29.00	6.00	1.00	1.00	0.00	0.0020	0.0164	0.0678	33.89	1.99
5.25 m	5.00	33.00	53.00	4.00	2.00	3.00	0.00	0.0068	0.0500	0.1614	23.64	2.27
8.25 m	0.00	21.00	68.00	6.00	1.00	4.00	0.00	0.0255	0.1095	0.2215	8.67	2.12

GRAIN SIZE DISTRIBUTION CURVES

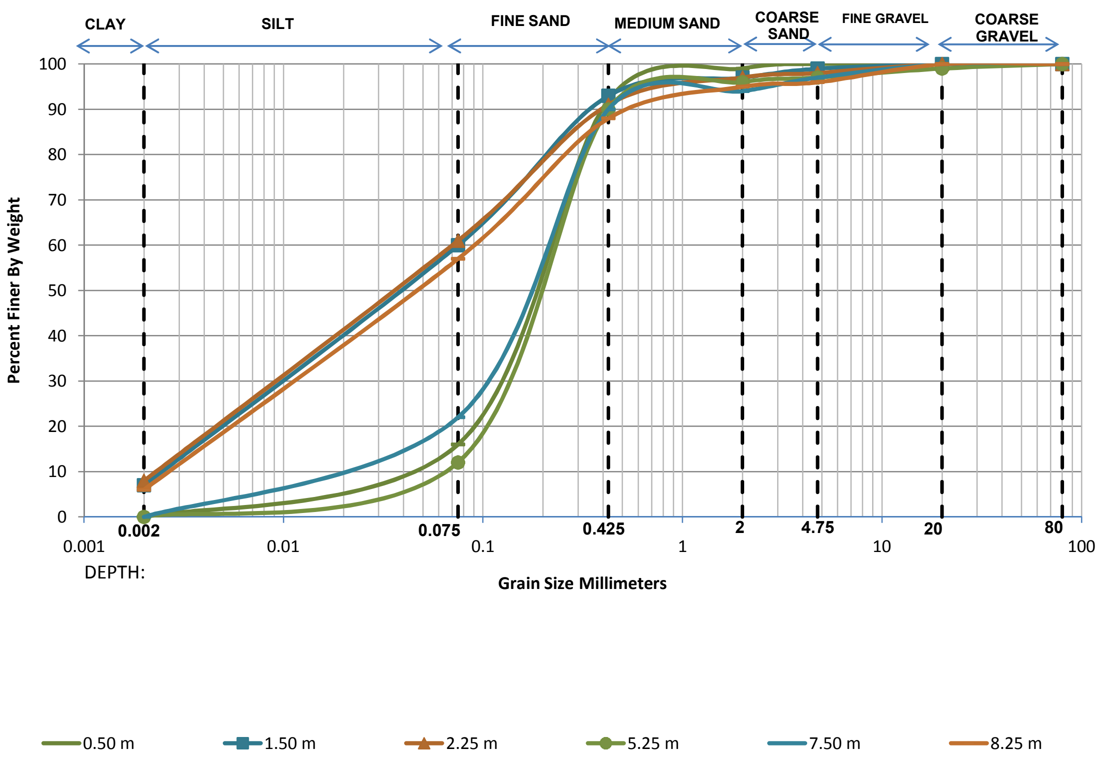
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	10+718 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
0.50 m	0.00	18.00	76.00	6.00	0.00	0.00	0.00	0.0339	0.1207	0.2198	6.48	1.95
2.25 m	5.00	36.00	50.00	7.00	1.00	1.00	0.00	0.0064	0.0436	0.1504	23.39	1.97
5.25 m	6.00	32.00	51.00	6.00	2.00	3.00	0.00	0.0054	0.0491	0.1664	30.70	2.67
8.25 m	8.00	52.00	30.00	5.00	2.00	3.00	0.00	0.0029	0.0198	0.0750	25.73	1.79

GRAIN SIZE DISTRIBUTION CURVES

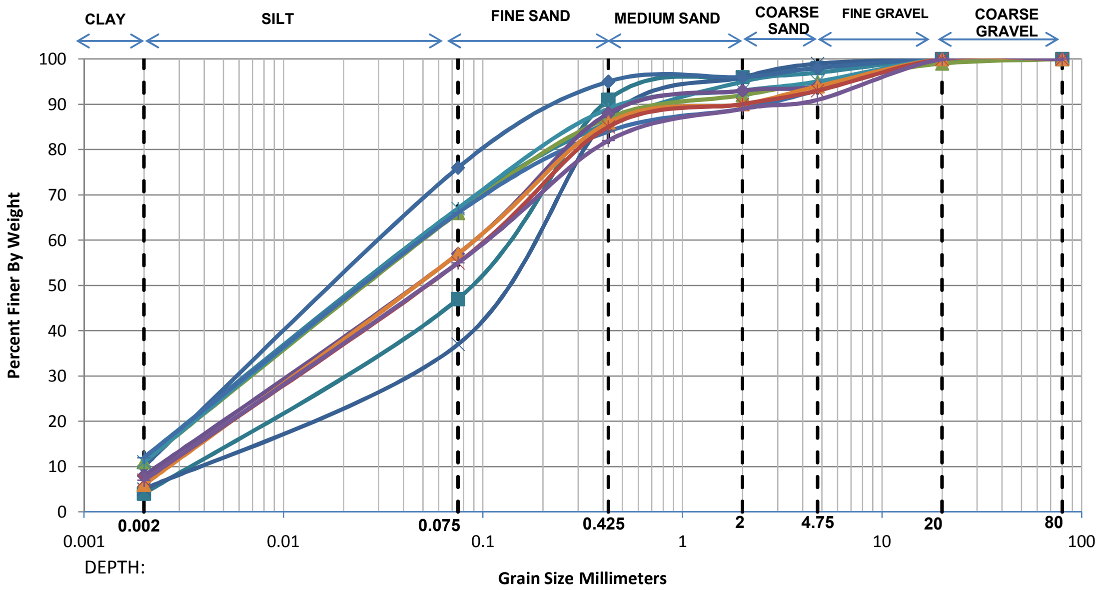
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	10+749 Minor Bridge
B.H. No.	BH-CL



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
0.50 m	0.00	16.00	76.00	7.00	1.00	0.00	0.00	0.0412	0.1300	0.2301	5.59	1.78
1.50 m	7.00	53.00	33.00	4.00	2.00	1.00	0.00	0.0035	0.0210	0.0750	21.14	1.66
2.25 m	8.00	53.00	30.00	6.00	1.00	2.00	0.00	0.0029	0.0193	0.0726	24.94	1.77
5.25 m	0.00	12.00	78.00	6.00	1.00	2.00	1.00	0.0624	0.1491	0.2459	3.94	1.45
7.50 m	0.00	22.00	68.00	4.00	3.00	3.00	0.00	0.0235	0.1051	0.2154	9.15	2.18
8.25 m	6.00	51.00	31.00	7.00	1.00	4.00	0.00	0.0044	0.0237	0.0848	19.36	1.52

GRAIN SIZE DISTRIBUTION CURVES

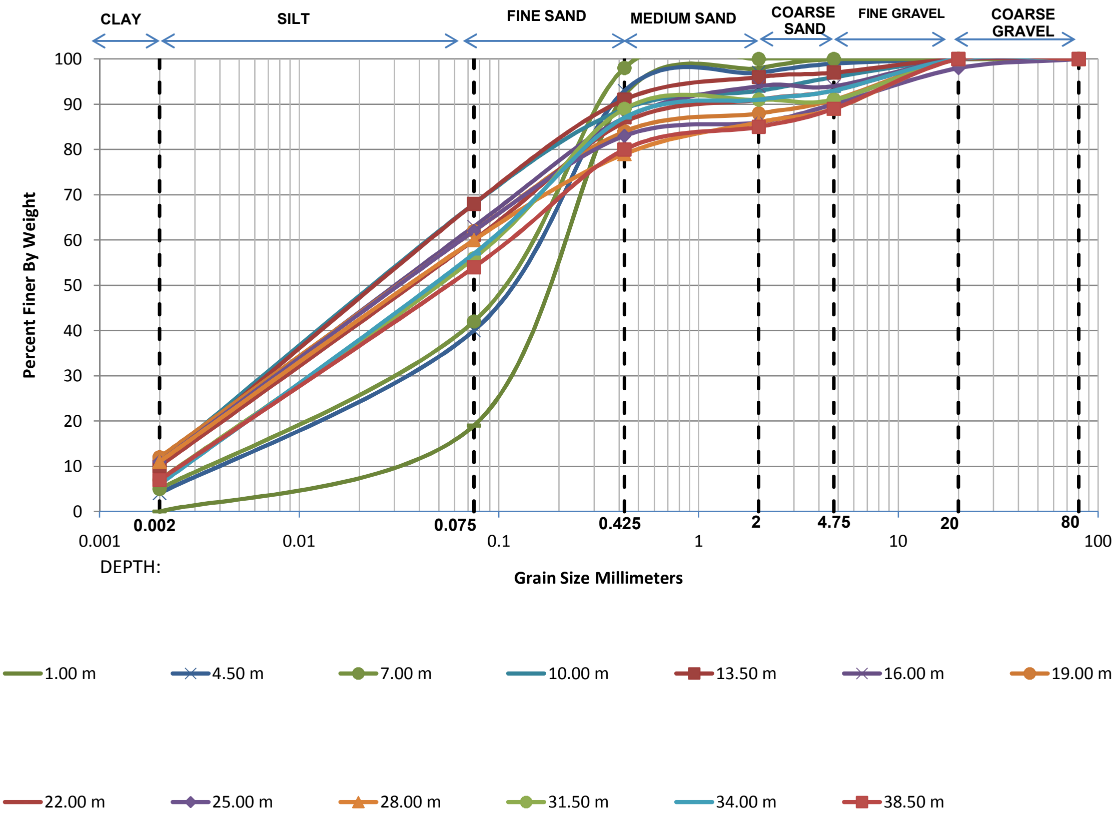
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	10+859 Major Bridge
B.H. No.	BH-A1_(R)



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	4.00	43.00	44.00	5.00	2.00	2.00	0.00	0.0073	0.0355	0.1247	17.12	1.39
5.50 m	5.00	32.00	50.00	9.00	3.00	1.00	0.00	0.0069	0.0522	0.1752	25.23	2.24
11.50 m	12.00	55.00	19.00	9.00	2.00	3.00	0.00	-	0.0129	0.0588	-	-
14.50 m	10.00	66.00	19.00	1.00	2.00	2.00	0.00	0.0020	0.0125	0.0460	23.02	1.70
17.50 m	11.00	55.00	21.00	5.00	3.00	4.00	1.00	-	0.0142	0.0611	-	-
20.50 m	11.00	56.00	22.00	4.00	2.00	5.00	0.00	-	0.0139	0.0592	-	-
23.50 m	12.00	54.00	18.00	5.00	4.00	7.00	0.00	-	0.0132	0.0607	-	-
28.00 m	8.00	49.00	31.00	5.00	1.00	6.00	0.00	0.0029	0.0215	0.0849	28.92	1.85
31.00 m	6.00	51.00	29.00	4.00	4.00	6.00	0.00	0.0044	0.0236	0.0851	19.46	1.50
34.00 m	7.00	48.00	30.00	5.00	3.00	7.00	0.00	0.0036	0.0238	0.0946	26.18	1.65
37.00 m	7.00	48.00	27.00	7.00	2.00	9.00	0.00	0.0036	0.0236	0.0971	26.90	1.59

GRAIN SIZE DISTRIBUTION CURVES

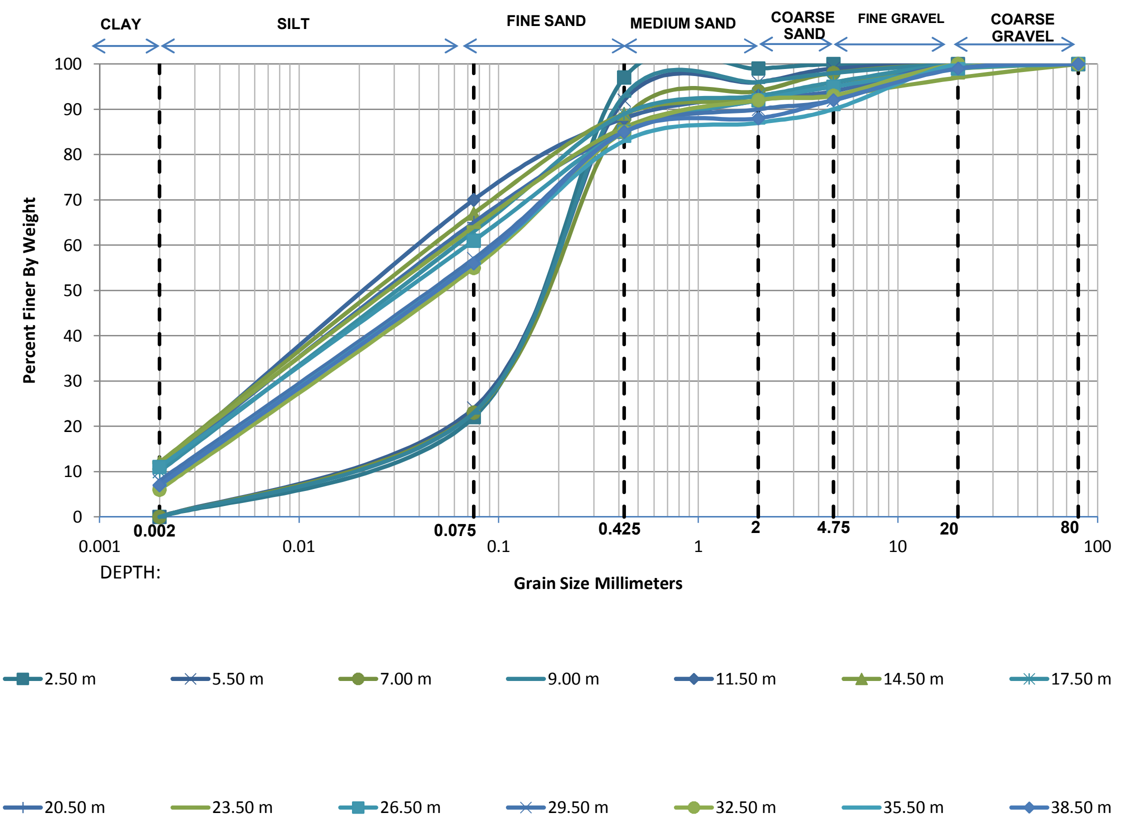
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	10+859 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	19.00	73.00	6.00	2.00	0.00	0.00	0.0307	0.1170	0.2207	7.18	2.02
4.50 m	4.00	36.00	53.00	4.00	2.00	1.00	0.00	0.0082	0.0467	0.1499	18.36	1.78
7.00 m	5.00	37.00	56.00	2.00	0.00	0.00	0.00	0.0064	0.0423	0.1364	21.40	2.05
10.00 m	11.00	57.00	21.00	4.00	3.00	4.00	0.00	-	0.0136	0.0573	-	-
13.50 m	10.00	58.00	23.00	5.00	1.00	3.00	0.00	0.0020	0.0145	0.0577	28.86	1.82
16.00 m	11.00	52.00	24.00	7.00	0.00	6.00	0.00	-	0.0153	0.0675	-	-
19.00 m	12.00	50.00	22.00	4.00	3.00	9.00	0.00	-	0.0147	0.0698	-	-
22.00 m	10.00	50.00	26.00	5.00	2.00	7.00	0.00	0.0020	0.0176	0.0750	37.50	2.06
25.00 m	11.00	51.00	21.00	3.00	4.00	8.00	2.00	-	0.0156	0.0698	-	-
28.00 m	11.00	49.00	19.00	7.00	3.00	11.00	0.00	-	0.0163	0.0750	-	-
31.50 m	7.00	49.00	33.00	2.00	0.00	9.00	0.00	0.0036	0.0233	0.0883	24.51	1.70
34.00 m	6.00	51.00	30.00	4.00	2.00	7.00	0.00	0.0044	0.0237	0.0849	19.39	1.51
38.50 m	7.00	47.00	26.00	5.00	4.00	11.00	0.00	0.0036	0.0242	0.1047	28.89	1.55

GRAIN SIZE DISTRIBUTION CURVES

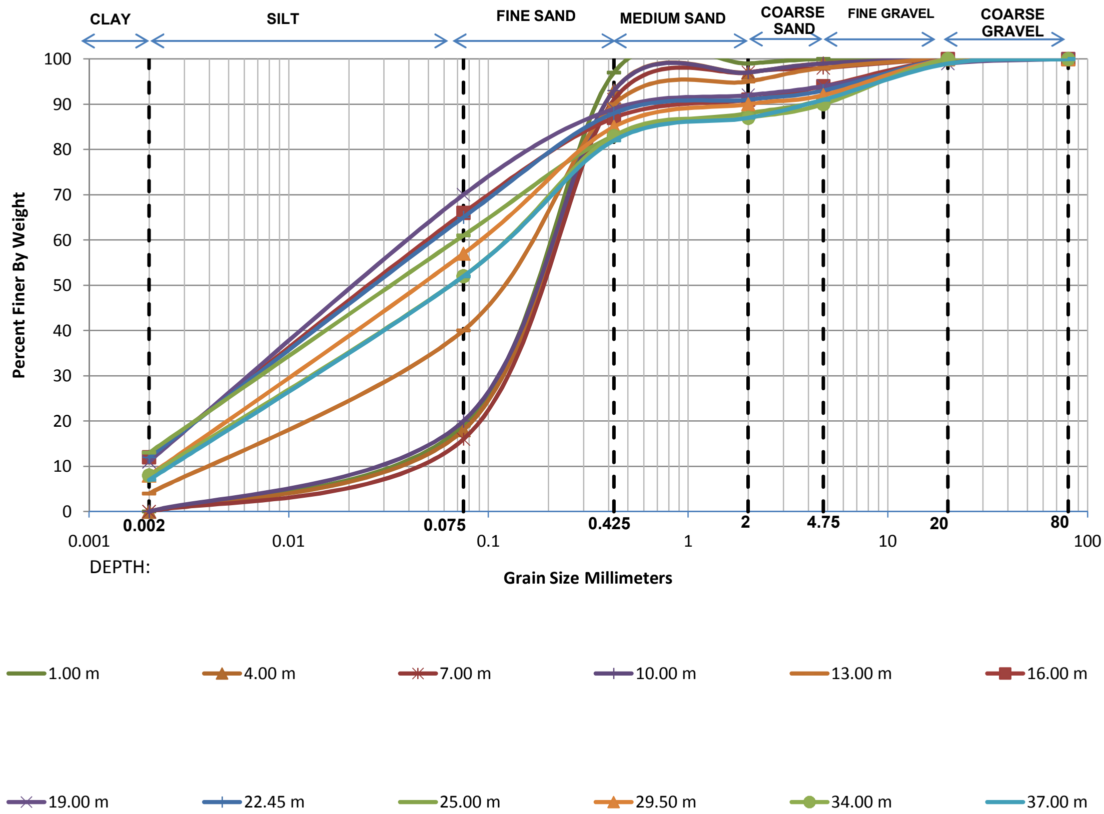
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	10+859 Major Bridge
B.H. No.	BH-P1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	0.00	22.00	75.00	2.00	1.00	0.00	0.00	0.0239	0.1038	0.2012	8.41	2.24
5.50 m	0.00	24.00	68.00	4.00	3.00	1.00	0.00	0.0202	0.0969	0.2048	10.15	2.27
7.00 m	0.00	23.00	65.00	6.00	4.00	2.00	0.00	0.0216	0.1015	0.2178	10.09	2.19
9.00 m	0.00	23.00	70.00	3.00	2.00	2.00	0.00	0.0219	0.1006	0.2056	9.41	2.25
11.50 m	11.00	59.00	18.00	5.00	2.00	5.00	0.00	-	0.0130	0.0538	-	-
14.50 m	12.00	55.00	22.00	3.00	4.00	3.00	1.00	-	0.0130	0.0589	-	-
17.50 m	10.00	53.00	26.00	4.00	3.00	4.00	0.00	0.0020	0.0163	0.0677	33.85	1.96
20.50 m	11.00	54.00	20.00	7.00	2.00	6.00	0.00	-	0.0144	0.0630	-	-
23.50 m	12.00	52.00	22.00	6.00	1.00	4.00	3.00	-	0.0140	0.0651	-	-
26.50 m	11.00	50.00	24.00	7.00	3.00	4.00	1.00	-	0.0161	0.0724	-	-
29.50 m	8.00	49.00	28.00	5.00	2.00	8.00	0.00	0.0029	0.0213	0.0857	29.19	1.81
32.50 m	6.00	49.00	30.00	7.00	1.00	7.00	0.00	0.0044	0.0249	0.0947	21.40	1.48
35.50 m	7.00	49.00	27.00	4.00	3.00	10.00	0.00	0.0036	0.0229	0.0909	25.28	1.61
38.50 m	7.00	49.00	29.00	3.00	4.00	7.00	1.00	0.0036	0.0231	0.0898	24.96	1.65

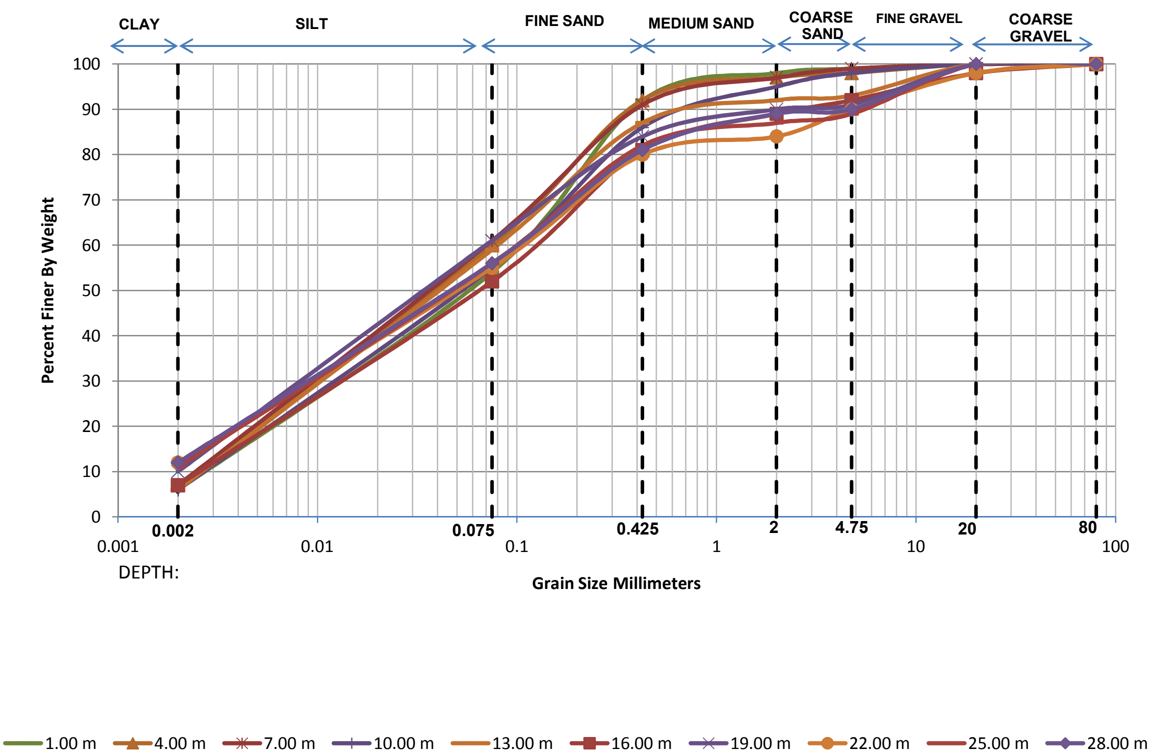
GRAIN SIZE DISTRIBUTION CURVES

Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	10+859 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	0.00	19.00	78.00	2.00	1.00	0.00	0.00	0.0311	0.1156	0.2104	6.77	2.05
4.00 m	0.00	18.00	75.00	4.00	2.00	1.00	0.00	0.0338	0.1209	0.2212	6.54	1.95
7.00 m	0.00	16.00	75.00	6.00	1.00	2.00	0.00	0.0411	0.1303	0.2319	5.64	1.78
10.00 m	0.00	20.00	73.00	4.00	2.00	1.00	0.00	0.0281	0.1126	0.2151	7.64	2.09
13.00 m	4.00	36.00	50.00	5.00	3.00	2.00	0.00	0.0081	0.0464	0.1551	19.08	1.71
16.00 m	12.00	54.00	21.00	4.00	3.00	6.00	0.00	-	0.0133	0.0608	-	-
19.00 m	11.00	59.00	19.00	3.00	2.00	5.00	1.00	-	0.0130	0.0539	-	-
22.45 m	12.00	53.00	23.00	3.00	2.00	7.00	0.00	-	0.0137	0.0629	-	-
25.00 m	13.00	48.00	22.00	5.00	3.00	9.00	0.00	-	0.0142	0.0723	-	-
29.50 m	8.00	49.00	28.00	5.00	2.00	8.00	0.00	0.0029	0.0213	0.0857	29.19	1.81
34.00 m	8.00	44.00	31.00	4.00	3.00	10.00	0.00	0.0030	0.0250	0.1120	37.59	1.87
37.00 m	7.00	45.00	30.00	5.00	4.00	8.00	1.00	0.0037	0.0260	0.1134	30.93	1.63

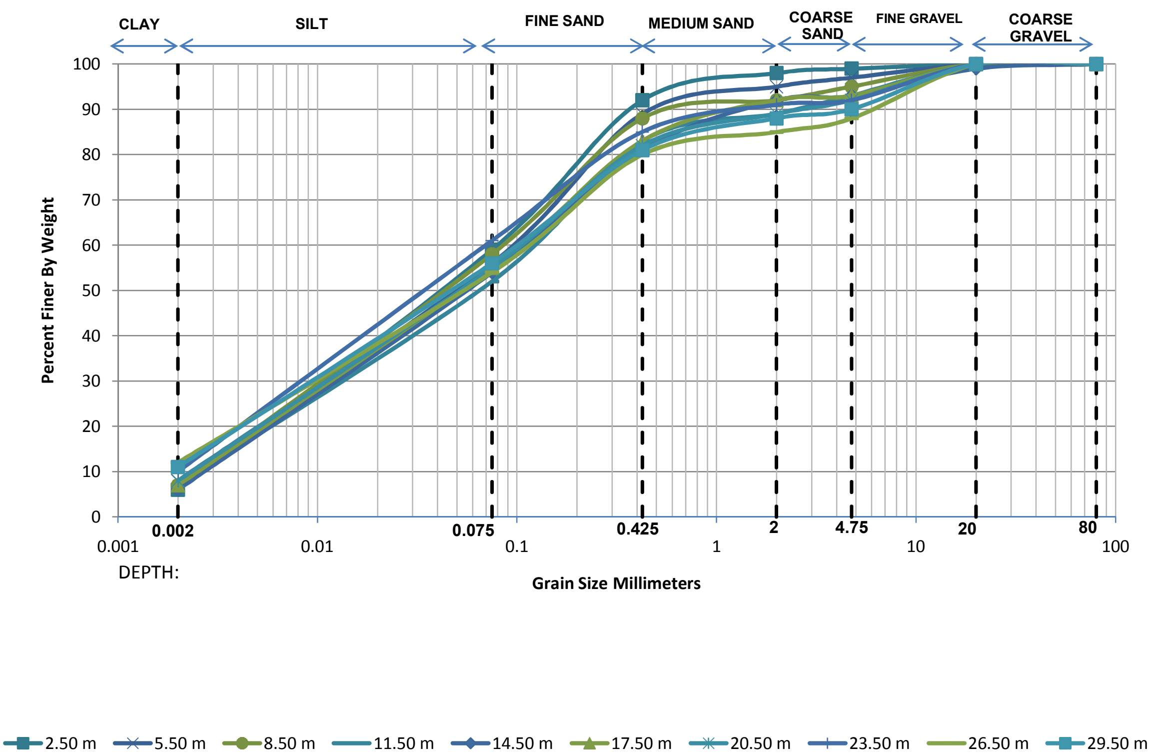
GRAIN SIZE DISTRIBUTION CURVES	
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	17+625 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	6.00	48.00	38.00	6.00	1.00	1.00	0.00	0.0045	0.0261	0.0953	21.30	1.60
4.00 m	7.00	53.00	32.00	5.00	1.00	2.00	0.00	0.0035	0.0210	0.0750	21.15	1.65
7.00 m	7.00	54.00	30.00	6.00	2.00	1.00	0.00	0.0035	0.0204	0.0726	20.56	1.62
10.00 m	6.00	49.00	31.00	9.00	3.00	2.00	0.00	0.0044	0.0250	0.0943	21.29	1.50
13.00 m	6.00	53.00	28.00	5.00	1.00	7.00	0.00	0.0043	0.0225	0.0778	17.98	1.50
16.00 m	7.00	45.00	29.00	8.00	3.00	6.00	2.00	0.0037	0.0260	0.1159	31.60	1.59
19.00 m	10.00	51.00	23.00	6.00	1.00	9.00	0.00	0.0020	0.0170	0.0724	36.20	1.99
22.00 m	12.00	43.00	25.00	4.00	6.00	8.00	2.00	-	0.0182	0.0995	-	-
25.00 m	11.00	45.00	26.00	5.00	2.00	11.00	0.00	-	0.0187	0.0922	-	-
28.00 m	12.00	44.00	25.00	8.00	1.00	10.00	0.00	-	0.0177	0.0933	-	-

GRAIN SIZE DISTRIBUTION CURVES

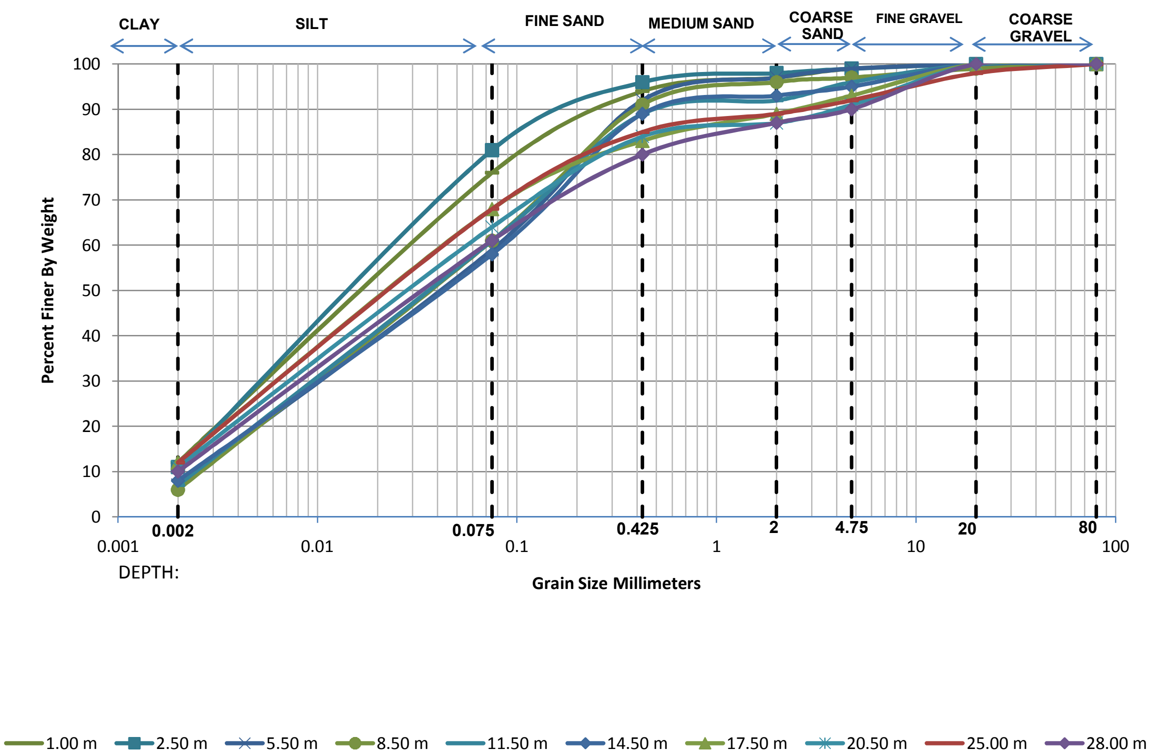
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	17+625 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	6.00	53.00	33.00	6.00	1.00	1.00	0.00	0.0043	0.0227	0.0776	17.89	1.53
5.50 m	8.00	48.00	33.00	6.00	2.00	3.00	0.00	0.0029	0.0222	0.0887	30.11	1.88
8.50 m	7.00	51.00	30.00	4.00	3.00	5.00	0.00	0.0036	0.0219	0.0811	22.71	1.66
11.50 m	7.00	45.00	31.00	6.00	4.00	7.00	0.00	0.0037	0.0261	0.1122	30.58	1.65
14.50 m	6.00	48.00	27.00	11.00	1.00	6.00	1.00	0.0044	0.0254	0.1044	23.50	1.40
17.50 m	7.00	48.00	28.00	9.00	1.00	7.00	0.00	0.0036	0.0237	0.0965	26.73	1.61
20.50 m	8.00	47.00	27.00	7.00	3.00	8.00	0.00	0.0029	0.0225	0.0973	32.99	1.76
23.50 m	10.00	51.00	24.00	6.00	1.00	8.00	0.00	0.0020	0.0170	0.0724	36.21	2.00
26.50 m	12.00	42.00	26.00	5.00	3.00	12.00	0.00	-	0.0189	0.1057	-	-
29.50 m	11.00	45.00	25.00	7.00	2.00	10.00	0.00	-	0.0186	0.0930	-	-

GRAIN SIZE DISTRIBUTION CURVES

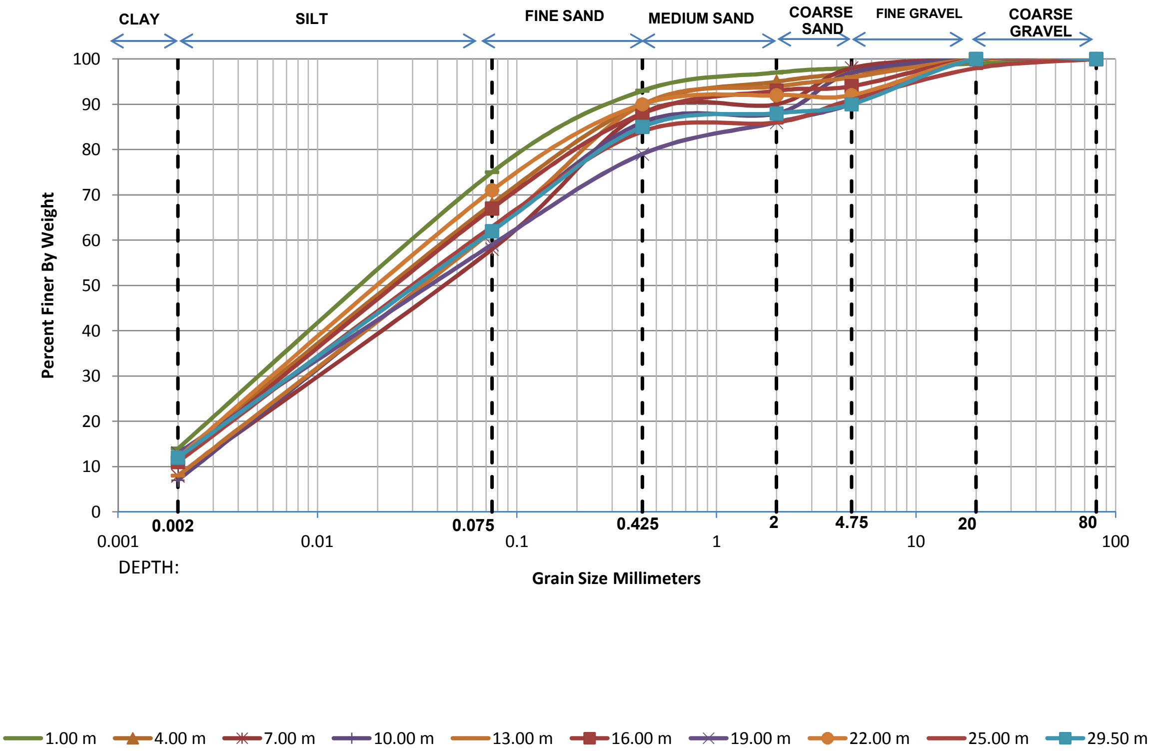
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	17+872 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	12.00	64.00	18.00	3.00	2.00	1.00	0.00	-	0.0109	0.0451	-	-
2.50 m	11.00	70.00	15.00	2.00	1.00	1.00	0.00	-	0.0108	0.0401	-	-
5.50 m	7.00	52.00	33.00	5.00	2.00	1.00	0.00	0.0036	0.0215	0.0777	21.81	1.68
8.50 m	6.00	55.00	30.00	5.00	1.00	2.00	1.00	0.0043	0.0216	0.0726	16.93	1.49
11.50 m	7.00	54.00	28.00	3.00	4.00	4.00	0.00	0.0035	0.0203	0.0726	20.57	1.61
14.50 m	8.00	50.00	31.00	4.00	2.00	5.00	0.00	0.0029	0.0209	0.0811	27.67	1.84
17.50 m	12.00	56.00	15.00	6.00	4.00	7.00	0.00	-	0.0125	0.0567	-	-
20.50 m	11.00	53.00	20.00	3.00	4.00	9.00	0.00	-	0.0148	0.0652	-	-
25.00 m	12.00	56.00	17.00	4.00	3.00	6.00	2.00	-	0.0126	0.0568	-	-
28.00 m	10.00	51.00	19.00	7.00	3.00	10.00	0.00	0.0020	0.0168	0.0724	36.19	1.95

GRAIN SIZE DISTRIBUTION CURVES

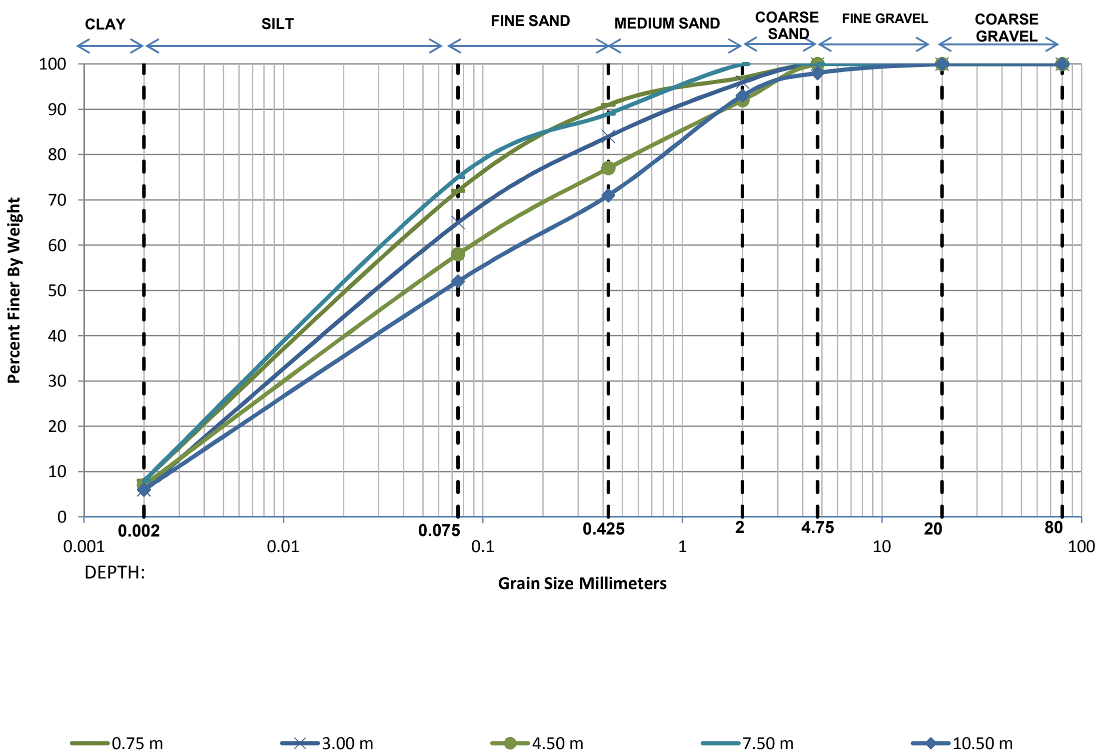
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	17+872 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	14.00	61.00	18.00	4.00	1.00	1.00	1.00	-	0.0097	0.0454	-	-
4.00 m	12.00	56.00	22.00	5.00	2.00	3.00	0.00	-	0.0128	0.0571	-	-
7.00 m	8.00	50.00	30.00	2.00	8.00	2.00	0.00	0.0029	0.0208	0.0811	27.70	1.83
10.00 m	7.00	55.00	24.00	2.00	9.00	3.00	0.00	0.0035	0.0197	0.0702	20.00	1.57
13.00 m	8.00	54.00	28.00	4.00	2.00	4.00	0.00	0.0029	0.0188	0.0702	24.20	1.73
16.00 m	11.00	56.00	21.00	5.00	1.00	6.00	0.00	-	0.0139	0.0591	-	-
19.00 m	13.00	46.00	20.00	7.00	4.00	10.00	0.00	-	0.0149	0.0786	-	-
22.00 m	12.00	59.00	19.00	2.00	0.00	8.00	0.00	-	0.0119	0.0519	-	-
25.00 m	11.00	52.00	21.00	2.00	5.00	7.00	2.00	-	0.0152	0.0675	-	-
29.50 m	12.00	50.00	23.00	3.00	2.00	10.00	0.00	-	0.0147	0.0698	-	-

GRAIN SIZE DISTRIBUTION CURVES

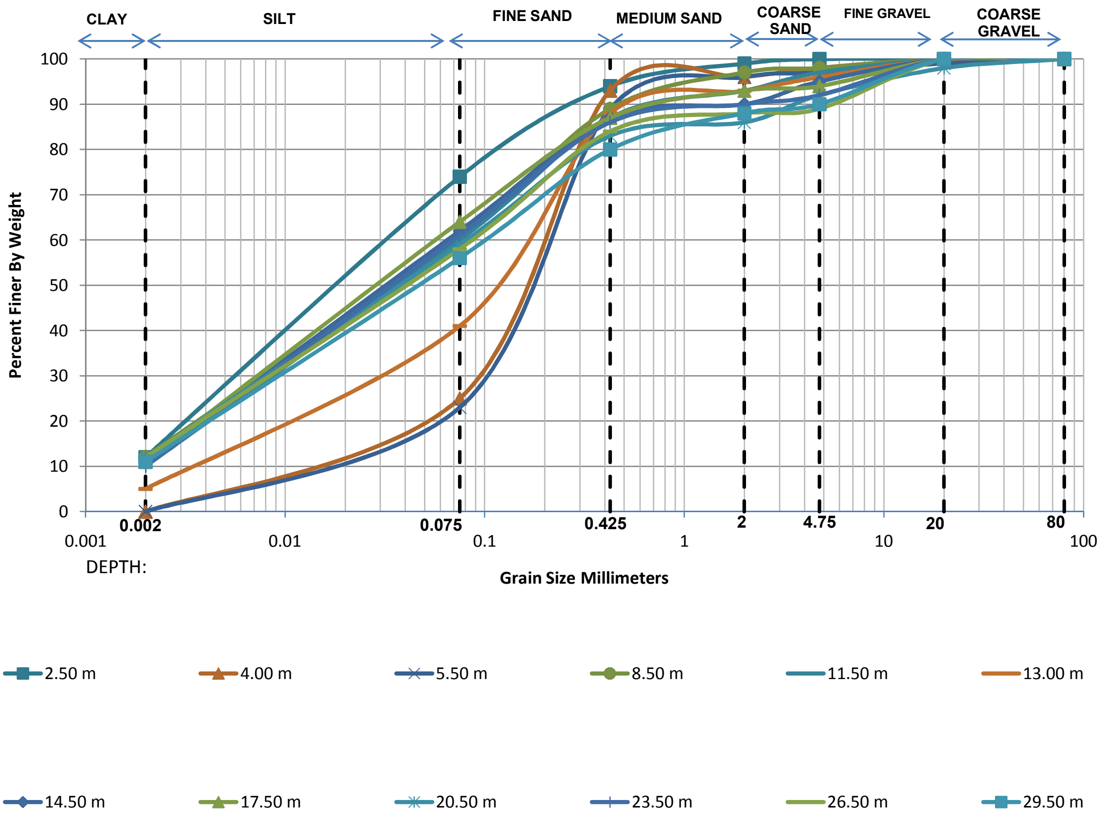
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	New Ch. 19+010 IMT Sohna Station
B.H. No.	BH-PLT-07



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
0.75 m	8.00	64.00	19.00	6.00	3.00	0.00	0.00	0.0028	0.0152	0.0520	18.25	1.55
3.00 m	6.00	59.00	19.00	12.00	4.00	0.00	0.00	0.0042	0.0194	0.0640	15.24	1.40
4.50 m	7.00	51.00	19.00	15.00	8.00	0.00	0.00	0.0036	0.0213	0.0842	23.69	1.52
7.50 m	8.00	67.00	14.00	11.00	0.00	0.00	0.00	0.0028	0.0143	0.0479	16.87	1.52
10.50 m	6.00	46.00	19.00	22.00	5.00	2.00	0.00	0.0045	0.0264	0.1596	35.71	0.98

GRAIN SIZE DISTRIBUTION CURVES

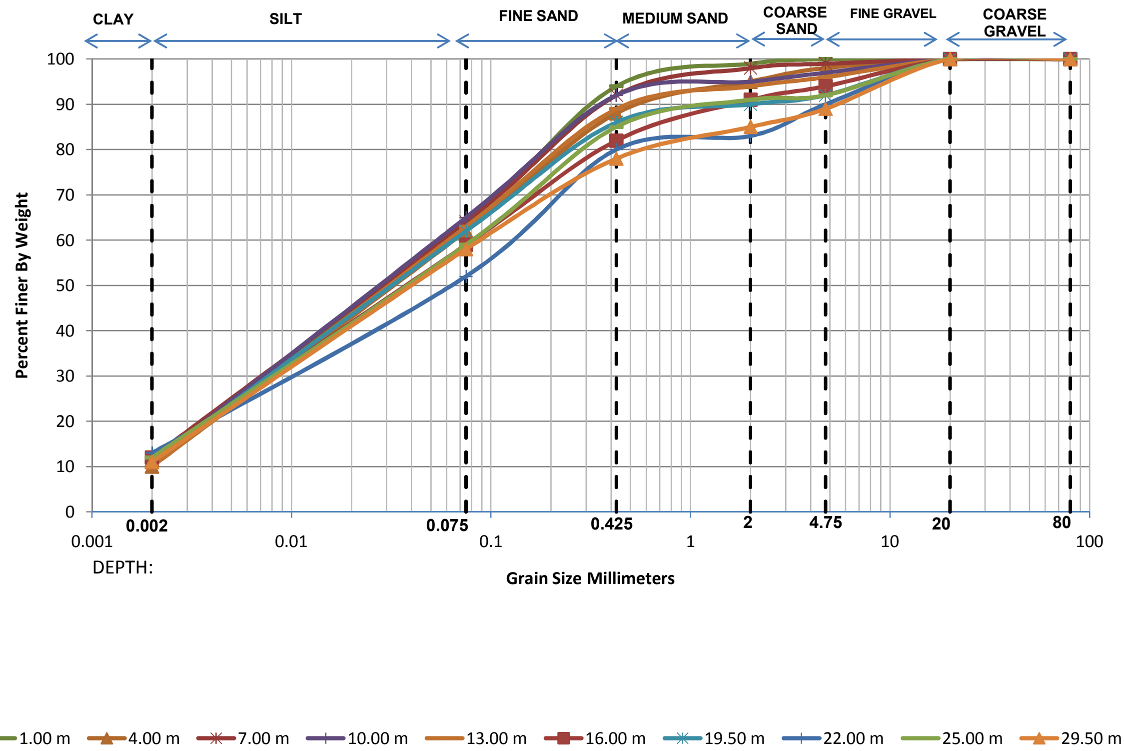
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	18+750 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	12.00	62.00	20.00	5.00	1.00	0.00	0.00	-	0.0114	0.0477	-	-
4.00 m	0.00	25.00	68.00	3.00	2.00	2.00	0.00	0.0188	0.0929	0.1993	10.63	2.31
5.50 m	0.00	23.00	66.00	7.00	1.00	2.00	1.00	0.0216	0.1013	0.2156	9.96	2.20
8.50 m	12.00	49.00	28.00	8.00	1.00	2.00	0.00	-	0.0153	0.0724	-	-
11.50 m	10.00	50.00	27.00	6.00	4.00	3.00	0.00	0.0020	0.0176	0.0750	37.50	2.07
13.00 m	5.00	36.00	47.00	5.00	3.00	4.00	0.00	0.0064	0.0434	0.1553	24.24	1.89
14.50 m	11.00	51.00	25.00	3.00	5.00	5.00	0.00	-	0.0157	0.0699	-	-
17.50 m	11.00	53.00	23.00	6.00	1.00	6.00	0.00	-	0.0149	0.0653	-	-
20.50 m	12.00	47.00	24.00	3.00	6.00	6.00	2.00	-	0.0160	0.0782	-	-
23.50 m	10.00	51.00	25.00	4.00	2.00	8.00	0.00	0.0020	0.0171	0.0724	36.21	2.02
26.50 m	12.00	46.00	26.00	4.00	1.00	11.00	0.00	-	0.0166	0.0820	-	-
29.50 m	11.00	45.00	24.00	8.00	2.00	10.00	0.00	-	0.0186	0.0939	-	-

GRAIN SIZE DISTRIBUTION CURVES

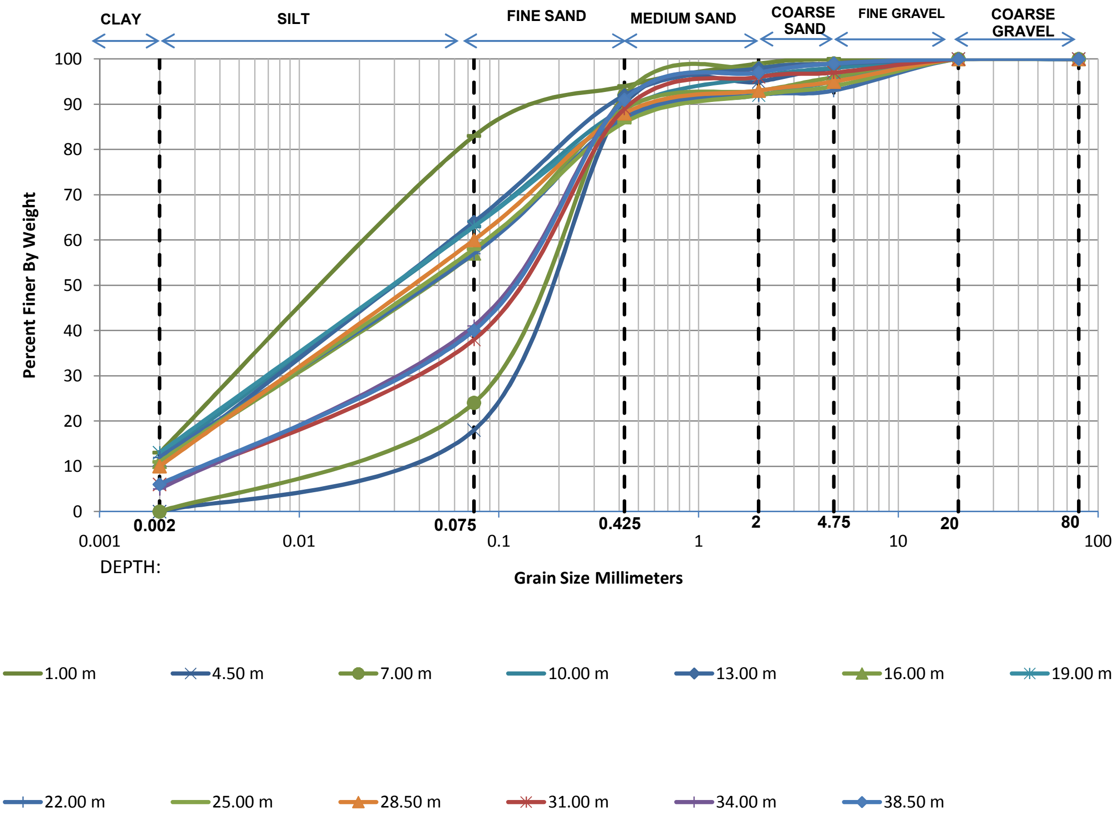
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	18+750 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	11.00	53.00	30.00	5.00	1.00	0.00	0.00	-	0.0152	0.0655	-	-
4.00 m	10.00	52.00	26.00	7.00	3.00	2.00	0.00	0.0020	0.0167	0.0700	35.00	1.99
7.00 m	12.00	52.00	28.00	6.00	1.00	1.00	0.00	-	0.0142	0.0653	-	-
10.00 m	11.00	54.00	27.00	3.00	2.00	3.00	0.00	-	0.0147	0.0633	-	-
13.00 m	10.00	53.00	26.00	5.00	2.00	4.00	0.00	0.0020	0.0163	0.0677	33.85	1.96
16.00 m	12.00	47.00	23.00	9.00	3.00	6.00	0.00	-	0.0160	0.0783	-	-
19.50 m	11.00	51.00	24.00	4.00	2.00	8.00	0.00	-	0.0157	0.0699	-	-
22.00 m	13.00	39.00	28.00	3.00	7.00	10.00	0.00	-	0.0194	0.1178	-	-
25.00 m	12.00	47.00	26.00	6.00	1.00	8.00	0.00	-	0.0161	0.0781	-	-
29.50 m	11.00	47.00	20.00	7.00	4.00	11.00	0.00	-	0.0173	0.0836	-	-

GRAIN SIZE DISTRIBUTION CURVES

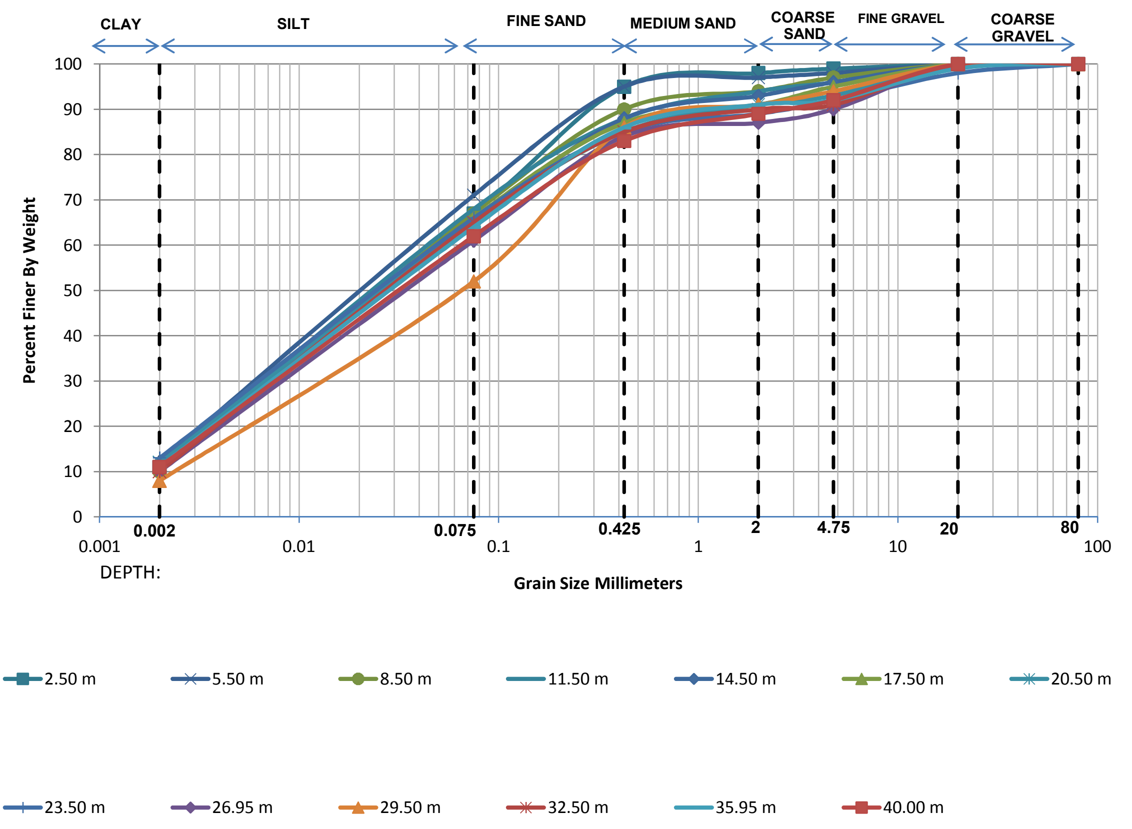
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	19+500 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	13.00	70.00	11.00	5.00	1.00	0.00	0.00	-	0.0091	0.0370	-	-
4.50 m	0.00	18.00	72.00	5.00	3.00	2.00	0.00	0.0336	0.1218	0.2278	6.77	1.94
7.00 m	0.00	24.00	68.00	6.00	1.00	1.00	0.00	0.0202	0.0969	0.2054	10.18	2.27
10.00 m	12.00	51.00	26.00	7.00	2.00	2.00	0.00	-	0.0145	0.0674	-	-
13.00 m	10.00	54.00	28.00	6.00	1.00	1.00	0.00	0.0020	0.0160	0.0656	32.79	1.95
16.00 m	11.00	46.00	32.00	4.00	3.00	4.00	0.00	-	0.0184	0.0851	-	-
19.00 m	13.00	50.00	24.00	5.00	3.00	5.00	0.00	-	0.0135	0.0673	-	-
22.00 m	12.00	45.00	30.00	5.00	1.00	7.00	0.00	-	0.0173	0.0856	-	-
25.00 m	11.00	47.00	28.00	6.00	2.00	6.00	0.00	-	0.0177	0.0817	-	-
28.50 m	10.00	50.00	28.00	5.00	2.00	5.00	0.00	0.0020	0.0177	0.0750	37.50	2.08
31.00 m	6.00	32.00	51.00	7.00	1.00	3.00	0.00	0.0054	0.0491	0.1667	30.75	2.66
34.00 m	5.00	36.00	50.00	6.00	2.00	1.00	0.00	0.0064	0.0436	0.1501	23.35	1.97
38.50 m	6.00	34.00	51.00	6.00	2.00	1.00	0.00	0.0052	0.0447	0.1547	29.56	2.47

GRAIN SIZE DISTRIBUTION CURVES

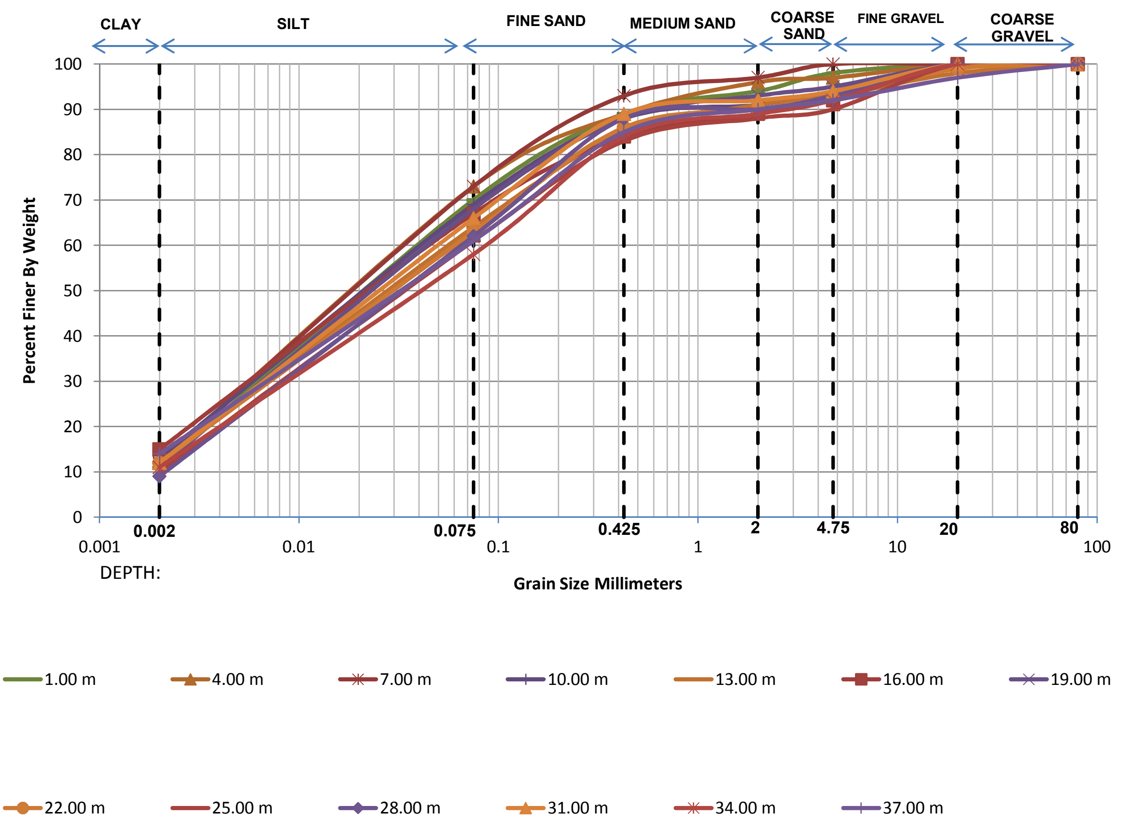
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	19+500 Major Bridge
B.H. No.	BH-P1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	11.00	56.00	28.00	3.00	1.00	1.00	0.00	-	0.0141	0.0595	-	-
5.50 m	12.00	59.00	24.00	2.00	1.00	2.00	0.00	-	0.0121	0.0522	-	-
8.50 m	10.00	57.00	23.00	4.00	3.00	3.00	0.00	0.0020	0.0148	0.0595	29.75	1.84
11.50 m	11.00	57.00	20.00	6.00	2.00	4.00	0.00	-	0.0135	0.0573	-	-
14.50 m	12.00	53.00	23.00	5.00	3.00	4.00	0.00	-	0.0137	0.0629	-	-
17.50 m	11.00	55.00	21.00	4.00	4.00	5.00	0.00	-	0.0142	0.0611	-	-
20.50 m	12.00	53.00	20.00	6.00	2.00	7.00	0.00	-	0.0136	0.0628	-	-
23.50 m	13.00	53.00	19.00	4.00	3.00	6.00	2.00	-	0.0124	0.0605	-	-
26.95 m	10.00	51.00	23.00	3.00	3.00	10.00	0.00	0.0020	0.0170	0.0724	36.20	1.99
29.50 m	8.00	44.00	34.00	5.00	3.00	6.00	0.00	0.0030	0.0252	0.1087	36.44	1.95
32.50 m	10.00	55.00	20.00	5.00	1.00	9.00	0.00	0.0020	0.0153	0.0632	31.62	1.86
35.95 m	11.00	53.00	22.00	5.00	1.00	7.00	1.00	-	0.0149	0.0652	-	-
40.00 m	11.00	51.00	21.00	6.00	3.00	8.00	0.00	-	0.0156	0.0698	-	-

GRAIN SIZE DISTRIBUTION CURVES

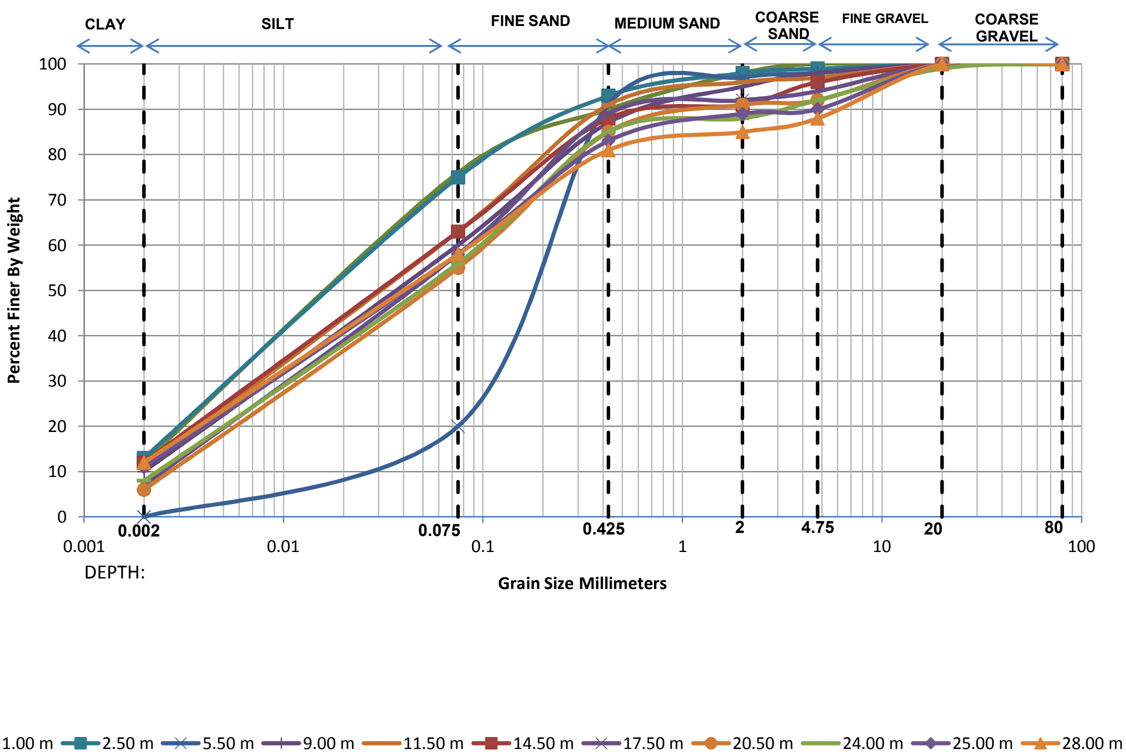
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	19+500 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	11.00	59.00	19.00	5.00	4.00	2.00	0.00	-	0.0130	0.0539	-	-
4.00 m	12.00	61.00	16.00	7.00	1.00	3.00	0.00	-	0.0114	0.0488	-	-
7.00 m	12.00	61.00	20.00	4.00	3.00	0.00	0.00	-	0.0115	0.0491	-	-
10.00 m	13.00	56.00	19.00	3.00	3.00	6.00	0.00	-	0.0116	0.0548	-	-
13.00 m	12.00	52.00	21.00	6.00	2.00	5.00	2.00	-	0.0139	0.0650	-	-
16.00 m	15.00	52.00	17.00	5.00	3.00	8.00	0.00	-	0.0105	0.0578	-	-
19.00 m	11.00	57.00	20.00	5.00	2.00	5.00	0.00	-	0.0135	0.0573	-	-
22.00 m	12.00	51.00	23.00	4.00	3.00	6.00	1.00	-	0.0144	0.0674	-	-
25.00 m	10.00	51.00	22.00	5.00	2.00	10.00	0.00	0.0020	0.0169	0.0724	36.20	1.98
28.00 m	9.00	53.00	26.00	2.00	3.00	7.00	0.00	0.0024	0.0177	0.0701	29.22	1.86
31.00 m	12.00	54.00	23.00	3.00	2.00	6.00	0.00	-	0.0134	0.0609	-	-
34.00 m	11.00	47.00	26.00	5.00	3.00	8.00	0.00	-	0.0176	0.0820	-	-
37.00 m	14.00	47.00	24.00	5.00	2.00	5.00	3.00	-	0.0134	0.0722	-	-

GRAIN SIZE DISTRIBUTION CURVES

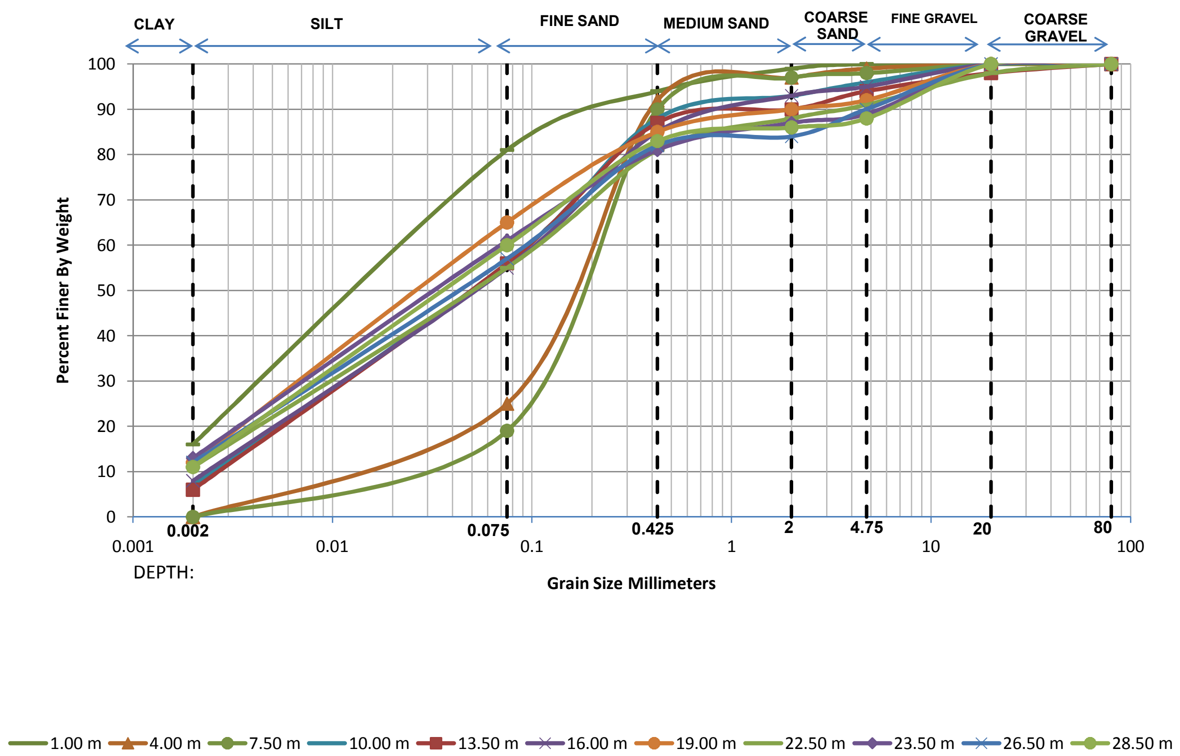
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	19+715 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	12.00	64.00	14.00	8.00	2.00	0.00	0.00	-	0.0108	0.0448	-	-
2.50 m	13.00	62.00	18.00	5.00	1.00	1.00	0.00	-	0.0104	0.0459	-	-
5.50 m	0.00	20.00	71.00	6.00	1.00	2.00	0.00	0.0280	0.1131	0.2199	7.85	2.08
9.00 m	10.00	50.00	27.00	8.00	3.00	2.00	0.00	0.0020	0.0176	0.0750	37.50	2.07
11.50 m	11.00	52.00	28.00	5.00	1.00	3.00	0.00	-	0.0155	0.0676	-	-
14.50 m	12.00	51.00	25.00	3.00	5.00	4.00	0.00	-	0.0144	0.0674	-	-
17.50 m	7.00	51.00	31.00	3.00	2.00	6.00	0.00	0.0036	0.0220	0.0810	22.67	1.67
20.50 m	6.00	49.00	30.00	6.00	1.00	8.00	0.00	0.0044	0.0249	0.0946	21.37	1.49
24.00 m	8.00	48.00	29.00	3.00	4.00	7.00	1.00	0.0029	0.0220	0.0899	30.57	1.82
25.00 m	11.00	47.00	25.00	6.00	1.00	10.00	0.00	-	0.0175	0.0822	-	-
28.00 m	12.00	46.00	23.00	4.00	3.00	12.00	0.00	-	0.0165	0.0826	-	-

GRAIN SIZE DISTRIBUTION CURVES

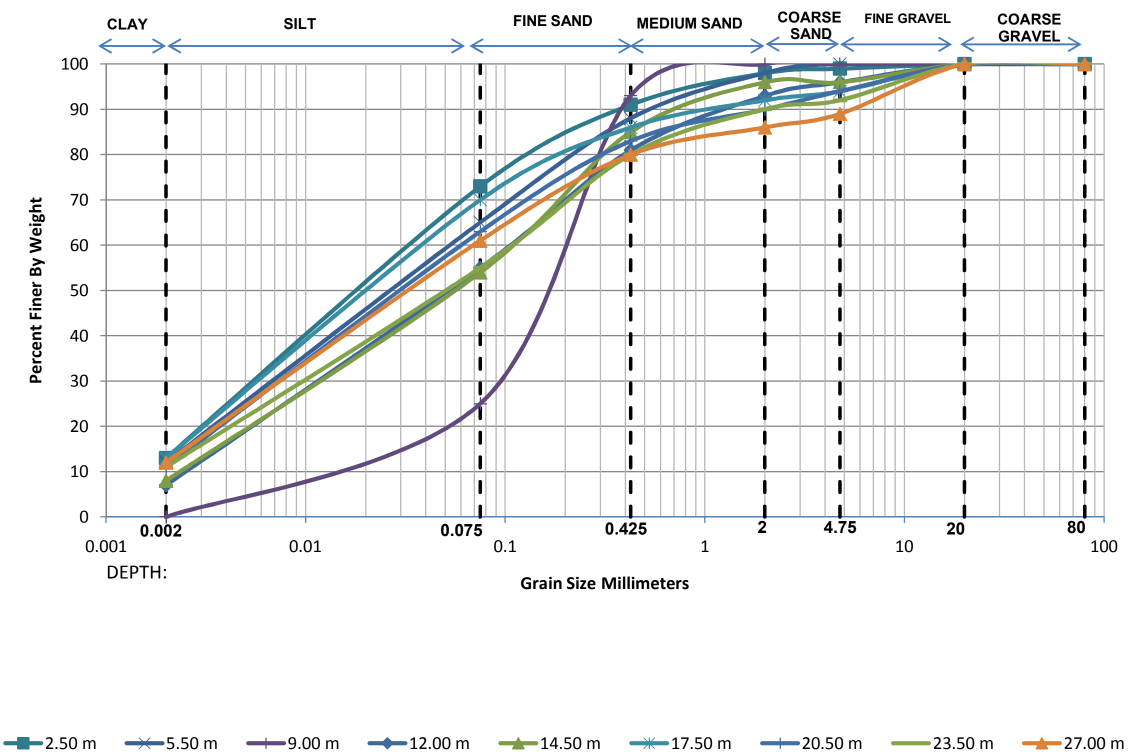
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	19+715 Major Bridge
B.H. No.	BH-P1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	16.00	65.00	13.00	5.00	1.00	0.00	0.00	-	0.0075	0.0373	-	-
4.00 m	0.00	25.00	67.00	5.00	2.00	1.00	0.00	0.0187	0.0930	0.2019	10.79	2.29
7.50 m	0.00	19.00	71.00	7.00	1.00	2.00	0.00	0.0306	0.1176	0.2254	7.36	2.00
10.00 m	7.00	49.00	32.00	5.00	3.00	4.00	0.00	0.0036	0.0232	0.0888	24.65	1.69
13.50 m	6.00	50.00	31.00	3.00	4.00	4.00	2.00	0.0044	0.0243	0.0889	20.19	1.51
16.00 m	8.00	47.00	30.00	8.00	2.00	5.00	0.00	0.0030	0.0227	0.0951	32.24	1.83
19.00 m	12.00	53.00	20.00	5.00	2.00	8.00	0.00	-	0.0136	0.0628	-	-
22.50 m	11.00	44.00	26.00	7.00	3.00	7.00	2.00	-	0.0193	0.0988	-	-
23.50 m	13.00	48.00	20.00	6.00	2.00	11.00	0.00	-	0.0141	0.0722	-	-
26.50 m	12.00	45.00	25.00	2.00	6.00	10.00	0.00	-	0.0171	0.0869	-	-
28.50 m	11.00	49.00	23.00	3.00	2.00	12.00	0.00	-	0.0165	0.0750	-	-

GRAIN SIZE DISTRIBUTION CURVES

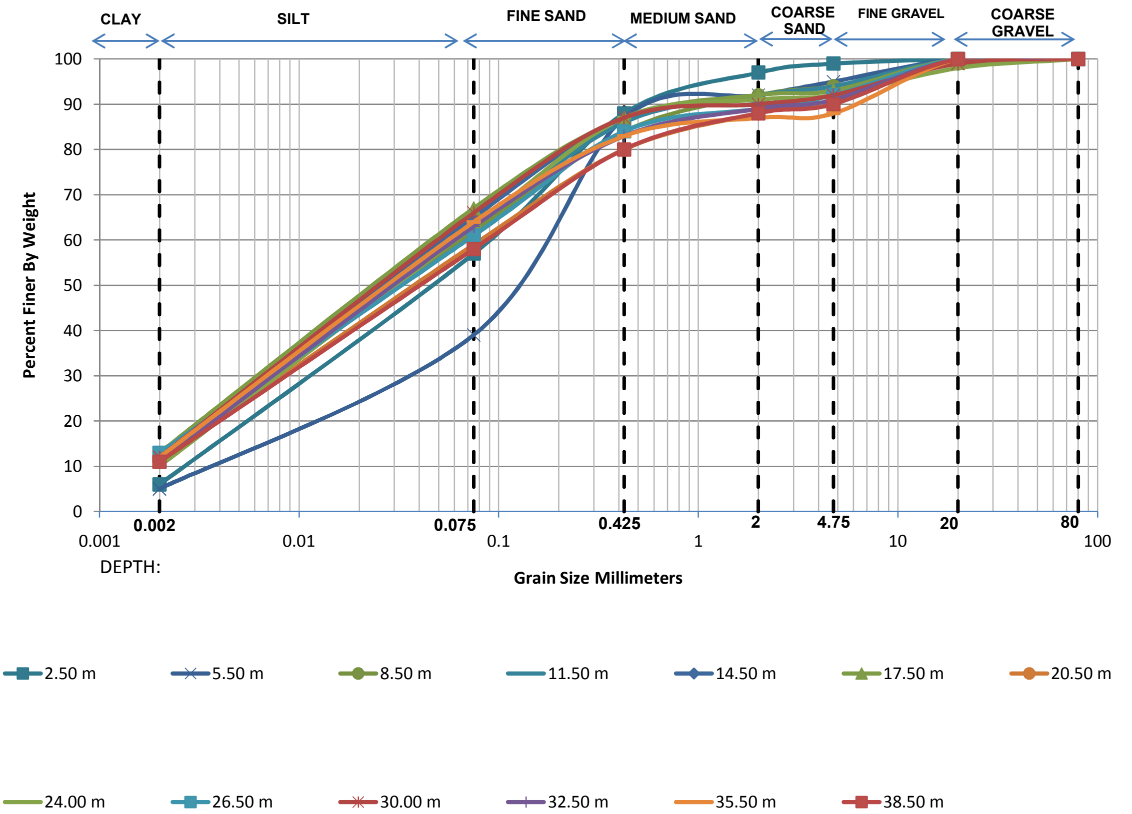
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	19+715 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	13.00	60.00	18.00	7.00	1.00	1.00	0.00	-	0.0107	0.0485	-	-
5.50 m	12.00	53.00	23.00	10.00	2.00	0.00	0.00	-	0.0137	0.0629	-	-
9.00 m	0.00	25.00	68.00	7.00	0.00	0.00	0.00	0.0188	0.0930	0.2004	10.69	2.30
12.00 m	7.00	48.00	26.00	12.00	3.00	4.00	0.00	0.0036	0.0235	0.0988	27.39	1.55
14.50 m	8.00	46.00	31.00	11.00	0.00	4.00	0.00	0.0030	0.0234	0.1005	33.95	1.84
17.50 m	13.00	57.00	16.00	6.00	2.00	6.00	0.00	-	0.0113	0.0530	-	-
20.50 m	11.00	52.00	20.00	7.00	4.00	6.00	0.00	-	0.0151	0.0674	-	-
23.50 m	11.00	44.00	25.00	10.00	2.00	8.00	0.00	-	0.0193	0.1003	-	-
27.00 m	12.00	49.00	19.00	6.00	3.00	11.00	0.00	-	0.0149	0.0723	-	-

GRAIN SIZE DISTRIBUTION CURVES

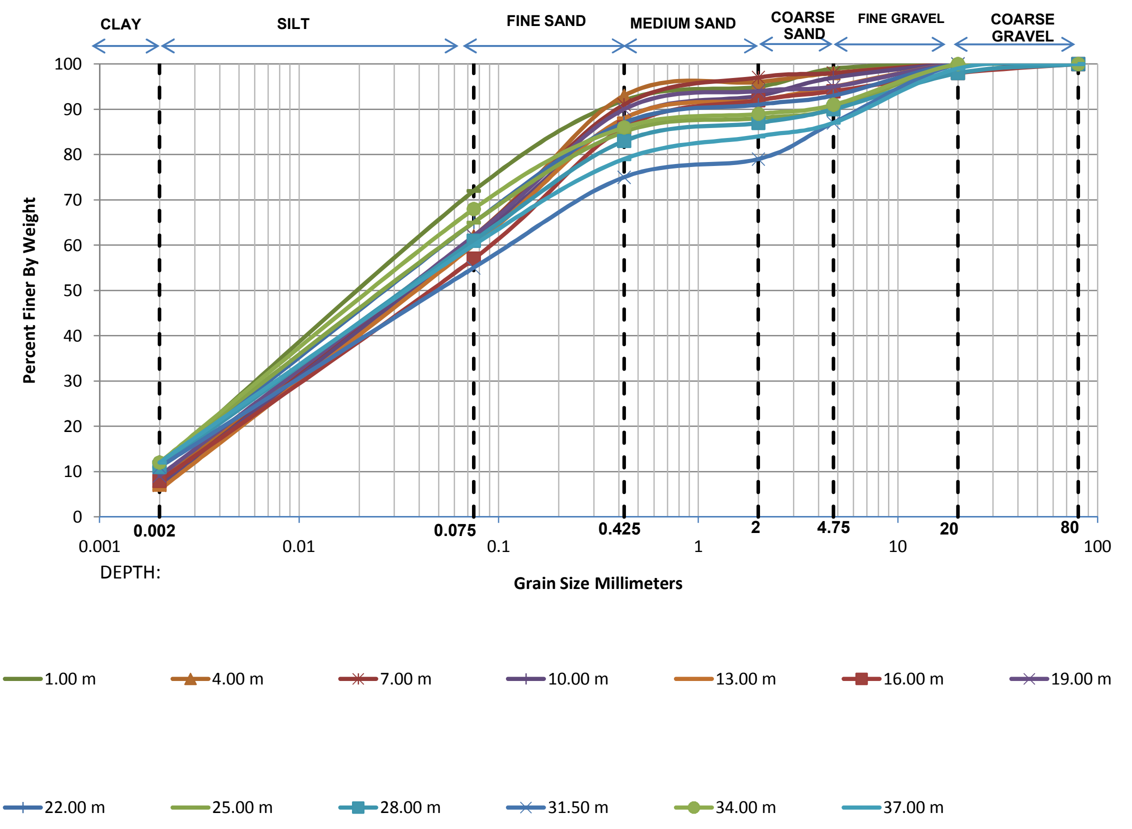
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	20+300 Major Bridge
B.H. No.	BH-A1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	6.00	51.00	31.00	9.00	2.00	1.00	0.00	0.0044	0.0237	0.0849	19.38	1.52
5.50 m	5.00	34.00	48.00	5.00	3.00	5.00	0.00	0.0066	0.0474	0.1657	24.94	2.04
8.50 m	11.00	51.00	22.00	8.00	2.00	5.00	1.00	-	0.0156	0.0698	-	-
11.50 m	12.00	51.00	23.00	6.00	2.00	6.00	0.00	-	0.0144	0.0674	-	-
14.50 m	12.00	53.00	22.00	3.00	2.00	8.00	0.00	-	0.0136	0.0629	-	-
17.50 m	13.00	54.00	20.00	5.00	1.00	7.00	0.00	-	0.0122	0.0585	-	-
20.50 m	11.00	48.00	21.00	8.00	3.00	9.00	0.00	-	0.0168	0.0784	-	-
24.00 m	10.00	53.00	24.00	4.00	1.00	6.00	2.00	0.0020	0.0162	0.0677	33.83	1.94
26.50 m	13.00	48.00	23.00	5.00	3.00	8.00	0.00	-	0.0142	0.0723	-	-
30.00 m	12.00	54.00	21.00	3.00	2.00	7.00	1.00	-	0.0133	0.0608	-	-
32.50 m	11.00	52.00	20.00	6.00	2.00	9.00	0.00	-	0.0151	0.0674	-	-
35.50 m	12.00	52.00	19.00	4.00	1.00	12.00	0.00	-	0.0138	0.0650	-	-
38.50 m	11.00	47.00	22.00	8.00	2.00	10.00	0.00	-	0.0174	0.0830	-	-

GRAIN SIZE DISTRIBUTION CURVES

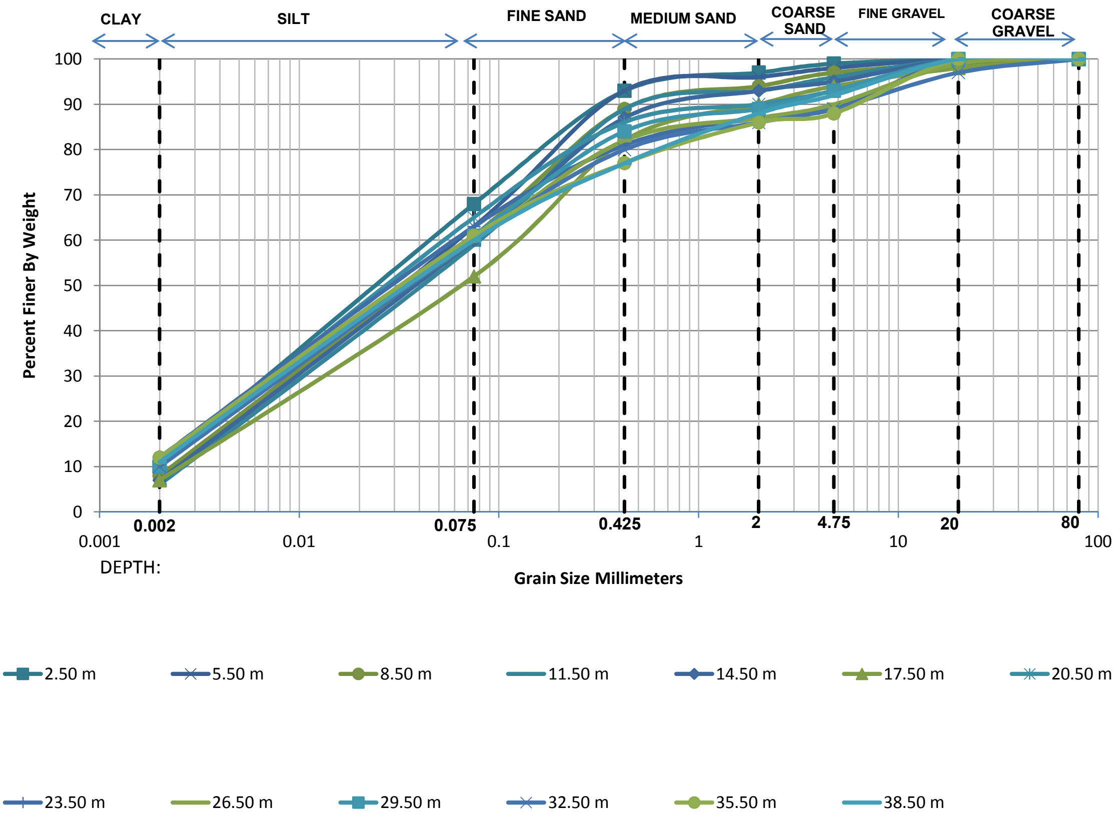
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	20+300 Major Bridge
B.H. No.	BH-P1



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	11.00	61.00	20.00	3.00	4.00	1.00	0.00	-	0.0125	0.0509	-	-
4.00 m	8.00	54.00	31.00	3.00	2.00	2.00	0.00	0.0029	0.0189	0.0703	24.20	1.75
7.00 m	7.00	55.00	29.00	6.00	1.00	2.00	0.00	0.0035	0.0199	0.0703	19.98	1.60
10.00 m	7.00	54.00	27.00	5.00	4.00	3.00	0.00	0.0035	0.0203	0.0726	20.57	1.60
13.00 m	6.00	54.00	28.00	4.00	3.00	5.00	0.00	0.0043	0.0219	0.0750	17.41	1.49
16.00 m	8.00	49.00	29.00	6.00	2.00	4.00	2.00	0.0029	0.0214	0.0854	29.11	1.82
19.00 m	9.00	53.00	28.00	4.00	1.00	5.00	0.00	0.0024	0.0178	0.0701	29.23	1.88
22.00 m	11.00	54.00	22.00	4.00	2.00	7.00	0.00	-	0.0145	0.0631	-	-
25.00 m	12.00	53.00	20.00	3.00	2.00	10.00	0.00	-	0.0136	0.0628	-	-
28.00 m	11.00	50.00	22.00	4.00	3.00	8.00	2.00	-	0.0160	0.0724	-	-
31.50 m	11.00	44.00	20.00	4.00	8.00	13.00	0.00	-	0.0190	0.1068	-	-
34.00 m	12.00	56.00	18.00	3.00	2.00	9.00	0.00	-	0.0126	0.0569	-	-
37.00 m	12.00	48.00	19.00	5.00	3.00	12.00	1.00	-	0.0154	0.0750	-	-

GRAIN SIZE DISTRIBUTION CURVES

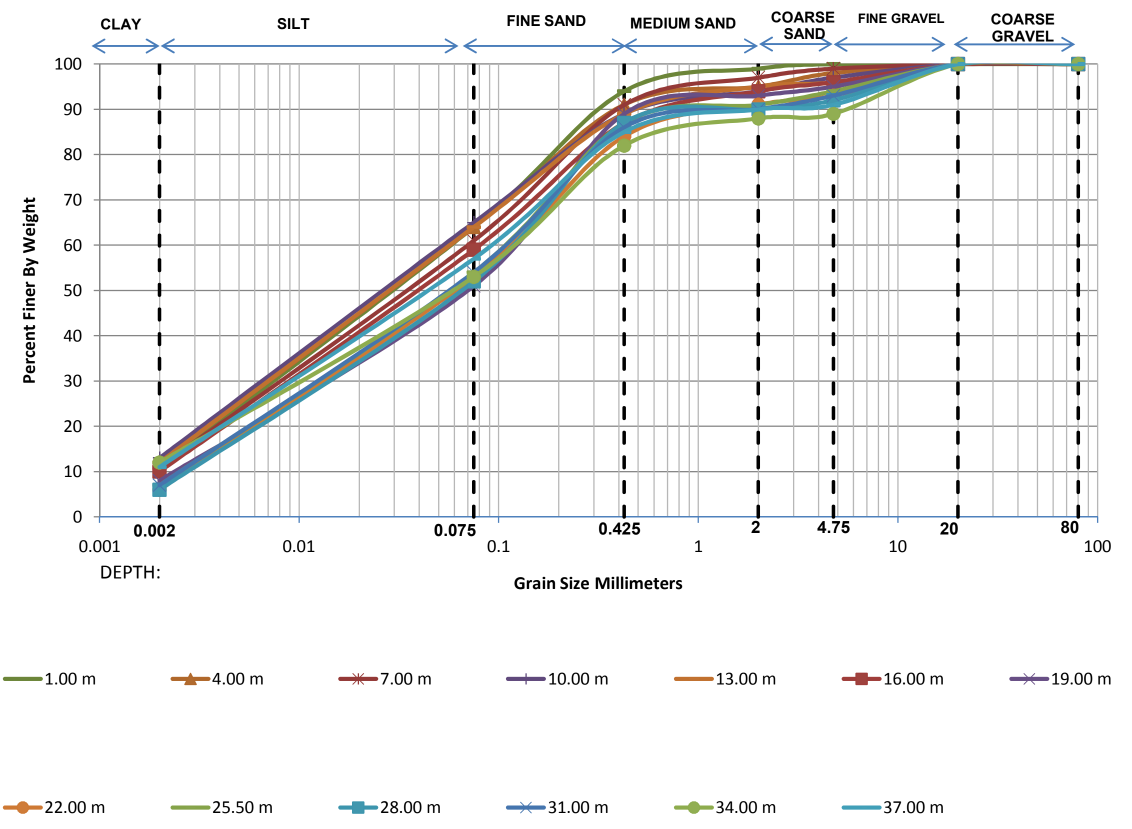
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	20+300 Major Bridge
B.H. No.	BH-P2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
2.50 m	10.00	58.00	25.00	4.00	2.00	1.00	0.00	0.0020	0.0146	0.0578	28.91	1.84
5.50 m	7.00	56.00	30.00	3.00	2.00	2.00	0.00	0.0035	0.0195	0.0682	19.43	1.59
8.50 m	8.00	53.00	28.00	5.00	3.00	2.00	1.00	0.0029	0.0192	0.0725	24.95	1.75
11.50 m	6.00	53.00	30.00	4.00	3.00	4.00	0.00	0.0043	0.0226	0.0777	17.94	1.51
14.50 m	7.00	53.00	27.00	6.00	2.00	5.00	0.00	0.0035	0.0207	0.0750	21.19	1.62
17.50 m	7.00	45.00	30.00	8.00	4.00	4.00	2.00	0.0037	0.0260	0.1142	31.13	1.62
20.50 m	10.00	55.00	21.00	4.00	3.00	7.00	0.00	0.0020	0.0154	0.0633	31.64	1.87
23.50 m	12.00	51.00	18.00	6.00	2.00	11.00	0.00	-	0.0142	0.0672	-	-
26.50 m	11.00	49.00	22.00	5.00	3.00	9.00	1.00	-	0.0164	0.0750	-	-
29.50 m	10.00	51.00	23.00	5.00	4.00	7.00	0.00	0.0020	0.0170	0.0724	36.20	1.99
32.50 m	10.00	50.00	20.00	6.00	3.00	8.00	3.00	0.0020	0.0173	0.0750	37.50	1.99
35.50 m	12.00	49.00	16.00	9.00	2.00	12.00	0.00	-	0.0148	0.0722	-	-
38.50 m	11.00	49.00	17.00	11.00	4.00	8.00	0.00	-	0.0162	0.0750	-	-

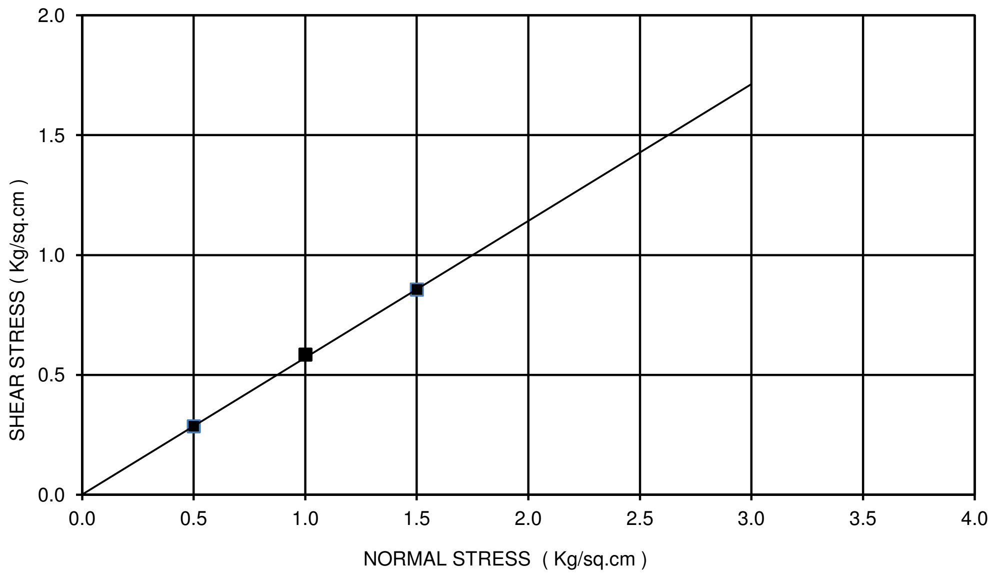
GRAIN SIZE DISTRIBUTION CURVES

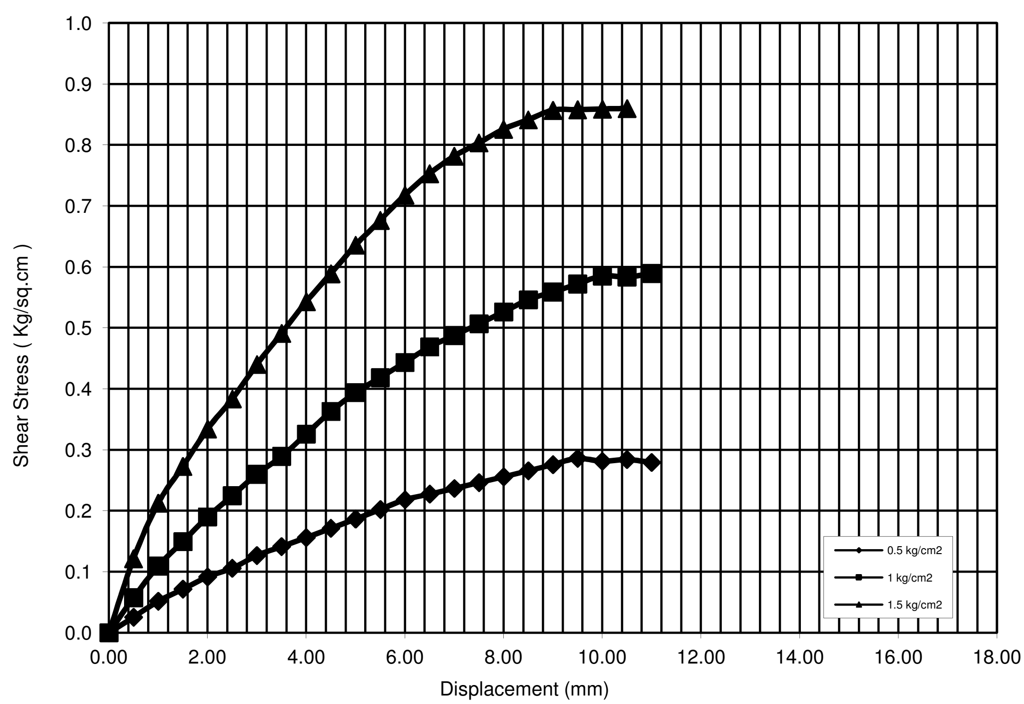
Project Name	Conducting geotechnical investigation, preparation of geotechnical report for designing of bridges and for embankment in connection with construction of Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.
Location/Chainage	20+300 Major Bridge
B.H. No.	BH-A2



Depth	Grain Size Distribution % wt retained							D10	D30	D60	Cu	Cc
	Clay	Silt	Sand			Gravel						
			Fine	Medium	Coarse	Fine	Coarse					
1.00 m	11.00	53.00	30.00	5.00	1.00	0.00	0.00	-	0.0152	0.0655	-	-
4.00 m	12.00	52.00	27.00	4.00	3.00	2.00	0.00	-	0.0142	0.0652	-	-
7.00 m	11.00	50.00	30.00	6.00	2.00	1.00	0.00	-	0.0164	0.0724	-	-
10.00 m	13.00	52.00	24.00	5.00	3.00	3.00	0.00	-	0.0129	0.0628	-	-
13.00 m	12.00	52.00	25.00	6.00	1.00	4.00	0.00	-	0.0141	0.0652	-	-
16.00 m	10.00	49.00	28.00	7.00	2.00	4.00	0.00	0.0020	0.0182	0.0780	38.98	2.12
19.00 m	8.00	43.00	38.00	4.00	2.00	5.00	0.00	0.0030	0.0263	0.1103	36.82	2.09
22.00 m	6.00	47.00	31.00	7.00	2.00	7.00	0.00	0.0045	0.0264	0.1056	23.56	1.48
25.50 m	7.00	47.00	33.00	4.00	3.00	6.00	0.00	0.0036	0.0247	0.0979	26.93	1.71
28.00 m	6.00	46.00	35.00	3.00	2.00	8.00	0.00	0.0045	0.0275	0.1069	23.60	1.56
31.00 m	7.00	47.00	32.00	4.00	3.00	7.00	0.00	0.0036	0.0246	0.0986	27.13	1.69
34.00 m	12.00	41.00	29.00	6.00	1.00	11.00	0.00	-	0.0198	0.1093	-	-
37.00 m	11.00	46.00	28.00	5.00	1.00	9.00	0.00	-	0.0182	0.0860	-	-

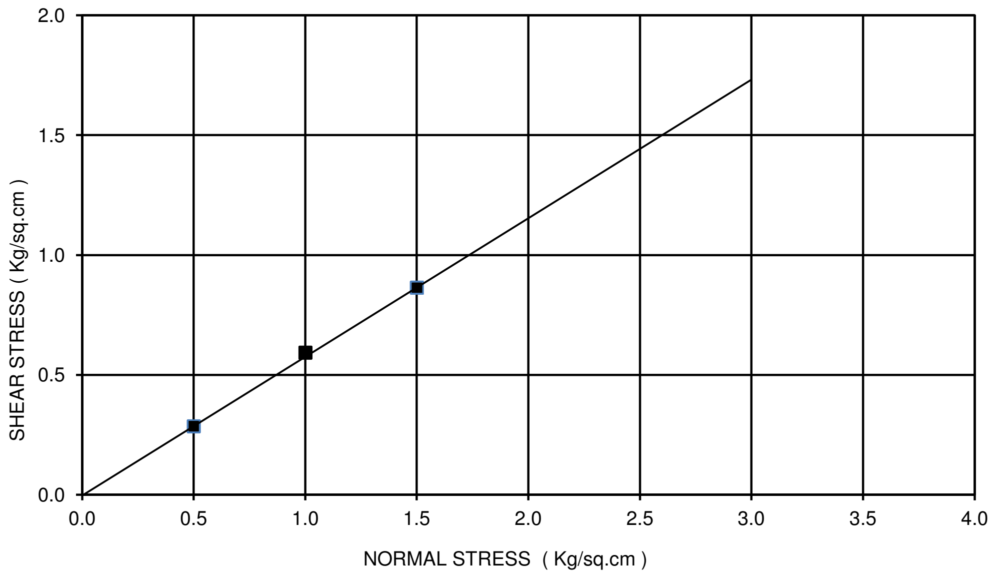
BORE HOLE NO: BH-CL
CHAINAGE : 0+627
SAMPLE NO.: UDS-1
DEPTH: 2.50 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 30 deg
TYPE OF THE TEST: DST

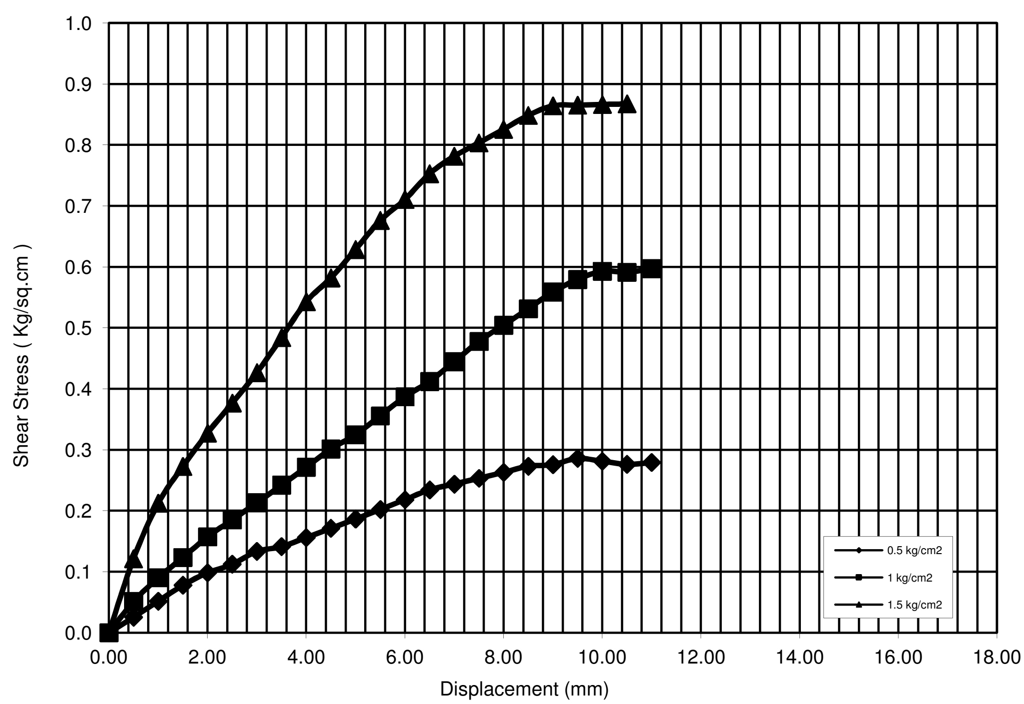




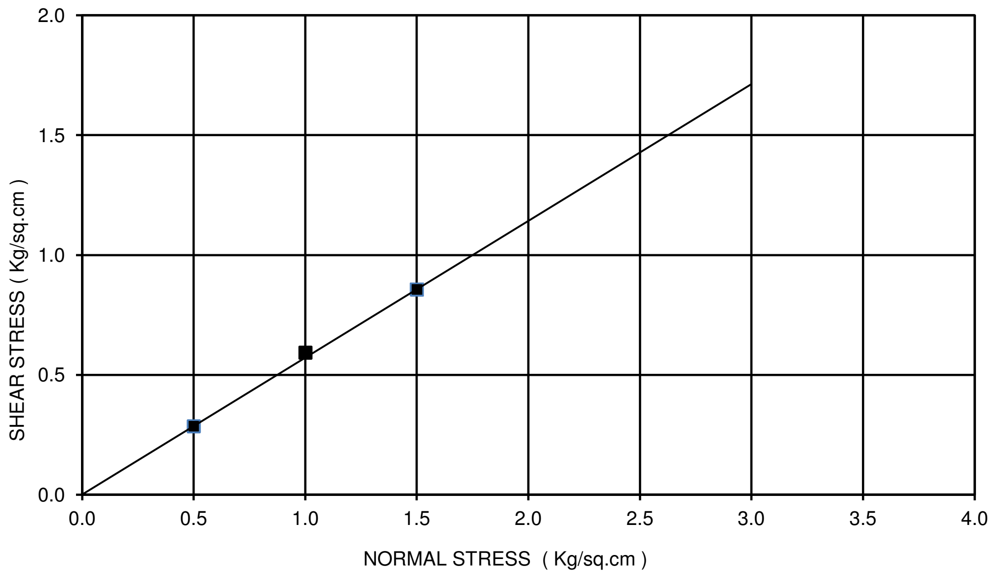
CEG Test House and Research Centre Pvt. Ltd.

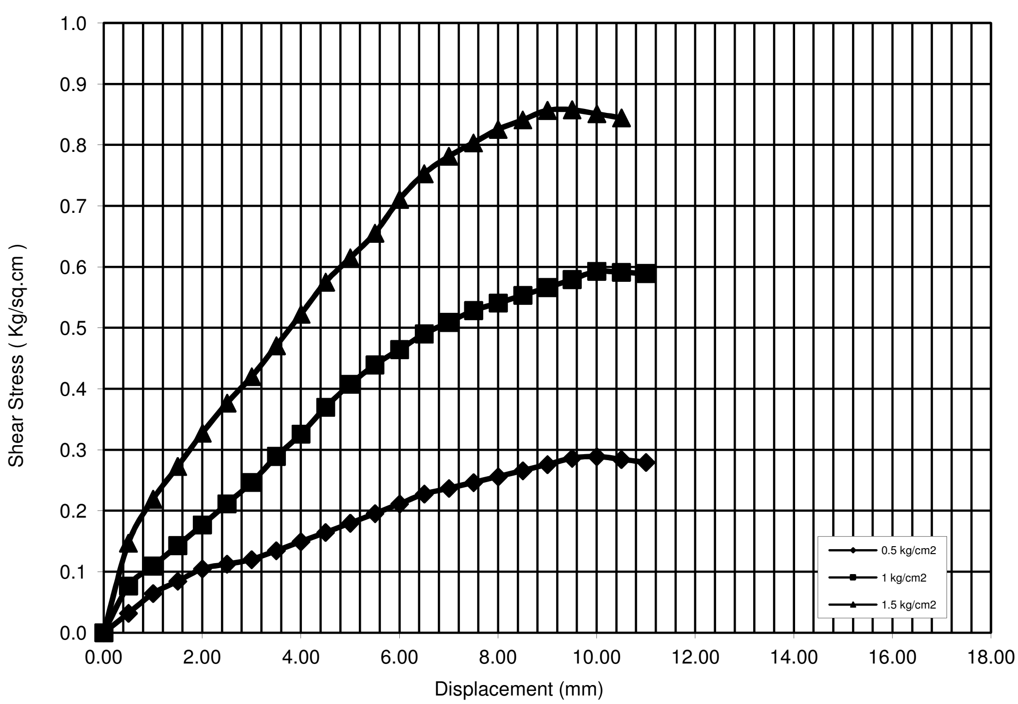
BORE HOLE NO: BH-CL
CHAINAGE : 0+529
SAMPLE NO.: UDS-2
DEPTH: 4.00 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 30 deg
TYPE OF THE TEST: DST





BOREHOLE NO.:- CL
SAMPLE NO.: UDS-1
DEPTH: 1.00m
COHESION (c): 0.00 kg/ sq. cm.
ANGLE OF FRICTION (phi): 30 deg.
TYPE OF TEST : DST





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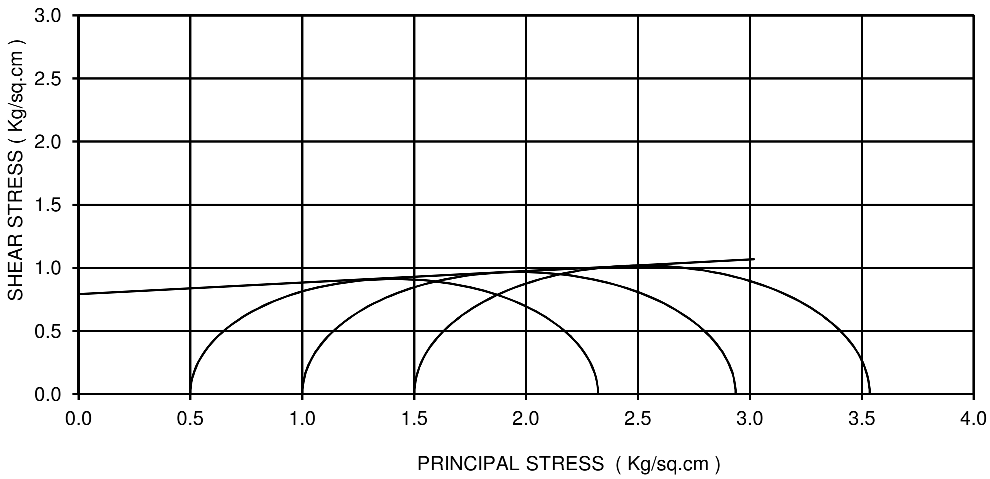
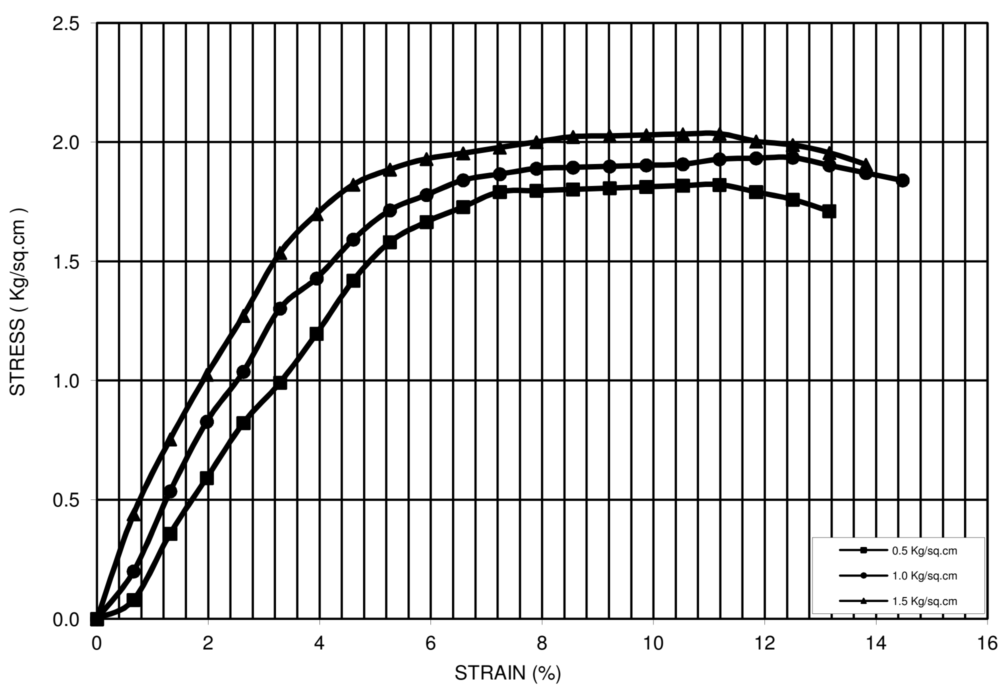
BORE HOLE NO: CL

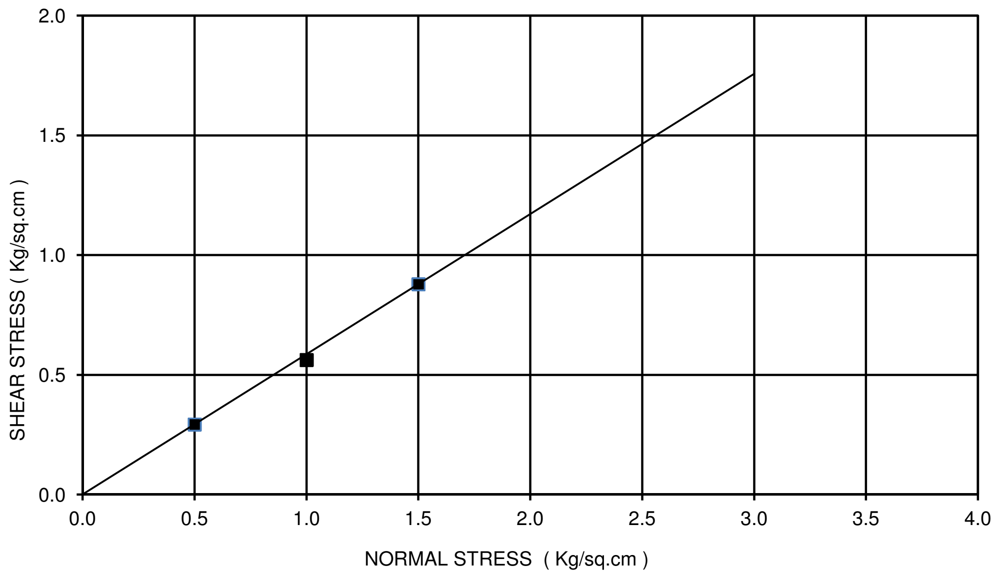
SAMPLE NO.: UDS-3
DEPTH:7.00 m
COHESION(C)= 0.79 kg/sq.cm
ANGLE OF FRICTION(Phi): 5 deg
TYPE OF THE TEST: UUT

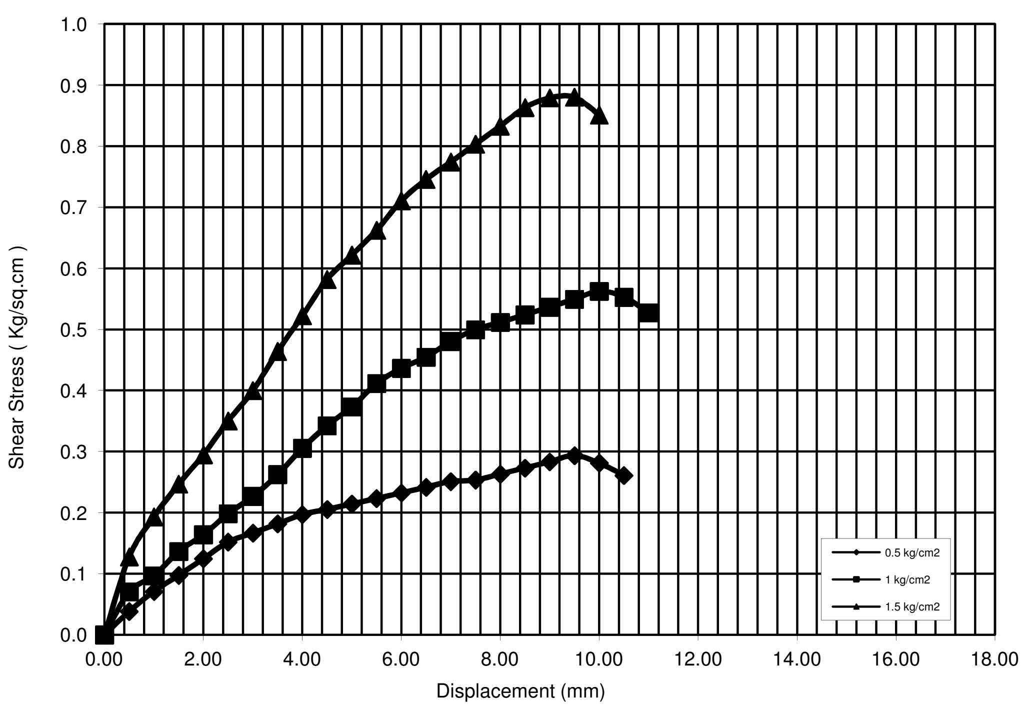




BORE HOLE NO: CL

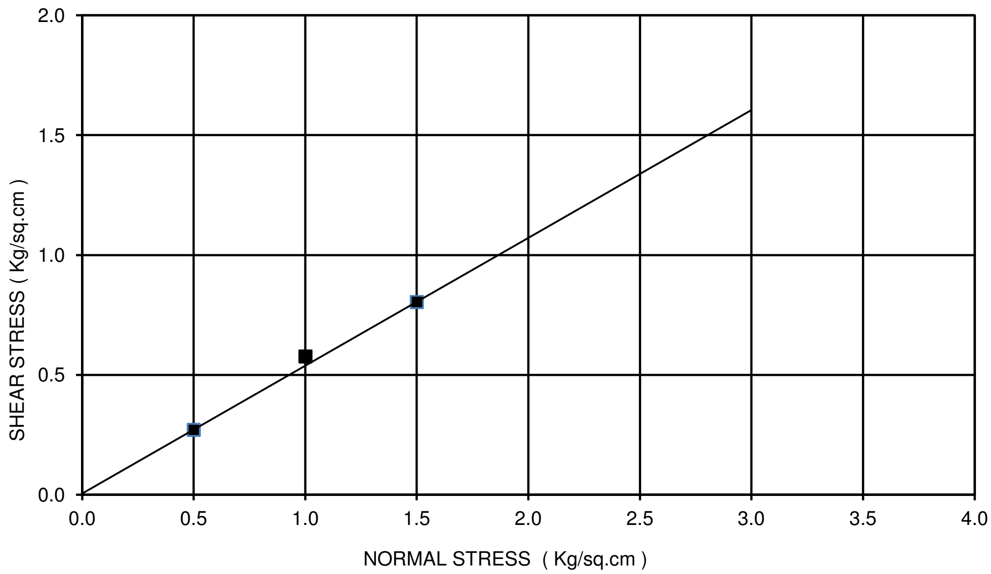
SAMPLE NO.: UDS-4
DEPTH: 10.00 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 30 deg
TYPE OF THE TEST: DST

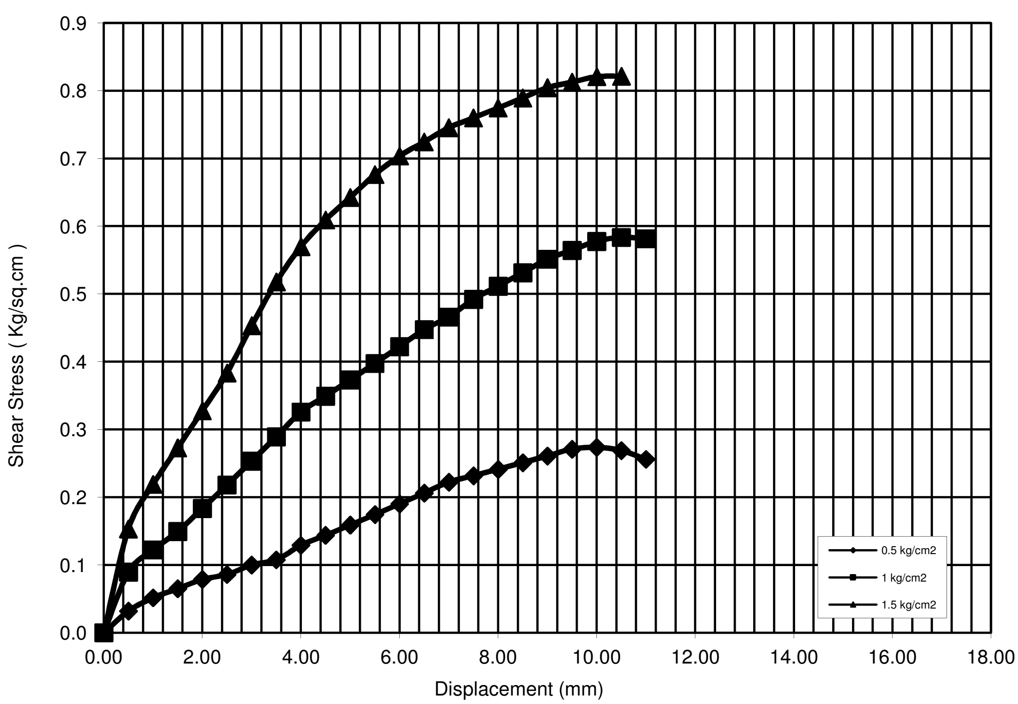




BORE HOLE NO: BH-R-61

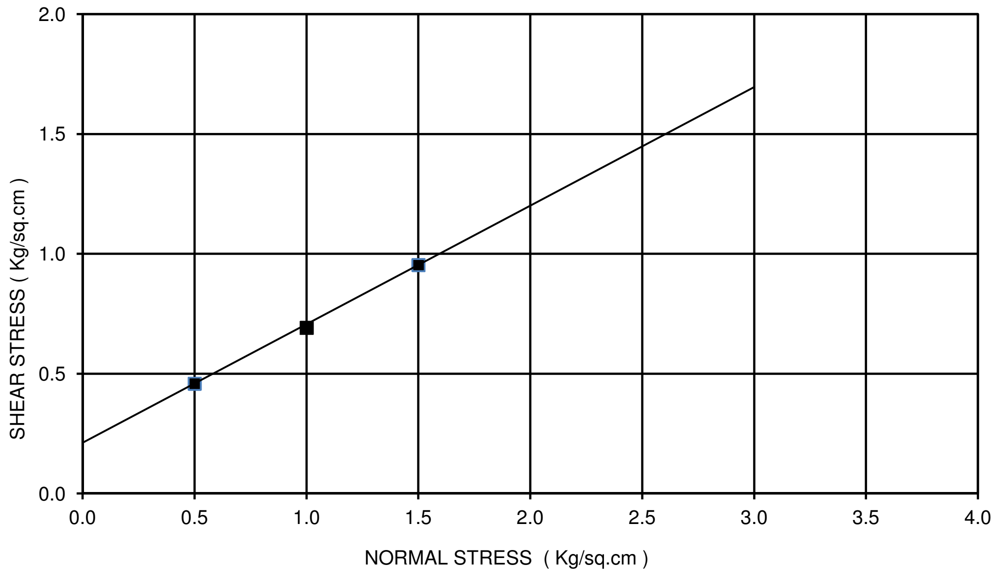
SAMPLE NO.: UDS-1
DEPTH: 4.00 m
COHESION(C)= 0.08 kg/sq.cm
ANGLE OF FRICTION(Phi): 27 deg
TYPE OF THE TEST: DST

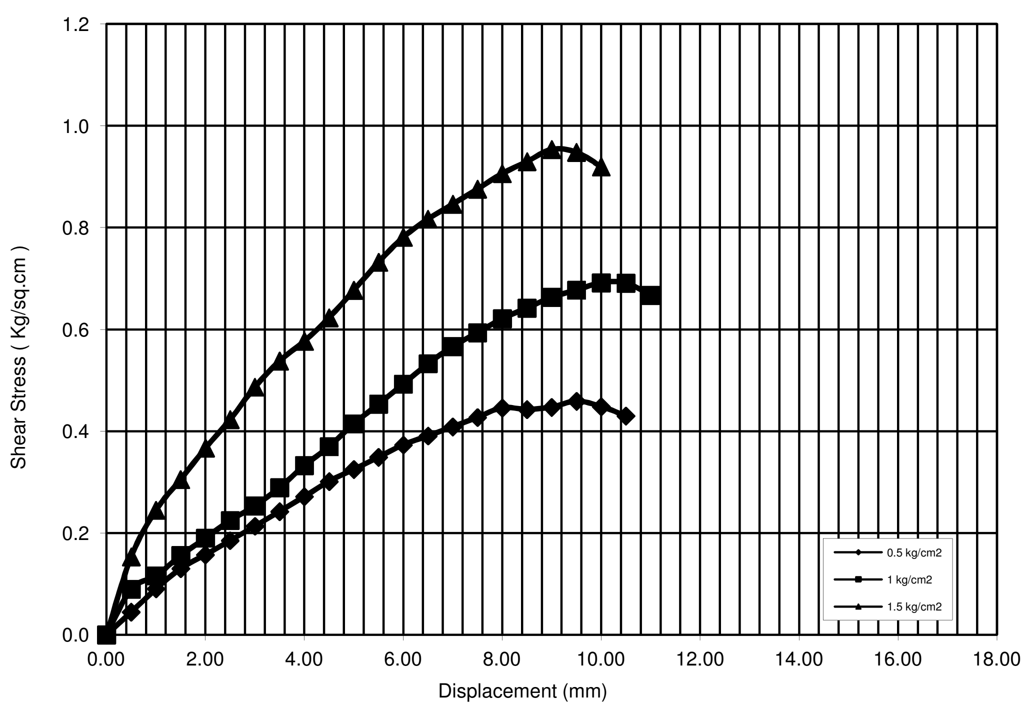




BORE HOLE NO: CL

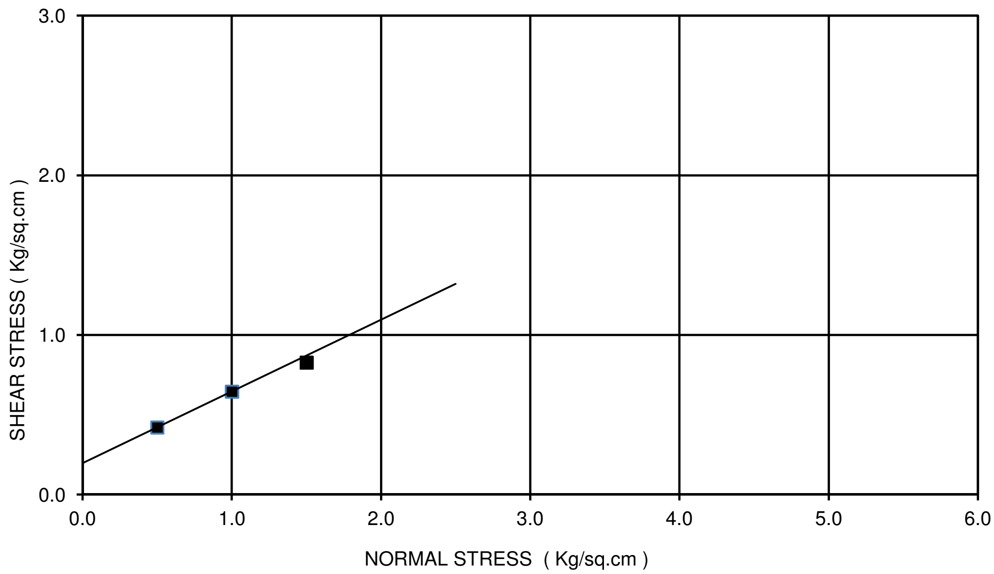
SAMPLE NO.: UDS-1
DEPTH: 2.50 m
COHESION(C)= 0.21 kg/sq.cm
ANGLE OF FRICTION(Phi): 26 deg
TYPE OF THE TEST: DST

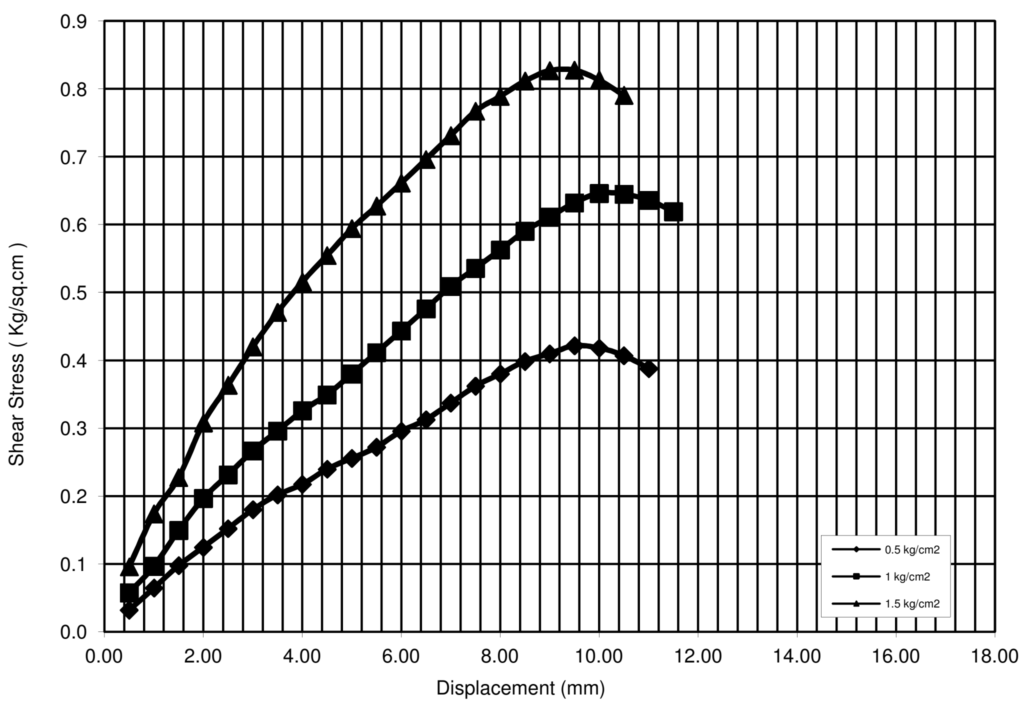




BORE HOLE NO: CL

SAMPLE NO.: UDS-2
DEPTH: 5.50 m
COHESION(C)= 0.20 kg/sq.cm
ANGLE OF FRICTION(Phi): 24 deg
TYPE OF THE TEST: DST





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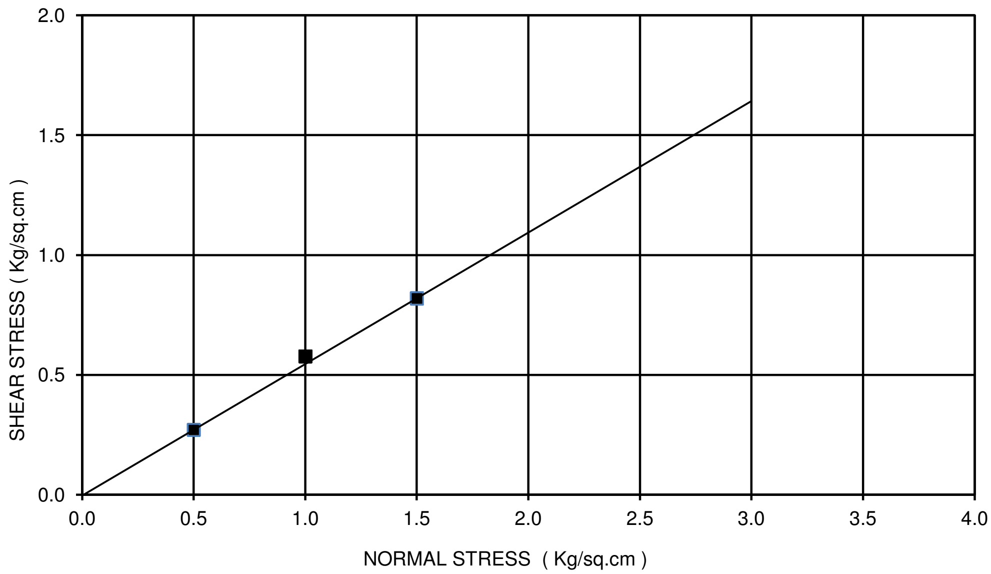
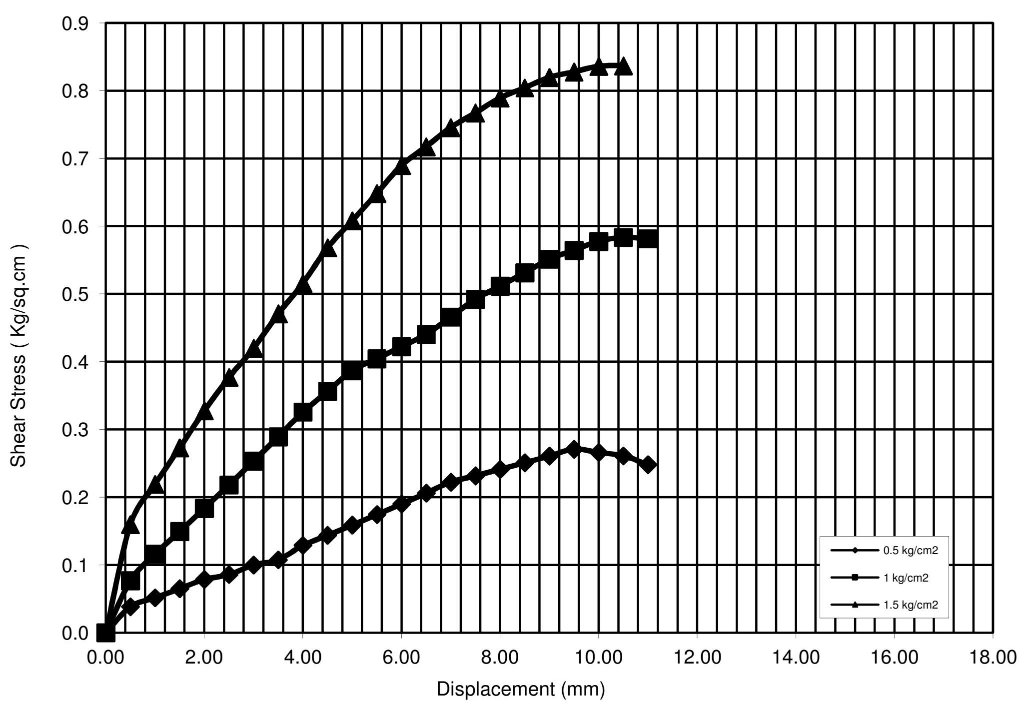
BORE HOLE NO: CL

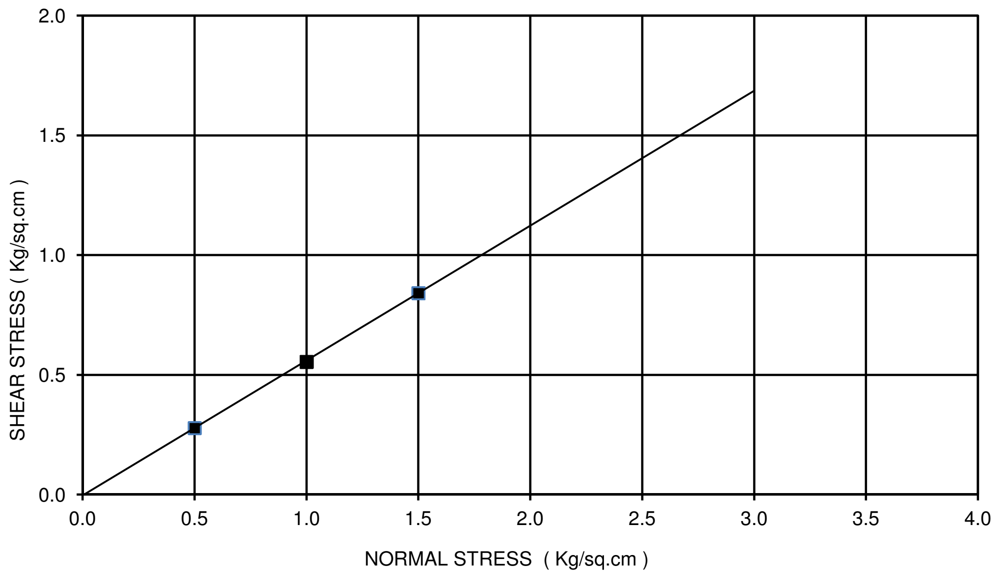
SAMPLE NO.: UDS-3
DEPTH: 8.50 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 29 deg
TYPE OF THE TEST: DST

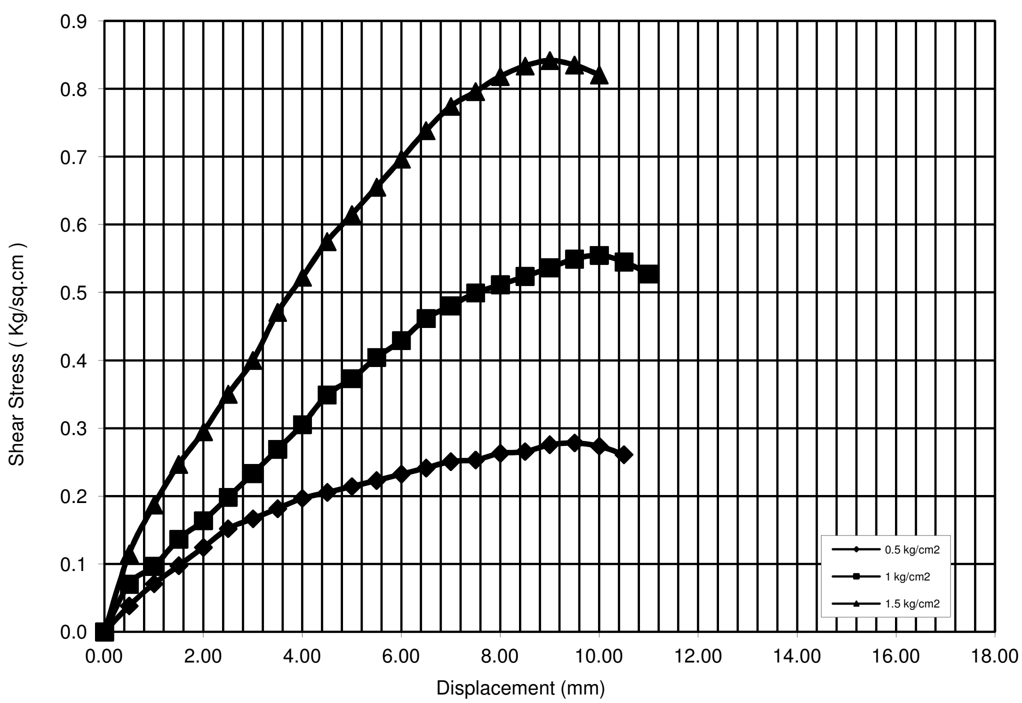




BORE HOLE NO: BH-CL

SAMPLE NO.: UDS-1
DEPTH: 2.50 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 29 deg
TYPE OF THE TEST: DST





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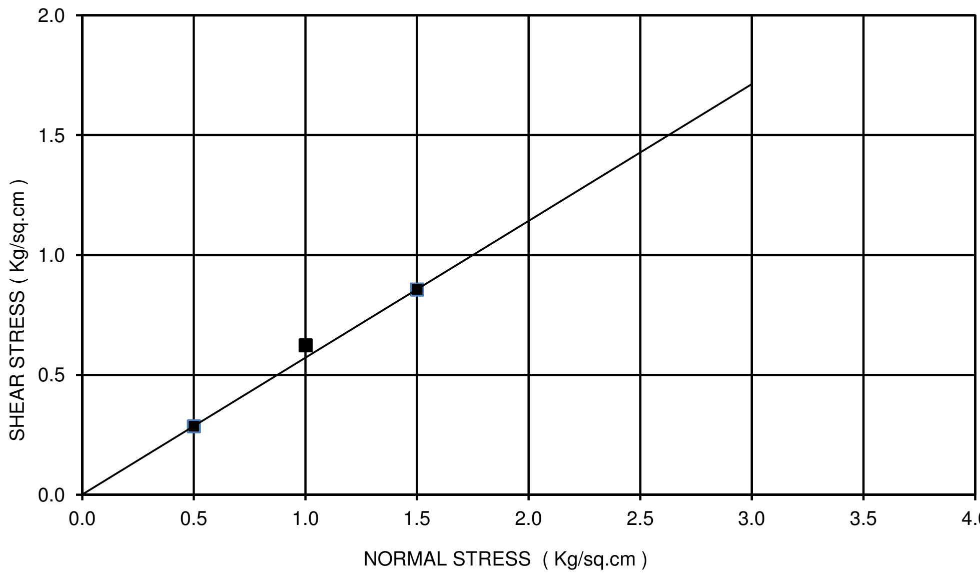
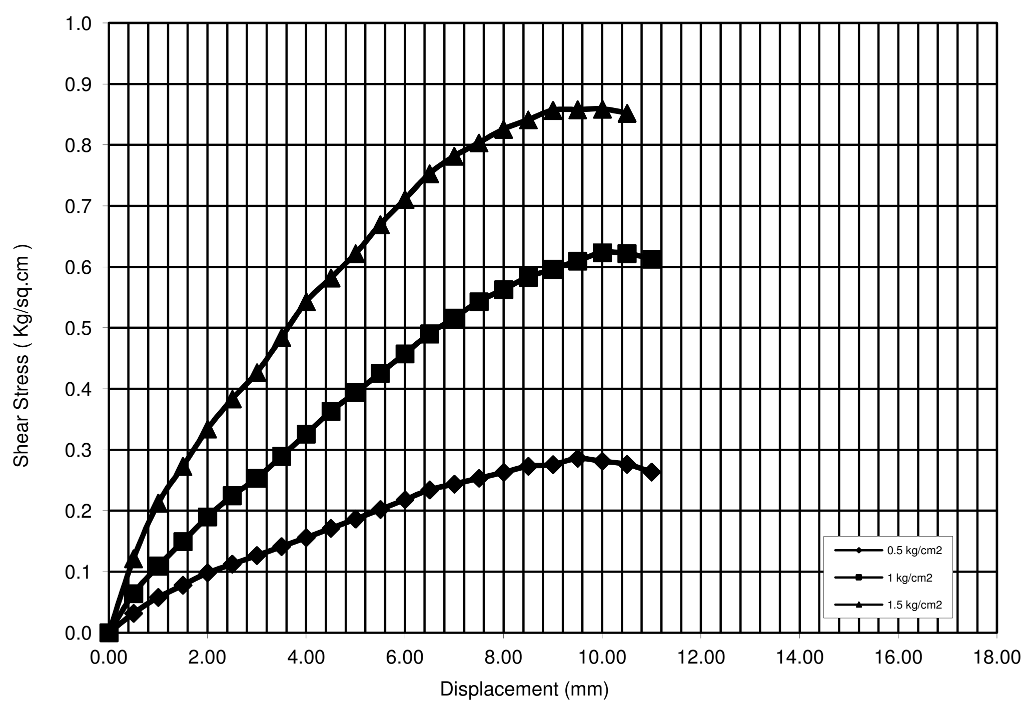
BORE HOLE NO: BH-CL

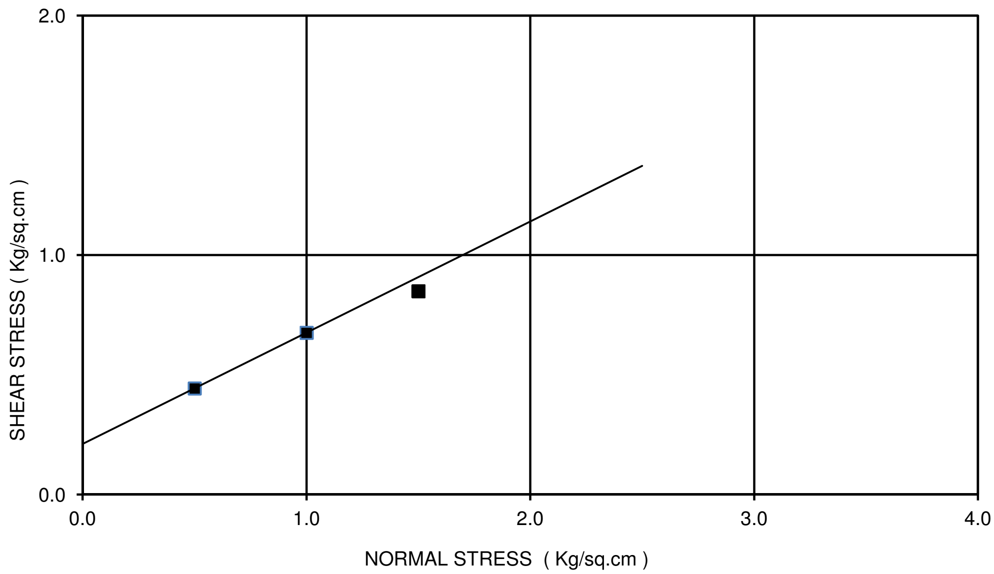
SAMPLE NO.: UDS-2
DEPTH: 5.50 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi):30deg
TYPE OF THE TEST: DST

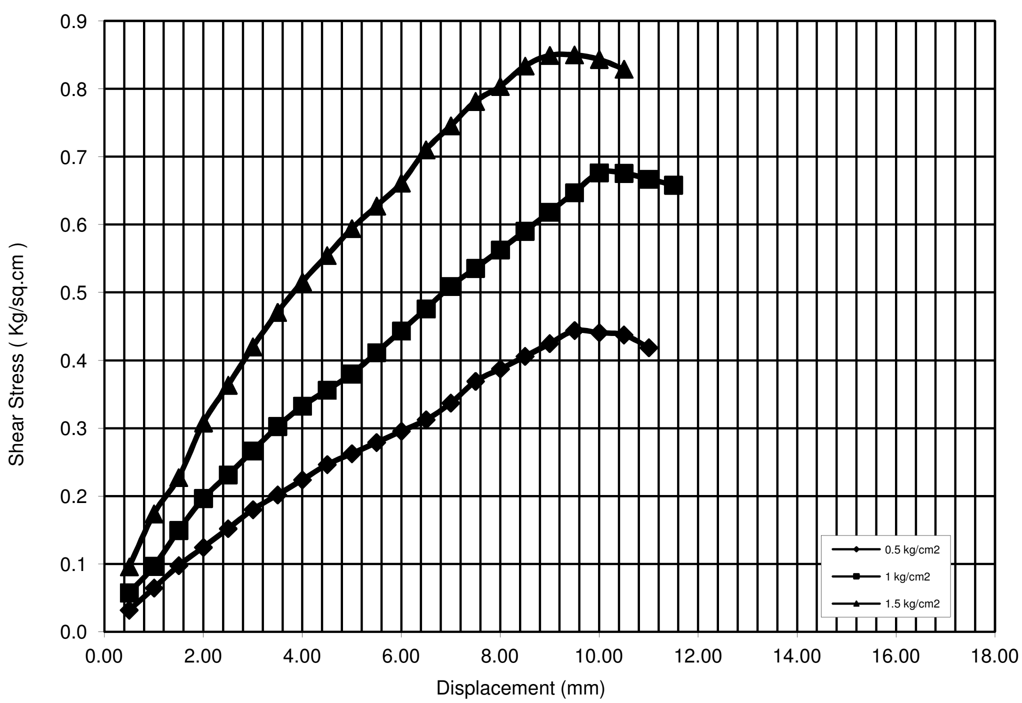




BORE HOLE NO: BH-CL

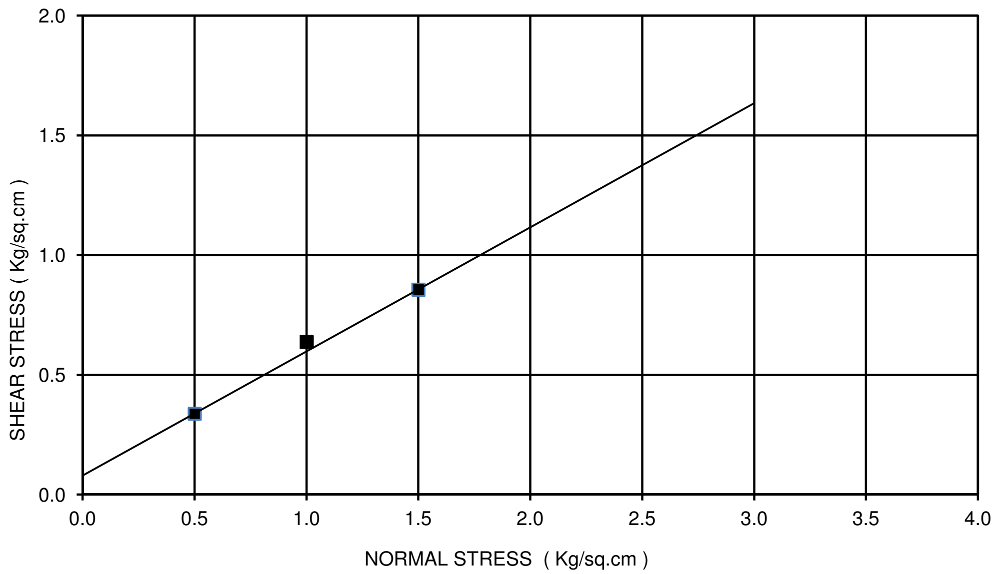
SAMPLE NO.: UDS-3
DEPTH: 8.50 m
COHESION(C)= 0.21 kg/sq.cm
ANGLE OF FRICTION(Phi): 25 deg
TYPE OF THE TEST: DST

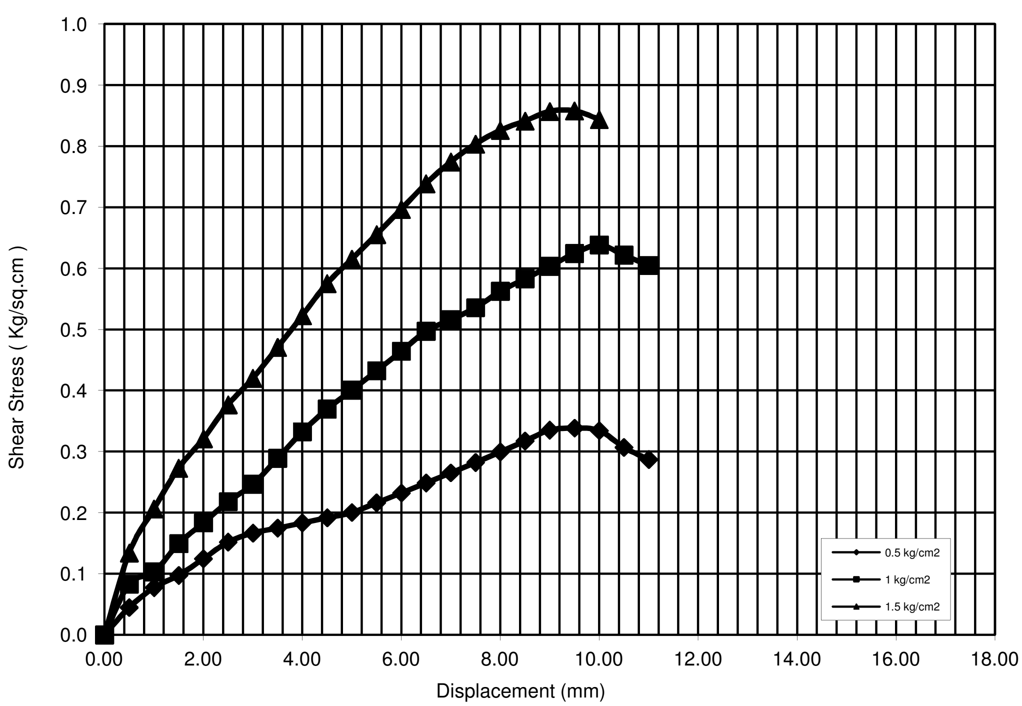




BORE HOLE NO: BH-CL

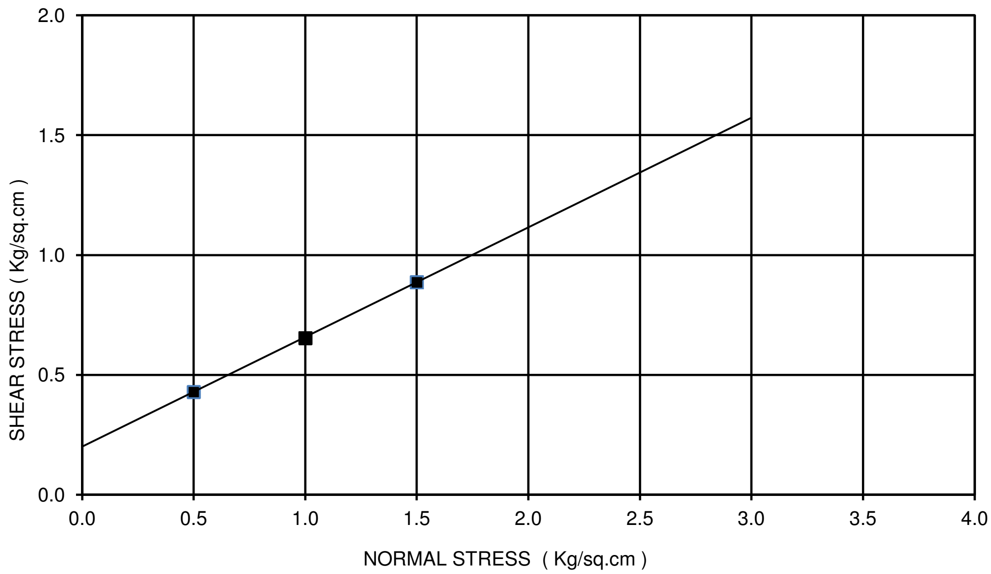
SAMPLE NO.: UDS-1
DEPTH: 2.50 m
COHESION(C)= 0.08 kg/sq.cm
ANGLE OF FRICTION(Phi): 27 deg
TYPE OF THE TEST: DST

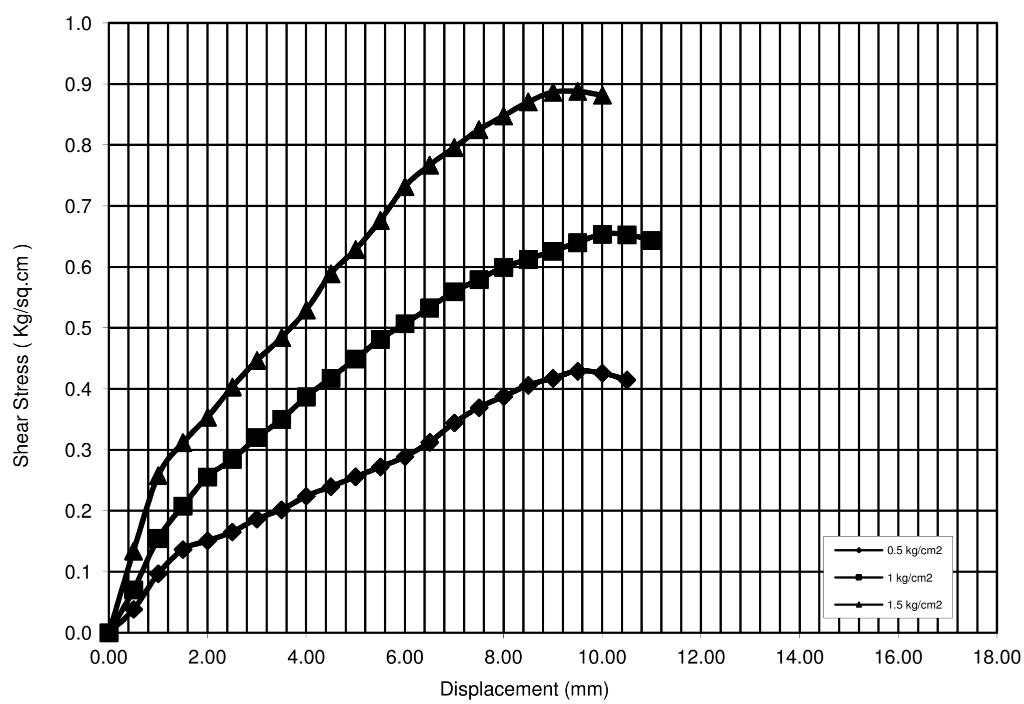




BORE HOLE NO: BH-CL

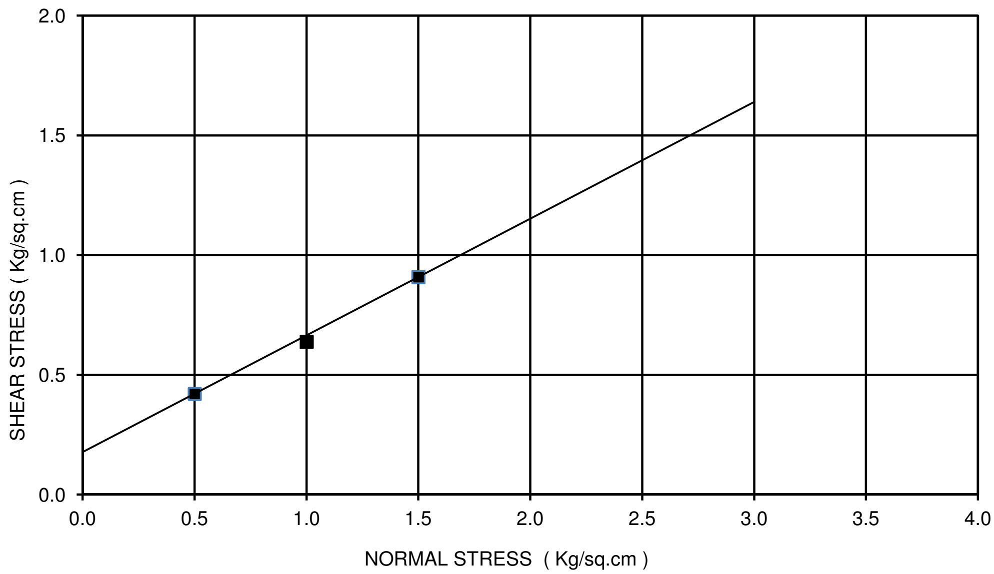
SAMPLE NO.: UDS-2
DEPTH: 5.50 m
COHESION(C)= 0.20 kg/sq.cm
ANGLE OF FRICTION(Phi): 25 deg
TYPE OF THE TEST: DST

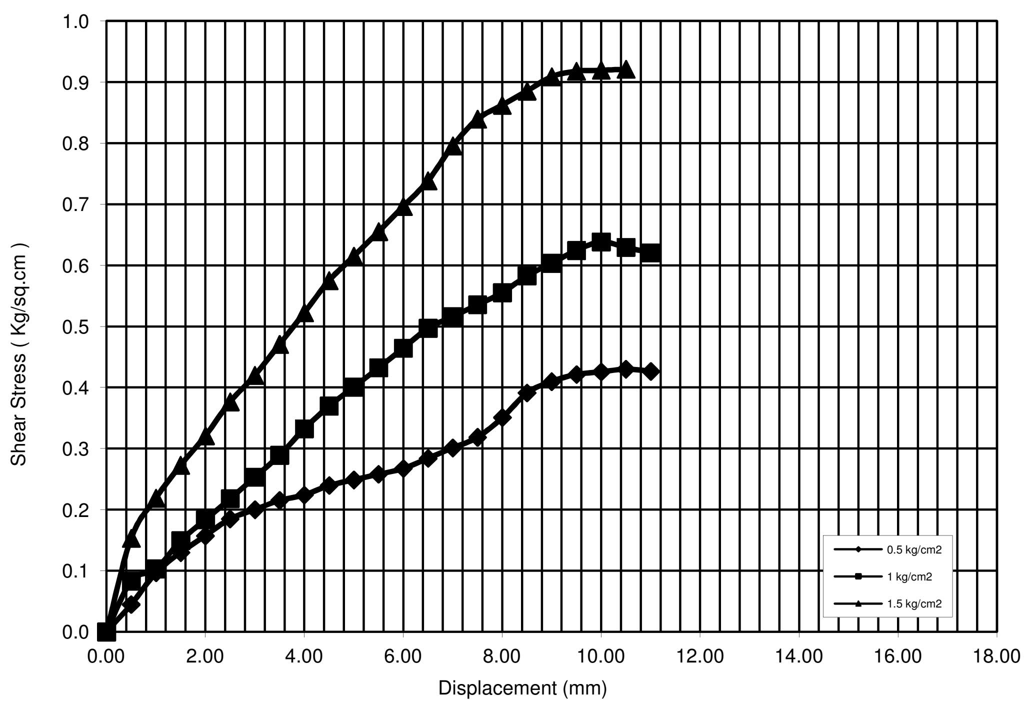




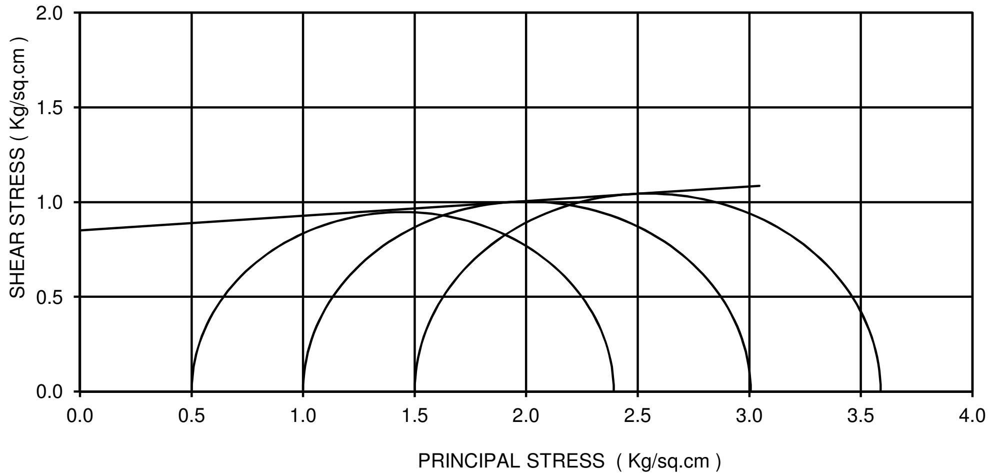
BORE HOLE NO: BH-CL

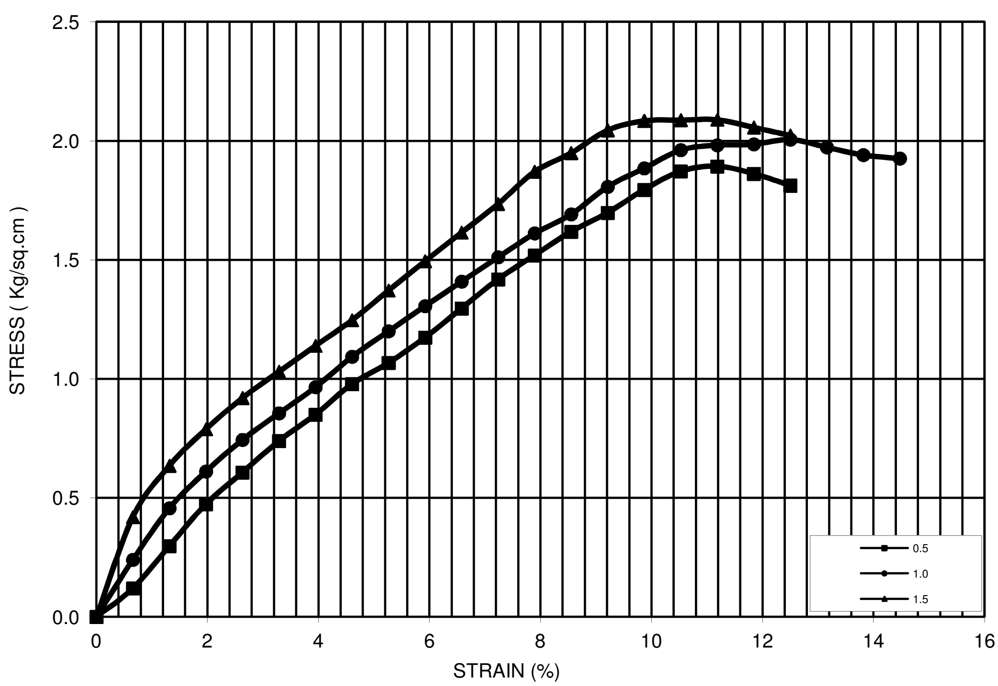
SAMPLE NO.: UDS-3
DEPTH: 8.50 m
COHESION(C)= 0.18 kg/sq.cm
ANGLE OF FRICTION(Phi): 26 deg
TYPE OF THE TEST: DST



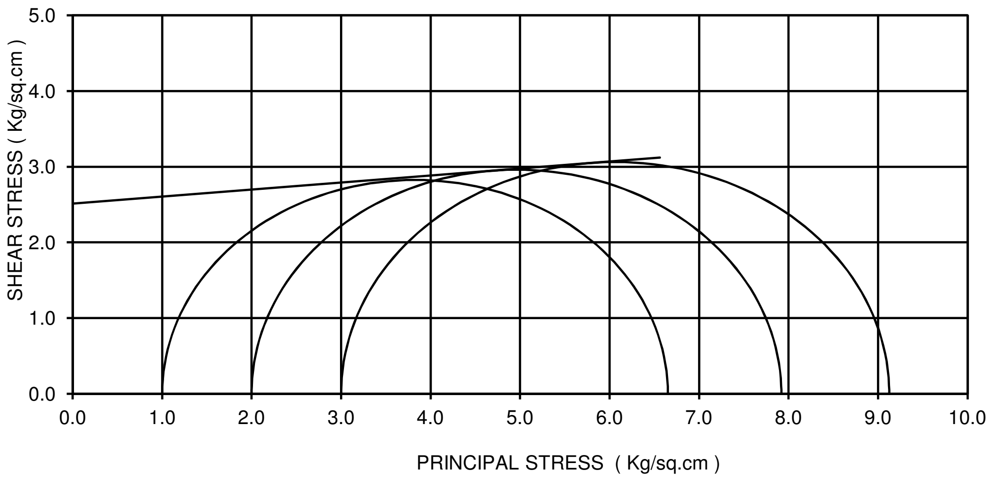


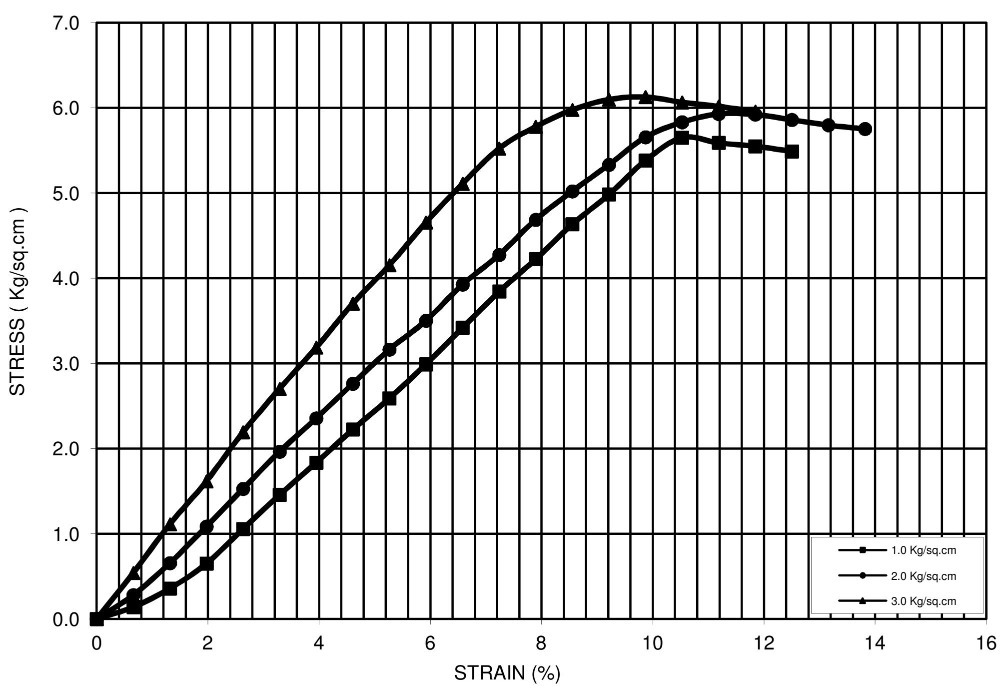
BORE HOLE NO: BH-A-1
CHAINAGE :3+497.7
SAMPLE NO.: UDS-2
DEPTH: 5.50 m
COHESION(C)= 0.85 kg/sq.cm
ANGLE OF FRICTION(Phi): 4 deg
TYPE OF THE TEST: UUT



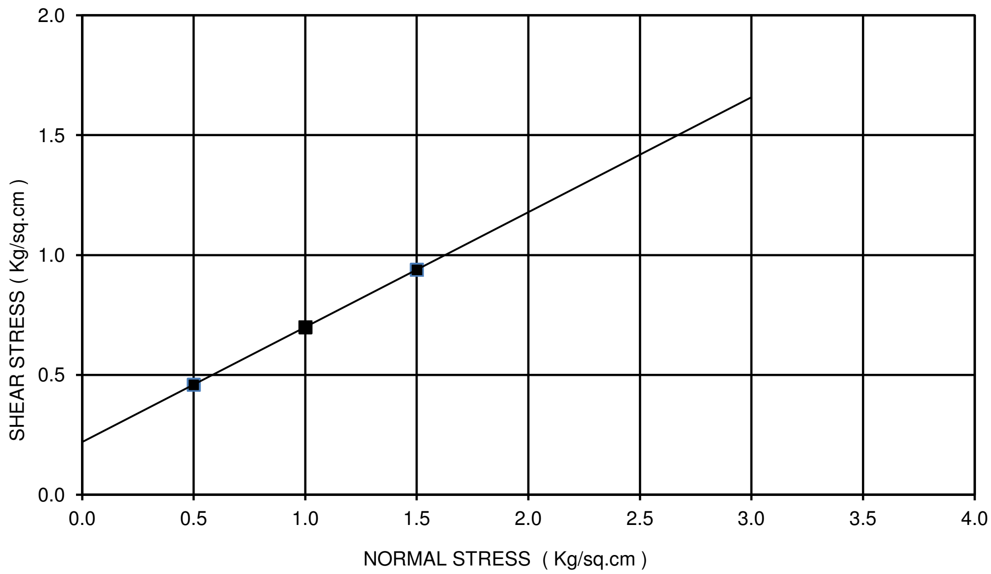


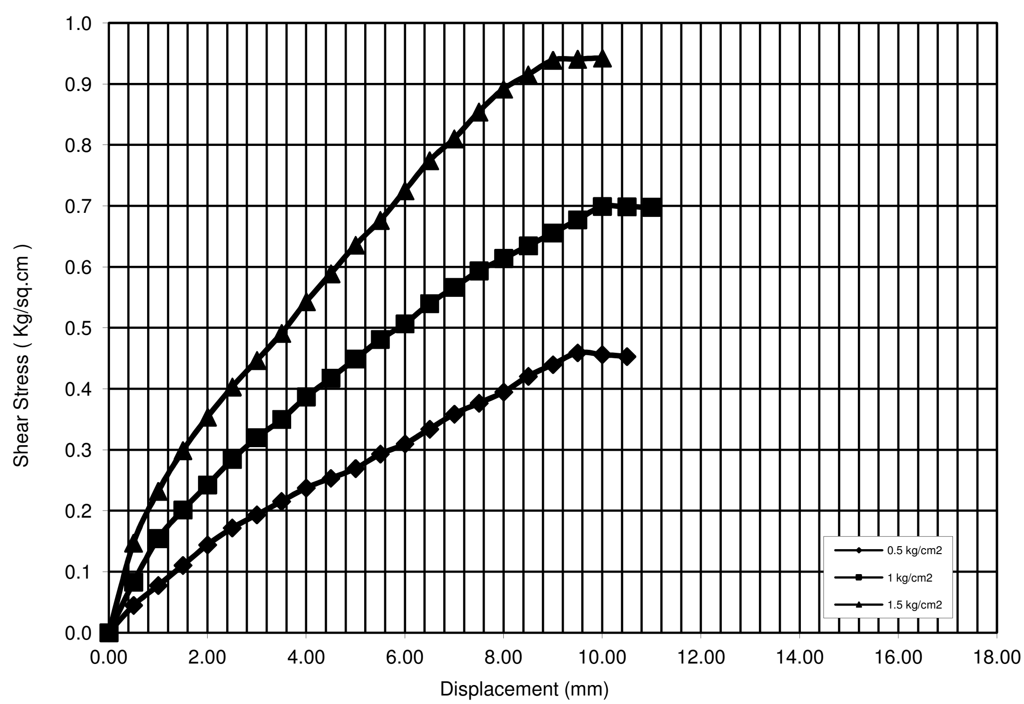
BORE HOLE NO: BH-A-1
CHAINAGE :3+497.7
SAMPLE NO.: UDS-10
DEPTH: 29.50 m
COHESION(C)= 2.51 kg/sq.cm
ANGLE OF FRICTION(Phi): 5 deg
TYPE OF THE TEST: UUT



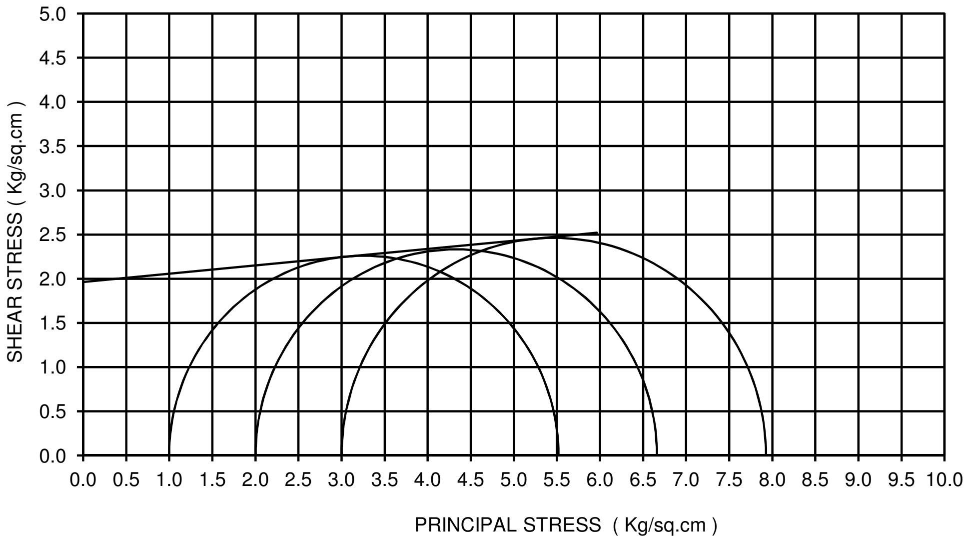


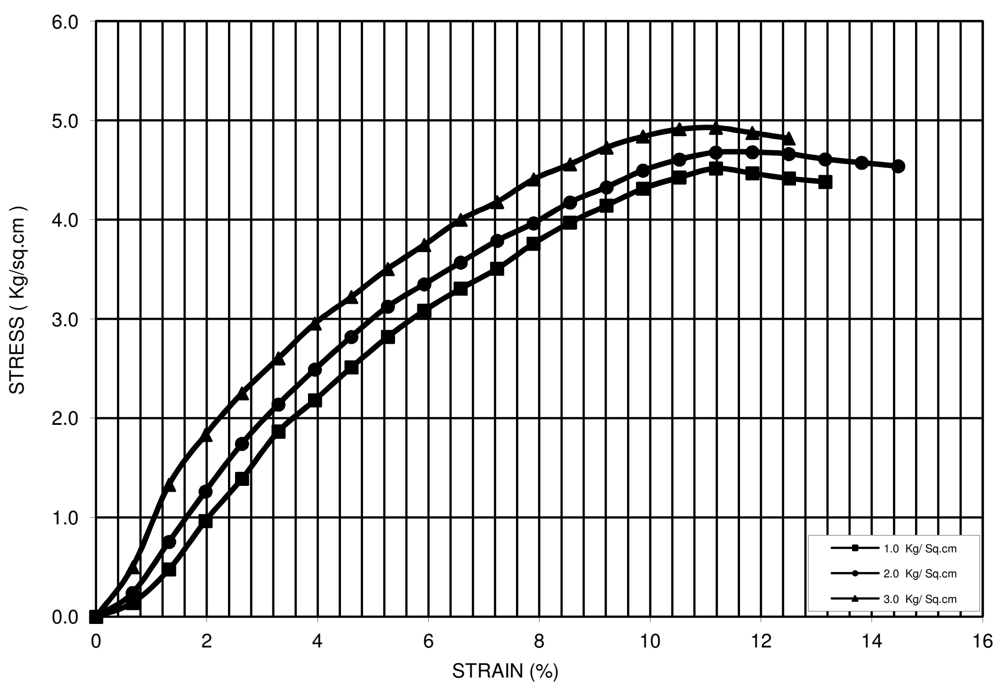
BORE HOLE NO: BH-P-1
CHAINAGE :3+497.7
SAMPLE NO.: UDS-2
DEPTH: 4.00 m
COHESION(C)= 0.22 kg/sq.cm
ANGLE OF FRICTION(Phi): 26 deg
TYPE OF THE TEST: DST



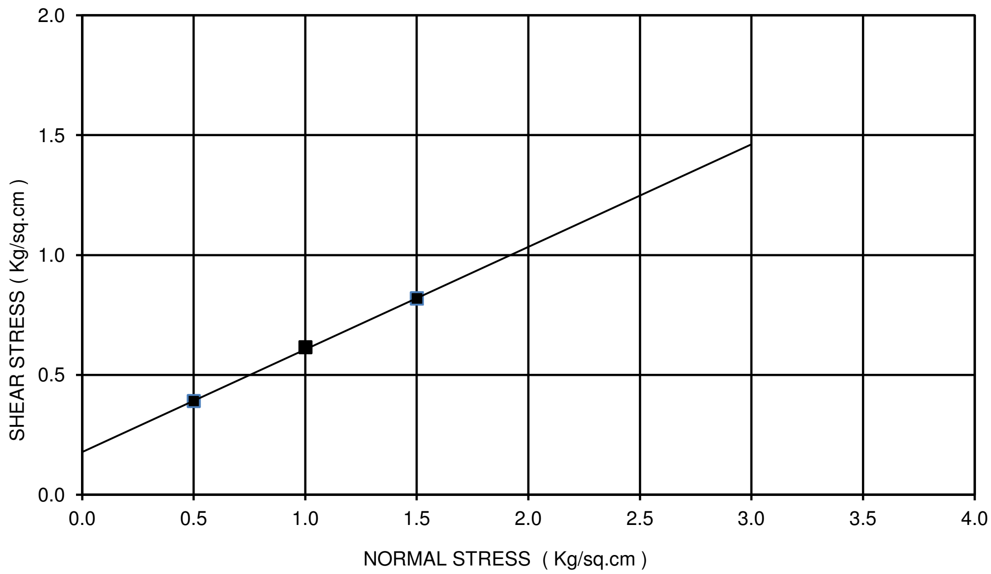


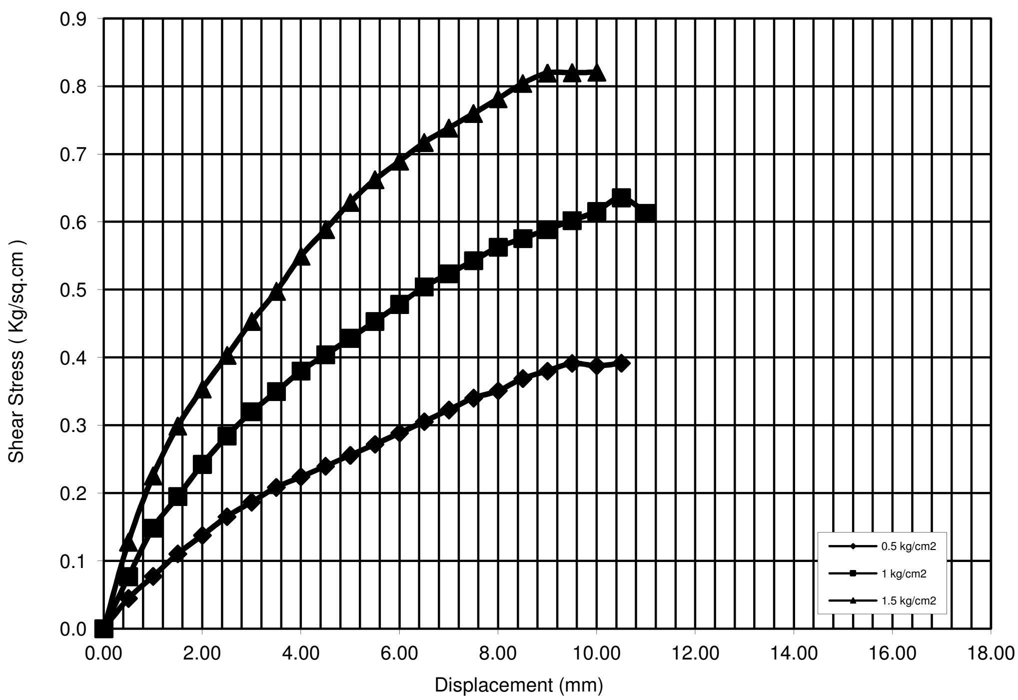
BORE HOLE NO: BH-P-1
CHAINAGE :3+497.7
SAMPLE NO.: UDS-7
DEPTH: 22.00 m
COHESION(C)= 1.96 kg/sq.cm
ANGLE OF FRICTION(Phi): 5 deg
TYPE OF THE TEST: UUT





BORE HOLE NO: BH-P-2
CHAINAGE :3+497.7
SAMPLE NO.: UDS-1
DEPTH: 2.50 m
COHESION(C)= 0.18 kg/sq.cm
ANGLE OF FRICTION(Phi): 23 deg
TYPE OF THE TEST: DST





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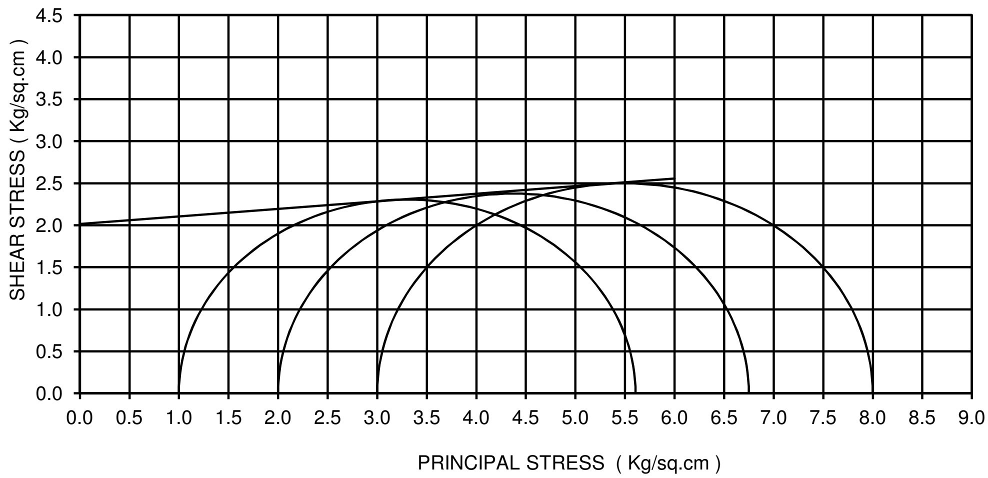
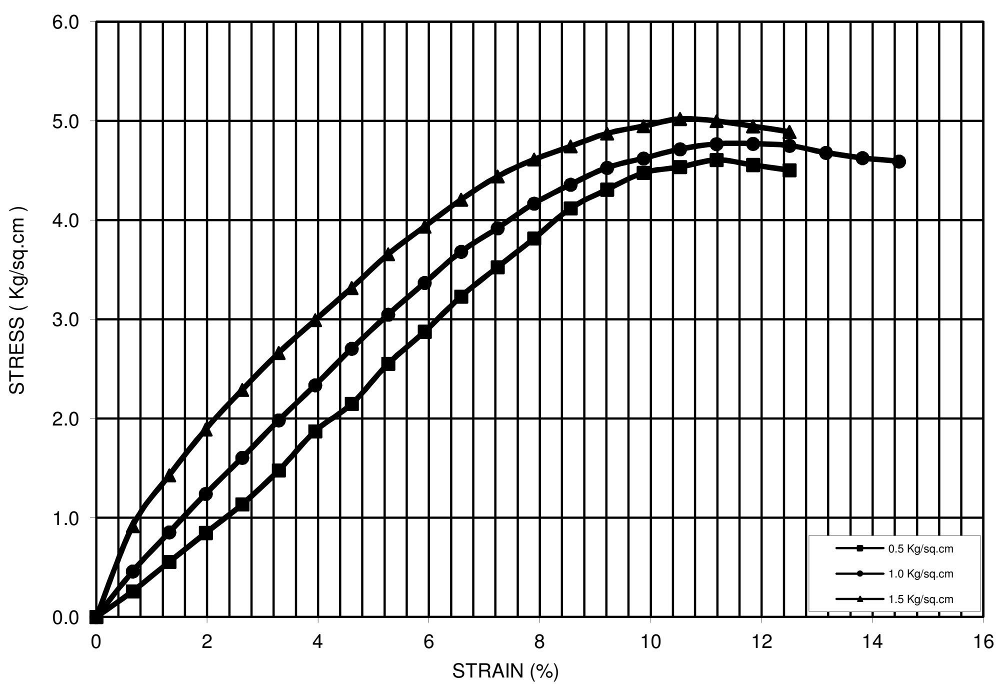
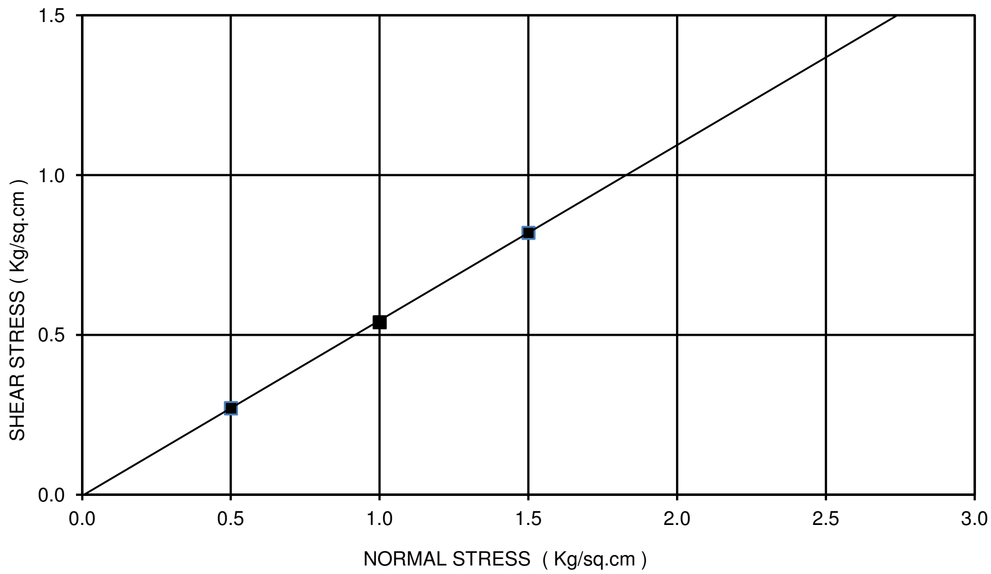
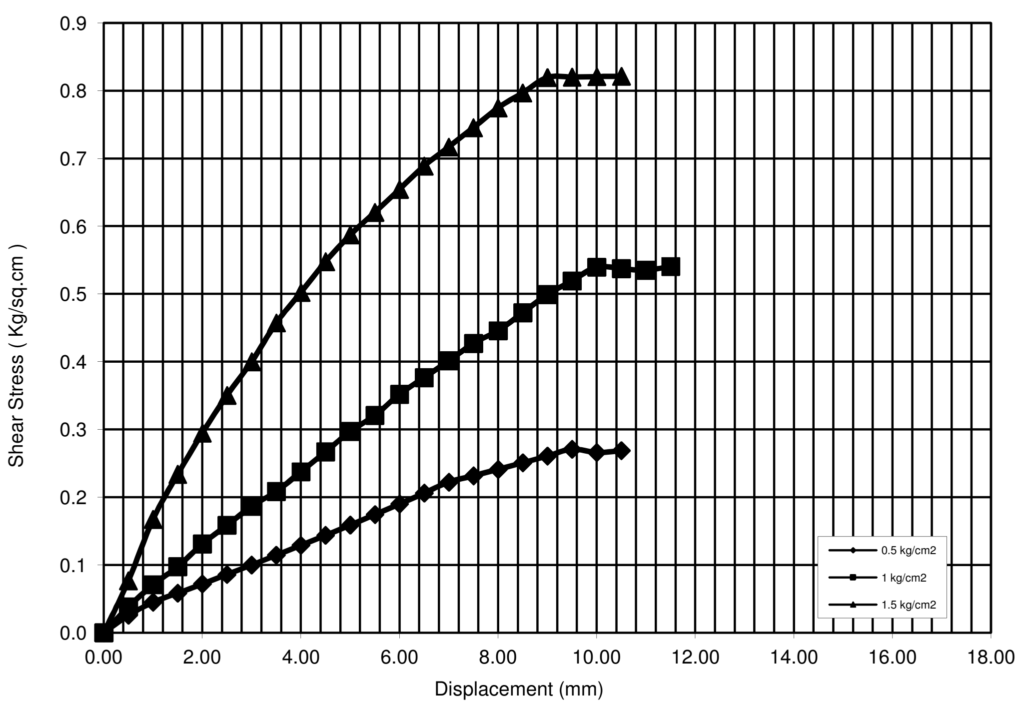
BORE HOLE NO: BH-P-2
CHAINAGE :3+497.7
SAMPLE NO.: UDS-10
DEPTH: 29.50 m
COHESION(C)= 2.02 kg/sq.cm
ANGLE OF FRICTION(Phi): 5 deg
TYPE OF THE TEST: UUT



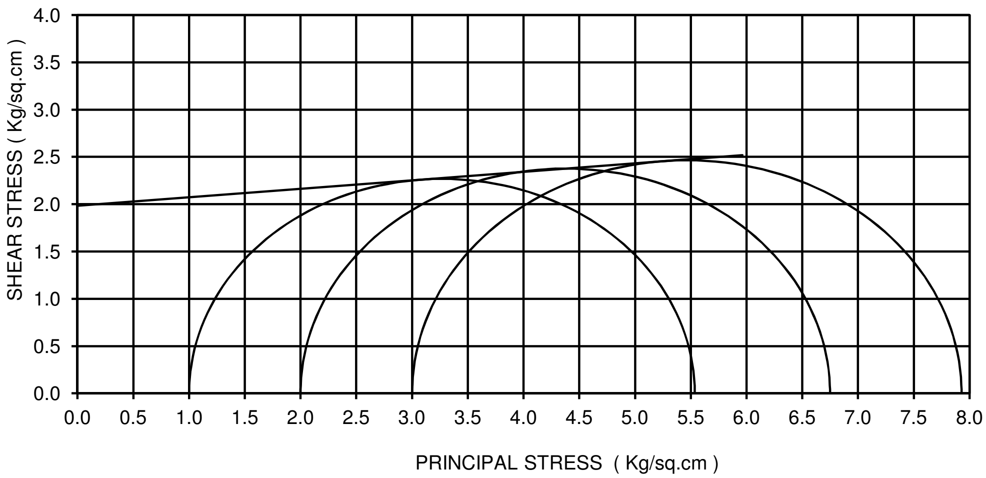


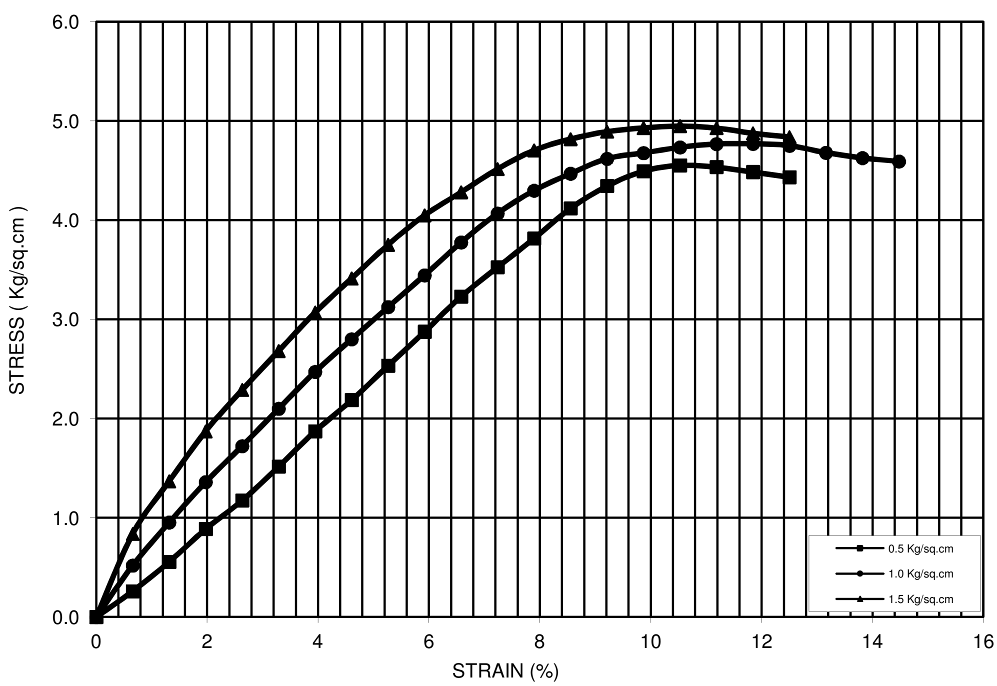
BORE HOLE NO: BH-P-3
CHAINAGE :3+497.7
SAMPLE NO.: UDS-2
DEPTH: 4.00 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 29 deg
TYPE OF THE TEST: DST





BORE HOLE NO: BH-P-3
CHAINAGE :3+497.7
SAMPLE NO.: UDS-9
DEPTH: 25.00 m
COHESION(C)= 1.98 kg/sq.cm
ANGLE OF FRICTION(Phi): 5 deg
TYPE OF THE TEST: UUT





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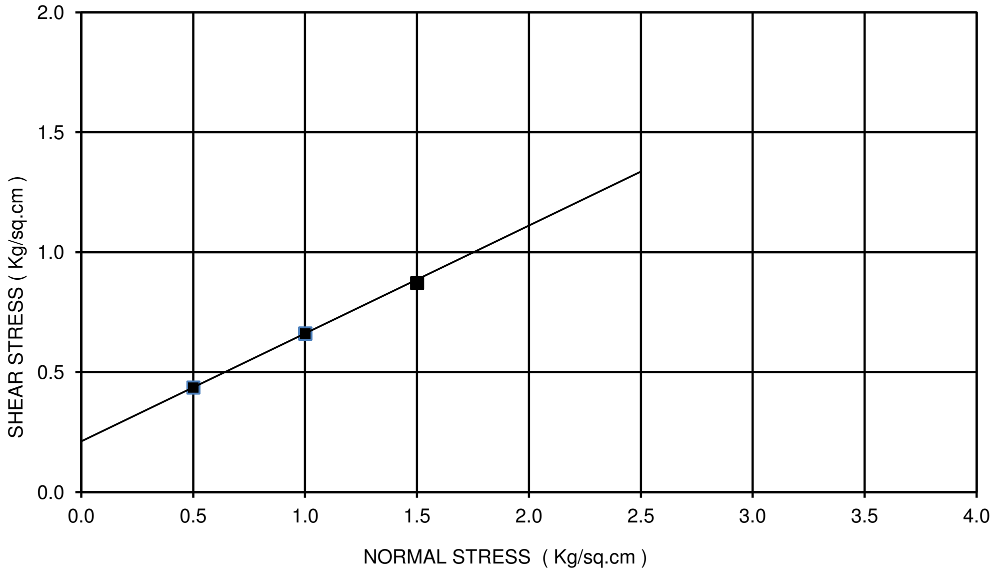
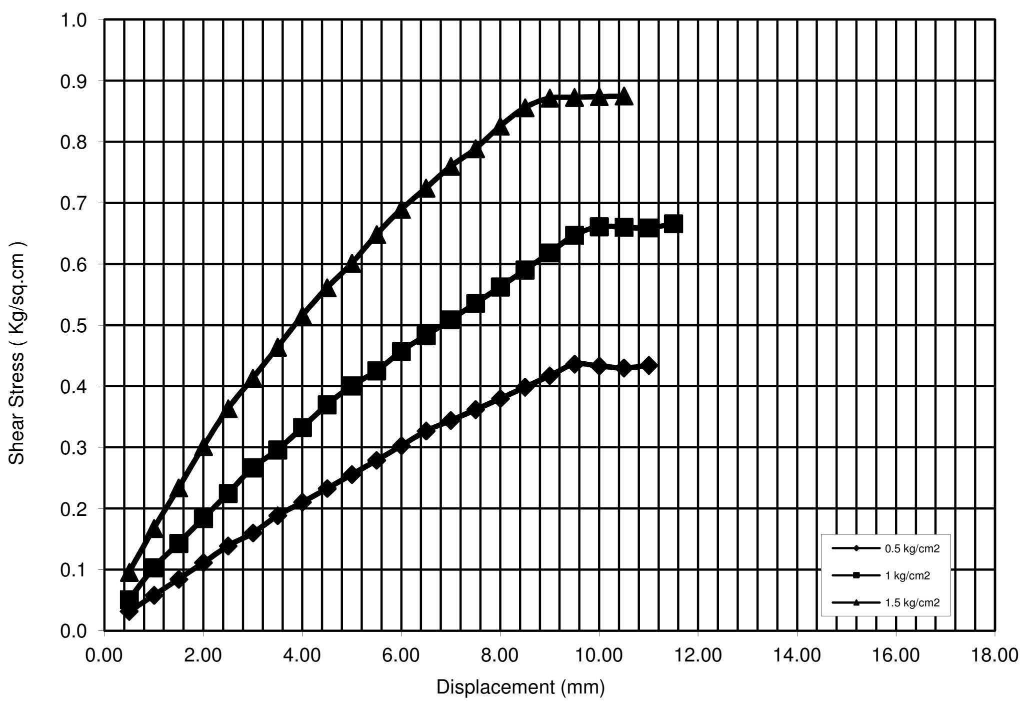
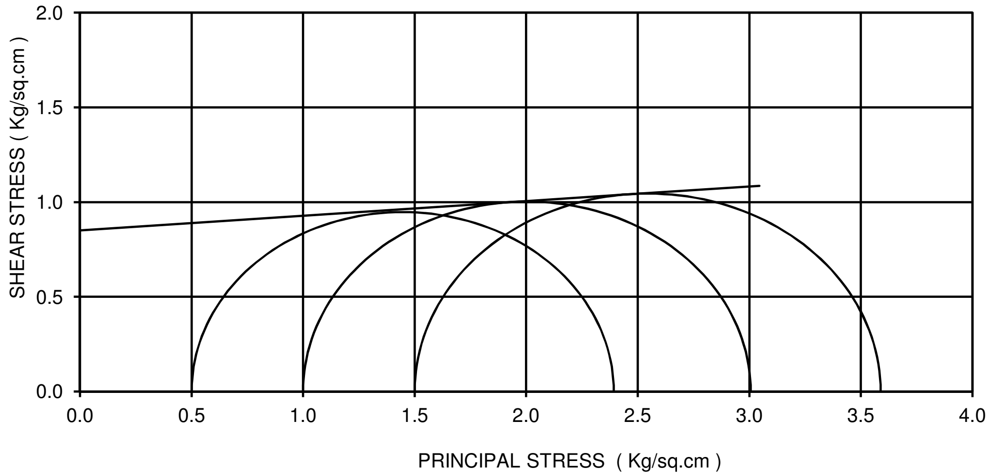
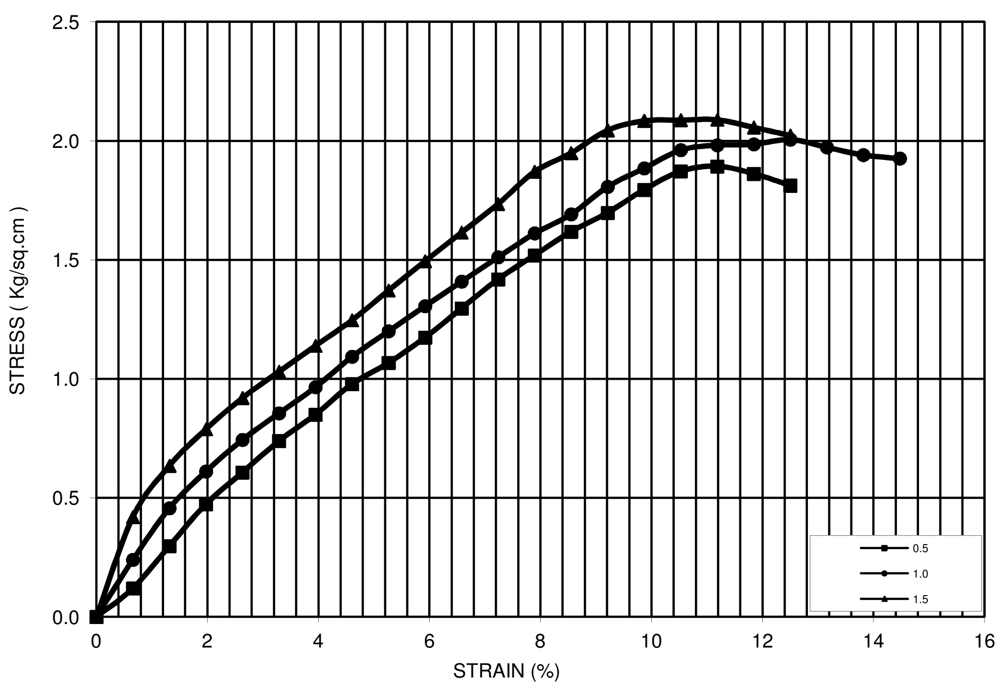
BORE HOLE NO: BH-A-2
CHAINAGE :3+497.7
SAMPLE NO.: UDS-1
DEPTH: 2.50 m
COHESION(C)= 0.21 kg/sq.cm
ANGLE OF FRICTION(Phi): 24 deg
TYPE OF THE TEST: DST



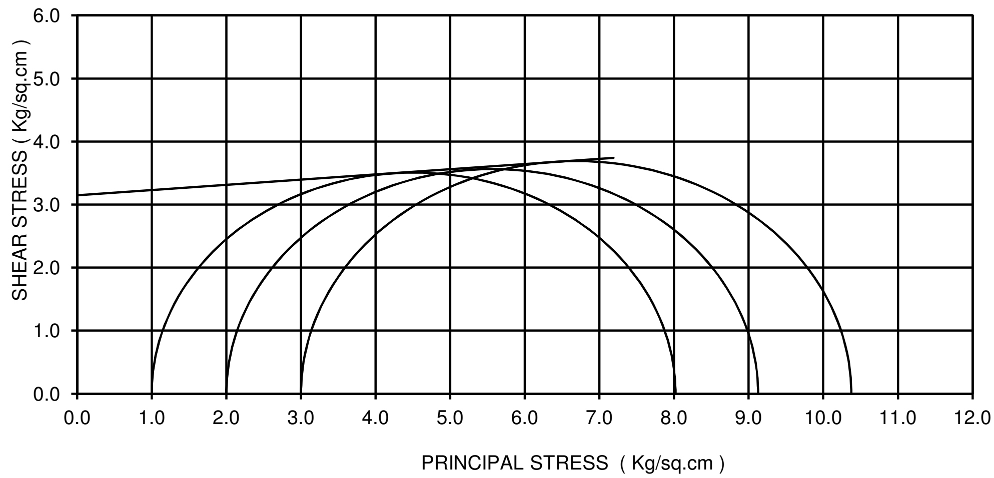


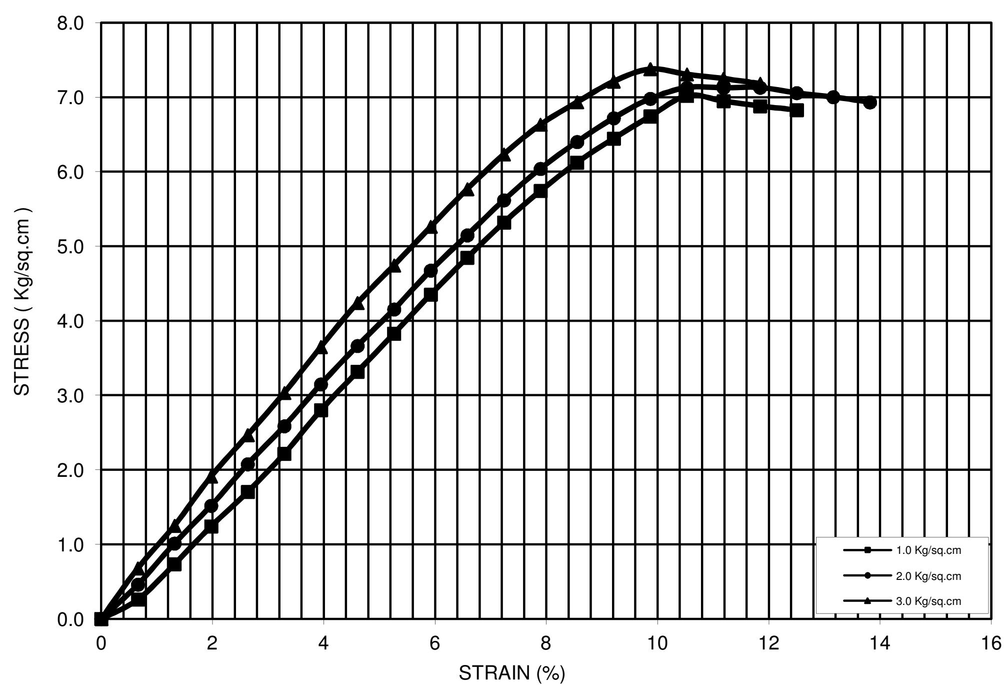
BORE HOLE NO: BH-A-1
CHAINAGE :3+497.7
SAMPLE NO.: UDS-2
DEPTH: 5.50 m
COHESION(C)= 0.85 kg/sq.cm
ANGLE OF FRICTION(Phi): 4 deg
TYPE OF THE TEST: UUT



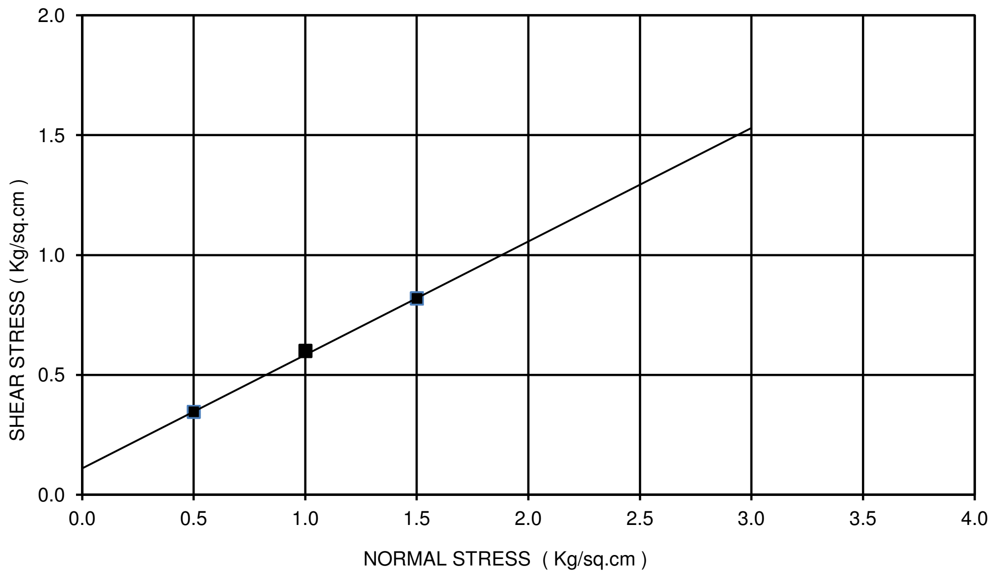


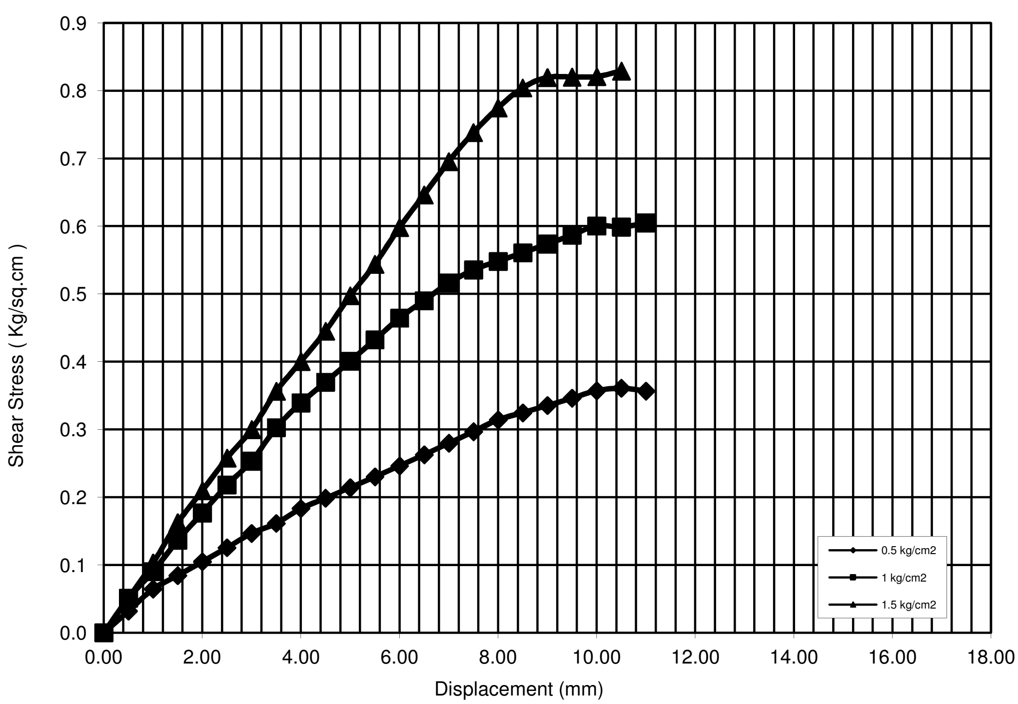
BORE HOLE NO: BH-A-2
CHAINAGE :3+497.7
SAMPLE NO.: UDS-8
DEPTH: 29.50 m
COHESION(C)= 3.15 kg/sq.cm
ANGLE OF FRICTION(Phi): 5 deg
TYPE OF THE TEST: UUT





BORE HOLE NO: BH-A-1
CHAINAGE : 3+691 KM
SAMPLE NO.: UDS-1
DEPTH: 2.50 m
COHESION(C)= 0.11 kg/sq.cm
ANGLE OF FRICTION(Phi): 25 deg
TYPE OF THE TEST: DST





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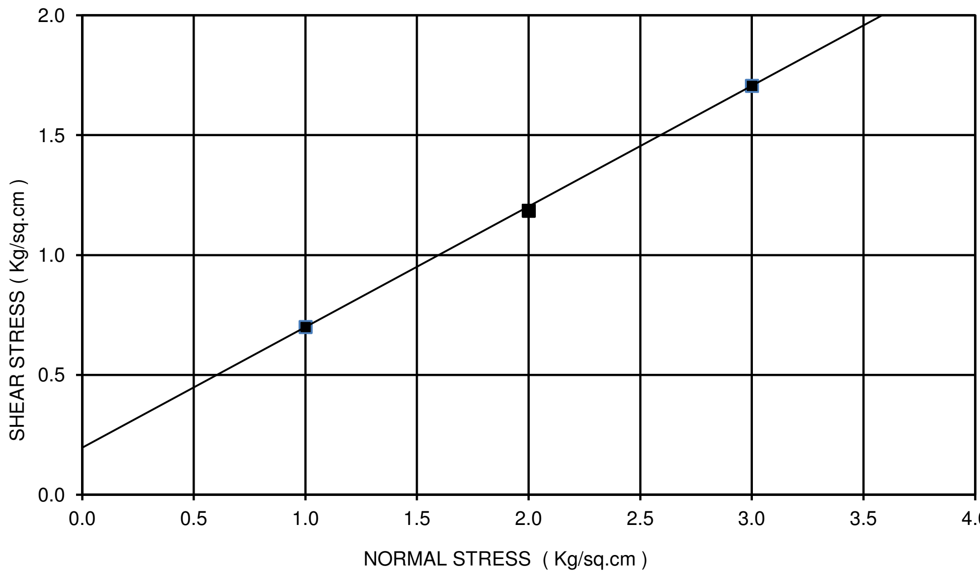
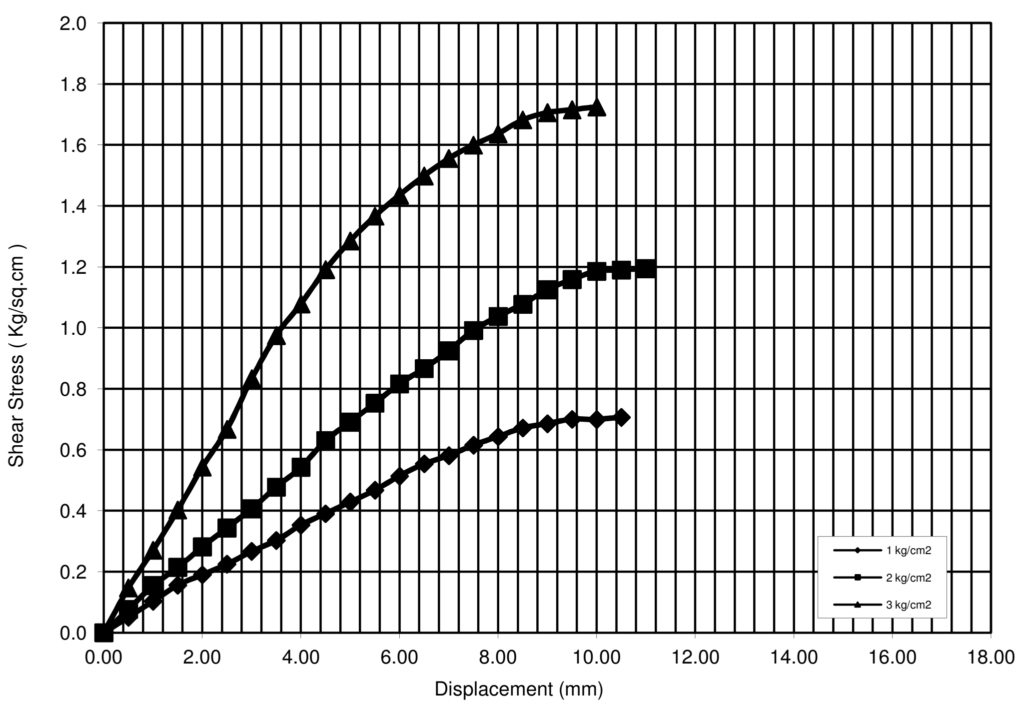
BORE HOLE NO: BH-A-1
CHAINAGE : 3+691KM
SAMPLE NO.: UDS-6
DEPTH: 17.50 m
COHESION(C)= 0.20 kg/sq.cm
ANGLE OF FRICTION(Phi): 27 deg
TYPE OF THE TEST: DST





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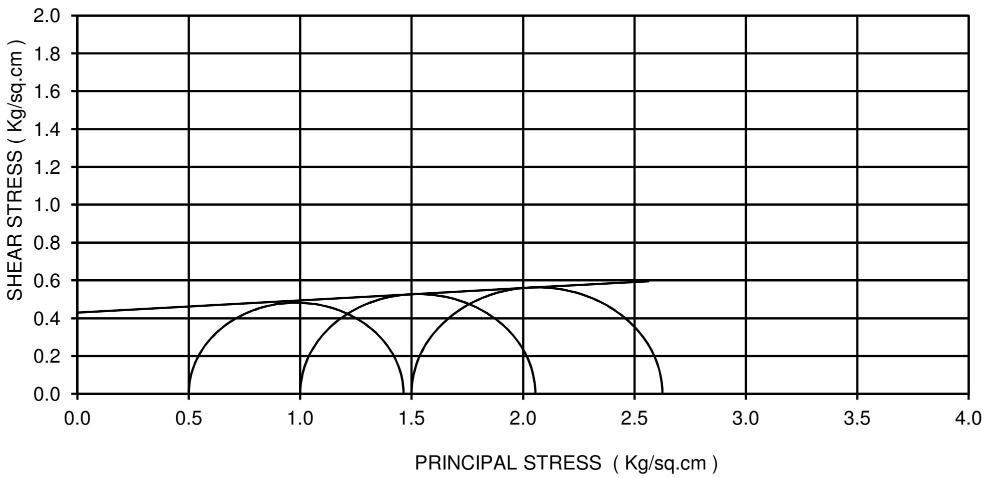
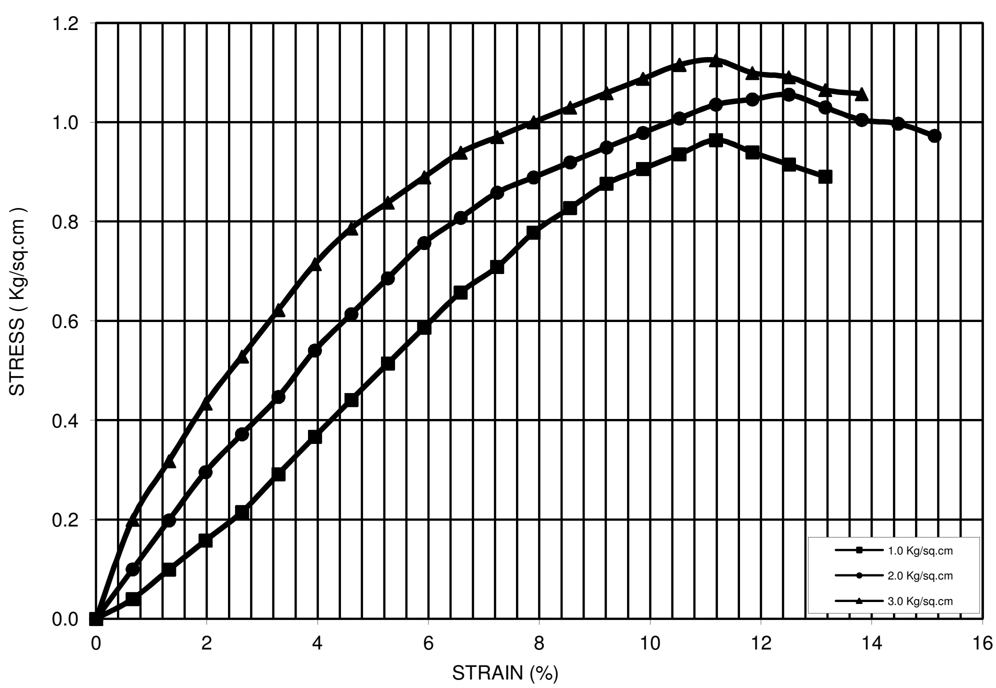
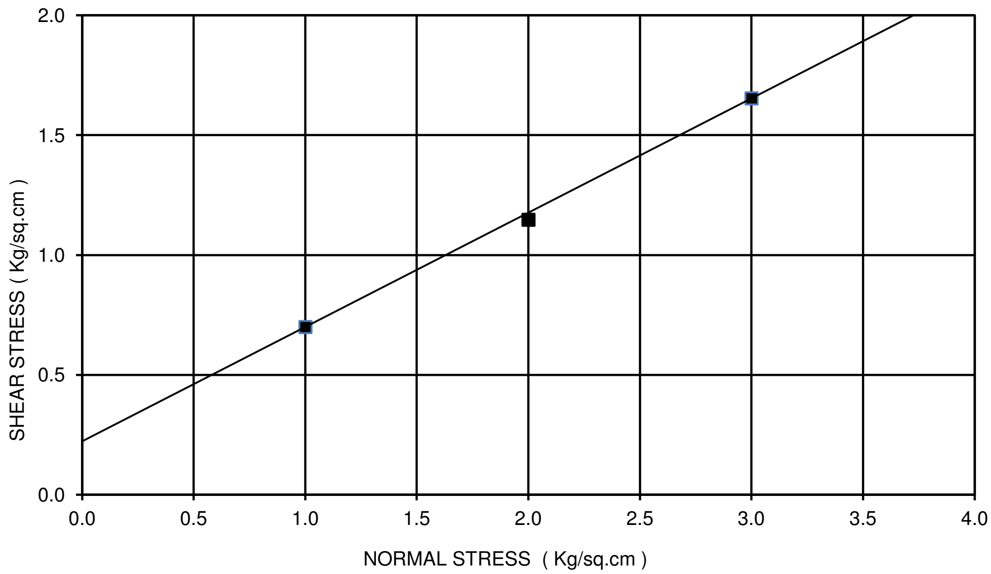
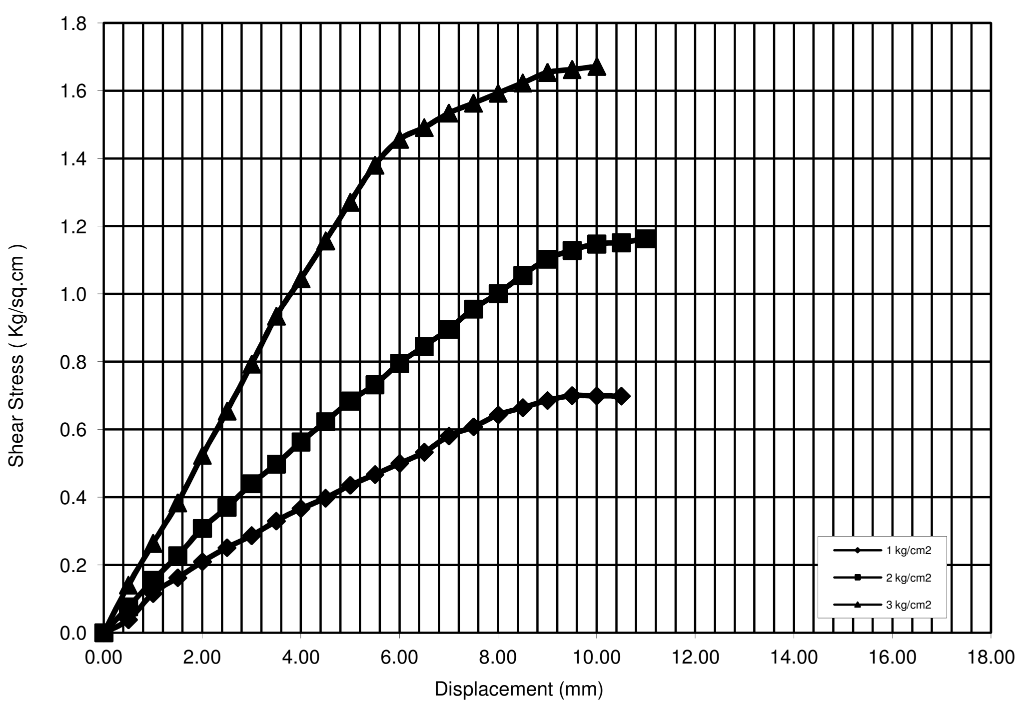
BORE HOLE NO: BH-A-2
CHAINAGE : 3+691 KM
SAMPLE NO.: UDS-1
DEPTH: 1.00 m
COHESION(C)= 0.43 kg/sq.cm
ANGLE OF FRICTION(Phi): 4 deg
TYPE OF THE TEST: UUT



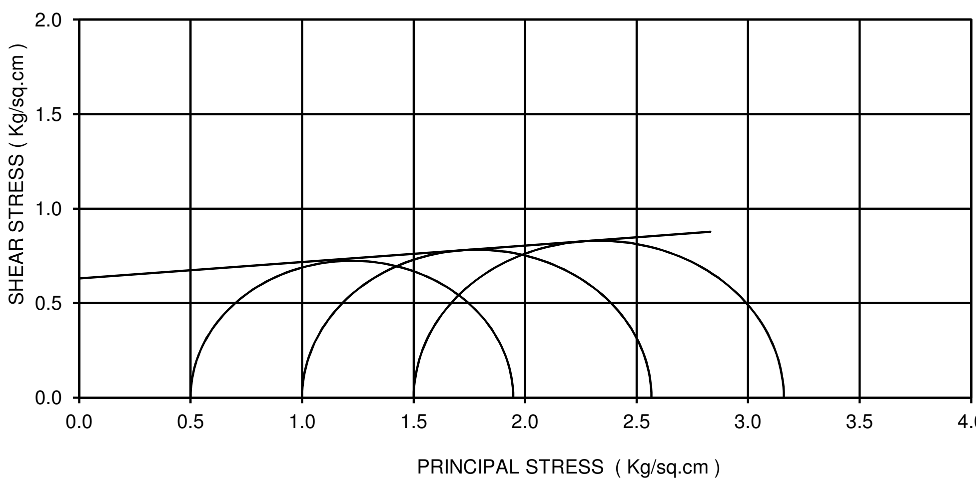


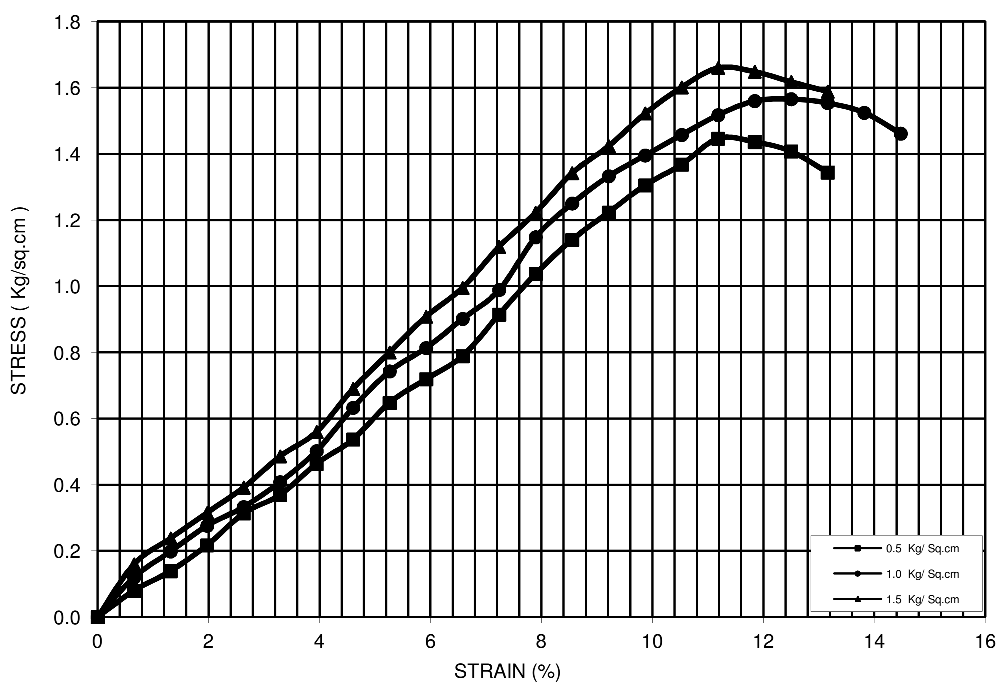
BORE HOLE NO: BH-A-2
CHAINAGE : 3+691 KM
SAMPLE NO.: UDS-7
DEPTH: 19.00 m
COHESION(C)= 0.22 kg/sq.cm
ANGLE OF FRICTION(Phi): 26 deg
TYPE OF THE TEST: DST



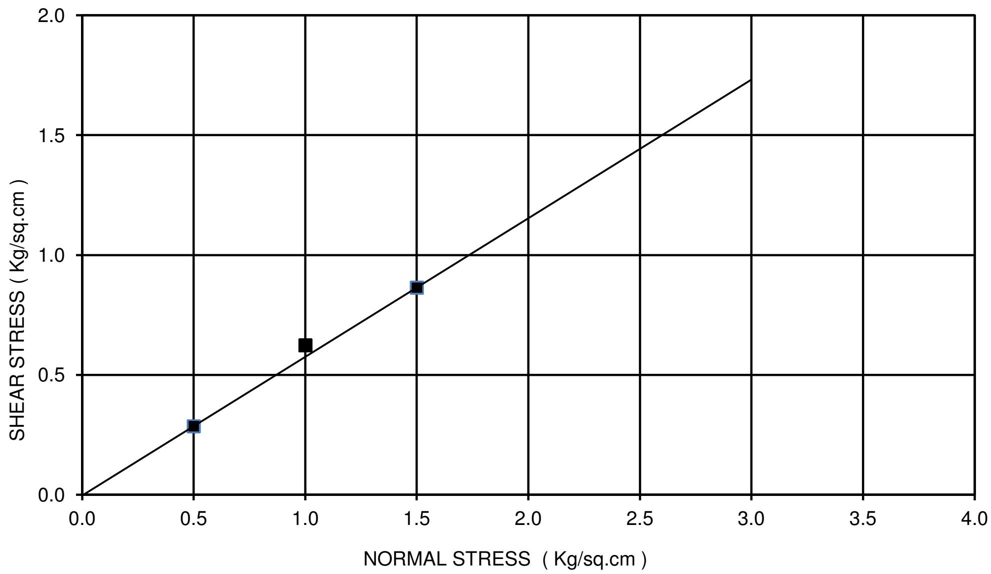


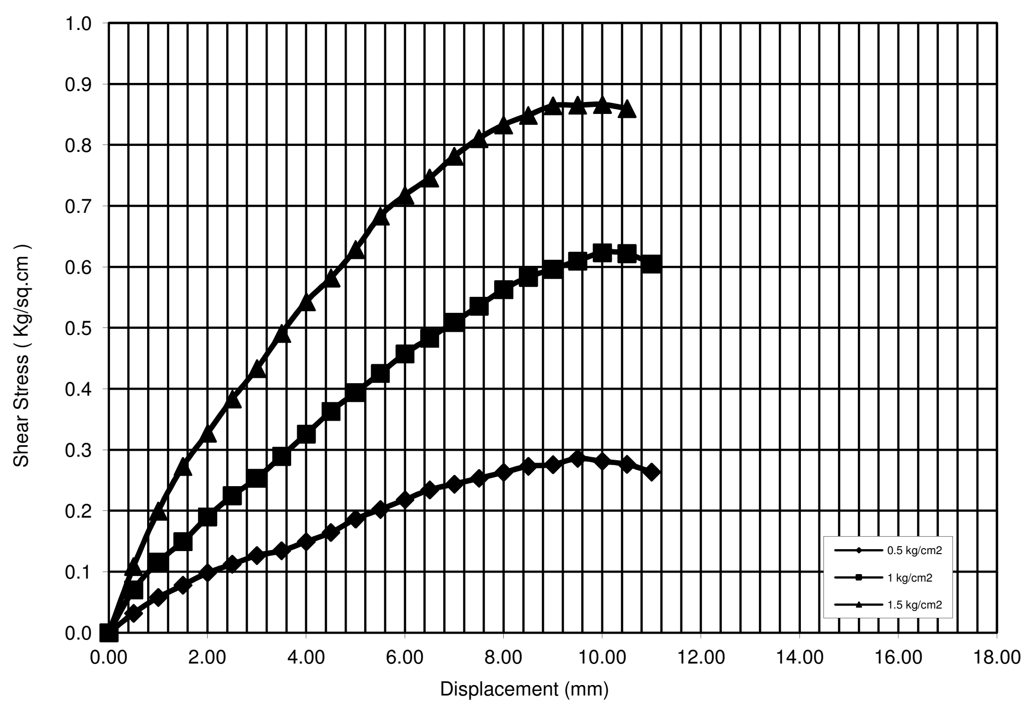
BORE HOLE NO: BH-CL
CHAINAGE : 4+174
SAMPLE NO.: UDS-2
DEPTH: 4.00 m
COHESION(C)= 0.63 kg/sq.cm
ANGLE OF FRICTION(Phi): 5 deg
TYPE OF THE TEST: UUT



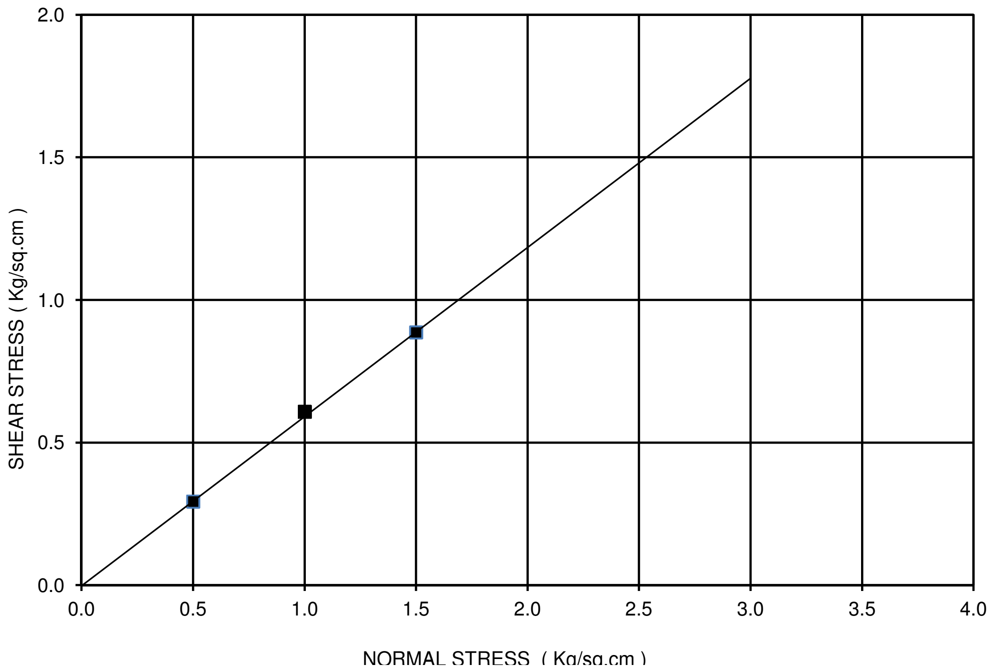


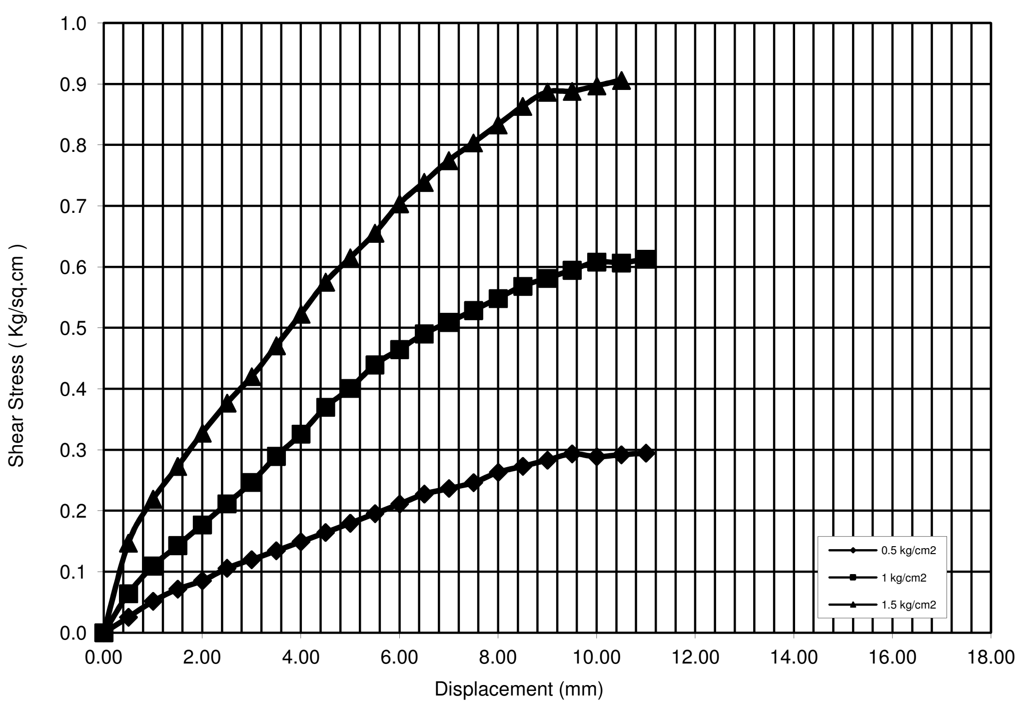
BORE HOLE NO: BH-CL
CHAINAGE : 4+207.23
SAMPLE NO.: UDS-2
DEPTH: 5.50 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 30 deg
TYPE OF THE TEST: DST





BORE HOLE NO: BH-CL
CHAINAGE : 4+655.51
SAMPLE NO.: UDS-1
DEPTH: 2.50 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 31 deg
TYPE OF THE TEST: DST





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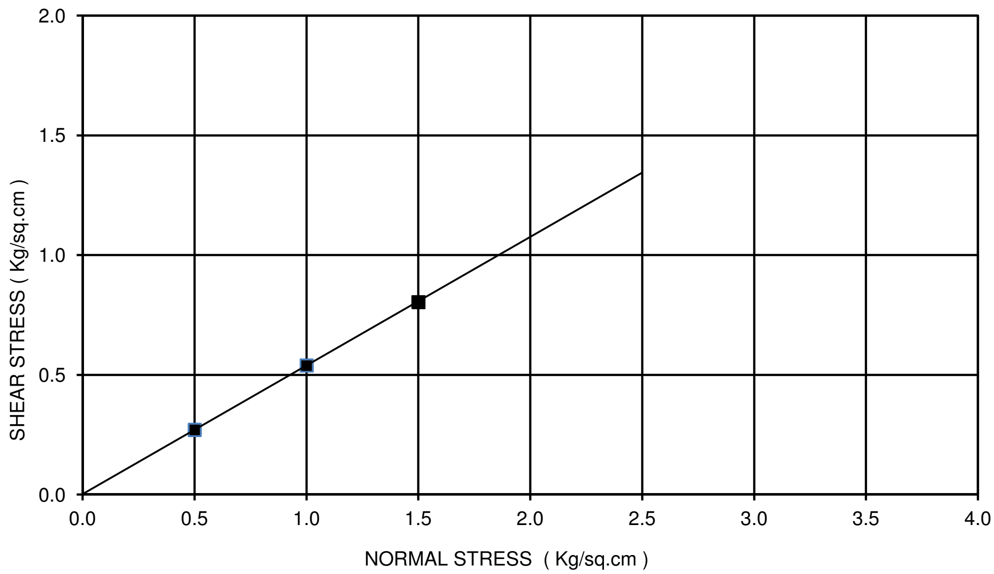
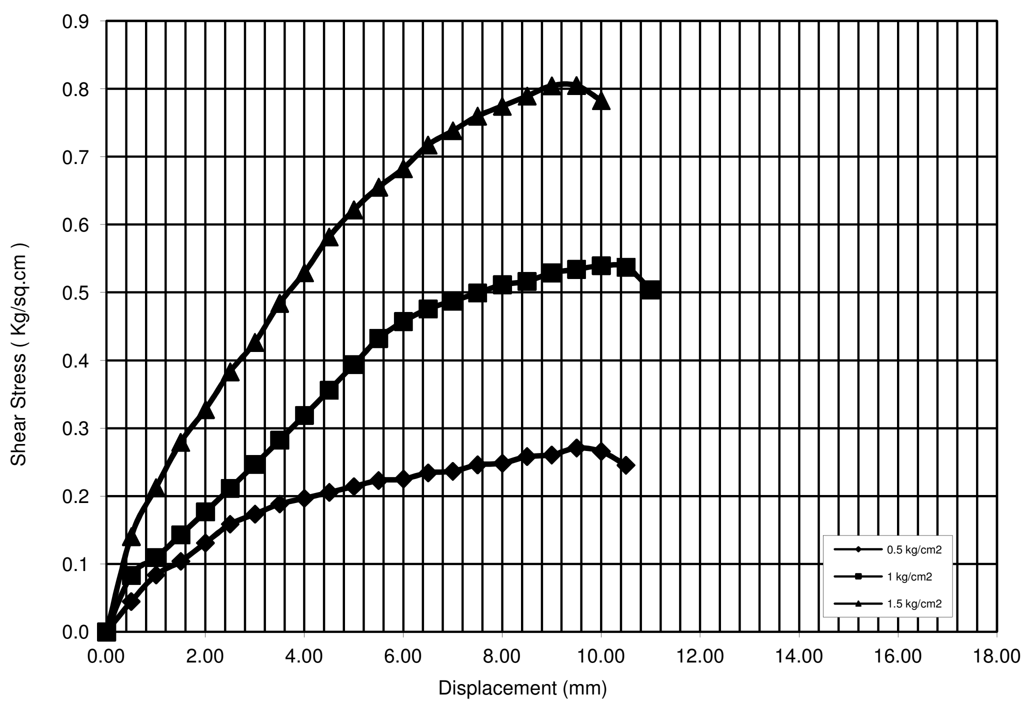
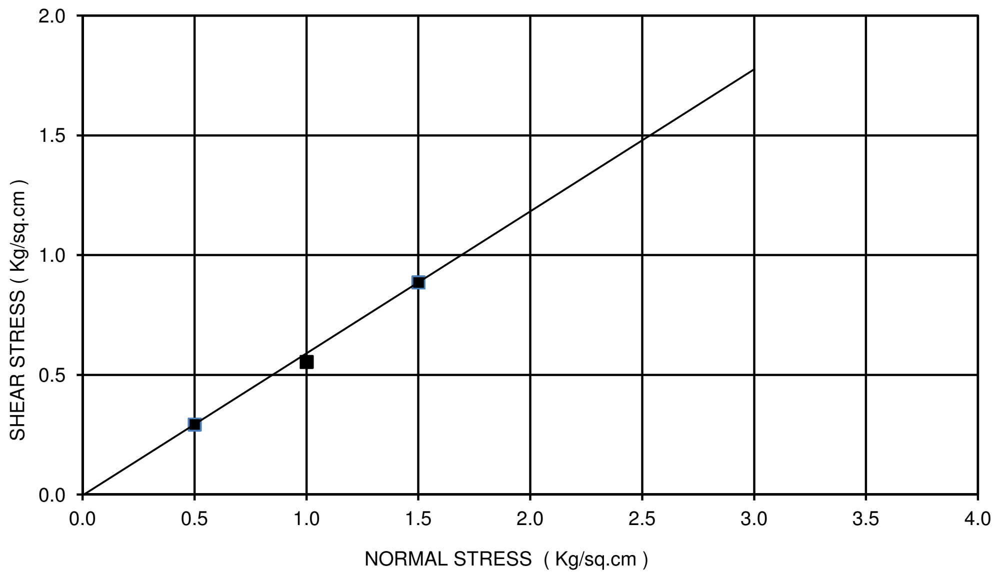
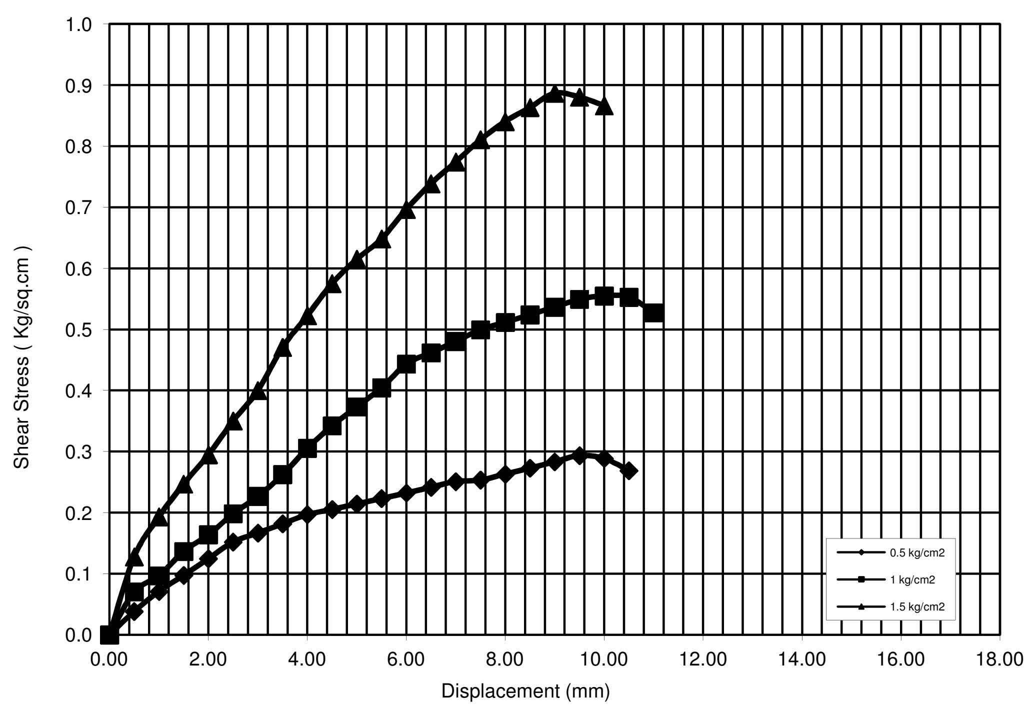
BORE HOLE NO: CL
CHAINAGE : 5+730.2
SAMPLE NO.: UDS-1
DEPTH: 2.5 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 28 deg
TYPE OF THE TEST: DST



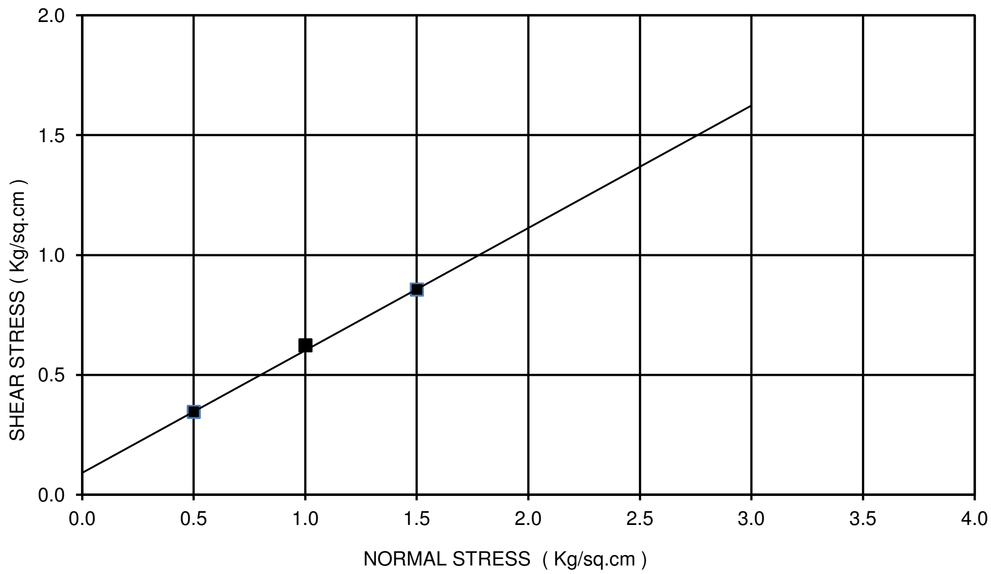


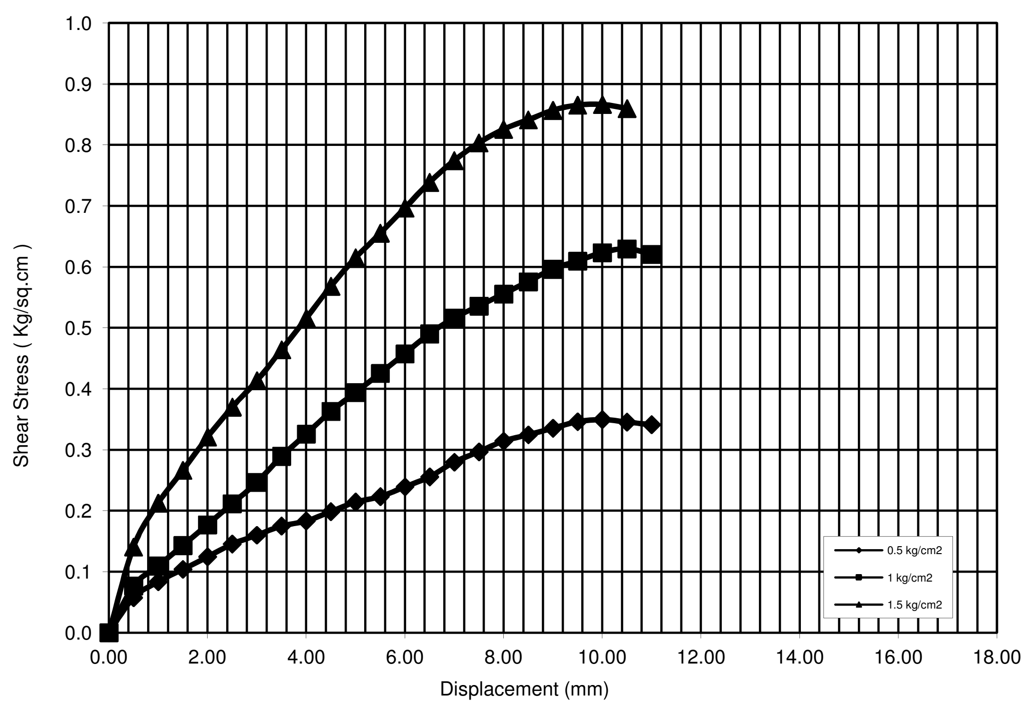
BORE HOLE NO: BH-CL
CHAINAGE : 6+197
SAMPLE NO.: UDS-4
DEPTH: 10.00 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 31 deg
TYPE OF THE TEST: DST



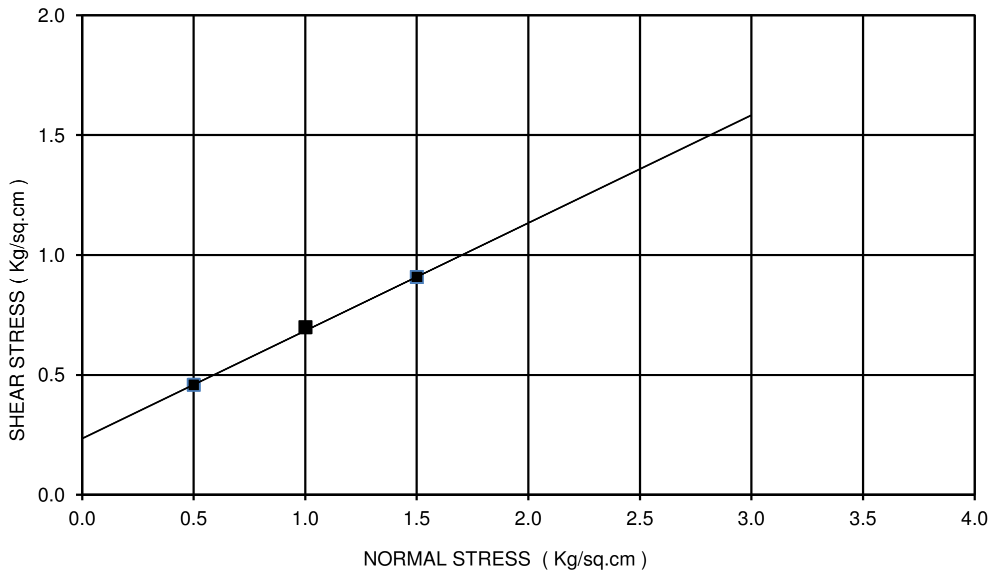


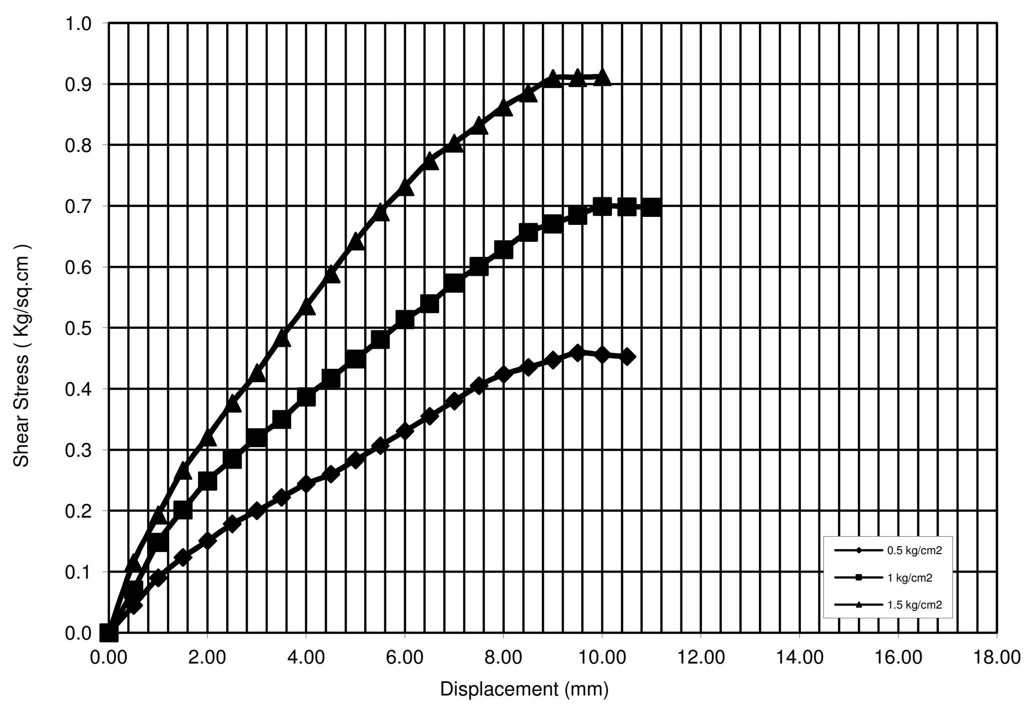
BORE HOLE NO: BH-CL
CHAINAGE :6+877
SAMPLE NO.: UDS-1
DEPTH: 2.50 m
COHESION(C)= 0.09 kg/sq.cm
ANGLE OF FRICTION(Phi): 27 deg
TYPE OF THE TEST: DST



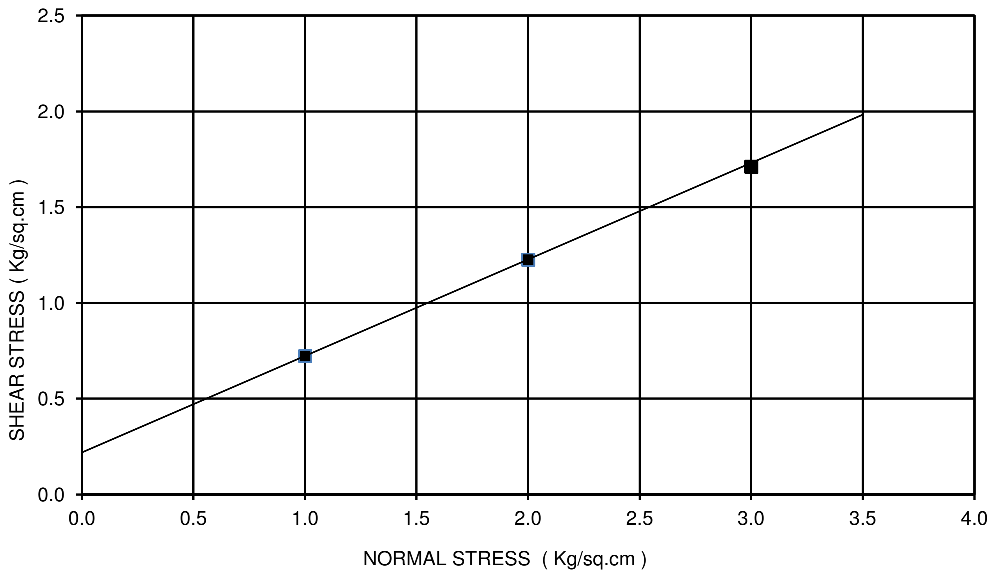


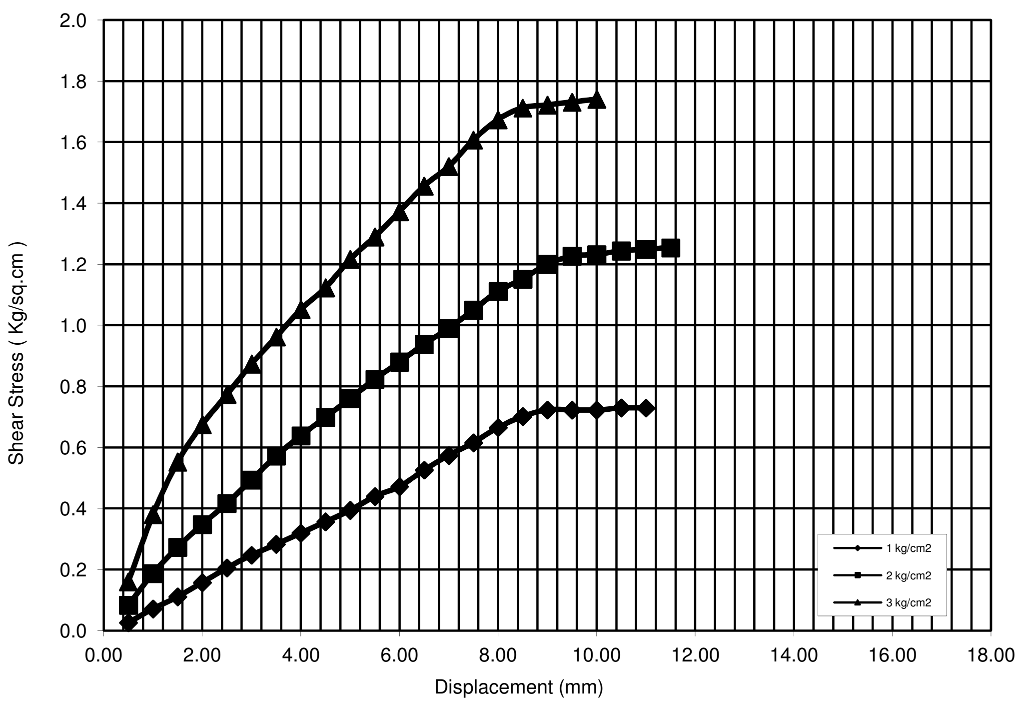
BORE HOLE NO: BH-A-1
CHAINAGE : 7+078 KM
SAMPLE NO.: UDS-3
DEPTH: 10.00 m
COHESION(C)= 0.23 kg/sq.cm
ANGLE OF FRICTION(Phi): 24 deg
TYPE OF THE TEST: DST





BORE HOLE NO: BH-A-1
CHAINAGE : 7+078 KM
SAMPLE NO.: UDS-5
DEPTH: 16.00 m
COHESION(C)= 0.22 kg/sq.cm
ANGLE OF FRICTION(Phi): 27 deg
TYPE OF THE TEST: DST





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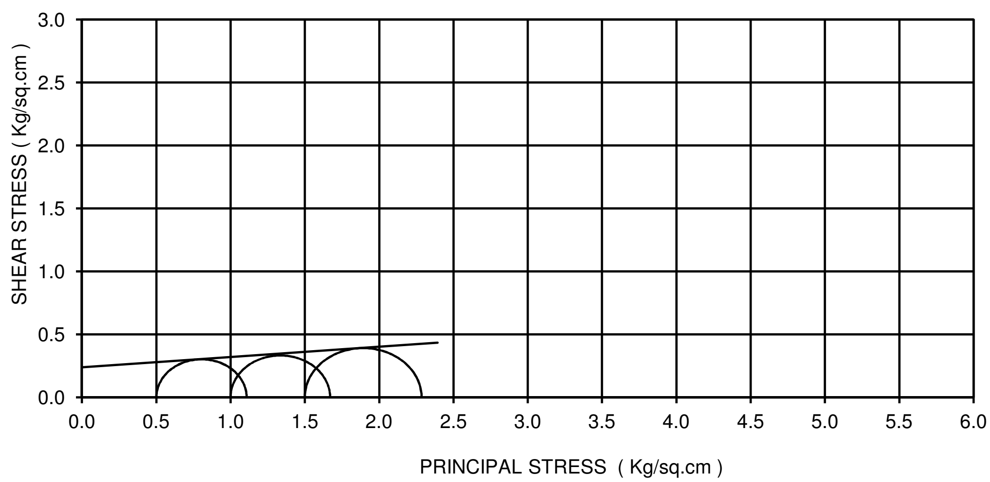
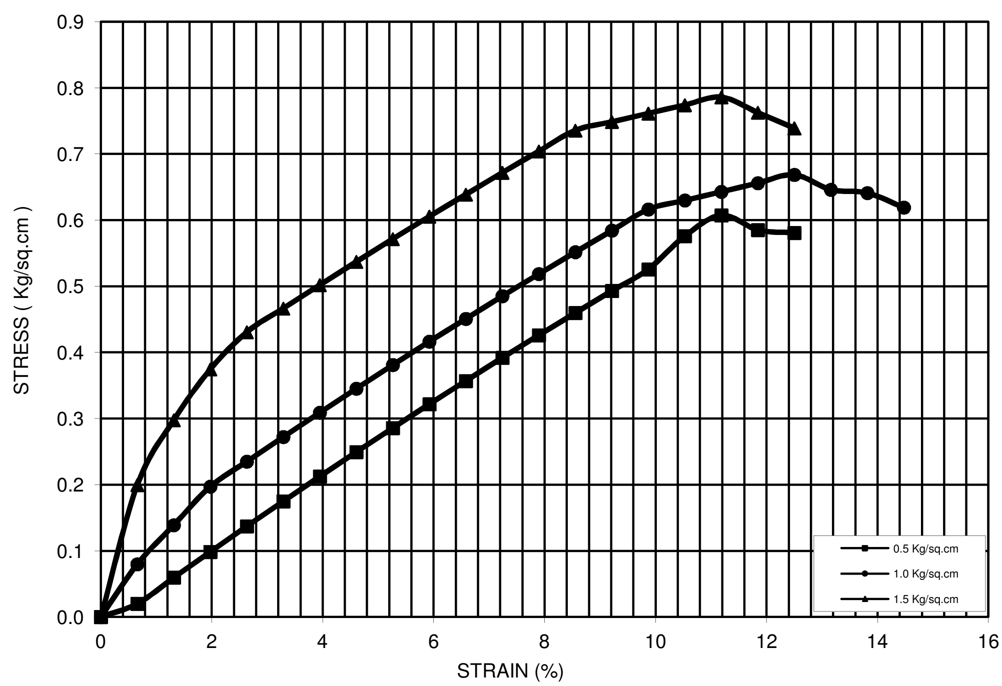
BORE HOLE NO: BH-A-2
CHAINAGE :7+078 KM
SAMPLE NO.: UDS-1
DEPTH: 2.50 m
COHESION(C)= 0.24 kg/sq.cm
ANGLE OF FRICTION(Phi): 5 deg
TYPE OF THE TEST: UUT





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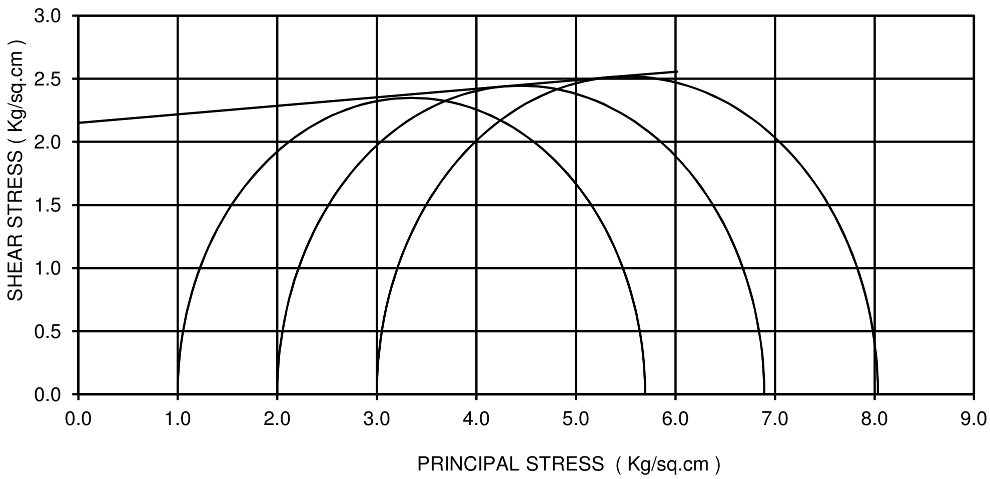
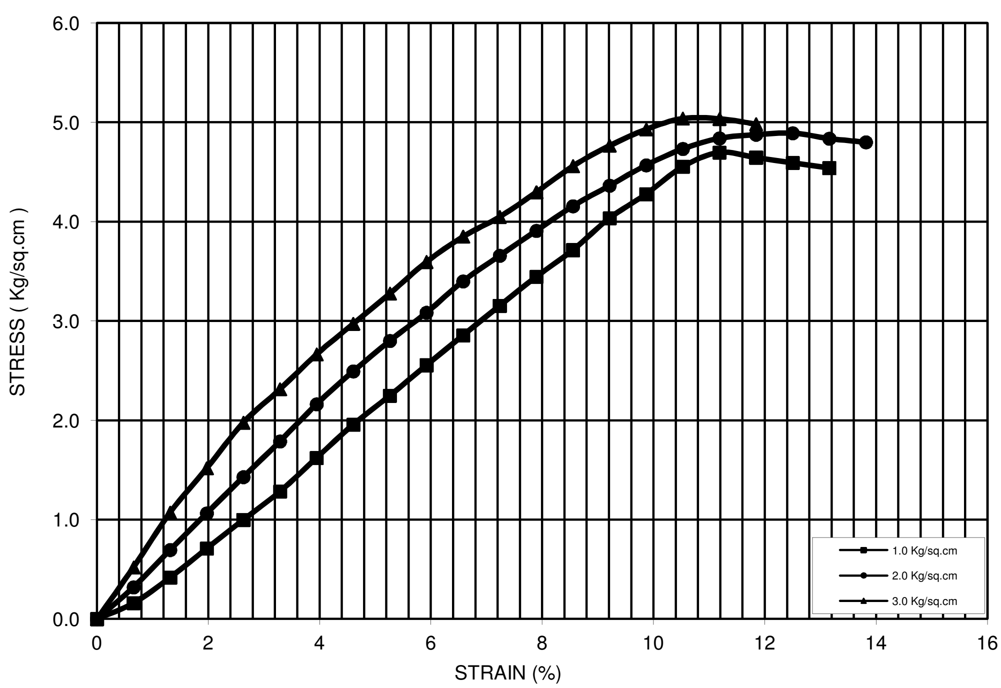
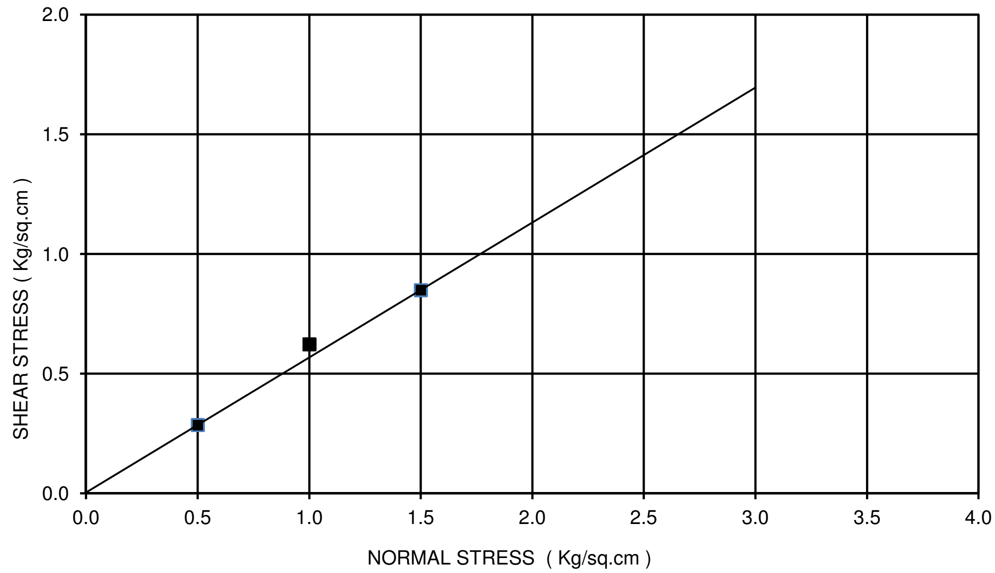
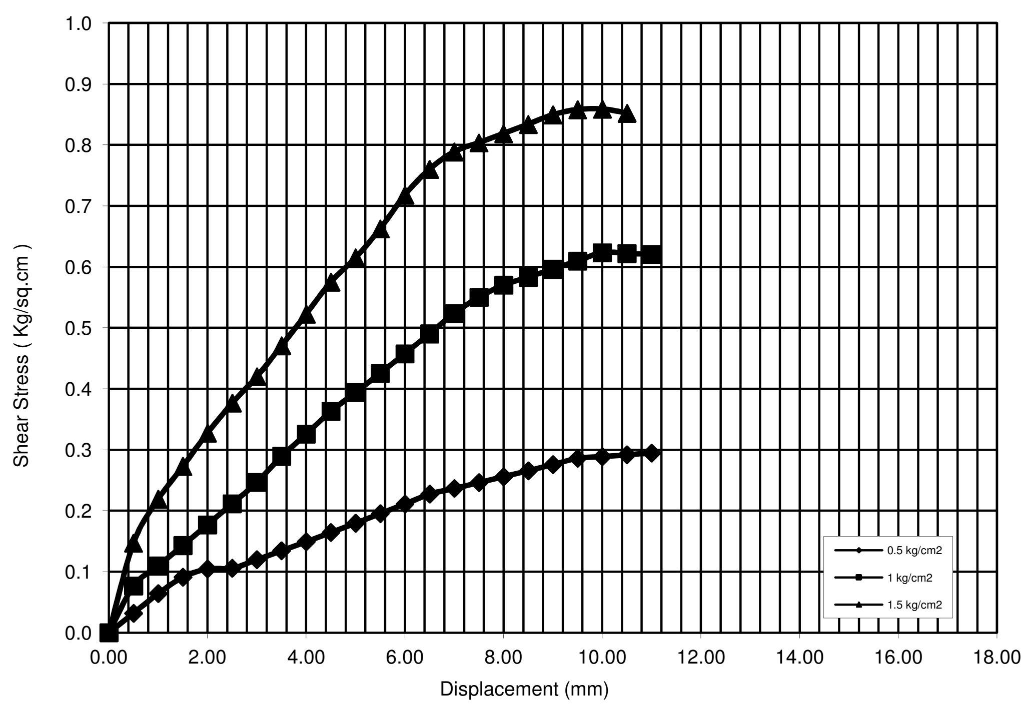
BORE HOLE NO: BH-A-2
CHAINAGE: 7+078 KM
SAMPLE NO.: UDS-5
DEPTH: 23.50 m
COHESION(C)= 2.15 kg/sq.cm
ANGLE OF FRICTION(Phi): 4 deg
TYPE OF THE TEST: UUT





BORE HOLE NO: BH-CL
CHAINAGE : 7+256
SAMPLE NO.: UDS-1
DEPTH: 2.50 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 29 deg
TYPE OF THE TEST: DST





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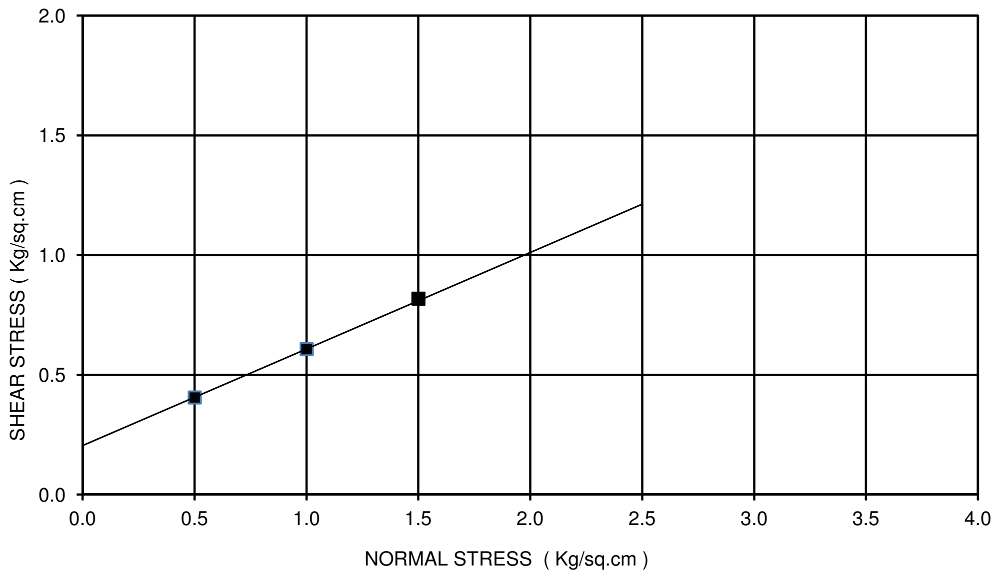
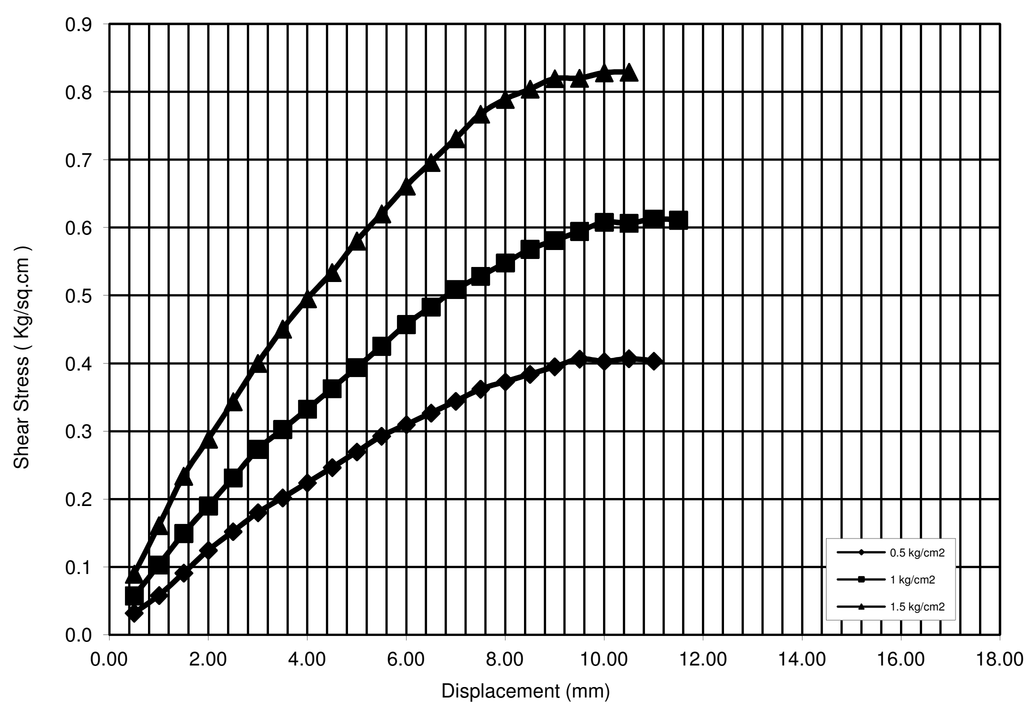
BORE HOLE NO: BH-A-1
CHAIANGE : 7+351
SAMPLE NO.: UDS-1
DEPTH: 2.50 m
COHESION(C)= 0.20 kg/sq.cm
ANGLE OF FRICTION(Phi): 22 deg
TYPE OF THE TEST: DST





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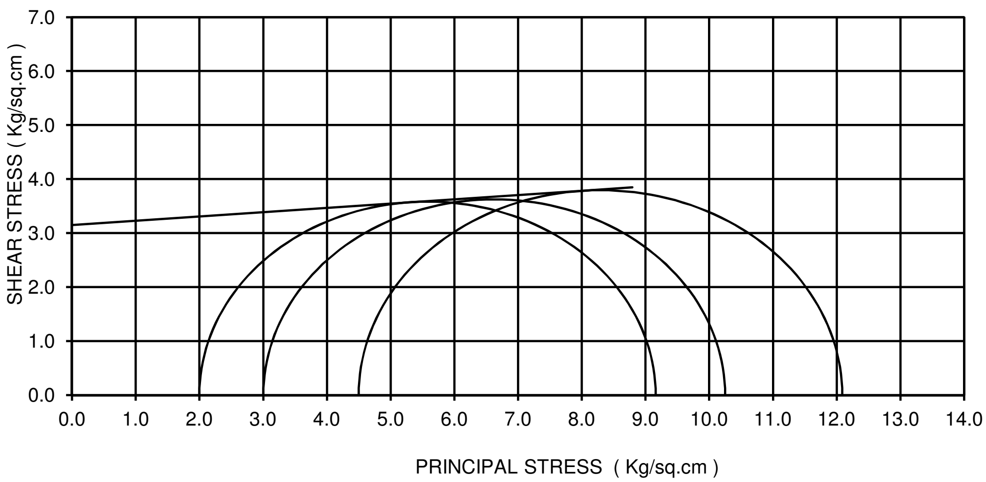
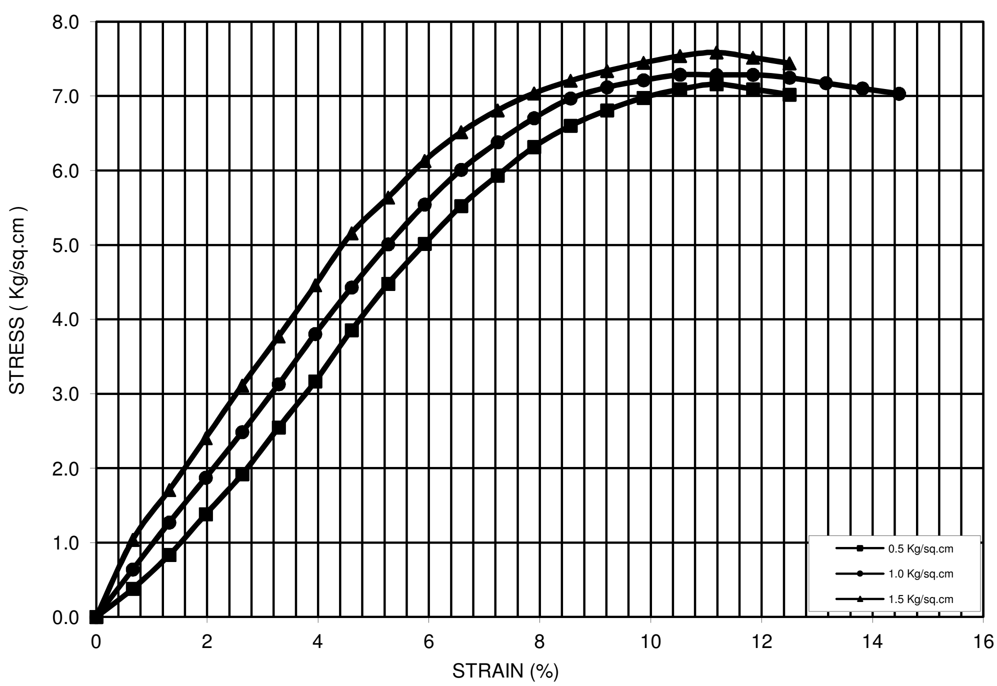
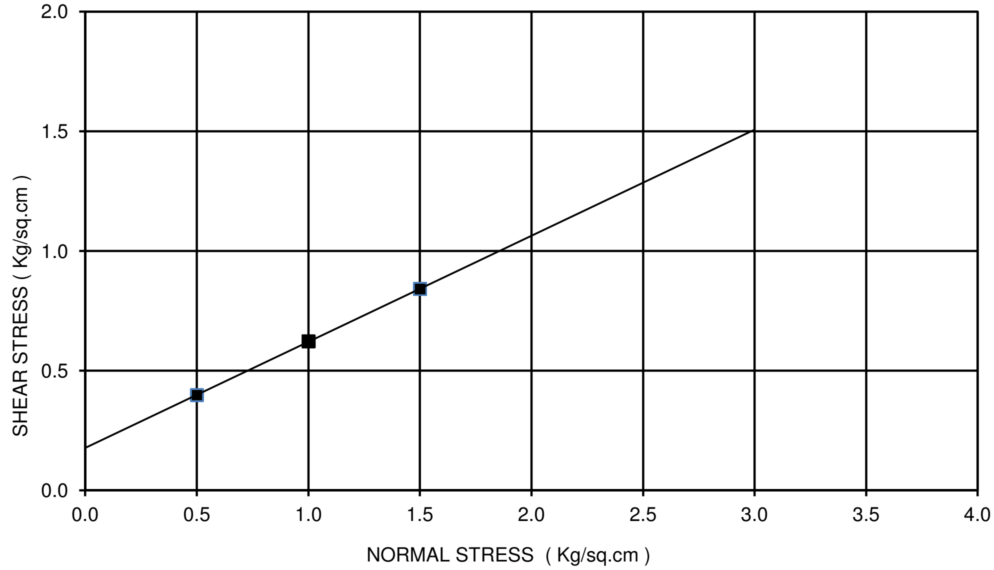
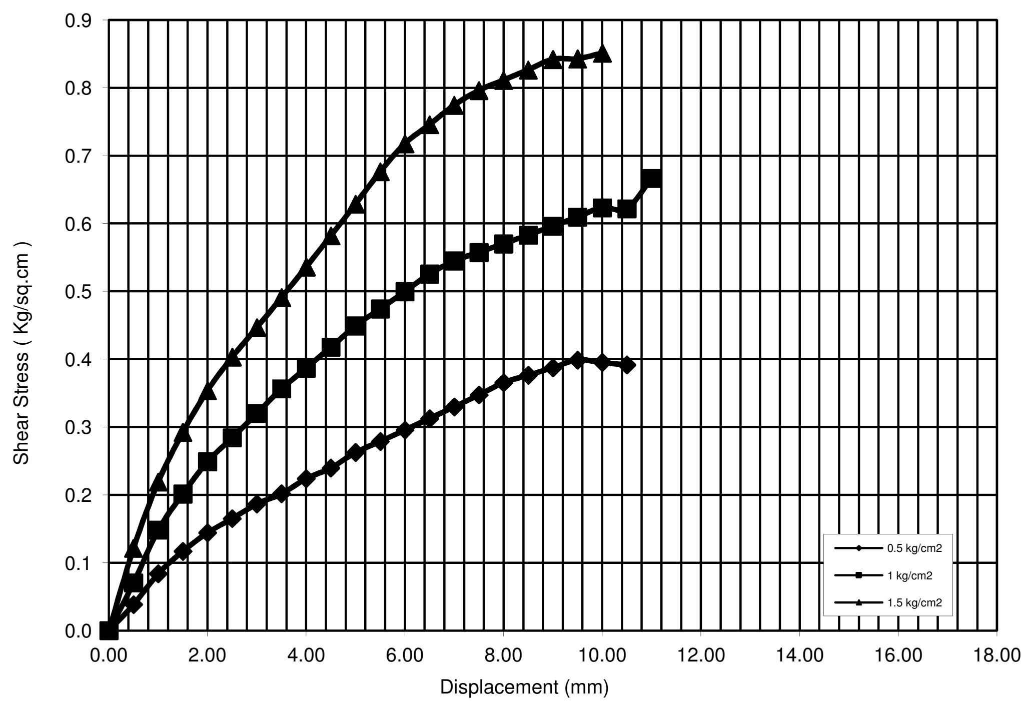
BORE HOLE NO: BH-A-1
CHAINAGE : 7+351
SAMPLE NO.: UDS-10
DEPTH: 35.50 m
COHESION(C)= 3.15 kg/sq.cm
ANGLE OF FRICTION(Phi): 5 deg
TYPE OF THE TEST: UUT



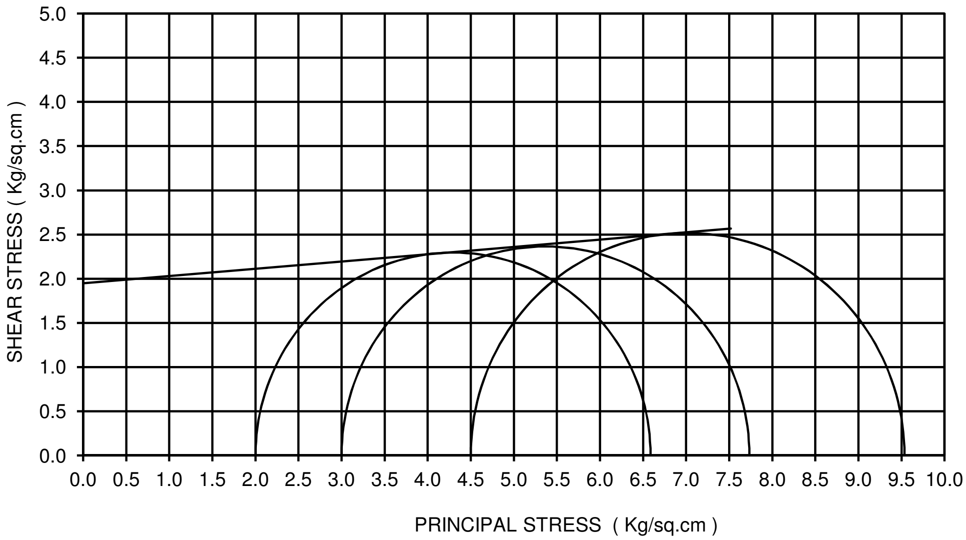


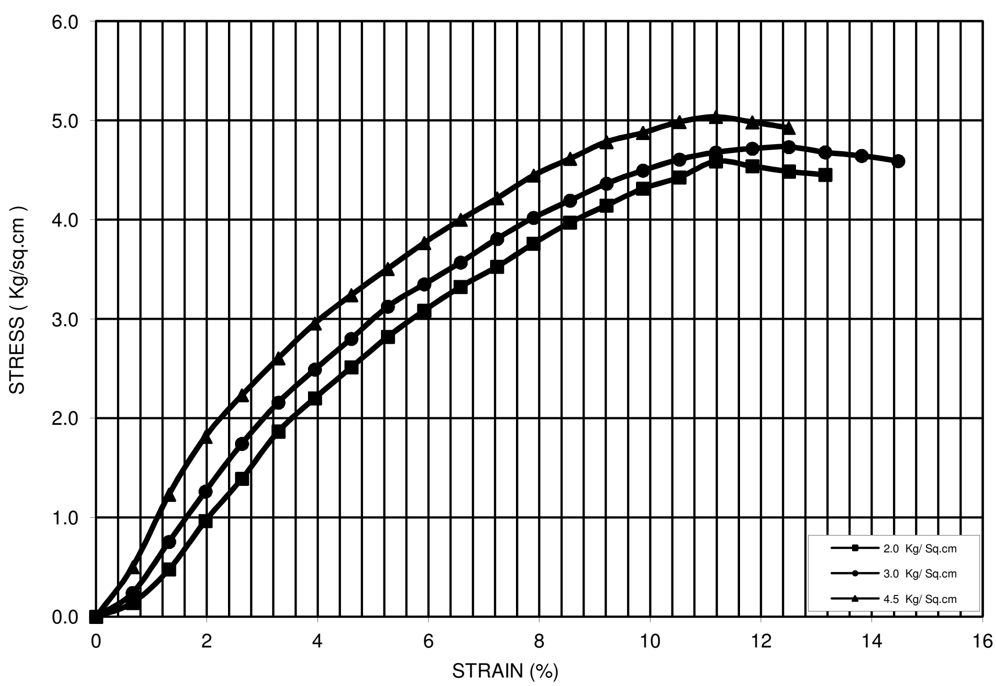
BORE HOLE NO: BH-P-1
CHAIANGE : 7+351
SAMPLE NO.: UDS-1
DEPTH: 1.00 m
COHESION(C)= 0.18 kg/sq.cm
ANGLE OF FRICTION(Phi): 24 deg
TYPE OF THE TEST: DST



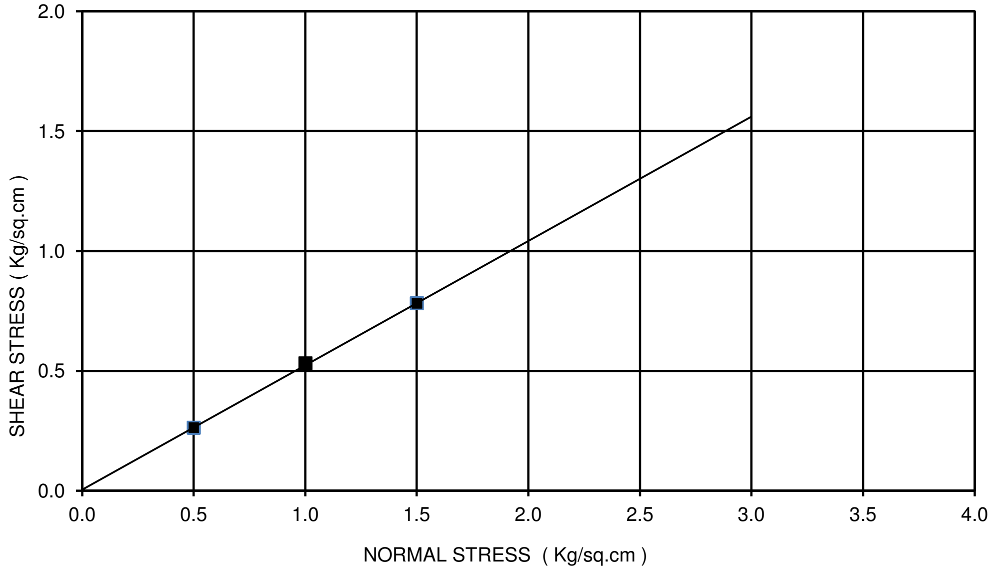


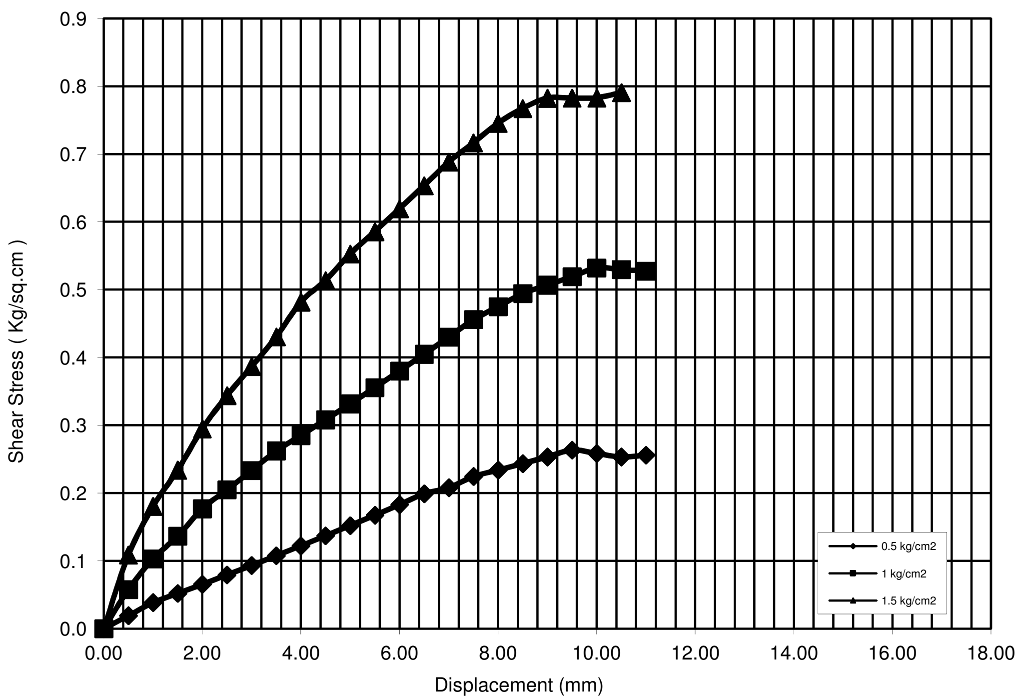
BORE HOLE NO: BH-P-1
CHAIANGE : 7+351
SAMPLE NO.: UDS-10
DEPTH: 31.00 m
COHESION(C)= 1.95 kg/sq.cm
ANGLE OF FRICTION(Phi): 5 deg
TYPE OF THE TEST: UUT



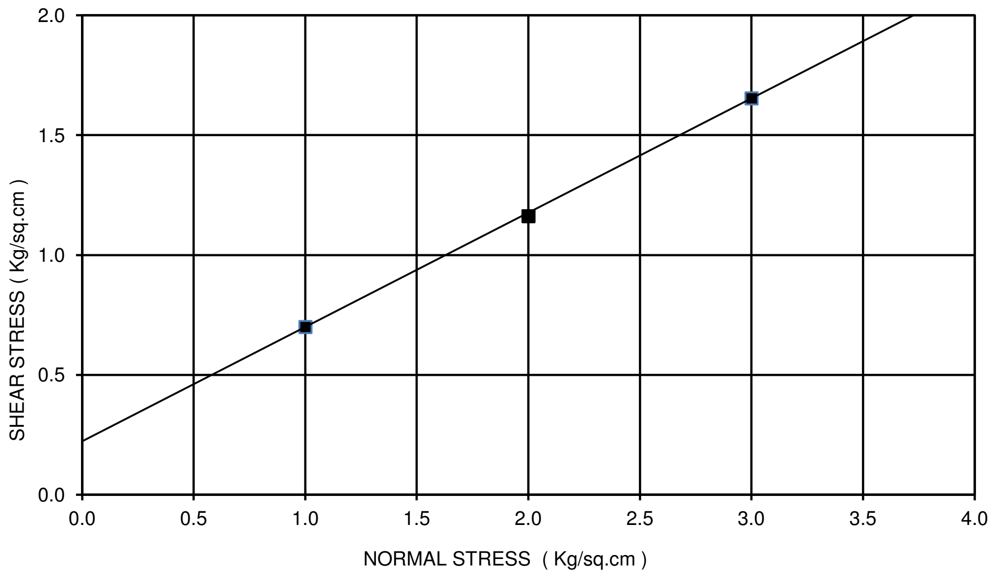


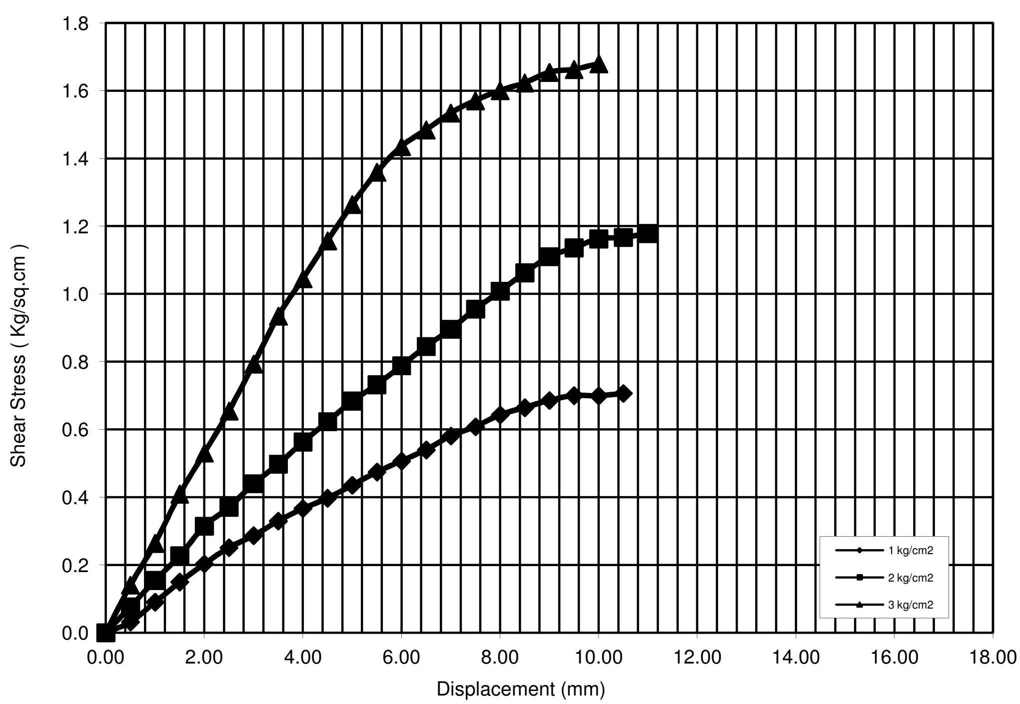
BORE HOLE NO: BH-A-2
CHAIANGE : 7+351
SAMPLE NO.: UDS-1
DEPTH: 2.50 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi): 27 deg
TYPE OF THE TEST: DST



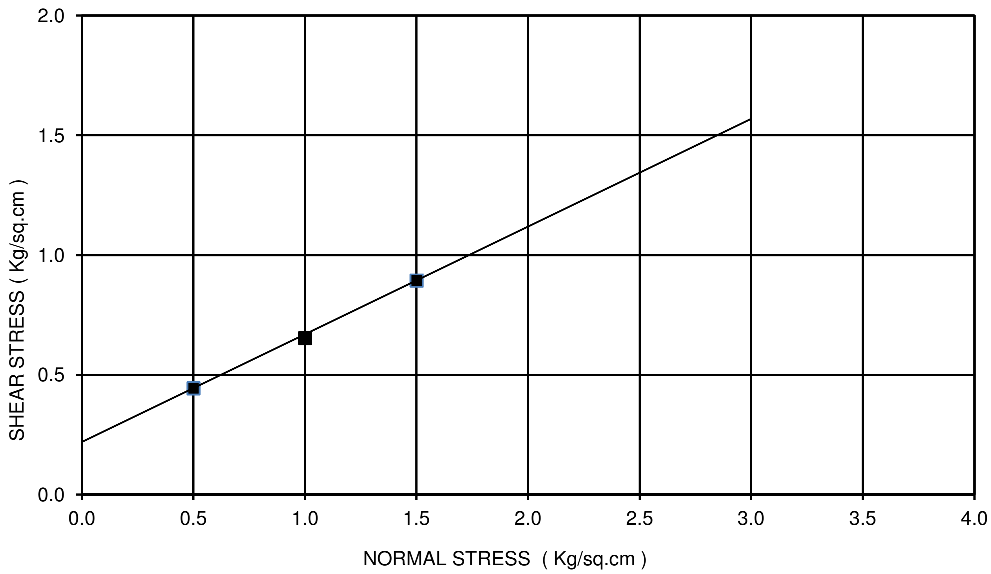


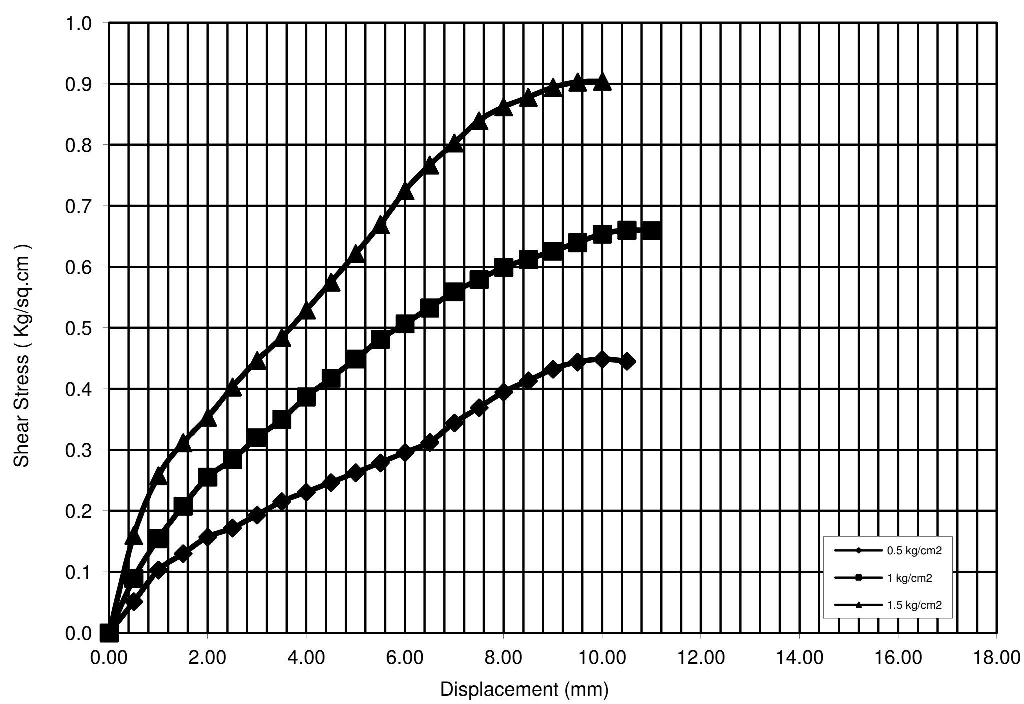
BORE HOLE NO: BH-A-2
CHAIANGE : 7+351
SAMPLE NO.: UDS-5
DEPTH: 14.50 m
COHESION(C)= 0.22 kg/sq.cm
ANGLE OF FRICTION(Phi): 26 deg
TYPE OF THE TEST: DST



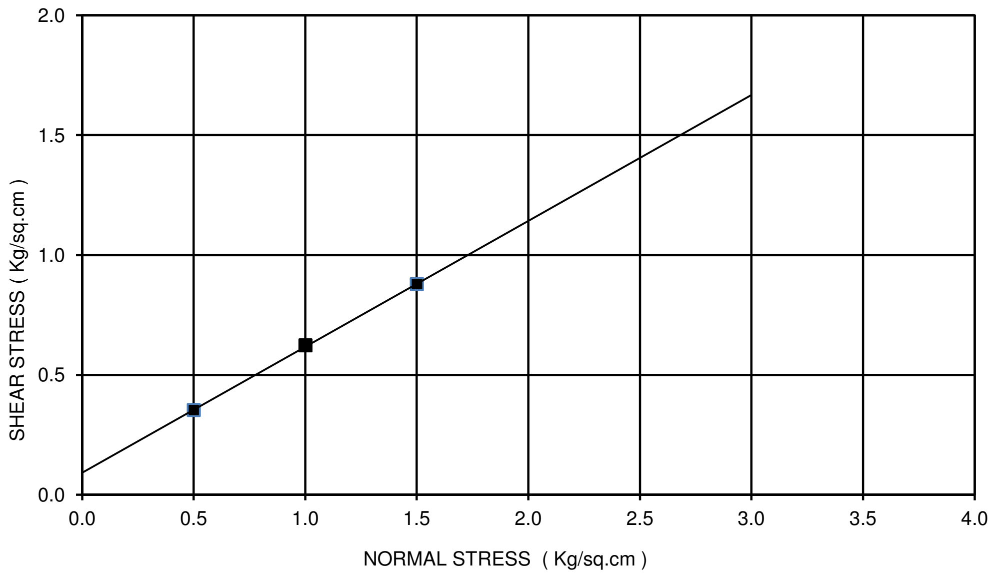


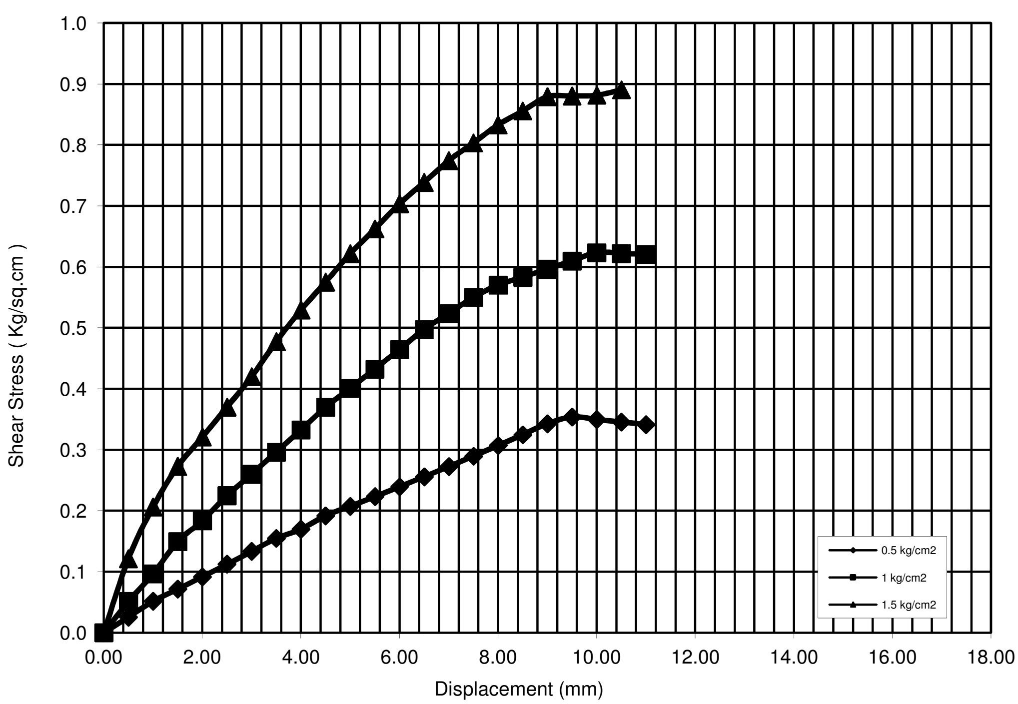
BORE HOLE NO: BH-CL
CHAIANGE : 7+457
SAMPLE NO.: UDS-4
DEPTH: 13.00 m
COHESION(C)= 0.08 kg/sq.cm
ANGLE OF FRICTION(Phi): 26 deg
TYPE OF THE TEST: DST



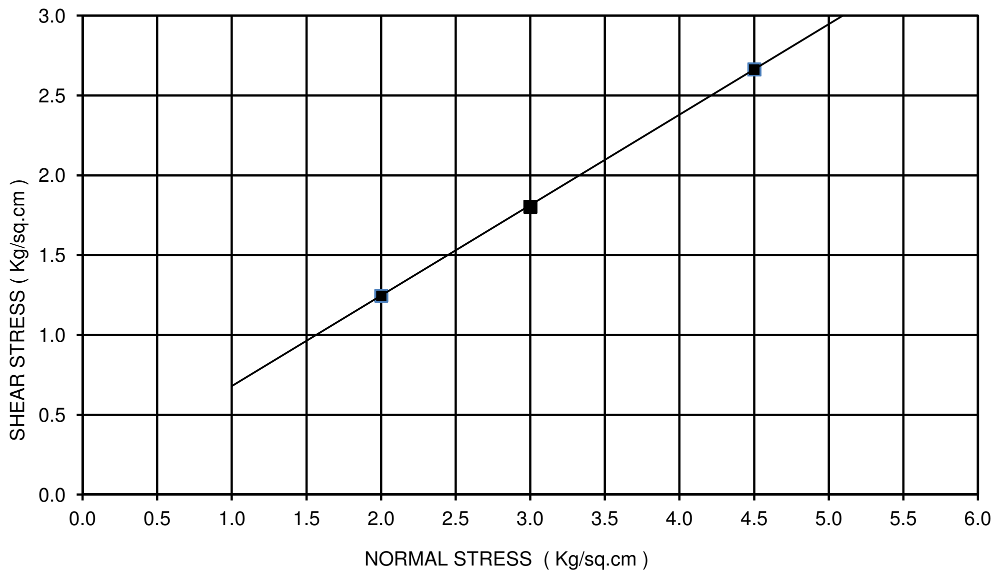


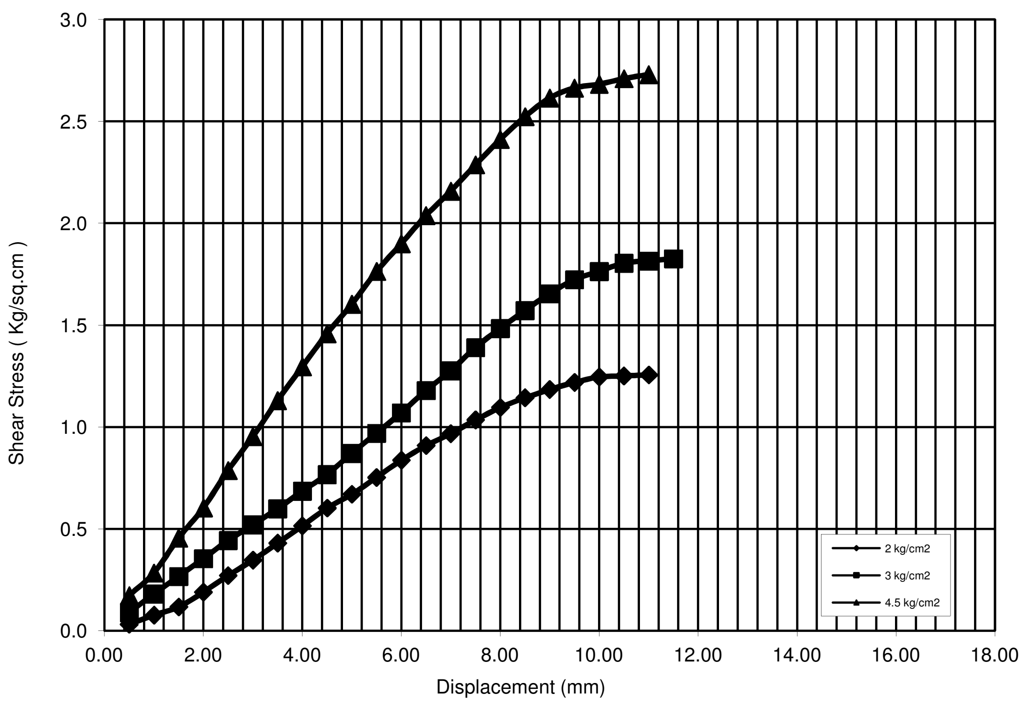
BORE HOLE NO: BH-A-1
CHAIANGE : 7+613
SAMPLE NO.: UDS-2
DEPTH: 5.50 m
COHESION(C)= 0.09 kg/sq.cm
ANGLE OF FRICTION(Phi): 28 deg
TYPE OF THE TEST: DST



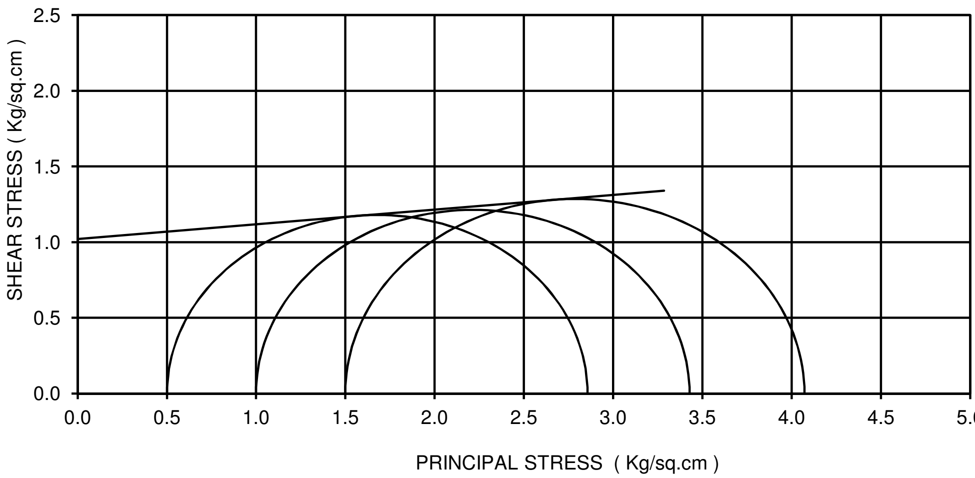


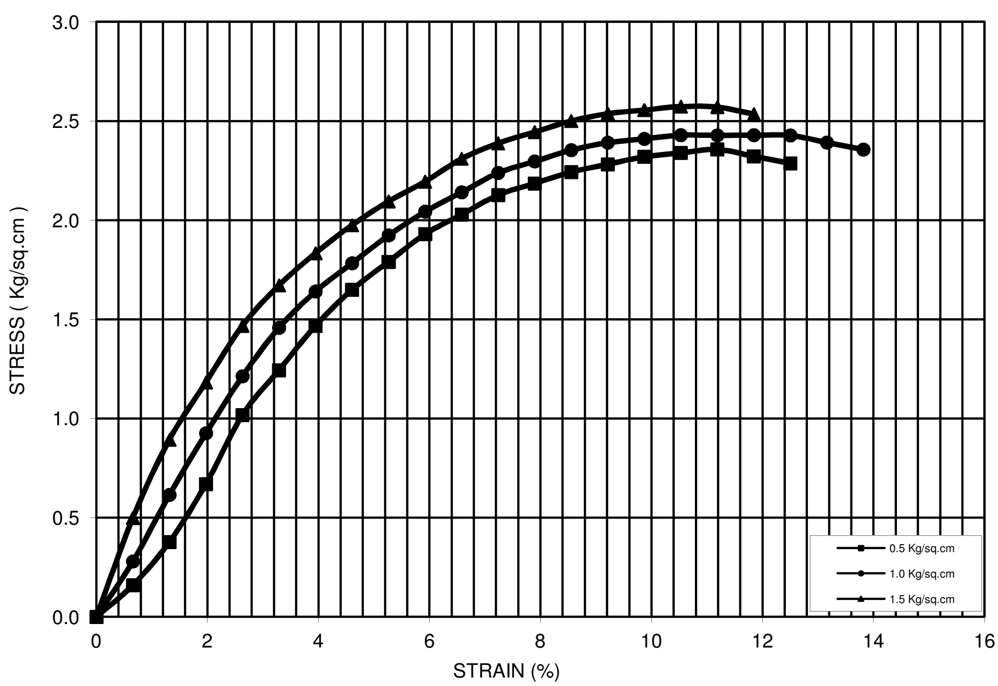
BORE HOLE NO: BH-A-1
CHAIANGE : 7+613
SAMPLE NO.: UDS-10
DEPTH: 32.50 m
COHESION(C)= 0.11 kg/sq.cm
ANGLE OF FRICTION(Phi): 30 deg
TYPE OF THE TEST: DST



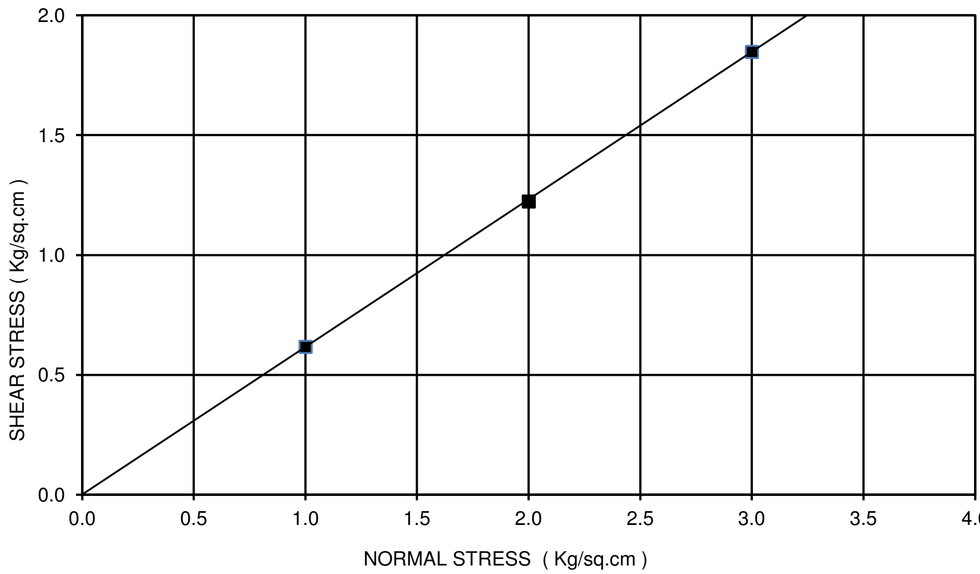


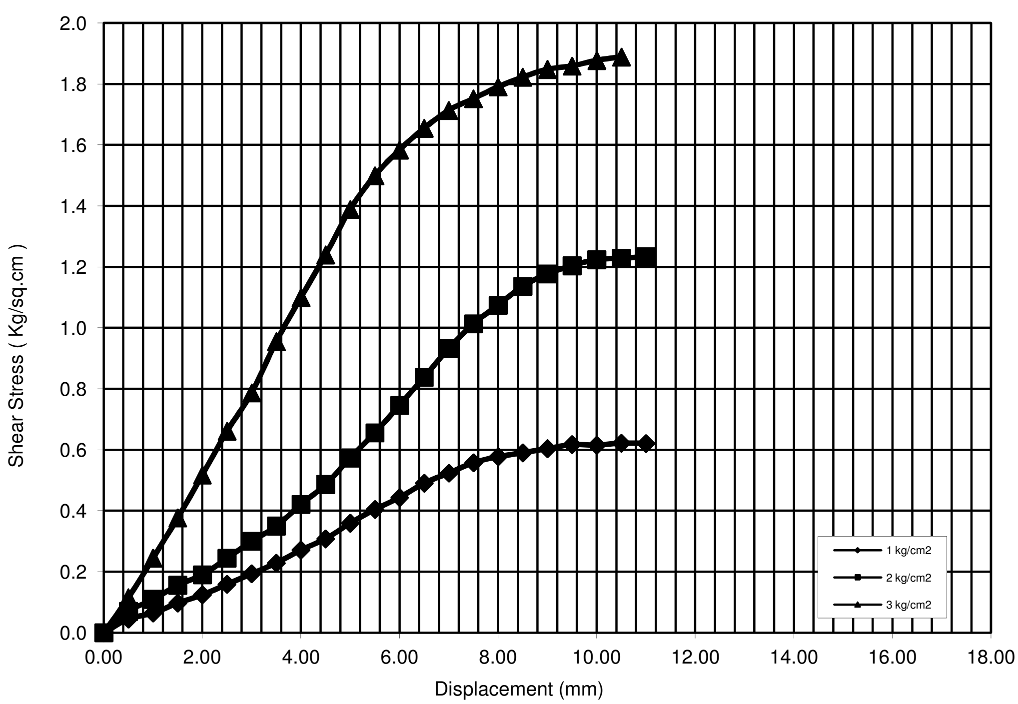
BORE HOLE NO: BH-A-2
CHAIANGE : 7+613
SAMPLE NO.: UDS-3
DEPTH: 7.00 m
COHESION(C)= 1.02 kg/sq.cm
ANGLE OF FRICTION(Phi): 6 deg
TYPE OF THE TEST: UUT



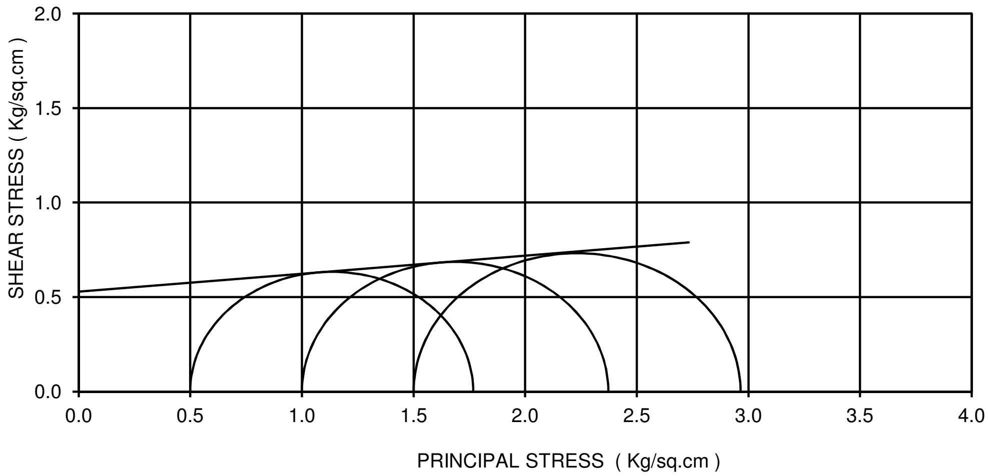


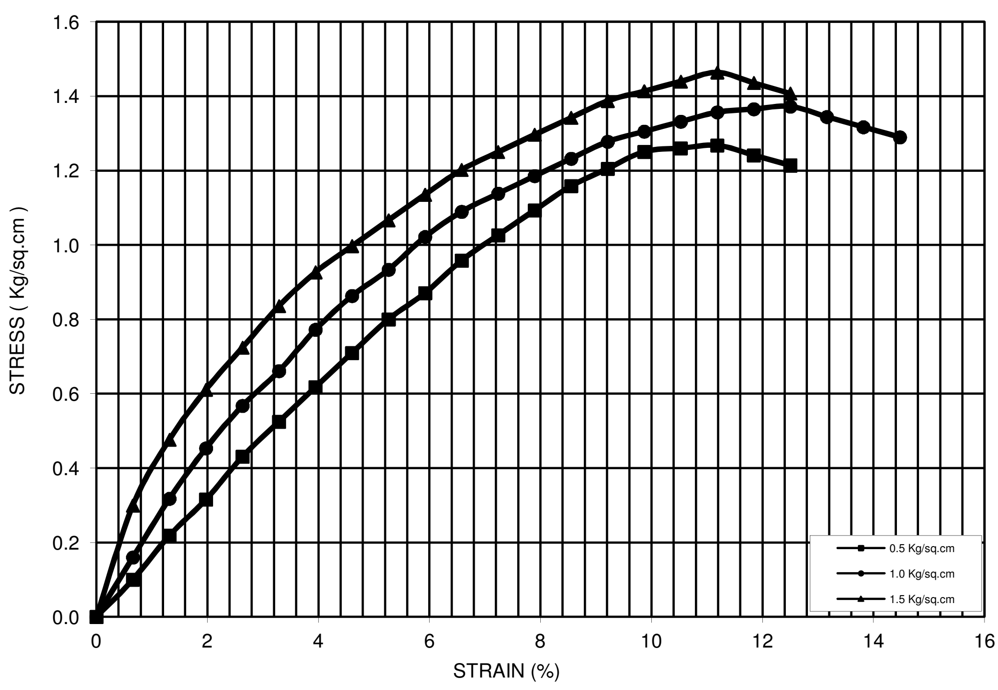
BORE HOLE NO: BH-A-2
CHAIANGE : 7+613
SAMPLE NO.: UDS-7
DEPTH: 19.00 m
COHESION(C)= 0.00 kg/sq.cm
ANGLE OF FRICTION(Phi):32 deg
TYPE OF THE TEST: DST



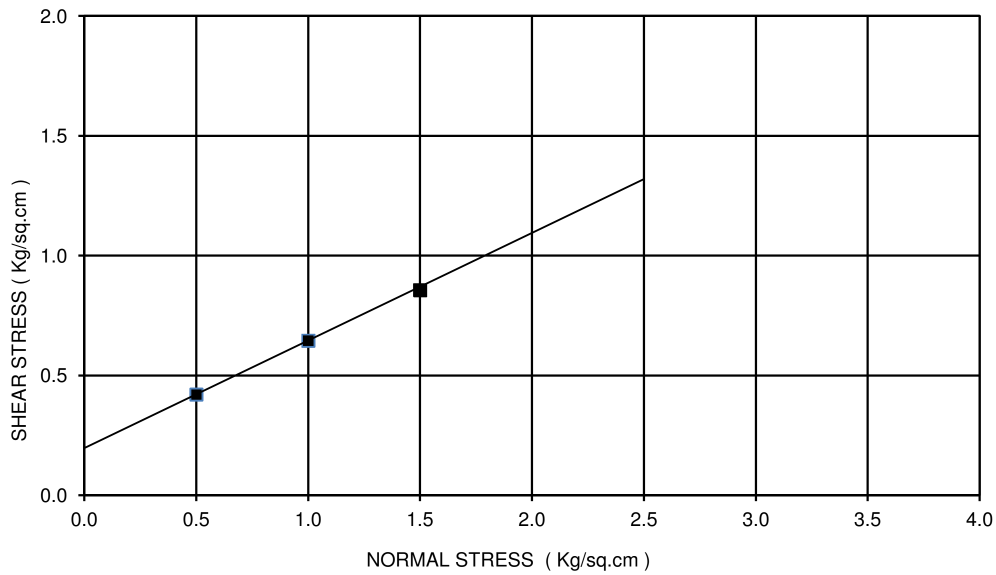


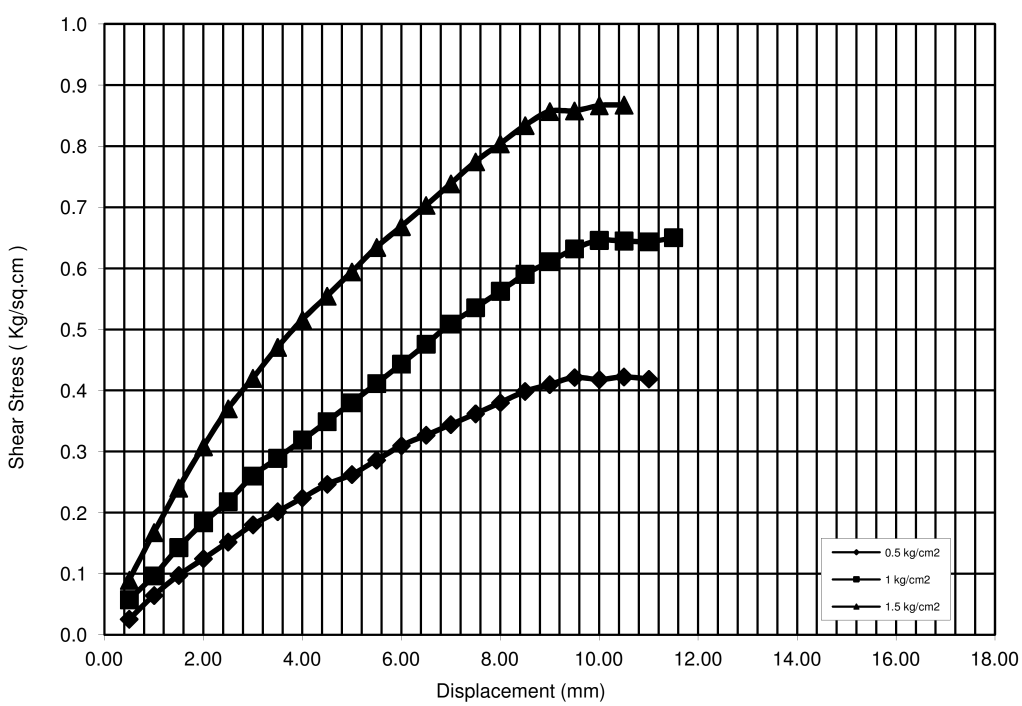
BORE HOLE NO: BH-CL
CHAIANGE : 7+907
SAMPLE NO.: UDS-2
DEPTH: 4.00 m
COHESION(C)= 0.53 kg/sq.cm
ANGLE OF FRICTION(Phi): 5 deg
TYPE OF THE TEST: UUT



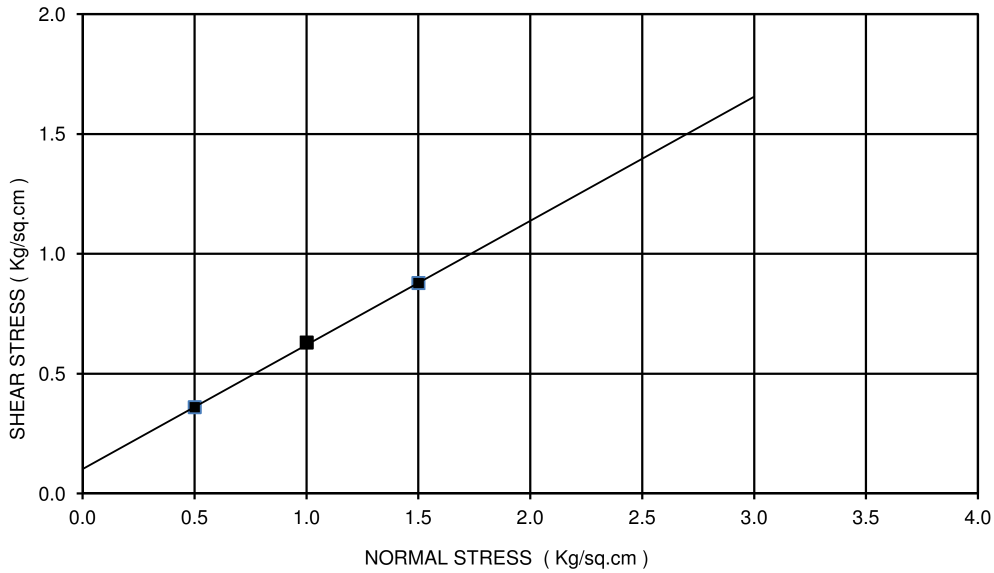


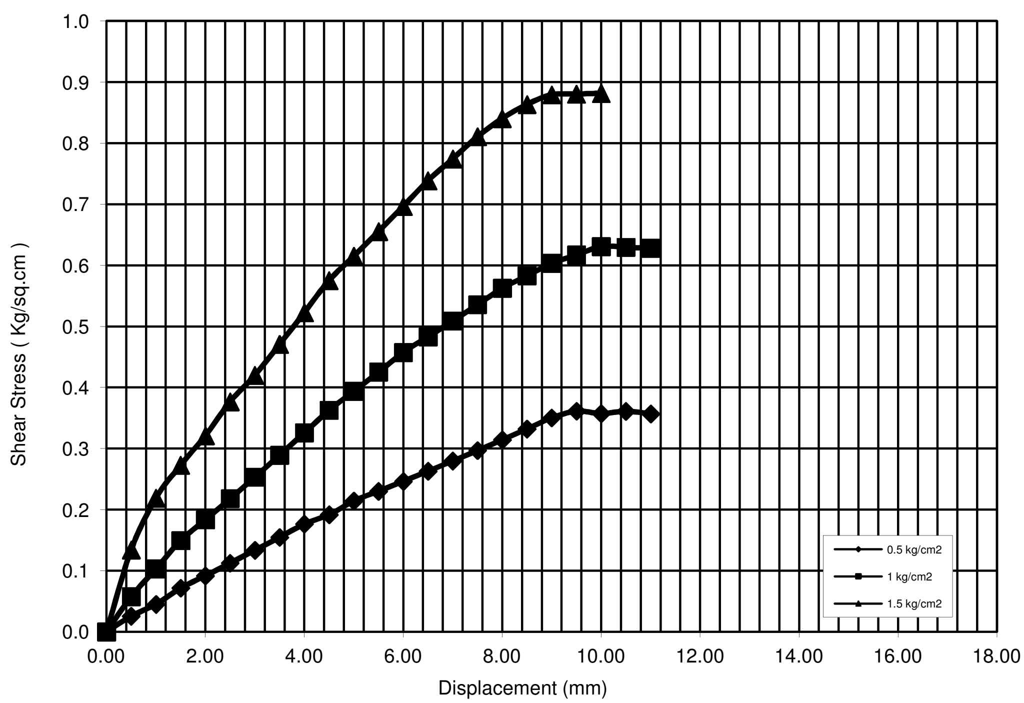
BORE HOLE NO: BH-CL
CHAIANGE : 8+207
SAMPLE NO.: UDS-1
DEPTH: 2.50 m
COHESION(C)= 0.20 kg/sq.cm
ANGLE OF FRICTION(Phi): 24 deg
TYPE OF THE TEST: DST



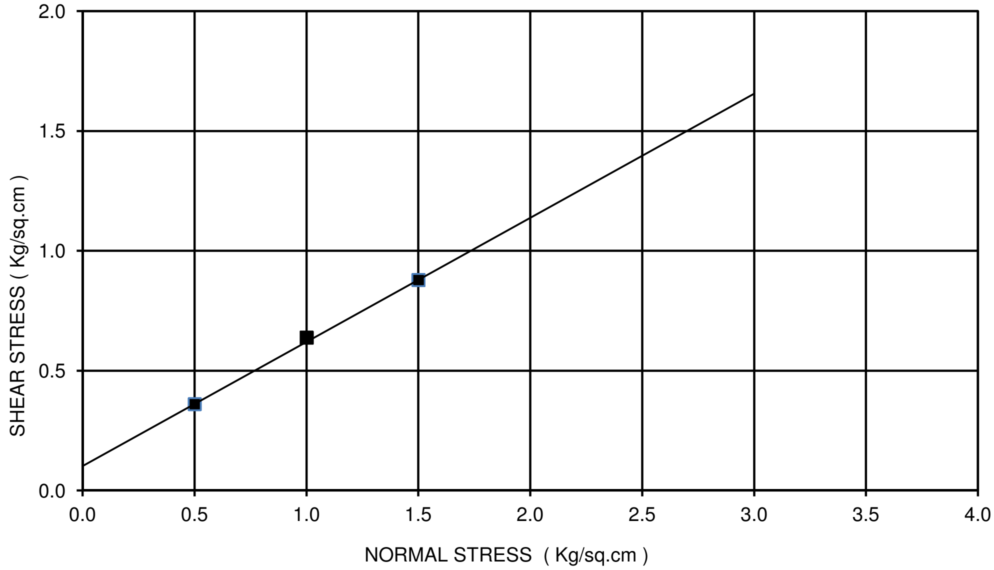


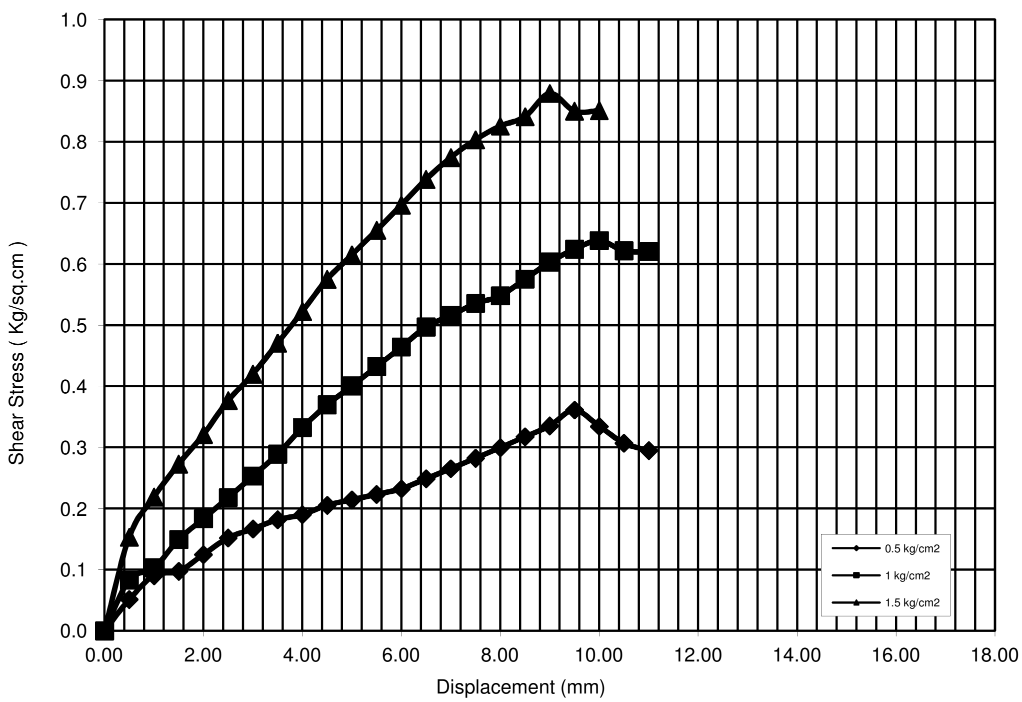
BORE HOLE NO: BH-CL
CHAIANGE : 8+610
SAMPLE NO.: UDS-2
DEPTH: 4.00 m
COHESION(C)= 0.10 kg/sq.cm
ANGLE OF FRICTION(Phi): 27 deg
TYPE OF THE TEST: DST



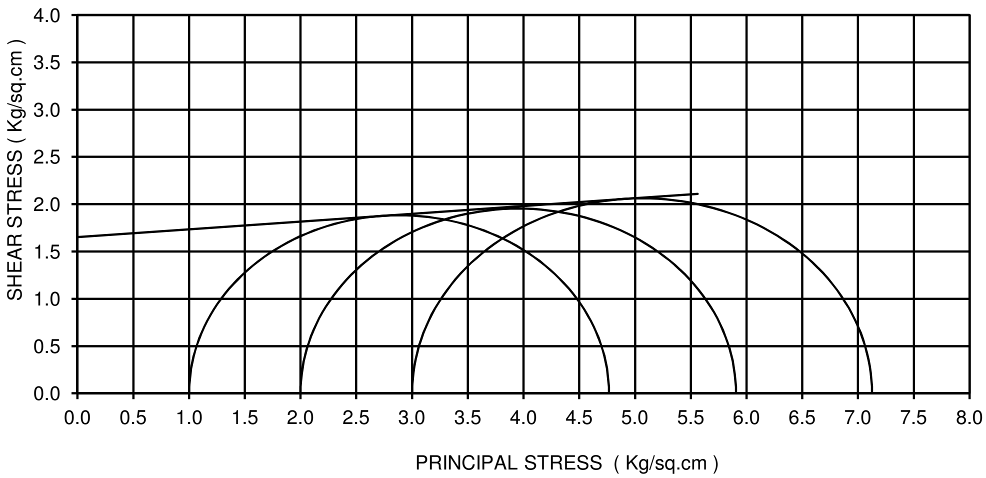


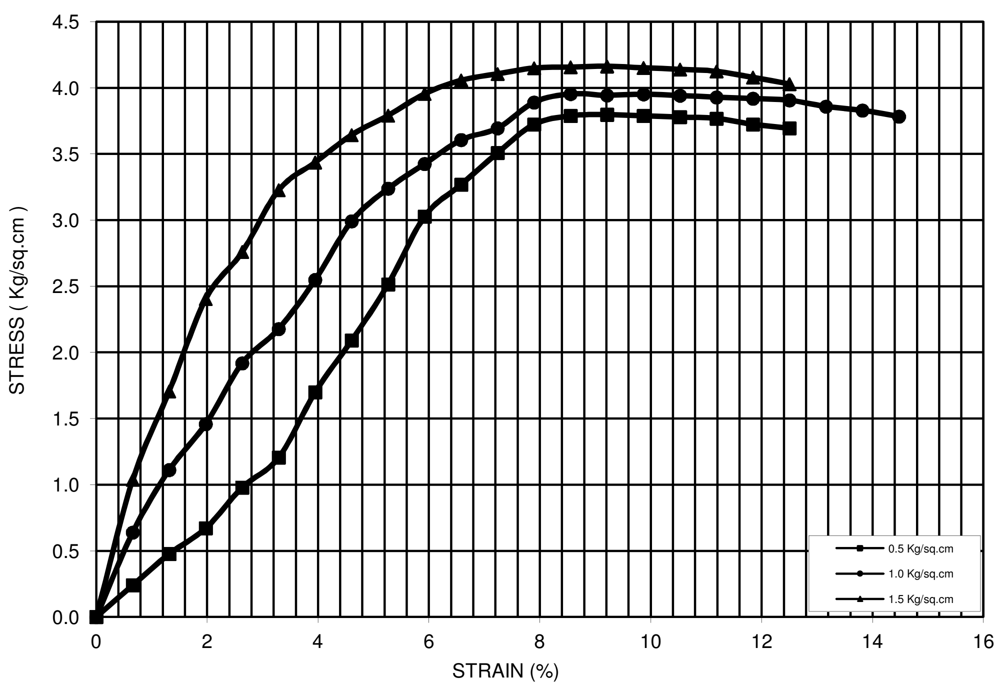
BORE HOLE NO: BH-A1
CHAIANGE : 8+852
SAMPLE NO.: UDS-1
DEPTH: 2.50 m
COHESION(C)= 0.10 kg/sq.cm
ANGLE OF FRICTION(Phi): 27 deg
TYPE OF THE TEST: DST



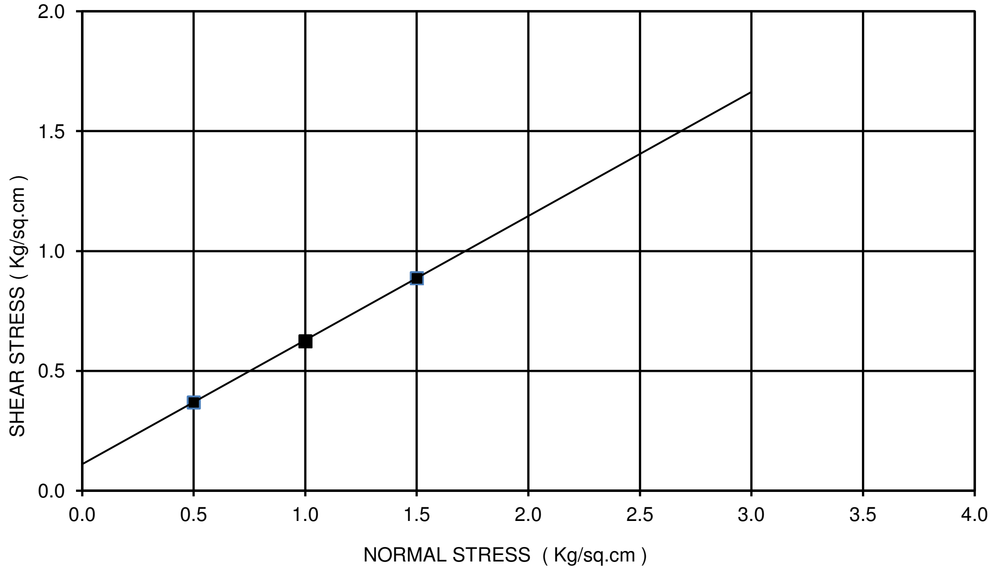


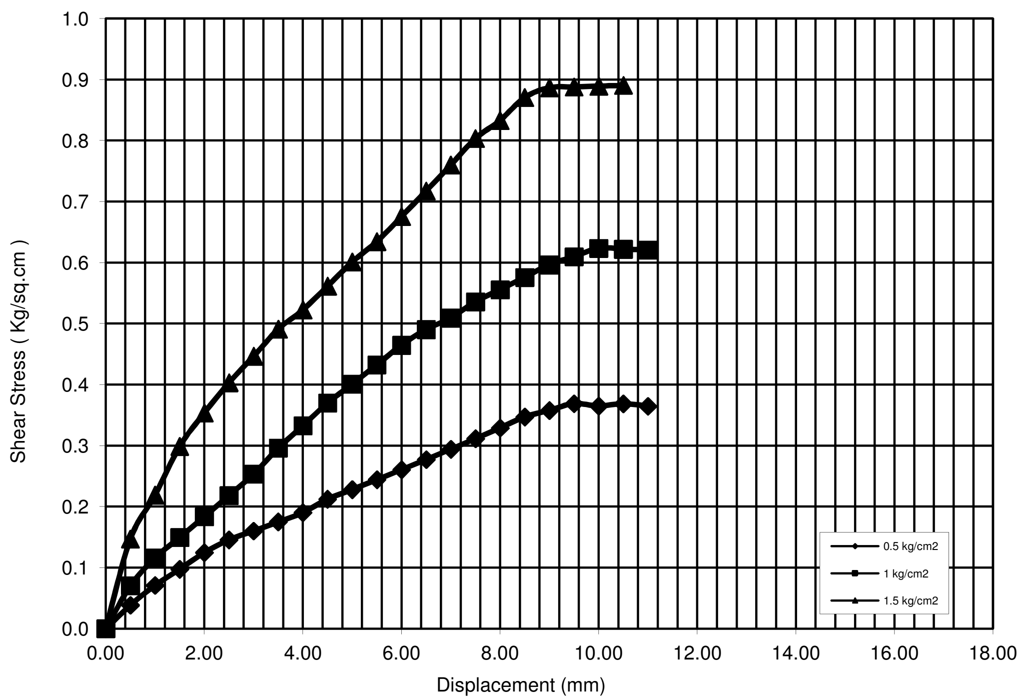
BORE HOLE NO: BH-A1
CHAINAGE : 8+852
SAMPLE NO.: UDS-8
DEPTH: 26.50 m
COHESION(C)= 1.65 kg/sq.cm
ANGLE OF FRICTION(Phi): 5 deg
TYPE OF THE TEST: UUT



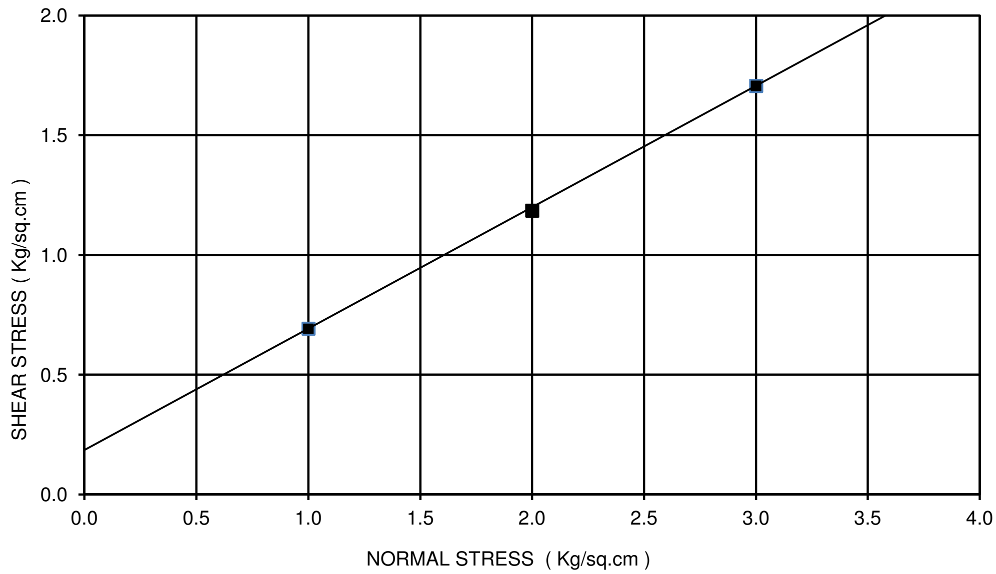


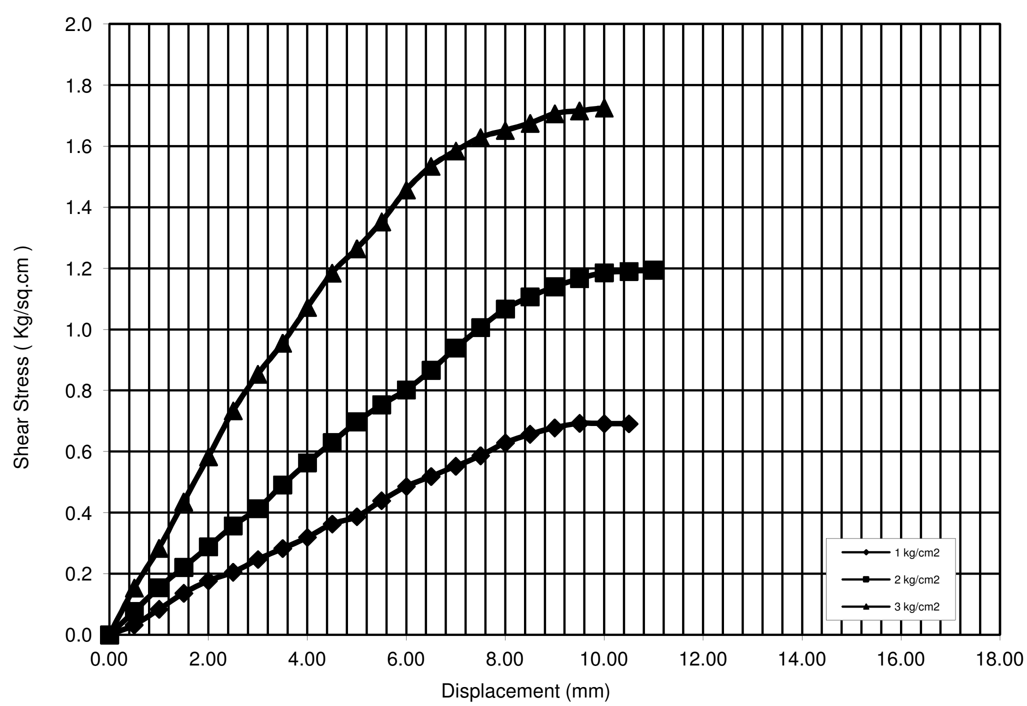
BORE HOLE NO: BH-A2
CHAINAGE : 8+852
SAMPLE NO.: UDS-1
DEPTH: 1.00 m
COHESION(C)= 0.11 kg/sq.cm
ANGLE OF FRICTION(Phi): 27 deg
TYPE OF THE TEST: DST

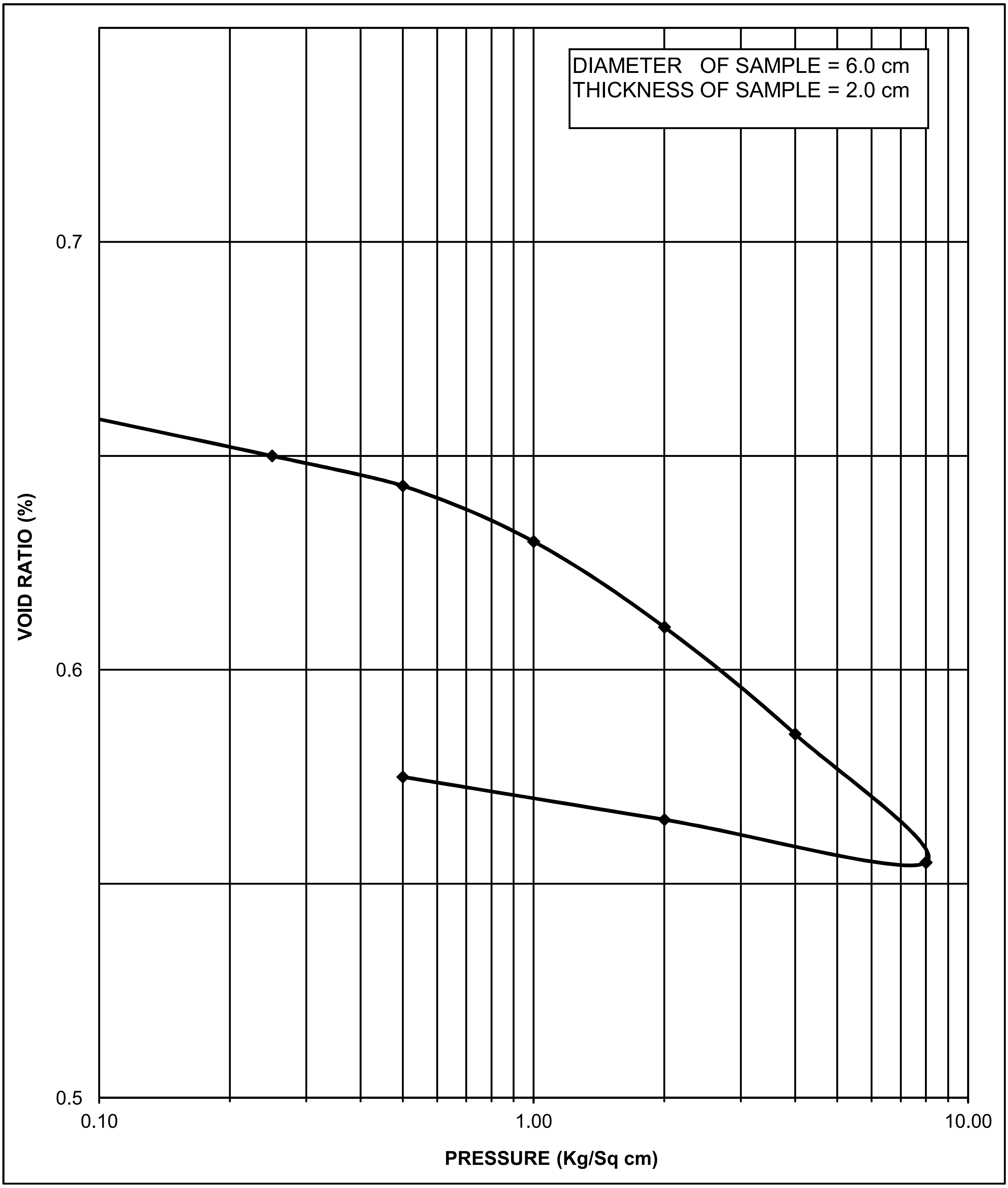




BORE HOLE NO: BH-A-2
CHAINAGE : 8+852
SAMPLE NO.: UDS-8
DEPTH: 22.00 m
COHESION(C)= 0.19 kg/sq.cm
ANGLE OF FRICTION(Phi): 27 deg
TYPE OF THE TEST: DST







BORE HOLE NO. = BH-A1

CHAINAGE = 3+691

SAMPLE NO. = UDS-05

DEPTH = 14.50 M

TYPE OF SOIL = CL

INITIAL WATER CONTENT = 19.72%

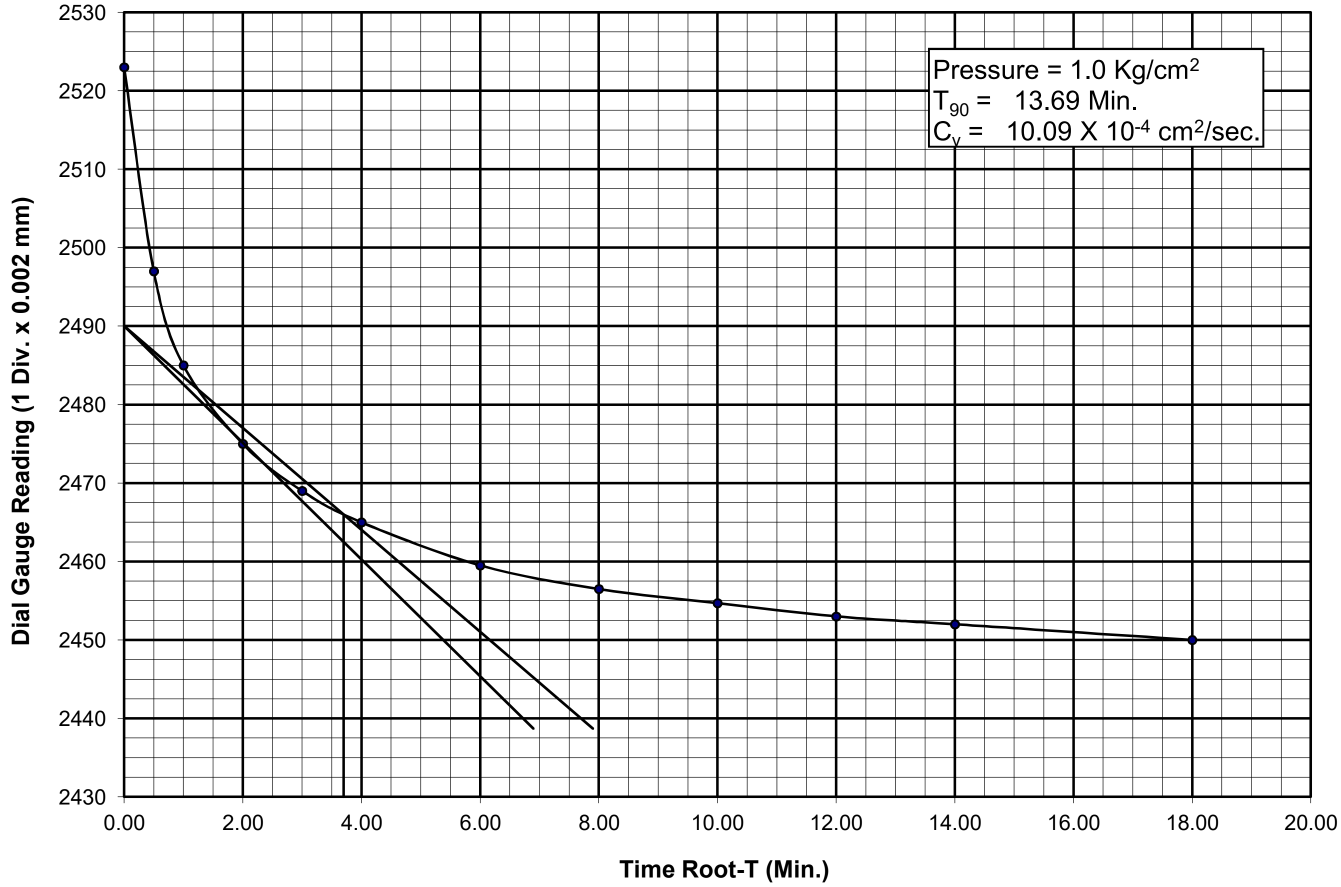
DRY DENSITY = 1.62 gm/cm^3

VOID RATIO (e_o) = 0.655

COMPRESSION INDEX (C_c) = 0.100

FIGURE NO. PRESSURE Vs VOID RATIO CURVE (e-log p)

BORE HOLE NO. = BH-A1
CHAINAGE = 3+691
SAMPLE NO. = UDS-05
DEPTH = 14.50 M



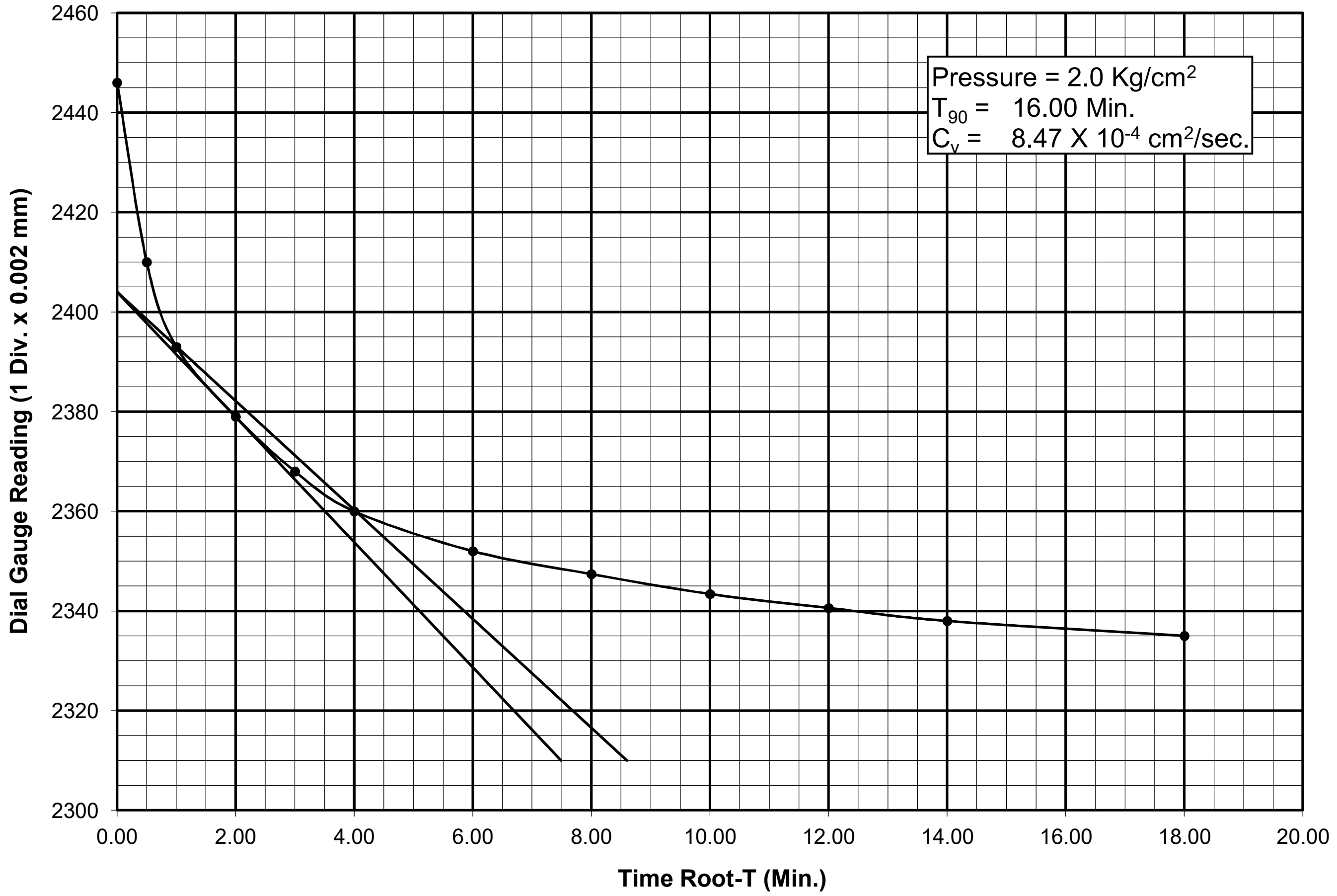
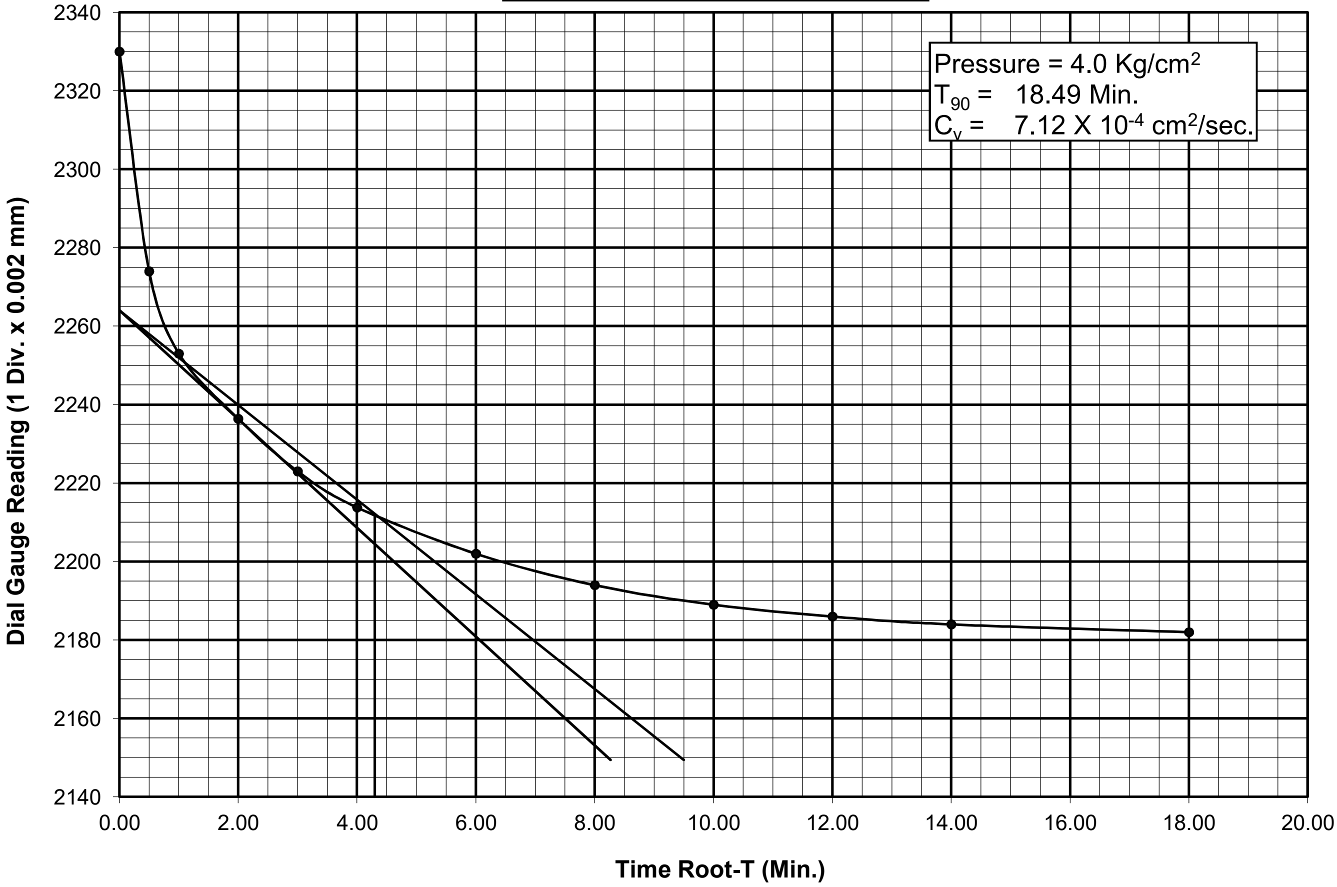


Figure No. -

BORE HOLE NO.	=	BH-A1
CHAINAGE	=	3+691
SAMPLE NO.	=	UDS-05
DEPTH	=	14.50 M



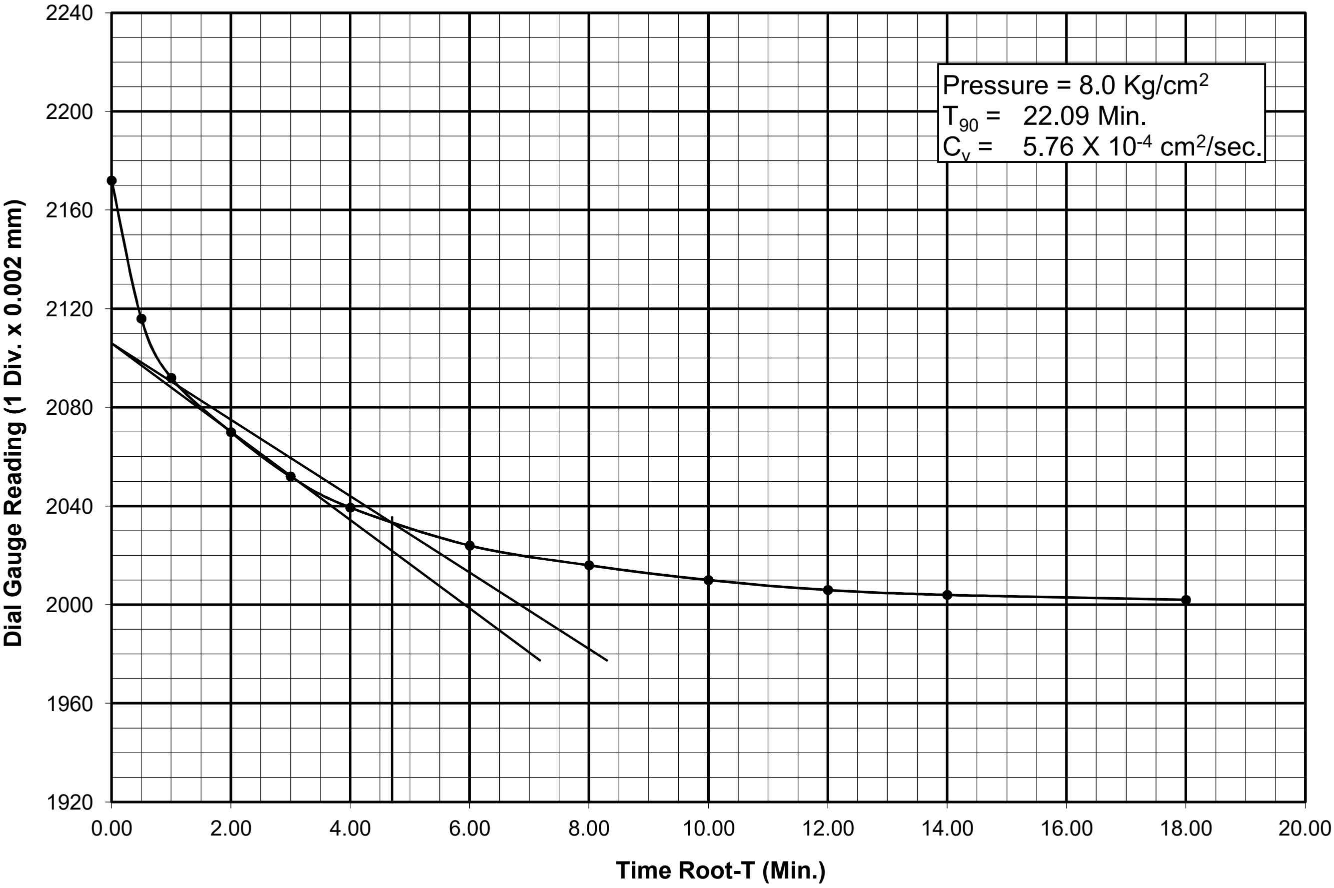
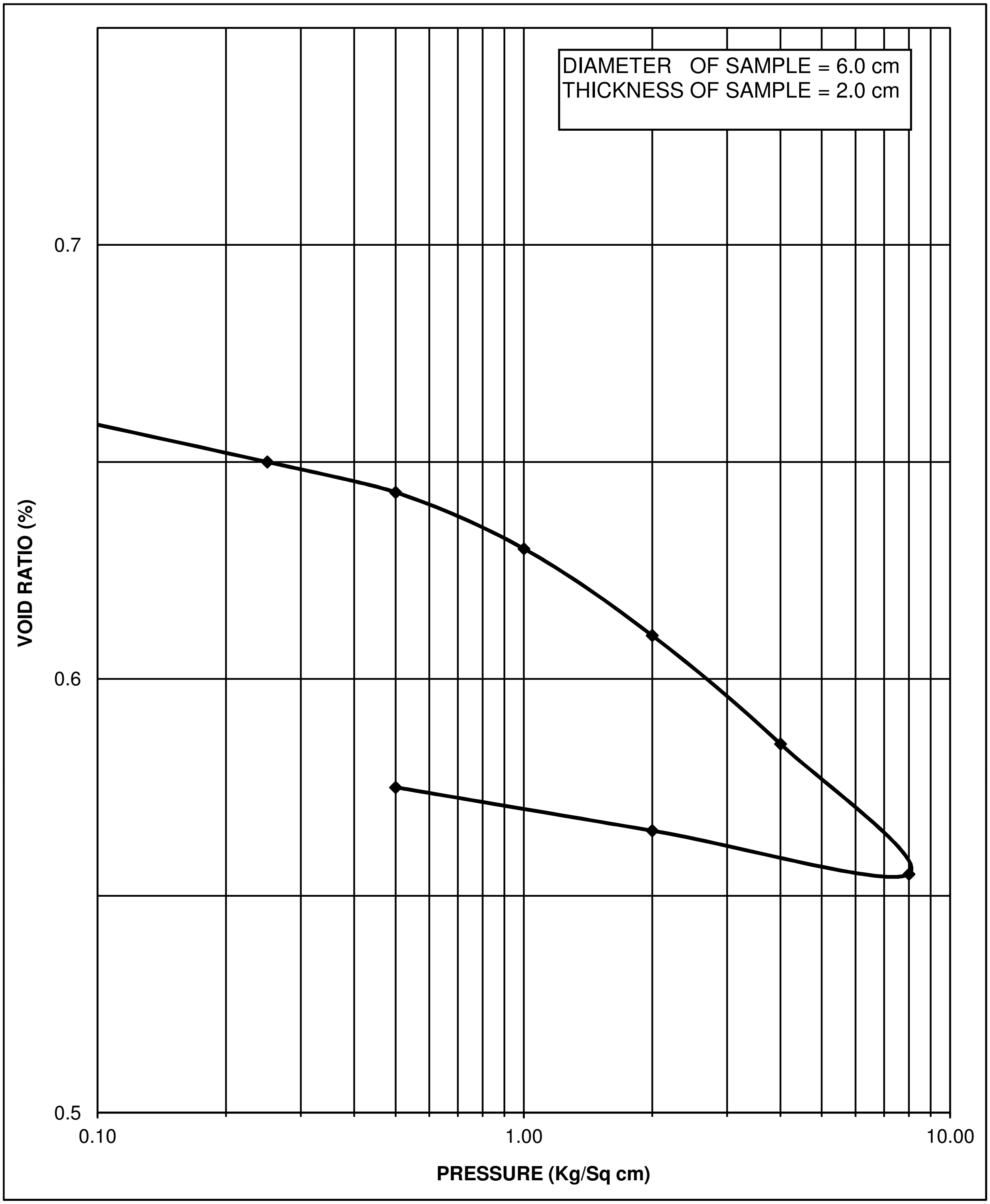


Figure No. -



BORE HOLE NO. = BH-A1

CHAINAGE = 3+691

SAMPLE NO. = UDS-05

DEPTH = 14.50 M

TYPE OF SOIL = CL

INITIAL WATER CONTENT = 19.72%

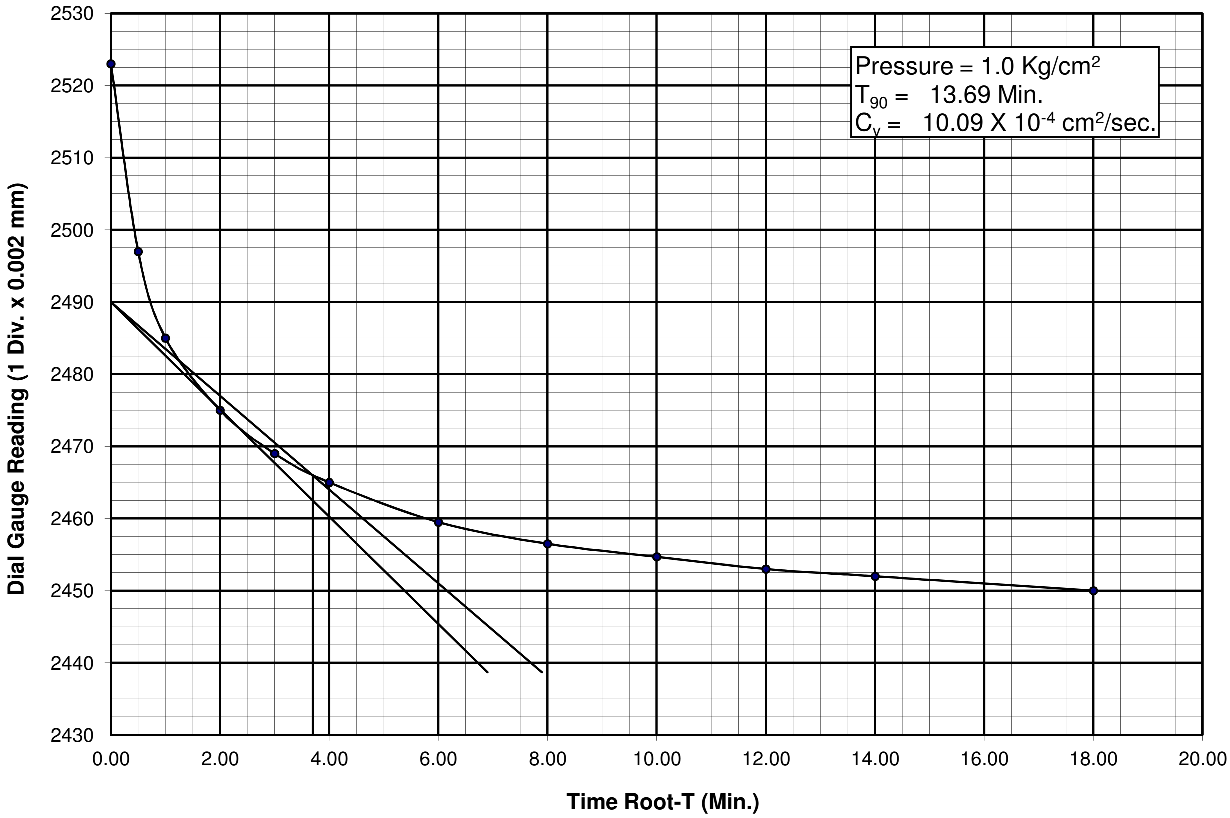
DRY DENSITY = 1.62 gm/cm^3

VOID RATIO (e_o) = 0.655

COMPRESSION INDEX (C_c) = 0.100

FIGURE NO. PRESSURE Vs VOID RATIO CURVE (e-log p)

BORE HOLE NO. =	BH-A1
CHAINAGE =	3+691
SAMPLE NO. =	UDS-05
DEPTH =	14.50 M



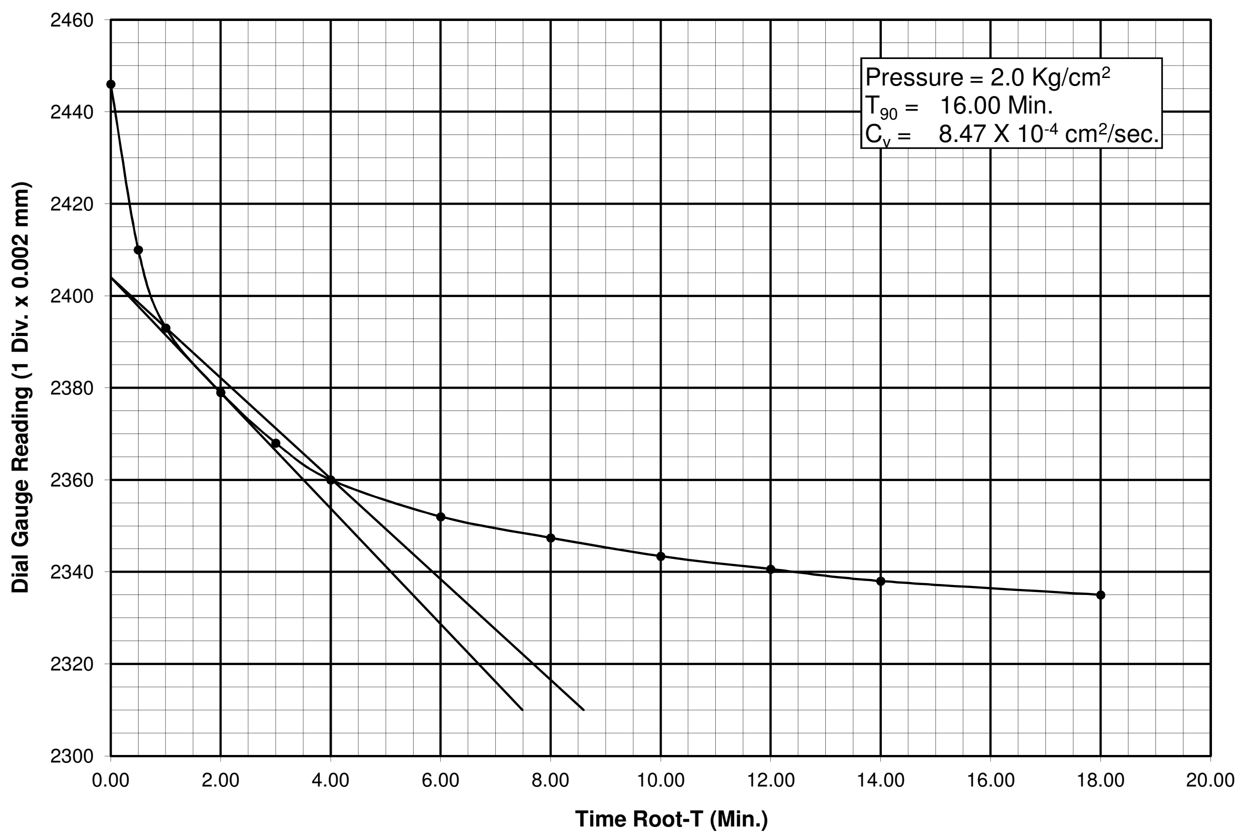
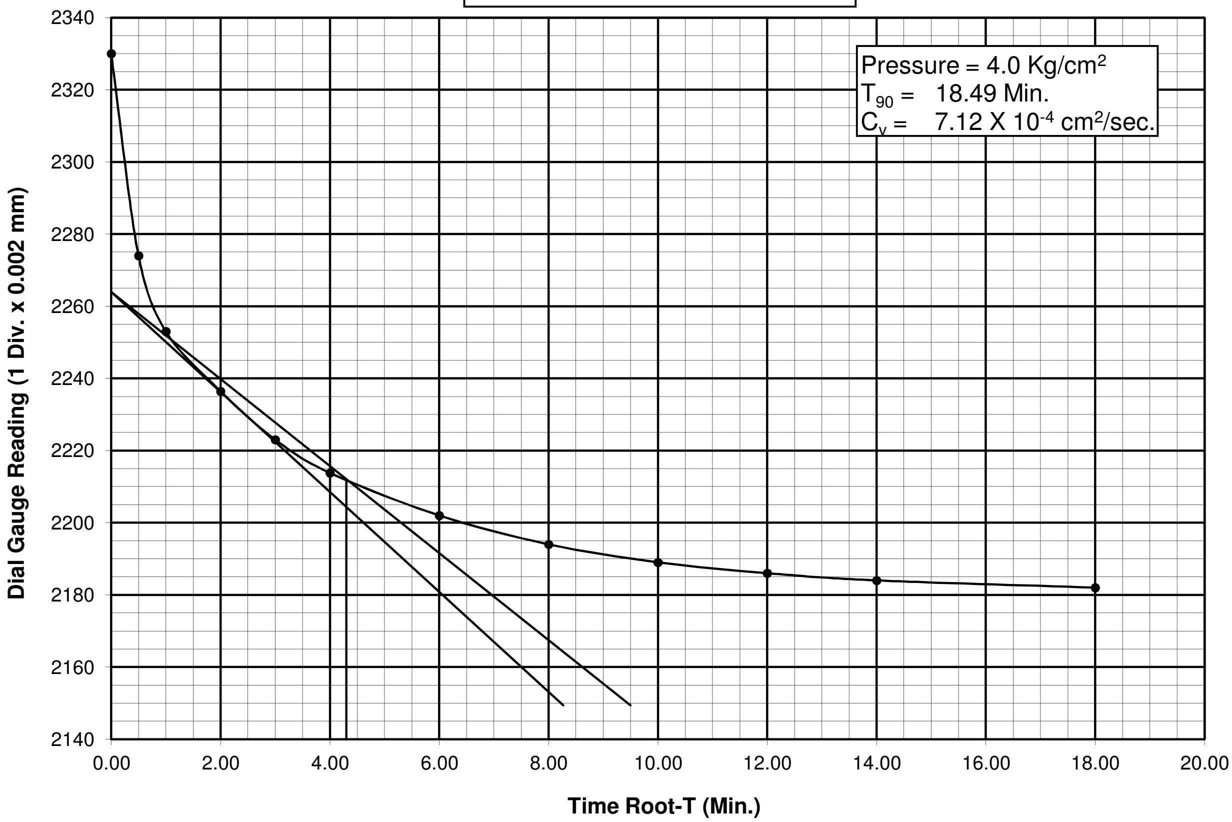


Figure No. -

BORE HOLE NO. = BH-A1
CHAINAGE = 3+691
SAMPLE NO. = UDS-05
DEPTH = 14.50 M



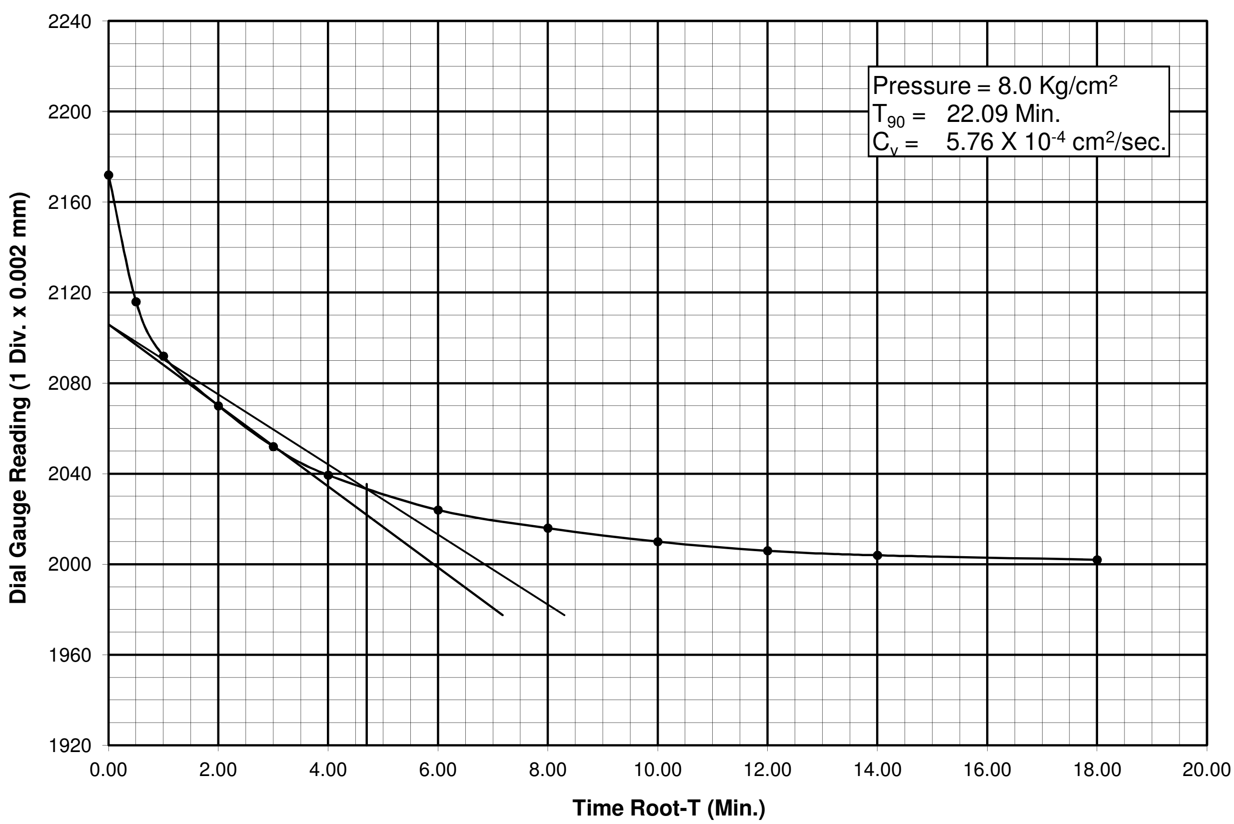
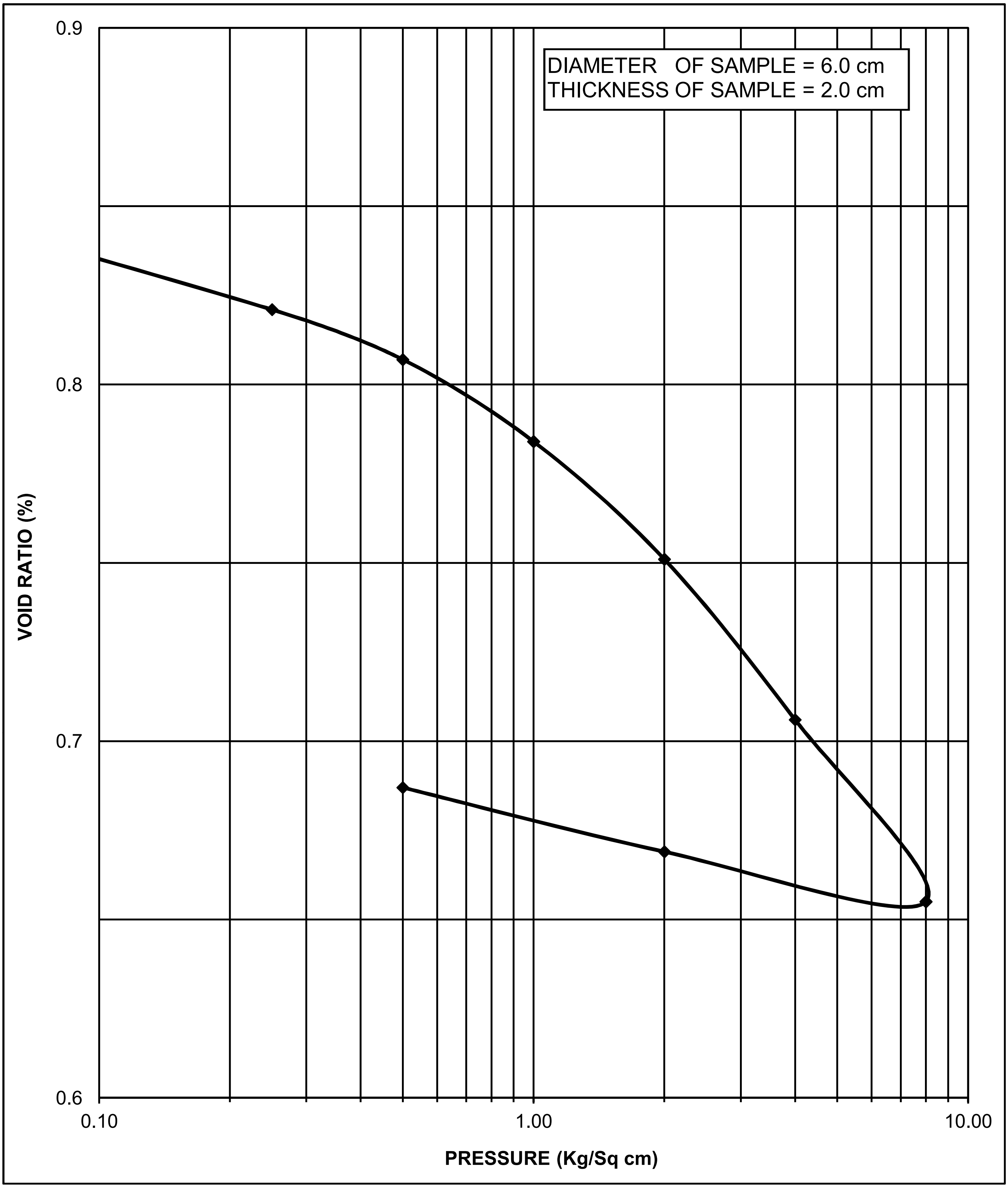


Figure No. -



BORE HOLE NO. = BH-A2

CHAINAGE = 7+078

SAMPLE NO. = UDS-01

DEPTH = 2.50 M

TYPE OF SOIL = CL

INITIAL WATER CONTENT = 29.10 %

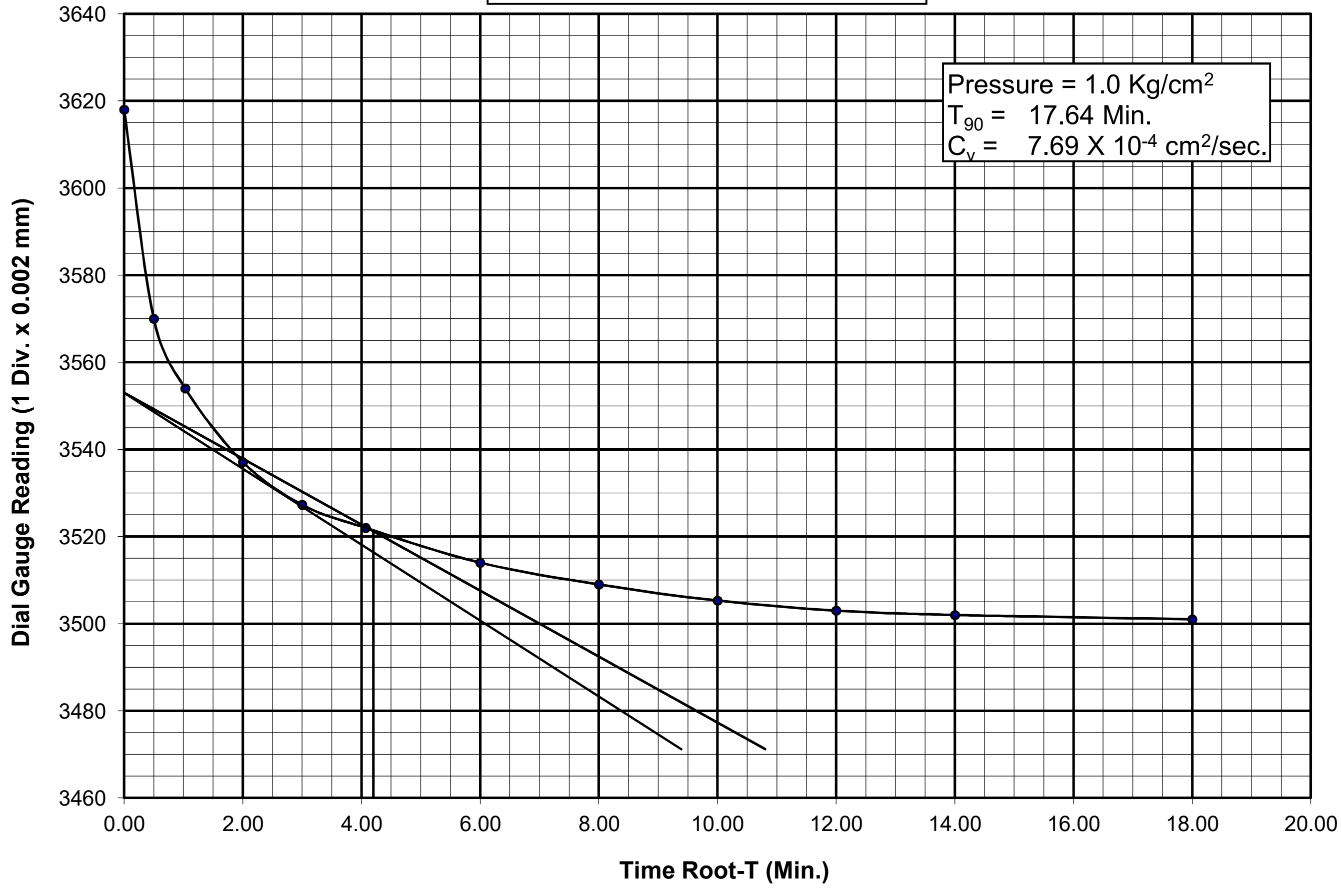
DRY DENSITY = 1.46 gm/cm^3

VOID RATIO (e_o) = 0.835

COMPRESSION INDEX (C_c) = 0.169

FIGURE NO. PRESSURE Vs VOID RATIO CURVE (e-log p)

BORE HOLE NO. = BH-A2
CHAINAGE = 7+078
SAMPLE NO. = UDS-01
DEPTH = 2.50 M



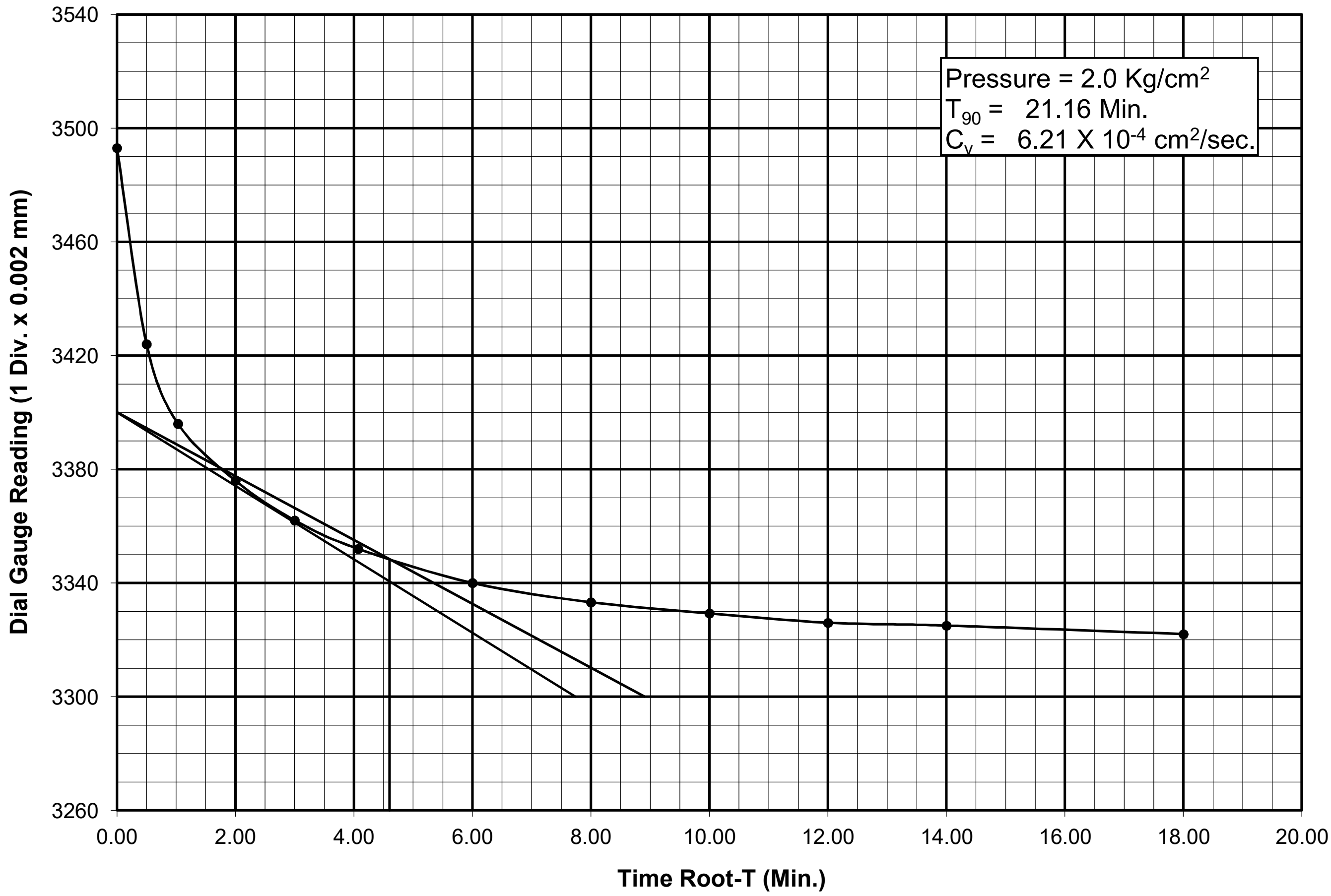
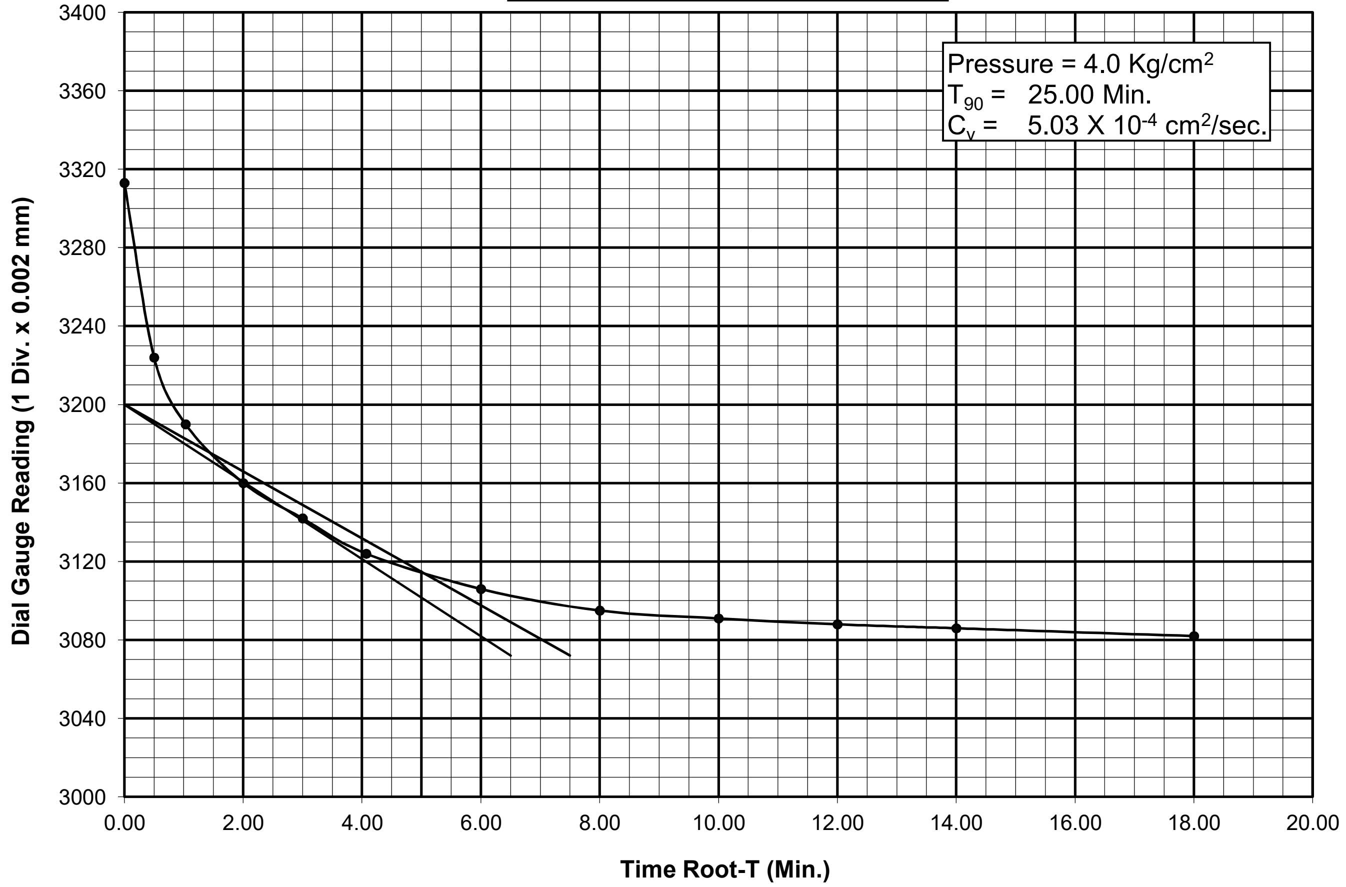


Figure No. -

BORE HOLE NO.	=	BH-A2
CHAINAGE	=	7+078
SAMPLE NO.	=	UDS-01
DEPTH	=	2.50 M



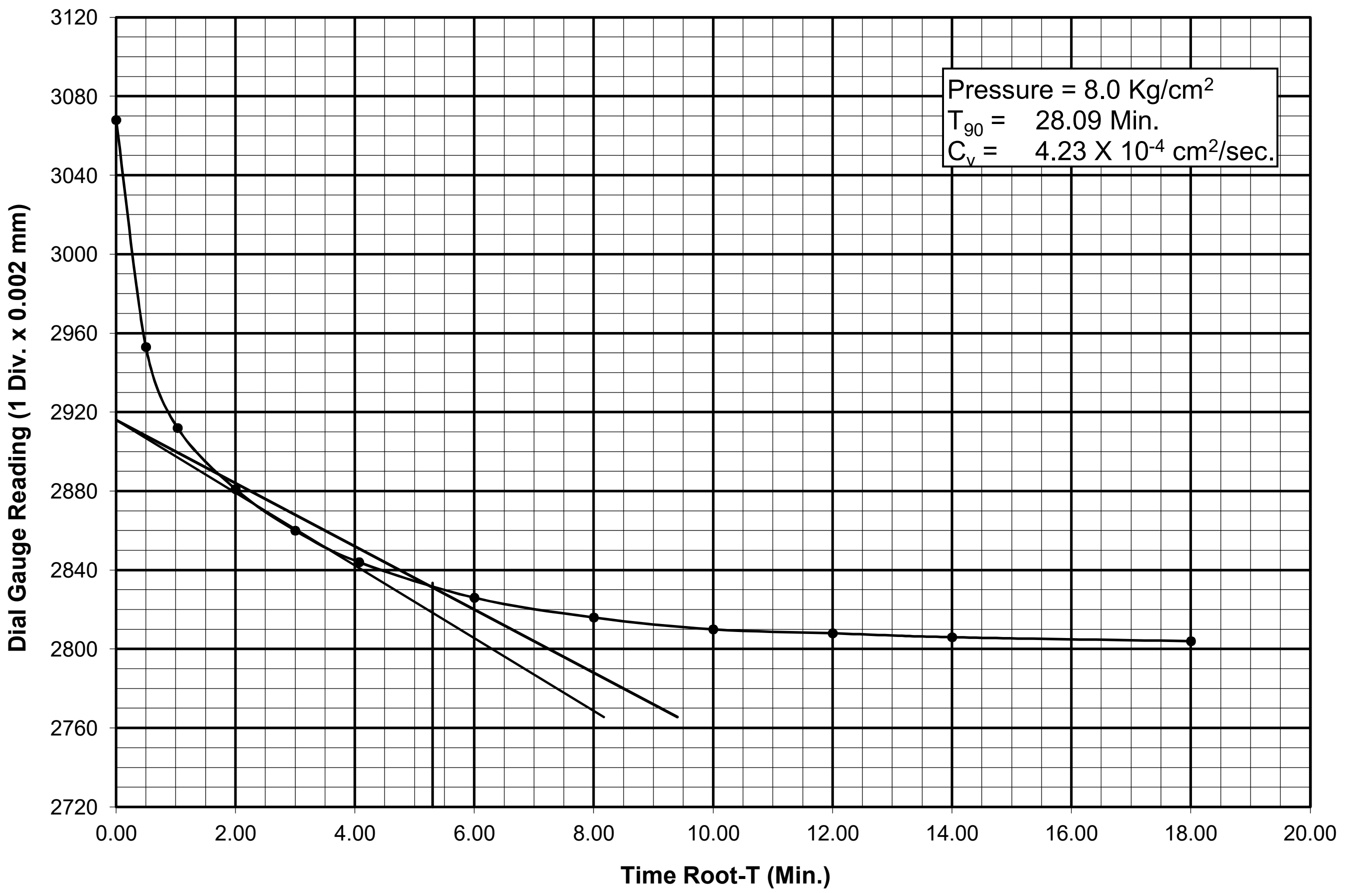
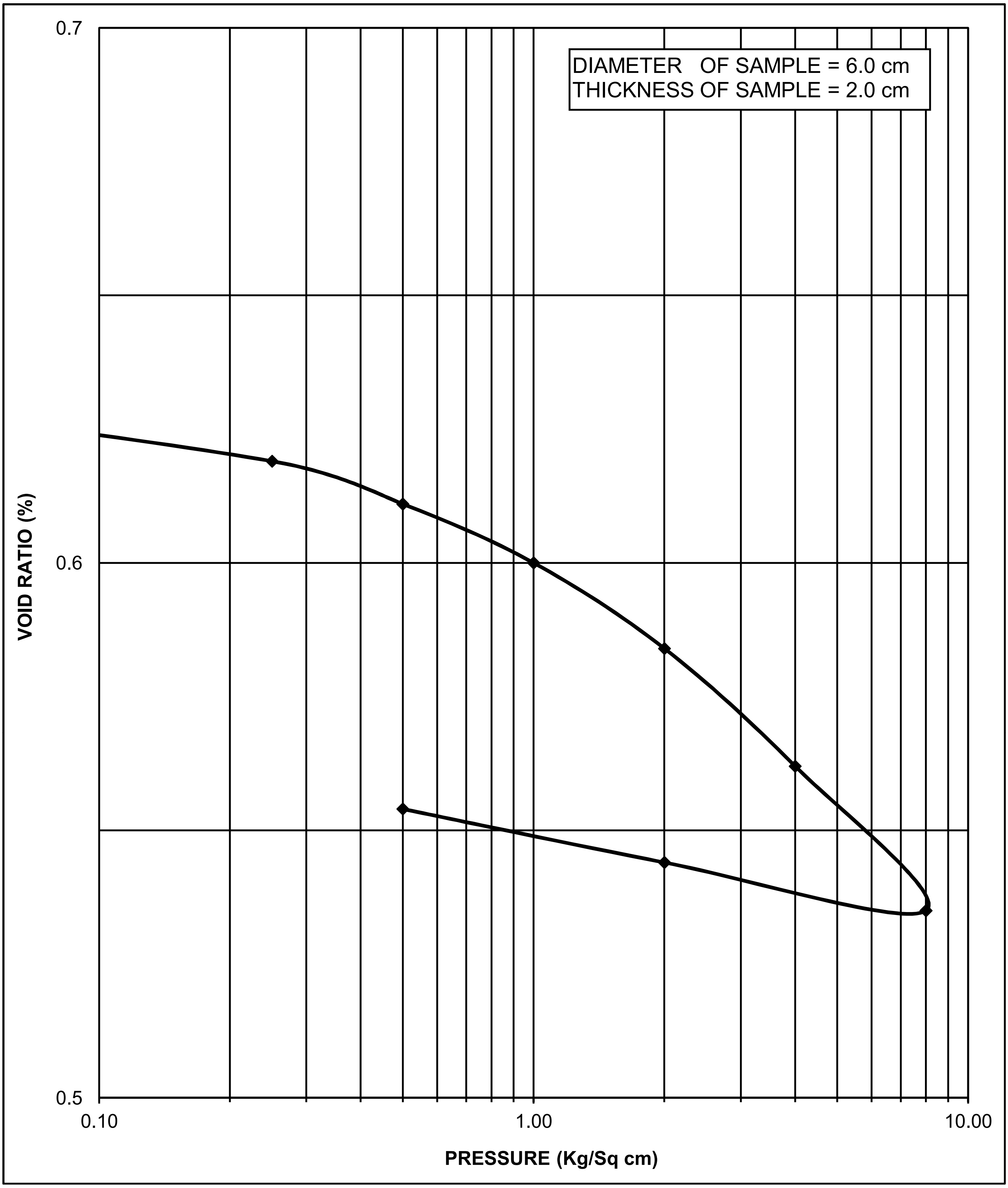


Figure No. -



BORE HOLE NO. = BH-A2

CHAINAGE = 8.852

SAMPLE NO. = UDS-05

DEPTH = 13.00 M

TYPE OF SOIL = CL

INITIAL WATER CONTENT = 22.67 %

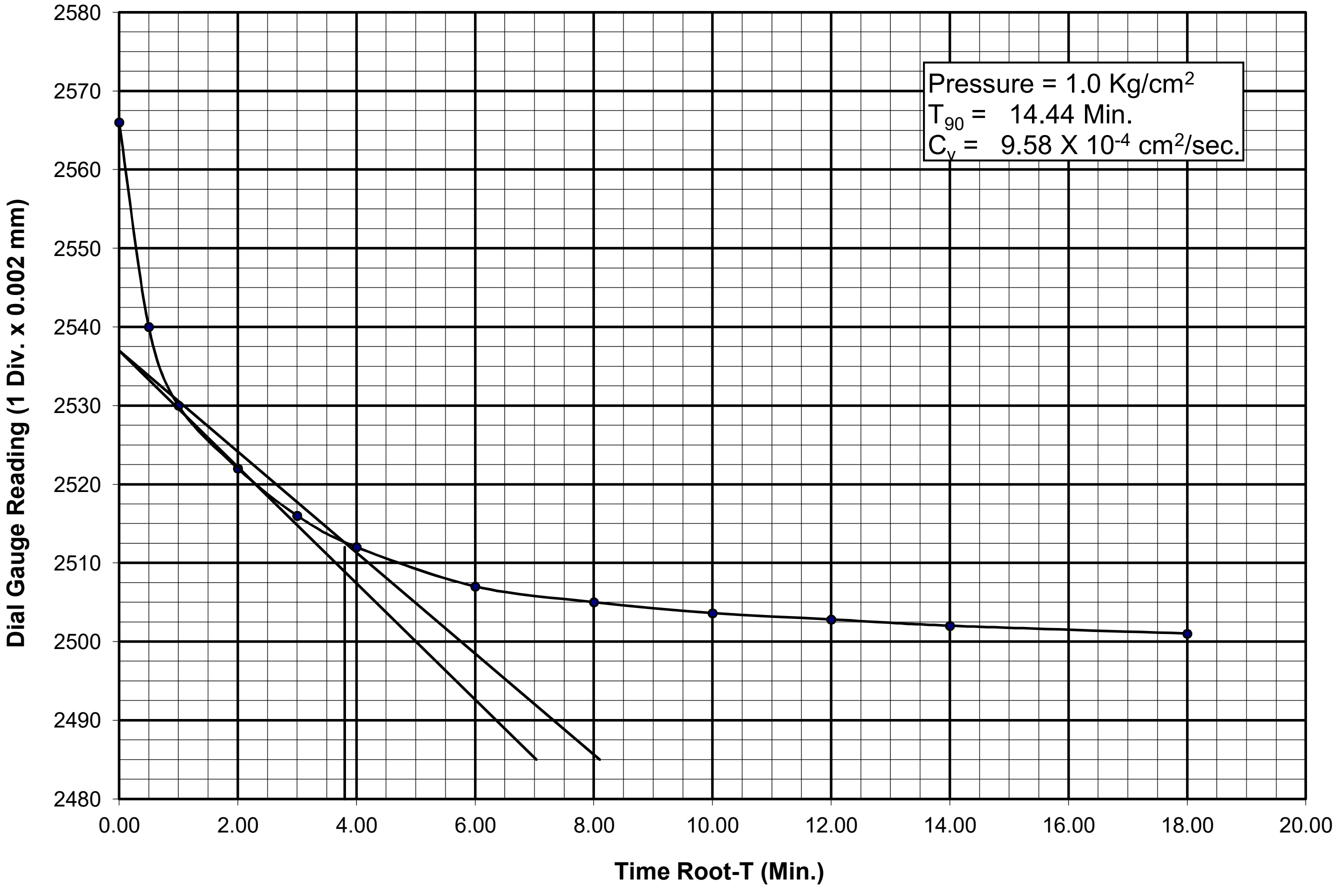
DRY DENSITY = 1.65 gm/cm^3

VOID RATIO (e_o) = 0.625

COMPRESSION INDEX (C_c) = 0.090

FIGURE NO. PRESSURE Vs VOID RATIO CURVE (e-log p)

BORE HOLE NO.	=	BH-A2
CHAINAGE	=	8+852
SAMPLE NO.	=	UDS-05
DEPTH	=	13.00 M



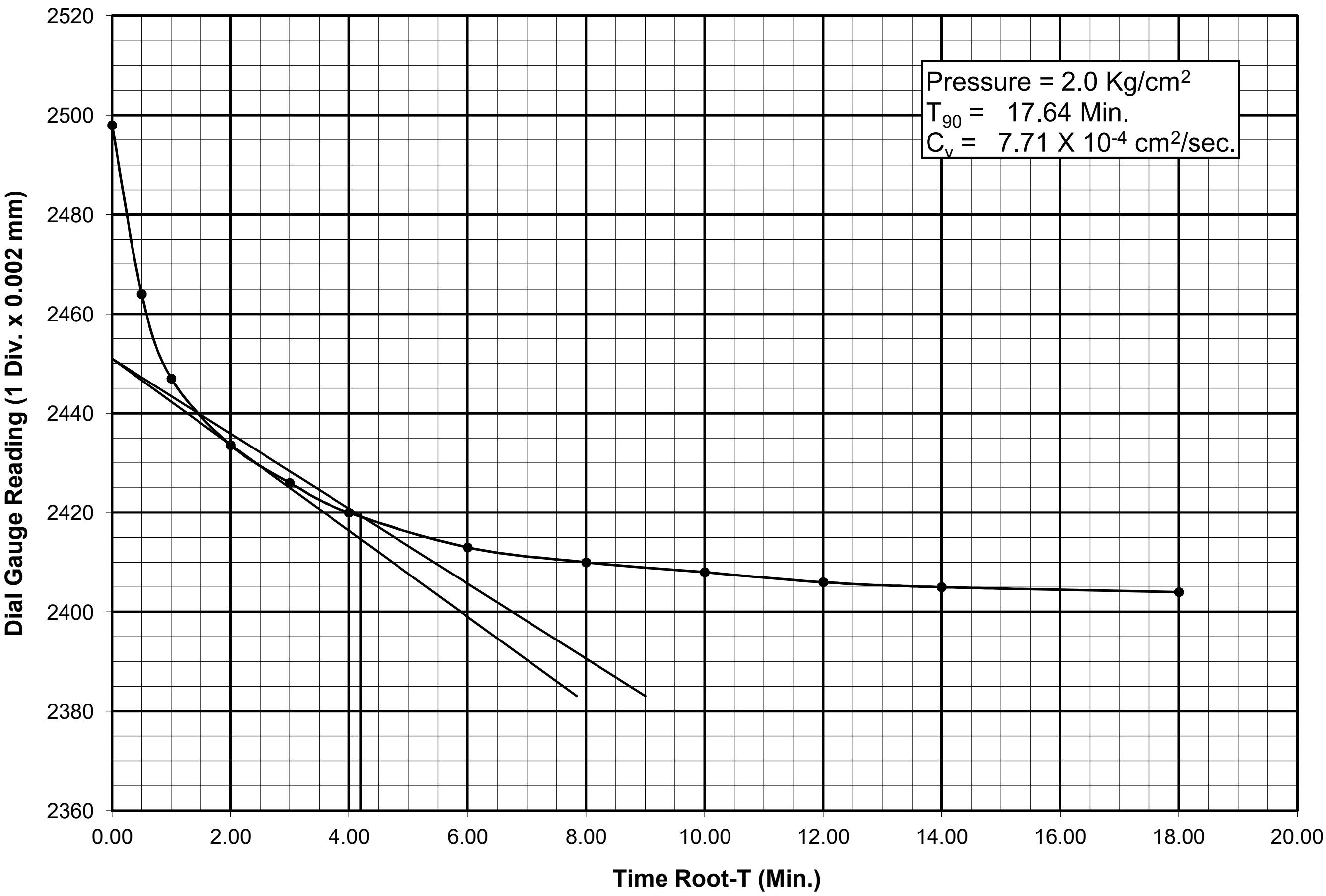
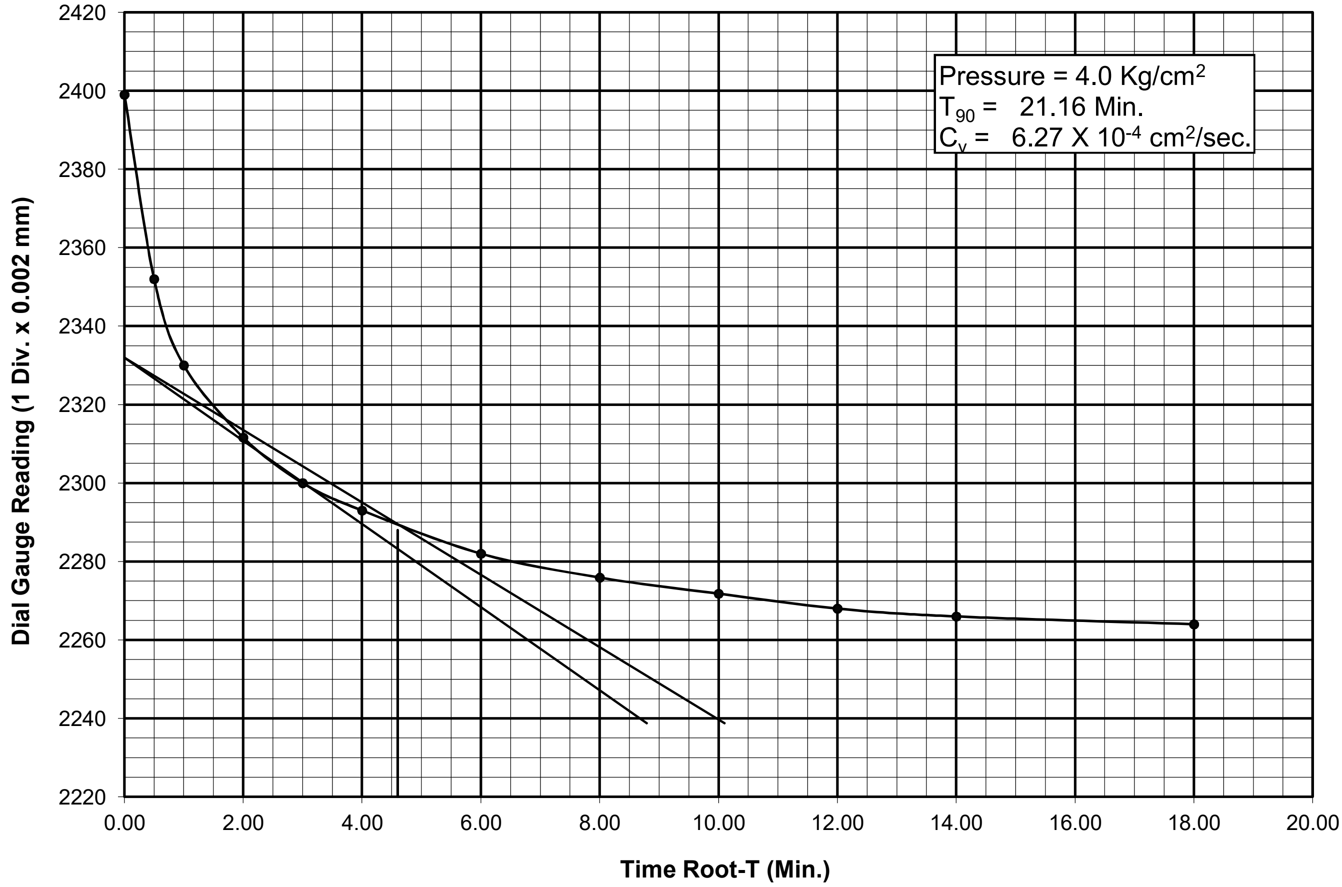


Figure No. -

BORE HOLE NO.	=	BH-A2
CHAINAGE	=	8+852
SAMPLE NO.	=	UDS-05
DEPTH	=	13.00 M



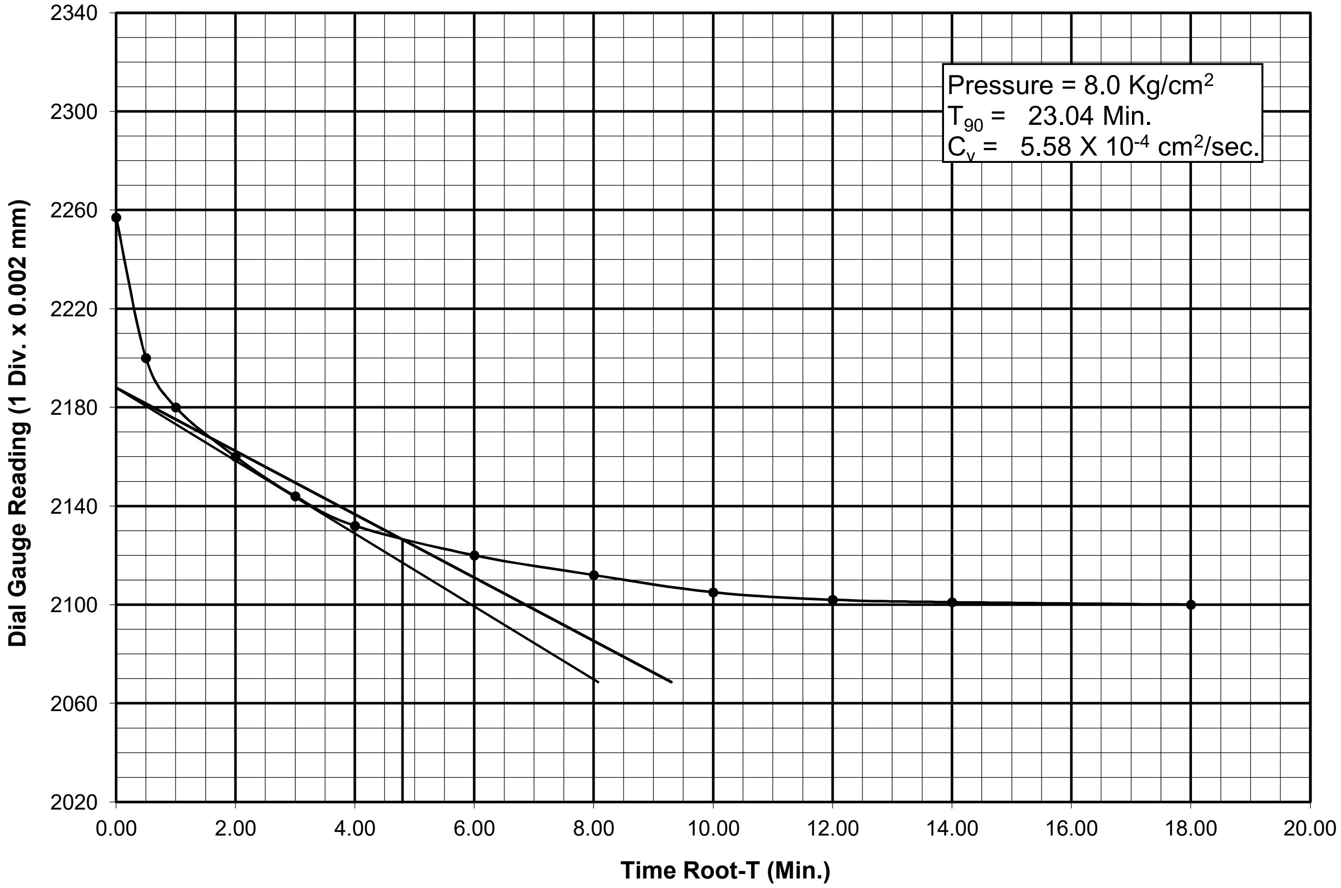
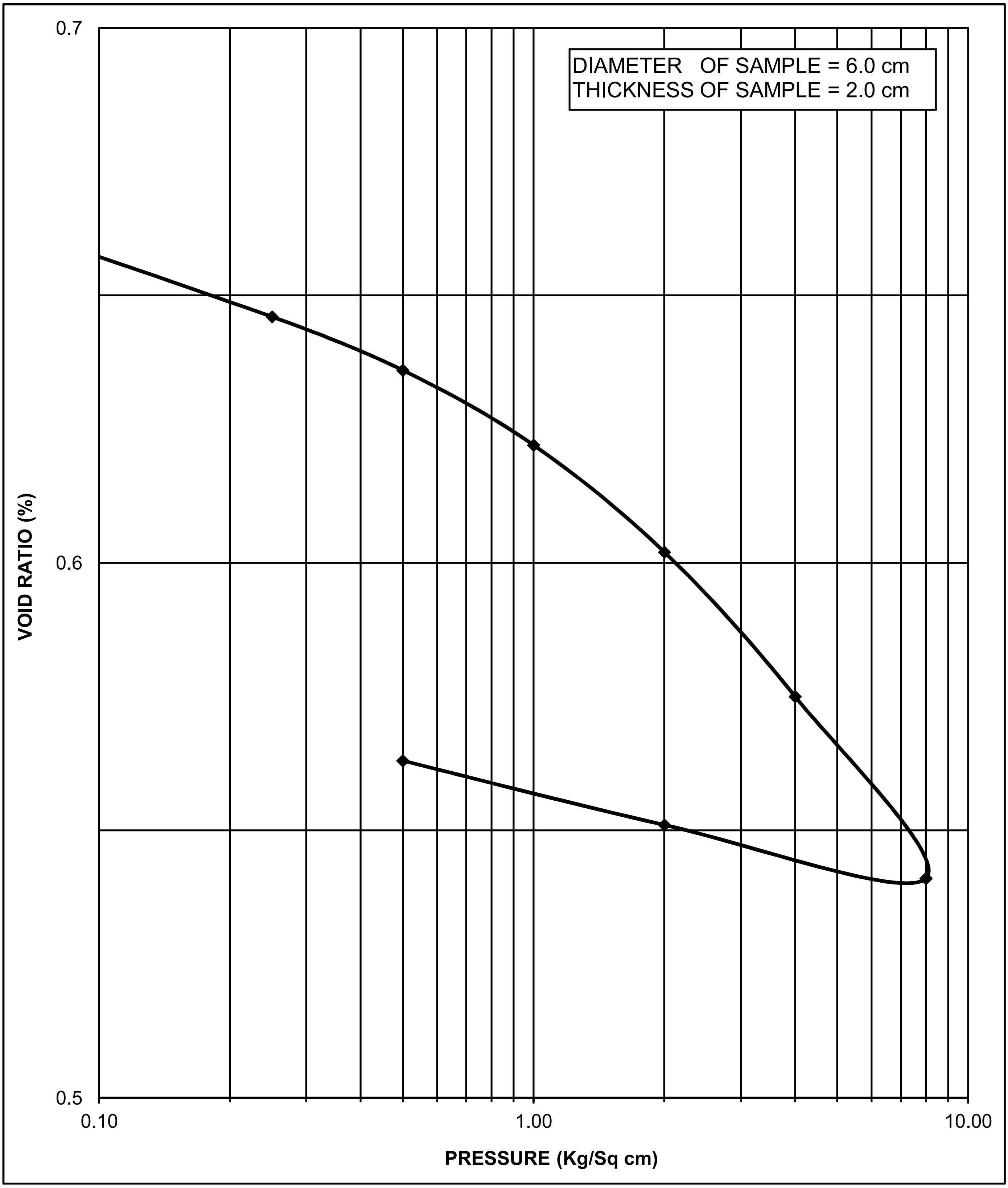


Figure No. -



BORE HOLE NO. = BH-A1

CHAINAGE = 9+726

SAMPLE NO. = UDS-07

DEPTH = 20.50 M

TYPE OF SOIL = CL

INITIAL WATER CONTENT = 23.40 %

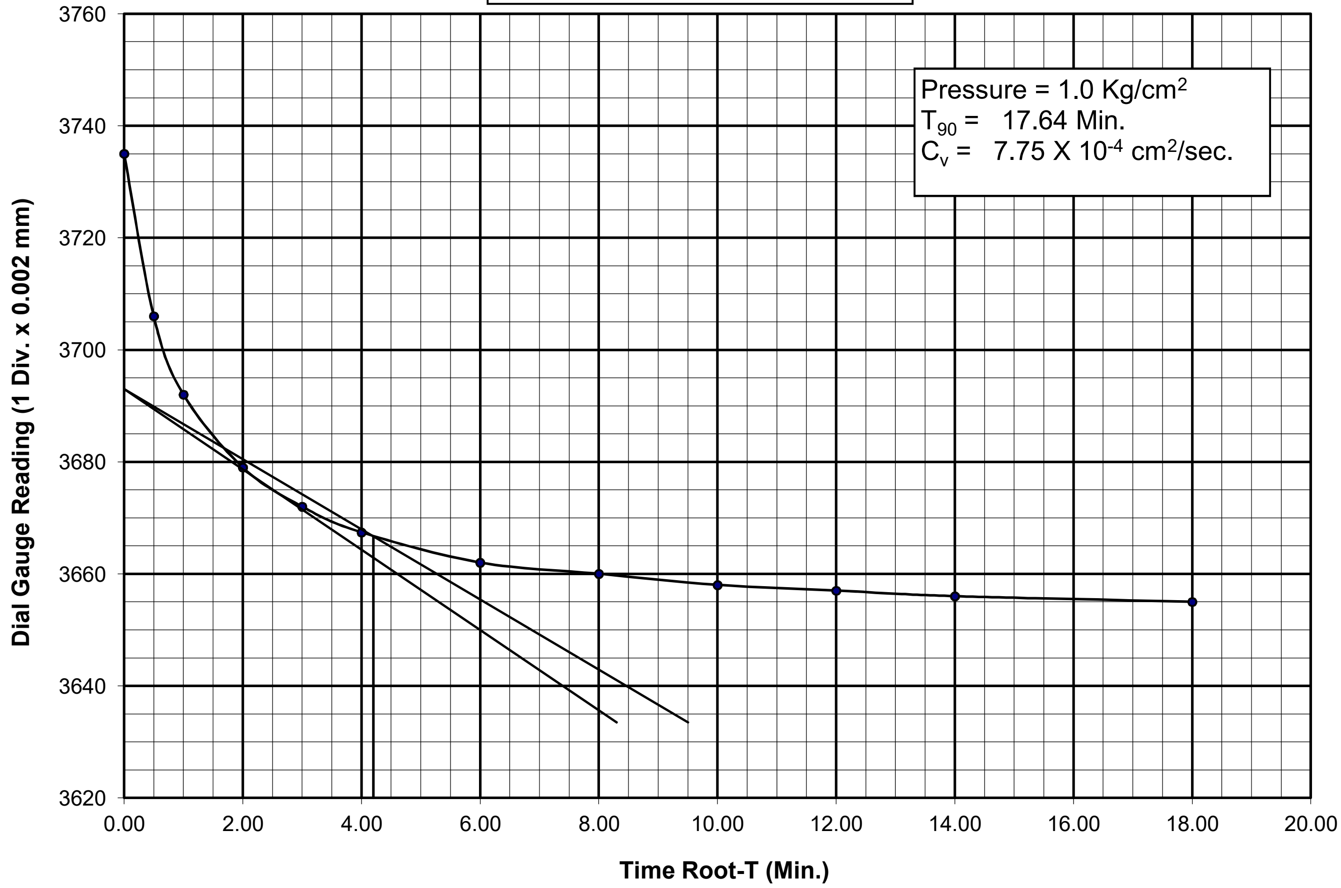
DRY DENSITY = 1.62 gm/cm^3

VOID RATIO (e_o) = 0.655

COMPRESSION INDEX (C_c) = 0.113

FIGURE NO. PRESSURE Vs VOID RATIO CURVE (e-log p)

BORE HOLE NO. =	BH-A1
CHAINAGE =	9+726
SAMPLE NO. =	UDS-07
DEPTH =	20.50 M



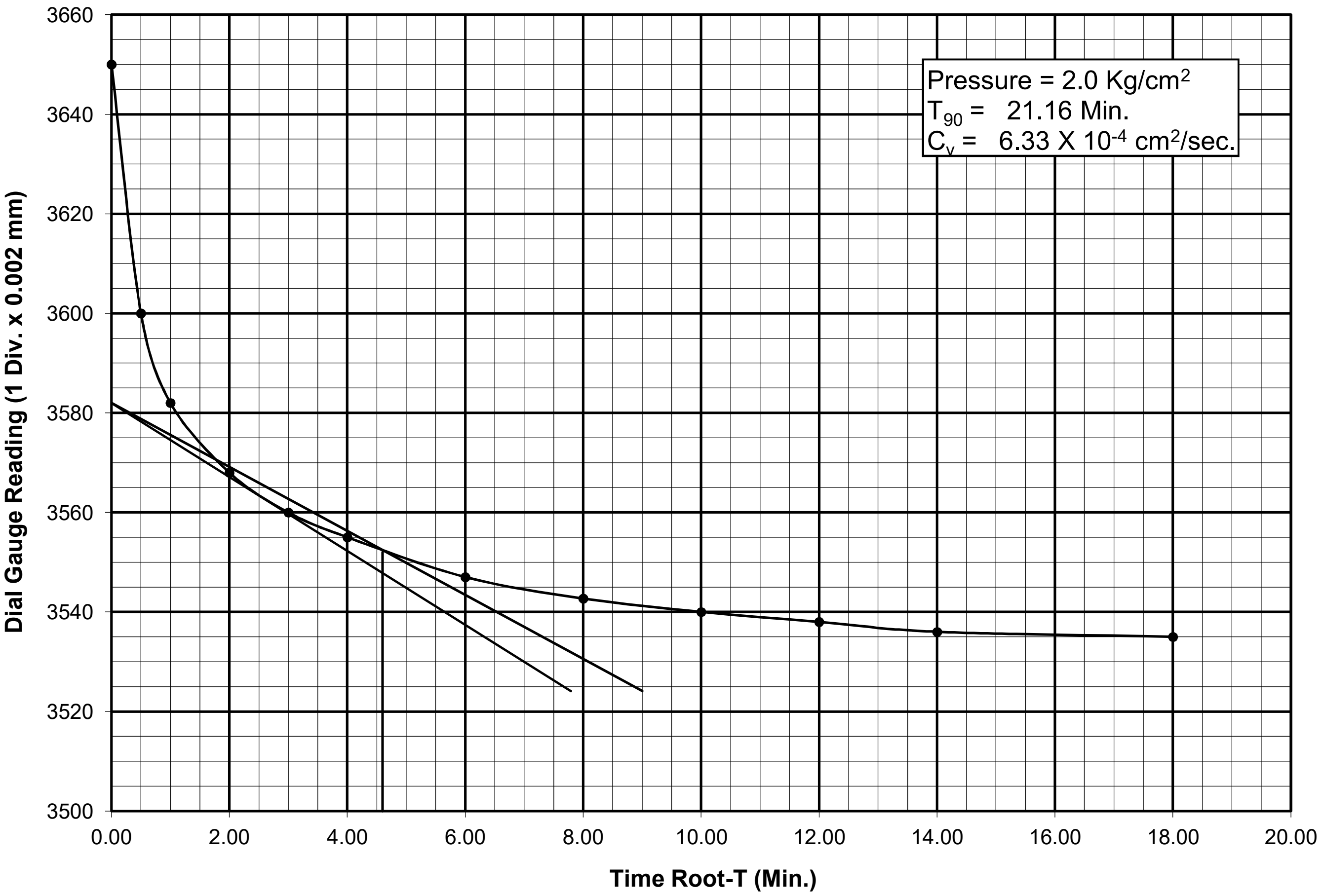
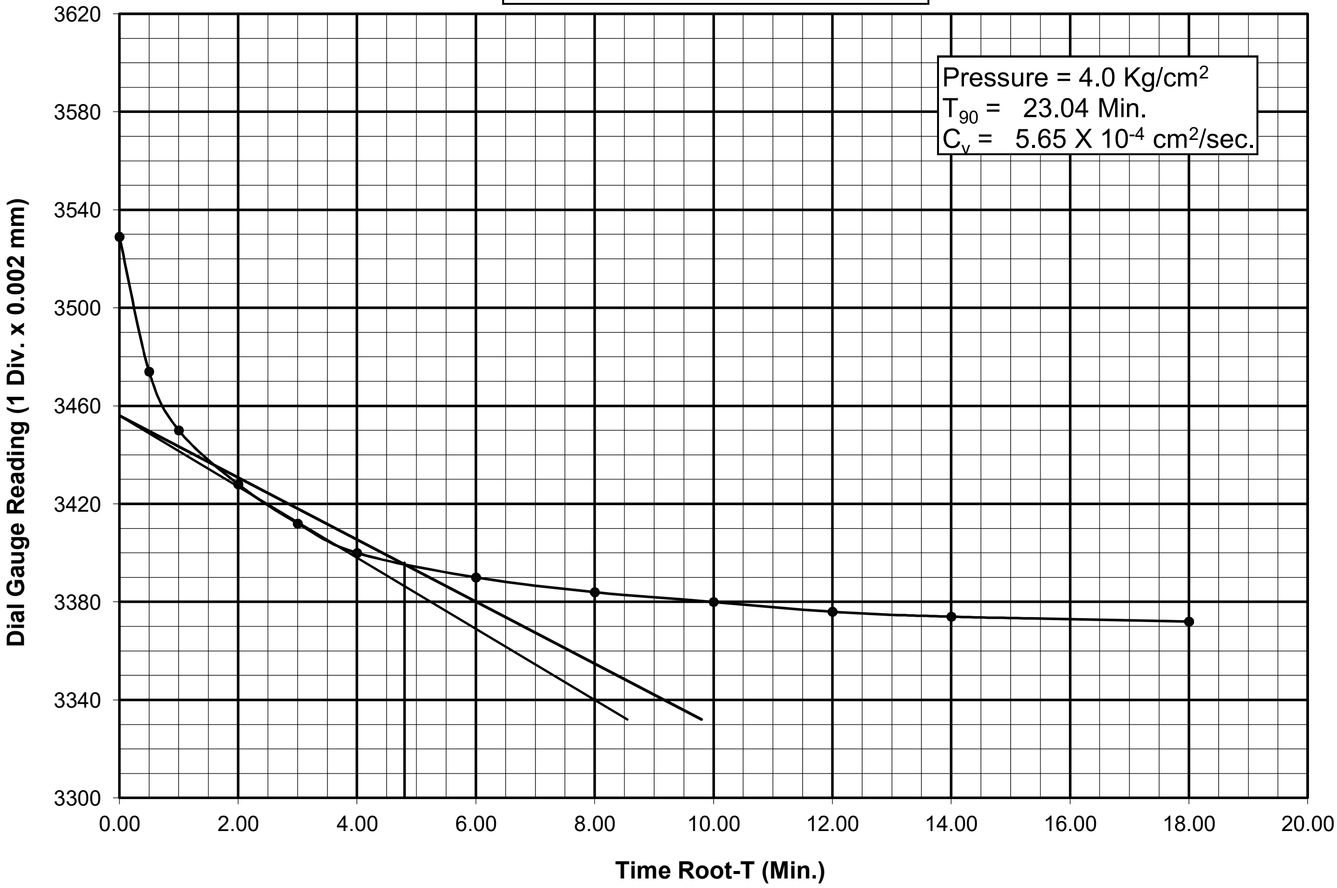


Figure No. -

BORE HOLE NO.	=	BH-A1
CHAINAGE	=	9+726
SAMPLE NO.	=	UDS-07
DEPTH	=	20.50 M



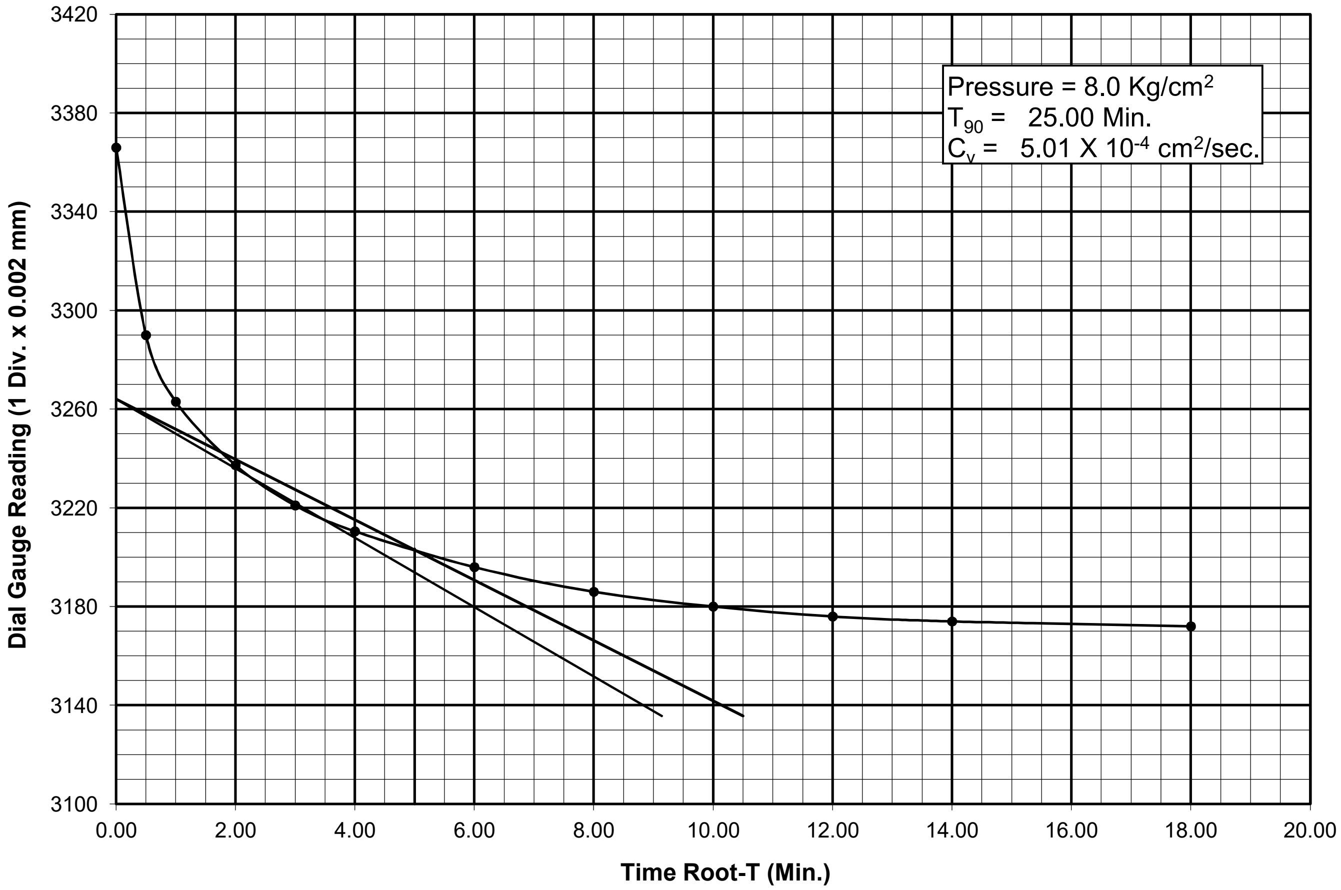
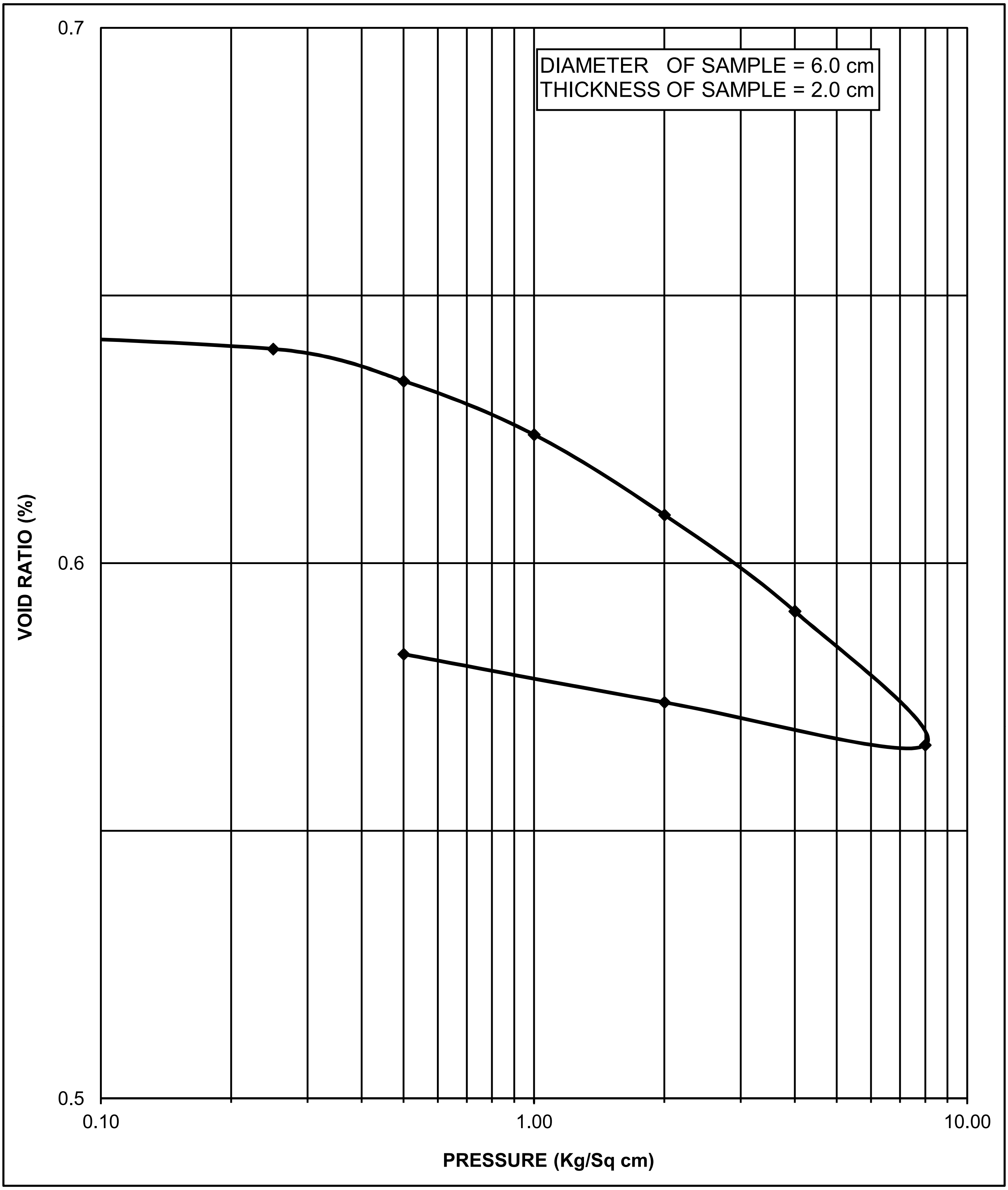


Figure No. -



BORE HOLE NO. = BH-A1

CHAINAGE = 17+625

SAMPLE NO. = UDS- 07

DEPTH = 19.00 M

TYPY OF SOIL = CL

INITIAL WATER CONTENT = 21.46 %

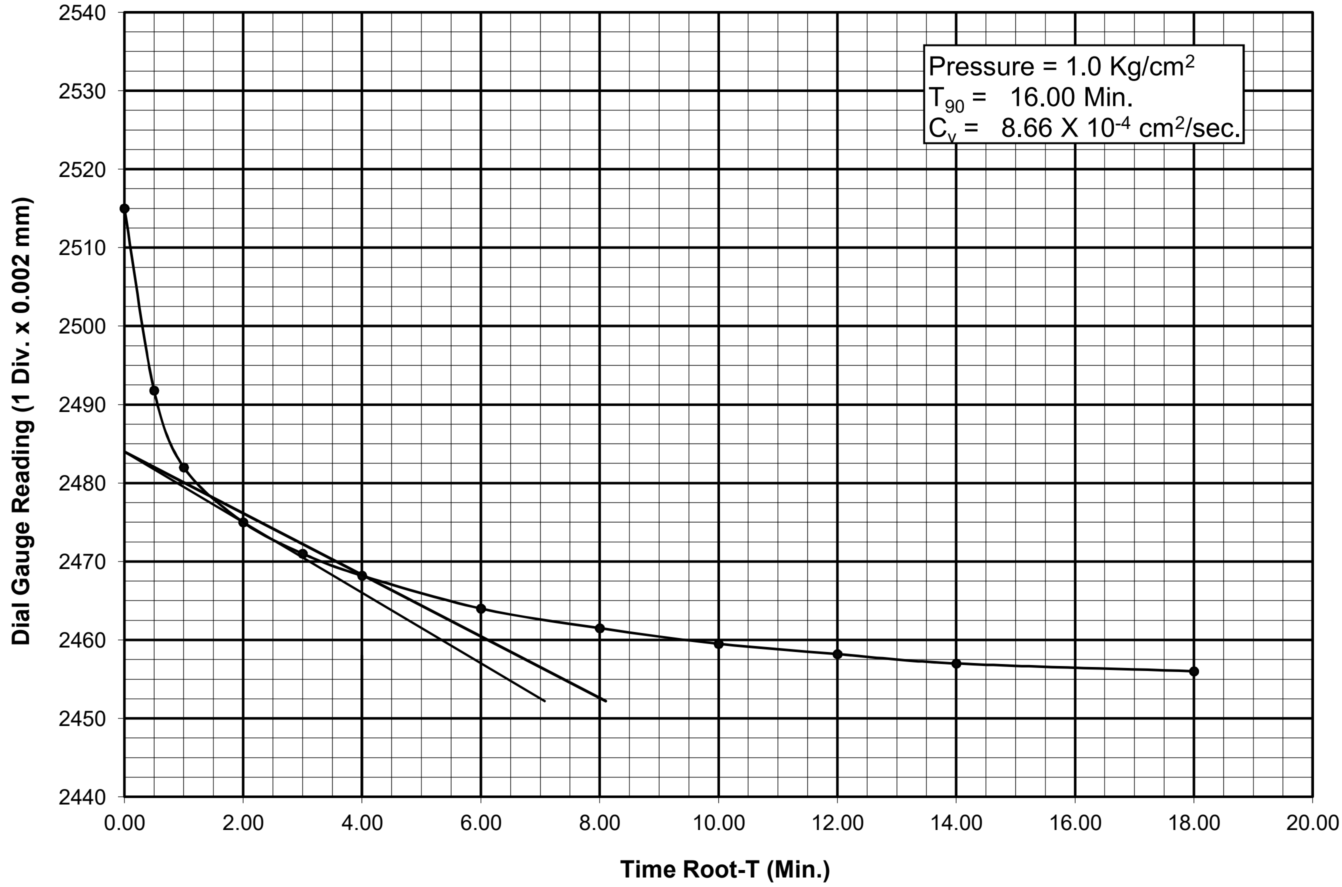
DRY DENSITY = 1.68 gm/cm^3

VOID RATIO (e_o) = 0.595

COMPRESIVE INDEX (C_c) = 0.083

FIGURE NO. PRESSURE Vs VOID RATIO CURVE (e-log p)

BORE HOLE NO. = BH-A1
CHAINAGE = 17+625
SAMPLE NO. = UDS-07
DEPTH = 19.00 M



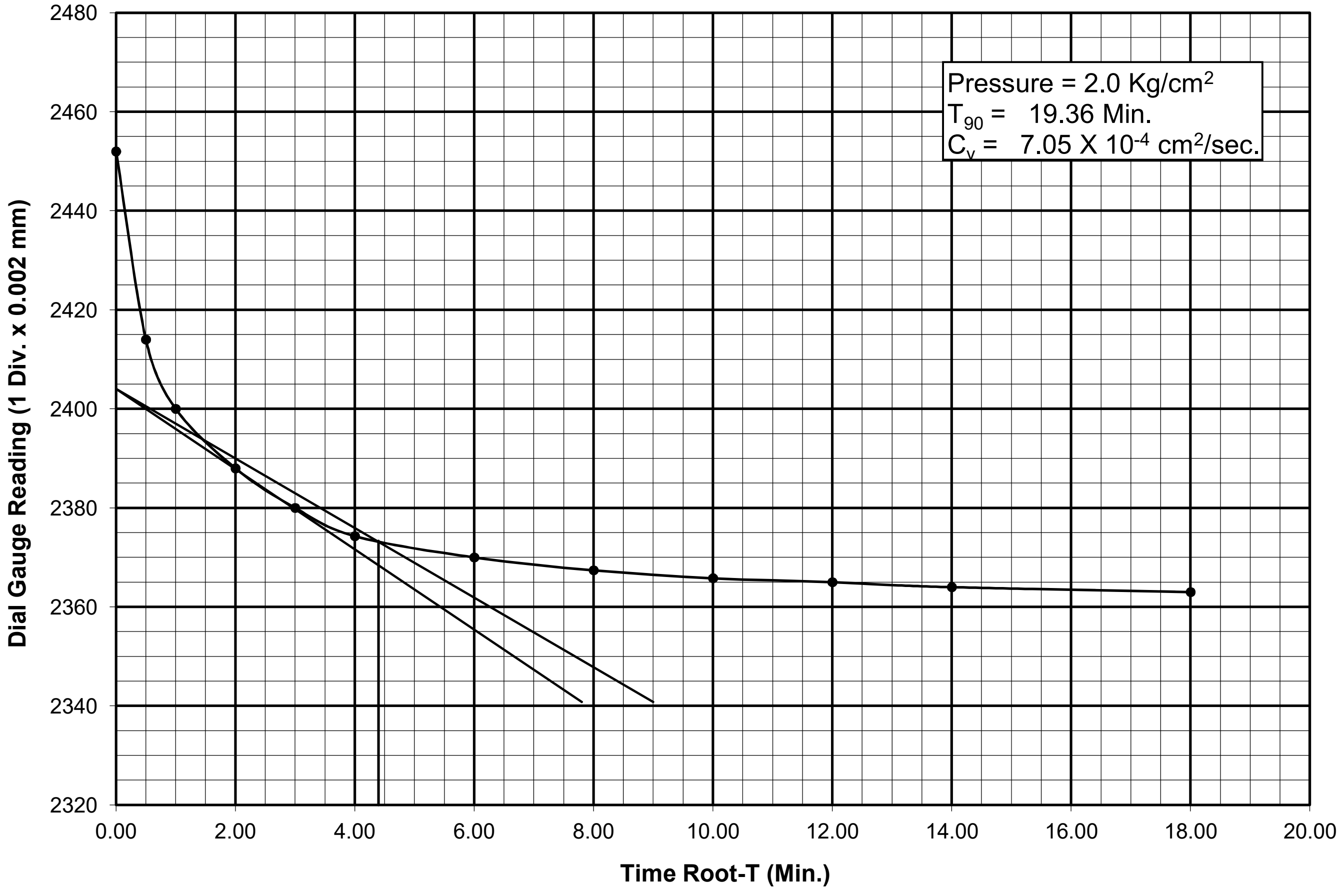
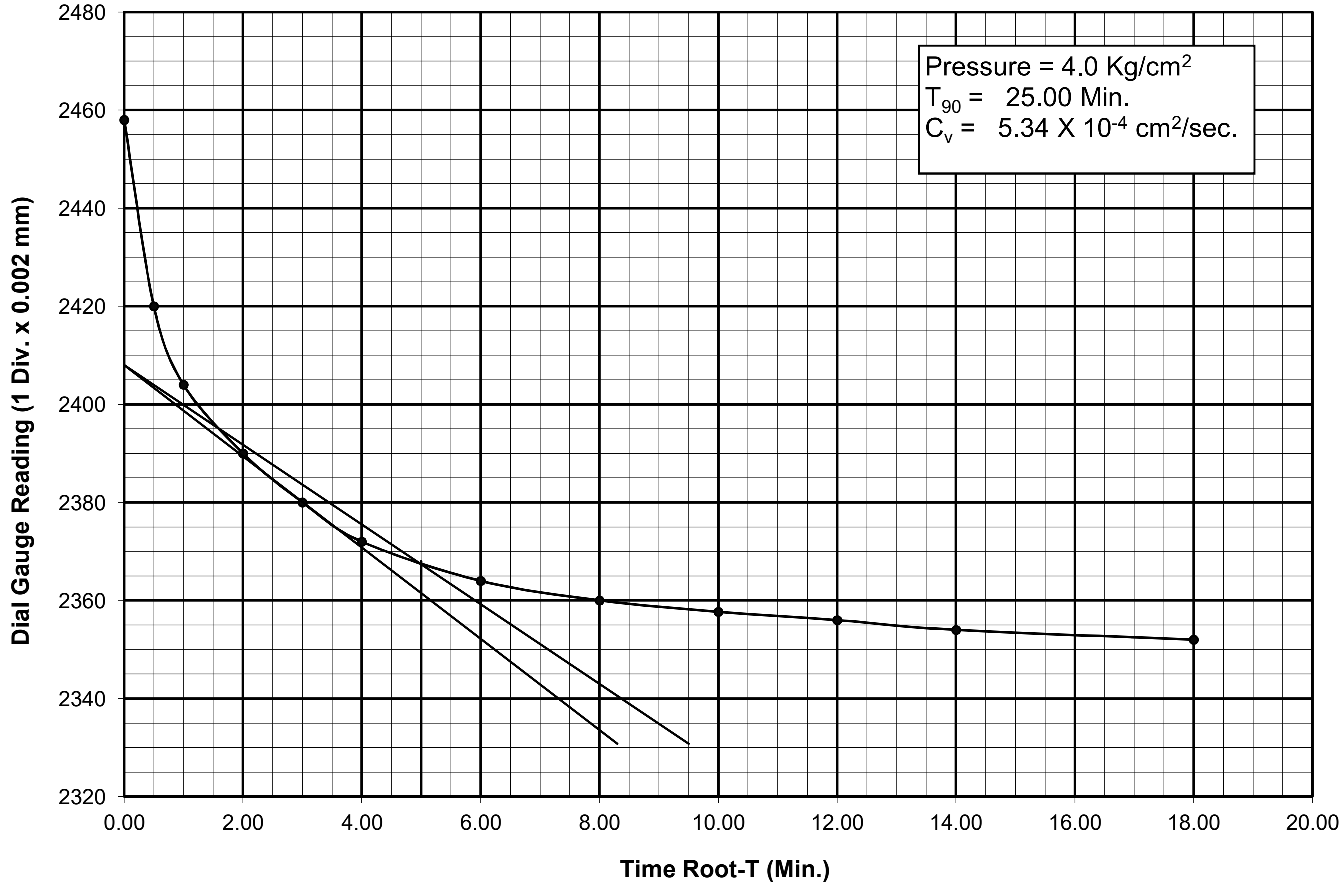


Figure No. -

BORE HOLE NO.	=	BH-A1
CHAINAGE	=	17+625
SAMPLE NO.	=	UDS-07
DEPTH	=	19.00 M



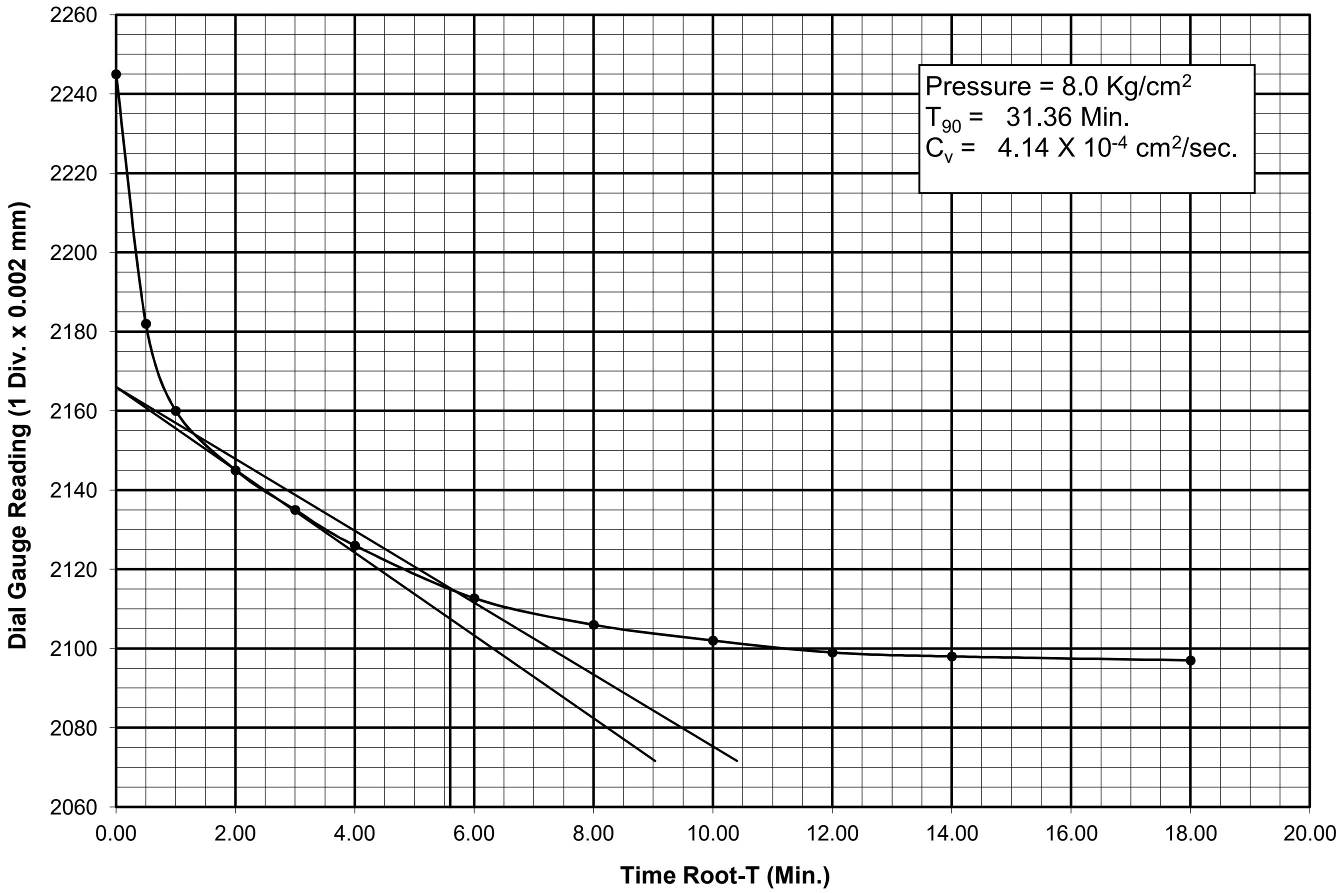
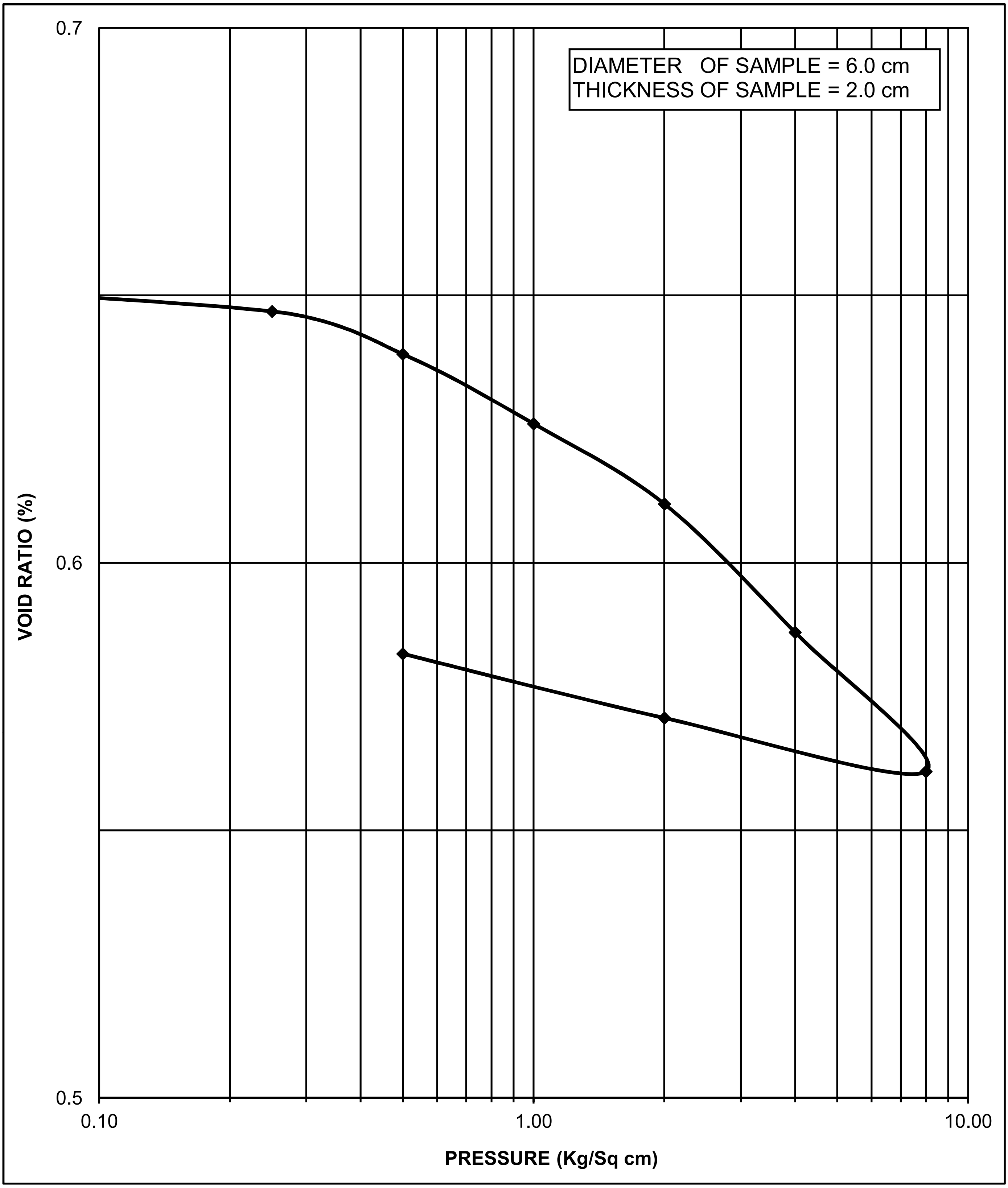


Figure No. -



BORE HOLE NO. = BH-A1

CHAINAGE = 18+750

SAMPLE NO. = UDS-8

DEPTH = 23.50 M

TYPE OF SOIL = CL

INITIAL WATER CONTENT = 20.46 %

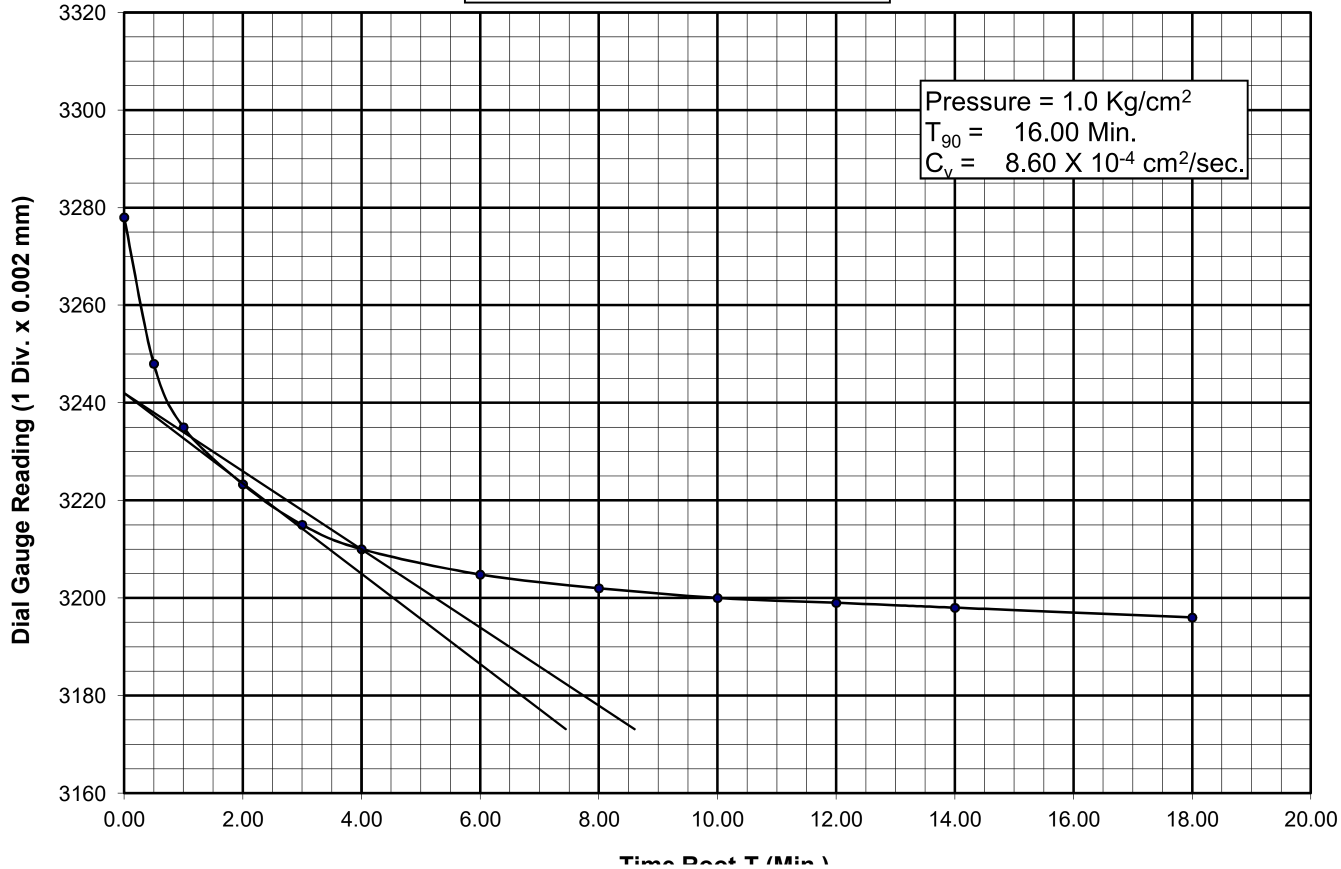
DRY DENSITY = 1.69 gm/cm^3

VOID RATIO (e_o) = 0.605

COMPRESSION INDEX (C_c) = 0.086

FIGURE NO. PRESSURE Vs VOID RATIO CURVE (e-log p)

BORE HOLE NO. = BH-A1
CHAINAGE = 18+750
SAMPLE NO. = UDS-08
DEPTH = 23.50 M



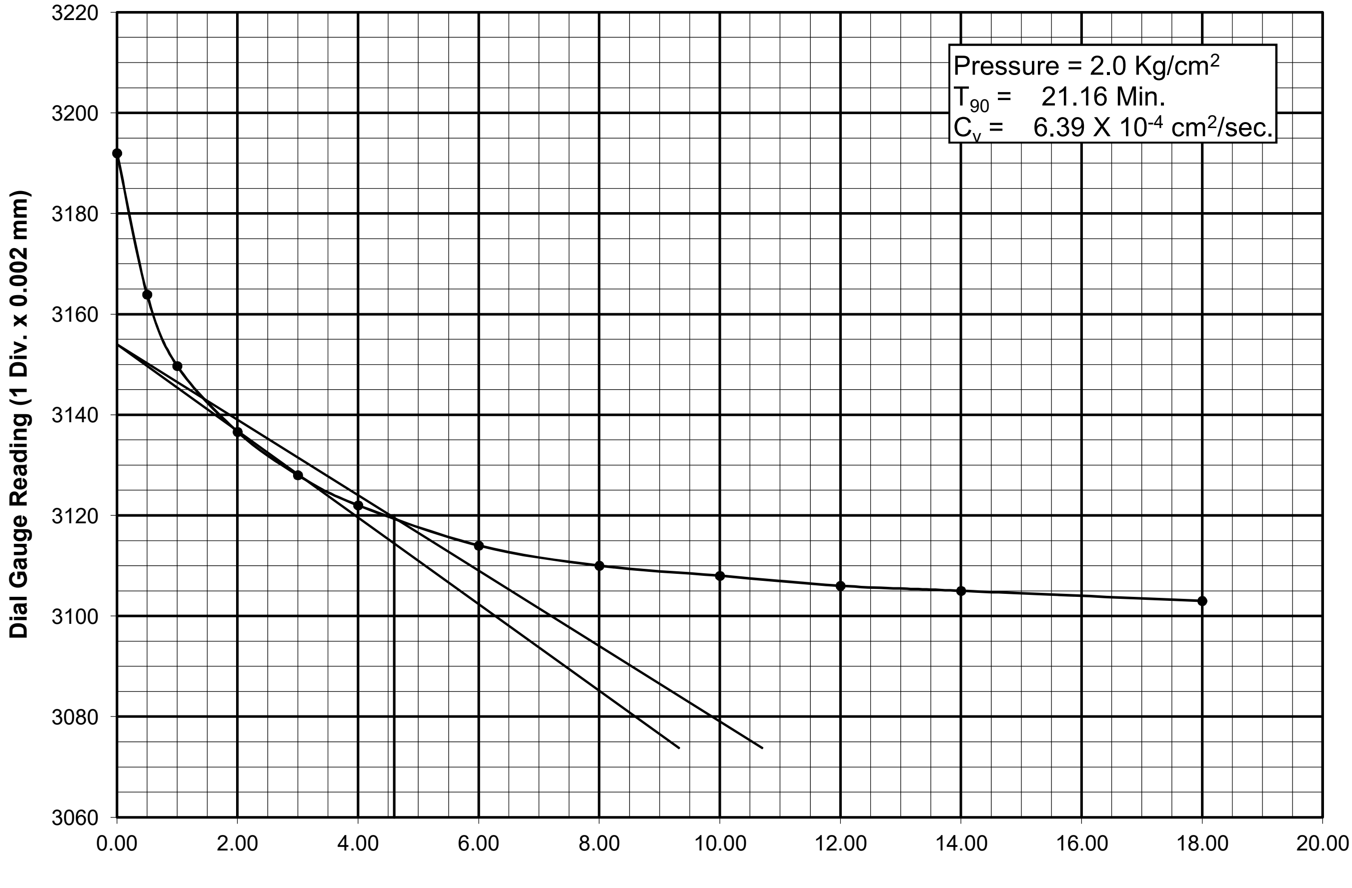
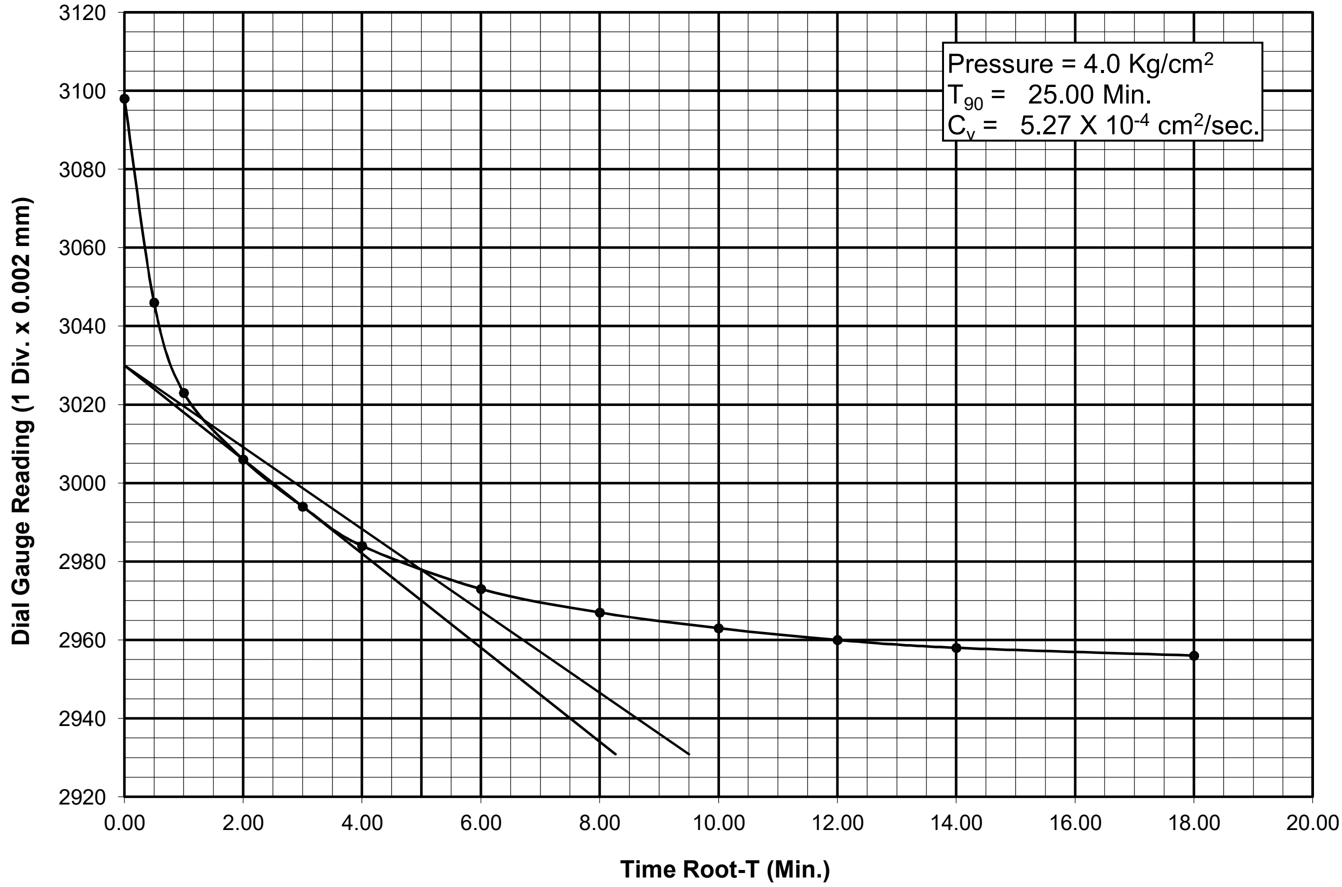


Figure No. -

BORE HOLE NO. =	BH-A1
CHAINAGE =	18+750
SAMPLE NO. =	UDS-08
DEPTH =	23.50 M



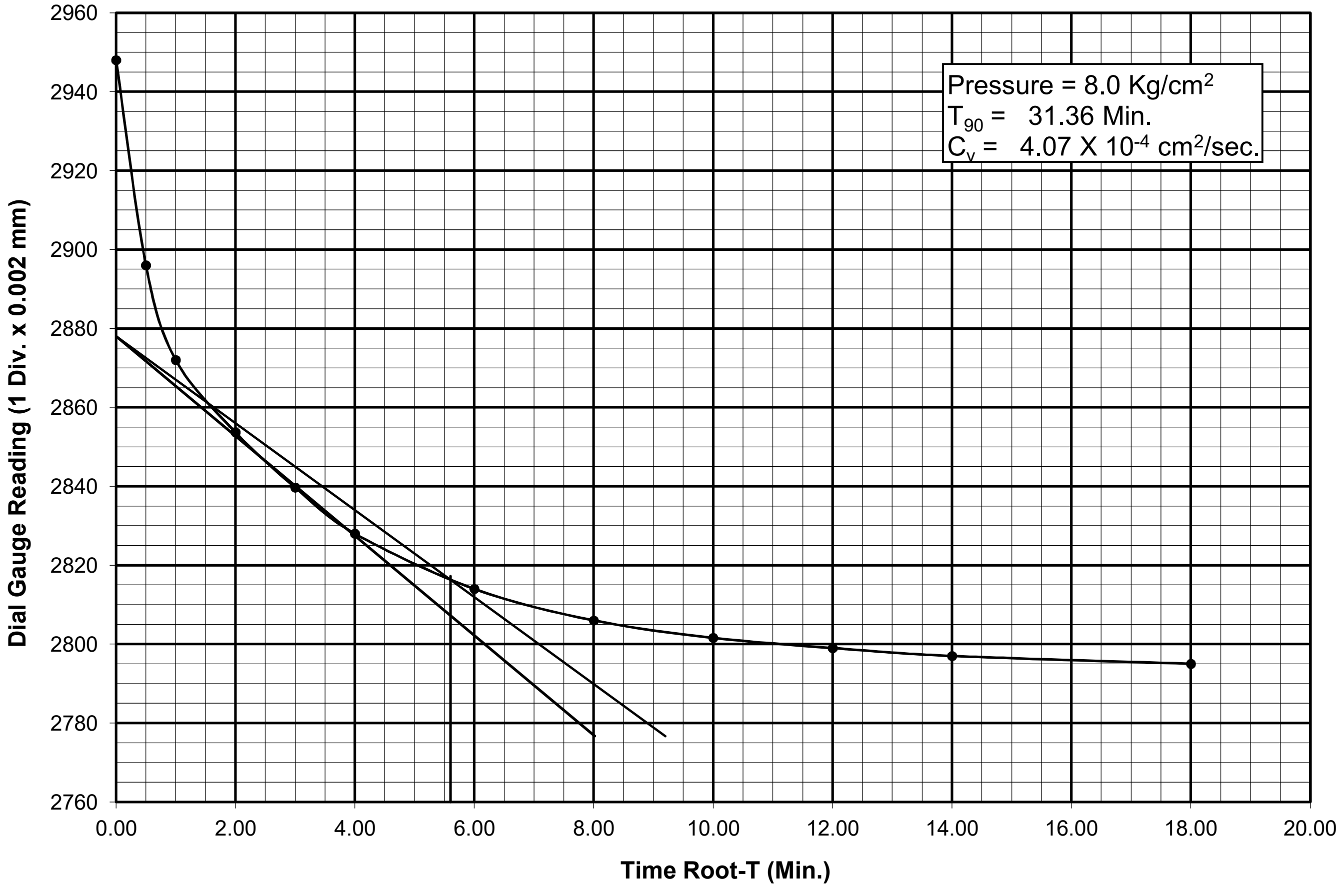
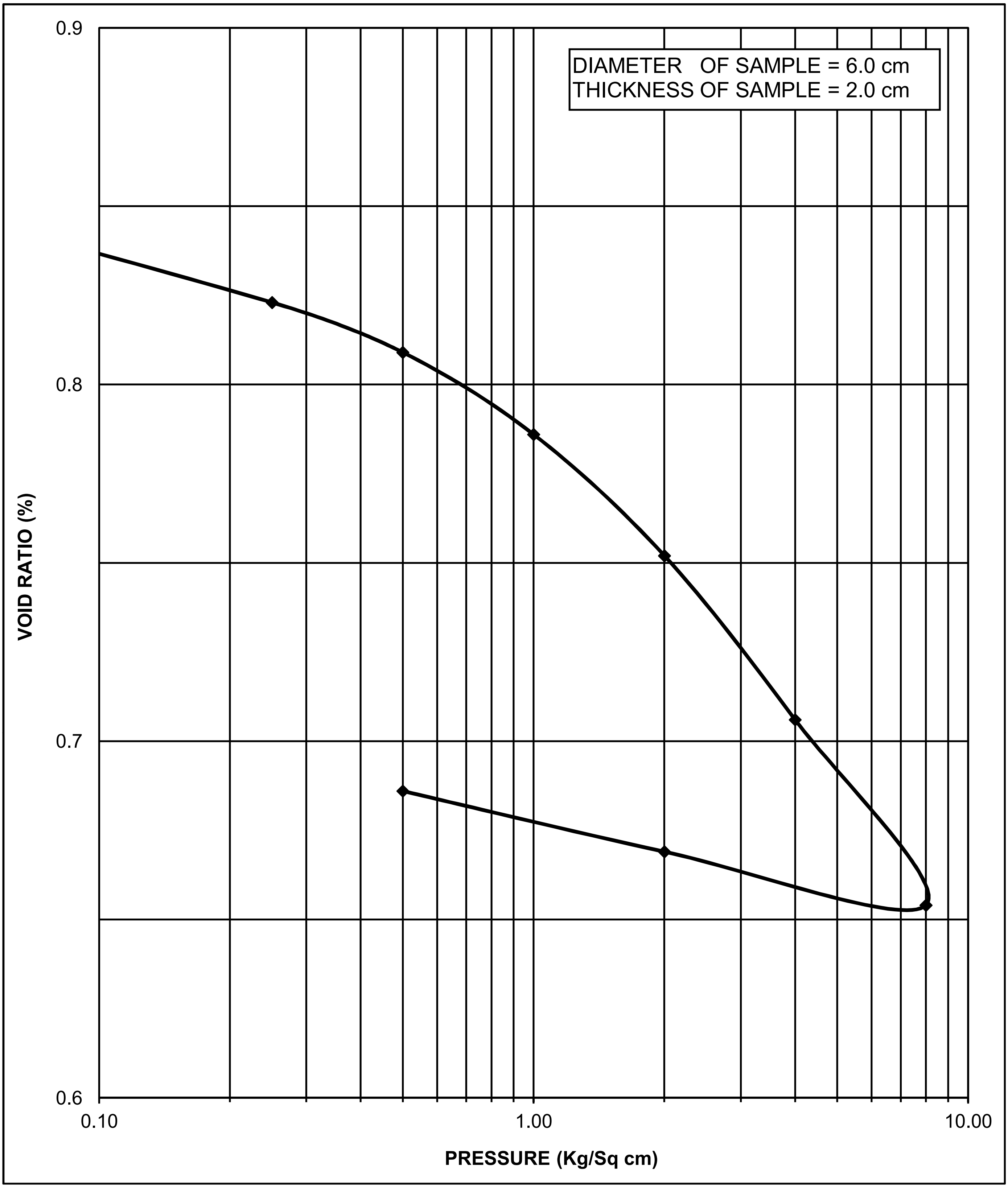


Figure No. -



BORE HOLE NO. = BH-P2

CHAINAGE = 20+300

SAMPLE NO. = UDS-01

DEPTH = 2.50 M

TYPE OF SOIL = CL

INITIAL WATER CONTENT = 28.13 %

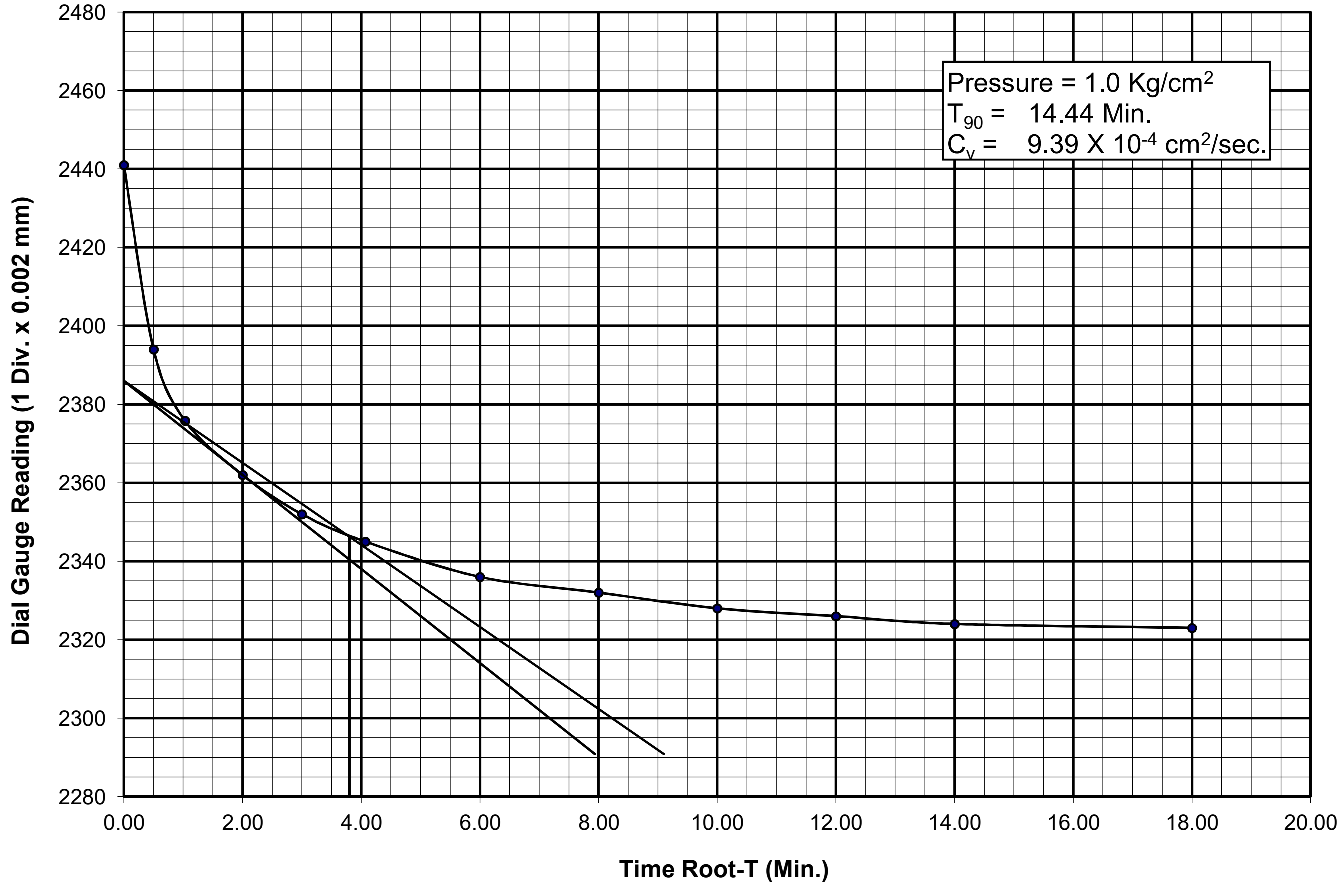
DRY DENSITY = 1.46 gm/cm^3

VOID RATIO (e_o) = 0.835

COMPRESSION INDEX (C_c) = 0.173

FIGURE NO. PRESSURE Vs VOID RATIO CURVE (e-log p)

BORE HOLE NO. = BH-P2
CHAINAGE = 20+300
SAMPLE NO. = UDS-01
DEPTH = 2.50 M



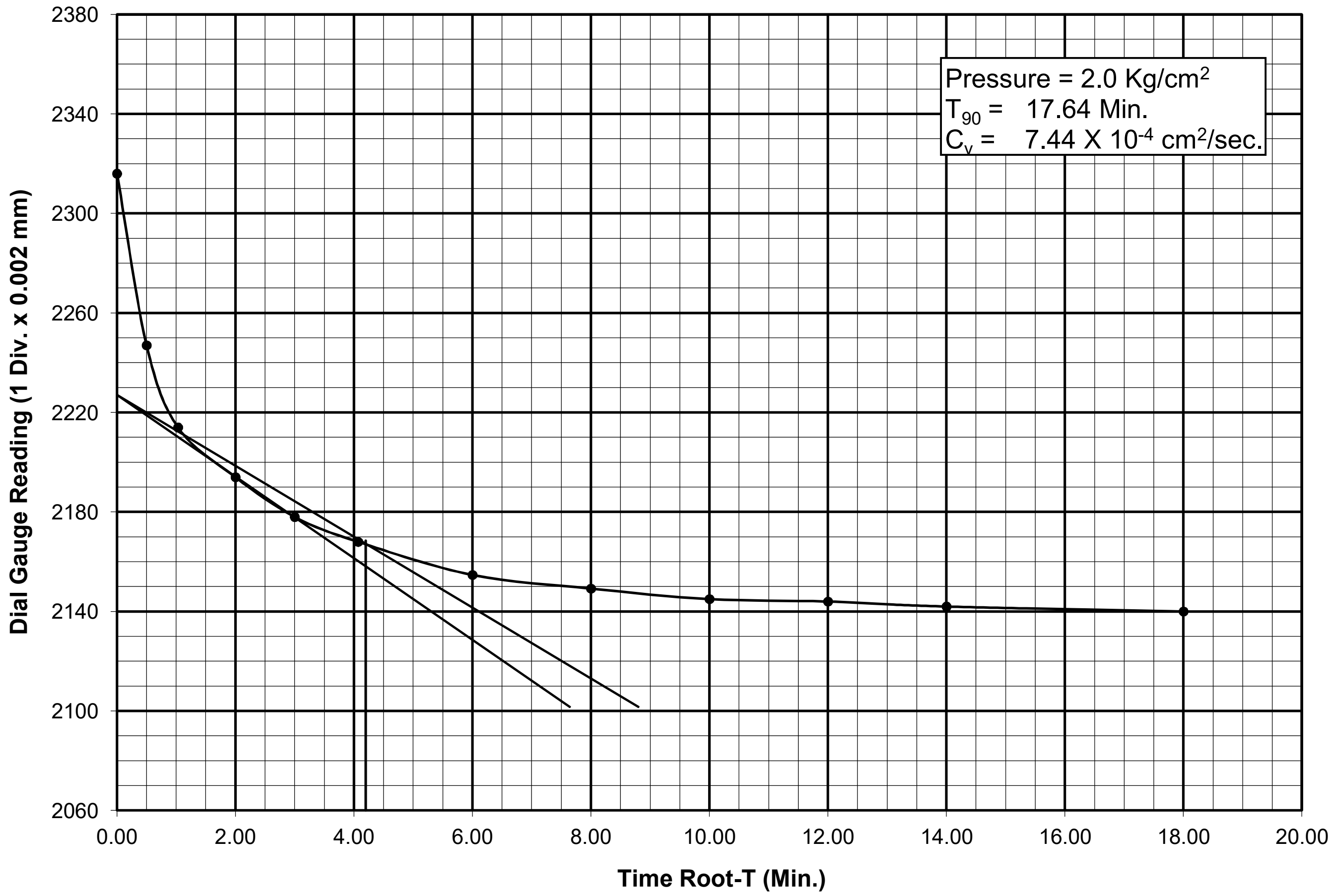
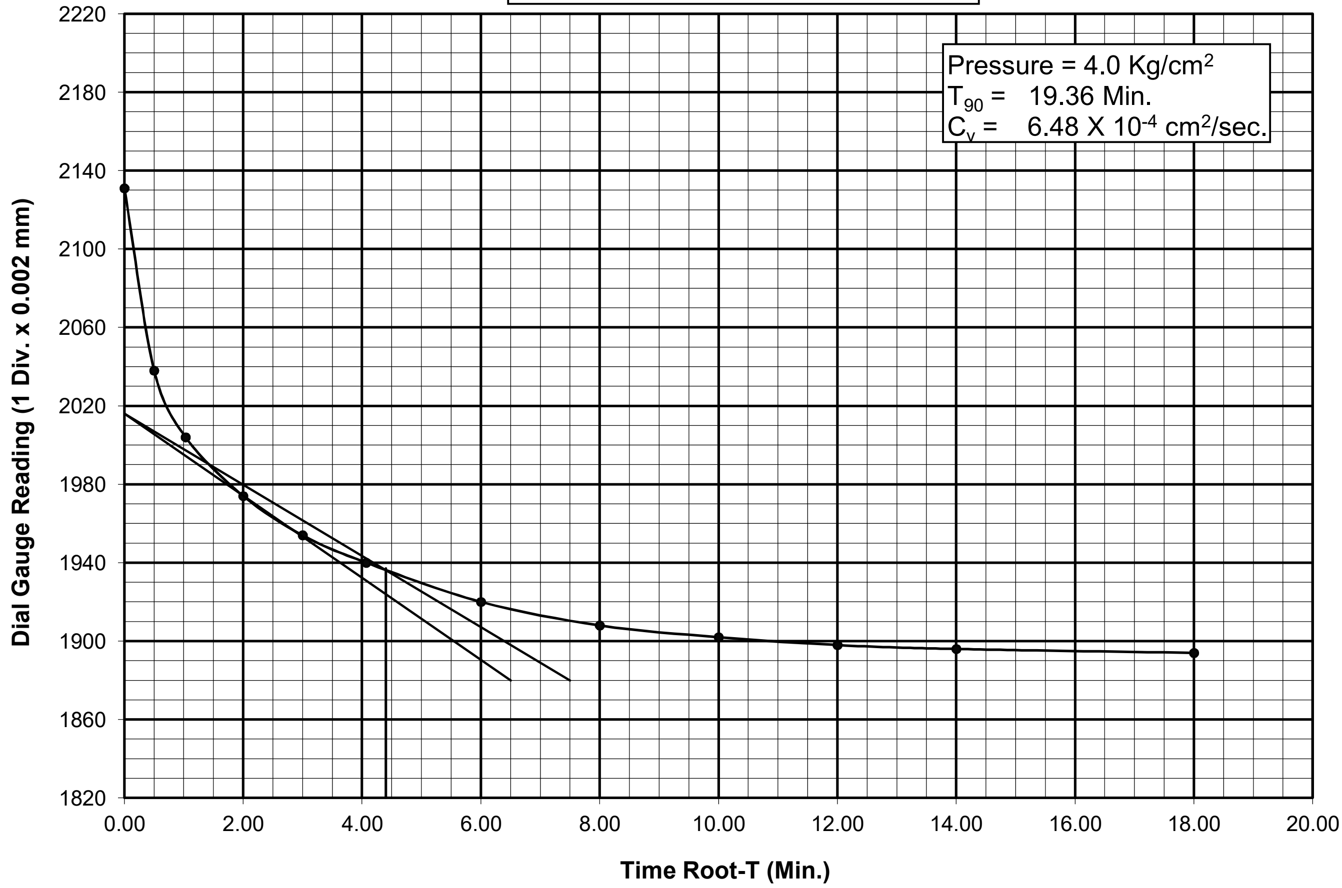


Figure No. -

BORE HOLE NO. = BH-P2
CHAINAGE = 20+300
SAMPLE NO. = UDS-01
DEPTH = 2.50 M



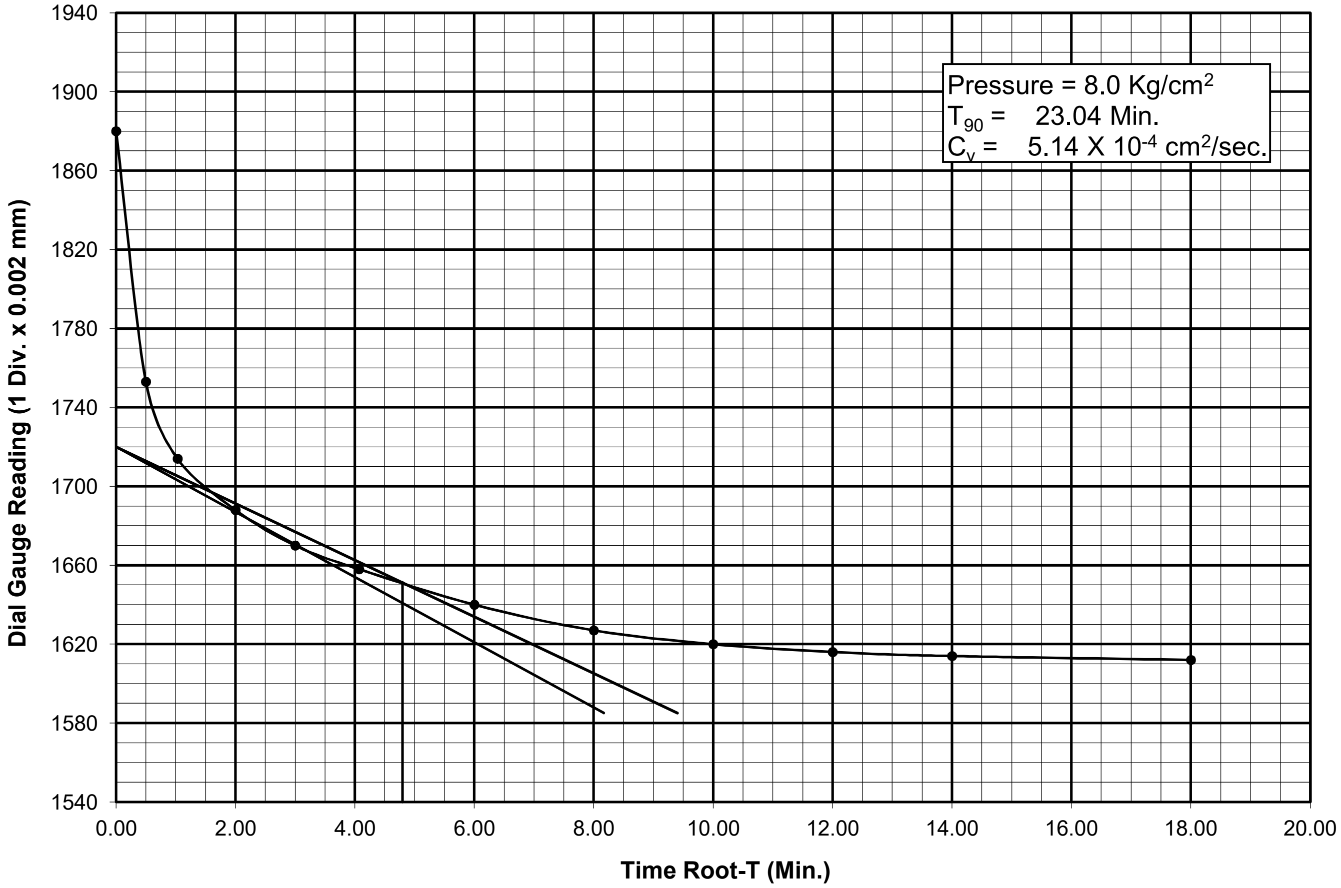


Figure No. -

APPENDIX – C
(ANALYSIS & RECOMENDATION)

Appendix No.	ITEMS
C-1	SAMPLE CALCULATION SHEET OF LIQUEFACTION ANALYSIS RESULTS
C-2	SAMPLE CALCULATIONS FOR COMPUTATION OF ALLOWABLE BEARING CAPACITY OF SUB-STRATA FOR SHALLOW FOUNDATION
C-3	SAMPLE CALCULATION FOR COMPUTATION OF SAFE LOAD CARRYING CAPACITY OF NORMAL BORED CAST-IN-SITU RCC PILE IN COMPRESSION & UPLIFT
C-4	SAMPLE CALCULATION FOR COMPUTATION OF SAFE LOAD CARRYING CAPACITY OF NORMAL BORED CAST-IN-SITU RCC PILE IN LATERAL

Liquefaction Analysis as per 2. IS code1893 Part I: 2016, IRC:75-2015 & RDSO BS-118

Chainage (Km)	(-)0+627	BH No.:-	BH-CL	Liquefiable upto=	NL		Water Table depth considered for analysis (m):-	0.00	

Depth Below G.L. (z) in m	Observed SPT Value	Saturated Density (t/m^3)	Submerged Density (t/m^3)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Moisture Content @ 100% saturation	Strata Type	Liquefaction Check for Cohesive Strata	Fine Content (%)	Stress Reduction Coefficient (rd)	Total Overburden Press (σ_v), t/m^2	Effective Overburden (σ'_v), t/m^2	Critical Stress Ratio (CSR)	C_{60}	Stress Normalization Factor(C_N)	SPT Corrected $(N1)_{60}$	α	β	$(N1)_{60CS}$	$CRR_{M=7.5}$	K_M	Kα	Kσ	CRR_{Mw}	FOS	Conclusion
1.00	20	1.99	1.99					Cohesionless		14	0.992	1.80	0.80	0.348	1.000	1.70	34.0	2.20	1.04	37.65	NA	1.19	1	1.00	NA	>1	Non Liquefiable
4.00	28	1.99	1.99					Cohesionless		14	0.969	7.77	6.77	0.174	1.000	1.20	33.7	2.20	1.04	37.33	NA	1.19	1	1.00	NA	>1	Non Liquefiable
7.00	41	2.00	1.00					Cohesionless		18	0.946	13.74	12.74	0.159	1.000	0.88	36.0	3.23	1.07	41.59	NA	1.19	1	1.00	NA	>1	Non Liquefiable
10.00	51	1.99	0.99					Cohesionless		15	0.907	19.75	15.75	0.177	1.000	0.79	40.2	2.50	1.05	44.67	NA	1.19	1	1.00	NA	>1	Non Liquefiable

Calculation of SBC for shallow foundations as per IS : 6403 - 1981

INPUT DATA

CH. (KM) :- 3+497

BH NO. :- BH-A1

Type of footing

1 Continuous Strip
2 Rectangular
3 Square
4 Circular

Square	**3**	

Angle of internal friction (ϕ °)	4.00
Cohesion (c in t/m^2)	8.50
Void ratio (e), e = (G.γ_w/γ_d)-1	0.70
Direction of load with vertical (°)	0.00
Density of foundation soil (t/m^3) γ_{bulk}	1.82
Depth of water table(m)	13.25
Factor of safety	2.50

S.no.	Depth (m) of footing (D_f) below EGL	Width (m)
1	2.00	7.20
2	3.00	7.20
3	4.00	7.20

SHEAR FAILURE CRITERIA

Assumptions and formula used in calculation as per IS:6403-1981 are given below -

NOTE: The type of failure used for bearing capacity analysis depends upon the value of void ratio (see IS 6403 : 1981, Page No. 9, Table No. 3).

The ultimate net bearing capacity in case of general shear failure is given by (from IS 6403 : 1981, page No. 8)

$$q_d = c\, N_c\, s_c\, d_c\, i_c + q\, (N_q\text{-}1)\, s_q\, d_q\, i_q + (1/2)\, B\, \gamma\, N_\gamma\, s_\gamma\, d_\gamma\, i_\gamma\, W'$$

The ultimate net bearing capacity in case of local shear failure is given by (from IS 6403 : 1981, page No. 8)

$$q'_d = (2/3)\, c\, N'_c\, s_c\, d_c\, i_c + q\, (N'_q\text{-}1)\, s_q\, d_q\, i_q + (1/2)\, B\, \gamma\, N'_\gamma\, s_\gamma\, d_\gamma\, i_\gamma\, W'$$

Where,

d_c = 1+ 0.2 (D_f/B)*SQRT(N_ϕ)
$d_q = d_\gamma$ = 1 for ϕ <10°
$d_q = d_\gamma$ = 1 + 0.1 (D_f/B)*SQRT(N_ϕ) for ϕ >10°
(from IS 6403 : 1981, page No. 9)
$N_\phi = \tan^2(\pi/4 + \phi/2)$
ϕ' is friction angle for local shear failure = $\tan^{-1}$ (0.67 tanϕ)

OUTPUT

The computer aided results for shear failure criteria are tabulated below. The results are interpolated values of bearing capacity obtained from general and local shear failure criteria.

Bearing capacity factors : (from IS 6403 : 1981, page No. 8, Table No. 1)

ϕ	4.00	ϕ'	2.68
N_c	6.19	N'_c	5.81
N_q	1.43	N'_q	1.27
N_γ	0.34	N'_γ	0.21

Shape factors : (from IS 6403 : 1981, page No. 8, Table No. 2)

S.no.	Width(m)	S_c	S_q	S_γ
1	7.20	1.30	1.20	0.80
2	7.20	1.30	1.20	0.80
3	7.20	1.30	1.20	0.80

Depth factors : (from IS 6403 : 1981, page No. 9)

S.no.	Depth(m)	Width(m)	dc	d_q	d_γ
1	2.00	7.20	1.06	1.00	1.00
2	3.00	7.20	1.09	1.00	1.00
3	4.00	7.20	1.12	1.00	1.00

Inclination factors : (from IS 6403 : 1981, page No. 9)

$i_c = (1-\alpha / 90)^2$	$i_q = (1-\alpha / 90)^2$	$i_\gamma = (1- \alpha / \phi)^2$
1.00	1.00	1.00

Water table factor : (from IS 6403 : 1981, page No. 9)

S.no.	Depth(m)	Width(m)	Z_w/B	W'
1	2.00	7.20	1.56	1.00
2	3.00	7.20	1.42	1.00
3	4.00	7.20	1.28	1.00

Safe Bearing Capacity

S.no.	Depth(m)	Width(m)	SBC in (t/m^2)		
			General shear	Local shear	Recommended
1	2.00	7.20	30.44	19.07	22.13
2	3.00	7.20	31.63	19.82	23.00
3	4.00	7.20	32.82	20.57	23.86

SETTLEMENT CALCULATION AS PER 8009 Part-1 1976														CH. (KM): 3+497						BH NO. :- BH-A1			
Layer	Depth below FGL (m)	From (m)	To (m)	Layer Thickness	Stress at Foundation level (Kg/Cm2)	Length (m)	Breadth (m)	Layer Thickness(m)	Dispersed Length (m)	Dispersed Breadth (m)	Stress Increment at top for cohesionless layer & at mid Depth for cohesive layer (kg/Cm2)	Average N-Value	Mvc (Cm^2/Kg)	Consolidation Settlement (mm)	Water Table Correction Factor	Modulus of Soil (Kg/Cm^2)	Poission's Ratio	Settlement (mm) for 10 t/m2 (from IS:8009 (Part I), Fig. 9, Page NO. 17)	Settlement in Non-Cohesive Soil Si (mm)	Total Settlement (mm)	Depth Factor	Rigidity Factor	Corrected Total Settlement (mm)
Layer 1		2.00	4.00	2.00				2.00	7.20	7.200	0.716	8			0.50	57.5	0.30	80.00	19.26	19.26			
Layer 2		4.00	8.50	4.50				4.50	11.450	11.450	0.283	26	0.0051	6.54	0.50	96	0.45			6.54			
Layer 3		8.50	11.50	3.00				3.00	13.700	13.700	0.198	43				290	0.30	6.50	0.35	0.35			
Layer 4	2.00	11.50	12.80	1.30	0.72	7.20	7.20	1.30	17.350	17.350	0.123	27	0.0049	0.79	0.50	99	0.45			0.79	0.93	1.00	25.00
Layer 1		3.00	4.00	1.00				1.00	7.20	7.200	1.023	8			0.50	57.5	0.30	80.00	14.45	14.45			
Layer 2		4.00	8.50	4.50				4.50	10.450	10.450	0.486	26	0.0051	11.21	0.50	96	0.45			11.21			
Layer 3		8.50	11.50	3.00				3.00	12.700	12.700	0.329	43				290	0.30	6.50	0.62	0.62			
Layer 4	3.00	11.50	13.80	2.30	1.02	7.20	7.20	2.30	16.850	16.850	0.187	27	0.0049	2.12	0.50	99	0.45			2.12	0.88	1.00	25.00
Layer 1		4.00	8.50	4.50				4.50	9.45	9.450	1.005	26	0.0051	23.19	0.50	96	0.45			23.19			
Layer 2		8.50	11.50	3.00				3.00	11.700	11.700	0.656	43			0.50	290	0.30	6.50	1.33	1.33			
Layer 3		11.50	14.80	3.30				3.30	16.350	16.350	0.336	27	0.0049	5.47		99	0.45			5.47			
	4.00				1.73	7.20	7.20								0.50						0.83	1.00	25.00

SETTLEMENT CALCULATION AS PER 8009 Part-1 1976														CH. (KM): 3+497						BH NO. :- BH-A1			
Layer	Depth below FGL (m)	From (m)	To (m)	Layer Thickness	Stress at Foundation level (Kg/Cm2)	Length (m)	Breadth (m)	Layer Thickness(m)	Dispersed Length (m)	Dispersed Breadth (m)	Stress Increment at top for cohesionless layer & at mid Depth for cohesive layer (kg/Cm2)	Average N-Value	Mvc (Cm^2/Kg)	Consolidation Settlement (mm)	Water Table Correction Factor	Modulus of Soil (Kg/Cm^2)	Poission's Ratio	Settlement (mm) for 10 t/m2 (from IS:8009 (Part I), Fig. 9, Page NO. 17)	Settlement in Non-Cohesive Soil Si (mm)	Total Settlement (mm)	Depth Factor	Rigidity Factor	Corrected Total Settlement (mm)
Layer 1		2.00	4.00	2.00				2.00	7.20	7.200	1.433	8			0.50	57.5	0.30	80.00	38.52	38.52			
Layer 2		4.00	8.50	4.50				4.50	11.450	11.450	0.567	26	0.0051	13.07	0.50	96	0.45			13.07			
Layer 3		8.50	11.50	3.00				3.00	13.700	13.700	0.396	43				290	0.30	6.50	0.70	0.70			
Layer 4	2.00	11.50	12.80	1.30	1.43	7.20	7.20	1.30	17.350	17.350	0.247	27	0.0049	1.58	0.50	99	0.45			1.58	0.93	1.00	50.00
Layer 1		3.00	4.00	1.00				1.00	7.20	7.200	2.046	8			0.50	57.5	0.30	80.00	28.90	28.90			
Layer 2		4.00	8.50	4.50				4.50	10.450	10.450	0.971	26	0.0051	22.41	0.50	96	0.45			22.41			
Layer 3		8.50	11.50	3.00				3.00	12.700	12.700	0.658	43				290	0.30	6.50	1.24	1.24			
Layer 4	3.00	11.50	13.80	2.30	2.05	7.20	7.20	2.30	16.850	16.850	0.374	27	0.0049	4.24	0.50	99	0.45			4.24	0.88	1.00	50.00
Layer 1		4.00	8.50	4.50				4.50	9.45	9.450	2.010	26	0.0051	46.38	0.50	96	0.45			46.38			
Layer 2		8.50	11.50	3.00				3.00	11.700	11.700	1.311	43			0.50	290	0.30	6.50	2.66	2.66			
Layer 3		11.50	14.80	3.30				3.30	16.350	16.350	0.671	27	0.0049	10.94	0.50	99	0.45			10.94			
	4.00				3.46	7.20	7.20														0.83	1.00	50.00

Calculation of SBC for shallow foundations as per IS : 6403 - 1981

INPUT DATA

CH. (KM) :- 3+497

BH NO. :- BH-A1

Type of footing

1 Continuous Strip
2 Rectangular
3 Square
4 Circular

Square **3**

Angle of internal friction (ϕ ^{o})	12.29
Cohesion (c in t/m^2)	5.89
Void ratio (e), $e = (G.\gamma_w/\gamma_d)-1$	0.67
Direction of load with vertical (^{o})	0.00
Density of foundation soil (t/m^3) γ_{bulk}	1.82
Depth of water table(m)	13.25
Factor of safety	2.50

S.no.	Depth (m) of footing (D_f) below EGL	Width (m)
1	2.00	7.20
2	3.00	7.20
3	4.00	7.20

SHEAR FAILURE CRITERIA

Assumptions and formula used in calculation as per IS:6403-1981 are given below -

NOTE: The type of failure used for bearing capacity analysis depends upon the value of void ratio (see IS 6403 : 1981, Page No. 9, Table No. 3).

The ultimate net bearing capacity in case of general shear failure is given by (from IS 6403 : 1981, page No. 8)

$$q_d = c\ N_c\ s_c\ d_c\ i_c + q\ (N_q\text{-}1)\ s_q\ d_q\ i_q + (1/2)\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$$

The ultimate net bearing capacity in case of local shear failure is given by (from IS 6403 : 1981, page No. 8)

$$q'_d = (2/3)\ c\ N'_c\ s_c\ d_c\ i_c + q\ (N'_q\text{-}1)\ s_q\ d_q\ i_q + (1/2)\ B\ \gamma\ N'_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$$

Where,

$d_c = 1 + 0.2\ (D_f/B)*SQRT(N_\phi)$

$d_q = d_\gamma = 1$ for $\phi < 10^o$

$d_q = d_\gamma = 1 + 0.1\ (D_f/B)*SQRT(N_\phi)$ for $\phi > 10^o$

(from IS 6403 : 1981, page No. 9)

$N_\phi = \tan^2(\pi/4 + \phi/2)$

ϕ' is friction angle for local shear failure = $\tan^{-1}$ (0.67 $\tan\phi$)

OUTPUT

The computer aided results for shear failure criteria are tabulated below. The results are interpolated values of bearing capacity obtained from general and local shear failure criteria.

Bearing capacity factors : (from IS 6403 : 1981, page No. 8, Table No. 1)

ϕ	12.29	ϕ'	8.31
N_c	9.43	N'_c	7.65
N_q	3.06	N'_q	2.12
N_γ	1.77	N'_γ	0.91

Shape factors : (from IS 6403 : 1981, page No. 8, Table No. 2)

S.no.	Width(m)	S_c	S_q	S_γ
1	7.20	1.30	1.20	0.80
2	7.20	1.30	1.20	0.80
3	7.20	1.30	1.20	0.80

Depth factors : (from IS 6403 : 1981, page No. 9)

S.no.	Depth(m)	Width(m)	dc	d_q	d_γ
1	2.00	7.20	1.07	1.03	1.03
2	3.00	7.20	1.10	1.05	1.05
3	4.00	7.20	1.14	1.07	1.07

Inclination factors : (from IS 6403 : 1981, page No. 9)

$i_c = (1-\alpha / 90)^2$	$i_q = (1-\alpha / 90)^2$	$i_\gamma = (1- \alpha / \phi)^2$
1.00	1.00	1.00

Water table factor : (from IS 6403 : 1981, page No. 9)

S.no.	Depth(m)	Width(m)	Z_w/B	W'
1	2.00	7.20	1.56	1.00
2	3.00	7.20	1.42	1.00
3	4.00	7.20	1.28	1.00

Safe Bearing Capacity

S.no.	Depth(m)	Width(m)	SBC in (t/m^2)		
			General shear	Local shear	Recommended
1	2.00	7.20	38.41	20.67	27.63
2	3.00	7.20	41.42	22.29	29.80
3	4.00	7.20	44.48	23.95	32.01

SETTLEMENT CALCULATION AS PER 8009 Part-1 1976 | CH. (KM): 3+497 | BH NO. :- BH-A1

Layer	Depth below FGL (m)	From (m)	To (m)	Layer Thickness	Stress at Foundation level (Kg/Cm2)	Length (m)	Breadth (m)	Layer Thickness(m)	Dispersed Length (m)	Dispersed Breadth (m)	Stress Increment at top for cohesionless layer & at mid Depth for cohesive layer (kg/Cm2)	Average N-Value	Mvc (Cm^2/Kg)	Consolidation Settlement (mm)	Water Table Correction Factor	Modulus of Soil (Kg/Cm^2)	Poission's Ratio	Settlement (mm) for 10 t/m2 (from IS:8009 (Part I), Fig. 9, Page NO. 17)	Settlement in Non-Cohesive Soil Si (mm)	Total Settlement (mm)	Depth Factor	Rigidity Factor	Corrected Total Settlement (mm)
Layer 1		2.00	5.00	3.00				3.00	7.20	7.200	1.375	25			0.50	100	0.30	11.50	15.13	15.13			
Layer 2		5.00	8.50	3.50				3.50	11.950	11.950	0.499	26	0.0051	8.96	0.50	96	0.45			8.96			
Layer 3		8.50	11.50	3.00				3.00	13.700	13.700	0.380	43			0.50	145	0.30	6.50	1.34	1.34			
Layer 4	2.00	11.50	12.80	1.30	1.37	7.20	7.20	1.30	17.350	17.350	0.237	27	0.0049	1.52	0.50	99	0.45			1.52	0.93	1.00	25.00
Layer 1		3.00	5.00	2.00				2.00	7.20	7.200	1.513	25			0.50	100	0.30	11.50	11.69	11.69			
Layer 2		5.00	8.50	3.50				3.50	10.950	10.950	0.654	26	0.0051	11.74	0.50	96	0.45			11.74			
Layer 3		8.50	11.50	3.00				3.00	12.700	12.700	0.486	43			0.50	145	0.30	6.50	1.83	1.83			
Layer 4	3.00	11.50	13.80	2.30	1.51	7.20	7.20	2.30	16.850	16.850	0.276	27	0.0049	3.14	0.50	99	0.45			3.14	0.88	1.00	25.00
Layer 1		4.00	5.00	1.00				1.00	7.20	7.200	1.651	25			0.50	100	0.30	11.50	6.71	6.71			
Layer 2		5.00	8.50	3.50				3.50	9.950	9.950	0.865	26	0.0051	15.52	0.50	96	0.45			15.52			
Layer 3		8.50	11.50	3.00				3.00	11.700	11.700	0.625	43			0.50	145	0.30	6.50	2.54	2.54			
Layer 4	4.00	11.50	14.80	3.30	1.65	7.20	7.20	3.30	16.350	16.350	0.320	27	0.0049	5.22	0.50	99	0.45			5.22	0.83	1.00	25.00

SETTLEMENT CALCULATION AS PER 8009 Part-1 1976														CH. (KM): 3+497						BH NO. :- BH-A1			
Layer	Depth below FGL (m)	From (m)	To (m)	Layer Thickness	Stress at Foundation level (Kg/Cm2)	Length (m)	Breadth (m)	Layer Thickness(m)	Dispersed Length (m)	Dispersed Breadth (m)	Stress Increment at top for cohesionless layer & at mid Depth for cohesive layer (kg/Cm2)	Average N-Value	Mvc (Cm^2/Kg)	Consolidation Settlement (mm)	Water Table Correction Factor	Modulus of Soil (Kg/Cm^2)	Poission's Ratio	Settlement (mm) for 10 t/m2 (from IS:8009 (Part I), Fig. 9, Page NO. 17)	Settlement in Non-Cohesive Soil Si (mm)	Total Settlement (mm)	Depth Factor	Rigidity Factor	Corrected Total Settlement (mm)
Layer 1		2.00	5.00	3.00				3.00	7.20	7.200	2.749	25			0.50	100	0.30	11.50	30.25	30.25			
Layer 2		5.00	8.50	3.50				3.50	11.950	11.950	0.998	26	0.0051	17.91	0.50	96	0.45			17.91			
Layer 3		8.50	11.50	3.00				3.00	13.700	13.700	0.759	43			0.50	145	0.30	6.50	2.67	2.67			
Layer 4	2.00	11.50	12.80	1.30	2.75	7.20	7.20	1.30	17.350	17.350	0.473	27	0.0049	3.04	0.50	99	0.45			3.04	0.93	1.00	50.00
Layer 1		3.00	5.00	2.00				2.00	7.20	7.200	3.025	25			0.50	100	0.30	11.50	23.38	23.38			
Layer 2		5.00	8.50	3.50				3.50	10.950	10.950	1.308	26	0.0051	23.47	0.50	96	0.45			23.47			
Layer 3		8.50	11.50	3.00				3.00	12.700	12.700	0.972	43			0.50	145	0.30	6.50	3.67	3.67			
Layer 4	3.00	11.50	13.80	2.30	3.03	7.20	7.20	2.30	16.850	16.850	0.552	27	0.0049	6.27	0.50	99	0.45			6.27	0.88	1.00	50.00
Layer 1		4.00	5.00	1.00				1.00	7.20	7.200	3.303	25			0.50	100	0.30	11.50	13.42	13.42			
Layer 2		5.00	8.50	3.50				3.50	9.950	9.950	1.730	26	0.0051	31.04	0.50	96	0.45			31.04			
Layer 3		8.50	11.50	3.00				3.00	11.700	11.700	1.251	43			0.50	145	0.30	6.50	5.08	5.08			
Layer 4	4.00	11.50	14.80	3.30	3.30	7.20	7.20	3.30	16.350	16.350	0.641	27	0.0049	10.44	0.50	99	0.45			10.44	0.83	1.00	50.00

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 18.00 m | **Bore Hole No =** BH-A1 | **Ch. (KM)** 1+006 | **Dia of pile =** 1.00 m | **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D | **Water Table depth considered for analysis =** 20.00 m | **Scour Depth =** Non-scourable | **Liquefaction Depth =** Non-Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Nγ	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					1.67	200	0.17											
1.00		2.00	4.00	0.00	28	1.00	1.00	1.67	200	0.50								314.29		16.75	
1.00		4.00	7.00	0.00	29	1.00	1.00	1.76	300	0.93								314.29		48.71	
1.00		7.00	11.50	0.00	31	1.00	1.00	1.83	450	1.61								314.29		136.66	
1.00		11.50	14.50	0.00	31	1.00	1.00	1.84	300	2.30								314.29		130.11	
1.00		14.50	15.00	0.00	32	1.00	1.00	1.88	50	2.62								314.29		25.72	
1.00		15.00	19.00	0.00	32	1.00	1.00	1.88	400	2.67								314.29		209.49	
1.00		19.00	20.00	0.18	27	1.00	1.00	1.88	100	2.67	2.67	0.88	0.18	27	9	13.39	14.47	314.29	7857.14	48.36	298.18
																				615.80	298.18

Qu,comp.= qs + Qp

Qa,comp.= (615.8 + 298.18) / 2.5

Qa,comp.= 365.59 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 615.8 / 3 + 35.34

Qa,uplift = 240.61 T

Say **Qa,comp.= 365.00 T** **Qa,uplift = 240.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 20.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** 1+006 **Dia of pile =** 1.00 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 20.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non-Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Nγ	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					1.67	200	0.17											
1.00		2.00	4.00	0.00	28	1.00	1.00	1.67	200	0.50								314.29		16.75	
1.00		4.00	7.00	0.00	29	1.00	1.00	1.76	300	0.93								314.29		48.71	
1.00		7.00	11.50	0.00	31	1.00	1.00	1.83	450	1.61								314.29		136.66	
1.00		11.50	14.50	0.00	31	1.00	1.00	1.84	300	2.30								314.29		130.11	
1.00		14.50	15.00	0.00	32	1.00	1.00	1.88	50	2.62								314.29		25.72	
1.00		15.00	19.00	0.00	32	1.00	1.00	1.88	400	2.67								314.29		209.49	
1.00		19.00	20.00	0.18	27	1.00	1.00	1.88	100	2.67								314.29		48.36	
1.00		20.00	22.00	0.18	27	1.00	1.00	0.88	200	2.67	2.67	0.88	0.18	27	9	13.39	14.47	314.29	7857.14	96.72	298.18
																				712.53	298.18

Qu,comp.= qs + Qp

Qa,comp.= (712.53 + 298.18) / 2.5

Qa,comp.= 404.28 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 712.53 / 3 + 39.27

Qa,uplift = 276.78 T

Say **Qa,comp.= 404.00 T** **Qa,uplift = 276.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 22.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** 1+006 **Dia of pile =** 1.00 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 20.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non-Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Nγ	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					1.67	200	0.17											
1.00		2.00	4.00	0.00	28	1.00	1.00	1.67	200	0.50								314.29		16.75	
1.00		4.00	7.00	0.00	29	1.00	1.00	1.76	300	0.93								314.29		48.71	
1.00		7.00	11.50	0.00	31	1.00	1.00	1.83	450	1.61								314.29		136.66	
1.00		11.50	14.50	0.00	31	1.00	1.00	1.84	300	2.30								314.29		130.11	
1.00		14.50	15.00	0.00	32	1.00	1.00	1.88	50	2.62								314.29		25.72	
1.00		15.00	19.00	0.00	32	1.00	1.00	1.88	400	2.67								314.29		209.49	
1.00		19.00	20.00	0.18	27	1.00	1.00	1.88	100	2.67								314.29		48.36	
1.00		20.00	23.50	0.18	27	1.00	1.00	0.88	350	2.67								314.29		169.26	
1.00		23.50	24.00	0.18	28	1.00	1.00	0.97	50	2.67	2.67	0.88	0.18	27	9	13.39	14.47	314.29	7857.14	25.11	298.18
																				810.18	298.18

Qu,comp.= qs + Qp

Qa,comp.= (810.18 + 298.18) / 2.5

Qa,comp.= 443.34 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 810.18 / 3 + 43.2

Qa,uplift = 313.26 T

Say **Qa,comp.= 443.00 T** **Qa,uplift = 313.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 24.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** 1+006 **Dia of pile =** 1.00 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 20.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non-Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					1.67	200	0.17											
1.00		2.00	4.00	0.00	28	1.00	1.00	1.67	200	0.50								314.29		16.75	
1.00		4.00	7.00	0.00	29	1.00	1.00	1.76	300	0.93								314.29		48.71	
1.00		7.00	11.50	0.00	31	1.00	1.00	1.83	450	1.61								314.29		136.66	
1.00		11.50	14.50	0.00	31	1.00	1.00	1.84	300	2.30								314.29		130.11	
1.00		14.50	15.00	0.00	32	1.00	1.00	1.88	50	2.62								314.29		25.72	
1.00		15.00	19.00	0.00	32	1.00	1.00	1.88	400	2.67								314.29		209.49	
1.00		19.00	20.00	0.18	27	1.00	1.00	1.88	100	2.67								314.29		48.36	
1.00		20.00	23.50	0.18	27	1.00	1.00	0.88	350	2.67								314.29		169.26	
1.00		23.50	26.00	0.18	28	1.00	1.00	0.97	250	2.67	2.67	0.97	0.18	28	9	15.50	16.72	314.29	7857.14	125.55	343.60
																				910.62	343.60

Qu,comp.= qs + Qp

Qa,comp.= (910.62 + 343.6) / 2.5

Qa,comp.= 501.69 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 910.62 / 3 + 47.12

Qa,uplift = 350.66 T

Say **Qa,comp.= 501.00 T** **Qa,uplift = 350.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 26.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** 1+006 **Dia of pile =** 1.00 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 20.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non-Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Nγ	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					1.67	200	0.17											
1.00		2.00	4.00	0.00	28	1.00	1.00	1.67	200	0.50								314.29		16.75	
1.00		4.00	7.00	0.00	29	1.00	1.00	1.76	300	0.93								314.29		48.71	
1.00		7.00	11.50	0.00	31	1.00	1.00	1.83	450	1.61								314.29		136.66	
1.00		11.50	14.50	0.00	31	1.00	1.00	1.84	300	2.30								314.29		130.11	
1.00		14.50	15.00	0.00	32	1.00	1.00	1.88	50	2.62								314.29		25.72	
1.00		15.00	19.00	0.00	32	1.00	1.00	1.88	400	2.67								314.29		209.49	
1.00		19.00	20.00	0.18	27	1.00	1.00	1.88	100	2.67								314.29		48.36	
1.00		20.00	23.50	0.18	27	1.00	1.00	0.88	350	2.67								314.29		169.26	
1.00		23.50	28.00	0.18	28	1.00	1.00	0.97	450	2.67	2.67	0.98	1.56	4	9	1.43	0.34	314.29	7857.14	225.99	140.45
																				1011.06	140.45

Qu,comp.= qs + Qp

Qa,comp.= (1011.06 + 140.45) / 2.5

Qa,comp.= 460.60 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 1011.06 / 3 + 51.05

Qa,uplift = 388.07 T

Say **Qa,comp.= 460.00 T** **Qa,uplift = 388.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 28.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** 1+006 **Dia of pile =** 1.00 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 20.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non-Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					1.67	200	0.17											
1.00		2.00	4.00	0.00	28	1.00	1.00	1.67	200	0.50								314.29		16.75	
1.00		4.00	7.00	0.00	29	1.00	1.00	1.76	300	0.93								314.29		48.71	
1.00		7.00	11.50	0.00	31	1.00	1.00	1.83	450	1.61								314.29		136.66	
1.00		11.50	14.50	0.00	31	1.00	1.00	1.84	300	2.30								314.29		130.11	
1.00		14.50	15.00	0.00	32	1.00	1.00	1.88	50	2.62								314.29		25.72	
1.00		15.00	19.00	0.00	32	1.00	1.00	1.88	400	2.67								314.29		209.49	
1.00		19.00	20.00	0.18	27	1.00	1.00	1.88	100	2.67								314.29		48.36	
1.00		20.00	23.50	0.18	27	1.00	1.00	0.88	350	2.67								314.29		169.26	
1.00		23.50	29.50	0.18	28	1.00	1.00	0.97	600	2.67								314.29		301.32	
1.00		29.50	30.00	1.56	4	1.00	0.29	0.98	50	2.67	2.67	0.98	1.56	4	9	1.43	0.34	314.29	7857.14	10.02	140.45
																				1096.41	140.45

Qu,comp.= qs + Qp

Qa,comp.= (1096.41 + 140.45) / 2.5

Qa,comp.= 494.74 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 1096.41 / 3 + 54.98

Qa,uplift = 420.45 T

Say **Qa,comp.= 494.00 T** **Qa,uplift = 420.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 18.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** 1+006 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 20.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non-Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					1.67	200	0.17											
1.20		2.00	4.00	0.00	28	1.00	1.00	1.67	200	0.50								377.14		20.10	
1.20		4.00	7.00	0.00	29	1.00	1.00	1.76	300	0.93								377.14		58.46	
1.20		7.00	11.50	0.00	31	1.00	1.00	1.83	450	1.61								377.14		163.99	
1.20		11.50	14.50	0.00	31	1.00	1.00	1.84	300	2.30								377.14		156.13	
1.20		14.50	18.00	0.00	32	1.00	1.00	1.88	350	2.90								377.14		239.36	
1.20		18.00	19.00	0.00	32	1.00	1.00	1.88	100	3.23								377.14		76.14	
1.20		19.00	20.00	0.18	27	1.00	1.00	1.88	100	3.23	3.23	0.88	0.18	27	9	13.39	14.47	377.14	11314.29	68.88	516.25
																				783.05	516.25

Qu,comp.= qs + Qp

Qa,comp.= (783.05 + 516.25) / 2.5

Qa,comp.= 519.72 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 783.05 / 3 + 50.89

Qa,uplift = 311.91 T

Say **Qa,comp.= 519.00 T** **Qa,uplift = 311.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 20.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** 1+006 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 20.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non-Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					1.67	200	0.17											
1.20		2.00	4.00	0.00	28	1.00	1.00	1.67	200	0.50								377.14		20.10	
1.20		4.00	7.00	0.00	29	1.00	1.00	1.76	300	0.93								377.14		58.46	
1.20		7.00	11.50	0.00	31	1.00	1.00	1.83	450	1.61								377.14		163.99	
1.20		11.50	14.50	0.00	31	1.00	1.00	1.84	300	2.30								377.14		156.13	
1.20		14.50	18.00	0.00	32	1.00	1.00	1.88	350	2.90								377.14		239.36	
1.20		18.00	19.00	0.00	32	1.00	1.00	1.88	100	3.23								377.14		76.14	
1.20		19.00	20.00	0.18	27	1.00	1.00	1.88	100	3.23								377.14		68.88	
1.20		20.00	22.00	0.18	27	1.00	1.00	0.88	200	3.23	3.23	0.88	0.18	27	9	13.39	14.47	377.14	11314.29	137.75	516.25
																				920.80	516.25

Qu,comp.= qs + Qp

Qa,comp.= (920.8 + 516.25) / 2.5

Qa,comp.= 574.82 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 920.8 / 3 + 56.55

Qa,uplift = 363.48 T

Say **Qa,comp.= 574.00 T** **Qa,uplift = 363.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 22.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** 1+006 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 20.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non-Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Nγ	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					1.67	200	0.17											
1.20		2.00	4.00	0.00	28	1.00	1.00	1.67	200	0.50								377.14		20.10	
1.20		4.00	7.00	0.00	29	1.00	1.00	1.76	300	0.93								377.14		58.46	
1.20		7.00	11.50	0.00	31	1.00	1.00	1.83	450	1.61								377.14		163.99	
1.20		11.50	14.50	0.00	31	1.00	1.00	1.84	300	2.30								377.14		156.13	
1.20		14.50	18.00	0.00	32	1.00	1.00	1.88	350	2.90								377.14		239.36	
1.20		18.00	19.00	0.00	32	1.00	1.00	1.88	100	3.23								377.14		76.14	
1.20		19.00	20.00	0.18	27	1.00	1.00	1.88	100	3.23								377.14		68.88	
1.20		20.00	23.50	0.18	27	1.00	1.00	0.88	350	3.23								377.14		241.06	
1.20		23.50	24.00	0.18	28	1.00	1.00	0.97	50	3.23	3.23	0.88	0.18	27	9	13.39	14.47	377.14	11314.29	35.79	516.25
																				1059.90	516.25

Qu,comp.= qs + Qp

Qa,comp.= (1059.9 + 516.25) / 2.5

Qa,comp.= 630.46 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 1059.9 / 3 + 62.2

Qa,uplift = 415.50 T

Say **Qa,comp.= 630.00 T** **Qa,uplift = 415.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 24.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** 1+006 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 20.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non-Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Nγ	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					1.67	200	0.17											
1.20		2.00	4.00	0.00	28	1.00	1.00	1.67	200	0.50								377.14		20.10	
1.20		4.00	7.00	0.00	29	1.00	1.00	1.76	300	0.93								377.14		58.46	
1.20		7.00	11.50	0.00	31	1.00	1.00	1.83	450	1.61								377.14		163.99	
1.20		11.50	14.50	0.00	31	1.00	1.00	1.84	300	2.30								377.14		156.13	
1.20		14.50	18.00	0.00	32	1.00	1.00	1.88	350	2.90								377.14		239.36	
1.20		18.00	19.00	0.00	32	1.00	1.00	1.88	100	3.23								377.14		76.14	
1.20		19.00	20.00	0.18	27	1.00	1.00	1.88	100	3.23								377.14		68.88	
1.20		20.00	23.50	0.18	27	1.00	1.00	0.88	350	3.23								377.14		241.06	
1.20		23.50	26.00	0.18	28	1.00	1.00	0.97	250	3.23	3.23	0.97	0.18	28	9	15.50	16.72	377.14	11314.29	178.95	595.48
																				1203.06	595.48

Qu,comp.= qs + Qp Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,comp.= (1203.06 + 595.48) / 2.5 Qa,uplift = 1203.06 / 3 + 67.86

Qa,comp.= 719.42 T Qa,uplift = 468.88 T

Say **Qa,comp.= 719.00 T** **Qa,uplift = 468.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 26.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** 1+006 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 20.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non-Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Nγ	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					1.67	200	0.17											
1.20		2.00	4.00	0.00	28	1.00	1.00	1.67	200	0.50								377.14		20.10	
1.20		4.00	7.00	0.00	29	1.00	1.00	1.76	300	0.93								377.14		58.46	
1.20		7.00	11.50	0.00	31	1.00	1.00	1.83	450	1.61								377.14		163.99	
1.20		11.50	14.50	0.00	31	1.00	1.00	1.84	300	2.30								377.14		156.13	
1.20		14.50	18.00	0.00	32	1.00	1.00	1.88	350	2.90								377.14		239.36	
1.20		18.00	19.00	0.00	32	1.00	1.00	1.88	100	3.23								377.14		76.14	
1.20		19.00	20.00	0.18	27	1.00	1.00	1.88	100	3.23								377.14		68.88	
1.20		20.00	23.50	0.18	27	1.00	1.00	0.88	350	3.23								377.14		241.06	
1.20		23.50	28.00	0.18	28	1.00	1.00	0.97	450	3.23	3.23	0.98	1.56	4	9	1.43	0.34	377.14	11314.29	322.10	211.42
																				1346.22	211.42

Qu,comp.= qs + Qp

Qa,comp.= (1346.22 + 211.42) / 2.5

Qa,comp.= 623.05 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 1346.22 / 3 + 73.51

Qa,uplift = 522.25 T

Say **Qa,comp.= 623.00 T** **Qa,uplift = 522.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 28.00 m **Bore Hole No =** BH-A1 **Ch. (KM)** 1+006 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 20.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** Non-Liquefiable

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Nγ	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					1.67	200	0.17											
1.20		2.00	4.00	0.00	28	1.00	1.00	1.67	200	0.50								377.14		20.10	
1.20		4.00	7.00	0.00	29	1.00	1.00	1.76	300	0.93								377.14		58.46	
1.20		7.00	11.50	0.00	31	1.00	1.00	1.83	450	1.61								377.14		163.99	
1.20		11.50	14.50	0.00	31	1.00	1.00	1.84	300	2.30								377.14		156.13	
1.20		14.50	18.00	0.00	32	1.00	1.00	1.88	350	2.90								377.14		239.36	
1.20		18.00	19.00	0.00	32	1.00	1.00	1.88	100	3.23								377.14		76.14	
1.20		19.00	20.00	0.18	27	1.00	1.00	1.88	100	3.23								377.14		68.88	
1.20		20.00	23.50	0.18	27	1.00	1.00	0.88	350	3.23								377.14		241.06	
1.20		23.50	29.50	0.18	28	1.00	1.00	0.97	600	3.23								377.14		429.47	
1.20		29.50	30.00	1.56	4	1.00	0.29	0.98	50	3.23	3.23	0.98	1.56	4	9	1.43	0.34	377.14	11314.29	12.76	211.42
																				1466.35	211.42

Qu,comp.= qs + Qp

Qa,comp.= (1466.35 + 211.42) / 2.5

Qa,comp.= 671.11 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 1466.35 / 3 + 79.17

Qa,uplift = 567.95 T

Say **Qa,comp.= 671.00 T** **Qa,uplift = 567.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 22.00 m **Bore Hole No =** BH-A2 **Ch. (KM)** 7+351 **Dia of pile =** 1.00 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 0.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** 7.00 m

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					0.65	200	0.06											
1.00		2.00	5.50	0.00	29	1.00	1.00	0.65	350	0.24								314.29		0.00	
1.00		5.50	7.00	0.00	29	1.00	1.00	0.66	150	0.41								314.29		0.00	
1.00		7.00	8.50	0.00	29	1.00	1.00	0.66	150	0.51								314.29		13.21	
1.00		8.50	11.50	0.10	29	1.00	1.00	0.75	300	0.67								314.29		44.36	
1.00		11.50	14.50	0.11	30	1.00	1.00	0.79	300	0.90								314.29		59.37	
1.00		14.50	15.00	0.22	29	1.00	1.00	0.94	50	1.04								314.29		12.54	
1.00		15.00	18.00	0.22	29	1.00	1.00	0.94	300	1.07								314.29		76.43	
1.00		18.00	24.00	0.19	30	1.00	1.00	0.96	600	1.07	1.07	0.98	0.15	30	9	20.75	22.40	314.29	7857.14	151.84	192.88
																				357.75	192.88

Qu,comp.= qs + Qp Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,comp.= (357.75 + 192.88) / 2.5 Qa,uplift = 357.75 / 3 + 43.2

Qa,comp.= 220.25 T Qa,uplift = 162.45 T

Say **Qa,comp.= 220.00 T** **Qa,uplift = 162.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 24.00 m **Bore Hole No =** BH-A2 **Ch. (KM)** 7+351 **Dia of pile =** 1.00 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 0.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** 7.00 m

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					0.65	200	0.06											
1.00		2.00	5.50	0.00	29	1.00	1.00	0.65	350	0.24								314.29		0.00	
1.00		5.50	7.00	0.00	29	1.00	1.00	0.66	150	0.41								314.29		0.00	
1.00		7.00	8.50	0.00	29	1.00	1.00	0.66	150	0.51								314.29		13.21	
1.00		8.50	11.50	0.10	29	1.00	1.00	0.75	300	0.67								314.29		44.36	
1.00		11.50	14.50	0.11	30	1.00	1.00	0.79	300	0.90								314.29		59.37	
1.00		14.50	15.00	0.22	29	1.00	1.00	0.94	50	1.04								314.29		12.54	
1.00		15.00	18.00	0.22	29	1.00	1.00	0.94	300	1.07								314.29		76.43	
1.00		18.00	25.00	0.19	30	1.00	1.00	0.96	700	1.07								314.29		177.15	
1.00		25.00	26.00	0.15	30	1.00	1.00	0.98	100	1.07	1.07	0.98	0.15	30	9	20.75	22.40	314.29	7857.14	24.05	192.88
																				407.11	192.88

Qu,comp.= qs + Qp

Qa,comp.= (407.11 + 192.88) / 2.5

Qa,comp.= 240.00 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 407.11 / 3 + 47.12

Qa,uplift = 182.83 T

Say **Qa,comp.= 239.00 T** **Qa,uplift = 182.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 26.00 m **Bore Hole No =** BH-A2 **Ch. (KM)** 7+351 **Dia of pile =** 1.00 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 0.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** 7.00 m

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					0.65	200	0.06											
1.00		2.00	5.50	0.00	29	1.00	1.00	0.65	350	0.24								314.29		0.00	
1.00		5.50	7.00	0.00	29	1.00	1.00	0.66	150	0.41								314.29		0.00	
1.00		7.00	8.50	0.00	29	1.00	1.00	0.66	150	0.51								314.29		13.21	
1.00		8.50	11.50	0.10	29	1.00	1.00	0.75	300	0.67								314.29		44.36	
1.00		11.50	14.50	0.11	30	1.00	1.00	0.79	300	0.90								314.29		59.37	
1.00		14.50	15.00	0.22	29	1.00	1.00	0.94	50	1.04								314.29		12.54	
1.00		15.00	18.00	0.22	29	1.00	1.00	0.94	300	1.07								314.29		76.43	
1.00		18.00	25.00	0.19	30	1.00	1.00	0.96	700	1.07								314.29		177.15	
1.00		25.00	28.00	0.15	30	1.00	1.00	0.98	300	1.07	1.07	0.98	0.15	30	9	20.75	22.40	314.29	7857.14	72.15	192.88
																				455.21	192.88

Qu,comp.= qs + Qp

Qa,comp.= (455.21 + 192.88) / 2.5

Qa,comp.= 259.24 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 455.21 / 3 + 51.05

Qa,uplift = 202.79 T

Say **Qa,comp.= 259.00 T** **Qa,uplift = 202.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 28.00 m **Bore Hole No =** BH-A2 **Ch. (KM)** 7+351 **Dia of pile =** 1.00 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 0.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** 7.00 m

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					0.65	200	0.06											
1.00		2.00	5.50	0.00	29	1.00	1.00	0.65	350	0.24								314.29		0.00	
1.00		5.50	7.00	0.00	29	1.00	1.00	0.66	150	0.41								314.29		0.00	
1.00		7.00	8.50	0.00	29	1.00	1.00	0.66	150	0.51								314.29		13.21	
1.00		8.50	11.50	0.10	29	1.00	1.00	0.75	300	0.67								314.29		44.36	
1.00		11.50	14.50	0.11	30	1.00	1.00	0.79	300	0.90								314.29		59.37	
1.00		14.50	15.00	0.22	29	1.00	1.00	0.94	50	1.04								314.29		12.54	
1.00		15.00	18.00	0.22	29	1.00	1.00	0.94	300	1.07								314.29		76.43	
1.00		18.00	25.00	0.19	30	1.00	1.00	0.96	700	1.07								314.29		177.15	
1.00		25.00	30.00	0.15	30	1.00	1.00	0.98	500	1.07	1.07	0.98	0.15	30	9	20.75	22.40	314.29	7857.14	120.25	192.88
																				503.30	192.88

Qu,comp.= qs + Qp

Qa,comp.= (503.3 + 192.88) / 2.5

Qa,comp.= 278.47 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 503.3 / 3 + 54.98

Qa,uplift = 222.75 T

Say **Qa,comp.= 278.00 T** **Qa,uplift = 222.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 30.00 m **Bore Hole No =** BH-A2 **Ch. (KM)** 7+351 **Dia of pile =** 1.00 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 0.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** 7.00 m

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					0.65	200	0.06											
1.00		2.00	5.50	0.00	29	1.00	1.00	0.65	350	0.24								314.29		0.00	
1.00		5.50	7.00	0.00	29	1.00	1.00	0.66	150	0.41								314.29		0.00	
1.00		7.00	8.50	0.00	29	1.00	1.00	0.66	150	0.51								314.29		13.21	
1.00		8.50	11.50	0.10	29	1.00	1.00	0.75	300	0.67								314.29		44.36	
1.00		11.50	14.50	0.11	30	1.00	1.00	0.79	300	0.90								314.29		59.37	
1.00		14.50	15.00	0.22	29	1.00	1.00	0.94	50	1.04								314.29		12.54	
1.00		15.00	18.00	0.22	29	1.00	1.00	0.94	300	1.07								314.29		76.43	
1.00		18.00	25.00	0.19	30	1.00	1.00	0.96	700	1.07								314.29		177.15	
1.00		25.00	32.00	0.15	30	1.00	1.00	0.98	700	1.07	1.07	0.98	0.15	30	9	20.75	22.40	314.29	7857.14	168.35	192.88
																				551.40	192.88

Qu,comp.=	qs + Qp	Qu,uplift =	Safe Frictional Resistance + Weight of Pile
Qa,comp.=	(551.4 + 192.88) / 2.5	Qa,uplift =	551.4 / 3 + 58.9
Qa,comp.=	297.71 T	Qa,uplift =	242.71 T

Say **Qa,comp.= 297.00 T** **Qa,uplift = 242.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 32.00 m **Bore Hole No =** BH-A2 **Ch. (KM)** 7+351 **Dia of pile =** 1.00 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 0.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** 7.00 m

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.00	2.00	0.00	2.00					0.65	200	0.06											
1.00		2.00	5.50	0.00	29	1.00	1.00	0.65	350	0.24								314.29		0.00	
1.00		5.50	7.00	0.00	29	1.00	1.00	0.66	150	0.41								314.29		0.00	
1.00		7.00	8.50	0.00	29	1.00	1.00	0.66	150	0.51								314.29		13.21	
1.00		8.50	11.50	0.10	29	1.00	1.00	0.75	300	0.67								314.29		44.36	
1.00		11.50	14.50	0.11	30	1.00	1.00	0.79	300	0.90								314.29		59.37	
1.00		14.50	15.00	0.22	29	1.00	1.00	0.94	50	1.04								314.29		12.54	
1.00		15.00	18.00	0.22	29	1.00	1.00	0.94	300	1.07								314.29		76.43	
1.00		18.00	25.00	0.19	30	1.00	1.00	0.96	700	1.07								314.29		177.15	
1.00		25.00	34.00	0.15	30	1.00	1.00	0.98	900	1.07	1.07	0.98	0.15	30	9	20.75	22.40	314.29	7857.14	216.44	192.88
																				599.50	192.88

Qu,comp.= qs + Qp

Qa,comp.= (599.5 + 192.88) / 2.5

Qa,comp.= 316.95 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 599.5 / 3 + 62.83

Qa,uplift = 262.67 T

Say **Qa,comp.= 316.00 T** **Qa,uplift = 262.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 22.00 m **Bore Hole No =** BH-A2 **Ch. (KM)** 7+351 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 0.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** 7.00 m

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Nγ	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					0.65	200	0.06											
1.20		2.00	5.50	0.00	29	1.00	1.00	0.65	350	0.24								377.14		0.00	
1.20		5.50	7.00	0.00	29	1.00	1.00	0.66	150	0.41								377.14		0.00	
1.20		7.00	8.50	0.00	29	1.00	1.00	0.66	150	0.51								377.14		15.85	
1.20		8.50	11.50	0.10	29	1.00	1.00	0.75	300	0.67								377.14		53.24	
1.20		11.50	14.50	0.11	30	1.00	1.00	0.79	300	0.90								377.14		71.24	
1.20		14.50	18.00	0.22	29	1.00	1.00	0.94	350	1.18								377.14		115.56	
1.20		18.00	24.00	0.19	30	1.00	1.00	0.96	600	1.35	1.35	0.98	0.15	30	9	20.75	22.40	377.14	11314.29	218.88	346.11
																				474.78	346.11

Qu,comp.= qs + Qp

Qa,comp.= (474.78 + 346.11) / 2.5

Qa,comp.= 328.35 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 474.78 / 3 + 62.2

Qa,uplift = 220.46 T

Say **Qa,comp.= 328.00 T** **Qa,uplift = 220.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 24.00 m **Bore Hole No =** BH-A2 **Ch. (KM)** 7+351 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 0.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** 7.00 m

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					0.65	200	0.06											
1.20		2.00	5.50	0.00	29	1.00	1.00	0.65	350	0.24								377.14		0.00	
1.20		5.50	7.00	0.00	29	1.00	1.00	0.66	150	0.41								377.14		0.00	
1.20		7.00	8.50	0.00	29	1.00	1.00	0.66	150	0.51								377.14		15.85	
1.20		8.50	11.50	0.10	29	1.00	1.00	0.75	300	0.67								377.14		53.24	
1.20		11.50	14.50	0.11	30	1.00	1.00	0.79	300	0.90								377.14		71.24	
1.20		14.50	18.00	0.22	29	1.00	1.00	0.94	350	1.18								377.14		115.56	
1.20		18.00	25.00	0.19	30	1.00	1.00	0.96	700	1.35								377.14		255.36	
1.20		25.00	26.00	0.15	30	1.00	1.00	0.98	100	1.35	1.35	0.98	0.15	30	9	20.75	22.40	377.14	11314.29	34.97	346.11
																				546.23	346.11

Qu,comp.= qs + Qp

Qa,comp.= (546.23 + 346.11) / 2.5

Qa,comp.= 356.94 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 546.23 / 3 + 67.86

Qa,uplift = 249.93 T

Say **Qa,comp.= 356.00 T** **Qa,uplift = 249.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 26.00 m **Bore Hole No =** BH-A2 **Ch. (KM)** 7+351 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 0.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** 7.00 m

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					0.65	200	0.06											
1.20		2.00	5.50	0.00	29	1.00	1.00	0.65	350	0.24								377.14		0.00	
1.20		5.50	7.00	0.00	29	1.00	1.00	0.66	150	0.41								377.14		0.00	
1.20		7.00	8.50	0.00	29	1.00	1.00	0.66	150	0.51								377.14		15.85	
1.20		8.50	11.50	0.10	29	1.00	1.00	0.75	300	0.67								377.14		53.24	
1.20		11.50	14.50	0.11	30	1.00	1.00	0.79	300	0.90								377.14		71.24	
1.20		14.50	18.00	0.22	29	1.00	1.00	0.94	350	1.18								377.14		115.56	
1.20		18.00	25.00	0.19	30	1.00	1.00	0.96	700	1.35								377.14		255.36	
1.20		25.00	28.00	0.15	30	1.00	1.00	0.98	300	1.35	1.35	0.98	0.15	30	9	20.75	22.40	377.14	11314.29	104.91	346.11
																				616.17	346.11

Qu,comp.= qs + Qp

Qa,comp.= (616.17 + 346.11) / 2.5

Qa,comp.= 384.91 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 616.17 / 3 + 73.51

Qa,uplift = 278.90 T

Say **Qa,comp.= 384.00 T** **Qa,uplift = 278.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 28.00 m **Bore Hole No =** BH-A2 **Ch. (KM)** 7+351 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 0.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** 7.00 m

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					0.65	200	0.06											
1.20		2.00	5.50	0.00	29	1.00	1.00	0.65	350	0.24								377.14		0.00	
1.20		5.50	7.00	0.00	29	1.00	1.00	0.66	150	0.41								377.14		0.00	
1.20		7.00	8.50	0.00	29	1.00	1.00	0.66	150	0.51								377.14		15.85	
1.20		8.50	11.50	0.10	29	1.00	1.00	0.75	300	0.67								377.14		53.24	
1.20		11.50	14.50	0.11	30	1.00	1.00	0.79	300	0.90								377.14		71.24	
1.20		14.50	18.00	0.22	29	1.00	1.00	0.94	350	1.18								377.14		115.56	
1.20		18.00	25.00	0.19	30	1.00	1.00	0.96	700	1.35								377.14		255.36	
1.20		25.00	30.00	0.15	30	1.00	1.00	0.98	500	1.35	1.35	0.98	0.15	30	9	20.75	22.40	377.14	11314.29	174.86	346.11
																				686.12	346.11

Qu,comp.= qs + Qp

Qa,comp.= (686.12 + 346.11) / 2.5

Qa,comp.= 412.89 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 686.12 / 3 + 79.17

Qa,uplift = 307.87 T

Say **Qa,comp.= 412.00 T** **Qa,uplift = 307.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 30.00 m **Bore Hole No =** BH-A2 **Ch. (KM)** 7+351 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 0.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** 7.00 m

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Nγ	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					0.65	200	0.06											
1.20		2.00	5.50	0.00	29	1.00	1.00	0.65	350	0.24								377.14		0.00	
1.20		5.50	7.00	0.00	29	1.00	1.00	0.66	150	0.41								377.14		0.00	
1.20		7.00	8.50	0.00	29	1.00	1.00	0.66	150	0.51								377.14		15.85	
1.20		8.50	11.50	0.10	29	1.00	1.00	0.75	300	0.67								377.14		53.24	
1.20		11.50	14.50	0.11	30	1.00	1.00	0.79	300	0.90								377.14		71.24	
1.20		14.50	18.00	0.22	29	1.00	1.00	0.94	350	1.18								377.14		115.56	
1.20		18.00	25.00	0.19	30	1.00	1.00	0.96	700	1.35								377.14		255.36	
1.20		25.00	32.00	0.15	30	1.00	1.00	0.98	700	1.35	1.35	0.98	0.15	30	9	20.75	22.40	377.14	11314.29	244.80	346.11
																				756.06	346.11

Qu,comp.= qs + Qp

Qa,comp.= (756.06 + 346.11) / 2.5

Qa,comp.= 440.87 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 756.06 / 3 + 84.82

Qa,uplift = 336.84 T

Say **Qa,comp.= 440.00 T** **Qa,uplift = 336.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

NAME OF PROJECT:- "GTI for designing of bridges and embankment for Haryana Orbital Rail Corridor (HORC) project from Palwal to Harsana Kalan including connectivity to existing IR network in the state of Haryana.

Length of Pile below cut of level = 32.00 m **Bore Hole No =** BH-A2 **Ch. (KM)** 7+351 **Dia of pile =** 1.20 m **Cut-off Level =** 2.00 m below EGL

Restricting PD to 15D **Water Table depth considered for analysis =** 0.00 m **Scour Depth =** Non-scourable **Liquefaction Depth =** 7.00 m

Dia. of Pile	Cut-off Depth	Soil layers		Properties of layers/for Skin Friction							For End Bearing										
		from	to	c	Ø	k	α	γeff	ΔL	pd (s.f)	Pd (e.b)	γeff	c	Ø	Nc	Nq	Ny	As/cm	Ap	qs	Qp
(m)	(m)	(m)	(m)	kg/cm^2	deg			gm/cc	cm	kg/cm^2	kg/cm^2	gm/cc	kg/cm^2	deg				cm^2	cm^2	t	t
1.20	2.00	0.00	2.00					0.65	200	0.06											
1.20		2.00	5.50	0.00	29	1.00	1.00	0.65	350	0.24								377.14		0.00	
1.20		5.50	7.00	0.00	29	1.00	1.00	0.66	150	0.41								377.14		0.00	
1.20		7.00	8.50	0.00	29	1.00	1.00	0.66	150	0.51								377.14		15.85	
1.20		8.50	11.50	0.10	29	1.00	1.00	0.75	300	0.67								377.14		53.24	
1.20		11.50	14.50	0.11	30	1.00	1.00	0.79	300	0.90								377.14		71.24	
1.20		14.50	18.00	0.22	29	1.00	1.00	0.94	350	1.18								377.14		115.56	
1.20		18.00	25.00	0.19	30	1.00	1.00	0.96	700	1.35								377.14		255.36	
1.20		25.00	34.00	0.15	30	1.00	1.00	0.98	900	1.35	1.35	0.98	0.15	30	9	20.75	22.40	377.14	11314.29	314.74	346.11
																				826.00	346.11

Qu,comp.= qs + Qp

Qa,comp.= (826 + 346.11) / 2.5

Qa,comp.= 468.84 T

Qu,uplift = Safe Frictional Resistance + Weight of Pile

Qa,uplift = 826 / 3 + 90.48

Qa,uplift = 365.81 T

Say **Qa,comp.= 468.00 T** **Qa,uplift = 365.00 T**

*FOS for Vertical Capacity of pile in compression = 2.5

**FOS for Uplift Capacity of pile = 3.0

Lateral Load capacity of Pile

BH-A1

1+006

Type of Strata = Sandy

Le = Embedded Length of Pile in Meter = 20.000 m **Fck = 35.0 N/mm^2** **D = 100 cm**

Pile cap bottom level -2.0 m

Max. of Liquefaction & Scour Depth -2.0 m

E = Young's Modulus of Pile (Kg/cm^2) = $5000\sqrt{F_{ck}}$ N/mm^2 = 295803.99 Kg/cm^2

I = Moment of Inertia (cm^2) = $\pi x D^4/64$ = 4908738.5 cm^4

K_1 = Constant for Sandy / Normally Consolidated Clay (Kg/cm^3) = **0.385**

T, Relative stiffness factor in Sand $T = \sqrt[5]{\frac{EI}{K_1}}$ = **327.6** cm

For Long Pile If $L_e > 4T$

L1 = = **0.000** cm

$\frac{L_1}{T}$ = 0.00

For Fixed Head Pile

$\frac{L_f}{T}$ = **2.219** From Fig. 4

Lf = 726.95 cm

Equivalent length of cantilever L= L1+LF: 0.00 + 726.95089 = **726.95** cm

Y = Pile Head Deflection (Cm) = $\frac{Q(L_1 + L_F)^3}{12\ EI}$ (for fixed Head pile)

Q = Lateral Load in Kg

Lateral Load For Pile Head Deflection .5 cm Q = 22678.27 Kg

= **22.68 T**

Say 22.0 T

Lateral Load capacity of Pile

BH-A1

1+006

Type of Strata = Sandy

Le = Embedded Length of Pile in Meter = 20.000 m **Fck = 35.0 N/mm^2** **D = 120 cm**

Pile cap bottom level -2.0 m

Max. of Liquefaction & Scour Depth -2.0 m

E = Young's Modulus of Pile (Kg/cm^2) = $5000\sqrt{F_{ck}}$ N/mm^2 = 295803.99 Kg/cm^2

I = Moment of Inertia (cm^2) = $\pi x D^4/64$ = 10178760.2 cm^4

K_1 = Constant for Sandy / Normally Consolidated Clay (Kg/cm^3) = **0.385**

T, Relative stiffness factor in Sand

$$T = \sqrt[5]{\frac{EI}{K_1}}$$

= **379.0** cm

For Long Pile If $L_e > 4T$

L1 = = **0.000** cm

$\frac{L_1}{T}$ = 0.00

For Fixed Head Pile

$\frac{L_f}{T}$ = **2.219** From Fig. 4

Lf = 841.10 cm

Equivalent length of cantilever L= $L1+L_F$ 0.00 + 841.10472 = **841.10** cm

Y = Pile Head Deflection (Cm) = $\frac{Q(L_1 + L_F)^3}{12 EI}$ (for fixed Head pile)

Q = Lateral Load in Kg

Lateral Load For Pile Head Deflection .5 cm Q = 30359.87 Kg

= **30.36 T**

Say 30.0 T

Lateral Load capacity of Pile

BH-A2

7+351

Type of Strata = Sandy

Le = Embedded Length of Pile in Meter = 24.000 m Fck = 35.0 N/mm^2 D = 100 cm

Bed level	**0.0 m**
Pile cap bottom level	**-2.0 m**
Max. of Liquefaction & Scour Depth	**-7.0 m**

E = Young's Modulus of Pile (Kg/cm^2) = $5000\sqrt{F_{ck}}$ N/mm^2 = 295803.99 Kg/cm^2

I = Moment of Inertia (cm^2) = $\pi x D^4/64$ = 4908738.5 cm^4

K_1 = Constant for Sandy / Normally Consolidated Clay (Kg/cm^3) = **0.284**

T, Relative stiffness factor in Sand $T = \sqrt[5]{\frac{EI}{K_1}}$ = **348.1** cm

For Long Pile If $L_e > 4T$

L1 = = **500.000** cm

$\frac{L_1}{T}$ = 1.44

For Fixed Head Pile

$\frac{L_f}{T}$ = **1.958** From Fig. 4

Lf = 681.75 cm

Equivalent length of cantilever L= L1+LF: 500.00 + 681.75139 = **1181.75** cm

Y = Pile Head Deflection (Cm) = $\frac{Q(L_1 + L_F)^3}{12 EI}$ (for fixed Head pile)

Q = Lateral Load in Kg

Safe Lateral resistance of Pile = Lateral resistance at pile head corresponding to deflection 5mm at liquefaction level 0.8 cm

= **8.59 T**

Say 8 T

Lateral Load capacity of Pile

BH-A2

7+351

Type of Strata = Sandy

Le = Embedded Length of Pile in Meter = 24.000 m Fck = 35.0 N/mm^2 D = 120 cm

Bed level	**0.0 m**
Pile cap bottom level	**-2.0 m**
Max. of Liquefaction & Scour Depth	**-7.0 m**

E = Young's Modulus of Pile (Kg/cm^2) = $5000\sqrt{F_{ck}}$ N/mm^2 = 295803.99 Kg/cm^2

I = Moment of Inertia (cm^2) = $\pi x D^4/64$ = 10178760.2 cm^4

K_1 = Constant for Sandy / Normally Consolidated Clay (Kg/cm^3) = **0.284**

T, Relative stiffness factor in Sand $T = \sqrt[5]{\frac{EI}{K_1}}$ = **402.8** cm

For Long Pile If $L_e > 4T$

L1 = = **500.000** cm

$\frac{L_1}{T}$ = 1.24

For Fixed Head Pile

$\frac{L_f}{T}$ = **1.977** From Fig. 4

Lf = 796.12 cm

Equivalent length of cantilever L= L1+L_F 500.00 + 796.12422 = **1296.12** cm

Y = Pile Head Deflection (Cm) = $\frac{Q(L_1 + L_F)^3}{12\ EI}$ (for fixed Head pile)

Q = Lateral Load in Kg

Safe Lateral resistance of Pile = Lateral resistance at pile head corresponding to deflection 5mm at liquefaction level 0.7 cm

= **12.41 T**

Say 12 T

7.3 *Additional Geotechnical Investigation Reports*

CONTENTS

Note: Additional Geotechnical Investigation Report (indicative report) for 87 Nos. of boreholes included with these reports for Tenderer's reference

Report No: 1901-HORC-I

Report No.: 1901-HORC-I

Date: Oct 16th; 2023

GEOTECHNICAL INVESTIGATION REPORT

ULR No.: TC916923000000032P
REVISION-R1

AT THE SITE FOR

HORC VIADUCT BETWEEN SOHANA & DHULAWAT STATIONS OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT, HARYANA

FROM BOREHOLES A1 TO P20

CLIENT

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.

Plot No. 143, 5th floor RailTel tower, Sector-44,
Gurugram, Haryana 122003

GENERAL CONSULTANTS

RITES-SMEC JV

Gurugram, Haryana

GEOTECHNICAL CONSULTANTS

TECHPRO ENGINEERS PVT. LTD.

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G T ROAD, KANPUR-209 217, Phone: 9793209918

e-mail: info@techproindia.com

TC-6100

REVISION NOTES

REVISION NO.	DATE	DESCRIPTION
R1	09.12.23	• Vertical and Lateral pile load capacity in Table 1 to 4 of Appendix-H and recommendations revised. • Field bore log charts added in Appendix-K.

REPORT FORMAT

Report No.	Bore included	Total Number of Bores
1901-HORC-I	A1 to P20	21
1901-HORC-II	P21 to P40	20
1901-HORC-III	P41 to P60	20
1901-HORC-IV	P61 to P80	20
1901-HORC-V	P81 to P100	20
1901-HORC-VI	P101 to P113	13
1901-HORC-VII	P114A to P133A	20
1901-HORC-VIII	P134A to A2A	16
1901-HORC-IX	P114B to P133B	20
1901-HORC-X	P134B to A2B	16

TABLE OF CONTENTS

APPENDICES

National Accreditation Board for
Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

TECHPRO ENGINEERS PVT. LTD. (LABORATORY DIVISION)

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G.T. ROAD, KANPUR, UTTAR PRADESH, INDIA

in the field of

TESTING

Certificate Number: TC-9169

Issue Date: 23/12/2022 Valid Until: 22/12/2024

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
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Name of Legal Identity : Techpro Engineers Private Limited

Signed for and on behalf of NABL

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Oct 16th; 2023

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We are pleased to submit the part-1 of the report of Geotechnical investigation, conducted for the boreholes A1 and P1 to P20 for the design of foundations for HORC Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) project in the state of Haryana, India.

We hereby, convey our sincere thanks to Mr. Neeraj Bhandari (CPM/South) and Mr. Raju Solanki (DGM/C/South), HRIDCL for trust and support during the investigation. We also acknowledge our thanks to Mr. Uma Maheshwara Rao B, DGM/C/West, HRIDCL for awarding the said work to us. We are also grateful Mr. Ravindra Dutta Upadhyay (Geotech Expert), Mr. PS Gautam & Mr. Jitender Parashar, Site Engineer from the RITES- SMEC JV and Mohd. Ishak (Executive/Civil) from HRIDCL, for their help rendered during and prior to the investigation work.

We are also thankful to our staff members for conducting field and laboratory test, preparing sketches, and typing the report.

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech. (Civil), M.Tech.
Principal Consultant &
Managing Director

1. INTRODUCTION:

Haryana Rail Infrastructure Development Corporation Ltd. (HRIDC) and Ministry of Railways, Govt. of India has come together to form a new company namely Haryana Orbital Rail Corporation Limited (HORCL), to design and construction of new BG line from Palwal to Sonipat named Haryana Orbital Rail Corridor (HORC), in the state of Haryana, India. In this connection, a Geotechnical investigation has been planned for the design of foundations of Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) Project in the state of Haryana. The work of conducting the detailed Geotechnical Investigation has been awarded to us by HRIDC, through work order No. HRIDC/HORC/GTI/211/2023-2024/Vol-0 dated 02-09-2023, which includes investigation in field, laboratory testing of disturbed and undisturbed samples, collected from the field, and submission of the geotechnical **investigation** test report.

A geotechnical investigation was carried out, with the locations, planned by the client. Purpose of the investigation is to determine the nature and properties of soil and rock strata across the bore holes and representing them through log sections showing the levels, nature, and properties of various strata up to a sufficient depth below the founding level, proneness of site to artesian conditions, seismic disturbance and other engineering properties of soil and rock strata.

This part -1 of the report includes the detailed methodology of investigation, collection of samples, field and laboratory test result including their interpretation/ analysis, recommendations on the properties of soils and rock required for design of foundation and suggesting suitable type and depth of foundation with allowable bearing capacity for safe and strong foundations for the Bore Hole numbers A1 and P1 to P20.

2. SCOPE OF WORK:

For the design of foundation of viaduct, it is required to determine the allowable bearing capacity together with necessary engineering characteristics of underlying soil & rock strata. In general, the geotechnical investigation has been planned as per IS:1892-2021 and further extended to IS: 1904, IS:2911 (part-1/Sec 2) & IRC 78:2014 for planning the laboratory testing and computing the allowable bearing capacity, hence the scope of work is as follows:

2.1. Mobilisation of all tools & plants along with accessories, materials, labours etc. at site of work for drilling and testing work, including setting up boring and shifting to different bore holes point etc.

2.2. Exploratory drilling of 150 mm diameter bore holes through soil deposits and 75 mm in rock within the proposed alignment upto the required depth.

2.3. Collection of disturbed soil samples at an interval of 3.00 meter in all the bore holes.

2.4. Collection of undisturbed soil samples at every 3.00 m interval or at change of stratum from all the boreholes.

2.5. To conduct Standard Penetration Test (SPT) at an interval of 3.00 m or noticeable change of stratum in soil deposits in all bore holes.

2.6. Collection of rock core samples and preserving them in core boxes.

2.7. To collect ground water sample on completion of bore holes.

2.8. To record the ground water table in all the bore holes.

2.9. Transporting all the disturbed, undisturbed soil and rock core samples collected during the field investigation to our NABL accredited Geotech Engineering laboratory at Kanpur.

2.10. To conduct the laboratory tests on all the soil and rock core samples collected during field investigation for determination of their engineering characteristics.

2.11. To compile of field and laboratory test results, working out the allowable bearing capacity and preparing the report including detailed recommendations and necessary precautions.

3. GEOLOGICAL INFORMATION OF THE REGION:

3.1. Geography:

The project location is in the bordering area of Gurugram and Nuh (recent old name-Mewat), districts in the Indian state of Haryana. The stretch of the alignment of the proposed corridor starts from southmost part of Gurugram in the town of Sohna and ends at Dhulawat, which is a village lying at the north of Nuh district.

Haryana is a state located in the northern part of India. Gurugram is among one

of the districts in Haryana which is also the part of National Capital Region (30km south of New Delhi). It lies at an elevation of 217 m above msl. Sohna is a small town located 25km in the south of Gurugram. Sohna is well known for its hot water springs and famous Shiva temple. Sohna is located in between 28°15’ N latitude and 77°40' E longitude at the elevation of 212.14m above msl. Mewat district is located at 28 °12′ N latitude, 77 °3′ E longitude, at the south of Gurugram at an elevation of 199 m above msl. The location is bordered by Rewari district on west and Faridabad & Palwal district on the east.

3.2. Geology:

The Gurugram district is having of almost flat topography, however, in the north-eastern part small isolated hillocks of Precambrian rocks are exposed. Small hill ranges which are part of the Aravali and Mangar Bani ranges exists in the district. The major part of district is underlain by Quaternary alluvium consisting of sand, clay and silt. The alluvial plain is formed by the Sahibi river which is a tributary of River Yamuna. Soils of the Gurgaon district is classified as tropical and brown soils, existing in the north western extreme, northern and north eastern parts of the district and water logged and salt affected soils in the southern parts of the district. The soils are medium textured loamy sand is the average texture in Gurgaon and Sohna blocks.

3.3. Rainfall and Climate:

The area has hot semi-arid type of climate characterising extreme dryness of the air except in the monsoon season. Intense hot summer and cold winters. The total annual rainfall in the region is about 596 mm, of which 75 to 80% is because of the south-west monsoon.

3.4. Seismicity:

The site under consideration exists in the district of Gurugram and Mewat which lies in the Seismic Zone IV (high damage risk zone), as per the current seismic zonation map of India (IS 1893-2016): RA 2021 and have a zone factor of 0.24 for design basis earthquake. The region is surrounded by many in-homogeneities in the form of faults and ridges like Sohna Fault, Moradabad Fault, Delhi-Moradabad Fault, Delhi-Haridwar ridge, junction of Aravalli and Alluvium near Delhi. The Sohna fault line lies between the Delhi ridge and Sohna town and falls between the Arjangarh and

Manesar outcrops. All the developed area in Gurugram comes within 200 km of the fault line. The Sohna fault line is located at the junction between the hard rock terrain of the Aravalli hills and the sandy formation of the Yamuna River and is currently inactive from several years and is capable of a disastrous earthquake.

The project location has been marked in Fig.1 Seismic zone map of India.

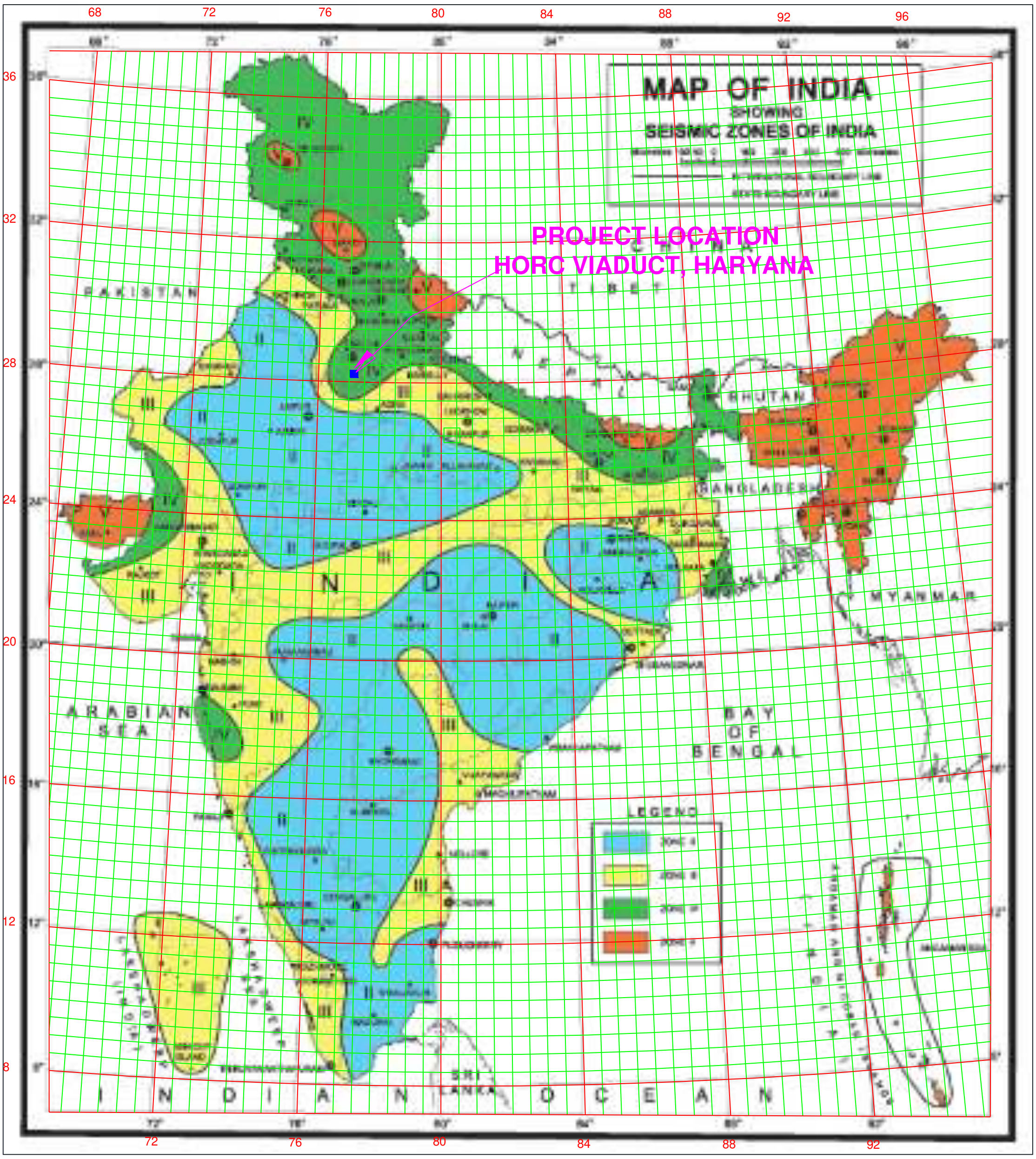


Fig.1: Seismic Zone Map of India

4. FIELD INVESTIGATION:

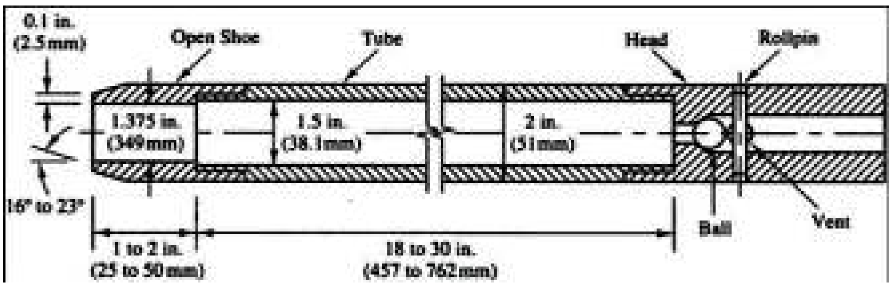
The field investigation work at this site was carried out from Sep 20th; 2023 to Sep 23rd; 2023 & Oct 15th; 2023 to Oct 22nd; 2023. The following investigation

work was carried out:

4.1. **Six number** of **boreholes** (marked as A1, P6, P12, P13, P17 & P18) of diameter 150 mm in soil were made within the proposed alignment for conducting Standard Penetration Test and collection of disturbed and undisturbed soil samples. The boreholes were progressed using power operated winch machine under percussion method of drilling. Casing was used to keep the borehole stable, and Bentonite was also used as drilling mud to help prevent wall collapse of boreholes at deeper depth. The records of achieved depth of bore holes have been given in Para No. 6, the details of drilled bores along with depth of casing used have been reported in Appendix B. Locations of boreholes have been reported in "TEST LOCATION PLAN" in Appendix A.

4.2. **Standard Penetration Tests** were conducted at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth, as per the procedure in IS: 2131-1981-(RA: 2021) in all the bore holes. The **standard SPT sampler** (without liner and with no space for liner) and **auto-trip hammer** of standard weight of 63.50 kg have been used to perform the test.

For conducting the test, the bottom of the borehole was properly cleaned, and split spoon sampler was properly seated in position in the borehole. The split spoon sampler resting on the bottom of borehole was allowed to sink under its own weight; then the sampler was allowed to penetrate 15 cm with the blows of the hammer 63.50 kg weight falling free through 75cm, thereafter the split spoon sampler was further driven by another 15 cm. For the 3rd and final drive, the sampler was further allowed to penetrate 15 cm. The number of blows required to get each 15 cm of penetration, was recorded. The first 15 cm of drive is seating drive.



Structure of SPT Sampler

The total blows of penetration for the second and third 15 cm of penetration is

termed the penetration resistance N. The N' values are indicative of the compactness/ relative density of cohesion less soils and consistency of cohesive soils.

In case the blows count of SPT in soil (including the number of blows of seating) exceeds 100, the corresponding penetration was recorded and this particular test at that depth stopped. If the total penetration is more than the seating penetration of 15 cm, then breakup of blow counts for 15 cm seating penetration and for remaining portion of penetration is also given.

SPT 'N' values are correlated with non-cohesive stratum as per BS: 5930 (1999) – for sandy strata and with consistency of cohesive stratum.

Correlation For Clay/Plastic Silt		Correlation For Sand/Non-Plastic Silt	
Consistency of clays	**Penetration Value**	**Relative Density of sand**	**Penetration Value**
Very Soft	0 to 2 Blows	Very loose	0 to 4 Blows
Soft	3 to 4 Blows	Loose	5 to 10 Blows
Medium Stiff	5 to 8 Blows	Medium	11 to 30 Blows
Stiff	9 to 16 Blows	Dense	31 to 50 Blows
Very Stiff	17 to 32 Blows	Very Dense	Above 50
Hard	Above 32		

In this method, the sampler acts as a probe and the driving energy is supplied by the fall of the drop weight. The values of 'N' depend on the compactness or relative density of the material. In hard formations, the testing is discontinued if 'N' value is found to be more than 100. It is termed as 'Refusal'. Refusal is also recorded when SPT blow count records 50 or more for any of the single drive of 15 cm.

'N' value depends upon degree of saturation and over burden pressure of the formation. Silty fine sand and fine sand below the water table develop pore water pressure depending on the in-situ void ratio which in turn affects the effective stress. This change in effective stress influences the 'N' value considerably.

Depth of overburden affects the SPT values in none to low cohesive soils and hence need correction. The SPT value after the overburden correction, N' is as follows:

$$N' = 0.77x \log (2000/q) \times N$$

Where, q= Overburden Pressure (kN/m^2) and N = observed SPT value

N' is corrected further for dilatancy in case of saturated fine sands and silts for the values of N' greater than 15.

Modified value after dilatancy correction N" = 15+ (N'-15)/2

Soil samples obtained from split spoon sampler were collected in the polythene bags of suitable size. These samples were property sealed, labelled, and carefully transported to the laboratory for testing. The results have been reported in Table 1 to 6 of Appendix B under the title "SUMMARY OF TEST RESULTS".

4.3. **Disturbed soil samples** were collected at 0.50 metre, then at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth and at significant change of stratum. Soil from cutting edge of SPT samplers and retained in split spoon, used for Standard Penetration Tests was taken as disturbed samples. These samples were placed without delay in adequately sealed polythene bags. Where the collection of disturbed soil samples could not be collected from SPT samples, Shelby tubes were driven and retained soil samples were obtained. The laboratory tests were conducted on the collected soil samples and reported in Table 1 to 6 of Appendix-B under the title "SUMMARY OF TEST RESULTS".

4.4. **Undisturbed soil samples** were collected in accordance with IS: 2132-1986-(RA: 2021) at an interval of 3.00 metre or at change of stratum, starting from the depth of 1.00 or 2.00 m, by using 100 mm dia. and 450 mm long MS tubes provided with sampler head with ball check arrangement. However, the some of the samples could not be extracted due to the partial penetration or slippage during the evacuation.

Moreover, collection of Undisturbed samples in very hard cohesive soils/ dense granular soils/gravels/ cobbles/ pebbles/ boulders, refusal strata is practically not possible and such collected samples will not truly represent the undisturbed conditions.

Immediately after taking undisturbed sample in the tube, the adopter head was removed along with the disturbed material. The visible ends of the samples shall then be trimmed off any wet disturbed soil. The ends will then be coated alternately with four layers of molten wax. More molten wax will then be added to give a total thickness

of not less than 25 mm. The laboratory test results have been reported in Table 1 to 6 of Appendix-B.

4.5. The **ground water table** in the borehole was allowed to stabilize and measured after 8, 16, 24 and 48 hours after completion of the bore hole. It was ensured that last two reading were identical. The records of ground water table have been given in Para No.6.

4.6. **Ground water samples** were collected from borehole as per IS: 6935-1973-(RA:2019) for chemical analysis to determine aggressiveness in relation to attack on concrete / reinforcement including determination of pH value.

5. LABORATORY TESTS:

The following laboratory tests were conducted to determine the engineering characteristics of sub-soils:

5.1. **Field moisture contents** were determined by oven drying method as per IS: 2720 (part II)-1973-(RA: 2020). The results have been reported in Table 1 to 6: "SUMMARY OF TEST RESULTS" of Appendix B.

5.2. **Bulk density** of soil strata was obtained using Shelby tubes in accordance with IS 2720 (part XXIX)-1975-(RA: 2020). The results have been reported in Table 1 to 6: "SUMMARY OF TEST RESULTS" of Appendix B.

5.3. **Mechanical sieve analysis** test was performed in accordance with IS: 2720 (Part IV) – 1985-(RA: 2020), for the purpose of identification by grain size analysis, on coarse part of the soil samples and the results have been reported in Table 1 to 6: "SUMMARY OF TEST RESULTS" of Appendix B.

5.4. **Particle size analysis** test by **Hydrometer method** were performed in accordance with IS: 2720 (Part IV) -1985-(RA: 2020) on the part of soil samples obtained after the sieve analysis. The results have been reported in Table 1 to 6: "SUMMARY OF TEST RESULTS" of Appendix B.

5.5. **Atterbergs' limits tests** were performed in accordance with IS: 2720 (part V)-1985-(RA: 2020) and results have been reported in Table 1 to 6: "SUMMARY OF TEST RESULTS" of Appendix B.

5.6. **Specific gravity tests** were performed in accordance with IS 2720 (part III-sec. 1) - 1980-(RA: 2021) and the results have been reported in Table 1 to 6: "SUMMARY OF TEST RESULTS" of Appendix B.

5.7. **Consolidation tests** were performed on cohesive soil samples in accordance with IS: 2720 (part XV)-1965-(RA: 2021). The results have been reported in Table 1 to 6: "SUMMARY OF TEST RESULTS" of Appendix B.

5.8. **Direct shear tests** were performed as per IS: 2720 (part XIII)-1986-(RA: 2021), on the undisturbed soil samples obtained during the field investigation. The results and the density of samples have been reported in Table 1 to 6: "SUMMARY OF TEST RESULTS" of Appendix B.

5.9. **Tri-axial Compression Test** under Unconsolidated Un-drained (UU) condition as per IS: 2720 (Part-XI)-1993-(RA: 2021) were performed on the selected undisturbed soil samples, obtained during the field investigation. The results have been reported in Table 1 to 6: "SUMMARY OF TEST RESULTS" of Appendix B.

5.10. **Unconfined Compressive strength tests** were performed in accordance with IS 2720 (Part-X) -1991-(RA:2020) on selected undisturbed soil samples and the results have been reported in Table 9 of Appendix B

5.11. **Shrinkage Limit tests** were performed in accordance with IS 2720 (part-VI) -1972-(RA: 2021) and the results have been reported in Table 1 to 6: "SUMMARY OF TEST RESULTS" of Appendix B.

5.12. **Free Swell Index** were performed in accordance with IS 2720 (part-XL) -1977-(RA: 2021) and the results have been reported in Table 1 to 6: "SUMMARY OF TEST RESULTS" of Appendix B.

5.13. **Chemical analysis on soil samples** was performed in accordance with IS: 2720 (Part-XXVI)-1987-(RA: 2021) for pH value, IS: 2720 (Part-XXVII)-1977-(RA: 2020) for Sulphate & BS:1377-3-2018 for chlorides and results have been reported in Table 7 "CHEMICAL TEST ON SOIL SAMPLES" of Appendix B.

5.14. **Chemical analysis on Ground Water sample** was performed in accordance with IS: 3025 (Part-XI)-2022 for pH value, IS: 3025 (Part-XXIV: Sec-1)-2022 for Sulphate & IS: 3025-(Part-XXXII)-1988-(RA: 2019) for chlorides and results have been reported in

Table 8 “CHEMICAL TEST ON GROUND WATER SAMPLES” of Appendix B.

6. GROUND WATER TABLE:

The water table at this site was encountered during the drilling operation up to the depth of investigation.

Borehole No.	Chainage	Global Co-ordinates (UTM format)		Reduced level (m)	Depth of Borehole (m)	Water table (m)
		Easting	Northing			
A1	20915.887	702633.931	3118903.449	191.636	40.00	0.50
P6	21073.087	702477.831	3118922.470	192.181	40.00	1.20
P12	21230.287	702321.763	3118941.487	191.831	40.00	1.50
P13	21256.487	702295.755	3118944.656	191.690	40.00	1.50
P17	21361.287	702191.763	3118957.327	191.107	40.00	1.20
P18	21387.487	702165.761	3118960.484	191.128	40.00	1.20

7. DESCRIPTION OF STRATA:

The classification of soil stratum has been done with the help of soil characteristics obtained in laboratory tests as per IS 1498-1970-(RA:2021). The classification of rock masses has been done based on RMR as per IS: 4464-1985, IS: 13365-1. The detailed nature of the strata has been reported in Table 1 to 6: “SUMMARY OF TEST RESULTS” of Appendix-B and represented through Lithological plots in Appendix-C.

The strata exhibited in the bore holes, is predominantly comprising of inorganic silty clays of low plasticity and inorganic silts of non to low plastic category. Silty sands were encountered at variable depth and thickness of 4 to 18 meters. Some lenses consisting of Inorganic silts and silty clays of intermediate plasticity were also found in some of the bores.

8. SAFE BEARING CAPACITY COMPUTATIONS:

For the construction of viaducts, deep foundation **(Bored Cast-In-Situ RCC piles)** have been considered for computation of load bearing capacity of the underlying soil strata. The computation of load bearing capacity of bored cast-in-situ RCC piles have been done as per IS 2911 (part-1, section-2)-2010-(RA: 2020) with due consideration of effects of liquefaction.

8.1. Design Parameters:

Factor of safety in compression	=	2.50
Factor of safety in tension	=	3.00
Depth of critical water table	=	0.00 m
Diameter of pile	=	1.00 & 1.20 m
Cut off length	=	2.50 m
Type of pile head consider	=	Fixed

8.2. Computation of friction along pile stem:

$Q_{uf} = \sum K_i.P_{di}.\tan\delta_i.A_{si}$

where,

Q_{uf} = Ultimate shaft friction (kN/m^2)

K_i = Coefficient of earth pressure at mid-depth of ith layer

P_{di} = Effective overburden pressure at mid-depth of ith layer (kN/m^2)

A_{si} = Surface area of pile stem in ith layer (m^2)

δ_i = Angle of wall friction between pile and soil of ith layer (= ϕ) (degree)

ϕ_i = Angle of internal friction of soil in ith layer (degree)

$\sum$ = Sum of all layers up to ith layer

8.3. Computation of Cohesion along the stem of pile:

$Q_{uc} = \sum \alpha_i.c_i.A_{si}$

where,

c_i = Cohesion in ith layer

A_{si} = Surface area of pile stem in ith layer (m^2)

α_i = Adhesion factor for ith layer of soil depending of consistency of soils

$\sum$ = Sum of cohesion of all layers considered

8.4. Computation of end bearing resistance:

$Q_{ub} = A_p\,(c.N_c + q.N_q + 0.5.\,\gamma.B.N_\gamma)$

where,

A_p = Area of the pile toe (m^2)

c = cohesion of soils at pile toe (kN/m^2)

γ = Effective Unit weight of soils at pile toe (kN/m^3)

B = Diameter of pile (m)

q = Effective overburden pressure at pile toe (kN/m^2)

N_c = Bearing Capacity Factor (Recommended equal to 9)

N_q, N_γ = Bearing Capacity Factor

8.5. Lateral load capacity of piles in soils:

$Q_u = 12.E.I.\delta/(L_1+L_f)^3$

where,

Q_u = Ultimate lateral load capacity of pile (kN)

δ = Permissible deflection (m) = 5 mm

E = Young Modulus of pile material (kN/m^2)

I = Moment of Inertia of the pile cross section (m^4)

L_1 = Cantilever Length of pile (m)

L_f = Length of fixity (m)

Detailed calculations of pile load carrying capacity in compression & uplift in soil have been reported in **Table-1 to 2** of **Appendix-H.**

Pile lateral Load capacity has been given in **Table-3 to 4** of **Appendix-H**.

9. LIQUEFACTION ANALYSIS:

Liquefaction is the sudden loss of shear strength of the loose fine sands due to earthquake-induced vibration under saturated conditions. Liquefaction generally takes place in loose fine sands (fines < 10 %, D_{60}= 0.20 mm to 1.0 mm and C_u between 2 to 5) with N value less than 15. In case of soil strata having N>15, liquefaction of soil will not take place, normally.

The present site falls in **seismic zone – IV.** Considering the history of past earthquakes and available seismic data, an earthquake of **magnitude 7.0** having peak ground acceleration **a_{max}= 0.24 g** is considered in the present analysis.

Preliminary assessment of liquefaction potential of foundation strata is made by simplified approach proposed by IS: 1893 (part-1)-2016-(RA: 2021) from the data obtained in Standard Penetration Test.

In this method, cyclic shear stress likely to be induced in the foundation strata by Design Basis Earthquake is first evaluated. Next threshold cyclic shear stress, which is good enough to cause liquefaction, is determined from SPT data and the empirical relations. Finally, comparison of these two stresses is used in the estimation of liquefaction susceptibility of the foundation strata.

Cyclic Stress Ratio (CSR):

The equivalent average of shear stress likely to be induced in the foundation material due to an earthquake is calculated by using the equations

Cyclic Resistance Ratio (CRR):

It expresses capacity of soil to resist liquefaction. CRR is determined using correlation between corrected blow count $(N_1)_{60}$ and CRR for earthquake of magnitude 7.5. $(N_1)_{60}$ is the SPT blow count corrected to an effective overburden pressure of 100 kPa and to hammer energy efficiency of 60 %.

Following variable have been adopted in calculation of N_{60} (SPT value for 60% efficiency)

Energy correction to SPT values:

C_{60} = 1.00 (Energy correction factor)

Design Earthquake Base:

Earthquake zone	= IV
Magnitude of earthquake	= 7
Seismic Zone factor	= 0.24

Status of Liquefaction:

The value of CSR and CRR are computed at different depth and then the ratio of CRR to CSR to get the factor of safety towards the susceptibility of the stratum towards liquefaction potential.

If factor of safety:

< 1.00 : Stratum is to be considered as liquefiable

> 1.00 : Non-Liquefiable

The detailed calculations of liquefaction, have been reported in **Table-5** of **Appendix-H.**

10. RECOMMENDATIONS:

Keeping in mind, the field test results, laboratory test results and IS codes of practice the following recommendations are hereby made:

10.1. Bored Cast-In-Situ RCC Piles of diameter 1000 and 1200 mm have been adopted for SBC computations of foundation for Viaduct.

10.2. Cut off length of piles have been considered as 2.50 m from the existing ground level for the purpose of computation of SBC.

10.3. Pile length recommended in the table below, shall be measured **after the cut-off depth.**

10.4. Allowable load carrying capacity of pile corresponding to the length and diameter of pile shall be read from the tables below:

10.4.1. For Pile diameter = 1000 mm

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
A1	25.00	1950	1500	45
	27.50	2300	1700	
	30.00	2950	1900	
	32.50	3850	2150	
	35.00	3100	2400	
P6	25.00	2200	1700	160
	27.50	2450	1900	
	30.00	2650	2150	
	32.50	2850	2300	
	35.00	3300	2500	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P12	25.00	2350	1850	120
	27.50	3350	2050	
	30.00	3900	2300	
	32.50	4150	2550	
	35.00	4450	2800	
P13	25.00	1850	1400	35
	27.50	2100	1650	
	30.00	2900	1850	
	32.50	3150	2050	
	35.00	3350	2250	
P17	25.00	1950	1500	40
	27.50	2200	1750	
	30.00	3250	1950	
	32.50	2950	2200	
	35.00	3750	2400	
P18	25.00	1950	1550	135
	27.50	3200	1700	
	30.00	3350	1950	
	32.50	2600	2150	
	35.00	2900	2300	

** Indicates Grade of Concrete*

10.4.2. Pile diameter = 1200 mm

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
A1	25.00	2500	1900	75
	27.50	3000	2150	
	30.00	4000	2400	
	32.50	5300	2750	
	35.00	4100	3100	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P6	25.00	2850	2200	225
	27.50	3200	2450	
	30.00	3450	2750	
	32.50	3650	2950	
	35.00	4450	3200	
P12	25.00	3000	2300	180
	27.50	4800	2600	
	30.00	5700	2950	
	32.50	6000	3300	
	35.00	6500	3700	
P13	25.00	2450	1850	55
	27.50	2800	2100	
	30.00	4150	2400	
	32.50	4450	2700	
	35.00	4750	3000	
P17	25.00	2500	1900	65
	27.50	2800	2150	
	30.00	4400	2500	
	32.50	3900	2800	
	35.00	5100	3100	
P18	25.00	2600	2000	190
	27.50	4750	2250	
	30.00	4950	2550	
	32.50	3550	2850	
	35.00	3950	3100	

** Indicates Grade of Concrete*

10.5. Liquefaction Potential: All the bore holes have been analysed for Liquefaction potential as per IS: 1893 (part-1)-2016-(RA: 2021) with Seismic Zone IV, earthquake intensity of 7.0 on Richter scale and critical ground water table at existing ground level. Out of which several boreholes show the potential at various depths mentioned in the table below:

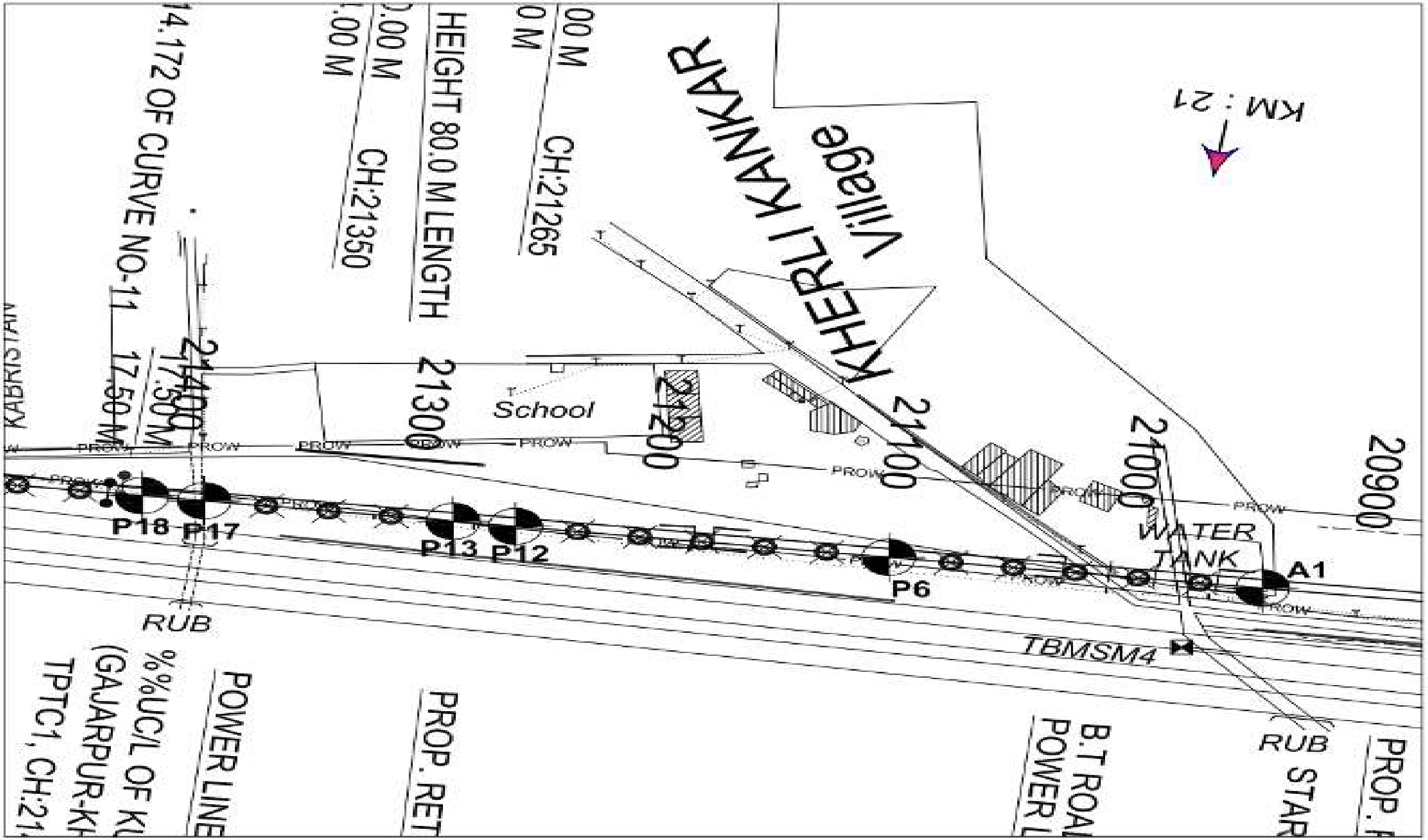
Bore No.	Liquefiable depth zone (meter)
A1	Top 1.00, 3.00 to 4.00 & 6.00 to 7.00
P6	Top 1.00
P12	Top 1.00
P13	Top 1.00, 2.00 to 3.00, 4.00 to 6.00, 7.00 to 10.00
P17	2.00 to 9.00
P18	Top 3.00

10.6. Type of cement to be used: Chloride content in the soil sample is slightly higher but still within the permissible limits. Other harmful salt sulphite is much low to the permissible limits. Hence, Ordinary Portland Cement or Portland Pozzolana Cement may be used for all civil constructions.

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech.(Civil), M.Tech.
Principal Consultant &
Managing Director

APPENDIX-A
TEST LOCATION PLAN



APPENDIX "B"
TABLE 1: SUMMARY OF TEST RESULTS

Bore No: A1	**Ground Elevation: RL 191.636 m**	**Method of drilling: Percussion**	**Depth of Water: 0.50 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 20/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 20915.887	**Casing Lowered: 24.00 m**	**Ending Date: 23/09/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	0	39	57	4	16.43	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	D	2	1	1	3	4	4.19	CL	0	0	1	42	44	13	21.52	-	-	29.0	18.0	11.0	-	-	-	-	-	-	-	30	16	-	Inorganic clays of low plasticity											
	2.00	D	3	-	-	-	-	-	-	-	-	-	-	-	-	24.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	2	3	3	6	10.68	ML	0	0	1	48	51	0	20.72	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	4.00	D	5	3	5	6	11	17.17	SM	1	0	0	62	37	0	27.56	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	5.00	U	6	-	-	-	-	-	SM	3	0	1	67	29	0	20.79	1.88	1.56	Non-Plastic			2.64	DST	2.0	23.6	-	0.692	-	-	-	-												
	6.00	D	7	5	6	6	12	16.85	-	-	-	-	-	-	-	20.77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	4	6	7	13	18.04	-	-	-	-	-	-	-	19.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	U	9	-	-	-	-	-	ML	0	1	0	46	49	4	19.13	2.03	1.70	23.0	20.0	3.0	2.64	-	-	-	-	0.553	-	-	-	-	Inorganic Silts of low plasticity											
	9.00	D	10	5	6	8	14	17.43	CL	1	1	2	32	57	7	20.16	-	-	26.0	19.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	10.00	D	11	4	5	5	10	13.27	CL	3	2	2	36	48	9	16.13	-	-	28.0	19.0	9.0	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL	2	1	2	22	64	9	20.75	2.13	1.76	27.0	18.0	9.0	-	UU	37.0	10.4	-	-	-	-	-	-												
	12.50	D	13	6	10	11	21	20.57	CL-ML	1	2	2	34	56	5	20.60	-	-	25.0	20.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	14.00	U	14	-	-	-	-	-	CL	4	2	3	30	51	10	18.09	2.00	1.69	29.0	18.0	11.0	2.67	-	-	-	-	0.580	-	-	-	-	Inorganic clays of low plasticity											
	15.50	D	15	4	7	12	19	26.53	-	-	-	-	-	-	-	20.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	U	16	-	-	-	-	-	CL	4	4	5	13	61	13	15.62	1.99	1.72	33.5	19.0	14.5	2.68	UU	45.0	8.6	0.192	0.558	-	25	14	-												

APPENDIX "B"

TABLE 1: SUMMARY OF TEST RESULTS

Bore No: A1	**Ground Elevation: RL 191.636 m**	**Method of drilling: Percussion**	**Depth of Water: 0.50 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 20/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 20915.887	**Casing Lowered: 24.00 m**	**Ending Date: 23/09/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	8	15	20	35	48.88	-	-	-	-	-	-	-	16.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	20.00	U	18	-	-	-	-	-	CL	6	3	4	19	58	10	16.50	2.03	1.74	28.5	19.5	9.0	2.67	-	-	-	-	0.534	-	-	-	-												
	21.50	D	19	8	17	22	39	54.46	CL	4	3	4	16	61	12	18.56	-	-	31.0	18.0	13.0	-	-	-	-	-	-	-	-	-	-												
	23.00	D	20	-	-	-	-	-	-	-	-	-	-	-	-	19.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	24.50	D	21	11	13	17	30	41.90	-	-	-	-	-	-	-	15.75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	U	22	-	-	-	-	-	CL	1	1	1	16	72	9	21.80	2.09	1.72	28.5	20.5	8.0	2.66	UU	39.0	13.8	-	0.547	-	9	20	-												
	27.50	D	23	10	14	18	32	44.69	CL	3	2	1	18	64	12	18.79	-	-	30.0	18.0	12.0	-	-	-	-	-	-	-	-	-	-												
	29.00	U	24	-	-	-	-	-	CL-ML	3	3	1	38	49	6	18.96	1.89	1.59	25.0	20.0	5.0	2.66	DST	14.0	24.4	-	0.673	-	-	-	-	Inorganic Silty Clays of low plasticity											
	30.50	D	25	11	15	20	35	48.88	CL	3	2	2	28	56	9	20.80	-	-	27.0	18.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	32.00	D	26	35	65	-	R	-	SM	0	0	1	52	47	0	19.09	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	33.50	D	27	15	35	45	80	38.10	SM	0	0	0	62	38	0	25.02	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	35.00	D	28	10	37	42	79	37.13	-	-	-	-	-	-	-	21.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	36.50	D	29	8	17	27	44	61.45	CL	4	3	5	17	59	12	14.81	-	-	28.5	18.5	10.0	-	-	-	-	-	-	-	8	18	-	Inorganic clays of low plasticity											
	38.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	22.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	9	18	30	48	24.44	CL-ML	0	1	1	32	60	6	17.71	-	-	24.0	19.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No: P6	**Ground Elevation: RL 192.181 m**	**Method of drilling: Percussion**	**Depth of Water: 1.20 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 21/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 21073.087	**Casing Lowered: 18.00 m**	**Ending Date: 23/09/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	1	62	37	0	6.02	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	U	2	-	-	-	-	-	CL	8	1	1	20	55	15	20.52	2.06	1.71	31.0	19.0	12.0	2.67	UU	44.0	6.4	0.152	0.561	-	0	14	-	Inorganic clays of low plasticity											
	2.00	D	3	2	3	4	7	7.33	CL	2	1	1	16	67	13	28.83	-	-	32.0	19.0	13.0	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	2	4	6	10	15.41	ML	0	0	0	38	62	0	22.35	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	4.00	D	5	-	-	-	-	-	SM	0	0	0	69	31	0	21.18	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	5.00	D	6	4	9	12	21	22.95	SM	0	0	0	70	30	0	22.29	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	5	7	11	18	19.78	-	-	-	-	-	-	-	26.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	-	-	-	-	-	SM	0	0	2	66	32	0	28.06	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	7	12	17	29	27.04	-	-	-	-	-	-	-	27.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	9	12	18	30	26.70	SM	0	1	1	65	33	0	26.27	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	-	-	-	-	-	-	-	-	-	-	-	-	27.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	D	12	8	10	14	24	33.52	CL	3	2	3	8	73	11	18.15	-	-	27.5	19.5	8.0	-	-	-	-	-	-	-	0	18	-	Inorganic clays of low plasticity											
	12.00	D	13	6	10	12	22	30.72	-	-	-	-	-	-	-	19.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	4	2	2	7	76	9	17.17	2.09	1.78	27.0	19.5	7.5	2.66	UU	41.0	12.4	0.115	0.494	-	0	18	-												
	14.50	D	15	7	14	18	32	44.69	-	-	-	-	-	-	-	17.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	D	16	-	-	-	-	-	CL	2	1	1	9	75	12	23.93	-	-	30.0	18.0	12.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	17.50	D	17	6	10	15	25	34.91	-	-	-	-	-	-	-	19.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No: P6	**Ground Elevation: RL 192.181 m**	**Method of drilling: Percussion**	**Depth of Water: 1.20 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 21/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 21073.087	**Casing Lowered: 18.00 m**	**Ending Date: 23/09/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	D	18	-	-	-	-	-	-	-	-	-	-	-	-	16.82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	20.50	D	19	8	22	40	62	86.58	CL	2	2	3	25	59	9	17.42	-	-	28.0	19.0	9.0	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	CL	1	2	2	23	64	8	20.12	1.81	1.51	27.5	18.0	9.5	2.66	UU	40.0	11.5	-	0.762	-	0	17	-												
	23.50	D	21	9	23	38	61	85.19	CL	3	2	1	12	69	13	13.13	-	-	30.0	18.0	12.0	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	CL	0	0	1	16	75	8	21.17	2.11	1.74	26.0	18.0	8.0	-	-	-	-	-	-	-	-	-	-												
	26.50	D	23	10	19	26	45	62.84	-	-	-	-	-	-	-	21.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	U	24	-	-	-	-	-	MI	1	1	1	1	73	23	25.08	1.99	1.59	44.0	28.0	16.0	-	UU	48.0	11.8	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	29.50	D	25	10	17	20	37	51.67	-	-	-	-	-	-	-	26.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	U	26	-	-	-	-	-	CL-ML	2	0	2	34	55	7	23.75	2.09	1.69	24.5	18.0	6.5	2.65	DST	10.0	24.7	-	0.568	-	0	18	-	Inorganic Silty Clays of low plasticity											
	32.50	D	27	11	19	22	41	57.26	MI	0	1	1	2	83	13	31.36	-	-	38.0	28.0	10.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	34.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	24.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	35.50	D	29	16	19	26	45	23.53	CL-ML	8	3	4	21	60	4	19.57	-	-	23.0	18.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	37.00	D	30	-	-	-	-	-	ML	0	2	2	44	52	0	20.01	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	38.50	D	31	19	26	33	59	27.67	-	-	-	-	-	-	-	24.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	40.00	D	32	22	30	40	70	30.98	-	-	-	-	-	-	-	23.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed samples.

APPENDIX "B"
TABLE 3: SUMMARY OF TEST RESULTS

Bore No: P12	Ground Elevation: RL 191.831 m	Method of drilling: Percussion	Depth of Water: 1.50 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 15/10/2023	SPT Sampler: Standard
Location / Chainage: 21230.287	Casing Lowered: 21.00 m	Ending Date: 18/10/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	0	46	54	0	13.72	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	D	2	1	2	2	4	6.21	CL-ML	0	0	0	42	52	6	13.77	-	-	26.0	20.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	2.00	U	3	-	-	-	-	-	MI	3	2	1	4	79	11	29.02	1.93	1.50	42.0	28.0	14.0	2.69	UU	64.0	7.9	-	0.798	-	8	21	-	Inorganic Silts of Intermediate plasticity											
	3.00	D	4	2	2	3	5	6.42	CL	2	1	2	24	66	5	27.58	-	-	27.0	20.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	4.00	D	5	2	3	4	7	8.53	-	-	-	-	-	-	-	25.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	5.00	D	6	-	-	-	-	-	MI	0	0	0	4	85	11	26.96	-	-	38.0	27.0	11.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	6.00	D	7	4	7	8	15	15.95	ML	6	1	0	24	69	0	18.31	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	7.00	D	8	3	8	10	18	17.26	-	-	-	-	-	-	-	17.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	-	-	-	-	-	SM	0	0	0	71	29	0	21.54	1.92	1.58	Non-Plastic			2.65	RDST	0.0	25.9	-	0.677	-	-	-	-	Silty Sands											
	9.00	D	10	4	8	11	19	17.13	-	-	-	-	-	-	-	22.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	5	9	12	21	17.82	-	-	-	-	-	-	-	22.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL-ML	1	1	1	20	69	8	18.99	2.03	1.71	28.0	21.5	6.5	2.66	DST	15.0	24.5	-	0.556	-	9	17	-	Inorganic Silty Clays of low plasticity											
	12.50	D	13	4	8	11	19	19.00	CL	0	0	1	14	74	11	20.45	-	-	30.0	19.0	11.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	14.00	U	14	-	-	-	-	-	CL	0	0	1	16	71	12	18.75	2.03	1.71	31.0	19.5	11.5	2.67	UU	56.0	8.5	0.119	0.561	-	-	-	-												
	15.50	D	15	6	10	12	22	22.00	-	-	-	-	-	-	-	21.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	U	16	-	-	-	-	-	CL	8	6	6	14	53	13	16.06	1.90	1.64	32.0	20.5	11.5	2.67	UU	54.0	11.5	-	0.628	-	-	-	-												

APPENDIX "B"

TABLE 3: SUMMARY OF TEST RESULTS

Bore No: P12	Ground Elevation: RL 191.831 m	Method of drilling: Percussion	Depth of Water: 1.50 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 15/10/2023	SPT Sampler: Standard
Location / Chainage: 21230.287	Casing Lowered: 21.00 m	Ending Date: 18/10/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	7	13	19	32	32.00	-	-	-	-	-	-	-	16.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	20.00	U	18	-	-	-	-	-	CL	8	4	5	11	60	12	16.22	2.06	1.77	30.0	19.5	10.5	2.68	UU	59.0	10.8	-	0.514	-	0	15	-												
	21.50	D	19	9	17	24	41	41.00	-	-	-	-	-	-	-	14.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.00	D	20	-	-	-	-	-	CL	6	4	4	13	59	14	16.81	2.04	1.75	33.0	19.5	13.5	2.67	UU	61.0	9.1	-	0.526	-	-	-	-												
	24.50	D	21	8	19	25	44	44.00	-	-	-	-	-	-	-	17.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	U	22	-	-	-	-	-	CL	3	2	1	14	68	12	17.96	2.06	1.75	32.0	20.5	11.5	2.67	UU	53.0	9.5	-	0.526	-	-	-	-												
	27.50	D	23	11	22	27	49	49.00	-	-	-	-	-	-	-	18.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.00	D	24	17	28	32	60	26.51	SM	0	0	0	56	44	0	22.66	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	30.50	D	25	18	30	36	66	27.92	-	-	-	-	-	-	-	19.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.00	D	26	19	35	44	79	31.38	SM	0	0	0	64	36	0	19.55	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	33.50	D	27	17	33	41	74	29.31	SM	0	0	2	60	38	0	19.02	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	35.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	19.35	2.01	1.68	-	-	-	2.65	RDST	3.0	30.4	-	0.577	-	-	-	-												
	36.50	D	29	19	34	43	77	29.11	SM	0	0	0	63	37	0	18.32	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	20.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	21	37	48	85	30.19	SM	0	1	1	58	40	0	19.68	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed samples.

APPENDIX "B"
TABLE 4: SUMMARY OF TEST RESULTS

Bore No: P13	**Ground Elevation: RL 191.69 m**	**Method of drilling: Percussion**	**Depth of Water: 1.50 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 19/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 21256.487	**Casing Lowered: 22.00 m**	**Ending Date: 22/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	1	55	44	0	8.05	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	U	2	-	-	-	-	-	CL	0	1	1	22	66	10	19.44	1.97	1.65	29.0	20.5	8.5	2.67	UU	44.0	9.5	-	0.618	-	8	17	-	Inorganic clays of low plasticity											
	2.00	D	3	1	2	2	4	5.43	SM	0	0	1	56	43	0	17.30	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	3.00	D	4	2	2	3	5	5.00	CL	0	1	1	24	65	9	19.11	-	-	28.0	20.0	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	4.00	U	5	-	-	-	-	-	ML	2	1	2	42	48	5	15.13	1.95	1.69	25.0	21.0	4.0	2.64	DST	5.0	26.3	-	0.562	-	-	-	-	Inorganic Silts of low plasticity											
	5.00	D	6	1	2	2	4	4.62	-	-	-	-	-	-	-	22.13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	2	3	3	6	6.66	CL-ML	0	0	1	18	74	7	23.64	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts Clays of low plasticity											
	7.00	D	8	-	-	-	-	-	ML	0	0	1	34	65	0	17.91	1.91	1.62	Non-Plastic			2.64	RDST	10.0	24.7	-	0.630	-	-	-	-	Inorganic Silts of low plasticity											
	8.00	D	9	2	3	5	8	8.28	SM	0	0	1	52	47	0	14.59	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	9.00	D	10	4	5	7	12	12.03	-	-	-	-	-	-	-	14.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	3	1	3	9	75	9	15.68	2.04	1.76	29.0	20.0	9.0	2.67	UU	48.0	10.5	0.114	0.517	-	0	19	-	Inorganic clays of low plasticity											
	11.00	D	12	9	14	17	31	31.00	-	-	-	-	-	-	-	16.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	8	15	19	34	34.00	-	-	-	-	-	-	-	17.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	SM	0	0	0	61	39	0	12.29	1.95	1.74	Non-Plastic			2.63	DST	2.0	28.0	-	0.511	-	-	-	-	Silty Sands											
	14.50	D	15	9	16	20	36	22.91	-	-	-	-	-	-	-	17.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	1	0	2	8	80	9	16.77	2.05	1.75	28.0	20.5	7.5	2.66	UU	49.0	10.2	-	0.516	-	-	-	-	Inorganic clays of low plasticity											
	17.50	D	17	8	13	16	29	29.00	-	-	-	-	-	-	-	19.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 4: SUMMARY OF TEST RESULTS

Bore No: P13	Ground Elevation: RL 191.69 m	Method of drilling: Percussion	Depth of Water: 1.50 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 19/10/2023	SPT Sampler: Standard
Location / Chainage: 21256.487	Casing Lowered: 22.00 m	Ending Date: 22/10/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL	1	1	1	24	65	8	20.85	2.10	1.74	28.0	20.0	8.0	2.66	UU	47.0	10.8	-	0.529	-	-	-	-	Inorganic clays of low plasticity											
	20.50	D	19	11	20	22	42	42.00	-	-	-	-	-	-	-	18.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	D	20	-	-	-	-	-	-	-	-	-	-	-	-	19.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.50	D	21	13	26	33	59	59.00	CL	9	2	3	9	67	10	16.78	-	-	29.0	21.0	8.0	-	-	-	-	-	-	-	-	-	-												
	25.00	D	22	15	27	35	62	62.00	-	-	-	-	-	-	-	16.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.50	D	23	17	34	41	75	75.00	-	-	-	-	-	-	-	18.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	14	32	39	71	30.60	CL	9	5	3	12	62	9	21.02	-	-	27.5	20.5	7.0	-	-	-	-	-	-	-	-	-	-												
	29.50	D	25	11	28	31	59	26.23	-	-	-	-	-	-	-	19.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	10	25	30	55	55.00	CL	2	1	2	18	69	8	19.16	-	-	28.0	20.0	8.0	-	-	-	-	-	-	-	-	-	-												
	32.50	D	27	10	27	31	58	24.99	SM	0	0	1	60	39	0	20.35	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	34.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	19.90	2.10	1.75	-	-	-	2.65	RDST	3.0	28.6	-	0.514	-	-	-	-												
	35.50	D	29	8	24	29	53	22.64	-	-	-	-	-	-	-	17.76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	SM	0	0	1	59	40	0	17.68	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	10	26	31	57	23.08	SM	0	1	2	54	43	0	19.69	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	11	27	32	59	23.30	-	-	-	-	-	-	-	16.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample

APPENDIX "B"
TABLE 5: SUMMARY OF TEST RESULTS

Bore No: P17	**Ground Elevation: RL 191.107 m**	**Method of drilling: Percussion**	**Depth of Water: 1.20 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 18/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 21361.287	**Casing Lowered: 15.00 m**	**Ending Date: 21/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	CL-ML	0	0	1	48	44	7	12.34	-	-	26.0	19.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	1.00	D	2	1	1	2	3	4.63	-	-	-	-	-	-	-	11.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	2.00	U	3	-	-	-	-	-	SM-SC	0	0	1	50	43	6	12.14	1.98	1.77	25.0	20.0	5.0	2.65	DST	8.0	26.5	-	0.497	-	0	15	-	Silty Sands with clay binder											
	3.00	D	4	1	2	2	4	5.18	SM	0	0	0	58	42	0	21.89	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	D	5	2	3	3	6	7.35	-	-	-	-	-	-	-	22.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	5.00	D	6	-	-	-	-	-	SM	1	2	2	72	23	0	22.66	1.94	1.58	Non-Plastic			2.63	RDST	0.0	24.1	-	0.665	-	-	-	-												
	6.00	D	7	3	4	5	9	10.08	SM	1	1	3	70	25	0	21.57	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	3	4	6	10	10.78	-	-	-	-	-	-	-	21.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	-	-	-	-	-	SP-ML	2	2	3	84	9	0	22.58	1.98	1.61	Non-Plastic			2.62	RDST	0.0	29.5	-	0.623	-	-	-	-	Poorly Graded Sands with inorganic Silts of low plasticity											
	9.00	D	10	5	10	15	25	20.06	-	-	-	-	-	-	-	24.46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	8	12	22	34	24.05	SM	0	0	0	74	26	0	25.29	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	11.00	U	12	-	-	-	-	-	-	-	-	-	-	-	-	18.25	1.85	1.57	-	-	-	2.62	DST	0.0	28.3	-	0.671	-	-	-	-												
	12.50	D	13	6	11	16	27	27.00	CL	2	1	0	11	74	12	16.27	-	-	31.0	21.5	9.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	14.00	U	14	-	-	-	-	-	CL-ML	3	2	2	24	62	7	17.04	1.90	1.62	27.0	21.5	5.5	2.66	DST	14.0	24.5	-	0.642	-	8	18	-	Inorganic Silty Clays of low plasticity											
	15.50	D	15	7	13	17	30	30.00	CL	2	1	0	9	75	13	19.56	-	-	32.0	20.5	11.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	17.00	U	16	-	-	-	-	-	CL	3	2	3	12	69	11	19.62	2.02	1.69	30.0	21.5	8.5	2.67	UU	50.0	9.5	0.136	0.580	-	-	-	-												

APPENDIX "B"
TABLE 5: SUMMARY OF TEST RESULTS

Bore No: P17	**Ground Elevation: RL 191.107 m**	**Method of drilling: Percussion**	**Depth of Water: 1.20 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 18/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 21361.287	**Casing Lowered: 15.00 m**	**Ending Date: 21/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	15	18	20	38	38.00	CI	5	2	3	8	65	17	14.24	-	-	38.0	23.0	15.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of Intermediate plasticity											
	20.00	U	18	-	-	-	-	-	-	-	-	-	-	-	-	17.27	1.91	1.63	-	-	-	2.68	UU	64.0	8.5	-	0.644	-	-	-	-												
	21.50	D	19	16	30	35	65	65.00	CI	2	1	3	6	73	15	16.84	-	-	36.0	22.5	13.5	-	-	-	-	-	-	-	-	-	-												
	23.00	U	20	-	-	-	-	-	CL	2	1	1	11	72	13	13.47	2.03	1.79	34.0	22.0	12.0	2.68	UU	57.0	8.9	-	0.497	-	17	20	-	Inorganic clays of low plasticity											
	24.50	D	21	17	32	38	70	70.00	-	-	-	-	-	-	-	12.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	D	22	15	25	27	52	52.00	CL	0	1	2	8	78	11	20.70	-	-	32.0	21.5	10.5	-	-	-	-	-	-	-	-	-	-												
	27.50	D	23	7	15	26	41	41.00	CL	1	1	1	9	79	9	11.87	-	-	29.0	20.0	9.0	-	-	-	-	-	-	-	-	-	-												
	29.00	U	24	-	-	-	-	-	-	-	-	-	-	-	-	12.31	2.04	1.82	-	-	-	2.67	UU	54.0	8.3	-	0.467	-	-	-	-												
	30.50	D	25	16	22	34	56	25.00	SM	2	1	1	54	42	0	12.37	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	32.00	D	26	20	27	38	65	27.28	-	-	-	-	-	-	-	17.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	33.50	D	27	14	26	35	61	25.67	ML	0	0	1	48	51	0	14.95	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	35.00	D	28	17	32	36	68	27.36	-	-	-	-	-	-	-	11.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	36.50	D	29	19	38	45	83	31.29	SM	0	0	2	52	46	0	10.87	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	38.00	D	30	18	25	30	55	55.00	CL	3	2	1	14	69	11	9.85	-	-	31.0	20.5	10.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	40.00	D	31	18	27	36	63	63.00	CL	0	0	1	22	68	9	15.14	-	-	29.0	21.5	7.5	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed samples.

APPENDIX "B"

TABLE 6: SUMMARY OF TEST RESULTS

Bore No: P18	**Ground Elevation: RL 191.128 m**	**Method of drilling: Percussion**	**Depth of Water: 1.20 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 15/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 21387.487	**Casing Lowered: 27.00 m**	**Ending Date: 18/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	1	1	1	54	43	0	8.63	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	U	2	-	-	-	-	-	-	-	-	-	-	-	-	14.35	1.91	1.67	-	-	-	2.64	DST	0.0	23.6	-	0.581	-	-	-	-												
	2.00	D	3	3	4	5	9	12.62	SM-SC	0	0	0	64	31	5	16.52	-	-	25.5	20.0	5.5	-	-	-	-	-	-	-	0	16	-	Silty Sands with clay binder											
	3.00	D	4	4	5	5	10	13.14	SM	0	0	0	68	32	0	22.58	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	4.00	U	5	-	-	-	-	-	-	-	-	-	-	-	-	23.27	1.99	1.61	-	-	-	2.62	DST	0.0	28.0	-	0.623	-	-	-	-												
	5.00	D	6	5	7	8	15	16.33	SM	0	0	0	70	30	0	23.77	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	6	9	10	19	18.20	-	-	-	-	-	-	-	23.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	-	-	-	-	-	SM	1	0	0	68	31	0	21.81	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	4	6	11	17	16.40	SM	0	0	1	66	33	0	19.82	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	5	8	13	21	18.19	-	-	-	-	-	-	-	20.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Silty Sands											
	10.00	U	11	-	-	-	-	-	SM	0	1	0	71	28	0	19.70	1.79	1.50	Non-Plastic			2.62	DST	0.0	28.3	-	0.753	-	-	-	-												
	11.00	D	12	5	9	15	24	19.10	-	-	-	-	-	-	-	19.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	6	11	17	28	20.71	SM	0	1	0	65	34	0	23.31	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	-	-	-	-	-	-	-	18.45	1.97	1.66	-	-	-	2.63	DST	0.0	28.6	-	0.584	-	-	-	-												
	14.50	D	15	4	7	10	17	14.99	SM	0	0	0	58	42	0	11.76	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	SM	4	1	2	74	19	0	16.81	2.00	1.71	Non-Plastic			2.61	DST	0.0	29.1	-	0.525	-	-	-	-												
	17.50	D	17	5	8	12	20	20.00	CL	0	0	0	8	80	12	20.61	-	-	29.5	18.5	11.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											

APPENDIX "B"

TABLE 6: SUMMARY OF TEST RESULTS

Bore No: P18	**Ground Elevation: RL 191.128 m**	**Method of drilling: Percussion**	**Depth of Water: 1.20 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 15/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 21387.487	**Casing Lowered: 27.00 m**	**Ending Date: 18/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL	0	0	0	12	77	11	21.12	2.06	1.70	28.5	19.0	9.5	2.67	UU	54.0	9.5	-	0.570	-	8	16	-												
	20.50	D	19	9	15	18	33	33.00	-	-	-	-	-	-	-	20.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	-	-	-	-	-	-	-	21.45	1.99	1.64	-	-	-	2.67	UU	46.0	10.0	-	0.628	-	-	-	-	Inorganic clays of low plasticity											
	23.50	D	21	8	17	19	36	36.00	CL	0	0	1	14	75	10	22.41	-	-	28.0	20.0	8.0	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	CL	3	3	1	28	56	9	23.95	2.08	1.68	27.5	20.0	7.5	2.66	UU	42.0	11.5	-	0.585	-	-	-	-												
	26.50	D	23	8	15	19	34	34.00	MI	0	0	1	12	73	14	28.39	-	-	38.0	27.0	11.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	28.00	U	24	-	-	-	-	-	CL-CI	2	0	2	16	66	14	24.40	2.09	1.68	35.0	22.0	13.0	2.67	UU	44.0	11.0	-	0.589	-	-	-	-	Inorganic Clays of low to Intermediate plasticity											
	29.50	D	25	19	38	45	83	33.84	SM	0	0	1	58	41	0	19.79	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	31.00	D	26	22	48	52	R	-	-	-	-	-	-	-	-	18.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.50	D	27	17	35	42	77	30.73	SM-SC	0	1	1	55	39	4	17.38	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Silty Sands with clay binder											
	34.00	D	28	19	39	47	86	32.85	CL-ML	0	1	1	18	74	6	20.13	-	-	26.5	21.0	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	35.50	D	29	16	31	35	66	26.56	-	-	-	-	-	-	-	15.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	14	28	40	68	26.70	CL	1	1	1	28	61	8	20.31	-	-	27.5	20.5	7.0	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	15	32	35	67	25.99	-	-	-	-	-	-	-	22.78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	40.00	D	32	14	33	41	74	74.00	CL	0	1	2	12	74	11	19.80	-	-	30.0	20.0	10.0	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed samples.

APPENDIX-B
TABLE 7: CHEMICAL TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	SULPHATE CONTENT AS SO_3 (%)	CHLORIDE CONTENT (%)	pH VALUE
A1	1.00	0.055	0.121	8.23
P6	1.00	0.051	0.200	8.23

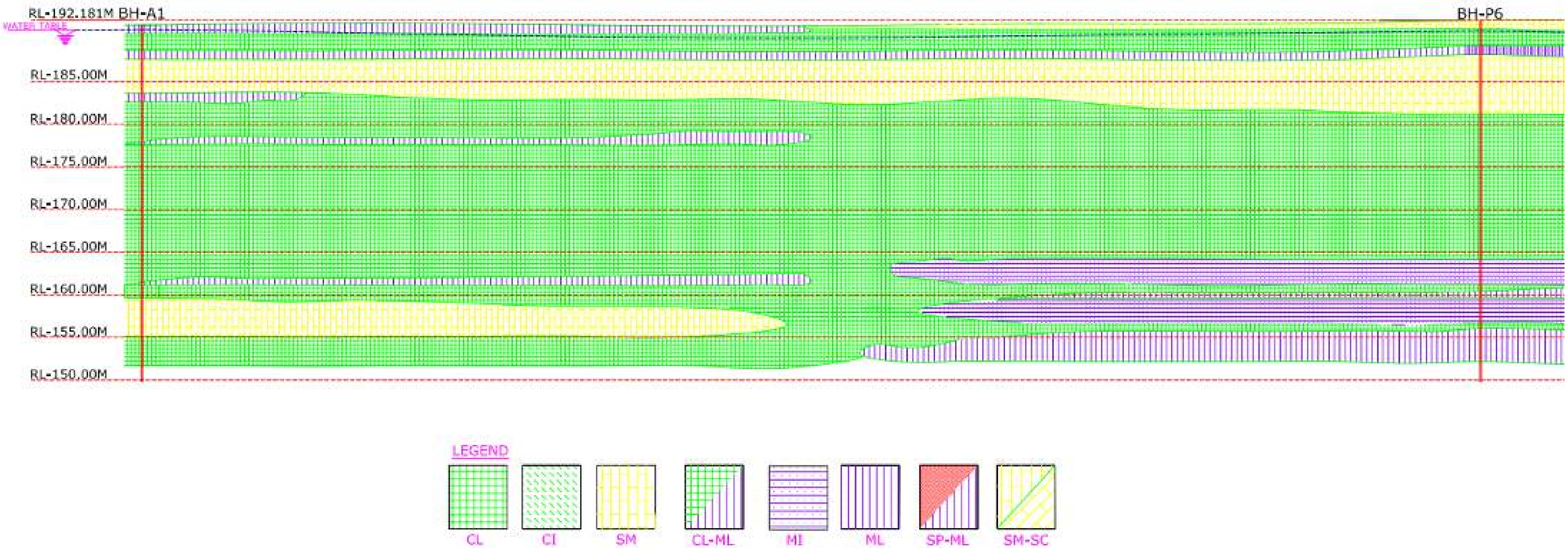
APPENDIX-B
TABLE 8: CHEMICAL TEST ON GROUND WATER SAMPLES

BH No.	SULPHATE CONTENT AS SO_3 (mg/l)	CHLORIDE CONTENT (mg/l)	pH VALUE
A1	246.900	797.753	7.16
P6	82.300	647.799	7.09

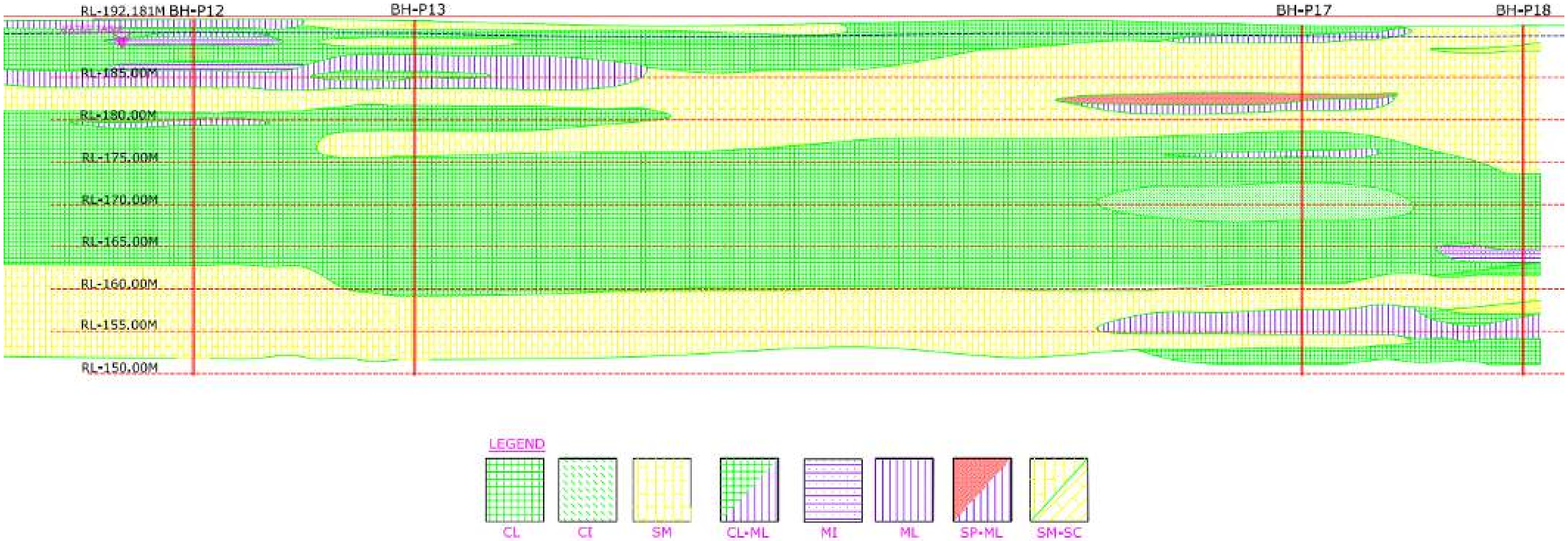
APPENDIX-B
TABLE 9: UCS TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	UCS (kg/cm²)
A1	11.00	0.45
	17.00	0.60
	26.00	0.68
P6	1.00	0.60
	13.00	0.64
	28.00	1.31
P12	2.00	0.81
	14.00	0.73
	17.00	0.68
	20.00	0.77
	23.00	0.71
	26.00	0.64
P13	1.00	0.47
	10.00	0.54
	16.00	0.56
	19.00	0.53
P17	17.00	0.63
	20.00	0.89
	23.00	0.76
	29.00	0.72
P18	19.00	0.82
	22.00	0.67
	25.00	0.62
	28.00	0.57

APPENDIX-C
PLOT 1: LITHOLOGICAL PROFILE-01



APPENDIX-C
PLOT 2: LITHOLOGICAL PROFILE-02



APPENDIX-C
PLOT 3: LITHOLOGICAL PLOTS

BH-A1-20915.8870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
Inorganic clays of low plasticity	CL		1.00	D	4	-	-
			2.00	D		-	-
Inorganic Silts of low plasticity	ML		3.00	D	6	-	-
Silty Sands	SM		4.00	D	11	-	-
			5.00	U		-	-
			6.00	D	12	-	-
			7.00	D	13	-	-
Inorganic Silts of low plasticity	ML		8.00	U		-	-
Inorganic clays of low plasticity	CL		9.00	D	14	-	-
			10.00	D	10	-	-
			11.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		12.50	D	21	-	-
Inorganic clays of low plasticity	CL		14.00	U		-	-
			15.50	D	19	-	-
			17.00	U		-	-
			18.50	D	35	-	-
			20.00	U		-	-

BH-A1-20915.8870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.00	D		-	-
			21.50	D	39	-	-
			23.00	D		-	-
			24.50	D	30	-	-
			26.00	U		-	-
			27.50	D	32	-	-
Inorganic Silty Clays of low plasticity	CL-ML		29.00	U		-	-
Inorganic clays of low plasticity	CL		30.50	D	35	-	-
Silty Sands	SM		32.00	D	R	-	-
			33.50	D	80	-	-
			35.00	D	79	-	-
Inorganic clays of low plasticity	CL		36.50	D	44	-	-
			38.00	D		-	-
			40.00	D	48	-	-

APPENDIX-C

PLOT 4: LITHOLOGICAL PLOTS

BH-P6-21073.0870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
	WATER LEVEL		1.00	U		-	-
Inorganic clays of low plasticity	CL		2.00	D	7	-	-
Inorganic Silts of low plasticity	ML		3.00	D	10	-	-
			4.00	D		-	-
			5.00	D	21	-	-
			6.00	D	18	-	-
Silty Sands	SM		7.00	D		-	-
			8.00	D	29	-	-
			9.00	D	30	-	-
			10.00	D		-	-
			11.00	D	24	-	-
			12.00	D	22	-	-
			13.00	U		-	-
			14.50	D	37	-	-
Inorganic clays of low plasticity	CL		16.00	D		-	-
			17.50	D	25	-	-
			19.00	D		-	-
			20.00	D	52	-	-

BH-P6-21073.0870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.50	D	62	-	-
			22.00	U		-	-
Inorganic clays of low plasticity	CL		23.50	D	61	-	-
			25.00	U		-	-
			26.50	D	45	-	-
			28.00	U		-	-
Inorganic Silts of Intermediate plasticity	MI		29.50	D	37	-	-
Inorganic Silty Clays of low plasticity	CL-ML		31.00	U		-	-
			32.50	D	41	-	-
Inorganic Silts of Intermediate plasticity	MI		34.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		35.50	D	45	-	-
			37.00	D		-	-
Inorganic Silts of low plasticity	ML		38.50	D	59	-	-
			40.00	D	70	-	-

APPENDIX-C
PLOT 5: LITHOLOGICAL PLOTS

BH-P12-21230.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
Inorganic Silty Clays of low plasticity	WATER LVL CL-ML		1.00	D	4	-	-
Inorganic Silts of Intermediate plasticity	MI		2.00	U		-	-
			3.00	D	5	-	-
Inorganic clays of low plasticity	CL		4.00	D	7	-	-
Inorganic Silts of Intermediate plasticity	MI		5.00	D		-	-
			6.00	D	15	-	-
Inorganic Silts of low plasticity	ML		7.00	D	18	-	-
			8.00	D		-	-
Silty Sands	SM		9.00	D	19	-	-
			10.00	D	21	-	-
Inorganic Silty Clays of low plasticity	CL-ML		11.00	U		-	-
			12.50	D	19	-	-
			14.00	U		-	-
Inorganic clays of low plasticity	CL		15.50	D	22	-	-
			17.00	U		-	-
			18.50	D	32	-	-
			20.00	U		-	-

BH-P12-21230.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	D		-	-
			21.50	D	41	-	-
			23.00	D		-	-
Inorganic clays of low plasticity	CL		24.50	D	44	-	-
			26.00	U		-	-
			27.50	D	49	-	-
			29.00	D	60	-	-
			30.50	D	66	-	-
			32.00	D	79	-	-
			33.50	D	74	-	-
Silty Sands	SM		35.00	D		-	-
			36.50	D	77	-	-
			38.00	D		-	-
			40.00	D	85	-	-

APPENDIX-C
PLOT 6: LITHOLOGICAL PLOTS

BH-P13-21256.487

DESCRIPTION	I.S. GROUP	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM	0.50	D		-	-
Inorganic clays of low plasticity		1.00	U		-	-
Silty Sands	SM	2.00	D	4	-	-
Inorganic clays of low plasticity	CL	3.00	D	5	-	-
		4.00	U		-	-
Inorganic Silts of low plasticity	ML	5.00	D	4	-	-
Inorganic Silty Clays of low plasticity	CL-ML	6.00	D	6	-	-
Inorganic Silts of low plasticity	ML	7.00	D		-	-
		8.00	D	8	-	-
Silty Sands	SM	9.00	D	12	-	-
		10.00	U		-	-
Inorganic clays of low plasticity	CL	11.00	D	31	-	-
		12.00	D	34	-	-
		13.00	U		-	-
Silty Sands	SM	14.50	D	36	-	-
		16.00	U		-	-
Inorganic clays of low plasticity	CL	17.50	D	29	-	-
		19.00	U		-	-
		20.00	D	42	-	-
Inorganic clays of low plasticity	CL	20.50	D	42	-	-
		22.00	D		-	-
		23.50	D	59	-	-
		25.00	D	62	-	-
		26.50	D	75	-	-
		28.00	D	71	-	-
		29.50	D	59	-	-
		31.00	D	55	-	-
Silty Sands	SM	32.50	D	58	-	-
		34.00	D		-	-
		35.50	D	53	-	-
		37.00	D		-	-
		38.50	D	57	-	-
		40.00	D	59	-	-

APPENDIX-C
PLOT 7: LITHOLOGICAL PLOTS

BH-P17-21361.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML		0.50	D		-	-
			1.00	D	3	-	-
Silty Sands with clay binder	SM-SC		2.00	U		-	-
Silty Sands	SM		3.00	D	4	-	-
			4.00	D	6	-	-
			5.00	D		-	-
			6.00	D	9	-	-
			7.00	D	10	-	-
Poorly Graded Sands with inorganic Silts of low plasticity	SP-ML		8.00	D		-	-
			9.00	D	25	-	-
			10.00	D	34	-	-
Silty Sands	SM		11.00	U		-	-
Inorganic clays of low plasticity	CL		12.50	D	27	-	-
Inorganic Silty Clays of low plasticity	CL-ML		14.00	U		-	-
			15.50	D	30	-	-
Inorganic clays of low plasticity	CL		17.00	U		-	-
Inorganic clays of intermediate plasticity	CI		18.50	D	38	-	-
			20.00	U		-	-

BH-P17-21361.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	U		-	-
Inorganic clays of intermediate plasticity	CI		21.50	D	65	-	-
Inorganic clays of low plasticity	CL		23.00	U		-	-
			24.50	D	70	-	-
			26.00	D	52	-	-
			27.50	D	41	-	-
			29.00	U		-	-
Silty Sands	SM		30.50	D	56	-	-
			32.00	D	65	-	-
Inorganic Silts of low plasticity	ML		33.50	D	61	-	-
			35.00	D	68	-	-
Silty Sands	SM		36.50	D	83	-	-
Inorganic clays of low plasticity	CL		38.00	D	55	-	-
			40.00	D	63	-	-

APPENDIX-C
PLOT 8: LITHOLOGICAL PLOTS

BH-P18-21387.4870

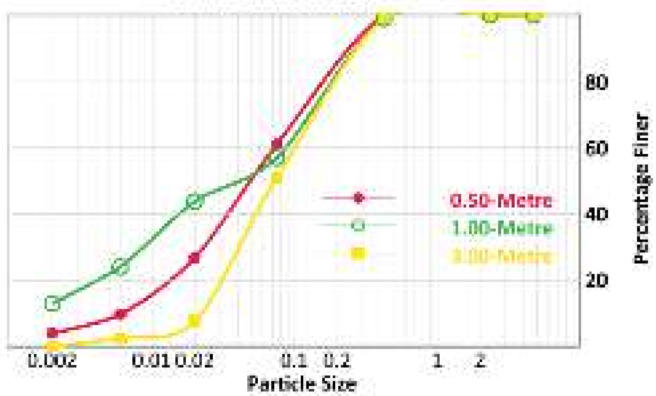
DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands			0.50	D		-	-
	SM		1.00	U		-	-
Silty Sands with clay binder	SM-SC		2.00	D	9	-	-
			3.00	D	10	-	-
			4.00	U		-	-
			5.00	D	15	-	-
			6.00	D	19	-	-
			7.00	D		-	-
			8.00	D	17	-	-
			9.00	D	21	-	-
Silty Sands	SM		10.00	U		-	-
			11.00	D	24	-	-
			12.00	D	28	-	-
			13.00	U		-	-
			14.50	D	17	-	-
			16.00	U		-	-
			17.50	D	20	-	-
Inorganic clays of low plasticity	CL		19.00	U		-	-
			20.00	D	33	-	-

BH-P18-21387.4870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.50	D	33	-	-
			22.00	U		-	-
Inorganic clays of low plasticity	CL		23.50	D	36	-	-
			25.00	U		-	-
			26.50	D	34	-	-
Inorganic Silts of Intermediate plasticity	MI		28.00	U		-	-
Inorganic Clays of low to intermediate plasticity	CL-CI		29.50	D	83	-	-
Silty Sands	SM		31.00	D	100	-	-
			32.50	D	77	-	-
Silty Sands with clay binder	SM-SC		34.00	D	86	-	-
Inorganic Silty Clays of low plasticity	CI-MI		35.50	D	66	-	-
			37.00	D	68	-	-
Inorganic clays of low plasticity	CL		38.50	D	67	-	-
			40.00	D	74	-	-

APPENDIX-D
PLOT 1: GRAIN SIZE DISTRIBUTION PLOTS

BH- A1-CH.20915.8870



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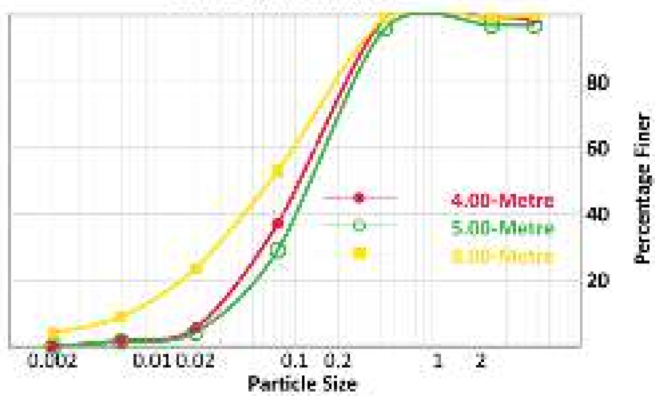

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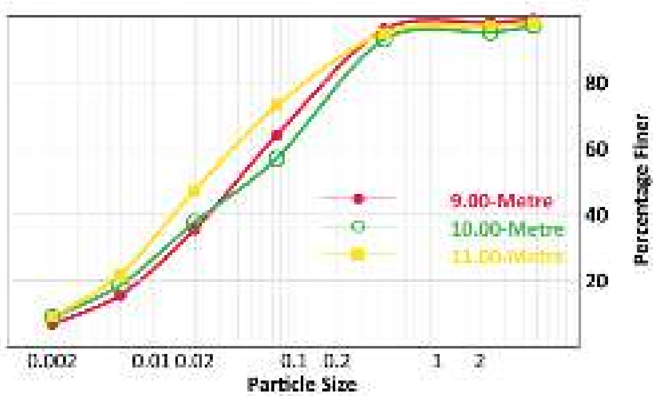

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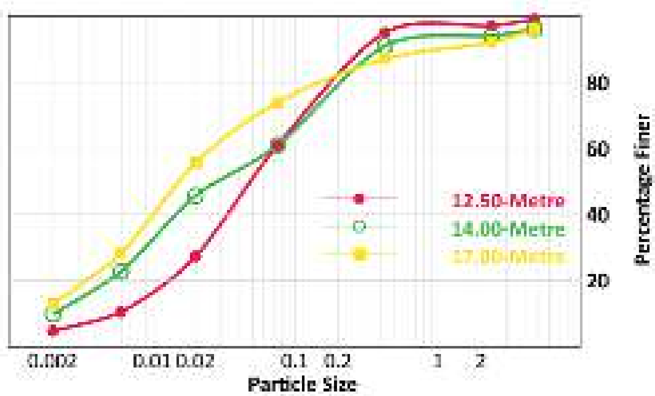

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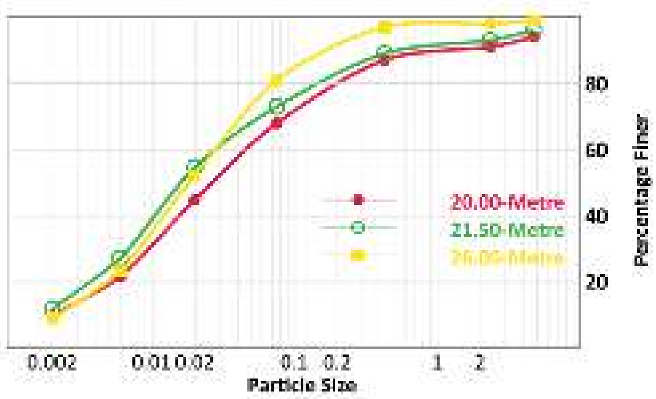

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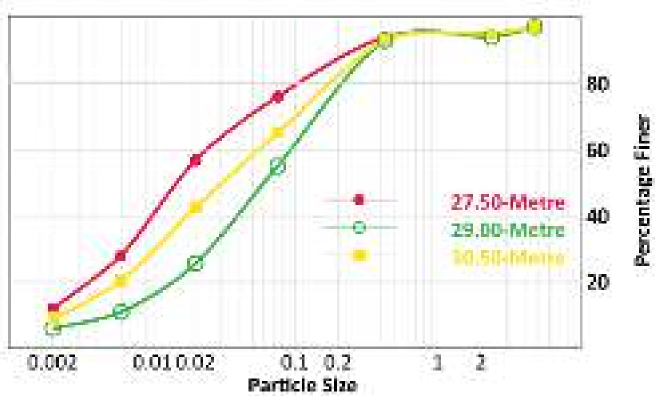

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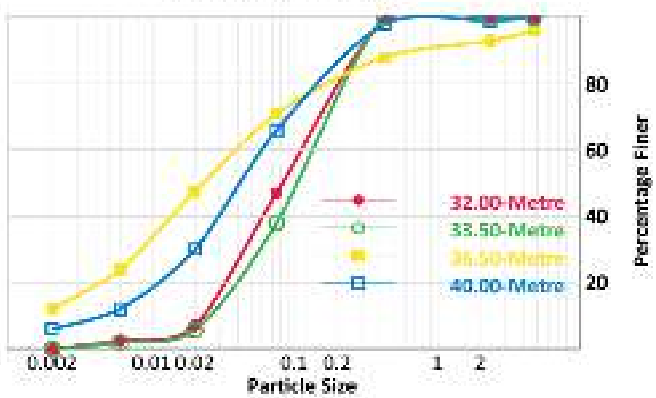

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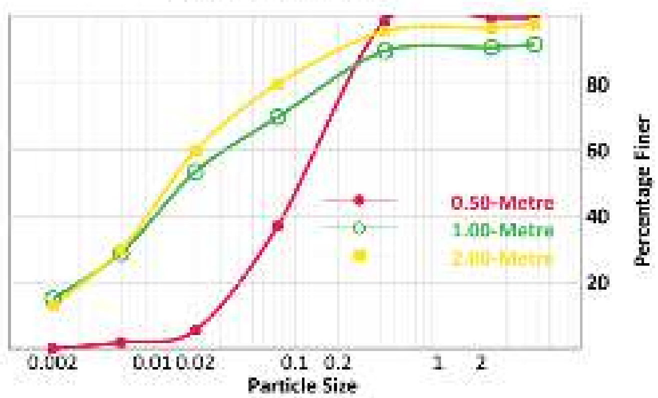
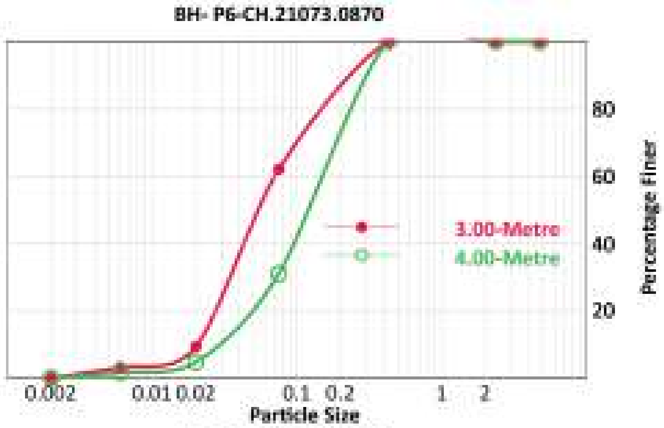
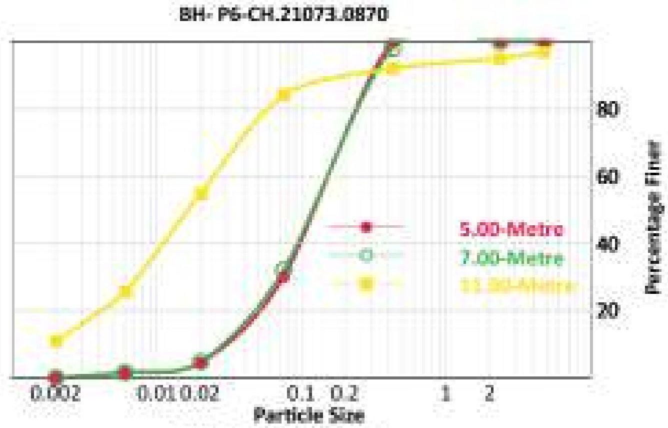
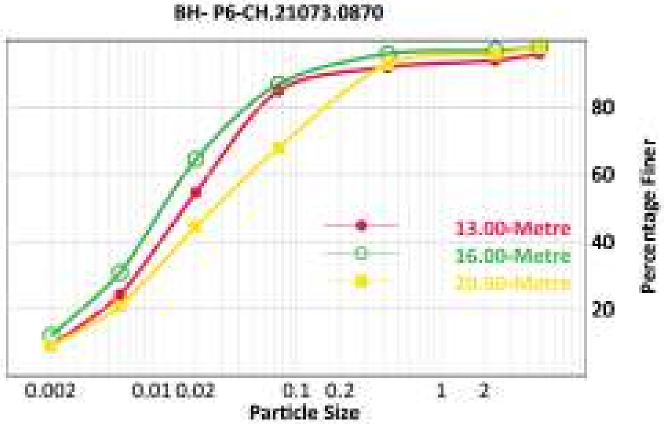
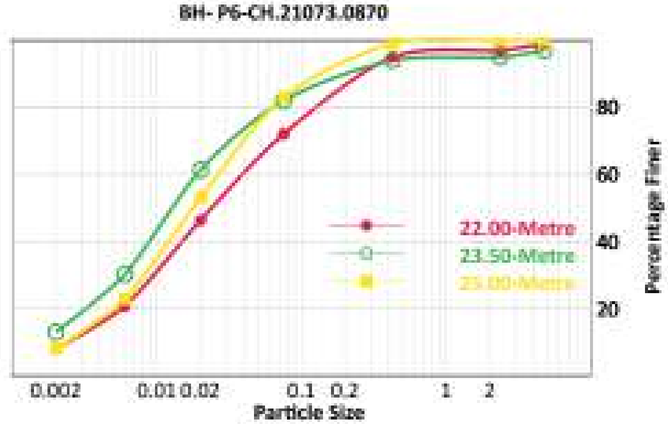


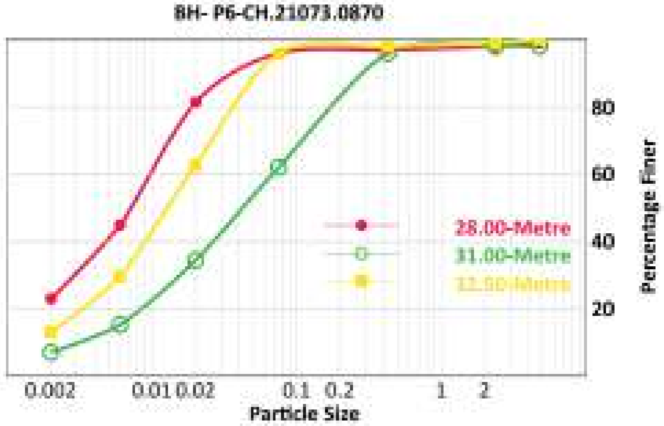
APPENDIX-D
PLOT 2: GRAIN SIZE DISTRIBUTION PLOTS

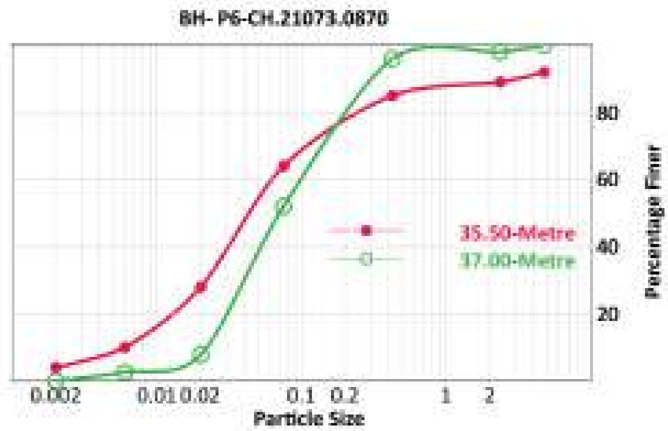




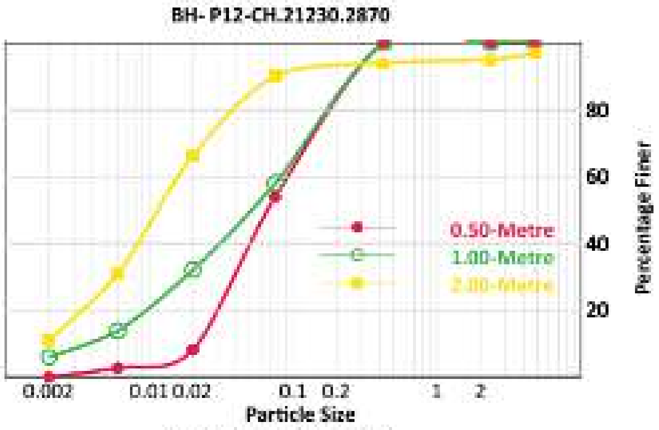


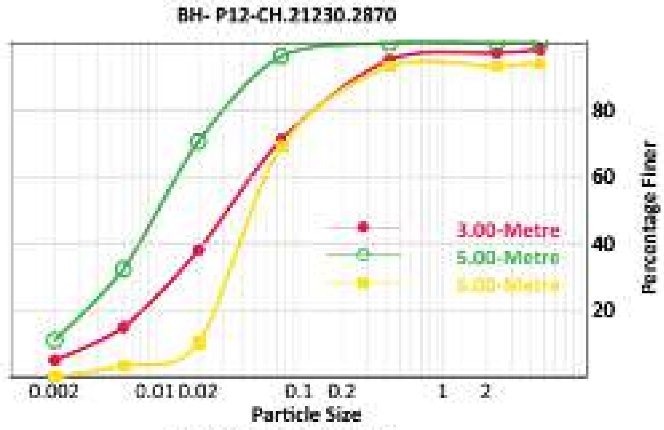


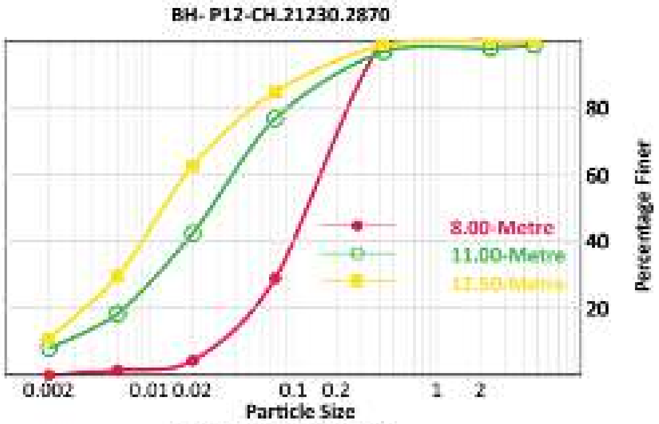


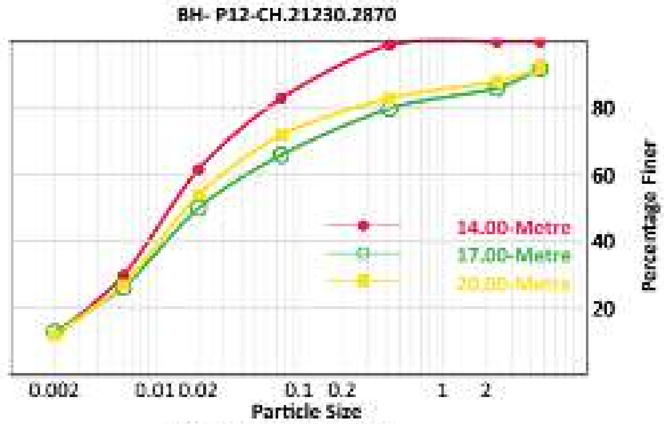


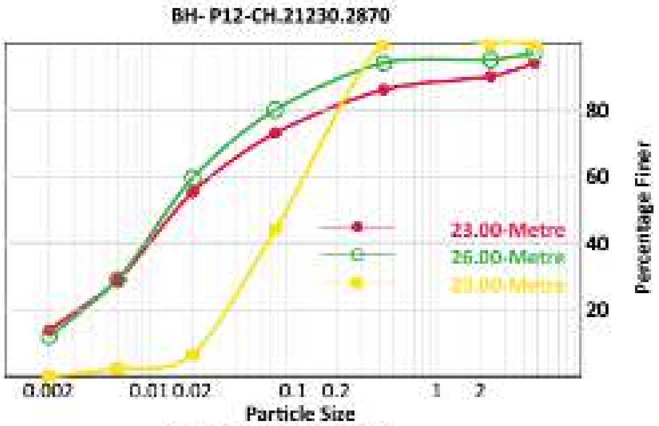
APPENDIX-D
PLOT 3: GRAIN SIZE DISTRIBUTION PLOTS

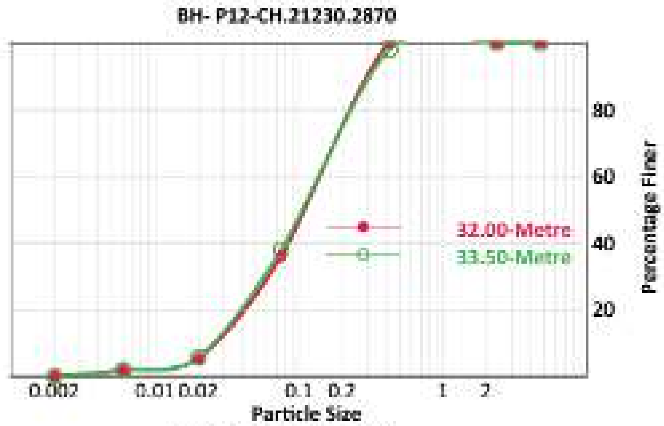


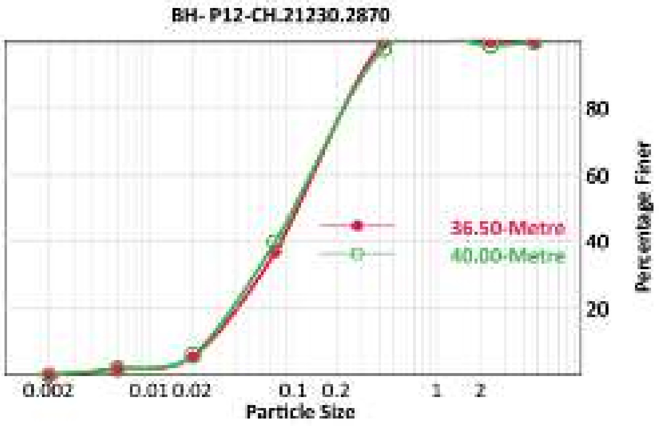


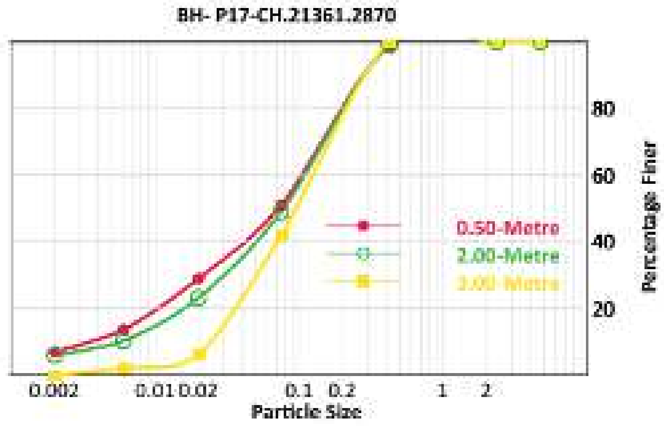




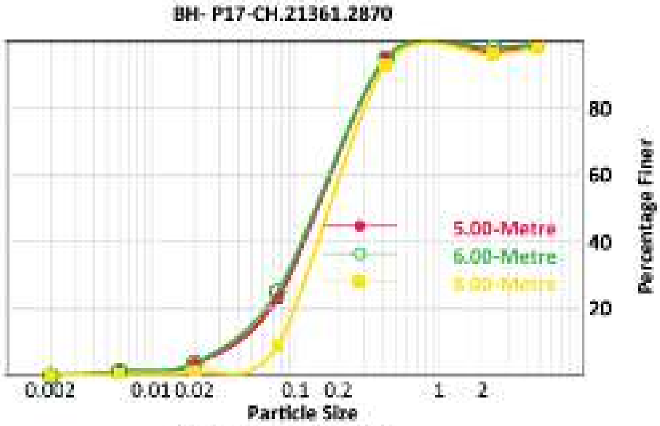


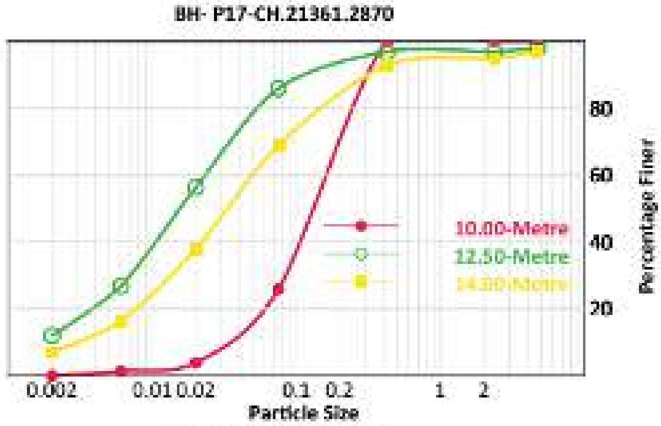


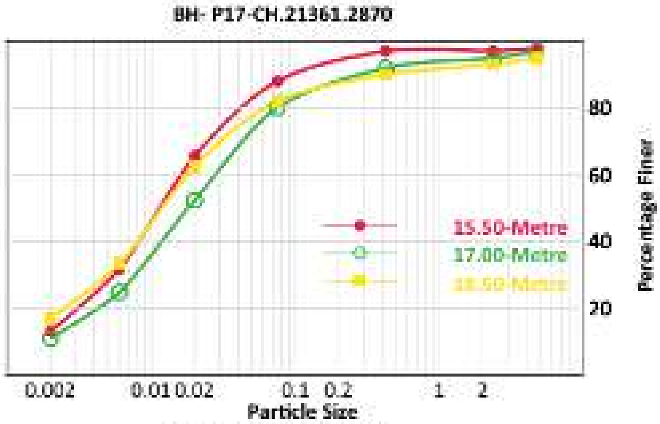


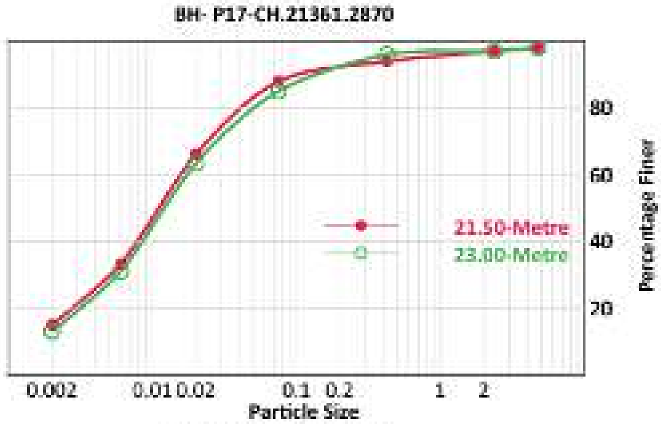


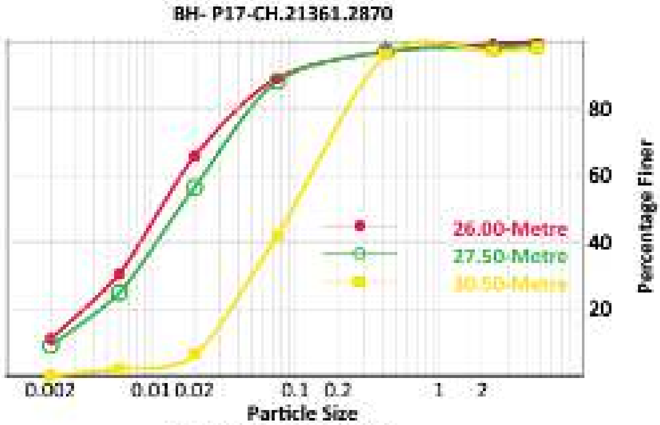
APPENDIX-D
PLOT 4: GRAIN SIZE DISTRIBUTION PLOTS

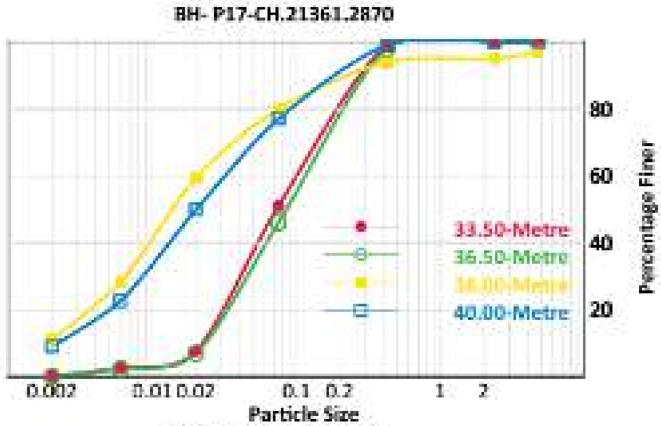


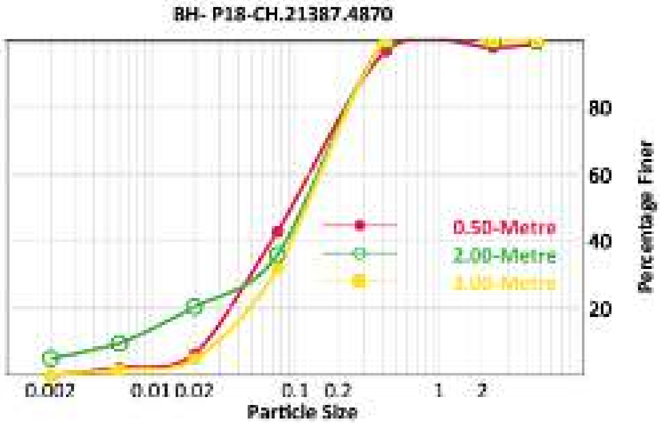


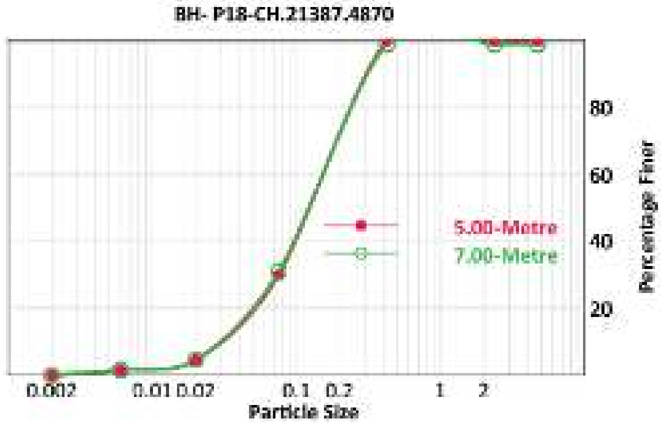




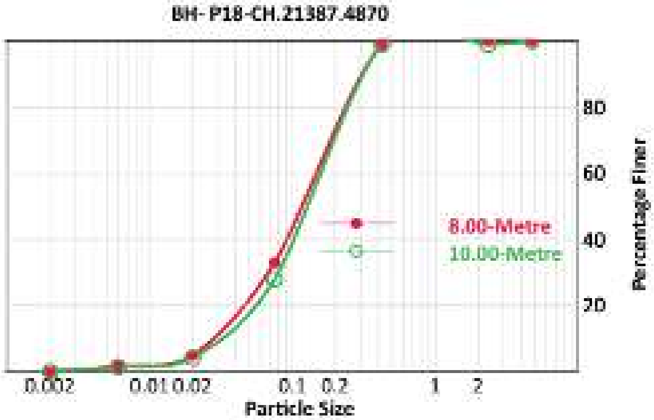


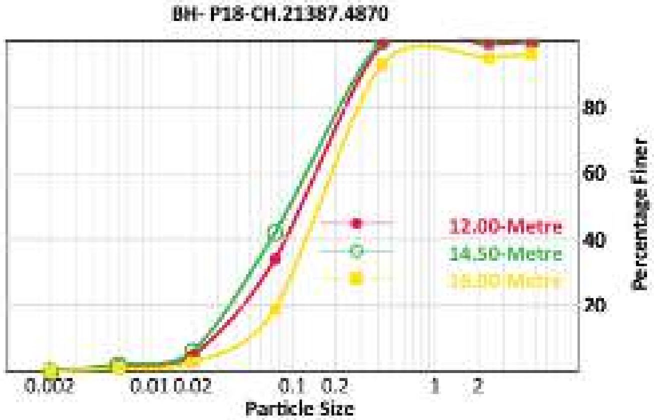


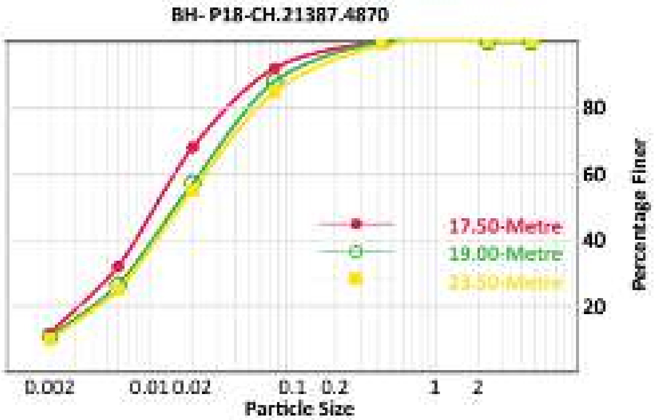


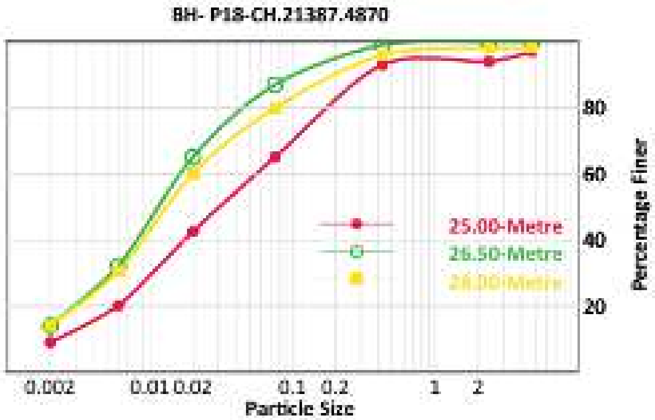


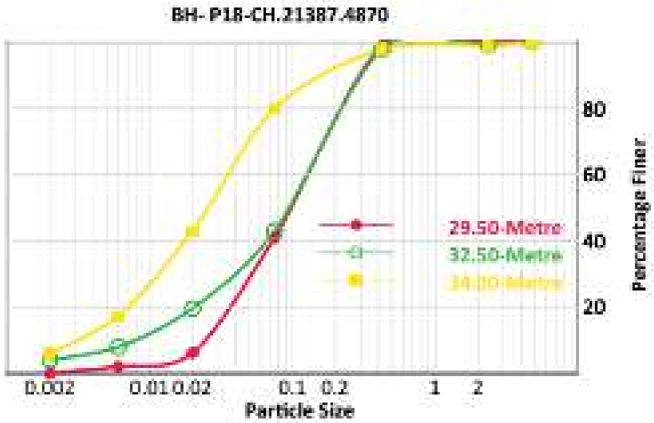
APPENDIX-D
PLOT 5: GRAIN SIZE DISTRIBUTION PLOTS

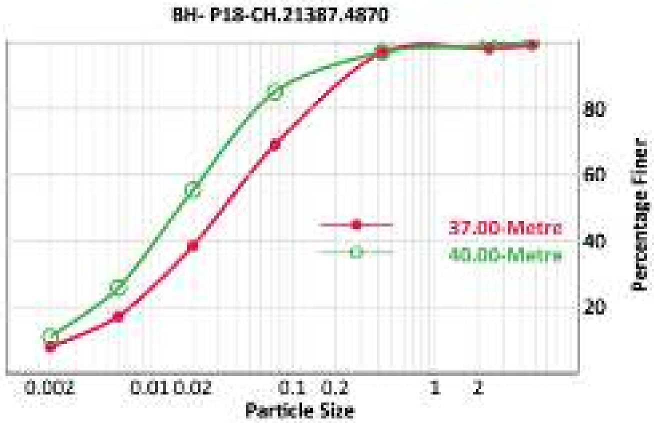








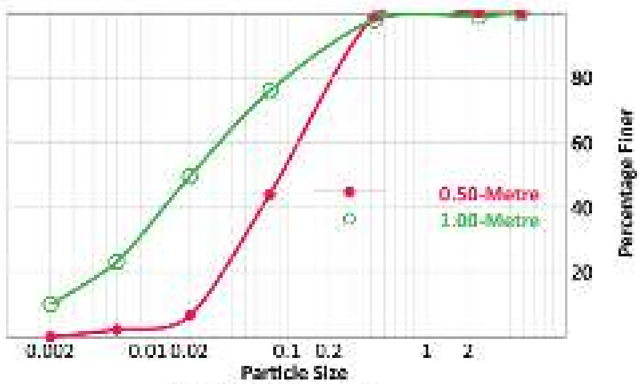




APPENDIX-D

PLOT 6: GRAIN SIZE DISTRIBUTION PLOTS

BH- P13-CH.21256.487



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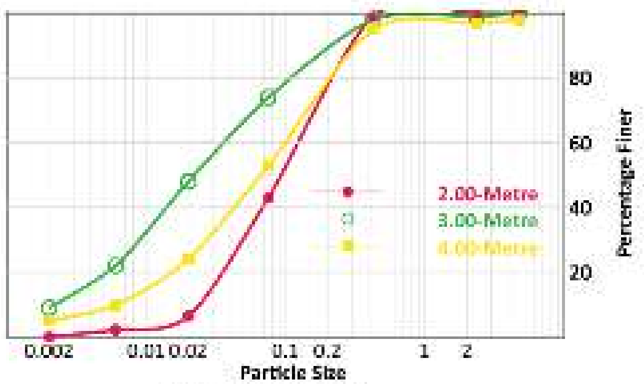
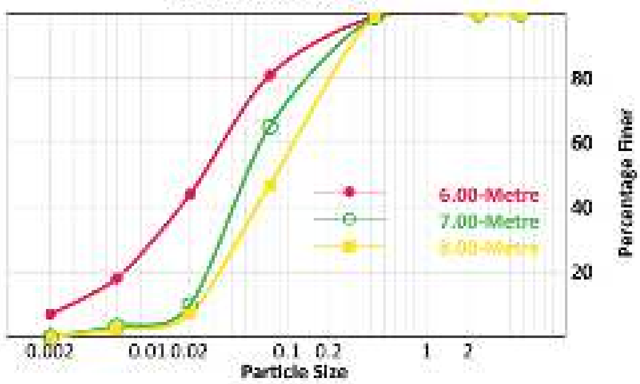
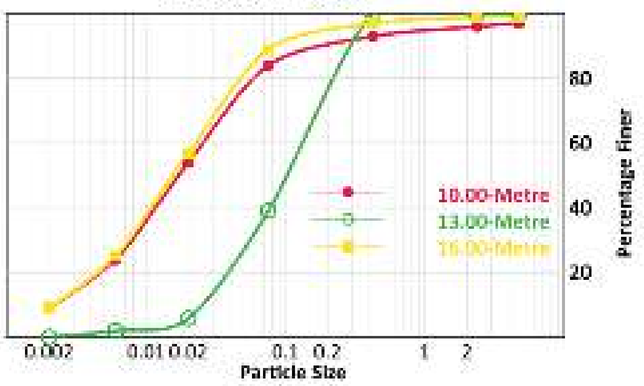


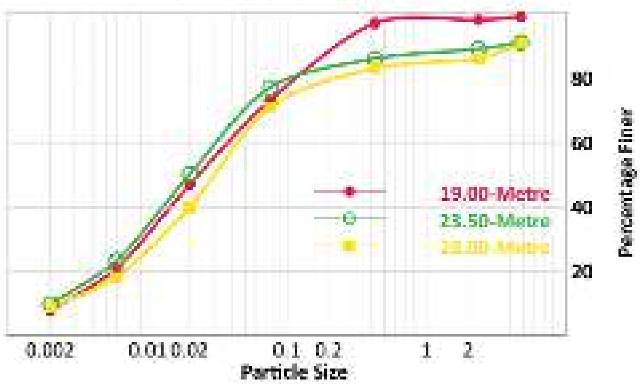
BH- P13-CH.21256.487



BH- P13-CH.21256.487



BH- P13-CH.21256.487



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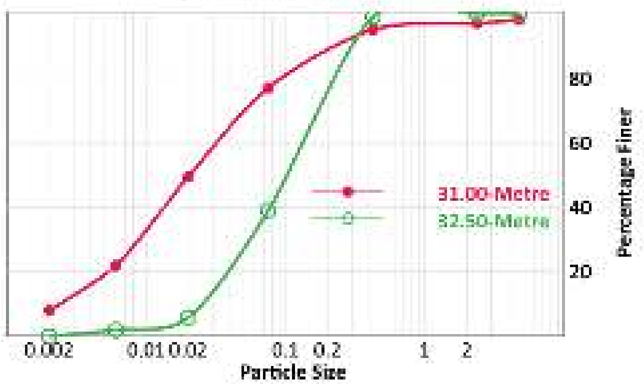

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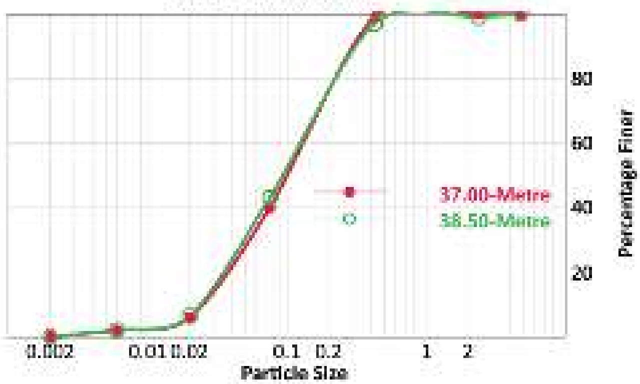
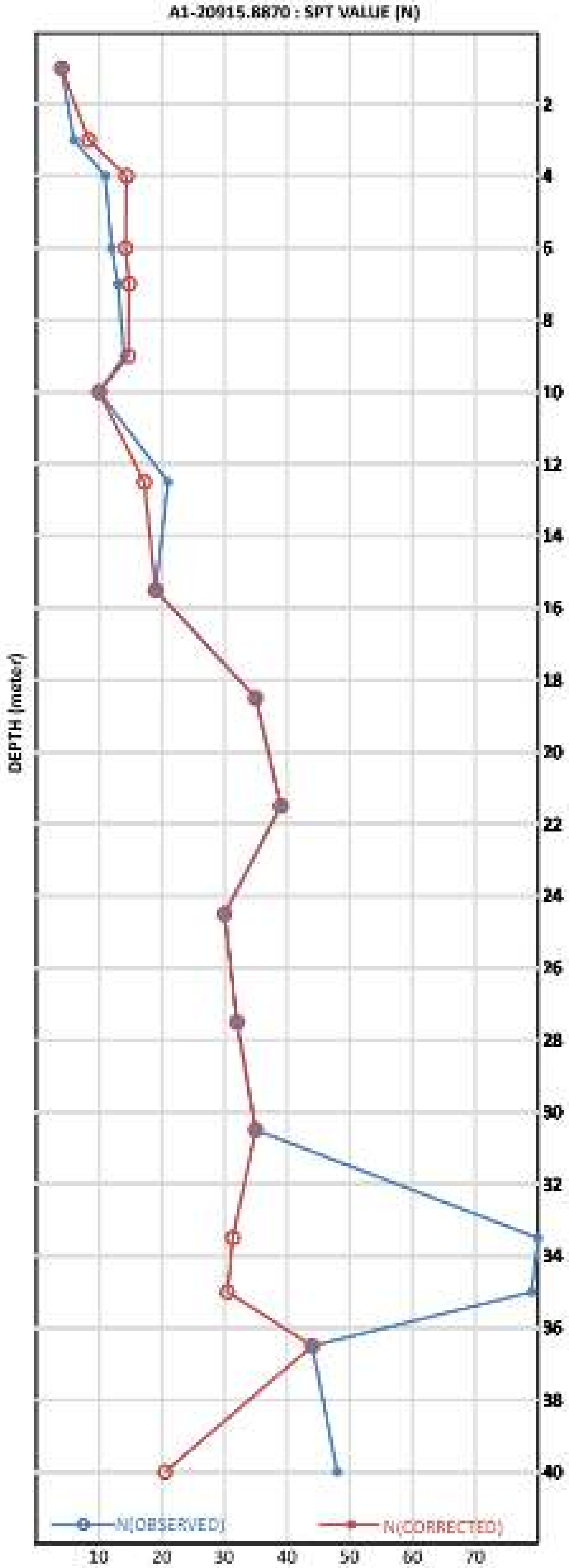
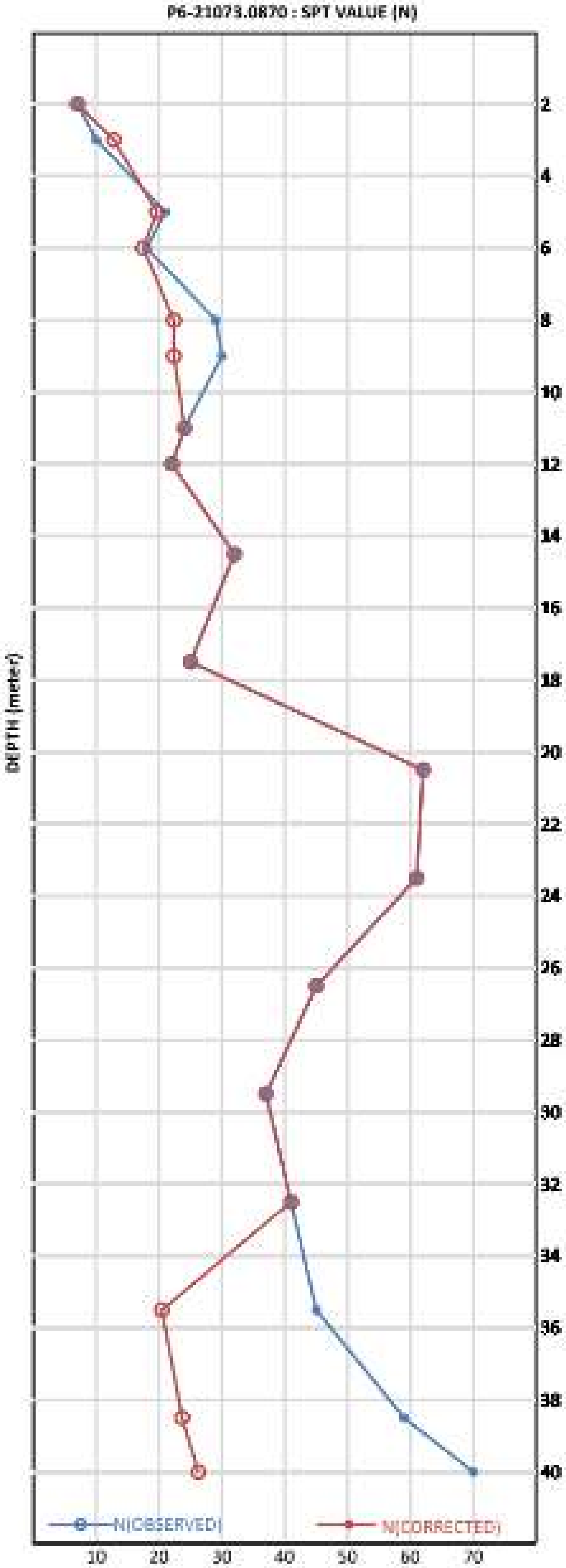
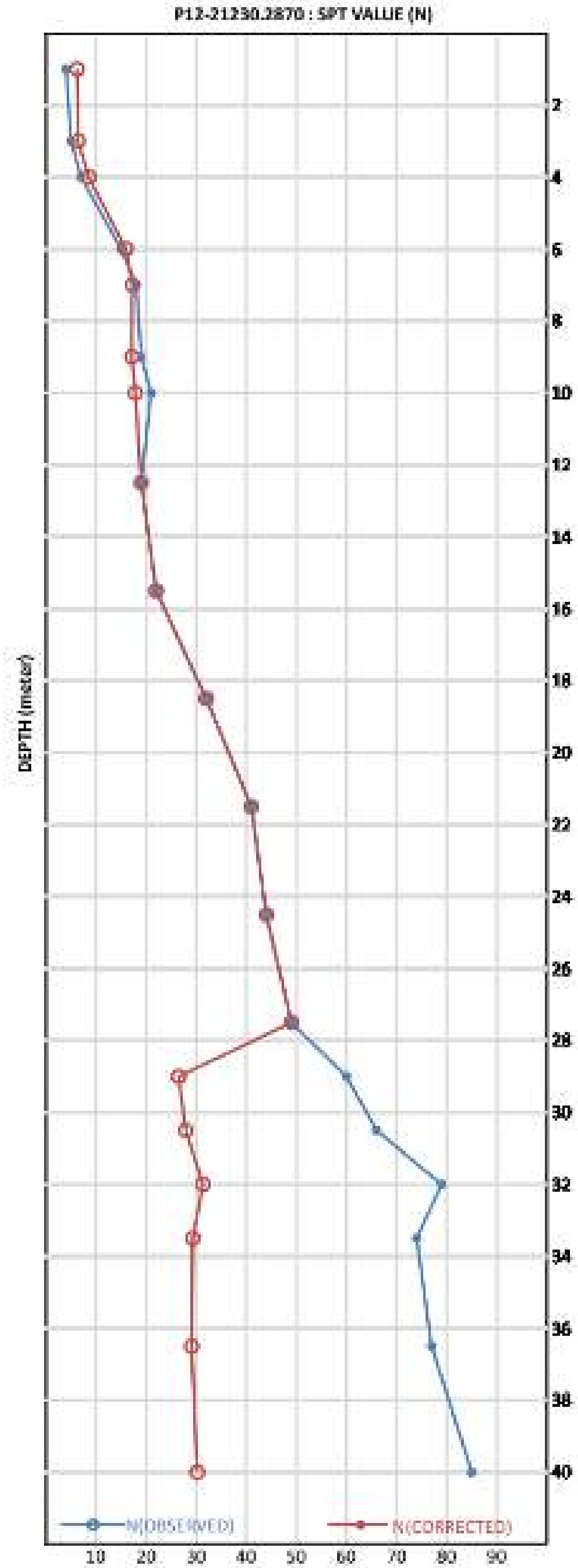


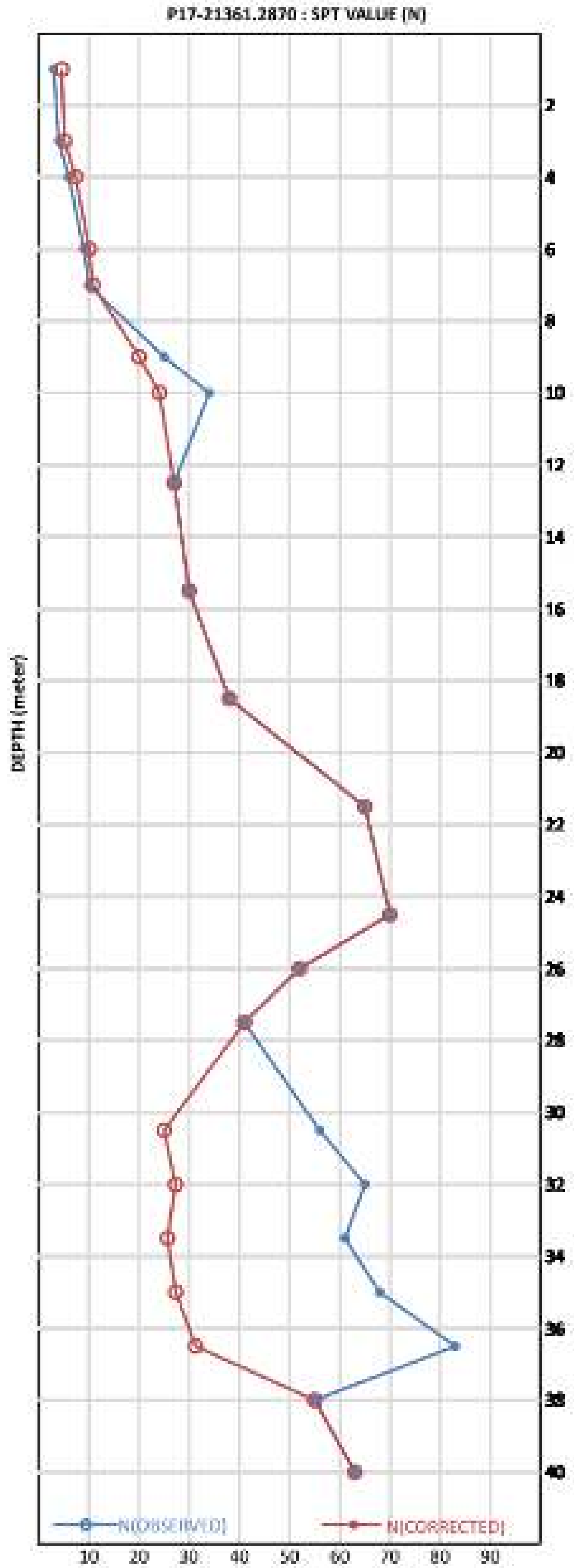
APPENDIX-E
PLOT 1: RECORDED SPT Vs CORRECTED SPT



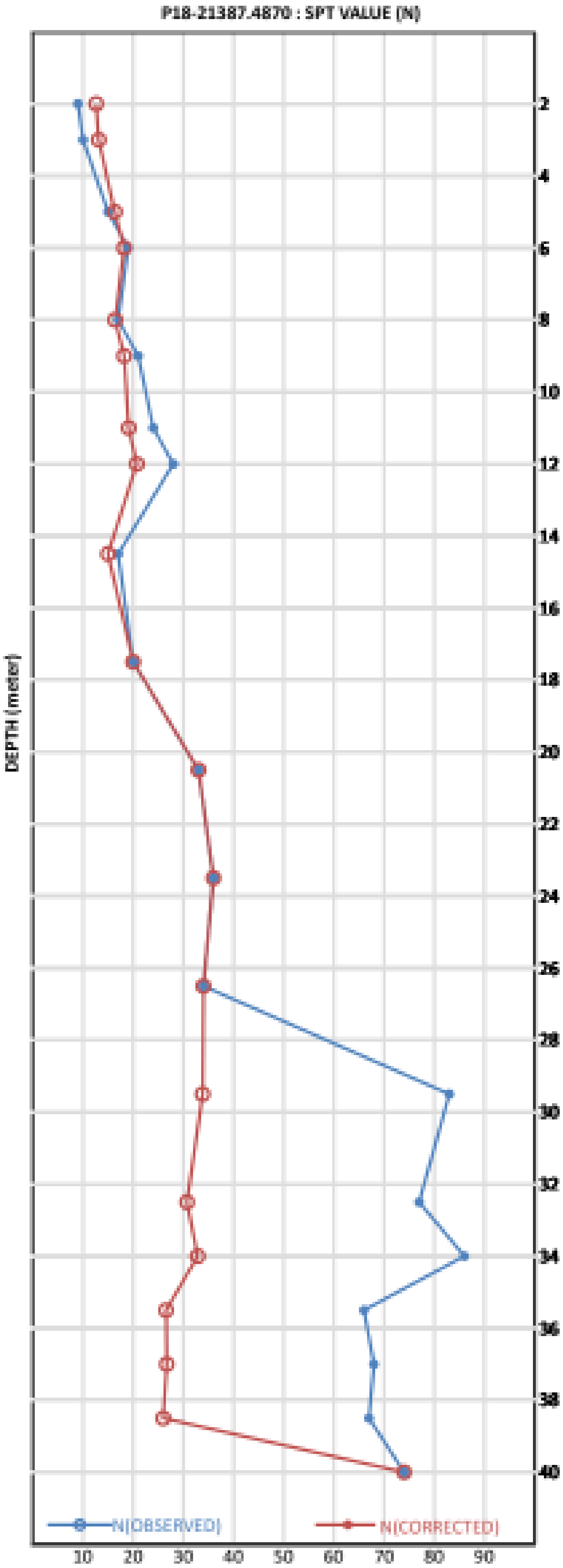


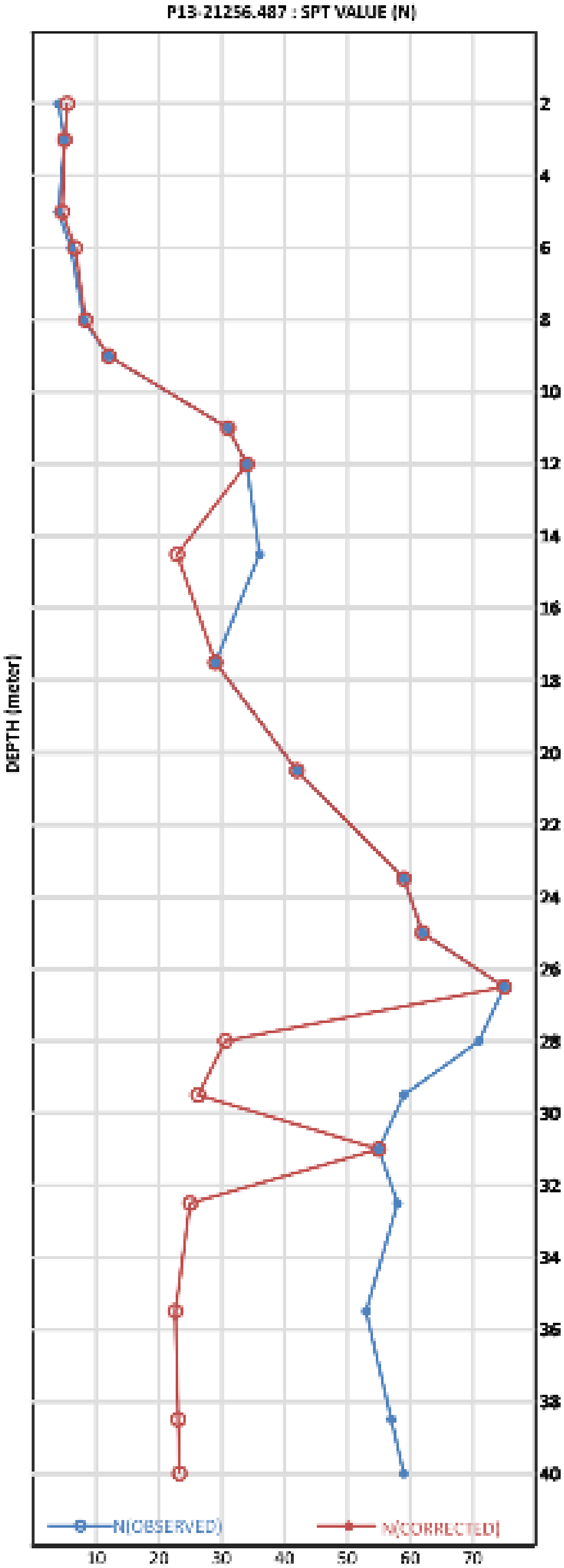
APPENDIX-E
PLOT 2: RECORDED SPT Vs CORRECTED SPT





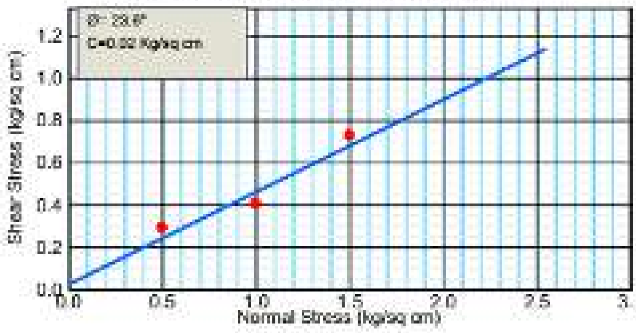
APPENDIX-E
PLOT 3: RECORDED SPT Vs CORRECTED SPT



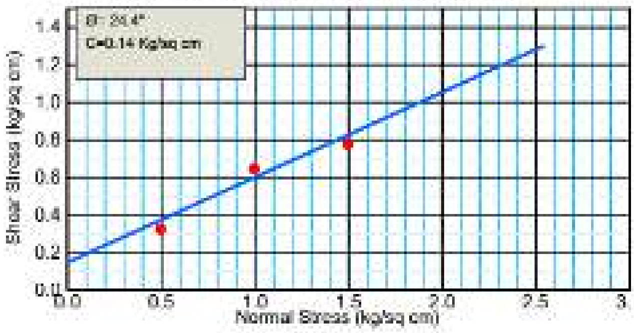


APPENDIX-F
GRAPH 1: DST GRAPH

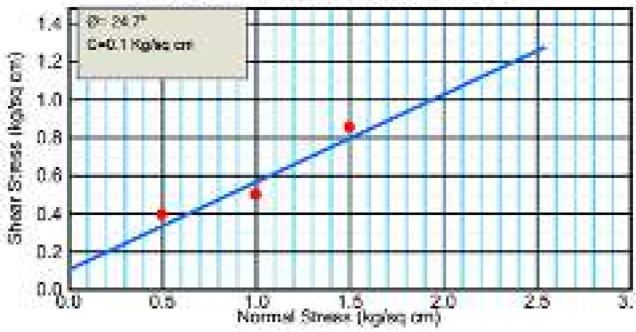
1901-HRIDC-I-20915.0870
BH-A1, DEPTH=5.00M, DIRECT SHEAR TEST



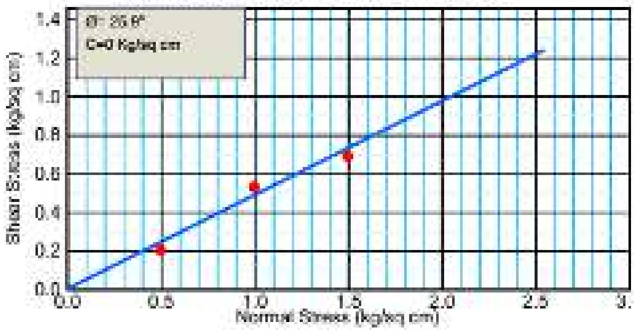
1901-HRIDC-I-20915.0870
BH-A1, DEPTH=20.00M, DIRECT SHEAR TEST



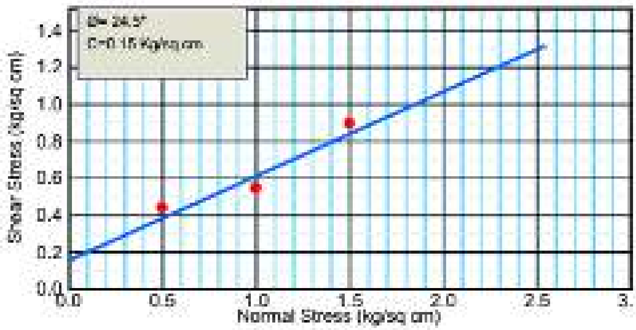
1901-HRIDC-I-21073.0870
BH-P6, DEPTH=31.00M, DIRECT SHEAR TEST



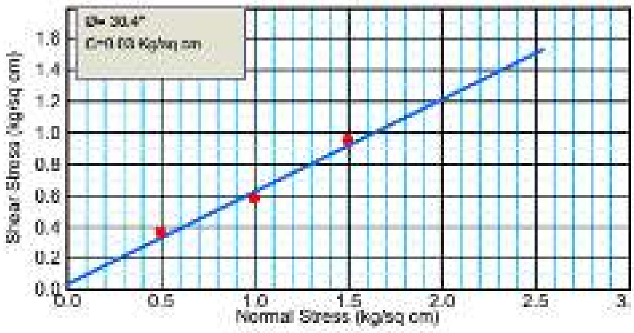
1901-HRIDC-I-21230.2870
BH-P12, DEPTH=6.00M, DIRECT SHEAR TEST



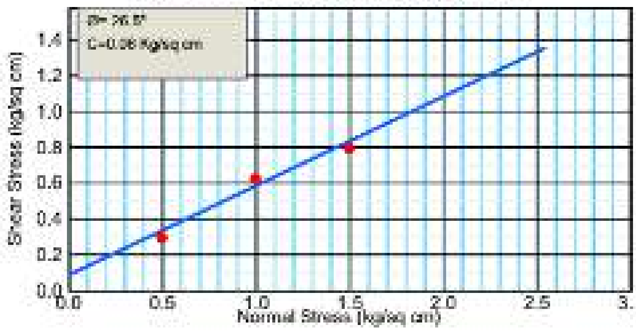
1901-HRIDC-I-21230.2870
BH-P12, DEPTH=11.00M, DIRECT SHEAR TEST



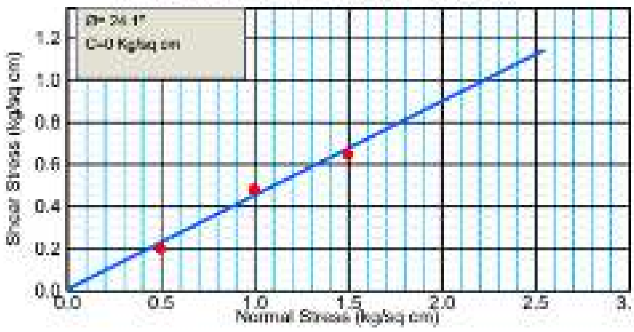
1901-HRIDC-I-21230.2870
BH-P12, DEPTH=35.00M, DIRECT SHEAR TEST



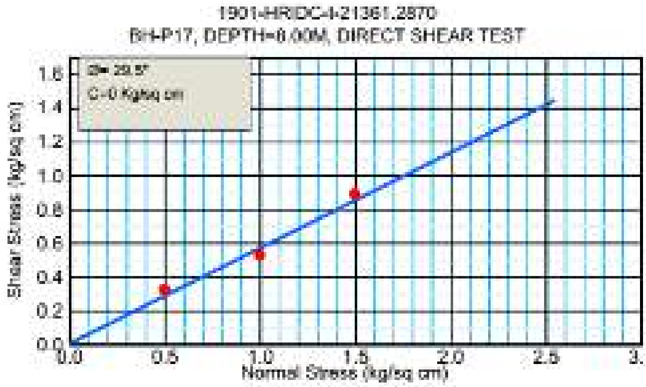
1901-HRIDC-I-21361.2870
BH-P17, DEPTH=2.00M, DIRECT SHEAR TEST

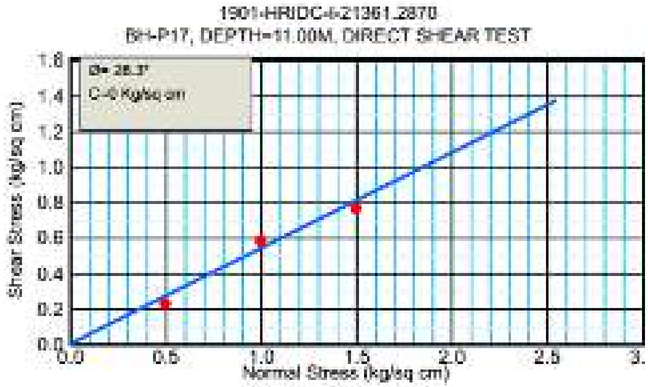


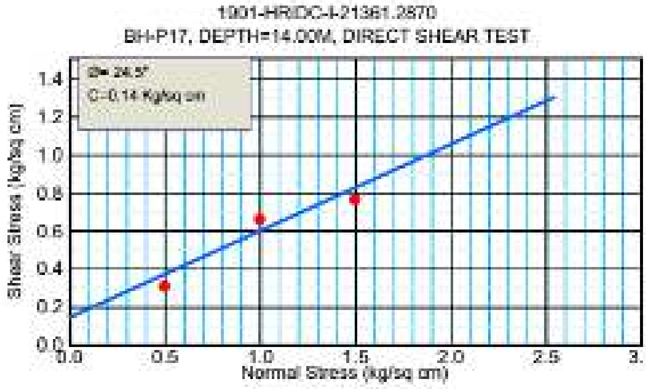
1901-HRIDC-I-21361.2870
BH-P17, DEPTH=5.00M, DIRECT SHEAR TEST

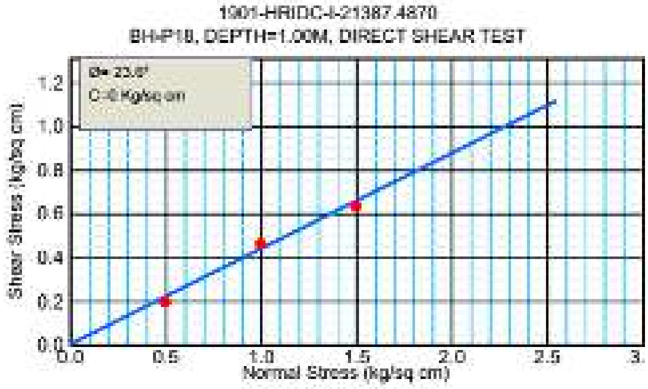


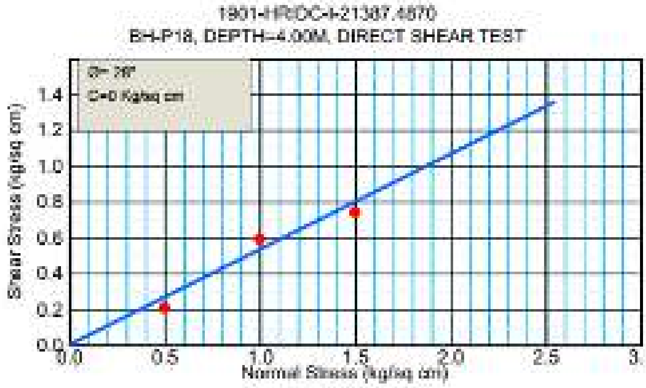
APPENDIX-F
GRAPH 2: DST GRAPH

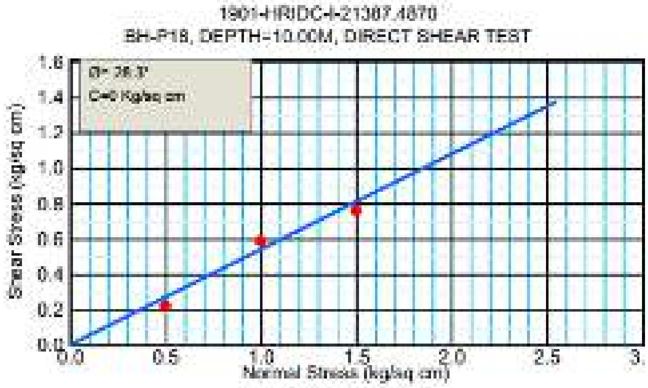


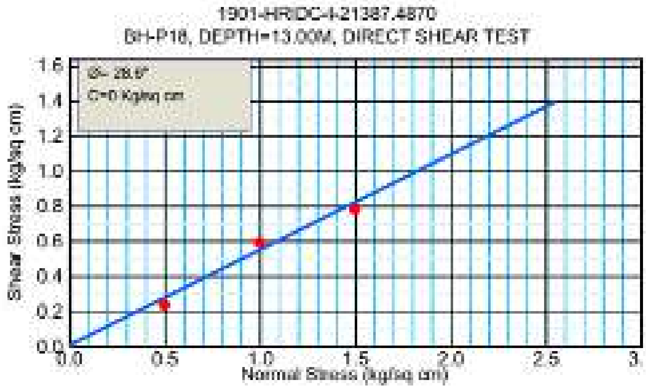


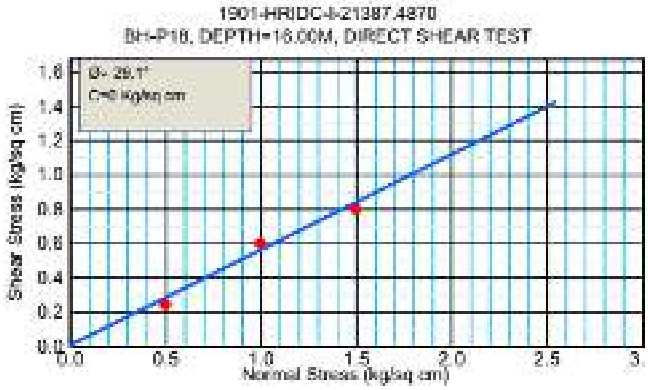




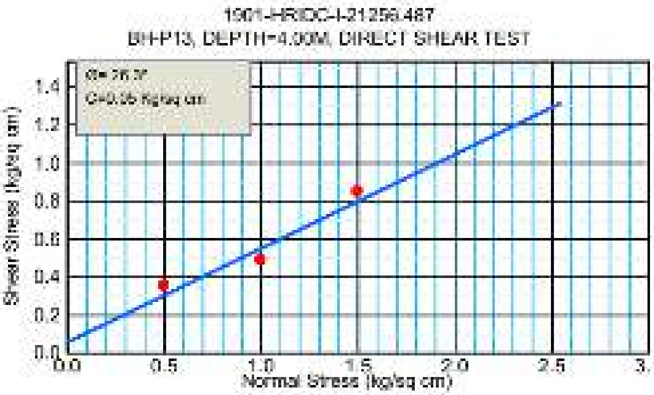


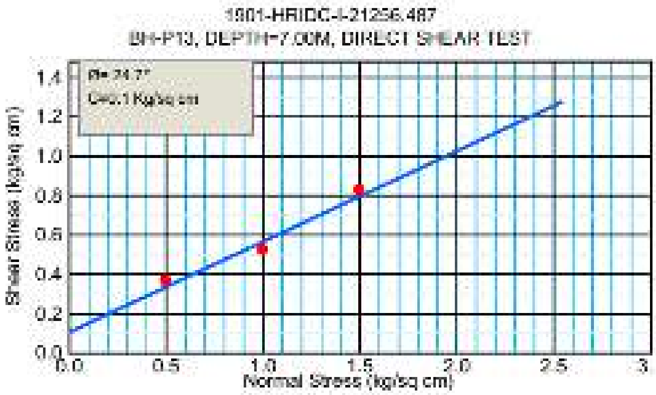


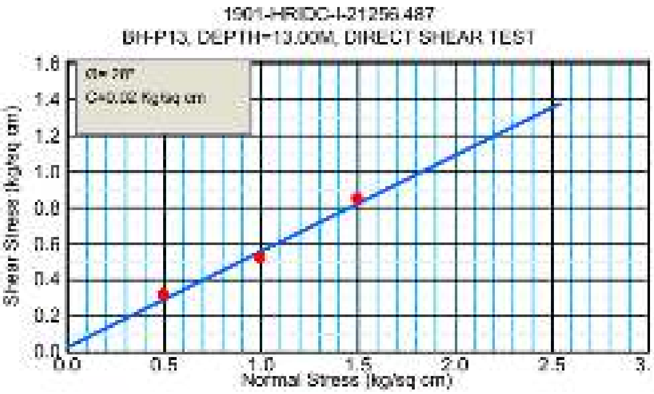


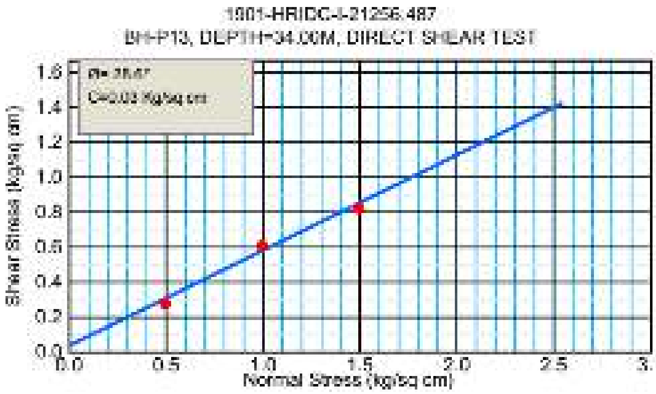


APPENDIX-F
GRAPH 3: DST GRAPH

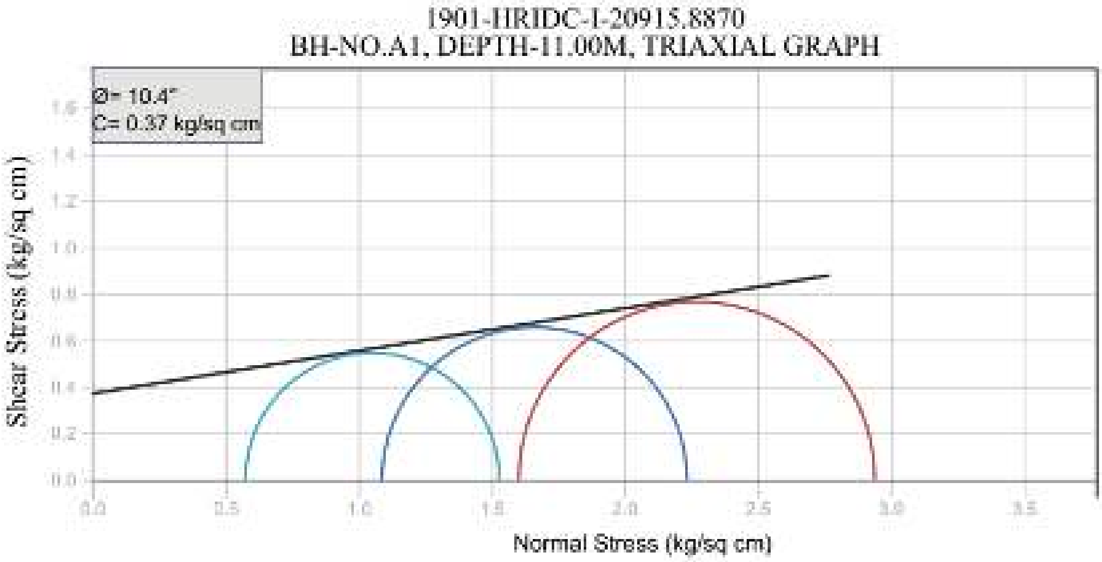


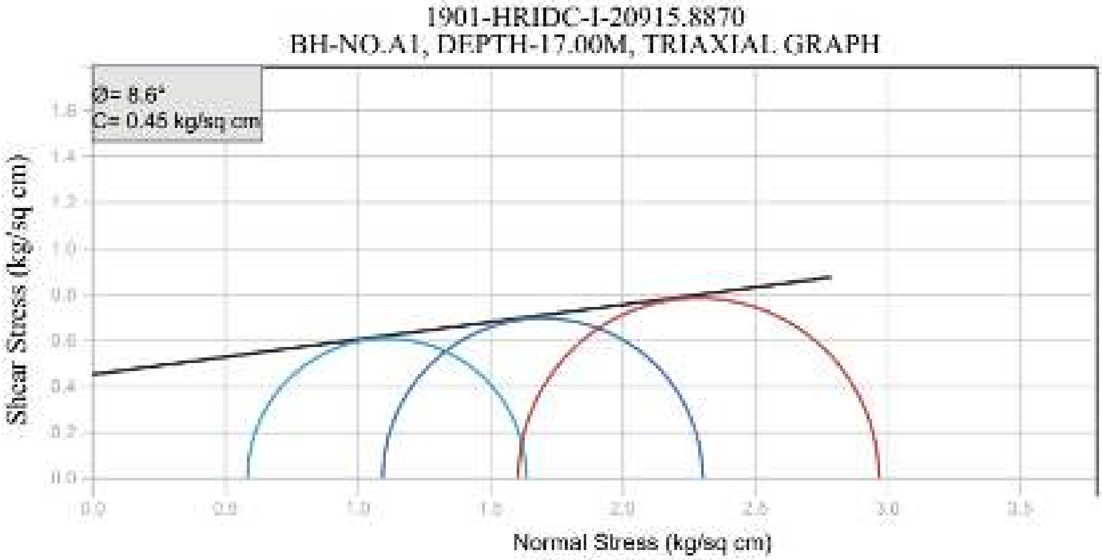






APPENDIX-G
GRAPH 1: UU GRAPH



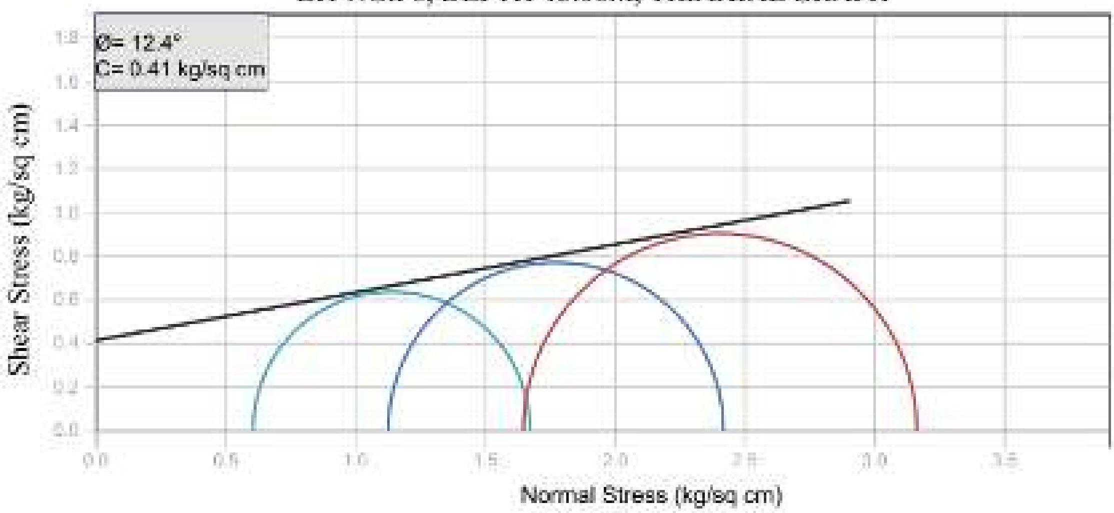


APPENDIX-G

GRAPH 2: UU GRAPH

1901-HRIDC-I-21073.0870
BH-NO.P6, DEPTH-1.00M, TRIAXIAL GRAPH

1901-HRIDC-I-21073.0870
BH-NO.P6, DEPTH-13.00M, TRIAXIAL GRAPH

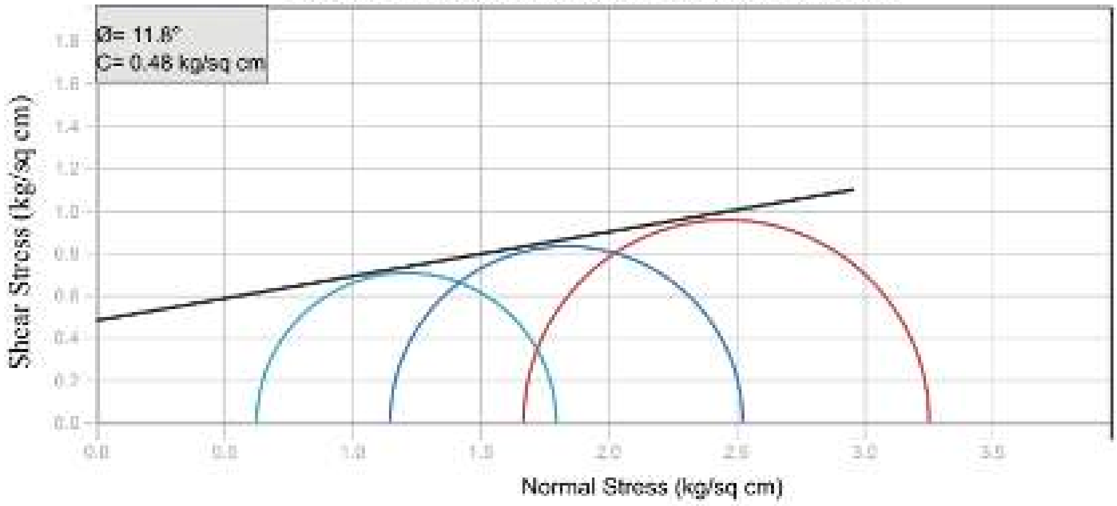


1901-HRIDC-I-21073.0870
BH-NO.P6, DEPTH-22.00M, TRIAXIAL GRAPH

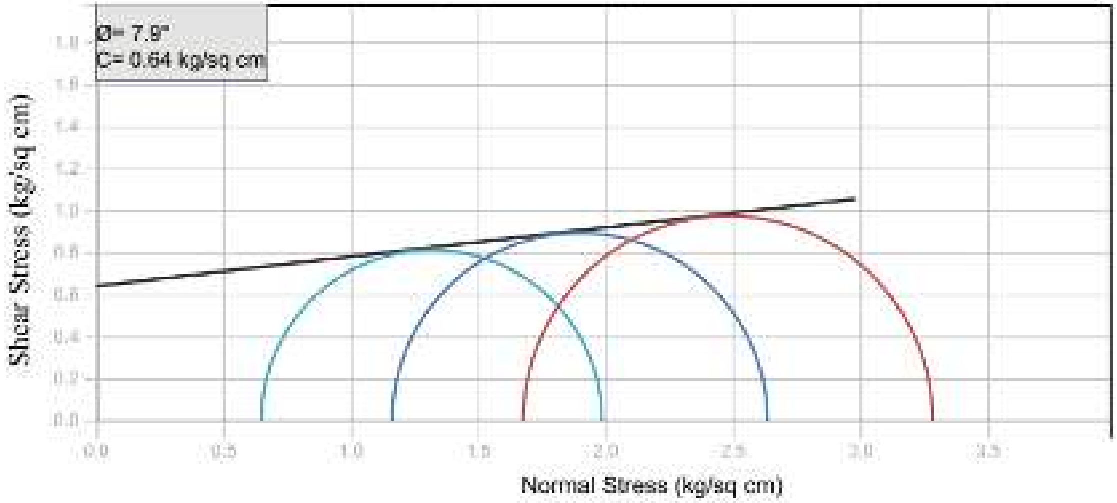
APPENDIX-G

GRAPH 3: UU GRAPH

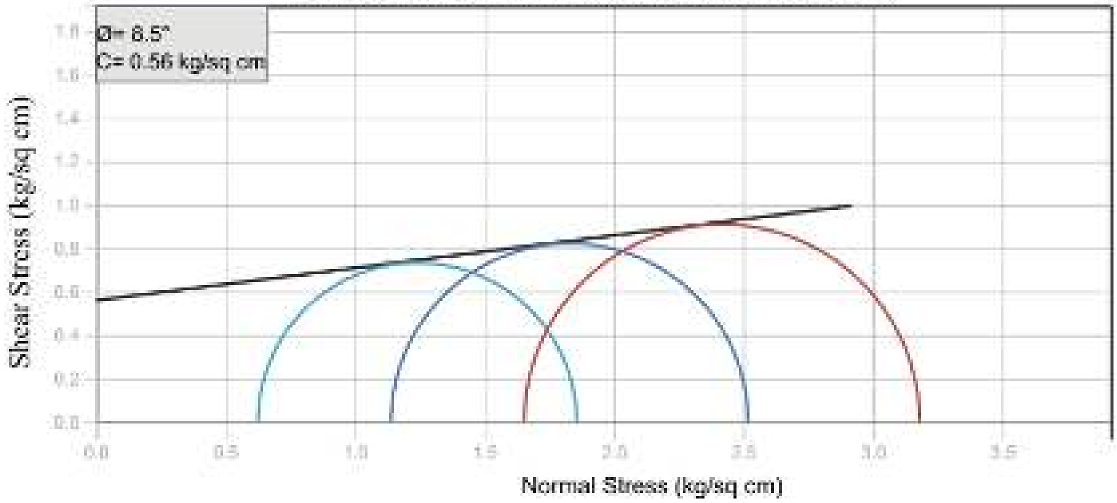
1901-HRIDC-I-21073.0870
BH-NO.P6, DEPTH-28.00M, TRIAXIAL GRAPH



1901-HRIDC-I-21230.2870
BH-NO.P12, DEPTH-2.00M, TRIAXIAL GRAPH

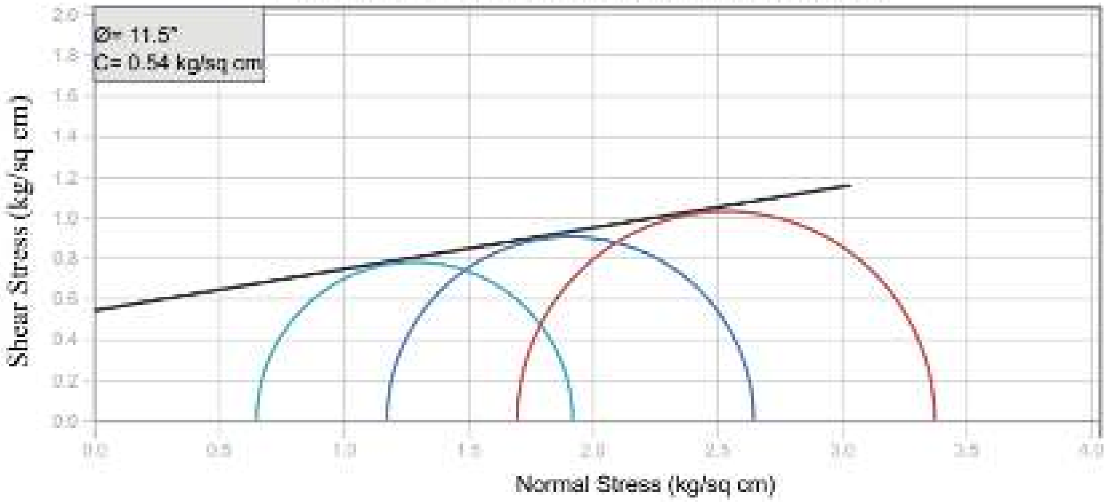


1901-HRIDC-I-21230.2870
BH-NO.P12, DEPTH-14.00M, TRIAXIAL GRAPH

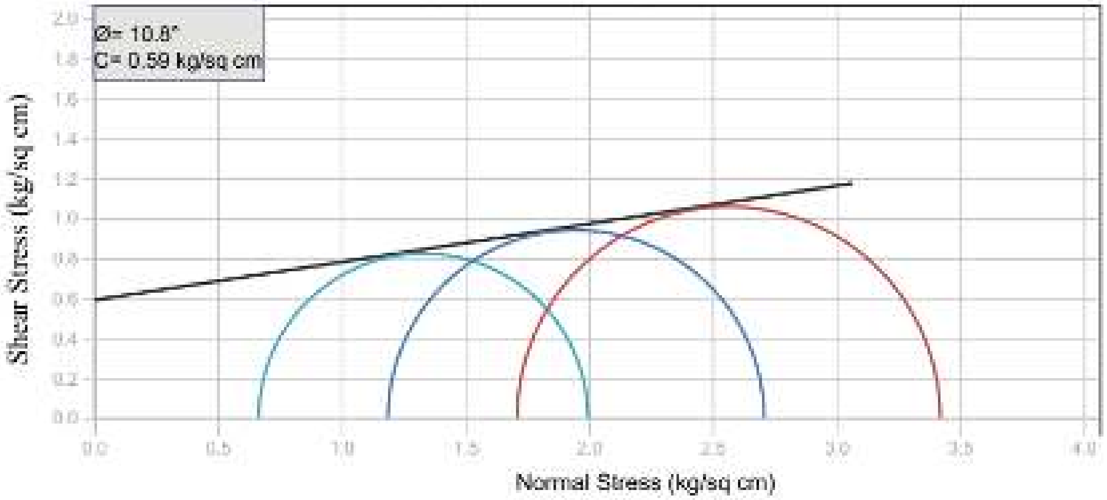


APPENDIX-G
GRAPH 4: UU GRAPH

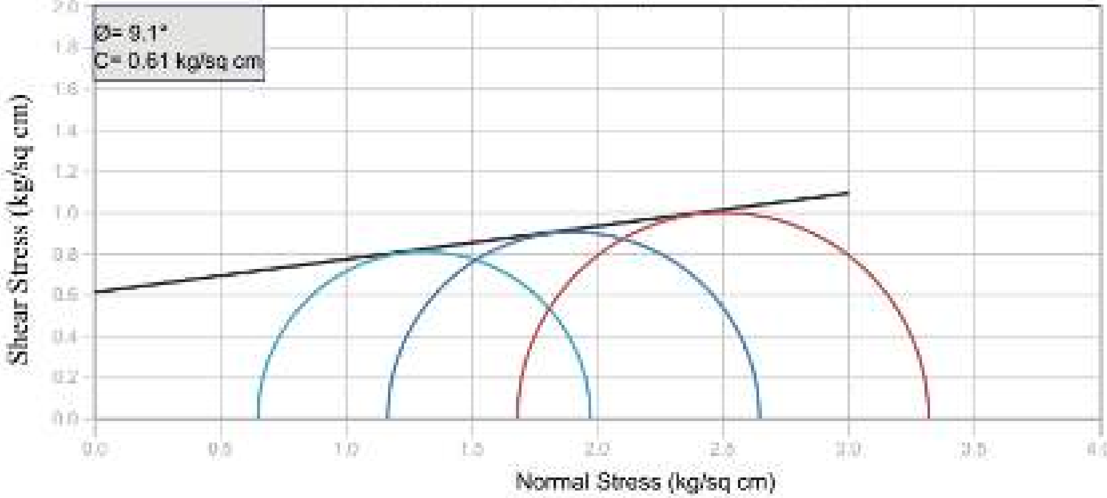
1901-HRIDC-I-21230.2870
BH-NO.P12, DEPTH-17.00M, TRIAXIAL GRAPH



1901-HRIDC-I-21230.2870
BH-NO.P12, DEPTH-20.00M, TRIAXIAL GRAPH

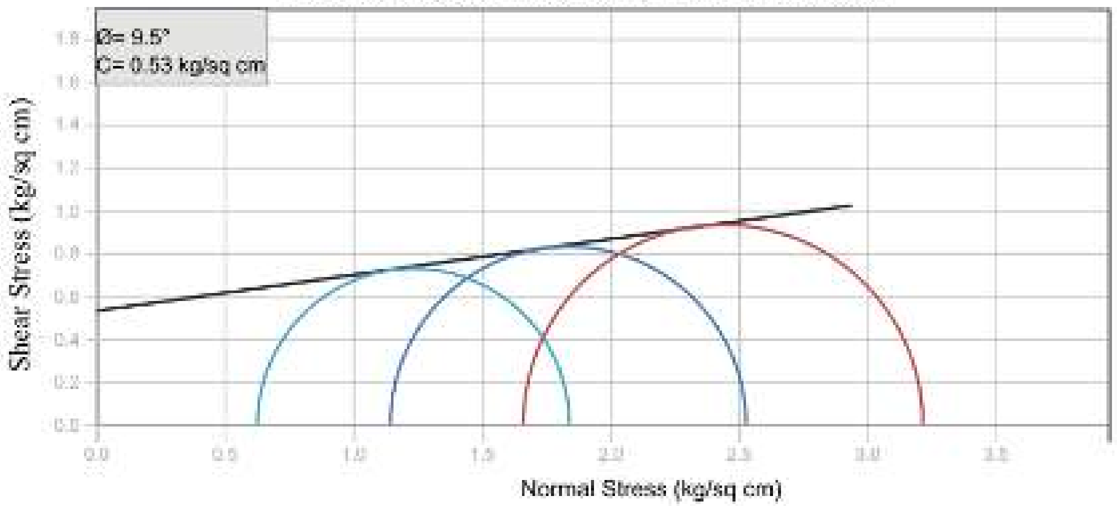


1901-HRIDC-I-21230.2870
BH-NO.P12, DEPTH-23.00M, TRIAXIAL GRAPH

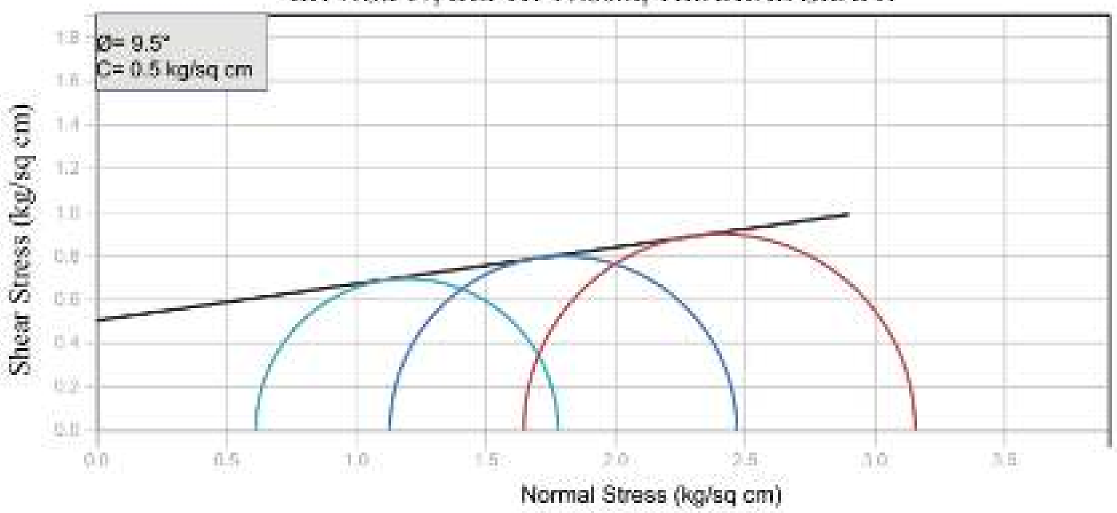


APPENDIX-G
GRAPH 5: UU GRAPH

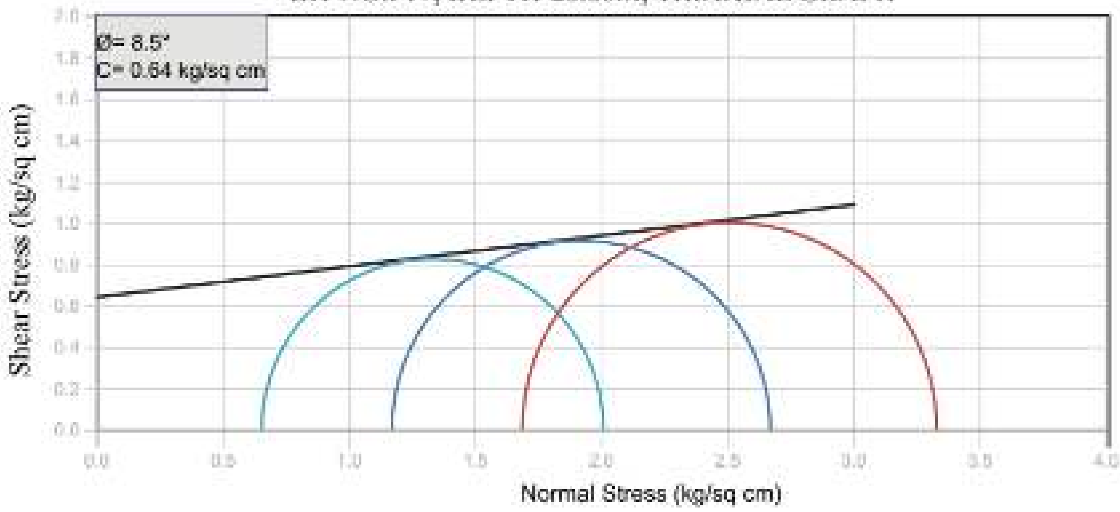
1901-HRIDC-I-21230.2870
BH-NO.P12, DEPTH-26.00M, TRIAXIAL GRAPH



1901-HRIDC-I-21361.2870
BH-NO.P17, DEPTH-17.00M, TRIAXIAL GRAPH



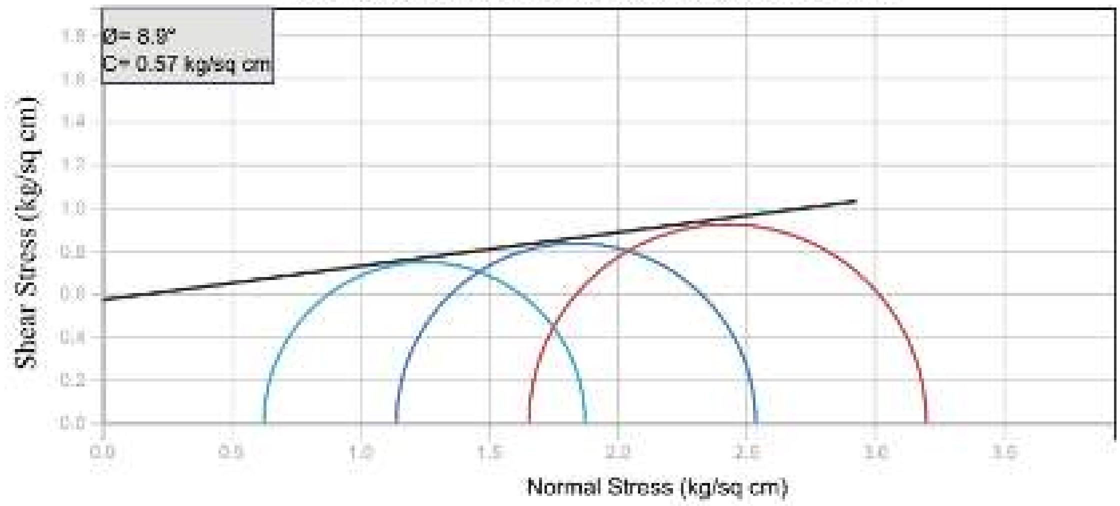
1901-HRIDC-I-21361.2870
BH-NO.P17, DEPTH-20.00M, TRIAXIAL GRAPH



APPENDIX-G

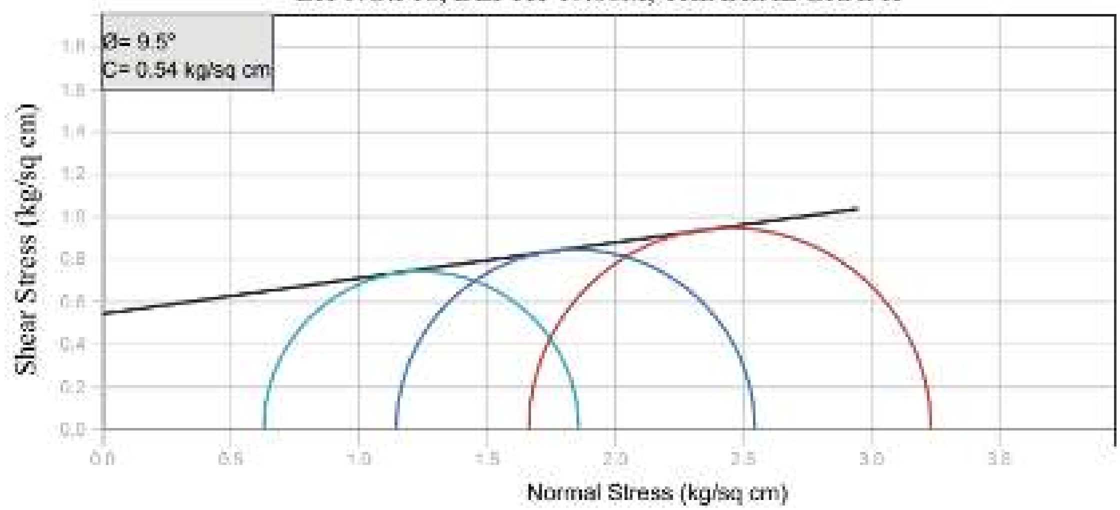
GRAPH 6: UU GRAPH

1901-HRIDC-I-21361.2870
BH-NO.P17, DEPTH-23.00M, TRIAXIAL GRAPH



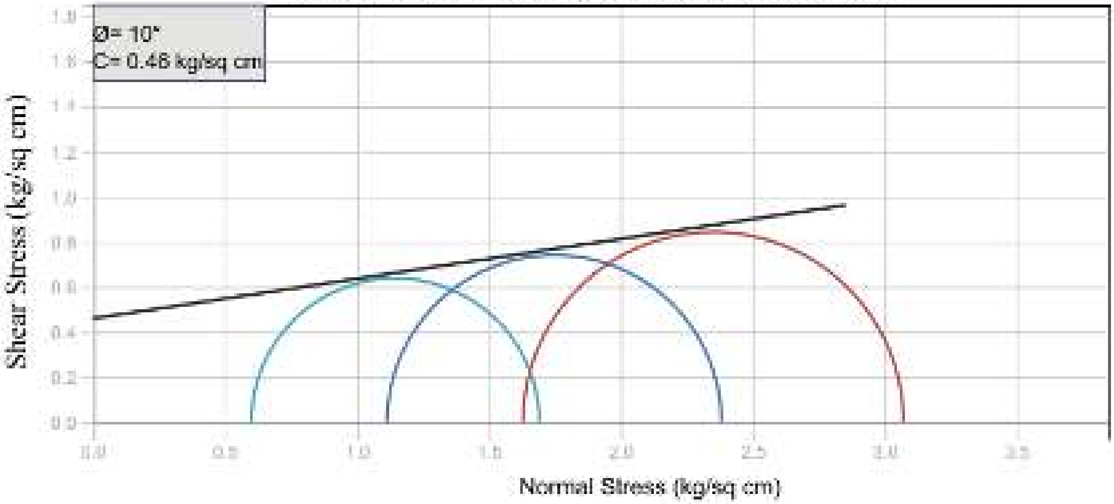
1901-HRIDC-I-21361.2870
BH-NO.P17, DEPTH-29.00M, TRIAXIAL GRAPH

1901-HRIDC-I-21387.4870
BH-NO.P18, DEPTH-19.00M, TRIAXIAL GRAPH

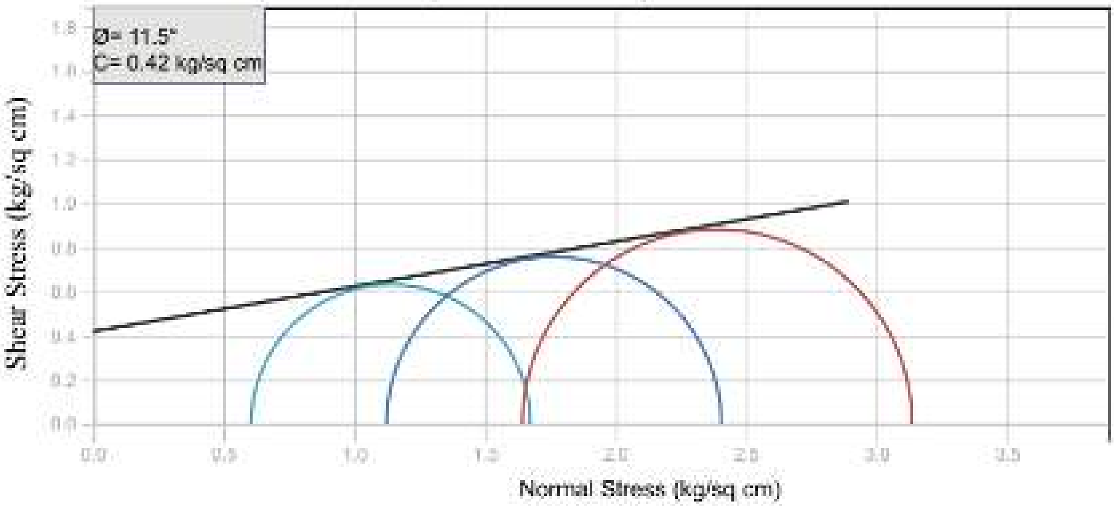


APPENDIX-G
GRAPH 7: UU GRAPH

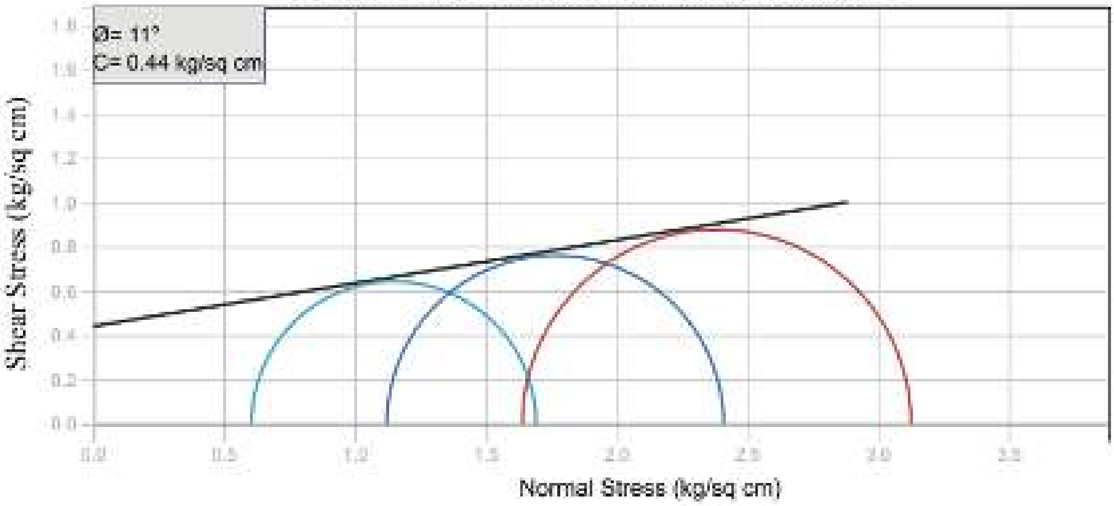
1901-HRIDC-I-21387.4870
BH-NO.P18, DEPTH-22.00M, TRIAXIAL GRAPH



1901-HRIDC-I-21387.4870
BH-NO.P18, DEPTH-25.00M, TRIAXIAL GRAPH

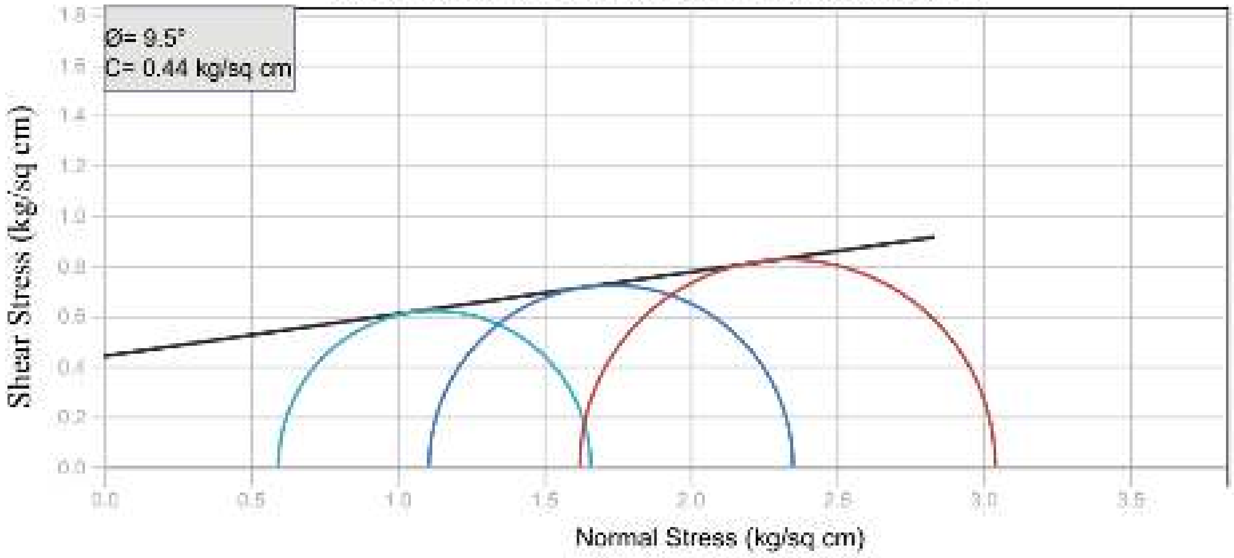


1901-HRIDC-I-21387.4870
BH-NO.P18, DEPTH-28.00M, TRIAXIAL GRAPH

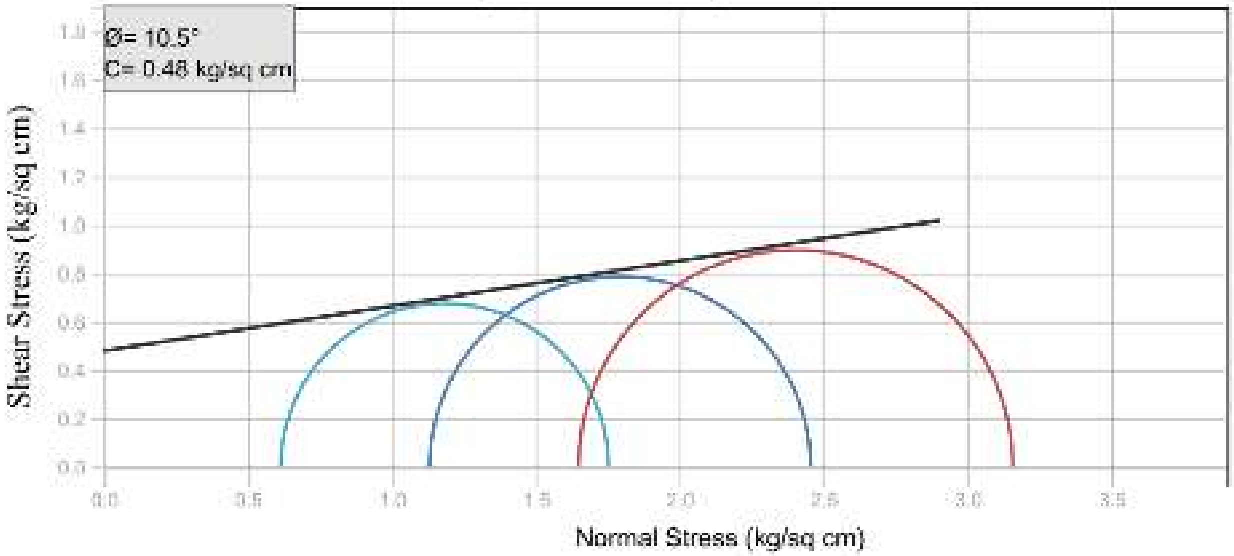


APPENDIX-G
GRAPH 8: UU GRAPH

1901-HRIDC-I-21256.487
BH-NO.P13, DEPTH-1.00M, TRIAXIAL GRAPH



1901-HRIDC-I-21256.487
BH-NO.P13, DEPTH-10.00M, TRIAXIAL GRAPH



APPENDIX-G
GRAPH 9: UU GRAPH

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
BORE NO: A1, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	18.84	8.84	24.31	1.57	12.9	12.9	1.0	8.75	0	42	1.0	66.0	0	3.0	18.9	0	8.84	5.82	4.79	26.5	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	18.84	8.84	30.94	3.14	18.9	18.9	1.0	33.29	0	0	1.0	0.0	0	4.0	23.6	2	8.84	8.99	9.34	35.4	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	6.00	5.00	2.00	3.50	18.84	8.84	44.20	6.29	23.6	23.6	1.0	121.38	0	2	1.0	12.6	0	6.0	23.6	2	8.84	8.99	9.34	53.0	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	7.00	6.50	1.00	4.50	18.84	8.84	57.46	3.14	23.6	23.6	1.0	78.90	0	2	1.0	6.3	0	7.0	28.5	0	8.84	17.88	18.94	61.9	935.2	935.2	53.0	53.0	**374.08**	**17.67**
7.00	8.00	7.50	1.00	5.50	18.84	8.84	66.30	3.14	28.5	28.5	1.0	113.14	113.14	0	1.0	0.0	0.00	8.0	19.3	10	10.25	6.03	5.01	70.7	425.8	538.9	64.8	177.9	**215.58**	**59.31**
8.00	9.00	8.50	1.00	6.50	20.25	10.25	75.85	3.14	19.3	19.3	1.0	83.48	196.61	10	1.0	31.4	31.43	9.0	13.5	40	10.25	3.50	2.22	81.0	514.5	742.5	76.6	304.6	**297.00**	**101.54**
9.00	10.00	9.50	1.00	7.50	20.25	10.25	86.10	3.14	13.5	13.5	1.0	64.96	261.57	40	1.0	125.7	157.14	10.0	10.4	37	11.25	2.59	1.33	91.2	453.0	871.7	88.4	507.1	**348.69**	**169.02**
10.00	12.50	11.25	2.50	10.00	21.25	11.25	105.28	7.86	10.4	10.4	1.0	151.82	413.40	37	1.0	290.7	447.86	12.5	18.6	11	11.25	5.69	4.62	119.3	631.5	1492.8	117.8	979.1	**597.11**	**326.35**
12.50	14.00	13.25	1.50	11.50	21.25	11.25	127.78	4.71	18.6	18.6	1.0	202.73	616.13	11	1.0	51.9	499.71	14.0	12.6	45	9.96	3.23	1.96	136.2	671.9	1787.8	135.5	1251.3	**715.12**	**417.11**
14.00	15.50	14.75	1.50	13.00	19.96	9.96	143.69	4.71	12.6	12.6	1.0	151.42	767.54	45	1.0	212.1	711.86	15.5	8.6	45	9.89	2.22	1.00	136.2	559.5	2038.9	153.2	1632.6	**815.56**	**544.18**
15.50	18.50	17.00	3.00	16.00	19.89	9.89	143.69	9.43	8.6	8.6	1.0	204.89	972.44	45	1.0	424.3	1136.14	18.5	8.6	45	10.27	2.22	1.00	136.2	559.7	2668.2	188.5	2297.1	**1067.30**	**765.69**
18.50	21.50	20.00	3.00	19.00	20.27	10.27	143.69	9.43	8.6	8.6	1.0	204.89	1177.33	45	1.0	424.3	1560.43	21.5	11.5	52	10.27	2.91	1.65	136.2	685.9	3423.7	223.8	2961.6	**1369.48**	**987.20**
21.50	24.50	23.00	3.00	22.00	20.27	10.27	143.69	9.43	11.5	11.5	1.0	275.64	1452.97	52	1.0	490.3	2050.71	24.5	11.5	52	10.95	2.91	1.65	136.2	686.4	4190.1	259.2	3762.9	**1676.02**	**1254.29**
24.50	27.50	26.00	3.00	25.00	20.95	10.95	143.69	9.43	11.5	11.5	1.0	275.64	1728.60	52	1.0	490.3	2541.00	27.5	12.0	48	10.95	3.06	1.79	136.2	674.4	4944.0	294.5	4564.1	**1977.61**	**1521.38**
27.50	29.00	28.25	1.50	26.50	20.95	10.95	143.69	4.71	12.0	12.0	1.0	143.98	1872.59	48	1.0	226.3	2767.29	29.0	22.5	0	8.91	8.20	8.14	136.2	906.1	5546.0	312.2	4952.1	**2218.40**	**1650.69**
29.00	30.00	29.50	1.00	27.50	18.91	8.91	143.69	3.14	22.5	22.5	1.0	187.06	2059.64	0	1.0	0.0	2767.29	30.0	22.5	0	8.91	8.20	8.14	136.2	906.1	5733.1	324.0	5150.9	**2293.22**	**1716.97**
30.00	30.50	30.25	0.50	28.00	18.91	8.91	143.69	1.57	22.5	22.5	1.0	93.53	2153.17	0	1.0	0.0	2767.29	30.5	12.3	45	8.91	3.15	1.88	136.2	661.5	5581.9	329.9	5250.3	**2232.77**	**1750.11**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
30.50	32.00	31.25	1.50	29.50	18.91	8.91	143.69	4.71	12.3	12.3	1.0	147.70	2300.87	45	1.0	212.1	2979.43	32.0	27.1	0	8.91	14.73	15.72	136.2	1631.5	6911.8	347.5	5627.8	**2764.70**	**1875.95**
32.00	32.50	32.25	0.50	30.00	18.91	8.91	143.69	1.57	27.1	27.1	1.0	115.55	2416.42	0	1.0	0.0	2979.43	32.5	28.9	0	7.27	18.78	19.87	136.2	2067.0	7462.9	353.4	5749.3	**2985.15**	**1916.42**
32.50	33.50	33.00	1.00	31.00	17.27	7.27	143.69	3.14	28.9	28.9	1.0	249.30	2665.71	0	1.0	0.0	2979.43	33.5	31.5	0	10.00	28.82	30.09	136.2	3202.3	8847.5	365.2	6010.3	**3538.99**	**2003.45**
33.50	35.00	34.25	1.50	32.50	20.00	10.00	143.69	4.71	31.5	31.5	1.1	446.24	3111.95	0	1.0	0.0	2979.43	35.0	32.1	0	9.48	31.84	33.16	136.2	3531.1	9622.5	382.9	6474.3	**3849.01**	**2158.09**
35.00	36.50	35.75	1.50	34.00	19.48	9.48	143.69	4.71	32.1	32.1	1.1	469.55	3581.50	0	1.0	0.0	2979.43	36.5	14.5	40	8.37	3.80	2.51	136.2	697.3	7258.2	400.6	6961.5	**2903.28**	**2320.49**
36.50	37.50	37.00	1.00	35.00	18.37	8.37	143.69	3.14	14.5	14.5	1.0	116.79	3698.29	40	1.0	125.7	3105.14	37.5	23.1	10	8.37	8.63	8.79	136.2	1023.5	7826.9	412.3	7215.8	**3130.78**	**2405.26**
37.50	40.00	38.75	2.50	37.50	18.37	8.37	143.69	7.86	23.1	23.1	1.0	481.56	4179.85	10	1.0	78.6	3183.71	40.0	23.1	10	8.37	8.63	8.79	136.2	1023.5	8387.1	441.8	7805.3	**3354.83**	**2601.78**
BORE NO: P6, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.61	10.61	29.18	1.57	6.4	6.4	1.0	5.14	5.14	44	1.0	69.1	69.1	3.0	22.3	0	10.61	8.06	7.92	31.8	234.5	308.8	5.9	80.2	**123.50**	**26.73**
3.00	4.00	3.50	1.00	1.5	20.61	10.61	37.14	3.14	22.3	22.3	1.0	47.87	53.01	0	1.0	0.0	69.1	4.0	29.2	0	10.61	19.46	20.56	42.4	734.5	856.7	17.7	139.8	**342.67**	**46.61**
4.00	5.00	4.50	1.00	2.5	20.61	10.61	47.75	3.14	29.2	29.2	1.0	83.86	136.87	0	1.0	0.0	69.1	5.0	28.6	0	9.57	18.11	19.17	53.1	826.8	1032.8	29.5	235.5	**413.13**	**78.49**
5.00	6.00	5.50	1.00	3.5	19.57	9.57	57.84	3.14	28.6	28.6	1.0	99.10	235.98	0	1.0	0.0	69.1	6.0	30.4	0	10.19	23.27	24.45	62.6	1243.0	1548.1	41.2	346.4	**619.25**	**115.45**
6.00	8.00	7.00	2.00	5.5	20.19	10.19	72.81	6.29	30.4	30.4	1.0	273.88	509.85	0	1.0	0.0	69.1	8.0	30.1	0	10.40	21.76	22.91	83.0	1512.9	2091.9	64.8	643.8	**836.76**	**214.60**
8.00	9.00	8.50	1.00	6.5	20.40	10.40	88.20	3.14	30.1	30.1	1.0	161.49	671.35	0	1.0	0.0	69.1	9.0	31.6	0	10.86	29.32	30.60	93.4	2282.2	3022.7	76.6	817.1	**1209.07**	**272.35**
9.00	11.00	10.00	2.00	8.5	20.86	10.86	104.26	6.29	31.6	31.6	1.1	435.43	1106.77	0	1.0	0.0	69.1	11.0	12.4	45	10.86	3.17	1.91	115.1	613.5	1789.4	100.1	1276.1	**715.77**	**425.35**
11.00	12.00	11.50	1.00	9.5	20.86	10.86	120.55	3.14	12.4	12.4	1.0	83.30	1190.07	45	1.0	141.4	210.6	12.0	12.4	41	10.86	3.17	1.91	126.0	612.3	2013.0	111.9	1512.6	**805.18**	**504.19**
12.00	14.50	13.25	2.50	12.0	20.86	10.86	139.56	7.86	12.4	12.4	1.0	241.08	1431.15	41	1.0	322.1	532.7	14.5	12.4	41	10.86	3.17	1.91	153.1	680.0	2643.9	141.4	2105.2	**1057.56**	**701.75**
14.50	17.50	16.00	3.00	15.0	20.86	10.86	139.56	9.43	12.4	12.4	1.0	289.30	1720.45	41	1.0	386.6	919.3	17.5	11.0	48	8.14	2.76	1.51	153.1	676.8	3316.5	176.7	2816.5	**1326.62**	**938.82**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
17.50	20.50	19.00	3.00	18.0	18.14	8.14	139.56	9.43	11.0	11.0	1.0	255.77	1976.22	48	1.0	452.6	1371.9	20.5	11.5	40	8.14	2.91	1.65	153.1	638.4	3986.4	212.1	3560.1	**1594.58**	**1186.71**
20.50	23.50	22.00	3.00	21.0	18.14	8.14	139.56	9.43	11.5	11.5	1.0	267.70	2243.92	40	1.0	377.1	1749.0	23.5	8.5	52	11.08	2.20	0.99	153.1	636.7	4629.6	247.4	4240.3	**1851.86**	**1413.44**
23.50	26.50	25.00	3.00	24.0	21.08	11.08	139.56	9.43	8.5	8.5	1.0	196.65	2440.57	52	1.0	490.3	2239.3	26.5	8.5	48	11.08	2.20	0.99	153.1	608.4	5288.3	282.7	4962.6	**2115.31**	**1654.20**
26.50	27.50	27.00	1.00	25.0	21.08	11.08	139.56	3.14	8.5	8.5	1.0	65.55	2506.12	48	1.0	150.9	2390.1	27.5	8.5	48	11.08	2.20	0.99	153.1	608.4	5504.7	294.5	5190.8	**2201.88**	**1730.26**
27.50	28.00	27.75	0.50	25.5	21.08	11.08	139.56	1.57	8.5	8.5	1.0	32.77	2538.90	48	1.0	75.4	2465.6	28.0	11.8	48	9.89	3.00	1.73	153.1	707.0	5711.5	300.4	5304.9	**2284.60**	**1768.29**
28.00	29.50	28.75	1.50	27.0	19.89	9.89	139.56	4.71	11.8	11.8	1.0	137.44	2676.34	48	1.0	226.3	2691.9	29.5	11.8	48	9.89	3.00	1.73	153.1	707.0	6075.2	318.1	5686.3	**2430.09**	**1895.43**
29.50	30.00	29.75	0.50	27.5	19.89	9.89	139.56	1.57	11.8	11.8	1.0	45.81	2722.15	48	1.0	75.4	2767.3	30.0	11.8	48	9.89	3.00	1.73	153.1	707.0	6196.5	324.0	5813.4	**2478.58**	**1937.80**
30.00	31.00	30.50	1.00	28.5	19.89	9.89	139.56	3.14	11.8	11.8	1.0	91.63	2813.78	48	1.0	150.9	2918.1	31.0	24.7	11	10.91	9.78	10.55	153.1	1300.2	7032.1	335.8	6067.7	**2812.84**	**2022.56**
31.00	32.50	31.75	1.50	30.0	20.91	10.91	139.56	4.71	24.7	24.7	1.0	302.60	3116.38	11	1.0	51.9	2970.0	32.5	8.3	40	10.91	2.16	0.96	153.1	547.3	6633.7	353.4	6439.8	**2653.48**	**2146.60**
32.50	35.00	33.75	2.50	32.5	20.91	10.91	139.56	7.86	8.3	8.3	1.0	159.96	3276.34	40	1.0	314.3	3284.3	35.0	8.0	40	11.02	2.11	0.91	153.1	540.7	7101.3	382.9	6943.5	**2840.52**	**2314.50**
35.00	35.50	35.25	0.50	33.0	21.02	11.02	139.56	1.57	8.0	8.0	1.0	30.82	3307.17	40	1.0	62.9	3347.1	35.5	23.6	10	9.13	8.99	9.34	153.1	1186.1	7840.4	388.8	7043.1	**3136.17**	**2347.69**
35.50	37.00	36.25	1.50	34.5	19.13	9.13	139.56	4.71	23.6	23.6	1.0	287.43	3594.60	10	1.0	47.1	3394.3	37.0	23.6	10	9.13	8.99	9.34	153.1	1186.1	8175.0	406.4	7395.3	**3270.00**	**2465.11**
37.00	37.50	37.25	0.50	35.0	19.13	9.13	139.56	1.57	23.6	23.6	1.0	95.81	3690.41	10	1.0	15.7	3410.0	37.5	23.6	10	9.13	8.99	9.34	153.1	1186.1	8286.5	412.3	7512.7	**3314.61**	**2504.25**
37.50	38.50	38.00	1.00	36.0	19.13	9.13	139.56	3.14	23.6	23.6	1.0	191.62	3882.03	10	1.0	31.4	3441.4	38.5	23.6	10	9.89	8.99	9.34	153.1	1188.9	8512.4	424.1	7747.6	**3404.94**	**2582.52**
38.50	40.00	39.25	1.50	37.5	19.89	9.89	139.56	4.71	23.6	23.6	1.0	287.43	4169.46	10	1.0	47.1	3488.6	40.0	23.6	10	9.89	8.99	9.34	153.1	1188.9	8846.9	441.8	8099.8	**3538.77**	**2699.94**
BORE NO: P12, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.31	9.31	25.60	1.57	7.9	7.9	1.0	5.58	5.58	64	1.0	100.6	100.6	3.0	11.6	26	9.31	2.94	1.68	27.9	254.5	360.7	5.9	112.0	**144.27**	**37.35**
3.00	4.00	3.50	1.00	1.5	19.31	9.31	32.59	3.14	11.6	11.6	1.0	21.02	26.60	26	1.0	81.7	182.3	4.0	11.6	26	9.31	2.94	1.68	37.2	276.0	484.9	17.7	226.6	**193.97**	**75.52**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
4.00	5.00	4.50	1.00	2.5	19.31	9.31	41.90	3.14	11.6	11.6	1.0	27.03	53.63	26	1.0	81.7	264.0	5.0	7.3	66	9.31	1.98	0.80	46.6	542.2	859.9	29.5	347.1	**343.94**	**115.69**
5.00	6.00	5.50	1.00	3.5	19.31	9.31	51.21	3.14	7.3	7.3	1.0	20.62	74.25	66	1.0	207.4	471.4	6.0	11.6	29	9.20	2.94	1.68	55.9	340.2	885.9	41.2	586.9	**354.35**	**195.64**
6.00	7.00	6.50	1.00	4.5	19.20	9.20	60.46	3.14	11.6	11.6	1.0	39.00	113.25	29	1.0	91.1	562.6	7.0	11.6	29	9.20	2.94	1.68	65.1	361.4	1037.3	53.0	728.8	**414.91**	**242.95**
7.00	8.00	7.50	1.00	5.5	19.20	9.20	69.66	3.14	11.6	11.6	1.0	44.94	158.19	29	1.0	91.1	653.7	8.0	25.9	0	9.20	12.03	12.95	74.3	748.5	1560.4	64.8	876.7	**624.18**	**292.23**
8.00	9.00	8.50	1.00	6.5	19.20	9.20	78.86	3.14	25.9	25.9	1.0	120.35	278.54	0	1.0	0.0	653.7	9.0	25.9	0	9.20	12.03	12.95	83.5	835.5	1767.7	76.6	1008.8	**707.09**	**336.28**
9.00	10.00	9.50	1.00	7.5	19.20	9.20	88.06	3.14	25.9	25.9	1.0	134.39	412.93	0	1.0	0.0	653.7	10.0	25.0	0	9.20	10.00	10.88	92.7	767.4	1834.0	88.4	1155.0	**733.60**	**385.00**
10.00	11.00	10.50	1.00	8.5	19.20	9.20	97.26	3.14	25.0	25.0	1.0	142.54	555.47	0	1.0	0.0	653.7	11.0	24.5	15	10.35	9.64	10.33	101.9	919.6	2128.8	100.1	1309.3	**851.51**	**436.44**
11.00	12.50	11.75	1.50	10.0	20.35	10.35	109.62	4.71	24.5	24.5	1.0	235.52	790.98	15	1.0	70.7	724.4	12.5	8.5	56	10.31	2.20	0.99	117.4	602.9	2118.3	117.8	1633.2	**847.33**	**544.41**
12.50	15.50	14.00	3.00	13.0	20.31	10.31	132.85	9.43	8.5	8.5	1.0	187.20	978.18	56	1.0	528.0	1252.4	15.5	11.5	54	9.03	2.91	1.65	117.4	656.2	2886.8	153.2	2383.8	**1154.72**	**794.59**
15.50	18.50	17.00	3.00	16.0	19.03	9.03	132.85	9.43	11.5	11.5	1.0	254.84	1233.02	54	1.0	509.1	1761.6	18.5	10.8	59	10.57	2.71	1.45	117.4	672.7	3667.3	188.5	3183.1	**1466.93**	**1061.03**
18.50	21.50	20.00	3.00	19.0	20.57	10.57	132.85	9.43	10.8	10.8	1.0	238.94	1471.97	59	1.0	556.3	2317.9	21.5	9.1	61	10.44	2.31	1.08	117.4	648.7	4438.5	223.8	4013.7	**1775.39**	**1337.89**
21.50	24.50	23.00	3.00	22.0	20.44	10.44	132.85	9.43	9.1	9.1	1.0	200.63	1672.60	61	1.0	575.1	2893.0	24.5	9.5	53	10.64	2.38	1.14	117.4	599.1	5164.7	259.2	4824.8	**2065.87**	**1608.26**
24.50	27.50	26.00	3.00	25.0	20.64	10.64	132.85	9.43	9.5	9.5	1.0	209.61	1882.21	53	1.0	499.7	3392.7	27.5	9.5	53	10.64	2.38	1.14	117.4	599.1	5874.0	294.5	5569.4	**2349.60**	**1856.48**
27.50	29.00	28.25	1.50	26.5	20.64	10.64	132.85	4.71	9.5	9.5	1.0	104.81	1987.02	53	1.0	249.9	3642.6	29.0	30.6	0	10.64	24.28	25.48	117.4	2346.0	7975.6	312.2	5941.8	**3190.25**	**1980.59**
29.00	30.00	29.50	1.00	27.5	20.64	10.64	132.85	3.14	30.6	30.6	1.0	254.33	2241.35	0	1.0	0.0	3642.6	30.0	31.0	0	9.63	26.30	27.53	117.4	2529.5	8413.5	324.0	6207.9	**3365.38**	**2069.30**
30.00	30.50	30.25	0.50	28.0	19.63	9.63	132.85	1.57	31.0	31.0	1.1	131.71	2373.06	0	1.0	0.0	3642.6	30.5	31.0	0	10.05	26.30	27.53	117.4	2534.1	8549.7	329.9	6345.5	**3419.88**	**2115.17**
30.50	32.00	31.25	1.50	29.5	20.05	10.05	132.85	4.71	31.0	31.0	1.1	395.13	2768.19	0	1.0	0.0	3642.6	32.0	32.5	0	10.05	33.85	35.22	117.4	3261.3	9672.1	347.5	6758.3	**3868.84**	**2252.77**
32.00	32.50	32.25	0.50	30.0	20.05	10.05	132.85	1.57	32.5	32.5	1.1	149.62	2917.81	0	1.0	0.0	3642.6	32.5	32.5	0	10.05	33.85	35.22	117.4	3261.3	9821.7	353.4	6913.8	**3928.69**	**2304.60**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
32.50	33.50	33.00	1.00	31.0	20.05	10.05	132.85	3.14	32.5	32.5	1.1	299.24	3217.06	0	1.0	0.0	3642.6	33.5	32.1	0	10.05	31.84	33.16	117.4	3067.4	9927.0	365.2	7224.8	**3970.81**	**2408.28**
33.50	35.00	34.25	1.50	32.5	20.05	10.05	132.85	4.71	32.1	32.1	1.1	434.12	3651.18	0	1.0	0.0	3642.6	35.0	32.1	0	10.05	31.84	33.16	117.4	3067.4	10361.2	382.9	7676.6	**4144.46**	**2558.88**
35.00	36.50	35.75	1.50	34.0	20.05	10.05	132.85	4.71	32.1	32.1	1.1	434.12	4085.30	0	1.0	0.0	3642.6	36.5	32.3	0	10.05	32.85	34.19	117.4	3164.4	10892.3	400.6	8128.4	**4356.90**	**2709.48**
36.50	37.50	37.00	1.00	35.0	20.05	10.05	132.85	3.14	32.3	32.3	1.1	294.30	4379.61	0	1.0	0.0	3642.6	37.5	32.3	0	10.05	32.85	34.19	117.4	3164.4	11186.6	412.3	8434.5	**4474.62**	**2811.51**
37.50	40.00	38.75	2.50	37.5	20.05	10.05	132.85	7.86	32.3	32.3	1.1	735.76	5115.37	0	1.0	0.0	3642.6	40.0	32.3	0	10.05	32.85	34.19	117.4	3164.4	11922.3	441.8	9199.7	**4768.93**	**3066.58**
BORE NO: P13, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.71	9.71	26.70	1.57	24.3	24.3	1.0	18.95	0	0	1.0	0.0	0	3.0	26.3	5	9.71	12.93	13.88	29.1	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.5	19.71	9.71	33.99	3.14	26.3	26.3	1.0	52.79	0	5	1.0	15.7	0	4.0	26.3	5	9.46	12.93	13.88	38.8	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.5	19.46	9.46	43.57	3.14	26.3	26.3	1.0	67.68	0	5	1.0	15.7	0	5.0	24.7	10	9.46	9.78	10.55	48.3	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.46	9.46	53.03	3.14	24.7	24.7	1.0	76.66	0	10	1.0	31.4	0	6.0	24.7	10	9.46	9.78	10.55	57.8	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	7.00	6.50	1.00	4.5	19.46	9.46	62.49	3.14	24.7	24.7	1.0	90.33	0	10	1.0	31.4	0	7.0	24.7	10	9.10	9.78	10.55	67.2	0	0.0	53.0	53.0	**0.00**	**17.67**
7.00	8.00	7.50	1.00	5.5	19.10	9.10	71.77	3.14	24.7	24.7	1.0	103.75	0	10	1.0	31.4	0	8.0	24.2	0	9.10	9.42	10.00	76.3	0	0.0	64.8	64.8	**0.00**	**21.60**
8.00	9.00	8.50	1.00	6.5	19.10	9.10	80.87	3.14	24.2	24.2	1.0	114.23	0	0	1.0	0.0	0	9.0	24.2	0	9.10	9.42	10.00	85.4	0	0.0	76.6	76.6	**0.00**	**25.53**
9.00	10.00	9.50	1.00	7.5	19.10	9.10	89.97	3.14	24.2	24.2	1.0	127.08	0	0	1.0	0.0	0	10.0	10.5	48	10.36	2.62	1.36	94.5	539.3	539.3	88.4	88.4	**215.73**	**29.45**
10.00	11.00	10.50	1.00	8.5	20.36	10.36	99.70	3.14	10.5	10.5	1.0	58.07	58.07	48	1.0	150.9	150.9	11.0	10.5	48	10.36	2.62	1.36	104.9	560.6	769.6	100.1	309.1	**307.83**	**103.02**
11.00	12.00	11.50	1.00	9.5	20.36	10.36	110.06	3.14	10.5	10.5	1.0	64.11	122.18	48	1.0	150.9	301.7	12.0	10.5	48	10.36	2.62	1.36	115.2	581.9	1005.8	111.9	535.8	**402.33**	**178.61**
12.00	13.00	12.50	1.00	10.5	20.36	10.36	120.42	3.14	10.5	10.5	1.0	70.14	192.33	48	1.0	150.9	452.6	13.0	28.0	0	9.54	16.76	17.79	125.6	1720.2	2365.1	123.7	768.6	**946.05**	**256.20**
13.00	14.50	13.75	1.50	12.0	19.54	9.54	132.76	4.71	28.0	28.0	1.0	332.77	525.10	0	1.0	0.0	452.6	14.5	28.0	0	9.54	16.76	17.79	139.9	1908.6	2886.3	141.4	1119.0	**1154.52**	**373.01**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
14.50	16.00	15.25	1.50	13.5	19.54	9.54	132.76	4.71	28.0	28.0	1.0	332.77	857.86	0	1.0	0.0	452.6	16.0	10.2	49	10.49	2.53	1.28	139.9	629.8	1940.2	159.0	1469.5	**776.07**	**489.83**
16.00	17.50	16.75	1.50	15.0	20.49	10.49	132.76	4.71	10.2	10.2	1.0	112.61	970.47	49	1.0	231.0	683.6	17.5	10.8	49	11.03	2.71	1.45	139.9	650.2	2304.2	176.7	1830.8	**921.68**	**610.25**
17.50	20.50	19.00	3.00	18.0	21.03	11.03	132.76	9.43	10.8	10.8	1.0	238.77	1209.24	49	1.0	462.0	1145.6	20.5	13.5	47	11.03	3.50	2.22	139.9	726.7	3081.5	212.1	2566.9	**1232.62**	**855.62**
20.50	23.50	22.00	3.00	21.0	21.03	11.03	132.76	9.43	13.5	13.5	1.0	300.50	1509.75	47	1.0	443.1	1588.7	23.5	11.5	47	8.68	2.91	1.65	139.9	658.0	3756.4	247.4	3345.9	**1502.58**	**1115.29**
23.50	25.00	24.25	1.50	22.5	18.68	8.68	132.76	4.71	11.5	11.5	1.0	127.33	1637.08	47	1.0	221.6	1810.3	25.0	11.5	47	8.61	2.91	1.65	139.9	657.9	4105.3	265.1	3712.4	**1642.12**	**1237.48**
25.00	26.50	25.75	1.50	24.0	18.61	8.61	132.76	4.71	11.5	11.5	1.0	127.33	1764.41	47	1.0	221.6	2031.9	26.5	11.5	47	8.99	2.91	1.65	139.9	658.2	4454.4	282.7	4079.0	**1781.78**	**1359.67**
26.50	27.50	27.00	1.00	25.0	18.99	8.99	132.76	3.14	11.5	11.5	1.0	84.89	1849.29	47	1.0	147.7	2179.6	27.5	11.5	47	8.99	2.91	1.65	139.9	658.2	4687.0	294.5	4323.4	**1874.82**	**1441.13**
27.50	28.00	27.75	0.50	25.5	18.99	8.99	132.76	1.57	11.5	11.5	1.0	42.44	1891.74	47	1.0	73.9	2253.4	28.0	12.5	49	9.36	3.20	1.94	139.9	705.8	4851.0	300.4	4445.6	**1940.40**	**1481.86**
28.00	29.50	28.75	1.50	27.0	19.36	9.36	132.76	4.71	12.5	12.5	1.0	138.75	2030.48	49	1.0	231.0	2484.4	29.5	12.5	49	9.08	3.20	1.94	139.9	705.6	5220.5	318.1	4833.0	**2088.21**	**1611.00**
29.50	30.00	29.75	0.50	27.5	19.08	9.08	132.76	1.57	12.5	12.5	1.0	46.25	2076.73	49	1.0	77.0	2561.4	30.0	12.5	49	10.98	3.20	1.94	139.9	707.1	5345.2	324.0	4962.1	**2138.09**	**1654.05**
30.00	31.00	30.50	1.00	28.5	20.98	10.98	132.76	3.14	12.5	12.5	1.0	92.50	2169.23	49	1.0	154.0	2715.4	31.0	12.5	49	10.98	3.20	1.94	139.9	707.1	5591.7	335.8	5220.4	**2236.69**	**1740.14**
31.00	32.50	31.75	1.50	30.0	20.98	10.98	132.76	4.71	12.5	12.5	1.0	138.75	2307.98	49	1.0	231.0	2946.4	32.5	28.6	0	10.98	18.11	19.17	139.9	2073.2	7327.6	353.4	5607.8	**2931.04**	**1869.28**
32.50	35.00	33.75	2.50	32.5	20.98	10.98	132.76	7.86	28.6	28.6	1.0	568.70	2876.68	0	1.0	0.0	2946.4	35.0	28.6	0	10.98	18.11	19.17	139.9	2073.2	7896.3	382.9	6206.0	**3158.52**	**2068.66**
35.00	35.50	35.25	0.50	33.0	20.98	10.98	132.76	1.57	28.6	28.6	1.0	113.74	2990.42	0	1.0	0.0	2946.4	35.5	28.5	0	10.98	17.88	18.94	139.9	2047.4	7984.3	388.8	6325.6	**3193.71**	**2108.54**
35.50	37.50	36.50	2.00	35.0	20.98	10.98	132.76	6.29	28.5	28.5	1.0	453.07	3443.49	0	1.0	0.0	2946.4	37.5	28.5	0	8.84	17.88	18.94	139.9	2031.5	8421.4	412.3	6802.3	**3368.57**	**2267.42**
37.50	38.50	38.00	1.00	36.0	18.84	8.84	132.76	3.14	28.5	28.5	1.0	226.54	3670.03	0	1.0	0.0	2946.4	38.5	28.5	0	9.15	17.88	18.94	139.9	2033.8	8650.3	424.1	7040.6	**3460.11**	**2346.86**
38.50	40.00	39.25	1.50	37.5	19.15	9.15	132.76	4.71	28.5	28.5	1.0	339.81	4009.84	0	1.0	0.0	2946.4	40.0	28.5	0	9.15	17.88	18.94	139.9	2033.8	8990.1	441.8	7398.1	**3596.03**	**2466.02**
BORE NO: P17, CUT OFF LENGTH: 2.50 m, Nc= 9																														

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
2.50	3.00	2.75	0.50	0.5	19.85	9.85	27.09	1.57	26.5	26.5	1.0	21.22	0	8	1.0	12.6	0	3.0	24.1	0	9.85	9.35	9.89	29.6	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.5	19.85	9.85	34.48	3.14	24.1	24.1	1.0	48.47	0	0	1.0	0.0	0	4.0	24.1	0	9.38	9.35	9.89	39.4	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	6.00	5.00	2.00	3.5	19.38	9.38	48.78	6.29	24.1	24.1	1.0	137.16	0	0	1.0	0.0	0	6.0	27.0	0	9.38	14.50	15.49	58.2	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	7.00	6.50	1.00	4.5	19.38	9.38	62.85	3.14	27.0	27.0	1.0	100.65	0	0	1.0	0.0	0	7.0	29.5	0	9.38	20.13	21.25	67.5	0	0.0	53.0	53.0	**0.00**	**17.67**
7.00	8.00	7.50	1.00	5.5	19.38	9.38	72.23	3.14	29.5	29.5	1.0	128.44	0	0	1.0	0.0	0	8.0	29.5	0	9.79	20.13	21.25	76.9	0	0.0	64.8	64.8	**0.00**	**21.60**
8.00	9.00	8.50	1.00	6.5	19.79	9.79	81.82	3.14	29.5	29.5	1.0	145.48	0	0	1.0	0.0	0	9.0	28.3	0	9.79	17.43	18.48	86.7	1258.7	1258.7	76.6	76.6	**503.47**	**25.53**
9.00	10.00	9.50	1.00	7.5	19.79	9.79	91.61	3.14	28.3	28.3	1.0	155.02	155.02	0	1.0	0.0	0.0	10.0	28.3	0	8.54	17.43	18.48	96.5	1383.7	1538.7	88.4	243.4	**615.48**	**81.13**
10.00	12.50	11.25	2.50	10.0	18.54	8.54	107.18	7.86	28.3	28.3	1.0	453.42	608.44	0	1.0	0.0	0.0	12.5	9.3	55	8.54	2.34	1.11	117.9	609.7	1218.1	117.8	726.2	**487.26**	**242.08**
12.50	14.00	13.25	1.50	11.5	18.54	8.54	124.26	4.71	9.3	9.3	1.0	95.92	704.36	55	1.0	259.3	259.3	14.0	24.5	14	8.96	9.64	10.33	130.7	1125.0	2088.7	135.5	1099.1	**835.47**	**366.38**
14.00	15.50	14.75	1.50	13.0	18.96	8.96	137.38	4.71	24.5	24.5	1.0	295.15	999.51	14	1.0	66.0	325.3	15.5	9.5	50	10.22	2.38	1.14	130.7	602.5	1927.3	153.2	1478.0	**770.92**	**492.65**
15.50	18.50	17.00	3.00	16.0	20.22	10.22	137.38	9.43	9.5	9.5	1.0	216.76	1216.27	50	1.0	471.4	796.7	18.5	8.5	64	9.12	2.20	0.99	130.7	682.0	2695.0	188.5	2201.5	**1077.98**	**733.83**
18.50	21.50	20.00	3.00	19.0	19.12	9.12	137.38	9.43	8.5	8.5	1.0	193.58	1409.85	64	1.0	603.4	1400.1	21.5	8.5	64	9.12	2.20	0.99	130.7	682.0	3492.0	223.8	3033.8	**1396.79**	**1011.28**
21.50	23.00	22.25	1.50	20.5	19.12	9.12	137.38	4.71	8.5	8.5	1.0	96.79	1506.65	64	1.0	301.7	1701.9	23.0	8.9	57	10.31	2.27	1.05	130.7	640.6	3849.1	241.5	3450.0	**1539.63**	**1150.00**
23.00	24.50	23.75	1.50	22.0	20.31	10.31	137.38	4.71	8.9	8.9	1.0	101.42	1608.06	57	1.0	268.7	1970.6	24.5	8.9	57	10.31	2.27	1.05	130.7	640.6	4219.2	259.2	3837.8	**1687.68**	**1279.27**
24.50	26.00	25.25	1.50	23.5	20.31	10.31	137.38	4.71	8.9	8.9	1.0	101.42	1709.48	57	1.0	268.7	2239.3	26.0	8.5	55	10.31	2.20	0.99	130.7	618.8	4567.6	276.9	4225.6	**1827.02**	**1408.54**
26.00	27.50	26.75	1.50	25.0	20.31	10.31	137.38	4.71	8.5	8.5	1.0	96.79	1806.28	55	1.0	259.3	2498.6	27.5	8.5	55	10.44	2.20	0.99	130.7	618.8	4923.7	294.5	4599.4	**1969.47**	**1533.12**
27.50	30.00	28.75	2.50	27.5	20.44	10.44	137.38	7.86	8.5	8.5	1.0	161.32	1967.59	55	1.0	432.1	2930.7	30.0	8.3	54	10.44	2.16	0.96	130.7	607.9	5506.3	324.0	5222.3	**2202.50**	**1740.76**
30.00	30.50	30.25	0.50	28.0	20.44	10.44	137.38	1.57	8.3	8.3	1.0	31.49	1999.09	54	1.0	84.9	3015.6	30.5	31.2	0	10.44	27.30	28.55	130.7	2920.2	7934.9	329.9	5344.5	**3173.95**	**1781.51**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
30.50	32.00	31.25	1.50	29.5	20.44	10.44	137.38	4.71	31.2	31.2	1.1	415.76	2414.85	0	1.0	0.0	3015.6	32.0	31.2	0	10.44	27.30	28.55	130.7	2920.2	8350.6	347.5	5778.0	**3340.26**	**1925.99**
32.00	32.50	32.25	0.50	30.0	20.44	10.44	137.38	1.57	31.2	31.2	1.1	138.59	2553.44	0	1.0	0.0	3015.6	32.5	30.6	0	8.78	24.28	25.48	130.7	2580.7	8149.7	353.4	5922.4	**3259.88**	**1974.15**
32.50	33.50	33.00	1.00	31.0	18.78	8.78	137.38	3.14	30.6	30.6	1.0	263.01	2816.45	0	1.0	0.0	3015.6	33.5	25.4	10	8.39	10.90	11.80	130.7	1228.7	7060.7	365.2	6197.2	**2824.29**	**2065.74**
33.50	35.00	34.25	1.50	32.5	18.39	8.39	137.38	4.71	25.4	25.4	1.0	307.53	3123.97	10	1.0	47.1	3062.7	35.0	25.4	10	7.89	10.90	11.80	130.7	1226.4	7413.1	382.9	6569.6	**2965.23**	**2189.86**
35.00	36.50	35.75	1.50	34.0	17.89	7.89	137.38	4.71	25.4	25.4	1.0	307.53	3431.50	10	1.0	47.1	3109.9	36.5	30.6	0	7.74	24.28	25.48	130.7	2570.3	9111.6	400.6	6941.9	**3644.66**	**2313.97**
36.50	37.50	37.00	1.00	35.0	17.74	7.74	137.38	3.14	30.6	30.6	1.0	263.01	3694.50	0	1.0	0.0	3109.9	37.5	30.6	0	7.74	24.28	25.48	130.7	2570.3	9374.6	412.3	7216.7	**3749.86**	**2405.57**
37.50	38.00	37.75	0.50	35.5	17.74	7.74	137.38	1.57	30.6	30.6	1.0	131.50	3826.01	0	1.0	0.0	3109.9	38.0	10.0	50	7.58	2.47	1.22	130.7	610.8	7546.6	418.2	7354.1	**3018.66**	**2451.36**
38.00	40.00	39.00	2.00	37.5	17.58	7.58	137.38	6.29	10.0	10.0	1.0	152.26	3978.27	50	1.0	314.3	3424.1	40.0	10.0	50	7.58	2.47	1.22	130.7	610.8	8013.2	441.8	7844.2	**3205.28**	**2614.73**
BORE NO: P18, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.10	9.10	25.03	1.57	28.0	28.0	1.0	20.91	0	0	1.0	0.0	0	3.0	28.0	0	9.90	16.76	17.79	27.3	428.6	428.6	5.9	5.9	**171.44**	**1.96**
3.00	5.00	4.00	2.00	2.5	19.90	9.90	37.20	6.29	28.0	28.0	1.0	124.33	124.33	0	1.0	0.0	0.0	5.0	28.0	0	9.90	16.76	17.79	47.1	689.3	813.6	29.5	153.8	**325.44**	**51.26**
5.00	6.00	5.50	1.00	3.5	19.90	9.90	52.05	3.14	28.0	28.0	1.0	86.98	211.31	0	1.0	0.0	0.0	6.0	27.9	0	9.90	16.53	17.56	57.0	808.6	1019.9	41.2	252.5	**407.98**	**84.18**
6.00	8.00	7.00	2.00	5.5	19.90	9.90	66.90	6.29	27.9	27.9	1.0	222.65	433.96	0	1.0	0.0	0.0	8.0	28.3	0	7.90	17.43	18.48	76.8	1109.2	1543.2	64.8	498.8	**617.27**	**166.25**
8.00	9.00	8.50	1.00	6.5	17.90	7.90	80.75	3.14	28.3	28.3	1.0	136.65	570.61	0	1.0	0.0	0.0	9.0	28.3	0	7.90	17.43	18.48	84.7	1217.4	1788.0	76.6	647.2	**715.21**	**215.73**
9.00	11.00	10.00	2.00	8.5	17.90	7.90	92.60	6.29	28.3	28.3	1.0	313.41	884.01	0	1.0	0.0	0.0	11.0	28.6	0	7.90	18.11	19.17	100.5	1489.3	2373.3	100.1	984.2	**949.33**	**328.05**
11.00	12.00	11.50	1.00	9.5	17.90	7.90	104.45	3.14	28.6	28.6	1.0	178.98	1062.99	0	1.0	0.0	0.0	12.0	26.7	0	9.66	13.83	14.80	108.4	1233.9	2296.9	111.9	1174.9	**918.77**	**391.64**
12.00	14.50	13.25	2.50	12.0	19.66	9.66	120.48	7.86	26.7	26.7	1.0	476.08	1539.08	0	1.0	0.0	0.0	14.5	29.1	0	10.00	19.23	20.33	132.6	2082.9	3622.0	141.4	1680.5	**1448.78**	**560.15**
14.50	17.50	16.00	3.00	15.0	20.00	10.00	120.48	9.43	29.1	29.1	1.0	632.24	2171.32	0	1.0	0.0	0.0	17.5	9.5	54	10.60	2.38	1.14	132.6	634.5	2805.8	176.7	2348.0	**1122.32**	**782.68**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
17.50	20.50	19.00	3.00	18.0	20.60	10.60	120.48	9.43	9.5	9.5	1.0	190.09	2361.40	54	1.0	509.1	509.1	20.5	10.0	46	9.92	2.47	1.22	132.6	587.3	3457.8	212.1	3082.6	**1383.13**	**1027.53**
20.50	23.50	22.00	3.00	21.0	19.92	9.92	120.48	9.43	10.0	10.0	1.0	200.29	2561.69	46	1.0	433.7	942.9	23.5	11.5	42	10.80	2.91	1.65	132.6	607.2	4111.7	247.4	3752.0	**1644.69**	**1250.65**
23.50	26.50	25.00	3.00	24.0	20.80	10.80	120.48	9.43	11.5	11.5	1.0	231.10	2792.80	42	1.0	396.0	1338.9	26.5	11.0	44	10.80	2.76	1.51	132.6	605.4	4737.0	282.7	4414.4	**1894.82**	**1471.47**
26.50	27.50	27.00	1.00	25.0	20.80	10.80	120.48	3.14	11.0	11.0	1.0	73.60	2866.40	44	1.0	138.3	1477.1	27.5	11.0	44	10.80	2.76	1.51	132.6	605.4	4948.9	294.5	4638.1	**1979.57**	**1546.02**
27.50	28.00	27.75	0.50	25.5	20.80	10.80	120.48	1.57	11.0	11.0	1.0	36.80	2903.20	44	1.0	69.1	1546.3	28.0	10.0	44	10.90	2.47	1.22	132.6	573.6	5023.1	300.4	4749.9	**2009.24**	**1583.30**
28.00	29.50	28.75	1.50	27.0	20.90	10.90	120.48	4.71	10.0	10.0	1.0	100.15	3003.34	44	1.0	207.4	1753.7	29.5	31.6	0	10.90	29.32	30.60	132.6	3184.6	7941.6	318.1	5075.1	**3176.64**	**1691.71**
29.50	30.00	29.75	0.50	27.5	20.90	10.90	120.48	1.57	31.6	31.6	1.1	125.79	3129.13	0	1.0	0.0	1753.7	30.0	31.6	0	10.90	29.32	30.60	132.6	3184.6	8067.4	324.0	5206.8	**3226.96**	**1735.61**
30.00	31.00	30.50	1.00	28.5	20.90	10.90	120.48	3.14	31.6	31.6	1.1	251.57	3380.70	0	1.0	0.0	1753.7	31.0	31.6	0	10.90	29.32	30.60	132.6	3184.6	8319.0	335.8	5470.2	**3327.59**	**1823.39**
31.00	32.50	31.75	1.50	30.0	20.90	10.90	120.48	4.71	31.6	31.6	1.1	377.36	3758.06	0	1.0	0.0	1753.7	32.5	31.2	0	8.78	27.30	28.55	132.6	2942.1	8453.9	353.4	5865.2	**3381.57**	**1955.07**
32.50	34.00	33.25	1.50	31.5	18.78	8.78	120.48	4.71	31.2	31.2	1.1	364.60	4122.66	0	1.0	0.0	1753.7	34.0	12.3	29	9.22	3.15	1.88	132.6	539.5	6415.9	371.1	6247.5	**2566.34**	**2082.49**
34.00	35.00	34.50	1.00	32.5	19.22	9.22	120.48	3.14	12.3	12.3	1.0	82.56	4205.22	29	1.0	91.1	1844.9	35.0	12.3	29	9.22	3.15	1.88	132.6	539.5	6589.6	382.9	6433.0	**2635.82**	**2144.32**
35.00	35.50	35.25	0.50	33.0	19.22	9.22	120.48	1.57	12.3	12.3	1.0	41.28	4246.50	29	1.0	45.6	1890.4	35.5	15.0	35	8.44	3.94	2.65	132.6	666.6	6803.5	388.8	6525.7	**2721.42**	**2175.23**
35.50	37.00	36.25	1.50	34.5	18.44	8.44	120.48	4.71	15.0	15.0	1.0	152.18	4398.68	35	1.0	165.0	2055.4	37.0	15.5	44	9.25	4.19	2.92	132.6	757.7	7211.8	406.4	6860.6	**2884.73**	**2286.85**
37.00	37.50	37.25	0.50	35.0	19.25	9.25	120.48	1.57	15.5	15.5	1.0	52.50	4451.18	44	1.0	69.1	2124.6	37.5	15.5	44	9.25	4.19	2.92	132.6	757.7	7333.5	412.3	6988.1	**2933.39**	**2329.36**
37.50	38.50	38.00	1.00	36.0	19.25	9.25	120.48	3.14	15.5	15.5	1.0	105.00	4556.19	44	1.0	138.3	2262.9	38.5	15.5	44	9.64	4.19	2.92	132.6	758.2	7577.2	424.1	7243.2	**3030.89**	**2414.39**
38.50	40.00	39.25	1.50	37.5	19.64	9.64	120.48	4.71	15.5	15.5	1.0	157.51	4713.70	44	1.0	207.4	2470.3	40.0	15.5	50	9.64	4.19	2.92	132.6	800.6	7984.6	441.8	7625.8	**3193.83**	**2541.92**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: A1, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	18.84	8.84	24.31	1.89	12.9	12.9	1.0	10.50	0	42	1.0	79.2	0	3.0	18.9	0	8.84	5.82	4.79	26.5	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	18.84	8.84	30.94	3.77	18.9	18.9	1.0	39.95	0	0	1.0	0.0	0	4.0	23.6	2	8.84	8.99	9.34	35.4	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	6.00	5.00	2.00	3.50	18.84	8.84	44.20	7.54	23.6	23.6	1.0	145.66	0	2	1.0	15.1	0	6.0	23.6	2	8.84	8.99	9.34	53.0	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	7.00	6.50	1.00	4.50	18.84	8.84	57.46	3.77	23.6	23.6	1.0	94.68	0	2	1.0	7.5	0	7.0	28.5	0	8.84	17.88	18.94	61.9	1365.6	1365.6	76.3	76.3	**546.25**	**25.45**
7.00	8.00	7.50	1.00	5.50	18.84	8.84	66.30	3.77	28.5	28.5	1.0	135.76	135.76	0	1.0	0.0	0.00	8.0	19.3	10	10.25	6.03	5.01	70.7	619.0	754.7	93.3	229.1	**301.89**	**76.36**
8.00	9.00	8.50	1.00	6.50	20.25	10.25	75.85	3.77	19.3	19.3	1.0	100.17	235.93	10	1.0	37.7	37.71	9.0	13.5	40	10.25	3.50	2.22	81.0	743.4	1017.1	110.3	383.9	**406.82**	**127.97**
9.00	10.00	9.50	1.00	7.50	20.25	10.25	86.10	3.77	13.5	13.5	1.0	77.95	313.89	40	1.0	150.9	188.57	10.0	10.4	37	11.25	2.59	1.33	91.2	654.0	1156.5	127.2	629.7	**462.59**	**209.90**
10.00	12.50	11.25	2.50	10.00	21.25	11.25	105.28	9.43	10.4	10.4	1.0	182.19	496.08	37	1.0	348.9	537.43	12.5	18.6	11	11.25	5.69	4.62	119.3	915.3	1948.8	169.6	1203.2	**779.51**	**401.05**
12.50	14.00	13.25	1.50	11.50	21.25	11.25	127.78	5.66	18.6	18.6	1.0	243.28	739.35	11	1.0	62.2	599.66	14.0	12.6	45	9.96	3.23	1.96	136.2	969.8	2308.8	195.1	1534.1	**923.53**	**511.37**
14.00	15.50	14.75	1.50	13.00	19.96	9.96	143.69	5.66	12.6	12.6	1.0	181.70	921.05	45	1.0	254.6	854.23	15.5	8.6	45	9.89	2.22	1.00	151.2	844.3	2619.6	220.5	1995.8	**1047.84**	**665.27**
15.50	18.50	17.00	3.00	16.00	19.89	9.89	166.00	11.31	8.6	8.6	1.0	284.04	1205.09	45	1.0	509.1	1363.37	18.5	8.6	45	10.27	2.22	1.00	151.2	844.6	3413.0	271.4	2839.9	**1365.21**	**946.63**
18.50	21.50	20.00	3.00	19.00	20.27	10.27	166.00	11.31	8.6	8.6	1.0	284.04	1489.13	45	1.0	509.1	1872.51	21.5	11.5	52	10.27	2.91	1.65	151.2	1038.9	4400.5	322.3	3684.0	**1760.20**	**1227.99**
21.50	24.50	23.00	3.00	22.00	20.27	10.27	166.00	11.31	11.5	11.5	1.0	382.11	1871.24	52	1.0	588.3	2460.86	24.5	11.5	52	10.95	2.91	1.65	151.2	1039.6	5371.7	373.2	4705.3	**2148.69**	**1568.44**
24.50	27.50	26.00	3.00	25.00	20.95	10.95	166.00	11.31	11.5	11.5	1.0	382.11	2253.34	52	1.0	588.3	3049.20	27.5	12.0	48	10.95	3.06	1.79	151.2	1025.1	6327.6	424.1	5726.7	**2531.06**	**1908.89**
27.50	29.00	28.25	1.50	26.50	20.95	10.95	166.00	5.66	12.0	12.0	1.0	199.60	2452.95	48	1.0	271.5	3320.74	29.0	22.5	0	8.91	8.20	8.14	151.2	1451.6	7225.3	449.6	6223.3	**2890.13**	**2074.42**
29.00	30.00	29.50	1.00	27.50	18.91	8.91	166.00	3.77	22.5	22.5	1.0	259.31	2712.26	0	1.0	0.0	3320.74	30.0	22.5	0	8.91	8.20	8.14	151.2	1451.6	7484.6	466.5	6499.5	**2993.85**	**2166.51**
30.00	30.50	30.25	0.50	28.00	18.91	8.91	166.00	1.89	22.5	22.5	1.0	129.66	2841.92	0	1.0	0.0	3320.74	30.5	12.3	45	8.91	3.15	1.88	151.2	1007.6	7170.2	475.0	6637.7	**2868.09**	**2212.56**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
30.50	32.00	31.25	1.50	29.50	18.91	8.91	166.00	5.66	12.3	12.3	1.0	204.75	3046.66	45	1.0	254.6	3575.31	32.0	27.1	0	8.91	14.73	15.72	151.2	2614.1	9236.1	500.5	7122.4	**3694.44**	**2374.14**
32.00	32.50	32.25	0.50	30.00	18.91	8.91	166.00	1.89	27.1	27.1	1.0	160.18	3206.84	0	1.0	0.0	3575.31	32.5	28.9	0	7.27	18.78	19.87	151.2	3310.3	10092.5	508.9	7291.1	**4037.00**	**2430.37**
32.50	33.50	33.00	1.00	31.00	17.27	7.27	166.00	3.77	28.9	28.9	1.0	345.59	3552.44	0	1.0	0.0	3575.31	33.5	31.5	0	10.00	28.82	30.09	151.2	5132.5	12260.3	525.9	7653.7	**4904.10**	**2551.22**
33.50	35.00	34.25	1.50	32.50	20.00	10.00	166.00	5.66	31.5	31.5	1.1	618.61	4171.05	0	1.0	0.0	3575.31	35.0	32.1	0	9.48	31.84	33.16	151.2	5658.6	13405.0	551.3	8297.7	**5361.99**	**2765.90**
35.00	36.50	35.75	1.50	34.00	19.48	9.48	166.00	5.66	32.1	32.1	1.1	650.92	4821.97	0	1.0	0.0	3575.31	36.5	14.5	40	8.37	3.80	2.51	151.2	1070.6	9467.9	576.8	8974.1	**3787.16**	**2991.36**
36.50	37.50	37.00	1.00	35.00	18.37	8.37	166.00	3.77	14.5	14.5	1.0	161.90	4983.88	40	1.0	150.9	3726.17	37.5	23.1	10	8.37	8.63	8.79	151.2	1628.1	10338.1	593.8	9303.8	**4135.26**	**3101.27**
37.50	40.00	38.75	2.50	37.50	18.37	8.37	166.00	9.43	23.1	23.1	1.0	667.57	5651.45	10	1.0	94.3	3820.46	40.0	23.1	10	8.37	8.63	8.79	151.2	1628.1	11100.0	636.2	10108.1	**4440.00**	**3369.36**
BORE NO: P6, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.61	10.61	29.18	1.89	6.4	6.4	1.0	6.17	6.17	44	1.0	83.0	83.0	3.0	22.3	0	10.61	8.06	7.92	31.8	347.1	436.3	8.5	97.6	**174.51**	**32.54**
3.00	4.00	3.50	1.00	1.5	20.61	10.61	37.14	3.77	22.3	22.3	1.0	57.44	63.61	0	1.0	0.0	83.0	4.0	29.2	0	10.61	19.46	20.56	42.4	1082.4	1229.0	25.4	172.0	**491.59**	**57.34**
4.00	5.00	4.50	1.00	2.5	20.61	10.61	47.75	3.77	29.2	29.2	1.0	100.64	164.25	0	1.0	0.0	83.0	5.0	28.6	0	9.57	18.11	19.17	53.1	1211.4	1458.6	42.4	289.6	**583.44**	**96.54**
5.00	6.00	5.50	1.00	3.5	19.57	9.57	57.84	3.77	28.6	28.6	1.0	118.92	283.17	0	1.0	0.0	83.0	6.0	30.4	0	10.19	23.27	24.45	62.6	1818.1	2184.3	59.4	425.5	**873.71**	**141.84**
6.00	8.00	7.00	2.00	5.5	20.19	10.19	72.81	7.54	30.4	30.4	1.0	328.66	611.83	0	1.0	0.0	83.0	8.0	30.1	0	10.40	21.76	22.91	83.0	2205.5	2900.3	93.3	788.1	**1160.13**	**262.70**
8.00	9.00	8.50	1.00	6.5	20.40	10.40	88.20	3.77	30.1	30.1	1.0	193.79	805.61	0	1.0	0.0	83.0	9.0	31.6	0	10.86	29.32	30.60	93.4	3323.9	4212.5	110.3	998.9	**1685.01**	**332.95**
9.00	11.00	10.00	2.00	8.5	20.86	10.86	104.26	7.54	31.6	31.6	1.1	522.51	1328.13	0	1.0	0.0	83.0	11.0	12.4	45	10.86	3.17	1.91	115.1	885.8	2296.9	144.2	1555.3	**918.76**	**518.43**
11.00	12.00	11.50	1.00	9.5	20.86	10.86	120.55	3.77	12.4	12.4	1.0	99.96	1428.09	45	1.0	169.7	252.7	12.0	12.4	41	10.86	3.17	1.91	126.0	884.1	2564.9	161.2	1841.9	**1025.94**	**613.98**
12.00	14.50	13.25	2.50	12.0	20.86	10.86	139.56	9.43	12.4	12.4	1.0	289.30	1717.39	41	1.0	386.6	639.3	14.5	12.4	41	10.86	3.17	1.91	153.1	981.6	3338.2	203.6	2560.2	**1335.30**	**853.41**
14.50	17.50	16.00	3.00	15.0	20.86	10.86	169.42	11.31	12.4	12.4	1.0	421.45	2138.84	41	1.0	463.9	1103.1	17.5	11.0	48	8.14	2.76	1.51	185.7	1077.9	4319.8	254.5	3496.4	**1727.94**	**1165.48**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								φ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	φ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
17.50	20.50	19.00	3.00	18.0	18.14	8.14	169.42	11.31	11.0	11.0	1.0	372.60	2511.44	48	1.0	543.1	1646.2	20.5	11.5	40	8.14	2.91	1.65	185.7	1028.1	5185.7	305.4	4463.0	**2074.30**	**1487.68**
20.50	23.50	22.00	3.00	21.0	18.14	8.14	169.42	11.31	11.5	11.5	1.0	389.99	2901.43	40	1.0	452.6	2098.8	23.5	8.5	52	11.08	2.20	0.99	185.7	999.2	5999.4	356.3	5356.5	**2399.77**	**1785.49**
23.50	26.50	25.00	3.00	24.0	21.08	11.08	169.42	11.31	8.5	8.5	1.0	286.48	3187.91	52	1.0	588.3	2687.1	26.5	8.5	48	11.08	2.20	0.99	185.7	958.5	6833.5	407.2	6282.2	**2733.41**	**2094.07**
26.50	27.50	27.00	1.00	25.0	21.08	11.08	169.42	3.77	8.5	8.5	1.0	95.49	3283.40	48	1.0	181.0	2868.2	27.5	8.5	48	11.08	2.20	0.99	185.7	958.5	7110.0	424.1	6575.7	**2844.02**	**2191.89**
27.50	28.00	27.75	0.50	25.5	21.08	11.08	169.42	1.89	8.5	8.5	1.0	47.75	3331.14	48	1.0	90.5	2958.7	28.0	11.8	48	9.89	3.00	1.73	185.7	1130.6	7420.4	432.6	6722.4	**2968.18**	**2240.81**
28.00	29.50	28.75	1.50	27.0	19.89	9.89	169.42	5.66	11.8	11.8	1.0	200.23	3531.37	48	1.0	271.5	3230.2	29.5	11.8	48	9.89	3.00	1.73	185.7	1130.6	7892.2	458.0	7219.6	**3156.88**	**2406.55**
29.50	30.00	29.75	0.50	27.5	19.89	9.89	169.42	1.89	11.8	11.8	1.0	66.74	3598.11	48	1.0	90.5	3320.7	30.0	11.8	48	9.89	3.00	1.73	185.7	1130.6	8049.5	466.5	7385.4	**3219.79**	**2461.79**
30.00	31.00	30.50	1.00	28.5	19.89	9.89	169.42	3.77	11.8	11.8	1.0	133.48	3731.60	48	1.0	181.0	3501.8	31.0	24.7	11	10.91	9.78	10.55	185.7	2245.9	9479.3	483.5	7716.9	**3791.73**	**2572.29**
31.00	32.50	31.75	1.50	30.0	20.91	10.91	169.42	5.66	24.7	24.7	1.0	440.83	4172.43	11	1.0	62.2	3564.0	32.5	8.3	40	10.91	2.16	0.96	185.7	869.1	8605.5	508.9	8245.4	**3442.21**	**2748.46**
32.50	35.00	33.75	2.50	32.5	20.91	10.91	169.42	9.43	8.3	8.3	1.0	233.03	4405.46	40	1.0	377.1	3941.1	35.0	8.0	40	11.02	2.11	0.91	185.7	857.5	9204.1	551.3	8898.0	**3681.64**	**2965.98**
35.00	35.50	35.25	0.50	33.0	21.02	11.02	169.42	1.89	8.0	8.0	1.0	44.90	4450.36	40	1.0	75.4	4016.6	35.5	23.6	10	9.13	8.99	9.34	185.7	2049.1	10516.0	559.8	9026.8	**4206.42**	**3008.92**
35.50	37.00	36.25	1.50	34.5	19.13	9.13	169.42	5.66	23.6	23.6	1.0	418.73	4869.09	10	1.0	56.6	4073.1	37.0	23.6	10	9.13	8.99	9.34	185.7	2049.1	10991.3	585.3	9527.5	**4396.54**	**3175.84**
37.00	37.50	37.25	0.50	35.0	19.13	9.13	169.42	1.89	23.6	23.6	1.0	139.58	5008.67	10	1.0	18.9	4092.0	37.5	23.6	10	9.13	8.99	9.34	185.7	2049.1	11149.8	593.8	9694.4	**4459.91**	**3231.48**
37.50	38.50	38.00	1.00	36.0	19.13	9.13	169.42	3.77	23.6	23.6	1.0	279.15	5287.82	10	1.0	37.7	4129.7	38.5	23.6	10	9.89	8.99	9.34	185.7	2053.9	11471.5	610.7	10028.3	**4588.59**	**3342.75**
38.50	40.00	39.25	1.50	37.5	19.89	9.89	169.42	5.66	23.6	23.6	1.0	418.73	5706.55	10	1.0	56.6	4186.3	40.0	23.6	10	9.89	8.99	9.34	185.7	2053.9	11946.8	636.2	10529.0	**4778.71**	**3509.67**
BORE NO: P12, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.31	9.31	25.60	1.89	7.9	7.9	1.0	6.70	6.70	64	1.0	120.7	120.7	3.0	11.6	26	9.31	2.94	1.68	27.9	368.3	495.7	8.5	135.9	**198.26**	**45.29**
3.00	4.00	3.50	1.00	1.5	19.31	9.31	32.59	3.77	11.6	11.6	1.0	25.23	31.93	26	1.0	98.1	218.7	4.0	11.6	26	9.31	2.94	1.68	37.2	399.2	649.9	25.4	276.1	**259.97**	**92.04**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 1.13 m^2

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
4.00	5.00	4.50	1.00	2.5	19.31	9.31	41.90	3.77	11.6	11.6	1.0	32.43	64.36	26	1.0	98.1	316.8	5.0	7.3	66	9.31	1.98	0.80	46.6	781.6	1162.8	42.4	423.6	**465.12**	**141.19**
5.00	6.00	5.50	1.00	3.5	19.31	9.31	51.21	3.77	7.3	7.3	1.0	24.74	89.10	66	1.0	248.9	565.7	6.0	11.6	29	9.20	2.94	1.68	55.9	491.6	1146.4	59.4	714.2	**458.57**	**238.06**
6.00	7.00	6.50	1.00	4.5	19.20	9.20	60.46	3.77	11.6	11.6	1.0	46.81	135.90	29	1.0	109.4	675.1	7.0	11.6	29	9.20	2.94	1.68	65.1	522.2	1333.2	76.3	887.3	**533.29**	**295.78**
7.00	8.00	7.50	1.00	5.5	19.20	9.20	69.66	3.77	11.6	11.6	1.0	53.93	189.83	29	1.0	109.4	784.5	8.0	25.9	0	9.20	12.03	12.95	74.3	1091.4	2065.7	93.3	1067.6	**826.27**	**355.86**
8.00	9.00	8.50	1.00	6.5	19.20	9.20	78.86	3.77	25.9	25.9	1.0	144.42	334.25	0	1.0	0.0	784.5	9.0	25.9	0	9.20	12.03	12.95	83.5	1216.6	2335.3	110.3	1229.0	**934.11**	**409.66**
9.00	10.00	9.50	1.00	7.5	19.20	9.20	88.06	3.77	25.9	25.9	1.0	161.26	495.51	0	1.0	0.0	784.5	10.0	25.0	0	9.20	10.00	10.88	92.7	1116.3	2396.3	127.2	1407.2	**958.52**	**469.07**
10.00	11.00	10.50	1.00	8.5	19.20	9.20	97.26	3.77	25.0	25.0	1.0	171.05	666.56	0	1.0	0.0	784.5	11.0	24.5	15	10.35	9.64	10.33	101.9	1336.3	2787.3	144.2	1595.2	**1114.93**	**531.74**
11.00	12.50	11.75	1.50	10.0	20.35	10.35	109.62	5.66	24.5	24.5	1.0	282.62	949.18	15	1.0	84.9	869.3	12.5	8.5	56	10.31	2.20	0.99	117.4	869.4	2687.8	169.6	1988.1	**1075.14**	**662.71**
12.50	15.50	14.00	3.00	13.0	20.31	10.31	132.85	11.31	8.5	8.5	1.0	224.64	1173.82	56	1.0	633.6	1502.9	15.5	11.5	54	9.03	2.91	1.65	148.3	1048.5	3725.2	220.5	2897.3	**1490.08**	**965.76**
15.50	18.50	17.00	3.00	16.0	19.03	9.03	161.86	11.31	11.5	11.5	1.0	372.59	1546.41	54	1.0	611.0	2113.9	18.5	10.8	59	10.57	2.71	1.45	148.3	1065.1	4725.4	271.4	3931.7	**1890.17**	**1310.58**
18.50	21.50	20.00	3.00	19.0	20.57	10.57	161.86	11.31	10.8	10.8	1.0	349.34	1895.75	59	1.0	667.5	2781.4	21.5	9.1	61	10.44	2.31	1.08	148.3	1016.1	5693.3	322.3	4999.5	**2277.32**	**1666.50**
21.50	24.50	23.00	3.00	22.0	20.44	10.44	161.86	11.31	9.1	9.1	1.0	293.33	2189.08	61	1.0	690.2	3471.6	24.5	9.5	53	10.64	2.38	1.14	148.3	947.3	6608.0	373.2	6033.9	**2643.21**	**2011.30**
24.50	27.50	26.00	3.00	25.0	20.64	10.64	161.86	11.31	9.5	9.5	1.0	306.46	2495.54	53	1.0	599.7	4071.3	27.5	9.5	53	10.64	2.38	1.14	148.3	947.3	7514.1	424.1	6990.9	**3005.65**	**2330.31**
27.50	29.00	28.25	1.50	26.5	20.64	10.64	161.86	5.66	9.5	9.5	1.0	153.23	2648.77	53	1.0	299.8	4371.1	29.0	30.6	0	10.64	24.28	25.48	148.3	4258.7	11278.6	449.6	7469.4	**4511.43**	**2489.81**
29.00	30.00	29.50	1.00	27.5	20.64	10.64	161.86	3.77	30.6	30.6	1.0	371.85	3020.62	0	1.0	0.0	4371.1	30.0	31.0	0	9.63	26.30	27.53	148.3	4592.8	11984.5	466.5	7858.2	**4793.80**	**2619.41**
30.00	30.50	30.25	0.50	28.0	19.63	9.63	161.86	1.89	31.0	31.0	1.1	192.57	3213.18	0	1.0	0.0	4371.1	30.5	31.0	0	10.05	26.30	27.53	148.3	4600.6	12184.9	475.0	8059.3	**4873.96**	**2686.43**
30.50	32.00	31.25	1.50	29.5	20.05	10.05	161.86	5.66	31.0	31.0	1.1	577.70	3790.88	0	1.0	0.0	4371.1	32.0	32.5	0	10.05	33.85	35.22	148.3	5921.1	14083.0	500.5	8662.4	**5633.21**	**2887.47**
32.00	32.50	32.25	0.50	30.0	20.05	10.05	161.86	1.89	32.5	32.5	1.1	218.75	4009.63	0	1.0	0.0	4371.1	32.5	32.5	0	10.05	33.85	35.22	148.3	5921.1	14301.8	508.9	8889.7	**5720.72**	**2963.22**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
32.50	33.50	33.00	1.00	31.0	20.05	10.05	161.86	3.77	32.5	32.5	1.1	437.51	4447.14	0	1.0	0.0	4371.1	33.5	32.1	0	10.05	31.84	33.16	148.3	5569.0	14387.2	525.9	9344.1	**5754.87**	**3114.71**
33.50	35.00	34.25	1.50	32.5	20.05	10.05	161.86	5.66	32.1	32.1	1.1	634.71	5081.85	0	1.0	0.0	4371.1	35.0	32.1	0	10.05	31.84	33.16	148.3	5569.0	15021.9	551.3	10004.3	**6008.76**	**3334.76**
35.00	36.50	35.75	1.50	34.0	20.05	10.05	161.86	5.66	32.1	32.1	1.1	634.71	5716.56	0	1.0	0.0	4371.1	36.5	32.3	0	10.05	32.85	34.19	148.3	5745.0	15832.7	576.8	10664.4	**6333.06**	**3554.81**
36.50	37.50	37.00	1.00	35.0	20.05	10.05	161.86	3.77	32.3	32.3	1.1	430.29	6146.84	0	1.0	0.0	4371.1	37.5	32.3	0	10.05	32.85	34.19	148.3	5745.0	16262.9	593.8	11111.7	**6505.18**	**3703.90**
37.50	40.00	38.75	2.50	37.5	20.05	10.05	161.86	9.43	32.3	32.3	1.1	1075.71	7222.56	0	1.0	0.0	4371.1	40.0	32.3	0	10.05	32.85	34.19	148.3	5745.0	17338.7	636.2	12229.8	**6935.46**	**4076.60**
BORE NO: P13, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.71	9.71	26.70	1.89	24.3	24.3	1.0	22.74	0	0	1.0	0.0	0	3.0	26.3	5	9.71	12.93	13.88	29.1	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.5	19.71	9.71	33.99	3.77	26.3	26.3	1.0	63.35	0	5	1.0	18.9	0	4.0	26.3	5	9.46	12.93	13.88	38.8	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	5.00	4.50	1.00	2.5	19.46	9.46	43.57	3.77	26.3	26.3	1.0	81.21	0	5	1.0	18.9	0	5.0	24.7	10	9.46	9.78	10.55	48.3	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.46	9.46	53.03	3.77	24.7	24.7	1.0	91.99	0	10	1.0	37.7	0	6.0	24.7	10	9.46	9.78	10.55	57.8	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	7.00	6.50	1.00	4.5	19.46	9.46	62.49	3.77	24.7	24.7	1.0	108.40	0	10	1.0	37.7	0	7.0	24.7	10	9.10	9.78	10.55	67.2	0	0.0	76.3	76.3	**0.00**	**25.45**
7.00	8.00	7.50	1.00	5.5	19.10	9.10	71.77	3.77	24.7	24.7	1.0	124.50	0	10	1.0	37.7	0	8.0	24.2	0	9.10	9.42	10.00	76.3	0	0.0	93.3	93.3	**0.00**	**31.10**
8.00	9.00	8.50	1.00	6.5	19.10	9.10	80.87	3.77	24.2	24.2	1.0	137.07	0	0	1.0	0.0	0	9.0	24.2	0	9.10	9.42	10.00	85.4	0	0.0	110.3	110.3	**0.00**	**36.76**
9.00	10.00	9.50	1.00	7.5	19.10	9.10	89.97	3.77	24.2	24.2	1.0	152.49	0	0	1.0	0.0	0	10.0	10.5	48	10.36	2.62	1.36	94.5	778.2	778.2	127.2	127.2	**311.29**	**42.41**
10.00	11.00	10.50	1.00	8.5	20.36	10.36	99.70	3.77	10.5	10.5	1.0	69.69	69.69	48	1.0	181.0	181.0	11.0	10.5	48	10.36	2.62	1.36	104.9	808.9	1059.6	144.2	394.9	**423.85**	**131.64**
11.00	12.00	11.50	1.00	9.5	20.36	10.36	110.06	3.77	10.5	10.5	1.0	76.93	146.62	48	1.0	181.0	362.1	12.0	10.5	48	10.36	2.62	1.36	115.2	839.6	1348.3	161.2	669.8	**539.30**	**223.28**
12.00	13.00	12.50	1.00	10.5	20.36	10.36	120.42	3.77	10.5	10.5	1.0	84.17	230.79	48	1.0	181.0	543.1	13.0	28.0	0	9.54	16.76	17.79	125.6	2496.3	3270.2	178.1	952.0	**1308.09**	**317.34**
13.00	14.50	13.75	1.50	12.0	19.54	9.54	132.76	5.66	28.0	28.0	1.0	399.32	630.11	0	1.0	0.0	543.1	14.5	28.0	0	9.54	16.76	17.79	139.9	2767.6	3940.8	203.6	1376.8	**1576.33**	**458.93**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
14.50	16.00	15.25	1.50	13.5	19.54	9.54	147.07	5.66	28.0	28.0	1.0	442.37	1072.48	0	1.0	0.0	543.1	16.0	10.2	49	10.49	2.53	1.28	154.2	949.3	2564.9	229.0	1844.6	**1025.95**	**614.86**
16.00	17.50	16.75	1.50	15.0	20.49	10.49	162.09	5.66	10.2	10.2	1.0	164.99	1237.47	49	1.0	277.2	820.3	17.5	10.8	49	11.03	2.71	1.45	170.0	1030.0	3087.7	254.5	2312.2	**1235.10**	**770.74**
17.50	20.50	19.00	3.00	18.0	21.03	11.03	162.09	11.31	10.8	10.8	1.0	349.84	1587.30	49	1.0	554.4	1374.7	20.5	13.5	47	11.03	3.50	2.22	170.0	1168.2	4130.2	305.4	3267.4	**1652.09**	**1089.12**
20.50	23.50	22.00	3.00	21.0	21.03	11.03	162.09	11.31	13.5	13.5	1.0	440.28	2027.58	47	1.0	531.8	1906.5	23.5	11.5	47	8.68	2.91	1.65	170.0	1048.1	4982.1	356.3	4290.3	**1992.85**	**1430.10**
23.50	25.00	24.25	1.50	22.5	18.68	8.68	162.09	5.66	11.5	11.5	1.0	186.56	2214.14	47	1.0	265.9	2172.3	25.0	11.5	47	8.61	2.91	1.65	170.0	1048.0	5434.5	381.7	4768.2	**2173.79**	**1589.40**
25.00	26.50	25.75	1.50	24.0	18.61	8.61	162.09	5.66	11.5	11.5	1.0	186.56	2400.69	47	1.0	265.9	2438.2	26.5	11.5	47	8.99	2.91	1.65	170.0	1048.4	5887.3	407.2	5246.1	**2354.94**	**1748.69**
26.50	27.50	27.00	1.00	25.0	18.99	8.99	162.09	3.77	11.5	11.5	1.0	124.37	2525.07	47	1.0	177.3	2615.5	27.5	11.5	47	8.99	2.91	1.65	170.0	1048.4	6189.0	424.1	5564.7	**2475.59**	**1854.89**
27.50	28.00	27.75	0.50	25.5	18.99	8.99	162.09	1.89	11.5	11.5	1.0	62.19	2587.25	47	1.0	88.6	2704.1	28.0	12.5	49	9.36	3.20	1.94	170.0	1127.4	6418.7	432.6	5724.0	**2567.49**	**1907.99**
28.00	29.50	28.75	1.50	27.0	19.36	9.36	162.09	5.66	12.5	12.5	1.0	203.28	2790.53	49	1.0	277.2	2981.3	29.5	12.5	49	9.08	3.20	1.94	170.0	1127.0	6898.8	458.0	6229.9	**2759.54**	**2076.63**
29.50	30.00	29.75	0.50	27.5	19.08	9.08	162.09	1.89	12.5	12.5	1.0	67.76	2858.30	49	1.0	92.4	3073.7	30.0	12.5	49	10.98	3.20	1.94	170.0	1129.5	7061.5	466.5	6398.5	**2824.60**	**2132.85**
30.00	31.00	30.50	1.00	28.5	20.98	10.98	162.09	3.77	12.5	12.5	1.0	135.52	2993.82	49	1.0	184.8	3258.5	31.0	12.5	49	10.98	3.20	1.94	170.0	1129.5	7381.8	483.5	6735.8	**2952.73**	**2245.27**
31.00	32.50	31.75	1.50	30.0	20.98	10.98	162.09	5.66	12.5	12.5	1.0	203.28	3197.10	49	1.0	277.2	3535.7	32.5	28.6	0	10.98	18.11	19.17	170.0	3624.7	10357.5	508.9	7241.8	**4143.02**	**2413.92**
32.50	35.00	33.75	2.50	32.5	20.98	10.98	162.09	9.43	28.6	28.6	1.0	833.23	4030.33	0	1.0	0.0	3535.7	35.0	28.6	0	10.98	18.11	19.17	170.0	3624.7	11190.8	551.3	8117.4	**4476.31**	**2705.80**
35.00	35.50	35.25	0.50	33.0	20.98	10.98	162.09	1.89	28.6	28.6	1.0	166.65	4196.98	0	1.0	0.0	3535.7	35.5	28.5	0	10.98	17.88	18.94	170.0	3579.7	11312.4	559.8	8292.5	**4524.96**	**2764.17**
35.50	37.50	36.50	2.00	35.0	20.98	10.98	162.09	7.54	28.5	28.5	1.0	663.82	4860.80	0	1.0	0.0	3535.7	37.5	28.5	0	8.84	17.88	18.94	170.0	3552.2	11948.7	593.8	8990.3	**4779.48**	**2996.76**
37.50	38.50	38.00	1.00	36.0	18.84	8.84	162.09	3.77	28.5	28.5	1.0	331.91	5192.71	0	1.0	0.0	3535.7	38.5	28.5	0	9.15	17.88	18.94	170.0	3556.2	12284.6	610.7	9339.1	**4913.84**	**3113.05**
38.50	40.00	39.25	1.50	37.5	19.15	9.15	162.09	5.66	28.5	28.5	1.0	497.86	5690.57	0	1.0	0.0	3535.7	40.0	28.5	0	9.15	17.88	18.94	170.0	3556.2	12782.5	636.2	9862.5	**5112.98**	**3287.49**

BORE NO: P17, CUT OFF LENGTH: 2.50 m, Nc= 9

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Factor of Safety in Compression: 2.5
Area of Pile: 1.13 m^2
Critical water table: 0.00 m
Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
2.50	3.00	2.75	0.50	0.5	19.85	9.85	27.09	1.89	26.5	26.5	1.0	25.47	0	8	1.0	15.1	0	3.0	24.1	0	9.85	9.35	9.89	29.6	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.5	19.85	9.85	34.48	3.77	24.1	24.1	1.0	58.16	0	0	1.0	0.0	0	4.0	24.1	0	9.38	9.35	9.89	39.4	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	6.00	5.00	2.00	3.5	19.38	9.38	48.78	7.54	24.1	24.1	1.0	164.59	0	0	1.0	0.0	0	6.0	27.0	0	9.38	14.50	15.49	58.2	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	7.00	6.50	1.00	4.5	19.38	9.38	62.85	3.77	27.0	27.0	1.0	120.78	0	0	1.0	0.0	0	7.0	29.5	0	9.38	20.13	21.25	67.5	0	0.0	76.3	76.3	**0.00**	**25.45**
7.00	8.00	7.50	1.00	5.5	19.38	9.38	72.23	3.77	29.5	29.5	1.0	154.12	0	0	1.0	0.0	0	8.0	29.5	0	9.79	20.13	21.25	76.9	0	0.0	93.3	93.3	**0.00**	**31.10**
8.00	9.00	8.50	1.00	6.5	19.79	9.79	81.82	3.77	29.5	29.5	1.0	174.57	0	0	1.0	0.0	0	9.0	28.3	0	9.79	17.43	18.48	86.7	1833.0	1833.0	110.3	110.3	**733.18**	**36.76**
9.00	10.00	9.50	1.00	7.5	19.79	9.79	91.61	3.77	28.3	28.3	1.0	186.02	186.02	0	1.0	0.0	0.0	10.0	28.3	0	8.54	17.43	18.48	96.5	2010.4	2196.4	127.2	313.3	**878.55**	**104.42**
10.00	12.50	11.25	2.50	10.0	18.54	8.54	107.18	9.43	28.3	28.3	1.0	544.10	730.12	0	1.0	0.0	0.0	12.5	9.3	55	8.54	2.34	1.11	117.9	879.1	1609.2	169.6	899.8	**643.67**	**299.92**
12.50	14.00	13.25	1.50	11.5	18.54	8.54	124.26	5.66	9.3	9.3	1.0	115.11	845.23	55	1.0	311.1	311.1	14.0	24.5	14	8.96	9.64	10.33	130.7	1630.5	2786.9	195.1	1351.5	**1114.75**	**450.49**
14.00	15.50	14.75	1.50	13.0	18.96	8.96	137.38	5.66	24.5	24.5	1.0	354.18	1199.41	14	1.0	79.2	390.3	15.5	9.5	50	10.22	2.38	1.14	144.1	905.1	2494.9	220.5	1810.3	**997.94**	**603.43**
15.50	18.50	17.00	3.00	16.0	20.22	10.22	159.43	11.31	9.5	9.5	1.0	301.86	1501.27	50	1.0	565.7	956.1	18.5	8.5	64	9.12	2.20	0.99	144.1	1016.5	3473.8	271.4	2728.8	**1389.54**	**909.59**
18.50	21.50	20.00	3.00	19.0	19.12	9.12	159.43	11.31	8.5	8.5	1.0	269.59	1770.86	64	1.0	724.1	1680.2	21.5	8.5	64	9.12	2.20	0.99	144.1	1016.5	4467.5	322.3	3773.4	**1787.02**	**1257.79**
21.50	23.00	22.25	1.50	20.5	19.12	9.12	159.43	5.66	8.5	8.5	1.0	134.79	1905.65	64	1.0	362.1	2042.2	23.0	8.9	57	10.31	2.27	1.05	144.1	958.2	4906.1	347.8	4295.7	**1962.43**	**1431.88**
23.00	24.50	23.75	1.50	22.0	20.31	10.31	159.43	5.66	8.9	8.9	1.0	141.24	2046.89	57	1.0	322.5	2364.7	24.5	8.9	57	10.31	2.27	1.05	144.1	958.2	5369.8	373.2	4784.8	**2147.91**	**1594.93**
24.50	26.00	25.25	1.50	23.5	20.31	10.31	159.43	5.66	8.9	8.9	1.0	141.24	2188.12	57	1.0	322.5	2687.1	26.0	8.5	55	10.31	2.20	0.99	144.1	925.7	5800.9	398.7	5273.9	**2320.37**	**1757.98**
26.00	27.50	26.75	1.50	25.0	20.31	10.31	159.43	5.66	8.5	8.5	1.0	134.79	2322.92	55	1.0	311.1	2998.3	27.5	8.5	55	10.44	2.20	0.99	144.1	925.8	6247.0	424.1	5745.3	**2498.78**	**1915.11**
27.50	30.00	28.75	2.50	27.5	20.44	10.44	159.43	9.43	8.5	8.5	1.0	224.65	2547.57	55	1.0	518.6	3516.9	30.0	8.3	54	10.44	2.16	0.96	144.1	909.5	6973.9	466.5	6531.0	**2789.56**	**2176.98**
30.00	30.50	30.25	0.50	28.0	20.44	10.44	159.43	1.89	8.3	8.3	1.0	43.86	2591.43	54	1.0	101.8	3618.7	30.5	31.2	0	10.44	27.30	28.55	144.1	4654.0	10864.2	475.0	6685.1	**4345.66**	**2228.37**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Factor of Safety in Compression: 2.5
Area of Pile: 1.13 m^2
Critical water table: 0.00 m
Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
30.50	32.00	31.25	1.50	29.5	20.44	10.44	159.43	5.66	31.2	31.2	1.1	578.99	3170.42	0	1.0	0.0	3618.7	32.0	31.2	0	10.44	27.30	28.55	144.1	4654.0	11443.1	500.5	7289.6	**4577.26**	**2429.86**
32.00	32.50	32.25	0.50	30.0	20.44	10.44	159.43	1.89	31.2	31.2	1.1	193.00	3363.42	0	1.0	0.0	3618.7	32.5	30.6	0	8.78	24.28	25.48	144.1	4110.8	11092.9	508.9	7491.0	**4437.14**	**2497.02**
32.50	33.50	33.00	1.00	31.0	18.78	8.78	159.43	3.77	30.6	30.6	1.0	366.26	3729.69	0	1.0	0.0	3618.7	33.5	25.4	10	8.39	10.90	11.80	144.1	1946.3	9294.7	525.9	7874.3	**3717.87**	**2624.76**
33.50	35.00	34.25	1.50	32.5	18.39	8.39	159.43	5.66	25.4	25.4	1.0	428.26	4157.95	10	1.0	56.6	3675.3	35.0	25.4	10	7.89	10.90	11.80	144.1	1942.3	9775.5	551.3	8384.6	**3910.20**	**2794.85**
35.00	36.50	35.75	1.50	34.0	17.89	7.89	159.43	5.66	25.4	25.4	1.0	428.26	4586.21	10	1.0	56.6	3731.8	36.5	30.6	0	7.74	24.28	25.48	144.1	4092.8	12410.8	576.8	8894.8	**4964.32**	**2964.94**
36.50	37.50	37.00	1.00	35.0	17.74	7.74	159.43	3.77	30.6	30.6	1.0	366.26	4952.47	0	1.0	0.0	3731.8	37.5	30.6	0	7.74	24.28	25.48	144.1	4092.8	12777.1	593.8	9278.1	**5110.83**	**3092.69**
37.50	38.00	37.75	0.50	35.5	17.74	7.74	159.43	1.89	30.6	30.6	1.0	183.13	5135.60	0	1.0	0.0	3731.8	38.0	10.0	50	7.58	2.47	1.22	144.1	918.1	9785.6	602.2	9469.7	**3914.22**	**3156.56**
38.00	40.00	39.00	2.00	37.5	17.58	7.58	159.43	7.54	10.0	10.0	1.0	212.04	5347.65	50	1.0	377.1	4109.0	40.0	10.0	50	7.58	2.47	1.22	144.1	918.1	10374.7	636.2	10092.8	**4149.90**	**3364.26**
BORE NO: P18, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.10	9.10	25.03	1.89	28.0	28.0	1.0	25.09	0	0	1.0	0.0	0	3.0	28.0	0	9.90	16.76	17.79	27.3	637.1	637.1	8.5	8.5	**254.85**	**2.83**
3.00	5.00	4.00	2.00	2.5	19.90	9.90	37.20	7.54	28.0	28.0	1.0	149.19	149.19	0	1.0	0.0	0.0	5.0	28.0	0	9.90	16.76	17.79	47.1	1012.5	1161.7	42.4	191.6	**464.67**	**63.87**
5.00	6.00	5.50	1.00	3.5	19.90	9.90	52.05	3.77	28.0	28.0	1.0	104.38	253.57	0	1.0	0.0	0.0	6.0	27.9	0	9.90	16.53	17.56	57.0	1184.1	1437.7	59.4	312.9	**575.07**	**104.32**
6.00	8.00	7.00	2.00	5.5	19.90	9.90	66.90	7.54	27.9	27.9	1.0	267.18	520.75	0	1.0	0.0	0.0	8.0	28.3	0	7.90	17.43	18.48	76.8	1613.8	2134.5	93.3	614.1	**853.82**	**204.69**
8.00	9.00	8.50	1.00	6.5	17.90	7.90	80.75	3.77	28.3	28.3	1.0	163.98	684.73	0	1.0	0.0	0.0	9.0	28.3	0	7.90	17.43	18.48	84.7	1769.6	2454.3	110.3	795.0	**981.73**	**265.00**
9.00	11.00	10.00	2.00	8.5	17.90	7.90	92.60	7.54	28.3	28.3	1.0	376.09	1060.82	0	1.0	0.0	0.0	11.0	28.6	0	7.90	18.11	19.17	100.5	2161.7	3222.6	144.2	1205.0	**1289.02**	**401.67**
11.00	12.00	11.50	1.00	9.5	17.90	7.90	104.45	3.77	28.6	28.6	1.0	214.78	1275.59	0	1.0	0.0	0.0	12.0	26.7	0	9.66	13.83	14.80	108.4	1793.0	3068.6	161.2	1436.8	**1227.45**	**478.92**
12.00	14.50	13.25	2.50	12.0	19.66	9.66	120.48	9.43	26.7	26.7	1.0	571.30	1846.89	0	1.0	0.0	0.0	14.5	29.1	0	10.00	19.23	20.33	132.6	3022.3	4869.2	203.6	2050.5	**1947.70**	**683.49**
14.50	17.50	16.00	3.00	15.0	20.00	10.00	147.55	11.31	29.1	29.1	1.0	929.19	2776.08	0	1.0	0.0	0.0	17.5	9.5	54	10.60	2.38	1.14	162.6	995.8	3771.9	254.5	3030.6	**1508.76**	**1010.18**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
17.50	20.50	19.00	3.00	18.0	20.60	10.60	147.55	11.31	9.5	9.5	1.0	279.37	3055.45	54	1.0	611.0	611.0	20.5	10.0	46	9.92	2.47	1.22	162.6	930.9	4597.3	305.4	3971.8	**1838.93**	**1323.93**
20.50	23.50	22.00	3.00	21.0	19.92	9.92	147.55	11.31	10.0	10.0	1.0	294.36	3349.81	46	1.0	520.5	1131.4	23.5	11.5	42	10.80	2.91	1.65	162.6	975.1	5456.4	356.3	4837.5	**2182.55**	**1612.50**
23.50	26.50	25.00	3.00	24.0	20.80	10.80	147.55	11.31	11.5	11.5	1.0	339.65	3689.46	42	1.0	475.2	1606.6	26.5	11.0	44	10.80	2.76	1.51	162.6	967.4	6263.5	407.2	5703.2	**2505.41**	**1901.08**
26.50	27.50	27.00	1.00	25.0	20.80	10.80	147.55	3.77	11.0	11.0	1.0	108.17	3797.63	44	1.0	165.9	1772.6	27.5	11.0	44	10.80	2.76	1.51	162.6	967.4	6537.6	424.1	5994.3	**2615.05**	**1998.11**
27.50	28.00	27.75	0.50	25.5	20.80	10.80	147.55	1.89	11.0	11.0	1.0	54.08	3851.71	44	1.0	83.0	1855.5	28.0	10.0	44	10.90	2.47	1.22	162.6	911.3	6618.6	432.6	6139.9	**2647.44**	**2046.62**
28.00	29.50	28.75	1.50	27.0	20.90	10.90	147.55	5.66	10.0	10.0	1.0	147.18	3998.90	44	1.0	248.9	2104.5	29.5	31.6	0	10.90	29.32	30.60	162.6	5618.7	11722.0	458.0	6561.4	**4688.81**	**2187.13**
29.50	30.00	29.75	0.50	27.5	20.90	10.90	147.55	1.89	31.6	31.6	1.1	184.87	4183.76	0	1.0	0.0	2104.5	30.0	31.6	0	10.90	29.32	30.60	162.6	5618.7	11906.9	466.5	6754.7	**4762.76**	**2251.58**
30.00	31.00	30.50	1.00	28.5	20.90	10.90	147.55	3.77	31.6	31.6	1.1	369.73	4553.49	0	1.0	0.0	2104.5	31.0	31.6	0	10.90	29.32	30.60	162.6	5618.7	12276.6	483.5	7141.4	**4910.65**	**2380.48**
31.00	32.50	31.75	1.50	30.0	20.90	10.90	147.55	5.66	31.6	31.6	1.1	554.60	5108.09	0	1.0	0.0	2104.5	32.5	31.2	0	8.78	27.30	28.55	162.6	5191.8	12404.4	508.9	7721.5	**4961.76**	**2573.83**
32.50	34.00	33.25	1.50	31.5	18.78	8.78	147.55	5.66	31.2	31.2	1.1	535.85	5643.94	0	1.0	0.0	2104.5	34.0	12.3	29	9.22	3.15	1.88	162.6	885.6	8634.0	534.4	8282.8	**3453.59**	**2760.93**
34.00	35.00	34.50	1.00	32.5	19.22	9.22	147.55	3.77	12.3	12.3	1.0	121.33	5765.28	29	1.0	109.4	2213.8	35.0	12.3	29	9.22	3.15	1.88	162.6	885.6	8864.7	551.3	8530.5	**3545.87**	**2843.48**
35.00	35.50	35.25	0.50	33.0	19.22	9.22	147.55	1.89	12.3	12.3	1.0	60.67	5825.94	29	1.0	54.7	2268.5	35.5	15.0	35	8.44	3.94	2.65	162.6	1096.2	9190.7	559.8	8654.3	**3676.26**	**2884.76**
35.50	37.00	36.25	1.50	34.5	18.44	8.44	147.55	5.66	15.0	15.0	1.0	223.66	6049.60	35	1.0	198.0	2466.5	37.0	15.5	44	9.25	4.19	2.92	162.6	1236.3	9752.4	585.3	9101.4	**3900.95**	**3033.80**
37.00	37.50	37.25	0.50	35.0	19.25	9.25	147.55	1.89	15.5	15.5	1.0	77.16	6126.76	44	1.0	83.0	2549.5	37.5	15.5	44	9.25	4.19	2.92	162.6	1236.3	9912.5	593.8	9270.0	**3965.01**	**3090.00**
37.50	38.50	38.00	1.00	36.0	19.25	9.25	147.55	3.77	15.5	15.5	1.0	154.32	6281.09	44	1.0	165.9	2715.4	38.5	15.5	44	9.64	4.19	2.92	162.6	1237.0	10233.6	610.7	9607.2	**4093.42**	**3202.41**
38.50	40.00	39.25	1.50	37.5	19.64	9.64	147.55	5.66	15.5	15.5	1.0	231.49	6512.57	44	1.0	248.9	2964.3	40.0	15.5	50	9.64	4.19	2.92	162.6	1298.1	10775.1	636.2	10113.1	**4310.02**	**3371.03**

APPENDIX-H

TABLE 3: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1000 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Depth of Fixity (m)	Allowable Load capacity of pile(kN)
A1	1.00	2.50	0.00	35	29580399	0.0491	14	1976	3.74	4.50	1.20	2.05	0.005	7.67	48
P6	1.00	2.50	0.00	35	29580399	0.0491	16	2264	3.64	0.00	0.00	2.23	0.005	8.12	163
P12	1.00	2.50	0.00	35	29580399	0.0491	10	1400	4.01	0.00	0.00	2.23	0.005	8.94	122
P13	1.00	2.50	0.00	35	29580399	0.0491	29	4136	3.23	7.50	2.32	1.92	0.005	6.21	34
P17	1.00	2.50	0.00	35	29580399	0.0491	25	3560	3.33	6.50	1.95	1.94	0.005	6.45	40
P18	1.00	2.50	0.00	35	29580399	0.0491	15	2120	3.69	0.50	0.14	2.21	0.005	8.16	134

APPENDIX-H

TABLE 4: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1200 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Depth of Fixity (m)	Allowable Load capacity of pile(kN)
A1	1.20	2.50	0.00	35	29580399	0.1018	15	2120	4.27	4.50	1.05	2.07	0.005	8.85	76
P6	1.20	2.50	0.00	35	29580399	0.1018	17	2408	4.16	0.00	0.00	2.23	0.005	9.28	226
P12	1.20	2.50	0.00	35	29580399	0.1018	12	1688	4.47	0.00	0.00	2.23	0.005	9.97	182
P13	1.20	2.50	0.00	35	29580399	0.1018	29	4136	3.74	7.50	2.01	1.93	0.005	7.21	57
P17	1.20	2.50	0.00	35	29580399	0.1018	25	3560	3.85	6.50	1.69	1.98	0.005	7.61	64
P18	1.20	2.50	0.00	35	29580399	0.1018	16	2264	4.21	0.50	0.12	2.21	0.005	9.32	191

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
A1	0.50	ML	61	4	9.40	5.00	4.40	1.00	0.332	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.510	Liquefiable
	1.00	CL	57	4	18.80	10.00	8.80	0.99	0.331	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
	3.00	ML	51	6	56.40	30.00	26.40	0.98	0.326	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.672	Liquefiable
	4.00	SM	37	11	75.20	40.00	35.20	0.97	0.323	1.69	18.54	5.00	1.20	27.25	0.35	1.00	0.412	1.275	Non-liquefiable
	6.00	SM	29	12	112.80	60.00	52.80	0.95	0.318	1.38	16.51	4.64	1.15	23.57	0.27	1.00	0.317	0.998	Liquefiable
	7.00	SM	29	13	131.60	70.00	61.60	0.95	0.315	1.27	16.56	4.64	1.15	23.62	0.27	1.00	0.318	1.009	Non-liquefiable
	8.00	ML	53	13	162.40	80.00	82.40	0.94	0.289	1.10	14.32	5.00	1.20	22.19	0.24	1.00	0.292	1.011	Non-liquefiable
	9.00	CL	64	14	182.70	90.00	92.70	0.93	0.286	1.04	14.54	5.00	1.20	22.45	0.25	1.00	-	-	Non-liquefiable
	10.00	CL	57	10	203.00	100.00	103.00	0.91	0.279	0.99	9.85	5.00	1.20	16.82	0.18	1.00	-	-	Non-liquefiable
	12.50	CL-ML	61	21	266.25	125.00	141.25	0.84	0.247	0.84	17.67	5.00	1.20	26.20	0.32	1.00	-	-	Non-liquefiable
	14.00	CL	61	21	280.00	140.00	140.00	0.80	0.250	0.85	17.75	5.00	1.20	26.30	0.32	1.00	-	-	Non-liquefiable
	15.50	CL	61	19	310.00	155.00	155.00	0.76	0.237	0.80	15.26	5.00	1.20	23.31	0.26	0.88	-	-	Non-liquefiable
	18.50	CL	74	35	368.15	185.00	183.15	0.68	0.213	0.74	25.86	5.00	1.20	36.03	0.52	0.82	-	-	Non-liquefiable
	21.50	CL	73	39	436.45	215.00	221.45	0.60	0.184	0.67	26.21	5.00	1.20	36.45	0.52	0.77	-	-	Non-liquefiable
	24.50	CL	73	30	497.35	245.00	252.35	0.56	0.172	0.63	18.89	5.00	1.20	27.66	0.36	0.73	-	-	Non-liquefiable
	27.50	CL	76	32	574.75	275.00	299.75	0.56	0.167	0.58	18.48	5.00	1.20	27.18	0.34	0.72	-	-	Non-liquefiable
	29.00	CL-ML	55	32	548.10	290.00	258.10	0.56	0.185	0.62	19.92	5.00	1.20	28.90	0.41	0.80	-	-	Non-liquefiable
	30.50	CL	65	35	576.45	305.00	271.45	0.56	0.185	0.61	21.24	5.00	1.20	30.49	0.51	0.79	-	-	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	32.00	SM	47	100	604.80	320.00	284.80	0.56	0.185	0.59	59.26	5.00	1.20	76.11	0.52	0.78	0.484	2.608	Non-liquefiable
	33.50	SM	38	80	633.15	335.00	298.15	0.56	0.185	0.58	46.33	5.00	1.20	60.60	0.52	0.78	0.484	2.608	Non-liquefiable
	35.00	SM	38	79	661.50	350.00	311.50	0.56	0.185	0.57	44.76	5.00	1.20	58.71	0.52	0.77	0.478	2.575	Non-liquefiable
	36.50	CL	71	44	689.85	365.00	324.85	0.56	0.185	0.55	24.41	5.00	1.20	34.29	0.52	0.76	-	-	Non-liquefiable
	40.00	CL-ML	66	48	756.00	400.00	356.00	0.56	0.185	0.53	25.44	5.00	1.20	35.53	0.52	0.75	-	-	Non-liquefiable
P6	0.50	SM	37	7	10.30	5.00	5.30	1.00	0.302	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.816	Liquefiable
	1.00	CL	70	7	20.60	10.00	10.60	0.99	0.301	1.70	11.90	5.00	1.20	19.28	0.21	1.00	-	-	Non-liquefiable
	2.00	CL	80	7	41.20	20.00	21.20	0.98	0.299	1.70	11.90	5.00	1.20	19.28	0.21	1.00	-	-	Non-liquefiable
	3.00	ML	62	10	61.80	30.00	31.80	0.98	0.296	1.70	17.00	5.00	1.20	25.40	0.30	1.00	0.358	1.208	Non-liquefiable
	4.00	SM	31	10	82.40	40.00	42.40	0.97	0.294	1.54	15.36	4.77	1.16	22.62	0.25	1.00	0.300	1.019	Non-liquefiable
	5.00	SM	30	21	103.00	50.00	53.00	0.96	0.292	1.37	28.85	4.71	1.15	38.00	0.52	1.00	0.620	2.127	Non-liquefiable
	6.00	SM	30	18	123.60	60.00	63.60	0.95	0.289	1.25	22.57	4.71	1.15	30.76	0.52	1.00	0.620	2.144	Non-liquefiable
	8.00	SM	32	29	164.80	80.00	84.80	0.94	0.285	1.09	31.49	4.83	1.17	41.71	0.52	1.00	0.620	2.179	Non-liquefiable
	9.00	SM	33	30	185.40	90.00	95.40	0.93	0.282	1.02	30.71	4.88	1.18	41.11	0.52	1.00	0.620	2.197	Non-liquefiable
	11.00	CL	84	24	226.60	110.00	116.60	0.88	0.267	0.93	22.23	5.00	1.20	31.67	0.52	1.00	-	-	Non-liquefiable
	12.00	CL	84	22	247.20	120.00	127.20	0.85	0.259	0.89	19.51	5.00	1.20	28.41	0.38	1.00	-	-	Non-liquefiable
	14.50	CL	85	32	303.05	145.00	158.05	0.79	0.235	0.80	25.45	5.00	1.20	35.54	0.52	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 Earthquake Zone= IV amax/g=0.24 K(alpha)= 1.00 MSF= 1.193 Critical Water Table (m)=0.00 m

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	17.50	CL	87	25	365.75	175.00	190.75	0.71	0.211	0.72	18.10	5.00	1.20	26.72	0.33	0.80	-	-	Non-liquefiable
	20.50	CL	68	62	428.45	205.00	223.45	0.63	0.187	0.67	41.48	5.00	1.20	54.77	0.52	0.74	-	-	Non-liquefiable
	23.50	CL	82	61	425.35	235.00	190.35	0.56	0.195	0.72	44.21	5.00	1.20	58.06	0.52	0.91	-	-	Non-liquefiable
	26.50	CL	83	45	559.15	265.00	294.15	0.56	0.166	0.58	26.24	5.00	1.20	36.49	0.52	0.93	-	-	Non-liquefiable
	28.00	MI	96	45	557.20	280.00	277.20	0.56	0.176	0.60	27.03	5.00	1.20	37.43	0.52	0.91	-	-	Non-liquefiable
	29.50	MI	96	37	587.05	295.00	292.05	0.56	0.176	0.59	21.65	5.00	1.20	30.98	0.52	0.91	-	-	Non-liquefiable
	31.00	CL-ML	62	37	647.90	310.00	337.90	0.56	0.167	0.54	20.13	5.00	1.20	29.15	0.42	0.70	-	-	Non-liquefiable
	32.50	MI	96	41	679.25	325.00	354.25	0.56	0.167	0.53	21.78	5.00	1.20	31.14	0.52	0.69	-	-	Non-liquefiable
	35.50	CL-ML	64	45	741.95	355.00	386.95	0.56	0.167	0.51	22.88	5.00	1.20	32.45	0.52	0.67	-	-	Non-liquefiable
	37.00	ML	52	45	773.30	370.00	403.30	0.56	0.167	0.50	22.41	5.00	1.20	31.89	0.52	0.66	0.409	2.444	Non-liquefiable
	38.50	ML	52	59	804.65	385.00	419.65	0.56	0.167	0.49	28.80	5.00	1.20	39.56	0.52	0.65	0.403	2.407	Non-liquefiable
	40.00	ML	52	70	836.00	400.00	436.00	0.56	0.167	0.48	33.52	5.00	1.20	45.23	0.52	0.64	0.397	2.370	Non-liquefiable
P12	0.50	ML	54	4	9.65	5.00	4.65	1.00	0.323	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.525	Liquefiable
P12	1.00	CL-ML	58	4	19.30	10.00	9.30	0.99	0.321	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
P12	2.00	MI	90	4	38.60	20.00	18.60	0.98	0.319	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
P12	3.00	CL	71	5	57.90	30.00	27.90	0.98	0.316	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
P12	4.00	CL	71	7	77.20	40.00	37.20	0.97	0.314	1.64	11.48	5.00	1.20	18.77	0.20	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 | Earthquake Zone= IV | a_{max}/g=0.24 | K(alpha)= 1.00 | MSF= 1.193 | Critical Water Table (m)=0.00 m

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	5.00	MI	96	7	96.50	50.00	46.50	0.96	0.311	1.47	10.27	5.00	1.20	17.32	0.18	1.00	-	-	Non-liquefiable
	6.00	ML	69	15	115.80	60.00	55.80	0.95	0.309	1.34	20.08	5.00	1.20	29.10	0.41	1.00	0.495	1.602	Non-liquefiable
	7.00	ML	69	18	135.10	70.00	65.10	0.95	0.306	1.24	22.31	5.00	1.20	31.77	0.52	1.00	0.620	2.024	Non-liquefiable
	8.00	SM	29	18	154.40	80.00	74.40	0.94	0.304	1.16	20.87	4.64	1.15	28.56	0.39	1.00	0.466	1.533	Non-liquefiable
	9.00	SM	29	19	172.80	90.00	82.80	0.93	0.303	1.10	20.88	4.64	1.15	28.57	0.39	1.00	0.467	1.539	Non-liquefiable
	10.00	SM	29	21	192.00	100.00	92.00	0.91	0.295	1.04	21.89	4.64	1.15	29.73	0.45	1.00	0.537	1.817	Non-liquefiable
	11.00	CL-ML	77	21	211.20	110.00	101.20	0.88	0.287	0.99	20.88	5.00	1.20	30.05	0.47	1.00	-	-	Non-liquefiable
	12.50	CL	85	19	253.75	125.00	128.75	0.84	0.258	0.88	16.74	5.00	1.20	25.09	0.29	1.00	-	-	Non-liquefiable
	15.50	CL	83	22	314.65	155.00	159.65	0.76	0.234	0.79	17.41	5.00	1.20	25.89	0.31	0.87	-	-	Non-liquefiable
	18.50	CL	66	32	375.55	185.00	190.55	0.68	0.209	0.72	23.18	5.00	1.20	32.82	0.52	0.82	-	-	Non-liquefiable
	21.50	CL	72	41	408.50	215.00	193.50	0.60	0.198	0.72	29.47	5.00	1.20	40.37	0.52	0.83	-	-	Non-liquefiable
	24.50	CL	73	44	504.70	245.00	259.70	0.56	0.170	0.62	27.30	5.00	1.20	37.76	0.52	0.71	-	-	Non-liquefiable
	27.50	CL	80	49	561.00	275.00	286.00	0.56	0.171	0.59	28.97	5.00	1.20	39.77	0.52	0.69	-	-	Non-liquefiable
	29.00	SM	44	60	597.40	290.00	307.40	0.56	0.170	0.57	34.22	5.00	1.20	46.07	0.52	0.67	0.416	2.448	Non-liquefiable
	30.50	SM	44	66	628.30	305.00	323.30	0.56	0.170	0.56	36.71	5.00	1.20	49.05	0.52	0.66	0.409	2.412	Non-liquefiable
	32.00	SM	36	79	659.20	320.00	339.20	0.56	0.170	0.54	42.89	5.00	1.20	56.47	0.52	0.64	0.397	2.338	Non-liquefiable
	33.50	SM	38	74	690.10	335.00	355.10	0.56	0.170	0.53	39.27	5.00	1.20	52.12	0.52	0.63	0.391	2.302	Non-liquefiable
	36.50	SM	37	77	751.90	365.00	386.90	0.56	0.170	0.51	39.15	5.00	1.20	51.98	0.52	0.61	0.378	2.229	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	40.00	SM	40	85	804.00	400.00	404.00	0.56	0.174	0.50	42.29	5.00	1.20	55.75	0.52	0.65	0.403	2.319	Non-liquefiable
P13	0.50	SM	44	4	9.85	5.00	4.85	1.00	0.316	1.700	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.54	Liquefiable
	1.00	CL	76	4	19.70	10.00	9.70	0.99	0.314	1.700	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
	2.00	SM	43	4	39.40	20.00	19.40	0.98	0.312	1.700	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.54	Liquefiable
	3.00	CL	74	5	59.10	30.00	29.10	0.98	0.310	1.700	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
	4.00	ML	53	5	78.80	40.00	38.80	0.97	0.307	1.605	8.03	5.00	1.20	14.63	0.16	1.00	0.187	0.61	Liquefiable
	5.00	ML	53	4	98.30	50.00	48.30	0.96	0.305	1.439	5.76	5.00	1.20	11.91	0.13	1.00	0.155	0.51	Liquefiable
	6.00	CL-ML	81	6	117.80	60.00	57.80	0.95	0.303	1.315	7.89	5.00	1.20	14.47	0.15	1.00	-	-	Non-liquefiable
	7.00	ML	65	6	137.30	70.00	67.30	0.95	0.301	1.219	7.31	5.00	1.20	13.78	0.15	1.00	0.177	0.59	Liquefiable
	8.00	SM	47	8	156.40	80.00	76.40	0.94	0.300	1.144	9.15	5.00	1.20	15.98	0.17	1.00	0.203	0.68	Liquefiable
	9.00	SM	47	12	175.50	90.00	85.50	0.93	0.298	1.081	12.98	5.00	1.20	20.57	0.22	1.00	0.266	0.89	Liquefiable
	10.00	CL	84	12	194.60	100.00	94.60	0.91	0.291	1.028	12.34	5.00	1.20	19.81	0.21	1.00	-	-	Non-liquefiable
	11.00	CL	84	31	215.00	110.00	105.00	0.88	0.281	0.976	30.25	5.00	1.20	41.30	0.52	1.00	-	-	Non-liquefiable
	12.00	CL	84	34	235.40	120.00	115.40	0.85	0.272	0.931	31.65	5.00	1.20	42.98	0.52	1.00	-	-	Non-liquefiable
	13.00	SM	39	34	255.80	130.00	125.80	0.83	0.262	0.892	30.31	5.00	1.20	41.38	0.52	1.00	0.620	2.36	Non-liquefiable
	14.50	SM	39	36	285.05	145.00	140.05	0.79	0.250	0.845	30.42	5.00	1.20	41.50	0.52	1.00	0.620	2.48	Non-liquefiable
	16.00	CL	89	36	314.30	160.00	154.30	0.75	0.237	0.805	28.98	5.00	1.20	39.78	0.52	0.84	-	-	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	17.50	CL	89	29	345.05	175.00	170.05	0.71	0.224	0.767	22.24	5.00	1.20	31.69	0.52	0.81	-	-	Non-liquefiable
	20.50	CL	73	42	406.55	205.00	201.55	0.63	0.197	0.704	29.58	5.00	1.20	40.50	0.52	0.77	-	-	Non-liquefiable
	23.50	CL	77	59	469.55	235.00	234.55	0.56	0.175	0.653	38.52	5.00	1.20	51.23	0.52	0.73	-	-	Non-liquefiable
	25.00	CL	77	62	501.05	250.00	251.05	0.56	0.174	0.631	39.13	5.00	1.20	51.96	0.52	0.71	-	-	Non-liquefiable
	26.50	CL	77	75	532.55	265.00	267.55	0.56	0.174	0.611	45.85	5.00	1.20	60.02	0.52	0.69	-	-	Non-liquefiable
	28.00	CL	71	71	564.05	280.00	284.05	0.56	0.173	0.593	42.13	5.00	1.20	55.55	0.52	0.68	-	-	Non-liquefiable
	29.50	CL	71	59	595.55	295.00	300.55	0.56	0.173	0.577	34.03	5.00	1.20	45.84	0.52	0.66	-	-	Non-liquefiable
	31.00	CL	77	55	627.05	310.00	317.05	0.56	0.173	0.562	30.89	5.00	1.20	42.07	0.52	0.65	-	-	Non-liquefiable
	32.50	SM	39	58	658.55	325.00	333.55	0.56	0.172	0.548	31.76	5.00	1.20	43.11	0.52	0.64	0.394	2.29	Non-liquefiable
	35.50	SM	39	53	721.55	355.00	366.55	0.56	0.172	0.522	27.68	5.00	1.20	38.22	0.52	0.60	0.371	2.16	Non-liquefiable
	38.50	SM	43	57	784.55	385.00	399.55	0.56	0.172	0.500	28.52	5.00	1.20	39.22	0.52	0.58	0.359	2.09	Non-liquefiable
	40.00	SM	43	59	816.05	400.00	416.05	0.56	0.171	0.490	28.93	5.00	1.20	39.71	0.52	0.57	0.353	2.06	Non-liquefiable
P17	0.50	CL-ML	51	3	9.90	5.00	4.90	1.00	0.314	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
P17	1.00	CL-ML	51	3	19.80	10.00	9.80	0.99	0.313	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
P17	2.00	SM-SC	49	3	39.60	20.00	19.60	0.98	0.310	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.473	Liquefiable
P17	3.00	SM	42	4	59.40	30.00	29.40	0.98	0.308	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.550	Liquefiable
P17	4.00	SM	42	6	79.20	40.00	39.20	0.97	0.306	1.60	9.58	5.00	1.20	16.50	0.18	1.00	0.209	0.685	Liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	6.00	SM	25	9	118.80	60.00	58.80	0.95	0.301	1.30	11.74	4.29	1.12	17.38	0.18	1.00	0.221	0.733	Liquefiable
	7.00	SM	25	10	135.80	70.00	65.80	0.95	0.305	1.23	12.33	4.29	1.12	18.03	0.19	1.00	0.229	0.752	Liquefiable
	8.00	SP-ML	9	10	155.20	80.00	75.20	0.94	0.302	1.15	11.53	0.56	1.02	12.28	0.13	1.00	0.160	0.528	Liquefiable
	9.00	SP-ML	9	25	178.20	90.00	88.20	0.93	0.293	1.06	26.62	0.56	1.02	27.63	0.36	1.00	0.426	1.451	Non-liquefiable
	10.00	SM	26	34	198.00	100.00	98.00	0.91	0.286	1.01	34.35	4.39	1.12	42.94	0.52	1.00	0.620	2.170	Non-liquefiable
	12.50	CL	86	27	247.50	125.00	122.50	0.84	0.265	0.90	24.39	5.00	1.20	34.27	0.52	1.00	-	-	Non-liquefiable
	14.00	CL-ML	69	27	259.00	140.00	119.00	0.80	0.272	0.92	24.75	5.00	1.20	34.70	0.52	1.00	-	-	Non-liquefiable
	15.50	CL	88	30	294.50	155.00	139.50	0.76	0.250	0.85	25.40	5.00	1.20	35.48	0.52	0.91	-	-	Non-liquefiable
	18.50	CI	82	38	351.50	185.00	166.50	0.68	0.224	0.77	29.45	5.00	1.20	40.34	0.52	0.88	-	-	Non-liquefiable
	21.50	CI	88	65	434.30	215.00	219.30	0.60	0.185	0.68	43.89	5.00	1.20	57.67	0.52	0.80	-	-	Non-liquefiable
	23.00	CL	85	65	439.30	230.00	209.30	0.56	0.183	0.69	44.93	5.00	1.20	58.92	0.52	0.83	-	-	Non-liquefiable
	24.50	CL	85	70	497.35	245.00	252.35	0.56	0.172	0.63	44.07	5.00	1.20	57.88	0.52	0.70	-	-	Non-liquefiable
	26.00	CL	89	52	527.80	260.00	267.80	0.56	0.172	0.61	31.78	5.00	1.20	43.13	0.52	0.68	-	-	Non-liquefiable
	27.50	CL	88	41	558.25	275.00	283.25	0.56	0.172	0.59	24.36	5.00	1.20	34.23	0.52	0.67	-	-	Non-liquefiable
	30.50	SM	42	56	619.15	305.00	314.15	0.56	0.172	0.56	31.60	5.00	1.20	42.91	0.52	0.64	0.397	2.306	Non-liquefiable
	32.00	SM	42	65	652.80	320.00	332.80	0.56	0.171	0.55	35.63	5.00	1.20	47.76	0.52	0.60	0.372	2.172	Non-liquefiable
	33.50	ML	51	61	683.40	335.00	348.40	0.56	0.171	0.54	32.68	5.00	1.20	44.22	0.52	0.58	0.360	2.100	Non-liquefiable
	35.00	ML	51	68	714.00	350.00	364.00	0.56	0.171	0.52	35.64	5.00	1.20	47.77	0.52	0.57	0.354	2.063	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	36.50	SM	46	83	744.60	365.00	379.60	0.56	0.171	0.51	42.60	5.00	1.20	56.12	0.52	0.56	0.347	2.027	Non-liquefiable
	38.00	CL	80	55	775.20	380.00	395.20	0.56	0.171	0.50	27.67	5.00	1.20	38.20	0.52	0.55	-	-	Non-liquefiable
	40.00	CL	77	63	816.00	400.00	416.00	0.56	0.171	0.49	30.89	5.00	1.20	42.07	0.52	0.54	-	-	Non-liquefiable
P18	0.50	SM	43	9	9.55	5.00	4.55	1.00	0.326	1.70	15.30	5.00	1.20	23.36	0.26	1.00	0.313	0.961	Liquefiable
	2.00	SM-SC	36	9	38.20	20.00	18.20	0.98	0.322	1.70	15.30	5.00	1.20	23.36	0.26	1.00	0.313	0.972	Liquefiable
	3.00	SM	32	10	57.30	30.00	27.30	0.98	0.320	1.70	17.00	4.83	1.17	24.74	0.29	1.00	0.342	1.069	Non-liquefiable
	5.00	SM	30	15	95.50	50.00	45.50	0.96	0.315	1.48	22.24	4.71	1.15	30.38	0.50	1.00	0.592	1.880	Non-liquefiable
	6.00	SM	30	19	119.40	60.00	59.40	0.95	0.299	1.30	24.65	4.71	1.15	33.16	0.52	1.00	0.620	2.073	Non-liquefiable
	8.00	SM	33	17	159.20	80.00	79.20	0.94	0.294	1.12	19.10	4.88	1.18	27.41	0.35	1.00	0.418	1.420	Non-liquefiable
	9.00	SM	33	21	179.10	90.00	89.10	0.93	0.292	1.06	22.25	4.88	1.18	31.12	0.52	1.00	0.620	2.124	Non-liquefiable
	11.00	SM	28	24	218.90	110.00	108.90	0.88	0.276	0.96	23.00	4.56	1.14	30.74	0.52	1.00	0.620	2.247	Non-liquefiable
	12.00	SM	34	28	214.80	120.00	94.80	0.85	0.302	1.03	28.76	4.93	1.19	39.10	0.52	1.00	0.620	2.056	Non-liquefiable
	14.50	SM	42	17	259.55	145.00	114.55	0.79	0.278	0.93	15.88	5.00	1.20	24.06	0.27	1.00	0.327	1.177	Non-liquefiable
	17.50	CL	92	20	344.75	175.00	169.75	0.71	0.224	0.77	15.35	5.00	1.20	23.42	0.26	0.86	-	-	Non-liquefiable
	20.50	CL	88	33	410.00	205.00	205.00	0.63	0.196	0.70	23.05	5.00	1.20	32.66	0.52	0.78	-	-	Non-liquefiable
	23.50	CL	85	36	484.10	235.00	249.10	0.56	0.170	0.63	22.81	5.00	1.20	32.37	0.52	0.77	-	-	Non-liquefiable
	26.50	MI	87	34	527.35	265.00	262.35	0.56	0.176	0.62	20.99	5.00	1.20	30.19	0.48	0.79	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	28.00	CL-CI	80	34	582.40	280.00	302.40	0.56	0.168	0.58	19.55	5.00	1.20	28.46	0.39	0.74	-	-	Non-liquefiable
	29.50	SM	41	83	616.55	295.00	321.55	0.56	0.167	0.56	46.29	5.00	1.20	60.54	0.52	0.73	0.453	2.703	Non-liquefiable
	31.00	SM	41	100	647.90	310.00	337.90	0.56	0.167	0.54	54.40	5.00	1.20	70.28	0.52	0.72	0.447	2.666	Non-liquefiable
	32.50	SM-SC	43	77	679.25	325.00	354.25	0.56	0.167	0.53	40.91	5.00	1.20	54.09	0.52	0.71	0.440	2.629	Non-liquefiable
	34.00	CL-ML	80	86	710.60	340.00	370.60	0.56	0.167	0.52	44.67	5.00	1.20	58.61	0.52	0.70	-	-	Non-liquefiable
	35.50	CL-ML	80	66	741.95	355.00	386.95	0.56	0.167	0.51	33.55	5.00	1.20	45.26	0.52	0.69	-	-	Non-liquefiable
	37.00	CL	69	68	773.30	370.00	403.30	0.56	0.167	0.50	33.86	5.00	1.20	45.63	0.52	0.68	-	-	Non-liquefiable
	38.50	CL	69	67	804.65	385.00	419.65	0.56	0.167	0.49	32.71	5.00	1.20	44.25	0.52	0.67	-	-	Non-liquefiable
	40.00	CL	85	74	836.00	400.00	436.00	0.56	0.167	0.48	35.44	5.00	1.20	47.53	0.52	0.66	-	-	Non-liquefiable

APPENDIX-I
SITE PHOTOGRAPHS


SPT at depth 24.50 m

SPT sample at depth 36.50 m

SPT sample at depth 11.00 m

UDS at depth 25.00 m

APPENDIX-I
SITE PHOTOGRAPHS

SPT sample at depth 12.50 m


SPT at depth 27.50 m

SPT sample at depth 17.50 m


SPT at depth 31.00 m

APPENDIX-I
SITE PHOTOGRAPHS

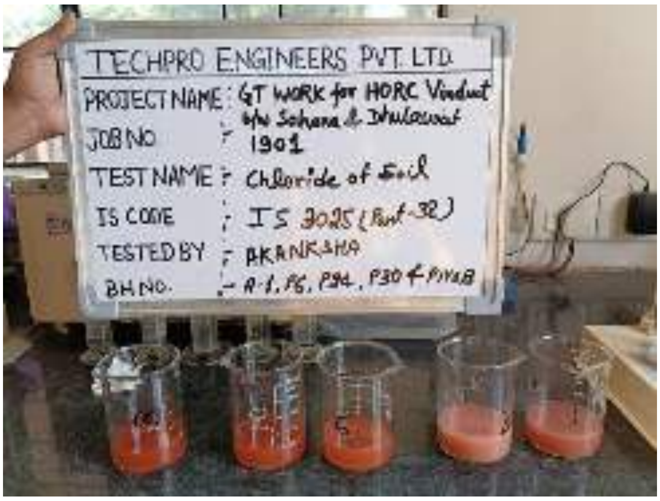
 SPT at depth 10.00 m	 SPT sample at depth 12.50 m
 SPT at depth 9.00 m	 SPT sample at depth 29.50 m

APPENDIX-J
LABORATORY PHOTOGRAPHS

Water content test

Atterbergs' limit test

UCS of soil



Chemical test of soil

APPENDIX-J
LABORATORY PHOTOGRAPHS

Atterbergs' limit test


Triaxial test

Direct shear test

APPENDIX-K
CHART 1: FIELD BORE LOG CHARTS (A1)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GT Work For HORC Viaduct b/w Sohana & Dhulawat station			Project Code:	1901
Coordinate:	N: 3118903.449	E: 702633.931		Location/ Chainage:	20915.8870
Method of Drilling:	Percussion	Drilling Equipment:	Power winch	Bore No.:	A1
Casing Lowered (M):	24 M, Bentonite Used: No	Standard Sampler:	yes	Barrel Type:	NA
Ground Elevation:	RL - 191.636	Date: From	20-9-23 to 23-9-23	Water Table (M):	0.50 M

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
20/9/23	0.0	0.50	0.50	D	SX	Collected				–	–	–	–	–	–	Cohesive Soil
"	1.00	1.45	0.45	DP	–	1	1	3	4	–	–	–	–	–	–	"
"	2.00	2.45	0.45	U	–	Slipped				–	–	–	–	–	–	Cohesive Soil ~~DS Collected~~
"	3.00	3.45	0.45	DP	–	2	3	3	6	–	–	–	–	–		Low Brownish Cohesive Soil
"	4.00	4.45	0.45	DP	–	3	5	6	11	–	–	–	–	–		Non cohesive Soil
"	5.00	5.45	0.45	U	–	Received				–	–	–	–	–		"
21/9/23	6.00	6.45	0.45	DP	–	5	6	6	12	–	–	–	–	–	–	"
"	7.00	7.45	0.45	DP	–	4	6	7	13	–	–	–	–	–	–	"
"	8.00	8.45	0.45	U	–	Received				–	–	–	–	–	–	"
"	9.00	9.45	0.45	DP	–	5	6	8	14	–	–	–	–	–	–	"
"	10.00	10.45	0.45	DP	–	4	5	5	10	–	–	–	–	–	–	Cohesive Soil with Gravel
"	11.00	11.45	0.45	U	–	Received				–	–	–	–	–		"
"	12.50	12.95	0.45	DP	–	6	10	11	21	–	–	–	–	–	–	"
"	14.00	14.45	0.45	U	–	Received				–	–	–	–	–	–	"
"	15.50	15.95	0.45	DP	–	4	7	12	19	–	–	–	–	–	–	"
"	17.00	17.45	0.45	U	–	Received				–	–	–	–	–	–	"
"	18.50	18.95	0.45	DP	–	8	15	20	35	–	–	–	–	–	–	"
22/9/23	20.00	20.45	0.45	U	–	Received				–	–	–	–	–	–	"
"	21.50	21.95	0.45	DP	–	8	17	22	39	–	–	–	–	–	–	"
"	23.00	23.45	0.45	U	–	Slipped				–	–	–	–	–	–	" DS Collected
"	24.50	24.95	0.45	DP	–	11	13	17	30	–	–	–	–	–	–	"
"	26.00	26.45	0.45	U	–	Received				–	–	–	–	–	–	"
"	27.50	27.95	0.45	DP	–	10	14	18	32	–	–	–	–	–	–	"
"	29.00	29.45	0.45	U	–	Received				–	–	–	–	–	–	"

C P Kashyap
Supervisor

E-in-C
SE

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

Techpro Engg. Pvt. Ltd. Kanpur

APPENDIX-K
CHART 2: FIELD BORE LOG CHARTS (A1)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date.:	28.12.2021

Project Name: GT Work For HORC Viaduct b/w Sohana & Dhulawat station
Project Code: 1901
Coordinate: N: 3118903.449 E: 702633.931
Location/ Chainage: 20915.8870
Method of Drilling: Percussion
Drilling Equipment: Power winch
Bore No.: A1
Casing Lowered (M): 24 M
Bentonite Used: NO
Standard Sampler: yes
Barrel Type: NA
Ground Elevation: RL-191.636
Date: From 20-9-23 **to** 23-9-23
Water Table (M): 0.50M

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
22/9/23	30.50	30.95	0.45	DP	SX	11	15	20	35	—	—	—	—	—	—	Cohesive Soil with Gravel
"	32.00	32.28	0.28	DP	—	35	65	-	R	—	—	—	—	—	—	Non Cohesive
"	33.50	33.95	0.45	DP	—	15	35	45	80	—	—	—	—	—	—	"
"	35.00	35.45	0.45	DP	—	10	37	42	79	—	—	—	—	—	—	Cohesive Soil with Gravel
23/9/23	36.50	36.95	0.45	DP	—	8	17	27	44	—	—	—	—	—	—	"
"	38.00	38.45	0.45	U	—	Slipped				—	—	—	—	—	—	" / DS Collected
"	40.00	40.45	0.45	DP	—	9	18	30	48	—	—	—	—	—	—	"

C.P. Kashyap
Supervisor

Techpro Engineers Kanpur

E-in-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 3: FIELD BORE LOG CHARTS (P6)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev No.:	R03
		Rev Date.:	28.12.2021

Project Name:	GIT for HORC viaduct between Sohana & Dhulawat stations			Project Code:	1901
Coordinate:	N: 3118922.47	E: 702477.831		Location/ Chainage:	21073.0870
Method of Drilling:	Percussion	Drilling Equipment	Power winch	Bore No.:	P6
Casing Lowered (M):	18.00	Bentonite Used: Yes	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	RL-192.181	Date: From 21/9/23 to 23/9/23		Water Table (M):	1.20M

Day / Date	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
21/9/23	0.0	0.50	0.50	DS	SX	Received				—						Yellwoish NON
"	1.00	1.45	0.45	U	"	Received				—						cohessive soil
"	2.00	2.45	0.45	DP	"	2	3	4	7							Brownish NON cohesive
"	3.00	3.45	0.45	DP	"	2	4	6	10							Soil
"	4.00	4.45	0.45	U	"	Slipped										"
"	5.00	5.45	0.45	DP	"	4	9	12	21							"
"	6.00	6.45	0.45	DP	"	5	7	11	18							"
"	7.00	7.45	0.45	U	"	Slipped			-							"
"	8.00	8.45	0.45	DP	"	7	12	17	29							"
"	9.00	9.45	0.45	DP	"	9	12	18	30							"
"	10.00	10.45	0.45	U	"	Slipped			-							"
"	11.00	11.45	0.45	DP	"	8	10	14	24							Yellwoish soil - -
"	12.00	12.45	0.45	DP	"	6	10	12	22							cohessive soil with
"	13.00	13.45	0.45	U	"	Received			-							Gravel soil
"	14.50	14.95	0.45	DP	"	7	14	18	32							"
22/9/23	16.00	16.45	0.45	U	"	Slipped			-							"
"	17.50	17.95	0.45	DP	"	6	10	15	25							"
"	19.00	19.45	0.45	U	"	Slipped			-							"
"	20.50	20.95	0.45	DP	"	8	22	40	62							"
"	22.00	22.45	0.45	U	"	Received			-							"
"	23.50	23.95	0.45	DP	"	9	23	38	61							"
"	25.00	25.45	0.45	U	"	Received			-							"
"	26.50	26.95	0.45	DP	"	10	19	26	45							"
"	28.00	28.45	0.45	U	"	Received			-							"

Supervisor

E - in - C

SE

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 4: FIELD BORE LOG CHARTS (P6)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No:	R03
		Rev. Date:	28.12.2021

Project Name:	G/T for HORC viaduct between Sohana & Dhulawat stations			Project Code:	1901
Coordinate:	N: 3118922.47	E: 702477.831	Location/ Chainage: 21073.0870		
Method of Drilling:	Percussion	Drilling Equipment:	Powerwinch	Bore No.:	P6
Casing Lowered (M):	18.00	Bentonite Used: Yes	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	RL- 192.18	Date: From 21/9/23	to 23/9/23	Water Table (M):	1.20

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
28/9/23	29.50	29.95	0.45	DP	SX	10	17	20	37							Cohessive soil
"	31.00	31.45	0.45	U	"	Received			–							"
"	32.50	32.95	0.45	DP	"	11	19	22	41							"
"	34.00	34.45	0.45	U	"	Slipped			–							Non cohessive soil
"	35.50	35.95	0.45	DP	"	16	19	26	45							"
"	37.00	37.45	0.45	U	"	Slipped			–							"
"	38.50	38.95	0.45	DP	"	19	26	33	59							"
"	40.00	40.45	0.45	DP	"	22	30	40	70							"

Supervisor

E - in - C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 5: FIELD BORE LOG CHARTS (P12)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No	GT/ 003
Date of Issue:	01.04.2018
Rev. No	R03
Rev. Date	28.12.2021

Project Name:	GT work for HORC viaduct B/w Sohana & Dhulawat [illegible]			Project Code:	1901
Coordinate:	N: 3118341.487	E: 702321.763		Location/ Chainage:	21930-2870
Method of Drilling:	Percussion	Drilling Equipment:	Automatic [illegible]	Bore No.:	P-12
Casing Lowered (M):	21 m	Bentonite Used:	No	Standard Sampler: Yes	Barrel Type: N/A
Ground Elevation:	RL-191.931	Date: From	[illegible] to [illegible]	Water Table (M):	150 m

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
[illegible]	0.0	0.50	0.50	D	SX	Collect				—	—	—	—	—	—	Non cohesive soil
''	1.00	1.45	0.45	DP	—	1	2	2	4	—	—	—	—	—	—	— do —
''	2.00	2.45	0.45	U	—	Received				—	—	—	—	—	—	Non cohesive soil with kankar
''	3.00	3.45	0.45	DP	—	2	2	3	5	—	—	—	—	—	—	Non cohesive soil
''	4.00	4.45	0.45	DP	—	2	3	4	7	—	—	—	—	—	—	— do —
''	5.00	5.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do — DS collect
''	6.00	6.45	0.45	DP	—	4	7	8	15	—	—	—	—	—	—	Non cohesive soil
''	7.00	7.45	0.45	DP	—	3	8	10	18	—	—	—	—	—	—	— do —
[illegible]	8.00	8.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do — DS collect
''	9.00	9.45	0.45	DP	—	4	8	11	19	—	—	—	—	—	—	Non cohesive soil
''	10.00	10.45	0.45	DP	—	5	9	12	21	—	—	—	—	—	—	— do —
''	11.00	11.45	0.45	U	—	Received				—	—	—	—	—	—	cohesive soil
''	12.50	12.95	0.45	DP	—	4	8	11	19	—	—	—	—	—	—	— do —
''	14.00	14.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
''	15.50	15.95	0.45	DP	—	6	10	12	22	—	—	—	—	—	—	— do —
''	17.00	17.45	0.45	U	—	Received				—	—	—	—	—	—	cohesive soil with kankars
''	18.50	18.95	0.45	DP	—	7	13	19	32	—	—	—	—	—	—	— do —
''	20.00	20.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
''	21.50	21.95	0.45	DP	—	9	17	24	41	—	—	—	—	—	—	— do —
''	23.00	23.45	0.45	U	—	Received				—	—	—	—	—	—	cohesive soil
''	24.50	24.95	0.45	DP	—	8	19	25	44	—	—	—	—	—	—	— do —
''	26.00	26.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
''	27.50	27.95	0.45	DP	—	11	23	26	49	—	—	—	—	—	—	— do —
[illegible]	29.00	29.45	0.45	DP	—	17	28	33	61	—	—	—	—	—	—	Non cohesive soil

Supervisor

E-In-C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 6: FIELD BORE LOG CHARTS (P12)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	Civil work for HORC viaduct B/w Sohana & Dhulawat station			Project Code:	1901
Coordinate:	N: 3118941.484	E: 702321.763		Location/ Chainage:	21230 - 22370
Method of Drilling:	Percussion	Drilling Equipment:	Auto Trip/ Bowlerinch	Bore No.:	P-12
Casing Lowered (M):	21 m	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L - 191.831	Date: From 15/10/2023 to 18/10/2023		Water Table (M):	160.m

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C.R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
17/10/23	30.50	30.95	0.45	DP	SX	18	30	36	66	—	—	—	—	—	-	Non cohesive soil
"	32.00	32.45	0.45	DP	—	19	35	44	79	—	—	—	—	—	—	— do —
"	33.50	33.95	0.45	DP	—	17	33	41	64	—	—	—	—	—	—	— do —
"	35.00	35.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do — TOS collect
"	36.50	36.95	0.45	DP	—	19	34	43	77	—	—	—	—	—	—	Non cohesive soil
18/10/23	38.00	38.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do — TOS collected
"	40.00	40.45	0.45	DP	—	21	37	48	85	—	—	—	—	—	—	Non cohesive soil

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 7: FIELD BORE LOG CHARTS (P13)

TECHPRO ENGINEERS PVT. LTD. — BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date:	28.12.2021

Project Name: GT work for HORC viaduct b/w Sohna & Dhulawat station — Project Code: 1901

Coordinate: N: 3118944.656 — E: 702295.755 — Location/ Chainage: 21256.4870

Method of Drilling: Percussion — Drilling Equipment: Power winch — Bore No.: P-13

Casing Lowered (M): 22.00 — Bentonite Used: NO — Standard Sampler: Yes — Barrel Type: N/A

Ground Elevation: R.L-191.69 — Date: From 19/10/2023 to 22/10/2023 — Water Table (M): 1.50 m

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
19/10/23	0.00	0.50	0.50	D	SX	Collect				—	—	—	—	—	—	Non cohesive soil
"	1.00	1.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	2.00	2.45	0.45	DP	—	1	2	2	4	—	—	—	—	—	—	— do —
"	3.00	3.45	0.45	DP	—	2	2	3	5	—	—	—	—	—	—	Non cohesive soil with gravels
"	4.00	4.45	0.45	U	—	Received				—	—	—	—	—	—	Non cohesive soil
"	5.00	5.45	0.45	DP	—	1	2	2	4	—	—	—	—	—	—	— do —
"	6.00	6.45	0.45	DP	—	2	3	3	6	—	—	—	—	—	—	— do —
"	7.00	7.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do — DS collect
"	8.00	8.45	0.45	DP	—	2	3	5	8	—	—	—	—	—	—	Non cohesive soil
20/10/23	9.00	9.45	0.45	DP	—	4	5	7	12	—	—	—	—	—	—	— do —
"	10.00	10.45	0.45	U	—	Received				—	—	—	—	—	—	Cohesive soil
"	11.00	11.45	0.45	DP	—	9	14	17	31	—	—	—	—	—	—	— do —
"	12.00	12.45	0.45	DP	—	8	15	19	34	—	—	—	—	—	—	— do —
"	13.00	13.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	14.50	14.95	0.45	DP	—	9	16	20	36	—	—	—	—	—	—	Non cohesive soil
"	16.00	16.45	0.45	U	—	Received				—	—	—	—	—	—	cohesive soil with gravels
"	17.50	17.95	0.45	DP	—	8	13	16	29	—	—	—	—	—	—	— do —
"	19.00	19.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	20.50	20.95	0.45	DP	—	11	20	22	42	—	—	—	—	—	—	cohesive soil
21/10/23	22.00	22.45	0.45	U	—	Slipped				—	—	—	—	—	—	Cohesive soil with gravels
"	23.50	23.95	0.45	DP	—	13	26	33	59	—	—	—	—	—	—	— do —
"	25.00	25.45	0.45	DP	—	15	27	35	62	—	—	—	—	—	—	cohesive soil with gravels
"	26.50	26.95	0.45	DP	—	17	34	41	75	—	—	—	—	—	—	— do —
"	28.00	28.45	0.45	DP	—	14	32	39	71	—	—	—	—	—	—	— do —

Supervisor — E-in-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 8: FIELD BORE LOG CHARTS (P13)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name: Wrt work for HORC viaduct B/w Sohna & Dhullawat station				Project Code:	1901
Coordinate:	N: 3118944.656	E: 702295.755		Location/ Chainage:	21256.4870
Method of Drilling:	Percussion	Drilling Equipment:	Power winch	Bore No.:	P-13
Casing Lowered (M):	22.m	Bentonite Used: NO	Standard Sampler: YES	Barrel Type :	N/A
Ground Elevation:	R-L-191.69	Date: From 9/10/2023 to 22/10/2023		Water Table (M):	1.50, m

Day	Depth/RUN (m)		Length(m)	Nature of sample	Hole Size	SPT Record				Run Time		CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
	From	To				0-15cm	15-30cm	30-45cm	N Value	Start	End					
22/10/23	27.50	27.95	0.45	DP	SX	11	28	31	59	—	—	—	—	—	—	cohesive soil with gravels
"	31.00	31.45	0.45	DP	—	10	25	30	55	—	—	—	—	—	—	— do —
"	32.50	32.95	0.45	DP	—	10	27	31	58	—	—	—	—	—	—	Non cohesive soil
"	34.00	34.45	0.45	U	—	slipped				—	—	—	—	—	—	Non cohesive soil / DS
"	35.50	35.95	0.45	DP	—	8	29	29	53	—	—	—	—	—	—	Non cohesive soil
"	37.00	37.45	0.45	U	—	slipped				—	—	—	—	—	—	Non cohesive soil/DS
"	38.50	38.95	0.45	DP	—	10	26	31	57	—	—	—	—	—	—	Non cohesive soil
"	40.00	40.45	0.45	DP	—	11	27	32	59	—	—	—	—	—	—	— do —

Supervisor

Techpro Engineers

E - In - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 9: FIELD BORE LOG CHARTS (P17)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GT For HORC Viaduct between Sohana Dhulawat S.			Project Code:	1901
Coordinate:	N: 3118957.327	E: 702191.763	Location/ Chainage: 21361.287		
Method of Drilling:	Percussion	Drilling Equipment:	Auto Trip Fourwinch	Bore No.:	P-17
Casing Lowered (M):	16	Bentonite Used: NA	Standard Sampler: Yes.	Barrel Type:	NA
Ground Elevation:	RL-191.107	Date: From 18/10/23 to 31/10/23		Water Table (M):	1.20

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
18/10/23	0.00	0.50	0.50	D	SX	collected				–	–	–	–	–	–	Non cohesive soil
"	1.00	1.45	0.45	DP	"	1	1	2	3	–	–	–	–	–	–	do
"	2.00	2.45	0.45	U	"	Received				–	–	–	–	–	–	do
"	3.00	3.45	0.45	DP	"	1	2	2	4	–	–	–	–	–	–	do
"	4.00	4.45	0.45	DP	"	2	3	3	6	–	–	–	–	–	–	do
"	5.00	5.45	0.45	U/D	"	slipped				–	–	–	–	–	–	Grey Non cohesive soil
"	6.00	6.45	0.45	DP	"	3	4	5	9	–	–	–	–	–	–	do
19/10/23	7.00	7.45	0.45	DP	"	3	4	6	10	–	–	–	–	–	–	do
"	8.00	8.45	0.45	U/D	"	Slipped				–	–	–	–	–	–	do
"	9.00	9.45	0.45	DP	"	5	10	15	25	–	–	–	–	–	–	Grey Non cohesive soil
"	10.00	10.45	0.45	DP	"	8	12	22	34	–	–	–	–	–	–	do
"	11.00	11.45	0.45	U	"	Received				–	–	–	–	–	–	do
"	12.50	12.95	0.45	DP	"	6	11	16	27	–	–	–	–	–	–	cohesive soil
"	14.00	14.45	0.45	U	"	Received				–	–	–	–	–	–	do
"	15.50	15.95	0.45	DP	"	7	13	17	30	–	–	–	–	–	–	do
"	17.00	17.45	0.45	U	"	Received				–	–	–	–	–	–	cohesive soil
"	18.50	18.95	0.45	DP	"	15	18	20	38	–	–	–	–	–	–	do
"	20.00	20.45	0.45	U	"	Received				–	–	–	–	–	–	do
"	21.50	21.95	0.45	DP	"	16	30	35	65	–	–	–	–	–	–	cohesive soil
"	23.00	23.45	0.45	U	"	Received				–	–	–	–	–	–	"
20/10/23	24.50	24.95	0.45	DP	"	17	32	38	70	–	–	–	–	–	–	cohesive soil
"	26.00	26.45	0.45	U	"	15	25	27	52	–	–	–	–	–	–	cohesive soil with Gravel
"	27.50	27.95	0.45	DP	"	7	15	26	41	–	–	–	–	–	–	cohesive soil
"	29.00	29.45	0.45	U	"	Received				–	–	–	–	–	–	do

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 10: FIELD BORE LOG CHARTS (P17)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R00
		Rev. Date.:	28.12.2021

Project Name:	GI for HORC Viaduct between Sohana Dhulawat st			Project Code:	1901
Coordinate:	N: 3118957.327	E: 702191.763	Location/ Chainage: 21367.2870		
Method of Drilling:	Percussion	Drilling Equipment:	Auger/Power winch	Bore No.:	P17
Casing Lowered (M):	15.0	Bentonite Used: NA	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	8u-191.107	Date: From 19/10/22 to 21/10/22		Water Table (M):	1.20

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
20/10/22	30.50	30.95	0.45	DP	SX	16	22	34	56	–	–	–	–	–	–	Non cohesive soil
"	32.00	32.45	0.45	DP	"	20	27	38	65	–	–	–	–	–	–	– do
"	33.50	33.95	0.45	DP	"	14	26	35	61	–	–	–	–	–	–	Non cohesive soil
"	35.00	35.45	0.45	DP	"	17	32	36	68	–	–	–	–	–	–	– do
"	36.50	36.50	0.45	DP	"	19	38	45	83	–	–	–	–	–	–	– do
21/10/22	38.00	38.45	0.45	DP	"	10	25	30	55	–	–	–	–	–	–	– do –
	40.00	40.45	0.45	DP	"	18	23	31	53	–	–	–	–	–	–	– do –

Supervisor

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N > 100). Sampler means SPT sampler

E-in-C

APPENDIX-K
CHART 11: FIELD BORE LOG CHARTS (P18)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No	GT/ 003
		Date of Issue:	01 04 2018
		Rev. No.:	R03
		Rev. Date.:	28 12 2021

Project Name:	GT-For HORC Viaduct between Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3118960.484	E: 702165.761	Location/ Chainage: 21387.487		
Method of Drilling:	Percussion	Drilling Equipment:	Auto Trip/ Power Winch	Bore No.:	P-18
Casing Lowered (M):	27.00 Bentonite Used: NA	Standard Sampler:	Yes	Barrel Type:	NA
Ground Elevation:	RL-191.128	Date: From 15/10/23 to 18/10/23		Water Table (M):	1.20 m

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Colored Return Water	Description
15/10/23	0.00	0.50	0.45	D	SX	Collected				-	-	-	-	-	-	Non cohesive soil
"	1.00	1.45	0.45	U	"	Received				-	-	-	-	-	-	do
"	2.00	2.45	0.45	DP	"	3	4	5	9	-	-	-	-	-	-	do
"	3.00	3.45	0.45	DP	"	4	5	5	10	-	-	-	-	-	-	do
"	4.00	4.45	0.45	U	"	Received				-	-	-	-	-	-	do
"	5.00	5.45	0.45	DP	"	5	7	8	15	-	-	-	-	-	-	Non cohesive soil
"	6.00	6.45	0.45	DP	"	6	9	10	19	-	-	-	-	-	-	do
"	7.00	7.45	0.45	UDS	"	slipped				-	-	-	-	-	-	do
"	8.00	8.45	0.45	DP	"	4	6	11	17	-	-	-	-	-	-	do
"	9.00	9.45	0.45	DP	"	5	8	13	21	-	-	-	-	-	-	do
"	10.00	10.45	0.45	U	"	Received				-	-	-	-	-	-	do
16/10/23	11.00	11.45	0.45	DP	"	5	9	15	24	-	-	-	-	-	-	Non cohesive soil
"	12.00	12.45	0.45	DP	"	6	11	17	28	-	-	-	-	-	-	do
"	13.00	13.45	0.45	U	"	Received				-	-	-	-	-	-	do
"	14.50	14.95	0.45	DP	"	4	7	10	17	-	-	-	-	-	-	do
"	16.00	16.45	0.45	U	"	Received				-	-	-	-	-	-	do
"	17.50	17.95	0.45	DP	"	5	8	12	20	-	-	-	-	-	-	cohesive soil
"	19.00	19.45	0.45	U	"	Received				-	-	-	-	-	-	do
"	20.50	20.95	0.45	DP	"	9	15	18	33	-	-	-	-	-	-	do
"	22.00	22.45	0.45	U	"	Received				-	-	-	-	-	-	do
"	23.50	23.95	0.45	DP	"	8	17	19	36	-	-	-	-	-	-	cohesive soil
"	25.00	25.45	0.45	U	"	Received				-	-	-	-	-	-	do
"	26.50	26.95	0.45	DP	"	8	15	19	34	-	-	-	-	-	-	do
"	28.00	28.45	0.45	U	"	Received				-	-	-	-	-	-	do

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K

CHART 12: FIELD BORE LOG CHARTS (P18)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/003
Date of Issue:	01.04.2018
Rev. No:	R03
Rev. Date:	28.12.2021

Project Name:	GT For HORC Viaduct between Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3118960.484	E: 702165.761	Location/ Chainage: 21387.4870		
Method of Drilling:	Percussion	Drilling Equipment:	Auto Trip/ Powerwinch	Bore No.:	P-18
Casing Lowered (M):	27.00	Bentonite Used: NA	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-191.128	Date: From 17/10/23 to 18/10/23		Water Table (M):	1.20 m

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
17/10/23	29.50	29.95	0.45	DP	Nx	19	38	45	83	–	–	–	–	–	–	Non Cohesive soil
"	31.00	31.45	0.45	DP	"	22	48	52	100	–	–	–	–	–	–	do
"	32.50	32.95	0.45	DP	"	17	35	42	77	–	–	–	–	–	–	do
"	34.00	34.45	0.45	DP	"	19	39	47	86	–	–	–	–	–	–	Non cohesive soil with Gravel
"	35.50	35.95	0.45	DP	"	16	31	35	66	–	–	–	–	–	–	cohesive soil
18/10/23	37.00	37.45	0.45	DP	"	14	28	40	68	–	–	–	–	–	–	None cohesive soil
"	38.50	38.95	0.45	DP	"	15	32	35	67	–	–	–	–	–	–	cohesive soil
"	40.00	40.45	0.45	DP	"	14	33	41	74	–	–	–	–	–	–	do

Supervisor — E - In - C

Techpro Engineers Pvt. Ltd. Kanpur

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

End of Report

Report No: 1901-HORC-II

Report No.: 1901-HORC-II Date: Oct 16th; 2023

GEOTECHNICAL INVESTIGATION REPORT

ULR No.: TC916923000000032P
REVISION-R1

AT THE SITE FOR

HORC VIADUCT BETWEEN SOHANA & DHULAWAT STATIONS OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT, HARYANA

FROM BOREHOLES P21 TO P40

CLIENT

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.

Plot No. 143, 5th floor RailTel tower, Sector-44,
Gurugram, Haryana 122003

GENERAL CONSULTANTS

RITES-SMEC JV

Gurugram, Haryana

GEOTECHNICAL CONSULTANTS

TECHPRO ENGINEERS PVT. LTD.

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G T ROAD, KANPUR-209 217, Phone: 9793209918

e-mail: info@techproindia.com

TC-9169

REVISION NOTES

REVISION NO.	DATE	DESCRIPTION
R1	13.12.2023	• Lithological profile added in Appendix-C.

REPORT FORMAT

Report No.	Bore included	Total Number of Bores
1901-HORC-I	A1 to P20	21
1901-HORC-II	P21 to P40	20
1901-HORC-III	P41 to P60	20
1901-HORC-IV	P61 to P80	20
1901-HORC-V	P81 to P100	20
1901-HORC-VI	P101 to P113	13
1901-HORC-VII	P114A to P133A	20
1901-HORC-VIII	P134A to A2A	16
1901-HORC-IX	P114B to P133B	20
1901-HORC-X	P134B to A2B	16

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APPENDICES

National Accreditation Board for
Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

TECHPRO ENGINEERS PVT. LTD. (LABORATORY DIVISION)

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G.T. ROAD, KANPUR, UTTAR PRADESH, INDIA

in the field of

TESTING

Certificate Number: TC-9169

Issue Date: 23/12/2022 Valid Until: 22/12/2024

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Identity : Techpro Engineers Private Limited

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

TECHPRO ENGINEERS PVT. LTD.
114, Ram Ganga Housing Society, Naramau, G T Road, Kanpur-209 217
Tel.: 9793209918, e-mail: info@techproindia.com
Web site: www.techproindia.com

Oct 16th; 2023

ACKNOWLEDGEMENTS

We are pleased to submit the part-2 of the report of Geotechnical investigation, conducted for the boreholes P21 to P40 for the design of foundations for HORC Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) project in the state of Haryana, India.

We hereby, convey our sincere thanks to Mr. Neeraj Bhandari (CPM/South) and Mr. Raju Solanki (DGM/C/South), HRIDCL for trust and support during the investigation. We also acknowledge our thanks to Mr. Uma Maheshwara Rao B, DGM/C/West, HRIDCL for awarding the said work to us. We are also grateful Mr. Ravindra Dutta Upadhyay (Geotech Expert), Mr. PS Gautam & Mr. Jitender Parashar, Site Engineer from the RITES- SMEC JV and Mohd. Ishak (Executive/Civil) from HRIDCL, for their help rendered during and prior to the investigation work.

We are also thankful to our staff members for conducting field and laboratory test, preparing sketches, and typing the report.

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech. (Civil), M.Tech.
Principal Consultant &
Managing Director

1. INTRODUCTION:

Haryana Rail Infrastructure Development Corporation Ltd. (HRIDC) and Ministry of Railways, Govt. of India has come together to form a new company namely Haryana Orbital Rail Corporation Limited (HORCL), to design and construction of new BG line from Palwal to Sonipat named Haryana Orbital Rail Corridor (HORC), in the state of Haryana, India. In this connection, a Geotechnical investigation has been planned for the design of foundations of Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) Project in the state of Haryana. The work of conducting the detailed Geotechnical Investigation has been awarded to us by HRIDC, through work order No. HRIDC/HORC/GTI/211/2023-2024/Vol-0 dated 02-09-2023, which includes investigation in field, laboratory testing of disturbed and undisturbed samples, collected from the field, and submission of the geotechnical **investigation** test report.

A geotechnical investigation was carried out, with the locations, planned by the client. Purpose of the investigation is to determine the nature and properties of soil and rock strata across the bore holes and representing them through log sections showing the levels, nature, and properties of various strata up to a sufficient depth below the founding level, proneness of site to artesian conditions, seismic disturbance and other engineering properties of soil and rock strata.

This part -2 of the report includes the detailed methodology of investigation, collection of samples, field and laboratory test result including their interpretation/ analysis, recommendations on the properties of soils and rock required for design of foundation and suggesting suitable type and depth of foundation with allowable bearing capacity for safe and strong foundations for the Bore Hole numbers P21 to P40.

2. SCOPE OF WORK:

For the design of foundation of viaduct, it is required to determine the allowable bearing capacity together with necessary engineering characteristics of underlying soil & rock strata. In general, the geotechnical investigation has been planned as per IS:1892-2021 and further extended to IS: 1904, IS:2911 (part-1/Sec 2) & IRC 78:2014 for planning the laboratory testing and computing the allowable bearing capacity, hence the scope of work is as follows:

2.1. Mobilisation of all tools & plants along with accessories, materials, labours etc. at site of work for drilling and testing work, including setting up boring and shifting to different bore holes point etc.

2.2. Exploratory drilling of 150 mm diameter bore holes through soil deposits and 75 mm in rock within the proposed alignment upto the required depth.

2.3. Collection of disturbed soil samples at an interval of 3.00 meter in all the bore holes.

2.4. Collection of undisturbed soil samples at every 3.00 m interval or at change of stratum from all the boreholes.

2.5. To conduct Standard Penetration Test (SPT) at an interval of 3.00 m or noticeable change of stratum in soil deposits in all bore holes.

2.6. Collection of rock core samples and preserving them in core boxes.

2.7. To collect ground water sample on completion of bore holes.

2.8. To record the ground water table in all the bore holes.

2.9. Transporting all the disturbed, undisturbed soil and rock core samples collected during the field investigation to our NABL accredited Geotech Engineering laboratory at Kanpur.

2.10. To conduct the laboratory tests on all the soil and rock core samples collected during field investigation for determination of their engineering characteristics.

2.11. To compile of field and laboratory test results, working out the allowable bearing capacity and preparing the report including detailed recommendations and necessary precautions.

3. GEOLOGICAL INFORMATION OF THE REGION:

3.1. Geography:

The project location is in the bordering area of Gurugram and Nuh (recent old name-Mewat), districts in the Indian state of Haryana. The stretch of the alignment of the proposed corridor starts from southmost part of Gurugram in the town of Sohna and ends at Dhulawat, which is a village lying at the north of Nuh district.

Haryana is a state located in the northern part of India. Gurugram is among one

of the districts in Haryana which is also the part of National Capital Region (30km south of New Delhi). It lies at an elevation of 217 m above msl. Sohna is a small town located 25km in the south of Gurugram. Sohna is well known for its hot water springs and famous Shiva temple. Sohna is located in between 28°15’ N latitude and 77°40' E longitude at the elevation of 212.14m above msl. Mewat district is located at 28 °12′ N latitude, 77 °3′ E longitude, at the south of Gurugram at an elevation of 199 m above msl. The location is bordered by Rewari district on west and Faridabad & Palwal district on the east.

3.2. Geology:

The Gurugram district is having of almost flat topography, however, in the north-eastern part small isolated hillocks of Precambrian rocks are exposed. Small hill ranges which are part of the Aravali and Mangar Bani ranges exists in the district. The major part of district is underlain by Quaternary alluvium consisting of sand, clay and silt. The alluvial plain is formed by the Sahibi river which is a tributary of River Yamuna. Soils of the Gurgaon district is classified as tropical and brown soils, existing in the north western extreme, northern and north eastern parts of the district and water logged and salt affected soils in the southern parts of the district. The soils are medium textured loamy sand is the average texture in Gurgaon and Sohna blocks.

3.3. Rainfall and Climate:

The area has hot semi-arid type of climate characterising extreme dryness of the air except in the monsoon season. Intense hot summer and cold winters. The total annual rainfall in the region is about 596 mm, of which 75 to 80% is because of the south-west monsoon.

3.4. Seismicity:

The site under consideration exists in the district of Gurugram and Mewat which lies in the Seismic Zone IV (high damage risk zone), as per the current seismic zonation map of India (IS 1893-2016): RA 2021 and have a zone factor of 0.24 for design basis earthquake. The region is surrounded by many in-homogeneities in the form of faults and ridges like Sohna Fault, Moradabad Fault, Delhi-Moradabad Fault, Delhi-Haridwar ridge, junction of Aravalli and Alluvium near Delhi. The Sohna fault line lies between the Delhi ridge and Sohna town and falls between the Arjangarh and

Manesar outcrops. All the developed area in Gurugram comes within 200 km of the fault line. The Sohna fault line is located at the junction between the hard rock terrain of the Aravalli hills and the sandy formation of the Yamuna River and is currently inactive from several years and is capable of a disastrous earthquake.

The project location has been marked in Fig.1 Seismic zone map of India.

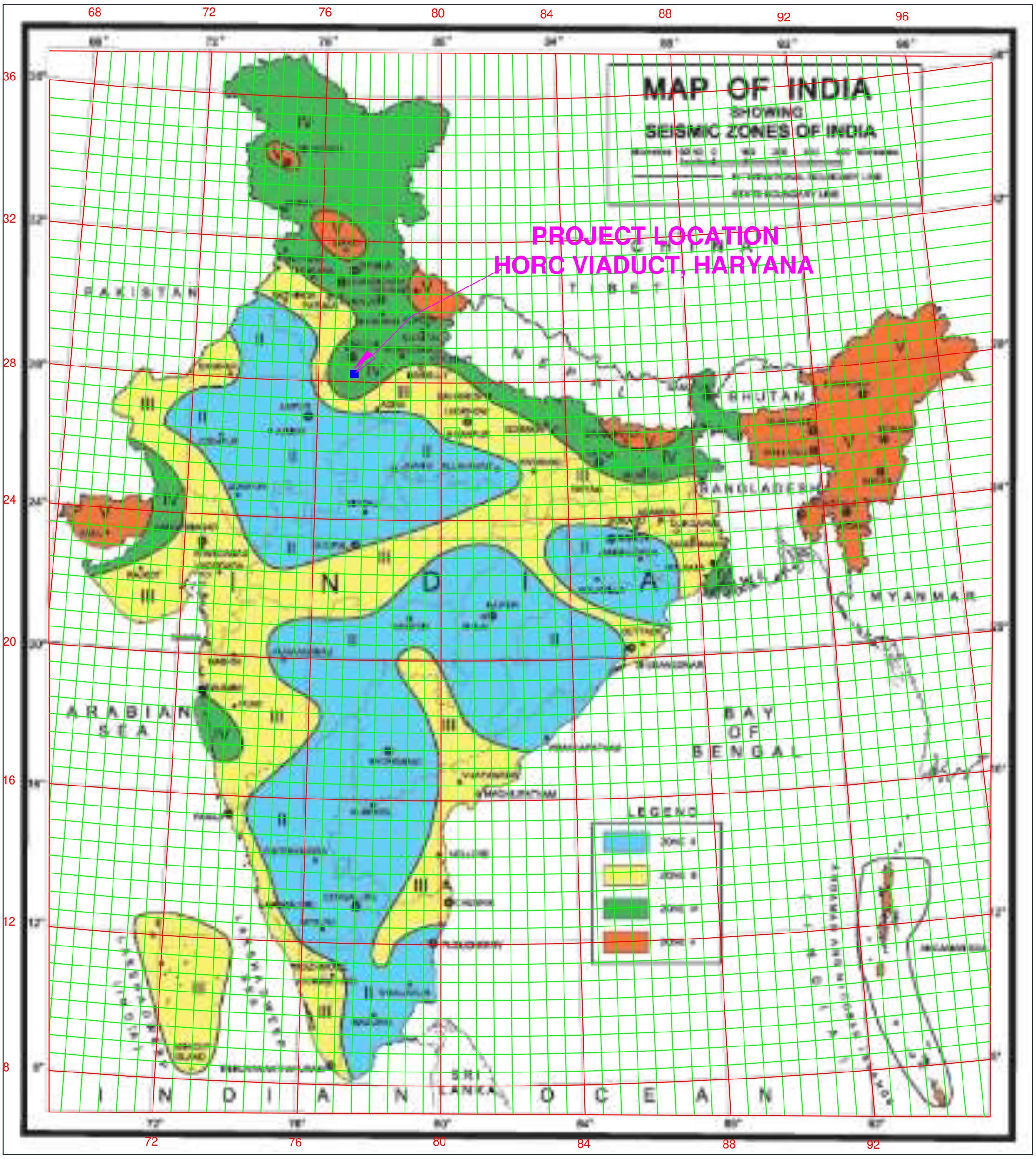


Fig.1: Seismic Zone Map of India

4. FIELD INVESTIGATION:

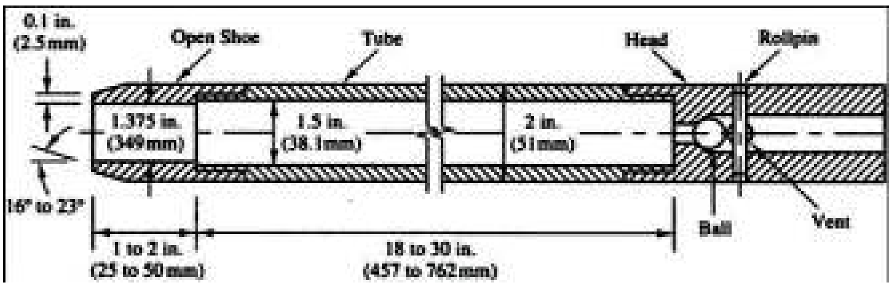
The field investigation work at this site was carried out from Sep 24th; 2023 to Sep 27th; 2023, Oct 15th; 2023 to Oct 22nd; 2023 & Nov 06th; 2023 to Nov 09th;

2023. The following investigation work was carried out:

4.1. **Eight number** of **boreholes** (marked as P24, P30, P32, P33, P34, P36, P39 & P40) of diameter 150 mm in soil were made within the proposed alignment for conducting Standard Penetration Test and collection of disturbed and undisturbed soil samples. The boreholes were progressed using power operated winch and hydraulic rig machine under **percussion** and **rotary** method of drilling respectively. Casing was used to keep the borehole stable, and Bentonite was also used as drilling mud to help prevent wall collapse of boreholes at deeper depth. The records of achieved depth of bore holes have been given in Para No. 6, the details of drilled bores along with depth of casing used have been reported in Appendix B. Locations of boreholes have been reported in "TEST LOCATION PLAN" in Appendix A.

4.2. **Standard Penetration Tests** were conducted at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth, as per the procedure in IS: 2131-1981-(RA: 2021) in all the bore holes. The **standard SPT sampler** (without liner and with no space for liner) and **auto-trip and rope-pulley driven hammer** of standard weight of 63.50 kg have been used to perform the test.

For conducting the test, the bottom of the borehole was properly cleaned, and split spoon sampler was properly seated in position in the borehole. The split spoon sampler resting on the bottom of borehole was allowed to sink under its own weight; then the sampler was allowed to penetrate 15 cm with the blows of the hammer 63.50 kg weight falling free through 75cm, thereafter the split spoon sampler was further driven by another 15 cm. For the 3rd and final drive, the sampler was further allowed to penetrate 15 cm. The number of blows required to get each 15 cm of penetration, was recorded. The first 15 cm of drive is seating drive.



Structure of SPT Sampler

The total blows of penetration for the second and third 15 cm of penetration is

termed the penetration resistance N. The N' values are indicative of the compactness/ relative density of cohesion less soils and consistency of cohesive soils.

In case the blows count of SPT in soil (including the number of blows of seating) exceeds 100, the corresponding penetration was recorded and this particular test at that depth stopped. If the total penetration is more than the seating penetration of 15 cm, then breakup of blow counts for 15 cm seating penetration and for remaining portion of penetration is also given.

SPT 'N' values are correlated with non-cohesive stratum as per BS: 5930 (1999) – for sandy strata and with consistency of cohesive stratum.

Correlation For Clay/Plastic Silt		**Correlation For Sand/Non-Plastic Silt**	
Consistency of clays	**Penetration Value**	**Relative Density of sand**	**Penetration Value**
Very Soft	0 to 2 Blows	Very loose	0 to 4 Blows
Soft	3 to 4 Blows	Loose	5 to 10 Blows
Medium Stiff	5 to 8 Blows	Medium	11 to 30 Blows
Stiff	9 to 16 Blows	Dense	31 to 80 Blows
Very Stiff	17 to 32 Blows	Very Dense	Above 50
Hard	Above 32		

In this method, the sampler acts as a probe and the driving energy is supplied by the fall of the drop weight. The values of 'N' depend on the compactness or relative density of the material. In hard formations, the testing is discontinued if 'N' value is found to be more than 100. It is termed as 'Refusal'. Refusal is also recorded when SPT blow count records 50 or more for any of the single drive of 15 cm.

'N' value depends upon degree of saturation and over burden pressure of the formation. Silty fine sand and fine sand below the water table develop pore water pressure depending on the in-situ void ratio which in turn affects the effective stress. This change in effective stress influences the 'N' value considerably.

Depth of overburden affects the SPT values in none to low cohesive soils and hence need correction. The SPT value after the overburden correction, N' is as follows:

$$N' = 0.77x \log (2000/q) \times N$$

Where, q= Overburden Pressure (kN/m^2) and N = observed SPT value

N' is corrected further for dilatancy in case of saturated fine sands and silts for the values of N' greater than 15.

Modified value after dilatancy correction N" = 15+ (N'-15)/2

Soil samples obtained from split spoon sampler were collected in the polythene bags of suitable size. These samples were property sealed, labelled, and carefully transported to the laboratory for testing. The results have been reported in Table 1 to 8 of Appendix B under the title "SUMMARY OF TEST RESULTS".

4.3. Disturbed soil samples were collected at 0.50 metre, then at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth and at significant change of stratum. Soil from cutting edge of SPT samplers and retained in split spoon, used for Standard Penetration Tests was taken as disturbed samples. These samples were placed without delay in adequately sealed polythene bags. Where the collection of disturbed soil samples could not be collected from SPT samples, Shelby tubes were driven and retained soil samples were obtained. The laboratory tests were conducted on the collected soil samples and reported in Table 1 to 8 of Appendix-B under the title "SUMMARY OF TEST RESULTS".

4.4. Undisturbed soil samples were collected in accordance with IS: 2132-1986-(RA: 2021) at an interval of 3.00 metre or at change of stratum, starting from the depth of 1.00 or 2.00 m, by using 100 mm dia. and 450 mm long MS tubes provided with sampler head with ball check arrangement. However, the some of the samples could not be extracted due to the partial penetration or slippage during the evacuation.

Moreover, collection of Undisturbed samples in very hard cohesive soils/ dense granular soils/gravels/ cobbles/ pebbles/ boulders, refusal strata is practically not possible and such collected samples will not truly represent the undisturbed conditions.

Immediately after taking undisturbed sample in the tube, the adopter head was removed along with the disturbed material. The visible ends of the samples shall then be trimmed off any wet disturbed soil. The ends will then be coated alternately with four layers of molten wax. More molten wax will then be added to give a total thickness

of not less than 25 mm. The laboratory test results have been reported in Table 1 to 8 of Appendix-B.

4.5. The **ground water table** in the borehole was allowed to stabilize and measured after 8, 16, 24 and 48 hours after completion of the bore hole. It was ensured that last two reading were identical. The records of ground water table have been given in Para No.6.

4.6. **Ground water samples** were collected from borehole as per IS: 6935-1973-(RA:2019) for chemical analysis to determine aggressiveness in relation to attack on concrete / reinforcement including determination of pH value.

5. LABORATORY TESTS:

The following laboratory tests were conducted to determine the engineering characteristics of sub-soils:

5.1. **Field moisture contents** were determined by oven drying method as per IS: 2720 (part II)-1973-(RA: 2020). The results have been reported in Table 1 to 8: “SUMMARY OF TEST RESULTS” of Appendix B.

5.2. **Bulk density** of soil strata was obtained using Shelby tubes in accordance with IS 2720 (part XXIX)-1975-(RA: 2020). The results have been reported in Table 1 to 8: “SUMMARY OF TEST RESULTS” of Appendix B.

5.3. **Mechanical sieve analysis** test was performed in accordance with IS: 2720 (Part IV) – 1985-(RA: 2020), for the purpose of identification by grain size analysis, on coarse part of the soil samples and the results have been reported in Table 1 to 8: “SUMMARY OF TEST RESULTS” of Appendix B.

5.4. **Particle size analysis** test by **Hydrometer method** were performed in accordance with IS: 2720 (Part IV) -1985-(RA: 2020) on the part of soil samples obtained after the sieve analysis. The results have been reported in Table 1 to 8: “SUMMARY OF TEST RESULTS” of Appendix B.

5.5. **Atterbergs’ limits tests** were performed in accordance with IS: 2720 (part V)-1985-(RA: 2020) and results have been reported in Table 1 to 8: “SUMMARY OF TEST RESULTS” of Appendix B.

5.6. **Specific gravity tests** were performed in accordance with IS 2720 (part III-sec. 1) - 1980-(RA: 2021) and the results have been reported in Table 1 to 8: "SUMMARY OF TEST RESULTS" of Appendix B.

5.7. **Consolidation tests** were performed on cohesive soil samples in accordance with IS: 2720 (part XV)-1965-(RA: 2021). The results have been reported in Table 1 to 8: "SUMMARY OF TEST RESULTS" of Appendix B.

5.8. **Direct shear tests** were performed as per IS: 2720 (part XIII)-1986-(RA: 2021), on the undisturbed soil samples obtained during the field investigation. The results and the density of samples have been reported in Table 1 to 8: "SUMMARY OF TEST RESULTS" of Appendix B.

5.9. **Tri-axial Compression Test** under Unconsolidated Un-drained (UU) condition as per IS: 2720 (Part-XI)-1993-(RA: 2021) were performed on the selected undisturbed soil samples, obtained during the field investigation. The results have been reported in Table 1 to 8: "SUMMARY OF TEST RESULTS" of Appendix B.

5.10. **Unconfined Compressive strength tests** were performed in accordance with IS 2720 (Part-X) -1991-(RA:2020) on selected undisturbed soil samples and the results have been reported in Table 11 of Appendix B.

5.11. **Shrinkage Limit tests** were performed in accordance with IS 2720 (part-VI) -1972-(RA: 2021) and the results have been reported in Table 1 to 8: "SUMMARY OF TEST RESULTS" of Appendix B.

5.12. **Free Swell Index** were performed in accordance with IS 2720 (part-XL) -1977-(RA: 2021) and the results have been reported in Table 1 to 8: "SUMMARY OF TEST RESULTS" of Appendix B.

5.13. **Chemical analysis on soil samples** was performed in accordance with IS: 2720 (Part-XXVI)-1987-(RA: 2021) for pH value, IS: 2720 (Part-XXVII)-1977-(RA: 2020) for Sulphate & BS:1377-3-2018 for chlorides and results have been reported in Table 9 "CHEMICAL TEST ON SOIL SAMPLES" of Appendix B.

5.14. **Chemical analysis on Ground Water sample** was performed in accordance with IS: 3025 (Part-XI)-2022 for pH value, IS: 3025 (Part-XXIV: Sec-1)-2022 for Sulphate & IS: 3025-(Part-XXXII)-1988-(RA: 2019) for chlorides and results have been reported in

Table 10 "CHEMICAL TEST ON GROUND WATER SAMPLES" of Appendix B.

6. GROUND WATER TABLE:

The water table at this site was encountered during the drilling operation up to the depth of investigation.

Borehole No.	Chainage	Global Co-ordinates (UTM format)		Reduced level (m)	Depth of Borehole (m)	Water table (m)
		Easting	Northing			
P24	21544.687	702009.821	3118982.298	192.043	40.00	1.40
P30	21701.887	701856.668	3119020.255	191.396	40.00	1.50
P32	21754.287	701806.797	3119037.179	191.328	40.00	1.30
P33	21780.487	701782.232	3119046.389	191.287	40.00	1.35
P34	21806.687	701757.766	3119056.154	191.452	40.00	1.40
P36	21859.087	701709.564	3119077.181	191.271	40.00	1.30
P39	21937.687	701638.957	3119112.511	191.204	40.00	1.30
P40	21963.887	701615.905	3119125.287	191.009	40.00	1.40

7. DESCRIPTION OF STRATA:

The classification of soil stratum has been done with the help of soil characteristics obtained in laboratory tests as per IS 1498-1970-(RA:2021). The classification of rock masses has been done based on RMR as per IS: 4464-1985, IS: 13365-1. The detailed nature of the strata has been reported in Table 1 to 8: "SUMMARY OF TEST RESULTS" of Appendix-B and represented through Lithological plots in Appendix-C.

The strata exhibited in the boreholes, is predominantly comprising of inorganic silty clays of low plasticity and inorganic silts of non to low plastic category. Silty sands were encountered at variable depth and thickness. Inorganic silts and silty clays of intermediate plasticity were also encountered at some depth and thickness in some of the bores.

8. SAFE BEARING CAPACITY COMPUTATIONS:

For the construction of viaducts, deep foundation **(Bored Cast-In-Situ RCC piles)** have been considered for computation of load bearing capacity of the underlying soil strata. The computation of load bearing capacity of bored cast-in-situ RCC piles have been done as per IS 2911 (part-1, section-2)-2010-(RA: 2020) with due consideration of effects of liquefaction.

8.1. Design Parameters:

Factor of safety in compression	=	2.50
Factor of safety in tension	=	3.00
Depth of critical water table	=	0.00 m
Diameter of pile	=	1.00 & 1.20 m
Cut off length	=	2.50 m
Type of pile head consider	=	Fixed

8.2. Computation of friction along pile stem:

$Q_{uf} = \sum K_i . P_{di} . \tan\delta_i . A_{si}$

where,

Q_{uf} = Ultimate shaft friction (kN/m^2)

K_i = Coefficient of earth pressure at mid-depth of ith layer

P_{di} = Effective overburden pressure at mid-depth of ith layer (kN/m^2)

A_{si} = Surface area of pile stem in ith layer (m^2)

δ_i = Angle of wall friction between pile and soil of ith layer (= ϕ) (degree)

ϕ_i = Angle of internal friction of soil in ith layer (degree)

$\sum$ = Sum of all layers up to ith layer

8.3. Computation of Cohesion along the stem of pile:

$Q_{uc} = \sum \alpha_i . c_i . A_{si}$

Where,

c_i = Cohesion in ith layer

A_{si} = Surface area of pile stem in ith layer (m^2)

α_i = Adhesion factor for ith layer of soil depending of consistency of soils

$\sum$ = Sum of cohesion of all layers considered

8.4. Computation of end bearing resistance:

$$Q_{ub} = A_p\,(c.N_c + q.N_q + 0.5.\,\gamma.B.N_\gamma)$$

Where,

A_p = Area of the pile toe (m^2)

c = cohesion of soils at pile toe (kN/m^2)

γ = Effective Unit weight of soils at pile toe (kN/m^3)

B = Diameter of pile (m)

q = Effective overburden pressure at pile toe (kN/m^2)

N_c = Bearing Capacity Factor (Recommended equal to 9)

N_q, N_γ = Bearing Capacity Factor

8.5. Lateral load capacity of piles in soils:

$$Q_u = 12.E.I.\delta/(L_1+L_f)^3$$

where,

Q_u = Ultimate lateral load capacity of pile (kN)

δ = Permissible deflection (m) = 1% of diameter of pile

E = Young Modulus of pile material (kN/m^2)

I = Moment of Inertia of the pile cross section (m^4)

L_1 = Cantilever Length of pile (m)

L_f = Length of fixity (m)

Detailed calculations of pile load carrying capacity in compression & uplift in soil have been reported in **Table-1 to 2** of **APPENDIX-H.**

Pile lateral Load capacity has been given in **Table-3 to 4** of **APPENDIX-H**.

9. LIQUEFACTION ANALYSIS:

Liquefaction is the sudden loss of shear strength of the loose fine sands due to earthquake-induced vibration under saturated conditions. Liquefaction generally takes place in loose fine sands (fines < 10 %, D_{60}= 0.20 mm to 1.0 mm and C_u between 2 to 5) with N value less than 15. In case of soil strata having N>15, liquefaction of soil will not take place normally.

The present site falls in **seismic zone – IV.** Considering the history of past earthquakes and available seismic data, an earthquake of **magnitude 7.0** having peak ground acceleration **a_{max}= 0.24 g** is considered in the present analysis.

Preliminary assessment of liquefaction potential of foundation strata is made by simplified approach proposed by IS: 1893 (part-1)-2016-(RA: 2021) from the data obtained in Standard Penetration Test.

In this method, cyclic shear stress likely to be induced in the foundation strata by Design Basis Earthquake is first evaluated. Next threshold cyclic shear stress, which is good enough to cause liquefaction, is determined from SPT data and the empirical relations. Finally, comparison of these two stresses is used in the estimation of liquefaction susceptibility of the foundation strata.

Cyclic Stress Ratio (CSR):

The equivalent average of shear stress likely to be induced in the foundation material due to an earthquake is calculated by using the equations.

Cyclic Resistance Ratio (CRR):

It expresses capacity of soil to resist liquefaction. CRR is determined using correlation between corrected blow count $(N_1)_{60}$ and CRR for earthquake of magnitude 7.5. $(N_1)_{60}$ is the SPT blow count corrected to an effective overburden pressure of 100 kPa and to hammer energy efficiency of 60 %.

Following variable have been adopted in calculation of N_{60} (SPT value for 60% efficiency)

Energy correction to SPT values:

C_{60} = 1.00 (energy efficiency factor)

Design Earthquake Base:

Earthquake zone	= IV
Magnitude of earthquake	= 7
Seismic Zone factor	= 0.24

Status of Liquefaction:

The value of CSR and CRR are computed at different depth and then the ratio of CRR to CSR to get the factor of safety towards the susceptibility of the stratum towards liquefaction potential.

If factor of safety:

< 1.00 : Stratum is to be considered as liquefiable.

> 1.20 : Non-Liquefiable

The detailed calculations of liquefaction have been reported in **Table-5** of **APPENDIX-H.**

10. RECOMMENDATIONS:

Keeping in mind, the field test results, laboratory test results and IS codes of practice the following recommendations are hereby made:

10.1. **Bored Cast-In-Situ RCC Piles** of diameter 1000 and 1200 mm have been adopted for SBC computations of foundation for Viaduct.

10.2. **Cut off length** of piles have been considered as 2.50 m from the existing ground level for the purpose of computation of SBC.

10.3. **Pile length** recommended in the table below, shall be measured **after the cut-off depth.**

10.4. **Allowable load carrying capacity** of pile corresponding to the length and diameter of pile shall be read from the tables below:

10.4.1. For Pile diameter = 1000 mm

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P24	25.00	2350	1750	55
	27.50	2600	2050	
	30.00	2900	2300	
	32.50	3600	2500	
	35.00	4350	2750	
P30	25.00	1700	1350	30
	27.50	1950	1500	
	30.00	2150	1700	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	32.50	2350	1900	
	35.00	2600	2050	
P32	25.00	2150	1700	40
	27.50	2400	1900	
	30.00	2600	2100	
	32.50	2850	2300	
	35.00	3100	2500	
P33	25.00	2300	1750	65
	27.50	2600	2000	
	30.00	2850	2250	
	32.50	3100	2500	
	35.00	3350	2700	
P34	25.00	2200	1700	105
	27.50	2450	1950	
	30.00	2800	2200	
	32.50	2950	2400	
	35.00	3150	2600	
P36	25.00	2450	1900	140
	27.50	2750	2150	
	30.00	3150	2350	
	32.50	3300	2600	
	35.00	3650	2850	
P39	25.00	2050	1600	35
	27.50	2200	1750	
	30.00	2750	1950	
	32.50	2650	2100	
	35.00	2900	2300	
P40	25.00	2000	1550	30
	27.50	2350	1750	
	30.00	3000	2000	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	32.50	3050	2200	
	35.00	2950	2350	

** Indicates Grade of Concrete*

10.4.2. For Pile diameter = 1200 mm

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P24	25.00	3100	2250	85
	27.50	3450	2600	
	30.00	3800	2900	
	32.50	4950	3200	
	35.00	6250	3550	
P30	25.00	2300	1750	45
	27.50	2600	1950	
	30.00	2850	2250	
	32.50	3150	2500	
	35.00	3450	2700	
P32	25.00	2800	2150	65
	27.50	3100	2400	
	30.00	3350	2650	
	32.50	3700	2900	
	35.00	4000	3200	
P33	25.00	2950	2200	100
	27.50	3350	2500	
	30.00	3700	2850	
	32.50	4000	3150	
	35.00	4250	3400	
P34	25.00	2850	2150	150
	27.50	3150	2450	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	30.00	3700	2800	
	32.50	3850	3100	
	35.00	4150	3350	
P36	25.00	3150	2400	190
	27.50	3550	2700	
	30.00	4100	3000	
	32.50	4300	3300	
	35.00	4750	3650	
P39	25.00	2650	2050	55
	27.50	2850	2250	
	30.00	3800	2500	
	32.50	3500	2800	
	35.00	3850	3050	
P40	25.00	2600	2000	50
	27.50	3100	2250	
	30.00	4250	2600	
	32.50	4300	2900	
	35.00	3950	3150	

** Indicates Grade of Concrete*

10.5. Liquefaction Potential: All the bore holes have been analysed for Liquefaction potential as per IS: 1893 (part-1)-2016-(RA: 2021) with Seismic Zone IV, earthquake intensity of 7.0 on Richter scale and critical ground water table at existing ground level. Out of which several boreholes show the potential at various depths mentioned in the table below:

Bore No.	Liquefiable depth zone (meter)
P24	Top 1.00 & 6.00 to 7.00
P30	Top to 10.00
P32	Top 1.00 & 2.00 to 8.00

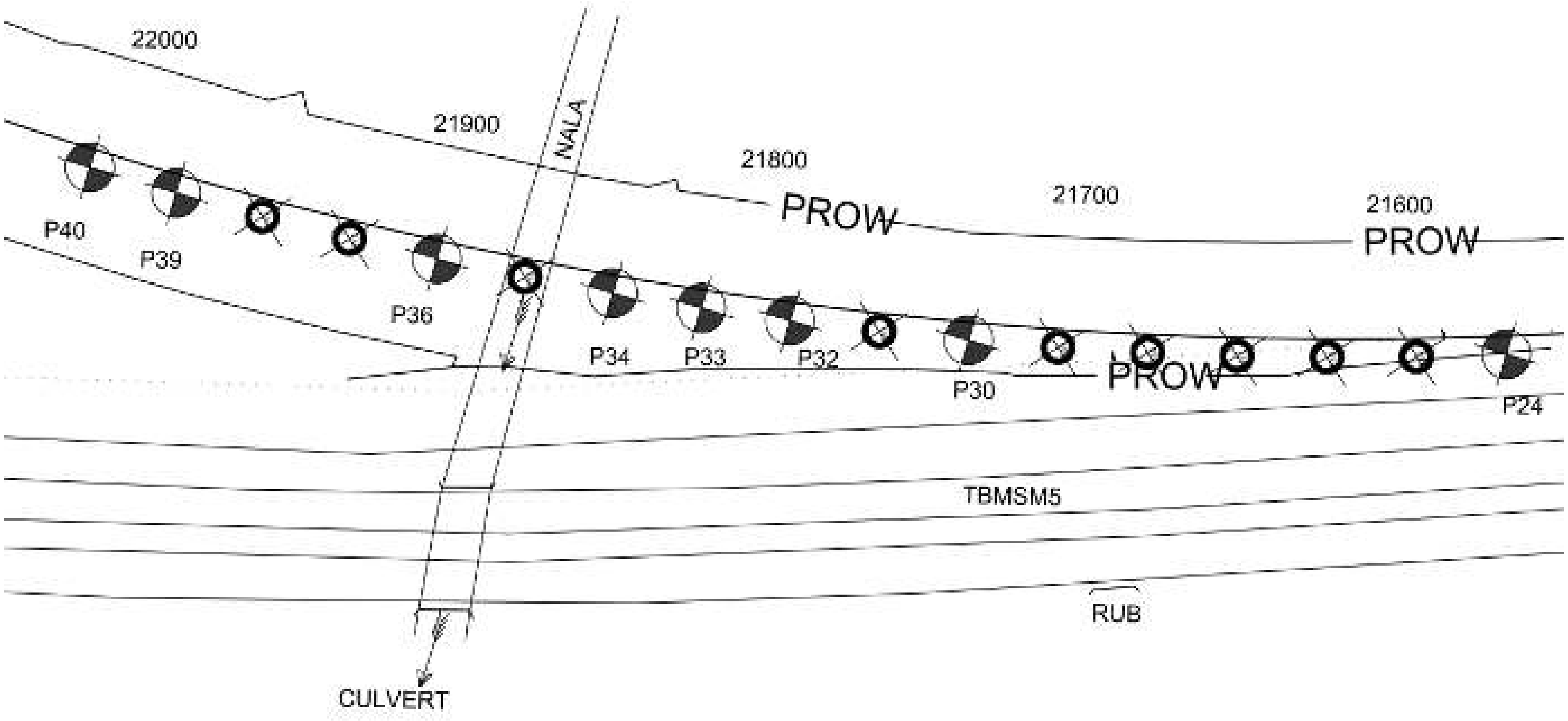
Bore No.	Liquefiable depth zone (meter)
P33	Top 6.00
P34	Top 4.00
P36	1.00 to 3.00
P39	Top 9.00
P40	Top 1.00, 5.00 to 6.00 & 8.00 to 9.00

10.6. Type of cement to be used: Harmful chemical contents in the soil samples are within the permissible limit. So, Ordinary Portland Cement or Portland Pozzolana Cement may be used for all civil constructions.

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech.(Civil), M.Tech.
Principal Consultant &
Managing Director

APPENDIX-A
TEST LOCATION PLAN



APPENDIX "B"
TABLE 1: SUMMARY OF TEST RESULTS

Bore No: P24	**Ground Elevation: RL 192.043 m**	**Method of drilling: Percussion**	**Depth of Water: 1.40 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 24/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 21544.687	**Casing Lowered: 19.00 m**	**Ending Date: 27/09/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	2	34	64	0	10.85	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	D	2	1	2	2	4	6.10	CL-ML	3	2	1	22	65	7	21.40	-	-	26.0	20.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	2.00	U	3	-	-	-	-	-	CL	10	1	4	33	44	8	20.41	2.10	1.74	29.0	19.0	10.0	2.68	UU	51.0	7.5	-	0.540	-	8	19	-	Inorganic clays of low plasticity											
	3.00	D	4	5	6	8	14	16.29	SM	4	1	3	66	26	0	22.82	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	D	5	6	8	10	18	18.17	-	-	-	-	-	-	-	22.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	5.00	D	6	-	-	-	-	-	-	-	-	-	-	-	-	23.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	3	5	7	12	13.15	SM	2	1	4	70	23	0	21.57	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	4	7	12	19	17.55	-	-	-	-	-	-	-	26.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	U	9	-	-	-	-	-	SP-ML	0	0	0	90	10	0	24.78	1.90	1.52	Non-Plastic			2.65	DST	2.0	28.0	-	0.743	-	-	-	-	Poorly Graded Sands with inorganic Silts of low plasticity											
	9.00	D	10	5	9	14	23	18.93	-	-	-	-	-	-	-	26.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	6	10	16	26	20.06	SM	0	0	0	87	13	0	23.88	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	11.00	U	12	-	-	-	-	-	-	-	-	-	-	-	-	26.75	1.91	1.51	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.50	D	13	6	11	17	28	20.15	-	-	-	-	-	-	-	28.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL-ML	1	1	2	21	68	7	19.75	2.10	1.75	24.0	18.0	6.0	-	DST	14.0	26.5	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	15.50	D	15	4	8	10	18	14.94	ML	2	2	2	28	61	5	21.10	-	-	23.0	19.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	17.00	U	16	-	-	-	-	-	CL	4	1	4	30	48	13	21.94	2.09	1.71	27.5	18.0	9.5	2.67	UU	45.0	14.6	-	0.561	-	8	19	-	Inorganic clays of low plasticity											

APPENDIX "B"
TABLE 1: SUMMARY OF TEST RESULTS

Bore No: P24	Ground Elevation: RL 192.043 m	Method of drilling: Percussion	Depth of Water: 1.40 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 24/09/2023	SPT Sampler: Standard
Location / Chainage: 21544.687	Casing Lowered: 19.00 m	Ending Date: 27/09/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	5	10	12	22	22.00	-	-	-	-	-	-	-	16.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	20.00	U	18	-	-	-	-	-	CL	6	4	3	30	46	11	18.52	2.09	1.76	26.0	18.0	8.0	-	-	-	-	-	-	-	-	-	-												
	21.50	D	19	8	15	20	35	35.00	-	-	-	-	-	-	-	14.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	23.00	U	20	-	-	-	-	-	CL	9	1	2	9	70	9	19.01	2.02	1.70	30.0	21.0	9.0	2.67	UU	44.0	11.1	0.140	0.571	-	8	17	-												
	24.50	D	21	9	16	16	32	32.00	-	-	-	-	-	-	-	16.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	U	22	-	-	-	-	-	CI	7	2	1	11	64	15	21.12	2.03	1.68	36.0	20.5	15.5	2.68	-	-	-	-	0.595	-	8	17	-	Inorganic clays of Intermediate plasticity											
	27.50	D	23	10	18	20	38	38.00	-	-	-	-	-	-	-	21.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.00	U	24	-	-	-	-	-	CL	3	2	5	21	57	12	18.13	1.91	1.62	31.0	18.5	12.5	-	UU	54.0	13.3	-	-	-	17	14	-												
	30.50	D	25	10	15	18	33	33.00	-	-	-	-	-	-	-	19.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	32.00	D	26	-	-	-	-	-	CL	7	2	2	15	63	11	17.31	-	-	30.0	18.0	12.0	-	-	-	-	-	-	-	-	-	-												
	33.50	D	27	11	18	21	39	39.00	-	-	-	-	-	-	-	18.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	35.00	D	28	-	-	-	-	-	SM	0	0	1	62	37	0	18.94	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	36.50	D	29	12	14	22	36	17.54	SM	0	0	1	83	16	0	23.66	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	38.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	25.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	17	24	45	69	25.84	-	-	-	-	-	-	-	17.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No: P30	Ground Elevation: RL 191.396 m	Method of drilling: Percussion	Depth of Water: 1.50 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 25/09/2023	SPT Sampler: Standard
Location / Chainage: 21701.887	Casing Lowered: 25.00 m	Ending Date: 27/09/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	0	68	32	0	17.34	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	U	2	-	-	-	-	-	SM	0	0	0	70	30	0	21.46	1.80	1.48	Non-Plastic			-	DST	12.0	27.2	-	-	-	-	-	-												
	2.00	D	3	2	2	3	5	6.97	-	-	-	-	-	-	-	24.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	3	4	5	9	11.86	-	-	-	-	-	-	-	25.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	U	5	-	-	-	-	-	SM	0	1	0	86	13	0	27.71	1.92	1.50	Non-Plastic			-	DST	9.0	28.3	-	-	-	-	-	-												
	5.00	D	6	4	5	6	11	13.07	-	-	-	-	-	-	-	28.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	3	5	7	12	13.66	SM	0	1	1	85	13	0	25.04	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	-	-	-	-	-	-	-	-	-	-	-	-	27.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	4	6	8	14	14.74	-	-	-	-	-	-	-	27.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	5	7	9	16	15.60	SM	0	1	2	82	15	0	28.54	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	8	4	7	15	54	12	20.27	2.10	1.75	29.5	20.0	9.5	2.67	UU	40.0	10.6	-	0.526	-	0	18	-	Inorganic clays of low plasticity											
	11.00	D	12	4	7	8	15	15.00	-	-	-	-	-	-	-	21.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	4	8	9	17	17.00	-	-	-	-	-	-	-	18.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	1	4	1	18	67	9	20.36	2.15	1.79	27.0	19.0	8.0	-	-	-	-	0.146	-	-	8	15	-												
	14.50	D	15	4	9	12	21	21.00	-	-	-	-	-	-	-	18.77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	3	2	3	16	64	12	19.34	2.14	1.79	29.0	18.0	11.0	-	UU	45.0	11.2	-	-	-	-	-	-												
	17.50	D	17	6	9	13	22	22.00	-	-	-	-	-	-	-	18.65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"

TABLE 2: SUMMARY OF TEST RESULTS

Bore No: P30	**Ground Elevation: RL 191.396 m**	**Method of drilling: Percussion**	**Depth of Water: 1.50 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 25/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 21701.887	**Casing Lowered: 25.00 m**	**Ending Date: 27/09/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																						
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery % / R.Q.D % / Density (gm /cc) / Specific gravity / Moisture content (%) / Water absorption (%) / Point load Index / U.C.S (MPa) / Porosity / Hardness / Modulus of Elasticity / Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL
	19.00	U	18	-	-	-	-	-	SM-SC	2	1	3	45	44	5	17.47	2.07	1.76	25.5	20.0	5.5	2.66	DST	10.0	24.3	-	0.511	-	-	16	-	Silty Sands with clay binder
	20.50	D	19	7	11	15	26	26.00	CL	0	1	2	28	61	8	16.98	-	-	26.0	18.0	8.0	-	-	-	-	-	-	-	-	-	-	
	22.00	D	20	-	-	-	-	-	-	-	-	-	-	-	-	19.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	23.50	D	21	6	10	13	23	23.00	-	-	-	-	-	-	-	18.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	25.00	U	22	-	-	-	-	-	CL	1	1	3	13	68	14	26.47	2.18	1.72	34.0	21.5	12.5	2.67	UU	41.0	8.6	-	0.552	-	0	17	-	Inorganic clays of low plasticity
	26.50	D	23	5	9	13	22	22.00	-	-	-	-	-	-	-	23.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	28.00	D	24	-	-	-	-	-	CL	2	1	4	15	66	12	20.72	-	-	31.0	20.5	10.5	-	-	-	-	-	-	-	-	-	-	
	29.50	D	25	6	11	15	26	26.00	-	-	-	-	-	-	-	16.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	31.00	U	26	-	-	-	-	-	CL-ML	5	2	2	34	52	5	28.46	1.93	1.50	25.0	19.0	6.0	-	DST	5.0	27.8	-	-	-	8	-	-	Inorganic Silty Clays of low plasticity
	32.50	D	27	8	14	18	32	32.00	CL	0	0	1	16	71	12	15.94	-	-	31.0	19.0	12.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity
	34.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	16.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	35.50	D	29	9	18	22	40	18.63	CL-ML	4	1	1	18	71	5	20.07	-	-	24.0	19.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity
	37.00	D	30	-	-	-	-	-	CL	0	1	1	12	72	14	21.46	-	-	32.0	18.0	14.0	-	-	-	-	-	-	-	-	-	-	
	38.50	D	31	10	20	30	50	50.00	CL	5	4	3	20	56	12	24.79	-	-	28.5	19.5	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity
	40.00	D	32	11	23	36	59	59.00	-	-	-	-	-	-	-	14.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 3: SUMMARY OF TEST RESULTS

Bore No : P32	**Ground Elevation : RL 191.328 m**	**Method of drilling :Rotary**	**Depth of Water : 1.30 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 06/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 21754.287	**Casing Lowered : 0.00 m**	**Ending Date : 09/11/2023**	**Hammer type: Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	1	55	44	0	5.80	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	U	2	-	-	-	-	-	CL-ML	2	1	1	38	51	7	10.99	1.97	1.78	26.0	20.5	5.5	2.66	DST	5.0	25.2	-	0.499	-	-	-	-	Inorganic Silty Clays of low plasticity											
	2.00	D	3	1	2	2	4	5.51	SM	0	0	0	76	24	0	25.30	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	3.00	D	4	2	2	3	5	6.46	-	-	-	-	-	-	-	23.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	-	-	-	-	-	SM	4	0	0	65	31	0	20.42	1.94	1.61	Non-Plastic			2.62	DST	0.0	28.2	-	0.627	-	-	-	-												
	5.00	D	6	3	3	4	7	8.17	SM-SC	3	3	4	42	43	5	15.91	-	-	25.0	21.0	4.0	-	-	-	-	-	-	-	-	-	-	Silty Sands with clay binder											
	6.00	D	7	3	4	5	9	10.08	SM	0	0	1	77	22	0	23.35	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	7.00	D	8	-	-	-	-	-	-	-	-	-	-	-	-	21.25	1.96	1.62	-	-	-	-	RDST	0.0	28.5	-	-	-	-	-	-												
	8.00	D	9	4	6	7	13	13.50	CL-ML	2	1	1	24	66	6	17.61	-	-	27.0	21.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	9.00	D	10	5	8	9	17	16.04	-	-	-	-	-	-	-	16.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	4	2	2	11	70	11	18.31	2.04	1.72	28.0	19.0	9.0	2.68	UU	54.0	11.6	0.141	0.555	-	8	16	-	Inorganic clays of low plasticity											
	11.00	D	12	5	8	10	18	18.00	-	-	-	-	-	-	-	19.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	6	10	12	22	22.00	-	-	-	-	-	-	-	19.78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	D	15	-	-	-	-	-	SM	0	0	0	56	44	0	18.51	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	14.50	D	16	8	14	22	36	22.86	-	-	-	-	-	-	-	16.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	17	-	-	-	-	-	CL	3	2	2	18	65	10	21.54	2.02	1.66	28.0	20.5	7.5	2.68	UU	51.0	10.4	-	0.614	-	10	18	-	Inorganic clays of low plasticity											
	17.50	D	18	5	9	10	19	19.00	-	-	-	-	-	-	-	18.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 3: SUMMARY OF TEST RESULTS

Bore No : P32	**Ground Elevation : RL 191.328 m**	**Method of drilling :Rotary**	**Depth of Water : 1.30 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 06/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 21754.287	**Casing Lowered : 0.00 m**	**Ending Date : 09/11/2023**	**Hammer type: Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	19	-	-	-	-	-	CL-ML	4	1	0	28	60	7	21.18	2.00	1.65	26.0	20.0	6.0	2.66	DST	12.0	24.0	-	0.612	-	-	-	-	Inorganic Silty Clays of low plasticity											
	20.50	D	20	11	18	20	38	38.00	CL	0	1	0	12	76	11	18.63	-	-	29.0	21.0	8.0	-	-	-	-	-	-	-	-	-	-												
	22.00	U	21	-	-	-	-	-	CL	2	1	2	8	74	13	18.70	2.04	1.72	33.0	20.0	13.0	2.68	UU	62.0	9.3	-	0.558	-	-	-	-												
	23.50	D	22	27	35	40	75	75.00	-	-	-	-	-	-	-	19.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	D	23	17	28	35	63	63.00	-	-	-	-	-	-	-	17.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	26.50	D	24	21	32	39	71	71.00	CL	2	1	1	6	78	12	16.16	-	-	30.0	19.5	10.5	-	-	-	-	-	-	-	-	-	-												
	28.00	D	25	19	35	40	75	75.00	CL	4	0	1	6	76	13	18.11	-	-	32.0	21.5	10.5	2.68	-	-	-	-	-	-	-	-	-												
	29.50	D	26	14	25	37	62	62.00	-	-	-	-	-	-	-	17.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	D	27	20	42	60	R	-	CL-ML	0	0	1	10	81	8	23.33	-	-	27.0	20.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	32.50	D	28	21	45	50	95	95.00	CL	4	1	1	8	76	10	15.86	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	34.00	D	29	32	48	55	R	-	ML	0	0	1	22	72	5	19.58	-	-	27.0	22.0	5.0	2.66	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	35.50	D	30	22	40	47	87	87.00	CL	1	1	0	5	80	13	17.41	-	-	31.0	21.0	10.0	-	-	-	-	-	-	-	-	-	-												
	37.00	D	31	25	43	48	91	91.00	-	-	-	-	-	-	-	19.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	38.50	D	32	27	38	45	83	83.00	CL	1	1	2	10	75	11	17.66	-	-	30.0	20.5	9.5	-	-	-	-	-	-	-	-	-	-												
	40.00	D	33	14	19	37	56	56.00	-	-	-	-	-	-	-	20.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 4: SUMMARY OF TEST RESULTS

Bore No : P33	**Ground Elevation : RL 191.287m**	**Method of drilling :Rotary**	**Depth of Water : 1.35 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 06/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 21780.487	**Casing Lowered : 0.00 m**	**Ending Date : 08/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.00	D	1	-	-	-	-	-	CL-ML	0	0	1	46	47	6	11.63	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	1.00	U	2	-	-	-	-	-	CL-ML	0	0	0	44	49	7	13.09	1.98	1.75	27.0	21.0	6.0	2.66	DST	8.0	25.5	-	0.520	-	-	-	-												
	2.00	D	3	2	2	3	5	6.86	SM	0	0	1	55	44	0	19.27	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	3.00	D	4	2	3	4	7	9.00	-	-	-	-	-	-	-	21.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	U	5	-	-	-	-	-	SM	0	0	1	62	37	0	19.07	1.95	1.64	Non-Plastic			2.61	DST	0.0	28.6	-	0.591	-	-	-	-												
	5.00	D	6	3	4	6	10	11.62	-	-	-	-	-	-	-	26.78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	4	5	7	12	13.37	-	-	-	-	-	-	-	27.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	U	8	-	-	-	-	-	SM	0	0	0	70	30	0	24.71	1.95	1.56	Non-Plastic			2.61	DST	0.0	29.3	-	0.673	-	-	-	-												
	8.00	D	9	5	6	8	14	14.50	-	-	-	-	-	-	-	25.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	4	9	11	20	20.00	CL	3	2	1	7	79	8	17.42	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	10.00	U	11	-	-	-	-	-	CL	4	1	1	9	74	11	13.73	2.02	1.78	29.0	21.0	8.0	2.67	UU	56.0	12.2	0.148	0.500	-	6	17	-												
	11.00	D	12	11	14	16	30	21.60	SM-SC	1	1	0	52	42	4	16.18	-	-	24.0	19.0	5.0	-	-	-	-	-	-	-	-	-	-	Silty Sands with clay binder											
	12.00	D	13	9	12	17	29	20.73	SM	0	0	1	55	44	0	16.46	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	13.00	U	14	-	-	-	-	-	CL	3	2	1	8	74	12	22.84	2.04	1.66	30.0	21.0	9.0	2.68	UU	59.0	8.6	-	0.614	-	-	-	-	Inorganic clays of low plasticity											
	14.50	D	15	11	15	17	32	32.00	-	-	-	-	-	-	-	21.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	3	2	0	7	75	13	18.44	2.06	1.74	30.0	19.0	11.0	2.68	UU	62.0	10.3	-	0.540	-	10	16	-												
	17.50	D	17	13	17	22	39	39.00	-	-	-	-	-	-	-	19.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"

TABLE 4: SUMMARY OF TEST RESULTS

Bore No : P33	**Ground Elevation : RL 191.287m**	**Method of drilling :Rotary**	**Depth of Water : 1.35 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 06/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 21780.487	**Casing Lowered : 0.00 m**	**Ending Date : 08/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL	0	0	1	6	79	14	16.01	2.04	1.76	33.0	21.0	12.0	2.69	UU	65.0	11.6	-	0.528	-	-	-	-	Inorganic clays of low plasticity											
	20.50	D	19	15	19	23	42	42.00	-	-	-	-	-	-	-	14.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	CL-ML	2	0	1	44	49	4	19.10	1.97	1.65	24.0	19.5	4.5	2.66	DST	8.0	25.2	-	0.612	-	-	-	-	Inorganic Silty Clays of low plasticity											
	23.50	D	21	32	43	45	88	88.00	CL	3	2	2	9	73	11	19.26	-	-	29.0	20.5	8.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	25.00	D	22	12	35	40	75	75.00	-	-	-	-	-	-	-	16.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.50	D	23	25	38	42	80	80.00	-	-	-	-	-	-	-	17.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	27	42	45	87	87.00	CL-CI	4	2	0	6	74	14	21.63	-	-	35.0	21.5	13.5	-	-	-	-	-	-	-	-	-	-	Inorganic Clays of low to Intermediate plasticity											
	29.50	D	25	32	45	56	R	-	-	-	-	-	-	-	-	17.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	24	32	50	82	82.00	-	-	-	-	-	-	-	18.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.50	D	27	23	35	55	90	90.00	CL	4	2	1	16	66	11	18.51	-	-	31.0	21.5	9.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	34.00	D	28	25	38	60	98	98.00	-	-	-	-	-	-	-	18.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	35.50	D	29	21	35	37	72	72.00	CL	4	1	0	12	75	8	16.53	-	-	29.0	21.5	7.5	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	26	38	50	88	88.00	CL	2	1	1	6	77	13	19.23	-	-	32.0	20.0	12.0	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	30	42	58	R	-	-	-	-	-	-	-	-	12.97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	29	43	53	96	96.00	CL	1	1	2	12	74	10	21.70	-	-	30.0	20.5	9.5	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 5: SUMMARY OF TEST RESULTS

Bore No : P34	**Ground Elevation : RL 191.452 m**	**Method of drilling :Rotary**	**Depth of Water : 1.40 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 06/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 21806.687	**Casing Lowered : 0.00 m**	**Ending Date : 08/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT									LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion C (kN/m2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	1	52	47	0	23.24	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	D	2	1	1	2	3	4.64	SM-SC	1	0	1	48	45	5	16.32	-	-	25.0	20.5	4.5	-	-	-	-	-	-	-	-	-	-	Silty Sands with clay binder											
	2.00	U	3	-	-	-	-	-	-	-	-	-	-	-	-	15.88	1.96	1.69	-	-	-	2.66	DST	6.0	26.7	-	0.574	-	-	-	-												
	3.00	D	4	2	2	4	6	7.72	ML	3	1	1	44	51	0	20.01	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	4.00	D	5	3	6	8	14	16.03	SM	0	0	0	70	30	0	25.69	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	5.00	U	6	-	-	-	-	-	SM	6	2	3	65	24	0	21.35	1.93	1.59	Non-Plastic			2.61	RDST	0.0	30.8	-	0.642	-	-	-	-												
	6.00	D	7	3	7	11	18	17.55	SM	0	2	3	75	20	0	23.73	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	5	11	12	23	19.87	SM	0	0	0	55	45	0	19.54	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	8.00	U	9	-	-	-	-	-	ML	0	0	1	48	51	0	17.54	1.97	1.68	Non-Plastic			2.65	DST	7.0	25.8	-	0.577	-	-	-	-	Inorganic Silts of low plasticity											
	9.00	D	10	4	7	8	15	15.02	SM	2	0	0	54	44	0	18.10	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	10.00	D	11	6	8	12	20	17.22	-	-	-	-	-	-	-	18.81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	SM	0	0	1	53	46	0	17.43	1.95	1.66	Non-Plastic			2.65	DST	9.0	26.2	-	0.596	-	-	-	-												
	12.50	D	13	5	9	10	19	19.00	CL	0	0	1	5	81	13	20.88	-	-	32.0	21.5	10.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	14.00	U	14	-	-	-	-	-	CL	1	1	0	6	81	11	22.21	2.04	1.67	30.0	20.5	9.5	2.67	UU	55.0	9.5	-	0.599	-	0	17	-												
	15.50	D	15	4	5	7	12	12.00	-	-	-	-	-	-	-	21.30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	D	16	-	-	-	-	-	-	-	-	-	-	-	-	19.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	18.50	D	17	6	8	13	21	21.00	CL	0	1	1	7	79	12	19.07	-	-	32.0	21.5	10.5	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 5: SUMMARY OF TEST RESULTS

Bore No : P34	**Ground Elevation : RL 191.452 m**	**Method of drilling :Rotary**	**Depth of Water : 1.40 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 06/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 21806.687	**Casing Lowered : 0.00 m**	**Ending Date : 08/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion C (kN/m2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	20.00	U	18	-	-	-	-	-	CL	7	2	3	8	69	11	17.16	2.06	1.76	30.0	20.5	9.5	2.67	UU	58.0	11.5	-	0.517	-	8	17	-	Inorganic clays of low plasticity											
	21.50	D	19	8	16	14	30	30.00	-	-	-	-	-	-	-	19.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.00	U	20	-	-	-	-	-	CL	2	0	1	5	79	13	21.33	2.01	1.66	32.0	21.0	11.0	2.68	UU	62.0	8.2	-	0.614	-	-	-	-												
	24.50	D	21	11	17	21	38	38.00	-	-	-	-	-	-	-	16.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	D	22	-	-	-	-	-	-	-	-	-	-	-	-	19.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	27.50	D	23	14	22	25	47	47.00	CL	1	1	0	6	80	12	20.51	-	-	30.0	20.5	9.5	-	-	-	-	-	-	-	-	-	-												
	29.00	D	24	-	-	-	-	-	-	-	-	-	-	-	-	18.99	2.06	1.73	-	-	-	2.67	RUU	59.0	9.1	-	0.543	-	-	-	-												
	30.50	D	25	17	32	39	71	29.18	SM	0	0	0	64	36	0	16.69	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	32.00	D	26	18	34	41	75	29.80	CL-ML	3	0	2	34	56	5	18.52	-	-	25.0	20.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	33.50	D	27	15	30	38	68	27.25	-	-	-	-	-	-	-	21.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	35.00	D	28	11	20	35	55	23.12	CL-ML	1	0	1	22	70	6	19.59	-	-	27.0	21.5	5.5	-	-	-	-	-	-	-	-	-	-												
	36.50	D	29	13	24	28	52	21.95	-	-	-	-	-	-	-	19.82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	16	29	36	65	65.00	CL	2	1	1	12	75	9	19.04	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	40.00	D	31	15	22	31	53	53.00	-	-	-	-	-	-	-	23.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 6: SUMMARY OF TEST RESULTS

Bore No: P36	**Ground Elevation: RL 191.271 m**	**Method of drilling: Percussion**	**Depth of Water: 1.30 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 15/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 21859.087	**Casing Lowered: 22.00 m**	**Ending Date: 17/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	CL-ML	0	0	1	42	51	6	12.41	-	-	26.5	21.5	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	1.00	U	2	-	-	-	-	-	SM	1	0	0	58	41	0	17.43	2.04	1.74	Non-Plastic			2.65	DST	0.0	25.9	-	-	-	-	-	-	Silty Sands											
	2.00	D	3	2	3	3	6	8.18	SM-SC	1	1	2	46	43	7	19.33	-	-	27.0	21.5	5.5	-	-	-	-	-	-	-	-	-	-	Silty Sands with clay binder											
	3.00	D	4	3	5	5	10	12.74	SM	2	1	0	57	40	0	22.55	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	U	5	-	-	-	-	-	SM	3	0	0	59	38	0	27.83	2.07	1.62	Non-Plastic			2.62	DST	0.0	29.5	-	0.617	-	-	-	-												
	5.00	D	6	4	7	9	16	16.64	SM	0	0	0	76	24	0	26.28	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	3	9	13	22	19.51	-	-	-	-	-	-	-	25.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	U	8	-	-	-	-	-	-	-	-	-	-	-	-	24.15	2.05	1.65	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	3	6	11	17	16.09	CL-ML	1	1	0	18	74	6	17.92	-	-	26.0	20.0	6.0	2.63	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	9.00	D	10	5	11	11	22	18.24	-	-	-	-	-	-	-	19.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	3	3	3	14	66	11	19.59	2.05	1.71	31.0	21.5	9.5	2.67	UU	49.0	9.5	0.162	0.557	-	-	-	-	Inorganic clays of low plasticity											
	11.00	D	12	6	12	17	29	20.80	CL-ML	3	2	2	7	79	7	17.25	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	0	18	-	Inorganic Silty Clays of low plasticity											
	12.00	D	13	7	11	15	26	19.08	-	-	-	-	-	-	-	19.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	SM	0	0	0	55	45	0	19.70	2.00	1.67	Non-Plastic			-	DST	4.0	26.1	-	-	-	-	-	-	Silty Sands											
	14.50	D	15	5	12	15	27	18.78	-	-	-	-	-	-	-	19.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	1	1	1	23	63	11	20.97	2.06	1.70	29.5	19.5	10.0	2.67	UU	54.0	9.0	-	0.571	-	8	15	-	Inorganic clays of low plasticity											
	17.50	D	17	6	9	14	23	23.00	CL	1	1	1	18	67	12	16.48	-	-	31.0	18.5	12.5	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"

TABLE 6: SUMMARY OF TEST RESULTS

Bore No: P36	**Ground Elevation: RL 191.271 m**	**Method of drilling: Percussion**	**Depth of Water: 1.30 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 15/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 21859.087	**Casing Lowered: 22.00 m**	**Ending Date: 17/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	-	-	-	-	-	-	-	17.68	2.08	1.77	-	-	-	2.68	UU	60.0	10.0	-	0.514	-	-	-	-	Inorganic clays of low plasticity											
	20.50	D	19	7	9	17	26	26.00	-	-	-	-	-	-	-	17.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	CL	0	0	0	14	72	14	18.22	2.07	1.75	32.0	19.0	13.0	2.68	UU	64.0	9.5	-	0.531	-	15	15	-												
	23.50	D	21	6	12	17	29	29.00	CL	5	4	4	11	64	12	17.97	-	-	30.0	18.5	11.5	-	-	-	-	-	-	-	-	-	-												
	25.00	D	22	-	-	-	-	-	CL	3	1	3	14	71	8	21.35	-	-	27.5	20.0	7.5	-	-	-	-	-	-	-	-	-	-												
	26.50	D	23	11	17	28	45	45.00	-	-	-	-	-	-	-	19.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	U	24	-	-	-	-	-	MI	1	1	0	14	68	16	19.30	2.05	1.72	36.0	25.0	11.0	2.69	UU	68.0	11.5	-	0.564	-	20	20	-	Inorganic Silts of Intermediate plasticity											
	29.50	D	25	11	19	26	45	45.00	-	-	-	-	-	-	-	19.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	-	-	-	-	-	CL-ML	2	1	2	18	68	9	19.18	-	-	27.5	21.5	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	32.50	D	27	17	26	30	56	23.79	ML	0	1	1	42	56	0	19.86	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	34.00	D	28	16	29	33	62	25.14	CL-ML	0	0	1	28	65	6	18.90	-	-	25.5	21.0	4.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	35.50	D	29	18	20	29	49	49.00	CL	2	1	2	22	64	9	20.07	-	-	28.5	20.5	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	37.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	18.24	2.05	1.73	-	-	-	2.67	RDST	16.0	20.2	-	0.543	-	-	-	-												
	38.50	D	31	16	22	26	48	20.18	CL-ML	0	1	1	32	60	6	17.08	-	-	26.5	21.5	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	40.00	D	32	17	24	30	54	21.43	-	-	-	-	-	-	-	17.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"

TABLE 7: SUMMARY OF TEST RESULTS

Bore No: P39	**Ground Elevation: RL 191.204 m**	**Method of drilling: Percussion**	**Depth of Water: 1.30 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 17/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 21937.687	**Casing Lowered: 22.00 m**	**Ending Date: 19/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	0	56	44	0	10.61	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	D	2	-	-	-	-	-	ML	0	0	0	46	49	5	22.14	-	-	26.5	22.0	4.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	2.00	D	3	2	3	4	7	9.79	SM-SC	4	2	2	46	39	7	20.85	-	-	27.5	21.5	6.0	-	-	-	-	-	-	-	-	-	-	Silty Sands with clay binder											
	3.00	D	4	2	3	3	6	7.88	SM	7	3	4	44	42	0	20.69	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	U	5	-	-	-	-	-	-	-	-	-	-	-	-	18.45	1.90	1.60	-	-	-	2.63	DST	7.0	24.5	-	0.644	-	-	-	-												
	5.00	D	6	3	3	4	7	8.32	ML	0	0	0	36	64	0	18.50	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	6.00	D	7	3	3	5	8	9.11	ML	0	0	1	39	60	0	19.18	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	-	-	-	-	-	-	-	-	-	-	-	-	19.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	3	4	5	9	9.58	ML	0	0	0	44	56	0	18.34	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	3	4	6	10	10.26	CL-ML	1	1	1	24	68	5	18.71	-	-	26.0	20.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	10.00	U	11	-	-	-	-	-	CL	7	6	5	14	60	8	16.15	2.02	1.74	29.0	21.0	8.0	2.67	UU	51.0	9.5	0.131	0.535	-	8	17	-	Inorganic clays of low plasticity											
	11.00	D	12	5	9	14	23	23.00	-	-	-	-	-	-	-	20.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	6	12	13	25	25.00	-	-	-	-	-	-	-	20.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	2	1	1	11	72	13	19.90	2.05	1.71	32.0	21.0	11.0	2.67	UU	56.0	8.2	-	0.562	-	-	-	-												
	14.50	D	15	4	7	11	18	15.30	CL-ML	0	1	1	32	61	5	21.24	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	16.00	U	16	-	-	-	-	-	CL	9	5	5	9	61	11	20.78	2.05	1.70	30.0	20.0	10.0	2.67	UU	53.0	11.5	-	0.573	-	-	-	-	Inorganic clays of low plasticity											
	17.50	D	17	4	6	9	15	15.00	CL	1	1	1	14	71	12	20.51	-	-	31.0	19.5	11.5	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"

TABLE 7: SUMMARY OF TEST RESULTS

Bore No: P39	Ground Elevation: RL 191.204 m	Method of drilling: Percussion	Depth of Water: 1.30 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 17/10/2023	SPT Sampler: Standard
Location / Chainage: 21937.687	Casing Lowered: 22.00 m	Ending Date: 19/10/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL	5	4	3	16	60	12	17.30	1.99	1.70	31.0	22.0	9.0	2.67	UU	58.0	10.5	-	0.574	-	-	-	-	Inorganic clays of low plasticity											
	20.50	D	19	5	7	12	19	19.00	CL	9	3	3	17	58	10	19.43	-	-	29.0	19.5	9.5	-	-	-	-	-	-	-	0	19	-												
	22.00	U	20	-	-	-	-	-	CI	4	3	4	9	64	16	18.23	2.03	1.72	37.0	23.0	14.0	2.68	UU	62.0	9.7	-	0.561	-	-	-	-	Inorganic clays of Intermediate plasticity											
	23.50	D	21	6	15	27	42	42.00	-	-	-	-	-	-	-	20.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	CL	1	1	1	17	71	9	22.72	2.06	1.68	28.0	21.0	7.0	2.67	UU	46.0	10.4	-	0.591	-	-	-	-	Inorganic clays of low plasticity											
	26.50	D	23	11	22	29	51	24.46	-	-	-	-	-	-	-	20.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	-	-	-	-	-	-	-	-	-	-	-	-	20.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.50	D	25	12	24	30	54	24.61	CL-ML	0	0	2	28	63	7	18.31	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	31.00	D	26	16	19	27	46	46.00	CL	1	1	1	12	76	9	19.96	-	-	28.0	19.5	8.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	32.50	D	27	14	20	29	49	22.32	SM	0	0	1	52	47	0	18.43	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	34.00	D	28	-	-	-	-	-	CL	2	1	2	18	69	8	17.57	-	-	27.5	20.5	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	35.50	D	29	17	24	26	50	21.86	ML	2	2	3	28	61	4	13.25	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	37.00	D	30	-	-	-	-	-	CL	2	1	1	12	73	11	16.66	2.04	1.75	29.0	19.0	10.0	2.67	RUU	54.0	9.6	-	0.526	-	-	-	-	Inorganic clays of low plasticity											
	38.50	D	31	16	22	30	52	52.00	-	-	-	-	-	-	-	11.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	18	24	38	62	62.00	-	-	-	-	-	-	-	20.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 8: SUMMARY OF TEST RESULTS

Bore No: P40	**Ground Elevation: RL 191.009 m**	**Method of drilling: Percussion**	**Depth of Water: 1.40 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 20/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 21963.887	**Casing Lowered: 21.00 m**	**Ending Date: 22/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	0	62	38	0	10.72	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	U	2	-	-	-	-	-	CL	2	1	1	44	44	8	22.17	2.01	1.65	27.5	20.5	7.0	2.66	DST	8.0	26.0	-	0.617	-	-	-	-												
	2.00	D	3	1	2	2	4	4.00	CL	0	0	0	24	63	13	24.75	-	-	33.0	23.0	10.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	3.00	D	4	2	2	3	5	5.00	-	-	-	-	-	-	-	23.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	-	-	-	-	-	CL-ML	0	0	1	35	59	5	20.50	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	5.00	D	6	2	3	4	7	8.08	SM	0	0	1	58	41	0	26.44	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	3	6	6	12	13.28	SM	0	0	1	68	31	0	28.88	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	7.00	U	8	-	-	-	-	-	SM	0	0	1	52	47	0	19.76	1.96	1.64	Non-Plastic			2.63	DST	5.0	27.5	-	0.604	-	-	-	-												
	8.00	D	9	2	3	6	9	9.25	SM	0	0	1	62	37	0	27.91	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	3	3	5	8	8.00	CL	0	0	1	12	76	11	21.38	-	-	30.0	20.0	10.0	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	3	1	2	12	70	12	19.66	2.04	1.70	33.0	22.0	11.0	2.67	UU	56.0	10.5	0.162	0.567	-	-	16	13.80												
	11.00	D	12	5	10	13	23	23.00	-	-	-	-	-	-	-	20.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	12.00	D	13	5	7	9	16	16.00	-	-	-	-	-	-	-	21.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	3	1	2	9	72	13	21.68	2.05	1.68	32.0	20.0	12.0	2.67	UU	58.0	9.6	-	0.586	-	-	17	16.60												
	14.50	D	15	2	6	8	14	11.84	CL-ML	0	1	1	18	71	9	20.81	-	-	28.0	21.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	16.00	U	16	-	-	-	-	-	CL	2	1	2	17	66	12	19.59	2.01	1.68	30.0	18.5	11.5	2.68	UU	60.0	8.3	-	0.595	-	-	-	-	Inorganic clays of low plasticity											
	17.50	D	17	5	10	12	22	22.00	-	-	-	-	-	-	-	19.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 8: SUMMARY OF TEST RESULTS

Bore No: P40	**Ground Elevation: RL 191.009 m**	**Method of drilling: Percussion**	**Depth of Water: 1.40 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 20/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 21963.887	**Casing Lowered: 21.00 m**	**Ending Date: 22/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL	2	1	3	26	58	10	19.69	2.03	1.70	29.0	20.0	9.0	2.67	UU	52.0	10.2	-	0.573	-	-	-	-	Inorganic clays of low plasticity											
	20.50	D	19	8	10	14	24	16.35	CL-ML	0	0	1	36	58	5	17.83	-	-	24.0	19.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	22.00	D	20	-	-	-	-	-	-	-	-	-	-	-	-	21.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.50	D	21	5	11	15	26	26.00	CL	4	2	3	14	64	13	20.84	-	-	33.0	21.0	12.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	25.00	D	22	-	-	-	-	-	CL	0	1	3	28	60	8	20.40	-	-	28.5	21.0	7.5	-	-	-	-	-	-	-	-	-	-												
	26.50	D	23	12	19	30	49	49.00	CL	0	1	1	14	76	8	19.50	-	-	29.0	20.5	8.5	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	-	-	-	-	-	-	-	-	-	-	-	-	22.63	2.08	1.70	-	-	-	2.67	RUU	49.0	8.7	-	0.571	-	-	-	-												
	29.50	D	25	7	13	19	32	32.00	CI	5	2	1	11	66	15	19.31	-	-	42.0	24.0	18.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of Intermediate plasticity											
	31.00	D	26	-	-	-	-	-	SM	0	0	0	54	46	0	19.95	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	32.50	D	27	18	20	30	50	22.22	-	-	-	-	-	-	-	18.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	-	-	-	-	-	CL-ML	0	0	1	41	53	5	19.82	2.00	1.67	26.0	21.5	4.5	2.66	RDST	7.0	26.3	-	0.593	-	-	-	-	Inorganic Silty Clays of low plasticity											
	35.50	D	29	17	22	27	49	21.24	-	-	-	-	-	-	-	25.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	MI	2	1	1	11	71	14	22.39	-	-	38.0	27.0	11.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	38.50	D	31	18	24	29	53	21.72	CL-ML	4	2	2	34	53	5	20.66	-	-	27.0	21.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	40.00	D	32	20	28	33	61	23.52	-	-	-	-	-	-	-	20.37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX-B
TABLE 9: CHEMICAL TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	SULPHATE CONTENT AS SO_3 (%)	CHLORIDE CONTENT (%)	pH VALUE
P24	2.00	0.034	0.030	8.42
P30	4.00	0.069	0.069	8.97

APPENDIX-B
TABLE 10: CHEMICAL TEST ON GROUND WATER SAMPLES

BH No.	SULPHATE CONTENT AS SO_3 (mg/l)	CHLORIDE CONTENT (mg/l)	pH VALUE
P24	61.725	447.861	7.22
P30	57.610	417.870	7.00

APPENDIX-B
TABLE 11: UCS TEST ON SOIL SAMPLES

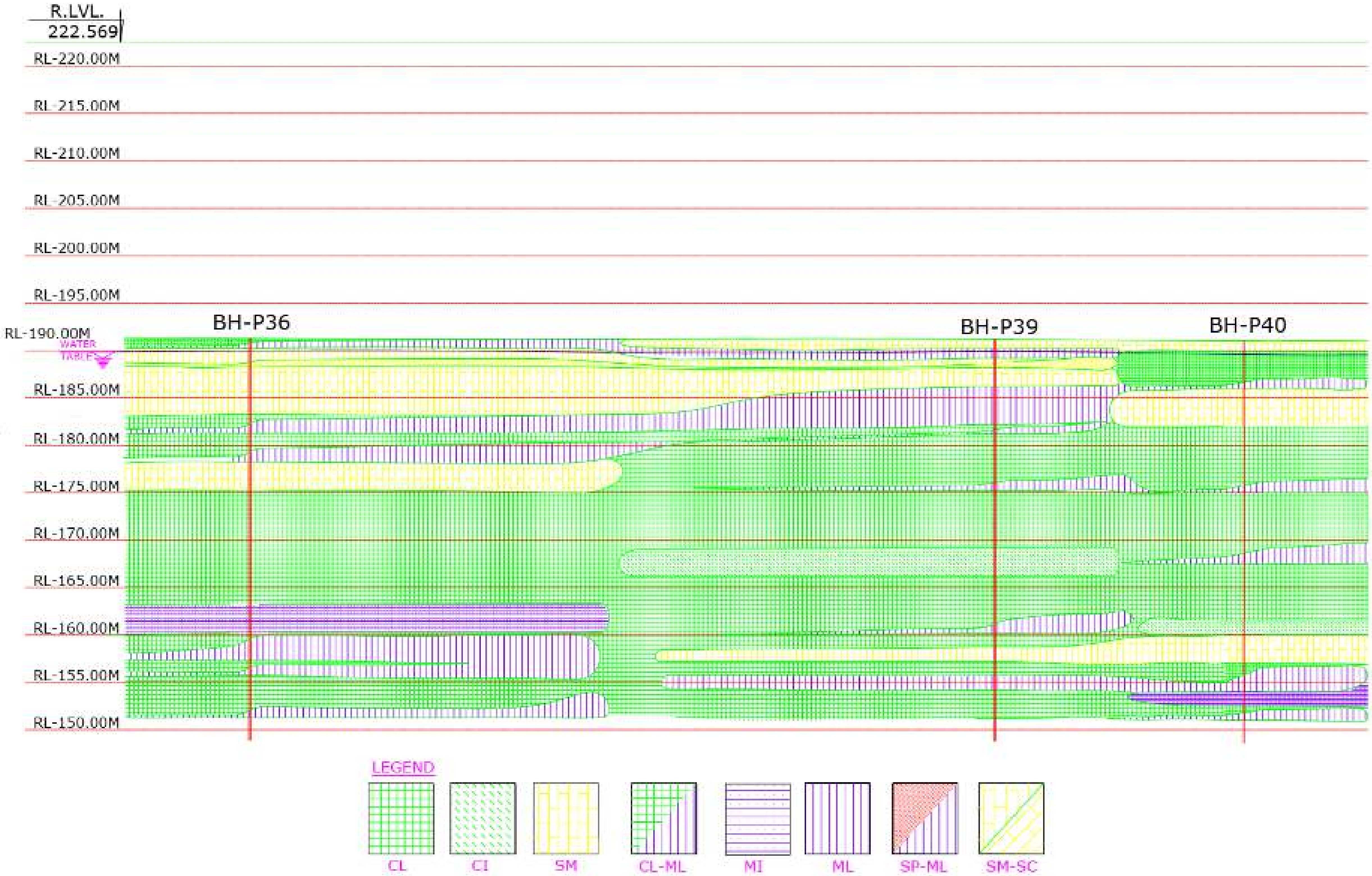
BH No.	DEPTH (m)	UCS (kg/cm²)
P24	2.00	0.75
	23.00	0.47
	29.00	0.37
P30	10.00	0.32
	25.00	0.71
	31.00	0.20
P32	10.00	0.63
	16.00	0.60
	22.00	0.71
P33	10.00	0.62
	13.00	0.66
	16.00	0.72
	19.00	0.75
P34	14.00	0.66
	20.00	0.70
	23.00	0.75
P36	10.00	0.73
	16.00	0.76
	19.00	0.81
	22.00	0.84
	28.00	0.89
P39	10.00	0.78
	13.00	0.76
	16.00	0.79
	19.00	0.81
	22.00	0.96
	25.00	0.68
P40	10.00	0.78
	13.00	0.83
	16.00	0.95
	19.00	0.71

APPENDIX-C

PLOT 1: LITHOLOGICAL PROFILE-1

APPENDIX-C
PLOT 2: LITHOLOGICAL PROFILE-2

APPENDIX-C
PLOT 3: LITHOLOGICAL PROFILE-3



APPENDIX-C
PLOT 4: LITHOLOGICAL PLOTS

BH-P24-21544.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		1.00	D	4	-	-
Inorganic clays of low plasticity	CL		2.00	U		-	-
Silty Sands	SM		3.00	D	14	-	-
			4.00	D	18	-	-
			5.00	D		-	-
			6.00	D	12	-	-
			7.00	D	19	-	-
Poorly Graded Sands with Inorganic Silts of low plasticity	SP-ML		8.00	U		-	-
			9.00	D	23	-	-
Silty Sands	SM		10.00	D	20	-	-
			11.00	U		-	-
			12.50	D	28	-	-
Inorganic Silty Clays of low plasticity	CL-ML		14.00	U		-	-
Inorganic Silts of low plasticity	ML		15.50	D	18	-	-
Inorganic clays of low plasticity	CL		17.00	U		-	-
			18.50	D	22	-	-
			20.00	U		-	-

BH-P24-21544.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.00	U		-	-
			21.50	D	35	-	-
			23.00	U		-	-
			24.50	D	37	-	-
Inorganic clays of Intermediate plasticity	CI		26.00	U		-	-
			27.50	D	38	-	-
Inorganic clays of low plasticity	CL		29.00	U		-	-
			30.50	D	33	-	-
			32.00	D		-	-
			33.50	D	39	-	-
Silty Sands	SM		35.00	D		-	-
			36.50	D	36	-	-
			38.00	D		-	-
			40.00	D	69	-	-

APPENDIX-C
PLOT 5: LITHOLOGICAL PLOTS

BH-P30-21701.8870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	U		-	-
			2.00	D	5	-	-
			3.00	D	9	-	-
			4.00	U		-	-
			5.00	D	11	-	-
			6.00	D	12	-	-
			7.00	D		-	-
			8.00	D	14	-	-
			9.00	D	16	-	-
Inorganic clays of low plasticity	CL		10.00	U		-	-
			11.00	D	15	-	-
			12.00	D	17	-	-
			13.00	U		-	-
			14.50	D	21	-	-
			16.00	U		-	-
			17.50	D	22	-	-
Silty Sands with clay binder	SM-SC		19.00	U		-	-
			20.00	D	26	-	-

BH-P30-21701.8870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands with clay binder	SM-SC						
Inorganic clays of low plasticity	CL		20.50	D	26	-	-
			22.00	D		-	-
			23.50	D	23	-	-
			25.00	U		-	-
			26.50	D	22	-	-
			28.00	D		-	-
			29.50	D	26	-	-
Inorganic Silty Clays of low plasticity	CL-ML		31.00	U		-	-
			32.50	D	32	-	-
Inorganic clays of low plasticity	CL		34.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		35.50	D	40	-	-
			37.00	D		-	-
Inorganic clays of low plasticity	CL		38.50	D	50	-	-
			40.00	D	59	-	-

APPENDIX-C
PLOT 6: LITHOLOGICAL PLOTS

BH-P32-21754.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML	WATER LEVEL	1.00	U		-	-
			2.00	D	4	-	-
Silty Sands	SM		3.00	D	5	-	-
			4.00	D		-	-
			5.00	D	7	-	-
Silty Sands with clay binder	SM-SC		6.00	D	9	-	-
Silty Sands	SM		7.00	D		-	-
			8.00	D	13	-	-
Inorganic Silty Clays of low plasticity	CL-ML		9.00	D	17	-	-
			10.00	U		-	-
Inorganic clays of low plasticity	CL		11.00	D	18	-	-
			12.00	D	22	-	-
			13.00	D		-	-
Silty Sands	SM		14.50	D	36	-	-
			16.00	U		-	-
Inorganic clays of low plasticity	CL		17.50	D	19	-	-
Inorganic Silty Clays of low plasticity	CL-ML		19.00	U		-	-
			20.00	D	38	-	-

BH-P32-21754.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML		20.50	D	38	-	-
			22.00	U		-	-
			23.50	D	75	-	-
			25.00	D	63	-	-
Inorganic clays of low plasticity	CL		26.50	D	71	-	-
			28.00	D	75	-	-
			29.50	D	62	-	-
			31.00	D	102	-	-
Inorganic Silty Clays of low plasticity	CL-ML		32.50	D	95	-	-
Inorganic clays of low plasticity	CL		34.00	D	103	-	-
Inorganic Silts of low plasticity	ML		35.50	D	87	-	-
			37.00	D	91	-	-
Inorganic clays of low plasticity	CL		38.50	D	83	-	-
			40.00	D	56	-	-

APPENDIX-C
PLOT 7: LITHOLOGICAL PLOTS

BH-P33-21780.4870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			0.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		1.00	U		-	-
			2.00	D	5	-	-
			3.00	D	7	-	-
			4.00	U		-	-
Silty Sands	SM		5.00	D	10	-	-
			6.00	D	12	-	-
			7.00	U		-	-
			8.00	D	14	-	-
			9.00	D	20	-	-
Inorganic clays of low plasticity	CL		10.00	U		-	-
Silty Sands with clay binder	SM-SC		11.00	D	30	-	-
Silty Sands	SM		12.00	D	29	-	-
			13.00	U		-	-
			14.50	D	32	-	-
Inorganic clays of low plasticity	CL		16.00	U		-	-
			17.50	D	39	-	-
			19.00	U		-	-
			20.00	D	42	-	-

BH-P33-21780.4870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.50	D	42	-	-
			22.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		23.50	D	88	-	-
			25.00	D	75	-	-
Inorganic clays of low plasticity	CL		26.50	D	80	-	-
			28.00	D	87	-	-
			29.50	D	101	-	-
Inorganic Clays of low to intermediate plasticity	CL-CI		31.00	D	82	-	-
			32.50	D	90	-	-
			34.00	D	98	-	-
			35.50	D	72	-	-
Inorganic clays of low plasticity	CL		37.00	D	88	-	-
			38.50	D	100	-	-
			40.00	D	96	-	-

APPENDIX-C
PLOT 8: LITHOLOGICAL PLOTS

BH-P34-21806.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	D	3	-	-
Silty Sands with clay binder	SM-SC		2.00	U		-	-
Inorganic Silts of low plasticity	ML		3.00	D	6	-	-
			4.00	D	14	-	-
			5.00	U		-	-
Silty Sands	SM		6.00	D	18	-	-
			7.00	D	23	-	-
Inorganic Silts of low plasticity	ML		8.00	U		-	-
			9.00	D	15	-	-
Silty Sands	SM		10.00	D	20	-	-
			11.00	U		-	-
			12.50	D	19	-	-
			14.00	U		-	-
Inorganic clays of low plasticity	CL		15.50	D	12	-	-
			17.00	D		-	-
			18.50	D	21	-	-
			20.00	U		-	-

BH-P34-21806.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	U		-	-
			21.50	D	30	-	-
			23.00	U		-	-
Inorganic clays of low plasticity	CL		24.50	D	38	-	-
			26.00	D		-	-
			27.50	D	47	-	-
			29.00	D		-	-
Silty Sands	SM		30.50	D	71	-	-
			32.00	D	75	-	-
			33.50	D	68	-	-
Inorganic Silty Clays of low plasticity	CL-ML		35.00	D	55	-	-
			36.50	D	52	-	-
			38.00	D	65	-	-
Inorganic clays of low plasticity	CL		40.00	D	53	-	-

APPENDIX-C
PLOT 9: LITHOLOGICAL PLOTS

BH-P36-21859.0870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML		0.50	D		-	-
Silty Sands			1.00	U		-	-
Silty Sands with clay binder	SM-SC		2.00	D	6	-	-
			3.00	D	10	-	-
Silty Sands	SM		4.00	U		-	-
			5.00	D	16	-	-
			6.00	D	22	-	-
			7.00	U		-	-
			8.00	D	17	-	-
Inorganic Silty Clays of low plasticity	CL-ML		9.00	D	22	-	-
Inorganic clays of low plasticity	CL		10.00	U		-	-
			11.00	D	29	-	-
Inorganic Silty Clays of low plasticity	CL-ML		12.00	D	26	-	-
			13.00	U		-	-
Silty Sands	SM		14.50	D	27	-	-
			16.00	U		-	-
Inorganic clays of low plasticity	CL		17.50	D	21	-	-
			19.00	U		-	-
			20.00	D	26	-	-

BH-P36-21859.0870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.50	D	26	-	-
			22.00	U		-	-
			23.50	D	29	-	-
			25.00	D		-	-
			26.50	D	45	-	-
			28.00	U		-	-
Inorganic Silts of Intermediate plasticity	MI		29.50	D	45	-	-
Inorganic Silty Clays of low plasticity	CL-ML		31.00	D		-	-
Inorganic Silts of low plasticity	ML		32.50	D	56	-	-
Inorganic Silty Clays of low plasticity	CL-ML		34.00	D	62	-	-
			35.50	D	40	-	-
Inorganic clays of low plasticity	CL		37.00	D		-	-
			38.50	D	48	-	-
Inorganic Silty Clays of low plasticity	CL-ML		40.00	D	54	-	-

APPENDIX-C
PLOT 10: LITHOLOGICAL PLOTS

BH-P39-21937.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
Inorganic Silts of low plasticity	ML		1.00	D		-	-
Silty Sands with clay binder	SM-SC		2.00	D	7	-	-
			3.00	D	6	-	-
Silty Sands	SM		4.00	U		-	-
			5.00	D	7	-	-
			6.00	D	8	-	-
Inorganic Silts of low plasticity	ML		7.00	D		-	-
			8.00	D	9	-	-
Inorganic Silty Clays of low plasticity	CL-ML		9.00	D	10	-	-
			10.00	U		-	-
			11.00	D	23	-	-
Inorganic clays of low plasticity	CL		12.00	D	25	-	-
			13.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		14.50	D	18	-	-
			16.00	U		-	-
Inorganic clays of low plasticity	CL		17.50	D	15	-	-
			19.00	U		-	-
			20.00	D	19	-	-

BH-P39-21937.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.50	D	19	-	-
			22.00	U		-	-
Inorganic clays of Intermediate plasticity	CI		23.50	D	42	-	-
			25.00	U		-	-
			26.50	D	51	-	-
Inorganic clays of low plasticity	CL		28.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		29.50	D	54	-	-
			31.00	D	46	-	-
Inorganic clays of low plasticity	CL		32.50	D	49	-	-
Silty Sands	SM		34.00	D		-	-
Inorganic clays of low plasticity	CL		35.50	D	50	-	-
Inorganic Silts of low plasticity	ML		37.00	D		-	-
Inorganic clays of low plasticity	CL		38.50	D	52	-	-
			40.00	D	62	-	-

APPENDIX-C
PLOT 11: LITHOLOGICAL PLOTS

BH-P40-21963.8870

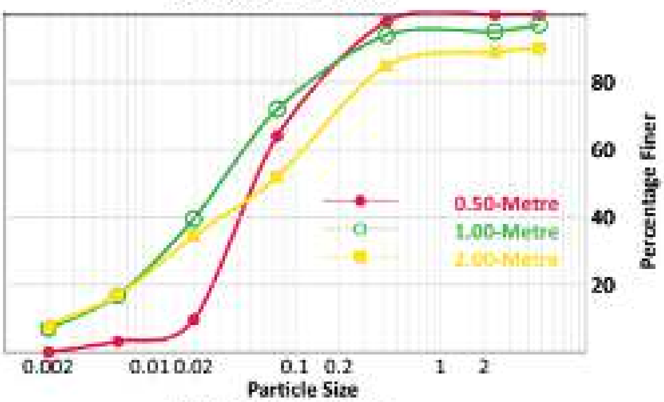
DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	U		-	-
Inorganic clays of low plasticity	CL		2.00	D	4	-	-
			3.00	D	5	-	-
			4.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-MI		5.00	D	7	-	-
			6.00	D	12	-	-
Silty Sands	SM		7.00	U		-	-
			8.00	D	9	-	-
			9.00	D	8	-	-
			10.00	U		-	-
			11.00	D	23	-	-
Inorganic clays of low plasticity	CL		12.00	D	16	-	-
			13.00	U		-	-
			14.50	D	14	-	-
Inorganic Silty Clays of low plasticity	CL-MI		16.00	U		-	-
			17.50	D	22	-	-
Inorganic clays of low plasticity	CI		19.00	U		-	-
			20.00	D	24	-	-

BH-P40-21963.8870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CI		20.50	D	24	-	-
Inorganic Silty Clays of low plasticity	CL-ML		22.00	D		-	-
			23.50	D	26	-	-
			25.00	D		-	-
Inorganic clays of low plasticity	CL		26.50	D	49	-	-
			28.00	D		-	-
			29.50	D	32	-	-
Inorganic clays of intermediate plasticity	CI		31.00	D		-	-
Silty Sands	SM		32.50	D	50	-	-
			34.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-MI		35.50	D	40	-	-
			37.00	D		-	-
Inorganic Silts of Intermediate plasticity	MI		38.50	D	53	-	-
Inorganic Silty Clays of low plasticity	CL-MI		40.00	D	61	-	-

APPENDIX-D
PLOT 1: GRAIN SIZE DISTRIBUTION PLOTS

BH- P24-CH.21544.6870



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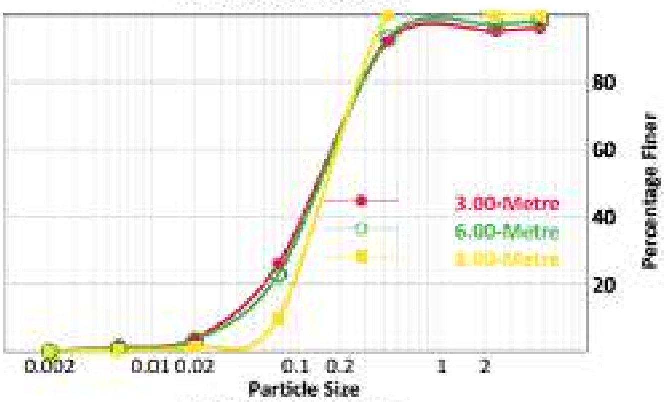

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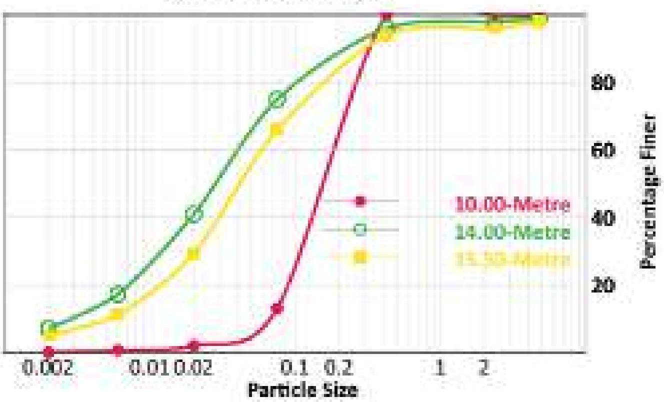

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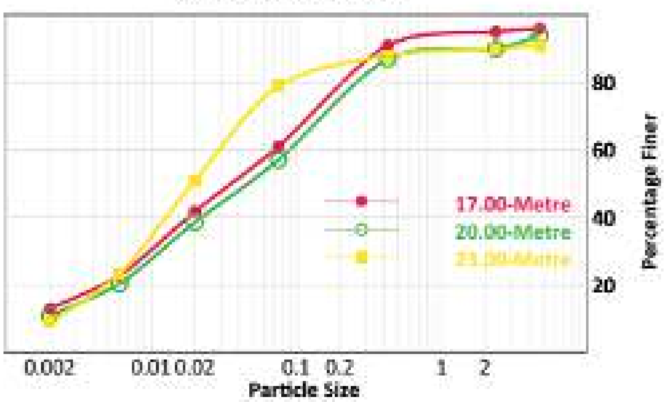

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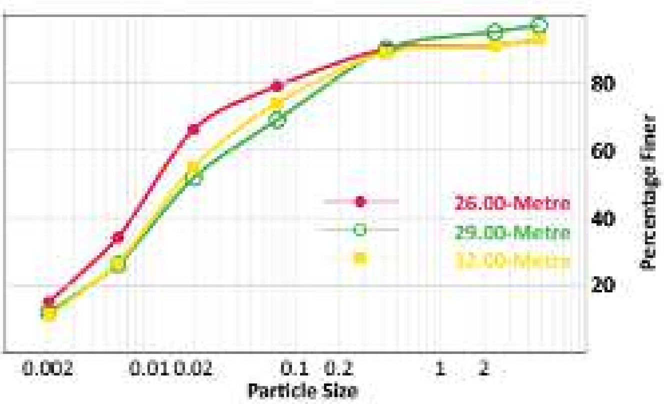

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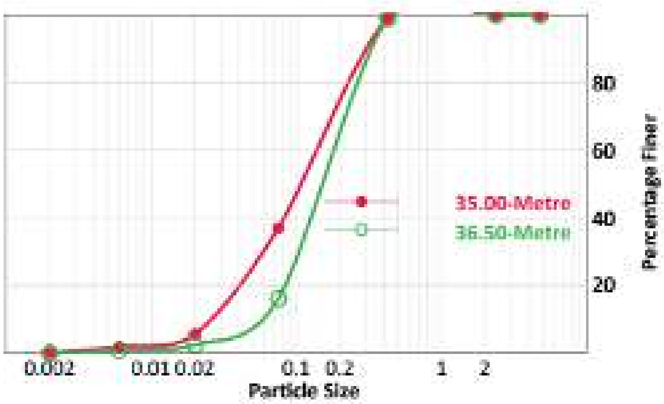

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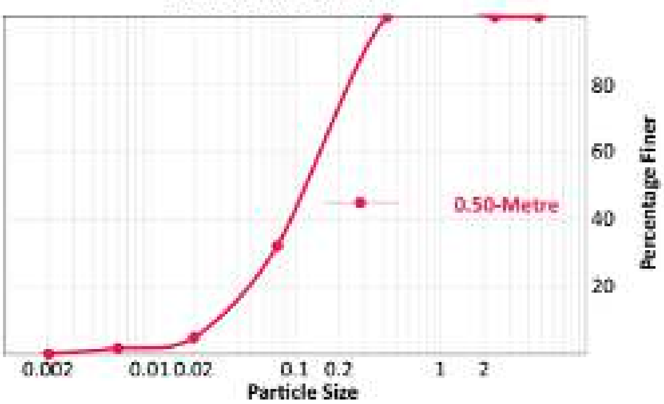

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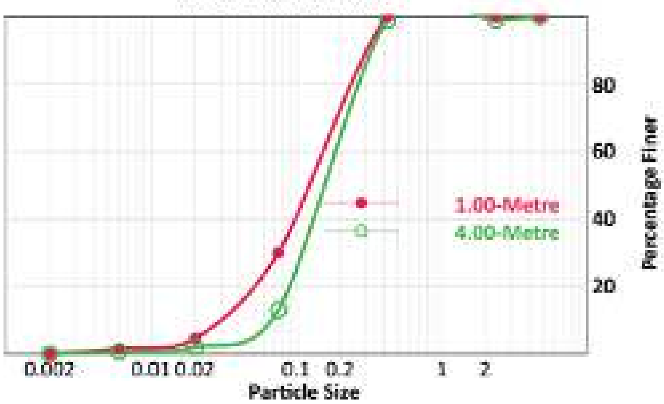
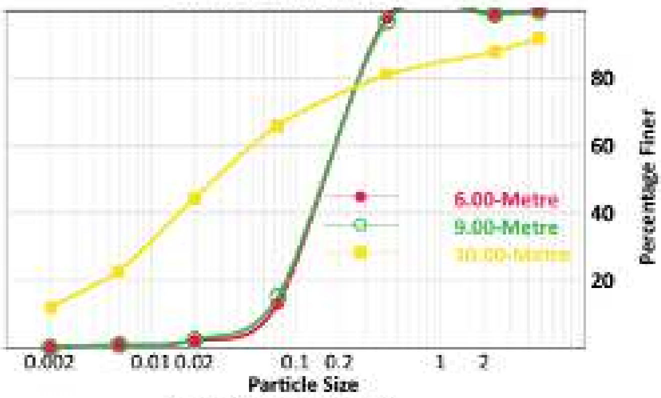


APPENDIX-D

PLOT 2: GRAIN SIZE DISTRIBUTION PLOTS

BH- P30-CH.21701.8870



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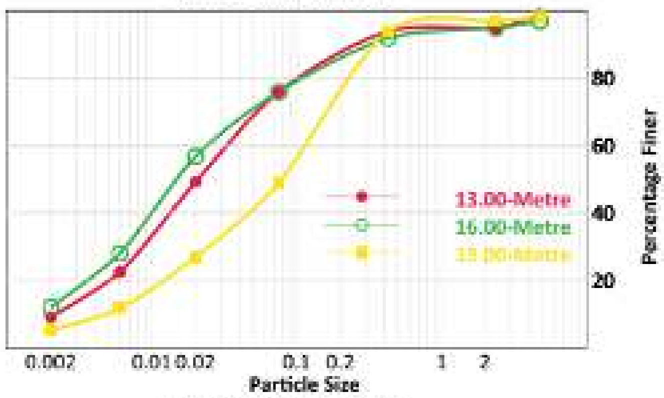

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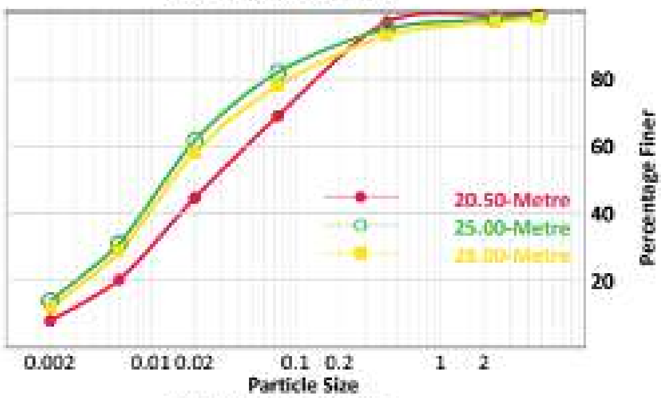

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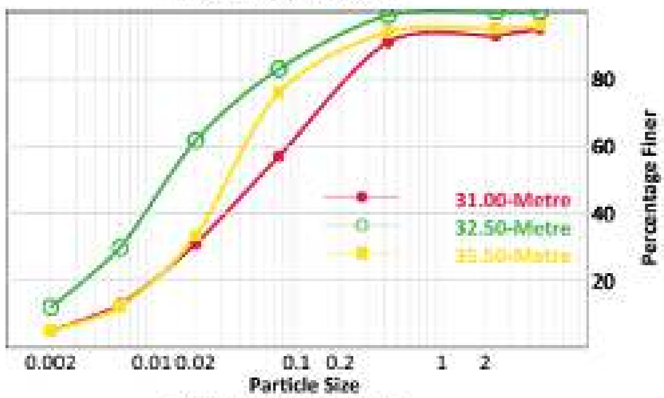

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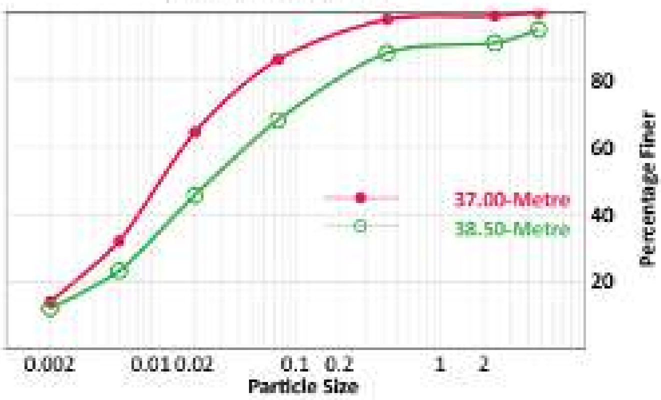
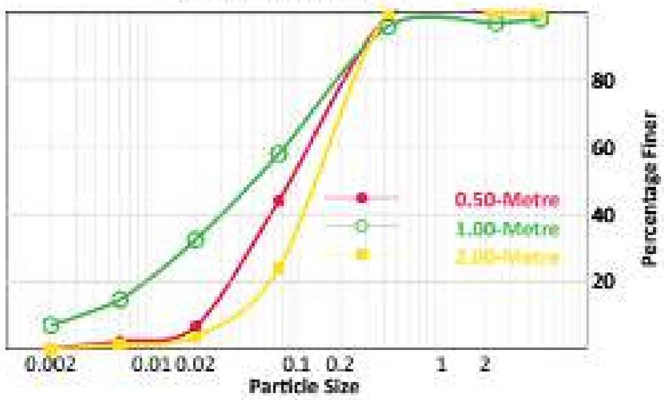


BH- P32-CH.21754.2870



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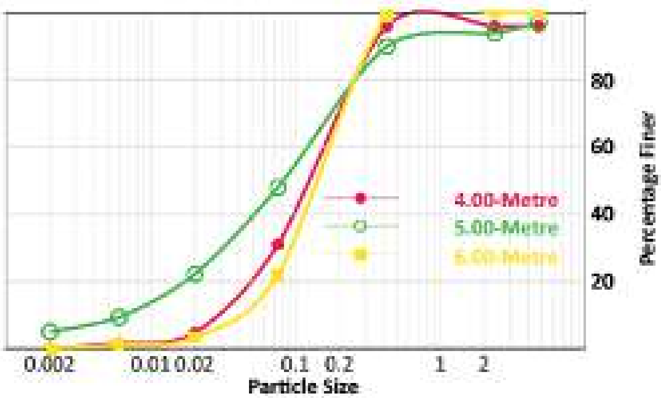

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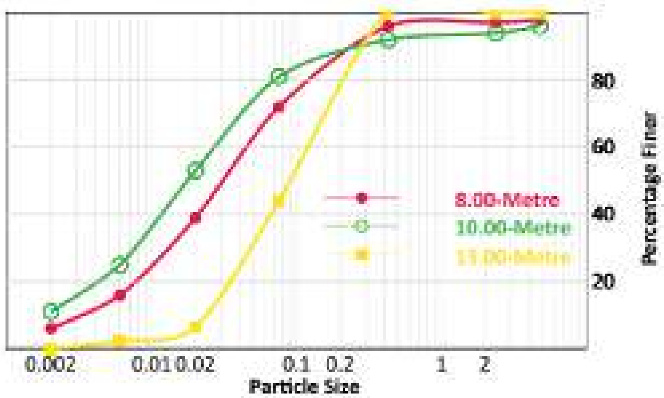
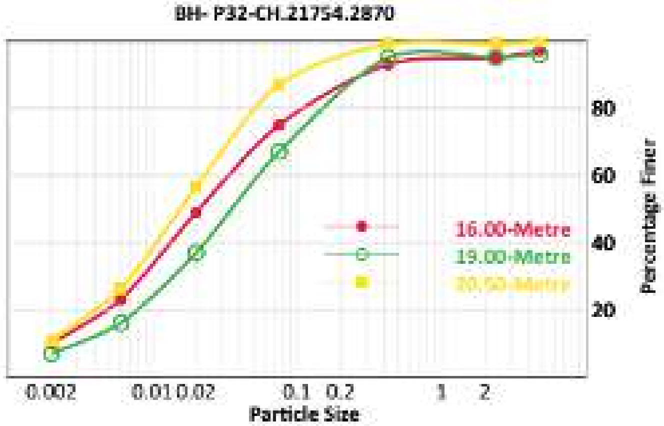
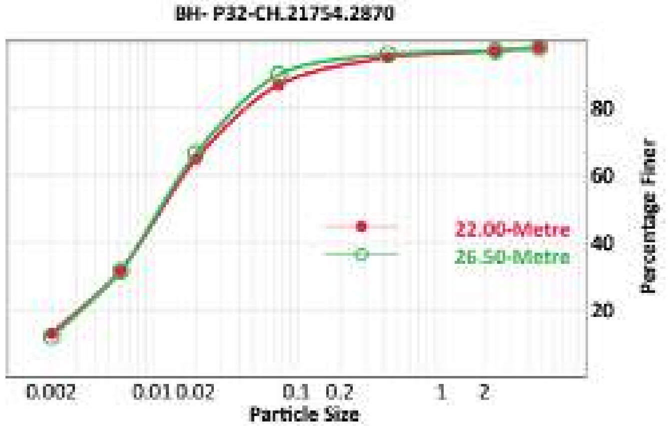
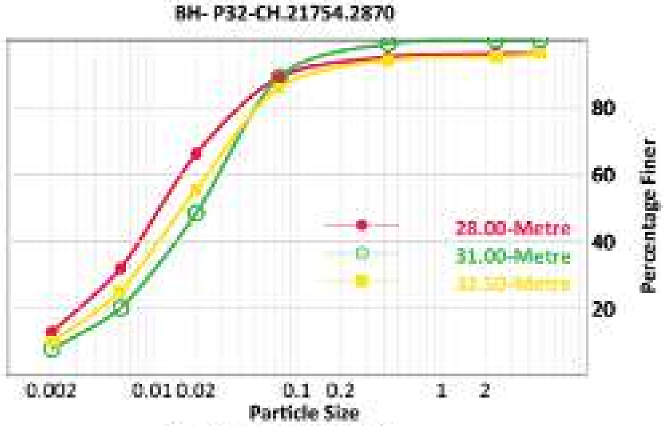
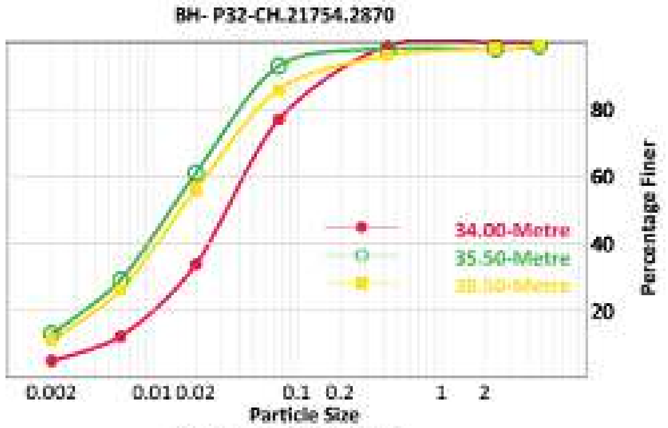


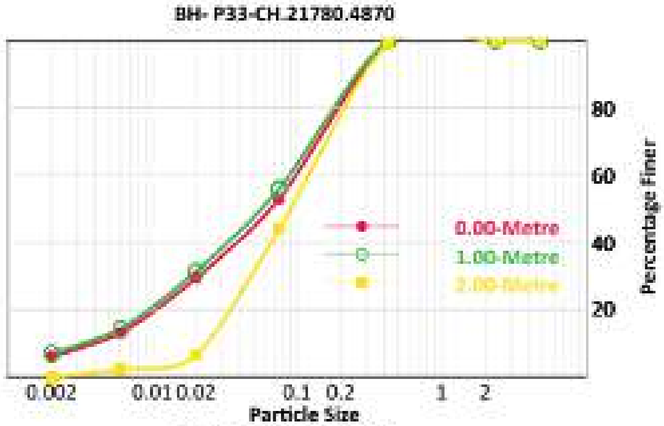
APPENDIX-D
PLOT 3: GRAIN SIZE DISTRIBUTION PLOTS

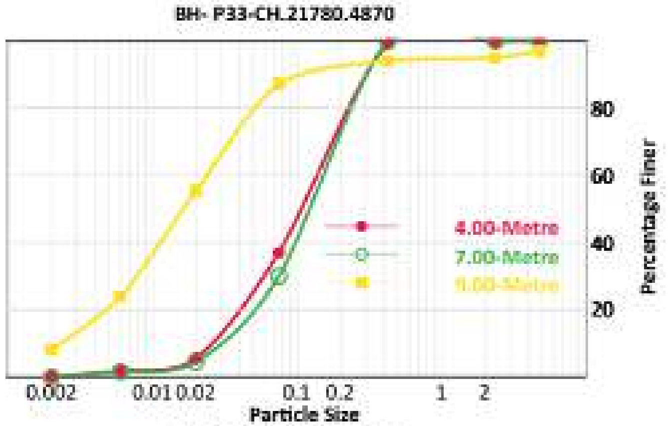


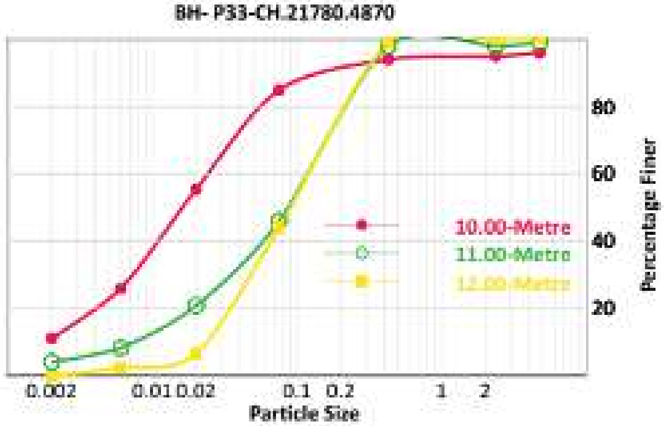


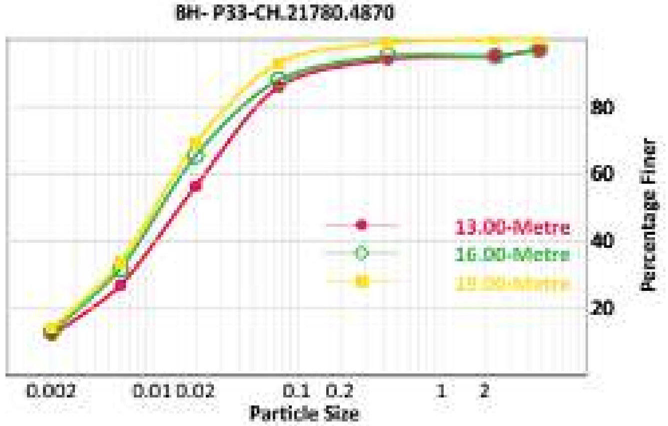




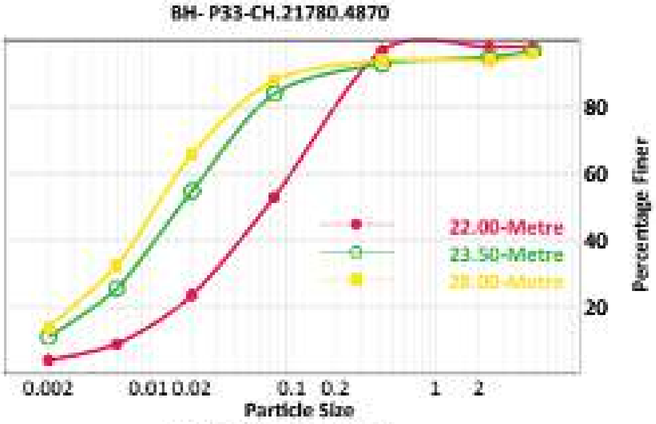


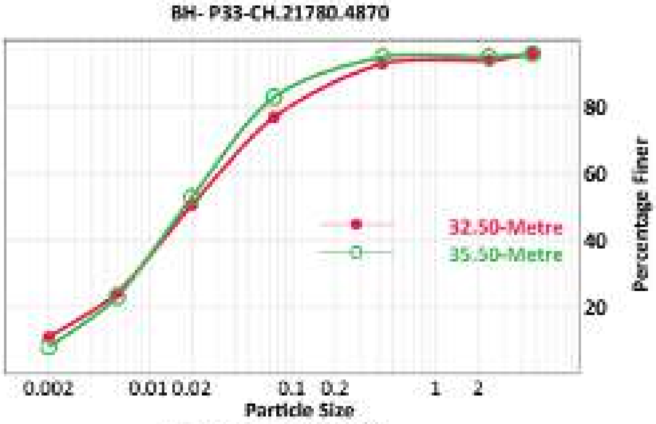


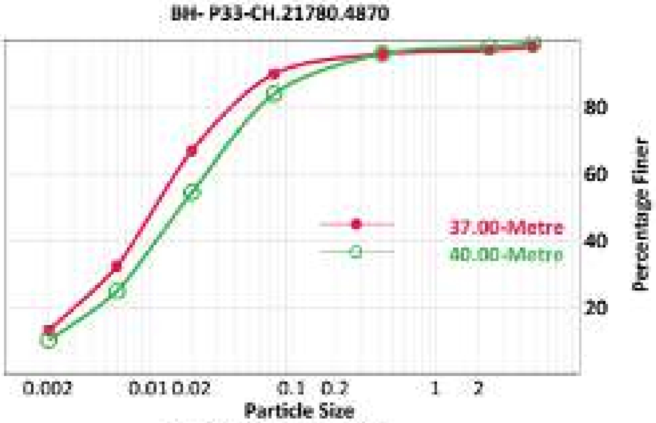


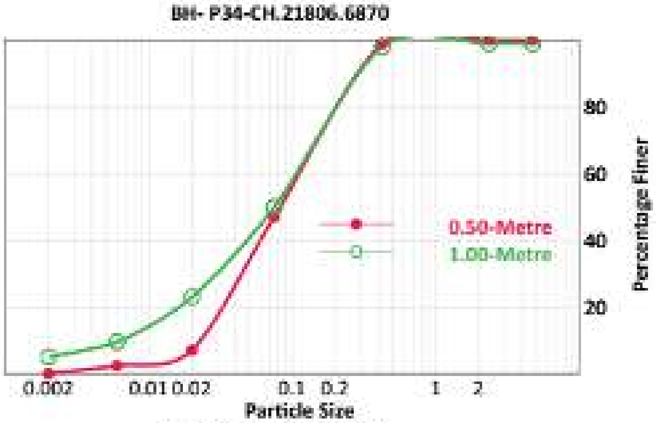


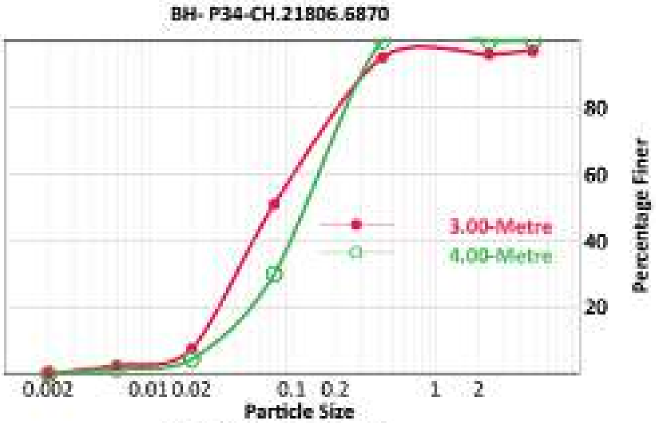
APPENDIX-D
PLOT 4: GRAIN SIZE DISTRIBUTION PLOTS

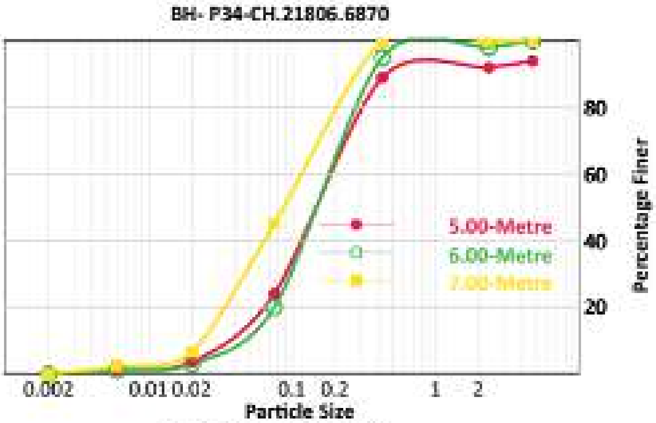


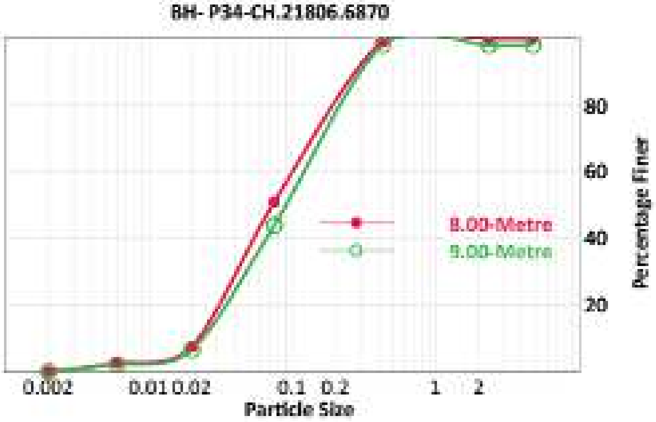


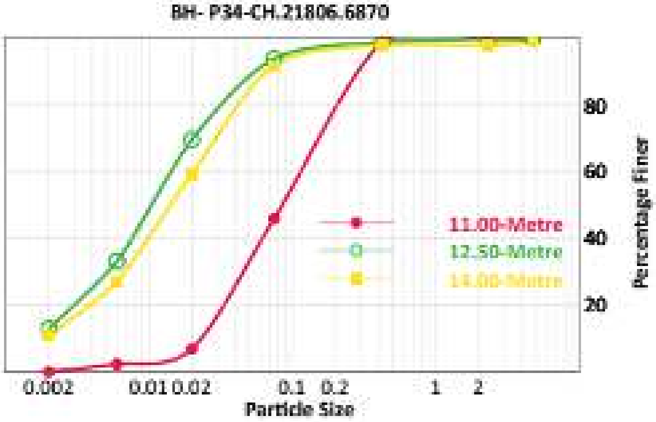




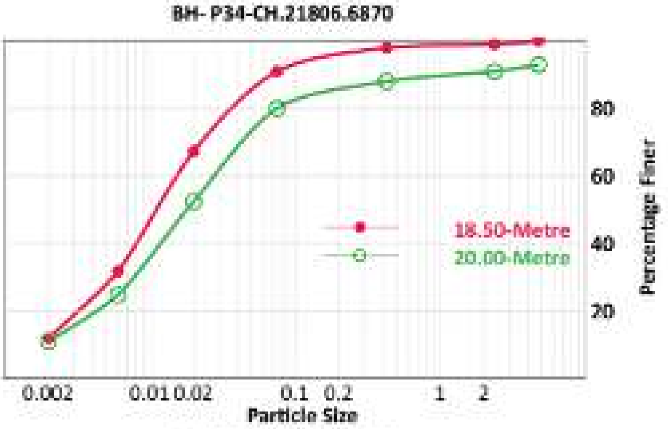


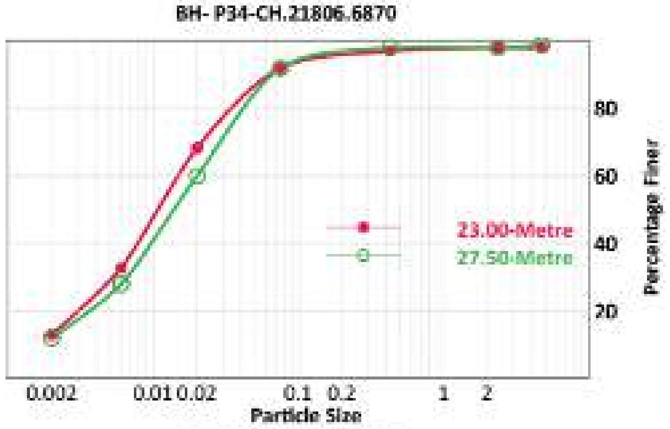


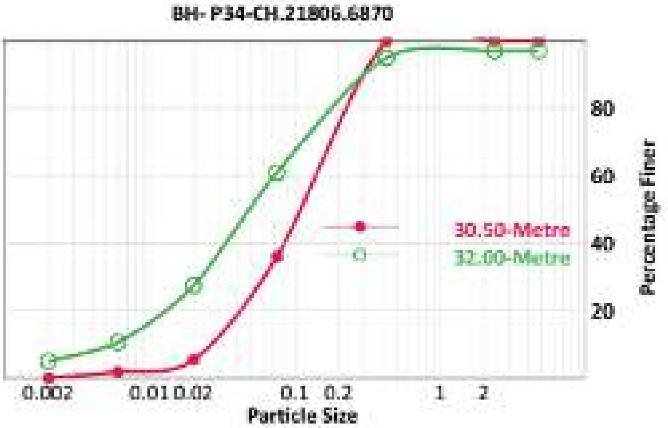


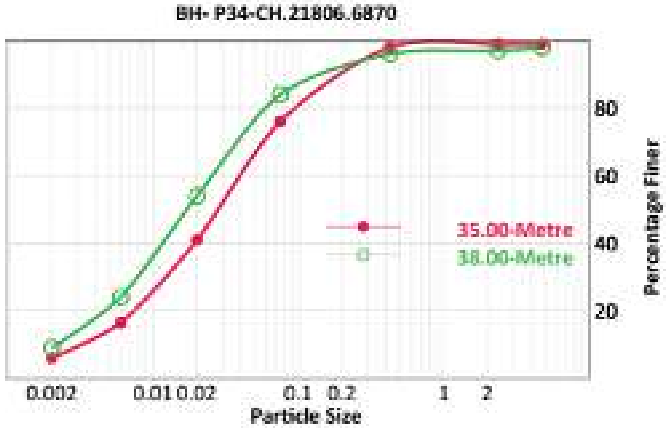


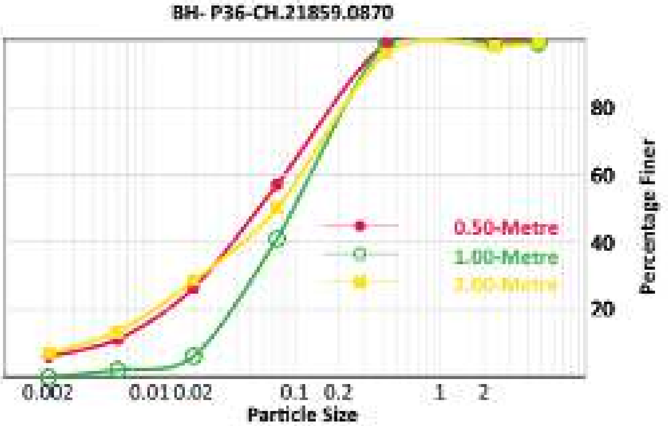
APPENDIX-D
PLOT 5: GRAIN SIZE DISTRIBUTION PLOTS

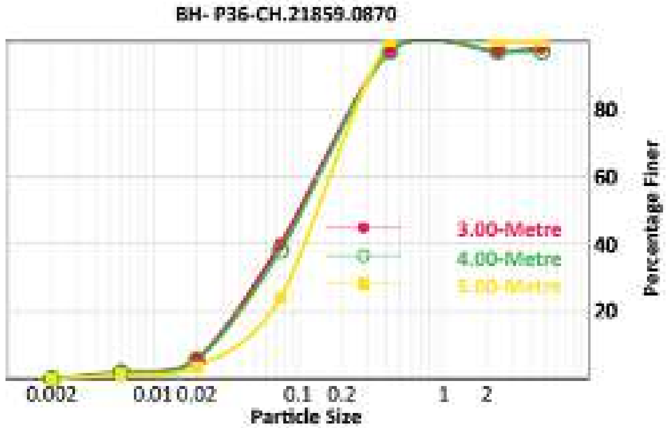


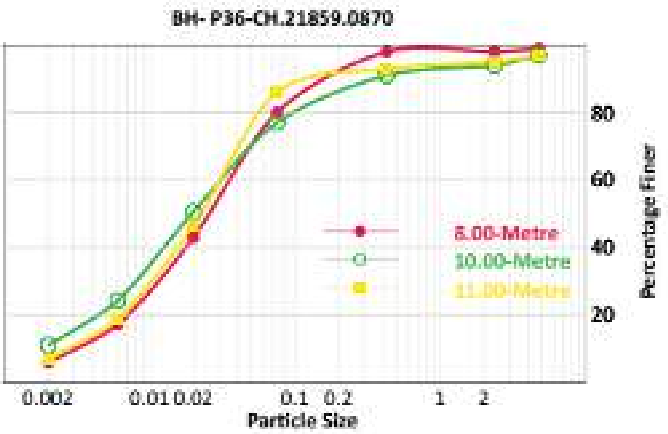


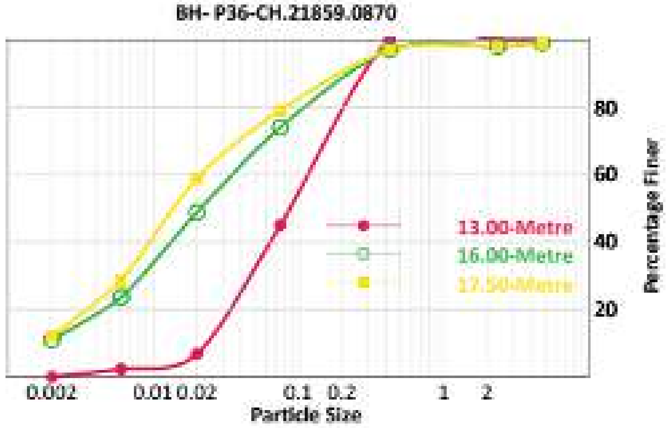






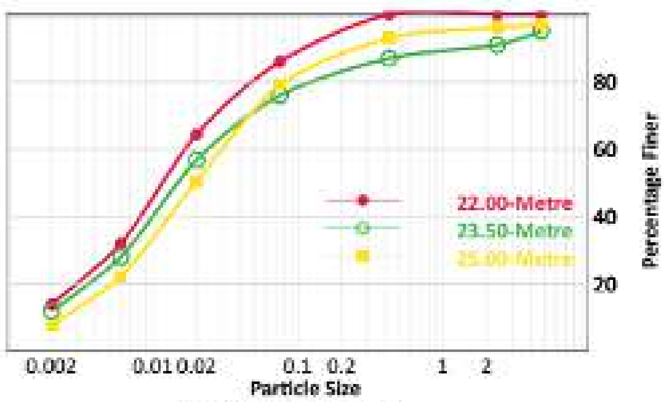






APPENDIX-D
PLOT 6: GRAIN SIZE DISTRIBUTION PLOTS

BH- P36-CH.21859.0870



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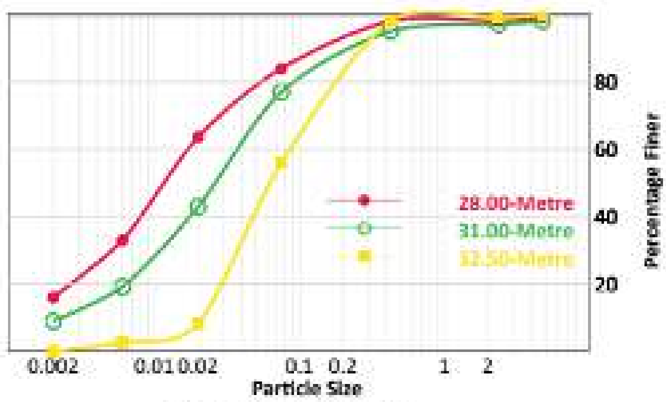

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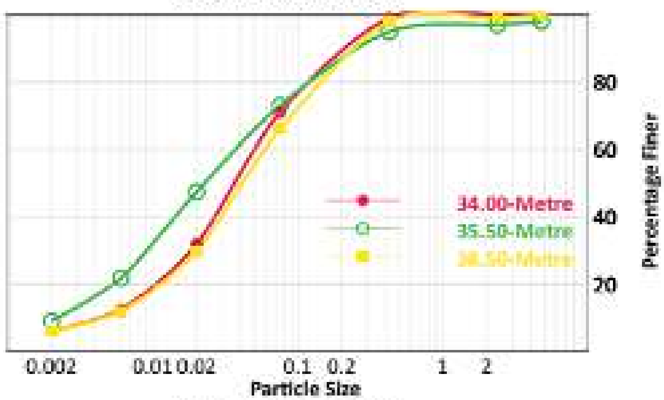
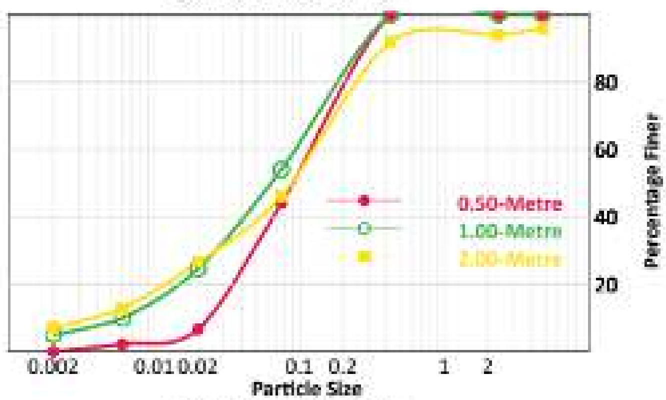


BH- P39-CH.21937.6870



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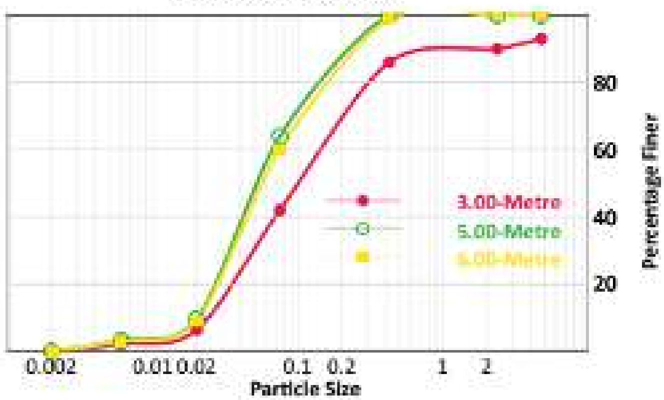

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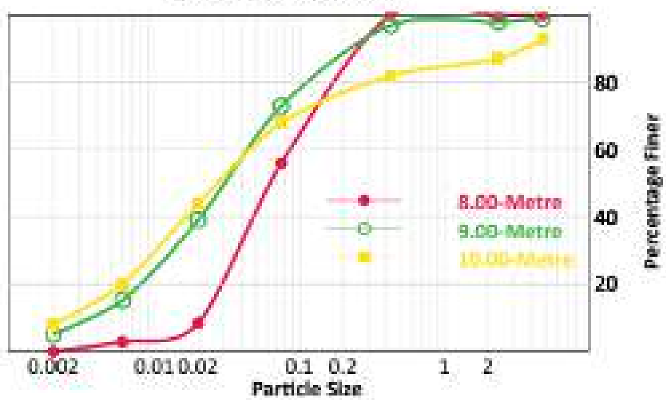

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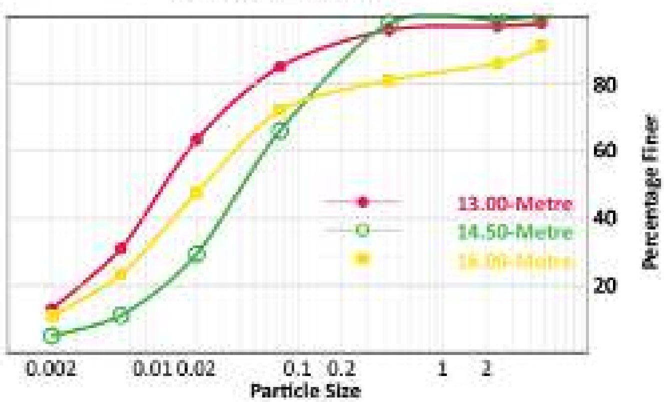

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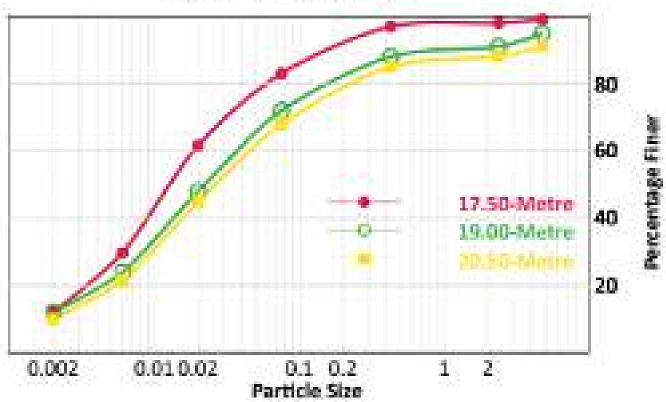
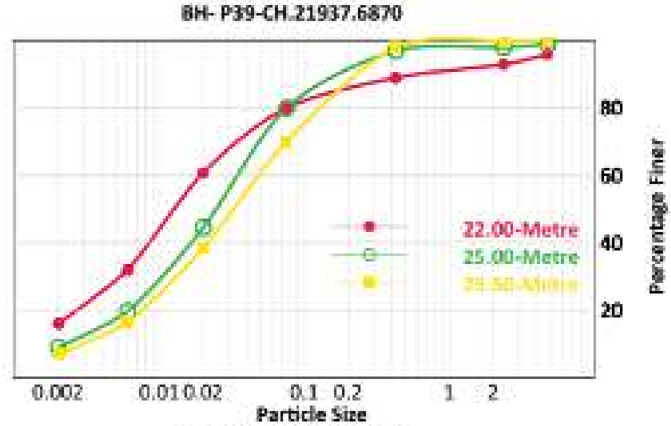
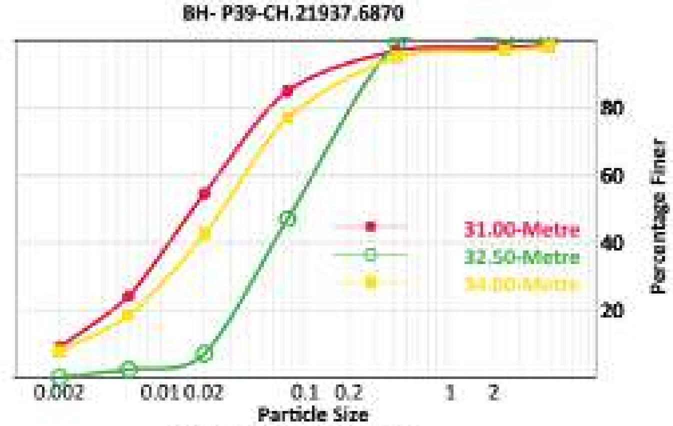
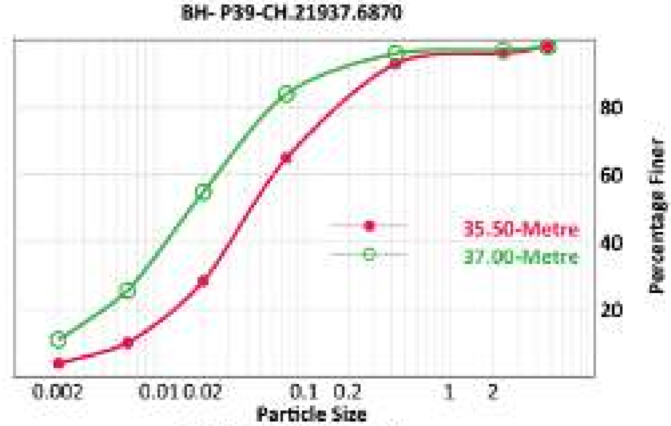
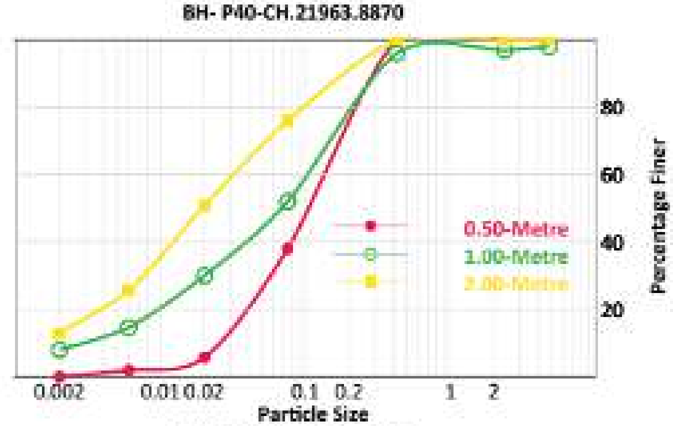


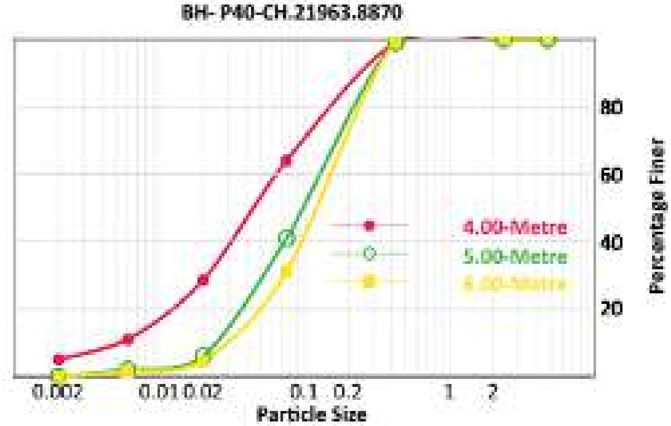
APPENDIX-D
PLOT 7: GRAIN SIZE DISTRIBUTION PLOTS

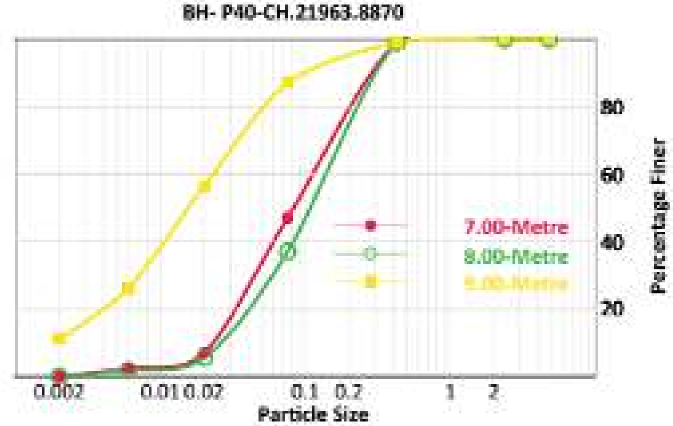


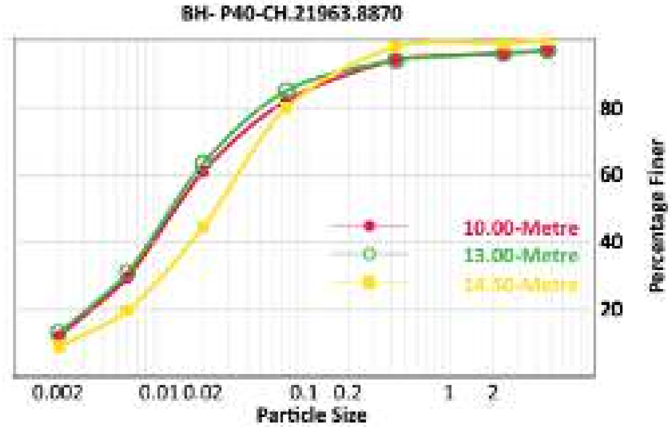


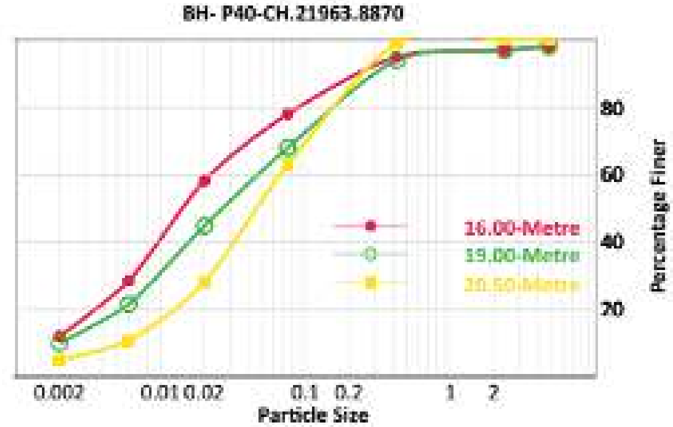






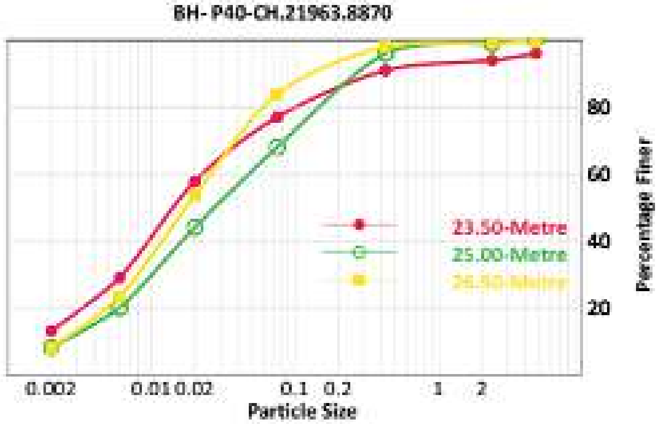


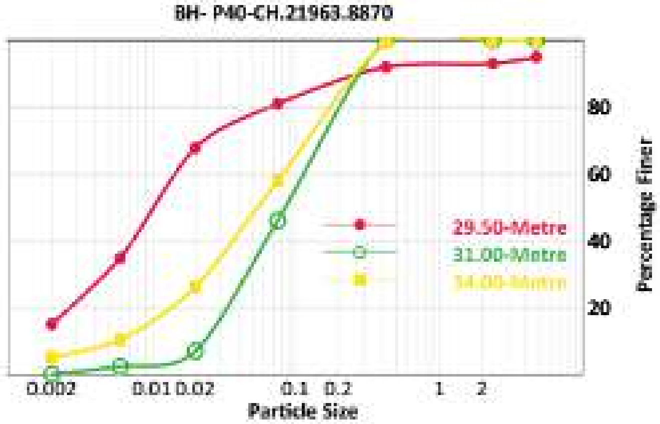


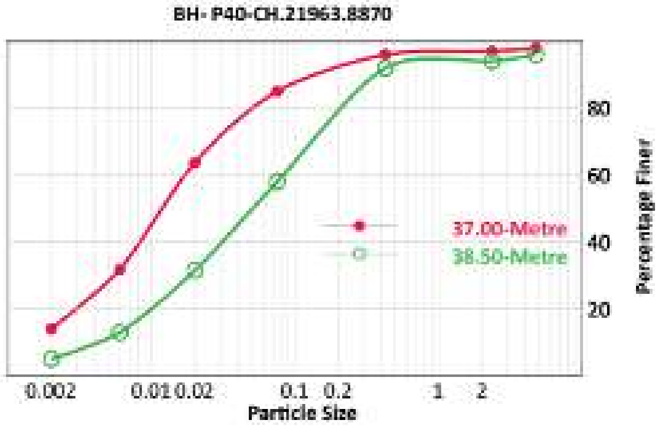


APPENDIX-D

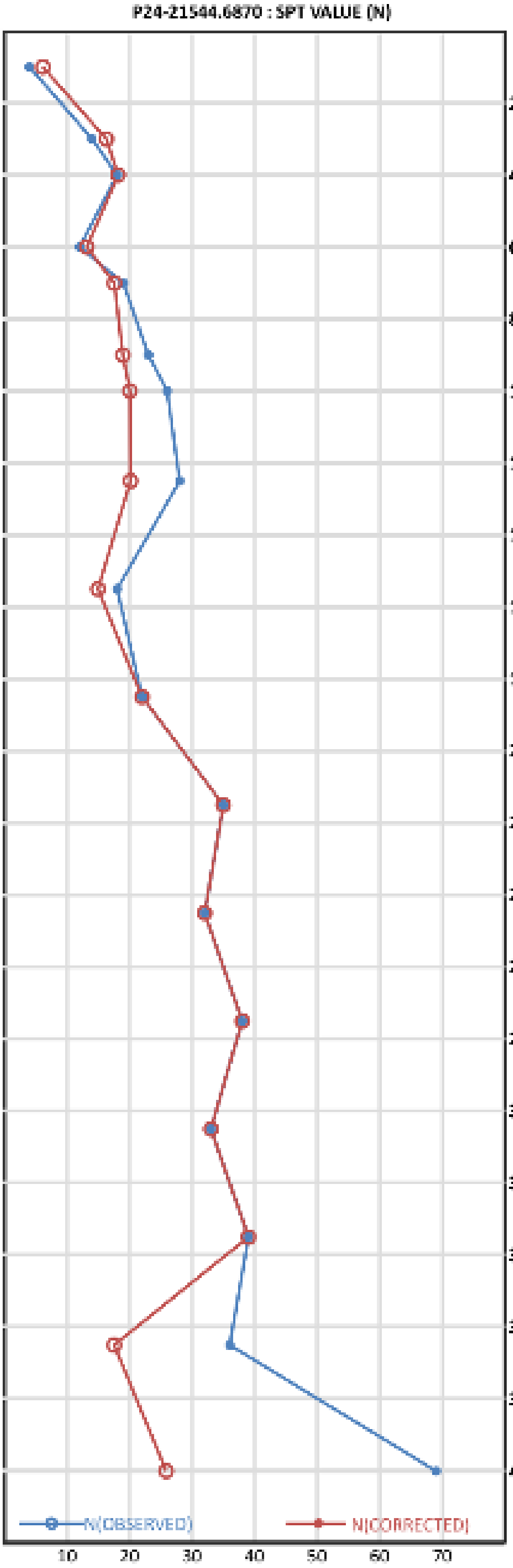
PLOT 8: GRAIN SIZE DISTRIBUTION PLOTS

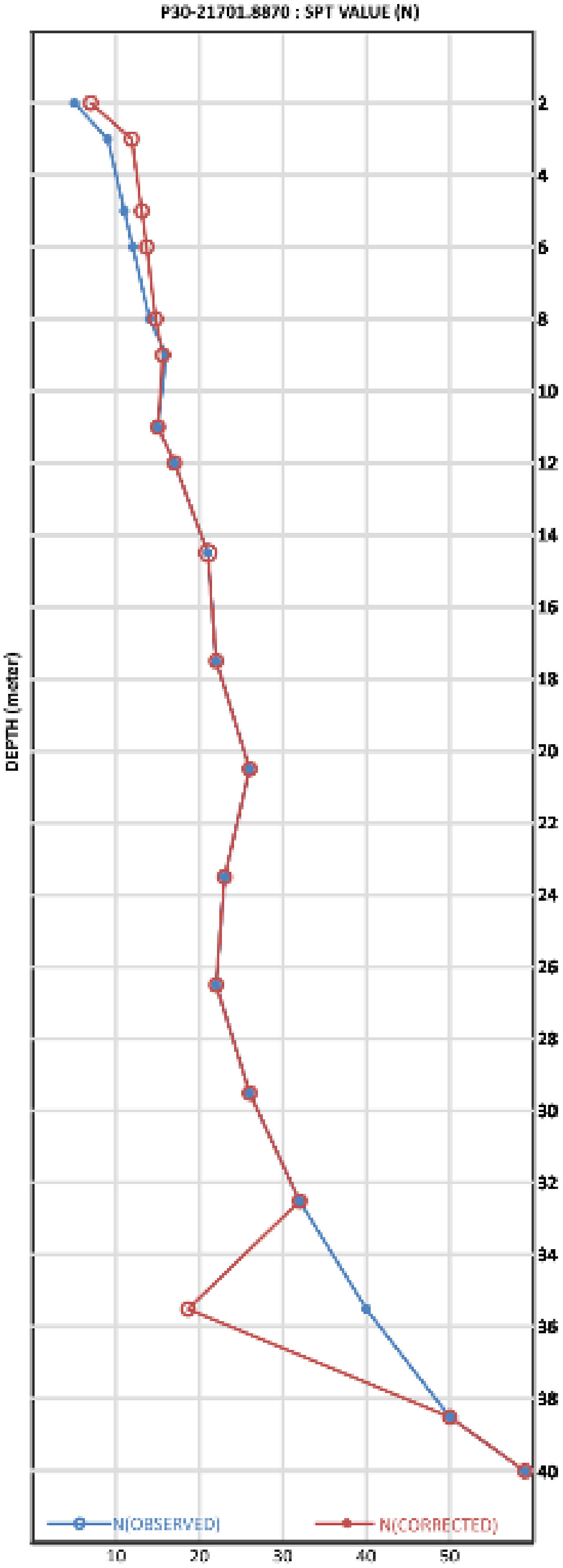




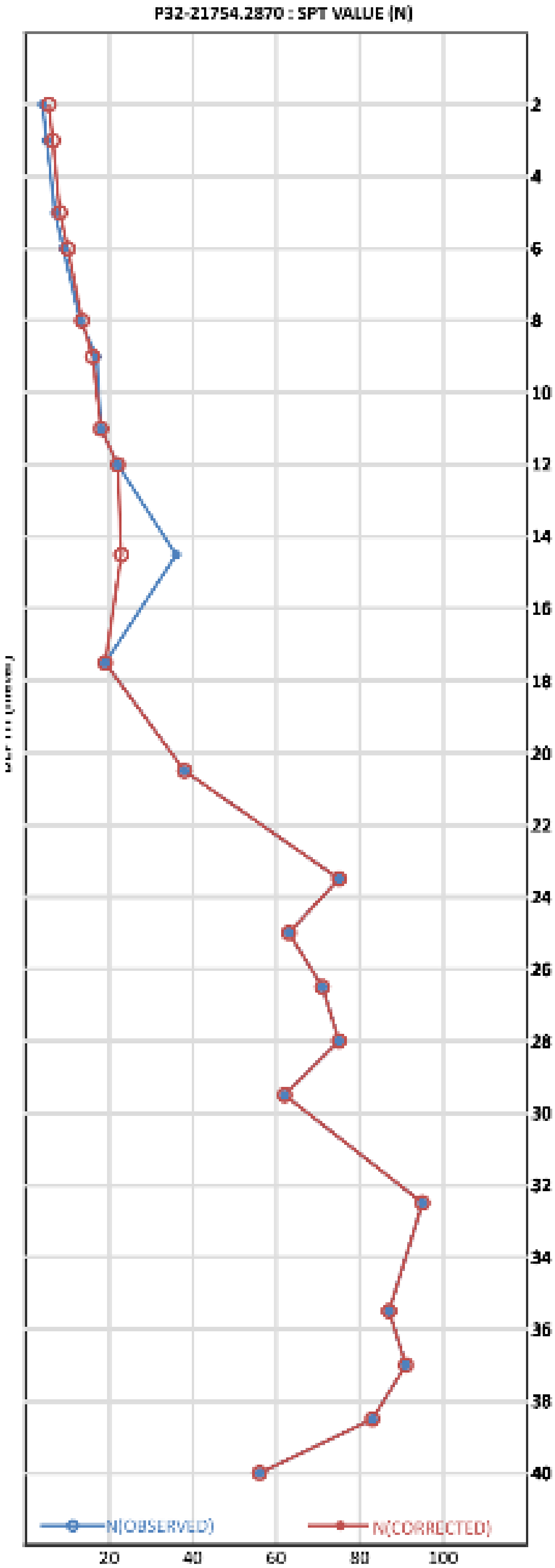


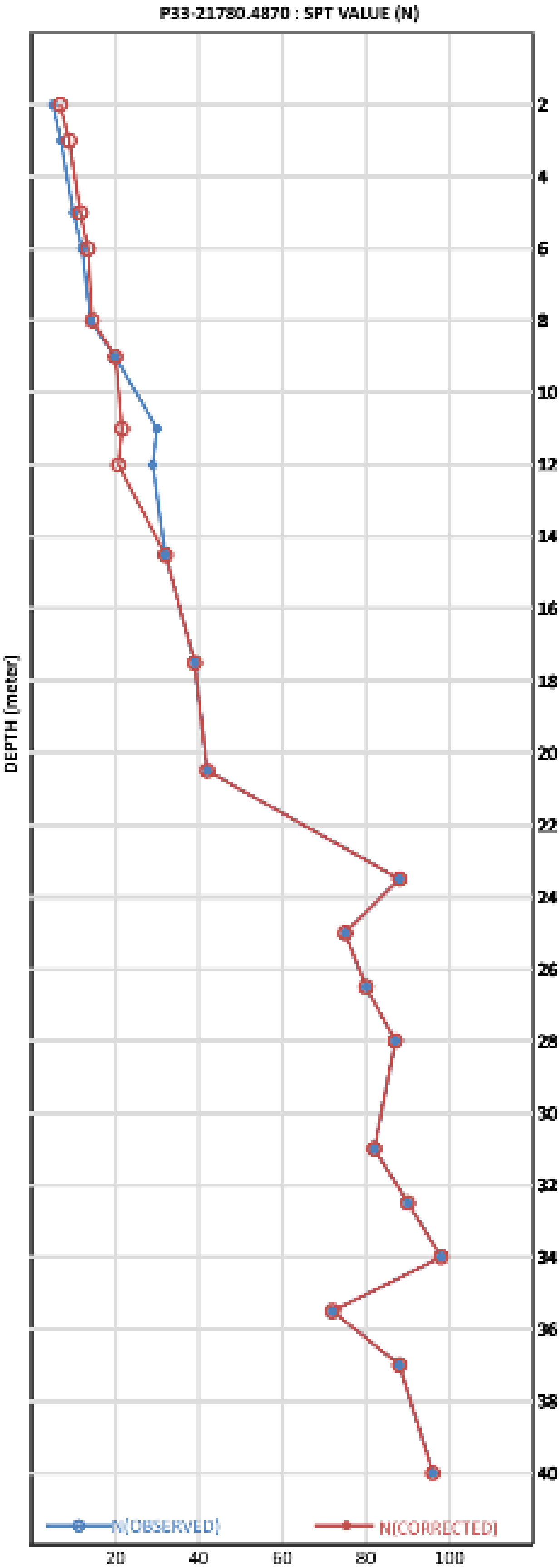
APPENDIX-E
PLOT 1: RECORDED SPT Vs CORRECTED SPT



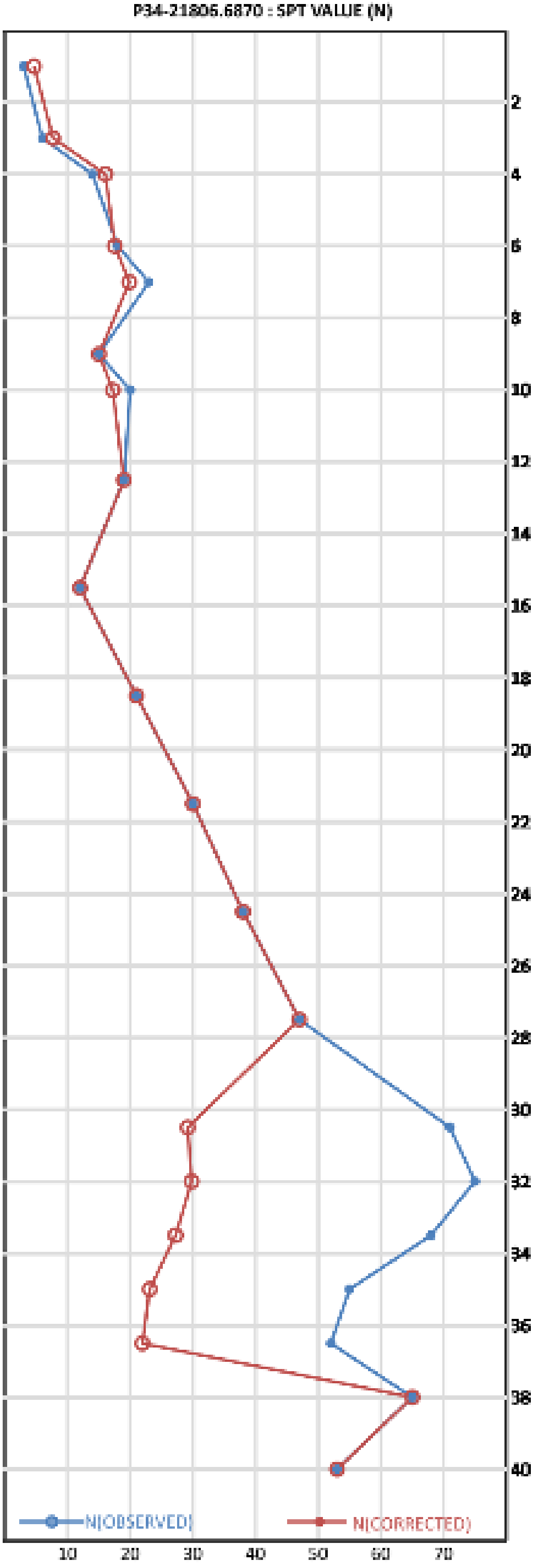


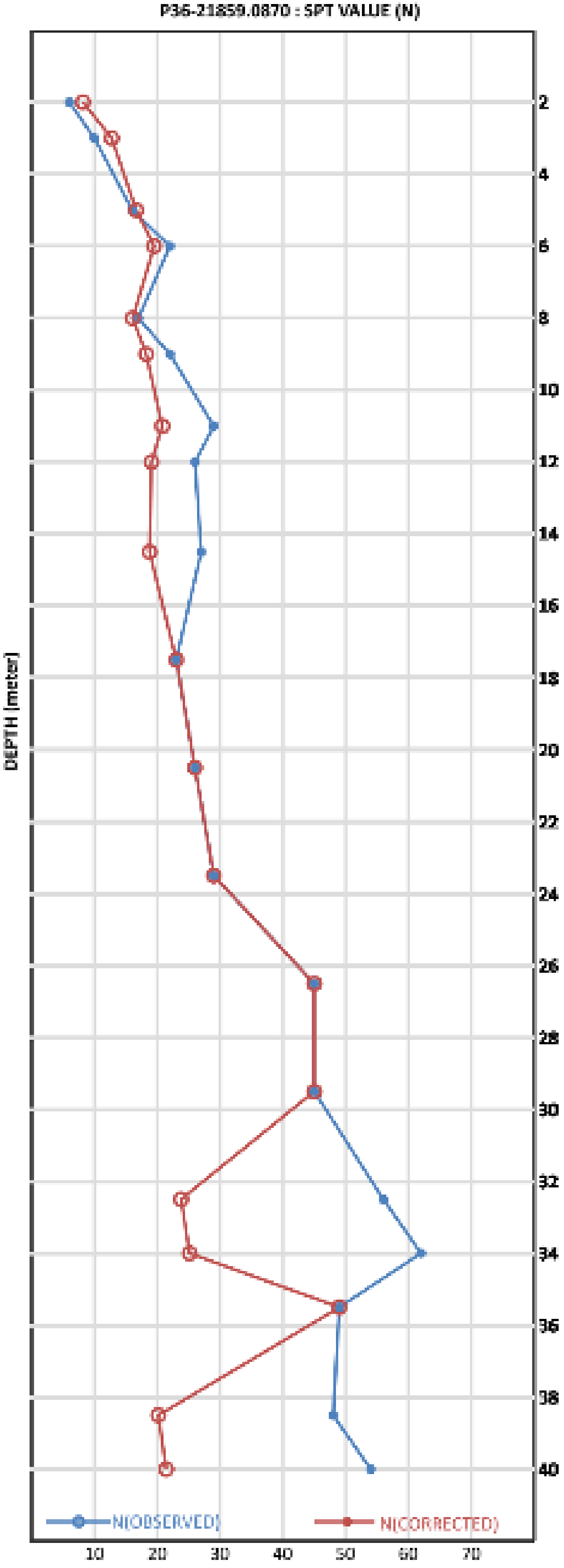
APPENDIX-E
PLOT 2: RECORDED SPT Vs CORRECTED SPT



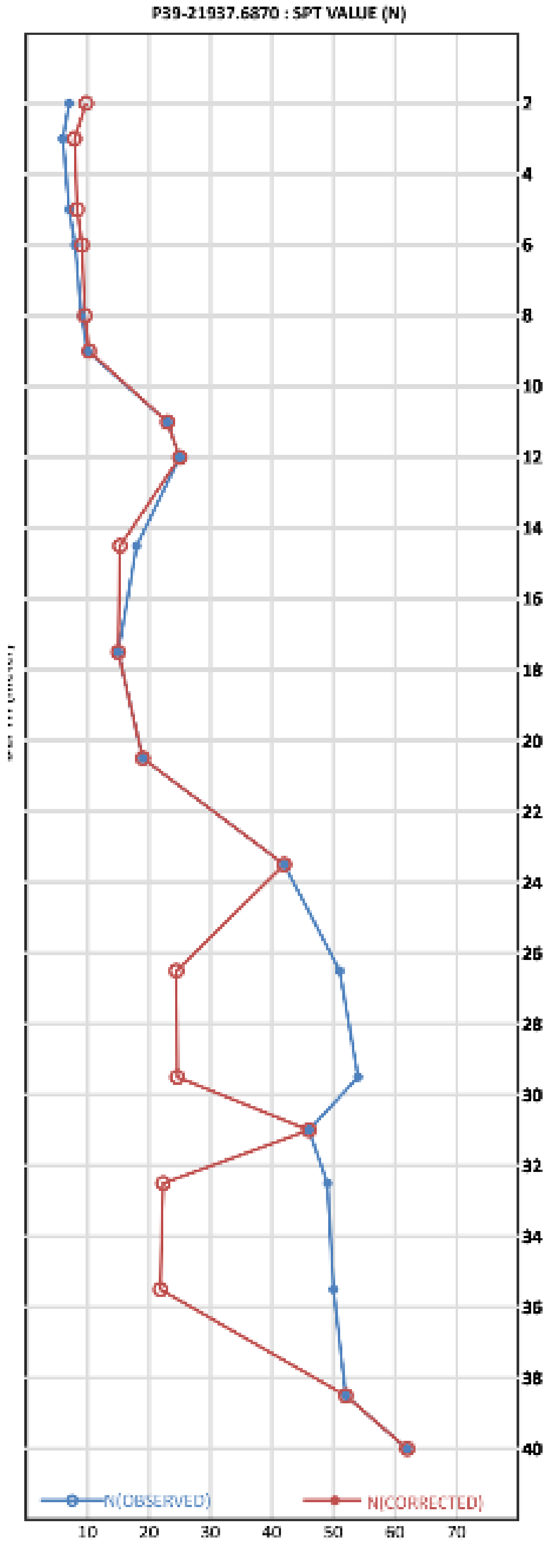


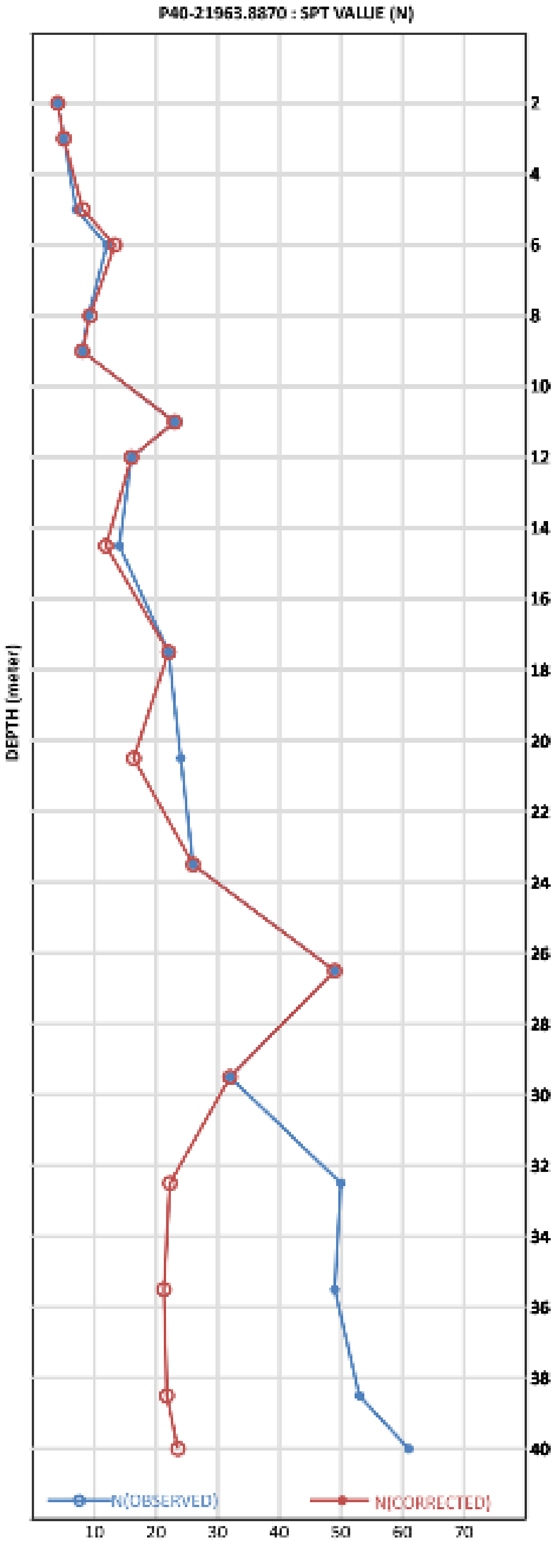
APPENDIX-E
PLOT 3: RECORDED SPT Vs CORRECTED SPT



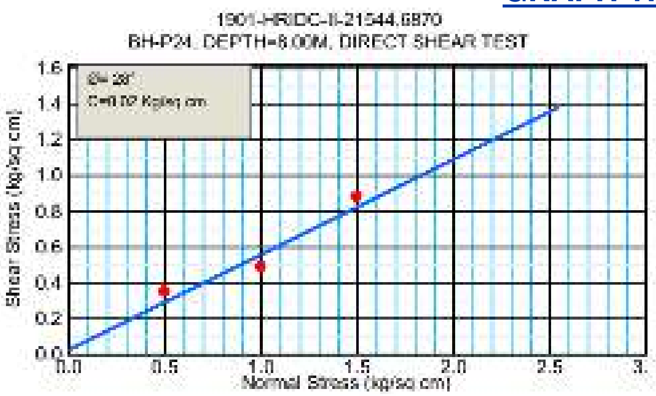


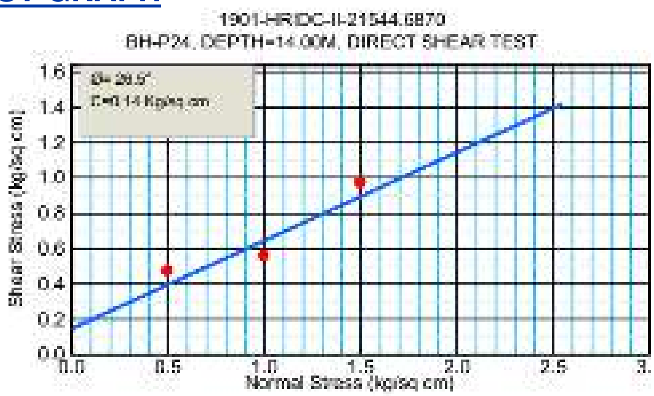
APPENDIX-E
PLOT 4: RECORDED SPT Vs CORRECTED SPT

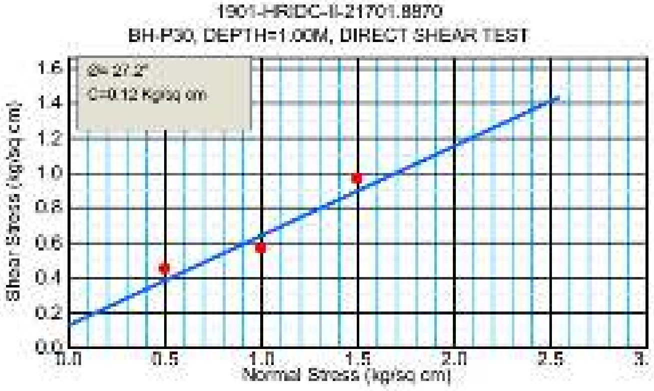


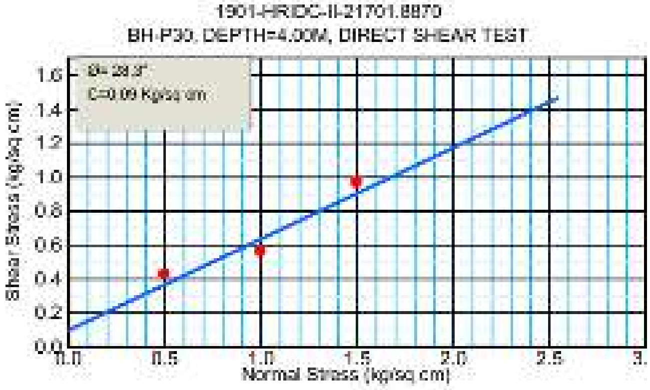


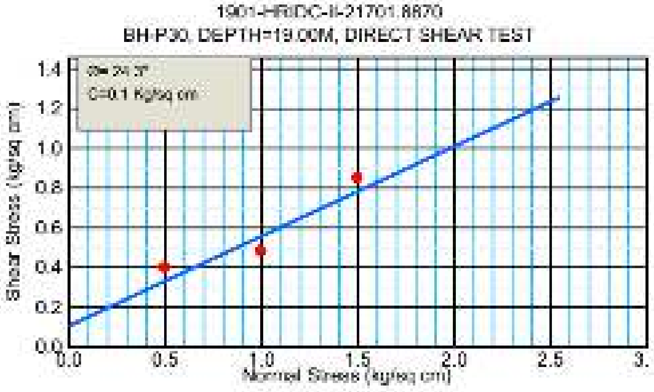
APPENDIX-F
GRAPH 1: DST GRAPH

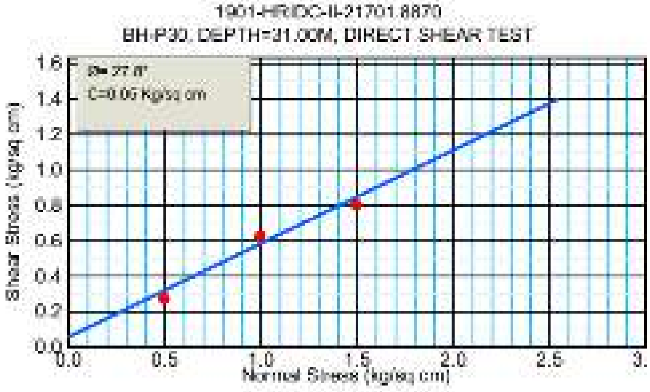


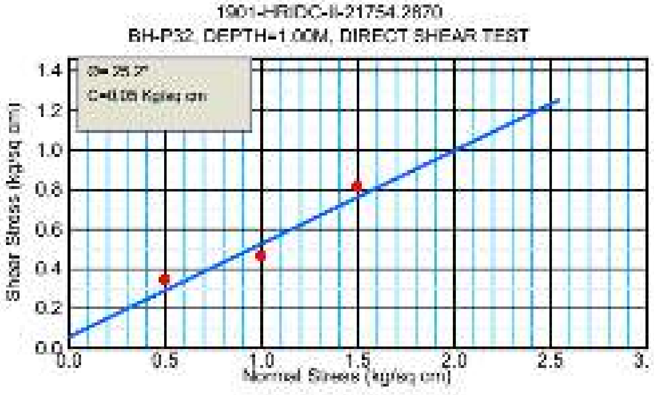


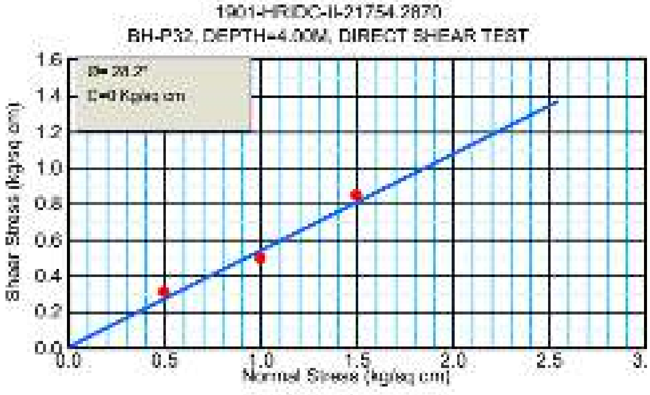






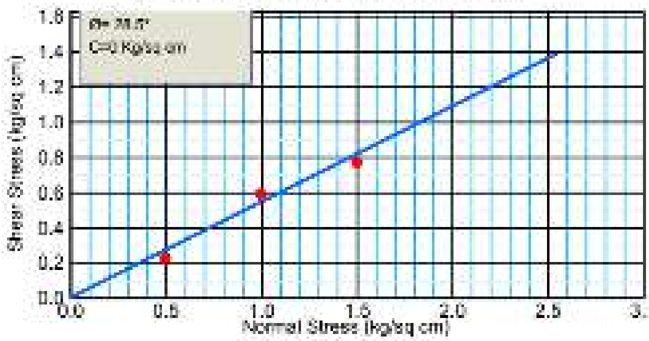






APPENDIX-F
GRAPH 2: DST GRAPH

1901-HRIDC-II-21754.2870
BH-P32, DEPTH=7.00M, DIRECT SHEAR TEST



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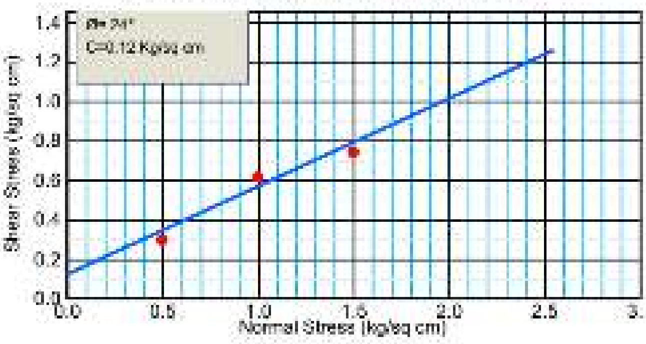
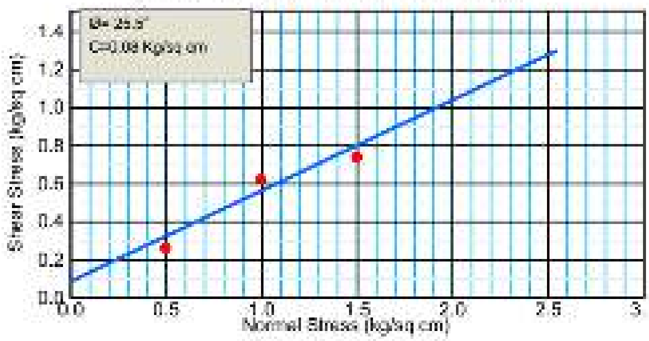


1901-HRIDC-II-21780.4870
BH-P33, DEPTH=1.00M, DIRECT SHEAR TEST



1901-HRIDC-II-21780.4870
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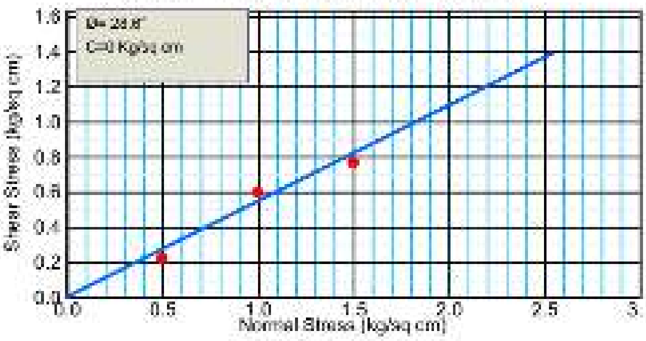
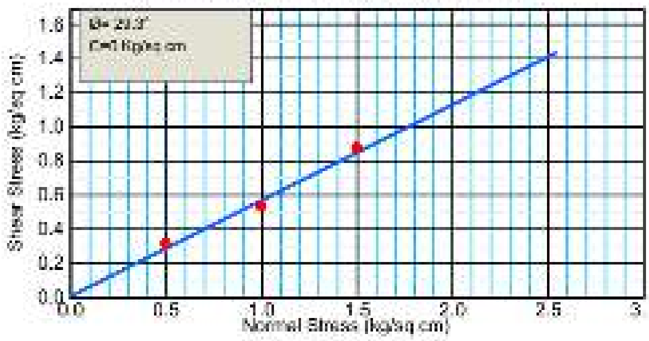


1901-HRIDC-II-21780.4870
BH-P33, DEPTH=7.00M, DIRECT SHEAR TEST



1901-HRIDC-II-21780.4870
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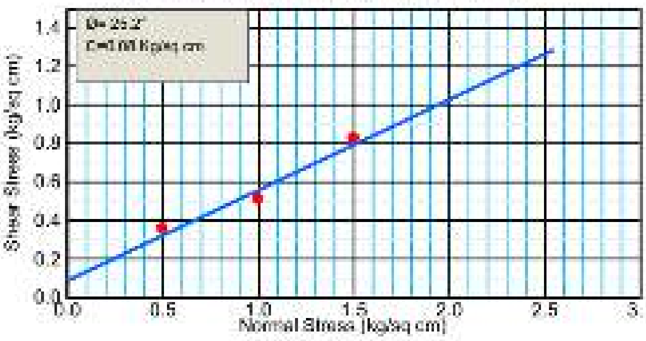

1901-HRIDC-II-21806.6870
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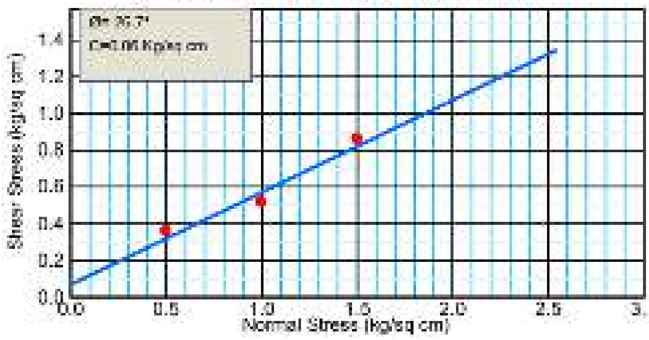
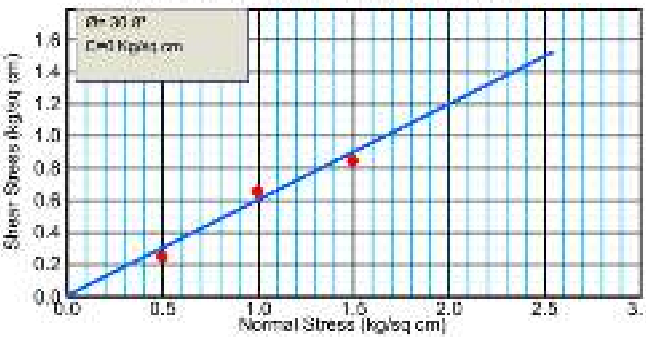
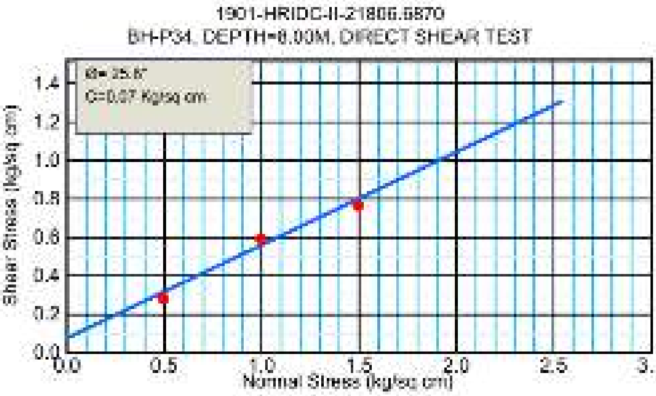
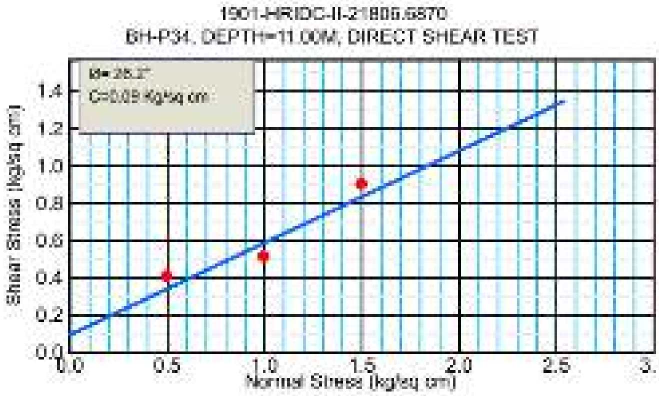


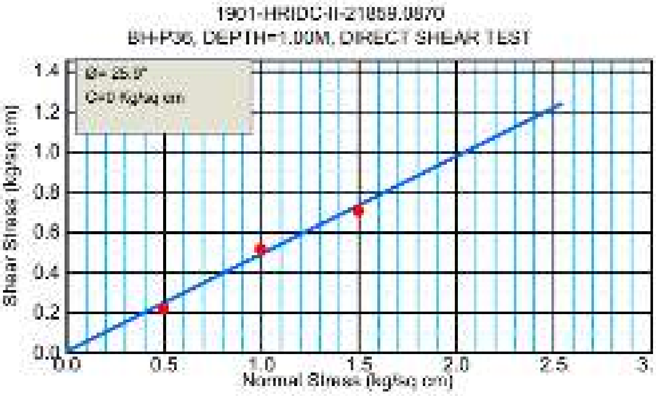
1901-HRIDC-II-21806.6870
BH-P34, DEPTH=5.00M, DIRECT SHEAR TEST

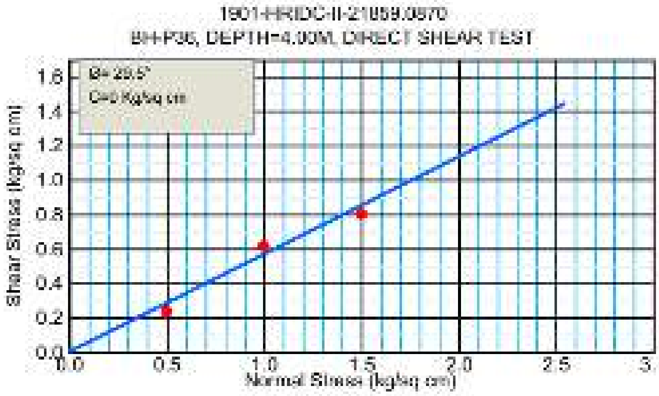


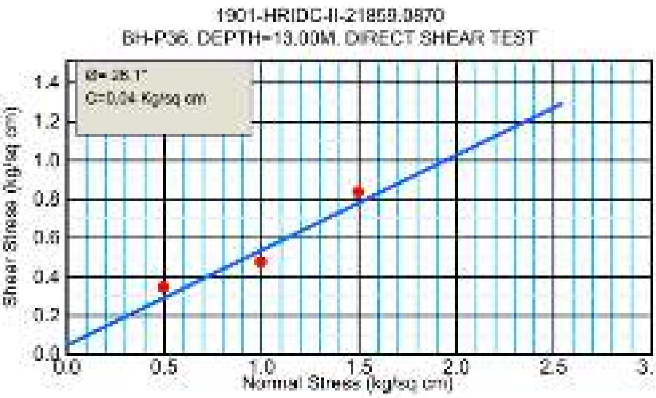
APPENDIX-F
GRAPH 3: DST GRAPH

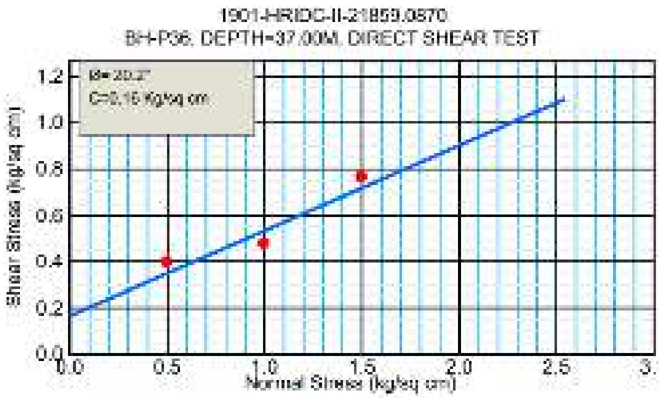




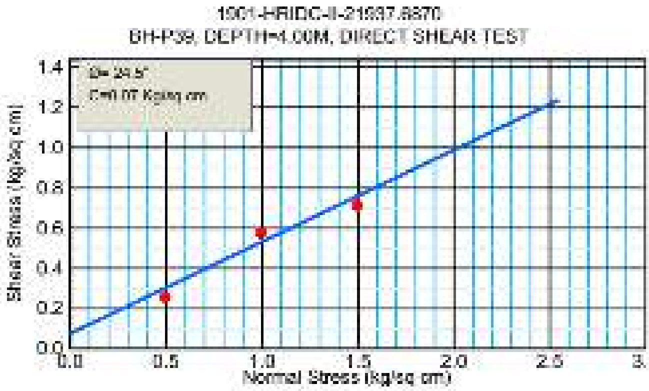


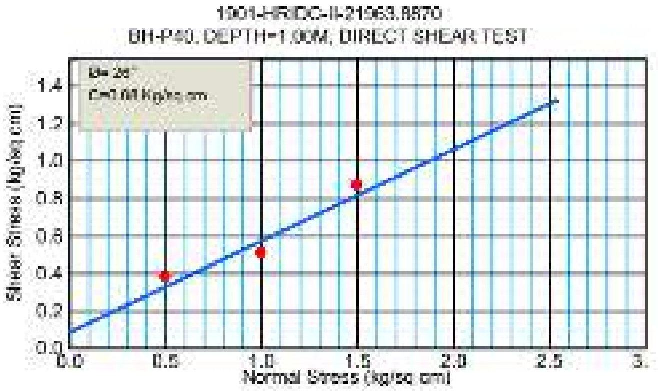


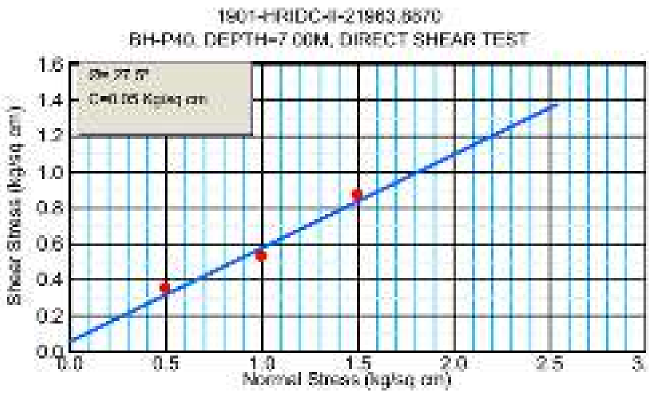


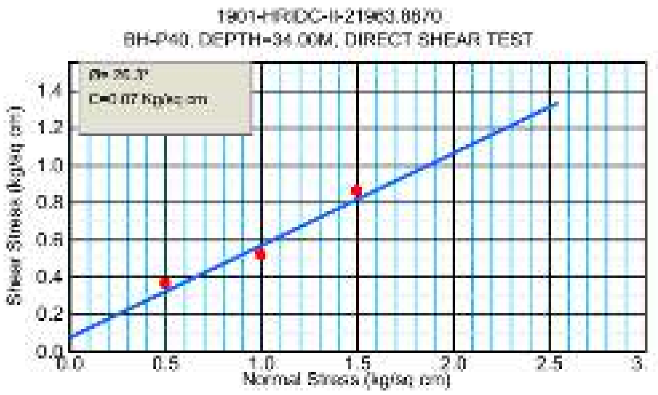


APPENDIX-F
GRAPH 4: DST GRAPH

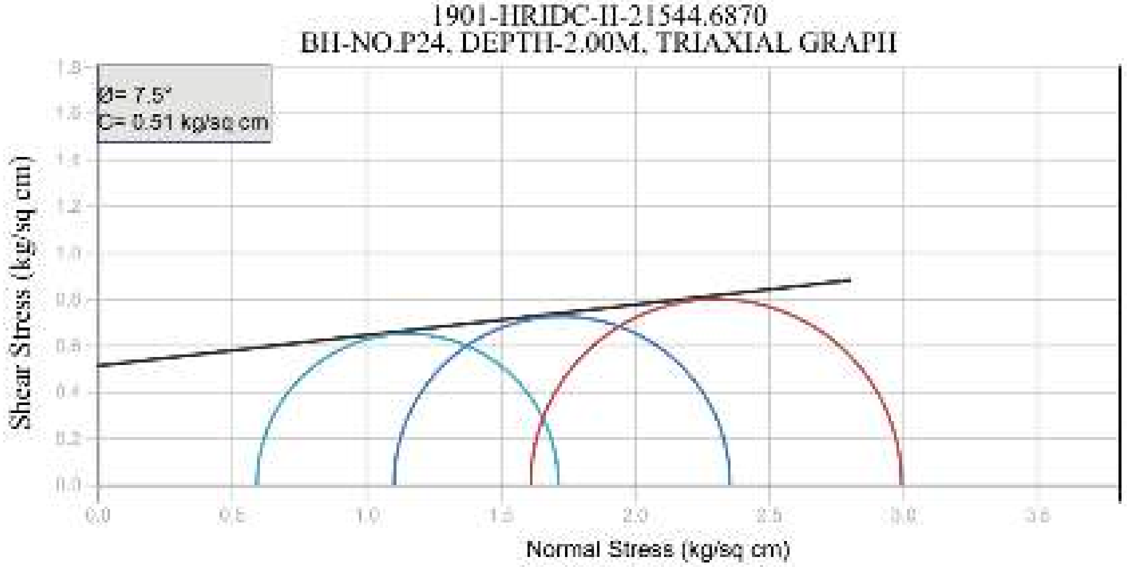








APPENDIX-G
GRAPH 1: UU GRAPH

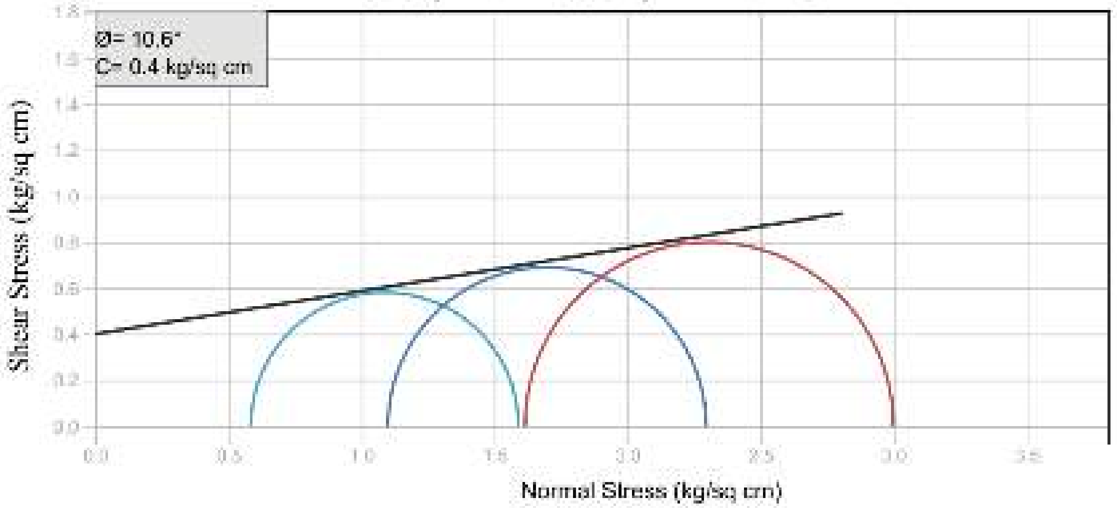


APPENDIX-G

GRAPH 2: UU GRAPH

1901-HRIDC-II-21544.6870
BH-NO.P24, DEPTH-29.00M, TRIAXIAL GRAPH

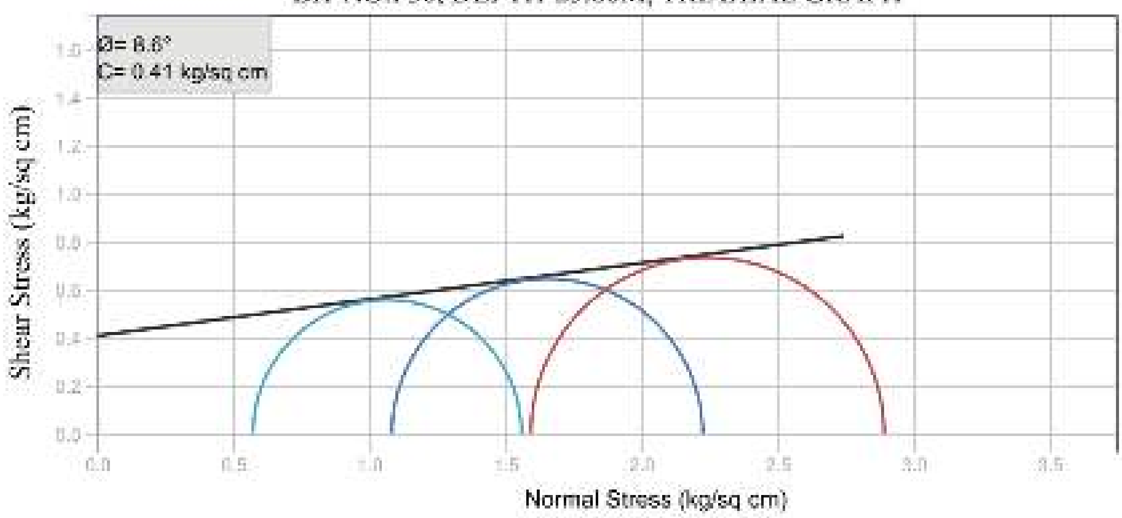
1901-HRIDC-II-21701.8870
BH-NO.P30, DEPTH-10.00M, TRIAXIAL GRAPH



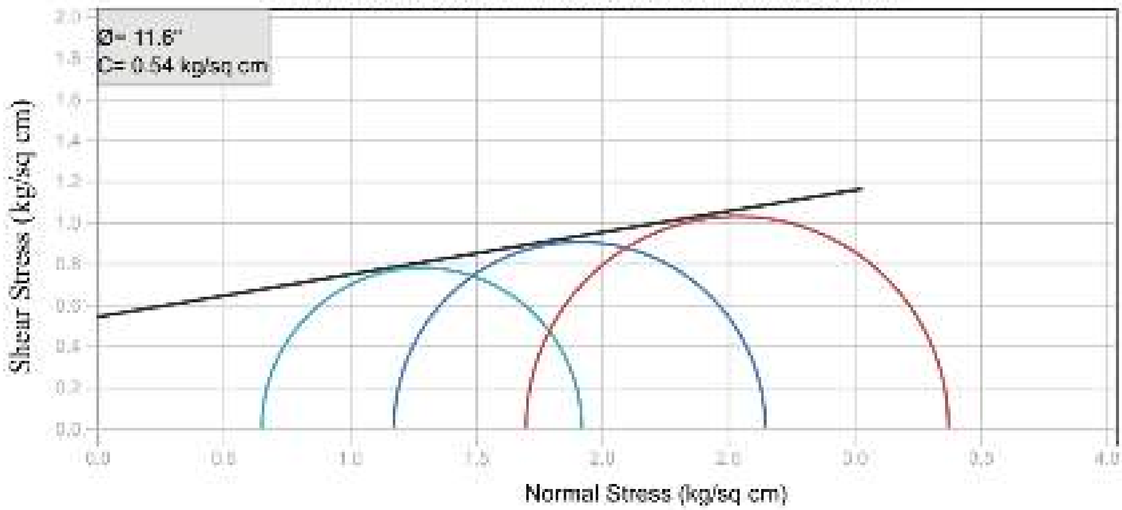
1901-HRIDC-II-21701.8870
BH-NO.P30, DEPTH-16.00M, TRIAXIAL GRAPH

APPENDIX-G
GRAPH 3: UU GRAPH

1901-HRIDC-II-21701.8870
BH-NO.P30, DEPTH-25.00M, TRIAXIAL GRAPH

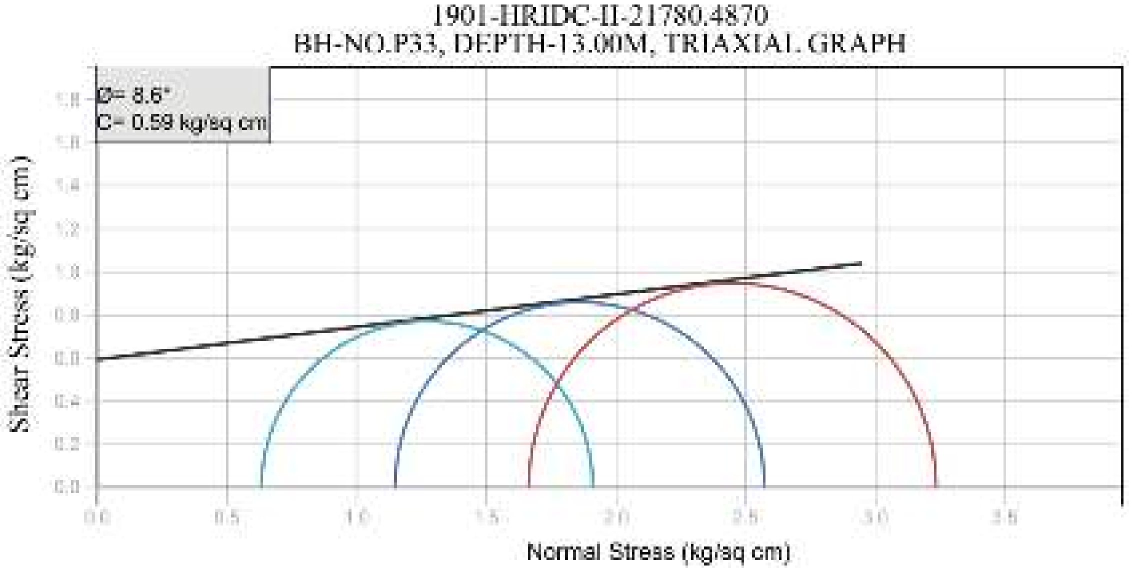


1901-HRIDC-II-21754.2870
BH-NO.P32, DEPTH-10.00M, TRIAXIAL GRAPH



1901-HRIDC-II-21754.2870
BH-NO.P32, DEPTH-16.00M, TRIAXIAL GRAPH

APPENDIX-G
GRAPH 4: UU GRAPH



APPENDIX-G
GRAPH 5: UU GRAPH

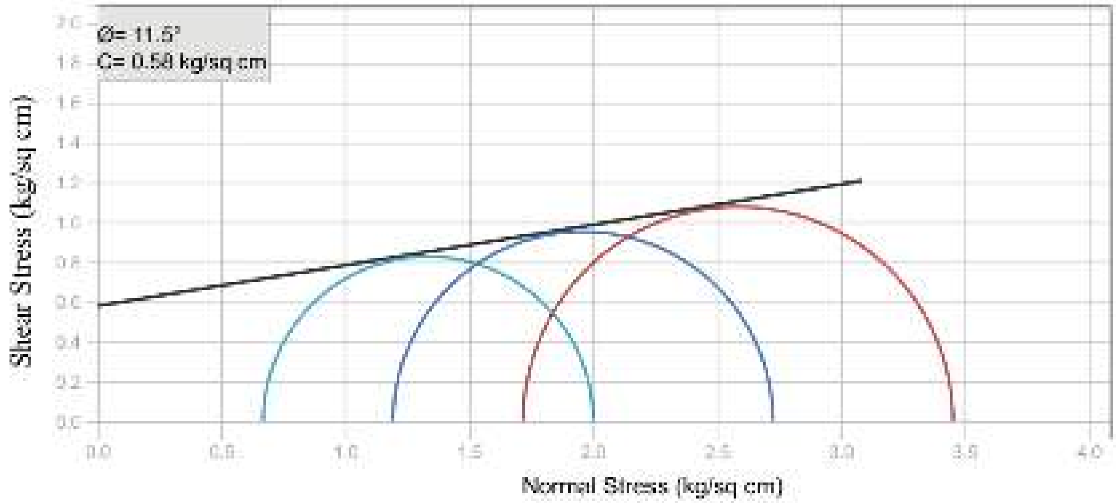
1901-HRIDC-II-21780.4870
BH-NO.P33, DEPTH-16.00M, TRIAXIAL GRAPH

1901-HRIDC-II-21780.4870
BH-NO.P33, DEPTH-19.00M, TRIAXIAL GRAPH

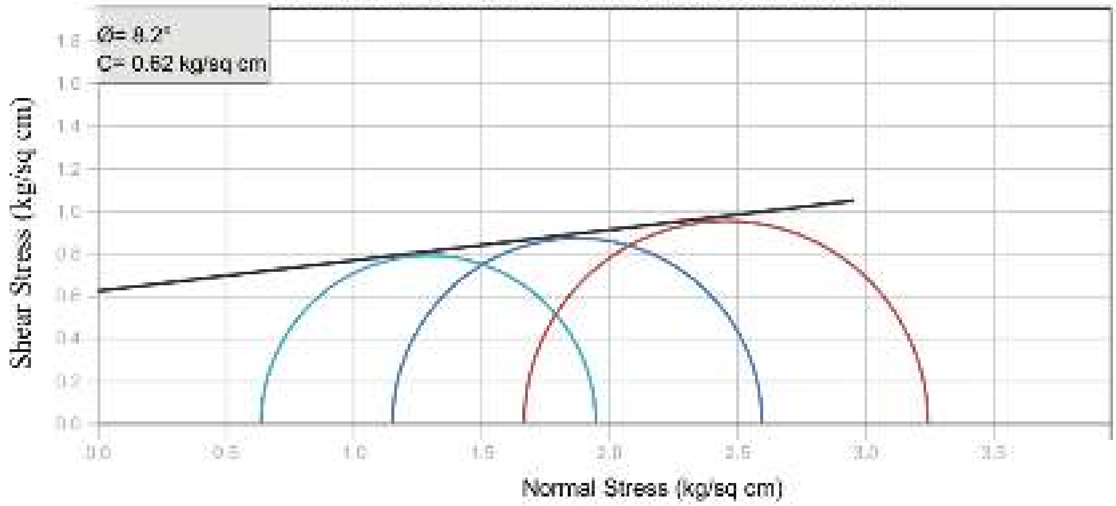
1901-HRIDC-II-21806.6870
BH-NO.P34, DEPTH-14.00M, TRIAXIAL GRAPH

APPENDIX-G
GRAPH 6: UU GRAPH

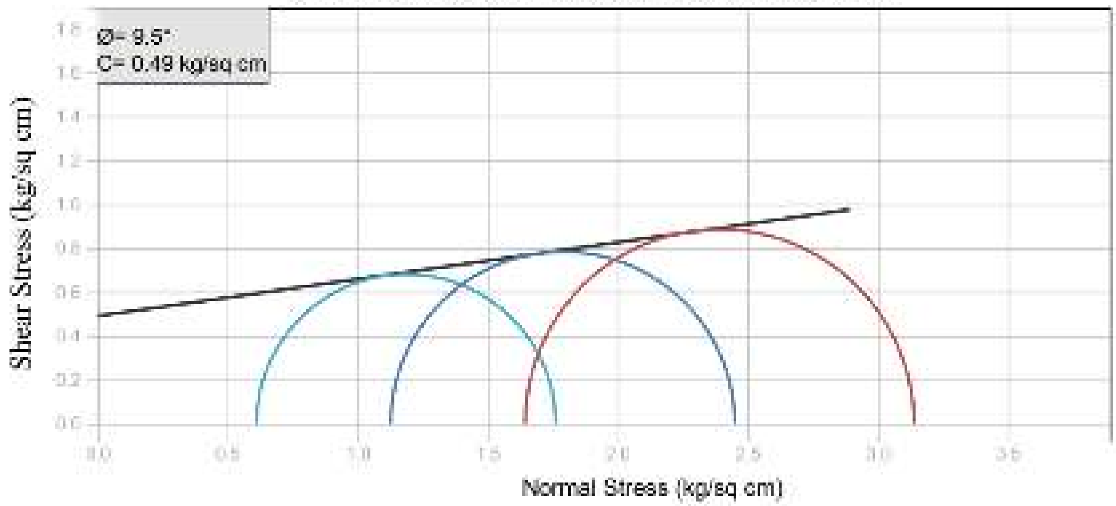
1901-HRIDC-II-21806.6870
BH-NO.P34, DEPTH-20.00M, TRIAXIAL GRAPH



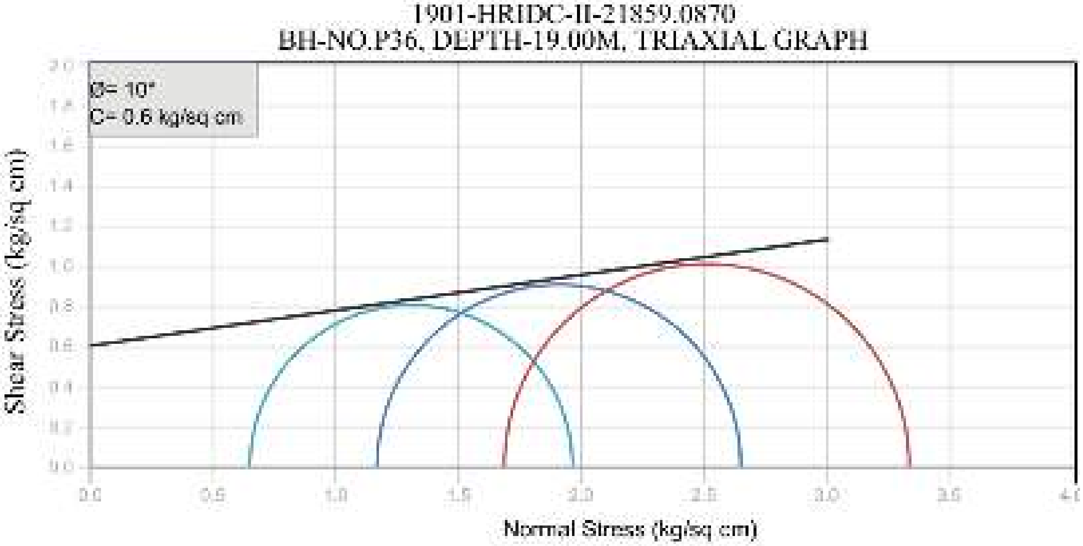
1901-HRIDC-II-21806.6870
BH-NO.P34, DEPTH-23.00M, TRIAXIAL GRAPH

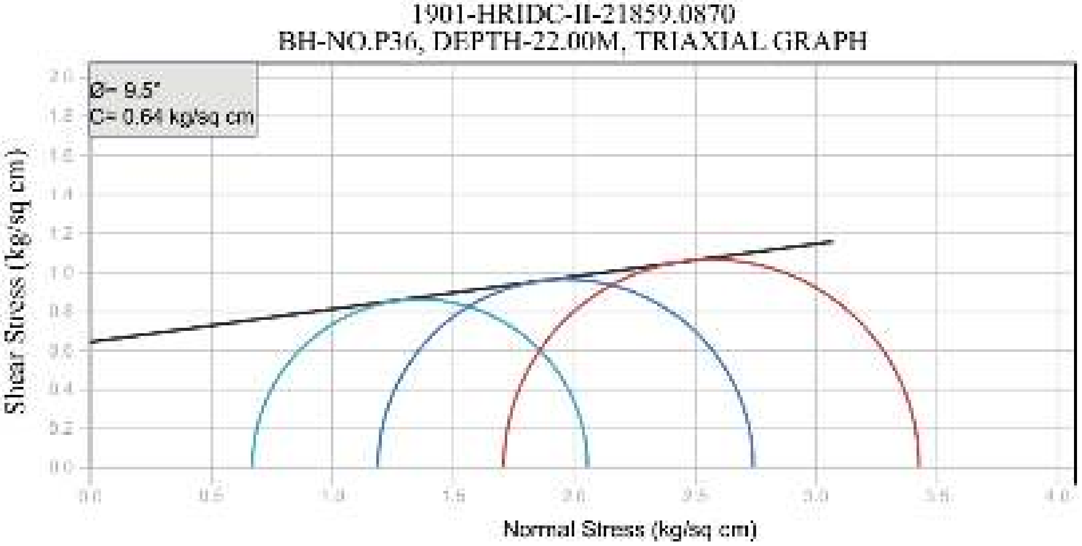


1901-HRIDC-II-21859.0870
BH-NO.P36, DEPTH-10.00M, TRIAXIAL GRAPH



APPENDIX-G
GRAPH 7: UU GRAPH

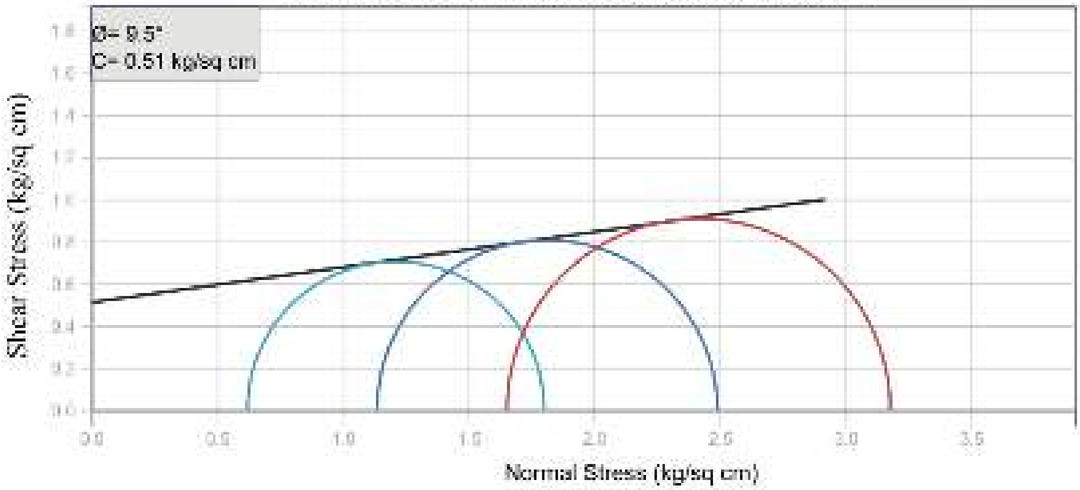




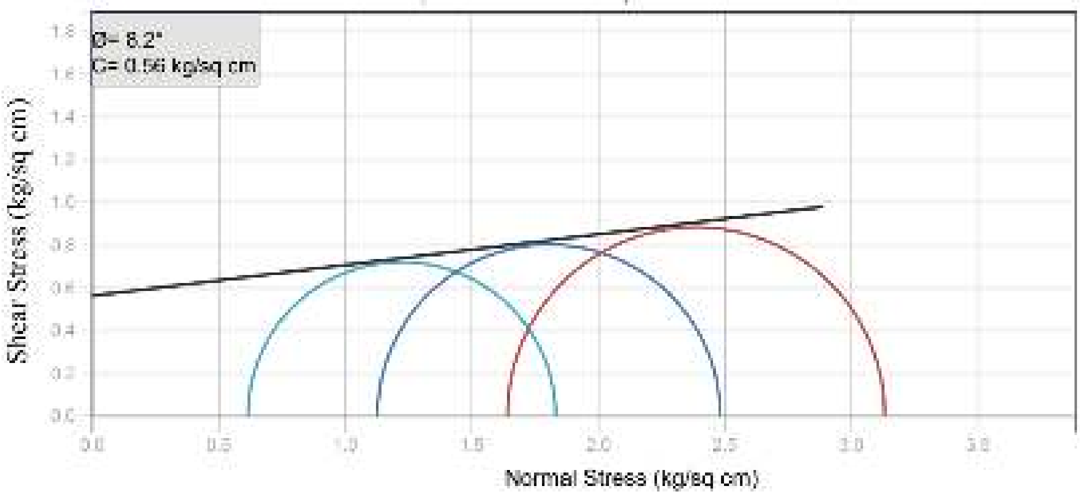
APPENDIX-G
GRAPH 8: UU GRAPH

1901-HRIDC-II-21859.0870
BH-NO.P36, DEPTH-28.00M, TRIAXIAL GRAPH

1901-HRIDC-II-21937.6870
BH-NO.P39, DEPTH-10.00M, TRIAXIAL GRAPH



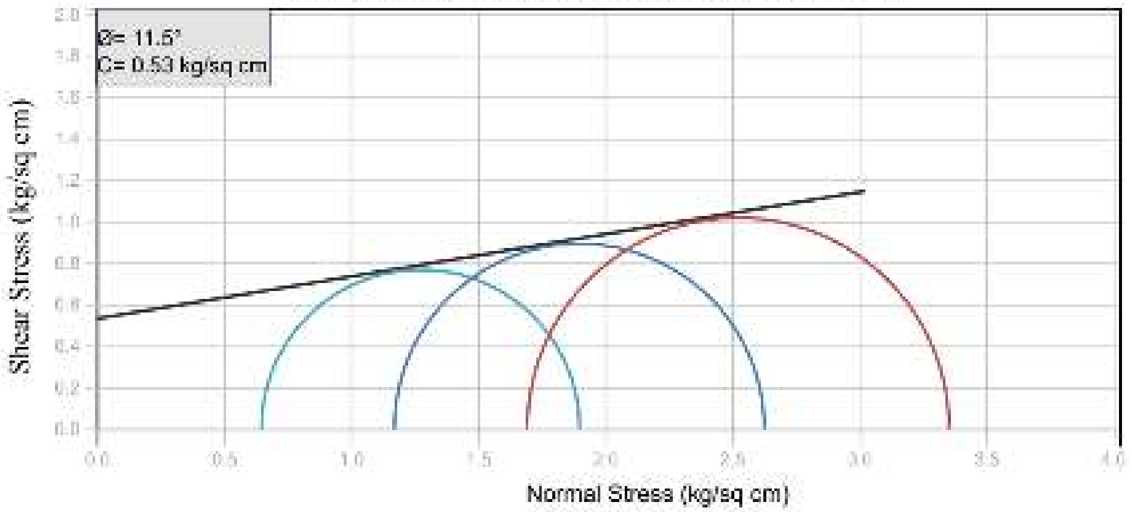
1901-HRIDC-II-21937.6870
BH-NO.P39, DEPTH-13.00M, TRIAXIAL GRAPH



APPENDIX-G

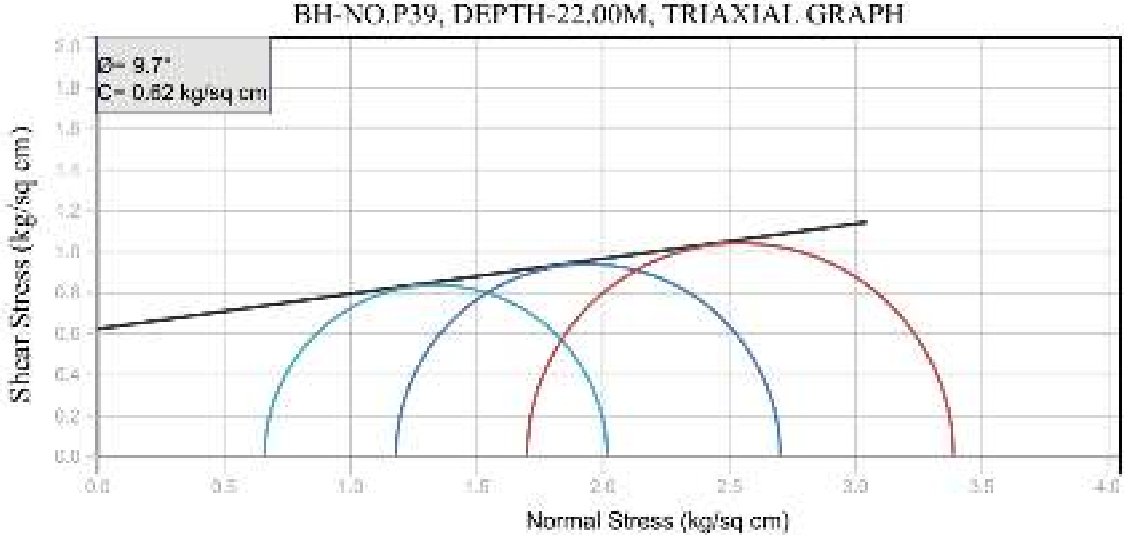
GRAPH 9: UU GRAPH

1901-HRIDC-II-21937.6870
BH-NO.P39, DEPTH-16.00M, TRIAXIAL GRAPH



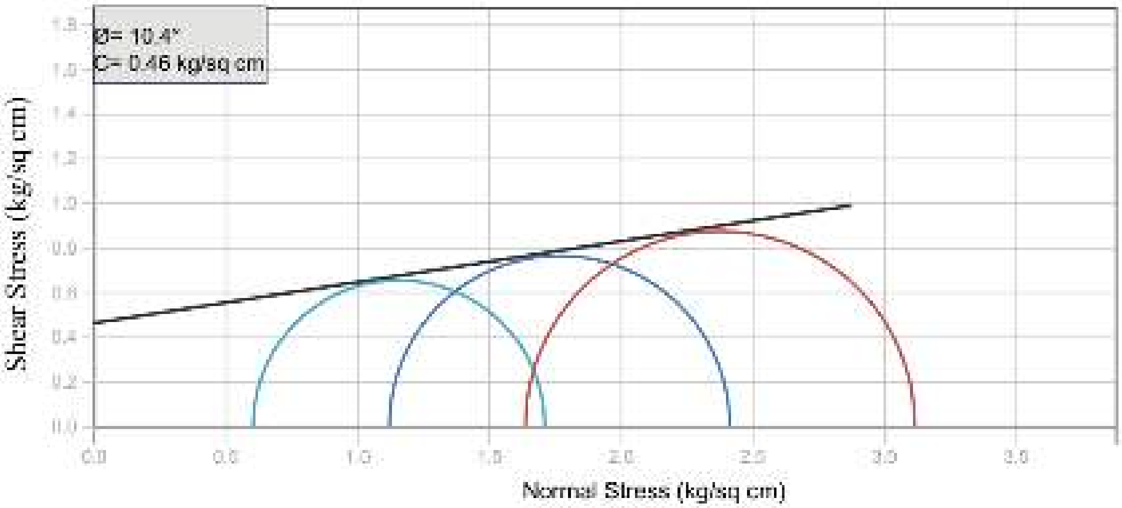
1901-HRIDC-II-21937.6870
BH-NO.P39, DEPTH-19.00M, TRIAXIAL GRAPH

1901-HRIDC-II-21937.6870
BH-NO.P39, DEPTH-22.00M, TRIAXIAL GRAPH

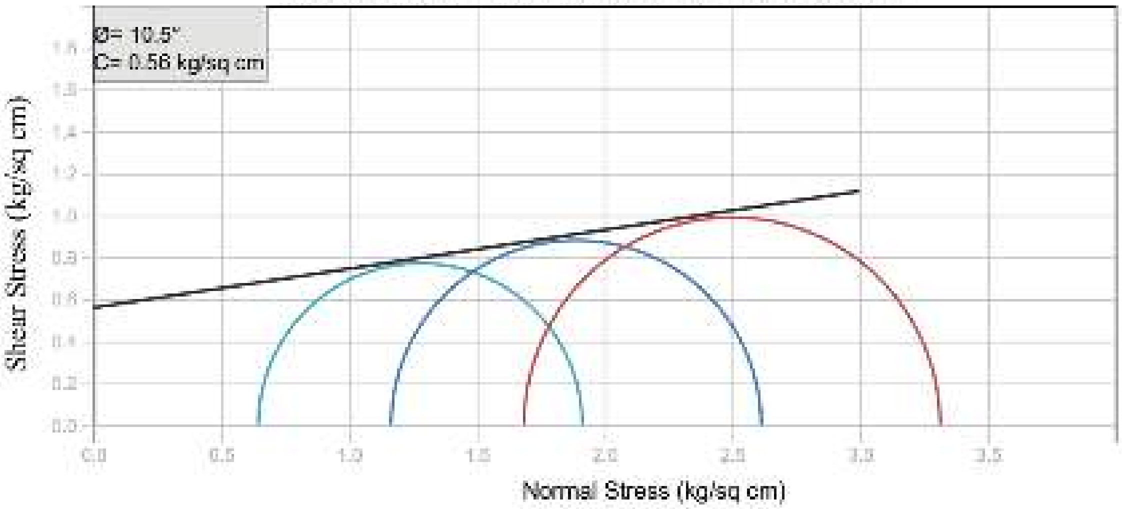


APPENDIX-G
GRAPH 10: UU GRAPH

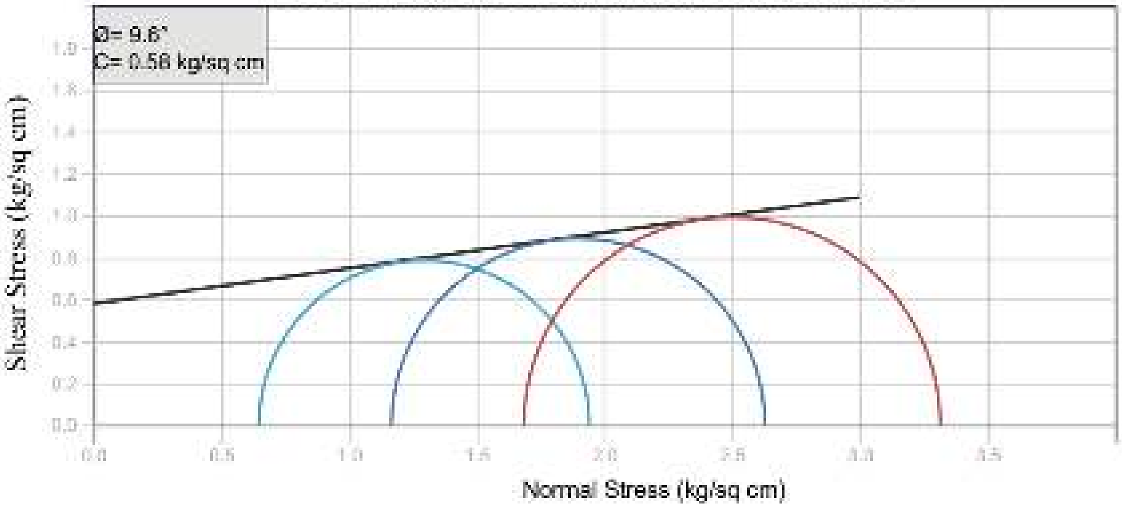
1901-HRIDC-II-21937.6870
BH-NO.P39, DEPTH-25.00M, TRIAXIAL GRAPH



1901-HRIDC-II-21963.8870
BH-NO.P40, DEPTH-10.00M, TRIAXIAL GRAPH

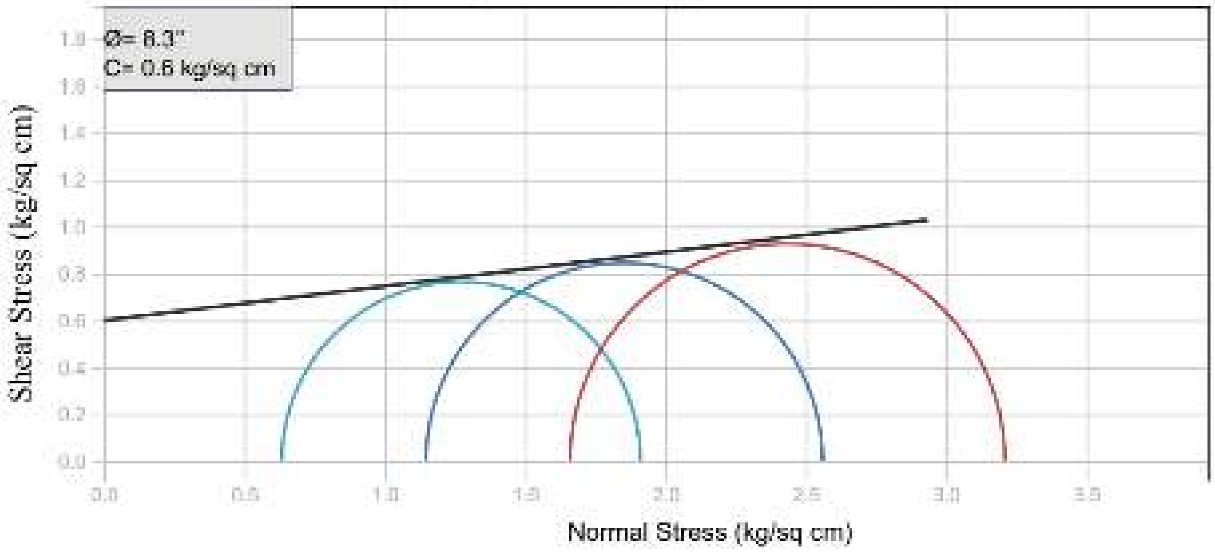


1901-HRIDC-II-21963.8870
BH-NO.P40, DEPTH-13.00M, TRIAXIAL GRAPH

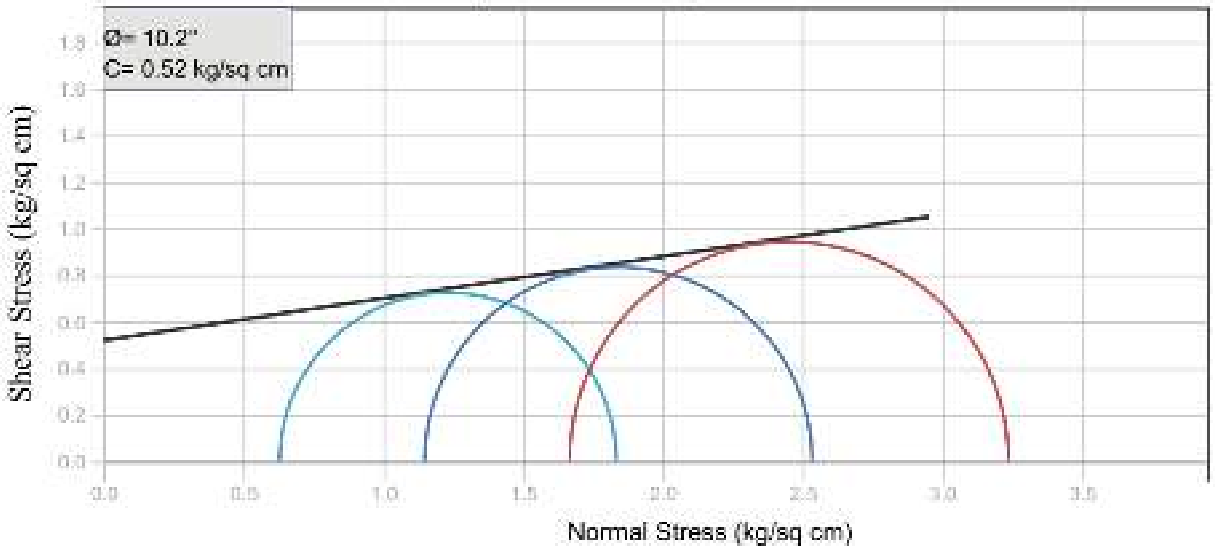


APPENDIX-G
GRAPH 11: UU GRAPH

1901-HRIDC-II-21963.8870
BH-NO.P40, DEPTH-16.00M, TRIAXIAL GRAPH

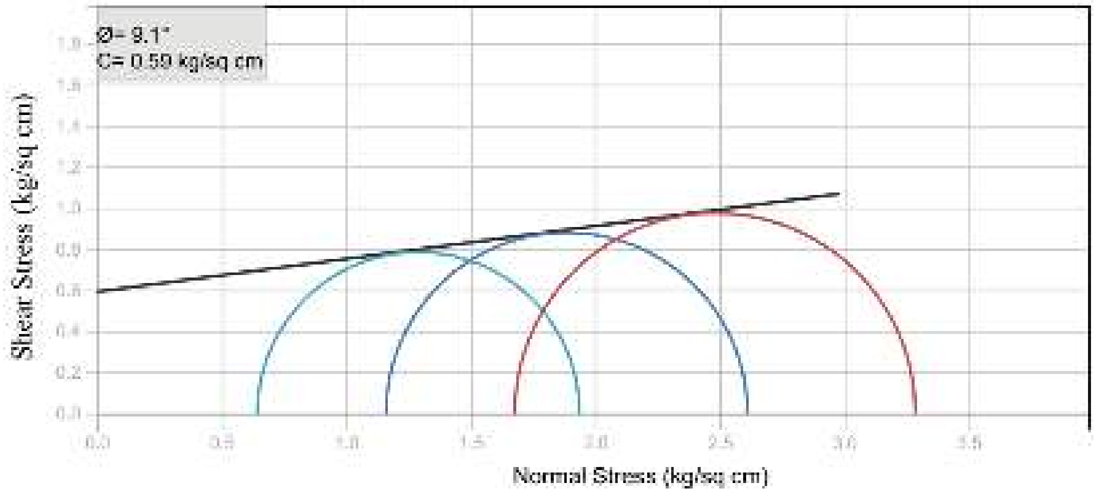


1901-HRIDC-II-21963.8870
BH-NO.P40, DEPTH-19.00M, TRIAXIAL GRAPH

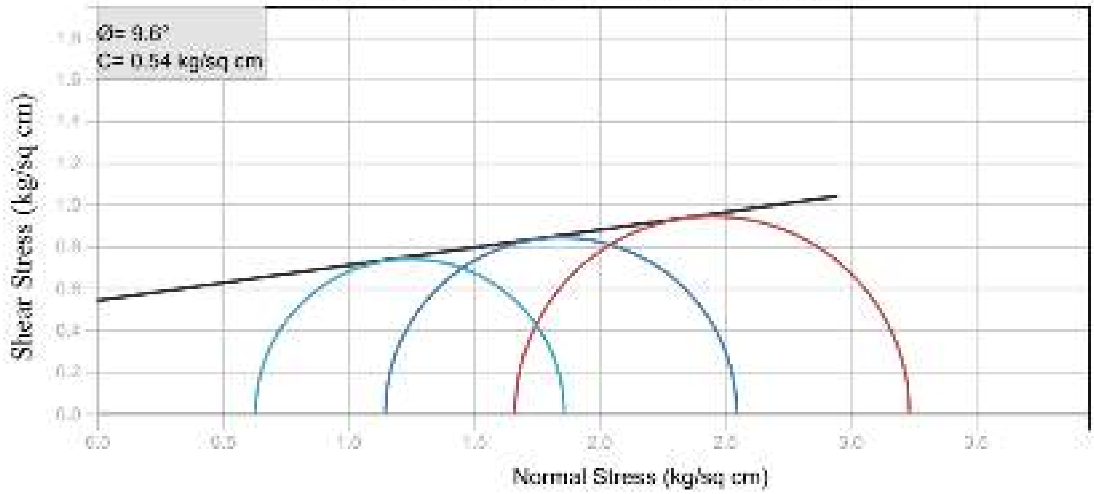


APPENDIX-G
GRAPH 12: RUU GRAPH

1901-HRIDC-II-21806.6870
BH-NO.P34, DEPTH-29.00M, TRIAXIAL GRAPH



1901-HRIDC-II-21937.6870
BH-NO.P39, DEPTH-37.00M, TRIAXIAL GRAPH



1901-HRIDC-II-21963.8870
BH-NO.P40, DEPTH-28.00M, TRIAXIAL GRAPH

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: P24, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.95	10.95	30.11	1.57	7.5	7.5	1.0	6.23	0	51	1.0	80.1	0	3.0	29.5	0	10.95	20.13	21.25	32.9	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.5	20.95	10.95	38.33	3.14	29.5	29.5	1.0	68.15	0	0	1.0	0.0	0	4.0	28.2	0	10.95	17.21	18.25	43.8	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	6.00	5.00	2.00	3.5	20.95	10.95	54.75	6.29	28.2	28.2	1.0	184.53	0	0	1.0	0.0	0	6.0	28.0	2	8.97	16.76	17.79	65.7	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	7.00	6.50	1.00	4.5	18.97	8.97	70.19	3.14	28.0	28.0	1.0	117.29	0	2	1.0	6.3	0	7.0	28.0	2	8.97	16.76	17.79	74.7	1059.9	1059.9	53.0	53.0	**423.95**	**17.67**
7.00	8.00	7.50	1.00	5.5	18.97	8.97	79.16	3.14	28.0	28.0	1.0	132.27	132.27	2	1.0	6.3	6.3	8.0	28.0	2	8.97	16.76	17.79	83.6	1178.0	1316.5	64.8	203.4	**526.62**	**67.79**
8.00	9.00	8.50	1.00	6.5	18.97	8.97	88.13	3.14	28.0	28.0	1.0	147.26	279.54	2	1.0	6.3	12.6	9.0	28.0	2	8.97	16.76	17.79	92.6	1296.1	1588.2	76.6	368.7	**635.27**	**122.90**
9.00	10.00	9.50	1.00	7.5	18.97	8.97	97.10	3.14	28.0	28.0	1.0	162.25	441.79	2	1.0	6.3	18.9	10.0	32.8	0	9.14	35.36	36.75	101.6	2954.5	3415.1	88.4	549.0	**1366.06**	**183.00**
10.00	12.50	11.25	2.50	10.0	19.14	9.14	113.01	7.86	32.8	32.8	1.1	652.32	1094.11	0	1.0	0.0	18.9	12.5	32.8	0	9.14	35.36	36.75	124.4	3589.4	4702.4	117.8	1230.8	**1880.95**	**410.26**
12.50	14.00	13.25	1.50	11.5	19.14	9.14	131.29	4.71	32.8	32.8	1.1	454.70	1548.82	0	1.0	0.0	18.9	14.0	26.5	14	10.96	13.38	14.34	138.1	1612.7	3180.4	135.5	1703.2	**1272.17**	**567.72**
14.00	15.50	14.75	1.50	13.0	20.96	10.96	146.36	4.71	26.5	26.5	1.0	344.01	1892.83	14	1.0	66.0	84.9	15.5	26.5	0	10.96	13.38	14.34	138.1	1513.7	3491.4	153.2	2130.8	**1396.57**	**710.28**
15.50	17.00	16.25	1.50	14.5	20.96	10.96	146.36	4.71	26.5	26.5	1.0	344.01	2236.84	0	1.0	0.0	84.9	17.0	14.6	45	10.85	3.82	2.54	138.1	744.1	3065.8	170.8	2492.5	**1226.31**	**830.84**
17.00	18.50	17.75	1.50	16.0	20.85	10.85	146.36	4.71	14.6	14.6	1.0	179.73	2416.57	45	1.0	212.1	297.0	18.5	14.6	45	10.86	3.82	2.54	138.1	744.1	3457.7	188.5	2902.1	**1383.06**	**967.36**
18.50	21.50	20.00	3.00	19.0	20.86	10.86	146.36	9.43	14.6	14.6	1.0	359.45	2776.02	45	1.0	424.3	721.3	21.5	11.1	44	10.23	2.79	1.53	138.1	620.5	4117.8	223.8	3721.1	**1647.12**	**1240.38**
21.50	24.50	23.00	3.00	22.0	20.23	10.23	146.36	9.43	11.1	11.1	1.0	270.74	3046.76	44	1.0	414.9	1136.1	24.5	10.5	56	10.23	2.62	1.36	138.1	685.5	4868.4	259.2	4442.1	**1947.37**	**1480.70**
24.50	26.00	25.25	1.50	23.5	20.23	10.23	146.36	4.71	10.5	10.5	1.0	127.88	3174.64	56	1.0	264.0	1400.1	26.0	10.5	75	10.35	2.62	1.36	138.1	819.9	5394.7	276.9	4851.6	**2157.89**	**1617.21**
26.00	27.50	26.75	1.50	25.0	20.35	10.35	146.36	4.71	10.5	10.5	1.0	127.88	3302.52	75	1.0	353.6	1753.7	27.5	10.5	75	10.35	2.62	1.36	138.1	819.9	5876.2	294.5	5350.8	**2350.47**	**1783.59**
27.50	29.00	28.25	1.50	26.5	20.35	10.35	146.36	4.71	10.5	10.5	1.0	127.88	3430.41	75	1.0	353.6	2107.3	29.0	13.3	54	9.14	3.44	2.16	138.1	763.0	6300.7	312.2	5849.9	**2520.28**	**1949.96**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
29.00	30.00	29.50	1.00	27.5	19.14	9.14	146.36	3.14	13.3	13.3	1.0	108.74	3539.14	54	1.0	169.7	2277.0	30.0	13.3	54	9.14	3.44	2.16	138.1	763.0	6579.1	324.0	6140.1	**2631.66**	**2046.71**
30.00	30.50	30.25	0.50	28.0	19.14	9.14	146.36	1.57	13.3	13.3	1.0	54.37	3593.51	54	1.0	84.9	2361.9	30.5	13.3	54	9.14	3.44	2.16	138.1	763.0	6718.4	329.9	6285.2	**2687.35**	**2095.08**
30.50	32.50	31.50	2.00	30.0	19.14	9.14	146.36	6.29	13.3	13.3	1.0	217.47	3810.98	54	1.0	339.4	2701.3	32.5	13.0	50	9.17	3.35	2.08	138.1	724.7	7236.9	353.4	6865.7	**2894.77**	**2288.57**
32.50	33.50	33.00	1.00	31.0	19.17	9.17	146.36	3.14	13.0	13.0	1.0	106.20	3917.18	50	1.0	157.1	2858.4	33.5	13.0	50	8.93	3.35	2.08	138.1	724.5	7500.1	365.2	7140.8	**3000.03**	**2380.27**
33.50	35.00	34.25	1.50	32.5	18.93	8.93	146.36	4.71	13.0	13.0	1.0	159.30	4076.48	50	1.0	235.7	3094.1	35.0	27.7	0	8.93	16.08	17.10	138.1	1805.3	8975.9	382.9	7553.5	**3590.37**	**2517.83**
35.00	36.50	35.75	1.50	34.0	18.93	8.93	146.36	4.71	27.7	27.7	1.0	362.25	4438.72	0	1.0	0.0	3094.1	36.5	31.2	0	9.79	27.30	28.55	138.1	3073.4	10606.3	400.6	7933.4	**4242.51**	**2644.47**
36.50	37.50	37.00	1.00	35.0	19.79	9.79	146.36	3.14	31.2	31.2	1.1	295.29	4734.02	0	1.0	0.0	3094.1	37.5	31.2	0	9.79	27.30	28.55	138.1	3073.4	10901.6	412.3	8240.5	**4360.62**	**2746.83**
37.50	40.00	38.75	2.50	37.5	19.79	9.79	146.36	7.86	31.2	31.2	1.1	738.23	5472.25	0	1.0	0.0	3094.1	40.0	31.2	0	9.79	27.30	28.55	138.1	3073.4	11639.8	441.8	9008.2	**4655.92**	**3002.73**
BORE NO: P30, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	17.98	7.98	21.95	1.57	27.2	27.2	1.0	17.72	0	12	1.0	18.9	0	3.0	28.3	9	9.16	17.43	18.48	23.9	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.5	19.16	9.16	33.10	6.29	28.3	28.3	1.0	112.03	0	9	1.0	56.6	0	5.0	28.3	9	9.16	17.43	18.48	42.3	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.16	9.16	46.84	3.14	28.3	28.3	1.0	79.27	0	9	1.0	28.3	0	6.0	28.3	0	9.16	17.43	18.48	51.4	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	8.00	7.00	2.00	5.5	19.16	9.16	60.58	6.29	28.3	28.3	1.0	205.03	0	0	1.0	0.0	0	8.0	28.3	0	11.05	17.43	18.48	69.7	0	0.0	64.8	64.8	**0.00**	**21.60**
8.00	9.00	8.50	1.00	6.5	21.05	11.05	75.27	3.14	28.3	28.3	1.0	127.37	0	0	1.0	0.0	0	9.0	28.3	0	11.05	17.43	18.48	80.8	0	0.0	76.6	76.6	**0.00**	**25.53**
9.00	10.00	9.50	1.00	7.5	21.05	11.05	86.32	3.14	28.3	28.3	1.0	146.07	0	0	1.0	0.0	0	10.0	10.6	40	11.05	2.65	1.39	91.8	479.9	479.9	88.4	88.4	**191.94**	**29.45**
10.00	11.00	10.50	1.00	8.5	21.05	11.05	97.37	3.14	10.6	10.6	1.0	57.27	57.27	40	1.0	125.7	125.7	11.0	10.6	40	11.05	2.65	1.39	102.9	502.8	685.8	100.1	283.1	**274.33**	**94.37**
11.00	12.00	11.50	1.00	9.5	21.05	11.05	108.42	3.14	10.6	10.6	1.0	63.77	121.03	40	1.0	125.7	251.4	12.0	11.4	45	11.54	2.88	1.62	113.9	583.5	956.0	111.9	484.4	**382.40**	**161.46**
12.00	14.50	13.25	2.50	12.0	21.54	11.54	128.37	7.86	11.4	11.4	1.0	203.37	324.40	45	1.0	353.6	605.0	14.5	11.2	45	11.36	2.82	1.56	142.8	641.9	1571.3	141.4	1070.8	**628.51**	**356.92**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
14.50	17.50	16.00	3.00	15.0	21.36	11.36	128.37	9.43	11.2	11.2	1.0	239.65	564.04	45	1.0	424.3	1029.3	17.5	11.2	45	11.36	2.82	1.56	142.8	641.9	2235.2	176.7	1770.0	**894.09**	**590.02**
17.50	19.00	18.25	1.50	16.5	21.36	11.36	128.37	4.71	11.2	11.2	1.0	119.82	683.87	45	1.0	212.1	1241.4	19.0	24.3	10	10.67	9.50	10.11	142.8	1178.5	3103.8	194.4	2119.7	**1241.51**	**706.56**
19.00	20.50	19.75	1.50	18.0	20.67	10.67	128.37	4.71	24.3	24.3	1.0	273.24	957.10	10	1.0	47.1	1288.6	20.5	15.5	42	10.67	4.19	2.92	142.8	778.9	3024.6	212.1	2457.7	**1209.83**	**819.24**
20.50	23.50	22.00	3.00	21.0	20.67	10.67	128.37	9.43	15.5	15.5	1.0	335.65	1292.75	42	1.0	396.0	1684.6	23.5	8.6	41	11.75	2.22	1.00	142.8	543.4	3520.7	247.4	3224.7	**1408.29**	**1074.91**
23.50	26.50	25.00	3.00	24.0	21.75	11.75	128.37	9.43	8.6	8.6	1.0	183.04	1475.79	41	1.0	386.6	2071.1	26.5	8.6	41	11.75	2.22	1.00	142.8	543.4	4090.3	282.7	3829.7	**1636.14**	**1276.56**
26.50	27.50	27.00	1.00	25.0	21.75	11.75	128.37	3.14	8.6	8.6	1.0	61.01	1536.80	41	1.0	128.9	2200.0	27.5	9.0	41	11.75	2.29	1.07	142.8	551.8	4288.6	294.5	4031.3	**1715.43**	**1343.78**
27.50	29.50	28.50	2.00	27.0	21.75	11.75	128.37	6.29	9.0	9.0	1.0	127.79	1664.60	41	1.0	257.7	2457.7	29.5	11.0	41	9.27	2.76	1.51	142.8	605.5	4727.8	318.1	4440.4	**1891.13**	**1480.13**
29.50	30.00	29.75	0.50	27.5	19.27	9.27	128.37	1.57	11.0	11.0	1.0	39.21	1703.81	41	1.0	64.4	2522.1	30.0	11.0	41	9.27	2.76	1.51	142.8	605.5	4831.5	324.0	4549.9	**1932.58**	**1516.64**
30.00	31.00	30.50	1.00	28.5	19.27	9.27	128.37	3.14	11.0	11.0	1.0	78.42	1782.23	41	1.0	128.9	2651.0	31.0	27.8	5	9.27	16.31	17.33	142.8	1927.8	6361.0	335.8	4769.0	**2544.41**	**1589.66**
31.00	32.50	31.75	1.50	30.0	19.27	9.27	128.37	4.71	27.8	27.8	1.0	319.06	2101.29	5	1.0	23.6	2674.6	32.5	8.5	48	9.27	2.20	0.99	142.8	589.9	5365.7	353.4	5129.3	**2146.28**	**1709.76**
32.50	35.00	33.75	2.50	32.5	19.27	9.27	128.37	7.86	8.5	8.5	1.0	150.73	2252.02	48	1.0	377.1	3051.7	35.0	8.1	48	8.55	2.13	0.93	142.8	581.3	5885.0	382.9	5686.6	**2354.01**	**1895.54**
35.00	35.50	35.25	0.50	33.0	18.55	8.55	128.37	1.57	8.1	8.1	1.0	28.71	2280.73	48	1.0	75.4	3127.1	35.5	10.8	33	9.21	2.71	1.45	142.8	542.1	5950.0	388.8	5796.6	**2379.99**	**1932.21**
35.50	37.00	36.25	1.50	34.5	19.21	9.21	128.37	4.71	10.8	10.8	1.0	115.44	2396.17	33	1.0	155.6	3282.7	37.0	9.4	56	9.21	2.36	1.13	142.8	665.1	6344.0	406.4	6085.3	**2537.58**	**2028.44**
37.00	37.50	37.25	0.50	35.0	19.21	9.21	128.37	1.57	9.4	9.4	1.0	33.39	2429.56	56	1.0	88.0	3370.7	37.5	10.2	56	9.21	2.53	1.28	142.8	684.3	6484.6	412.3	6212.6	**2593.84**	**2070.87**
37.50	38.50	38.00	1.00	36.0	19.21	9.21	128.37	3.14	10.2	10.2	1.0	72.59	2502.15	56	1.0	176.0	3546.7	38.5	14.3	48	9.97	3.74	2.45	142.8	768.3	6817.1	424.1	6473.0	**2726.86**	**2157.66**
38.50	40.00	39.25	1.50	37.5	19.97	9.97	128.37	4.71	14.3	14.3	1.0	154.25	2656.40	48	1.0	226.3	3773.0	40.0	14.3	48	9.97	3.74	2.45	142.8	768.3	7197.7	441.8	6871.2	**2879.07**	**2290.40**
BORE NO: P32, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.70	9.70	26.68	1.57	28.2	28.2	1.0	22.48	0	0	1.0	0.0	0	3.0	28.2	0	9.39	17.21	18.25	29.1	0	0.0	5.9	5.9	**0.00**	**1.96**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
3.00	5.00	4.00	2.00	2.5	19.39	9.39	38.49	6.29	28.2	28.2	1.0	129.73	0	0	1.0	0.0	0	5.0	28.5	0	9.39	17.88	18.94	47.9	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.39	9.39	52.58	3.14	28.5	28.5	1.0	89.72	0	0	1.0	0.0	0	6.0	28.5	0	9.64	17.88	18.94	57.3	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	8.00	7.00	2.00	5.5	19.64	9.64	66.91	6.29	28.5	28.5	1.0	228.35	0	0	1.0	0.0	0	8.0	11.6	54	9.64	2.94	1.68	76.6	565.1	565.1	64.8	64.8	**226.03**	**21.60**
8.00	9.00	8.50	1.00	6.5	19.64	9.64	81.37	3.14	11.6	11.6	1.0	52.49	52.49	54	1.0	169.7	169.7	9.0	11.6	54	9.64	2.94	1.68	86.2	587.3	809.5	76.6	298.8	**323.82**	**99.60**
9.00	10.00	9.50	1.00	7.5	19.64	9.64	91.01	3.14	11.6	11.6	1.0	58.71	111.21	54	1.0	169.7	339.4	10.0	11.6	54	10.40	2.94	1.68	95.8	610.1	1060.7	88.4	539.0	**424.30**	**179.66**
10.00	11.00	10.50	1.00	8.5	20.40	10.40	101.03	3.14	11.6	11.6	1.0	65.18	176.39	54	1.0	169.7	509.1	11.0	11.6	54	10.40	2.94	1.68	106.2	634.1	1319.7	100.1	785.7	**527.87**	**261.89**
11.00	12.00	11.50	1.00	9.5	20.40	10.40	111.43	3.14	11.6	11.6	1.0	71.89	248.27	54	1.0	169.7	678.9	12.0	9.0	66	10.40	2.29	1.07	116.6	680.9	1608.1	111.9	1039.1	**643.22**	**346.35**
12.00	13.00	12.50	1.00	10.5	20.40	10.40	121.83	3.14	9.0	9.0	1.0	60.64	308.92	66	1.0	207.4	886.3	13.0	29.0	0	10.40	19.01	20.10	127.0	1979.2	3174.4	123.7	1318.9	**1269.78**	**439.63**
13.00	14.50	13.75	1.50	12.0	20.40	10.40	134.83	4.71	29.0	29.0	1.0	352.33	661.25	0	1.0	0.0	886.3	14.5	29.0	0	10.18	19.01	20.10	142.6	2210.5	3758.0	141.4	1688.9	**1503.21**	**562.97**
14.50	16.00	15.25	1.50	13.5	20.18	10.18	134.83	4.71	29.0	29.0	1.0	352.33	1013.59	0	1.0	0.0	886.3	16.0	10.4	51	10.18	2.59	1.33	142.6	656.0	2555.8	159.0	2058.9	**1022.33**	**686.31**
16.00	17.50	16.75	1.50	15.0	20.18	10.18	134.83	4.71	10.4	10.4	1.0	116.66	1130.25	51	1.0	240.4	1126.7	17.5	10.4	51	10.18	2.59	1.33	142.6	656.0	2912.9	176.7	2433.7	**1165.17**	**811.22**
17.50	19.00	18.25	1.50	16.5	20.18	10.18	134.83	4.71	10.4	10.4	1.0	116.66	1246.91	51	1.0	240.4	1367.1	19.0	24.0	12	9.99	9.28	9.78	142.6	1163.2	3777.3	194.4	2808.4	**1510.91**	**936.14**
19.00	20.50	19.75	1.50	18.0	19.99	9.99	134.83	4.71	24.0	24.0	1.0	283.00	1529.90	12	1.0	56.6	1423.7	20.5	9.3	62	10.42	2.34	1.11	142.6	705.7	3659.3	212.1	3165.7	**1463.71**	**1055.23**
20.50	23.50	22.00	3.00	21.0	20.42	10.42	134.83	9.43	9.3	9.3	1.0	208.18	1738.08	62	1.0	584.6	2008.3	23.5	9.3	62	10.42	2.34	1.11	142.6	705.7	4452.0	247.4	3993.8	**1780.81**	**1331.26**
23.50	25.00	24.25	1.50	22.5	20.42	10.42	134.83	4.71	9.3	9.3	1.0	104.09	1842.17	62	1.0	292.3	2300.6	25.0	9.3	62	10.42	2.34	1.11	142.6	705.7	4848.4	265.1	4407.8	**1939.36**	**1469.27**
25.00	26.50	25.75	1.50	24.0	20.42	10.42	134.83	4.71	9.3	9.3	1.0	104.09	1946.26	62	1.0	292.3	2592.9	26.5	7.5	60	8.59	2.02	0.84	142.6	653.5	5192.6	282.7	4821.9	**2077.04**	**1607.29**
26.50	27.50	27.00	1.00	25.0	18.59	8.59	134.83	3.14	7.5	7.5	1.0	55.79	2002.04	60	1.0	188.6	2781.4	27.5	7.5	60	8.59	2.02	0.84	142.6	653.5	5437.0	294.5	5078.0	**2174.78**	**1692.67**
27.50	28.00	27.75	0.50	25.5	18.59	8.59	134.83	1.57	7.5	7.5	1.0	27.89	2029.94	60	1.0	94.3	2875.7	28.0	7.5	60	9.11	2.02	0.84	142.6	653.6	5559.3	300.4	5206.1	**2223.72**	**1735.36**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
28.00	29.50	28.75	1.50	27.0	19.11	9.11	134.83	4.71	7.5	7.5	1.0	83.68	2113.62	60	1.0	282.9	3158.6	29.5	7.5	60	8.85	2.02	0.84	142.6	653.6	5925.8	318.1	5590.3	**2370.30**	**1863.43**
29.50	30.00	29.75	0.50	27.5	18.85	8.85	134.83	1.57	7.5	7.5	1.0	27.89	2141.51	60	1.0	94.3	3252.9	30.0	8.0	54	8.85	2.11	0.91	142.6	621.5	6015.9	324.0	5718.3	**2406.34**	**1906.12**
30.00	31.00	30.50	1.00	28.5	18.85	8.85	134.83	3.14	8.0	8.0	1.0	59.55	2201.07	54	1.0	169.7	3422.6	31.0	9.2	44	9.73	2.33	1.10	142.6	576.0	6199.6	335.8	5959.4	**2479.86**	**1986.47**
31.00	32.50	31.75	1.50	30.0	19.73	9.73	134.83	4.71	9.2	9.2	1.0	102.95	2304.02	44	1.0	207.4	3630.0	32.5	7.0	51	8.54	1.93	0.76	142.6	579.5	6513.5	353.4	6287.4	**2605.40**	**2095.82**
32.50	34.00	33.25	1.50	31.5	18.54	8.54	134.83	4.71	7.0	7.0	1.0	78.05	2382.06	51	1.0	240.4	3870.4	34.0	11.5	48	9.73	2.91	1.65	142.6	672.0	6924.4	371.1	6623.6	**2769.78**	**2207.86**
34.00	35.00	34.50	1.00	32.5	19.73	9.73	134.83	3.14	11.5	11.5	1.0	86.21	2468.28	48	1.0	150.9	4021.3	35.0	11.5	48	9.73	2.91	1.65	142.6	672.0	7161.5	382.9	6872.4	**2864.61**	**2290.81**
35.00	35.50	35.25	0.50	33.0	19.73	9.73	134.83	1.57	11.5	11.5	1.0	43.11	2511.38	48	1.0	75.4	4096.7	35.5	8.0	60	8.79	2.11	0.91	142.6	663.9	7272.0	388.8	6996.9	**2908.80**	**2332.29**
35.50	37.00	36.25	1.50	34.5	18.79	8.79	134.83	4.71	8.0	8.0	1.0	89.33	2600.71	60	1.0	282.9	4379.6	37.0	8.0	60	9.18	2.11	0.91	142.6	664.0	7644.3	406.4	7386.7	**3057.73**	**2462.24**
37.00	37.50	37.25	0.50	35.0	19.18	9.18	134.83	1.57	8.0	8.0	1.0	29.78	2630.49	60	1.0	94.3	4473.9	37.5	8.0	60	9.18	2.11	0.91	142.6	664.0	7768.4	412.3	7516.7	**3107.35**	**2505.56**
37.50	38.50	38.00	1.00	36.0	19.18	9.18	134.83	3.14	8.0	8.0	1.0	59.55	2690.05	60	1.0	188.6	4662.4	38.5	9.2	56	8.83	2.33	1.10	142.6	660.5	8012.9	424.1	7776.6	**3205.18**	**2592.20**
38.50	40.00	39.25	1.50	37.5	18.83	8.83	134.83	4.71	9.2	9.2	1.0	102.95	2792.99	56	1.0	264.0	4926.4	40.0	9.2	56	0.00	2.33	1.10	142.6	656.7	8376.1	441.8	8161.2	**3350.44**	**2720.40**
BORE NO: P33, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.79	9.79	26.92	1.57	28.6	28.6	1.0	23.07	0	0	1.0	0.0	0	3.0	28.6	0	9.53	18.11	19.17	29.4	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.5	19.53	9.53	38.90	6.29	28.6	28.6	1.0	133.31	0	0	1.0	0.0	0	5.0	29.3	0	9.53	19.68	20.79	48.4	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.53	9.53	53.20	3.14	29.3	29.3	1.0	93.82	0	0	1.0	0.0	0	6.0	29.3	0	9.45	19.68	20.79	58.0	973.5	973.5	41.2	41.2	**389.42**	**13.74**
6.00	8.00	7.00	2.00	5.5	19.45	9.45	67.41	6.29	29.3	29.3	1.0	237.78	237.78	0	1.0	0.0	0.0	8.0	29.3	0	9.45	19.68	20.79	76.9	1265.8	1503.6	64.8	302.6	**601.45**	**100.86**
8.00	9.00	8.50	1.00	6.5	19.45	9.45	81.59	3.14	29.3	29.3	1.0	143.89	381.67	0	1.0	0.0	0.0	9.0	12.2	56	10.24	3.12	1.85	86.3	614.8	996.4	76.6	458.2	**398.58**	**152.75**
9.00	11.00	10.00	2.00	8.5	20.24	10.24	96.55	6.29	12.2	12.2	1.0	131.21	512.88	56	1.0	352.0	352.0	11.0	27.7	0	10.24	16.08	17.10	106.8	1418.0	2282.9	100.1	965.0	**913.16**	**321.67**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
11.00	12.00	11.50	1.00	9.5	20.24	10.24	111.91	3.14	27.7	27.7	1.0	184.66	697.54	0	1.0	0.0	352.0	12.0	28.0	0	10.24	16.76	17.79	117.0	1612.3	2661.8	111.9	1161.5	**1064.74**	**387.15**
12.00	13.00	12.50	1.00	10.5	20.24	10.24	122.15	3.14	28.0	28.0	1.0	204.12	901.66	0	1.0	0.0	352.0	13.0	8.6	59	10.39	2.22	1.00	127.3	643.1	1896.8	123.7	1377.4	**758.71**	**459.12**
13.00	14.50	13.75	1.50	12.0	20.39	10.39	135.06	4.71	8.6	8.6	1.0	96.30	997.96	59	1.0	278.1	630.1	14.5	8.6	59	10.61	2.22	1.00	142.9	670.4	2298.5	141.4	1769.5	**919.38**	**589.82**
14.50	17.50	16.00	3.00	15.0	20.61	10.61	135.06	9.43	8.6	8.6	1.0	192.59	1190.55	59	1.0	556.3	1186.4	17.5	10.3	62	10.42	2.56	1.31	142.9	730.9	3107.9	176.7	2553.7	**1243.16**	**851.23**
17.50	20.50	19.00	3.00	18.0	20.42	10.42	135.06	9.43	10.3	10.3	1.0	231.42	1421.97	62	1.0	584.6	1771.0	20.5	11.6	65	10.42	2.94	1.68	142.9	796.6	3989.5	212.1	3405.0	**1595.81**	**1135.01**
20.50	22.00	21.25	1.50	19.5	20.42	10.42	135.06	4.71	11.6	11.6	1.0	130.70	1552.67	65	1.0	306.4	2077.4	22.0	25.2	8	9.65	10.45	11.34	142.9	1272.5	4902.7	229.7	3859.8	**1961.06**	**1286.61**
22.00	23.50	22.75	1.50	21.0	19.65	9.65	135.06	4.71	25.2	25.2	1.0	299.62	1852.29	8	1.0	37.7	2115.1	23.5	11.0	56	9.65	2.76	1.51	142.9	711.9	4679.4	247.4	4214.8	**1871.75**	**1404.95**
23.50	25.00	24.25	1.50	22.5	19.65	9.65	135.06	4.71	11.0	11.0	1.0	123.77	1976.06	56	1.0	264.0	2379.1	25.0	11.0	56	9.65	2.76	1.51	142.9	711.9	5067.2	265.1	4620.3	**2026.86**	**1540.09**
25.00	26.50	25.75	1.50	24.0	19.65	9.65	135.06	4.71	11.0	11.0	1.0	123.77	2099.83	56	1.0	264.0	2643.1	26.5	11.0	56	8.78	2.76	1.51	142.9	711.4	5454.4	282.7	5025.7	**2181.76**	**1675.24**
26.50	27.50	27.00	1.00	25.0	18.78	8.78	135.06	3.14	11.0	11.0	1.0	82.51	2182.34	56	1.0	176.0	2819.1	27.5	11.0	56	8.78	2.76	1.51	142.9	711.4	5712.9	294.5	5296.0	**2285.17**	**1765.33**
27.50	28.00	27.75	0.50	25.5	18.78	8.78	135.06	1.57	11.0	11.0	1.0	41.26	2223.59	56	1.0	88.0	2907.1	28.0	11.6	65	9.46	2.94	1.68	142.9	795.9	5926.7	300.4	5431.2	**2370.66**	**1810.38**
28.00	29.50	28.75	1.50	27.0	19.46	9.46	135.06	4.71	11.6	11.6	1.0	130.70	2354.29	65	1.0	306.4	3213.6	29.5	11.6	65	8.75	2.94	1.68	142.9	795.4	6363.3	318.1	5886.0	**2545.33**	**1961.98**
29.50	30.00	29.75	0.50	27.5	18.75	8.75	135.06	1.57	11.6	11.6	1.0	43.57	2397.86	65	1.0	102.1	3315.7	30.0	11.6	65	8.75	2.94	1.68	142.9	795.4	6509.0	324.0	6037.6	**2603.61**	**2012.52**
30.00	31.00	30.50	1.00	28.5	18.75	8.75	135.06	3.14	11.6	11.6	1.0	87.13	2484.99	65	1.0	204.3	3520.0	31.0	11.6	65	8.97	2.94	1.68	142.9	795.6	6800.6	335.8	6340.8	**2720.24**	**2113.58**
31.00	32.50	31.75	1.50	30.0	18.97	8.97	135.06	4.71	11.6	11.6	1.0	130.70	2615.69	65	1.0	306.4	3826.4	32.5	11.5	57	8.96	2.91	1.65	142.9	735.6	7177.7	353.4	6795.6	**2871.10**	**2265.18**
32.50	34.00	33.25	1.50	31.5	18.96	8.96	135.06	4.71	11.5	11.5	1.0	129.54	2745.24	57	1.0	268.7	4095.1	34.0	11.5	57	8.95	2.91	1.65	142.9	735.6	7576.0	371.1	7211.5	**3030.40**	**2403.83**
34.00	35.00	34.50	1.00	32.5	18.95	8.95	135.06	3.14	11.5	11.5	1.0	86.36	2831.60	57	1.0	179.1	4274.3	35.0	11.5	57	8.95	2.91	1.65	142.9	735.6	7841.5	382.9	7488.8	**3136.60**	**2496.26**
35.00	35.50	35.25	0.50	33.0	18.95	8.95	135.06	1.57	11.5	11.5	1.0	43.18	2874.78	57	1.0	89.6	4363.9	35.5	8.5	46	8.64	2.20	0.99	142.9	575.6	7814.2	388.8	7627.4	**3125.69**	**2542.47**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
35.50	37.00	36.25	1.50	34.5	18.64	8.64	135.06	4.71	8.5	8.5	1.0	95.16	2969.94	46	1.0	216.9	4580.7	37.0	8.7	60	9.08	2.24	1.02	142.9	678.9	8229.6	406.4	7957.1	**3291.82**	**2652.37**
37.00	37.50	37.25	0.50	35.0	19.08	9.08	135.06	1.57	8.7	8.7	1.0	32.48	3002.42	60	1.0	94.3	4675.0	37.5	8.7	60	9.08	2.24	1.02	142.9	678.9	8356.3	412.3	8089.8	**3342.53**	**2696.58**
37.50	38.50	38.00	1.00	36.0	19.08	9.08	135.06	3.14	8.7	8.7	1.0	64.95	3067.37	60	1.0	188.6	4863.6	38.5	8.7	60	8.75	2.24	1.02	142.9	678.8	8609.7	424.1	8355.1	**3443.88**	**2785.02**
38.50	40.00	39.25	1.50	37.5	18.75	8.75	135.06	4.71	8.7	8.7	1.0	97.43	3164.80	60	1.0	282.9	5146.4	40.0	9.8	54	0.00	2.43	1.19	142.9	655.1	8966.3	441.8	8753.0	**3586.52**	**2917.67**
BORE NO: P34, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.58	9.58	26.35	1.57	23.3	23.3	1.0	17.83	0	0	1.0	0.0	0	3.0	15.9	26	9.58	4.38	3.14	28.7	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.5	19.58	9.58	33.53	3.14	15.9	15.9	1.0	30.02	0	26	1.0	81.7	0	4.0	30.8	0	9.29	25.29	26.50	38.3	858.1	858.1	17.7	17.7	**343.26**	**5.89**
4.00	6.00	5.00	2.00	3.5	19.29	9.29	47.61	6.29	30.8	30.8	1.0	185.53	185.53	0	1.0	0.0	0.0	6.0	30.8	0	9.29	25.29	26.50	56.9	1227.3	1412.9	41.2	226.8	**565.15**	**75.59**
6.00	7.00	6.50	1.00	4.5	19.29	9.29	61.55	3.14	30.8	30.8	1.0	119.92	305.45	0	1.0	0.0	0.0	7.0	27.4	0	9.29	15.40	16.41	66.2	861.0	1166.5	53.0	358.5	**466.59**	**119.49**
7.00	8.00	7.50	1.00	5.5	19.29	9.29	70.84	3.14	27.4	27.4	1.0	115.40	420.85	0	1.0	0.0	0.0	8.0	25.8	7	9.75	11.80	12.72	75.5	798.1	1219.0	64.8	485.6	**487.59**	**161.88**
8.00	9.00	8.50	1.00	6.5	19.75	9.75	80.36	3.14	25.8	25.8	1.0	122.08	542.93	7	1.0	22.0	22.0	9.0	26.2	9	9.75	12.70	13.64	85.2	966.5	1531.5	76.6	641.5	**612.59**	**213.84**
9.00	10.00	9.50	1.00	7.5	19.75	9.75	90.11	3.14	26.2	26.2	1.0	139.35	682.28	9	1.0	28.3	50.3	10.0	26.0	0	9.49	12.25	13.18	95.0	963.5	1696.0	88.4	820.9	**678.42**	**273.64**
10.00	12.50	11.25	2.50	10.0	19.49	9.49	106.84	7.86	26.0	26.0	1.0	409.44	1091.72	0	1.0	0.0	50.3	12.5	9.5	55	10.41	2.38	1.14	118.7	615.6	1757.6	117.8	1259.8	**703.03**	**419.94**
12.50	15.50	14.00	3.00	13.0	20.41	10.41	134.32	9.43	9.5	9.5	1.0	211.93	1303.65	55	1.0	518.6	568.9	15.5	9.5	55	10.41	2.38	1.14	118.7	615.6	2488.1	153.2	2025.7	**995.23**	**675.22**
15.50	18.50	17.00	3.00	16.0	20.41	10.41	134.32	9.43	9.5	9.5	1.0	211.93	1515.58	55	1.0	518.6	1087.4	18.5	9.5	55	10.62	2.38	1.14	118.7	615.7	3218.7	188.5	2791.5	**1287.47**	**930.50**
18.50	21.50	20.00	3.00	19.0	20.62	10.62	134.32	9.43	9.5	9.5	1.0	211.93	1727.51	55	1.0	518.6	1606.0	21.5	11.5	58	10.14	2.91	1.65	118.7	688.2	4021.7	223.8	3557.3	**1608.69**	**1185.78**
21.50	24.50	23.00	3.00	22.0	20.14	10.14	134.32	9.43	11.5	11.5	1.0	257.66	1985.17	58	1.0	546.9	2152.9	24.5	8.2	62	10.14	2.15	0.94	118.7	642.3	4780.4	259.2	4397.2	**1912.15**	**1465.74**
24.50	27.50	26.00	3.00	25.0	20.14	10.14	134.32	9.43	8.2	8.2	1.0	182.50	2167.67	62	1.0	584.6	2737.4	27.5	8.2	60	10.59	2.15	0.94	118.7	628.4	5533.5	294.5	5199.6	**2213.38**	**1733.21**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
27.50	30.00	28.75	2.50	27.5	20.59	10.59	134.32	7.86	8.2	8.2	1.0	152.08	2319.75	60	1.0	471.4	3208.9	30.0	9.1	59	10.59	2.31	1.08	118.7	637.0	6165.6	324.0	5852.6	**2466.23**	**1950.86**
30.00	30.50	30.25	0.50	28.0	20.59	10.59	134.32	1.57	9.1	9.1	1.0	33.81	2353.56	59	1.0	92.7	3301.6	30.5	32.5	0	10.59	33.85	35.22	118.7	3303.9	8959.1	329.9	5985.0	**3583.62**	**1995.00**
30.50	32.00	31.25	1.50	29.5	20.59	10.59	134.32	4.71	32.5	32.5	1.1	453.83	2807.39	0	1.0	0.0	3301.6	32.0	19.5	32	10.59	6.13	5.12	118.7	819.7	6928.6	347.5	6456.5	**2771.46**	**2152.17**
32.00	32.50	32.25	0.50	30.0	20.59	10.59	134.32	1.57	19.5	19.5	1.0	74.75	2882.14	32	1.0	50.3	3351.9	32.5	19.5	32	8.96	6.13	5.12	118.7	816.4	7050.4	353.4	6587.4	**2820.16**	**2195.81**
32.50	33.50	33.00	1.00	31.0	18.96	8.96	134.32	3.14	19.5	19.5	1.0	149.49	3031.63	32	1.0	100.6	3452.4	33.5	19.5	32	9.42	6.13	5.12	118.7	817.3	7301.4	365.2	6849.3	**2920.55**	**2283.09**
33.50	35.00	34.25	1.50	32.5	19.42	9.42	134.32	4.71	19.5	19.5	1.0	224.24	3255.86	32	1.0	150.9	3603.3	35.0	11.4	39	9.13	2.88	1.62	118.7	550.4	7409.5	382.9	7242.0	**2963.80**	**2414.01**
35.00	36.50	35.75	1.50	34.0	19.13	9.13	134.32	4.71	11.4	11.4	1.0	127.68	3383.54	39	1.0	183.9	3787.1	36.5	11.4	39	9.17	2.88	1.62	118.7	550.4	7721.1	400.6	7571.2	**3088.43**	**2523.75**
36.50	37.50	37.00	1.00	35.0	19.17	9.17	134.32	3.14	11.4	11.4	1.0	85.12	3468.66	39	1.0	122.6	3909.7	37.5	12.0	39	9.17	3.06	1.79	118.7	567.5	7945.8	412.3	7790.7	**3178.33**	**2596.90**
37.50	38.00	37.75	0.50	35.5	19.17	9.17	134.32	1.57	12.0	12.0	1.0	44.87	3513.53	39	1.0	61.3	3971.0	38.0	8.0	50	9.05	2.11	0.91	118.7	553.6	8038.1	418.2	7902.8	**3215.26**	**2634.25**
38.00	40.00	39.00	2.00	37.5	19.05	9.05	134.32	6.29	8.0	8.0	1.0	118.66	3632.19	50	1.0	314.3	4285.3	40.0	8.0	50	0.00	2.11	0.91	118.7	550.4	8467.8	441.8	8359.3	**3387.14**	**2786.42**
BORE NO: P36, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.43	10.43	28.68	1.57	29.5	29.5	1.0	25.50	0	0	1.0	0.0	0	3.0	29.5	0	10.71	20.13	21.25	31.3	584.4	584.4	5.9	5.9	**233.75**	**1.96**
3.00	5.00	4.00	2.00	2.5	20.71	10.71	42.00	6.29	29.5	29.5	1.0	149.36	149.36	0	1.0	0.0	0.0	5.0	29.5	0	10.71	20.13	21.25	52.7	923.2	1072.6	29.5	178.8	**429.04**	**59.61**
5.00	6.00	5.50	1.00	3.5	20.71	10.71	58.07	3.14	29.5	29.5	1.0	103.25	252.61	0	1.0	0.0	0.0	6.0	29.3	0	10.48	19.68	20.79	63.4	1066.4	1319.0	41.2	293.8	**527.60**	**97.95**
6.00	8.00	7.00	2.00	5.5	20.48	10.48	73.90	6.29	29.3	29.3	1.0	260.67	513.29	0	1.0	0.0	0.0	8.0	9.5	49	10.48	2.38	1.14	84.4	509.0	1022.3	64.8	578.1	**408.91**	**192.69**
8.00	9.00	8.50	1.00	6.5	20.48	10.48	89.62	3.14	9.5	9.5	1.0	47.13	560.42	49	1.0	154.0	154.0	9.0	9.5	49	10.48	2.38	1.14	94.9	528.6	1243.0	76.6	791.0	**497.21**	**263.67**
9.00	10.00	9.50	1.00	7.5	20.48	10.48	100.10	3.14	9.5	9.5	1.0	52.65	613.07	49	1.0	154.0	308.0	10.0	9.5	49	10.50	2.38	1.14	105.3	548.2	1469.3	88.4	1009.4	**587.71**	**336.47**
10.00	11.00	10.50	1.00	8.5	20.50	10.50	110.59	3.14	9.5	9.5	1.0	58.16	671.23	49	1.0	154.0	462.0	11.0	9.5	49	10.50	2.38	1.14	115.8	567.8	1701.1	100.1	1233.4	**680.43**	**411.12**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								φ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	φ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
11.00	12.00	11.50	1.00	9.5	20.50	10.50	121.09	3.14	9.5	9.5	1.0	63.69	734.91	49	1.0	154.0	616.0	12.0	6.7	69	10.50	1.88	0.71	126.3	677.1	2028.0	111.9	1462.8	**811.20**	**487.61**
12.00	13.00	12.50	1.00	10.5	20.50	10.50	131.59	3.14	6.7	6.7	1.0	48.58	783.50	69	1.0	216.9	832.9	13.0	26.9	0	9.99	14.28	15.26	136.8	1595.1	3211.4	123.7	1740.1	**1284.57**	**580.02**
13.00	14.50	13.75	1.50	12.0	19.99	9.99	144.33	4.71	26.9	26.9	1.0	345.20	1128.70	0	1.0	0.0	832.9	14.5	26.9	0	9.99	14.28	15.26	151.8	1763.2	3724.7	141.4	2102.9	**1489.90**	**700.97**
14.50	16.00	15.25	1.50	13.5	19.99	9.99	144.33	4.71	26.9	26.9	1.0	345.20	1473.90	0	1.0	0.0	832.9	16.0	9.0	54	10.56	2.29	1.07	151.8	659.5	2966.2	159.0	2465.8	**1186.48**	**821.93**
16.00	17.50	16.75	1.50	15.0	20.56	10.56	144.33	4.71	9.0	9.0	1.0	107.77	1581.66	54	1.0	254.6	1087.4	17.5	10.0	60	10.83	2.47	1.22	151.8	724.1	3393.2	176.7	2845.8	**1357.29**	**948.60**
17.50	20.50	19.00	3.00	18.0	20.83	10.83	144.33	9.43	10.0	10.0	1.0	239.95	1821.62	60	1.0	565.7	1653.1	20.5	9.5	64	10.69	2.38	1.14	151.8	741.3	4216.0	212.1	3686.8	**1686.42**	**1228.94**
20.50	23.50	22.00	3.00	21.0	20.69	10.69	144.33	9.43	9.5	9.5	1.0	227.73	2049.35	64	1.0	603.4	2256.6	23.5	9.5	64	10.69	2.38	1.14	151.8	741.3	5047.2	247.4	4553.3	**2018.88**	**1517.77**
23.50	26.50	25.00	3.00	24.0	20.69	10.69	144.33	9.43	9.5	9.5	1.0	227.73	2277.07	64	1.0	603.4	2860.0	26.5	9.5	64	10.52	2.38	1.14	151.8	741.2	5878.3	282.7	5419.8	**2351.31**	**1806.61**
26.50	27.50	27.00	1.00	25.0	20.52	10.52	144.33	3.14	9.5	9.5	1.0	75.91	2352.98	64	1.0	201.1	3061.1	27.5	10.5	60	10.52	2.62	1.36	151.8	742.1	6156.2	294.5	5708.7	**2462.49**	**1902.88**
27.50	28.00	27.75	0.50	25.5	20.52	10.52	144.33	1.57	10.5	10.5	1.0	42.04	2395.02	60	1.0	94.3	3155.4	28.0	11.5	68	10.52	2.91	1.65	151.8	834.9	6385.4	300.4	5850.9	**2554.15**	**1950.29**
28.00	29.50	28.75	1.50	27.0	20.52	10.52	144.33	4.71	11.5	11.5	1.0	138.43	2533.45	68	1.0	320.6	3476.0	29.5	11.5	68	10.52	2.91	1.65	151.8	834.9	6844.4	318.1	6327.5	**2737.75**	**2109.18**
29.50	30.00	29.75	0.50	27.5	20.52	10.52	144.33	1.57	11.5	11.5	1.0	46.14	2579.60	68	1.0	106.9	3582.9	30.0	11.5	60	10.52	2.91	1.65	151.8	778.4	6940.8	324.0	6486.4	**2776.33**	**2162.14**
30.00	31.00	30.50	1.00	28.5	20.52	10.52	144.33	3.14	11.5	11.5	1.0	92.29	2671.89	60	1.0	188.6	3771.4	31.0	12.9	38	10.52	3.32	2.05	151.8	673.3	7116.6	335.8	6779.1	**2846.66**	**2259.69**
31.00	32.50	31.75	1.50	30.0	20.52	10.52	144.33	4.71	12.9	12.9	1.0	155.84	2827.73	38	1.0	179.1	3950.6	32.5	19.8	45	10.46	6.29	5.28	151.8	1090.7	7869.0	353.4	7131.7	**3147.59**	**2377.24**
32.50	34.00	33.25	1.50	31.5	20.46	10.46	144.33	4.71	19.8	19.8	1.0	244.97	3072.69	45	1.0	212.1	4162.7	34.0	13.8	45	10.46	3.59	2.31	151.8	755.9	7991.4	371.1	7606.5	**3196.54**	**2535.50**
34.00	35.00	34.50	1.00	32.5	20.46	10.46	144.33	3.14	13.8	13.8	1.0	111.42	3184.11	45	1.0	141.4	4304.1	35.0	14.5	48	10.46	3.80	2.51	151.8	802.4	8290.7	382.9	7871.1	**3316.28**	**2623.71**
35.00	35.50	35.25	0.50	33.0	20.46	10.46	144.33	1.57	14.5	14.5	1.0	58.66	3242.77	48	1.0	75.4	4379.6	35.5	13.5	54	10.46	3.50	2.22	151.8	808.5	8430.8	388.8	8011.1	**3372.34**	**2670.37**
35.50	37.50	36.50	2.00	35.0	20.46	10.46	144.33	6.29	13.5	13.5	1.0	217.81	3460.58	54	1.0	339.4	4719.0	37.5	20.2	16	10.46	6.54	5.61	151.8	916.8	9096.4	412.3	8591.9	**3638.56**	**2863.97**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
37.50	38.50	38.00	1.00	36.0	20.46	10.46	144.33	3.14	20.2	20.2	1.0	166.90	3627.48	16	1.0	50.3	4769.3	38.5	20.0	16	10.46	6.40	5.39	151.8	898.8	9295.5	424.1	8820.9	**3718.21**	**2940.29**
38.50	40.00	39.25	1.50	37.5	20.46	10.46	144.33	4.71	20.0	20.0	1.0	247.65	3875.13	16	1.0	75.4	4844.7	40.0	20.0	16	10.46	6.40	5.39	151.8	898.8	9618.6	441.8	9161.6	**3847.44**	**3053.88**
BORE NO: P39, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	18.95	8.95	24.61	1.57	24.5	24.5	1.0	17.63	0	7	1.0	11.0	0	3.0	24.5	7	8.95	9.64	10.33	26.9	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.5	18.95	8.95	35.80	6.29	24.5	24.5	1.0	102.55	0	7	1.0	44.0	0	5.0	13.5	17	8.95	3.50	2.22	44.8	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	18.95	8.95	49.23	3.14	13.5	13.5	1.0	37.14	0	17	1.0	53.4	0	6.0	15.0	20	8.95	3.94	2.65	53.7	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	8.00	7.00	2.00	5.5	18.95	8.95	62.65	6.29	15.0	15.0	1.0	105.52	0	20	1.0	125.7	0	8.0	13.2	21	10.20	3.41	2.14	71.6	0	0.0	64.8	64.8	**0.00**	**21.60**
8.00	9.00	8.50	1.00	6.5	20.20	10.20	76.70	3.14	13.2	13.2	1.0	56.54	0	21	1.0	66.0	0	9.0	9.5	51	10.20	2.38	1.14	81.8	518.2	518.2	76.6	76.6	**207.28**	**25.53**
9.00	10.00	9.50	1.00	7.5	20.20	10.20	86.90	3.14	9.5	9.5	1.0	45.70	45.70	51	1.0	160.3	160.3	10.0	9.5	51	10.20	2.38	1.14	92.0	537.3	743.3	88.4	294.3	**297.30**	**98.12**
10.00	11.00	10.50	1.00	8.5	20.20	10.20	97.10	3.14	9.5	9.5	1.0	51.07	96.77	51	1.0	160.3	320.6	11.0	9.5	51	10.20	2.38	1.14	102.2	556.3	973.7	100.1	517.5	**389.47**	**172.49**
11.00	12.00	11.50	1.00	9.5	20.20	10.20	107.30	3.14	9.5	9.5	1.0	56.43	153.20	51	1.0	160.3	480.9	12.0	8.2	56	10.49	2.15	0.94	112.4	589.4	1223.5	111.9	746.0	**489.39**	**248.66**
12.00	14.50	13.25	2.50	12.0	20.49	10.49	125.51	7.86	8.2	8.2	1.0	142.11	295.31	56	1.0	440.0	920.9	14.5	12.8	27	10.49	3.29	2.02	138.6	557.8	1773.9	141.4	1357.5	**709.58**	**452.51**
14.50	16.00	15.25	1.50	13.5	20.49	10.49	125.51	4.71	12.8	12.8	1.0	134.43	429.75	27	1.0	127.3	1048.1	16.0	11.5	53	10.50	2.91	1.65	138.6	698.7	2176.5	159.0	1636.9	**870.62**	**545.64**
16.00	17.50	16.75	1.50	15.0	20.50	10.50	125.51	4.71	11.5	11.5	1.0	120.38	550.13	53	1.0	249.9	1298.0	17.5	10.5	58	9.89	2.62	1.36	138.6	700.5	2548.6	176.7	2024.8	**1019.44**	**674.95**
17.50	20.50	19.00	3.00	18.0	19.89	9.89	125.51	9.43	10.5	10.5	1.0	219.33	769.46	58	1.0	546.9	1844.9	20.5	14.4	80	9.89	3.77	2.48	138.6	985.5	3599.9	212.1	2826.4	**1439.94**	**942.12**
20.50	22.00	21.25	1.50	19.5	19.89	9.89	125.51	4.71	14.4	14.4	1.0	151.92	921.38	80	1.0	377.1	2222.0	22.0	9.7	62	10.30	2.42	1.17	138.6	706.3	3849.7	229.7	3373.1	**1539.88**	**1124.37**
22.00	23.50	22.75	1.50	21.0	20.30	10.30	125.51	4.71	9.7	9.7	1.0	101.14	1022.52	62	1.0	292.3	2514.3	23.5	9.7	62	10.30	2.42	1.17	138.6	706.3	4243.1	247.4	3784.2	**1697.26**	**1261.40**
23.50	25.00	24.25	1.50	22.5	20.30	10.30	125.51	4.71	9.7	9.7	1.0	101.14	1123.67	62	1.0	292.3	2806.6	25.0	10.4	46	10.60	2.59	1.33	138.6	612.7	4542.9	265.1	4195.3	**1817.17**	**1398.44**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
25.00	26.50	25.75	1.50	24.0	20.60	10.60	125.51	4.71	10.4	10.4	1.0	108.60	1232.26	46	1.0	216.9	3023.4	26.5	10.0	46	10.60	2.47	1.22	138.6	599.4	4855.1	282.7	4538.4	**1942.04**	**1512.81**
26.50	27.50	27.00	1.00	25.0	20.60	10.60	125.51	3.14	10.0	10.0	1.0	69.56	1301.82	46	1.0	144.6	3168.0	27.5	10.0	46	10.60	2.47	1.22	138.6	599.4	5069.2	294.5	4764.3	**2027.69**	**1588.11**
27.50	29.50	28.50	2.00	27.0	20.60	10.60	125.51	6.29	10.0	10.0	1.0	139.11	1440.93	46	1.0	289.1	3457.1	29.5	14.3	30	8.93	3.74	2.45	138.6	627.8	5525.8	318.1	5216.2	**2210.34**	**1738.72**
29.50	30.00	29.75	0.50	27.5	18.93	8.93	125.51	1.57	14.3	14.3	1.0	50.27	1491.20	30	1.0	47.1	3504.3	30.0	9.5	30	8.93	2.38	1.14	138.6	475.4	5470.9	324.0	5319.5	**2188.35**	**1773.16**
30.00	31.00	30.50	1.00	28.5	18.93	8.93	125.51	3.14	9.5	9.5	1.0	66.01	1557.21	30	1.0	94.3	3598.6	31.0	9.5	50	9.19	2.38	1.14	138.6	616.9	5772.7	335.8	5491.5	**2309.09**	**1830.51**
31.00	32.50	31.75	1.50	30.0	19.19	9.19	125.51	4.71	9.5	9.5	1.0	99.02	1656.23	50	1.0	235.7	3834.3	32.5	26.1	0	10.42	12.48	13.41	138.6	1413.9	6904.4	353.4	5843.9	**2761.77**	**1947.98**
32.50	34.00	33.25	1.50	31.5	20.42	10.42	125.51	4.71	27.5	27.5	1.0	308.02	1964.25	0	1.0	0.0	3834.3	34.0	10.9	47	10.42	2.73	1.48	138.6	636.3	6434.8	371.1	6169.6	**2573.92**	**2056.55**
34.00	35.00	34.50	1.00	32.5	20.42	10.42	125.51	3.14	10.9	10.9	1.0	75.96	2040.21	47	1.0	147.7	3982.0	35.0	10.9	47	10.42	2.73	1.48	138.6	636.3	6658.5	382.9	6405.1	**2663.39**	**2135.03**
35.00	35.50	35.25	0.50	33.0	20.42	10.42	125.51	1.57	10.9	10.9	1.0	37.98	2078.20	47	1.0	73.9	4055.9	35.5	15.8	39	10.42	4.33	3.09	138.6	760.4	6894.5	388.8	6522.8	**2757.80**	**2174.27**
35.50	37.00	36.25	1.50	34.5	20.42	10.42	125.51	4.71	15.8	15.8	1.0	167.43	2245.63	39	1.0	183.9	4239.7	37.0	9.6	54	10.42	2.40	1.16	138.6	647.8	7133.1	406.4	6891.8	**2853.25**	**2297.26**
37.00	37.50	37.25	0.50	35.0	20.42	10.42	125.51	1.57	9.6	9.6	1.0	33.36	2278.99	54	1.0	84.9	4324.6	37.5	9.6	54	10.42	2.40	1.16	138.6	647.8	7251.3	412.3	7015.9	**2900.54**	**2338.63**
37.50	38.50	38.00	1.00	36.0	20.42	10.42	125.51	3.14	9.6	9.6	1.0	66.72	2345.71	54	1.0	169.7	4494.3	38.5	8.0	54	10.42	2.11	0.91	138.6	615.4	7455.4	424.1	7264.1	**2982.16**	**2421.37**
38.50	40.00	39.25	1.50	37.5	20.42	10.42	125.51	4.71	8.0	8.0	1.0	83.16	2428.87	54	1.0	254.6	4748.9	40.0	8.0	96	10.42	2.11	0.91	138.6	912.4	8090.1	441.8	7619.5	**3236.05**	**2539.84**
BORE NO: P40, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.10	10.10	27.78	1.57	9.6	9.6	1.0	7.38	0	48	1.0	75.4	0	3.0	9.6	30	10.10	2.40	1.16	30.3	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.5	20.10	10.10	35.35	3.14	9.6	9.6	1.0	18.79	0	30	1.0	94.3	0	4.0	13.5	16	10.10	3.50	2.22	40.4	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.5	20.10	10.10	45.45	3.14	13.5	13.5	1.0	34.29	0	16	1.0	50.3	0	5.0	27.5	5	9.64	15.63	16.64	50.5	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.64	9.64	55.32	3.14	27.5	27.5	1.0	90.51	0	5	1.0	15.7	0	6.0	27.5	5	9.64	15.63	16.64	60.1	0	0.0	41.2	41.2	**0.00**	**13.74**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
6.00	8.00	7.00	2.00	5.5	19.64	9.64	69.78	6.29	27.5	27.5	1.0	228.33	0	5	1.0	31.4	0	8.0	25.2	0	9.64	10.45	11.34	79.4	0	0.0	64.8	64.8	**0.00**	**21.60**
8.00	9.00	8.50	1.00	6.5	19.64	9.64	84.24	3.14	25.2	25.2	1.0	124.58	0	0	1.0	0.0	0	9.0	10.5	56	10.39	2.62	1.36	89.1	584.7	584.7	76.6	76.6	**233.88**	**25.53**
9.00	11.00	10.00	2.00	8.5	20.39	10.39	99.45	6.29	10.5	10.5	1.0	115.86	115.86	56	1.0	352.0	352.0	11.0	9.6	58	10.39	2.40	1.16	109.8	621.8	1089.7	100.1	568.0	**435.87**	**189.33**
11.00	12.00	11.50	1.00	9.5	20.39	10.39	115.04	3.14	9.6	9.6	1.0	61.15	177.01	58	1.0	182.3	534.3	12.0	7.1	59	10.49	1.95	0.77	120.2	604.4	1315.7	111.9	823.2	**526.29**	**274.40**
12.00	14.50	13.25	2.50	12.0	20.49	10.49	133.34	7.86	7.1	7.1	1.0	130.50	307.50	59	1.0	463.6	997.9	14.5	9.5	46	10.49	2.38	1.14	146.5	603.9	1909.2	141.4	1446.7	**763.69**	**482.24**
14.50	16.00	15.25	1.50	13.5	20.49	10.49	133.34	4.71	9.5	9.5	1.0	105.19	412.70	46	1.0	216.9	1214.7	16.0	8.3	60	10.09	2.16	0.96	146.5	677.1	2304.5	159.0	1786.5	**921.80**	**595.49**
16.00	17.50	16.75	1.50	15.0	20.09	10.09	133.34	4.71	8.3	8.3	1.0	91.70	504.40	60	1.0	282.9	1497.6	17.5	8.3	52	10.31	2.16	0.96	146.5	620.6	2622.6	176.7	2178.7	**1049.03**	**726.23**
17.50	20.50	19.00	3.00	18.0	20.31	10.31	133.34	9.43	8.3	8.3	1.0	183.41	687.81	52	1.0	490.3	1987.9	20.5	18.5	28	10.31	5.64	4.57	146.5	865.7	3541.4	212.1	2887.7	**1416.56**	**962.58**
20.50	23.50	22.00	3.00	21.0	20.31	10.31	133.34	9.43	18.5	18.5	1.0	420.66	1108.48	28	1.0	264.0	2251.9	23.5	11.2	57	10.85	2.82	1.56	146.5	734.6	4094.9	247.4	3607.7	**1637.96**	**1202.58**
23.50	26.50	25.00	3.00	24.0	20.85	10.85	133.34	9.43	11.2	11.2	1.0	248.94	1357.41	57	1.0	537.4	2789.3	26.5	8.7	50	10.85	2.24	1.02	146.5	615.2	4761.9	282.7	4429.4	**1904.77**	**1476.48**
26.50	27.50	27.00	1.00	25.0	20.85	10.85	133.34	3.14	8.7	8.7	1.0	64.13	1421.54	50	1.0	157.1	2946.4	27.5	8.7	49	10.85	2.24	1.02	146.5	608.1	4976.1	294.5	4662.5	**1990.45**	**1554.17**
27.50	29.50	28.50	2.00	27.0	20.85	10.85	133.34	6.29	8.7	8.7	1.0	128.26	1549.80	49	1.0	308.0	3254.4	29.5	9.5	88	10.85	2.38	1.14	146.5	901.0	5705.3	318.1	5122.3	**2282.10**	**1707.44**
29.50	30.00	29.75	0.50	27.5	20.85	10.85	133.34	1.57	9.5	9.5	1.0	35.06	1584.86	88	1.0	138.3	3392.7	30.0	9.5	88	10.85	2.38	1.14	146.5	901.0	5878.6	324.0	5301.6	**2351.44**	**1767.18**
30.00	31.00	30.50	1.00	28.5	20.85	10.85	133.34	3.14	9.5	9.5	1.0	70.13	1654.99	88	1.0	276.6	3669.3	31.0	27.7	0	10.85	16.08	17.10	146.5	1923.3	7247.5	335.8	5660.0	**2899.02**	**1886.68**
31.00	32.50	31.75	1.50	30.0	20.85	10.85	133.34	4.71	27.7	27.7	1.0	330.03	1985.02	0	1.0	0.0	3669.3	32.5	27.7	0	10.01	16.08	17.10	146.5	1917.6	7571.9	353.4	6007.7	**3028.77**	**2002.58**
32.50	34.00	33.25	1.50	31.5	20.01	10.01	133.34	4.71	27.7	27.7	1.0	330.03	2315.05	0	1.0	0.0	3669.3	34.0	26.3	7	10.01	12.93	13.88	146.5	1591.7	7576.0	371.1	6355.4	**3030.40**	**2118.48**
34.00	35.00	34.50	1.00	32.5	20.01	10.01	133.34	3.14	26.3	26.3	1.0	207.12	2522.17	7	1.0	22.0	3691.3	35.0	26.0	7	10.01	12.25	13.18	146.5	1511.2	7724.7	382.9	6596.3	**3089.86**	**2198.78**
35.00	35.50	35.25	0.50	33.0	20.01	10.01	133.34	1.57	26.0	26.0	1.0	102.20	2624.37	7	1.0	11.0	3702.3	35.5	18.9	7	10.01	5.82	4.79	146.5	738.4	7065.0	388.8	6715.4	**2826.01**	**2238.48**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	∑Qi	c	α	α.c.Asi	∑Qi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
35.50	37.00	36.25	1.50	34.5	20.01	10.01	133.34	4.71	18.9	18.9	1.0	215.22	2839.59	7	1.0	33.0	3735.3	37.0	8.9	56	10.01	2.27	1.05	146.5	661.6	7236.5	406.4	6981.3	**2894.58**	**2327.11**
37.00	37.50	37.25	0.50	35.0	20.01	10.01	133.34	1.57	8.9	8.9	1.0	32.81	2872.41	56	1.0	88.0	3823.3	37.5	8.9	56	10.16	2.27	1.05	146.5	661.6	7357.3	412.3	7108.0	**2942.93**	**2369.34**
37.50	38.50	38.00	1.00	36.0	20.16	10.16	133.34	3.14	8.9	8.9	1.0	65.63	2938.03	56	1.0	176.0	3999.3	38.5	8.9	56	9.31	2.27	1.05	146.5	661.3	7598.6	424.1	7361.4	**3039.44**	**2453.81**
38.50	40.00	39.25	1.50	37.5	19.31	9.31	133.34	4.71	8.9	8.9	1.0	98.44	3036.47	56	1.0	264.0	4263.3	40.0	18.9	10	9.31	5.82	4.79	146.5	758.3	8058.0	441.8	7741.5	**3223.21**	**2580.51**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: P24, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.95	10.95	30.11	1.89	7.5	7.5	1.0	7.48	0	51	1.0	96.2	0	3.0	29.5	0	10.95	20.13	21.25	32.9	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.5	20.95	10.95	38.33	3.77	29.5	29.5	1.0	81.78	0	0	1.0	0.0	0	4.0	28.2	0	10.95	17.21	18.25	43.8	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	6.00	5.00	2.00	3.5	20.95	10.95	54.75	7.54	28.2	28.2	1.0	221.43	0	0	1.0	0.0	0	6.0	28.0	2	8.97	16.76	17.79	65.7	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	7.00	6.50	1.00	4.5	18.97	8.97	70.19	3.77	28.0	28.0	1.0	140.74	0	2	1.0	7.5	0	7.0	28.0	2	8.97	16.76	17.79	74.7	1544.3	1544.3	76.3	76.3	**617.72**	**25.45**
7.00	8.00	7.50	1.00	5.5	18.97	8.97	79.16	3.77	28.0	28.0	1.0	158.73	158.73	2	1.0	7.5	7.5	8.0	28.0	2	8.97	16.76	17.79	83.6	1714.3	1880.6	93.3	259.6	**752.25**	**86.53**
8.00	9.00	8.50	1.00	6.5	18.97	8.97	88.13	3.77	28.0	28.0	1.0	176.72	335.45	2	1.0	7.5	15.1	9.0	28.0	2	8.97	16.76	17.79	92.6	1884.4	2234.9	110.3	460.8	**893.97**	**153.60**
9.00	10.00	9.50	1.00	7.5	18.97	8.97	97.10	3.77	28.0	28.0	1.0	194.71	530.15	2	1.0	7.5	22.6	10.0	32.8	0	9.14	35.36	36.75	101.6	4292.5	4845.3	127.2	680.0	**1938.11**	**226.67**
10.00	12.50	11.25	2.50	10.0	19.14	9.14	113.01	9.43	32.8	32.8	1.1	782.78	1312.94	0	1.0	0.0	22.6	12.5	32.8	0	9.14	35.36	36.75	124.4	5206.8	6542.3	169.6	1505.2	**2616.93**	**501.74**
12.50	14.00	13.25	1.50	11.5	19.14	9.14	131.29	5.66	32.8	32.8	1.1	545.65	1858.58	0	1.0	0.0	22.6	14.0	26.5	14	10.96	13.38	14.34	138.1	2340.1	4221.3	195.1	2076.3	**1688.53**	**692.10**
14.00	15.50	14.75	1.50	13.0	20.96	10.96	146.36	5.66	26.5	26.5	1.0	412.82	2271.40	14	1.0	79.2	101.8	15.5	26.5	0	10.96	13.38	14.34	154.6	2446.4	4819.6	220.5	2593.8	**1927.85**	**864.59**
15.50	17.00	16.25	1.50	14.5	20.96	10.96	162.80	5.66	26.5	26.5	1.0	459.19	2730.58	0	1.0	0.0	101.8	17.0	14.6	45	10.85	3.82	2.54	171.0	1216.8	4049.2	246.0	3078.4	**1619.70**	**1026.13**
17.00	18.50	17.75	1.50	16.0	20.85	10.85	179.16	5.66	14.6	14.6	1.0	264.00	2994.58	45	1.0	254.6	356.4	18.5	14.6	45	10.86	3.82	2.54	171.0	1216.9	4567.8	271.4	3622.4	**1827.14**	**1207.47**
18.50	21.50	20.00	3.00	19.0	20.86	10.86	179.16	11.31	14.6	14.6	1.0	528.00	3522.59	45	1.0	509.1	865.5	21.5	11.1	44	10.23	2.79	1.53	171.0	999.2	5387.3	322.3	4710.5	**2154.94**	**1570.15**
21.50	24.50	23.00	3.00	22.0	20.23	10.23	179.16	11.31	11.1	11.1	1.0	397.69	3920.28	44	1.0	497.8	1363.4	24.5	10.5	56	10.23	2.62	1.36	171.0	1086.1	6369.7	373.2	5656.9	**2547.89**	**1885.62**
24.50	26.00	25.25	1.50	23.5	20.23	10.23	179.16	5.66	10.5	10.5	1.0	187.84	4108.12	56	1.0	316.8	1680.2	26.0	10.5	75	10.35	2.62	1.36	171.0	1279.7	7068.0	398.7	6187.0	**2827.19**	**2062.32**
26.00	27.50	26.75	1.50	25.0	20.35	10.35	179.16	5.66	10.5	10.5	1.0	187.84	4295.97	75	1.0	424.3	2104.5	27.5	10.5	75	10.35	2.62	1.36	171.0	1279.7	7680.1	424.1	6824.5	**3072.04**	**2274.85**
27.50	29.00	28.25	1.50	26.5	20.35	10.35	179.16	5.66	10.5	10.5	1.0	187.84	4483.81	75	1.0	424.3	2528.7	29.0	13.3	54	9.14	3.44	2.16	171.0	1228.9	8241.5	449.6	7462.1	**3296.59**	**2487.37**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
29.00	30.00	29.50	1.00	27.5	19.14	9.14	179.16	3.77	13.3	13.3	1.0	159.72	4643.54	54	1.0	203.7	2732.4	30.0	13.3	54	9.14	3.44	2.16	171.0	1228.9	8604.9	466.5	7842.5	**3441.95**	**2614.15**
30.00	30.50	30.25	0.50	28.0	19.14	9.14	179.16	1.89	13.3	13.3	1.0	79.86	4723.40	54	1.0	101.8	2834.2	30.5	13.3	54	9.14	3.44	2.16	171.0	1228.9	8786.6	475.0	8032.6	**3514.62**	**2677.54**
30.50	32.50	31.50	2.00	30.0	19.14	9.14	179.16	7.54	13.3	13.3	1.0	319.45	5042.84	54	1.0	407.3	3241.5	32.5	13.0	50	9.17	3.35	2.08	171.0	1170.3	9454.7	508.9	8793.3	**3781.87**	**2931.11**
32.50	33.50	33.00	1.00	31.0	19.17	9.17	179.16	3.77	13.0	13.0	1.0	155.99	5198.84	50	1.0	188.6	3430.1	33.5	13.0	50	8.93	3.35	2.08	171.0	1170.0	9798.9	525.9	9154.9	**3919.56**	**3051.62**
33.50	35.00	34.25	1.50	32.5	18.93	8.93	179.16	5.66	13.0	13.0	1.0	233.99	5432.83	50	1.0	282.9	3713.0	35.0	27.7	0	8.93	16.08	17.10	171.0	3215.1	12360.9	551.3	9697.1	**4944.37**	**3232.38**
35.00	36.50	35.75	1.50	34.0	18.93	8.93	179.16	5.66	27.7	27.7	1.0	532.11	5964.94	0	1.0	0.0	3713.0	36.5	31.2	0	9.79	27.30	28.55	171.0	5473.1	15151.0	576.8	10254.7	**6060.39**	**3418.23**
36.50	37.50	37.00	1.00	35.0	19.79	9.79	179.16	3.77	31.2	31.2	1.1	433.76	6398.70	0	1.0	0.0	3713.0	37.5	31.2	0	9.79	27.30	28.55	171.0	5473.1	15584.7	593.8	10705.4	**6233.90**	**3568.48**
37.50	40.00	38.75	2.50	37.5	19.79	9.79	179.16	9.43	31.2	31.2	1.1	1084.40	7483.09	0	1.0	0.0	3713.0	40.0	31.2	0	9.79	27.30	28.55	171.0	5473.1	16669.1	636.2	11832.2	**6667.66**	**3944.08**
BORE NO: P30, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	17.98	7.98	21.95	1.89	27.2	27.2	1.0	21.27	0	12	1.0	22.6	0	3.0	28.3	9	9.16	17.43	18.48	23.9	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.5	19.16	9.16	33.10	7.54	28.3	28.3	1.0	134.43	0	9	1.0	67.9	0	5.0	28.3	9	9.16	17.43	18.48	42.3	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.16	9.16	46.84	3.77	28.3	28.3	1.0	95.12	0	9	1.0	33.9	0	6.0	28.3	0	9.16	17.43	18.48	51.4	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	8.00	7.00	2.00	5.5	19.16	9.16	60.58	7.54	28.3	28.3	1.0	246.04	0	0	1.0	0.0	0	8.0	28.3	0	11.05	17.43	18.48	69.7	0	0.0	93.3	93.3	**0.00**	**31.10**
8.00	9.00	8.50	1.00	6.5	21.05	11.05	75.27	3.77	28.3	28.3	1.0	152.84	0	0	1.0	0.0	0	9.0	28.3	0	11.05	17.43	18.48	80.8	0	0.0	110.3	110.3	**0.00**	**36.76**
9.00	10.00	9.50	1.00	7.5	21.05	11.05	86.32	3.77	28.3	28.3	1.0	175.28	0	0	1.0	0.0	0	10.0	10.6	40	11.05	2.65	1.39	91.8	692.7	692.7	127.2	127.2	**277.10**	**42.41**
10.00	11.00	10.50	1.00	8.5	21.05	11.05	97.37	3.77	10.6	10.6	1.0	68.72	68.72	40	1.0	150.9	150.9	11.0	10.6	40	11.05	2.65	1.39	102.9	725.8	945.4	144.2	363.8	**378.16**	**121.26**
11.00	12.00	11.50	1.00	9.5	21.05	11.05	108.42	3.77	10.6	10.6	1.0	76.52	145.24	40	1.0	150.9	301.7	12.0	11.4	45	11.54	2.88	1.62	113.9	842.4	1289.4	161.2	608.1	**515.74**	**202.71**
12.00	14.50	13.25	2.50	12.0	21.54	11.54	128.37	9.43	11.4	11.4	1.0	244.04	389.28	45	1.0	424.3	726.0	14.5	11.2	45	11.36	2.82	1.56	142.8	926.3	2041.6	203.6	1318.9	**816.64**	**439.62**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m　　Factor of Safety in Compression: 2.5　　Area of Pile: 1.13 m^2

Critical water table: 0.00 m　　Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								φ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	φ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
14.50	17.50	16.00	3.00	15.0	21.36	11.36	159.83	11.31	11.2	11.2	1.0	358.07	747.34	45	1.0	509.1	1235.1	17.5	11.2	45	11.36	2.82	1.56	176.9	1035.2	3017.7	254.5	2237.0	**1207.06**	**745.65**
17.50	19.00	18.25	1.50	16.5	21.36	11.36	159.83	5.66	11.2	11.2	1.0	179.03	926.38	45	1.0	254.6	1489.7	19.0	24.3	10	10.67	9.50	10.11	176.9	2075.4	4491.5	279.9	2696.0	**1796.58**	**898.67**
19.00	20.50	19.75	1.50	18.0	20.67	10.67	159.83	5.66	24.3	24.3	1.0	408.25	1334.63	10	1.0	56.6	1546.3	20.5	15.5	42	10.67	4.19	2.92	176.9	1286.5	4167.5	305.4	3186.3	**1666.98**	**1062.09**
20.50	23.50	22.00	3.00	21.0	20.67	10.67	159.83	11.31	15.5	15.5	1.0	501.50	1836.13	42	1.0	475.2	2021.5	23.5	8.6	41	11.75	2.22	1.00	176.9	869.4	4727.0	356.3	4213.9	**1890.79**	**1404.63**
23.50	26.50	25.00	3.00	24.0	21.75	11.75	159.83	11.31	8.6	8.6	1.0	273.49	2109.62	41	1.0	463.9	2485.4	26.5	8.6	41	11.75	2.22	1.00	176.9	869.4	5464.4	407.2	5002.1	**2185.74**	**1667.38**
26.50	27.50	27.00	1.00	25.0	21.75	11.75	159.83	3.77	8.6	8.6	1.0	91.16	2200.79	41	1.0	154.6	2640.0	27.5	9.0	41	11.75	2.29	1.07	176.9	884.3	5725.1	424.1	5264.9	**2290.02**	**1754.97**
27.50	29.50	28.50	2.00	27.0	21.75	11.75	159.83	7.54	9.0	9.0	1.0	190.94	2391.73	41	1.0	309.3	2949.3	29.5	11.0	41	9.27	2.76	1.51	176.9	980.1	6321.1	458.0	5799.0	**2528.43**	**1933.01**
29.50	30.00	29.75	0.50	27.5	19.27	9.27	159.83	1.89	11.0	11.0	1.0	58.59	2450.32	41	1.0	77.3	3026.6	30.0	11.0	41	9.27	2.76	1.51	176.9	980.1	6457.0	466.5	5943.4	**2582.79**	**1981.14**
30.00	31.00	30.50	1.00	28.5	19.27	9.27	159.83	3.77	11.0	11.0	1.0	117.17	2567.49	41	1.0	154.6	3181.2	31.0	27.8	5	9.27	16.31	17.33	176.9	3422.9	9171.6	483.5	6232.2	**3668.65**	**2077.39**
31.00	32.50	31.75	1.50	30.0	19.27	9.27	159.83	5.66	27.8	27.8	1.0	476.72	3044.21	5	1.0	28.3	3209.5	32.5	8.5	48	9.27	2.20	0.99	176.9	935.3	7188.9	508.9	6762.6	**2875.58**	**2254.21**
32.50	35.00	33.75	2.50	32.5	19.27	9.27	159.83	9.43	8.5	8.5	1.0	225.22	3269.42	48	1.0	452.6	3662.1	35.0	8.1	48	8.55	2.13	0.93	176.9	920.0	7851.5	551.3	7482.8	**3140.60**	**2494.28**
35.00	35.50	35.25	0.50	33.0	18.55	8.55	159.83	1.89	8.1	8.1	1.0	42.89	3312.32	48	1.0	90.5	3752.6	35.5	10.8	33	9.21	2.71	1.45	176.9	886.4	7951.3	559.8	7624.7	**3180.53**	**2541.57**
35.50	37.00	36.25	1.50	34.5	19.21	9.21	159.83	5.66	10.8	10.8	1.0	172.48	3484.80	33	1.0	186.7	3939.3	37.0	9.4	56	9.21	2.36	1.13	176.9	1050.0	8474.0	585.3	8009.3	**3389.61**	**2669.78**
37.00	37.50	37.25	0.50	35.0	19.21	9.21	159.83	1.89	9.4	9.4	1.0	49.90	3534.70	56	1.0	105.6	4044.9	37.5	10.2	56	9.21	2.53	1.28	176.9	1084.3	8663.8	593.8	8173.3	**3465.53**	**2724.44**
37.50	38.50	38.00	1.00	36.0	19.21	9.21	159.83	3.77	10.2	10.2	1.0	108.46	3643.15	56	1.0	211.2	4256.1	38.5	14.3	48	9.97	3.74	2.45	176.9	1253.2	9152.4	610.7	8509.9	**3660.96**	**2836.65**
38.50	40.00	39.25	1.50	37.5	19.97	9.97	159.83	5.66	14.3	14.3	1.0	230.47	3873.63	48	1.0	271.5	4527.6	40.0	14.3	48	9.97	3.74	2.45	176.9	1253.2	9654.4	636.2	9037.4	**3861.77**	**3012.47**
BORE NO: P32, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.70	9.70	26.68	1.89	28.2	28.2	1.0	26.97	0	0	1.0	0.0	0	3.0	28.2	0	9.39	17.21	18.25	29.1	0	0.0	8.5	8.5	**0.00**	**2.83**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
3.00	5.00	4.00	2.00	2.5	19.39	9.39	38.49	7.54	28.2	28.2	1.0	155.67	0	0	1.0	0.0	0	5.0	28.5	0	9.39	17.88	18.94	47.9	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.39	9.39	52.58	3.77	28.5	28.5	1.0	107.66	0	0	1.0	0.0	0	6.0	28.5	0	9.64	17.88	18.94	57.3	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	8.00	7.00	2.00	5.5	19.64	9.64	66.91	7.54	28.5	28.5	1.0	274.03	0	0	1.0	0.0	0	8.0	11.6	54	9.64	2.94	1.68	76.6	815.5	815.5	93.3	93.3	**326.21**	**31.10**
8.00	9.00	8.50	1.00	6.5	19.64	9.64	81.37	3.77	11.6	11.6	1.0	62.99	62.99	54	1.0	203.7	203.7	9.0	11.6	54	9.64	2.94	1.68	86.2	847.6	1114.2	110.3	376.9	**445.70**	**125.64**
9.00	10.00	9.50	1.00	7.5	19.64	9.64	91.01	3.77	11.6	11.6	1.0	70.46	133.45	54	1.0	203.7	407.3	10.0	11.6	54	10.40	2.94	1.68	95.8	880.5	1421.3	127.2	668.0	**568.52**	**222.67**
10.00	11.00	10.50	1.00	8.5	20.40	10.40	101.03	3.77	11.6	11.6	1.0	78.21	211.66	54	1.0	203.7	611.0	11.0	11.6	54	10.40	2.94	1.68	106.2	915.1	1737.8	144.2	966.8	**695.11**	**322.28**
11.00	12.00	11.50	1.00	9.5	20.40	10.40	111.43	3.77	11.6	11.6	1.0	86.26	297.93	54	1.0	203.7	814.6	12.0	9.0	66	10.40	2.29	1.07	116.6	981.8	2094.3	161.2	1273.7	**837.73**	**424.57**
12.00	13.00	12.50	1.00	10.5	20.40	10.40	121.83	3.77	9.0	9.0	1.0	72.77	370.70	66	1.0	248.9	1063.5	13.0	29.0	0	10.40	19.01	20.10	127.0	2873.8	4308.0	178.1	1612.4	**1723.20**	**537.46**
13.00	14.50	13.75	1.50	12.0	20.40	10.40	134.83	5.66	29.0	29.0	1.0	422.80	793.50	0	1.0	0.0	1063.5	14.5	29.0	0	10.18	19.01	20.10	142.6	3206.2	5063.3	203.6	2060.6	**2025.32**	**686.87**
14.50	16.00	15.25	1.50	13.5	20.18	10.18	150.27	5.66	29.0	29.0	1.0	471.20	1264.70	0	1.0	0.0	1063.5	16.0	10.4	51	10.18	2.59	1.33	157.9	990.8	3319.1	229.0	2557.3	**1327.63**	**852.42**
16.00	17.50	16.75	1.50	15.0	20.18	10.18	165.54	5.66	10.4	10.4	1.0	171.87	1436.58	51	1.0	288.5	1352.1	17.5	10.4	51	10.18	2.59	1.33	173.2	1035.5	3824.2	254.5	3043.1	**1529.67**	**1014.37**
17.50	19.00	18.25	1.50	16.5	20.18	10.18	165.54	5.66	10.4	10.4	1.0	171.87	1608.45	51	1.0	288.5	1640.6	19.0	24.0	12	9.99	9.28	9.78	173.2	2006.8	5255.8	279.9	3528.9	**2102.31**	**1176.31**
19.00	20.50	19.75	1.50	18.0	19.99	9.99	165.54	5.66	24.0	24.0	1.0	416.94	2025.38	12	1.0	67.9	1708.5	20.5	9.3	62	10.42	2.34	1.11	173.2	1098.5	4832.3	305.4	4039.2	**1932.92**	**1346.40**
20.50	23.50	22.00	3.00	21.0	20.42	10.42	165.54	11.31	9.3	9.3	1.0	306.70	2332.09	62	1.0	701.5	2409.9	23.5	9.3	62	10.42	2.34	1.11	173.2	1098.5	5840.5	356.3	5098.3	**2336.20**	**1699.43**
23.50	25.00	24.25	1.50	22.5	20.42	10.42	165.54	5.66	9.3	9.3	1.0	153.35	2485.44	62	1.0	350.7	2760.7	25.0	9.3	62	10.42	2.34	1.11	173.2	1098.5	6344.6	381.7	5627.8	**2537.83**	**1875.94**
25.00	26.50	25.75	1.50	24.0	20.42	10.42	165.54	5.66	9.3	9.3	1.0	153.35	2638.79	62	1.0	350.7	3111.4	26.5	7.5	60	8.59	2.02	0.84	173.2	1011.6	6761.8	407.2	6157.4	**2704.73**	**2052.46**
26.50	27.50	27.00	1.00	25.0	18.59	8.59	165.54	3.77	7.5	7.5	1.0	82.19	2720.98	60	1.0	226.3	3337.7	27.5	7.5	60	8.59	2.02	0.84	173.2	1011.6	7070.3	424.1	6482.8	**2828.12**	**2160.94**
27.50	28.00	27.75	0.50	25.5	18.59	8.59	165.54	1.89	7.5	7.5	1.0	41.10	2762.07	60	1.0	113.1	3450.9	28.0	7.5	60	9.11	2.02	0.84	173.2	1011.9	7224.8	432.6	6645.5	**2889.94**	**2215.18**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
28.00	29.50	28.75	1.50	27.0	19.11	9.11	165.54	5.66	7.5	7.5	1.0	123.29	2885.36	60	1.0	339.4	3790.3	29.5	7.5	60	8.85	2.02	0.84	173.2	1011.8	7687.4	458.0	7133.7	**3074.96**	**2377.90**
29.50	30.00	29.75	0.50	27.5	18.85	8.85	165.54	1.89	7.5	7.5	1.0	41.10	2926.46	60	1.0	113.1	3903.4	30.0	8.0	54	8.85	2.11	0.91	173.2	968.8	7798.6	466.5	7296.4	**3119.46**	**2432.14**
30.00	31.00	30.50	1.00	28.5	18.85	8.85	165.54	3.77	8.0	8.0	1.0	87.74	3014.20	54	1.0	203.7	4107.1	31.0	9.2	44	9.73	2.33	1.10	173.2	911.0	8032.3	483.5	7604.8	**3212.92**	**2534.92**
31.00	32.50	31.75	1.50	30.0	19.73	9.73	165.54	5.66	9.2	9.2	1.0	151.67	3165.87	44	1.0	248.9	4356.0	32.5	7.0	51	8.54	1.93	0.76	173.2	901.9	8423.7	508.9	8030.8	**3369.49**	**2676.94**
32.50	34.00	33.25	1.50	31.5	18.54	8.54	165.54	5.66	7.0	7.0	1.0	114.98	3280.85	51	1.0	288.5	4644.5	34.0	11.5	48	9.73	2.91	1.65	173.2	1070.0	8995.4	534.4	8459.7	**3598.15**	**2819.92**
34.00	35.00	34.50	1.00	32.5	19.73	9.73	165.54	3.77	11.5	11.5	1.0	127.02	3407.87	48	1.0	181.0	4825.5	35.0	11.5	48	9.73	2.91	1.65	173.2	1070.0	9303.4	551.3	8784.8	**3721.37**	**2928.25**
35.00	35.50	35.25	0.50	33.0	19.73	9.73	165.54	1.89	11.5	11.5	1.0	63.51	3471.37	48	1.0	90.5	4916.1	35.5	8.0	60	8.79	2.11	0.91	173.2	1029.8	9417.3	559.8	8947.3	**3766.90**	**2982.42**
35.50	37.00	36.25	1.50	34.5	18.79	8.79	165.54	5.66	8.0	8.0	1.0	131.61	3602.98	60	1.0	339.4	5255.5	37.0	8.0	60	9.18	2.11	0.91	173.2	1030.1	9888.5	585.3	9443.7	**3955.41**	**3147.92**
37.00	37.50	37.25	0.50	35.0	19.18	9.18	165.54	1.89	8.0	8.0	1.0	43.87	3646.85	60	1.0	113.1	5368.6	37.5	8.0	60	9.18	2.11	0.91	173.2	1030.1	10045.5	593.8	9609.2	**4018.22**	**3203.08**
37.50	38.50	38.00	1.00	36.0	19.18	9.18	165.54	3.77	8.0	8.0	1.0	87.74	3734.59	60	1.0	226.3	5594.9	38.5	9.2	56	8.83	2.33	1.10	173.2	1032.5	10362.1	610.7	9940.2	**4144.82**	**3313.41**
38.50	40.00	39.25	1.50	37.5	18.83	8.83	165.54	5.66	9.2	9.2	1.0	151.67	3886.27	56	1.0	316.8	5911.7	40.0	9.2	56	0.00	2.33	1.10	173.2	1026.0	10824.0	636.2	10434.2	**4329.58**	**3478.05**
BORE NO: P33, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.79	9.79	26.92	1.89	28.6	28.6	1.0	27.68	0	0	1.0	0.0	0	3.0	28.6	0	9.53	18.11	19.17	29.4	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.5	19.53	9.53	38.90	7.54	28.6	28.6	1.0	159.98	0	0	1.0	0.0	0	5.0	29.3	0	9.53	19.68	20.79	48.4	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.53	9.53	53.20	3.77	29.3	29.3	1.0	112.58	0	0	1.0	0.0	0	6.0	29.3	0	9.45	19.68	20.79	58.0	1424.1	1424.1	59.4	59.4	**569.65**	**19.79**
6.00	8.00	7.00	2.00	5.5	19.45	9.45	67.41	7.54	29.3	29.3	1.0	285.34	285.34	0	1.0	0.0	0.0	8.0	29.3	0	9.45	19.68	20.79	76.9	1845.0	2130.4	93.3	378.6	**852.15**	**126.21**
8.00	9.00	8.50	1.00	6.5	19.45	9.45	81.59	3.77	29.3	29.3	1.0	172.67	458.01	0	1.0	0.0	0.0	9.0	12.2	56	10.24	3.12	1.85	86.3	887.4	1345.4	110.3	568.3	**538.17**	**189.43**
9.00	11.00	10.00	2.00	8.5	20.24	10.24	96.55	7.54	12.2	12.2	1.0	157.46	615.46	56	1.0	422.4	422.4	11.0	27.7	0	10.24	16.08	17.10	106.8	2061.8	3099.6	144.2	1182.1	**1239.85**	**394.02**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
11.00	12.00	11.50	1.00	9.5	20.24	10.24	111.91	3.77	27.7	27.7	1.0	221.59	837.05	0	1.0	0.0	422.4	12.0	28.0	0	10.24	16.76	17.79	117.0	2342.3	3601.8	161.2	1420.6	**1440.71**	**473.54**
12.00	13.00	12.50	1.00	10.5	20.24	10.24	122.15	3.77	28.0	28.0	1.0	244.95	1082.00	0	1.0	0.0	422.4	13.0	8.6	59	10.39	2.22	1.00	127.3	927.3	2431.7	178.1	1682.5	**972.66**	**560.84**
13.00	14.50	13.75	1.50	12.0	20.39	10.39	135.06	5.66	8.6	8.6	1.0	115.55	1197.55	59	1.0	333.8	756.2	14.5	8.6	59	10.61	2.22	1.00	142.9	966.5	2920.2	203.6	2157.3	**1168.10**	**719.10**
14.50	17.50	16.00	3.00	15.0	20.61	10.61	158.77	11.31	8.6	8.6	1.0	271.68	1469.23	59	1.0	667.5	1423.7	17.5	10.3	62	10.42	2.56	1.31	174.7	1146.2	4039.1	254.5	3147.4	**1615.65**	**1049.14**
17.50	20.50	19.00	3.00	18.0	20.42	10.42	158.77	11.31	10.3	10.3	1.0	326.46	1795.68	62	1.0	701.5	2125.2	20.5	11.6	65	10.42	2.94	1.68	174.7	1254.9	5175.8	305.4	4226.2	**2070.31**	**1408.75**
20.50	22.00	21.25	1.50	19.5	20.42	10.42	158.77	5.66	11.6	11.6	1.0	184.37	1980.05	65	1.0	367.7	2492.9	22.0	25.2	8	9.65	10.45	11.34	174.7	2221.2	6694.2	330.8	4803.8	**2677.67**	**1601.26**
22.00	23.50	22.75	1.50	21.0	19.65	9.65	158.77	5.66	25.2	25.2	1.0	422.65	2402.71	8	1.0	45.3	2538.2	23.5	11.0	56	9.65	2.76	1.51	174.7	1126.4	6067.3	356.3	5297.1	**2426.91**	**1765.71**
23.50	25.00	24.25	1.50	22.5	19.65	9.65	158.77	5.66	11.0	11.0	1.0	174.59	2577.30	56	1.0	316.8	2855.0	25.0	11.0	56	9.65	2.76	1.51	174.7	1126.4	6558.7	381.7	5814.0	**2623.46**	**1937.99**
25.00	26.50	25.75	1.50	24.0	19.65	9.65	158.77	5.66	11.0	11.0	1.0	174.59	2751.88	56	1.0	316.8	3171.8	26.5	11.0	56	8.78	2.76	1.51	174.7	1125.5	7049.2	407.2	6330.8	**2819.66**	**2110.27**
26.50	27.50	27.00	1.00	25.0	18.78	8.78	158.77	3.77	11.0	11.0	1.0	116.39	2868.28	56	1.0	211.2	3383.0	27.5	11.0	56	8.78	2.76	1.51	174.7	1125.5	7376.8	424.1	6675.4	**2950.70**	**2225.12**
27.50	28.00	27.75	0.50	25.5	18.78	8.78	158.77	1.89	11.0	11.0	1.0	58.20	2926.47	56	1.0	105.6	3488.6	28.0	11.6	65	9.46	2.94	1.68	174.7	1253.8	7668.9	432.6	6847.6	**3067.54**	**2282.55**
28.00	29.50	28.75	1.50	27.0	19.46	9.46	158.77	5.66	11.6	11.6	1.0	184.37	3110.84	65	1.0	367.7	3856.3	29.5	11.6	65	8.75	2.94	1.68	174.7	1253.0	8220.1	458.0	7425.2	**3288.05**	**2475.06**
29.50	30.00	29.75	0.50	27.5	18.75	8.75	158.77	1.89	11.6	11.6	1.0	61.46	3172.30	65	1.0	122.6	3978.9	30.0	11.6	65	8.75	2.94	1.68	174.7	1253.0	8404.2	466.5	7617.7	**3361.66**	**2539.23**
30.00	31.00	30.50	1.00	28.5	18.75	8.75	158.77	3.77	11.6	11.6	1.0	122.91	3295.22	65	1.0	245.1	4224.0	31.0	11.6	65	8.97	2.94	1.68	174.7	1253.3	8772.5	483.5	8002.7	**3508.99**	**2667.57**
31.00	32.50	31.75	1.50	30.0	18.97	8.97	158.77	5.66	11.6	11.6	1.0	184.37	3479.59	65	1.0	367.7	4591.7	32.5	11.5	57	8.96	2.91	1.65	174.7	1165.8	9237.1	508.9	8580.2	**3694.84**	**2860.08**
32.50	34.00	33.25	1.50	31.5	18.96	8.96	158.77	5.66	11.5	11.5	1.0	182.74	3662.32	57	1.0	322.5	4914.2	34.0	11.5	57	8.95	2.91	1.65	174.7	1165.8	9742.3	534.4	9110.9	**3896.91**	**3036.96**
34.00	35.00	34.50	1.00	32.5	18.95	8.95	158.77	3.77	11.5	11.5	1.0	121.83	3784.15	57	1.0	215.0	5129.1	35.0	11.5	57	8.95	2.91	1.65	174.7	1165.8	10079.1	551.3	9464.6	**4031.63**	**3154.88**
35.00	35.50	35.25	0.50	33.0	18.95	8.95	158.77	1.89	11.5	11.5	1.0	60.91	3845.06	57	1.0	107.5	5236.6	35.5	8.5	46	8.64	2.20	0.99	174.7	909.0	9990.7	559.8	9641.5	**3996.29**	**3213.84**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Factor of Safety in Compression: 2.5
Area of Pile: 1.13 m^2
Critical water table: 0.00 m
Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
35.50	37.00	36.25	1.50	34.5	18.64	8.64	158.77	5.66	8.5	8.5	1.0	134.23	3979.30	46	1.0	260.2	5496.9	37.0	8.7	60	9.08	2.24	1.02	174.7	1059.2	10535.3	585.3	10061.4	**4214.14**	**3353.81**
37.00	37.50	37.25	0.50	35.0	19.08	9.08	158.77	1.89	8.7	8.7	1.0	45.81	4025.11	60	1.0	113.1	5610.0	37.5	8.7	60	9.08	2.24	1.02	174.7	1059.2	10694.3	593.8	10228.9	**4277.72**	**3409.62**
37.50	38.50	38.00	1.00	36.0	19.08	9.08	158.77	3.77	8.7	8.7	1.0	91.63	4116.74	60	1.0	226.3	5836.3	38.5	8.7	60	8.75	2.24	1.02	174.7	1059.0	11012.0	610.7	10563.7	**4404.79**	**3521.25**
38.50	40.00	39.25	1.50	37.5	18.75	8.75	158.77	5.66	8.7	8.7	1.0	137.44	4254.18	60	1.0	339.4	6175.7	40.0	9.8	54	0.00	2.43	1.19	174.7	1030.9	11460.8	636.2	11066.1	**4584.33**	**3688.69**
BORE NO: P34, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.58	9.58	26.35	1.89	23.3	23.3	1.0	21.40	0	0	1.0	0.0	0	3.0	15.9	26	9.58	4.38	3.14	28.7	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.5	19.58	9.58	33.53	3.77	15.9	15.9	1.0	36.02	0	26	1.0	98.1	0	4.0	30.8	0	9.29	25.29	26.50	38.3	1263.6	1263.6	25.4	25.4	**505.44**	**8.48**
4.00	6.00	5.00	2.00	3.5	19.29	9.29	47.61	7.54	30.8	30.8	1.0	222.64	222.64	0	1.0	0.0	0.0	6.0	30.8	0	9.29	25.29	26.50	56.9	1795.2	2017.9	59.4	282.0	**807.14**	**94.00**
6.00	7.00	6.50	1.00	4.5	19.29	9.29	61.55	3.77	30.8	30.8	1.0	143.90	366.54	0	1.0	0.0	0.0	7.0	27.4	0	9.29	15.40	16.41	66.2	1257.1	1623.7	76.3	442.9	**649.47**	**147.63**
7.00	8.00	7.50	1.00	5.5	19.29	9.29	70.84	3.77	27.4	27.4	1.0	138.48	505.02	0	1.0	0.0	0.0	8.0	25.8	7	9.75	11.80	12.72	75.5	1163.3	1668.4	93.3	598.3	**667.35**	**199.44**
8.00	9.00	8.50	1.00	6.5	19.75	9.75	80.36	3.77	25.8	25.8	1.0	146.50	651.52	7	1.0	26.4	26.4	9.0	26.2	9	9.75	12.70	13.64	85.2	1406.9	2084.8	110.3	788.2	**833.91**	**262.73**
9.00	10.00	9.50	1.00	7.5	19.75	9.75	90.11	3.77	26.2	26.2	1.0	167.21	818.73	9	1.0	33.9	60.3	10.0	26.0	0	9.49	12.25	13.18	95.0	1401.6	2280.6	127.2	1006.3	**912.26**	**335.44**
10.00	12.50	11.25	2.50	10.0	19.49	9.49	106.84	9.43	26.0	26.0	1.0	491.33	1310.06	0	1.0	0.0	60.3	12.5	9.5	55	10.41	2.38	1.14	118.7	887.8	2258.2	169.6	1540.1	**903.28**	**513.35**
12.50	15.50	14.00	3.00	13.0	20.41	10.41	134.32	11.31	9.5	9.5	1.0	254.32	1564.38	55	1.0	622.3	682.6	15.5	9.5	55	10.41	2.38	1.14	149.9	971.9	3218.9	220.5	2467.5	**1287.55**	**822.52**
15.50	18.50	17.00	3.00	16.0	20.41	10.41	165.55	11.31	9.5	9.5	1.0	313.45	1877.82	55	1.0	622.3	1304.9	18.5	9.5	55	10.62	2.38	1.14	149.9	972.0	4154.8	271.4	3454.2	**1661.91**	**1151.39**
18.50	21.50	20.00	3.00	19.0	20.62	10.62	165.55	11.31	9.5	9.5	1.0	313.45	2191.27	55	1.0	622.3	1927.2	21.5	11.5	58	10.14	2.91	1.65	149.9	1095.8	5214.3	322.3	4440.8	**2085.70**	**1480.27**
21.50	24.50	23.00	3.00	22.0	20.14	10.14	165.55	11.31	11.5	11.5	1.0	381.08	2572.35	58	1.0	656.2	2583.4	24.5	8.2	62	10.14	2.15	0.94	149.9	1001.9	6157.7	373.2	5529.0	**2463.06**	**1843.00**
24.50	27.50	26.00	3.00	25.0	20.14	10.14	165.55	11.31	8.2	8.2	1.0	269.91	2842.27	62	1.0	701.5	3284.9	27.5	8.2	60	10.59	2.15	0.94	149.9	981.8	7109.0	424.1	6551.3	**2843.59**	**2183.77**

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
27.50	30.00	28.75	2.50	27.5	20.59	10.59	165.55	9.43	8.2	8.2	1.0	224.93	3067.20	60	1.0	565.7	3850.6	30.0	9.1	59	10.59	2.31	1.08	149.9	1000.1	7917.9	466.5	7384.4	**3167.17**	**2461.45**
30.00	30.50	30.25	0.50	28.0	20.59	10.59	165.55	1.89	9.1	9.1	1.0	50.00	3117.20	59	1.0	111.3	3961.9	30.5	32.5	0	10.59	33.85	35.22	149.9	5996.0	13075.1	475.0	7554.1	**5230.05**	**2518.03**
30.50	32.00	31.25	1.50	29.5	20.59	10.59	165.55	5.66	32.5	32.5	1.1	671.22	3788.42	0	1.0	0.0	3961.9	32.0	19.5	32	10.59	6.13	5.12	149.9	1403.2	9153.5	500.5	8250.8	**3661.41**	**2750.25**
32.00	32.50	32.25	0.50	30.0	20.59	10.59	165.55	1.89	19.5	19.5	1.0	110.55	3898.97	32	1.0	60.3	4022.2	32.5	19.5	32	8.96	6.13	5.12	149.9	1397.5	9318.7	508.9	8430.1	**3727.50**	**2810.05**
32.50	33.50	33.00	1.00	31.0	18.96	8.96	165.55	3.77	19.5	19.5	1.0	221.10	4120.07	32	1.0	120.7	4142.9	33.5	19.5	32	9.42	6.13	5.12	149.9	1399.1	9662.1	525.9	8788.9	**3864.85**	**2929.63**
33.50	35.00	34.25	1.50	32.5	19.42	9.42	165.55	5.66	19.5	19.5	1.0	331.65	4451.71	32	1.0	181.0	4323.9	35.0	11.4	39	9.13	2.88	1.62	149.9	896.0	9671.7	551.3	9327.0	**3868.67**	**3109.00**
35.00	36.50	35.75	1.50	34.0	19.13	9.13	165.55	5.66	11.4	11.4	1.0	188.84	4640.55	39	1.0	220.6	4544.6	36.5	11.4	39	9.17	2.88	1.62	149.9	896.1	10081.2	576.8	9761.9	**4032.47**	**3253.97**
36.50	37.50	37.00	1.00	35.0	19.17	9.17	165.55	3.77	11.4	11.4	1.0	125.89	4766.45	39	1.0	147.1	4691.7	37.5	12.0	39	9.17	3.06	1.79	149.9	927.0	10385.2	593.8	10051.9	**4154.06**	**3350.62**
37.50	38.00	37.75	0.50	35.5	19.17	9.17	165.55	1.89	12.0	12.0	1.0	66.36	4832.80	39	1.0	73.5	4765.2	38.0	8.0	50	9.05	2.11	0.91	149.9	872.7	10470.7	602.2	10200.2	**4188.28**	**3400.08**
38.00	40.00	39.00	2.00	37.5	19.05	9.05	165.55	7.54	8.0	8.0	1.0	175.50	5008.30	50	1.0	377.1	5142.3	40.0	8.0	50	0.00	2.11	0.91	149.9	867.1	11017.7	636.2	10786.8	**4407.09**	**3595.60**
BORE NO: P36, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.43	10.43	28.68	1.89	29.5	29.5	1.0	30.60	0	0	1.0	0.0	0	3.0	29.5	0	10.71	20.13	21.25	31.3	867.3	867.3	8.5	8.5	**346.90**	**2.83**
3.00	5.00	4.00	2.00	2.5	20.71	10.71	42.00	7.54	29.5	29.5	1.0	179.24	179.24	0	1.0	0.0	0.0	5.0	29.5	0	10.71	20.13	21.25	52.7	1355.2	1534.4	42.4	221.6	**613.78**	**73.88**
5.00	6.00	5.50	1.00	3.5	20.71	10.71	58.07	3.77	29.5	29.5	1.0	123.90	303.13	0	1.0	0.0	0.0	6.0	29.3	0	10.48	19.68	20.79	63.4	1560.3	1863.4	59.4	362.5	**745.36**	**120.84**
6.00	8.00	7.00	2.00	5.5	20.48	10.48	73.90	7.54	29.3	29.3	1.0	312.81	615.94	0	1.0	0.0	0.0	8.0	9.5	49	10.48	2.38	1.14	84.4	734.3	1350.3	93.3	709.2	**540.10**	**236.42**
8.00	9.00	8.50	1.00	6.5	20.48	10.48	89.62	3.77	9.5	9.5	1.0	56.56	672.50	49	1.0	184.8	184.8	9.0	9.5	49	10.48	2.38	1.14	94.9	762.5	1619.8	110.3	967.6	**647.93**	**322.52**
9.00	10.00	9.50	1.00	7.5	20.48	10.48	100.10	3.77	9.5	9.5	1.0	63.18	735.68	49	1.0	184.8	369.6	10.0	9.5	49	10.50	2.38	1.14	105.3	790.8	1896.0	127.2	1232.5	**758.42**	**410.84**
10.00	11.00	10.50	1.00	8.5	20.50	10.50	110.59	3.77	9.5	9.5	1.0	69.80	805.47	49	1.0	184.8	554.4	11.0	9.5	49	10.50	2.38	1.14	115.8	819.0	2178.9	144.2	1504.1	**871.57**	**501.36**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
11.00	12.00	11.50	1.00	9.5	20.50	10.50	121.09	3.77	9.5	9.5	1.0	76.42	881.90	49	1.0	184.8	739.2	12.0	6.7	69	10.50	1.88	0.71	126.3	975.9	2597.0	161.2	1782.3	**1038.78**	**594.09**
12.00	13.00	12.50	1.00	10.5	20.50	10.50	131.59	3.77	6.7	6.7	1.0	58.30	940.20	69	1.0	260.2	999.4	13.0	26.9	0	9.99	14.28	15.26	136.8	2314.2	4253.8	178.1	2117.8	**1701.51**	**705.92**
13.00	14.50	13.75	1.50	12.0	19.99	9.99	144.33	5.66	26.9	26.9	1.0	414.24	1354.44	0	1.0	0.0	999.4	14.5	26.9	0	9.99	14.28	15.26	151.8	2556.2	4910.1	203.6	2557.4	**1964.04**	**852.48**
14.50	16.00	15.25	1.50	13.5	19.99	9.99	159.32	5.66	26.9	26.9	1.0	457.25	1811.68	0	1.0	0.0	999.4	16.0	9.0	54	10.56	2.29	1.07	166.8	989.7	3800.8	229.0	3040.1	**1520.33**	**1013.38**
16.00	17.50	16.75	1.50	15.0	20.56	10.56	174.73	5.66	9.0	9.0	1.0	156.56	1968.24	54	1.0	305.5	1304.9	17.5	10.0	60	10.83	2.47	1.22	182.7	1130.4	4403.5	254.5	3527.6	**1761.41**	**1175.87**
17.50	20.50	19.00	3.00	18.0	20.83	10.83	174.73	11.31	10.0	10.0	1.0	348.59	2316.83	60	1.0	678.9	1983.8	20.5	9.5	64	10.69	2.38	1.14	182.7	1151.8	5452.4	305.4	4606.0	**2180.98**	**1535.32**
20.50	23.50	22.00	3.00	21.0	20.69	10.69	174.73	11.31	9.5	9.5	1.0	330.83	2647.66	64	1.0	724.1	2707.9	23.5	9.5	64	10.69	2.38	1.14	182.7	1151.8	6507.4	356.3	5711.8	**2602.95**	**1903.93**
23.50	26.50	25.00	3.00	24.0	20.69	10.69	174.73	11.31	9.5	9.5	1.0	330.83	2978.48	64	1.0	724.1	3432.0	26.5	9.5	64	10.52	2.38	1.14	182.7	1151.7	7562.2	407.2	6817.6	**3024.88**	**2272.54**
26.50	27.50	27.00	1.00	25.0	20.52	10.52	174.73	3.77	9.5	9.5	1.0	110.28	3088.76	64	1.0	241.4	3673.4	27.5	10.5	60	10.52	2.62	1.36	182.7	1161.5	7923.7	424.1	7186.2	**3169.46**	**2395.42**
27.50	28.00	27.75	0.50	25.5	20.52	10.52	174.73	1.89	10.5	10.5	1.0	61.07	3149.83	60	1.0	113.1	3786.5	28.0	11.5	68	10.52	2.91	1.65	182.7	1305.8	8242.1	432.6	7368.9	**3296.85**	**2456.31**
28.00	29.50	28.75	1.50	27.0	20.52	10.52	174.73	5.66	11.5	11.5	1.0	201.11	3350.93	68	1.0	384.7	4171.2	29.5	11.5	68	10.52	2.91	1.65	182.7	1305.8	8827.9	458.0	7980.2	**3531.17**	**2660.06**
29.50	30.00	29.75	0.50	27.5	20.52	10.52	174.73	1.89	11.5	11.5	1.0	67.04	3417.97	68	1.0	128.2	4299.4	30.0	11.5	60	10.52	2.91	1.65	182.7	1224.3	8941.7	466.5	8183.9	**3576.69**	**2727.97**
30.00	31.00	30.50	1.00	28.5	20.52	10.52	174.73	3.77	11.5	11.5	1.0	134.07	3552.04	60	1.0	226.3	4525.7	31.0	12.9	38	10.52	3.32	2.05	182.7	1087.8	9165.6	483.5	8561.2	**3666.24**	**2853.75**
31.00	32.50	31.75	1.50	30.0	20.52	10.52	174.73	5.66	12.9	12.9	1.0	226.39	3778.43	38	1.0	215.0	4740.7	32.5	19.8	45	10.46	6.29	5.28	182.7	1796.3	10315.4	508.9	9028.1	**4126.18**	**3009.35**
32.50	34.00	33.25	1.50	31.5	20.46	10.46	174.73	5.66	19.8	19.8	1.0	355.87	4134.30	45	1.0	254.6	4995.3	34.0	13.8	45	10.46	3.59	2.31	182.7	1216.5	10346.1	534.4	9663.9	**4138.42**	**3221.32**
34.00	35.00	34.50	1.00	32.5	20.46	10.46	174.73	3.77	13.8	13.8	1.0	161.86	4296.16	45	1.0	169.7	5165.0	35.0	14.5	48	10.46	3.80	2.51	182.7	1290.8	10752.0	551.3	10012.5	**4300.79**	**3337.50**
35.00	35.50	35.25	0.50	33.0	20.46	10.46	174.73	1.89	14.5	14.5	1.0	85.21	4381.38	48	1.0	90.5	5255.5	35.5	13.5	54	10.46	3.50	2.22	182.7	1288.9	10925.8	559.8	10196.7	**4370.32**	**3398.90**
35.50	37.50	36.50	2.00	35.0	20.46	10.46	174.73	7.54	13.5	13.5	1.0	316.42	4697.79	54	1.0	407.3	5662.8	37.5	20.2	16	10.46	6.54	5.61	182.7	1555.1	11915.7	593.8	10954.4	**4766.28**	**3651.45**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
37.50	38.50	38.00	1.00	36.0	20.46	10.46	174.73	3.77	20.2	20.2	1.0	242.46	4940.25	16	1.0	60.3	5723.1	38.5	20.0	16	10.46	6.40	5.39	182.7	1523.8	12187.2	610.7	11274.1	**4874.87**	**3758.04**
38.50	40.00	39.25	1.50	37.5	20.46	10.46	174.73	5.66	20.0	20.0	1.0	359.77	5300.02	16	1.0	90.5	5813.7	40.0	20.0	16	10.46	6.40	5.39	182.7	1523.8	12637.5	636.2	11749.9	**5054.99**	**3916.62**
BORE NO: P39, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	18.95	8.95	24.61	1.89	24.5	24.5	1.0	21.15	0	7	1.0	13.2	0	3.0	24.5	7	8.95	9.64	10.33	26.9	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.5	18.95	8.95	35.80	7.54	24.5	24.5	1.0	123.06	0	7	1.0	52.8	0	5.0	13.5	17	8.95	3.50	2.22	44.8	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	18.95	8.95	49.23	3.77	13.5	13.5	1.0	44.57	0	17	1.0	64.1	0	6.0	15.0	20	8.95	3.94	2.65	53.7	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	8.00	7.00	2.00	5.5	18.95	8.95	62.65	7.54	15.0	15.0	1.0	126.62	0	20	1.0	150.9	0	8.0	13.2	21	10.20	3.41	2.14	71.6	0	0.0	93.3	93.3	**0.00**	**31.10**
8.00	9.00	8.50	1.00	6.5	20.20	10.20	76.70	3.77	13.2	13.2	1.0	67.85	0	21	1.0	79.2	0	9.0	9.5	51	10.20	2.38	1.14	81.8	747.5	747.5	110.3	110.3	**299.00**	**36.76**
9.00	10.00	9.50	1.00	7.5	20.20	10.20	86.90	3.77	9.5	9.5	1.0	54.84	54.84	51	1.0	192.3	192.3	10.0	9.5	51	10.20	2.38	1.14	92.0	775.0	1022.2	127.2	374.4	**408.87**	**124.81**
10.00	11.00	10.50	1.00	8.5	20.20	10.20	97.10	3.77	9.5	9.5	1.0	61.28	116.13	51	1.0	192.3	384.7	11.0	9.5	51	10.20	2.38	1.14	102.2	802.4	1303.3	144.2	645.0	**521.30**	**215.00**
11.00	12.00	11.50	1.00	9.5	20.20	10.20	107.30	3.77	9.5	9.5	1.0	67.72	183.85	51	1.0	192.3	577.0	12.0	8.2	56	10.49	2.15	0.94	112.4	849.9	1610.7	161.2	922.0	**644.30**	**307.35**
12.00	14.50	13.25	2.50	12.0	20.49	10.49	125.51	9.43	8.2	8.2	1.0	170.53	354.38	56	1.0	528.0	1105.0	14.5	12.8	27	10.49	3.29	2.02	138.6	805.6	2265.0	203.6	1663.0	**906.00**	**554.33**
14.50	16.00	15.25	1.50	13.5	20.49	10.49	146.49	5.66	12.8	12.8	1.0	188.28	542.66	27	1.0	152.7	1257.8	16.0	11.5	53	10.50	2.91	1.65	154.4	1059.8	2860.3	229.0	2029.5	**1144.11**	**676.48**
16.00	17.50	16.75	1.50	15.0	20.50	10.50	162.24	5.66	11.5	11.5	1.0	186.73	729.38	53	1.0	299.8	1557.6	17.5	10.5	58	9.89	2.62	1.36	170.1	1103.4	3390.4	254.5	2541.5	**1356.17**	**847.15**
17.50	20.50	19.00	3.00	18.0	19.89	9.89	162.24	11.31	10.5	10.5	1.0	340.20	1069.59	58	1.0	656.2	2213.8	20.5	14.4	80	9.89	3.77	2.48	170.1	1556.1	4839.5	305.4	3588.8	**1935.81**	**1196.26**
20.50	22.00	21.25	1.50	19.5	19.89	9.89	162.24	5.66	14.4	14.4	1.0	235.65	1305.24	80	1.0	452.6	2666.4	22.0	9.7	62	10.30	2.42	1.17	170.1	1104.5	5076.2	330.8	4302.4	**2030.47**	**1434.15**
22.00	23.50	22.75	1.50	21.0	20.30	10.30	162.24	5.66	9.7	9.7	1.0	156.88	1462.12	62	1.0	350.7	3017.1	23.5	9.7	62	10.30	2.42	1.17	170.1	1104.5	5583.8	356.3	4835.5	**2233.52**	**1611.84**
23.50	25.00	24.25	1.50	22.5	20.30	10.30	162.24	5.66	9.7	9.7	1.0	156.88	1619.00	62	1.0	350.7	3367.9	25.0	10.4	46	10.60	2.59	1.33	170.1	976.0	5962.9	381.7	5368.6	**2385.17**	**1789.53**

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2
Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
25.00	26.50	25.75	1.50	24.0	20.60	10.60	162.24	5.66	10.4	10.4	1.0	168.45	1787.44	46	1.0	260.2	3628.1	26.5	10.0	46	10.60	2.47	1.22	170.1	952.6	6368.1	407.2	5822.7	**2547.26**	**1940.90**
26.50	27.50	27.00	1.00	25.0	20.60	10.60	162.24	3.77	10.0	10.0	1.0	107.89	1895.33	46	1.0	173.5	3801.6	27.5	10.0	46	10.60	2.47	1.22	170.1	952.6	6649.5	424.1	6121.0	**2659.81**	**2040.35**
27.50	29.50	28.50	2.00	27.0	20.60	10.60	162.24	7.54	10.0	10.0	1.0	215.77	2111.10	46	1.0	347.0	4148.6	29.5	14.3	30	8.93	3.74	2.45	170.1	1039.6	7299.3	458.0	6717.7	**2919.70**	**2239.24**
29.50	30.00	29.75	0.50	27.5	18.93	8.93	162.24	1.89	14.3	14.3	1.0	77.98	2189.08	30	1.0	56.6	4205.1	30.0	9.5	30	8.93	2.38	1.14	170.1	770.5	7164.7	466.5	6860.8	**2865.89**	**2286.92**
30.00	31.00	30.50	1.00	28.5	18.93	8.93	162.24	3.77	9.5	9.5	1.0	102.39	2291.47	30	1.0	113.1	4318.3	31.0	9.5	50	9.19	2.38	1.14	170.1	974.3	7584.1	483.5	7093.2	**3033.64**	**2364.42**
31.00	32.50	31.75	1.50	30.0	19.19	9.19	162.24	5.66	9.5	9.5	1.0	153.58	2445.06	50	1.0	282.9	4601.1	32.5	26.1	0	10.42	12.48	13.41	170.1	2496.3	9542.5	508.9	7555.1	**3817.01**	**2518.38**
32.50	34.00	33.25	1.50	31.5	20.42	10.42	162.24	5.66	27.5	27.5	1.0	477.77	2922.83	0	1.0	0.0	4601.1	34.0	10.9	47	10.42	2.73	1.48	170.1	1015.4	8539.3	534.4	8058.4	**3415.73**	**2686.12**
34.00	35.00	34.50	1.00	32.5	20.42	10.42	162.24	3.77	10.9	10.9	1.0	117.83	3040.65	47	1.0	177.3	4778.4	35.0	10.9	47	10.42	2.73	1.48	170.1	1015.4	8834.4	551.3	8370.4	**3533.77**	**2790.13**
35.00	35.50	35.25	0.50	33.0	20.42	10.42	162.24	1.89	10.9	10.9	1.0	58.91	3099.56	47	1.0	88.6	4867.0	35.5	15.8	39	10.42	4.33	3.09	170.1	1253.1	9219.6	559.8	8526.4	**3687.86**	**2842.14**
35.50	37.00	36.25	1.50	34.5	20.42	10.42	162.24	5.66	15.8	15.8	1.0	259.71	3359.27	39	1.0	220.6	5087.7	37.0	9.6	54	10.42	2.40	1.16	170.1	1019.6	9466.5	585.3	9032.2	**3786.61**	**3010.74**
37.00	37.50	37.25	0.50	35.0	20.42	10.42	162.24	1.89	9.6	9.6	1.0	51.74	3411.02	54	1.0	101.8	5189.5	37.5	9.6	54	10.42	2.40	1.16	170.1	1019.6	9620.1	593.8	9194.3	**3848.04**	**3064.75**
37.50	38.50	38.00	1.00	36.0	20.42	10.42	162.24	3.77	9.6	9.6	1.0	103.49	3514.50	54	1.0	203.7	5393.1	38.5	8.0	54	10.42	2.11	0.91	170.1	962.4	9870.1	610.7	9518.4	**3948.03**	**3172.79**
38.50	40.00	39.25	1.50	37.5	20.42	10.42	162.24	5.66	8.0	8.0	1.0	128.99	3643.49	54	1.0	305.5	5698.6	40.0	8.0	96	10.42	2.11	0.91	170.1	1390.1	10732.2	636.2	9978.3	**4292.89**	**3326.10**
BORE NO: P40, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.10	10.10	27.78	1.89	9.6	9.6	1.0	8.86	0	48	1.0	90.5	0	3.0	9.6	30	10.10	2.40	1.16	30.3	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.5	20.10	10.10	35.35	3.77	9.6	9.6	1.0	22.55	0	30	1.0	113.1	0	4.0	13.5	16	10.10	3.50	2.22	40.4	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	5.00	4.50	1.00	2.5	20.10	10.10	45.45	3.77	13.5	13.5	1.0	41.15	0	16	1.0	60.3	0	5.0	27.5	5	9.64	15.63	16.64	50.5	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.64	9.64	55.32	3.77	27.5	27.5	1.0	108.61	0	5	1.0	18.9	0	6.0	27.5	5	9.64	15.63	16.64	60.1	0	0.0	59.4	59.4	**0.00**	**19.79**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
6.00	8.00	7.00	2.00	5.5	19.64	9.64	69.78	7.54	27.5	27.5	1.0	274.00	0	5	1.0	37.7	0	8.0	25.2	0	9.64	10.45	11.34	79.4	0	0.0	93.3	93.3	**0.00**	**31.10**
8.00	9.00	8.50	1.00	6.5	19.64	9.64	84.24	3.77	25.2	25.2	1.0	149.50	0	0	1.0	0.0	0	9.0	10.5	56	10.39	2.62	1.36	89.1	843.6	843.6	110.3	110.3	**337.42**	**36.76**
9.00	11.00	10.00	2.00	8.5	20.39	10.39	99.45	7.54	10.5	10.5	1.0	139.03	139.03	56	1.0	422.4	422.4	11.0	9.6	58	10.39	2.40	1.16	109.8	896.8	1458.2	144.2	705.6	**583.29**	**235.21**
11.00	12.00	11.50	1.00	9.5	20.39	10.39	115.04	3.77	9.6	9.6	1.0	73.38	212.41	58	1.0	218.7	641.1	12.0	7.1	59	10.49	1.95	0.77	120.2	871.3	1724.8	161.2	1014.7	**689.94**	**338.24**
12.00	14.50	13.25	2.50	12.0	20.49	10.49	133.34	9.43	7.1	7.1	1.0	156.60	369.01	59	1.0	556.3	1197.4	14.5	9.5	46	10.49	2.38	1.14	146.5	870.9	2437.4	203.6	1770.0	**974.94**	**590.00**
14.50	16.00	15.25	1.50	13.5	20.49	10.49	154.32	5.66	9.5	9.5	1.0	146.09	515.10	46	1.0	260.2	1457.7	16.0	8.3	60	10.09	2.16	0.96	162.2	1014.6	2987.4	229.0	2201.8	**1194.96**	**733.93**
16.00	17.50	16.75	1.50	15.0	20.09	10.09	169.76	5.66	8.3	8.3	1.0	140.10	655.20	60	1.0	339.4	1797.1	17.5	8.3	52	10.31	2.16	0.96	177.3	970.4	3422.7	254.5	2706.8	**1369.07**	**902.25**
17.50	20.50	19.00	3.00	18.0	20.31	10.31	169.76	11.31	8.3	8.3	1.0	280.20	935.40	52	1.0	588.3	2385.4	20.5	18.5	28	10.31	5.64	4.57	177.3	1449.0	4769.9	305.4	3626.2	**1907.95**	**1208.73**
20.50	23.50	22.00	3.00	21.0	20.31	10.31	169.76	11.31	18.5	18.5	1.0	642.65	1578.05	28	1.0	316.8	2702.2	23.5	11.2	57	10.85	2.82	1.56	177.3	1158.3	5438.6	356.3	4636.5	**2175.42**	**1545.51**
23.50	26.50	25.00	3.00	24.0	20.85	10.85	169.76	11.31	11.2	11.2	1.0	380.31	1958.35	57	1.0	644.9	3347.1	26.5	8.7	50	10.85	2.24	1.02	177.3	965.3	6270.8	407.2	5712.6	**2508.30**	**1904.22**
26.50	27.50	27.00	1.00	25.0	20.85	10.85	169.76	3.77	8.7	8.7	1.0	97.97	2056.32	50	1.0	188.6	3535.7	27.5	8.7	49	10.85	2.24	1.02	177.3	955.1	6547.1	424.1	6016.2	**2618.85**	**2005.38**
27.50	29.50	28.50	2.00	27.0	20.85	10.85	169.76	7.54	8.7	8.7	1.0	195.94	2252.26	49	1.0	369.6	3905.3	29.5	9.5	88	10.85	2.38	1.14	177.3	1382.0	7539.6	458.0	6615.6	**3015.83**	**2205.21**
29.50	30.00	29.75	0.50	27.5	20.85	10.85	169.76	1.89	9.5	9.5	1.0	53.57	2305.83	88	1.0	165.9	4071.3	30.0	9.5	88	10.85	2.38	1.14	177.3	1382.0	7759.1	466.5	6843.6	**3103.64**	**2281.20**
30.00	31.00	30.50	1.00	28.5	20.85	10.85	169.76	3.77	9.5	9.5	1.0	107.14	2412.97	88	1.0	331.9	4403.1	31.0	27.7	0	10.85	16.08	17.10	177.3	3352.1	10168.2	483.5	7299.6	**4067.29**	**2433.20**
31.00	32.50	31.75	1.50	30.0	20.85	10.85	169.76	5.66	27.7	27.7	1.0	504.19	2917.16	0	1.0	0.0	4403.1	32.5	27.7	0	10.01	16.08	17.10	177.3	3342.4	10662.7	508.9	7829.2	**4265.07**	**2609.75**
32.50	34.00	33.25	1.50	31.5	20.01	10.01	169.76	5.66	27.7	27.7	1.0	504.19	3421.35	0	1.0	0.0	4403.1	34.0	26.3	7	10.01	12.93	13.88	177.3	2759.2	10583.7	534.4	8358.9	**4233.48**	**2786.29**
34.00	35.00	34.50	1.00	32.5	20.01	10.01	169.76	3.77	26.3	26.3	1.0	316.42	3737.77	7	1.0	26.4	4429.5	35.0	26.0	7	10.01	12.25	13.18	177.3	2619.0	10786.3	551.3	8718.7	**4314.52**	**2906.22**
35.00	35.50	35.25	0.50	33.0	20.01	10.01	169.76	1.89	26.0	26.0	1.0	156.13	3893.90	7	1.0	13.2	4442.7	35.5	18.9	7	10.01	5.82	4.79	177.3	1272.0	9608.7	559.8	8896.5	**3843.47**	**2965.49**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	∑Qi	c	α	α.c.Asi	∑Qi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
35.50	37.00	36.25	1.50	34.5	20.01	10.01	169.76	5.66	18.9	18.9	1.0	328.80	4222.70	7	1.0	39.6	4482.3	37.0	8.9	56	10.01	2.27	1.05	177.3	1033.2	9738.3	585.3	9290.3	**3895.30**	**3096.77**
37.00	37.50	37.25	0.50	35.0	20.01	10.01	169.76	1.89	8.9	8.9	1.0	50.13	4272.83	56	1.0	105.6	4587.9	37.5	8.9	56	10.16	2.27	1.05	177.3	1033.3	9894.1	593.8	9454.5	**3957.64**	**3151.51**
37.50	38.50	38.00	1.00	36.0	20.16	10.16	169.76	3.77	8.9	8.9	1.0	100.26	4373.08	56	1.0	211.2	4799.1	38.5	8.9	56	9.31	2.27	1.05	177.3	1032.7	10204.9	610.7	9783.0	**4081.98**	**3260.98**
38.50	40.00	39.25	1.50	37.5	19.31	9.31	169.76	5.66	8.9	8.9	1.0	150.39	4523.47	56	1.0	316.8	5115.9	40.0	18.9	10	9.31	5.82	4.79	177.3	1300.3	10939.7	636.2	10275.6	**4375.89**	**3425.19**

APPENDIX-H
TABLE 3: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1000 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Depth of Fixity (m)	Allowable Load capacity of pile(kN)
P24	1.00	2.50	0.00	35	29580399	0.0491	19	2696	3.52	4.50	1.28	2.04	0.005	7.17	55
P30	1.00	2.50	0.00	35	29580399	0.0491	17	2408	3.60	7.50	2.08	1.93	0.005	6.94	29
P32	1.00	2.50	0.00	35	29580399	0.0491	17	2408	3.60	5.50	1.53	2.00	0.005	7.20	43
P33	1.00	2.50	0.00	35	29580399	0.0491	18	2552	3.56	3.50	0.98	2.08	0.005	7.41	67
P34	1.00	2.50	0.00	35	29580399	0.0491	17	2408	3.60	1.50	0.42	2.17	0.005	7.80	108
P36	1.00	2.50	0.00	35	29580399	0.0491	16	2264	3.64	0.50	0.14	2.21	0.005	8.05	139
P39	1.00	2.50	0.00	35	29580399	0.0491	18	2552	3.56	6.50	1.83	1.96	0.005	6.96	36
P40	1.00	2.50	0.00	35	29580399	0.0491	14	1976	3.74	6.50	1.74	1.97	0.005	7.37	33

APPENDIX-H

TABLE 4: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1200 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Depth of Fixity (m)	Allowable Load capacity of pile(kN)
P24	1.20	2.50	0.00	35	29580399	0.1018	19	2696	4.07	4.50	1.11	2.06	0.005	8.40	84
P30	1.20	2.50	0.00	35	29580399	0.1018	18	2552	4.11	7.50	1.82	1.96	0.005	8.05	48
P32	1.20	2.50	0.00	35	29580399	0.1018	18	2552	4.11	5.50	1.34	2.03	0.005	8.35	68
P33	1.20	2.50	0.00	35	29580399	0.1018	18	2552	4.11	3.50	0.85	2.10	0.005	8.65	101
P34	1.20	2.50	0.00	35	29580399	0.1018	17	2408	4.16	1.50	0.36	2.18	0.005	9.06	153
P36	1.20	2.50	0.00	35	29580399	0.1018	16	2264	4.21	0.50	0.12	2.21	0.005	9.32	191
P39	1.20	2.50	0.00	35	29580399	0.1018	18	2552	4.11	6.50	1.58	1.99	0.005	8.20	57
P40	1.20	2.50	0.00	35	29580399	0.1018	15	2120	4.27	6.50	1.52	2.00	0.005	8.55	53

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
P24	0.50	ML	64	4.00	10.50	5.00	5.50	1.00	0.30	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.17	0.571	Liquefiable
	1.00	CL-ML	72	4.00	21.00	10.00	11.00	0.99	0.30	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
	2.00	CL	52	4.00	42.00	20.00	22.00	0.98	0.29	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
	3.00	SM	26	14.00	63.00	30.00	33.00	0.98	0.29	1.70	23.80	4.39	1.12	31.11	0.52	1.00	0.62	2.131	Non-liquefiable
	4.00	SM	26	18.00	84.00	40.00	44.00	0.97	0.29	1.51	27.14	4.39	1.12	34.85	0.52	1.00	0.62	2.148	Non-liquefiable
	6.00	SM	23	12.00	126.00	60.00	66.00	0.95	0.28	1.23	14.77	4.06	1.10	20.31	0.22	1.00	0.26	0.921	Liquefiable
	7.00	SM	23	19.00	147.00	70.00	77.00	0.95	0.28	1.14	21.65	4.06	1.10	27.88	0.37	1.00	0.44	1.547	Non-liquefiable
	8.00	SP-ML	10	19.00	152.00	80.00	72.00	0.94	0.31	1.18	22.39	0.87	1.02	23.75	0.27	1.00	0.32	1.038	Non-liquefiable
	9.00	SP-ML	10	23.00	171.00	90.00	81.00	0.93	0.31	1.11	25.56	0.87	1.02	26.98	0.34	1.00	0.40	1.314	Non-liquefiable
	10.00	SM	13	26.00	190.00	100.00	90.00	0.91	0.30	1.05	27.41	1.89	1.04	30.31	0.49	1.00	0.59	1.959	Non-liquefiable
	12.50	SM	13	28.00	238.75	125.00	113.75	0.84	0.28	0.94	26.25	1.89	1.04	29.11	0.42	1.00	0.50	1.802	Non-liquefiable
	14.00	CL-ML	75	28.00	294.00	140.00	154.00	0.80	0.24	0.81	22.56	5.00	1.20	32.08	0.52	1.00	-	-	Non-liquefiable
	15.50	ML	66	18.00	325.50	155.00	170.50	0.76	0.23	0.77	13.79	5.00	1.20	21.54	0.24	0.96	0.27	1.192	Non-liquefiable
	17.00	CL	61	18.00	355.30	170.00	185.30	0.72	0.22	0.73	13.22	5.00	1.20	20.87	0.23	0.85	-	-	Non-liquefiable
	18.50	CL	61	22.00	386.65	185.00	201.65	0.68	0.20	0.70	15.49	5.00	1.20	23.59	0.27	0.83	-	-	Non-liquefiable
	21.50	CL	57	35.00	449.35	215.00	234.35	0.60	0.18	0.65	22.86	5.00	1.20	32.44	0.52	0.78	-	-	Non-liquefiable
	24.50	CL	79	32.00	494.90	245.00	249.90	0.56	0.17	0.63	20.24	5.00	1.20	29.29	0.42	0.74	-	-	Non-liquefiable
	26.00	CI	79	32.00	527.80	260.00	267.80	0.56	0.17	0.61	19.55	5.00	1.20	28.47	0.39	0.75	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	27.50	CI	79	38.00	558.25	275.00	283.25	0.56	0.17	0.59	22.58	5.00	1.20	32.09	0.52	0.74	-	-	Non-liquefiable
	29.00	CL	69	38.00	553.90	290.00	263.90	0.56	0.18	0.62	23.39	5.00	1.20	33.07	0.52	0.71	-	-	Non-liquefiable
	30.50	CL	69	33.00	582.55	305.00	277.55	0.56	0.18	0.60	19.81	5.00	1.20	28.77	0.40	0.70	-	-	Non-liquefiable
	33.50	CL	74	39.00	639.85	335.00	304.85	0.56	0.18	0.57	22.34	5.00	1.20	31.80	0.52	0.68	-	-	Non-liquefiable
	35.00	SM	37	39.00	668.50	350.00	318.50	0.56	0.18	0.56	21.85	5.00	1.20	31.22	0.52	0.67	0.42	2.267	Non-liquefiable
	36.50	SM	16	36.00	697.15	365.00	332.15	0.56	0.18	0.55	19.75	2.77	1.05	23.59	0.27	0.67	0.21	1.161	Non-liquefiable
	40.00	SM	16	69.00	764.00	400.00	364.00	0.56	0.18	0.52	36.17	2.77	1.05	40.89	0.52	0.65	0.40	2.199	Non-liquefiable
P30	0.50	SM	32	5.00	9.00	5.00	4.00	1.00	0.35	1.70	8.50	4.83	1.17	14.78	0.16	1.00	0.19	0.539	Liquefiable
	2.00	SM	30	5.00	36.00	20.00	16.00	0.98	0.35	1.70	8.50	4.71	1.15	14.52	0.16	1.00	0.19	0.536	Liquefiable
	3.00	SM	30	9.00	54.00	30.00	24.00	0.98	0.34	1.70	15.30	4.71	1.15	22.37	0.25	1.00	0.30	0.860	Liquefiable
	5.00	SM	13	11.00	96.00	50.00	46.00	0.96	0.31	1.47	16.22	1.89	1.04	18.71	0.20	1.00	0.24	0.761	Liquefiable
	6.00	SM	13	12.00	115.20	60.00	55.20	0.95	0.31	1.35	16.15	1.89	1.04	18.64	0.20	1.00	0.24	0.764	Liquefiable
	8.00	SM	13	14.00	153.60	80.00	73.60	0.94	0.31	1.17	16.32	1.89	1.04	18.81	0.20	1.00	0.24	0.785	Liquefiable
	9.00	SM	15	16.00	172.80	90.00	82.80	0.93	0.30	1.10	17.58	2.50	1.05	20.93	0.23	1.00	0.27	0.894	Liquefiable
	10.00	CL	66	16.00	210.00	100.00	110.00	0.91	0.27	0.95	15.26	5.00	1.20	23.31	0.26	1.00	-	-	Non-liquefiable
	11.00	CL	66	15.00	231.00	110.00	121.00	0.88	0.26	0.91	13.64	5.00	1.20	21.36	0.23	1.00	-	-	Non-liquefiable
	12.00	CL	66	17.00	252.00	120.00	132.00	0.85	0.25	0.87	14.80	5.00	1.20	22.76	0.25	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	14.50	CL	76	21.00	311.75	145.00	166.75	0.79	0.23	0.77	16.26	5.00	1.20	24.51	0.28	1.00	-	-	Non-liquefiable
	17.50	CL	76	22.00	374.50	175.00	199.50	0.71	0.21	0.71	15.58	5.00	1.20	23.69	0.27	0.85	-	-	Non-liquefiable
	19.00	SM-SC	49	22.00	393.30	190.00	203.30	0.67	0.20	0.70	15.43	5.00	1.20	23.52	0.27	0.79	0.25	1.242	Non-liquefiable
	20.50	CL	69	26.00	424.35	205.00	219.35	0.63	0.19	0.68	17.56	5.00	1.20	26.07	0.31	0.77	-	-	Non-liquefiable
	23.50	CL	69	23.00	486.45	235.00	251.45	0.56	0.17	0.63	14.50	5.00	1.20	22.41	0.25	0.73	-	-	Non-liquefiable
	26.50	CL	82	22.00	577.70	265.00	312.70	0.56	0.16	0.57	12.44	5.00	1.20	19.93	0.21	0.75	-	-	Non-liquefiable
	29.50	CL	78	26.00	643.10	295.00	348.10	0.56	0.16	0.54	13.94	5.00	1.20	21.72	0.24	0.72	-	-	Non-liquefiable
	31.00	CL-ML	57	26.00	598.30	310.00	288.30	0.56	0.18	0.59	15.31	5.00	1.20	23.38	0.26	0.65	-	-	Non-liquefiable
	32.50	CL	83	32.00	627.25	325.00	302.25	0.56	0.18	0.58	18.41	5.00	1.20	27.09	0.34	0.64	-	-	Non-liquefiable
	35.50	CL-ML	76	40.00	685.15	355.00	330.15	0.56	0.18	0.55	22.01	5.00	1.20	31.42	0.52	0.62	-	-	Non-liquefiable
	37.00	CL	86	40.00	714.10	370.00	344.10	0.56	0.18	0.54	21.56	5.00	1.20	30.88	0.52	0.61	-	-	Non-liquefiable
	38.50	CL	68	50.00	743.05	385.00	358.05	0.56	0.18	0.53	26.42	5.00	1.20	36.71	0.52	0.61	-	-	Non-liquefiable
	40.00	CL	68	59.00	772.00	400.00	372.00	0.56	0.18	0.52	30.59	5.00	1.20	41.71	0.52	0.60	-	-	Non-liquefiable
P32	0.50	SM	44	4	9.85	5.00	4.85	1.00	0.316	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.537	Liquefiable
	1.00	CL-ML	58	4	19.70	10.00	9.70	0.99	0.314	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
	2.00	SM	24	4	39.40	20.00	19.40	0.98	0.312	1.70	6.80	4.18	1.11	11.71	0.13	1.00	0.153	0.491	Liquefiable
	3.00	SM	24	5	59.10	30.00	29.10	0.98	0.310	1.70	8.50	4.18	1.11	13.59	0.15	1.00	0.174	0.563	Liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	5.00	SM-SC	48	7	98.50	50.00	48.50	0.96	0.305	1.44	10.05	5.00	1.20	17.06	0.18	1.00	0.216	0.710	Liquefiable
	6.00	SM	22	9	116.40	60.00	56.40	0.95	0.307	1.33	11.98	3.93	1.09	17.03	0.18	1.00	0.216	0.703	Liquefiable
	8.00	CL-ML	72	13	155.20	80.00	75.20	0.94	0.302	1.15	14.99	5.00	1.20	22.99	0.26	1.00	-	-	Non-liquefiable
	9.00	CL-ML	72	17	176.40	90.00	86.40	0.93	0.297	1.08	18.29	5.00	1.20	26.95	0.34	1.00	-	-	Non-liquefiable
	10.00	CL	81	17	196.00	100.00	96.00	0.91	0.289	1.02	17.35	5.00	1.20	25.82	0.31	1.00	-	-	Non-liquefiable
	11.00	CL	81	18	224.40	110.00	114.40	0.88	0.269	0.93	16.83	5.00	1.20	25.19	0.30	1.00	-	-	Non-liquefiable
	12.00	CL	81	22	244.80	120.00	124.80	0.85	0.261	0.90	19.69	5.00	1.20	28.63	0.39	1.00	-	-	Non-liquefiable
	13.00	SM	44	22	265.20	130.00	135.20	0.83	0.253	0.86	18.92	5.00	1.20	27.70	0.36	1.00	0.429	1.695	Non-liquefiable
	14.50	SM	44	36	295.80	145.00	150.80	0.79	0.241	0.81	29.32	5.00	1.20	40.18	0.52	1.00	0.620	2.576	Non-liquefiable
	16.00	CL	75	36	326.40	160.00	166.40	0.75	0.229	0.78	27.91	5.00	1.20	38.49	0.52	0.87	-	-	Non-liquefiable
	17.50	CL	75	19	353.50	175.00	178.50	0.71	0.218	0.75	14.22	5.00	1.20	22.07	0.24	0.86	-	-	Non-liquefiable
	19.00	CL-ML	67	19	383.80	190.00	193.80	0.67	0.206	0.72	13.65	5.00	1.20	21.38	0.23	0.84	-	-	Non-liquefiable
	20.50	CL	87	38	410.00	205.00	205.00	0.63	0.196	0.70	26.54	5.00	1.20	36.85	0.52	0.82	-	-	Non-liquefiable
	23.50	CL	87	75	470.00	235.00	235.00	0.56	0.175	0.65	48.92	5.00	1.20	63.71	0.52	0.75	-	-	Non-liquefiable
	25.00	CL	87	63	510.00	250.00	260.00	0.56	0.171	0.62	39.07	5.00	1.20	51.89	0.52	0.72	-	-	Non-liquefiable
	26.50	CL	90	71	540.60	265.00	275.60	0.56	0.171	0.60	42.77	5.00	1.20	56.32	0.52	0.71	-	-	Non-liquefiable
	28.00	CL	89	75	571.20	280.00	291.20	0.56	0.171	0.59	43.95	5.00	1.20	57.74	0.52	0.70	-	-	Non-liquefiable
	29.50	CL	89	62	601.80	295.00	306.80	0.56	0.171	0.57	35.40	5.00	1.20	47.48	0.52	0.68	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	31.00	CL-ML	89	102	632.40	310.00	322.40	0.56	0.171	0.56	56.81	5.00	1.20	73.17	0.52	0.67	-	-	Non-liquefiable
	32.50	CL	86	95	663.00	325.00	338.00	0.56	0.171	0.54	51.67	5.00	1.20	67.01	0.52	0.66	-	-	Non-liquefiable
	34.00	ML	77	103	693.60	340.00	353.60	0.56	0.171	0.53	54.77	5.00	1.20	70.73	0.52	0.65	0.404	2.356	Non-liquefiable
	35.50	CL	93	87	724.20	355.00	369.20	0.56	0.171	0.52	45.28	5.00	1.20	59.33	0.52	0.64	-	-	Non-liquefiable
	37.00	CL	93	91	754.80	370.00	384.80	0.56	0.171	0.51	46.39	5.00	1.20	60.67	0.52	0.63	-	-	Non-liquefiable
	38.50	CL	86	83	785.40	385.00	400.40	0.56	0.171	0.50	41.48	5.00	1.20	54.78	0.52	0.62	-	-	Non-liquefiable
	40.00	CL	86	56	816.00	400.00	416.00	0.56	0.171	0.49	27.46	5.00	1.20	37.95	0.52	0.62	-	-	Non-liquefiable
P33	2.00	SM	44	5	39.60	20.00	19.60	0.98	0.310	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.623	Liquefiable
	3.00	SM	44	7	59.40	30.00	29.40	0.98	0.308	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.800	Liquefiable
	5.00	SM	37	10	99.00	50.00	49.00	0.96	0.303	1.43	14.29	5.00	1.20	22.14	0.24	1.00	0.291	0.960	Liquefiable
	6.00	SM	37	12	117.00	60.00	57.00	0.95	0.306	1.32	15.89	5.00	1.20	24.07	0.27	1.00	0.328	1.072	Non-liquefiable
	8.00	SM	30	14	156.00	80.00	76.00	0.94	0.301	1.15	16.06	4.71	1.15	23.24	0.26	1.00	0.311	1.035	Non-liquefiable
	9.00	CL	87	20	175.50	90.00	85.50	0.93	0.298	1.08	21.63	5.00	1.20	30.96	0.52	1.00	-	-	Non-liquefiable
	11.00	SM-SC	46	30	214.50	110.00	104.50	0.88	0.282	0.98	29.35	5.00	1.20	40.22	0.52	1.00	0.620	2.200	Non-liquefiable
	12.00	SM	44	29	242.40	120.00	122.40	0.85	0.264	0.90	26.21	5.00	1.20	36.45	0.52	1.00	0.620	2.352	Non-liquefiable
	13.00	CL	86	29	262.60	130.00	132.60	0.83	0.255	0.87	25.18	5.00	1.20	35.22	0.52	1.00	-	-	Non-liquefiable
	14.50	CL	86	32	295.80	145.00	150.80	0.79	0.241	0.81	26.06	5.00	1.20	36.27	0.52	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	17.50	CL	88	39	357.00	175.00	182.00	0.71	0.216	0.74	28.91	5.00	1.20	39.69	0.52	0.80	-	-	Non-liquefiable
	20.50	CL	93	42	422.30	205.00	217.30	0.63	0.190	0.68	28.49	5.00	1.20	39.19	0.52	0.75	-	-	Non-liquefiable
	22.00	CL-ML	53	42	448.80	220.00	228.80	0.59	0.179	0.66	27.77	5.00	1.20	38.32	0.52	0.80	-	-	Non-liquefiable
	23.50	CL	84	88	462.95	235.00	227.95	0.56	0.177	0.66	58.29	5.00	1.20	74.94	0.52	0.80	-	-	Non-liquefiable
	25.00	CL	84	75	492.50	250.00	242.50	0.56	0.177	0.64	48.16	5.00	1.20	62.79	0.52	0.79	-	-	Non-liquefiable
	26.50	CL	84	80	522.05	265.00	257.05	0.56	0.177	0.62	49.90	5.00	1.20	64.88	0.52	0.77	-	-	Non-liquefiable
	28.00	CL-CI	88	87	551.60	280.00	271.60	0.56	0.177	0.61	52.79	5.00	1.20	68.35	0.52	0.76	-	-	Non-liquefiable
	29.50	CL-CI	88	101	581.15	295.00	286.15	0.56	0.177	0.59	59.71	5.00	1.20	76.65	0.52	0.75	-	-	Non-liquefiable
	31.00	CL-CI	88	82	610.70	310.00	300.70	0.56	0.177	0.58	47.29	5.00	1.20	61.75	0.52	0.74	-	-	Non-liquefiable
	32.50	CL	77	90	640.25	325.00	315.25	0.56	0.177	0.56	50.69	5.00	1.20	65.83	0.52	0.73	-	-	Non-liquefiable
	34.00	CL	77	98	669.80	340.00	329.80	0.56	0.177	0.55	53.96	5.00	1.20	69.76	0.52	0.72	-	-	Non-liquefiable
	35.50	CL	83	72	699.35	355.00	344.35	0.56	0.177	0.54	38.80	5.00	1.20	51.56	0.52	0.71	-	-	Non-liquefiable
	37.00	CL	90	88	728.90	370.00	358.90	0.56	0.177	0.53	46.45	5.00	1.20	60.74	0.52	0.71	-	-	Non-liquefiable
	38.50	CL	90	100	758.45	385.00	373.45	0.56	0.177	0.52	51.75	5.00	1.20	67.10	0.52	0.70	-	-	Non-liquefiable
	40.00	CL	84	96	788.00	400.00	388.00	0.56	0.177	0.51	48.74	5.00	1.20	63.48	0.52	0.69	-	-	Non-liquefiable
P34	0.50	SM	47	3	9.80	5.00	4.80	1.00	0.317	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.463	Liquefiable
	1.00	SM-SC	50	3	19.60	10.00	9.60	0.99	0.316	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.465	Liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	3.00	ML	51	6	58.80	30.00	28.80	0.98	0.311	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.703	Liquefiable
	4.00	SM	30	14	78.40	40.00	38.40	0.97	0.309	1.61	22.59	4.71	1.15	30.79	0.52	1.00	0.620	2.009	Non-liquefiable
	6.00	SM	20	18	117.60	60.00	57.60	0.95	0.304	1.32	23.72	3.61	1.08	29.22	0.42	1.00	0.502	1.652	Non-liquefiable
	7.00	SM	45	23	135.10	70.00	65.10	0.95	0.306	1.24	28.51	5.00	1.20	39.21	0.52	1.00	0.620	2.024	Non-liquefiable
	8.00	ML	51	23	154.40	80.00	74.40	0.94	0.304	1.16	26.66	5.00	1.20	37.00	0.52	1.00	0.620	2.041	Non-liquefiable
	9.00	SM	44	15	177.30	90.00	87.30	0.93	0.295	1.07	16.05	5.00	1.20	24.26	0.28	1.00	0.332	1.124	Non-liquefiable
	10.00	SM	44	20	197.00	100.00	97.00	0.91	0.287	1.02	20.31	5.00	1.20	29.37	0.43	1.00	0.512	1.780	Non-liquefiable
	12.50	CL	94	19	246.25	125.00	121.25	0.84	0.266	0.91	17.25	5.00	1.20	25.71	0.31	1.00	-	-	Non-liquefiable
	15.50	CL	92	12	302.25	155.00	147.25	0.76	0.243	0.82	9.89	5.00	1.20	16.87	0.18	0.89	-	-	Non-liquefiable
	18.50	CL	91	21	377.40	185.00	192.40	0.68	0.208	0.72	15.14	5.00	1.20	23.17	0.26	0.83	-	-	Non-liquefiable
	21.50	CL	80	30	438.60	215.00	223.60	0.60	0.184	0.67	20.06	5.00	1.20	29.08	0.41	0.73	-	-	Non-liquefiable
	24.50	CL	92	38	504.70	245.00	259.70	0.56	0.170	0.62	23.58	5.00	1.20	33.30	0.52	0.77	-	-	Non-liquefiable
	27.50	CL	92	47	552.75	275.00	277.75	0.56	0.174	0.60	28.20	5.00	1.20	38.84	0.52	0.76	-	-	Non-liquefiable
	30.50	SM	36	71	613.05	305.00	308.05	0.56	0.174	0.57	40.45	5.00	1.20	53.54	0.52	0.67	0.414	2.383	Non-liquefiable
	32.00	CL-ML	61	75	659.20	320.00	339.20	0.56	0.170	0.54	40.72	5.00	1.20	53.87	0.52	0.65	-	-	Non-liquefiable
	33.50	CL-ML	61	68	690.10	335.00	355.10	0.56	0.170	0.53	36.09	5.00	1.20	48.30	0.52	0.63	-	-	Non-liquefiable
	35.00	CL-ML	76	55	721.00	350.00	371.00	0.56	0.170	0.52	28.55	5.00	1.20	39.27	0.52	0.62	-	-	Non-liquefiable
	36.50	CL-ML	76	52	751.90	365.00	386.90	0.56	0.170	0.51	26.44	5.00	1.20	36.72	0.52	0.62	-	-	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	38.00	CL	84	65	782.80	380.00	402.80	0.56	0.170	0.50	32.39	5.00	1.20	43.86	0.52	0.61	-	-	Non-liquefiable
	40.00	CL	84	53	824.00	400.00	424.00	0.56	0.170	0.49	25.74	5.00	1.20	35.89	0.52	0.60	-	-	Non-liquefiable
P36	0.50	CL-ML	57	6.00	10.20	5.00	5.20	1.00	0.30	1.70	10.20	5.00	1.20	17.24	0.18	1.00	-	-	Non-liquefiable
P36	1.00	SM	41	6.00	20.40	10.00	10.40	0.99	0.30	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.22	0.720	Liquefiable
P36	2.00	SM-SC	50	6.00	40.80	20.00	20.80	0.98	0.30	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.22	0.726	Liquefiable
P36	3.00	SM	40	10.00	61.20	30.00	31.20	0.98	0.30	1.70	17.00	5.00	1.20	25.40	0.30	1.00	0.36	1.197	Non-liquefiable
P36	5.00	SM	24	16.00	103.50	50.00	53.50	0.96	0.29	1.37	21.87	4.18	1.11	28.41	0.38	1.00	0.46	1.581	Non-liquefiable
P36	6.00	SM	24	22.00	124.20	60.00	64.20	0.95	0.29	1.25	27.46	4.18	1.11	34.59	0.52	1.00	0.62	2.154	Non-liquefiable
P36	8.00	CL-ML	80	17.00	164.00	80.00	84.00	0.94	0.29	1.09	18.55	5.00	1.20	27.26	0.35	1.00	-	-	Non-liquefiable
P36	9.00	CL-ML	80	22.00	184.50	90.00	94.50	0.93	0.28	1.03	22.63	5.00	1.20	32.16	0.52	1.00	-	-	Non-liquefiable
P36	10.00	CL	77	22.00	205.00	100.00	105.00	0.91	0.28	0.98	21.47	5.00	1.20	30.76	0.52	1.00	-	-	Non-liquefiable
P36	11.00	CL-ML	86	29.00	225.50	110.00	115.50	0.88	0.27	0.93	26.98	5.00	1.20	37.38	0.52	1.00	-	-	Non-liquefiable
P36	12.00	CL-ML	86	26.00	246.00	120.00	126.00	0.85	0.26	0.89	23.16	5.00	1.20	32.80	0.52	1.00	-	-	Non-liquefiable
P36	13.00	SM	45	26.00	260.00	130.00	130.00	0.83	0.26	0.88	22.80	5.00	1.20	32.36	0.52	1.00	0.62	2.404	Non-liquefiable
P36	14.50	SM	45	27.00	290.00	145.00	145.00	0.79	0.25	0.83	22.42	5.00	1.20	31.91	0.52	1.00	0.62	2.526	Non-liquefiable
P36	16.00	CL	74	27.00	329.60	160.00	169.60	0.75	0.23	0.77	20.73	5.00	1.20	29.88	0.46	0.86	-	-	Non-liquefiable
P36	17.50	CL	79	23.00	360.50	175.00	185.50	0.71	0.21	0.73	16.89	5.00	1.20	25.26	0.30	0.84	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	20.50	CL	79	26.00	426.40	205.00	221.40	0.63	0.19	0.67	17.47	5.00	1.20	25.97	0.31	0.76	-	-	Non-liquefiable
	23.50	CL	76	29.00	486.45	235.00	251.45	0.56	0.17	0.63	18.29	5.00	1.20	26.95	0.34	0.73	-	-	Non-liquefiable
	26.50	CL	79	45.00	548.55	265.00	283.55	0.56	0.17	0.59	26.72	5.00	1.20	37.07	0.52	0.70	-	-	Non-liquefiable
	28.00	MI	84	45.00	574.00	280.00	294.00	0.56	0.17	0.58	26.24	5.00	1.20	36.49	0.52	0.71	-	-	Non-liquefiable
	29.50	MI	84	45.00	604.75	295.00	309.75	0.56	0.17	0.57	25.57	5.00	1.20	35.68	0.52	0.70	-	-	Non-liquefiable
	31.00	CL-ML	77	45.00	635.50	310.00	325.50	0.56	0.17	0.55	24.94	5.00	1.20	34.93	0.52	0.69	-	-	Non-liquefiable
	32.50	ML	56	56.00	666.25	325.00	341.25	0.56	0.17	0.54	30.31	5.00	1.20	41.38	0.52	0.68	0.42	2.473	Non-liquefiable
	34.00	CL-ML	71	62.00	697.00	340.00	357.00	0.56	0.17	0.53	32.81	5.00	1.20	44.38	0.52	0.67	-	-	Non-liquefiable
	35.50	CL	73	49.00	727.75	355.00	372.75	0.56	0.17	0.52	25.38	5.00	1.20	35.46	0.52	0.66	-	-	Non-liquefiable
	38.50	CL-ML	66	48.00	789.25	385.00	404.25	0.56	0.17	0.50	23.87	5.00	1.20	33.65	0.52	0.62	-	-	Non-liquefiable
	40.00	CL-ML	66	54.00	820.00	400.00	420.00	0.56	0.17	0.49	26.35	5.00	1.20	36.62	0.52	0.61	-	-	Non-liquefiable
P39	0.50	SM	44	7.00	9.50	5.00	4.50	1.00	0.33	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.25	0.751	Liquefiable
	1.00	ML	54	7.00	19.00	10.00	9.00	0.99	0.33	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.25	0.754	Liquefiable
	2.00	SM-SC	46	7.00	38.00	20.00	18.00	0.98	0.32	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.25	0.760	Liquefiable
	3.00	SM	42	6.00	57.00	30.00	27.00	0.98	0.32	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.22	0.680	Liquefiable
	5.00	ML	64	7.00	95.00	50.00	45.00	0.96	0.32	1.49	10.43	5.00	1.20	17.52	0.19	1.00	0.22	0.702	Liquefiable
	6.00	ML	60	8.00	114.00	60.00	54.00	0.95	0.31	1.36	10.89	5.00	1.20	18.06	0.19	1.00	0.23	0.731	Liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	8.00	ML	56	9.00	152.00	80.00	72.00	0.94	0.31	1.18	10.61	5.00	1.20	17.73	0.19	1.00	0.23	0.728	Liquefiable
	9.00	CL-ML	73	10.00	171.00	90.00	81.00	0.93	0.31	1.11	11.11	5.00	1.20	18.33	0.20	1.00	-	-	Non-liquefiable
	10.00	CL	68	10.00	202.00	100.00	102.00	0.91	0.28	0.99	9.90	5.00	1.20	16.88	0.18	1.00	-	-	Non-liquefiable
	11.00	CL	68	23.00	222.20	110.00	112.20	0.88	0.27	0.94	21.71	5.00	1.20	31.06	0.52	1.00	-	-	Non-liquefiable
	12.00	CL	68	25.00	242.40	120.00	122.40	0.85	0.26	0.90	22.60	5.00	1.20	32.12	0.52	1.00	-	-	Non-liquefiable
	14.50	CL-ML	66	18.00	297.25	145.00	152.25	0.79	0.24	0.81	14.59	5.00	1.20	22.51	0.25	1.00	-	-	Non-liquefiable
	16.00	CL	72	18.00	328.00	160.00	168.00	0.75	0.23	0.77	13.89	5.00	1.20	21.66	0.24	0.89	-	-	Non-liquefiable
	17.50	CL	83	15.00	358.75	175.00	183.75	0.71	0.22	0.74	11.07	5.00	1.20	18.28	0.19	0.86	-	-	Non-liquefiable
	20.50	CL	68	19.00	407.95	205.00	202.95	0.63	0.20	0.70	13.34	5.00	1.20	21.00	0.23	0.80	-	-	Non-liquefiable
	22.00	CI	80	19.00	446.60	220.00	226.60	0.59	0.18	0.66	12.62	5.00	1.20	20.15	0.22	0.78	-	-	Non-liquefiable
	23.50	CI	80	42.00	477.05	235.00	242.05	0.56	0.17	0.64	27.00	5.00	1.20	37.40	0.52	0.76	-	-	Non-liquefiable
	25.00	CL	80	42.00	515.00	250.00	265.00	0.56	0.17	0.61	25.80	5.00	1.20	35.96	0.52	0.78	-	-	Non-liquefiable
	26.50	CL	80	51.00	545.90	265.00	280.90	0.56	0.17	0.60	30.43	5.00	1.20	41.52	0.52	0.76	-	-	Non-liquefiable
	29.50	CL-ML	70	54.00	607.70	295.00	312.70	0.56	0.17	0.57	30.54	5.00	1.20	41.64	0.52	0.74	-	-	Non-liquefiable
	31.00	CL	85	46.00	638.60	310.00	328.60	0.56	0.17	0.55	25.38	5.00	1.20	35.45	0.52	0.73	-	-	Non-liquefiable
	32.50	SM	47	49.00	669.50	325.00	344.50	0.56	0.17	0.54	26.40	5.00	1.20	36.68	0.52	0.72	0.45	2.631	Non-liquefiable
	34.00	CL	77	49.00	700.40	340.00	360.40	0.56	0.17	0.53	25.81	5.00	1.20	35.97	0.52	0.71	-	-	Non-liquefiable
	35.50	ML	65	50.00	731.30	355.00	376.30	0.56	0.17	0.52	25.78	5.00	1.20	35.93	0.52	0.70	0.43	2.558	Non-liquefiable

APPENDIX-H
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Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	37.00	CL	84	50.00	754.80	370.00	384.80	0.56	0.17	0.51	25.49	5.00	1.20	35.59	0.52	0.62	-	-	Non-liquefiable
	38.50	CL	84	52.00	785.40	385.00	400.40	0.56	0.17	0.50	25.99	5.00	1.20	36.18	0.52	0.61	-	-	Non-liquefiable
	40.00	CL	84	62.00	816.00	400.00	416.00	0.56	0.17	0.49	30.40	5.00	1.20	41.48	0.52	0.60	-	-	Non-liquefiable
P40	0.50	SM	38	4.00	10.05	5.00	5.05	1.00	0.31	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.17	0.548	Liquefiable
P40	1.00	CL	52	4.00	20.10	10.00	10.10	0.99	0.31	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
P40	2.00	CL	76	4.00	40.20	20.00	20.20	0.98	0.31	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
P40	3.00	CL	76	5.00	60.30	30.00	30.30	0.98	0.30	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
P40	4.00	CL-ML	64	5.00	80.40	40.00	40.40	0.97	0.30	1.57	7.87	5.00	1.20	14.44	0.15	1.00	-	-	Non-liquefiable
P40	5.00	SM	41	7.00	100.50	50.00	50.50	0.96	0.30	1.41	9.85	5.00	1.20	16.82	0.18	1.00	0.21	0.715	Liquefiable
P40	6.00	SM	31	12.00	120.60	60.00	60.60	0.95	0.30	1.28	15.42	4.77	1.16	22.69	0.25	1.00	0.30	1.015	Non-liquefiable
P40	8.00	SM	37	9.00	156.80	80.00	76.80	0.94	0.30	1.14	10.27	5.00	1.20	17.32	0.18	1.00	0.22	0.735	Liquefiable
P40	9.00	CL	87	8.00	176.40	90.00	86.40	0.93	0.30	1.08	8.61	5.00	1.20	15.33	0.16	1.00	-	-	Non-liquefiable
P40	11.00	CL	82	23.00	224.40	110.00	114.40	0.88	0.27	0.93	21.50	5.00	1.20	30.80	0.52	1.00	-	-	Non-liquefiable
P40	12.00	CL	82	16.00	244.80	120.00	124.80	0.85	0.26	0.90	14.32	5.00	1.20	22.19	0.24	1.00	-	-	Non-liquefiable
P40	14.50	CL-ML	80	14.00	297.25	145.00	152.25	0.79	0.24	0.81	11.35	5.00	1.20	18.62	0.20	1.00	-	-	Non-liquefiable
P40	16.00	CL	78	14.00	321.60	160.00	161.60	0.75	0.23	0.79	11.01	5.00	1.20	18.22	0.19	0.87	-	-	Non-liquefiable
P40	17.50	CL	78	22.00	351.75	175.00	176.75	0.71	0.22	0.75	16.55	5.00	1.20	24.86	0.29	0.85	-	-	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	20.50	CL-ML	63	24.00	416.15	205.00	211.15	0.63	0.19	0.69	16.52	5.00	1.20	24.82	0.29	0.80	-	-	Non-liquefiable
	23.50	CL	77	26.00	477.05	235.00	242.05	0.56	0.17	0.64	16.71	5.00	1.20	25.05	0.29	0.76	-	-	Non-liquefiable
	26.50	CL	84	49.00	537.95	265.00	272.95	0.56	0.17	0.61	29.66	5.00	1.20	40.59	0.52	0.73	-	-	Non-liquefiable
	29.50	CI	81	32.00	613.60	295.00	318.60	0.56	0.17	0.56	17.93	5.00	1.20	26.51	0.33	0.72	-	-	Non-liquefiable
	31.00	SM	46	32.00	644.80	310.00	334.80	0.56	0.17	0.55	17.49	5.00	1.20	25.99	0.31	0.71	0.26	1.575	Non-liquefiable
	32.50	SM	46	50.00	676.00	325.00	351.00	0.56	0.17	0.53	26.69	5.00	1.20	37.03	0.52	0.69	0.43	2.544	Non-liquefiable
	34.00	CL-ML	58	50.00	680.00	340.00	340.00	0.56	0.17	0.54	27.12	5.00	1.20	37.54	0.52	0.69	-	-	Non-liquefiable
	35.50	CL-ML	58	49.00	710.00	355.00	355.00	0.56	0.17	0.53	26.01	5.00	1.20	36.21	0.52	0.68	-	-	Non-liquefiable
	37.00	MI	85	49.00	740.00	370.00	370.00	0.56	0.17	0.52	25.47	5.00	1.20	35.57	0.52	0.67	-	-	Non-liquefiable
	38.50	CL-ML	58	53.00	770.00	385.00	385.00	0.56	0.17	0.51	27.01	5.00	1.20	37.41	0.52	0.67	-	-	Non-liquefiable
	40.00	CL-ML	58	61.00	800.00	400.00	400.00	0.56	0.17	0.50	30.50	5.00	1.20	41.60	0.52	0.66	-	-	Non-liquefiable

APPENDIX-I
SITE PHOTOGRAPHS

SPT sample at depth 4.00 m

SPT at depth 33.50 m


SPT sample at depth 20.50 m


UDS at depth 34.00 m

APPENDIX-I
SITE PHOTOGRAPHS

SPT sample at depth 12.00 m

SPT at depth 20.50 m

UDS at depth 22.00 m

SPT sample at depth 31.00 m

APPENDIX-I
SITE PHOTOGRAPHS

SPT at depth 27.50 m

SPT sample at depth 30.50 m

SPT at depth 14.50 m

SPT sample at depth 29.50 m

APPENDIX-I
SITE PHOTOGRAPHS

 SPT sample at depth 9.00 m	 UDS at depth 25.00 m
 SPT sample at depth 9.00 m	 SPT at depth 26.50 m

APPENDIX-J
LABORATORY PHOTOGRAPHS

 Atterbergs' limit test	 Triaxial test
 UCS test soil	 Grain size analysis

APPENDIX-J
LABORATORY PHOTOGRAPHS

Atterbergs' limit test

Triaxial test


UCS test soil


Direct shear test

APPENDIX-J
LABORATORY PHOTOGRAPHS

Shrinkage limit test

Atterbergs' limit test

APPENDIX-K
CHART 1: FIELD BORELOG CHARTS (P24)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev No:	R03
		Rev. Date:	28.12.2021

Project Name:	GT-For HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3118982.298	E: 702009.821		Location/ Chainage:	21544.6870
Method of Drilling:	Percussion	Drilling Equipment	Power winch	Bore No.:	P24
Casing Lowered (M):	19.00	Bentonite Used: Yes	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	RL-193.043	Date: From 24/09/23 to 27/9/23		Water Table (M):	1.40

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
	0.0	0.50	0.50	DS	SX	Received										Brownish soil
	1.00	1.45	0.45	DP	"	1	2	2	4							Non-cohesive soil with Gra
	2.00	2.45	0.45	U	"	Received										— do —
	3.00	3.45	0.45	DP	"	5	6	8	14							Non-cohesive
	4.00	4.45	0.45	DP	"	6	8	10	18							— do —
	5.00	5.45	0.45	U	"	slipped										— do —
	6.00	6.45	0.45	DP	"	3	5	7	12							— do —
	7.00	7.45	0.45	DP	"	4	7	12	19							— do —
	8.00	8.45	0.45	U	"	Received										— do —
	9.00	9.45	0.45	DP	"	5	9	14	23							— do —
	10.00	10.45	0.45	DP	"	6	10	16	26							— do —
	11.00	11.45	0.45	U	"	Received										— do —
	12.50	12.95	0.45	DP	"	6	11	17	28							— do —
	14.00	14.45	0.45	U	"	Received										— Brownish
	15.50	15.95	0.45	DP	"	4	8	10	18							Light Brownish Non-cohesive
	17.00	17.45	0.45	U	"	Received										Yellowish soil cohesive soil with gravel
	18.50	18.95	0.45	DP	"	5	10	12	22							— do —
	20.00	20.45	0.45	U	"	Received										— do —
	21.50	21.95	0.45	DP	"	8	15	20	35							— do —
	23.00	23.45	0.45	U	"	Received										— do —
	24.50	24.95	0.45	DP	"	9	16	16	32							— do —
	26.00	26.45	0.45	U	"	Received										Yellowish soil Cohesive soil
	27.50	27.95	0.45	DP	"	10	18	20	38							— do —
	29.00	29.45	0.45	U	"	Received										— do —

Supervisor — E-in-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 2: FIELD BORELOG CHARTS (P24)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev No:	R03
		Rev Date:	28.12.2021

Project Name:	GT for HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3118982.298	E: 702009.821		Location/ Chainage:	21544.6870
Method of Drilling:	Percussion	Drilling Equipment	Rotary winch	Bore No.:	P24
Casing Lowered (M):	19.00	Bentonite Used: Yes	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	RL-192.043	Date: From 24/09/23 to 27/9/23		Water Table (M):	1.40

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
	30.50	30.95	0.45	DP		10	15	18	33							— do —
	32.00	32.45	0.45	U		slipped										— do —
	33.50	33.95	0.45	DP		11	18	21	39							— do —
	35.00	35.45	0.45	U		slipped										Non-cohesive soil Brown/ish
	36.50	36.95	0.45	DP		12	14	22	36							— do —
	38.00	38.45	0.45	U		slipped										— do —
	40.00	40.45	0.45	DP		17	24	45	69							— do —

Jitender Prasad

Supervisor | Engineer-in-Charge

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 3: FIELD BORELOG CHARTS (P30)

TECHPRO ENGINEERS PVT. LTD. — BORE/ DRILL LOG

Doc No:	GT/003
Date of Issue:	01.04.2018
Rev. No:	R03
Rev. Date:	28.12.2021

Project Name: GT Work For HORC Viaduct B/w Sohana & Dhulawat station | Project Code: 1901

Coordinate: N: 3119020.255 | E: 70185.6.668 | Location/ Chainage: 21701.8870

Method of Drilling: Percussion | Drilling Equipment: Power Winch | Bore No.: P30

Casing Lowered (M): 25 M | Bentonite Used: yes | Standard Sampler: yes | Barrel Type: NA

Ground Elevation: RL 191.396 | Date: From 25-9-23 to 27-9-23 | Water Table (M): 1.50

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT 0-15cm	SPT 15-30cm	SPT 30-45cm	N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
1	0.0	0.50	0.50	D	SX	Collected				–	–	–	–	–	–	Non Cohesive Soil
"	1.00	1.45	0.45	U	–	Received				–	–	–	–	–	–	"
"	2.00	2.45	0.45	LP	–	2	2	3	5	–	–	–	–	–	–	"
"	3.00	3.45	0.45	DP	–	3	4	5	9	–	–	–	–	–	–	"
"	4.00	4.45	0.45	U	–	Received				–	–	–	–	–	–	"
"	5.00	5.45	0.45	DP	–	4	5	6	11	–	–	–	–	–	–	"
"	6.00	6.45	0.45	DP	–	3	5	7	12	–	–	–	–	–	–	"
"	7.00	7.45	0.45	U	–	Slipped				–	–	–	–	–	–	" / DS Collected
"	8.00	8.45	0.45	DP	–	4	6	8	14	–	–	–	–	–	–	"
"	9.00	9.45	0.45	DP	–	5	7	9	16	–	–	–	–	–	–	"
"	10.00	10.45	0.45	U	–	Received				–	–	–	–	–	–	Cohesive Soil
"	11.00	11.45	0.45	DP	–	4	7	8	15	–	–	–	–	–	–	"
"	12.00	12.45	0.45	DP	–	4	8	9	17	–	–	–	–	–	–	"
"	13.00	13.45	0.45	U	–	Received				–	–	–	–	–	–	"
"	14.50	14.95	0.45	DP	–	4	9	12	21	–	–	–	–	–	–	"
"	16.00	16.45	0.45	U	–	Received				–	–	–	–	–	–	Cohesive Soil with Gravel
"	17.50	17.95	0.45	DP	–	6	9	13	22	–	–	–	–	–	–	"
"	19.00	19.45	0.45	U	–	Received				–	–	–	–	–	–	"
"	20.50	20.95	0.45	DP	–	7	11	15	26	–	–	–	–	–	–	"
"	22.00	22.45	0.45	U	–	Slipped				–	–	–	–	–	–	" DS Collected
"	23.50	23.95	0.45	DP	–	6	10	13	23	–	–	–	–	–	–	"
"	25.00	25.45	0.45	U	–	Received				–	–	–	–	–	–	"
2	26.50	26.95	0.45	DP	–	5	9	13	22	–	–	–	–	–	–	"
"	28.00	28.45	0.45	U	–	Slipped				–	–	–	–	–	–	" DS Collected

C.P. Kashyap
Supervisor

E - in - C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 4: FIELD BORELOG CHARTS (P30)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date:	28.12.2021

Project Name: GT Work For HORC Viaduct B/w Sohana & Dhulawat Stations | **Project Code:** 1901

Coordinate: N: 3119020.255 E: 70185 6.668 | **Location/ Chainage:** 21701.8870

Method of Drilling: Percussion | **Drilling Equipment:** Power winch | **Bore No.:** P30

Casing Lowered (M): 25 M | **Bentonite Used:** yes | **Standard Sampler:** yes | **Barrel Type:** NA

Ground Elevation: RL 191.336 | **Date: From** 25-9-23 **to** 27-9-23 | **Water Table (M):** 1.50

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
2	29.50	29.95	0.45	DP	SX	6	11	15	26	–	–	–	–	–	–	Cohesive Soil with Gravel
"	31.00	31.45	0.45	U	–	Received				–	–	–	–	–	–	"
"	32.50	32.95	0.45	DP	–	8	14	18	32	–	–	–	–	–	–	"
3	34.00	34.45	0.45	U	–	Slipped				–	–	–	–	–	–	Non Cohesive Soil
4	35.50	35.95	0.45	DP	–	9	18	22	40	–	–	–	–	–	–	"
"	37.00	37.45	0.45	U	–	Slipped				–	–	–	–	–	–	"
"	38.50	38.95	0.45	DP	–	10	20	30	50	–	–	–	–	–	–	"
"	40.00	40.45	0.45	DP	–	11	23	36	59	–	–	–	–	–	–	"

Jitender Parmar

Techpro Engineers Pvt. Ltd. Jaipur

C.P. Kashyap
Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 5: FIELD BORELOG CHARTS (P32)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name: GTIV FOR HORC Viaduct B/W Sohana Dhulawat Station				Project Code:	1901
Coordinate: N: 3119037.179	E: 701806.797	Location/ Chainage:	21754.2870		
Method of Drilling: Rotery		Drilling Equipment:	Manual Type Hydrolic	Bore No.:	P-32
Casing Lowered (M): —	Bentonite Used: NA	Standard Sampler :	Yes	Barrel Type :	NA
Ground Elevation: R.L.-191.338	Date: From 06/11/23 to 9/11/23			Water Table (M):	1.30

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
6/11/23	0.50	0.50	0.50	D	Sx	collected				—	—	—	—	—	—	Non cohesive soil
"	1.00	1.45	0.45	U	"	Received				—	—	—	—	—	—	do
"	2.00	2.45	0.45	DP	"	1	2	2	4	—	—	—	—	—	—	do
"	3.00	3.45	0.45	DP	"	2	2	3	5	—	—	—	—	—	—	do
7/11/23	4.00	4.45	0.45	U/D	"	slipped				—	—	—	—	—	—	Non cohesive soil
"	5.00	5.45	0.45	DP	"	3	3	4	7	—	—	—	—	—	—	do
"	6.00	6.45	0.45	DP	"	3	4	5	9	—	—	—	—	—	—	do
"	7.00	7.45	0.45	U	"	slipped				—	—	—	—	—	—	do
"	8.00	8.45	0.45	DP	"	4	6	7	13	—	—	—	—	—	—	do
"	9.00	9.45	0.45	DP	"	5	8	9	17	—	—	—	—	—	—	do
"	10.00	10.45	0.45	U	"	Received				—	—	—	—	—	—	Non cohesive soil.
"	11.00	11.45	0.45	DP	Sx	5	8	10	18	—	—	—	—	—	—	do
"	12.00	12.45	0.45	DP	"	6	10	12	22	—	—	—	—	—	—	do
"	13.00	13.45	0.45	U	"	slipped				—	—	—	—	—	—	do
"	14.50	14.95	0.45	DP	"	8	14	22	36	—	—	—	—	—	—	do
"	16.00	16.45	0.45	U	"	Received				—	—	—	—	—	—	Cohesive soil.
"	17.50	17.95	0.45	DP	"	5	9	10	19	—	—	—	—	—	—	Cohesive soil with Gravel
"	19.00	19.45	0.45	U	"	Received				—	—	—	—	—	—	do
"	20.50	20.95	0.45	DP	"	11	18	20	38	—	—	—	—	—	—	do
"	22.00	22.45	0.45	U	"	Received				—	—	—	—	—	—	Cohesive soil with Gravel
"	23.50	23.95	0.45	DP	"	27	35	40	75	—	—	—	—	—	—	do
"	25.00	25.45	0.45	U	"	17	28	35	63	—	—	—	—	—	—	do
"	26.50	26.95	0.45	DP	"	21	32	39	71	—	—	—	—	—	—	do
8/11/23	28.00	28.45	0.45	U	"	19	35	40	75	—	—	—	—	—	—	do

Supervisor

S.E. Civil

E - In - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 6: FIELD BORELOG CHARTS (P32)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW For HORC Viaduct b/w Sohana Dhulawat station	Project Code:	1901
Coordinate:	N: 3119037.179 E: 701806.797	Location/ Chainage:	21754.2870
Method of Drilling:	Rotary; Drilling Equipment: Hydraulic	Bore No.:	P-32
Casing Lowered (M):	—; Bentonite Used: NA; Standard Sampler: yes	Barrel Type:	NA
Ground Elevation:	RL-191.328; Date: From 06/11/23 to 9/11/23	Water Table (M):	1.30

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
8/11/23	29.50	29.95	0.45	DP	SX	14	25	37	62	—	—	—	—	—	—	Cohesive soil with Gravel
"	31.00	31.45	0.45	DP	"	20	42	60	102	—	—	—	—	—	—	do
"	32.50	32.95	0.45	DP	"	21	45	50	95	—	—	—	—	—	—	do
"	34.00	34.45	0.45	DP	"	32	48	55	103	—	—	—	—	—	—	Non cohesive soil
9/11/23	35.50	35.95	0.45	DP	"	22	40	47	87	—	—	—	—	—	—	do
"	37.00	37.45	0.45	DP	"	25	43	48	91	—	—	—	—	—	—	Cohesive soil with Gravel
"	38.50	38.95	0.45	DP	"	27	38	45	93	—	—	—	—	—	—	do
"	40.00	40.45	0.45	DP	"	14	19	37	56	—	—	—	—	—	—	do

Supervisor

Techpro Engineers Pvt. Ltd.

Eng - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 7: FIELD BORELOG CHARTS (P33)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/003
		Date of Issue:	01.04.2018
		Rev. No:	R03
		Rev. Date:	28.12.2021

Project Name:	GTI for HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3190496.389	E: 701782212	Location/ Chainage: 21780.4870 Dhulawat		
Method of Drilling:	Rotary	Drilling Equipment	Hydraulic	Bore No.:	P 33
Casing Lowered (M):	4.55 Bentonite Used: NA	Standard Sampler:	Yes	Barrel Type:	NA
Ground Elevation:	R.L. 191.287	Date: From 06/11/23 to 8/11/23		Water Table (M):	1.55

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
06.11.23	0.00	0.50	0.50	D	SX	Collected				–	–	–	–	–	–	Non cohesive soil
"	1.00	1.45	0.45	U	"	Received				–	–	–	–	–	–	do
"	2.00	2.45	0.45	DP	"	2	2	3	5	–	–	–	–	–	–	do
"	3.00	3.45	0.45	DP	"	2	3	4	7	–	–	–	–	–	–	do
07.11.23	4.00	4.45	0.45	U	"	Received				–	–	–	–	–	–	Non cohesive soil
"	5.00	5.45	0.45	DP	"	3	4	6	10	–	–	–	–	–	–	do
"	6.00	6.45	0.45	DP	"	4	5	7	12	–	–	–	–	–	–	do
"	7.00	7.45	0.45	U	"	Received				–	–	–	–	–	–	do
"	8.00	8.45	0.45	DP	"	5	6	8	14	–	–	–	–	–	–	do
"	9.00	9.45	0.45	DP	"	4	9	11	20	–	–	–	–	–	–	cohesive soil
"	10.00	10.45	0.45	U	"	Received				–	–	–	–	–	–	do
"	11.00	11.45	0.45	DP	SX	11	14	16	30	–	–	–	–	–	–	Non cohesive soil
"	12.00	12.45	0.45	DP	"	9	12	17	29	–	–	–	–	–	–	do
"	13.00	13.45	0.45	U	"	Received				–	–	–	–	–	–	cohesive soil
"	14.50	14.95	0.45	DP	"	11	15	17	32	–	–	–	–	–	–	do
"	16.00	16.45	0.45	U	"	Received				–	–	–	–	–	–	do
"	17.50	17.95	0.45	DP	"	13	17	22	39	–	–	–	–	–	–	do
"	19.00	19.45	0.45	U	"	Received				–	–	–	–	–	–	cohesive soil with Gravel
"	20.50	20.95	0.45	DP	"	15	19	23	42	–	–	–	–	–	–	do
"	22.00	22.45	0.45	U	"	Received				–	–	–	–	–	–	Non cohesive soil
"	23.50	23.95	0.45	DP	"	32	43	45	88	–	–	–	–	–	–	cohesive soil with Gravel
"	25.00	25.45	0.45	U	"	32	35	40	75	–	–	–	–	–	–	do
"	26.50	26.95	0.45	DP	"	25	38	42	80	–	–	–	–	–	–	do
"	28.00	28.45	0.45	U	"	37	42	45	87	–	–	–	–	–	–	do

Supervisor

Engg.-In-C

Techpro Engineers Pvt. Ltd. Kanpur

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 8: FIELD BORELOG CHARTS (P33)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW For HORC Viaduct B/w Sohana Dhulawat station	Project Code:	1901
Coordinate:	N: 3119046.389 E: 701782232	Location/ Chainage:	21780.4870
Method of Drilling:	Rotary	Drilling Equipment:	Auto Trip Hydraulic
Bore No.:	P-33		
Casing Lowered (M):	—	Bentonite Used:	NA
Standard Sampler:	Yes	Barrel Type:	NA
Ground Elevation:	R.L-191.287	Date: From	06/11/23 to 08/11/23
Water Table (M):	1.35		

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
7/11/23	29.50	29.95	0.45	DP	SX	32	45	56	101	—	—	—	—	—	—	cohesive soil with Gravel
8/11/23	31.00	31.45	0.45	DP	"	54	32	50	82	—	—	—	—	—	—	do
"	32.50	32.95	0.45	DP	"	23	25	55	90	—	—	—	—	—	—	do
"	34.00	34.45	0.45	DP	"	25	38	60	98	—	—	—	—	—	—	do
"	35.50	35.95	0.45	DP	"	21	35	37	72	—	—	—	—	—	—	cohesive soil with Gravel
"	37.00	37.45	0.45	DP	"	26	38	50	88	—	—	—	—	—	—	do
"	38.50	38.95	0.45	DP	"	30	42	58	100	—	—	—	—	—	—	do
"	40.00	40.45	0.45	DP	"	29	43	53	96	—	—	—	—	—	—	do

Supervisor

Techpro Engineers Pvt. Ltd. Kanpur

S.E-1/23

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 9: FIELD BORELOG CHARTS (P34)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW HORC Viaduct b/w Sohna & Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119056.154	E: 704757.766	Location/ Chainage: 21806.6870		
Method of Drilling:	Rotary	Drilling Equipment:	Automatic Hydraulic	Bore No.:	P-34
Casing Lowered (M):	— Bentonite Used: Not	Standard Sampler:	Yes	Barrel Type:	NA
Ground Elevation:	RL-191.452	Date: From	06/11/2023 to 08/11/2023	Water Table (M):	1.40

Day / Date	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
06/11/23	0.00	0.50	0.50	DS	Sc	Collected										Non-Cohesive Soil
"	1.00	1.45	0.45	DP	"	1	1	2	3							—do—
"	2.00	2.45	0.45	U	"	Received.										—do—
"	3.00	3.45	0.45	DP	"	2	2	4	6							Cohesive Soil with Gravel
"	4.00	4.45	0.45	DP	"	3	6	8	14							Non-Cohesive with Gravel.
"	5.00	5.45	0.45	U	"	Received.										—do—
"	6.00	6.45	0.45	DP	"	3	7	11	18							Non-Cohesive Soil
"	7.00	7.45	0.45	DP	"	5	11	12	23							Brownish Non-Cohesive Soil
"	8.00	8.45	0.45	U	"	Received.										Cohesive Soil with Gravel
"	9.00	9.45	0.45	DP	"	4	7	8	15							Cohesive Soil.
"	10.00	10.45	0.45	DP	"	6	8	12	20							—do—
07/11/23	11.00	11.45	0.45	U	"	Received.										—do—
"	12.50	12.95	0.45	DP	"	5	9	10	19							—do—
"	14.00	14.45	0.45	U	"	Received.										Cohesive Soil with Gravel.
"	15.50	15.95	0.45	DP	"	4	5	7	12							—do—
"	17.00	17.45	0.45	U	"	Skipped.										—do— DS Collected
"	18.50	18.95	0.45	DP	"	6	8	13	21							Cohesive Soil.
"	20.00	20.45	0.45	U	"	Received										—do—
"	21.50	21.95	0.45	DP	"	8	14	16	30							—do—
"	23.00	23.45	0.45	U	"	Received.										—do—
"	24.50	24.95	0.45	DP	"	11	17	21	38							Cohesive Soil with Gravel
"	26.00	26.45	0.45	U	"	Skipped.										—do— DS Collected.
"	27.50	27.95	0.45	DP	"	14	22	25	47							—do—
"	29.00	29.45	0.45	U		Skipped.										—do— DS Collected

Rajat
Supervisor

Techpro Engineers Pvt. Ltd.

S.E-RITES
E-in-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 10: FIELD BORELOG CHARTS (P34)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GTW HORC Viaduct b/w Sohna & Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119056.154	E: 701757.766	Location/ Chainage: 21806.6870	Bore No.:	P-34
Method of Drilling:	Rotary	Drilling Equipment:	Automatic Hydraulic	Barrel Type:	NA
Casing Lowered (M):	–	Bentonite Used: Not	Standard Sampler: Yes	Water Table (M):	1.40
Ground Elevation:	R.L-191.452	Date: From 06/11/2023 to 08/11/2023			

Day Date	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
"	30.50	30.95	0.45	DP	Sx	17	32	39	71							Non-Cohesive Soil with Gravel
"	32.00	32.45	0.45	DP	"	18	34	41	75							——do——
06/11/23	33.50	33.95	0.45	DP	"	15	30	38	68							——do——
"	35.00	35.45	0.45	DP	"	11	20	35	55							Cohesive Soil with Gravel
"	36.50	36.95	0.45	DP	"	13	24	28	52							——do——
"	38.00	38.45	0.45	DP	"	16	29	36	65							——do——
"	40.00	40.45	0.45	DP	"	15	22	31	53							——do——

Supervisor

Techpro Engineers Pvt. Ltd.

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 11: FIELD BORELOG CHARTS (P36)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No:	R03
		Rev. Date.:	28.12.2021

Project Name:	RITES for HORC viaduct b/w Sohna Dhulawat station	Project Code:	1901
Coordinate:	N: 3119077.181 E: 701709.564	Location/ Chainage:	21859.0870
Method of Drilling:	Percussion; Drilling Equipment: Powerwinch	Bore No.:	P36
Casing Lowered (M):	22.00; Bentonite Used: NO; Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-191.271; Date: From 13/10/23 to 17/10/23	Water Table (M):	1.30

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
13/10/23	0.0	0.50	0.45	DS	Sx	-	Received									NON cohesive soil
"	1.00	1.45	0.45	U	"	-	Received									— do —
"	2.00	2.45	0.45	DP	"	2	3	3	6							— do —
"	3.00	3.45	0.45	DP	"	3	5	5	10							— do —
"	4.00	4.45	0.45	U	"	Received			—							— do —
"	5.00	5.45	0.45	DP	"	4	7	9	16							— do —
"	6.00	6.45	0.45	DP	"	3	9	13	22							— do —
"	7.00	7.45	0.45	U	"	Received			—							— do —
"	8.00	8.45	0.45	DP	"	3	6	11	17							— do —
"	9.00	9.45	0.45	DP	"	5	11	11	22							— do —
"	10.00	10.45	0.45	U	"	Received			—							— do —
"	11.00	11.45	0.45	DP	"	6	12	17	29							NON cohesive soil with Gravel Soil
"	12.00	12.45	0.45	DP	"	7	11	15	26							
"	13.00	13.45	0.45	U	"	Received			-							— do —
"	14.50	14.95	0.45	DP	"	5	12	15	27							NON cohesive soil
"	16.00	16.45	0.45	U	"	Received			—							Cohesive soil
"	17.50	17.95	0.45	DP	"	6	9	14	23							— do —
"	19.00	19.45	0.45	U	"	Received			—							— do —
"	20.50	20.95	0.45	DP	"	7	9	17	26							— do —
"	22.00	22.45	0.45	U	"	Received			—							— do —
"	23.50	23.95	0.45	DP	"	6	12	17	29							— do —
16/10/23	25.00	25.45	0.45	U	"	Slipped			—							NON cohesive soil
"	26.50	26.95	0.45	DP	"	11	17	28	45							— do —
"	28.00	28.45	0.45	U	"	Received			—							Cohesive soil with Gravel

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 12: FIELD BORELOG CHARTS (P36)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue	01.04.2015
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GIT for HORC Viaduct b/w Sohna Dhulawat Station	Project Code:	1901
Coordinate:	N: 3119077.181 E: 701709.564	Location/ Chainage:	21859.0870
Method of Drilling:	Percussion	Drilling Equipment	Rig winch
Casing Lowered (M):	22.00	Bentonite Used:	NC
Standard Sampler:	Yes	Bore No.:	P36
Ground Elevation:	R.L-191.271	Barrel Type:	N/A
Date: From	16/10/23 to 17/10/23	Water Table (M):	1.30

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
16/10/23	29.50	29.95	0.45	DP	SX	11	19	26	45							
"	31.00	31.45	0.45	U	"	Slipped										cohesive soil with gravel soil
"	32.50	32.95	0.45	DP	"	17	26	30	56							-do-
"	34.00	34.45	0.45	DP	"	16	29	33	62							Non cohesive soil
"	35.50	35.95	0.45	DP	"	18	20	29	49							-do-
17/10/23	37.00	37.45	0.45	U	"	Slipped										-do-
"	38.50	38.95	0.45	DP	"	16	22	26	48							-do-
"	40.00	40.45	0.45	DP	"	17	24	30	54							-do-

Supervisor

E - in - C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 13: FIELD BORELOG CHARTS (P39)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GT. for HORC viaduct b/w Sohna Dhulawat Station	Project Code:	1901
Coordinate: N: 3119112.311	E: 701638.937	Location/ Chainage:	21937.6870
Method of Drilling: Percussion	Drilling Equipment: Auto Tool P/ Percussion	Bore No.:	P39
Casing Lowered (M): 28.00 · Bentonite Used: NO	Standard Sampler: YES	Barrel Type:	N/A
Ground Elevation: RL-191.204	Date: From 17/10/23 to 19/10/23	Water Table (M):	1.30

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
17/10/23	0.0	0.50	0.50	DS	SX	Received										Non cohesive soil
"	1.00	1.45	0.45	U	"	Slipped										-do-
"	2.00	2.45	0.45	DP	"	2	3	4	7							Non cohesive soil
"	3.00	3.45	0.45	DP	"	2	3	3	6							with Gravel soil
"	4.00	4.45	0.45	U	"	Received										-do-
"	5.00	5.45	0.45	DP	"	3	3	4	7							-do-
"	6.00	6.45	0.45	DP	"	3	3	5	8							-do-
"	7.00	7.45	0.45	U	"	Slipped										-do-
"	8.00	8.45	0.45	DP	"	3	4	5	9							-do-
"	9.00	9.45	0.45	DP	"	3	4	6	10							-do-
"	10.00	10.45	0.45	U	"	Received										-do-
"	11.00	11.45	0.45	DP	"	3	9	14	23							-do-
"	12.00	12.45	0.45	DP	"	6	12	13	25							Non cohesive soil
"	13.00	13.45	0.45	U	"	Received										cohesive soil with
"	14.50	14.95	0.45	DP	"	4	7	11	18							Gravel soil
"	16.00	16.45	0.45	U	"	Received										-do-
"	17.50	17.95	0.45	DP	"	4	6	9	15							-do-
"	19.00	19.45	0.45	U	"	Received										-do-
"	20.50	20.95	0.45	DP	"	5	7	12	19							-do-
18/10/23	22.00	22.45	0.45	U	"	Received										-do-
"	23.50	23.95	0.45	DP	"	6	15	27	42							-do-
"	25.00	25.45	0.45	U	"	Received										Non cohesive soil
"	26.50	26.95	0.45	DP	"	11	22	29	51							-do-
"	28.00	28.45	0.45	U	"	Slipped										-do-

Supervisor E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 14: FIELD BORELOG CHARTS (P39)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GT for HORC viaduct b/w Sohna Dhulawat station			Project Code:	1901
Coordinate:	N: 309112.510	E: 706638.937		Location/ Chainage:	21937.6870
Method of Drilling:	Percussion	Drilling Equipment:	Auger/Percussion	Bore No.:	P39
Casing Lowered (M):	22.00	Bentonite Used:	No	Standard Sampler:	Yes
Barrel Type:	N/A				
Ground Elevation:	R.L-191.204	Date: From	17/12/23 to 19/12/23	Water Table (M):	1.30

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
19/12/23	29.50	29.95	0.45	DP	SX	12	24	30	54							Non cohesive soil with
"	31.00	31.45	0.45	DP	"	16	19	27	46							Gravel
"	32.50	32.95	0.45	DP	"	14	20	29	49							— do —
"	34.00	34.45	0.45	U	"	Slipped										— do —
19/12/23	35.50	35.95	0.45	DP	"	17	24	26	50							— do —
"	37.00	37.45	0.45	U	"	Slipped										— do —
"	38.50	38.95	0.45	DP	"	16	22	30	52							Non cohesive soil
"	40.00	40.45	0.45	DP	"	18	24	38	62							— do —

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 15: FIELD BORELOG CHARTS (P40)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No	QT/ 003
Date of Issue	01.04.2018
Rev No	R01
Rev Date	28.12.2021

Project Name:	GTD- HORC Viaduct Btw Sohana Dhulawal station			Project Code:	B01
Coordinate:	N: 2119125.283	E: 701616.905	Location/ Chainage: 21963.8870		
Method of Drilling:	Percussion	Drilling Equipment	Percussion Winch	Bore No.:	P-40
Casing Lowered (M):	3.00	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	RL-191.009	Date: From 21/12/25 to 22/12/25		Water Table (M):	1.90

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
21/12/25	0.00	0.50	0.50	DS	SX	Received										Non Cohesive Soil
"	1.00	1.45	0.45	U	"	Received										- do -
"	2.00	2.45	0.45	DP	"	1	2	2	4							- do -
"	3.00	3.45	0.45	DP	"	2	2	3	5							- do -
"	4.00	4.45	0.45	U	"	Slipped										- do -
"	5.00	5.45	0.45	DP	"	2	3	4	7							- do -
"	6.00	6.45	0.45	DP	"	3	6	6	12							- do -
"	7.00	7.45	0.45	U	"	Received										- do -
"	8.00	8.45	0.45	DP	"	2	3	6	9							- do -
"	9.00	9.45	0.45	DP	"	3	3	5	8							- do -
"	10.00	10.45	0.45	U	"	Received										Cohesive Soil with gravel
"	11.00	11.45	0.45	DP	"	5	10	13	23							- do -
"	12.00	12.45	0.45	DP	"	5	7	9	16							- do -
"	13.00	13.45	0.45	U	"	Received										- do -
"	14.50	14.95	0.45	DP	"	2	6	8	14							Cohesive Soil
"	16.00	16.45	0.45	U	"	Received										- do -
"	17.50	17.95	0.45	DP	"	5	10	12	22							- do -
"	19.00	19.45	0.45	U	"	Received										- do -
"	20.50	20.95	0.45	DP	"	8	12	14	26							Non Cohesive Soil
22/12/25	22.00	22.45	0.45	U	"	Slipped										- do -
"	23.50	23.95	0.45	DP	"	5	11	15	26							Cohesive Soil with gravel
"	25.00	25.45	0.45	U	"	Slipped										Non Cohesive Soil
"	26.50	26.95	0.45	DP	"	12	19	30	49							- do -
"	28.00	28.45	0.45	U	"	Slipped										- do -

Supervisor

E - In - C

Abbreviation Used:- U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 16: FIELD BORELOG CHARTS (P40)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date:	28.12.2021

Project Name:	GTW- HORC Viaduct B/w Sohana Dhulawal Station	Project Code:	1901
Coordinate:	N: 3119125.287 E: 701615.905	Location/ Chainage:	21963.8870
Method of Drilling:	Percussion	Drilling Equipment:	[illegible]
Bore No.:	P.40		
Casing Lowered (M):	[illegible]	Bentonite Used:	No
Standard Sampler:	Yes	Barrel Type:	NA
Ground Elevation:	R.L-191.009	Date: From	20/10/23 to 22/10/23
Water Table (M):	1.40		

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
21/10/23	29.50	29.95	0.45	DP	SX	7	13	19	32							- do -
"	31.00	31.45	0.45	U	"	Slipped										- do -
"	32.50	32.95	0.45	DP	"	18	20	30	50							Non Cohesive Soil with gravel
"	34.00	34.45	0.45	U	"	Slipped-										Cohesive Soil
22/10/23	35.50	35.95	0.45	DP	"	17	22	27	49							- do -
"	37.00	37.45	0.45	U	"	Slipped-										Non Cohesive Soil
"	38.50	38.95	0.45	DP	"	18	24	29	53							- do -
"	40.00	40.45	0.45	DP	"	20	28	33	61							- do -

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

End of Report

Report No: 1901-HORC-III

Report No.: 1901-HORC-III

Date: Nov 04th; 2023

GEOTECHNICAL INVESTIGATION REPORT

ULR No.: TC916923000000032P
REVISION-R1

AT THE SITE FOR

HORC VIADUCT BETWEEN SOHANA & DHULAWAT STATIONS OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT, HARYANA

FROM BOREHOLES P41 TO P60

CLIENT

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.

Plot No. 143, 5th floor RailTel tower, Sector-44,
Gurugram, Haryana 122003

GENERAL CONSULTANTS

RITES-SMEC JV

Gurugram, Haryana

GEOTECHNICAL CONSULTANTS

TECHPRO ENGINEERS PVT. LTD.

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G T ROAD, KANPUR-209 217, Phone: 9793209918

e-mail: info@techproindia.com

TC-9169

REVISION NOTES

REVISION NO.	DATE	DESCRIPTION
R1	14.12.23	• Lithological profile added in Appendix-C

REPORT FORMAT

Report No.	Bore included	Total Number of Bores
1901-HORC-I	A1 to P20	21
1901-HORC-II	P21 to P40	20
1901-HORC-III	P41 to P60	20
1901-HORC-IV	P61 to P80	20
1901-HORC-V	P81 to P100	20
1901-HORC-VI	P101 to P113	13
1901-HORC-VII	P114A to P133A	20
1901-HORC-VIII	P134A to A2A	16
1901-HORC-IX	P114B to P133B	20
1901-HORC-X	P134B to A2B	16

TABLE OF CONTENTS

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Tel.: 9793209918, e-mail: info@techproindia.com
Web site: www.techproindia.com

APPENDICES

National Accreditation Board for Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

TECHPRO ENGINEERS PVT. LTD. (LABORATORY DIVISION)

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G.T. ROAD, KANPUR, UTTAR PRADESH, INDIA

in the field of

TESTING

Certificate Number:	TC-9169		
Issue Date:	23/12/2022	Valid Until:	22/12/2024

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Identity : Techpro Engineers Private Limited

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

TECHPRO ENGINEERS PVT. LTD.
114, Ram Ganga Housing Society, Naramau, G T Road, Kanpur-209 217
Tel.: 9793209918, e-mail: info@techproindia.com
Web site: www.techproindia.com

Nov 04th; 2023

ACKNOWLEDGEMENTS

We are pleased to submit the part-3 of the report of Geotechnical investigation, conducted for the boreholes P41 to P60 for the design of foundations for HORC Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) project in the state of Haryana, India.

We hereby, convey our sincere thanks to Mr. Neeraj Bhandari (CPM/South) and Mr. Raju Solanki (DGM/C/South), HRIDCL for trust and support during the investigation. We also acknowledge our thanks to Mr. Uma Maheshwara Rao B, DGM/C/West, HRIDCL for awarding the said work to us. We are also grateful Mr. Ravindra Dutta Upadhyay (Geotech Expert), Mr. PS Gautam & Mr. Jitender Parashar, Site Engineer from the RITES- SMEC JV and Mohd. Ishak (Executive/Civil) from HRIDCL, for their help rendered during and prior to the investigation work.

We are also thankful to our staff members for conducting field and laboratory test, preparing sketches, and typing the report.

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech. (Civil), M.Tech.
Principal Consultant &
Managing Director

1. INTRODUCTION:

Haryana Rail Infrastructure Development Corporation Ltd. (HRIDC) and Ministry of Railways, Govt. of India has come together to form a new company namely Haryana Orbital Rail Corporation Limited (HORCL), to design and construction of new BG line from Palwal to Sonipat named Haryana Orbital Rail Corridor (HORC), in the state of Haryana, India. In this connection, a Geotechnical investigation has been planned for the design of foundations of Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) Project in the state of Haryana. The work of conducting the detailed Geotechnical Investigation has been awarded to us by HRIDC, through work order No. HRIDC/HORC/GTI/211/2023-2024/Vol-0 dated 02-09-2023, which includes investigation in field, laboratory testing of disturbed and undisturbed samples, collected from the field, and submission of the geotechnical **investigation** test report.

A geotechnical investigation was carried out, with the locations, planned by the client. Purpose of the investigation is to determine the nature and properties of soil and rock strata across the bore holes and representing them through log sections showing the levels, nature, and properties of various strata up to a sufficient depth below the founding level, proneness of site to artesian conditions, seismic disturbance and other engineering properties of soil and rock strata.

This part -3 of the report includes the detailed methodology of investigation, collection of samples, field and laboratory test result including their interpretation/ analysis, recommendations on the properties of soils and rock required for design of foundation and suggesting suitable type and depth of foundation with allowable bearing capacity for safe and strong foundations for the Bore Hole numbers P41 to P60.

2. SCOPE OF WORK:

For the design of foundation of viaduct, it is required to determine the allowable bearing capacity together with necessary engineering characteristics of underlying soil & rock strata. In general, the geotechnical investigation has been planned as per IS:1892-2021 and further extended to IS: 1904, IS:2911 (part-1/Sec 2) & IRC 78:2014 for planning the laboratory testing and computing the allowable bearing capacity, hence the scope of work is as follows:

2.1. Mobilisation of all tools & plants along with accessories, materials, labours etc. at site of work for drilling and testing work, including setting up boring and shifting to different bore holes point etc.

2.2. Exploratory drilling of 150 mm diameter bore holes through soil deposits and 75 mm in rock within the proposed alignment upto the required depth.

2.3. Collection of disturbed soil samples at an interval of 3.00 meter in all the bore holes.

2.4. Collection of undisturbed soil samples at every 3.00 m interval or at change of stratum from all the boreholes.

2.5. To conduct Standard Penetration Test (SPT) at an interval of 3.00 m or noticeable change of stratum in soil deposits in all bore holes.

2.6. Collection of rock core samples and preserving them in core boxes.

2.7. To collect ground water sample on completion of bore holes.

2.8. To record the ground water table in all the bore holes.

2.9. Transporting all the disturbed, undisturbed soil and rock core samples collected during the field investigation to our NABL accredited Geotech Engineering laboratory at Kanpur.

2.10. To conduct the laboratory tests on all the soil and rock core samples collected during field investigation for determination of their engineering characteristics.

2.11. To compile of field and laboratory test results, working out the allowable bearing capacity and preparing the report including detailed recommendations and necessary precautions.

3. GEOLOGICAL INFORMATION OF THE REGION:

3.1. Geography:

The project location is in the bordering area of Gurugram and Nuh (recent old name-Mewat), districts in the Indian state of Haryana. The stretch of the alignment of the proposed corridor starts from southmost part of Gurugram in the town of Sohna and ends at Dhulawat, which is a village lying at the north of Nuh district.

Haryana is a state located in the northern part of India. Gurugram is among one

of the districts in Haryana which is also the part of National Capital Region (30km south of New Delhi). It lies at an elevation of 217 m above msl. Sohna is a small town located 25km in the south of Gurugram. Sohna is well known for its hot water springs and famous Shiva temple. Sohna is located in between 28°15' N latitude and 77°40' E longitude at the elevation of 212.14m above msl. Mewat district is located at 28 °12′ N latitude, 77 °3′ E longitude, at the south of Gurugram at an elevation of 199 m above msl. The location is bordered by Rewari district on west and Faridabad & Palwal district on the east.

3.2. Geology:

The Gurugram district is having of almost flat topography, however, in the north-eastern part small isolated hillocks of Precambrian rocks are exposed. Small hill ranges which are part of the Aravali and Mangar Bani ranges exists in the district. The major part of district is underlain by Quaternary alluvium consisting of sand, clay and silt. The alluvial plain is formed by the Sahibi river which is a tributary of River Yamuna. Soils of the Gurgaon district is classified as tropical and brown soils, existing in the north western extreme, northern and north eastern parts of the district and water logged and salt affected soils in the southern parts of the district. The soils are medium textured loamy sand is the average texture in Gurgaon and Sohna blocks.

3.3. Rainfall and Climate:

The area has hot semi-arid type of climate characterising extreme dryness of the air except in the monsoon season. Intense hot summer and cold winters. The total annual rainfall in the region is about 596 mm, of which 75 to 80% is because of the south-west monsoon.

3.4. Seismicity:

The site under consideration exists in the district of Gurugram and Mewat which lies in the Seismic Zone IV (high damage risk zone), as per the current seismic zonation map of India (IS 1893-2016): RA 2021 and have a zone factor of 0.24 for design basis earthquake. The region is surrounded by many in-homogeneities in the form of faults and ridges like Sohna Fault, Moradabad Fault, Delhi-Moradabad Fault, Delhi-Haridwar ridge, junction of Aravalli and Alluvium near Delhi. The Sohna fault line lies between the Delhi ridge and Sohna town and falls between the Arjangarh and

Manesar outcrops. All the developed area in Gurugram comes within 200 km of the fault line. The Sohna fault line is located at the junction between the hard rock terrain of the Aravalli hills and the sandy formation of the Yamuna River and is currently inactive from several years and is capable of a disastrous earthquake.

The project location has been marked in Fig.1 Seismic zone map of India.

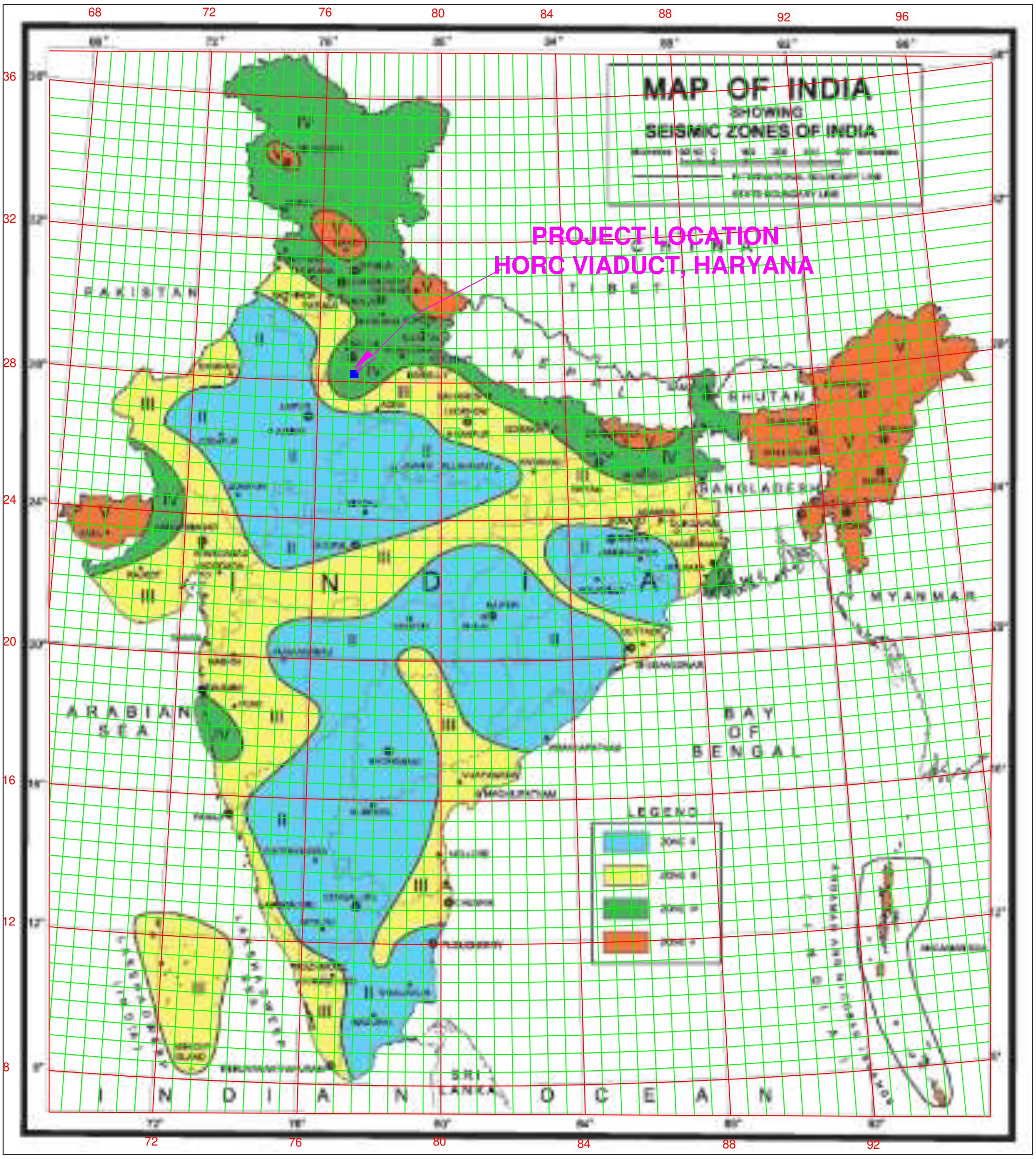


Fig.1: Seismic Zone Map of India

4. FIELD INVESTIGATION:

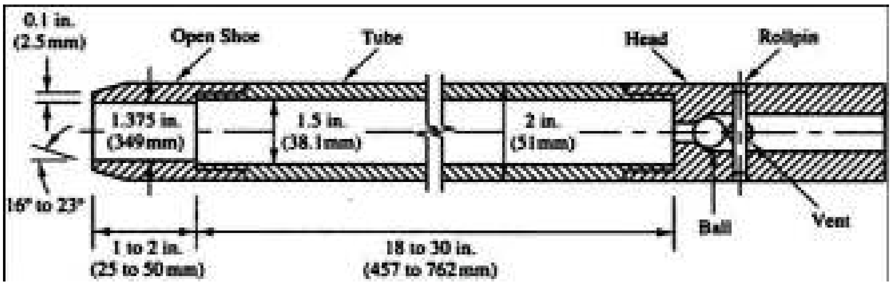
The field investigation work at this site was carried out from Sep 27th; 2023 to Oct 2nd; 2023 & Oct 12th; 2023 to Oct 22nd; 2023 & Oct 31st; 2023 to Nov 10th

2023. The following investigation work was carried out:

4.1. Twenty number of **boreholes** (marked as P41 to P60) of diameter 150 mm in soil were made within the proposed alignment for conducting Standard Penetration Test and collection of disturbed and undisturbed samples. The boreholes were progressed using power operated winch machine under **percussion** method of drilling. Casing was used to keep the borehole stable. The records of achieved depth of bore holes have been given in Para No. 6, the details of drilled bores along with depth of casing used have been reported in Appendix B. Locations of boreholes have been reported in “TEST LOCATION PLAN” in Appendix A.

4.2. Standard Penetration Tests were conducted at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth, as per the procedure in IS: 2131-1981-(RA: 2021) in all the bore holes. The **standard SPT sampler** (without liner and with no space for liner) and **auto-trip and rope-pulley driven hammer** of standard weight of 63.50 kg have been used to perform the test.

For conducting the test, the bottom of the borehole was properly cleaned, and split spoon sampler was properly seated in position in the borehole. The split spoon sampler resting on the bottom of borehole was allowed to sink under its own weight; then the sampler was allowed to penetrate 15 cm with the blows of the hammer 63.50 kg weight falling free through 75cm, thereafter the split spoon sampler was further driven by another 15 cm. For the 3rd and final drive, the sampler was further allowed to penetrate 15 cm. The number of blows required to get each 15 cm of penetration, was recorded. The first 15 cm of drive is seating drive.



Structure of SPT Sampler

The total blows of penetration for the second and third 15 cm of penetration is termed the penetration resistance N. The N’ values are indicative of the compactness/ relative density of cohesion less soils and consistency of cohesive soils.

In case the blows count of SPT in soil (including the number of blows of seating) exceeds 100, the corresponding penetration was recorded and this particular test at that depth stopped. If the total penetration is more than the seating penetration of 15 cm, then breakup of blow counts for 15 cm seating penetration and for remaining portion of penetration is also given.

SPT 'N' values are correlated with non-cohesive stratum as per BS: 5930 (1999) – for sandy strata and with consistency of cohesive stratum.

Correlation For Clay/Plastic Silt		Correlation For Sand/Non-Plastic Silt	
Consistency of clays	**Penetration Value**	**Relative Density of sand**	**Penetration Value**
Very Soft	0 to 2 Blows	Very loose	0 to 4 Blows
Soft	3 to 4 Blows	Loose	5 to 10 Blows
Medium Stiff	5 to 8 Blows	Medium	11 to 30 Blows
Stiff	9 to 16 Blows	Dense	31 to 50 Blows
Very Stiff	17 to 32 Blows	Very Dense	Above 50
Hard	Above 32		

In this method, the sampler acts as a probe and the driving energy is supplied by the fall of the drop weight. The values of 'N' depend on the compactness or relative density of the material. In hard formations, the testing is discontinued if 'N' value is found to be more than 100. It is termed as 'Refusal'. Refusal is also recorded when SPT blow count records 50 or more for any of the single drive of 15 cm.

'N' value depends upon degree of saturation and over burden pressure of the formation. Silty fine sand and fine sand below the water table develop pore water pressure depending on the in-situ void ratio which in turn affects the effective stress. This change in effective stress influences the 'N' value considerably.

Depth of overburden affects the SPT values in none to low cohesive soils and hence need correction. The SPT value after the overburden correction, N' is as follows:

$$N' = 0.77x \log (2000/q) \times N$$

Where, q= Overburden Pressure (kN/m^2) and N = observed SPT value

N' is corrected further for dilatancy in case of saturated fine sands and silts for the values of N' greater than 15.

Modified value after dilatancy correction N" = 15+ (N'-15)/2

Soil samples obtained from split spoon sampler were collected in the polythene bags of suitable size. These samples were property sealed, labelled, and carefully transported to the laboratory for testing. The results have been reported in Table 1 to 20 of Appendix B under the title "SUMMARY OF TEST RESULTS".

4.3. **Disturbed soil samples** were collected at 0.50 metre, then at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth and at significant change of stratum. Soil from cutting edge of SPT samplers and retained in split spoon, used for Standard Penetration Tests was taken as disturbed samples. These samples were placed without delay in adequately sealed polythene bags. Where the collection of disturbed soil samples could not be collected from SPT samples, Shelby tubes were driven and retained soil samples were obtained. The laboratory tests were conducted on the collected soil samples and reported in Table 1 to 20 of Appendix-B under the title "SUMMARY OF TEST RESULTS".

4.4. **Undisturbed soil samples** were collected in accordance with IS: 2132-1986-(RA: 2021) at an interval of 3.00 metre or at change of stratum, starting from the depth of 1.00 or 2.00 m, by using 100 mm dia. and 450 mm long MS tubes provided with sampler head with ball check arrangement. However, the some of the samples could not be extracted due to the partial penetration or slippage during the evacuation.

Moreover, collection of Undisturbed samples in very hard cohesive soils/ dense granular soils/gravels/ cobbles/ pebbles/ boulders, refusal strata is practically not possible and such collected samples will not truly represent the undisturbed conditions.

Immediately after taking undisturbed sample in the tube, the adopter head was removed along with the disturbed material. The visible ends of the samples shall then be trimmed off any wet disturbed soil. The ends will then be coated alternately with four layers of molten wax. More molten wax will then be added to give a total thickness of not less than 25 mm. The laboratory test results have been reported in Table 1 to 20 of Appendix-B.

4.5. The **ground water table** in the borehole was allowed to stabilize and measured after 8, 16, 24 and 48 hours after completion of the bore hole. It was ensured that last two reading were identical. The records of ground water table have been given in Para No.6.

4.6. **Ground water samples** were collected from borehole as per IS: 6935-1973-(RA:2019) for chemical analysis to determine aggressiveness in relation to attack on concrete / reinforcement including determination of pH value.

5. LABORATORY TESTS:

The following laboratory tests were conducted to determine the engineering characteristics of sub-soils:

5.1. **Field moisture contents** were determined by oven drying method as per IS: 2720 (part II)-1973-(RA: 2020). The results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.2. **Bulk density** of soil strata was obtained using Shelby tubes in accordance with IS 2720 (part XXIX)-1975-(RA: 2020). The results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.3. **Mechanical sieve analysis** test was performed in accordance with IS: 2720 (Part IV) – 1985-(RA: 2020), for the purpose of identification by grain size analysis, on coarse part of the soil samples and the results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.4. **Particle size analysis** test by **Hydrometer method** were performed in accordance with IS: 2720 (Part IV) -1985-(RA: 2020) on the part of soil samples obtained after the sieve analysis. The results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.5. **Atterbergs' limits tests** were performed in accordance with IS: 2720 (part V)-1985-(RA: 2020) and results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.6. **Specific gravity tests** were performed in accordance with IS 2720 (part III-sec. 1) -1980-(RA: 2021) and the results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.7. **Consolidation tests** were performed on cohesive soil samples in accordance with IS: 2720 (part XV)-1965-(RA: 2021). The results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.8. **Direct shear tests** were performed as per IS: 2720 (part XIII)-1986-(RA: 2021), on the undisturbed soil samples obtained during the field investigation. The results and the density of samples have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.9. **Tri-axial Compression Test** under Unconsolidated Un-drained (UU) condition as per IS: 2720 (Part-XI)-1993-(RA: 2021) were performed on the selected undisturbed soil samples, obtained during the field investigation. The results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.10. **Unconfined Compressive strength tests** were performed in accordance with IS 2720 (Part-X) -1991-(RA:2020) on selected undisturbed soil samples and the results have been reported in Table 22 of Appendix B.

5.11. **Shrinkage Limit tests** were performed in accordance with IS 2720 (part-VI) -1972-(RA: 2021) and the results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.12. **Free Swell Index** were performed in accordance with IS 2720 (part-XL) -1977-(RA: 2021) and the results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.13. **Chemical analysis on soil samples** was performed in accordance with IS: 2720 (Part-XXVI)-1987-(RA: 2021) for pH value, IS: 2720 (Part-XXVII)-1977-(RA: 2020) for Sulphate & BS:1377-3-2018 for chlorides and results have been reported in Table 21 "CHEMICAL TEST ON SOIL SAMPLES" of Appendix B.

6. GROUND WATER TABLE:

The water table at this site was encountered during the drilling operation up to the depth of investigation.

Borehole No.	Chainage	Global Co-ordinates (UTM format)		Reduced level (m)	Depth of Borehole (m)	Water table (m)
		Easting	Northing			
P41	21990.087	701593.231	3119138.485	191.144	40.00	1.40
P42	22016.287	701570.762	3119152.203	191.252	40.00	1.28
P43	22042.487	701548.586	3119166.393	191.241	40.00	1.30
P44	22068.687	701526.726	3119181.037	191.270	40.00	1.20
P45	22094.887	701505.144	3119196.164	191.379	40.00	1.50
P46	22121.087	701483.921	3119221.716	191.386	40.00	1.60
P47	22147.287	701463.030	3119227.711	191.466	40.00	1.60
P48	22173.487	701442.481	3119244.143	191.215	40.00	1.70
P49	22199.687	701422.282	3119261.003	191.249	40.00	1.80
P50	22225.887	701402.424	3119278.301	191.295	40.00	1.60
P51	22252.087	701383.032	3119295.948	191.293	40.00	1.60
P52	22278.287	701363.889	3119314.080	191.228	40.00	1.50
P53	22304.487	701345.190	3119332.567	192.054	40.00	1.40
P54	22330.687	701326.868	3119351.461	191.242	40.00	1.20
P55	22356.887	701308.964	3119370.719	191.309	40.00	1.40
P56	22383.087	701291.429	3119390.395	191.384	40.00	1.40
P57	22409.287	701274.370	3119410.368	191.353	40.00	1.20
P58	22435.487	701257.706	3119430.729	191.933	40.00	1.40
P59	22461.687	701241.448	3119459.473	191.466	40.00	1.50
P60	22487.887	701225.673	3119472.497	191.483	40.00	1.65

7. DESCRIPTION OF STRATA:

The classification of soil stratum has been done with the help of soil characteristics obtained in laboratory tests as per IS 1498-1970-(RA:2021). The classification of rock masses has been done based on RMR as per IS: 4464-1985, IS: 13365-1. The detailed nature of the strata has been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix-B and represented through Lithological plots in Appendix-C.

The strata exhibited in the boreholes, is predominantly consisting of inorganic silty clays of low plasticity, inorganic silts of non to low plastic category and silty sands and silty sands at varying depth and thickness. Inorganic silty clays, silts of intermediate plasticity and silty sands with clays binders were also found at varying depths and thickness in some of the boreholes. An exception of inorganic silty clays of high plastic category was found in borehole P60 at the upper depth of 2.00 to 3.00 metres.

8. SAFE BEARING CAPACITY COMPUTATIONS:

For the construction of viaducts, deep foundation **(Bored Cast-In-Situ RCC piles)** have been considered for computation of load bearing capacity of the underlying soil strata. The computation of load bearing capacity of bored cast-in-situ RCC piles have been done as per IS 2911 (part-1, section-2)-2010-(RA: 2020) with due consideration of effects of liquefaction.

8.1. Design Parameters:

Factor of safety in compression	=	2.50
Factor of safety in tension	=	3.00
Depth of critical water table	=	0.00 m
Diameter of pile	=	1.00 & 1.20 m
Cut off length	=	2.50 m
Type of pile head consider	=	Fixed

8.2. Computation of friction along pile stem:

$Q_{uf} = \sum K_i . P_{di} . \tan\delta_i . A_{si}$

where,

Q_{uf} = Ultimate shaft friction (kN/m^2)

K_i = Coefficient of earth pressure at mid-depth of ith layer

P_{di} = Effective overburden pressure at mid-depth of ith layer (kN/m^2)

A_{si} = Surface area of pile stem in ith layer (m^2)

δ_i = Angle of wall friction between pile and soil of ith layer (= ϕ) (degree)

ϕ_i = Angle of internal friction of soil in ith layer (degree)

Σ = Sum of all layers up to ith layer

8.3. Computation of Cohesion along the stem of pile:

$Q_{uc} = \sum \alpha_i . c_i . A_{si}$

Where,

c_i = Cohesion in i^{th} layer

A_{si} = Surface area of pile stem in i^{th} layer (m^2)

α_i = Adhesion factor for i^{th} layer of soil depending of consistency of soils

$\sum$ = Sum of cohesion of all layers considered

8.4. Computation of end bearing resistance:

$Q_{ub} = A_p (c.Nc + q.Nq + 0.5. \gamma.B.N\gamma)$

Where,

A_p = Area of the pile toe (m^2)

c = cohesion of soils at pile toe (kN/m^2)

γ = Effective Unit weight of soils at pile toe (kN/m^3)

B = Diameter of pile (m)

q = Effective overburden pressure at pile toe (kN/m^2)

N_c = Bearing Capacity Factor (Recommended equal to 9)

$Nq, N\gamma$ = Bearing Capacity Factor

8.5. Lateral load capacity of piles in soils:

$Q_u = 12.E.I.\delta/(L_1+L_f)^3$

where,

Q_u = Ultimate lateral load capacity of pile (kN)

δ = Permissible deflection (m) = 1% of diameter of pile

E = Young Modulus of pile material (kN/m^2)

I = Moment of Inertia of the pile cross section (m^4)

L_1 = Cantilever Length of pile (m)

L_f = Length of fixity (m)

Detailed calculations of pile load carrying capacity in compression & uplift in soil have been reported in **Table-1** to **2** of **Appendix-H.**

Pile lateral Load capacity has been given in **Table-3** to **4** of **Appendix-H**.

9. LIQUEFACTION ANALYSIS:

Liquefaction is the sudden loss of shear strength of the loose fine sands due to earthquake-induced vibration under saturated conditions. Liquefaction generally takes place in loose fine sands (fines < 10 %, D_{60}= 0.20 mm to 1.0 mm and C_u between 2 to 5) with N value less than 15. In case of soil strata having N>15, liquefaction of soil will not take place normally.

The present site falls in **seismic zone – IV.** Considering the history of past earthquakes and available seismic data, an earthquake of **magnitude 7.0** having peak ground acceleration **a_{max}= 0.24 g** is considered in the present analysis.

Preliminary assessment of liquefaction potential of foundation strata is made by simplified approach proposed by IS: 1893 (part-1)-2016-(RA: 2021) from the data obtained in Standard Penetration Test.

In this method, cyclic shear stress likely to be induced in the foundation strata by Design Basis Earthquake is first evaluated. Next threshold cyclic shear stress, which is good enough to cause liquefaction, is determined from SPT data and the empirical relations. Finally, comparison of these two stresses is used in the estimation of liquefaction susceptibility of the foundation strata.

Cyclic Stress Ratio (CSR):

The equivalent average of shear stress likely to be induced in the foundation material due to an earthquake is calculated by using the equations

Cyclic Resistance Ratio (CRR):

It expresses capacity of soil to resist liquefaction. CRR is determined using correlation between corrected blow count $(N_1)_{60}$ and CRR for earthquake of magnitude 7.5. $(N_1)_{60}$ is the SPT blow count corrected to an effective overburden pressure of 100 kPa and to hammer energy efficiency of 60 %.

Following variable have been adopted in calculation of N_{60} (SPT value for 60% efficiency)

Energy correction to SPT values:

C_{60} = 1.00 (Energy correction factor)

Design Earthquake Base:

Earthquake zone = IV

Magnitude of earthquake = 7

Seismic Zone factor = 0.24

Status of Liquefaction:

The value of CSR and CRR are computed at different depth and then the ratio of CRR to CSR to get the factor of safety towards the susceptibility of the stratum towards liquefaction potential.

If factor of safety:

< 1.00 : Stratum is to be considered as liquefiable

> 1.20 : Non-Liquefiable

The detailed calculations of liquefaction, have been reported in **Table-5** of **Appendix-H.**

10. RECOMMENDATIONS:

Keeping in mind, the field test results, laboratory test results and IS codes of practice the following recommendations are hereby made:

10.1. **Bored Cast-In-Situ RCC Piles** of diameter 1000 and 1200 mm have been adopted for SBC computations of foundation for Viaduct.

10.2. **Cut off length** of piles have been considered as 2.50 m from the existing ground level for the purpose of computation of SBC.

10.3. **Pile length** recommended in the table below, shall be measured **after the cut-off depth.**

10.4. **Allowable load carrying capacity** of pile corresponding to the length and diameter of pile shall be read from the tables below:

10.4.1. For Pile diameter = 1000 mm

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P41	25.00	2200	1750	65

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	27.50	2600	1950	
	30.00	2600	2100	
	32.50	3150	2300	
	35.00	3100	2500	
P42	25.00	2050	1600	35
	27.50	2750	1800	
	30.00	2500	2000	
	32.50	2700	2200	
	35.00	3050	2400	
P43	25.00	2150	1650	80
	27.50	2400	1900	
	30.00	3300	2100	
	32.50	3350	2300	
	35.00	3400	2500	
P44	25.00	2250	1750	135
	27.50	2700	1950	
	30.00	2800	2150	
	32.50	3050	2350	
	35.00	3800	2550	
P45	25.00	2300	1750	80
	27.50	2700	2050	
	30.00	2900	2300	
	32.50	3150	2500	
	35.00	3400	2650	
P46	25.00	1900	1500	35
	27.50	2900	1700	
	30.00	4100	1900	
	32.50	4250	2200	
	35.00	4600	2450	
P47	25.00	2200	1700	135

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	27.50	2400	1900	
	30.00	3500	2150	
	32.50	3750	2350	
	35.00	3900	2600	
P48	25.00	2150	1600	30
	27.50	2300	1850	
	30.00	2850	2050	
	32.50	2900	2250	
	35.00	3100	2450	
P49	25.00	2400	1500	30
	27.50	2550	1750	
	30.00	2450	1950	
	32.50	2650	2150	
	35.00	2950	2350	
P50	25.00	2250	1750	85
	27.50	2500	2000	
	30.00	2750	2200	
	32.50	3100	2400	
	35.00	3800	2600	
P51	25.00	2450	1600	80
	27.50	2800	1800	
	30.00	3050	2000	
	32.50	3450	2200	
	35.00	3700	2400	
P52	25.00	1650	1200	20
	27.50	2800	1450	
	30.00	3300	1700	
	32.50	3900	1950	
	35.00	2850	2200	
P53	25.00	2900	1650	70

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	27.50	3050	1900	
	30.00	4000	2100	
	32.50	4750	2350	
	35.00	4250	2600	
P54	25.00	1950	1500	65
	27.50	2200	1700	
	30.00	2500	1950	
	32.50	2750	2200	
	35.00	2950	2400	
P55	25.00	1950	1450	30
	27.50	2300	1700	
	30.00	2650	1950	
	32.50	2750	2200	
	35.00	3050	2400	
P56	25.00	2150	1650	40
	27.50	2400	1900	
	30.00	2650	2100	
	32.50	2950	2350	
	35.00	3200	2600	
P57	25.00	2700	1650	65
	27.50	2450	1900	
	30.00	2650	2100	
	32.50	3550	2300	
	35.00	3950	2550	
P58	25.00	2150	1650	100
	27.50	2350	1900	
	30.00	2800	2100	
	32.50	3800	2350	
	35.00	4200	2600	
P59	25.00	1900	1450	40

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	27.50	2200	1700	
	30.00	2900	1900	
	32.50	3300	2100	
	35.00	3450	2250	
P60	25.00	2250	1750	65
	27.50	2450	1950	
	30.00	2650	2150	
	32.50	3000	2350	
	35.00	3150	2550	

** Indicates Grade of Concrete*

10.4.2. For Pile diameter = 1200 mm

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P41	25.00	2850	2200	95
	27.50	3500	2500	
	30.00	3400	2750	
	32.50	4300	3000	
	35.00	4100	3300	
P42	25.00	2750	2100	55
	27.50	3900	2350	
	30.00	3400	2600	
	32.50	3650	2900	
	35.00	4100	3200	
P43	25.00	2800	2100	130
	27.50	3100	2400	
	30.00	4600	2650	
	32.50	4650	2950	
	35.00	4600	3250	
P44	25.00	2900	2200	180

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	27.50	3650	2500	
	30.00	3800	2800	
	32.50	4050	3050	
	35.00	5350	3350	
P45	25.00	2950	2250	115
	27.50	3500	2600	
	30.00	3700	2950	
	32.50	4150	3150	
	35.00	4550	3400	
P46	25.00	2550	1950	60
	27.50	4250	2250	
	30.00	6300	2550	
	32.50	6500	3000	
	35.00	7050	3400	
P47	25.00	2900	2150	180
	27.50	3150	2400	
	30.00	5050	2750	
	32.50	5350	3100	
	35.00	5550	3450	
P48	25.00	2850	2150	50
	27.50	3050	2400	
	30.00	4000	2700	
	32.50	3900	3000	
	35.00	4150	3250	
P49	25.00	3350	1950	50
	27.50	3600	2250	
	30.00	3250	2550	
	32.50	3550	2800	
	35.00	3950	3100	
P50	25.00	2950	2200	130

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	27.50	3250	2500	
	30.00	3550	2750	
	32.50	4050	3050	
	35.00	5250	3300	
P51	25.00	3500	2100	120
	27.50	4050	2400	
	30.00	4350	2650	
	32.50	4950	2950	
	35.00	5300	3250	
P52	25.00	2250	1700	30
	27.50	4300	2000	
	30.00	5050	2350	
	32.50	6050	2700	
	35.00	4100	3050	
P53	25.00	4200	2150	105
	27.50	4400	2450	
	30.00	5950	2750	
	32.50	7150	3150	
	35.00	6250	3500	
P54	25.00	2600	1950	100
	27.50	2900	2200	
	30.00	3250	2500	
	32.50	3550	2800	
	35.00	3850	3050	
P55	25.00	2650	1900	50
	27.50	3150	2250	
	30.00	3600	2600	
	32.50	3700	2900	
	35.00	4100	3200	
P56	25.00	2750	2100	70

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	27.50	3100	2350	
	30.00	3400	2650	
	32.50	3750	2950	
	35.00	4100	3250	
P57	25.00	3850	2150	95
	27.50	3250	2450	
	30.00	3500	2750	
	32.50	5000	3050	
	35.00	5650	3400	
P58	25.00	2900	2200	150
	27.50	3200	2450	
	30.00	3900	2800	
	32.50	5800	3200	
	35.00	6450	3550	
P59	25.00	2550	1900	65
	27.50	2950	2200	
	30.00	4150	2500	
	32.50	4700	2750	
	35.00	4950	3050	
P60	25.00	3000	2350	95
	27.50	3250	2600	
	30.00	3550	2850	
	32.50	4050	3100	
	35.00	4200	3400	

** Indicates Grade of Concrete*

10.5. Liquefaction Potential: All the bore holes have been analysed for Liquefaction potential as per IS: 1893 (part-1)-2016-(RA: 2021) with Seismic Zone IV, earthquake intensity of 7.0 on Richter scale and critical ground water table at existing ground level. Out of which several boreholes show the potential at various depths mentioned in the table below:

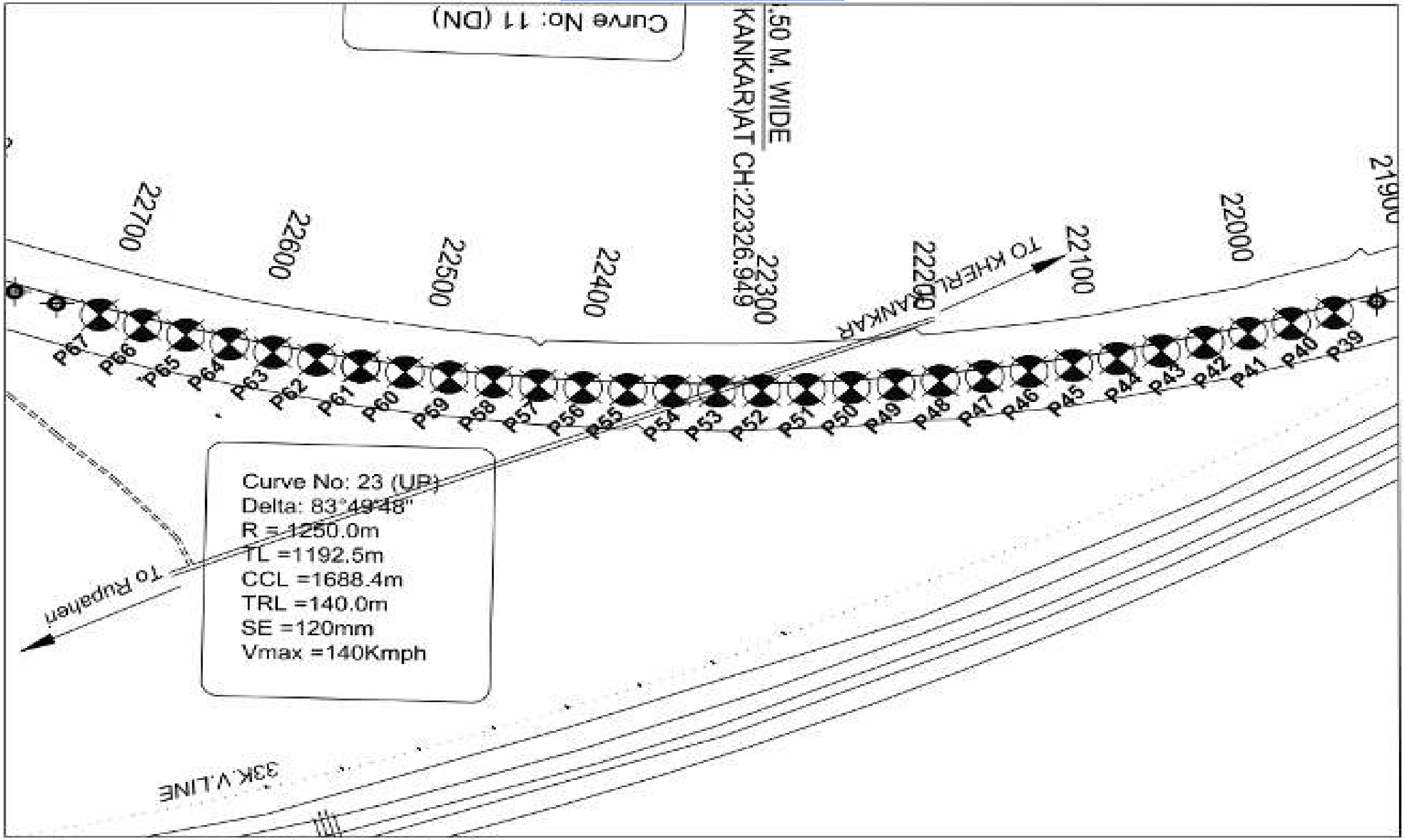
Bore No.	Liquefiable depth zone (meter)
P41	Top 1.00 & 5.00 to 6.00
P42	6.00 to 9.00
P43	Top 1.00 & 3.00 to 5.00
P44	Top 1.00 & 2.00 to 3.00
P45	4.00 to 5.00
P46	Top 9.00
P47	Top 1.00 & 2.00 to 3.00
P48	Top 1.00, 2.00 to 3.00 & 6.00 to 10.00
P49	Top 1.00, 3.00 to 4.00, 7.00 to 8.00 & 9.00 to 10.00
P50	Top 1.00 & 3.00 to 5.00
P51	Top 5.00
P52	Top 9.00 & 11.00 to 12.00
P53	Top 6.00
P54	Top 6.00
P55	Top 6.00 & 9.00 to 10.00
P56	Top 8.00
P57	Top 6.00
P58	Top 2.00 & 3.00 to 4.00
P59	Top 4.00 & 7.00 to 8.00
P60	Top 2.00 & 5.00 to 6.00

10.6. Type of cement to be used: No harmful chemicals are found within the soils. So, Ordinary Portland Cement or Portland Pozzolana Cement may be used for all civil constructions.

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech.(Civil), M.Tech.
Principal Consultant &
Managing Director

APPENDIX-A
TEST LOCATION PLAN



APPENDIX "B"
TABLE 1: SUMMARY OF TEST RESULTS

Bore No : P41	**Ground Elevation : RL 191.144m**	**Method of drilling :Percussion**	**Depth of Water : 1.40 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 08/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 21990.087	**Casing Lowered : 20.00 m**	**Ending Date : 10/11/2023**	**Hammer type: Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	1	1	48	50	0	13.24	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	D	2	1	1	2	3	3.00	CI	1	1	2	7	69	20	21.69	-	-	48.0	23.5	24.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of Intermediate plasticity											
	2.00	U	3	-	-	-	-	-	CL-CI	2	1	3	12	70	12	21.94	2.06	1.69	35.0	22.0	13.0	2.70	UU	62.0	7.4	-	0.598	-	18	13	-	Inorganic Clays of low to Intermediate plasticity											
	3.00	D	4	2	3	4	7	7.00	CI	0	0	1	7	75	17	22.88	-	-	44.0	23.0	21.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of Intermediate plasticity											
	4.00	D	5	3	3	6	9	9.00	CL	0	0	1	14	75	10	22.62	-	-	29.0	20.0	9.0	-	-	-	-	-	-	-	14	12	-	Inorganic clays of low plasticity											
	5.00	U	6	-	-	-	-	-	SM	0	0	0	64	36	0	26.29	1.93	1.53	Non Plastic			2.62	DST	1.0	28.3	-	0.712	-	-	-	-	Silty Sands											
	6.00	D	7	4	7	9	16	16.28	-	-	-	-	-	-	-	24.58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	4	8	9	17	16.50	ML	0	0	1	30	69	0	24.98	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	8.00	U	9	-	-	-	-	-	CL-ML	2	1	1	12	76	8	23.16	2.01	1.63	27.0	20.5	6.5	2.67	UU	43.0	12.2	0.106	0.638	-	-	-	-	Inorganic Silty Clays of low plasticity											
	9.00	D	10	5	8	10	18	16.38	-	-	-	-	-	-	-	19.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	4	9	11	20	17.06	-	-	-	-	-	-	-	21.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL	2	1	1	7	78	11	22.74	2.04	1.66	29.0	21.0	8.0	2.68	UU	53.0	10.7	-	0.614	-	6	16	-	Inorganic clays of low plasticity											
	12.50	D	13	6	7	12	19	19.00	-	-	-	-	-	-	-	21.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL	2	2	1	8	77	10	20.71	2.02	1.67	28.0	19.5	8.5	2.68	UU	58.0	11.5	-	0.605	-	-	-	-												
	15.50	D	15	8	10	13	23	23.00	-	-	-	-	-	-	-	19.81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	U	16	-	-	-	-	-	CL	0	0	2	11	75	12	19.28	2.04	1.71	30.0	20.0	10.0	2.68	UU	62.0	9.7	-	0.567	-	-	-	-												
	18.50	D	17	9	12	15	27	17.85	ML	3	0	0	34	63	0	20.96	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											

APPENDIX "B"
TABLE 1: SUMMARY OF TEST RESULTS

Bore No : P41	**Ground Elevation : RL 191.144m**	**Method of drilling :Percussion**	**Depth of Water : 1.40 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 08/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 21990.087	**Casing Lowered : 20.00 m**	**Ending Date : 10/11/2023**	**Hammer type: Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	20.00	D	18	-	-	-	-	-	CL	3	0	2	7	75	13	16.69	-	-	33.0	21.5	11.5	-	-	-	-	-	-	-	-	-	-												
	21.50	D	19	13	17	20	37	20.75	CL	2	1	2	10	78	7	19.41	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-												
	23.00	D	20	-	-	-	-	-	-	-	-	-	-	-	-	22.00	2.09	1.71	-	-	-	-	RUU	48.0	8.9	-	-	-	-	-	-	Inorganic clays of low plasticity											
	24.50	D	21	14	20	22	42	21.63	-	-	-	-	-	-	-	23.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	U	22	-	-	-	-	-	CL-ML	1	0	1	35	57	6	21.81	1.95	1.60	25.0	20.0	5.0	2.65	DST	8.0	24.8	-	0.656	-	-	-	-	Inorganic Silty Clays of low plasticity											
	27.50	D	23	12	19	21	40	20.28	CL	0	0	1	10	81	8	22.00	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	29.00	U	24	-	-	-	-	-	CL-ML	0	0	0	24	69	7	21.25	1.98	1.63	27.0	20.5	6.5	2.66	DST	10.0	24.7	-	0.632	-	-	-	-	Inorganic Silty Clays of low plasticity											
	30.50	D	25	15	21	26	47	21.78	ML	0	0	1	42	57	0	19.70	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	32.00	D	26	-	-	-	-	-	CL-ML	0	2	1	8	80	9	18.07	2.04	1.73	28	21.5	6.5	-	RUU	41.0	7.6	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	33.50	D	27	17	20	29	49	21.63	SM	0	0	1	54	45	0	19.15	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	35.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	18.40	2.08	1.76	-	-	-	2.65	RDST	4.0	26.1	-	0.506	-	-	-	-												
	36.50	D	29	21	25	29	54	54.00	CL	2	1	1	7	78	11	13.75	-	-	30.0	20.0	10.0	-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	22	25	32	57	57.00	-	-	-	-	-	-	-	22.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	40.00	D	31	26	29	35	64	64.00	-	-	-	-	-	-	-	22.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No: P42	**Ground Elevation: RL 191.252 m**	**Method of drilling: Percussion**	**Depth of Water: 1.28 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 14/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 22016.287	**Casing Lowered: 19.00 m**	**Ending Date: 17/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	1	55	44	0	14.15	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	U	2	-	-	-	-	-	CI	0	0	0	17	66	17	21.44	2.03	1.67	39.5	22.0	17.5	2.67	UU	69.0	8.6	0.208	0.599	-	20	19	-	Inorganic clays of Intermediate plasticity											
	2.00	D	3	4	4	6	10	10.00	CL	1	1	0	12	74	12	19.64	-	-	33.0	21.0	12.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	3.00	D	4	2	4	8	12	12.00	CL	0	1	0	47	43	9	19.82	-	-	29.0	19.5	9.5	-	-	-	-	-	-	-	-	-	-												
	4.00	U	5	-	-	-	-	-	CI	0	1	0	6	76	17	28.69	2.01	1.56	38.0	23.0	15.0	2.68	UU	71.0	7.8	-	0.718	-	-	-	-	Inorganic clays of Intermediate plasticity											
	5.00	D	6	5	7	9	16	16.72	SM	0	0	1	77	22	0	23.94	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	6.00	D	7	3	5	9	14	15.22	SM	0	0	0	83	17	0	24.96	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	-	-	-	-	-	-	-	-	-	-	-	-	24.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	4	5	8	13	13.34	-	-	-	-	-	-	-	25.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	3	4	7	11	11.00	CL	5	2	2	7	72	12	17.92	-	-	30.0	19.5	10.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	10.00	U	11	-	-	-	-	-	CL	7	3	3	10	67	10	23.58	2.08	1.68	28.5	18.5	10.0	2.67	UU	52.0	11.6	-	0.589	-	8	15	-												
	11.00	D	12	5	7	11	18	18.00	-	-	-	-	-	-	-	19.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	6	11	14	25	25.00	CL	2	1	0	8	82	7	21.13	-	-	27.5	20.0	7.5	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	1	0	2	9	77	11	20.68	2.04	1.69	31.0	19.5	11.5	2.67	UU	56.0	10.4	-	0.580	-	14	15	-												
	14.50	D	15	4	7	10	17	17.00	CL	5	2	3	11	66	13	20.99	-	-	33.0	20.0	13.0	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	0	1	1	16	75	7	21.74	2.03	1.67	28.0	21.0	7.0	2.66	DST	14.0	24.6	-	0.593	-	-	-	-												
	17.50	D	17	4	7	11	18	18.00	CL	6	2	3	15	62	12	18.72	-	-	31.0	19.5	11.5	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No: P42	**Ground Elevation: RL 191.252 m**	**Method of drilling: Percussion**	**Depth of Water: 1.28 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 14/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 22016.287	**Casing Lowered: 19.00 m**	**Ending Date: 17/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL	6	3	2	20	62	7	22.14	2.00	1.64	28.5	21.5	7.0	2.67	DST	11.0	26.3	-	0.628	-	8	20	-	Inorganic clays of low plasticity											
	20.50	D	19	3	7	21	28	17.77	-	-	-	-	-	-	-	22.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	CI	1	1	1	5	78	14	19.24	2.02	1.69	37.0	22.0	15.0	2.68	UU	62.0	8.3	-	0.586	-	-	-	-	Inorganic clays of Intermediate plasticity											
	23.50	D	21	6	17	19	36	36.00	-	-	-	-	-	-	-	18.54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	CL	3	1	1	10	76	9	19.72	2.04	1.70	29.0	21.0	8.0	2.66	UU	49.0	10.6	-	0.565	-	-	-	-	Inorganic clays of low plasticity											
	26.50	D	23	17	27	29	56	56.00	-	-	-	-	-	-	-	18.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	U	24	-	-	-	-	-	MI	0	0	0	6	82	12	27.95	2.07	1.62	36.0	26.0	10.0	2.68	UU	54.0	9.7	-	0.654	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	29.50	D	25	13	18	29	47	21.98	SM	0	0	0	65	35	0	19.78	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	31.00	U	26	-	-	-	-	-	ML	0	0	0	48	52	0	17.24	2.00	1.71	Non-Plastic			2.62	DST	2.0	26.5	-	0.532	-	-	-	-	Inorganic Silts of low plasticity											
	32.50	D	27	17	26	30	56	23.90	CL-ML	0	0	1	18	76	5	19.77	-	-	26.5	21.5	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	34.00	D	28	16	24	29	53	22.65	-	-	-	-	-	-	-	17.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	35.50	D	29	16	18	32	50	50.00	CL	2	1	1	22	66	8	18.74	-	-	27.5	19.5	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	37.00	D	30	12	14	35	49	49.00	-	-	-	-	-	-	-	20.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	14	20	27	47	47.00	CL	0	1	2	32	58	7	20.00	-	-	27.5	19.5	8.0	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	16	21	29	50	50.00	-	-	-	-	-	-	-	19.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 3: SUMMARY OF TEST RESULTS

Bore No: P43	**Ground Elevation: RL 191.241 m**	**Method of drilling: Percussion**	**Depth of Water: 1.30 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 20/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 22042.487	**Casing Lowered: 20.00 m**	**Ending Date: 22/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	1	54	45	0	11.65	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	D	2	-	-	-	-	-	CL	0	0	1	34	58	7	20.67	-	-	27.5	19.5	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	2.00	D	3	1	2	4	6	6.00	CL	0	0	0	28	60	12	21.01	-	-	32.0	20.0	12.0	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	2	3	3	6	7.85	SM	0	0	0	55	45	0	21.55	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	U	5	-	-	-	-	-	SM	0	0	0	65	35	0	28.36	1.94	1.51	Non-Plastic			2.62	DST	0.0	27.3	-	0.735	-	-	-	-												
	5.00	D	6	4	4	8	12	14.16	-	-	-	-	-	-	-	25.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	3	5	7	12	13.57	-	-	-	-	-	-	-	26.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	U	8	-	-	-	-	-	CL-ML	0	1	1	25	66	7	19.04	2.04	1.71	26.0	21.5	4.5	2.66	DST	8.0	26.5	-	0.556	-	8	17	-	Inorganic Silty Clays of low plasticity											
	8.00	D	9	4	6	7	13	13.54	CL	0	0	1	18	72	9	19.30	-	-	27.5	20.5	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	9.00	D	10	5	7	9	16	15.54	-	-	-	-	-	-	-	20.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	3	1	1	14	71	10	23.64	2.02	1.63	29.0	19.5	9.5	2.67	UU	44.0	9.5	0.139	0.638	-	-	-	-												
	11.00	D	12	8	12	15	27	27.00	-	-	-	-	-	-	-	18.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	10	13	18	31	31.00	CL	1	1	1	8	77	12	21.12	-	-	31.0	20.5	10.5	-	-	-	-	-	-	-	17	19	-												
	13.00	U	14	-	-	-	-	-	-	-	-	-	-	-	-	20.75	2.06	1.71	-	-	-	2.67	UU	54.0	8.5	-	0.561	-	-	-	-												
	14.50	D	15	4	6	8	14	14.00	-	-	-	-	-	-	-	21.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	0	1	1	10	77	11	21.39	2.03	1.67	31.0	20.0	11.0	2.68	UU	57.0	9.3	-	0.605	-	-	-	-												
	17.50	D	17	4	8	10	18	18.00	CL	0	0	1	8	81	10	21.56	-	-	30.5	20.0	10.5	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 3: SUMMARY OF TEST RESULTS

Bore No: P43	**Ground Elevation: RL 191.241 m**	**Method of drilling: Percussion**	**Depth of Water: 1.30 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 20/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 22042.487	**Casing Lowered: 20.00 m**	**Ending Date: 22/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	D	18	-	-	-	-	-	-	-	-	-	-	-	-	25.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	20.50	D	19	7	8	14	22	15.65	CL-ML	2	1	1	34	55	7	19.74	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	22.00	U	20	-	-	-	-	-	CL	0	2	3	14	72	9	20.77	2.04	1.69	28.0	20.0	8.0	2.66	UU	52.0	9.4	-	0.574	-	9	18	-												
	23.50	D	21	13	15	16	31	31.00	CL	6	2	3	27	56	6	17.59	-	-	28.0	20.0	8.0	-	-	-	-	-	-	-	-	-	-												
	25.00	D	22	-	-	-	-	-	CL	1	1	1	14	73	10	22.62	-	-	29.0	20.0	9.0	-	-	-	-	-	-	-	-	-	-												
	26.50	D	23	9	17	32	49	49.00	-	-	-	-	-	-	-	21.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	28.00	D	24	-	-	-	-	-	CL	0	0	1	11	76	12	23.35	2.10	1.70	32.0	21.0	11.0	2.67	RUU	62.0	9.2	-	0.571	-	-	-	-												
	29.50	D	25	13	17	22	39	39.00	-	-	-	-	-	-	-	16.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	U	26	-	-	-	-	-	CL	2	1	2	34	53	8	18.22	1.96	1.66	28.0	19.5	8.5	2.66	UU	46.0	10.8	-	0.602	-	-	-	-												
	32.50	D	27	28	32	35	67	27.21	SM	0	0	0	55	45	0	19.96	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	20	28	30	58	24.17	-	-	-	-	-	-	-	17.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Silty Sands											
	35.50	D	29	17	20	28	48	20.96	-	-	-	-	-	-	-	18.65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	CL-ML	5	2	2	38	45	8	17.31	2.03	1.73	27.5	21.5	6.0	2.66	RDST	18.0	25.4	-	0.538	-	-	-	-												
	38.50	D	31	16	20	30	50	20.85	-	-	-	-	-	-	-	14.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	40.00	D	32	15	24	33	57	22.37	CL-ML	1	1	4	35	52	7	12.95	-	-	27.0	21.5	5.5	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 4: SUMMARY OF TEST RESULTS

Bore No: P44	**Ground Elevation: RL 191.27 m**	**Method of drilling: Percussion**	**Depth of Water: 1.20 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 17/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 22068.687	**Casing Lowered: 19.00 m**	**Ending Date: 19/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	0	52	48	0	11.72	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	U	2	-	-	-	-	-	MI	4	2	3	8	70	13	15.92	2.07	1.79	36.0	25.0	11.0	2.67	UU	57.0	10.2	-	0.492	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	2.00	D	3	2	3	3	6	8.21	ML	0	0	1	44	55	0	18.25	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	3.00	D	4	4	7	10	17	18.33	SM	0	0	1	59	40	0	18.59	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	U	5	-	-	-	-	-	SM	0	0	0	82	18	0	20.42	1.94	1.61	Non-Plastic			2.65	DST	5.0	26.7	-	0.646	-	-	-	-												
	5.00	D	6	5	6	8	14	15.59	-	-	-	-	-	-	-	24.82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	5	7	9	16	16.38	SM	0	0	1	55	44	0	27.62	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	7.00	U	8	-	-	-	-	-	CL-ML	3	1	2	38	49	7	16.82	2.01	1.72	26.0	21.0	5.0	2.65	DST	8.0	26.2	0.133	0.541	-	-	-	-	Inorganic Silty Clays of low plasticity											
	8.00	D	9	3	5	7	12	12.33	-	-	-	-	-	-	-	18.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	3	4	8	12	12.00	CL	5	4	7	8	64	12	17.19	-	-	31.0	20.5	10.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	10.00	U	11	-	-	-	-	-	CL	0	0	1	9	79	11	15.42	1.90	1.65	32.0	22.0	10.0	2.67	UU	58.0	8.6	-	0.618	-	14	19	-												
	11.00	D	12	5	6	9	15	15.00	-	-	-	-	-	-	-	17.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	5	7	9	16	16.00	CL	0	0	1	14	75	10	21.37	-	-	29.0	20.0	9.0	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	3	1	2	8	74	12	17.08	2.06	1.76	33.0	22.0	11.0	2.68	UU	57.0	9.8	-	0.523	-	16	17	-												
	14.50	D	15	3	6	8	14	14.00	-	-	-	-	-	-	-	13.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	D	16	-	-	-	-	-	CL	1	1	2	12	74	10	10.84	-	-	32.0	22.0	10.0	-	-	-	-	-	-	-	-	-	-												
	17.50	D	17	4	6	12	18	18.00	-	-	-	-	-	-	-	15.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"

TABLE 4: SUMMARY OF TEST RESULTS

Bore No: P44	Ground Elevation: RL 191.27 m	Method of drilling: Percussion	Depth of Water: 1.20 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 17/10/2023	SPT Sampler: Standard
Location / Chainage: 22068.687	Casing Lowered: 19.00 m	Ending Date: 19/10/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen										
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL										
	19.00	U	18	-	-	-	-	-	-	-	-	-	-	-	-	17.31	2.02	1.72	-	-	-	2.67	UU	52.0	9.5	-	0.552	-	-	-	-											
	20.50	D	19	6	11	18	29	18.26	CL	0	1	1	24	65	9	18.23	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity										
	22.00	D	20	-	-	-	-	-	-	-	-	-	-	-	-	15.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
	23.50	D	21	7	8	14	22	15.16	CL-ML	3	1	2	36	53	5	12.00	-	-	26.0	21.5	4.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity										
	25.00	U	22	-	-	-	-	-	CL	4	2	1	8	73	12	18.12	2.06	1.74	31.0	19.5	11.5	2.68	UU	55.0	10.2	-	0.540	-	-	-	-	Inorganic clays of low plasticity										
	26.50	D	23	8	12	23	35	18.99	CL-ML	4	1	2	15	70	8	12.50	-	-	28.0	21.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity										
	28.00	U	24	-	-	-	-	-	SM-SC	6	3	5	41	40	5	15.96	1.97	1.70	25.0	20.0	5.0	2.64	DST	2.0	28.5	-	0.553	-	-	-	-	Silty Sands with clay binder										
	29.50	D	25	12	24	28	52	23.71	ML	0	0	1	48	51	0	15.43	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity										
	31.00	D	26	15	18	27	45	21.19	SM-SC	6	2	4	41	42	5	11.67	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Silty Sands with clay binder										
	32.50	D	27	18	22	28	50	22.41	ML	0	0	1	44	55	0	10.95	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity										
	34.00	D	28	19	25	26	51	22.41	CL-ML	3	2	1	34	54	6	13.18	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity										
	35.50	D	29	20	28	22	50	21.83	SM-SC	7	2	3	46	37	5	13.19	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Silty Sands with clay binder										
	37.00	D	30	14	24	29	53	22.41	-	-	-	-	-	-	-	9.75	-	-	-	-	-	2.65	-	-	-	-	-	-	-	-	-											
	38.50	D	31	13	23	28	51	21.58	ML	2	1	1	42	54	0	12.97	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity										
	40.00	D	32	14	21	27	48	20.49	SM	1	3	2	46	48	0	14.23	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands										

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 5: SUMMARY OF TEST RESULTS

Bore No : P45	**Ground Elevation : RL 191.379 m**	**Method of drilling :Percussion**	**Depth of Water : 1.50 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 08/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22094.887	**Casing Lowered : 18.00 m**	**Ending Date : 10/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	CL-ML	1	1	1	42	49	6	12.74	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	1.00	U	2	-	-	-	-	-	CL-ML	1	0	1	44	47	7	11.28	1.95	1.75	25.0	20.0	5.0	2.66	DST	4.0	26.7	-	0.520	-	-	-	-												
	2.00	D	3	2	3	4	7	7.00	CL	4	2	1	16	67	10	19.78	-	-	29.0	20.5	8.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	3.00	D	4	2	2	4	6	6.00	-	-	-	-	-	-	-	18.75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	U	5	-	-	-	-	-	SM	0	0	0	65	35	0	22.50	1.96	1.60	Non-Plastic			2.62	DST	0.0	27.2	-	0.638	-	-	-	-	Silty Sands											
	5.00	D	6	5	7	9	16	16.77	SM	0	0	1	62	37	0	29.51	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	4	6	8	14	15.27	-	-	-	-	-	-	-	21.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	U	8	-	-	-	-	-	SM	0	0	1	67	32	0	24.66	1.97	1.58	Non-Plastic			2.63	DST	0.0	28.1	-	-	-	-	-	-												
	8.00	D	9	3	5	8	13	13.40	SM	0	1	2	61	36	0	25.12	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	5	7	12	19	16.98	-	-	-	-	-	-	-	22.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	2	1	1	10	77	9	22.22	2.02	1.65	28.0	21.0	7.0	2.67	UU	47.0	12.3	0.123	0.618	-	8	18	-	Inorganic clays of low plasticity											
	11.00	D	12	5	9	14	23	18.27	-	-	-	-	-	-	-	20.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	6	8	13	21	17.05	-	-	-	-	-	-	-	19.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	15	-	-	-	-	-	CL	2	1	1	8	77	11	22.26	2.04	1.67	29.0	19.5	9.5	2.68	UU	55.0	10.9	-	-	-	6	15	-												
	14.50	D	16	5	9	14	23	23.00	-	-	-	-	-	-	-	18.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	17	-	-	-	-	-	CL	4	1	2	7	74	12	21.72	2.06	1.69	31.0	21.0	10.0	2.68	UU	59.0	9.3	-	0.586	-	-	-	-												
	17.50	D	18	9	14	24	38	38.00	-	-	-	-	-	-	-	15.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"

TABLE 5: SUMMARY OF TEST RESULTS

Bore No : P45	**Ground Elevation : RL 191.379 m**	**Method of drilling :Percussion**	**Depth of Water : 1.50 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 08/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22094.887	**Casing Lowered : 18.00 m**	**Ending Date : 10/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	19	-	-	-	-	-	CL	2	1	1	9	76	11	19.90	2.05	1.71	29.0	19.0	10.0	2.68	UU	57.0	11.2	-	0.567	-	-	-	-	Inorganic clays of low plasticity											
	20.50	D	20	11	17	26	43	43.00	-	-	-	-	-	-	-	21.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	21	-	-	-	-	-	CL	2	1	2	5	77	13	19.04	2.04	1.71	30.0	20.5	9.5	2.67	UU	61.0	8.2	-	0.561	-	-	-	-												
	23.50	D	22	8	18	27	45	45.00	-	-	-	-	-	-	-	21.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	U	23	-	-	-	-	-	CL	1	1	2	7	78	11	15.84	2.05	1.77	32.0	22.5	9.5	2.68	UU	55.0	10.4	-	-	-	-	-	-												
	26.50	D	24	12	17	25	42	21.22	ML	0	0	1	27	68	4	21.24	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	28.00	U	25	-	-	-	-	-	MI	0	0	1	7	74	18	33.36	2.04	1.53	42.0	28.0	14.0	2.70	UU	77.0	12.3	-	0.765	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	29.50	D	26	18	27	35	62	62.00	-	-	-	-	-	-	-	28.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	D	27	17	22	33	55	55.00	-	-	-	-	-	-	-	27.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.50	D	28	13	20	25	45	20.71	CL-ML	4	2	2	12	73	7	16.80	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	34.00	D	29	-	-	-	-	-	CL-ML	3	2	3	22	62	8	15.99	2.01	1.73	27.0	20.5	6.5	2.66	RDST	14.0	20.1	-	-	-	-	-	-												
	35.50	D	30	14	25	35	60	24.27	-	-	-	-	-	-	-	16.82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	37.00	D	31	16	28	28	56	22.79	ML	0	0	0	44	56	0	17.32	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	38.50	D	32	13	21	25	46	19.80	-	-	-	-	-	-	-	17.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	33	14	22	32	54	21.65	CL-ML	5	2	3	32	52	6	17.37	-	-	26	20.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 6: SUMMARY OF TEST RESULTS

Bore No : P46	**Ground Elevation : RL 191.386 m**	**Method of drilling :Percussion**	**Depth of Water : 1.60 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 06/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22121.087	**Casing Lowered : 20.00 m**	**Ending Date : 09/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	1	55	44	0	9.36	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	U	2	-	-	-	-	-	SM-SC	1	1	0	53	40	5	13.54	1.94	1.71	25.0	20.5	4.5	2.65	DST	6.0	25.7	-	0.550	-	-	-	-	Silty Sands with clay binder											
	2.00	D	3	1	2	3	5	6.77	SM-SC	5	2	3	43	40	7	17.97	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	3	3	6	9	11.47	-	-	-	-	-	-	-	18.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	-	-	-	-	-	SM	0	0	0	75	25	0	23.60	2.00	1.62	Non-Plastic			-	RDST	1.0	26.3	-	-	-	-	-	-	Silty Sands											
	5.00	D	6	2	2	4	6	6.90	-	-	-	-	-	-	-	25.58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	2	3	5	8	8.81	-	-	-	-	-	-	-	23.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	U	8	-	-	-	-	-	SM	0	0	1	82	17	0	23.93	1.90	1.53	Non-Plastic			2.61	DST	0.0	29.5	-	0.706	-	-	-	-												
	8.00	D	9	3	5	7	12	12.35	-	-	-	-	-	-	-	22.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	5	8	9	17	17.00	CL	7	2	4	22	56	9	18.30	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	10.00	U	11	-	-	-	-	-	CL	4	2	1	24	59	10	20.49	2.02	1.68	28.0	19.0	9.0	2.66	UU	47.0	10.2	0.140	0.583	-	6	17	-												
	11.00	D	12	4	8	11	19	19.00	-	-	-	-	-	-	-	19.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	6	10	12	22	22.00	-	-	-	-	-	-	-	19.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	0	0	1	8	79	12	18.76	2.04	1.72	31.0	20.5	10.5	2.67	UU	57.0	9.2	-	0.552	-	8	18	-												
	14.50	D	15	8	14	17	31	31.00	-	-	-	-	-	-	-	19.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL-ML	2	1	1	32	58	6	18.54	2.02	1.70	25.0	20.0	5.0	2.66	DST	7.0	26.2	-	0.565	-	-	-	-	Inorganic Silty Clays of low plasticity											
	17.50	D	17	6	12	16	28	18.56	-	-	-	-	-	-	-	19.65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 6: SUMMARY OF TEST RESULTS

Bore No : P46	**Ground Elevation : RL 191.386 m**	**Method of drilling :Percussion**	**Depth of Water : 1.60 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 06/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22121.087	**Casing Lowered : 20.00 m**	**Ending Date : 09/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL	3	2	1	22	63	9	17.95	2.02	1.71	28.0	20.5	7.5	2.66	UU	48.0	10.7	-	0.556	-	-	-	-	Inorganic clays of low plasticity											
	20.50	D	19	9	17	22	39	39.00	CL	0	0	0	6	82	12	14.99	-	-	29.0	19.0	10.0	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	CL	1	1	0	12	77	9	19.62	2.03	1.70	28.0	20.0	8.0	2.68	UU	52.0	11.6	-	0.576	-	-	-	-												
	23.50	D	21	18	24	31	55	26.62	CL-ML	0	0	1	32	62	5	16.43	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	25.00	D	22	15	20	29	49	49.00	CL	0	0	1	14	75	10	14.57	-	-	29.0	19.5	9.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	26.50	D	23	15	24	32	56	56.00	-	-	-	-	-	-	-	21.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	17	28	33	61	61.00	CL	0	1	0	6	80	13	24.14	-	-	33.0	19.0	14.0	-	-	-	-	-	-	-	-	-	-												
	29.50	D	25	20	31	34	65	27.87	SM-SC	2	1	2	46	44	5	14.74	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Silty Sands with clay binder											
	31.00	D	26	22	34	34	68	28.35	-	-	-	-	-	-	-	15.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.50	D	27	19	28	29	57	24.47	SM	0	0	0	81	19	0	22.42	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	34.00	D	28	-	-	-	-	-	SM	0	1	2	79	18	0	22.33	2.17	1.77	Non-Plastic			2.65	RDST	0.0	32.1	-	0.497	-	-	-	-												
	35.50	D	29	16	25	27	52	22.12	-	-	-	-	-	-	-	21.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	SM	0	0	1	82	17	0	22.48	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	17	26	29	55	22.29	-	-	-	-	-	-	-	21.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	20	28	31	59	23.03	SM	0	0	2	77	21	0	19.95	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 7: SUMMARY OF TEST RESULTS

Bore No : P47	**Ground Elevation : RL 191.466 m**	**Method of drilling :Percussion**	**Depth of Water : 1.60 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 05/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22147.287	**Casing Lowered : 20.00 m**	**Ending Date : 08/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	1	55	44	0	7.54	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	D	2	1	1	1	2	2.00	CL	0	0	1	28	63	8	22.00	-	-	27.0	19.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	2.00	D	3	-	-	-	-	-	ML	4	2	3	36	51	4	18.33	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	3.00	D	4	2	4	5	9	11.68	CL-ML	3	2	1	14	71	9	17.41	-	-	28.0	21.5	6.5	-	-	-	-	-	-	-	8	20	-	Inorganic Silty Clays of low plasticity											
	4.00	D	5	4	5	6	11	13.55	SM	0	0	0	65	35	0	25.78	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	5.00	U	6	-	-	-	-	-	SM	0	0	0	75	25	0	26.43	1.89	1.49	Non-Plastic			2.62	DST	0.0	27.4	-	0.753	-	-	-	-												
	6.00	D	7	5	7	9	16	16.55	-	-	-	-	-	-	-	24.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	5	10	11	21	18.94	-	-	-	-	-	-	-	30.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	U	9	-	-	-	-	-	SM	0	0	1	70	29	0	22.45	1.93	1.58	Non-Plastic			2.61	DST	0.0	28.2	-	0.652	-	-	-	-												
	9.00	D	10	4	8	9	17	16.14	SM	0	0	2	62	36	0	28.53	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	5	8	11	19	16.86	-	-	-	-	-	-	-	28.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL	2	1	1	7	79	10	20.77	2.02	1.67	28.0	20.5	7.5	2.67	UU	50.0	9.1	0.139	0.599	-	-	-	-	Inorganic clays of low plasticity											
	12.50	D	13	8	13	15	28	28.00	-	-	-	-	-	-	-	21.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	D	15	-	-	-	-	-	SM	0	0	0	66	34	0	21.09	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	15.50	D	16	5	9	11	20	15.92	CL-ML	0	0	1	18	74	7	19.99	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	17.00	U	17	-	-	-	-	-	CL	7	2	3	7	70	11	16.14	2.03	1.75	29.0	19.5	9.5	2.67	UU	54.0	10.4	-	0.526	-	10	17	-	Inorganic clays of low plasticity											
	18.50	D	18	9	14	20	34	34.00	-	-	-	-	-	-	-	16.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 7: SUMMARY OF TEST RESULTS

Bore No : P47	**Ground Elevation : RL 191.466 m**	**Method of drilling :Percussion**	**Depth of Water : 1.60 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 05/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22147.287	**Casing Lowered : 20.00 m**	**Ending Date : 08/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	20.00	U	19	-	-	-	-	-	-	-	-	-	-	-	-	18.45	2.02	1.70	-	-	-	2.67	UU	53.0	10.6	-	0.566	-	-	-	-	Inorganic clays of low plasticity											
	21.50	D	20	8	15	22	37	37.00	CL	2	1	1	8	80	8	16.59	-	-	27.0	19.5	7.5	-	-	-	-	-	-	-	-	-	-												
	23.00	U	21	-	-	-	-	-	CL	2	1	0	5	79	13	17.76	2.05	1.74	33.0	22.5	10.5	2.69	UU	63.0	9.4	-	0.546	-	-	-	-												
	24.50	D	22	12	22	30	52	52.00	CL	0	0	1	7	82	10	18.53	-	-	29.0	21.0	8.0	-	-	-	-	-	-	-	-	-	-												
	26.00	D	23	9	17	24	41	21.23	ML	0	0	1	38	57	4	22.07	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	27.50	D	24	11	20	25	45	22.15	-	-	-	-	-	-	-	18.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.00	U	25	-	-	-	-	-	CL	2	1	0	7	78	12	15.84	2.02	1.74	30.0	20.5	9.5	2.68	UU	57.0	11.6	-	0.540	-	-	-	-	Inorganic clays of low plasticity											
	30.50	D	26	13	22	26	48	22.31	SM	0	0	0	72	28	0	22.94	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	32.00	D	27	-	-	-	-	-	SM	0	0	1	67	32	0	20.56	2.09	1.73	Non-Plastic			-	RDST	0.0	29.3	-	-	-	-	-	-												
	33.50	D	28	15	24	27	51	22.40	-	-	-	-	-	-	-	18.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	35.00	D	29	-	-	-	-	-	SM	0	0	0	62	38	0	19.98	2.08	1.73	Non-Plastic			2.65	RDST	0.0	30.6	-	0.532	-	-	-	-												
	36.50	D	30	16	28	32	60	24.14	-	-	-	-	-	-	-	23.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.00	D	31	18	25	31	56	22.65	SM	0	1	2	57	40	0	23.93	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	21	29	33	62	23.86	-	-	-	-	-	-	-	13.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"

TABLE 8: SUMMARY OF TEST RESULTS

Bore No: P48	Ground Elevation: RL 191.215 m	Method of drilling: Percussion	Depth of Water: 1.70 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 12/10/2023	SPT Sampler: Standard
Location / Chainage: 22173.487	Casing Lowered: 18.00 m	Ending Date: 15/10/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	1	42	57	0	6.24	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	D	2	1	1	2	3	3.00	CL	1	1	0	14	76	8	17.33	-	-	27.5	20.0	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	2.00	U	3	-	-	-	-	-	SM-SC	2	1	1	55	36	5	21.83	2.01	1.65	26.0	20.5	5.5	2.65	DST	3.0	27.6	-	0.606	-	0	19	-	Silty Sands with clay binder											
	3.00	D	4	3	5	6	11	13.77	CL-ML	2	2	2	10	76	8	21.31	-	-	28.0	22.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	4.00	D	5	3	5	7	12	14.25	SM	0	0	0	53	47	0	25.40	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	5.00	D	6	-	-	-	-	-	-	-	-	-	-	-	-	22.68	2.00	1.63	-	-	-	2.65	RDST	0.0	25.9	-	0.626	-	-	-	-												
	6.00	D	7	3	4	6	10	10.87	SM	0	0	1	62	37	0	27.07	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	7.00	D	8	4	5	7	12	12.56	-	-	-	-	-	-	-	24.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	-	-	-	-	-	SM	0	0	0	61	39	0	25.31	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	3	4	5	9	8.91	ML	1	1	1	35	62	0	16.22	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	10.00	D	11	3	6	7	13	13.00	CL	7	3	3	9	66	12	18.91	-	-	32.0	22.5	9.5	2.67	-	-	-	-	-	-	8	19	-												
	11.00	U	12	-	-	-	-	-	-	-	-	-	-	-	-	20.32	2.02	1.68	-	-	-	2.67	UU	55.0	9.8	0.164	0.589	-	-	-	-	Inorganic clays of low plasticity											
	12.50	D	13	8	14	17	31	31.00	CL	1	1	2	8	80	8	21.39	-	-	27.5	19.5	8.0	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CI	0	2	4	7	73	14	16.63	2.06	1.77	36.0	21.5	14.5	2.67	UU	71.0	11.2	-	0.508	-	15	17	-	Inorganic clays of Intermediate plasticity											
	15.50	D	15	6	12	15	27	27.00	CL	4	2	3	9	69	13	18.88	-	-	34.0	20.0	14.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	17.00	U	16	-	-	-	-	-	CI	0	2	2	26	57	13	16.20	2.02	1.74	36.0	23.5	12.5	2.67	UU	57.0	10.6	-	0.534	-	-	-	-	Inorganic clays of Intermediate plasticity											
	18.50	D	17	8	17	19	36	36.00	CL	3	1	1	22	63	10	17.95	-	-	29.0	19.5	9.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											

APPENDIX "B"
TABLE 8: SUMMARY OF TEST RESULTS

Bore No: P48	**Ground Elevation: RL 191.215 m**	**Method of drilling: Percussion**	**Depth of Water: 1.70 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 12/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 22173.487	**Casing Lowered: 18.00 m**	**Ending Date: 15/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen												
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL												
	20.00	U	18	-	-	-	-	-	CL	1	1	2	14	70	12	19.89	2.07	1.73	29.0	20.5	8.5	2.66	UU	53.0	11.2	-	0.538	-	-	18	-	Inorganic clays of low plasticity												
	21.50	D	19	12	20	25	45	23.64	CL-ML	3	0	1	21	68	7	23.15	-	-	26.5	21.5	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity												
	23.00	D	20	-	-	-	-	-	SM	0	0	1	55	44	0	10.02	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands												
	24.50	D	21	9	18	27	45	22.70	SM	3	2	2	45	48	0	19.41	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-													
	26.00	U	22	-	-	-	-	-	CL-ML	2	2	1	34	56	5	20.08	2.04	1.70	24.5	20.0	4.5	2.65	DST	2.0	27.1	-	0.559	-	-	-	-	Inorganic Silty Clays of low plasticity												
	27.50	D	23	8	21	29	50	50.00	MI	1	1	1	9	73	15	26.49	-	-	40.0	26.5	13.5	-	-	-	-	-	-	-	-	15	-	Inorganic Silts of Intermediate plasticity												
	29.00	D	24	-	-	-	-	-	CL-ML	0	1	1	16	75	7	15.68	-	-	26.5	21.5	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity												
	30.50	D	25	10	20	31	51	22.94	ML	0	0	0	42	54	4	17.97	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity												
	32.00	D	26	-	-	-	-	-	-	-	-	-	-	-	-	18.10	2.02	1.71	-	-	-	2.65	RDST	3.0	27.6	-	0.550	-	-	-	-													
	33.50	D	27	11	23	33	56	23.62	CL-ML	2	1	1	22	67	7	16.57	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity												
	35.00	D	28	-	-	-	-	-	CL-ML	0	1	1	19	74	5	14.56	-	-	25.0	20.5	4.5	-	-	-	-	-	-	-	-	-	-													
	36.50	D	29	12	25	30	55	22.66	-	-	-	-	-	-	-	18.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	38.00	D	30	-	-	-	-	-	CL-ML	1	2	1	23	66	7	16.84	-	-	26.5	20.5	6.0	-	-	-	-	-	-	-	-	-	-													
	40.00	D	31	13	27	36	63	24.05	CL	2	0	2	19	69	8	17.95	-	-	27.0	20.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 9: SUMMARY OF TEST RESULTS

Bore No: P49	**Ground Elevation: RL 191.249 m**	**Method of drilling: Percussion**	**Depth of Water: 1.80 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 18/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 22199.687	**Casing Lowered: 18.00 m**	**Ending Date: 20/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	1	1	0	54	44	0	4.48	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	D	2	1	2	3	5	7.88	CL-ML	1	0	0	46	47	6	16.19	-	-	26.0	20.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	2.00	D	3	-	-	-	-	-	-	-	-	-	-	-	-	15.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	2	3	5	8	10.15	SM	0	0	0	62	38	0	25.94	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	D	5	3	5	7	12	14.42	ML	0	0	0	17	78	5	24.52	-	-	27.0	22.0	5.0	-	-	-	-	-	-	-	8	-	-	Inorganic Silts of low plasticity											
	5.00	D	6	-	-	-	-	-	ML	0	0	0	40	60	0	22.60	2.00	1.63	Non-Plastic			2.65	RDST	0.0	24.5	-	0.626	-	-	-	-												
	6.00	D	7	3	6	8	14	15.19	SM	0	0	1	77	22	0	21.93	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	7.00	D	8	5	6	7	13	13.73	-	-	-	-	-	-	-	15.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	-	-	-	-	-	ML	0	1	1	28	66	4	17.02	1.92	1.64	25.0	21.0	4.0	-	RDST	7.0	24.7	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	9.00	D	10	4	4	5	9	8.92	-	-	-	-	-	-	-	16.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	5	8	15	23	23.00	CL	2	1	1	12	75	9	18.52	-	-	29.0	19.5	9.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	11.00	U	12	-	-	-	-	-	-	-	-	-	-	-	-	18.41	2.05	1.73	-	-	-	2.66	UU	48.0	8.2	0.142	0.538	-	-	-	-												
	12.50	D	13	6	7	14	21	21.00	CL	0	0	1	12	75	12	14.98	-	-	30.0	17.5	12.5	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	-	-	-	-	-	-	-	18.81	2.03	1.71	-	-	-	2.67	UU	61.0	9.1	-	0.561	-	-	-	-												
	15.50	D	15	5	7	10	17	17.00	-	-	-	-	-	-	-	16.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	U	16	-	-	-	-	-	CL	3	1	2	9	74	11	18.64	2.01	1.69	32.0	22.0	10.0	2.67	UU	56.0	8.7	-	0.580	-	0	18	-												

APPENDIX "B"

TABLE 9: SUMMARY OF TEST RESULTS

Bore No: P49	**Ground Elevation: RL 191.249 m**	**Method of drilling: Percussion**	**Depth of Water: 1.80 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 18/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 22199.687	**Casing Lowered: 18.00 m**	**Ending Date: 20/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	7	11	15	26	17.51	CL-ML	2	2	1	42	47	6	17.21	-	-	28.5	22.0	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	20.00	U	18	-	-	-	-	-	CL	4	2	3	22	57	12	19.02	1.96	1.65	31.0	21.5	9.5	2.66	UU	52.0	9.8	-	0.612	-	-	-	-	Inorganic clays of low plasticity											
	21.50	D	19	10	19	22	41	41.00	CL	1	1	0	12	78	8	15.25	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-												
	23.00	U	20	-	-	-	-	-	CL	4	2	2	14	67	11	14.21	2.06	1.80	32.0	22.0	10.0	2.67	UU	58.0	10.4	-	0.483	-	-	-	-												
	24.50	D	21	10	17	27	44	44.00	-	-	-	-	-	-	-	18.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	D	22	-	-	-	-	-	CL	2	1	1	10	73	13	20.77	-	-	33.0	21.0	12.0	-	-	-	-	-	-	-	-	-	-												
	27.50	D	23	9	15	28	43	21.37	SM	0	0	0	54	46	0	14.31	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	29.00	U	24	-	-	-	-	-	CL	4	1	2	34	48	11	12.88	2.00	1.77	29.0	20.0	9.0	2.66	DST	13.0	26.5	-	0.503	-	-	-	-	Inorganic clays of low plasticity											
	30.50	D	25	10	16	26	42	20.36	SM	3	2	2	46	47	0	13.78	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	32.00	U	26	-	-	-	-	-	CL	3	2	1	28	56	10	20.82	1.96	1.62	30.0	20.5	9.5	2.66	UU	49.0	11.5	-	0.642	-	-	-	-	Inorganic clays of low plasticity											
	33.50	D	27	12	18	28	46	46.00	-	-	-	-	-	-	-	16.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	35.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	18.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	36.50	D	29	14	19	30	49	21.11	CL-ML	2	2	1	30	59	6	16.45	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	38.00	D	30	-	-	-	-	-	SM	2	3	1	47	47	0	17.65	2.02	1.72	Non-Plastic			-	RDST	0.0	27.6	-	-	-	-	-	-	Silty Sands											
	40.00	D	31	16	22	33	55	21.95	-	-	-	-	-	-	-	18.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 10: SUMMARY OF TEST RESULTS

Bore No: P50	**Ground Elevation: RL 191.295 m**	**Method of drilling: Percussion**	**Depth of Water: 1.60 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 16/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 22225.887	**Casing Lowered: 18.00 m**	**Ending Date: 18/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen												
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL												
	0.50	D	1	-	-	-	-	-	SM	0	0	1	55	44	0	4.99	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands												
	1.00	U	2	-	-	-	-	-	CL-ML	2	2	1	42	46	7	20.40	2.03	1.69	26.0	21.5	4.5	2.66	DST	8.0	24.5	-	0.578	-	0	19	-	Inorganic Silty Clays of low plasticity												
	2.00	D	3	1	1	2	3	4.01	-	-	-	-	-	-	-	19.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	3.00	D	4	2	3	4	7	8.79	ML	0	0	1	38	61	0	19.99	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity												
	4.00	D	5	-	-	-	-	-	SM	0	0	1	70	29	0	25.68	1.92	1.53	Non-Plastic			2.65	RDST	0.0	27.6	-	0.732	-	-	-	-	Silty Sands												
	5.00	D	6	4	6	8	14	15.51	-	-	-	-	-	-	-	25.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	6.00	D	7	5	7	9	16	16.30	SM	0	0	1	65	34	0	25.35	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-													
	7.00	D	8	-	-	-	-	-	-	-	-	-	-	-	-	24.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	8.00	D	9	7	9	13	22	18.72	SM	0	0	0	68	32	0	25.47	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-													
	9.00	D	10	7	10	15	25	19.82	-	-	-	-	-	-	-	28.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	10.00	U	11	-	-	-	-	-	CL	4	2	2	11	68	13	20.66	2.03	1.68	32.0	20.5	11.5	2.68	UU	54.0	8.5	0.162	0.593	-	25	16	-	Inorganic clays of low plasticity												
	11.00	D	12	5	9	15	24	24.00	-	-	-	-	-	-	-	19.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	12.00	D	13	7	13	17	30	20.99	SM	3	2	2	55	38	0	18.18	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands												
	13.00	U	14	-	-	-	-	-	CL	2	1	1	14	70	12	18.30	2.03	1.72	31.0	22.0	9.0	2.67	UU	58.0	8.3	-	0.556	-	-	-	-	Inorganic clays of low plasticity												
	14.50	D	15	6	9	12	21	21.00	-	-	-	-	-	-	-	18.13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	16.00	U	16	-	-	-	-	-	-	-	-	-	-	-	-	18.52	2.01	1.70	-	-	-	2.67	UU	57.0	8.6	-	0.571	-	-	-	-													
	17.50	D	17	5	10	13	23	23.00	CL	2	1	1	14	69	13	18.45	-	-	32.0	21.0	11.0	-	-	-	-	-	-	-	-	-	-													

APPENDIX "B"

TABLE 10: SUMMARY OF TEST RESULTS

Bore No: P50	**Ground Elevation: RL 191.295 m**	**Method of drilling: Percussion**	**Depth of Water: 1.60 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 16/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 22225.887	**Casing Lowered: 18.00 m**	**Ending Date: 18/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	ML	0	1	1	47	51	0	19.13	1.98	1.66	Non-Plastic			2.63	DST	7.0	27.2	-	0.584	-	-	-	-	Inorganic Silts of low plasticity											
	20.50	D	19	4	8	14	22	15.60	CL-ML	0	0	1	28	63	8	21.72	-	-	28.0	21.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	22.00	D	20	-	-	-	-	-	-	-	-	-	-	-	-	20.58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.50	D	21	6	11	17	28	17.16	-	-	-	-	-	-	-	21.46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	D	22	-	-	-	-	-	CL	0	1	1	22	68	8	23.70	2.09	1.69	29.0	21.0	8.0	2.67	RUU	42.0	14.3	-	0.580	-	-	-	-	Inorganic clays of low plasticity											
	26.50	D	23	12	19	28	47	47.00	CL	0	1	2	18	70	9	22.51	-	-	29.0	20.5	8.5	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	-	-	-	-	-	-	-	-	-	-	-	-	19.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.50	D	25	11	20	27	47	47.00	CI	4	2	3	12	65	14	17.43	-	-	41.0	25.0	16.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of Intermediate plasticity											
	31.00	U	26	-	-	-	-	-	-	-	-	-	-	-	-	18.14	2.06	1.74	-	-	-	2.68	UU	61.0	7.5	-	0.540	-	-	-	-												
	32.50	D	27	12	22	28	50	50.00	CL	3	1	2	18	64	12	16.19	-	-	32.0	20.5	11.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	34.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	24.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	35.50	D	29	11	20	25	45	19.96	ML	0	0	1	48	51	0	20.58	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	37.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	17.70	2.06	1.75	-	-	-	2.65	RDST	0.0	28.5	-	0.514	-	-	-	-												
	38.50	D	31	14	21	27	48	20.14	ML	0	0	2	44	54	0	18.85	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	17	25	31	56	21.90	-	-	-	-	-	-	-	20.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 11: SUMMARY OF TEST RESULTS

Bore No: P51	Ground Elevation: RL 191.293 m	Method of drilling: Percussion	Depth of Water: 1.60 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 20/10/2023	SPT Sampler: Standard
Location / Chainage: 22252.087	Casing Lowered: 21.00 m	Ending Date: 22/10/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	1	1	0	46	47	5	6.59	-	-	25.0	21.5	3.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	D	2	-	-	-	-	-	-	-	-	-	-	-	-	21.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	2.00	D	3	1	2	3	5	6.85	SM	0	0	1	53	46	0	20.02	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	3.00	D	4	2	2	4	6	7.71	-	-	-	-	-	-	-	20.78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	-	-	-	-	-	SM	0	0	1	61	38	0	27.88	1.97	1.54	Non-Plastic			2.65	RDST	0.0	26.4	-	0.721	-	-	-	-												
	5.00	D	6	3	5	7	12	13.92	SM	0	0	1	72	27	0	27.00	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	3	6	8	14	15.28	SM	0	0	2	75	23	0	27.15	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	-	-	-	-	-	-	-	-	-	-	-	-	25.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	6	9	12	21	18.31	SM	0	0	1	82	17	0	25.17	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	10	13	17	30	22.39	-	-	-	-	-	-	-	29.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	SM	0	0	0	78	22	0	21.53	2.07	1.70	Non-Plastic			2.61	DST	0.0	28.5	0.146	0.535	-	-	-	-												
	11.00	D	12	5	9	13	22	17.73	CL-ML	0	0	1	12	80	7	19.96	-	-	26.5	20.5	6.0	-	-	-	-	-	-	-	0	19	-	Inorganic Silty Clays of low plasticity											
	12.00	D	13	4	8	15	23	17.88	-	-	-	-	-	-	-	17.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	2	1	1	9	75	12	17.77	2.05	1.74	31.0	19.5	11.5	2.67	UU	53.0	9.5	-	0.534	-	8	15	-	Inorganic clays of low plasticity											
	14.50	D	15	9	14	16	30	30.00	-	-	-	-	-	-	-	19.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	3	1	1	10	72	13	16.41	2.06	1.77	32.0	20.0	12.0	2.68	UU	58.0	10.4	-	0.514	-	-	-	-												
	17.50	D	17	6	9	14	23	23.00	-	-	-	-	-	-	-	17.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"

TABLE 11: SUMMARY OF TEST RESULTS

Bore No: P51	**Ground Elevation: RL 191.293 m**	**Method of drilling: Percussion**	**Depth of Water: 1.60 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 20/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 22252.087	**Casing Lowered: 21.00 m**	**Ending Date: 22/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	SM	0	1	2	53	44	0	20.68	1.87	1.55	Non-Plastic			2.65	DST	3.0	27.4	-	0.710	-	-	-	-	Silty Sands											
	20.50	D	19	6	8	13	21	15.27	SM	0	1	1	51	47	0	13.02	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	22.00	D	20	-	-	-	-	-	-	-	-	-	-	-	-	16.26	1.83	1.57	-	-	-	-	RDST	0.0	26.1	-	-	-	-	-	-												
	23.50	D	21	10	15	20	35	19.82	ML	0	0	0	48	52	0	19.55	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	25.00	D	22	-	-	-	-	-	-	-	-	-	-	-	-	14.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.50	D	23	12	17	22	39	20.59	SM	0	0	0	58	42	0	19.35	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	28.00	U	24	-	-	-	-	-	-	-	-	-	-	-	-	16.26	1.84	1.58	-	-	-	2.63	DST	0.0	26.7	-	0.665	-	-	-	-												
	29.50	D	25	14	20	26	46	22.25	SM	0	0	0	55	45	0	15.38	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	-	-	-	-	-	SM	0	0	0	54	46	0	19.81	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	32.50	D	27	16	22	29	51	23.08	SM	0	0	1	58	41	0	17.00	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	34.00	U	28	-	-	-	-	-	-	-	-	-	-	-	-	17.63	1.93	1.64	-	-	-	2.64	DST	0.0	27.8	-	0.610	-	-	-	-												
	35.50	D	29	16	24	26	50	22.08	SM	0	0	1	62	37	0	16.12	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	SM	0	1	2	59	38	0	12.57	1.89	1.68	Non-Plastic			-	RDST	0.0	29.3	-	-	-	-	-	-												
	38.50	D	31	18	27	30	57	23.42	-	-	-	-	-	-	-	16.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	20	29	33	62	24.46	SM	0	1	1	53	45	0	10.03	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 12: SUMMARY OF TEST RESULTS

Bore No : P52	**Ground Elevation : RL 191.228 m**	**Method of drilling :Percussion**	**Depth of Water : 1.50 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 05/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22278.287	**Casing Lowered : 18.00 m**	**Ending Date : 07/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	3	0	0	54	43	0	4.23	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	1.00	U	2	-	-	-	-	-	SM	0	0	1	52	47	0	15.82	1.94	1.68	Non-Plastic			2.62	DST	4.0	26.6	-	0.560	-	-	-	-												
	2.00	D	3	2	3	3	6	8.18	-	-	-	-	-	-	-	14.76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	2	4	5	9	11.53	SM	0	0	0	64	36	0	22.47	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	4.00	U	5	-	-	-	-	-	SM	0	0	0	75	25	0	25.42	1.94	1.55	Non-Plastic			2.62	DST	0.0	28.6	-	0.690	-	-	-	-	Silty Sands											
	5.00	D	6	3	4	6	10	11.60	-	-	-	-	-	-	-	25.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	6	5	7	12	13.36	-	-	-	-	-	-	-	27.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	U	8	-	-	-	-	-	SM	0	0	1	72	27	0	24.57	1.95	1.57	Non-Plastic			2.63	DST	0.0	27.9	-	0.676	-	-	-	-												
	8.00	D	9	4	5	7	12	12.41	-	-	-	-	-	-	-	27.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	4	6	8	14	14.01	CL-ML	2	2	1	42	48	5	18.25	-	-	25.0	20.5	4.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	10.00	U	11	-	-	-	-	-	CL-ML	1	1	2	32	57	7	21.12	1.98	1.64	27.0	21.0	6.0	2.66	DST	6.0	26.2	-	0.624	-	-	-	-												
	11.00	D	12	3	5	8	13	12.23	ML	0	0	1	44	55	0	15.52	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	12.00	D	13	4	6	9	15	13.72	CL-ML	0	0	1	35	58	6	16.48	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	13.00	U	14	-	-	-	-	-	CL	2	1	1	25	63	8	19.16	2.01	1.69	28.0	21.0	7.0	2.66	UU	46.0	10.4	0.142	0.574	-	0	20	-	Inorganic clays of low plasticity											
	14.50	D	15	8	11	13	24	17.76	-	-	-	-	-	-	-	21.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL-ML	0	0	1	18	72	9	17.01	2.02	1.73	27.0	20.5	6.5	2.66	UU	44.0	12.2	-	0.538	-	-	-	-	Inorganic Silty Clays of low plasticity											
	17.50	D	17	6	10	12	22	16.24	-	-	-	-	-	-	-	17.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 12: SUMMARY OF TEST RESULTS

Bore No : P52	**Ground Elevation : RL 191.228 m**	**Method of drilling :Percussion**	**Depth of Water : 1.50 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 05/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22278.287	**Casing Lowered : 18.00 m**	**Ending Date : 07/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	ML	1	0	0	42	53	4	17.44	1.94	1.65	24.0	20.0	4.0	2.65	DST	5.0	25.4	-	0.606	-	-	-	-	Inorganic Silts of low plasticity											
	20.50	D	19	8	15	18	33	19.83	-	-	-	-	-	-	-	18.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	SM	1	0	1	64	34	0	20.49	1.96	1.63	Non-Plastic			2.63	DST	1.0	28.3	-	0.613	-	-	-	-	Silty Sands											
	23.50	D	21	8	14	19	33	19.13	SM	0	1	1	52	46	0	19.17	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	25.00	D	22	-	-	-	-	-	SM	0	0	1	62	37	0	19.91	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	26.50	D	23	18	24	33	57	57.00	MI	1	1	1	4	76	17	26.78	-	-	41.0	27.0	14.0	2.70	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	28.00	D	24	15	20	32	52	24.37	SM	0	0	1	55	44	0	18.63	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	29.50	D	25	12	27	32	59	26.19	-	-	-	-	-	-	-	19.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	17	26	50	76	31.00	SM	0	0	1	64	35	0	19.86	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	32.50	D	27	18	25	35	60	25.64	-	-	-	-	-	-	-	18.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	17	30	32	62	25.77	SM	0	0	1	72	27	0	26.44	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	35.50	D	29	15	28	33	61	25.08	ML	1	1	1	42	50	5	18.77	-	-	25.0	21.0	4.0	2.65	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	37.00	D	30	14	23	38	61	24.70	CL-ML	1	1	1	32	59	6	19.53	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	38.50	D	31	17	26	32	58	23.49	-	-	-	-	-	-	-	21.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	18	30	35	65	25.04	SM	2	1	1	48	48	0	19.12	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 13: SUMMARY OF TEST RESULTS

Bore No : P53	**Ground Elevation : RL 192.054 m**	**Method of drilling :Percussion**	**Depth of Water : 1.40 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 05/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22304.487	**Casing Lowered : 18.00 m**	**Ending Date : 08/11/2023**	**Hammer type: Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen										
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL										
	0.50	D	1	-	-	-	-	-	SM	0	0	1	53	46	0	8.14	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands										
	1.00	U	2	-	-	-	-	-	SM-SC	2	1	0	48	45	4	19.70	1.96	1.64	24.0	20.0	4.0	2.62	DST	5.0	26.2	-	0.598	-	-	-	-	Silty Sands with clay binder										
	2.00	D	3	3	3	3	6	8.22	-	-	-	-	-	-	-	17.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
	3.00	D	4	2	3	4	7	8.99	-	-	-	-	-	-	-	17.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
	4.00	U	5	-	-	-	-	-	SM	0	0	1	72	27	0	24.23	1.92	1.55	Non-Plastic			2.61	DST	0.0	28.9	-	0.688	-	-	-	-	Silty Sands										
	5.00	D	6	3	4	6	10	11.65	SM	0	1	1	75	23	0	25.52	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-											
	6.00	D	7	3	5	8	13	14.54	-	-	-	-	-	-	-	24.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
	7.00	D	8	-	-	-	-	-	SM	0	0	2	77	21	0	26.05	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-											
	8.00	D	9	8	12	16	28	22.02	-	-	-	-	-	-	-	23.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
	9.00	D	10	6	9	14	23	23.00	CL	3	2	1	12	71	11	18.38	-	-	30.0	21.5	8.5	-	-	-	-	-	-	-	0	18	-	Inorganic clays of low plasticity										
	10.00	U	11	-	-	-	-	-	CL-ML	2	1	1	24	65	7	18.93	1.98	1.66	27.0	20.5	6.5	2.64	DST	11.0	24.2	-	0.586	-	-	-	-	Inorganic Silty Clays of low plasticity										
	11.00	D	12	10	17	20	37	24.94	-	-	-	-	-	-	-	22.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
	12.00	D	13	8	15	18	33	22.62	CL-ML	0	1	1	8	82	8	21.98	-	-	27.0	20.5	6.5	-	-	-	-	-	-	-	-	-	-											
	13.00	U	14	-	-	-	-	-	CL	5	2	3	14	66	10	19.31	2.04	1.71	28.0	21.0	7.0	2.67	UU	52.0	9.4	0.136	0.561	-	6	15	-	Inorganic clays of low plasticity										
	14.50	D	15	7	12	21	33	21.61	-	-	-	-	-	-	-	21.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
	16.00	U	16	-	-	-	-	-	CL	8	3	3	16	59	11	16.27	2.02	1.74	29.0	21.0	8.0	2.68	UU	49.0	11.5	-	0.540	-	-	-	-											
	17.50	D	17	11	14	19	33	33.00	-	-	-	-	-	-	-	16.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											

APPENDIX "B"

TABLE 13: SUMMARY OF TEST RESULTS

Bore No : P53	**Ground Elevation : RL 192.054 m**	**Method of drilling :Percussion**	**Depth of Water : 1.40 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 05/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22304.487	**Casing Lowered : 18.00 m**	**Ending Date : 08/11/2023**	**Hammer type: Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL-ML	6	1	2	27	56	8	18.06	2.00	1.69	24.0	18.0	6.0	2.66	DST	7.0	26.4	-	0.574	-	-	-	-	Inorganic Silty Clays of low plasticity											
	20.50	D	19	14	20	25	45	24.26	CL	2	1	1	12	74	10	27.55	-	-	29.0	22.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	22.00	U	20	-	-	-	-	-	CL-ML	4	2	1	17	68	8	18.43	1.96	1.65	25.0	18.5	6.5	2.66	DST	9.0	25.8	-	0.608	-	-	-	-	Inorganic Silty Clays of low plasticity											
	23.50	D	21	20	28	32	60	28.58	-	-	-	-	-	-	-	14.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	D	22	12	18	22	40	21.17	SM	0	0	0	74	26	0	22.55	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	26.50	D	23	10	15	20	35	19.11	-	-	-	-	-	-	-	24.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	U	24	-	-	-	-	-	MI	3	1	1	5	74	16	27.56	2.07	1.62	42.0	26.0	16.0	2.70	UU	74.0	11.4	-	0.667	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	29.50	D	25	8	22	28	50	23.17	SM	1	0	1	70	28	0	22.10	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	31.00	D	26	-	-	-	-	-	-	-	-	-	-	-	-	24.66	2.11	1.69	-	-	-	-	RDST	2.0	29.3	-	-	-	-	-	-												
	32.50	D	27	18	28	32	60	25.27	SM	8	4	6	52	30	0	15.83	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	20	28	35	63	25.66	SM	0	0	0	75	25	0	17.67	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	35.50	D	29	25	32	40	72	27.81	SM	0	0	1	67	32	0	18.16	-	-	Non-Plastic			2.65	-	-	-	-	-	-	-	-	-												
	37.00	D	30	20	28	32	60	24.07	-	-	-	-	-	-	-	18.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	18	23	35	58	23.19	SM	1	0	1	52	46	0	17.29	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	21	32	35	67	25.26	-	-	-	-	-	-	-	17.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 14: SUMMARY OF TEST RESULTS

Bore No: P54	**Ground Elevation: RL 191.242 m**	**Method of drilling: Percussion**	**Depth of Water: 1.20 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 12/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 22330.687	**Casing Lowered: 20.00 m**	**Ending Date: 14/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	1	0	61	38	0	12.25	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	D	2	-	-	-	-	-	ML	0	0	0	48	48	4	20.09	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	2.00	D	3	1	2	3	5	7.07	-	-	-	-	-	-	-	19.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	2	3	4	7	9.25	ML	5	1	0	34	60	0	21.49	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	-	-	-	-	-	-	-	-	-	-	-	-	22.59	1.94	1.58	-	-	-	2.63	RDST	4.0	21.9	-	-	-	-	-	-												
	5.00	D	6	2	3	6	9	10.69	ML	1	1	0	45	53	0	25.19	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	4	7	8	15	16.03	-	-	-	-	-	-	-	26.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	-	-	-	-	-	SM	0	0	0	58	42	0	26.28	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	8.00	D	9	4	10	11	21	18.59	-	-	-	-	-	-	-	19.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	5	11	12	23	19.26	CL-ML	2	2	2	13	74	7	17.84	-	-	27.5	21.5	6.0	-	-	-	-	-	-	-	8	18	-	Inorganic Silty Clays of low plasticity											
	10.00	U	11	-	-	-	-	-	SM	1	1	2	67	29	0	19.79	1.90	1.59	Non-Plastic			2.62	DST	2.0	27.5	-	0.652	-	-	-	-	Silty Sands											
	11.00	D	12	5	8	13	21	21.00	CL	0	0	1	14	77	8	20.69	-	-	27.5	20.0	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	12.00	D	13	4	7	12	19	19.00	-	-	-	-	-	-	-	21.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	SM	0	1	0	78	21	0	21.16	1.92	1.58	Non-Plastic			2.63	DST	0.0	29.5	-	0.660	-	-	-	-	Silty Sands											
	14.50	D	15	5	9	13	22	22.00	CL	1	1	1	19	67	11	20.00	-	-	31.0	20.5	10.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	16.00	U	16	-	-	-	-	-	CL	1	1	1	37	50	10	18.80	2.06	1.73	29.0	19.5	9.5	2.66	UU	42.0	12.5	0.148	0.534	-	9	15	-												
	17.50	D	17	9	13	21	34	34.00	CL	8	4	4	24	51	9	16.96	-	-	27.5	20.0	7.5	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"

TABLE 14: SUMMARY OF TEST RESULTS

Bore No: P54	**Ground Elevation: RL 191.242 m**	**Method of drilling: Percussion**	**Depth of Water: 1.20 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 12/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 22330.687	**Casing Lowered: 20.00 m**	**Ending Date: 14/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	D	18	-	-	-	-	-	CL	3	1	2	14	72	8	20.65	-	-	26.5	19.5	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	20.50	D	19	8	16	20	36	21.27	-	-	-	-	-	-	-	19.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	D	20	-	-	-	-	-	SM	0	1	2	72	25	0	21.73	1.91	1.57	Non-Plastic			-	RDST	0.0	27.3	-	-	-	-	-	-	Silty Sands											
	23.50	D	21	9	17	26	43	23.04	ML	0	0	1	42	57	0	18.57	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	25.00	U	22	-	-	-	-	-	CL	1	1	1	17	74	6	20.04	2.03	1.69	25.5	18.5	7.0	2.65	DST	13.0	25.5	-	0.568	-	-	-	-	Inorganic clays of low plasticity											
	26.50	D	23	10	14	20	34	19.07	-	-	-	-	-	-	-	18.46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	U	24	-	-	-	-	-	CI	1	0	1	8	74	16	28.01	1.92	1.50	39.5	25.0	14.5	2.68	UU	62.0	8.5	-	0.791	-	0	19	-	Inorganic clays of Intermediate plasticity											
	29.50	D	25	12	16	22	38	38.00	CL	0	0	1	14	73	12	16.35	-	-	34.0	22.0	12.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	31.00	D	26	-	-	-	-	-	CL	3	2	2	9	70	14	17.80	-	-	34.0	20.0	14.0	-	-	-	-	-	-	-	-	-	-												
	32.50	D	27	14	18	26	44	44.00	-	-	-	-	-	-	-	16.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	-	-	-	-	-	CL	1	1	2	11	73	12	17.63	2.02	1.72	31.0	20.5	10.5	2.67	RUU	54.0	9.1	-	0.552	-	-	-	-												
	35.50	D	29	16	19	28	47	47.00	-	-	-	-	-	-	-	18.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	15.37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	18	23	32	55	55.00	CL	2	1	3	14	67	13	19.01	-	-	32.0	22.0	10.0	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	17	24	36	60	60.00	-	-	-	-	-	-	-	18.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 15: SUMMARY OF TEST RESULTS

Bore No : P55	**Ground Elevation : RL 191.309 m**	**Method of drilling :Percussion**	**Depth of Water : 1.40 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 03/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22356.887	**Casing Lowered : 22.00 m**	**Ending Date : 06/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	1	54	45	0	10.72	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	U	2	-	-	-	-	-	ML	0	0	1	48	47	4	8.91	1.97	1.81	24.0	20.0	4.0	2.63	DST	5.0	25.7	-	0.453	-	-	-	-	Inorganic Silts of low plasticity											
	2.00	D	3	2	3	5	8	10.95	SM	1	1	1	56	41	0	20.38	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	3.00	D	4	2	3	3	6	7.70	SM	0	0	0	68	32	0	20.43	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	4.00	U	5	-	-	-	-	-	SM	0	0	0	75	25	0	25.88	1.91	1.52	Non-Plastic			2.62	DST	0.0	28.7	-	0.724	-	-	-	-												
	5.00	D	6	3	5	6	11	12.81	-	-	-	-	-	-	-	25.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	3	5	8	13	14.54	-	-	-	-	-	-	-	25.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	-	-	-	-	-	SM	0	0	0	80	20	0	25.60	1.90	1.51	Non-Plastic			2.61	RDST	0.0	29.6	-	0.728	-	-	-	-												
	8.00	D	9	5	6	9	15	15.32	SM	4	5	5	64	22	0	22.21	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	4	6	8	14	14.15	-	-	-	-	-	-	-	19.69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL-ML	1	1	0	16	73	9	20.11	2.01	1.67	26.0	19.5	6.5	2.66	UU	48.0	9.2	0.131	0.593	-	9	18	-	Inorganic Silty Clays of low plasticity											
	11.00	D	12	5	7	9	16	15.08	CL-ML	1	1	10	22	59	7	18.71	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	6	8	11	19	16.24	CL	1	0	0	7	82	10	19.94	-	-	27.0	20.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	13.00	U	14	-	-	-	-	-	-	-	-	-	-	-	-	17.63	2.00	1.70	-	-	-	2.67	UU	54.0	8.5	-	0.571	-	-	-	-												
	14.50	D	15	8	12	17	29	29.00	CL	2	1	1	8	76	12	16.52	-	-	30.0	18.5	11.5	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	4	2	1	11	70	12	16.36	2.03	1.75	29.0	19.0	10.0	2.68	UU	56.0	11.6	-	0.536	-	-	-	-												
	17.50	D	17	5	13	19	32	20.28	ML	0	0	1	46	53	0	16.45	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											

APPENDIX "B"
TABLE 15: SUMMARY OF TEST RESULTS

Bore No : P55	**Ground Elevation : RL 191.309 m**	**Method of drilling :Percussion**	**Depth of Water : 1.40 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 03/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22356.887	**Casing Lowered : 22.00 m**	**Ending Date : 06/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL	0	0	1	17	72	10	19.64	1.96	1.64	28.0	20.0	8.0	2.66	UU	51.0	10.5	-	0.622	-	-	-	-	Inorganic clays of low plasticity											
	20.50	D	19	11	17	22	39	22.12	CL-ML	5	2	1	24	61	7	20.95	-	-	26.0	19.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	22.00	U	20	-	-	-	-	-	-	-	-	-	-	-	-	16.44	1.99	1.71	-	-	-	2.66	DST	11.0	23.9	-	0.556	-	-	-	-												
	23.50	D	21	12	18	25	43	22.68	-	-	-	-	-	-	-	18.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	MI	2	0	1	5	74	18	27.61	2.04	1.60	42.0	28.0	14.0	2.69	UU	70.0	12.6	-	0.681	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	26.50	D	23	18	22	32	54	54.00	-	-	-	-	-	-	-	26.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	16	18	35	53	53.00	-	-	-	-	-	-	-	25.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.50	D	25	14	24	32	56	25.18	CL-ML	0	0	1	36	58	5	19.89	-	-	25.0	20.5	4.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	31.00	D	26	16	25	32	57	25.10	-	-	-	-	-	-	-	15.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.50	D	27	18	22	35	57	24.71	CL-ML	4	1	0	35	53	7	18.38	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	21	28	36	64	64.00	CL	0	1	1	14	74	10	21.34	-	-	28.0	19.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	35.50	D	29	20	31	38	69	69.00	CL	0	1	2	20	68	9	15.84	-	-	27.5	19.5	8.0	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	25	32	36	68	68.00	-	-	-	-	-	-	-	22.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	20	31	38	69	26.52	CL-ML	0	0	1	28	64	7	22.74	-	-	26.0	20.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	40.00	D	32	22	36	42	78	28.55	-	-	-	-	-	-	-	19.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 16: SUMMARY OF TEST RESULTS

Bore No : P56	**Ground Elevation : RL 191.384 m**	**Method of drilling :Percussion**	**Depth of Water : 1.40 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 03/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22383.087	**Casing Lowered : 18.00 m**	**Ending Date : 05/11/2023**	**Hammer type: Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	1	48	51	0	11.29	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	U	2	-	-	-	-	-	SM-SC	2	1	2	52	38	5	17.90	1.95	1.65	24.0	20.0	4.0	2.63	DST	4.0	27.1	-	0.594	-	-	-	-	Silty Sands with clay binder											
	2.00	D	3	2	2	2	4	5.49	-	-	-	-	-	-	-	17.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	2	3	5	8	10.31	SM	2	1	1	56	40	0	20.69	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	U	5	-	-	-	-	-	-	-	-	-	-	-	-	21.75	1.93	1.59	-	-	-	2.63	DST	0.0	29.7	-	0.658	-	-	-	-												
	5.00	D	6	3	5	4	9	10.50	SM	1	1	2	60	36	0	26.14	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	2	4	4	8	8.96	-	-	-	-	-	-	-	26.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	U	8	-	-	-	-	-	SM	0	0	1	72	27	0	24.98	1.93	1.54	Non-Plastic			2.61	DST	0.0	28.9	-	0.690	-	-	-	-												
	8.00	D	9	3	5	7	12	12.00	CL	2	1	1	12	73	11	18.09	-	-	30.0	20.0	10.0	-	-	-	-	-	-	-	8	19	-	Inorganic clays of low plasticity											
	9.00	D	10	4	6	8	14	14.00	-	-	-	-	-	-	-	20.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	0	0	1	24	67	8	22.45	2.00	1.63	26.0	19.0	7.0	2.66	UU	42.0	11.4	0.146	0.632	-	-	-	-												
	11.00	D	12	3	5	7	12	11.35	-	-	-	-	-	-	-	18.63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.50	D	13	4	6	8	14	14.00	CL	0	0	1	10	79	10	19.49	-	-	27.0	19.0	8.0	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	1	0	0	14	76	9	20.68	2.01	1.67	25.0	18.0	7.0	2.67	UU	46.0	9.4	-	0.603	-	-	-	-												
	14.50	D	15	9	17	24	41	41.00	CL	0	0	1	8	79	12	20.87	-	-	32.0	22.0	10.0	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	5	2	2	6	72	13	17.84	2.04	1.73	31.0	20.0	11.0	2.68	UU	58.0	8.2	-	0.549	-	-	-	-												
	17.50	D	17	8	15	22	37	37.00	-	-	-	-	-	-	-	17.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 16: SUMMARY OF TEST RESULTS

Bore No : P56	**Ground Elevation : RL 191.384 m**	**Method of drilling :Percussion**	**Depth of Water : 1.40 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 03/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22383.087	**Casing Lowered : 18.00 m**	**Ending Date : 05/11/2023**	**Hammer type: Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL	4	2	2	14	67	11	14.46	2.03	1.77	29.0	20.5	8.5	2.67	UU	52.0	9.7	-	0.508	-	-	-	-												
	20.50	D	19	12	17	25	42	42.00	-	-	-	-	-	-	-	18.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	CL	1	0	0	8	79	12	20.00	2.05	1.71	31.0	20.0	11.0	2.68	UU	60.0	8.0	-	0.567	-	-	-	-	Inorganic clays of low plasticity											
	23.50	D	21	15	21	27	48	48.00	-	-	-	-	-	-	-	21.37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	D	22	-	-	-	-	-	CL	2	1	1	16	71	9	24.00	-	-	30.0	22.0	8.0	-	-	-	-	-	-	-	-	-	-												
	26.50	D	23	12	22	42	64	64.00	MI	0	0	1	5	77	17	25.61	-	-	38.0	26.0	12.0	2.68	-	-	-	-	-	-	-	-	-												
	28.00	D	24	11	21	32	53	53.00	-	-	-	-	-	-	-	23.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	29.50	D	25	8	19	21	40	40.00	-	-	-	-	-	-	-	17.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	-	-	-	-	-	CL	0	0	1	7	79	13	18.22	2.03	1.72	34.0	21.0	13.0	2.68	RUU	66.0	8.7	-	-	-	-	-	-												
	32.50	D	27	18	27	32	59	59.00	CL	2	1	1	12	75	9	17.12	-	-	29.0	21.5	7.5	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	17	26	31	57	57.00	CL	1	1	1	7	79	11	17.86	-	-	32.0	21.0	11.0	-	-	-	-	-	-	-	-	-	-												
	35.50	D	29	16	30	35	65	65.00	-	-	-	-	-	-	-	18.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	37.00	D	30	18	25	32	57	57.00	-	-	-	-	-	-	-	19.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	19	32	35	67	67.00	CL	0	1	1	10	77	11	19.93	-	-	30.0	20.5	9.5	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	17	23	32	55	55.00	-	-	-	-	-	-	-	20.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 17: SUMMARY OF TEST RESULTS

Bore No : P57	**Ground Elevation : RL 191.353 m**	**Method of drilling :Percussion**	**Depth of Water : 1.20 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 31/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 22409.287	**Casing Lowered : 20.00 m**	**Ending Date : 02/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen												
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM-SC	0	0	1	53	43	3	9.51	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Silty Sands with clay binder											
	1.00	U	2	-	-	-	-	-	SM-SC	0	1	1	58	33	7	21.67	1.96	1.61	26.0	21.5	4.5	2.64	DST	3.0	27.2	-	0.640	-	-	-	-												
	2.00	D	3	1	1	2	3	4.17	-	-	-	-	-	-	-	21.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	1	2	2	4	5.21	SM-SC	1	1	2	60	28	8	19.26	-	-	26.5	21.5	5.0	-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	-	-	-	-	-	-	-	-	-	-	-	-	24.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	5.00	D	6	2	3	6	9	10.59	SM	1	0	1	68	30	0	24.26	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	6.00	D	7	3	5	7	12	13.45	SM	0	0	2	64	34	0	25.69	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	-	-	-	-	-	SM	0	1	1	60	38	0	27.22	2.07	1.63	Non-Plastic			2.63	RDST	2.0	27.6	-	0.613	-	-	-	-												
	8.00	D	9	5	7	10	17	16.27	-	-	-	-	-	-	-	27.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	5	8	12	20	20.00	CL	2	1	1	5	82	9	20.21	-	-	29.0	21.0	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	10.00	U	11	-	-	-	-	-	CL	0	0	1	7	82	10	20.97	2.03	1.68	28.5	21.5	7.0	2.67	UU	53.0	9.6	0.106	0.589	-	0	20	-												
	11.00	D	12	7	9	10	19	16.36	-	-	-	-	-	-	-	21.58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	5	9	12	21	17.01	-	-	-	-	-	-	-	22.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL-ML	2	1	0	9	79	9	19.32	2.04	1.71	27.0	20.5	6.5	2.66	UU	48.0	10.5	-	0.556	-	-	-	-	Inorganic Silty Clays of low plasticity											
	14.50	D	15	8	13	18	31	20.62	-	-	-	-	-	-	-	16.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	1	0	2	39	47	11	17.07	2.06	1.76	25.5	17.0	8.5	2.67	UU	56.0	11.3	-	0.517	-	0	17	-	Inorganic clays of low plasticity											
	17.50	D	17	9	15	21	36	36.00	-	-	-	-	-	-	-	17.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	19.00	U	18	-	-	-	-	-	SM-SC	2	2	2	46	43	5	16.39	1.96	1.68	25.0	21.0	4.0	2.66	DST	6.0	25.2	-	0.583	-	-	-	-	Silty Sands with clay binder											

APPENDIX "B"
TABLE 17: SUMMARY OF TEST RESULTS

Bore No : P57	**Ground Elevation : RL 191.353 m**	**Method of drilling :Percussion**	**Depth of Water : 1.20 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 31/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 22409.287	**Casing Lowered : 20.00 m**	**Ending Date : 02/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	20.50	D	19	7	16	21	37	21.16	CL-ML	3	1	2	18	68	8	17.23	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	22.50	U	20	-	-	-	-	-	CL	4	2	2	12	69	11	18.63	2.02	1.70	29.0	20.5	8.5	2.67	UU	57.0	9.1	-	0.571	-	-	-	-	Inorganic clays of low plasticity											
	23.50	D	21	10	19	23	42	42.00	-	-	-	-	-	-	-	18.30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	D	22	-	-	-	-	-	SM	1	0	1	70	28	0	25.59	-	-		Non-Plastic		-	-	-	-	-	-	-	-	-	-	Silty Sands											
	26.50	D	23	14	28	30	58	26.56	-	-	-	-	-	-	-	25.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	13	27	33	60	60.00	CL	1	1	3	20	65	10	15.75	-	-	29.0	20.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	29.50	D	25	16	29	32	61	61.00	-	-	-	-	-	-	-	16.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	14	26	30	56	56.00	CL	1	1	2	17	71	8	23.56	-	-	28.0	20.0	8.0	-	-	-	-	-	-	-	-	-	-												
	32.50	D	27	15	27	31	58	58.00	-	-	-	-	-	-	-	22.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	-	-	-	-	-	SM	1	0	1	69	29	0	20.39	2.12	1.76		Non-Plastic		2.65	RDST	0.0	29.3	-	0.506	-	-	-	-	Silty Sands											
	35.50	D	29	15	25	27	52	22.14	SM	1	1	2	64	32	0	18.46	-	-		Non-Plastic		-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	17.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	13	24	25	49	20.72	SM	0	1	0	65	34	0	18.82	-	-		Non-Plastic		-	-	-	-	-	-	-	-	-	-	Silty Sands											
	40.00	D	32	16	23	27	50	20.71	-	-	-	-	-	-	-	19.69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"

TABLE 18: SUMMARY OF TEST RESULTS

Bore No : P58	Ground Elevation : RL 191.433 m	Method of drilling :Percussion	Depth of Water : 1.40 m
Diameter of Bore Hole : 150 mm	Bore Retained using : Casing	Starting Date : 02/11/2023	SPT Sampler: Standard
Location / Chainage : 22435.487	Casing Lowered : 20.00 m	Ending Date : 05/11/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	1	0	1	48	50	0	10.63	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	D	2	1	1	1	2	3.08	-	-	-	-	-	-	-	10.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	2.00	U	3	-	-	-	-	-	CL-ML	1	0	1	42	48	8	25.32	2.01	1.60	28.0	21.5	6.5	2.67	UU	44.0	11.5	0.147	0.669	-	8	18	-	Inorganic Silty Clays of low plasticity											
	3.00	D	4	1	2	2	4	5.10	SM	0	0	0	55	45	0	23.16	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	3	4	6	10	12.07	-	-	-	-	-	-	-	23.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	5.00	U	6	-	-	-	-	-	SM	0	0	0	52	48	0	23.37	1.98	1.60	Non-Plastic			2.62	DST	2.0	27.4	-	0.633	-	-	-	-												
	6.00	D	7	5	8	9	17	16.88	-	-	-	-	-	-	-	19.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	6	9	11	20	18.12	-	-	-	-	-	-	-	29.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Silty Sands											
	8.00	U	9	-	-	-	-	-	SM	0	0	1	70	29	0	26.81	1.94	1.53	Non-Plastic			2.62	DST	0.0	28.7	-	0.712	-	-	-	-												
	9.00	D	10	4	7	8	15	14.91	-	-	-	-	-	-	-	26.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	5	7	10	17	15.70	-	-	-	-	-	-	-	26.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	ML	0	1	1	32	59	7	21.73	2.02	1.66	27.0	22.0	5.0	2.66	DST	8.0	24.8	-	0.602	-	-	-	-	Inorganic Silts of low plasticity											
	12.50	D	13	6	8	11	19	19.00	CL	0	1	0	8	82	9	22.31	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL	2	1	1	6	80	10	19.96	2.03	1.69	29.0	21.0	8.0	2.67	UU	50.0	10.6	-	0.580	-	-	20	-	Inorganic clays of low plasticity											
	15.50	D	15	8	10	12	22	22.00	-	-	-	-	-	-	-	22.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	U	16	-	-	-	-	-	SM	0	0	1	55	44	0	19.81	1.93	1.61	Non-Plastic			2.63	DST	4.0	26.8	-	0.634	-	-	-	-	Silty Sands											
	18.50	D	17	9	14	18	32	19.93	-	-	-	-	-	-	-	21.37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"

TABLE 18: SUMMARY OF TEST RESULTS

Bore No : P58	Ground Elevation : RL 191.433 m	Method of drilling :Percussion	Depth of Water : 1.40 m
Diameter of Bore Hole : 150 mm	Bore Retained using : Casing	Starting Date : 02/11/2023	SPT Sampler: Standard
Location / Chainage : 22435.487	Casing Lowered : 20.00 m	Ending Date : 05/11/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	20.00	U	18	-	-	-	-	-	ML	3	2	0	40	50	5	21.48	1.97	1.62	26.0	22.0	4.0	2.65	DST	6.0	27.2	-	0.636	-	-	-	-	Inorganic Silts of low plasticity											
	21.50	D	19	12	27	30	57	28.32	CL	0	1	0	12	78	9	10.56	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	23.00	D	20	15	29	31	60	28.79	-	-	-	-	-	-	-	16.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	24.50	D	21	11	21	26	47	23.68	-	-	-	-	-	-	-	22.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	U	22	-	-	-	-	-	CL	1	1	0	5	81	12	21.96	2.04	1.67	30.0	20.5	9.5	2.68	UU	58.0	9.4	-	0.605	-	-	-	-												
	27.50	D	23	17	27	35	62	62.00	MI	0	1	0	3	79	17	30.80	-	-	42.0	27.0	15.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	29.00	D	24	13	20	23	43	43.00	CL	2	1	0	10	76	11	17.31	-	-	30.0	21.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	30.50	D	25	19	80	-	R	-	SM	2	1	1	53	43	0	19.11	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	32.00	D	26	43	100	-	R	-	CL-ML	0	1	1	38	55	5	15.96	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	33.50	D	27	30	36	38	74	29.44	SM	0	0	0	62	38	0	17.88	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	35.00	D	28	27	30	32	62	25.49	-	-	-	-	-	-	-	16.81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	36.50	D	29	28	29	36	65	25.97	-	-	-	-	-	-	-	16.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	29	33	38	71	27.26	SM	0	0	0	73	27	0	16.35	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	30	38	40	78	28.62	-	-	-	-	-	-	-	17.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 19: SUMMARY OF TEST RESULTS

Bore No : P59	**Ground Elevation : RL 191.466 m**	**Method of drilling :Percussion**	**Depth of Water : 1.50 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 03/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22461.687	**Casing Lowered : 21.00 m**	**Ending Date : 05/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	1	55	44	0	13.07	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	U	2	-	-	-	-	-	ML	0	0	1	48	47	4	14.20	1.94	1.70	24.0	20.0	4.0	2.64	DST	4.0	26.7	-	0.553	-	-	-	-	Inorganic Silts of low plasticity											
	2.00	D	3	1	2	2	4	5.46	-	-	-	-	-	-	-	20.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	1	2	3	5	6.41	SM	0	0	1	72	27	0	25.43	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	D	5	-	-	-	-	-	MI	0	1	1	5	81	12	22.89	1.93	1.57	38.0	26.0	12.0	2.67	RUU	62.0	7.2	-	0.701	-	14	14	-	Inorganic Silts of Intermediate plasticity											
	5.00	D	6	3	3	4	7	7.00	-	-	-	-	-	-	-	30.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	4	5	5	10	10.00	-	-	-	-	-	-	-	30.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	U	8	-	-	-	-	-	SM	0	0	0	72	28	0	26.30	1.90	1.50	Non-Plastic			2.61	DST	0.0	28.4	-	0.735	-	-	-	-	Silty Sands											
	8.00	D	9	6	7	9	16	15.82	-	-	-	-	-	-	-	26.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	5	8	10	18	16.57	-	-	-	-	-	-	-	24.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL-ML	4	2	1	14	72	7	19.30	2.01	1.68	27.0	21.0	6.0	2.66	UU	40.0	11.5	0.138	0.579	-	-	-	-	Inorganic Silty Clays of low plasticity											
	11.00	D	12	3	6	9	15	15.00	CL	1	0	0	8	82	9	23.80	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	12.00	D	13	5	8	12	20	20.00	-	-	-	-	-	-	-	20.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	3	1	1	7	77	11	20.20	2.03	1.69	29.0	20.5	8.5	2.67	UU	55.0	8.4	-	0.580	-	10	17	-												
	14.50	D	15	5	9	13	22	22.00	-	-	-	-	-	-	-	20.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	1	1	0	18	72	8	19.84	1.98	1.65	27.0	20.0	7.0	2.66	UU	50.0	11.8	-	0.612	-	-	-	-												
	17.50	D	17	7	12	15	27	18.28	-	-	-	-	-	-	-	18.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"

TABLE 19: SUMMARY OF TEST RESULTS

Bore No : P59	**Ground Elevation : RL 191.466 m**	**Method of drilling :Percussion**	**Depth of Water : 1.50 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 03/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22461.687	**Casing Lowered : 21.00 m**	**Ending Date : 05/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	SM	2	0	0	54	44	0	18.31	1.95	1.65	Non-Plastic			2.63	DST	2.0	27.6	-	0.594	-	-	-	-												
	20.50	D	19	9	15	18	33	19.88	-	-	-	-	-	-	-	17.46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Silty Sands											
	22.00	D	20	-	-	-	-	-	SM	0	0	0	74	26	0	24.20	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	23.50	D	21	17	26	38	64	30.22	CL-ML	1	1	0	14	77	7	19.20	-	-	28.0	22.0	6.0	-	-	-	-	-	-	-	-	-	-												
	25.00	D	22	14	23	32	55	26.50	-	-	-	-	-	-	-	21.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	26.50	D	23	16	28	31	59	27.32	CL-ML	4	1	1	17	70	7	23.76	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	18	27	33	60	60.00	MI	0	0	0	4	80	16	31.69	-	-	42.0	27.0	15.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	29.50	D	25	14	18	29	47	22.41	CL	5	2	3	24	59	7	16.66	-	-	27.5	20.5	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	31.00	U	26	-	-	-	-	-	SM-SC	1	0	1	48	46	4	19.06	2.01	1.69	24.0	20.0	4.0	2.65	DST	6.0	28.4	-	0.568	-	-	-	-	Silty Sands with clay binder											
	32.50	D	27	12	20	30	50	22.56	-	-	-	-	-	-	-	16.54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	U	28	-	-	-	-	-	CL-ML	0	0	1	42	52	5	18.60	2.03	1.71	26.0	21.0	5.0	2.65	DST	5.0	29.6	-	0.550	-	-	-	-	Inorganic Silty Clays of low plasticity											
	35.50	D	29	15	25	32	57	23.81	SM	0	0	1	54	45	0	18.05	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	17	26	33	59	23.97	-	-	-	-	-	-	-	17.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Silty Sands											
	38.50	D	31	20	25	35	60	23.91	SM	0	0	1	52	47	0	17.47	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	22	26	38	64	24.65	-	-	-	-	-	-	-	16.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 20: SUMMARY OF TEST RESULTS

Bore No: P60	**Ground Elevation: RL 191.483 m**	**Method of drilling: Percussion**	**Depth of Water: 1.65 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 27/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 22487.887	**Casing Lowered: 28.50 m**	**Ending Date: 02/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	0	65	35	0	13.02	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	D	2	2	3	3	6	9.17	-	-	-	-	-	-	-	17.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	2.00	U	3	-	-	-	-	-	CH	1	1	3	32	43	20	21.16	2.07	1.71	55.5	20.5	35.0	2.68	UU	62.0	9.7	0.250	0.567	-	-	15	-	Inorganic clays of high plasticity											
	3.00	D	4	3	5	9	14	14.00	CL	3	2	4	9	72	10	19.38	-	-	31.5	22.0	9.5	-	-	-	-	-	-	-	-	17	-	Inorganic clays of low plasticity											
	4.00	D	5	3	4	5	9	9.00	-	-	-	-	-	-	-	25.75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	5.00	U	6	-	-	-	-	-	SM	0	1	0	70	29	0	19.77	1.96	1.64	Non-Plastic			2.66	DST	5.0	29.4	-	0.622	-	-	-	-	Silty Sands											
	6.00	D	7	5	7	8	15	15.62	-	-	-	-	-	-	-	25.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	6	8	10	18	16.89	-	-	-	-	-	-	-	27.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	-	-	-	-	-	SM	0	0	1	65	34	0	21.55	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	7	9	15	24	19.26	CL-ML	1	1	2	28	60	8	19.74	-	-	25.0	19.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	10.00	D	11	6	10	12	22	17.94	-	-	-	-	-	-	-	21.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL	0	1	4	9	77	9	20.08	2.04	1.70	26.5	19.5	7.0	2.66	DST	14.0	24.6	-	0.565	-	-	-	-	Inorganic clays of low plasticity											
	12.50	D	13	7	11	15	26	18.97	-	-	-	-	-	-	-	18.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL-ML	3	0	1	11	77	8	22.68	2.09	1.70	27.5	21.5	6.0	2.66	-	-	-	-	0.565	-	-	-	-	Inorganic Silty Clays of low plasticity											
	15.50	D	15	7	12	13	25	17.67	CL-ML	2	2	1	16	72	7	18.42	-	-	25.0	19.0	6.0	-	-	-	-	-	-	-	-	-	-												
	17.00	U	16	-	-	-	-	-	CL	1	1	1	38	51	8	16.71	2.07	1.77	27.0	20.0	7.0	2.66	DST	15.0	23.9	-	0.503	-	-	-	-	Inorganic clays of low plasticity											

APPENDIX "B"
TABLE 20: SUMMARY OF TEST RESULTS

Bore No: P60	**Ground Elevation: RL 191.483 m**	**Method of drilling: Percussion**	**Depth of Water: 1.65 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 27/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 22487.887	**Casing Lowered: 28.50 m**	**Ending Date: 02/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction (Deg)	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	7	14	19	33	20.00	ML	0	0	1	42	57	0	18.51	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	20.00	U	18	-	-	-	-	-	CL	2	1	1	10	76	10	19.35	2.06	1.73	28.0	19.0	9.0	2.67	DST	19.0	23.7	-	0.543	-	-	-	-	Inorganic clays of low plasticity											
	21.50	D	19	9	15	20	35	35.00	-	-	-	-	-	-	-	20.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.00	U	20	-	-	-	-	-	CL	2	1	1	12	75	9	18.46	1.98	1.67	28.0	20.0	8.0	-	-	-	-	-	-	-	-	-	-												
	24.50	D	21	12	17	19	36	36.00	-	-	-	-	-	-	-	20.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	U	22	-	-	-	-	-	MI	0	0	0	1	81	18	28.76	2.00	1.55	47.5	27.5	20.0	2.69	UU	60.0	6.4	-	0.735	-	-	21	-	Inorganic Silts of Intermediate plasticity											
	27.50	D	23	10	15	19	34	34.00	-	-	-	-	-	-	-	32.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.00	U	24	-	-	-	-	-	CL-ML	0	1	2	28	64	5	20.57	2.09	1.73	26.5	20.5	6.0	2.65	UU	39.0	9.1	-	0.532	-	-	-	-	Inorganic Silty Clays of low plasticity											
	30.50	D	25	11	17	21	38	38.00	MI	0	0	0	3	81	16	31.08	-	-	47.0	28.0	19.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	32.00	U	26	-	-	-	-	-	CL-ML	1	4	3	27	59	6	19.15	1.93	1.62	25.0	20.0	5.0	2.65	-	-	-	-	0.636	-	-	-	-	Inorganic Silty Clays of low plasticity											
	33.50	D	27	10	22	33	55	23.29	ML	0	0	1	45	54	0	18.69	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	35.00	D	28	13	28	37	65	65.00	ML	3	2	4	22	61	8	15.88	-	-	33.0	24.0	9.0	-	-	-	-	-	-	-	-	-	-												
	36.50	D	29	19	35	42	77	28.63	ML	0	0	0	17	76	7	22.49	-	-	32.0	25.0	7.0	-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	25	39	50	89	89.00	CL-CI	3	2	2	10	70	13	13.13	-	-	35.0	22.0	13.0	-	-	-	-	-	-	-	-	-	-	Inorganic Clays of low to Intermediate plasticity											
	40.00	D	31	22	66	34	100	100.00	-	-	-	-	-	-	-	15.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX-B
TABLE 21: CHEMICAL TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	SULPHATE CONTENT AS SO_3 (%)	CHLORIDE CONTENT (%)	pH VALUE
P60	3.00	0.069	0.092	8.13

APPENDIX-B
TABLE 22: UCS TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	UCS (kg/cm²)
P41	2.00	0.71
	8.00	0.49
	11.00	0.58
	14.00	0.64
	17.00	0.60
P42	1.00	0.91
	4.00	0.95
	10.00	0.65
	13.00	0.67
	22.00	0.71
	25.00	0.60
	28.00	0.65
P43	10.00	0.68
	13.00	0.76
	16.00	0.92
	22.00	0.83
	31.00	0.71
P44	1.00	0.76
	10.00	0.82
	13.00	0.72
	19.00	0.67
	25.00	0.75
P45	10.00	0.52
	13.00	0.63
	16.00	0.68
	19.00	0.60
	22.00	0.69
	25.00	0.60
	28.00	0.83
P46	10.00	0.58
	13.00	0.71

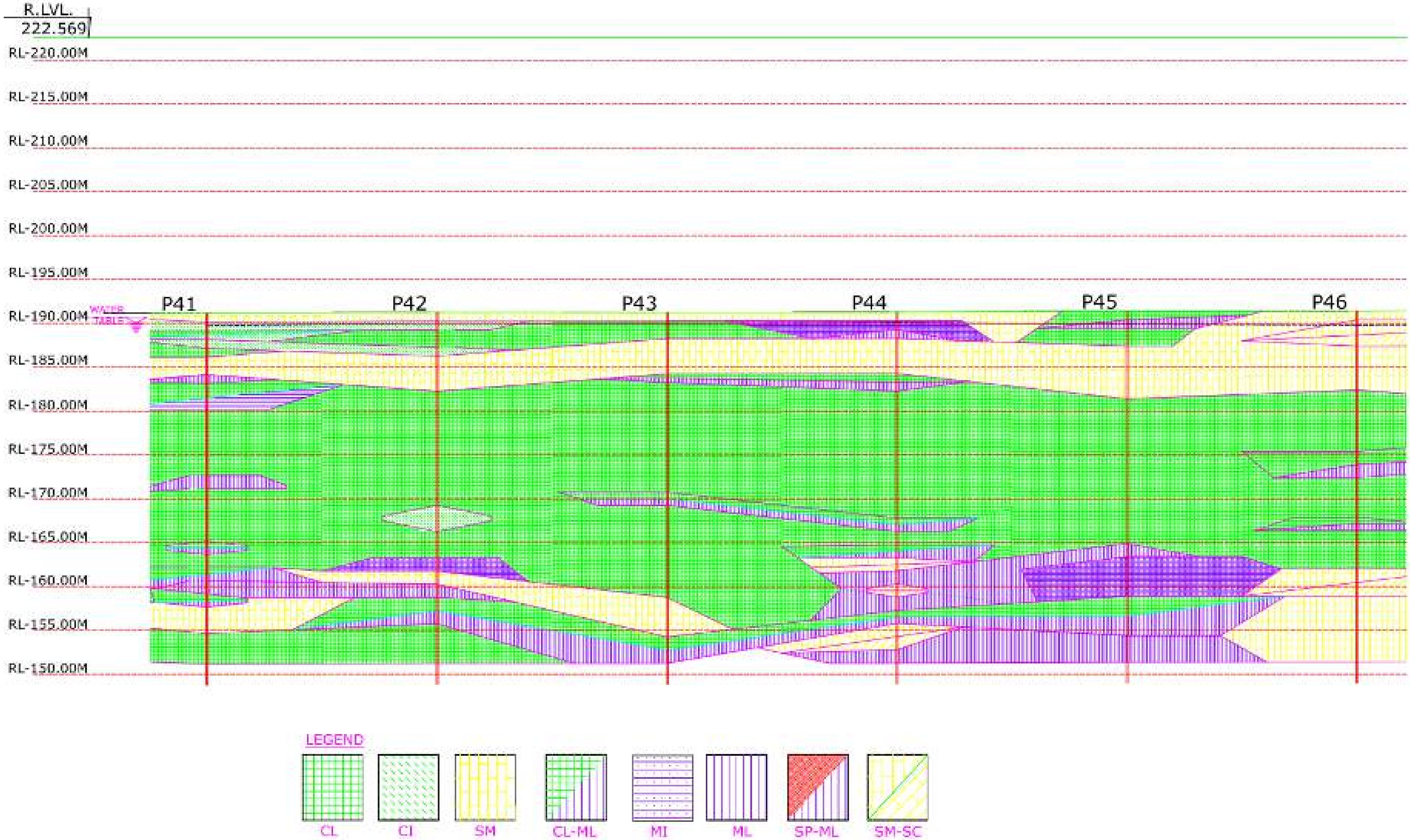
APPENDIX-B
TABLE 22: UCS TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	UCS (kg/cm²)
	19.00	0.62
	22.00	0.69
P47	11.00	0.70
	17.00	0.64
	20.00	0.67
	23.00	0.69
	29.00	0.62
P48	11.00	0.64
	14.00	0.89
	17.00	0.62
	20.00	0.61
P49	11.00	0.63
	14.00	0.69
	17.00	0.73
	20.00	0.76
	23.00	0.86
	32.00	0.67
P50	10.00	0.79
	13.00	0.86
	16.00	0.89
	31.00	1.02
P51	13.00	0.78
	16.00	0.82
P52	13.00	0.58
	16.00	0.52
P53	13.00	0.70
	16.00	0.67
	28.00	0.87
P54	16.00	0.52
	28.00	0.71
P55	10.00	0.61

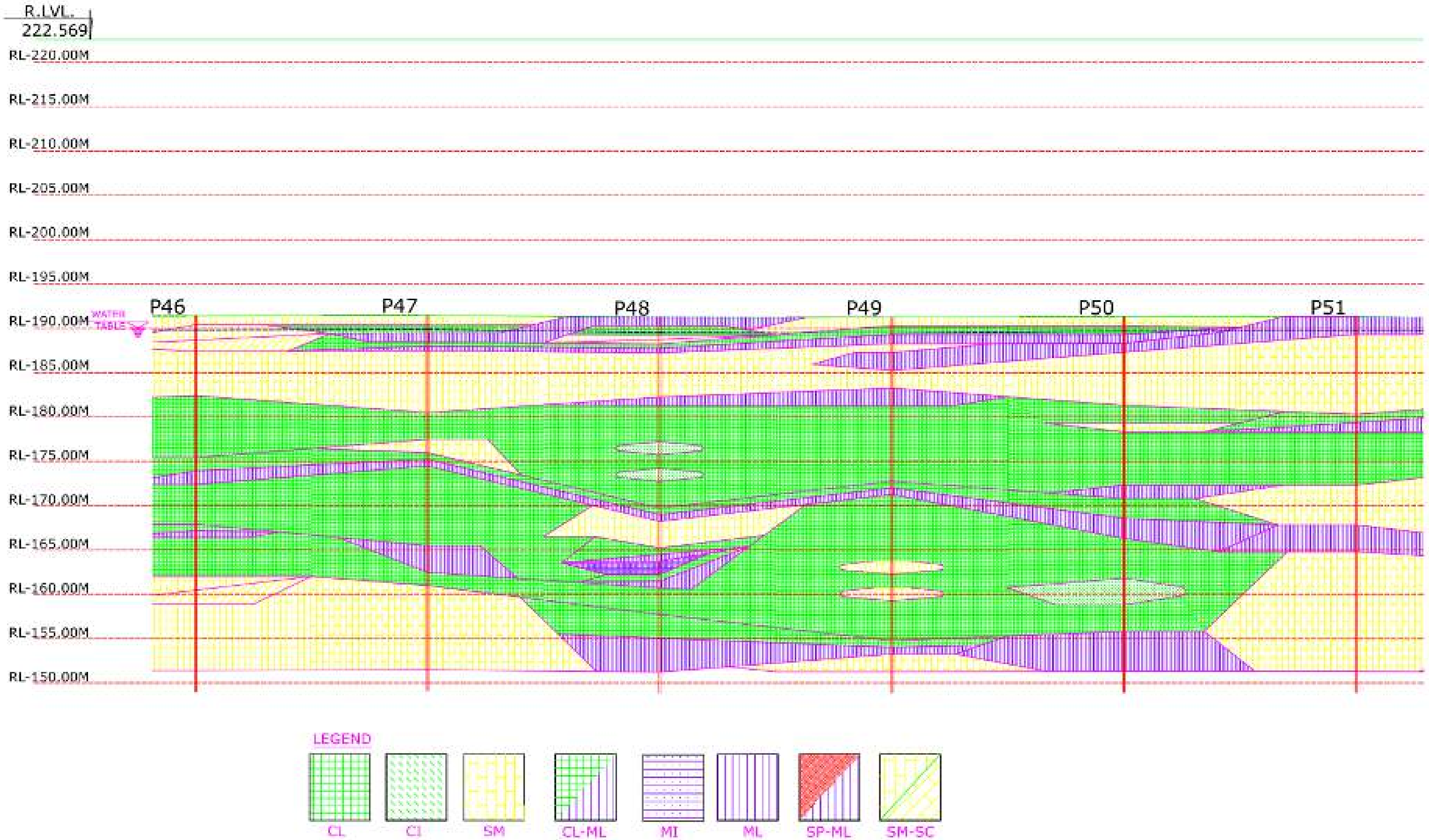
APPENDIX-B
TABLE 22: UCS TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	UCS (kg/cm²)
	13.00	0.72
	16.00	0.69
	19.00	0.66
	25.00	0.85
P56	10.00	0.58
	13.00	0.54
	16.00	0.64
	19.00	0.63
	22.00	0.75
P57	10.00	0.68
	13.00	0.53
	16.00	0.62
	22.50	0.55
P58	2.00	0.49
	14.00	0.63
	26.00	0.68
P59	10.00	0.45
	13.00	0.58
	16.00	0.61
P60	2.00	0.70
	26.00	0.53
	29.00	0.64

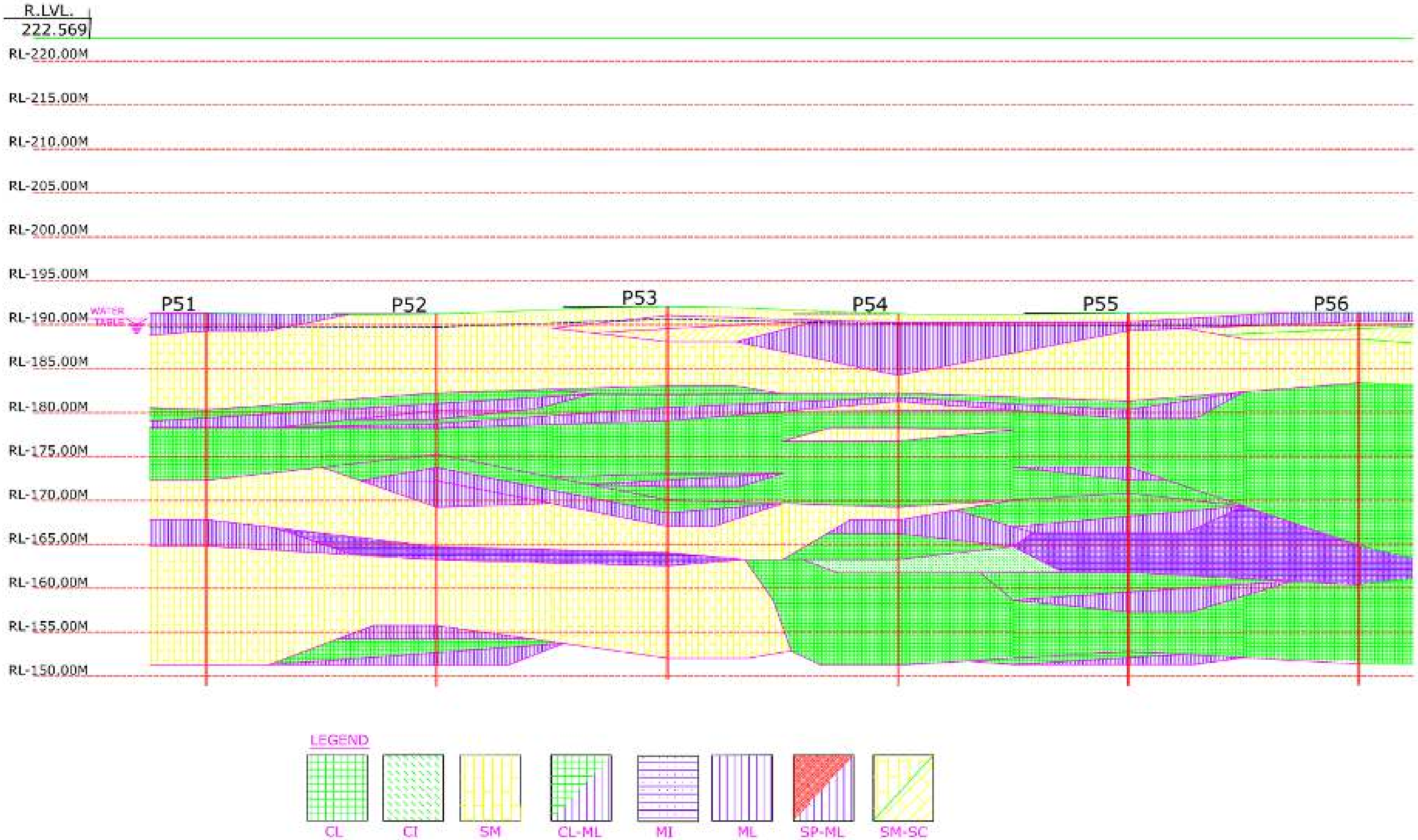
APPENDIX-C
PLOT 1: LITHOLOGICAL PROFILE-01



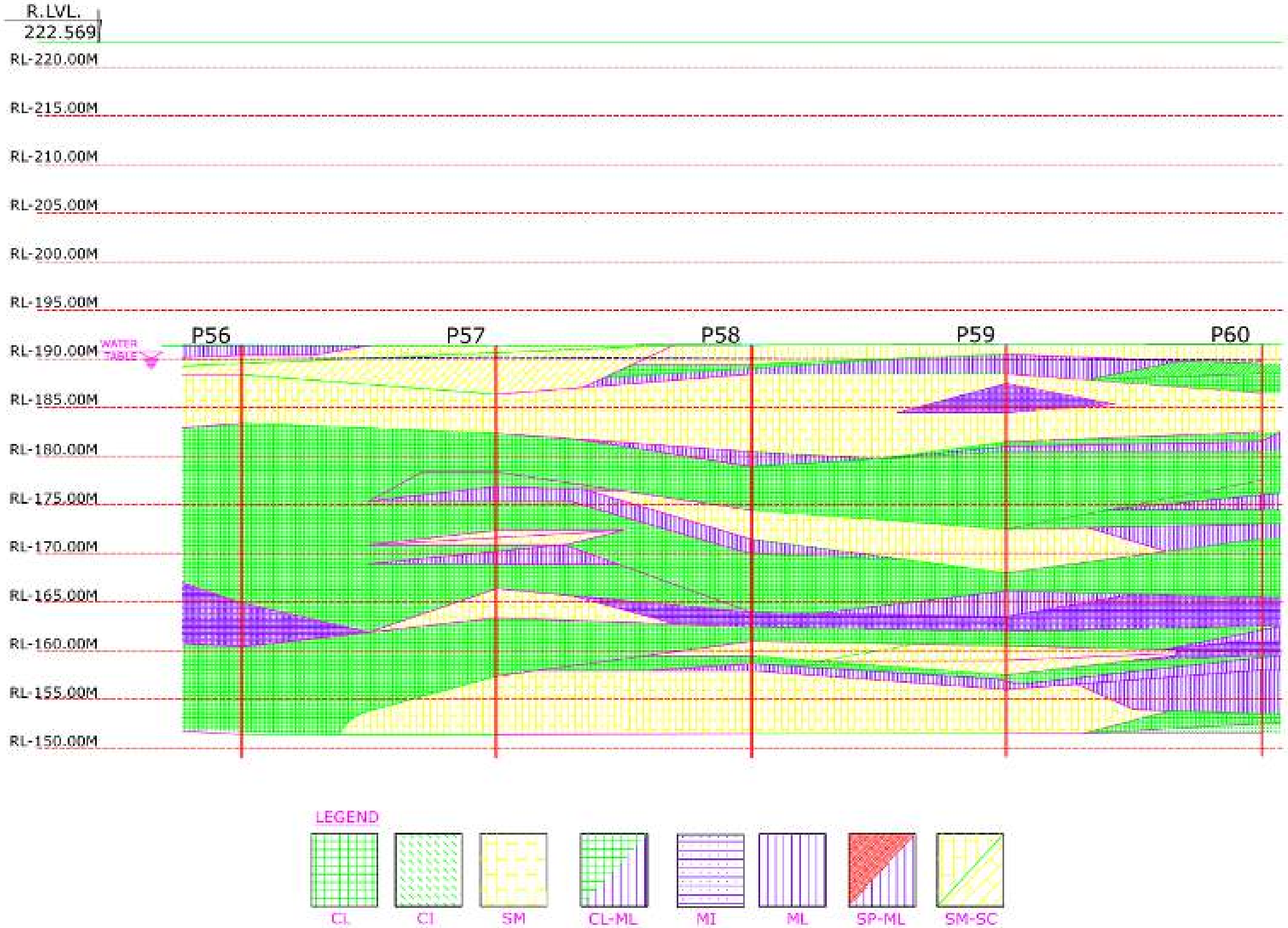
APPENDIX-C
PLOT 2: LITHOLOGICAL PROFILE-02



APPENDIX-C
PLOT 3: LITHOLOGICAL PROFILE-03



APPENDIX-C
PLOT 4: LITHOLOGICAL PROFILE-04



APPENDIX-C
PLOT 5: LITHOLOGICAL PLOTS

BH-P41-21990.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
Inorganic clays of Intermediate plasticity			1.00	D	3	-	-
Inorganic Clays of low to intermediate plasticity	CL-CI		2.00	U		-	-
Inorganic clays of Intermediate plasticity	CI		3.00	D	7	-	-
Inorganic clays of low plasticity	CL		4.00	D	9	-	-
			5.00	U		-	-
Silty Sands	SM		6.00	D	16	-	-
Inorganic Silts of low plasticity	ML		7.00	D	17	-	-
			8.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		9.00	D	18	-	-
			10.00	U	20	-	-
			11.00	U		-	-
Inorganic clays of low plasticity	CL		12.50	D	19	-	-
			14.00	U		-	-
			15.50	D	23	-	-
			17.00	U		-	-
Inorganic Silts of low plasticity	ML		18.50	D	27	-	-
			20.00	D		-	-

BH-P41-21990.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	U		-	-
Inorganic clays of low plasticity	CL		21.50	D	37	-	-
			23.00	D		-	-
			24.50	D	42	-	-
			26.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		27.50	D	40	-	-
Inorganic clays of low plasticity	CL		29.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		30.50	D	47	-	-
Inorganic Silts of low plasticity	ML		32.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		33.50	D	49	-	-
Silty Sands	SM		35.00	D		-	-
			36.50	D	54	-	-
Inorganic clays of low plasticity	CL		38.00	D	57	-	-
			40.00	D	64	-	-

APPENDIX-C

PLOT 6: LITHOLOGICAL PLOTS

BH-P42-22016.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
Inorganic clays of Intermediate plasticity	CI		1.00	U		-	-
			2.00	D	10	-	-
Inorganic clays of low plasticity	CL		3.00	D	12	-	-
Inorganic clays of Intermediate plasticity	CI		4.00	U		-	-
Silty Sands	SM		5.00	D	16	-	-
			6.00	D	14	-	-
			7.00	D		-	-
			8.00	D	13	-	-
Inorganic clays of low plasticity	CI		9.00	D	11	-	-
			10.00	U		-	-
			11.00	D	18	-	-
			12.00	D	25	-	-
			13.00	U		-	-
			14.50	D	17	-	-
			16.00	U		-	-
			17.50	D	18	-	-
			19.00	U		-	-
			20.00	D	28	-	-

BH-P42-22016.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.50	D	28	-	-
Inorganic clays of Intermediate plasticity	CI		22.00	U		-	-
			23.50	D	36	-	-
Inorganic clays of low plasticity	CL		25.00	U		-	-
			26.50	D	56	-	-
Inorganic Silts of Intermediate plasticity	MI		28.00	U		-	-
Silty Sands	SM		29.50	D	47	-	-
Inorganic Silts of low plasticity	ML		31.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		32.50	D	56	-	-
			34.00	D	53	-	-
Inorganic clays of low plasticity	CL		35.50	D	50	-	-
			37.00	D	49	-	-
			38.50	D	47	-	-
			40.00	D	50	-	-

APPENDIX-C
PLOT 7: LITHOLOGICAL PLOTS

BH-P43-22042.4870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	U		-	-
Inorganic clays of low plasticity	CL		2.00	D	6	-	-
Silty Sands	SM		3.00	D	6	-	-
			4.00	U		-	-
			5.00	D	12	-	-
			6.00	D	12	-	-
Inorganic Silty Clays of low plasticity	CL-ML		7.00	U		-	-
Inorganic clays of low plasticity	CL		8.00	D	13	-	-
			9.00	D	16	-	-
			10.00	U		-	-
			11.00	D	27	-	-
			12.00	D	31	-	-
			13.00	U		-	-
			14.50	D	14	-	-
			16.00	U		-	-
			17.50	D	18	-	-
			19.00	D		-	-
			20.00	D	22	-	-

WATER LEVEL

BH-P43-22042.4870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CI		20.50	D	22	-	-
Inorganic Silty Clays of low plasticity	CL-ML		22.00	U		-	-
Inorganic clays of low plasticity	CL		23.50	D	31	-	-
			25.00	D		-	-
			26.50	D	49	-	-
			28.00	D		-	-
			29.50	D	39	-	-
			31.00	U		-	-
Silty Sands	SM		32.50	D	67	-	-
			34.00	D	58	-	-
			35.50	D	48	-	-
Inorganic Silty Clays of low plasticity	CL-ML		37.00	D		-	-
			38.50	D	50	-	-
			40.00	D	57	-	-

APPENDIX-C
PLOT 8: LITHOLOGICAL PLOTS

BH-P44-22068.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	U		-	-
Inorganic Silts of intermediate plasticity	MI						
Inorganic Silts of low plasticity	ML		2.00	D	6	-	-
			3.00	D	17	-	-
Silty Sands	SM		4.00	U		-	-
			5.00	D	14	-	-
			6.00	D	16	-	-
			7.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		8.00	D	12	-	-
			9.00	D	12	-	-
Inorganic clays of low plasticity	CL		10.00	U		-	-
			11.00	D	15	-	-
			12.00	D	16	-	-
			13.00	U		-	-
			14.50	D	14	-	-
			16.00	D		-	-
			17.50	D	18	-	-
			19.00	U		-	-
			20.00	D	29	-	-

BH-P44-22068.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.50	D	29	-	-
			22.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		23.50	D	22	-	-
			25.00	U		-	-
Inorganic clays of low plasticity	CL		26.50	D	35	-	-
Inorganic Silty Clays of low plasticity	CL-ML		28.00	U		-	-
Silty Sands with clay binder	SM-SC		29.50	D	52	-	-
Inorganic Silts of low plasticity	ML		31.00	D	45	-	-
Silty Sands with clay binder	SM-SC		32.50	D	50	-	-
Inorganic Silts of low plasticity	ML		34.00	D	51	-	-
Inorganic Silty Clays of low plasticity	CL-ML		35.50	D	50	-	-
Silty Sands with clay binder	SM-SC		37.00	D	53	-	-
			38.50	D	51	-	-
Inorganic Silts of low plasticity	ML		40.00	D	48	-	-

APPENDIX-C
PLOT 9: LITHOLOGICAL PLOTS

BH-P45-22094.887

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CI-ML		0.50	D		-	-
			1.00	U		-	-
Inorganic clays of low plasticity	CL		2.00	D	7	-	-
			3.00	D	6	-	-
Silty Sands	SM		4.00	U		-	-
			5.00	D	16	-	-
			6.00	D	14	-	-
			7.00	U		-	-
			8.00	D	13	-	-
			9.00	D	19	-	-
Inorganic clays of low plasticity	CL		10.00	U		-	-
			11.00	D	23	-	-
			12.00	D	21	-	-
			13.00	U		-	-
			14.50	D	23	-	-
			16.00	U		-	-
			17.50	D	38	-	-
			19.00	U		-	-
			20.00	D	43	-	-

BH-P45-22094.887

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.50	D	43	-	-
			22.00	U		-	-
			23.50	D	45	-	-
			25.00	U		-	-
Inorganic Silts of low plasticity	ML		26.50	D	42	-	-
			28.00	U		-	-
Inorganic Silts of Intermediate plasticity	MI		29.50	D	62	-	-
			31.00	D	55	-	-
Inorganic Silty Clays of low plasticity	CI-ML		32.50	D	45	-	-
			34.00	D		-	-
			35.50	D	60	-	-
Inorganic Silts of low plasticity	ML		37.00	D	56	-	-
			38.50	D	46	-	-
			40.00	D	54	-	-

APPENDIX-C
PLOT 10: LITHOLOGICAL PLOTS

BH-P46-22121.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
Silty Sands with clay binder	SM-SC		1.00	U		-	-
			2.00	D	5	-	-
			3.00	D	9	-	-
Silty Sands	SM		4.00	D		-	-
			5.00	D	6	-	-
			6.00	D	8	-	-
			7.00	U		-	-
			8.00	D	12	-	-
Inorganic clays of low plasticity	CL		9.00	D	17	-	-
			10.00	U		-	-
			11.00	D	19	-	-
			12.00	D	22	-	-
			13.00	U		-	-
			14.50	D	31	-	-
Inorganic Silty Clays of low plasticity	CI-MI		16.00	U		-	-
			17.50	D	28	-	-
Inorganic clays of low plasticity	CL		19.00	U		-	-
			20.00	D	39	-	-

BH-P46-22121.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.50	D	39	-	-
			22.00	U		-	-
Inorganic Silty Clays of low plasticity	CI-MI		23.50	D	55	-	-
Inorganic clays of low plasticity	CL		25.00	D	49	-	-
			26.50	D	56	-	-
			28.00	D	61	-	-
Silty Sands with clay binder	SM-SC		29.50	D	65	-	-
			31.00	D	68	-	-
Silty Sands	SM		32.50	D	57	-	-
			34.00	D		-	-
			35.50	D	52	-	-
			37.00	D		-	-
			38.50	D	55	-	-
			40.00	D	59	-	-

APPENDIX-C

PLOT 11: LITHOLOGICAL PLOTS

BH-P47-22147.287

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
Inorganic clays of low plasticity	CL		1.00	D	2	-	-
Inorganic Silts of low plasticity	ML		2.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		3.00	D	9	-	-
			4.00	D	11	-	-
			5.00	U		-	-
			6.00	D	16	-	-
Silty Sands	SM		7.00	D	21	-	-
			8.00	U		-	-
			9.00	D	17	-	-
			10.00	D	19	-	-
			11.00	U		-	-
Inorganic clays of low plasticity	CL		12.50	D	28	-	-
Silty Sands	SM		14.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		15.50	D	20	-	-
			17.00	U		-	-
Inorganic clays of low plasticity	CL		18.50	D	34	-	-
			20.00	U		-	-

BH-P47-22147.287

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	U		-	-
			21.50	D	37	-	-
Inorganic clays of low plasticity	CL		23.00	U		-	-
			24.50	D	52	-	-
			26.00	D	41	-	-
Inorganic Silts of low plasticity	ML		27.50	D	45	-	-
Inorganic clays of low plasticity	CL		29.00	U		-	-
			30.50	D	48	-	-
			32.00	D		-	-
			33.50	D	51	-	-
Silty Sands	SM		35.00	D		-	-
			36.50	D	60	-	-
			38.00	D	56	-	-
			40.00	D	62	-	-

APPENDIX-C
PLOT 12: LITHOLOGICAL PLOTS

BH-P48-22173.4870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
Inorganic clays of low plasticity	CL		1.00	D	3	-	-
Silty Sands with clay binder	SM-SC		2.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		3.00	D	11	-	-
Silty Sands	SM		4.00	D	12	-	-
			5.00	D		-	-
			6.00	D	10	-	-
			7.00	D	12	-	-
			8.00	D		-	-
Inorganic Silts of low plasticity	ML		9.00	D	9	-	-
Inorganic clays of low plasticity	CL		10.00	D	13	-	-
			11.00	U		-	-
			12.50	D	31	-	-
Inorganic clays of Intermediate plasticity	CI		14.00	U		-	-
Inorganic clays of low plasticity	CL		15.50	D	27	-	-
Inorganic clays of Intermediate plasticity	CI		17.00	U		-	-
Inorganic clays of low plasticity	CL		18.50	D	36	-	-
			20.00	U		-	-

BH-P48-22173.4870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		21.50	D	45	-	-
Silty Sands	SM		23.00	D		-	-
			24.50	D	45	-	-
Inorganic Silty Clays of low plasticity	CL-ML		26.00	U		-	-
Inorganic Silts of Intermediate plasticity	MI		27.50	D	50	-	-
Inorganic Silty Clays of low plasticity	CL-ML		29.00	D		-	-
Inorganic Silts of low plasticity	ML		30.50	D	51	-	-
			32.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		33.50	D	56	-	-
			35.00	D		-	-
			36.50	D	55	-	-
			38.00	D		-	-
			40.00	D	63	-	-

APPENDIX-C
PLOT 13: LITHOLOGICAL PLOTS

BH-P49-22199.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	D	5	-	-
Inorganic Silty Clays of low plasticity			2.00	D		-	-
Silty Sands	SM		3.00	D	8	-	-
			4.00	D	12	-	-
Inorganic Silts of low plasticity	ML		5.00	D		-	-
			6.00	D	14	-	-
Silty Sands	SM		7.00	D	13	-	-
			8.00	D		-	-
Inorganic Silts of low plasticity	ML		9.00	D	9	-	-
			10.00	D	23	-	-
			11.00	U		-	-
			12.50	D	21	-	-
Inorganic clays of low plasticity	CL		14.00	U		-	-
			15.50	D	17	-	-
			17.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		18.50	D	26	-	-
			20.00	U		-	-

BH-P49-22199.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	U		-	-
			21.50	D	41	-	-
Inorganic clays of low plasticity	CL		23.00	U		-	-
			24.50	D	44	-	-
			26.00	D		-	-
Silty Sands	SM		27.50	D	43	-	-
Inorganic clays of low plasticity	CL		29.00	U		-	-
Silty Sands	SM		30.50	D	42	-	-
			32.00	U		-	-
			33.50	D	46	-	-
Inorganic clays of low plasticity	CL		35.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		36.50	D	49	-	-
Silty Sands	SM		38.00	D		-	-
			40.00	D	55	-	-

APPENDIX-C
PLOT 14: LITHOLOGICAL PLOTS

BH-P50-22225.8870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
		WATER LEVEL	1.00	U		-	-
Inorganic Silty Clays of low plasticity	CI-ML		2.00	D	8	-	-
Inorganic Silts of low plasticity	ML		3.00	D	7	-	-
			4.00	D		-	-
			5.00	D	14	-	-
			6.00	D	16	-	-
Silty Sands	SM		7.00	D		-	-
			8.00	D	22	-	-
			9.00	D	25	-	-
			10.00	U		-	-
Inorganic clays of low plasticity	CI		11.00	D	24	-	-
Silty Sands	SM		12.00	D	30	-	-
			13.00	U		-	-
			14.50	D	21	-	-
Inorganic clays of low plasticity	CI		16.00	U		-	-
			17.50	D	23	-	-
Inorganic Silts of low plasticity	ML		19.00	U		-	-
			20.00	D	22	-	-

BH-P50-22225.8870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		20.50	D	22	-	-
			22.00	D		-	-
Inorganic Silty Clays of low plasticity	CI-ML		23.50	D	28	-	-
			25.00	D		-	-
			26.50	D	47	-	-
Inorganic clays of low plasticity	CL		28.00	D		-	-
			29.50	D	47	-	-
Inorganic clays of intermediate plasticity	CI		31.00	U		-	-
			32.50	D	50	-	-
Inorganic clays of low plasticity	CL		34.00	D		-	-
			35.50	D	45	-	-
			37.00	D		-	-
Inorganic Silts of low plasticity	ML		38.50	D	48	-	-
			40.00	D	56	-	-

APPENDIX-C
PLOT 15: LITHOLOGICAL PLOTS

BH-P51-22252.0870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	D		-	-
Silty Sands	SM		2.00	D	5	-	-
			3.00	D	6	-	-
			4.00	D		-	-
			5.00	D	12	-	-
			6.00	D	14	-	-
			7.00	D		-	-
			8.00	D	21	-	-
			9.00	D	30	-	-
			10.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		11.00	D	22	-	-
			12.00	D	23	-	-
Inorganic clays of low plasticity	CL		13.00	U		-	-
			14.50	D	30	-	-
			16.00	U		-	-
			17.50	D	23	-	-
Silty Sands	SM		19.00	U		-	-
			20.00	D	21	-	-

BH-P51-22252.0870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		20.50	D	21	-	-
			22.00	D		-	-
Inorganic Silts of low plasticity	ML		23.50	D	35	-	-
			25.00	D		-	-
Silty Sands	SM		26.50	D	39	-	-
			28.00	U		-	-
			29.50	D	46	-	-
			31.00	D		-	-
			32.50	D	51	-	-
			34.00	U		-	-
			35.50	D	50	-	-
			37.00	D		-	-
			38.50	D	57	-	-
			40.00	D	62	-	-

APPENDIX-C
PLOT 16: LITHOLOGICAL PLOTS

BH-P52-22278.287

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			0.50	D		-	-
	WATER LVL		1.00	U		-	-
			2.00	D	6	-	-
			3.00	D	9	-	-
Silty Sands	SM		4.00	U		-	-
			5.00	D	10	-	-
			6.00	D	12	-	-
			7.00	U		-	-
			8.00	D	12	-	-
			9.00	D	14	-	-
Inorganic Silty Clays of low plasticity	CL-ML		10.00	U		-	-
Inorganic Silts of low plasticity	ML		11.00	D	13	-	-
Inorganic Silty Clays of low plasticity	CL-ML		12.00	D	15	-	-
			13.00	U		-	-
Inorganic clays of low plasticity	CI		14.50	D	24	-	-
			16.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		17.50	D	22	-	-
Inorganic Silts of low plasticity	ML		19.00	U		-	-
			20.00	D	33	-	-

BH-P52-22278.287

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		20.50	D	33	-	-
			22.00	U		-	-
Silty Sands	SM		23.50	D	33	-	-
			25.00	D		-	-
			26.50	D	57	-	-
Inorganic Silts of Intermediate plasticity	MI		28.00	D	52	-	-
			29.50	D	59	-	-
Silty Sands	SM		31.00	D	76	-	-
			32.50	D	60	-	-
			34.00	D	62	-	-
			35.50	D	61	-	-
Inorganic Silts of low plasticity	ML		37.00	D	61	-	-
Inorganic Silty Clays of low plasticity	CL-ML		38.50	D	58	-	-
			40.00	D	65	-	-

APPENDIX-C

PLOT 17: LITHOLOGICAL PLOTS

BH-P53-22304.487

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	U		-	-
Silty Sands with clay binder	SM-SC		2.00	D	6	-	-
			3.00	D	7	-	-
Silty Sands	SM		4.00	U		-	-
			5.00	D	10	-	-
			6.00	D	13	-	-
			7.00	D		-	-
			8.00	D	26	-	-
Inorganic clays of low plasticity	CL		9.00	D	23	-	-
			10.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		11.00	D	37	-	-
			12.00	D	33	-	-
Inorganic clays of low plasticity	CL		13.00	U		-	-
			14.50	D	33	-	-
			16.00	U		-	-
			17.50	D	33	-	-
Inorganic Silty Clays of low plasticity	CL-ML		19.00	U		-	-
			20.00	D	45	-	-

BH-P53-22304.487

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML						
Inorganic clays of low plasticity	CL		20.50	D	45	-	-
			22.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		23.50	D	60	-	-
Silty Sands	SM		25.00	D	40	-	-
			26.50	D	35	-	-
Inorganic Silts of Intermediate plasticity	MI		28.00	U		-	-
Silty Sands	SM		29.50	D	50	-	-
			31.00	D		-	-
			32.50	D	60	-	-
			34.00	D	63	-	-
			35.50	D	72	-	-
			37.00	D	60	-	-
			38.50	D	58	-	-
			40.00	D	67	-	-

APPENDIX-C
PLOT 18: LITHOLOGICAL PLOTS

BH-P54-22330.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
	WATER LVL		1.00	D		-	-
Inorganic Silts of low plasticity	ML		2.00	D	5	-	-
			3.00	D	7	-	-
			4.00	D		-	-
			5.00	D	9	-	-
			6.00	D	15	-	-
Silty Sands	SM		7.00	D		-	-
			8.00	D	21	-	-
Inorganic Silty Clays of low plasticity	CL-ML		9.00	D	23	-	-
Silty Sands	SM		10.00	U		-	-
Inorganic clays of low plasticity	CL		11.00	D	21	-	-
			12.00	D	19	-	-
Silty Sands	SM		13.00	U		-	-
Inorganic clays of low plasticity	CL		14.50	D	22	-	-
			16.00	U		-	-
			17.50	D	34	-	-
			19.00	D		-	-
			20.00	D	36	-	-

BH-P54-22330.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.50	D	36	-	-
Silty Sands	SM		22.00	D		-	-
Inorganic Silts of low plasticity	ML		23.50	D	43	-	-
Inorganic clays of low plasticity	CL		25.00	U		-	-
			26.50	D	34	-	-
Inorganic clays of intermediate plasticity	CI		28.00	U		-	-
Inorganic clays of low plasticity	CL		29.50	D	38	-	-
			31.00	D		-	-
			32.50	D	44	-	-
			34.00	D		-	-
			35.50	D	47	-	-
			37.00	D		-	-
			38.50	D	55	-	-
			40.00	D	60	-	-

APPENDIX-C

PLOT 19: LITHOLOGICAL PLOTS

BH-P55-22356.887

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
Inorganic Silts of low plasticity	ML		1.00	U		-	-
			2.00	D	8	-	-
			3.00	D	6	-	-
			4.00	U		-	-
			5.00	D	11	-	-
Silty Sands	SM		6.00	D	13	-	-
			7.00	D		-	-
			8.00	D	15	-	-
			9.00	D	14	-	-
			10.00	U		-	-
Inorganic Silty Clays of low plasticity	CI-ML		11.00	D	16	-	-
			12.00	D	19	-	-
			13.00	U		-	-
Inorganic clays of low plasticity	CL		14.50	D	29	-	-
			16.00	U		-	-
			17.50	D	32	-	-
Inorganic Silts of low plasticity	ML						
Inorganic clays of low plasticity	CL		19.00	U		-	-
			20.00	D	39	-	-

BH-P55-22356.887

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.50	D	39	-	-
			22.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		23.50	D	43	-	-
			25.00	U		-	-
			26.50	D	54	-	-
Inorganic Silts of Intermediate plasticity	MI		28.00	D	53	-	-
			29.50	D	56	-	-
			31.00	D	57	-	-
Inorganic Silty Clays of low plasticity	CL-ML		32.50	D	57	-	-
			34.00	D	64	-	-
			35.50	D	69	-	-
Inorganic clays of low plasticity	CL		37.00	D	68	-	-
			38.50	D	69	-	-
Inorganic Silty Clays of low plasticity	CL-ML		40.00	D	78	-	-

APPENDIX-C
PLOT 20: LITHOLOGICAL PLOTS

BH-P56-22383.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	U		-	-
Silty Sands with clay binder	SM-SC		2.00	D	4	-	-
			3.00	D	8	-	-
			4.00	U		-	-
Silty Sands	SM		5.00	D	9	-	-
			6.00	D	8	-	-
			7.00	U		-	-
			8.00	D	12	-	-
			9.00	D	14	-	-
			10.00	U		-	-
			11.00	D	12	-	-
			12.50	D	14	-	-
			13.00	U		-	-
Inorganic clays of low plasticity	CL		14.50	D	41	-	-
			16.00	U		-	-
			17.50	D	37	-	-
			19.00	U		-	-
			20.00	D	42	-	-

BH-P56-22383.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.50	D	42	-	-
			22.00	U		-	-
Inorganic clays of low plasticity	CL		23.50	D	48	-	-
			25.00	D		-	-
			26.50	D	64	-	-
Inorganic Silts of intermediate plasticity	MI		28.00	D	53	-	-
			29.50	D	40	-	-
			31.00	D		-	-
			32.50	D	59	-	-
			34.00	D	57	-	-
Inorganic clays of low plasticity	CL		35.50	D	65	-	-
			37.00	D	57	-	-
			38.50	D	67	-	-
			40.00	D	55	-	-

APPENDIX-C
PLOT 21: LITHOLOGICAL PLOTS

BH-P57-22409.287

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands with clay binder	SM-SC		0.50	D		-	-
			1.00	U		-	-
			2.00	D	3	-	-
			3.00	D	4	-	-
			4.00	D		-	-
Silty Sands	SM		5.00	D	9	-	-
			6.00	D	12	-	-
			7.00	D		-	-
			8.00	D	17	-	-
Inorganic clays of low plasticity	CL		9.00	D	20	-	-
			10.00	U		-	-
			11.00	D	19	-	-
			12.00	D	21	-	-
			13.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		14.50	D	31	-	-
Inorganic clays of low plasticity	CL		16.00	U		-	-
			17.50	D	36	-	-
Silty Sands with clay binder	SM-SC		19.00	U		-	-
			20.00	D	37	-	-

BH-P57-22409.287

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands with clay binder	SM-SC						
Inorganic Silty Clays of low plasticity	CL-ML		20.50	D	37	-	-
			22.50	U		-	-
Inorganic clays of low plasticity	CL		23.50	D	42	-	-
Silty Sands	SM		25.00	D		-	-
			26.50	D	58	-	-
Inorganic clays of low plasticity	CL		28.00	D	60	-	-
			29.50	D	61	-	-
			31.00	D	56	-	-
			32.50	D	58	-	-
Silty Sands	SM		34.00	D		-	-
			35.50	D	52	-	-
			37.00	D		-	-
			38.50	D	49	-	-
			40.00	D	50	-	-

APPENDIX-C

PLOT 22: LITHOLOGICAL PLOTS

BH-P58-22435.487

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	D	2	-	-
Inorganic Silty Clays of low plasticity	CL-ML		2.00	U		-	-
			3.00	D	4	-	-
			4.00	D	10	-	-
			5.00	U		-	-
			6.00	D	17	-	-
Silty Sands	SM		7.00	D	20	-	-
			8.00	U		-	-
			9.00	D	15	-	-
			10.00	D	17	-	-
Inorganic Silts of low plasticity	ML		11.00	U		-	-
			12.50	D	19	-	-
Inorganic clays of low plasticity	CL		14.00	U		-	-
			15.50	D	22	-	-
			17.00	U		-	-
Silty Sands	SM		18.50	D	32	-	-
			20.00	U		-	-

BH-P58-22435.487

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		20.00	U		-	-
			21.50	D	57	-	-
			23.00	D	60	-	-
Inorganic clays of low plasticity	CL		24.50	D	47	-	-
			26.00	U		-	-
			27.50	D	67	-	-
Inorganic Silts of Intermediate plasticity	MI						
Inorganic clays of low plasticity	CL		29.00	D	43	-	-
Silty Sands	SM		30.50	D	R	-	-
Inorganic Silty Clays of low plasticity	CL-ML		32.00	D	R	-	-
			33.50	D	74	-	-
			35.00	D	67	-	-
Silty Sands	SM		36.50	D	65	-	-
			38.00	D	71	-	-
			40.00	D	78	-	-

APPENDIX-C
PLOT 23: LITHOLOGICAL PLOTS

BH-P59-22461.687

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	U		-	-
Inorganic Silts of low plasticity	ML		2.00	D	4	-	-
Silty Sands	SM		3.00	D	5	-	-
			4.00	D		-	-
Inorganic Silts of Intermediate plasticity	MI		5.00	D	7	-	-
			6.00	D	10	-	-
			7.00	U		-	-
Silty Sands	SM		8.00	D	16	-	-
			9.00	D	18	-	-
Inorganic Silty Clays of low plasticity	CL-ML		10.00	U		-	-
			11.00	D	15	-	-
			12.00	D	20	-	-
			13.00	U		-	-
Inorganic clays of low plasticity	CL		14.50	D	22	-	-
			16.00	U		-	-
			17.50	D	27	-	-
Silty Sands	SM		19.00	U		-	-
			20.00	D	33	-	-

BH-P59-22461.687

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.50	D	33	-	-
Silty Sands	SM		22.00	D		-	-
			23.50	D	64	-	-
Inorganic Silty Clays of low plasticity	CL-ML		25.00	D	55	-	-
			26.50	D	59	-	-
Inorganic Silts of Intermediate plasticity	MI		28.00	D	60	-	-
Inorganic clays of low plasticity	CL		29.50	D	47	-	-
			31.00	U		-	-
Silty Sands with clay binder	SM-SC		32.50	D	50	-	-
			34.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		35.50	D	57	-	-
Silty Sands	SM		37.00	D	59	-	-
			38.50	D	60	-	-
			40.00	D	64	-	-

APPENDIX-C
PLOT 24: LITHOLOGICAL PLOTS

BH-P60-22487.8870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	D	6	-	-
Inorganic clays of high plasticity	CH		2.00	U		-	-
Inorganic clays of low plasticity	CL		3.00	D	14	-	-
			4.00	D	9	-	-
Silty Sands	SM		5.00	U		-	-
			6.00	D	15	-	-
			7.00	D	18	-	-
			8.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		9.00	D	24	-	-
			10.00	D	22	-	-
Inorganic clays of low plasticity	CL		11.00	U		-	-
			12.50	D	26	-	-
Inorganic Silty Clays of low plasticity	CL-ML		14.00	U		-	-
			15.50	D	25	-	-
Inorganic clays of low plasticity	CL		17.00	U		-	-
Inorganic Silts of low plasticity	ML		18.50	D	33	-	-
			20.00	U		-	-

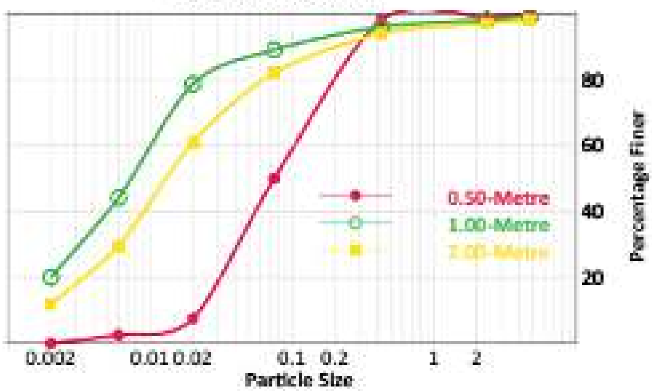
BH-P60-22487.8870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.00	U		-	-
			21.50	D	35	-	-
			23.00	U		-	-
			24.50	D	36	-	-
Inorganic Silts of Intermediate plasticity	MI		26.00	U		-	-
			27.50	D	34	-	-
Inorganic Silty Clays of low plasticity	CL-ML		29.00	U		-	-
Inorganic Silts of Intermediate plasticity	MI		30.50	D	38	-	-
Inorganic Silty Clays of low plasticity	CL-ML		32.00	U		-	-
Inorganic Silts of low plasticity	ML		33.50	D	55	-	-
			35.00	D	65	-	-
			36.50	D	77	-	-
Inorganic Clays of low to Intermediate plasticity	CL-CI		38.00	D	89	-	-
			40.00	D	100	-	-

APPENDIX-D

PLOT 1: GRAIN SIZE DISTRIBUTION PLOTS

BH- P41-CH.21990.087



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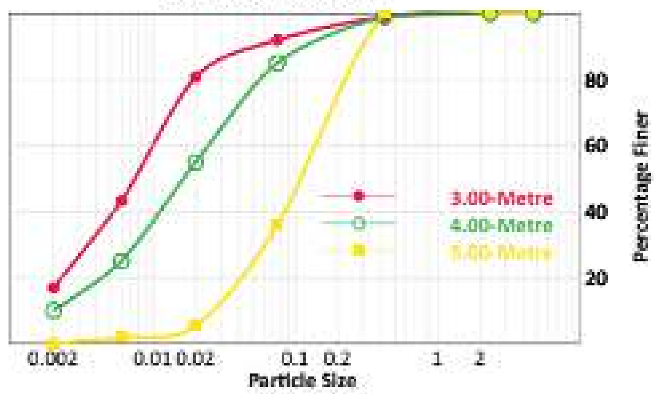

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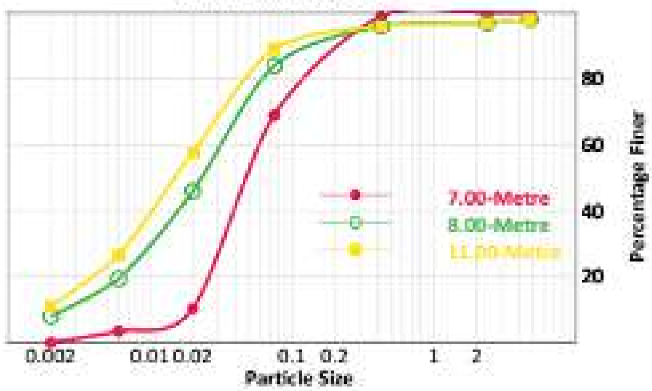
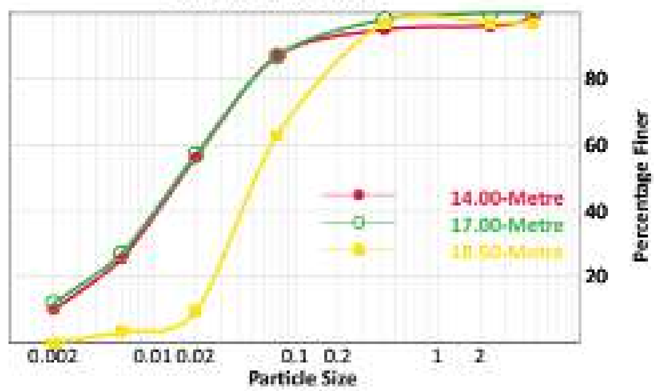
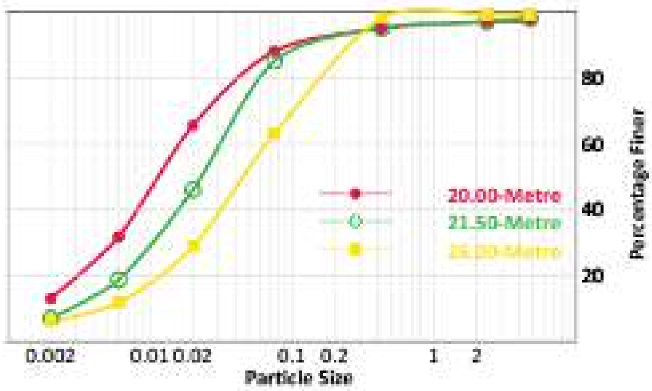


BH- P41-CH.21990.087



BH- P41-CH.21990.087



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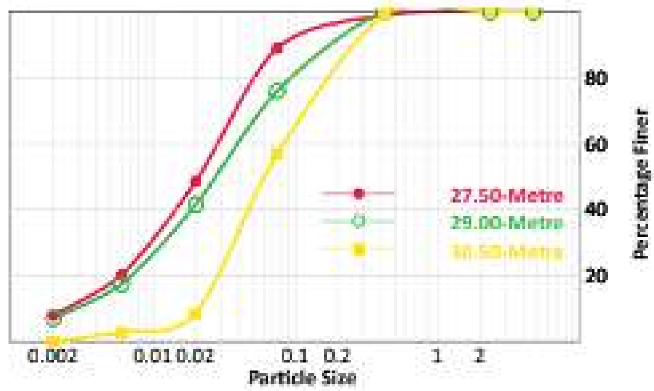
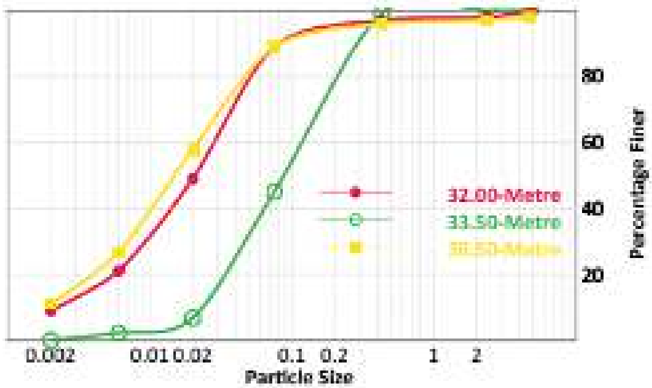
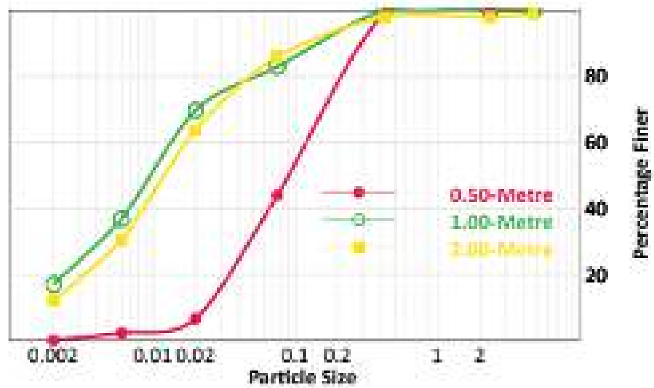


BH- P41-CH.21990.087

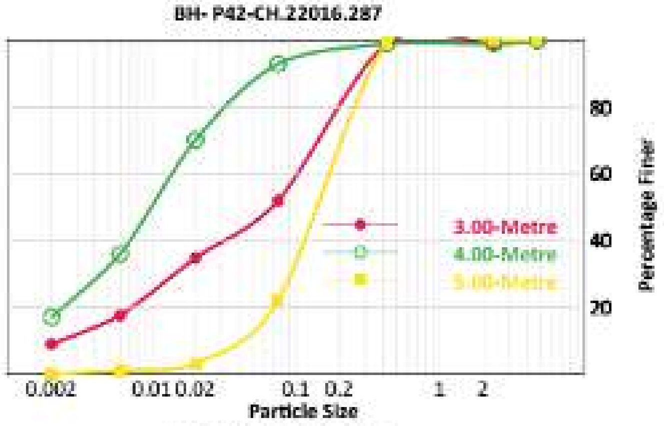


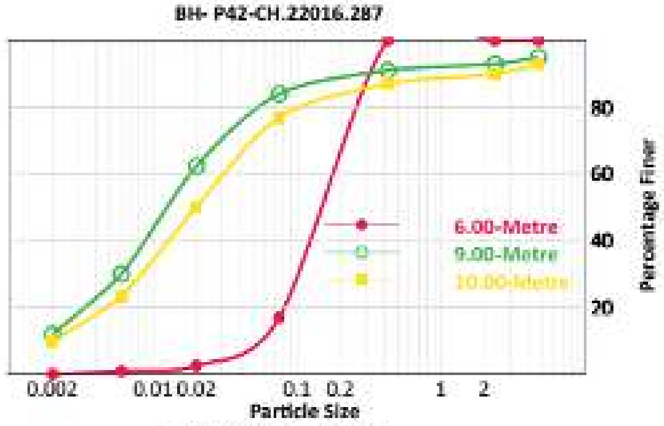
BH- P42-CH.22016.287

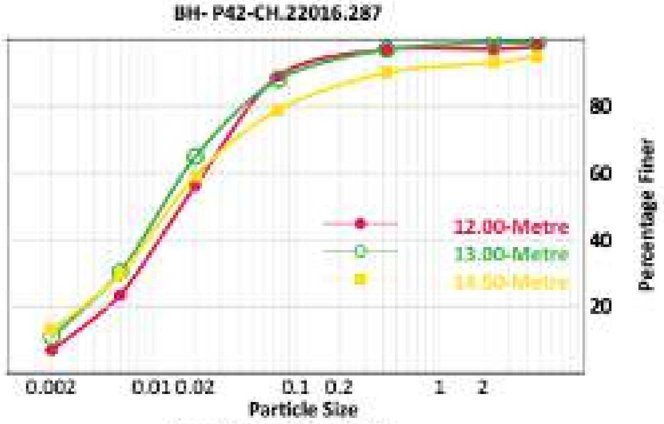


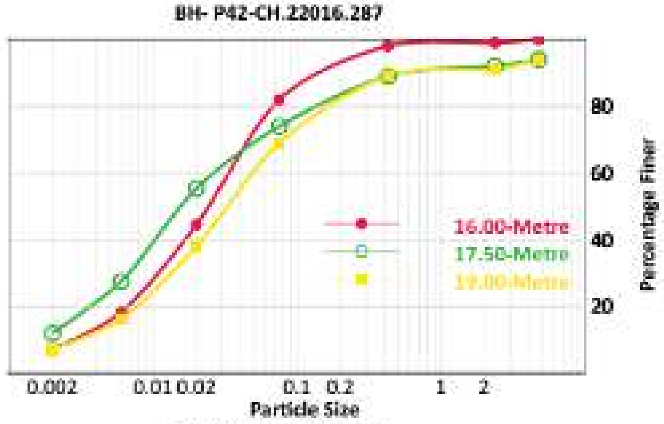
APPENDIX-D

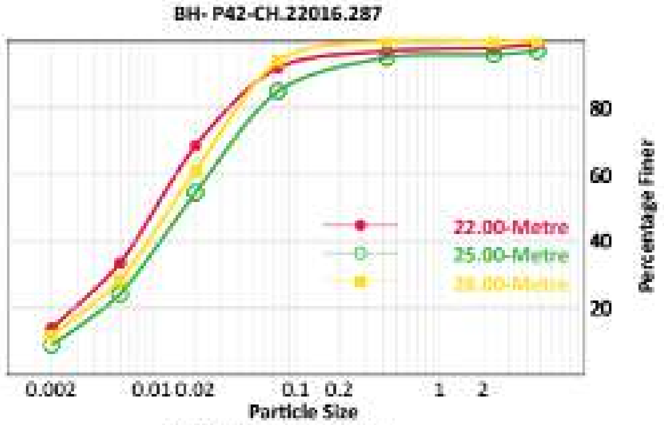
PLOT 2: GRAIN SIZE DISTRIBUTION PLOTS

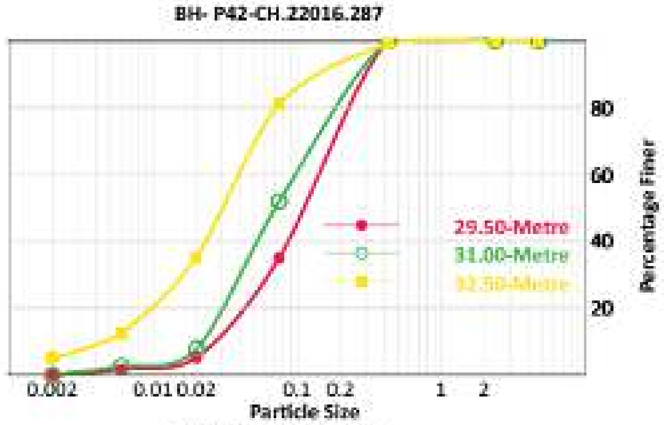


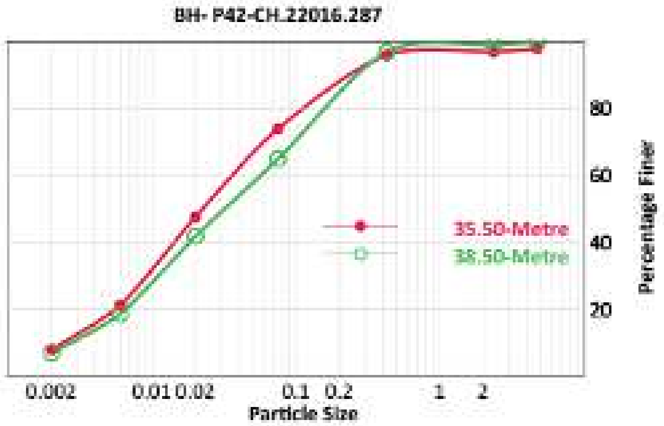


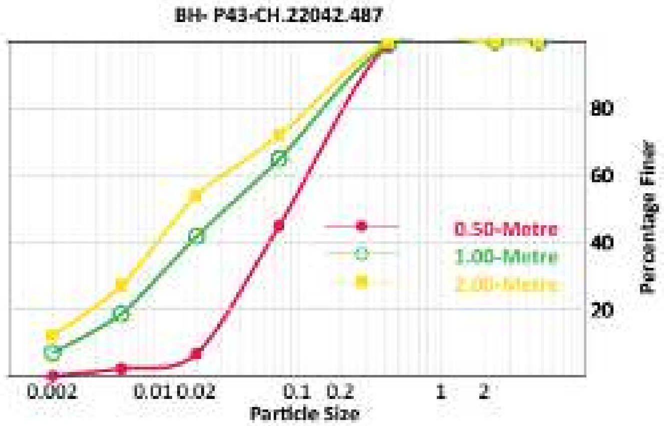




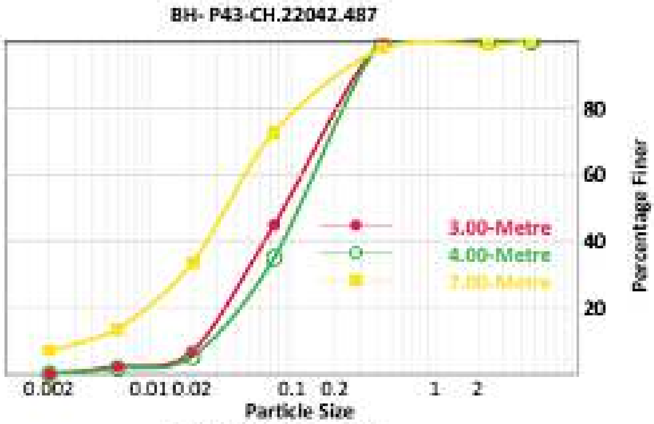


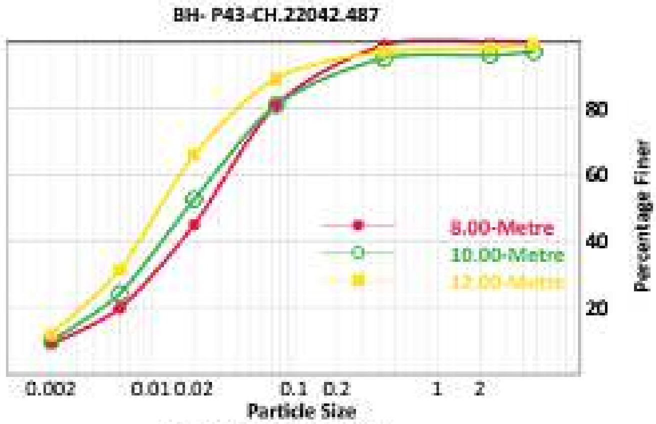


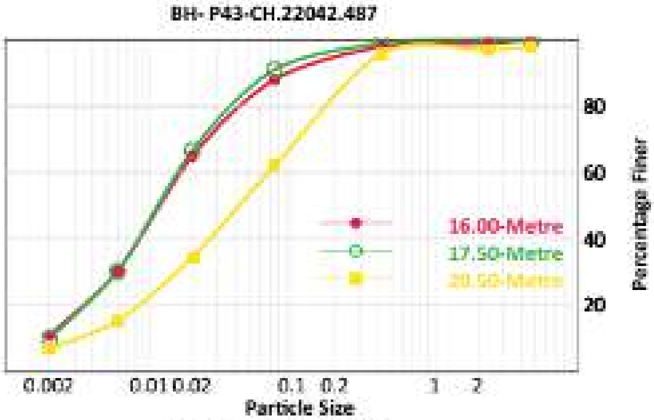


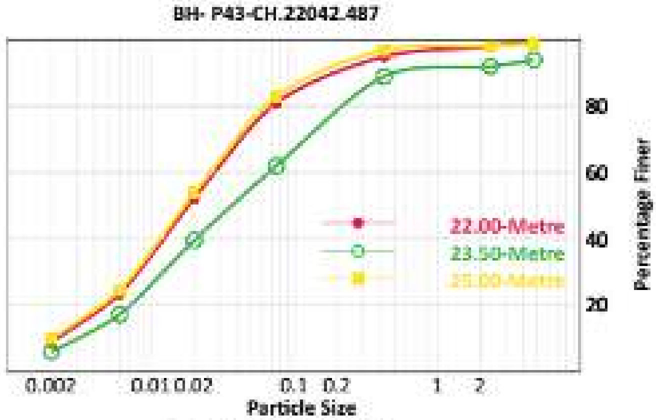


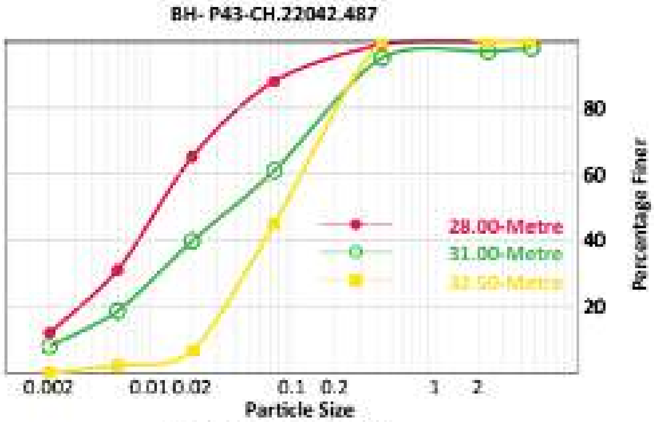
APPENDIX-D
PLOT 3: GRAIN SIZE DISTRIBUTION PLOTS

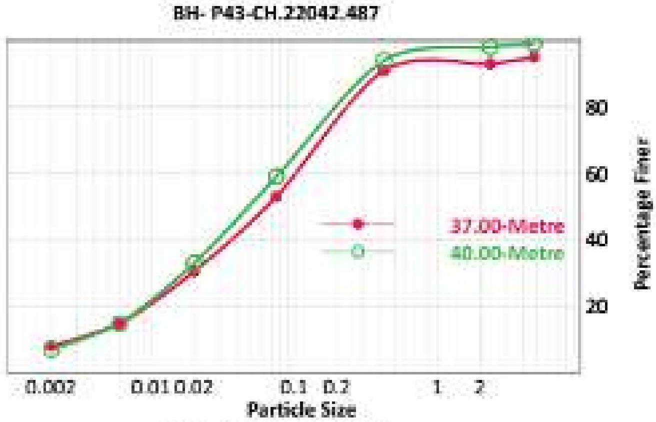


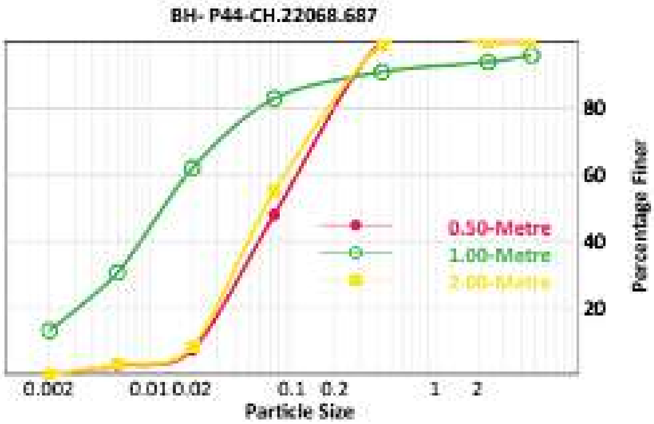


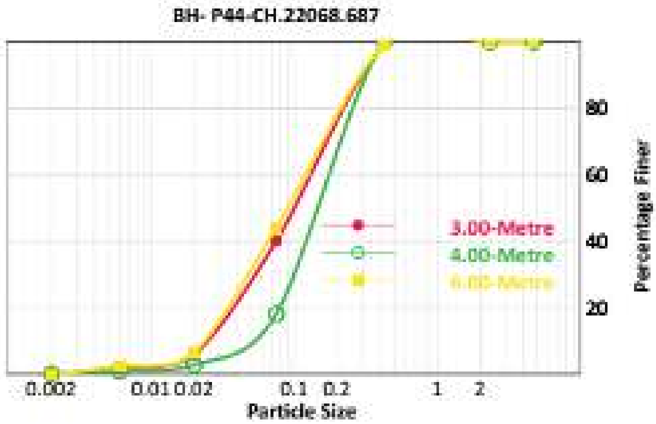




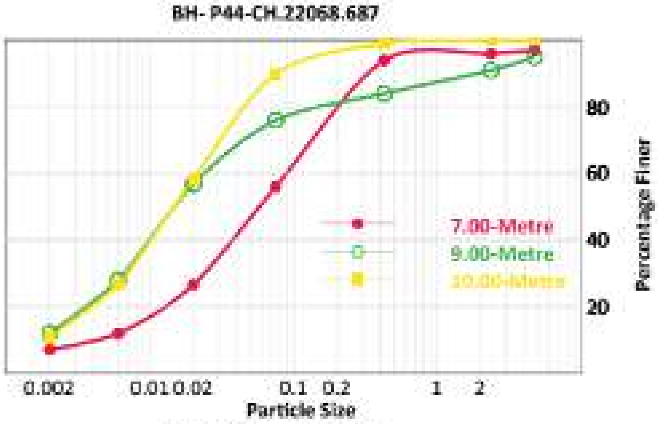


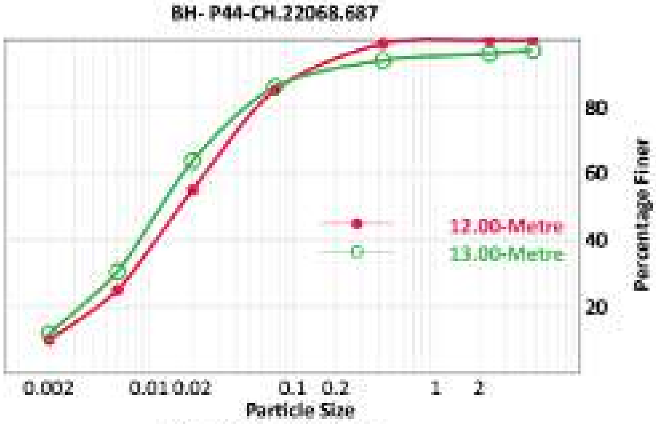


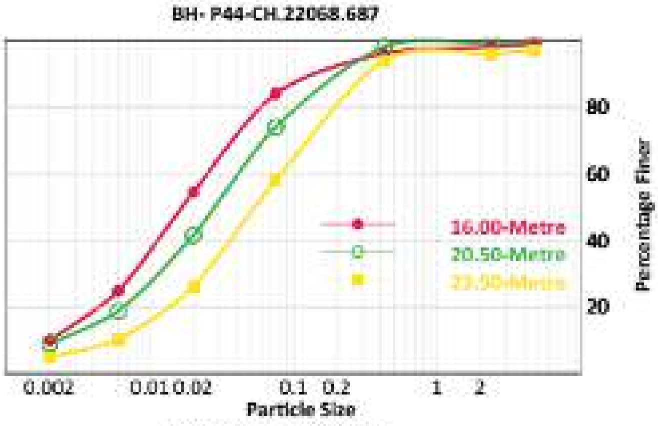


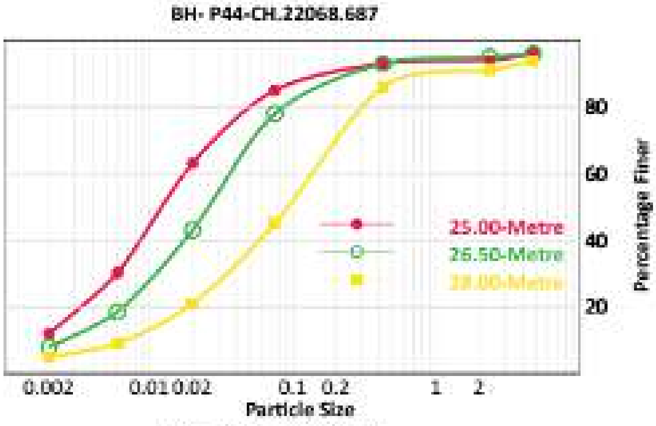


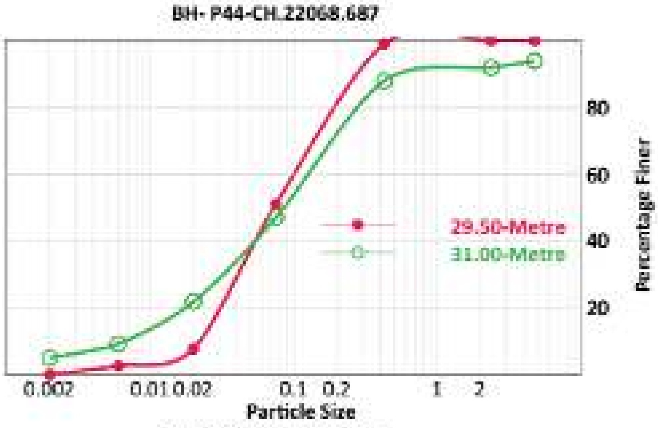
APPENDIX-D
PLOT 4: GRAIN SIZE DISTRIBUTION PLOTS

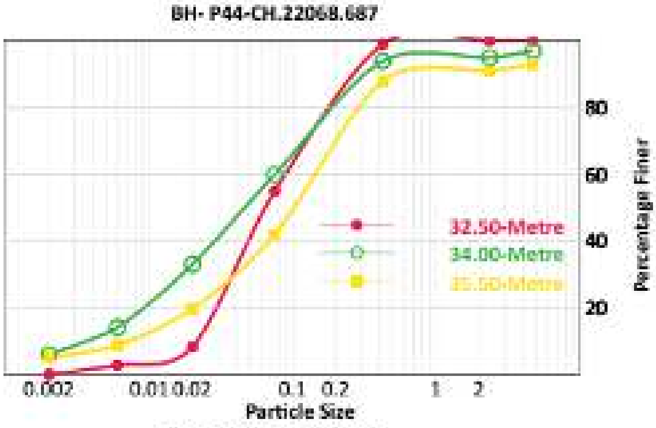


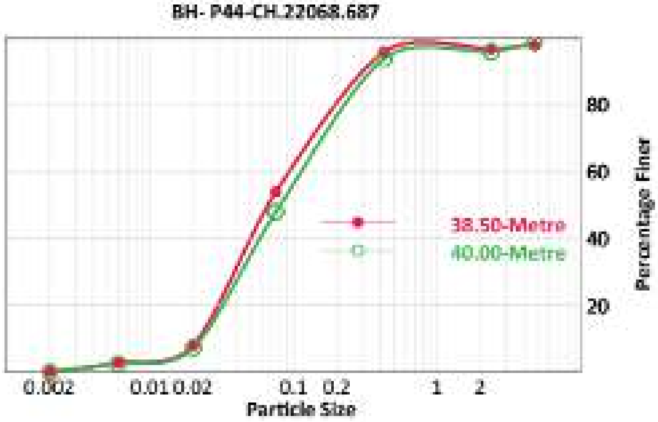


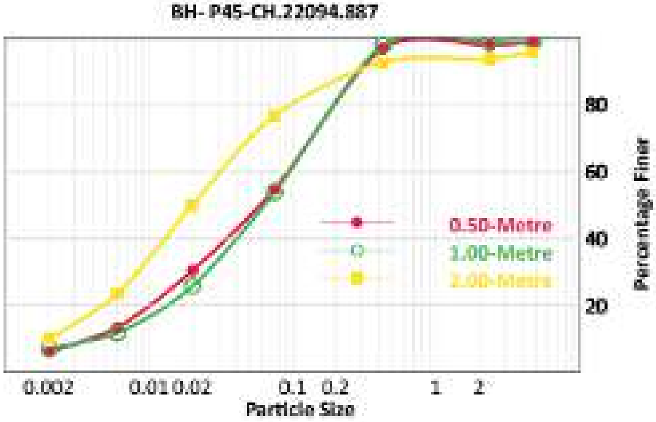




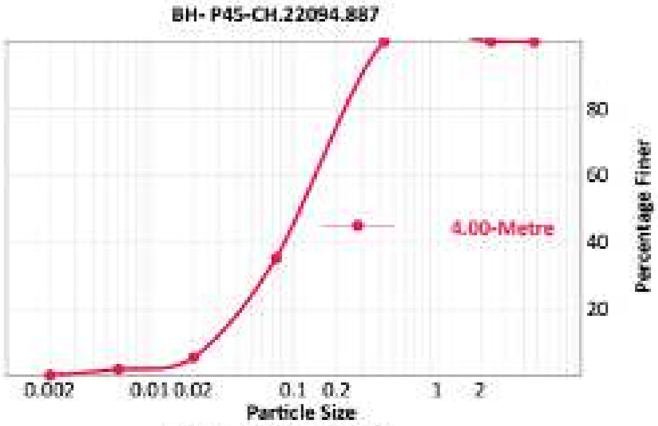


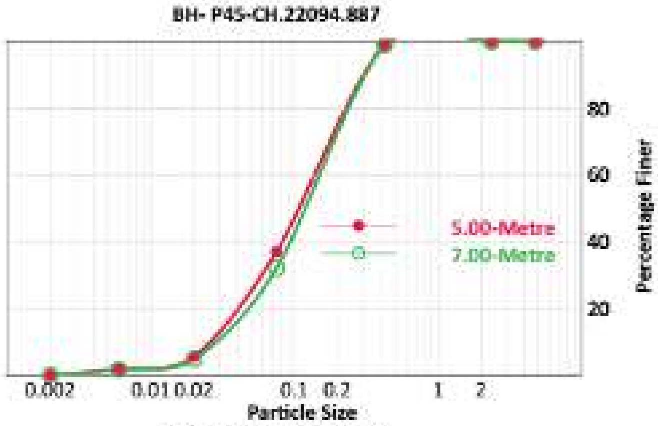


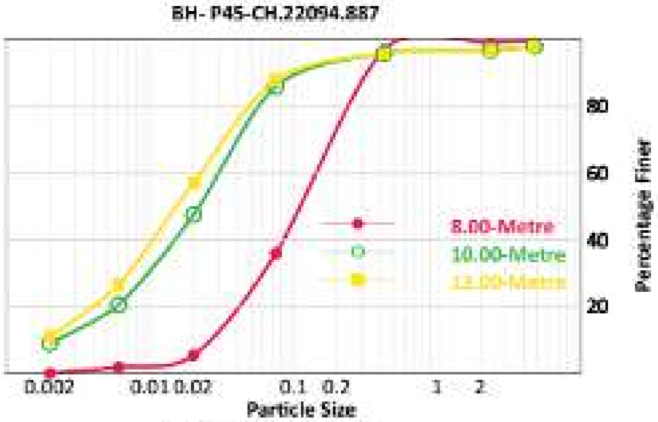


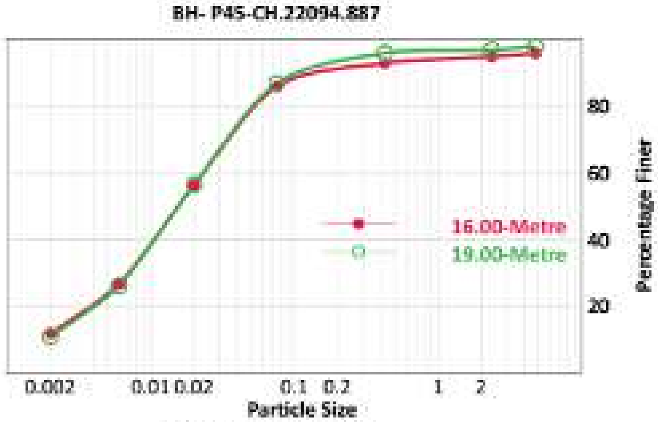


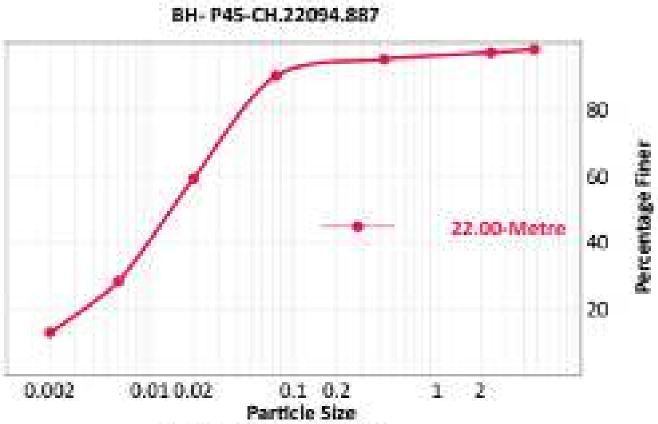
APPENDIX-D
PLOT 5: GRAIN SIZE DISTRIBUTION PLOTS

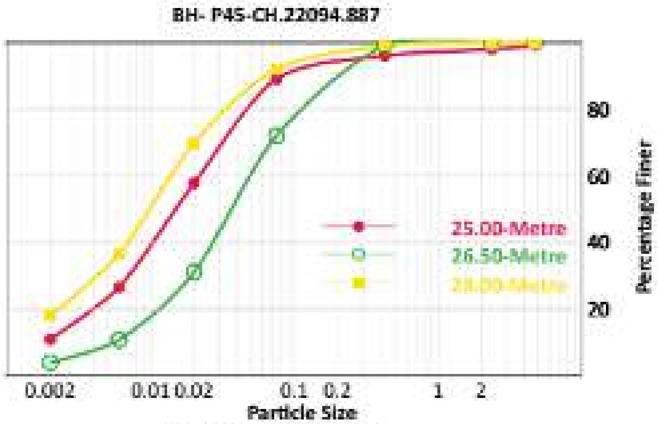


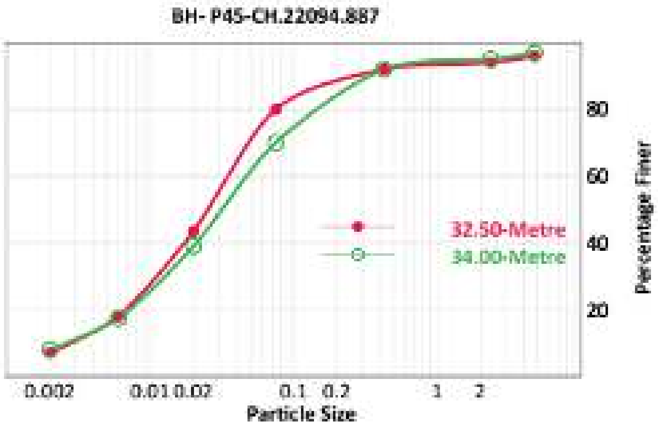


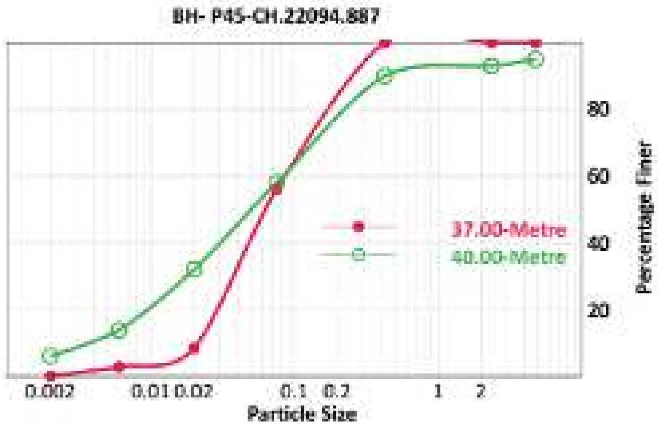




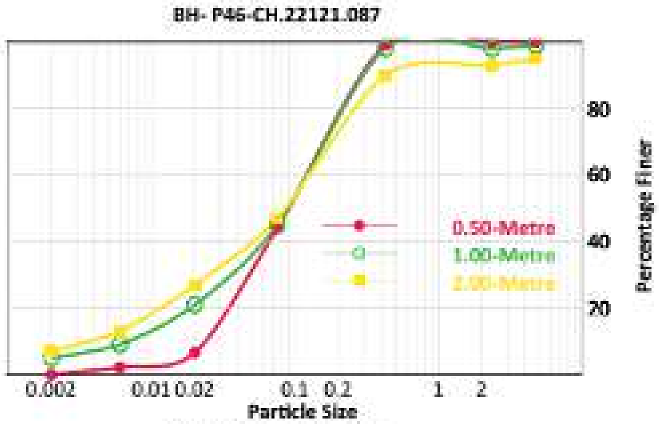


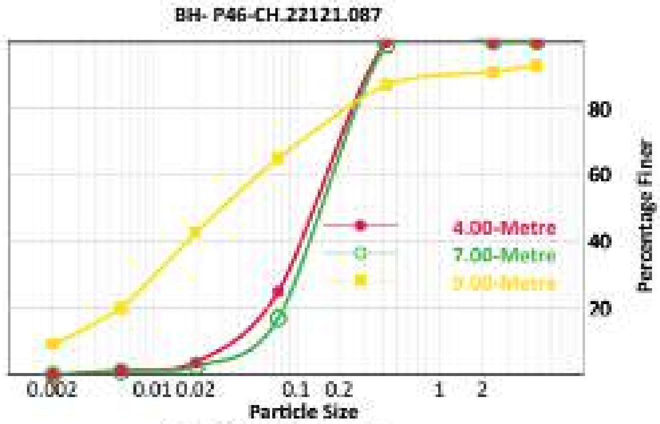


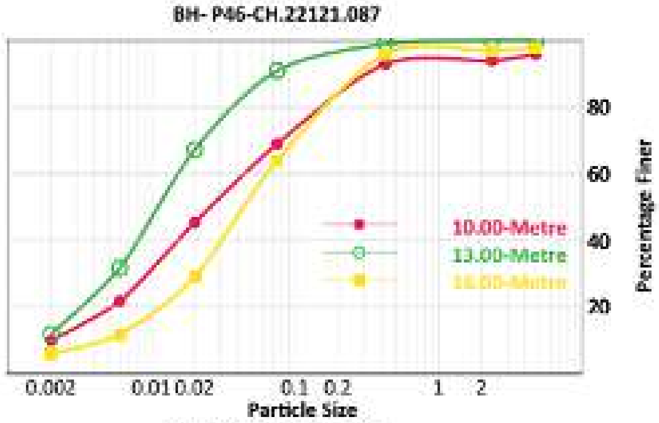


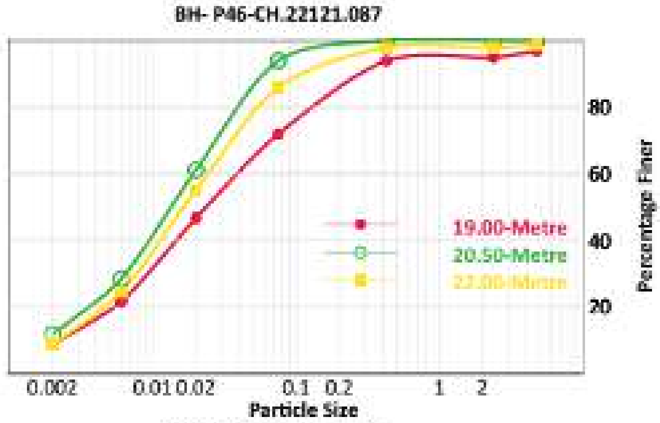


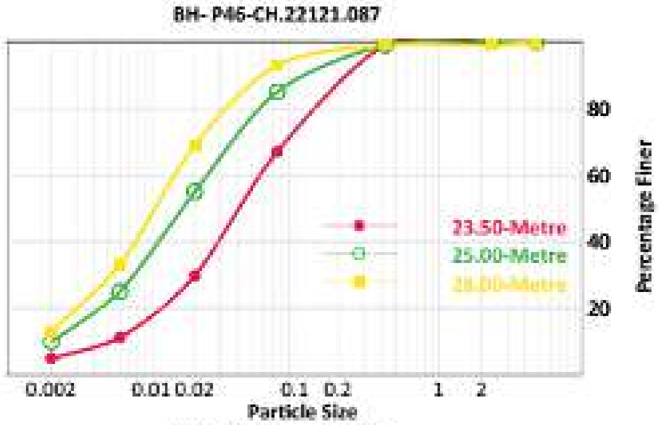
APPENDIX-D
PLOT 6: GRAIN SIZE DISTRIBUTION PLOTS

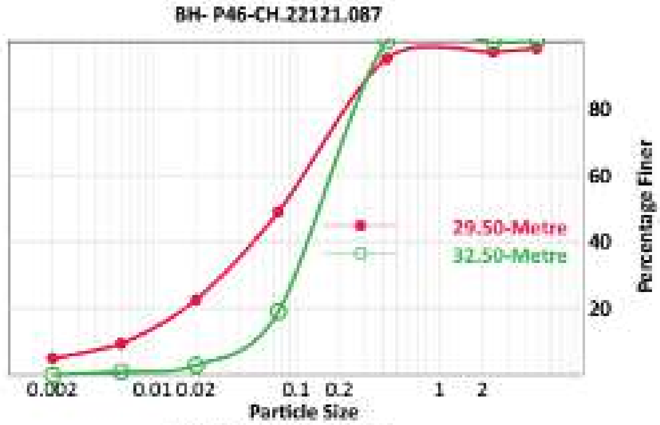


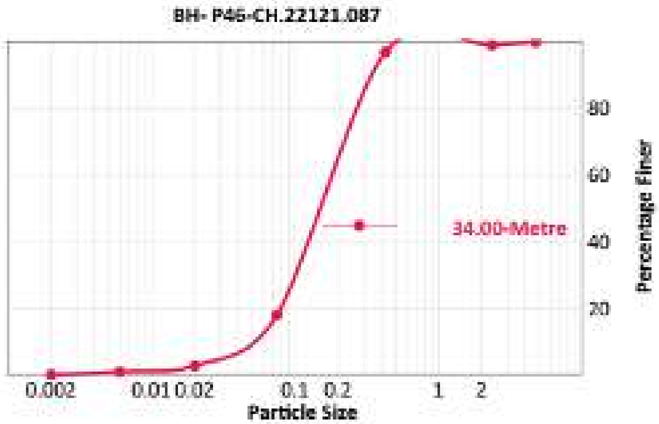


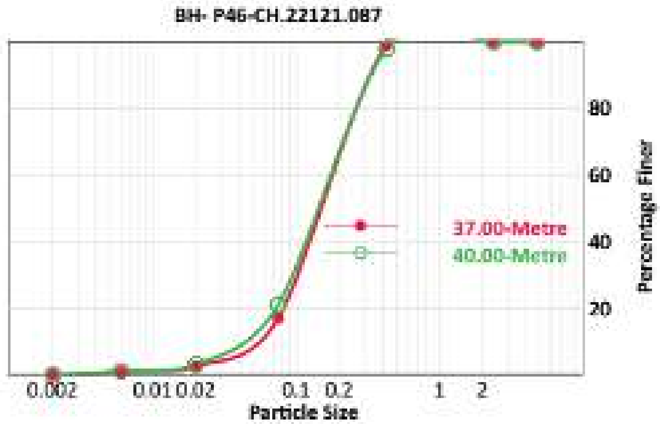




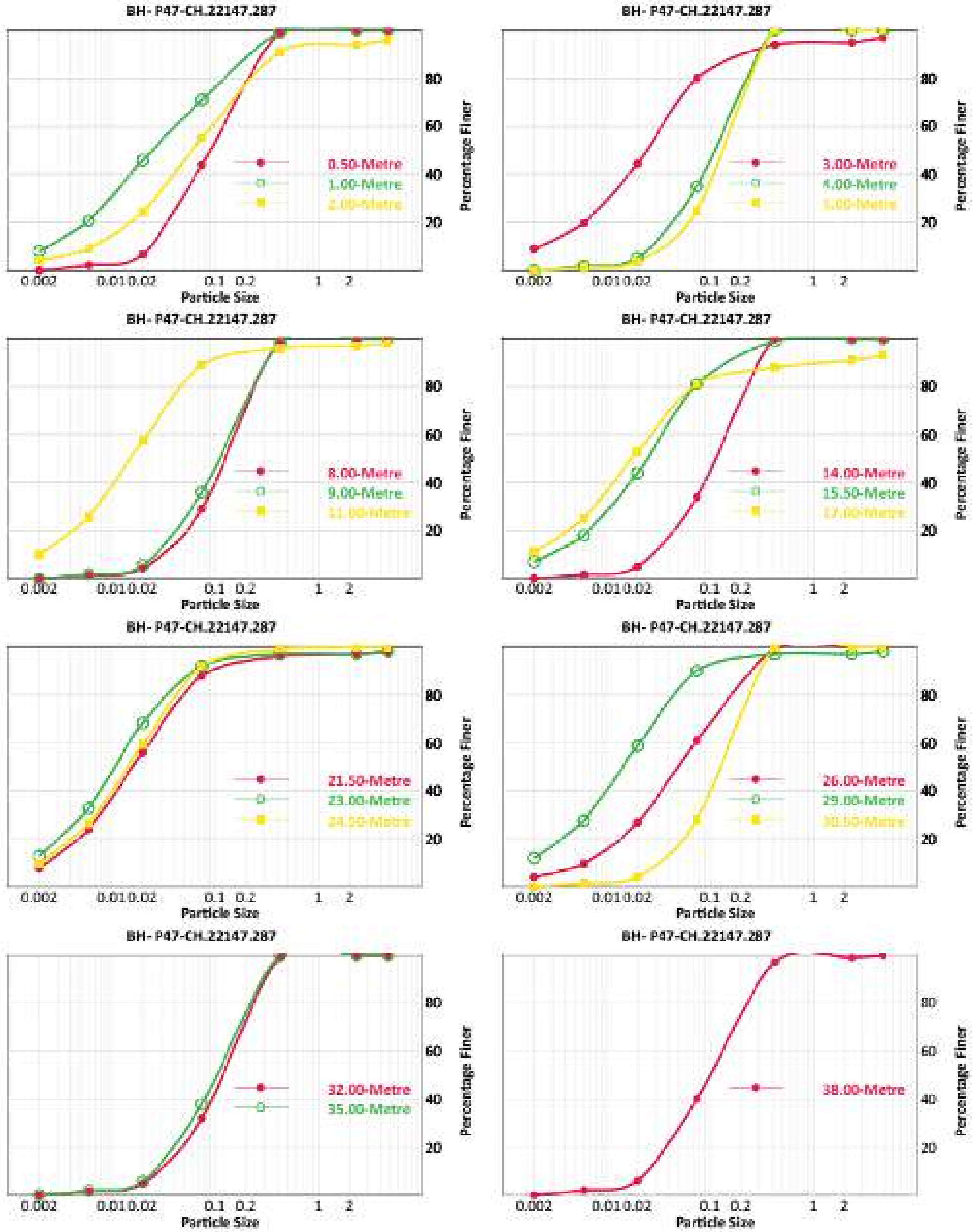






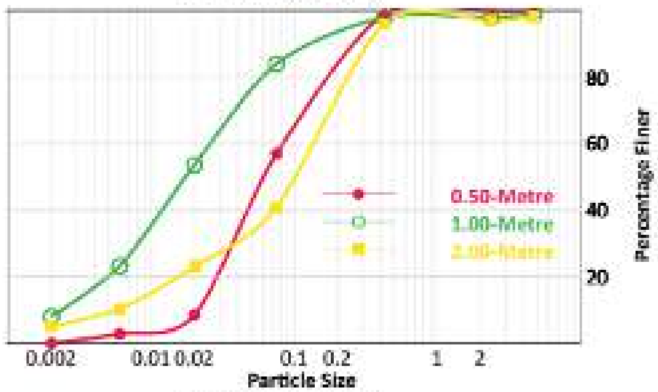


APPENDIX-D
PLOT 7: GRAIN SIZE DISTRIBUTION PLOTS



APPENDIX-D
PLOT 8: GRAIN SIZE DISTRIBUTION PLOTS

BH- P48-CH.22173.487



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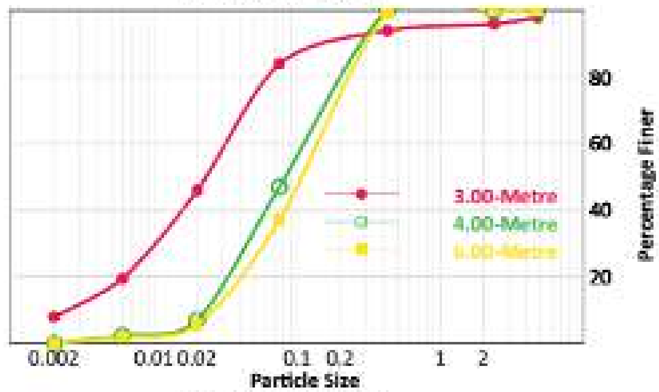

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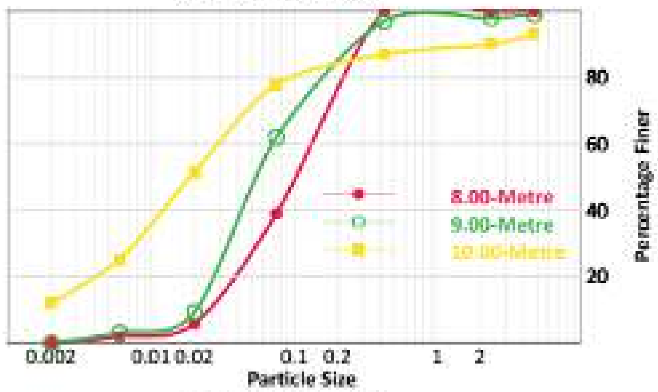

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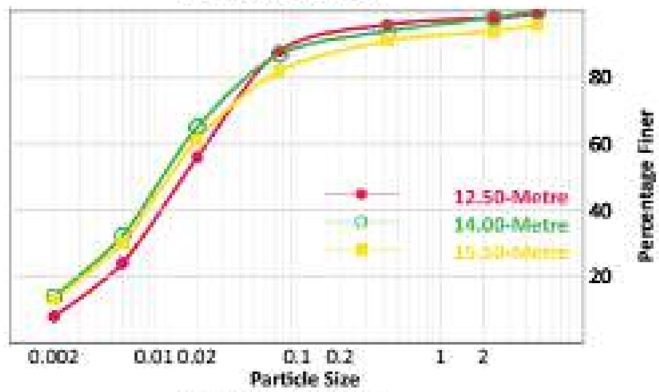

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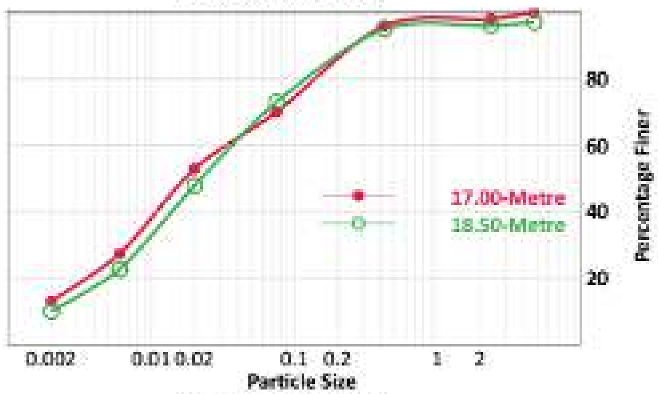

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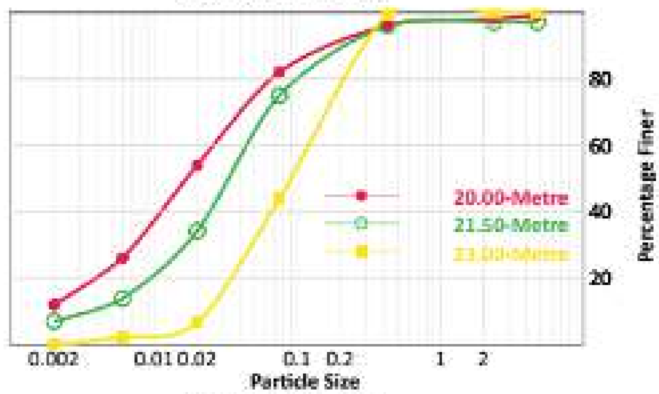

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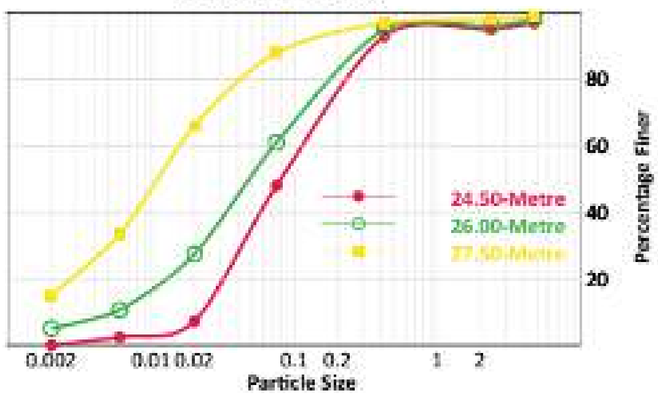

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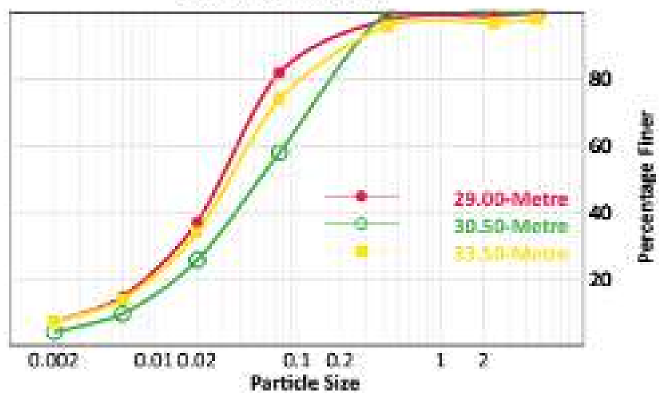

APPENDIX-D
PLOT 9: GRAIN SIZE DISTRIBUTION PLOTS

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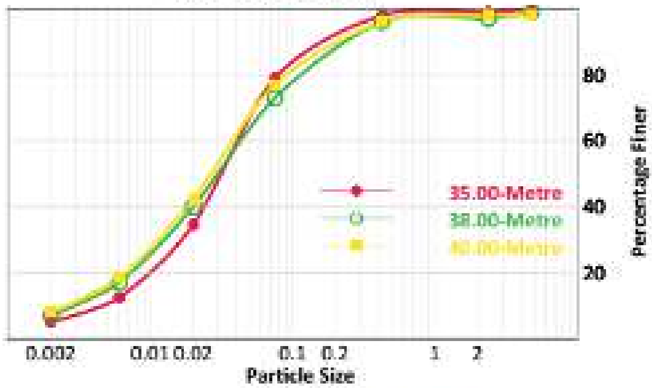

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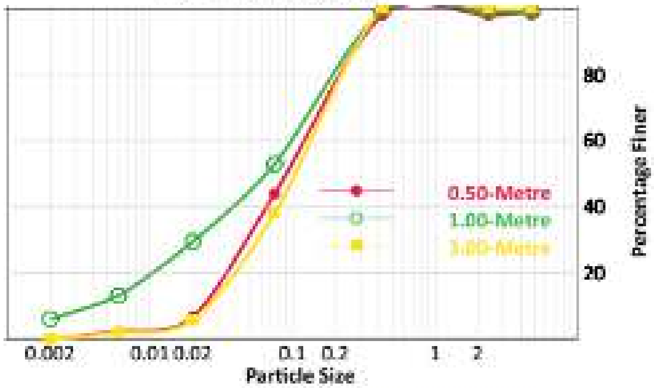

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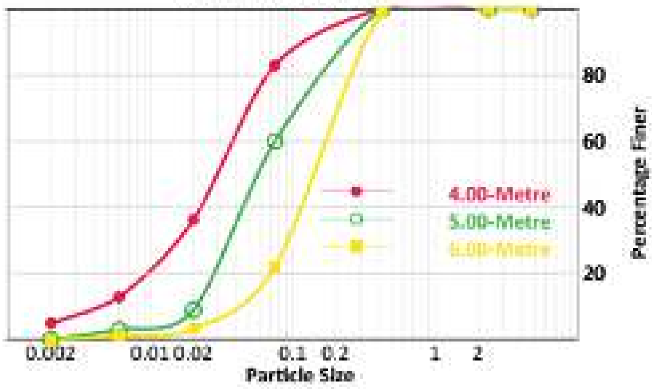

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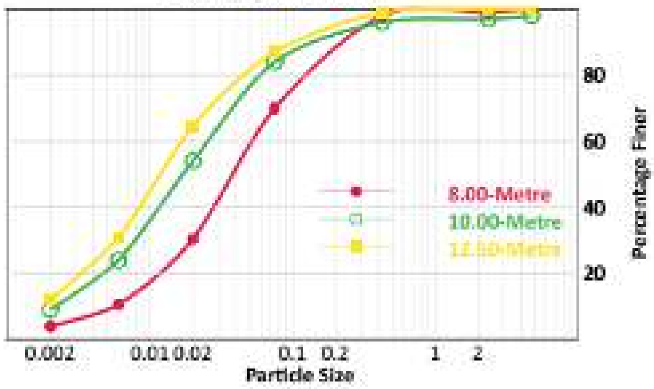

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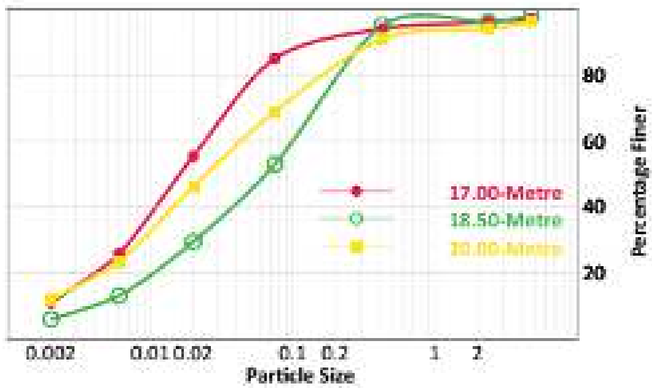

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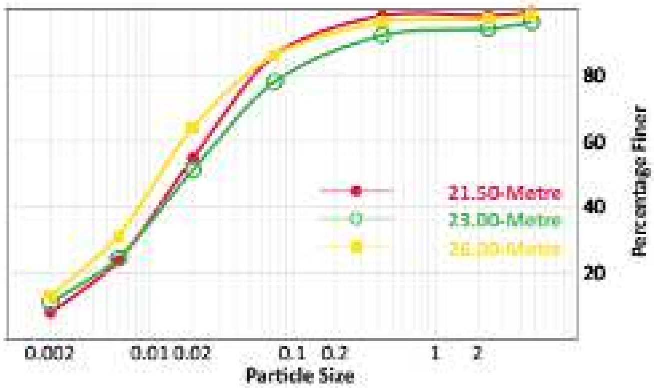

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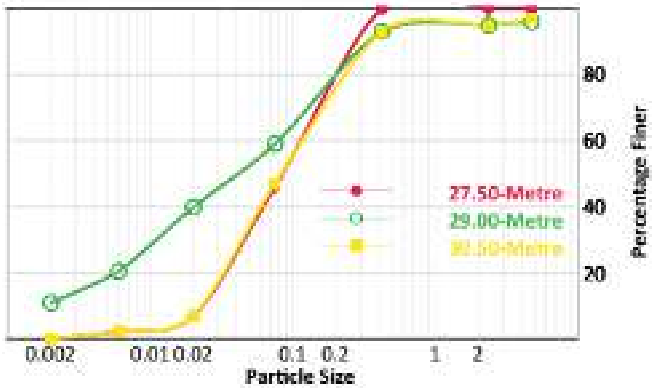

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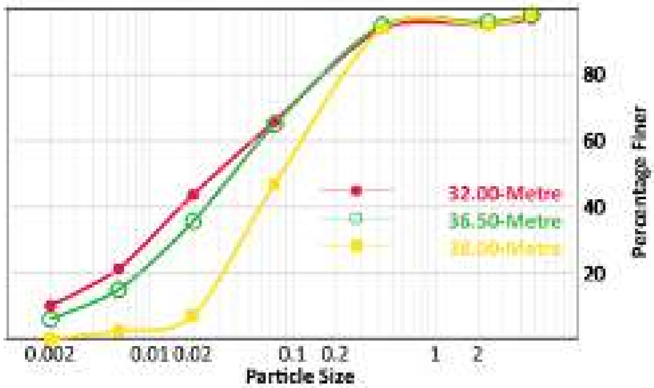
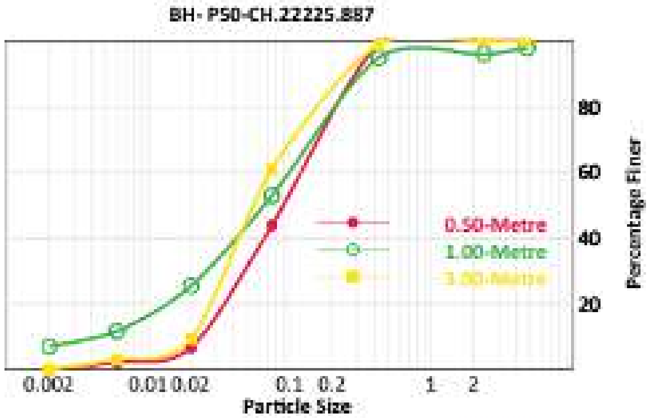
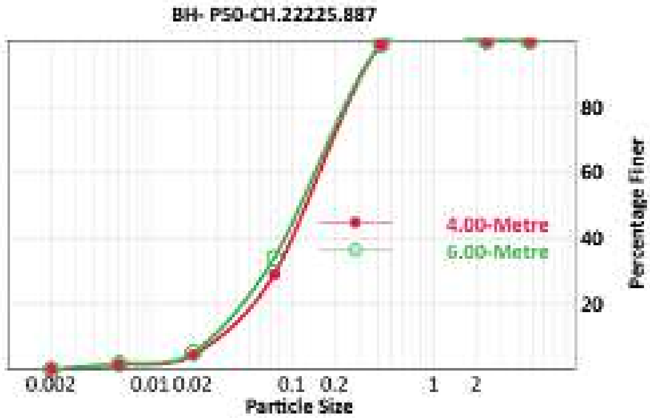
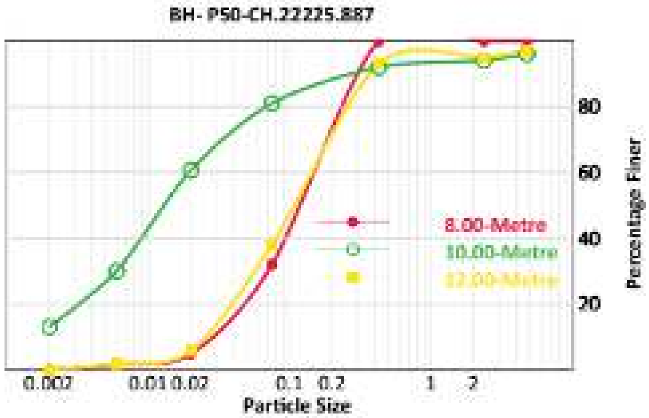
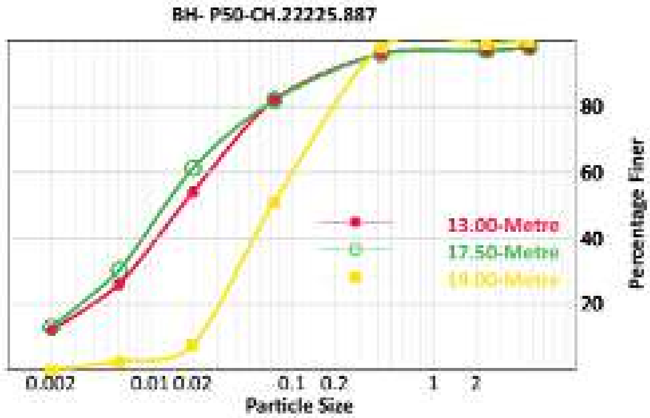


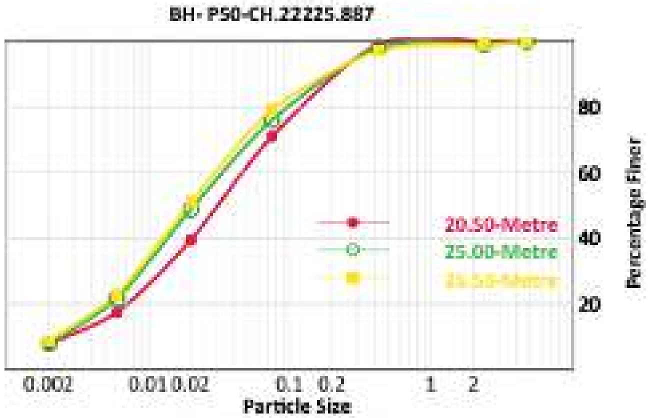
APPENDIX-D
PLOT 10: GRAIN SIZE DISTRIBUTION PLOTS

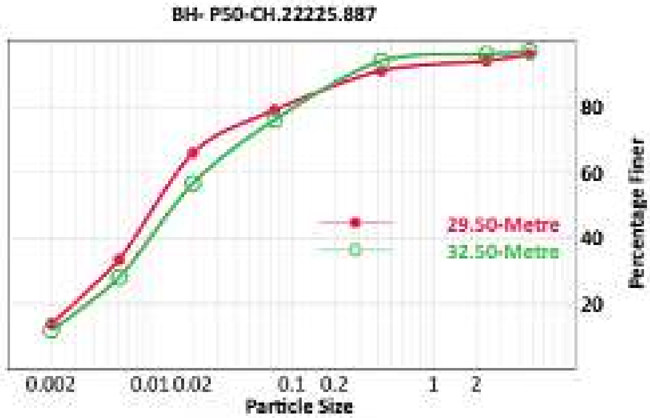


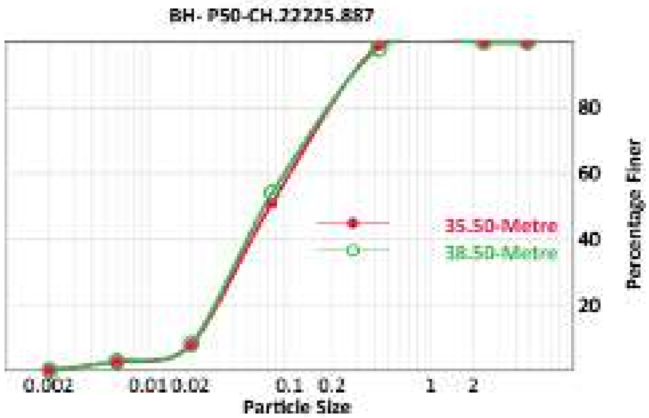


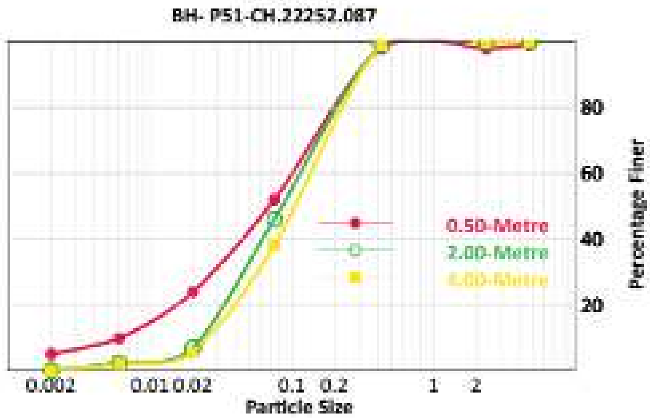




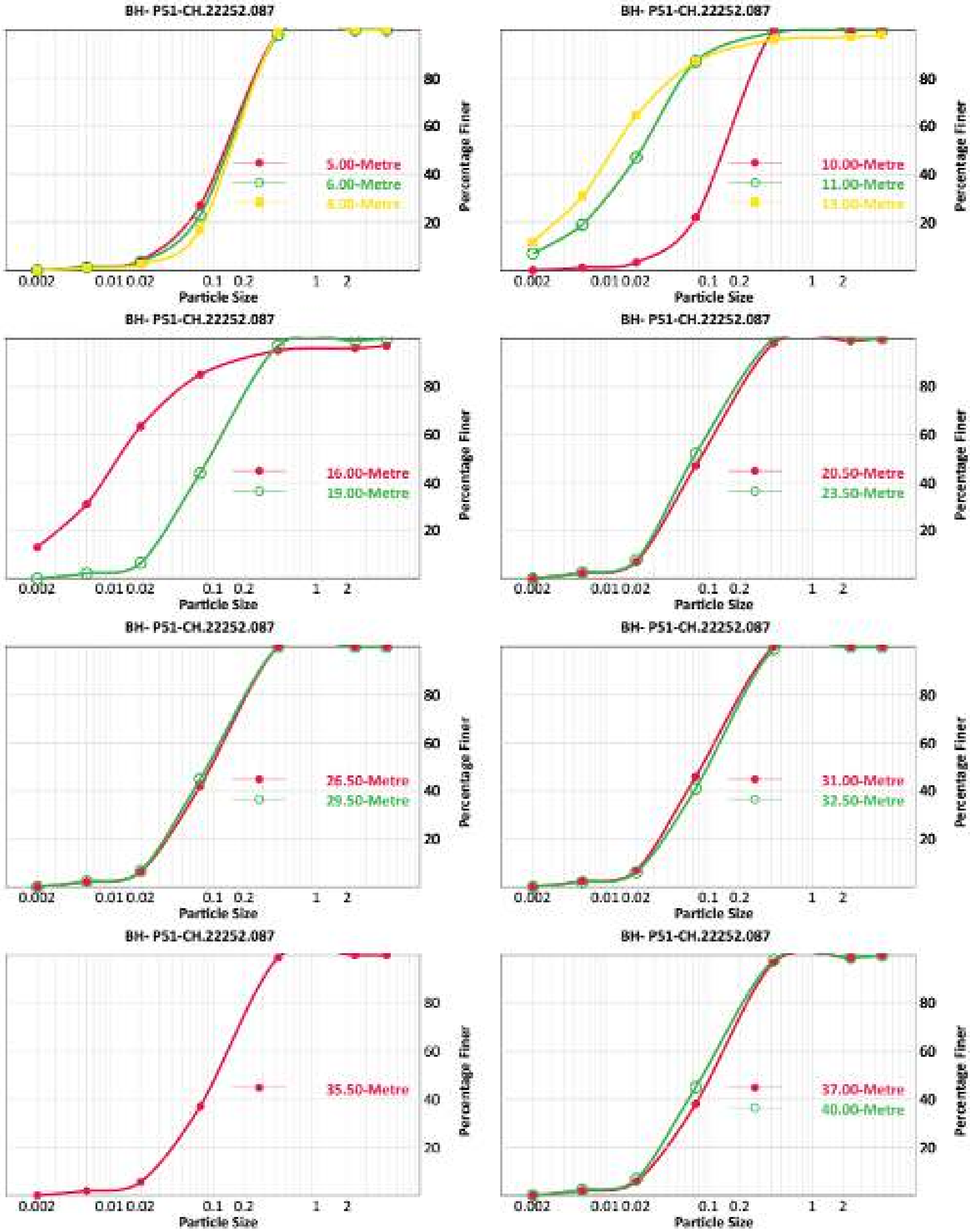




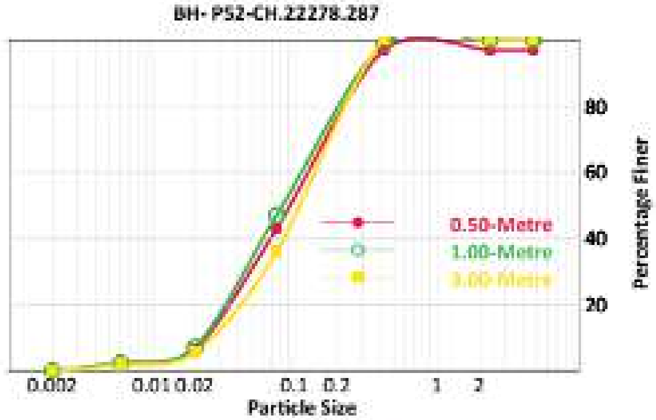


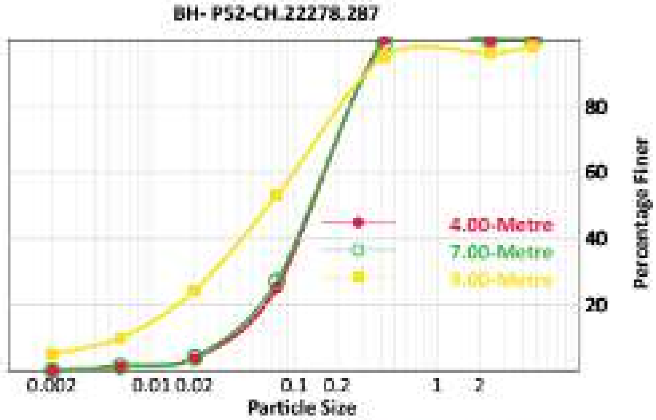


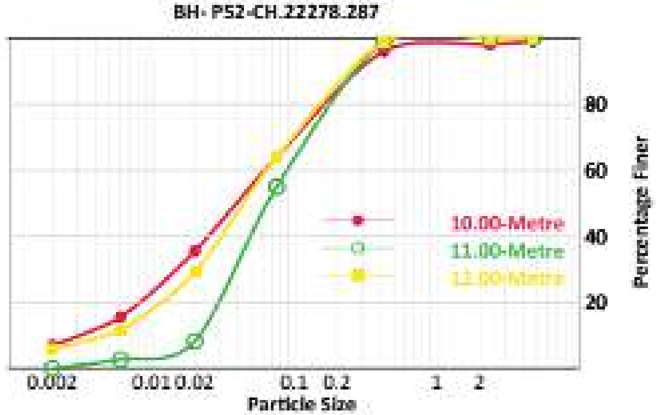
APPENDIX-D
PLOT 11: GRAIN SIZE DISTRIBUTION PLOTS

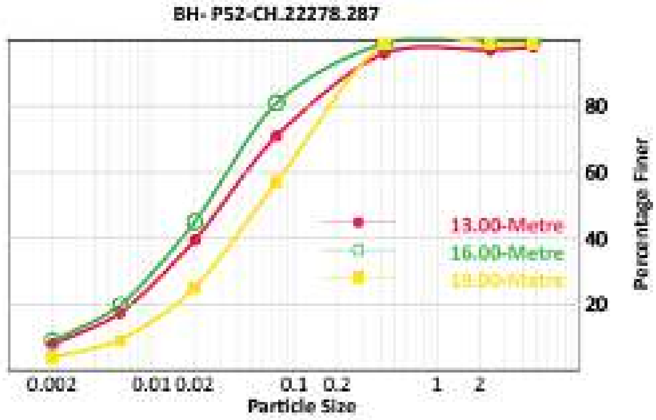


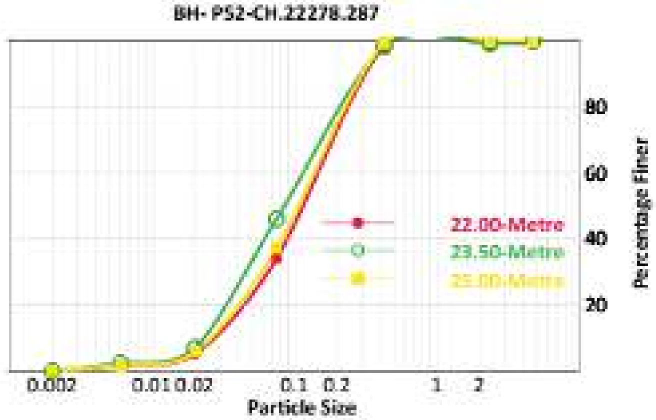
APPENDIX-D
PLOT 12: GRAIN SIZE DISTRIBUTION PLOTS

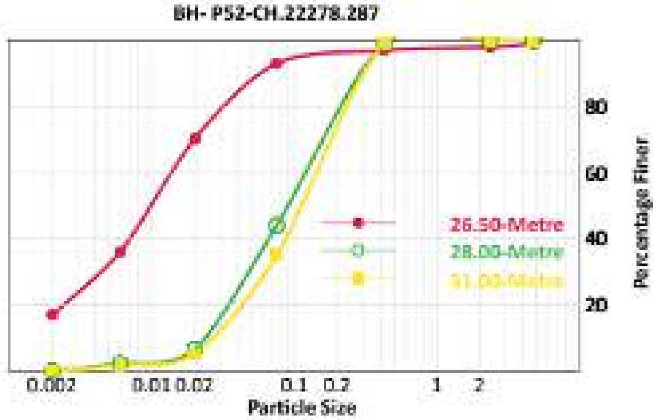


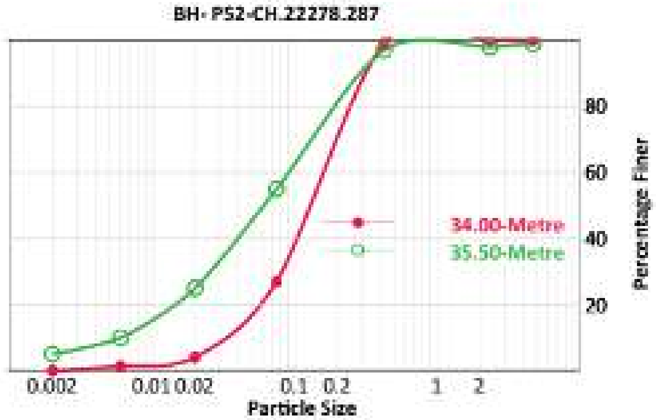


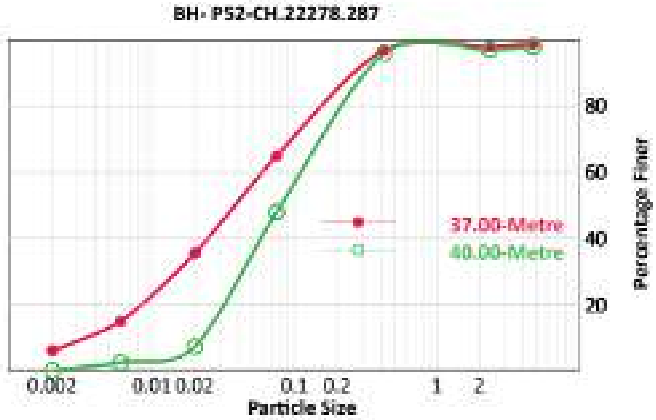




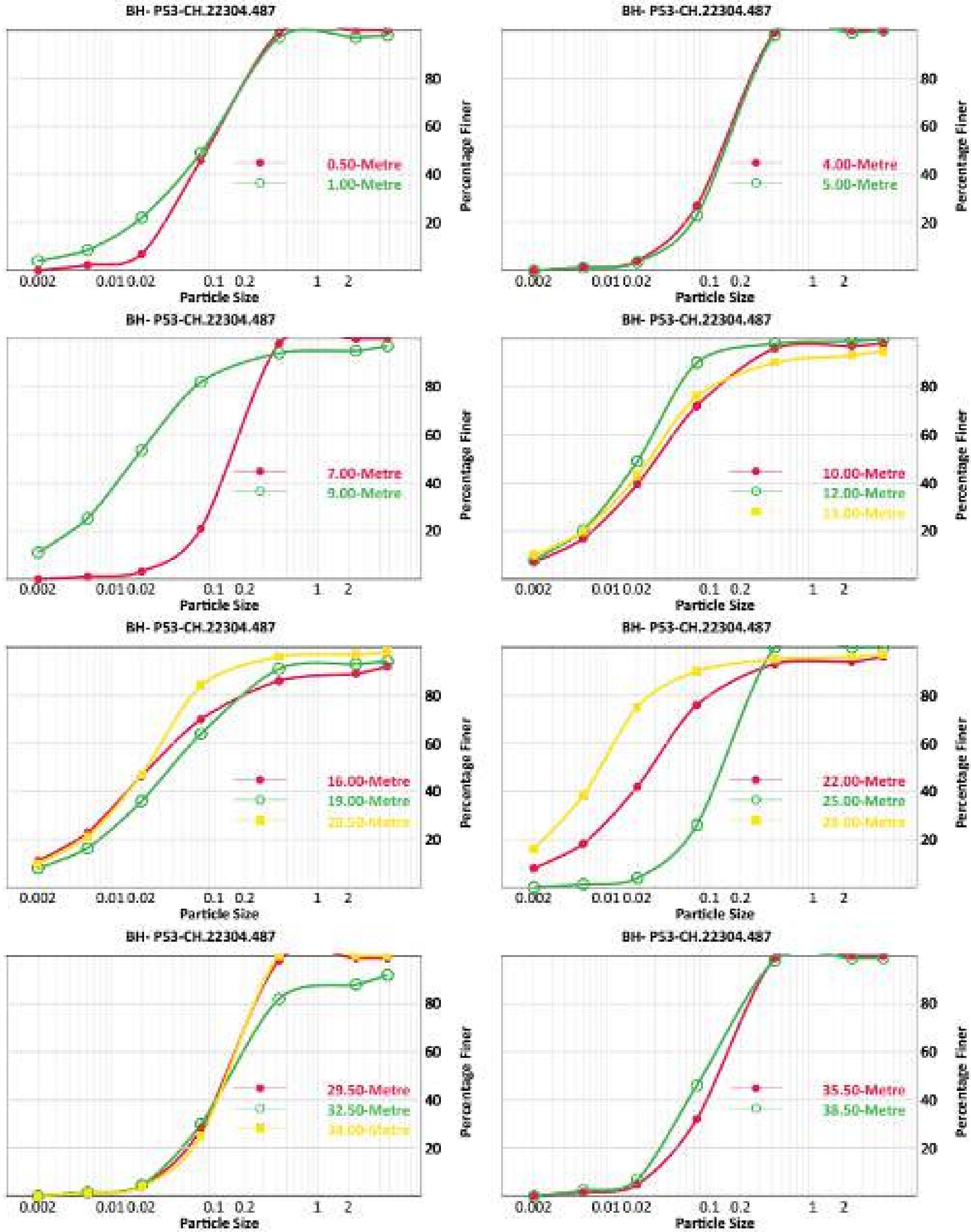




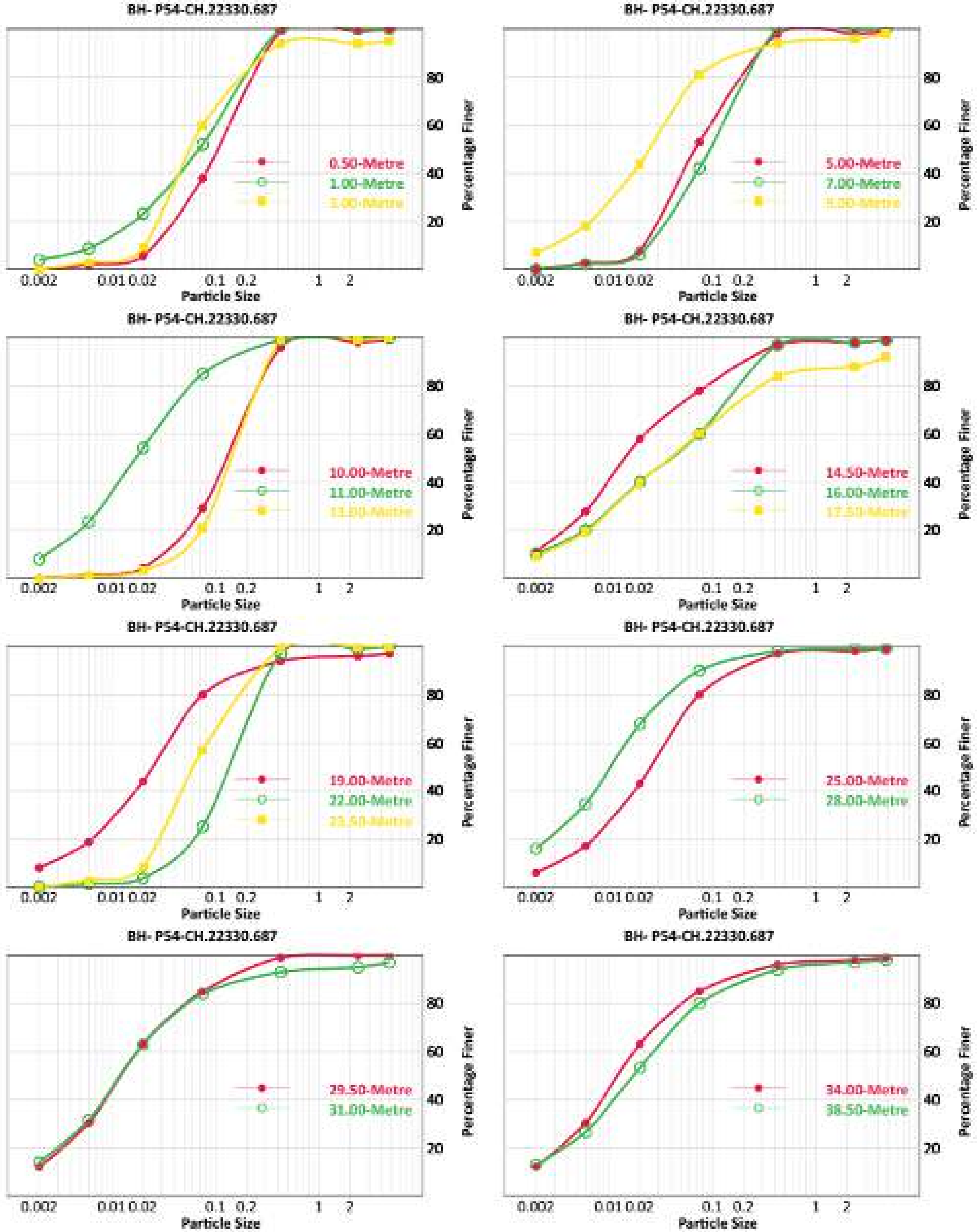




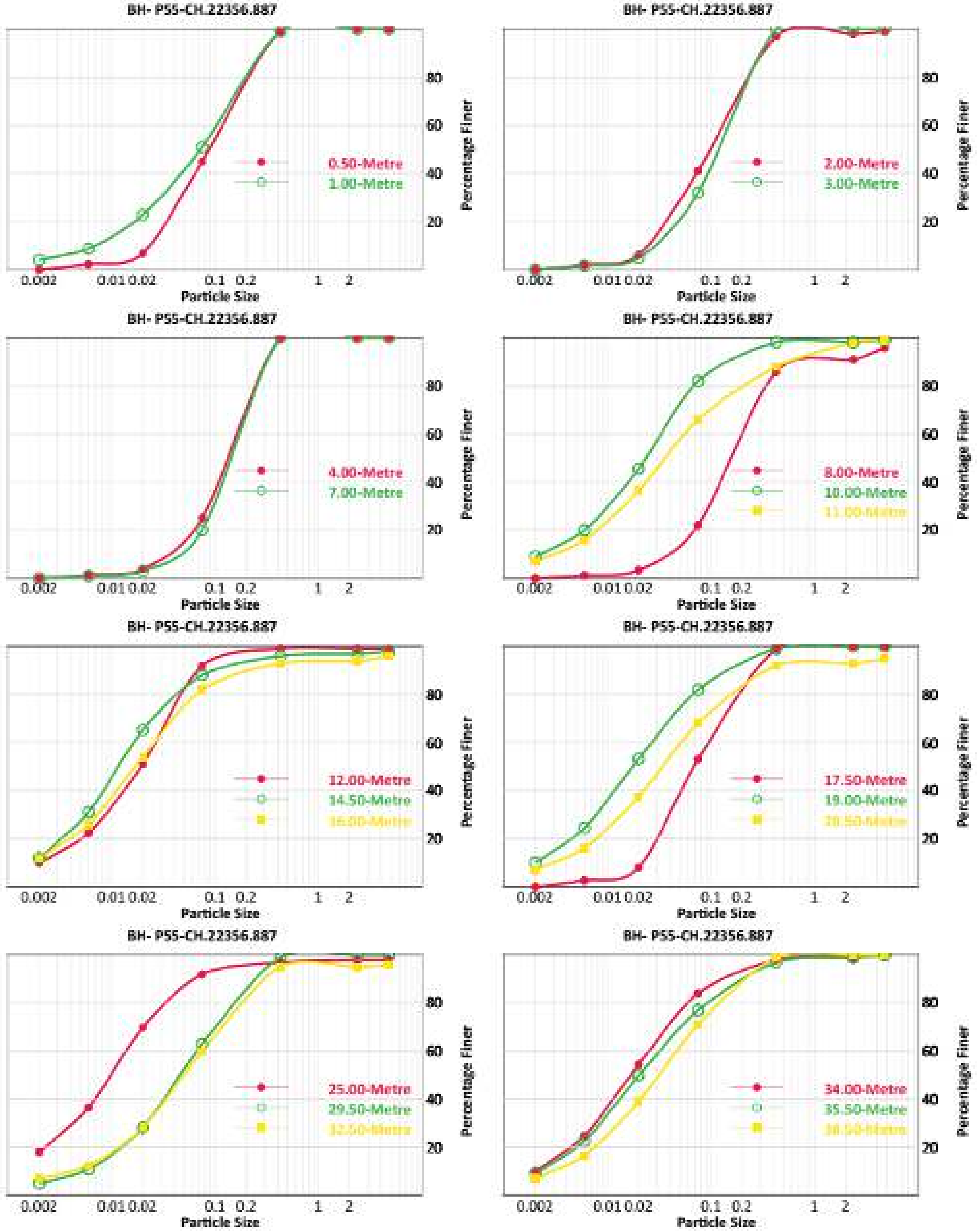
APPENDIX-D
PLOT 13: GRAIN SIZE DISTRIBUTION PLOTS



APPENDIX-D
PLOT 14: GRAIN SIZE DISTRIBUTION PLOTS

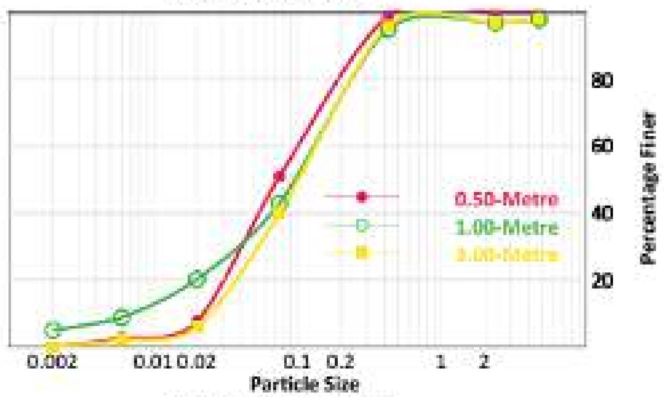


APPENDIX-D
PLOT 15: GRAIN SIZE DISTRIBUTION PLOTS

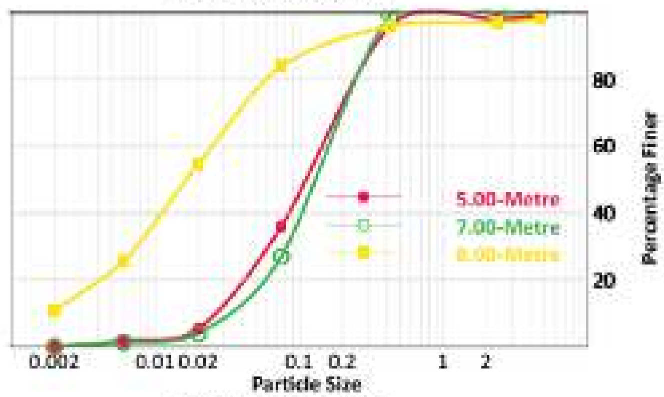


APPENDIX-D
PLOT 16: GRAIN SIZE DISTRIBUTION PLOTS

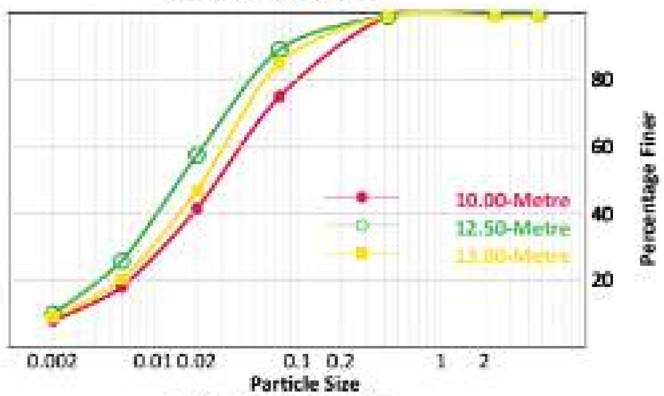
BH- P56-CH.22383.087



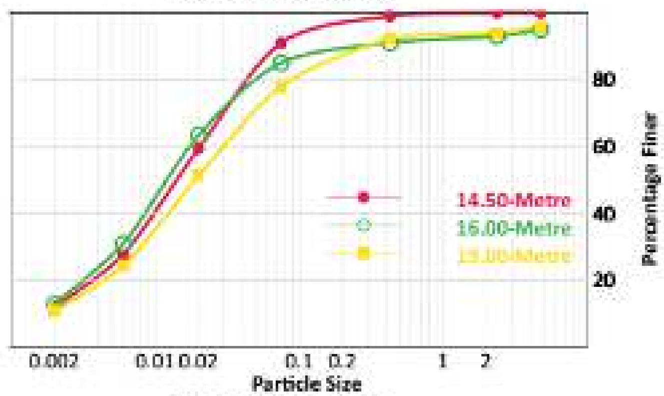
BH- P56-CH.22383.087



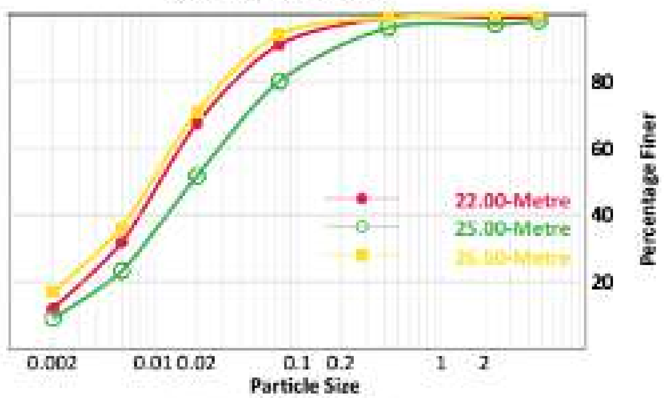
BH- P56-CH.22383.087



BH- P56-CH.22383.087



BH- P56-CH.22383.087



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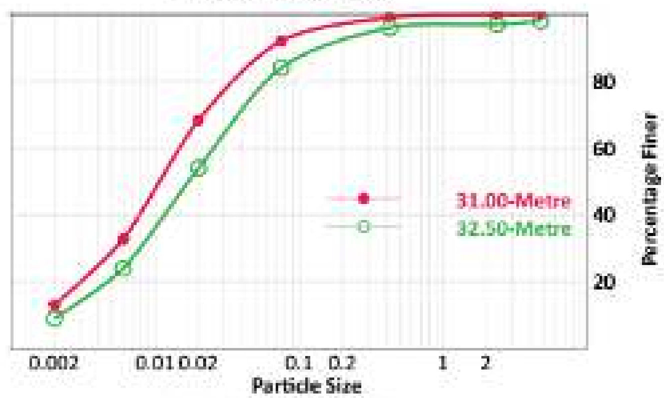

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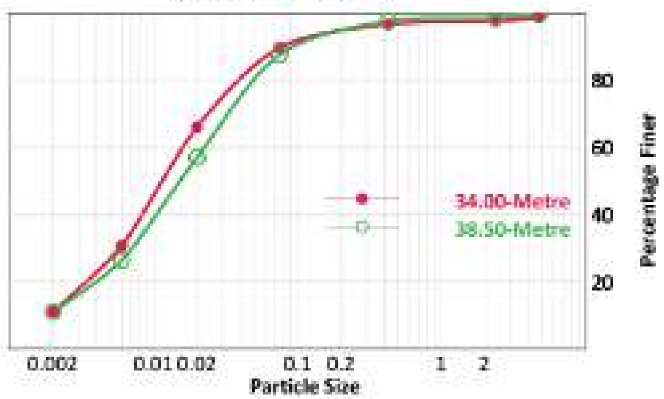
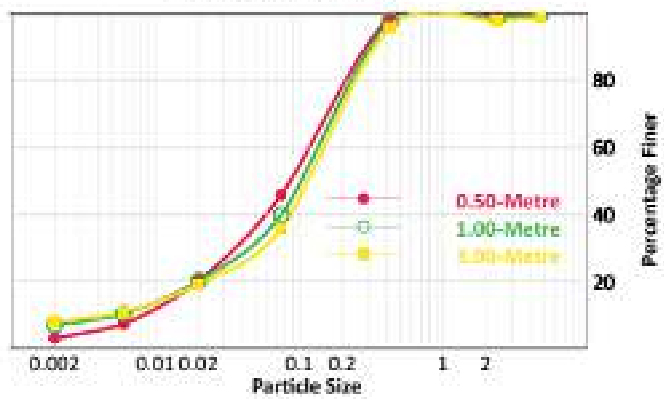
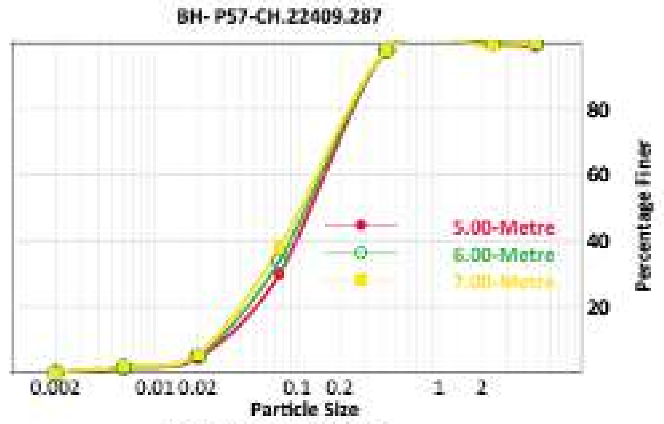
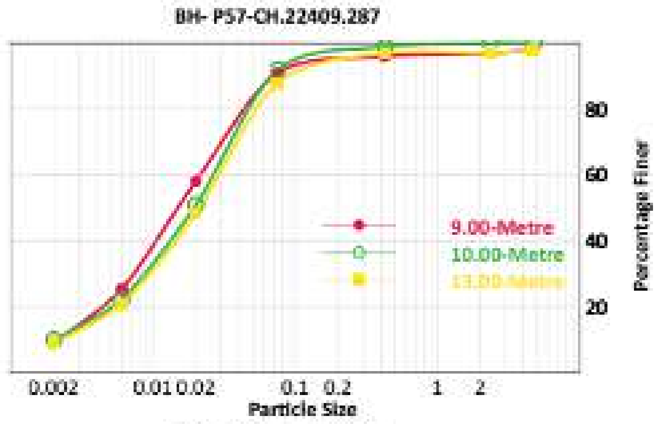


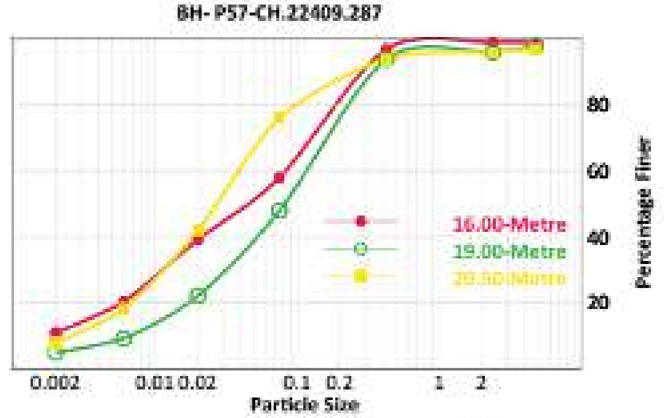
BH- P57-CH.22409.287

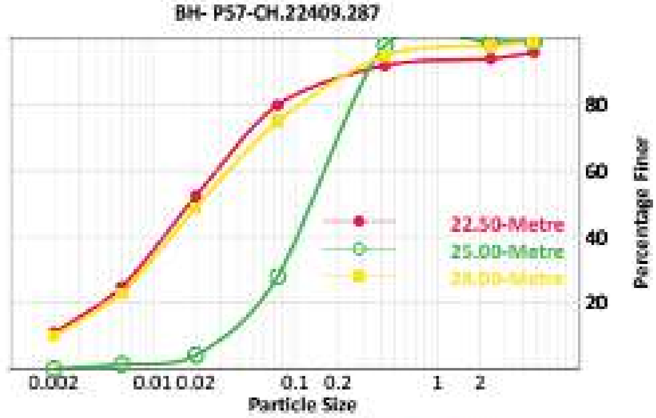


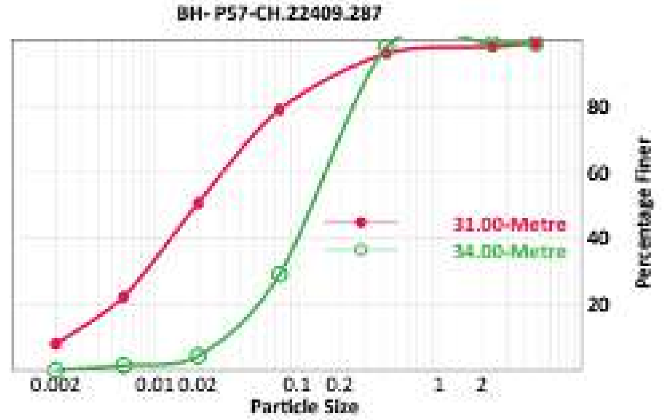
APPENDIX-D
PLOT 17: GRAIN SIZE DISTRIBUTION PLOTS

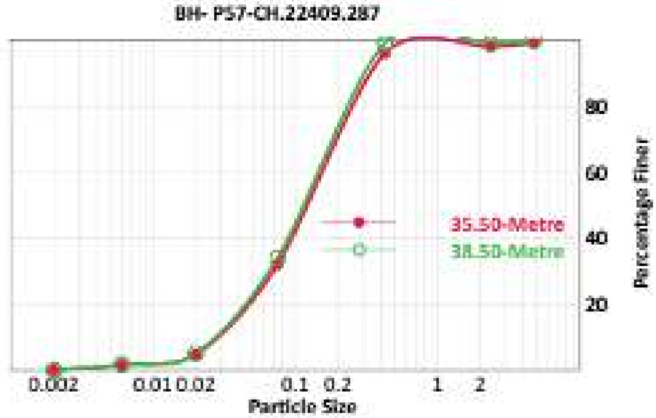


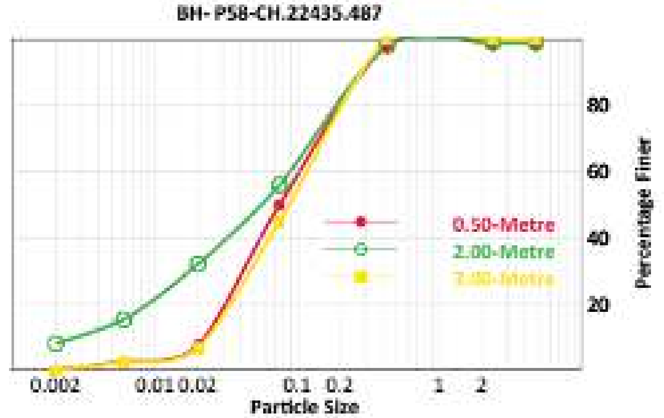


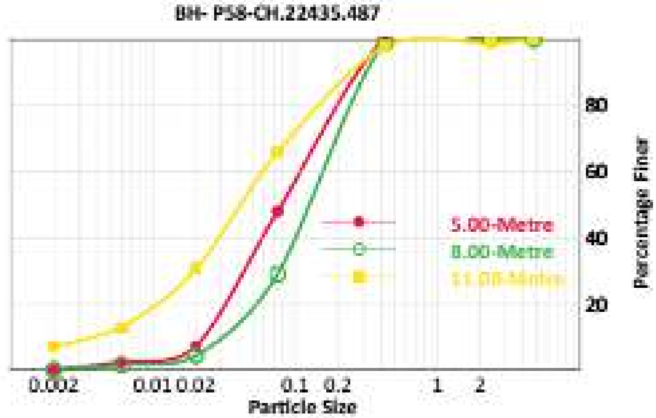




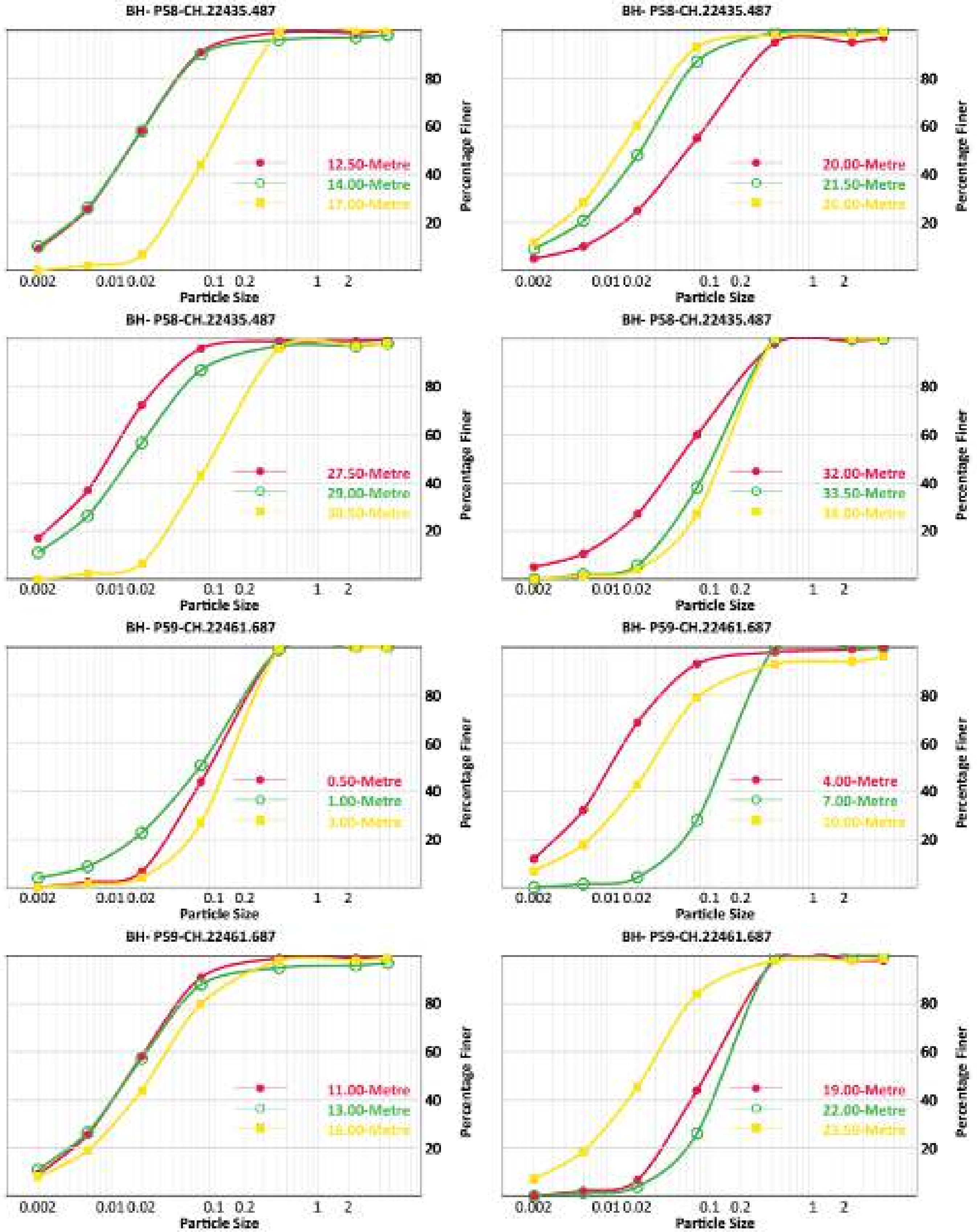






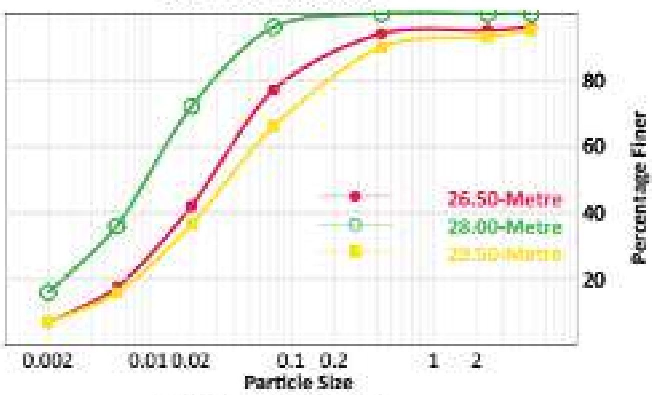


APPENDIX-D
PLOT 18: GRAIN SIZE DISTRIBUTION PLOTS

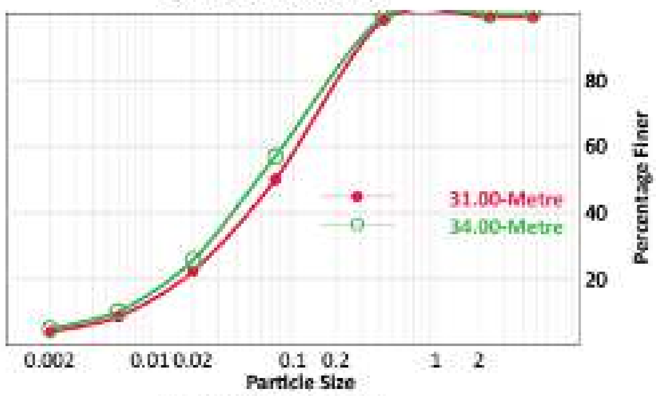


APPENDIX-D
PLOT 19: GRAIN SIZE DISTRIBUTION PLOTS

BH- P59-CH.22461.687



BH- P59-CH.22461.687



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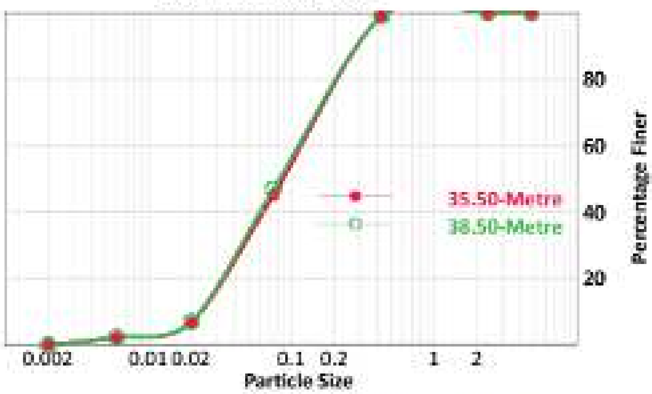
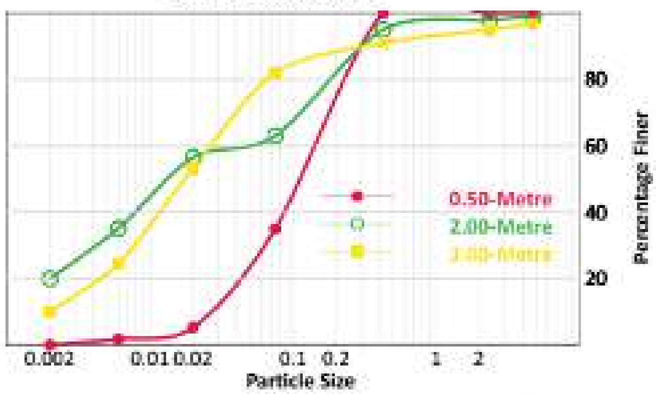


BH- P60-CH.22487.887



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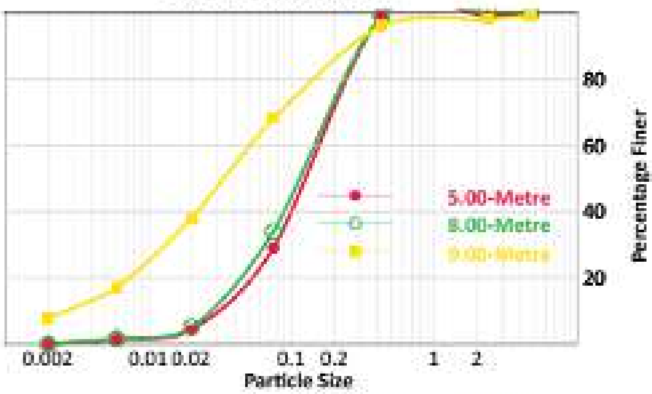

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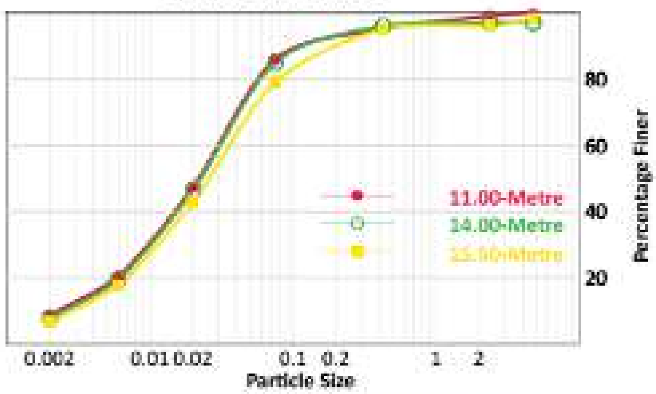

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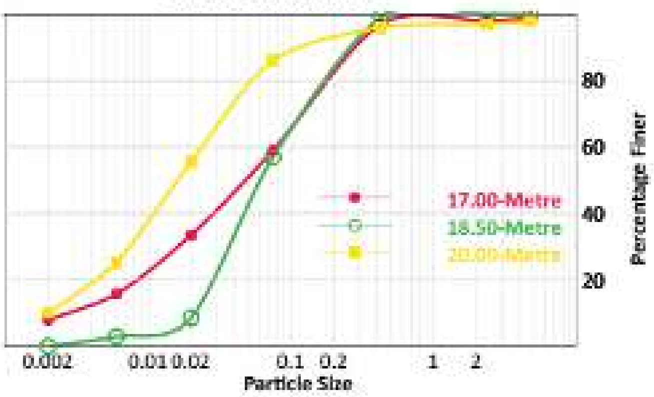
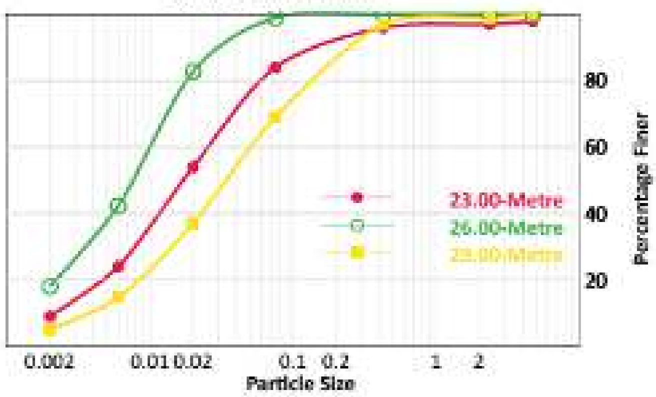
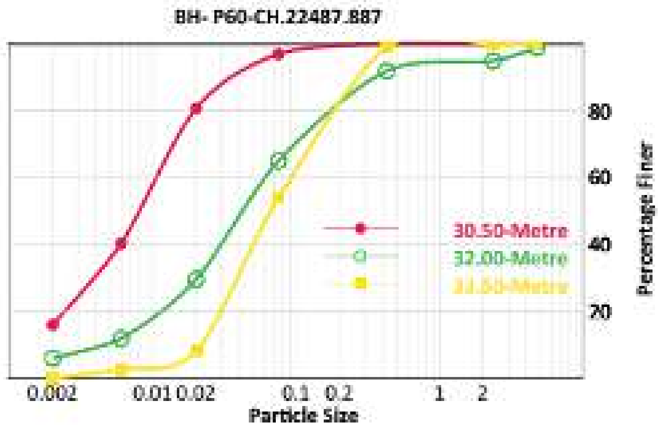
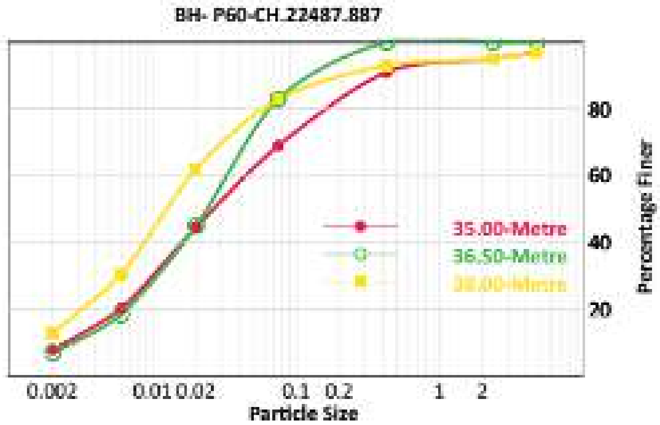


BH- P60-CH.22487.887

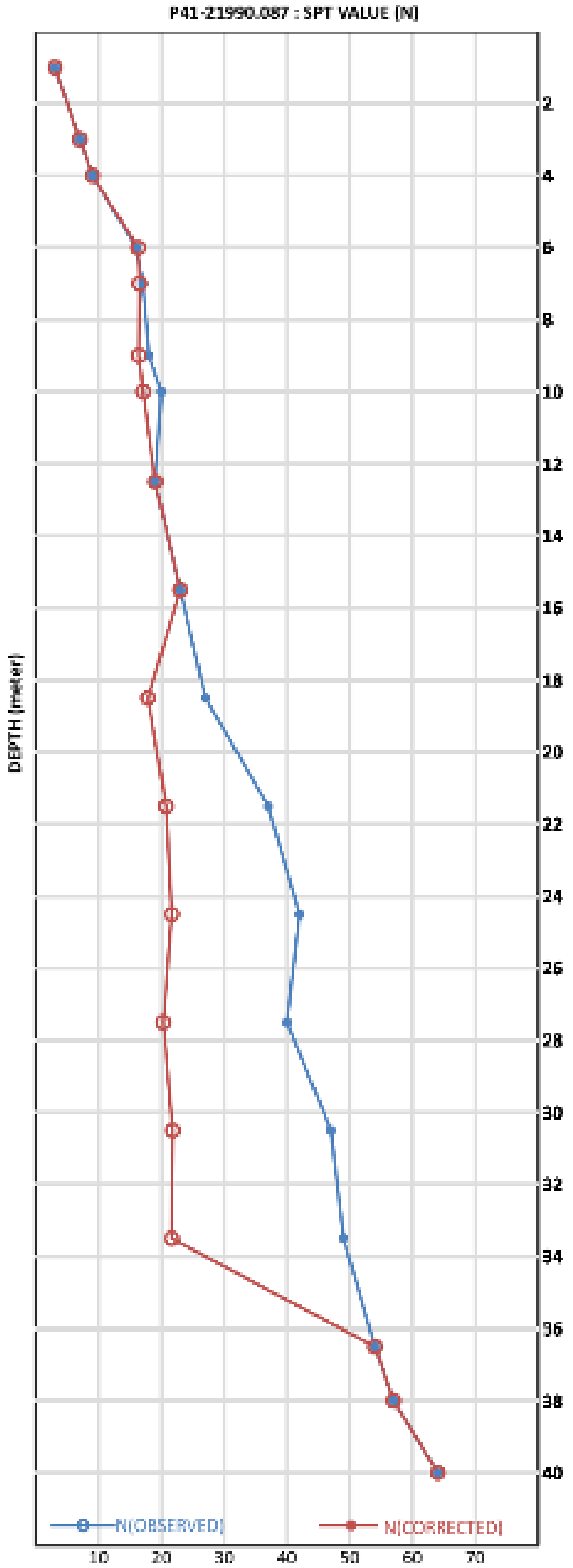


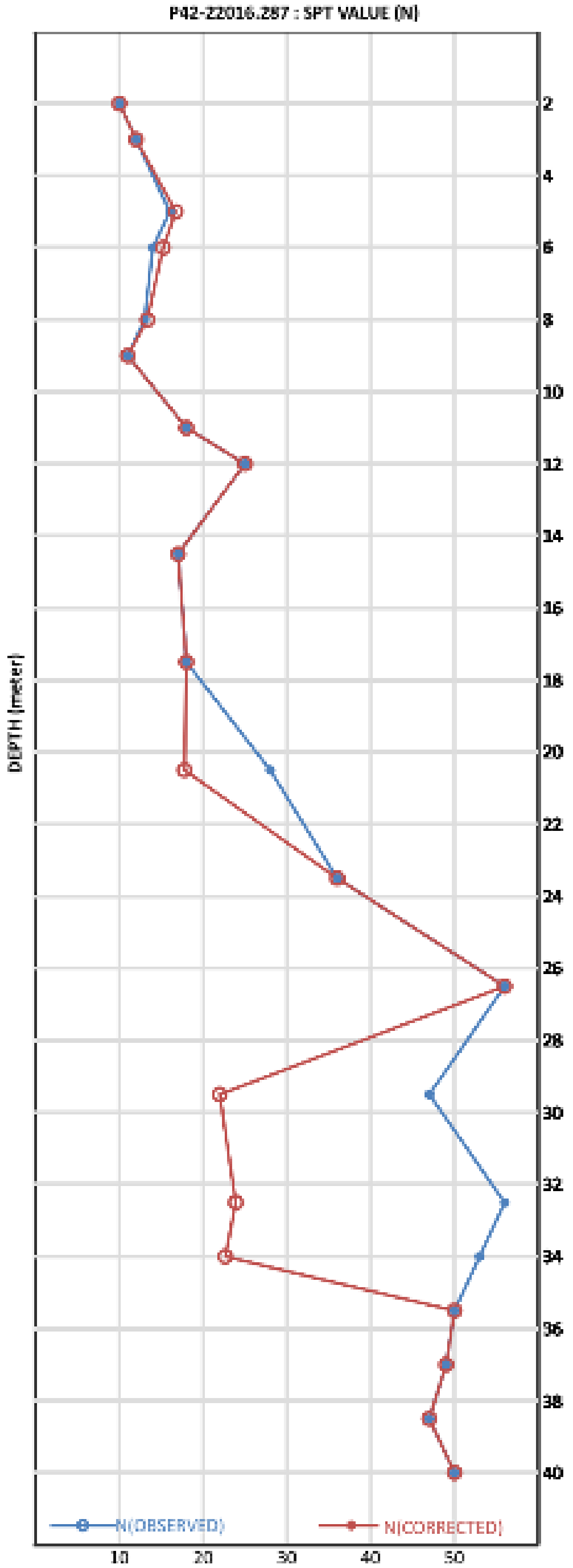
APPENDIX-D
PLOT 20: GRAIN SIZE DISTRIBUTION PLOTS



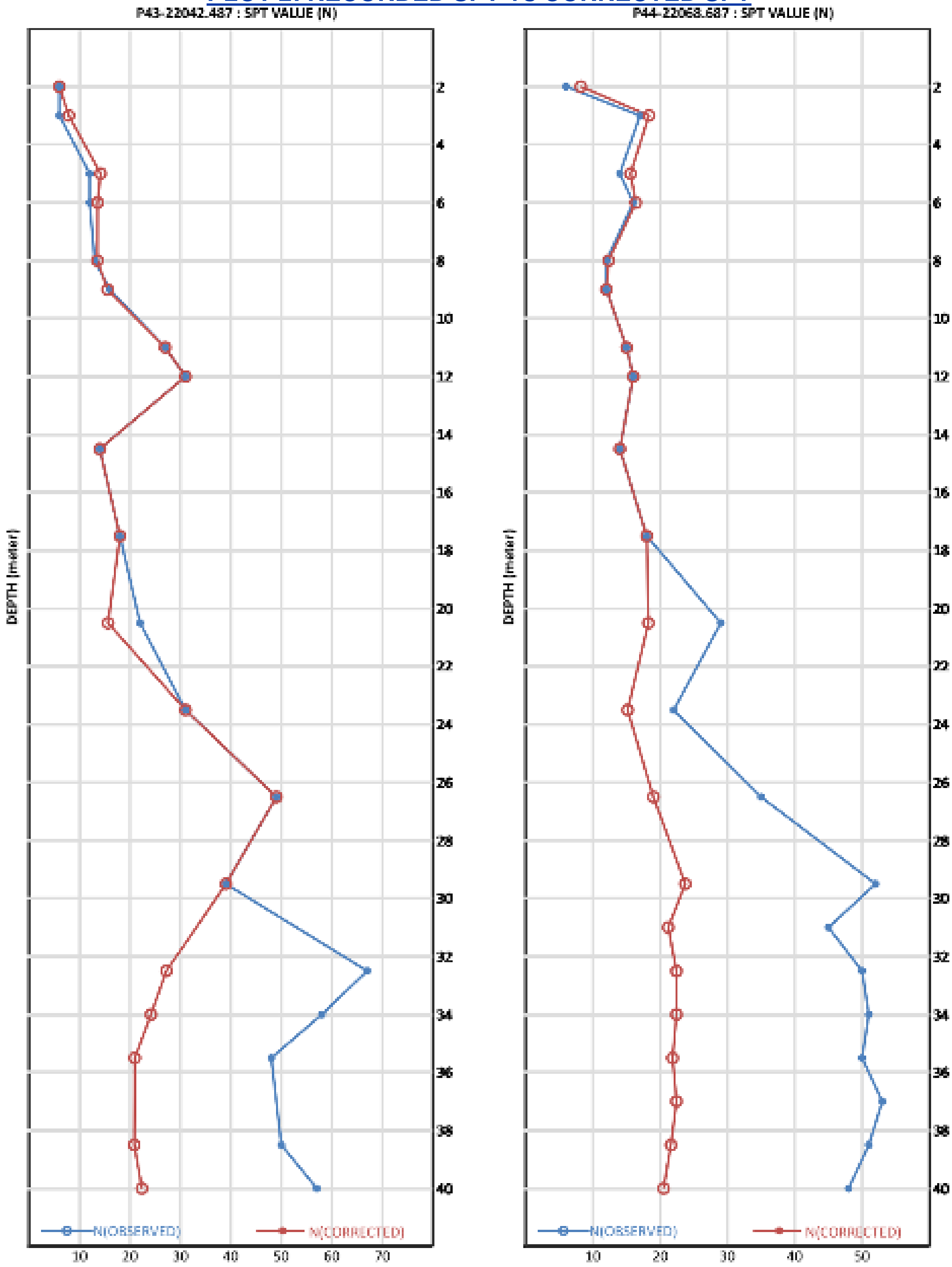


APPENDIX-E
PLOT 1: RECORDED SPT Vs CORRECTED SPT

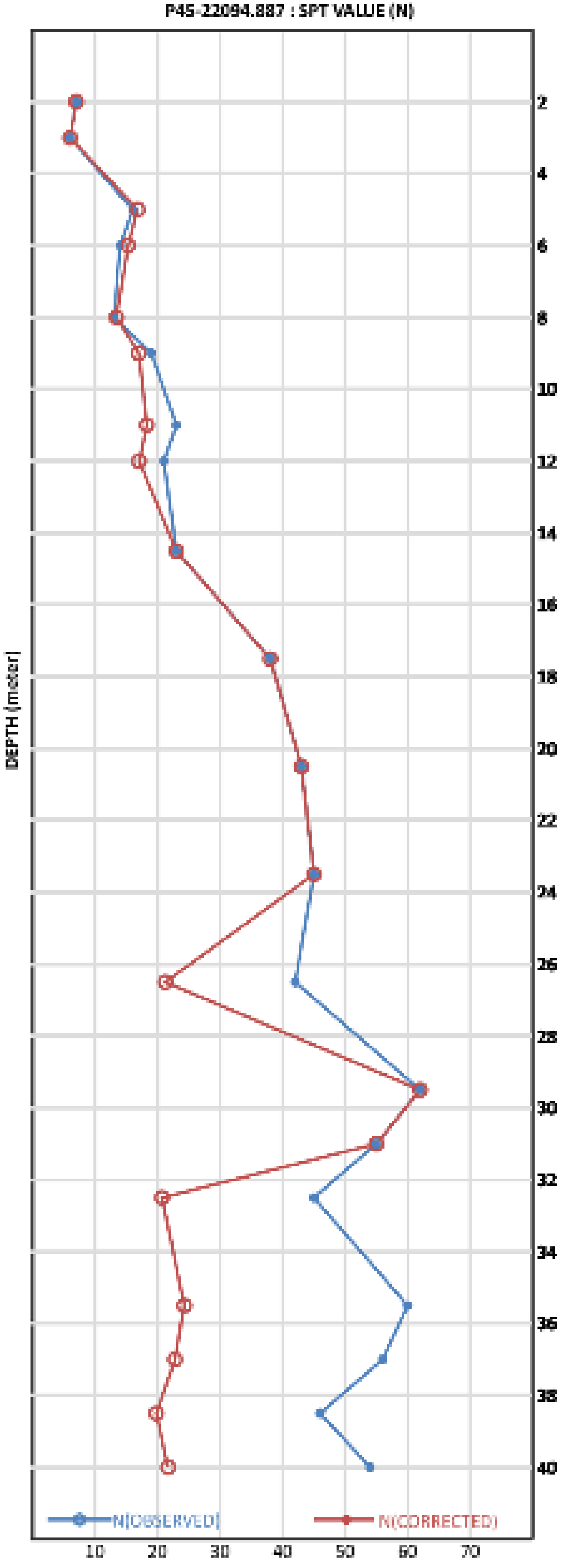


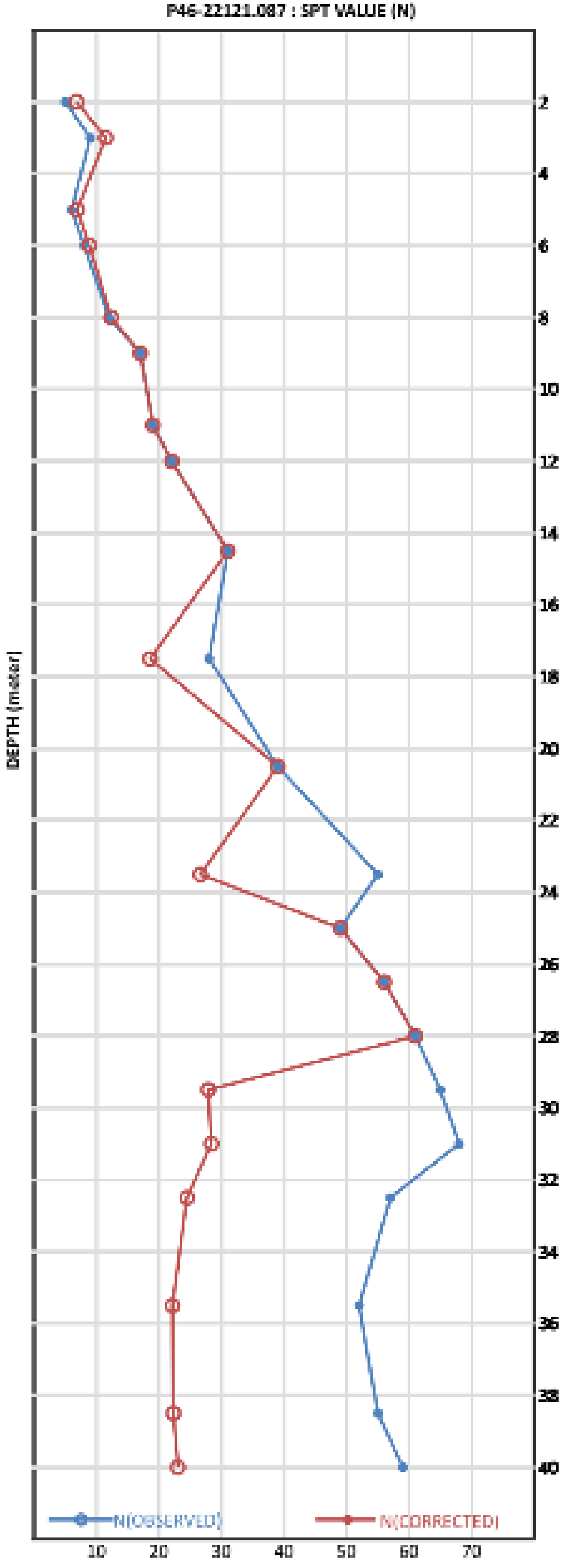


APPENDIX-E
PLOT 2: RECORDED SPT Vs CORRECTED SPT

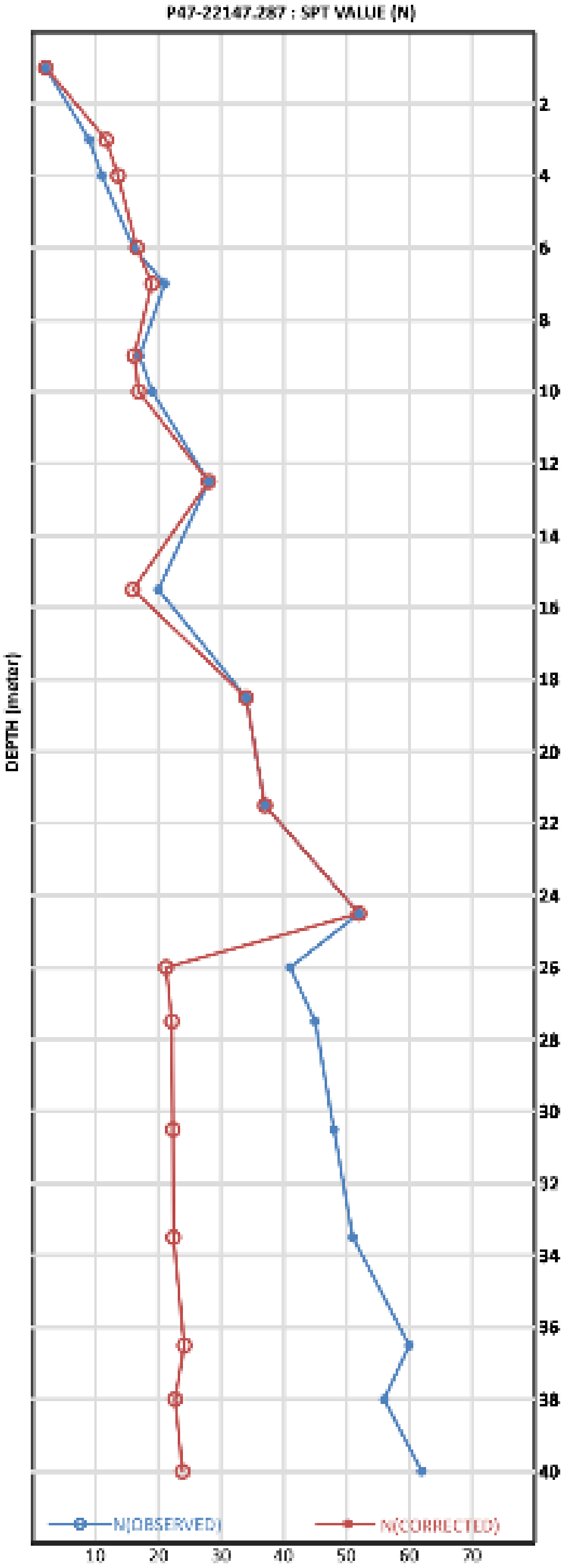


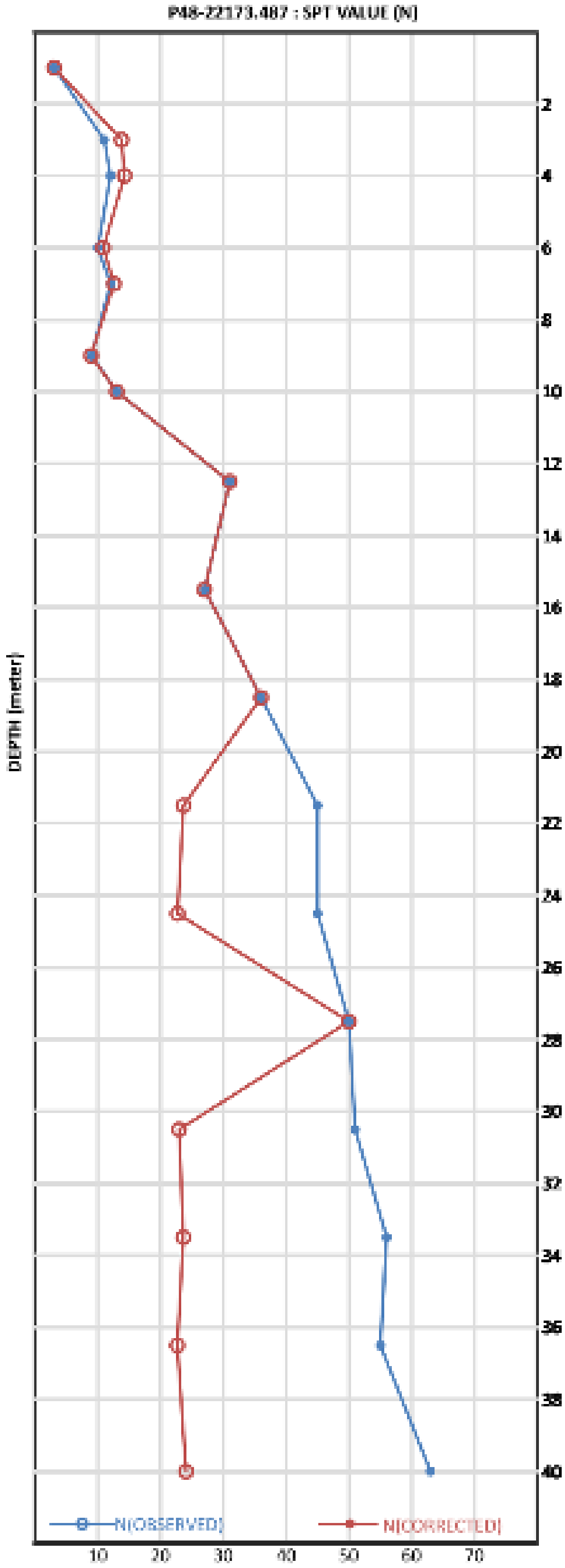
APPENDIX-E
PLOT 3: RECORDED SPT Vs CORRECTED SPT





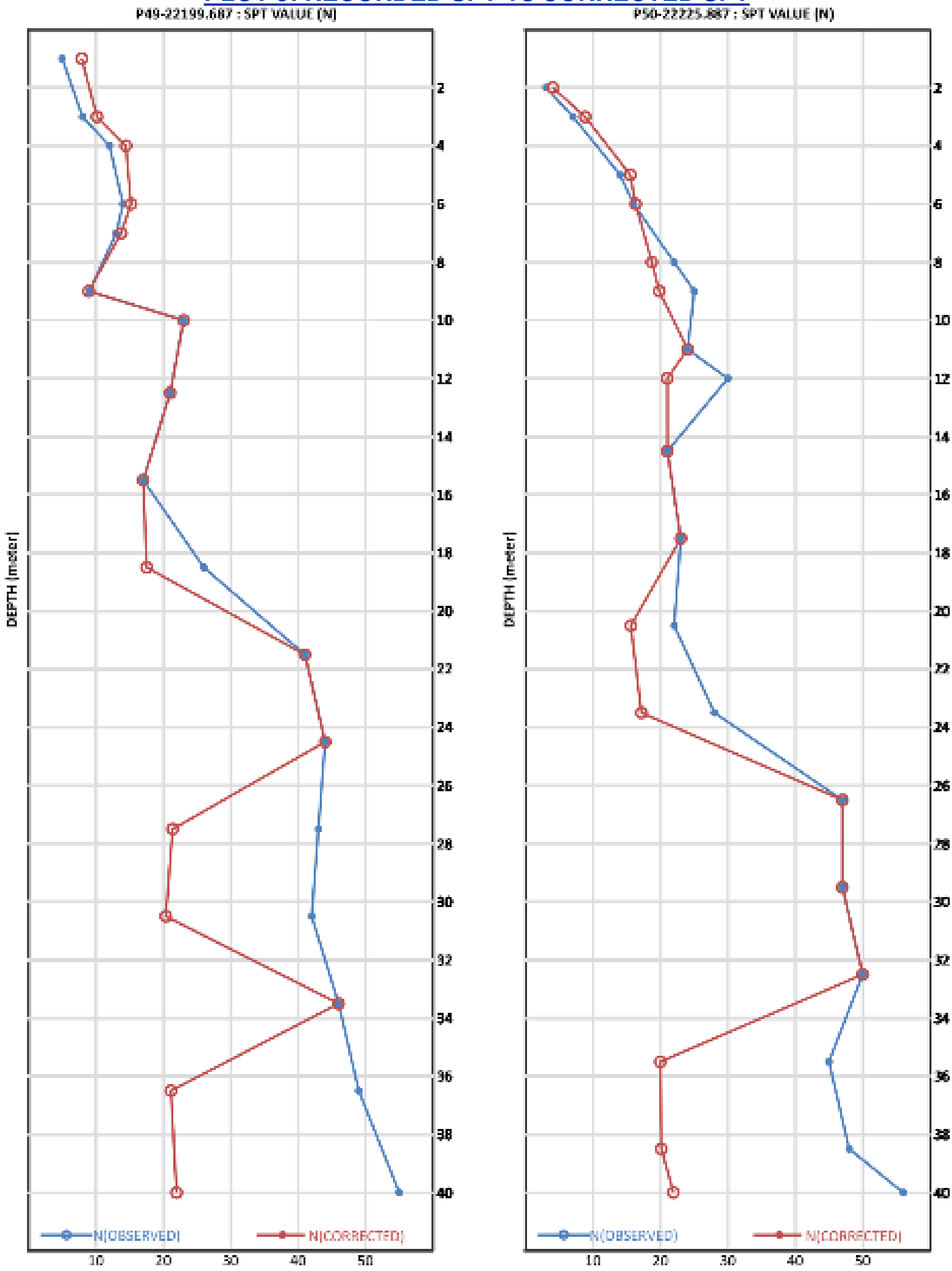
APPENDIX-E
PLOT 4: RECORDED SPT Vs CORRECTED SPT



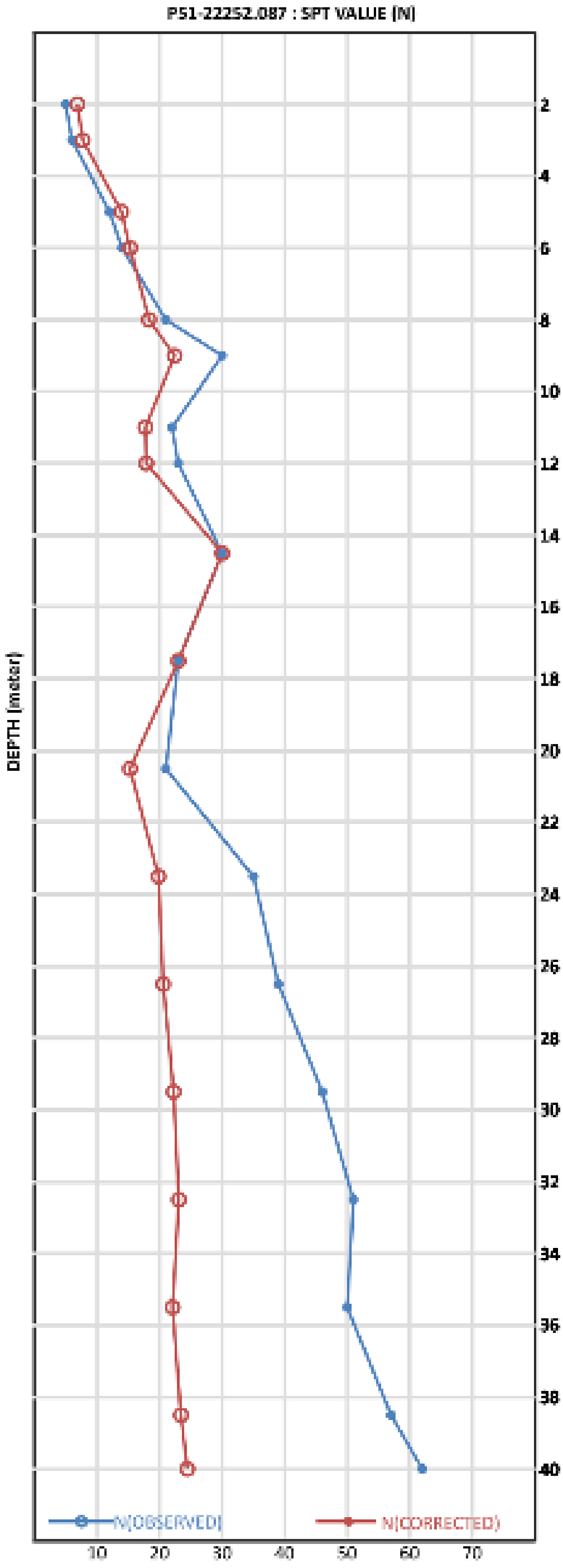


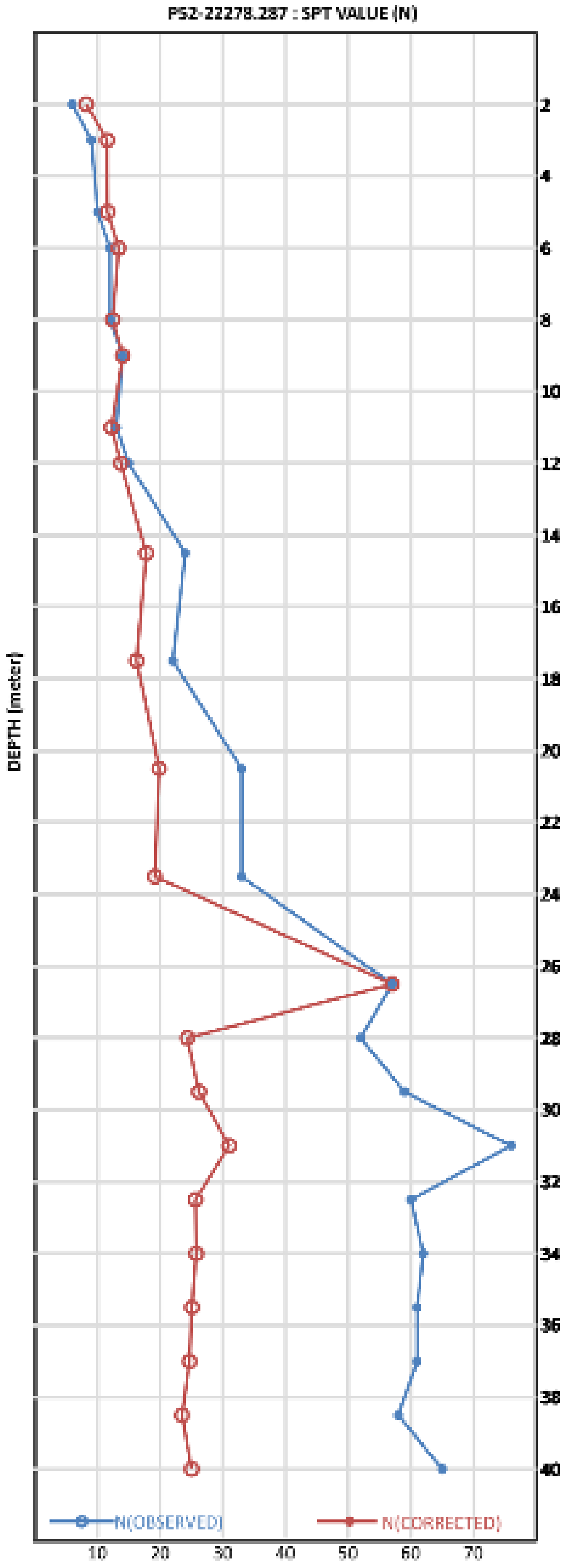
APPENDIX-E

PLOT 5: RECORDED SPT Vs CORRECTED SPT

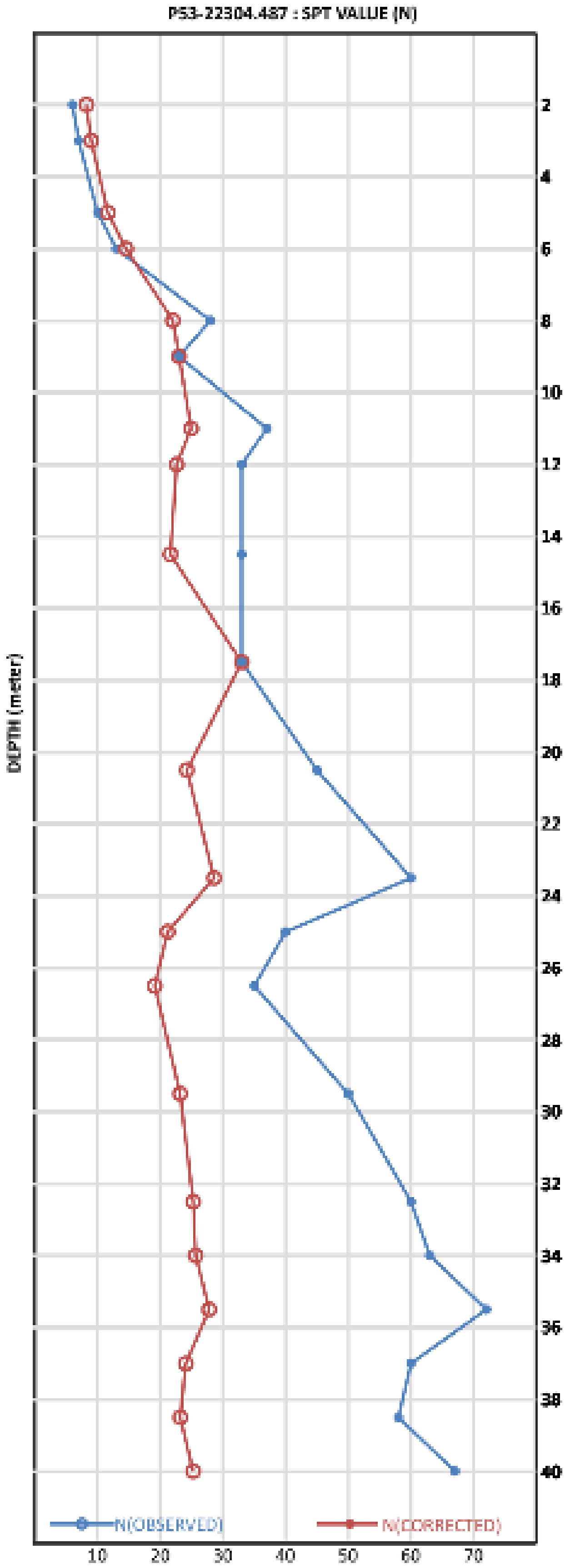


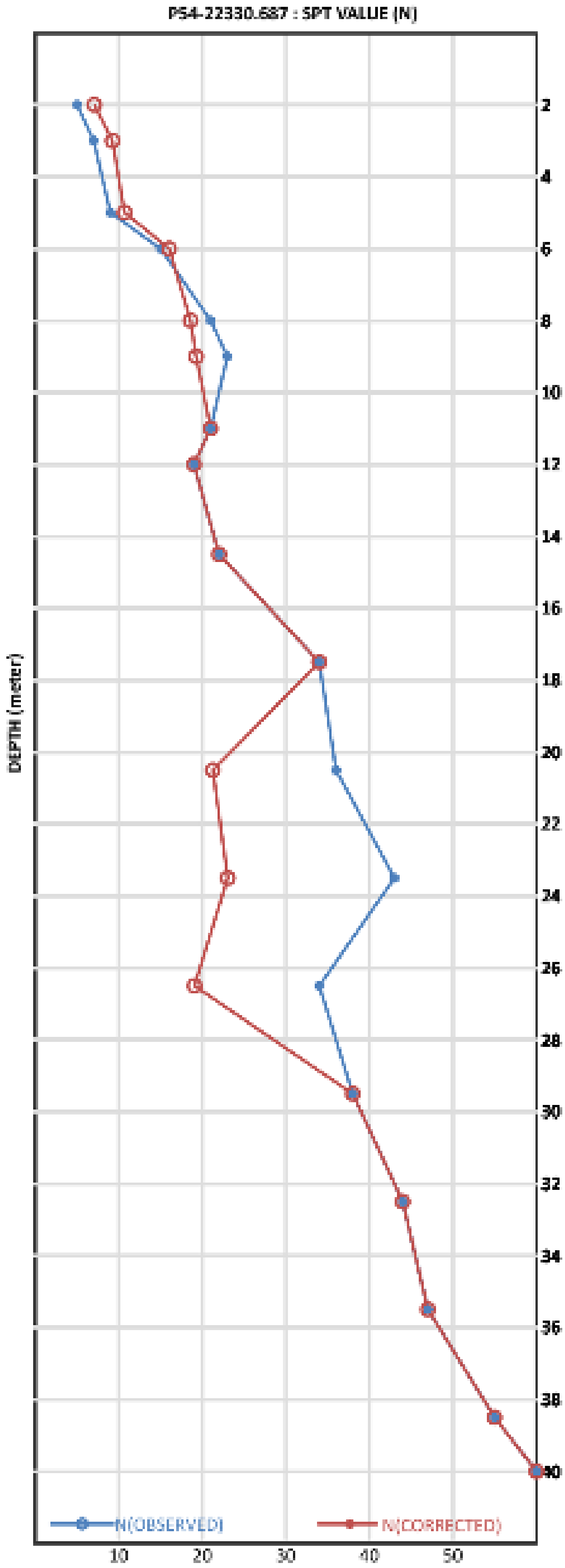
APPENDIX-E
PLOT 6: RECORDED SPT Vs CORRECTED SPT





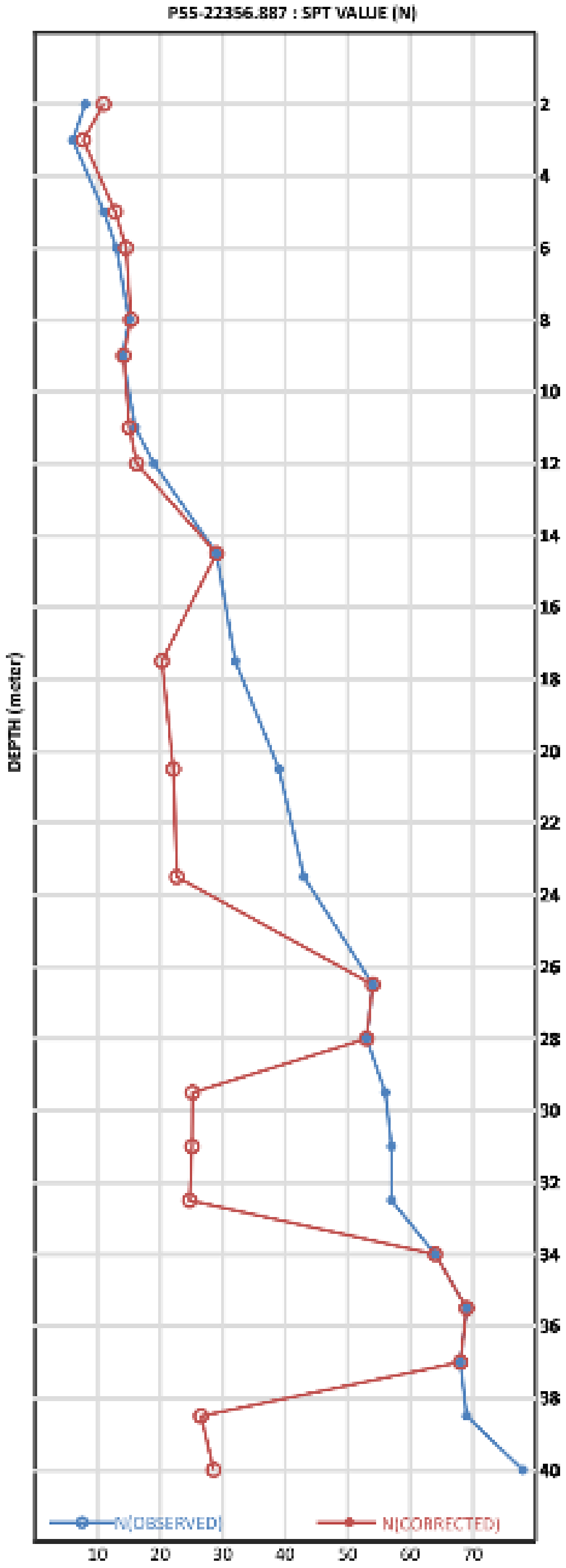
APPENDIX-E
PLOT 7: RECORDED SPT Vs CORRECTED SPT

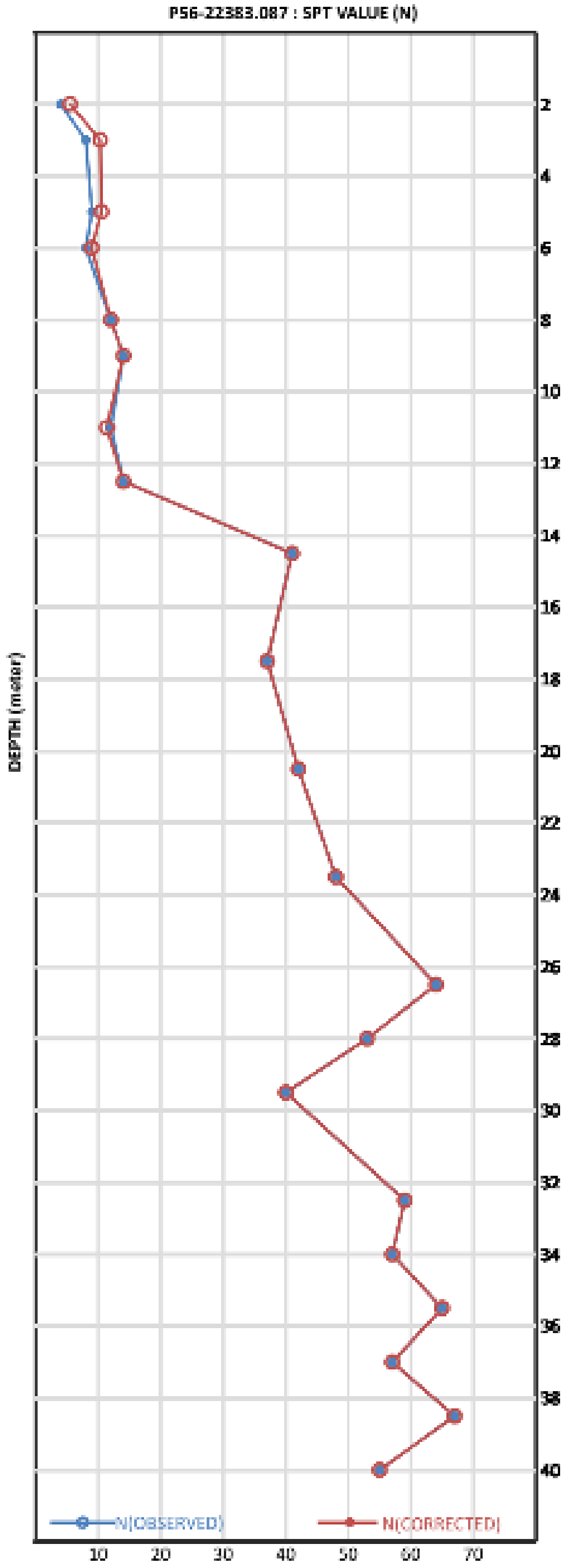




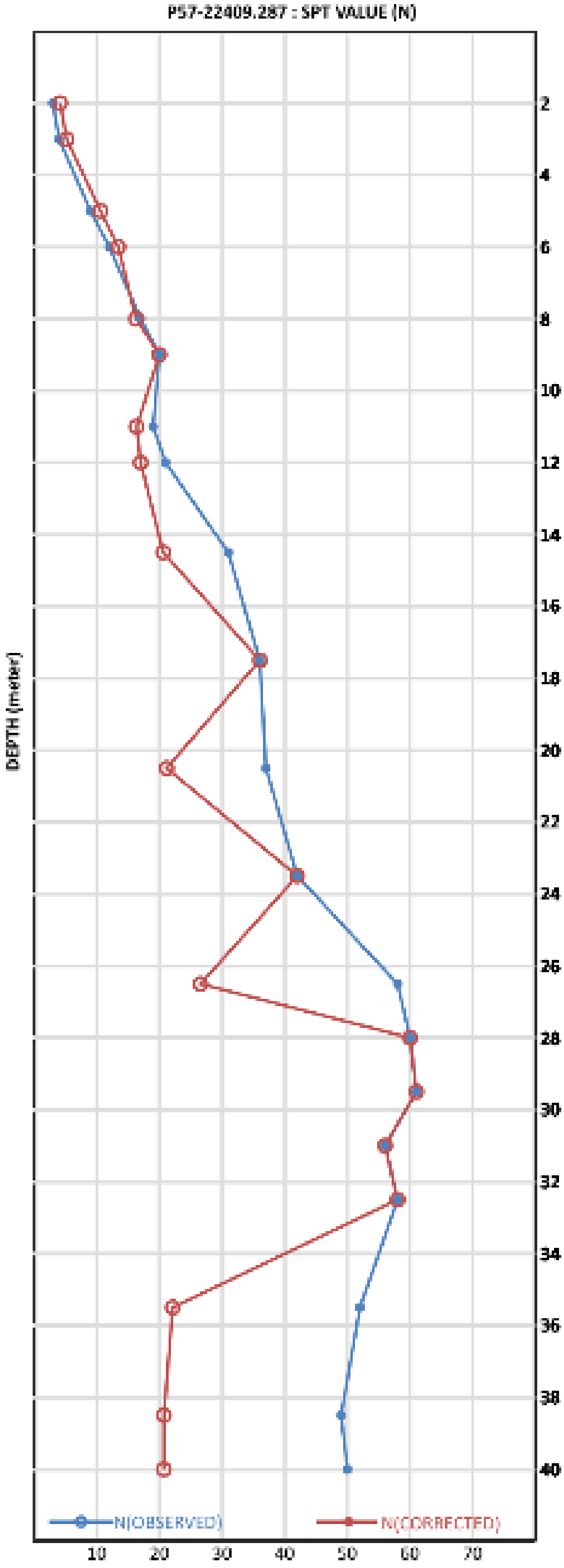
APPENDIX-E

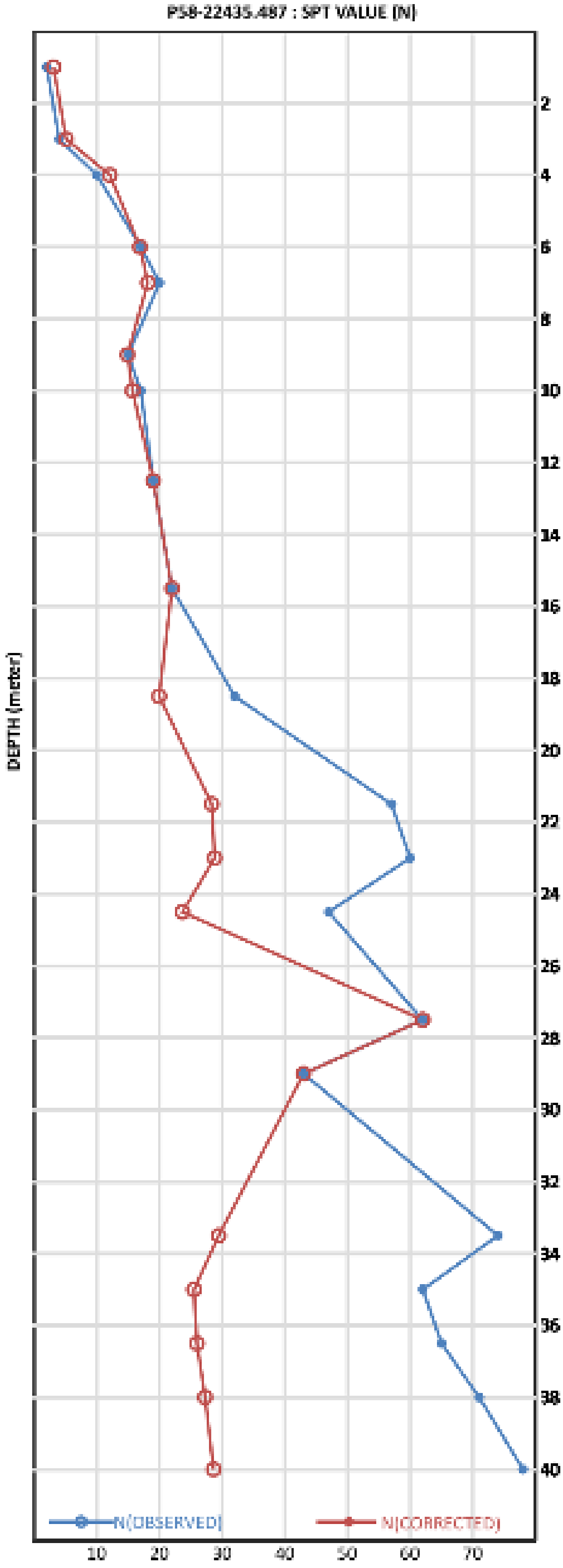
PLOT 8: RECORDED SPT Vs CORRECTED SPT



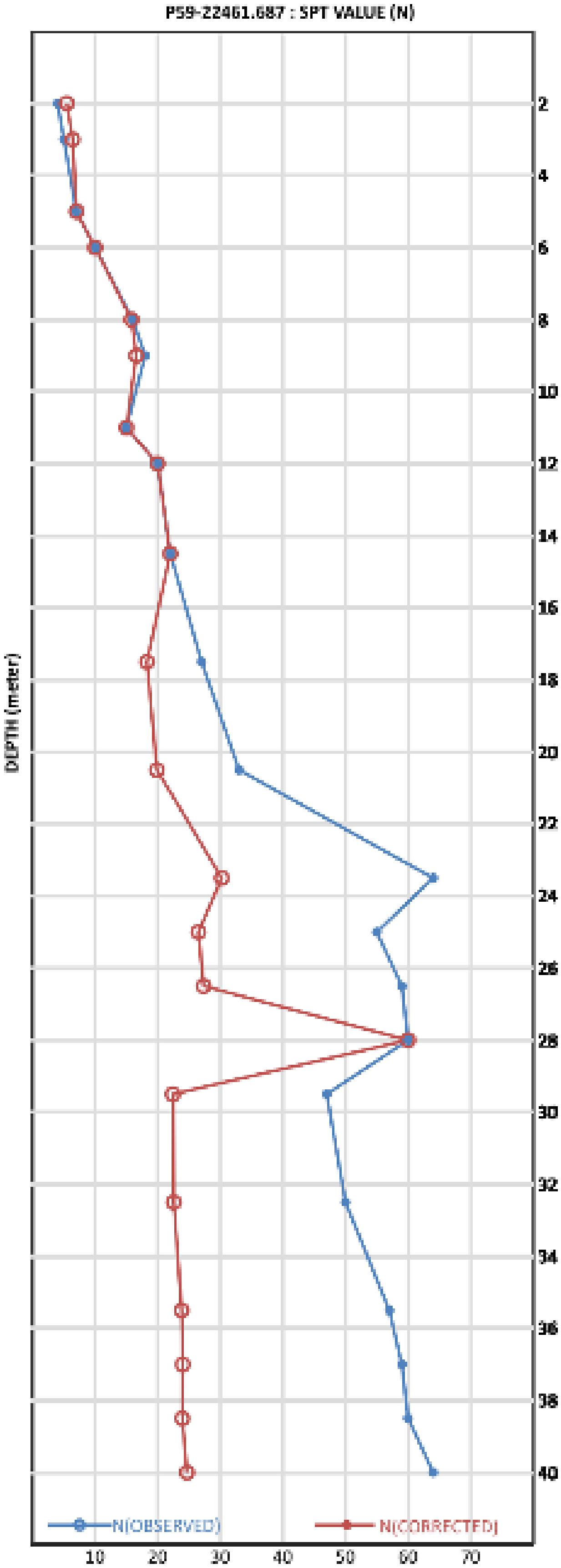


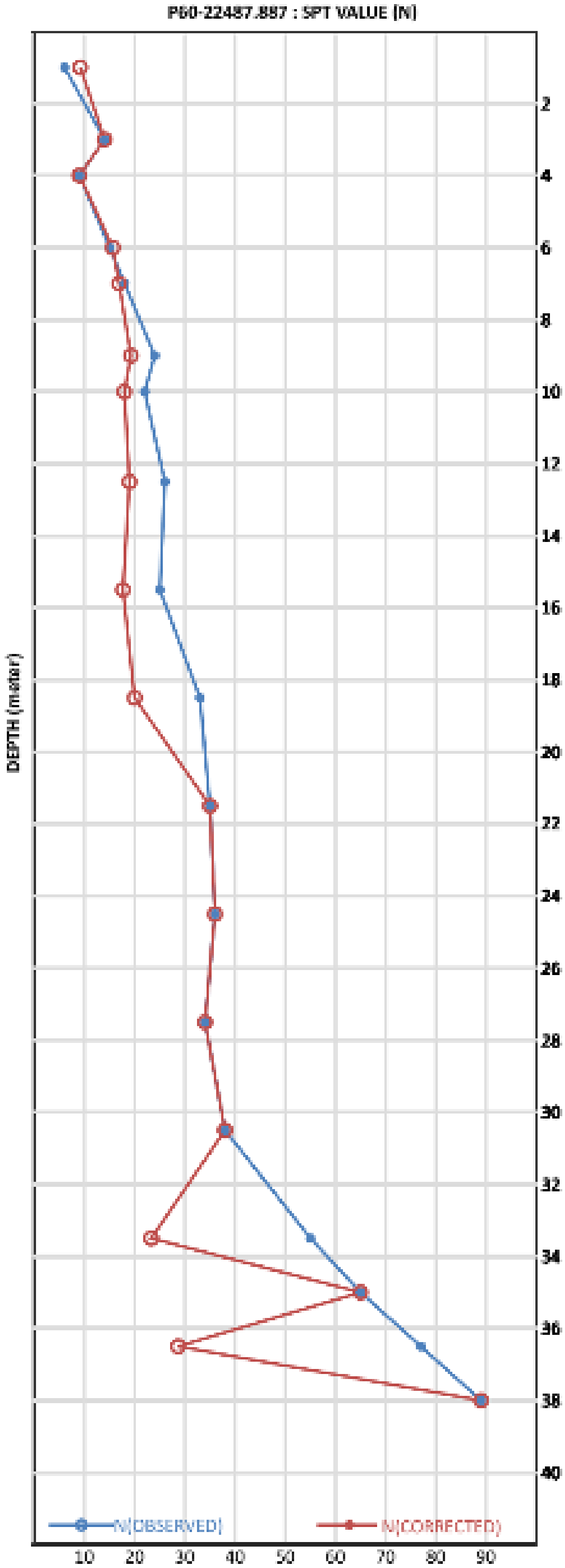
APPENDIX-E
PLOT 9: RECORDED SPT Vs CORRECTED SPT



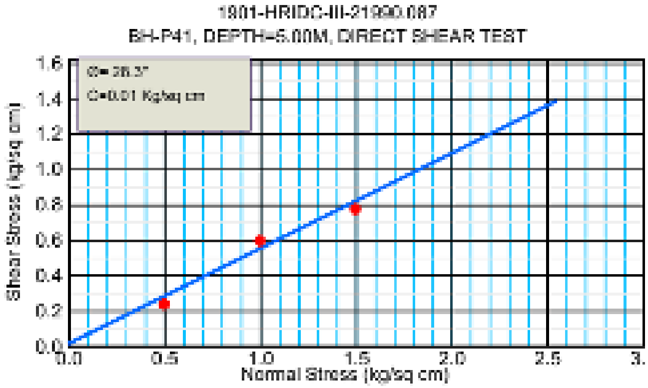


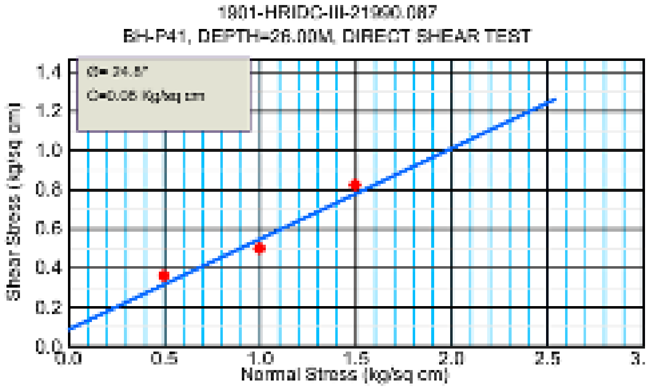
APPENDIX-E
PLOT 10: RECORDED SPT Vs CORRECTED SPT

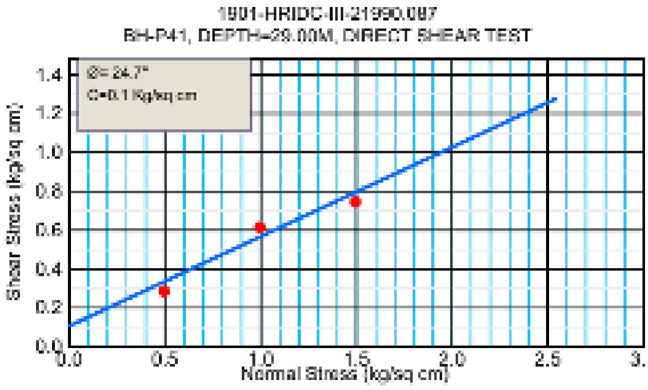


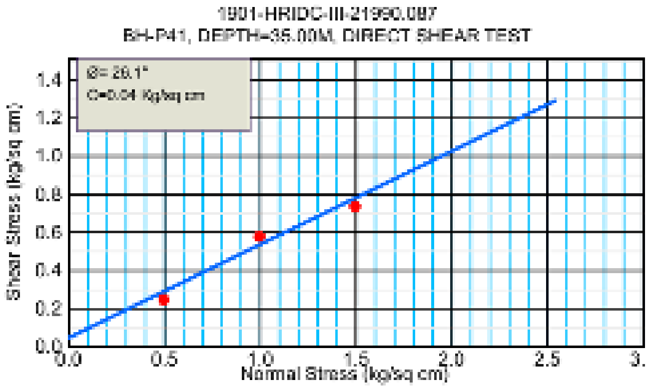


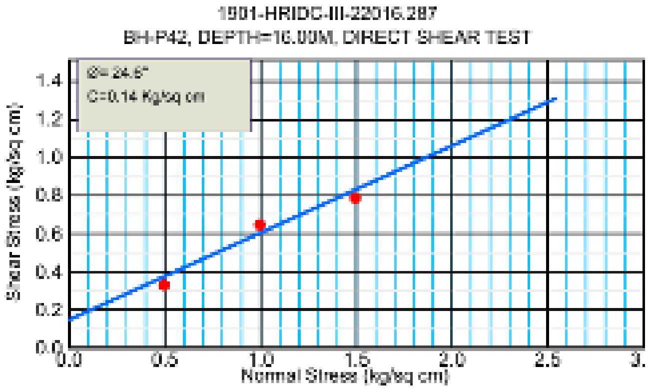
APPENDIX-F
GRAPH 1: DST GRAPH

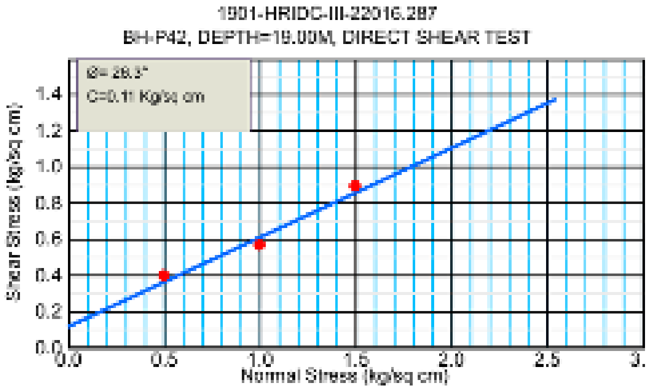


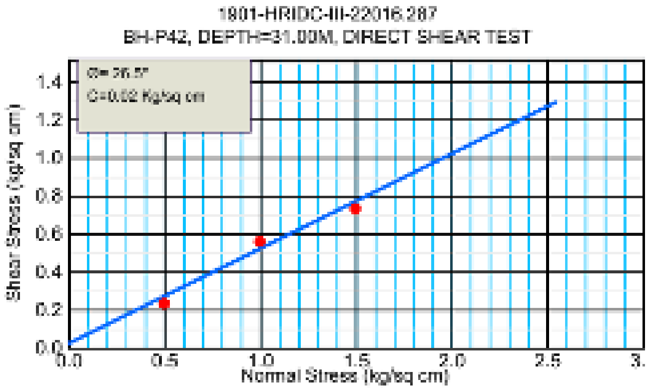


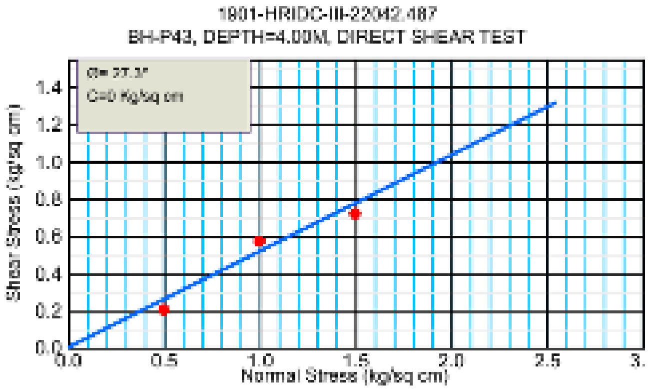




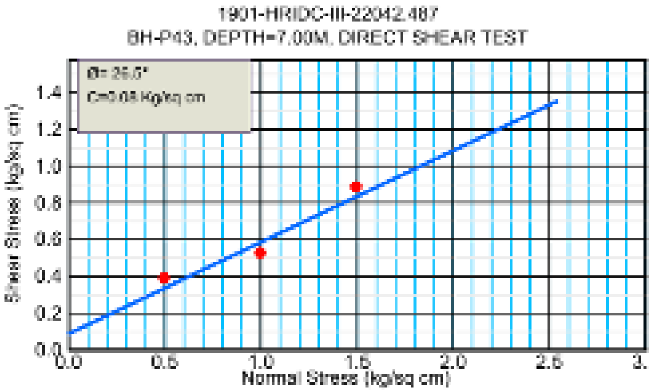


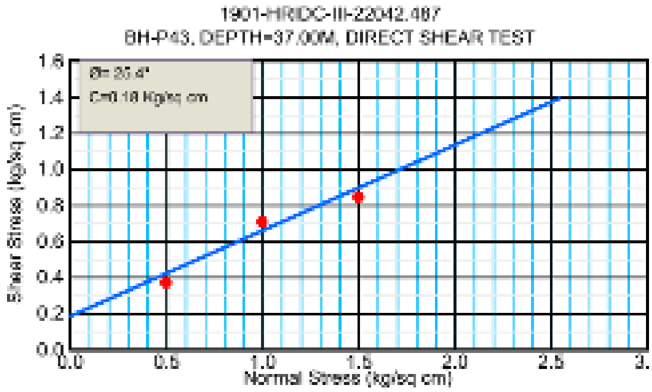


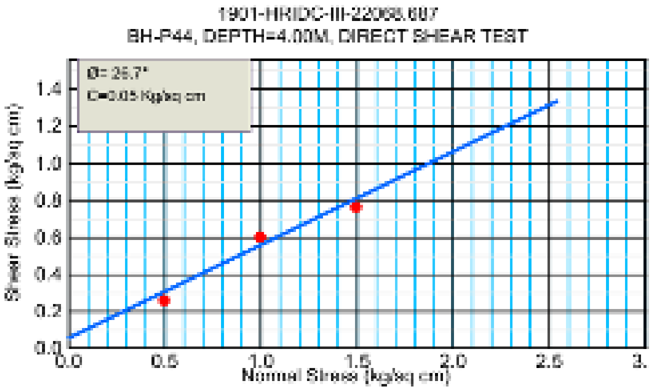


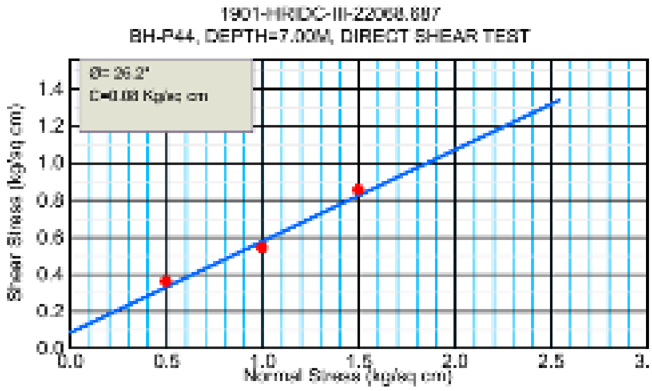


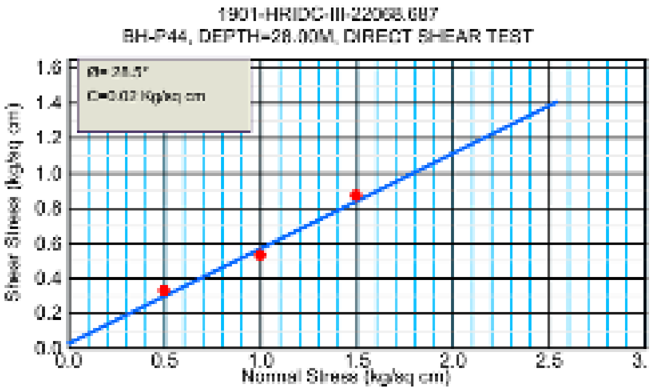
APPENDIX-F
GRAPH 2: DST GRAPH

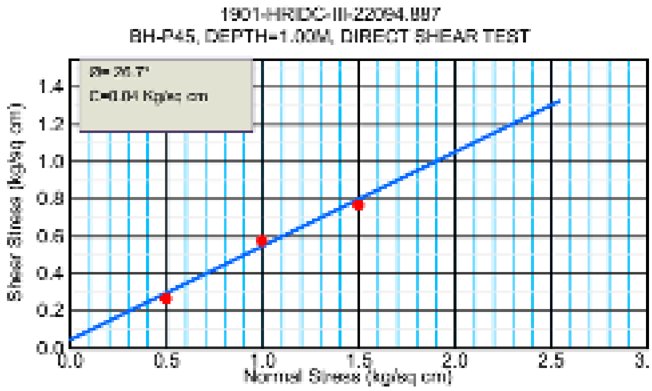


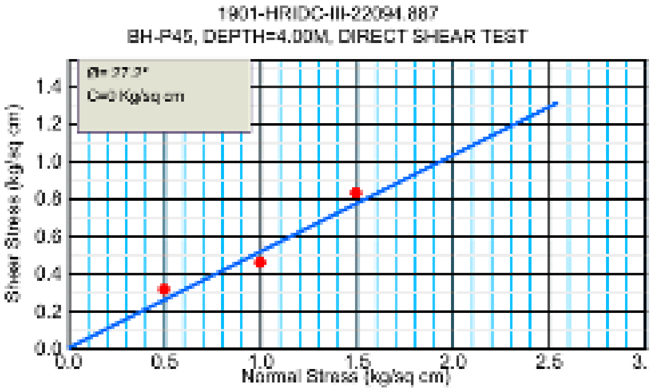


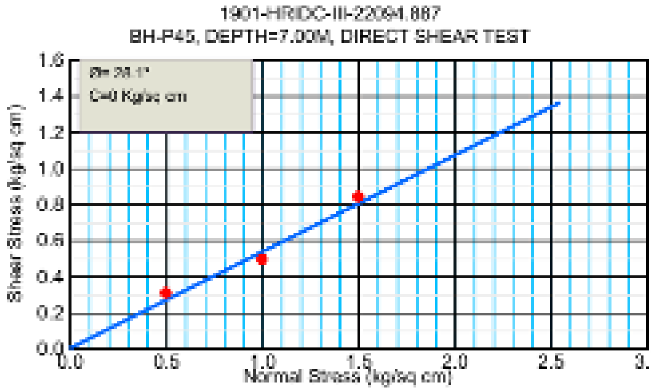






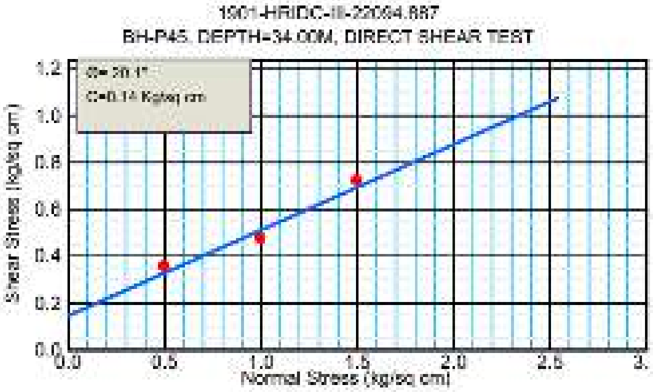


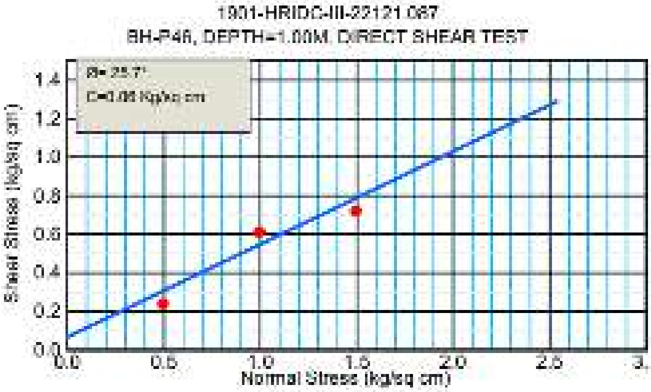


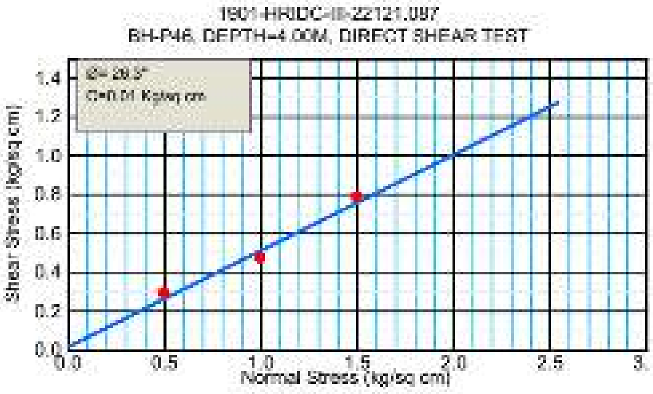


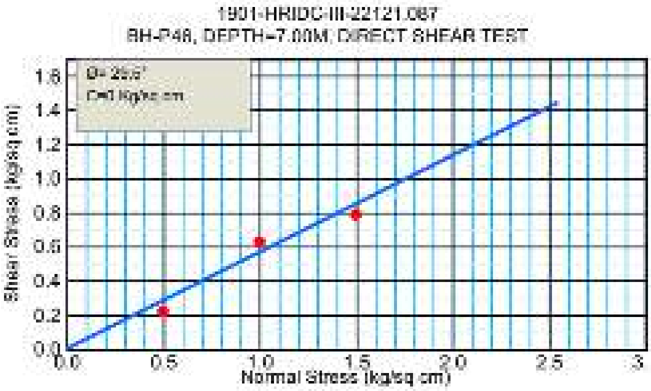
APPENDIX-F

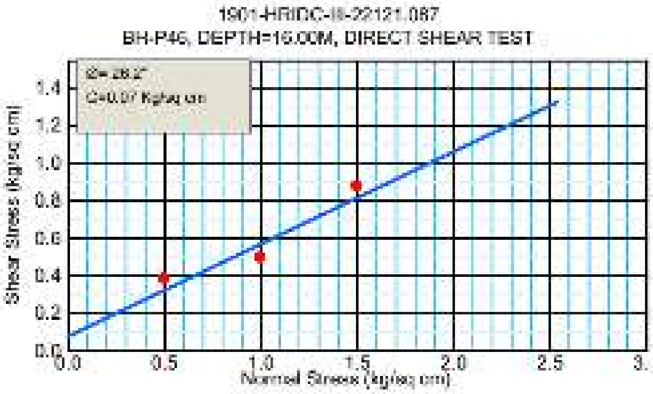
GRAPH 3: DST GRAPH

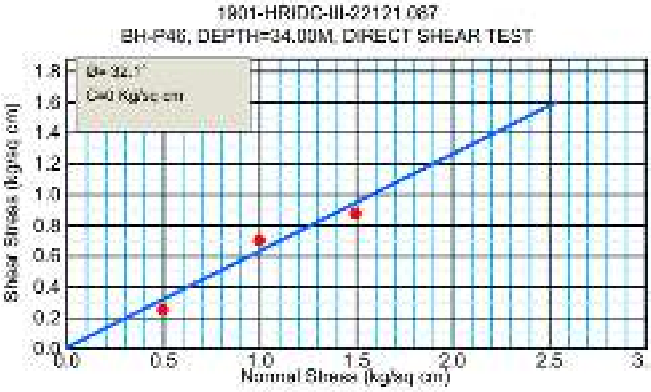


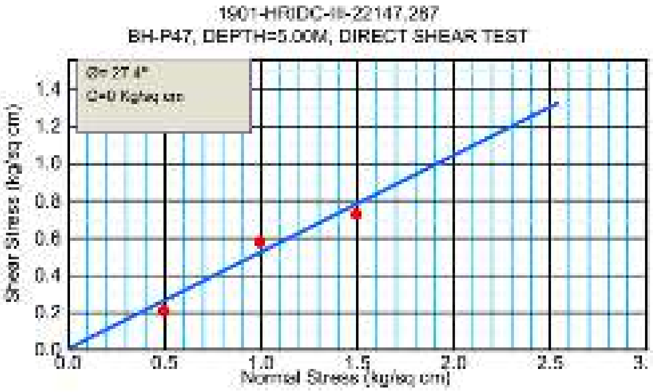


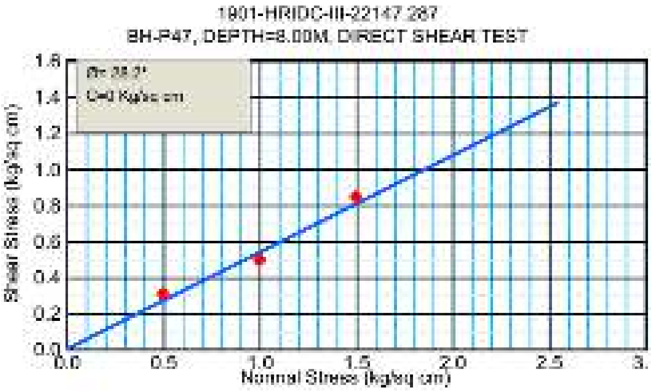








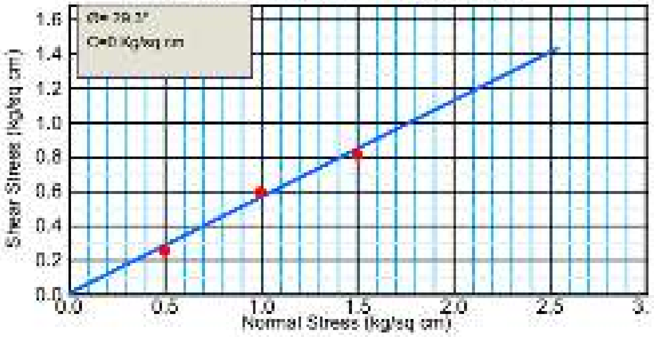




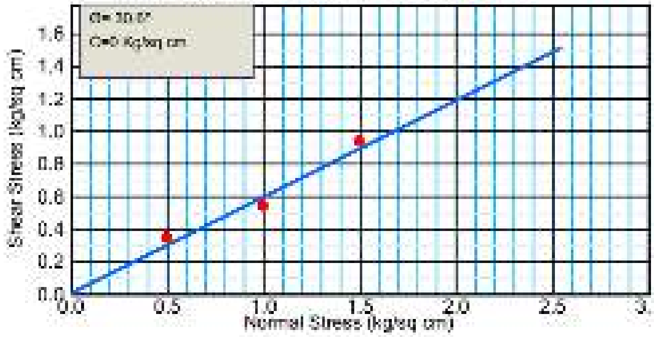
APPENDIX-F

GRAPH 4: DST GRAPH

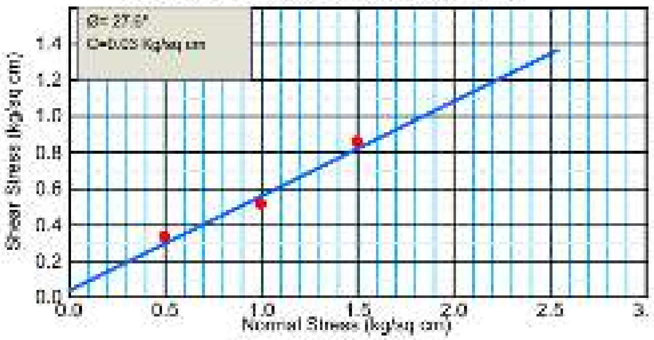
1901-HRIDC-III-22147.267
BH-P47, DEPTH=32.00M, DIRECT SHEAR TEST



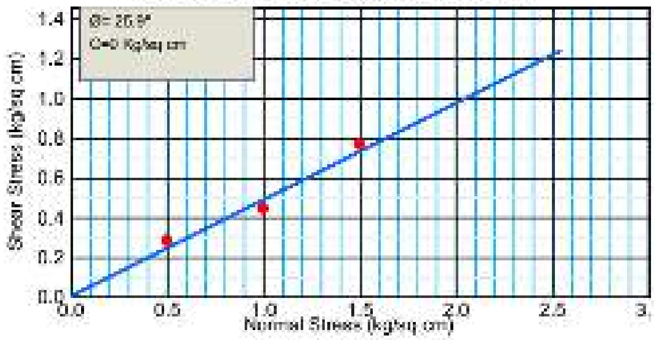
1901-HRIDC-III-22147.267
BH-P47, DEPTH=35.00M, DIRECT SHEAR TEST



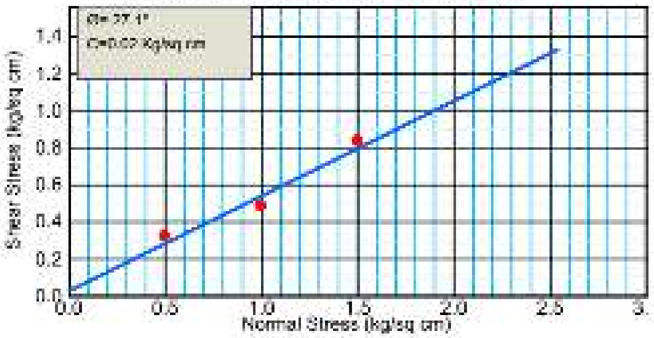
1901-HRIDC-III-22173.467
BH-P48, DEPTH=2.00M, DIRECT SHEAR TEST



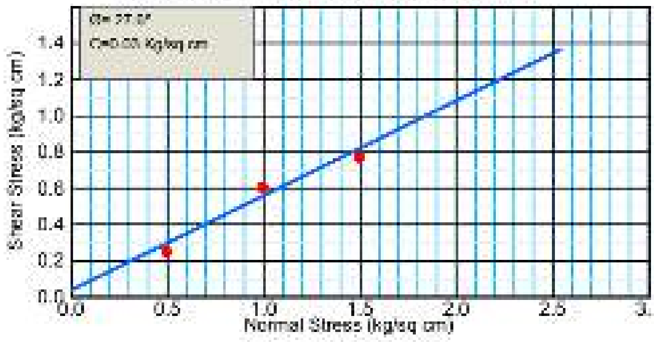
1901-HRIDC-III-22173.467
BH-P48, DEPTH=5.00M, DIRECT SHEAR TEST



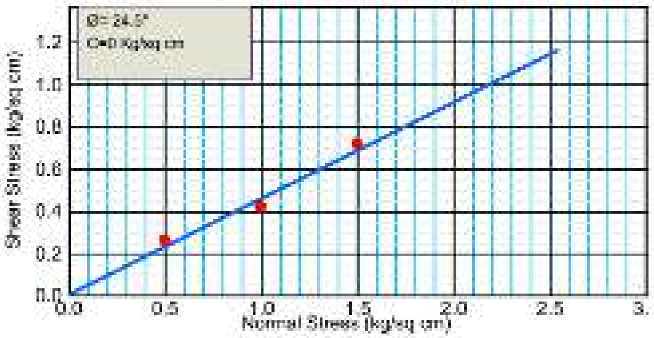
1901-HRIDC-III-22173.467
BH-P48, DEPTH=26.00M, DIRECT SHEAR TEST



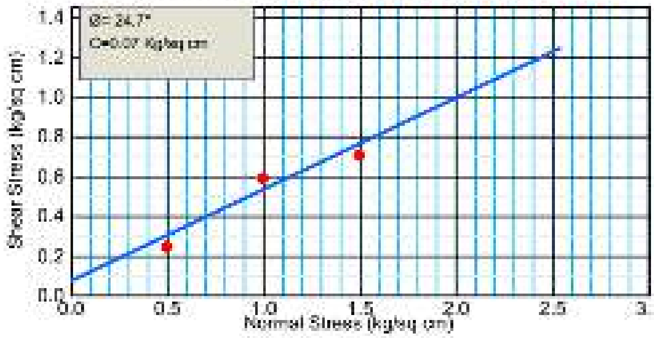
1901-HRIDC-III-22173.467
BH-P48, DEPTH=32.00M, DIRECT SHEAR TEST



1901-HRIDC-III-22199.667
BH-P49, DEPTH=5.00M, DIRECT SHEAR TEST

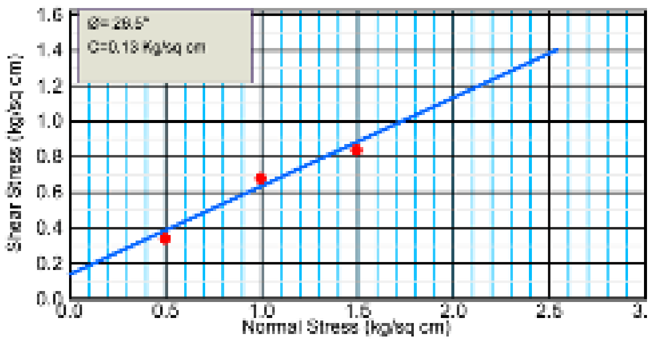


1901-HRIDC-III-22199.667
BH-P49, DEPTH=8.00M, DIRECT SHEAR TEST

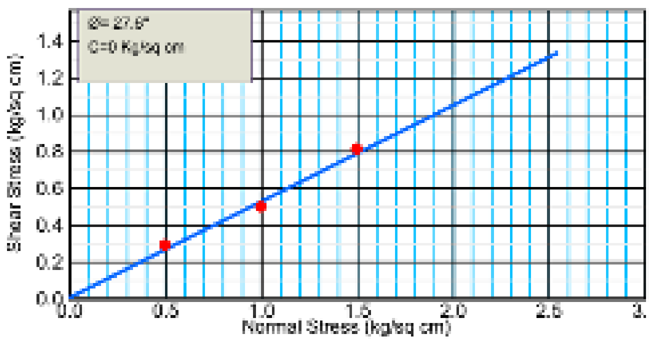


APPENDIX-F
GRAPH 5: DST GRAPH

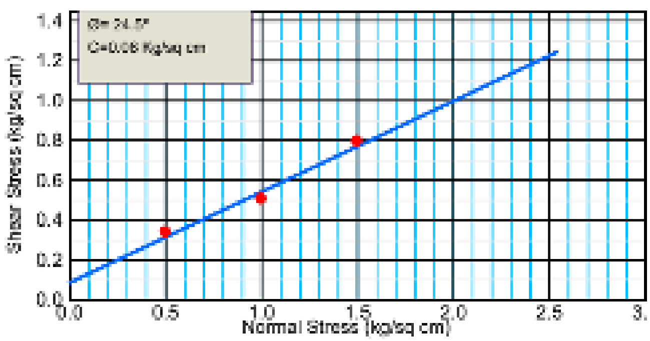
1901-HRIDC-III-22199.687
BH-P49, DEPTH=28.00M, DIRECT SHEAR TEST



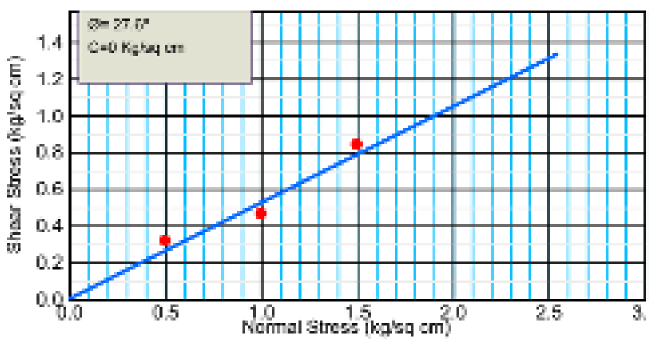
1901-HRIDC-III-22199.687
BH-P49, DEPTH=38.00M, DIRECT SHEAR TEST



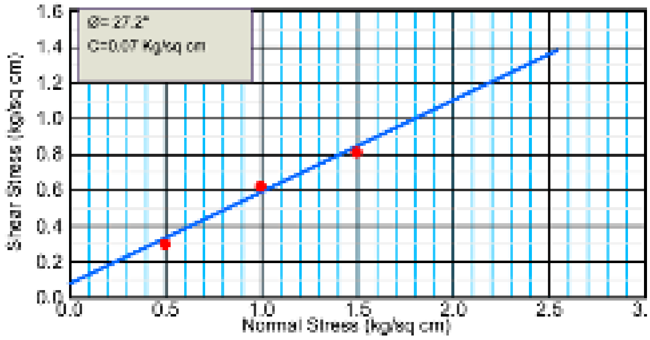
1901-HRIDC-III-22225.887
BH-P50, DEPTH=1.00M, DIRECT SHEAR TEST



1901-HRIDC-III-22225.887
BH-P50, DEPTH=4.00M, DIRECT SHEAR TEST



1901-HRIDC-III-22225.887
BH-P50, DEPTH=19.00M, DIRECT SHEAR TEST



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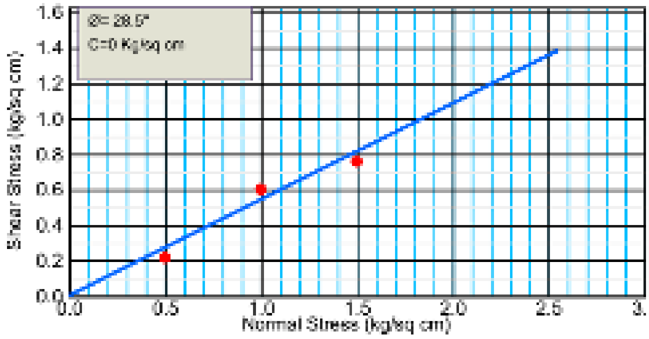
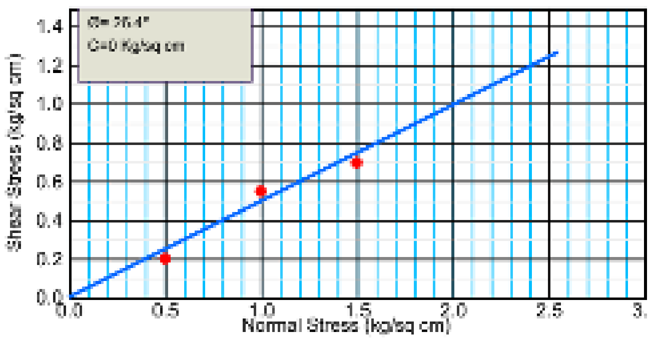
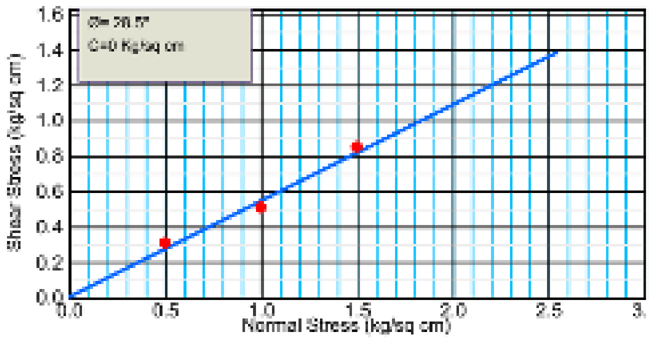
BH-P50, DEPTH=37.00M, DIRECT SHEAR TEST



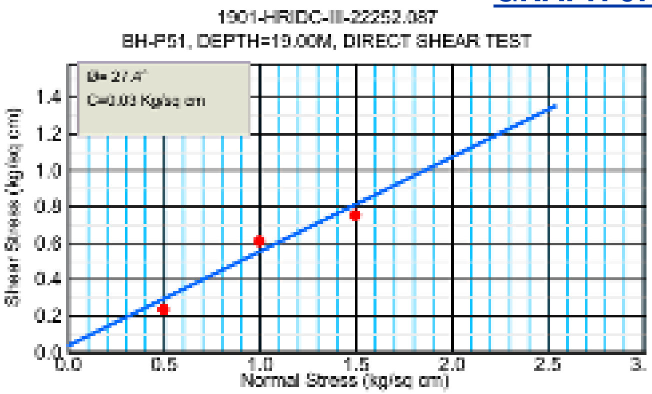
1901-HRIDC-III-22252.087
BH-P51, DEPTH=4.00M, DIRECT SHEAR TEST

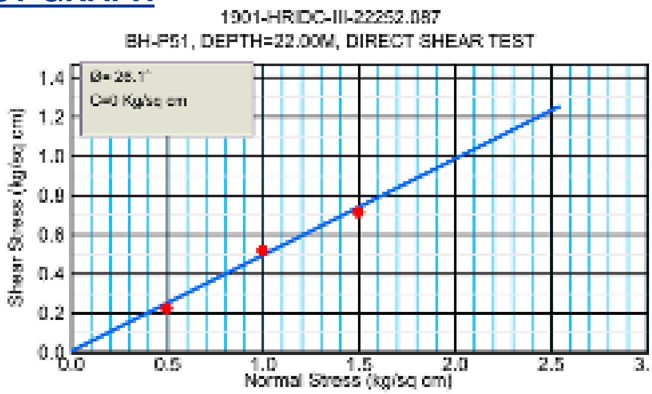


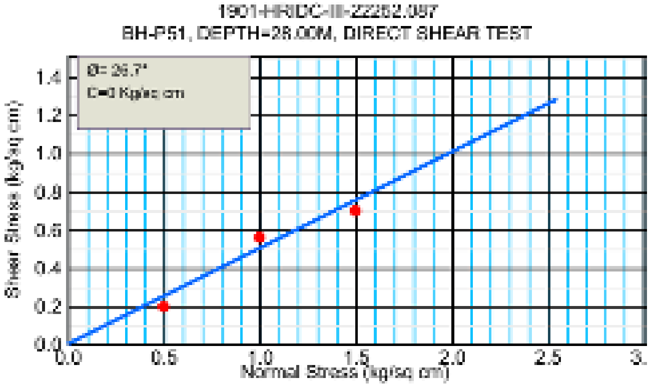
1901-HRIDC-III-22252.087
BH-P51, DEPTH=10.00M, DIRECT SHEAR TEST

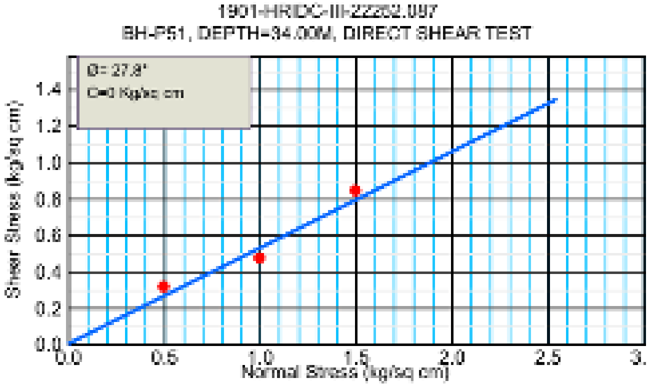


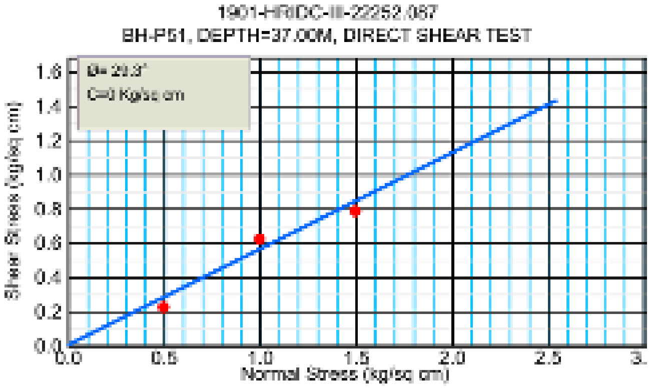
APPENDIX-F
GRAPH 6: DST GRAPH

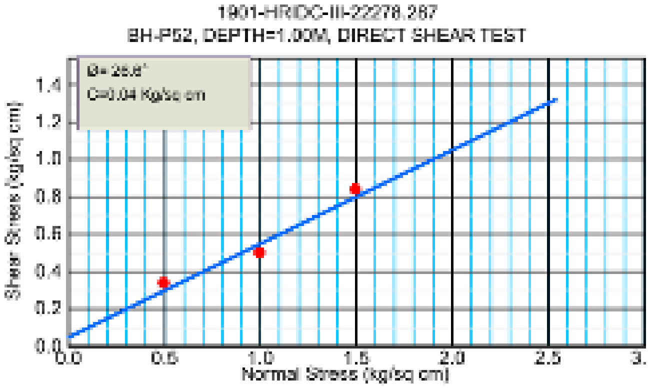


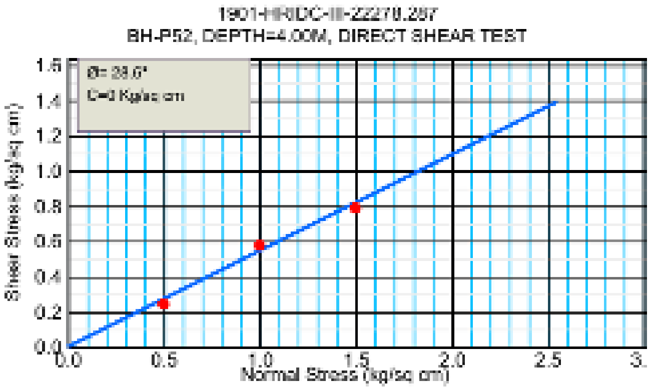


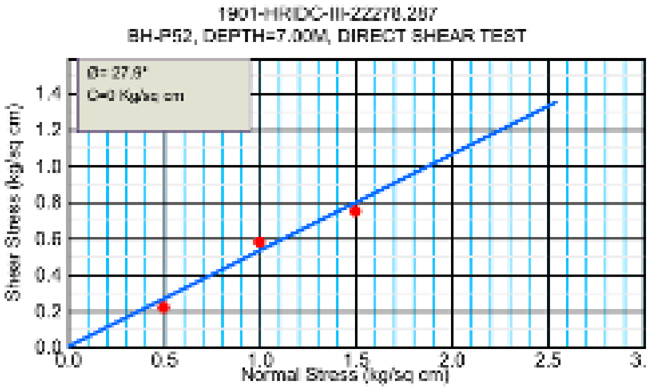




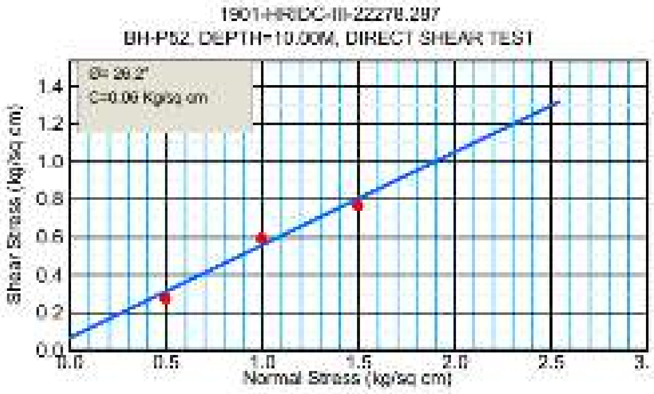


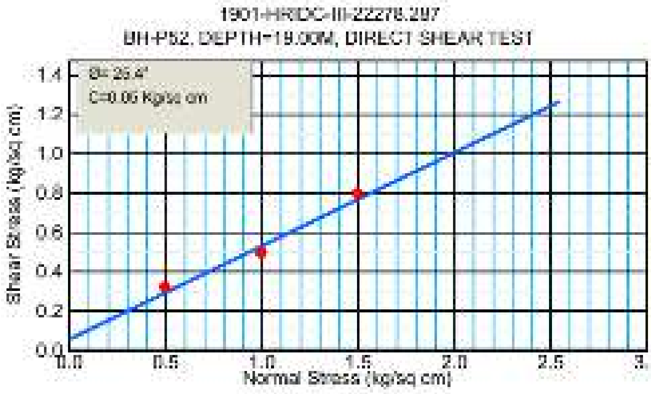


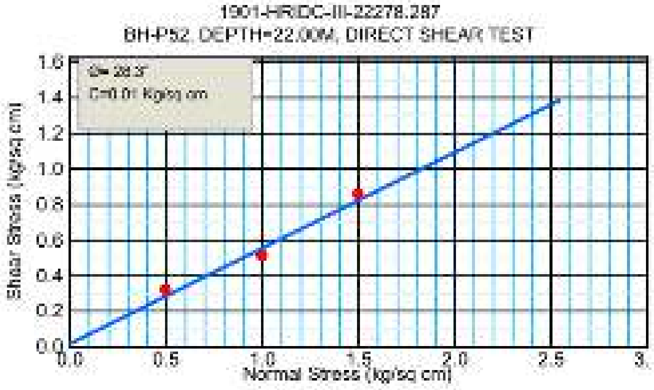


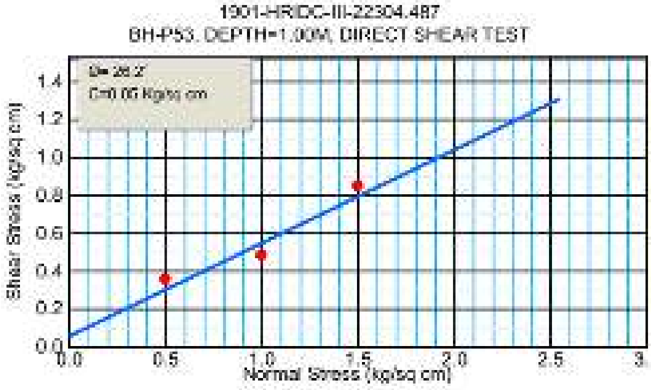


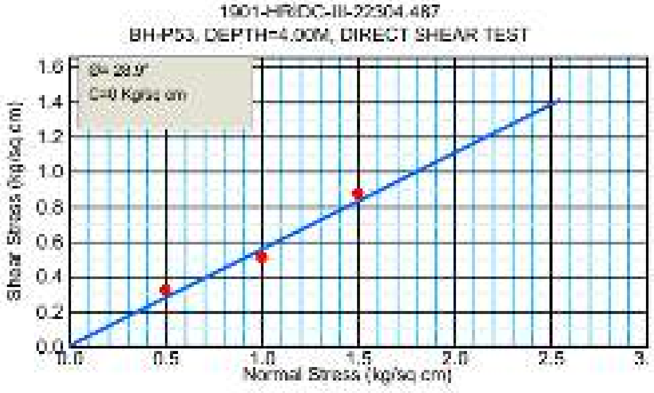
APPENDIX-F
GRAPH 7: DST GRAPH

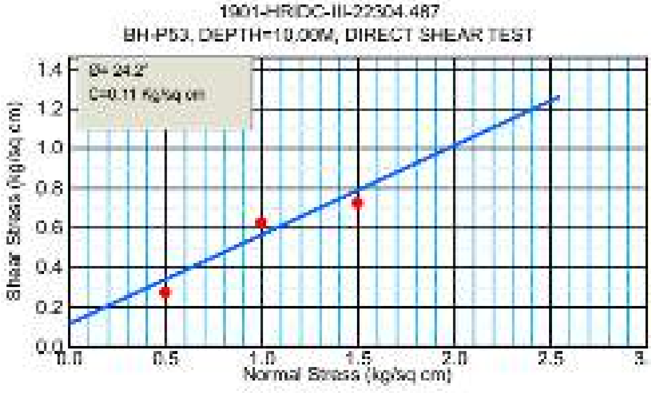


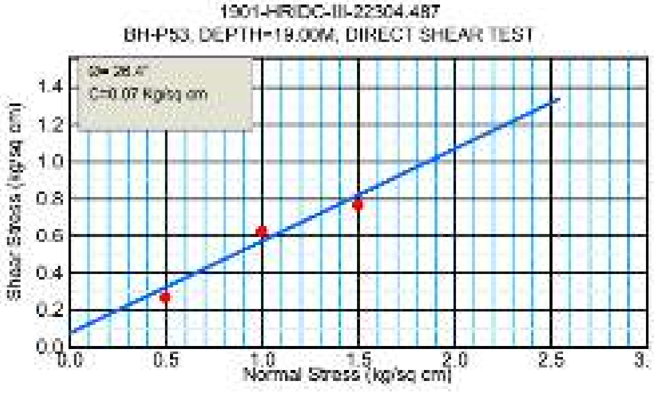


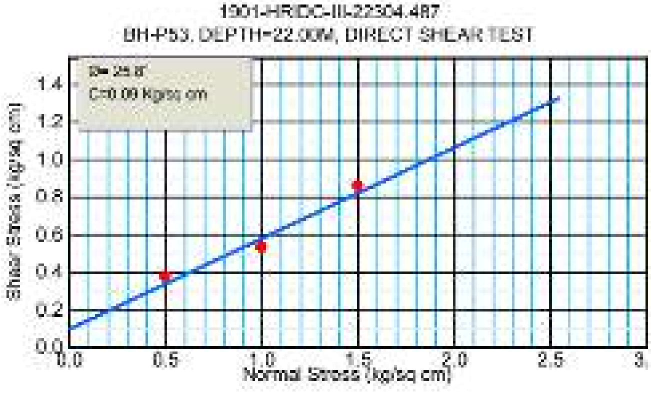




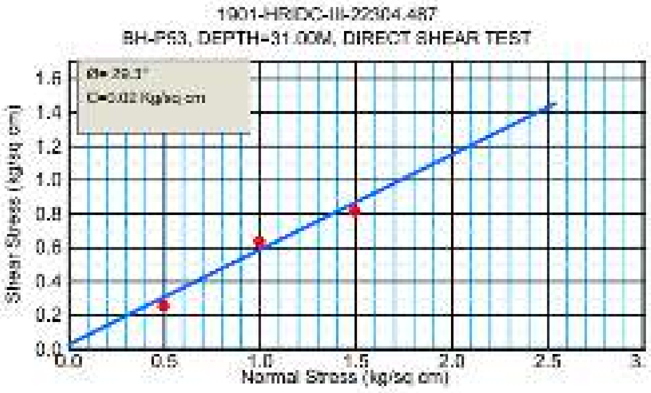


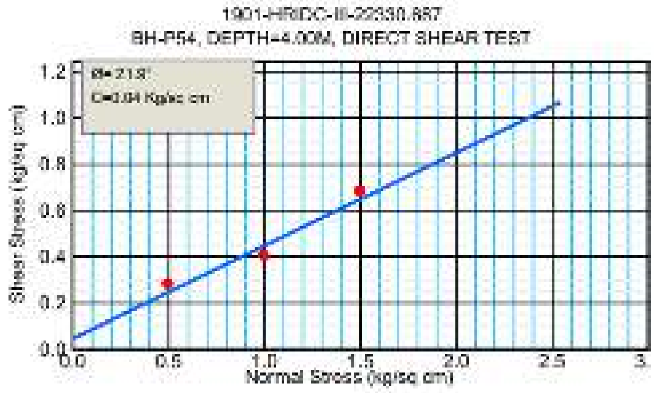


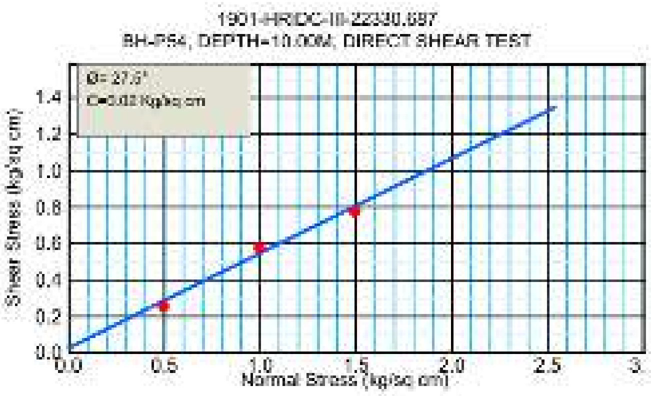


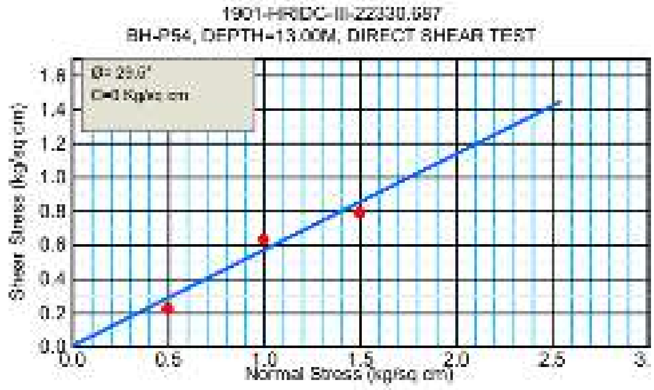


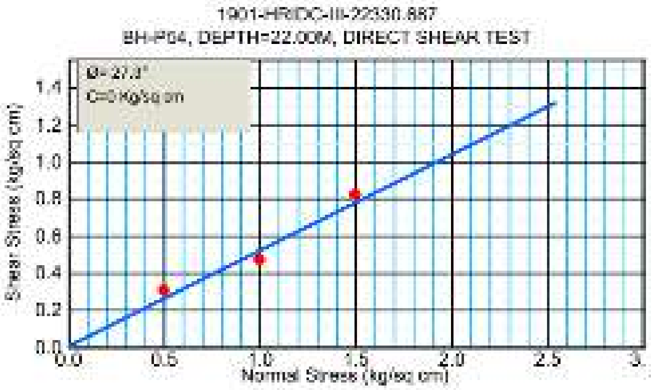
APPENDIX-F
GRAPH 8: DST GRAPH

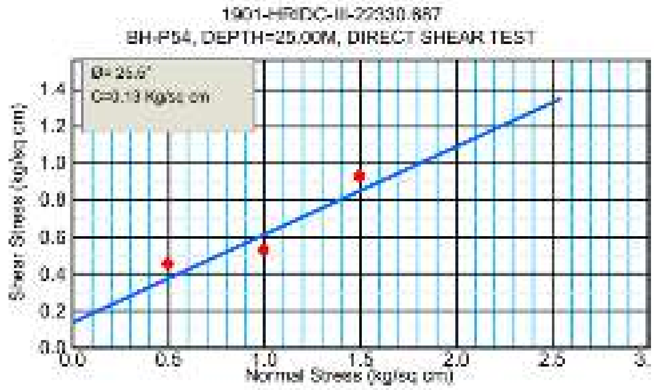


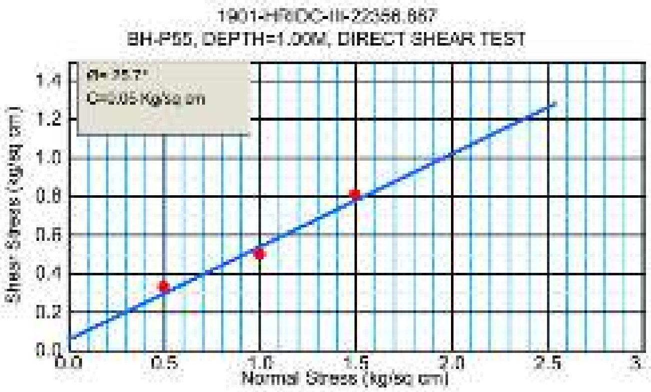


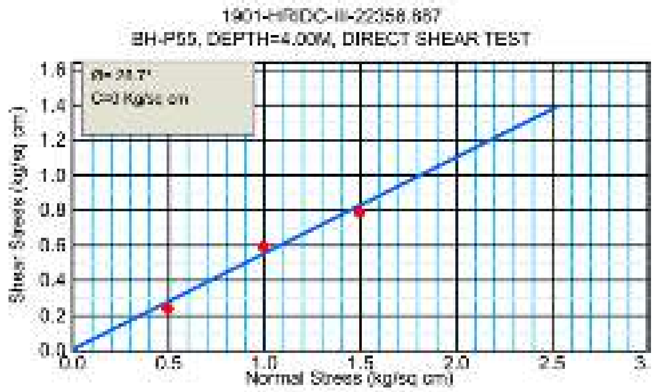






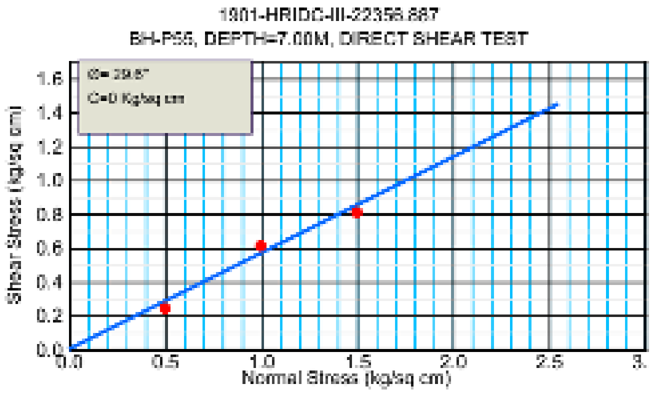


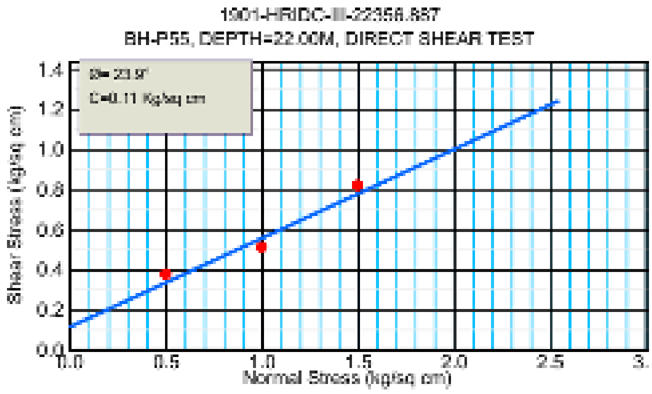


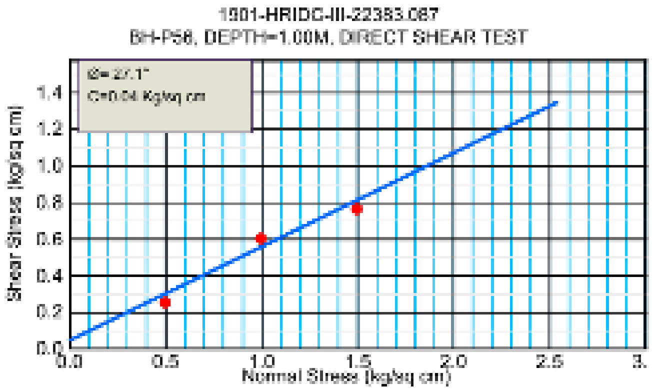


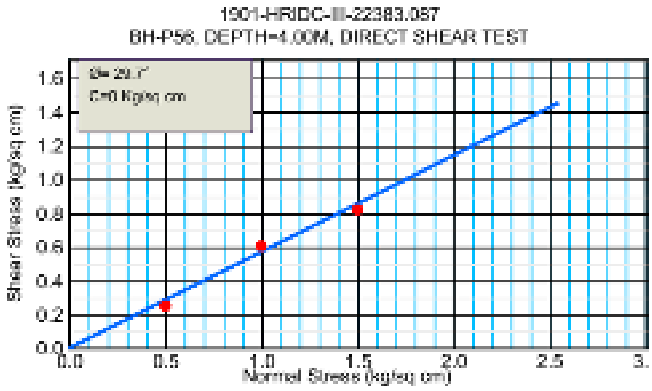
APPENDIX-F

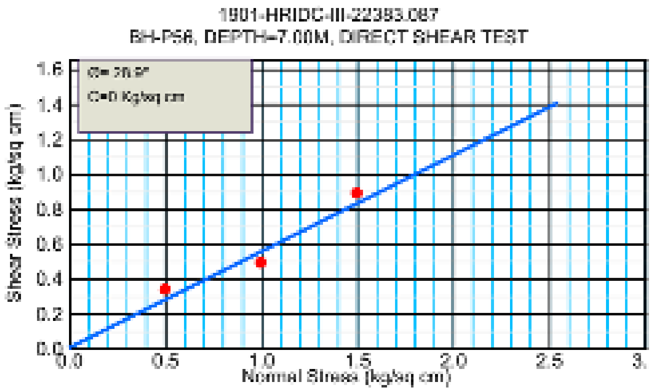
GRAPH 9: DST GRAPH

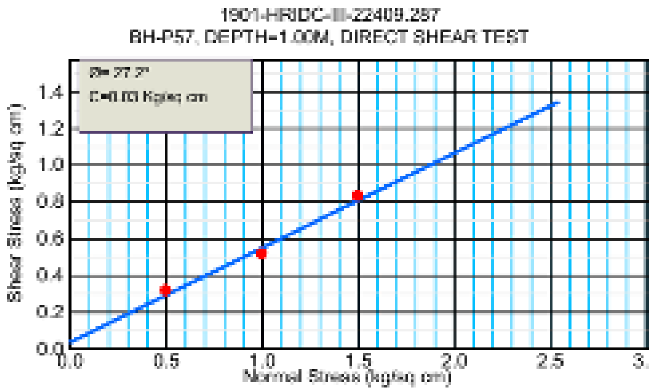


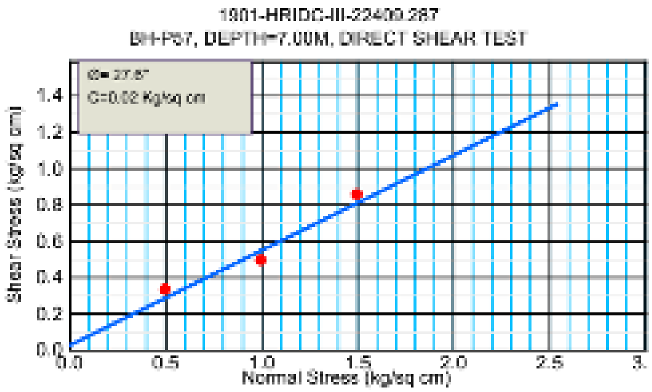


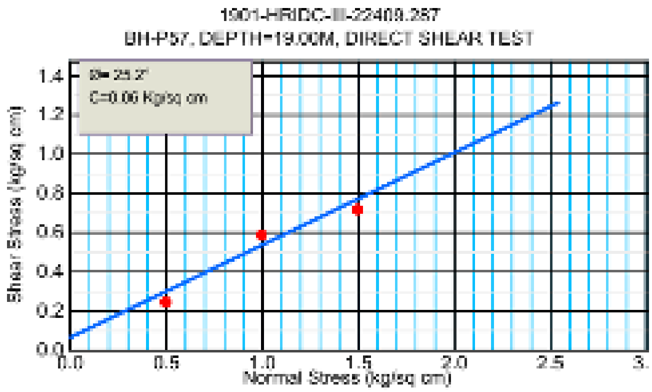




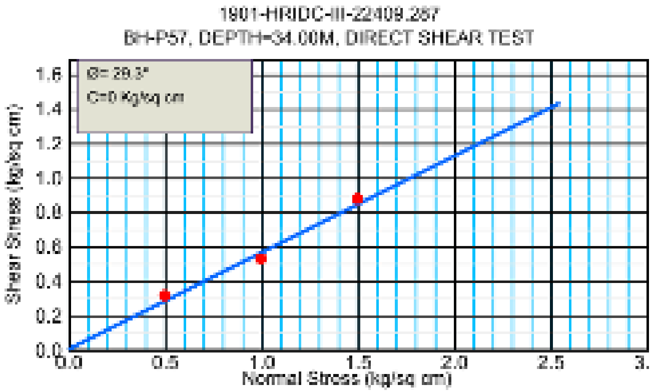


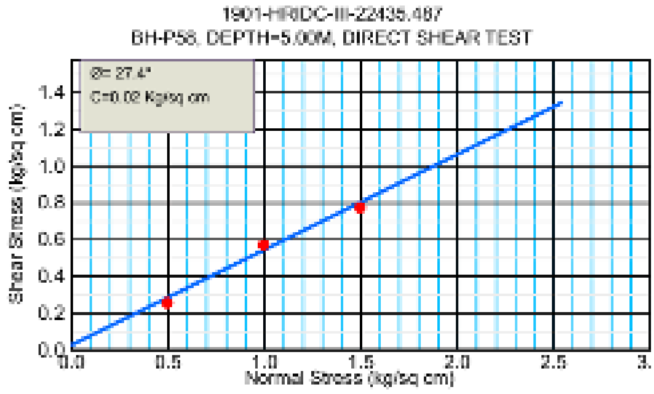


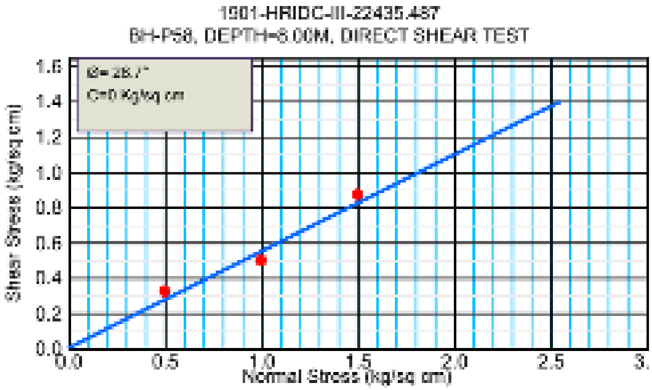


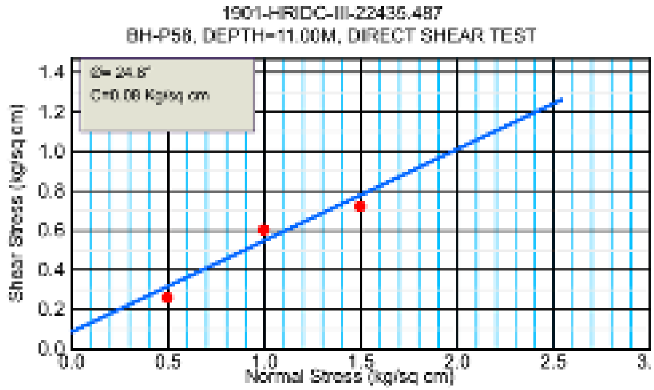


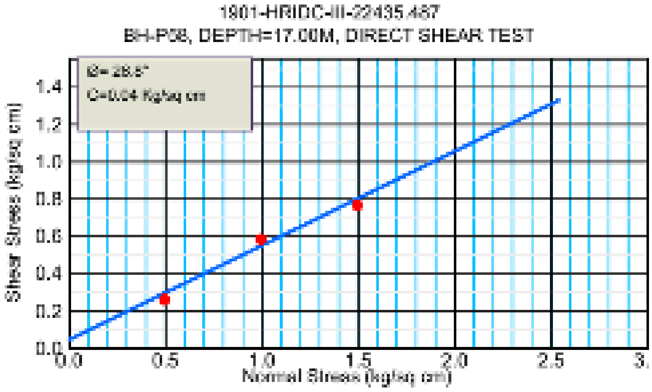
APPENDIX-F
GRAPH 10: DST GRAPH

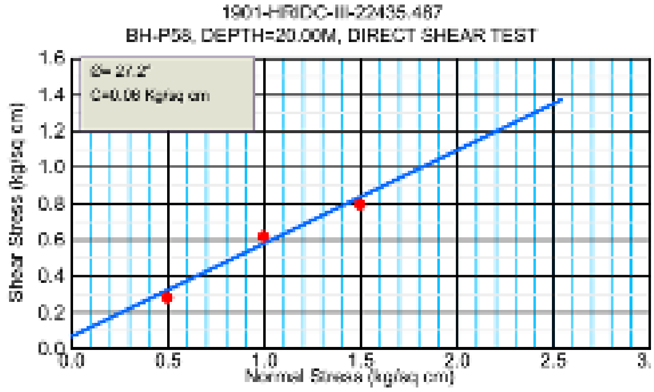


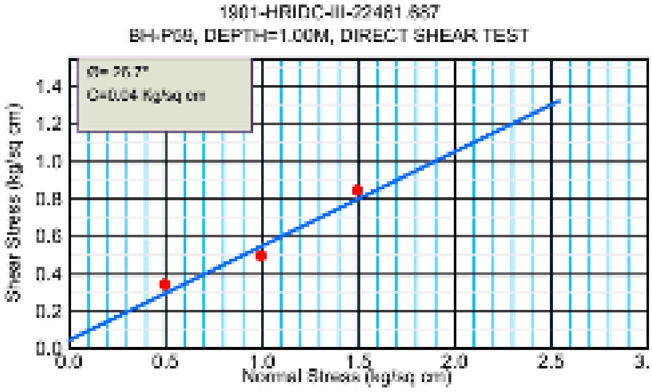


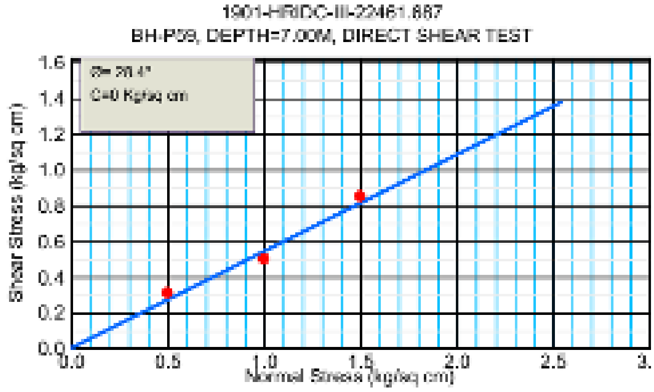




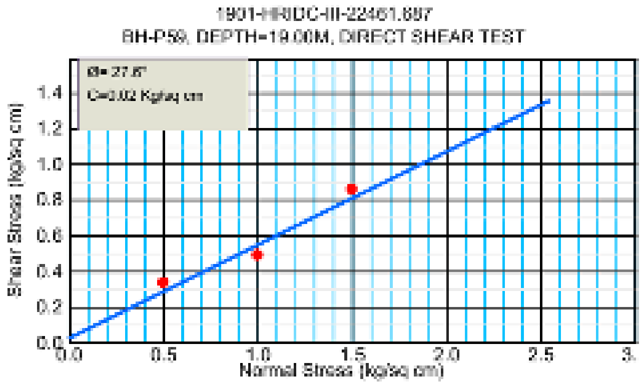


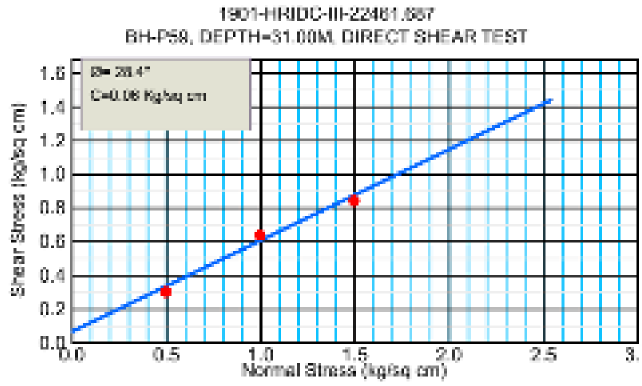


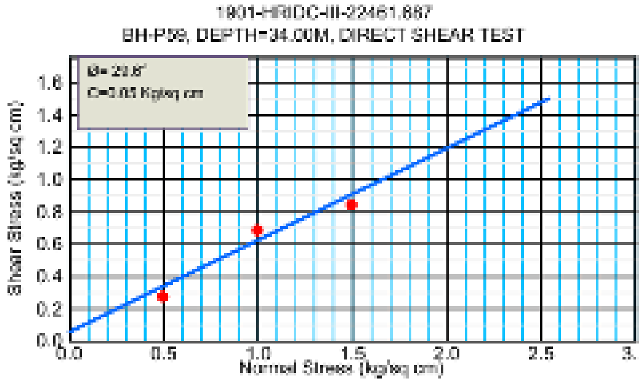


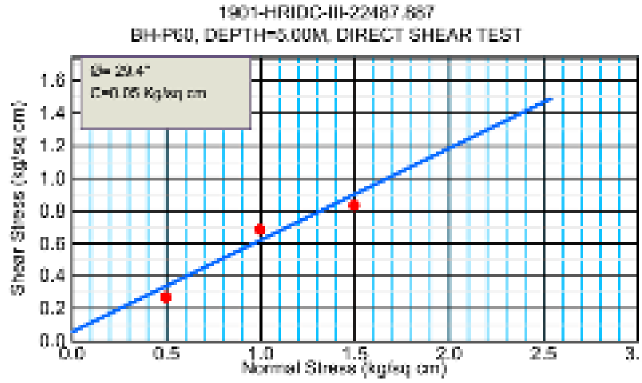


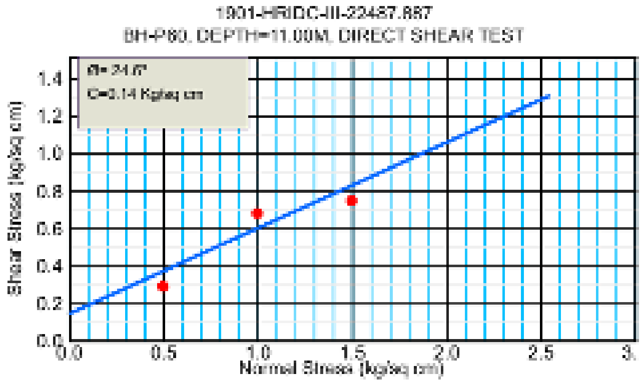
APPENDIX-F
GRAPH 11: DST GRAPH

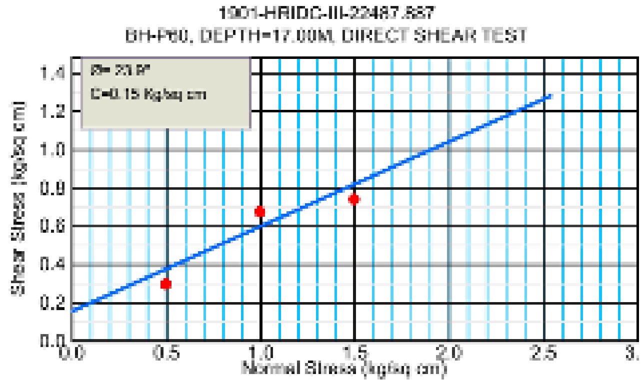


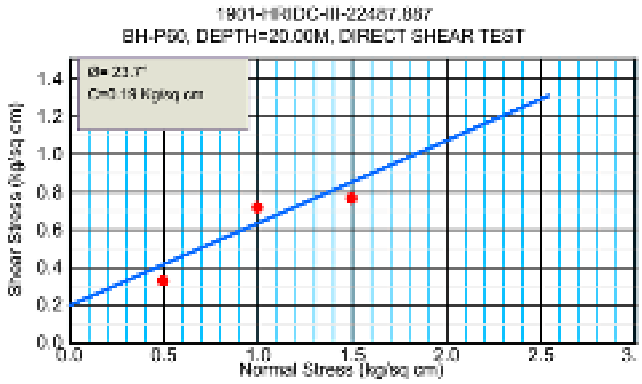




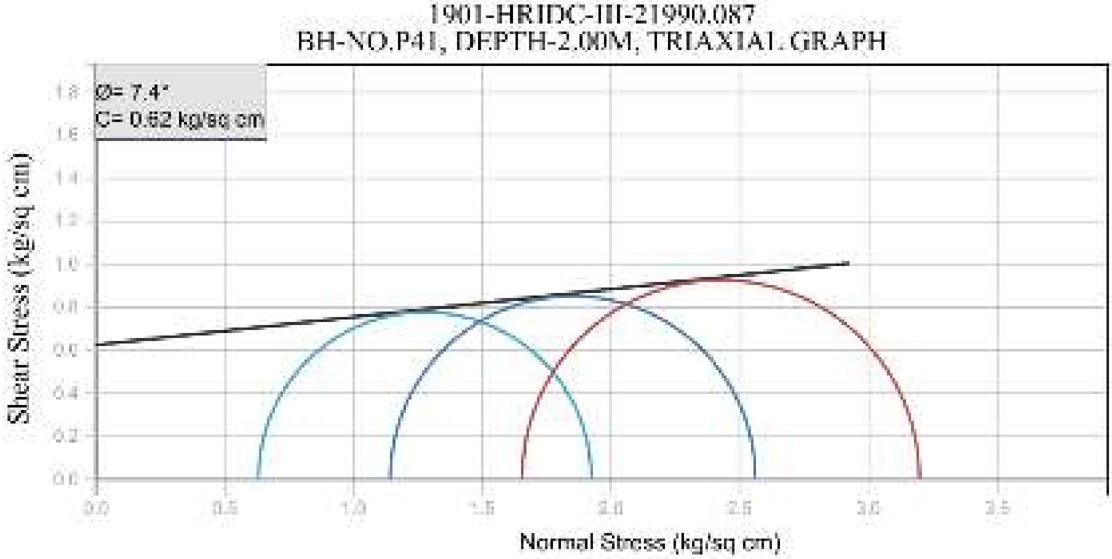


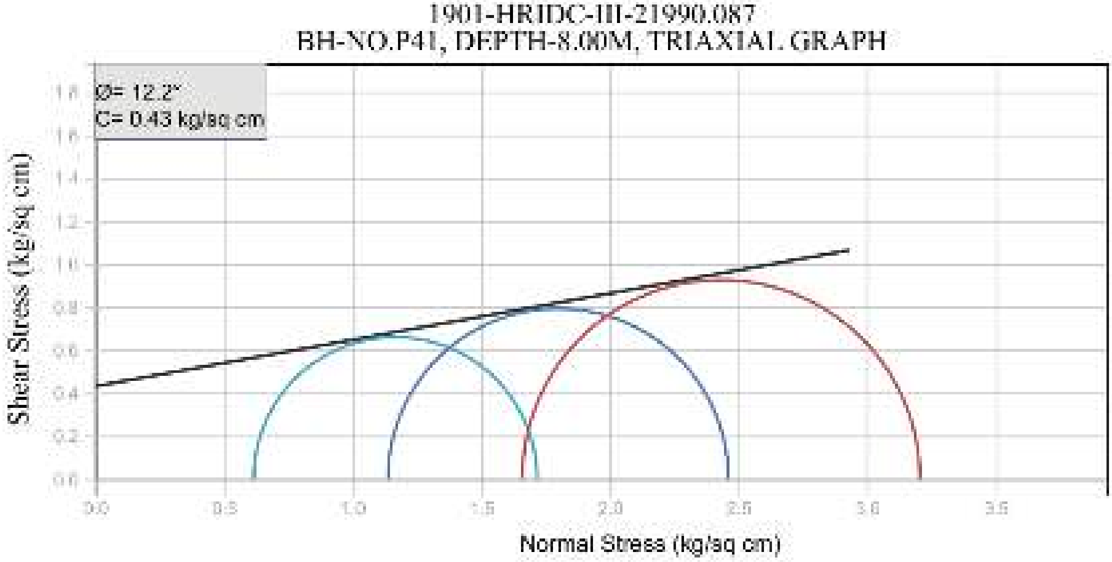


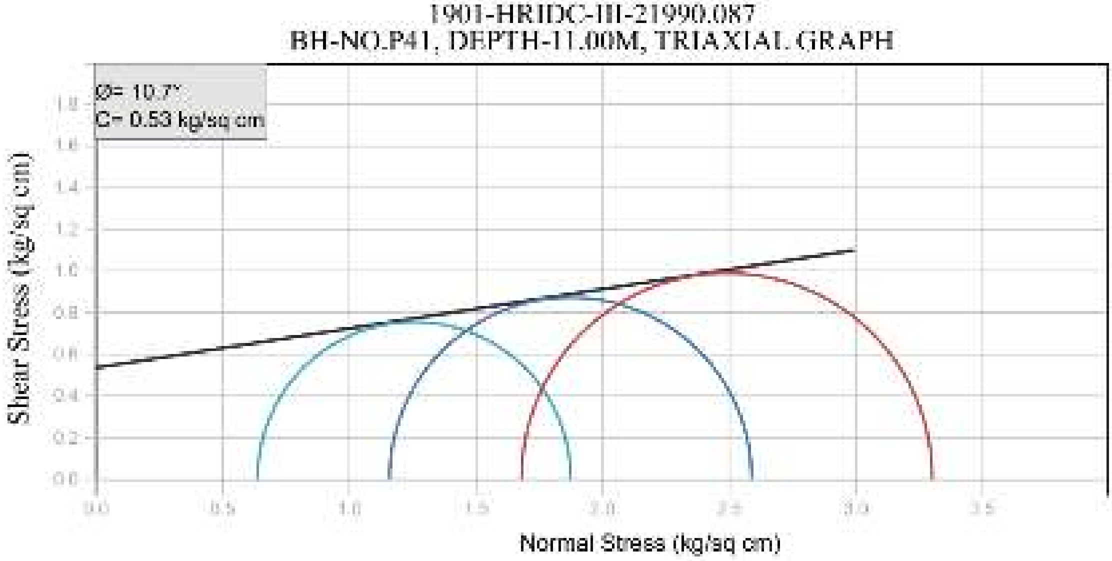




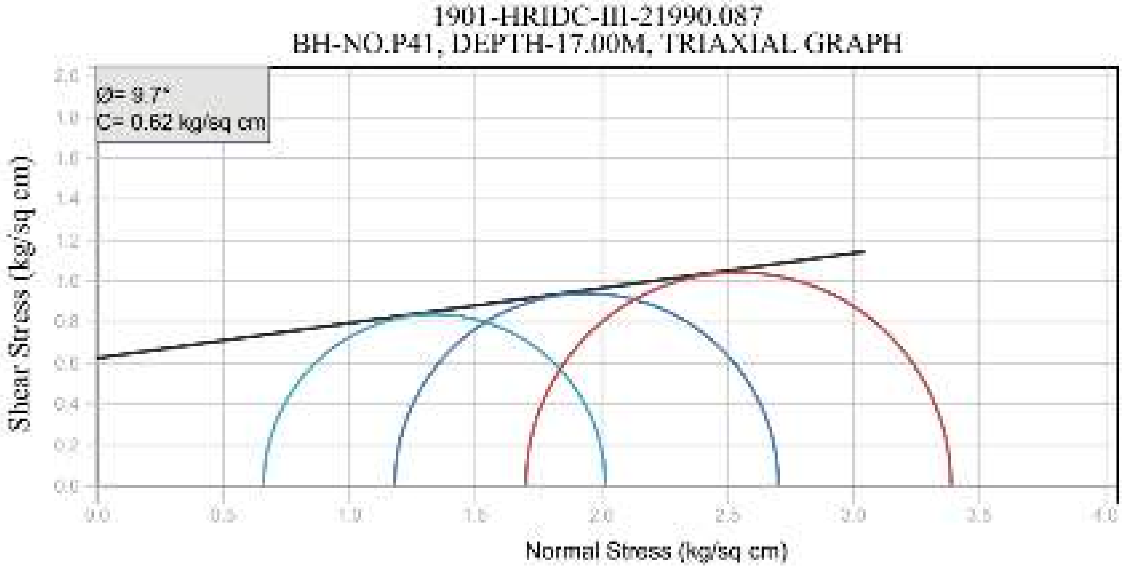
APPENDIX-G
GRAPH 1: UU GRAPH

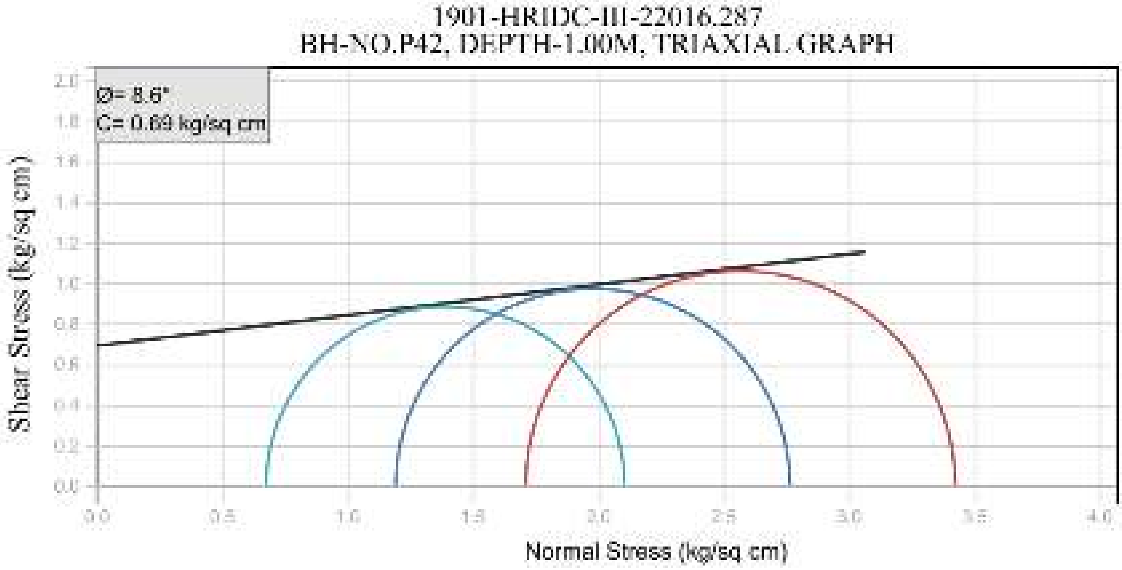






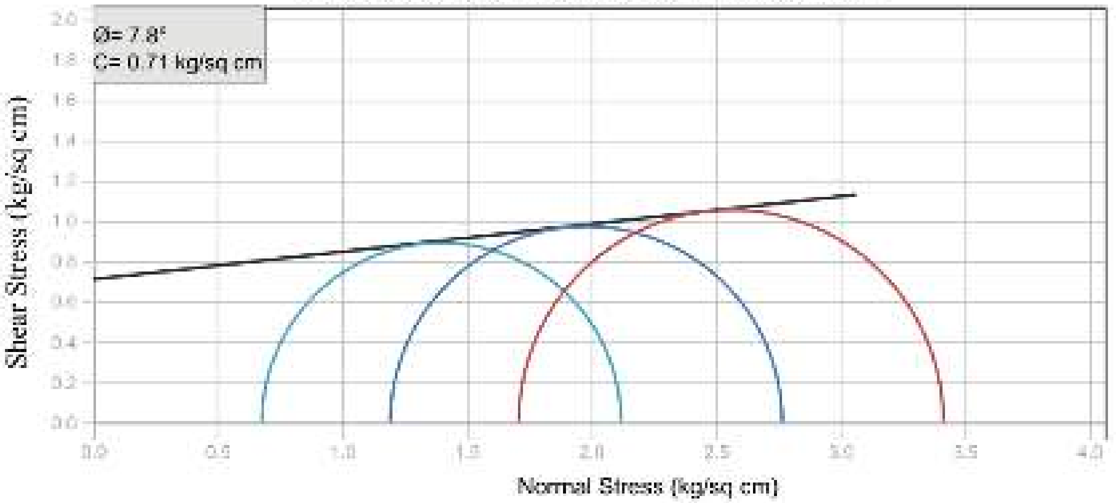
APPENDIX-G
GRAPH 2: UU GRAPH





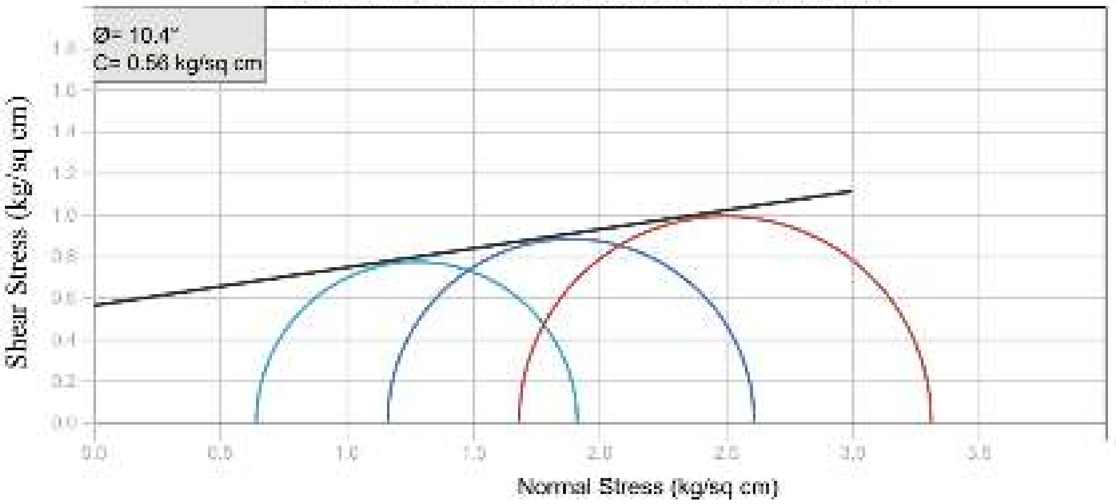
APPENDIX-G
GRAPH 3: UU GRAPH

1901-HRIDC-III-22016.287
BH-NO.P42, DEPTH-4.00M, TRIAXIAL GRAPH



1901-HRIDC-III-22016.287
BH-NO.P42, DEPTH-10.00M, TRIAXIAL GRAPH

1901-HRIDC-III-22016.287
BH-NO.P42, DEPTH-13.00M, TRIAXIAL GRAPH

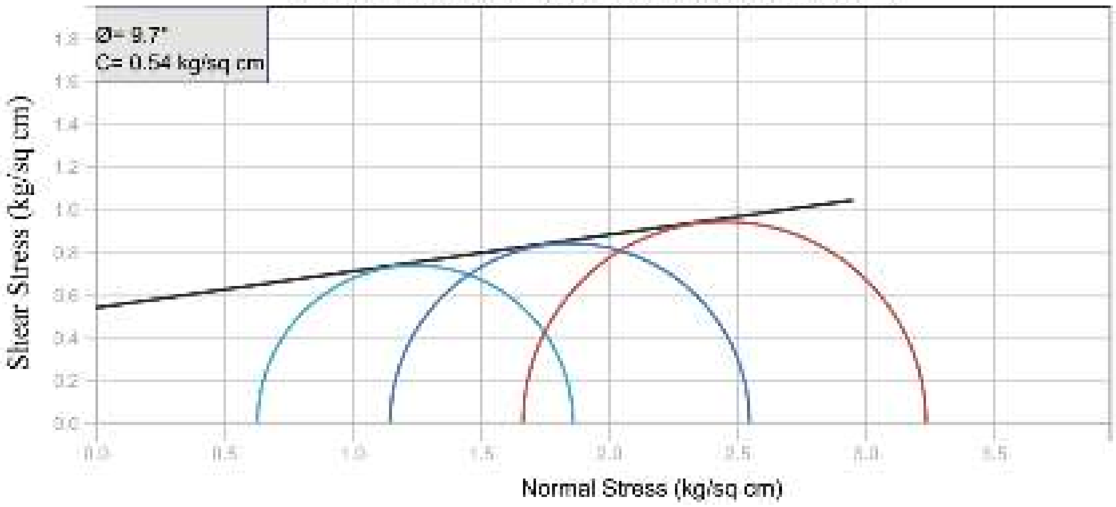


APPENDIX-G
GRAPH 4: UU GRAPH

1901-HRIDC-III-22016.287
BH-NO.P42, DEPTH-22.00M, TRIAXIAL GRAPH

1901-HRIDC-III-22016.287
BH-NO.P42, DEPTH-25.00M, TRIAXIAL GRAPH

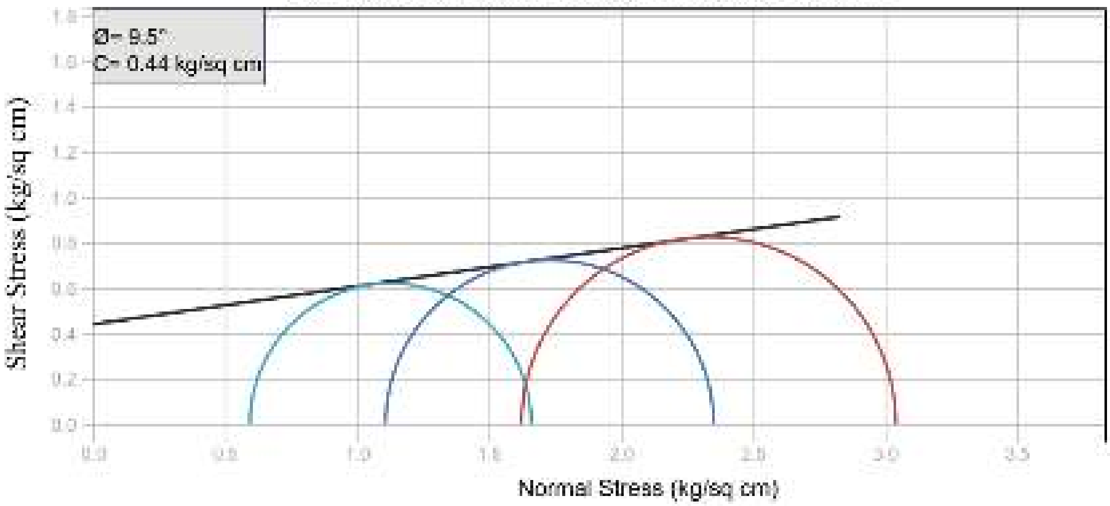
1901-HRIDC-III-22016.287
BH-NO.P42, DEPTH-28.00M, TRIAXIAL GRAPH



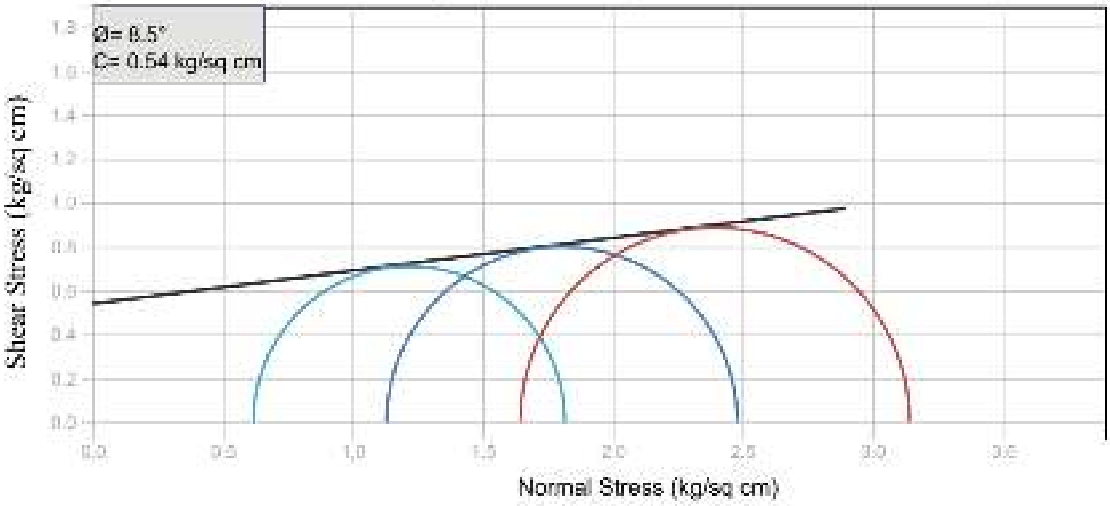
APPENDIX-G

GRAPH 5: UU GRAPH

1901-HRIDC-III-22042.487
BH-NO.P43, DEPTH-10.00M, TRIAXIAL GRAPH



1901-HRIDC-III-22042.487
BH-NO.P43, DEPTH-13.00M, TRIAXIAL GRAPH

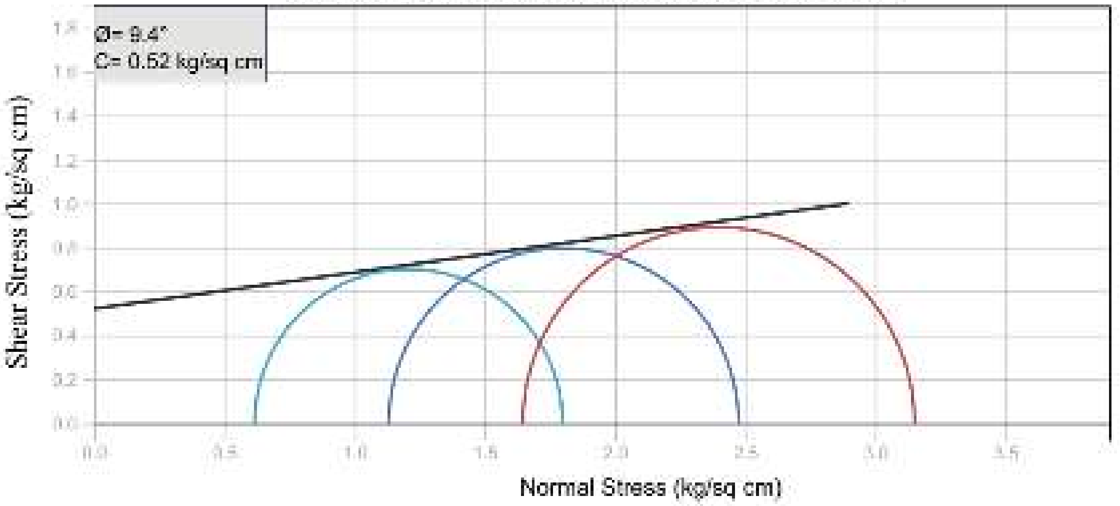


1901-HRIDC-III-22042.487
BH-NO.P43, DEPTH-16.00M, TRIAXIAL GRAPH

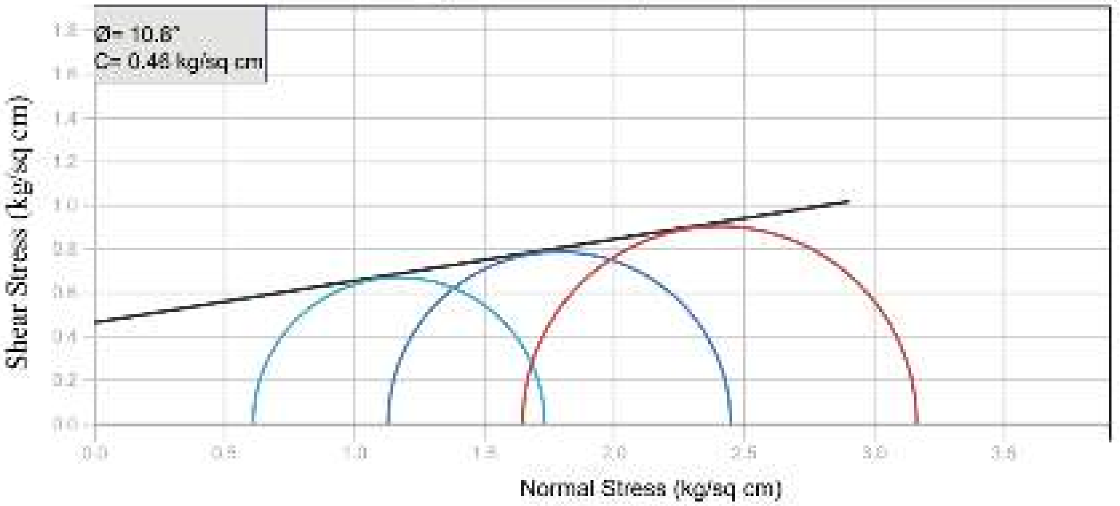
APPENDIX-G

GRAPH 6: UU GRAPH

1901-HRIDC-III-22042.487
BH-NO.P43, DEPTH-22.00M, TRIAXIAL GRAPH

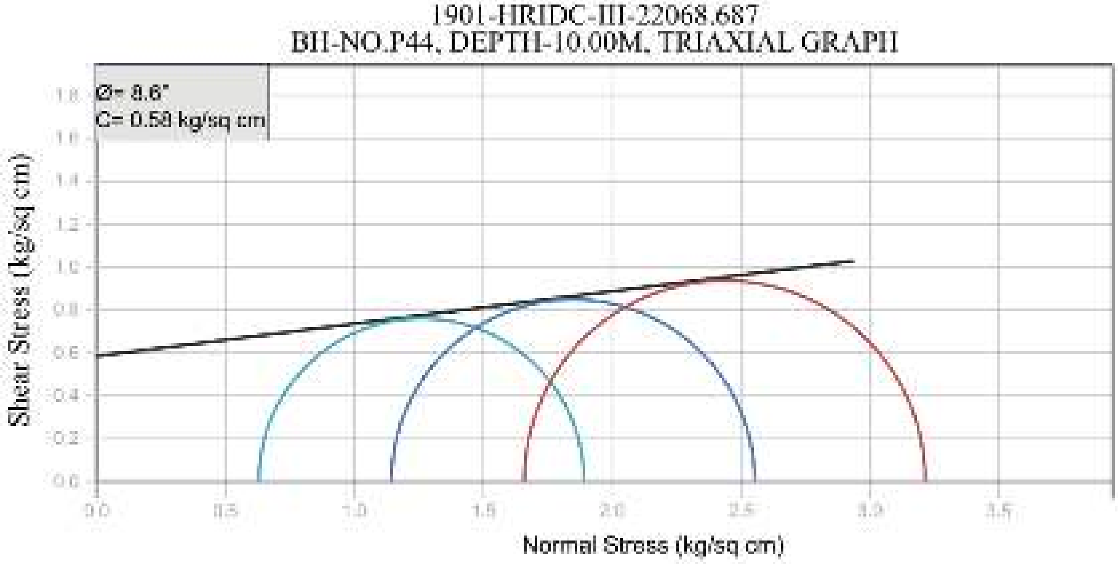


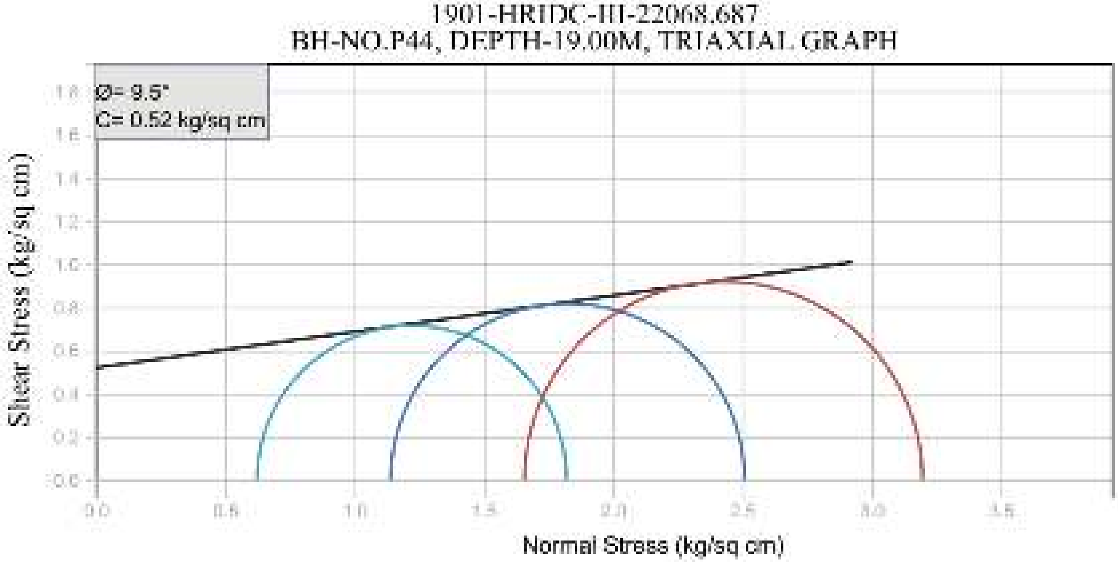
1901-HRIDC-III-22042.487
BH-NO.P43, DEPTH-31.00M, TRIAXIAL GRAPH



1901-HRIDC-III-22068.687
BH-NO.P44, DEPTH-1.00M, TRIAXIAL GRAPH

APPENDIX-G
GRAPH 7: UU GRAPH

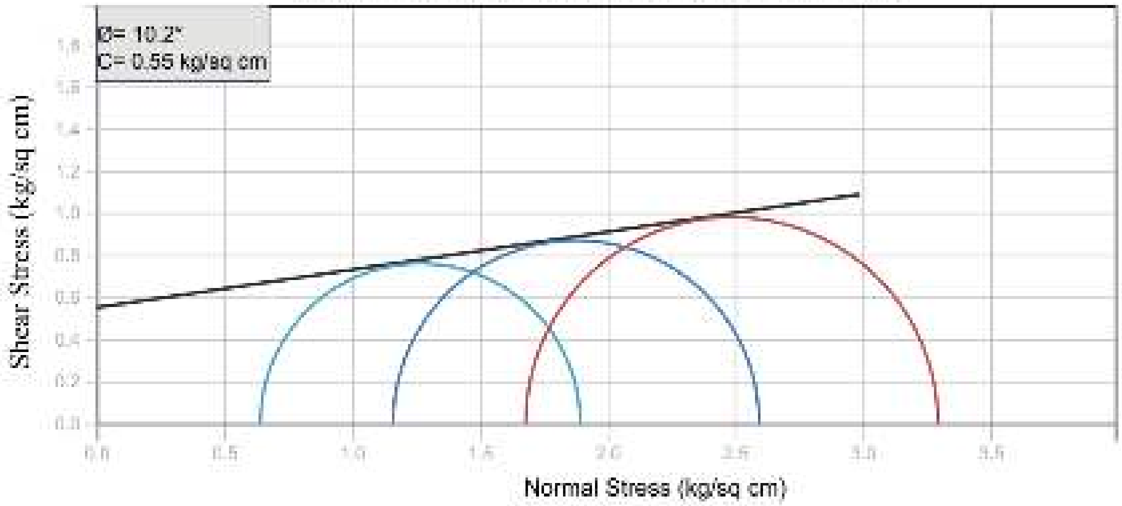




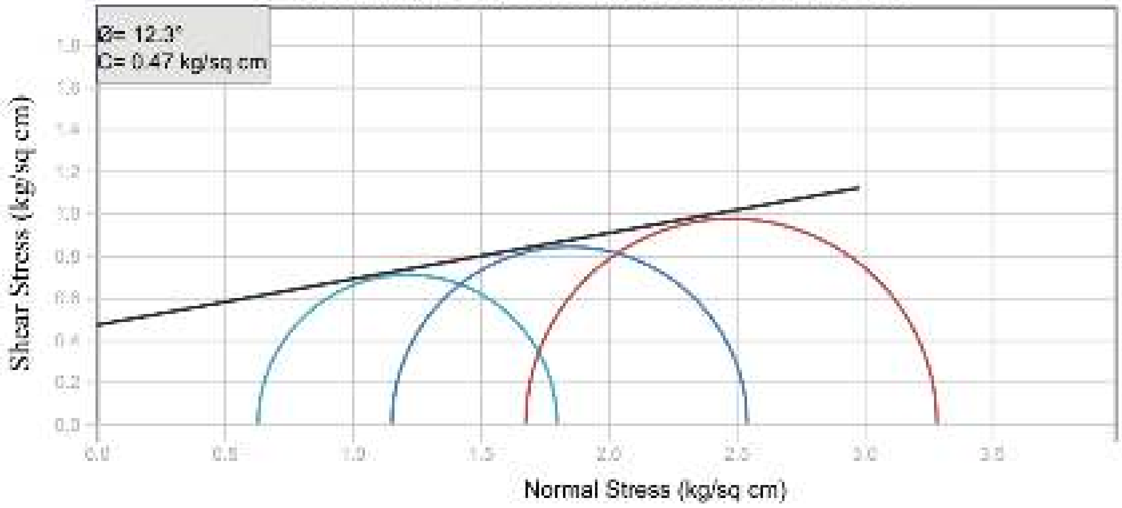
APPENDIX-G

GRAPH 8: UU GRAPH

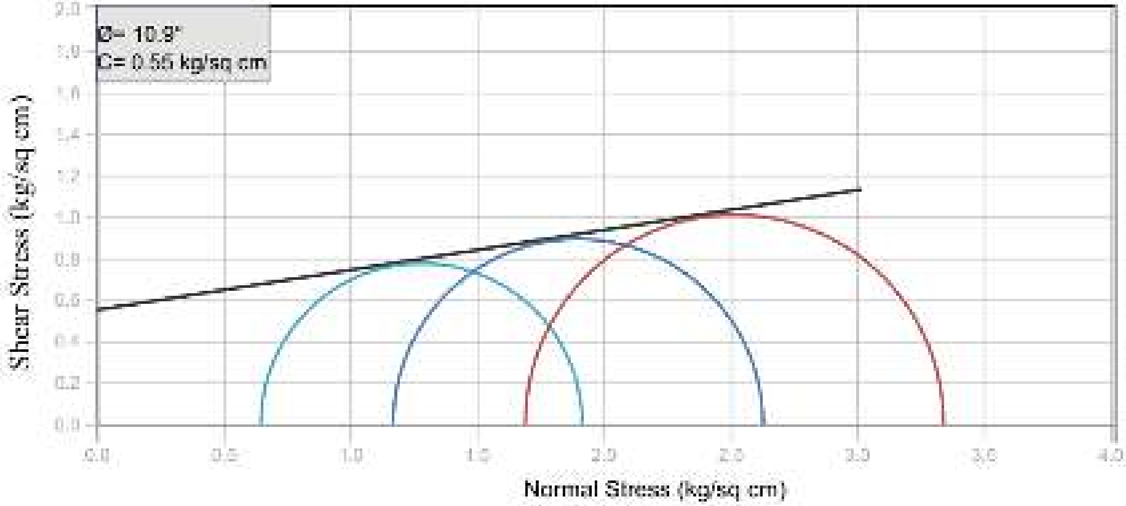
1901-HRIDC-III-22068.687
BH-NO.P44, DEPTH-25.00M, TRIAXIAL GRAPH



1901-HRIDC-III-22094.887
BH-NO.P45, DEPTH-10.00M, TRIAXIAL GRAPH



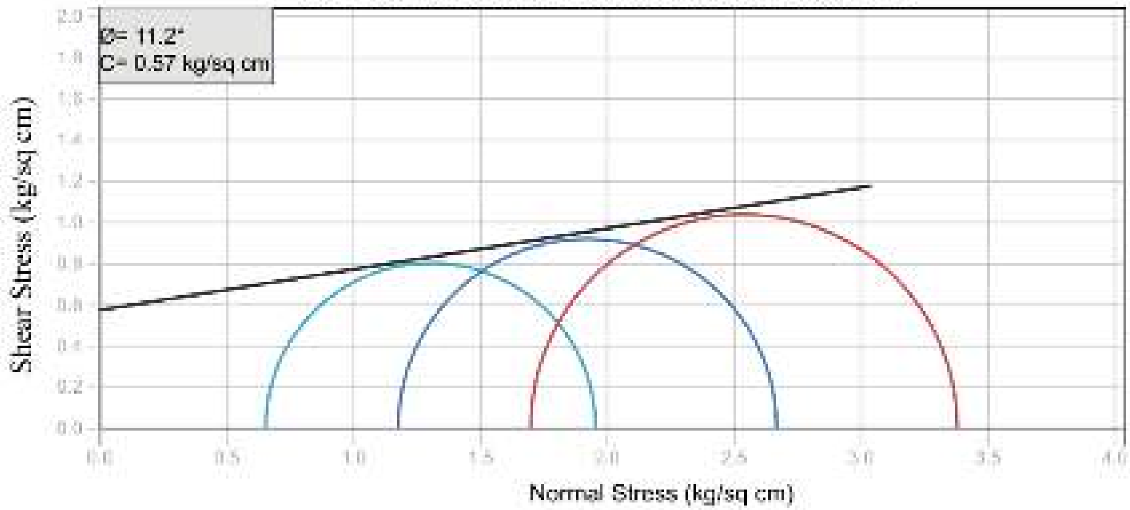
1901-HRIDC-III-22094.887
BH-NO.P45, DEPTH-13.00M, TRIAXIAL GRAPH



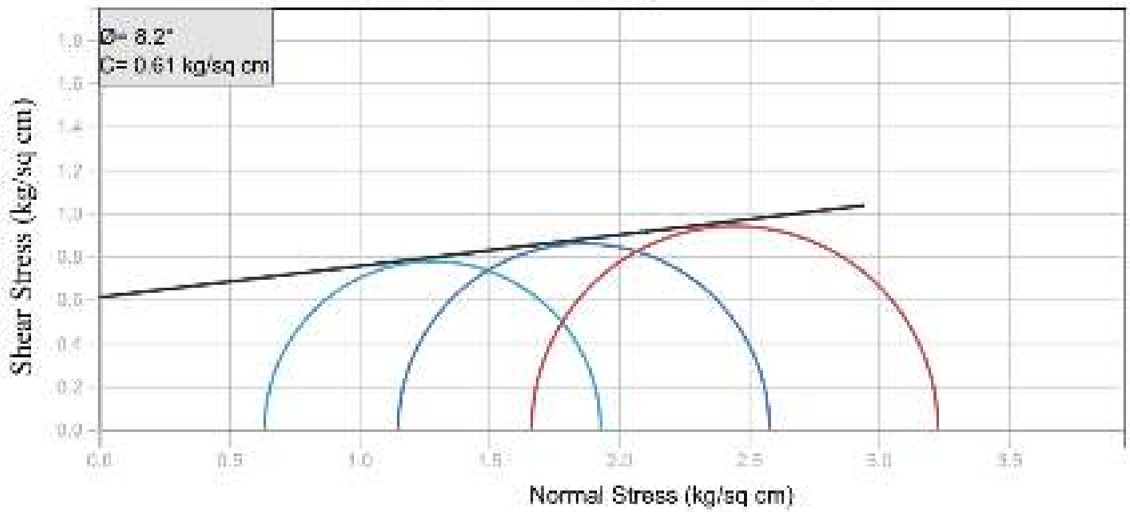
APPENDIX-G
GRAPH 9: UU GRAPH

1901-HRIDC-III-22094.887
BH-NO.P45, DEPTH-16.00M, TRIAXIAL GRAPH

1901-HRIDC-III-22094.887
BH-NO.P45, DEPTH-19.00M, TRIAXIAL GRAPH



1901-HRIDC-III-22094.887
BH-NO.P45, DEPTH-22.00M, TRIAXIAL GRAPH

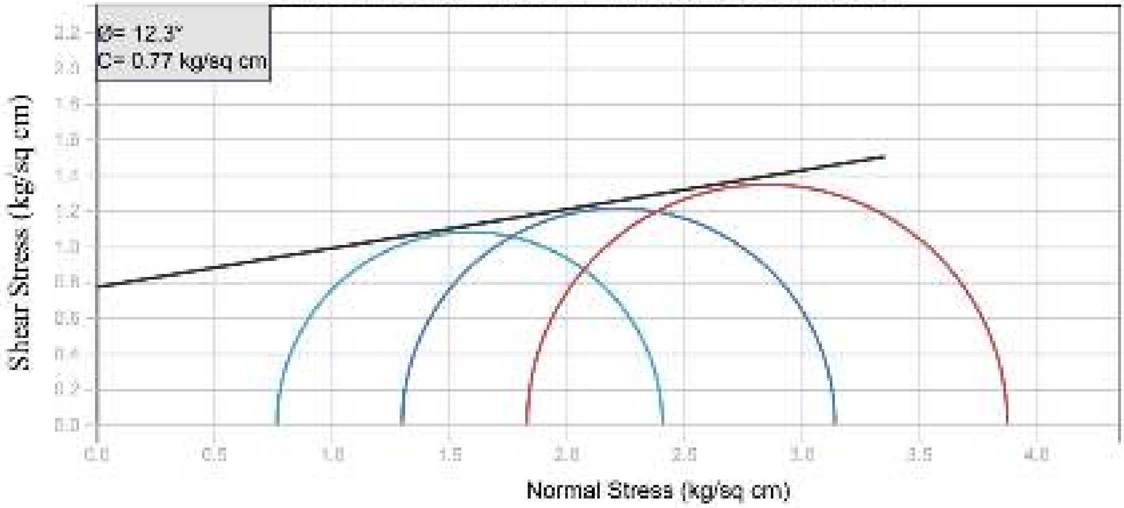


APPENDIX-G

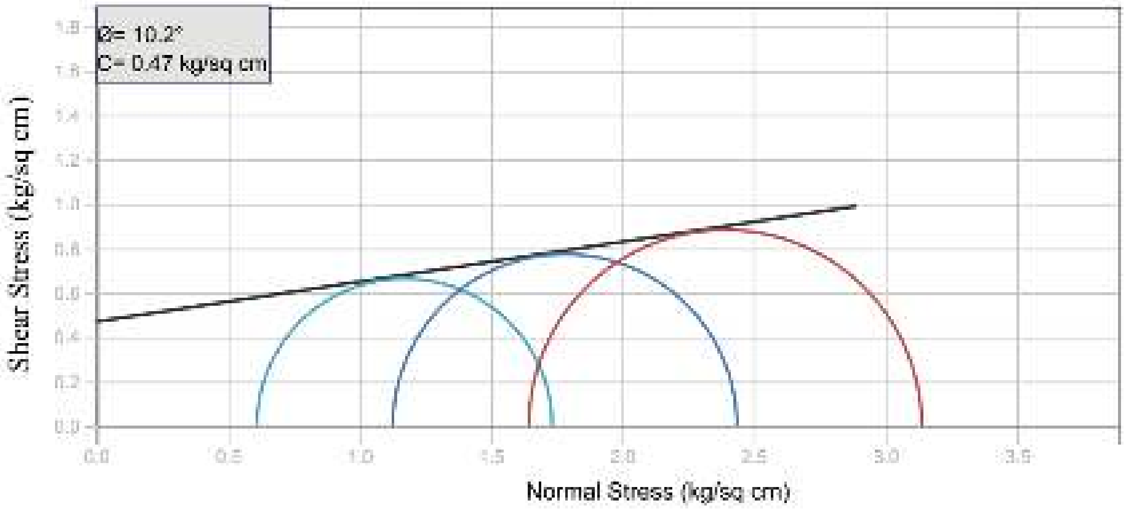
GRAPH 10: UU GRAPH

1901-HRIDC-III-22094.887
BH-NO.P45, DEPTH-25.00M, TRIAXIAL GRAPH

1901-HRIDC-III-22094.887
BH-NO.P45, DEPTH-28.00M, TRIAXIAL GRAPH



1901-HRIDC-III-22121.087
BH-NO.P46, DEPTH-10.00M, TRIAXIAL GRAPH

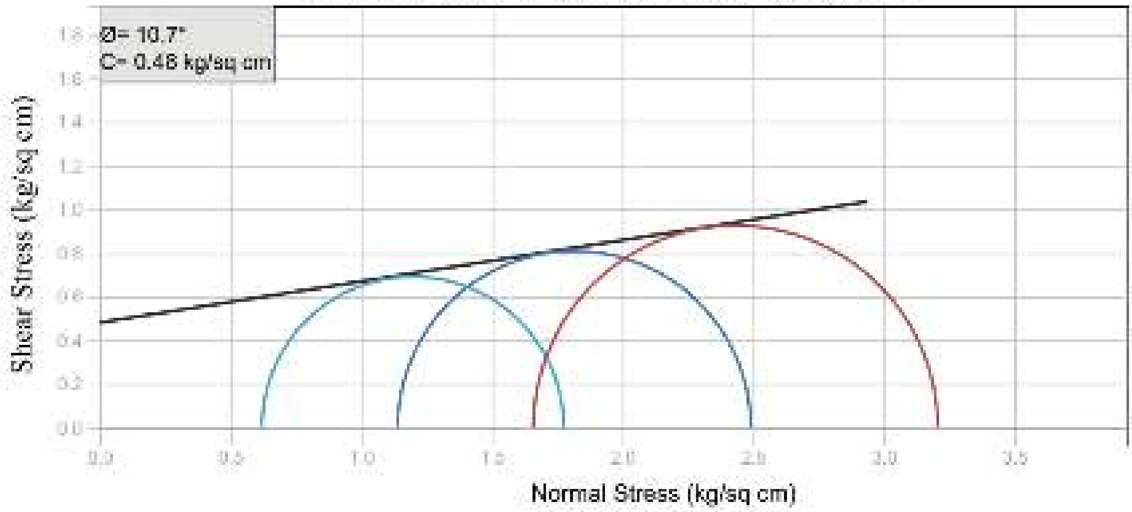


APPENDIX-G

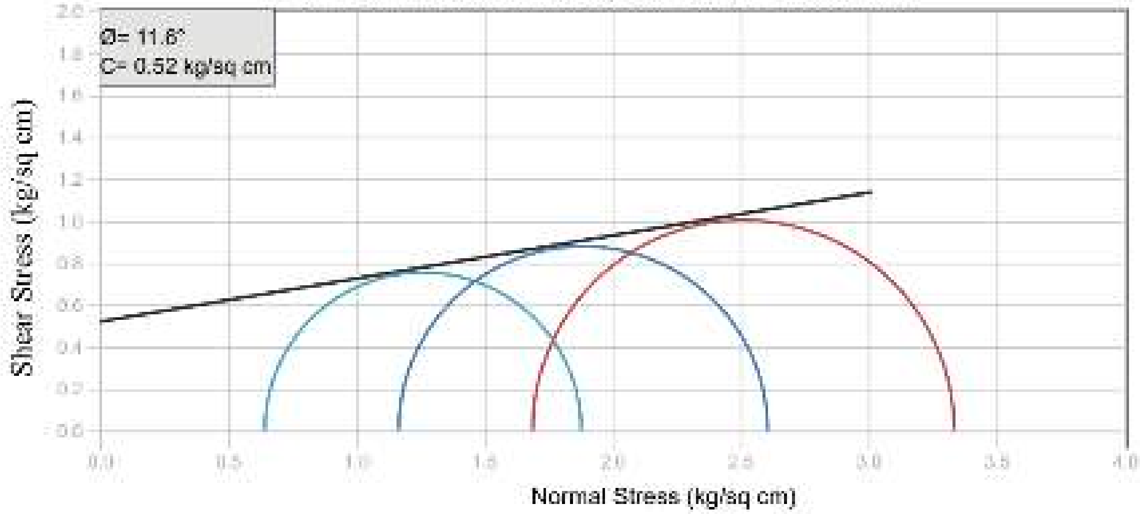
GRAPH 11: UU GRAPH

1901-HRIDC-III-22121.087
BH-NO.P46, DEPTH-13.00M, TRIAXIAL GRAPH

1901-HRIDC-III-22121.087
BH-NO.P46, DEPTH-19.00M, TRIAXIAL GRAPH

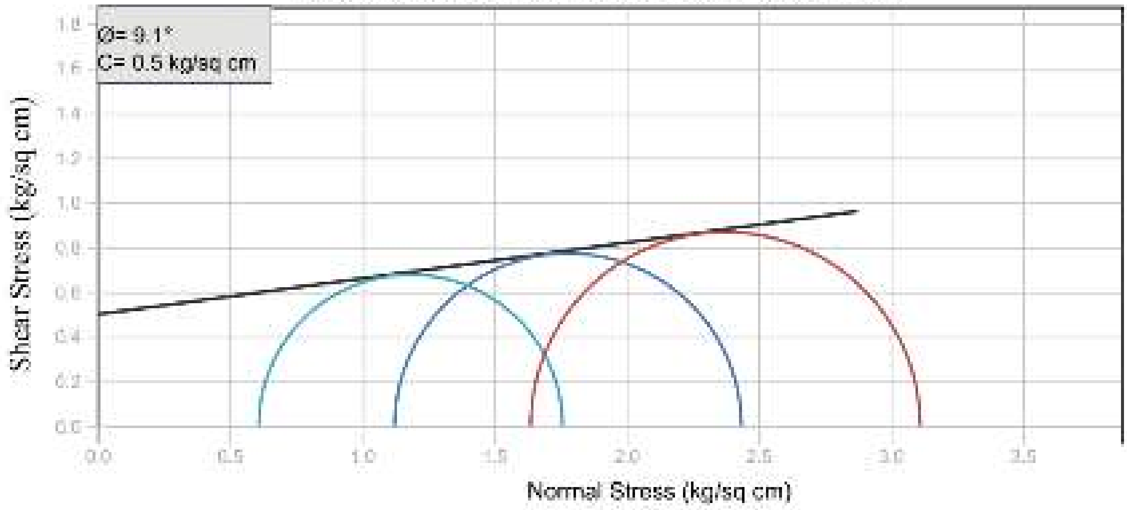


1901-HRIDC-III-22121.087
BH-NO.P46, DEPTH-22.00M, TRIAXIAL GRAPH



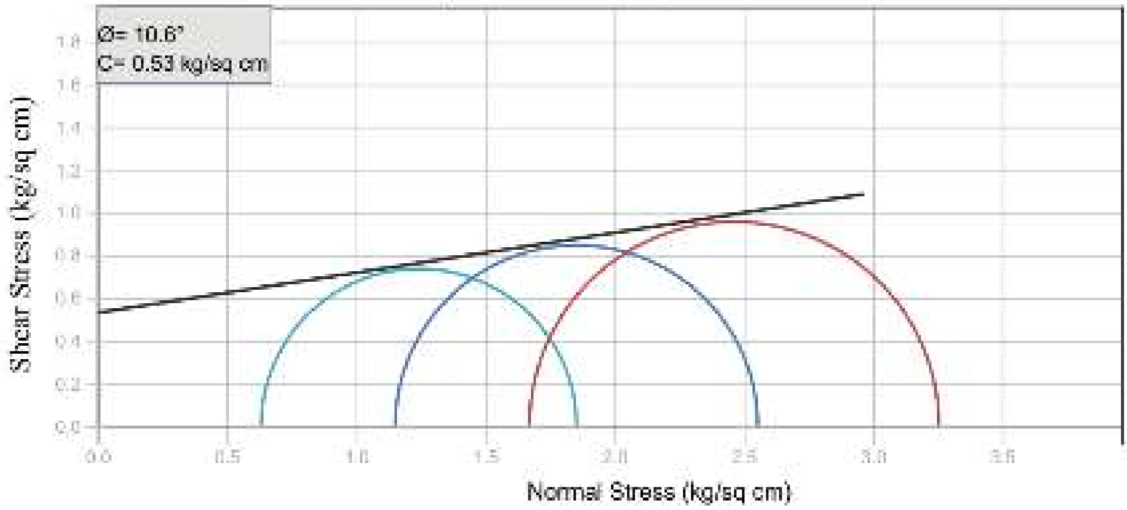
APPENDIX-G
GRAPH 12: UU GRAPH

1901-HRIDC-III-22147.287
BH-NO.P47, DEPTH-11.00M, TRIAXIAL GRAPH

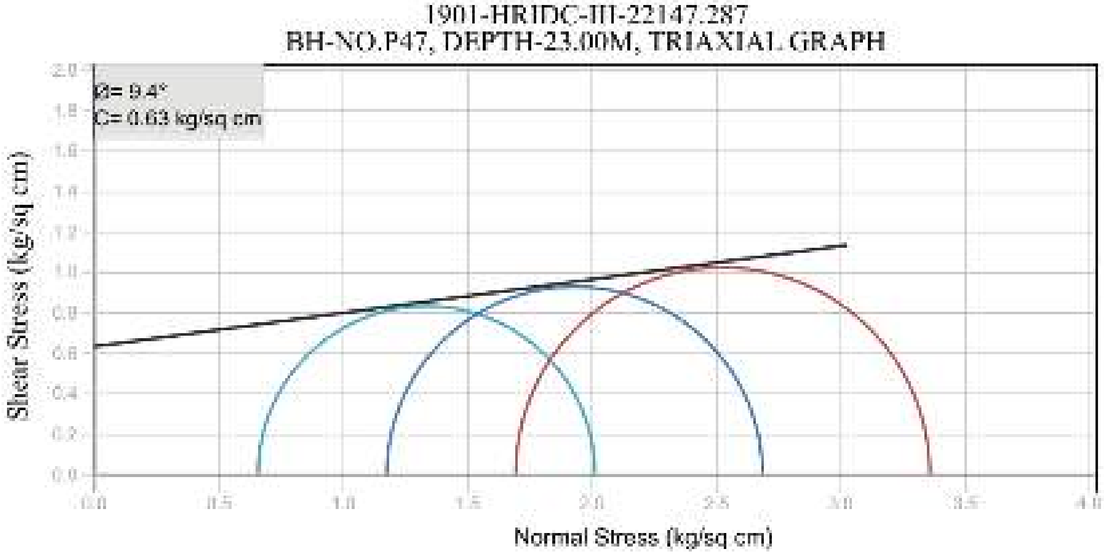


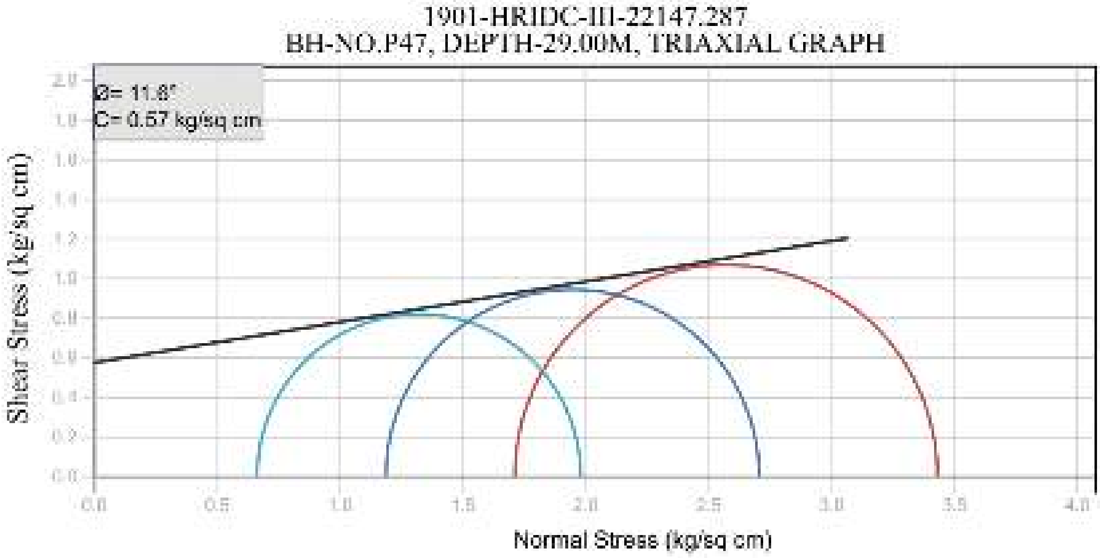
1901-HRIDC-III-22147.287
BH-NO.P47, DEPTH-17.00M, TRIAXIAL GRAPH

1901-HRIDC-III-22147.287
BH-NO.P47, DEPTH-20.00M, TRIAXIAL GRAPH



APPENDIX-G
GRAPH 13: UU GRAPH

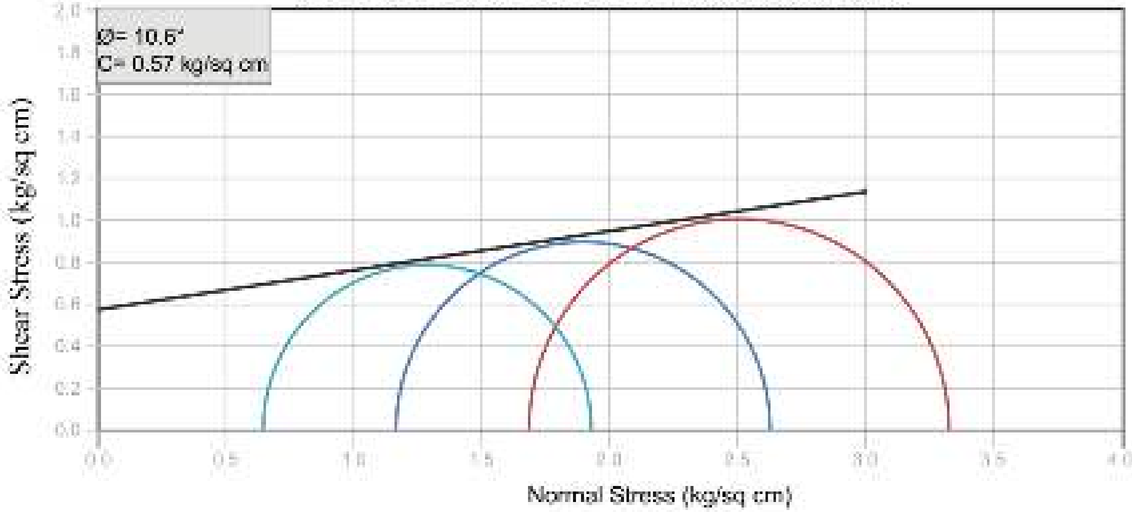




APPENDIX-G
GRAPH 14: UU GRAPH

1901-HRIDC-III-22173.487
BH-NO.P48, DEPTH-14.00M, TRIAXIAL GRAPH

1901-HRIDC-III-22173.487
BH-NO.P48, DEPTH-17.00M, TRIAXIAL GRAPH



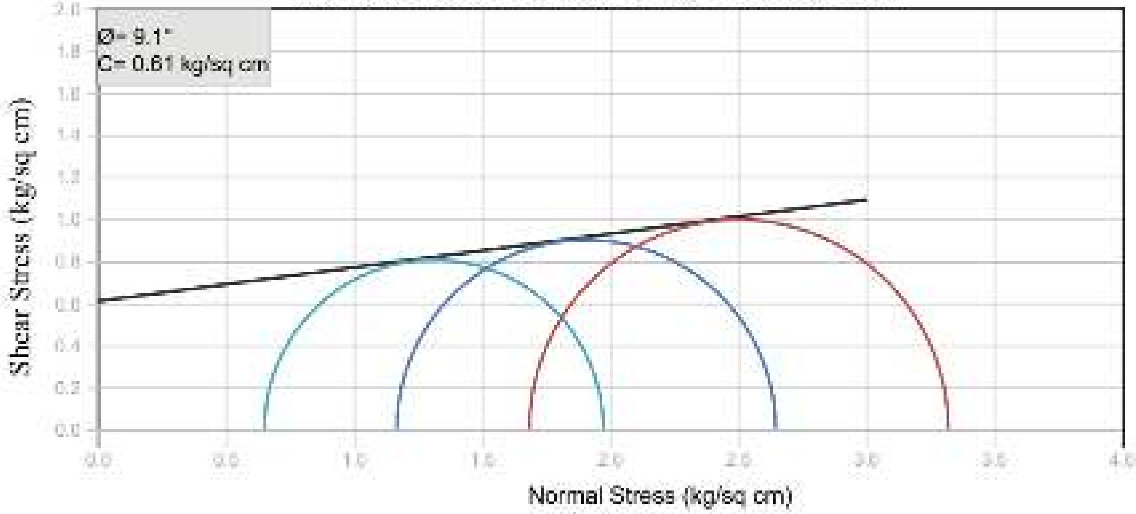
1901-HRIDC-III-22173.487
BH-NO.P48, DEPTH-20.00M, TRIAXIAL GRAPH

APPENDIX-G

GRAPH 15: UU GRAPH

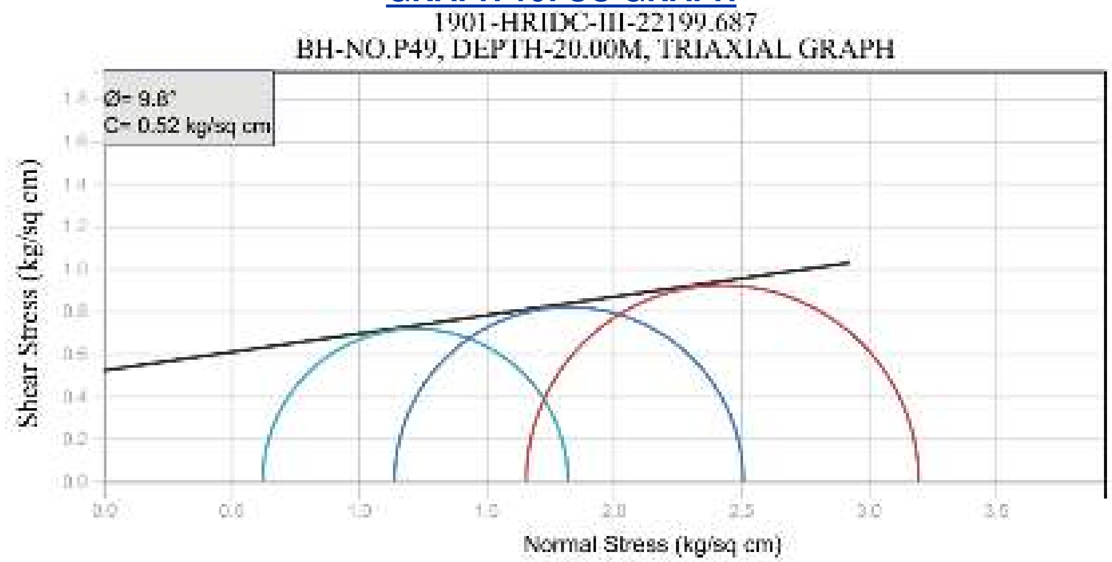
1901-HRIDC-III-22199.687
BH-NO.P49, DEPTH-11.00M, TRIAXIAL GRAPH

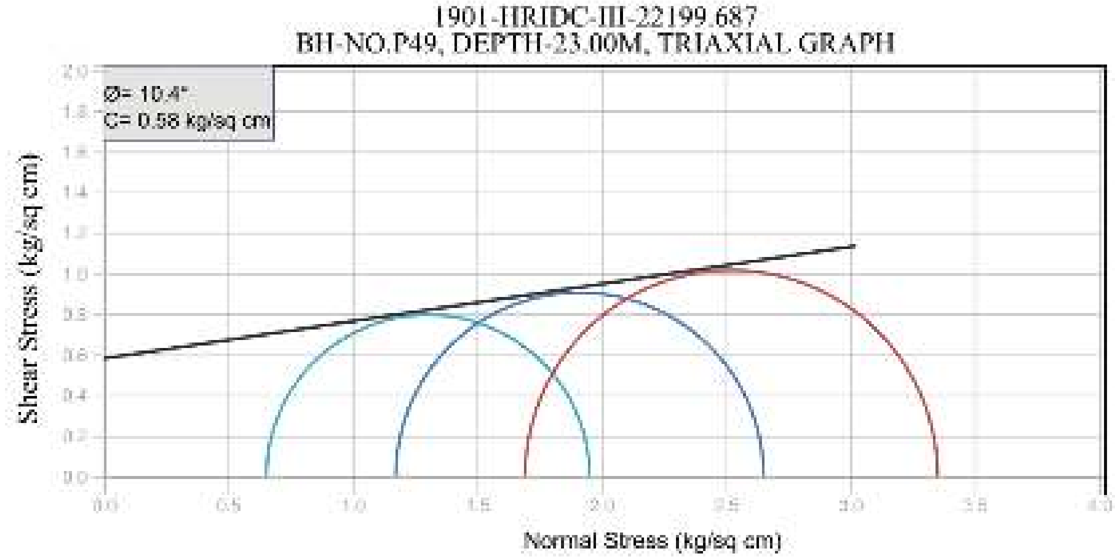
1901-HRIDC-III-22199.687
BH-NO.P49, DEPTH-14.00M, TRIAXIAL GRAPH

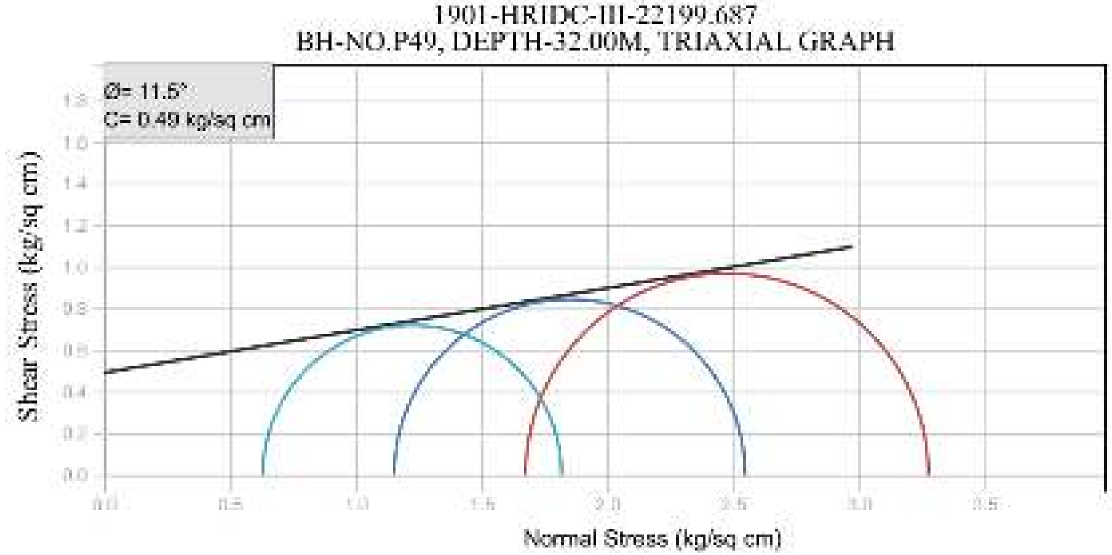


1901-HRIDC-III-22199.687
BH-NO.P49, DEPTH-17.00M, TRIAXIAL GRAPH

APPENDIX-G
GRAPH 16: UU GRAPH

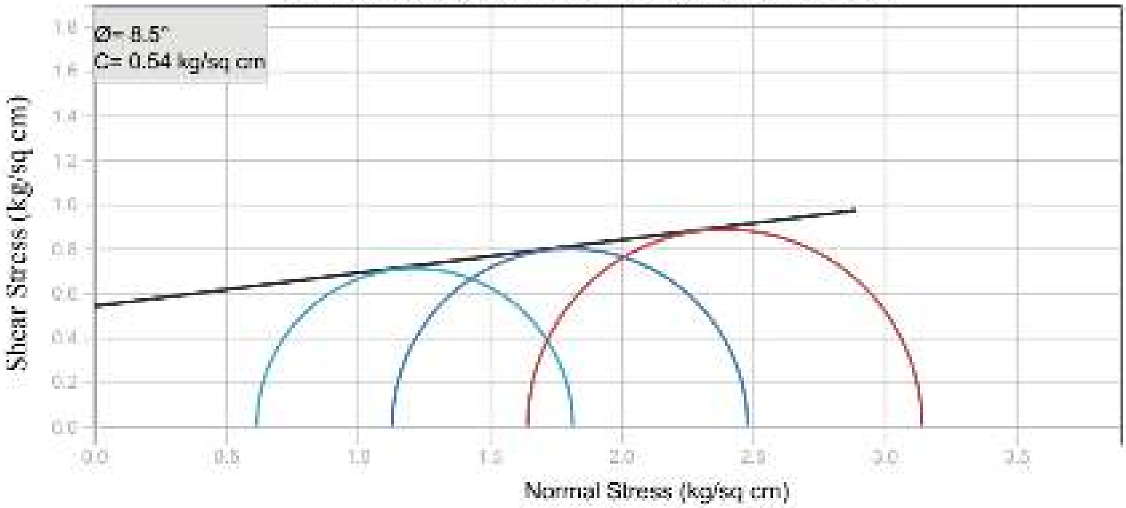






APPENDIX-G
GRAPH 17: UU GRAPH

1901-HRIDC-III-22225.887
BH-NO.P50, DEPTH-10.00M, TRIAXIAL GRAPH

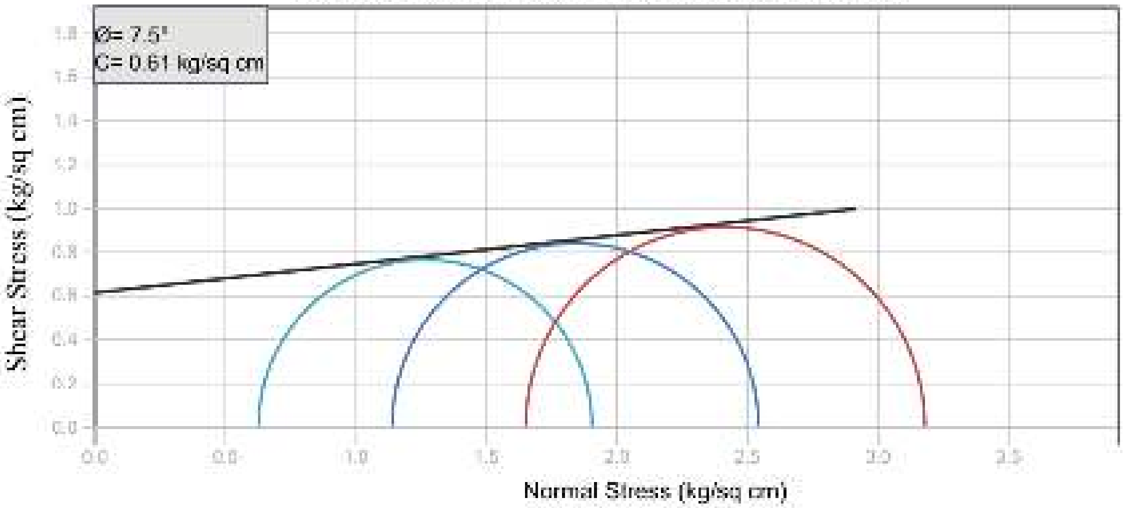


1901-HRIDC-III-22225.887
BH-NO.P50, DEPTH-13.00M, TRIAXIAL GRAPH

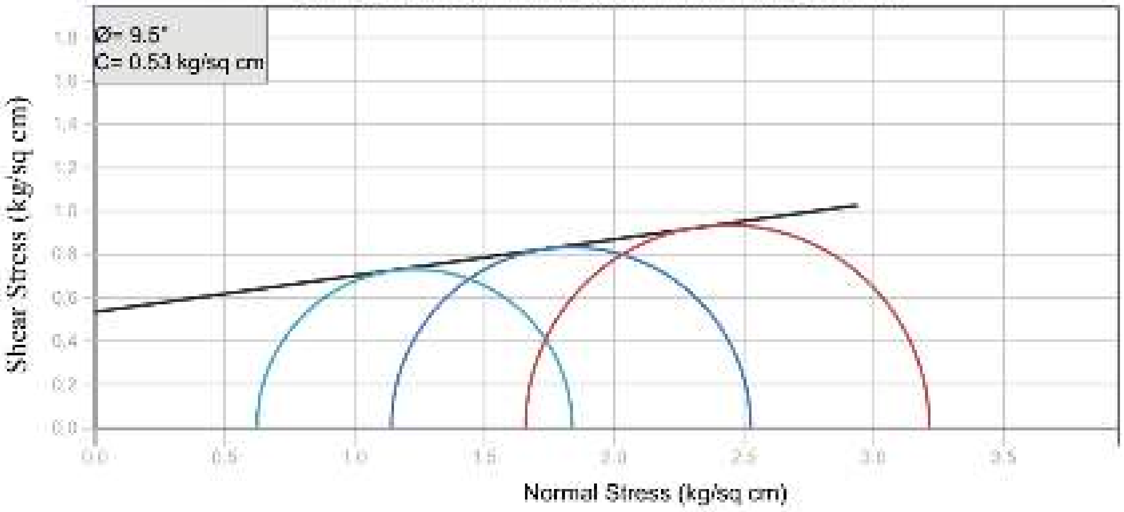
1901-HRIDC-III-22225.887
BH-NO.P50, DEPTH-16.00M, TRIAXIAL GRAPH

APPENDIX-G
GRAPH 18: UU GRAPH

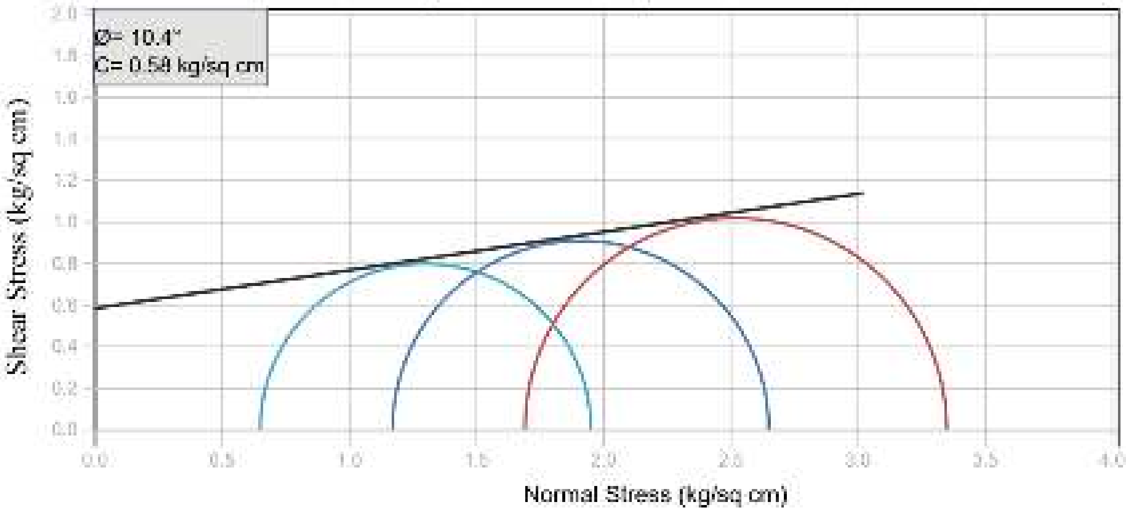
1901-HRIDC-III-22225.887
BH-NO.P50, DEPTH-31.00M, TRIAXIAL GRAPH



1901-HRIDC-III-22252.087
BH-NO.P51, DEPTH-13.00M, TRIAXIAL GRAPH

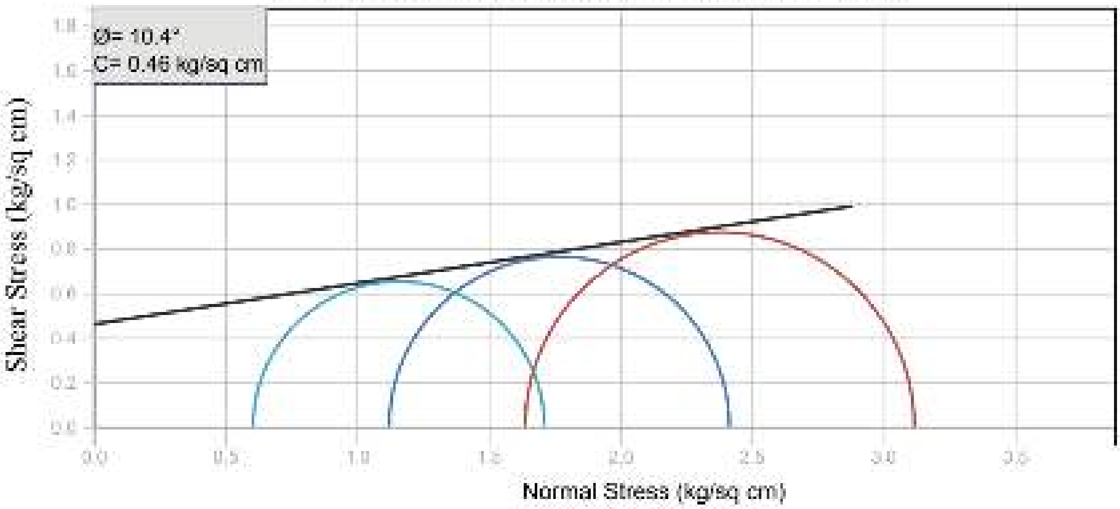


1901-HRIDC-III-22252.087
BH-NO.P51, DEPTH-16.00M, TRIAXIAL GRAPH

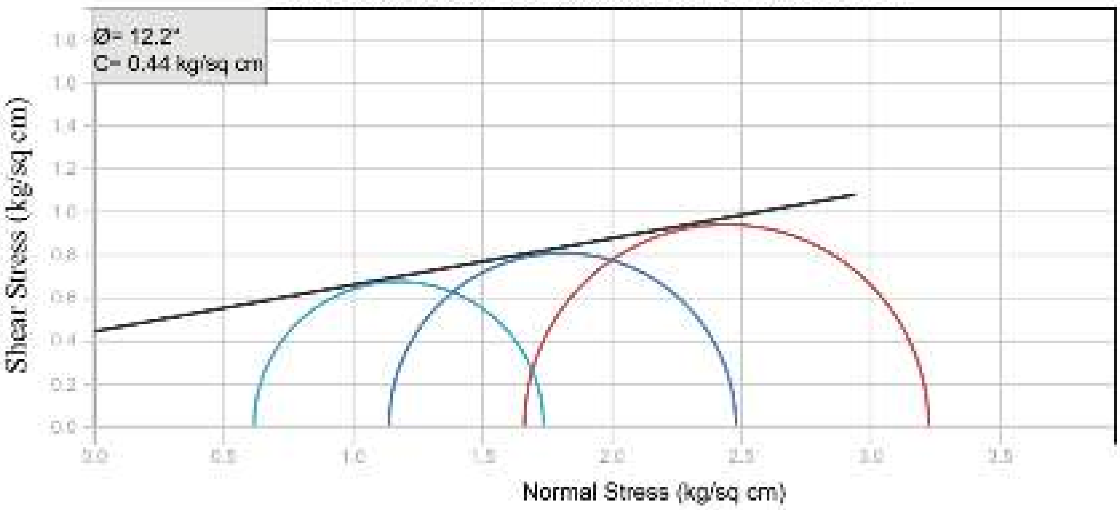


APPENDIX-G
GRAPH 19: UU GRAPH

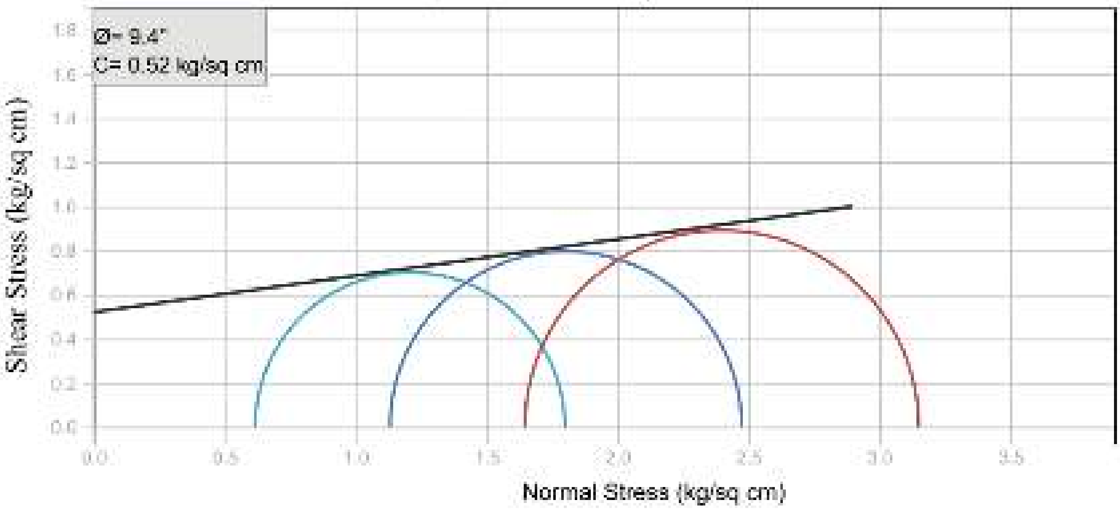
1901-HRIDC-III-22278.287
BH-NO.P52, DEPTH-13.00M, TRIAXIAL GRAPH



1901-HRIDC-III-22278.287
BH-NO.P52, DEPTH-16.00M, TRIAXIAL GRAPH

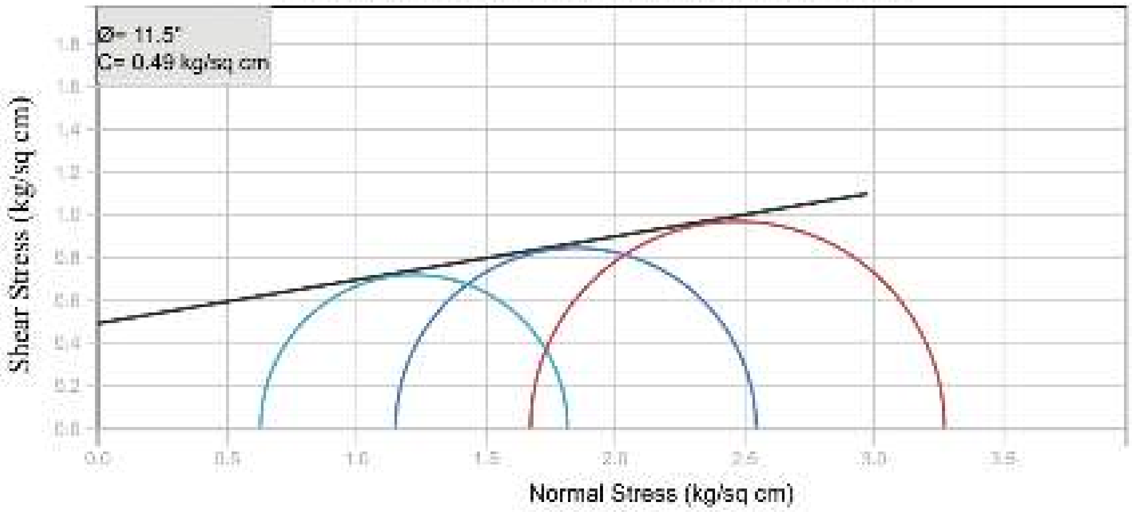


1901-HRIDC-III-22304.487
BH-NO.P53, DEPTH-13.00M, TRIAXIAL GRAPH



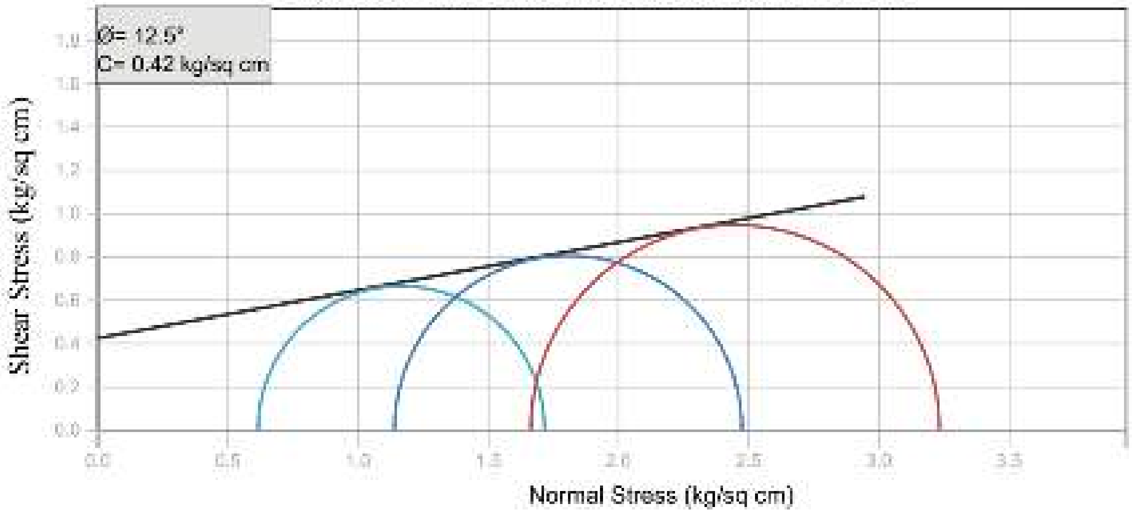
APPENDIX-G
GRAPH 20: UU GRAPH

1901-HRIDC-III-22304.487
BH-NO.P53, DEPTH-16.00M, TRIAXIAL GRAPH



1901-HRIDC-III-22304.487
BH-NO.P53, DEPTH-28.00M, TRIAXIAL GRAPH

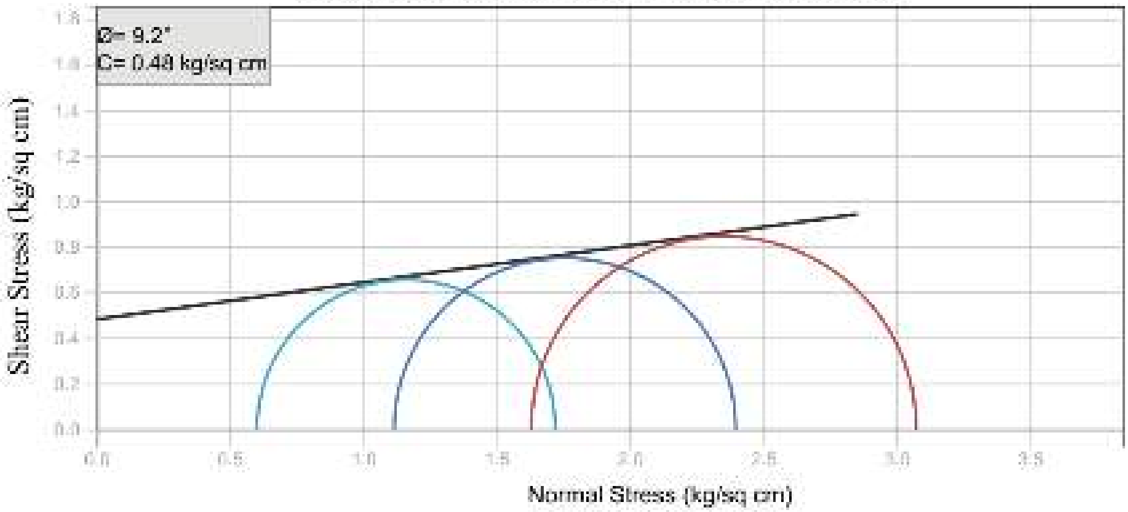
1901-HRIDC-III-22330.687
BH-NO.P54, DEPTH-16.00M, TRIAXIAL GRAPH



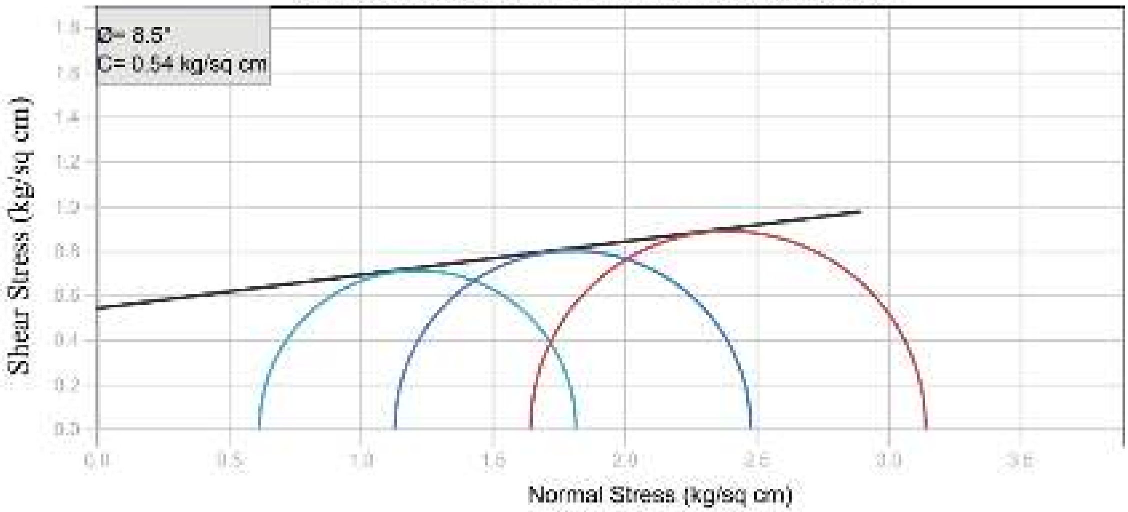
APPENDIX-G
GRAPH 21: UU GRAPH

1901-HRIDC-III-22330.687
BH-NO.P54, DEPTH-28.00M, TRIAXIAL GRAPH

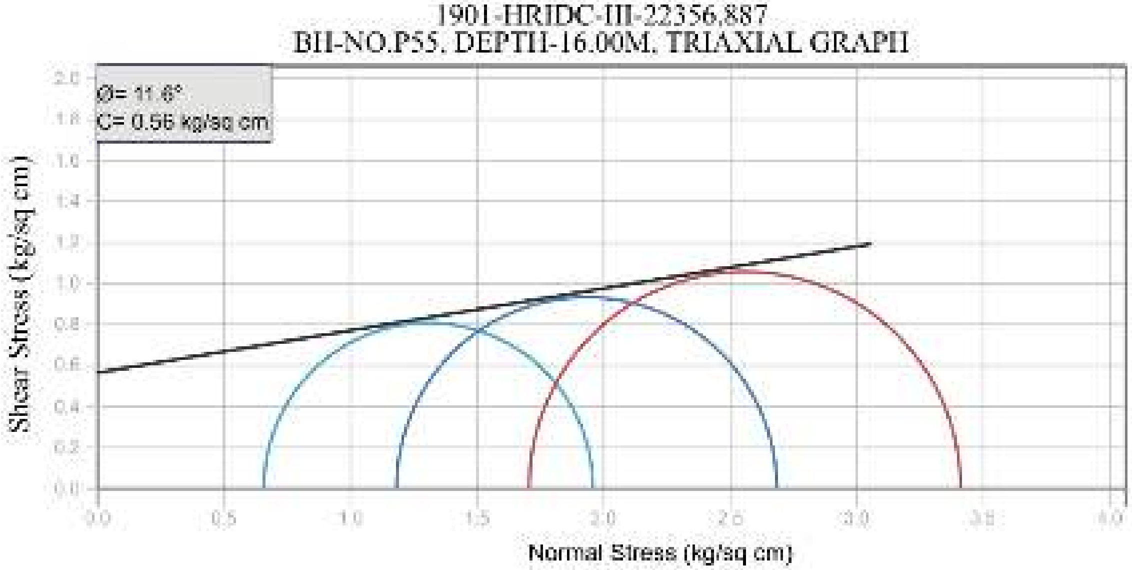
1901-HRIDC-III-22356.887
BH-NO.P55, DEPTH-10.00M, TRIAXIAL GRAPH

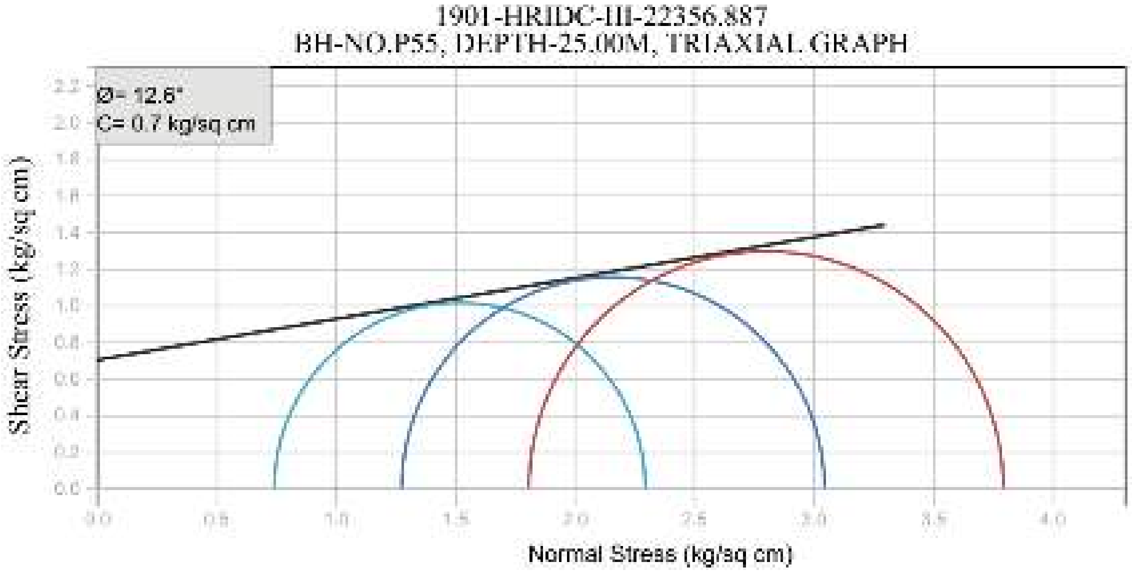


1901-HRIDC-III-22356.887
BH-NO.P55, DEPTH-13.00M, TRIAXIAL GRAPH

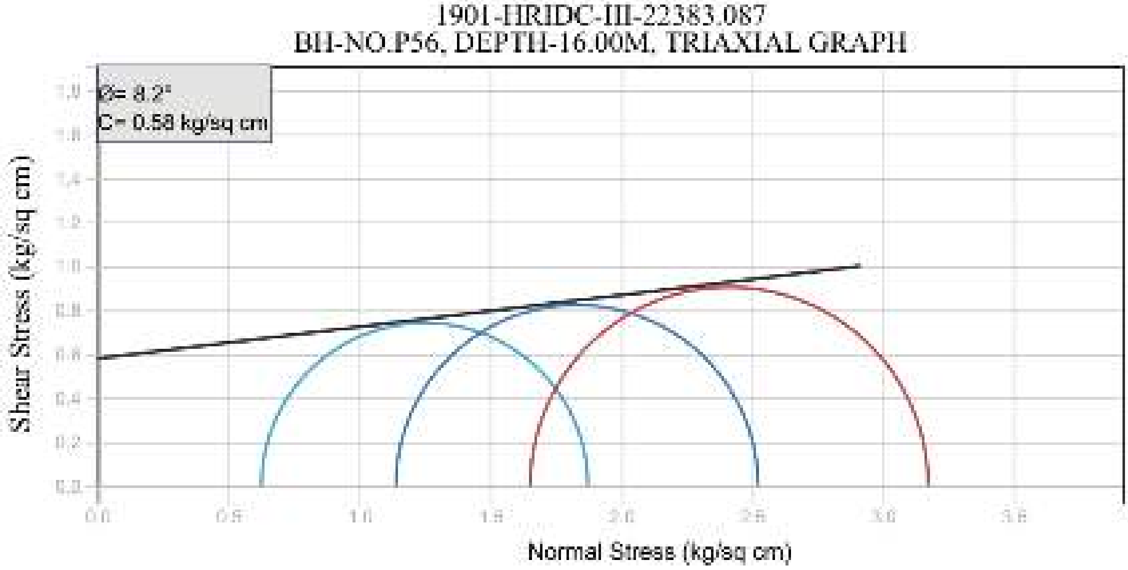


APPENDIX-G
GRAPH 22: UU GRAPH



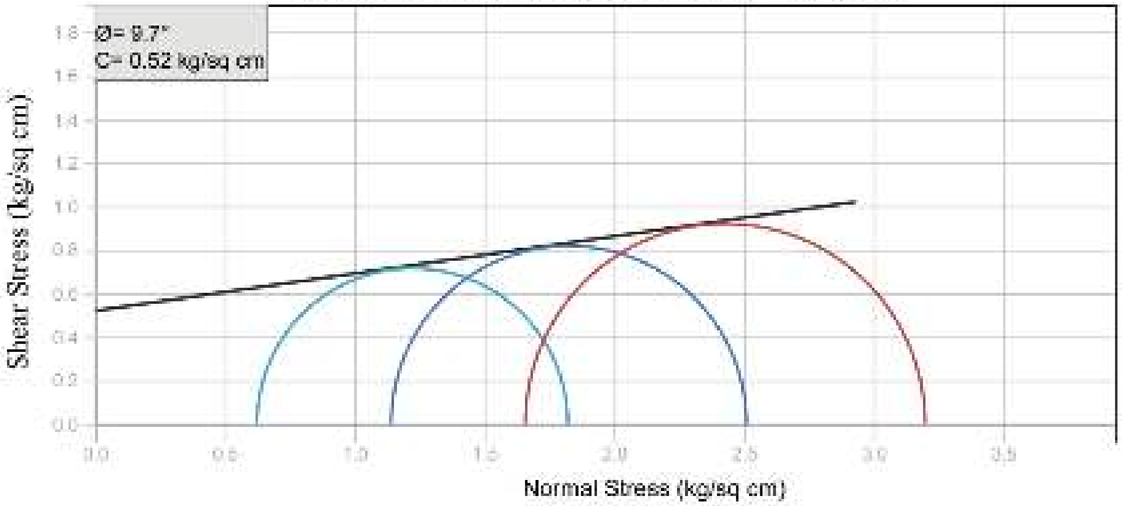


APPENDIX-G
GRAPH 23: UU GRAPH

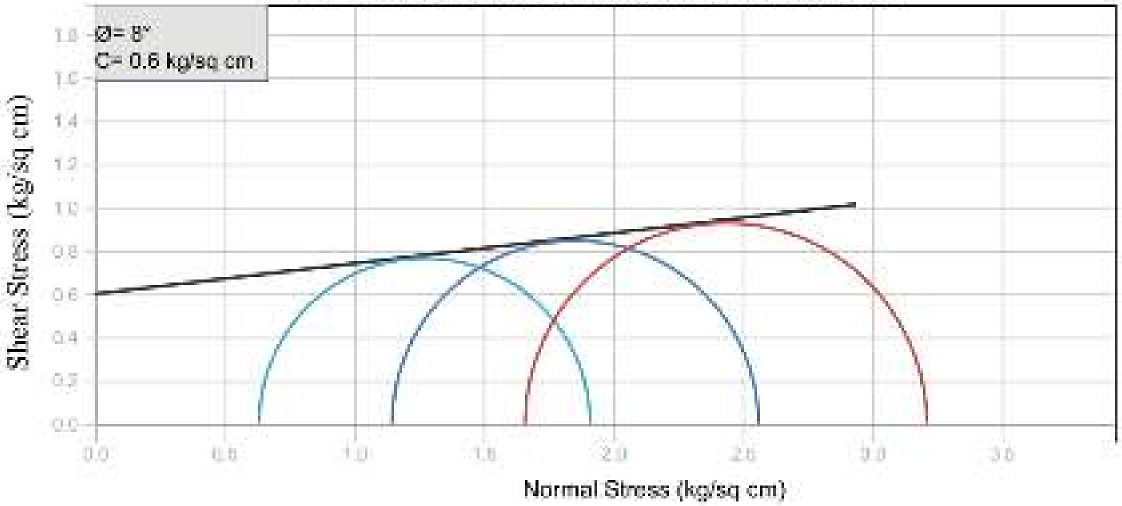


APPENDIX-G
GRAPH 24: UU GRAPH

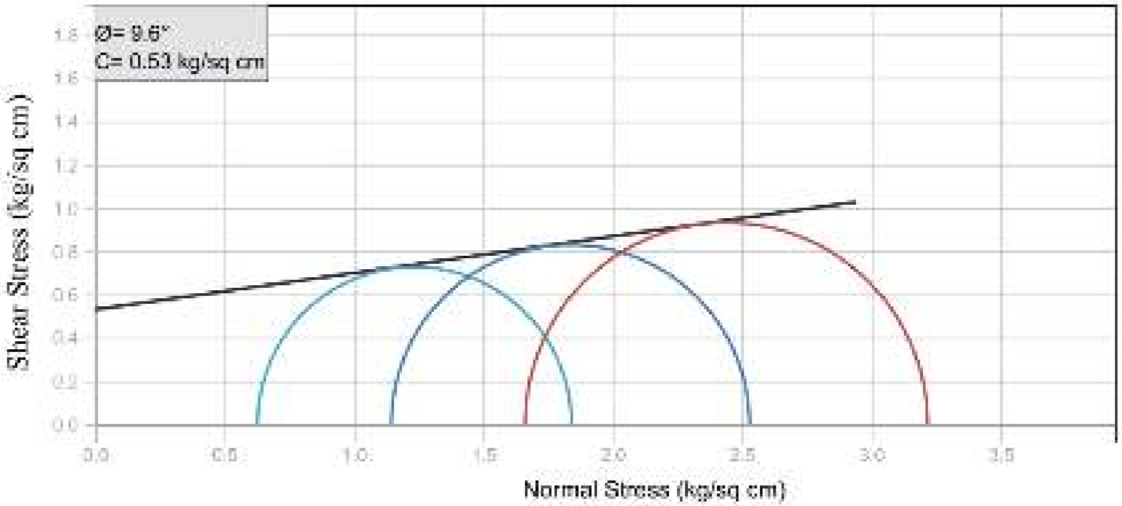
1901-HRIDC-III-22383.087
BH-NO.P56, DEPTH-19.00M, TRIAXIAL GRAPH



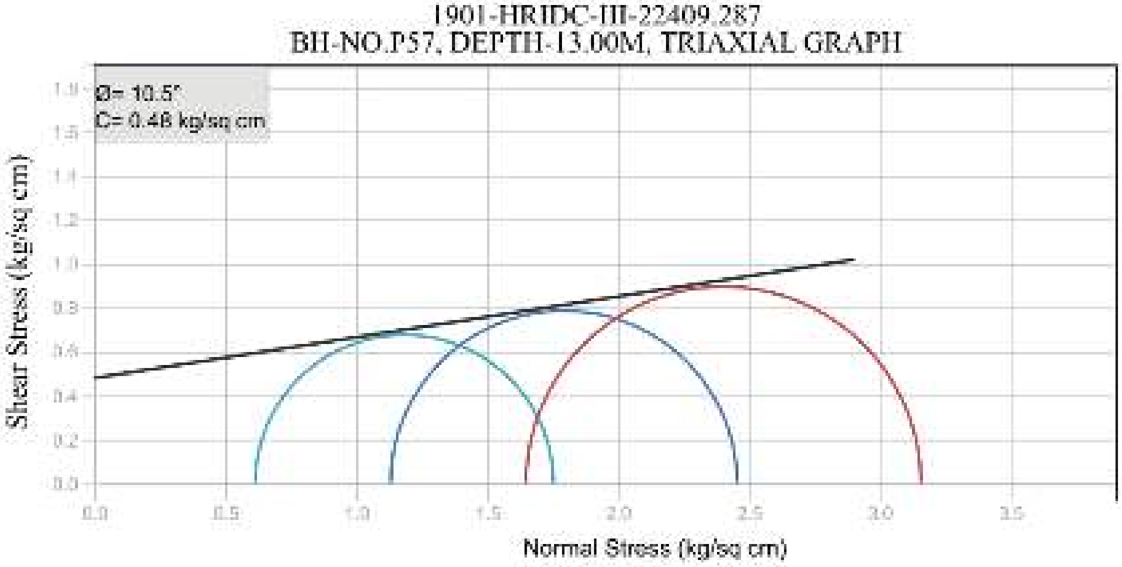
1901-HRIDC-III-22383.087
BH-NO.P56, DEPTH-22.00M, TRIAXIAL GRAPH

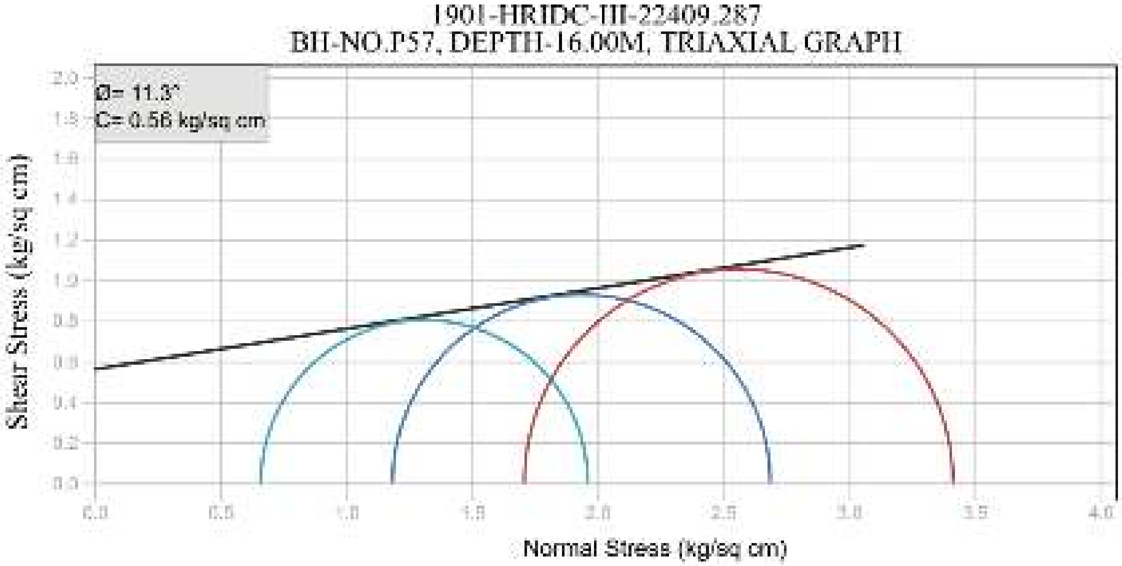


1901-HRIDC-III-22409.287
BH-NO.P57, DEPTH-10.00M, TRIAXIAL GRAPH



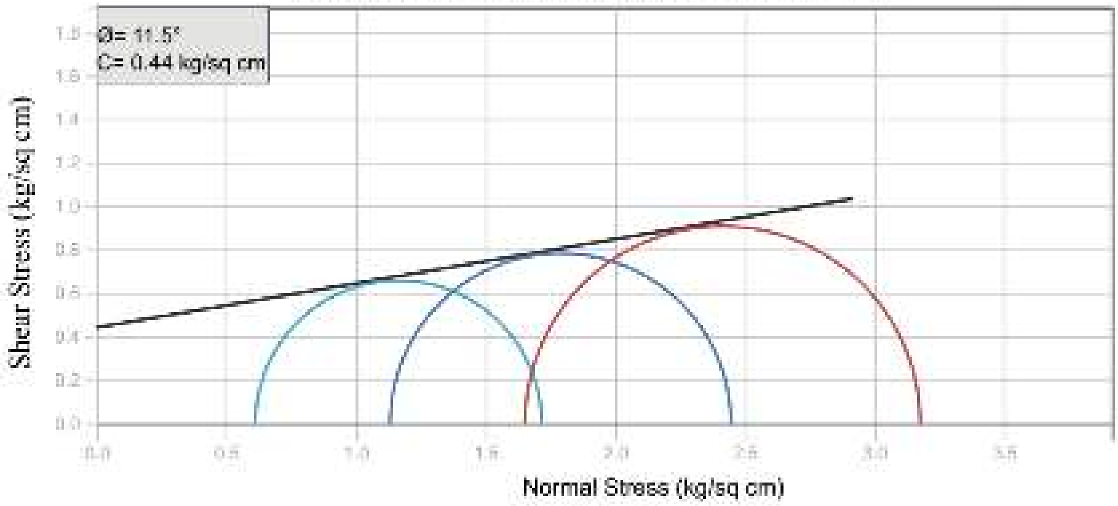
APPENDIX-G
GRAPH 25: UU GRAPH



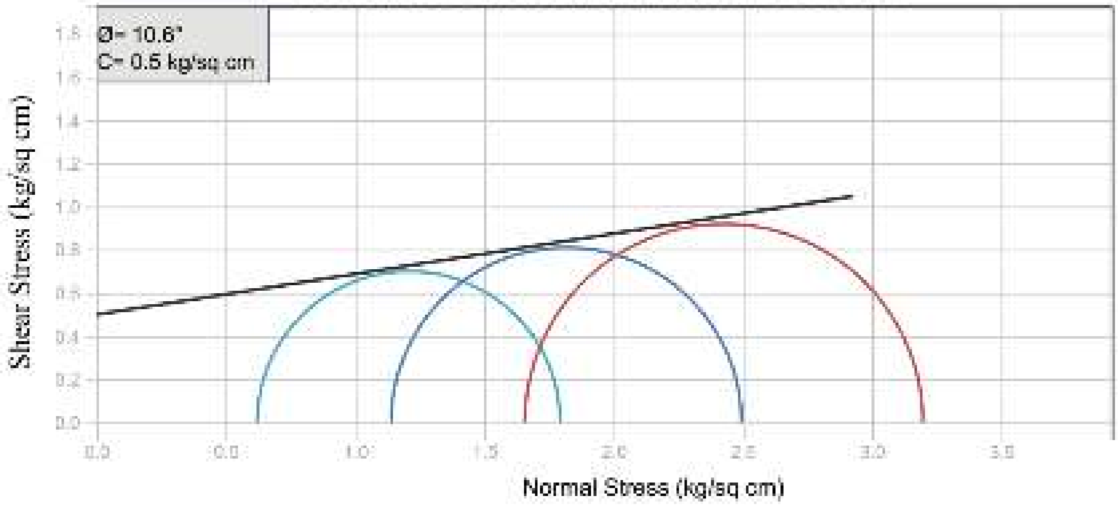


APPENDIX-G
GRAPH 26: UU GRAPH

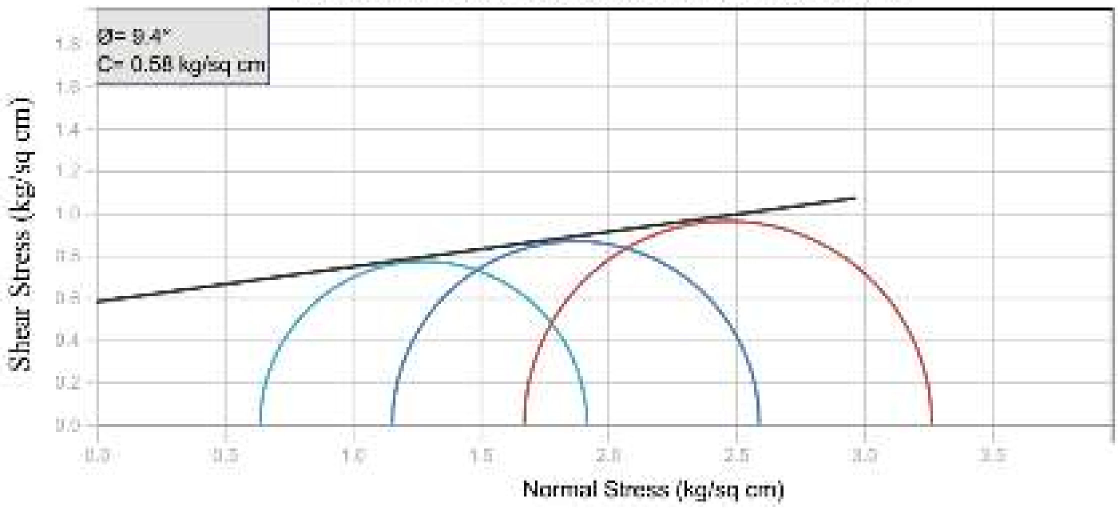
1901-HRIDC-III-22435.487
BH-NO.P58, DEPTH-2.00M, TRIAXIAL GRAPH



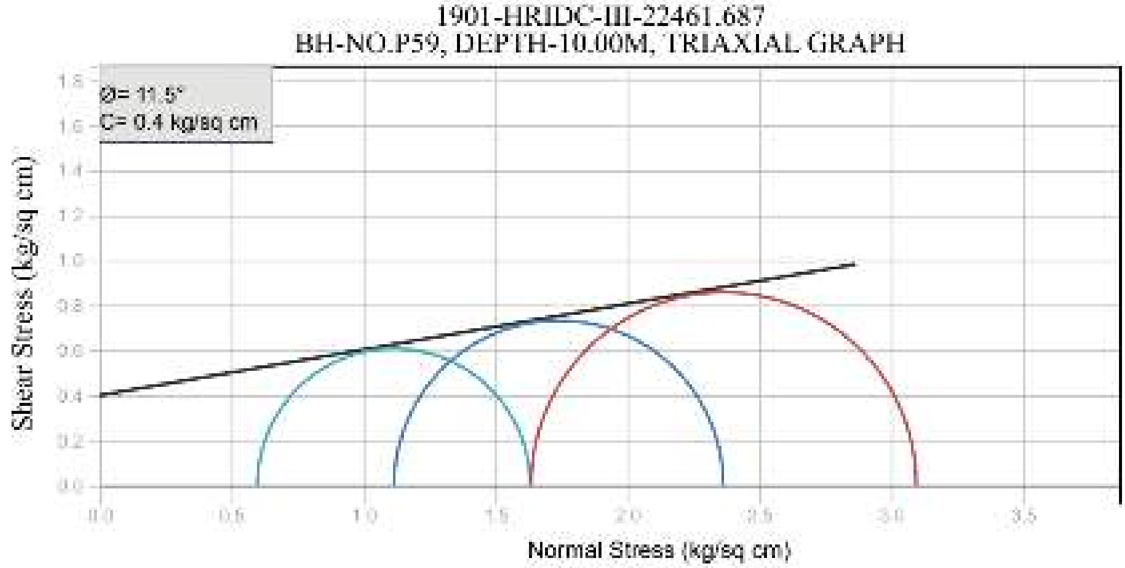
1901-HRIDC-III-22435.487
BH-NO.P58, DEPTH-14.00M, TRIAXIAL GRAPH

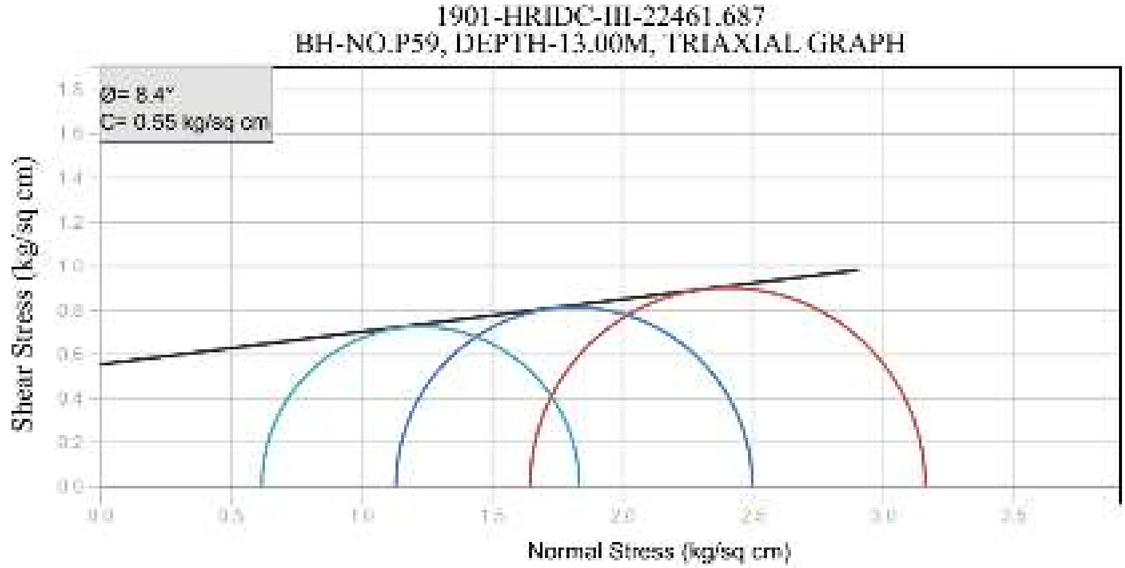


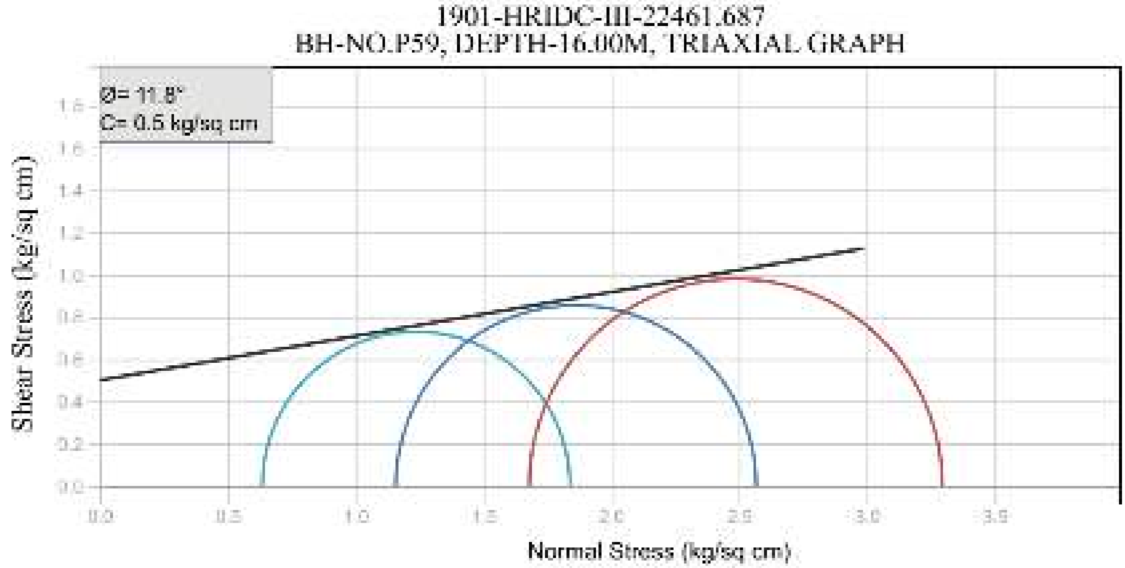
1901-HRIDC-III-22435.487
BH-NO.P58, DEPTH-26.00M, TRIAXIAL GRAPH



APPENDIX-G
GRAPH 27: UU GRAPH

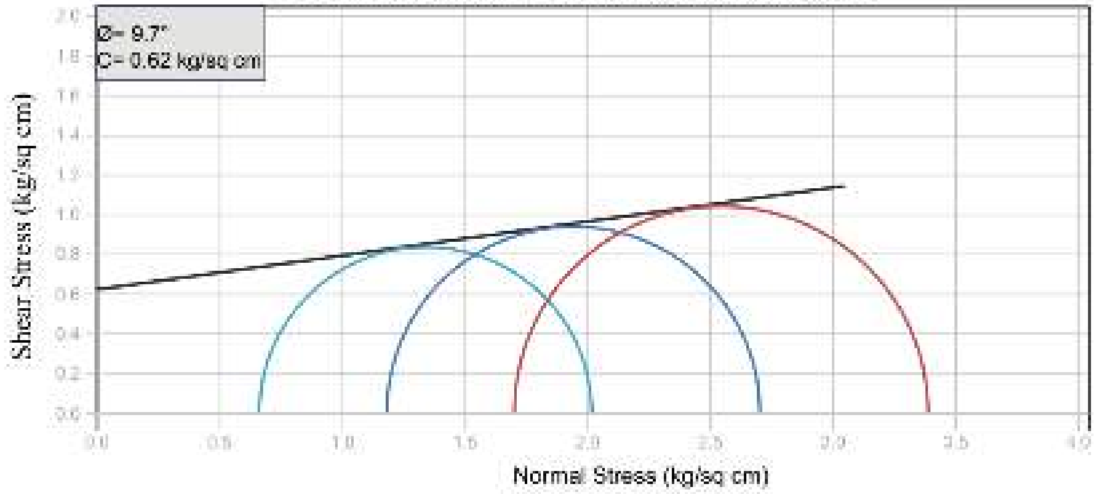




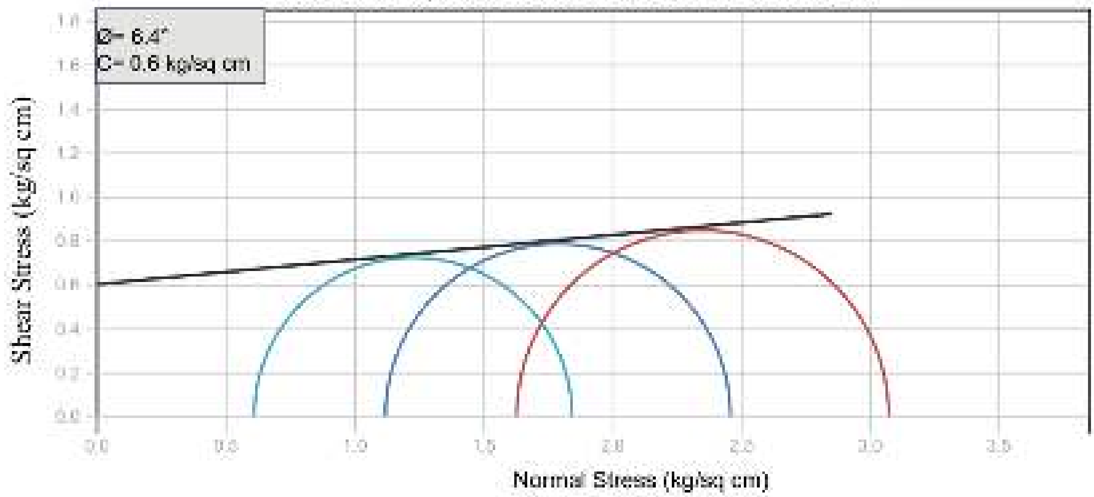


APPENDIX-G
GRAPH 28: UU GRAPH

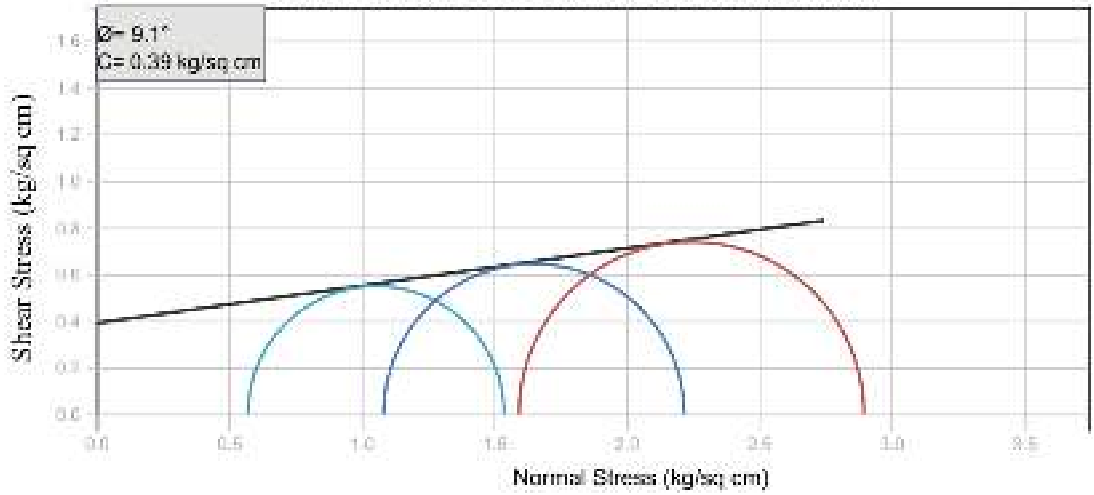
1901-HRIDC-III-22487.887
BH-NO.P60, DEPTH-2.00M, TRIAXIAL GRAPH



1901-HRIDC-III-22487.887
BH-NO.P60, DEPTH-26.00M, TRIAXIAL GRAPH

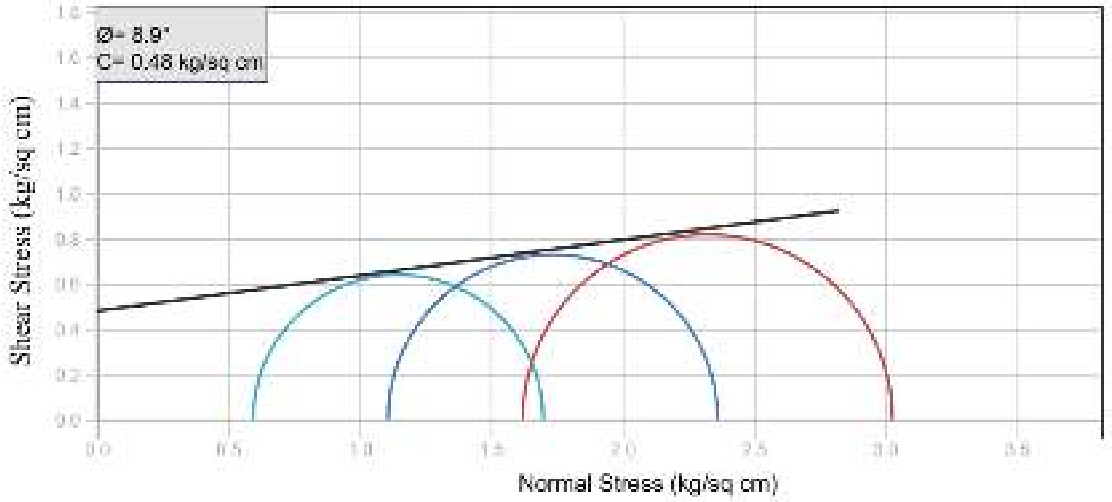


1901-HRIDC-III-22487.887
BH-NO.P60, DEPTH-29.00M, TRIAXIAL GRAPH

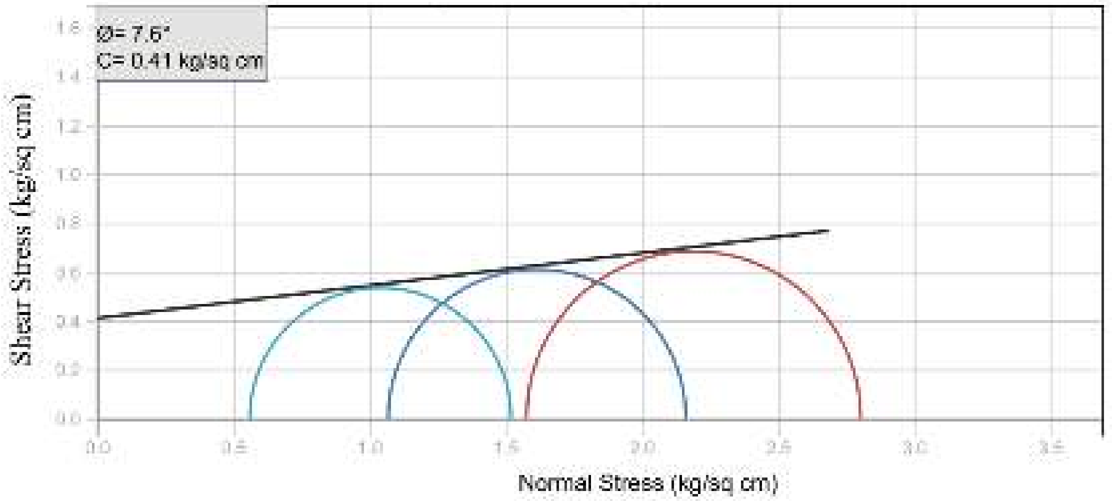


APPENDIX-G
GRAPH 29: RUU GRAPH

1901-HRIDC-III-21990.087
BH-NO.P41, DEPTH-23.00M, TRIAXIAL GRAPH

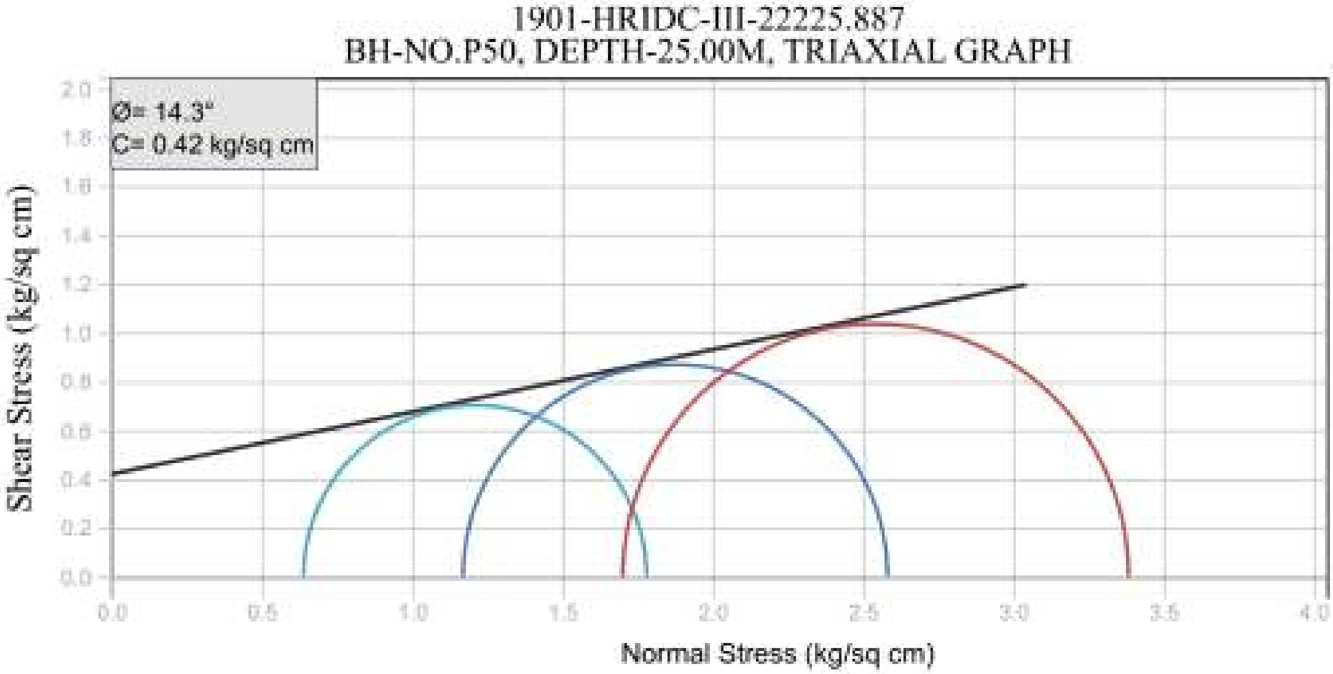


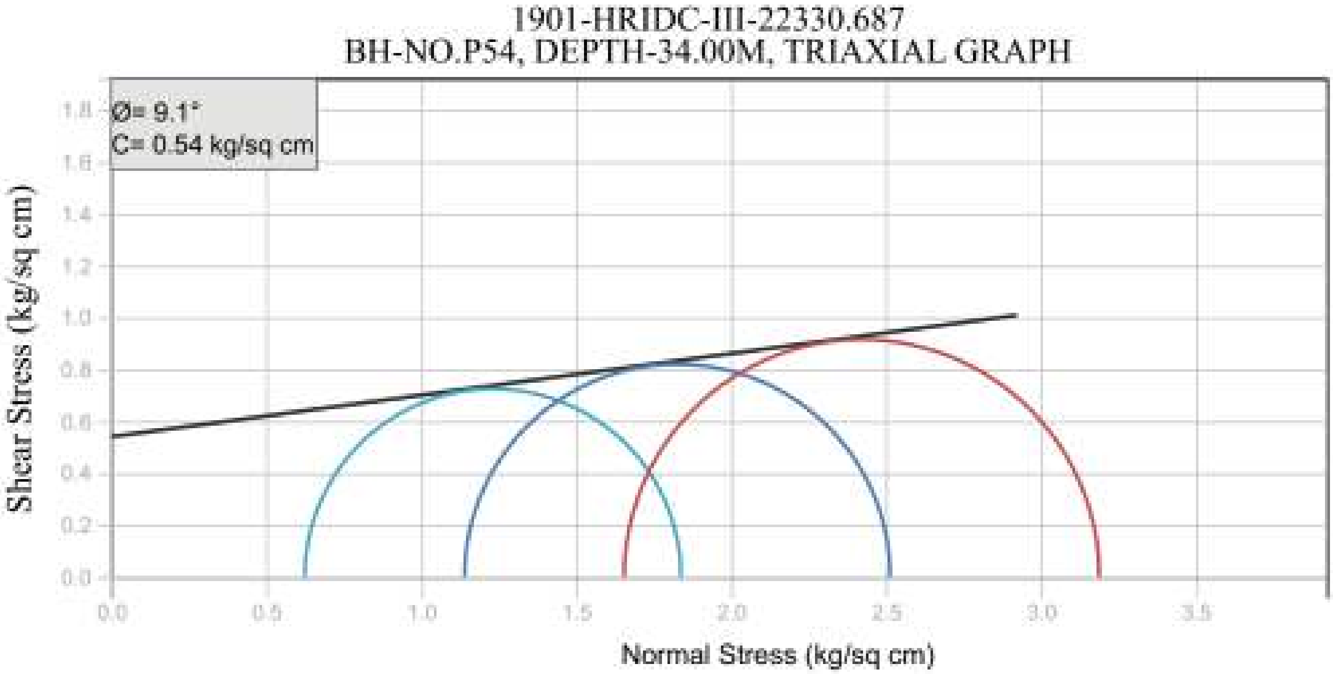
1901-HRIDC-III-21990.087
BH-NO.P41, DEPTH-32.00M, TRIAXIAL GRAPH



1901-HRIDC-III-22042.487
BH-NO.P43, DEPTH-28.00M, TRIAXIAL GRAPH

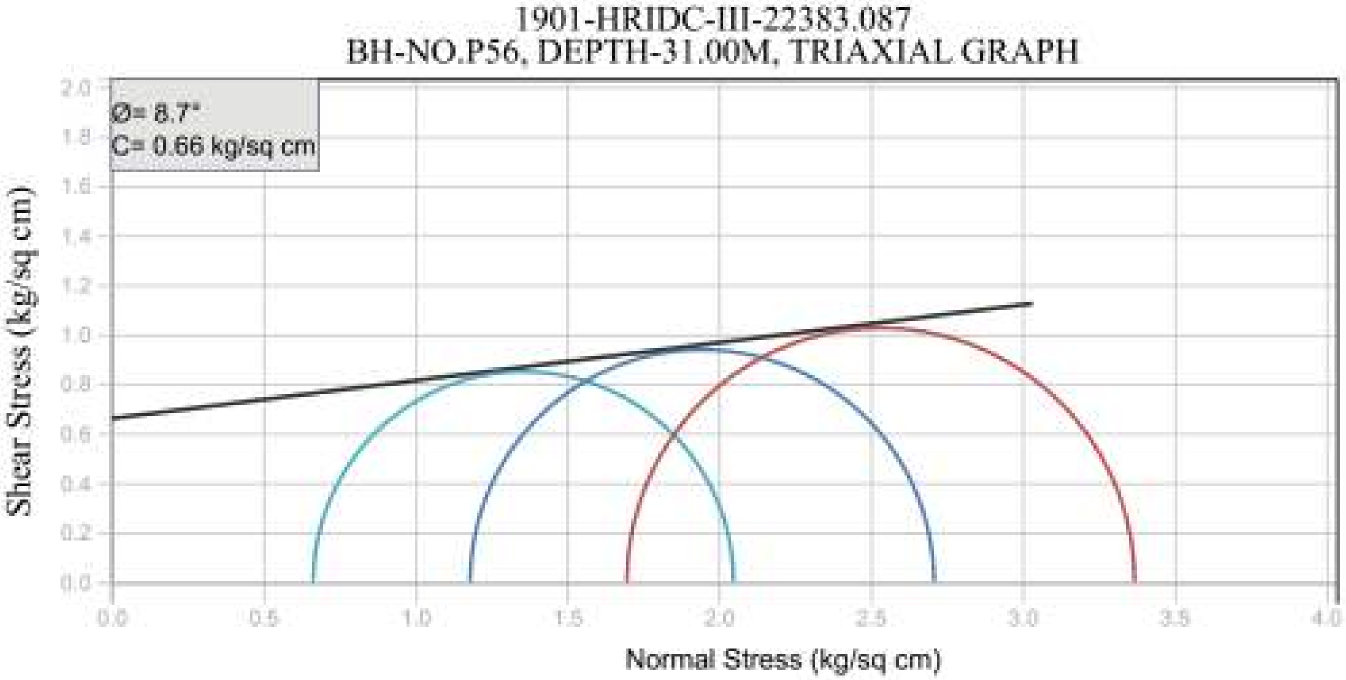
APPENDIX-G
GRAPH 30: RUU GRAPH

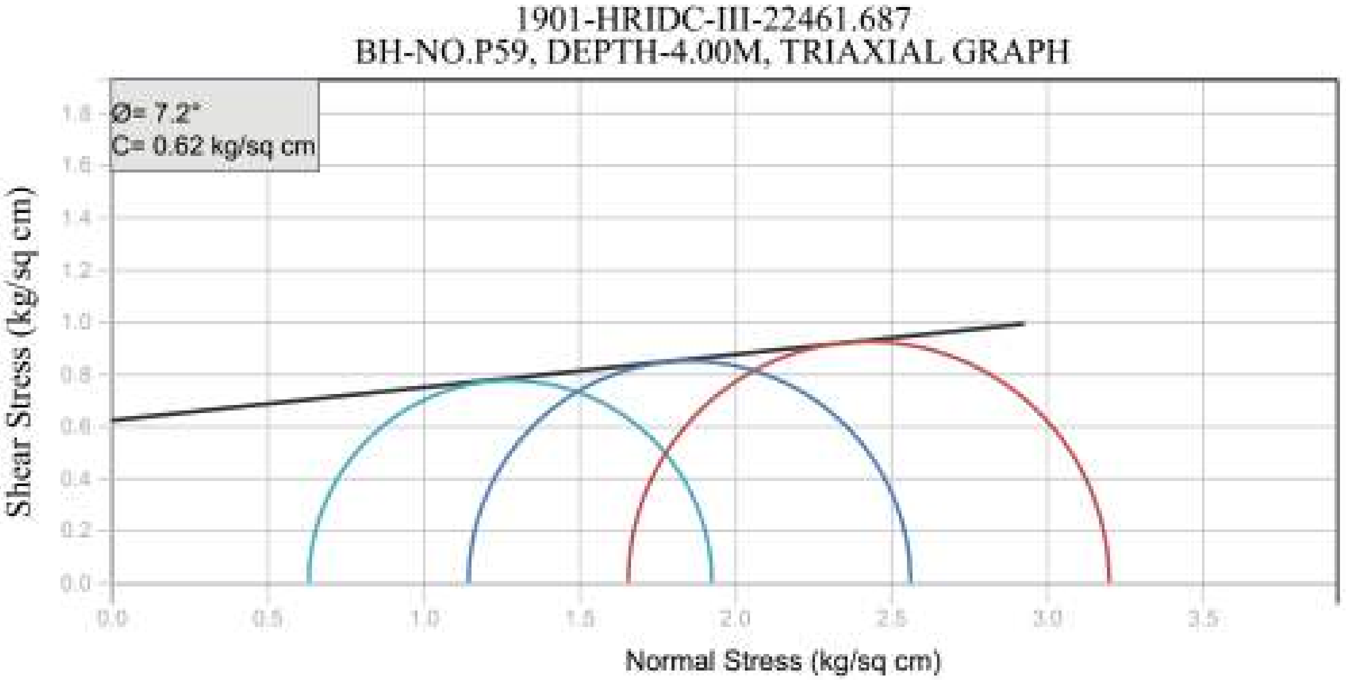




APPENDIX-G

GRAPH 31: RUU GRAPH





APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: P41, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.61	10.61	29.18	1.57	7.4	7.4	1.0	5.95	0	62	1.0	97.4	0	3.0	7.4	62	10.61	2.00	0.82	31.8	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.5	20.61	10.61	37.14	3.14	7.4	7.4	1.0	15.16	0	62	1.0	194.9	0	4.0	6.8	60	10.61	1.89	0.73	42.4	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.5	20.61	10.61	47.75	3.14	6.8	6.8	1.0	17.89	0	60	1.0	188.6	0	5.0	28.3	1	9.32	17.43	18.48	53.1	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.32	9.32	57.71	3.14	28.3	28.3	1.0	97.66	0	1	1.0	3.1	0	6.0	28.3	1	9.32	17.43	18.48	62.4	929.0	929.0	41.2	41.2	**371.59**	**13.74**
6.00	7.00	6.50	1.00	4.5	19.32	9.32	67.03	3.14	28.3	28.3	1.0	113.43	113.43	1	1.0	3.1	3.1	7.0	12.2	43	9.32	3.12	1.85	71.7	486.4	603.0	53.0	169.6	**241.18**	**56.53**
7.00	8.00	7.50	1.00	5.5	19.32	9.32	76.35	3.14	12.2	12.2	1.0	51.88	165.31	43	1.0	135.1	138.3	8.0	12.2	43	10.08	3.12	1.85	81.0	509.8	813.4	64.8	368.4	**325.34**	**122.80**
8.00	9.00	8.50	1.00	6.5	20.08	10.08	86.05	3.14	12.2	12.2	1.0	58.47	223.78	43	1.0	135.1	273.4	9.0	12.2	43	10.08	3.12	1.85	91.1	534.4	1031.6	76.6	573.8	**412.66**	**191.26**
9.00	10.00	9.50	1.00	7.5	20.08	10.08	96.13	3.14	12.2	12.2	1.0	65.32	289.11	43	1.0	135.1	408.6	10.0	10.7	53	10.08	2.68	1.42	101.2	593.1	1290.8	88.4	786.0	**516.32**	**262.01**
10.00	11.00	10.50	1.00	8.5	20.08	10.08	106.21	3.14	10.7	10.7	1.0	63.07	352.18	53	1.0	166.6	575.1	11.0	10.7	53	10.37	2.68	1.42	111.3	614.5	1541.8	100.1	1027.5	**616.71**	**342.49**
11.00	12.50	11.75	1.50	10.0	20.37	10.37	119.03	4.71	10.7	10.7	1.0	106.03	458.20	53	1.0	249.9	825.0	12.5	11.5	58	10.16	2.91	1.65	126.8	706.8	1990.0	117.8	1401.0	**795.98**	**467.00**
12.50	15.50	14.00	3.00	13.0	20.16	10.16	142.05	9.43	11.5	11.5	1.0	272.48	730.68	58	1.0	546.9	1371.9	15.5	9.7	62	10.40	2.42	1.17	126.8	683.9	2786.5	153.2	2255.7	**1114.59**	**751.90**
15.50	18.50	17.00	3.00	16.0	20.40	10.40	142.05	9.43	9.7	9.7	1.0	228.93	959.61	62	1.0	584.6	1956.4	18.5	14.8	31	10.40	3.88	2.59	126.8	616.6	3532.6	188.5	3104.5	**1413.05**	**1034.85**
18.50	20.00	19.25	1.50	17.5	20.40	10.40	142.05	4.71	14.8	14.8	1.0	176.93	1136.54	31	1.0	146.1	2102.6	20.0	8.3	60	10.40	2.16	0.96	126.8	643.8	3882.9	206.2	3445.3	**1553.17**	**1148.43**
20.00	21.50	20.75	1.50	19.0	20.40	10.40	142.05	4.71	8.3	8.3	1.0	97.69	1234.23	60	1.0	282.9	2385.4	21.5	8.9	48	10.86	2.27	1.05	126.8	570.3	4189.9	223.8	3843.5	**1675.97**	**1281.17**
21.50	24.50	23.00	3.00	22.0	20.86	10.86	142.05	9.43	8.9	8.9	1.0	209.73	1443.95	48	1.0	452.6	2838.0	24.5	8.9	48	10.86	2.27	1.05	126.8	570.3	4852.2	259.2	4541.1	**1940.89**	**1513.71**
24.50	26.00	25.25	1.50	23.5	20.86	10.86	142.05	4.71	8.9	8.9	1.0	104.86	1548.82	48	1.0	226.3	3064.3	26.0	24.8	8	9.49	9.86	10.66	126.8	1078.3	5691.4	276.9	4890.0	**2276.56**	**1629.99**
26.00	27.50	26.75	1.50	25.0	19.49	9.49	142.05	4.71	24.8	24.8	1.0	309.42	1858.24	8	1.0	37.7	3102.0	27.5	10.0	45	9.49	2.47	1.22	126.8	568.9	5529.1	294.5	5254.8	**2211.64**	**1751.59**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
27.50	29.00	28.25	1.50	26.5	19.49	9.49	142.05	4.71	10.0	10.0	1.0	118.08	1976.31	45	1.0	212.1	3314.1	29.0	24.7	10	9.76	9.78	10.55	126.8	1086.0	6376.4	312.2	5602.6	**2550.57**	**1867.55**
29.00	30.00	29.50	1.00	27.5	19.76	9.76	142.05	3.14	24.7	24.7	1.0	205.33	2181.64	10	1.0	31.4	3345.6	30.0	24.0	0	9.76	9.28	9.78	126.8	962.1	6489.3	324.0	5851.2	**2595.72**	**1950.40**
30.00	30.50	30.25	0.50	28.0	19.76	9.76	142.05	1.57	24.0	24.0	1.0	99.38	2281.03	0	1.0	0.0	3345.6	30.5	24.4	0	9.76	9.57	10.22	126.8	992.5	6619.1	329.9	5956.5	**2647.63**	**1985.49**
30.50	32.00	31.25	1.50	29.5	19.76	9.76	142.05	4.71	24.4	24.4	1.0	303.76	2584.79	0	1.0	0.0	3345.6	32.0	7.6	41	10.43	2.04	0.85	126.8	496.5	6426.8	347.5	6277.9	**2570.73**	**2092.63**
32.00	32.50	32.25	0.50	30.0	20.43	10.43	142.05	1.57	7.6	7.6	1.0	29.78	2614.57	41	1.0	64.4	3410.0	32.5	7.6	41	10.43	2.04	0.85	126.8	496.5	6521.0	353.4	6378.0	**2608.41**	**2126.00**
32.50	33.50	33.00	1.00	31.0	20.43	10.43	142.05	3.14	7.6	7.6	1.0	59.57	2674.14	41	1.0	128.9	3538.9	33.5	28.3	0	10.43	17.43	18.48	126.8	1812.5	8025.5	365.2	6578.2	**3210.18**	**2192.73**
33.50	35.00	34.25	1.50	32.5	20.43	10.43	142.05	4.71	28.3	28.3	1.0	360.56	3034.70	0	1.0	0.0	3538.9	35.0	26.1	4	10.84	12.48	13.41	126.8	1328.5	7902.1	382.9	6956.4	**3160.84**	**2318.81**
35.00	36.50	35.75	1.50	34.0	20.84	10.84	142.05	4.71	26.1	26.1	1.0	328.05	3362.76	4	1.0	18.9	3557.7	36.5	8.1	60	10.84	2.13	0.93	126.8	640.3	7560.7	400.6	7321.0	**3024.29**	**2440.34**
36.50	37.50	37.00	1.00	35.0	20.84	10.84	142.05	3.14	8.1	8.1	1.0	63.54	3426.29	60	1.0	188.6	3746.3	37.5	8.1	60	10.84	2.13	0.93	126.8	640.3	7812.8	412.3	7584.9	**3125.13**	**2528.30**
37.50	38.00	37.75	0.50	35.5	20.84	10.84	142.05	1.57	8.1	8.1	1.0	31.77	3458.06	60	1.0	94.3	3840.6	38.0	8.1	60	9.63	2.13	0.93	126.8	639.8	7938.4	418.2	7716.9	**3175.38**	**2572.29**
38.00	40.00	39.00	2.00	37.5	19.63	9.63	142.05	6.29	8.1	8.1	1.0	127.07	3585.13	60	1.0	377.1	4217.7	40.0	8.1	60	9.20	2.13	0.93	126.8	639.7	8442.5	441.8	8244.6	**3377.00**	**2748.21**
BORE NO: P42, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.28	10.28	28.27	1.57	8.6	8.6	1.0	6.72	0	47	1.0	73.9	0	3.0	14.4	36	10.28	3.77	2.48	30.8	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.5	20.28	10.28	35.98	3.14	14.4	14.4	1.0	29.03	0	36	1.0	113.1	0	4.0	7.8	71	10.08	2.07	0.88	41.1	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.5	20.08	10.08	46.16	3.14	7.8	7.8	1.0	19.87	0	71	1.0	223.1	0	5.0	28.8	0	10.08	18.56	19.64	51.2	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	20.08	10.08	56.24	3.14	28.8	28.8	1.0	97.17	0	0	1.0	0.0	0	6.0	29.0	0	10.08	19.01	20.10	61.3	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	8.00	7.00	2.00	5.5	20.08	10.08	71.36	6.29	29.0	29.0	1.0	248.63	0	0	1.0	0.0	0	8.0	28.5	0	10.76	17.88	18.94	81.4	0	0.0	64.8	64.8	**0.00**	**21.60**
8.00	9.00	8.50	1.00	6.5	20.76	10.76	86.82	3.14	28.5	28.5	1.0	148.15	0	0	1.0	0.0	0	9.0	11.6	52	10.76	2.94	1.68	92.2	587.8	587.8	76.6	76.6	**235.13**	**25.53**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
9.00	11.00	10.00	2.00	8.5	20.76	10.76	102.96	6.29	11.6	11.6	1.0	132.85	132.85	52	1.0	326.9	326.9	11.0	11.6	52	10.76	2.94	1.68	113.7	637.5	1097.2	100.1	559.8	**438.90**	**186.61**
11.00	12.00	11.50	1.00	9.5	20.76	10.76	119.10	3.14	11.6	11.6	1.0	76.84	209.68	52	1.0	163.4	490.3	12.0	10.0	50	10.39	2.47	1.22	124.5	600.1	1300.1	111.9	811.9	**520.04**	**270.63**
12.00	14.50	13.25	2.50	12.0	20.39	10.39	137.47	7.86	10.0	10.0	1.0	190.45	400.13	50	1.0	392.9	883.1	14.5	24.6	14	10.33	9.71	10.44	150.5	1289.5	2572.7	141.4	1424.6	**1029.10**	**474.88**
14.50	17.50	16.00	3.00	15.0	20.33	10.33	137.47	9.43	24.6	24.6	1.0	593.41	993.54	14	1.0	132.0	1015.1	17.5	26.3	11	10.03	12.93	13.88	150.5	1660.7	3669.4	176.7	2185.4	**1467.75**	**728.47**
17.50	20.50	19.00	3.00	18.0	20.03	10.03	137.47	9.43	26.3	26.3	1.0	640.58	1634.13	11	1.0	103.7	1118.9	20.5	12.4	62	10.03	3.17	1.91	150.5	821.2	3574.2	212.1	2965.0	**1429.69**	**988.35**
20.50	22.00	21.25	1.50	19.5	20.03	10.03	137.47	4.71	12.4	12.4	1.0	142.49	1776.61	62	1.0	292.3	1411.1	22.0	8.3	62	10.15	2.16	0.96	150.5	698.1	3885.8	229.7	3417.5	**1554.33**	**1139.16**
22.00	23.50	22.75	1.50	21.0	20.15	10.15	137.47	4.71	8.3	8.3	1.0	94.54	1871.16	62	1.0	292.3	1703.4	23.5	8.3	62	10.15	2.16	0.96	150.5	698.1	4272.6	247.4	3822.0	**1709.06**	**1273.99**
23.50	25.00	24.25	1.50	22.5	20.15	10.15	137.47	4.71	8.3	8.3	1.0	94.54	1965.70	62	1.0	292.3	1995.7	25.0	10.6	49	10.35	2.65	1.39	150.5	665.0	4626.4	265.1	4226.5	**1850.57**	**1408.83**
25.00	26.50	25.75	1.50	24.0	20.35	10.35	137.47	4.71	10.6	10.6	1.0	121.28	2086.98	49	1.0	231.0	2226.7	26.5	10.6	49	10.35	2.65	1.39	150.5	665.0	4978.7	282.7	4596.4	**1991.48**	**1532.15**
26.50	27.50	27.00	1.00	25.0	20.35	10.35	137.47	3.14	10.6	10.6	1.0	80.85	2167.83	49	1.0	154.0	2380.7	27.5	9.7	54	10.35	2.42	1.17	150.5	672.2	5220.8	294.5	4843.1	**2088.31**	**1614.36**
27.50	28.00	27.75	0.50	25.5	20.35	10.35	137.47	1.57	9.7	9.7	1.0	36.93	2204.76	54	1.0	84.9	2465.6	28.0	9.0	40	10.73	2.29	1.07	150.5	558.1	5228.4	300.4	4970.7	**2091.36**	**1656.91**
28.00	29.50	28.75	1.50	27.0	20.73	10.73	137.47	4.71	9.0	9.0	1.0	102.64	2307.40	40	1.0	188.6	2654.1	29.5	27.1	0	10.73	14.73	15.72	150.5	1807.4	6769.0	318.1	5279.6	**2707.59**	**1759.88**
29.50	30.00	29.75	0.50	27.5	20.73	10.73	137.47	1.57	27.1	27.1	1.0	110.54	2417.94	0	1.0	0.0	2654.1	30.0	27.1	0	10.73	14.73	15.72	150.5	1807.4	6879.5	324.0	5396.1	**2751.81**	**1798.69**
30.00	31.00	30.50	1.00	28.5	20.73	10.73	137.47	3.14	27.1	27.1	1.0	221.09	2639.03	0	1.0	0.0	2654.1	31.0	26.5	2	10.05	13.38	14.34	150.5	1652.2	6945.4	335.8	5628.9	**2778.15**	**1876.31**
31.00	32.50	31.75	1.50	30.0	20.05	10.05	137.47	4.71	26.5	26.5	1.0	323.11	2962.14	2	1.0	9.4	2663.6	32.5	12.0	46	10.05	3.06	1.79	150.5	693.9	6319.6	353.4	5979.1	**2527.83**	**1993.05**
32.50	34.00	33.25	1.50	31.5	20.05	10.05	137.47	4.71	12.0	12.0	1.0	137.75	3099.89	46	1.0	216.9	2880.4	34.0	9.5	46	10.05	2.38	1.14	150.5	611.1	6591.5	371.1	6351.4	**2636.59**	**2117.14**
34.00	35.00	34.50	1.00	32.5	20.05	10.05	137.47	3.14	9.5	9.5	1.0	72.30	3172.19	46	1.0	144.6	3025.0	35.0	9.5	48	8.75	2.38	1.14	150.5	624.7	6821.9	382.9	6580.1	**2728.76**	**2193.36**
35.00	35.50	35.25	0.50	33.0	18.75	8.75	137.47	1.57	9.5	9.5	1.0	36.15	3208.34	48	1.0	75.4	3100.4	35.5	13.0	57	9.00	3.35	2.08	150.5	806.4	7115.2	388.8	6697.5	**2846.08**	**2232.51**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
35.50	37.00	36.25	1.50	34.5	19.00	9.00	137.47	4.71	13.0	13.0	1.0	149.62	3357.96	57	1.0	268.7	3369.1	37.0	13.0	57	9.22	3.35	2.08	150.5	806.6	7533.7	406.4	7133.5	**3013.49**	**2377.85**
37.00	37.50	37.25	0.50	35.0	19.22	9.22	137.47	1.57	13.0	13.0	1.0	49.87	3407.83	57	1.0	89.6	3458.7	37.5	13.0	57	9.22	3.35	2.08	150.5	806.6	7673.2	412.3	7278.9	**3069.26**	**2426.29**
37.50	38.50	38.00	1.00	36.0	19.22	9.22	137.47	3.14	13.0	13.0	1.0	99.74	3507.57	57	1.0	179.1	3637.9	38.5	17.5	57	9.20	5.17	4.02	150.5	1028.8	8174.2	424.1	7569.5	**3269.68**	**2523.18**
38.50	40.00	39.25	1.50	37.5	19.20	9.20	137.47	4.71	17.5	17.5	1.0	204.33	3711.91	57	1.0	268.7	3906.6	40.0	17.5	57	9.20	5.17	4.02	150.5	1028.8	8647.2	441.8	8060.3	**3458.90**	**2686.75**
BORE NO: P43, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.38	9.38	25.80	1.57	11.2	11.2	1.0	8.03	0	31	1.0	48.7	0	3.0	27.3	0	9.38	15.18	16.18	28.1	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.5	19.38	9.38	37.52	6.29	27.3	27.3	1.0	121.73	0	0	1.0	0.0	0	5.0	27.3	0	9.38	15.18	16.18	46.9	619.0	619.0	29.5	29.5	**247.59**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.38	9.38	51.59	3.14	27.3	27.3	1.0	83.69	83.69	0	1.0	0.0	0.0	6.0	26.3	0	9.38	12.93	13.88	56.3	622.8	706.5	41.2	124.9	**282.59**	**41.64**
6.00	7.00	6.50	1.00	4.5	19.38	9.38	60.97	3.14	26.3	26.3	1.0	94.70	178.39	0	1.0	0.0	0.0	7.0	26.5	8	10.36	13.38	14.34	65.7	805.1	983.5	53.0	231.4	**393.39**	**77.14**
7.00	8.00	7.50	1.00	5.5	20.36	10.36	70.84	3.14	26.5	26.5	1.0	111.00	289.40	8	1.0	25.1	25.1	8.0	9.0	48	10.36	2.29	1.07	76.0	480.5	795.1	64.8	379.3	**318.03**	**126.44**
8.00	9.00	8.50	1.00	6.5	20.36	10.36	81.20	3.14	9.0	9.0	1.0	40.42	329.82	48	1.0	150.9	176.0	9.0	9.5	44	10.15	2.38	1.14	86.4	477.2	983.0	76.6	582.4	**393.22**	**194.13**
9.00	11.00	10.00	2.00	8.5	20.15	10.15	96.53	6.29	9.5	9.5	1.0	101.54	431.35	44	1.0	276.6	452.6	11.0	9.5	44	10.15	2.38	1.14	106.7	515.2	1399.1	100.1	984.1	**559.65**	**328.02**
11.00	12.00	11.50	1.00	9.5	20.15	10.15	111.76	3.14	9.5	9.5	1.0	58.78	490.13	44	1.0	138.3	590.9	12.0	8.5	55	10.65	2.20	0.99	116.8	595.0	1676.0	111.9	1192.9	**670.40**	**397.63**
12.00	14.50	13.25	2.50	12.0	20.65	10.65	130.14	7.86	8.5	8.5	1.0	152.82	642.95	55	1.0	432.1	1023.0	14.5	8.5	57	10.27	2.20	0.99	143.5	655.0	2321.0	141.4	1807.3	**928.39**	**602.44**
14.50	17.50	16.00	3.00	15.0	20.27	10.27	130.14	9.43	8.5	8.5	1.0	183.39	826.33	57	1.0	537.4	1560.4	17.5	9.3	57	10.27	2.34	1.11	143.5	671.8	3058.5	176.7	2563.5	**1223.41**	**854.49**
17.50	20.50	19.00	3.00	18.0	20.27	10.27	130.14	9.43	9.3	9.3	1.0	200.94	1027.27	57	1.0	537.4	2097.9	20.5	14.3	39	10.41	3.74	2.45	143.5	707.0	3832.1	212.1	3337.2	**1532.86**	**1112.40**
20.50	22.00	21.25	1.50	19.5	20.41	10.41	130.14	4.71	14.3	14.3	1.0	156.39	1183.66	39	1.0	183.9	2281.7	22.0	9.4	52	10.41	2.36	1.13	143.5	638.6	4103.9	229.7	3695.1	**1641.57**	**1231.70**
22.00	23.50	22.75	1.50	21.0	20.41	10.41	130.14	4.71	9.4	9.4	1.0	101.57	1285.23	52	1.0	245.1	2526.9	23.5	9.4	52	10.41	2.36	1.13	143.5	638.6	4450.6	247.4	4059.5	**1780.26**	**1353.16**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
23.50	26.50	25.00	3.00	24.0	20.41	10.41	130.14	9.43	9.4	9.4	1.0	203.14	1488.37	52	1.0	490.3	3017.1	26.5	9.4	60	10.97	2.36	1.13	143.5	695.4	5200.9	282.7	4788.3	**2080.35**	**1596.08**
26.50	27.50	27.00	1.00	25.0	20.97	10.97	130.14	3.14	9.4	9.4	1.0	67.71	1556.08	60	1.0	188.6	3205.7	27.5	9.2	62	10.97	2.33	1.10	143.5	705.3	5467.1	294.5	5056.3	**2186.85**	**1685.44**
27.50	29.50	28.50	2.00	27.0	20.97	10.97	130.14	6.29	9.2	9.2	1.0	132.49	1688.57	62	1.0	389.7	3595.4	29.5	9.2	62	10.97	2.33	1.10	143.5	705.3	5989.3	318.1	5602.1	**2395.73**	**1867.36**
29.50	30.00	29.75	0.50	27.5	20.97	10.97	130.14	1.57	9.2	9.2	1.0	33.12	1721.70	62	1.0	97.4	3692.9	30.0	10.8	46	9.62	2.71	1.45	143.5	635.7	6050.2	324.0	5738.5	**2420.09**	**1912.84**
30.00	32.50	31.25	2.50	30.0	19.62	9.62	130.14	7.86	10.8	10.8	1.0	195.06	1916.76	46	1.0	361.4	4054.3	32.5	29.4	0	9.62	19.91	21.02	143.5	2323.4	8294.4	353.4	6324.5	**3317.78**	**2108.16**
32.50	34.00	33.25	1.50	31.5	19.62	9.62	130.14	4.71	29.4	29.4	1.0	345.71	2262.46	0	1.0	0.0	4054.3	34.0	29.4	0	9.62	19.91	21.02	143.5	2323.4	8640.1	371.1	6687.8	**3456.06**	**2229.28**
34.00	35.00	34.50	1.00	32.5	19.62	9.62	130.14	3.14	29.4	29.4	1.0	230.47	2492.93	0	1.0	0.0	4054.3	35.0	27.8	0	10.29	16.31	17.33	143.5	1907.9	8455.1	382.9	6930.1	**3382.05**	**2310.03**
35.00	35.50	35.25	0.50	33.0	20.29	10.29	130.14	1.57	27.8	27.8	1.0	107.83	2600.76	0	1.0	0.0	4054.3	35.5	27.8	0	10.29	16.31	17.33	143.5	1907.9	8563.0	388.8	7043.8	**3425.18**	**2347.94**
35.50	37.00	36.25	1.50	34.5	20.29	10.29	130.14	4.71	27.8	27.8	1.0	323.48	2924.24	0	1.0	0.0	4054.3	37.0	25.4	18	10.29	10.90	11.80	143.5	1403.7	8382.2	406.4	7385.0	**3352.88**	**2461.65**
37.00	37.50	37.25	0.50	35.0	20.29	10.29	130.14	1.57	25.4	25.4	1.0	97.11	3021.34	18	1.0	28.3	4082.6	37.5	25.4	18	10.29	10.90	11.80	143.5	1403.7	8507.6	412.3	7516.2	**3403.03**	**2505.42**
37.50	38.50	38.00	1.00	36.0	20.29	10.29	130.14	3.14	25.4	25.4	1.0	194.22	3215.56	18	1.0	56.6	4139.1	38.5	21.2	36	10.29	7.26	6.71	143.5	1100.4	8455.1	424.1	7778.8	**3382.06**	**2592.94**
38.50	40.00	39.25	1.50	37.5	20.29	10.29	130.14	4.71	21.2	21.2	1.0	237.97	3453.53	36	1.0	169.7	4308.9	40.0	21.2	36	10.29	7.26	6.71	143.5	1100.4	8862.8	441.8	8204.2	**3545.13**	**2734.73**
BORE NO: P44, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.75	10.75	29.56	1.57	18.0	18.0	1.0	15.09	0	33	1.0	51.9	0	3.0	26.7	5	9.39	13.83	14.80	32.3	440.3	440.3	5.9	5.9	**176.14**	**1.96**
3.00	5.00	4.00	2.00	2.5	19.39	9.39	41.64	6.29	26.7	26.7	1.0	131.64	131.64	5	1.0	31.4	31.4	5.0	26.7	5	9.39	13.83	14.80	51.0	644.4	807.5	29.5	192.5	**322.98**	**64.17**
5.00	6.00	5.50	1.00	3.5	19.39	9.39	55.73	3.14	26.7	26.7	1.0	88.08	219.72	5	1.0	15.7	47.1	6.0	25.8	0	9.39	11.80	12.72	60.4	607.2	874.1	41.2	308.1	**349.62**	**102.70**
6.00	7.00	6.50	1.00	4.5	19.39	9.39	65.12	3.14	25.8	25.8	1.0	98.93	318.65	0	1.0	0.0	47.1	7.0	26.2	8	10.09	12.70	13.64	69.8	807.4	1173.2	53.0	418.8	**469.27**	**139.60**
7.00	8.00	7.50	1.00	5.5	20.09	10.09	74.86	3.14	26.2	26.2	1.0	115.76	434.42	8	1.0	25.1	72.3	8.0	26.2	8	10.09	12.70	13.64	79.9	908.1	1414.8	64.8	571.5	**565.92**	**190.50**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
8.00	9.00	8.50	1.00	6.5	20.09	10.09	84.95	3.14	26.2	26.2	1.0	131.37	565.78	8	1.0	25.1	97.4	9.0	8.6	58	9.04	2.22	1.00	90.0	570.5	1233.7	76.6	739.8	**493.50**	**246.60**
9.00	11.00	10.00	2.00	8.5	19.04	9.04	99.03	6.29	8.6	8.6	1.0	94.14	659.92	58	1.0	364.6	462.0	11.0	8.6	58	9.04	2.22	1.00	108.1	602.0	1724.0	100.1	1222.1	**689.59**	**407.35**
11.00	12.00	11.50	1.00	9.5	19.04	9.04	112.59	3.14	8.6	8.6	1.0	53.52	713.44	58	1.0	182.3	644.3	12.0	9.8	57	10.61	2.43	1.19	117.1	632.0	1989.7	111.9	1469.6	**795.89**	**489.88**
12.00	14.50	13.25	2.50	12.0	20.61	10.61	130.37	7.86	9.8	9.8	1.0	176.94	890.37	57	1.0	447.9	1092.1	14.5	9.8	57	10.61	2.43	1.19	143.6	682.7	2665.2	141.4	2123.9	**1066.09**	**707.96**
14.50	17.50	16.00	3.00	15.0	20.61	10.61	130.37	9.43	9.8	9.8	1.0	212.32	1102.70	57	1.0	537.4	1629.6	17.5	9.5	52	10.18	2.38	1.14	143.6	640.9	3373.2	176.7	2909.0	**1349.26**	**969.66**
17.50	20.50	19.00	3.00	18.0	20.18	10.18	130.37	9.43	9.5	9.5	1.0	205.70	1308.40	52	1.0	490.3	2119.9	20.5	9.5	52	10.18	2.38	1.14	143.6	640.9	4069.1	212.1	3640.3	**1627.66**	**1213.44**
20.50	23.50	22.00	3.00	21.0	20.18	10.18	130.37	9.43	9.5	9.5	1.0	205.70	1514.10	52	1.0	490.3	2610.1	23.5	13.7	23	10.55	3.56	2.28	143.6	573.9	4698.1	247.4	4371.6	**1879.24**	**1457.22**
23.50	25.00	24.25	1.50	22.5	20.55	10.55	130.37	4.71	13.7	13.7	1.0	149.83	1663.93	23	1.0	108.4	2718.6	25.0	10.2	55	10.55	2.53	1.28	143.6	679.6	5062.1	265.1	4647.6	**2024.85**	**1549.19**
25.00	26.50	25.75	1.50	24.0	20.55	10.55	130.37	4.71	10.2	10.2	1.0	110.59	1774.52	55	1.0	259.3	2977.9	26.5	9.9	50	10.55	2.45	1.20	143.6	635.3	5387.7	282.7	5035.1	**2155.06**	**1678.37**
26.50	27.50	27.00	1.00	25.0	20.55	10.55	130.37	3.14	9.9	9.9	1.0	71.51	1846.03	50	1.0	157.1	3135.0	27.5	9.9	50	10.55	2.45	1.20	143.6	635.3	5616.3	294.5	5275.6	**2246.53**	**1758.52**
27.50	28.00	27.75	0.50	25.5	20.55	10.55	130.37	1.57	9.9	9.9	1.0	35.76	1881.78	50	1.0	78.6	3213.6	28.0	28.5	2	9.71	17.88	18.94	143.6	2104.5	7199.8	300.4	5395.8	**2879.93**	**1798.59**
28.00	29.50	28.75	1.50	27.0	19.71	9.71	130.37	4.71	28.5	28.5	1.0	333.71	2215.49	2	1.0	9.4	3223.0	29.5	24.5	20	9.71	9.64	10.33	143.6	1268.8	6707.3	318.1	5756.6	**2682.90**	**1918.86**
29.50	30.00	29.75	0.50	27.5	19.71	9.71	130.37	1.57	24.5	24.5	1.0	93.37	2308.86	20	1.0	31.4	3254.4	30.0	24.0	20	9.71	9.28	9.78	143.6	1226.0	6789.3	324.0	5887.3	**2715.73**	**1962.42**
30.00	31.00	30.50	1.00	28.5	19.71	9.71	130.37	3.14	24.0	24.0	1.0	182.43	2491.28	20	1.0	62.9	3317.3	31.0	28.2	0	9.71	17.21	18.25	143.6	2011.4	7820.0	335.8	6144.3	**3128.00**	**2048.11**
31.00	32.50	31.75	1.50	30.0	19.71	9.71	130.37	4.71	28.2	28.2	1.0	329.55	2820.84	0	1.0	0.0	3317.3	32.5	20.3	25	7.75	6.62	5.72	143.6	940.9	7079.0	353.4	6491.6	**2831.59**	**2163.85**
32.50	34.00	33.25	1.50	31.5	17.75	7.75	130.37	4.71	20.3	20.3	1.0	227.35	3048.19	25	1.0	117.9	3435.1	34.0	18.0	39	8.11	5.42	4.29	143.6	900.7	7384.0	371.1	6854.4	**2953.61**	**2284.81**
34.00	35.00	34.50	1.00	32.5	18.11	8.11	130.37	3.14	18.0	18.0	1.0	133.13	3181.32	39	1.0	122.6	3557.7	35.0	18.0	39	8.11	5.42	4.29	143.6	900.7	7639.7	382.9	7121.9	**3055.89**	**2373.97**
35.00	35.50	35.25	0.50	33.0	18.11	8.11	130.37	1.57	18.0	18.0	1.0	66.57	3247.89	39	1.0	61.3	3619.0	35.5	29.1	0	8.11	19.23	20.33	143.6	2235.3	9102.2	388.8	7255.7	**3640.88**	**2418.55**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
35.50	37.00	36.25	1.50	34.5	18.11	8.11	130.37	4.71	29.1	29.1	1.0	342.09	3589.98	0	1.0	0.0	3619.0	37.0	29.1	0	7.75	19.23	20.33	143.6	2232.4	9441.4	406.4	7615.4	**3776.56**	**2538.47**
37.00	37.50	37.25	0.50	35.0	17.75	7.75	130.37	1.57	29.1	29.1	1.0	114.03	3704.01	0	1.0	0.0	3619.0	37.5	28.9	0	7.75	18.78	19.87	143.6	2180.2	9503.2	412.3	7735.3	**3801.28**	**2578.45**
37.50	38.50	38.00	1.00	36.0	17.75	7.75	130.37	3.14	28.9	28.9	1.0	226.19	3930.20	0	1.0	0.0	3619.0	38.5	20.7	39	8.08	6.90	6.16	143.6	1074.5	8623.7	424.1	7973.3	**3449.48**	**2657.77**
38.50	40.00	39.25	1.50	37.5	18.08	8.08	130.37	4.71	20.7	20.7	1.0	232.24	4162.44	39	1.0	183.9	3802.9	40.0	20.7	39	8.08	6.90	6.16	143.6	1074.5	9039.8	441.8	8407.1	**3615.92**	**2802.36**
BORE NO: P45, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.47	9.47	26.04	1.57	9.2	9.2	1.0	6.63	0	50	1.0	78.6	0	3.0	9.2	50	9.47	2.33	1.10	28.4	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.5	19.47	9.47	33.15	3.14	9.2	9.2	1.0	16.87	0	50	1.0	157.1	0	4.0	27.2	0	9.60	14.95	15.95	37.9	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.5	19.60	9.60	42.68	3.14	27.2	27.2	1.0	68.94	0	0	1.0	0.0	0	5.0	28.1	0	9.60	16.98	18.02	47.5	701.5	701.5	29.5	29.5	**280.58**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.60	9.60	52.28	3.14	28.1	28.1	1.0	87.73	87.73	0	1.0	0.0	0.0	6.0	28.1	0	9.70	16.98	18.02	57.1	830.2	918.0	41.2	129.0	**367.19**	**42.99**
6.00	8.00	7.00	2.00	5.5	19.70	9.70	66.78	6.29	28.1	28.1	1.0	224.13	311.86	0	1.0	0.0	0.0	8.0	28.1	0	9.70	16.98	18.02	76.5	1089.1	1400.9	64.8	376.7	**560.38**	**125.55**
8.00	9.00	8.50	1.00	6.5	19.70	9.70	81.33	3.14	28.1	28.1	1.0	136.48	448.35	0	1.0	0.0	0.0	9.0	27.4	0	9.70	15.40	16.41	86.2	1105.6	1554.0	76.6	524.9	**621.59**	**174.97**
9.00	10.00	9.50	1.00	7.5	19.70	9.70	91.03	3.14	27.4	27.4	1.0	148.30	596.64	0	1.0	0.0	0.0	10.0	12.3	47	10.17	3.15	1.88	95.9	576.8	1173.5	88.4	685.0	**469.39**	**228.33**
10.00	11.00	10.50	1.00	8.5	20.17	10.17	100.97	3.14	12.3	12.3	1.0	69.19	665.83	47	1.0	147.7	147.7	11.0	10.9	55	10.17	2.73	1.48	106.1	622.7	1436.2	100.1	913.7	**574.49**	**304.56**
11.00	12.00	11.50	1.00	9.5	20.17	10.17	111.14	3.14	10.9	10.9	1.0	67.26	733.09	55	1.0	172.9	320.6	12.0	12.0	69	10.42	3.06	1.79	116.2	774.5	1828.2	111.9	1165.6	**731.27**	**388.53**
12.00	14.50	13.25	2.50	12.0	20.42	10.42	129.25	7.86	12.0	12.0	1.0	215.85	948.94	69	1.0	542.1	862.7	14.5	9.3	59	10.57	2.34	1.11	142.3	683.9	2495.5	141.4	1953.0	**998.20**	**651.01**
14.50	17.50	16.00	3.00	15.0	20.57	10.57	129.25	9.43	9.3	9.3	1.0	199.55	1148.49	59	1.0	556.3	1419.0	17.5	11.2	57	10.50	2.82	1.56	142.3	725.1	3292.6	176.7	2744.2	**1317.02**	**914.74**
17.50	20.50	19.00	3.00	18.0	20.50	10.50	129.25	9.43	11.2	11.2	1.0	241.29	1389.78	57	1.0	537.4	1956.4	20.5	8.2	61	10.36	2.15	0.94	142.3	675.1	4021.3	212.1	3558.3	**1608.52**	**1186.09**
20.50	23.50	22.00	3.00	21.0	20.36	10.36	129.25	9.43	8.2	8.2	1.0	175.60	1565.38	61	1.0	575.1	2531.6	23.5	10.4	55	10.50	2.59	1.33	142.3	683.7	4780.6	247.4	4344.4	**1912.26**	**1448.12**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
23.50	26.50	25.00	3.00	24.0	20.50	10.50	129.25	9.43	10.4	10.4	1.0	223.65	1789.04	55	1.0	518.6	3050.1	26.5	13.3	41	10.50	3.44	2.16	142.3	683.4	5522.6	282.7	5121.9	**2209.03**	**1707.31**
26.50	27.50	27.00	1.00	25.0	20.50	10.50	129.25	3.14	13.3	13.3	1.0	96.02	1885.06	41	1.0	128.9	3179.0	27.5	13.3	41	10.50	3.44	2.16	142.3	683.4	5747.4	294.5	5358.6	**2298.98**	**1786.19**
27.50	28.00	27.75	0.50	25.5	20.50	10.50	129.25	1.57	13.3	13.3	1.0	48.01	1933.07	41	1.0	64.4	3243.4	28.0	12.3	77	10.40	3.15	1.88	142.3	903.8	6080.3	300.4	5476.9	**2432.12**	**1825.64**
28.00	29.50	28.75	1.50	27.0	20.40	10.40	129.25	4.71	12.3	12.3	1.0	132.85	2065.92	77	1.0	363.0	3606.4	29.5	12.3	77	10.40	3.15	1.88	142.3	903.8	6576.1	318.1	5990.4	**2630.46**	**1996.81**
29.50	30.00	29.75	0.50	27.5	20.40	10.40	129.25	1.57	12.3	12.3	1.0	44.28	2110.20	77	1.0	121.0	3727.4	30.0	12.3	77	10.40	3.15	1.88	142.3	903.8	6741.4	324.0	6161.6	**2696.57**	**2053.87**
30.00	31.00	30.50	1.00	28.5	20.40	10.40	129.25	3.14	12.3	12.3	1.0	88.57	2198.77	77	1.0	242.0	3969.4	31.0	12.3	77	10.40	3.15	1.88	142.3	903.8	7072.0	335.8	6504.0	**2828.80**	**2167.98**
31.00	32.50	31.75	1.50	30.0	20.40	10.40	129.25	4.71	12.3	12.3	1.0	132.85	2331.62	77	1.0	363.0	4332.4	32.5	12.0	30	10.07	3.06	1.79	142.3	561.1	7225.1	353.4	7017.5	**2890.04**	**2339.16**
32.50	35.00	33.75	2.50	32.5	20.07	10.07	129.25	7.86	12.0	12.0	1.0	215.85	2547.47	30	1.0	235.7	4568.1	35.0	20.1	14	10.07	6.47	5.50	142.3	844.2	7959.8	382.9	7498.5	**3183.93**	**2499.50**
35.00	35.50	35.25	0.50	33.0	20.07	10.07	129.25	1.57	20.1	20.1	1.0	74.32	2621.79	14	1.0	22.0	4590.1	35.5	20.0	14	10.07	6.40	5.39	142.3	835.7	8047.7	388.8	7600.7	**3219.07**	**2533.57**
35.50	37.00	36.25	1.50	34.5	20.07	10.07	129.25	4.71	20.0	20.0	1.0	221.77	2843.56	14	1.0	66.0	4656.1	37.0	23.0	10	10.07	8.56	8.68	142.3	1061.9	8561.6	406.4	7906.1	**3424.65**	**2635.38**
37.00	37.50	37.25	0.50	35.0	20.07	10.07	129.25	1.57	23.0	23.0	1.0	86.21	2929.77	10	1.0	15.7	4671.9	37.5	23.0	0	8.77	8.56	8.68	142.3	986.8	8588.4	412.3	8014.0	**3435.36**	**2671.32**
37.50	38.50	38.00	1.00	36.0	18.77	8.77	129.25	3.14	23.0	23.0	1.0	172.42	3102.19	0	1.0	0.0	4671.9	38.5	19.8	35	8.81	6.29	5.28	142.3	969.3	8743.3	424.1	8198.2	**3497.34**	**2732.72**
38.50	40.00	39.25	1.50	37.5	18.81	8.81	129.25	4.71	19.8	19.8	1.0	219.36	3321.55	35	1.0	165.0	4836.9	40.0	19.8	35	8.81	6.29	5.28	142.3	969.3	9127.7	441.8	8600.2	**3651.08**	**2866.73**
BORE NO: P46, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.42	9.42	25.91	1.57	26.3	26.3	1.0	20.12	0	1	1.0	1.6	0	3.0	26.3	1	9.42	12.93	13.88	28.3	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.5	19.42	9.42	32.97	3.14	26.3	26.3	1.0	51.21	0	1	1.0	3.1	0	4.0	26.3	1	10.02	12.93	13.88	37.7	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.5	20.02	10.02	42.69	3.14	26.3	26.3	1.0	66.31	0	1	1.0	3.1	0	5.0	29.5	0	10.02	20.13	21.25	47.7	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	20.02	10.02	52.71	3.14	29.5	29.5	1.0	93.73	0	0	1.0	0.0	0	6.0	29.5	0	8.96	20.13	21.25	57.7	0	0.0	41.2	41.2	**0.00**	**13.74**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
6.00	8.00	7.00	2.00	5.5	18.96	8.96	66.68	6.29	29.5	29.5	1.0	237.13	0	0	1.0	0.0	0	8.0	29.5	0	8.96	20.13	21.25	75.6	0	0.0	64.8	64.8	**0.00**	**21.60**
8.00	9.00	8.50	1.00	6.5	18.96	8.96	80.12	3.14	29.5	29.5	1.0	142.46	0	0	1.0	0.0	0	9.0	10.2	47	10.24	2.53	1.28	84.6	505.6	505.6	76.6	76.6	**202.24**	**25.53**
9.00	11.00	10.00	2.00	8.5	20.24	10.24	94.84	6.29	10.2	10.2	1.0	107.26	107.26	47	1.0	295.4	295.4	11.0	10.2	47	10.24	2.53	1.28	105.1	546.3	949.0	100.1	502.8	**379.59**	**167.61**
11.00	12.00	11.50	1.00	9.5	20.24	10.24	110.20	3.14	10.2	10.2	1.0	62.32	169.58	47	1.0	147.7	443.1	12.0	9.2	57	10.43	2.33	1.10	115.3	618.3	1231.0	111.9	724.6	**492.42**	**241.55**
12.00	14.50	13.25	2.50	12.0	20.43	10.43	128.36	7.86	9.2	9.2	1.0	163.35	332.92	57	1.0	447.9	891.0	14.5	9.2	57	10.43	2.33	1.10	141.4	666.0	1889.9	141.4	1365.3	**755.96**	**455.10**
14.50	16.00	15.25	1.50	13.5	20.43	10.43	128.36	4.71	9.2	9.2	1.0	98.01	430.93	57	1.0	268.7	1159.7	16.0	26.2	7	10.15	12.70	13.64	141.4	1515.1	3105.7	159.0	1749.7	**1242.29**	**583.23**
16.00	17.50	16.75	1.50	15.0	20.15	10.15	128.36	4.71	26.2	26.2	1.0	297.75	728.68	7	1.0	33.0	1192.7	17.5	26.2	7	10.15	12.70	13.64	141.4	1515.1	3436.5	176.7	2098.1	**1374.59**	**699.37**
17.50	19.00	18.25	1.50	16.5	20.15	10.15	128.36	4.71	26.2	26.2	1.0	297.75	1026.44	7	1.0	33.0	1225.7	19.0	10.7	48	10.17	2.68	1.42	141.4	642.4	2894.5	194.4	2446.5	**1157.81**	**815.51**
19.00	20.50	19.75	1.50	18.0	20.17	10.17	128.36	4.71	10.7	10.7	1.0	114.34	1140.77	48	1.0	226.3	1452.0	20.5	10.0	52	10.34	2.47	1.22	141.4	647.1	3239.9	212.1	2804.8	**1295.94**	**934.94**
20.50	23.50	22.00	3.00	21.0	20.34	10.34	128.36	9.43	10.0	10.0	1.0	213.40	1354.17	52	1.0	490.3	1942.3	23.5	16.5	30	10.34	4.68	3.47	141.4	746.0	4042.4	247.4	3543.9	**1616.96**	**1181.29**
23.50	25.00	24.25	1.50	22.5	20.34	10.34	128.36	4.71	16.5	16.5	1.0	179.24	1533.41	30	1.0	141.4	2083.7	25.0	9.5	50	10.34	2.38	1.14	141.4	622.6	4239.8	265.1	3882.2	**1695.90**	**1294.07**
25.00	26.50	25.75	1.50	24.0	20.34	10.34	128.36	4.71	9.5	9.5	1.0	101.26	1634.67	50	1.0	235.7	2319.4	26.5	9.5	50	9.38	2.38	1.14	141.4	622.2	4576.3	282.7	4236.8	**1830.52**	**1412.28**
26.50	27.50	27.00	1.00	25.0	19.38	9.38	128.36	3.14	9.5	9.5	1.0	67.51	1702.18	50	1.0	157.1	2476.6	27.5	9.5	50	9.38	2.38	1.14	141.4	622.2	4800.9	294.5	4473.3	**1920.38**	**1491.09**
27.50	28.00	27.75	0.50	25.5	19.38	9.38	128.36	1.57	9.5	9.5	1.0	33.75	1735.94	50	1.0	78.6	2555.1	28.0	7.3	72	9.86	1.98	0.80	141.4	732.7	5023.8	300.4	4591.5	**2009.50**	**1530.50**
28.00	29.50	28.75	1.50	27.0	19.86	9.86	128.36	4.71	7.3	7.3	1.0	77.52	1813.45	72	1.0	339.4	2894.6	29.5	30.0	0	8.36	21.26	22.40	141.4	2435.4	7143.4	318.1	5026.1	**2857.38**	**1675.37**
29.50	30.00	29.75	0.50	27.5	18.36	8.36	128.36	1.57	30.0	30.0	1.0	116.45	1929.91	0	1.0	0.0	2894.6	30.0	30.0	0	11.65	21.26	22.40	141.4	2464.4	7288.8	324.0	5148.5	**2915.54**	**1716.15**
30.00	31.00	30.50	1.00	28.5	21.65	11.65	128.36	3.14	30.0	30.0	1.0	232.91	2162.82	0	1.0	0.0	2894.6	31.0	28.7	0	11.65	18.33	19.40	141.4	2125.4	7182.8	335.8	5393.1	**2873.13**	**1797.71**
31.00	32.50	31.75	1.50	30.0	21.65	11.65	128.36	4.71	28.7	28.7	1.0	331.29	2494.11	0	1.0	0.0	2894.6	32.5	34.2	0	11.65	42.42	43.93	141.4	4913.4	10302.1	353.4	5742.1	**4120.83**	**1914.04**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
32.50	35.00	33.75	2.50	32.5	21.65	11.65	128.36	7.86	34.2	34.2	1.2	829.32	3323.43	0	1.0	0.0	2894.6	35.0	33.4	0	11.65	38.39	39.83	141.4	4446.9	10664.9	382.9	6600.9	**4265.96**	**2200.29**
35.00	35.50	35.25	0.50	33.0	21.65	11.65	128.36	1.57	33.4	33.4	1.2	155.61	3479.04	0	1.0	0.0	2894.6	35.5	33.4	0	11.65	38.39	39.83	141.4	4446.9	10820.5	388.8	6762.4	**4328.21**	**2254.13**
35.50	37.50	36.50	2.00	35.0	21.65	11.65	128.36	6.29	33.4	33.4	1.2	622.44	4101.48	0	1.0	0.0	2894.6	37.5	33.6	0	9.47	39.39	40.85	141.4	4528.5	11524.6	412.3	7408.4	**4609.84**	**2469.46**
37.50	38.50	38.00	1.00	36.0	19.47	9.47	128.36	3.14	33.6	33.6	1.2	316.27	4417.75	0	1.0	0.0	2894.6	38.5	34.1	0	9.44	41.91	43.42	141.4	4817.4	12129.7	424.1	7736.4	**4851.88**	**2578.81**
38.50	40.00	39.25	1.50	37.5	19.44	9.44	128.36	4.71	34.1	34.1	1.2	493.68	4911.43	0	1.0	0.0	2894.6	40.0	34.1	0	9.44	41.91	43.42	141.4	4817.4	12623.4	441.8	8247.8	**5049.35**	**2749.26**
BORE NO: P47, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	18.89	8.89	24.45	1.57	13.5	13.5	1.0	9.22	0	18	1.0	28.3	0	3.0	9.0	41	8.89	2.29	1.07	26.7	341.6	341.6	5.9	5.9	**136.66**	**1.96**
3.00	4.00	3.50	1.00	1.5	18.89	8.89	31.12	3.14	9.0	9.0	1.0	15.49	15.49	41	1.0	128.9	128.9	4.0	27.4	0	8.89	15.40	16.41	35.6	487.7	632.1	17.7	162.0	**252.82**	**54.01**
4.00	6.00	5.00	2.00	3.5	18.89	8.89	44.45	6.29	27.4	27.4	1.0	144.83	160.32	0	1.0	0.0	128.9	6.0	28.2	0	8.89	17.21	18.25	53.3	784.9	1074.0	41.2	330.4	**429.61**	**110.14**
6.00	7.00	6.50	1.00	4.5	18.89	8.89	57.79	3.14	28.2	28.2	1.0	97.38	257.69	0	1.0	0.0	128.9	7.0	28.2	0	9.35	17.21	18.25	62.2	908.3	1294.9	53.0	439.6	**517.96**	**146.52**
7.00	9.00	8.00	2.00	6.5	19.35	9.35	71.58	6.29	28.2	28.2	1.0	241.25	498.95	0	1.0	0.0	128.9	9.0	28.2	0	9.35	17.21	18.25	80.9	1161.1	1788.9	76.6	704.4	**715.58**	**234.79**
9.00	10.00	9.50	1.00	7.5	19.35	9.35	85.61	3.14	28.2	28.2	1.0	144.26	643.21	0	1.0	0.0	128.9	10.0	27.4	0	9.35	15.40	16.41	90.3	1153.0	1925.1	88.4	860.4	**770.02**	**286.81**
10.00	11.00	10.50	1.00	8.5	19.35	9.35	94.96	3.14	27.4	27.4	1.0	154.69	797.90	0	1.0	0.0	128.9	11.0	9.1	50	10.17	2.31	1.08	99.6	538.6	1465.3	100.1	1026.9	**586.13**	**342.30**
11.00	12.50	11.75	1.50	10.0	20.17	10.17	107.26	4.71	9.1	9.1	1.0	80.99	878.89	50	1.0	235.7	364.6	12.5	9.1	50	10.17	2.31	1.08	114.9	566.2	1809.7	117.8	1361.3	**723.87**	**453.76**
12.50	14.00	13.25	1.50	11.5	20.17	10.17	122.51	4.71	9.1	9.1	1.0	92.51	971.40	50	1.0	235.7	600.3	14.0	27.2	0	10.17	14.95	15.95	130.1	1592.8	3164.5	135.5	1707.2	**1265.81**	**569.05**
14.00	15.50	14.75	1.50	13.0	20.17	10.17	137.77	4.71	27.2	27.2	1.0	333.78	1305.18	0	1.0	0.0	600.3	15.5	9.0	51	10.32	2.29	1.07	130.1	599.1	2504.6	153.2	2058.6	**1001.84**	**686.21**
15.50	17.00	16.25	1.50	14.5	20.32	10.32	137.77	4.71	9.0	9.0	1.0	102.87	1408.05	51	1.0	240.4	840.7	17.0	10.4	54	10.32	2.59	1.33	130.1	651.9	2900.6	170.8	2419.6	**1160.25**	**806.53**
17.00	18.50	17.75	1.50	16.0	20.32	10.32	137.77	4.71	10.4	10.4	1.0	119.20	1527.25	54	1.0	254.6	1095.3	18.5	10.4	54	10.19	2.59	1.33	130.1	651.8	3274.3	188.5	2811.0	**1309.73**	**937.01**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	∑Qi	c	α	α.c.Asi	∑Qi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
18.50	21.50	20.00	3.00	19.0	20.19	10.19	137.77	9.43	10.4	10.4	1.0	238.40	1765.65	54	1.0	509.1	1604.4	21.5	10.6	53	10.49	2.65	1.39	130.1	651.1	4021.2	223.8	3593.9	**1608.48**	**1197.97**
21.50	24.50	23.00	3.00	22.0	20.49	10.49	137.77	9.43	10.6	10.6	1.0	243.09	2008.74	53	1.0	499.7	2104.1	24.5	9.4	63	10.49	2.36	1.13	130.1	691.7	4804.6	259.2	4372.1	**1921.82**	**1457.36**
24.50	26.00	25.25	1.50	23.5	20.49	10.49	137.77	4.71	9.4	9.4	1.0	107.52	2116.26	63	1.0	297.0	2401.1	26.0	17.6	20	10.49	5.22	4.07	130.1	691.9	5209.3	276.9	4794.3	**2083.72**	**1598.09**
26.00	27.50	26.75	1.50	25.0	20.49	10.49	137.77	4.71	17.6	17.6	1.0	206.03	2322.29	20	1.0	94.3	2495.4	27.5	17.6	20	10.16	5.22	4.07	130.1	691.4	5509.1	294.5	5112.2	**2203.64**	**1704.08**
27.50	29.00	28.25	1.50	26.5	20.16	10.16	137.77	4.71	17.6	17.6	1.0	206.03	2528.32	20	1.0	94.3	2589.7	29.0	11.6	57	10.16	2.94	1.68	130.1	710.4	5828.5	312.2	5430.2	**2331.38**	**1810.08**
29.00	30.00	29.50	1.00	27.5	20.16	10.16	137.77	3.14	11.6	11.6	1.0	88.88	2617.19	57	1.0	179.1	2768.9	30.0	12.0	50	10.16	3.06	1.79	130.1	673.4	6059.5	324.0	5710.0	**2423.79**	**1903.34**
30.00	30.50	30.25	0.50	28.0	20.16	10.16	137.77	1.57	12.0	12.0	1.0	46.02	2663.21	50	1.0	78.6	2847.4	30.5	31.6	0	10.16	29.32	30.60	130.1	3120.1	8630.8	329.9	5840.5	**3452.31**	**1946.84**
30.50	32.50	31.50	2.00	30.0	20.16	10.16	137.77	6.29	31.6	31.6	1.1	575.37	3238.58	0	1.0	0.0	2847.4	32.5	30.9	0	10.86	25.79	27.01	130.1	2752.7	8838.7	353.4	6439.4	**3535.47**	**2146.48**
32.50	33.50	33.00	1.00	31.0	20.86	10.86	137.77	3.14	30.9	30.9	1.0	270.80	3509.37	0	1.0	0.0	2847.4	33.5	30.9	0	10.86	25.79	27.01	130.1	2752.7	9109.5	365.2	6722.0	**3643.79**	**2240.67**
33.50	35.00	34.25	1.50	32.5	20.86	10.86	137.77	4.71	30.9	30.9	1.0	406.19	3915.57	0	1.0	0.0	2847.4	35.0	30.6	0	10.76	24.28	25.48	130.1	2590.6	9353.6	382.9	7145.9	**3741.44**	**2381.96**
35.00	36.50	35.75	1.50	34.0	20.76	10.76	137.77	4.71	30.6	30.6	1.0	395.62	4311.19	0	1.0	0.0	2847.4	36.5	30.6	0	10.76	24.28	25.48	130.1	2590.6	9749.2	400.6	7559.2	**3899.68**	**2519.72**
36.50	37.50	37.00	1.00	35.0	20.76	10.76	137.77	3.14	30.6	30.6	1.0	263.75	4574.94	0	1.0	0.0	2847.4	37.5	30.1	0	10.76	21.76	22.91	130.1	2322.2	9744.6	412.3	7834.7	**3897.83**	**2611.57**
37.50	38.00	37.75	0.50	35.5	20.76	10.76	137.77	1.57	30.1	30.1	1.0	126.12	4701.06	0	1.0	0.0	2847.4	38.0	30.1	0	9.83	21.76	22.91	130.1	2313.8	9862.3	418.2	7966.7	**3944.93**	**2655.57**
38.00	40.00	39.00	2.00	37.5	19.83	9.83	137.77	6.29	30.1	30.1	1.0	504.49	5205.55	0	1.0	0.0	2847.4	40.0	30.1	0	9.83	21.76	22.91	130.1	2313.8	10366.8	441.8	8494.8	**4146.73**	**2831.59**
BORE NO: P48, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.10	10.10	27.78	1.57	27.6	27.6	1.0	22.82	0	3	1.0	4.7	0	3.0	7.2	43	10.10	1.97	0.79	30.3	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.5	20.10	10.10	35.35	3.14	7.2	7.2	1.0	14.04	0	43	1.0	135.1	0	4.0	25.9	0	10.00	12.03	12.95	40.4	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	6.00	5.00	2.00	3.5	20.00	10.00	50.40	6.29	25.9	25.9	1.0	153.83	0	0	1.0	0.0	0	6.0	25.9	0	10.00	12.03	12.95	60.4	0	0.0	41.2	41.2	**0.00**	**13.74**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
6.00	7.00	6.50	1.00	4.5	20.00	10.00	65.40	3.14	25.9	25.9	1.0	99.81	0	0	1.0	0.0	0	7.0	24.9	0	10.00	9.93	10.77	70.4	0	0.0	53.0	53.0	**0.00**	**17.67**
7.00	9.00	8.00	2.00	6.5	20.00	10.00	80.40	6.29	24.9	24.9	1.0	234.59	0	0	1.0	0.0	0	9.0	14.3	20	10.21	3.74	2.45	90.4	0	0.0	76.6	76.6	**0.00**	**25.53**
9.00	10.00	9.50	1.00	7.5	20.21	10.21	95.51	3.14	14.3	14.3	1.0	76.51	0	20	1.0	62.9	0	10.0	11.0	55	10.21	2.76	1.51	100.6	613.5	613.5	88.4	88.4	**245.39**	**29.45**
10.00	12.50	11.25	2.50	10.0	20.21	10.21	113.37	7.86	11.0	11.0	1.0	173.15	173.15	55	1.0	432.1	432.1	12.5	9.8	55	10.21	2.43	1.19	126.1	634.9	1240.2	117.8	723.1	**496.09**	**241.03**
12.50	14.00	13.25	1.50	11.5	20.21	10.21	133.79	4.71	9.8	9.8	1.0	108.95	282.10	55	1.0	259.3	691.4	14.0	11.2	71	10.64	2.82	1.56	141.5	822.3	1795.9	135.5	1109.0	**718.34**	**369.67**
14.00	15.50	14.75	1.50	13.0	20.64	10.64	149.43	4.71	11.2	11.2	1.0	139.49	421.58	71	1.0	334.7	1026.1	15.5	11.2	71	10.64	2.82	1.56	141.5	822.3	2270.1	153.2	1600.9	**908.02**	**533.63**
15.50	17.00	16.25	1.50	14.5	20.64	10.64	149.43	4.71	11.2	11.2	1.0	139.49	561.07	71	1.0	334.7	1360.9	17.0	10.6	57	10.22	2.65	1.39	141.5	702.8	2624.7	170.8	2092.8	**1049.88**	**697.58**
17.00	18.50	17.75	1.50	16.0	20.22	10.22	149.43	4.71	10.6	10.6	1.0	131.84	692.91	57	1.0	268.7	1629.6	18.5	11.2	53	10.74	2.82	1.56	141.5	695.1	3017.6	188.5	2511.0	**1207.03**	**836.99**
18.50	21.50	20.00	3.00	19.0	20.74	10.74	149.43	9.43	11.2	11.2	1.0	278.97	971.88	53	1.0	499.7	2129.3	21.5	12.5	48	10.74	3.20	1.94	141.5	703.7	3804.8	223.8	3325.0	**1521.94**	**1108.33**
21.50	23.00	22.25	1.50	20.5	20.74	10.74	149.43	4.71	12.5	12.5	1.0	156.17	1128.05	48	1.0	226.3	2355.6	23.0	29.0	0	10.74	19.01	20.10	141.5	2197.3	5680.9	241.5	3725.1	**2272.36**	**1241.71**
23.00	24.50	23.75	1.50	22.0	20.74	10.74	149.43	4.71	29.0	29.0	1.0	390.49	1518.54	0	1.0	0.0	2355.6	24.5	28.3	0	10.41	17.43	18.48	141.5	2012.9	5887.0	259.2	4133.3	**2354.80**	**1377.76**
24.50	26.00	25.25	1.50	23.5	20.41	10.41	149.43	4.71	28.3	28.3	1.0	379.31	1897.85	0	1.0	0.0	2355.6	26.0	27.1	2	10.41	14.73	15.72	141.5	1715.4	5968.8	276.9	4530.3	**2387.53**	**1510.09**
26.00	27.50	26.75	1.50	25.0	20.41	10.41	149.43	4.71	27.1	27.1	1.0	360.49	2258.34	2	1.0	9.4	2365.0	27.5	9.0	70	10.41	2.29	1.07	141.5	753.9	5377.2	294.5	4917.9	**2150.88**	**1639.29**
27.50	29.00	28.25	1.50	26.5	20.41	10.41	149.43	4.71	9.0	9.0	1.0	111.57	2369.91	70	1.0	330.0	2695.0	29.0	9.0	40	10.41	2.29	1.07	141.5	541.7	5606.6	312.2	5377.1	**2242.65**	**1792.37**
29.00	30.00	29.50	1.00	27.5	20.41	10.41	149.43	3.14	9.0	9.0	1.0	74.38	2444.29	40	1.0	125.7	2820.7	30.0	9.0	40	10.20	2.29	1.07	141.5	541.6	5806.6	324.0	5589.0	**2322.66**	**1862.99**
30.00	30.50	30.25	0.50	28.0	20.20	10.20	149.43	1.57	9.0	9.0	1.0	37.19	2481.49	40	1.0	62.9	2883.6	30.5	25.2	0	10.20	10.45	11.34	141.5	1206.9	6571.9	329.9	5694.9	**2628.78**	**1898.31**
30.50	32.50	31.50	2.00	30.0	20.20	10.20	149.43	6.29	25.2	25.2	1.0	441.99	2923.47	0	1.0	0.0	2883.6	32.5	26.0	0	10.20	12.25	13.18	141.5	1414.5	7221.5	353.4	6160.5	**2888.62**	**2053.49**
32.50	33.50	33.00	1.00	31.0	20.20	10.20	149.43	3.14	27.6	27.6	1.0	245.52	3168.99	0	1.0	0.0	2883.6	33.5	18.0	28	10.20	5.42	4.29	141.5	817.1	6869.7	365.2	6417.8	**2747.88**	**2139.26**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
33.50	35.00	34.25	1.50	32.5	20.20	10.20	149.43	4.71	18.0	18.0	1.0	228.89	3397.89	28	1.0	132.0	3015.6	35.0	18.0	28	10.20	5.42	4.29	141.5	817.1	7230.6	382.9	6796.3	**2892.24**	**2265.45**
35.00	36.50	35.75	1.50	34.0	20.20	10.20	149.43	4.71	18.0	18.0	1.0	228.89	3626.78	28	1.0	132.0	3147.6	36.5	18.0	30	8.98	5.42	4.29	141.5	829.2	7603.6	400.6	7174.9	**3041.43**	**2391.63**
36.50	37.50	37.00	1.00	35.0	18.98	8.98	149.43	3.14	18.0	18.0	1.0	152.59	3779.37	30	1.0	94.3	3241.9	37.5	13.5	48	8.98	3.50	2.22	141.5	736.3	7757.5	412.3	7433.6	**3102.99**	**2477.85**
37.50	40.00	38.75	2.50	37.5	18.98	8.98	149.43	7.86	13.5	13.5	1.0	281.87	4061.25	48	1.0	377.1	3619.0	40.0	13.5	48	8.98	3.50	2.22	141.5	736.3	8416.5	441.8	8122.0	**3366.60**	**2707.34**
BORE NO: P49, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.98	9.98	27.45	1.57	14.1	14.1	1.0	10.83	0	31	1.0	48.7	0	3.0	26.1	0	9.98	12.48	13.41	29.9	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.5	19.98	9.98	34.93	3.14	26.1	26.1	1.0	53.78	0	0	1.0	0.0	0	4.0	24.5	0	9.98	9.64	10.33	39.9	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	6.00	5.00	2.00	3.5	19.98	9.98	49.90	6.29	24.5	24.5	1.0	142.94	0	0	1.0	0.0	0	6.0	28.3	0	9.98	17.43	18.48	59.9	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	7.00	6.50	1.00	4.5	19.98	9.98	64.87	3.14	28.3	28.3	1.0	109.78	0	0	1.0	0.0	0	7.0	28.3	0	9.98	17.43	18.48	69.9	0	0.0	53.0	53.0	**0.00**	**17.67**
7.00	8.00	7.50	1.00	5.5	19.98	9.98	74.85	3.14	28.3	28.3	1.0	126.67	0	0	1.0	0.0	0	8.0	24.7	7	9.19	9.78	10.55	79.8	0	0.0	64.8	64.8	**0.00**	**21.60**
8.00	9.00	8.50	1.00	6.5	19.19	9.19	84.44	3.14	24.7	24.7	1.0	122.06	0	7	1.0	22.0	0	9.0	24.7	7	9.19	9.78	10.55	89.0	0	0.0	76.6	76.6	**0.00**	**25.53**
9.00	10.00	9.50	1.00	7.5	19.19	9.19	93.63	3.14	24.7	24.7	1.0	135.34	0	7	1.0	22.0	0	10.0	8.2	48	10.48	2.15	0.94	98.2	508.9	508.9	88.4	88.4	**203.57**	**29.45**
10.00	12.50	11.25	2.50	10.0	20.48	10.48	111.32	7.86	8.2	8.2	1.0	126.04	126.04	48	1.0	377.1	377.1	12.5	9.1	61	10.32	2.31	1.08	124.4	661.4	1164.6	117.8	621.0	**465.82**	**207.00**
12.50	15.50	14.00	3.00	13.0	20.32	10.32	139.90	9.43	9.1	9.1	1.0	211.28	337.32	61	1.0	575.1	952.3	15.5	8.7	56	10.05	2.24	1.02	124.4	618.6	1908.2	153.2	1442.8	**763.29**	**480.92**
15.50	18.50	17.00	3.00	16.0	20.05	10.05	139.90	9.43	8.7	8.7	1.0	201.84	539.16	56	1.0	528.0	1480.3	18.5	18.8	40	10.05	5.78	4.73	124.4	866.4	2885.8	188.5	2207.9	**1154.32**	**735.98**
18.50	20.00	19.25	1.50	17.5	20.05	10.05	139.90	4.71	18.8	18.8	1.0	224.52	763.68	40	1.0	188.6	1668.9	20.0	9.8	52	9.64	2.43	1.19	124.4	610.2	3042.7	206.2	2638.7	**1217.08**	**879.57**
20.00	21.50	20.75	1.50	19.0	19.64	9.64	139.90	4.71	9.8	9.8	1.0	113.92	877.61	52	1.0	245.1	1914.0	21.5	9.5	52	10.56	2.38	1.14	124.4	605.1	3396.7	223.8	3015.4	**1358.69**	**1005.15**
21.50	24.50	23.00	3.00	22.0	20.56	10.56	139.90	9.43	9.5	9.5	1.0	220.73	1098.34	52	1.0	490.3	2404.3	24.5	10.4	58	10.56	2.59	1.33	124.4	668.6	4171.3	259.2	3761.8	**1668.51**	**1253.94**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
24.50	27.50	26.00	3.00	25.0	20.56	10.56	139.90	9.43	10.4	10.4	1.0	242.09	1340.43	58	1.0	546.9	2951.1	27.5	27.9	0	9.98	16.53	17.56	124.4	1684.9	5976.4	294.5	4586.1	**2390.57**	**1528.70**
27.50	29.00	28.25	1.50	26.5	19.98	9.98	139.90	4.71	27.9	27.9	1.0	349.20	1689.63	0	1.0	0.0	2951.1	29.0	26.5	13	9.98	13.38	14.34	124.4	1455.9	6096.7	312.2	4953.0	**2438.69**	**1650.99**
29.00	30.00	29.50	1.00	27.5	19.98	9.98	139.90	3.14	26.5	26.5	1.0	219.22	1908.85	13	1.0	40.9	2992.0	30.0	27.3	0	9.98	15.18	16.18	124.4	1547.3	6448.2	324.0	5224.8	**2579.28**	**1741.61**
30.00	30.50	30.25	0.50	28.0	19.98	9.98	139.90	1.57	27.3	27.3	1.0	113.47	2022.32	0	1.0	0.0	2992.0	30.5	27.3	0	9.98	15.18	16.18	124.4	1547.3	6561.7	329.9	5344.2	**2624.67**	**1781.40**
30.50	32.00	31.25	1.50	29.5	19.98	9.98	139.90	4.71	27.3	27.3	1.0	340.41	2362.73	0	1.0	0.0	2992.0	32.0	11.5	49	9.57	2.91	1.65	124.4	637.3	5992.0	347.5	5702.3	**2396.80**	**1900.76**
32.00	32.50	32.25	0.50	30.0	19.57	9.57	139.90	1.57	11.5	11.5	1.0	44.73	2407.46	49	1.0	77.0	3069.0	32.5	11.5	49	9.57	2.91	1.65	124.4	637.3	6113.7	353.4	5829.9	**2445.49**	**1943.30**
32.50	33.50	33.00	1.00	31.0	19.57	9.57	139.90	3.14	11.5	11.5	1.0	89.46	2496.91	49	1.0	154.0	3223.0	33.5	11.5	49	9.57	2.91	1.65	124.4	637.3	6357.2	365.2	6085.1	**2542.88**	**2028.37**
33.50	35.00	34.25	1.50	32.5	19.57	9.57	139.90	4.71	11.5	11.5	1.0	134.18	2631.10	49	1.0	231.0	3454.0	35.0	11.5	49	9.57	2.91	1.65	124.4	637.3	6722.4	382.9	6468.0	**2688.95**	**2155.99**
35.00	36.50	35.75	1.50	34.0	19.57	9.57	139.90	4.71	11.5	11.5	1.0	134.18	2765.28	49	1.0	231.0	3685.0	36.5	15.8	38	10.24	4.33	3.09	124.4	704.8	7155.1	400.6	6850.8	**2862.03**	**2283.61**
36.50	37.50	37.00	1.00	35.0	20.24	10.24	139.90	3.14	15.8	15.8	1.0	124.42	2889.70	38	1.0	119.4	3804.4	37.5	15.8	38	10.24	4.33	3.09	124.4	704.8	7398.9	412.3	7106.5	**2959.56**	**2368.82**
37.50	38.00	37.75	0.50	35.5	20.24	10.24	139.90	1.57	15.8	15.8	1.0	62.21	2951.91	38	1.0	59.7	3864.1	38.0	28.0	0	10.24	16.76	17.79	124.4	1709.6	8525.6	418.2	7234.3	**3410.26**	**2411.42**
38.00	40.00	39.00	2.00	37.5	20.24	10.24	139.90	6.29	28.0	28.0	1.0	467.57	3419.48	0	1.0	0.0	3864.1	40.0	28.0	0	10.24	16.76	17.79	124.4	1709.6	8993.2	441.8	7725.4	**3597.28**	**2575.14**
BORE NO: P50, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.30	10.30	28.33	1.57	24.5	24.5	1.0	20.28	0	8	1.0	12.6	0	3.0	24.5	8	10.30	9.64	10.33	30.9	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.5	20.30	10.30	36.05	3.14	24.5	24.5	1.0	51.63	0	8	1.0	25.1	0	4.0	27.6	0	9.23	15.85	16.87	41.2	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.5	19.23	9.23	45.82	3.14	27.6	27.6	1.0	75.28	0	0	1.0	0.0	0	5.0	27.6	0	9.23	15.85	16.87	50.4	689.4	689.4	29.5	29.5	**275.76**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.23	9.23	55.05	3.14	27.6	27.6	1.0	90.44	90.44	0	1.0	0.0	0.0	6.0	28.7	0	9.23	18.33	19.40	59.7	929.7	1020.1	41.2	131.7	**408.05**	**43.89**
6.00	8.00	7.00	2.00	5.5	19.23	9.23	68.89	6.29	28.7	28.7	1.0	237.07	327.51	0	1.0	0.0	0.0	8.0	29.6	0	10.30	20.36	21.48	78.1	1336.5	1664.0	64.8	392.3	**665.62**	**130.77**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
8.00	9.00	8.50	1.00	6.5	20.30	10.30	83.27	3.14	29.6	29.6	1.0	148.67	476.18	0	1.0	0.0	0.0	9.0	29.6	0	10.30	20.36	21.48	88.4	1501.3	1977.5	76.6	552.8	**790.99**	**184.25**
9.00	10.00	9.50	1.00	7.5	20.30	10.30	93.57	3.14	29.6	29.6	1.0	167.06	643.24	0	1.0	0.0	0.0	10.0	8.5	54	10.30	2.20	0.99	98.7	556.5	1199.7	88.4	731.6	**479.90**	**243.87**
10.00	11.00	10.50	1.00	8.5	20.30	10.30	103.87	3.14	8.5	8.5	1.0	48.79	692.03	54	1.0	169.7	169.7	11.0	8.5	54	10.30	2.20	0.99	109.0	574.3	1436.1	100.1	961.9	**574.42**	**320.63**
11.00	12.00	11.50	1.00	9.5	20.30	10.30	114.17	3.14	8.5	8.5	1.0	53.63	745.66	54	1.0	169.7	339.4	12.0	29.1	0	10.30	19.23	20.33	119.3	1885.4	2970.4	111.9	1197.0	**1188.18**	**399.00**
12.00	13.00	12.50	1.00	10.5	20.30	10.30	124.47	3.14	29.1	29.1	1.0	217.73	963.39	0	1.0	0.0	339.4	13.0	8.3	58	10.30	2.16	0.96	129.6	634.4	1937.2	123.7	1426.5	**774.89**	**475.51**
13.00	14.50	13.75	1.50	12.0	20.30	10.30	137.35	4.71	8.3	8.3	1.0	94.46	1057.85	58	1.0	273.4	612.9	14.5	8.6	57	10.15	2.22	1.00	145.1	659.9	2330.6	141.4	1812.1	**932.24**	**604.03**
14.50	17.50	16.00	3.00	15.0	20.15	10.15	137.35	9.43	8.6	8.6	1.0	195.85	1253.69	57	1.0	537.4	1150.3	17.5	8.6	57	10.15	2.22	1.00	145.1	659.9	3063.9	176.7	2580.7	**1225.55**	**860.23**
17.50	19.00	18.25	1.50	16.5	20.15	10.15	137.35	4.71	8.6	8.6	1.0	97.92	1351.62	57	1.0	268.7	1419.0	19.0	27.2	7	9.78	14.95	15.95	145.1	1815.3	4585.9	194.4	2965.0	**1834.37**	**988.33**
19.00	20.50	19.75	1.50	18.0	19.78	9.78	137.35	4.71	27.2	27.2	1.0	332.76	1684.38	7	1.0	33.0	1452.0	20.5	12.3	58	9.78	3.15	1.88	145.1	775.9	3912.3	212.1	3348.4	**1564.91**	**1116.15**
20.50	23.50	22.00	3.00	21.0	19.78	9.78	137.35	9.43	12.3	12.3	1.0	282.35	1966.73	58	1.0	546.9	1998.9	23.5	12.3	58	10.91	3.15	1.88	145.1	776.7	4742.3	247.4	4213.0	**1896.93**	**1404.33**
23.50	25.00	24.25	1.50	22.5	20.91	10.91	137.35	4.71	12.3	12.3	1.0	141.17	2107.90	58	1.0	273.4	2272.3	25.0	14.3	42	10.91	3.74	2.45	145.1	733.5	5113.6	265.1	4645.3	**2045.46**	**1548.42**
25.00	26.50	25.75	1.50	24.0	20.91	10.91	137.35	4.71	14.3	14.3	1.0	165.04	2272.94	42	1.0	198.0	2470.3	26.5	10.5	58	10.91	2.62	1.36	145.1	714.3	5457.5	282.7	5026.0	**2183.00**	**1675.32**
26.50	27.50	27.00	1.00	25.0	20.91	10.91	137.35	3.14	10.5	10.5	1.0	80.00	2352.95	58	1.0	182.3	2652.6	27.5	10.5	58	10.91	2.62	1.36	145.1	714.3	5719.8	294.5	5300.0	**2287.92**	**1766.68**
27.50	29.50	28.50	2.00	27.0	20.91	10.91	137.35	6.29	10.5	10.5	1.0	160.01	2512.95	58	1.0	364.6	3017.1	29.5	7.5	61	10.56	2.02	0.84	145.1	665.1	6195.2	318.1	5848.2	**2478.06**	**1949.39**
29.50	30.00	29.75	0.50	27.5	20.56	10.56	137.35	1.57	7.5	7.5	1.0	28.41	2541.37	61	1.0	95.9	3113.0	30.0	7.5	61	10.56	2.02	0.84	145.1	665.1	6319.4	324.0	5978.3	**2527.77**	**1992.78**
30.00	32.50	31.25	2.50	30.0	20.56	10.56	137.35	7.86	7.5	7.5	1.0	142.07	2683.44	61	1.0	479.3	3592.3	32.5	8.6	60	10.56	2.22	1.00	145.1	681.3	6957.0	353.4	6629.2	**2782.80**	**2209.72**
32.50	35.00	33.75	2.50	32.5	20.56	10.56	137.35	7.86	8.6	8.6	1.0	163.20	2846.64	60	1.0	471.4	4063.7	35.0	19.6	30	10.60	6.19	5.17	145.1	938.9	7849.3	382.9	7293.2	**3139.71**	**2431.08**
35.00	35.50	35.25	0.50	33.0	20.60	10.60	137.35	1.57	19.6	19.6	1.0	76.85	2923.49	30	1.0	47.1	4110.9	35.5	26.4	0	10.60	13.15	14.11	145.1	1557.9	8592.3	388.8	7423.1	**3436.91**	**2474.37**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
35.50	37.50	36.50	2.00	35.0	20.60	10.60	137.35	6.29	26.4	26.4	1.0	428.55	3352.05	0	1.0	0.0	4110.9	37.5	28.5	0	10.60	17.88	18.94	145.1	2117.1	9580.0	412.3	7875.2	**3832.00**	**2625.08**
37.50	38.50	38.00	1.00	36.0	20.60	10.60	137.35	3.14	28.5	28.5	1.0	234.37	3586.42	0	1.0	0.0	4110.9	38.5	28.0	0	10.60	16.76	17.79	145.1	1984.0	9681.2	424.1	8121.4	**3872.50**	**2707.13**
38.50	40.00	39.25	1.50	37.5	20.60	10.60	137.35	4.71	28.0	28.0	1.0	344.27	3930.69	0	1.0	0.0	4110.9	40.0	28.0	0	10.60	16.76	17.79	145.1	1984.0	10025.5	441.8	8483.3	**4010.21**	**2827.78**
BORE NO: P51, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.69	9.69	26.65	1.57	23.9	23.9	1.0	18.56	0	0	1.0	0.0	0	3.0	26.4	0	9.69	13.15	14.11	29.1	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.5	19.69	9.69	38.76	6.29	26.4	26.4	1.0	120.94	0	0	1.0	0.0	0	5.0	26.4	0	9.69	13.15	14.11	48.5	554.4	554.4	29.5	29.5	**221.76**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.69	9.69	53.30	3.14	26.4	26.4	1.0	83.15	83.15	0	1.0	0.0	0.0	6.0	30.3	0	9.69	22.77	23.94	58.1	1131.3	1214.5	41.2	124.4	**485.79**	**41.46**
6.00	8.00	7.00	2.00	5.5	19.69	9.69	67.83	6.29	30.3	30.3	1.0	252.88	336.03	0	1.0	0.0	0.0	8.0	28.5	0	10.66	17.88	18.94	77.5	1168.5	1504.5	64.8	400.8	**601.80**	**133.61**
8.00	9.00	8.50	1.00	6.5	20.66	10.66	82.85	3.14	28.5	28.5	1.0	141.38	477.41	0	1.0	0.0	0.0	9.0	28.5	0	10.66	17.88	18.94	88.2	1318.3	1795.7	76.6	554.0	**718.26**	**184.66**
9.00	11.00	10.00	2.00	8.5	20.66	10.66	98.84	6.29	28.5	28.5	1.0	337.33	814.73	0	1.0	0.0	0.0	11.0	10.4	40	10.66	2.59	1.33	109.5	511.1	1325.8	100.1	914.9	**530.32**	**304.96**
11.00	12.00	11.50	1.00	9.5	20.66	10.66	114.83	3.14	10.4	10.4	1.0	66.24	880.97	40	1.0	125.7	125.7	12.0	10.4	40	10.66	2.59	1.33	120.2	532.7	1539.4	111.9	1118.6	**615.77**	**372.87**
12.00	13.00	12.50	1.00	10.5	20.66	10.66	125.49	3.14	10.4	10.4	1.0	72.39	953.36	40	1.0	125.7	251.4	13.0	9.5	53	10.49	2.38	1.14	130.8	624.1	1828.9	123.7	1328.5	**731.57**	**442.83**
13.00	14.50	13.75	1.50	12.0	20.49	10.49	138.69	4.71	9.5	9.5	1.0	109.41	1062.77	53	1.0	249.9	501.3	14.5	10.4	58	10.60	2.59	1.33	146.6	713.7	2277.7	141.4	1705.4	**911.09**	**568.47**
14.50	17.50	16.00	3.00	15.0	20.60	10.60	138.69	9.43	10.4	10.4	1.0	239.99	1302.76	58	1.0	546.9	1048.1	17.5	10.4	58	10.60	2.59	1.33	146.6	713.7	3064.6	176.7	2527.6	**1225.83**	**842.54**
17.50	19.00	18.25	1.50	16.5	20.60	10.60	138.69	4.71	10.4	10.4	1.0	120.00	1422.76	58	1.0	273.4	1321.6	19.0	27.4	0	8.71	15.40	16.41	146.6	1830.0	4574.3	194.4	2938.7	**1829.73**	**979.57**
19.00	20.50	19.75	1.50	18.0	18.71	8.71	138.69	4.71	27.4	27.4	1.0	338.90	1761.66	0	1.0	0.0	1321.6	20.5	26.1	0	8.25	12.48	13.41	146.6	1480.2	4563.5	212.1	3295.3	**1825.38**	**1098.43**
20.50	23.50	22.00	3.00	21.0	18.25	8.25	138.69	9.43	26.1	26.1	1.0	640.60	2402.26	0	1.0	0.0	1321.6	23.5	26.0	0	8.25	12.25	13.18	146.6	1453.5	5177.4	247.4	3971.2	**2070.95**	**1323.74**
23.50	26.50	25.00	3.00	24.0	18.25	8.25	138.69	9.43	26.0	26.0	1.0	637.77	3040.03	0	1.0	0.0	1321.6	26.5	26.7	0	8.37	13.83	14.80	146.6	1641.0	6002.6	282.7	4644.3	**2401.03**	**1548.12**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m — Factor of Safety in Compression: 2.5 — Area of Pile: 0.79 m^2

Critical water table: 0.00 m — Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
26.50	27.50	27.00	1.00	25.0	18.37	8.37	138.69	3.14	26.7	26.7	1.0	219.22	3259.25	0	1.0	0.0	1321.6	27.5	26.7	0	8.37	13.83	14.80	146.6	1641.0	6221.8	294.5	4875.4	**2488.72**	**1625.12**
27.50	29.50	28.50	2.00	27.0	18.37	8.37	138.69	6.29	26.7	26.7	1.0	438.44	3697.70	0	1.0	0.0	1321.6	29.5	27.5	0	8.37	15.63	16.64	146.6	1854.5	6873.8	318.1	5337.4	**2749.50**	**1779.12**
29.50	30.00	29.75	0.50	27.5	18.37	8.37	138.69	1.57	27.5	27.5	1.0	113.45	3811.15	0	1.0	0.0	1321.6	30.0	27.8	0	8.37	16.31	17.33	146.6	1934.6	7067.3	324.0	5456.7	**2826.91**	**1818.90**
30.00	32.50	31.25	2.50	30.0	18.37	8.37	138.69	7.86	27.8	27.8	1.0	574.53	4385.68	0	1.0	0.0	1321.6	32.5	27.8	0	9.29	16.31	17.33	146.6	1940.8	7648.1	353.4	6060.7	**3059.23**	**2020.23**
32.50	35.00	33.75	2.50	32.5	19.29	9.29	138.69	7.86	27.8	27.8	1.0	574.53	4960.20	0	1.0	0.0	1321.6	35.0	29.3	0	9.29	19.68	20.79	146.6	2342.4	8624.2	382.9	6664.7	**3449.67**	**2221.55**
35.00	35.50	35.25	0.50	33.0	19.29	9.29	138.69	1.57	29.3	29.3	1.0	122.30	5082.51	0	1.0	0.0	1321.6	35.5	29.3	0	9.29	19.68	20.79	146.6	2342.4	8746.5	388.8	6792.8	**3498.59**	**2264.28**
35.50	37.50	36.50	2.00	35.0	19.29	9.29	138.69	6.29	29.3	29.3	1.0	489.20	5571.71	0	1.0	0.0	1321.6	37.5	29.3	0	8.91	19.68	20.79	146.6	2339.3	9232.6	412.3	7305.6	**3693.03**	**2435.20**
37.50	38.50	38.00	1.00	36.0	18.91	8.91	138.69	3.14	29.3	29.3	1.0	244.60	5816.31	0	1.0	0.0	1321.6	38.5	29.0	0	8.91	19.01	20.10	146.6	2259.1	9397.0	424.1	7562.0	**3758.78**	**2520.67**
38.50	40.00	39.25	1.50	37.5	18.91	8.91	138.69	4.71	29.0	29.0	1.0	362.41	6178.72	0	1.0	0.0	1321.6	40.0	29.0	0	8.91	19.01	20.10	146.6	2259.1	9759.4	441.8	7942.1	**3903.75**	**2647.36**
BORE NO: P52, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.45	9.45	25.99	1.57	28.6	28.6	1.0	22.27	0	0	1.0	0.0	0	3.0	28.6	0	9.44	18.11	19.17	28.4	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.5	19.44	9.44	37.79	6.29	28.6	28.6	1.0	129.51	0	0	1.0	0.0	0	5.0	27.9	0	9.44	16.53	17.56	47.2	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.44	9.44	51.95	3.14	27.9	27.9	1.0	86.45	0	0	1.0	0.0	0	6.0	27.9	0	9.55	16.53	17.56	56.7	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	8.00	7.00	2.00	5.5	19.55	9.55	66.22	6.29	27.9	27.9	1.0	220.39	0	0	1.0	0.0	0	8.0	27.9	0	9.55	16.53	17.56	75.8	0	0.0	64.8	64.8	**0.00**	**21.60**
8.00	9.00	8.50	1.00	6.5	19.55	9.55	80.55	3.14	27.9	27.9	1.0	134.03	0	0	1.0	0.0	0	9.0	26.2	6	9.84	12.70	13.64	85.3	0	0.0	76.6	76.6	**0.00**	**25.53**
9.00	11.00	10.00	2.00	8.5	19.84	9.84	95.16	6.29	26.2	26.2	1.0	294.33	0	6	1.0	37.7	0	11.0	24.0	0	9.84	9.28	9.78	105.0	0	0.0	100.1	100.1	**0.00**	**33.38**
11.00	12.00	11.50	1.00	9.5	19.84	9.84	109.92	3.14	24.0	24.0	1.0	153.81	0	0	1.0	0.0	0	12.0	13.5	21	9.84	3.50	2.22	114.8	472.9	472.9	111.9	111.9	**189.16**	**37.31**
12.00	13.00	12.50	1.00	10.5	19.84	9.84	119.76	3.14	13.5	13.5	1.0	90.36	90.36	21	1.0	66.0	66.0	13.0	10.4	46	10.14	2.59	1.33	124.7	584.1	740.5	123.7	280.1	**296.18**	**93.35**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
13.00	14.50	13.75	1.50	12.0	20.14	10.14	132.29	4.71	10.4	10.4	1.0	114.46	204.82	46	1.0	216.9	282.9	14.5	10.4	46	10.14	2.59	1.33	139.9	615.0	1102.7	141.4	629.0	**441.08**	**209.68**
14.50	16.00	15.25	1.50	13.5	20.14	10.14	132.29	4.71	10.4	10.4	1.0	114.46	319.28	46	1.0	216.9	499.7	16.0	12.2	44	10.24	3.12	1.85	139.9	661.1	1480.1	159.0	978.0	**592.04**	**326.01**
16.00	17.50	16.75	1.50	15.0	20.24	10.24	132.29	4.71	12.2	12.2	1.0	134.83	454.11	44	1.0	207.4	707.1	17.5	12.2	44	10.24	3.12	1.85	139.9	661.1	1822.4	176.7	1338.0	**728.95**	**445.99**
17.50	19.00	18.25	1.50	16.5	20.24	10.24	132.29	4.71	12.2	12.2	1.0	134.83	588.94	44	1.0	207.4	914.6	19.0	25.4	5	9.38	10.90	11.80	139.9	1277.0	2780.5	194.4	1697.9	**1112.20**	**565.97**
19.00	20.50	19.75	1.50	18.0	19.38	9.38	132.29	4.71	25.4	25.4	1.0	296.12	885.07	5	1.0	23.6	938.1	20.5	25.4	5	9.38	10.90	11.80	139.9	1277.0	3100.2	212.1	2035.3	**1240.08**	**678.42**
20.50	22.00	21.25	1.50	19.5	19.38	9.38	132.29	4.71	25.4	25.4	1.0	296.12	1181.19	5	1.0	23.6	961.7	22.0	28.3	0	9.64	17.43	18.48	139.9	1985.9	4128.8	229.7	2372.6	**1651.53**	**790.88**
22.00	23.50	22.75	1.50	21.0	19.64	9.64	132.29	4.71	28.3	28.3	1.0	335.79	1516.98	0	1.0	0.0	961.7	23.5	28.3	0	9.64	17.43	18.48	139.9	1985.9	4464.6	247.4	2726.1	**1785.85**	**908.70**
23.50	26.50	25.00	3.00	24.0	19.64	9.64	132.29	9.43	28.3	28.3	1.0	671.58	2188.56	0	1.0	0.0	961.7	26.5	6.2	70	10.28	1.79	0.63	139.9	693.9	3844.1	282.7	3433.0	**1537.66**	**1144.34**
26.50	27.50	27.00	1.00	25.0	20.28	10.28	132.29	3.14	6.2	6.2	1.0	45.17	2233.72	70	1.0	220.0	1181.7	27.5	6.2	70	10.28	1.79	0.63	139.9	693.9	4109.3	294.5	3710.0	**1643.72**	**1236.65**
27.50	28.00	27.75	0.50	25.5	20.28	10.28	132.29	1.57	6.2	6.2	1.0	22.58	2256.30	70	1.0	110.0	1291.7	28.0	30.4	0	8.98	23.27	24.45	139.9	2644.4	6192.5	300.4	3848.4	**2476.98**	**1282.81**
28.00	29.50	28.75	1.50	27.0	18.98	8.98	132.29	4.71	30.4	30.4	1.0	373.20	2629.50	0	1.0	0.0	1291.7	29.5	30.4	0	9.07	23.27	24.45	139.9	2645.3	6566.5	318.1	4239.3	**2626.61**	**1413.10**
29.50	30.00	29.75	0.50	27.5	19.07	9.07	132.29	1.57	30.4	30.4	1.0	124.40	2753.90	0	1.0	0.0	1291.7	30.0	31.0	0	9.07	26.30	27.53	139.9	2988.5	7034.1	324.0	4369.6	**2813.64**	**1456.53**
30.00	31.00	30.50	1.00	28.5	19.07	9.07	132.29	3.14	31.0	31.0	1.1	262.30	3016.20	0	1.0	0.0	1291.7	31.0	31.9	0	9.18	30.83	32.14	139.9	3504.6	7812.5	335.8	4643.7	**3125.01**	**1547.89**
31.00	32.50	31.75	1.50	30.0	19.18	9.18	132.29	4.71	31.9	31.9	1.1	425.05	3441.25	0	1.0	0.0	1291.7	32.5	31.9	0	8.92	30.83	32.14	139.9	3501.3	8234.3	353.4	5086.4	**3293.72**	**1695.47**
32.50	34.00	33.25	1.50	31.5	18.92	8.92	132.29	4.71	31.9	31.9	1.1	425.05	3866.31	0	1.0	0.0	1291.7	34.0	33.4	0	10.23	38.39	39.83	139.9	4379.3	9537.3	371.1	5529.1	**3814.93**	**1843.04**
34.00	35.00	34.50	1.00	32.5	20.23	10.23	132.29	3.14	33.4	33.4	1.2	320.74	4187.05	0	1.0	0.0	1291.7	35.0	33.2	0	10.23	37.38	38.80	139.9	4264.4	9743.2	382.9	5861.6	**3897.28**	**1953.88**
35.00	35.50	35.25	0.50	33.0	20.23	10.23	132.29	1.57	33.2	33.2	1.2	157.80	4344.84	0	1.0	0.0	1291.7	35.5	22.5	28	9.00	8.20	8.14	139.9	1128.1	6764.6	388.8	6025.3	**2705.84**	**2008.44**
35.50	37.00	36.25	1.50	34.5	19.00	9.00	132.29	4.71	22.5	22.5	1.0	258.32	4603.16	28	1.0	132.0	1423.7	37.0	20.5	34	9.12	6.76	5.94	139.9	1004.7	7031.6	406.4	6433.3	**2812.64**	**2144.44**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m³)	Eff. Unit Weight (kN/m³)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m³)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
37.00	37.50	37.25	0.50	35.0	19.12	9.12	132.29	1.57	20.5	20.5	1.0	77.72	4680.88	34	1.0	53.4	1477.1	37.5	20.5	34	9.12	6.76	5.94	139.9	1004.7	7162.7	412.3	6570.4	**2865.10**	**2190.12**
37.50	38.50	38.00	1.00	36.0	19.12	9.12	132.29	3.14	20.5	20.5	1.0	155.44	4836.32	34	1.0	106.9	1584.0	38.5	20.5	34	9.37	6.76	5.94	139.9	1005.3	7425.6	424.1	6844.4	**2970.25**	**2281.48**
38.50	40.00	39.25	1.50	37.5	19.37	9.37	132.29	4.71	20.5	20.5	1.0	233.17	5069.49	34	1.0	160.3	1744.3	40.0	28.0	0	9.37	16.76	17.79	139.9	1907.2	8720.9	441.8	7255.6	**3488.38**	**2418.52**
BORE NO: P53, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.63	9.63	26.48	1.57	28.9	28.9	1.0	22.97	0	0	1.0	0.0	0	3.0	28.9	0	9.63	18.78	19.87	28.9	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.5	19.63	9.63	33.71	3.14	28.9	28.9	1.0	58.48	0	0	1.0	0.0	0	4.0	28.9	0	9.21	18.78	19.87	38.5	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.5	19.21	9.21	43.13	3.14	28.9	28.9	1.0	74.82	0	0	1.0	0.0	0	5.0	28.4	0	9.21	17.66	18.71	47.7	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.21	9.21	52.34	3.14	28.4	28.4	1.0	88.93	0	0	1.0	0.0	0	6.0	32.8	0	9.21	35.36	36.75	56.9	1715.1	1715.1	41.2	41.2	**686.05**	**13.74**
6.00	8.00	7.00	2.00	5.5	19.21	9.21	66.15	6.29	32.8	32.8	1.1	305.48	305.48	0	1.0	0.0	0.0	8.0	31.2	0	9.80	27.30	28.55	75.4	1726.7	2032.1	64.8	370.3	**812.85**	**123.43**
8.00	9.00	8.50	1.00	6.5	19.80	9.80	80.26	3.14	31.2	31.2	1.1	161.93	467.41	0	1.0	0.0	0.0	9.0	24.2	11	9.80	9.42	10.00	85.2	746.9	1214.3	76.6	544.0	**485.71**	**181.33**
9.00	10.00	9.50	1.00	7.5	19.80	9.80	90.06	3.14	24.2	24.2	1.0	127.21	594.62	11	1.0	34.6	34.6	10.0	24.2	11	9.80	9.42	10.00	95.0	819.4	1448.6	88.4	717.5	**579.45**	**239.18**
10.00	11.00	10.50	1.00	8.5	19.80	9.80	99.86	3.14	24.2	24.2	1.0	141.05	735.66	11	1.0	34.6	69.1	11.0	24.2	11	9.80	9.42	10.00	104.8	892.0	1696.8	100.1	904.9	**678.72**	**301.65**
11.00	12.00	11.50	1.00	9.5	19.80	9.80	109.66	3.14	24.2	24.2	1.0	154.89	890.55	11	1.0	34.6	103.7	12.0	9.4	52	9.80	2.36	1.13	114.6	584.7	1578.9	111.9	1106.2	**631.57**	**368.73**
12.00	13.00	12.50	1.00	10.5	19.80	9.80	119.46	3.14	9.4	9.4	1.0	62.15	952.71	52	1.0	163.4	267.1	13.0	9.4	52	10.40	2.36	1.13	124.4	603.1	1823.0	123.7	1343.6	**729.19**	**447.85**
13.00	14.50	13.75	1.50	12.0	20.40	10.40	132.16	4.71	9.4	9.4	1.0	103.14	1055.85	52	1.0	245.1	512.3	14.5	11.5	49	10.23	2.91	1.65	140.0	673.2	2241.4	141.4	1709.5	**896.55**	**569.84**
14.50	17.50	16.00	3.00	15.0	20.23	10.23	132.16	9.43	11.5	11.5	1.0	253.52	1309.37	49	1.0	462.0	974.3	17.5	11.5	49	10.23	2.91	1.65	140.0	673.2	2956.9	176.7	2460.4	**1182.76**	**820.12**
17.50	19.00	18.25	1.50	16.5	20.23	10.23	132.16	4.71	11.5	11.5	1.0	126.76	1436.13	49	1.0	231.0	1205.3	19.0	26.4	7	9.95	13.15	14.11	140.0	1551.0	4192.4	194.4	2835.8	**1676.97**	**945.27**
19.00	20.50	19.75	1.50	18.0	19.95	9.95	132.16	4.71	26.4	26.4	1.0	309.28	1745.41	7	1.0	33.0	1238.3	20.5	25.8	9	9.95	11.80	12.72	140.0	1411.2	4394.9	212.1	3195.8	**1757.95**	**1065.25**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
20.50	22.00	21.25	1.50	19.5	19.95	9.95	132.16	4.71	25.8	25.8	1.0	301.19	2046.60	9	1.0	42.4	1280.7	22.0	25.8	9	9.59	11.80	12.72	140.0	1409.4	4736.7	229.7	3557.0	**1894.67**	**1185.68**
22.00	23.50	22.75	1.50	21.0	19.59	9.59	132.16	4.71	25.8	25.8	1.0	301.19	2347.79	9	1.0	42.4	1323.1	23.5	25.9	9	9.59	12.03	12.95	140.0	1435.0	5105.9	247.4	3918.3	**2042.37**	**1306.11**
23.50	25.00	24.25	1.50	22.5	19.59	9.59	132.16	4.71	25.9	25.9	1.0	302.53	2650.32	9	1.0	42.4	1365.6	25.0	30.3	0	9.59	22.77	23.94	140.0	2594.3	6610.1	265.1	4281.0	**2644.06**	**1426.99**
25.00	26.50	25.75	1.50	24.0	19.59	9.59	132.16	4.71	30.3	30.3	1.0	369.54	3019.86	0	1.0	0.0	1365.6	26.5	30.3	0	10.66	22.77	23.94	140.0	2604.3	6989.7	282.7	4668.2	**2795.90**	**1556.06**
26.50	27.50	27.00	1.00	25.0	20.66	10.66	132.16	3.14	30.3	30.3	1.0	246.36	3266.21	0	1.0	0.0	1365.6	27.5	30.3	0	10.66	22.77	23.94	140.0	2604.3	7236.1	294.5	4926.3	**2894.44**	**1642.10**
27.50	28.00	27.75	0.50	25.5	20.66	10.66	132.16	1.57	30.3	30.3	1.0	123.18	3389.39	0	1.0	0.0	1365.6	28.0	11.4	74	10.66	2.88	1.62	140.0	847.0	5601.9	300.4	5055.4	**2240.77**	**1685.13**
28.00	29.50	28.75	1.50	27.0	20.66	10.66	132.16	4.71	11.4	11.4	1.0	125.63	3515.02	74	1.0	348.9	1714.4	29.5	32.1	0	10.66	31.84	33.16	140.0	3640.1	8869.5	318.1	5547.5	**3547.81**	**1849.18**
29.50	30.00	29.75	0.50	27.5	20.66	10.66	132.16	1.57	32.1	32.1	1.1	143.96	3658.98	0	1.0	0.0	1714.4	30.0	29.3	2	11.07	19.68	20.79	140.0	2269.1	7642.5	324.0	5697.4	**3056.99**	**1899.13**
30.00	32.50	31.25	2.50	30.0	21.07	11.07	132.16	7.86	29.3	29.3	1.0	582.72	4241.70	2	1.0	15.7	1730.1	32.5	32.8	0	11.07	35.36	36.75	140.0	4048.8	10020.6	353.4	6325.3	**4008.26**	**2108.42**
32.50	34.00	33.25	1.50	31.5	21.07	11.07	132.16	4.71	32.8	32.8	1.1	457.73	4699.43	0	1.0	0.0	1730.1	34.0	33.8	0	11.07	40.40	41.88	140.0	4625.1	11054.6	371.1	6800.7	**4421.85**	**2266.89**
34.00	35.00	34.50	1.00	32.5	21.07	11.07	132.16	3.14	33.8	33.8	1.2	330.89	5030.32	0	1.0	0.0	1730.1	35.0	34.7	0	8.83	44.94	46.49	140.0	5102.8	11863.2	382.9	7143.3	**4745.29**	**2381.12**
35.00	35.50	35.25	0.50	33.0	18.83	8.83	132.16	1.57	34.7	34.7	1.2	177.60	5207.92	0	1.0	0.0	1730.1	35.5	31.8	0	8.91	30.33	31.63	140.0	3445.7	10383.8	388.8	7326.8	**4153.51**	**2442.28**
35.50	37.00	36.25	1.50	34.5	18.91	8.91	132.16	4.71	31.8	31.8	1.1	421.07	5628.99	0	1.0	0.0	1730.1	37.0	31.8	0	8.90	30.33	31.63	140.0	3445.6	10804.7	406.4	7765.6	**4321.89**	**2588.53**
37.00	37.50	37.25	0.50	35.0	18.90	8.90	132.16	1.57	31.8	31.8	1.1	140.36	5769.35	0	1.0	0.0	1730.1	37.5	31.4	0	8.90	28.31	29.58	140.0	3216.8	10716.3	412.3	7911.8	**4286.53**	**2637.27**
37.50	38.50	38.00	1.00	36.0	18.90	8.90	132.16	3.14	31.4	31.4	1.1	271.28	6040.63	0	1.0	0.0	1730.1	38.5	29.6	0	8.77	20.36	21.48	140.0	2312.8	10083.6	424.1	8194.9	**4033.44**	**2731.63**
38.50	40.00	39.25	1.50	37.5	18.77	8.77	132.16	4.71	29.6	29.6	1.0	353.94	6394.57	0	1.0	0.0	1730.1	40.0	29.6	0	8.77	20.36	21.48	140.0	2312.8	10437.5	441.8	8566.5	**4175.01**	**2855.50**
BORE NO: P54, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.37	9.37	25.77	1.57	21.9	21.9	1.0	16.28	0	4	1.0	6.3	0	3.0	21.9	4	9.37	7.77	7.48	28.1	0	0.0	5.9	5.9	**0.00**	**1.96**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
3.00	5.00	4.00	2.00	2.5	19.37	9.37	37.48	6.29	21.9	21.9	1.0	94.71	0	4	1.0	25.1	0	5.0	21.9	4	9.37	7.77	7.48	46.9	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.37	9.37	51.54	3.14	21.9	21.9	1.0	65.11	0	4	1.0	12.6	0	6.0	15.3	26	9.37	4.09	2.81	56.2	374.8	374.8	41.2	41.2	**149.91**	**13.74**
6.00	7.00	6.50	1.00	4.5	19.37	9.37	60.91	3.14	15.3	15.3	1.0	52.37	52.37	26	1.0	81.7	81.7	7.0	27.4	0	9.37	15.40	16.41	65.6	854.3	988.4	53.0	187.1	**395.34**	**62.36**
7.00	8.00	7.50	1.00	5.5	19.37	9.37	70.28	3.14	27.4	27.4	1.0	114.49	166.85	0	1.0	0.0	81.7	8.0	27.6	0	9.00	15.85	16.87	75.0	993.5	1242.0	64.8	313.4	**496.81**	**104.45**
8.00	9.00	8.50	1.00	6.5	19.00	9.00	79.46	3.14	27.6	27.6	1.0	130.56	297.41	0	1.0	0.0	81.7	9.0	9.0	38	9.00	2.29	1.07	84.0	423.6	802.7	76.6	455.7	**321.07**	**151.90**
9.00	10.00	9.50	1.00	7.5	19.00	9.00	88.46	3.14	9.0	9.0	1.0	44.03	341.44	38	1.0	119.4	201.1	10.0	27.5	2	9.00	15.63	16.64	93.0	1214.6	1757.2	88.4	630.9	**702.86**	**210.31**
10.00	11.00	10.50	1.00	8.5	19.00	9.00	97.46	3.14	27.5	27.5	1.0	159.45	500.89	2	1.0	6.3	207.4	11.0	7.1	57	9.00	1.95	0.77	102.0	561.9	1270.2	100.1	808.5	**508.07**	**269.49**
11.00	12.00	11.50	1.00	9.5	19.00	9.00	106.46	3.14	7.1	7.1	1.0	41.68	542.57	57	1.0	179.1	386.6	12.0	7.1	57	9.00	1.95	0.77	111.0	575.6	1504.8	111.9	1041.1	**601.91**	**347.02**
12.00	13.00	12.50	1.00	10.5	19.00	9.00	115.46	3.14	7.1	7.1	1.0	45.20	587.77	57	1.0	179.1	565.7	13.0	29.5	0	9.19	20.13	21.25	120.0	1974.4	3127.9	123.7	1277.2	**1251.15**	**425.73**
13.00	14.50	13.75	1.50	12.0	19.19	9.19	126.85	4.71	29.5	29.5	1.0	338.34	926.11	0	1.0	0.0	565.7	14.5	12.5	42	10.60	3.20	1.94	133.7	641.8	2133.6	141.4	1633.2	**853.43**	**544.40**
14.50	17.50	16.00	3.00	15.0	20.60	10.60	126.85	9.43	12.5	12.5	1.0	265.16	1191.26	42	1.0	396.0	961.7	17.5	10.0	42	10.60	2.47	1.22	133.7	561.6	2714.6	176.7	2329.7	**1085.85**	**776.56**
17.50	20.50	19.00	3.00	18.0	20.60	10.60	126.85	9.43	10.0	10.0	1.0	210.89	1402.16	42	1.0	396.0	1357.7	20.5	10.0	40	9.11	2.47	1.22	133.7	546.8	3306.7	212.1	2971.9	**1322.66**	**990.64**
20.50	22.00	21.25	1.50	19.5	19.11	9.11	126.85	4.71	10.0	10.0	1.0	105.45	1507.60	40	1.0	188.6	1546.3	22.0	27.3	0	9.11	15.18	16.18	133.7	1653.0	4706.9	229.7	3283.6	**1882.77**	**1094.54**
22.00	23.50	22.75	1.50	21.0	19.11	9.11	126.85	4.71	27.3	27.3	1.0	308.66	1816.26	0	1.0	0.0	1546.3	23.5	25.4	0	9.11	10.90	11.80	133.7	1187.7	4550.3	247.4	3610.0	**1820.12**	**1203.32**
23.50	25.00	24.25	1.50	22.5	19.11	9.11	126.85	4.71	25.4	25.4	1.0	283.96	2100.22	0	1.0	0.0	1546.3	25.0	25.5	13	10.29	11.13	12.03	133.7	1309.7	4956.3	265.1	3911.6	**1982.50**	**1303.86**
25.00	26.50	25.75	1.50	24.0	20.29	10.29	126.85	4.71	25.5	25.5	1.0	285.24	2385.47	13	1.0	61.3	1607.6	26.5	25.5	13	10.29	11.13	12.03	133.7	1309.7	5302.8	282.7	4275.8	**2121.11**	**1425.26**
26.50	27.50	27.00	1.00	25.0	20.29	10.29	126.85	3.14	25.5	25.5	1.0	190.16	2575.63	13	1.0	40.9	1648.4	27.5	9.5	62	10.29	2.38	1.14	133.7	693.2	4917.2	294.5	4518.6	**1966.88**	**1506.19**
27.50	28.00	27.75	0.50	25.5	20.29	10.29	126.85	1.57	9.5	9.5	1.0	33.36	2608.98	62	1.0	97.4	1745.9	28.0	8.5	62	9.15	2.20	0.99	133.7	673.2	5028.0	300.4	4655.3	**2011.20**	**1551.75**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Factor of Safety in Compression: 2.5
Area of Pile: 0.79 m^2
Critical water table: 0.00 m
Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	∑Qi	c	α	α.c.Asi	∑Qi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
28.00	29.50	28.75	1.50	27.0	19.15	9.15	126.85	4.71	8.5	8.5	1.0	89.37	2698.36	62	1.0	292.3	2038.1	29.5	8.5	62	9.15	2.20	0.99	133.7	673.2	5409.7	318.1	5054.6	**2163.87**	**1684.86**
29.50	30.00	29.75	0.50	27.5	19.15	9.15	126.85	1.57	8.5	8.5	1.0	29.79	2728.15	62	1.0	97.4	2135.6	30.0	8.5	68	9.15	2.20	0.99	133.7	715.6	5579.3	324.0	5187.7	**2231.73**	**1729.23**
30.00	32.50	31.25	2.50	30.0	19.15	9.15	126.85	7.86	8.5	8.5	1.0	148.96	2877.11	68	1.0	534.3	2669.9	32.5	8.5	68	10.23	2.20	0.99	133.7	716.0	6263.0	353.4	5900.4	**2505.19**	**1966.80**
32.50	35.00	33.75	2.50	32.5	20.23	10.23	126.85	7.86	8.5	8.5	1.0	148.96	3026.06	68	1.0	534.3	3204.1	35.0	9.1	54	10.23	2.31	1.08	133.7	628.7	6858.9	382.9	6613.1	**2743.58**	**2204.36**
35.00	35.50	35.25	0.50	33.0	20.23	10.23	126.85	1.57	9.1	9.1	1.0	31.93	3057.99	54	1.0	84.9	3289.0	35.5	9.1	54	10.23	2.31	1.08	133.7	628.7	6975.7	388.8	6735.8	**2790.29**	**2245.26**
35.50	37.50	36.50	2.00	35.0	20.23	10.23	126.85	6.29	9.1	9.1	1.0	127.72	3185.71	54	1.0	339.4	3628.4	37.5	9.1	54	8.90	2.31	1.08	133.7	628.2	7442.3	412.3	7226.5	**2976.93**	**2408.82**
37.50	38.50	38.00	1.00	36.0	18.90	8.90	126.85	3.14	9.1	9.1	1.0	63.86	3249.57	54	1.0	169.7	3798.1	38.5	10.0	52	9.04	2.47	1.22	133.7	631.6	7679.3	424.1	7471.8	**3071.73**	**2490.61**
38.50	40.00	39.25	1.50	37.5	19.04	9.04	126.85	4.71	10.0	10.0	1.0	105.45	3355.01	52	1.0	245.1	4043.3	40.0	10.0	52	9.04	2.47	1.22	133.7	631.6	8029.9	441.8	7840.1	**3211.96**	**2613.36**
BORE NO: P55, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.71	9.71	26.70	1.57	24.6	24.6	1.0	19.21	0	0	1.0	0.0	0	3.0	28.7	0	9.13	18.33	19.40	29.1	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.5	19.13	9.13	38.26	6.29	28.7	28.7	1.0	131.67	0	0	1.0	0.0	0	5.0	29.6	0	9.13	20.36	21.48	47.4	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.13	9.13	51.96	3.14	29.6	29.6	1.0	92.76	0	0	1.0	0.0	0	6.0	29.6	0	8.97	20.36	21.48	56.5	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	8.00	7.00	2.00	5.5	18.97	8.97	65.49	6.29	29.6	29.6	1.0	233.85	0	0	1.0	0.0	0	8.0	29.6	0	8.97	20.36	21.48	74.5	0	0.0	64.8	64.8	**0.00**	**21.60**
8.00	9.00	8.50	1.00	6.5	18.97	8.97	78.95	3.14	29.6	29.6	1.0	140.95	0	0	1.0	0.0	0	9.0	28.5	0	8.97	17.88	18.94	83.4	0	0.0	76.6	76.6	**0.00**	**25.53**
9.00	10.00	9.50	1.00	7.5	18.97	8.97	87.92	3.14	28.5	28.5	1.0	150.02	0	0	1.0	0.0	0	10.0	9.2	48	10.06	2.33	1.10	92.4	512.6	512.6	88.4	88.4	**205.05**	**29.45**
10.00	11.00	10.50	1.00	8.5	20.06	10.06	97.43	3.14	9.2	9.2	1.0	49.59	49.59	48	1.0	150.9	150.9	11.0	12.8	52	10.06	3.29	2.02	102.5	640.7	841.1	100.1	300.6	**336.46**	**100.20**
11.00	12.00	11.50	1.00	9.5	20.06	10.06	107.49	3.14	12.8	12.8	1.0	76.75	126.35	52	1.0	163.4	314.3	12.0	8.5	54	10.00	2.20	0.99	112.5	580.2	1020.9	111.9	552.6	**408.35**	**184.18**
12.00	14.50	13.25	2.50	12.0	20.00	10.00	125.02	7.86	8.5	8.5	1.0	146.81	273.15	54	1.0	424.3	738.6	14.5	11.6	56	10.30	2.94	1.68	137.5	720.5	1732.2	141.4	1153.1	**692.89**	**384.37**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
14.50	17.50	16.00	3.00	15.0	20.30	10.30	125.02	9.43	11.6	11.6	1.0	241.96	515.12	56	1.0	528.0	1266.6	17.5	23.2	0	10.30	8.70	8.90	137.5	976.5	2758.2	176.7	1958.4	**1103.28**	**652.80**
17.50	19.00	18.25	1.50	16.5	20.30	10.30	125.02	4.71	23.2	23.2	1.0	252.61	767.73	0	1.0	0.0	1266.6	19.0	10.5	51	9.62	2.62	1.36	137.5	648.6	2682.9	194.4	2228.7	**1073.14**	**742.89**
19.00	20.50	19.75	1.50	18.0	19.62	9.62	125.02	4.71	10.5	10.5	1.0	109.24	876.96	51	1.0	240.4	1507.0	20.5	23.9	11	9.91	9.21	9.67	137.5	1110.4	3494.3	212.1	2596.0	**1397.74**	**865.34**
20.50	23.50	22.00	3.00	21.0	19.91	9.91	125.02	9.43	23.9	23.9	1.0	522.35	1399.32	11	1.0	103.7	1610.7	23.5	23.9	11	9.91	9.21	9.67	137.5	1110.4	4120.4	247.4	3257.4	**1648.16**	**1085.81**
23.50	25.00	24.25	1.50	22.5	19.91	9.91	125.02	4.71	23.9	23.9	1.0	261.18	1660.49	11	1.0	51.9	1662.6	25.0	12.6	70	10.42	3.23	1.96	137.5	852.4	4175.5	265.1	3588.1	**1670.18**	**1196.05**
25.00	26.50	25.75	1.50	24.0	20.42	10.42	125.02	4.71	12.6	12.6	1.0	131.74	1792.24	70	1.0	330.0	1992.6	26.5	12.6	70	10.42	3.23	1.96	137.5	852.4	4637.2	282.7	4067.5	**1854.88**	**1355.85**
26.50	27.50	27.00	1.00	25.0	20.42	10.42	125.02	3.14	12.6	12.6	1.0	87.83	1880.06	70	1.0	220.0	2212.6	27.5	12.6	70	10.42	3.23	1.96	137.5	852.4	4945.0	294.5	4387.2	**1978.01**	**1462.39**
27.50	28.00	27.75	0.50	25.5	20.42	10.42	125.02	1.57	12.6	12.6	1.0	43.91	1923.98	70	1.0	110.0	2322.6	28.0	12.6	70	10.42	3.23	1.96	137.5	852.4	5098.9	300.4	4547.0	**2039.58**	**1515.65**
28.00	29.50	28.75	1.50	27.0	20.42	10.42	125.02	4.71	12.6	12.6	1.0	131.74	2055.72	70	1.0	330.0	2652.6	29.5	18.5	48	9.18	5.64	4.57	137.5	965.5	5673.8	318.1	5026.4	**2269.53**	**1675.46**
29.50	30.00	29.75	0.50	27.5	19.18	9.18	125.02	1.57	18.5	18.5	1.0	65.73	2121.45	48	1.0	75.4	2728.0	30.0	18.5	48	9.18	5.64	4.57	137.5	965.5	5815.0	324.0	5173.4	**2325.99**	**1724.48**
30.00	31.00	30.50	1.00	28.5	19.18	9.18	125.02	3.14	18.5	18.5	1.0	131.47	2252.92	48	1.0	150.9	2878.9	31.0	18.5	48	8.41	5.64	4.57	137.5	964.1	6095.9	335.8	5467.5	**2438.37**	**1822.51**
31.00	32.50	31.75	1.50	30.0	18.41	8.41	125.02	4.71	18.5	18.5	1.0	197.20	2450.13	48	1.0	226.3	3105.1	32.5	20.0	48	8.94	6.40	5.39	137.5	1049.9	6605.2	353.4	5908.7	**2642.06**	**1969.57**
32.50	34.00	33.25	1.50	31.5	18.94	8.94	125.02	4.71	20.0	20.0	1.0	214.52	2664.64	48	1.0	226.3	3331.4	34.0	12.0	54	9.41	3.06	1.79	137.5	718.9	6715.0	371.1	6367.2	**2685.99**	**2122.39**
34.00	35.00	34.50	1.00	32.5	19.41	9.41	125.02	3.14	12.0	12.0	1.0	83.52	2748.16	54	1.0	169.7	3501.1	35.0	12.0	54	9.41	3.06	1.79	137.5	718.9	6968.2	382.9	6632.2	**2787.28**	**2210.73**
35.00	35.50	35.25	0.50	33.0	19.41	9.41	125.02	1.57	12.0	12.0	1.0	41.76	2789.92	54	1.0	84.9	3586.0	35.5	14.1	52	8.53	3.68	2.39	137.5	773.3	7149.2	388.8	6764.7	**2859.67**	**2254.90**
35.50	37.00	36.25	1.50	34.5	18.53	8.53	125.02	4.71	14.1	14.1	1.0	148.04	2937.96	52	1.0	245.1	3831.1	37.0	14.1	52	9.58	3.68	2.39	137.5	774.2	7543.3	406.4	7175.5	**3017.34**	**2391.85**
37.00	37.50	37.25	0.50	35.0	19.58	9.58	125.02	1.57	14.1	14.1	1.0	49.35	2987.31	52	1.0	81.7	3912.9	37.5	14.1	52	9.58	3.68	2.39	137.5	774.2	7674.4	412.3	7312.5	**3069.76**	**2437.50**
37.50	38.50	38.00	1.00	36.0	19.58	9.58	125.02	3.14	14.1	14.1	1.0	98.69	3086.00	52	1.0	163.4	4076.3	38.5	14.5	36	9.64	3.80	2.51	137.5	674.1	7836.4	424.1	7586.4	**3134.56**	**2528.80**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
38.50	40.00	39.25	1.50	37.5	19.64	9.64	125.02	4.71	14.5	14.5	1.0	152.42	3238.43	36	1.0	169.7	4246.0	40.0	14.5	36	9.64	3.80	2.51	137.5	674.1	8158.5	441.8	7926.2	**3263.42**	**2642.07**
BORE NO: P56, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.45	9.45	25.99	1.57	27.1	27.1	1.0	20.90	0	4	1.0	6.3	0	3.0	29.7	0	9.31	20.58	21.71	28.4	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.5	19.31	9.31	37.66	6.29	29.7	29.7	1.0	135.02	0	0	1.0	0.0	0	5.0	28.9	0	9.31	18.78	19.87	47.0	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.31	9.31	51.63	3.14	28.9	28.9	1.0	89.57	0	0	1.0	0.0	0	6.0	28.9	0	9.30	18.78	19.87	56.3	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	8.00	7.00	2.00	5.5	19.30	9.30	65.58	6.29	28.9	28.9	1.0	227.56	0	0	1.0	0.0	0	8.0	11.4	42	9.30	2.88	1.62	74.9	472.5	472.5	64.8	64.8	**188.98**	**21.60**
8.00	9.00	8.50	1.00	6.5	19.30	9.30	79.53	3.14	11.4	11.4	1.0	50.40	50.40	42	1.0	132.0	132.0	9.0	11.4	42	9.96	2.88	1.62	84.2	493.9	676.3	76.6	259.0	**270.53**	**86.33**
9.00	11.00	10.00	2.00	8.5	19.96	9.96	94.14	6.29	11.4	11.4	1.0	119.32	169.71	42	1.0	264.0	396.0	11.0	10.6	42	9.96	2.65	1.39	104.1	518.9	1084.6	100.1	665.9	**433.85**	**221.95**
11.00	12.50	11.75	1.50	10.0	19.96	9.96	111.57	4.71	10.6	10.6	1.0	98.43	268.15	42	1.0	198.0	594.0	12.5	7.5	96	10.11	2.02	0.84	119.0	871.1	1733.3	117.8	980.0	**693.30**	**326.65**
12.50	14.50	13.50	2.00	12.0	20.11	10.11	129.15	6.29	7.5	7.5	1.0	106.88	375.02	96	1.0	603.4	1197.4	14.5	8.2	58	10.39	2.15	0.94	139.3	648.8	2221.3	141.4	1713.8	**888.50**	**571.27**
14.50	17.50	16.00	3.00	15.0	20.39	10.39	129.15	9.43	8.2	8.2	1.0	175.47	550.50	58	1.0	546.9	1744.3	17.5	9.7	52	10.26	2.42	1.17	139.3	636.8	2931.6	176.7	2471.5	**1172.63**	**823.83**
17.50	20.50	19.00	3.00	18.0	20.26	10.26	129.15	9.43	9.7	9.7	1.0	208.15	758.64	52	1.0	490.3	2234.6	20.5	8.0	60	10.52	2.11	0.91	139.3	658.9	3652.1	212.1	3205.3	**1460.86**	**1068.42**
20.50	23.50	22.00	3.00	21.0	20.52	10.52	129.15	9.43	8.0	8.0	1.0	171.14	929.78	60	1.0	565.7	2800.3	23.5	8.0	60	10.52	2.11	0.91	139.3	658.9	4389.0	247.4	3977.5	**1755.60**	**1325.82**
23.50	26.50	25.00	3.00	24.0	20.52	10.52	129.15	9.43	8.0	8.0	1.0	171.14	1100.91	60	1.0	565.7	3366.0	26.5	7.5	65	10.10	2.02	0.84	139.3	684.0	5150.9	282.7	4749.7	**2060.36**	**1583.22**
26.50	27.50	27.00	1.00	25.0	20.10	10.10	129.15	3.14	7.5	7.5	1.0	53.44	1154.35	65	1.0	204.3	3570.3	27.5	7.5	65	10.33	2.02	0.84	139.3	684.1	5408.7	294.5	5019.2	**2163.48**	**1673.05**
27.50	28.00	27.75	0.50	25.5	20.33	10.33	129.15	1.57	7.5	7.5	1.0	26.72	1181.07	65	1.0	102.1	3672.4	28.0	7.5	65	10.33	2.02	0.84	139.3	684.1	5537.6	300.4	5153.9	**2215.02**	**1717.97**
28.00	29.50	28.75	1.50	27.0	20.33	10.33	129.15	4.71	7.5	7.5	1.0	80.16	1261.23	65	1.0	306.4	3978.9	29.5	7.5	65	10.33	2.02	0.84	139.3	684.1	5924.1	318.1	5558.2	**2369.66**	**1852.72**
29.50	30.00	29.75	0.50	27.5	20.33	10.33	129.15	1.57	7.5	7.5	1.0	26.72	1287.95	65	1.0	102.1	4081.0	30.0	8.7	66	10.33	2.24	1.02	139.3	715.5	6084.5	324.0	5692.9	**2433.78**	**1897.64**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
30.00	31.00	30.50	1.00	28.5	20.33	10.33	129.15	3.14	8.7	8.7	1.0	62.11	1350.06	66	1.0	207.4	4288.4	31.0	8.7	66	10.33	2.24	1.02	139.3	715.5	6354.0	335.8	5974.2	**2541.60**	**1991.41**
31.00	32.50	31.75	1.50	30.0	20.33	10.33	129.15	4.71	8.7	8.7	1.0	93.17	1443.23	66	1.0	311.1	4599.6	32.5	8.7	60	10.33	2.24	1.02	139.3	673.1	6715.9	353.4	6396.2	**2686.35**	**2132.08**
32.50	34.00	33.25	1.50	31.5	20.33	10.33	129.15	4.71	8.7	8.7	1.0	93.17	1536.39	60	1.0	282.9	4882.4	34.0	8.7	66	10.33	2.24	1.02	139.3	715.5	7134.3	371.1	6789.9	**2853.73**	**2263.31**
34.00	35.00	34.50	1.00	32.5	20.33	10.33	129.15	3.14	8.7	8.7	1.0	62.11	1598.50	66	1.0	207.4	5089.9	35.0	8.7	65	8.86	2.24	1.02	139.3	707.9	7396.2	382.9	7071.2	**2958.49**	**2357.08**
35.00	35.50	35.25	0.50	33.0	18.86	8.86	129.15	1.57	8.7	8.7	1.0	31.06	1629.56	65	1.0	102.1	5192.0	35.5	8.7	65	8.94	2.24	1.02	139.3	707.9	7529.4	388.8	7210.3	**3011.78**	**2403.44**
35.50	37.00	36.25	1.50	34.5	18.94	8.94	129.15	4.71	8.7	8.7	1.0	93.17	1722.73	65	1.0	306.4	5498.4	37.0	9.0	65	8.86	2.29	1.07	139.3	713.9	7935.1	406.4	7627.6	**3174.03**	**2542.53**
37.00	37.50	37.25	0.50	35.0	18.86	8.86	129.15	1.57	9.0	9.0	1.0	32.14	1754.87	65	1.0	102.1	5600.6	37.5	9.0	62	8.86	2.29	1.07	139.3	692.7	8048.1	412.3	7767.8	**3219.26**	**2589.26**
37.50	38.50	38.00	1.00	36.0	18.86	8.86	129.15	3.14	9.0	9.0	1.0	64.29	1819.16	62	1.0	194.9	5795.4	38.5	10.0	59	9.19	2.47	1.22	139.3	691.9	8306.5	424.1	8038.7	**3322.59**	**2679.57**
38.50	40.00	39.25	1.50	37.5	19.19	9.19	129.15	4.71	10.0	10.0	1.0	107.36	1926.52	59	1.0	278.1	6073.6	40.0	10.0	59	9.19	2.47	1.22	139.3	691.9	8692.0	441.8	8441.9	**3476.79**	**2813.96**
BORE NO: P57, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.59	9.59	26.37	1.57	24.8	24.8	1.0	19.15	0	0	1.0	0.0	0	3.0	25.4	0	9.59	10.90	11.80	28.8	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.5	19.59	9.59	38.36	6.29	25.4	25.4	1.0	114.49	0	0	1.0	0.0	0	5.0	27.6	2	10.74	15.85	16.87	48.0	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	20.74	10.74	53.32	3.14	27.6	27.6	1.0	87.61	0	2	1.0	6.3	0	6.0	27.6	2	10.74	15.85	16.87	58.7	816.5	816.5	41.2	41.2	**326.58**	**13.74**
6.00	8.00	7.00	2.00	5.5	20.74	10.74	69.43	6.29	27.6	27.6	1.0	228.15	228.15	2	1.0	12.6	12.6	8.0	27.6	2	10.74	15.85	16.87	80.2	1084.0	1324.8	64.8	305.5	**529.91**	**101.84**
8.00	9.00	8.50	1.00	6.5	20.74	10.74	85.54	3.14	27.6	27.6	1.0	140.55	368.70	2	1.0	6.3	18.9	9.0	9.6	53	10.32	2.40	1.16	90.9	550.8	938.3	76.6	464.1	**375.33**	**154.71**
9.00	11.00	10.00	2.00	8.5	20.32	10.32	101.23	6.29	9.6	9.6	1.0	107.62	476.32	53	1.0	333.1	352.0	11.0	9.6	53	10.32	2.40	1.16	111.6	589.7	1418.0	100.1	928.5	**567.19**	**309.49**
11.00	12.00	11.50	1.00	9.5	20.32	10.32	116.71	3.14	9.6	9.6	1.0	62.04	538.36	53	1.0	166.6	518.6	12.0	9.6	53	10.32	2.40	1.16	121.9	609.1	1666.0	111.9	1168.9	**666.41**	**389.62**
12.00	13.00	12.50	1.00	10.5	20.32	10.32	127.03	3.14	9.6	9.6	1.0	67.53	605.89	53	1.0	166.6	685.1	13.0	10.5	48	10.40	2.62	1.36	132.2	616.8	1907.8	123.7	1414.7	**763.14**	**471.58**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
13.00	14.50	13.75	1.50	12.0	20.40	10.40	139.99	4.71	10.5	10.5	1.0	122.32	728.20	48	1.0	226.3	911.4	14.5	10.5	48	10.40	2.62	1.36	147.8	648.9	2288.5	141.4	1781.0	**915.41**	**593.67**
14.50	16.00	15.25	1.50	13.5	20.40	10.40	139.99	4.71	10.5	10.5	1.0	122.32	850.52	48	1.0	226.3	1137.7	16.0	11.3	56	10.60	2.85	1.59	147.8	733.8	2722.1	159.0	2147.3	**1088.82**	**715.76**
16.00	17.50	16.75	1.50	15.0	20.60	10.60	139.99	4.71	11.3	11.3	1.0	131.87	982.39	56	1.0	264.0	1401.7	17.5	11.3	56	10.60	2.85	1.59	147.8	733.8	3117.9	176.7	2560.8	**1247.17**	**853.61**
17.50	19.00	18.25	1.50	16.5	20.60	10.60	139.99	4.71	11.3	11.3	1.0	131.87	1114.26	56	1.0	264.0	1665.7	19.0	25.2	6	9.55	10.45	11.34	147.8	1298.5	4078.5	194.4	2974.4	**1631.38**	**991.45**
19.00	20.50	19.75	1.50	18.0	19.55	9.55	139.99	4.71	25.2	25.2	1.0	310.55	1424.81	6	1.0	28.3	1694.0	20.5	9.1	45	9.55	2.31	1.08	147.8	590.3	3709.1	212.1	3330.9	**1483.64**	**1110.29**
20.50	22.50	21.50	2.00	20.0	19.55	9.55	139.99	6.29	9.1	9.1	1.0	140.94	1565.75	45	1.0	282.9	1976.9	22.5	9.1	57	10.17	2.31	1.08	147.8	675.4	4218.0	235.6	3778.2	**1687.20**	**1259.41**
22.50	23.50	23.00	1.00	21.0	20.17	10.17	139.99	3.14	9.1	9.1	1.0	70.47	1636.23	57	1.0	179.1	2156.0	23.5	9.1	57	10.17	2.31	1.08	147.8	675.4	4467.6	247.4	4039.6	**1787.05**	**1346.54**
23.50	25.00	24.25	1.50	22.5	20.17	10.17	139.99	4.71	9.1	9.1	1.0	105.71	1741.93	57	1.0	268.7	2424.7	25.0	28.1	0	10.17	16.98	18.02	147.8	2043.8	6210.5	265.1	4431.7	**2484.20**	**1477.24**
25.00	26.50	25.75	1.50	24.0	20.17	10.17	139.99	4.71	28.1	28.1	1.0	352.38	2094.32	0	1.0	0.0	2424.7	26.5	28.1	0	10.03	16.98	18.02	147.8	2042.8	6561.9	282.7	4801.8	**2624.75**	**1600.59**
26.50	27.50	27.00	1.00	25.0	20.03	10.03	139.99	3.14	28.1	28.1	1.0	234.92	2329.24	0	1.0	0.0	2424.7	27.5	28.1	0	10.03	16.98	18.02	147.8	2042.8	6796.8	294.5	5048.5	**2718.72**	**1682.83**
27.50	28.00	27.75	0.50	25.5	20.03	10.03	139.99	1.57	28.1	28.1	1.0	117.46	2446.70	0	1.0	0.0	2424.7	28.0	12.5	54	8.52	3.20	1.94	147.8	760.4	5631.8	300.4	5171.8	**2252.72**	**1723.94**
28.00	29.50	28.75	1.50	27.0	18.52	8.52	139.99	4.71	12.5	12.5	1.0	146.31	2593.01	54	1.0	254.6	2679.3	29.5	12.5	54	8.71	3.20	1.94	147.8	760.5	6032.8	318.1	5590.4	**2413.13**	**1863.46**
29.50	30.00	29.75	0.50	27.5	18.71	8.71	139.99	1.57	12.5	12.5	1.0	48.77	2641.77	54	1.0	84.9	2764.1	30.0	12.5	54	11.19	3.20	1.94	147.8	762.4	6168.3	324.0	5729.9	**2467.33**	**1909.96**
30.00	31.00	30.50	1.00	28.5	21.19	11.19	139.99	3.14	12.5	12.5	1.0	97.54	2739.31	54	1.0	169.7	2933.9	31.0	10.5	50	11.19	2.62	1.36	147.8	663.5	6336.6	335.8	6008.9	**2534.65**	**2002.98**
31.00	32.50	31.75	1.50	30.0	21.19	11.19	139.99	4.71	10.5	10.5	1.0	122.32	2861.63	50	1.0	235.7	3169.6	32.5	10.5	50	11.19	2.62	1.36	147.8	663.5	6694.7	353.4	6384.6	**2677.86**	**2128.21**
32.50	34.00	33.25	1.50	31.5	21.19	11.19	139.99	4.71	10.5	10.5	1.0	122.32	2983.94	50	1.0	235.7	3405.3	34.0	28.8	0	11.19	18.56	19.64	147.8	2241.2	8630.4	371.1	6760.3	**3452.17**	**2253.44**
34.00	35.00	34.50	1.00	32.5	21.19	11.19	139.99	3.14	28.8	28.8	1.0	241.87	3225.82	0	1.0	0.0	3405.3	35.0	28.8	0	11.19	18.56	19.64	147.8	2241.2	8872.3	382.9	7014.0	**3548.92**	**2338.00**
35.00	35.50	35.25	0.50	33.0	21.19	11.19	139.99	1.57	28.8	28.8	1.0	120.94	3346.76	0	1.0	0.0	3405.3	35.5	30.9	0	11.19	25.79	27.01	147.8	3113.9	9865.9	388.8	7140.8	**3946.37**	**2380.27**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
35.50	37.50	36.50	2.00	35.0	21.19	11.19	139.99	6.29	30.9	30.9	1.0	550.33	3897.09	0	1.0	0.0	3405.3	37.5	30.1	0	8.95	21.76	22.91	147.8	2607.7	9910.1	412.3	7714.7	**3964.04**	**2571.57**
37.50	38.50	38.00	1.00	36.0	18.95	8.95	139.99	3.14	30.1	30.1	1.0	256.32	4153.40	0	1.0	0.0	3405.3	38.5	29.8	0	9.01	20.81	21.94	147.8	2494.0	10052.7	424.1	7982.8	**4021.09**	**2660.93**
38.50	40.00	39.25	1.50	37.5	19.01	9.01	139.99	4.71	29.8	29.8	1.0	377.96	4531.36	0	1.0	0.0	3405.3	40.0	29.8	0	9.01	20.81	21.94	147.8	2494.0	10430.7	441.8	8378.4	**4172.27**	**2792.81**
BORE NO: P58, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.05	10.05	27.64	1.57	12.1	12.1	1.0	9.31	0	15	1.0	23.6	0	3.0	24.5	0	10.05	9.64	10.33	30.2	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.5	20.05	10.05	35.18	3.14	24.5	24.5	1.0	50.38	0	0	1.0	0.0	0	4.0	27.4	2	9.79	15.40	16.41	40.2	563.8	563.8	17.7	17.7	**225.53**	**5.89**
4.00	6.00	5.00	2.00	3.5	19.79	9.79	49.99	6.29	27.4	27.4	1.0	162.88	162.88	2	1.0	12.6	12.6	6.0	28.7	0	9.79	18.33	19.40	59.8	935.7	1111.1	41.2	216.7	**444.46**	**72.23**
6.00	7.00	6.50	1.00	4.5	19.79	9.79	64.68	3.14	28.7	28.7	1.0	111.28	274.16	0	1.0	0.0	12.6	7.0	28.7	0	9.40	18.33	19.40	69.6	1073.7	1360.5	53.0	339.7	**544.18**	**113.25**
7.00	9.00	8.00	2.00	6.5	19.40	9.40	78.97	6.29	28.7	28.7	1.0	271.76	545.92	0	1.0	0.0	12.6	9.0	28.7	0	9.40	18.33	19.40	88.4	1344.5	1903.0	76.6	635.1	**761.21**	**211.69**
9.00	10.00	9.50	1.00	7.5	19.40	9.40	93.07	3.14	28.7	28.7	1.0	160.14	706.07	0	1.0	0.0	12.6	10.0	28.0	0	9.40	16.76	17.79	97.8	1352.9	2071.5	88.4	807.0	**828.60**	**269.00**
10.00	11.00	10.50	1.00	8.5	19.40	9.40	102.47	3.14	28.0	28.0	1.0	171.24	877.30	0	1.0	0.0	12.6	11.0	24.8	8	10.21	9.86	10.66	107.2	929.3	1819.1	100.1	990.0	**727.65**	**330.00**
11.00	12.50	11.75	1.50	10.0	20.21	10.21	114.83	4.71	24.8	24.8	1.0	250.13	1127.43	8	1.0	37.7	50.3	12.5	10.6	50	10.27	2.65	1.39	122.5	613.9	1791.6	117.8	1295.5	**716.64**	**431.84**
12.50	15.50	14.00	3.00	13.0	20.27	10.27	137.89	9.43	10.6	10.6	1.0	243.31	1370.74	50	1.0	471.4	521.7	15.5	10.6	50	10.27	2.65	1.39	122.5	613.9	2506.3	153.2	2045.6	**1002.53**	**681.87**
15.50	17.00	16.25	1.50	14.5	20.27	10.27	137.89	4.71	10.6	10.6	1.0	121.65	1492.39	50	1.0	235.7	757.4	17.0	26.8	0	9.29	14.05	15.03	122.5	1407.3	3657.1	170.8	2420.6	**1462.86**	**806.88**
17.00	18.50	17.75	1.50	16.0	19.29	9.29	137.89	4.71	26.8	26.8	1.0	328.37	1820.76	0	1.0	0.0	757.4	18.5	26.8	0	9.29	14.05	15.03	122.5	1407.3	3985.5	188.5	2766.7	**1594.20**	**922.23**
18.50	20.00	19.25	1.50	17.5	19.29	9.29	137.89	4.71	26.8	26.8	1.0	328.37	2149.12	0	1.0	0.0	757.4	20.0	27.2	6	9.68	14.95	15.95	122.5	1542.2	4448.8	206.2	3112.7	**1779.52**	**1037.57**
20.00	21.50	20.75	1.50	19.0	19.68	9.68	137.89	4.71	27.2	27.2	1.0	334.08	2483.21	6	1.0	28.3	785.7	21.5	11.0	45	9.68	2.76	1.51	122.5	589.9	3858.9	223.8	3492.8	**1543.55**	**1164.25**
21.50	23.00	22.25	1.50	20.5	19.68	9.68	137.89	4.71	11.0	11.0	1.0	126.36	2609.56	45	1.0	212.1	997.9	23.0	11.0	45	9.68	2.76	1.51	122.5	589.9	4197.4	241.5	3848.9	**1678.95**	**1282.98**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
23.00	24.50	23.75	1.50	22.0	19.68	9.68	137.89	4.71	11.0	11.0	1.0	126.36	2735.92	45	1.0	212.1	1210.0	24.5	9.4	58	10.37	2.36	1.13	122.5	642.1	4588.0	259.2	4205.1	**1835.19**	**1401.70**
24.50	27.50	26.00	3.00	25.0	20.37	10.37	137.89	9.43	9.4	9.4	1.0	215.23	2951.15	58	1.0	546.9	1756.9	27.5	7.0	70	10.37	1.93	0.76	122.5	683.8	5391.8	294.5	5002.5	**2156.73**	**1667.51**
27.50	29.00	28.25	1.50	26.5	20.37	10.37	137.89	4.71	7.0	7.0	1.0	79.82	3030.97	70	1.0	330.0	2086.9	29.0	9.0	54	10.37	2.29	1.07	122.5	606.6	5724.4	312.2	5430.0	**2289.76**	**1810.01**
29.00	30.00	29.50	1.00	27.5	20.37	10.37	137.89	3.14	9.0	9.0	1.0	68.64	3099.61	54	1.0	169.7	2256.6	30.0	9.0	54	8.77	2.29	1.07	122.5	605.9	5962.1	324.0	5680.2	**2384.84**	**1893.39**
30.00	30.50	30.25	0.50	28.0	18.77	8.77	137.89	1.57	9.0	9.0	1.0	34.32	3133.93	54	1.0	84.9	2341.4	30.5	31.2	0	9.06	27.30	28.55	122.5	2729.4	8204.7	329.9	5805.2	**3281.88**	**1935.07**
30.50	32.00	31.25	1.50	29.5	19.06	9.06	137.89	4.71	31.2	31.2	1.1	417.31	3551.23	0	1.0	0.0	2341.4	32.0	20.0	48	9.06	6.40	5.39	122.5	974.5	6867.2	347.5	6240.2	**2746.88**	**2080.07**
32.00	32.50	32.25	0.50	30.0	19.06	9.06	137.89	1.57	20.0	20.0	1.0	78.87	3630.10	48	1.0	75.4	2416.9	32.5	20.0	48	9.06	6.40	5.39	122.5	974.5	7021.5	353.4	6400.4	**2808.60**	**2133.46**
32.50	33.50	33.00	1.00	31.0	19.06	9.06	137.89	3.14	20.0	20.0	1.0	157.73	3787.83	48	1.0	150.9	2567.7	33.5	31.1	0	8.86	26.80	28.04	122.5	2676.8	9032.4	365.2	6720.8	**3612.96**	**2240.25**
33.50	35.00	34.25	1.50	32.5	18.86	8.86	137.89	4.71	31.1	31.1	1.1	413.70	4201.54	0	1.0	0.0	2567.7	35.0	31.3	0	8.69	27.81	29.06	122.5	2775.4	9544.7	382.9	7152.1	**3817.87**	**2384.04**
35.00	36.50	35.75	1.50	34.0	18.69	8.69	137.89	4.71	31.3	31.3	1.1	420.93	4622.47	0	1.0	0.0	2567.7	36.5	31.3	0	8.63	27.81	29.06	122.5	2774.7	9964.9	400.6	7590.7	**3985.97**	**2530.24**
36.50	37.50	37.00	1.00	35.0	18.63	8.63	137.89	3.14	31.3	31.3	1.1	280.62	4903.09	0	1.0	0.0	2567.7	37.5	31.9	0	8.63	30.83	32.14	122.5	3076.1	10546.9	412.3	7883.1	**4218.74**	**2627.71**
37.50	38.00	37.75	0.50	35.5	18.63	8.63	137.89	1.57	31.9	31.9	1.1	147.69	5050.77	0	1.0	0.0	2567.7	38.0	34.3	0	8.62	42.92	44.44	122.5	4281.1	11899.6	418.2	8036.7	**4759.83**	**2678.90**
38.00	40.00	39.00	2.00	37.5	18.62	8.62	137.89	6.29	34.3	34.3	1.2	718.37	5769.14	0	1.0	0.0	2567.7	40.0	34.3	0	8.62	42.92	44.44	122.5	4281.1	12617.9	441.8	8778.6	**5047.18**	**2926.21**
BORE NO: P59, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.41	9.41	25.88	1.57	26.7	26.7	1.0	20.45	0	4	1.0	6.3	0	3.0	26.7	0	9.41	13.83	14.80	28.2	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.5	19.41	9.41	32.94	3.14	26.7	26.7	1.0	52.06	0	0	1.0	0.0	0	4.0	7.2	62	9.29	1.97	0.79	37.6	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.5	19.29	9.29	42.29	3.14	7.2	7.2	1.0	16.79	0	62	1.0	194.9	0	5.0	7.2	62	9.29	1.97	0.79	46.9	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.29	9.29	51.58	3.14	7.2	7.2	1.0	20.48	0	62	1.0	194.9	0	6.0	7.2	62	9.29	1.97	0.79	56.2	0	0.0	41.2	41.2	**0.00**	**13.74**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
6.00	7.00	6.50	1.00	4.5	19.29	9.29	60.87	3.14	7.2	7.2	1.0	24.17	0	62	1.0	194.9	0	7.0	28.4	0	9.00	17.66	18.71	65.5	0	0.0	53.0	53.0	**0.00**	**17.67**
7.00	8.00	7.50	1.00	5.5	19.00	9.00	70.01	3.14	28.4	28.4	1.0	118.97	0	0	1.0	0.0	0	8.0	28.4	0	9.00	17.66	18.71	74.5	1099.8	1099.8	64.8	64.8	**439.94**	**21.60**
8.00	9.00	8.50	1.00	6.5	19.00	9.00	79.01	3.14	28.4	28.4	1.0	134.26	134.26	0	1.0	0.0	0.0	9.0	28.7	0	9.00	18.33	19.40	83.5	1271.5	1405.7	76.6	210.8	**562.29**	**70.28**
9.00	10.00	9.50	1.00	7.5	19.00	9.00	88.01	3.14	28.7	28.7	1.0	151.44	285.70	0	1.0	0.0	0.0	10.0	11.5	40	10.10	2.91	1.65	92.5	501.0	786.7	88.4	374.1	**314.68**	**124.69**
10.00	11.00	10.50	1.00	8.5	20.10	10.10	97.56	3.14	11.5	11.5	1.0	62.38	348.08	40	1.0	125.7	125.7	11.0	8.4	55	10.10	2.18	0.97	102.6	568.7	1042.5	100.1	573.9	**417.00**	**191.31**
11.00	12.00	11.50	1.00	9.5	20.10	10.10	107.66	3.14	8.4	8.4	1.0	49.96	398.05	55	1.0	172.9	298.6	12.0	8.4	55	10.31	2.18	0.97	112.7	586.1	1282.7	111.9	808.5	**513.09**	**269.51**
12.00	14.50	13.25	2.50	12.0	20.31	10.31	125.60	7.86	8.4	8.4	1.0	145.72	543.77	55	1.0	432.1	730.7	14.5	8.4	55	9.77	2.18	0.97	138.5	630.1	1904.6	141.4	1415.9	**761.83**	**471.95**
14.50	17.50	16.00	3.00	15.0	19.77	9.77	125.60	9.43	8.4	8.4	1.0	174.87	718.64	55	1.0	518.6	1249.3	17.5	11.8	50	9.77	3.00	1.73	138.5	686.6	2654.5	176.7	2144.6	**1061.80**	**714.88**
17.50	19.00	18.25	1.50	16.5	19.77	9.77	125.60	4.71	11.8	11.8	1.0	123.70	842.34	50	1.0	235.7	1485.0	19.0	27.6	2	9.52	15.85	16.87	138.5	1802.4	4129.7	194.4	2521.7	**1651.90**	**840.57**
19.00	20.50	19.75	1.50	18.0	19.52	9.52	125.60	4.71	27.6	27.6	1.0	309.54	1151.88	2	1.0	9.4	1494.4	20.5	27.6	2	9.52	15.85	16.87	138.5	1802.4	4448.7	212.1	2858.4	**1779.49**	**952.79**
20.50	23.50	22.00	3.00	21.0	19.52	9.52	125.60	9.43	27.6	27.6	1.0	619.09	1770.97	2	1.0	18.9	1513.3	23.5	12.6	38	9.07	3.23	1.96	138.5	627.5	3911.8	247.4	3531.7	**1564.71**	**1177.22**
23.50	25.00	24.25	1.50	22.5	19.07	9.07	125.60	4.71	12.6	12.6	1.0	132.35	1903.32	38	1.0	179.1	1692.4	25.0	12.6	38	9.41	3.23	1.96	138.5	627.8	4223.5	265.1	3860.8	**1689.41**	**1286.94**
25.00	26.50	25.75	1.50	24.0	19.41	9.41	125.60	4.71	12.6	12.6	1.0	132.35	2035.67	38	1.0	179.1	1871.6	26.5	12.6	38	9.80	3.23	1.96	138.5	628.1	4535.3	282.7	4190.0	**1814.13**	**1396.66**
26.50	27.50	27.00	1.00	25.0	19.80	9.80	125.60	3.14	12.6	12.6	1.0	88.23	2123.90	38	1.0	119.4	1991.0	27.5	13.0	45	10.12	3.35	2.08	138.5	691.0	4805.9	294.5	4409.4	**1922.36**	**1469.81**
27.50	28.00	27.75	0.50	25.5	20.12	10.12	125.60	1.57	13.0	13.0	1.0	45.57	2169.47	45	1.0	70.7	2061.7	28.0	7.0	75	10.12	1.93	0.76	138.5	743.4	4974.6	300.4	4531.6	**1989.82**	**1510.53**
28.00	29.50	28.75	1.50	27.0	20.12	10.12	125.60	4.71	7.0	7.0	1.0	72.70	2242.17	75	1.0	353.6	2415.3	29.5	15.3	40	10.12	4.09	2.81	138.5	738.8	5396.3	318.1	4975.5	**2158.51**	**1658.51**
29.50	30.00	29.75	0.50	27.5	20.12	10.12	125.60	1.57	15.3	15.3	1.0	53.99	2296.16	40	1.0	62.9	2478.1	30.0	15.3	40	10.12	4.09	2.81	138.5	738.8	5513.1	324.0	5098.3	**2205.25**	**1699.43**
30.00	31.00	30.50	1.00	28.5	20.12	10.12	125.60	3.14	15.3	15.3	1.0	107.99	2404.15	40	1.0	125.7	2603.9	31.0	28.4	0	10.12	17.66	18.71	138.5	1995.6	7003.6	335.8	5343.8	**2801.44**	**1781.25**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
31.00	32.50	31.75	1.50	30.0	20.12	10.12	125.60	4.71	28.4	28.4	1.0	320.15	2724.30	0	1.0	0.0	2603.9	32.5	28.4	0	10.12	17.66	18.71	138.5	1995.6	7323.7	353.4	5681.6	**2929.50**	**1893.86**
32.50	34.00	33.25	1.50	31.5	20.12	10.12	125.60	4.71	28.4	28.4	1.0	320.15	3044.45	0	1.0	0.0	2603.9	34.0	29.6	5	10.28	20.36	21.48	138.5	2337.3	7985.6	371.1	6019.4	**3194.25**	**2006.47**
34.00	35.00	34.50	1.00	32.5	20.28	10.28	125.60	3.14	29.6	29.6	1.0	224.24	3268.69	5	1.0	15.7	2619.6	35.0	29.6	5	10.28	20.36	21.48	138.5	2337.3	8225.6	382.9	6271.1	**3290.23**	**2090.38**
35.00	35.50	35.25	0.50	33.0	20.28	10.28	125.60	1.57	29.6	29.6	1.0	112.12	3380.81	5	1.0	7.9	2627.4	35.5	29.2	0	10.28	19.46	20.56	138.5	2200.2	8208.5	388.8	6397.0	**3283.39**	**2132.34**
35.50	37.00	36.25	1.50	34.5	20.28	10.28	125.60	4.71	29.2	29.2	1.0	330.91	3711.72	0	1.0	0.0	2627.4	37.0	29.2	0	10.28	19.46	20.56	138.5	2200.2	8539.4	406.4	6745.6	**3415.76**	**2248.53**
37.00	37.50	37.25	0.50	35.0	20.28	10.28	125.60	1.57	29.2	29.2	1.0	110.30	3822.03	0	1.0	0.0	2627.4	37.5	29.2	0	8.86	19.46	20.56	138.5	2188.8	8638.2	412.3	6861.8	**3455.29**	**2287.26**
37.50	38.50	38.00	1.00	36.0	18.86	8.86	125.60	3.14	29.2	29.2	1.0	220.61	4042.64	0	1.0	0.0	2627.4	38.5	29.2	0	8.80	19.46	20.56	138.5	2188.3	8858.4	424.1	7094.2	**3543.34**	**2364.73**
38.50	40.00	39.25	1.50	37.5	18.80	8.80	125.60	4.71	29.2	29.2	1.0	330.91	4373.55	0	1.0	0.0	2627.4	40.0	29.2	0	8.80	19.46	20.56	138.5	2188.3	9189.3	441.8	7442.8	**3675.71**	**2480.92**
BORE NO: P60, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.72	10.72	29.48	1.57	9.7	9.7	1.0	7.92	0	62.0	1.0	97.4	0	3.0	8.1	30	10.72	2.13	0.93	32.2	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.5	20.72	10.72	37.52	3.14	8.1	8.1	1.0	16.78	0	30.0	1.0	94.3	0	4.0	8.1	30	10.72	2.13	0.93	42.9	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.5	20.72	10.72	48.24	3.14	8.1	8.1	1.0	21.58	0	30.0	1.0	94.3	0	5.0	29.4	5	9.64	19.91	21.02	53.6	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.5	19.64	9.64	58.42	3.14	29.4	29.4	1.0	103.46	0	5.0	1.0	15.7	0	6.0	29.4	5	9.64	19.91	21.02	63.2	1104.2	1104.2	41.2	41.2	**441.67**	**13.74**
6.00	7.00	6.50	1.00	4.5	19.64	9.64	68.06	3.14	29.4	29.4	1.0	120.53	120.53	5.0	1.0	15.7	15.7	7.0	28.7	0	9.64	18.33	19.40	72.9	1123.2	1259.5	53.0	189.3	**503.79**	**63.09**
7.00	9.00	8.00	2.00	6.5	19.64	9.64	82.52	6.29	28.7	28.7	1.0	283.98	404.51	0.0	1.0	0.0	15.7	9.0	24.6	14	10.41	9.71	10.44	92.2	845.0	1265.2	76.6	496.8	**506.07**	**165.60**
9.00	10.00	9.50	1.00	7.5	20.41	10.41	97.37	3.14	24.6	24.6	1.0	140.10	544.61	14.0	1.0	44.0	59.7	10.0	24.6	14	10.41	9.71	10.44	102.6	924.4	1528.7	88.4	692.7	**611.49**	**230.89**
10.00	11.00	10.50	1.00	8.5	20.41	10.41	107.78	3.14	24.6	24.6	1.0	155.08	699.68	14.0	1.0	44.0	103.7	11.0	24.6	14	10.41	9.71	10.44	113.0	1003.8	1807.2	100.1	903.5	**722.89**	**301.18**
11.00	12.50	11.75	1.50	10.0	20.41	10.41	120.79	4.71	24.6	24.6	1.0	260.70	960.39	14.0	1.0	66.0	169.7	12.5	24.6	14	10.41	9.71	10.44	128.6	1123.0	2253.1	117.8	1247.9	**901.24**	**415.97**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m — Factor of Safety in Compression: 2.5 — Area of Pile: 0.79 m^2

Critical water table: 0.00 m — Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
12.50	14.00	13.25	1.50	11.5	20.41	10.41	136.40	4.71	24.6	24.6	1.0	294.41	1254.80	14.0	1.0	66.0	235.7	14.0	24.6	14	10.86	9.71	10.44	144.2	1244.0	2734.5	135.5	1626.0	**1093.80**	**542.00**
14.00	15.50	14.75	1.50	13.0	20.86	10.86	152.36	4.71	24.6	24.6	1.0	328.84	1583.63	14.0	1.0	66.0	301.7	15.5	24.6	14	10.86	9.71	10.44	144.2	1244.0	3129.3	153.2	2038.5	**1251.74**	**679.50**
15.50	17.00	16.25	1.50	14.5	20.86	10.86	152.36	4.71	24.6	24.6	1.0	328.84	1912.47	14.0	1.0	66.0	367.7	17.0	23.9	15	10.66	9.21	9.67	144.2	1189.9	3470.1	170.8	2451.0	**1388.04**	**817.00**
17.00	18.50	17.75	1.50	16.0	20.66	10.66	152.36	4.71	23.9	23.9	1.0	318.28	2230.75	15.0	1.0	70.7	438.4	18.5	23.9	15	10.66	9.21	9.67	144.2	1189.9	3859.1	188.5	2857.7	**1543.64**	**952.56**
18.50	20.00	19.25	1.50	17.5	20.66	10.66	152.36	4.71	23.9	23.9	1.0	318.28	2549.04	15.0	1.0	70.7	509.1	20.0	23.7	19	10.65	9.06	9.45	144.2	1200.9	4259.1	206.2	3264.3	**1703.64**	**1088.12**
20.00	21.50	20.75	1.50	19.0	20.65	10.65	152.36	4.71	23.7	23.7	1.0	315.29	2864.32	19.0	1.0	89.6	598.7	21.5	23.7	19	9.78	9.06	9.45	144.2	1197.7	4660.7	223.8	3686.9	**1864.29**	**1228.96**
21.50	24.50	23.00	3.00	22.0	19.78	9.78	152.36	9.43	23.7	23.7	1.0	630.58	3494.90	19.0	1.0	179.1	777.9	24.5	23.7	19	9.78	9.06	9.45	144.2	1197.7	5470.5	259.2	4531.9	**2188.18**	**1510.65**
24.50	26.00	25.25	1.50	23.5	19.78	9.78	152.36	4.71	23.7	23.7	1.0	315.29	3810.19	19.0	1.0	89.6	867.4	26.0	6.4	60	9.96	1.82	0.67	144.2	633.3	5311.0	276.9	4954.5	**2124.38**	**1651.49**
26.00	27.50	26.75	1.50	25.0	19.96	9.96	152.36	4.71	6.4	6.4	1.0	80.56	3890.75	60.0	1.0	282.9	1150.3	27.5	6.4	60	9.96	1.82	0.67	144.2	633.3	5674.4	294.5	5335.6	**2269.75**	**1778.52**
27.50	29.00	28.25	1.50	26.5	19.96	9.96	152.36	4.71	6.4	6.4	1.0	80.56	3971.32	60.0	1.0	282.9	1433.1	29.0	9.1	39	10.86	2.31	1.08	144.2	541.9	5946.4	312.2	5716.7	**2378.55**	**1905.55**
29.00	30.00	29.50	1.00	27.5	20.86	10.86	152.36	3.14	9.1	9.1	1.0	76.70	4048.01	39.0	1.0	122.6	1555.7	30.0	9.1	39	10.86	2.31	1.08	144.2	541.9	6145.6	324.0	5927.7	**2458.26**	**1975.90**
30.00	30.50	30.25	0.50	28.0	20.86	10.86	152.36	1.57	9.1	9.1	1.0	38.35	4086.36	39.0	1.0	61.3	1617.0	30.5	6.4	60	10.86	1.82	0.67	144.2	633.6	6336.9	329.9	6033.2	**2534.77**	**2011.08**
30.50	32.00	31.25	1.50	29.5	20.86	10.86	152.36	4.71	6.4	6.4	1.0	80.56	4166.92	60.0	1.0	282.9	1899.9	32.0	9.1	39	9.30	2.31	1.08	144.2	541.3	6608.0	347.5	6414.3	**2643.21**	**2138.11**
32.00	32.50	32.25	0.50	30.0	19.30	9.30	152.36	1.57	9.1	9.1	1.0	38.35	4205.27	39.0	1.0	61.3	1961.1	32.5	9.1	39	9.30	2.31	1.08	144.2	541.3	6707.7	353.4	6519.8	**2683.07**	**2173.28**
32.50	33.50	33.00	1.00	31.0	19.30	9.30	152.36	3.14	9.1	9.1	1.0	76.70	4281.97	39.0	1.0	122.6	2083.7	33.5	23.0	0	9.30	8.56	8.68	144.2	1001.6	7367.3	365.2	6730.9	**2946.93**	**2243.63**
33.50	35.00	34.25	1.50	32.5	19.30	9.30	152.36	4.71	23.0	23.0	1.0	304.88	4586.84	0.0	1.0	0.0	2083.7	35.0	15.5	52	9.30	4.19	2.92	144.2	852.7	7523.3	382.9	7053.4	**3009.31**	**2351.15**
35.00	36.50	35.75	1.50	34.0	19.30	9.30	152.36	4.71	15.5	15.5	1.0	199.19	4786.03	52.0	1.0	245.1	2328.9	36.5	8.5	46	9.60	2.20	0.99	144.2	578.3	7693.2	400.6	7515.4	**3077.27**	**2505.15**
36.50	37.50	37.00	1.00	35.0	19.60	9.60	152.36	3.14	8.5	8.5	1.0	71.56	4857.59	46.0	1.0	144.6	2473.4	37.5	8.5	46	9.60	2.20	0.99	144.2	578.3	7909.3	412.3	7743.4	**3163.73**	**2581.12**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	∑Qi	c	α	α.c.Asi	∑Qi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
37.50	38.00	37.75	0.50	35.5	19.60	9.60	152.36	1.57	8.5	8.5	1.0	35.78	4893.37	46.0	1.0	72.3	2545.7	38.0	8.5	67	8.10	2.20	0.99	144.2	726.2	8165.3	418.2	7857.3	**3266.12**	**2619.10**
38.00	40.00	39.00	2.00	37.5	18.10	8.10	152.36	6.29	8.5	8.5	1.0	143.12	5036.50	67.0	1.0	421.1	2966.9	40.0	8.5	67	8.10	2.20	0.99	144.2	726.2	8729.6	441.8	8445.1	**3491.83**	**2815.05**

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2
Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: P41, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.61	10.61	29.18	1.89	7.4	7.4	1.0	7.15	0	62	1.0	116.9	0	3.0	7.4	62	10.61	2.00	0.82	31.8	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.5	20.61	10.61	37.14	3.77	7.4	7.4	1.0	18.19	0	62	1.0	233.8	0	4.0	6.8	60	10.61	1.89	0.73	42.4	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	5.00	4.50	1.00	2.5	20.61	10.61	47.75	3.77	6.8	6.8	1.0	21.47	0	60	1.0	226.3	0	5.0	28.3	1	9.32	17.43	18.48	53.1	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.32	9.32	57.71	3.77	28.3	28.3	1.0	117.19	0	1	1.0	3.8	0	6.0	28.3	1	9.32	17.43	18.48	62.4	1357.2	1357.2	59.4	59.4	**542.88**	**19.79**
6.00	7.00	6.50	1.00	4.5	19.32	9.32	67.03	3.77	28.3	28.3	1.0	136.12	136.12	1	1.0	3.8	3.8	7.0	12.2	43	9.32	3.12	1.85	71.7	702.3	842.2	76.3	216.2	**336.89**	**72.08**
7.00	8.00	7.50	1.00	5.5	19.32	9.32	76.35	3.77	12.2	12.2	1.0	62.26	198.37	43	1.0	162.2	165.9	8.0	12.2	43	10.08	3.12	1.85	81.0	736.2	1100.5	93.3	457.6	**440.19**	**152.54**
8.00	9.00	8.50	1.00	6.5	20.08	10.08	86.05	3.77	12.2	12.2	1.0	70.17	268.54	43	1.0	162.2	328.1	9.0	12.2	43	10.08	3.12	1.85	91.1	771.7	1368.4	110.3	706.9	**547.34**	**235.64**
9.00	10.00	9.50	1.00	7.5	20.08	10.08	96.13	3.77	12.2	12.2	1.0	78.39	346.93	43	1.0	162.2	490.3	10.0	10.7	53	10.08	2.68	1.42	101.2	855.7	1692.9	127.2	964.4	**677.16**	**321.48**
10.00	11.00	10.50	1.00	8.5	20.08	10.08	106.21	3.77	10.7	10.7	1.0	75.69	422.61	53	1.0	199.9	690.2	11.0	10.7	53	10.37	2.68	1.42	111.3	886.5	1999.3	144.2	1257.0	**799.71**	**418.99**
11.00	12.50	11.75	1.50	10.0	20.37	10.37	119.03	5.66	10.7	10.7	1.0	127.23	549.85	53	1.0	299.8	990.0	12.5	11.5	58	10.16	2.91	1.65	126.8	1019.6	2559.5	169.6	1709.5	**1023.79**	**569.83**
12.50	15.50	14.00	3.00	13.0	20.16	10.16	142.05	11.31	11.5	11.5	1.0	326.98	876.82	58	1.0	656.2	1646.2	15.5	9.7	62	10.40	2.42	1.17	157.3	1069.6	3592.6	220.5	2743.6	**1437.05**	**914.53**
15.50	18.50	17.00	3.00	16.0	20.40	10.40	172.89	11.31	9.7	9.7	1.0	334.36	1211.18	62	1.0	701.5	2347.7	18.5	14.8	31	10.40	3.88	2.59	157.3	1024.8	4583.7	271.4	3830.3	**1833.48**	**1276.78**
18.50	20.00	19.25	1.50	17.5	20.40	10.40	172.89	5.66	14.8	14.8	1.0	258.41	1469.59	31	1.0	175.4	2523.1	20.0	8.3	60	10.40	2.16	0.96	157.3	1002.8	4995.5	296.9	4289.6	**1998.20**	**1429.85**
20.00	21.50	20.75	1.50	19.0	20.40	10.40	172.89	5.66	8.3	8.3	1.0	142.68	1612.27	60	1.0	339.4	2862.5	21.5	8.9	48	10.86	2.27	1.05	157.3	900.8	5375.6	322.3	4797.1	**2150.25**	**1599.04**
21.50	24.50	23.00	3.00	22.0	20.86	10.86	172.89	11.31	8.9	8.9	1.0	306.31	1918.58	48	1.0	543.1	3405.6	24.5	8.9	48	10.86	2.27	1.05	157.3	900.8	6225.0	373.2	5697.4	**2490.01**	**1899.13**
24.50	26.00	25.25	1.50	23.5	20.86	10.86	172.89	5.66	8.9	8.9	1.0	153.16	2071.74	48	1.0	271.5	3677.1	26.0	24.8	8	9.49	9.86	10.66	157.3	1904.1	7653.0	398.7	6147.5	**3061.18**	**2049.18**

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m — Factor of Safety in Compression: 2.5 — Area of Pile: 1.13 m^2

Critical water table: 0.00 m — Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
26.00	27.50	26.75	1.50	25.0	19.49	9.49	172.89	5.66	24.8	24.8	1.0	451.92	2523.65	8	1.0	45.3	3722.4	27.5	10.0	45	9.49	2.47	1.22	157.3	905.6	7151.7	424.1	6670.2	**2860.68**	**2223.39**
27.50	29.00	28.25	1.50	26.5	19.49	9.49	172.89	5.66	10.0	10.0	1.0	172.45	2696.10	45	1.0	254.6	3977.0	29.0	24.7	10	9.76	9.78	10.55	157.3	1912.9	8585.9	449.6	7122.6	**3434.38**	**2374.21**
29.00	30.00	29.50	1.00	27.5	19.76	9.76	172.89	3.77	24.7	24.7	1.0	299.90	2996.00	10	1.0	37.7	4014.7	30.0	24.0	0	9.76	9.28	9.78	157.3	1716.3	8726.9	466.5	7477.2	**3490.78**	**2492.40**
30.00	30.50	30.25	0.50	28.0	19.76	9.76	172.89	1.89	24.0	24.0	1.0	145.15	3141.15	0	1.0	0.0	4014.7	30.5	24.4	0	9.76	9.57	10.22	157.3	1770.4	8926.2	475.0	7630.8	**3570.50**	**2543.62**
30.50	32.00	31.25	1.50	29.5	19.76	9.76	172.89	5.66	24.4	24.4	1.0	443.66	3584.81	0	1.0	0.0	4014.7	32.0	7.6	41	10.43	2.04	0.85	157.3	786.2	8385.7	500.5	8099.9	**3354.28**	**2699.98**
32.00	32.50	32.25	0.50	30.0	20.43	10.43	172.89	1.89	7.6	7.6	1.0	43.50	3628.31	41	1.0	77.3	4092.0	32.5	7.6	41	10.43	2.04	0.85	157.3	786.2	8506.5	508.9	8229.2	**3402.60**	**2743.08**
32.50	33.50	33.00	1.00	31.0	20.43	10.43	172.89	3.77	7.6	7.6	1.0	87.00	3715.31	41	1.0	154.6	4246.6	33.5	28.3	0	10.43	17.43	18.48	157.3	3232.9	11194.8	525.9	8487.8	**4477.93**	**2829.28**
33.50	35.00	34.25	1.50	32.5	20.43	10.43	172.89	5.66	28.3	28.3	1.0	526.62	4241.92	0	1.0	0.0	4246.6	35.0	26.1	4	10.84	12.48	13.41	157.3	2359.8	10848.4	551.3	9039.9	**4339.35**	**3013.30**
35.00	36.50	35.75	1.50	34.0	20.84	10.84	172.89	5.66	26.1	26.1	1.0	479.13	4721.06	4	1.0	22.6	4269.3	36.5	8.1	60	10.84	2.13	0.93	157.3	996.5	9986.8	576.8	9567.1	**3994.72**	**3189.04**
36.50	37.50	37.00	1.00	35.0	20.84	10.84	172.89	3.77	8.1	8.1	1.0	92.80	4813.85	60	1.0	226.3	4495.5	37.5	8.1	60	10.84	2.13	0.93	157.3	996.5	10305.9	593.8	9903.2	**4122.35**	**3301.05**
37.50	38.00	37.75	0.50	35.5	20.84	10.84	172.89	1.89	8.1	8.1	1.0	46.40	4860.25	60	1.0	113.1	4608.7	38.0	8.1	60	9.63	2.13	0.93	157.3	995.7	10464.7	602.2	10071.2	**4185.87**	**3357.06**
38.00	40.00	39.00	2.00	37.5	19.63	9.63	172.89	7.54	8.1	8.1	1.0	185.59	5045.85	60	1.0	452.6	5061.3	40.0	8.1	60	9.20	2.13	0.93	157.3	995.5	11102.6	636.2	10743.3	**4441.02**	**3581.09**
BORE NO: P42, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.28	10.28	28.27	1.89	8.6	8.6	1.0	8.06	0	47	1.0	88.6	0	3.0	14.4	36	10.28	3.77	2.48	30.8	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.5	20.28	10.28	35.98	3.77	14.4	14.4	1.0	34.84	0	36	1.0	135.8	0	4.0	7.8	71	10.08	2.07	0.88	41.1	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	5.00	4.50	1.00	2.5	20.08	10.08	46.16	3.77	7.8	7.8	1.0	23.85	0	71	1.0	267.8	0	5.0	28.8	0	10.08	18.56	19.64	51.2	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	20.08	10.08	56.24	3.77	28.8	28.8	1.0	116.61	0	0	1.0	0.0	0	6.0	29.0	0	10.08	19.01	20.10	61.3	0	0.0	59.4	59.4	**0.00**	**19.79**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
6.00	8.00	7.00	2.00	5.5	20.08	10.08	71.36	7.54	29.0	29.0	1.0	298.36	0	0	1.0	0.0	0	8.0	28.5	0	10.76	17.88	18.94	81.4	0	0.0	93.3	93.3	**0.00**	**31.10**
8.00	9.00	8.50	1.00	6.5	20.76	10.76	86.82	3.77	28.5	28.5	1.0	177.78	0	0	1.0	0.0	0	9.0	11.6	52	10.76	2.94	1.68	92.2	848.5	848.5	110.3	110.3	**339.40**	**36.76**
9.00	11.00	10.00	2.00	8.5	20.76	10.76	102.96	7.54	11.6	11.6	1.0	159.42	159.42	52	1.0	392.2	392.2	11.0	11.6	52	10.76	2.94	1.68	113.7	920.1	1471.7	144.2	695.8	**588.69**	**231.95**
11.00	12.00	11.50	1.00	9.5	20.76	10.76	119.10	3.77	11.6	11.6	1.0	92.20	251.62	52	1.0	196.1	588.3	12.0	10.0	50	10.39	2.47	1.22	124.5	865.6	1705.6	161.2	1001.1	**682.23**	**333.71**
12.00	14.50	13.25	2.50	12.0	20.39	10.39	137.47	9.43	10.0	10.0	1.0	228.54	480.16	50	1.0	471.4	1059.8	14.5	24.6	14	10.33	9.71	10.44	150.5	1869.0	3409.0	203.6	1743.5	**1363.59**	**581.17**
14.50	17.50	16.00	3.00	15.0	20.33	10.33	165.95	11.31	24.6	24.6	1.0	859.64	1339.79	14	1.0	158.4	1218.2	17.5	26.3	11	10.03	12.93	13.88	181.4	2860.4	5418.4	254.5	2812.4	**2167.34**	**937.48**
17.50	20.50	19.00	3.00	18.0	20.03	10.03	165.95	11.31	26.3	26.3	1.0	927.97	2267.77	11	1.0	124.5	1342.6	20.5	12.4	62	10.03	3.17	1.91	181.4	1296.1	4906.5	305.4	3915.8	**1962.59**	**1305.25**
20.50	22.00	21.25	1.50	19.5	20.03	10.03	165.95	5.66	12.4	12.4	1.0	206.41	2474.17	62	1.0	350.7	1693.4	22.0	8.3	62	10.15	2.16	0.96	181.4	1082.2	5249.7	330.8	4498.4	**2099.90**	**1499.45**
22.00	23.50	22.75	1.50	21.0	20.15	10.15	165.95	5.66	8.3	8.3	1.0	136.96	2611.13	62	1.0	350.7	2044.1	23.5	8.3	62	10.15	2.16	0.96	181.4	1082.2	5737.4	356.3	5011.5	**2294.97**	**1670.50**
23.50	25.00	24.25	1.50	22.5	20.15	10.15	165.95	5.66	8.3	8.3	1.0	136.96	2748.09	62	1.0	350.7	2394.9	25.0	10.6	49	10.35	2.65	1.39	181.4	1052.0	6195.0	381.7	5524.6	**2477.99**	**1841.55**
25.00	26.50	25.75	1.50	24.0	20.35	10.35	165.95	5.66	10.6	10.6	1.0	175.69	2923.78	49	1.0	277.2	2672.1	26.5	10.6	49	10.35	2.65	1.39	181.4	1052.0	6647.9	407.2	6003.0	**2659.14**	**2001.00**
26.50	27.50	27.00	1.00	25.0	20.35	10.35	165.95	3.77	10.6	10.6	1.0	117.13	3040.91	49	1.0	184.8	2856.9	27.5	9.7	54	10.35	2.42	1.17	181.4	1054.1	6951.9	424.1	6321.9	**2780.75**	**2107.29**
27.50	28.00	27.75	0.50	25.5	20.35	10.35	165.95	1.89	9.7	9.7	1.0	53.49	3094.40	54	1.0	101.8	2958.7	28.0	9.0	40	10.73	2.29	1.07	181.4	885.2	6938.3	432.6	6485.7	**2775.31**	**2161.89**
28.00	29.50	28.75	1.50	27.0	20.73	10.73	165.95	5.66	9.0	9.0	1.0	148.69	3243.09	40	1.0	226.3	3185.0	29.5	27.1	0	10.73	14.73	15.72	181.4	3138.2	9566.3	458.0	6886.1	**3826.52**	**2295.37**
29.50	30.00	29.75	0.50	27.5	20.73	10.73	165.95	1.89	27.1	27.1	1.0	160.14	3403.23	0	1.0	0.0	3185.0	30.0	27.1	0	10.73	14.73	15.72	181.4	3138.2	9726.4	466.5	7054.7	**3890.58**	**2351.58**
30.00	31.00	30.50	1.00	28.5	20.73	10.73	165.95	3.77	27.1	27.1	1.0	320.27	3723.50	0	1.0	0.0	3185.0	31.0	26.5	2	10.05	13.38	14.34	181.4	2864.5	9773.0	483.5	7392.0	**3909.21**	**2463.99**
31.00	32.50	31.75	1.50	30.0	20.05	10.05	165.95	5.66	26.5	26.5	1.0	468.07	4191.57	2	1.0	11.3	3196.3	32.5	12.0	46	10.05	3.06	1.79	181.4	1108.4	8496.3	508.9	7896.8	**3398.51**	**2632.26**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
32.50	34.00	33.25	1.50	31.5	20.05	10.05	165.95	5.66	12.0	12.0	1.0	199.55	4391.12	46	1.0	260.2	3456.5	34.0	9.5	46	10.05	2.38	1.14	181.4	964.8	8812.4	534.4	8382.0	**3524.98**	**2794.01**
34.00	35.00	34.50	1.00	32.5	20.05	10.05	165.95	3.77	9.5	9.5	1.0	104.73	4495.85	46	1.0	173.5	3630.0	35.0	9.5	48	8.75	2.38	1.14	181.4	984.2	9110.0	551.3	8677.2	**3644.01**	**2892.40**
35.00	35.50	35.25	0.50	33.0	18.75	8.75	165.95	1.89	9.5	9.5	1.0	52.37	4548.22	48	1.0	90.5	3720.5	35.5	13.0	57	9.00	3.35	2.08	181.4	1280.8	9549.6	559.8	8828.6	**3819.83**	**2942.86**
35.50	37.00	36.25	1.50	34.5	19.00	9.00	165.95	5.66	13.0	13.0	1.0	216.74	4764.96	57	1.0	322.5	4043.0	37.0	13.0	57	9.22	3.35	2.08	181.4	1281.2	10089.1	585.3	9393.2	**4035.64**	**3131.07**
37.00	37.50	37.25	0.50	35.0	19.22	9.22	165.95	1.89	13.0	13.0	1.0	72.25	4837.21	57	1.0	107.5	4150.5	37.5	13.0	57	9.22	3.35	2.08	181.4	1281.2	10268.8	593.8	9581.4	**4107.53**	**3193.81**
37.50	38.50	38.00	1.00	36.0	19.22	9.22	165.95	3.77	13.0	13.0	1.0	144.49	4981.70	57	1.0	215.0	4365.4	38.5	17.5	57	9.20	5.17	4.02	181.4	1666.9	11014.0	610.7	9957.9	**4405.61**	**3319.28**
38.50	40.00	39.25	1.50	37.5	19.20	9.20	165.95	5.66	17.5	17.5	1.0	296.00	5277.70	57	1.0	322.5	4687.9	40.0	17.5	57	9.20	5.17	4.02	181.4	1666.9	11632.5	636.2	10601.8	**4652.99**	**3533.92**
BORE NO: P43, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.38	9.38	25.80	1.89	11.2	11.2	1.0	9.63	0	31	1.0	58.5	0	3.0	27.3	0	9.38	15.18	16.18	28.1	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.5	19.38	9.38	37.52	7.54	27.3	27.3	1.0	146.07	0	0	1.0	0.0	0	5.0	27.3	0	9.38	15.18	16.18	46.9	908.5	908.5	42.4	42.4	**363.40**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.38	9.38	51.59	3.77	27.3	27.3	1.0	100.42	100.42	0	1.0	0.0	0.0	6.0	26.3	0	9.38	12.93	13.88	56.3	911.5	1012.0	59.4	159.8	**404.78**	**53.27**
6.00	7.00	6.50	1.00	4.5	19.38	9.38	60.97	3.77	26.3	26.3	1.0	113.65	214.07	0	1.0	0.0	0.0	7.0	26.5	8	10.36	13.38	14.34	65.7	1176.1	1390.2	76.3	290.4	**556.08**	**96.80**
7.00	8.00	7.50	1.00	5.5	20.36	10.36	70.84	3.77	26.5	26.5	1.0	133.21	347.27	8	1.0	30.2	30.2	8.0	9.0	48	10.36	2.29	1.07	76.0	693.2	1070.7	93.3	470.8	**428.27**	**156.92**
8.00	9.00	8.50	1.00	6.5	20.36	10.36	81.20	3.77	9.0	9.0	1.0	48.50	395.78	48	1.0	181.0	211.2	9.0	9.5	44	10.15	2.38	1.14	86.4	688.5	1295.5	110.3	717.2	**518.20**	**239.08**
9.00	11.00	10.00	2.00	8.5	20.15	10.15	96.53	7.54	9.5	9.5	1.0	121.84	517.62	44	1.0	331.9	543.1	11.0	9.5	44	10.15	2.38	1.14	106.7	743.2	1803.9	144.2	1204.9	**721.56**	**401.64**
11.00	12.00	11.50	1.00	9.5	20.15	10.15	111.76	3.77	9.5	9.5	1.0	70.53	588.15	44	1.0	165.9	709.0	12.0	8.5	55	10.65	2.20	0.99	116.8	858.0	2155.2	161.2	1458.3	**862.08**	**486.12**
12.00	14.50	13.25	2.50	12.0	20.65	10.65	130.14	9.43	8.5	8.5	1.0	183.39	771.54	55	1.0	518.6	1227.6	14.5	8.5	57	10.27	2.20	0.99	143.5	944.4	2943.5	203.6	2202.7	**1177.41**	**734.24**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
14.50	17.50	16.00	3.00	15.0	20.27	10.27	158.86	11.31	8.5	8.5	1.0	268.62	1040.16	57	1.0	644.9	1872.5	17.5	9.3	57	10.27	2.34	1.11	174.3	1050.3	3963.0	254.5	3167.1	**1585.21**	**1055.71**
17.50	20.50	19.00	3.00	18.0	20.27	10.27	158.86	11.31	9.3	9.3	1.0	294.33	1334.49	57	1.0	644.9	2517.4	20.5	14.3	39	10.41	3.74	2.45	174.3	1151.3	5003.2	305.4	4157.3	**2001.27**	**1385.76**
20.50	22.00	21.25	1.50	19.5	20.41	10.41	158.86	5.66	14.3	14.3	1.0	229.07	1563.57	39	1.0	220.6	2738.1	22.0	9.4	52	10.41	2.36	1.13	174.3	1003.2	5304.8	330.8	4632.4	**2121.93**	**1544.14**
22.00	23.50	22.75	1.50	21.0	20.41	10.41	158.86	5.66	9.4	9.4	1.0	148.78	1712.34	52	1.0	294.2	3032.2	23.5	9.4	52	10.41	2.36	1.13	174.3	1003.2	5747.8	356.3	5100.8	**2299.11**	**1700.28**
23.50	26.50	25.00	3.00	24.0	20.41	10.41	158.86	11.31	9.4	9.4	1.0	297.56	2009.90	52	1.0	588.3	3620.6	26.5	9.4	60	10.97	2.36	1.13	174.3	1085.1	6715.6	407.2	6037.6	**2686.22**	**2012.54**
26.50	27.50	27.00	1.00	25.0	20.97	10.97	158.86	3.77	9.4	9.4	1.0	99.19	2109.09	60	1.0	226.3	3846.9	27.5	9.2	62	10.97	2.33	1.10	174.3	1098.1	7054.1	424.1	6380.1	**2821.62**	**2126.69**
27.50	29.50	28.50	2.00	27.0	20.97	10.97	158.86	7.54	9.2	9.2	1.0	194.08	2303.16	62	1.0	467.7	4314.5	29.5	9.2	62	10.97	2.33	1.10	174.3	1098.1	7715.8	458.0	7075.7	**3086.32**	**2358.57**
29.50	30.00	29.75	0.50	27.5	20.97	10.97	158.86	1.89	9.2	9.2	1.0	48.52	2351.68	62	1.0	116.9	4431.4	30.0	10.8	46	9.62	2.71	1.45	174.3	1011.3	7794.4	466.5	7249.6	**3117.74**	**2416.55**
30.00	32.50	31.25	2.50	30.0	19.62	9.62	158.86	9.43	10.8	10.8	1.0	285.72	2637.41	46	1.0	433.7	4865.1	32.5	29.4	0	9.62	19.91	21.02	174.3	4062.6	11565.1	508.9	8011.5	**4626.04**	**2670.50**
32.50	34.00	33.25	1.50	31.5	19.62	9.62	158.86	5.66	29.4	29.4	1.0	506.39	3143.79	0	1.0	0.0	4865.1	34.0	29.4	0	9.62	19.91	21.02	174.3	4062.6	12071.5	534.4	8543.3	**4828.60**	**2847.77**
34.00	35.00	34.50	1.00	32.5	19.62	9.62	158.86	3.77	29.4	29.4	1.0	337.59	3481.38	0	1.0	0.0	4865.1	35.0	27.8	0	10.29	16.31	17.33	174.3	3336.0	11682.5	551.3	8897.9	**4673.00**	**2965.96**
35.00	35.50	35.25	0.50	33.0	20.29	10.29	158.86	1.89	27.8	27.8	1.0	157.94	3639.33	0	1.0	0.0	4865.1	35.5	27.8	0	10.29	16.31	17.33	174.3	3336.0	11840.4	559.8	9064.3	**4736.17**	**3021.43**
35.50	37.00	36.25	1.50	34.5	20.29	10.29	158.86	5.66	27.8	27.8	1.0	473.83	4113.15	0	1.0	0.0	4865.1	37.0	25.4	18	10.29	10.90	11.80	174.3	2415.0	11393.3	585.3	9563.6	**4557.33**	**3187.86**
37.00	37.50	37.25	0.50	35.0	20.29	10.29	158.86	1.89	25.4	25.4	1.0	142.24	4255.40	18	1.0	33.9	4899.1	37.5	25.4	18	10.29	10.90	11.80	174.3	2415.0	11569.5	593.8	9748.2	**4627.80**	**3249.42**
37.50	38.50	38.00	1.00	36.0	20.29	10.29	158.86	3.77	25.4	25.4	1.0	284.49	4539.89	18	1.0	67.9	4967.0	38.5	21.2	36	10.29	7.26	6.71	174.3	1845.7	11352.5	610.7	10117.6	**4541.01**	**3372.53**
38.50	40.00	39.25	1.50	37.5	20.29	10.29	158.86	5.66	21.2	21.2	1.0	348.58	4888.47	36	1.0	203.7	5170.6	40.0	21.2	36	10.29	7.26	6.71	174.3	1845.7	11904.8	636.2	10695.3	**4761.91**	**3565.09**
BORE NO: P44, CUT OFF LENGTH: 2.50 m, Nc= 9																														

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
2.50	3.00	2.75	0.50	0.5	20.75	10.75	29.56	1.89	18.0	18.0	1.0	18.11	0	33	1.0	62.2	0	3.0	26.7	5	9.39	13.83	14.80	32.3	649.8	649.8	8.5	8.5	**259.92**	**2.83**
3.00	5.00	4.00	2.00	2.5	19.39	9.39	41.64	7.54	26.7	26.7	1.0	157.97	157.97	5	1.0	37.7	37.7	5.0	26.7	5	9.39	13.83	14.80	51.0	943.6	1139.3	42.4	238.1	**455.73**	**79.36**
5.00	6.00	5.50	1.00	3.5	19.39	9.39	55.73	3.77	26.7	26.7	1.0	105.70	263.67	5	1.0	18.9	56.6	6.0	25.8	0	9.39	11.80	12.72	60.4	887.9	1208.1	59.4	379.6	**483.24**	**126.54**
6.00	7.00	6.50	1.00	4.5	19.39	9.39	65.12	3.77	25.8	25.8	1.0	118.72	382.39	0	1.0	0.0	56.6	7.0	26.2	8	10.09	12.70	13.64	69.8	1178.2	1617.2	76.3	515.3	**646.87**	**171.77**
7.00	8.00	7.50	1.00	5.5	20.09	10.09	74.86	3.77	26.2	26.2	1.0	138.91	521.30	8	1.0	30.2	86.7	8.0	26.2	8	10.09	12.70	13.64	79.9	1323.2	1931.3	93.3	701.3	**772.51**	**233.78**
8.00	9.00	8.50	1.00	6.5	20.09	10.09	84.95	3.77	26.2	26.2	1.0	157.64	678.94	8	1.0	30.2	116.9	9.0	8.6	58	9.04	2.22	1.00	90.0	822.6	1618.5	110.3	906.1	**647.38**	**302.04**
9.00	11.00	10.00	2.00	8.5	19.04	9.04	99.03	7.54	8.6	8.6	1.0	112.97	791.91	58	1.0	437.5	554.4	11.0	8.6	58	9.04	2.22	1.00	108.1	868.0	2214.3	144.2	1490.5	**885.71**	**496.84**
11.00	12.00	11.50	1.00	9.5	19.04	9.04	112.59	3.77	8.6	8.6	1.0	64.22	856.12	58	1.0	218.7	773.1	12.0	9.8	57	10.61	2.43	1.19	117.1	911.5	2540.8	161.2	1790.4	**1016.31**	**596.81**
12.00	14.50	13.25	2.50	12.0	20.61	10.61	130.37	9.43	9.8	9.8	1.0	212.32	1068.45	57	1.0	537.4	1310.6	14.5	9.8	57	10.61	2.43	1.19	143.6	984.5	3363.6	203.6	2582.6	**1345.43**	**860.87**
14.50	17.50	16.00	3.00	15.0	20.61	10.61	159.55	11.31	9.8	9.8	1.0	311.81	1380.26	57	1.0	644.9	1955.5	17.5	9.5	52	10.18	2.38	1.14	175.5	1009.9	4345.6	254.5	3590.2	**1738.26**	**1196.74**
17.50	20.50	19.00	3.00	18.0	20.18	10.18	159.55	11.31	9.5	9.5	1.0	302.09	1682.35	52	1.0	588.3	2543.8	20.5	9.5	52	10.18	2.38	1.14	175.5	1009.9	5236.1	305.4	4531.5	**2094.43**	**1510.51**
20.50	23.50	22.00	3.00	21.0	20.18	10.18	159.55	11.31	9.5	9.5	1.0	302.09	1984.43	52	1.0	588.3	3132.2	23.5	13.7	23	10.55	3.56	2.28	175.5	957.3	6073.9	356.3	5472.9	**2429.55**	**1824.29**
23.50	25.00	24.25	1.50	22.5	20.55	10.55	159.55	5.66	13.7	13.7	1.0	220.03	2204.46	23	1.0	130.1	3262.3	25.0	10.2	55	10.55	2.53	1.28	175.5	1071.2	6538.0	381.7	5848.5	**2615.19**	**1949.48**
25.00	26.50	25.75	1.50	24.0	20.55	10.55	159.55	5.66	10.2	10.2	1.0	162.40	2366.86	55	1.0	311.1	3573.4	26.5	9.9	50	10.55	2.45	1.20	175.5	1004.6	6944.8	407.2	6347.4	**2777.94**	**2115.81**
26.50	27.50	27.00	1.00	25.0	20.55	10.55	159.55	3.77	9.9	9.9	1.0	105.02	2471.88	50	1.0	188.6	3762.0	27.5	9.9	50	10.55	2.45	1.20	175.5	1004.6	7238.4	424.1	6658.0	**2895.38**	**2219.33**
27.50	28.00	27.75	0.50	25.5	20.55	10.55	159.55	1.89	9.9	9.9	1.0	52.51	2524.39	50	1.0	94.3	3856.3	28.0	28.5	2	9.71	17.88	18.94	175.5	3695.2	10075.9	432.6	6813.3	**4030.36**	**2271.09**
28.00	29.50	28.75	1.50	27.0	19.71	9.71	159.55	5.66	28.5	28.5	1.0	490.07	3014.46	2	1.0	11.3	3867.6	29.5	24.5	20	9.71	9.64	10.33	175.5	2185.5	9067.6	458.0	7340.1	**3627.04**	**2446.70**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
29.50	30.00	29.75	0.50	27.5	19.71	9.71	159.55	1.89	24.5	24.5	1.0	137.11	3151.58	20	1.0	37.7	3905.3	30.0	24.0	20	9.71	9.28	9.78	175.5	2110.5	9167.3	466.5	7523.4	**3666.94**	**2507.81**
30.00	31.00	30.50	1.00	28.5	19.71	9.71	159.55	3.77	24.0	24.0	1.0	267.91	3419.48	20	1.0	75.4	3980.7	31.0	28.2	0	9.71	17.21	18.25	175.5	3536.2	10936.4	483.5	7883.7	**4374.56**	**2627.91**
31.00	32.50	31.75	1.50	30.0	19.71	9.71	159.55	5.66	28.2	28.2	1.0	483.97	3903.45	0	1.0	0.0	3980.7	32.5	20.3	25	7.75	6.62	5.72	175.5	1598.1	9482.3	508.9	8393.1	**3792.92**	**2797.71**
32.50	34.00	33.25	1.50	31.5	17.75	7.75	159.55	5.66	20.3	20.3	1.0	333.88	4237.33	25	1.0	141.4	4122.2	34.0	18.0	39	8.11	5.42	4.29	175.5	1496.0	9855.5	534.4	8893.9	**3942.20**	**2964.63**
34.00	35.00	34.50	1.00	32.5	18.11	8.11	159.55	3.77	18.0	18.0	1.0	195.51	4432.85	39	1.0	147.1	4269.3	35.0	18.0	39	8.11	5.42	4.29	175.5	1496.0	10198.1	551.3	9253.5	**4079.24**	**3084.48**
35.00	35.50	35.25	0.50	33.0	18.11	8.11	159.55	1.89	18.0	18.0	1.0	97.76	4530.60	39	1.0	73.5	4342.8	35.5	29.1	0	8.11	19.23	20.33	175.5	3930.1	12803.5	559.8	9433.2	**5121.41**	**3144.41**
35.50	37.00	36.25	1.50	34.5	18.11	8.11	159.55	5.66	29.1	29.1	1.0	502.38	5032.98	0	1.0	0.0	4342.8	37.0	29.1	0	7.75	19.23	20.33	175.5	3925.2	13300.9	585.3	9961.1	**5320.38**	**3320.35**
37.00	37.50	37.25	0.50	35.0	17.75	7.75	159.55	1.89	29.1	29.1	1.0	167.46	5200.44	0	1.0	0.0	4342.8	37.5	28.9	0	7.75	18.78	19.87	175.5	3833.3	13376.6	593.8	10137.0	**5350.62**	**3379.00**
37.50	38.50	38.00	1.00	36.0	17.75	7.75	159.55	3.77	28.9	28.9	1.0	332.17	5532.62	0	1.0	0.0	4342.8	38.5	20.7	39	8.08	6.90	6.16	175.5	1801.5	11677.0	610.7	10486.1	**4670.78**	**3495.38**
38.50	40.00	39.25	1.50	37.5	18.08	8.08	159.55	5.66	20.7	20.7	1.0	341.06	5873.68	39	1.0	220.6	4563.4	40.0	20.7	39	8.08	6.90	6.16	175.5	1801.5	12238.6	636.2	11073.3	**4895.46**	**3691.09**
BORE NO: P45, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.47	9.47	26.04	1.89	9.2	9.2	1.0	7.95	0	50	1.0	94.3	0	3.0	9.2	50	9.47	2.33	1.10	28.4	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.5	19.47	9.47	33.15	3.77	9.2	9.2	1.0	20.25	0	50	1.0	188.6	0	4.0	27.2	0	9.60	14.95	15.95	37.9	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	5.00	4.50	1.00	2.5	19.60	9.60	42.68	3.77	27.2	27.2	1.0	82.72	0	0	1.0	0.0	0	5.0	28.1	0	9.60	16.98	18.02	47.5	1029.7	1029.7	42.4	42.4	**411.87**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.60	9.60	52.28	3.77	28.1	28.1	1.0	105.28	105.28	0	1.0	0.0	0.0	6.0	28.1	0	9.70	16.98	18.02	57.1	1215.3	1320.6	59.4	164.7	**528.25**	**54.89**
6.00	8.00	7.00	2.00	5.5	19.70	9.70	66.78	7.54	28.1	28.1	1.0	268.96	374.24	0	1.0	0.0	0.0	8.0	28.1	0	9.70	16.98	18.02	76.5	1588.1	1962.3	93.3	467.5	**784.92**	**155.85**
8.00	9.00	8.50	1.00	6.5	19.70	9.70	81.33	3.77	28.1	28.1	1.0	163.78	538.02	0	1.0	0.0	0.0	9.0	27.4	0	9.70	15.40	16.41	86.2	1610.1	2148.1	110.3	648.3	**859.25**	**216.09**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
9.00	10.00	9.50	1.00	7.5	19.70	9.70	91.03	3.77	27.4	27.4	1.0	177.96	715.97	0	1.0	0.0	0.0	10.0	12.3	47	10.17	3.15	1.88	95.9	832.8	1548.8	127.2	843.2	**619.51**	**281.07**
10.00	11.00	10.50	1.00	8.5	20.17	10.17	100.97	3.77	12.3	12.3	1.0	83.02	799.00	47	1.0	177.3	177.3	11.0	10.9	55	10.17	2.73	1.48	106.1	898.4	1874.6	144.2	1120.5	**749.85**	**373.48**
11.00	12.00	11.50	1.00	9.5	20.17	10.17	111.14	3.77	10.9	10.9	1.0	80.71	879.71	55	1.0	207.4	384.7	12.0	12.0	69	10.42	3.06	1.79	116.2	1117.4	2381.8	161.2	1425.6	**952.72**	**475.19**
12.00	14.50	13.25	2.50	12.0	20.42	10.42	129.25	9.43	12.0	12.0	1.0	259.02	1138.73	69	1.0	650.6	1035.3	14.5	9.3	59	10.57	2.34	1.11	142.3	986.1	3160.1	203.6	2377.6	**1264.03**	**792.52**
14.50	17.50	16.00	3.00	15.0	20.57	10.57	158.13	11.31	9.3	9.3	1.0	292.97	1431.70	59	1.0	667.5	1702.8	17.5	11.2	57	10.50	2.82	1.56	174.0	1147.2	4281.7	254.5	3389.0	**1712.69**	**1129.66**
17.50	20.50	19.00	3.00	18.0	20.50	10.50	158.13	11.31	11.2	11.2	1.0	354.25	1785.95	57	1.0	644.9	2347.7	20.5	8.2	61	10.36	2.15	0.94	174.0	1050.2	5183.9	305.4	4439.0	**2073.55**	**1479.67**
20.50	23.50	22.00	3.00	21.0	20.36	10.36	158.13	11.31	8.2	8.2	1.0	257.81	2043.76	61	1.0	690.2	3037.9	23.5	10.4	55	10.50	2.59	1.33	174.0	1078.9	6160.6	356.3	5437.9	**2464.23**	**1812.63**
23.50	26.50	25.00	3.00	24.0	20.50	10.50	158.13	11.31	10.4	10.4	1.0	328.36	2372.11	55	1.0	622.3	3660.2	26.5	13.3	41	10.50	3.44	2.16	174.0	1110.1	7142.4	407.2	6439.4	**2856.94**	**2146.48**
26.50	27.50	27.00	1.00	25.0	20.50	10.50	158.13	3.77	13.3	13.3	1.0	140.97	2513.08	41	1.0	154.6	3814.8	27.5	13.3	41	10.50	3.44	2.16	174.0	1110.1	7438.0	424.1	6752.0	**2975.18**	**2250.67**
27.50	28.00	27.75	0.50	25.5	20.50	10.50	158.13	1.89	13.3	13.3	1.0	70.49	2583.57	41	1.0	77.3	3892.1	28.0	12.3	77	10.40	3.15	1.88	174.0	1416.5	7892.2	432.6	6908.3	**3156.89**	**2302.76**
28.00	29.50	28.75	1.50	27.0	20.40	10.40	158.13	5.66	12.3	12.3	1.0	195.04	2778.61	77	1.0	435.6	4327.7	29.5	12.3	77	10.40	3.15	1.88	174.0	1416.5	8522.9	458.0	7564.4	**3409.14**	**2521.46**
29.50	30.00	29.75	0.50	27.5	20.40	10.40	158.13	1.89	12.3	12.3	1.0	65.01	2843.62	77	1.0	145.2	4472.9	30.0	12.3	77	10.40	3.15	1.88	174.0	1416.5	8733.1	466.5	7783.1	**3493.23**	**2594.36**
30.00	31.00	30.50	1.00	28.5	20.40	10.40	158.13	3.77	12.3	12.3	1.0	130.03	2973.65	77	1.0	290.4	4763.3	31.0	12.3	77	10.40	3.15	1.88	174.0	1416.5	9153.5	483.5	8220.5	**3661.40**	**2740.15**
31.00	32.50	31.75	1.50	30.0	20.40	10.40	158.13	5.66	12.3	12.3	1.0	195.04	3168.69	77	1.0	435.6	5198.9	32.5	12.0	30	10.07	3.06	1.79	174.0	919.7	9287.3	508.9	8876.5	**3714.92**	**2958.85**
32.50	35.00	33.75	2.50	32.5	20.07	10.07	158.13	9.43	12.0	12.0	1.0	316.90	3485.59	30	1.0	282.9	5481.8	35.0	20.1	14	10.07	6.47	5.50	174.0	1454.1	10421.5	551.3	9518.7	**4168.60**	**3172.90**
35.00	35.50	35.25	0.50	33.0	20.07	10.07	158.13	1.89	20.1	20.1	1.0	109.12	3594.71	14	1.0	26.4	5508.2	35.5	20.0	14	10.07	6.40	5.39	174.0	1439.2	10542.1	559.8	9662.7	**4216.84**	**3220.90**
35.50	37.00	36.25	1.50	34.5	20.07	10.07	158.13	5.66	20.0	20.0	1.0	325.58	3920.29	14	1.0	79.2	5587.4	37.0	23.0	10	10.07	8.56	8.68	174.0	1846.2	11353.9	585.3	10092.9	**4541.54**	**3364.31**

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
37.00	37.50	37.25	0.50	35.0	20.07	10.07	158.13	1.89	23.0	23.0	1.0	126.57	4046.86	10	1.0	18.9	5606.2	37.5	23.0	0	8.77	8.56	8.68	174.0	1736.7	11389.8	593.8	10246.9	**4555.92**	**3415.62**
37.50	38.50	38.00	1.00	36.0	18.77	8.77	158.13	3.77	23.0	23.0	1.0	253.14	4300.00	0	1.0	0.0	5606.2	38.5	19.8	35	8.81	6.29	5.28	174.0	1626.9	11533.1	610.7	10517.0	**4613.23**	**3505.65**
38.50	40.00	39.25	1.50	37.5	18.81	8.81	158.13	5.66	19.8	19.8	1.0	322.05	4622.05	35	1.0	198.0	5804.2	40.0	19.8	35	8.81	6.29	5.28	174.0	1626.9	12053.1	636.2	11062.5	**4821.25**	**3687.49**
BORE NO: P46, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.42	9.42	25.91	1.89	26.3	26.3	1.0	24.14	0	1	1.0	1.9	0	3.0	26.3	1	9.42	12.93	13.88	28.3	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.5	19.42	9.42	32.97	3.77	26.3	26.3	1.0	61.45	0	1	1.0	3.8	0	4.0	26.3	1	10.02	12.93	13.88	37.7	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	5.00	4.50	1.00	2.5	20.02	10.02	42.69	3.77	26.3	26.3	1.0	79.57	0	1	1.0	3.8	0	5.0	29.5	0	10.02	20.13	21.25	47.7	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	20.02	10.02	52.71	3.77	29.5	29.5	1.0	112.47	0	0	1.0	0.0	0	6.0	29.5	0	8.96	20.13	21.25	57.7	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	8.00	7.00	2.00	5.5	18.96	8.96	66.68	7.54	29.5	29.5	1.0	284.56	0	0	1.0	0.0	0	8.0	29.5	0	8.96	20.13	21.25	75.6	0	0.0	93.3	93.3	**0.00**	**31.10**
8.00	9.00	8.50	1.00	6.5	18.96	8.96	80.12	3.77	29.5	29.5	1.0	170.96	0	0	1.0	0.0	0	9.0	10.2	47	10.24	2.53	1.28	84.6	729.5	729.5	110.3	110.3	**291.81**	**36.76**
9.00	11.00	10.00	2.00	8.5	20.24	10.24	94.84	7.54	10.2	10.2	1.0	128.71	128.71	47	1.0	354.5	354.5	11.0	10.2	47	10.24	2.53	1.28	105.1	788.1	1271.4	144.2	627.4	**508.54**	**209.14**
11.00	12.00	11.50	1.00	9.5	20.24	10.24	110.20	3.77	10.2	10.2	1.0	74.78	203.49	47	1.0	177.3	531.8	12.0	9.2	57	10.43	2.33	1.10	115.3	891.7	1626.9	161.2	896.4	**650.78**	**298.81**
12.00	14.50	13.25	2.50	12.0	20.43	10.43	128.36	9.43	9.2	9.2	1.0	196.01	399.51	57	1.0	537.4	1069.2	14.5	9.2	57	10.43	2.33	1.10	141.4	960.3	2429.0	203.6	1672.3	**971.60**	**557.43**
14.50	16.00	15.25	1.50	13.5	20.43	10.43	149.22	5.66	9.2	9.2	1.0	136.72	536.23	57	1.0	322.5	1391.7	16.0	26.2	7	10.15	12.70	13.64	157.0	2422.2	4350.1	229.0	2156.9	**1740.05**	**718.97**
16.00	17.50	16.75	1.50	15.0	20.15	10.15	164.65	5.66	26.2	26.2	1.0	458.34	994.57	7	1.0	39.6	1431.3	17.5	26.2	7	10.15	12.70	13.64	172.3	2641.0	5066.9	254.5	2680.3	**2026.75**	**893.43**
17.50	19.00	18.25	1.50	16.5	20.15	10.15	164.65	5.66	26.2	26.2	1.0	458.34	1452.90	7	1.0	39.6	1470.9	19.0	10.7	48	10.17	2.68	1.42	172.3	1020.1	3943.9	279.9	3203.7	**1577.55**	**1067.89**
19.00	20.50	19.75	1.50	18.0	20.17	10.17	164.65	5.66	10.7	10.7	1.0	176.00	1628.91	48	1.0	271.5	1742.4	20.5	10.0	52	10.34	2.47	1.22	172.3	1019.5	4390.8	305.4	3676.7	**1756.32**	**1225.56**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
20.50	23.50	22.00	3.00	21.0	20.34	10.34	164.65	11.31	10.0	10.0	1.0	328.48	1957.39	52	1.0	588.3	2330.7	23.5	16.5	30	10.34	4.68	3.47	172.3	1241.6	5529.8	356.3	4644.4	**2211.90**	**1548.13**
23.50	25.00	24.25	1.50	22.5	20.34	10.34	164.65	5.66	16.5	16.5	1.0	275.91	2233.30	30	1.0	169.7	2500.5	25.0	9.5	50	10.34	2.38	1.14	172.3	981.0	5714.8	381.7	5115.5	**2285.92**	**1705.15**
25.00	26.50	25.75	1.50	24.0	20.34	10.34	164.65	5.66	9.5	9.5	1.0	155.87	2389.17	50	1.0	282.9	2783.3	26.5	9.5	50	9.38	2.38	1.14	172.3	980.3	6152.8	407.2	5579.6	**2461.11**	**1859.88**
26.50	27.50	27.00	1.00	25.0	19.38	9.38	164.65	3.77	9.5	9.5	1.0	103.92	2493.09	50	1.0	188.6	2971.9	27.5	9.5	50	9.38	2.38	1.14	172.3	980.3	6445.3	424.1	5889.1	**2578.11**	**1963.03**
27.50	28.00	27.75	0.50	25.5	19.38	9.38	164.65	1.89	9.5	9.5	1.0	51.96	2545.05	50	1.0	94.3	3066.2	28.0	7.3	72	9.86	1.98	0.80	172.3	1125.2	6736.5	432.6	6043.8	**2694.58**	**2014.61**
28.00	29.50	28.75	1.50	27.0	19.86	9.86	164.65	5.66	7.3	7.3	1.0	119.32	2664.37	72	1.0	407.3	3473.5	29.5	30.0	0	8.36	21.26	22.40	172.3	4270.7	10408.6	458.0	6595.9	**4163.43**	**2198.63**
29.50	30.00	29.75	0.50	27.5	18.36	8.36	164.65	1.89	30.0	30.0	1.0	179.26	2843.63	0	1.0	0.0	3473.5	30.0	30.0	0	11.65	21.26	22.40	172.3	4320.8	10637.9	466.5	6783.6	**4255.15**	**2261.21**
30.00	31.00	30.50	1.00	28.5	21.65	11.65	164.65	3.77	30.0	30.0	1.0	358.52	3202.15	0	1.0	0.0	3473.5	31.0	28.7	0	11.65	18.33	19.40	172.3	3726.5	10402.1	483.5	7159.1	**4160.85**	**2386.38**
31.00	32.50	31.75	1.50	30.0	21.65	11.65	164.65	5.66	28.7	28.7	1.0	509.96	3712.11	0	1.0	0.0	3473.5	32.5	34.2	0	11.65	42.42	43.93	172.3	8614.7	15800.3	508.9	7694.5	**6320.11**	**2564.85**
32.50	35.00	33.75	2.50	32.5	21.65	11.65	164.65	9.43	34.2	34.2	1.2	1276.59	4988.71	0	1.0	0.0	3473.5	35.0	33.4	0	11.65	38.39	39.83	172.3	7796.8	16259.0	551.3	9013.5	**6503.59**	**3004.51**
35.00	35.50	35.25	0.50	33.0	21.65	11.65	164.65	1.89	33.4	33.4	1.2	239.53	5228.24	0	1.0	0.0	3473.5	35.5	33.4	0	11.65	38.39	39.83	172.3	7796.8	16498.5	559.8	9261.6	**6599.41**	**3087.19**
35.50	37.50	36.50	2.00	35.0	21.65	11.65	164.65	7.54	33.4	33.4	1.2	958.13	6186.37	0	1.0	0.0	3473.5	37.5	33.6	0	9.47	39.39	40.85	172.3	7940.8	17600.7	593.8	10253.6	**7040.26**	**3417.87**
37.50	38.50	38.00	1.00	36.0	19.47	9.47	164.65	3.77	33.6	33.6	1.2	486.84	6673.21	0	1.0	0.0	3473.5	38.5	34.1	0	9.44	41.91	43.42	172.3	8447.3	18594.0	610.7	10757.4	**7437.60**	**3585.81**
38.50	40.00	39.25	1.50	37.5	19.44	9.44	164.65	5.66	34.1	34.1	1.2	759.93	7433.14	0	1.0	0.0	3473.5	40.0	34.1	0	9.44	41.91	43.42	172.3	8447.3	19353.9	636.2	11542.8	**7741.57**	**3847.60**
BORE NO: P47, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	18.89	8.89	24.45	1.89	13.5	13.5	1.0	11.07	0	18	1.0	33.9	0	3.0	9.0	41	8.89	2.29	1.07	26.7	493.0	493.0	8.5	8.5	**197.21**	**2.83**
3.00	4.00	3.50	1.00	1.5	18.89	8.89	31.12	3.77	9.0	9.0	1.0	18.59	18.59	41	1.0	154.6	154.6	4.0	27.4	0	8.89	15.40	16.41	35.6	718.8	892.0	25.4	198.7	**356.81**	**66.22**

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
4.00	6.00	5.00	2.00	3.5	18.89	8.89	44.45	7.54	27.4	27.4	1.0	173.79	192.38	0	1.0	0.0	154.6	6.0	28.2	0	8.89	17.21	18.25	53.3	1148.6	1495.6	59.4	406.4	**598.22**	**135.46**
6.00	7.00	6.50	1.00	4.5	18.89	8.89	57.79	3.77	28.2	28.2	1.0	116.85	309.23	0	1.0	0.0	154.6	7.0	28.2	0	9.35	17.21	18.25	62.2	1327.3	1791.2	76.3	540.2	**716.47**	**180.07**
7.00	9.00	8.00	2.00	6.5	19.35	9.35	71.58	7.54	28.2	28.2	1.0	289.50	598.73	0	1.0	0.0	154.6	9.0	28.2	0	9.35	17.21	18.25	80.9	1691.4	2444.7	110.3	863.6	**977.89**	**287.88**
9.00	10.00	9.50	1.00	7.5	19.35	9.35	85.61	3.77	28.2	28.2	1.0	173.11	771.85	0	1.0	0.0	154.6	10.0	27.4	0	9.35	15.40	16.41	90.3	1677.7	2604.1	127.2	1053.7	**1041.66**	**351.24**
10.00	11.00	10.50	1.00	8.5	19.35	9.35	94.96	3.77	27.4	27.4	1.0	185.63	957.48	0	1.0	0.0	154.6	11.0	9.1	50	10.17	2.31	1.08	99.6	776.8	1888.9	144.2	1256.3	**755.55**	**418.77**
11.00	12.50	11.75	1.50	10.0	20.17	10.17	107.26	5.66	9.1	9.1	1.0	97.19	1054.67	50	1.0	282.9	437.5	12.5	9.1	50	10.17	2.31	1.08	114.9	816.6	2308.8	169.6	1661.8	**923.51**	**553.93**
12.50	14.00	13.25	1.50	11.5	20.17	10.17	122.51	5.66	9.1	9.1	1.0	111.01	1165.68	50	1.0	282.9	720.3	14.0	27.2	0	10.17	14.95	15.95	130.1	2312.0	4198.0	195.1	2081.1	**1679.22**	**693.70**
14.00	15.50	14.75	1.50	13.0	20.17	10.17	137.77	5.66	27.2	27.2	1.0	400.54	1566.22	0	1.0	0.0	720.3	15.5	9.0	51	10.32	2.29	1.07	145.4	903.5	3190.1	220.5	2507.1	**1276.03**	**835.70**
15.50	17.00	16.25	1.50	14.5	20.32	10.32	153.14	5.66	9.0	9.0	1.0	137.21	1703.43	51	1.0	288.5	1008.9	17.0	10.4	54	10.32	2.59	1.33	160.9	1030.2	3742.5	246.0	2958.3	**1497.00**	**986.09**
17.00	18.50	17.75	1.50	16.0	20.32	10.32	168.62	5.66	10.4	10.4	1.0	175.07	1878.50	54	1.0	305.5	1314.3	18.5	10.4	54	10.19	2.59	1.33	160.9	1030.1	4222.9	271.4	3464.3	**1689.17**	**1154.76**
18.50	21.50	20.00	3.00	19.0	20.19	10.19	168.62	11.31	10.4	10.4	1.0	350.14	2228.64	54	1.0	611.0	1925.3	21.5	10.6	53	10.49	2.65	1.39	160.9	1031.3	5185.2	322.3	4476.3	**2074.10**	**1492.09**
21.50	24.50	23.00	3.00	22.0	20.49	10.49	168.62	11.31	10.6	10.6	1.0	357.03	2585.66	53	1.0	599.7	2525.0	24.5	9.4	63	10.49	2.36	1.13	160.9	1079.5	6190.1	373.2	5483.9	**2476.05**	**1827.95**
24.50	26.00	25.25	1.50	23.5	20.49	10.49	168.62	5.66	9.4	9.4	1.0	157.91	2743.58	63	1.0	356.4	2881.4	26.0	17.6	20	10.49	5.22	4.07	160.9	1182.7	6807.6	398.7	6023.6	**2723.05**	**2007.87**
26.00	27.50	26.75	1.50	25.0	20.49	10.49	168.62	5.66	17.6	17.6	1.0	302.59	3046.17	20	1.0	113.1	2994.5	27.5	17.6	20	10.16	5.22	4.07	160.9	1181.8	7222.4	424.1	6464.8	**2888.97**	**2154.93**
27.50	29.00	28.25	1.50	26.5	20.16	10.16	168.62	5.66	17.6	17.6	1.0	302.59	3348.75	20	1.0	113.1	3107.7	29.0	11.6	57	10.16	2.94	1.68	160.9	1127.2	7583.6	449.6	6906.0	**3033.45**	**2301.99**
29.00	30.00	29.50	1.00	27.5	20.16	10.16	168.62	3.77	11.6	11.6	1.0	130.54	3479.29	57	1.0	215.0	3322.6	30.0	12.0	50	10.16	3.06	1.79	160.9	1078.1	7880.0	466.5	7268.4	**3152.01**	**2422.82**
30.00	30.50	30.25	0.50	28.0	20.16	10.16	168.62	1.89	12.0	12.0	1.0	67.58	3546.87	50	1.0	94.3	3416.9	30.5	31.6	0	10.16	29.32	30.60	160.9	5547.7	12511.5	475.0	7438.8	**5004.61**	**2479.60**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
30.50	32.50	31.50	2.00	30.0	20.16	10.16	168.62	7.54	31.6	31.6	1.1	845.04	4391.91	0	1.0	0.0	3416.9	32.5	30.9	0	10.86	25.79	27.01	160.9	4894.0	12702.8	508.9	8317.8	**5081.13**	**2772.59**
32.50	33.50	33.00	1.00	31.0	20.86	10.86	168.62	3.77	30.9	30.9	1.0	397.72	4789.63	0	1.0	0.0	3416.9	33.5	30.9	0	10.86	25.79	27.01	160.9	4894.0	13100.5	525.9	8732.4	**5240.22**	**2910.81**
33.50	35.00	34.25	1.50	32.5	20.86	10.86	168.62	5.66	30.9	30.9	1.0	596.57	5386.20	0	1.0	0.0	3416.9	35.0	30.6	0	10.76	24.28	25.48	160.9	4605.9	13409.0	551.3	9354.5	**5363.59**	**3118.16**
35.00	36.50	35.75	1.50	34.0	20.76	10.76	168.62	5.66	30.6	30.6	1.0	581.05	5967.25	0	1.0	0.0	3416.9	36.5	30.6	0	10.76	24.28	25.48	160.9	4605.9	13990.0	576.8	9961.0	**5596.01**	**3320.32**
36.50	37.50	37.00	1.00	35.0	20.76	10.76	168.62	3.77	30.6	30.6	1.0	387.36	6354.61	0	1.0	0.0	3416.9	37.5	30.1	0	10.76	21.76	22.91	160.9	4128.7	13900.2	593.8	10365.3	**5560.08**	**3455.10**
37.50	38.00	37.75	0.50	35.5	20.76	10.76	168.62	1.89	30.1	30.1	1.0	185.24	6539.85	0	1.0	0.0	3416.9	38.0	30.1	0	9.83	21.76	22.91	160.9	4114.2	14071.0	602.2	10559.0	**5628.39**	**3519.67**
38.00	40.00	39.00	2.00	37.5	19.83	9.83	168.62	7.54	30.1	30.1	1.0	740.95	7280.79	0	1.0	0.0	3416.9	40.0	30.1	0	9.83	21.76	22.91	160.9	4114.2	14811.9	636.2	11333.9	**5924.77**	**3777.96**
BORE NO: P48, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.10	10.10	27.78	1.89	27.6	27.6	1.0	27.38	0	3	1.0	5.7	0	3.0	7.2	43	10.10	1.97	0.79	30.3	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.5	20.10	10.10	35.35	3.77	7.2	7.2	1.0	16.84	0	43	1.0	162.2	0	4.0	25.9	0	10.00	12.03	12.95	40.4	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	6.00	5.00	2.00	3.5	20.00	10.00	50.40	7.54	25.9	25.9	1.0	184.60	0	0	1.0	0.0	0	6.0	25.9	0	10.00	12.03	12.95	60.4	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	7.00	6.50	1.00	4.5	20.00	10.00	65.40	3.77	25.9	25.9	1.0	119.77	0	0	1.0	0.0	0	7.0	24.9	0	10.00	9.93	10.77	70.4	0	0.0	76.3	76.3	**0.00**	**25.45**
7.00	9.00	8.00	2.00	6.5	20.00	10.00	80.40	7.54	24.9	24.9	1.0	281.50	0	0	1.0	0.0	0	9.0	14.3	20	10.21	3.74	2.45	90.4	0	0.0	110.3	110.3	**0.00**	**36.76**
9.00	10.00	9.50	1.00	7.5	20.21	10.21	95.51	3.77	14.3	14.3	1.0	91.81	0	20	1.0	75.4	0	10.0	11.0	55	10.21	2.76	1.51	100.6	885.1	885.1	127.2	127.2	**354.05**	**42.41**
10.00	12.50	11.25	2.50	10.0	20.21	10.21	113.37	9.43	11.0	11.0	1.0	207.78	207.78	55	1.0	518.6	518.6	12.5	9.8	55	10.21	2.43	1.19	126.1	915.7	1642.0	169.6	896.0	**656.81**	**298.67**
12.50	14.00	13.25	1.50	11.5	20.21	10.21	133.79	5.66	9.8	9.8	1.0	130.74	338.52	55	1.0	311.1	829.7	14.0	11.2	71	10.64	2.82	1.56	141.5	1186.0	2354.3	195.1	1363.3	**941.71**	**454.44**
14.00	15.50	14.75	1.50	13.0	20.64	10.64	149.43	5.66	11.2	11.2	1.0	167.38	505.90	71	1.0	401.7	1231.4	15.5	11.2	71	10.64	2.82	1.56	157.4	1237.0	2974.3	220.5	1957.8	**1189.71**	**652.60**

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
15.50	17.00	16.25	1.50	14.5	20.64	10.64	165.39	5.66	11.2	11.2	1.0	185.26	691.16	71	1.0	401.7	1633.0	17.0	10.6	57	10.22	2.65	1.39	173.4	1109.2	3433.4	246.0	2570.2	**1373.35**	**856.73**
17.00	18.50	17.75	1.50	16.0	20.22	10.22	181.04	5.66	10.6	10.6	1.0	191.66	882.82	57	1.0	322.5	1955.5	18.5	11.2	53	10.74	2.82	1.56	173.4	1104.8	3943.1	271.4	3109.7	**1577.24**	**1036.58**
18.50	21.50	20.00	3.00	19.0	20.74	10.74	181.04	11.31	11.2	11.2	1.0	405.57	1288.39	53	1.0	599.7	2555.1	21.5	12.5	48	10.74	3.20	1.94	173.4	1131.4	4974.9	322.3	4165.9	**1989.96**	**1388.62**
21.50	23.00	22.25	1.50	20.5	20.74	10.74	181.04	5.66	12.5	12.5	1.0	227.05	1515.44	48	1.0	271.5	2826.7	23.0	29.0	0	10.74	19.01	20.10	173.4	3875.0	8217.1	347.8	4689.9	**3286.84**	**1563.30**
23.00	24.50	23.75	1.50	22.0	20.74	10.74	181.04	5.66	29.0	29.0	1.0	567.69	2083.13	0	1.0	0.0	2826.7	24.5	28.3	0	10.41	17.43	18.48	173.4	3549.9	8459.7	373.2	5283.0	**3383.87**	**1761.01**
24.50	26.00	25.25	1.50	23.5	20.41	10.41	181.04	5.66	28.3	28.3	1.0	551.44	2634.57	0	1.0	0.0	2826.7	26.0	27.1	2	10.41	14.73	15.72	173.4	3020.6	8481.9	398.7	5859.9	**3392.75**	**1953.31**
26.00	27.50	26.75	1.50	25.0	20.41	10.41	181.04	5.66	27.1	27.1	1.0	524.08	3158.65	2	1.0	11.3	2838.0	27.5	9.0	70	10.41	2.29	1.07	173.4	1169.5	7166.2	424.1	6420.8	**2866.47**	**2140.26**
27.50	29.00	28.25	1.50	26.5	20.41	10.41	181.04	5.66	9.0	9.0	1.0	162.21	3320.86	70	1.0	396.0	3234.0	29.0	9.0	40	10.41	2.29	1.07	173.4	864.0	7418.9	449.6	7004.4	**2967.56**	**2334.81**
29.00	30.00	29.50	1.00	27.5	20.41	10.41	181.04	3.77	9.0	9.0	1.0	108.14	3429.00	40	1.0	150.9	3384.9	30.0	9.0	40	10.20	2.29	1.07	173.4	863.9	7677.8	466.5	7280.4	**3071.10**	**2426.79**
30.00	30.50	30.25	0.50	28.0	20.20	10.20	181.04	1.89	9.0	9.0	1.0	54.07	3483.07	40	1.0	75.4	3460.3	30.5	25.2	0	10.20	10.45	11.34	173.4	2128.4	9071.8	475.0	7418.4	**3628.71**	**2472.79**
30.50	32.50	31.50	2.00	30.0	20.20	10.20	181.04	7.54	25.2	25.2	1.0	642.57	4125.64	0	1.0	0.0	3460.3	32.5	26.0	0	10.20	12.25	13.18	173.4	2494.6	10080.5	508.9	8094.9	**4032.20**	**2698.29**
32.50	33.50	33.00	1.00	31.0	20.20	10.20	181.04	3.77	27.6	27.6	1.0	356.94	4482.57	0	1.0	0.0	3460.3	33.5	18.0	28	10.20	5.42	4.29	173.4	1377.2	9320.1	525.9	8468.8	**3728.04**	**2822.92**
33.50	35.00	34.25	1.50	32.5	20.20	10.20	181.04	5.66	18.0	18.0	1.0	332.76	4815.34	28	1.0	158.4	3618.7	35.0	18.0	28	10.20	5.42	4.29	173.4	1377.2	9811.3	551.3	8985.4	**3924.50**	**2995.12**
35.00	36.50	35.75	1.50	34.0	20.20	10.20	181.04	5.66	18.0	18.0	1.0	332.76	5148.10	28	1.0	158.4	3777.1	36.5	18.0	30	8.98	5.42	4.29	173.4	1394.0	10319.2	576.8	9502.0	**4127.69**	**3167.33**
36.50	37.50	37.00	1.00	35.0	18.98	8.98	181.04	3.77	18.0	18.0	1.0	221.84	5369.94	30	1.0	113.1	3890.2	37.5	13.5	48	8.98	3.50	2.22	173.4	1188.9	10449.0	593.8	9853.9	**4179.61**	**3284.64**
37.50	40.00	38.75	2.50	37.5	18.98	8.98	181.04	9.43	13.5	13.5	1.0	409.79	5779.73	48	1.0	452.6	4342.8	40.0	13.5	48	8.98	3.50	2.22	173.4	1188.9	11311.4	636.2	10758.7	**4524.56**	**3586.24**

BORE NO: P49, CUT OFF LENGTH: 2.50 m, Nc= 9

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2
Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
2.50	3.00	2.75	0.50	0.5	19.98	9.98	27.45	1.89	14.1	14.1	1.0	13.00	0	31	1.0	58.5	0	3.0	26.1	0	9.98	12.48	13.41	29.9	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.5	19.98	9.98	34.93	3.77	26.1	26.1	1.0	64.54	0	0	1.0	0.0	0	4.0	24.5	0	9.98	9.64	10.33	39.9	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	6.00	5.00	2.00	3.5	19.98	9.98	49.90	7.54	24.5	24.5	1.0	171.53	0	0	1.0	0.0	0	6.0	28.3	0	9.98	17.43	18.48	59.9	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	7.00	6.50	1.00	4.5	19.98	9.98	64.87	3.77	28.3	28.3	1.0	131.73	0	0	1.0	0.0	0	7.0	28.3	0	9.98	17.43	18.48	69.9	0	0.0	76.3	76.3	**0.00**	**25.45**
7.00	8.00	7.50	1.00	5.5	19.98	9.98	74.85	3.77	28.3	28.3	1.0	152.00	0	0	1.0	0.0	0	8.0	24.7	7	9.19	9.78	10.55	79.8	0	0.0	93.3	93.3	**0.00**	**31.10**
8.00	9.00	8.50	1.00	6.5	19.19	9.19	84.44	3.77	24.7	24.7	1.0	146.47	0	7	1.0	26.4	0	9.0	24.7	7	9.19	9.78	10.55	89.0	0	0.0	110.3	110.3	**0.00**	**36.76**
9.00	10.00	9.50	1.00	7.5	19.19	9.19	93.63	3.77	24.7	24.7	1.0	162.41	0	7	1.0	26.4	0	10.0	8.2	48	10.48	2.15	0.94	98.2	734.0	734.0	127.2	127.2	**293.59**	**42.41**
10.00	12.50	11.25	2.50	10.0	20.48	10.48	111.32	9.43	8.2	8.2	1.0	151.25	151.25	48	1.0	452.6	452.6	12.5	9.1	61	10.32	2.31	1.08	124.4	953.6	1557.5	169.6	773.5	**622.98**	**257.82**
12.50	15.50	14.00	3.00	13.0	20.32	10.32	139.90	11.31	9.1	9.1	1.0	253.53	404.78	61	1.0	690.2	1142.7	15.5	8.7	56	10.05	2.24	1.02	155.4	970.3	2517.8	220.5	1768.1	**1007.13**	**589.36**
15.50	18.50	17.00	3.00	16.0	20.05	10.05	170.46	11.31	8.7	8.7	1.0	295.11	699.90	56	1.0	633.6	1776.3	18.5	18.8	40	10.05	5.78	4.73	155.4	1455.3	3931.6	271.4	2747.7	**1572.62**	**915.89**
18.50	20.00	19.25	1.50	17.5	20.05	10.05	170.46	5.66	18.8	18.8	1.0	328.27	1028.17	40	1.0	226.3	2002.6	20.0	9.8	52	9.64	2.43	1.19	155.4	965.2	3996.0	296.9	3327.7	**1598.39**	**1109.23**
20.00	21.50	20.75	1.50	19.0	19.64	9.64	170.46	5.66	9.8	9.8	1.0	166.56	1194.73	52	1.0	294.2	2296.8	21.5	9.5	52	10.56	2.38	1.14	155.4	956.1	4447.6	322.3	3813.9	**1779.06**	**1271.29**
21.50	24.50	23.00	3.00	22.0	20.56	10.56	170.46	11.31	9.5	9.5	1.0	322.73	1517.46	52	1.0	588.3	2885.1	24.5	10.4	58	10.56	2.59	1.33	155.4	1055.1	5457.7	373.2	4775.8	**2183.07**	**1591.94**
24.50	27.50	26.00	3.00	25.0	20.56	10.56	170.46	11.31	10.4	10.4	1.0	353.96	1871.42	58	1.0	656.2	3541.4	27.5	27.9	0	9.98	16.53	17.56	155.4	3025.1	8437.9	424.1	5836.9	**3375.14**	**1945.64**
27.50	29.00	28.25	1.50	26.5	19.98	9.98	170.46	5.66	27.9	27.9	1.0	510.56	2381.99	0	1.0	0.0	3541.4	29.0	26.5	13	9.98	13.38	14.34	155.4	2581.3	8504.7	449.6	6372.9	**3401.88**	**2124.31**
29.00	30.00	29.50	1.00	27.5	19.98	9.98	170.46	3.77	26.5	26.5	1.0	320.52	2702.50	13	1.0	49.0	3590.4	30.0	27.3	0	9.98	15.18	16.18	155.4	2778.2	9071.1	466.5	6759.4	**3628.43**	**2253.14**
30.00	30.50	30.25	0.50	28.0	19.98	9.98	170.46	1.89	27.3	27.3	1.0	165.90	2868.41	0	1.0	0.0	3590.4	30.5	27.3	0	9.98	15.18	16.18	155.4	2778.2	9237.0	475.0	6933.8	**3694.79**	**2311.27**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
30.50	32.00	31.25	1.50	29.5	19.98	9.98	170.46	5.66	27.3	27.3	1.0	497.71	3366.11	0	1.0	0.0	3590.4	32.0	11.5	49	9.57	2.91	1.65	155.4	1021.4	7977.9	500.5	7457.0	**3191.18**	**2485.66**
32.00	32.50	32.25	0.50	30.0	19.57	9.57	170.46	1.89	11.5	11.5	1.0	65.40	3431.51	49	1.0	92.4	3682.8	32.5	11.5	49	9.57	2.91	1.65	155.4	1021.4	8135.7	508.9	7623.2	**3254.30**	**2541.08**
32.50	33.50	33.00	1.00	31.0	19.57	9.57	170.46	3.77	11.5	11.5	1.0	130.79	3562.30	49	1.0	184.8	3867.6	33.5	11.5	49	9.57	2.91	1.65	155.4	1021.4	8451.3	525.9	7955.8	**3380.53**	**2651.93**
33.50	35.00	34.25	1.50	32.5	19.57	9.57	170.46	5.66	11.5	11.5	1.0	196.19	3758.48	49	1.0	277.2	4144.8	35.0	11.5	49	9.57	2.91	1.65	155.4	1021.4	8924.7	551.3	8454.6	**3569.89**	**2818.21**
35.00	36.50	35.75	1.50	34.0	19.57	9.57	170.46	5.66	11.5	11.5	1.0	196.19	3954.67	49	1.0	277.2	4422.0	36.5	15.8	38	10.24	4.33	3.09	155.4	1170.3	9546.9	576.8	8953.5	**3818.78**	**2984.49**
36.50	37.50	37.00	1.00	35.0	20.24	10.24	170.46	3.77	15.8	15.8	1.0	181.91	4136.58	38	1.0	143.3	4565.3	37.5	15.8	38	10.24	4.33	3.09	155.4	1170.3	9872.2	593.8	9295.7	**3948.87**	**3098.55**
37.50	38.00	37.75	0.50	35.5	20.24	10.24	170.46	1.89	15.8	15.8	1.0	90.96	4227.54	38	1.0	71.7	4637.0	38.0	28.0	0	10.24	16.76	17.79	155.4	3069.4	11933.9	602.2	9466.8	**4773.55**	**3155.58**
38.00	40.00	39.00	2.00	37.5	20.24	10.24	170.46	7.54	28.0	28.0	1.0	683.63	4911.17	0	1.0	0.0	4637.0	40.0	28.0	0	10.24	16.76	17.79	155.4	3069.4	12617.5	636.2	10184.3	**5047.00**	**3394.77**
BORE NO: P50, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.30	10.30	28.33	1.89	24.5	24.5	1.0	24.34	0	8	1.0	15.1	0	3.0	24.5	8	10.30	9.64	10.33	30.9	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.5	20.30	10.30	36.05	3.77	24.5	24.5	1.0	61.96	0	8	1.0	30.2	0	4.0	27.6	0	9.23	15.85	16.87	41.2	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	5.00	4.50	1.00	2.5	19.23	9.23	45.82	3.77	27.6	27.6	1.0	90.33	0	0	1.0	0.0	0	5.0	27.6	0	9.23	15.85	16.87	50.4	1010.4	1010.4	42.4	42.4	**404.14**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.23	9.23	55.05	3.77	27.6	27.6	1.0	108.53	108.53	0	1.0	0.0	0.0	6.0	28.7	0	9.23	18.33	19.40	59.7	1359.0	1467.5	59.4	167.9	**587.02**	**55.97**
6.00	8.00	7.00	2.00	5.5	19.23	9.23	68.89	7.54	28.7	28.7	1.0	284.49	393.02	0	1.0	0.0	0.0	8.0	29.6	0	10.30	20.36	21.48	78.1	1949.6	2342.7	93.3	486.3	**937.06**	**162.11**
8.00	9.00	8.50	1.00	6.5	20.30	10.30	83.27	3.77	29.6	29.6	1.0	178.40	571.42	0	1.0	0.0	0.0	9.0	29.6	0	10.30	20.36	21.48	88.4	2186.9	2758.3	110.3	681.7	**1103.32**	**227.23**
9.00	10.00	9.50	1.00	7.5	20.30	10.30	93.57	3.77	29.6	29.6	1.0	200.47	771.89	0	1.0	0.0	0.0	10.0	8.5	54	10.30	2.20	0.99	98.7	802.5	1574.4	127.2	899.1	**629.76**	**299.71**
10.00	11.00	10.50	1.00	8.5	20.30	10.30	103.87	3.77	8.5	8.5	1.0	58.55	830.44	54	1.0	203.7	203.7	11.0	8.5	54	10.30	2.20	0.99	109.0	828.2	1862.3	144.2	1178.3	**744.90**	**392.76**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
11.00	12.00	11.50	1.00	9.5	20.30	10.30	114.17	3.77	8.5	8.5	1.0	64.35	894.79	54	1.0	203.7	407.3	12.0	29.1	0	10.30	19.23	20.33	119.3	2738.6	4040.7	161.2	1463.3	**1616.28**	**487.76**
12.00	13.00	12.50	1.00	10.5	20.30	10.30	124.47	3.77	29.1	29.1	1.0	261.28	1156.07	0	1.0	0.0	407.3	13.0	8.3	58	10.30	2.16	0.96	129.6	914.7	2478.1	178.1	1741.5	**991.22**	**580.50**
13.00	14.50	13.75	1.50	12.0	20.30	10.30	137.35	5.66	8.3	8.3	1.0	113.35	1269.42	58	1.0	328.1	735.4	14.5	8.6	57	10.15	2.22	1.00	145.1	951.4	2956.2	203.6	2208.4	**1182.50**	**736.14**
14.50	17.50	16.00	3.00	15.0	20.15	10.15	160.30	11.31	8.6	8.6	1.0	274.28	1543.70	57	1.0	644.9	1380.3	17.5	8.6	57	10.15	2.22	1.00	175.5	1027.8	3951.9	254.5	3178.5	**1580.74**	**1059.51**
17.50	19.00	18.25	1.50	16.5	20.15	10.15	160.30	5.66	8.6	8.6	1.0	137.14	1680.85	57	1.0	322.5	1702.8	19.0	27.2	7	9.78	14.95	15.95	175.5	3146.9	6530.5	279.9	3663.6	**2612.22**	**1221.19**
19.00	20.50	19.75	1.50	18.0	19.78	9.78	160.30	5.66	27.2	27.2	1.0	466.04	2146.88	7	1.0	39.6	1742.4	20.5	12.3	58	9.78	3.15	1.88	175.5	1227.8	5117.0	305.4	4194.6	**2046.81**	**1398.22**
20.50	23.50	22.00	3.00	21.0	19.78	9.78	160.30	11.31	12.3	12.3	1.0	395.43	2542.32	58	1.0	656.2	2398.6	23.5	12.3	58	10.91	3.15	1.88	175.5	1229.2	6170.1	356.3	5297.2	**2468.06**	**1765.73**
23.50	25.00	24.25	1.50	22.5	20.91	10.91	160.30	5.66	12.3	12.3	1.0	197.72	2740.03	58	1.0	328.1	2726.7	25.0	14.3	42	10.91	3.74	2.45	175.5	1187.9	6654.7	381.7	5848.5	**2661.89**	**1949.49**
25.00	26.50	25.75	1.50	24.0	20.91	10.91	160.30	5.66	14.3	14.3	1.0	231.14	2971.18	42	1.0	237.6	2964.3	26.5	10.5	58	10.91	2.62	1.36	175.5	1120.4	7055.9	407.2	6342.7	**2822.37**	**2114.22**
26.50	27.50	27.00	1.00	25.0	20.91	10.91	160.30	3.77	10.5	10.5	1.0	112.05	3083.22	58	1.0	218.7	3183.1	27.5	10.5	58	10.91	2.62	1.36	175.5	1120.4	7386.7	424.1	6690.4	**2954.69**	**2230.14**
27.50	29.50	28.50	2.00	27.0	20.91	10.91	160.30	7.54	10.5	10.5	1.0	224.09	3307.31	58	1.0	437.5	3620.6	29.5	7.5	61	10.56	2.02	0.84	175.5	1028.3	7956.2	458.0	7385.9	**3182.47**	**2461.98**
29.50	30.00	29.75	0.50	27.5	20.56	10.56	160.30	1.89	7.5	7.5	1.0	39.79	3347.11	61	1.0	115.0	3735.6	30.0	7.5	61	10.56	2.02	0.84	175.5	1028.3	8111.0	466.5	7549.2	**3244.40**	**2516.41**
30.00	32.50	31.25	2.50	30.0	20.56	10.56	160.30	9.43	7.5	7.5	1.0	198.97	3546.08	61	1.0	575.1	4310.7	32.5	8.6	60	10.56	2.22	1.00	175.5	1058.6	8915.5	508.9	8365.8	**3566.19**	**2788.59**
32.50	35.00	33.75	2.50	32.5	20.56	10.56	160.30	9.43	8.6	8.6	1.0	228.57	3774.65	60	1.0	565.7	4876.5	35.0	19.6	30	10.60	6.19	5.17	175.5	1571.4	10222.5	551.3	9202.5	**4089.00**	**3067.49**
35.00	35.50	35.25	0.50	33.0	20.60	10.60	160.30	1.89	19.6	19.6	1.0	107.63	3882.29	30	1.0	56.6	4933.0	35.5	26.4	0	10.60	13.15	14.11	175.5	2713.5	11528.8	559.8	9375.1	**4611.51**	**3125.05**
35.50	37.50	36.50	2.00	35.0	20.60	10.60	160.30	7.54	26.4	26.4	1.0	600.19	4482.48	0	1.0	0.0	4933.0	37.5	28.5	0	10.60	17.88	18.94	175.5	3687.4	13102.9	593.8	10009.3	**5241.17**	**3336.42**
37.50	38.50	38.00	1.00	36.0	20.60	10.60	160.30	3.77	28.5	28.5	1.0	328.24	4810.72	0	1.0	0.0	4933.0	38.5	28.0	0	10.60	16.76	17.79	175.5	3455.5	13199.3	610.7	10354.5	**5279.71**	**3451.49**

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
38.50	40.00	39.25	1.50	37.5	20.60	10.60	160.30	5.66	28.0	28.0	1.0	482.16	5292.88	0	1.0	0.0	4933.0	40.0	28.0	0	10.60	16.76	17.79	175.5	3455.5	13681.4	636.2	10862.1	**5472.57**	**3620.69**
BORE NO: P51, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.69	9.69	26.65	1.89	23.9	23.9	1.0	22.27	0	0	1.0	0.0	0	3.0	26.4	0	9.69	13.15	14.11	29.1	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.5	19.69	9.69	38.76	7.54	26.4	26.4	1.0	145.13	0	0	1.0	0.0	0	5.0	26.4	0	9.69	13.15	14.11	48.5	813.8	813.8	42.4	42.4	**325.52**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.69	9.69	53.30	3.77	26.4	26.4	1.0	99.78	99.78	0	1.0	0.0	0.0	6.0	30.3	0	9.69	22.77	23.94	58.1	1655.4	1755.1	59.4	159.2	**702.05**	**53.05**
6.00	8.00	7.00	2.00	5.5	19.69	9.69	67.83	7.54	30.3	30.3	1.0	303.46	403.23	0	1.0	0.0	0.0	8.0	28.5	0	10.66	17.88	18.94	77.5	1705.5	2108.7	93.3	496.5	**843.48**	**165.51**
8.00	9.00	8.50	1.00	6.5	20.66	10.66	82.85	3.77	28.5	28.5	1.0	169.65	572.89	0	1.0	0.0	0.0	9.0	28.5	0	10.66	17.88	18.94	88.2	1921.1	2494.0	110.3	683.2	**997.61**	**227.72**
9.00	11.00	10.00	2.00	8.5	20.66	10.66	98.84	7.54	28.5	28.5	1.0	404.79	977.68	0	1.0	0.0	0.0	11.0	10.4	40	10.66	2.59	1.33	109.5	737.6	1715.2	144.2	1121.9	**686.09**	**373.96**
11.00	12.00	11.50	1.00	9.5	20.66	10.66	114.83	3.77	10.4	10.4	1.0	79.48	1057.16	40	1.0	150.9	150.9	12.0	10.4	40	10.66	2.59	1.33	120.2	768.8	1976.8	161.2	1369.2	**790.71**	**456.40**
12.00	13.00	12.50	1.00	10.5	20.66	10.66	125.49	3.77	10.4	10.4	1.0	86.86	1144.03	40	1.0	150.9	301.7	13.0	9.5	53	10.49	2.38	1.14	130.8	900.1	2345.8	178.1	1623.9	**938.34**	**541.29**
13.00	14.50	13.75	1.50	12.0	20.49	10.49	138.69	5.66	9.5	9.5	1.0	131.29	1275.32	53	1.0	299.8	601.5	14.5	10.4	58	10.60	2.59	1.33	146.6	1029.3	2906.1	203.6	2080.4	**1162.46**	**693.48**
14.50	17.50	16.00	3.00	15.0	20.60	10.60	162.46	11.31	10.4	10.4	1.0	337.35	1612.67	58	1.0	656.2	1257.8	17.5	10.4	58	10.60	2.59	1.33	178.4	1122.4	3992.8	254.5	3124.9	**1597.13**	**1041.64**
17.50	19.00	18.25	1.50	16.5	20.60	10.60	162.46	5.66	10.4	10.4	1.0	168.67	1781.34	58	1.0	328.1	1585.9	19.0	27.4	0	8.71	15.40	16.41	178.4	3205.6	6572.8	279.9	3647.1	**2629.13**	**1215.71**
19.00	20.50	19.75	1.50	18.0	18.71	8.71	162.46	5.66	27.4	27.4	1.0	476.38	2257.72	0	1.0	0.0	1585.9	20.5	26.1	0	8.25	12.48	13.41	178.4	2593.0	6436.6	305.4	4149.0	**2574.63**	**1382.99**
20.50	23.50	22.00	3.00	21.0	18.25	8.25	162.46	11.31	26.1	26.1	1.0	900.46	3158.18	0	1.0	0.0	1585.9	23.5	26.0	0	8.25	12.25	13.18	178.4	2546.2	7290.3	356.3	5100.3	**2916.12**	**1700.11**
23.50	26.50	25.00	3.00	24.0	18.25	8.25	162.46	11.31	26.0	26.0	1.0	896.48	4054.66	0	1.0	0.0	1585.9	26.5	26.7	0	8.37	13.83	14.80	178.4	2874.6	8515.1	407.2	6047.7	**3406.04**	**2015.90**
26.50	27.50	27.00	1.00	25.0	18.37	8.37	162.46	3.77	26.7	26.7	1.0	308.15	4362.81	0	1.0	0.0	1585.9	27.5	26.7	0	8.37	13.83	14.80	178.4	2874.6	8823.3	424.1	6372.8	**3529.30**	**2124.27**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
27.50	29.50	28.50	2.00	27.0	18.37	8.37	162.46	7.54	26.7	26.7	1.0	616.30	4979.11	0	1.0	0.0	1585.9	29.5	27.5	0	8.37	15.63	16.64	178.4	3248.6	9813.6	458.0	7023.0	**3925.43**	**2341.01**
29.50	30.00	29.75	0.50	27.5	18.37	8.37	162.46	1.89	27.5	27.5	1.0	159.47	5138.58	0	1.0	0.0	1585.9	30.0	27.8	0	8.37	16.31	17.33	178.4	3388.8	10113.3	466.5	7191.0	**4045.32**	**2397.00**
30.00	32.50	31.25	2.50	30.0	18.37	8.37	162.46	9.43	27.8	27.8	1.0	807.58	5946.17	0	1.0	0.0	1585.9	32.5	27.8	0	9.29	16.31	17.33	178.4	3399.7	10931.7	508.9	8041.0	**4372.68**	**2680.33**
32.50	35.00	33.75	2.50	32.5	19.29	9.29	162.46	9.43	27.8	27.8	1.0	807.58	6753.75	0	1.0	0.0	1585.9	35.0	29.3	0	9.29	19.68	20.79	178.4	4103.1	12442.7	551.3	8891.0	**4977.09**	**2963.66**
35.00	35.50	35.25	0.50	33.0	19.29	9.29	162.46	1.89	29.3	29.3	1.0	171.91	6925.66	0	1.0	0.0	1585.9	35.5	29.3	0	9.29	19.68	20.79	178.4	4103.1	12614.6	559.8	9071.4	**5045.85**	**3023.79**
35.50	37.50	36.50	2.00	35.0	19.29	9.29	162.46	7.54	29.3	29.3	1.0	687.65	7613.31	0	1.0	0.0	1585.9	37.5	29.3	0	8.91	19.68	20.79	178.4	4097.7	13296.9	593.8	9793.0	**5318.77**	**3264.32**
37.50	38.50	38.00	1.00	36.0	18.91	8.91	162.46	3.77	29.3	29.3	1.0	343.82	7957.14	0	1.0	0.0	1585.9	38.5	29.0	0	8.91	19.01	20.10	178.4	3957.2	13500.2	610.7	10153.7	**5400.09**	**3384.58**
38.50	40.00	39.25	1.50	37.5	18.91	8.91	162.46	5.66	29.0	29.0	1.0	509.43	8466.56	0	1.0	0.0	1585.9	40.0	29.0	0	8.91	19.01	20.10	178.4	3957.2	14009.7	636.2	10688.6	**5603.86**	**3562.87**
BORE NO: P52, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.45	9.45	25.99	1.89	28.6	28.6	1.0	26.72	0	0	1.0	0.0	0	3.0	28.6	0	9.44	18.11	19.17	28.4	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.5	19.44	9.44	37.79	7.54	28.6	28.6	1.0	155.41	0	0	1.0	0.0	0	5.0	27.9	0	9.44	16.53	17.56	47.2	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.44	9.44	51.95	3.77	27.9	27.9	1.0	103.74	0	0	1.0	0.0	0	6.0	27.9	0	9.55	16.53	17.56	56.7	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	8.00	7.00	2.00	5.5	19.55	9.55	66.22	7.54	27.9	27.9	1.0	264.47	0	0	1.0	0.0	0	8.0	27.9	0	9.55	16.53	17.56	75.8	0	0.0	93.3	93.3	**0.00**	**31.10**
8.00	9.00	8.50	1.00	6.5	19.55	9.55	80.55	3.77	27.9	27.9	1.0	160.84	0	0	1.0	0.0	0	9.0	26.2	6	9.84	12.70	13.64	85.3	0	0.0	110.3	110.3	**0.00**	**36.76**
9.00	11.00	10.00	2.00	8.5	19.84	9.84	95.16	7.54	26.2	26.2	1.0	353.19	0	6	1.0	45.3	0	11.0	24.0	0	9.84	9.28	9.78	105.0	0	0.0	144.2	144.2	**0.00**	**48.07**
11.00	12.00	11.50	1.00	9.5	19.84	9.84	109.92	3.77	24.0	24.0	1.0	184.57	0	0	1.0	0.0	0	12.0	13.5	21	9.84	3.50	2.22	114.8	683.4	683.4	161.2	161.2	**273.38**	**53.72**
12.00	13.00	12.50	1.00	10.5	19.84	9.84	119.76	3.77	13.5	13.5	1.0	108.44	108.44	21	1.0	79.2	79.2	13.0	10.4	46	10.14	2.59	1.33	124.7	842.6	1030.3	178.1	365.8	**412.10**	**121.92**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
13.00	14.50	13.75	1.50	12.0	20.14	10.14	132.29	5.66	10.4	10.4	1.0	137.35	245.78	46	1.0	260.2	339.4	14.5	10.4	46	10.14	2.59	1.33	139.9	887.2	1472.4	203.6	788.8	**588.95**	**262.93**
14.50	16.00	15.25	1.50	13.5	20.14	10.14	147.50	5.66	10.4	10.4	1.0	153.14	398.93	46	1.0	260.2	599.7	16.0	12.2	44	10.24	3.12	1.85	155.1	1007.8	2006.4	229.0	1227.6	**802.55**	**409.20**
16.00	17.50	16.75	1.50	15.0	20.24	10.24	162.78	5.66	12.2	12.2	1.0	199.10	598.02	44	1.0	248.9	848.6	17.5	12.2	44	10.24	3.12	1.85	170.5	1061.9	2508.5	254.5	1701.1	**1003.41**	**567.02**
17.50	19.00	18.25	1.50	16.5	20.24	10.24	162.78	5.66	12.2	12.2	1.0	199.10	797.12	44	1.0	248.9	1097.5	19.0	25.4	5	9.38	10.90	11.80	170.5	2228.4	4123.0	279.9	2174.5	**1649.21**	**724.84**
19.00	20.50	19.75	1.50	18.0	19.38	9.38	162.78	5.66	25.4	25.4	1.0	437.26	1234.38	5	1.0	28.3	1125.8	20.5	25.4	5	9.38	10.90	11.80	170.5	2228.4	4588.6	305.4	2665.5	**1835.43**	**888.51**
20.50	22.00	21.25	1.50	19.5	19.38	9.38	162.78	5.66	25.4	25.4	1.0	437.26	1671.65	5	1.0	28.3	1154.1	22.0	28.3	0	9.64	17.43	18.48	170.5	3482.8	6308.5	330.8	3156.5	**2523.41**	**1052.17**
22.00	23.50	22.75	1.50	21.0	19.64	9.64	162.78	5.66	28.3	28.3	1.0	495.84	2167.48	0	1.0	0.0	1154.1	23.5	28.3	0	9.64	17.43	18.48	170.5	3482.8	6804.4	356.3	3677.8	**2721.74**	**1225.93**
23.50	26.50	25.00	3.00	24.0	19.64	9.64	162.78	11.31	28.3	28.3	1.0	991.67	3159.16	0	1.0	0.0	1154.1	26.5	6.2	70	10.28	1.79	0.63	170.5	1061.7	5374.9	407.2	4720.4	**2149.96**	**1573.46**
26.50	27.50	27.00	1.00	25.0	20.28	10.28	162.78	3.77	6.2	6.2	1.0	66.69	3225.85	70	1.0	264.0	1418.1	27.5	6.2	70	10.28	1.79	0.63	170.5	1061.7	5705.6	424.1	5068.0	**2282.24**	**1689.34**
27.50	28.00	27.75	0.50	25.5	20.28	10.28	162.78	1.89	6.2	6.2	1.0	33.35	3259.20	70	1.0	132.0	1550.1	28.0	30.4	0	8.98	23.27	24.45	170.5	4637.9	9447.1	432.6	5241.9	**3778.84**	**1747.28**
28.00	29.50	28.75	1.50	27.0	18.98	8.98	162.78	5.66	30.4	30.4	1.0	551.08	3810.27	0	1.0	0.0	1550.1	29.5	30.4	0	9.07	23.27	24.45	170.5	4639.3	9999.7	458.0	5818.4	**3999.87**	**1939.46**
29.50	30.00	29.75	0.50	27.5	19.07	9.07	162.78	1.89	30.4	30.4	1.0	183.69	3993.96	0	1.0	0.0	1550.1	30.0	31.0	0	9.07	26.30	27.53	170.5	5241.2	10785.2	466.5	6010.5	**4314.09**	**2003.52**
30.00	31.00	30.50	1.00	28.5	19.07	9.07	162.78	3.77	31.0	31.0	1.1	387.32	4381.28	0	1.0	0.0	1550.1	31.0	31.9	0	9.18	30.83	32.14	170.5	6146.4	12077.7	483.5	6414.8	**4831.09**	**2138.28**
31.00	32.50	31.75	1.50	30.0	19.18	9.18	162.78	5.66	31.9	31.9	1.1	627.64	5008.93	0	1.0	0.0	1550.1	32.5	31.9	0	8.92	30.83	32.14	170.5	6140.7	12699.7	508.9	7067.9	**5079.88**	**2355.97**
32.50	34.00	33.25	1.50	31.5	18.92	8.92	162.78	5.66	31.9	31.9	1.1	627.64	5636.57	0	1.0	0.0	1550.1	34.0	33.4	0	10.23	38.39	39.83	170.5	7680.0	14866.6	534.4	7721.0	**5946.65**	**2573.67**
34.00	35.00	34.50	1.00	32.5	20.23	10.23	162.78	3.77	33.4	33.4	1.2	473.62	6110.19	0	1.0	0.0	1550.1	35.0	33.2	0	10.23	37.38	38.80	170.5	7478.6	15138.8	551.3	8211.6	**6055.53**	**2737.20**
35.00	35.50	35.25	0.50	33.0	20.23	10.23	162.78	1.89	33.2	33.2	1.2	233.01	6343.20	0	1.0	0.0	1550.1	35.5	22.5	28	9.00	8.20	8.14	170.5	1916.3	9809.6	559.8	8453.1	**3923.82**	**2817.69**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
35.50	37.00	36.25	1.50	34.5	19.00	9.00	162.78	5.66	22.5	22.5	1.0	381.44	6724.63	28	1.0	158.4	1708.5	37.0	20.5	34	9.12	6.76	5.94	170.5	1686.7	10119.8	585.3	9018.4	**4047.93**	**3006.12**
37.00	37.50	37.25	0.50	35.0	19.12	9.12	162.78	1.89	20.5	20.5	1.0	114.77	6839.40	34	1.0	64.1	1772.6	37.5	20.5	34	9.12	6.76	5.94	170.5	1686.7	10298.7	593.8	9205.7	**4119.49**	**3068.58**
37.50	38.50	38.00	1.00	36.0	19.12	9.12	162.78	3.77	20.5	20.5	1.0	229.53	7068.93	34	1.0	128.2	1900.8	38.5	20.5	34	9.37	6.76	5.94	170.5	1687.8	10657.5	610.7	9580.5	**4262.99**	**3193.49**
38.50	40.00	39.25	1.50	37.5	19.37	9.37	162.78	5.66	20.5	20.5	1.0	344.30	7413.23	34	1.0	192.3	2093.1	40.0	28.0	0	9.37	16.76	17.79	170.5	3344.7	12851.1	636.2	10142.5	**5140.44**	**3380.85**
BORE NO: P53, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.63	9.63	26.48	1.89	28.9	28.9	1.0	27.57	0	0	1.0	0.0	0	3.0	28.9	0	9.63	18.78	19.87	28.9	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.5	19.63	9.63	33.71	3.77	28.9	28.9	1.0	70.17	0	0	1.0	0.0	0	4.0	28.9	0	9.21	18.78	19.87	38.5	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	5.00	4.50	1.00	2.5	19.21	9.21	43.13	3.77	28.9	28.9	1.0	89.78	0	0	1.0	0.0	0	5.0	28.4	0	9.21	17.66	18.71	47.7	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.21	9.21	52.34	3.77	28.4	28.4	1.0	106.72	0	0	1.0	0.0	0	6.0	32.8	0	9.21	35.36	36.75	56.9	2508.1	2508.1	59.4	59.4	**1003.23**	**19.79**
6.00	8.00	7.00	2.00	5.5	19.21	9.21	66.15	7.54	32.8	32.8	1.1	366.58	366.58	0	1.0	0.0	0.0	8.0	31.2	0	9.80	27.30	28.55	75.4	2518.0	2884.6	93.3	459.9	**1153.85**	**153.29**
8.00	9.00	8.50	1.00	6.5	19.80	9.80	80.26	3.77	31.2	31.2	1.1	194.32	560.89	0	1.0	0.0	0.0	9.0	24.2	11	9.80	9.42	10.00	85.2	1086.6	1647.5	110.3	671.2	**658.99**	**223.72**
9.00	10.00	9.50	1.00	7.5	19.80	9.80	90.06	3.77	24.2	24.2	1.0	152.65	713.54	11	1.0	41.5	41.5	10.0	24.2	11	9.80	9.42	10.00	95.0	1191.1	1946.1	127.2	882.3	**778.44**	**294.09**
10.00	11.00	10.50	1.00	8.5	19.80	9.80	99.86	3.77	24.2	24.2	1.0	169.26	882.80	11	1.0	41.5	83.0	11.0	24.2	11	9.80	9.42	10.00	104.8	1295.6	2261.3	144.2	1110.0	**904.53**	**369.99**
11.00	12.00	11.50	1.00	9.5	19.80	9.80	109.66	3.77	24.2	24.2	1.0	185.87	1068.67	11	1.0	41.5	124.5	12.0	9.4	52	9.80	2.36	1.13	114.6	843.2	2036.3	161.2	1354.3	**814.51**	**451.43**
12.00	13.00	12.50	1.00	10.5	19.80	9.80	119.46	3.77	9.4	9.4	1.0	74.59	1143.25	52	1.0	196.1	320.6	13.0	9.4	52	10.40	2.36	1.13	124.4	869.8	2333.6	178.1	1642.0	**933.45**	**547.32**
13.00	14.50	13.75	1.50	12.0	20.40	10.40	132.16	5.66	9.4	9.4	1.0	123.77	1267.02	52	1.0	294.2	614.7	14.5	11.5	49	10.23	2.91	1.65	140.0	971.4	2853.1	203.6	2085.3	**1141.26**	**695.11**
14.50	17.50	16.00	3.00	15.0	20.23	10.23	155.31	11.31	11.5	11.5	1.0	357.50	1624.52	49	1.0	554.4	1169.1	17.5	11.5	49	10.23	2.91	1.65	170.7	1072.5	3866.1	254.5	3048.1	**1546.45**	**1016.04**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
17.50	19.00	18.25	1.50	16.5	20.23	10.23	155.31	5.66	11.5	11.5	1.0	178.75	1803.27	49	1.0	277.2	1446.3	19.0	26.4	7	9.95	13.15	14.11	170.7	2706.1	5955.7	279.9	3529.5	**2382.27**	**1176.51**
19.00	20.50	19.75	1.50	18.0	19.95	9.95	155.31	5.66	26.4	26.4	1.0	436.13	2239.40	7	1.0	39.6	1485.9	20.5	25.8	9	9.95	11.80	12.72	170.7	2456.2	6181.6	305.4	4030.7	**2472.62**	**1343.57**
20.50	22.00	21.25	1.50	19.5	19.95	9.95	155.31	5.66	25.8	25.8	1.0	424.72	2664.13	9	1.0	50.9	1536.9	22.0	25.8	9	9.59	11.80	12.72	170.7	2453.1	6654.1	330.8	4531.8	**2661.63**	**1510.60**
22.00	23.50	22.75	1.50	21.0	19.59	9.59	155.31	5.66	25.8	25.8	1.0	424.72	3088.85	9	1.0	50.9	1587.8	23.5	25.9	9	9.59	12.03	12.95	170.7	2498.1	7174.7	356.3	5032.9	**2869.88**	**1677.63**
23.50	25.00	24.25	1.50	22.5	19.59	9.59	155.31	5.66	25.9	25.9	1.0	426.62	3515.47	9	1.0	50.9	1638.7	25.0	30.3	0	9.59	22.77	23.94	170.7	4552.4	9706.5	381.7	5535.9	**3882.61**	**1845.29**
25.00	26.50	25.75	1.50	24.0	19.59	9.59	155.31	5.66	30.3	30.3	1.0	521.10	4036.57	0	1.0	0.0	1638.7	26.5	30.3	0	10.66	22.77	23.94	170.7	4569.8	10245.0	407.2	6082.4	**4098.01**	**2027.47**
26.50	27.50	27.00	1.00	25.0	20.66	10.66	155.31	3.77	30.3	30.3	1.0	347.40	4383.97	0	1.0	0.0	1638.7	27.5	30.3	0	10.66	22.77	23.94	170.7	4569.8	10592.4	424.1	6446.8	**4236.97**	**2148.92**
27.50	28.00	27.75	0.50	25.5	20.66	10.66	155.31	1.89	30.3	30.3	1.0	173.70	4557.67	0	1.0	0.0	1638.7	28.0	11.4	74	10.66	2.88	1.62	170.7	1321.6	7518.0	432.6	6629.0	**3007.20**	**2209.65**
28.00	29.50	28.75	1.50	27.0	20.66	10.66	155.31	5.66	11.4	11.4	1.0	177.15	4734.83	74	1.0	418.6	2057.3	29.5	32.1	0	10.66	31.84	33.16	170.7	6387.3	13179.4	458.0	7250.2	**5271.76**	**2416.73**
29.50	30.00	29.75	0.50	27.5	20.66	10.66	155.31	1.89	32.1	32.1	1.1	203.00	4937.83	0	1.0	0.0	2057.3	30.0	29.3	2	11.07	19.68	20.79	170.7	3977.0	10972.1	466.5	7461.7	**4388.85**	**2487.22**
30.00	32.50	31.25	2.50	30.0	21.07	11.07	155.31	9.43	29.3	29.3	1.0	821.73	5759.56	2	1.0	18.9	2076.2	32.5	32.8	0	11.07	35.36	36.75	170.7	7104.3	14940.0	508.9	8344.7	**5976.00**	**2781.56**
32.50	34.00	33.25	1.50	31.5	21.07	11.07	155.31	5.66	32.8	32.8	1.1	645.48	6405.04	0	1.0	0.0	2076.2	34.0	33.8	0	11.07	40.40	41.88	170.7	8115.4	16596.6	534.4	9015.6	**6638.65**	**3005.20**
34.00	35.00	34.50	1.00	32.5	21.07	11.07	155.31	3.77	33.8	33.8	1.2	466.61	6871.64	0	1.0	0.0	2076.2	35.0	34.7	0	8.83	44.94	46.49	170.7	8954.7	17902.6	551.3	9499.2	**7161.03**	**3166.39**
35.00	35.50	35.25	0.50	33.0	18.83	8.83	155.31	1.89	34.7	34.7	1.2	250.44	7122.08	0	1.0	0.0	2076.2	35.5	31.8	0	8.91	30.33	31.63	170.7	6046.8	15245.0	559.8	9758.1	**6098.01**	**3252.70**
35.50	37.00	36.25	1.50	34.5	18.91	8.91	155.31	5.66	31.8	31.8	1.1	593.77	7715.85	0	1.0	0.0	2076.2	37.0	31.8	0	8.90	30.33	31.63	170.7	6046.6	15838.6	585.3	10377.3	**6335.43**	**3459.10**
37.00	37.50	37.25	0.50	35.0	18.90	8.90	155.31	1.89	31.8	31.8	1.1	197.92	7913.78	0	1.0	0.0	2076.2	37.5	31.4	0	8.90	28.31	29.58	170.7	5645.1	15635.1	593.8	10583.7	**6254.03**	**3527.90**
37.50	38.50	38.00	1.00	36.0	18.90	8.90	155.31	3.77	31.4	31.4	1.1	382.55	8296.33	0	1.0	0.0	2076.2	38.5	29.6	0	8.77	20.36	21.48	170.7	4058.7	14431.2	610.7	10983.2	**5772.48**	**3661.08**

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
38.50	40.00	39.25	1.50	37.5	18.77	8.77	155.31	5.66	29.6	29.6	1.0	499.10	8795.44	0	1.0	0.0	2076.2	40.0	29.6	0	8.77	20.36	21.48	170.7	4058.7	14930.3	636.2	11507.8	**5972.13**	**3835.93**
BORE NO: P54, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.37	9.37	25.77	1.89	21.9	21.9	1.0	19.53	0	4	1.0	7.5	0	3.0	21.9	4	9.37	7.77	7.48	28.1	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.5	19.37	9.37	37.48	7.54	21.9	21.9	1.0	113.65	0	4	1.0	30.2	0	5.0	21.9	4	9.37	7.77	7.48	46.9	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.37	9.37	51.54	3.77	21.9	21.9	1.0	78.13	0	4	1.0	15.1	0	6.0	15.3	26	9.37	4.09	2.81	56.2	542.7	542.7	59.4	59.4	**217.07**	**19.79**
6.00	7.00	6.50	1.00	4.5	19.37	9.37	60.91	3.77	15.3	15.3	1.0	62.84	62.84	26	1.0	98.1	98.1	7.0	27.4	0	9.37	15.40	16.41	65.6	1247.6	1408.5	76.3	237.2	**563.38**	**79.08**
7.00	8.00	7.50	1.00	5.5	19.37	9.37	70.28	3.77	27.4	27.4	1.0	137.38	200.22	0	1.0	0.0	98.1	8.0	27.6	0	9.00	15.85	16.87	75.0	1447.8	1746.0	93.3	391.6	**698.42**	**130.53**
8.00	9.00	8.50	1.00	6.5	19.00	9.00	79.46	3.77	27.6	27.6	1.0	156.67	356.89	0	1.0	0.0	98.1	9.0	9.0	38	9.00	2.29	1.07	84.0	611.0	1065.9	110.3	565.2	**426.38**	**188.41**
9.00	10.00	9.50	1.00	7.5	19.00	9.00	88.46	3.77	9.0	9.0	1.0	52.84	409.73	38	1.0	143.3	241.4	10.0	27.5	2	9.00	15.63	16.64	93.0	1765.9	2417.0	127.2	778.3	**966.81**	**259.44**
10.00	11.00	10.50	1.00	8.5	19.00	9.00	97.46	3.77	27.5	27.5	1.0	191.34	601.07	2	1.0	7.5	248.9	11.0	7.1	57	9.00	1.95	0.77	102.0	809.9	1659.9	144.2	994.2	**663.94**	**331.39**
11.00	12.00	11.50	1.00	9.5	19.00	9.00	106.46	3.77	7.1	7.1	1.0	50.01	651.08	57	1.0	215.0	463.9	12.0	7.1	57	9.00	1.95	0.77	111.0	829.7	1944.7	161.2	1276.1	**777.87**	**425.38**
12.00	13.00	12.50	1.00	10.5	19.00	9.00	115.46	3.77	7.1	7.1	1.0	54.24	705.32	57	1.0	215.0	678.9	13.0	29.5	0	9.19	20.13	21.25	120.0	2865.2	4249.4	178.1	1562.3	**1699.76**	**520.77**
13.00	14.50	13.75	1.50	12.0	19.19	9.19	126.85	5.66	29.5	29.5	1.0	406.01	1111.33	0	1.0	0.0	678.9	14.5	12.5	42	10.60	3.20	1.94	133.7	926.4	2716.6	203.6	1993.8	**1086.65**	**664.59**
14.50	17.50	16.00	3.00	15.0	20.60	10.60	149.65	11.31	12.5	12.5	1.0	375.36	1486.69	42	1.0	475.2	1154.1	17.5	10.0	42	10.60	2.47	1.22	165.5	899.1	3539.8	254.5	2895.2	**1415.94**	**965.07**
17.50	20.50	19.00	3.00	18.0	20.60	10.60	149.65	11.31	10.0	10.0	1.0	298.54	1785.23	42	1.0	475.2	1629.3	20.5	10.0	40	9.11	2.47	1.22	165.5	877.5	4292.0	305.4	3719.9	**1716.79**	**1239.95**
20.50	22.00	21.25	1.50	19.5	19.11	9.11	149.65	5.66	10.0	10.0	1.0	149.27	1934.50	40	1.0	226.3	1855.5	22.0	27.3	0	9.11	15.18	16.18	165.5	2943.2	6733.2	330.8	4120.9	**2693.30**	**1373.62**
22.00	23.50	22.75	1.50	21.0	19.11	9.11	149.65	5.66	27.3	27.3	1.0	436.94	2371.45	0	1.0	0.0	1855.5	23.5	25.4	0	9.11	10.90	11.80	165.5	2114.7	6341.7	356.3	4583.2	**2536.69**	**1527.75**

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
23.50	25.00	24.25	1.50	22.5	19.11	9.11	149.65	5.66	25.4	25.4	1.0	401.98	2773.42	0	1.0	0.0	1855.5	25.0	25.5	13	10.29	11.13	12.03	165.5	2300.3	6929.3	381.7	5010.7	**2771.72**	**1670.22**
25.00	26.50	25.75	1.50	24.0	20.29	10.29	149.65	5.66	25.5	25.5	1.0	403.79	3177.21	13	1.0	73.5	1929.1	26.5	25.5	13	10.29	11.13	12.03	165.5	2300.3	7406.6	407.2	5513.5	**2962.66**	**1837.82**
26.50	27.50	27.00	1.00	25.0	20.29	10.29	149.65	3.77	25.5	25.5	1.0	269.19	3446.41	13	1.0	49.0	1978.1	27.5	9.5	62	10.29	2.38	1.14	165.5	1085.1	6509.6	424.1	5848.6	**2603.85**	**1949.55**
27.50	28.00	27.75	0.50	25.5	20.29	10.29	149.65	1.89	9.5	9.5	1.0	47.22	3493.63	62	1.0	116.9	2095.0	28.0	8.5	62	9.15	2.20	0.99	165.5	1049.5	6638.2	432.6	6021.3	**2655.28**	**2007.09**
28.00	29.50	28.75	1.50	27.0	19.15	9.15	149.65	5.66	8.5	8.5	1.0	126.52	3620.15	62	1.0	350.7	2445.8	29.5	8.5	62	9.15	2.20	0.99	165.5	1049.5	7115.5	458.0	6524.0	**2846.19**	**2174.65**
29.50	30.00	29.75	0.50	27.5	19.15	9.15	149.65	1.89	8.5	8.5	1.0	42.17	3662.32	62	1.0	116.9	2562.7	30.0	8.5	68	9.15	2.20	0.99	165.5	1110.6	7335.7	466.5	6691.5	**2934.26**	**2230.51**
30.00	32.50	31.25	2.50	30.0	19.15	9.15	149.65	9.43	8.5	8.5	1.0	210.87	3873.19	68	1.0	641.1	3203.8	32.5	8.5	68	10.23	2.20	0.99	165.5	1111.4	8188.4	508.9	7586.0	**3275.35**	**2528.65**
32.50	35.00	33.75	2.50	32.5	20.23	10.23	149.65	9.43	8.5	8.5	1.0	210.87	4084.05	68	1.0	641.1	3845.0	35.0	9.1	54	10.23	2.31	1.08	165.5	989.7	8918.7	551.3	8480.4	**3567.48**	**2826.79**
35.00	35.50	35.25	0.50	33.0	20.23	10.23	149.65	1.89	9.1	9.1	1.0	45.20	4129.25	54	1.0	101.8	3946.8	35.5	9.1	54	10.23	2.31	1.08	165.5	989.7	9065.7	559.8	8635.9	**3626.29**	**2878.63**
35.50	37.50	36.50	2.00	35.0	20.23	10.23	149.65	7.54	9.1	9.1	1.0	180.80	4310.05	54	1.0	407.3	4354.1	37.5	9.1	54	8.90	2.31	1.08	165.5	988.7	9652.9	593.8	9257.9	**3861.15**	**3085.98**
37.50	38.50	38.00	1.00	36.0	18.90	8.90	149.65	3.77	9.1	9.1	1.0	90.40	4400.45	54	1.0	203.7	4557.8	38.5	10.0	52	9.04	2.47	1.22	165.5	999.6	9957.9	610.7	9568.9	**3983.14**	**3189.65**
38.50	40.00	39.25	1.50	37.5	19.04	9.04	149.65	5.66	10.0	10.0	1.0	149.27	4549.72	52	1.0	294.2	4851.9	40.0	10.0	52	9.04	2.47	1.22	165.5	999.6	10401.3	636.2	10037.8	**4160.52**	**3345.95**
BORE NO: P55, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.71	9.71	26.70	1.89	24.6	24.6	1.0	23.05	0	0	1.0	0.0	0	3.0	28.7	0	9.13	18.33	19.40	29.1	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.5	19.13	9.13	38.26	7.54	28.7	28.7	1.0	158.00	0	0	1.0	0.0	0	5.0	29.6	0	9.13	20.36	21.48	47.4	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.13	9.13	51.96	3.77	29.6	29.6	1.0	111.31	0	0	1.0	0.0	0	6.0	29.6	0	8.97	20.36	21.48	56.5	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	8.00	7.00	2.00	5.5	18.97	8.97	65.49	7.54	29.6	29.6	1.0	280.62	0	0	1.0	0.0	0	8.0	29.6	0	8.97	20.36	21.48	74.5	0	0.0	93.3	93.3	**0.00**	**31.10**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
8.00	9.00	8.50	1.00	6.5	18.97	8.97	78.95	3.77	29.6	29.6	1.0	169.14	0	0	1.0	0.0	0	9.0	28.5	0	8.97	17.88	18.94	83.4	0	0.0	110.3	110.3	**0.00**	**36.76**
9.00	10.00	9.50	1.00	7.5	18.97	8.97	87.92	3.77	28.5	28.5	1.0	180.03	0	0	1.0	0.0	0	10.0	9.2	48	10.06	2.33	1.10	92.4	739.4	739.4	127.2	127.2	**295.77**	**42.41**
10.00	11.00	10.50	1.00	8.5	20.06	10.06	97.43	3.77	9.2	9.2	1.0	59.51	59.51	48	1.0	181.0	181.0	11.0	12.8	52	10.06	3.29	2.02	102.5	924.9	1165.4	144.2	384.7	**466.17**	**128.25**
11.00	12.00	11.50	1.00	9.5	20.06	10.06	107.49	3.77	12.8	12.8	1.0	92.10	151.62	52	1.0	196.1	377.1	12.0	8.5	54	10.00	2.20	0.99	112.5	836.7	1365.4	161.2	689.9	**546.17**	**229.97**
12.00	14.50	13.25	2.50	12.0	20.00	10.00	125.02	9.43	8.5	8.5	1.0	176.17	327.78	54	1.0	509.1	886.3	14.5	11.6	56	10.30	2.94	1.68	137.5	1039.5	2253.5	203.6	1417.6	**901.42**	**472.55**
14.50	17.50	16.00	3.00	15.0	20.30	10.30	152.97	11.31	11.6	11.6	1.0	355.27	683.05	56	1.0	633.6	1519.9	17.5	23.2	0	10.30	8.70	8.90	168.4	1720.8	3923.8	254.5	2457.4	**1569.52**	**819.14**
17.50	19.00	18.25	1.50	16.5	20.30	10.30	152.97	5.66	23.2	23.2	1.0	370.90	1053.95	0	1.0	0.0	1519.9	19.0	10.5	51	9.62	2.62	1.36	168.4	1026.9	3600.7	279.9	2853.8	**1440.30**	**951.25**
19.00	20.50	19.75	1.50	18.0	19.62	9.62	152.97	5.66	10.5	10.5	1.0	160.39	1214.34	51	1.0	288.5	1808.4	20.5	23.9	11	9.91	9.21	9.67	168.4	1931.7	4954.5	305.4	3328.1	**1981.78**	**1109.37**
20.50	23.50	22.00	3.00	21.0	19.91	9.91	152.97	11.31	23.9	23.9	1.0	766.96	1981.30	11	1.0	124.5	1932.9	23.5	23.9	11	9.91	9.21	9.67	168.4	1931.7	5845.9	356.3	4270.4	**2338.35**	**1423.47**
23.50	25.00	24.25	1.50	22.5	19.91	9.91	152.97	5.66	23.9	23.9	1.0	383.48	2364.78	11	1.0	62.2	1995.1	25.0	12.6	70	10.42	3.23	1.96	168.4	1342.8	5702.7	381.7	4741.6	**2281.06**	**1580.52**
25.00	26.50	25.75	1.50	24.0	20.42	10.42	152.97	5.66	12.6	12.6	1.0	193.43	2558.22	70	1.0	396.0	2391.1	26.5	12.6	70	10.42	3.23	1.96	168.4	1342.8	6292.1	407.2	5356.5	**2516.84**	**1785.48**
26.50	27.50	27.00	1.00	25.0	20.42	10.42	152.97	3.77	12.6	12.6	1.0	128.96	2687.17	70	1.0	264.0	2655.1	27.5	12.6	70	10.42	3.23	1.96	168.4	1342.8	6685.1	424.1	5766.4	**2674.02**	**1922.12**
27.50	28.00	27.75	0.50	25.5	20.42	10.42	152.97	1.89	12.6	12.6	1.0	64.48	2751.65	70	1.0	132.0	2787.1	28.0	12.6	70	10.42	3.23	1.96	168.4	1342.8	6881.5	432.6	5971.3	**2752.61**	**1990.44**
28.00	29.50	28.75	1.50	27.0	20.42	10.42	152.97	5.66	12.6	12.6	1.0	193.43	2945.08	70	1.0	396.0	3183.1	29.5	18.5	48	9.18	5.64	4.57	168.4	1592.4	7720.5	458.0	6586.2	**3088.21**	**2195.40**
29.50	30.00	29.75	0.50	27.5	19.18	9.18	152.97	1.89	18.5	18.5	1.0	96.52	3041.60	48	1.0	90.5	3273.6	30.0	18.5	48	9.18	5.64	4.57	168.4	1592.4	7907.6	466.5	6781.7	**3163.02**	**2260.58**
30.00	31.00	30.50	1.00	28.5	19.18	9.18	152.97	3.77	18.5	18.5	1.0	193.03	3234.63	48	1.0	181.0	3454.6	31.0	18.5	48	8.41	5.64	4.57	168.4	1590.0	8279.2	483.5	7172.8	**3311.69**	**2390.92**
31.00	32.50	31.75	1.50	30.0	18.41	8.41	152.97	5.66	18.5	18.5	1.0	289.55	3524.18	48	1.0	271.5	3726.2	32.5	20.0	48	8.94	6.40	5.39	168.4	1741.0	8991.4	508.9	7759.3	**3596.56**	**2586.43**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
32.50	34.00	33.25	1.50	31.5	18.94	8.94	152.97	5.66	20.0	20.0	1.0	314.97	3839.15	48	1.0	271.5	3997.7	34.0	12.0	54	9.41	3.06	1.79	168.4	1144.0	8980.9	534.4	8371.3	**3592.36**	**2790.42**
34.00	35.00	34.50	1.00	32.5	19.41	9.41	152.97	3.77	12.0	12.0	1.0	122.63	3961.78	54	1.0	203.7	4201.4	35.0	12.0	54	9.41	3.06	1.79	168.4	1144.0	9307.2	551.3	8714.5	**3722.88**	**2904.83**
35.00	35.50	35.25	0.50	33.0	19.41	9.41	152.97	1.89	12.0	12.0	1.0	61.31	4023.10	54	1.0	101.8	4303.2	35.5	14.1	52	8.53	3.68	2.39	168.4	1244.4	9570.7	559.8	8886.1	**3828.28**	**2962.04**
35.50	37.00	36.25	1.50	34.5	18.53	8.53	152.97	5.66	14.1	14.1	1.0	217.37	4240.46	52	1.0	294.2	4597.4	37.0	14.1	52	9.58	3.68	2.39	168.4	1246.1	10084.0	585.3	9423.1	**4033.58**	**3141.04**
37.00	37.50	37.25	0.50	35.0	19.58	9.58	152.97	1.89	14.1	14.1	1.0	72.46	4312.92	52	1.0	98.1	4695.4	37.5	14.1	52	9.58	3.68	2.39	168.4	1246.1	10254.5	593.8	9602.1	**4101.79**	**3200.70**
37.50	38.50	38.00	1.00	36.0	19.58	9.58	152.97	3.77	14.1	14.1	1.0	144.91	4457.83	52	1.0	196.1	4891.5	38.5	14.5	36	9.64	3.80	2.51	168.4	1106.1	10455.5	610.7	9960.1	**4182.21**	**3320.03**
38.50	40.00	39.25	1.50	37.5	19.64	9.64	152.97	5.66	14.5	14.5	1.0	223.80	4681.63	36	1.0	203.7	5095.2	40.0	14.5	36	9.64	3.80	2.51	168.4	1106.1	10883.0	636.2	10413.0	**4353.19**	**3471.00**
BORE NO: P56, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.45	9.45	25.99	1.89	27.1	27.1	1.0	25.08	0	4	1.0	7.5	0	3.0	29.7	0	9.31	20.58	21.71	28.4	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.5	19.31	9.31	37.66	7.54	29.7	29.7	1.0	162.03	0	0	1.0	0.0	0	5.0	28.9	0	9.31	18.78	19.87	47.0	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.31	9.31	51.63	3.77	28.9	28.9	1.0	107.48	0	0	1.0	0.0	0	6.0	28.9	0	9.30	18.78	19.87	56.3	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	8.00	7.00	2.00	5.5	19.30	9.30	65.58	7.54	28.9	28.9	1.0	273.07	0	0	1.0	0.0	0	8.0	11.4	42	9.30	2.88	1.62	74.9	682.0	682.0	93.3	93.3	**272.82**	**31.10**
8.00	9.00	8.50	1.00	6.5	19.30	9.30	79.53	3.77	11.4	11.4	1.0	60.48	60.48	42	1.0	158.4	158.4	9.0	11.4	42	9.96	2.88	1.62	84.2	713.1	932.0	110.3	329.1	**372.79**	**109.72**
9.00	11.00	10.00	2.00	8.5	19.96	9.96	94.14	7.54	11.4	11.4	1.0	143.18	203.66	42	1.0	316.8	475.2	11.0	10.6	42	9.96	2.65	1.39	104.1	748.8	1427.6	144.2	823.1	**571.06**	**274.35**
11.00	12.50	11.75	1.50	10.0	19.96	9.96	111.57	5.66	10.6	10.6	1.0	118.12	321.78	42	1.0	237.6	712.8	12.5	7.5	96	10.11	2.02	0.84	119.0	1255.3	2289.9	169.6	1204.2	**915.97**	**401.41**
12.50	14.50	13.50	2.00	12.0	20.11	10.11	129.15	7.54	7.5	7.5	1.0	128.25	450.03	96	1.0	724.1	1436.9	14.5	8.2	58	10.39	2.15	0.94	139.3	935.4	2822.3	203.6	2090.5	**1128.93**	**696.84**
14.50	17.50	16.00	3.00	15.0	20.39	10.39	154.85	11.31	8.2	8.2	1.0	252.46	702.49	58	1.0	656.2	2093.1	17.5	9.7	52	10.26	2.42	1.17	170.4	1003.6	3799.2	254.5	3050.1	**1519.68**	**1016.70**

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2
Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
17.50	20.50	19.00	3.00	18.0	20.26	10.26	154.85	11.31	9.7	9.7	1.0	299.47	1001.96	52	1.0	588.3	2681.5	20.5	8.0	60	10.52	2.11	0.91	170.4	1024.4	4707.8	305.4	3988.8	**1883.12**	**1329.60**
20.50	23.50	22.00	3.00	21.0	20.52	10.52	154.85	11.31	8.0	8.0	1.0	246.22	1248.18	60	1.0	678.9	3360.3	23.5	8.0	60	10.52	2.11	0.91	170.4	1024.4	5632.9	356.3	4964.8	**2253.15**	**1654.93**
23.50	26.50	25.00	3.00	24.0	20.52	10.52	154.85	11.31	8.0	8.0	1.0	246.22	1494.40	60	1.0	678.9	4039.2	26.5	7.5	65	10.10	2.02	0.84	170.4	1057.1	6590.7	407.2	5940.8	**2636.29**	**1980.25**
26.50	27.50	27.00	1.00	25.0	20.10	10.10	154.85	3.77	7.5	7.5	1.0	76.88	1571.28	65	1.0	245.1	4284.3	27.5	7.5	65	10.33	2.02	0.84	170.4	1057.3	6912.9	424.1	6279.7	**2765.15**	**2093.25**
27.50	28.00	27.75	0.50	25.5	20.33	10.33	154.85	1.89	7.5	7.5	1.0	38.44	1609.73	65	1.0	122.6	4406.9	28.0	7.5	65	10.33	2.02	0.84	170.4	1057.3	7073.9	432.6	6449.2	**2829.56**	**2149.75**
28.00	29.50	28.75	1.50	27.0	20.33	10.33	154.85	5.66	7.5	7.5	1.0	115.32	1725.05	65	1.0	367.7	4774.6	29.5	7.5	65	10.33	2.02	0.84	170.4	1057.3	7556.9	458.0	6957.7	**3022.77**	**2319.24**
29.50	30.00	29.75	0.50	27.5	20.33	10.33	154.85	1.89	7.5	7.5	1.0	38.44	1763.49	65	1.0	122.6	4897.2	30.0	8.7	66	10.33	2.24	1.02	170.4	1110.4	7771.1	466.5	7127.2	**3108.43**	**2375.74**
30.00	31.00	30.50	1.00	28.5	20.33	10.33	154.85	3.77	8.7	8.7	1.0	89.36	1852.86	66	1.0	248.9	5146.1	31.0	8.7	66	10.33	2.24	1.02	170.4	1110.4	8109.4	483.5	7482.5	**3243.74**	**2494.15**
31.00	32.50	31.75	1.50	30.0	20.33	10.33	154.85	5.66	8.7	8.7	1.0	134.04	1986.90	66	1.0	373.4	5519.5	32.5	8.7	60	10.33	2.24	1.02	170.4	1049.3	8555.7	508.9	8015.3	**3422.27**	**2671.77**
32.50	34.00	33.25	1.50	31.5	20.33	10.33	154.85	5.66	8.7	8.7	1.0	134.04	2120.94	60	1.0	339.4	5858.9	34.0	8.7	66	10.33	2.24	1.02	170.4	1110.4	9090.2	534.4	8514.2	**3636.10**	**2838.08**
34.00	35.00	34.50	1.00	32.5	20.33	10.33	154.85	3.77	8.7	8.7	1.0	89.36	2210.31	66	1.0	248.9	6107.8	35.0	8.7	65	8.86	2.24	1.02	170.4	1099.2	9417.3	551.3	8869.5	**3766.93**	**2956.49**
35.00	35.50	35.25	0.50	33.0	18.86	8.86	154.85	1.89	8.7	8.7	1.0	44.68	2254.99	65	1.0	122.6	6230.4	35.5	8.7	65	8.94	2.24	1.02	170.4	1099.2	9584.6	559.8	9045.2	**3833.85**	**3015.07**
35.50	37.00	36.25	1.50	34.5	18.94	8.94	154.85	5.66	8.7	8.7	1.0	134.04	2389.03	65	1.0	367.7	6598.1	37.0	9.0	65	8.86	2.29	1.07	170.4	1109.9	10097.0	585.3	9572.4	**4038.81**	**3190.81**
37.00	37.50	37.25	0.50	35.0	18.86	8.86	154.85	1.89	9.0	9.0	1.0	46.25	2435.28	65	1.0	122.6	6720.7	37.5	9.0	62	8.86	2.29	1.07	170.4	1079.3	10235.3	593.8	9749.7	**4094.12**	**3249.91**
37.50	38.50	38.00	1.00	36.0	18.86	8.86	154.85	3.77	9.0	9.0	1.0	92.49	2527.77	62	1.0	233.8	6954.5	38.5	10.0	59	9.19	2.47	1.22	170.4	1084.7	10567.0	610.7	10093.0	**4226.79**	**3364.34**
38.50	40.00	39.25	1.50	37.5	19.19	9.19	154.85	5.66	10.0	10.0	1.0	154.46	2682.23	59	1.0	333.8	7288.3	40.0	10.0	59	9.19	2.47	1.22	170.4	1084.7	11055.2	636.2	10606.7	**4422.08**	**3535.56**

BORE NO: P57, CUT OFF LENGTH: 2.50 m, Nc= 9

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
2.50	3.00	2.75	0.50	0.5	19.59	9.59	26.37	1.89	24.8	24.8	1.0	22.98	0	0	1.0	0.0	0	3.0	25.4	0	9.59	10.90	11.80	28.8	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.5	19.59	9.59	38.36	7.54	25.4	25.4	1.0	137.39	0	0	1.0	0.0	0	5.0	27.6	2	10.74	15.85	16.87	48.0	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	20.74	10.74	53.32	3.77	27.6	27.6	1.0	105.13	0	2	1.0	7.5	0	6.0	27.6	2	10.74	15.85	16.87	58.7	1196.2	1196.2	59.4	59.4	**478.48**	**19.79**
6.00	8.00	7.00	2.00	5.5	20.74	10.74	69.43	7.54	27.6	27.6	1.0	273.78	273.78	2	1.0	15.1	15.1	8.0	27.6	2	10.74	15.85	16.87	80.2	1581.5	1870.4	93.3	382.2	**748.15**	**127.39**
8.00	9.00	8.50	1.00	6.5	20.74	10.74	85.54	3.77	27.6	27.6	1.0	168.66	442.44	2	1.0	7.5	22.6	9.0	9.6	53	10.32	2.40	1.16	90.9	794.5	1259.5	110.3	575.3	**503.81**	**191.78**
9.00	11.00	10.00	2.00	8.5	20.32	10.32	101.23	7.54	9.6	9.6	1.0	129.15	571.59	53	1.0	399.8	422.4	11.0	9.6	53	10.32	2.40	1.16	111.6	850.5	1844.4	144.2	1138.2	**737.78**	**379.40**
11.00	12.00	11.50	1.00	9.5	20.32	10.32	116.71	3.77	9.6	9.6	1.0	74.45	646.03	53	1.0	199.9	622.3	12.0	9.6	53	10.32	2.40	1.16	121.9	878.5	2146.8	161.2	1429.5	**858.71**	**476.49**
12.00	13.00	12.50	1.00	10.5	20.32	10.32	127.03	3.77	9.6	9.6	1.0	81.03	727.07	53	1.0	199.9	822.2	13.0	10.5	48	10.40	2.62	1.36	132.2	889.8	2439.0	178.1	1727.4	**975.62**	**575.79**
13.00	14.50	13.75	1.50	12.0	20.40	10.40	139.99	5.66	10.5	10.5	1.0	146.78	873.84	48	1.0	271.5	1093.7	14.5	10.5	48	10.40	2.62	1.36	147.8	936.0	2903.6	203.6	2171.1	**1161.42**	**723.71**
14.50	16.00	15.25	1.50	13.5	20.40	10.40	155.59	5.66	10.5	10.5	1.0	163.13	1036.98	48	1.0	271.5	1365.3	16.0	11.3	56	10.60	2.85	1.59	163.4	1109.0	3511.2	229.0	2631.3	**1404.48**	**877.09**
16.00	17.50	16.75	1.50	15.0	20.60	10.60	171.34	5.66	11.3	11.3	1.0	193.68	1230.66	56	1.0	316.8	1682.1	17.5	11.3	56	10.60	2.85	1.59	179.3	1160.3	4073.0	254.5	3167.2	**1629.20**	**1055.73**
17.50	19.00	18.25	1.50	16.5	20.60	10.60	171.34	5.66	11.3	11.3	1.0	193.68	1424.35	56	1.0	316.8	1998.9	19.0	25.2	6	9.55	10.45	11.34	179.3	2254.5	5677.7	279.9	3703.1	**2271.09**	**1234.37**
19.00	20.50	19.75	1.50	18.0	19.55	9.55	171.34	5.66	25.2	25.2	1.0	456.12	1880.46	6	1.0	33.9	2032.8	20.5	9.1	45	9.55	2.31	1.08	179.3	933.4	4846.7	305.4	4218.6	**1938.68**	**1406.21**
20.50	22.50	21.50	2.00	20.0	19.55	9.55	171.34	7.54	9.1	9.1	1.0	207.01	2087.47	45	1.0	339.4	2372.2	22.5	9.1	57	10.17	2.31	1.08	179.3	1056.1	5515.8	339.3	4799.0	**2206.31**	**1599.66**
22.50	23.50	23.00	1.00	21.0	20.17	10.17	171.34	3.77	9.1	9.1	1.0	103.50	2190.97	57	1.0	215.0	2587.2	23.5	9.1	57	10.17	2.31	1.08	179.3	1056.1	5834.2	356.3	5134.4	**2333.70**	**1711.48**
23.50	25.00	24.25	1.50	22.5	20.17	10.17	171.34	5.66	9.1	9.1	1.0	155.26	2346.23	57	1.0	322.5	2909.7	25.0	28.1	0	10.17	16.98	18.02	179.3	3569.1	8825.0	381.7	5637.6	**3529.98**	**1879.20**
25.00	26.50	25.75	1.50	24.0	20.17	10.17	171.34	5.66	28.1	28.1	1.0	517.56	2863.79	0	1.0	0.0	2909.7	26.5	28.1	0	10.03	16.98	18.02	179.3	3567.4	9340.8	407.2	6180.6	**3736.32**	**2060.20**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2
Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
26.50	27.50	27.00	1.00	25.0	20.03	10.03	171.34	3.77	28.1	28.1	1.0	345.04	3208.82	0	1.0	0.0	2909.7	27.5	28.1	0	10.03	16.98	18.02	179.3	3567.4	9685.8	424.1	6542.6	**3874.33**	**2180.86**
27.50	28.00	27.75	0.50	25.5	20.03	10.03	171.34	1.89	28.1	28.1	1.0	172.52	3381.34	0	1.0	0.0	2909.7	28.0	12.5	54	8.52	3.20	1.94	179.3	1211.0	7502.0	432.6	6723.6	**3000.80**	**2241.20**
28.00	29.50	28.75	1.50	27.0	18.52	8.52	171.34	5.66	12.5	12.5	1.0	214.89	3596.23	54	1.0	305.5	3215.1	29.5	12.5	54	8.71	3.20	1.94	179.3	1211.3	8022.6	458.0	7269.4	**3209.05**	**2423.14**
29.50	30.00	29.75	0.50	27.5	18.71	8.71	171.34	1.89	12.5	12.5	1.0	71.63	3667.86	54	1.0	101.8	3317.0	30.0	12.5	54	11.19	3.20	1.94	179.3	1214.5	8199.3	466.5	7451.4	**3279.74**	**2483.78**
30.00	31.00	30.50	1.00	28.5	21.19	11.19	171.34	3.77	12.5	12.5	1.0	143.26	3811.12	54	1.0	203.7	3520.6	31.0	10.5	50	11.19	2.62	1.36	179.3	1050.4	8382.1	483.5	7815.2	**3352.84**	**2605.08**
31.00	32.50	31.75	1.50	30.0	21.19	11.19	171.34	5.66	10.5	10.5	1.0	179.65	3990.76	50	1.0	282.9	3803.5	32.5	10.5	50	11.19	2.62	1.36	179.3	1050.4	8844.6	508.9	8303.2	**3537.85**	**2767.73**
32.50	34.00	33.25	1.50	31.5	21.19	11.19	171.34	5.66	10.5	10.5	1.0	179.65	4170.41	50	1.0	282.9	4086.3	34.0	28.8	0	11.19	18.56	19.64	179.3	3913.6	12170.3	534.4	8791.1	**4868.13**	**2930.38**
34.00	35.00	34.50	1.00	32.5	21.19	11.19	171.34	3.77	28.8	28.8	1.0	355.25	4525.66	0	1.0	0.0	4086.3	35.0	28.8	0	11.19	18.56	19.64	179.3	3913.6	12525.6	551.3	9163.4	**5010.23**	**3054.45**
35.00	35.50	35.25	0.50	33.0	21.19	11.19	171.34	1.89	28.8	28.8	1.0	177.62	4703.29	0	1.0	0.0	4086.3	35.5	30.9	0	11.19	25.79	27.01	179.3	5437.5	14227.1	559.8	9349.5	**5690.83**	**3116.49**
35.50	37.50	36.50	2.00	35.0	21.19	11.19	171.34	7.54	30.9	30.9	1.0	808.29	5511.57	0	1.0	0.0	4086.3	37.5	30.1	0	8.95	21.76	22.91	179.3	4554.0	14151.9	593.8	10191.7	**5660.76**	**3397.23**
37.50	38.50	38.00	1.00	36.0	18.95	8.95	171.34	3.77	30.1	30.1	1.0	376.46	5888.03	0	1.0	0.0	4086.3	38.5	29.8	0	9.01	20.81	21.94	179.3	4355.4	14329.8	610.7	10585.1	**5731.91**	**3528.37**
38.50	40.00	39.25	1.50	37.5	19.01	9.01	171.34	5.66	29.8	29.8	1.0	555.12	6443.15	0	1.0	0.0	4086.3	40.0	29.8	0	9.01	20.81	21.94	179.3	4355.4	14884.9	636.2	11165.7	**5953.96**	**3721.89**
BORE NO: P58, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.05	10.05	27.64	1.89	12.1	12.1	1.0	11.17	0	15	1.0	28.3	0	3.0	24.5	0	10.05	9.64	10.33	30.2	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.5	20.05	10.05	35.18	3.77	24.5	24.5	1.0	60.46	0	0	1.0	0.0	0	4.0	27.4	2	9.79	15.40	16.41	40.2	830.1	830.1	25.4	25.4	**332.03**	**8.48**
4.00	6.00	5.00	2.00	3.5	19.79	9.79	49.99	7.54	27.4	27.4	1.0	195.45	195.45	2	1.0	15.1	15.1	6.0	28.7	0	9.79	18.33	19.40	59.8	1368.9	1579.4	59.4	269.9	**631.77**	**89.97**
6.00	7.00	6.50	1.00	4.5	19.79	9.79	64.68	3.77	28.7	28.7	1.0	133.54	328.99	0	1.0	0.0	15.1	7.0	28.7	0	9.40	18.33	19.40	69.6	1566.8	1910.9	76.3	420.4	**764.35**	**140.14**

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
7.00	9.00	8.00	2.00	6.5	19.40	9.40	78.97	7.54	28.7	28.7	1.0	326.11	655.11	0	1.0	0.0	15.1	9.0	28.7	0	9.40	18.33	19.40	88.4	1956.7	2626.9	110.3	780.5	**1050.78**	**260.15**
9.00	10.00	9.50	1.00	7.5	19.40	9.40	93.07	3.77	28.7	28.7	1.0	192.17	847.28	0	1.0	0.0	15.1	10.0	28.0	0	9.40	16.76	17.79	97.8	1967.0	2829.4	127.2	989.6	**1131.77**	**329.87**
10.00	11.00	10.50	1.00	8.5	19.40	9.40	102.47	3.77	28.0	28.0	1.0	205.48	1052.76	0	1.0	0.0	15.1	11.0	24.8	8	10.21	9.86	10.66	107.2	1350.4	2418.3	144.2	1212.0	**967.32**	**404.02**
11.00	12.50	11.75	1.50	10.0	20.21	10.21	114.83	5.66	24.8	24.8	1.0	300.16	1352.92	8	1.0	45.3	60.3	12.5	10.6	50	10.27	2.65	1.39	122.5	885.6	2298.9	169.6	1582.9	**919.54**	**527.64**
12.50	15.50	14.00	3.00	13.0	20.27	10.27	137.89	11.31	10.6	10.6	1.0	291.97	1644.89	50	1.0	565.7	626.1	15.5	10.6	50	10.27	2.65	1.39	153.3	977.8	3248.8	220.5	2491.5	**1299.51**	**830.49**
15.50	17.00	16.25	1.50	14.5	20.27	10.27	161.00	5.66	10.6	10.6	1.0	170.45	1815.34	50	1.0	282.9	908.9	17.0	26.8	0	9.29	14.05	15.03	168.7	2777.2	5501.4	246.0	2970.2	**2200.57**	**990.08**
17.00	18.50	17.75	1.50	16.0	19.29	9.29	175.67	5.66	26.8	26.8	1.0	501.99	2317.33	0	1.0	0.0	908.9	18.5	26.8	0	9.29	14.05	15.03	168.7	2777.2	6003.4	271.4	3497.7	**2401.37**	**1165.89**
18.50	20.00	19.25	1.50	17.5	19.29	9.29	175.67	5.66	26.8	26.8	1.0	501.99	2819.32	0	1.0	0.0	908.9	20.0	27.2	6	9.68	14.95	15.95	168.7	3020.2	6748.5	296.9	4025.1	**2699.39**	**1341.71**
20.00	21.50	20.75	1.50	19.0	19.68	9.68	175.67	5.66	27.2	27.2	1.0	510.73	3330.05	6	1.0	33.9	942.9	21.5	11.0	45	9.68	2.76	1.51	168.7	995.7	5268.6	322.3	4595.2	**2107.44**	**1531.75**
21.50	23.00	22.25	1.50	20.5	19.68	9.68	175.67	5.66	11.0	11.0	1.0	193.17	3523.22	45	1.0	254.6	1197.4	23.0	11.0	45	9.68	2.76	1.51	168.7	995.7	5716.3	347.8	5068.4	**2286.54**	**1689.48**
23.00	24.50	23.75	1.50	22.0	19.68	9.68	175.67	5.66	11.0	11.0	1.0	193.17	3716.39	45	1.0	254.6	1452.0	24.5	9.4	58	10.37	2.36	1.13	168.7	1049.4	6217.8	373.2	5541.6	**2487.11**	**1847.20**
24.50	27.50	26.00	3.00	25.0	20.37	10.37	175.67	11.31	9.4	9.4	1.0	329.04	4045.43	58	1.0	656.2	2108.2	27.5	7.0	70	10.37	1.93	0.76	168.7	1086.5	7240.2	424.1	6577.8	**2896.07**	**2192.59**
27.50	29.00	28.25	1.50	26.5	20.37	10.37	175.67	5.66	7.0	7.0	1.0	122.02	4167.45	70	1.0	396.0	2504.2	29.0	9.0	54	10.37	2.29	1.07	168.7	994.5	7666.2	449.6	7121.2	**3066.46**	**2373.75**
29.00	30.00	29.50	1.00	27.5	20.37	10.37	175.67	3.77	9.0	9.0	1.0	104.93	4272.38	54	1.0	203.7	2707.9	30.0	9.0	54	8.77	2.29	1.07	168.7	993.3	7973.6	466.5	7446.8	**3189.43**	**2482.27**
30.00	30.50	30.25	0.50	28.0	18.77	8.77	175.67	1.89	9.0	9.0	1.0	52.47	4324.85	54	1.0	101.8	2809.7	30.5	31.2	0	9.06	27.30	28.55	168.7	5387.3	12521.8	475.0	7609.6	**5008.73**	**2536.52**
30.50	32.00	31.25	1.50	29.5	19.06	9.06	175.67	5.66	31.2	31.2	1.1	637.96	4962.81	0	1.0	0.0	2809.7	32.0	20.0	48	9.06	6.40	5.39	168.7	1743.5	9516.0	500.5	8273.0	**3806.41**	**2757.66**
32.00	32.50	32.25	0.50	30.0	19.06	9.06	175.67	1.89	20.0	20.0	1.0	120.57	5083.38	48	1.0	90.5	2900.2	32.5	20.0	48	9.06	6.40	5.39	168.7	1743.5	9727.1	508.9	8492.5	**3890.85**	**2830.85**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
32.50	33.50	33.00	1.00	31.0	19.06	9.06	175.67	3.77	20.0	20.0	1.0	241.14	5324.52	48	1.0	181.0	3081.3	33.5	31.1	0	8.86	26.80	28.04	168.7	5284.1	13689.9	525.9	8931.7	**5475.97**	**2977.23**
33.50	35.00	34.25	1.50	32.5	18.86	8.86	175.67	5.66	31.1	31.1	1.1	632.46	5956.97	0	1.0	0.0	3081.3	35.0	31.3	0	8.69	27.81	29.06	168.7	5479.3	14517.5	551.3	9589.6	**5807.00**	**3196.53**
35.00	36.50	35.75	1.50	34.0	18.69	8.69	175.67	5.66	31.3	31.3	1.1	643.50	6600.47	0	1.0	0.0	3081.3	36.5	31.3	0	8.63	27.81	29.06	168.7	5478.1	15159.8	576.8	10258.5	**6063.92**	**3419.51**
36.50	37.50	37.00	1.00	35.0	18.63	8.63	175.67	3.77	31.3	31.3	1.1	429.00	7029.47	0	1.0	0.0	3081.3	37.5	31.9	0	8.63	30.83	32.14	168.7	6073.0	16183.7	593.8	10704.5	**6473.49**	**3568.16**
37.50	38.00	37.75	0.50	35.5	18.63	8.63	175.67	1.89	31.9	31.9	1.1	225.78	7255.25	0	1.0	0.0	3081.3	38.0	34.3	0	8.62	42.92	44.44	168.7	8452.4	18788.9	602.2	10938.8	**7515.56**	**3646.25**
38.00	40.00	39.00	2.00	37.5	18.62	8.62	175.67	7.54	34.3	34.3	1.2	1098.21	8353.46	0	1.0	0.0	3081.3	40.0	34.3	0	8.62	42.92	44.44	168.7	8452.4	19887.1	636.2	12070.9	**7954.84**	**4023.63**
BORE NO: P59, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	19.41	9.41	25.88	1.89	26.7	26.7	1.0	24.54	0	4	1.0	7.5	0	3.0	26.7	0	9.41	13.83	14.80	28.2	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.5	19.41	9.41	32.94	3.77	26.7	26.7	1.0	62.47	0	0	1.0	0.0	0	4.0	7.2	62	9.29	1.97	0.79	37.6	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	5.00	4.50	1.00	2.5	19.29	9.29	42.29	3.77	7.2	7.2	1.0	20.15	0	62	1.0	233.8	0	5.0	7.2	62	9.29	1.97	0.79	46.9	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.29	9.29	51.58	3.77	7.2	7.2	1.0	24.57	0	62	1.0	233.8	0	6.0	7.2	62	9.29	1.97	0.79	56.2	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	7.00	6.50	1.00	4.5	19.29	9.29	60.87	3.77	7.2	7.2	1.0	29.00	0	62	1.0	233.8	0	7.0	28.4	0	9.00	17.66	18.71	65.5	0	0.0	76.3	76.3	**0.00**	**25.45**
7.00	8.00	7.50	1.00	5.5	19.00	9.00	70.01	3.77	28.4	28.4	1.0	142.76	0	0	1.0	0.0	0	8.0	28.4	0	9.00	17.66	18.71	74.5	1602.8	1602.8	93.3	93.3	**641.13**	**31.10**
8.00	9.00	8.50	1.00	6.5	19.00	9.00	79.01	3.77	28.4	28.4	1.0	161.12	161.12	0	1.0	0.0	0.0	9.0	28.7	0	9.00	18.33	19.40	83.5	1850.7	2011.8	110.3	271.4	**804.72**	**90.46**
9.00	10.00	9.50	1.00	7.5	19.00	9.00	88.01	3.77	28.7	28.7	1.0	181.72	342.84	0	1.0	0.0	0.0	10.0	11.5	40	10.10	2.91	1.65	92.5	723.3	1066.2	127.2	470.1	**426.46**	**156.69**
10.00	11.00	10.50	1.00	8.5	20.10	10.10	97.56	3.77	11.5	11.5	1.0	74.86	417.70	40	1.0	150.9	150.9	11.0	8.4	55	10.10	2.18	0.97	102.6	820.1	1388.6	144.2	712.8	**555.44**	**237.58**
11.00	12.00	11.50	1.00	9.5	20.10	10.10	107.66	3.77	8.4	8.4	1.0	59.96	477.66	55	1.0	207.4	358.3	12.0	8.4	55	10.31	2.18	0.97	112.7	845.1	1681.1	161.2	997.1	**672.43**	**332.37**

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2
Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
12.00	14.50	13.25	2.50	12.0	20.31	10.31	125.60	9.43	8.4	8.4	1.0	174.87	652.52	55	1.0	518.6	876.9	14.5	8.4	55	9.77	2.18	0.97	138.5	908.4	2437.8	203.6	1733.0	**975.11**	**577.65**
14.50	17.50	16.00	3.00	15.0	19.77	9.77	153.14	11.31	8.4	8.4	1.0	255.86	908.38	55	1.0	622.3	1499.1	17.5	11.8	50	9.77	3.00	1.73	167.8	1090.0	3497.6	254.5	2662.0	**1399.03**	**887.33**
17.50	19.00	18.25	1.50	16.5	19.77	9.77	153.14	5.66	11.8	11.8	1.0	180.99	1089.37	50	1.0	282.9	1782.0	19.0	27.6	2	9.52	15.85	16.87	167.8	3139.4	6010.8	279.9	3151.3	**2404.32**	**1050.43**
19.00	20.50	19.75	1.50	18.0	19.52	9.52	153.14	5.66	27.6	27.6	1.0	452.91	1542.28	2	1.0	11.3	1793.3	20.5	27.6	2	9.52	15.85	16.87	167.8	3139.4	6475.0	305.4	3641.0	**2590.01**	**1213.65**
20.50	23.50	22.00	3.00	21.0	19.52	9.52	153.14	11.31	27.6	27.6	1.0	905.82	2448.10	2	1.0	22.6	1815.9	23.5	12.6	38	9.07	3.23	1.96	167.8	1012.9	5276.9	356.3	4620.3	**2110.76**	**1540.10**
23.50	25.00	24.25	1.50	22.5	19.07	9.07	153.14	5.66	12.6	12.6	1.0	193.65	2641.75	38	1.0	215.0	2030.9	25.0	12.6	38	9.41	3.23	1.96	167.8	1013.3	5686.0	381.7	5054.4	**2274.39**	**1684.79**
25.00	26.50	25.75	1.50	24.0	19.41	9.41	153.14	5.66	12.6	12.6	1.0	193.65	2835.39	38	1.0	215.0	2245.9	26.5	12.6	38	9.80	3.23	1.96	167.8	1013.8	6095.1	407.2	5488.4	**2438.04**	**1829.48**
26.50	27.50	27.00	1.00	25.0	19.80	9.80	153.14	3.77	12.6	12.6	1.0	129.10	2964.49	38	1.0	143.3	2389.2	27.5	13.0	45	10.12	3.35	2.08	167.8	1108.5	6462.2	424.1	5777.8	**2584.88**	**1925.94**
27.50	28.00	27.75	0.50	25.5	20.12	10.12	153.14	1.89	13.0	13.0	1.0	66.67	3031.16	45	1.0	84.9	2474.1	28.0	7.0	75	10.12	1.93	0.76	167.8	1135.3	6640.5	432.6	5937.8	**2656.22**	**1979.27**
28.00	29.50	28.75	1.50	27.0	20.12	10.12	153.14	5.66	7.0	7.0	1.0	106.37	3137.54	75	1.0	424.3	2898.3	29.5	15.3	40	10.12	4.09	2.81	167.8	1202.7	7238.6	458.0	6493.9	**2895.42**	**2164.64**
29.50	30.00	29.75	0.50	27.5	20.12	10.12	153.14	1.89	15.3	15.3	1.0	79.00	3216.54	40	1.0	75.4	2973.8	30.0	15.3	40	10.12	4.09	2.81	167.8	1202.7	7393.0	466.5	6656.8	**2957.19**	**2218.94**
30.00	31.00	30.50	1.00	28.5	20.12	10.12	153.14	3.77	15.3	15.3	1.0	158.00	3374.54	40	1.0	150.9	3124.6	31.0	28.4	0	10.12	17.66	18.71	167.8	3480.6	9979.8	483.5	6982.7	**3991.91**	**2327.55**
31.00	32.50	31.75	1.50	30.0	20.12	10.12	153.14	5.66	28.4	28.4	1.0	468.43	3842.96	0	1.0	0.0	3124.6	32.5	28.4	0	10.12	17.66	18.71	167.8	3480.6	10448.2	508.9	7476.5	**4179.28**	**2492.18**
32.50	34.00	33.25	1.50	31.5	20.12	10.12	153.14	5.66	28.4	28.4	1.0	468.43	4311.39	0	1.0	0.0	3124.6	34.0	29.6	5	10.28	20.36	21.48	167.8	4065.9	11501.9	534.4	7970.4	**4600.76**	**2656.80**
34.00	35.00	34.50	1.00	32.5	20.28	10.28	153.14	3.77	29.6	29.6	1.0	328.10	4639.49	5	1.0	18.9	3143.5	35.0	29.6	5	10.28	20.36	21.48	167.8	4065.9	11848.8	551.3	8334.3	**4739.54**	**2778.11**
35.00	35.50	35.25	0.50	33.0	20.28	10.28	153.14	1.89	29.6	29.6	1.0	164.05	4803.54	5	1.0	9.4	3152.9	35.5	29.2	0	10.28	19.46	20.56	167.8	3837.5	11794.0	559.8	8516.3	**4717.59**	**2838.76**
35.50	37.00	36.25	1.50	34.5	20.28	10.28	153.14	5.66	29.2	29.2	1.0	484.18	5287.71	0	1.0	0.0	3152.9	37.0	29.2	0	10.28	19.46	20.56	167.8	3837.5	12278.2	585.3	9025.9	**4911.26**	**3008.64**

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2
Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
37.00	37.50	37.25	0.50	35.0	20.28	10.28	153.14	1.89	29.2	29.2	1.0	161.39	5449.11	0	1.0	0.0	3152.9	37.5	29.2	0	8.86	19.46	20.56	167.8	3817.7	12419.7	593.8	9195.8	**4967.89**	**3065.26**
37.50	38.50	38.00	1.00	36.0	18.86	8.86	153.14	3.77	29.2	29.2	1.0	322.79	5771.89	0	1.0	0.0	3152.9	38.5	29.2	0	8.80	19.46	20.56	167.8	3816.9	12741.7	610.7	9535.5	**5096.67**	**3178.51**
38.50	40.00	39.25	1.50	37.5	18.80	8.80	153.14	5.66	29.2	29.2	1.0	484.18	6256.07	0	1.0	0.0	3152.9	40.0	29.2	0	8.80	19.46	20.56	167.8	3816.9	13225.9	636.2	10045.2	**5290.34**	**3348.39**
BORE NO: P60, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.5	20.72	10.72	29.48	1.89	9.7	9.7	1.0	9.50	0	62.0	1.0	116.9	0	3.0	8.1	30	10.72	2.13	0.93	32.2	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.5	20.72	10.72	37.52	3.77	8.1	8.1	1.0	20.14	0	30.0	1.0	113.1	0	4.0	8.1	30	10.72	2.13	0.93	42.9	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	5.00	4.50	1.00	2.5	20.72	10.72	48.24	3.77	8.1	8.1	1.0	25.89	0	30.0	1.0	113.1	0	5.0	29.4	5	9.64	19.91	21.02	53.6	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.5	19.64	9.64	58.42	3.77	29.4	29.4	1.0	124.15	0	5.0	1.0	18.9	0	6.0	29.4	5	9.64	19.91	21.02	63.2	1612.9	1612.9	59.4	59.4	**645.17**	**19.79**
6.00	7.00	6.50	1.00	4.5	19.64	9.64	68.06	3.77	29.4	29.4	1.0	144.63	144.63	5.0	1.0	18.9	18.9	7.0	28.7	0	9.64	18.33	19.40	72.9	1638.6	1802.1	76.3	239.8	**720.85**	**79.94**
7.00	9.00	8.00	2.00	6.5	19.64	9.64	82.52	7.54	28.7	28.7	1.0	340.77	485.41	0.0	1.0	0.0	18.9	9.0	24.6	14	10.41	9.71	10.44	92.2	1229.0	1733.3	110.3	614.5	**693.32**	**204.84**
9.00	10.00	9.50	1.00	7.5	20.41	10.41	97.37	3.77	24.6	24.6	1.0	168.12	653.53	14.0	1.0	52.8	71.7	10.0	24.6	14	10.41	9.71	10.44	102.6	1343.4	2068.6	127.2	852.4	**827.44**	**284.14**
10.00	11.00	10.50	1.00	8.5	20.41	10.41	107.78	3.77	24.6	24.6	1.0	186.09	839.62	14.0	1.0	52.8	124.5	11.0	24.6	14	10.41	9.71	10.44	113.0	1457.8	2421.9	144.2	1108.3	**968.76**	**369.43**
11.00	12.50	11.75	1.50	10.0	20.41	10.41	120.79	5.66	24.6	24.6	1.0	312.84	1152.47	14.0	1.0	79.2	203.7	12.5	24.6	14	10.41	9.71	10.44	128.6	1629.4	2985.5	169.6	1525.8	**1194.21**	**508.59**
12.50	14.00	13.25	1.50	11.5	20.41	10.41	136.40	5.66	24.6	24.6	1.0	353.29	1505.75	14.0	1.0	79.2	282.9	14.0	24.6	14	10.86	9.71	10.44	144.2	1804.2	3592.8	195.1	1983.7	**1437.12**	**661.23**
14.00	15.50	14.75	1.50	13.0	20.86	10.86	152.36	5.66	24.6	24.6	1.0	394.61	1900.36	14.0	1.0	79.2	362.1	15.5	24.6	14	10.86	9.71	10.44	160.5	1983.2	4245.6	220.5	2483.0	**1698.24**	**827.65**
15.50	17.00	16.25	1.50	14.5	20.86	10.86	168.65	5.66	24.6	24.6	1.0	436.80	2337.16	14.0	1.0	79.2	441.3	17.0	23.9	15	10.66	9.21	9.67	176.8	2064.6	4843.0	246.0	3024.4	**1937.19**	**1008.13**
17.00	18.50	17.75	1.50	16.0	20.66	10.66	184.79	5.66	23.9	23.9	1.0	463.24	2800.40	15.0	1.0	84.9	526.1	18.5	23.9	15	10.66	9.21	9.67	176.8	2064.6	5391.1	271.4	3597.9	**2156.43**	**1199.31**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
18.50	20.00	19.25	1.50	17.5	20.66	10.66	184.79	5.66	23.9	23.9	1.0	463.24	3263.63	15.0	1.0	84.9	611.0	20.0	23.7	19	10.65	9.06	9.45	176.8	2074.8	5949.4	296.9	4171.5	**2379.78**	**1390.50**
20.00	21.50	20.75	1.50	19.0	20.65	10.65	184.79	5.66	23.7	23.7	1.0	458.88	3722.51	19.0	1.0	107.5	718.5	21.5	23.7	19	9.78	9.06	9.45	176.8	2069.3	6510.2	322.3	4763.3	**2604.09**	**1587.77**
21.50	24.50	23.00	3.00	22.0	19.78	9.78	184.79	11.31	23.7	23.7	1.0	917.76	4640.27	19.0	1.0	215.0	933.4	24.5	23.7	19	9.78	9.06	9.45	176.8	2069.3	7643.0	373.2	5946.9	**3057.18**	**1982.31**
24.50	26.00	25.25	1.50	23.5	19.78	9.78	184.79	5.66	23.7	23.7	1.0	458.88	5099.15	19.0	1.0	107.5	1040.9	26.0	6.4	60	9.96	1.82	0.67	176.8	979.9	7120.0	398.7	6538.7	**2847.99**	**2179.58**
26.00	27.50	26.75	1.50	25.0	19.96	9.96	184.79	5.66	6.4	6.4	1.0	117.26	5216.40	60.0	1.0	339.4	1380.3	27.5	6.4	60	9.96	1.82	0.67	176.8	979.9	7576.7	424.1	7020.9	**3030.67**	**2340.29**
27.50	29.00	28.25	1.50	26.5	19.96	9.96	184.79	5.66	6.4	6.4	1.0	117.26	5333.66	60.0	1.0	339.4	1719.8	29.0	9.1	39	10.86	2.31	1.08	176.8	866.8	7920.2	449.6	7503.0	**3168.08**	**2501.00**
29.00	30.00	29.50	1.00	27.5	20.86	10.86	184.79	3.77	9.1	9.1	1.0	111.63	5445.29	39.0	1.0	147.1	1866.9	30.0	9.1	39	10.86	2.31	1.08	176.8	866.8	8178.9	466.5	7778.7	**3271.56**	**2592.89**
30.00	30.50	30.25	0.50	28.0	20.86	10.86	184.79	1.89	9.1	9.1	1.0	55.81	5501.10	39.0	1.0	73.5	1940.4	30.5	6.4	60	10.86	1.82	0.67	176.8	980.3	8421.8	475.0	7916.5	**3368.73**	**2638.84**
30.50	32.00	31.25	1.50	29.5	20.86	10.86	184.79	5.66	6.4	6.4	1.0	117.26	5618.35	60.0	1.0	339.4	2279.8	32.0	9.1	39	9.30	2.31	1.08	176.8	865.6	8763.8	500.5	8398.6	**3505.52**	**2799.55**
32.00	32.50	32.25	0.50	30.0	19.30	9.30	184.79	1.89	9.1	9.1	1.0	55.81	5674.17	39.0	1.0	73.5	2353.4	32.5	9.1	39	9.30	2.31	1.08	176.8	865.6	8893.2	508.9	8536.5	**3557.26**	**2845.49**
32.50	33.50	33.00	1.00	31.0	19.30	9.30	184.79	3.77	9.1	9.1	1.0	111.63	5785.79	39.0	1.0	147.1	2500.5	33.5	23.0	0	9.30	8.56	8.68	176.8	1767.0	10053.3	525.9	8812.2	**4021.32**	**2937.38**
33.50	35.00	34.25	1.50	32.5	19.30	9.30	184.79	5.66	23.0	23.0	1.0	443.73	6229.52	0.0	1.0	0.0	2500.5	35.0	15.5	52	9.30	4.19	2.92	176.8	1385.3	10115.3	551.3	9281.3	**4046.10**	**3093.78**
35.00	36.50	35.75	1.50	34.0	19.30	9.30	184.79	5.66	15.5	15.5	1.0	289.90	6519.42	52.0	1.0	294.2	2794.6	36.5	8.5	46	9.60	2.20	0.99	176.8	914.9	10229.0	576.8	9890.8	**4091.59**	**3296.95**
36.50	37.50	37.00	1.00	35.0	19.60	9.60	184.79	3.77	8.5	8.5	1.0	104.15	6623.58	46.0	1.0	173.5	2968.1	37.5	8.5	46	9.60	2.20	0.99	176.8	914.9	10506.6	593.8	10185.5	**4202.64**	**3395.15**
37.50	38.00	37.75	0.50	35.5	19.60	9.60	184.79	1.89	8.5	8.5	1.0	52.08	6675.65	46.0	1.0	86.7	3054.9	38.0	8.5	67	8.10	2.20	0.99	176.8	1127.7	10858.3	602.2	10332.8	**4343.30**	**3444.25**
38.00	40.00	39.00	2.00	37.5	18.10	8.10	184.79	7.54	8.5	8.5	1.0	208.31	6883.96	67.0	1.0	505.4	3560.2	40.0	8.5	67	8.10	2.20	0.99	176.8	1127.7	11571.9	636.2	11080.4	**4628.77**	**3693.45**

APPENDIX-H

TABLE 3: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1000 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Depth of Fixity (m)	Allowable Load capacity of pile(kN)
P41	1.00	2.50	0.00	35	29580399	0.0491	16	2264	3.64	3.50	0.96	2.09	0.005	7.60	64
P42	1.00	2.50	0.00	35	29580399	0.0491	17	2408	3.60	6.50	1.81	1.96	0.005	7.05	35
P43	1.00	2.50	0.00	35	29580399	0.0491	16	2264	3.64	2.50	0.69	2.13	0.005	7.75	81
P44	1.00	2.50	0.00	35	29580399	0.0491	15	2120	3.69	0.50	0.14	2.21	0.005	8.16	134
P45	1.00	2.50	0.00	35	29580399	0.0491	16	2264	3.64	2.50	0.69	2.13	0.005	7.75	81
P46	1.00	2.50	0.00	35	29580399	0.0491	22	3128	3.41	6.50	1.90	1.94	0.005	6.64	38
P47	1.00	2.50	0.00	35	29580399	0.0491	15	2120	3.69	0.50	0.14	2.21	0.005	8.16	134
P48	1.00	2.50	0.00	35	29580399	0.0491	23	3272	3.38	7.50	2.22	1.92	0.005	6.51	32
P49	1.00	2.50	0.00	35	29580399	0.0491	20	2840	3.48	7.50	2.15	1.93	0.005	6.71	30
P50	1.00	2.50	0.00	35	29580399	0.0491	18	2552	3.56	2.50	0.70	2.12	0.005	7.56	86
P51	1.00	2.50	0.00	35	29580399	0.0491	17	2408	3.60	2.50	0.69	2.13	0.005	7.65	83
P52	1.00	2.50	0.00	35	29580399	0.0491	16	2264	3.64	9.50	2.61	1.91	0.005	6.97	19
P53	1.00	2.50	0.00	35	29580399	0.0491	21	2984	3.45	3.50	1.02	2.08	0.005	7.16	72
P54	1.00	2.50	0.00	35	29580399	0.0491	18	2552	3.56	3.50	0.98	2.08	0.005	7.41	67
P55	1.00	2.50	0.00	35	29580399	0.0491	20	2840	3.48	7.50	2.15	1.93	0.005	6.71	30
P56	1.00	2.50	0.00	35	29580399	0.0491	18	2552	3.56	5.50	1.55	2.00	0.005	7.11	43
P57	1.00	2.50	0.00	35	29580399	0.0491	16	2264	3.64	3.50	0.96	2.09	0.005	7.60	64
P58	1.00	2.50	0.00	35	29580399	0.0491	15	2120	3.69	1.50	0.41	2.17	0.005	8.01	101
P59	1.00	2.50	0.00	35	29580399	0.0491	17	2408	3.60	5.50	1.53	2.00	0.005	7.20	43
P60	1.00	2.50	0.00	35	29580399	0.0491	17	2408	3.60	3.50	0.97	2.08	0.005	7.50	65

APPENDIX-H

TABLE 4: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1200 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Depth of Fixity (m)	Allowable Load capacity of pile(kN)
P41	1.20	2.50	0.00	35	29580399	0.1018	17	2408	4.16	3.50	0.84	2.10	0.005	8.76	98
P42	1.20	2.50	0.00	35	29580399	0.1018	17	2408	4.16	6.50	1.56	2.00	0.005	8.31	56
P43	1.20	2.50	0.00	35	29580399	0.1018	19	2696	4.07	2.50	0.61	2.14	0.005	8.70	129
P44	1.20	2.50	0.00	35	29580399	0.1018	15	2120	4.27	0.50	0.12	2.21	0.005	9.45	183
P45	1.20	2.50	0.00	35	29580399	0.1018	16	2264	4.21	2.50	0.59	2.14	0.005	9.02	118
P46	1.20	2.50	0.00	35	29580399	0.1018	21	2984	3.99	6.50	1.63	1.99	0.005	7.92	60
P47	1.20	2.50	0.00	35	29580399	0.1018	15	2120	4.27	0.50	0.12	2.21	0.005	9.45	183
P48	1.20	2.50	0.00	35	29580399	0.1018	24	3416	3.88	7.50	1.93	1.94	0.005	7.53	53
P49	1.20	2.50	0.00	35	29580399	0.1018	20	2840	4.03	7.50	1.86	1.95	0.005	7.86	50
P50	1.20	2.50	0.00	35	29580399	0.1018	19	2696	4.07	2.50	0.61	2.14	0.005	8.70	129
P51	1.20	2.50	0.00	35	29580399	0.1018	17	2408	4.16	2.50	0.60	2.14	0.005	8.91	122
P52	1.20	2.50	0.00	35	29580399	0.1018	16	2264	4.21	9.50	2.25	1.92	0.005	8.11	33
P53	1.20	2.50	0.00	35	29580399	0.1018	21	2984	3.99	3.50	0.88	2.10	0.005	8.37	108
P54	1.20	2.50	0.00	35	29580399	0.1018	19	2696	4.07	3.50	0.86	2.10	0.005	8.55	103
P55	1.20	2.50	0.00	35	29580399	0.1018	20	2840	4.03	7.50	1.86	1.95	0.005	7.86	50
P56	1.20	2.50	0.00	35	29580399	0.1018	19	2696	4.07	5.50	1.35	2.03	0.005	8.25	69
P57	1.20	2.50	0.00	35	29580399	0.1018	17	2408	4.16	3.50	0.84	2.10	0.005	8.76	98
P58	1.20	2.50	0.00	35	29580399	0.1018	16	2264	4.21	1.50	0.36	2.18	0.005	9.17	149
P59	1.20	2.50	0.00	35	29580399	0.1018	18	2552	4.11	5.50	1.34	2.03	0.005	8.35	68
P60	1.20	2.50	0.00	35	29580399	0.1018	17	2408	4.16	3.50	0.84	2.10	0.005	8.76	98

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
P41	0.50	SM	35	6	10.35	5.00	5.35	1.00	0.301	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.728	Liquefiable
	1.00	SM	35	6	20.70	10.00	10.70	0.99	0.299	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.731	Liquefiable
	2.00	CH	63	6	41.40	20.00	21.40	0.98	0.297	1.70	10.20	5.00	1.20	17.24	0.18	1.00	-	-	Non-liquefiable
	3.00	CL	82	14	62.10	30.00	32.10	0.98	0.295	1.70	23.80	5.00	1.20	33.56	0.52	1.00	-	-	Non-liquefiable
	4.00	CL	82	9	82.80	40.00	42.80	0.97	0.293	1.53	13.76	5.00	1.20	21.51	0.24	1.00	-	-	Non-liquefiable
	5.00	SM	29	9	98.00	50.00	48.00	0.96	0.306	1.44	12.99	4.64	1.15	19.53	0.21	1.00	0.250	0.816	Liquefiable
	6.00	SM	29	15	117.60	60.00	57.60	0.95	0.304	1.32	19.76	4.64	1.15	27.29	0.35	1.00	0.414	1.361	Non-liquefiable
	7.00	SM	29	18	137.20	70.00	67.20	0.95	0.301	1.22	21.96	4.64	1.15	29.80	0.45	1.00	0.542	1.799	Non-liquefiable
	9.00	CL-ML	68	24	176.40	90.00	86.40	0.93	0.297	1.08	25.82	5.00	1.20	35.98	0.52	1.00	-	-	Non-liquefiable
	10.00	CL-ML	68	22	196.00	100.00	96.00	0.91	0.289	1.02	22.45	5.00	1.20	31.94	0.52	1.00	-	-	Non-liquefiable
	11.00	CL	86	22	224.40	110.00	114.40	0.88	0.269	0.93	20.57	5.00	1.20	29.68	0.45	1.00	-	-	Non-liquefiable
	12.50	CL	86	26	255.00	125.00	130.00	0.84	0.257	0.88	22.80	5.00	1.20	32.36	0.52	1.00	-	-	Non-liquefiable
	14.00	CL-ML	85	26	292.60	140.00	152.60	0.80	0.239	0.81	21.05	5.00	1.20	30.26	0.49	1.00	-	-	Non-liquefiable
	15.50	CL-ML	79	25	323.95	155.00	168.95	0.76	0.227	0.77	19.23	5.00	1.20	28.08	0.37	0.88	-	-	Non-liquefiable
	17.00	CL	59	25	351.90	170.00	181.90	0.72	0.217	0.74	18.54	5.00	1.20	27.24	0.35	0.82	-	-	Non-liquefiable
	18.50	ML	57	33	382.95	185.00	197.95	0.68	0.205	0.71	23.46	5.00	1.20	33.15	0.52	0.79	0.490	2.387	Non-liquefiable
	20.00	CL	86	33	412.00	200.00	212.00	0.64	0.194	0.69	22.66	5.00	1.20	32.20	0.52	0.79	-	-	Non-liquefiable
	21.50	CL	86	35	442.90	215.00	227.90	0.60	0.182	0.66	23.18	5.00	1.20	32.82	0.52	0.77	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	24.50	CL	84	36	485.10	245.00	240.10	0.56	0.176	0.65	23.23	5.00	1.20	32.88	0.52	0.71	-	-	Non-liquefiable
	26.00	MI	99	36	520.00	260.00	260.00	0.56	0.175	0.62	22.33	5.00	1.20	31.79	0.52	0.89	-	-	Non-liquefiable
	27.50	MI	99	34	550.00	275.00	275.00	0.56	0.175	0.60	20.50	5.00	1.20	29.60	0.44	0.88	-	-	Non-liquefiable
	29.00	CL-ML	69	34	606.10	290.00	316.10	0.56	0.167	0.56	19.12	5.00	1.20	27.95	0.37	0.69	-	-	Non-liquefiable
	30.50	MI	97	38	637.45	305.00	332.45	0.56	0.167	0.55	20.84	5.00	1.20	30.01	0.47	0.67	-	-	Non-liquefiable
	32.00	CL-ML	65	38	617.60	320.00	297.60	0.56	0.181	0.58	22.03	5.00	1.20	31.43	0.52	0.74	-	-	Non-liquefiable
	33.50	ML	54	55	646.55	335.00	311.55	0.56	0.181	0.57	31.16	5.00	1.20	42.39	0.52	0.73	0.453	2.498	Non-liquefiable
	35.00	ML	69	65	675.50	350.00	325.50	0.56	0.181	0.55	36.03	5.00	1.20	48.23	0.52	0.72	0.447	2.464	Non-liquefiable
	36.50	ML	83	77	704.45	365.00	339.45	0.56	0.181	0.54	41.79	5.00	1.20	55.15	0.52	0.72	0.447	2.464	Non-liquefiable
	38.00	CL-CI	83	89	733.40	380.00	353.40	0.56	0.181	0.53	47.34	5.00	1.20	61.81	0.52	0.71	-	-	Non-liquefiable
	40.00	CL-CI	83	100	772.00	400.00	372.00	0.56	0.181	0.52	51.85	5.00	1.20	67.22	0.52	0.70	-	-	Non-liquefiable
P42	0.50	SM	44	10	10.15	5.00	5.15	1.00	0.306	1.70	17.00	5.00	1.20	25.40	0.30	1.00	0.358	1.168	Non-liquefiable
P42	1.00	CI	83	10	20.30	10.00	10.30	0.99	0.305	1.70	17.00	5.00	1.20	25.40	0.30	1.00	-	-	Non-liquefiable
P42	2.00	CL	86	10	40.60	20.00	20.60	0.98	0.303	1.70	17.00	5.00	1.20	25.40	0.30	1.00	-	-	Non-liquefiable
P42	3.00	CL	52	12	60.90	30.00	30.90	0.98	0.300	1.70	20.40	5.00	1.20	29.48	0.44	1.00	-	-	Non-liquefiable
P42	4.00	CI	93	12	81.20	40.00	41.20	0.97	0.298	1.56	18.70	5.00	1.20	27.43	0.35	1.00	-	-	Non-liquefiable
P42	5.00	SM	22	16	100.50	50.00	50.50	0.96	0.299	1.41	22.52	3.93	1.09	28.54	0.39	1.00	0.465	1.558	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	6.00	SM	17	14	120.60	60.00	60.60	0.95	0.296	1.28	17.98	3.01	1.06	22.08	0.24	1.00	0.290	0.979	Liquefiable
	8.00	SM	17	13	160.80	80.00	80.80	0.94	0.291	1.11	14.46	3.01	1.06	18.34	0.20	1.00	0.233	0.801	Liquefiable
	9.00	CL	84	11	180.90	90.00	90.90	0.93	0.289	1.05	11.54	5.00	1.20	18.84	0.20	1.00	-	-	Non-liquefiable
	11.00	CL	77	18	221.10	110.00	111.10	0.88	0.273	0.95	17.08	5.00	1.20	25.49	0.30	1.00	-	-	Non-liquefiable
	12.00	CL	89	25	249.60	120.00	129.60	0.85	0.256	0.88	21.96	5.00	1.20	31.35	0.52	1.00	-	-	Non-liquefiable
	14.50	CL	79	17	301.60	145.00	156.60	0.79	0.236	0.80	13.58	5.00	1.20	21.30	0.23	1.00	-	-	Non-liquefiable
	17.50	CL	74	18	357.00	175.00	182.00	0.71	0.216	0.74	13.34	5.00	1.20	21.01	0.23	0.83	-	-	Non-liquefiable
	20.50	CL	69	28	416.15	205.00	211.15	0.63	0.193	0.69	19.27	5.00	1.20	28.12	0.37	0.80	-	-	Non-liquefiable
	22.00	CI	92	28	440.00	220.00	220.00	0.59	0.183	0.67	18.88	5.00	1.20	27.65	0.36	0.81	-	-	Non-liquefiable
	23.50	CI	92	36	474.70	235.00	239.70	0.56	0.173	0.65	23.25	5.00	1.20	32.90	0.52	0.76	-	-	Non-liquefiable
	25.00	CL	85	36	505.00	250.00	255.00	0.56	0.173	0.63	22.54	5.00	1.20	32.05	0.52	0.75	-	-	Non-liquefiable
	26.50	CL	85	56	540.60	265.00	275.60	0.56	0.171	0.60	33.73	5.00	1.20	45.48	0.52	0.72	-	-	Non-liquefiable
	28.00	MI	94	56	571.20	280.00	291.20	0.56	0.171	0.59	32.82	5.00	1.20	44.38	0.52	0.70	-	-	Non-liquefiable
	29.50	SM	35	47	610.65	295.00	315.65	0.56	0.169	0.56	26.45	5.00	1.20	36.75	0.52	0.78	0.484	2.863	Non-liquefiable
	31.00	ML	52	47	641.70	310.00	331.70	0.56	0.169	0.55	25.81	5.00	1.20	35.97	0.52	0.77	0.478	2.826	Non-liquefiable
	32.50	CL-ML	81	56	650.00	325.00	325.00	0.56	0.175	0.55	31.06	5.00	1.20	42.28	0.52	0.64	-	-	Non-liquefiable
	34.00	CL-ML	81	53	680.00	340.00	340.00	0.56	0.175	0.54	28.74	5.00	1.20	39.49	0.52	0.63	-	-	Non-liquefiable
	35.50	CL	74	50	710.00	355.00	355.00	0.56	0.175	0.53	26.54	5.00	1.20	36.84	0.52	0.62	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	37.00	CL	74	49	740.00	370.00	370.00	0.56	0.175	0.52	25.47	5.00	1.20	35.57	0.52	0.61	-	-	Non-liquefiable
	38.50	CL	65	47	770.00	385.00	385.00	0.56	0.175	0.51	23.95	5.00	1.20	33.74	0.52	0.60	-	-	Non-liquefiable
	40.00	CL	65	50	800.00	400.00	400.00	0.56	0.175	0.50	25.00	5.00	1.20	35.00	0.52	0.59	-	-	Non-liquefiable
P43	0.50	SM	45	6	9.70	5.00	4.70	1.00	0.321	1.70	10.20	0.50	1.20	12.74	0.14	1.00	0.165	0.514	Liquefiable
P43	1.00	CL	65	6	19.40	10.00	9.40	0.99	0.319	1.70	10.20	0.50	1.20	12.74	0.14	1.00	-	-	Non-liquefiable
P43	2.00	CL	72	6	38.80	20.00	18.80	0.98	0.317	1.70	10.20	0.50	1.20	12.74	0.14	1.00	-	-	Non-liquefiable
P43	3.00	SM	45	6	58.20	30.00	28.20	0.98	0.315	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.696	Liquefiable
P43	5.00	SM	35	12	97.00	50.00	47.00	0.96	0.310	1.46	17.50	5.00	1.20	26.00	0.31	1.00	0.374	1.207	Non-liquefiable
P43	6.00	SM	35	12	116.40	60.00	56.40	0.95	0.307	1.33	15.98	5.00	1.20	24.17	0.28	1.00	0.330	1.073	Non-liquefiable
P43	7.00	CL-ML	73	12	135.80	70.00	65.80	0.95	0.305	1.23	14.79	5.00	1.20	22.75	0.25	1.00	-	-	Non-liquefiable
P43	8.00	CL	81	13	163.20	80.00	83.20	0.94	0.287	1.10	14.25	5.00	1.20	22.10	0.24	1.00	-	-	Non-liquefiable
P43	9.00	CL	81	16	183.60	90.00	93.60	0.93	0.285	1.03	16.54	5.00	1.20	24.85	0.29	1.00	-	-	Non-liquefiable
P43	11.00	CL	81	27	224.40	110.00	114.40	0.88	0.269	0.93	25.24	5.00	1.20	35.29	0.52	1.00	-	-	Non-liquefiable
P43	12.00	CL	89	31	242.40	120.00	122.40	0.85	0.264	0.90	28.02	5.00	1.20	38.62	0.52	1.00	-	-	Non-liquefiable
P43	14.50	CL	89	14	292.90	145.00	147.90	0.79	0.243	0.82	11.51	5.00	1.20	18.81	0.20	1.00	-	-	Non-liquefiable
P43	17.50	CL	91	18	360.50	175.00	185.50	0.71	0.214	0.73	13.22	5.00	1.20	20.86	0.23	0.83	-	-	Non-liquefiable
P43	20.50	CL-ML	62	22	416.15	205.00	211.15	0.63	0.193	0.69	15.14	5.00	1.20	23.17	0.26	0.82	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	22.00	CL	81	22	446.60	220.00	226.60	0.59	0.180	0.66	14.61	5.00	1.20	22.54	0.25	0.80	-	-	Non-liquefiable
	23.50	CL	62	31	479.40	235.00	244.40	0.56	0.171	0.64	19.83	5.00	1.20	28.80	0.40	0.76	-	-	Non-liquefiable
	26.50	CL	83	49	540.60	265.00	275.60	0.56	0.171	0.60	29.52	5.00	1.20	40.42	0.52	0.73	-	-	Non-liquefiable
	29.50	CL	88	39	601.80	295.00	306.80	0.56	0.171	0.57	22.27	5.00	1.20	31.72	0.52	0.70	-	-	Non-liquefiable
	32.50	SM	45	67	682.50	325.00	357.50	0.56	0.167	0.53	35.44	5.00	1.20	47.52	0.52	0.68	0.422	2.529	Non-liquefiable
	34.00	SM	45	58	666.40	340.00	326.40	0.56	0.178	0.55	32.10	5.00	1.20	43.52	0.52	0.70	0.434	2.435	Non-liquefiable
	35.50	SM	45	48	695.80	355.00	340.80	0.56	0.178	0.54	26.00	5.00	1.20	36.20	0.52	0.69	0.428	2.400	Non-liquefiable
	37.00	CL-ML	53	48	725.20	370.00	355.20	0.56	0.178	0.53	25.47	5.00	1.20	35.56	0.52	0.69	-	-	Non-liquefiable
	38.50	CL-ML	53	50	781.55	385.00	396.55	0.56	0.172	0.50	25.11	5.00	1.20	35.13	0.52	0.61	-	-	Non-liquefiable
	40.00	CL-ML	59	57	812.00	400.00	412.00	0.56	0.172	0.49	28.08	5.00	1.20	38.70	0.52	0.60	-	-	Non-liquefiable
P44	0.50	SM	48	6	10.35	5.00	5.35	1.00	0.301	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.728	Liquefiable
P44	1.00	MI	83	6	20.70	10.00	10.70	0.99	0.299	1.70	10.20	5.00	1.20	17.24	0.18	1.00	-	-	Non-liquefiable
P44	2.00	ML	55	6	41.40	20.00	21.40	0.98	0.297	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.736	Liquefiable
P44	3.00	SM	40	17	62.10	30.00	32.10	0.98	0.295	1.70	28.90	5.00	1.20	39.68	0.52	1.00	0.620	2.103	Non-liquefiable
P44	5.00	SM	18	14	103.50	50.00	53.50	0.96	0.290	1.37	19.14	3.23	1.07	23.64	0.27	1.00	0.319	1.099	Non-liquefiable
P44	6.00	SM	44	16	116.40	60.00	56.40	0.95	0.307	1.33	21.30	5.00	1.20	30.57	0.51	1.00	0.612	1.992	Non-liquefiable
P44	7.00	CL-ML	56	16	135.80	70.00	65.80	0.95	0.305	1.23	19.72	5.00	1.20	28.67	0.40	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	8.00	CL-ML	56	12	160.80	80.00	80.80	0.94	0.291	1.11	13.35	5.00	1.20	21.02	0.23	1.00	-	-	Non-liquefiable
	9.00	CL	76	12	180.90	90.00	90.90	0.93	0.289	1.05	12.59	5.00	1.20	20.10	0.22	1.00	-	-	Non-liquefiable
	11.00	CL	90	15	221.10	110.00	111.10	0.88	0.273	0.95	14.23	5.00	1.20	22.08	0.24	1.00	-	-	Non-liquefiable
	12.00	CL	85	16	228.00	120.00	108.00	0.85	0.281	0.96	15.40	5.00	1.20	23.48	0.26	1.00	-	-	Non-liquefiable
	14.50	CL	86	14	275.50	145.00	130.50	0.79	0.259	0.88	12.26	5.00	1.20	19.71	0.21	1.00	-	-	Non-liquefiable
	17.50	CL	84	18	360.50	175.00	185.50	0.71	0.214	0.73	13.22	5.00	1.20	20.86	0.23	0.80	-	-	Non-liquefiable
	20.50	CL	74	29	422.30	205.00	217.30	0.63	0.190	0.68	19.67	5.00	1.20	28.61	0.39	0.75	-	-	Non-liquefiable
	23.50	CL-ML	58	22	474.70	235.00	239.70	0.56	0.173	0.65	14.21	5.00	1.20	22.05	0.24	0.74	-	-	Non-liquefiable
	25.00	CL	85	22	505.00	250.00	255.00	0.56	0.173	0.63	13.78	5.00	1.20	21.53	0.24	0.72	-	-	Non-liquefiable
	26.50	CL-ML	78	35	545.90	265.00	280.90	0.56	0.170	0.60	20.88	5.00	1.20	30.06	0.47	0.70	-	-	Non-liquefiable
	28.00	SM-SC	45	35	576.80	280.00	296.80	0.56	0.170	0.58	20.32	5.00	1.20	29.38	0.43	0.68	0.348	2.052	Non-liquefiable
	29.50	ML	51	52	581.15	295.00	286.15	0.56	0.177	0.59	30.74	5.00	1.20	41.89	0.52	0.68	0.422	2.378	Non-liquefiable
	31.00	SM-SC	47	45	610.70	310.00	300.70	0.56	0.177	0.58	25.95	5.00	1.20	36.14	0.52	0.67	0.416	2.343	Non-liquefiable
	32.50	ML	55	50	640.25	325.00	315.25	0.56	0.177	0.56	28.16	5.00	1.20	38.79	0.52	0.66	0.409	2.308	Non-liquefiable
	34.00	CL-ML	60	51	669.80	340.00	329.80	0.56	0.177	0.55	28.08	5.00	1.20	38.70	0.52	0.65	-	-	Non-liquefiable
	35.50	SM-SC	42	50	699.35	355.00	344.35	0.56	0.177	0.54	26.94	5.00	1.20	37.33	0.52	0.64	0.397	2.238	Non-liquefiable
	37.00	SM-SC	42	53	728.90	370.00	358.90	0.56	0.177	0.53	27.98	5.00	1.20	38.57	0.52	0.63	0.391	2.203	Non-liquefiable
	38.50	ML	54	51	758.45	385.00	373.45	0.56	0.177	0.52	26.39	5.00	1.20	36.67	0.52	0.63	0.391	2.203	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	40.00	SM	48	48	788.00	400.00	388.00	0.56	0.177	0.51	24.37	5.00	1.20	34.24	0.52	0.62	0.385	2.168	Non-liquefiable
P45	0.50	CL-ML	55	7	9.75	5.00	4.75	1.00	0.319	1.70	11.90	5.00	1.20	19.28	0.21	1.00	-	-	Non-liquefiable
	2.00	CL	77	7	39.00	20.00	19.00	0.98	0.315	1.70	11.90	5.00	1.20	19.28	0.21	1.00	-	-	Non-liquefiable
	3.00	CL	77	6	58.50	30.00	28.50	0.98	0.313	1.70	10.20	5.00	1.20	17.24	0.18	1.00	-	-	Non-liquefiable
	4.00	SM	35	6	78.00	40.00	38.00	0.97	0.310	1.62	9.73	5.00	1.20	16.68	0.18	1.00	0.212	0.682	Liquefiable
	5.00	SM	37	16	98.00	50.00	48.00	0.96	0.306	1.44	23.09	5.00	1.20	32.71	0.52	1.00	0.620	2.025	Non-liquefiable
	6.00	SM	37	14	117.60	60.00	57.60	0.95	0.304	1.32	18.45	5.00	1.20	27.14	0.34	1.00	0.408	1.343	Non-liquefiable
	8.00	SM	36	13	156.80	80.00	76.80	0.94	0.299	1.14	14.83	5.00	1.20	22.80	0.25	1.00	0.303	1.013	Non-liquefiable
	9.00	SM	36	19	177.30	90.00	87.30	0.93	0.295	1.07	20.34	5.00	1.20	29.40	0.43	1.00	0.514	1.741	Non-liquefiable
	10.00	CL	86	19	197.00	100.00	97.00	0.91	0.287	1.02	19.29	5.00	1.20	28.15	0.37	1.00	-	-	Non-liquefiable
	11.00	CL	86	23	222.20	110.00	112.20	0.88	0.272	0.94	21.71	5.00	1.20	31.06	0.52	1.00	-	-	Non-liquefiable
	12.00	CL	86	21	242.40	120.00	122.40	0.85	0.264	0.90	18.98	5.00	1.20	27.78	0.36	1.00	-	-	Non-liquefiable
	14.50	CL	88	23	292.90	145.00	147.90	0.79	0.243	0.82	18.91	5.00	1.20	27.69	0.36	1.00	-	-	Non-liquefiable
	17.50	CL	86	38	357.00	175.00	182.00	0.71	0.216	0.74	28.17	5.00	1.20	38.80	0.52	0.83	-	-	Non-liquefiable
	20.50	CL	87	43	422.30	205.00	217.30	0.63	0.190	0.68	29.17	5.00	1.20	40.00	0.52	0.77	-	-	Non-liquefiable
	23.50	CL	90	45	481.75	235.00	246.75	0.56	0.171	0.64	28.65	5.00	1.20	39.38	0.52	0.74	-	-	Non-liquefiable
	26.50	ML	72	42	540.60	265.00	275.60	0.56	0.171	0.60	25.30	5.00	1.20	35.36	0.52	0.71	0.441	2.574	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	28.00	MI	92	42	574.00	280.00	294.00	0.56	0.171	0.58	24.49	5.00	1.20	34.39	0.52	0.92	-	-	Non-liquefiable
	29.50	MI	92	62	601.80	295.00	306.80	0.56	0.171	0.57	35.40	5.00	1.20	47.48	0.52	0.91	-	-	Non-liquefiable
	31.00	MI	92	55	632.40	310.00	322.40	0.56	0.171	0.56	30.63	5.00	1.20	41.76	0.52	0.91	-	-	Non-liquefiable
	32.50	CL-ML	80	45	663.00	325.00	338.00	0.56	0.171	0.54	24.48	5.00	1.20	34.37	0.52	0.91	-	-	Non-liquefiable
	35.50	CL-ML	70	60	724.20	355.00	369.20	0.56	0.171	0.52	31.23	5.00	1.20	42.47	0.52	0.90	-	-	Non-liquefiable
	37.00	ML	56	56	743.70	370.00	373.70	0.56	0.174	0.52	28.97	5.00	1.20	39.76	0.52	0.90	0.557	3.206	Non-liquefiable
	38.50	ML	56	46	773.85	385.00	388.85	0.56	0.174	0.51	23.33	5.00	1.20	32.99	0.52	0.90	0.555	3.195	Non-liquefiable
	40.00	CL-ML	58	54	804.00	400.00	404.00	0.56	0.174	0.50	26.87	5.00	1.20	37.24	0.52	0.89	-	-	Non-liquefiable
P46	0.50	SM	44	5	9.70	5.00	4.70	1.00	0.321	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.603	Liquefiable
P46	1.00	SM-SC	45	5	19.40	10.00	9.40	0.99	0.319	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.605	Liquefiable
P46	2.00	SM-SC	47	5	38.80	20.00	18.80	0.98	0.317	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.610	Liquefiable
P46	3.00	SM-SC	47	9	58.20	30.00	28.20	0.98	0.315	1.70	15.30	5.00	1.20	23.36	0.26	1.00	0.313	0.996	Liquefiable
P46	4.00	SM	25	9	77.60	40.00	37.60	0.97	0.312	1.63	14.68	4.29	1.12	20.65	0.22	1.00	0.267	0.855	Liquefiable
P46	5.00	SM	25	6	100.00	50.00	50.00	0.96	0.300	1.41	8.49	4.29	1.12	13.75	0.15	1.00	0.176	0.587	Liquefiable
P46	6.00	SM	25	8	120.00	60.00	60.00	0.95	0.298	1.29	10.33	4.29	1.12	15.80	0.17	1.00	0.201	0.674	Liquefiable
P46	8.00	SM	17	12	160.00	80.00	80.00	0.94	0.293	1.12	13.42	3.01	1.06	17.23	0.18	1.00	0.219	0.747	Liquefiable
P46	9.00	CL	65	17	171.00	90.00	81.00	0.93	0.307	1.11	18.89	5.00	1.20	27.67	0.36	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	11.00	CL	69	19	209.00	110.00	99.00	0.88	0.290	1.01	19.10	5.00	1.20	27.91	0.37	1.00	-	-	Non-liquefiable
	12.00	CL	69	22	242.40	120.00	122.40	0.85	0.264	0.90	19.89	5.00	1.20	28.86	0.40	1.00	-	-	Non-liquefiable
	14.50	CL	91	31	292.90	145.00	147.90	0.79	0.243	0.82	25.49	5.00	1.20	35.59	0.52	1.00	-	-	Non-liquefiable
	16.00	CL-ML	64	31	326.40	160.00	166.40	0.75	0.229	0.78	24.03	5.00	1.20	33.84	0.52	0.84	-	-	Non-liquefiable
	17.50	CL-ML	64	28	353.50	175.00	178.50	0.71	0.218	0.75	20.96	5.00	1.20	30.15	0.48	0.83	-	-	Non-liquefiable
	19.00	CL	72	28	383.80	190.00	193.80	0.67	0.206	0.72	20.11	5.00	1.20	29.14	0.42	0.80	-	-	Non-liquefiable
	20.50	CL	94	39	414.10	205.00	209.10	0.63	0.194	0.69	26.97	5.00	1.20	37.36	0.52	0.78	-	-	Non-liquefiable
	23.50	CL-ML	67	55	474.70	235.00	239.70	0.56	0.173	0.65	35.52	5.00	1.20	47.63	0.52	0.76	-	-	Non-liquefiable
	25.00	CL	85	49	507.50	250.00	257.50	0.56	0.172	0.62	30.54	5.00	1.20	41.64	0.52	0.74	-	-	Non-liquefiable
	26.50	CL	85	56	537.95	265.00	272.95	0.56	0.172	0.61	33.90	5.00	1.20	45.68	0.52	0.73	-	-	Non-liquefiable
	28.00	CL	93	61	568.40	280.00	288.40	0.56	0.172	0.59	35.92	5.00	1.20	48.10	0.52	0.71	-	-	Non-liquefiable
	29.50	SM-SC	49	65	598.85	295.00	303.85	0.56	0.172	0.57	37.29	5.00	1.20	49.75	0.52	0.70	0.436	2.532	Non-liquefiable
	31.00	SM-SC	49	68	629.30	310.00	319.30	0.56	0.172	0.56	38.05	5.00	1.20	50.67	0.52	0.69	0.429	2.492	Non-liquefiable
	32.50	SM	19	57	659.75	325.00	334.75	0.56	0.172	0.55	31.15	3.43	1.07	36.86	0.52	0.68	0.423	2.455	Non-liquefiable
	35.50	SM	18	52	720.65	355.00	365.65	0.56	0.172	0.52	27.19	3.23	1.07	32.23	0.52	0.58	0.362	2.100	Non-liquefiable
	38.50	SM	17	55	835.45	385.00	450.45	0.56	0.162	0.47	25.91	3.01	1.06	30.48	0.51	0.53	0.322	1.990	Non-liquefiable
	40.00	SM	21	59	868.00	400.00	468.00	0.56	0.162	0.46	27.27	3.78	1.09	33.40	0.52	0.53	0.326	2.014	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
P47	0.50	SM	44	2	9.45	5.00	4.45	1.00	0.330	1.70	3.40	5.00	1.20	9.08	0.11	1.00	0.125	0.380	Liquefiable
	1.00	CL	71	2	18.90	10.00	8.90	0.99	0.329	1.70	3.40	5.00	1.20	9.08	0.11	1.00	-	-	Non-liquefiable
	2.00	ML	55	2	37.80	20.00	17.80	0.98	0.326	1.70	3.40	5.00	1.20	9.08	0.11	1.00	0.125	0.384	Liquefiable
	3.00	CL-ML	80	9	56.70	30.00	26.70	0.98	0.324	1.70	15.30	5.00	1.20	23.36	0.26	1.00	-	-	Non-liquefiable
	4.00	SM	35	11	75.60	40.00	35.60	0.97	0.321	1.68	18.44	5.00	1.20	27.12	0.34	1.00	0.408	1.270	Non-liquefiable
	6.00	SM	25	16	113.40	60.00	53.40	0.95	0.316	1.37	21.90	4.29	1.12	28.70	0.40	1.00	0.473	1.497	Non-liquefiable
	7.00	SM	25	21	132.30	70.00	62.30	0.95	0.314	1.27	26.61	4.29	1.12	33.95	0.52	1.00	0.620	1.978	Non-liquefiable
	9.00	SM	36	17	170.10	90.00	80.10	0.93	0.308	1.12	18.99	5.00	1.20	27.79	0.36	1.00	0.432	1.402	Non-liquefiable
	10.00	SM	36	19	193.00	100.00	93.00	0.91	0.294	1.04	19.70	5.00	1.20	28.64	0.39	1.00	0.470	1.602	Non-liquefiable
	11.00	CL	89	19	212.30	110.00	102.30	0.88	0.285	0.99	18.79	5.00	1.20	27.54	0.35	1.00	-	-	Non-liquefiable
	12.50	CL	89	28	252.50	125.00	127.50	0.84	0.260	0.89	24.80	5.00	1.20	34.76	0.52	1.00	-	-	Non-liquefiable
	14.00	SM	34	28	282.80	140.00	142.80	0.80	0.247	0.84	23.43	4.93	1.19	32.77	0.52	1.00	0.620	2.509	Non-liquefiable
	15.50	CL-ML	81	20	313.10	155.00	158.10	0.76	0.235	0.80	15.91	5.00	1.20	24.09	0.27	0.88	-	-	Non-liquefiable
	17.00	CL	81	20	343.40	170.00	173.40	0.72	0.222	0.76	15.19	5.00	1.20	23.23	0.26	0.81	-	-	Non-liquefiable
	18.50	CL	81	34	375.55	185.00	190.55	0.68	0.209	0.72	24.63	5.00	1.20	34.56	0.52	0.78	-	-	Non-liquefiable
	21.50	CL	88	37	436.45	215.00	221.45	0.60	0.184	0.67	24.86	5.00	1.20	34.84	0.52	0.77	-	-	Non-liquefiable
	24.50	CL	92	52	494.90	245.00	249.90	0.56	0.173	0.63	32.89	5.00	1.20	44.47	0.52	0.72	-	-	Non-liquefiable
	26.00	ML	61	41	533.00	260.00	273.00	0.56	0.171	0.61	24.81	5.00	1.20	34.78	0.52	0.70	0.434	2.546	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	27.50	ML	61	45	563.75	275.00	288.75	0.56	0.171	0.59	26.48	5.00	1.20	36.78	0.52	0.69	0.426	2.496	Non-liquefiable
	29.00	CL	90	45	594.50	290.00	304.50	0.56	0.171	0.57	25.79	5.00	1.20	35.95	0.52	0.67	-	-	Non-liquefiable
	30.50	SM	28	48	616.10	305.00	311.10	0.56	0.173	0.57	27.21	4.56	1.14	35.54	0.52	0.66	0.411	2.376	Non-liquefiable
	33.50	SM	32	51	676.70	335.00	341.70	0.56	0.173	0.54	27.59	4.83	1.17	37.14	0.52	0.64	0.397	2.297	Non-liquefiable
	36.50	SM	38	60	762.85	365.00	397.85	0.56	0.167	0.50	30.08	5.00	1.20	41.10	0.52	0.60	0.371	2.214	Non-liquefiable
	38.00	SM	40	56	790.40	380.00	410.40	0.56	0.168	0.49	27.64	5.00	1.20	38.17	0.52	0.59	0.367	2.179	Non-liquefiable
	40.00	SM	40	62	832.00	400.00	432.00	0.56	0.168	0.48	29.83	5.00	1.20	40.80	0.52	0.58	0.360	2.138	Non-liquefiable
P48	0.50	ML	57	3	10.05	5.00	5.05	1.00	0.309	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.475	Liquefiable
P48	1.00	CL	84	3	20.10	10.00	10.10	0.99	0.308	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
P48	2.00	SM-SC	41	3	40.20	20.00	20.20	0.98	0.306	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.480	Liquefiable
P48	3.00	CL-ML	84	11	60.30	30.00	30.30	0.98	0.303	1.70	18.70	5.00	1.20	27.44	0.35	1.00	-	-	Non-liquefiable
P48	4.00	SM	47	12	80.40	40.00	40.40	0.97	0.301	1.57	18.88	5.00	1.20	27.66	0.36	1.00	0.427	1.419	Non-liquefiable
P48	6.00	SM	37	10	120.60	60.00	60.60	0.95	0.296	1.28	12.85	5.00	1.20	20.42	0.22	1.00	0.263	0.888	Liquefiable
P48	7.00	SM	37	12	140.00	70.00	70.00	0.95	0.295	1.20	14.34	5.00	1.20	22.21	0.25	1.00	0.292	0.990	Liquefiable
P48	9.00	ML	62	9	180.00	90.00	90.00	0.93	0.291	1.05	9.49	5.00	1.20	16.38	0.17	1.00	0.208	0.716	Liquefiable
P48	10.00	CL	78	13	200.00	100.00	100.00	0.91	0.283	1.00	13.00	5.00	1.20	20.60	0.22	1.00	-	-	Non-liquefiable
P48	12.50	CL	88	31	250.00	125.00	125.00	0.84	0.262	0.89	27.73	5.00	1.20	38.27	0.52	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	14.00	CI	87	31	282.80	140.00	142.80	0.80	0.247	0.84	25.94	5.00	1.20	36.13	0.52	1.00	-	-	Non-liquefiable
	15.50	CL	82	27	319.30	155.00	164.30	0.76	0.230	0.78	21.06	5.00	1.20	30.28	0.49	0.83	-	-	Non-liquefiable
	17.00	CI	70	27	350.20	170.00	180.20	0.72	0.218	0.74	20.11	5.00	1.20	29.14	0.42	0.80	-	-	Non-liquefiable
	18.50	CL	73	36	373.70	185.00	188.70	0.68	0.210	0.73	26.21	5.00	1.20	36.45	0.52	0.79	-	-	Non-liquefiable
	21.50	CL-ML	75	45	434.30	215.00	219.30	0.60	0.185	0.68	30.39	5.00	1.20	41.46	0.52	0.75	-	-	Non-liquefiable
	23.00	SM	44	45	476.10	230.00	246.10	0.56	0.169	0.64	28.69	5.00	1.20	39.42	0.52	0.73	0.453	2.679	Non-liquefiable
	24.50	SM	48	45	507.15	245.00	262.15	0.56	0.169	0.62	27.79	5.00	1.20	38.35	0.52	0.71	0.440	2.606	Non-liquefiable
	26.00	CL-ML	61	45	538.20	260.00	278.20	0.56	0.169	0.60	26.98	5.00	1.20	37.38	0.52	0.70	-	-	Non-liquefiable
	27.50	MI	88	50	561.00	275.00	286.00	0.56	0.171	0.59	29.57	5.00	1.20	40.48	0.52	0.70	-	-	Non-liquefiable
	29.00	CL-ML	82	50	591.60	290.00	301.60	0.56	0.171	0.58	28.79	5.00	1.20	39.55	0.52	0.69	-	-	Non-liquefiable
	30.50	ML	58	51	622.20	305.00	317.20	0.56	0.171	0.56	28.64	5.00	1.20	39.36	0.52	0.68	0.422	2.462	Non-liquefiable
	33.50	CL-ML	74	56	683.40	335.00	348.40	0.56	0.171	0.54	30.00	5.00	1.20	41.00	0.52	0.66	-	-	Non-liquefiable
	36.50	CL-ML	79	55	737.30	365.00	372.30	0.56	0.173	0.52	28.50	5.00	1.20	39.21	0.52	0.63	-	-	Non-liquefiable
	40.00	CL	77	63	808.00	400.00	408.00	0.56	0.173	0.50	31.19	5.00	1.20	42.43	0.52	0.61	-	-	Non-liquefiable
	0.50	SM	44	5	10.00	5.00	5.00	1.00	0.311	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.622	Liquefiable
P49	1.00	CL-ML	53	5	20.00	10.00	10.00	0.99	0.310	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
	3.00	SM	38	8	60.00	30.00	30.00	0.98	0.305	1.70	13.60	5.00	1.20	21.32	0.23	1.00	0.277	0.910	Liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	4.00	ML	83	12	80.00	40.00	40.00	0.97	0.302	1.58	18.97	5.00	1.20	27.77	0.36	1.00	0.431	1.426	Non-liquefiable
	6.00	SM	22	14	120.00	60.00	60.00	0.95	0.298	1.29	18.07	3.93	1.09	23.68	0.27	1.00	0.320	1.074	Non-liquefiable
	7.00	SM	22	13	140.00	70.00	70.00	0.95	0.295	1.20	15.54	3.93	1.09	20.91	0.23	1.00	0.271	0.917	Liquefiable
	8.00	ML	70	13	160.00	80.00	80.00	0.94	0.293	1.12	14.53	5.00	1.20	22.44	0.25	1.00	0.296	1.012	Non-liquefiable
	9.00	ML	70	9	172.80	90.00	82.80	0.93	0.303	1.10	9.89	5.00	1.20	16.87	0.18	1.00	0.214	0.706	Liquefiable
	10.00	CL	84	23	192.00	100.00	92.00	0.91	0.295	1.04	23.98	5.00	1.20	33.77	0.52	1.00	-	-	Non-liquefiable
	12.50	CL	87	21	240.00	125.00	115.00	0.84	0.274	0.93	19.58	5.00	1.20	28.50	0.39	1.00	-	-	Non-liquefiable
	15.50	CL	87	17	317.75	155.00	162.75	0.76	0.232	0.78	13.33	5.00	1.20	20.99	0.23	0.86	-	-	Non-liquefiable
	18.50	CL-ML	53	26	375.55	185.00	190.55	0.68	0.209	0.72	18.84	5.00	1.20	27.60	0.36	0.82	-	-	Non-liquefiable
	20.00	CL	69	26	402.00	200.00	202.00	0.64	0.199	0.70	18.29	5.00	1.20	26.95	0.34	0.81	-	-	Non-liquefiable
	21.50	CL	86	41	421.40	215.00	206.40	0.60	0.191	0.70	28.54	5.00	1.20	39.25	0.52	0.81	-	-	Non-liquefiable
	24.50	CL	78	44	480.20	245.00	235.20	0.56	0.178	0.65	28.69	5.00	1.20	39.43	0.52	0.79	-	-	Non-liquefiable
	27.50	SM	46	43	566.50	275.00	291.50	0.56	0.170	0.59	25.19	5.00	1.20	35.22	0.52	0.65	0.403	2.375	Non-liquefiable
	29.00	CL	59	43	597.40	290.00	307.40	0.56	0.170	0.57	24.53	5.00	1.20	34.43	0.52	0.63	-	-	Non-liquefiable
	30.50	SM	47	42	610.00	305.00	305.00	0.56	0.175	0.57	24.05	5.00	1.20	33.86	0.52	0.63	0.391	2.237	Non-liquefiable
	32.00	CL	66	42	640.00	320.00	320.00	0.56	0.175	0.56	23.48	5.00	1.20	33.17	0.52	0.62	-	-	Non-liquefiable
	33.50	CL	66	46	656.60	335.00	321.60	0.56	0.178	0.56	25.65	5.00	1.20	35.78	0.52	0.75	-	-	Non-liquefiable
	36.50	CL-ML	65	49	715.40	365.00	350.40	0.56	0.178	0.53	26.18	5.00	1.20	36.41	0.52	0.74	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (σ_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (σ_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	38.00	SM	47	49	744.80	380.00	364.80	0.56	0.178	0.52	25.65	5.00	1.20	35.79	0.52	0.73	0.453	2.539	Non-liquefiable
	40.00	SM	47	55	808.00	400.00	408.00	0.56	0.173	0.50	27.23	5.00	1.20	37.67	0.52	0.72	0.447	2.582	Non-liquefiable
P50	0.50	SM	44	3	10.15	5.00	5.15	1.00	0.306	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.479	Liquefiable
	1.00	CL-ML	53	3	20.30	10.00	10.30	0.99	0.305	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
	2.00	CL-ML	53	3	40.60	20.00	20.60	0.98	0.303	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
	3.00	ML	61	7	60.90	30.00	30.90	0.98	0.300	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.820	Liquefiable
	4.00	SM	29	7	81.20	40.00	41.20	0.97	0.298	1.56	10.91	4.64	1.15	17.14	0.18	1.00	0.217	0.730	Liquefiable
	5.00	SM	29	14	96.00	50.00	46.00	0.96	0.313	1.47	20.64	4.64	1.15	28.30	0.38	1.00	0.454	1.449	Non-liquefiable
	6.00	SM	34	16	115.20	60.00	55.20	0.95	0.311	1.35	21.54	4.93	1.19	30.52	0.51	1.00	0.607	1.954	Non-liquefiable
	8.00	SM	32	22	153.60	80.00	73.60	0.94	0.306	1.17	25.64	4.83	1.17	34.86	0.52	1.00	0.620	2.029	Non-liquefiable
	9.00	SM	32	25	172.80	90.00	82.80	0.93	0.303	1.10	27.47	4.83	1.17	37.00	0.52	1.00	0.620	2.046	Non-liquefiable
	10.00	CL	81	25	192.00	100.00	92.00	0.91	0.295	1.04	26.06	5.00	1.20	36.28	0.52	1.00	-	-	Non-liquefiable
	11.00	CL	81	24	223.30	110.00	113.30	0.88	0.271	0.94	22.55	5.00	1.20	32.06	0.52	1.00	-	-	Non-liquefiable
	12.00	SM	38	30	243.60	120.00	123.60	0.85	0.262	0.90	26.98	5.00	1.20	37.38	0.52	1.00	0.620	2.363	Non-liquefiable
	13.00	CL	82	30	263.90	130.00	133.90	0.83	0.254	0.86	25.93	5.00	1.20	36.11	0.52	1.00	-	-	Non-liquefiable
	14.50	CL	82	21	294.35	145.00	149.35	0.79	0.242	0.82	17.18	5.00	1.20	25.62	0.30	1.00	-	-	Non-liquefiable
	17.50	CL	82	23	355.25	175.00	180.25	0.71	0.217	0.74	17.13	5.00	1.20	25.56	0.30	0.83	-	-	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	19.00	ML	51	23	381.90	190.00	191.90	0.67	0.207	0.72	16.60	5.00	1.20	24.92	0.29	0.81	0.281	1.355	Non-liquefiable
	20.50	CL-ML	71	22	405.90	205.00	200.90	0.63	0.198	0.71	15.52	5.00	1.20	23.63	0.27	0.80	-	-	Non-liquefiable
	23.50	CL-ML	71	28	465.30	235.00	230.30	0.56	0.176	0.66	18.45	5.00	1.20	27.14	0.34	0.77	-	-	Non-liquefiable
	25.00	CL	76	28	495.00	250.00	245.00	0.56	0.176	0.64	17.89	5.00	1.20	26.47	0.32	0.76	-	-	Non-liquefiable
	26.50	CL	79	47	553.85	265.00	288.85	0.56	0.167	0.59	27.65	5.00	1.20	38.19	0.52	0.74	-	-	Non-liquefiable
	29.50	CI	79	47	616.55	295.00	321.55	0.56	0.167	0.56	26.21	5.00	1.20	36.45	0.52	0.71	-	-	Non-liquefiable
	32.50	CL	76	50	679.25	325.00	354.25	0.56	0.167	0.53	26.57	5.00	1.20	36.88	0.52	0.69	-	-	Non-liquefiable
	35.50	ML	51	45	731.30	355.00	376.30	0.56	0.170	0.52	23.20	5.00	1.20	32.84	0.52	0.63	0.391	2.302	Non-liquefiable
	38.50	ML	54	48	793.10	385.00	408.10	0.56	0.170	0.50	23.76	5.00	1.20	33.51	0.52	0.61	0.378	2.229	Non-liquefiable
	40.00	ML	54	56	824.00	400.00	424.00	0.56	0.170	0.49	27.20	5.00	1.20	37.64	0.52	0.57	0.354	2.083	Non-liquefiable
P51	0.50	ML	52	5	9.85	5.00	4.85	1.00	0.316	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.612	Liquefiable
P51	2.00	SM	46	5	39.40	20.00	19.40	0.98	0.312	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.620	Liquefiable
P51	3.00	SM	46	6	59.10	30.00	29.10	0.98	0.310	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.707	Liquefiable
P51	5.00	SM	27	12	98.50	50.00	48.50	0.96	0.305	1.44	17.23	4.48	1.13	23.95	0.27	1.00	0.325	1.067	Non-liquefiable
P51	6.00	SM	23	14	118.20	60.00	58.20	0.95	0.302	1.31	18.35	4.06	1.10	24.25	0.28	1.00	0.331	1.096	Non-liquefiable
P51	8.00	SM	17	21	157.60	80.00	77.60	0.94	0.297	1.14	23.84	3.01	1.06	28.28	0.38	1.00	0.453	1.523	Non-liquefiable
P51	9.00	SM	17	30	177.30	90.00	87.30	0.93	0.295	1.07	32.11	3.01	1.06	37.05	0.52	1.00	0.620	2.102	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	11.00	CL-ML	87	22	216.70	110.00	106.70	0.88	0.279	0.97	21.30	5.00	1.20	30.56	0.51	1.00	-	-	Non-liquefiable
	12.00	CL-ML	87	23	248.40	120.00	128.40	0.85	0.258	0.88	20.30	5.00	1.20	29.36	0.43	1.00	-	-	Non-liquefiable
	13.00	CL	87	23	269.10	130.00	139.10	0.83	0.250	0.85	19.50	5.00	1.20	28.40	0.38	1.00	-	-	Non-liquefiable
	14.50	CL	87	30	297.25	145.00	152.25	0.79	0.240	0.81	24.31	5.00	1.20	34.18	0.52	1.00	-	-	Non-liquefiable
	17.50	CL	85	23	358.75	175.00	183.75	0.71	0.215	0.74	16.97	5.00	1.20	25.36	0.30	0.81	-	-	Non-liquefiable
	19.00	SM	44	23	391.40	190.00	201.40	0.67	0.202	0.70	16.21	5.00	1.20	24.45	0.28	0.77	0.258	1.279	Non-liquefiable
	20.50	SM	47	21	383.35	205.00	178.35	0.63	0.210	0.75	15.72	5.00	1.20	23.87	0.27	0.90	0.291	1.385	Non-liquefiable
	23.50	ML	52	35	439.45	235.00	204.45	0.56	0.188	0.70	24.48	5.00	1.20	34.37	0.52	0.88	0.546	2.907	Non-liquefiable
	26.50	SM	42	39	484.95	265.00	219.95	0.56	0.193	0.67	26.30	5.00	1.20	36.56	0.52	0.87	0.540	2.802	Non-liquefiable
	29.50	SM	45	46	539.85	295.00	244.85	0.56	0.193	0.64	29.40	5.00	1.20	40.28	0.52	0.86	0.533	2.770	Non-liquefiable
	32.50	SM	41	51	598.00	325.00	273.00	0.56	0.191	0.61	30.87	5.00	1.20	42.04	0.52	0.79	0.490	2.561	Non-liquefiable
	35.50	SM	37	50	653.20	355.00	298.20	0.56	0.191	0.58	28.95	5.00	1.20	39.75	0.52	0.78	0.484	2.529	Non-liquefiable
	38.50	SM	38	57	743.05	385.00	358.05	0.56	0.181	0.53	30.12	5.00	1.20	41.15	0.52	0.70	0.434	2.395	Non-liquefiable
	40.00	SM	45	62	756.00	400.00	356.00	0.56	0.185	0.53	32.86	5.00	1.20	44.43	0.52	0.70	0.434	2.341	Non-liquefiable
P52	0.50	SM	43	6	9.70	5.00	4.70	1.00	0.321	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.682	Liquefiable
P52	2.00	SM	47	6	38.80	20.00	18.80	0.98	0.317	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.690	Liquefiable
P52	3.00	SM	36	9	58.20	30.00	28.20	0.98	0.315	1.70	15.30	5.00	1.20	23.36	0.26	1.00	0.313	0.996	Liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	5.00	SM	25	10	97.00	50.00	47.00	0.96	0.310	1.46	14.59	4.29	1.12	20.55	0.22	1.00	0.265	0.857	Liquefiable
	6.00	SM	25	12	116.40	60.00	56.40	0.95	0.307	1.33	15.98	4.29	1.12	22.11	0.24	1.00	0.290	0.946	Liquefiable
	8.00	SM	27	12	155.20	80.00	75.20	0.94	0.302	1.15	13.84	4.48	1.13	20.12	0.22	1.00	0.259	0.856	Liquefiable
	9.00	CL-ML	53	14	175.50	90.00	85.50	0.93	0.298	1.08	15.14	5.00	1.20	23.17	0.26	1.00	-	-	Non-liquefiable
	11.00	ML	55	13	214.50	110.00	104.50	0.88	0.282	0.98	12.72	5.00	1.20	20.26	0.22	1.00	0.261	0.925	Liquefiable
	12.00	CL-ML	64	15	237.60	120.00	117.60	0.85	0.269	0.92	13.83	5.00	1.20	21.60	0.24	1.00	-	-	Non-liquefiable
	13.00	CL	71	15	257.40	130.00	127.40	0.83	0.261	0.89	13.29	5.00	1.20	20.95	0.23	1.00	-	-	Non-liquefiable
	14.50	CL	71	24	291.45	145.00	146.45	0.79	0.244	0.83	19.83	5.00	1.20	28.80	0.40	1.00	-	-	Non-liquefiable
	16.00	CL-ML	81	24	321.60	160.00	161.60	0.75	0.232	0.79	18.88	5.00	1.20	27.66	0.36	0.84	-	-	Non-liquefiable
	17.50	CL-ML	81	22	353.50	175.00	178.50	0.71	0.218	0.75	16.47	5.00	1.20	24.76	0.29	0.81	-	-	Non-liquefiable
	19.00	ML	57	22	383.80	190.00	193.80	0.67	0.206	0.72	15.80	5.00	1.20	23.96	0.27	0.83	0.270	1.312	Non-liquefiable
	20.50	ML	57	33	397.70	205.00	192.70	0.63	0.202	0.72	23.77	5.00	1.20	33.53	0.52	0.83	0.516	2.558	Non-liquefiable
	22.00	SM	34	33	426.80	220.00	206.80	0.59	0.189	0.70	22.95	4.93	1.19	32.20	0.52	0.82	0.509	2.697	Non-liquefiable
	23.50	SM	46	33	460.60	235.00	225.60	0.56	0.178	0.67	21.97	5.00	1.20	31.36	0.52	0.80	0.497	2.789	Non-liquefiable
	26.50	MI	93	57	519.40	265.00	254.40	0.56	0.178	0.63	35.74	5.00	1.20	47.88	0.52	0.78	-	-	Non-liquefiable
	28.00	SM	44	52	548.80	280.00	268.80	0.56	0.178	0.61	31.72	5.00	1.20	43.06	0.52	0.76	0.474	2.660	Non-liquefiable
	29.50	SM	44	59	578.20	295.00	283.20	0.56	0.178	0.59	35.06	5.00	1.20	47.07	0.52	0.75	0.468	2.622	Non-liquefiable
	31.00	SM	35	76	607.60	310.00	297.60	0.56	0.178	0.58	44.06	5.00	1.20	57.87	0.52	0.74	0.461	2.587	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	32.50	SM	35	60	637.00	325.00	312.00	0.56	0.178	0.57	33.97	5.00	1.20	45.76	0.52	0.73	0.456	2.554	Non-liquefiable
	34.00	SM	27	62	666.40	340.00	326.40	0.56	0.178	0.55	34.32	4.48	1.13	43.27	0.52	0.73	0.450	2.523	Non-liquefiable
	35.50	ML	55	61	695.80	355.00	340.80	0.56	0.178	0.54	33.04	5.00	1.20	44.65	0.52	0.72	0.445	2.494	Non-liquefiable
	37.00	CL-ML	65	61	725.20	370.00	355.20	0.56	0.178	0.53	32.37	5.00	1.20	43.84	0.52	0.71	-	-	Non-liquefiable
	38.50	CL-ML	65	58	754.60	385.00	369.60	0.56	0.178	0.52	30.17	5.00	1.20	41.20	0.52	0.70	-	-	Non-liquefiable
	40.00	SM	48	65	784.00	400.00	384.00	0.56	0.178	0.51	33.17	5.00	1.20	44.80	0.52	0.69	0.431	2.415	Non-liquefiable
P53	0.50	SM	46	6	9.80	5.00	4.80	1.00	0.317	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.690	Liquefiable
	1.00	SM-SC	49	6	19.60	10.00	9.60	0.99	0.316	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.692	Liquefiable
	2.00	SM-SC	49	6	39.20	20.00	19.20	0.98	0.314	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.698	Liquefiable
	3.00	SM-SC	49	7	58.80	30.00	28.80	0.98	0.311	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.792	Liquefiable
	4.00	SM	27	7	78.40	40.00	38.40	0.97	0.309	1.61	11.30	4.48	1.13	17.25	0.18	1.00	0.219	0.709	Liquefiable
	5.00	SM	23	10	96.00	50.00	46.00	0.96	0.313	1.47	14.74	4.06	1.10	20.28	0.22	1.00	0.261	0.834	Liquefiable
	6.00	SM	23	13	115.20	60.00	55.20	0.95	0.311	1.35	17.50	4.06	1.10	23.31	0.26	1.00	0.312	1.006	Non-liquefiable
	8.00	SM	21	28	153.60	80.00	73.60	0.94	0.306	1.17	32.64	3.78	1.09	39.23	0.52	1.00	0.620	2.029	Non-liquefiable
	9.00	CL	82	23	172.80	90.00	82.80	0.93	0.303	1.10	25.28	5.00	1.20	35.33	0.52	1.00	-	-	Non-liquefiable
	10.00	CL-ML	72	23	192.00	100.00	92.00	0.91	0.295	1.04	23.98	5.00	1.20	33.77	0.52	1.00	-	-	Non-liquefiable
	11.00	CL-ML	72	37	217.80	110.00	107.80	0.88	0.277	0.96	35.64	5.00	1.20	47.76	0.52	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	12.00	CL-ML	90	33	237.60	120.00	117.60	0.85	0.269	0.92	30.43	5.00	1.20	41.52	0.52	1.00	-	-	Non-liquefiable
	13.00	CL	76	33	257.40	130.00	127.40	0.83	0.261	0.89	29.24	5.00	1.20	40.08	0.52	1.00	-	-	Non-liquefiable
	14.50	CL	76	33	295.80	145.00	150.80	0.79	0.241	0.81	26.87	5.00	1.20	37.25	0.52	1.00	-	-	Non-liquefiable
	17.50	CL	70	33	357.00	175.00	182.00	0.71	0.216	0.74	24.46	5.00	1.20	34.35	0.52	0.80	-	-	Non-liquefiable
	19.00	CL-ML	64	33	383.80	190.00	193.80	0.67	0.206	0.72	23.70	5.00	1.20	33.45	0.52	0.81	-	-	Non-liquefiable
	20.50	CL	84	45	410.00	205.00	205.00	0.63	0.196	0.70	31.43	5.00	1.20	42.72	0.52	0.79	-	-	Non-liquefiable
	22.00	CL-ML	76	45	440.00	220.00	220.00	0.59	0.183	0.67	30.34	5.00	1.20	41.41	0.52	0.80	-	-	Non-liquefiable
	23.50	CL-ML	76	60	460.60	235.00	225.60	0.56	0.178	0.67	39.95	5.00	1.20	52.94	0.52	0.80	-	-	Non-liquefiable
	25.00	SM	26	40	490.00	250.00	240.00	0.56	0.178	0.65	25.82	4.39	1.12	33.37	0.52	0.78	0.486	2.728	Non-liquefiable
	26.50	SM	26	35	519.40	265.00	254.40	0.56	0.178	0.63	21.94	4.39	1.12	29.02	0.41	0.77	0.379	2.123	Non-liquefiable
	28.00	MI	90	35	548.80	280.00	268.80	0.56	0.178	0.61	21.35	5.00	1.20	30.62	0.52	0.82	-	-	Non-liquefiable
	29.50	SM	28	50	610.65	295.00	315.65	0.56	0.169	0.56	28.14	4.56	1.14	36.59	0.52	0.79	0.491	2.904	Non-liquefiable
	32.50	SM	30	60	672.75	325.00	347.75	0.56	0.169	0.54	32.17	4.71	1.15	41.85	0.52	0.78	0.481	2.847	Non-liquefiable
	34.00	SM	25	63	717.40	340.00	377.40	0.56	0.166	0.51	32.43	4.29	1.12	40.45	0.52	0.76	0.473	2.850	Non-liquefiable
	35.50	SM	32	72	749.05	355.00	394.05	0.56	0.166	0.50	36.27	4.83	1.17	47.30	0.52	0.76	0.469	2.825	Non-liquefiable
	37.00	SM	32	60	780.70	370.00	410.70	0.56	0.166	0.49	29.61	4.83	1.17	39.50	0.52	0.75	0.465	2.801	Non-liquefiable
	38.50	SM	46	58	812.35	385.00	427.35	0.56	0.166	0.48	28.06	5.00	1.20	38.67	0.52	0.74	0.461	2.779	Non-liquefiable
	40.00	SM	46	67	844.00	400.00	444.00	0.56	0.166	0.47	31.80	5.00	1.20	43.16	0.52	0.74	0.458	2.757	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
P54	0.50	SM	38	5	9.70	5.00	4.70	1.00	0.321	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.603	Liquefiable
	1.00	ML	52	5	19.40	10.00	9.40	0.99	0.319	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.605	Liquefiable
	2.00	ML	52	5	38.80	20.00	18.80	0.98	0.317	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.610	Liquefiable
	3.00	ML	60	7	58.20	30.00	28.20	0.98	0.315	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.783	Liquefiable
	5.00	ML	53	9	97.00	50.00	47.00	0.96	0.310	1.46	13.13	5.00	1.20	20.75	0.23	1.00	0.268	0.867	Liquefiable
	6.00	ML	53	15	116.40	60.00	56.40	0.95	0.307	1.33	19.97	5.00	1.20	28.97	0.41	1.00	0.488	1.587	Non-liquefiable
	7.00	SM	42	15	135.80	70.00	65.80	0.95	0.305	1.23	18.49	5.00	1.20	27.19	0.34	1.00	0.410	1.346	Non-liquefiable
	8.00	SM	42	21	155.20	80.00	75.20	0.94	0.302	1.15	24.22	5.00	1.20	34.06	0.52	1.00	0.620	2.052	Non-liquefiable
	9.00	CL-ML	81	23	174.60	90.00	84.60	0.93	0.300	1.09	25.01	5.00	1.20	35.01	0.52	1.00	-	-	Non-liquefiable
	10.00	SM	29	23	194.00	100.00	94.00	0.91	0.292	1.03	23.72	4.64	1.15	31.83	0.52	1.00	0.620	2.124	Non-liquefiable
	11.00	CL	85	21	209.00	110.00	99.00	0.88	0.290	1.01	21.11	5.00	1.20	30.33	0.49	1.00	-	-	Non-liquefiable
	12.00	CL	85	19	228.00	120.00	108.00	0.85	0.281	0.96	18.28	5.00	1.20	26.94	0.34	1.00	-	-	Non-liquefiable
	13.00	SM	21	19	247.00	130.00	117.00	0.83	0.272	0.92	17.57	3.78	1.09	22.86	0.25	1.00	0.304	1.116	Non-liquefiable
	14.50	CL	78	22	278.40	145.00	133.40	0.79	0.256	0.87	19.05	5.00	1.20	27.86	0.36	1.00	-	-	Non-liquefiable
	17.50	CL	60	34	336.00	175.00	161.00	0.71	0.230	0.79	26.80	5.00	1.20	37.15	0.52	0.90	-	-	Non-liquefiable
	20.50	CL	80	36	422.30	205.00	217.30	0.63	0.190	0.68	24.42	5.00	1.20	34.31	0.52	0.78	-	-	Non-liquefiable
	22.00	SM	25	36	453.20	220.00	233.20	0.59	0.178	0.65	23.57	4.29	1.12	30.57	0.51	0.76	0.466	2.619	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 Earthquake Zone= IV amax/g=0.24 K(alpha)= 1.00 MSF= 1.193 Critical Water Table (m)=0.00 m

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	23.50	ML	57	43	448.85	235.00	213.85	0.56	0.183	0.68	29.40	5.00	1.20	40.29	0.52	0.74	0.459	2.504	Non-liquefiable
	25.00	CL	80	43	477.50	250.00	227.50	0.56	0.183	0.66	28.51	5.00	1.20	39.21	0.52	0.73	-	-	Non-liquefiable
	26.50	CL	80	34	537.95	265.00	272.95	0.56	0.172	0.61	20.58	5.00	1.20	29.70	0.45	0.74	-	-	Non-liquefiable
	28.00	CI	90	34	568.40	280.00	288.40	0.56	0.172	0.59	20.02	5.00	1.20	29.02	0.41	0.72	-	-	Non-liquefiable
	29.50	CL	85	38	566.40	295.00	271.40	0.56	0.182	0.61	23.07	5.00	1.20	32.68	0.52	0.95	-	-	Non-liquefiable
	32.50	CL	84	44	624.00	325.00	299.00	0.56	0.182	0.58	25.45	5.00	1.20	35.54	0.52	0.95	-	-	Non-liquefiable
	35.50	CL	85	47	681.60	355.00	326.60	0.56	0.182	0.55	26.01	5.00	1.20	36.21	0.52	0.94	-	-	Non-liquefiable
	38.50	CL	80	55	777.70	385.00	392.70	0.56	0.173	0.50	27.75	5.00	1.20	38.31	0.52	0.64	-	-	Non-liquefiable
	40.00	CL	80	60	808.00	400.00	408.00	0.56	0.173	0.50	29.70	5.00	1.20	40.65	0.52	0.63	-	-	Non-liquefiable
P55	0.50	SM	45	8	9.85	5.00	4.85	1.00	0.316	1.70	13.60	5.00	1.20	21.32	0.23	1.00	0.277	0.879	Liquefiable
P55	1.00	ML	51	8	19.70	10.00	9.70	0.99	0.314	1.70	13.60	5.00	1.20	21.32	0.23	1.00	0.277	0.882	Liquefiable
P55	2.00	SM	41	8	39.40	20.00	19.40	0.98	0.312	1.70	13.60	5.00	1.20	21.32	0.23	1.00	0.277	0.889	Liquefiable
P55	3.00	SM	32	6	59.10	30.00	29.10	0.98	0.310	1.70	10.20	4.83	1.17	16.77	0.18	1.00	0.213	0.687	Liquefiable
P55	5.00	SM	25	11	98.50	50.00	48.50	0.96	0.305	1.44	15.80	4.29	1.12	21.90	0.24	1.00	0.287	0.942	Liquefiable
P55	6.00	SM	25	13	114.60	60.00	54.60	0.95	0.312	1.35	17.59	4.29	1.12	23.91	0.27	1.00	0.324	1.038	Non-liquefiable
P55	8.00	SM	22	15	152.80	80.00	72.80	0.94	0.307	1.17	17.58	3.93	1.09	23.14	0.26	1.00	0.309	1.006	Non-liquefiable
P55	9.00	SM	22	14	171.00	90.00	81.00	0.93	0.307	1.11	15.56	3.93	1.09	20.93	0.23	1.00	0.271	0.884	Liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	10.00	CL-ML	82	14	190.00	100.00	90.00	0.91	0.299	1.05	14.76	5.00	1.20	22.71	0.25	1.00	-	-	Non-liquefiable
	11.00	CL-ML	66	16	221.10	110.00	111.10	0.88	0.273	0.95	15.18	5.00	1.20	23.22	0.26	1.00	-	-	Non-liquefiable
	12.00	CL	92	19	241.20	120.00	121.20	0.85	0.265	0.91	17.26	5.00	1.20	25.71	0.31	1.00	-	-	Non-liquefiable
	14.50	CL	88	29	291.45	145.00	146.45	0.79	0.244	0.83	23.96	5.00	1.20	33.76	0.52	1.00	-	-	Non-liquefiable
	17.50	ML	53	32	350.00	175.00	175.00	0.71	0.221	0.76	24.19	5.00	1.20	34.03	0.52	0.81	0.505	2.290	Non-liquefiable
	19.00	CL	82	32	385.70	190.00	195.70	0.67	0.205	0.71	22.87	5.00	1.20	32.45	0.52	0.84	-	-	Non-liquefiable
	20.50	CL-ML	68	39	401.80	205.00	196.80	0.63	0.200	0.71	27.80	5.00	1.20	38.36	0.52	0.84	-	-	Non-liquefiable
	23.50	CL-ML	68	43	460.60	235.00	225.60	0.56	0.178	0.67	28.63	5.00	1.20	39.35	0.52	0.76	-	-	Non-liquefiable
	25.00	MI	92	43	497.50	250.00	247.50	0.56	0.176	0.64	27.33	5.00	1.20	37.80	0.52	0.84	-	-	Non-liquefiable
	26.50	MI	92	54	540.60	265.00	275.60	0.56	0.171	0.60	32.53	5.00	1.20	44.03	0.52	0.83	-	-	Non-liquefiable
	28.00	MI	92	53	571.20	280.00	291.20	0.56	0.171	0.59	31.06	5.00	1.20	42.27	0.52	0.82	-	-	Non-liquefiable
	29.50	CL-ML	63	56	601.80	295.00	306.80	0.56	0.171	0.57	31.97	5.00	1.20	43.37	0.52	0.81	-	-	Non-liquefiable
	31.00	CL-ML	63	57	632.40	310.00	322.40	0.56	0.171	0.56	31.75	5.00	1.20	43.09	0.52	0.80	-	-	Non-liquefiable
	32.50	CL-ML	60	57	663.00	325.00	338.00	0.56	0.171	0.54	31.00	5.00	1.20	42.20	0.52	0.80	-	-	Non-liquefiable
	34.00	CL	84	64	693.60	340.00	353.60	0.56	0.171	0.53	34.03	5.00	1.20	45.84	0.52	0.79	-	-	Non-liquefiable
	35.50	CL	77	69	724.20	355.00	369.20	0.56	0.171	0.52	35.91	5.00	1.20	48.09	0.52	0.78	-	-	Non-liquefiable
	37.00	CL	77	68	754.80	370.00	384.80	0.56	0.171	0.51	34.67	5.00	1.20	46.60	0.52	0.78	-	-	Non-liquefiable
	38.50	CL-ML	71	69	785.40	385.00	400.40	0.56	0.171	0.50	34.48	5.00	1.20	46.38	0.52	0.77	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	40.00	CL-ML	71	78	816.00	400.00	416.00	0.56	0.171	0.49	38.24	5.00	1.20	50.89	0.52	0.77	-	-	Non-liquefiable
P56	0.50	ML	51	4	9.75	5.00	4.75	1.00	0.319	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.531	Liquefiable
	1.00	SM-SC	43	4	19.50	10.00	9.50	0.99	0.318	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.533	Liquefiable
	2.00	SM-SC	43	4	39.00	20.00	19.00	0.98	0.315	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.537	Liquefiable
	3.00	SM	40	8	58.50	30.00	28.50	0.98	0.313	1.70	13.60	5.00	1.20	21.32	0.23	1.00	0.277	0.887	Liquefiable
	5.00	SM	36	9	97.50	50.00	47.50	0.96	0.308	1.45	13.06	5.00	1.20	20.67	0.22	1.00	0.267	0.867	Liquefiable
	6.00	SM	36	8	115.80	60.00	55.80	0.95	0.309	1.34	10.71	5.00	1.20	17.85	0.19	1.00	0.227	0.734	Liquefiable
	8.00	CL	84	12	154.40	80.00	74.40	0.94	0.304	1.16	13.91	5.00	1.20	21.69	0.24	1.00	-	-	Non-liquefiable
	9.00	CL	84	14	173.70	90.00	83.70	0.93	0.301	1.09	15.30	5.00	1.20	23.36	0.26	1.00	-	-	Non-liquefiable
	11.00	CL	75	12	212.30	110.00	102.30	0.88	0.285	0.99	11.86	5.00	1.20	19.24	0.21	1.00	-	-	Non-liquefiable
	12.50	CL	89	14	250.00	125.00	125.00	0.84	0.262	0.89	12.52	5.00	1.20	20.03	0.22	1.00	-	-	Non-liquefiable
	14.50	CL	91	41	290.00	145.00	145.00	0.79	0.245	0.83	34.05	5.00	1.20	45.86	0.52	1.00	-	-	Non-liquefiable
	17.50	CL	85	37	351.75	175.00	176.75	0.71	0.219	0.75	27.83	5.00	1.20	38.40	0.52	0.82	-	-	Non-liquefiable
	20.50	CL	78	42	418.20	205.00	213.20	0.63	0.192	0.68	28.76	5.00	1.20	39.52	0.52	0.74	-	-	Non-liquefiable
	23.50	CL	91	48	477.05	235.00	242.05	0.56	0.172	0.64	30.85	5.00	1.20	42.02	0.52	0.75	-	-	Non-liquefiable
	26.50	MI	94	64	543.25	265.00	278.25	0.56	0.171	0.60	38.37	5.00	1.20	51.04	0.52	0.71	-	-	Non-liquefiable
	28.00	MI	94	53	574.00	280.00	294.00	0.56	0.171	0.58	30.91	5.00	1.20	42.09	0.52	0.70	-	-	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 | **Earthquake Zone= IV** | **amax/g=0.24** | **K(alpha)= 1.00** | **MSF= 1.193** | **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	29.50	MI	94	40	604.75	295.00	309.75	0.56	0.171	0.57	22.73	5.00	1.20	32.27	0.52	0.69	-	-	Non-liquefiable
	31.00	CL	92	40	635.50	310.00	325.50	0.56	0.171	0.55	22.17	5.00	1.20	31.61	0.52	0.68	-	-	Non-liquefiable
	32.50	CL	84	59	659.75	325.00	334.75	0.56	0.172	0.55	32.25	5.00	1.20	43.70	0.52	0.67	-	-	Non-liquefiable
	34.00	CL	90	57	690.20	340.00	350.20	0.56	0.172	0.53	30.46	5.00	1.20	41.55	0.52	0.66	-	-	Non-liquefiable
	35.50	CL	90	65	720.65	355.00	365.65	0.56	0.172	0.52	33.99	5.00	1.20	45.79	0.52	0.65	-	-	Non-liquefiable
	37.00	CL	90	57	751.10	370.00	381.10	0.56	0.172	0.51	29.20	5.00	1.20	40.04	0.52	0.64	-	-	Non-liquefiable
	38.50	CL	88	67	781.55	385.00	396.55	0.56	0.172	0.50	33.65	5.00	1.20	45.37	0.52	0.64	-	-	Non-liquefiable
	40.00	CL	88	55	812.00	400.00	412.00	0.56	0.172	0.49	27.10	5.00	1.20	37.52	0.52	0.63	-	-	Non-liquefiable
	0.50	SM-SC	46	3	9.80	5.00	4.80	1.00	0.317	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.463	Liquefiable
	2.00	SM-SC	40	3	39.20	20.00	19.20	0.98	0.314	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.468	Liquefiable
	3.00	SM-SC	36	4	58.80	30.00	28.80	0.98	0.311	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.545	Liquefiable
	5.00	SM	30	9	98.00	50.00	48.00	0.96	0.306	1.44	12.99	4.71	1.15	19.70	0.21	1.00	0.253	0.824	Liquefiable
P57	6.00	SM	34	12	117.60	60.00	57.60	0.95	0.304	1.32	15.81	4.93	1.19	23.72	0.27	1.00	0.320	1.054	Non-liquefiable
	8.00	SM	38	17	156.80	80.00	76.80	0.94	0.299	1.14	19.40	5.00	1.20	28.28	0.38	1.00	0.453	1.515	Non-liquefiable
	9.00	CL	91	20	186.30	90.00	96.30	0.93	0.281	1.02	20.38	5.00	1.20	29.46	0.43	1.00	-	-	Non-liquefiable
	11.00	CL	92	19	227.70	110.00	117.70	0.88	0.266	0.92	17.51	5.00	1.20	26.02	0.31	1.00	-	-	Non-liquefiable
	12.00	CL	92	21	243.60	120.00	123.60	0.85	0.262	0.90	18.89	5.00	1.20	27.67	0.36	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 Earthquake Zone= IV amax/g=0.24 K(alpha)= 1.00 MSF= 1.193 Critical Water Table (m)=0.00 m

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	13.00	CL-ML	88	21	263.90	130.00	133.90	0.83	0.254	0.86	18.15	5.00	1.20	26.78	0.33	1.00	-	-	Non-liquefiable
	14.50	CL-ML	88	31	295.80	145.00	150.80	0.79	0.241	0.81	25.24	5.00	1.20	35.29	0.52	1.00	-	-	Non-liquefiable
	16.00	CL	58	31	326.40	160.00	166.40	0.75	0.229	0.78	24.03	5.00	1.20	33.84	0.52	0.82	-	-	Non-liquefiable
	17.50	CL	58	36	360.50	175.00	185.50	0.71	0.214	0.73	26.43	5.00	1.20	36.72	0.52	0.79	-	-	Non-liquefiable
	19.00	SM-SC	48	36	391.40	190.00	201.40	0.67	0.202	0.70	25.37	5.00	1.20	35.44	0.52	0.81	0.500	2.472	Non-liquefiable
	20.50	CL-ML	76	37	401.80	205.00	196.80	0.63	0.200	0.71	26.37	5.00	1.20	36.65	0.52	0.81	-	-	Non-liquefiable
	22.50	CL	80	37	441.00	225.00	216.00	0.57	0.183	0.68	25.18	5.00	1.20	35.21	0.52	0.78	-	-	Non-liquefiable
	23.50	CL	80	42	474.70	235.00	239.70	0.56	0.173	0.65	27.13	5.00	1.20	37.55	0.52	0.75	-	-	Non-liquefiable
	25.00	SM	28	42	505.00	250.00	255.00	0.56	0.173	0.63	26.30	4.56	1.14	34.50	0.52	0.74	0.458	2.648	Non-liquefiable
	26.50	SM	28	58	535.30	265.00	270.30	0.56	0.173	0.61	35.28	4.56	1.14	44.71	0.52	0.72	0.450	2.599	Non-liquefiable
	28.00	CL	75	60	565.60	280.00	285.60	0.56	0.173	0.59	35.50	5.00	1.20	47.60	0.52	0.71	-	-	Non-liquefiable
	29.50	CL	75	61	595.90	295.00	300.90	0.56	0.173	0.58	35.17	5.00	1.20	47.20	0.52	0.70	-	-	Non-liquefiable
	31.00	CL	79	56	626.20	310.00	316.20	0.56	0.173	0.56	31.49	5.00	1.20	42.79	0.52	0.69	-	-	Non-liquefiable
	32.50	CL	79	58	656.50	325.00	331.50	0.56	0.173	0.55	31.86	5.00	1.20	43.23	0.52	0.68	-	-	Non-liquefiable
	34.00	SM	29	58	686.80	340.00	346.80	0.56	0.173	0.54	31.15	4.64	1.15	40.33	0.52	0.60	0.375	2.167	Non-liquefiable
	35.50	SM	32	52	752.60	355.00	397.60	0.56	0.165	0.50	26.08	4.83	1.17	35.37	0.52	0.57	0.355	2.145	Non-liquefiable
	38.50	SM	34	49	816.20	385.00	431.20	0.56	0.165	0.48	23.60	4.93	1.19	32.97	0.52	0.55	0.343	2.076	Non-liquefiable
	40.00	SM	34	50	848.00	400.00	448.00	0.56	0.165	0.47	23.62	4.93	1.19	33.00	0.52	0.54	0.338	2.044	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
P58	0.50	SM	50	2	10.05	5.00	5.05	1.00	0.309	1.70	3.40	5.00	1.20	9.08	0.11	1.00	0.125	0.405	Liquefiable
	1.00	SM	50	2	20.10	10.00	10.10	0.99	0.308	1.70	3.40	5.00	1.20	9.08	0.11	1.00	0.125	0.407	Liquefiable
	2.00	CL-ML	56	2	40.20	20.00	20.20	0.98	0.306	1.70	3.40	5.00	1.20	9.08	0.11	1.00	-	-	Non-liquefiable
	3.00	SM	45	4	60.30	30.00	30.30	0.98	0.303	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.559	Liquefiable
	4.00	SM	45	10	80.40	40.00	40.40	0.97	0.301	1.57	15.73	5.00	1.20	23.88	0.27	1.00	0.324	1.075	Non-liquefiable
	6.00	SM	48	17	120.60	60.00	60.60	0.95	0.296	1.28	21.84	5.00	1.20	31.21	0.52	1.00	0.620	2.094	Non-liquefiable
	7.00	SM	48	20	138.60	70.00	68.60	0.95	0.298	1.21	24.15	5.00	1.20	33.98	0.52	1.00	0.620	2.079	Non-liquefiable
	9.00	SM	29	15	178.20	90.00	88.20	0.93	0.293	1.06	15.97	4.64	1.15	22.94	0.26	1.00	0.305	1.041	Non-liquefiable
	10.00	SM	29	17	194.00	100.00	94.00	0.91	0.292	1.03	17.53	4.64	1.15	24.73	0.29	1.00	0.342	1.171	Non-liquefiable
	11.00	ML	66	17	213.40	110.00	103.40	0.88	0.283	0.98	16.72	5.00	1.20	25.06	0.29	1.00	0.350	1.233	Non-liquefiable
	12.50	CL	91	19	252.50	125.00	127.50	0.84	0.260	0.89	16.83	5.00	1.20	25.19	0.30	1.00	-	-	Non-liquefiable
	15.50	CL	90	22	313.10	155.00	158.10	0.76	0.235	0.80	17.50	5.00	1.20	26.00	0.31	0.87	-	-	Non-liquefiable
	17.00	SM	44	22	345.10	170.00	175.10	0.72	0.221	0.76	16.63	5.00	1.20	24.95	0.29	0.87	0.302	1.366	Non-liquefiable
	18.50	SM	44	32	357.05	185.00	172.05	0.68	0.220	0.76	24.40	5.00	1.20	34.28	0.52	0.88	0.543	2.466	Non-liquefiable
	20.00	ML	55	32	386.00	200.00	186.00	0.64	0.207	0.73	23.46	5.00	1.20	33.16	0.52	0.86	0.534	2.575	Non-liquefiable
	21.50	CL	87	57	423.55	215.00	208.55	0.60	0.190	0.69	39.47	5.00	1.20	52.36	0.52	0.84	-	-	Non-liquefiable
	23.00	CL	87	60	453.10	230.00	223.10	0.56	0.177	0.67	40.17	5.00	1.20	53.20	0.52	0.82	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	24.50	CL	87	47	482.65	245.00	237.65	0.56	0.177	0.65	30.49	5.00	1.20	41.59	0.52	0.81	-	-	Non-liquefiable
	27.50	MI	96	62	541.75	275.00	266.75	0.56	0.177	0.61	37.96	5.00	1.20	50.55	0.52	0.76	-	-	Non-liquefiable
	29.00	CL	87	43	591.60	290.00	301.60	0.56	0.171	0.58	24.76	5.00	1.20	34.71	0.52	0.73	-	-	Non-liquefiable
	30.50	SM	43	100	622.20	305.00	317.20	0.56	0.171	0.56	56.15	5.00	1.20	72.38	0.52	0.72	0.448	2.616	Non-liquefiable
	32.00	CL-ML	60	100	652.80	320.00	332.80	0.56	0.171	0.55	54.82	5.00	1.20	70.78	0.52	0.71	-	-	Non-liquefiable
	33.50	SM	38	74	683.40	335.00	348.40	0.56	0.171	0.54	39.65	5.00	1.20	52.57	0.52	0.70	0.437	2.548	Non-liquefiable
	35.00	SM	38	62	714.00	350.00	364.00	0.56	0.171	0.52	32.50	5.00	1.20	44.00	0.52	0.70	0.431	2.517	Non-liquefiable
	36.50	SM	38	65	744.60	365.00	379.60	0.56	0.171	0.51	33.36	5.00	1.20	45.03	0.52	0.69	0.426	2.488	Non-liquefiable
	38.00	SM	27	71	775.20	380.00	395.20	0.56	0.171	0.50	35.71	4.48	1.13	44.85	0.52	0.68	0.421	2.460	Non-liquefiable
	40.00	SM	27	78	816.00	400.00	416.00	0.56	0.171	0.49	38.24	4.48	1.13	47.70	0.52	0.67	0.415	2.424	Non-liquefiable
	0.50	SM	44	4	9.70	5.00	4.70	1.00	0.321	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.528	Liquefiable
	1.00	ML	51	4	19.40	10.00	9.40	0.99	0.319	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.530	Liquefiable
	2.00	ML	51	4	38.80	20.00	18.80	0.98	0.317	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.534	Liquefiable
P59	3.00	SM	27	5	58.20	30.00	28.20	0.98	0.315	1.70	8.50	4.48	1.13	14.09	0.15	1.00	0.180	0.573	Liquefiable
	4.00	MI	93	5	77.60	40.00	37.60	0.97	0.312	1.63	8.15	5.00	1.20	14.78	0.16	1.00	-	-	Non-liquefiable
	5.00	MI	93	7	96.50	50.00	46.50	0.96	0.311	1.47	10.27	5.00	1.20	17.32	0.18	1.00	-	-	Non-liquefiable
	6.00	MI	93	10	115.80	60.00	55.80	0.95	0.309	1.34	13.39	5.00	1.20	21.06	0.23	1.00	-	-	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	7.00	SM	28	10	135.10	70.00	65.10	0.95	0.306	1.24	12.39	4.56	1.14	18.67	0.20	1.00	0.238	0.776	Liquefiable
	8.00	SM	28	16	152.00	80.00	72.00	0.94	0.309	1.18	18.86	4.56	1.14	26.02	0.31	1.00	0.374	1.210	Non-liquefiable
	9.00	SM	28	18	171.00	90.00	81.00	0.93	0.307	1.11	20.00	4.56	1.14	27.32	0.35	1.00	0.415	1.352	Non-liquefiable
	10.00	CL-ML	79	18	190.00	100.00	90.00	0.91	0.299	1.05	18.97	5.00	1.20	27.77	0.36	1.00	-	-	Non-liquefiable
	11.00	CL	91	15	221.10	110.00	111.10	0.88	0.273	0.95	14.23	5.00	1.20	22.08	0.24	1.00	-	-	Non-liquefiable
	12.00	CL	91	20	241.20	120.00	121.20	0.85	0.265	0.91	18.17	5.00	1.20	26.80	0.33	1.00	-	-	Non-liquefiable
	14.50	CL	88	22	291.45	145.00	146.45	0.79	0.244	0.83	18.18	5.00	1.20	26.82	0.33	1.00	-	-	Non-liquefiable
	17.50	CL	80	27	355.25	175.00	180.25	0.71	0.217	0.74	20.11	5.00	1.20	29.13	0.42	0.85	-	-	Non-liquefiable
	19.00	SM	44	27	376.20	190.00	186.20	0.67	0.210	0.73	19.79	5.00	1.20	28.74	0.40	0.83	0.396	1.884	Non-liquefiable
	20.50	SM	44	33	399.75	205.00	194.75	0.63	0.201	0.72	23.65	5.00	1.20	33.38	0.52	0.82	0.510	2.539	Non-liquefiable
	23.50	CL-ML	84	64	458.25	235.00	223.25	0.56	0.179	0.67	42.83	5.00	1.20	56.40	0.52	0.79	-	-	Non-liquefiable
	25.00	CL-ML	84	55	487.50	250.00	237.50	0.56	0.179	0.65	35.69	5.00	1.20	47.83	0.52	0.77	-	-	Non-liquefiable
	26.50	CL-ML	77	59	516.75	265.00	251.75	0.56	0.179	0.63	37.18	5.00	1.20	49.62	0.52	0.76	-	-	Non-liquefiable
	28.00	MI	96	60	546.00	280.00	266.00	0.56	0.179	0.61	36.79	5.00	1.20	49.15	0.52	0.75	-	-	Non-liquefiable
	29.50	CL	66	47	575.25	295.00	280.25	0.56	0.179	0.60	28.08	5.00	1.20	38.69	0.52	0.74	-	-	Non-liquefiable
	31.00	SM-SC	50	47	604.50	310.00	294.50	0.56	0.179	0.58	27.39	5.00	1.20	37.87	0.52	0.70	0.435	2.429	Non-liquefiable
	32.50	SM-SC	50	50	653.25	325.00	328.25	0.56	0.174	0.55	27.60	5.00	1.20	38.12	0.52	0.68	0.420	2.418	Non-liquefiable
	34.00	CL-ML	57	50	683.40	340.00	343.40	0.56	0.174	0.54	26.98	5.00	1.20	37.38	0.52	0.65	-	-	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	35.50	SM	45	57	720.65	355.00	365.65	0.56	0.172	0.52	29.81	5.00	1.20	40.77	0.52	0.64	0.394	2.289	Non-liquefiable
	37.00	SM	45	59	751.10	370.00	381.10	0.56	0.172	0.51	30.22	5.00	1.20	41.27	0.52	0.63	0.388	2.256	Non-liquefiable
	38.50	SM	47	60	781.55	385.00	396.55	0.56	0.172	0.50	30.13	5.00	1.20	41.16	0.52	0.62	0.383	2.225	Non-liquefiable
	40.00	SM	47	64	812.00	400.00	412.00	0.56	0.172	0.49	31.53	5.00	1.20	42.84	0.52	0.61	0.378	2.195	Non-liquefiable
P60	0.50	SM	35	6	10.35	5.00	5.35	1.00	0.301	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.728	Liquefiable
P60	1.00	SM	35	6	20.70	10.00	10.70	0.99	0.299	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.731	Liquefiable
P60	2.00	CH	63	6	41.40	20.00	21.40	0.98	0.297	1.70	10.20	5.00	1.20	17.24	0.18	1.00	-	-	Non-liquefiable
P60	3.00	CL	82	14	62.10	30.00	32.10	0.98	0.295	1.70	23.80	5.00	1.20	33.56	0.52	1.00	-	-	Non-liquefiable
P60	4.00	CL	82	9	82.80	40.00	42.80	0.97	0.293	1.53	13.76	5.00	1.20	21.51	0.24	1.00	-	-	Non-liquefiable
P60	5.00	SM	29	9	98.00	50.00	48.00	0.96	0.306	1.44	12.99	4.64	1.15	19.53	0.21	1.00	0.250	0.816	Liquefiable
P60	6.00	SM	29	15	117.60	60.00	57.60	0.95	0.304	1.32	19.76	4.64	1.15	27.29	0.35	1.00	0.414	1.361	Non-liquefiable
P60	7.00	SM	29	18	137.20	70.00	67.20	0.95	0.301	1.22	21.96	4.64	1.15	29.80	0.45	1.00	0.542	1.799	Non-liquefiable
P60	9.00	CL-ML	68	24	176.40	90.00	86.40	0.93	0.297	1.08	25.82	5.00	1.20	35.98	0.52	1.00	-	-	Non-liquefiable
P60	10.00	CL-ML	68	22	196.00	100.00	96.00	0.91	0.289	1.02	22.45	5.00	1.20	31.94	0.52	1.00	-	-	Non-liquefiable
P60	11.00	CL	86	22	224.40	110.00	114.40	0.88	0.269	0.93	20.57	5.00	1.20	29.68	0.45	1.00	-	-	Non-liquefiable
P60	12.50	CL	86	26	255.00	125.00	130.00	0.84	0.257	0.88	22.80	5.00	1.20	32.36	0.52	1.00	-	-	Non-liquefiable
P60	14.00	CL-ML	85	26	292.60	140.00	152.60	0.80	0.239	0.81	21.05	5.00	1.20	30.26	0.49	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 | Earthquake Zone= IV | amax/g=0.24 | K(alpha)= 1.00 | MSF= 1.193 | Critical Water Table (m)=0.00 m

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	15.50	CL-ML	79	25	323.95	155.00	168.95	0.76	0.227	0.77	19.23	5.00	1.20	28.08	0.37	0.88	-	-	Non-liquefiable
	17.00	CL	59	25	351.90	170.00	181.90	0.72	0.217	0.74	18.54	5.00	1.20	27.24	0.35	0.82	-	-	Non-liquefiable
	18.50	ML	57	33	382.95	185.00	197.95	0.68	0.205	0.71	23.46	5.00	1.20	33.15	0.52	0.79	0.490	2.387	Non-liquefiable
	20.00	CL	86	33	412.00	200.00	212.00	0.64	0.194	0.69	22.66	5.00	1.20	32.20	0.52	0.79	-	-	Non-liquefiable
	21.50	CL	86	35	442.90	215.00	227.90	0.60	0.182	0.66	23.18	5.00	1.20	32.82	0.52	0.77	-	-	Non-liquefiable
	24.50	CL	84	36	485.10	245.00	240.10	0.56	0.176	0.65	23.23	5.00	1.20	32.88	0.52	0.71	-	-	Non-liquefiable
	26.00	MI	99	36	520.00	260.00	260.00	0.56	0.175	0.62	22.33	5.00	1.20	31.79	0.52	0.89	-	-	Non-liquefiable
	27.50	MI	99	34	550.00	275.00	275.00	0.56	0.175	0.60	20.50	5.00	1.20	29.60	0.44	0.88	-	-	Non-liquefiable
	29.00	CL-ML	69	34	606.10	290.00	316.10	0.56	0.167	0.56	19.12	5.00	1.20	27.95	0.37	0.69	-	-	Non-liquefiable
	30.50	MI	97	38	637.45	305.00	332.45	0.56	0.167	0.55	20.84	5.00	1.20	30.01	0.47	0.67	-	-	Non-liquefiable
	32.00	CL-ML	65	38	617.60	320.00	297.60	0.56	0.181	0.58	22.03	5.00	1.20	31.43	0.52	0.74	-	-	Non-liquefiable
	33.50	ML	54	55	646.55	335.00	311.55	0.56	0.181	0.57	31.16	5.00	1.20	42.39	0.52	0.73	0.453	2.498	Non-liquefiable
	35.00	ML	69	65	675.50	350.00	325.50	0.56	0.181	0.55	36.03	5.00	1.20	48.23	0.52	0.72	0.447	2.464	Non-liquefiable
	36.50	ML	83	77	704.45	365.00	339.45	0.56	0.181	0.54	41.79	5.00	1.20	55.15	0.52	0.72	0.447	2.464	Non-liquefiable
	38.00	CL-CI	83	89	733.40	380.00	353.40	0.56	0.181	0.53	47.34	5.00	1.20	61.81	0.52	0.71	-	-	Non-liquefiable
	40.00	CL-CI	83	100	772.00	400.00	372.00	0.56	0.181	0.52	51.85	5.00	1.20	67.22	0.52	0.70	-	-	Non-liquefiable

APPENDIX-I
SITE PHOTOGRAPHS

SPT sample at depth 10.00 m


UDS at depth 7.00 m


SPT at depth 23.50 m

SPT sample at depth 5.00 m

APPENDIX-I
SITE PHOTOGRAPHS

SPT at depth 23.50 m

SPT at depth 6.00 m

SPT sample at depth 26.50 m

UDS at depth 10.00 m

APPENDIX-I
SITE PHOTOGRAPHS

SPT at depth 20.50 m

SPT at depth 6.00 m


SPT at depth 4.00 m


SPT at depth 27.50 m

APPENDIX-I
SITE PHOTOGRAPHS


SPT sample at depth 27.50 m


SPT at depth 6.00 m


SPT sample at depth 26.50 m


SPT at depth 20.50 m

APPENDIX-I
SITE PHOTOGRAPHS

SPT at depth 17.50 m

SPT sample at depth 11.00 m

SPT at depth 11.00 m

SPT at depth 33.50 m

APPENDIX-I
SITE PHOTOGRAPHS


SPT at depth 17.50 m


SPT at depth 11.00 m


UDS at depth 1.00 m


SPT at depth 24.50 m

APPENDIX-I
SITE PHOTOGRAPHS


SPT at depth 6.00 m

SPT sample at depth 14.50 m


SPT at depth 3.00 m

SPT sample at depth 24.50 m

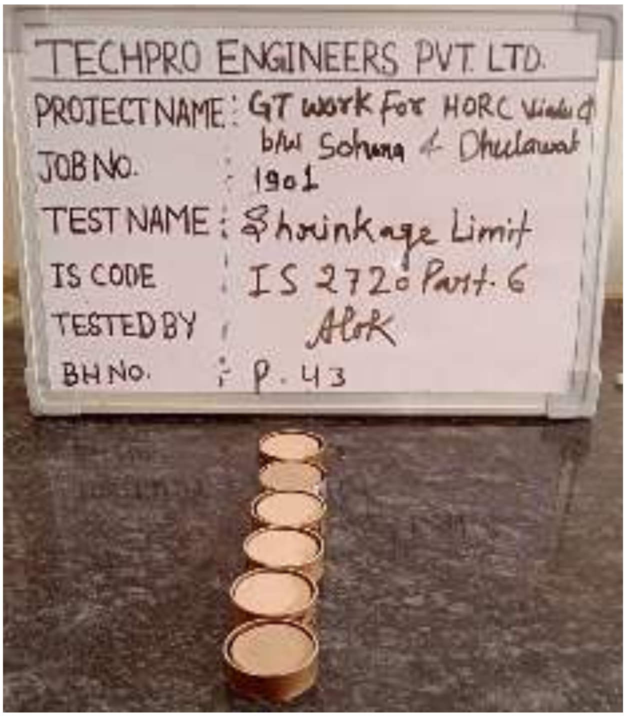
APPENDIX-J
LABORATORY PHOTOGRAPHS

Water content test

Atterbergs' limit test

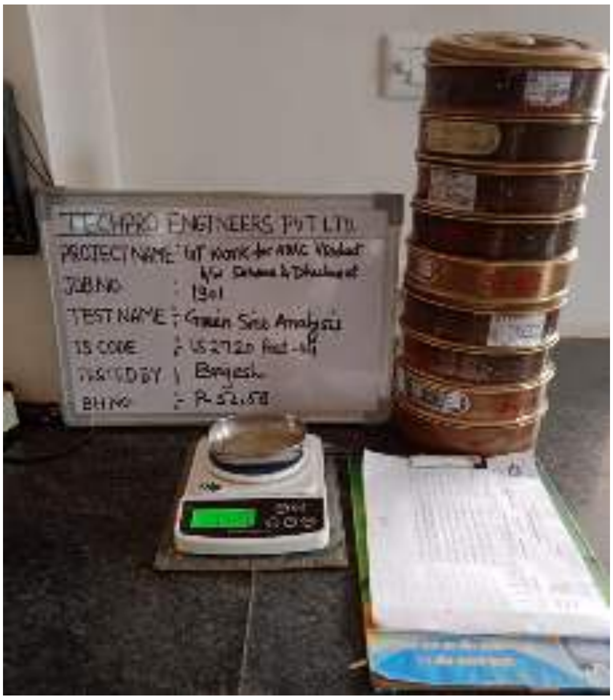
Direct shear test

APPENDIX-J
LABORATORY PHOTOGRAPHS



Shrinkage limit test

UCS test soil



Grain size analysis test

Water content test

APPENDIX-K
CHART 1: FIELD BORELOG CHART (P41)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev No.:	R03
		Rev Date:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N:3119128.485	E:701593.231	Location/ Chainage: 21990.0870		
Method of Drilling:	Percussion	Drilling Equipment:	Manual Powerwinch	Bore No.:	P41
Casing Lowered (M):	20.00 / Bentonite Used: NO	Standard Sampler:	Yes	Barrel Type:	N/A
Ground Elevation:	R.L-191.144	Date: From 8/11/23 to 10/11/23		Water Table (M):	1.40

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
8/11/23	0.00	0.50	0.50	DS	6X	collected										cohesive soil
"	1.00	1.45	0.45	DP	"	1	1	2	3							cohesive soil with gravel
"	2.00	2.45	0.45	U	"	Received										— do —
"	3.00	3.45	0.45	DP	"	2	3	4	7							— do —
"	4.00	4.45	0.45	DP	"	3	3	6	9							— do —
"	5.00	5.45	0.45	U	"	Received										Non-cohesive soil
"	6.00	6.45	0.45	DP	"	4	7	9	16							— do —
"	7.00	7.45	0.45	DP	"	4	8	9	17							— do —
"	8.00	8.45	0.45	U	"	Received										— do —
"	9.00	9.45	0.45	DP	"	5	8	10	18							— do —
"	10.00	10.45	0.45	DP	"	4	9	11	20							— do —
"	11.00	11.45	0.45	U	"	Received										cohesive soil with gravel
"	12.50	12.95	0.45	DP	"	6	7	12	19							— do —
"	14.00	14.45	0.45	U	"	Received										— do —
"	15.50	15.95	0.45	DP	"	8	10	13	23							— do —
"	17.00	17.45	0.45	U	"	Received										— do —
"	18.50	18.95	0.45	DP	"	9	12	15	27							Non-cohesive soil
"	20.00	20.45	0.45	U	"	slipped										-do- DS collected
"	21.50	21.95	0.45	DP	"	13	17	20	37							Non-cohesive soil with gravel
"	23.00	23.45	0.45	U	"	slipped										-do- DS collected
9/11/23	24.50	24.95	0.45	DP	"	14	20	22	42							Non-cohesive soil
"	26.00	26.45	0.45	U	"	Received										Non-cohesive soil with gravel
"	27.50	27.95	0.45	DP	"	12	19	21	40							— do —
"	29.00	29.45	0.45	U	"	Received										Non-cohesive soil

Nilesh
Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K

CHART 2: FIELD BORELOG CHART (P41)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date.:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w. Sohana Dhulawat हरियाणा			Project Code:	1901
Coordinate:	N: 3119138.485	E: 701593.931	Location/ Chainage: 91990.0870	Bore No.:	P41
Method of Drilling:	Percussion	Drilling Equipment:	Mannual Percussion rig		
Casing Lowered (M):	20.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-191.144	Date: From 9/11/23	to 10/11/23	Water Table (M):	1.40

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
9/11/23	30.50	30.95	0.45	DP	SX	15	21	26	47							Non-cohesive soil
"	32.00	32.45	0.45	U	"	slipped										-do- no collected
"	33.50	33.95	0.45	DP	"	17	20	29	49							Non-cohesive soil
"	35.00	35.45	0.45	U	"	slipped										-do- no collected
"	36.50	36.95	0.45	DP	"	21	25	29	54							Non-cohesive soil
10/11/23	38.00	38.45	0.45	DP	"	22	25	32	57							—do—
"	40.00	40.45	0.45	DP	"	26	29	35	64							—do—

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 3: FIELD BORELOG CHART (P42)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev No.:	R03
Rev. Date.:	28.12.2021

Project Name: GT for HORC Viaduct Sohana-Dhulawat station | Project Code: 1901

Coordinate: N: 3119152.203 | E: 701570.362 | Location/ Chainage: 22516.2810

Method of Drilling: Percussion | Drilling Equipment: Percussion | Bore No.: P42

Casing Lowered (M): 19.00 | Bentonite Used: Not | Standard Sampler: Yes | Barrel Type: N/A

Ground Elevation: RL-191.352 | Date: From 11/10/22 to 13/10/22 | Water Table (M): 1.38

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C.R.(%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
11/10/22	1.00	1.30	0.30	DP	8"	Collected				-	-	-	-	-	-	Non Cohesive Soil
"	1.50	1.95	0.45	U	"	Received				-	-	-	-	-	-	-do-
"	2.50	2.95	0.45	DP	"	4	4	6	10	-	-	-	-	-	-	-do-
12/10/22	3.50	3.95	0.45	DP	"	2	4	8	12	-	-	-	-	-	-	-do-
"	4.00	4.45	0.45	U	"	Received				-	-	-	-	-	-	-do-
"	5.00	5.45	0.45	DP	"	5	7	9	16	-	-	-	-	-	-	-do-
"	6.00	6.45	0.45	DP	"	3	5	9	14	-	-	-	-	-	-	-do-
"	7.00	7.45	0.45	U	"	Slipped				-	-	-	-	-	-	-do-
"	8.00	8.45	0.45	DP	"	4	5	8	13	-	-	-	-	-	-	-do-
"	9.00	9.45	0.45	DP	"	3	4	7	11	-	-	-	-	-	-	-do-
"	10.00	10.45	0.45	U	"	Received				-	-	-	-	-	-	Cohesive Soil
"	11.00	11.45	0.45	DP	"	5	7	11	18	-	-	-	-	-	-	-do-
"	12.00	12.45	0.45	DP	"	6	11	14	25	-	-	-	-	-	-	-do-
"	13.00	13.45	0.45	U	"	Received				-	-	-	-	-	-	Cohesive Soil with Gravel
"	14.50	14.95	0.45	DP	"	4	7	10	17	-	-	-	-	-	-	
"	16.00	16.45	0.45	U	"	Received				-	-	-	-	-	-	-do-
"	17.50	17.95	0.45	DP	"	4	7	11	18	-	-	-	-	-	-	-do-
13/10/22	19.00	19.45	0.45	U	"	Received				-	-	-	-	-	-	-do-
"	20.50	20.95	0.45	DP	"	3	7	9	16	-	-	-	-	-	-	-do-
"	22.00	22.45	0.45	U	"	Received				-	-	-	-	-	-	-do-
"	23.50	23.95	0.45	DP	"	6	13	19	32	-	-	-	-	-	-	-do-
"	25.00	25.45	0.45	U	"	Received				-	-	-	-	-	-	-do-
"	26.50	26.95	0.45	DP	"	17	27	29	56	-	-	-	-	-	-	-do-
"	28.00	28.45	0.45	U	"	Received				-	-	-	-	-	-	-do-

Supervisor | E-in-C

Abbreviation Used: U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P-(Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 4: FIELD BORELOG CHART (P42)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GTY003
Date of Issue:	01 04 2018
Rev. No:	R03
Rev. Date:	28 12 2021

Project Name:	GTI for horc viaduct Sohana dhulawat station			Project Code:	1901
Coordinate:	N: 3119152.293	E: 701570.762		Location/ Chainage:	22016.2830
Method of Drilling:	Percussion	Drilling Equipment:	Bore wire	Bore No.:	P-02
Casing Lowered (M):	19.00	Bentonite Used: Not	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	RL-191.292	Date: From 11/10/23 to 13/10/23		Water Table (M):	1.20

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C.R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
"	[illegible]	[illegible]	0.45	DP	8"	13	18	29	47	-	-	-	-	-	-	Cohesive Soil (with
"	[illegible]	[illegible]	0.45	U	"	Received				-	-	-	-	-	-	gravel)
"	[illegible]	[illegible]	0.45	DP	"	17	26	30	56	-	-	-	-	-	-	— do —
12	[illegible]	[illegible]	0.45	DP	"	16	20	29	53	-	-	-	-	-	-	Non Cohesive Soil
"	[illegible]	[illegible]	0.45	DP	"	16	18	31	50	-	-	-	-	-	-	— do —
13	[illegible]	[illegible]	0.45	DP	"	15	14	35	49	-	-	-	-	-	-	— do —
"	[illegible]	[illegible]	0.45	DP	"	14	20	23	43	-	-	-	-	-	-	— do —
"	[illegible]	[illegible]	0.45	DP	"	16	21	29	50	-	-	-	-	-	-	— do —

Supervisor E - in - C

Abbreviation Used :- U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K

CHART 5: FIELD BORELOG CHART (P43)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTwJ HORC Viaduct B/W Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119166.393	E: 701548.586	Location/ Chainage:	22042.4870	
Method of Drilling:	Percussion	Drilling Equipment:	Rig Percussion	Bore No.:	P.43
Casing Lowered (M):	20.00 / Bentonite Used: NO	Standard Sampler:	YES	Barrel Type:	NA
Ground Elevation:	RL-131.241	Date: From 20/10/22 to 22/10/22		Water Table (M):	1.30

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
20/10/22	0.00	0.50	0.50	DS	SR	Collected				-	-	-	-	-	-	Non Cohesive Soil
"	1.00	1.45	0.45	U	"	Slipped				-	-	-	-	-	-	-do-
"	2.00	2.45	0.45	DP	"	1	2	4	6	-	-	-	-	-	-	-do-
"	3.00	3.45	0.45	DP	"	2	3	3	6	-	-	-	-	-	-	-do-
"	4.00	4.45	0.45	U	"	Received				-	-	-	-	-	-	-do-
"	5.00	5.45	0.45	DP	"	4	4	8	12	-	-	-	-	-	-	-do-
"	6.00	6.45	0.45	DP	"	3	5	7	12	-	-	-	-	-	-	-do-
"	7.00	7.45	0.45	U	"	Received				-	-	-	-	-	-	-do-
"	8.00	8.45	0.45	DP	"	4	6	7	13	-	-	-	-	-	-	-do-
"	9.00	9.45	0.45	DP	"	5	7	9	16	-	-	-	-	-	-	-do-
"	10.00	10.45	0.45	U	"	Received				-	-	-	-	-	-	Cohesive Soil with gravel
"	11.00	11.45	0.45	DP	"	8	12	15	27	-	-	-	-	-	-	-do-
"	12.00	12.45	0.45	DP	"	10	13	18	31	-	-	-	-	-	-	-do-
"	13.00	13.45	0.45	U	"	Received				-	-	-	-	-	-	-do-
"	14.50	14.95	0.45	DP	"	4	6	8	14	-	-	-	-	-		Non Cohesive Soil
21/10/22	16.00	16.45	0.45	U	"	Received				-	-	-	-	-	-	
"	17.50	17.95	0.45	DP	"	4	8	10	18	-	-	-	-	-	-	
"	19.00	19.45	0.45	U	"	Slipped				-	-	-	-	-	-	
"	20.50	20.95	0.45	DP	"	7	8	14	22	-	-	-	-	-	-	
"	22.00	22.45	0.45	U	"	Recieved				-	-	-	-	-	-	Cohesive Soil with gravel
"	23.50	23.95	0.45	DP	"	13	15	16	31	-	-	-	-	-	-	-do-
"	25.00	25.45	0.45	U	"	Slipped				-	-	-	-	-	-	Non Cohesive Soil
"	26.50	26.95	0.45	DP	"	9	17	32	49	-	-	-	-	-	-	-do-
"	28.00	28.45	0.45	U	"	Sripped				-	-	-	-	-	-	-do-

Supervisor Baldev yadav

Techpro Engineers Pvt.

E-in-C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test Appendix-100). Sampler means SPT sampler

APPENDIX-K
CHART 6: FIELD BORELOG CHART (P43)

Auto Trip Hammer

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date.:	28.12.2021

Project Name:	GTWJ - HORC Viaduct B/W Sohana-Dhulawat station			Project Code:	1901
Coordinate:	N: 3119166.393	E: 701548.586		Location/ Chainage:	88042.487
Method of Drilling:	Percussion	Drilling Equipment:	Power winch	Bore No.:	P43
Casing Lowered (M):	90.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	RL-191.341	Date: From 18/10/23 to 22/10/23		Water Table (M):	1.90

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
21/10/22	29.50	29.95	0.45	DP	9x	13	17	22	39	–	–	–	–	–	–	- do -
"	31.00	31.45	0.45	U	"	Received				–	–	–	–	–	–	- do -
"	32.50	32.95	0.45	DP	"	28	32	35	67	–	–	–	–	–	–	- do -
22/10/22	34.00	34.45	0.45	U/DP	"	20	28	30	58	–	–	–	–	–	–	- do -
22/10/22	35.50	35.95	0.45	DP	"	17	20	28	48	–	–	–	–	–	–	Non Cohesive Soil
"	37.00	37.45	0.45	U	"	Slipped				–	–	–	–	–	–	- do - NS Collected
"	38.50	38.95	0.45	DP	"	16	20	30	50	–	–	–	–	–	–	Non Cohesive Soil
"	40.00	40.45	0.45	DP	"	15	24	33	57	–	–	–	–	–	–	- do -

Supervisor: Jaldev yadav

E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (SPT>100), Sampler means SPT sampler

APPENDIX-K
CHART 7: FIELD BORELOG CHART (P44)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/003
		Date of Issue:	01.04.2019
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTL- Horc viaduct b/w Sohana Dhulawat station	Project Code:	1901
Coordinate:	N: 3131361.037 E: 701526.726	Location/ Chainage:	33068.6850
Method of Drilling:	Percussion / Drilling Equipment: Auger/Shell	Bore No.:	P.44
Casing Lowered (M):	10 / Bentonite Used: NO / Standard Sampler: yes	Barrel Type:	NA
Ground Elevation:	RL-191-27 / Date: From 17/12/22 to 19/12/22	Water Table (M):	1.25

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
17/12/22	0.00	0.50	0.50	SP	9X	Collected				-	-	-	-	-	-	NonCohesive Soil
"	1.00	1.45	0.45	U	"	Received				-	-	-	-	-	-	-do-
"	2.00	2.45	0.45	SP	"	2	3	3	6	-	-	-	-	-	-	-do-
"	3.00	3.45	0.45	SP	"	4	7	10	17	-	-	-	-	-	-	-do-
"	4.00	4.45	0.45	U	"	Received				-	-	-	-	-	-	-do-
"	5.00	5.45	0.45	SP	"	5	6	8	14	-	-	-	-	-	-	-do-
"	6.00	6.45	0.45	SP	"	5	7	9	16	-	-	-	-	-	-	-do-
"	7.00	7.45	0.45	U	"	Received				-	-	-	-	-	-	-do-
"	8.00	8.45	0.45	SP	"	3	5	7	12	-	-	-	-	-	-	-do-
"	9.00	9.45	0.45	SP	"	3	4	8	12	-	-	-	-	-	-	-do-
"	10.00	10.45	0.45	U	"	Received				-	-	-	-	-	-	Cohesive Soil with
"	11.00	11.45	0.45	SP	"	5	6	9	15	-	-	-	-	-	-	gravel
"	12.00	12.45	0.45	SP	"	5	7	9	16	-	-	-	-	-	-	-do-
18/12/22	13.00	13.45	0.45	U	"	Received				-	-	-	-	-	-	-do-
"	14.50	14.95	0.45	SP	"	3	6	8	14	-	-	-	-	-	-	-do-
"	16.00	16.45	0.45	U	"	Slipped				-	-	-	-	-	-	-do-
"	17.50	17.95	0.45	SP	"	4	6	12	18	-	-	-	-	-	-	-do-
"	19.00	19.45	0.45	U	"	Received				-	-	-	-	-	-	-do-
"	20.50	20.95	0.45	SP	"	6	11	18	29	-	-	-	-	-	-	-do-
"	22.00	22.45	0.45	U	"	Slipped				-	-	-	-	-	-	Cohesive Soil with gravel
"	23.50	23.95	0.45	SP	"	7	8	14	22	-	-	-	-	-	-	-do-
"	25.00	25.45	0.45	U	"	Received				-	-	-	-	-	-	-do-
"	26.50	26.95	0.45	SP	"	6	12	23	35	-	-	-	-	-	-	-do-
"	28.00	28.45	0.45	U	"	Received				-	-	-	-	-	-	-do-

Supervisor E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 8: FIELD BORELOG CHART (P44)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc. No.	[illegible]
Date of Issue	[illegible]
Rev. No.	[illegible]
Rev. Date	28.12.2021

Project Name:	GTW- HORC Viaduct b/w Sohana Dhulawat station	Project Code:	1901
Coordinate: N:	3113181.037	E:	701526.226
Location/ Chainage:	[illegible]		
Method of Drilling:	Percussion	Drilling Equipment:	Automatic Hydraulic rig
Casing Lowered (M):	10	Bentonite Used:	NO
Standard Sampler:	Yes	Bore No.:	P-44
Ground Elevation:	RL-191.27	Barrel Type:	NX
Date: From	13/10/22 to 19/10/22	Water Table (M):	[illegible]

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
〃	29.50	29.95	0.45	SP	[illegible]	12	24	38	62	-	-	-	-	-	-	Cohesionless soil with
〃	31.00	31.45	0.45	SP	〃	15	18	27	45	-	-	-	-	-	-	-do- gravel
[illegible]	32.50	32.95	0.45	SP	〃	19	22	28	50	-	-	-	-	-	-	-do-
〃	34.00	34.45	0.45	SP	〃	18	26	26	51	-	-	-	-	-	-	-do-
〃	35.50	35.95	0.45	SP	〃	20	28	22	50	-	-	-	-	-	-	-do-
〃	37.00	37.45	0.45	SP	〃	14	20	29	49	-	-	-	-	-	-	-do-
〃	38.50	38.95	0.45	SP	〃	13	23	28	51	-	-	-	-	-	-	-do-
〃	40.00	40.45	0.45	SP	〃	14	21	27	46	-	-	-	-	-	-	-do-

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100). Sampler means SPT sampler

APPENDIX-K

CHART 9: FIELD BORELOG CHART (P45)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	QT/ 003
Date of Issue	01.04.2018
Rev. No.:	R03
Rev. Date:	28.12.2021

Project Name: GTW FOR HORC Viaduct B/w Sohana Dhulawat Station — Project Code: 1901

Coordinate: N: 3119196.164 — E: 701505.144 — Location/ Chainage: 92094.8870

Method of Drilling: Percussion — Drilling Equipment: Auto-trip Power Winch — Bore No.: P-45

Casing Lowered (M): 18.00 — Bentonite Used: NO — Standard Sampler: Yes — Barrel Type: NA

Ground Elevation: R.L.-191.379 — Date: From 8/11/23 to 10/11/23 — Water Table (M): 1.50

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
8/11/23	0.0	0.50	0.50	DS	8x	Collected-										Non Cohesive Soil
"	1.00	1.45	0.45	U	"	Received										do-
"	2.00	2.45	0.45	DP	"	2	3	4	7							do-
"	3.00	3.45	0.45	DP	"	2	2	4	6							do-
"	4.00	4.45	0.45	U	"	Received										do-
"	5.00	5.45	0.45	DP	"	5	7	9	16							do-
"	6.00	6.45	0.45	DP	"	4	6	8	14							do-
"	7.00	7.45	0.45	U	"	Received										do-
"	8.00	8.45	0.45	DP	"	3	5	8	13							do-
"	9.00	9.45	0.45	DP	"	5	7	12	19							do-
"	10.00	10.45	0.45	U	"	Received										Non Cohesive soil with
"	11.00	11.45	0.45	DP	"	5	9	14	23							do- Gravel
"	12.00	12.45	0.45	DP	"	6	8	13	21							do-
"	13.00	13.45	0.45	U	"	Received										do-
"	14.50	14.95	0.45	DP	"	5	9	14	23							do-
"	16.00	16.45	0.45	U	"	Received										do-
"	17.50	17.95	0.45	DP	"	9	14	24	38							Non Cohesive Soil
"	19.00	19.45	0.45	U	"	Received										do-
"	20.50	20.95	0.45	DP	"	11	17	26	43							do-
"	22.00	22.45	0.45	U	"	Received										Non Cohesive Soil-
"	23.50	23.95	0.45	DP	"	8	18	27	45							do- with Gravel
9/11/23	25.00	25.45	0.45	U	"	Received-										do-
"	26.50	26.95	0.45	DP	"	12	17	25	42							do-
"	28.00	28.45	0.45	U	"	Received										Cohesive Soil

Supervisor — E-In-C

Abbreviation Used: U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), DP sampler means SPT sampler

APPENDIX-K

CHART 10: FIELD BORELOG CHART (P45)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	CT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW FOR HORC Viaduct B/W Sohana Dhulawat Station	Project Code:	1901
Coordinate:	N: 3119196.164 E: 701505.144	Location/ Chainage:	22094.8870
Method of Drilling:	Percussion	Drilling Equipment:	Percussion rig
Bore No.:	P.45	Casing Lowered (M):	16.00
Bentonite Used:	Not	Standard Sampler:	Yes
Barrel Type:	NA	Ground Elevation:	R.L- 191.379
Date: From	8/11/23 to 10/11/23	Water Table (M):	1.50

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
9/11/23	29.00	29.45	0.45	DP	Nx	18	27	35	62							Cohesive soil
"	31.00	31.45	0.45	DP	"	17	22	33	55							do
"	32.50	32.95	0.45	DP	"	13	20	25	45							Non Cohesive Soil
"	34.00	34.45	0.45	U	"	slipped										do
10/11/23	35.50	35.95	0.45	DP	"	14	25	35	60							do
"	37.00	37.45	0.45	DP	"	16	28	28	56							do
"	38.50	38.95	0.45	DP	"	13	21	25	46							do
"	40.00	40.45	0.45	DP	"	14	22	32	54							do

Supervisor Lokesh yadav

Techpro Engineers Pvt. Ltd.

E - in - C

Abbreviation Used :- U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) >50), Sampler means SPT sampler

APPENDIX-K
CHART 11: FIELD BORELOG CHART (P46)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No:	R03
		Rev. Date.:	28.12.2021

Project Name:	GTW For HORC B/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119211-716	E: 701483-921	Location/ Chainage: 22121.0870		
Method of Drilling:	Percussion	Drilling Equipment:	Tripod Arrangement	Bore No.:	P46
Casing Lowered (M):	20 m	Bentonite Used: NA	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L-191.396	Date: From 6/11/2023 to 9/11/2023		Water Table (M):	16.0 m

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
6/11/23	0.00	0.50	0.50	D	SX	collected				-	-	-	-	-	-	Non cohesive soil
"	1.00	1.45	0.45	U	"	Received				-	-	-	-	-	-	d/o
"	2.00	2.45	0.45	DP	"	1	2	3	5	-	-	-	-	-	-	d/o
"	3.00	3.45	0.45	DP	"	3	3	6	9	-	-	-	-	-	-	d/o
"	4.00	4.45	0.45	U/D	"	slipped				-	-	-	-	-	-	Non cohesive soil
"	5.00	5.45	0.45	DP	"	2	2	4	6	-	-	-	-	-	-	d/o
"	6.00	6.45	0.45	DP	"	2	3	5	8	-	-	-	-	-	-	d/o
"	7.00	7.45	0.45	U	"	Received				-	-	-	-	-	-	Non cohesive soil with gravel
"	8.00	2.45	0.45	DP	"	3	5	7	12	-	-	-	-	-	-	d/o
"	9.00	9.45	0.45	DP	"	5	8	9	17	-	-	-	-	-	-	cohesive soil with Gravel
"	10.00	10.45	0.45	U	"	Received				-	-	-	-	-	-	d/o
"	11.00	11.45	0.45	DP	"	4	8	11	19	-	-	-	-	-	-	d/o
"	12.00	12.45	0.45	DP	"	6	10	12	22	-	-	-	-	-	-	d/o
7/11/23	13.00	13.45	0.45	U	"	Received				-	-	-	-	-	-	d/o
"	14.50	14.95	0.45	DP	"	8	14	17	31	-	-	-	-	-	-	d/o
"	16.00	16.45	0.45	U	"	Received				-	-	-	-	-	-	cohesive soil
"	17.50	17.95	0.45	DP	"	6	12	16	28	-	-	-	-	-	-	d/o
"	19.00	19.45	0.45	U	"	Received				-	-	-	-	-	-	cohesive soil with Gravel
8/11/23	20.50	20.95	0.45	DP	"	9	17	22	39	-	-	-	-	-	-	d/o
"	22.00	22.45	0.45	U	"	Received				-	-	-	-	-	-	d/o
"	23.50	23.95	0.45	DP	"	18	24	31	55	-	-	-	-	-	-	Non cohesive soil
"	25.00	25.45	0.45	DP	"	15	20	29	49	-	-	-	-	-	-	d/o
"	26.50	26.95	0.45	DP	"	15	24	32	56	-	-	-	-	-	-	cohesive soil with Gravel
"	28.00	28.45	0.45	DP	"	17	28	33	61	-	-	-	-	-	-	d/o

Supervisor E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 12: FIELD BORELOG CHART (P46)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date.:	28.12.2021

Project Name:	GTW FOR HORC B/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3142211.716	E: 701483.921	Location/ Chainage: 27121.0870		
Method of Drilling:	Percussion	Drilling Equipment:	Rotatory Equipment	Bore No.:	P.46
Casing Lowered (M):	20 m	Bentonite Used: NA	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L-191.306	Date: From 6/11/2023 to 9/11/2023		Water Table (M):	16.0 m

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
"	29.50	29.95	0.45	DP	SX	20	31	34	65	–	–	–	–	–	–	Non cohesive soil
"	31.00	31.45	0.45	DP	"	22	34	34	68	–	–	–	–	–	–	do
"	32.50	32.95	0.45	DP	"	19	28	29	57	–	–	–	–	–	–	do
"	34.00	34.45	0.45	UD	"	slipped				–	–	–	–	–	–	do
[illegible]	35.50	35.95	0.45	DP	"	16	25	27	52	–	–	–	–	–	–	do
"	37.00	37.45	0.45	UD	"	slipped				–	–	–	–	–	–	do
"	38.50	38.95	0.45	DP	"	17	26	29	55	–	–	–	–	–	–	do
"	40.00	40.45	0.45	DP	"	20	28	31	59	–	–	–	–	–	–	do

Supervisor

Engineer - In - C

Techpro Engineers Pvt. Ltd.

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 13: FIELD BORELOG CHART (P47)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	G.T.I. for HORC Viaduct B/w Sohana Dhulawat station	Project Code:	1901
Coordinate:	N: 3113227.711 E: 701463.03	Location/ Chainage:	22147.2870
Method of Drilling:	Percussion; Drilling Equipment: Auto trip / Rotary winch	Bore No.:	P-47
Casing Lowered (M):	20.m; Bentonite Used: NO; Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L-191.466; Date: From 5/11/2023 to 8/11/2023	Water Table (M):	160.m

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
5/11/23	0.00	0.50	0.50	D	SX	Collected				—	—	—	—	—	—	Non cohesive soil
"	1.00	1.45	0.45	DP	—	1	1	1	2	—	—	—	—	—	—	— do —
"	2.00	2.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do —
"	3.00	3.45	0.45	DP	—	2	4	5	9	—	—	—	—	—	—	— do —
"	4.00	4.45	0.45	DP	—	4	5	6	11	—	—	—	—	—	—	— do —
"	5.00	5.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	6.00	6.45	0.45	DP	—	5	7	9	16	—	—	—	—	—	—	— do —
"	7.00	7.45	0.45	DP	—	5	10	11	21	—	—	—	—	—	—	— do —
"	8.00	8.45	0.45	U	—	Received				—	—	—	—	—	—	Non cohesive soil
"	9.00	9.45	0.45	DP	—	4	8	9	17	—	—	—	—	—	—	— do —
"	10.00	10.45	0.45	DP	—	5	8	11	19	—	—	—	—	—	—	— do —
6/11/23	11.00	11.45	0.45	U	—	Received				—	—	—	—	—	—	cohesive soil
"	12.50	12.95	0.45	DP	—	8	13	15	28	—	—	—	—	—	—	— do —
"	14.00	14.45	0.45	U	—	Slipped				—	—	—	—	—	—	Non cohesive soil
"	15.50	15.95	0.45	DP	—	5	9	11	20	—	—	—	—	—	—	— do —
"	17.00	17.45	0.45	U	—	Received				—	—	—	—	—	—	
7/11/23	18.50	18.95	0.45	DP	—	9	14	20	34	—	—	—	—	—	—	cohesive soil with gravel
"	20.00	20.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	21.50	21.95	0.45	DP	—	8	15	22	37	—	—	—	—	—	—	— do —
"	23.00	23.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	24.50	24.95	0.45	DP	—	12	22	30	52	—	—	—	—	—	—	— do —
"	26.00	26.45	0.45	DP	—	9	17	24	41	—	—	—	—	—	—	Non cohesive soil
"	27.50	27.95	0.45	DP	—	11	20	25	45	—	—	—	—	—	—	— do —
"	29.00	29.45	0.45	U	—	Received				—	—	—	—	—	—	— do —

Supervisor E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 14: FIELD BORELOG CHART (P47)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/003
		Date of Issue:	01.04.2018
		Rev. No:	R03
		Rev. Date:	28.12.2021

Project Name:	Const. for HORC Viaduct B/w Sohana Dhullawat Station			Project Code:	1901
Coordinate:	N: 3119227.711	E: 701463.103	Location/ Chainage: 22140.2270		
Method of Drilling:	Percussion	Drilling Equipment	Auto trip Winch	Bore No.:	P 47
Casing Lowered (M):	20.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	RL-191.466	Date: From 5/11/2023 to 5/11/2023		Water Table (M):	160.00

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
11	30.50	30.95	0.45	DP	SX	13	22	26	48	–	–	–	–	–	–	Non cohesive soil
11	32.00	32.45	0.45	U	–	Slipped				–	–	–	–	–	–	-do-
11	33.50	33.95	0.45	DP	–	15	24	27	51	–	–	–	–	–	–	-do-
11	35.00	35.45	0.45	U	–	Slipped				–	–	–	–	–	–	-do-
[illegible]	36.50	36.95	0.45	DP	–	16	28	32	60	–	–	–	–	–	–	-do-
11	38.00	38.45	0.45	DP	–	18	25	31	56	–	–	–	–	–	–	-do-
11	40.00	40.45	0.45	DP	–	21	29	33	62	–	–	–	–	–	–	Non cohesive soil

Supervisor

Engineer-C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 15: FIELD BORELOG CHART (P48)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/003
		Date of Issue:	01.04.2018
		Rev. No.:	R05
		Rev. Date:	28.12.2021

Project Name:	HRIDC-HORC Viaduct b/w Sohana Dhulawat Station	Project Code:	1901
Coordinate:	N: 3119844.143 E: 701448.481	Location/ Chainage:	29173.4870
Method of Drilling:	Percussion	Drilling Equipment:	Auto/Tripod/Winch
Casing Lowered (M): 16.00	Bentonite Used: NO	Standard Sampler: Yes	Bore No.: P48
Ground Elevation:	261.215	Date: From 12/10/23 to 15/10/23	Barrel Type: N/A
		Water Table (M):	1.70

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
12/10/23	0.00	0.50	0.50	DS	SX	collected										Non-cohesive soil
"	1.00	1.45	0.45	DP	"	1	1	2	3							—do—
"	2.00	2.45	0.45	U	"	Received										—do—
"	3.00	3.45	0.45	DP	"	3	5	6	11							—do—
"	4.00	4.45	0.45	DP	"	3	5	7	12							—do—
"	5.00	5.45	0.45	U	"	slipped										—do— DS collected
13/10/23	6.00	6.45	0.45	DP	"	3	4	6	10							Non-cohesive soil
"	7.00	7.45	0.45	DP	"	4	5	7	12							—do—
"	8.00	8.45	0.45	U	"	slipped										—do—
"	9.00	9.45	0.45	DP	"	3	4	5	9							—do—
"	10.00	10.45	0.45	DP	"	3	6	7	13							Cohesive soil with Kankar
"	11.00	11.45	0.45	U	"	Received										—do—
"	12.00	12.45	0.45	DP	"	8	14	17	31							—do—
"	14.00	14.45	0.45	U	"	Received										—do—
"	15.50	15.95	0.45	DP	"	6	12	15	27							—do—
"	17.00	17.45	0.45	U	"	Received										—do—
14/10/23	18.50	18.95	0.45	DP	"	8	17	19	36							—do—
"	20.00	20.45	0.45	U	"	Received										—do—
"	21.50	21.95	0.45	DP	"	12	20	25	45							Non-cohesive soil with Gravel
"	23.00	23.45	0.45	U	"	slipped										—do—
"	24.50	24.95	0.45	DP	"	9	18	27	45							—do—
"	26.00	26.45	0.45	U	"	Received										—do—
"	27.50	27.95	0.45	DP	"	8	21	29	50							Non-cohesive soil with Gravel
"	29.00	29.45	0.45	U	"	slipped										—do— DS collected

Nitesh

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 16: FIELD BORELOG CHART (P48)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No	GT/ 005
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N:3119244.143	E: 701442.481	Location/ Chainage: 29173.4870		
Method of Drilling:	Percussion	Drilling Equipment	Automatic Powerwinch	Bore No.:	P48
Casing Lowered (M):	18.00	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	RL-191.215	Date: From 13/11/23 to 15/11/23		Water Table (M):	1.70

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
14/11/23	30.50	30.95	0.45	DP	SX	10	20	31	51							Non-cohesive soil with Gravel
"	32.00	32.45	0.45	U	"	slipped										-do- D.S collected
"	33.50	33.95	0.45	DP	"	11	23	33	56							Non-cohesive soil with Gravel
15/11/23	35.00	35.45	0.45	U	"	slipped										Non-cohesive soil
"	36.50	36.95	0.45	DP	"	12	25	30	55							-do-
"	38.00	38.45	0.45	U	"	slipped										-do-
"	40.00	40.45	0.45	DP	"	13	27	36	63							-do-

Nitesh
Supervisor

Techpro Engineers Pvt. Ltd.

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100). Sampler means SPT sampler

APPENDIX-K
CHART 17: FIELD BORELOG CHART (P49)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	CT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R02
		Rev. Date:	28.12.2021

Project Name:	GTK-HORC Viaduct b/w Sohana Dhulawat Station	Project Code:	1901
Coordinate: N:3119961.003	E:701422.282	Location/ Chainage:	99199.6830
Method of Drilling:	Percussion	Drilling Equipment: Auxiliary Equipment	Bore No.: P49
Casing Lowered (M): 19.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type: N/A
Ground Elevation:	RL-191.349	Date: From 18/10/23 to 20/10/23	Water Table (M): 1.80

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
18/10/23	0.00	0.50	0.50	D.S	6X	collected										Non-cohesive soil
"	1.00	1.45	0.45	DP	"	1	2	3	5							— do —
"	2.00	2.45	0.45	U	"	slipped										-do- DS collected
"	3.00	3.45	0.45	DP	"	2	3	5	8							Non-cohesive soil
"	4.00	4.45	0.45	DP	"	3	5	7	12							— do —
"	5.00	5.45	0.45	U	"	slipped										-do- DS collected
"	6.00	6.45	0.45	DP	"	3	6	8	14							Non-cohesive soil
"	7.00	7.45	0.45	DP	"	5	6	7	13							— do —
"	8.00	8.45	0.45	U	"	slipped										-do- DS collected
"	9.00	9.45	0.45	DP	"	4	4	5	9							Non-cohesive soil
"	10.00	10.45	0.45	DP	"	5	8	15	23							— do —
"	11.00	11.45	0.45	U	"	Received										Non-cohesive soil with gravel
"	12.50	12.95	0.45	DP	"	6	7	14	21							cohesive soil
"	14.00	14.45	0.45	U	"	Received										— do —
19/10/23	15.50	15.95	0.45	DP	"	5	7	10	17							— do —
"	17.00	17.45	0.45	U	"	Received										Cohesive soil with gravel
"	18.50	18.95	0.45	DP	"	7	11	15	26							— do —
"	20.00	20.45	0.45	U	"	Received										— do —
"	21.50	21.95	0.45	DP	"	10	19	22	41							— do —
"	23.00	23.45	0.45	U	"	Received										— do —
"	24.50	24.95	0.45	DP	"	10	17	27	44							— do —
"	26.00	26.45	0.45	U	"	slipped										-do- DS collected
"	27.50	27.95	0.45	DP	"	9	15	28	43							Cohesive soil with gravel
"	29.00	29.45	0.45	U	"	Received										— do —

Supervisor

Abbreviation Used: U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

E - in - C

APPENDIX-K
CHART 18: FIELD BORELOG CHART (P49)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No.	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.	R03
		Rev. Date.:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat station	Project Code:	1901
Coordinate:	N: 3119961.003 E: 701499.288	Location/ Chainage:	32199.6870
Method of Drilling:	Percussion	Drilling Equipment:	Auto trip Power winch
Casing Lowered (M):	18.00 Bentonite Used: NO	Standard Sampler:	Yes
Bore No.:	P49	Barrel Type:	N/A
Ground Elevation:	R.L-191.349	Date: From	19/10/23 to 20/10/23
Water Table (M):	1.80		

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
19/10/23	30.50	30.95	0.45	DP	SX	10	16	26	42							Non-cohesive soil
"	32.00	32.45	0.45	U	"	Received										— do —
"	33.50	33.95	0.45	DP	"	12	18	28	46							— do —
"	35.00	35.45	0.45	U	"	slipped										-do- DS collected
20/10/23	36.50	36.95	0.45	DP	"	14	19	30	49							Non-cohesive soil
"	38.00	38.45	0.45	U	"	slipped										-do- DS collected
"	40.00	40.45	0.45	DP	"	16	22	33	55							Non-cohesive soil

Nilesh
Supervisor

Techpro Engineers Pvt. Ltd.

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

E-in-C

APPENDIX-K
CHART 19: FIELD BORELOG CHART (P50)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat stations	Project Code:	1901
Coordinate:	N:3119278.301 E:701463.424	Location/ Chainage:	28295-8870
Method of Drilling:	Percussion	Drilling Equipment:	Rotary/Percussion
Casing Lowered (M):	16.00	Bentonite Used:	NO
Standard Sampler:	Yes	Bore No.:	P50
Barrel Type:	N/A	Ground Elevation:	R.L-191.295
Date: From	15/10/23 to 17/10/23	Water Table (M):	1.60

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
15/10/23	0.00	0.50	0.50	D.S	SX	collected										Non-cohesive soil
"	1.00	1.45	0.45	U	"	Received										Non-cohesive soil with Gravel
"	2.00	2.45	0.45	DP	"	1	1	2	3							— do —
"	3.00	3.45	0.45	DP	"	2	3	4	7							— do —
"	4.00	4.45	0.45	U	"	slipped										— do — DS collected
"	5.00	5.45	0.45	DP	"	4	6	8	14							Non-cohesive soil
"	6.00	6.45	0.45	DP	"	5	7	9	16							— do —
"	7.00	7.45	0.45	U	"	slipped										— do —
"	8.00	8.45	0.45	DP	"	7	9	13	22							— do —
"	9.00	9.45	0.45	DP	"	7	10	15	25							— do —
"	10.00	10.45	0.45	U	"	Received										— do —
"	11.00	11.45	0.45	DP	"	5	9	15	24							— do —
"	12.00	12.45	0.45	DP	"	7	13	17	30							— do —
"	13.00	13.45	0.45	U	"	Received										Cohesive soil with Gravel
"	14.50	14.95	0.45	DP	"	6	9	12	21							Cohesive soil with Gravel
"	16.00	16.45	0.45	U	"	Received										— do —
"	17.50	17.95	0.45	DP	"	5	10	13	23							— do —
"	19.00	19.45	0.45	U	"	Received										— do —
"	20.50	20.95	0.45	DP	"	4	8	14	22							— do —
"	22.00	22.45	0.45	U	"	slipped										— do — DS collected
16/10	23.50	23.95	0.45	DP	"	6	11	17	28							Cohesive soil with Gravel
23	25.00	25.45	0.45	U	"	slipped										— do — DS collected
"	26.50	26.95	0.45	DP	"	13	19	28	47							Cohesive soil with Gravel
"	28.00	28.45	0.45	U	"	slipped										— do — DS collected

Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 20: FIELD BORELOG CHART (P50)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119348.301	E: 701403.424	Location/ Chainage: 32295.8870		
Method of Drilling:	Percussion	Drilling Equipment:	Auto Trip / Motor Winch	Bore No.:	P50
Casing Lowered (M):	15.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	RL-191.295	Date: From 16/11/23 to 18/11/23		Water Table (M):	1.60

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C.R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
17/11/23	29.50	29.95	0.45	DP	SX	11	20	23	43							Cohesive soil with gravel
"	31.00	31.45	0.45	U	"	Recovered										— do —
"	32.50	32.95	0.45	DP	"	12	28	22	50							— do —
"	34.00	34.45	0.45	U	"	slipped										-do- no collected
18/11/23	35.50	35.95	0.45	DP	"	11	20	25	45							Non-cohesive soil
"	37.00	37.45	0.45	U	"	slipped										-do- no collected
"	38.50	38.95	0.45	DP	"	14	21	27	48							Non-cohesive soil
"	40.00	40.45	0.45	DP	"	17	25	31	56							— do —

Nitesh
Supervisor

Techpro Engineers Pvt. Ltd.

E-in-C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 21: FIELD BORELOG CHART (P51)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/003
		Date of Issue:	01.04.2018
		Rev. No:	003
		Rev. Date:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat Station	Project Code:	1901
Coordinate:	N: 3119295.948 E: 701383.032	Location/ Chainage:	38352.0870
Method of Drilling:	Percussion	Drilling Equipment: [illegible]	Bore No.: P51
Casing Lowered (M): 26.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type: N/A
Ground Elevation:	R.L-191.297	Date: From 20/10/23 to 23/10/23	Water Table (M): 1.60

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
20/10/23	0.00	0.50	0.50	DS	SX	collected										Non-cohesive soil
"	1.00	1.45	0.45	U	"	slipped										-do- DS collected
"	2.00	2.45	0.45	DP	"	1	2	3	5							Non-cohesive soil
"	3.00	3.45	0.45	DP	"	2	2	4	6							—do—
"	4.00	4.45	0.45	U	"	slipped										-do- DS collected
"	5.00	5.45	0.45	DP	"	3	5	7	12							Non-cohesive soil
"	6.00	6.45	0.45	DP	"	3	6	8	14							—do—
"	7.00	7.45	0.45	U	"	slipped										-do- DS collected
"	8.00	8.45	0.45	DP	"	6	9	12	21							Non-cohesive soil
"	9.00	9.45	0.45	DP	"	10	13	17	30							—do—
"	10.00	10.45	0.45	U	"	Received										Non-cohesive soil with gravel
"	11.00	11.45	0.45	DP	"	5	9	15	22							cohesive soil with gravel
"	12.00	12.45	0.45	DP	"	4	8	15	23							—do—
"	13.00	13.45	0.45	U	"	Received										—do—
"	14.50	14.95	0.45	DP	"	9	14	16	30							—do—
20/10	16.00	16.45	0.45	U	"	Received										—do—
21/10/23	17.50	17.95	0.45	DP	"	6	9	14	23							—do—
22/10/23	19.00	19.45	0.45	U	"	Received										Non-cohesive soil
"	20.50	20.95	0.45	DP	"	6	8	13	21							—do—
"	22.00	22.45	0.45	U	"	slipped										-do- DS collected
"	23.50	23.95	0.45	DP	"	10	15	20	35							Non-cohesive soil with gravel
"	25.00	25.45	0.45	U	"	slipped										Non-cohesive soil
"	26.50	26.95	0.45	DP	"	12	17	22	39							—do—
"	28.00	28.45	0.45	U	"	Received										—do—

Nitesh
Supervisor

Techpro Engineers Pvt. Ltd.

E-in-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Value (N) > 100), Sampler means SPT sampler

APPENDIX-K

CHART 22: FIELD BORELOG CHART (P51)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No.	GT/003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name: GTW-HORC Viaduct b/w Sohana Dhulawat station		Project Code:	1901
Coordinate: N: 3119995.948	E: 701383.032	Location/ Chainage:	99959.0870
Method of Drilling: Percussion	Drilling Equipment: Auto tripod/ Power winch	Bore No.:	P51
Casing Lowered (M): 9.1m; Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation: R.L-191.293	Date: From 20/10/22 to 22/10/22	Water Table (M):	1.60

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
21/10/22	29.50	29.95	0.45	DP	SX	14	20	26	46							Non-cohesive soil
"	31.00	31.45	0.45	U	"	slipped										-do- DS collected
"	32.50	32.95	0.45	DP	"	16	22	29	51							Non-cohesive soil
22/10/22	34.00	34.45	0.45	U	"	Received										-do-
"	35.50	35.95	0.45	DP	"	16	24	26	50							-do-
"	37.00	37.45	0.45	U	"	slipped										-do- DS collected
"	38.50	38.95	0.45	DP	"	18	27	30	57							Non-cohesive soil
"	40.00	40.45	0.45	DP	"	20	29	33	62							-do-

Nitesh
Supervisor

Techpro Engineers Pvt. Ltd. Gurugram

E-in-C

Abbreviation Used: U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 23: FIELD BORELOG CHART (P52)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R(I)G
		Rev. Date:	28.12.2021

Project Name:	GTW for HORC Viaduct B/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119311.08	E: 701363.889	Location/ Chainage: 32278.2870		
Method of Drilling:	Percussion	Drilling Equipment	Automatic Rig/winch	Bore No.:	P. 52
Casing Lowered (M):	18.00 / Bentonite Used: NO	Standard Sampler :	Yes	Barrel Type :	NA
Ground Elevation:	RL - 191.238	Date: From 5/11/22 to 7/11/22		Water Table (M):	1.50

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
5/11/22	0.0	0.50	0.50	DS	8x	Collected										Non Cohesive Soil
"	1.00	1.45	0.45	U	"	Received										do
"	2.00	2.45	0.45	DP	"	2	3	3	6							do
"	3.00	3.45	0.45	DP	"	2	4	5	9							do
"	4.00	4.45	0.45	U	"	Received										do
"	5.00	5.45	0.45	DP	"	3	4	6	10							do
"	6.00	6.45	0.45	DP	"	6	5	7	12							do
"	7.00	7.45	0.45	U	"	Received										do
"	8.00	8.45	0.45	DP	"	4	5	7	12							Non Cohesive Soil
"	9.00	9.45	0.45	DP	"	4	6	8	14							with gravel
"	10.00	10.45	0.45	U	"	Received										do
"	11.00	11.45	0.45	DP	"	3	5	8	13							Non Cohesive Soil
"	12.00	12.45	0.45	DP	"	4	6	9	15							do
"	13.00	13.45	0.45	U	"	Received										do
"	14.50	14.95	0.45	DP	"	8	11	13	24							do
"	16.00	16.45	0.45	U	"	Received										do
6/11/22	17.50	17.95	0.45	DP	"	6	10	12	22							do
"	19.00	19.45	0.45	U	"	Received										do
"	20.50	20.95	0.45	DP	"	8	15	18	33							do
"	22.00	22.45	0.45	U	"	Received										do
"	23.50	23.95	0.45	DP	"	8	14	19	33							Non Cohesive Soil
"	25.00	25.45	0.45	U	"	Slipped										with gravel
"	26.50	26.95	0.45	DP	"	18	24	33	57							Cohesive Soil with gravel
"	28.00	28.45	0.45	DP	"	15	20	32	52							Non Cohesive Soil

Supervisor Lakhvinder

E - In - C

Abbreviation used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N>50)), Sampler means SPT sampler

APPENDIX-K
CHART 24: FIELD BORELOG CHART (P52)

TECHPRO ENGINEERS PVT. LTD. | **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date.:	28.12.2021

Project Name:	GTO FOR HORC Viaduct B/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119314.68	E: 701363.869	Location/ Chainage: 32278.3670		
Method of Drilling:	Percussion	Drilling Equipment:	Auto-trip Power winch	Bore No.:	P.52
Casing Lowered (M):	18.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L-191.238	Date: From 5/11/23 to 7/11/23		Water Table (M):	1.50

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
6/11/23	29.50	29.95	0.45	DP	9K	12	27	32	59							Non Cohesive soil
"	31.00	31.45	0.45	DP		17	26	50	76							Non Cohesive Soil
7/11/23	32.50	32.95	0.45	DP		18	25	35	60							with Gravel
"	34.00	34.45	0.45	DP		17	30	32	62							-do-
"	35.50	35.95	0.45	DP		15	28	33	61							-do-
"	37.00	37.45	0.45	DP		14	23	38	61							-do-
"	38.50	38.95	0.45	DP		17	26	32	58							do
"	40.00	40.45	0.45	DP		18	30	35	65							-do-
																do

Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K

CHART 25: FIELD BORELOG CHART (P53)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev No:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW FOR HORC Viaduct B/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119332.567	E: 701345.19		Location/ Chainage:	92304.4830
Method of Drilling:	Percussion	Drilling Equipment	Manual Power winch	Bore No.:	P.53
Casing Lowered (M):	18.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L-192.654	Date: From 5/11/23	to 8/11/23	Water Table (M):	1.00

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
5/11/23	0.0	0.50	0.50	DS	SX	Collected										Non Cohesive Soil
	1.00	1.45	0.45	UD	"	Received										do
	2.00	2.45	0.45	DP	"	3	3	3	6							do
	3.00	3.45	0.45	DP	"	2	3	4	7							do
	4.00	4.45	0.45	U	"	Received										do
	5.00	5.45	0.45	DP	"	3	4	6	10							do
	6.00	6.45	0.45	DP	"	3	5	8	13							do
	7.00	7.45	0.45	U	"	Slipped										Non Cohesive Soil
	8.00	8.45	0.45	DP	"	8	12	16	28							do
	9.00	9.45	0.45	DP	"	6	9	14	23							Cohesive soil with gravel
	10.00	10.45	0.45	U	"	Received										do
	11.00	11.45	0.45	DP	"	10	17	20	37							do
	12.00	12.45	0.45	DP	"	8	15	18	33							do
	13.00	13.45	0.45	U	"	Received										do
	14.50	14.95	0.45	DP	"	7	12	21	33							do
	16.00	16.45	0.45	U	"	Received										do
	17.50	17.95	0.45	DP	"	11	14	19	33							Non Cohesive Soil -
	19.00	19.45	0.45	U	"	Received										with gravel
6/11/23	20.50	20.95	0.45	DP	"	14	20	25	45							Non Cohesive Soil
	22.00	22.45	0.45	U	"	Received										do.
	23.50	23.95	0.45	DP	"	20	28	32	60							Non Cohesive Soil.
7/11/23	25.00	25.45	0.45	DP	"	12	18	22	40							do - with Gravel
	26.50	26.95	0.45	DP	"	16	15	20	35							do
	28.00	28.45	0.45	U	"	Received.										Cohesive Soil

Supervisor [signature] Techpro Engineers Pvt. Ltd. [stamp] [signature] E - In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 26: FIELD BORELOG CHART (P53)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GI for HORC Viaduct b/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119332.567	E: 701345.19	Location/ Chainage: 82304.4870		
Method of Drilling:	Percussion	Drilling Equipment	Manual Power winch	Bore No.:	P.53
Casing Lowered (M):	16.00	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	RL-192.654	Date: From 5/11/23	to 8/11/23	Water Table (M):	1.40

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
7/11/23	29.50	29.95	0.45	DP	SW	8	22	28	50							Non Cohesive Soil
"	31.00	31.45	0.45	U	"	9	Lifted	/	-							-do-
"	32.50	32.95	0.45	DP	"	18	28	32	60							Non Cohesive Soil
"	34.00	34.45	0.45	DP	"	20	28	35	63							-do- with Gravel
"	35.50	35.95	0.45	DP	"	25	32	40	72							-do-
8/11/23	37.00	37.45	0.45	DP	"	20	28	32	60							-do-
"	38.50	38.95	0.45	DP	"	18	23	35	58							-do-
"	40.00	40.45	0.45	DP	"	21	32	35	67							-do-

Supervisor: Lakhan yadav

Techpro Engineers Pvt. Ltd.

E-in-C

Abbreviation Used:- U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (Nvalue>50), Sampler means SPT sampler

APPENDIX-K
CHART 27: FIELD BORELOG CHART (P54)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No:	R03
Rev. Date:	21.12.2021

Project Name:	Geotech HORC viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3110351.461	E: 701326.868	Location/ Chainage: 22336.870		
Method of Drilling:	Percussion	Drilling Equipment:	Power winch	Bore No.:	P 54
Casing Lowered (M):	20.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L - 191.243	Date: From 12/10/23 to 14/10/23		Water Table (M):	1.20 M

Day Date	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	Run Time End	C.R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
12/10/23	0.0	0.50	0.50	DS	SX	Received			-							Non cohesive soil
"	1.00	1.45	0.45	U	"	Slipped			-							— do —
"	2.00	2.45	0.45	DP	"	1	2	3	5							— do —
"	3.00	3.45	0.45	DP	"	2	3	4	7							— do —
"	4.00	4.45	0.45	U	"	Slipped			-							— do —
"	5.00	5.45	0.45	DP	"	2	3	6	9							— do —
"	6.00	6.45	0.45	DP	"	4	7	8	15							— do —
"	7.00	7.45	0.45	U	"	Slipped			-							— do —
"	8.00	8.45	0.45	DP	"	4	10	11	21							— do —
"	9.00	9.45	0.45	DP	"	5	11	12	23							Non cohesive soil
"	10.00	10.45	0.45	U	"	Received			-							— do —
"	11.00	11.45	0.45	DP	"	5	8	13	21							— do —
"	12.00	12.45	0.45	DP	"	4	7	12	19							— do —
"	13.00	13.45	0.45	U	"	Received										cohesive soil
"	14.00	14.45	0.45	DP	"	5	7	15	22							— do —
"	16.00	16.45	0.45	U	"	Received			-							— do —
"	17.50	17.95	0.45	DP	"	9	13	21	34							— do —
13/10/23	19.00	19.45	0.45	U	"	Slipped										Non cohesive soil
"	20.50	20.95	0.45	DP	"	8	16	20	36							— do —
"	22.00	22.45	0.45	U	"	Slipped			-							— do —
"	23.50	23.95	0.45	DP	"	7	17	26	43							— do —
"	25.00	25.45	0.45	U	"	Received										— do —
"	26.50	26.95	0.45	DP	"	15	19	20	34							— do —
"	28.00	28.45	0.45	U	"	Received			-							— do —

Supervisor

E - In - C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 28: FIELD BORELOG CHARTS (P54)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	QT/003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date:	28.12.2021

Project Name:	GTW for HORC Viaduct Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119351.461	E: 701326.060	Location/ Chainage: 59336.1870		
Method of Drilling:	Percussion	Drilling Equipment: Percussion rig		Bore No.:	P54
Casing Lowered (M):	30.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-191.242	Date: From 13/10/23 to 14/10/23		Water Table (M):	1.20 M

Day / Date	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
13/10/23	29.50	29.95	0.45	DP	SV	12	16	22	38							Non cohesive soil with gravel
"	31.00	31.45	0.45	U	"	Slipped			–							
"	32.50	32.95	0.45	DP	"	14	18	26	44							– do –
"	34.00	34.45	0.45	U	"	Slipped			–							– do –
"	35.50	35.95	0.45	DP	"	16	19	28	47							– do –
14/10/23	37.00	37.45	0.45	U	"	Slipped			–							– do –
"	38.50	38.95	0.45	DP	"	18	23	32	55							– do –
"	40.00	40.45	0.45	DP	"	17	24	36	60							– do –

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 29: FIELD BORELOG CHART (P55)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	ENG/ 003
		Date of Issue:	01.04.2018
		Rev. No:	003
		Rev. Date:	28.12.2021

Project Name:	GITW FOR HORC Viaduct B/W Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119310.319	E: 701308.964	Location/ Chainage: 92356.8870		
Method of Drilling:	Percussion	Drilling Equipment	Automated Power winch	Bore No.:	P.55
Casing Lowered (M):	24.00	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	RL-191.309	Date: From 3/11/23 to 6/11/23		Water Table (M):	1.40

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
3-11/23	0.00	0.50	0.50	DS	150	Collected-										Non Cohesive Soil
"	1.00	1.45	0.45	U	"	Received										do
"	2.00	2.45	0.45	DP	"	2	3	5	8							do
"	3.00	3.45	0.45	DP	"	2	3	3	6							do
4-11/23	4.00	4.45	0.45	U	"	Received										Non Cohesive Soil
"	5.00	5.45	0.45	DP	"	3	5	6	11							do
"	6.00	6.45	0.45	DP	"	3	5	8	13							do
"	7.00	7.45	0.45	U	"	Slipped										do
"	8.00	8.45	0.45	DP	"	5	6	9	15							Non Cohesive Soil
"	9.00	9.45	0.45	DP	"	4	6	8	14							do with gravel
"	10.00	10.45	0.45	U	"	Received-										Cohesive soil with gravel
"	11.00	11.45	0.45	DP	"	5	7	9	16							do
"	12.00	12.45	0.45	DP	"	6	8	11	19							do
"	13.00	13.45	0.45	U	"	Received-										Non Cohesive Soil
"	14.50	14.95	0.45	DP	"	8	12	17	29							do
"	16.00	16.45	0.45	U	"	Received-										Non Cohesive Soil
"	17.50	17.95	0.45	DP	"	5	13	19	32							do with gravel
"	19.00	19.45	0.45	U	"	Received										do
"	20.50	20.95	0.45	DP	"	11	17	22	39							do
"	22.00	22.45	0.45	U	"	Received-										Non Cohesive Soil
"	23.50	23.95	0.45	DP	"	12	18	25	43							Cohesive soil with gravel
5-11/23	25.00	25.45	0.45	U	"	Received										do
"	26.50	26.95	0.45	DP	"	18	22	32	54							do
"	28.00	28.45	0.45	DP	"	16	18	35	53							do

Supervisor Lalit Yadav

E-In-C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N>100), Sampler means SPT sampler

APPENDIX-K
CHART 30: FIELD BORELOG CHART (P55)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	OT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name: GTW FOR HORC Viaduct B/W Sohana Dhulawat Station				Project Code:	1901
Coordinate:	N: 3119370.719	E: 701308.964	Location/ Chainage: 92256.8870		
Method of Drilling:	Percussion	Drilling Equipment:	Auto trip Powerwinch	Bore No.:	P-55
Casing Lowered (M): 32.00	Bentonite Used: NO	Standard Sampler:	Yes	Barrel Type:	NA
Ground Elevation:	RL-191.309	Date: From 3/11/23	to 6/11/23	Water Table (M):	1.40

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C.R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
5/11/23	29.50	29.95	0.45	DP	SX	14	24	32	56							Cohesive soil with gravel
〃	31.00	31.45	0.45	DP	〃	16	25	32	57							do
〃	32.50	32.95	0.45	DP	〃	18	22	35	57							do
〃	34.00	34.45	0.45	U/DP	〃	21	28	36	64							do
〃	35.50	35.95	0.45	DP	〃	20	31	38	69							do
6/11/23	37.00	37.45	0.45	U/DP	〃	25	32	36	68							Non Cohesive soil with gravel
〃	38.50	38.95	0.45	DP	〃	26	31	38	69							do
〃	40.00	40.45	0.45	DP	〃	32	36	42	78							do

Techpro Engineers Pvt. Ltd.

Supervisor [signature]

E-in-C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test >100 blows), Sampler means SPT sampler

APPENDIX-K
CHART 31: FIELD BORELOG CHART (P56)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW For HORC Viaduct Btw Sohana Dhulawat Station	Project Code:	1901
Coordinate:	N: 3119290·395 E: 7601291·429	Location/ Chainage:	52383·0870
Method of Drilling:	Percussion; Drilling Equipment: manual Boring winch	Bore No.:	P.56
Casing Lowered (M):	18·00; Bentonite Used: NO; Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L-191·784; Date: From 3/11/23 to 5/11/23	Water Table (M):	1·40

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
3/11/23	0·00	0·50	0·50	DS	SX	Collected				-						Non Cohesive Soil
	1·00	1·45	0·45	U	"	Received										-do-
	2·00	2·45	0·45	DP	"	2	2	2	4							-do-
	3·00	3·45	0·45	DP	"	2	3	5	8							-do-
	4·00	4·45	0·45	U	"	Received										-do-
	5·00	5·45	0·45	DP	"	3	5	4	9							-do-
	6·00	6·45	0·45	DP	"	2	4	4	8							-do-
	7·00	7·45	0·45	U	"	Received										-do-
	8·00	8·45	0·45	DP	"	3	5	7	12							Cohesive Soil with gravel
	9·00	9·45	0·45	DP	"	4	6	8	14							-do-
	10·00	10·45	0·45	U	"	Received										-do-
	11·00	11·45	0·45	DP	"	3	5	7	12							Non Cohesive Soil
	12·00	12·45	0·45	DP	"	4	6	8	14							-do-
	13·00	13·45	0·45	U	"	Received										-do-
	14·50	14·95	0·45	DP	"	9	17	24	41							-do-
	16·00	16·45	0·45	U	"	Received										-do-
	17·50	17·95	0·45	DP	"	8	15	22	37							-do-
	19·00	19·45	0·45	U	"	Received										-do-
	20·50	20·95	0·45	DP	"	12	17	25	42							-do-
	22·00	22·45	0·45	U	"	Received										-do-
4/11/23	23·50	23·95	0·45	DP	"	15	21	27	48							-do-
	25·00	25·45	0·45	U	"	Slipped										do
	26·50	26·95	0·45	DP	"	12	22	42	64							Non Cohesive Soil with gravel
	28·00	28·45	0·45	DP	"	11	21	32	53							

Supervisor tablas yadav

Techpro Engineers Pvt. Ltd.

GE-in-C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test N > 100), Sampler means SPT sampler

APPENDIX-K
CHART 32: FIELD BORELOG CHART (P56)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date.:	28.12.2021

Project Name:	GTWO HORC Viaduct B/W Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119390.395	E: 7001291.429	Location/ Chainage: 82385.6870		
Method of Drilling:	Percussion	Drilling Equipment	Manual Boreworth	Bore No.:	P.56
Casing Lowered (M):	16.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L-191.385	Date: From 3/11/23 to 5/11/23		Water Table (M):	1.40

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
4/11/23	29.50	29.95	0.45	DP	3"	8	19	21	40							Non Cohesive Soil
"	31.00	31.45	0.45	U	"	3 U/P Recd										with gravel
"	32.50	32.95	0.45	DP	"	18	27	32	59							Cohesive ~~do~~ soil
"	34.00	34.45	0.45	DP	"	17	26	31	57							-do-
"	35.50	35.95	0.45	DP	"	16	30	35	65							-do-
5/11/23	37.00	37.45	0.45	DP	"	18	25	32	57							-do-
"	38.50	38.95	0.45	DP	"	19	32	35	67							-do-
"	40.00	40.45	0.45	DP	"	17	23	32	55							-do-

Supervisor: lalderwadom

Abbreviation Used: U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test N>100), Sampler means SPT sampler

Techpro Engineers Pvt. Ltd. Raipur

APPENDIX-K
CHART 33: FIELD BORELOG CHART (P57)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No: GT/ 003 Date of Issue: 01.04.2018 Rev. No.: R03 Rev. Date.: 28.12.2021

Project Name:	Crnw.vor HORC Viaduct B\w Sohana Dhulawat Station	Project Code:	1901
Coordinate:	N: 3119410.368 E: 701274.37	Location/ Chainage:	22409.2870
Method of Drilling:	Percussion	Drilling Equipment:	Auger/Power winch
Bore No.:	P-57		
Casing Lowered (M):	20.m Bentonite Used: No	Standard Sampler:	Yes
Barrel Type:	N/A		
Ground Elevation:	R.L-191.353	Date: From	31/10/2023 to 02/11/2023
Water Table (M):	1.20.m		

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
31/10/23	00	0.50	0.50	D	SX	Collected				—	—	—	—	—	—	Non cohesive soil
"	1.00	1.45	0.45	U	—	Received				—	—	—	—	—	—	Non cohesive soil with gravel
"	2.00	2.45	0.45	DP	—	1	1	2	3	—	—	—	—	—	—	— do —
"	3.00	3.45	0.45	DP	—	1	2	2	4	—	—	—	—	—	—	Non cohesive soil
"	4.00	4.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do — DS collected
"	5.00	5.45	0.45	DP	—	2	3	6	9	—	—	—	—	—	—	Non cohesive soil
"	6.00	6.45	0.45	DP	—	3	5	7	12	—	—	—	—	—	—	— do —
"	7.00	7.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do — DS collected
"	8.00	8.45	0.45	DP	—	5	7	10	17	—	—	—	—	—	—	Non cohesive soil
"	9.00	9.45	0.45	DP	—	5	8	12	20	—	—	—	—	—	—	cohesive soil with gravel
"	10.00	10.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	11.00	11.45	0.45	DP	—	7	9	10	19	—	—	—	—	—	—	Cohesive soil
"	12.00	12.45	0.45	DP	—	5	9	12	21	—	—	—	—	—	—	— do —
"	13.00	13.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	14.50	14.95	0.45	DP	—	8	13	18	31	—	—	—	—	—	—	— do —
"	16.00	16.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	17.50	17.95	0.45	DP	—	9	15	21	36	—	—	—	—	—	—	— do —
"	19.00	19.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	20.50	20.95	0.45	DP	—	7	16	21	37	—	—	—	—	—	—	cohesive soil with gravel
"	22.50	22.95	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	23.50	23.95	0.45	DP	—	10	19	23	42	—	—	—	—	—	—	— do —
2/11/23	25.00	25.45	0.45	U	—	Slipped				—	—	—	—	—	—	Non cohesive soil
"	26.50	26.95	0.45	DP	—	14	28	30	58	—	—	—	—	—	—	Non cohesive soil
"	28.00	28.45	0.45	DP	—	13	27	33	60	—	—	—	—	—	—	Cohesive Soil

Supervisor E - In - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 34: FIELD BORELOG CHART (P57)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	OT/001
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	Const. for HORC Viaduct B/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119910.368	E: 701274.37	Location/ Chainage: 22909.287		
Method of Drilling:	Percussion	Drilling Equipment:	Auger/Percussion	Bore No.:	P.57
Casing Lowered (M):	20.m	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-191.353	Date: From 31/10/2023 to 7/11/2023		Water Table (M):	1.80 m

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT 0-15cm	SPT 15-30cm	SPT 30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
3/11/23	29.50	29.95	0.45	DP	SX	16	27	32	61	—	—	—	—	—	—	cohesive soil
〃	31.00	31.45	0.45	DP	—	14	26	30	56	—	—	—	—	—	—	— do —
〃	32.50	32.95	0.45	DP	—	15	27	31	58	—	—	—	—	—	—	— do —
〃	34.00	34.45	0.45	U	—	Slipped				—	—	—	—	—	—	Non cohesive soil
〃	35.50	35.95	0.45	DP	—	15	25	27	52	—	—	—	—	—	—	— do —
〃	37.00	37.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do —
7/11/23	38.50	38.95	0.45	DP	—	13	24	25	49	—	—	—	—	—	—	— do —
〃	40.00	40.45	0.45	DP	—	16	23	27	50	—	—	—	—	—	—	Non cohesive soil

Supervisor

E-In-G

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 35: FIELD BORELOG CHART (P58)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW for HORC Viaduct B/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119430.7.29	E: 701257.706	Location/ Chainage: 22435.0870		
Method of Drilling:	Percussion	Drilling Equipment: Auto/Tripod Power Winch		Bore No.:	P-58
Casing Lowered (M):	20 m	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	RL-191.433	Date: From 24/11/2023 to 5/1/2023		Water Table (M):	1.40 m

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
[illegible]	0.0	0.50	0.50	D	SX	Collected				-	-	-	-	-	-	Non cohesive soil
''	1.00	1.45	0.45	DP	-	1	1	1	2	-	-	-	-	-	-	— do —
''	2.00	2.45	0.45	U	-	Received				-	-	-	-	-	-	cohesive soil with no gravel
''	3.00	3.45	0.45	DP	-	1	2	2	4	-	-	-	-	-	-	Non cohesive soil
''	4.00	4.45	0.45	DP	-	3	4	6	10	-	-	-	-	-	-	— do —
''	5.00	5.45	0.45	U	-	Received				-	-	-	-	-	-	— do —
''	6.00	6.45	0.45	DP	-	5	8	9	17	-	-	-	-	-	-	— do —
''	7.00	7.45	0.45	DP	-	6	9	11	20	-	-	-	-	-	-	— do —
[illegible]	8.00	8.45	0.45	U	-	Received				-	-	-	-	-	-	Non cohesive soil
''	9.00	9.45	0.45	DP	-	4	7	8	15	-	-	-	-	-	-	— do —
''	10.00	10.45	0.45	DP	-	5	7	10	17	-	-	-	-	-	-	— do —
''	11.00	11.45	0.45	U	-	Received				-	-	-	-	-	-	Non cohesive soil with no gravel
''	12.50	12.95	0.45	DP	-	6	8	11	19	-	-	-	-	-	-	cohesive soil with gravel
''	14.00	14.45	0.45	U	-	Received				-	-	-	-	-	-	— do —
''	15.50	15.95	0.45	DP	-	8	10	12	22	-	-	-	-	-	-	cohesive soil
''	17.00	17.45	0.45	U	-	Received				-	-	-	-	-	-	Non cohesive soil with gravel
''	18.50	18.95	0.45	DP	-	9	14	18	32	-	-	-	-	-	-	— do —
''	20.00	20.45	0.45	U	-	Received				-	-	-	-	-	-	cohesive soil
''	21.50	21.95	0.45	DP	-	12	27	30	57	-	-	-	-	-	-	cohesive soil with no gravel
''	23.00	23.45	0.45	DP	-	15	29	31	60	-	-	-	-	-	-	— do —
''	24.50	24.95	0.45	DP	-	11	21	26	47	-	-	-	-	-	-	cohesive soil
''	26.00	26.45	0.45	U	-	Received				-	-	-	-	-	-	— do —
[illegible]	27.50	27.95	0.45	DP	-	17	27	35	62	-	-	-	-	-	-	— do —
''	29.00	29.45	0.45	DP	-	13	20	23	43	-	-	-	-	-	-	cohesive soil with gravel

Supervisor

Techpro Engineers Pvt. Ltd.

E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 36: FIELD BORELOG CHART (P58)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue	01.04.2018
Rev. No.:	R03
Rev. Date:	28.12.2021

Project Name:	C.T.W. for HORC viaduct B/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119430.729	E: 701257.706	Location/ Chainage: 22435.4870		
Method of Drilling:	Percussion	Drilling Equipment:	Auto trip Powerwinch	Bore No.:	P-58
Casing Lowered (M):	20.m	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-191.933	Date: From 2/11/2023 to 5/11/2023		Water Table (M):	1.40 m

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
3/11/23	30.50	30.69	0.19	DP	SX	19	80/4	–	R	–	–	–	–	–	–	Non cohesive soil
"	32.00	32.25	0.25	DP	–	43	100	–	R	–	–	–	–	–	–	Non cohesive soil with gravel
"	33.50	33.95	0.45	DP	–	30	36	38	74	–	–	–	–	–	–	– do –
"	35.00	35.45	0.45	DP	–	27	30	32	62	–	–	–	–	–	–	– do –
"	36.50	36.95	0.45	DP	–	28	29	36	65	–	–	–	–	–	–	– do –
5/11/23	38.00	38.45	0.45	DP	–	29	33	38	71	–	–	–	–	–	–	– do –
"	40.00	40.45	0.45	DP	–	30	38	40	78	–	–	–	–	–	–	Non cohesive soil with gravel

Supervisor

S.E. (Civil)

E - In - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 37: FIELD BORELOG CHART (P59)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date:	28.12.2021

Project Name:	GTI-SI for HORC for Viaduct B/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119459.473	E: 701391.445		Location/ Chainage:	22961.6870
Method of Drilling:	Percussion	Drilling Equipment:	Auto SPT Rotary Drilling	Bore No.:	P-59
Casing Lowered (M):	21 m, Bentonite Used: No	Standard Sampler:	Yes	Barrel Type:	N/A
Ground Elevation:	RL-191.466	Date: From	3/11/2023 to 5/11/2023	Water Table (M):	1.50 m

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
3/11/23	0.0	0.5	0.50	D	SX	Collected				–	–	–	–	–	–	Non cohesive soil
"	1.00	1.95	0.45	U	–	Received				–	–	–	–	–	–	— do —
"	2.00	2.45	0.45	DP	–	1	2	2	4	–	–	–	–	–	–	cohesive soil
"	3.00	3.45	0.45	DP	–	1	2	3	5	–	–	–	–	–	–	Non cohesive soil
"	4.00	4.45	0.45	U	–	Slipped				–	–	–	–	–	–	— do — DS collected
"	5.00	5.45	0.45	DP	–	3	3	4	7	–	–	–	–	–	–	cohesive soil
"	6.00	6.45	0.45	DP	–	9	5	5	10	–	–	–	–	–	–	— do —
"	7.00	7.45	0.45	U	–	Received				–	–	–	–	–	–	Non cohesive soil
"	8.00	8.45	0.45	DP	–	6	7	9	16	–	–	–	–	–	–	— do —
"	9.00	9.45	0.45	DP	–	5	8	10	18	–	–	–	–	–	–	— do —
"	10.00	10.45	0.45	U	–	Received				–	–	–	–	–	–	cohesive soil with gravel
"	11.50	11.95	0.45	DP	–	3	6	9	15	–	–	–	–	–	–	— do —
"	12.50	12.95	0.45	DP	–	5	8	12	20	–	–	–	–	–	–	— do —
"	13.50	13.95	0.45	U	–	Received				–	–	–	–	–	–	— do —
"	14.50	14.95	0.45	DP	–	5	9	13	22	–	–	–	–	–	–	— do —
"	16.00	16.45	0.45	U	–	Received				–	–	–	–	–	–	— do —
"	17.50	17.95	0.45	DP	–	7	12	15	27	–	–	–	–	–	–	— do —
"	19.00	19.45	0.45	U	–	Received				–	–	–	–	–	–	Non cohesive soil
"	20.50	20.95	0.45	DP	–	9	15	18	33	–	–	–	–	–	–	— do —
"	22.00	22.45	0.45	U	–	Slipped				–	–	–	–	–	–	— do — DS collected
5/11/23	23.50	23.95	0.45	DP	–	13	26	38	64	–	–	–	–	–	–	cohesive soil with gravel
"	25.00	25.45	0.45	DP	–	14	23	32	55	–	–	–	–	–	–	— do —
"	26.50	26.95	0.45	DP	–	16	28	31	59	–	–	–	–	–	–	— do —
"	28.00	28.45	0.45	DP	–	18	27	33	60	–	–	–	–	–	–	cohesive soil

Supervisor E - In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 38: FIELD BORELOG CHART (P59)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GI work for for HORC viaduct B/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119459.473	E: 7012 41.448	Location/ Chainage: 22961.6840		
Method of Drilling:	Percussion	Drilling Equipment	Automatic & winch	Bore No.:	P 59
Casing Lowered (M):	21 m	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-191.466	Date: From 3/11/2023 to 5/11/2023		Water Table (M):	1.50 m

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
''	29.50	29.95	0.45	DP	SX	14	18	29	47	–	–	–	–	–	–	Cohesive Soil with gravel
''	31.00	31.45	0.45	U	–	Received				–	–	–	–	–	–	Non cohesive soil
''	32.50	32.95	0.45	DP	–	12	20	30	50	–	–	–	–	–	–	Cohesive Soil
''	34.00	34.45	0.45	U	–	Received				–	–	–	–	–	–	Non cohesive soil
''	35.50	35.95	0.45	DP	–	15	23	34	57	–	–	–	–	–	–	– do –
''	37.00	37.45	0.45	DP	–	17	26	33	59	–	–	–	–	–	–	– do –
05/11	38.50	38.95	0.45	DP	–	20	25	35	60	–	–	–	–	–	–	– do –
''	40.00	40.45	0.45	DP	–	22	26	38	64	–	–	–	–	–	–	Non cohesive Soil

Supervisor

Techpro Engineers Pvt. Ltd.

E - in - C

Abbreviation Used ; U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 39: FIELD BORELOG CHART (P60)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/003
		Date of Issue:	01.04.2018
		Rev. No.:	003
		Rev. Date:	28.12.2021

Project Name:	GT FOR HORC Viaduct Between Sohana Dhulawat Station	Project Code:	1901
Coordinate:	N: 7119472.497 E: 701275.673	Location/ Chainage:	22487.8870
Method of Drilling:	Percussion; Drilling Equipment: Rotary rig	Bore No.:	P-60
Casing Lowered (M):	28.50; Bentonite Used: NA; Standard Sampler: Yes.	Barrel Type:	NA
Ground Elevation:	61-191-403 (?); Date: From 27/09/23 to 02/10/2023	Water Table (M):	1.65

Day/Date	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD (%)	Water Losses (%)	Color of Return Water	Description
27-9-23	0.00	0.50	0.50	DS	SX	Collected										Non cohesive soil
"	1.00	1.45	0.45	DP	"	2	3	3	6							do
"	2.00	2.45	0.45	U	"	Received										do
"	3.00	3.45	0.45	DP	"	3	5	9	14							cohesive soil
28-9-23	4.00	4.45	0.45	DP	SX	3	4	5	9							do
"	5.00	5.45	0.45	U	"	Received										Non cohesive soil
"	6.00	6.45	0.45	DP	"	5	7	8	15							do
"	7.00	7.45	0.45	DP	"	6	8	10	18							do
"	8.00	8.45	0.45	UDS	"	Slipped										DS collect Non cohesive soil
"	9.00	9.45	0.45	DP	"	7	9	15	24							cohesive soil
"	10.00	10.45	0.45	DP	"	6	10	12	22							do
29-9-23	11.00	11.45	0.45	U	SX	Received										cohesive soil
"	12.50	12.95	0.45	DP	"	7	11	15	26							do
"	14.00	14.45	0.45	U	"	Received										do
"	15.50	15.95	0.45	DP	"	7	12	13	25							do
"	17.00	17.45	0.45	U	"	Received										Non cohesive soil
"	18.50	18.95	0.45	DP	"	7	14	19	33							do
"	20.00	20.45	0.45	U	"	Received										cohesive soil
"	21.50	21.95	0.45	DP	"	9	15	20	35							do
"	23.00	23.45	0.45	U	"	Received										Non cohesive soil
"	24.50	24.95	0.45	DP	"	13	17	19	36							do
"	26.00	26.45	0.45	U	"	Received										do
1-10-23	27.50	27.95	0.45	DP	SX	10	15	19	34							cohesive soil
"	29.00	29.45	0.45	U	"	Received										do

Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 40: FIELD BORELOG CHART (P60)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev No.:	R03
		Rev Date:	28.12.2021

Project Name:	GT For HORC Viaduct Between Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 7119492.497	E: 701725.673	Location/ Chainage:	27487.8570	
Method of Drilling:	Percussion	Drilling Equipment:	[illegible]	Bore No.:	P-60
Casing Lowered (M):	28.50	Bentonite Used: Not	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L.-191.483	Date: From 27/9/22 to 02/10/2022		Water Table (M):	1.65

Date/Time	Depth/RUN (m) From	Depth/RUN (m) To	Length (m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	CR (%)	RQD (%)	Water Losses (%)	Color of Return Water	Description
1/22	30.50	30.95	0.45	DP	Sx	11	17	21	38							cohesive soil
2-10-	32.00	32.45	0.45	U	"	Received										do
"	33.50	33.95	0.45	DP	"	10	22	33	55							Non cohesive soil
"	35.00	35.45	0.45	DP	"	13	28	37	65							cohesive soil
"	36.50	36.95	0.45	DP	"	19	35	42	77							Non cohesive soil
"	38.00	38.45	0.45	DP	"	25	39	50	84							cohesive soil
"	40.00	40.37	0.37	DP	"	22	66	34	100							cohesive soil with [illegible]

Supervisor E - In - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

End of Report

Report No: 1901-HORC-IV

Report No.: 1901-HORC-IV

Date: Nov 2nd; 2023

GEOTECHNICAL INVESTIGATION REPORT

ULR No.: TC916923000000032P
REVISION-R2

AT THE SITE FOR

HORC VIADUCT BETWEEN SOHANA & DHULAWAT STATIONS OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT, HARYANA

FROM BOREHOLES P61 TO P80

CLIENT

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.

Plot No. 143, 5th floor RailTel tower, Sector-44,
Gurugram, Haryana 122003

GENERAL CONSULTANTS

RITES-SMEC JV

Gurugram, Haryana

GEOTECHNICAL CONSULTANTS

TECHPRO ENGINEERS PVT. LTD.

**114, RAM GANGA HOUSING SOCIETY, NARAMAU, G T ROAD,
KANPUR-209 217, Phone: 9793209918**

e-mail: info@techproindia.com

TC-9169

REVISION NOTES

REVISION NO.	DATE	DESCRIPTION
R1	09.12.23	• Vertical and Lateral pile load capacity in Table 1 to 4 of Appendix-H and recommendations revised. • Field bore log charts added in Appendix-K.
R2	14.12.23	• Lithological profile added in Appendix-C

REPORT FORMAT

Report No.	Bore included	Total Number of Bores
1901-HORC-I	A1 to P20	21
1901-HORC-II	P21 to P40	20
1901-HORC-III	P41 to P60	20
1901-HORC-IV	P61 to P80	20
1901-HORC-V	P81 to P100	20
1901-HORC-VI	P101 to P113	13
1901-HORC-VII	P114A to P133A	20
1901-HORC-VIII	P134A to A2A	16
1901-HORC-IX	P114B to P133B	20
1901-HORC-X	P134B to A2B	16

TABLE OF CONTENTS

A P P E N D I C E S

National Accreditation Board for
Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

TECHPRO ENGINEERS PVT. LTD. (LABORATORY DIVISION)

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G.T. ROAD, KANPUR, UTTAR PRADESH, INDIA

in the field of

TESTING

Certificate Number: TC-9169

Issue Date: 23/12/2022 Valid Until: 22/12/2024

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Identity : Techpro Engineers Private Limited

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

TECHPRO ENGINEERS PVT. LTD.
114, Ram Ganga Housing Society, Naramau, G T Road, Kanpur-209 217
Tel.: 9793209918, e-mail: info@techproindia.com
Web site: www.techproindia.com

Nov 2nd; 2023

ACKNOWLEDGEMENTS

We are pleased to submit the part-4 of the report of Geotechnical investigation, conducted for the boreholes P61 to P80 for the design of foundations for HORC Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) project in the state of Haryana, India.

We hereby, convey our sincere thanks to Mr. Neeraj Bhandari (CPM/South) and Mr. Raju Solanki (DGM/C/South), HRIDCL for trust and support during the investigation. We also acknowledge our thanks to Mr. Uma Maheshwara Rao B, DGM/C/West, HRIDCL for awarding the said work to us. We are also grateful Mr. Ravindra Dutta Upadhyay (Geotech Expert), Mr. PS Gautam & Mr. Jitender Parashar, Site Engineer from the RITES- SMEC JV and Mohd. Ishak (Executive/Civil) from HRIDCL, for their help rendered during and prior to the investigation work.

We are also thankful to our staff members for conducting field and laboratory test, preparing sketches, and typing the report.

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech. (Civil), M.Tech.
Principal Consultant &
Managing Director

1. INTRODUCTION:

Haryana Rail Infrastructure Development Corporation Ltd. (HRIDC) and Ministry of Railways, Govt. of India has come together to form a new company namely Haryana Orbital Rail Corporation Limited (HORCL), to design and construction of new BG line from Palwal to Sonipat named Haryana Orbital Rail Corridor (HORC), in the state of Haryana, India. In this connection, a Geotechnical investigation has been planned for the design of foundations of Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) Project in the state of Haryana. The work of conducting the detailed Geotechnical Investigation has been awarded to us by HRIDC, through work order No. HRIDC/HORC/GTI/211/2023-2024/Vol-0 dated 02-09-2023, which includes investigation in field, laboratory testing of disturbed and undisturbed samples, collected from the field, and submission of the geotechnical **investigation** test report.

A geotechnical investigation was carried out, with the locations, planned by the client. Purpose of the investigation is to determine the nature and properties of soil and rock strata across the bore holes and representing them through log sections showing the levels, nature, and properties of various strata up to a sufficient depth below the founding level, proneness of site to artesian conditions, seismic disturbance and other engineering properties of soil and rock strata.

This part -4 of the report includes the detailed methodology of investigation, collection of samples, field and laboratory test result including their interpretation/ analysis, recommendations on the properties of soils and rock required for design of foundation and suggesting suitable type and depth of foundation with allowable bearing capacity for safe and strong foundations for the Bore Hole numbers P61 to P80.

2. SCOPE OF WORK:

For the design of foundation of viaduct, it is required to determine the allowable bearing capacity together with necessary engineering characteristics of underlying soil & rock strata. In general, the geotechnical investigation has been planned as per IS:1892-2021 and further extended to IS: 1904, IS:2911 (part-1/Sec 2) & IRC 78:2014 for planning the laboratory testing and computing the allowable bearing capacity, hence the scope of work is as follows:

2.1. Mobilisation of all tools & plants along with accessories, materials, labours etc. at site of work for drilling and testing work, including setting up boring and shifting to different bore holes point etc.

2.2. Exploratory drilling of 150 mm diameter bore holes through soil deposits and 75 mm in rock within the proposed alignment upto the required depth.

2.3. Collection of disturbed soil samples at an interval of 3.00 meter in all the bore holes.

2.4. Collection of undisturbed soil samples at every 3.00 m interval or at change of stratum from all the boreholes.

2.5. To conduct Standard Penetration Test (SPT) at an interval of 3.00 m or noticeable change of stratum in soil deposits in all bore holes.

2.6. Collection of rock core samples and preserving them in core boxes.

2.7. To collect ground water sample on completion of bore holes.

2.8. To record the ground water table in all the bore holes.

2.9. Transporting all the disturbed, undisturbed soil and rock core samples collected during the field investigation to our NABL accredited Geotech Engineering laboratory at Kanpur.

2.10. To conduct the laboratory tests on all the soil and rock core samples collected during field investigation for determination of their engineering characteristics.

2.11. To compile of field and laboratory test results, working out the allowable bearing capacity and preparing the report including detailed recommendations and necessary precautions.

3. GEOLOGICAL INFORMATION OF THE REGION:

3.1. Geography:

The project location is in the bordering area of Gurugram and Nuh (recent old name-Mewat), districts in the Indian state of Haryana. The stretch of the alignment of the proposed corridor starts from southmost part of Gurugram in the town of Sohna and ends at Dhulawat, which is a village lying at the north of Nuh district.

Haryana is a state located in the northern part of India. Gurugram is among one

of the districts in Haryana which is also the part of National Capital Region (30km south of New Delhi). It lies at an elevation of 217 m above msl. Sohna is a small town located 25km in the south of Gurugram. Sohna is well known for its hot water springs and famous Shiva temple. Sohna is located in between 28°15’ N latitude and 77°40' E longitude at the elevation of 212.14m above msl. Mewat district is located at 28 °12′ N latitude, 77 °3′ E longitude, at the south of Gurugram at an elevation of 199 m above msl. The location is bordered by Rewari district on west and Faridabad & Palwal district on the east.

3.2. Geology:

The Gurugram district is having of almost flat topography, however, in the north-eastern part small isolated hillocks of Precambrian rocks are exposed. Small hill ranges which are part of the Aravali and Mangar Bani ranges exists in the district. The major part of district is underlain by Quaternary alluvium consisting of sand, clay and silt. The alluvial plain is formed by the Sahibi river which is a tributary of River Yamuna. Soils of the Gurgaon district is classified as tropical and brown soils, existing in the north western extreme, northern and north eastern parts of the district and water logged and salt affected soils in the southern parts of the district. The soils are medium textured loamy sand is the average texture in Gurgaon and Sohna blocks.

3.3. Rainfall and Climate:

The area has hot semi-arid type of climate characterising extreme dryness of the air except in the monsoon season. Intense hot summer and cold winters. The total annual rainfall in the region is about 596 mm, of which 75 to 80% is because of the south-west monsoon.

3.4. Seismicity:

The site under consideration exists in the district of Gurugram and Mewat which lies in the Seismic Zone IV (high damage risk zone), as per the current seismic zonation map of India (IS 1893-2016): RA 2021 and have a zone factor of 0.24 for design basis earthquake. The region is surrounded by many in-homogeneities in the form of faults and ridges like Sohna Fault, Moradabad Fault, Delhi-Moradabad Fault, Delhi-Haridwar ridge, junction of Aravalli and Alluvium near Delhi. The Sohna fault line lies between the Delhi ridge and Sohna town and falls between the Arjangarh and

Manesar outcrops. All the developed area in Gurugram comes within 200 km of the fault line. The Sohna fault line is located at the junction between the hard rock terrain of the Aravalli hills and the sandy formation of the Yamuna River and is currently inactive from several years and is capable of a disastrous earthquake.

The project location has been marked in Fig.1 Seismic zone map of India.

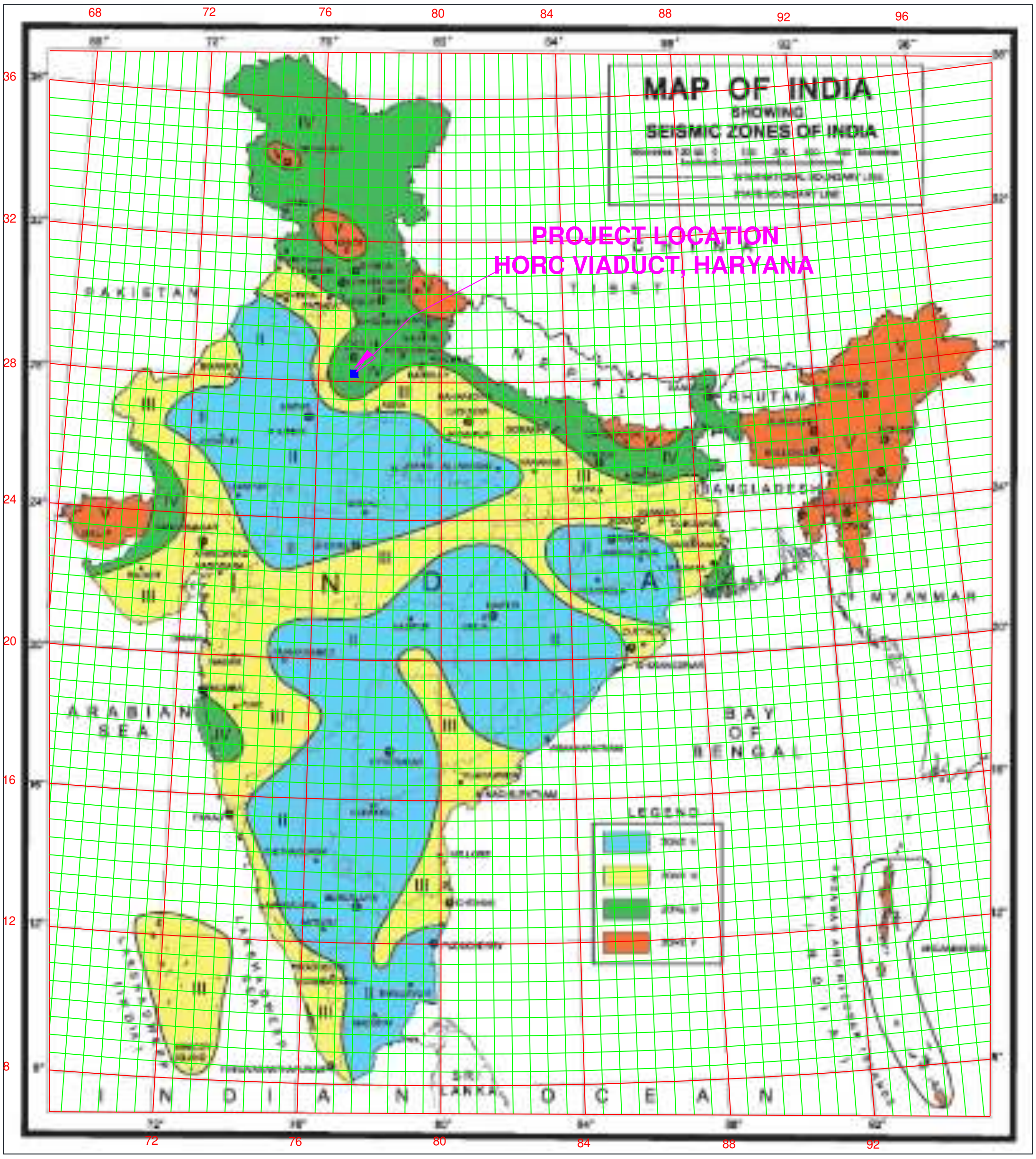


Fig.1: Seismic Zone Map of India

4. FIELD INVESTIGATION:

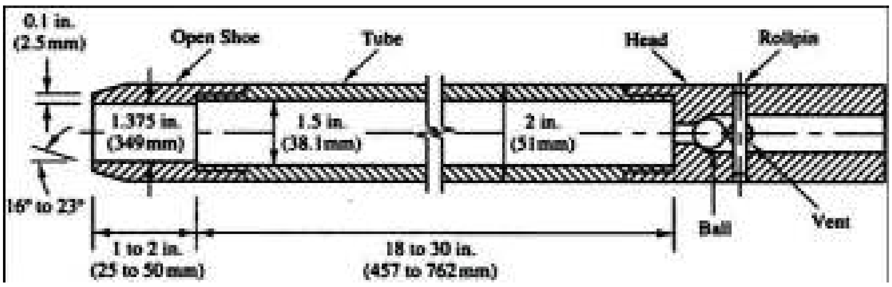
The field investigation work at this site was carried out from Sep 27th; 2023 to Oct 09th; 2023, Oct 21st; 2023 to Oct 24th; 2023 & Nov 03rd; 2023 to Nov 07th;

2023. The following investigation work was carried out:

4.1. **Twenty number** of **boreholes** (marked as P61 to P80) of diameter 150 mm in soil were made within the proposed alignment for conducting Standard Penetration Test and collection of disturbed and undisturbed samples. The boreholes were progressed using power operated winch and hydraulic rig machine under **percussion** and **rotary** method of drilling respectively. Casing was used to keep the borehole stable, and Bentonite was also used as drilling mud to help prevent wall collapse of boreholes at deeper depth. The records of achieved depth of bore holes have been given in Para No. 6, the details of drilled bores along with depth of casing used have been reported in Appendix B. Locations of boreholes have been reported in "TEST LOCATION PLAN" in Appendix A.

4.2. **Standard Penetration Tests** were conducted at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth, as per the procedure in IS: 2131-1981-(RA: 2021) in all the bore holes. The **standard SPT sampler** (without liner and with no space for liner) and **auto-trip and rope-pulley driven hammer** of standard weight of 63.50 kg have been used to perform the test.

For conducting the test, the bottom of the borehole was properly cleaned, and split spoon sampler was properly seated in position in the borehole. The split spoon sampler resting on the bottom of borehole was allowed to sink under its own weight; then the sampler was allowed to penetrate 15 cm with the blows of the hammer 63.50 kg weight falling free through 75cm, thereafter the split spoon sampler was further driven by another 15 cm. For the 3rd and final drive, the sampler was further allowed to penetrate 15 cm. The number of blows required to get each 15 cm of penetration, was recorded. The first 15 cm of drive is seating drive.



Structure of SPT Sampler

The total blows of penetration for the second and third 15 cm of penetration is

termed the penetration resistance N. The N' values are indicative of the compactness/ relative density of cohesion less soils and consistency of cohesive soils.

In case the blows count of SPT in soil (including the number of blows of seating) exceeds 100, the corresponding penetration was recorded and this particular test at that depth stopped. If the total penetration is more than the seating penetration of 15 cm, then breakup of blow counts for 15 cm seating penetration and for remaining portion of penetration is also given.

SPT 'N' values are correlated with non-cohesive stratum as per BS: 5930 (1999) – for sandy strata and with consistency of cohesive stratum.

Correlation For Clay/Plastic Silt		Correlation For Sand/Non-Plastic Silt	
Consistency of clays	**Penetration Value**	**Relative Density of sand**	**Penetration Value**
Very Soft	0 to 2 Blows	Very loose	0 to 4 Blows
Soft	3 to 4 Blows	Loose	5 to 10 Blows
Medium Stiff	5 to 8 Blows	Medium	11 to 30 Blows
Stiff	9 to 16 Blows	Dense	31 to 50 Blows
Very Stiff	17 to 32 Blows	Very Dense	Above 50
Hard	Above 32		

In this method, the sampler acts as a probe and the driving energy is supplied by the fall of the drop weight. The values of 'N' depend on the compactness or relative density of the material. In hard formations, the testing is discontinued if 'N' value is found to be more than 100. It is termed as 'Refusal'. Refusal is also recorded when SPT blow count records 50 or more for any of the single drive of 15 cm.

'N' value depends upon degree of saturation and over burden pressure of the formation. Silty fine sand and fine sand below the water table develop pore water pressure depending on the in-situ void ratio which in turn affects the effective stress. This change in effective stress influences the 'N' value considerably.

Depth of overburden affects the SPT values in none to low cohesive soils and hence need correction. The SPT value after the overburden correction, N' is as follows:

$$N' = 0.77x \log(2000/q) \times N$$

Where, q= Overburden Pressure (kN/m^2) and N = observed SPT value

N' is corrected further for dilatancy in case of saturated fine sands and silts for the values of N' greater than 15.

Modified value after dilatancy correction N" = 15+ (N'-15)/2

Soil samples obtained from split spoon sampler were collected in the polythene bags of suitable size. These samples were property sealed, labelled, and carefully transported to the laboratory for testing. The results have been reported in Table 1 to 20 of Appendix B under the title "SUMMARY OF TEST RESULTS".

4.3. **Disturbed soil samples** were collected at 0.50 metre, then at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth and at significant change of stratum. Soil from cutting edge of SPT samplers and retained in split spoon, used for Standard Penetration Tests was taken as disturbed samples. These samples were placed without delay in adequately sealed polythene bags. Where the collection of disturbed soil samples could not be collected from SPT samples, Shelby tubes were driven and retained soil samples were obtained. The laboratory tests were conducted on the collected soil samples and reported in Table 1 to 20 of Appendix-B under the title "SUMMARY OF TEST RESULTS".

4.4. **Undisturbed soil samples** were collected in accordance with IS: 2132-1986-(RA: 2021) at an interval of 3.00 metre or at change of stratum, starting from the depth of 1.00 or 2.00 m, by using 100 mm dia. and 450 mm long MS tubes provided with sampler head with ball check arrangement. However, the some of the samples could not be extracted due to the partial penetration or slippage during the evacuation.

Moreover, collection of Undisturbed samples in very hard cohesive soils/ dense granular soils/gravels/ cobbles/ pebbles/ boulders, refusal strata is practically not possible and such collected samples will not truly represent the undisturbed conditions.

Immediately after taking undisturbed sample in the tube, the adopter head was removed along with the disturbed material. The visible ends of the samples shall then be trimmed off any wet disturbed soil. The ends will then be coated alternately with four layers of molten wax. More molten wax will then be added to give a total thickness

of not less than 25 mm. The laboratory test results have been reported in Table 1 to 20 of Appendix-B.

4.5. The **ground water table** in the borehole was allowed to stabilize and measured after 8, 16, 24 and 48 hours after completion of the bore hole. It was ensured that last two reading were identical. The records of ground water table have been given in Para No.6.

4.6. **Ground water samples** were collected from borehole as per IS: 6935-1973-(RA:2019) for chemical analysis to determine aggressiveness in relation to attack on concrete / reinforcement including determination of pH value.

5. LABORATORY TESTS:

The following laboratory tests were conducted to determine the engineering characteristics of sub-soils:

5.1. **Field moisture contents** were determined by oven drying method as per IS: 2720 (part II)-1973-(RA: 2020). The results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.2. **Bulk density** of soil strata was obtained using Shelby tubes in accordance with IS 2720 (part XXIX)-1975-(RA: 2020). The results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.3. **Mechanical sieve analysis** test was performed in accordance with IS: 2720 (Part IV) – 1985-(RA: 2020), for the purpose of identification by grain size analysis, on coarse part of the soil samples and the results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.4. **Particle size analysis** test by **Hydrometer method** were performed in accordance with IS: 2720 (Part IV) -1985-(RA: 2020) on the part of soil samples obtained after the sieve analysis. The results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.5. **Atterbergs' limits tests** were performed in accordance with IS: 2720 (part V)-1985-(RA: 2020) and results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.6. **Specific gravity tests** were performed in accordance with IS 2720 (part III-sec. 1) -1980-(RA: 2021) and the results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.7. **Consolidation tests** were performed on cohesive soil samples in accordance with IS: 2720 (part XV)-1965-(RA: 2021). The results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.8. **Direct shear tests** were performed as per IS: 2720 (part XIII)-1986-(RA: 2021), on the undisturbed soil samples obtained during the field investigation. The results and the density of samples have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.9. **Tri-axial Compression Test** under Unconsolidated Un-drained (UU) condition as per IS: 2720 (Part-XI)-1993-(RA: 2021) were performed on the selected undisturbed soil samples, obtained during the field investigation. The results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.10. **Unconfined Compressive strength tests** were performed in accordance with IS 2720 (Part-X) -1991-(RA:2020) on selected undisturbed soil samples and the results have been reported in Table 23 of Appendix B

5.11. **Shrinkage Limit tests** were performed in accordance with IS 2720 (part-VI) -1972-(RA: 2021) and the results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.12. **Free Swell Index** were performed in accordance with IS 2720 (part-XL) -1977-(RA: 2021) and the results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.13. **Chemical analysis on soil samples** was performed in accordance with IS: 2720 (Part-XXVI)-1987-(RA: 2021) for pH value, IS: 2720 (Part-XXVII)-1977-(RA: 2020) for Sulphate & BS:1377-3-2018 for chlorides and results have been reported in Table 21 "CHEMICAL TEST ON SOIL SAMPLES" of Appendix B.

5.14. **Chemical analysis on Ground Water sample** was performed in accordance with IS: 3025 (Part-XI)-2022 for pH value, IS: 3025 (Part-XXIV: Sec-1)-2022 for Sulphate & IS: 3025-(Part-XXXII)-1988-(RA: 2019) for chlorides and results have been reported in

Table 22 "CHEMICAL TEST ON GROUND WATER SAMPLES" of Appendix B.

6. GROUND WATER TABLE:

The water table at this site was encountered during the drilling operation up to the depth of investigation.

Borehole No.	Chainage	Global Co-ordinates (UTM format)		Reduced level (m)	Depth of Borehole (m)	Water table (m)
		Easting	Northing			
P61	22514.0870	701210.312	3119493.892	191.635	40.00	1.52
P62	22540.2870	701195.421	3119515.583	191.610	40.00	1.50
P63	22566.4870	701180.991	3119537.582	191.645	40.00	1.50
P64	22592.6870	701167.064	3119559.818	191.728	40.00	1.60
P65	22618.8870	701153.570	3119582.405	191.825	40.00	1.60
P66	22645.0870	701140.518	3119605.336	191.818	40.00	1.50
P67	22671.2870	701127.988	3119628.472	191.985	40.00	1.80
P68	22697.4870	701115.947	3119651.866	191.917	40.00	1.60
P69	22723.6870	701104.421	3119675.469	191.999	40.00	1.70
P70	22749.8870	701093.375	3119699.349	192.161	40.00	1.60
P71	22776.0870	701082.834	3119723.456	192.287	40.00	1.70
P72	22802.2870	701072.794	3119747.802	192.289	40.00	1.60
P73	22828.4870	701063.285	3119772.310	192.387	40.00	1.85
P74	22854.6870	701054.272	3119797.076	192.472	40.00	2.45
P75	22880.8870	701045.810	3119821.943	192.565	40.00	1.80
P76	22907.0870	701037.860	3119847.024	192.717	40.00	2.55
P77	22933.2870	701030.427	3119872.310	192.676	40.00	2.62
P78	22959.4870	701023.541	3119897.704	192.731	40.00	2.60
P79	22985.6870	701017.190	3119923.237	192.898	40.00	2.20
P80	23011.8870	701011.378	3119948.898	193.042	40.00	2.35

7. DESCRIPTION OF STRATA:

The classification of soil stratum has been done with the help of soil characteristics obtained in laboratory tests as per IS 1498-1970-(RA:2021). The classification of rock masses has been done based on RMR as per IS: 4464-1985, IS:

13365-1. The detailed nature of the strata has been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix-B and represented through Lithological plots in Appendix-C.

The strata exhibited in all the bore hole, is predominantly comprising of inorganic silty clays of low plasticity and inorganic silts of non to low plastic category. Silty sands were encountered at variable depth and thickness in all of the boreholes. Inorganic silts and clays of intermediate plasticity were also found at varying depths and thickness in some of the boreholes. Some lenses of silty sands with clay binders were found as exception in some of the borehole such as P72, P75, etc.

8. SAFE BEARING CAPACITY COMPUTATIONS:

For the construction of viaducts, deep foundation **(Bored Cast-In-Situ RCC piles)** have been considered for computation of load bearing capacity of the underlying soil strata. The computation of load bearing capacity of bored cast-in-situ RCC piles have been done as per IS 2911 (part-1, section-2)-2010-(RA: 2020) with due consideration of effects of liquefaction.

8.1. Design Parameters:

Factor of safety in Compression	=	2.50
Factor of safety in Tension	=	3.00
Depth of critical water table	=	0.00 m
Diameter of pile	=	1.00 & 1.20 m
Cut off length	=	2.50 m
Type of pile head consider	=	Fixed

8.2. Computation of friction along pile stem:

$$Q_{uf} = \sum K_i.P_{di}.\tan\delta_i.A_{si}$$

where,

Q_{uf} = Ultimate shaft friction (kN/m^2)

K_i = Coefficient of earth pressure at mid-depth of ith layer

P_{di} = Effective overburden pressure at mid-depth of ith layer (kN/m^2)

A_{si} = Surface area of pile stem in ith layer (m^2)

δ_i = Angle of wall friction between pile and soil of i^{th} layer (= ϕ) (degree)

ϕ_i = Angle of internal friction of soil in i^{th} layer (degree)

Σ = Sum of all layers up to i^{th} layer

8.3. Computation of Cohesion along the stem of pile:

$Q_{uc} = \Sigma \alpha_i . c_i . A_{si}$

Where,

c_i = Cohesion in i^{th} layer

A_{si} = Surface area of pile stem in i^{th} layer (m^2)

α_i = Adhesion factor for i^{th} layer of soil depending of consistency of soils

Σ = Sum of cohesion of all layers considered

8.4. Computation of end bearing resistance:

Q_{ub} = A_p (c.Nc + q.Nq + 0.5. γ.B.Nγ)

Where,

A_p = Area of the pile toe (m^2)

c = cohesion of soils at pile toe (kN/m^2)

γ = Effective Unit weight of soils at pile toe (kN/m^3)

B = Diameter of pile (m)

q = Effective overburden pressure at pile toe (kN/m^2)

N_c = Bearing Capacity Factor (Recommended equal to 9)

Nq, Nγ = Bearing Capacity Factor

8.5. Lateral load capacity of piles in soils:

$Q_u = 12.E.I.\delta/(L_1+L_f)^3$

where,

Q_u = Ultimate lateral load capacity of pile (kN)

δ = Permissible deflection (m) = 5 mm

E = Young Modulus of pile material (kN/m^2)

I	=	Moment of Inertia of the pile cross section (m^4)
L_1	=	Cantilever Length of pile (m)
L_f	=	Length of fixity (m)

Detailed calculations of pile load carrying capacity in compression & uplift in soil have been reported in **Table-1 to 2** of **Appendix-H.**

Pile lateral Load capacity has been given in **Table-3 to 4** of **Appendix-H**.

9. LIQUEFACTION ANALYSIS:

Liquefaction is the sudden loss of shear strength of the loose fine sands due to earthquake-induced vibration under saturated conditions. Liquefaction generally takes place in loose fine sands (fines < 10 %, D_{60}= 0.20 mm to 1.0 mm and C_u between 2 to 5) with N value less than 15. In case of soil strata having N>15, liquefaction of soil will not take place normally.

The present site falls in **seismic zone – IV.** Considering the history of past earthquakes and available seismic data, an earthquake of **magnitude 7.0** having peak ground acceleration **a_{max}= 0.24 g** is considered in the present analysis.

Preliminary assessment of liquefaction potential of foundation strata is made by simplified approach proposed by IS: 1893 (part-1)-2016-(RA: 2021) from the data obtained in Standard Penetration Test.

In this method, cyclic shear stress likely to be induced in the foundation strata by Design Basis Earthquake is first evaluated. Next threshold cyclic shear stress, which is good enough to cause liquefaction, is determined from SPT data and the empirical relations. Finally, comparison of these two stresses is used in the estimation of liquefaction susceptibility of the foundation strata.

Cyclic Stress Ratio (CSR):

The equivalent average of shear stress likely to be induced in the foundation material due to an earthquake is calculated by using the equations.

Cyclic Resistance Ratio (CRR):

It expresses capacity of soil to resist liquefaction. CRR is determined using correlation between corrected blow count $(N_1)_{60}$ and CRR for earthquake of magnitude 7.5. $(N_1)_{60}$ is the SPT blow count corrected to an effective overburden pressure of 100 kPa and to hammer energy efficiency of 60 %.

Following variable have been adopted in calculation of N_{60} (SPT value for 60% efficiency)

Energy correction to SPT values:

C_{60} = 1.00 (Energy correction factor)

Design Earthquake Base:

Earthquake zone	= IV
Magnitude of earthquake	= 7
Seismic Zone factor	= 0.24

Status of Liquefaction:

The value of CSR and CRR are computed at different depth and then the ratio of CRR to CSR to get the factor of safety towards the susceptibility of the stratum towards liquefaction potential.

If factor of safety:

$<$ 1.00 : Stratum is to be considered as liquefiable

$>$ 1.20 : Non-Liquefiable

The detailed calculations of liquefaction have been reported in **Table-5** of **Appendix-H.**

10. RECOMMENDATIONS:

Keeping in mind, the field test results, laboratory test results and IS codes of practice the following recommendations are hereby made:

10.1. **Bored Cast-In-Situ RCC Piles** of diameter 1000 and 1200 mm have been adopted for SBC computations of foundation for Viaduct.

10.2. **Cut off length** of piles have been considered as 2.50 m from the existing ground level for the purpose of computation of SBC.

10.3. **Pile length** recommended in the table below, shall be measured **after the cut-off depth.**

10.4. **Allowable load carrying capacity** of pile corresponding to the length and diameter of pile shall be read from the tables below:

10.4.1. For Pile diameter = 1000 mm

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P61	25.00	1750	1400	35
	27.50	2250	1650	
	30.00	2350	1850	
	32.50	2650	2050	
	35.00	2850	2300	
P62	25.00	2100	1650	190
	27.50	2300	1850	
	30.00	3000	2050	
	32.50	2950	2200	
	35.00	2950	2400	
P63	25.00	2350	1850	135
	27.50	2600	2050	
	30.00	2850	2250	
	32.50	3100	2450	
	35.00	3250	2650	
P64	25.00	2100	1700	145
	27.50	2900	1850	
	30.00	2550	2100	
	32.50	2800	2250	
	35.00	3000	2450	
P65	25.00	2050	1650	80
	27.50	2400	1850	
	30.00	2650	2100	
	32.50	2900	2300	
	35.00	3100	2500	
P66	25.00	1950	1500	45
	27.50	2150	1700	
	30.00	2400	1900	
	32.50	2650	2100	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	35.00	2900	2300	
P67	25.00	2200	1750	65
	27.50	2650	1950	
	30.00	3100	2100	
	32.50	2950	2350	
	35.00	3750	2550	
P68	25.00	2300	1750	145
	27.50	2500	2000	
	30.00	2750	2200	
	32.50	3400	2400	
	35.00	3250	2600	
P69	25.00	2300	1800	130
	27.50	2500	2000	
	30.00	2750	2200	
	32.50	3050	2450	
	35.00	3250	2650	
P70	25.00	1900	1500	30
	27.50	2150	1700	
	30.00	2500	1900	
	32.50	3150	2150	
	35.00	3050	2350	
P71	25.00	2000	1500	35
	27.50	2250	1750	
	30.00	2500	1950	
	32.50	2800	2200	
	35.00	3050	2450	
P72	25.00	1800	1400	25
	27.50	2200	1550	
	30.00	2300	1750	
	32.50	2500	1950	
	35.00	2750	2200	
P73	25.00	1600	1300	30

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	27.50	2250	1450	
	30.00	2500	1650	
	32.50	2250	1850	
	35.00	2550	2000	
P74	25.00	1550	1150	10
	27.50	1850	1400	
	30.00	2050	1600	
	32.50	2100	1700	
	35.00	2350	1900	
P75	25.00	2150	1700	130
	27.50	2900	1900	
	30.00	3150	2100	
	32.50	3000	2350	
	35.00	3800	2600	
P76	25.00	2550	2000	130
	27.50	2800	2200	
	30.00	3100	2350	
	32.50	3250	2550	
	35.00	3550	2750	
P77	25.00	2500	1750	175
	27.50	2650	1950	
	30.00	2750	2150	
	32.50	3100	2350	
	35.00	3150	2500	
P78	25.00	2450	1700	65
	27.50	3200	1950	
	30.00	3400	2200	
	32.50	3500	2450	
	35.00	3650	2700	
P79	25.00	2250	1700	120
	27.50	2900	1950	
	30.00	3050	2100	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	32.50	3300	2300	
	35.00	3100	2500	
P80	25.00	2100	1600	85
	27.50	2500	1800	
	30.00	2500	2000	
	32.50	2900	2200	
	35.00	3200	2450	

** Indicates Grade of Concrete*

10.4.2. Pile diameter = 1200 mm

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P61	25.00	2300	1800	60
	27.50	3100	2100	
	30.00	3100	2350	
	32.50	3450	2650	
	35.00	3700	2950	
P62	25.00	2700	2050	265
	27.50	3000	2350	
	30.00	4200	2600	
	32.50	4000	2900	
	35.00	3950	3150	
P63	25.00	3000	2300	190
	27.50	3350	2600	
	30.00	3650	2850	
	32.50	4000	3150	
	35.00	4150	3350	
P64	25.00	2800	2200	210
	27.50	4250	2450	
	30.00	3400	2750	
	32.50	3750	3000	
	35.00	4000	3250	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P65	25.00	2750	2150	120
	27.50	3150	2450	
	30.00	3500	2700	
	32.50	3800	3000	
	35.00	4100	3300	
P66	25.00	2650	2000	70
	27.50	2950	2250	
	30.00	3250	2550	
	32.50	3600	2800	
	35.00	3900	3050	
P67	25.00	2850	2250	95
	27.50	3550	2500	
	30.00	4200	2700	
	32.50	3900	3000	
	35.00	5100	3350	
P68	25.00	2950	2200	195
	27.50	3200	2500	
	30.00	3500	2800	
	32.50	4700	3050	
	35.00	4200	3350	
P69	25.00	3000	2300	175
	27.50	3300	2550	
	30.00	3650	2850	
	32.50	4000	3150	
	35.00	4250	3400	
P70	25.00	2500	1900	50
	27.50	2800	2150	
	30.00	3300	2450	
	32.50	4400	2800	
	35.00	4150	3050	
P71	25.00	2700	2000	60
	27.50	3000	2300	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	30.00	3300	2600	
	32.50	3700	2900	
	35.00	4000	3200	
P72	25.00	2400	1800	40
	27.50	3150	2100	
	30.00	3300	2350	
	32.50	3500	2650	
	35.00	3800	2950	
P73	25.00	2250	1750	50
	27.50	3500	2000	
	30.00	3850	2250	
	32.50	3200	2500	
	35.00	3550	2750	
P74	25.00	2050	1450	20
	27.50	2450	1800	
	30.00	2650	2050	
	32.50	2750	2200	
	35.00	3050	2400	
P75	25.00	2850	2250	180
	27.50	4150	2500	
	30.00	4450	2800	
	32.50	4050	3150	
	35.00	5400	3450	
P76	25.00	3350	2550	160
	27.50	3600	2850	
	30.00	4150	3050	
	32.50	4350	3300	
	35.00	4750	3550	
P77	25.00	3550	2350	235
	27.50	3650	2600	
	30.00	3750	2850	
	32.50	4300	3150	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	35.00	4300	3400	
P78	25.00	3300	2150	95
	27.50	4400	2550	
	30.00	4700	2850	
	32.50	4750	3200	
	35.00	4950	3500	
P79	25.00	2950	2200	170
	27.50	4050	2500	
	30.00	4250	2750	
	32.50	4650	3050	
	35.00	4200	3350	
P80	25.00	2850	2100	130
	27.50	3500	2400	
	30.00	3400	2700	
	32.50	4000	2950	
	35.00	4400	3250	

** Indicates Grade of Concrete*

10.5. Liquefaction Potential: All the bore holes have been analysed for Liquefaction potential as per IS: 1893 (part-1)-2016-(RA: 2021) with Seismic Zone IV, earthquake intensity of 7.0 on Richter scale and critical ground water table at existing ground level. Out of which several boreholes show the potential at various depths mentioned in the table below:

Bore No.	Liquefiable depth zone (meter)
P61	Top 1.00 & 8.00 to 9.00
P62	Top 1.00
P63	Top 1.00
P64	Top 1.00 & 2.00 to 3.00
P65	Top 1.00, 2.00 to 3.00 & 4.00 to 5.00
P66	3.00 to 4.00 & 7.00 to 8.00
P67	Top 1.00 & 3.00 to 6.00

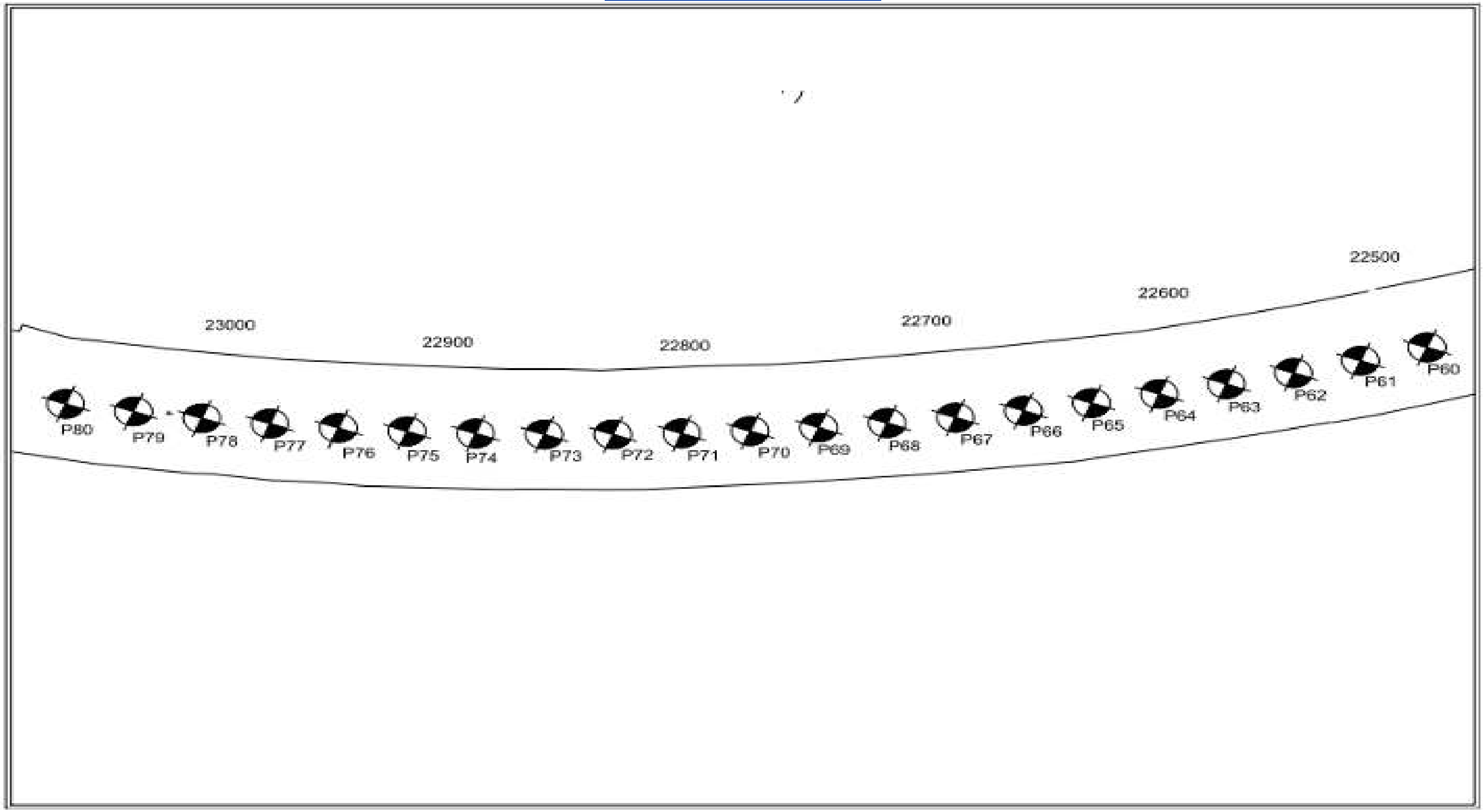
Bore No.	Liquefiable depth zone (meter)
P68	Top 1.00 & 2.00 to 3.00
P69	Top 1.00 & 2.00 to 3.00
P70	Top 1.00 & 4.00 to 9.00
P71	Top 2.00 & 5.00 to 9.00
P72	2.00 to 4.00 & 9.00 to 10.00
P73	Top 1.00 & 9.00 to 10.00
P74	Top 1.00, 2.00 to 3.00 & 14.00 to 15.50
P75	Top 1.00 & 2.00 to 3.00
P76	Top 2.00
P77	Top 2.00
P78	Top 3.00 & 4.00 to 6.00
P79	Top 1.00
P80	3.00 to 5.00

10.6. Type of cement to be used: Chemical content in the soil samples is slightly higher but still within the permissible limits. So, Ordinary Portland Cement or Portland Pozzolana Cement may be used for all civil constructions.

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech.(Civil), M.Tech.
Principal Consultant &
Managing Director

APPENDIX-A
TEST LOCATION PLAN



APPENDIX "B"
TABLE 1: SUMMARY OF TEST RESULTS

Bore No: P61	**Ground Elevation: RL 191.635 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.52 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 27/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 22514.087	**Casing Lowered: 28.00 m**	**Ending Date: 30/09/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	1	1	1	55	42	0	13.06	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	U	2	-	-	-	-	-	CI	0	1	0	32	46	21	19.79	2.12	1.77	37.5	17.5	20.0	2.68	UU	66.0	6.4	-	0.514	-	25	15	-	Inorganic clays of Intermediate plasticity											
	2.00	D	3	3	3	2	5	5.00	-	-	-	-	-	-	-	20.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	3	3	3	6	6.00	CL	3	2	3	16	65	11	19.14	-	-	32.0	21.0	11.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	4.00	U	5	-	-	-	-	-	CL	7	2	2	11	66	12	19.11	2.12	1.78	33.5	23.5	10.0	2.68	-	-	-	-	0.506	-	-	-	-												
	5.00	D	6	5	7	8	15	15.86	SM	0	0	1	62	37	0	21.72	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	6.00	D	7	6	8	13	21	18.70	-	-	-	-	-	-	-	24.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	U	8	-	-	-	-	-	SM	0	1	1	82	16	0	22.02	1.85	1.52	Non-Plastic			2.64	DST	3.0	26.9	-	0.737	-	-	-	-												
	8.00	D	9	5	6	9	15	15.03	-	-	-	-	-	-	-	23.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	9	11	14	25	19.70	CL	1	1	1	7	82	8	18.69	-	-	27.0	20.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	10.00	U	11	-	-	-	-	-	CL-ML	0	0	1	5	88	6	21.57	2.01	1.65	25.5	19.0	6.5	2.64	DST	13.0	24.7	-	0.600	-	-	-	-	Inorganic Silty Clays of low plasticity											
	11.00	D	12	7	11	13	24	18.53	-	-	-	-	-	-	-	19.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	8	13	15	28	20.01	-	-	-	-	-	-	-	20.82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	7	4	3	7	71	8	16.16	2.04	1.76	27.5	20.0	7.5	2.66	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	14.50	D	15	9	15	17	32	32.00	-	-	-	-	-	-	-	18.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	0	1	2	28	55	14	16.85	2.10	1.80	28.0	17.5	10.5	2.67	UU	52.0	11.2	0.140	0.483	-	9	17	-												
	17.50	D	17	7	11	14	25	17.18	CL	0	0	1	18	74	7	20.88	-	-	26.0	19.0	7.0	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 1: SUMMARY OF TEST RESULTS

Bore No: P61	**Ground Elevation: RL 191.635 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.52 m**
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FIELD TEST RESULT										LABORATORY TEST RESULT																																	
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RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL-ML	5	3	3	15	66	8	18.89	2.11	1.78	27.0	21.5	5.5	2.66	UU	43.0	8.1	-	0.496	-	-	19	-	Inorganic Silty Clays of low plasticity											
	20.50	D	19	11	20	32	52	26.27	-	-	-	-	-	-	-	19.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	CL	3	1	1	25	58	12	21.07	2.07	1.71	27.0	19.0	8.0	2.67	DST	18.0	23.7	-	0.561	-	-	16	-	Inorganic clays of low plasticity											
	23.50	D	21	12	23	35	58	58.00	-	-	-	-	-	-	-	15.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	ML	1	0	1	9	89	0	24.46	2.02	1.62	Non-Plastic			2.64	-	-	-	-	0.630	-	-	-	-	Inorganic Silts of low plasticity											
	26.50	D	23	12	23	27	50	23.55	-	-	-	-	-	-	-	23.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	U	24	-	-	-	-	-	MI	3	1	2	1	71	22	27.46	2.10	1.65	48.5	28.5	20.0	2.70	UU	72.0	8.5	-	0.636	-	-	24	-	Inorganic Silts of Intermediate plasticity											
	29.50	D	25	18	32	36	68	28.11	ML	0	0	1	45	54	0	18.85	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	31.00	D	26	17	35	39	74	29.31	CL	4	2	3	18	66	7	12.61	-	-	27.0	20.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	32.50	D	27	18	28	33	61	25.10	-	-	-	-	-	-	-	16.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	17	35	50	85	31.50	CL	2	1	2	22	67	6	17.75	-	-	26.0	19.0	7.0	-	-	-	-	-	-	-	-	-	-												
	35.50	D	29	12	27	37	64	25.18	-	-	-	-	-	-	-	20.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	15	31	52	83	83.00	CL	0	1	1	14	73	11	18.90	-	-	31.0	20.0	11.0	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	17	34	55	89	89.00	CL	1	2	4	8	75	10	16.23	-	-	32.0	21.0	11.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	40.00	D	32	25	65	36	101	100.00	-	-	-	-	-	-	-	16.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No: P62	**Ground Elevation: RL 191.61 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.50 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 28/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 22540.287	**Casing Lowered: 21.00 m**	**Ending Date: 01/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	1	60	39	0	5.75	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	D	2	1	2	3	5	5.00	CI	2	1	1	10	69	17	22.85	-	-	38.0	21.0	17.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of Intermediate plasticity											
	2.00	U	3	-	-	-	-	-	CL	0	0	2	33	47	18	20.15	1.98	1.65	33.0	18.5	14.5	2.67	UU	46.0	7.5	0.182	0.618	-	17	15	-	Inorganic clays of low plasticity											
	3.00	D	4	4	6	10	16	17.68	CL	1	1	2	26	63	7	14.90	-	-	26.0	19.0	7.0	-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	7	11	14	25	22.58	SM	0	0	1	68	31	0	22.15	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	5.00	U	6	-	-	-	-	-	SM	0	0	0	71	29	0	21.34	1.90	1.57	Non-Plastic			2.63	DST	5.0	29.9	-	0.679	-	-	-	-												
	6.00	D	7	9	14	16	30	24.15	-	-	-	-	-	-	-	24.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	8	17	19	36	26.78	-	-	-	-	-	-	-	23.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	-	-	-	-	-	SM	0	0	1	65	34	0	24.69	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	5	8	11	19	17.02	ML	5	1	1	8	81	4	20.68	-	-	23.0	19.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	10.00	D	11	7	10	15	25	19.70	-	-	-	-	-	-	-	19.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL-ML	1	1	1	20	71	6	19.71	1.81	1.51	26.0	20.0	6.0	2.66	DST	11.0	25.2	-	0.762	-	-	-	-	Inorganic Silty Clays of low plasticity											
	12.50	D	13	6	11	17	28	20.36	-	-	-	-	-	-	-	18.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL	2	1	2	25	59	11	27.00	1.94	1.53	26.5	19.0	7.5	2.68	UU	40.0	8.1	-	0.752	-	9	19	-	Inorganic clays of low plasticity											
	15.50	D	15	8	15	18	33	21.56	CL-ML	3	2	3	20	65	7	18.81	-	-	25.0	19.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	17.00	U	16	-	-	-	-	-	CL	5	1	3	30	53	8	15.46	2.10	1.82	26.5	19.0	7.5	2.66	-	-	-	-	0.462	-	9	-	-	Inorganic clays of low plasticity											

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No: P62	**Ground Elevation: RL 191.61 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.50 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 28/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 22540.287	**Casing Lowered: 21.00 m**	**Ending Date: 01/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	9	17	19	36	36.00	-	-	-	-	-	-	-	17.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	20.00	U	18	-	-	-	-	-	CL	3	1	2	25	62	7	13.93	2.08	1.83	26.0	18.5	7.5	-	-	-	-	-	-	-	-	-	-												
	21.50	D	19	9	18	21	39	39.00	-	-	-	-	-	-	-	17.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.00	U	20	-	-	-	-	-	CL	1	0	1	26	60	12	23.51	1.85	1.50	29.5	18.5	11.0	2.67	UU	45.0	9.6	-	0.780	-	12	16	-												
	24.50	D	21	11	29	33	62	62.00	-	-	-	-	-	-	-	16.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	U	22	-	-	-	-	-	ML	1	0	1	26	72	0	23.79	1.92	1.55	Non-Plastic			2.65	DST	14.0	25.7	-	0.710	-	-	-	-	Inorganic Silts of low plasticity											
	27.50	D	23	10	23	27	50	50.00	CL	0	0	1	18	69	12	24.70	-	-	34.0	22.0	12.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	29.00	D	24	-	-	-	-	-	-	-	-	-	-	-	-	20.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	30.50	D	25	13	25	31	56	25.23	SM	9	2	4	36	49	0	16.60	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	32.00	D	26	-	-	-	-	-	-	-	-	-	-	-	-	20.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	33.50	D	27	15	28	34	62	26.25	ML	1	1	6	40	52	0	18.04	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	35.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	20.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	36.50	D	29	19	32	37	69	27.39	CL-ML	0	0	1	30	65	4	22.37	-	-	24.0	19.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	38.00	D	30	-	-	-	-	-	ML	0	0	1	45	54	0	19.76	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	40.00	D	31	20	29	33	62	62.00	CL	0	4	5	8	75	8	17.47	-	-	30.0	20.0	10.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed samples.

APPENDIX "B"
TABLE 3: SUMMARY OF TEST RESULTS

Bore No: P63	**Ground Elevation: RL 191.645 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.50 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 02/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 22566.487	**Casing Lowered: 22.00 m**	**Ending Date: 03/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	2	20	78	0	4.71	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	U	2	-	-	-	-	-	CI	2	2	1	27	48	20	22.48	1.78	1.45	43.0	21.0	22.0	2.70	-	-	-	-	0.862	-	-	-	-	Inorganic clays of Intermediate plasticity											
	2.00	D	3	1	1	2	3	3.00	-	-	-	-	-	-	-	19.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	2	2	4	6	6.00	-	-	-	-	-	-	-	20.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	U	5	-	-	-	-	-	CI	1	2	7	26	43	21	19.50	1.82	1.52	39.0	17.5	21.5	2.69	UU	54.0	9.1	0.210	0.770	-	15	14	-												
	5.00	D	6	3	5	7	12	12.00	-	-	-	-	-	-	-	19.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	3	7	11	18	17.92	SM	0	1	1	50	48	0	13.67	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	7.00	D	8	-	-	-	-	-	SM	0	0	1	80	19	0	24.21	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	5	10	16	26	21.44	SP-ML	4	3	28	54	11	0	19.16	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Poorly Graded Sands with inorganic Silts of low plasticity											
	9.00	D	10	7	12	19	31	23.57	-	-	-	-	-	-	-	16.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL-ML	1	2	3	9	79	6	19.87	1.92	1.60	25.0	19.0	6.0	2.66	DST	12.0	25.0	-	0.663	-	-	-	-	Inorganic Silty Clays of low plasticity											
	11.00	D	12	8	15	22	37	25.53	-	-	-	-	-	-	-	18.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	7	18	23	41	26.92	-	-	-	-	-	-	-	19.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	1	1	2	18	68	10	14.36	1.91	1.67	28.0	19.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	14.50	D	15	9	15	17	32	32.00	-	-	-	-	-	-	-	15.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	1	2	3	24	64	6	16.05	2.04	1.76	26.5	19.5	7.0	2.66	UU	50.0	13.4	-	0.511	-	0	17	-												
	17.50	D	17	8	20	24	44	44.00	CL	1	1	1	14	73	10	16.29	-	-	28.0	19.0	9.0	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 3: SUMMARY OF TEST RESULTS

Bore No: P63	**Ground Elevation: RL 191.645 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.50 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 02/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 22566.487	**Casing Lowered: 22.00 m**	**Ending Date: 03/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	ML	1	2	3	38	56	0	17.90	1.87	1.59	Non-Plastic			-	DST	22.0	25.3	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	20.50	D	19	11	19	30	49	26.45	CL	0	0	1	14	78	7	17.96	-	-	26.0	19.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	22.00	U	20	-	-	-	-	-	CL	0	1	3	13	70	13	20.00	2.11	1.76	32.0	20.0	12.0	2.67	UU	52.0	9.5	-	0.517	-	7	17	-												
	23.50	D	21	9	17	25	42	42.00	-	-	-	-	-	-	-	15.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	CL	1	0	2	17	70	10	17.02	2.09	1.79	28.0	19.0	9.0	2.67	UU	51.0	10.7	-	0.492	-	-	-	-												
	26.50	D	23	11	20	26	46	46.00	-	-	-	-	-	-	-	16.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	U	24	-	-	-	-	-	ML	1	1	1	42	55	0	17.11	1.78	1.52	Non-Plastic			2.64	DST	7.0	27.6	-	0.737	-	-	-	-	Inorganic Silts of low plasticity											
	29.50	D	25	10	21	28	49	49.00	MI	2	1	3	9	70	15	19.48	-	-	43.0	28.5	14.5	-	-	-	-	-	-	-	-	25	-	Inorganic Silts of Intermediate plasticity											
	31.00	D	26	13	22	30	52	52.00	-	-	-	-	-	-	-	31.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.50	D	27	15	25	32	57	57.00	-	-	-	-	-	-	-	25.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	-	-	-	-	-	CL-ML	1	1	3	32	58	5	19.92	-	-	25.0	19.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	35.50	D	29	12	28	30	58	24.66	CL-ML	1	1	4	32	56	6	18.26	-	-	26.5	20.5	6.0	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	MI	0	0	1	10	81	8	28.88	-	-	37.0	28.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	38.50	D	31	10	27	33	60	60.00	-	-	-	-	-	-	-	28.37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	12	28	37	65	65.00	CL	0	1	2	14	74	9	25.32	-	-	31.5	21.0	10.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 4: SUMMARY OF TEST RESULTS

Bore No: P64	**Ground Elevation: RL 191.728 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.60 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 28/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 22592.687	**Casing Lowered: 22.00 m**	**Ending Date: 30/09/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	1	44	55	0	11.03	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	D	2	2	2	2	4	4.00	CL	0	1	2	34	48	15	20.55	-	-	33.0	19.5	13.5	-	-	-	-	-	-	-	8	15	-	Inorganic clays of low plasticity											
	2.00	U	3	-	-	-	-	-	ML	9	7	14	16	54	0	17.12	2.10	1.79	Non-Plastic			2.66	DST	0.0	23.1	-	0.486	-	-	-	-	Inorganic Silts of low plasticity											
	3.00	D	4	6	6	7	13	15.57	ML	0	0	1	43	56	0	19.65	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	7	9	11	20	19.23	SM	5	2	2	60	31	0	18.84	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	5.00	D	6	-	-	-	-	-	-	-	-	-	-	-	-	28.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	3	5	8	13	13.99	-	-	-	-	-	-	-	29.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	4	6	9	15	15.30	SM	0	1	1	68	30	0	25.03	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	8.00	U	9	-	-	-	-	-	SM	5	7	11	42	35	0	13.76	1.92	1.69	Non-Plastic			2.64	DST	7.0	26.7	-	0.562	-	-	-	-												
	9.00	D	10	9	10	14	24	24.00	CL	2	2	3	9	76	8	17.79	-	-	26.5	19.0	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	10.00	D	11	10	14	17	31	31.00	-	-	-	-	-	-	-	19.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL	5	3	4	8	71	9	20.63	1.96	1.62	27.0	19.0	8.0	-	DST	16.0	23.2	-	-	-	-	-	-												
	12.50	D	13	6	12	15	27	27.00	-	-	-	-	-	-	-	19.67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL	3	1	2	12	73	9	19.61	1.98	1.66	27.5	20.0	7.5	2.67	UU	41.0	11.1	0.141	0.613	-	8	17	-												
	15.50	D	15	8	14	18	32	32.00	-	-	-	-	-	-	-	18.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	U	16	-	-	-	-	-	SM	0	1	1	53	45	0	17.23	1.81	1.54	Non-Plastic			2.65	DST	5.0	26.8	-	0.716	-	-	-	-	Silty Sands											
	18.50	D	17	6	13	16	29	18.80	CL-ML	0	0	1	38	55	6	17.52	-	-	25.0	20.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											

APPENDIX "B"
TABLE 4: SUMMARY OF TEST RESULTS

Bore No: P64	**Ground Elevation: RL 191.728 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.60 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 28/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 22592.687	**Casing Lowered: 22.00 m**	**Ending Date: 30/09/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	20.00	U	18	-	-	-	-	-	CL	1	1	3	12	73	10	19.20	1.98	1.66	29.0	19.0	10.0	2.67	UU	46.0	11.2	-	0.608	-	9	-	-	Inorganic clays of low plasticity											
	21.50	D	19	9	14	19	33	33.00	-	-	-	-	-	-	-	19.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.00	U	20	-	-	-	-	-	CL	2	1	2	15	71	9	20.27	1.92	1.60	29.0	20.5	8.5	2.66	UU	42.0	12.5	-	0.663	-	-	16	-												
	24.50	D	21	10	24	42	66	66.00	-	-	-	-	-	-	-	19.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	D	22	-	-	-	-	-	CL-ML	0	0	1	38	57	4	19.75	-	-	24.0	19.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	27.50	D	23	12	26	30	56	25.89	CL-ML	1	1	1	12	78	7	18.30	-	-	26.0	20.0	6.0	-	-	-	-	-	-	-	-	-	-												
	29.00	U	24	-	-	-	-	-	SM	3	2	4	46	45	0	16.91	1.96	1.68	Non-Plastic			2.64	DST	4.0	28.9	-	0.571	-	-	-	-	Silty Sands											
	30.50	D	25	10	26	33	59	25.90	-	-	-	-	-	-	-	16.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.00	D	26	-	-	-	-	-	CL-ML	0	0	1	18	76	5	20.36	-	-	24.0	19.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	33.50	D	27	12	28	35	63	63.00	CL	3	0	2	9	76	10	9.69	-	-	28.0	20.0	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	35.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	19.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	36.50	D	29	10	29	38	67	67.00	-	-	-	-	-	-	-	13.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	-	-	-	-	-	CL	1	1	2	11	76	9	16.11	-	-	28.0	19.0	9.0	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	14	32	51	83	30.25	CL-ML	0	0	1	20	74	5	19.32	-	-	24.0	19.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"

TABLE 5: SUMMARY OF TEST RESULTS

Bore No: P65	Ground Elevation: RL 191.825 m	Method of drilling: Percussion	Depth of Water-table: 1.60 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 01/10/2023	SPT Sampler: Standard
Location / Chainage: 22618.887	Casing Lowered: 20.00 m	Ending Date: 02/10/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	1	40	59	0	11.40	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	U	2	-	-	-	-	-	CL	2	2	2	42	38	14	20.68	2.01	1.67	34.0	19.0	15.0	2.67	-	-	-	-	0.603	-	11	16	-	Inorganic clays of low plasticity											
	2.00	D	3	2	2	3	5	6.71	SM	0	1	0	57	42	0	12.71	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	3.00	D	4	2	5	5	10	10.00	CL	0	1	1	44	45	9	20.77	-	-	28.0	19.5	8.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	4.00	U	5	-	-	-	-	-	SM	1	2	1	78	18	0	18.61	1.91	1.61	Non-Plastic			2.62	DST	0.0	32.7	-	0.627	-	-	-	-												
	5.00	D	6	3	7	8	15	16.11	-	-	-	-	-	-	-	18.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	4	9	11	20	18.54	-	-	-	-	-	-	-	27.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Silty Sands											
	7.00	U	8	-	-	-	-	-	SM	4	3	5	68	20	0	10.92	2.00	1.80	Non-Plastic			2.63	DST	0.0	30.5	-	0.461	-	-	-	-												
	8.00	D	9	6	10	15	25	20.30	-	-	-	-	-	-	-	23.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	4	7	9	16	15.42	ML	0	0	1	22	72	5	22.01	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	ML	2	2	2	7	81	6	22.59	1.96	1.60	29.5	23.5	6.0	2.66	DST	12.0	25.3	0.138	0.663	-	0	18	-	Inorganic Silts of low plasticity											
	11.00	D	12	5	6	10	16	14.93	-	-	-	-	-	-	-	23.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	5	6	11	17	15.22	CL	1	1	2	9	80	7	18.81	-	-	29.0	22.0	7.0	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	1	2	4	8	76	9	18.07	2.01	1.70	27.0	19.0	8.0	2.67	DST	12.0	25.9	-	0.571	-	-	-	-												
	14.50	D	15	6	12	18	30	20.25	CL	2	1	2	11	78	6	21.11	-	-	26.0	19.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	16.00	D	16	-	-	-	-	-	-	-	-	-	-	-	-	17.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.50	D	17	6	10	13	23	16.67	-	-	-	-	-	-	-	18.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 5: SUMMARY OF TEST RESULTS

Bore No: P65	**Ground Elevation: RL 191.825 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.60 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 01/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 22618.887	**Casing Lowered: 20.00 m**	**Ending Date: 02/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	D	18	-	-	-	-	-	CL	0	2	2	9	76	11	14.28	-	-	28.0	20.0	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	20.50	D	19	6	11	16	27	27.00	-	-	-	-	-	-	-	22.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	CL	4	7	7	10	62	10	17.18	1.99	1.70	28.0	19.0	9.0	2.67	UU	47.0	12.5	-	0.571	-	-	-	-												
	23.50	D	21	10	22	30	52	52.00	-	-	-	-	-	-	-	16.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	-	-	-	-	-	-	-	20.66	2.10	1.74	-	-	-	2.68	-	-	-	-	0.540	-	-	-	-												
	26.50	D	23	11	17	24	41	21.06	ML	3	0	0	24	73	0	21.89	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	28.00	U	24	-	-	-	-	-	CL	0	0	1	27	64	8	16.96	2.08	1.78	27.5	17.0	10.5	2.67	UU	59.0	10.6	-	0.500	-	-	-	-	Inorganic clays of low plasticity											
	29.50	D	25	6	10	12	22	22.00	-	-	-	-	-	-	-	17.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	U	26	-	-	-	-	-	CL	5	8	8	25	46	8	16.26	2.10	1.81	26.5	19.5	7.0	2.66	UU	54.0	10.6	-	0.470	-	-	-	-												
	32.50	D	27	10	21	29	50	22.26	-	-	-	-	-	-	-	16.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	17.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	35.50	D	29	13	26	33	59	59.00	CL	1	1	1	18	69	10	12.75	-	-	28.0	19.0	9.0	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	17.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	9	16	28	44	19.45	ML	0	1	1	29	63	6	19.78	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	40.00	D	32	10	21	35	56	22.40	CL-ML	0	0	1	22	71	6	19.07	-	-	24.5	19.5	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 6: SUMMARY OF TEST RESULTS

Bore No: P66	**Ground Elevation: RL 191.818 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.50 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 28/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 22645.087	**Casing Lowered: 19.50 m**	**Ending Date: 30/09/2023**	**Hammer type: Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen												
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL												
	0.50	D	1	-	-	-	-	-	ML	0	1	1	45	53	0	10.35	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity												
	1.00	U	2	-	-	-	-	-	SM	0	0	1	63	36	0	14.89	1.93	1.68	Non-Plastic			2.64	-	-	-	-	0.571	-	-	-	-	Silty Sands												
	2.00	D	3	1	2	4	6	8.20	ML	2	5	8	33	47	5	17.75	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	18	-	Inorganic Silts of low plasticity												
	3.00	D	4	1	2	2	4	5.14	-	-	-	-	-	-	-	17.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	4.00	U	5	-	-	-	-	-	CL	0	1	2	44	41	12	19.74	2.03	1.70	27.5	18.5	9.0	2.67	UU	34.0	8.1	0.132	0.575	-	0	17	-	Inorganic clays of low plasticity												
	5.00	D	6	8	6	8	14	15.58	SM	1	1	1	76	21	0	24.14	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands												
	6.00	D	7	3	2	6	8	8.83	-	-	-	-	-	-	-	23.58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	7.00	D	8	-	-	-	-	-	SP-ML	1	1	3	86	9	0	19.49	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Poorly Graded Sands with inorganic Silts of low plasticity												
	8.00	D	9	10	18	28	46	31.28	SM	3	5	15	62	15	0	15.81	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands												
	9.00	D	10	3	7	8	15	14.97	CL	7	6	4	9	67	7	18.13	-	-	27.0	20.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity												
	10.00	U	11	-	-	-	-	-	ML	3	2	3	12	76	4	23.87	2.03	1.64	24.0	20.0	4.0	2.65	DST	17.0	25.3	-	0.616	-	-	18	-	Inorganic Silts of low plasticity												
	11.00	D	12	8	10	13	23	18.26	-	-	-	-	-	-	-	2.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	12.00	D	13	7	8	14	22	22.00	CL	2	1	1	6	81	9	20.40	-	-	27.0	19.0	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity												
	13.00	U	14	-	-	-	-	-	-	-	-	-	-	-	-	19.28	2.01	1.69	-	-	-	2.67	UU	48.0	7.5	-	0.585	-	-	-	-													
	14.50	D	15	4	6	8	14	14.00	-	-	-	-	-	-	-	20.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	16.00	U	16	-	-	-	-	-	CL	2	1	1	31	57	8	17.30	2.16	1.84	27.0	20.0	7.0	2.66	DST	16.0	25.5	-	0.446	-	-	-	-	Inorganic clays of low plasticity												
	17.50	D	17	11	25	32	57	29.83	-	-	-	-	-	-	-	21.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													

APPENDIX "B"

TABLE 6: SUMMARY OF TEST RESULTS

Bore No: P66	**Ground Elevation: RL 191.818 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.50 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 28/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 22645.087	**Casing Lowered: 19.50 m**	**Ending Date: 30/09/2023**	**Hammer type: Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL-ML	2	4	7	35	45	7	18.82	2.14	1.80	25.5	19.5	6.0	2.66	DST	15.0	24.5	-	0.478	-	-	-	-	Inorganic Silty Clays of low plasticity											
	20.50	D	19	18	30	34	64	30.82	-	-	-	-	-	-	-	18.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	D	20	10	27	31	58	27.93	ML	0	2	1	42	55	0	18.74	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	23.50	D	21	15	30	33	63	63.00	CL	1	1	1	12	76	9	20.21	-	-	28.0	19.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	25.00	U	22	-	-	-	-	-	CL	3	1	2	35	52	7	16.00	2.02	1.74	27.0	20.0	7.0	2.67	UU	39.0	12.1	-	0.534	-	-	-	-												
	26.50	D	23	10	12	40	52	52.00	CL	0	1	1	10	79	9	31.20	-	-	29.0	21.0	8.0	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	-	-	-	-	-	-	-	-	-	-	-	-	31.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.50	D	25	9	13	36	49	49.00	CL	0	1	2	16	68	13	20.06	-	-	29.0	18.0	11.0	-	-	-	-	-	-	-	-	-	-												
	31.00	U	26	-	-	-	-	-	CL	3	2	4	23	56	12	17.29	1.96	1.67	28.0	19.0	9.0	2.68	UU	49.0	11.2	-	0.605	-	-	-	-												
	32.50	D	27	8	29	30	59	24.79	CL-ML	2	1	2	27	61	7	18.66	-	-	25.5	19.0	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	34.00	D	28	-	-	-	-	-	CL-ML	1	2	3	24	63	7	19.16	-	-	26.0	20.0	6.0	-	-	-	-	-	-	-	-	-	-												
	35.50	D	29	14	26	31	57	23.50	CL-ML	3	3	5	31	52	6	17.60	-	-	25.0	19.0	6.0	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	17.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	17	27	33	60	60.00	CL	2	1	1	18	67	11	18.89	-	-	28.0	19.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	40.00	D	32	17	33	40	73	73.00	-	-	-	-	-	-	-	19.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 7: SUMMARY OF TEST RESULTS

Bore No: P67	**Ground Elevation: RL 191.985 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.80 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 30/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 22671.287	**Casing Lowered: 17.00 m**	**Ending Date: 02/10/2023**	**Hammer type: Rope-pulley/ Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	1	45	54	0	7.82	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	D	2	2	3	5	8	12.31	CL	0	1	2	34	56	7	18.18	-	-	26.0	19.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	2.00	U	3	-	-	-	-	-	CL-ML	3	4	8	29	49	7	17.24	2.01	1.71	25.0	19.0	6.0	2.65	DST	12.0	27.5	-	0.549	-	0	17	-	Inorganic Silty Clays of low plasticity											
	3.00	D	4	1	2	3	5	6.23	ML	1	1	2	27	64	5	16.57	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	4.00	D	5	2	3	4	7	8.28	SM	0	0	0	82	18	0	25.08	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	5.00	D	6	-	-	-	-	-	-	-	-	-	-	-	-	24.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	5	9	11	20	18.32	-	-	-	-	-	-	-	26.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	6	10	12	22	18.97	SM	0	0	1	84	15	0	22.85	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	-	-	-	-	-	-	-	-	-	-	-	-	26.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	5	6	8	14	14.00	CL	3	1	2	10	78	6	17.83	-	-	26.0	18.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	10.00	D	11	7	9	12	21	21.00	-	-	-	-	-	-	-	21.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL-ML	0	0	1	24	70	5	22.00	2.00	1.64	25.0	19.0	6.0	2.66	DST	16.0	24.8	-	0.622	-	-	-	-	Inorganic Silty Clays of low plasticity											
	12.50	D	13	5	7	11	18	15.51	-	-	-	-	-	-	-	18.47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL	2	2	1	13	73	9	18.56	2.07	1.75	28.5	20.0	8.5	2.67	UU	54.0	14.3	0.148	0.526	-	9	17	-	Inorganic clays of low plasticity											
	15.50	D	15	8	10	15	25	25.00	-	-	-	-	-	-	-	21.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	U	16	-	-	-	-	-	CL	3	2	2	24	60	9	14.78	2.06	1.80	27.0	19.0	8.0	2.66	DST	16.0	23.8	-	0.481	-	-	-	-												
	18.50	D	17	7	10	17	27	17.81	ML	1	1	1	42	55	0	20.58	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											

APPENDIX "B"

TABLE 7: SUMMARY OF TEST RESULTS

Bore No: P67	**Ground Elevation: RL 191.985 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.80 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 30/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 22671.287	**Casing Lowered: 17.00 m**	**Ending Date: 02/10/2023**	**Hammer type: Rope-pulley/ Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	20.00	D	18	-	-	-	-	-	SM	1	0	1	83	15	0	10.29	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	21.50	D	19	8	16	20	36	36.00	CL	2	1	3	10	73	11	20.00	-	-	29.0	18.5	10.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	23.00	U	20	-	-	-	-	-	CL	3	4	4	19	60	10	16.23	2.08	1.79	28.0	18.0	10.0	2.67	UU	46.0	12.2	-	0.492	-	-	-	-												
	24.50	D	21	8	18	33	51	24.61	CL	1	1	1	16	74	7	19.67	-	-	26.0	19.0	7.0	-	-	-	-	-	-	-	-	-	-												
	26.00	D	22	-	-	-	-	-	CL	0	1	1	10	78	10	17.75	-	-	28.0	19.0	9.0	-	-	-	-	-	-	-	-	-	-												
	27.50	D	23	10	21	36	57	25.51	ML	0	0	0	4	90	6	28.32	-	-	31.0	24.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	29.00	U	24	-	-	-	-	-	CL	7	1	3	23	57	9	17.03	2.12	1.81	27.0	19.0	8.0	2.67	DST	14.0	24.0	-	0.475	-	-	-	-	Inorganic clays of low plasticity											
	30.50	D	25	12	27	38	65	26.89	CL-ML	1	1	1	18	74	5	17.86	-	-	25.0	19.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	32.00	D	26	-	-	-	-	-	SM	1	1	3	70	25	0	19.08	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	33.50	D	27	21	33	40	73	28.34	-	-	-	-	-	-	-	18.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	35.00	D	28	23	36	43	79	79.00	CL	2	7	9	19	54	9	14.76	-	-	28.0	19.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	36.50	D	29	27	39	47	86	31.08	SM	0	1	5	62	32	0	15.74	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	38.00	D	30	23	37	51	88	31.15	-	-	-	-	-	-	-	16.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	29	38	54	92	31.58	-	-	-	-	-	-	-	15.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 8: SUMMARY OF TEST RESULTS

Bore No: P68	**Ground Elevation: RL 191.917 m**	**Method of drilling: Rotary**	**Depth of Water-table: 1.60 m**
Diameter of Bore Hole: 150 m	**Bore Retained using: Casing**	**Starting Date: 03/11/2023**	**SPT Sampler: Standard**
Location / Chainage: 22697.487	**Casing Lowered: 0.00 m**	**Ending Date: 06/11/2023**	**Hammer type: Rope pulley**

FIELD TEST RESULT									LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Correct N)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	2	1	3	55	39	0	5.56	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	D	2	2	2	3	5	7.74	CL-ML	0	0	1	47	47	5	16.90	-	-	25.0	20.5	4.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	2.00	U	3	-	-	-	-	-	SM-SC	0	0	1	52	43	4	11.12	1.96	1.76	24.0	19.0	5.0	2.66	DST	5.0	26.5	-	0.511	-	-	-	-	Silty Sands with clay binder											
	3.00	D	4	3	5	7	12	15.13	SM	3	1	1	56	39	0	18.31	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	D	5	5	8	8	16	17.15	-	-	-	-	-	-	-	21.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	5.00	D	6	-	-	-	-	-	SM	14	0	0	62	24	0	16.61	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	4	9	11	20	18.51	SM	4	0	0	72	24	0	25.15	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	5	8	10	18	17.05	-	-	-	-	-	-	-	15.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	U	9	-	-	-	-	-	SM	10	3	3	65	19	0	17.20	1.93	1.65	Non-Plastic			2.61	DST	0.0	30.2	-	0.582	-	-	-	-												
	9.00	D	10	6	9	11	20	17.44	SM	0	0	0	76	24	0	23.68	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	6	7	9	16	15.22	-	-	-	-	-	-	-	23.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL	1	1	2	12	76	8	23.61	2.02	1.63	26.0	19.0	7.0	2.67	UU	44.0	11.4	0.128	0.634	-	9	18	-	Inorganic clays of low plasticity											
	12.50	D	13	8	10	17	27	19.60	-	-	-	-	-	-	-	21.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL	7	3	3	7	69	11	20.03	2.04	1.70	29.0	21.0	8.0	2.67	UU	57.0	9.7	-	0.571	-	-	-	-												
	15.50	D	15	9	12	16	28	28.00	CL	0	0	1	5	84	10	17.73	-	-	30.0	22.0	8.0	-	-	-	-	-	-	-	-	-	-												
	17.00	U	16	-	-	-	-	-	CL	4	1	2	9	72	12	17.61	2.02	1.72	29.0	19.0	10.0	2.68	UU	60.0	8.1	-	0.558	-	-	-	-												

APPENDIX "B"
TABLE 8: SUMMARY OF TEST RESULTS

Bore No: P68	**Ground Elevation: RL 191.917 m**	**Method of drilling: Rotary**	**Depth of Water-table: 1.60 m**
Diameter of Bore Hole: 150 m	**Bore Retained using: Casing**	**Starting Date: 03/11/2023**	**SPT Sampler: Standard**
Location / Chainage: 22697.487	**Casing Lowered: 0.00 m**	**Ending Date: 06/11/2023**	**Hammer type: Rope pulley**

FIELD TEST RESULT									LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Correct N)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	11	17	20	37	37.00	-	-	-	-	-	-	-	14.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	20.00	U	18	-	-	-	-	-	CL	3	1	2	16	69	9	19.13	2.03	1.70	28.0	19.0	9.0	2.67	UU	52.0	10.5	-	0.571	-	-	-	-												
	21.50	D	19	8	15	17	32	32.00	CL	3	0	1	5	79	12	16.96	-	-	32.0	20.5	11.5	-	-	-	-	-	-	-	-	-	-												
	23.00	U	20	-	-	-	-	-	CL	2	1	2	6	79	10	22.63	2.06	1.68	30.0	20.5	9.5	2.68	UU	62.0	7.8	-	0.595	-	-	-	-												
	24.50	D	21	9	19	20	39	39.00	-	-	-	-	-	-	-	20.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	U	22	-	-	-	-	-	CL	0	1	2	6	79	12	23.64	2.03	1.64	31.0	21.0	10.0	2.68	UU	57.0	9.3	-	0.634	-	-	-	-												
	27.50	D	23	11	25	27	52	52.00	-	-	-	-	-	-	-	23.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.00	D	24	13	24	30	54	54.00	CL	2	1	1	4	78	14	17.62	-	-	34.0	21.0	13.0	-	-	-	-	-	-	-	-	-	-												
	30.50	D	25	14	26	35	61	61.00	-	-	-	-	-	-	-	23.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.00	D	26	17	30	37	67	67.00	-	-	-	-	-	-	-	24.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	33.50	D	27	19	32	40	72	28.45	SM-SC	2	1	2	52	38	5	18.81	-	-	23.0	19.0	4.0	-	-	-	-	-	-	-	-	-	-	Silty Sands with clay binder											
	35.00	D	28	21	35	42	77	29.51	-	-	-	-	-	-	-	8.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	36.50	D	29	17	25	27	52	52.00	CL	0	0	1	22	69	8	20.47	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	38.00	D	30	23	29	35	64	64.00	-	-	-	-	-	-	-	21.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	29	101	-	R	-	CL	4	1	2	14	68	11	14.73	-	-	30.0	20.5	9.5	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"

TABLE 9: SUMMARY OF TEST RESULTS

Bore No: P69	**Ground Elevation: RL 191.999 m**	**Method of drilling: Rotary**	**Depth of Water-table: 1.70 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date : 03/11/2023**	**SPT Sampler: Standard**
Location / Chainage: 22723.6870	**Casing Lowered: 0.00 m**	**Ending Date: 06/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT									LABORATORY TEST RESULT																							
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic				Shrinkage		Test on Rock Specimen
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Correct N)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %, R.Q.D %, Density (gm/cc), Specific gravity, Moisture content (%), Water absorption (%), Point load Index, U.C.S (MPa), Porosity, Hardness, Modulus of Elasticity, Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL
	0.50	D	1	-	-	-	-	-	SM	0	0	1	52	47	0	6.78	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands
	1.00	D	2	1	2	2	4	6.20	CL-ML	0	0	1	42	50	7	20.78	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity
	2.00	U	3	-	-	-	-	-	SM	0	0	1	53	46	0	20.86	1.94	1.60	Non-Plastic			2.64	DST	4.0	27.2	-	0.645	-	-	-	-	Silty Sands
	3.00	D	4	3	4	6	10	12.68	CL-ML	4	3	7	22	57	7	14.59	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	6	18	-	Inorganic Silty Clays of low plasticity
	4.00	D	5	4	5	7	12	14.45	-	-	-	-	-	-	-	16.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	5.00	U	6	-	-	-	-	-	SM	0	0	1	68	31	0	18.45	1.93	1.63	Non-Plastic			2.63	DST	0.0	29.1	-	0.613	-	-	-	-	Silty Sands
	6.00	D	7	3	6	9	15	15.80	SM	0	0	0	72	28	0	20.29	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	
	7.00	D	8	4	8	9	17	16.56	-	-	-	-	-	-	-	20.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	8.00	U	9	-	-	-	-	-	SM	0	1	1	62	36	0	19.57	1.96	1.64	Non-Plastic			2.61	DST	0.0	28.8	-	0.591	-	-	-	-	
	9.00	D	10	4	6	9	15	14.94	CL-ML	0	1	1	14	77	7	18.95	-	-	27.0	20.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity
	10.00	D	11	4	5	7	12	11.59	-	-	-	-	-	-	-	19.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	11.00	U	12	-	-	-	-	-	CL	2	0	1	10	79	8	20.73	2.02	1.67	28.0	21.0	7.0	2.67	UU	47.0	11.8	-	0.599	-	-	-	-	Inorganic clays of low plasticity
	12.50	D	13	5	7	11	18	15.57	-	-	-	-	-	-	-	20.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	14.00	U	14	-	-	-	-	-	CL	4	2	1	8	73	12	20.53	2.04	1.69	30.0	21.5	8.5	2.68	UU	57.0	10.2	-	0.586	-	14	17	-	
	15.50	D	15	7	12	15	27	27.00	-	-	-	-	-	-	-	18.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	17.00	U	16	-	-	-	-	-	CL-ML	2	1	1	32	58	6	21.20	1.96	1.62	26.0	20.0	6.0	2.66	DST	8.0	24.7	-	0.642	-	-	-	-	Inorganic Silty Clays of low plasticity

APPENDIX "B"
TABLE 9: SUMMARY OF TEST RESULTS

Bore No: P69	**Ground Elevation: RL 191.999 m**	**Method of drilling: Rotary**	**Depth of Water-table: 1.70 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date : 03/11/2023**	**SPT Sampler: Standard**
Location / Chainage: 22723.6870	**Casing Lowered: 0.00 m**	**Ending Date: 06/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT									LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic				Shrinkage		Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Correct N)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	11	20	24	44	44.00	CL	4	1	3	11	69	12	16.20	-	-	29.0	20.5	8.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	20.00	U	18	-	-	-	-	-	CL	1	0	1	14	74	10	16.19	2.01	1.73	28.0	20.5	7.5	2.67	UU	48.0	12.0	-	0.543	-	-	-	-												
	21.50	D	19	7	14	21	35	35.00	-	-	-	-	-	-	-	16.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.00	U	20	-	-	-	-	-	CL-ML	2	1	1	24	65	7	19.44	2.03	1.70	26.0	20.0	6.0	2.66	UU	44.0	11.3	-	0.565	-	-	-	-	Inorganic Silty Clays of low plasticity											
	24.50	D	21	14	20	23	43	43.00	CL	0	1	1	12	75	11	17.87	-	-	28.0	19.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	26.00	U	22	-	-	-	-	-	MI	0	1	1	7	77	14	25.92	2.04	1.62	36.0	27.0	9.0	2.69	UU	65.0	8.2	-	0.660	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	27.50	D	23	17	23	28	51	51.00	-	-	-	-	-	-	-	26.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.00	D	24	19	25	35	60	26.37	CL-ML	1	1	2	24	65	7	19.09	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	30.50	D	25	25	35	38	73	73.00	CL	0	0	2	14	74	10	19.19	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	32.00	D	26	15	25	39	64	64.00	CI	1	0	0	5	74	20	27.22	-	-	38.0	24.0	14.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of Intermediate plasticity											
	33.50	D	27	19	29	38	67	67.00	CL	4	2	2	8	72	12	12.08	-	-	32.0	21.5	10.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	35.00	D	28	21	32	43	75	75.00	CL	0	0	2	14	75	9	14.80	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-												
	36.50	D	29	27	42	50	92	92.00	-	-	-	-	-	-	-	20.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	24	39	45	84	84.00	CL	0	1	1	7	79	12	16.64	-	-	30.0	20.5	9.5	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	20	39	74	R	-	-	-	-	-	-	-	-	15.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 10: SUMMARY OF TEST RESULTS

Bore No : P70	**Ground Elevation : RL 192.161 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.60 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 03/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 22749.887	**Casing Lowered : 20.00 m**	**Ending Date : 05/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	1	30	65	4	12.40	-	-	20.0	16.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	U	2	-	-	-	-	-	CL	1	0	1	37	54	7	19.94	2.04	1.70	27.5	20.5	7.0	2.66	DST	7.0	24.5	0.146	0.565	-	-	-	-	Inorganic clays of low plasticity											
	2.00	D	3	1	1	2	3	3.00	CL	0	1	1	34	56	8	20.71	-	-	29.0	20.0	9.0	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	2	3	4	7	8.77	CL-ML	0	2	2	36	55	5	20.75	-	-	24.0	19.5	4.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	4.00	U	5	-	-	-	-	-	SM	0	0	1	60	39	0	11.73	1.86	1.66	Non-Plastic			2.63	DST	3.0	28.5	-	0.580	-	-	-	-	Silty Sands											
	5.00	D	6	3	4	6	10	11.49	SM	0	0	1	66	33	0	25.31	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	3	3	5	8	8.86	-	-	-	-	-	-	-	24.75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	-	-	-	-	-	SM	0	0	0	62	38	0	25.17	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	5	6	8	14	14.45	SM	0	0	0	74	26	0	23.68	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	5	7	10	17	15.97	-	-	-	-	-	-	-	21.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	ML	0	0	1	27	66	6	22.02	2.04	1.67	29.5	24.0	5.5	2.65	DST	8.0	25.8	-	0.587	-	-	-	-	Inorganic Silts of low plasticity											
	11.00	D	12	4	7	11	18	15.91	-	-	-	-	-	-	-	22.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	3	6	9	15	13.60	-	-	-	-	-	-	-	24.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	0	1	2	11	74	12	18.00	2.06	1.75	31.5	20.0	11.5	2.67	UU	46.0	8.1	-	0.529	-	17	16	-	Inorganic clays of low plasticity											
	14.50	D	15	3	5	10	15	15.00	ML	0	0	0	11	79	10	19.95	-	-	34.0	26.0	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	16.00	U	16	-	-	-	-	-	CL	1	1	1	46	44	7	17.12	2.06	1.76	26.5	19.0	7.5	2.67	UU	48.0	9.6	-	0.518	-	-	-	-	Inorganic clays of low plasticity											
	17.50	D	17	5	8	10	18	14.13	CL	1	2	2	28	59	8	19.34	-	-	27.0	20.0	7.0	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 10: SUMMARY OF TEST RESULTS

Bore No : P70	**Ground Elevation : RL 192.161 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.60 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 03/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 22749.887	**Casing Lowered : 20.00 m**	**Ending Date : 05/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	SC	6	4	6	34	42	8	16.22	2.07	1.78	28.0	20.5	7.5	2.67	-	-	-	-	0.500	-	8	17	-	Clayey Sands											
	20.50	D	19	7	9	11	20	20.00	CL	9	6	5	21	52	7	20.58	-	-	29.0	21.0	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	22.00	U	20	-	-	-	-	-	CL	1	1	2	11	74	11	20.45	1.99	1.65	30.0	19.0	11.0	2.68	UU	56.0	9.5	-	0.624	-	-	-	-												
	23.50	D	21	8	12	15	27	27.00	CL	2	1	2	12	73	10	21.24	-	-	29.0	18.0	11.0	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	CL	1	1	4	15	69	10	18.20	2.03	1.72	30.5	21.0	9.5	2.67	UU	59.0	10.2	-	0.552	-	8	15	-												
	26.50	D	23	10	14	17	31	31.00	MI	0	0	0	3	84	13	23.46	-	-	36.0	27.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	28.00	U	24	-	-	-	-	-	CI	5	4	4	3	70	14	19.00	2.04	1.71	36.0	24.0	12.0	2.68	UU	54.0	8.2	-	0.564	-	-	-	-	Inorganic clays of Intermediate plasticity											
	29.50	D	25	9	12	16	28	28.00	-	-	-	-	-	-	-	21.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	-	-	-	-	-	CL	0	1	0	25	64	10	20.28	-	-	29.5	19.0	10.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	32.50	D	27	11	15	21	36	36.00	CL	0	0	1	26	62	11	20.28	-	-	32.5	19.5	13.0	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	-	-	-	-	-	SM	0	0	2	49	49	0	20.25	1.96	1.63	Non-Plastic			2.63	RDST	0.0	27.4	-	0.613	-	-	-	-	Silty Sands											
	35.50	D	29	12	23	32	55	22.95	-	-	-	-	-	-	-	20.37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	ML	0	1	1	36	58	4	19.13	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	38.50	D	31	15	30	35	65	24.99	ML	1	1	2	38	58	0	19.61	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	17	32	40	72	26.49	-	-	-	-	-	-	-	17.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 11: SUMMARY OF TEST RESULTS

Bore No : P71	**Ground Elevation : RL 192.287 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.70 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 03/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22776.087	**Casing Lowered : 12.00 m**	**Ending Date : 05/11/2023**	**Hammer type: Rope pulley**

FIELD TEST RESULT									LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Correct N)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	1	44	55	0	3.95	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	D	2	1	1	2	3	4.69	ML	0	0	1	48	47	4	11.05	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-												
	2.00	D	3	-	-	-	-	-	CL-ML	0	1	1	18	74	6	21.41	1.86	1.53	27.0	21.0	6.0	2.66	RUU	41.0	11.2	-	0.739	-	-	-	-	Inorganic Silty Clays of low plasticity											
	3.00	D	4	2	2	3	5	5.00	CL	5	2	1	12	71	9	21.26	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	17	-	Inorganic clays of low plasticity											
	4.00	D	5	3	4	5	9	9.00	-	-	-	-	-	-	-	19.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	5.00	D	6	-	-	-	-	-	SM	0	0	0	64	36	0	23.83	2.01	1.62	Non Plastic			-	RDST	0.0	28.4	-	-	-	-	-	-	Silty Sands											
	6.00	D	7	3	3	4	7	7.80	-	-	-	-	-	-	-	25.97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	4	4	6	10	10.70	-	-	-	-	-	-	-	22.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	U	9	-	-	-	-	-	SM	0	0	1	68	31	0	21.14	1.94	1.60	Non Plastic			2.61	DST	0.0	28.6	-	0.631	-	-	-	-												
	9.00	D	10	6	9	10	19	19.00	CL	3	1	2	8	76	10	21.50	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	19	-	Inorganic clays of low plasticity											
	10.00	D	11	7	10	12	22	22.00	-	-	-	-	-	-	-	21.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	ML	2	1	1	18	74	4	21.23	1.99	1.64	26.0	22.0	4.0	2.66	DST	11.0	24.8	-	0.622	-	-	-	-	Inorganic Silts of low plasticity											
	12.50	D	13	10	12	15	27	19.69	-	-	-	-	-	-	-	21.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL	3	2	2	7	75	11	24.04	2.10	1.69	29.5	21.0	8.5	-	UU	58.0	9.2	-	-	-	-	-	-	Inorganic clays of low plasticity											
	15.50	D	15	10	14	17	31	31.00	-	-	-	-	-	-	-	20.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	U	16	-	-	-	-	-	ML	2	1	2	42	53	0	14.70	1.96	1.71	Non Plastic			2.62	DST	2.0	27.2	-	0.532	-	-	-	-	Inorganic Silts of low plasticity											

APPENDIX "B"
TABLE 11: SUMMARY OF TEST RESULTS

Bore No : P71	**Ground Elevation : RL 192.287 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.70 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 03/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22776.087	**Casing Lowered : 12.00 m**	**Ending Date : 05/11/2023**	**Hammer type: Rope pulley**

FIELD TEST RESULT									LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Correct N)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	12	17	21	38	22.26	CL-ML	4	5	7	18	59	7	15.21	-	-	27.0	20.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	20.00	D	18	-	-	-	-	-	CL	2	1	1	11	75	10	20.65	2.06	1.71	28.5	21.5	7.0	2.67	RUU	51.0	10.3	-	0.561	-	-	-	-	Inorganic clays of low plasticity											
	21.50	D	19	12	16	23	39	21.66	-	-	-	-	-	-	-	21.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.00	D	20	-	-	-	-	-	ML	3	2	2	34	54	5	20.43	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	24.50	D	21	16	22	20	42	21.91	CL-ML	1	1	0	16	75	7	21.22	-	-	27.0	21.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	26.00	U	22	-	-	-	-	-	CL-ML	2	1	1	30	61	5	18.77	1.97	1.66	25.0	20.0	5.0	2.65	DST	7.0	26.2	-	0.596	-	-	-	-												
	27.50	D	23	19	23	31	54	54.00	MI	0	0	1	7	77	15	31.57	-	-	39.0	26.5	12.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	29.00	D	24	20	24	32	56	56.00	-	-	-	-	-	-	-	29.58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	30.50	D	25	20	25	30	55	55.00	CL	2	1	1	13	75	8	19.45	-	-	29.0	21.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	32.00	D	26	23	26	33	59	59.00	-	-	-	-	-	-	-	20.13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	33.50	D	27	22	25	33	58	58.00	CI	0	0	1	8	77	14	25.98	-	-	36.0	23.0	13.0	2.67	-	-	-	-	-	-	-	-	-	Inorganic clays of Intermediate plasticity											
	35.00	D	28	24	29	32	61	61.00	CL	0	1	2	11	74	12	22.41	-	-	34.0	23.5	10.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	36.50	D	29	23	27	35	62	62.00	-	-	-	-	-	-	-	20.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	25	28	33	61	61.00	CL	0	0	1	15	74	10	23.41	-	-	30.5	22.0	8.5	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	25	29	37	66	66.00	-	-	-	-	-	-	-	20.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 12: SUMMARY OF TEST RESULTS

Bore No : P72	**Ground Elevation : RL 192.289 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.60 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date: 05/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22802.287	**Casing Lowered : 20.00 m**	**Ending Date: 07/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT									LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Correct N)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	CL-ML	1	1	1	34	56	7	6.73	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	1.00	D	2	1	2	2	4	6.16	-	-	-	-	-	-	-	18.77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	2.00	U	3	-	-	-	-	-	SM-SC	3	2	2	44	42	7	18.90	2.00	1.68	26.0	20.5	5.5	2.66	DST	11.0	25.4	-	0.583	-	0	18	-	Silty Sands with clay binder											
	3.00	D	4	2	3	4	7	8.83	SM	4	2	2	52	40	0	18.25	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	D	5	4	6	7	13	15.28	-	-	-	-	-	-	-	23.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	5.00	U	6	-	-	-	-	-	SM	0	0	0	70	30	0	24.99	1.94	1.55	Non Plastic			2.62	DST	0.0	28.5	-	0.690	-	-	-	-												
	6.00	D	7	5	6	9	15	15.75	-	-	-	-	-	-	-	23.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	4	6	11	17	16.51	-	-	-	-	-	-	-	24.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	-	-	-	-	-	SM	0	0	1	75	24	0	25.20	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	2	3	3	6	5.96	-	-	-	-	-	-	-	25.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	4	7	8	15	14.41	ML	4	0	0	22	68	6	23.29	-	-	25.0	21.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	11.00	U	12	-	-	-	-	-	CL-ML	2	1	2	12	74	9	23.47	2.02	1.64	27.0	20.5	6.5	2.66	UU	44.0	11.6	0.132	0.622	-	8	18	-	Inorganic Silty Clays of low plasticity											
	12.50	D	13	4	6	6	12	10.71	-	-	-	-	-	-	-	20.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL-ML	2	1	1	14	74	8	20.08	2.02	1.68	26.0	20.0	6.0	2.66	UU	40.0	11.0	-	0.583	-	-	-	-												
	15.50	D	15	6	7	9	16	13.21	-	-	-	-	-	-	-	17.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	U	16	-	-	-	-	-	CL	0	1	1	22	67	9	21.32	2.04	1.68	28.0	20.5	7.5	2.67	UU	48.0	10.6	-	0.589	-	-	-	-	Inorganic clays of low plasticity											
	18.50	D	17	7	9	11	20	15.19	ML	1	1	1	44	49	4	22.15	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											

APPENDIX "B"
TABLE 12: SUMMARY OF TEST RESULTS

Bore No : P72	**Ground Elevation : RL 192.289 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.60 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date: 05/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22802.287	**Casing Lowered : 20.00 m**	**Ending Date: 07/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Correct N)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	20.00	U	18	-	-	-	-	-	CL	3	1	1	14	71	10	21.13	2.03	1.68	28.0	20.5	7.5	2.68	UU	52.0	9.3	-	0.595	-	-	-	-	Inorganic clays of low plasticity											
	21.50	D	19	8	15	18	33	33.00	CL	10	5	5	17	52	11	17.48	-	-	29.0	20.0	9.0	-	-	-	-	-	-	-	-	-	-												
	23.00	D	20	-	-	-	-	-	SM	0	0	1	53	46	0	19.01	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	24.50	D	21	14	24	28	52	25.18	CL-ML	0	1	1	38	54	6	22.23	-	-	25.0	20.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	26.00	U	22	-	-	-	-	-	CL	4	1	1	16	68	10	24.02	2.01	1.62	28.0	20.5	7.5	2.68	UU	53.0	9.5	-	0.654	-	-	-	-	Inorganic clays of low plasticity											
	27.50	D	23	10	16	18	34	34.00	-	-	-	-	-	-	-	27.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.00	D	24	-	-	-	-	-	ML	0	1	1	44	54	0	18.19	2.02	1.71	Non Plastic			2.65	RDST	6.0	27.8	-	0.550	-	-	-	-	Inorganic Silts of low plasticity											
	30.50	D	25	13	23	27	50	22.75	ML	0	1	2	40	57	0	19.45	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	32.00	D	26	-	-	-	-	-	-	-	-	-	-	-	-	18.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	33.50	D	27	15	26	30	56	23.86	CL-ML	1	1	1	32	58	7	16.88	-	-	27.0	20.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	35.00	D	28	17	27	32	59	24.36	CL	1	0	1	28	62	8	17.70	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	36.50	D	29	14	20	26	46	20.32	-	-	-	-	-	-	-	17.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	-	-	-	-	-	CL-ML	0	0	1	35	58	6	17.73	2.04	1.73	26.0	20.0	6.0	2.66	RDST	10.0	27.1	-	0.538	-	-	-	-	Inorganic Silty Clays of low plasticity											
	40.00	D	31	20	26	34	60	23.31	-	-	-	-	-	-	-	20.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

Soil investigation for HORC Viaduct between Sohana & Dhulawat stations, Haryana

APPENDIX "B"
TABLE 13: SUMMARY OF TEST RESULTS

Bore No : P73	**Ground Elevation : RL 192.387 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.85 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 02/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 22828.487	**Casing Lowered : 29.00 m**	**Ending Date : 04/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	1	1	0	36	62	0	14.60	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	D	2	3	4	5	9	9.00	CL	0	0	1	18	74	7	12.62	-	-	26.5	18.5	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	2.00	U	3	-	-	-	-	-	CL	0	0	1	17	74	8	9.04	1.67	1.53	27.5	18.0	9.5	2.67	DST	10.0	21.0	-	0.745	-	9	16	-												
	3.00	D	4	4	5	8	13	13.00	CL	7	3	3	21	55	11	16.78	-	-	32.0	20.0	12.0	-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	5	7	9	16	16.00	-	-	-	-	-	-	-	17.76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	5.00	U	6	-	-	-	-	-	CL	0	1	0	6	86	7	23.69	1.97	1.59	27.0	20.0	7.0	2.67	DST	12.0	24.5	-	0.679	-	8	16	-												
	6.00	D	7	4	5	9	14	15.54	-	-	-	-	-	-	-	27.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	3	6	12	18	18.00	CL	0	0	1	5	86	8	20.81	-	-	27.5	20.1	7.5	-	-	-	-	-	-	-	-	-	-												
	8.00	U	9	-	-	-	-	-	SM	0	0	2	78	20	0	26.82	1.94	1.53	Non-Plastic			2.62	DST	0.0	29.0	-	0.712	-	-	-	-	Silty Sands											
	9.00	D	10	4	5	7	12	12.31	SM	0	0	1	62	37	0	20.09	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	5	9	10	19	19.00	CL	4	2	3	11	69	11	17.78	-	-	31.0	20.5	10.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	11.00	U	12	-	-	-	-	-	CL	0	0	1	5	84	10	21.33	1.98	1.63	29.5	19.0	10.5	2.67	UU	44.0	9.5	0.154	0.636	-	17	14	-												
	12.50	D	13	3	5	9	14	14.00	-	-	-	-	-	-	-	18.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	-	-	-	-	-	-	-	19.20	2.00	1.68	-	-	-	2.67	UU	46.0	9.0	-	0.591	-	-	-	-												
	15.50	D	15	7	11	15	26	26.00	CL	0	1	2	10	76	11	16.40	-	-	30.0	19.0	11.0	-	-	-	-	-	-	-	-	-	-												
	17.00	U	16	-	-	-	-	-	ML	1	0	1	38	60	0	12.71	1.85	1.64	Non-Plastic			2.64	DST	4.0	26.5	-	0.608	-	-	-	-	Inorganic Silts of low plasticity											
	18.50	D	17	9	14	19	33	20.71	-	-	-	-	-	-	-	17.07	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 13: SUMMARY OF TEST RESULTS

Bore No : P73	**Ground Elevation : RL 192.387 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.85 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 02/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 22828.487	**Casing Lowered : 29.00 m**	**Ending Date : 04/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	20.00	U	18	-	-	-	-	-	ML	3	1	1	9	77	9	14.85	1.81	1.58	30.5	23.5	7.0	2.67	UU	42.0	11.5	-	0.694	-	-	-	-												
	21.50	D	19	11	22	32	54	27.99	-	-	-	-	-	-	-	20.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.00	D	20	13	24	37	61	61.00	CL	1	1	1	13	74	10	13.22	-	-	30.0	19.5	10.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	24.50	D	21	15	27	37	64	30.54	SM	0	1	1	51	47	0	18.04	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	26.00	D	22	14	28	30	58	27.84	CL-ML	1	0	1	9	84	5	18.52	-	-	25.0	19.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	27.50	D	23	13	25	27	52	25.25	-	-	-	-	-	-	-	25.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.00	D	24	10	23	28	51	24.46	SM	0	0	0	71	29	0	21.82	1.94	1.59	Non-Plastic			2.65	RDST	0.0	28.5	-	0.667	-	-	-	-	Silty Sands											
	30.50	D	25	7	25	30	55	55.00	CL	0	0	1	6	82	11	14.70	-	-	30.0	21.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	32.00	D	26	11	27	31	58	25.84	SM	0	1	0	55	44	0	17.34	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	33.50	D	27	12	29	33	62	62.00	CL	2	2	1	10	73	12	15.29	-	-	31.0	20.0	11.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	35.00	D	28	10	24	35	59	59.00	-	-	-	-	-	-	-	14.75	2.01	1.75	-	-	-	2.67	RUU	53.0	8.5	-	0.526	-	-	-	-												
	36.50	D	29	14	29	35	64	64.00	CL	7	2	1	11	68	11	12.39	-	-	32.0	20.0	12.0	-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	17	32	40	72	72.00	-	-	-	-	-	-	-	14.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	24	60	42	102	100.00	-	-	-	-	-	-	-	15.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 14: SUMMARY OF TEST RESULTS

Bore No : P74	**Ground Elevation : RL 192.472 m**	**Method of drilling :Rotary**	**Depth of Water-table: 2.45 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 04/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22854.687	**Casing Lowered : 20.00 m**	**Ending Date : 06/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT									LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Correct N)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	1	1	0	53	45	0	5.69	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	D	2	2	3	3	6	9.28	CL	0	0	1	44	48	7	15.05	-	-	26.0	19.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	2.00	U	3	-	-	-	-	-	SM	0	0	0	54	46	0	14.79	1.96	1.71	Non Plastic			2.65	DST	3.0	27.3	-	0.550	-	-	-	-	Silty Sands											
	3.00	D	4	2	2	3	5	6.06	CL-ML	0	0	2	28	65	5	19.14	-	-	25.0	20.5	4.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	4.00	D	5	3	5	6	11	12.72	ML	1	0	0	32	67	0	21.99	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	5.00	U	6	-	-	-	-	-	SM	0	0	0	56	44	0	10.31	1.95	1.77	Non Plastic			2.64	DST	2.0	26.9	-	0.492	-	-	-	-	Silty Sands											
	6.00	D	7	5	8	10	18	17.11	SM	0	0	0	68	32	0	25.74	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	4	7	12	19	17.30	-	-	-	-	-	-	-	26.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	U	9	-	-	-	-	-	SM	3	0	1	72	24	0	24.60	1.94	1.56	Non Plastic			2.63	DST	0.0	28.9	-	0.686	-	-	-	-												
	9.00	D	10	6	10	13	23	18.64	-	-	-	-	-	-	-	26.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	5	7	10	17	15.50	CL-ML	0	0	0	24	71	5	20.20	-	-	26.0	21.5	4.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	11.00	U	12	-	-	-	-	-	ML	0	0	1	48	47	4	13.70	1.97	1.73	24.0	20.0	4.0	2.65	DST	7.0	26.3	-	0.532	-	-	-	-	Inorganic Silts of low plasticity											
	12.50	D	13	4	6	8	14	12.32	CL-ML	0	0	1	31	62	6	21.43	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	14.00	D	14	-	-	-	-	-	SM	0	1	4	56	39	0	20.21	1.98	1.65	Non Plastic			-	RDST	0.0	27.1	-	-	-	-	-	-	Silty Sands											
	15.50	D	15	7	8	13	21	21.00	CL	4	2	1	14	70	9	20.87	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	17.00	U	16	-	-	-	-	-	CL	7	2	2	14	67	8	16.73	2.03	1.74	27.0	20.0	7.0	2.67	UU	52.0	11.7	0.135	0.534	-	0	18	-												

APPENDIX "B"
TABLE 14: SUMMARY OF TEST RESULTS

Bore No : P74	Ground Elevation : RL 192.472 m	Method of drilling :Rotary	Depth of Water-table: 2.45 m
Diameter of Bore Hole : 150 mm	Bore Retained using : Casing	Starting Date : 04/11/2023	SPT Sampler: Standard
Location / Chainage : 22854.687	Casing Lowered : 20.00 m	Ending Date : 06/11/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Correct N)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	10	13	16	29	18.56	SM	0	0	0	55	45	0	21.50	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	20.00	D	18	-	-	-	-	-	CL	3	2	1	12	74	8	21.74	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	21.50	D	19	12	23	32	55	55.00	CL	0	0	1	7	82	10	17.89	-	-	29.0	21.0	8.0	-	-	-	-	-	-	-	-	-	-												
	23.00	D	20	11	20	30	50	50.00	-	-	-	-	-	-	-	16.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	24.50	D	21	13	24	35	59	59.00	MI	0	0	1	5	77	17	30.42	-	-	40.0	27.0	13.0	2.68	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	26.00	D	22	9	22	28	50	50.00	-	-	-	-	-	-	-	27.65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	27.50	D	23	10	20	25	45	45.00	-	-	-	-	-	-	-	28.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.00	D	24	9	25	30	55	24.80	CL-ML	0	0	1	35	59	5	16.39	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	30.50	D	25	10	22	29	51	23.16	-	-	-	-	-	-	-	21.30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.00	D	26	12	25	28	53	53.00	CL	1	1	0	7	79	12	20.97	-	-	30.0	21.0	9.0	2.67	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	33.50	D	27	11	27	31	58	58.00	-	-	-	-	-	-	-	20.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	35.00	D	28	13	26	34	60	24.67	CL-ML	4	1	1	18	71	5	22.66	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	36.50	D	29	12	25	32	57	57.00	CL	1	1	0	12	78	8	16.86	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	38.00	D	30	15	30	39	69	69.00	-	-	-	-	-	-	-	18.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	20	35	40	75	75.00	-	-	-	-	-	-	-	17.67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 15: SUMMARY OF TEST RESULTS

Bore No : P75	**Ground Elevation : RL 192.565 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.80 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 05/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22880.887	**Casing Lowered : 18.00 m**	**Ending Date : 07/11/2023**	**Hammer type: Rope pulley**

FIELD TEST RESULT									LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Correct N)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	1	55	44	0	5.41	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	D	2	1	1	2	3	4.64	CL-ML	4	2	1	42	44	7	19.54	-	-	27.0	20.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	2.00	U	3	-	-	-	-	-	SM-SC	7	4	4	36	41	8	17.93	1.97	1.67	28.0	21.0	7.0	2.66	DST	10.0	26.3	-	0.593	-	0	19	-	Silty Sands with clay binder											
	3.00	D	4	2	3	4	7	8.78	CL-ML	1	0	1	18	73	7	19.85	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	4.00	D	5	4	5	7	12	14.29	CL-ML	0	0	1	28	67	4	22.54	-	-	25.0	20.5	4.5	-	-	-	-	-	-	-	-	-	-												
	5.00	U	6	-	-	-	-	-	ML	0	0	1	35	64	0	25.86	1.98	1.57	Non Plastic			2.65	DST	6.0	25.8	-	0.688	-	-	-	-	Inorganic Silts of low plasticity											
	6.00	D	7	4	6	8	14	15.15	-	-	-	-	-	-	-	24.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	6	8	9	17	16.44	SM	0	0	1	55	44	0	23.19	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	8.00	D	9	-	-	-	-	-	-	-	-	-	-	-	-	25.08	2.09	1.67	-	-	-	-	RDST	2.0	25.7	-	-	-	-	-	-												
	9.00	D	10	5	10	11	21	17.75	CL-ML	1	1	0	18	73	7	20.75	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	10.00	D	11	5	11	12	23	18.36	-	-	-	-	-	-	-	21.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL-ML	2	0	0	34	59	5	22.24	1.98	1.62	26.5	21.5	5.0	2.66	DST	12.0	24.6	-	0.642	-	-	-	-												
	12.50	D	13	6	8	10	18	15.43	-	-	-	-	-	-	-	21.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	D	14	-	-	-	-	-	CL	2	1	1	8	77	11	22.05	2.03	1.66	29.0	21.0	8.0	-	RUU	62.0	8.2	-	-	-	6	18	-	Inorganic clays of low plasticity											
	15.50	D	15	7	11	14	25	25.00	-	-	-	-	-	-	-	22.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	D	16	-	-	-	-	-	SM	0	1	1	52	46	0	14.60	1.95	1.70	Non Plastic			2.65	RDST	3.0	27.6	-	0.559	-	-	-	-	Silty Sands											

APPENDIX "B"
TABLE 15: SUMMARY OF TEST RESULTS

Bore No : P75	**Ground Elevation : RL 192.565 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.80 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 05/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 22880.887	**Casing Lowered : 18.00 m**	**Ending Date : 07/11/2023**	**Hammer type: Rope pulley**

FIELD TEST RESULT									LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Correct N)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	11	14	16	30	18.99	SM	4	6	11	40	39	0	15.89	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	20.00	D	18	-	-	-	-	-	SM	4	2	0	52	42	0	20.21	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	21.50	D	19	12	17	21	38	38.00	CL	2	0	1	10	76	11	18.08	-	-	30.0	22.0	8.0	-	-	-	-	-	-	-	-		-	Inorganic clays of low plasticity											
	23.00	U	20	-	-	-	-	-	CL	7	2	1	12	68	10	18.69	2.04	1.72	29.0	21.0	8.0	2.68	UU	56.0	9.3	-	0.558	-	-	-	-												
	24.50	D	21	13	16	20	36	19.67	SM	0	0	1	52	47	0	18.32	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	26.00	D	22	-	-	-	-	-	ML	0	0	0	45	55	0	19.12	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	27.50	D	23	14	19	23	42	20.97	CL-ML	2	1	1	18	71	7	19.00	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	29.00	U	24	-	-	-	-	-	SM	0	0	0	56	44	0	19.75	1.96	1.64	Non Plastic			2.64	DST	0.0	28.7	-	0.610	-	-	-	-	Silty Sands											
	30.50	D	25	16	20	24	44	44.00	MI	0	0	1	5	78	16	28.30	-	-	38.0	27.0	11.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	32.00	U	26	-	-	-	-	-	SM	2	1	1	53	43	0	21.11	1.99	1.64	Non Plastic			2.64	DST	0.0	27.6	-	0.610	-	-	-	-	Silty Sands											
	33.50	D	27	20	25	27	52	52.00	CL	1	1	1	7	78	12	21.27	-	-	32.0	21.0	11.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	35.00	D	28	22	26	30	56	23.37	CL-ML	0	0	1	35	58	6	17.60	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	36.50	D	29	20	24	28	52	21.92	SM	0	1	1	52	46	0	18.72	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	38.00	D	30	25	27	31	58	23.26	-	-	-	-	-	-	-	17.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	24	29	35	64	24.40	SM	0	1	2	48	49	0	20.04	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 16: SUMMARY OF TEST RESULTS

Bore No : P76	**Ground Elevation : RL 192.717 m**	**Method of drilling :Percussion**	**Depth of Water-table: 2.55 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 04/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 22907.087	**Casing Lowered : 30.00 m**	**Ending Date : 06/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	1	1	1	44	53	0	11.58	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	U	2	-	-	-	-	-	SM	0	1	1	48	50	0	7.21	1.61	1.50	Non-Plastic			2.64	DST	4.0	21.3	-	0.760	-	-	-	-	Silty Sands											
	2.00	D	3	1	2	3	5	5.00	CL	5	5	5	25	49	11	17.31	-	-	30.0	19.0	11.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	3.00	D	4	3	4	6	10	10.00	-	-	-	-	-	-	-	17.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	U	5	-	-	-	-	-	CL	2	1	1	17	70	9	16.95	1.92	1.64	28.5	19.0	9.5	2.67	UU	50.0	12.4	-	0.628	-	0	15	-												
	5.00	D	6	2	4	5	9	9.00	-	-	-	-	-	-	-	23.97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	3	5	8	13	14.49	CL-ML	1	1	2	14	74	8	23.19	-	-	25.5	19.0	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	7.00	U	8	-	-	-	-	-	CL	6	3	3	7	72	9	19.91	2.03	1.69	30.0	22.0	8.0	2.67	UU	47.0	10.5	0.153	0.577	-	8	17	-	Inorganic clays of low plasticity											
	8.00	D	9	2	3	5	8	8.00	-	-	-	-	-	-	-	16.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	3	3	7	10	10.00	CL	8	4	5	8	65	10	1636.00	-	-	29.0	20.0	9.0	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL-ML	2	1	0	7	84	6	21.38	1.96	1.61	25.0	19.5	5.5	2.66	DST	9.0	26.5	-	0.647	-	0	16	-	Inorganic Silty Clays of low plasticity											
	11.00	D	12	6	10	12	22	22.00	CL	0	1	1	24	68	6	19.32	-	-	26.5	19.0	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	12.00	D	13	6	12	13	25	25.00	-	-	-	-	-	-	-	20.46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	3	2	3	36	49	7	15.62	2.03	1.76	26.5	19.0	7.5	2.65	DST	12.0	27.0	-	0.509	-	-	-	-												
	14.50	D	15	5	8	14	22	22.00	-	-	-	-	-	-	-	17.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	-	-	-	-	-	-	-	13.42	2.04	1.80	-	-	-	2.65	UU	38.0	12.5	-	0.473	-	-	-	-												
	17.50	D	17	6	11	16	27	18.18	ML	0	0	0	42	58	0	16.45	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											

APPENDIX "B"
TABLE 16: SUMMARY OF TEST RESULTS

Bore No : P76	**Ground Elevation : RL 192.717 m**	**Method of drilling :Percussion**	**Depth of Water-table: 2.55 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 04/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 22907.087	**Casing Lowered : 30.00 m**	**Ending Date : 06/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen												
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL												
	19.00	D	18	-	-	-	-	-	CL-ML	0	0	0	16	80	4	20.63	-	-	23.5	18.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity												
	20.50	D	19	8	15	17	32	19.42	-	-	-	-	-	-	-	19.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	22.00	D	20	-	-	-	-	-	CL-ML	3	3	4	24	59	7	21.63	-	-	26.0	20.0	6.0	-	-	-	-	-	-	-	-	-	-													
	23.50	D	21	11	20	22	42	22.25	-	-	-	-	-	-	-	17.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	25.00	U	22	-	-	-	-	-	SM	3	1	1	45	50	0	16.99	1.98	1.69	Non-Plastic			2.64	DST	4.0	28.3	-	0.560	-	-	-	-	Silty Sands												
	26.50	D	23	12	22	39	61	27.76	CL	0	1	2	27	62	8	20.07	-	-	26.5	19.5	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity												
	28.00	U	24	-	-	-	-	-	CL	8	4	6	7	63	12	19.51	2.08	1.74	31.5	19.0	12.5	2.69	UU	54.0	11.2	-	0.546	-	-	-	-													
	29.50	D	25	10	22	29	51	51.00	MI	1	0	3	4	74	18	30.28	-	-	44.0	28.0	16.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity												
	31.00	D	26	15	23	30	53	23.66	ML	1	1	2	36	56	4	18.56	-	-	23.0	19.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity												
	32.50	D	27	13	25	26	51	22.68	-	-	-	-	-	-	-	12.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	34.00	D	28	15	28	35	63	25.81	ML	3	1	2	37	52	5	17.75	1.95	1.66	24.0	20.0	4.0	2.66	RDST	7.0	23.5	-	0.602	-	-	-	-													
	35.50	D	29	16	33	40	73	28.23	-	-	-	-	-	-	-	18.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	37.00	D	30	18	35	39	74	74.00	CL	2	2	3	34	52	7	18.71	-	-	27.5	19.5	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity												
	38.50	D	31	20	38	45	83	83.00	-	-	-	-	-	-	-	19.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	40.00	D	32	25	32	55	87	87.00	CL	1	1	0	14	75	9	20.45	-	-	28.5	19.5	9.0	-	-	-	-	-	-	-	-	-	-													

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

Soil investigation for HORC Viaduct between Sohana & Dhulawat stations, Haryana

APPENDIX "B"

TABLE 17: SUMMARY OF TEST RESULTS

Bore No : P77	**Ground Elevation : RL 192.676 m**	**Method of drilling :Percussion**	**Depth of Water-table: 2.62 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 07/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 22933.287	**Casing Lowered : 29.00 m**	**Ending Date : 09/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	1	42	57	0	8.14	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	U	2	-	-	-	-	-	-	-	-	-	-	-	-	12.00	1.82	1.63	-	-	-	2.65	DST	6.0	21.7	-	0.631	-	-	-	-												
	2.00	D	3	1	2	3	5	5.00	CL	10	4	5	28	45	8	19.17	-	-	27.5	20.0	7.5	-	-	-	-	-	-	-	8	16	-	Inorganic clays of low plasticity											
	3.00	D	4	3	4	5	9	9.00	CL	3	2	2	18	64	11	25.50	-	-	30.0	18.0	12.0	-	-	-	-	-	-	-	-	-	-												
	4.00	U	5	-	-	-	-	-	MI	3	1	0	2	85	9	21.62	2.00	1.64	36.0	28.0	8.0	2.67	DST	18.0	23.6	0.172	0.624	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	5.00	D	6	5	8	10	18	17.56	ML	0	0	0	30	70	0	24.33	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	6.00	D	7	8	12	16	28	28.00	CL	5	1	2	6	77	9	21.00	-	-	29.0	21.0	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	7.00	U	8	-	-	-	-	-	CL	5	2	1	10	75	7	21.40	1.98	1.63	27.5	20.5	7.0	2.66	DST	13.0	25.5	-	0.631	-	-	-	-												
	8.00	D	9	7	9	17	26	20.51	-	-	-	-	-	-	-	17.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	8	13	17	30	30.00	CL	1	1	1	6	84	7	23.54	-	-	28.0	20.0	8.0	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL-ML	6	1	2	10	75	6	17.77	2.12	1.80	26.0	20.0	6.0	2.66	UU	38.0	12.5	-	0.478	-	8	17	-	Inorganic Silty Clays of low plasticity											
	11.00	D	12	7	10	12	22	22.00	CL	1	1	1	7	79	11	22.28	-	-	29.0	19.5	9.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	12.00	D	13	8	12	15	27	27.00	-	-	-	-	-	-	-	23.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	4	0	2	9	75	10	20.03	2.04	1.70	29.0	20.0	9.0	2.66	DST	18.0	24.2	-	0.565	-	-	-	-												
	14.50	D	15	7	13	18	31	20.28	SM	1	0	1	57	41	0	19.14	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	16.00	D	16	-	-	-	-	-	ML	0	0	1	32	63	4	20.22	-	-	25.0	21.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	17.50	D	17	9	15	20	35	20.98	ML	0	0	1	44	55	0	11.21	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 17: SUMMARY OF TEST RESULTS

Bore No : P77	**Ground Elevation : RL 192.676 m**	**Method of drilling :Percussion**	**Depth of Water-table: 2.62 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 07/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 22933.287	**Casing Lowered : 29.00 m**	**Ending Date : 09/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL	2	1	1	11	73	12	19.61	2.00	1.67	32.0	20.0	12.0	2.67	UU	56.0	11.6	-	0.597	-	-	-	-	Inorganic clays of low plasticity											
	20.50	D	19	9	16	25	41	22.33	ML	3	2	2	32	57	4	16.60	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	22.00	U	20	-	-	-	-	-	CL	8	8	6	19	49	10	18.17	2.06	1.74	27.0	19.0	8.0	2.67	UU	44.0	12.5	-	0.532	-	-	-	-	Inorganic clays of low plasticity											
	23.50	D	21	12	18	27	45	45.00	-	-	-	-	-	-	-	17.78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	SM	1	1	2	51	45	0	18.83	1.93	1.62	Non-Plastic			-	DST	0.0	25.6	-	-	-	-	-	-	Silty Sands											
	26.50	D	23	11	18	26	44	21.72	-	-	-	-	-	-	-	16.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	U	24	-	-	-	-	-	MI	3	1	1	9	68	18	28.00	2.06	1.61	45.5	29.0	16.5	2.69	UU	59.0	10.1	-	0.672	-	9	12	-	Inorganic Silts of Intermediate plasticity											
	29.50	D	25	19	40	60	100	100.00	CL	8	4	4	30	45	9	18.15	-	-	27.5	20.0	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	31.00	D	26	17	42	55	97	36.38	ML	2	0	1	42	55	0	17.44	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	32.50	D	27	19	40	46	86	86.00	CL	4	0	3	24	58	11	20.15	-	-	31.0	19.5	11.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	34.00	D	28	21	43	52	95	34.39	ML	0	0	1	38	61	0	17.52	2.03	1.73	Non-Plastic			2.65	RDST	0.0	24.3	-	0.532	-	-	-	-	Inorganic Silts of low plasticity											
	35.50	D	29	11	22	41	63	24.90	-	-	-	-	-	-	-	22.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	7	14	31	45	19.63	ML	0	0	2	27	67	4	23.12	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	14	29	35	64	24.41	-	-	-	-	-	-	-	16.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	19	35	58	93	93.00	CL	2	2	1	11	71	13	20.50	-	-	32.0	19.0	13.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 18: SUMMARY OF TEST RESULTS

Bore No : P78	**Ground Elevation : RL 192.731 m**	**Method of drilling :Percussion**	**Depth of Water-table: 2.60 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 06/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 22954.487	**Casing Lowered : 29.50 m**	**Ending Date : 08/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen												
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL												
	0.50	D	1	-	-	-	-	-	ML	0	0	1	38	61	0	11.19	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity												
	1.00	D	2	2	3	5	8	12.36	-	-	-	-	-	-	-	6.75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	2.00	U	3	-	-	-	-	-	ML	0	0	1	32	62	5	18.91	1.97	1.66	25.0	21.0	4.0	2.66	DST	17.0	22.5	0.131	0.606	-	-	-	-													
	3.00	D	4	3	4	6	10	12.01	-	-	-	-	-	-	-	17.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	4.00	D	5	2	3	6	9	10.32	-	-	-	-	-	-	-	18.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	5.00	U	6	-	-	-	-	-	SM-SC	6	3	5	37	41	8	19.79	1.99	1.66	27.5	20.5	7.0	2.67	DST	16.0	24.2	-	0.607	-	-	-	-	Silty Sands with clay binder												
	6.00	D	7	4	6	8	14	14.81	-	-	-	-	-	-	-	15.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	7.00	D	8	3	5	7	12	12.00	CL	2	2	1	18	68	9	20.90	-	-	28.0	19.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity												
	8.00	U	9	-	-	-	-	-	CL	11	3	2	14	60	10	20.49	2.05	1.70	28.5	19.5	9.0	2.67	UU	40.0	11.5	-	0.571	-	-	-	-													
	9.00	D	10	12	14	17	31	22.28	CL-ML	0	0	1	8	84	7	19.93	-	-	25.0	19.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity												
	10.00	D	11	4	6	10	16	16.00	CL	1	1	2	10	76	10	18.42	-	-	27.0	19.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity												
	11.00	U	12	-	-	-	-	-	CL-ML	0	0	1	17	75	7	21.92	2.02	1.66	26.0	19.5	6.5	2.67	UU	44.0	10.5	-	0.608	-	-	-	-	Inorganic Silty Clays of low plasticity												
	12.50	D	13	5	7	11	18	18.00	CL	4	2	2	6	75	11	20.29	-	-	28.0	19.5	8.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity												
	14.00	U	14	-	-	-	-	-	CL-ML	2	0	1	16	76	5	22.06	1.99	1.63	25.0	20.0	5.0	2.67	DST	13.0	25.2	-	0.638	-	-	-	-	Inorganic Silty Clays of low plasticity												
	15.50	D	15	9	13	15	28	18.74	-	-	-	-	-	-	-	20.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	17.00	U	16	-	-	-	-	-	CL-ML	2	1	1	18	71	7	21.61	2.04	1.68	26.0	19.5	6.5	2.66	DST	15.0	24.6	-	0.586	-	-	-	-													

APPENDIX "B"
TABLE 18: SUMMARY OF TEST RESULTS

Bore No : P78	**Ground Elevation : RL 192.731 m**	**Method of drilling :Percussion**	**Depth of Water-table: 2.60 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 06/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 22954.487	**Casing Lowered : 29.50 m**	**Ending Date : 08/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	11	12	15	27	17.62	-	-	-	-	-	-	-	20.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	20.00	U	18	-	-	-	-	-	CL	4	1	3	15	69	8	24.97	1.96	1.57	28.0	20.5	7.5	2.66	UU	48.0	11.0	-	0.696	-	-	-	-	Inorganic clays of low plasticity											
	21.50	D	19	9	15	18	33	19.17	CL	2	1	1	12	77	7	23.90	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-												
	23.00	D	20	-	-	-	-	-	ML	0	1	1	28	65	5	19.39	-	-	25.0	21.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	24.50	D	21	12	17	20	37	19.87	-	-	-	-	-	-	-	24.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	U	22	-	-	-	-	-	CL-ML	0	1	1	45	49	4	19.70	1.98	1.65	23.5	19.0	4.5	2.65	DST	7.0	26.0	-	0.602	-	-	-	-	Inorganic Silty Clays of low plasticity											
	27.50	D	23	13	26	29	55	24.95	-	-	-	-	-	-	-	20.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.00	D	24	15	27	32	59	25.74	SM	12	1	2	42	43	0	18.56	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	30.50	D	25	11	31	38	69	28.30	CL-ML	0	1	1	36	56	6	15.53	-	-	24.0	19.5	4.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	32.00	D	26	13	33	42	75	29.54	ML	0	1	1	47	51	0	18.64	2.01	1.69	Non-Plastic			2.65	RDST	0.0	29.6	-	0.568	-	-	-	-	Inorganic Silts of low plasticity											
	33.50	D	27	9	31	37	68	27.00	-	-	-	-	-	-	-	16.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	35.00	D	28	12	29	35	64	25.41	CL-ML	1	0	2	35	57	5	19.86	-	-	25.0	20.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	36.50	D	29	14	33	39	72	27.21	-	-	-	-	-	-	-	20.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	17	35	43	78	28.41	-	-	-	-	-	-	-	19.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	19	38	50	88	88.00	CL	2	1	2	25	62	8	20.29	-	-	27.5	18.5	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"

TABLE 19: SUMMARY OF TEST RESULTS

Bore No : P79	**Ground Elevation : RL 192.898 m**	**Method of drilling :Percussion**	**Depth of Water-table: 2.20 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 03/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 22985.687	**Casing Lowered : 20.00 m**	**Ending Date : 04/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen												
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL												
	0.50	D	1	-	-	-	-	-	SM	0	0	0	61	39	0	9.43	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands												
	1.00	U	2	-	-	-	-	-	CL	0	0	1	40	53	6	11.10	1.84	1.66	26.5	18.5	8.0	2.66	DST	9.0	23.5	-	0.602	-	-	-	-	Inorganic clays of low plasticity												
	2.00	D	3	1	2	2	4	4.00	-	-	-	-	-	-	-	16.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	3.00	D	4	2	3	5	8	10.02	CL	1	1	2	18	70	8	17.39	-	-	27.0	20.0	7.0	-	-	-	-	-	-	-	-	-	-													
	4.00	U	5	-	-	-	-	-	CL	1	3	3	6	79	8	20.02	1.96	1.63	28.0	20.0	8.0	2.66	UU	42.0	8.6	-	0.629	-	9	15	-													
	5.00	D	6	2	3	6	9	9.00	-	-	-	-	-	-	-	18.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	6.00	D	7	3	4	8	12	12.00	-	-	-	-	-	-	-	18.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	7.00	U	8	-	-	-	-	-	CL-ML	1	3	3	28	58	7	16.61	2.01	1.72	25.5	19.5	6.0	2.67	UU	51.0	13.0	0.120	0.549	-	-	-	-	Inorganic Silty Clays of low plasticity												
	8.00	D	9	7	11	15	26	26.00	CL	0	1	1	11	79	8	18.16	-	-	27.0	19.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity												
	9.00	D	10	8	10	13	23	23.00	-	-	-	-	-	-	-	20.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	10.00	U	11	-	-	-	-	-	CL	3	4	3	27	56	7	15.30	1.88	1.63	27.0	20.0	7.0	2.66	DST	21.0	23.8	-	0.631	-	-	-	-													
	11.00	D	12	5	7	9	16	16.00	CL	0	0	1	22	69	8	22.62	-	-	28.5	20.0	8.5	-	-	-	-	-	-	-	-	-	-													
	12.00	D	13	6	8	11	19	19.00	-	-	-	-	-	-	-	21.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	13.00	U	14	-	-	-	-	-	CL-ML	0	0	0	10	85	5	21.15	1.90	1.57	25.0	19.0	6.0	2.66	UU	38.0	12.5	-	0.696	-	-	-	-	Inorganic Silty Clays of low plasticity												
	14.50	D	15	4	9	13	22	16.90	CL	2	1	2	12	76	7	19.49	-	-	27.0	20.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity												
	16.00	U	16	-	-	-	-	-	ML	6	3	2	14	68	7	19.74	2.02	1.69	30.0	23.5	6.5	2.67	-	-	-	-	0.583	-	8	18	-	Inorganic Silts of low plasticity												
	17.50	D	17	8	12	24	36	21.80	ML	0	0	1	44	55	0	21.01	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-													

APPENDIX "B"

TABLE 19: SUMMARY OF TEST RESULTS

Bore No : P79	**Ground Elevation : RL 192.898 m**	**Method of drilling :Percussion**	**Depth of Water-table: 2.20 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 03/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 22985.687	**Casing Lowered : 20.00 m**	**Ending Date : 04/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	SM	1	1	1	54	43	0	15.46	1.81	1.57	Non-Plastic			2.64	DST	7.0	26.2	-	0.684	-	-	-	-	Silty Sands											
	20.50	D	19	7	23	28	51	51.00	CL	2	2	2	11	76	7	20.18	-	-	29.5	22.0	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	22.00	U	20	-	-	-	-	-	CL	4	2	3	10	70	11	20.14	1.98	1.65	31.0	20.0	11.0	2.68	UU	54.0	12.5	-	0.624	-	-	-	-												
	23.50	D	21	8	15	25	40	40.00	-	-	-	-	-	-	-	19.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	CL	0	0	1	43	49	7	15.12	1.98	1.72	26.5	19.5	7.0	2.66	UU	40.0	13.4	-	0.547	-	-	-	-												
	26.50	D	23	9	18	20	38	38.00	CL	0	0	1	15	76	8	22.85	-	-	28.5	19.0	9.5	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	-	-	-	-	-	-	-	-	-	-	-	-	21.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.50	D	25	8	15	23	38	19.64	SM	0	0	1	58	41	0	18.30	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	31.00	D	26	-	-	-	-	-	ML	1	0	2	34	59	4	13.39	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	32.50	D	27	15	17	26	43	20.56	CL-ML	0	1	1	24	70	4	22.79	-	-	25.0	19.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	34.00	D	28	-	-	-	-	-	CL-ML	3	4	6	26	56	5	13.66	1.98	1.74	25.0	19.0	6.0	2.67	RDST	10.0	27.4	-	0.534	-	-	-	-												
	35.50	D	29	19	23	30	53	22.83	CL	0	0	1	22	71	6	17.61	-	-	26.0	19.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	37.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	13.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	16	26	32	58	58.00	CL	1	1	2	11	76	9	14.29	-	-	29.0	19.0	10.0	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	18	28	36	64	64.00	-	-	-	-	-	-	-	15.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 20: SUMMARY OF TEST RESULTS

Bore No : P80	**Ground Elevation : RL 193.042 m**	**Method of drilling :Rotary**	**Depth of Water-table: 2.35 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 21/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23011.887	**Casing Lowered : 20.00 m**	**Ending Date : 24/10/2023**	**Hammer type: Rope pulley**

FIELD TEST RESULT									LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Correct N)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	CL-ML	0	0	1	38	55	6	9.39	-	-	27.0	21.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	1.00	U	2	-	-	-	-	-	-	-	-	-	-	-	-	19.54	2.08	1.74	-	-	-	-	-	-	-	-	-	-	-	-	-												
	2.00	D	3	2	2	3	5	5.00	CL	0	0	0	35	57	8	17.39	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	3.00	D	4	3	3	5	8	9.57	SM	0	2	4	52	42	0	18.69	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	U	5	-	-	-	-	-	-	-	-	-	-	-	-	18.34	1.96	1.66	-	-	-	2.64	DST	2.0	28.4	-	0.590	-	-	-	-												
	5.00	D	6	4	5	9	14	14.00	CL	1	1	0	14	74	10	18.15	-	-	29.0	20.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	6.00	D	7	3	5	8	13	13.74	ML	0	0	1	27	72	0	19.81	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	7.00	U	8	-	-	-	-	-	SM	0	0	0	51	49	0	19.81	1.96	1.64	Non Plastic			2.65	DST	2.0	29.2	-	0.616	-	-	-	-	Silty Sands											
	8.00	D	9	7	10	14	24	19.36	CL-ML	1	1	0	12	79	7	21.79	-	-	28.0	21.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	9.00	D	10	6	11	24	35	24.28	-	-	-	-	-	-	-	20.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	1	0	0	6	84	9	22.92	2.00	1.63	29.0	21.0	8.0	2.66	UU	42.0	9.5	-	0.632	-	8	19	-	Inorganic clays of low plasticity											
	11.00	D	12	7	12	25	37	24.23	ML	0	1	1	14	79	5	20.93	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	12.00	D	13	8	11	12	23	23.00	CL	2	1	1	7	77	12	22.67	-	-	31.5	21.0	10.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	13.00	U	14	-	-	-	-	-	CL	3	1	1	8	76	11	21.51	2.04	1.68	32.0	22.0	10.0	2.67	UU	54.0	8.2	0.152	0.589	-	18	16	-												
	14.50	D	15	8	12	18	30	30.00	-	-	-	-	-	-	-	19.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	SC	12	1	1	39	38	9	16.29	2.01	1.73	28.0	19.5	8.5	2.67	UU	52.0	10.3	-	0.543	-	9	17	-	Clayey Sands											
	17.50	D	17	12	20	26	46	46.00	-	-	-	-	-	-	-	16.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 20: SUMMARY OF TEST RESULTS

Bore No : P80	**Ground Elevation : RL 193.042 m**	**Method of drilling :Rotary**	**Depth of Water-table: 2.35 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 21/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23011.887	**Casing Lowered : 20.00 m**	**Ending Date : 24/10/2023**	**Hammer type: Rope pulley**

FIELD TEST RESULT									LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Correct N)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	SM	1	0	1	58	40	0	20.63	1.96	1.63	Non Plastic			2.63	DST	2.0	27.8	-	0.618	-	-	-	-	Silty Sands											
	20.50	D	19	15	22	27	49	25.25	SM-SC	0	1	1	48	45	5	20.48	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Silty Sands with clay binder											
	22.00	U	20	-	-	-	-	-	CL	5	1	0	43	40	11	20.92	1.99	1.65	28.5	20.5	8.0	2.66	UU	47.0	9.5	-	0.617	-	-	-	-	Inorganic clays of low plasticity											
	23.50	D	21	20	30	35	65	65.00	-	-	-	-	-	-	-	19.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	D	22	17	35	42	77	33.11	CL-ML	0	1	1	17	74	7	22.92	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	26.50	D	23	19	38	47	85	35.07	CL-ML	4	1	2	24	64	5	20.26	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	28	45	56	R	-	ML	0	0	1	48	51	0	18.55	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	29.50	D	25	16	24	27	51	23.28	-	-	-	-	-	-	-	18.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	15	28	35	63	26.54	CL-ML	0	0	1	38	56	5	19.26	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	32.50	D	27	17	32	40	72	72.00	CL	0	1	0	14	77	8	16.20	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	34.00	D	28	22	34	43	77	29.76	ML	0	0	1	35	58	6	20.45	-	-	27.0	22.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	35.50	D	29	20	36	44	80	30.12	CL-ML	2	0	1	42	50	5	19.65	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	37.00	D	30	23	38	50	88	31.83	-	-	-	-	-	-	-	22.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	25	37	48	85	30.48	-	-	-	-	-	-	-	21.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	28	39	52	91	31.58	CL-ML	1	0	1	34	59	5	20.40	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample

APPENDIX- B
TABLE 21: CHEMICAL TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	SULPHATE CONTENT AS SO_3 (%)	CHLORIDE CONTENT (%)	pH VALUE
P66	4.00	0.103	0.096	8.29
P76	4.00	0.112	0.098	8.16
	13.00	0.110	0.102	8.21

APPENDIX- B
TABLE 22: CHEMICAL TEST ON GROUND WATER SAMPLES

BH No.	SULPHATE CONTENT AS SO_3 (mg/l)	CHLORIDE CONTENT (mg/l)	pH VALUE
P61	154.970	996.711	7.14
P66	168.687	890.724	7.63
P76	171.861	723.589	7.46

APPENDIX-B
TABLE 23: UCS TEST ON SOIL SAMPLES

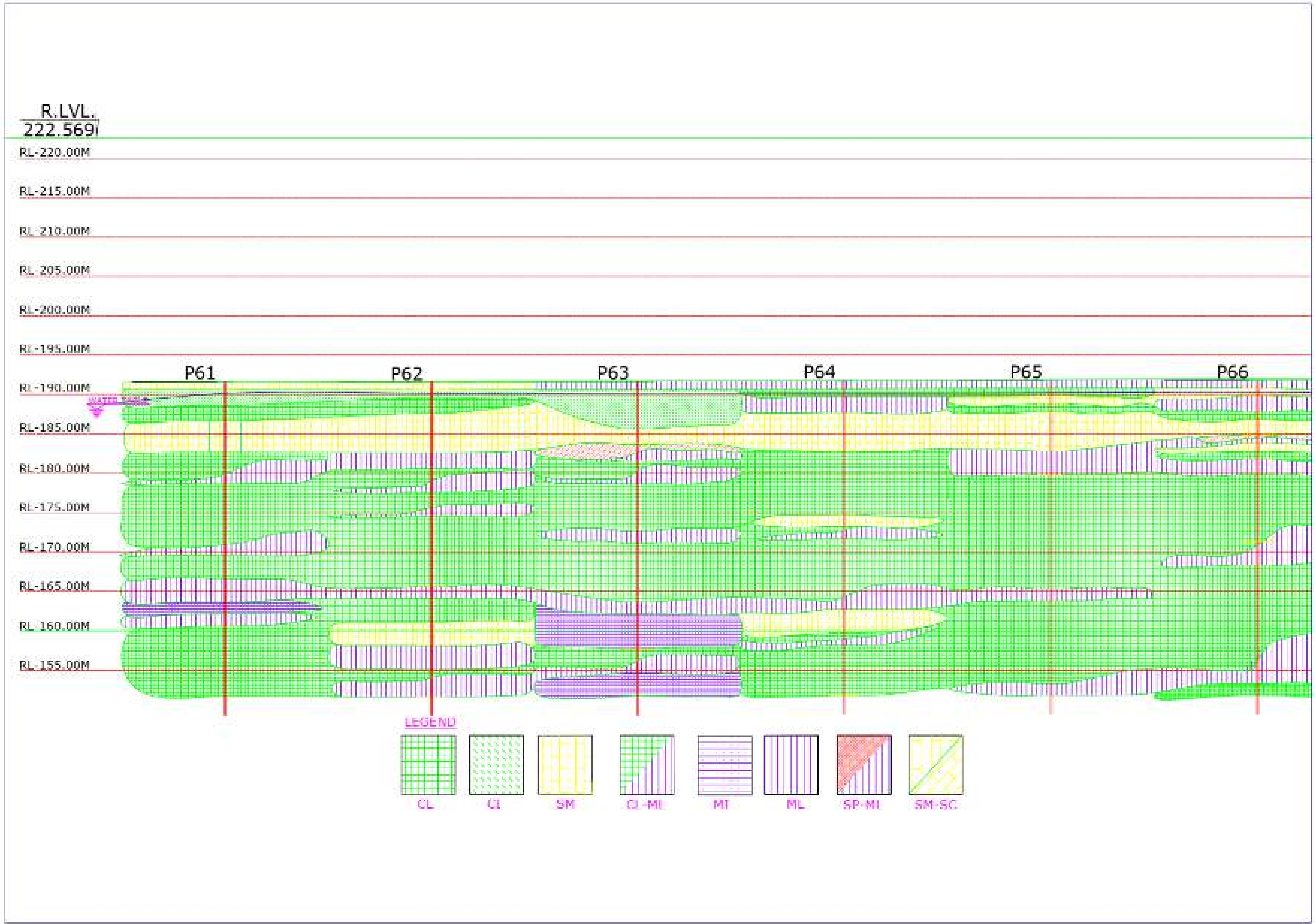
BH No.	DEPTH (m)	UCS (kg/cm²)
P61	1.00	0.80
	16.00	0.51
	19.00	0.41
P62	2.00	0.41
	14.00	0.41
P63	4.00	0.49
	16.00	0.43
	25.00	0.56
P64	14.00	0.37
	23.00	0.41
P65	22.00	0.63
	28.00	1.01
	31.00	1.06
P66	4.00	0.32
	25.00	0.46
P67	14.00	0.44
	23.00	0.57
P68	11.00	0.49
	14.00	0.64
	17.00	0.69
	20.00	0.59
	23.00	0.72
	26.00	0.67
P69	11.00	0.51
	14.00	0.62
	20.00	0.53
	23.00	0.49
	26.00	0.73
P70	13.00	0.65
	16.00	0.59
	22.00	0.49

APPENDIX-B
TABLE 23: UCS TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	UCS (kg/cm²)
	25.00	0.52
	28.00	0.46
P72	11.00	0.47
	14.00	0.43
	17.00	0.52
	20.00	0.59
	26.00	0.61
P73	11.00	0.68
	14.00	0.71
	20.00	0.54
P74	17.00	0.60
P75	23.00	0.66
P76	4.00	0.65
	7.00	0.74
	16.00	0.52
	28.00	0.79
P77	10.00	0.79
	19.00	0.73
	22.00	0.61
	28.00	0.82
P78	8.00	0.59
P79	4.00	0.42
	7.00	0.39
	13.00	0.45
	22.00	0.50
	25.00	0.52
P80	10.00	0.47
	13.00	0.67
	16.00	0.63
	22.00	0.53

APPENDIX-C

PLOT 1: LITHOLOGICAL PROFILE-01

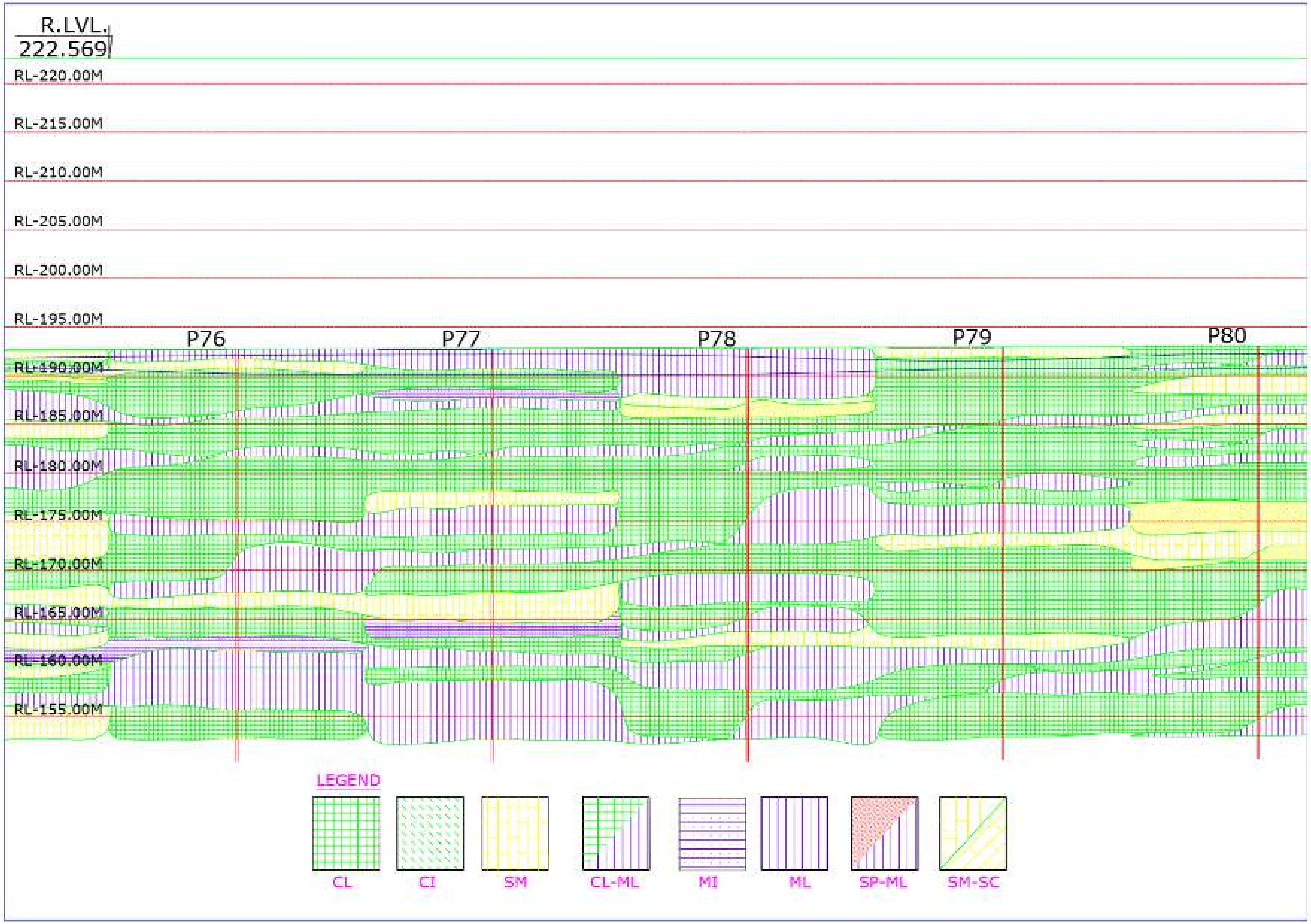


APPENDIX-C
PLOT 2: LITHOLOGICAL PROFILE-02

APPENDIX-C
PLOT 3: LITHOLOGICAL PROFILE-03

APPENDIX-C

PLOT 4: LITHOLOGICAL PROFILE-04



APPENDIX-C
PLOT 5: LITHOLOGICAL PLOTS

BH-P61-22514.0870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	U		-	-
Inorganic clays of Intermediate plasticity	CI		2.00	D	5	-	-
			3.00	D	6	-	-
Inorganic clays of low plasticity	CL		4.00	U		-	-
			5.00	D	15	-	-
			6.00	D	21	-	-
Silty Sands	SM		7.00	U		-	-
			8.00	D	15	-	-
Inorganic clays of low plasticity	CL		9.00	D	25	-	-
			10.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		11.00	D	24	-	-
			12.00	D	28	-	-
			13.00	U		-	-
			14.50	D	32	-	-
Inorganic clays of low plasticity	CL		16.00	U		-	-
			17.50	D	25	-	-
Inorganic Silty Clays of low plasticity	CL-ML		19.00	U		-	-
			20.00	D	52	-	-

BH-P61-22514.0870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML		20.50	D	52	-	-
			22.00	U		-	-
Inorganic clays of low plasticity	CL		23.50	D	58	-	-
			25.00	U		-	-
Inorganic Silts of low plasticity	ML		26.50	D	50	-	-
Inorganic Silts of Intermediate plasticity	MI		28.00	U		-	-
Inorganic Silts of low plasticity	ML		29.50	D	68	-	-
			31.00	D	74	-	-
			32.50	D	61	-	-
			34.00	D	85	-	-
Inorganic clays of low plasticity	CL		35.50	D	64	-	-
			37.00	D	83	-	-
			38.50	D	89	-	-
			40.00	D	101	-	-

APPENDIX-C

PLOT 6: LITHOLOGICAL PLOTS

BH-P62-22540.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
Inorganic clays of intermediate plasticity	CI		1.00	D	5	-	-
			2.00	U		-	-
Inorganic clays of low plasticity	CL		3.00	D	16	-	-
			4.00	D	25	-	-
			5.00	U		-	-
Silty Sands	SM		6.00	D	30	-	-
			7.00	D	36	-	-
			8.00	D		-	-
			9.00	D	19	-	-
Inorganic Silts of low plasticity	ML		10.00	D	25	-	-
			11.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		12.50	D	28	-	-
Inorganic clays of low plasticity	CL		14.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		15.50	D	33	-	-
			17.00	U		-	-
Inorganic clays of low plasticity	CL		18.50	D	36	-	-
			20.00	U		-	-

BH-P62-22540.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	U		-	-
			21.50	D	39	-	-
Inorganic clays of low plasticity	CL		23.00	U		-	-
			24.50	D	62	-	-
Inorganic Silts of low plasticity	ML		26.00	U		-	-
			27.50	D	50	-	-
Inorganic clays of low plasticity	CL		29.00	D		-	-
			30.50	D	56	-	-
Silty Sands	SM		32.00	D		-	-
			33.50	D	62	-	-
Inorganic Silts of low plasticity	ML		35.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		36.50	D	69	-	-
Inorganic Silts of low plasticity	ML		38.00	D		-	-
			40.00	D	62	-	-

APPENDIX-C
PLOT 7: LITHOLOGICAL PLOTS

BH-P63-22566.4870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	U		-	-
Inorganic clays of intermediate plasticity	CI		2.00	D	5	-	-
			3.00	D	6	-	-
			4.00	U		-	-
			5.00	D	12	-	-
Silty Sands	SM		6.00	D	18	-	-
			7.00	D		-	-
Poorly Graded Sands with inorganic Silts of low plasticity	SP-ML		8.00	D	26	-	-
			9.00	D	31	-	-
			10.00	U		-	-
Inorganic Silty Clays of low plasticity	CI-ML		11.00	D	37	-	-
			12.00	D	41	-	-
			13.00	U		-	-
Inorganic clays of low plasticity	CL		14.50	D	32	-	-
			16.00	U		-	-
			17.50	D	44	-	-
			19.00	U		-	-
Inorganic Silts of low plasticity	ML		20.00	D	49	-	-

BH-P63-22566.4870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		20.50	D	49	-	-
Inorganic clays of low plasticity	CL		22.00	U		-	-
			23.50	D	42	-	-
			25.00	U		-	-
			26.50	D	46	-	-
Inorganic Silts of low plasticity	ML		28.00	U		-	-
			29.50	D	49	-	-
Inorganic Silts of Intermediate plasticity	MI		31.00	D	52	-	-
			32.50	D	57	-	-
Inorganic Silty Clays of low plasticity	CI-ML		34.00	D		-	-
			35.50	D	58	-	-
			37.00	D		-	-
Inorganic Silts of Intermediate plasticity	MI		38.50	D	60	-	-
			40.00	D	65	-	-

APPENDIX-C
PLOT 8: LITHOLOGICAL PLOTS

BH-P64-22592.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
Inorganic clays of low plasticity	CL		1.00	D	4	-	-
			2.00	U		-	-
Inorganic Silts of low plasticity	ML		3.00	D	13	-	-
Silty Sands	SM		4.00	D	20	-	-
			5.00	D		-	-
			6.00	D	13	-	-
			7.00	D	15	-	-
			8.00	U		-	-
Inorganic clays of low plasticity	CL		9.00	D	24	-	-
			10.00	D	31	-	-
			11.00	U		-	-
			12.50	D	27	-	-
			14.00	U		-	-
			15.50	D	32	-	-
Silty Sands	SM		17.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		18.50	D	29	-	-
			20.00	U		-	-

BH-P64-22592.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.00	U		-	-
			21.50	D	33	-	-
			23.00	U		-	-
			24.50	D	66	-	-
Inorganic Silty Clays of low plasticity	CL-ML		26.00	D		-	-
			27.50	D	56	-	-
Silty Sands	SM		29.00	U		-	-
			30.50	D	59	-	-
Inorganic Silty Clays of low plasticity	CL-ML		32.00	D		-	-
Inorganic clays of low plasticity	CL		33.50	D	63	-	-
			35.00	D		-	-
			36.50	D	67	-	-
			38.00	D		-	-
			40.00	D	83	-	-

APPENDIX-C
PLOT 9: LITHOLOGICAL PLOTS

BH-P65-22618.8870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
Inorganic clays of low plasticity	CL		1.00	U		-	-
Silty Sands	SM		2.00	D	5	-	-
Inorganic clays of low plasticity	CL		3.00	D	10	-	-
			4.00	U		-	-
Silty Sands	SM		5.00	D	15	-	-
			6.00	D	20	-	-
			7.00	U		-	-
			8.00	D	25	-	-
Inorganic Silts of low plasticity	ML		9.00	D	16	-	-
			10.00	U		-	-
			11.00	D	16	-	-
Inorganic clays of low plasticity	CL		12.00	D	17	-	-
			13.00	U		-	-
			14.50	D	30	-	-
			16.00	D		-	-
			17.50	D	23	-	-
			19.00	D		-	-
			20.00	D	27	-	-

BH-P65-22618.8870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.50	D	27	-	-
			22.00	U		-	-
			23.50	D	52	-	-
			25.00	U		-	-
Inorganic Silts of low plasticity	ML		26.50	D	41	-	-
Inorganic clays of low plasticity	CL		28.00	U		-	-
			29.50	D	22	-	-
			31.00	U		-	-
			32.50	D	50	-	-
			34.00	D		-	-
			35.50	D	59	-	-
			37.00	D		-	-
Inorganic Silts of low plasticity	ML		38.50	D	44	-	-
			40.00	D	56	-	-

APPENDIX-C
PLOT 10: LITHOLOGICAL PLOTS

BH-P66-22645.0870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
Silty Sands	SM		1.00	U		-	-
			2.00	D	6	-	-
Inorganic Silts of low plasticity	ML		3.00	D	4	-	-
Inorganic clays of low plasticity	CL		4.00	U		-	-
			5.00	D	14	-	-
Silty Sands	SM		6.00	D	8	-	-
Poorly Graded Sands with Inorganic Silts of low plasticity	SP-ML		7.00	D		-	-
Silty Sands	SM		8.00	D	46	-	-
Inorganic clays of low plasticity	CL		9.00	D	15	-	-
			10.00	U		-	-
Inorganic Silts of low plasticity	ML		11.00	D	23	-	-
			12.00	D	22	-	-
			13.00	U		-	-
			14.50	D	14	-	-
Inorganic clays of low plasticity	CL		16.00	U		-	-
			17.50	D	57	-	-
Inorganic Silty Clays of low plasticity	CL-ML		19.00	U		-	-
			20.00	D	64	-	-

BH-P66-22645.0870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML		20.50	D	64	-	-
Inorganic Silts of low plasticity	ML		22.00	D	58	-	-
			23.50	D	63	-	-
			25.00	U		-	-
			26.50	D	52	-	-
Inorganic clays of low plasticity	CL		28.00	D		-	-
			29.50	D	49	-	-
			31.00	U		-	-
			32.50	D	59	-	-
			34.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		35.50	D	57	-	-
			37.00	D		-	-
			38.50	D	60	-	-
Inorganic clays of low plasticity	CL		40.00	D	73	-	-

APPENDIX-C
PLOT 11: LITHOLOGICAL PLOTS

BH-P67-22671.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
Inorganic clays of low plasticity	CL		1.00	D	8	-	-
Inorganic Silty Clays of low plasticity	CL-ML		2.00	U		-	-
Inorganic Silts of low plasticity	ML		3.00	D	5	-	-
Silty Sands	SM		4.00	D	7	-	-
			5.00	D		-	-
			6.00	D	20	-	-
			7.00	D	22	-	-
			8.00	D		-	-
Inorganic clays of low plasticity	CL		9.00	D	14	-	-
			10.00	D	21	-	-
Inorganic Silty Clays of low plasticity	CL-ML		11.00	U		-	-
			12.50	D	18	-	-
Inorganic clays of low plasticity	CL		14.00	U		-	-
			15.50	D	25	-	-
			17.00	U		-	-
Inorganic Silts of low plasticity	ML		18.50	D	27	-	-
			20.00	D		-	-

BH-P67-22671.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		20.00	D		-	-
Inorganic clays of low plasticity	CL		21.50	D	36	-	-
			23.00	U		-	-
			24.50	D	51	-	-
			26.00	D		-	-
Inorganic Silts of low plasticity	ML		27.50	D	57	-	-
Inorganic clays of low plasticity	CL		29.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		30.50	D	65	-	-
Silty Sands	SM		32.00	D		-	-
			33.50	D	73	-	-
Inorganic clays of low plasticity	CL		35.00	D	79	-	-
Silty Sands	SM		36.50	D	86	-	-
			38.00	D	88	-	-
			40.00	D	92	-	-

APPENDIX-C
PLOT 12: LITHOLOGICAL PLOTS

BH-P68-22697.487

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
Inorganic Silty Clays of low plasticity	CL-MI		1.00	D	5	-	-
Silty Sands with clay binder	SM-SC		2.00	U		-	-
Silty Sands	SM		3.00	D	12	-	-
			4.00	D	16	-	-
			5.00	D		-	-
			6.00	D	20	-	-
			7.00	D	18	-	-
			8.00	U		-	-
			9.00	D	20	-	-
			10.00	D	16	-	-
Inorganic clays of low plasticity	CL		11.00	U		-	-
			12.50	D	27	-	-
			14.00	U		-	-
			15.50	D	28	-	-
			17.00	U		-	-
			18.50	D	37	-	-
			20.00	U		-	-

BH-P68-22697.487

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.00	D		-	-
			21.50	D	32	-	-
			23.00	U		-	-
			24.50	D	39	-	-
			26.00	U		-	-
			27.50	D	52	-	-
			29.00	D	54	-	-
			30.50	D	61	-	-
			32.00	D	67	-	-
			33.50	D	72	-	-
Silty Sands with clay binder	SM-SC		35.00	D	77	-	-
			36.50	D	52	-	-
Inorganic clays of low plasticity	CL		38.00	D	64	-	-
			40.00	D	101	-	-

APPENDIX-C

PLOT 13: LITHOLOGICAL PLOTS

BH-P69-22723.687

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		1.00	D	4	-	-
Silty Sands	SM		2.00	U		-	-
			3.00	D	10	-	-
Inorganic Silty Clays of low plasticity	CL-ML		4.00	D	12	-	-
			5.00	U		-	-
			6.00	D	15	-	-
Silty Sands	SM		7.00	D	17	-	-
			8.00	U		-	-
			9.00	D	15	-	-
Inorganic Silty Clays of low plasticity	CL-ML		10.00	D	12	-	-
			11.00	U		-	-
			12.50	D	18	-	-
Inorganic clays of low plasticity	CL		14.00	U		-	-
			15.50	D	27	-	-
Inorganic Silty Clays of low plasticity	CL-ML		17.00	U		-	-
			18.50	D	44	-	-
Inorganic clays of low plasticity	CL		20.00	U		-	-

BH-P69-22723.687

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	U		-	-
Inorganic clays of low plasticity	CL		21.50	D	35	-	-
Inorganic Silty Clays of low plasticity	CL-ML		23.00	U		-	-
Inorganic clays of low plasticity	CL		24.50	D	43	-	-
			26.00	U		-	-
Inorganic Silts of intermediate plasticity	MI		27.50	D	51	-	-
Inorganic Silty Clays of low plasticity	CL-ML		29.00	D	60	-	-
Inorganic clays of low plasticity	CL		30.50	D	73	-	-
Inorganic clays of intermediate plasticity	CI		32.00	D	64	-	-
			33.50	D	67	-	-
			35.00	D	75	-	-
Inorganic clays of low plasticity	CL		36.50	D	92	-	-
			38.00	D	83	-	-
			40.00	D	113	-	-

APPENDIX-C
PLOT 14: LITHOLOGICAL PLOTS

BH-P70-22749.8870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	U		-	-
Inorganic clays of low plasticity	CL		2.00	D	3	-	-
Inorganic Silty Clays of low plasticity	CL-ML		3.00	D	7	-	-
			4.00	U		-	-
Silty Sands	SM		5.00	D	10	-	-
			6.00	D	8	-	-
			7.00	D		-	-
			8.00	D	14	-	-
			9.00	D	17	-	-
			10.00	U		-	-
Inorganic Silts of low plasticity	ML		11.00	D	18	-	-
			12.00	D	13	-	-
			13.00	U		-	-
Inorganic clays of low plasticity	CL						
Inorganic Silts of low plasticity	ML		14.50	D	15	-	-
			16.00	U		-	-
Inorganic clays of low plasticity	CL		17.50	D	18	-	-
Clayey Sands	SC		19.00	U		-	-
			20.00	D	20	-	-

BH-P70-22749.8870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Clayey Sands	SC		20.50	D	20	-	-
Inorganic clays of low plasticity	CL		22.00	U		-	-
			23.50	D	27	-	-
			25.00	U		-	-
			26.50	D	31	-	-
Inorganic Silts of Intermediate plasticity	MI		28.00	U		-	-
Inorganic clays of Intermediate plasticity	CI		29.50	D	28	-	-
			31.00	D		-	-
Inorganic clays of low plasticity	CL		32.50	D	36	-	-
			34.00	D		-	-
Silty Sands	SM		35.50	D	55	-	-
			37.00	D		-	-
Inorganic Silts of low plasticity	ML		38.50	D	65	-	-
			40.00	D	72	-	-

APPENDIX-C

PLOT 15: LITHOLOGICAL PLOTS

BH-P71-22776.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	D	3	-	-
Inorganic Silty Clays of low plasticity	CL-ML		2.00	D		-	-
Inorganic clays of low plasticity	CL		3.00	D	5	-	-
			4.00	D	9	-	-
Silty Sands	SM		5.00	D		-	-
			6.00	D	7	-	-
			7.00	D	10	-	-
			8.00	U		-	-
Inorganic clays of low plasticity	CL		9.00	D	19	-	-
			10.00	D	22	-	-
Inorganic Silts of low plasticity	ML		11.00	U		-	-
			12.50	D	27	-	-
Inorganic clays of low plasticity	CL		14.00	U		-	-
			15.50	D	31	-	-
Inorganic Silts of low plasticity	ML		17.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		18.50	D	38	-	-
			20.00	D		-	-

BH-P71-22776.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	D		-	-
Inorganic clays of low plasticity	CL		21.50	D	39	-	-
Inorganic Silts of low plasticity	ML		23.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		24.50	D	42	-	-
			26.00	U		-	-
Inorganic Silts of Intermediate plasticity	MI		27.50	D	54	-	-
			29.00	D	56	-	-
Inorganic clays of low plasticity	CL		30.50	D	55	-	-
			32.00	D	59	-	-
Inorganic clays of Intermediate plasticity	CI		33.50	D	58	-	-
Inorganic clays of low plasticity	CL		35.00	D	61	-	-
			36.50	D	62	-	-
			38.00	D	61	-	-
			40.00	D	66	-	-

APPENDIX-C
PLOT 16: LITHOLOGICAL PLOTS

BH-P72-22802.287

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML		0.50	D		-	-
			1.00	D	4	-	-
Silty Sands with clay binder	SM-SC		2.00	U		-	-
Silty Sands	SM		3.00	D	7	-	-
			4.00	D	13	-	-
			5.00	U		-	-
			6.00	D	15	-	-
			7.00	D	17	-	-
			8.00	D		-	-
			9.00	D	6	-	-
Inorganic Silts of low plasticity	ML		10.00	D	15	-	-
Inorganic Silty Clays of low plasticity	CL-ML		11.00	U		-	-
			12.50	D	12	-	-
			14.00	U		-	-
			15.50	D	16	-	-
Inorganic clays of low plasticity	CL		17.00	U		-	-
Inorganic Silts of low plasticity	ML		18.50	D	20	-	-
			20.00	U		-	-

BH-P72-22802.287

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.00	U		-	-
			21.50	D	31	-	-
Silty Sands	SM		23.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		24.50	D	52	-	-
Inorganic clays of low plasticity	CL		26.00	U		-	-
			27.50	D	34	-	-
Inorganic Silts of low plasticity	ML		29.00	D		-	-
			30.50	D	50	-	-
			32.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		33.50	D	56	-	-
Inorganic clays of low plasticity	CL		35.00	D	59	-	-
			36.50	D	46	-	-
Inorganic Silty Clays of low plasticity	CL-ML		38.00	D		-	-
			40.00	D	60	-	-

APPENDIX-C
PLOT 17: LITHOLOGICAL PLOTS

BH-P73-22828.4870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	U	9	-	-
			2.00	U		-	-
			3.00	D	13	-	-
Inorganic clays of low plasticity	CL		4.00	D	16	-	-
			5.00	U		-	-
			6.00	D	14	-	-
			7.00	D	18	-	-
			8.00	U		-	-
Silty Sands	SM		9.00	D	12	-	-
			10.00	D	19	-	-
			11.00	U		-	-
			12.50	D	14	-	-
Inorganic clays of low plasticity	CL		14.00	U		-	-
			15.50	D	26	-	-
			17.00	U		-	-
Inorganic Silts of low plasticity	ML		18.50	D	33	-	-
			20.00	U		-	-

BH-P73-22828.4870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	U		-	-
Inorganic Silts of low plasticity	ML		21.50	D	54	-	-
Inorganic clays of low plasticity	CL		23.00	D	61	-	-
Silty Sands	SM		24.50	D	64	-	-
			26.00	D	58	-	-
Inorganic Silty Clays of low plasticity	CL-ML		27.50	D	52	-	-
Silty Sands	SM		29.00	D	51	-	-
Inorganic clays of low plasticity	CL		30.50	D	55	-	-
Silty Sands	SM		32.00	D	58	-	-
			33.50	D	62	-	-
			35.00	D	59	-	-
Inorganic clays of low plasticity	CL		36.50	D	64	-	-
			38.00	D	72	-	-
			40.00	D	102	-	-

APPENDIX-C
PLOT 18: LITHOLOGICAL PLOTS

BH-P74-22854.687

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
Inorganic clays of low plasticity	CL		1.00	D	6	-	-
Silty Sands	SM (WATER LEVEL)		2.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		3.00	D	5	-	-
Inorganic Silts of low plasticity	ML		4.00	D	11	-	-
			5.00	U		-	-
			6.00	D	18	-	-
Silty Sands	SM		7.00	D	19	-	-
			8.00	U		-	-
			9.00	D	23	-	-
Inorganic Silty Clays of low plasticity	CL-ML		10.00	D	17	-	-
Inorganic Silts of low plasticity	ML		11.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		12.50	D	14	-	-
Silty Sands	SM		14.00	D		-	-
			15.50	D	21	-	-
Inorganic clays of low plasticity	CL		17.00	U		-	-
Silty Sands	SM		18.50	D	29	-	-
			20.00	D		-	-

BH-P74-22854.687

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	D		-	-
			21.50	D	55	-	-
Inorganic clays of low plasticity	CL		23.00	D	50	-	-
			24.50	D	59	-	-
Inorganic Silts of Intermediate plasticity	MI		26.00	D	50	-	-
			27.50	D	45	-	-
			29.00	D	55	-	-
Inorganic Silty Clays of low plasticity	CL-ML		30.50	D	51	-	-
			32.00	D	53	-	-
Inorganic clays of low plasticity	CL		33.50	D	58	-	-
Inorganic Silty Clays of low plasticity	CL-ML		35.00	D	60	-	-
			36.50	D	57	-	-
Inorganic clays of low plasticity	CL		38.00	D	69	-	-
			40.00	D	75	-	-

APPENDIX-C

PLOT 19: LITHOLOGICAL PLOTS

BH-P75-22880.887

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	D	3	-	-
Inorganic Silty Clays of low plasticity	CL-ML						
			2.00	U		-	-
Silty Sands with clay binder	SM-SC						
			3.00	D	7	-	-
Inorganic Silty Clays of low plasticity	CL-ML						
			4.00	D	12	-	-
			5.00	U		-	-
Inorganic Silts of low plasticity	ML		6.00	D	14	-	-
			7.00	D	17	-	-
Silty Sands	SM		8.00	D		-	-
			9.00	D	21	-	-
			10.00	D	21	-	-
			11.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML						
			12.50	D	18	-	-
			14.00	D		-	-
Inorganic clays of low plasticity	CL		15.50	D	25	-	-
			17.00	D		-	-
Silty Sands	SM		18.50	D	30	-	-
			20.00	D		-	-

BH-P75-22880.887

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	D		-	-
Silty Sands	SM						
			21.50	D	38	-	-
Inorganic clays of low plasticity	CL		23.00	U		-	-
			24.50	D	36	-	-
Silty Sands	SM						
			26.00	D		-	-
Inorganic Silts of low plasticity	ML						
			27.50	D	42	-	-
Inorganic Silty Clays of low plasticity	CL-ML						
			29.00	U		-	-
Silty Sands	SM						
			30.50	D	44	-	-
Inorganic Silts of intermediate plasticity	MI						
			32.00	U		-	-
Silty Sands	SM						
			33.50	D	52	-	-
Inorganic clays of low plasticity	CL						
			35.00	D	56	-	-
Inorganic Silty Clays of low plasticity	CL-ML						
			36.50	D	52	-	-
Silty Sands	SM		38.00	D	58	-	-
			40.00	D	64	-	-

APPENDIX-C
PLOT 20: LITHOLOGICAL PLOTS

BH-P76-22907.0870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
Silty Sands	SM		1.00	U		-	-
			2.00	D	5	-	-
			3.00	D	10	-	-
Inorganic clays of low plasticity	CL		4.00	U		-	-
			5.00	D	9	-	-
Inorganic Silty Clays of low plasticity	CL-ML		6.00	D	13	-	-
			7.00	U		-	-
Inorganic clays of low plasticity	CL		8.00	D	8	-	-
			9.00	D	10	-	-
Inorganic Silty Clays of low plasticity	CL-ML		10.00	U		-	-
			11.00	D	22	-	-
			12.00	D	25	-	-
			13.00	U		-	-
Inorganic clays of low plasticity	CL		14.50	D	22	-	-
			16.00	U		-	-
Inorganic Silts of low plasticity	ML		17.50	D	27	-	-
Inorganic Silty Clays of low plasticity	CL-ML		19.00	D		-	-
			20.00	D	32	-	-

BH-P76-22907.0870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.50	D	32	-	-
Inorganic Silty Clays of low plasticity	CL-ML		22.00	D		-	-
			23.50	D	42	-	-
Silty Sands	SM		25.00	U		-	-
			26.50	D	61	-	-
Inorganic clays of low plasticity	CL		28.00	U		-	-
Inorganic Silts of Intermediate plasticity	MI		29.50	D	51	-	-
			31.00	D	53	-	-
			32.50	D	51	-	-
Inorganic Silts of low plasticity	ML		34.00	D	63	-	-
			35.50	D	73	-	-
			37.00	D	74	-	-
Inorganic clays of low plasticity	CL		38.50	D	83	-	-
			40.00	D	87	-	-

APPENDIX-C

PLOT 21: LITHOLOGICAL PLOTS

BH-P77-22933.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	U		-	-
Inorganic clays of low plasticity	WATER LVL CL		2.00	D	5	-	-
			3.00	D	9	-	-
Inorganic Silts of Intermediate plasticity	MI		4.00	U		-	-
Inorganic Silts of low plasticity	ML		5.00	D	18	-	-
Inorganic clays of low plasticity	CL		6.00	D	28	-	-
			7.00	U		-	-
			8.00	D	26	-	-
			9.00	D	30	-	-
Inorganic Silty Clays of low plasticity	CL-ML		10.00	U		-	-
			11.00	D	22	-	-
Inorganic clays of low plasticity	CL		12.00	D	27	-	-
			13.00	U		-	-
Silty Sands	SM		14.50	D	31	-	-
Inorganic Silts of low plasticity	ML		16.00	D		-	-
			17.50	D	35	-	-
Inorganic clays of low plasticity	CL		19.00	U		-	-
			20.00	D	41	-	-

BH-P77-22933.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL						
Inorganic Silts of low plasticity	ML		20.50	D	41	-	-
Inorganic clays of low plasticity	CL		22.00	U		-	-
			23.50	D	45	-	-
Silty Sands	SM		25.00	U		-	-
			26.50	D	44	-	-
Inorganic Silts of Intermediate plasticity	MI		28.00	U		-	-
Inorganic clays of low plasticity	CL		29.50	D	100	-	-
Inorganic Silts of low plasticity	ML		31.00	D	97	-	-
Inorganic clays of low plasticity	CL		32.50	D	86	-	-
Inorganic Silts of low plasticity	ML		34.00	D	95	-	-
			35.50	D	63	-	-
			37.00	D	45	-	-
			38.50	D	64	-	-
			40.00	D	93	-	-

APPENDIX-C

PLOT 22: LITHOLOGICAL PLOTS

BH-P78-22954.4870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	D	8	-	-
			2.00	U		-	-
			3.00	D	10	-	-
			4.00	D	9	-	-
			5.00	U		-	-
Silty Sands with clay binder	SM-SC		6.00	D	14	-	-
			7.00	D	12	-	-
Inorganic clays of low plasticity	CI		8.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		9.00	D	31	-	-
Inorganic clays of low plasticity	CI		10.00	D	16	-	-
Inorganic Silty Clays of low plasticity	CL-ML		11.00	U		-	-
Inorganic clays of low plasticity	CI		12.50	D	18	-	-
			14.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		15.50	D	28	-	-
			17.00	U		-	-
			18.50	D	27	-	-
			20.00	U		-	-

BH-P78-22954.4870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	U		-	-
Inorganic clays of low plasticity	CI		21.50	D	33	-	-
			23.00	U		-	-
Inorganic Silts of low plasticity	ML		24.50	D	37	-	-
			26.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		27.50	D	55	-	-
			29.00	D	59	-	-
Silty Sands	SM		30.50	D	60	-	-
Inorganic Silty Clays of low plasticity	CL-ML		32.00	D	75	-	-
Inorganic Silts of low plasticity	ML		33.50	D	68	-	-
			35.00	D	64	-	-
Inorganic Silty Clays of low plasticity	CL-ML		36.50	D	72	-	-
			38.00	D	78	-	-
			40.00	D	88	-	-

APPENDIX-C
PLOT 23: LITHOLOGICAL PLOTS

BH-P79-22985.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	U		-	-
Inorganic clays of low plasticity	CL		2.00	D	4	-	-
			3.00	D	8	-	-
			4.00	U		-	-
			5.00	D	9	-	-
			6.00	D	12	-	-
Inorganic Silty Clays of low plasticity	CL-ML		7.00	U		-	-
Inorganic clays of low plasticity	CL		8.00	D	26	-	-
			9.00	D	23	-	-
			10.00	U		-	-
			11.00	D	16	-	-
			12.00	D	19	-	-
Inorganic Silty Clays of low plasticity	CL-ML		13.00	U		-	-
Inorganic clays of low plasticity	CL		14.50	D	22	-	-
Inorganic Silts of low plasticity	ML		16.00	U		-	-
			17.50	D	36	-	-
Silty Sands	SM		19.00	U		-	-
			20.00	D	51	-	-

BH-P79-22985.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		20.50	D	51	-	-
Inorganic clays of low plasticity	CL		22.00	U		-	-
			23.50	D	40	-	-
			25.00	U		-	-
			26.50	D	38	-	-
			28.00	D		-	-
Silty Sands	SM		29.50	D	38	-	-
Inorganic Silts of low plasticity	ML		31.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		32.50	D	43	-	-
			34.00	D		-	-
Inorganic clays of low plasticity	CL		35.50	D	53	-	-
			37.00	D		-	-
			38.50	D	58	-	-
			40.00	D	64	-	-

APPENDIX-C
PLOT 24: LITHOLOGICAL PLOTS

BH-P80-23011.887

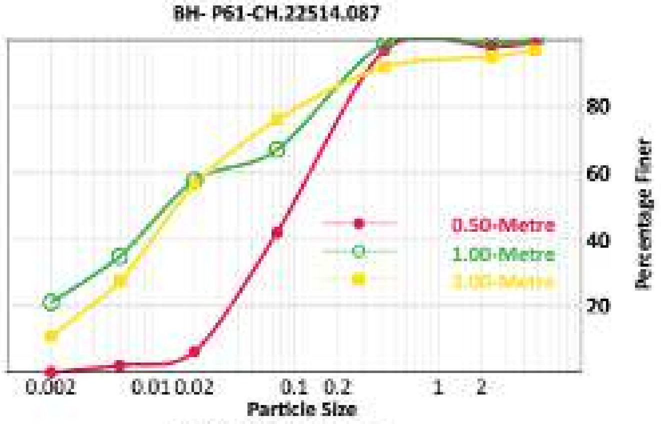
DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML		0.50	D		-	-
			1.00	U		-	-
Inorganic clays of low plasticity			2.00	D	5	-	-
Silty Sands	SM		3.00	D	8	-	-
			4.00	U		-	-
Inorganic clays of low plasticity	CL		5.00	D	14	-	-
Inorganic Silts of low plasticity	ML		6.00	D	13	-	-
Silty Sands	SM		7.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		8.00	D	24	-	-
			9.00	D	35	-	-
Inorganic clays of low plasticity	CL		10.00	U		-	-
Inorganic Silts of low plasticity	ML		11.00	D	37	-	-
Inorganic clays of low plasticity	CL		12.00	D	23	-	-
			13.00	U		-	-
			14.50	D	30	-	-
Clayey Sands	SC		16.00	U		-	-
			17.50	D	46	-	-
Silty Sands	SM		19.00	U		-	-
			20.00	D	49	-	-

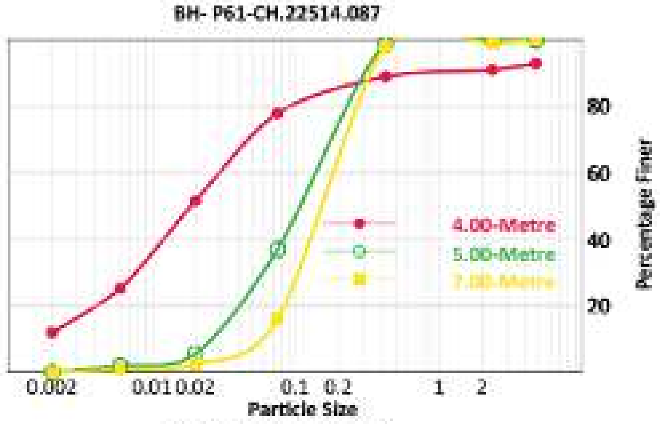
BH-P80-23011.887

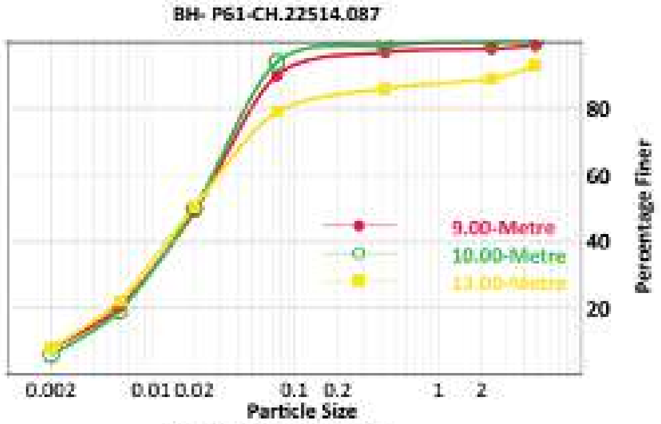
DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM						
Silty Sands with clay binder	SM-SC		20.50	D	49	-	-
Inorganic clays of low plasticity	CL		22.00	U		-	-
			23.50	D	65	-	-
			25.00	D	77	-	-
Inorganic Silty Clays of low plasticity	CL-ML		26.50	D	85	-	-
Inorganic Silts of low plasticity	ML		28.00	D	101	-	-
			29.50	D	51	-	-
Inorganic Silty Clays of low plasticity	CL-ML		31.00	D	63	-	-
Inorganic clays of low plasticity	CL		32.50	D	72	-	-
Inorganic Silts of low plasticity	ML		34.00	D	77	-	-
Inorganic Silty Clays of low plasticity	CL-ML		35.50	D	80	-	-
			37.00	D	88	-	-
			38.50	D	85	-	-
			40.00	D	91	-	-

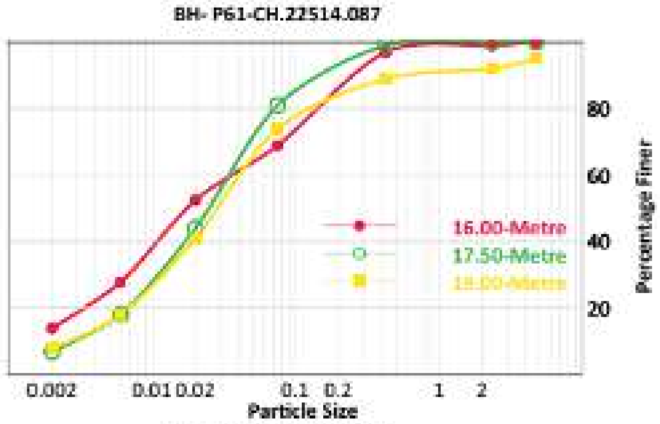
APPENDIX-D

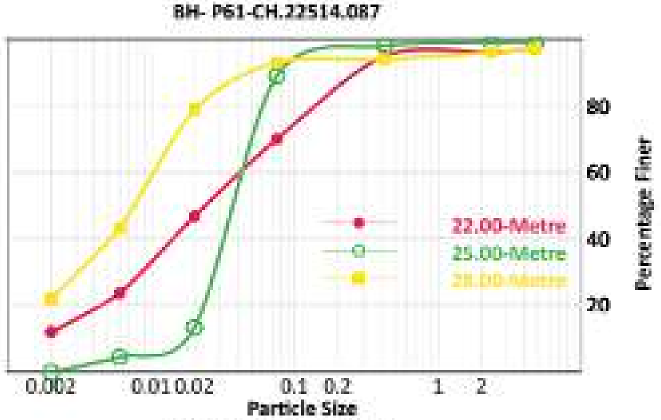
PLOT 1: GRAIN SIZE DISTRIBUTION PLOTS

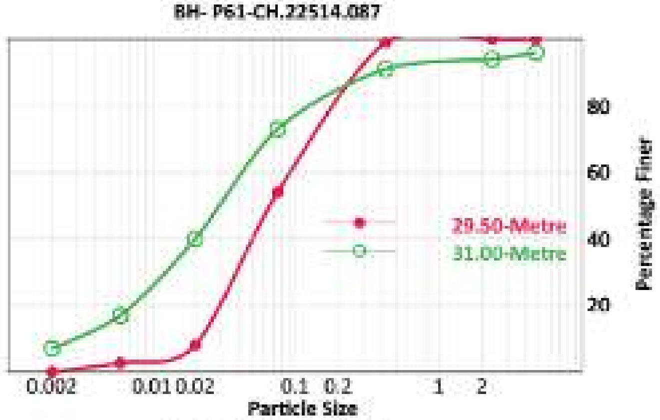


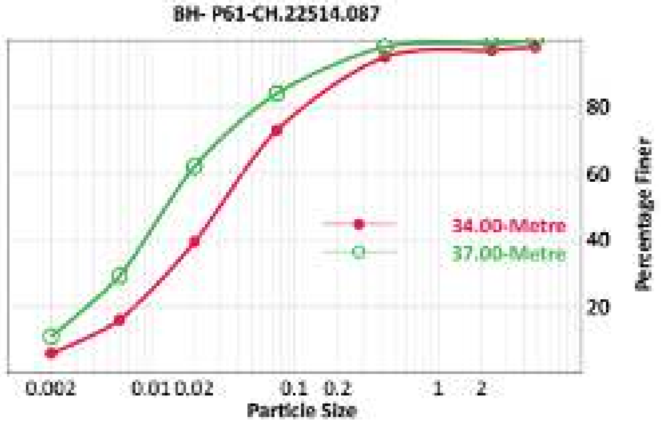


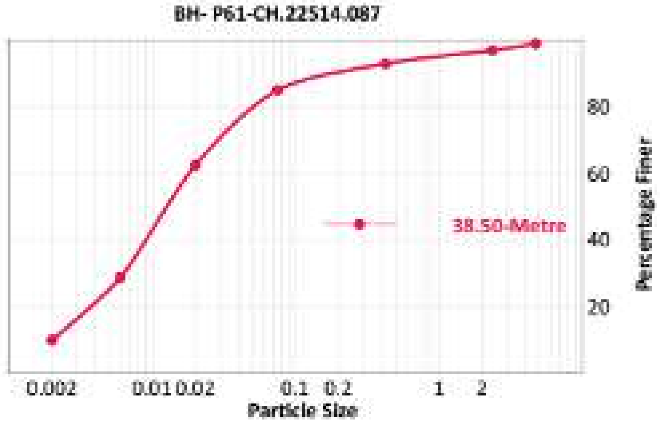






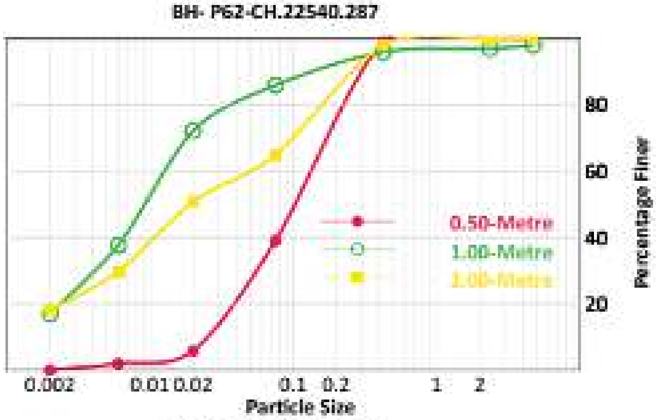


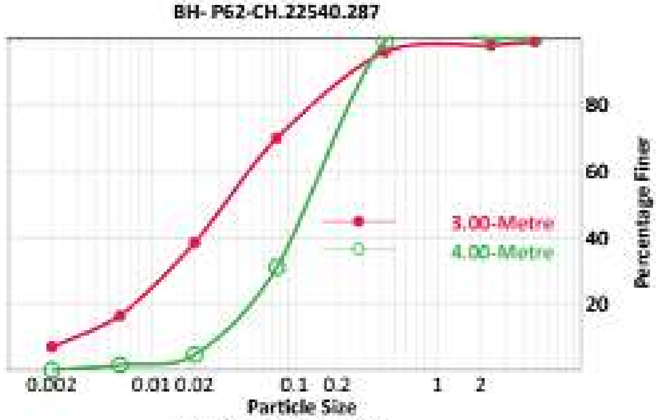


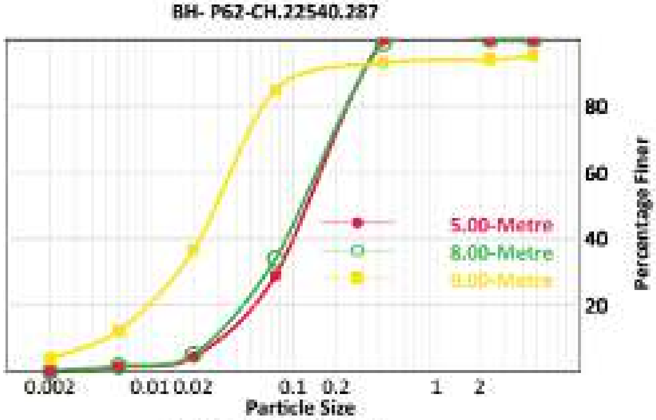


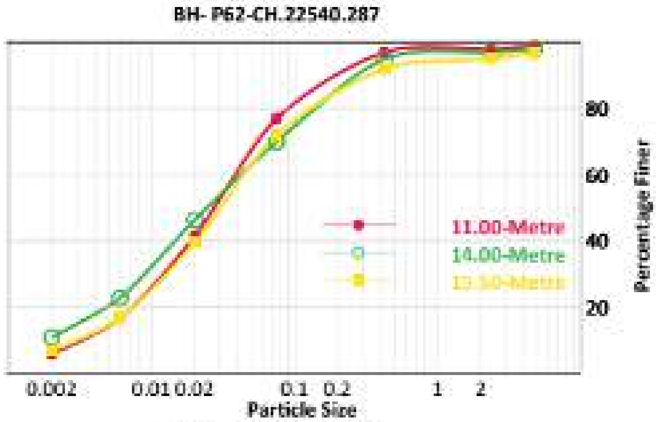
APPENDIX-D

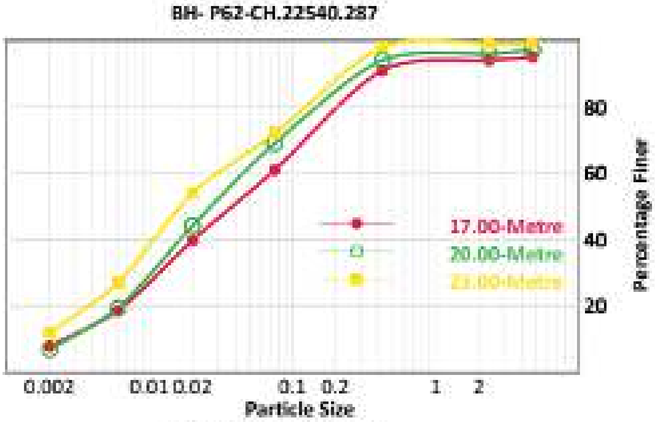
PLOT 2: GRAIN SIZE DISTRIBUTION PLOTS

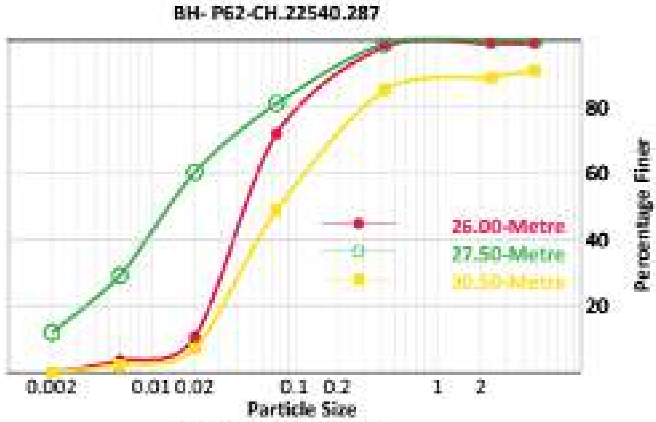


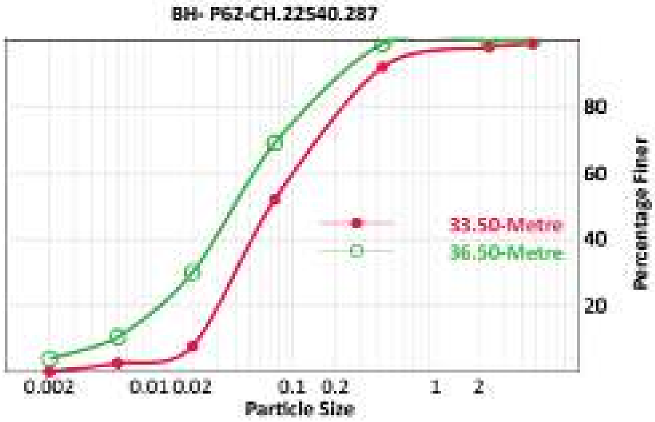


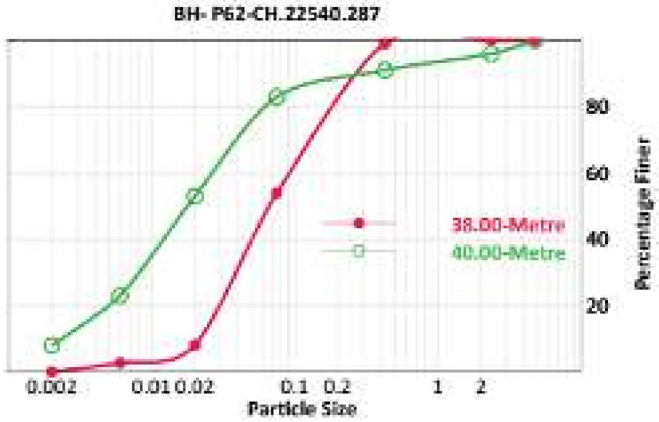




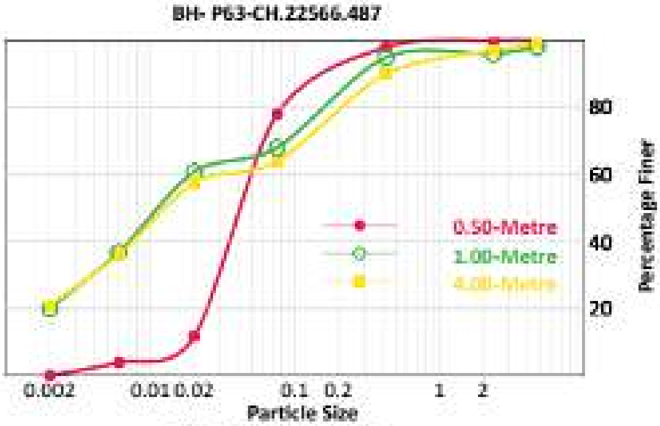


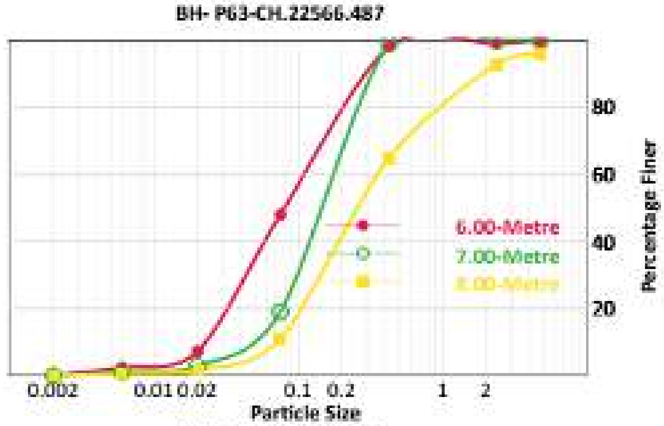


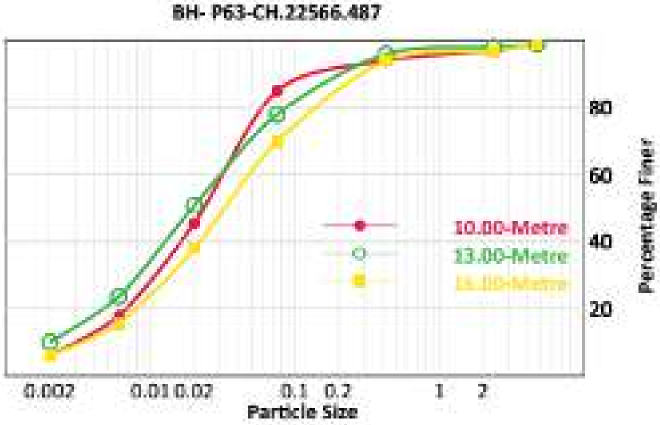


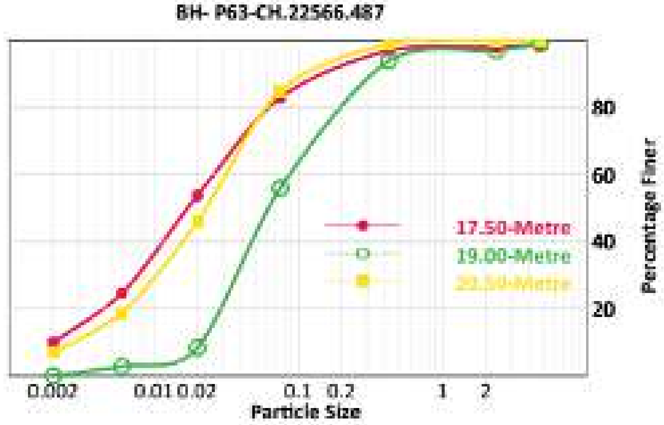


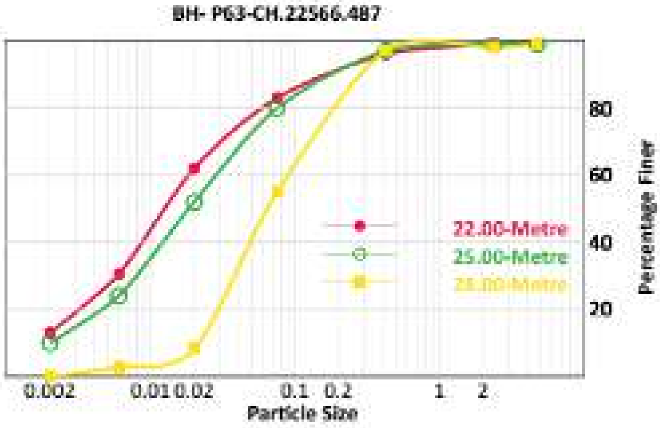
APPENDIX-D
PLOT 3: GRAIN SIZE DISTRIBUTION PLOTS

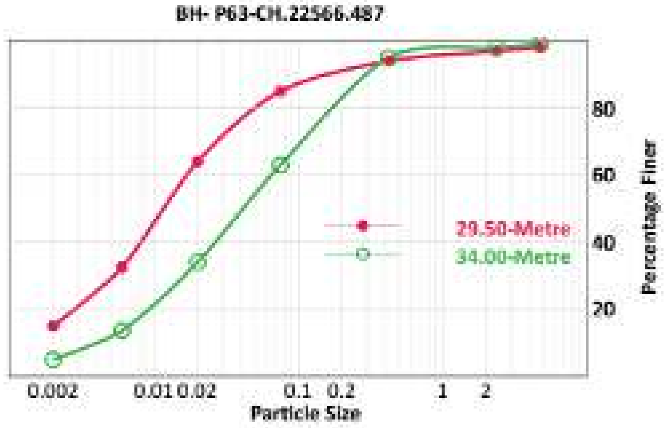


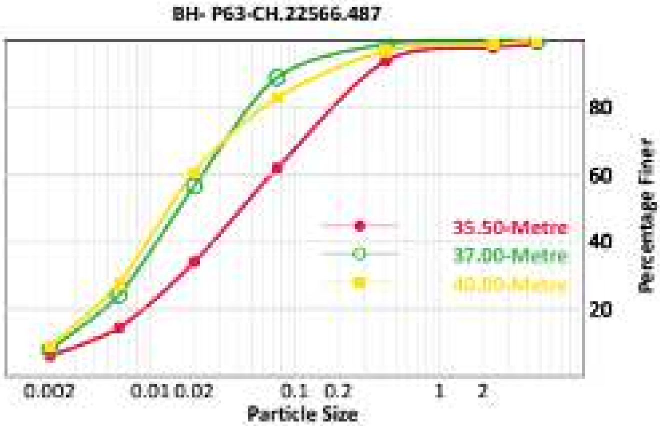


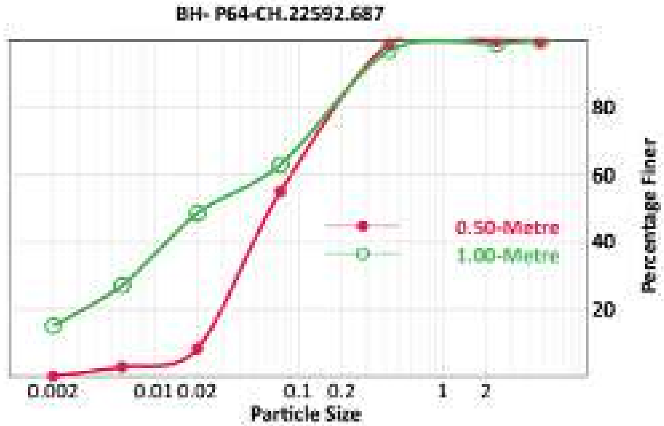




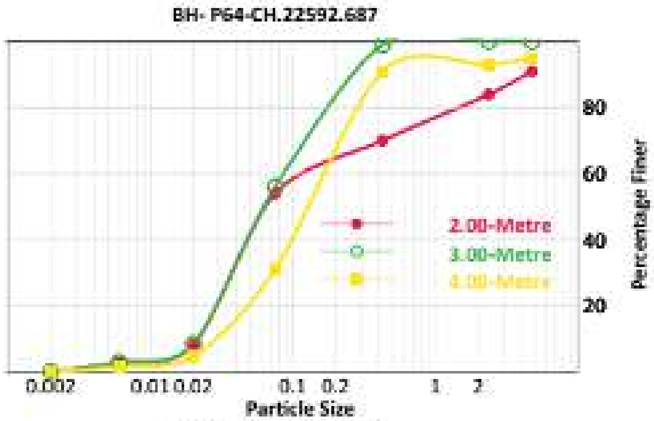


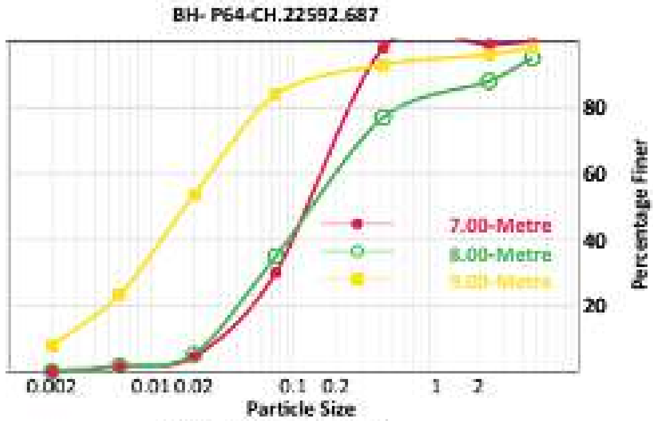


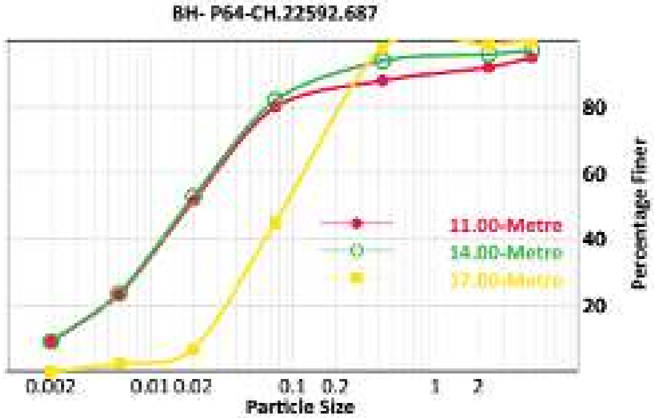


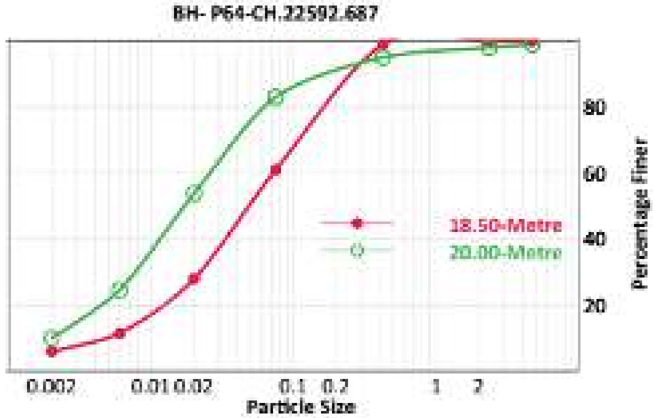


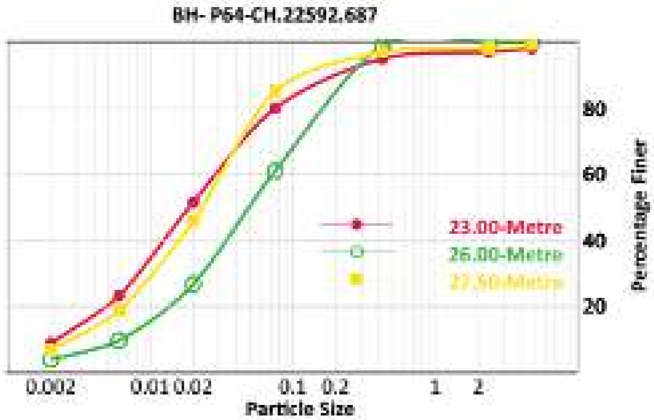
APPENDIX-D
PLOT 4: GRAIN SIZE DISTRIBUTION PLOTS

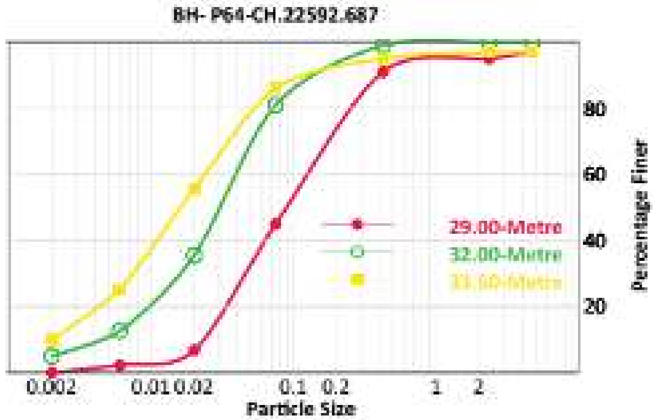


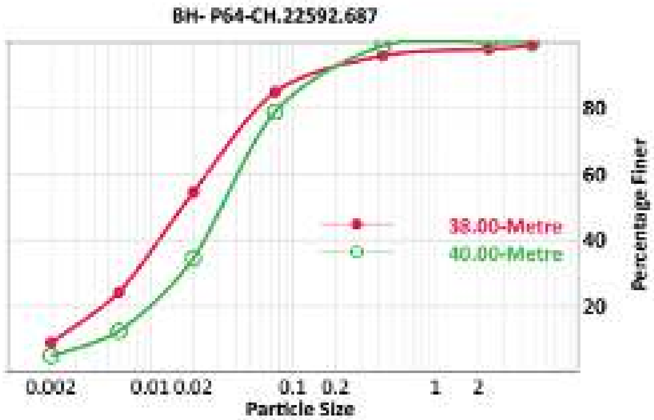


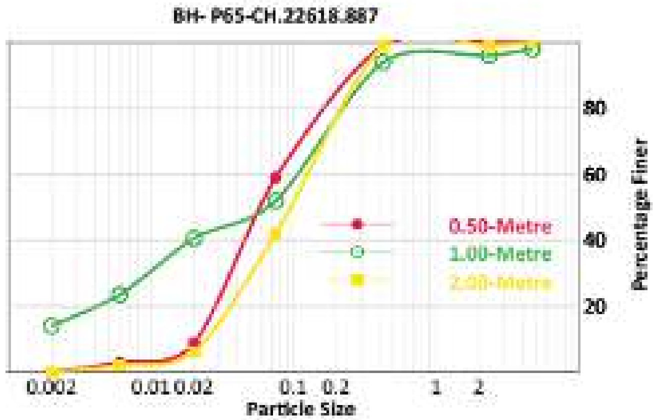








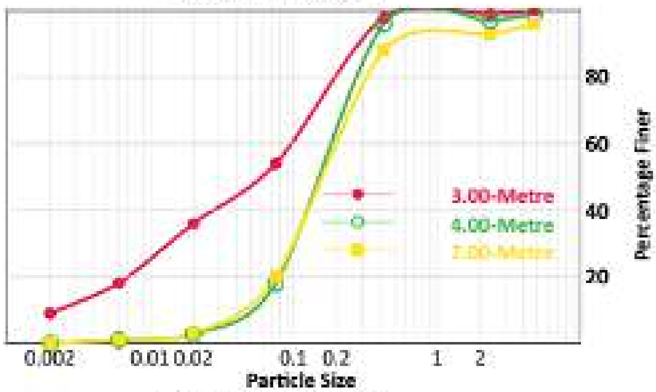




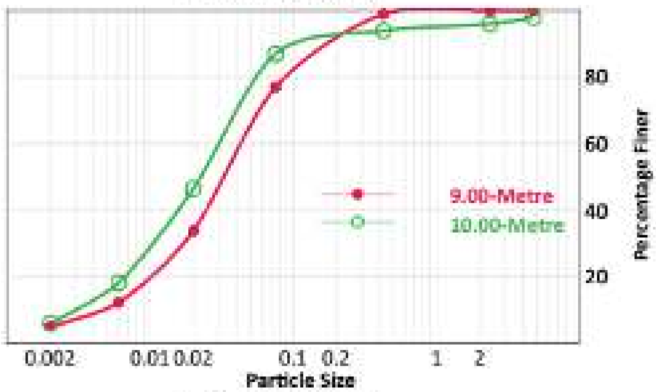
APPENDIX-D

PLOT 5: GRAIN SIZE DISTRIBUTION PLOTS

BH- P65-CH.22618.887



BH- P65-CH.22618.887



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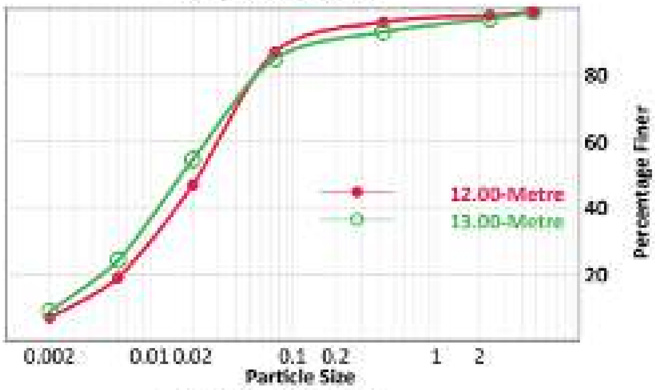

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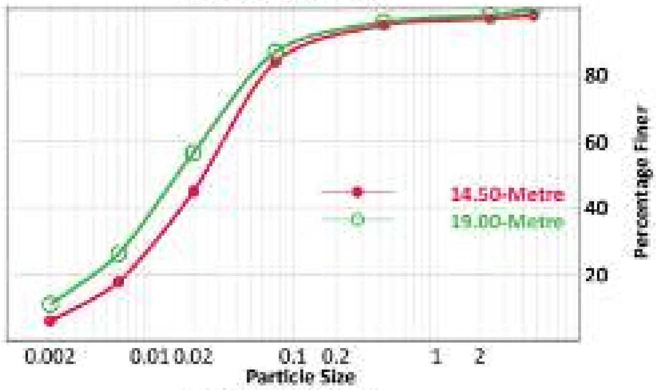

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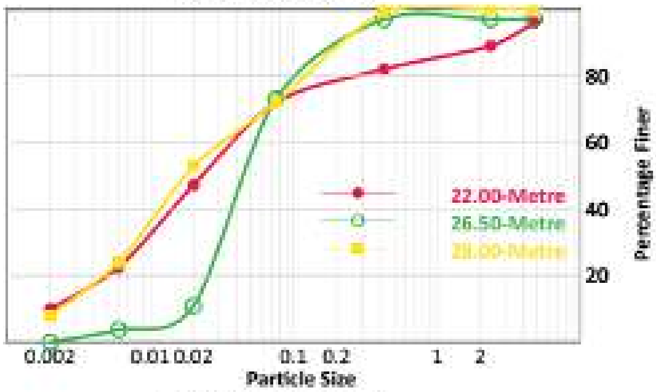

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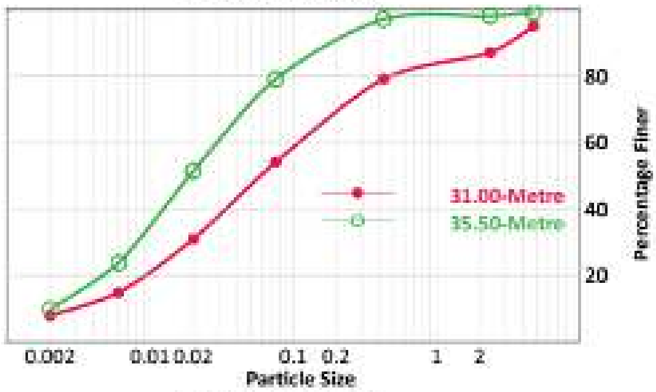

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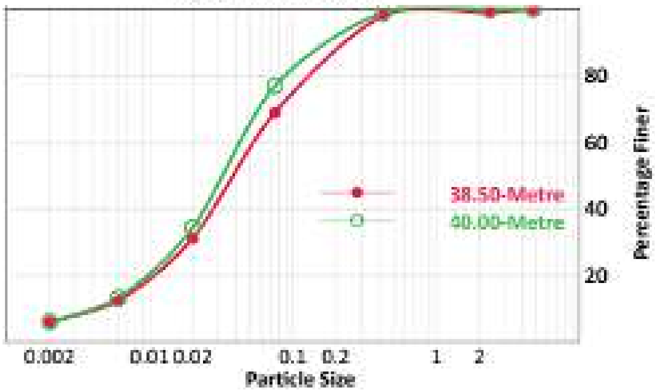
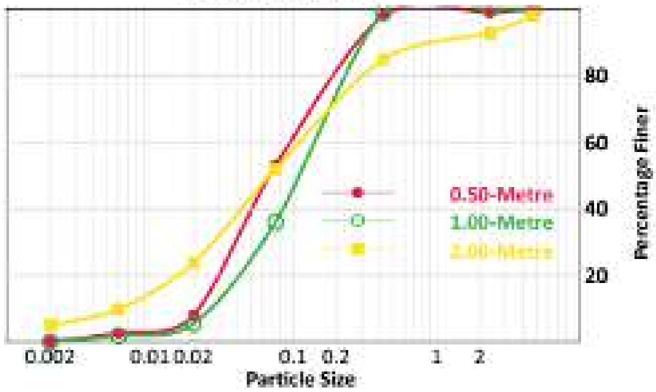
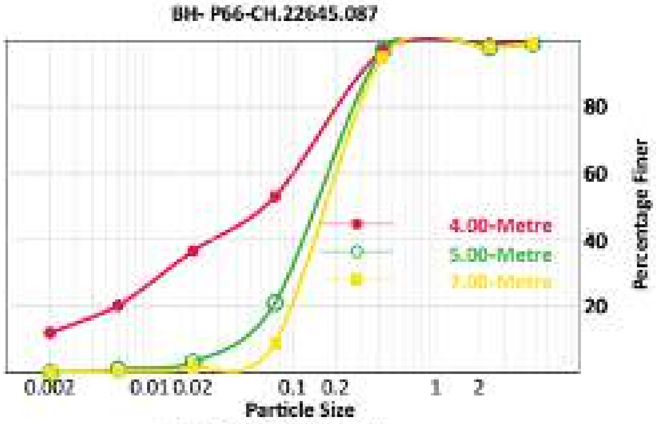
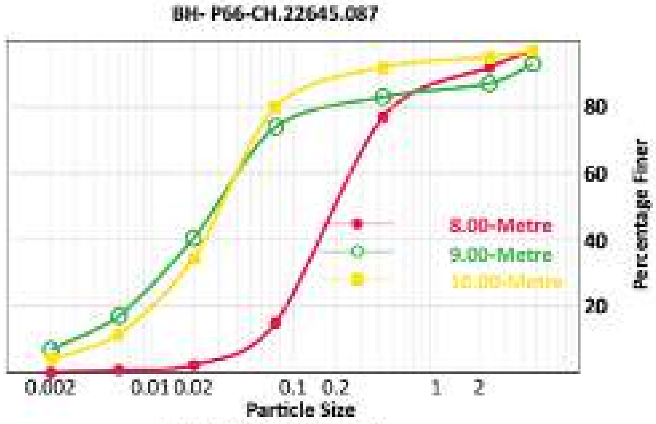


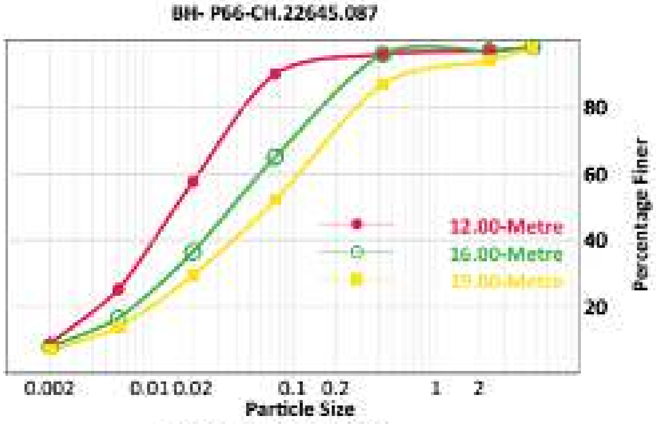
BH- P66-CH.22645.087

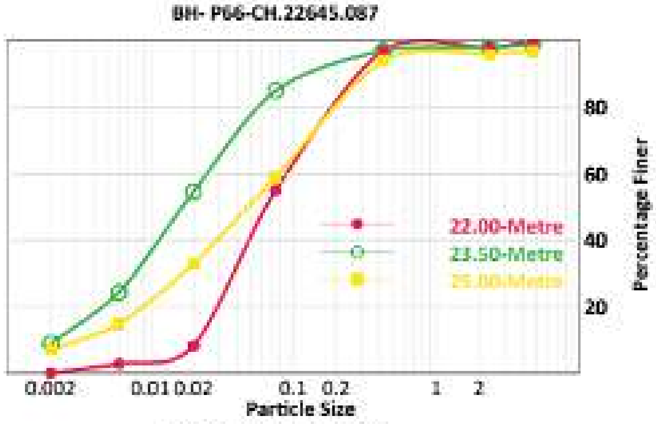


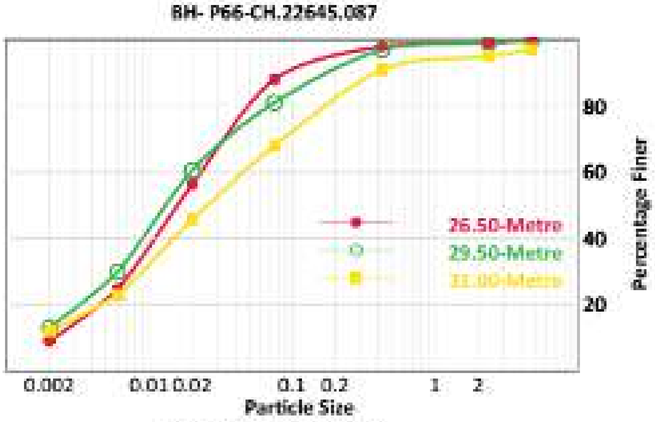
APPENDIX-D
PLOT 6: GRAIN SIZE DISTRIBUTION PLOTS

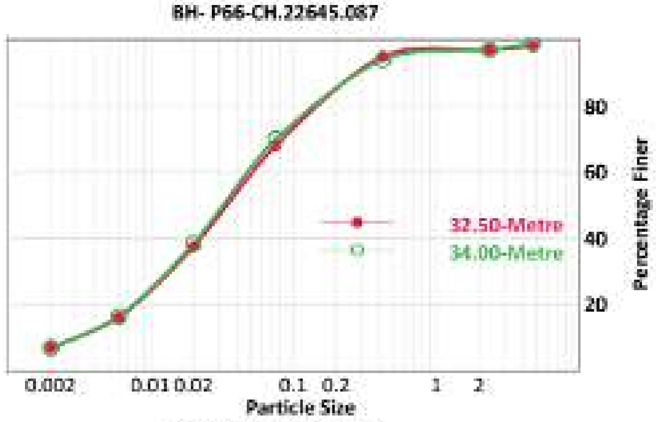


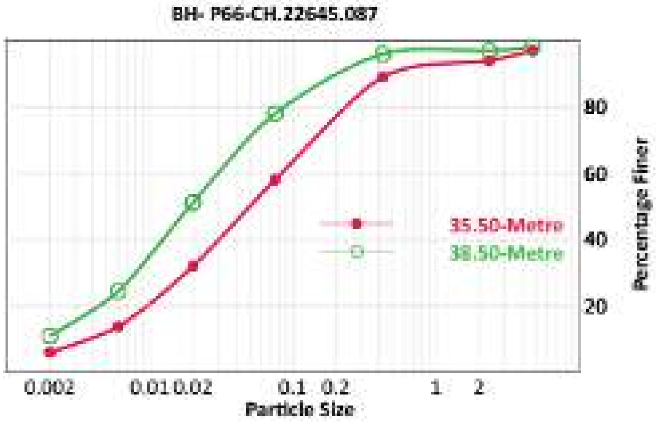


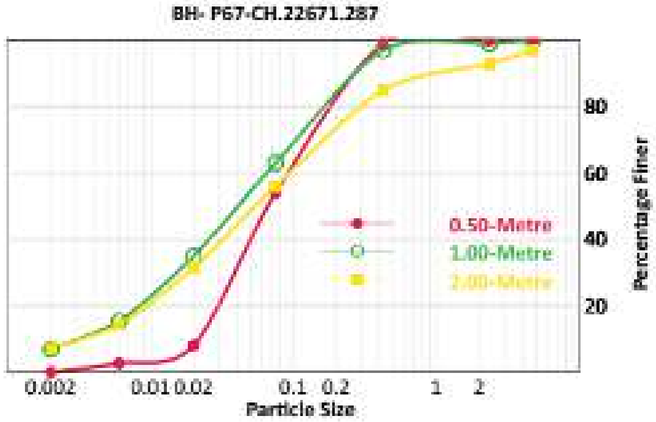




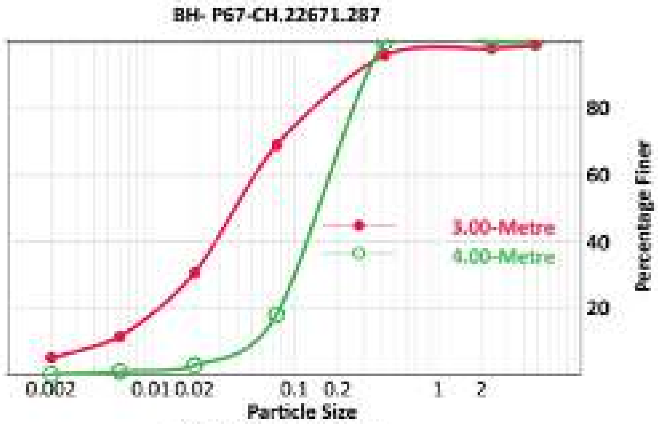


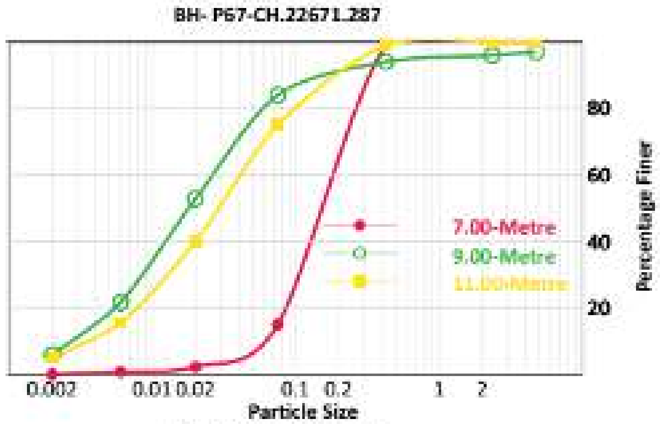


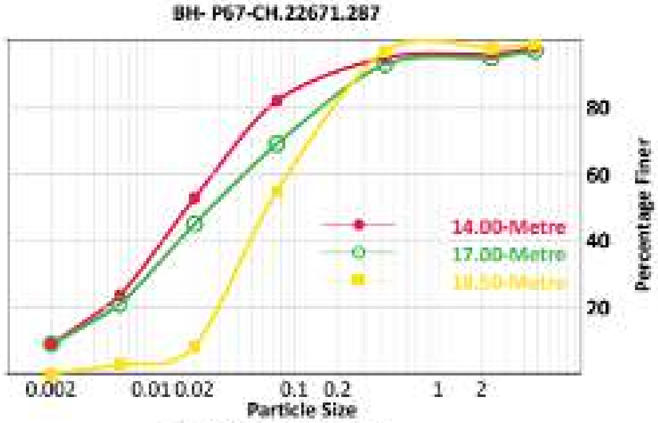


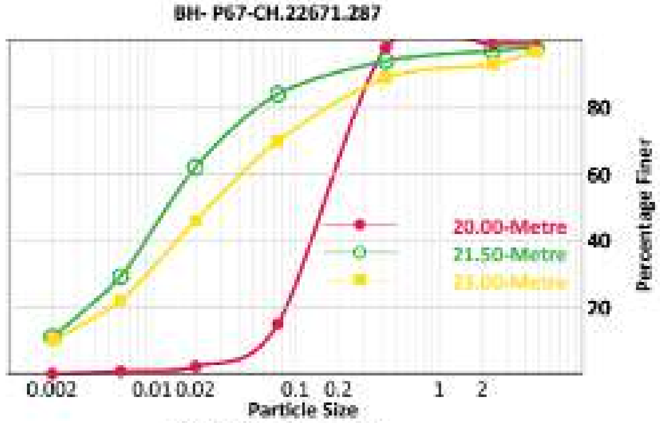


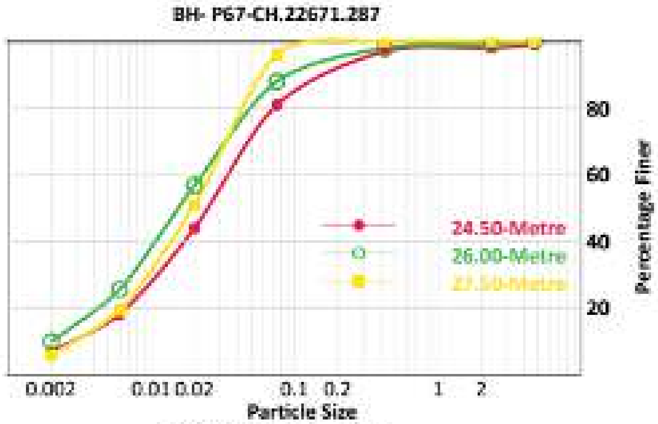
APPENDIX-D
PLOT 7: GRAIN SIZE DISTRIBUTION PLOTS

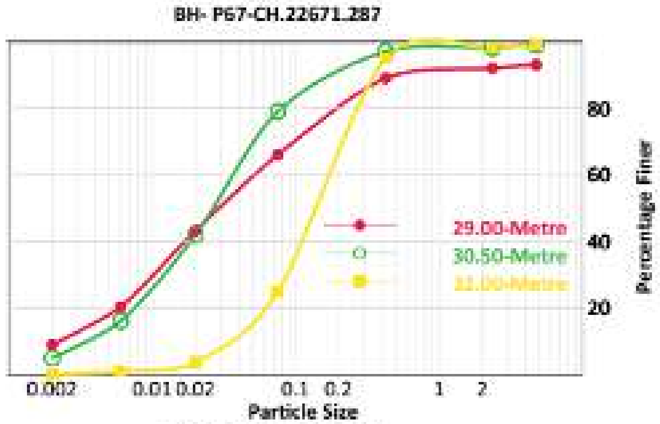


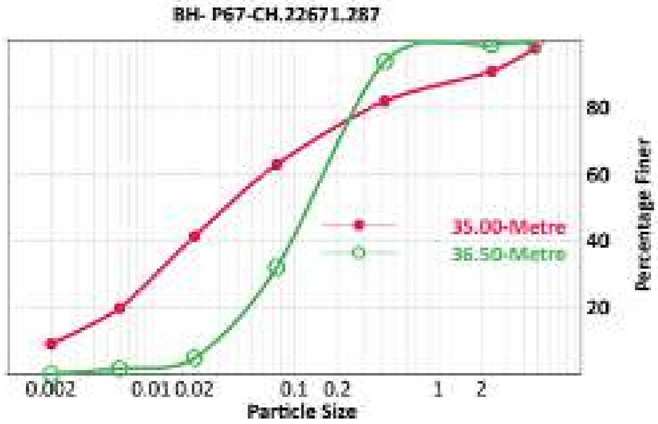


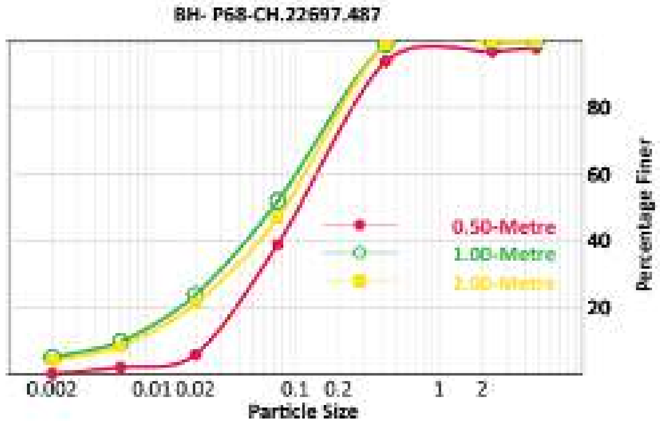




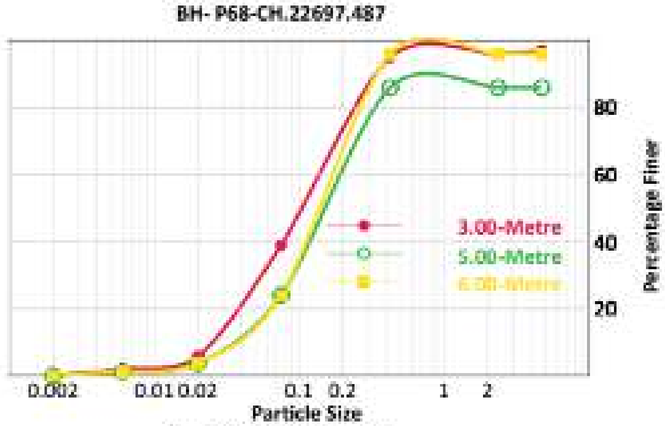


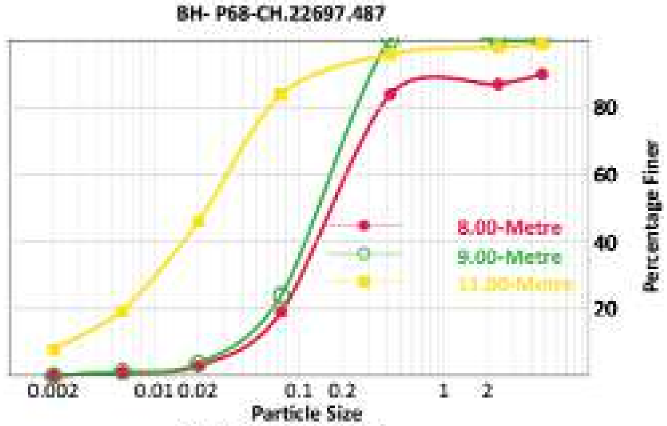


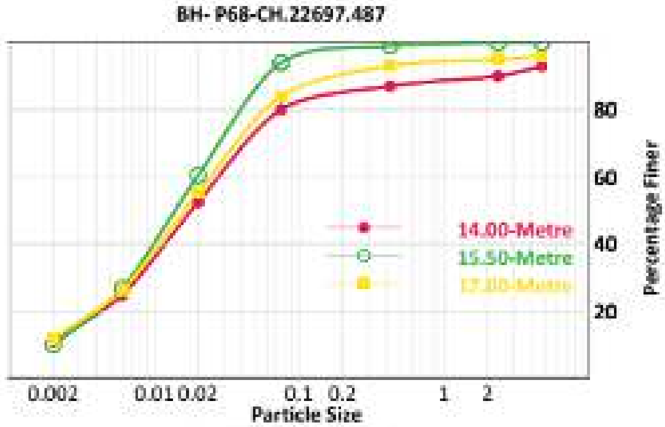


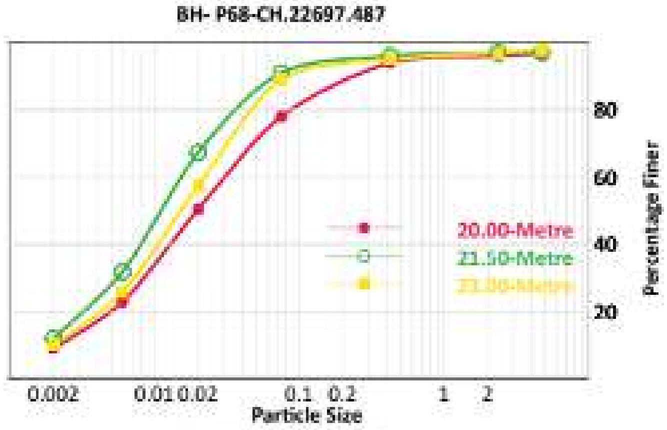


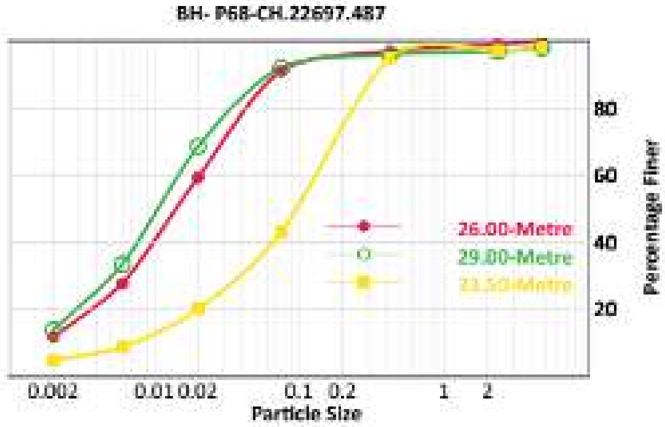
APPENDIX-D
PLOT 8: GRAIN SIZE DISTRIBUTION PLOTS

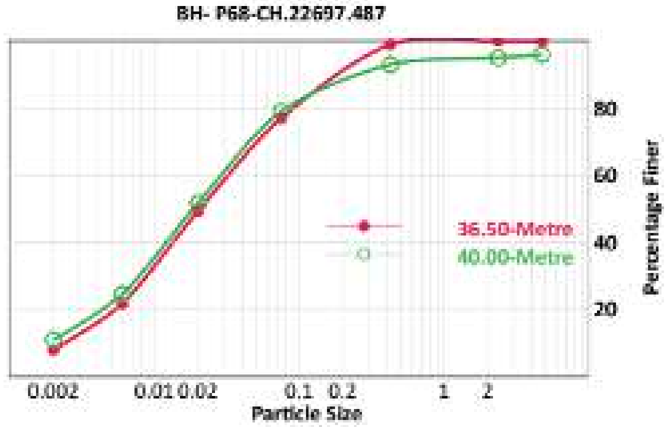


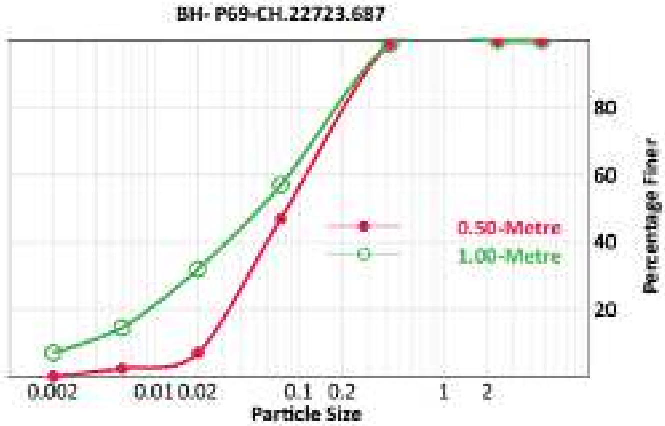


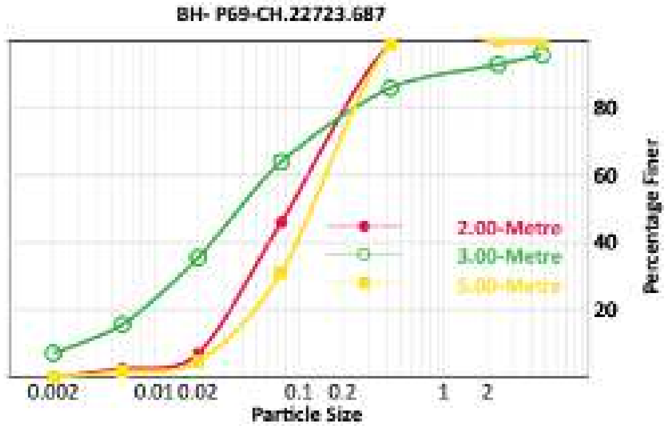






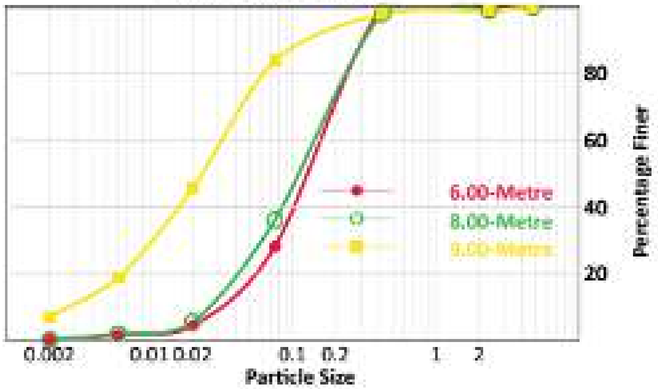




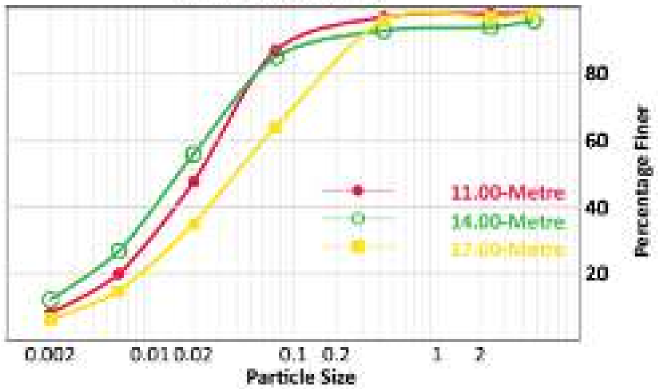


APPENDIX-D
PLOT 9: GRAIN SIZE DISTRIBUTION PLOTS

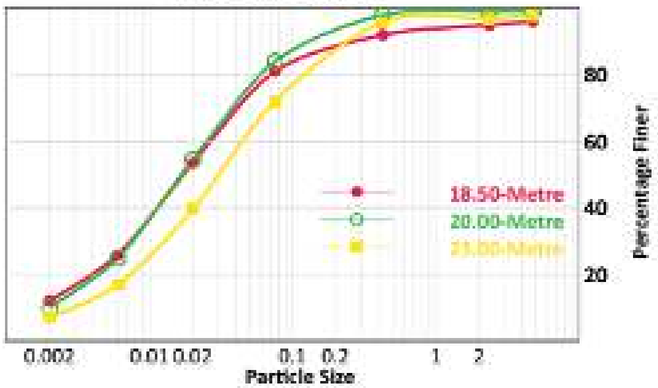
BH- P69-CH.22723.687



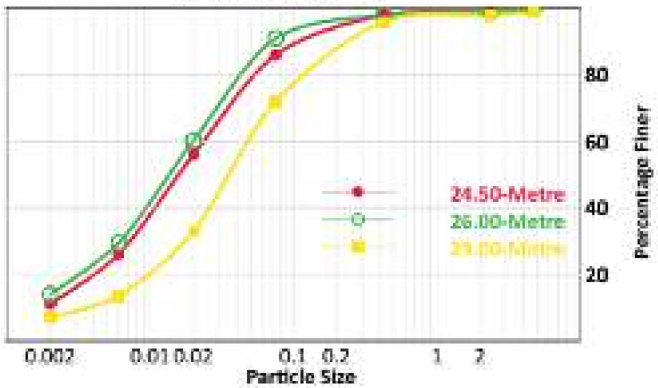
BH- P69-CH.22723.687



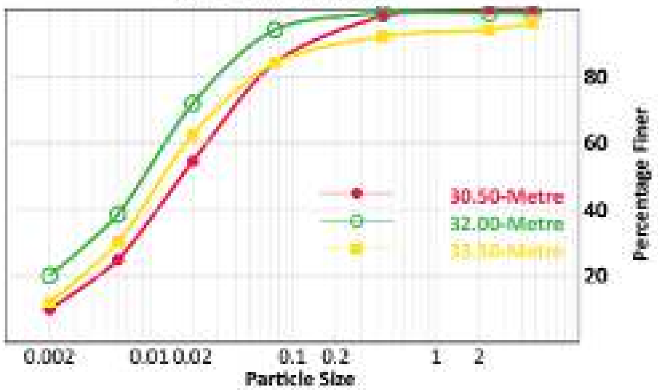
BH- P69-CH.22723.687



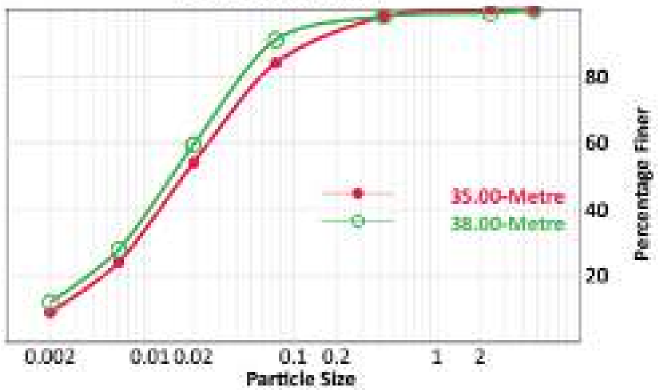
BH- P69-CH.22723.687



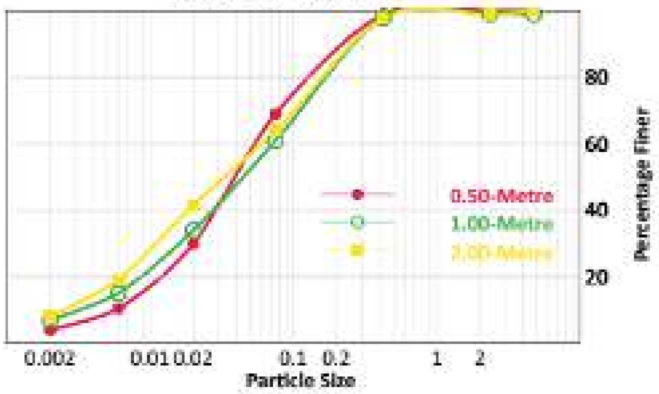
BH- P69-CH.22723.687



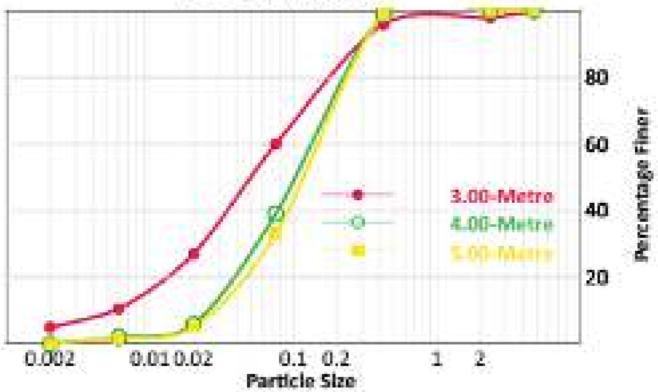
BH- P69-CH.22723.687



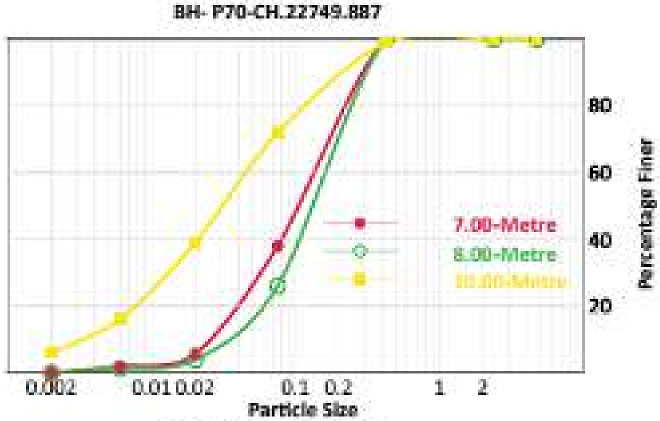
BH- P70-CH.22749.887

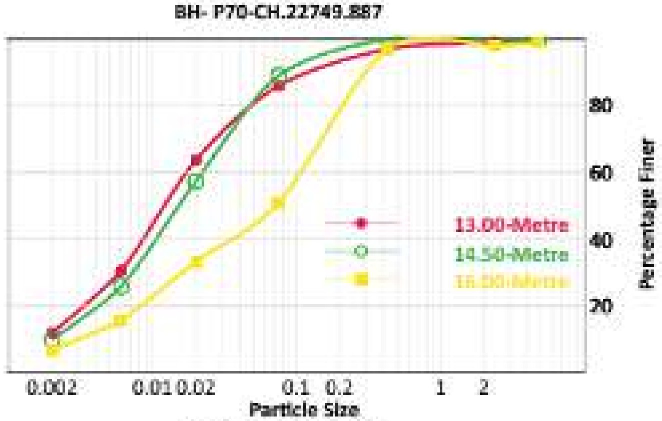


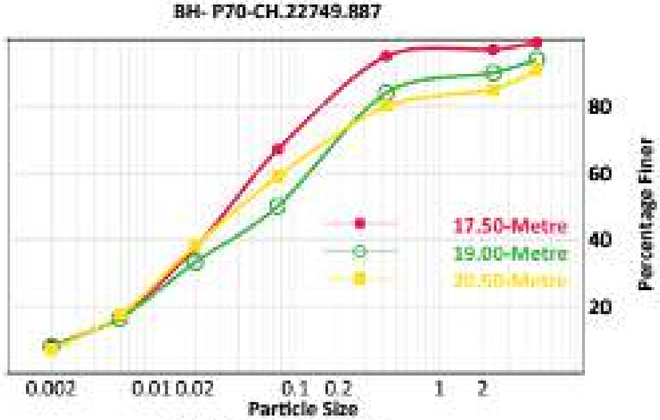
BH- P70-CH.22749.887

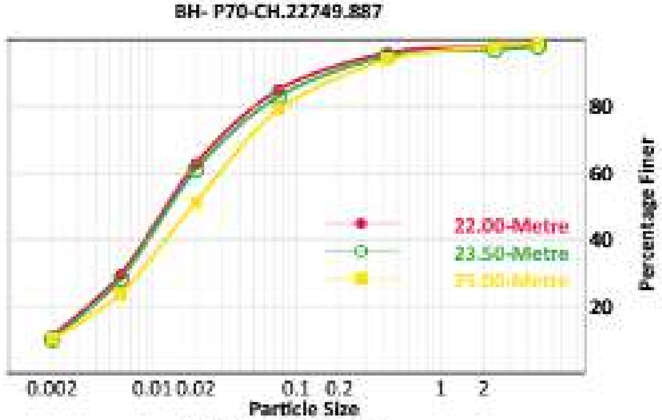


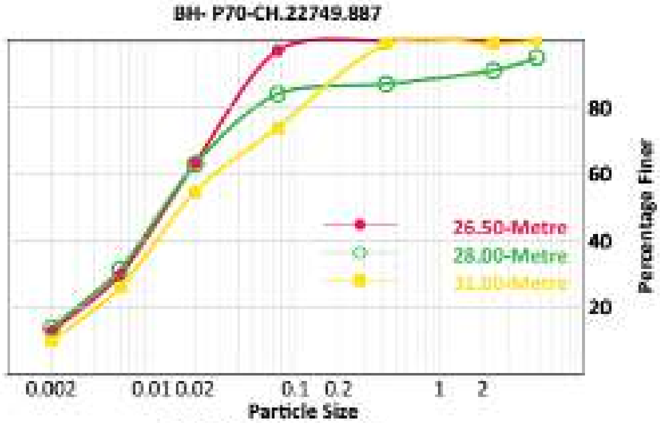
APPENDIX-D
PLOT 10: GRAIN SIZE DISTRIBUTION PLOTS

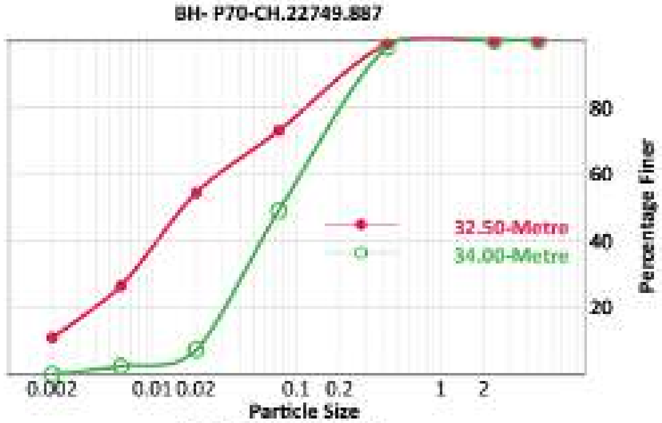


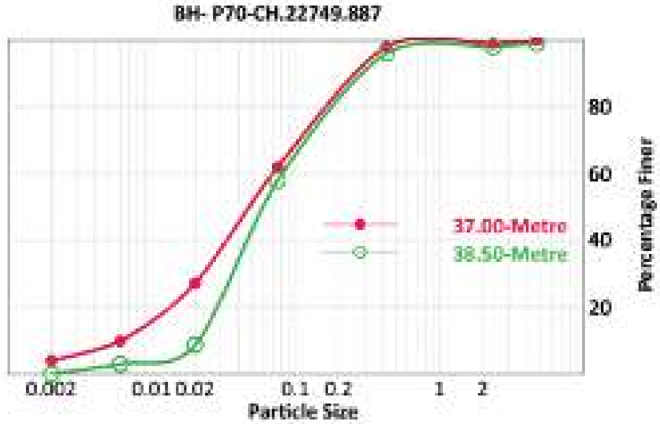


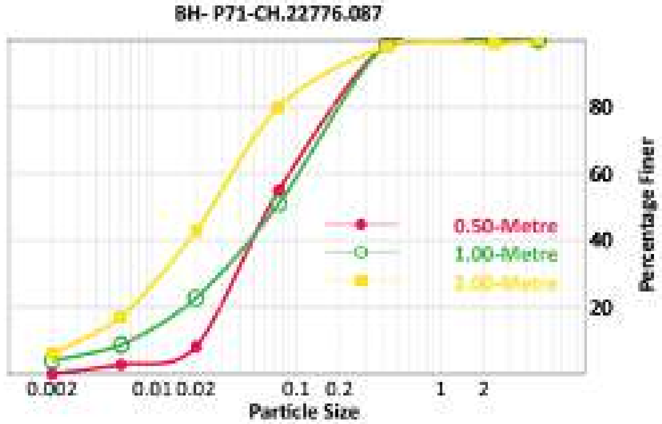




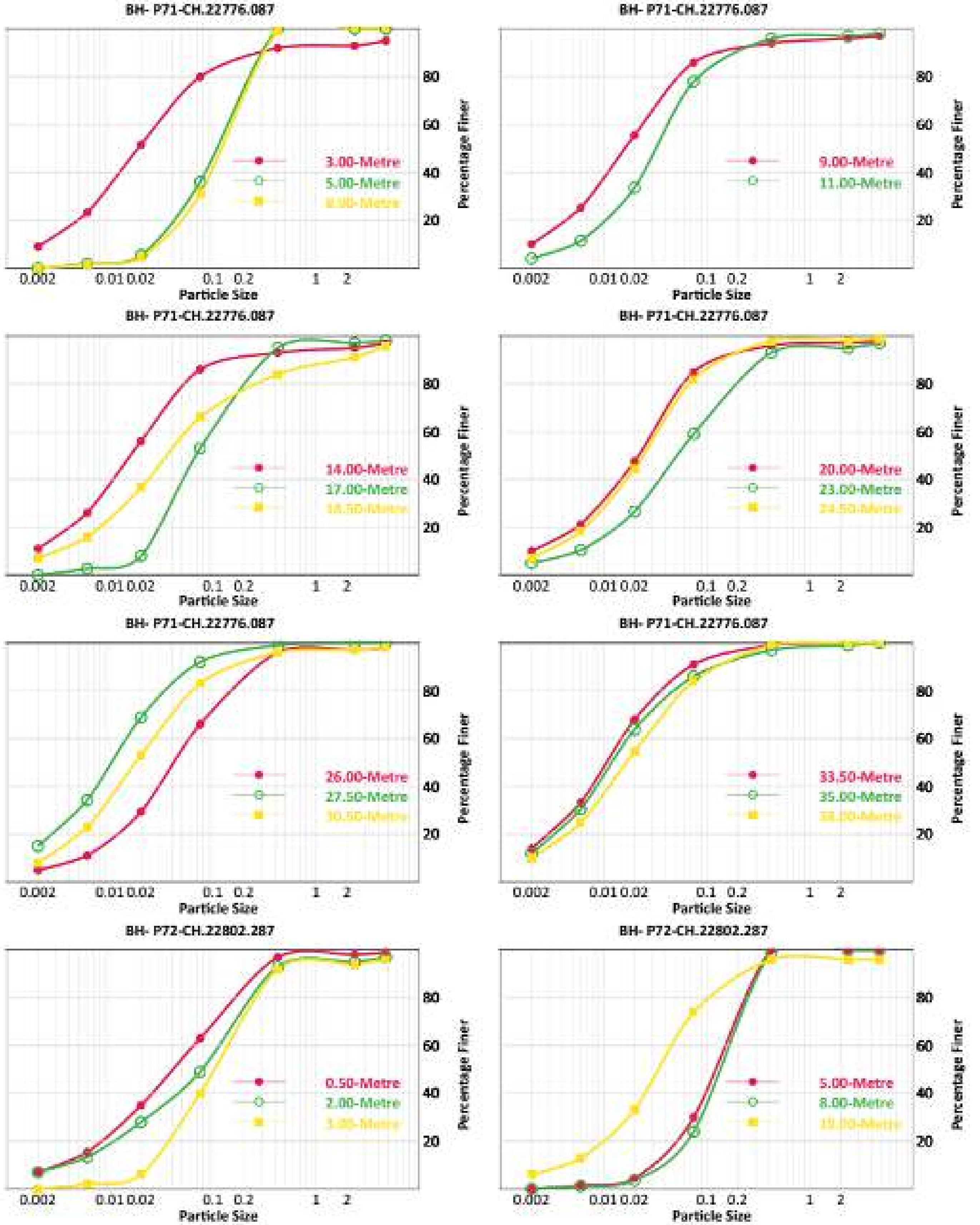






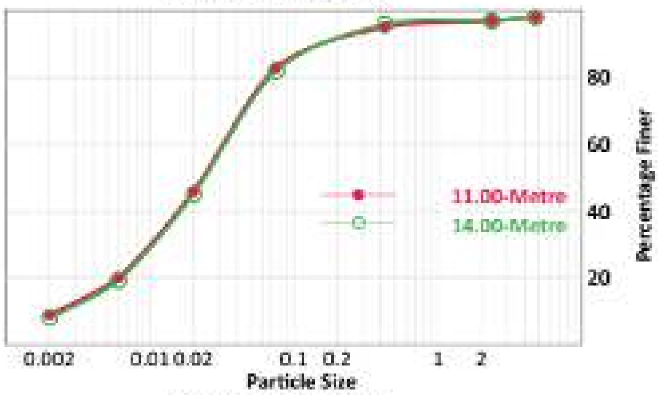


APPENDIX-D
PLOT 11: GRAIN SIZE DISTRIBUTION PLOTS

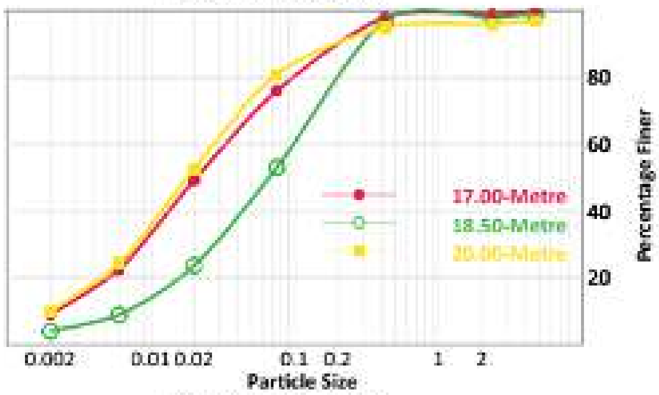


APPENDIX-D
PLOT 12: GRAIN SIZE DISTRIBUTION PLOTS

BH- P72-CH.22802.287



BH- P72-CH.22802.287



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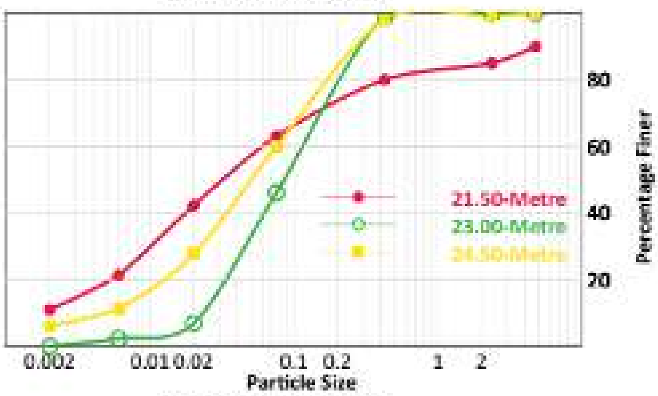

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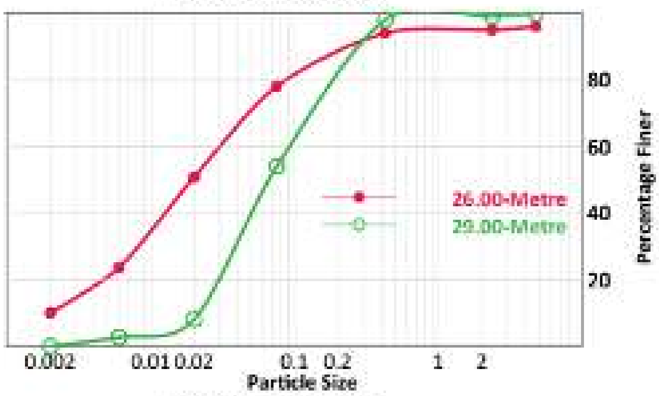

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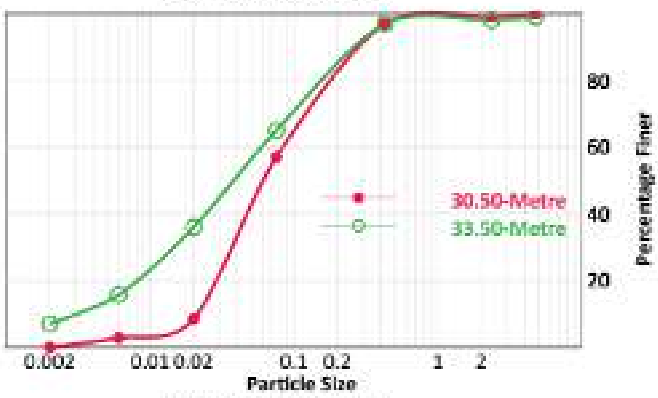

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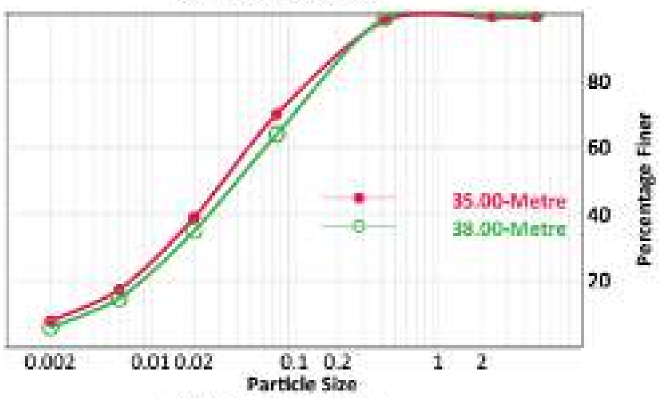

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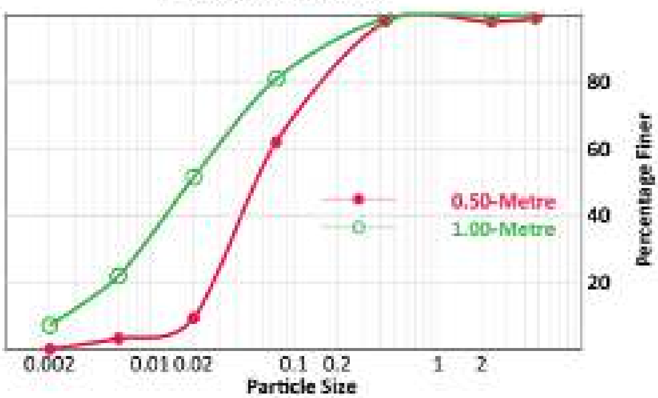

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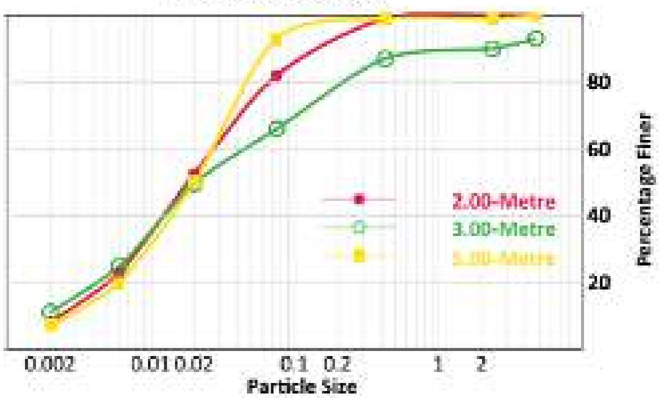
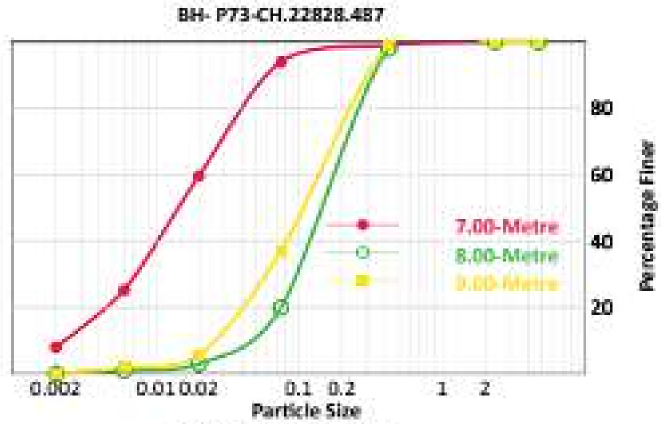
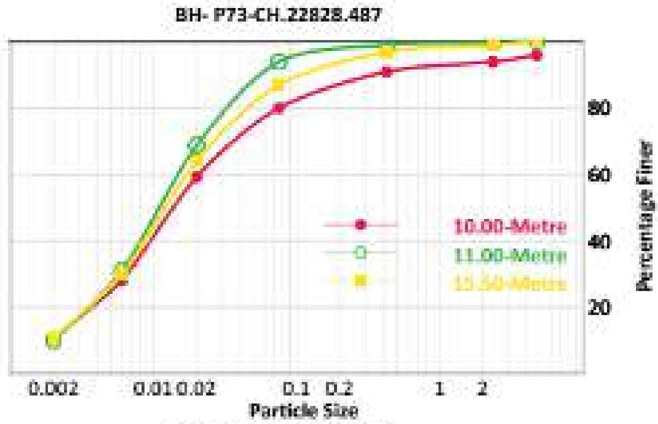
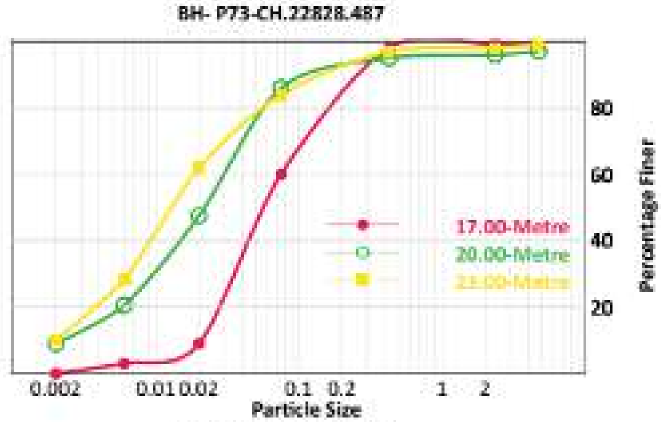
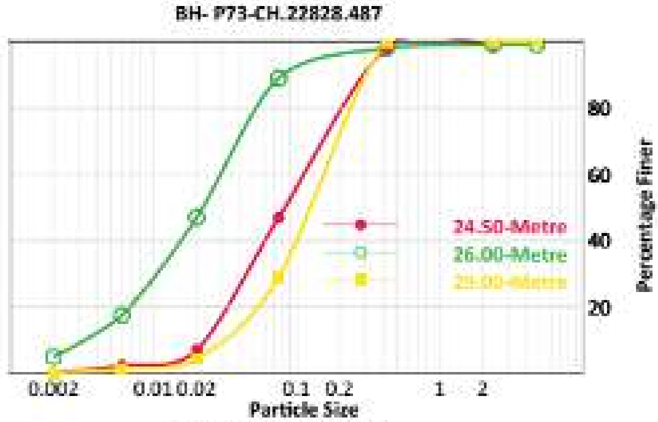


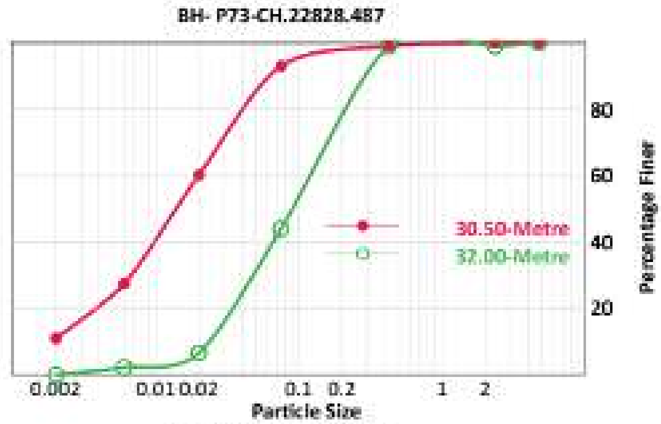
APPENDIX-D
PLOT 13: GRAIN SIZE DISTRIBUTION PLOTS

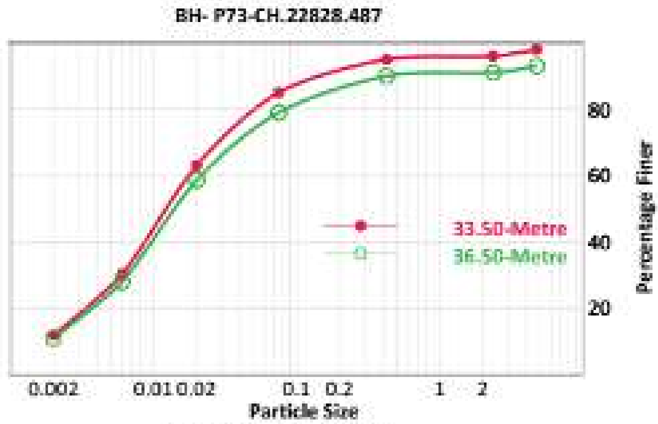


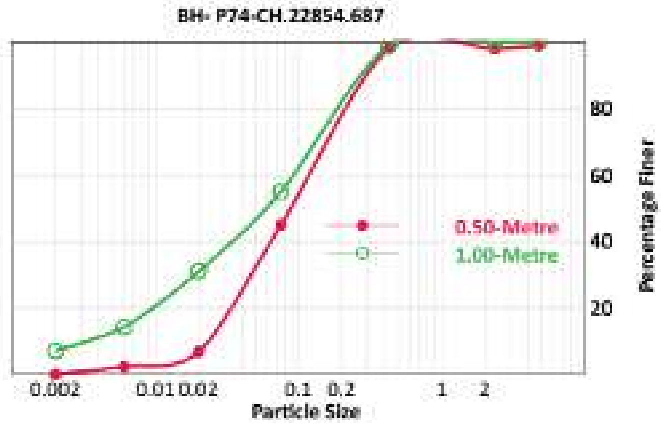


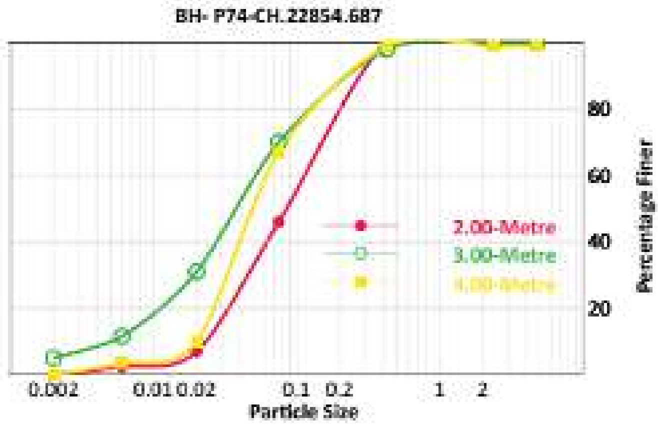






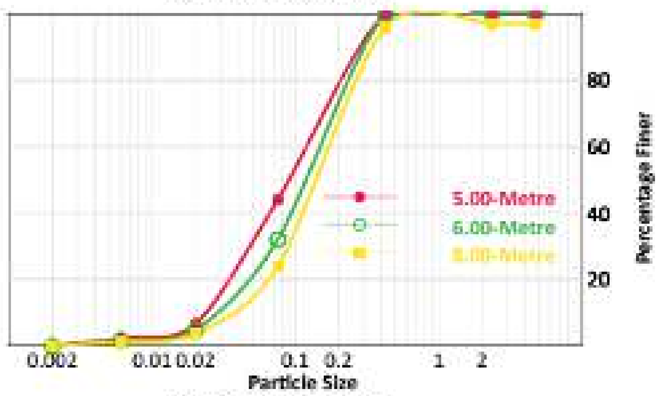






APPENDIX-D
PLOT 14: GRAIN SIZE DISTRIBUTION PLOTS

BH- P74-CH.22854.687



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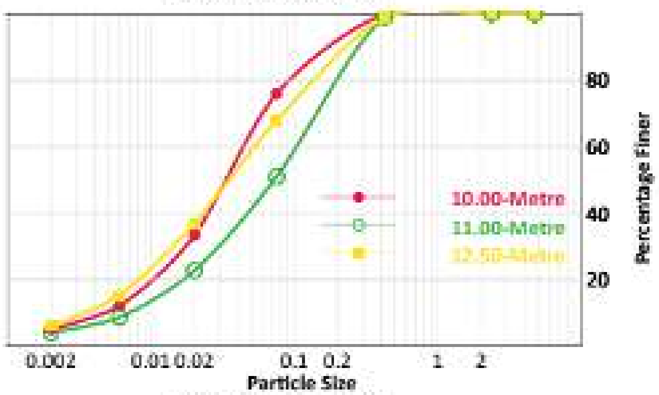

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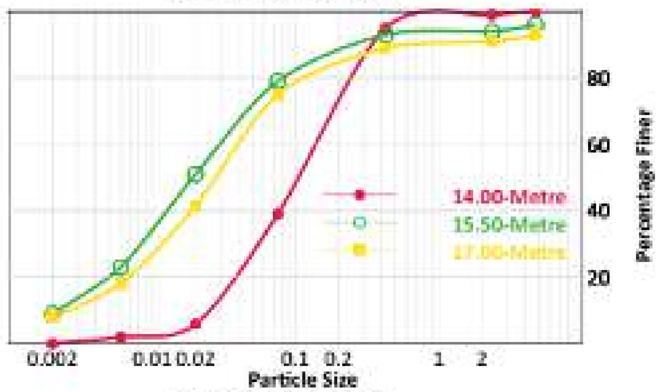

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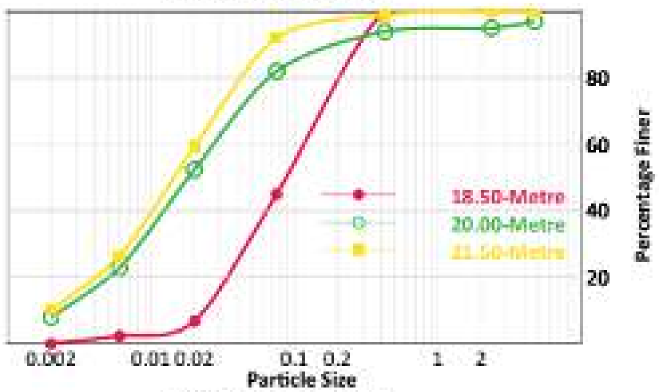

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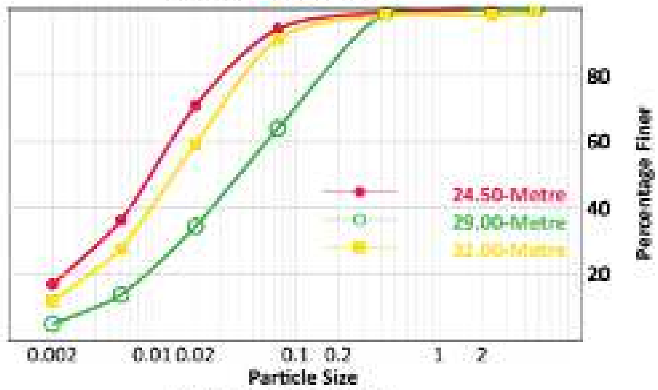

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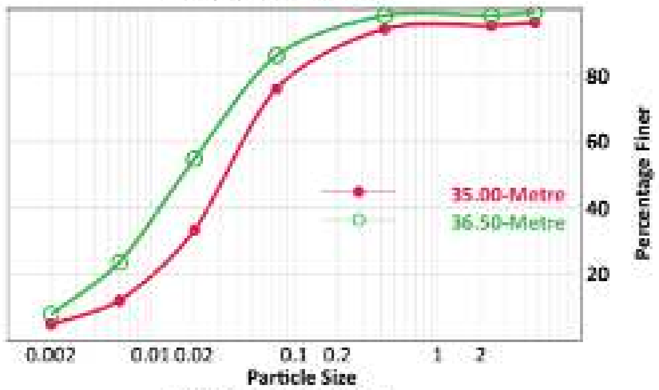

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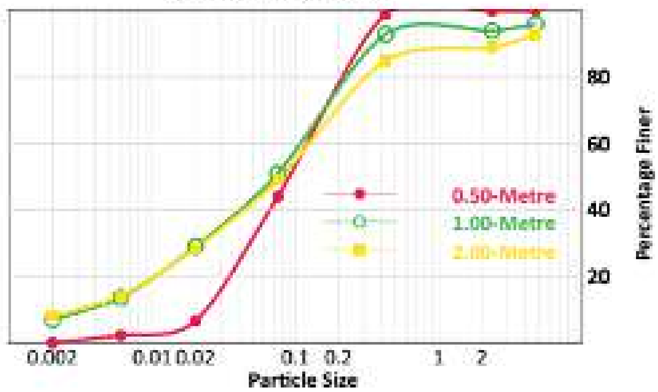
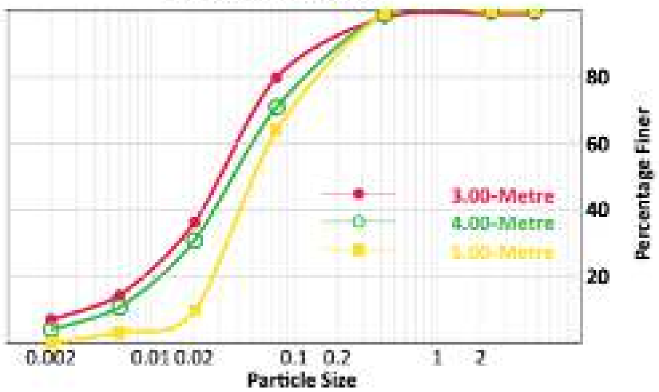
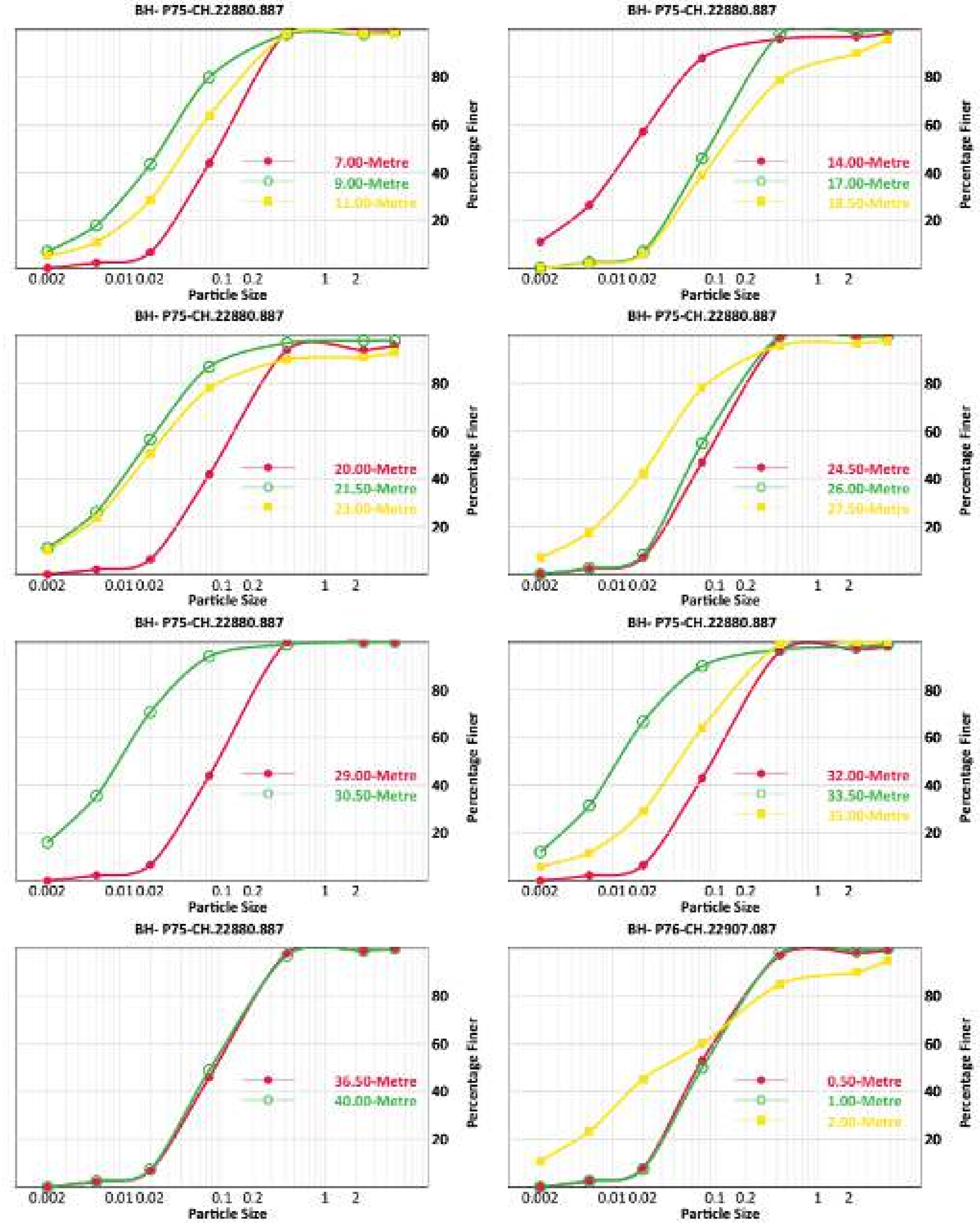


BH- P75-CH.22880.887

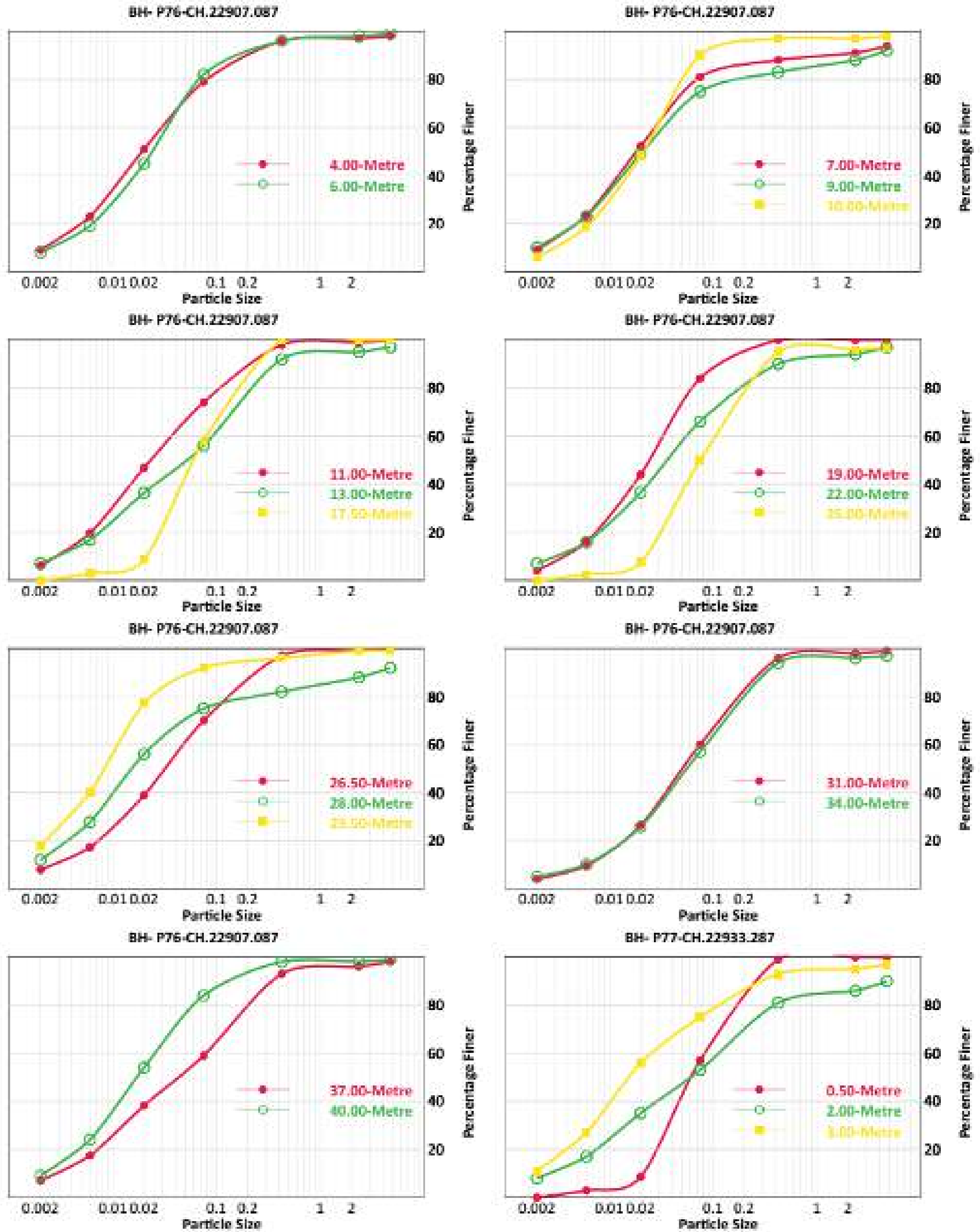


APPENDIX-D

PLOT 15: GRAIN SIZE DISTRIBUTION PLOTS

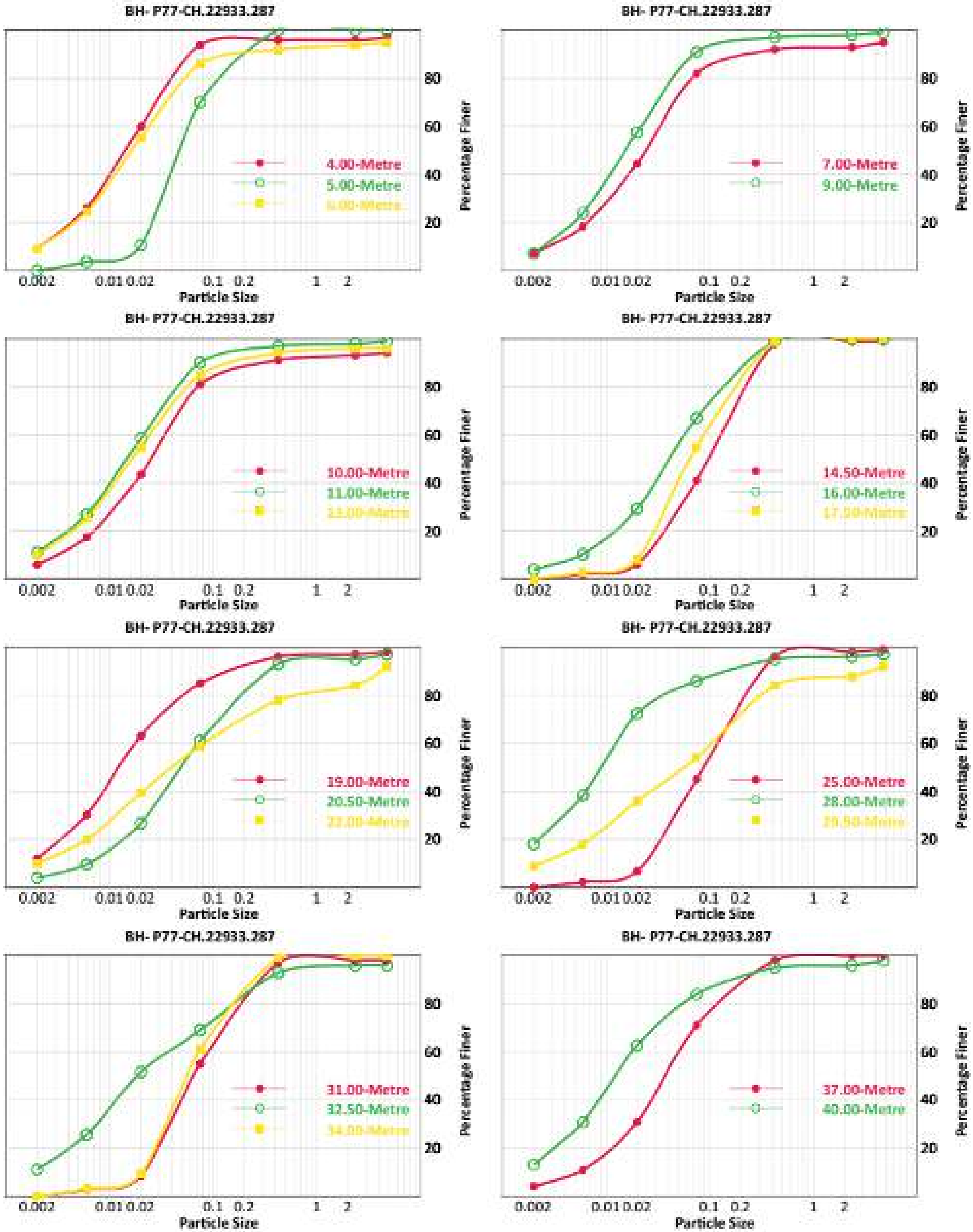


APPENDIX-D
PLOT 16: GRAIN SIZE DISTRIBUTION PLOTS

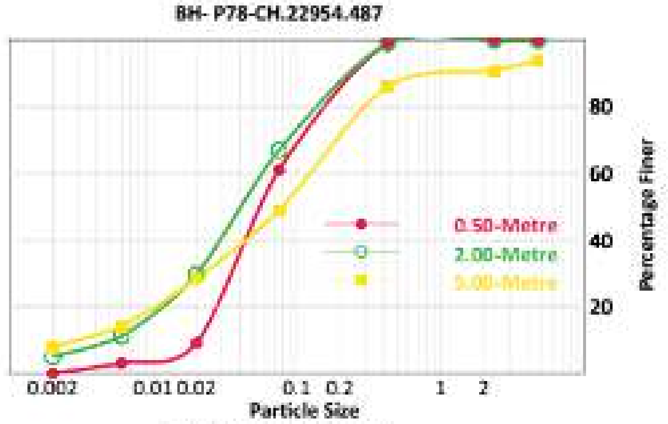


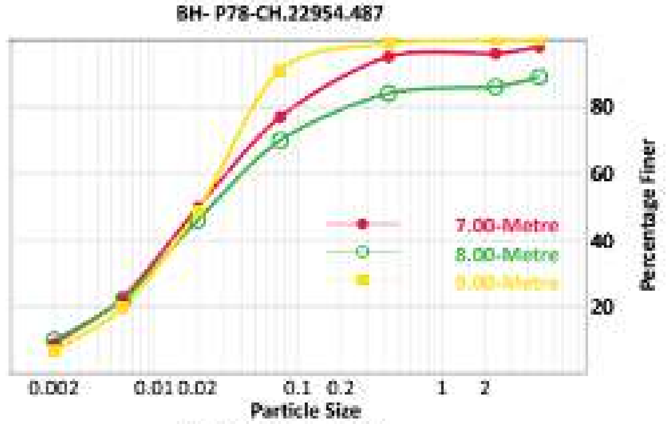
APPENDIX-D

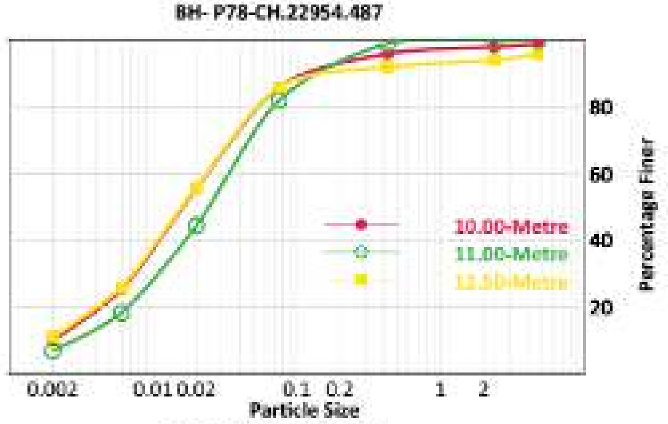
PLOT 17: GRAIN SIZE DISTRIBUTION PLOTS

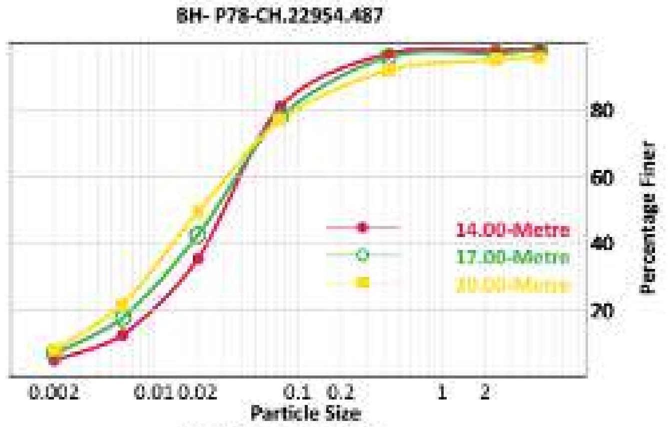


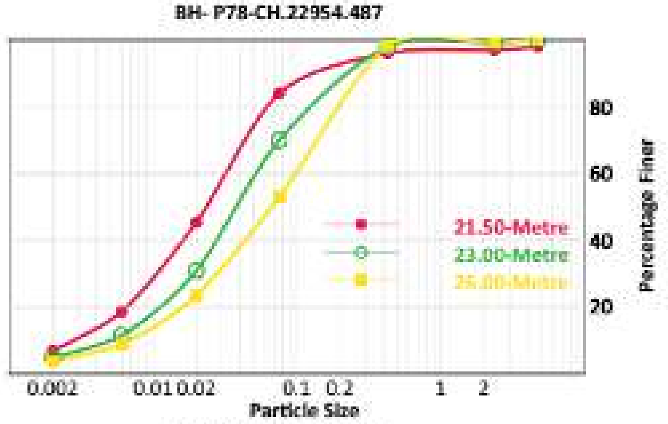
APPENDIX-D
PLOT 18: GRAIN SIZE DISTRIBUTION PLOTS

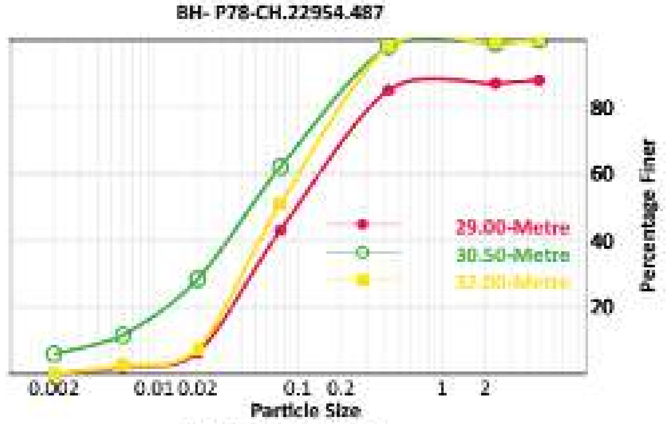


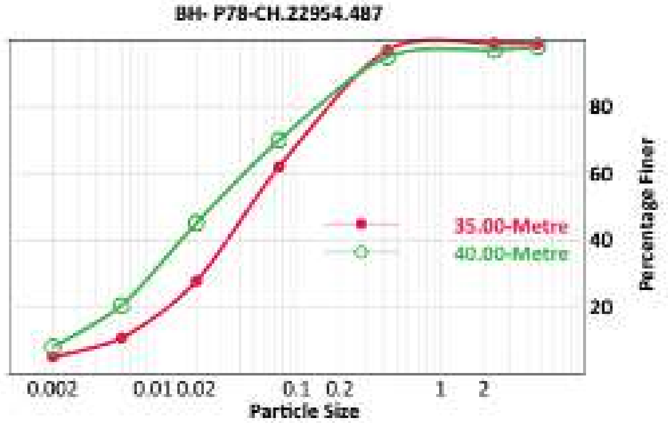


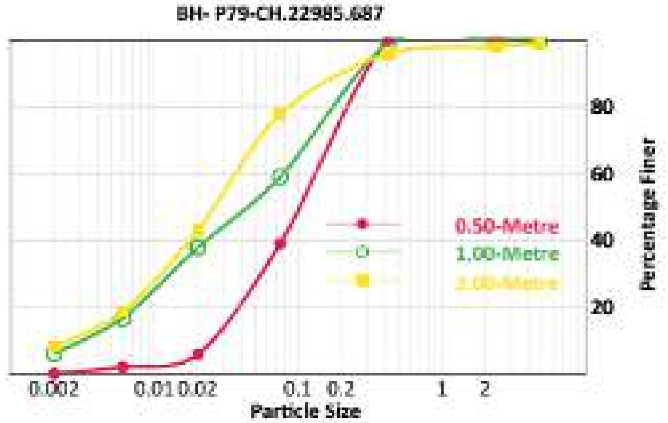




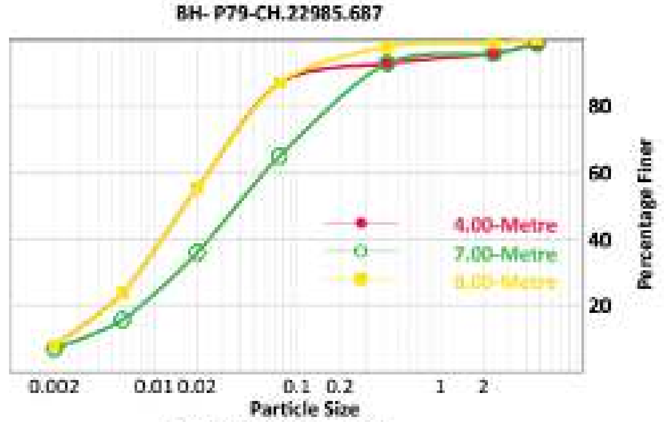


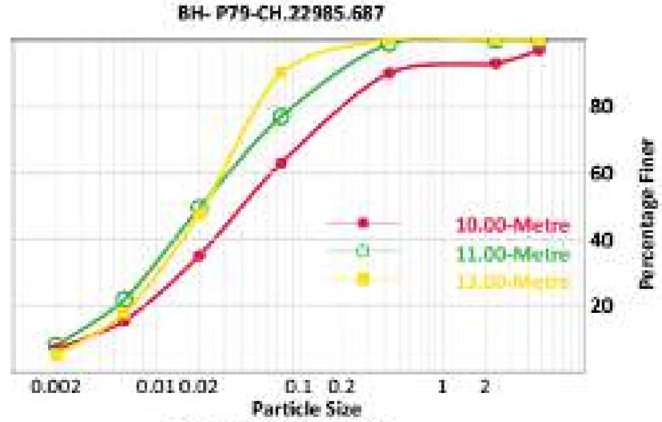


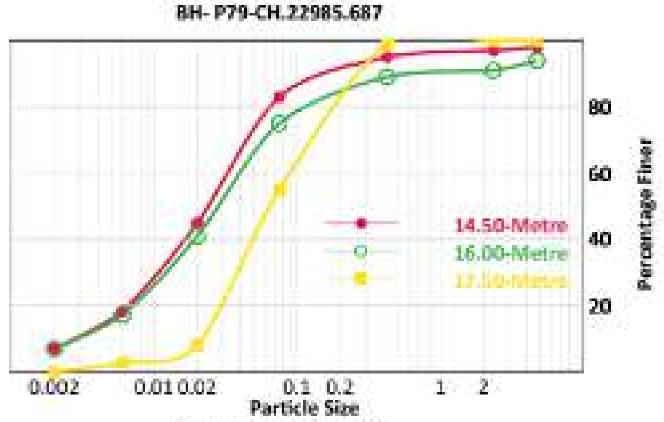


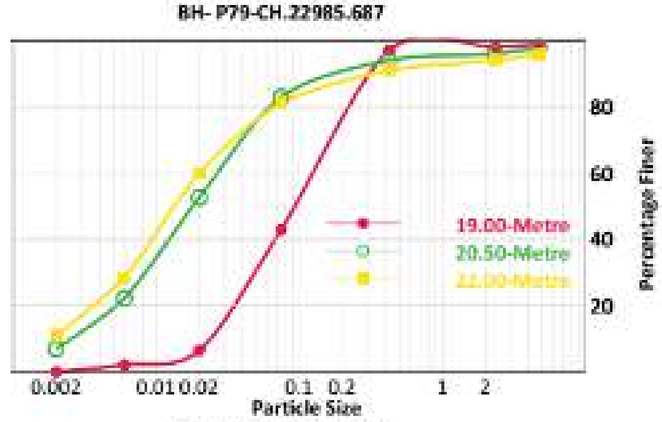


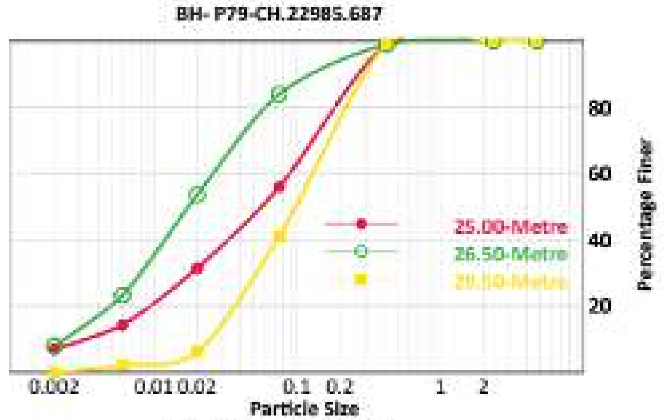
APPENDIX-D
PLOT 19: GRAIN SIZE DISTRIBUTION PLOTS

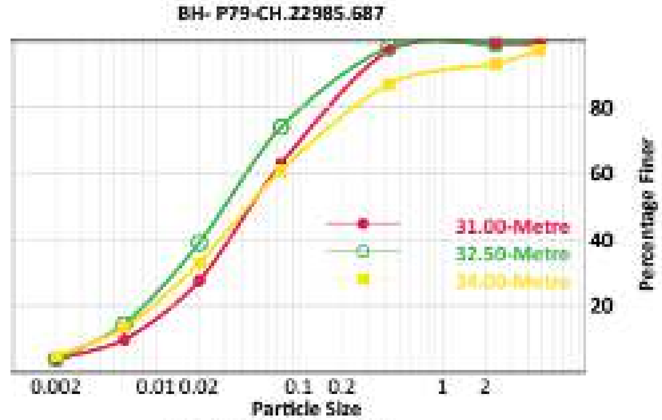


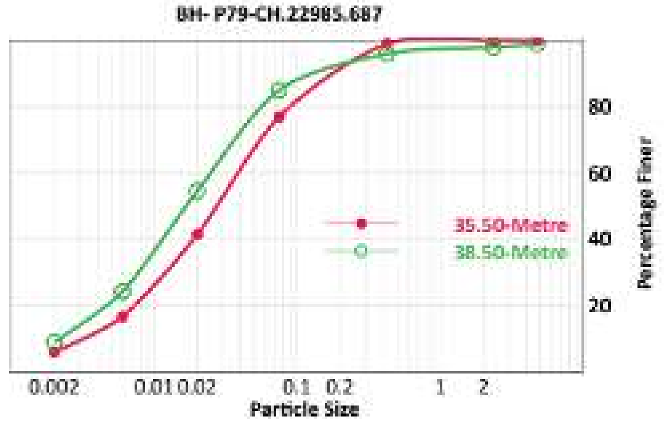


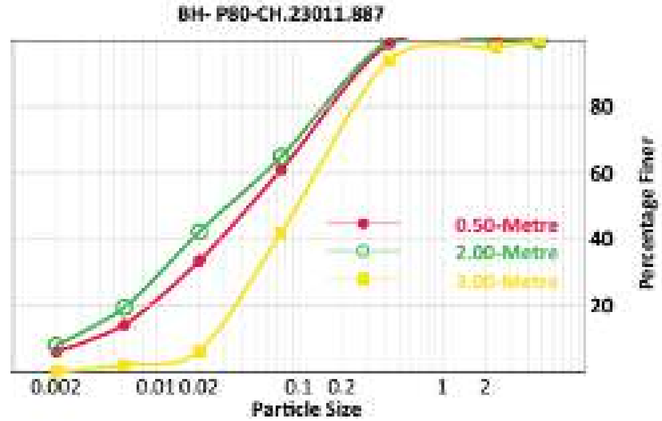




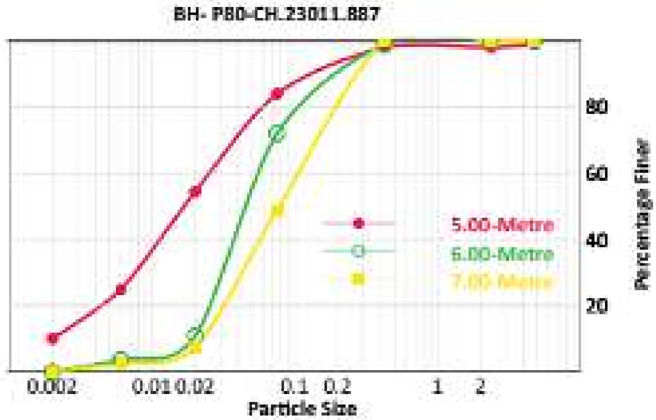


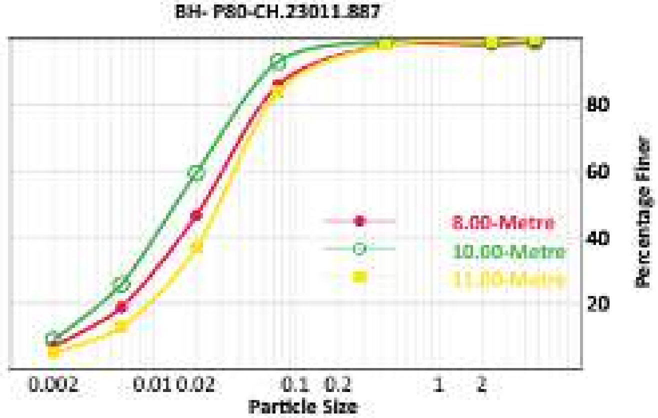


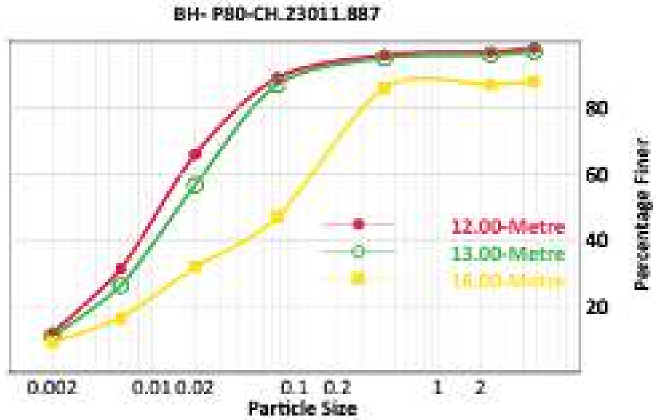


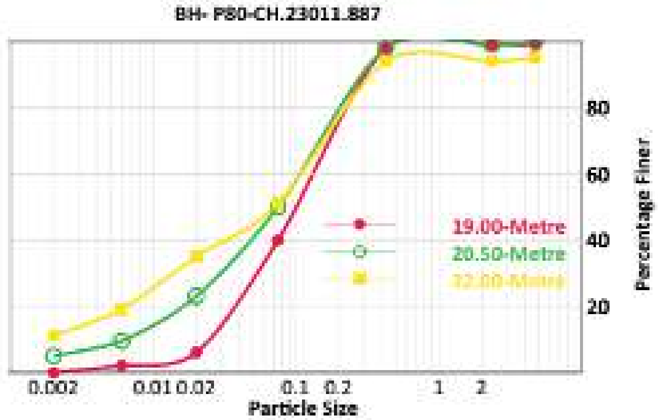


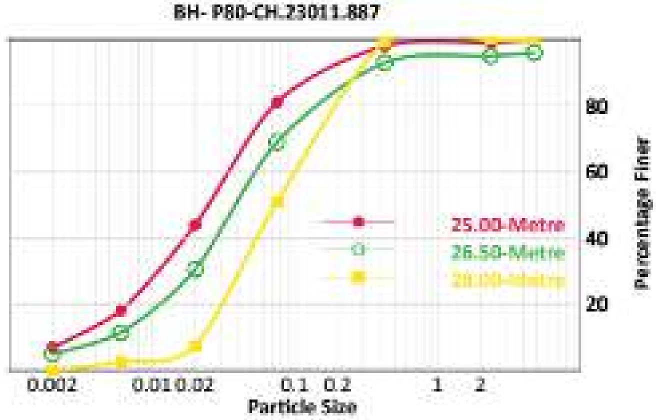
APPENDIX-D
PLOT 20: GRAIN SIZE DISTRIBUTION PLOTS

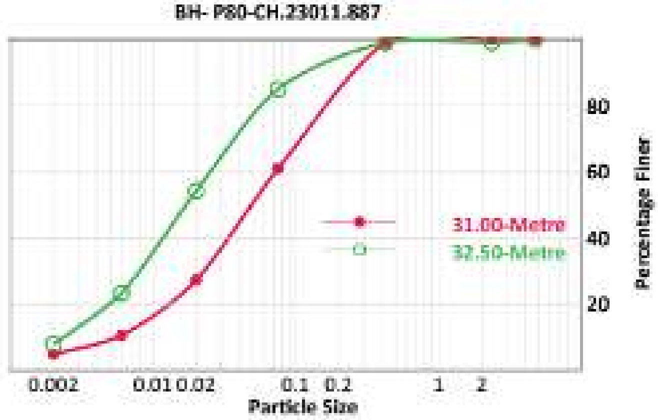


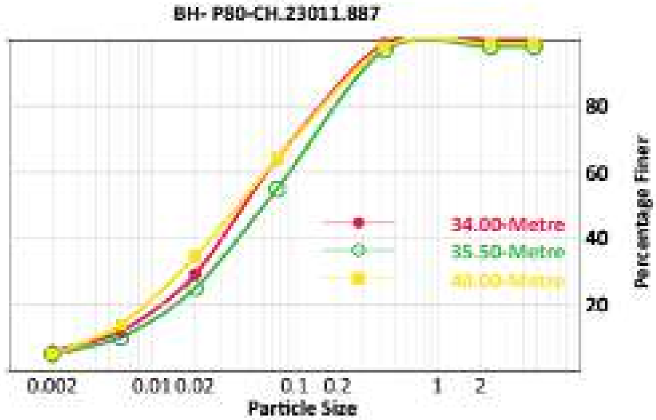




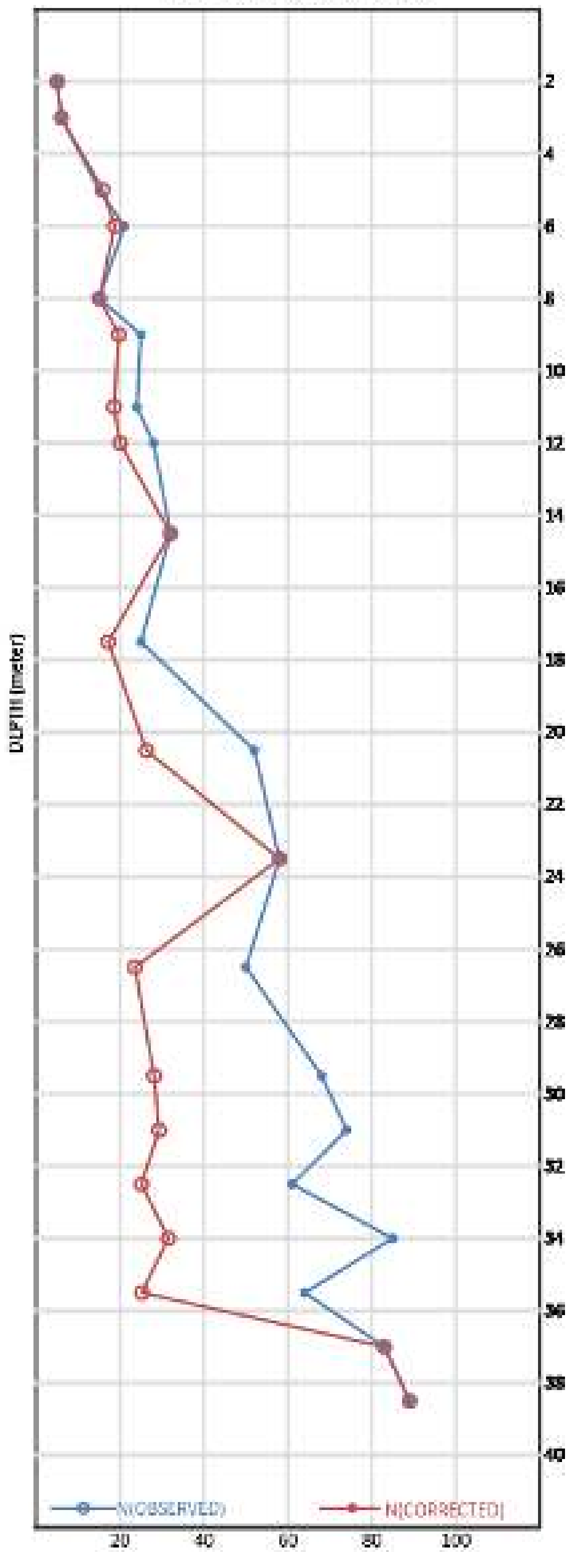


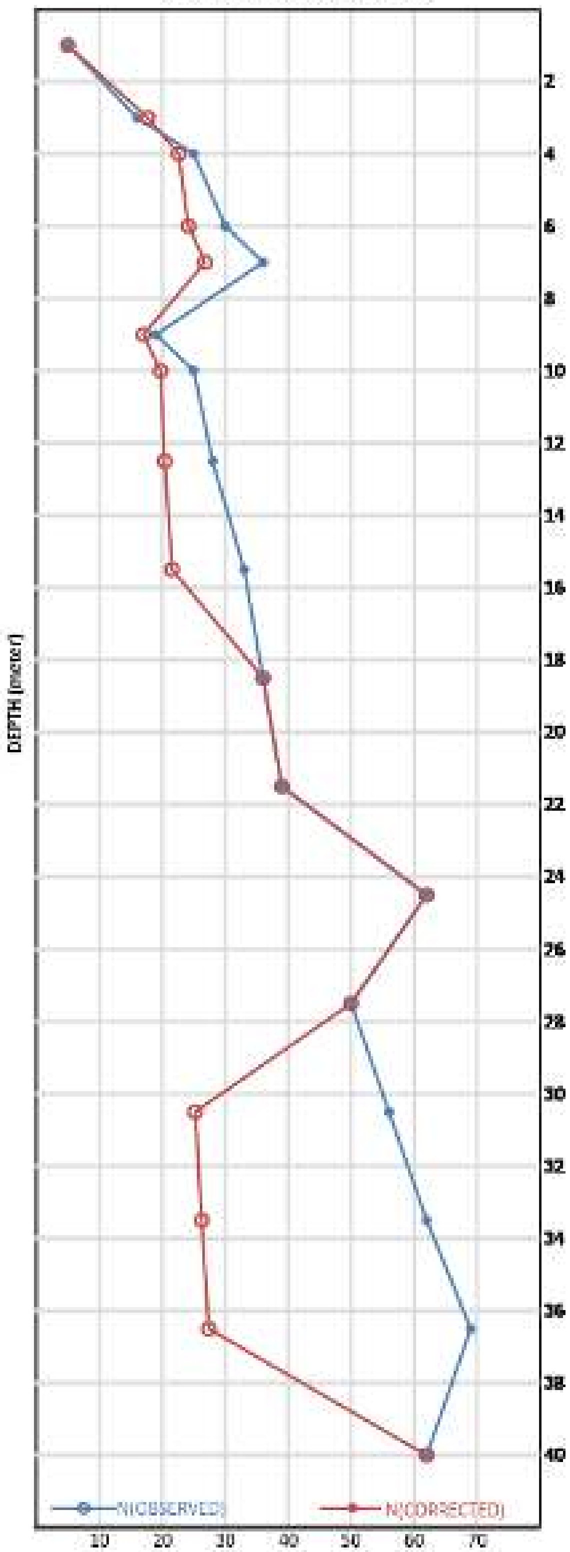




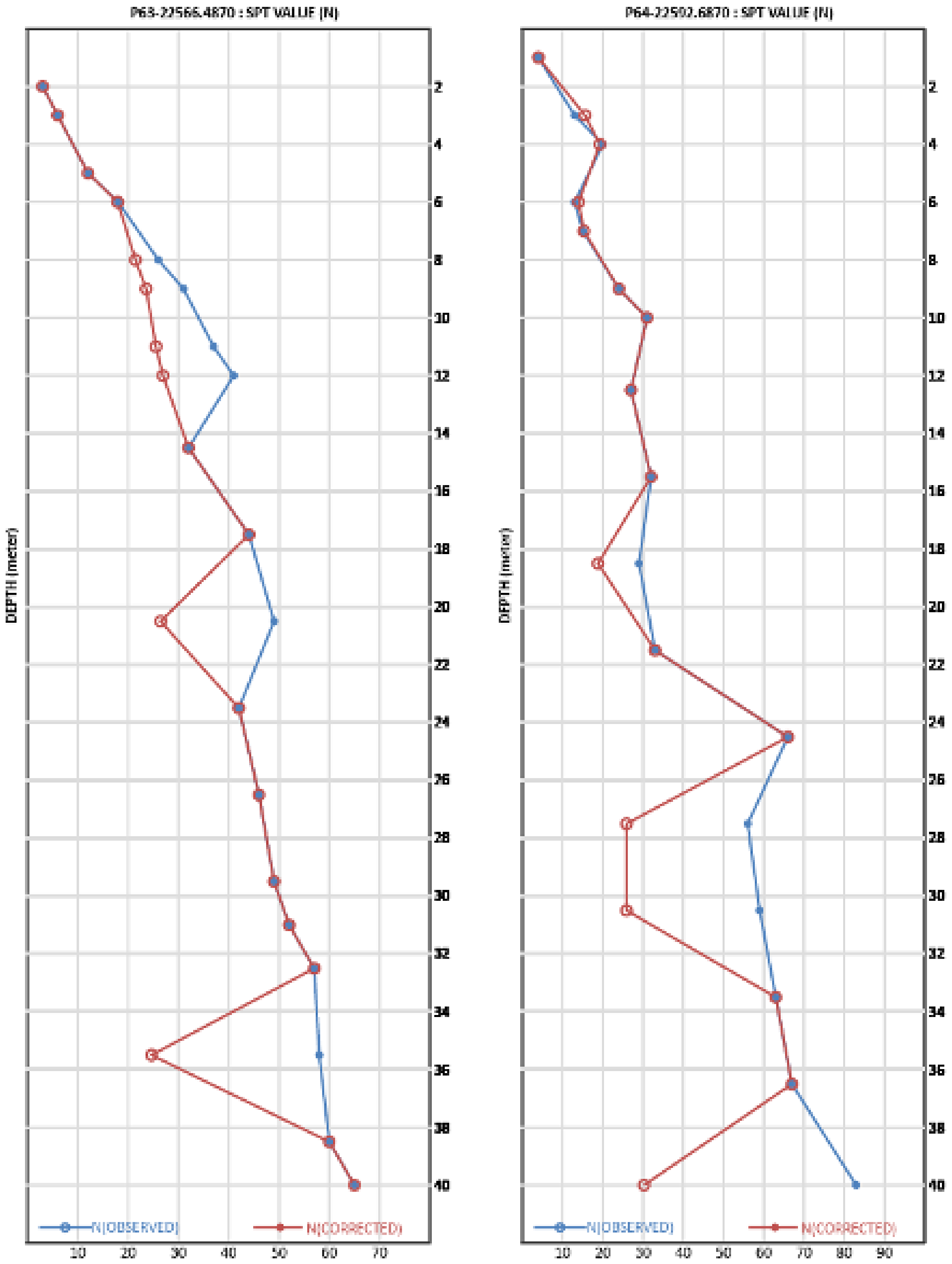


APPENDIX-E
PLOT 1: RECORDED SPT Vs CORRECTED SPT

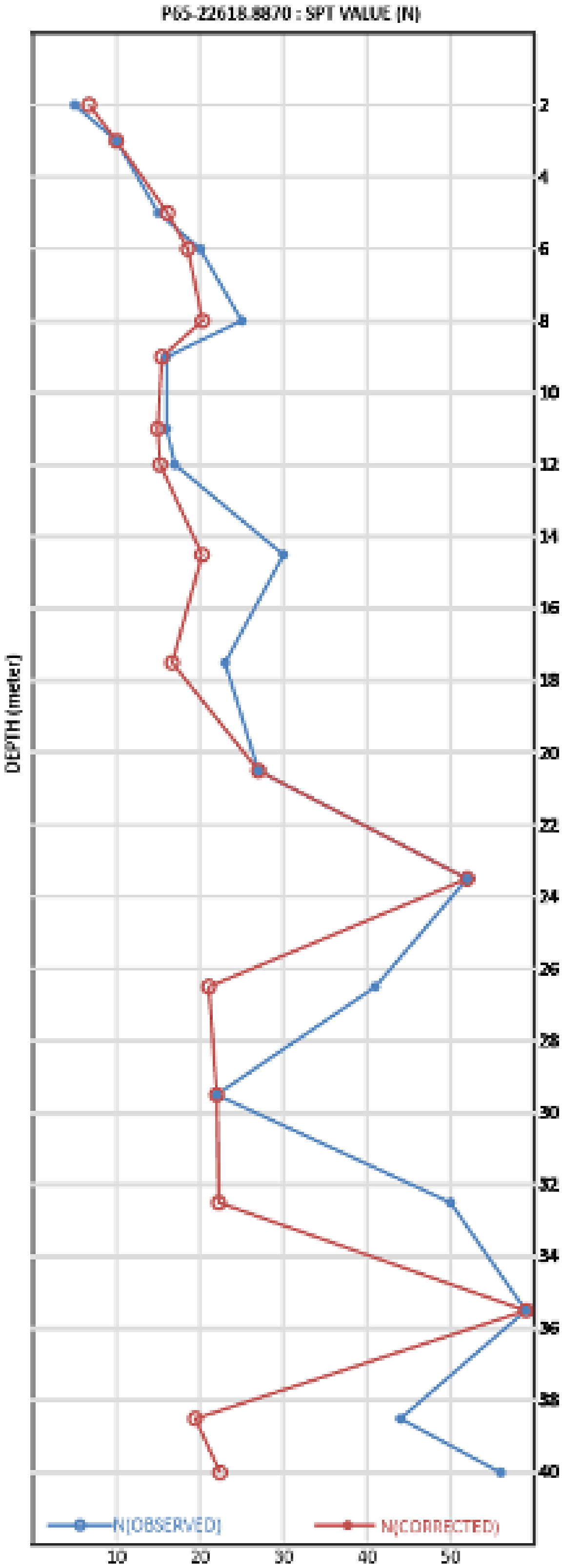


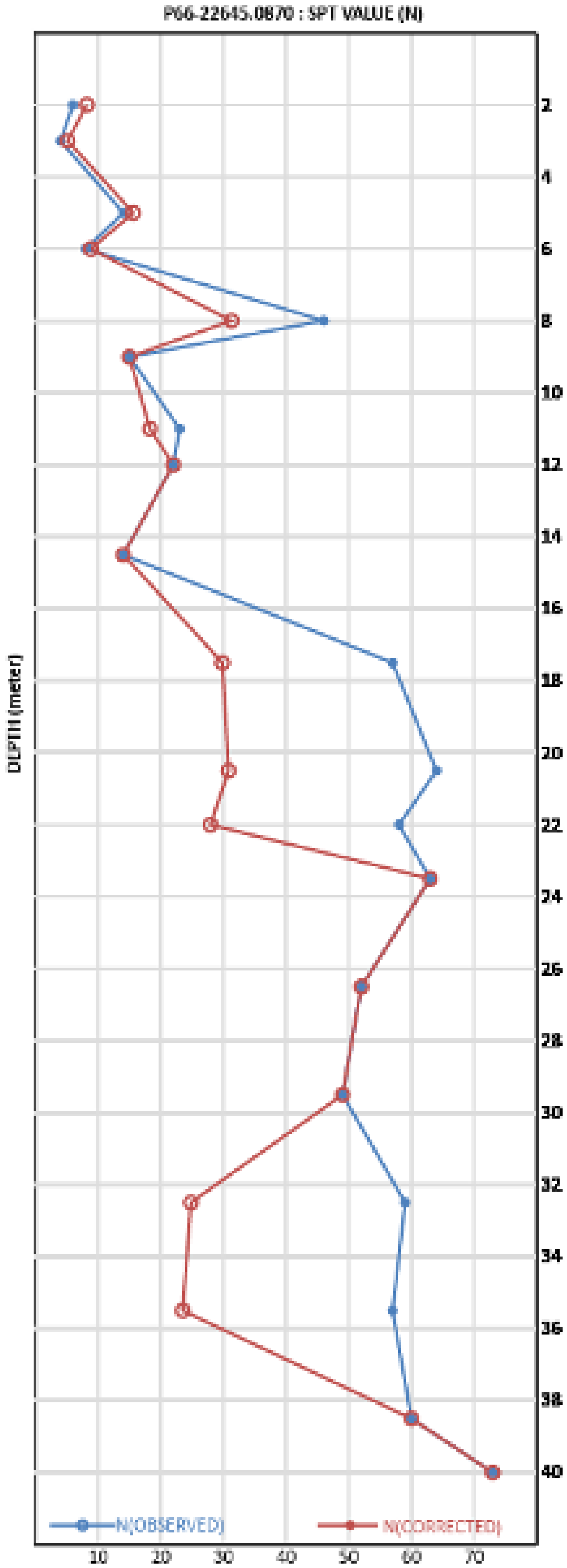


APPENDIX-E
PLOT 2: RECORDED SPT Vs CORRECTED SPT

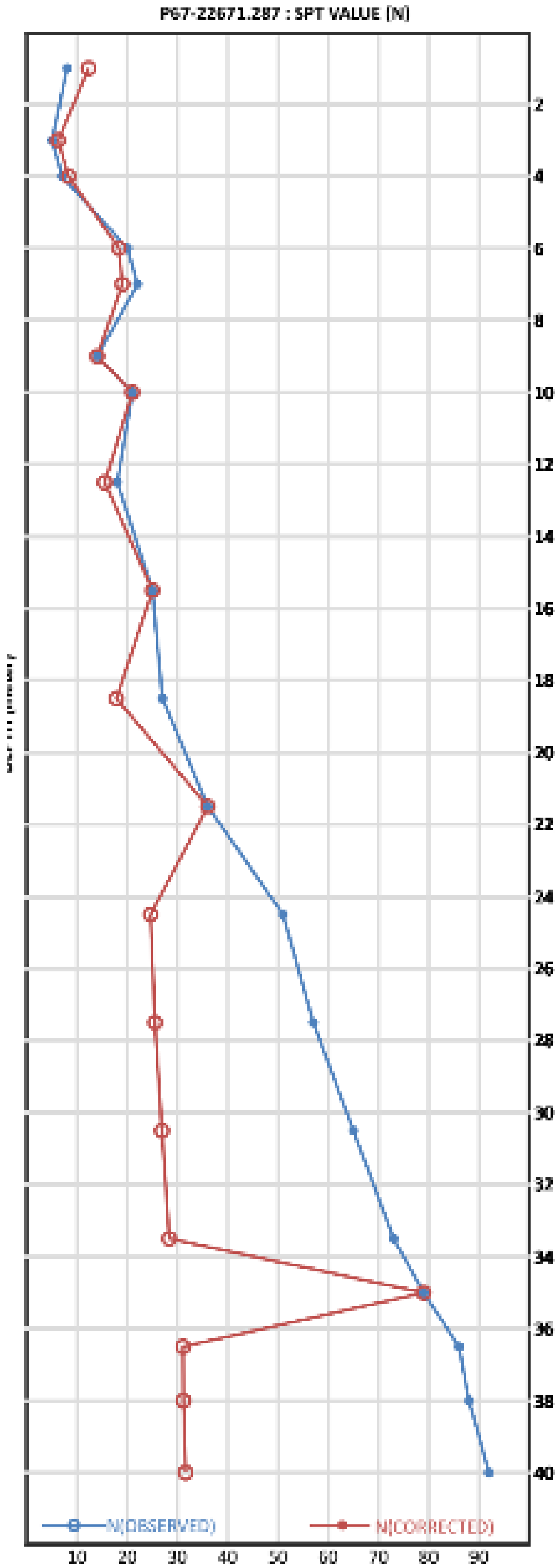


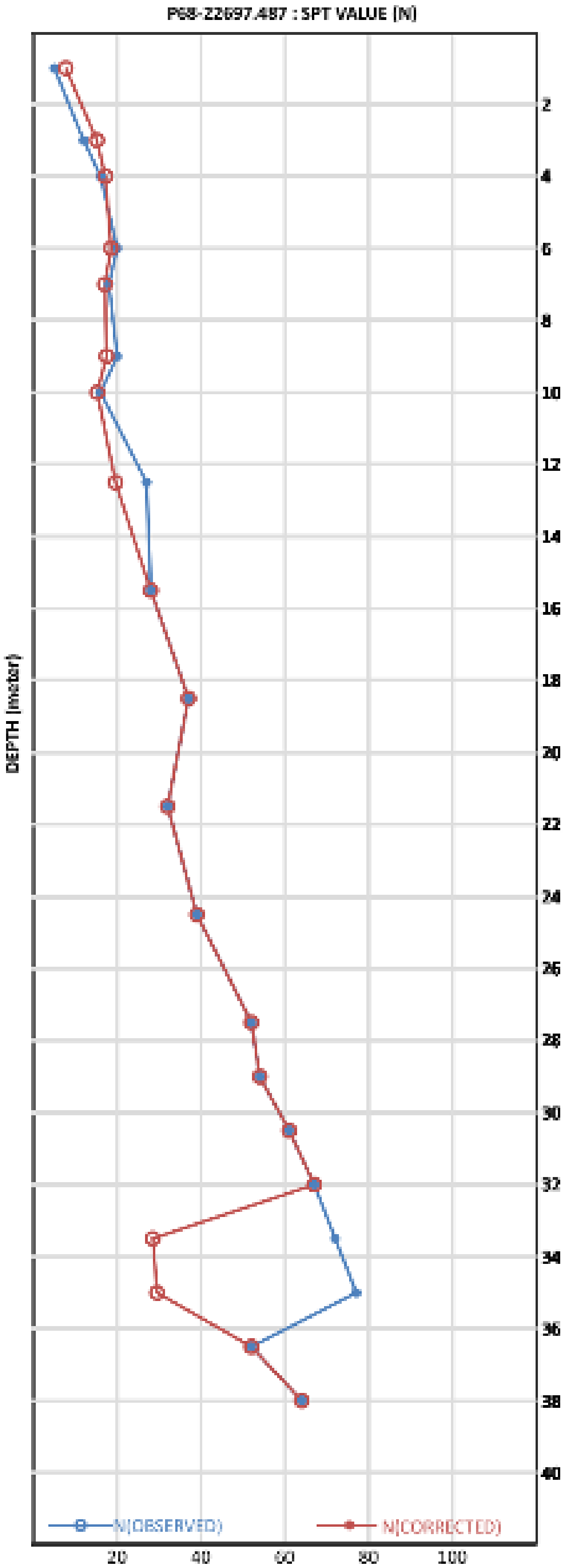
APPENDIX-E
PLOT 3: RECORDED SPT Vs CORRECTED SPT



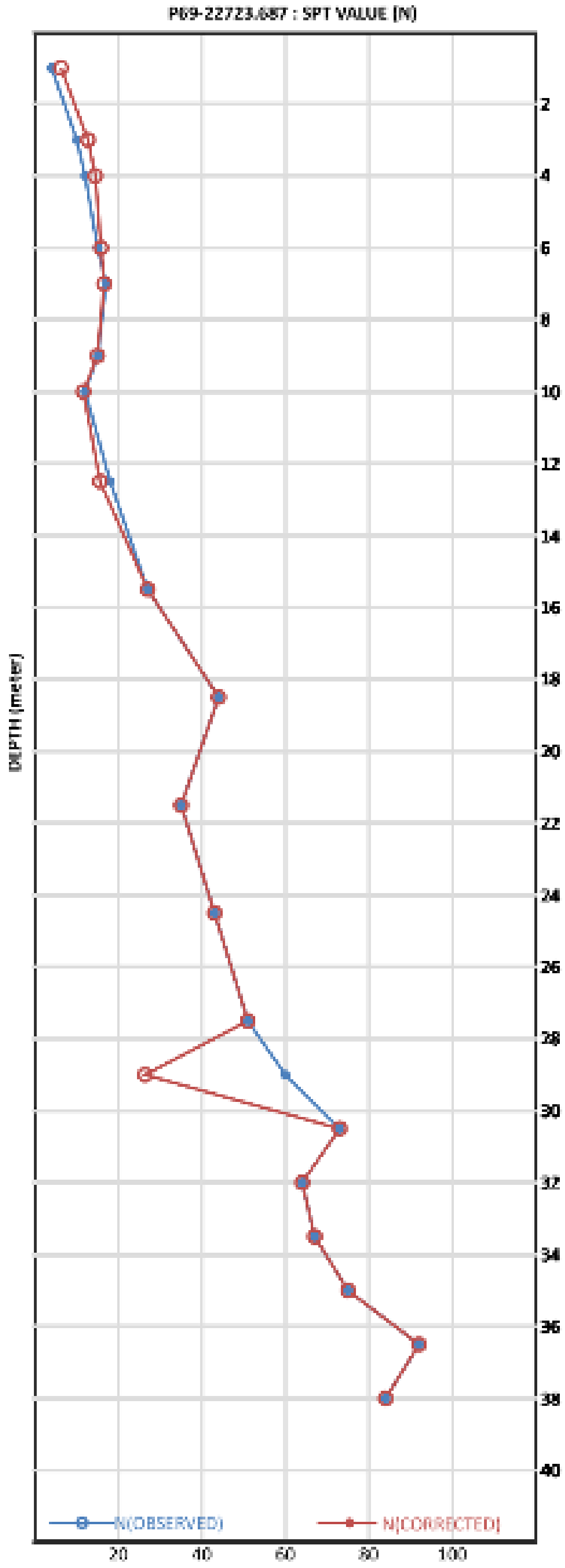


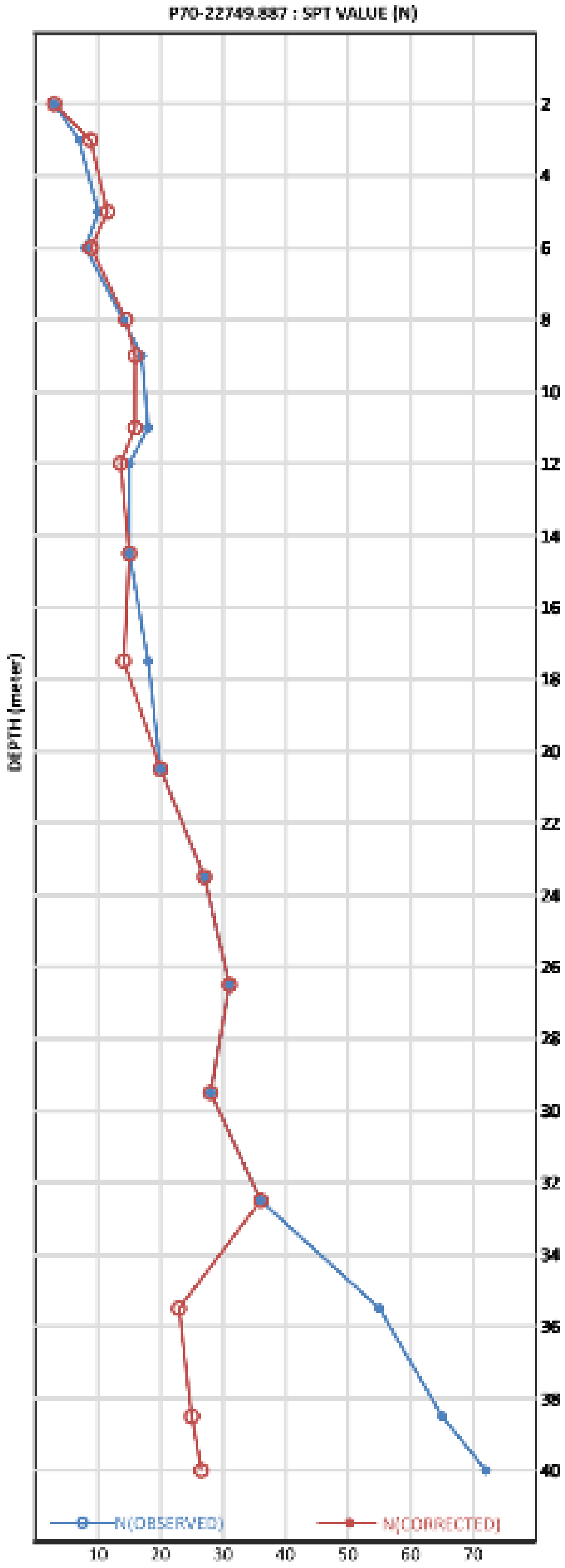
APPENDIX-E
PLOT 4: RECORDED SPT Vs CORRECTED SPT





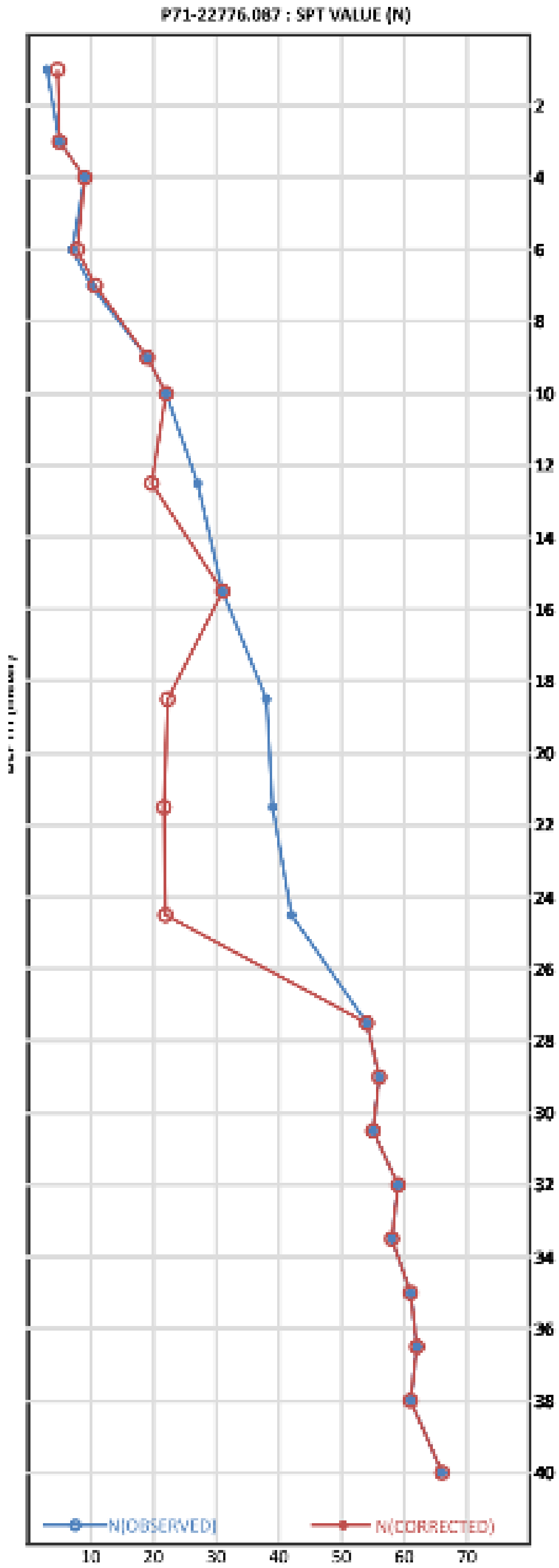
APPENDIX-E
PLOT 5: RECORDED SPT Vs CORRECTED SPT

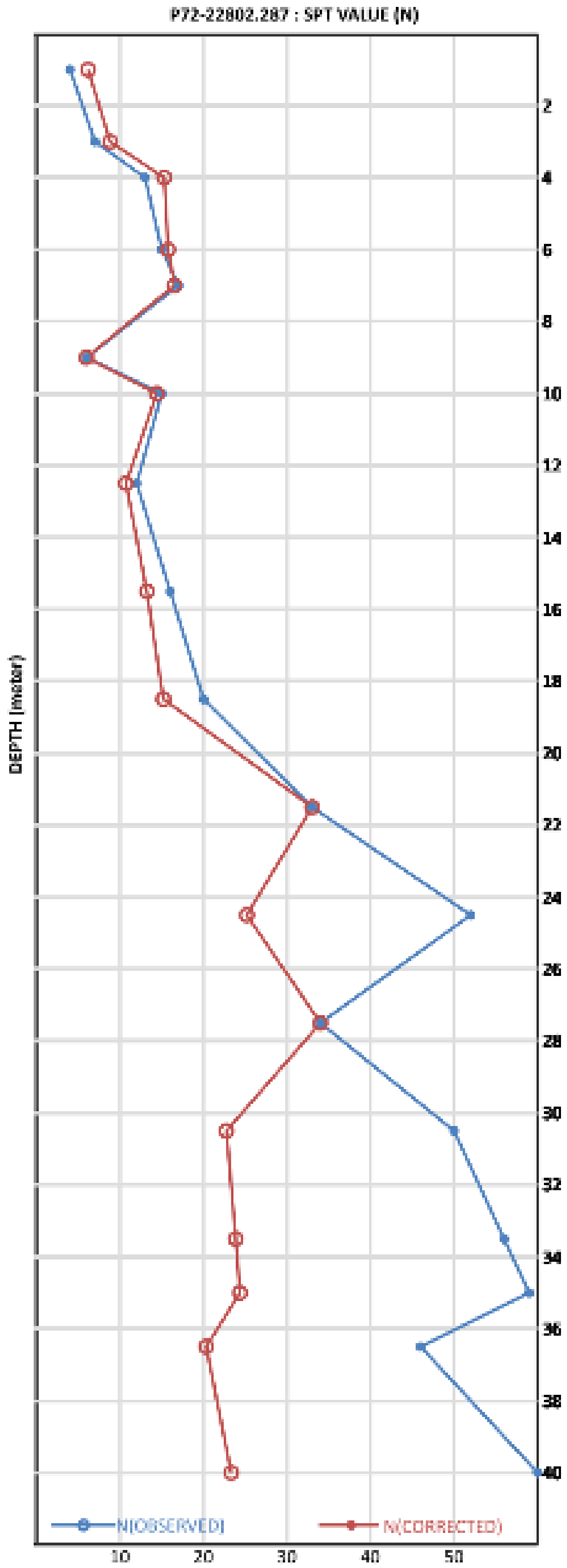




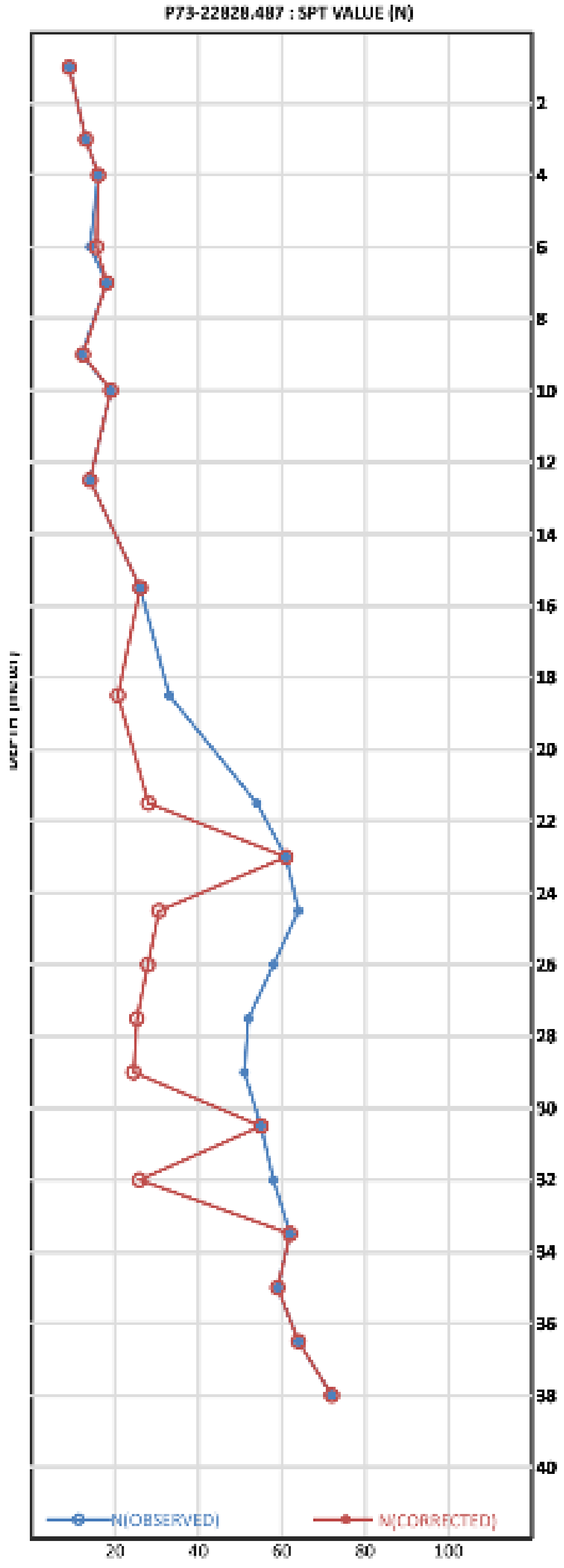
APPENDIX-E

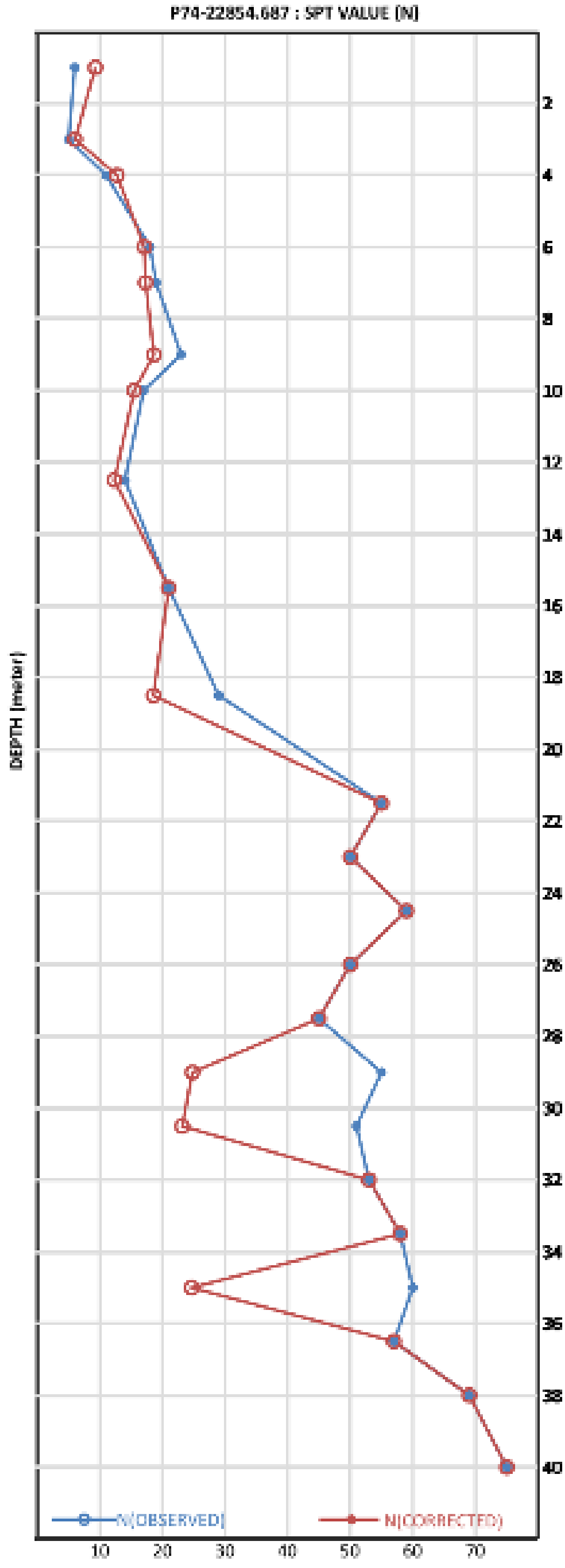
PLOT 6: RECORDED SPT Vs CORRECTED SPT



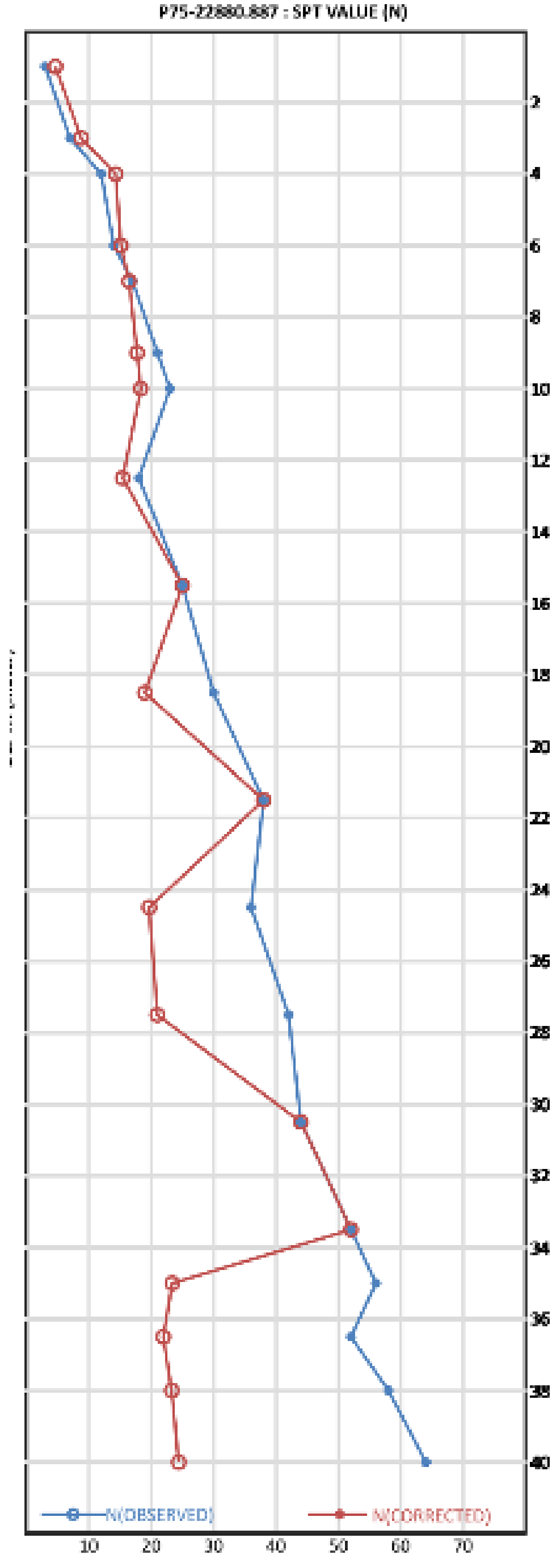


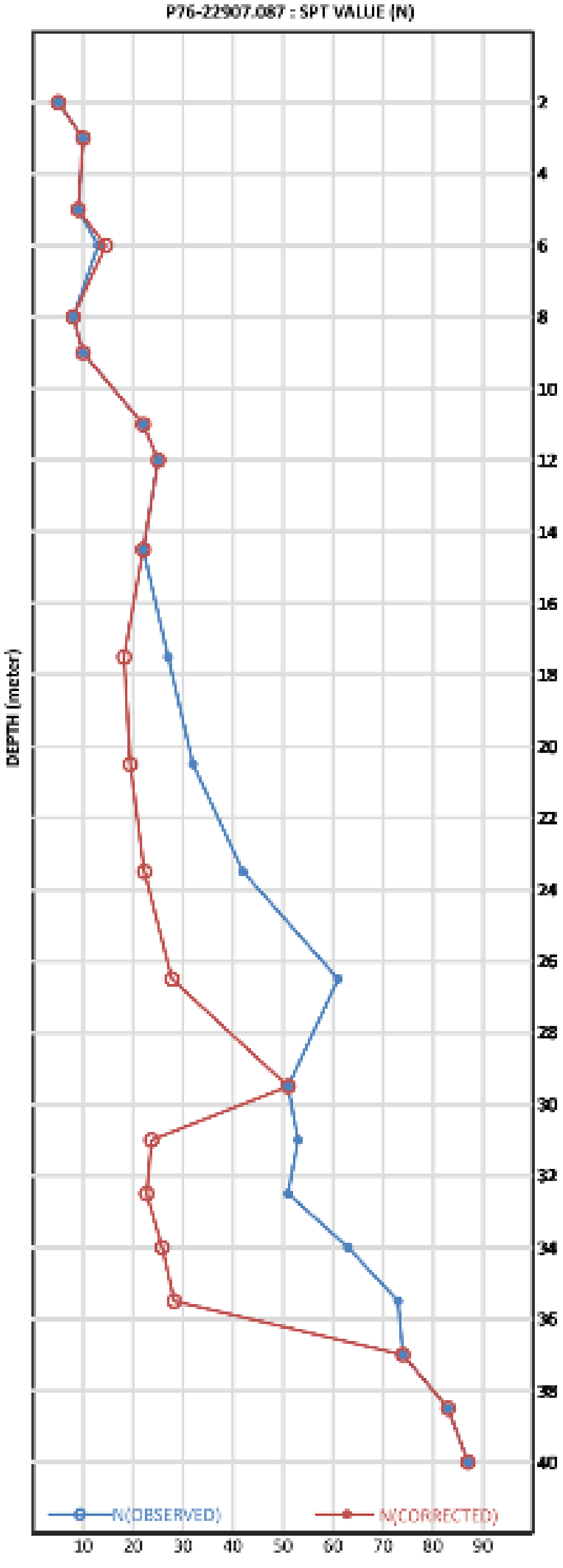
APPENDIX-E
PLOT 7: RECORDED SPT Vs CORRECTED SPT



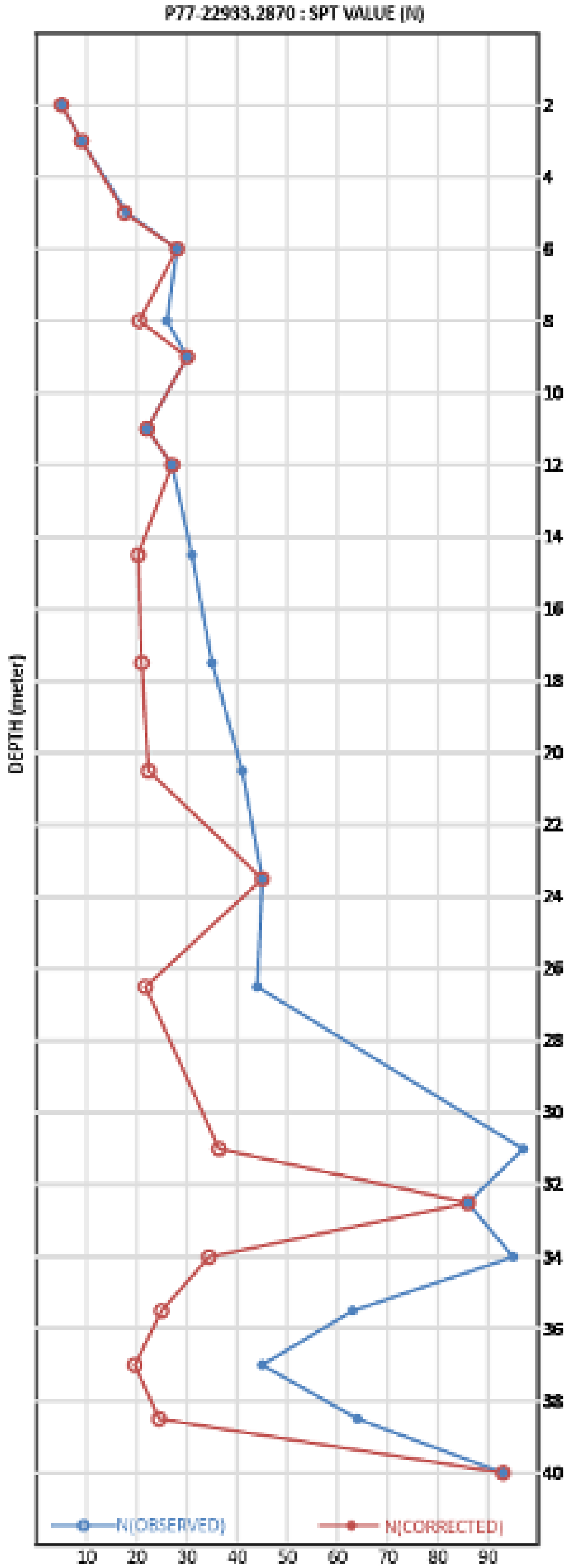


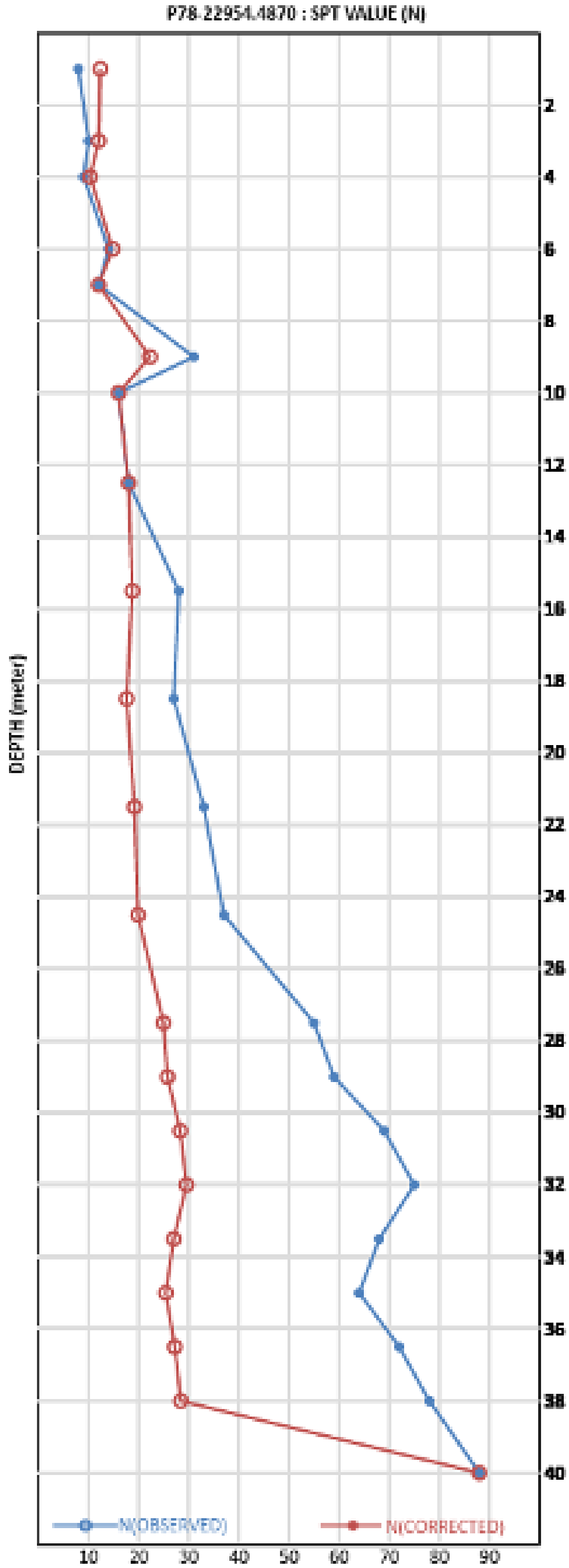
APPENDIX-E
PLOT 8: RECORDED SPT Vs CORRECTED SPT





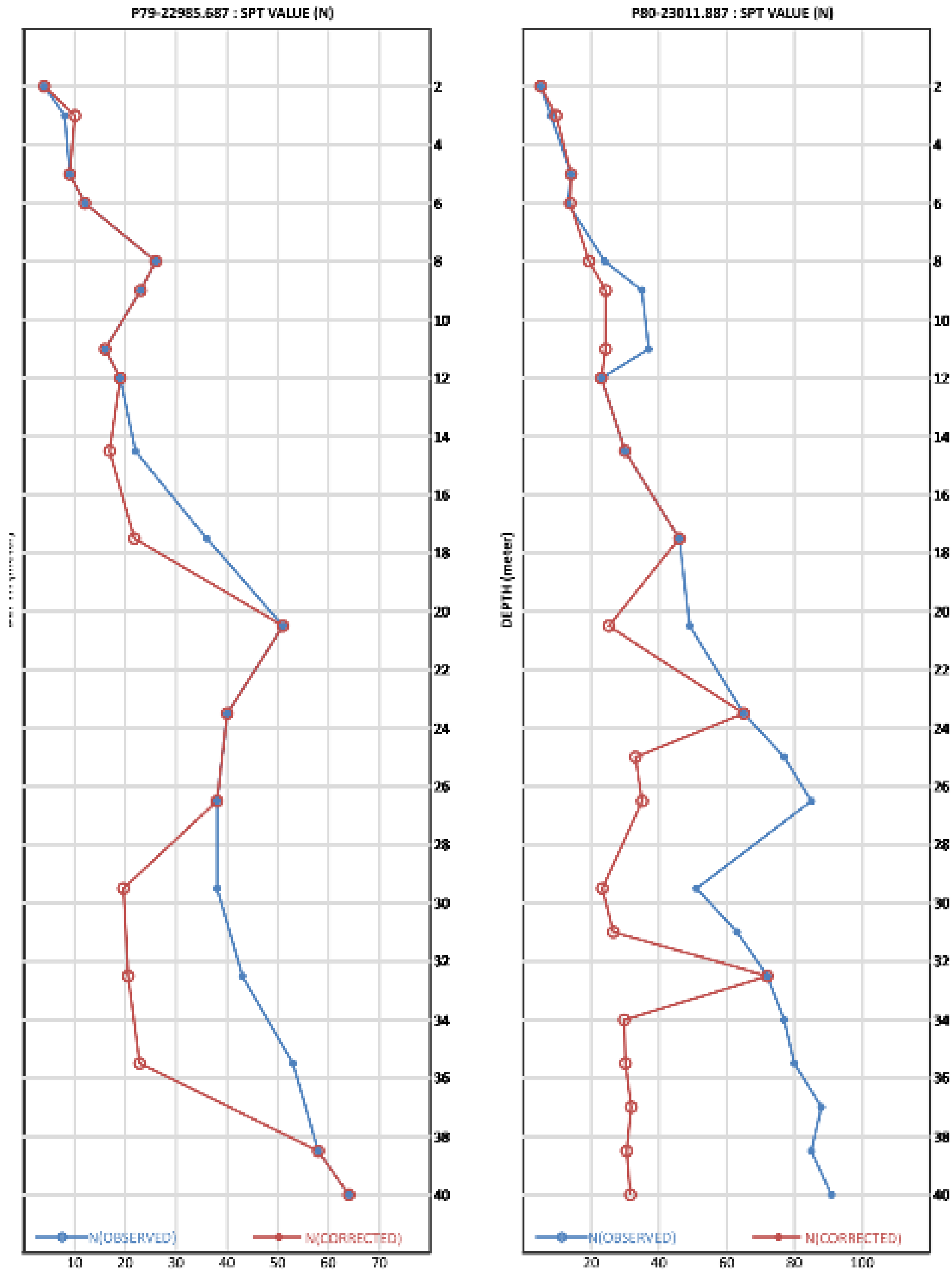
APPENDIX-E
PLOT 9: RECORDED SPT Vs CORRECTED SPT



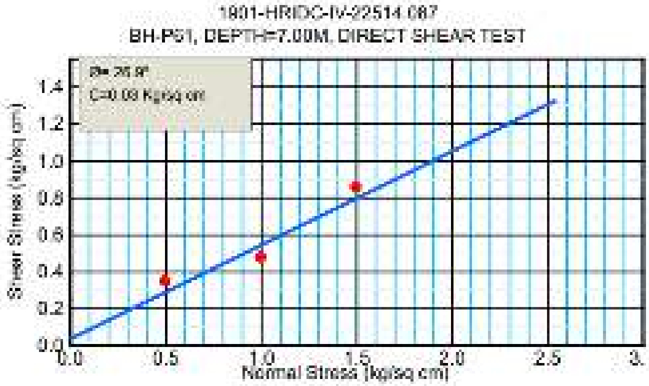


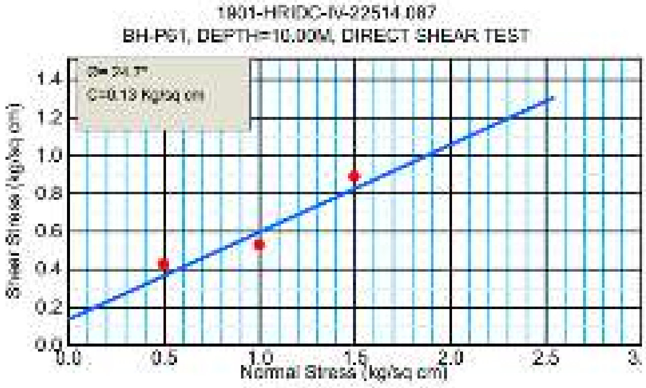
APPENDIX-E

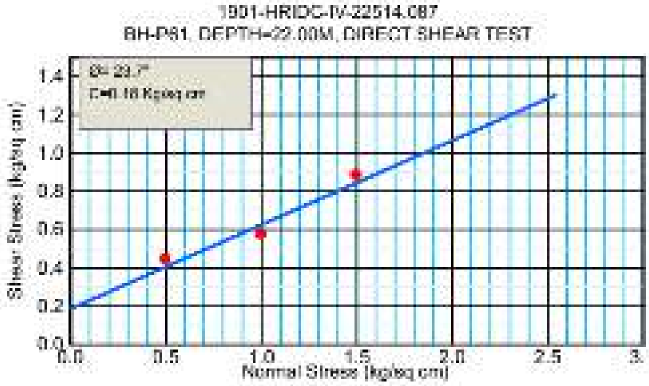
PLOT 10: RECORDED SPT Vs CORRECTED SPT

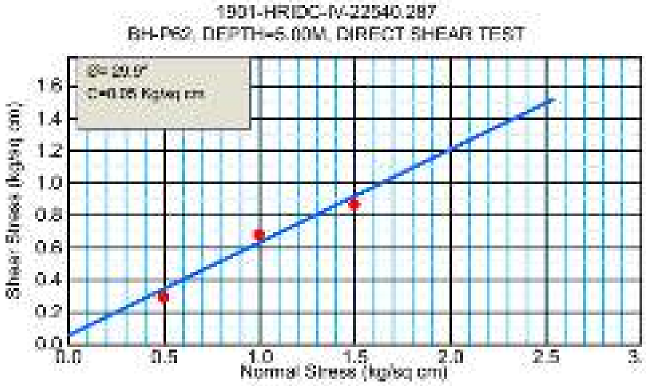


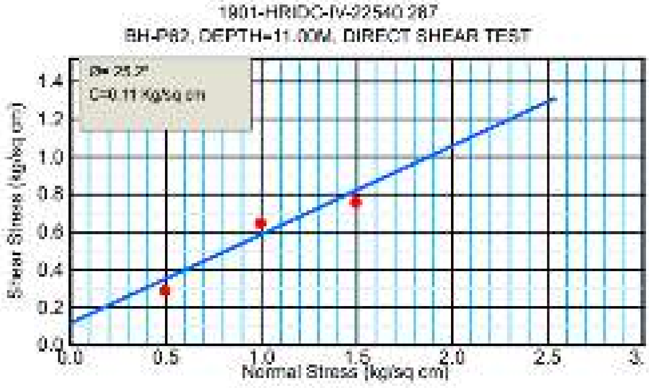
APPENDIX-F
GRAPH 1: DST GRAPH

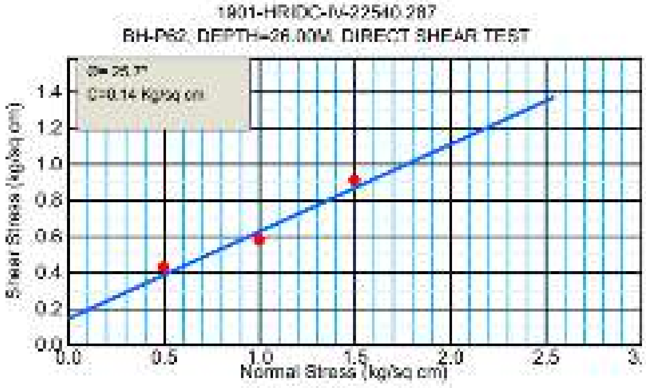


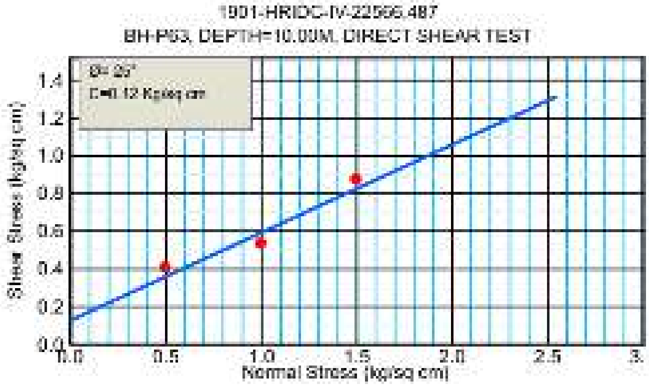


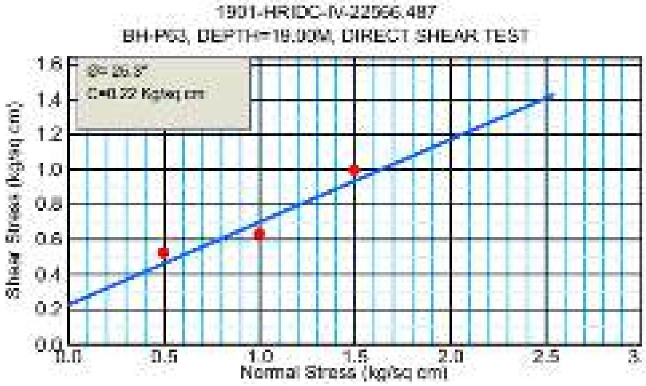






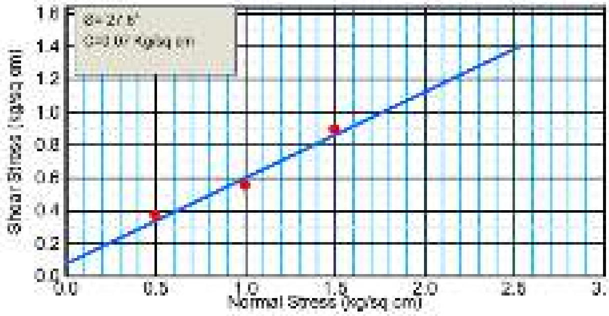




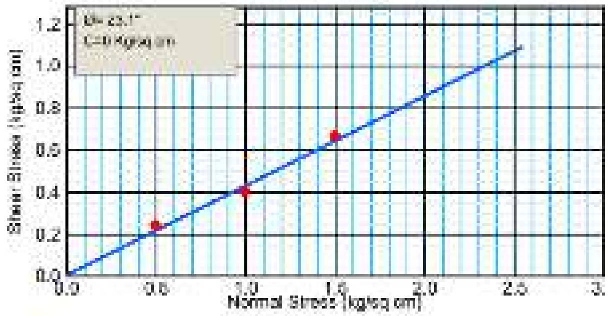


APPENDIX-F
GRAPH 2: DST GRAPH

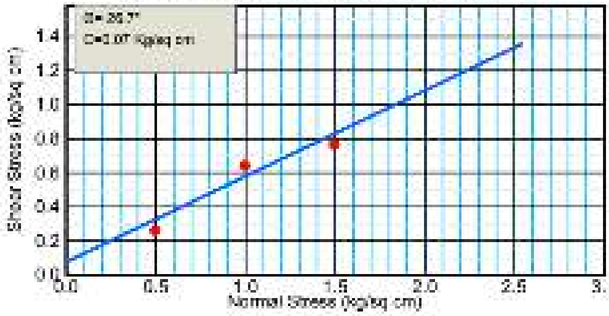
1901-HRIDC-IV-22586.487
BH-P63, DEPTH=28.00M, DIRECT SHEAR TEST



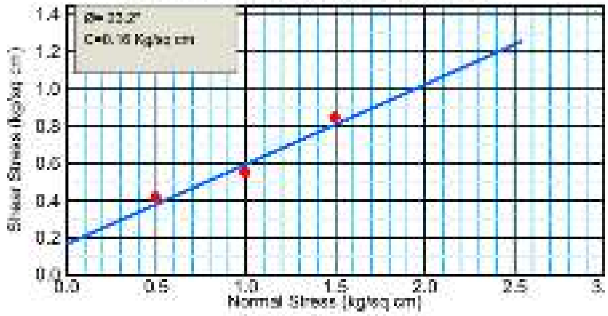
1901-HRIDC-IV-22592.687
BH-P64, DEPTH=2.00M, DIRECT SHEAR TEST



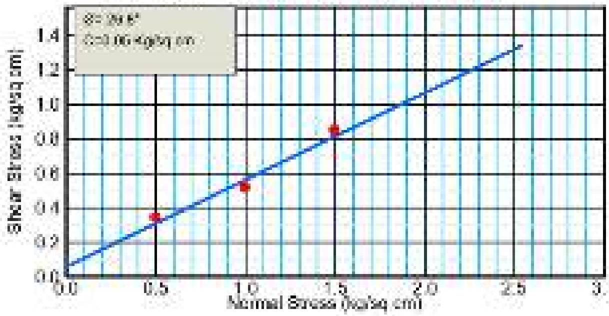
1901-HRIDC-IV-22592.687
BH-P64, DEPTH=8.00M, DIRECT SHEAR TEST



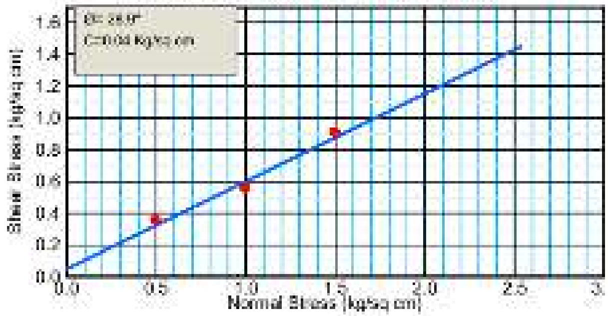
1901-HRIDC-IV-22592.687
BH-P64, DEPTH=11.00M, DIRECT SHEAR TEST



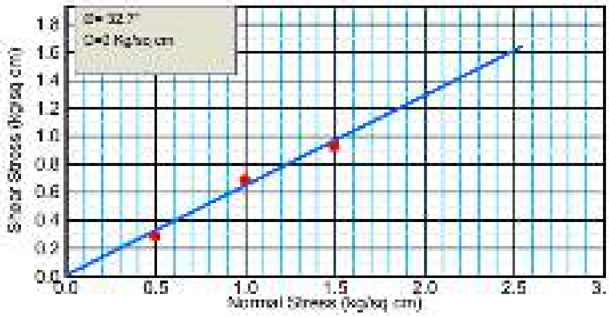
1901-HRIDC-IV-22592.687
BH-P64, DEPTH=17.00M, DIRECT SHEAR TEST



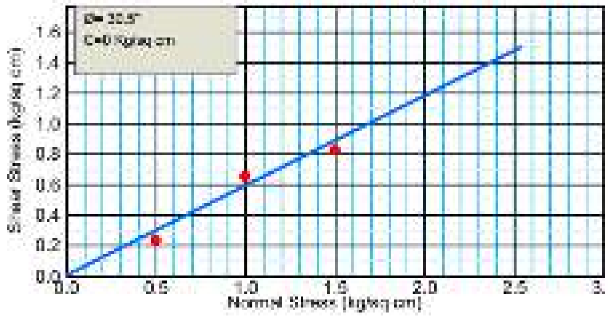
1901-HRIDC-IV-22592.687
BH-P64, DEPTH=28.00M, DIRECT SHEAR TEST



1901-HRIDC-IV-22618.687
BH-P65, DEPTH=4.00M, DIRECT SHEAR TEST

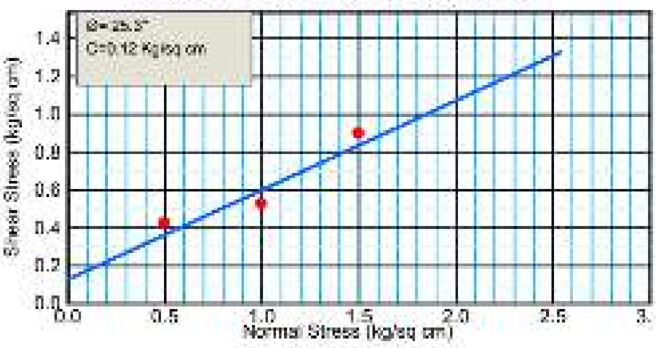


1901-HRIDC-IV-22618.687
BH-P65, DEPTH=7.00M, DIRECT SHEAR TEST

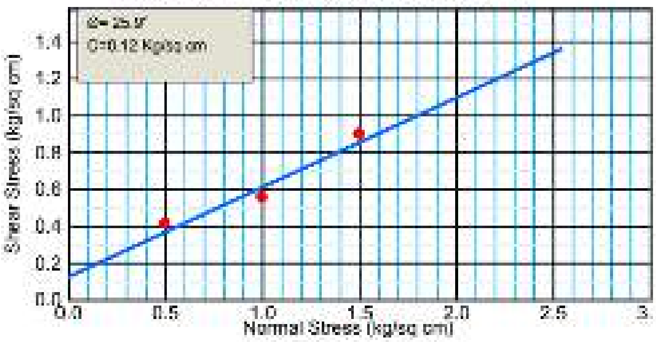


APPENDIX-F
GRAPH 3: DST GRAPH

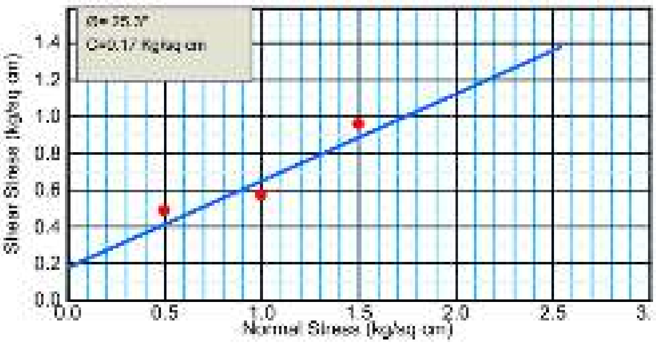
1901-HRIDC-IV-22618.887
BH-P85, DEPTH=10.00M, DIRECT SHEAR TEST



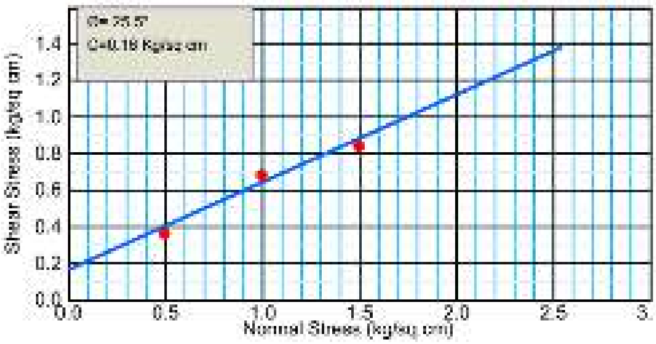
1901-HRIDC-IV-22618.887
BH-P85, DEPTH=13.00M, DIRECT SHEAR TEST



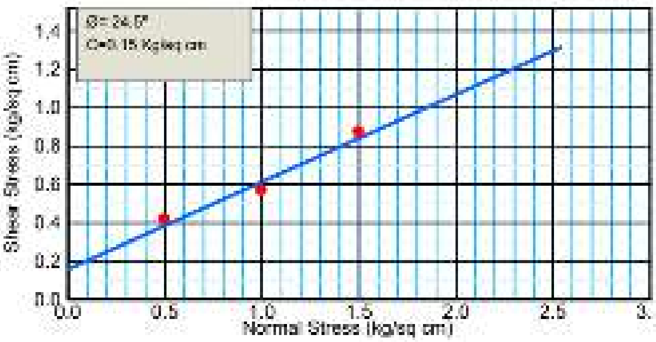
1901-HRIDC-IV-22645.087
BH-P86, DEPTH=10.00M, DIRECT SHEAR TEST



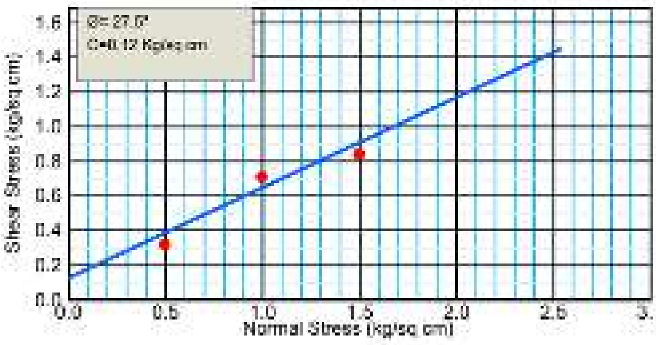
1901-HRIDC-IV-22645.087
BH-P86, DEPTH=16.00M, DIRECT SHEAR TEST



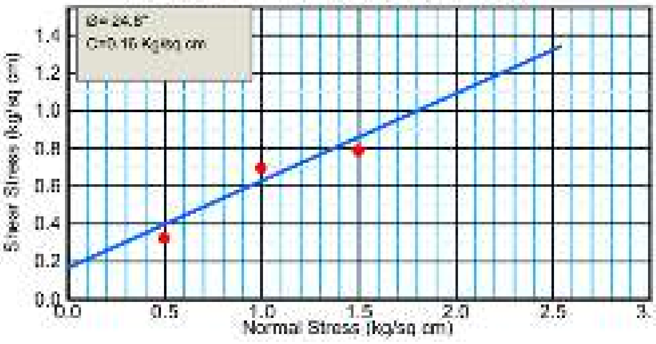
1901-HRIDC-IV-22645.087
BH-P86, DEPTH=19.00M, DIRECT SHEAR TEST



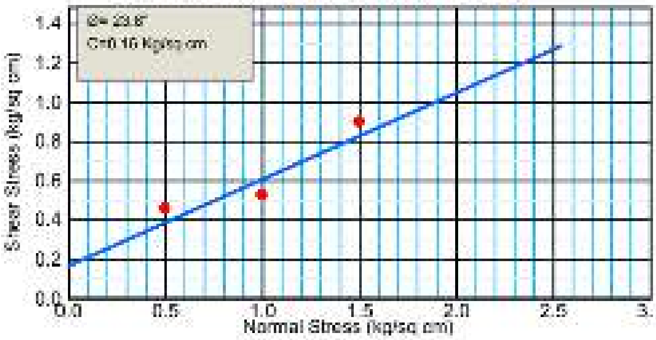
1901-HRIDC-IV-22671.287
BH-P87, DEPTH=2.00M, DIRECT SHEAR TEST



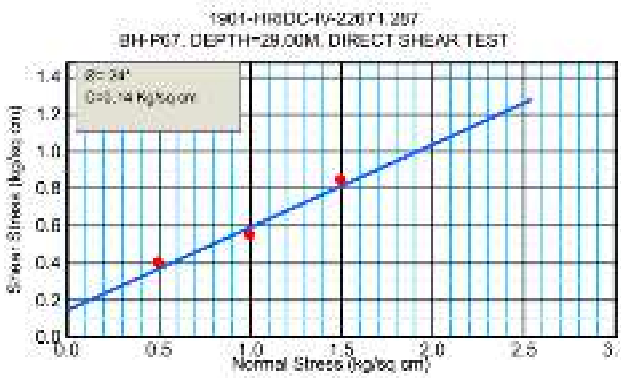
1901-HRIDC-IV-22671.287
BH-P87, DEPTH=11.00M, DIRECT SHEAR TEST

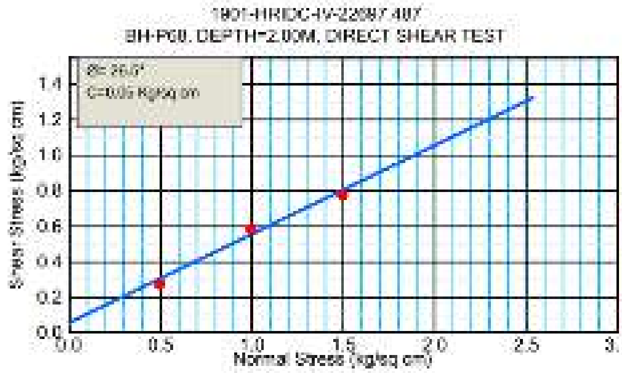


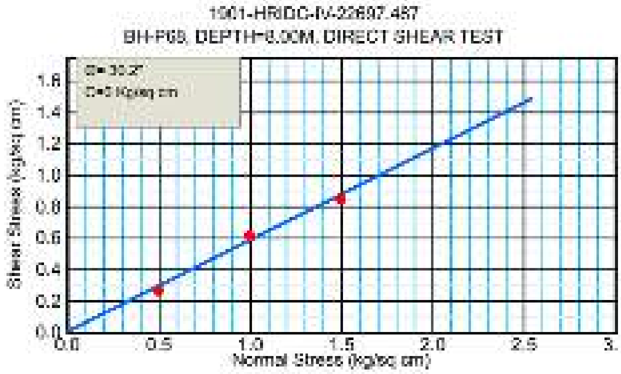
1901-HRIDC-IV-22671.287
BH-P87, DEPTH=17.00M, DIRECT SHEAR TEST

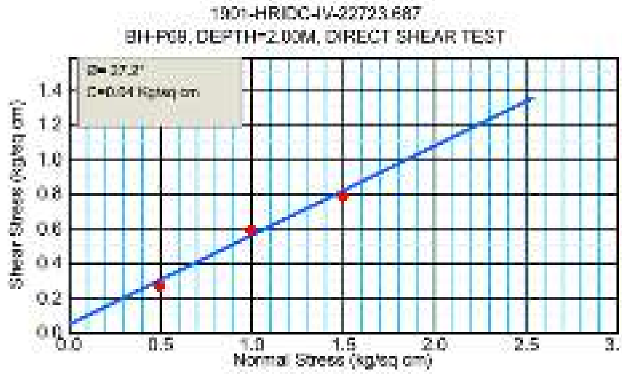


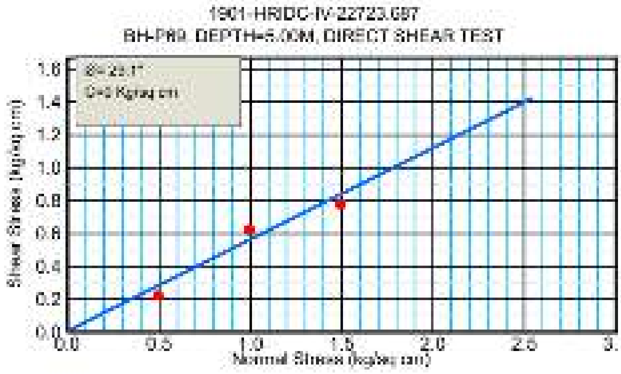
APPENDIX-F
GRAPH 4: DST GRAPH

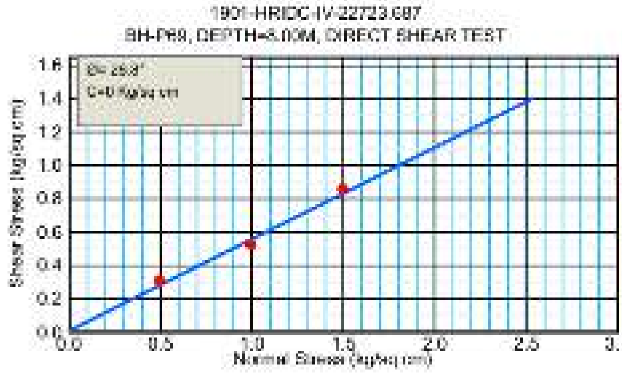


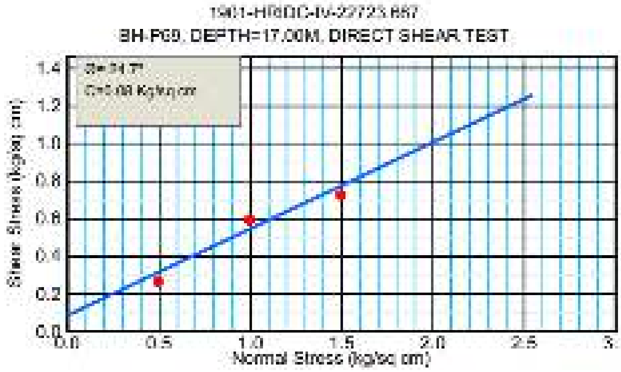


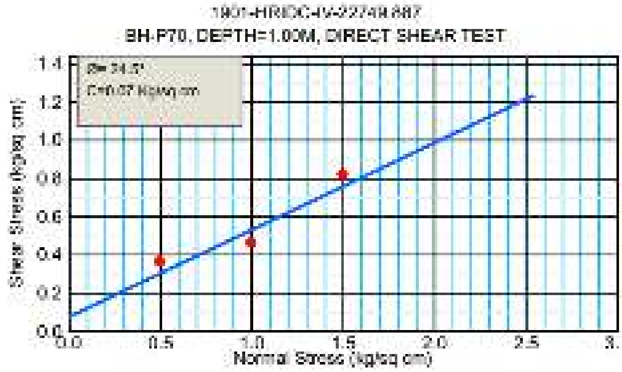




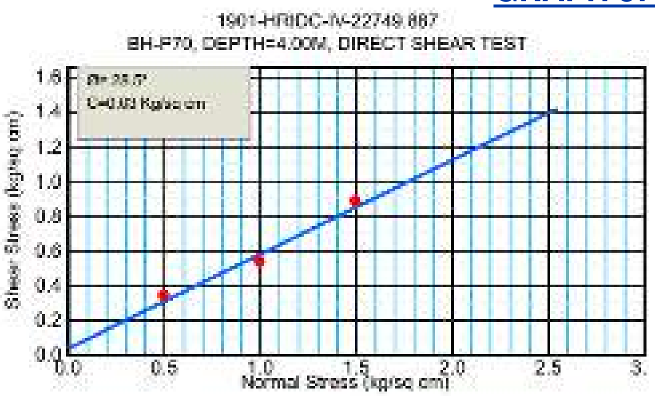


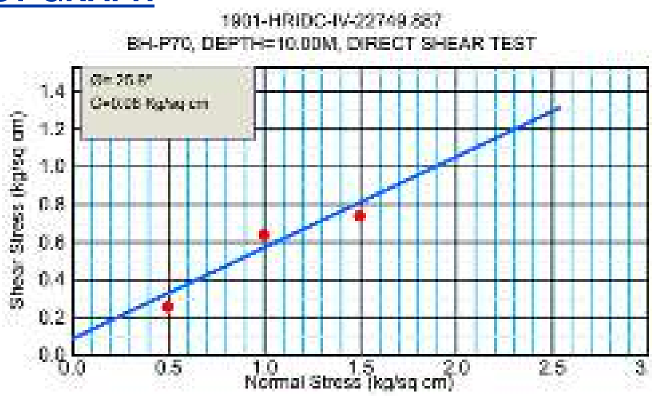


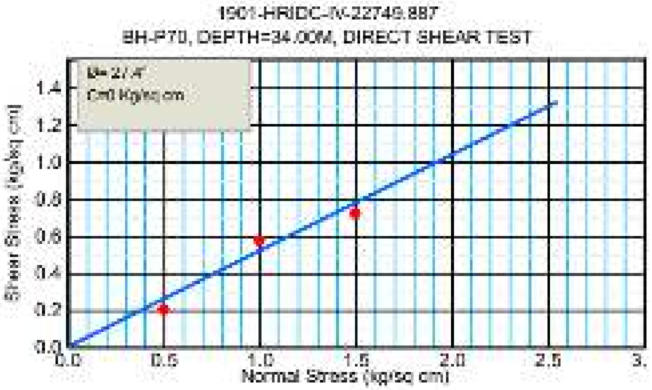


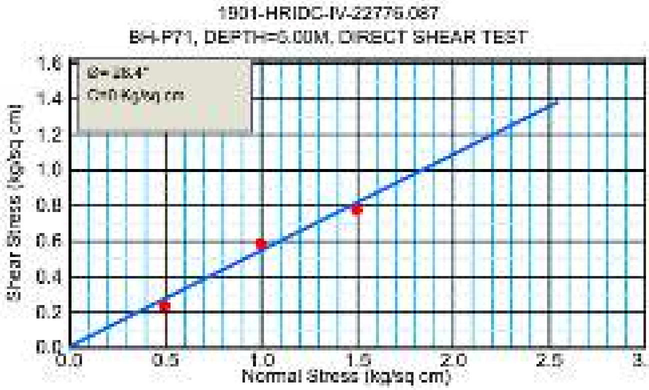


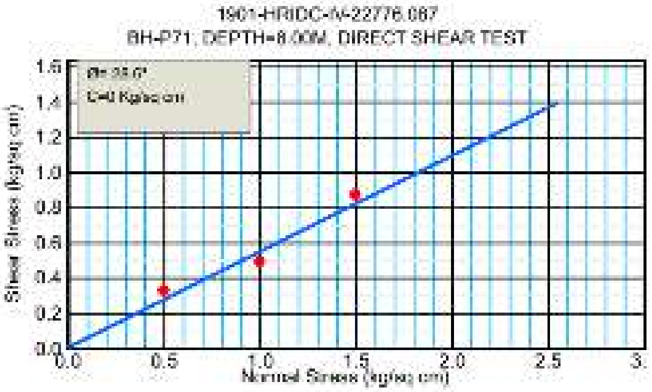
APPENDIX-F
GRAPH 5: DST GRAPH

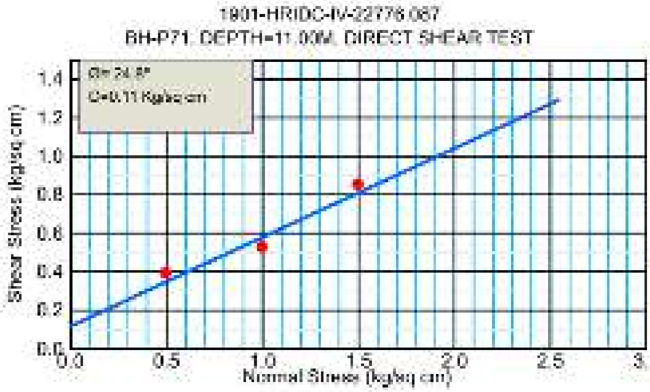


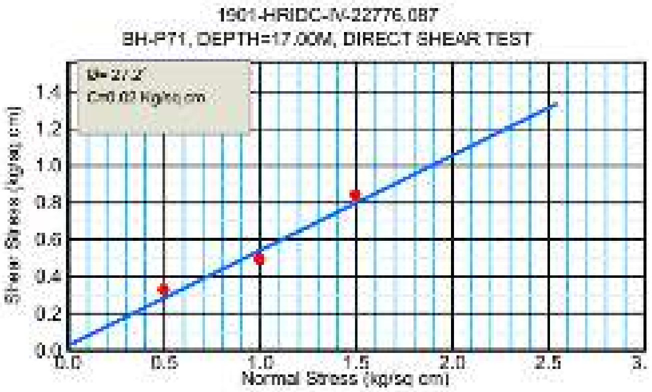


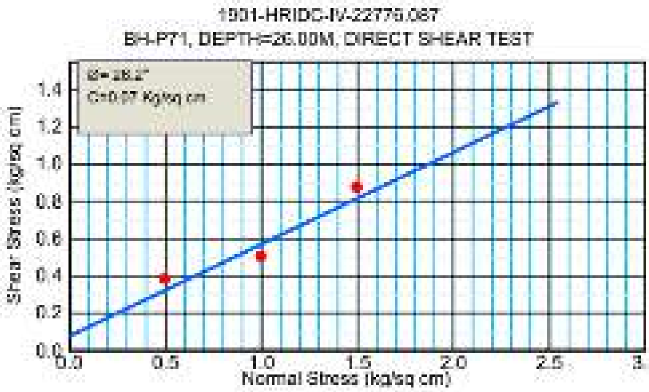






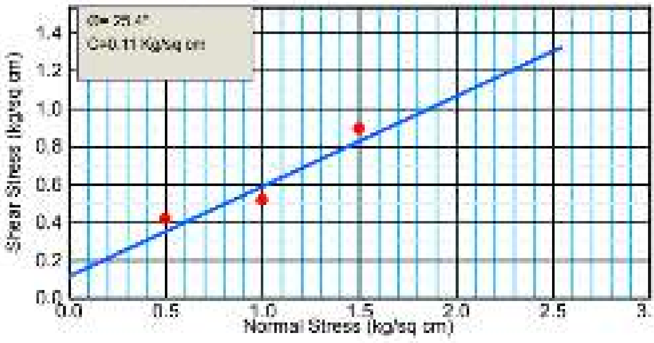




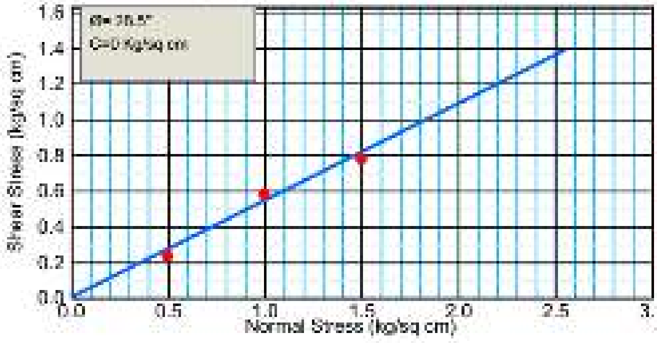


APPENDIX-F
GRAPH 6: DST GRAPH

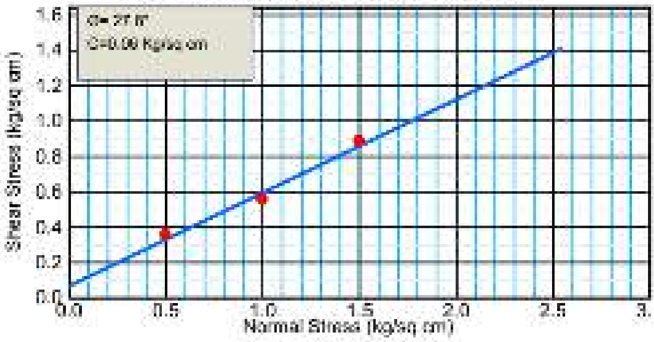
1901-HRIDC-IV-22802.287
BH-P72, DEPTH=2.00M, DIRECT SHEAR TEST



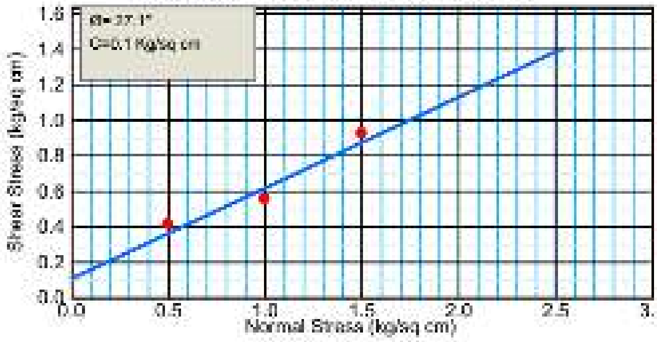
1901-HRIDC-IV-22802.287
BH-P72, DEPTH=5.00M, DIRECT SHEAR TEST



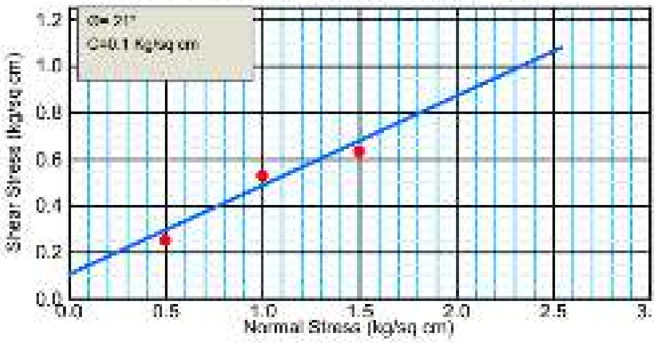
1901-HRIDC-IV-22802.287
BH-P72, DEPTH=25.00M, DIRECT SHEAR TEST



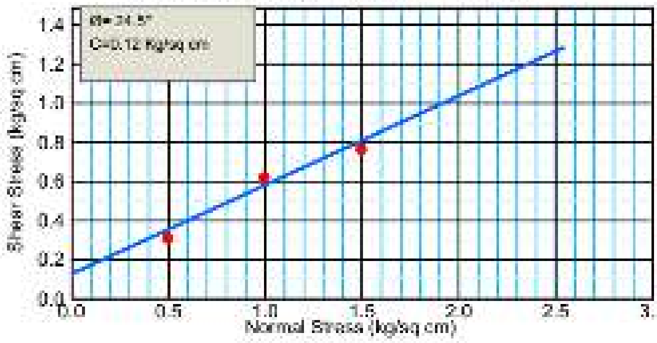
1901-HRIDC-IV-22802.287
BH-P72, DEPTH=38.00M, DIRECT SHEAR TEST



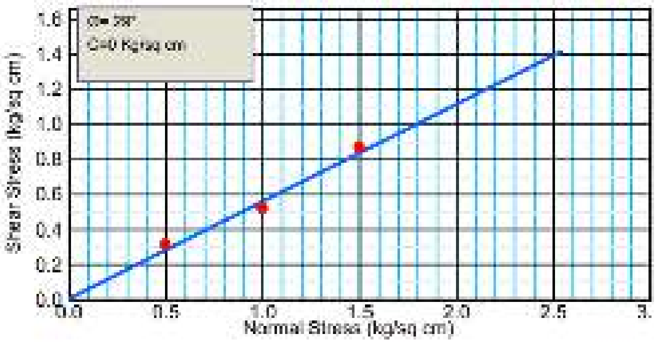
1901-HRIDC-IV-22828.487
BH-P73, DEPTH=2.00M, DIRECT SHEAR TEST



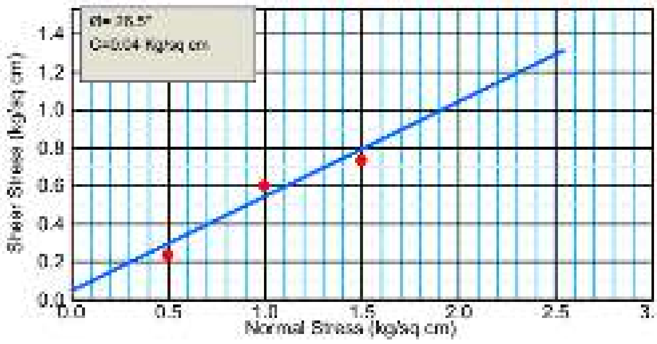
1901-HRIDC-IV-22828.487
BH-P73, DEPTH=5.00M, DIRECT SHEAR TEST



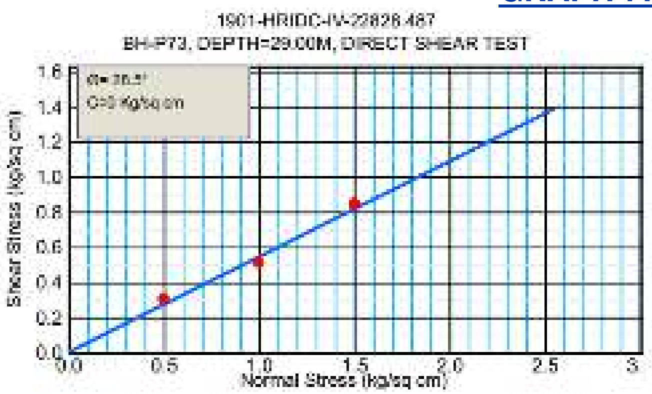
1901-HRIDC-IV-22828.487
BH-P73, DEPTH=8.00M, DIRECT SHEAR TEST

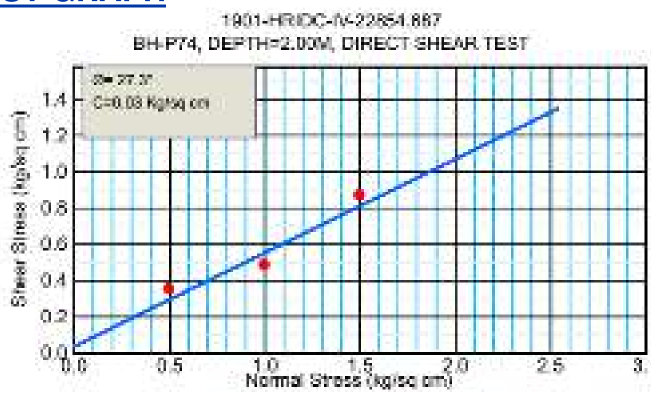


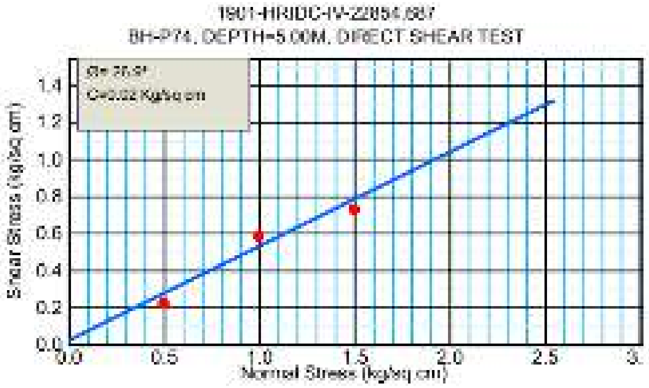
1901-HRIDC-IV-22828.487
BH-P73, DEPTH=17.00M, DIRECT SHEAR TEST

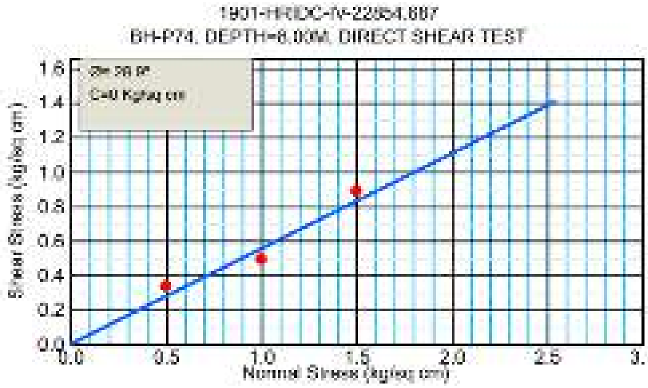


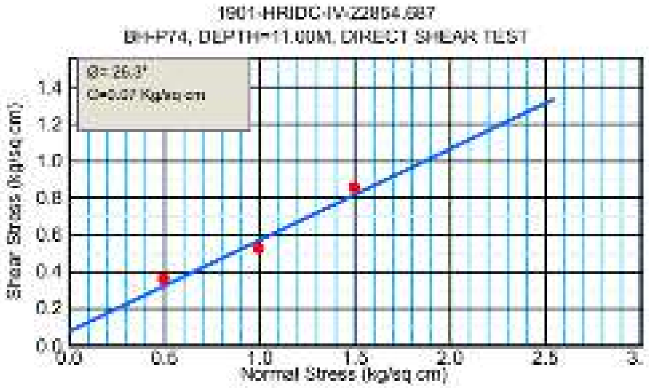
APPENDIX-F
GRAPH 7: DST GRAPH

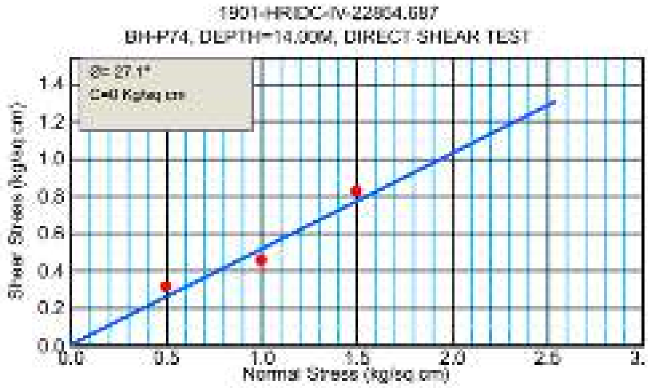


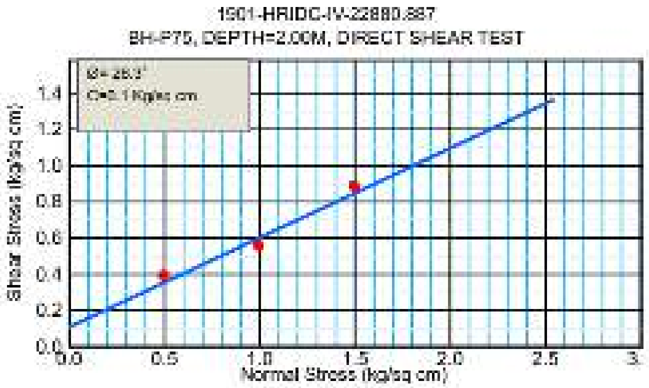


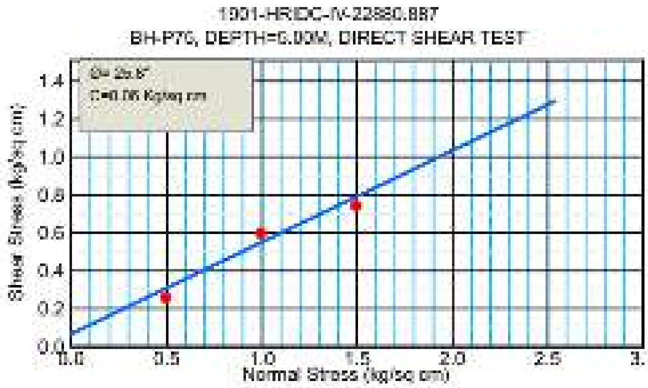






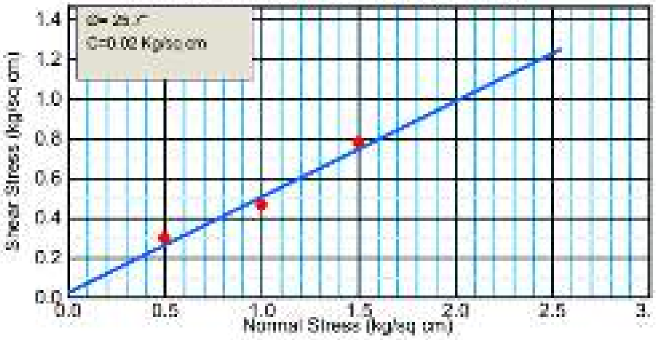




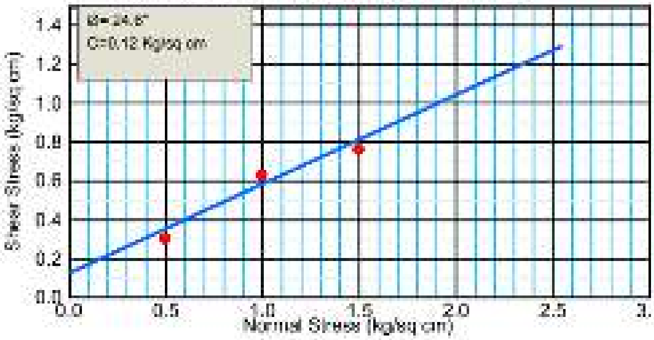


APPENDIX-F
GRAPH 8: DST GRAPH

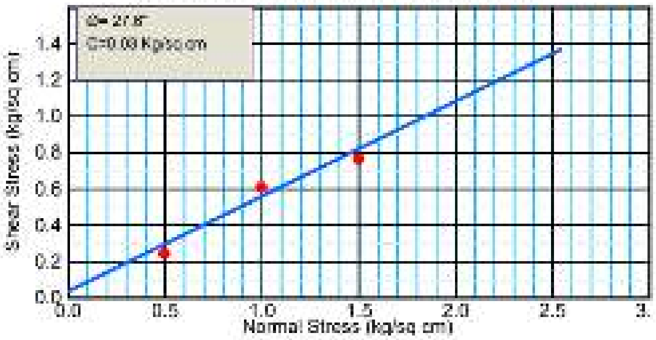
1901-HRIDC-IV-22880.887
BH-P75, DEPTH=8.00M, DIRECT SHEAR TEST



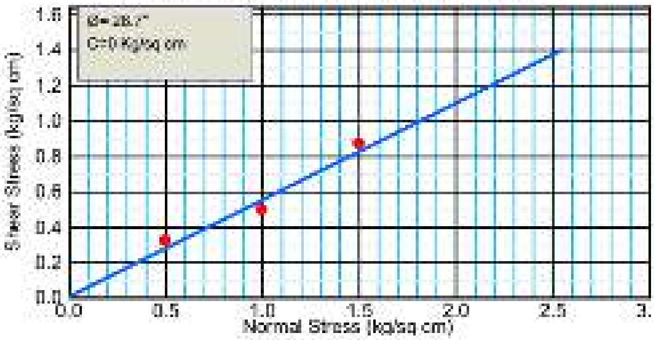
1901-HRIDC-IV-22880.887
BH-P75, DEPTH=11.00M, DIRECT SHEAR TEST



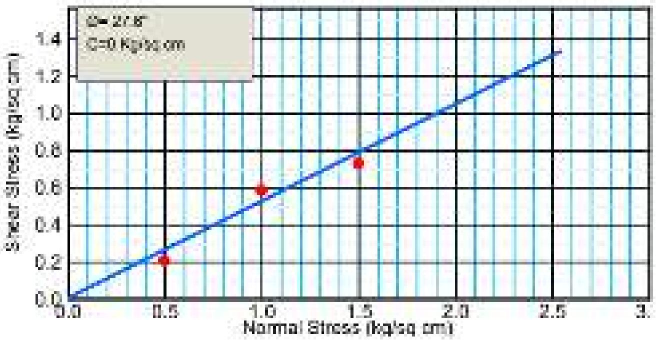
1901-HRIDC-IV-22880.887
BH-P75, DEPTH=17.00M, DIRECT SHEAR TEST



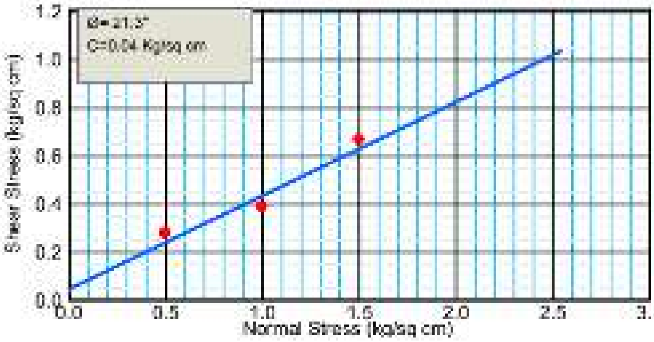
1901-HRIDC-IV-22880.887
BH-P75, DEPTH=29.00M, DIRECT SHEAR TEST



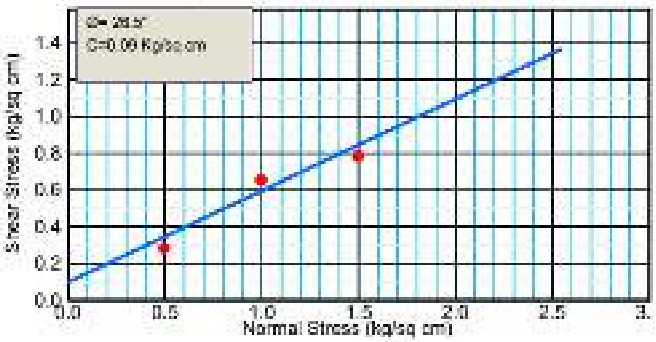
1901-HRIDC-IV-22880.887
BH-P75, DEPTH=32.00M, DIRECT SHEAR TEST



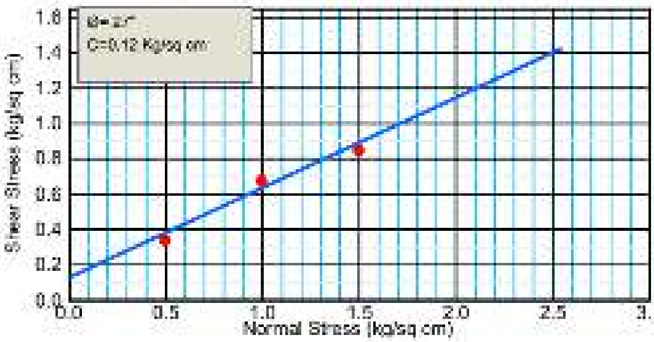
1901-HRIDC-IV-22907.087
BH-P76, DEPTH=1.00M, DIRECT SHEAR TEST



1901-HRIDC-IV-22907.087
BH-P76, DEPTH=10.00M, DIRECT SHEAR TEST

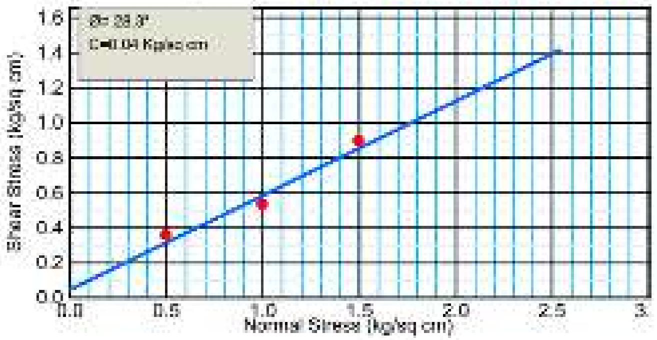


1901-HRIDC-IV-22907.087
BH-P76, DEPTH=13.00M, DIRECT SHEAR TEST



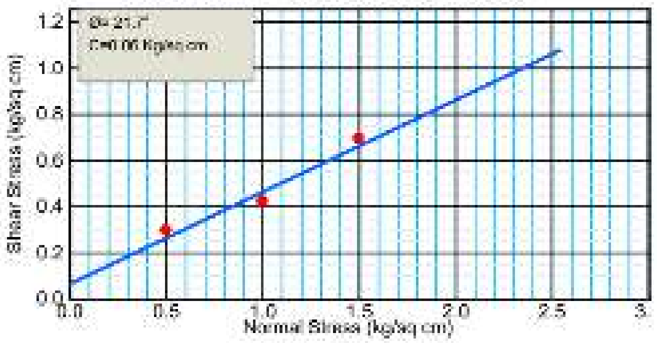
APPENDIX-F
GRAPH 9: DST GRAPH

1901-HRIDC-IV-22907.087
BH-P76, DEPTH=25.00M, DIRECT SHEAR TEST

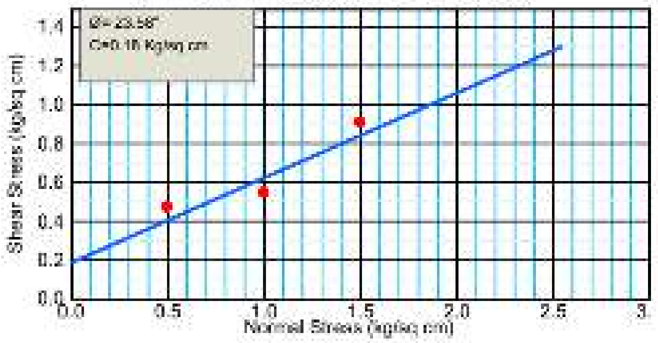


1901-HRIDC-IV-22907.087
BH-P76, DEPTH=34.00M, DIRECT SHEAR TEST

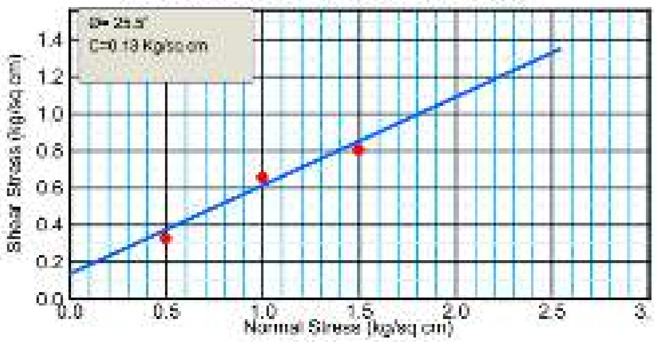
1901-HRIDC-IV-22933.287
BH-P77, DEPTH=1.00M, DIRECT SHEAR TEST



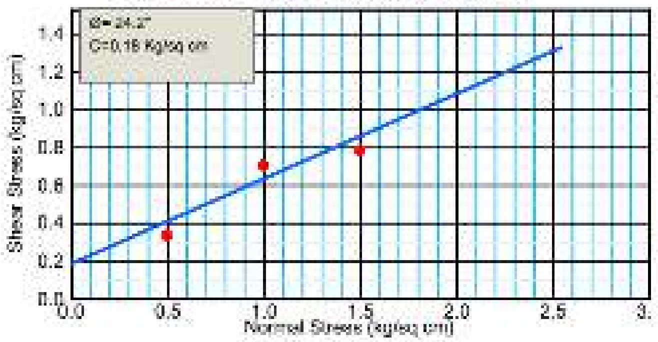
1901-HRIDC-IV-22933.287
BH-P77, DEPTH=4.00M, DIRECT SHEAR TEST



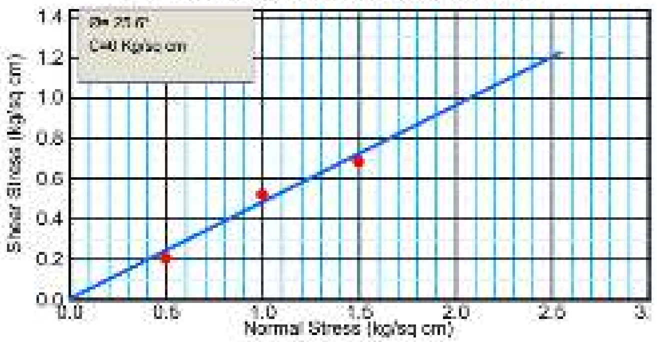
1901-HRIDC-IV-22933.287
BH-P77, DEPTH=7.00M, DIRECT SHEAR TEST



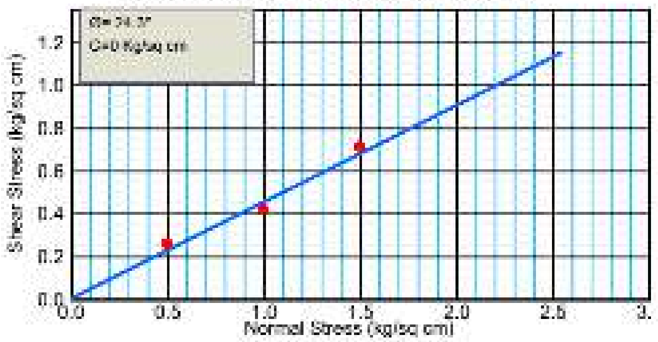
1901-HRIDC-IV-22933.287
BH-P77, DEPTH=13.00M, DIRECT SHEAR TEST



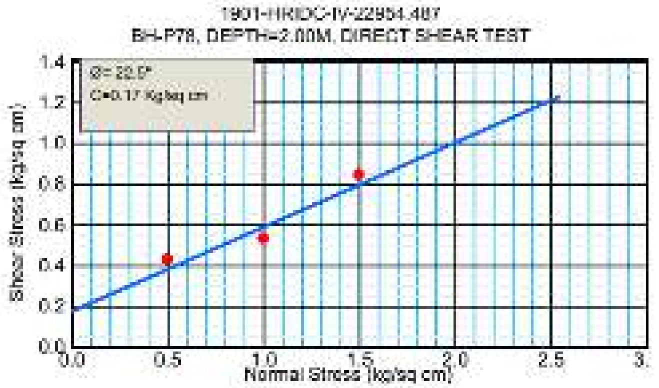
1901-HRIDC-IV-22933.287
BH-P77, DEPTH=25.00M, DIRECT SHEAR TEST

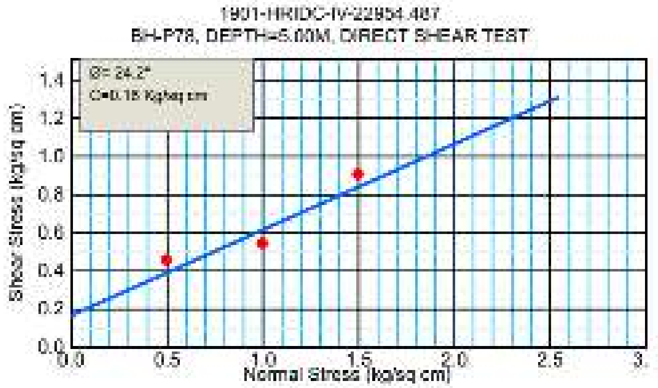


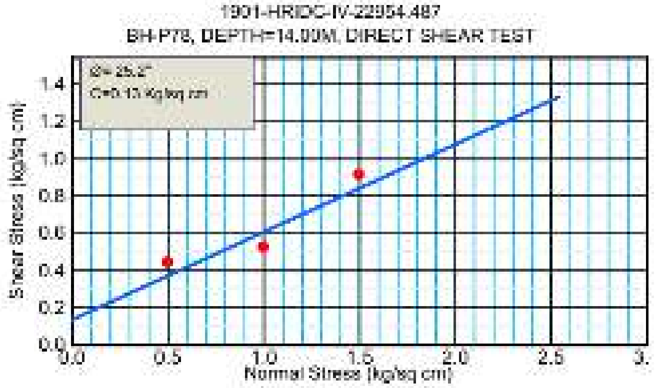
1901-HRIDC-IV-22933.287
BH-P77, DEPTH=34.00M, DIRECT SHEAR TEST

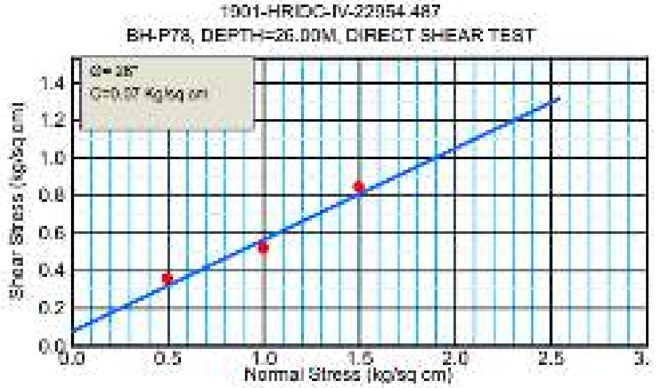


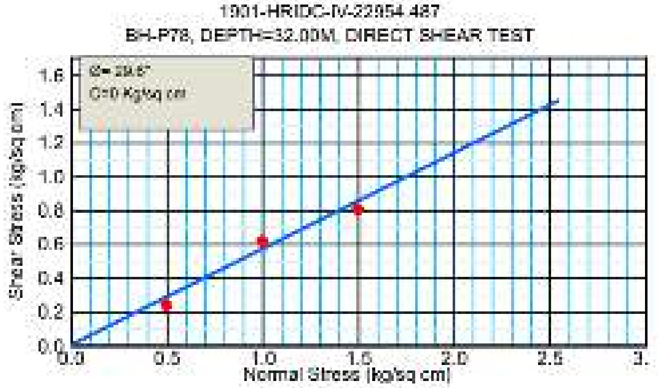
APPENDIX-F
GRAPH 10: DST GRAPH

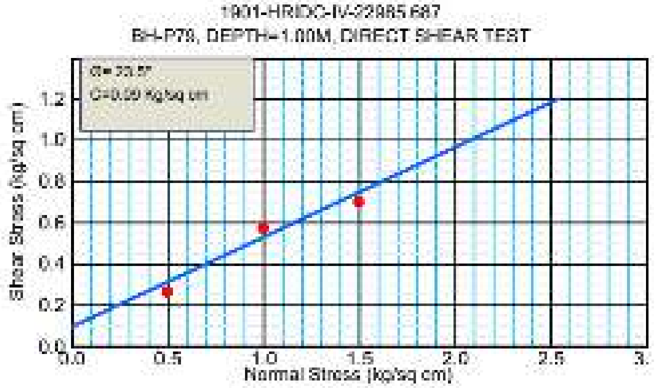


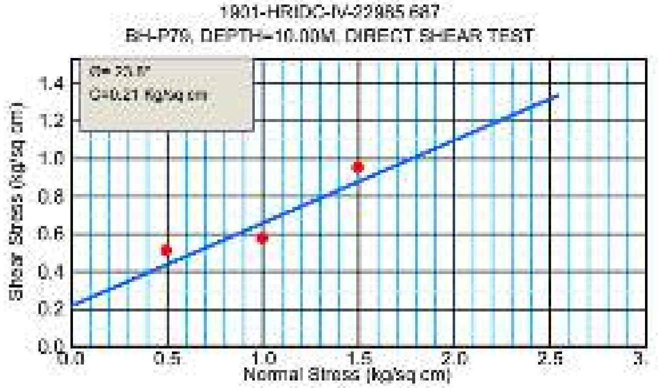




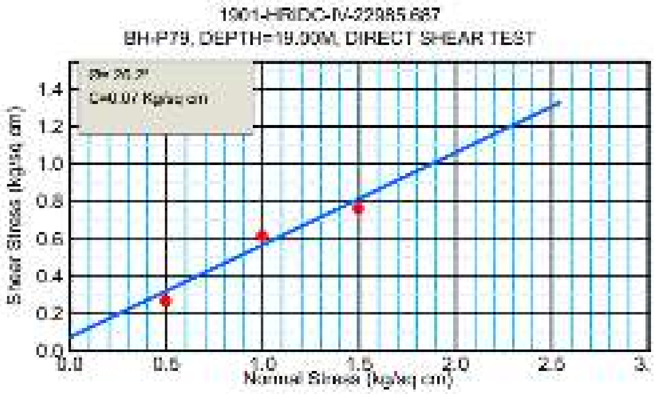


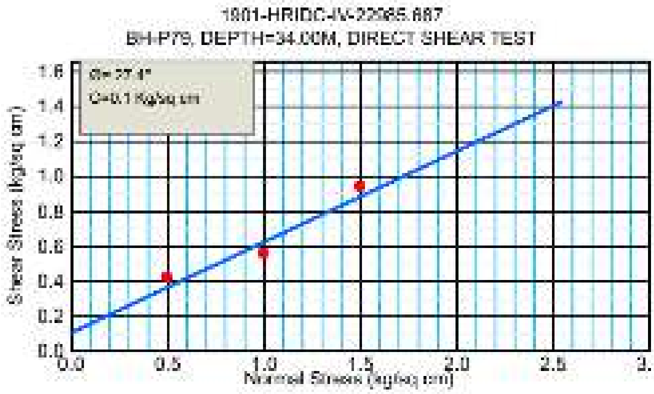


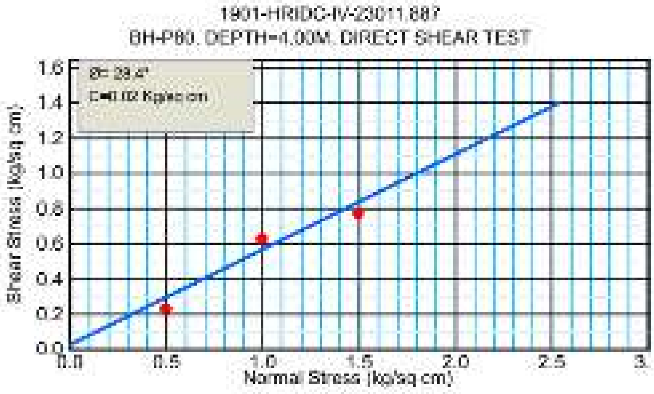


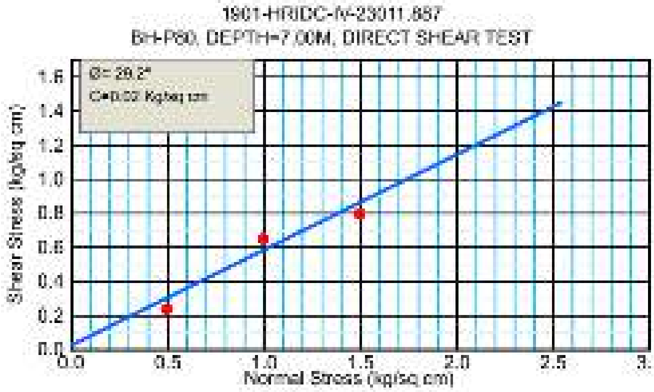


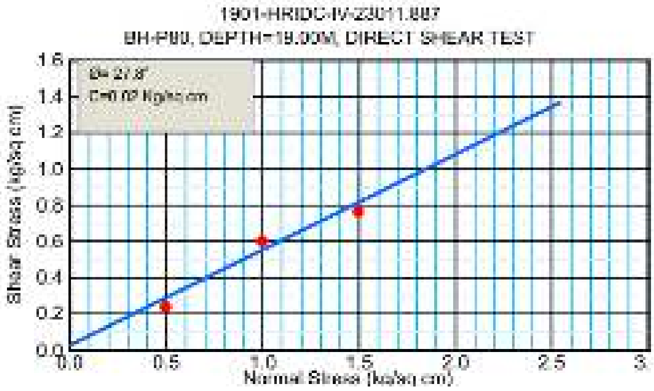
APPENDIX-F
GRAPH 11: DST GRAPH





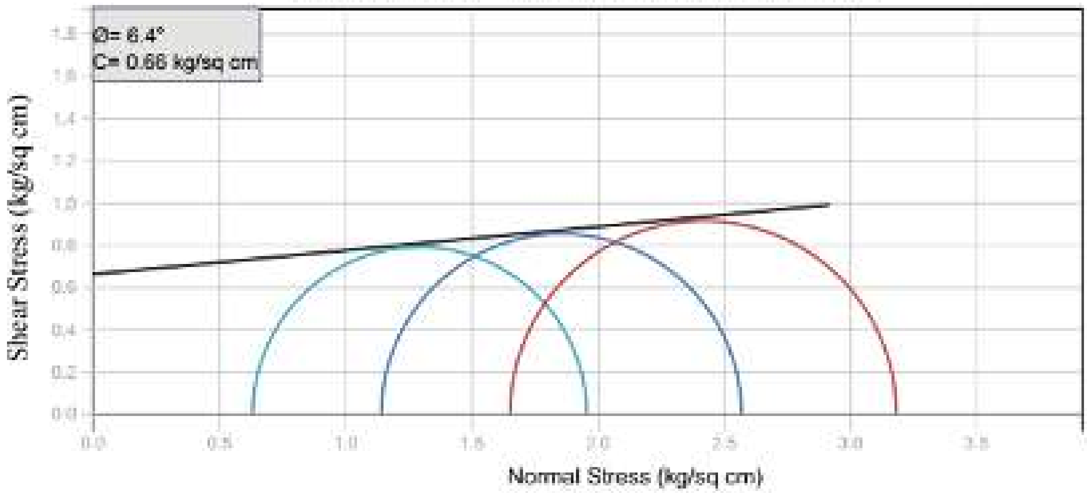




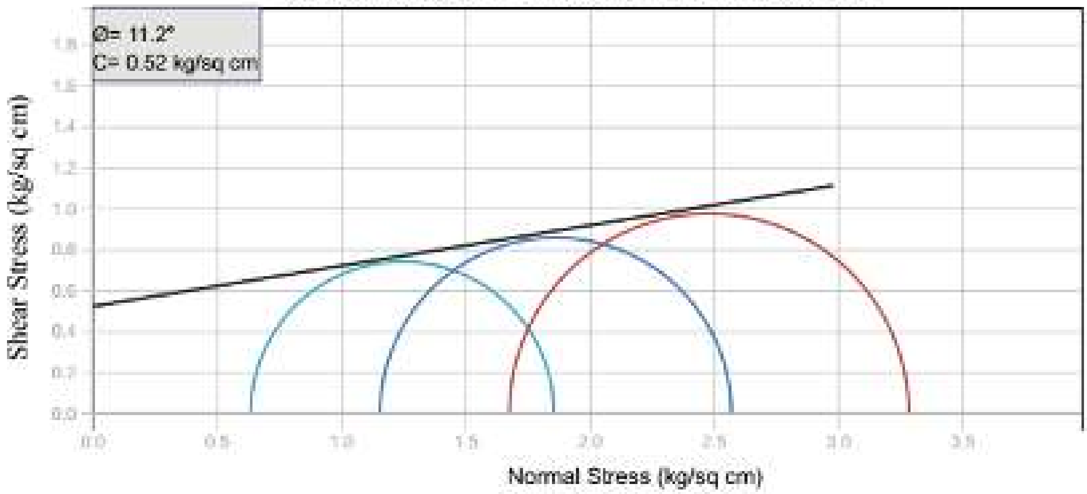


APPENDIX-G
GRAPH 1: UU GRAPH

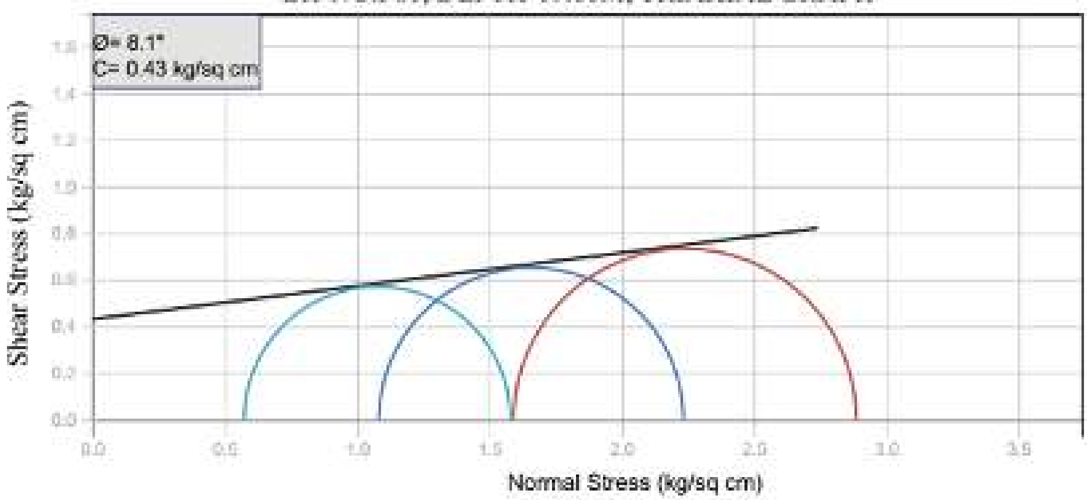
1901-HRIDC-IV-22514.0870
BH-NO.P61, DEPTH-1.00M, TRIAXIAL GRAPH



1901-HRIDC-IV-22514.0870
BH-NO.P61, DEPTH-16.00M, TRIAXIAL GRAPH



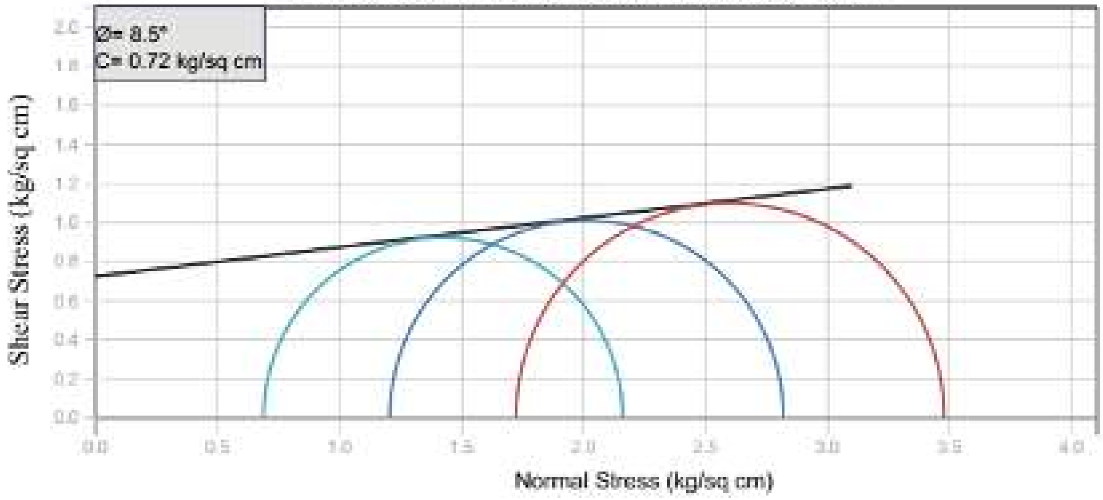
1901-HRIDC-IV-22514.0870
BH-NO.P61, DEPTH-19.00M, TRIAXIAL GRAPH



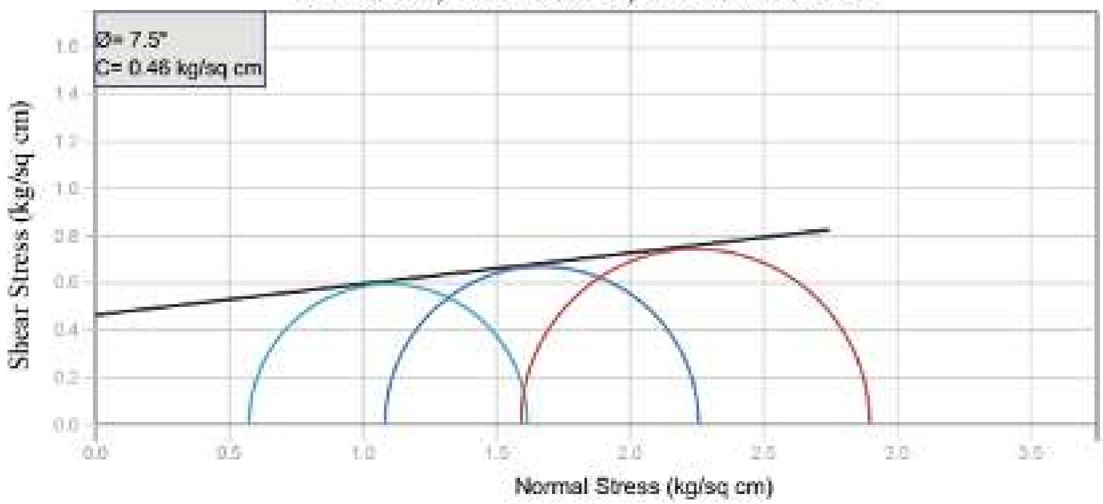
APPENDIX-G

GRAPH 2: UU GRAPH

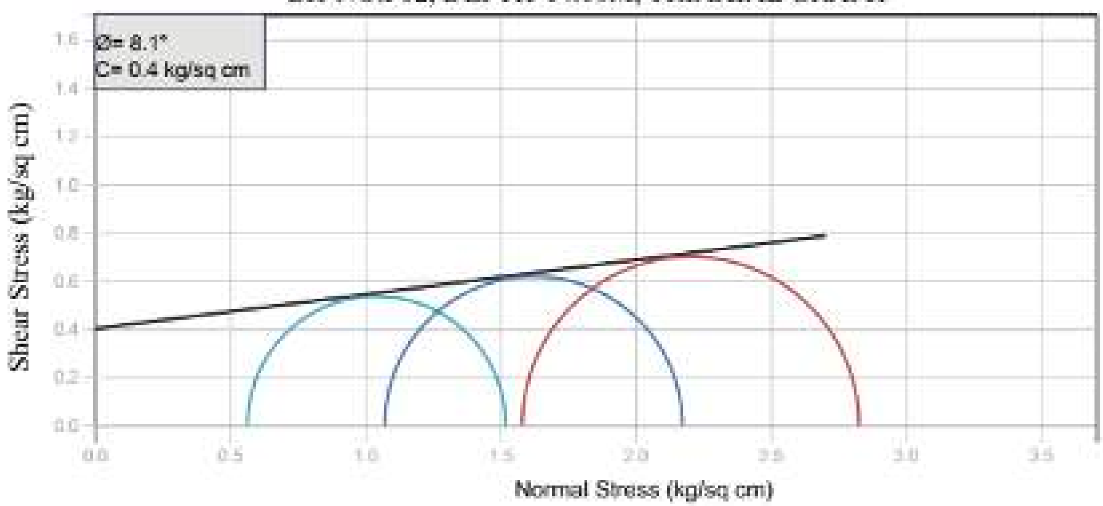
1901-HRIDC-IV-22514.0870
BH-NO.P61, DEPTH-28.00M, TRIAXIAL GRAPH



1901-HRIDC-IV-22540.2870
BH-NO.P62, DEPTH-2.00M, TRIAXIAL GRAPH

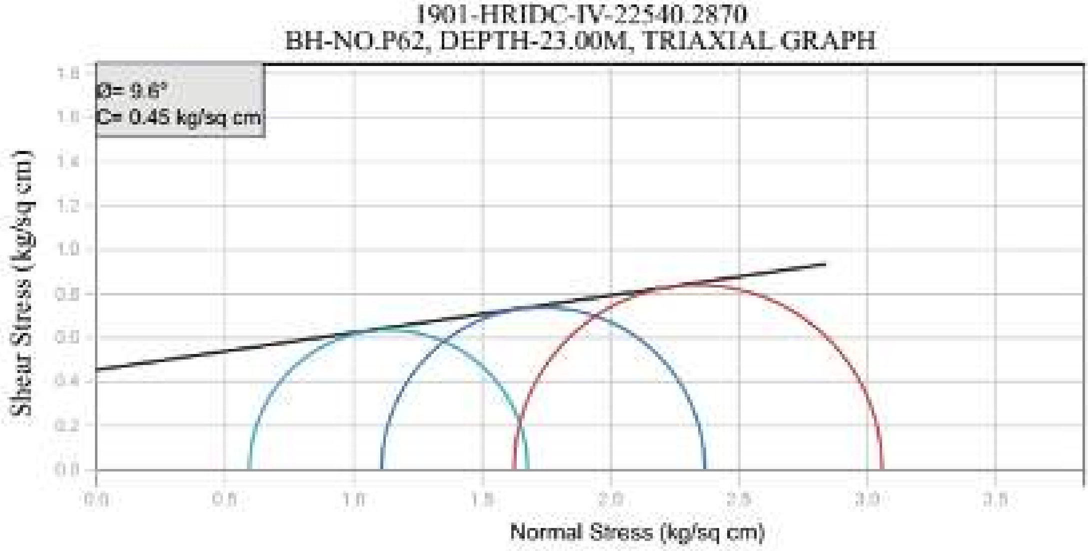


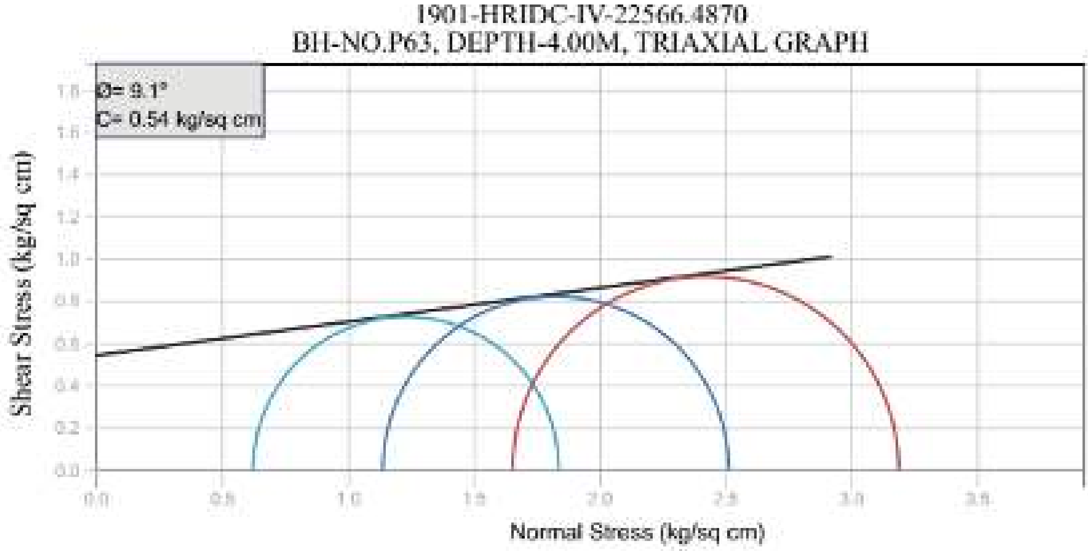
1901-HRIDC-IV-22540.2870
BH-NO.P62, DEPTH-14.00M, TRIAXIAL GRAPH

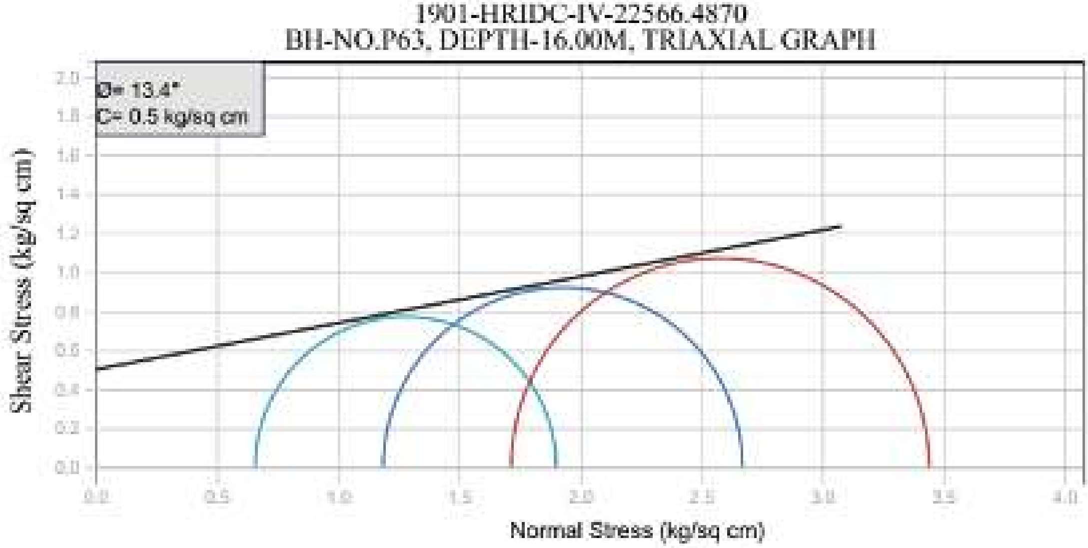


APPENDIX-G

GRAPH 3: UU GRAPH



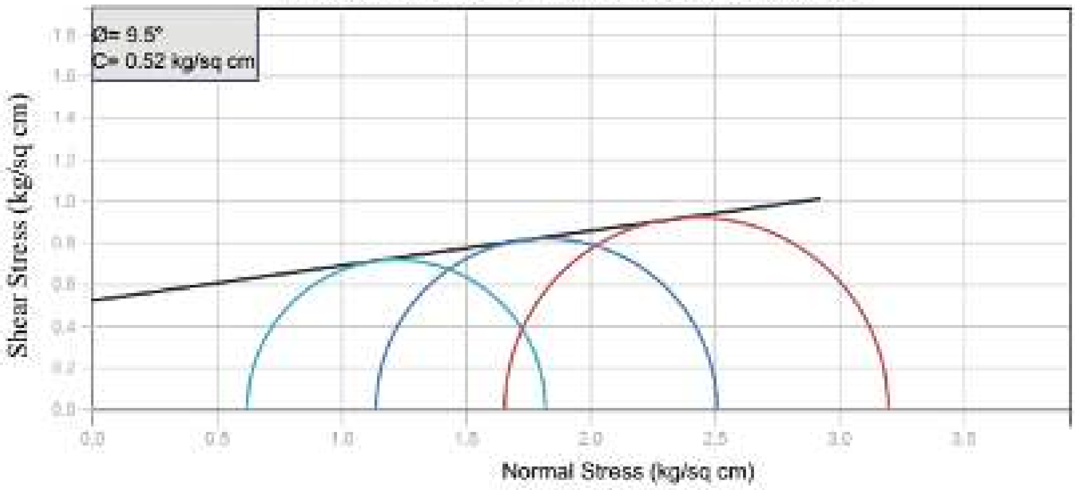




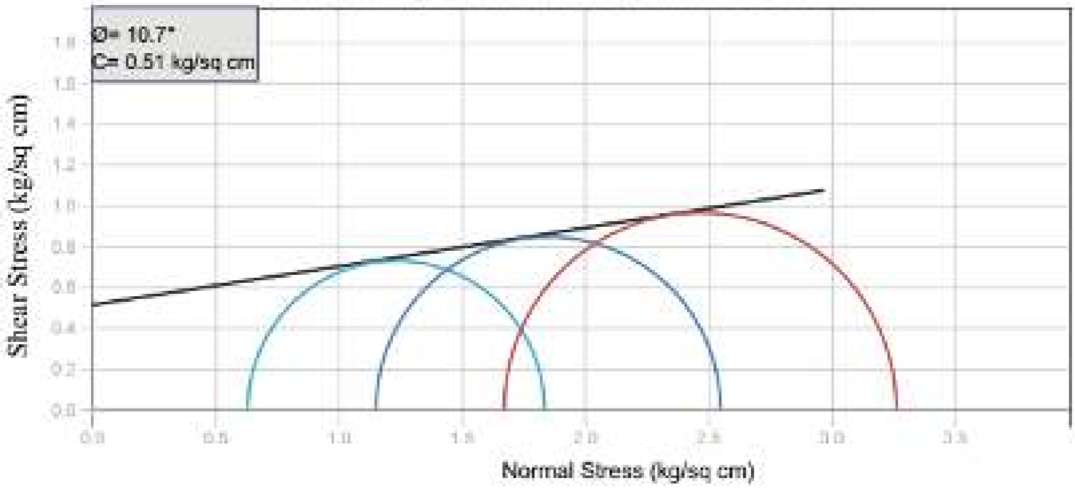
APPENDIX-G

GRAPH 4: UU GRAPH

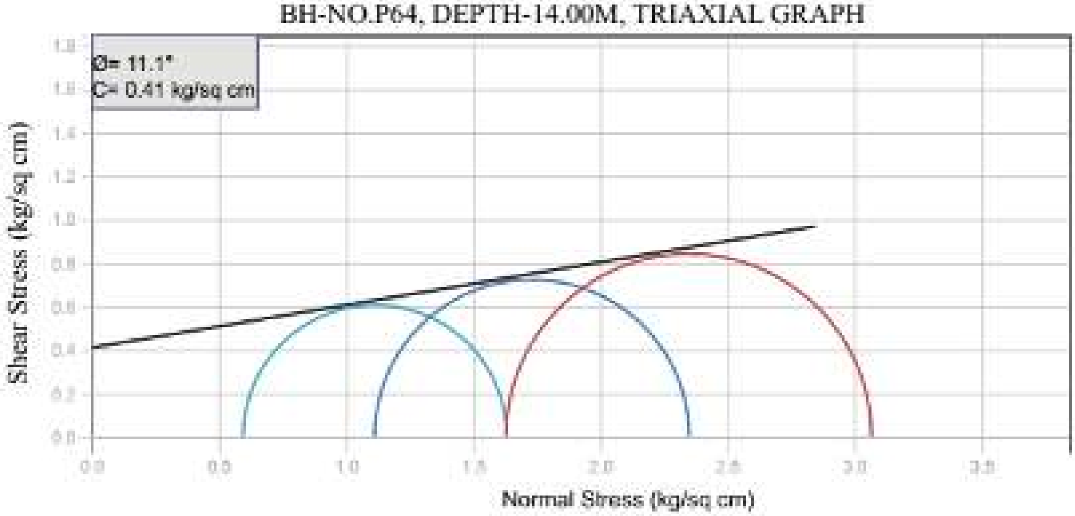
1901-HRIDC-IV-22566.4870
BH-NO.P63, DEPTH-22.00M, TRIAXIAL GRAPH



1901-HRIDC-IV-22566.4870
BH-NO.P63, DEPTH-25.00M, TRIAXIAL GRAPH

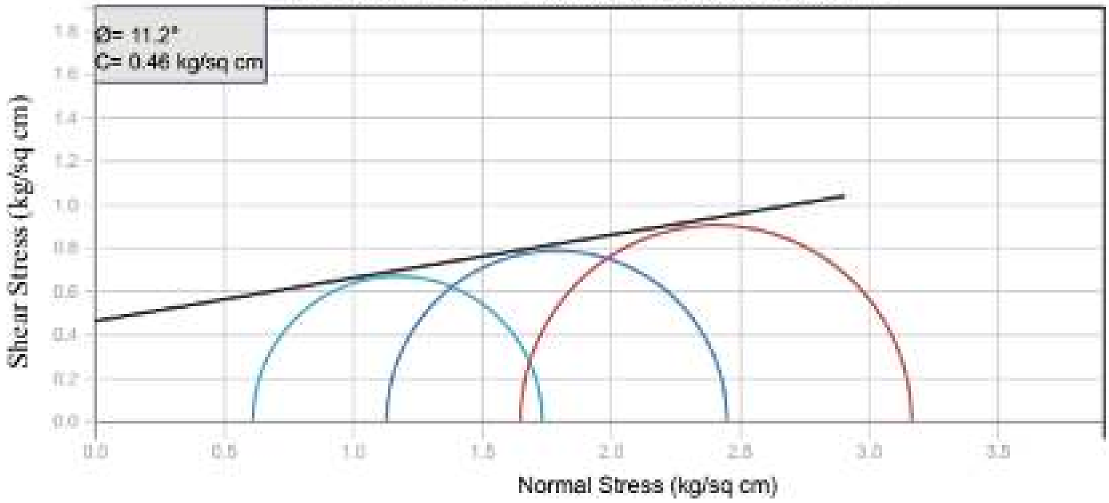


1901-HRIDC-IV-22592.6870
BH-NO.P64, DEPTH-14.00M, TRIAXIAL GRAPH

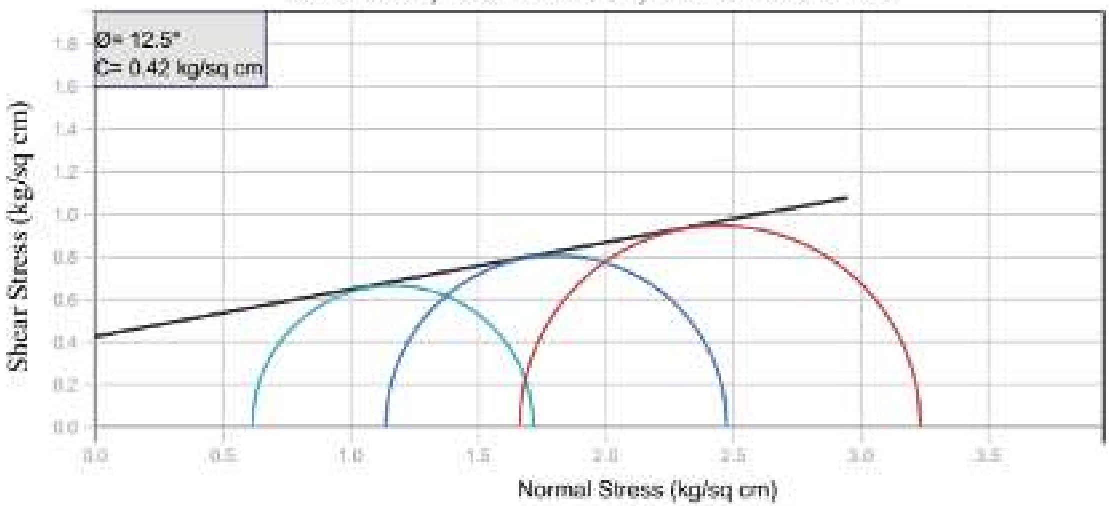


APPENDIX-G
GRAPH 5: UU GRAPH

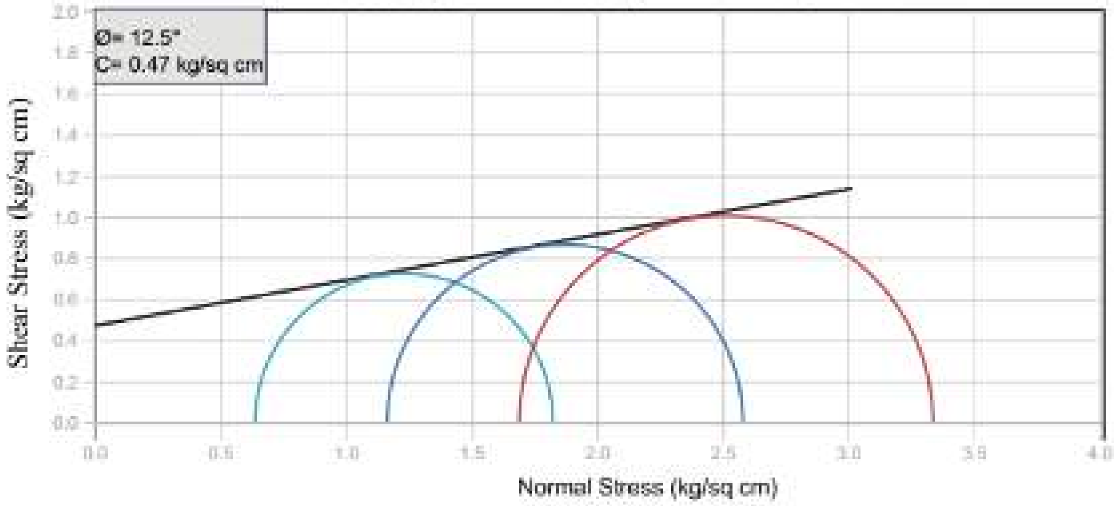
1901-HRIDC-IV-22592.6870
BH-NO.P64, DEPTH-20.00M, TRIAXIAL GRAPH



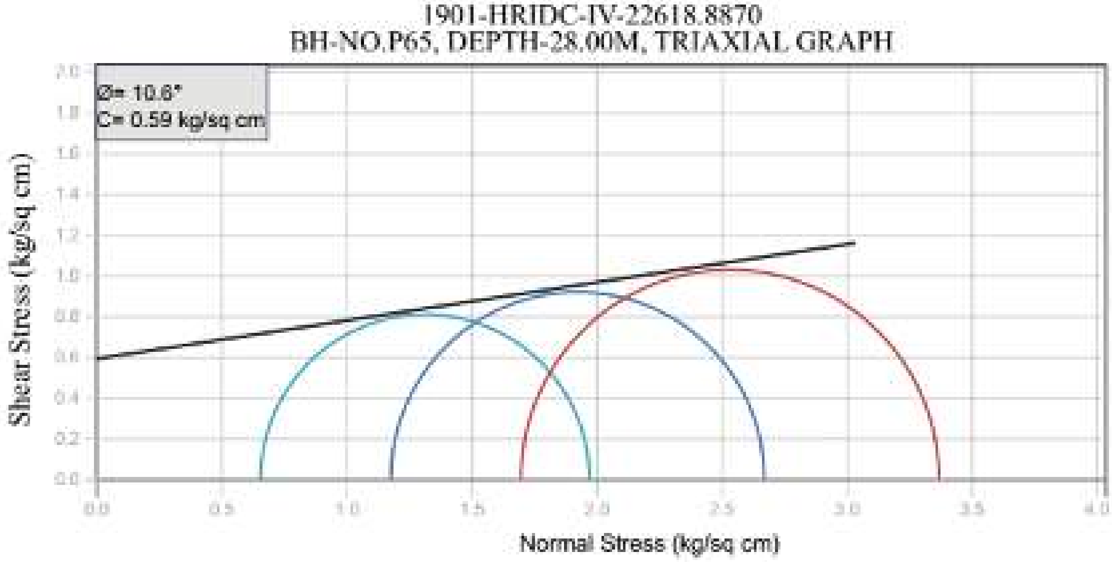
1901-HRIDC-IV-22592.6870
BH-NO.P64, DEPTH-23.00M, TRIAXIAL GRAPH

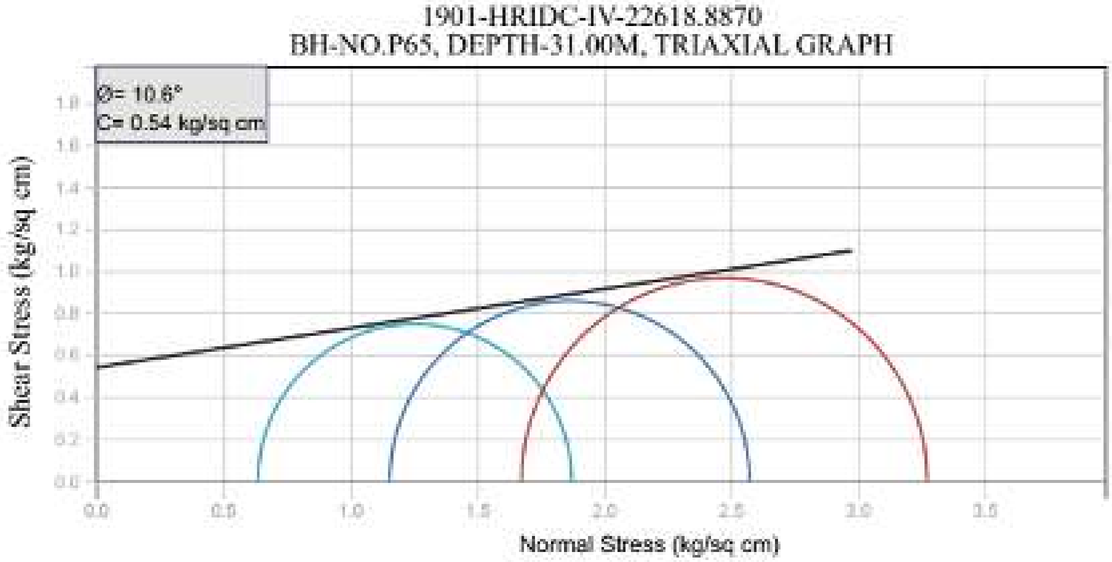


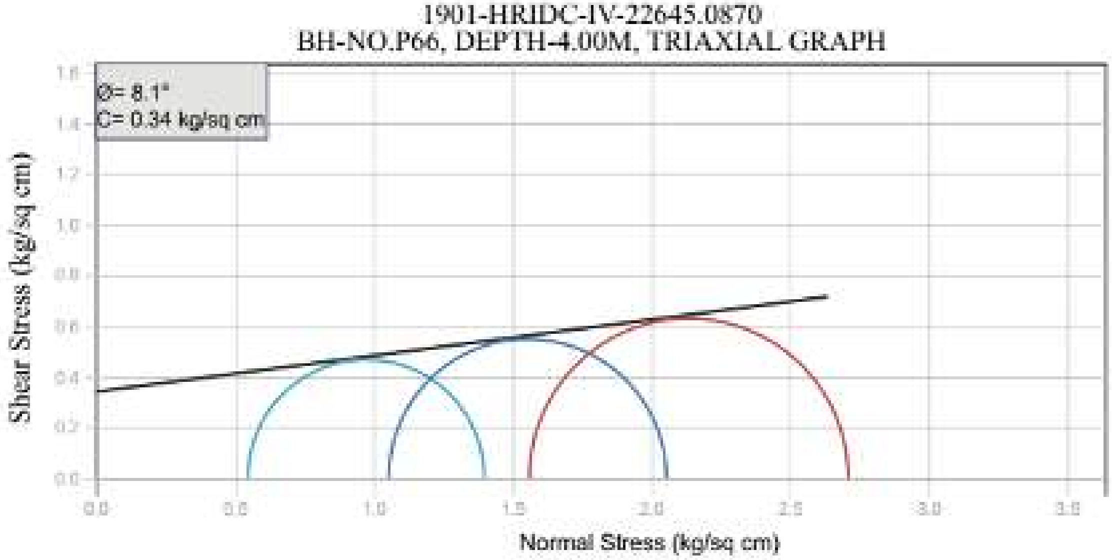
1901-HRIDC-IV-22618.8870
BH-NO.P65, DEPTH-22.00M, TRIAXIAL GRAPH



APPENDIX-G
GRAPH 6: UU GRAPH

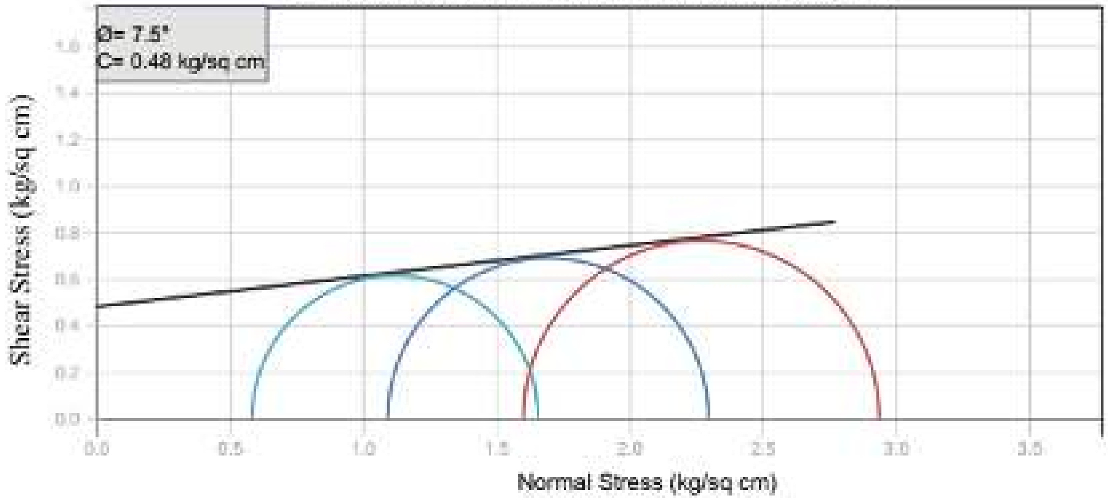




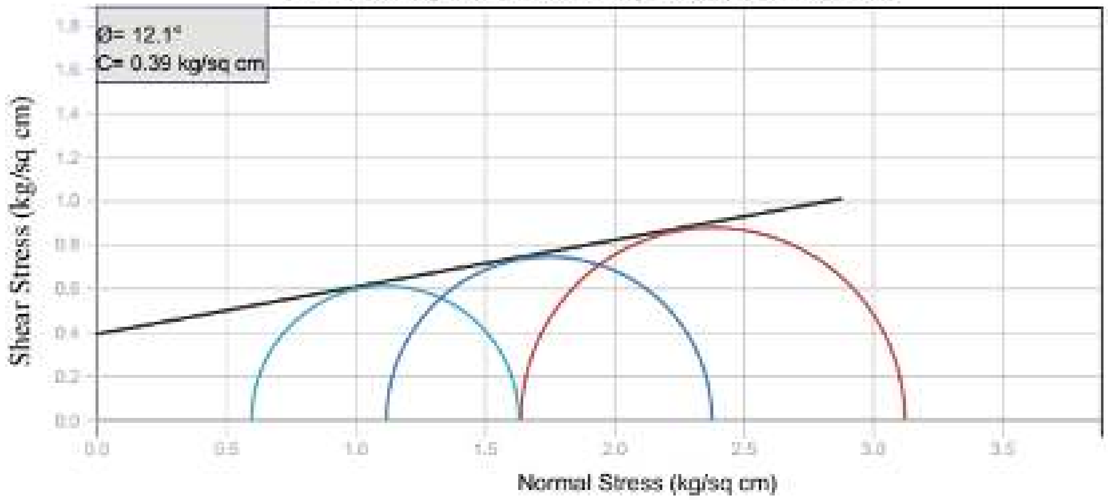


APPENDIX-G
GRAPH 7: UU GRAPH

1901-HRIDC-IV-22645.0870
BH-NO.P66, DEPTH-13.00M, TRIAXIAL GRAPH



1901-HRIDC-IV-22645.0870
BH-NO.P66, DEPTH-25.00M, TRIAXIAL GRAPH



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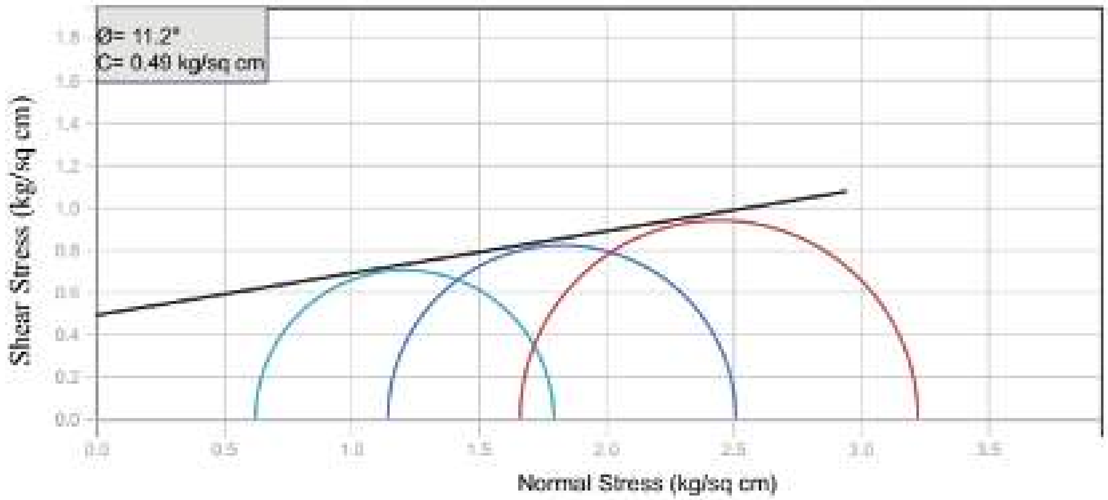
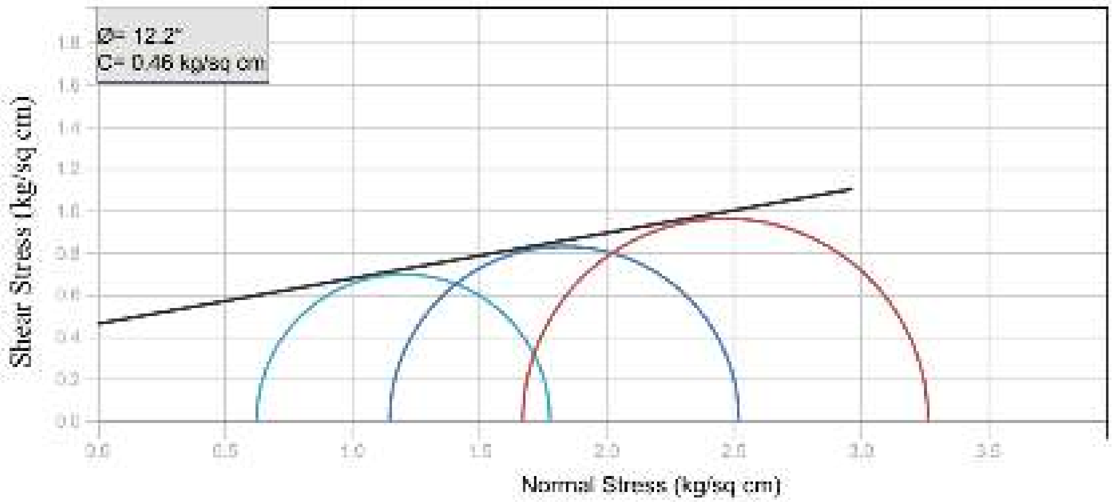
BH-NO.P66, DEPTH-31.00M, TRIAXIAL GRAPH



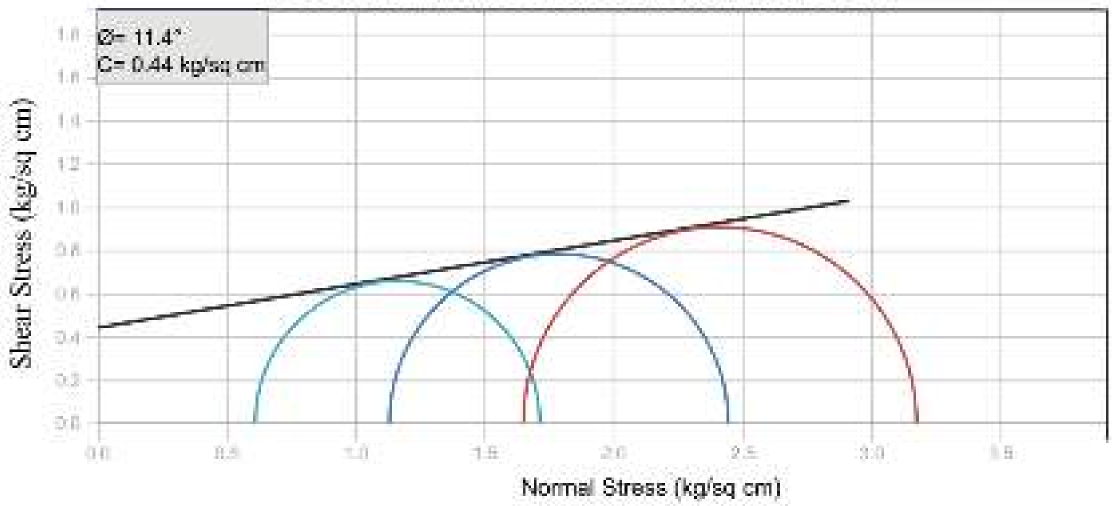
APPENDIX-G
GRAPH 8: UU GRAPH

1901-HRIDC-IV-22671.287
BH-NO.P67, DEPTH-14.00M, TRIAXIAL GRAPH

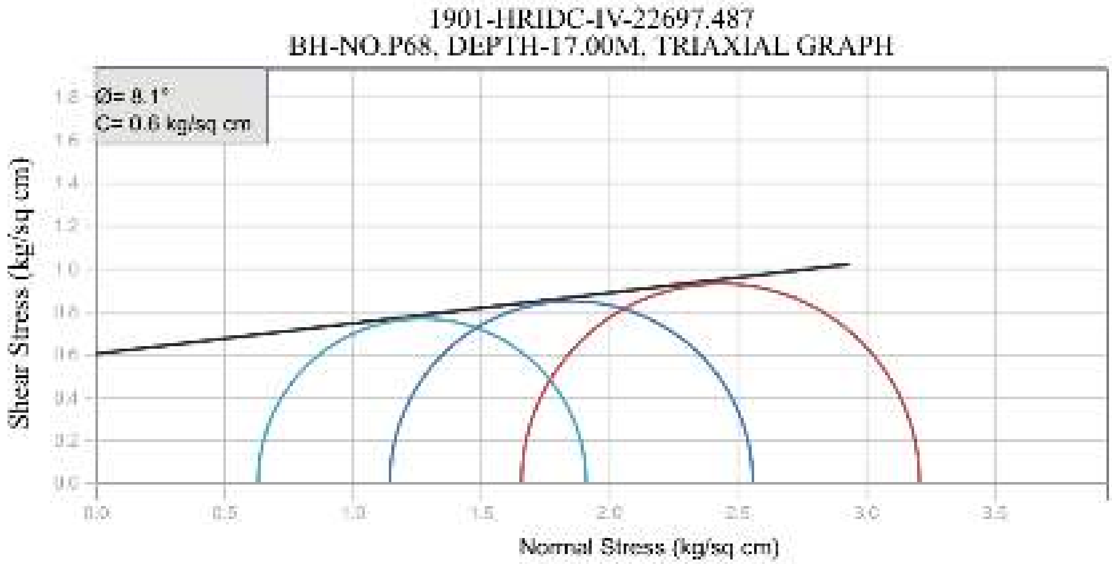
1901-HRIDC-IV-22671.287
BH-NO.P67, DEPTH-23.00M, TRIAXIAL GRAPH



1901-HRIDC-IV-22697.487
BH-NO.P68, DEPTH-11.00M, TRIAXIAL GRAPH

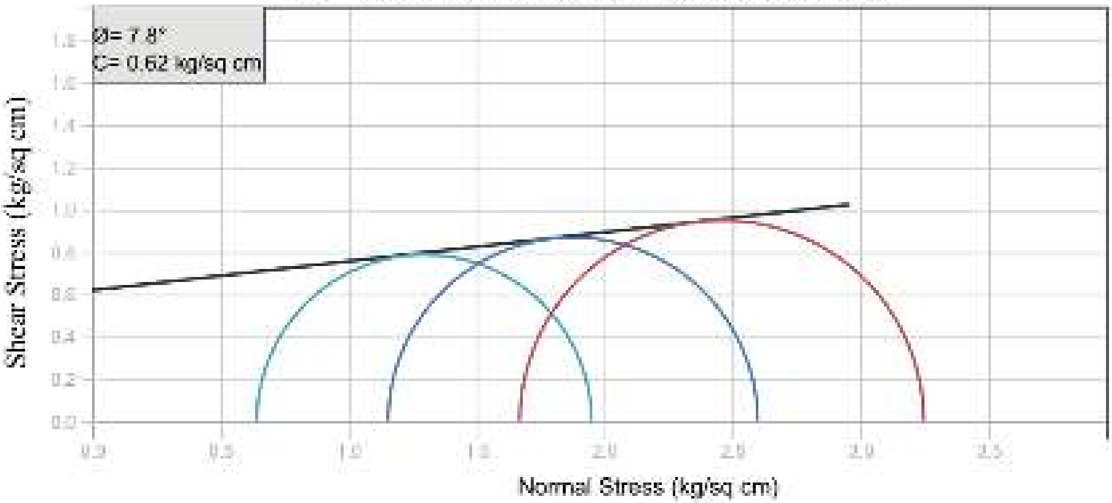


APPENDIX-G
GRAPH 9: UU GRAPH



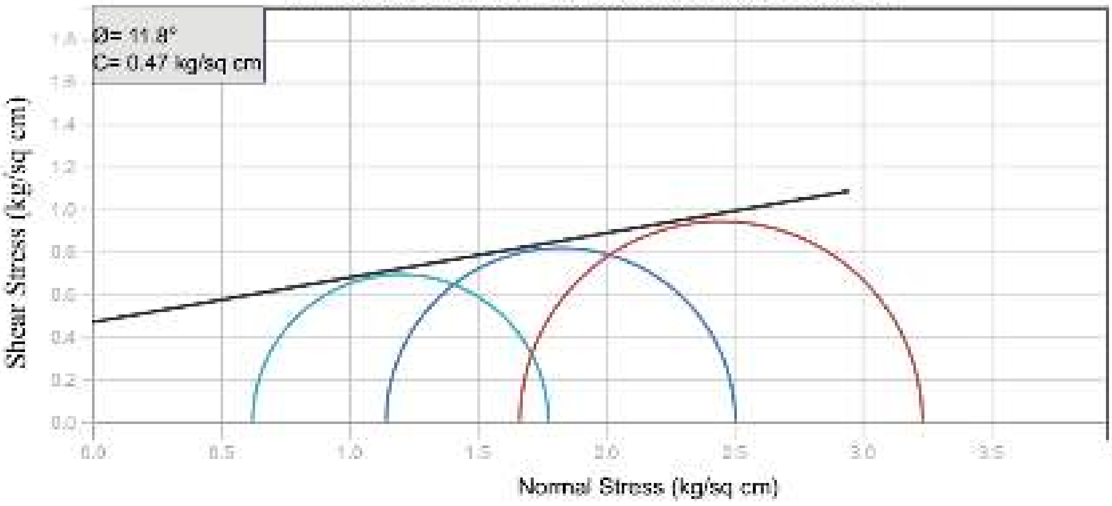
APPENDIX-G
GRAPH 10: UU GRAPH

1901-HRIDC-IV-22697.487
BH-NO.P68, DEPTH-23.00M, TRIAXIAL GRAPH

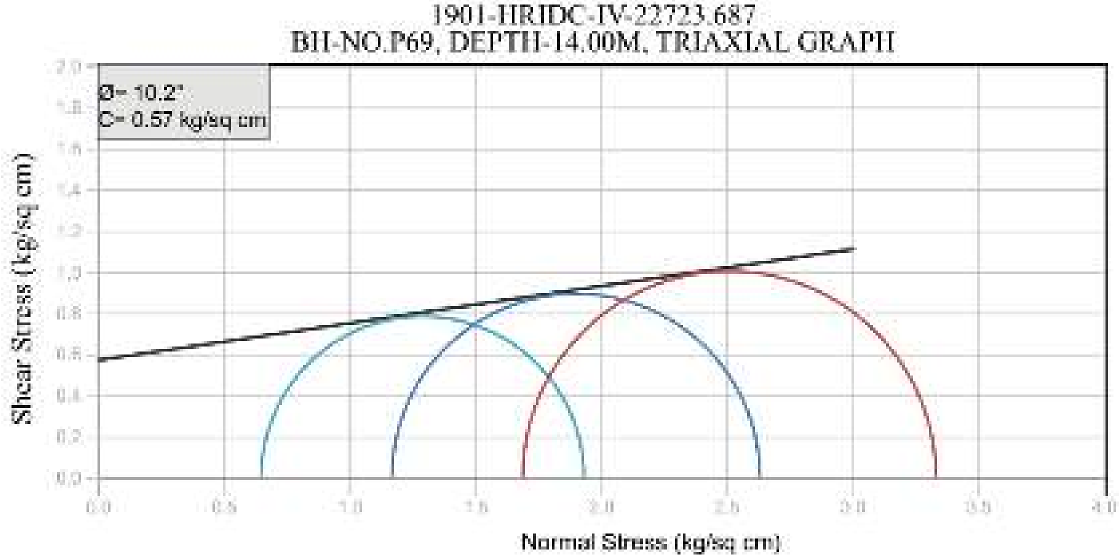


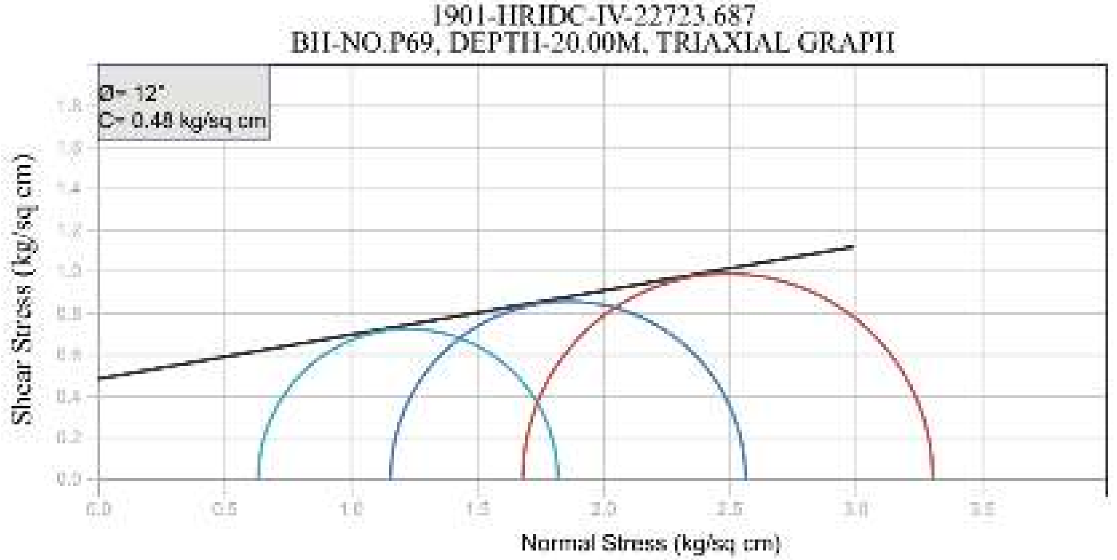
1901-HRIDC-IV-22697.487
BH-NO.P68, DEPTH-26.00M, TRIAXIAL GRAPH

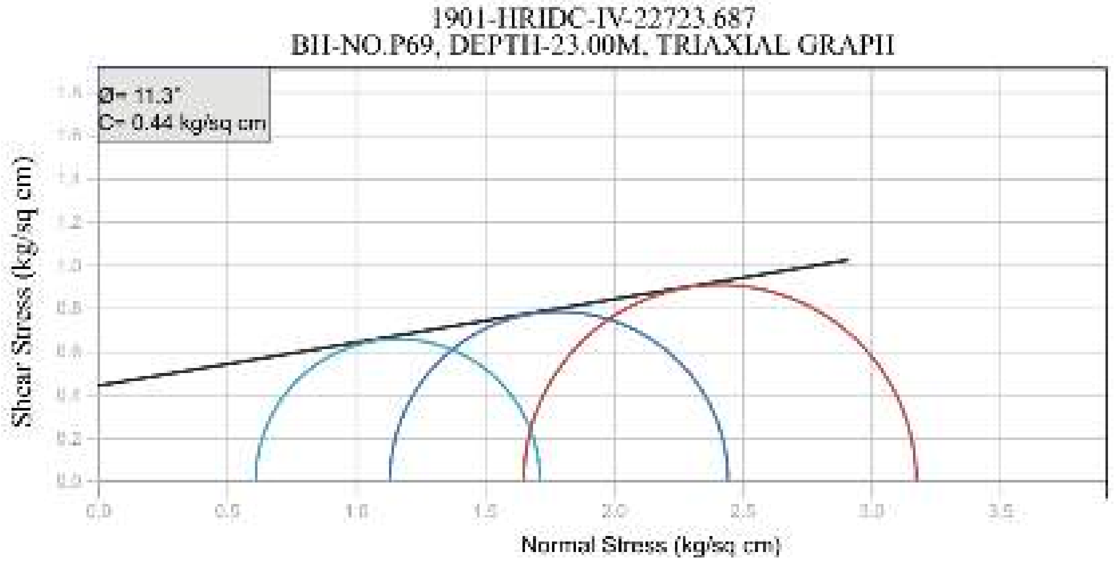
1901-HRIDC-IV-22723.687
BH-NO.P69, DEPTH-11.00M, TRIAXIAL GRAPH



APPENDIX-G
GRAPH 11: UU GRAPH

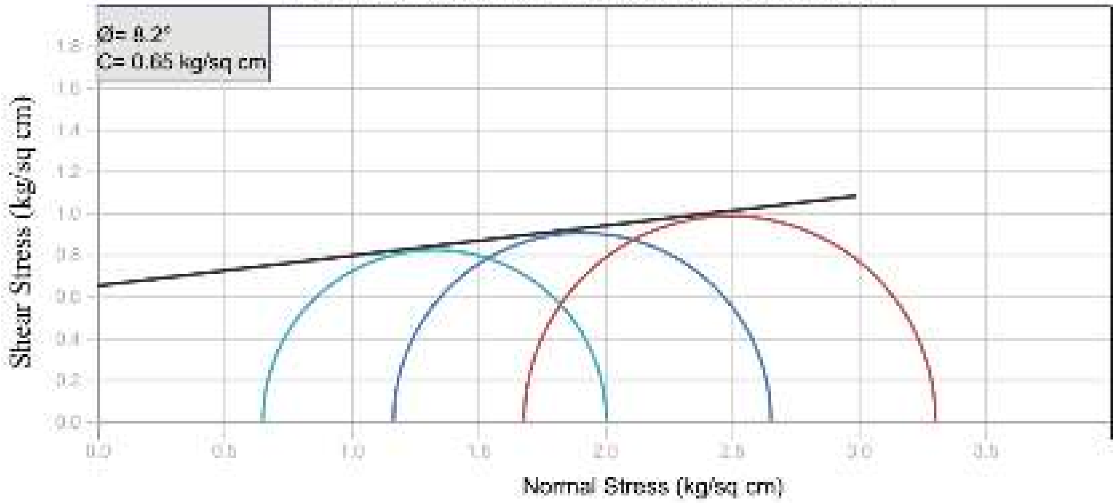




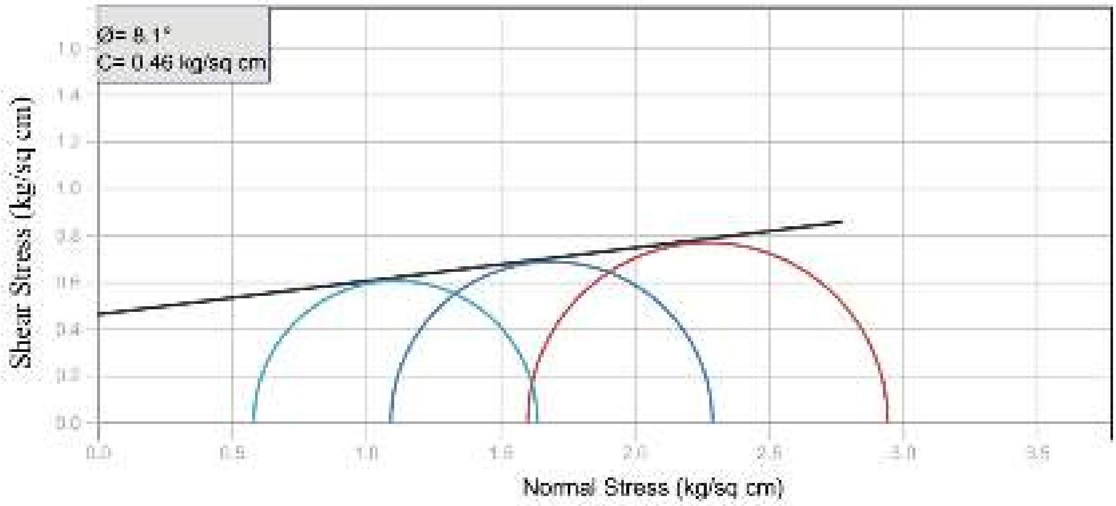


APPENDIX-G
GRAPH 12: UU GRAPH

1901-HRIDC-IV-22723.687
BH-NO.P69, DEPTH-26.00M, TRIAXIAL GRAPH



1901-HRIDC-IV-22749.887
BH-NO.P70, DEPTH-13.00M, TRIAXIAL GRAPH

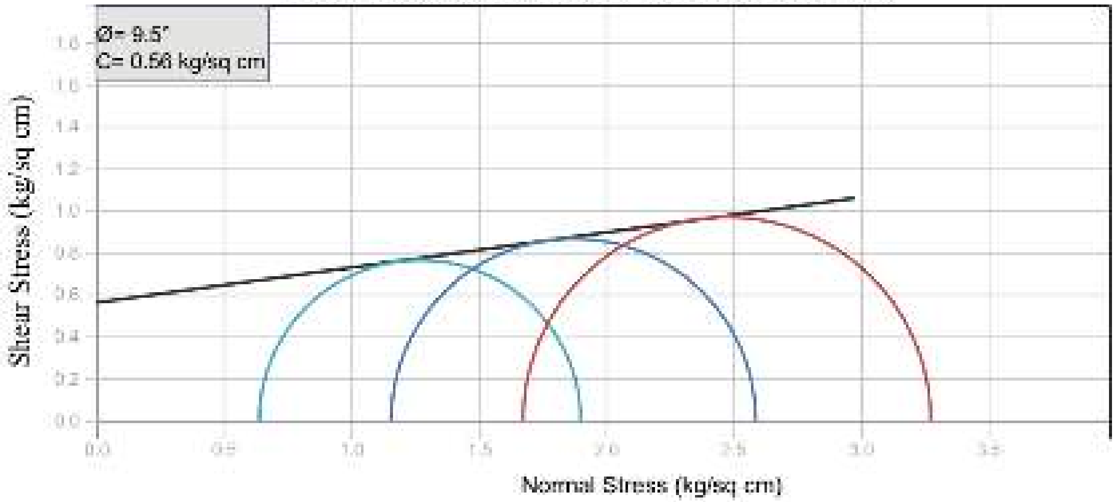


1901-HRIDC-IV-22749.887
BH-NO.P70, DEPTH-16.00M, TRIAXIAL GRAPH

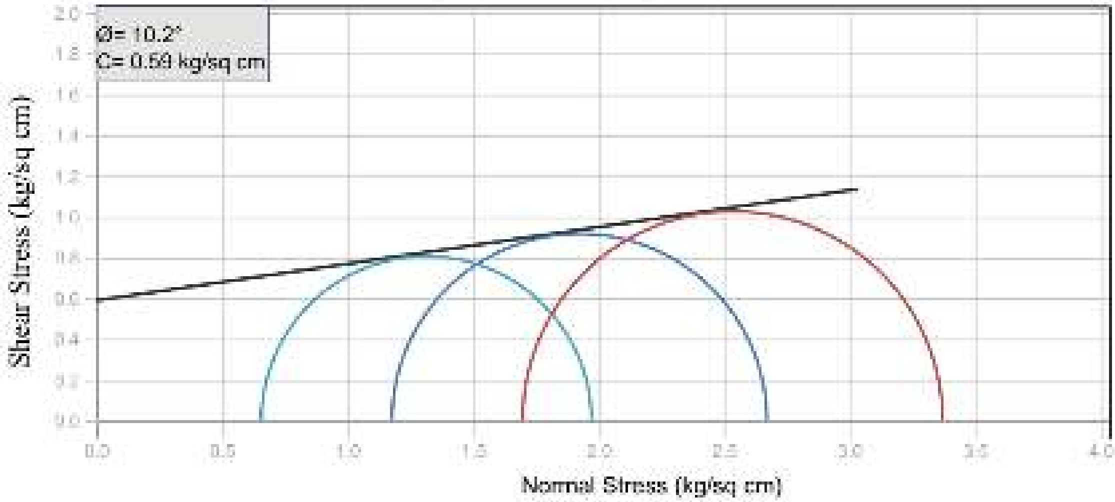
APPENDIX-G

GRAPH 13: UU GRAPH

1901-HRIDC-IV-22749.887
BH-NO.P70, DEPTH-22.00M, TRIAXIAL GRAPH



1901-HRIDC-IV-22749.887
BH-NO.P70, DEPTH-25.00M, TRIAXIAL GRAPH



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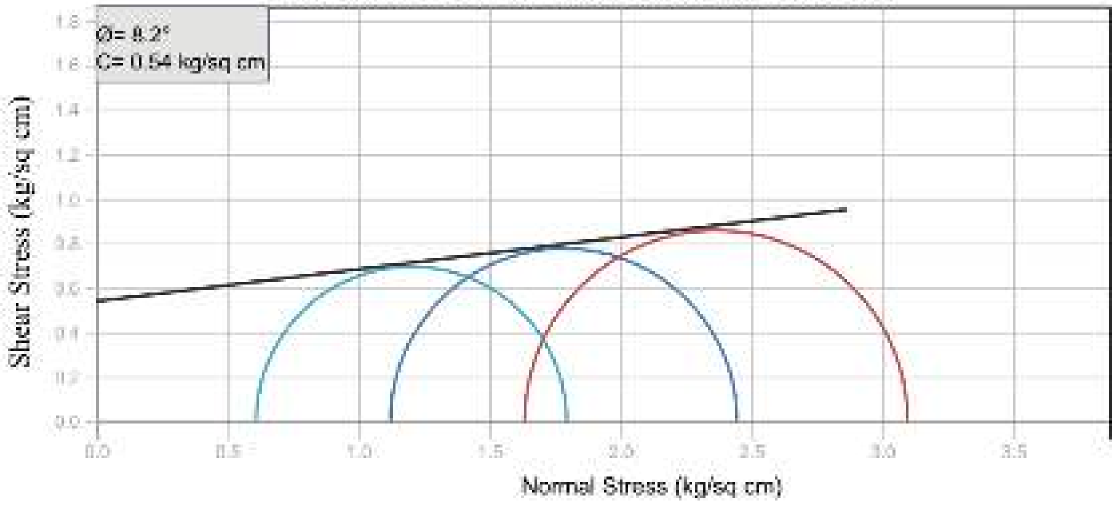
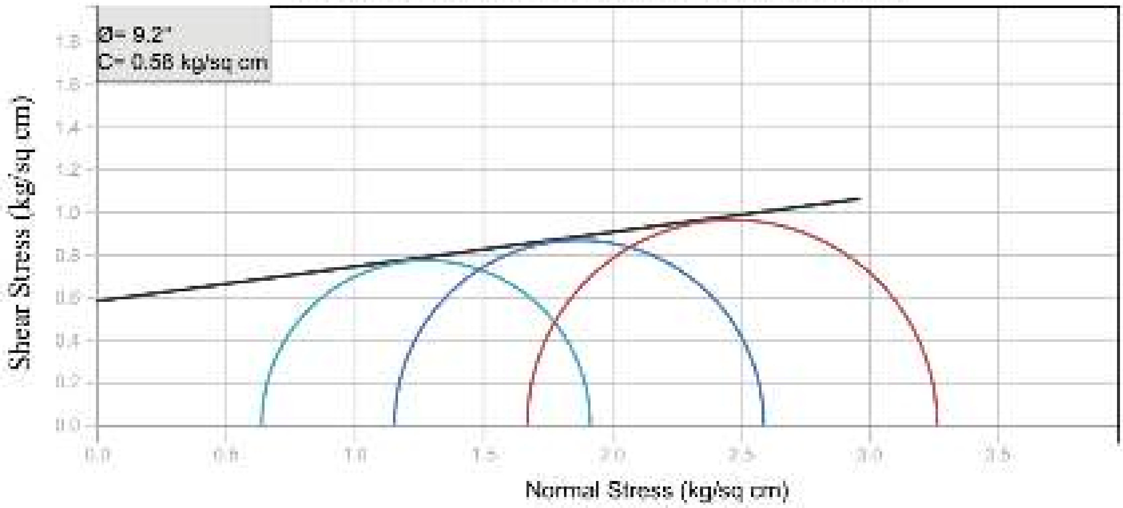
BH-NO.P70, DEPTH-28.00M, TRIAXIAL GRAPH

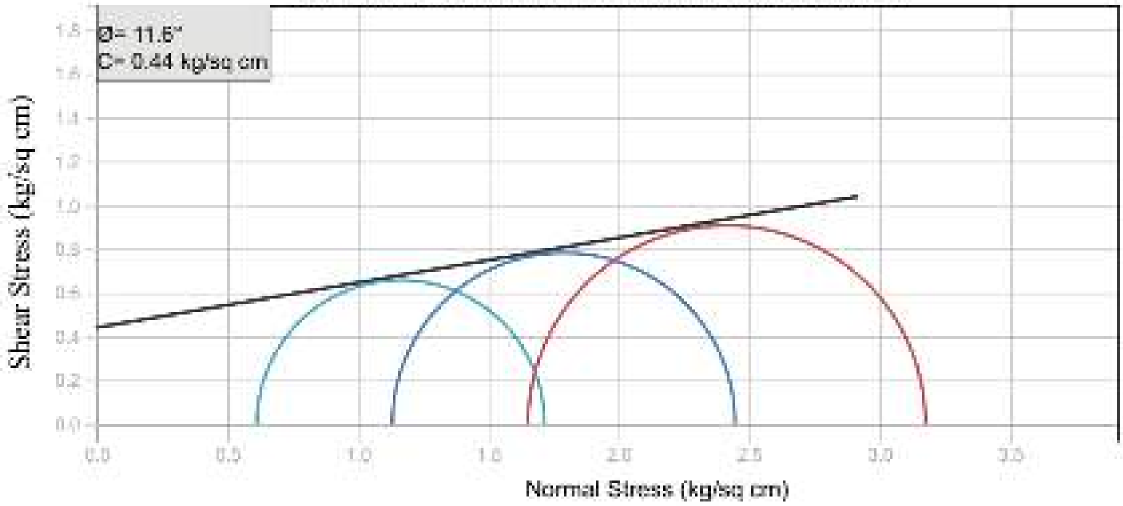


APPENDIX-G
GRAPH 14: UU GRAPH

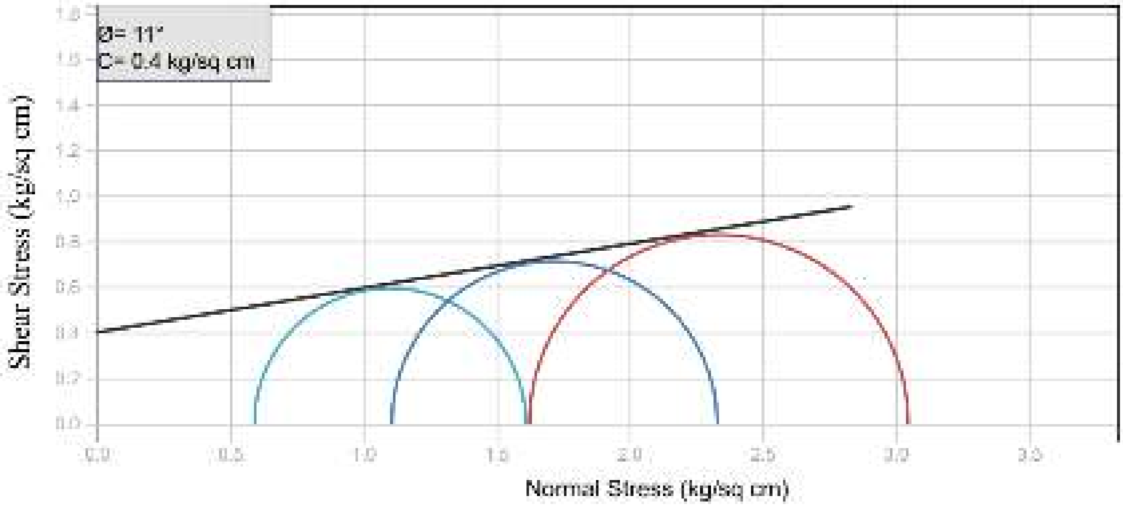
1901-HRIDC-IV-22776.087
BH-NO.P71, DEPTH-14.00M, TRIAXIAL GRAPH



1901-HRIDC-IV-22802.287
BH-NO.P72, DEPTH-11.00M, TRIAXIAL GRAPH

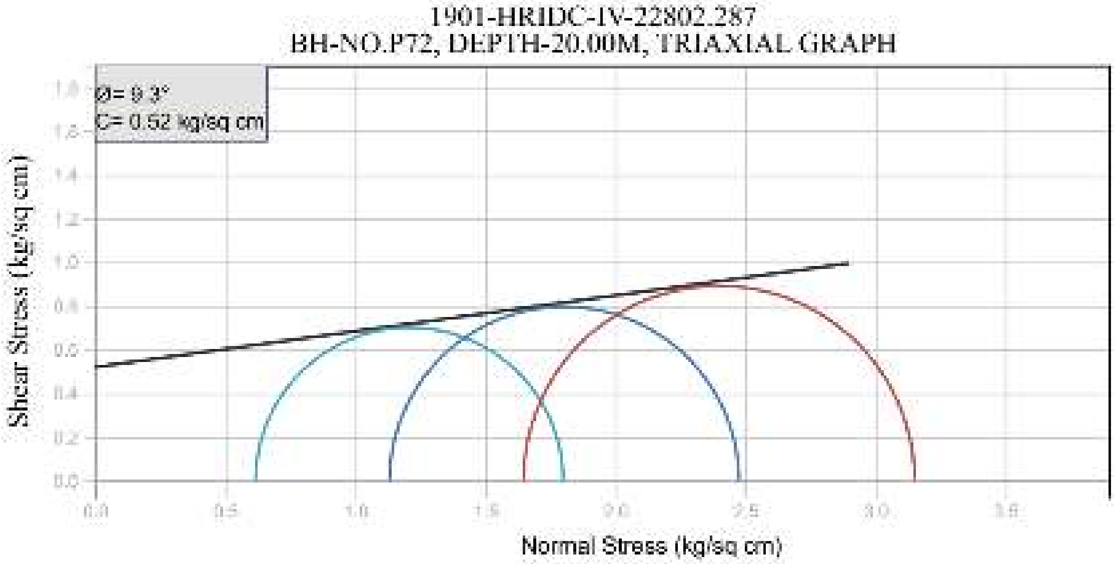


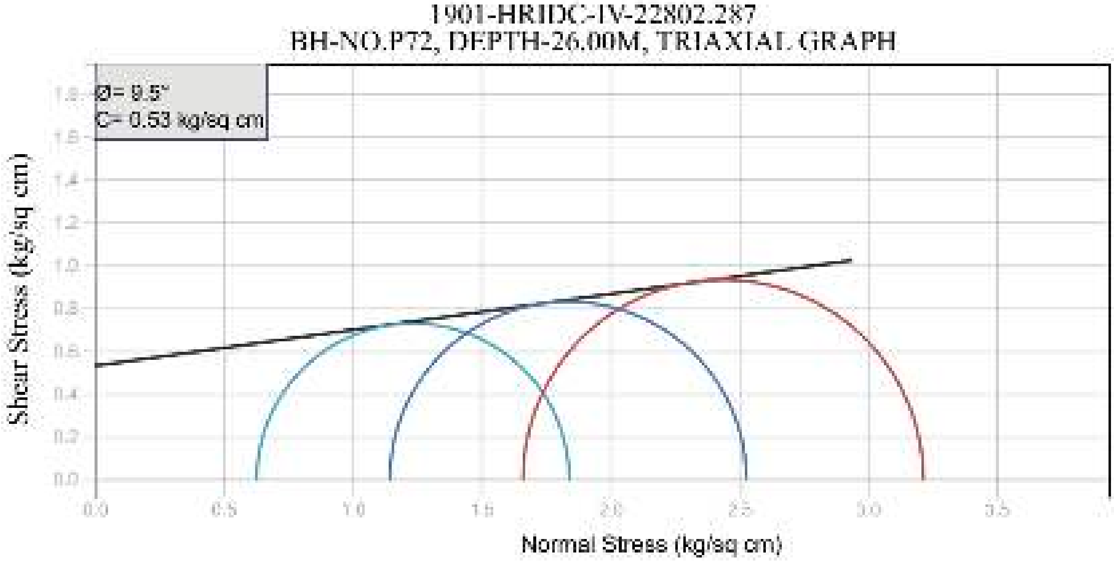
1901-HRIDC-IV-22802.287
BH-NO.P72, DEPTH-14.00M, TRIAXIAL GRAPH



APPENDIX-G

GRAPH 15: UU GRAPH

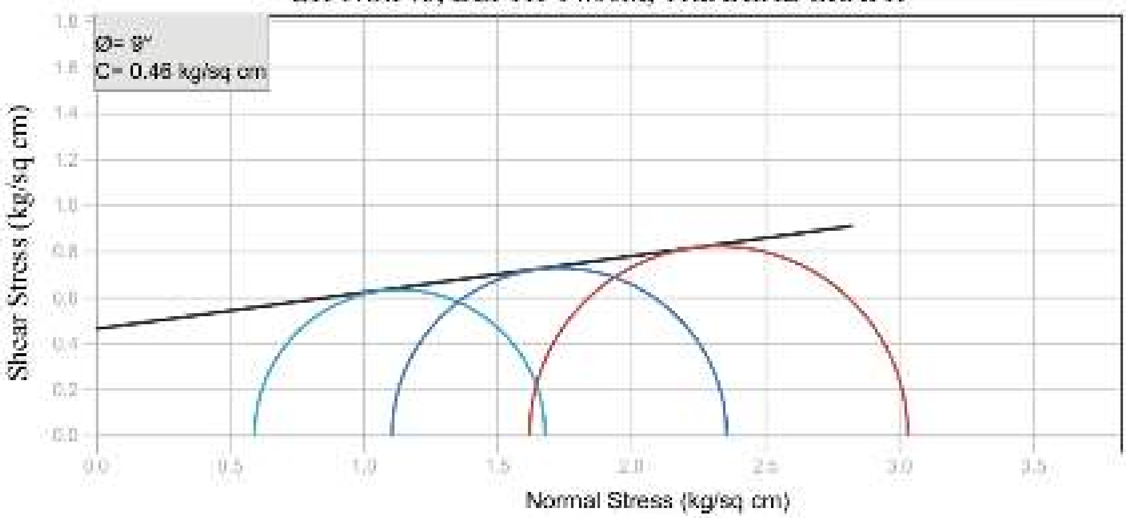




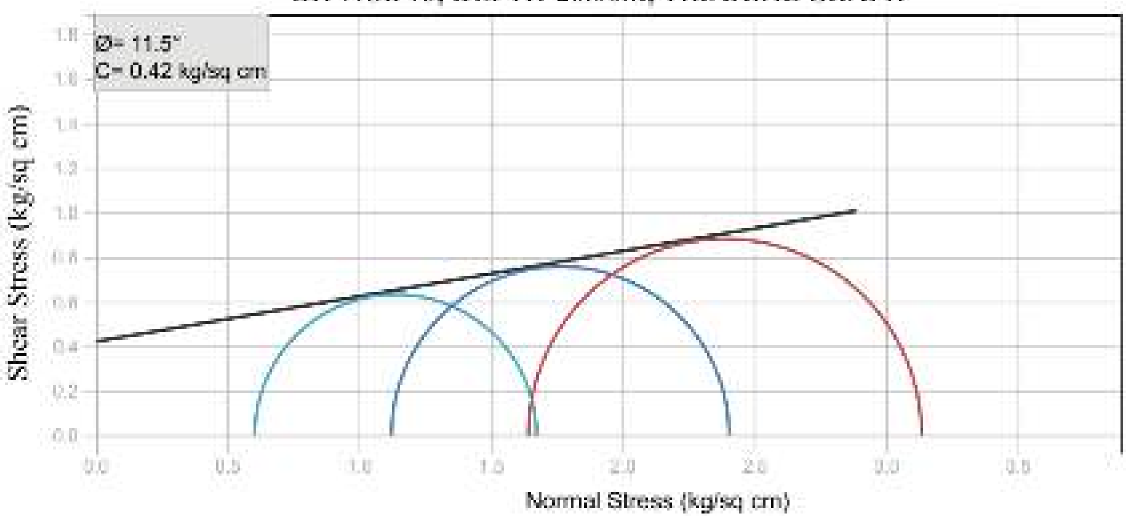
APPENDIX-G
GRAPH 16: UU GRAPH

1901-HRIDC-IV-22828.487
BH-NO.P73, DEPTH-11.00M, TRIAXIAL GRAPH

1901-HRIDC-IV-22828.487
BH-NO.P73, DEPTH-14.00M, TRIAXIAL GRAPH



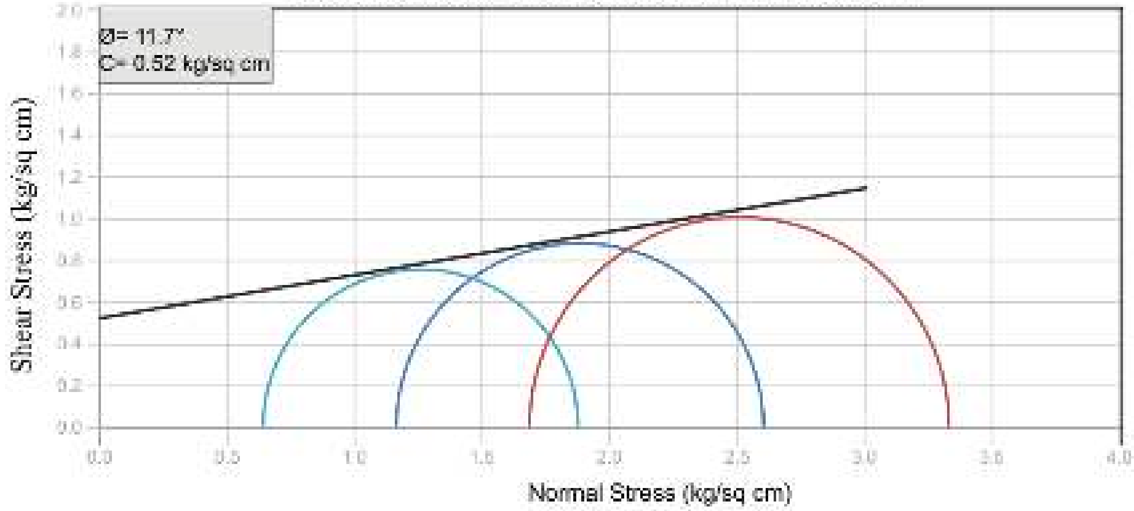
1901-HRIDC-IV-22828.487
BH-NO.P73, DEPTH-20.00M, TRIAXIAL GRAPH



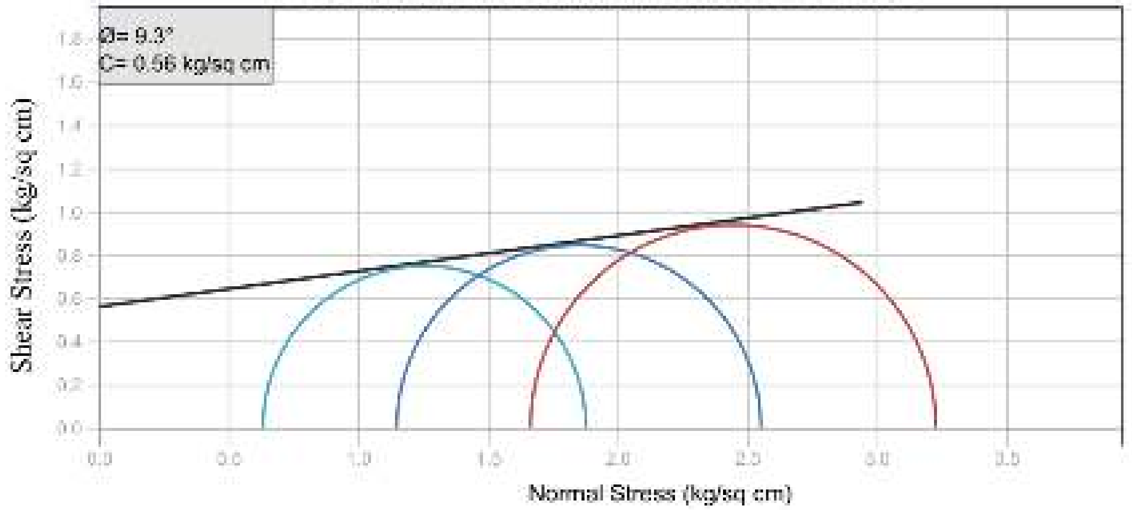
APPENDIX-G

GRAPH 17: UU GRAPH

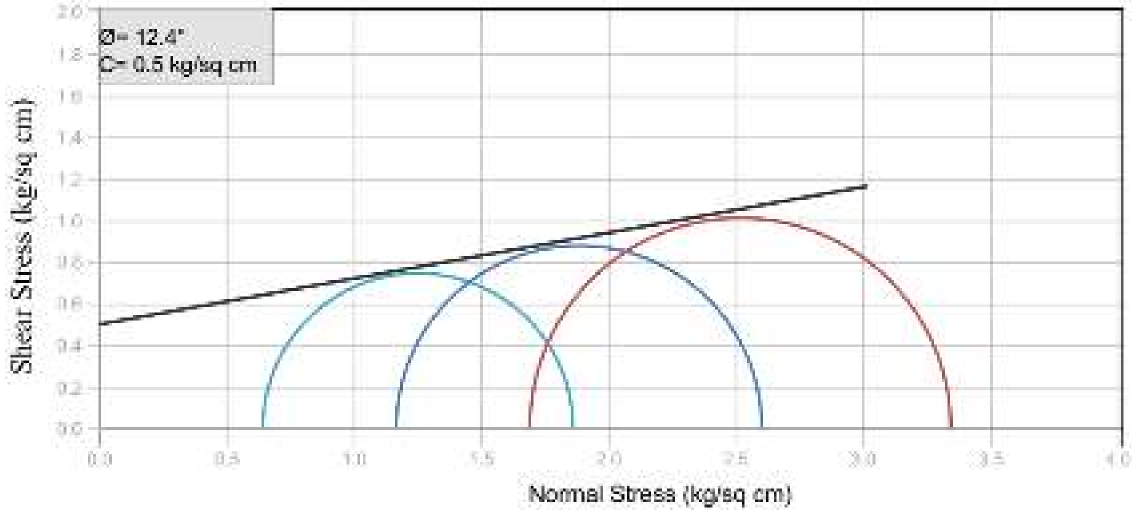
1901-HRIDC-IV-22854.687
BH-NO.P74, DEPTH-17.00M, TRIAXIAL GRAPH



1901-HRIDC-IV-22880.887
BH-NO.P75, DEPTH-23.00M, TRIAXIAL GRAPH



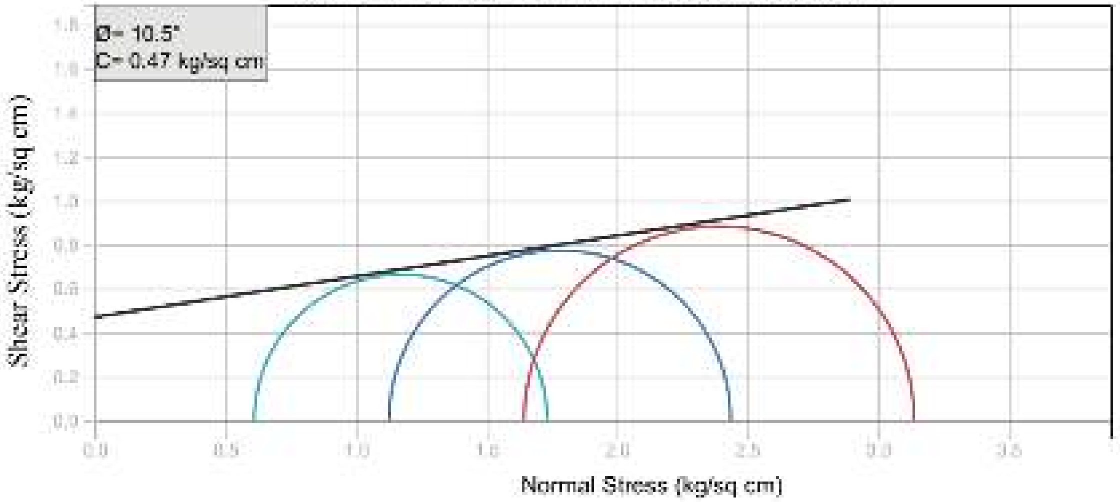
1901-HRIDC-IV-22907.087
BH-NO.P76, DEPTH-4.00M, TRIAXIAL GRAPH



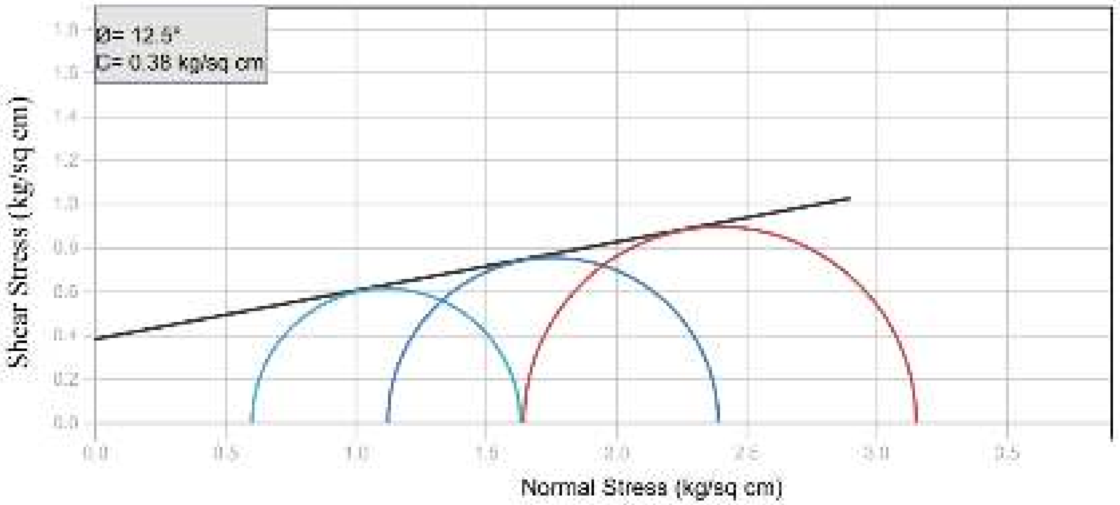
APPENDIX-G

GRAPH 18: APPENDIX-G

1901-HRIDC-IV-22907.087
BH-NO.P76, DEPTH-7.00M, TRIAXIAL GRAPH



1901-HRIDC-IV-22907.087
BH-NO.P76, DEPTH-16.00M, TRIAXIAL GRAPH

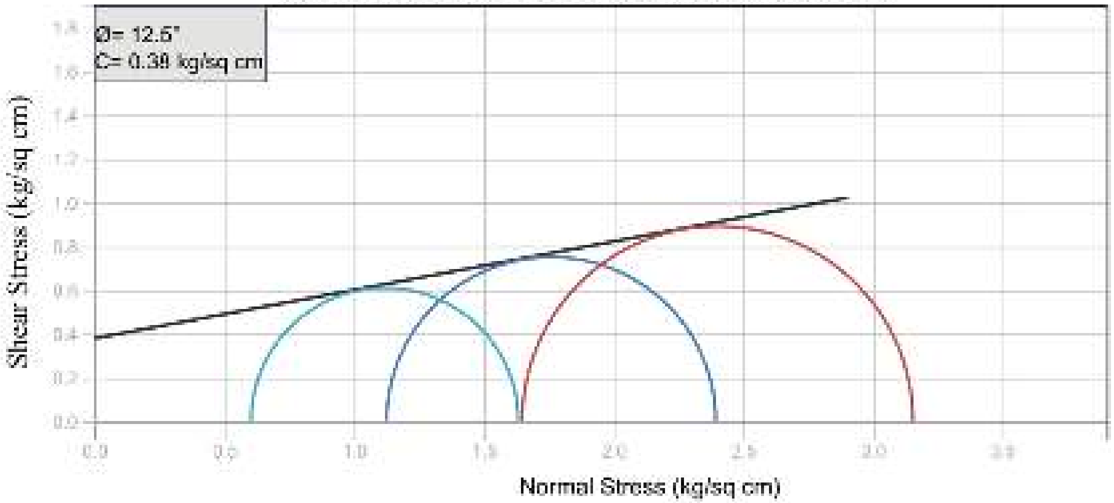


1901-HRIDC-IV-22907.087
BH-NO.P76, DEPTH-28.00M, TRIAXIAL GRAPH

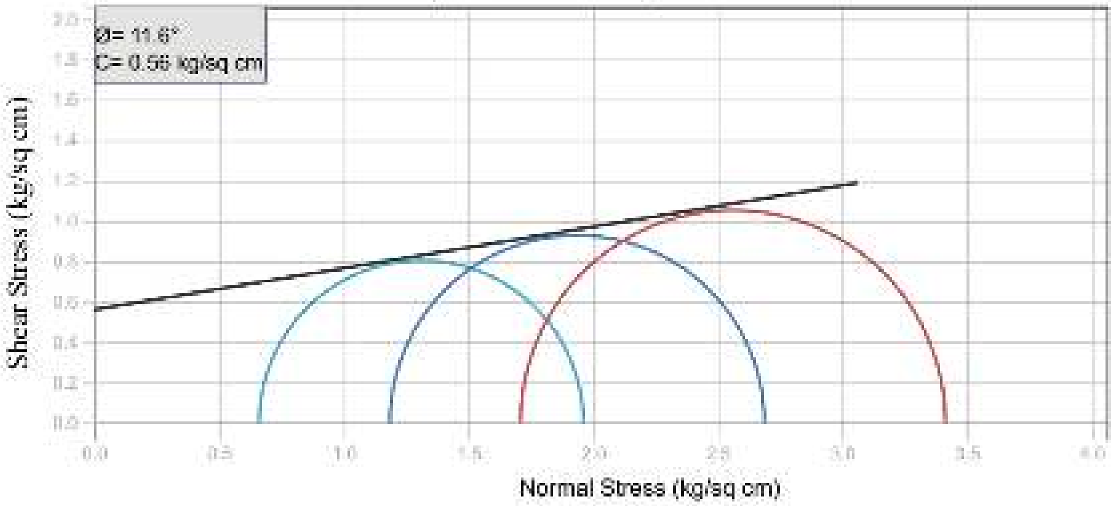
APPENDIX-G

GRAPH 19: APPENDIX-G

1901-HRIDC-IV-22933.287
BH-NO.P77, DEPTH-10.00M, TRIAXIAL GRAPH



1901-HRIDC-IV-22933.287
BH-NO.P77, DEPTH-19.00M, TRIAXIAL GRAPH

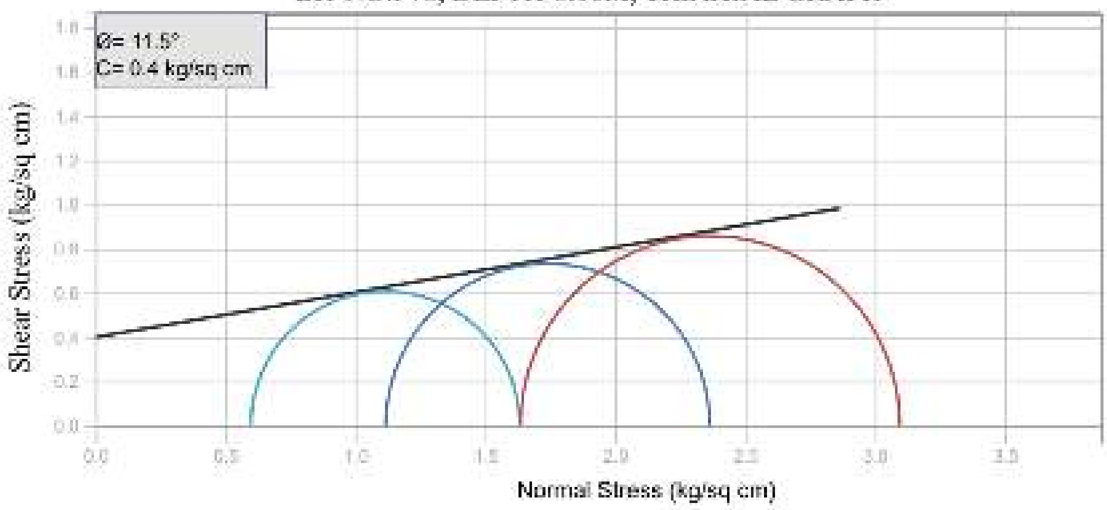


1901-HRIDC-IV-22933.287
BH-NO.P77, DEPTH-22.00M, TRIAXIAL GRAPH

APPENDIX-G
GRAPH 20: UU GRAPH

1901-HRIDC-IV-22933.287
BH-NO.P77, DEPTH-28.00M, TRIAXIAL GRAPH

1901-HRIDC-IV-22954.487
BH-NO.P78, DEPTH-8.00M, TRIAXIAL GRAPH



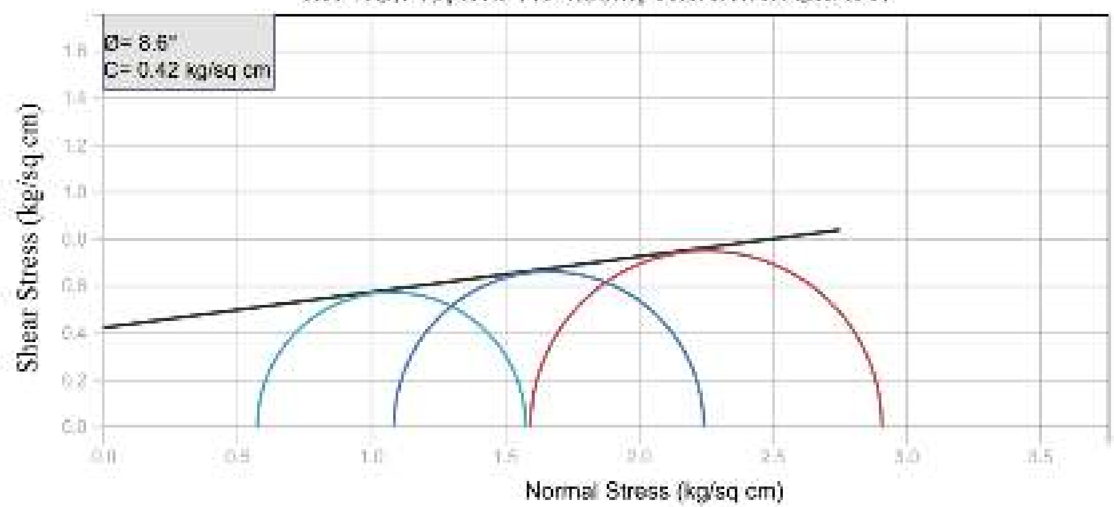
1901-HRIDC-IV-22954.487
BH-NO.P78, DEPTH-11.00M, TRIAXIAL GRAPH

APPENDIX-G

GRAPH 21: UU GRAPH

1901-HRIDC-IV-22954.487
BH-NO.P78, DEPTH-20.00M, TRIAXIAL GRAPH

1901-HRIDC-IV-22985.687
BH-NO.P79, DEPTH-4.00M, TRIAXIAL GRAPH

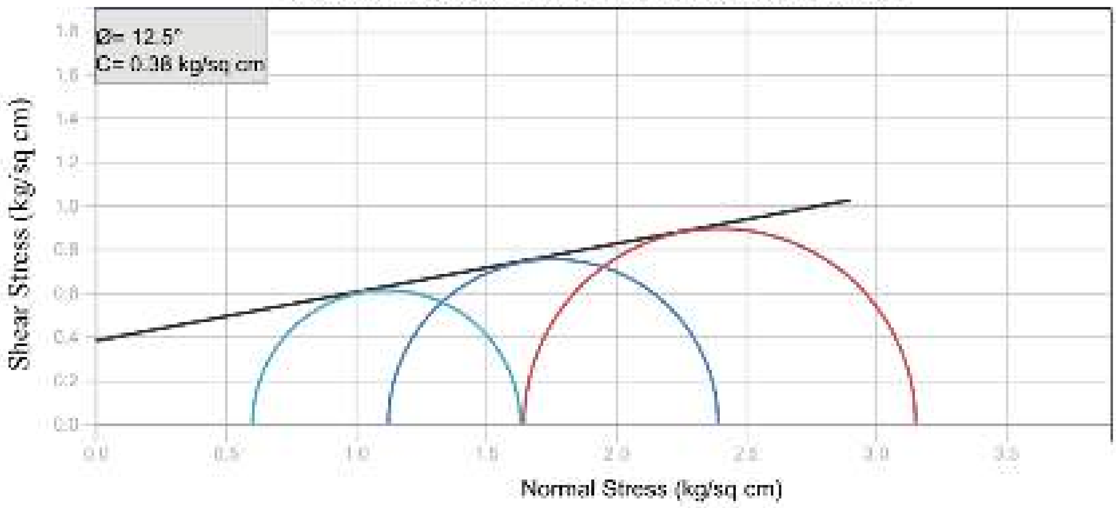


1901-HRIDC-IV-22985.687
BH-NO.P79, DEPTH-7.00M, TRIAXIAL GRAPH

APPENDIX-G

GRAPH 22: UU GRAPH

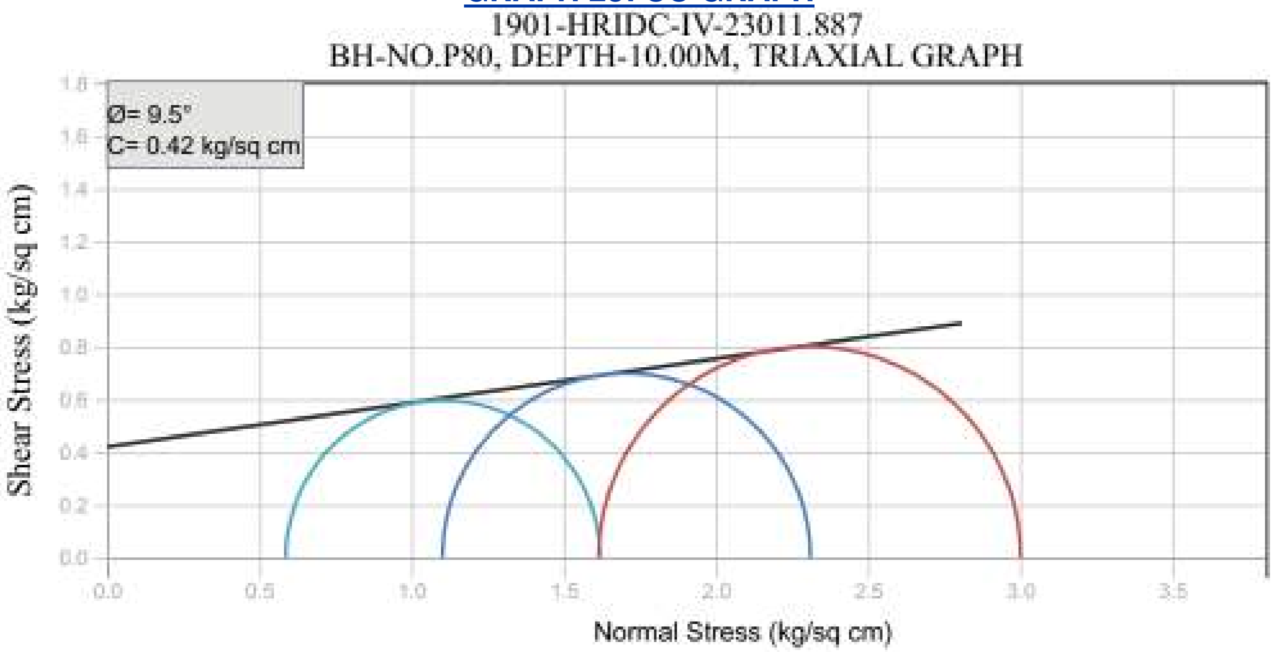
1901-HRIDC-IV-22985.687
BH-NO.P79, DEPTH-13.00M, TRIAXIAL GRAPH

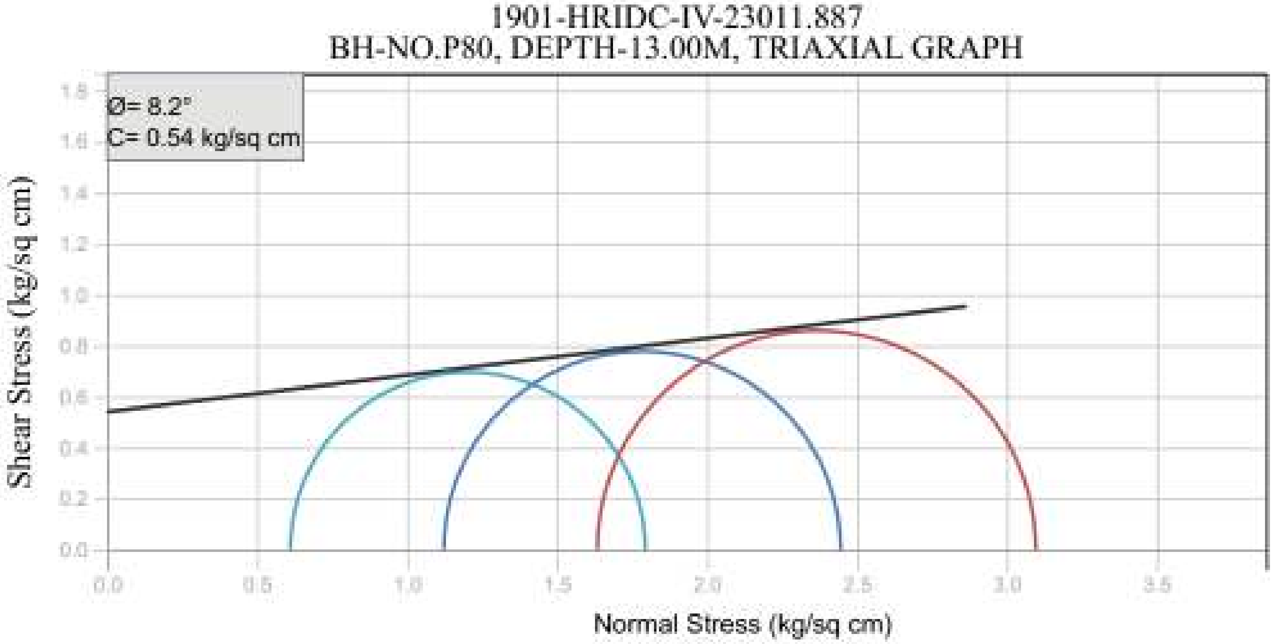


1901-HRIDC-IV-22985.687
BH-NO.P79, DEPTH-22.00M, TRIAXIAL GRAPH

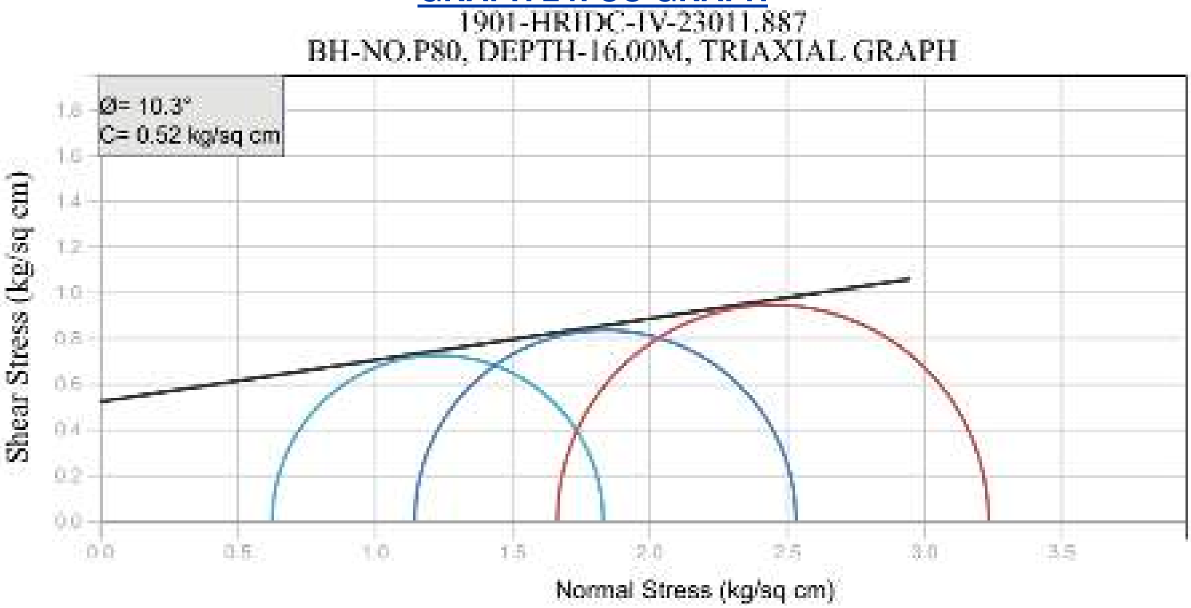
1901-HRIDC-IV-22985.687
BH-NO.P79, DEPTH-25.00M, TRIAXIAL GRAPH

APPENDIX-G
GRAPH 23: UU GRAPH



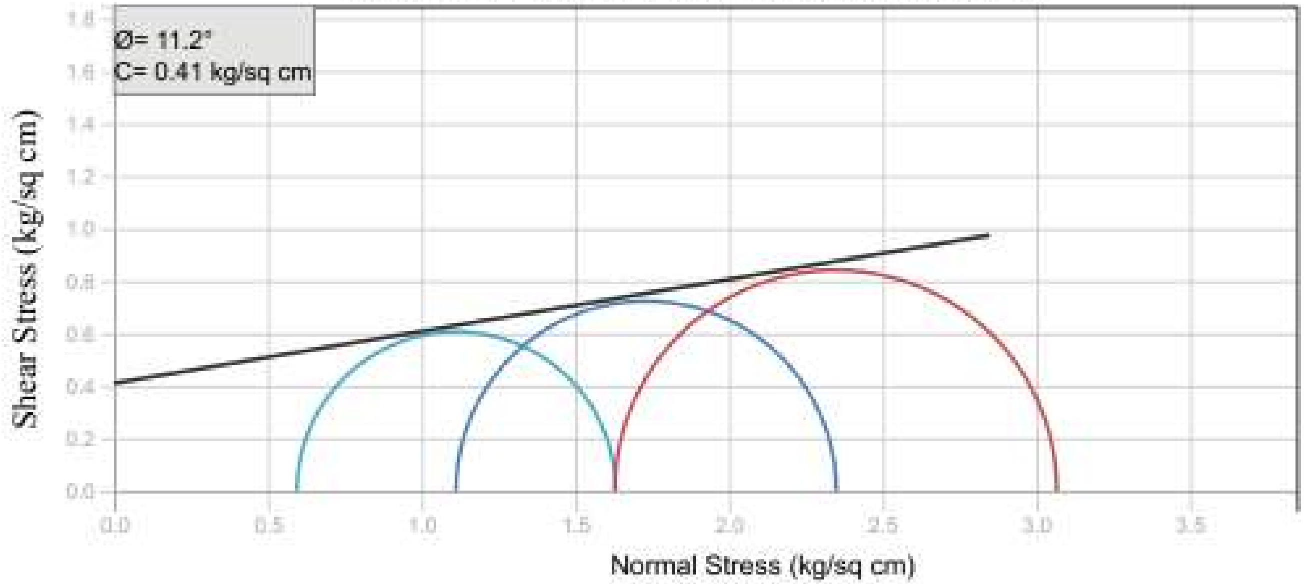


APPENDIX-G
GRAPH 24: UU GRAPH

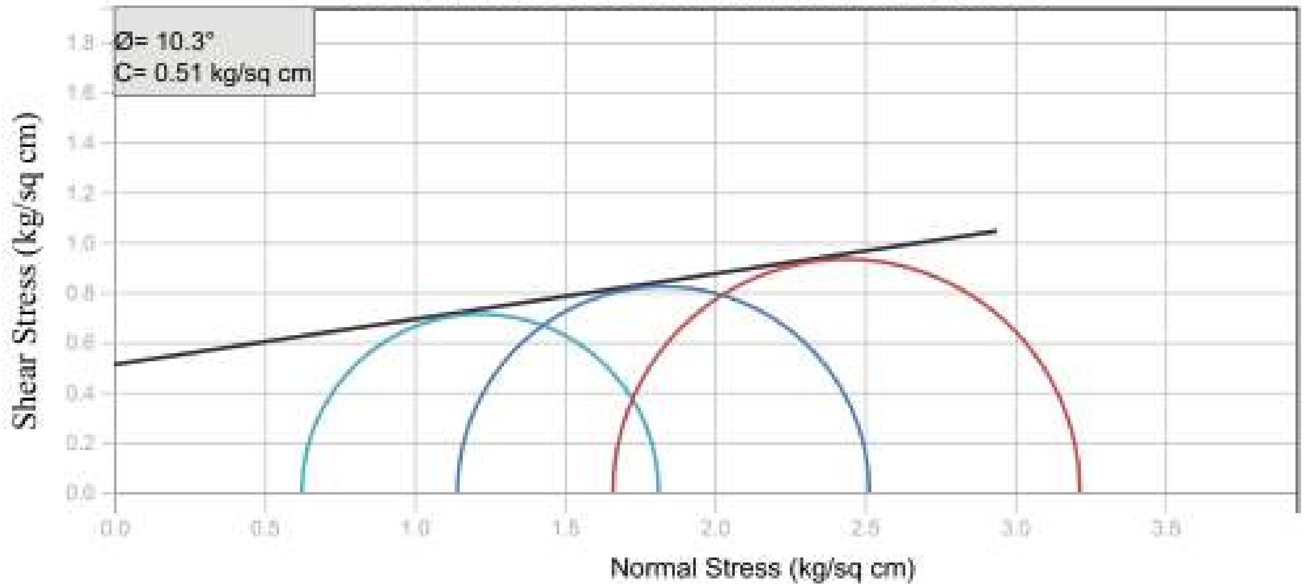


APPENDIX-G
GRAPH 25: RUU GRAPH

1901-HRIDC-IV-22776.087
BH-NO.P71, DEPTH-2.00M, TRIAXIAL GRAPH

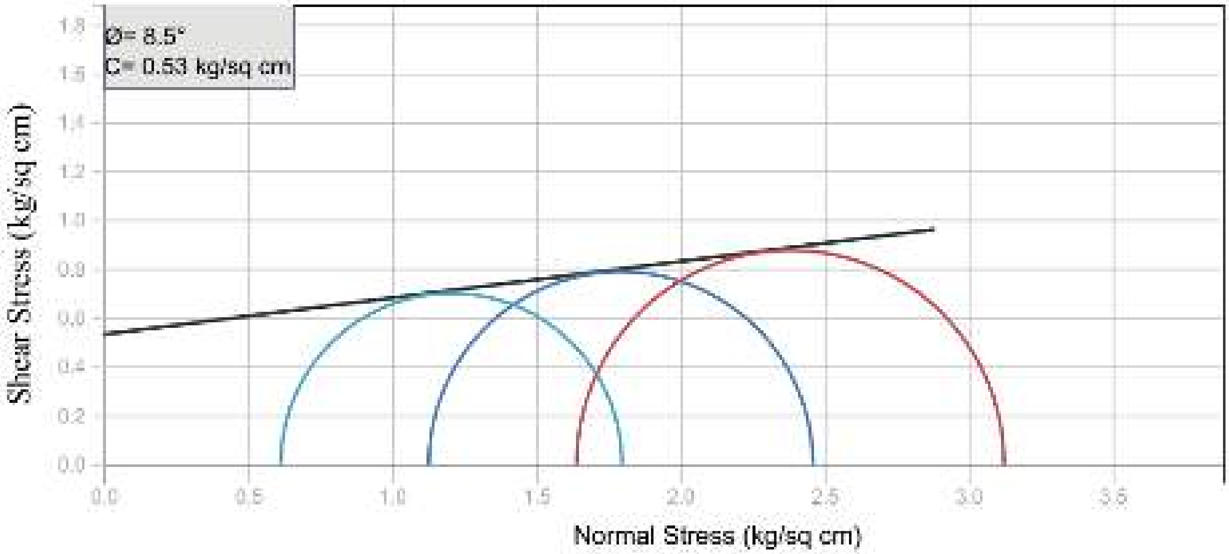


1901-HRIDC-IV-22776.087
BH-NO.P71, DEPTH-20.00M, TRIAXIAL GRAPH

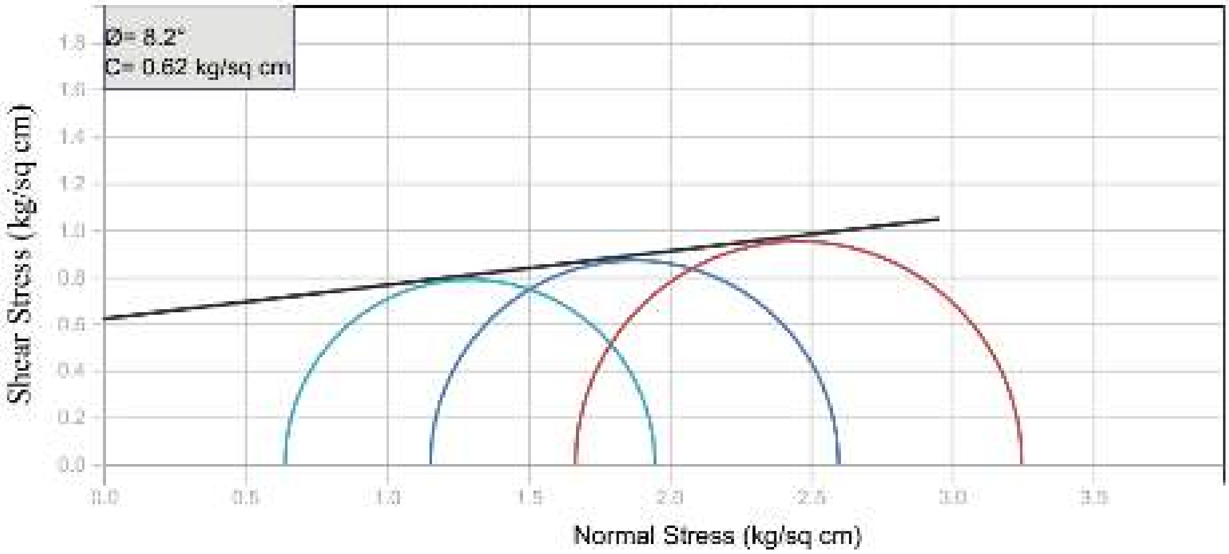


APPENDIX-G
GRAPH 26: RUU GRAPH

1901-HRIDC-IV-22828.487
BH-NO.P73, DEPTH-35.00M, TRIAXIAL GRAPH



1901-HRIDC-IV-22880.887
BH-NO.P75, DEPTH-14.00M, TRIAXIAL GRAPH



APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: P61, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	21.20	11.20	30.80	1.57	6.4	6.4	1.0	5.43	0	66	1.0	103.7	0	3.0	9.4	54	11.20	2.36	1.13	33.6	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.50	21.20	11.20	44.80	6.29	9.4	9.4	1.0	46.62	0	54	1.0	339.4	0	5.0	26.9	3	11.20	14.28	15.26	56.0	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	21.20	11.20	61.60	3.14	26.9	26.9	1.0	98.22	0	3	1.0	9.4	0	6.0	26.9	3	8.55	14.28	15.26	67.2	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	8.00	7.00	2.00	5.50	18.55	8.55	75.75	6.29	26.9	26.9	1.0	241.56	0	3	1.0	18.9	0	8.0	26.9	3	8.55	14.28	15.26	84.3	0	0.0	64.8	64.8	**0.00**	**21.60**
8.00	9.00	8.50	1.00	6.50	18.55	8.55	88.58	3.14	26.9	26.9	1.0	141.23	0	3	1.0	9.4	0	9.0	24.7	13	8.55	9.78	10.55	92.9	841.15	841.1	76.6	76.6	**336.46**	**25.53**
9.00	10.00	9.50	1.00	7.50	18.55	8.55	97.13	3.14	24.7	24.7	1.0	140.40	140.40	13	1.0	40.9	40.86	10.0	24.7	13	10.06	9.78	10.55	101.4	913.13	1094.4	88.4	269.6	**437.76**	**89.87**
10.00	11.00	10.50	1.00	8.50	20.06	10.06	106.43	3.14	24.7	24.7	1.0	153.85	294.25	13	1.0	40.9	81.71	11.0	24.7	10	10.06	9.78	10.55	111.5	969.25	1345.2	100.1	476.1	**538.09**	**158.70**
11.00	12.00	11.50	1.00	9.50	20.06	10.06	116.49	3.14	24.7	24.7	1.0	168.39	462.64	10	1.0	31.4	113.14	12.0	24.7	10	10.06	9.78	10.55	121.5	1046.59	1622.4	111.9	687.7	**648.95**	**229.23**
12.00	13.00	12.50	1.00	10.50	20.06	10.06	126.55	3.14	24.7	24.7	1.0	182.93	645.58	10	1.0	31.4	144.57	13.0	10.5	42	10.44	2.62	1.36	131.6	573.15	1363.3	123.7	913.8	**545.32**	**304.62**
13.00	14.50	13.75	1.50	12.00	20.44	10.44	139.41	4.71	10.5	10.5	1.0	121.81	767.38	42	1.0	198.0	342.57	14.5	11.2	52	11.03	2.82	1.56	147.2	701.05	1811.0	141.4	1251.3	**724.40**	**417.11**
14.50	17.50	16.00	3.00	15.00	21.03	11.03	139.41	9.43	11.2	11.2	1.0	260.27	1027.65	52	1.0	490.3	832.86	17.5	9.0	50	11.03	2.29	1.07	147.2	623.12	2483.6	176.7	2037.2	**993.45**	**679.07**
17.50	19.00	18.25	1.50	16.50	21.03	11.03	139.41	4.71	9.0	9.0	1.0	104.09	1131.74	50	1.0	235.7	1068.57	19.0	8.1	43	11.14	2.13	0.93	147.2	554.32	2754.6	194.4	2394.7	**1101.85**	**798.23**
19.00	20.50	19.75	1.50	18.00	21.14	11.14	139.41	4.71	8.1	8.1	1.0	93.54	1225.28	43	1.0	202.7	1271.29	20.5	8.1	43	11.14	2.13	0.93	147.2	554.32	3050.9	212.1	2708.6	**1220.35**	**902.87**
20.50	22.00	21.25	1.50	19.50	21.14	11.14	139.41	4.71	8.1	8.1	1.0	93.54	1318.82	43	1.0	202.7	1474.00	22.0	23.7	18	10.70	9.06	9.45	147.2	1215.62	4008.4	229.7	3022.5	**1603.37**	**1007.51**
22.00	23.50	22.75	1.50	21.00	20.70	10.70	139.41	4.71	23.7	23.7	1.0	288.50	1607.31	18	1.0	84.9	1558.86	23.5	23.7	18	10.70	9.06	9.45	147.2	1215.62	4381.8	247.4	3413.6	**1752.72**	**1137.86**
23.50	25.00	24.25	1.50	22.50	20.70	10.70	139.41	4.71	23.7	23.7	1.0	288.50	1895.81	18	1.0	84.9	1643.71	25.0	5.5	42	10.16	1.66	0.53	147.2	491.15	4030.7	265.1	3804.6	**1612.27**	**1268.20**
25.00	26.50	25.75	1.50	24.00	20.16	10.16	139.41	4.71	5.5	5.5	1.0	63.28	1959.10	42	1.0	198.0	1841.71	26.5	5.5	42	10.16	1.66	0.53	147.2	491.15	4292.0	282.7	4083.6	**1716.78**	**1361.18**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
26.50	27.50	27.00	1.00	25.00	20.16	10.16	139.41	3.14	5.5	5.5	1.0	42.19	2001.28	42	1.0	132.0	1973.71	27.5	5.5	42	10.16	1.66	0.53	147.2	491.15	4466.1	294.5	4269.5	**1786.46**	**1423.17**
27.50	28.00	27.75	0.50	25.50	20.16	10.16	139.41	1.57	5.5	5.5	1.0	21.09	2022.38	42	1.0	66.0	2039.71	28.0	8.5	72	11.03	2.20	0.99	147.2	767.94	4830.0	300.4	4362.5	**1932.01**	**1454.17**
28.00	29.50	28.75	1.50	27.00	21.03	11.03	139.41	4.71	8.5	8.5	1.0	98.22	2120.60	72	1.0	339.4	2379.14	29.5	23.0	10	11.03	8.56	8.68	147.2	1098.64	5598.4	318.1	4817.8	**2239.35**	**1605.94**
29.50	30.00	29.75	0.50	27.50	21.03	11.03	139.41	1.57	23.0	23.0	1.0	92.99	2213.59	10	1.0	15.7	2394.86	30.0	23.0	10	11.03	8.56	8.68	147.2	1098.64	5707.1	324.0	4932.4	**2282.83**	**1644.14**
30.00	31.00	30.50	1.00	28.50	21.03	11.03	139.41	3.14	23.0	23.0	1.0	185.98	2399.57	10	1.0	31.4	2426.29	31.0	12.8	49	11.03	3.29	2.02	147.2	736.06	5561.9	335.8	5161.6	**2224.77**	**1720.54**
31.00	32.50	31.75	1.50	30.00	21.03	11.03	139.41	4.71	12.8	12.8	1.0	149.32	2548.89	49	1.0	231.0	2657.29	32.5	13.5	49	8.70	3.50	2.22	147.2	759.00	5965.2	353.4	5559.6	**2386.07**	**1853.20**
32.50	34.00	33.25	1.50	31.50	18.70	8.70	139.41	4.71	13.5	13.5	1.0	157.78	2706.67	49	1.0	231.0	2888.29	34.0	13.5	49	8.84	3.50	2.22	147.2	759.12	6354.1	371.1	5966.1	**2541.63**	**1988.69**
34.00	35.00	34.50	1.00	32.50	18.84	8.84	139.41	3.14	13.5	13.5	1.0	105.19	2811.86	49	1.0	154.0	3042.29	35.0	13.5	49	8.84	3.50	2.22	147.2	759.12	6613.3	382.9	6237.0	**2645.31**	**2079.01**
35.00	35.50	35.25	0.50	33.00	18.84	8.84	139.41	1.57	13.5	13.5	1.0	52.59	2864.46	49	1.0	77.0	3119.29	35.5	13.5	49	9.35	3.50	2.22	147.2	759.57	6743.3	388.8	6372.5	**2697.33**	**2124.17**
35.50	37.00	36.25	1.50	34.50	19.35	9.35	139.41	4.71	13.5	13.5	1.0	157.78	3022.24	49	1.0	231.0	3350.29	37.0	9.3	60	9.02	2.34	1.11	147.2	699.40	7071.9	406.4	6779.0	**2828.77**	**2259.66**
37.00	37.50	37.25	0.50	35.00	19.02	9.02	139.41	1.57	9.3	9.3	1.0	35.87	3058.12	60	1.0	94.3	3444.57	37.5	8.0	60	9.02	2.11	0.91	147.2	671.62	7174.3	412.3	6915.0	**2869.72**	**2305.01**
37.50	38.50	38.00	1.00	36.00	19.02	9.02	139.41	3.14	8.0	8.0	1.0	61.58	3119.69	60	1.0	188.6	3633.14	38.5	8.0	60	8.60	2.11	0.91	147.2	671.47	7424.3	424.1	7177.0	**2969.72**	**2392.32**
38.50	40.00	39.25	1.50	37.50	18.60	8.60	139.41	4.71	8.0	8.0	1.0	92.37	3212.06	60	1.0	282.9	3916.00	40.0	8.0	60	8.60	2.11	0.91	147.2	671.47	7799.5	441.8	7569.8	**3119.81**	**2523.28**
BORE NO: P62, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.82	9.82	27.01	1.57	7.5	7.5	1.0	5.59	5.59	46	1.0	72.3	72.29	3.0	14.3	46	9.82	3.74	2.45	29.5	421.24	499.1	5.9	83.8	**199.64**	**27.92**
3.00	4.00	3.50	1.00	1.50	19.82	9.82	34.37	3.14	14.3	14.3	1.0	27.53	33.12	46	1.0	144.6	216.86	4.0	29.9	5	9.01	21.03	22.17	39.3	763.01	1013.0	17.7	267.6	**405.19**	**89.22**
4.00	6.00	5.00	2.00	3.50	19.01	9.01	48.29	6.29	29.9	29.9	1.0	174.54	207.66	5	1.0	31.4	248.29	6.0	29.9	5	9.01	21.03	22.17	57.3	1060.83	1516.8	41.2	497.2	**606.71**	**165.73**
6.00	7.00	6.50	1.00	4.50	19.01	9.01	61.81	3.14	29.9	29.9	1.0	111.70	319.36	5	1.0	15.7	264.00	7.0	28.2	0	9.01	17.21	18.25	66.3	961.06	1544.4	53.0	636.4	**617.77**	**212.12**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
7.00	9.00	8.00	2.00	6.50	19.01	9.01	75.32	6.29	28.2	28.2	1.0	253.86	573.21	0	1.0	0.0	264.00	9.0	25.2	11	8.08	10.45	11.34	84.3	806.22	1643.4	76.6	913.8	**657.37**	**304.60**
9.00	10.00	9.50	1.00	7.50	18.08	8.08	88.37	3.14	25.2	25.2	1.0	130.69	703.91	11	1.0	34.6	298.57	10.0	25.2	11	8.08	10.45	11.34	92.4	872.56	1875.0	88.4	1090.8	**750.02**	**363.61**
10.00	11.00	10.50	1.00	8.50	18.08	8.08	96.45	3.14	25.2	25.2	1.0	142.64	846.55	11	1.0	34.6	333.14	11.0	25.2	11	8.08	10.45	11.34	100.5	938.91	2118.6	100.1	1279.8	**847.44**	**426.61**
11.00	12.50	11.75	1.50	10.00	18.08	8.08	106.55	4.71	25.2	25.2	1.0	236.37	1082.92	11	1.0	51.9	385.00	12.5	25.2	11	8.08	10.45	11.34	112.6	1038.43	2506.3	117.8	1585.7	**1002.54**	**528.57**
12.50	14.00	13.25	1.50	11.50	18.08	8.08	118.67	4.71	25.2	25.2	1.0	263.25	1346.17	11	1.0	51.9	436.86	14.0	8.1	40	9.43	2.13	0.93	124.7	494.84	2277.9	135.5	1918.5	**911.15**	**639.50**
14.00	15.50	14.75	1.50	13.00	19.43	9.43	131.80	4.71	8.1	8.1	1.0	88.43	1434.60	40	1.0	188.6	625.43	15.5	8.7	40	9.43	2.24	1.02	124.7	505.77	2565.8	153.2	2213.2	**1026.32**	**737.73**
15.50	17.00	16.25	1.50	14.50	19.43	9.43	131.80	4.71	8.7	8.7	1.0	95.08	1529.68	40	1.0	188.6	814.00	17.0	11.3	40	11.01	2.85	1.59	124.7	569.26	2912.9	170.8	2514.5	**1165.18**	**838.17**
17.00	18.50	17.75	1.50	16.00	21.01	11.01	131.80	4.71	11.3	11.3	1.0	124.16	1653.84	40	1.0	188.6	1002.57	18.5	11.3	40	10.85	2.85	1.59	124.7	569.16	3225.6	188.5	2844.9	**1290.23**	**948.30**
18.50	21.50	20.00	3.00	19.00	20.85	10.85	131.80	9.43	11.3	11.3	1.0	248.32	1902.16	40	1.0	377.1	1379.71	21.5	11.0	45	8.53	2.76	1.51	124.7	594.14	3876.0	223.8	3505.7	**1550.40**	**1168.57**
21.50	24.50	23.00	3.00	22.00	18.53	8.53	131.80	9.43	11.0	11.0	1.0	241.56	2143.72	45	1.0	424.3	1804.00	24.5	9.6	45	8.53	2.40	1.16	124.7	557.11	4504.8	259.2	4206.9	**1801.93**	**1402.30**
24.50	26.00	25.25	1.50	23.50	18.53	8.53	131.80	4.71	9.6	9.6	1.0	105.09	2248.81	45	1.0	212.1	2016.14	26.0	25.7	14	9.19	11.58	12.49	124.7	1278.61	5543.6	276.9	4541.8	**2217.43**	**1513.94**
26.00	27.50	26.75	1.50	25.00	19.19	9.19	131.80	4.71	25.7	25.7	1.0	299.04	2547.85	14	1.0	66.0	2082.14	27.5	9.5	52	9.19	2.38	1.14	124.7	605.09	5235.1	294.5	4924.5	**2094.03**	**1641.51**
27.50	30.00	28.75	2.50	27.50	19.19	9.19	131.80	7.86	9.5	9.5	1.0	173.30	2721.15	52	1.0	408.6	2490.71	30.0	9.5	52	9.95	2.38	1.14	124.7	605.43	5817.3	324.0	5535.8	**2326.92**	**1845.28**
30.00	30.50	30.25	0.50	28.00	19.95	9.95	131.80	1.57	9.5	9.5	1.0	34.66	2755.81	52	1.0	81.7	2572.43	30.5	27.8	0	8.66	16.31	17.33	124.7	1656.92	6985.2	329.9	5658.1	**2794.06**	**1886.03**
30.50	32.50	31.50	2.00	30.00	18.66	8.66	131.80	6.29	27.8	27.8	1.0	436.80	3192.61	0	1.0	0.0	2572.43	32.5	28.3	0	8.66	17.43	18.48	124.7	1771.19	7536.2	353.4	6118.5	**3014.49**	**2039.49**
32.50	33.50	33.00	1.00	31.00	18.66	8.66	131.80	3.14	28.3	28.3	1.0	223.04	3415.65	0	1.0	0.0	2572.43	33.5	25.3	0	8.89	10.68	11.57	124.7	1086.64	7074.7	365.2	6353.3	**2829.89**	**2117.76**
33.50	35.00	34.25	1.50	32.50	18.89	8.89	131.80	4.71	25.3	25.3	1.0	293.71	3709.37	0	1.0	0.0	2572.43	35.0	25.3	0	8.89	10.68	11.57	124.7	1086.64	7368.4	382.9	6664.7	**2947.38**	**2221.56**
35.00	36.50	35.75	1.50	34.00	18.89	8.89	131.80	4.71	25.3	25.3	1.0	293.71	4003.08	0	1.0	0.0	2572.43	36.5	15.5	28	9.58	4.19	2.92	124.7	619.24	7194.8	400.6	6976.1	**2877.90**	**2325.35**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Factor of Safety in Compression: 2.5
Area of Pile: 0.79 m^2
Critical water table: 0.00 m
Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
36.50	37.50	37.00	1.00	35.00	19.58	9.58	131.80	3.14	15.5	15.5	1.0	114.88	4117.96	28	1.0	88.0	2660.43	37.5	15.5	28	9.58	4.19	2.92	124.7	619.24	7397.6	412.3	7190.7	**2959.05**	**2396.91**
37.50	38.00	37.75	0.50	35.50	19.58	9.58	131.80	1.57	15.5	15.5	1.0	57.44	4175.40	28	1.0	44.0	2704.43	38.0	23.0	10	9.58	8.56	8.68	124.7	942.30	7822.1	418.2	7298.1	**3128.85**	**2432.68**
38.00	40.00	39.00	2.00	37.50	19.58	9.58	131.80	6.29	23.0	23.0	1.0	351.67	4527.06	10	1.0	62.9	2767.29	40.0	8.1	45	9.58	2.13	0.93	124.7	530.25	7824.6	441.8	7736.1	**3129.84**	**2578.71**
BORE NO: P63, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	17.76	7.76	21.34	1.57	11.2	11.2	1.0	6.64	6.64	60	1.0	94.3	94.29	3.0	9.1	54	8.16	2.31	1.08	23.3	427.54	528.5	5.9	106.8	**211.39**	**35.61**
3.00	5.00	4.00	2.00	2.50	18.16	8.16	31.44	6.29	9.1	9.1	1.0	31.65	38.29	54	1.0	339.4	433.71	5.0	9.1	54	8.16	2.31	1.08	39.6	457.14	929.1	29.5	501.5	**371.66**	**167.15**
5.00	6.00	5.50	1.00	3.50	18.16	8.16	43.68	3.14	9.1	9.1	1.0	21.99	60.28	54	1.0	169.7	603.43	6.0	32.4	0	8.16	33.35	34.70	47.8	1362.70	2026.4	41.2	704.9	**810.57**	**234.98**
6.00	8.00	7.00	2.00	5.50	18.16	8.16	55.92	6.29	32.4	32.4	1.1	249.83	310.12	0	1.0	0.0	603.43	8.0	34.6	0	9.18	44.43	45.98	64.1	2402.90	3316.4	64.8	978.3	**1326.58**	**326.11**
8.00	9.00	8.50	1.00	6.50	19.18	9.18	68.67	3.14	34.6	34.6	1.2	183.13	493.25	0	1.0	0.0	603.43	9.0	34.6	0	9.18	44.43	45.98	73.3	2723.37	3820.0	76.6	1173.3	**1528.02**	**391.08**
9.00	10.00	9.50	1.00	7.50	19.18	9.18	77.85	3.14	34.6	34.6	1.2	207.61	700.85	0	1.0	0.0	603.43	10.0	25.0	12	9.18	10.00	10.88	82.4	771.84	2076.1	88.4	1392.6	**830.45**	**464.21**
10.00	11.00	10.50	1.00	8.50	19.18	9.18	87.03	3.14	25.0	25.0	1.0	127.55	828.40	12	1.0	37.7	641.14	11.0	25.0	12	9.18	10.00	10.88	91.6	843.97	2313.5	100.1	1569.7	**925.40**	**523.23**
11.00	12.00	11.50	1.00	9.50	19.18	9.18	96.21	3.14	25.0	25.0	1.0	141.00	969.40	12	1.0	37.7	678.86	12.0	7.5	55	9.18	2.02	0.84	100.8	551.92	2200.2	111.9	1760.2	**880.07**	**586.73**
12.00	13.00	12.50	1.00	10.50	19.18	9.18	105.39	3.14	7.5	7.5	1.0	43.61	1013.01	55	1.0	172.9	851.71	13.0	11.0	55	9.10	2.76	1.51	110.0	633.16	2497.9	123.7	1988.4	**999.15**	**662.81**
13.00	14.50	13.75	1.50	12.00	19.10	9.10	116.81	4.71	11.0	11.0	1.0	107.04	1120.04	55	1.0	259.3	1111.00	14.5	13.4	50	10.42	3.47	2.19	123.6	699.61	2930.7	141.4	2372.4	**1172.26**	**790.80**
14.50	17.50	16.00	3.00	15.00	20.42	10.42	116.81	9.43	13.4	13.4	1.0	262.37	1382.41	50	1.0	471.4	1582.43	17.5	13.4	50	10.42	3.47	2.19	123.6	699.61	3664.5	176.7	3141.6	**1465.78**	**1047.18**
17.50	19.00	18.25	1.50	16.50	20.42	10.42	116.81	4.71	13.4	13.4	1.0	131.18	1513.59	50	1.0	235.7	1818.14	19.0	25.3	22	8.75	10.68	11.57	123.6	1232.35	4564.1	194.4	3526.1	**1825.63**	**1175.37**
19.00	20.50	19.75	1.50	18.00	18.75	8.75	116.81	4.71	25.3	25.3	1.0	260.29	1773.89	22	1.0	103.7	1921.86	20.5	9.5	52	11.12	2.38	1.14	123.6	603.90	4299.6	212.1	3907.8	**1719.86**	**1302.60**
20.50	23.50	22.00	3.00	21.00	21.12	11.12	116.81	9.43	9.5	9.5	1.0	184.30	1958.18	52	1.0	490.3	2412.14	23.5	9.5	52	10.95	2.38	1.14	123.6	603.82	4974.1	247.4	4617.7	**1989.66**	**1539.24**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
23.50	26.50	25.00	3.00	24.00	20.95	10.95	116.81	9.43	9.5	9.5	1.0	184.30	2142.48	52	1.0	490.3	2902.43	26.5	10.7	51	10.95	2.68	1.42	123.6	626.67	5671.6	282.7	5327.6	**2268.63**	**1775.88**
26.50	27.50	27.00	1.00	25.00	20.95	10.95	116.81	3.14	10.7	10.7	1.0	69.36	2211.84	51	1.0	160.3	3062.71	27.5	10.7	51	10.95	2.68	1.42	123.6	626.67	5901.2	294.5	5569.1	**2360.49**	**1856.36**
27.50	28.00	27.75	0.50	25.50	20.95	10.95	116.81	1.57	10.7	10.7	1.0	34.68	2246.52	51	1.0	80.1	3142.86	28.0	27.6	7	7.80	15.85	16.87	123.6	1641.31	7030.7	300.4	5689.8	**2812.28**	**1896.60**
28.00	29.50	28.75	1.50	27.00	17.80	7.80	116.81	4.71	27.6	27.6	1.0	287.87	2534.40	7	1.0	33.0	3175.86	29.5	7.5	65	7.80	2.02	0.84	123.6	658.42	6368.7	318.1	6028.3	**2547.47**	**2009.45**
29.50	30.00	29.75	0.50	27.50	17.80	7.80	116.81	1.57	7.5	7.5	1.0	24.16	2558.56	65	1.0	102.1	3278.00	30.0	7.5	65	7.80	2.02	0.84	123.6	658.42	6495.0	324.0	6160.5	**2597.99**	**2053.51**
30.00	31.00	30.50	1.00	28.50	17.80	7.80	116.81	3.14	7.5	7.5	1.0	48.33	2606.89	65	1.0	204.3	3482.29	31.0	7.5	65	7.80	2.02	0.84	123.6	658.42	6747.6	335.8	6424.9	**2699.04**	**2141.64**
31.00	32.50	31.75	1.50	30.00	17.80	7.80	116.81	4.71	7.5	7.5	1.0	72.49	2679.39	65	1.0	306.4	3788.71	32.5	7.5	65	10.01	2.02	0.84	123.6	659.14	7127.2	353.4	6821.5	**2850.90**	**2273.84**
32.50	34.00	33.25	1.50	31.50	20.01	10.01	116.81	4.71	7.5	7.5	1.0	72.49	2751.88	65	1.0	306.4	4095.14	34.0	16.7	32	10.01	4.78	3.58	123.6	704.34	7551.4	371.1	7218.1	**3020.55**	**2406.04**
34.00	35.00	34.50	1.00	32.50	20.01	10.01	116.81	3.14	16.7	16.7	1.0	110.14	2862.02	32	1.0	100.6	4195.71	35.0	16.7	32	10.01	4.78	3.58	123.6	704.34	7762.1	382.9	7440.6	**3104.83**	**2480.20**
35.00	35.50	35.25	0.50	33.00	20.01	10.01	116.81	1.57	16.7	16.7	1.0	55.07	2917.08	32	1.0	50.3	4246.00	35.5	17.1	32	8.92	4.97	3.80	123.6	722.69	7885.8	388.8	7551.9	**3154.31**	**2517.29**
35.50	37.00	36.25	1.50	34.50	18.92	8.92	116.81	4.71	17.1	17.1	1.0	169.40	3086.49	32	1.0	150.9	4396.86	37.0	8.6	44	8.92	2.22	1.00	123.6	530.11	8013.5	406.4	7889.8	**3205.38**	**2629.93**
37.00	37.50	37.25	0.50	35.00	18.92	8.92	116.81	1.57	8.6	8.6	1.0	27.76	3114.25	44	1.0	69.1	4466.00	37.5	8.6	44	8.92	2.22	1.00	123.6	530.11	8110.4	412.3	7992.6	**3244.14**	**2664.19**
37.50	38.50	38.00	1.00	36.00	18.92	8.92	116.81	3.14	8.6	8.6	1.0	55.52	3169.77	44	1.0	138.3	4604.29	38.5	9.1	53	10.54	2.31	1.08	123.6	603.46	8377.5	424.1	8198.2	**3351.00**	**2732.72**
38.50	40.00	39.25	1.50	37.50	20.54	10.54	116.81	4.71	9.1	9.1	1.0	88.20	3257.97	53	1.0	249.9	4854.14	40.0	9.1	53	10.54	2.31	1.08	123.6	603.46	8715.6	441.8	8553.9	**3486.23**	**2851.30**
BORE NO: P64, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.96	10.96	30.14	1.57	23.1	23.1	1.0	20.20	0	0	1.0	0.0	0	3.0	23.1	0	10.96	8.63	8.79	32.9	260.87	260.9	5.9	5.9	**104.35**	**1.96**
3.00	4.00	3.50	1.00	1.50	20.96	10.96	38.36	3.14	23.1	23.1	1.0	51.42	51.42	0	1.0	0.0	0.00	4.0	27.7	0	10.96	16.08	17.10	43.8	627.52	678.9	17.7	69.1	**271.58**	**23.03**
4.00	6.00	5.00	2.00	3.50	20.96	10.96	54.80	6.29	27.7	27.7	1.0	180.84	232.27	0	1.0	0.0	0.00	6.0	27.9	0	9.23	16.53	17.56	65.8	917.79	1150.1	41.2	273.5	**460.02**	**91.17**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
6.00	7.00	6.50	1.00	4.50	19.23	9.23	70.38	3.14	27.9	27.9	1.0	117.11	349.38	0	1.0	0.0	0.00	7.0	26.7	7	9.23	13.83	14.80	75.0	917.92	1267.3	53.0	402.4	**506.92**	**134.13**
7.00	9.00	8.00	2.00	6.50	19.23	9.23	84.22	6.29	26.7	26.7	1.0	266.25	615.63	7	1.0	44.0	44.00	9.0	23.2	16	9.23	8.70	8.90	93.5	784.52	1444.1	76.6	736.2	**577.66**	**245.40**
9.00	10.00	9.50	1.00	7.50	19.23	9.23	98.07	3.14	23.2	23.2	1.0	132.10	747.72	16	1.0	50.3	94.29	10.0	23.2	16	9.59	8.70	8.90	102.7	848.90	1690.9	88.4	930.4	**676.36**	**310.12**
10.00	12.50	11.25	2.50	10.00	19.59	9.59	114.67	7.86	23.2	23.2	1.0	386.15	1133.88	16	1.0	125.7	220.00	12.5	23.0	16	9.80	8.56	8.68	126.7	998.42	2352.3	117.8	1471.7	**940.92**	**490.56**
12.50	15.50	14.00	3.00	13.00	19.80	9.80	141.36	9.43	23.0	23.0	1.0	565.73	1699.60	16	1.0	150.9	370.86	15.5	11.1	41	9.80	2.79	1.53	126.7	573.82	2644.3	153.2	2223.6	**1057.71**	**741.20**
15.50	17.00	16.25	1.50	14.50	19.80	9.80	141.36	4.71	11.1	11.1	1.0	130.74	1830.34	41	1.0	193.3	564.14	17.0	26.6	0	8.11	13.60	14.57	126.7	1400.11	3794.6	170.8	2565.3	**1517.84**	**855.10**
17.00	18.50	17.75	1.50	16.00	18.11	8.11	141.36	4.71	26.6	26.6	1.0	333.70	2164.05	0	1.0	0.0	564.14	18.5	15.6	33	8.11	4.24	2.98	126.7	664.31	3392.5	188.5	2916.7	**1357.00**	**972.23**
18.50	20.00	19.25	1.50	17.50	18.11	8.11	141.36	4.71	15.6	15.6	1.0	186.06	2350.11	33	1.0	155.6	719.71	20.0	11.2	46	9.79	2.82	1.56	126.7	612.21	3682.0	206.2	3276.0	**1472.81**	**1092.00**
20.00	21.50	20.75	1.50	19.00	19.79	9.79	141.36	4.71	11.2	11.2	1.0	131.95	2482.05	46	1.0	216.9	936.57	21.5	11.2	46	9.24	2.82	1.56	126.7	611.87	4030.5	223.8	3642.5	**1612.20**	**1214.15**
21.50	24.50	23.00	3.00	22.00	19.24	9.24	141.36	9.43	11.2	11.2	1.0	263.90	2745.95	46	1.0	433.7	1370.29	24.5	12.5	42	9.24	3.20	1.94	126.7	622.87	4739.1	259.2	4375.4	**1895.64**	**1458.47**
24.50	26.00	25.25	1.50	23.50	19.24	9.24	141.36	4.71	12.5	12.5	1.0	147.73	2893.69	42	1.0	198.0	1568.29	26.0	19.5	28	9.24	6.13	5.12	126.7	826.99	5289.0	276.9	4738.8	**2115.59**	**1579.61**
26.00	27.50	26.75	1.50	25.00	19.24	9.24	141.36	4.71	19.5	19.5	1.0	235.98	3129.67	28	1.0	132.0	1700.29	27.5	9.5	30	9.64	2.38	1.14	126.7	453.32	5283.3	294.5	5124.5	**2113.31**	**1708.16**
27.50	29.00	28.25	1.50	26.50	19.64	9.64	141.36	4.71	9.5	9.5	1.0	111.52	3241.18	30	1.0	141.4	1841.71	29.0	28.9	4	9.64	18.78	19.87	126.7	1972.65	7055.5	312.2	5395.1	**2822.22**	**1798.36**
29.00	30.00	29.50	1.00	27.50	19.64	9.64	141.36	3.14	28.9	28.9	1.0	245.24	3486.42	4	1.0	12.6	1854.29	30.0	28.8	0	9.64	18.56	19.64	126.7	1921.08	7261.8	324.0	5664.7	**2904.72**	**1888.23**
30.00	30.50	30.25	0.50	28.00	19.64	9.64	141.36	1.57	28.8	28.8	1.0	122.12	3608.54	0	1.0	0.0	1854.29	30.5	28.8	0	9.64	18.56	19.64	126.7	1921.08	7383.9	329.9	5792.7	**2953.56**	**1930.90**
30.50	32.00	31.25	1.50	29.50	19.64	9.64	141.36	4.71	28.8	28.8	1.0	366.35	3974.89	0	1.0	0.0	1854.29	32.0	9.5	32	9.64	2.38	1.14	126.7	467.46	6296.6	347.5	6176.7	**2518.65**	**2058.91**
32.00	32.50	32.25	0.50	30.00	19.64	9.64	141.36	1.57	9.5	9.5	1.0	37.17	4012.06	32	1.0	50.3	1904.57	32.5	9.5	32	8.64	2.38	1.14	126.7	467.01	6383.6	353.4	6270.1	**2553.46**	**2090.02**
32.50	33.50	33.00	1.00	31.00	18.64	8.64	141.36	3.14	9.5	9.5	1.0	74.34	4086.41	32	1.0	100.6	2005.14	33.5	8.7	48	7.55	2.24	1.02	126.7	564.97	6656.5	365.2	6456.8	**2662.61**	**2152.25**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
33.50	35.00	34.25	1.50	32.50	17.55	7.55	141.36	4.71	8.7	8.7	1.0	101.97	4188.38	48	1.0	226.3	2231.43	35.0	8.7	48	7.55	2.24	1.02	126.7	564.97	6984.8	382.9	6802.7	**2793.91**	**2267.56**
35.00	36.50	35.75	1.50	34.00	17.55	7.55	141.36	4.71	8.7	8.7	1.0	101.97	4290.35	48	1.0	226.3	2457.71	36.5	9.3	55	8.10	2.34	1.11	126.7	625.73	7373.8	400.6	7148.6	**2949.52**	**2382.87**
36.50	37.50	37.00	1.00	35.00	18.10	8.10	141.36	3.14	9.3	9.3	1.0	72.75	4363.10	55	1.0	172.9	2630.57	37.5	10.2	30	8.10	2.53	1.28	126.7	467.86	7461.5	412.3	7406.0	**2984.61**	**2468.67**
37.50	40.00	38.75	2.50	37.50	18.10	8.10	141.36	7.86	10.2	10.2	1.0	199.84	4562.94	30	1.0	235.7	2866.29	40.0	14.3	28	8.10	3.74	2.45	126.7	577.68	8006.9	441.8	7871.0	**3202.76**	**2623.67**
BORE NO: P65, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.11	10.11	27.80	1.57	24.5	24.5	1.0	19.91	0	0	1.0	0.0	0	3.0	13.8	31	10.11	3.59	2.31	30.3	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	20.11	10.11	35.39	3.14	13.8	13.8	1.0	27.32	0	31	1.0	97.4	0	4.0	32.7	0	9.10	34.86	36.24	40.4	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	19.10	9.10	44.99	3.14	32.7	32.7	1.1	103.03	0	0	1.0	0.0	0	5.0	30.5	0	9.10	23.78	24.96	49.5	1014.79	1014.8	29.5	29.5	**405.92**	**9.82**
5.00	6.00	5.50	1.00	3.50	19.10	9.10	54.09	3.14	30.5	30.5	1.0	102.64	102.64	0	1.0	0.0	0.00	6.0	30.5	0	9.97	23.78	24.96	58.6	1193.34	1296.0	41.2	143.9	**518.39**	**47.96**
6.00	8.00	7.00	2.00	5.50	19.97	9.97	68.61	6.29	30.5	30.5	1.0	260.38	363.02	0	1.0	0.0	0.00	8.0	30.5	0	9.97	23.78	24.96	78.6	1565.88	1928.9	64.8	427.8	**771.56**	**142.61**
8.00	9.00	8.50	1.00	6.50	19.97	9.97	83.57	3.14	30.5	30.5	1.0	158.57	521.59	0	1.0	0.0	0.00	9.0	25.3	12	9.61	10.68	11.57	88.6	871.30	1392.9	76.6	598.2	**557.16**	**199.39**
9.00	11.00	10.00	2.00	8.50	19.61	9.61	98.16	6.29	25.3	25.3	1.0	291.66	813.25	12	1.0	75.4	75.43	11.0	25.9	12	9.61	12.03	12.95	107.8	1152.14	2040.8	100.1	988.8	**816.33**	**329.61**
11.00	12.00	11.50	1.00	9.50	19.61	9.61	112.58	3.14	25.9	25.9	1.0	171.80	985.05	12	1.0	37.7	113.14	12.0	25.9	12	10.07	12.03	12.95	117.4	1245.29	2343.5	111.9	1210.1	**937.39**	**403.37**
12.00	14.50	13.25	2.50	12.00	20.07	10.07	129.97	7.86	25.9	25.9	1.0	495.86	1480.91	12	1.0	94.3	207.43	14.5	25.9	12	10.07	12.03	12.95	142.6	1483.18	3171.5	141.4	1829.7	**1268.61**	**609.90**
14.50	17.50	16.00	3.00	15.00	20.07	10.07	129.97	9.43	25.9	25.9	1.0	595.03	2075.93	12	1.0	113.1	320.57	17.5	24.0	12	9.92	9.28	9.78	142.6	1162.41	3558.9	176.7	2573.2	**1423.56**	**857.74**
17.50	20.50	19.00	3.00	18.00	19.92	9.92	129.97	9.43	24.0	24.0	1.0	545.59	2621.52	12	1.0	113.1	433.71	20.5	12.5	47	9.92	3.20	1.94	142.6	698.77	3754.0	212.1	3267.3	**1501.60**	**1089.10**
20.50	23.50	22.00	3.00	21.00	19.92	9.92	129.97	9.43	12.5	12.5	1.0	271.67	2893.18	47	1.0	443.1	876.86	23.5	12.6	47	10.99	3.23	1.96	142.6	702.98	4473.0	247.4	4017.4	**1789.21**	**1339.15**
23.50	26.50	25.00	3.00	24.00	20.99	10.99	129.97	9.43	12.6	12.6	1.0	273.91	3167.10	47	1.0	443.1	1320.00	26.5	12.2	47	10.99	3.12	1.85	142.6	689.40	5176.5	282.7	4769.8	**2070.60**	**1589.95**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
26.50	27.50	27.00	1.00	25.00	20.99	10.99	129.97	3.14	12.2	12.2	1.0	88.31	3255.41	47	1.0	147.7	1467.71	27.5	14.0	10	10.99	3.65	2.36	142.6	489.75	5212.9	294.5	5017.6	**2085.15**	**1672.55**
27.50	28.00	27.75	0.50	25.50	20.99	10.99	129.97	1.57	14.0	14.0	1.0	50.92	3306.33	10	1.0	15.7	1483.43	28.0	10.6	59	10.82	2.65	1.39	142.6	719.55	5509.3	300.4	5090.2	**2203.72**	**1696.72**
28.00	29.50	28.75	1.50	27.00	20.82	10.82	129.97	4.71	10.6	10.6	1.0	114.66	3421.00	59	1.0	278.1	1761.57	29.5	10.6	59	10.82	2.65	1.39	142.6	719.55	5902.1	318.1	5500.7	**2360.85**	**1833.55**
29.50	30.00	29.75	0.50	27.50	20.82	10.82	129.97	1.57	10.6	10.6	1.0	38.22	3459.22	59	1.0	92.7	1854.29	30.0	10.6	54	11.04	2.65	1.39	142.6	684.31	5997.8	324.0	5637.5	**2399.12**	**1879.16**
30.00	32.50	31.25	2.50	30.00	21.04	11.04	129.97	7.86	10.6	10.6	1.0	191.11	3650.32	54	1.0	424.3	2278.57	32.5	10.6	54	11.04	2.65	1.39	142.6	684.31	6613.2	353.4	6282.3	**2645.28**	**2094.11**
32.50	35.00	33.75	2.50	32.50	21.04	11.04	129.97	7.86	10.6	10.6	1.0	191.11	3841.43	54	1.0	424.3	2702.86	35.0	10.6	54	8.71	2.65	1.39	142.6	683.04	7227.3	382.9	6927.2	**2890.93**	**2309.06**
35.00	35.50	35.25	0.50	33.00	18.71	8.71	129.97	1.57	10.6	10.6	1.0	38.22	3879.65	54	1.0	84.9	2787.71	35.5	10.5	60	8.04	2.62	1.36	142.6	721.71	7389.1	388.8	7056.1	**2955.63**	**2352.05**
35.50	37.50	36.50	2.00	35.00	18.04	8.04	129.97	6.29	10.5	10.5	1.0	151.41	4031.06	60	1.0	377.1	3164.86	37.5	14.0	30	8.04	3.65	2.36	142.6	628.44	7824.4	412.3	7608.3	**3129.74**	**2536.09**
37.50	38.50	38.00	1.00	36.00	18.04	8.04	129.97	3.14	14.0	14.0	1.0	101.84	4132.91	30	1.0	94.3	3259.14	38.5	14.0	30	9.16	3.65	2.36	142.6	629.48	8021.5	424.1	7816.2	**3208.61**	**2605.39**
38.50	40.00	39.25	1.50	37.50	19.16	9.16	129.97	4.71	14.0	14.0	1.0	152.76	4285.67	30	1.0	141.4	3400.57	40.0	14.0	30	9.16	3.65	2.36	142.6	629.48	8315.7	441.8	8128.0	**3326.29**	**2709.34**
BORE NO: P66, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.30	9.30	25.58	1.57	12.0	12.0	1.0	8.54	0	5	1.0	7.9	0	3.0	8.1	34	9.30	2.13	0.93	27.9	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.30	9.30	32.55	3.14	8.1	8.1	1.0	14.56	0	34	1.0	106.9	0	4.0	8.1	34	10.30	2.13	0.93	37.2	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	20.30	10.30	42.35	3.14	8.1	8.1	1.0	18.94	0	34	1.0	106.9	0	5.0	27.6	0	10.30	15.85	16.87	47.5	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	20.30	10.30	52.65	3.14	27.6	27.6	1.0	86.51	0	0	1.0	0.0	0	6.0	27.6	0	10.30	15.85	16.87	57.8	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	7.00	6.50	1.00	4.50	20.30	10.30	62.95	3.14	27.6	27.6	1.0	103.43	0	0	1.0	0.0	0	7.0	33.8	0	10.30	40.40	41.88	68.1	0	0.0	53.0	53.0	**0.00**	**17.67**
7.00	8.00	7.50	1.00	5.50	20.30	10.30	73.25	3.14	33.8	33.8	1.2	183.40	0	0	1.0	0.0	0	8.0	28.5	0	10.31	17.88	18.94	78.4	1178.24	1178.2	64.8	64.8	**471.30**	**21.60**
8.00	9.00	8.50	1.00	6.50	20.31	10.31	83.56	3.14	28.5	28.5	1.0	142.58	142.58	0	1.0	0.0	0.00	9.0	25.3	17	10.31	10.68	11.57	88.7	911.18	1053.8	76.6	219.2	**421.50**	**73.05**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
9.00	10.00	9.50	1.00	7.50	20.31	10.31	93.87	3.14	25.3	25.3	1.0	139.45	282.03	17	1.0	53.4	53.43	10.0	25.3	17	10.31	10.68	11.57	99.0	997.66	1333.1	88.4	423.8	**533.25**	**141.27**
10.00	11.00	10.50	1.00	8.50	20.31	10.31	104.18	3.14	25.3	25.3	1.0	154.76	436.79	17	1.0	53.4	106.86	11.0	7.5	48	10.31	2.02	0.84	109.3	516.33	1060.0	100.1	643.8	**423.99**	**214.60**
11.00	12.00	11.50	1.00	9.50	20.31	10.31	114.49	3.14	7.5	7.5	1.0	47.37	484.16	48	1.0	150.9	257.71	12.0	7.5	48	10.10	2.02	0.84	119.6	532.63	1274.5	111.9	853.8	**509.80**	**284.60**
12.00	14.50	13.25	2.50	12.00	20.10	10.10	132.27	7.86	7.5	7.5	1.0	136.82	620.98	48	1.0	377.1	634.86	14.5	25.5	16	11.58	11.13	12.03	144.9	1434.48	2690.3	141.4	1397.2	**1076.13**	**465.74**
14.50	17.50	16.00	3.00	15.00	21.58	11.58	132.27	9.43	25.5	25.5	1.0	594.82	1215.80	16	1.0	150.9	785.71	17.5	25.0	16	11.58	10.00	10.88	144.9	1301.06	3302.6	176.7	2178.2	**1321.03**	**726.08**
17.50	19.00	18.25	1.50	16.50	21.58	11.58	132.27	4.71	25.0	25.0	1.0	290.76	1506.56	16	1.0	75.4	861.14	19.0	24.5	15	11.39	9.64	10.33	144.9	1249.74	3617.4	194.4	2562.1	**1446.98**	**854.03**
19.00	20.50	19.75	1.50	18.00	21.39	11.39	132.27	4.71	24.5	24.5	1.0	284.16	1790.72	15	1.0	70.7	931.86	20.5	24.5	15	11.39	9.64	10.33	144.9	1249.74	3972.3	212.1	2934.6	**1588.93**	**978.21**
20.50	22.00	21.25	1.50	19.50	21.39	11.39	132.27	4.71	24.5	24.5	1.0	284.16	2074.88	15	1.0	70.7	1002.57	22.0	23.6	10	11.39	8.99	9.34	144.9	1136.19	4213.6	229.7	3307.2	**1685.46**	**1102.39**
22.00	23.50	22.75	1.50	21.00	21.39	11.39	132.27	4.71	23.6	23.6	1.0	272.42	2347.30	10	1.0	47.1	1049.71	23.5	12.1	39	10.18	3.09	1.82	144.9	634.52	4031.5	247.4	3644.4	**1612.61**	**1214.80**
23.50	26.50	25.00	3.00	24.00	20.18	10.18	132.27	9.43	12.1	12.1	1.0	267.35	2614.65	39	1.0	367.7	1417.43	26.5	12.1	39	10.18	3.09	1.82	144.9	634.52	4666.6	282.7	4314.8	**1866.64**	**1438.27**
26.50	27.50	27.00	1.00	25.00	20.18	10.18	132.27	3.14	12.1	12.1	1.0	89.12	2703.76	39	1.0	122.6	1540.00	27.5	12.1	39	10.18	3.09	1.82	144.9	634.52	4878.3	294.5	4538.3	**1951.31**	**1512.76**
27.50	29.50	28.50	2.00	27.00	20.18	10.18	132.27	6.29	12.1	12.1	1.0	178.23	2882.00	39	1.0	245.1	1785.14	29.5	11.2	52	9.59	2.82	1.56	144.9	694.96	5362.1	318.1	4985.2	**2144.84**	**1661.74**
29.50	30.00	29.75	0.50	27.50	19.59	9.59	132.27	1.57	11.2	11.2	1.0	41.15	2923.15	52	1.0	81.7	1866.86	30.0	11.2	49	9.59	2.82	1.56	144.9	673.74	5463.8	324.0	5114.0	**2185.50**	**1704.66**
30.00	32.50	31.25	2.50	30.00	19.59	9.59	132.27	7.86	11.2	11.2	1.0	205.77	3128.92	49	1.0	385.0	2251.86	32.5	11.2	49	9.59	2.82	1.56	144.9	673.74	6054.5	353.4	5734.2	**2421.81**	**1911.40**
32.50	35.00	33.75	2.50	32.50	19.59	9.59	132.27	7.86	11.2	11.2	1.0	205.77	3334.70	49	1.0	385.0	2636.86	35.0	11.2	49	8.99	2.82	1.56	144.9	673.37	6644.9	382.9	6354.4	**2657.97**	**2118.14**
35.00	35.50	35.25	0.50	33.00	18.99	8.99	132.27	1.57	11.2	11.2	1.0	41.15	3375.85	49	1.0	77.0	2713.86	35.5	11.2	49	8.82	2.82	1.56	144.9	673.27	6763.0	388.8	6478.5	**2705.19**	**2159.49**
35.50	37.50	36.50	2.00	35.00	18.82	8.82	132.27	6.29	11.2	11.2	1.0	164.62	3540.47	49	1.0	308.0	3021.86	37.5	11.2	49	8.82	2.82	1.56	144.9	673.27	7235.6	412.3	6974.7	**2894.24**	**2324.89**
37.50	38.50	38.00	1.00	36.00	18.82	8.82	132.27	3.14	11.2	11.2	1.0	82.31	3622.78	49	1.0	154.0	3175.86	38.5	11.2	49	9.02	2.82	1.56	144.9	673.39	7472.0	424.1	7222.7	**2988.81**	**2407.58**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
38.50	40.00	39.25	1.50	37.50	19.02	9.02	132.27	4.71	11.2	11.2	1.0	123.46	3746.24	49	1.0	231.0	3406.86	40.0	11.2	49	9.02	2.82	1.56	144.9	673.39	7826.5	441.8	7594.9	**3130.60**	**2531.63**
BORE NO: P67, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.06	10.06	27.67	1.57	27.5	27.5	1.0	22.63	0	12	1.0	18.9	0	3.0	27.5	9	10.06	15.63	16.64	30.2	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	20.06	10.06	35.21	3.14	27.5	27.5	1.0	57.61	0	9	1.0	28.3	0	4.0	29.5	0	10.06	20.13	21.25	40.2	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	6.00	5.00	2.00	3.50	20.06	10.06	50.30	6.29	29.5	29.5	1.0	178.88	0	0	1.0	0.0	0	6.0	29.7	0	10.24	20.58	21.71	60.4	1063.54	1063.5	41.2	41.2	**425.42**	**13.74**
6.00	7.00	6.50	1.00	4.50	20.24	10.24	65.48	3.14	29.7	29.7	1.0	117.38	117.38	0	1.0	0.0	0.00	7.0	28.5	0	10.01	17.88	18.94	70.6	1066.42	1183.8	53.0	170.4	**473.52**	**56.80**
7.00	9.00	8.00	2.00	6.50	20.01	10.01	80.61	6.29	28.5	28.5	1.0	275.11	392.49	0	1.0	0.0	0.00	9.0	24.8	16	10.01	9.86	10.66	90.6	856.83	1249.3	76.6	469.1	**499.73**	**156.36**
9.00	10.00	9.50	1.00	7.50	20.01	10.01	95.63	3.14	24.8	24.8	1.0	138.87	531.36	16	1.0	50.3	50.29	10.0	24.8	16	10.01	9.86	10.66	100.6	934.34	1516.0	88.4	670.0	**606.40**	**223.33**
10.00	11.00	10.50	1.00	8.50	20.01	10.01	105.64	3.14	24.8	24.8	1.0	153.40	684.76	16	1.0	50.3	100.57	11.0	24.8	16	10.01	9.86	10.66	110.6	1011.86	1797.2	100.1	885.5	**718.88**	**295.16**
11.00	12.50	11.75	1.50	10.00	20.01	10.01	118.15	4.71	24.8	24.8	1.0	257.36	942.13	16	1.0	75.4	176.00	12.5	24.8	16	10.01	9.86	10.66	125.7	1128.14	2246.3	117.8	1235.9	**898.51**	**411.98**
12.50	14.00	13.25	1.50	11.50	20.01	10.01	133.16	4.71	24.8	24.8	1.0	290.07	1232.19	16	1.0	75.4	251.43	14.0	14.3	54	10.75	3.74	2.45	140.7	805.24	2288.9	135.5	1619.1	**915.55**	**539.70**
14.00	15.50	14.75	1.50	13.00	20.75	10.75	148.73	4.71	14.3	14.3	1.0	178.73	1410.92	54	1.0	254.6	506.00	15.5	14.3	54	10.61	3.74	2.45	140.7	805.11	2722.0	153.2	2070.1	**1088.81**	**690.02**
15.50	18.50	17.00	3.00	16.00	20.61	10.61	148.73	9.43	14.3	14.3	1.0	357.45	1768.37	54	1.0	509.1	1015.14	18.5	23.8	10	10.61	9.14	9.56	140.7	1120.34	3903.9	188.5	2972.0	**1561.54**	**990.67**
18.50	20.00	19.25	1.50	17.50	20.61	10.61	148.73	4.71	23.8	23.8	1.0	309.25	2077.62	10	1.0	47.1	1062.29	20.0	28.6	0	10.61	18.11	19.17	140.7	2081.21	5221.1	206.2	3346.1	**2088.45**	**1115.36**
20.00	21.50	20.75	1.50	19.00	20.61	10.61	148.73	4.71	28.6	28.6	1.0	382.29	2459.91	0	1.0	0.0	1062.29	21.5	12.2	46	10.81	3.12	1.85	140.7	677.58	4199.8	223.8	3746.0	**1679.91**	**1248.68**
21.50	24.50	23.00	3.00	22.00	20.81	10.81	148.73	9.43	12.2	12.2	1.0	303.20	2763.11	46	1.0	433.7	1496.00	24.5	12.2	46	10.81	3.12	1.85	140.7	677.58	4936.7	259.2	4518.3	**1974.68**	**1506.10**
24.50	27.50	26.00	3.00	25.00	20.81	10.81	148.73	9.43	12.2	12.2	1.0	303.20	3066.30	46	1.0	433.7	1929.71	27.5	8.0	40	11.18	2.11	0.91	140.7	520.07	5516.1	294.5	5290.5	**2206.44**	**1763.51**
27.50	29.00	28.25	1.50	26.50	21.18	11.18	148.73	4.71	8.0	8.0	1.0	98.54	3164.85	40	1.0	188.6	2118.29	29.0	24.0	14	11.18	9.28	9.78	140.7	1167.65	6450.8	312.2	5595.3	**2580.31**	**1865.11**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
29.00	30.00	29.50	1.00	27.50	21.18	11.18	148.73	3.14	24.0	24.0	1.0	208.12	3372.96	14	1.0	44.0	2162.29	30.0	24.0	14	11.18	9.28	9.78	140.7	1167.65	6702.9	324.0	5859.2	**2681.16**	**1953.08**
30.00	30.50	30.25	0.50	28.00	21.18	11.18	148.73	1.57	24.0	24.0	1.0	104.06	3477.02	14	1.0	22.0	2184.29	30.5	9.5	32	11.18	2.38	1.14	140.7	494.36	6155.7	329.9	5991.2	**2462.27**	**1997.06**
30.50	32.00	31.25	1.50	29.50	21.18	11.18	148.73	4.71	9.5	9.5	1.0	117.34	3594.36	32	1.0	150.9	2335.14	32.0	27.3	0	11.18	15.18	16.18	140.7	1748.78	7678.3	347.5	6277.0	**3071.31**	**2092.35**
32.00	32.50	32.25	0.50	30.00	21.18	11.18	148.73	1.57	27.3	27.3	1.0	120.63	3714.99	0	1.0	0.0	2335.14	32.5	27.3	0	8.86	15.18	16.18	140.7	1734.04	7784.2	353.4	6403.6	**3113.67**	**2134.52**
32.50	33.50	33.00	1.00	31.00	18.86	8.86	148.73	3.14	27.3	27.3	1.0	241.27	3956.26	0	1.0	0.0	2335.14	33.5	27.3	0	8.88	15.18	16.18	140.7	1734.17	8025.6	365.2	6656.6	**3210.23**	**2218.87**
33.50	35.00	34.25	1.50	32.50	18.88	8.88	148.73	4.71	27.3	27.3	1.0	361.90	4318.16	0	1.0	0.0	2335.14	35.0	15.1	48	8.36	3.99	2.70	140.7	789.22	7442.5	382.9	7036.2	**2977.01**	**2345.39**
35.00	36.50	35.75	1.50	34.00	18.36	8.36	148.73	4.71	15.1	15.1	1.0	189.19	4507.35	48	1.0	226.3	2561.43	36.5	28.8	0	8.52	18.56	19.64	140.7	2116.79	9185.6	400.6	7469.3	**3674.23**	**2489.78**
36.50	37.50	37.00	1.00	35.00	18.52	8.52	148.73	3.14	28.8	28.8	1.0	256.98	4764.33	0	1.0	0.0	2561.43	37.5	28.8	0	8.52	18.56	19.64	140.7	2116.79	9442.5	412.3	7738.1	**3777.02**	**2579.36**
37.50	38.00	37.75	0.50	35.50	18.52	8.52	148.73	1.57	28.8	28.8	1.0	128.49	4892.82	0	1.0	0.0	2561.43	38.0	28.8	0	8.62	18.56	19.64	140.7	2117.56	9571.8	418.2	7872.5	**3828.72**	**2624.16**
38.00	40.00	39.00	2.00	37.50	18.62	8.62	148.73	6.29	28.8	28.8	1.0	513.96	5406.78	0	1.0	0.0	2561.43	40.0	29.6	0	8.62	20.36	21.48	140.7	2322.92	10291.1	441.8	8410.0	**4116.45**	**2803.33**
BORE NO: P68, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.56	9.56	26.29	1.57	26.5	26.5	1.0	20.60	0	5	1.0	7.9	0	3.0	26.5	5	9.56	13.38	14.34	28.7	390.66	390.7	5.9	5.9	**156.26**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.56	9.56	33.46	3.14	26.5	26.5	1.0	52.43	52.43	5	1.0	15.7	15.71	4.0	30.4	0	9.56	23.27	24.45	38.2	791.13	859.3	17.7	85.8	**343.71**	**28.61**
4.00	6.00	5.00	2.00	3.50	19.56	9.56	47.80	6.29	30.4	30.4	1.0	179.80	232.23	0	1.0	0.0	15.71	6.0	30.2	0	9.34	22.27	23.43	57.4	1089.50	1337.4	41.2	289.2	**534.98**	**96.39**
6.00	7.00	6.50	1.00	4.50	19.34	9.34	62.03	3.14	30.2	30.2	1.0	114.60	346.83	0	1.0	0.0	15.71	7.0	30.2	0	9.34	22.27	23.43	66.7	1252.90	1615.5	53.0	415.6	**646.18**	**138.52**
7.00	9.00	8.00	2.00	6.50	19.34	9.34	76.04	6.29	30.2	30.2	1.0	280.96	627.80	0	1.0	0.0	15.71	9.0	28.5	0	9.34	17.88	18.94	85.4	1269.09	1912.6	76.6	720.1	**765.04**	**240.03**
9.00	10.00	9.50	1.00	7.50	19.34	9.34	90.05	3.14	28.5	28.5	1.0	153.66	781.46	0	1.0	0.0	15.71	10.0	28.5	0	9.34	17.88	18.94	94.7	1400.32	2197.5	88.4	885.5	**879.00**	**295.18**
10.00	11.00	10.50	1.00	8.50	19.34	9.34	99.39	3.14	28.5	28.5	1.0	169.60	951.06	0	1.0	0.0	15.71	11.0	11.4	44	10.20	2.88	1.62	104.1	553.24	1520.0	100.1	1066.9	**608.01**	**355.64**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
11.00	12.50	11.75	1.50	10.00	20.20	10.20	111.71	4.71	11.4	11.4	1.0	106.19	1057.25	44	1.0	207.4	223.14	12.5	11.4	44	10.41	2.88	1.62	119.4	588.01	1868.4	117.8	1398.2	**747.36**	**466.07**
12.50	15.50	14.00	3.00	13.00	20.41	10.41	134.98	9.43	11.4	11.4	1.0	256.61	1313.86	44	1.0	414.9	638.00	15.5	9.7	57	10.23	2.42	1.17	119.4	634.37	2586.2	153.2	2105.0	**1034.49**	**701.67**
15.50	18.50	17.00	3.00	16.00	20.23	10.23	134.98	9.43	9.7	9.7	1.0	217.53	1531.39	57	1.0	537.4	1175.43	18.5	8.1	60	10.25	2.13	0.93	119.4	627.59	3334.4	188.5	2895.3	**1333.76**	**965.10**
18.50	21.50	20.00	3.00	19.00	20.25	10.25	134.98	9.43	8.1	8.1	1.0	181.12	1712.51	60	1.0	565.7	1741.14	21.5	7.8	62	10.60	2.07	0.88	119.4	636.60	4090.3	223.8	3677.5	**1636.10**	**1225.83**
21.50	24.50	23.00	3.00	22.00	20.60	10.60	134.98	9.43	7.8	7.8	1.0	174.33	1886.84	62	1.0	584.6	2325.71	24.5	7.8	62	10.28	2.07	0.88	119.4	636.49	4849.0	259.2	4471.7	**1939.62**	**1490.58**
24.50	27.50	26.00	3.00	25.00	20.28	10.28	134.98	9.43	7.8	7.8	1.0	174.33	2061.17	62	1.0	584.6	2910.29	27.5	4.5	96	10.28	1.51	0.41	119.4	822.39	5793.8	294.5	5266.0	**2317.54**	**1755.33**
27.50	29.00	28.25	1.50	26.50	20.28	10.28	134.98	4.71	4.5	4.5	1.0	50.08	2111.24	96	1.0	452.6	3362.86	29.0	9.3	57	10.28	2.34	1.11	119.4	627.39	6101.5	312.2	5786.3	**2440.60**	**1928.77**
29.00	30.00	29.50	1.00	27.50	20.28	10.28	134.98	3.14	9.3	9.3	1.0	69.47	2180.71	57	1.0	179.1	3542.00	30.0	9.3	57	8.82	2.34	1.11	119.4	626.75	6349.5	324.0	6046.7	**2539.79**	**2015.56**
30.00	30.50	30.25	0.50	28.00	18.82	8.82	134.98	1.57	9.3	9.3	1.0	34.73	2215.44	57	1.0	89.6	3631.57	30.5	9.3	57	9.81	2.34	1.11	119.4	627.18	6474.2	329.9	6176.9	**2589.68**	**2058.96**
30.50	32.00	31.25	1.50	29.50	19.81	9.81	134.98	4.71	9.3	9.3	1.0	104.20	2319.64	57	1.0	268.7	3900.29	32.0	9.3	57	9.91	2.34	1.11	119.4	627.23	6847.2	347.5	6567.5	**2738.86**	**2189.16**
32.00	32.50	32.25	0.50	30.00	19.91	9.91	134.98	1.57	9.3	9.3	1.0	34.73	2354.38	57	1.0	89.6	3989.86	32.5	14.0	28	9.91	3.65	2.36	119.4	549.51	6893.7	353.4	6697.7	**2757.50**	**2232.55**
32.50	33.50	33.00	1.00	31.00	19.91	9.91	134.98	3.14	14.0	14.0	1.0	105.77	2460.14	28	1.0	88.0	4077.86	33.5	28.3	0	9.01	17.43	18.48	119.4	1700.18	8238.2	365.2	6903.2	**3295.27**	**2301.07**
33.50	35.00	34.25	1.50	32.50	19.01	9.01	134.98	4.71	28.3	28.3	1.0	342.62	2802.76	0	1.0	0.0	4077.86	35.0	28.3	0	7.32	17.43	18.48	119.4	1687.91	8568.5	382.9	7263.5	**3427.41**	**2421.17**
35.00	36.50	35.75	1.50	34.00	17.32	7.32	134.98	4.71	28.3	28.3	1.0	342.62	3145.38	0	1.0	0.0	4077.86	36.5	14.3	49	9.74	3.74	2.45	119.4	706.34	7929.6	400.6	7623.8	**3171.83**	**2541.26**
36.50	37.50	37.00	1.00	35.00	19.74	9.74	134.98	3.14	14.3	14.3	1.0	108.13	3253.51	49	1.0	154.0	4231.86	37.5	11.5	49	9.74	2.91	1.65	119.4	625.81	8111.2	412.3	7897.7	**3244.47**	**2632.57**
37.50	38.00	37.75	0.50	35.50	19.74	9.74	134.98	1.57	11.5	11.5	1.0	43.15	3296.66	49	1.0	77.0	4308.86	38.0	11.5	55	9.52	2.91	1.65	119.4	668.10	8273.6	418.2	8023.7	**3309.45**	**2674.58**
38.00	40.00	39.00	2.00	37.50	19.52	9.52	134.98	6.29	11.5	11.5	1.0	172.61	3469.27	55	1.0	345.7	4654.57	40.0	11.5	55	9.52	2.91	1.65	119.4	668.10	8791.9	441.8	8565.6	**3516.78**	**2855.21**

BORE NO: P69, CUT OFF LENGTH: 2.50 m, Nc= 9

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
2.50	3.00	2.75	0.50	0.50	19.39	9.39	25.82	1.57	27.2	27.2	1.0	20.85	0	4	1.0	6.3	0	3.0	13.5	43	9.39	3.50	2.22	28.2	389.73	389.7	5.9	5.9	**155.89**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.39	9.39	32.87	3.14	13.5	13.5	1.0	24.80	24.80	43	1.0	135.1	135.14	4.0	13.5	43	9.39	3.50	2.22	37.6	415.55	575.5	17.7	177.6	**230.20**	**59.20**
4.00	5.00	4.50	1.00	2.50	19.39	9.39	42.26	3.14	13.5	13.5	1.0	31.88	56.68	43	1.0	135.1	270.29	5.0	29.1	0	9.31	19.23	20.33	47.0	783.83	1110.8	29.5	356.4	**444.32**	**118.81**
5.00	6.00	5.50	1.00	3.50	19.31	9.31	51.61	3.14	29.1	29.1	1.0	90.27	146.95	0	1.0	0.0	270.29	6.0	28.8	0	9.31	18.56	19.64	56.3	892.13	1309.4	41.2	458.5	**523.75**	**152.82**
6.00	7.00	6.50	1.00	4.50	19.31	9.31	60.92	3.14	28.8	28.8	1.0	105.25	252.20	0	1.0	0.0	270.29	7.0	28.8	0	9.61	18.56	19.64	65.6	1030.19	1552.7	53.0	575.5	**621.07**	**191.83**
7.00	9.00	8.00	2.00	6.50	19.61	9.61	75.18	6.29	28.8	28.8	1.0	259.79	511.99	0	1.0	0.0	270.29	9.0	11.8	47	9.61	3.00	1.73	84.8	538.72	1321.0	76.6	858.9	**528.40**	**286.29**
9.00	10.00	9.50	1.00	7.50	19.61	9.61	89.60	3.14	11.8	11.8	1.0	58.83	570.82	47	1.0	147.7	418.00	10.0	7.2	35	9.61	1.97	0.79	94.4	396.30	1385.1	88.4	1077.2	**554.05**	**359.06**
10.00	11.00	10.50	1.00	8.50	19.61	9.61	99.21	3.14	7.2	7.2	1.0	39.39	610.21	35	1.0	110.0	528.00	11.0	11.8	47	10.16	3.00	1.73	104.0	584.38	1722.6	100.1	1238.3	**689.04**	**412.78**
11.00	12.50	11.75	1.50	10.00	20.16	10.16	111.63	4.71	11.8	11.8	1.0	109.94	720.15	47	1.0	221.6	749.57	12.5	11.8	47	10.37	3.00	1.73	119.3	620.44	2090.2	117.8	1587.5	**836.06**	**529.18**
12.50	15.50	14.00	3.00	13.00	20.37	10.37	134.81	9.43	11.8	11.8	1.0	265.53	985.68	47	1.0	443.1	1192.71	15.5	10.2	57	10.37	2.53	1.28	119.3	645.21	2823.6	153.2	2331.5	**1129.44**	**777.18**
15.50	17.00	16.25	1.50	14.50	20.37	10.37	134.81	4.71	10.2	10.2	1.0	114.35	1100.02	57	1.0	268.7	1461.43	17.0	24.7	8	9.63	9.78	10.55	119.3	1013.21	3574.7	170.8	2732.3	**1429.87**	**910.76**
17.00	18.50	17.75	1.50	16.00	19.63	9.63	134.81	4.71	24.7	24.7	1.0	292.30	1392.33	8	1.0	37.7	1499.14	18.5	12.0	48	10.10	3.06	1.79	119.3	633.06	3524.5	188.5	3080.0	**1409.81**	**1026.65**
18.50	21.50	20.00	3.00	19.00	20.10	10.10	134.81	9.43	12.0	12.0	1.0	270.16	1662.49	48	1.0	452.6	1951.71	21.5	12.0	48	10.10	3.06	1.79	119.3	633.06	4247.3	223.8	3838.0	**1698.91**	**1279.35**
21.50	23.00	22.25	1.50	20.50	20.10	10.10	134.81	4.71	12.0	12.0	1.0	135.08	1797.57	48	1.0	226.3	2178.00	23.0	11.3	44	10.30	2.85	1.59	119.3	584.82	4560.4	241.5	4217.1	**1824.16**	**1405.69**
23.00	24.50	23.75	1.50	22.00	20.30	10.30	134.81	4.71	11.3	11.3	1.0	126.99	1924.56	44	1.0	207.4	2385.43	24.5	8.2	65	10.30	2.15	0.94	119.3	664.53	4974.5	259.2	4569.2	**1989.81**	**1523.06**
24.50	26.00	25.25	1.50	23.50	20.30	10.30	134.81	4.71	8.2	8.2	1.0	91.58	2016.14	65	1.0	306.4	2691.86	26.0	8.2	65	10.40	2.15	0.94	119.3	664.57	5372.6	276.9	4984.8	**2149.02**	**1661.62**
26.00	27.50	26.75	1.50	25.00	20.40	10.40	134.81	4.71	8.2	8.2	1.0	91.58	2107.71	65	1.0	306.4	2998.29	27.5	8.2	65	10.40	2.15	0.94	119.3	664.57	5770.6	294.5	5400.5	**2308.23**	**1800.17**
27.50	29.00	28.25	1.50	26.50	20.40	10.40	134.81	4.71	8.2	8.2	1.0	91.58	2199.29	65	1.0	306.4	3304.71	29.0	14.0	30	10.40	3.65	2.36	119.3	563.79	6067.8	312.2	5816.2	**2427.12**	**1938.73**

APPENDIX-H
TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
29.00	30.00	29.50	1.00	27.50	20.40	10.40	134.81	3.14	14.0	14.0	1.0	105.63	2304.93	30	1.0	94.3	3399.00	30.0	14.0	30	9.05	3.65	2.36	119.3	562.54	6266.5	324.0	6027.9	**2506.59**	**2009.30**
30.00	30.50	30.25	0.50	28.00	19.05	9.05	134.81	1.57	14.0	14.0	1.0	52.82	2357.74	30	1.0	47.1	3446.14	30.5	10.3	48	9.07	2.56	1.31	119.3	583.78	6387.7	329.9	6133.8	**2555.06**	**2044.58**
30.50	32.00	31.25	1.50	29.50	19.07	9.07	134.81	4.71	10.3	10.3	1.0	115.49	2473.23	48	1.0	226.3	3672.43	32.0	8.2	68	10.36	2.15	0.94	119.3	685.77	6831.4	347.5	6493.2	**2732.57**	**2164.40**
32.00	32.50	32.25	0.50	30.00	20.36	10.36	134.81	1.57	8.2	8.2	1.0	30.53	2503.76	68	1.0	106.9	3779.29	32.5	8.2	68	10.36	2.15	0.94	119.3	685.77	6968.8	353.4	6636.5	**2787.53**	**2212.16**
32.50	33.50	33.00	1.00	31.00	20.36	10.36	134.81	3.14	8.2	8.2	1.0	61.05	2564.81	68	1.0	213.7	3993.00	33.5	8.2	68	7.93	2.15	0.94	119.3	684.87	7242.7	365.2	6923.0	**2897.07**	**2307.67**
33.50	35.00	34.25	1.50	32.50	17.93	7.93	134.81	4.71	8.2	8.2	1.0	91.58	2656.39	68	1.0	320.6	4313.57	35.0	12.0	48	8.37	3.06	1.79	119.3	631.84	7601.8	382.9	7352.8	**3040.72**	**2450.95**
35.00	36.50	35.75	1.50	34.00	18.37	8.37	134.81	4.71	12.0	12.0	1.0	135.08	2791.47	48	1.0	226.3	4539.86	36.5	12.0	48	9.23	3.06	1.79	119.3	632.45	7963.8	400.6	7731.9	**3185.51**	**2577.29**
36.50	37.50	37.00	1.00	35.00	19.23	9.23	134.81	3.14	12.0	12.0	1.0	90.05	2881.53	48	1.0	150.9	4690.71	37.5	8.0	58	9.23	2.11	0.91	119.3	611.15	8183.4	412.3	7984.6	**3273.36**	**2661.53**
37.50	38.00	37.75	0.50	35.50	19.23	9.23	134.81	1.57	8.0	8.0	1.0	29.77	2911.30	58	1.0	91.1	4781.86	38.0	8.0	58	8.66	2.11	0.91	119.3	610.95	8304.1	418.2	8111.4	**3321.64**	**2703.79**
38.00	40.00	39.00	2.00	37.50	18.66	8.66	134.81	6.29	8.0	8.0	1.0	119.09	3030.39	58	1.0	364.6	5146.43	40.0	8.0	58	8.66	2.11	0.91	119.3	610.95	8787.8	441.8	8618.6	**3515.10**	**2872.87**
BORE NO: P70, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.39	10.39	28.57	1.57	24.5	24.5	1.0	20.46	0	7	1.0	11.0	0	3.0	15.0	16	10.39	3.94	2.65	31.2	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	20.39	10.39	36.37	3.14	15.0	15.0	1.0	30.62	0	16	1.0	50.3	0	4.0	28.5	3	8.60	17.88	18.94	41.6	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	18.60	8.60	45.86	3.14	28.5	28.5	1.0	78.26	0	3	1.0	9.4	0	5.0	26.1	0	8.60	12.48	13.41	50.2	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	18.60	8.60	54.46	3.14	26.1	26.1	1.0	83.85	0	0	1.0	0.0	0	6.0	26.8	0	8.60	14.05	15.03	58.8	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	8.00	7.00	2.00	5.50	18.60	8.60	67.36	6.29	26.8	26.8	1.0	213.88	0	0	1.0	0.0	0	8.0	29.0	0	10.38	19.01	20.10	76.0	0	0.0	64.8	64.8	**0.00**	**21.60**
8.00	9.00	8.50	1.00	6.50	20.38	10.38	81.15	3.14	29.0	29.0	1.0	141.37	0	0	1.0	0.0	0	9.0	29.0	0	10.38	19.01	20.10	86.3	1371.40	1371.4	76.6	76.6	**548.56**	**25.53**
9.00	10.00	9.50	1.00	7.50	20.38	10.38	91.53	3.14	29.0	29.0	1.0	159.46	159.46	0	1.0	0.0	0.00	10.0	25.8	8	10.38	11.80	12.72	96.7	1005.30	1164.8	88.4	247.8	**465.90**	**82.60**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
10.00	11.00	10.50	1.00	8.50	20.38	10.38	101.91	3.14	25.8	25.8	1.0	154.83	314.29	8	1.0	25.1	25.14	11.0	25.8	8	10.38	11.80	12.72	107.1	1101.55	1441.0	100.1	439.6	**576.39**	**146.52**
11.00	12.00	11.50	1.00	9.50	20.38	10.38	112.29	3.14	25.8	25.8	1.0	170.60	484.89	8	1.0	25.1	50.29	12.0	11.9	50	10.38	3.03	1.76	117.5	640.32	1175.5	111.9	647.1	**470.20**	**215.70**
12.00	13.00	12.50	1.00	10.50	20.38	10.38	122.67	3.14	11.9	11.9	1.0	81.24	566.14	50	1.0	157.1	207.43	13.0	8.1	46	10.60	2.13	0.93	127.9	542.93	1316.5	123.7	897.3	**526.60**	**299.09**
13.00	14.50	13.75	1.50	12.00	20.60	10.60	135.81	4.71	8.1	8.1	1.0	91.12	657.26	46	1.0	216.9	424.29	14.5	9.6	48	10.60	2.40	1.16	143.8	615.12	1696.7	141.4	1222.9	**678.66**	**407.64**
14.50	16.00	15.25	1.50	13.50	20.60	10.60	135.81	4.71	9.6	9.6	1.0	108.29	765.55	48	1.0	226.3	650.57	16.0	9.6	48	10.60	2.40	1.16	143.8	615.12	2031.2	159.0	1575.2	**812.49**	**525.05**
16.00	17.50	16.75	1.50	15.00	20.60	10.60	135.81	4.71	9.6	9.6	1.0	108.29	873.84	48	1.0	226.3	876.86	17.5	9.6	48	10.60	2.40	1.16	143.8	615.12	2365.8	176.7	1927.4	**946.32**	**642.47**
17.50	19.00	18.25	1.50	16.50	20.60	10.60	135.81	4.71	9.6	9.6	1.0	108.29	982.13	48	1.0	226.3	1103.14	19.0	27.2	0	10.69	14.95	15.95	143.8	1756.12	3841.4	194.4	2279.7	**1536.56**	**759.89**
19.00	20.50	19.75	1.50	18.00	20.69	10.69	135.81	4.71	27.2	27.2	1.0	329.04	1311.17	0	1.0	0.0	1103.14	20.5	9.5	56	9.87	2.38	1.14	143.8	669.26	3083.6	212.1	2626.4	**1233.43**	**875.46**
20.50	23.50	22.00	3.00	21.00	19.87	9.87	135.81	9.43	9.5	9.5	1.0	214.28	1525.45	56	1.0	528.0	1631.14	23.5	10.2	59	10.33	2.53	1.28	143.8	708.04	3864.6	247.4	3404.0	**1545.85**	**1134.66**
23.50	26.50	25.00	3.00	24.00	20.33	10.33	135.81	9.43	10.2	10.2	1.0	230.40	1755.85	59	1.0	556.3	2187.43	26.5	10.2	59	10.33	2.53	1.28	143.8	708.04	4651.3	282.7	4226.0	**1860.53**	**1408.67**
26.50	27.50	27.00	1.00	25.00	20.33	10.33	135.81	3.14	10.2	10.2	1.0	76.80	1832.65	59	1.0	185.4	2372.86	27.5	8.2	54	10.33	2.15	0.94	143.8	628.08	4833.6	294.5	4500.0	**1933.44**	**1500.01**
27.50	28.00	27.75	0.50	25.50	20.33	10.33	135.81	1.57	8.2	8.2	1.0	30.75	1863.40	54	1.0	84.9	2457.71	28.0	8.2	54	10.40	2.15	0.94	143.8	628.11	4949.2	300.4	4621.5	**1979.69**	**1540.51**
28.00	29.50	28.75	1.50	27.00	20.40	10.40	135.81	4.71	8.2	8.2	1.0	92.26	1955.66	54	1.0	254.6	2712.29	29.5	8.2	54	10.40	2.15	0.94	143.8	628.11	5296.1	318.1	4986.0	**2118.42**	**1662.01**
29.50	30.00	29.75	0.50	27.50	20.40	10.40	135.81	1.57	8.2	8.2	1.0	30.75	1986.42	54	1.0	84.9	2797.14	30.0	8.2	54	10.40	2.15	0.94	143.8	628.11	5411.7	324.0	5107.5	**2164.67**	**1702.51**
30.00	31.00	30.50	1.00	28.50	20.40	10.40	135.81	3.14	8.2	8.2	1.0	61.51	2047.92	54	1.0	169.7	2966.86	31.0	13.0	60	10.40	3.35	2.08	143.8	811.17	5826.0	335.8	5350.5	**2330.38**	**1783.51**
31.00	32.50	31.75	1.50	30.00	20.40	10.40	135.81	4.71	13.0	13.0	1.0	147.81	2195.74	60	1.0	282.9	3249.71	32.5	13.5	60	9.60	3.50	2.22	143.8	828.00	6273.5	353.4	5798.9	**2509.38**	**1932.96**
32.50	34.00	33.25	1.50	31.50	19.60	9.60	135.81	4.71	13.5	13.5	1.0	153.71	2349.45	60	1.0	282.9	3532.57	34.0	27.4	0	9.60	15.40	16.41	143.8	1801.90	7683.9	371.1	6253.1	**3073.57**	**2084.37**
34.00	35.00	34.50	1.00	32.50	19.60	9.60	135.81	3.14	27.4	27.4	1.0	221.25	2570.69	0	1.0	0.0	3532.57	35.0	27.4	0	9.60	15.40	16.41	143.8	1801.90	7905.2	382.9	6486.1	**3162.07**	**2162.05**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
35.00	35.50	35.25	0.50	33.00	19.60	9.60	135.81	1.57	27.4	27.4	1.0	110.62	2681.32	0	1.0	0.0	3532.57	35.5	27.4	0	9.60	15.40	16.41	143.8	1801.90	8015.8	388.8	6602.7	**3206.32**	**2200.89**
35.50	37.00	36.25	1.50	34.50	19.60	9.60	135.81	4.71	27.4	27.4	1.0	331.87	3013.19	0	1.0	0.0	3532.57	37.0	23.4	0	9.60	8.85	9.12	143.8	1033.83	7579.6	406.4	6952.2	**3031.84**	**2317.40**
37.00	37.50	37.25	0.50	35.00	19.60	9.60	135.81	1.57	23.4	23.4	1.0	92.35	3105.54	0	1.0	0.0	3532.57	37.5	23.0	0	9.26	8.56	8.68	143.8	998.48	7636.6	412.3	7050.4	**3054.64**	**2350.15**
37.50	38.50	38.00	1.00	36.00	19.26	9.26	135.81	3.14	23.0	23.0	1.0	181.18	3286.72	0	1.0	0.0	3532.57	38.5	21.0	0	9.14	7.12	6.49	143.8	827.53	7646.8	424.1	7243.4	**3058.73**	**2414.47**
38.50	40.00	39.25	1.50	37.50	19.14	9.14	135.81	4.71	21.0	21.0	1.0	245.77	3532.49	0	1.0	0.0	3532.57	40.0	21.0	0	9.14	7.12	6.49	143.8	827.53	7892.6	441.8	7506.8	**3157.04**	**2502.28**
BORE NO: P71, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	18.58	8.58	23.60	1.57	11.2	11.2	1.0	7.34	0	41	1.0	64.4	0	3.0	11.2	41	8.58	2.82	1.56	25.7	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	18.58	8.58	30.03	3.14	11.2	11.2	1.0	18.69	0	41	1.0	128.9	0	4.0	11.2	41	8.58	2.82	1.56	34.3	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	18.58	8.58	38.61	3.14	11.2	11.2	1.0	24.03	0	41	1.0	128.9	0	5.0	28.4	0	10.06	17.66	18.71	42.9	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	20.06	10.06	47.93	3.14	28.4	28.4	1.0	81.45	0	0	1.0	0.0	0	6.0	25.4	0	10.06	10.90	11.80	53.0	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	7.00	6.50	1.00	4.50	20.06	10.06	57.99	3.14	25.4	25.4	1.0	86.54	0	0	1.0	0.0	0	7.0	28.6	0	9.38	18.11	19.17	63.0	0	0.0	53.0	53.0	**0.00**	**17.67**
7.00	9.00	8.00	2.00	6.50	19.38	9.38	72.40	6.29	28.6	28.6	1.0	248.12	0	0	1.0	0.0	0	9.0	9.2	50	9.38	2.33	1.10	81.8	507.07	507.1	76.6	76.6	**202.83**	**25.53**
9.00	10.00	9.50	1.00	7.50	19.38	9.38	86.47	3.14	9.2	9.2	1.0	44.02	44.02	50	1.0	157.1	157.14	10.0	9.2	50	9.38	2.33	1.10	91.2	524.21	725.4	88.4	289.5	**290.15**	**96.51**
10.00	11.00	10.50	1.00	8.50	19.38	9.38	95.85	3.14	9.2	9.2	1.0	48.79	92.81	50	1.0	157.1	314.29	11.0	24.8	11	9.88	9.86	10.66	100.5	897.75	1304.8	100.1	507.2	**521.93**	**169.08**
11.00	12.50	11.75	1.50	10.00	19.88	9.88	107.95	4.71	24.8	24.8	1.0	235.15	327.95	11	1.0	51.9	366.14	12.5	24.8	11	9.88	9.86	10.66	115.4	1012.51	1706.6	117.8	811.9	**682.64**	**270.64**
12.50	14.00	13.25	1.50	11.50	19.88	9.88	122.77	4.71	24.8	24.8	1.0	267.43	595.39	11	1.0	51.9	418.00	14.0	9.2	58	10.96	2.33	1.10	130.2	652.78	1666.2	135.5	1148.9	**666.47**	**382.96**
14.00	15.50	14.75	1.50	13.00	20.96	10.96	138.40	4.71	9.2	9.2	1.0	105.67	701.06	58	1.0	273.4	691.43	15.5	9.2	58	10.96	2.33	1.10	130.2	652.78	2045.3	153.2	1545.6	**818.11**	**515.21**
15.50	17.00	16.25	1.50	14.50	20.96	10.96	138.40	4.71	9.2	9.2	1.0	105.67	806.74	58	1.0	273.4	964.86	17.0	27.2	0	9.61	14.95	15.95	130.2	1589.79	3361.4	170.8	1942.4	**1344.55**	**647.47**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
17.00	18.50	17.75	1.50	16.00	19.61	9.61	138.40	4.71	27.2	27.2	1.0	335.32	1142.05	0	1.0	0.0	964.86	18.5	10.3	51	9.61	2.56	1.31	130.2	627.24	2734.1	188.5	2295.4	**1093.66**	**765.14**
18.50	20.00	19.25	1.50	17.50	19.61	9.61	138.40	4.71	10.3	10.3	1.0	118.57	1260.62	51	1.0	240.4	1205.29	20.0	10.3	51	10.63	2.56	1.31	130.2	627.76	3093.7	206.2	2672.1	**1237.47**	**890.69**
20.00	21.50	20.75	1.50	19.00	20.63	10.63	138.40	4.71	10.3	10.3	1.0	118.57	1379.20	51	1.0	240.4	1445.71	21.5	10.3	51	10.63	2.56	1.31	130.2	627.76	3452.7	223.8	3048.7	**1381.07**	**1016.25**
21.50	23.00	22.25	1.50	20.50	20.63	10.63	138.40	4.71	10.3	10.3	1.0	118.57	1497.77	51	1.0	240.4	1686.14	23.0	18.5	32	10.63	5.64	4.57	130.2	822.45	4006.4	241.5	3425.4	**1602.54**	**1141.81**
23.00	24.50	23.75	1.50	22.00	20.63	10.63	138.40	4.71	18.5	18.5	1.0	218.31	1716.08	32	1.0	150.9	1837.00	24.5	26.2	7	9.72	12.70	13.64	130.2	1400.85	4953.9	259.2	3812.3	**1981.57**	**1270.75**
24.50	27.50	26.00	3.00	25.00	19.72	9.72	138.40	9.43	26.2	26.2	1.0	642.10	2358.17	7	1.0	66.0	1903.00	27.5	9.0	75	9.72	2.29	1.07	130.2	768.66	5029.8	294.5	4555.7	**2011.93**	**1518.57**
27.50	29.00	28.25	1.50	26.50	19.72	9.72	138.40	4.71	9.0	9.0	1.0	103.34	2461.51	75	1.0	353.6	2256.57	29.0	9.0	75	9.72	2.29	1.07	130.2	768.66	5486.7	312.2	5030.3	**2194.70**	**1676.76**
29.00	30.00	29.50	1.00	27.50	19.72	9.72	138.40	3.14	9.0	9.0	1.0	68.89	2530.41	75	1.0	235.7	2492.29	30.0	9.5	50	10.73	2.38	1.14	130.2	601.83	5624.5	324.0	5346.7	**2249.81**	**1782.22**
30.00	30.50	30.25	0.50	28.00	20.73	10.73	138.40	1.57	9.5	9.5	1.0	36.39	2566.80	50	1.0	78.6	2570.86	30.5	9.5	50	9.11	2.38	1.14	130.2	601.10	5738.8	329.9	5467.5	**2295.50**	**1822.51**
30.50	32.00	31.25	1.50	29.50	19.11	9.11	138.40	4.71	9.5	9.5	1.0	109.18	2675.98	50	1.0	235.7	2806.57	32.0	8.5	56	9.22	2.20	0.99	130.2	624.61	6107.2	347.5	5830.1	**2442.87**	**1943.36**
32.00	32.50	32.25	0.50	30.00	19.22	9.22	138.40	1.57	8.5	8.5	1.0	32.50	2708.49	56	1.0	88.0	2894.57	32.5	8.5	56	9.22	2.20	0.99	130.2	624.61	6227.7	353.4	5956.5	**2491.07**	**1985.50**
32.50	33.50	33.00	1.00	31.00	19.22	9.22	138.40	3.14	8.5	8.5	1.0	65.01	2773.49	56	1.0	176.0	3070.57	33.5	8.3	78	10.16	2.16	0.96	130.2	776.74	6620.8	365.2	6209.3	**2648.32**	**2069.76**
33.50	35.00	34.25	1.50	32.50	20.16	10.16	138.40	4.71	8.3	8.3	1.0	95.18	2868.68	78	1.0	367.7	3438.29	35.0	9.2	63	9.59	2.33	1.10	130.2	687.55	6994.5	382.9	6689.8	**2797.80**	**2229.95**
35.00	36.50	35.75	1.50	34.00	19.59	9.59	138.40	4.71	9.2	9.2	1.0	105.67	2974.35	63	1.0	297.0	3735.29	36.5	9.2	63	9.35	2.33	1.10	130.2	687.44	7397.1	400.6	7110.2	**2958.83**	**2370.06**
36.50	37.50	37.00	1.00	35.00	19.35	9.35	138.40	3.14	9.2	9.2	1.0	70.45	3044.80	63	1.0	198.0	3933.29	37.5	9.2	57	9.35	2.33	1.10	130.2	645.01	7623.1	412.3	7390.4	**3049.24**	**2463.47**
37.50	38.00	37.75	0.50	35.50	19.35	9.35	138.40	1.57	9.2	9.2	1.0	35.22	3080.03	57	1.0	89.6	4022.86	38.0	9.2	57	9.59	2.33	1.10	130.2	645.12	7748.0	418.2	7521.1	**3099.20**	**2507.04**
38.00	40.00	39.00	2.00	37.50	19.59	9.59	138.40	6.29	9.2	9.2	1.0	140.90	3220.93	57	1.0	358.3	4381.14	40.0	9.2	57	9.59	2.33	1.10	130.2	645.12	8247.2	441.8	8043.9	**3298.88**	**2681.29**

BORE NO: P72, CUT OFF LENGTH: 2.50 m, Nc= 9

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
2.50	3.00	2.75	0.50	0.50	19.98	9.98	27.45	1.57	23.4	23.4	1.0	18.66	0	0	1.0	0.0	0	3.0	28.5	0	9.98	17.88	18.94	29.9	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.98	9.98	34.93	3.14	28.5	28.5	1.0	59.61	0	0	1.0	0.0	0	4.0	28.5	0	9.37	17.88	18.94	39.9	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	6.00	5.00	2.00	3.50	19.37	9.37	49.29	6.29	28.5	28.5	1.0	168.22	0	0	1.0	0.0	0	6.0	28.4	0	9.37	17.66	18.71	58.7	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	7.00	6.50	1.00	4.50	19.37	9.37	63.35	3.14	28.4	28.4	1.0	107.64	0	0	1.0	0.0	0	7.0	27.2	0	9.37	14.95	15.95	68.0	0	0.0	53.0	53.0	**0.00**	**17.67**
7.00	9.00	8.00	2.00	6.50	19.37	9.37	77.40	6.29	27.2	27.2	1.0	250.03	0	0	1.0	0.0	0	9.0	28.2	0	10.25	17.21	18.25	86.8	0	0.0	76.6	76.6	**0.00**	**25.53**
9.00	10.00	9.50	1.00	7.50	20.25	10.25	91.90	3.14	28.2	28.2	1.0	154.86	0	0	1.0	0.0	0	10.0	11.1	22	10.25	2.79	1.53	97.0	374.69	374.7	88.4	88.4	**149.88**	**29.45**
10.00	11.00	10.50	1.00	8.50	20.25	10.25	102.15	3.14	11.1	11.1	1.0	62.98	62.98	22	1.0	69.1	69.14	11.0	11.6	44	10.25	2.94	1.68	107.3	565.73	697.9	100.1	232.3	**279.14**	**77.42**
11.00	12.50	11.75	1.50	10.00	20.25	10.25	114.96	4.71	11.6	11.6	1.0	111.24	174.23	44	1.0	207.4	276.57	12.5	11.0	40	10.17	2.76	1.51	122.6	555.22	1006.0	117.8	568.6	**402.41**	**189.54**
12.50	15.50	14.00	3.00	13.00	20.17	10.17	137.90	9.43	11.0	11.0	1.0	252.73	426.96	40	1.0	377.1	653.71	15.5	8.1	40	10.17	2.13	0.93	122.6	491.62	1572.3	153.2	1233.8	**628.92**	**411.28**
15.50	17.00	16.25	1.50	14.50	20.17	10.17	137.90	4.71	8.1	8.1	1.0	92.52	519.48	40	1.0	188.6	842.29	17.0	10.2	46	10.38	2.53	1.28	122.6	574.18	1935.9	170.8	1532.6	**774.38**	**510.86**
17.00	18.50	17.75	1.50	16.00	20.38	10.38	137.90	4.71	10.2	10.2	1.0	116.97	636.46	46	1.0	216.9	1059.14	18.5	15.3	23	10.38	4.09	2.81	122.6	568.02	2263.6	188.5	1884.1	**905.45**	**628.03**
18.50	20.00	19.25	1.50	17.50	20.38	10.38	137.90	4.71	15.3	15.3	1.0	177.85	814.30	23	1.0	108.4	1167.57	20.0	9.3	52	10.35	2.34	1.11	122.6	598.11	2580.0	206.2	2188.0	**1032.00**	**729.35**
20.00	21.50	20.75	1.50	19.00	20.35	10.35	137.90	4.71	9.3	9.3	1.0	106.46	920.76	52	1.0	245.1	1412.71	21.5	9.3	52	10.35	2.34	1.11	122.6	598.11	2931.6	223.8	2557.3	**1172.64**	**852.44**
21.50	23.00	22.25	1.50	20.50	20.35	10.35	137.90	4.71	9.3	9.3	1.0	106.46	1027.22	52	1.0	245.1	1657.86	23.0	29.6	0	10.35	20.36	21.48	122.6	2049.18	4734.3	241.5	2926.6	**1893.70**	**975.53**
23.00	24.50	23.75	1.50	22.00	20.35	10.35	137.90	4.71	29.6	29.6	1.0	369.31	1396.53	0	1.0	0.0	1657.86	24.5	20.0	48	10.09	6.40	5.39	122.6	977.52	4031.9	259.2	3313.6	**1612.76**	**1104.52**
24.50	26.00	25.25	1.50	23.50	20.09	10.09	137.90	4.71	20.0	20.0	1.0	236.62	1633.14	48	1.0	226.3	1884.14	26.0	9.5	53	10.09	2.38	1.14	122.6	608.66	4125.9	276.9	3794.1	**1650.38**	**1264.71**
26.00	27.50	26.75	1.50	25.00	20.09	10.09	137.90	4.71	9.5	9.5	1.0	108.79	1741.93	53	1.0	249.9	2134.00	27.5	9.5	53	10.09	2.38	1.14	122.6	608.66	4484.6	294.5	4170.5	**1793.84**	**1390.15**
27.50	29.00	28.25	1.50	26.50	20.09	10.09	137.90	4.71	9.5	9.5	1.0	108.79	1850.72	53	1.0	249.9	2383.86	29.0	25.2	0	10.21	10.45	11.34	122.6	1052.53	5287.1	312.2	4546.8	**2114.84**	**1515.59**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
29.00	30.00	29.50	1.00	27.50	20.21	10.21	137.90	3.14	25.2	25.2	1.0	203.94	2054.67	0	1.0	0.0	2383.86	30.0	25.2	0	10.21	10.45	11.34	122.6	1052.53	5491.1	324.0	4762.5	**2196.42**	**1587.50**
30.00	30.50	30.25	0.50	28.00	20.21	10.21	137.90	1.57	25.2	25.2	1.0	101.97	2156.64	0	1.0	0.0	2383.86	30.5	25.0	0	10.21	10.00	10.88	122.6	1007.28	5547.8	329.9	4870.4	**2219.11**	**1623.45**
30.50	32.50	31.50	2.00	30.00	20.21	10.21	137.90	6.29	25.0	25.0	1.0	404.20	2560.83	0	1.0	0.0	2383.86	32.5	21.5	15	9.11	7.48	7.04	122.6	852.06	5796.7	353.4	5298.1	**2318.70**	**1766.04**
32.50	33.50	33.00	1.00	31.00	19.11	9.11	137.90	3.14	21.5	21.5	1.0	170.72	2731.55	15	1.0	47.1	2431.00	33.5	17.5	39	10.37	5.17	4.02	122.6	790.36	5952.9	365.2	5527.8	**2381.17**	**1842.59**
33.50	35.00	34.25	1.50	32.50	20.37	10.37	137.90	4.71	17.5	17.5	1.0	204.98	2936.53	39	1.0	183.9	2614.86	35.0	14.3	48	10.37	3.74	2.45	122.6	709.52	6260.9	382.9	5934.3	**2504.36**	**1978.09**
35.00	36.50	35.75	1.50	34.00	20.37	10.37	137.90	4.71	14.3	14.3	1.0	165.71	3102.24	48	1.0	226.3	2841.14	36.5	14.3	48	10.37	3.74	2.45	122.6	709.52	6652.9	400.6	6343.9	**2661.16**	**2114.64**
36.50	37.50	37.00	1.00	35.00	20.37	10.37	137.90	3.14	14.3	14.3	1.0	110.47	3212.71	48	1.0	150.9	2992.00	37.5	14.3	48	10.37	3.74	2.45	122.6	709.52	6914.2	412.3	6617.0	**2765.69**	**2205.68**
37.50	38.00	37.75	0.50	35.50	20.37	10.37	137.90	1.57	14.3	14.3	1.0	55.24	3267.95	48	1.0	75.4	3067.43	38.0	27.1	0	10.37	14.73	15.72	122.6	1483.38	7818.8	418.2	6753.6	**3127.50**	**2251.20**
38.00	40.00	39.00	2.00	37.50	20.37	10.37	137.90	6.29	27.1	27.1	1.0	443.56	3711.51	0	1.0	0.0	3067.43	40.0	18.0	0	10.37	5.42	4.29	122.6	539.40	7318.3	441.8	7220.7	**2927.34**	**2406.91**
BORE NO: P73, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	16.68	6.68	18.37	1.57	21.0	21.0	1.0	11.08	0	10	1.0	15.7	0	3.0	12.8	70	6.68	3.29	2.02	20.0	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	16.68	6.68	23.38	3.14	12.8	12.8	1.0	16.69	0	70	1.0	220.0	0	4.0	24.5	12	9.67	9.64	10.33	26.7	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	6.00	5.00	2.00	3.50	19.67	9.67	36.39	6.29	24.5	24.5	1.0	104.24	0	12	1.0	75.4	0	6.0	24.5	12	9.67	9.64	10.33	46.1	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	7.00	6.50	1.00	4.50	19.67	9.67	50.90	3.14	24.5	24.5	1.0	72.90	0	12	1.0	37.7	0	7.0	24.5	12	9.67	9.64	10.33	55.7	0	0.0	53.0	53.0	**0.00**	**17.67**
7.00	8.00	7.50	1.00	5.50	19.67	9.67	60.57	3.14	24.5	24.5	1.0	86.75	0	12	1.0	37.7	0	8.0	29.0	0	9.40	19.01	20.10	65.4	0	0.0	64.8	64.8	**0.00**	**21.60**
8.00	9.00	8.50	1.00	6.50	19.40	9.40	70.10	3.14	29.0	29.0	1.0	122.12	0	0	1.0	0.0	0	9.0	29.0	0	9.40	19.01	20.10	74.8	0	0.0	76.6	76.6	**0.00**	**25.53**
9.00	10.00	9.50	1.00	7.50	19.40	9.40	79.50	3.14	29.0	29.0	1.0	138.50	0	0	1.0	0.0	0	10.0	9.5	44	9.80	2.38	1.14	84.2	473.00	473.0	88.4	88.4	**189.20**	**29.45**
10.00	12.50	11.25	2.50	10.00	19.80	9.80	96.45	7.86	9.5	9.5	1.0	126.82	126.82	44	1.0	345.7	345.71	12.5	9.0	46	10.00	2.29	1.07	108.7	525.06	997.6	117.8	590.3	**399.03**	**196.78**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
12.50	15.50	14.00	3.00	13.00	20.00	10.00	123.70	9.43	9.0	9.0	1.0	184.73	311.54	46	1.0	433.7	779.43	15.5	9.0	46	10.00	2.29	1.07	108.7	525.06	1616.0	153.2	1244.1	**646.41**	**414.71**
15.50	17.00	16.25	1.50	14.50	20.00	10.00	123.70	4.71	9.0	9.0	1.0	92.36	403.90	46	1.0	216.9	996.29	17.0	26.5	4	8.50	13.38	14.34	108.7	1218.72	2618.9	170.8	1571.0	**1047.57**	**523.67**
17.00	18.50	17.75	1.50	16.00	18.50	8.50	123.70	4.71	26.5	26.5	1.0	290.75	694.66	4	1.0	18.9	1015.14	18.5	26.5	4	8.10	13.38	14.34	108.7	1216.47	2926.3	188.5	1898.3	**1170.51**	**632.76**
18.50	21.50	20.00	3.00	19.00	18.10	8.10	123.70	9.43	26.5	26.5	1.0	581.50	1276.16	4	1.0	37.7	1052.86	21.5	11.5	42	8.10	2.91	1.65	108.7	550.87	2879.9	223.8	2552.9	**1151.95**	**850.95**
21.50	23.00	22.25	1.50	20.50	18.10	8.10	123.70	4.71	11.5	11.5	1.0	118.64	1394.80	42	1.0	198.0	1250.86	23.0	8.0	62	8.10	2.11	0.91	108.7	621.54	3267.2	241.5	2887.2	**1306.88**	**962.39**
23.00	24.50	23.75	1.50	22.00	18.10	8.10	123.70	4.71	8.0	8.0	1.0	81.96	1476.76	62	1.0	292.3	1543.14	24.5	29.0	0	9.37	19.01	20.10	108.7	1697.36	4717.3	259.2	3279.1	**1886.91**	**1093.03**
24.50	26.00	25.25	1.50	23.50	19.37	9.37	123.70	4.71	29.0	29.0	1.0	323.25	1800.01	0	1.0	0.0	1543.14	26.0	7.5	38	9.37	2.02	0.84	108.7	444.31	3787.5	276.9	3620.0	**1514.99**	**1206.67**
26.00	27.50	26.75	1.50	25.00	19.37	9.37	123.70	4.71	7.5	7.5	1.0	76.77	1876.78	38	1.0	179.1	1722.29	27.5	7.5	38	9.37	2.02	0.84	108.7	444.31	4043.4	294.5	3893.6	**1617.35**	**1297.86**
27.50	29.00	28.25	1.50	26.50	19.37	9.37	123.70	4.71	7.5	7.5	1.0	76.77	1953.56	38	1.0	179.1	1901.43	29.0	28.5	0	9.37	17.88	18.94	108.7	1596.96	5451.9	312.2	4167.2	**2180.78**	**1389.06**
29.00	30.00	29.50	1.00	27.50	19.37	9.37	123.70	3.14	28.5	28.5	1.0	211.09	2164.64	0	1.0	0.0	1901.43	30.0	28.5	0	9.37	17.88	18.94	108.7	1596.96	5663.0	324.0	4390.0	**2265.21**	**1463.35**
30.00	30.50	30.25	0.50	28.00	19.37	9.37	123.70	1.57	28.5	28.5	1.0	105.54	2270.19	0	1.0	0.0	1901.43	30.5	7.5	50	9.37	2.02	0.84	108.7	529.17	4700.8	329.9	4501.5	**1880.31**	**1500.49**
30.50	32.00	31.25	1.50	29.50	19.37	9.37	123.70	4.71	7.5	7.5	1.0	76.77	2346.96	50	1.0	235.7	2137.14	32.0	29.0	0	9.37	19.01	20.10	108.7	1697.36	6181.5	347.5	4831.6	**2472.59**	**1610.55**
32.00	32.50	32.25	0.50	30.00	19.37	9.37	123.70	1.57	29.0	29.0	1.0	107.75	2454.71	0	1.0	0.0	2137.14	32.5	29.0	0	10.08	19.01	20.10	108.7	1702.97	6294.8	353.4	4945.3	**2517.93**	**1648.43**
32.50	33.50	33.00	1.00	31.00	20.08	10.08	123.70	3.14	29.0	29.0	1.0	215.50	2670.21	0	1.0	0.0	2137.14	33.5	8.5	53	10.08	2.20	0.99	108.7	566.60	5374.0	365.2	5172.6	**2149.58**	**1724.19**
33.50	35.00	34.25	1.50	32.50	20.08	10.08	123.70	4.71	8.5	8.5	1.0	87.15	2757.36	53	1.0	249.9	2387.00	35.0	8.5	53	10.08	2.20	0.99	108.7	566.60	5711.0	382.9	5527.2	**2284.38**	**1842.42**
35.00	36.50	35.75	1.50	34.00	20.08	10.08	123.70	4.71	8.5	8.5	1.0	87.15	2844.52	53	1.0	249.9	2636.86	36.5	8.5	53	10.08	2.20	0.99	108.7	566.60	6048.0	400.6	5881.9	**2419.19**	**1960.64**
36.50	37.50	37.00	1.00	35.00	20.08	10.08	123.70	3.14	8.5	8.5	1.0	58.10	2902.62	53	1.0	166.6	2803.43	37.5	10.5	72	10.08	2.62	1.36	108.7	738.05	6444.1	412.3	6118.4	**2577.64**	**2039.46**
37.50	38.00	37.75	0.50	35.50	20.08	10.08	123.70	1.57	10.5	10.5	1.0	36.03	2938.65	72	1.0	113.1	2916.57	38.0	10.5	72	8.28	2.62	1.36	108.7	737.09	6592.3	418.2	6273.4	**2636.92**	**2091.15**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
38.00	40.00	39.00	2.00	37.50	18.28	8.28	123.70	6.29	10.5	10.5	1.0	144.11	3082.76	72	1.0	452.6	3369.14	40.0	10.5	72	8.28	2.62	1.36	108.7	737.09	7189.0	441.8	6893.7	**2875.59**	**2297.90**
BORE NO: P74, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.63	9.63	26.48	1.57	23.9	23.9	1.0	18.44	0	0	1.0	0.0	0	3.0	12.8	24	9.63	3.29	2.02	28.9	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.63	9.63	33.71	3.14	12.8	12.8	1.0	24.07	0	24	1.0	75.4	0	4.0	12.4	24	9.63	3.17	1.91	38.5	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	19.63	9.63	43.34	3.14	12.4	12.4	1.0	29.94	0	24	1.0	75.4	0	5.0	26.9	6	9.52	14.28	15.26	48.2	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	19.52	9.52	52.91	3.14	26.9	26.9	1.0	84.36	0	6	1.0	18.9	0	6.0	28.9	6	9.52	18.78	19.87	57.7	0	0.0	41.2	41.2	**0.00**	**13.74**
6.00	7.00	6.50	1.00	4.50	19.52	9.52	62.43	3.14	28.9	28.9	1.0	108.31	0	6	1.0	18.9	0	7.0	28.9	2	9.44	18.78	19.87	67.2	0	0.0	53.0	53.0	**0.00**	**17.67**
7.00	9.00	8.00	2.00	6.50	19.44	9.44	76.63	6.29	28.9	28.9	1.0	265.90	0	2	1.0	12.6	0	9.0	28.9	2	9.44	18.78	19.87	86.1	0	0.0	76.6	76.6	**0.00**	**25.53**
9.00	10.00	9.50	1.00	7.50	19.44	9.44	90.79	3.14	28.9	28.9	1.0	157.52	0	2	1.0	6.3	0	10.0	10.2	24	9.44	2.53	1.28	95.5	0	0.0	88.4	88.4	**0.00**	**29.45**
10.00	11.00	10.50	1.00	8.50	19.44	9.44	100.23	3.14	10.2	10.2	1.0	56.68	0	24	1.0	75.4	0	11.0	26.3	7	9.67	12.93	13.88	105.0	0	0.0	100.1	100.1	**0.00**	**33.38**
11.00	12.50	11.75	1.50	10.00	19.67	9.67	112.20	4.71	26.3	26.3	1.0	261.43	0	7	1.0	33.0	0	12.5	12.0	30	9.67	3.06	1.79	119.5	0	0.0	117.8	117.8	**0.00**	**39.27**
12.50	14.00	13.25	1.50	11.50	19.67	9.67	126.71	4.71	12.0	12.0	1.0	126.97	0	30	1.0	141.4	0	14.0	27.1	0	9.83	14.73	15.72	134.0	0	0.0	135.5	135.5	**0.00**	**45.16**
14.00	15.50	14.75	1.50	13.00	19.83	9.83	141.33	4.71	27.1	27.1	1.0	340.95	0	0	1.0	0.0	0	15.5	11.7	52	10.31	2.97	1.71	134.0	687.21	687.2	153.2	153.2	**274.88**	**51.05**
15.50	18.50	17.00	3.00	16.00	20.31	10.31	141.33	9.43	11.7	11.7	1.0	275.96	275.96	52	1.0	490.3	490.29	18.5	26.9	0	10.31	14.28	15.26	134.0	1564.68	2330.9	188.5	954.7	**932.37**	**318.25**
18.50	20.00	19.25	1.50	17.50	20.31	10.31	141.33	4.71	26.9	26.9	1.0	338.02	613.98	0	1.0	0.0	490.29	20.0	11.7	56	10.31	2.97	1.71	134.0	715.49	1819.8	206.2	1310.4	**727.91**	**436.81**
20.00	21.50	20.75	1.50	19.00	20.31	10.31	141.33	4.71	11.7	11.7	1.0	137.98	751.97	56	1.0	264.0	754.29	21.5	10.0	56	8.86	2.47	1.22	134.0	660.22	2166.5	223.8	1730.1	**866.59**	**576.70**
21.50	23.00	22.25	1.50	20.50	18.86	8.86	141.33	4.71	10.0	10.0	1.0	117.48	869.45	56	1.0	264.0	1018.29	23.0	8.2	58	8.59	2.15	0.94	134.0	639.20	2526.9	241.5	2129.2	**1010.77**	**709.75**
23.00	24.50	23.75	1.50	22.00	18.59	8.59	141.33	4.71	8.2	8.2	1.0	96.01	965.46	58	1.0	273.4	1291.71	24.5	7.0	81	10.87	1.93	0.76	134.0	779.16	3036.3	259.2	2516.4	**1214.54**	**838.79**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
24.50	26.00	25.25	1.50	23.50	20.87	10.87	141.33	4.71	7.0	7.0	1.0	81.81	1047.27	81	1.0	381.9	1673.57	26.0	7.0	81	8.59	1.93	0.76	134.0	778.48	3499.3	276.9	2997.7	**1399.73**	**999.23**
26.00	27.50	26.75	1.50	25.00	18.59	8.59	141.33	4.71	7.0	7.0	1.0	81.81	1129.08	81	1.0	381.9	2055.43	27.5	7.0	81	10.54	1.93	0.76	134.0	779.07	3963.6	294.5	3479.0	**1585.43**	**1159.68**
27.50	29.00	28.25	1.50	26.50	20.54	10.54	141.33	4.71	7.0	7.0	1.0	81.81	1210.89	81	1.0	381.9	2437.29	29.0	18.0	26	8.62	5.42	4.29	134.0	768.46	4416.6	312.2	3960.4	**1766.65**	**1320.12**
29.00	30.00	29.50	1.00	27.50	18.62	8.62	141.33	3.14	18.0	18.0	1.0	144.33	1355.21	26	1.0	81.7	2519.00	30.0	18.0	26	8.62	5.42	4.29	134.0	768.46	4642.7	324.0	4198.2	**1857.07**	**1399.40**
30.00	30.50	30.25	0.50	28.00	18.62	8.62	141.33	1.57	18.0	18.0	1.0	72.16	1427.38	26	1.0	40.9	2559.86	30.5	18.0	26	9.41	5.42	4.29	134.0	769.79	4757.0	329.9	4317.1	**1902.81**	**1439.03**
30.50	32.00	31.25	1.50	29.50	19.41	9.41	141.33	4.71	18.0	18.0	1.0	216.49	1643.86	26	1.0	122.6	2682.43	32.0	8.0	63	9.36	2.11	0.91	134.0	670.94	4997.2	347.5	4673.8	**1998.89**	**1557.94**
32.00	32.50	32.25	0.50	30.00	19.36	9.36	141.33	1.57	8.0	8.0	1.0	31.21	1675.08	63	1.0	99.0	2781.43	32.5	8.0	63	9.36	2.11	0.91	134.0	670.94	5127.4	353.4	4809.9	**2050.98**	**1603.31**
32.50	33.50	33.00	1.00	31.00	19.36	9.36	141.33	3.14	8.0	8.0	1.0	62.43	1737.50	63	1.0	198.0	2979.43	33.5	4.5	0	9.29	1.51	0.41	134.0	160.73	4877.7	365.2	5082.1	**1951.06**	**1694.05**
33.50	35.00	34.25	1.50	32.50	19.29	9.29	141.33	4.71	4.5	4.5	1.0	52.44	1789.94	0	1.0	0.0	2979.43	35.0	12.0	25	9.63	3.06	1.79	134.0	505.43	5274.8	382.9	5152.3	**2109.92**	**1717.42**
35.00	36.50	35.75	1.50	34.00	19.63	9.63	141.33	4.71	12.0	12.0	1.0	141.62	1931.56	25	1.0	117.9	3097.29	36.5	9.1	53	8.70	2.31	1.08	134.0	621.41	5650.3	400.6	5429.4	**2260.10**	**1809.80**
36.50	37.50	37.00	1.00	35.00	18.70	8.70	141.33	3.14	9.1	9.1	1.0	71.15	2002.71	53	1.0	166.6	3263.86	37.5	9.1	53	8.70	2.31	1.08	134.0	621.41	5888.0	412.3	5678.9	**2355.19**	**1892.97**
37.50	38.00	37.75	0.50	35.50	18.70	8.70	141.33	1.57	9.1	9.1	1.0	35.57	2038.29	53	1.0	83.3	3347.14	38.0	9.1	53	8.96	2.31	1.08	134.0	621.52	6006.9	418.2	5803.7	**2402.78**	**1934.55**
38.00	40.00	39.00	2.00	37.50	18.96	8.96	141.33	6.29	9.1	9.1	1.0	142.29	2180.58	53	1.0	333.1	3680.29	40.0	9.1	53	8.96	1.93	1.08	134.0	581.73	6442.6	441.8	6302.7	**2577.04**	**2100.88**
BORE NO: P75, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.69	9.69	26.65	1.57	23.4	23.4	1.0	18.12	0	0	1.0	0.0	0	3.0	25.8	6	9.69	11.80	12.72	29.1	360.42	360.4	5.9	5.9	**144.17**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.69	9.69	33.92	3.14	25.8	25.8	1.0	51.53	51.53	6	1.0	18.9	18.86	4.0	25.8	6	9.69	11.80	12.72	38.8	450.27	520.7	17.7	88.1	**208.26**	**29.35**
4.00	5.00	4.50	1.00	2.50	19.69	9.69	43.61	3.14	25.8	25.8	1.0	66.25	117.78	6	1.0	18.9	37.71	5.0	25.8	6	9.76	11.80	12.72	48.5	540.47	696.0	29.5	184.9	**278.39**	**61.65**
5.00	6.00	5.50	1.00	3.50	19.76	9.76	53.33	3.14	25.8	25.8	1.0	81.03	198.80	6	1.0	18.9	56.57	6.0	25.8	6	9.76	11.80	12.72	58.2	630.97	886.3	41.2	296.6	**354.54**	**98.87**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
6.00	7.00	6.50	1.00	4.50	19.76	9.76	63.09	3.14	25.8	25.8	1.0	95.85	294.66	6	1.0	18.9	75.43	7.0	25.7	2	10.89	11.58	12.49	68.0	685.82	1055.9	53.0	423.1	**422.36**	**141.03**
7.00	9.00	8.00	2.00	6.50	20.89	10.89	78.86	6.29	25.7	25.7	1.0	238.56	533.22	2	1.0	12.6	88.00	9.0	24.6	2	10.89	9.71	10.44	89.8	743.68	1364.9	76.6	697.8	**545.96**	**232.60**
9.00	10.00	9.50	1.00	7.50	20.89	10.89	95.20	3.14	24.6	24.6	1.0	136.98	670.19	2	1.0	6.3	94.29	10.0	13.5	24	9.80	3.50	2.22	100.6	455.03	1219.5	88.4	852.8	**487.80**	**284.28**
10.00	12.50	11.25	2.50	10.00	19.80	9.80	112.89	7.86	13.5	13.5	1.0	212.95	883.14	24	1.0	188.6	282.86	12.5	13.5	24	9.80	3.50	2.22	125.1	522.40	1688.4	117.8	1283.8	**675.36**	**427.94**
12.50	14.00	13.25	1.50	11.50	19.80	9.80	132.49	4.71	13.5	13.5	1.0	149.95	1033.09	24	1.0	113.1	396.00	14.0	8.2	62	10.26	2.15	0.94	139.8	678.02	2107.1	135.5	1564.6	**842.85**	**521.53**
14.00	15.50	14.75	1.50	13.00	20.26	10.26	147.54	4.71	8.2	8.2	1.0	100.23	1133.32	62	1.0	292.3	688.29	15.5	8.2	62	10.26	2.15	0.94	139.8	678.02	2499.6	153.2	1974.8	**999.85**	**658.25**
15.50	17.00	16.25	1.50	14.50	20.26	10.26	147.54	4.71	8.2	8.2	1.0	100.23	1233.55	62	1.0	292.3	980.57	17.0	26.7	0	9.48	13.83	14.80	139.8	1574.48	3788.6	170.8	2384.9	**1515.44**	**794.98**
17.00	18.50	17.75	1.50	16.00	19.48	9.48	147.54	4.71	26.7	26.7	1.0	349.81	1583.36	0	1.0	0.0	980.57	18.5	31.0	0	9.48	26.30	27.53	139.8	2991.87	5555.8	188.5	2752.4	**2222.32**	**917.47**
18.50	21.50	20.00	3.00	19.00	19.48	9.48	147.54	9.43	31.0	31.0	1.1	877.61	2460.97	0	1.0	0.0	980.57	21.5	9.3	56	10.41	2.34	1.11	139.8	658.09	4099.6	223.8	3665.4	**1639.86**	**1221.79**
21.50	24.50	23.00	3.00	22.00	20.41	10.41	147.54	9.43	9.3	9.3	1.0	227.79	2688.76	56	1.0	528.0	1508.57	24.5	27.0	0	10.41	14.50	15.49	139.8	1656.94	5854.3	259.2	4456.5	**2341.71**	**1485.51**
24.50	26.00	25.25	1.50	23.50	20.41	10.41	147.54	4.71	27.0	27.0	1.0	354.39	3043.15	0	1.0	0.0	1508.57	26.0	24.3	5	10.41	9.50	10.11	139.8	1120.08	5671.8	276.9	4828.6	**2268.72**	**1609.53**
26.00	27.50	26.75	1.50	25.00	20.41	10.41	147.54	4.71	24.3	24.3	1.0	314.04	3357.19	5	1.0	23.6	1532.14	27.5	10.5	28	9.64	2.62	1.36	139.8	490.70	5380.0	294.5	5183.9	**2152.01**	**1727.95**
27.50	29.00	28.25	1.50	26.50	19.64	9.64	147.54	4.71	10.5	10.5	1.0	128.91	3486.10	28	1.0	132.0	1664.14	29.0	28.7	0	9.64	18.33	19.40	139.8	2087.71	7238.0	312.2	5462.4	**2895.18**	**1820.81**
29.00	30.00	29.50	1.00	27.50	19.64	9.64	147.54	3.14	28.7	28.7	1.0	253.86	3739.96	0	1.0	0.0	1664.14	30.0	28.0	0	9.64	16.76	17.79	139.8	1908.40	7312.5	324.0	5728.1	**2925.00**	**1909.36**
30.00	30.50	30.25	0.50	28.00	19.64	9.64	147.54	1.57	28.0	28.0	1.0	123.27	3863.23	0	1.0	0.0	1664.14	30.5	7.0	70	9.64	1.93	0.76	139.8	709.93	6237.3	329.9	5857.2	**2494.92**	**1952.41**
30.50	32.00	31.25	1.50	29.50	19.64	9.64	147.54	4.71	7.0	7.0	1.0	85.40	3948.63	70	1.0	330.0	1994.14	32.0	27.6	0	9.86	15.85	16.87	139.8	1807.40	7750.2	347.5	6290.3	**3100.07**	**2096.77**
32.00	32.50	32.25	0.50	30.00	19.86	9.86	147.54	1.57	27.6	27.6	1.0	121.20	4069.83	0	1.0	0.0	1994.14	32.5	27.6	0	9.86	15.85	16.87	139.8	1807.40	7871.4	353.4	6417.4	**3148.55**	**2139.13**
32.50	33.50	33.00	1.00	31.00	19.86	9.86	147.54	3.14	27.6	27.6	1.0	242.41	4312.24	0	1.0	0.0	1994.14	33.5	7.2	74	9.86	1.97	0.79	139.8	742.35	7048.7	365.2	6671.6	**2819.49**	**2223.86**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2
Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
33.50	35.00	34.25	1.50	32.50	19.86	9.86	147.54	4.71	7.2	7.2	1.0	87.86	4400.10	74	1.0	348.9	2343.00	35.0	16.2	43	9.86	4.53	3.31	139.8	814.66	7557.8	382.9	7126.0	**3023.10**	**2375.33**
35.00	36.50	35.75	1.50	34.00	19.86	9.86	147.54	4.71	16.2	16.2	1.0	202.07	4602.17	43	1.0	202.7	2545.71	36.5	28.1	0	9.00	16.98	18.02	139.8	1929.49	9077.4	400.6	7548.4	**3630.95**	**2516.15**
36.50	37.50	37.00	1.00	35.00	19.00	9.00	147.54	3.14	28.1	28.1	1.0	247.58	4849.75	0	1.0	0.0	2545.71	37.5	28.8	0	9.00	18.56	19.64	139.8	2108.39	9503.9	412.3	7807.8	**3801.54**	**2602.60**
37.50	38.00	37.75	0.50	35.50	19.00	9.00	147.54	1.57	28.8	28.8	1.0	127.46	4977.21	0	1.0	0.0	2545.71	38.0	29.2	0	8.87	19.46	20.56	139.8	2209.57	9732.5	418.2	7941.1	**3893.00**	**2647.05**
38.00	40.00	39.00	2.00	37.50	18.87	8.87	147.54	6.29	29.2	29.2	1.0	518.29	5495.50	0	1.0	0.0	2545.71	40.0	29.2	0	8.87	19.46	20.56	139.8	2209.57	10250.8	441.8	8483.0	**4100.31**	**2827.67**
BORE NO: P76, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	16.08	6.08	16.72	1.57	15.0	15.0	1.0	7.04	7.04	41	1.0	64.4	64.43	3.0	12.4	50	9.18	3.17	1.91	18.2	405.95	477.4	5.9	77.4	**190.97**	**25.79**
3.00	5.00	4.00	2.00	2.50	19.18	9.18	27.42	6.29	12.4	12.4	1.0	37.89	44.93	50	1.0	314.3	378.71	5.0	10.5	47	9.18	2.62	1.36	36.6	412.53	836.2	29.5	453.1	**334.47**	**151.03**
5.00	6.00	5.50	1.00	3.50	19.18	9.18	41.19	3.14	10.5	10.5	1.0	23.99	68.93	47	1.0	147.7	526.43	6.0	10.5	47	9.18	2.62	1.36	45.8	431.41	1026.8	41.2	636.6	**410.70**	**212.20**
6.00	7.00	6.50	1.00	4.50	19.18	9.18	50.37	3.14	10.5	10.5	1.0	29.34	98.27	47	1.0	147.7	674.14	7.0	10.5	47	10.30	2.62	1.36	55.0	450.88	1223.3	53.0	825.4	**489.32**	**275.14**
7.00	8.00	7.50	1.00	5.50	20.30	10.30	60.11	3.14	10.5	10.5	1.0	35.01	133.28	47	1.0	147.7	821.86	8.0	10.5	47	10.30	2.62	1.36	65.3	472.06	1427.2	64.8	1019.9	**570.88**	**339.98**
8.00	9.00	8.50	1.00	6.50	20.30	10.30	70.41	3.14	10.5	10.5	1.0	41.01	174.30	47	1.0	147.7	969.57	9.0	9.0	50	10.30	2.29	1.07	75.6	493.84	1637.7	76.6	1220.4	**655.08**	**406.81**
9.00	10.00	9.50	1.00	7.50	20.30	10.30	80.71	3.14	9.0	9.0	1.0	40.18	214.47	50	1.0	157.1	1126.71	10.0	26.5	9	9.60	13.38	14.34	85.9	1020.20	2361.4	88.4	1429.5	**944.55**	**476.51**
10.00	11.00	10.50	1.00	8.50	19.60	9.60	90.66	3.14	26.5	26.5	1.0	142.06	356.53	9	1.0	28.3	1155.00	11.0	27.0	12	9.60	14.50	15.49	95.5	1231.12	2742.6	100.1	1611.7	**1097.06**	**537.22**
11.00	12.00	11.50	1.00	9.50	19.60	9.60	100.26	3.14	27.0	27.0	1.0	160.55	517.09	12	1.0	37.7	1192.71	12.0	27.0	12	10.30	14.50	15.49	105.1	1344.78	3054.6	111.9	1821.7	**1221.83**	**607.24**
12.00	14.50	13.25	2.50	12.00	20.30	10.30	117.94	7.86	27.0	27.0	1.0	472.14	989.23	12	1.0	94.3	1287.00	14.5	12.5	38	10.40	3.20	1.94	130.8	605.92	2882.2	141.4	2417.6	**1152.86**	**805.87**
14.50	17.50	16.00	3.00	15.00	20.40	10.40	117.94	9.43	12.5	12.5	1.0	246.52	1235.74	38	1.0	358.3	1645.29	17.5	16.8	32	10.40	4.83	3.64	130.8	737.11	3618.1	176.7	3057.7	**1447.26**	**1019.25**
17.50	19.00	18.25	1.50	16.50	20.40	10.40	117.94	4.71	16.8	16.8	1.0	167.86	1403.60	32	1.0	150.9	1796.14	19.0	7.6	68	10.40	2.04	0.85	130.8	693.80	3893.5	194.4	3394.1	**1557.42**	**1131.38**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
19.00	20.50	19.75	1.50	18.00	20.40	10.40	117.94	4.71	7.6	7.6	1.0	74.18	1477.79	68	1.0	320.6	2116.71	20.5	15.3	78	9.80	4.09	2.81	130.8	982.53	4577.0	212.1	3806.6	**1830.81**	**1268.85**
20.50	23.50	22.00	3.00	21.00	19.80	9.80	117.94	9.43	15.3	15.3	1.0	304.20	1781.98	78	1.0	735.4	2852.14	23.5	15.3	78	9.80	4.09	2.81	130.8	982.53	5616.7	247.4	4881.5	**2246.66**	**1627.18**
23.50	25.00	24.25	1.50	22.50	19.80	9.80	117.94	4.71	15.3	15.3	1.0	152.10	1934.08	78	1.0	367.7	3219.86	25.0	28.3	0	9.80	17.43	18.48	130.8	1862.74	7016.7	265.1	5419.0	**2806.67**	**1806.34**
25.00	26.50	25.75	1.50	24.00	19.80	9.80	117.94	4.71	28.3	28.3	1.0	299.36	2233.45	0	1.0	0.0	3219.86	26.5	11.2	54	9.80	2.82	1.56	130.8	678.00	6131.3	282.7	5736.0	**2452.52**	**1912.02**
26.50	27.50	27.00	1.00	25.00	19.80	9.80	117.94	3.14	11.2	11.2	1.0	73.39	2306.84	54	1.0	169.7	3389.57	27.5	12.5	60	10.80	3.20	1.94	130.8	761.80	6458.2	294.5	5990.9	**2583.28**	**1996.98**
27.50	29.50	28.50	2.00	27.00	20.80	10.80	117.94	6.29	12.5	12.5	1.0	164.34	2471.18	60	1.0	377.1	3766.71	29.5	12.5	60	10.80	3.20	1.94	130.8	761.80	6999.7	318.1	6556.0	**2799.88**	**2185.33**
29.50	30.00	29.75	0.50	27.50	20.80	10.80	117.94	1.57	12.5	12.5	1.0	41.09	2512.27	60	1.0	94.3	3861.00	30.0	10.0	50	10.80	2.47	1.22	130.8	612.61	6985.9	324.0	6697.2	**2794.35**	**2232.41**
30.00	31.00	30.50	1.00	28.50	20.80	10.80	117.94	3.14	10.0	10.0	1.0	65.36	2577.62	50	1.0	157.1	4018.14	31.0	18.0	7	10.80	5.42	4.29	130.8	624.37	7220.1	335.8	6931.5	**2888.06**	**2310.51**
31.00	32.50	31.75	1.50	30.00	20.80	10.80	117.94	4.71	18.0	18.0	1.0	180.65	2758.27	7	1.0	33.0	4051.14	32.5	23.5	7	9.55	8.92	9.23	130.8	1000.93	7810.3	353.4	7162.8	**3124.14**	**2387.61**
32.50	34.00	33.25	1.50	31.50	19.55	9.55	117.94	4.71	23.5	23.5	1.0	241.75	3000.02	7	1.0	33.0	4084.14	34.0	21.5	7	9.55	7.48	7.04	130.8	844.69	7928.9	371.1	7455.3	**3171.54**	**2485.09**
34.00	35.00	34.50	1.00	32.50	19.55	9.55	117.94	3.14	21.5	21.5	1.0	146.00	3146.02	7	1.0	22.0	4106.14	35.0	21.5	20	9.55	7.48	7.04	130.8	936.62	8188.8	382.9	7635.0	**3275.51**	**2545.02**
35.00	35.50	35.25	0.50	33.00	19.55	9.55	117.94	1.57	21.5	21.5	1.0	73.00	3219.03	20	1.0	31.4	4137.57	35.5	21.5	20	9.55	7.48	7.04	130.8	936.62	8293.2	388.8	7745.4	**3317.29**	**2581.79**
35.50	37.00	36.25	1.50	34.50	19.55	9.55	117.94	4.71	21.5	21.5	1.0	219.01	3438.03	20	1.0	94.3	4231.86	37.0	20.5	48	9.55	6.76	5.94	130.8	1056.50	8726.4	406.4	8076.3	**3490.55**	**2692.11**
37.00	37.50	37.25	0.50	35.00	19.55	9.55	117.94	1.57	20.5	20.5	1.0	69.29	3507.32	48	1.0	75.4	4307.29	37.5	20.5	48	8.99	6.76	5.94	130.8	1055.19	8869.8	412.3	8226.9	**3547.92**	**2742.31**
37.50	38.50	38.00	1.00	36.00	18.99	8.99	117.94	3.14	20.5	20.5	1.0	138.58	3645.90	48	1.0	150.9	4458.14	38.5	14.3	52	9.13	3.74	2.45	130.8	760.59	8864.6	424.1	8528.2	**3545.85**	**2842.72**
38.50	40.00	39.25	1.50	37.50	19.13	9.13	117.94	4.71	14.3	14.3	1.0	141.72	3787.62	52	1.0	245.1	4703.29	40.0	10.2	54	9.13	2.53	1.28	130.8	646.35	9137.3	441.8	8932.7	**3654.90**	**2977.56**
BORE NO: P77, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	18.20	8.20	22.55	1.57	12.9	12.9	1.0	8.12	8.12	28	1.0	44.0	44.00	3.0	10.0	37	8.20	2.47	1.22	24.6	313.31	365.4	5.9	58.0	**146.17**	**19.34**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
3.00	4.00	3.50	1.00	1.50	18.20	8.20	28.70	3.14	10.0	10.0	1.0	15.90	24.02	37	1.0	116.3	160.29	4.0	23.6	18	9.99	8.99	9.34	32.8	395.69	580.0	17.7	202.0	**232.00**	**67.33**
4.00	5.00	4.50	1.00	2.50	19.99	9.99	37.80	3.14	23.6	23.6	1.0	51.90	75.92	18	1.0	56.6	216.86	5.0	25.5	13	9.99	11.13	12.03	42.8	513.21	806.0	29.5	322.2	**322.39**	**107.41**
5.00	6.00	5.50	1.00	3.50	19.99	9.99	47.79	3.14	25.5	25.5	1.0	71.63	147.55	13	1.0	40.9	257.71	6.0	25.5	13	9.80	11.13	12.03	52.8	599.65	1004.9	41.2	446.5	**401.96**	**148.83**
6.00	8.00	7.00	2.00	5.50	19.80	9.80	62.58	6.29	25.5	25.5	1.0	187.62	335.17	13	1.0	81.7	339.43	8.0	12.5	38	9.80	3.20	1.94	72.4	458.38	1133.0	64.8	739.4	**453.19**	**246.47**
8.00	9.00	8.50	1.00	6.50	19.80	9.80	77.28	3.14	12.5	12.5	1.0	53.85	389.02	38	1.0	119.4	458.86	9.0	12.5	38	9.80	3.20	1.94	82.2	483.05	1330.9	76.6	924.5	**532.37**	**308.15**
9.00	10.00	9.50	1.00	7.50	19.80	9.80	87.08	3.14	12.5	12.5	1.0	60.67	449.69	38	1.0	119.4	578.29	10.0	12.5	38	11.20	3.20	1.94	92.0	508.78	1536.8	88.4	1116.3	**614.70**	**372.11**
10.00	11.00	10.50	1.00	8.50	21.20	11.20	97.58	3.14	12.5	12.5	1.0	67.99	517.68	38	1.0	119.4	697.71	11.0	24.2	18	11.20	9.42	10.00	103.2	935.30	2150.7	100.1	1315.5	**860.28**	**438.51**
11.00	12.00	11.50	1.00	9.50	21.20	11.20	108.78	3.14	24.2	24.2	1.0	153.65	671.33	18	1.0	56.6	754.29	12.0	7.1	72	10.40	1.95	0.77	114.4	687.37	2113.0	111.9	1537.5	**845.19**	**512.51**
12.00	14.50	13.25	2.50	12.00	20.40	10.40	127.38	7.86	7.1	7.1	1.0	124.66	795.99	72	1.0	565.7	1320.00	14.5	28.0	0	10.40	16.76	17.79	140.4	1920.82	4036.8	141.4	2257.4	**1614.73**	**752.45**
14.50	16.00	15.25	1.50	13.50	20.40	10.40	127.38	4.71	28.0	28.0	1.0	319.29	1115.28	0	1.0	0.0	1320.00	16.0	13.2	37	10.40	3.41	2.14	140.4	646.48	3081.8	159.0	2594.3	**1232.71**	**864.78**
16.00	17.50	16.75	1.50	15.00	20.40	10.40	127.38	4.71	13.2	13.2	1.0	140.85	1256.13	37	1.0	174.4	1494.43	17.5	18.0	37	10.00	5.42	4.29	140.4	875.89	3626.4	176.7	2927.3	**1450.58**	**975.76**
17.50	19.00	18.25	1.50	16.50	20.00	10.00	127.38	4.71	18.0	18.0	1.0	195.12	1451.25	37	1.0	174.4	1668.86	19.0	11.6	56	10.00	2.94	1.68	140.4	726.91	3847.0	194.4	3314.5	**1538.81**	**1104.83**
19.00	20.50	19.75	1.50	18.00	20.00	10.00	127.38	4.71	11.6	11.6	1.0	123.27	1574.51	56	1.0	264.0	1932.86	20.5	17.6	40	10.00	5.22	4.07	140.4	874.54	4381.9	212.1	3719.4	**1752.76**	**1239.81**
20.50	22.00	21.25	1.50	19.50	20.00	10.00	127.38	4.71	17.6	17.6	1.0	190.49	1765.00	40	1.0	188.6	2121.43	22.0	12.5	44	10.60	3.20	1.94	140.4	672.60	4559.0	229.7	4116.2	**1823.61**	**1372.05**
22.00	23.50	22.75	1.50	21.00	20.60	10.60	127.38	4.71	12.5	12.5	1.0	133.13	1898.13	44	1.0	207.4	2328.86	23.5	12.5	44	10.60	3.20	1.94	140.4	672.60	4899.6	247.4	4474.4	**1959.84**	**1491.46**
23.50	25.00	24.25	1.50	22.50	20.60	10.60	127.38	4.71	12.5	12.5	1.0	133.13	2031.26	44	1.0	207.4	2536.29	25.0	25.6	0	9.25	11.35	12.26	140.4	1296.58	5864.1	265.1	4832.6	**2345.65**	**1610.87**
25.00	26.50	25.75	1.50	24.00	19.25	9.25	127.38	4.71	25.6	25.6	1.0	287.71	2318.98	0	1.0	0.0	2536.29	26.5	25.6	0	9.25	11.35	12.26	140.4	1296.58	6151.8	282.7	5138.0	**2460.74**	**1712.67**
26.50	27.50	27.00	1.00	25.00	19.25	9.25	127.38	3.14	25.6	25.6	1.0	191.81	2510.79	0	1.0	0.0	2536.29	27.5	25.6	0	9.25	11.35	12.26	140.4	1296.58	6343.6	294.5	5341.6	**2537.46**	**1780.53**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								φ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	φ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
27.50	28.00	27.75	0.50	25.50	19.25	9.25	127.38	1.57	25.6	25.6	1.0	95.90	2606.69	0	1.0	0.0	2536.29	28.0	10.1	59	10.60	2.50	1.25	140.4	698.09	5841.1	300.4	5443.4	**2336.43**	**1814.46**
28.00	29.50	28.75	1.50	27.00	20.60	10.60	127.38	4.71	10.1	10.1	1.0	106.97	2713.66	59	1.0	278.1	2814.43	29.5	23.0	10	10.60	8.56	8.68	140.4	1051.03	6579.1	318.1	5846.2	**2631.65**	**1948.72**
29.50	30.00	29.75	0.50	27.50	20.60	10.60	127.38	1.57	23.0	23.0	1.0	84.97	2798.62	10	1.0	15.7	2830.14	30.0	23.0	10	10.60	8.56	8.68	140.4	1051.03	6679.8	324.0	5952.7	**2671.92**	**1984.25**
30.00	31.00	30.50	1.00	28.50	20.60	10.60	127.38	3.14	23.0	23.0	1.0	169.93	2968.56	10	1.0	31.4	2861.57	31.0	22.5	0	10.60	8.20	8.14	140.4	938.32	6768.5	335.8	6165.9	**2707.38**	**2055.30**
31.00	32.50	31.75	1.50	30.00	20.60	10.60	127.38	4.71	22.5	22.5	1.0	248.74	3217.29	0	1.0	0.0	2861.57	32.5	15.5	48	10.33	4.19	2.92	140.4	813.00	6891.9	353.4	6432.3	**2756.75**	**2144.10**
32.50	34.00	33.25	1.50	31.50	20.33	10.33	127.38	4.71	15.5	15.5	1.0	166.53	3383.83	48	1.0	226.3	3087.86	34.0	24.3	0	10.33	9.50	10.11	140.4	1088.43	7560.1	371.1	6842.8	**3024.05**	**2280.93**
34.00	35.00	34.50	1.00	32.50	20.33	10.33	127.38	3.14	24.3	24.3	1.0	180.76	3564.59	0	1.0	0.0	3087.86	35.0	24.3	0	10.33	9.50	10.11	140.4	1088.43	7740.9	382.9	7035.3	**3096.35**	**2345.11**
35.00	35.50	35.25	0.50	33.00	20.33	10.33	127.38	1.57	24.3	24.3	1.0	90.38	3654.97	0	1.0	0.0	3087.86	35.5	24.0	15	10.33	9.28	9.78	140.4	1169.34	7912.2	388.8	7131.6	**3164.87**	**2377.20**
35.50	37.00	36.25	1.50	34.50	20.33	10.33	127.38	4.71	24.0	24.0	1.0	267.36	3922.33	15	1.0	70.7	3158.57	37.0	13.1	35	10.33	3.38	2.11	140.4	628.86	7709.8	406.4	7487.3	**3083.90**	**2495.78**
37.00	37.50	37.25	0.50	35.00	20.33	10.33	127.38	1.57	13.1	13.1	1.0	46.58	3968.91	35	1.0	55.0	3213.57	37.5	13.8	44	9.70	3.59	2.31	140.4	715.91	7898.4	412.3	7594.8	**3159.35**	**2531.61**
37.50	38.50	38.00	1.00	36.00	19.70	9.70	127.38	3.14	13.8	13.8	1.0	98.33	4067.24	44	1.0	138.3	3351.86	38.5	14.5	48	8.63	3.80	2.51	140.4	766.51	8185.6	424.1	7843.2	**3274.24**	**2614.41**
38.50	40.00	39.25	1.50	37.50	18.63	8.63	127.38	4.71	14.5	14.5	1.0	155.30	4222.54	48	1.0	226.3	3578.14	40.0	14.5	48	8.63	3.80	2.51	140.4	766.51	8567.2	441.8	8242.5	**3426.88**	**2747.49**
BORE NO: P78, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.70	9.70	26.68	1.57	22.5	22.5	1.0	17.36	0	17	1.0	26.7	0	3.0	22.5	17	9.70	8.20	8.14	29.1	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.70	9.70	33.95	3.14	22.5	22.5	1.0	44.20	0	17	1.0	53.4	0	4.0	12.4	19	9.70	3.17	1.91	38.8	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	19.70	9.70	43.65	3.14	12.4	12.4	1.0	30.16	0	19	1.0	59.7	0	5.0	24.2	16	9.90	9.42	10.00	48.5	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	19.90	9.90	53.45	3.14	24.2	24.2	1.0	75.50	0	16	1.0	50.3	0	6.0	24.6	0	9.90	9.71	10.44	58.4	486.25	486.2	41.2	41.2	**194.50**	**13.74**
6.00	7.00	6.50	1.00	4.50	19.90	9.90	63.35	3.14	24.6	24.6	1.0	91.16	91.16	0	1.0	0.0	0.00	7.0	11.5	40	10.48	2.91	1.65	68.3	445.86	537.0	53.0	144.2	**214.81**	**48.06**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								φ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	φ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
7.00	9.00	8.00	2.00	6.50	20.48	10.48	78.78	6.29	11.5	11.5	1.0	100.75	191.90	40	1.0	251.4	251.43	9.0	10.5	44	10.48	2.62	1.36	89.3	500.29	943.6	76.6	519.9	**377.45**	**173.30**
9.00	10.00	9.50	1.00	7.50	20.48	10.48	94.50	3.14	10.5	10.5	1.0	55.05	246.95	44	1.0	138.3	389.71	10.0	10.5	44	10.48	2.62	1.36	99.7	521.84	1158.5	88.4	725.0	**463.40**	**241.67**
10.00	11.00	10.50	1.00	8.50	20.48	10.48	104.98	3.14	10.5	10.5	1.0	61.15	308.10	44	1.0	138.3	528.00	11.0	10.5	44	10.24	2.62	1.36	110.2	543.26	1379.4	100.1	936.2	**551.74**	**312.08**
11.00	12.50	11.75	1.50	10.00	20.24	10.24	117.90	4.71	10.5	10.5	1.0	103.01	411.11	44	1.0	207.4	735.43	12.5	7.0	54	10.24	1.93	0.76	125.6	575.34	1721.9	117.8	1264.4	**688.75**	**421.45**
12.50	14.00	13.25	1.50	11.50	20.24	10.24	133.26	4.71	7.0	7.0	1.0	77.14	488.25	54	1.0	254.6	990.00	14.0	25.2	13	9.90	10.45	11.34	140.9	1293.30	2771.5	135.5	1613.7	**1108.62**	**537.91**
14.00	15.50	14.75	1.50	13.00	19.90	9.90	148.37	4.71	25.2	25.2	1.0	329.13	817.38	13	1.0	61.3	1051.29	15.5	24.6	15	10.40	9.71	10.44	140.9	1224.22	3092.9	153.2	2021.8	**1237.15**	**673.94**
15.50	18.50	17.00	3.00	16.00	20.40	10.40	148.37	9.43	24.6	24.6	1.0	640.45	1457.83	15	1.0	141.4	1192.71	18.5	24.0	15	10.40	9.28	9.78	140.9	1173.69	3824.2	188.5	2839.0	**1529.69**	**946.35**
18.50	20.00	19.25	1.50	17.50	20.40	10.40	148.37	4.71	24.0	24.0	1.0	311.41	1769.24	15	1.0	70.7	1263.43	20.0	11.0	48	9.60	2.76	1.51	140.9	651.19	3683.9	206.2	3238.8	**1473.54**	**1079.61**
20.00	21.50	20.75	1.50	19.00	19.60	9.60	148.37	4.71	11.0	11.0	1.0	135.96	1905.20	48	1.0	226.3	1489.71	21.5	11.0	48	9.60	2.76	1.51	140.9	651.19	4046.1	223.8	3618.7	**1618.44**	**1206.25**
21.50	23.00	22.25	1.50	20.50	19.60	9.60	148.37	4.71	11.0	11.0	1.0	135.96	2041.15	48	1.0	226.3	1716.00	23.0	13.5	35	9.60	3.50	2.22	140.9	643.46	4400.6	241.5	3998.7	**1760.25**	**1332.89**
23.00	24.50	23.75	1.50	22.00	19.60	9.60	148.37	4.71	13.5	13.5	1.0	167.92	2209.07	35	1.0	165.0	1881.00	24.5	13.5	35	9.80	3.50	2.22	140.9	643.64	4733.7	259.2	4349.3	**1893.48**	**1449.75**
24.50	26.00	25.25	1.50	23.50	19.80	9.80	148.37	4.71	13.5	13.5	1.0	167.92	2376.99	35	1.0	165.0	2046.00	26.0	26.0	7	9.80	12.25	13.18	140.9	1457.02	5880.0	276.9	4699.8	**2352.00**	**1566.61**
26.00	27.50	26.75	1.50	25.00	19.80	9.80	148.37	4.71	26.0	26.0	1.0	341.14	2718.13	7	1.0	33.0	2079.00	27.5	23.5	46	9.80	8.92	9.23	140.9	1348.62	6145.7	294.5	5091.7	**2458.30**	**1697.22**
27.50	29.00	28.25	1.50	26.50	19.80	9.80	148.37	4.71	23.5	23.5	1.0	304.12	3022.25	46	1.0	216.9	2295.86	29.0	29.2	0	9.80	19.46	20.56	140.9	2233.90	7552.0	312.2	5630.3	**3020.80**	**1876.77**
29.00	30.00	29.50	1.00	27.50	19.80	9.80	148.37	3.14	29.2	29.2	1.0	260.60	3282.85	0	1.0	0.0	2295.86	30.0	30.0	0	10.05	21.26	22.40	140.9	2442.69	8021.4	324.0	5902.7	**3208.56**	**1967.56**
30.00	30.50	30.25	0.50	28.00	20.05	10.05	148.37	1.57	30.0	30.0	1.0	134.61	3417.46	0	1.0	0.0	2295.86	30.5	29.6	0	10.05	20.36	21.48	140.9	2339.30	8052.6	329.9	6043.2	**3221.05**	**2014.39**
30.50	32.00	31.25	1.50	29.50	20.05	10.05	148.37	4.71	29.6	29.6	1.0	397.33	3814.79	0	1.0	0.0	2295.86	32.0	29.6	0	10.05	20.36	21.48	140.9	2339.30	8450.0	347.5	6458.2	**3379.98**	**2152.73**
32.00	32.50	32.25	0.50	30.00	20.05	10.05	148.37	1.57	29.6	29.6	1.0	132.44	3947.24	0	1.0	0.0	2295.86	32.5	29.6	0	10.05	20.36	21.48	140.9	2339.30	8582.4	353.4	6596.5	**3432.96**	**2198.84**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
32.50	33.50	33.00	1.00	31.00	20.05	10.05	148.37	3.14	29.6	29.6	1.0	264.89	4212.13	0	1.0	0.0	2295.86	33.5	24.5	46	10.05	9.64	10.33	140.9	1433.59	7941.6	365.2	6873.2	**3176.63**	**2291.06**
33.50	35.00	34.25	1.50	32.50	20.05	10.05	148.37	4.71	24.5	24.5	1.0	318.75	4530.88	46	1.0	216.9	2512.71	35.0	27.1	5	10.05	14.73	15.72	140.9	1728.49	8772.1	382.9	7426.5	**3508.83**	**2475.49**
35.00	36.50	35.75	1.50	34.00	20.05	10.05	148.37	4.71	27.1	27.1	1.0	357.92	4888.80	5	1.0	23.6	2536.29	36.5	27.1	5	9.25	14.73	15.72	140.9	1723.55	9148.6	400.6	7825.6	**3659.45**	**2608.55**
36.50	37.50	37.00	1.00	35.00	19.25	9.25	148.37	3.14	27.1	27.1	1.0	238.61	5127.41	5	1.0	15.7	2552.00	37.5	26.0	10	9.25	12.25	13.18	140.9	1475.38	9154.8	412.3	8091.7	**3661.92**	**2697.25**
37.50	38.00	37.75	0.50	35.50	19.25	9.25	148.37	1.57	26.0	26.0	1.0	113.71	5241.12	10	1.0	15.7	2567.71	38.0	15.3	53	9.05	4.09	2.81	140.9	837.45	8646.3	418.2	8227.1	**3458.51**	**2742.35**
38.00	40.00	39.00	2.00	37.50	19.05	9.05	148.37	6.29	15.3	15.3	1.0	255.13	5496.25	53	1.0	333.1	2900.86	40.0	15.3	53	9.05	4.09	2.81	140.9	837.45	9234.6	441.8	8838.9	**3693.82**	**2946.30**
BORE NO: P79, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	18.44	8.44	23.21	1.57	23.5	23.5	1.0	15.86	15.86	9	1.0	14.1	14.14	3.0	23.5	9	9.60	8.92	9.23	25.3	275.92	305.9	5.9	35.9	**122.37**	**11.96**
3.00	5.00	4.00	2.00	2.50	19.60	9.60	34.92	6.29	23.5	23.5	1.0	95.44	111.30	9	1.0	56.6	70.71	5.0	8.6	42	9.60	2.22	1.00	44.5	378.37	560.4	29.5	211.5	**224.15**	**70.49**
5.00	6.00	5.50	1.00	3.50	19.60	9.60	49.32	3.14	8.6	8.6	1.0	23.44	134.74	42	1.0	132.0	202.71	6.0	8.6	42	9.60	2.22	1.00	54.1	395.10	732.6	41.2	378.7	**293.02**	**126.23**
6.00	7.00	6.50	1.00	4.50	19.60	9.60	58.92	3.14	8.6	8.6	1.0	28.01	162.75	42	1.0	132.0	334.71	7.0	13.0	51	10.10	3.35	2.08	63.7	536.61	1034.1	53.0	550.5	**413.63**	**183.49**
7.00	8.00	7.50	1.00	5.50	20.10	10.10	68.77	3.14	13.0	13.0	1.0	49.90	212.65	51	1.0	160.3	495.00	8.0	10.3	41	10.10	2.56	1.31	73.8	443.49	1151.1	64.8	772.4	**460.45**	**257.48**
8.00	9.00	8.50	1.00	6.50	20.10	10.10	78.87	3.14	10.3	10.3	1.0	45.05	257.69	41	1.0	128.9	623.86	9.0	10.3	40	8.80	2.56	1.31	83.9	456.05	1337.6	76.6	958.1	**535.04**	**319.38**
9.00	11.00	10.00	2.00	8.50	18.80	8.80	92.72	6.29	10.3	10.3	1.0	105.91	363.61	40	1.0	251.4	875.29	11.0	23.8	21	8.80	9.14	9.56	101.5	910.30	2149.2	100.1	1339.0	**859.68**	**446.34**
11.00	12.00	11.50	1.00	9.50	18.80	8.80	105.92	3.14	23.8	23.8	1.0	146.82	510.43	21	1.0	66.0	941.29	12.0	23.8	21	8.80	9.14	9.56	110.3	973.47	2425.2	111.9	1563.6	**970.07**	**521.21**
12.00	13.00	12.50	1.00	10.50	18.80	8.80	114.72	3.14	23.8	23.8	1.0	159.02	669.45	21	1.0	66.0	1007.29	13.0	12.5	38	9.00	3.20	1.94	119.1	575.43	2252.2	123.7	1800.4	**900.87**	**600.15**
13.00	14.50	13.75	1.50	12.00	19.00	9.00	125.87	4.71	12.5	12.5	1.0	131.55	801.00	38	1.0	179.1	1186.43	14.5	11.9	38	9.00	3.03	1.76	132.6	590.53	2578.0	141.4	2128.8	**1031.19**	**709.60**
14.50	16.00	15.25	1.50	13.50	19.00	9.00	125.87	4.71	11.9	11.9	1.0	125.05	926.05	38	1.0	179.1	1365.57	16.0	11.9	38	10.20	3.03	1.76	132.6	591.36	2883.0	159.0	2450.7	**1153.19**	**816.89**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
16.00	17.50	16.75	1.50	15.00	20.20	10.20	125.87	4.71	11.9	11.9	1.0	125.05	1051.09	38	1.0	179.1	1544.71	17.5	24.3	0	10.20	9.50	10.11	132.6	1030.01	3625.8	176.7	2772.5	**1450.33**	**924.17**
17.50	19.00	18.25	1.50	16.50	20.20	10.20	125.87	4.71	24.3	24.3	1.0	267.92	1319.02	0	1.0	0.0	1544.71	19.0	26.2	0	8.10	12.70	13.64	132.6	1367.02	4230.7	194.4	3058.1	**1692.30**	**1019.37**
19.00	20.50	19.75	1.50	18.00	18.10	8.10	125.87	4.71	26.2	26.2	1.0	291.98	1611.00	0	1.0	0.0	1544.71	20.5	26.0	7	9.82	12.25	13.18	132.6	1377.03	4532.7	212.1	3367.8	**1813.10**	**1122.59**
20.50	23.50	22.00	3.00	21.00	19.82	9.82	125.87	9.43	26.0	26.0	1.0	578.83	2189.83	7	1.0	66.0	1610.71	23.5	12.5	54	9.80	3.20	1.94	132.6	723.17	4523.7	247.4	4047.9	**1809.48**	**1349.31**
23.50	26.50	25.00	3.00	24.00	19.80	9.80	125.87	9.43	12.5	12.5	1.0	263.10	2452.93	54	1.0	509.1	2119.86	26.5	11.3	66	9.80	2.85	1.59	132.6	770.05	5342.8	282.7	4855.5	**2137.13**	**1618.51**
26.50	27.50	27.00	1.00	25.00	19.80	9.80	125.87	3.14	11.3	11.3	1.0	79.05	2531.98	66	1.0	207.4	2327.29	27.5	10.0	69	9.80	2.47	1.22	132.6	750.00	5609.3	294.5	5153.8	**2243.71**	**1717.93**
27.50	29.50	28.50	2.00	27.00	19.80	9.80	125.87	6.29	10.0	10.0	1.0	139.51	2671.48	69	1.0	433.7	2761.00	29.5	27.6	0	8.93	15.85	16.87	132.6	1711.29	7143.8	318.1	5750.6	**2857.51**	**1916.86**
29.50	30.00	29.75	0.50	27.50	18.93	8.93	125.87	1.57	27.6	27.6	1.0	103.41	2774.89	0	1.0	0.0	2761.00	30.0	27.6	0	9.78	15.85	16.87	132.6	1716.93	7252.8	324.0	5859.9	**2901.13**	**1953.29**
30.00	31.00	30.50	1.00	28.50	19.78	9.78	125.87	3.14	27.6	27.6	1.0	206.81	2981.70	0	1.0	0.0	2761.00	31.0	24.8	0	9.78	9.86	10.66	132.6	1067.97	6810.7	335.8	6078.5	**2724.27**	**2026.15**
31.00	32.50	31.75	1.50	30.00	19.78	9.78	125.87	4.71	24.8	24.8	1.0	274.18	3255.88	0	1.0	0.0	2761.00	32.5	27.0	10	9.78	14.50	15.49	132.6	1641.54	7658.4	353.4	6370.3	**3063.37**	**2123.44**
32.50	35.00	33.75	2.50	32.50	19.78	9.78	125.87	7.86	27.0	27.0	1.0	503.91	3759.79	10	1.0	78.6	2839.57	35.0	27.4	10	9.78	15.40	16.41	132.6	1738.94	8338.3	382.9	6982.2	**3335.32**	**2327.42**
35.00	35.50	35.25	0.50	33.00	19.78	9.78	125.87	1.57	27.4	27.4	1.0	102.53	3862.32	10	1.0	15.7	2855.29	35.5	26.3	10	9.78	12.93	13.88	132.6	1471.09	8188.7	388.8	7106.4	**3275.48**	**2368.79**
35.50	37.50	36.50	2.00	35.00	19.78	9.78	125.87	6.29	26.3	26.3	1.0	391.03	4253.35	10	1.0	62.9	2918.14	37.5	11.5	49	8.82	2.91	1.65	132.6	655.54	7827.0	412.3	7583.8	**3130.81**	**2527.94**
37.50	38.50	38.00	1.00	36.00	18.82	8.82	125.87	3.14	11.5	11.5	1.0	80.48	4333.83	49	1.0	154.0	3072.14	38.5	7.5	60	8.29	2.02	0.84	132.6	637.49	8043.5	424.1	7830.1	**3217.39**	**2610.03**
38.50	40.00	39.25	1.50	37.50	18.29	8.29	125.87	4.71	7.5	7.5	1.0	78.12	4411.95	60	1.0	282.9	3355.00	40.0	7.5	60	8.29	2.02	0.84	132.6	637.49	8404.4	441.8	8208.7	**3361.78**	**2736.25**
BORE NO: P80, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.8	10.80	29.70	1.57	12.3	12.3	1.0	10.18	0	29	1.0	45.6	0	3.0	28.4	2	9.64	17.66	18.71	32.4	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.50	19.6	9.64	42.04	6.29	28.4	28.4	1.0	142.88	0	2	1.0	12.6	0	5.0	7.2	41	9.64	1.97	0.79	51.7	372.75	372.7	29.5	29.5	**149.10**	**9.82**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
5.00	6.00	5.50	1.00	3.50	19.6	9.64	56.50	3.14	7.2	7.2	1.0	22.43	22.43	41	1.0	128.9	128.86	6.0	11.9	21	9.64	3.03	1.76	61.3	301.10	452.4	41.2	192.5	**180.95**	**64.17**
6.00	7.00	6.50	1.00	4.50	19.6	9.64	66.14	3.14	11.9	11.9	1.0	43.80	66.24	21	1.0	66.0	194.86	7.0	29.2	2	9.65	19.46	20.56	71.0	1176.94	1438.0	53.0	314.1	**575.21**	**104.70**
7.00	8.00	7.50	1.00	5.50	19.7	9.65	75.79	3.14	29.2	29.2	1.0	133.12	199.35	2	1.0	6.3	201.14	8.0	9.5	42	9.65	2.38	1.14	80.6	452.07	852.6	64.8	465.3	**341.03**	**155.10**
8.00	9.00	8.50	1.00	6.50	19.7	9.65	85.44	3.14	9.5	9.5	1.0	44.93	244.29	42	1.0	132.0	333.14	9.0	9.5	42	9.65	2.38	1.14	90.3	470.12	1047.5	76.6	654.0	**419.02**	**218.00**
9.00	10.00	9.50	1.00	7.50	19.7	9.65	95.09	3.14	9.5	9.5	1.0	50.01	294.29	42	1.0	132.0	465.14	10.0	9.5	42	10.04	2.38	1.14	99.9	488.34	1247.8	88.4	847.8	**499.11**	**282.60**
10.00	11.00	10.50	1.00	8.50	20.0	10.04	104.93	3.14	9.5	9.5	1.0	55.19	349.48	42	1.0	132.0	597.14	11.0	9.5	42	10.04	2.38	1.14	110.0	507.11	1453.7	100.1	1046.8	**581.50**	**348.92**
11.00	12.00	11.50	1.00	9.50	20.0	10.04	114.97	3.14	9.5	9.5	1.0	60.47	409.95	42	1.0	132.0	729.14	12.0	8.2	54	10.41	2.15	0.94	120.0	588.03	1727.1	111.9	1251.0	**690.85**	**417.00**
12.00	14.50	13.25	2.50	12.00	20.4	10.41	133.00	7.86	8.2	8.2	1.0	150.59	560.54	54	1.0	424.3	1153.43	14.5	8.2	54	10.41	2.15	0.94	146.0	631.92	2345.9	141.4	1855.3	**938.35**	**618.45**
14.50	16.00	15.25	1.50	13.50	20.4	10.41	133.00	4.71	8.2	8.2	1.0	90.35	650.89	54	1.0	254.6	1408.00	16.0	10.3	52	10.12	2.56	1.31	146.0	666.40	2725.3	159.0	2217.9	**1090.12**	**739.31**
16.00	17.50	16.75	1.50	15.00	20.1	10.12	133.00	4.71	10.3	10.3	1.0	113.95	764.84	52	1.0	245.1	1653.14	17.5	10.3	52	10.12	2.56	1.31	146.0	666.40	3084.4	176.7	2594.7	**1233.75**	**864.90**
17.50	19.00	18.25	1.50	16.50	20.1	10.12	133.00	4.71	10.3	10.3	1.0	113.95	878.78	52	1.0	245.1	1898.29	19.0	27.8	0	9.60	16.31	17.33	146.0	1936.01	4713.1	194.4	2971.5	**1885.23**	**990.49**
19.00	20.50	19.75	1.50	18.00	19.6	9.60	133.00	4.71	27.8	27.8	1.0	330.59	1209.37	0	1.0	0.0	1898.29	20.5	27.0	0	9.60	14.50	15.49	146.0	1722.38	4830.0	212.1	3319.7	**1932.01**	**1106.57**
20.50	22.00	21.25	1.50	19.50	19.6	9.60	133.00	4.71	27.0	27.0	1.0	319.48	1528.85	0	1.0	0.0	1898.29	22.0	9.5	47	9.89	2.38	1.14	146.0	609.85	4037.0	229.7	3656.9	**1614.79**	**1218.95**
22.00	23.50	22.75	1.50	21.00	19.9	9.89	133.00	4.71	9.5	9.5	1.0	104.93	1633.78	47	1.0	221.6	2119.86	23.5	9.5	47	9.89	2.38	1.14	146.0	609.85	4363.5	247.4	4001.0	**1745.39**	**1333.68**
23.50	25.00	24.25	1.50	22.50	19.9	9.89	133.00	4.71	9.5	9.5	1.0	104.93	1738.70	47	1.0	221.6	2341.43	25.0	14.0	32	9.89	3.65	2.36	146.0	654.22	4734.4	265.1	4345.2	**1893.74**	**1448.40**
25.00	26.50	25.75	1.50	24.00	19.9	9.89	133.00	4.71	14.0	14.0	1.0	156.33	1895.03	32	1.0	150.9	2492.29	26.5	15.5	32	9.24	4.19	2.92	146.0	717.14	5104.5	282.7	4670.1	**2041.78**	**1556.69**
26.50	27.50	27.00	1.00	25.00	19.2	9.24	133.00	3.14	15.5	15.5	1.0	115.92	2010.96	32	1.0	100.6	2592.86	27.5	15.5	32	9.24	4.19	2.92	146.0	717.14	5321.0	294.5	4898.3	**2128.38**	**1632.78**
27.50	28.00	27.75	0.50	25.50	19.2	9.24	133.00	1.57	15.5	15.5	1.0	57.96	2068.92	32	1.0	50.3	2643.14	28.0	24.5	7	8.97	9.64	10.33	146.0	1191.87	5903.9	300.4	5012.5	**2361.57**	**1670.83**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
28.00	29.50	28.75	1.50	27.00	19.0	8.97	133.00	4.71	24.5	24.5	1.0	285.75	2354.66	7	1.0	33.0	2676.14	29.5	24.5	7	9.01	9.64	10.33	146.0	1192.03	6222.8	318.1	5348.9	**2489.13**	**1782.96**
29.50	30.00	29.75	0.50	27.50	19.0	9.01	133.00	1.57	24.5	24.5	1.0	95.25	2449.91	7	1.0	11.0	2687.14	30.0	24.5	7	9.01	9.64	10.33	146.0	1192.03	6329.1	324.0	5461.0	**2531.63**	**1820.34**
30.00	31.00	30.50	1.00	28.50	19.0	9.01	133.00	3.14	24.5	24.5	1.0	190.50	2640.41	7	1.0	22.0	2709.14	31.0	19.5	30	9.08	6.13	5.12	146.0	934.12	6283.7	335.8	5685.3	**2513.47**	**1895.10**
31.00	32.50	31.75	1.50	30.00	19.1	9.08	133.00	4.71	19.5	19.5	1.0	222.04	2862.45	30	1.0	141.4	2850.57	32.5	10.0	45	8.59	2.47	1.22	146.0	605.70	6318.7	353.4	6066.4	**2527.49**	**2022.15**
32.50	34.00	33.25	1.50	31.50	18.6	8.59	133.00	4.71	10.0	10.0	1.0	110.56	2973.01	45	1.0	212.1	3062.71	34.0	18.0	48	9.27	5.42	4.29	146.0	976.42	7012.1	371.1	6406.8	**2804.86**	**2135.61**
34.00	35.00	34.50	1.00	32.50	19.3	9.27	133.00	3.14	18.0	18.0	1.0	135.82	3108.82	48	1.0	150.9	3213.57	35.0	18.0	48	9.27	5.42	4.29	146.0	976.42	7298.8	382.9	6705.3	**2919.53**	**2235.09**
35.00	35.50	35.25	0.50	33.00	19.3	9.27	133.00	1.57	18.0	18.0	1.0	67.91	3176.73	48	1.0	75.4	3289.00	35.5	22.5	15	9.14	8.20	8.14	146.0	1076.04	7541.8	388.8	6854.5	**3016.71**	**2284.84**
35.50	37.00	36.25	1.50	34.50	19.1	9.14	133.00	4.71	22.5	22.5	1.0	259.72	3436.45	15	1.0	70.7	3359.71	37.0	22.5	15	9.52	8.20	8.14	146.0	1077.25	7873.4	406.4	7202.6	**3149.37**	**2400.87**
37.00	37.50	37.25	0.50	35.00	19.5	9.52	133.00	1.57	22.5	22.5	1.0	86.57	3523.02	15	1.0	23.6	3383.29	37.5	22.5	15	9.52	8.20	8.14	146.0	1077.25	7983.6	412.3	7318.6	**3193.42**	**2439.55**
37.50	38.50	38.00	1.00	36.00	19.5	9.52	133.00	3.14	22.5	22.5	1.0	173.14	3696.17	15	1.0	47.1	3430.43	38.5	22.5	15	9.41	8.20	8.14	146.0	1076.90	8203.5	424.1	7550.7	**3281.40**	**2516.90**
38.50	40.00	39.25	1.50	37.50	19.4	9.41	133.00	4.71	22.5	22.5	1.0	259.72	3955.88	15	1.0	70.7	3501.14	40.0	22.5	15	9.41	8.20	8.14	146.0	1076.90	8533.9	441.8	7898.8	**3413.57**	**2632.94**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: P61, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	21.20	11.20	30.80	1.89	6.4	6.4	1.0	6.51	0	66	1.0	124.5	0	3.0	9.4	54	11.20	2.36	1.13	33.6	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.50	21.20	11.20	44.80	7.54	9.4	9.4	1.0	55.94	0	54	1.0	407.3	0	5.0	26.9	3	11.20	14.28	15.26	56.0	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	21.20	11.20	61.60	3.77	26.9	26.9	1.0	117.86	0	3	1.0	11.3	0	6.0	26.9	3	8.55	14.28	15.26	67.2	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	8.00	7.00	2.00	5.50	18.55	8.55	75.75	7.54	26.9	26.9	1.0	289.87	0	3	1.0	22.6	0	8.0	26.9	3	8.55	14.28	15.26	84.3	0	0.0	93.3	93.3	**0.00**	**31.10**
8.00	9.00	8.50	1.00	6.50	18.55	8.55	88.58	3.77	26.9	26.9	1.0	169.48	0	3	1.0	11.3	0	9.0	24.7	13	8.55	9.78	10.55	92.9	1221.46	1221.5	110.3	110.3	**488.58**	**36.76**
9.00	10.00	9.50	1.00	7.50	18.55	8.55	97.13	3.77	24.7	24.7	1.0	168.48	168.48	13	1.0	49.0	49.03	10.0	24.7	13	10.06	9.78	10.55	101.4	1326.92	1544.4	127.2	344.7	**617.77**	**114.91**
10.00	11.00	10.50	1.00	8.50	20.06	10.06	106.43	3.77	24.7	24.7	1.0	184.62	353.10	13	1.0	49.0	98.06	11.0	24.7	10	10.06	9.78	10.55	111.5	1407.73	1858.9	144.2	595.4	**743.56**	**198.45**
11.00	12.00	11.50	1.00	9.50	20.06	10.06	116.49	3.77	24.7	24.7	1.0	202.07	555.17	10	1.0	37.7	135.77	12.0	24.7	10	10.06	9.78	10.55	121.5	1519.10	2210.0	161.2	852.1	**884.01**	**284.04**
12.00	13.00	12.50	1.00	10.50	20.06	10.06	126.55	3.77	24.7	24.7	1.0	219.52	774.69	10	1.0	37.7	173.49	13.0	10.5	42	10.44	2.62	1.36	131.6	826.94	1775.1	178.1	1126.3	**710.05**	**375.44**
13.00	14.50	13.75	1.50	12.00	20.44	10.44	139.41	5.66	10.5	10.5	1.0	146.17	920.86	42	1.0	237.6	411.09	14.5	11.2	52	11.03	2.82	1.56	147.2	1011.47	2343.4	203.6	1535.5	**937.37**	**511.84**
14.50	17.50	16.00	3.00	15.00	21.03	11.03	163.79	11.31	11.2	11.2	1.0	366.93	1287.79	52	1.0	588.3	999.43	17.5	9.0	50	11.03	2.29	1.07	180.3	984.35	3271.6	254.5	2541.7	**1308.63**	**847.23**
17.50	19.00	18.25	1.50	16.50	21.03	11.03	163.79	5.66	9.0	9.0	1.0	146.75	1434.54	50	1.0	282.9	1282.29	19.0	8.1	43	11.14	2.13	0.93	180.3	879.05	3595.9	279.9	2996.7	**1438.35**	**998.91**
19.00	20.50	19.75	1.50	18.00	21.14	11.14	163.79	5.66	8.1	8.1	1.0	131.87	1566.41	43	1.0	243.3	1525.54	20.5	8.1	43	11.14	2.13	0.93	180.3	879.05	3971.0	305.4	3397.3	**1588.40**	**1132.44**
20.50	22.00	21.25	1.50	19.50	21.14	11.14	163.79	5.66	8.1	8.1	1.0	131.87	1698.28	43	1.0	243.3	1768.80	22.0	23.7	18	10.70	9.06	9.45	180.3	2101.29	5568.4	330.8	3797.9	**2227.34**	**1265.96**
22.00	23.50	22.75	1.50	21.00	20.70	10.70	163.79	5.66	23.7	23.7	1.0	406.73	2105.01	18	1.0	101.8	1870.63	23.5	23.7	18	10.70	9.06	9.45	180.3	2101.29	6076.9	356.3	4331.9	**2430.77**	**1443.96**
23.50	25.00	24.25	1.50	22.50	20.70	10.70	163.79	5.66	23.7	23.7	1.0	406.73	2511.73	18	1.0	101.8	1972.46	25.0	5.5	42	10.16	1.66	0.53	180.3	770.01	5254.2	381.7	4865.9	**2101.68**	**1621.97**
25.00	26.50	25.75	1.50	24.00	20.16	10.16	163.79	5.66	5.5	5.5	1.0	89.22	2600.95	42	1.0	237.6	2210.06	26.5	5.5	42	10.16	1.66	0.53	180.3	770.01	5581.0	407.2	5218.2	**2232.41**	**1739.39**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
26.50	27.50	27.00	1.00	25.00	20.16	10.16	163.79	3.77	5.5	5.5	1.0	59.48	2660.43	42	1.0	158.4	2368.46	27.5	5.5	42	10.16	1.66	0.53	180.3	770.01	5798.9	424.1	5453.0	**2319.56**	**1817.67**
27.50	28.00	27.75	0.50	25.50	20.16	10.16	163.79	1.89	5.5	5.5	1.0	29.74	2690.17	42	1.0	79.2	2447.66	28.0	8.5	72	11.03	2.20	0.99	180.3	1189.44	6327.3	432.6	5570.4	**2530.91**	**1856.81**
28.00	29.50	28.75	1.50	27.00	21.03	11.03	163.79	5.66	8.5	8.5	1.0	138.47	2828.64	72	1.0	407.3	2854.97	29.5	23.0	10	11.03	8.56	8.68	180.3	1913.35	7597.0	458.0	6141.7	**3038.79**	**2047.22**
29.50	30.00	29.75	0.50	27.50	21.03	11.03	163.79	1.89	23.0	23.0	1.0	131.10	2959.74	10	1.0	18.9	2873.83	30.0	23.0	10	11.03	8.56	8.68	180.3	1913.35	7746.9	466.5	6300.1	**3098.77**	**2100.03**
30.00	31.00	30.50	1.00	28.50	21.03	11.03	163.79	3.77	23.0	23.0	1.0	262.20	3221.94	10	1.0	37.7	2911.54	31.0	12.8	49	11.03	3.29	2.02	180.3	1185.68	7319.2	483.5	6617.0	**2927.67**	**2205.66**
31.00	32.50	31.75	1.50	30.00	21.03	11.03	163.79	5.66	12.8	12.8	1.0	210.51	3432.45	49	1.0	277.2	3188.74	32.5	13.5	49	8.70	3.50	2.22	180.3	1226.18	7847.4	508.9	7130.1	**3138.95**	**2376.71**
32.50	34.00	33.25	1.50	31.50	18.70	8.70	163.79	5.66	13.5	13.5	1.0	222.45	3654.90	49	1.0	277.2	3465.94	34.0	13.5	49	8.84	3.50	2.22	180.3	1226.40	8347.2	534.4	7655.2	**3338.89**	**2551.74**
34.00	35.00	34.50	1.00	32.50	18.84	8.84	163.79	3.77	13.5	13.5	1.0	148.30	3803.19	49	1.0	184.8	3650.74	35.0	13.5	49	8.84	3.50	2.22	180.3	1226.40	8680.3	551.3	8005.3	**3472.13**	**2668.43**
35.00	35.50	35.25	0.50	33.00	18.84	8.84	163.79	1.89	13.5	13.5	1.0	74.15	3877.34	49	1.0	92.4	3743.14	35.5	13.5	49	9.35	3.50	2.22	180.3	1227.16	8847.7	559.8	8180.3	**3539.06**	**2726.77**
35.50	37.00	36.25	1.50	34.50	19.35	9.35	163.79	5.66	13.5	13.5	1.0	222.45	4099.79	49	1.0	277.2	4020.34	37.0	9.3	60	9.02	2.34	1.11	180.3	1096.03	9216.2	585.3	8705.4	**3686.46**	**2901.80**
37.00	37.50	37.25	0.50	35.00	19.02	9.02	163.79	1.89	9.3	9.3	1.0	50.58	4150.37	60	1.0	113.1	4133.49	37.5	8.0	60	9.02	2.11	0.91	180.3	1047.06	9330.9	593.8	8877.6	**3732.36**	**2959.20**
37.50	38.50	38.00	1.00	36.00	19.02	9.02	163.79	3.77	8.0	8.0	1.0	86.81	4237.18	60	1.0	226.3	4359.77	38.5	8.0	60	8.60	2.11	0.91	180.3	1046.80	9643.8	610.7	9207.7	**3857.50**	**3069.23**
38.50	40.00	39.25	1.50	37.50	18.60	8.60	163.79	5.66	8.0	8.0	1.0	130.22	4367.40	60	1.0	339.4	4699.20	40.0	8.0	60	8.60	2.11	0.91	180.3	1046.80	10113.4	636.2	9702.8	**4045.36**	**3234.26**
BORE NO: P62, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.82	9.82	27.01	1.89	7.5	7.5	1.0	6.70	6.70	46	1.0	86.7	86.74	3.0	14.3	46	9.82	3.74	2.45	29.5	609.30	702.8	8.5	101.9	**281.10**	**33.98**
3.00	4.00	3.50	1.00	1.50	19.82	9.82	34.37	3.77	14.3	14.3	1.0	33.04	39.74	46	1.0	173.5	260.23	4.0	29.9	5	9.01	21.03	22.17	39.3	1121.33	1421.3	25.4	325.4	**568.52**	**108.47**
4.00	6.00	5.00	2.00	3.50	19.01	9.01	48.29	7.54	29.9	29.9	1.0	209.45	249.19	5	1.0	37.7	297.94	6.0	29.9	5	9.01	21.03	22.17	57.3	1550.19	2097.3	59.4	606.5	**838.93**	**202.17**
6.00	7.00	6.50	1.00	4.50	19.01	9.01	61.81	3.77	29.9	29.9	1.0	134.03	383.23	5	1.0	18.9	316.80	7.0	28.2	0	9.01	17.21	18.25	66.3	1402.53	2102.6	76.3	776.4	**841.02**	**258.79**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction $Quf = \Sigma Ki.Pdi.\tan\delta.Asi$					Ultimate Shaft Cohesion $Quc = \Sigma\alpha.c.Asi$				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
7.00	9.00	8.00	2.00	6.50	19.01	9.01	75.32	7.54	28.2	28.2	1.0	304.63	687.86	0	1.0	0.0	316.80	9.0	25.2	11	8.08	10.45	11.34	84.3	1171.32	2176.0	110.3	1114.9	**870.39**	**371.64**
9.00	10.00	9.50	1.00	7.50	18.08	8.08	88.37	3.77	25.2	25.2	1.0	156.83	844.69	11	1.0	41.5	358.29	10.0	25.2	11	8.08	10.45	11.34	92.4	1266.86	2469.8	127.2	1330.2	**987.93**	**443.40**
10.00	11.00	10.50	1.00	8.50	18.08	8.08	96.45	3.77	25.2	25.2	1.0	171.17	1015.86	11	1.0	41.5	399.77	11.0	25.2	11	8.08	10.45	11.34	100.5	1362.40	2778.0	144.2	1559.8	**1111.21**	**519.94**
11.00	12.50	11.75	1.50	10.00	18.08	8.08	106.55	5.66	25.2	25.2	1.0	283.64	1299.50	11	1.0	62.2	462.00	12.5	25.2	11	8.08	10.45	11.34	112.6	1505.70	3267.2	169.6	1931.1	**1306.88**	**643.71**
12.50	14.00	13.25	1.50	11.50	18.08	8.08	118.67	5.66	25.2	25.2	1.0	315.91	1615.40	11	1.0	62.2	524.23	14.0	8.1	40	9.43	2.13	0.93	124.7	713.56	2853.2	195.1	2334.7	**1141.28**	**778.24**
14.00	15.50	14.75	1.50	13.00	19.43	9.43	131.80	5.66	8.1	8.1	1.0	106.12	1721.52	40	1.0	226.3	750.51	15.5	8.7	40	9.43	2.24	1.02	138.9	765.18	3237.2	220.5	2692.6	**1294.89**	**897.53**
15.50	17.00	16.25	1.50	14.50	19.43	9.43	145.95	5.66	8.7	8.7	1.0	126.34	1847.86	40	1.0	226.3	976.80	17.0	11.3	40	11.01	2.85	1.59	153.0	913.02	3737.7	246.0	3070.7	**1495.07**	**1023.55**
17.00	18.50	17.75	1.50	16.00	21.01	11.01	161.28	5.66	11.3	11.3	1.0	182.31	2030.17	40	1.0	226.3	1203.09	18.5	11.3	40	10.85	2.85	1.59	153.0	912.84	4146.1	271.4	3504.7	**1658.44**	**1168.23**
18.50	21.50	20.00	3.00	19.00	20.85	10.85	161.28	11.31	11.3	11.3	1.0	364.62	2394.79	40	1.0	452.6	1655.66	21.5	11.0	45	8.53	2.76	1.51	153.0	945.48	4995.9	322.3	4372.8	**1998.37**	**1457.59**
21.50	24.50	23.00	3.00	22.00	18.53	8.53	161.28	11.31	11.0	11.0	1.0	354.69	2749.49	45	1.0	509.1	2164.80	24.5	9.6	45	8.53	2.40	1.16	153.0	880.11	5794.4	373.2	5287.5	**2317.76**	**1762.50**
24.50	26.00	25.25	1.50	23.50	18.53	8.53	161.28	5.66	9.6	9.6	1.0	154.32	2903.80	45	1.0	254.6	2419.37	26.0	25.7	14	9.19	11.58	12.49	153.0	2224.72	7547.9	398.7	5721.8	**3019.16**	**1907.28**
26.00	27.50	26.75	1.50	25.00	19.19	9.19	161.28	5.66	25.7	25.7	1.0	439.09	3342.90	14	1.0	79.2	2498.57	27.5	9.5	52	9.19	2.38	1.14	153.0	948.69	6790.2	424.1	6265.6	**2716.06**	**2088.53**
27.50	30.00	28.75	2.50	27.50	19.19	9.19	161.28	9.43	9.5	9.5	1.0	254.46	3597.36	52	1.0	490.3	2988.86	30.0	9.5	52	9.95	2.38	1.14	153.0	949.28	7535.5	466.5	7052.7	**3014.20**	**2350.91**
30.00	30.50	30.25	0.50	28.00	19.95	9.95	161.28	1.89	9.5	9.5	1.0	50.89	3648.25	52	1.0	98.1	3086.91	30.5	27.8	0	8.66	16.31	17.33	153.0	2924.85	9660.0	475.0	7210.2	**3864.01**	**2403.39**
30.50	32.50	31.50	2.00	30.00	18.66	8.66	161.28	7.54	27.8	27.8	1.0	641.38	4289.64	0	1.0	0.0	3086.91	32.5	28.3	0	8.66	17.43	18.48	153.0	3126.56	10503.1	508.9	7885.5	**4201.24**	**2628.50**
32.50	33.50	33.00	1.00	31.00	18.66	8.66	161.28	3.77	28.3	28.3	1.0	327.51	4617.14	0	1.0	0.0	3086.91	33.5	25.3	0	8.89	10.68	11.57	153.0	1918.11	9622.2	525.9	8230.0	**3848.87**	**2743.32**
33.50	35.00	34.25	1.50	32.50	18.89	8.89	161.28	5.66	25.3	25.3	1.0	431.28	5048.42	0	1.0	0.0	3086.91	35.0	25.3	0	8.89	10.68	11.57	153.0	1918.11	10053.4	551.3	8686.7	**4021.38**	**2895.56**
35.00	36.50	35.75	1.50	34.00	18.89	8.89	161.28	5.66	25.3	25.3	1.0	431.28	5479.69	0	1.0	0.0	3086.91	36.5	15.5	28	9.58	4.19	2.92	153.0	1028.86	9595.5	576.8	9143.4	**3838.19**	**3047.80**

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
36.50	37.50	37.00	1.00	35.00	19.58	9.58	161.28	3.77	15.5	15.5	1.0	168.68	5648.38	28	1.0	105.6	3192.51	37.5	15.5	28	9.58	4.19	2.92	153.0	1028.86	9869.8	593.8	9434.7	**3947.90**	**3144.88**
37.50	38.00	37.75	0.50	35.50	19.58	9.58	161.28	1.89	15.5	15.5	1.0	84.34	5732.72	28	1.0	52.8	3245.31	38.0	23.0	10	9.58	8.56	8.68	153.0	1640.31	10618.3	602.2	9580.3	**4247.34**	**3193.42**
38.00	40.00	39.00	2.00	37.50	19.58	9.58	161.28	7.54	23.0	23.0	1.0	516.37	6249.09	10	1.0	75.4	3320.74	40.0	8.1	45	9.58	2.13	0.93	153.0	832.68	10402.5	636.2	10206.0	**4161.01**	**3402.00**
BORE NO: P63, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	17.76	7.76	21.34	1.89	11.2	11.2	1.0	7.97	7.97	60	1.0	113.1	113.14	3.0	9.1	54	8.16	2.31	1.08	23.3	616.66	737.8	8.5	129.6	**295.11**	**43.20**
3.00	5.00	4.00	2.00	2.50	18.16	8.16	31.44	7.54	9.1	9.1	1.0	37.98	45.95	54	1.0	407.3	520.46	5.0	9.1	54	8.16	2.31	1.08	39.6	659.27	1225.7	42.4	608.8	**490.27**	**202.94**
5.00	6.00	5.50	1.00	3.50	18.16	8.16	43.68	3.77	9.1	9.1	1.0	26.39	72.34	54	1.0	203.7	724.11	6.0	32.4	0	8.16	33.35	34.70	47.8	1994.33	2790.8	59.4	855.8	**1116.31**	**285.28**
6.00	8.00	7.00	2.00	5.50	18.16	8.16	55.92	7.54	32.4	32.4	1.1	299.80	372.14	0	1.0	0.0	724.11	8.0	34.6	0	9.18	44.43	45.98	64.1	3507.93	4604.2	93.3	1189.6	**1841.67**	**396.52**
8.00	9.00	8.50	1.00	6.50	19.18	9.18	68.67	3.77	34.6	34.6	1.2	219.75	591.89	0	1.0	0.0	724.11	9.0	34.6	0	9.18	44.43	45.98	73.3	3969.42	5285.4	110.3	1426.3	**2114.17**	**475.43**
9.00	10.00	9.50	1.00	7.50	19.18	9.18	77.85	3.77	34.6	34.6	1.2	249.13	841.02	0	1.0	0.0	724.11	10.0	25.0	12	9.18	10.00	10.88	82.4	1122.75	2687.9	127.2	1692.4	**1075.15**	**564.12**
10.00	11.00	10.50	1.00	8.50	19.18	9.18	87.03	3.77	25.0	25.0	1.0	153.05	994.08	12	1.0	45.3	769.37	11.0	25.0	12	9.18	10.00	10.88	91.6	1226.61	2990.1	144.2	1907.7	**1196.03**	**635.88**
11.00	12.00	11.50	1.00	9.50	19.18	9.18	96.21	3.77	25.0	25.0	1.0	169.20	1163.28	12	1.0	45.3	814.63	12.0	7.5	55	9.18	2.02	0.84	100.8	795.64	2773.5	161.2	2139.1	**1109.42**	**713.02**
12.00	13.00	12.50	1.00	10.50	19.18	9.18	105.39	3.77	7.5	7.5	1.0	52.33	1215.61	55	1.0	207.4	1022.06	13.0	11.0	55	9.10	2.76	1.51	110.0	913.30	3151.0	178.1	2415.8	**1260.38**	**805.26**
13.00	14.50	13.75	1.50	12.00	19.10	9.10	116.81	5.66	11.0	11.0	1.0	128.44	1344.05	55	1.0	311.1	1333.20	14.5	13.4	50	10.42	3.47	2.19	123.6	1010.03	3687.3	203.6	2880.8	**1474.91**	**960.28**
14.50	17.50	16.00	3.00	15.00	20.42	10.42	139.26	11.31	13.4	13.4	1.0	375.37	1719.42	50	1.0	565.7	1898.91	17.5	13.4	50	10.42	3.47	2.19	154.9	1132.76	4751.1	254.5	3872.8	**1900.44**	**1290.93**
17.50	19.00	18.25	1.50	16.50	20.42	10.42	139.26	5.66	13.4	13.4	1.0	187.68	1907.10	50	1.0	282.9	2181.77	19.0	25.3	22	8.75	10.68	11.57	154.9	2163.62	6252.5	279.9	4368.8	**2501.00**	**1456.26**
19.00	20.50	19.75	1.50	18.00	18.75	8.75	139.26	5.66	25.3	25.3	1.0	372.40	2279.50	22	1.0	124.5	2306.23	20.5	9.5	52	11.12	2.38	1.14	154.9	955.22	5541.0	305.4	4891.1	**2216.38**	**1630.36**
20.50	23.50	22.00	3.00	21.00	21.12	11.12	139.26	11.31	9.5	9.5	1.0	263.67	2543.17	52	1.0	588.3	2894.57	23.5	9.5	52	10.95	2.38	1.14	154.9	955.09	6392.8	356.3	5794.0	**2557.13**	**1931.33**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
23.50	26.50	25.00	3.00	24.00	20.95	10.95	139.26	11.31	9.5	9.5	1.0	263.67	2806.84	52	1.0	588.3	3482.91	26.5	10.7	51	10.95	2.68	1.42	154.9	998.81	7288.6	407.2	6696.9	**2915.42**	**2232.30**
26.50	27.50	27.00	1.00	25.00	20.95	10.95	139.26	3.77	10.7	10.7	1.0	99.24	2906.08	51	1.0	192.3	3675.26	27.5	10.7	51	10.95	2.68	1.42	154.9	998.81	7580.1	424.1	7005.4	**3032.06**	**2335.15**
27.50	28.00	27.75	0.50	25.50	20.95	10.95	139.26	1.89	10.7	10.7	1.0	49.62	2955.70	51	1.0	96.2	3771.43	28.0	27.6	7	7.80	15.85	16.87	154.9	2939.14	9666.3	432.6	7159.7	**3866.51**	**2386.57**
28.00	29.50	28.75	1.50	27.00	17.80	7.80	139.26	5.66	27.6	27.6	1.0	411.86	3367.56	7	1.0	39.6	3811.03	29.5	7.5	65	7.80	2.02	0.84	154.9	1020.31	8198.9	458.0	7636.6	**3279.56**	**2545.54**
29.50	30.00	29.75	0.50	27.50	17.80	7.80	139.26	1.89	7.5	7.5	1.0	34.57	3402.13	65	1.0	122.6	3933.60	30.0	7.5	65	7.80	2.02	0.84	154.9	1020.31	8356.0	466.5	7802.3	**3342.41**	**2600.75**
30.00	31.00	30.50	1.00	28.50	17.80	7.80	139.26	3.77	7.5	7.5	1.0	69.15	3471.27	65	1.0	245.1	4178.74	31.0	7.5	65	7.80	2.02	0.84	154.9	1020.31	8670.3	483.5	8133.5	**3468.13**	**2711.17**
31.00	32.50	31.75	1.50	30.00	17.80	7.80	139.26	5.66	7.5	7.5	1.0	103.72	3574.99	65	1.0	367.7	4546.46	32.5	7.5	65	10.01	2.02	0.84	154.9	1021.56	9143.0	508.9	8630.4	**3657.20**	**2876.80**
32.50	34.00	33.25	1.50	31.50	20.01	10.01	139.26	5.66	7.5	7.5	1.0	103.72	3678.71	65	1.0	367.7	4914.17	34.0	16.7	32	10.01	4.78	3.58	154.9	1187.24	9780.1	534.4	9127.3	**3912.05**	**3042.42**
34.00	35.00	34.50	1.00	32.50	20.01	10.01	139.26	3.77	16.7	16.7	1.0	157.57	3836.28	32	1.0	120.7	5034.86	35.0	16.7	32	10.01	4.78	3.58	154.9	1187.24	10058.4	551.3	9422.5	**4023.35**	**3140.83**
35.00	35.50	35.25	0.50	33.00	20.01	10.01	139.26	1.89	16.7	16.7	1.0	78.79	3915.06	32	1.0	60.3	5095.20	35.5	17.1	32	8.92	4.97	3.80	154.9	1220.41	10230.7	559.8	9570.1	**4092.27**	**3190.03**
35.50	37.00	36.25	1.50	34.50	18.92	8.92	139.26	5.66	17.1	17.1	1.0	242.36	4157.43	32	1.0	181.0	5276.23	37.0	8.6	44	8.92	2.22	1.00	154.9	842.83	10276.5	585.3	10018.9	**4110.59**	**3339.65**
37.00	37.50	37.25	0.50	35.00	18.92	8.92	139.26	1.89	8.6	8.6	1.0	39.72	4197.14	44	1.0	83.0	5359.20	37.5	8.6	44	8.92	2.22	1.00	154.9	842.83	10399.2	593.8	10150.1	**4159.67**	**3383.37**
37.50	38.50	38.00	1.00	36.00	18.92	8.92	139.26	3.77	8.6	8.6	1.0	79.43	4276.57	44	1.0	165.9	5525.14	38.5	9.1	53	10.54	2.31	1.08	154.9	951.90	10753.6	610.7	10412.4	**4301.45**	**3470.81**
38.50	40.00	39.25	1.50	37.50	20.54	10.54	139.26	5.66	9.1	9.1	1.0	126.19	4402.76	53	1.0	299.8	5824.97	40.0	9.1	53	10.54	2.31	1.08	154.9	951.90	11179.6	636.2	10863.9	**4471.85**	**3621.30**
BORE NO: P64, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.96	10.96	30.14	1.89	23.1	23.1	1.0	24.24	0	0	1.0	0.0	0	3.0	23.1	0	10.96	8.63	8.79	32.9	386.55	386.6	8.5	8.5	**154.62**	**2.83**
3.00	4.00	3.50	1.00	1.50	20.96	10.96	38.36	3.77	23.1	23.1	1.0	61.71	61.71	0	1.0	0.0	0.00	4.0	27.7	0	10.96	16.08	17.10	43.8	924.84	986.5	25.4	87.2	**394.62**	**29.05**
4.00	6.00	5.00	2.00	3.50	20.96	10.96	54.80	7.54	27.7	27.7	1.0	217.01	278.72	0	1.0	0.0	0.00	6.0	27.9	0	9.23	16.53	17.56	65.8	1339.95	1618.7	59.4	338.1	**647.47**	**112.70**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
6.00	7.00	6.50	1.00	4.50	19.23	9.23	70.38	3.77	27.9	27.9	1.0	140.53	419.25	0	1.0	0.0	0.00	7.0	26.7	7	9.23	13.83	14.80	75.0	1337.26	1756.5	76.3	495.6	**702.61**	**165.20**
7.00	9.00	8.00	2.00	6.50	19.23	9.23	84.22	7.54	26.7	26.7	1.0	319.50	738.75	7	1.0	52.8	52.80	9.0	23.2	16	9.23	8.70	8.90	93.5	1139.01	1930.6	110.3	901.8	**772.22**	**300.61**
9.00	10.00	9.50	1.00	7.50	19.23	9.23	98.07	3.77	23.2	23.2	1.0	158.52	897.27	16	1.0	60.3	113.14	10.0	23.2	16	9.59	8.70	8.90	102.7	1232.08	2242.5	127.2	1137.6	**897.00**	**379.22**
10.00	12.50	11.25	2.50	10.00	19.59	9.59	114.67	9.43	23.2	23.2	1.0	463.38	1360.65	16	1.0	150.9	264.00	12.5	23.0	16	9.80	8.56	8.68	126.7	1447.36	3072.0	169.6	1794.3	**1228.80**	**598.10**
12.50	15.50	14.00	3.00	13.00	19.80	9.80	141.36	11.31	23.0	23.0	1.0	678.88	2039.53	16	1.0	181.0	445.03	15.5	11.1	41	9.80	2.79	1.53	156.1	920.92	3405.5	220.5	2705.1	**1362.19**	**901.70**
15.50	17.00	16.25	1.50	14.50	19.80	9.80	163.41	5.66	11.1	11.1	1.0	181.36	2220.89	41	1.0	231.9	676.97	17.0	26.6	0	8.11	13.60	14.57	170.8	2708.27	5606.1	246.0	3143.8	**2242.45**	**1047.95**
17.00	18.50	17.75	1.50	16.00	18.11	8.11	176.84	5.66	26.6	26.6	1.0	500.96	2721.85	0	1.0	0.0	676.97	18.5	15.6	33	8.11	4.24	2.98	170.8	1170.66	4569.5	271.4	3670.3	**1827.79**	**1223.42**
18.50	20.00	19.25	1.50	17.50	18.11	8.11	176.84	5.66	15.6	15.6	1.0	279.32	3001.16	33	1.0	186.7	863.66	20.0	11.2	46	9.79	2.82	1.56	170.8	1024.16	4889.0	296.9	4161.7	**1955.59**	**1387.23**
20.00	21.50	20.75	1.50	19.00	19.79	9.79	176.84	5.66	11.2	11.2	1.0	198.08	3199.25	46	1.0	260.2	1123.89	21.5	11.2	46	9.24	2.82	1.56	170.8	1023.57	5346.7	322.3	4645.5	**2138.68**	**1548.49**
21.50	24.50	23.00	3.00	22.00	19.24	9.24	176.84	11.31	11.2	11.2	1.0	396.17	3595.41	46	1.0	520.5	1644.34	24.5	12.5	42	9.24	3.20	1.94	170.8	1058.82	6298.6	373.2	5613.0	**2519.43**	**1870.99**
24.50	26.00	25.25	1.50	23.50	19.24	9.24	176.84	5.66	12.5	12.5	1.0	221.78	3817.20	42	1.0	237.6	1881.94	26.0	19.5	28	9.24	6.13	5.12	170.8	1502.28	7201.4	398.7	6097.8	**2880.57**	**2032.60**
26.00	27.50	26.75	1.50	25.00	19.24	9.24	176.84	5.66	19.5	19.5	1.0	354.26	4171.45	28	1.0	158.4	2040.34	27.5	9.5	30	9.64	2.38	1.14	170.8	772.77	6984.6	424.1	6635.9	**2793.83**	**2211.97**
27.50	29.00	28.25	1.50	26.50	19.64	9.64	176.84	5.66	9.5	9.5	1.0	167.41	4338.86	30	1.0	169.7	2210.06	29.0	28.9	4	9.64	18.78	19.87	170.8	3799.45	10348.4	449.6	6998.5	**4139.35**	**2332.83**
29.00	30.00	29.50	1.00	27.50	19.64	9.64	176.84	3.77	28.9	28.9	1.0	368.17	4707.03	4	1.0	15.1	2225.14	30.0	28.8	0	9.64	18.56	19.64	170.8	3713.70	10645.9	466.5	7398.7	**4258.35**	**2466.23**
30.00	30.50	30.25	0.50	28.00	19.64	9.64	176.84	1.89	28.8	28.8	1.0	183.32	4890.35	0	1.0	0.0	2225.14	30.5	28.8	0	9.64	18.56	19.64	170.8	3713.70	10829.2	475.0	7590.5	**4331.68**	**2530.17**
30.50	32.00	31.25	1.50	29.50	19.64	9.64	176.84	5.66	28.8	28.8	1.0	549.97	5440.32	0	1.0	0.0	2225.14	32.0	9.5	32	9.64	2.38	1.14	170.8	793.14	8458.6	500.5	8165.9	**3383.44**	**2721.97**
32.00	32.50	32.25	0.50	30.00	19.64	9.64	176.84	1.89	9.5	9.5	1.0	55.80	5496.13	32	1.0	60.3	2285.49	32.5	9.5	32	8.64	2.38	1.14	170.8	792.36	8574.0	508.9	8290.6	**3429.59**	**2763.52**
32.50	33.50	33.00	1.00	31.00	18.64	8.64	176.84	3.77	9.5	9.5	1.0	111.61	5607.73	32	1.0	120.7	2406.17	33.5	8.7	48	7.55	2.24	1.02	170.8	925.99	8939.9	525.9	8539.8	**3575.96**	**2846.60**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
33.50	35.00	34.25	1.50	32.50	17.55	7.55	176.84	5.66	8.7	8.7	1.0	153.08	5760.81	48	1.0	271.5	2677.71	35.0	8.7	48	7.55	2.24	1.02	170.8	925.99	9364.5	551.3	8989.9	**3745.81**	**2996.63**
35.00	36.50	35.75	1.50	34.00	17.55	7.55	176.84	5.66	8.7	8.7	1.0	153.08	5913.90	48	1.0	271.5	2949.26	36.5	9.3	55	8.10	2.34	1.11	170.8	1019.03	9882.2	576.8	9439.9	**3952.87**	**3146.65**
36.50	37.50	37.00	1.00	35.00	18.10	8.10	176.84	3.77	9.3	9.3	1.0	109.21	6023.11	55	1.0	207.4	3156.69	37.5	10.2	30	8.10	2.53	1.28	170.8	801.07	9980.9	593.8	9773.6	**3992.34**	**3257.85**
37.50	40.00	38.75	2.50	37.50	18.10	8.10	176.84	9.43	10.2	10.2	1.0	300.00	6323.11	30	1.0	282.9	3439.54	40.0	14.3	28	8.10	3.74	2.45	170.8	1020.57	10783.2	636.2	10398.8	**4313.29**	**3466.27**
BORE NO: P65, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.11	10.11	27.80	1.89	24.5	24.5	1.0	23.89	0	0	1.0	0.0	0	3.0	13.8	31	10.11	3.59	2.31	30.3	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	20.11	10.11	35.39	3.77	13.8	13.8	1.0	32.78	0	31	1.0	116.9	0	4.0	32.7	0	9.10	34.86	36.24	40.4	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	5.00	4.50	1.00	2.50	19.10	9.10	44.99	3.77	32.7	32.7	1.1	123.64	0	0	1.0	0.0	0	5.0	30.5	0	9.10	23.78	24.96	49.5	1487.01	1487.0	42.4	42.4	**594.80**	**14.14**
5.00	6.00	5.50	1.00	3.50	19.10	9.10	54.09	3.77	30.5	30.5	1.0	123.17	123.17	0	1.0	0.0	0.00	6.0	30.5	0	9.97	23.78	24.96	58.6	1746.57	1869.7	59.4	182.5	**747.89**	**60.85**
6.00	8.00	7.00	2.00	5.50	19.97	9.97	68.61	7.54	30.5	30.5	1.0	312.46	435.63	0	1.0	0.0	0.00	8.0	30.5	0	9.97	23.78	24.96	78.6	2283.02	2718.7	93.3	528.9	**1087.46**	**176.31**
8.00	9.00	8.50	1.00	6.50	19.97	9.97	83.57	3.77	30.5	30.5	1.0	190.28	625.91	0	1.0	0.0	0.00	9.0	25.3	12	9.61	10.68	11.57	88.6	1267.25	1893.2	110.3	736.2	**757.26**	**245.39**
9.00	11.00	10.00	2.00	8.50	19.61	9.61	98.16	7.54	25.3	25.3	1.0	349.99	975.90	12	1.0	90.5	90.51	11.0	25.9	12	9.61	12.03	12.95	107.8	1673.17	2739.6	144.2	1210.6	**1095.83**	**403.54**
11.00	12.00	11.50	1.00	9.50	19.61	9.61	112.58	3.77	25.9	25.9	1.0	206.16	1182.06	12	1.0	45.3	135.77	12.0	25.9	12	10.07	12.03	12.95	117.4	1807.98	3125.8	161.2	1479.0	**1250.32**	**493.00**
12.00	14.50	13.25	2.50	12.00	20.07	10.07	129.97	9.43	25.9	25.9	1.0	595.03	1777.09	12	1.0	113.1	248.91	14.5	25.9	12	10.07	12.03	12.95	142.6	2150.54	4176.5	203.6	2229.6	**1670.62**	**743.19**
14.50	17.50	16.00	3.00	15.00	20.07	10.07	157.66	11.31	25.9	25.9	1.0	866.17	2643.26	12	1.0	135.8	384.69	17.5	24.0	12	9.92	9.28	9.78	172.8	2002.04	5030.0	254.5	3282.4	**2011.99**	**1094.14**
17.50	20.50	19.00	3.00	18.00	19.92	9.92	157.66	11.31	24.0	24.0	1.0	794.20	3437.46	12	1.0	135.8	520.46	20.5	12.5	47	9.92	3.20	1.94	172.8	1117.91	5075.8	305.4	4263.3	**2030.33**	**1421.09**
20.50	23.50	22.00	3.00	21.00	19.92	9.92	157.66	11.31	12.5	12.5	1.0	395.46	3832.92	47	1.0	531.8	1052.23	23.5	12.6	47	10.99	3.23	1.96	172.8	1125.24	6010.4	356.3	5241.4	**2404.16**	**1747.14**
23.50	26.50	25.00	3.00	24.00	20.99	10.99	157.66	11.31	12.6	12.6	1.0	398.73	4231.65	47	1.0	531.8	1584.00	26.5	12.2	47	10.99	3.12	1.85	172.8	1101.56	6917.2	407.2	6222.8	**2766.88**	**2074.27**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Factor of Safety in Compression: 2.5
Area of Pile: 1.13 m^2
Critical water table: 0.00 m
Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
26.50	27.50	27.00	1.00	25.00	20.99	10.99	157.66	3.77	12.2	12.2	1.0	128.56	4360.21	47	1.0	177.3	1761.26	27.5	14.0	10	10.99	3.65	2.36	172.8	832.94	6954.4	424.1	6545.6	**2781.76**	**2181.86**
27.50	28.00	27.75	0.50	25.50	20.99	10.99	157.66	1.89	14.0	14.0	1.0	74.13	4434.34	10	1.0	18.9	1780.11	28.0	10.6	59	10.82	2.65	1.39	172.8	1128.31	7342.8	432.6	6647.0	**2937.10**	**2215.68**
28.00	29.50	28.75	1.50	27.00	20.82	10.82	157.66	5.66	10.6	10.6	1.0	166.92	4601.25	59	1.0	333.8	2113.89	29.5	10.6	59	10.82	2.65	1.39	172.8	1128.31	7843.4	458.0	7173.2	**3137.38**	**2391.06**
29.50	30.00	29.75	0.50	27.50	20.82	10.82	157.66	1.89	10.6	10.6	1.0	55.64	4656.89	59	1.0	111.3	2225.14	30.0	10.6	54	11.04	2.65	1.39	172.8	1077.60	7959.6	466.5	7348.6	**3183.85**	**2449.52**
30.00	32.50	31.25	2.50	30.00	21.04	11.04	157.66	9.43	10.6	10.6	1.0	278.19	4935.08	54	1.0	509.1	2734.29	32.5	10.6	54	11.04	2.65	1.39	172.8	1077.60	8747.0	508.9	8178.3	**3498.79**	**2726.10**
32.50	35.00	33.75	2.50	32.50	21.04	11.04	157.66	9.43	10.6	10.6	1.0	278.19	5213.27	54	1.0	509.1	3243.43	35.0	10.6	54	8.71	2.65	1.39	172.8	1075.40	9532.1	551.3	9008.1	**3812.84**	**3002.68**
35.00	35.50	35.25	0.50	33.00	18.71	8.71	157.66	1.89	10.6	10.6	1.0	55.64	5268.91	54	1.0	101.8	3345.26	35.5	10.5	60	8.04	2.62	1.36	172.8	1129.96	9744.1	559.8	9174.0	**3897.65**	**3058.00**
35.50	37.50	36.50	2.00	35.00	18.04	8.04	157.66	7.54	10.5	10.5	1.0	220.41	5489.32	60	1.0	452.6	3797.83	37.5	14.0	30	8.04	3.65	2.36	172.8	1031.86	10319.0	593.8	9880.9	**4127.60**	**3293.64**
37.50	38.50	38.00	1.00	36.00	18.04	8.04	157.66	3.77	14.0	14.0	1.0	148.25	5637.57	30	1.0	113.1	3910.97	38.5	14.0	30	9.16	3.65	2.36	172.8	1033.66	10582.2	610.7	10159.3	**4232.88**	**3386.42**
38.50	40.00	39.25	1.50	37.50	19.16	9.16	157.66	5.66	14.0	14.0	1.0	222.38	5859.95	30	1.0	169.7	4080.69	40.0	14.0	30	9.16	3.65	2.36	172.8	1033.66	10974.3	636.2	10576.8	**4389.72**	**3525.60**
BORE NO: P66, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.30	9.30	25.58	1.89	12.0	12.0	1.0	10.25	0	5	1.0	9.4	0	3.0	8.1	34	9.30	2.13	0.93	27.9	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.30	9.30	32.55	3.77	8.1	8.1	1.0	17.47	0	34	1.0	128.2	0	4.0	8.1	34	10.30	2.13	0.93	37.2	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	5.00	4.50	1.00	2.50	20.30	10.30	42.35	3.77	8.1	8.1	1.0	22.73	0	34	1.0	128.2	0	5.0	27.6	0	10.30	15.85	16.87	47.5	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	20.30	10.30	52.65	3.77	27.6	27.6	1.0	103.81	0	0	1.0	0.0	0	6.0	27.6	0	10.30	15.85	16.87	57.8	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	7.00	6.50	1.00	4.50	20.30	10.30	62.95	3.77	27.6	27.6	1.0	124.12	0	0	1.0	0.0	0	7.0	33.8	0	10.30	40.40	41.88	68.1	0	0.0	76.3	76.3	**0.00**	**25.45**
7.00	8.00	7.50	1.00	5.50	20.30	10.30	73.25	3.77	33.8	33.8	1.2	220.08	0	0	1.0	0.0	0	8.0	28.5	0	10.31	17.88	18.94	78.4	1718.76	1718.8	93.3	93.3	**687.51**	**31.10**
8.00	9.00	8.50	1.00	6.50	20.31	10.31	83.56	3.77	28.5	28.5	1.0	171.10	171.10	0	1.0	0.0	0.00	9.0	25.3	17	10.31	10.68	11.57	88.7	1325.59	1496.7	110.3	281.4	**598.68**	**93.79**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
9.00	10.00	9.50	1.00	7.50	20.31	10.31	93.87	3.77	25.3	25.3	1.0	167.34	338.43	17	1.0	64.1	64.11	10.0	25.3	17	10.31	10.68	11.57	99.0	1450.12	1852.7	127.2	529.8	**741.07**	**176.59**
10.00	11.00	10.50	1.00	8.50	20.31	10.31	104.18	3.77	25.3	25.3	1.0	185.72	524.15	17	1.0	64.1	128.23	11.0	7.5	48	10.31	2.02	0.84	109.3	744.49	1396.9	144.2	796.6	**558.75**	**265.53**
11.00	12.00	11.50	1.00	9.50	20.31	10.31	114.49	3.77	7.5	7.5	1.0	56.84	581.00	48	1.0	181.0	309.26	12.0	7.5	48	10.10	2.02	0.84	119.6	767.94	1658.2	161.2	1051.4	**663.28**	**350.47**
12.00	14.50	13.25	2.50	12.00	20.10	10.10	132.27	9.43	7.5	7.5	1.0	164.18	745.18	48	1.0	452.6	761.83	14.5	25.5	16	11.58	11.13	12.03	144.9	2081.42	3588.4	203.6	1710.6	**1435.37**	**570.19**
14.50	17.50	16.00	3.00	15.00	21.58	11.58	162.26	11.31	25.5	25.5	1.0	875.66	1620.83	16	1.0	181.0	942.86	17.5	25.0	16	11.58	10.00	10.88	179.6	2280.84	4844.5	254.5	2818.2	**1937.81**	**939.39**
17.50	19.00	18.25	1.50	16.50	21.58	11.58	162.26	5.66	25.0	25.0	1.0	428.04	2048.87	16	1.0	90.5	1033.37	19.0	24.5	15	11.39	9.64	10.33	179.6	2191.84	5274.1	279.9	3362.2	**2109.63**	**1120.72**
19.00	20.50	19.75	1.50	18.00	21.39	11.39	162.26	5.66	24.5	24.5	1.0	418.32	2467.20	15	1.0	84.9	1118.23	20.5	24.5	15	11.39	9.64	10.33	179.6	2191.84	5777.3	305.4	3890.8	**2310.91**	**1296.93**
20.50	22.00	21.25	1.50	19.50	21.39	11.39	162.26	5.66	24.5	24.5	1.0	418.32	2885.52	15	1.0	84.9	1203.09	22.0	23.6	10	11.39	8.99	9.34	179.6	2001.59	6090.2	330.8	4419.4	**2436.08**	**1473.14**
22.00	23.50	22.75	1.50	21.00	21.39	11.39	162.26	5.66	23.6	23.6	1.0	401.03	3286.55	10	1.0	56.6	1259.66	23.5	12.1	39	10.18	3.09	1.82	179.6	1037.15	5583.4	356.3	4902.5	**2233.34**	**1634.16**
23.50	26.50	25.00	3.00	24.00	20.18	10.18	162.26	11.31	12.1	12.1	1.0	393.57	3680.13	39	1.0	441.3	1700.91	26.5	12.1	39	10.18	3.09	1.82	179.6	1037.15	6418.2	407.2	5788.2	**2567.28**	**1929.40**
26.50	27.50	27.00	1.00	25.00	20.18	10.18	162.26	3.77	12.1	12.1	1.0	131.19	3811.32	39	1.0	147.1	1848.00	27.5	12.1	39	10.18	3.09	1.82	179.6	1037.15	6696.5	424.1	6083.4	**2678.59**	**2027.81**
27.50	29.50	28.50	2.00	27.00	20.18	10.18	162.26	7.54	12.1	12.1	1.0	262.38	4073.70	39	1.0	294.2	2142.17	29.5	11.2	52	9.59	2.82	1.56	179.6	1113.39	7329.3	458.0	6673.9	**2931.70**	**2224.64**
29.50	30.00	29.75	0.50	27.50	19.59	9.59	162.26	1.89	11.2	11.2	1.0	60.58	4134.28	52	1.0	98.1	2240.23	30.0	11.2	49	9.59	2.82	1.56	179.6	1082.84	7457.4	466.5	6841.0	**2982.94**	**2280.35**
30.00	32.50	31.25	2.50	30.00	19.59	9.59	162.26	9.43	11.2	11.2	1.0	302.92	4437.21	49	1.0	462.0	2702.23	32.5	11.2	49	9.59	2.82	1.56	179.6	1082.84	8222.3	508.9	7648.4	**3288.91**	**2549.46**
32.50	35.00	33.75	2.50	32.50	19.59	9.59	162.26	9.43	11.2	11.2	1.0	302.92	4740.13	49	1.0	462.0	3164.23	35.0	11.2	49	8.99	2.82	1.56	179.6	1082.20	8986.6	551.3	8455.7	**3594.63**	**2818.57**
35.00	35.50	35.25	0.50	33.00	18.99	8.99	162.26	1.89	11.2	11.2	1.0	60.58	4800.72	49	1.0	92.4	3256.63	35.5	11.2	49	8.82	2.82	1.56	179.6	1082.02	9139.4	559.8	8617.2	**3655.75**	**2872.39**
35.50	37.50	36.50	2.00	35.00	18.82	8.82	162.26	7.54	11.2	11.2	1.0	242.34	5043.06	49	1.0	369.6	3626.23	37.5	11.2	49	8.82	2.82	1.56	179.6	1082.02	9751.3	593.8	9263.0	**3900.52**	**3087.68**
37.50	38.50	38.00	1.00	36.00	18.82	8.82	162.26	3.77	11.2	11.2	1.0	121.17	5164.23	49	1.0	184.8	3811.03	38.5	11.2	49	9.02	2.82	1.56	179.6	1082.23	10057.5	610.7	9586.0	**4023.00**	**3195.33**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
38.50	40.00	39.25	1.50	37.50	19.02	9.02	162.26	5.66	11.2	11.2	1.0	181.75	5345.98	49	1.0	277.2	4088.23	40.0	11.2	49	9.02	2.82	1.56	179.6	1082.23	10516.4	636.2	10070.4	**4206.58**	**3356.79**
BORE NO: P67, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.06	10.06	27.67	1.89	27.5	27.5	1.0	27.16	0	12	1.0	22.6	0	3.0	27.5	9	10.06	15.63	16.64	30.2	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	20.06	10.06	35.21	3.77	27.5	27.5	1.0	69.13	0	9	1.0	33.9	0	4.0	29.5	0	10.06	20.13	21.25	40.2	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	6.00	5.00	2.00	3.50	20.06	10.06	50.30	7.54	29.5	29.5	1.0	214.66	0	0	1.0	0.0	0	6.0	29.7	0	10.24	20.58	21.71	60.4	1556.65	1556.6	59.4	59.4	**622.66**	**19.79**
6.00	7.00	6.50	1.00	4.50	20.24	10.24	65.48	3.77	29.7	29.7	1.0	140.86	140.86	0	1.0	0.0	0.00	7.0	28.5	0	10.01	17.88	18.94	70.6	1557.10	1698.0	76.3	217.2	**679.18**	**72.40**
7.00	9.00	8.00	2.00	6.50	20.01	10.01	80.61	7.54	28.5	28.5	1.0	330.13	470.99	0	1.0	0.0	0.00	9.0	24.8	16	10.01	9.86	10.66	90.6	1245.90	1716.9	110.3	581.3	**686.76**	**193.75**
9.00	10.00	9.50	1.00	7.50	20.01	10.01	95.63	3.77	24.8	24.8	1.0	166.64	637.63	16	1.0	60.3	60.34	10.0	24.8	16	10.01	9.86	10.66	100.6	1357.53	2055.5	127.2	825.2	**822.20**	**275.07**
10.00	11.00	10.50	1.00	8.50	20.01	10.01	105.64	3.77	24.8	24.8	1.0	184.08	821.72	16	1.0	60.3	120.69	11.0	24.8	16	10.01	9.86	10.66	110.6	1469.15	2411.6	144.2	1086.6	**964.62**	**362.20**
11.00	12.50	11.75	1.50	10.00	20.01	10.01	118.15	5.66	24.8	24.8	1.0	308.83	1130.55	16	1.0	90.5	211.20	12.5	24.8	16	10.01	9.86	10.66	125.7	1636.59	2978.3	169.6	1511.4	**1191.34**	**503.80**
12.50	14.00	13.25	1.50	11.50	20.01	10.01	133.16	5.66	24.8	24.8	1.0	348.08	1478.63	16	1.0	90.5	301.71	14.0	14.3	54	10.75	3.74	2.45	140.7	1162.53	2942.9	195.1	1975.4	**1177.15**	**658.48**
14.00	15.50	14.75	1.50	13.00	20.75	10.75	148.73	5.66	14.3	14.3	1.0	214.47	1693.10	54	1.0	305.5	607.20	15.5	14.3	54	10.61	3.74	2.45	156.8	1230.47	3530.8	220.5	2520.8	**1412.31**	**840.28**
15.50	18.50	17.00	3.00	16.00	20.61	10.61	172.71	11.31	14.3	14.3	1.0	498.09	2191.20	54	1.0	611.0	1218.17	18.5	23.8	10	10.61	9.14	9.56	156.8	1791.45	5200.8	271.4	3680.8	**2080.33**	**1226.93**
18.50	20.00	19.25	1.50	17.50	20.61	10.61	172.71	5.66	23.8	23.8	1.0	430.93	2622.12	10	1.0	56.6	1274.74	20.0	28.6	0	10.61	18.11	19.17	156.8	3350.31	7247.2	296.9	4193.7	**2898.87**	**1397.92**
20.00	21.50	20.75	1.50	19.00	20.61	10.61	172.71	5.66	28.6	28.6	1.0	532.70	3154.83	0	1.0	0.0	1274.74	21.5	12.2	46	10.81	3.12	1.85	156.8	1034.84	5464.4	322.3	4751.9	**2185.76**	**1583.97**
21.50	24.50	23.00	3.00	22.00	20.81	10.81	172.71	11.31	12.2	12.2	1.0	422.49	3577.32	46	1.0	520.5	1795.20	24.5	12.2	46	10.81	3.12	1.85	156.8	1034.84	6407.4	373.2	5745.7	**2562.94**	**1915.25**
24.50	27.50	26.00	3.00	25.00	20.81	10.81	172.71	11.31	12.2	12.2	1.0	422.49	3999.80	46	1.0	520.5	2315.66	27.5	8.0	40	11.18	2.11	0.91	156.8	788.55	7104.0	424.1	6739.6	**2841.61**	**2246.53**
27.50	29.00	28.25	1.50	26.50	21.18	11.18	172.71	5.66	8.0	8.0	1.0	137.31	4137.12	40	1.0	226.3	2541.94	29.0	24.0	14	11.18	9.28	9.78	156.8	1863.10	8542.2	449.6	7128.6	**3416.86**	**2376.21**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
29.00	30.00	29.50	1.00	27.50	21.18	11.18	172.71	3.77	24.0	24.0	1.0	290.01	4427.12	14	1.0	52.8	2594.74	30.0	24.0	14	11.18	9.28	9.78	156.8	1863.10	8885.0	466.5	7488.4	**3553.99**	**2496.13**
30.00	30.50	30.25	0.50	28.00	21.18	11.18	172.71	1.89	24.0	24.0	1.0	145.00	4572.13	14	1.0	26.4	2621.14	30.5	9.5	32	11.18	2.38	1.14	156.8	756.74	7950.0	475.0	7668.3	**3180.01**	**2556.09**
30.50	32.00	31.25	1.50	29.50	21.18	11.18	172.71	5.66	9.5	9.5	1.0	163.50	4735.63	32	1.0	181.0	2802.17	32.0	27.3	0	11.18	15.18	16.18	156.8	2815.65	10353.5	500.5	8038.3	**4141.38**	**2679.42**
32.00	32.50	32.25	0.50	30.00	21.18	11.18	172.71	1.89	27.3	27.3	1.0	168.10	4903.73	0	1.0	0.0	2802.17	32.5	27.3	0	8.86	15.18	16.18	156.8	2790.17	10496.1	508.9	8214.8	**4198.43**	**2738.28**
32.50	33.50	33.00	1.00	31.00	18.86	8.86	172.71	3.77	27.3	27.3	1.0	336.19	5239.92	0	1.0	0.0	2802.17	33.5	27.3	0	8.88	15.18	16.18	156.8	2790.39	10832.5	525.9	8568.0	**4332.99**	**2856.00**
33.50	35.00	34.25	1.50	32.50	18.88	8.88	172.71	5.66	27.3	27.3	1.0	504.29	5744.21	0	1.0	0.0	2802.17	35.0	15.1	48	8.36	3.99	2.70	156.8	1211.82	9758.2	551.3	9097.7	**3903.28**	**3032.58**
35.00	36.50	35.75	1.50	34.00	18.36	8.36	172.71	5.66	15.1	15.1	1.0	263.63	6007.84	48	1.0	271.5	3073.71	36.5	28.8	0	8.52	18.56	19.64	156.8	3405.67	12487.2	576.8	9658.3	**4994.89**	**3219.45**
36.50	37.50	37.00	1.00	35.00	18.52	8.52	172.71	3.77	28.8	28.8	1.0	358.09	6365.93	0	1.0	0.0	3073.71	37.5	28.8	0	8.52	18.56	19.64	156.8	3405.67	12845.3	593.8	10033.4	**5138.12**	**3344.47**
37.50	38.00	37.75	0.50	35.50	18.52	8.52	172.71	1.89	28.8	28.8	1.0	179.05	6544.97	0	1.0	0.0	3073.71	38.0	28.8	0	8.62	18.56	19.64	156.8	3407.00	13025.7	602.2	10220.9	**5210.27**	**3406.98**
38.00	40.00	39.00	2.00	37.50	18.62	8.62	172.71	7.54	28.8	28.8	1.0	716.18	7261.15	0	1.0	0.0	3073.71	40.0	29.6	0	8.62	20.36	21.48	156.8	3737.38	14072.2	636.2	10971.0	**5628.90**	**3657.01**
BORE NO: P68, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.56	9.56	26.29	1.89	26.5	26.5	1.0	24.72	0	5	1.0	9.4	0	3.0	26.5	5	9.56	13.38	14.34	28.7	578.06	578.1	8.5	8.5	**231.22**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.56	9.56	33.46	3.77	26.5	26.5	1.0	62.92	62.92	5	1.0	18.9	18.86	4.0	30.4	0	9.56	23.27	24.45	38.2	1165.67	1247.4	25.4	107.2	**498.98**	**35.74**
4.00	6.00	5.00	2.00	3.50	19.56	9.56	47.80	7.54	30.4	30.4	1.0	215.76	278.68	0	1.0	0.0	18.86	6.0	30.2	0	9.34	22.27	23.43	57.4	1593.63	1891.2	59.4	356.9	**756.47**	**118.97**
6.00	7.00	6.50	1.00	4.50	19.34	9.34	62.03	3.77	30.2	30.2	1.0	137.52	416.20	0	1.0	0.0	18.86	7.0	30.2	0	9.34	22.27	23.43	66.7	1828.94	2264.0	76.3	511.4	**905.60**	**170.47**
7.00	9.00	8.00	2.00	6.50	19.34	9.34	76.04	7.54	30.2	30.2	1.0	337.16	753.36	0	1.0	0.0	18.86	9.0	28.5	0	9.34	17.88	18.94	85.4	1847.51	2619.7	110.3	882.5	**1047.89**	**294.16**
9.00	10.00	9.50	1.00	7.50	19.34	9.34	90.05	3.77	28.5	28.5	1.0	184.40	937.75	0	1.0	0.0	18.86	10.0	28.5	0	9.34	17.88	18.94	94.7	2036.47	2993.1	127.2	1083.8	**1197.23**	**361.28**
10.00	11.00	10.50	1.00	8.50	19.34	9.34	99.39	3.77	28.5	28.5	1.0	203.52	1141.28	0	1.0	0.0	18.86	11.0	11.4	44	10.20	2.88	1.62	104.1	798.54	1958.7	144.2	1304.3	**783.47**	**434.78**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
11.00	12.50	11.75	1.50	10.00	20.20	10.20	111.71	5.66	11.4	11.4	1.0	127.43	1268.70	44	1.0	248.9	267.77	12.5	11.4	44	10.41	2.88	1.62	119.4	848.65	2385.1	169.6	1706.1	**954.05**	**568.71**
12.50	15.50	14.00	3.00	13.00	20.41	10.41	134.98	11.31	11.4	11.4	1.0	307.93	1576.63	44	1.0	497.8	765.60	15.5	9.7	57	10.23	2.42	1.17	150.6	1000.22	3342.4	220.5	2562.8	**1336.98**	**854.26**
15.50	18.50	17.00	3.00	16.00	20.23	10.23	165.94	11.31	9.7	9.7	1.0	320.92	1897.54	57	1.0	644.9	1410.51	18.5	8.1	60	10.25	2.13	0.93	150.6	980.00	4288.1	271.4	3579.5	**1715.22**	**1193.16**
18.50	21.50	20.00	3.00	19.00	20.25	10.25	165.94	11.31	8.1	8.1	1.0	267.20	2164.74	60	1.0	678.9	2089.37	21.5	7.8	62	10.60	2.07	0.88	150.6	991.05	5245.2	322.3	4576.4	**2098.07**	**1525.48**
21.50	24.50	23.00	3.00	22.00	20.60	10.60	165.94	11.31	7.8	7.8	1.0	257.18	2421.92	62	1.0	701.5	2790.86	24.5	7.8	62	10.28	2.07	0.88	150.6	990.86	6203.6	373.2	5586.0	**2481.45**	**1862.00**
24.50	27.50	26.00	3.00	25.00	20.28	10.28	165.94	11.31	7.8	7.8	1.0	257.18	2679.10	62	1.0	701.5	3492.34	27.5	4.5	96	10.28	1.51	0.41	150.6	1238.17	7409.6	424.1	6595.6	**2963.84**	**2198.52**
27.50	29.00	28.25	1.50	26.50	20.28	10.28	165.94	5.66	4.5	4.5	1.0	73.88	2752.98	96	1.0	543.1	4035.43	29.0	9.3	57	10.28	2.34	1.11	150.6	987.56	7776.0	449.6	7238.0	**3110.39**	**2412.66**
29.00	30.00	29.50	1.00	27.50	20.28	10.28	165.94	3.77	9.3	9.3	1.0	102.48	2855.46	57	1.0	215.0	4250.40	30.0	9.3	57	8.82	2.34	1.11	150.6	986.46	8092.3	466.5	7572.4	**3236.93**	**2524.13**
30.00	30.50	30.25	0.50	28.00	18.82	8.82	165.94	1.89	9.3	9.3	1.0	51.24	2906.70	57	1.0	107.5	4357.89	30.5	9.3	57	9.81	2.34	1.11	150.6	987.20	8251.8	475.0	7739.6	**3300.71**	**2579.86**
30.50	32.00	31.25	1.50	29.50	19.81	9.81	165.94	5.66	9.3	9.3	1.0	153.72	3060.42	57	1.0	322.5	4680.34	32.0	9.3	57	9.91	2.34	1.11	150.6	987.28	8728.0	500.5	8241.2	**3491.22**	**2747.07**
32.00	32.50	32.25	0.50	30.00	19.91	9.91	165.94	1.89	9.3	9.3	1.0	51.24	3111.66	57	1.0	107.5	4787.83	32.5	14.0	28	9.91	3.65	2.36	150.6	922.92	8822.4	508.9	8408.4	**3528.96**	**2802.81**
32.50	33.50	33.00	1.00	31.00	19.91	9.91	165.94	3.77	14.0	14.0	1.0	156.03	3267.69	28	1.0	105.6	4893.43	33.5	28.3	0	9.01	17.43	18.48	150.6	3083.03	11244.1	525.9	8687.0	**4497.66**	**2895.67**
33.50	35.00	34.25	1.50	32.50	19.01	9.01	165.94	5.66	28.3	28.3	1.0	505.45	3773.14	0	1.0	0.0	4893.43	35.0	28.3	0	7.32	17.43	18.48	150.6	3061.82	11728.4	551.3	9217.9	**4691.36**	**3072.64**
35.00	36.50	35.75	1.50	34.00	17.32	7.32	165.94	5.66	28.3	28.3	1.0	505.45	4278.59	0	1.0	0.0	4893.43	36.5	14.3	49	9.74	3.74	2.45	150.6	1151.88	10323.9	576.8	9748.8	**4129.56**	**3249.60**
36.50	37.50	37.00	1.00	35.00	19.74	9.74	165.94	3.77	14.3	14.3	1.0	159.52	4438.10	49	1.0	184.8	5078.23	37.5	11.5	49	9.74	2.91	1.65	150.6	1005.84	10522.2	593.8	10110.1	**4208.87**	**3370.03**
37.50	38.00	37.75	0.50	35.50	19.74	9.74	165.94	1.89	11.5	11.5	1.0	63.66	4501.76	49	1.0	92.4	5170.63	38.0	11.5	55	9.52	2.91	1.65	150.6	1066.70	10739.1	602.2	10274.6	**4295.64**	**3424.88**
38.00	40.00	39.00	2.00	37.50	19.52	9.52	165.94	7.54	11.5	11.5	1.0	254.65	4756.41	55	1.0	414.9	5585.49	40.0	11.5	55	9.52	2.91	1.65	150.6	1066.70	11408.6	636.2	10978.1	**4563.44**	**3659.36**

BORE NO: P69, CUT OFF LENGTH: 2.50 m, Nc= 9

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
2.50	3.00	2.75	0.50	0.50	19.39	9.39	25.82	1.89	27.2	27.2	1.0	25.03	0	4	1.0	7.5	0	3.0	13.5	43	9.39	3.50	2.22	28.2	563.57	563.6	8.5	8.5	**225.43**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.39	9.39	32.87	3.77	13.5	13.5	1.0	29.76	29.76	43	1.0	162.2	162.17	4.0	13.5	43	9.39	3.50	2.22	37.6	600.76	792.7	25.4	217.4	**317.07**	**72.46**
4.00	5.00	4.50	1.00	2.50	19.39	9.39	42.26	3.77	13.5	13.5	1.0	38.26	68.02	43	1.0	162.2	324.34	5.0	29.1	0	9.31	19.23	20.33	47.0	1150.12	1542.5	42.4	434.8	**616.99**	**144.92**
5.00	6.00	5.50	1.00	3.50	19.31	9.31	51.61	3.77	29.1	29.1	1.0	108.33	176.34	0	1.0	0.0	324.34	6.0	28.8	0	9.31	18.56	19.64	56.3	1305.34	1806.0	59.4	560.1	**722.41**	**186.69**
6.00	7.00	6.50	1.00	4.50	19.31	9.31	60.92	3.77	28.8	28.8	1.0	126.30	302.64	0	1.0	0.0	324.34	7.0	28.8	0	9.61	18.56	19.64	65.6	1504.82	2131.8	76.3	703.3	**852.72**	**234.44**
7.00	9.00	8.00	2.00	6.50	19.61	9.61	75.18	7.54	28.8	28.8	1.0	311.75	614.39	0	1.0	0.0	324.34	9.0	11.8	47	9.61	3.00	1.73	84.8	777.64	1716.4	110.3	1049.0	**686.55**	**349.67**
9.00	10.00	9.50	1.00	7.50	19.61	9.61	89.60	3.77	11.8	11.8	1.0	70.59	684.98	47	1.0	177.3	501.60	10.0	7.2	35	9.61	1.97	0.79	94.4	571.53	1758.1	127.2	1313.8	**703.24**	**437.94**
10.00	11.00	10.50	1.00	8.50	19.61	9.61	99.21	3.77	7.2	7.2	1.0	47.27	732.25	35	1.0	132.0	633.60	11.0	11.8	47	10.16	3.00	1.73	104.0	843.51	2209.4	144.2	1510.0	**883.74**	**503.35**
11.00	12.50	11.75	1.50	10.00	20.16	10.16	111.63	5.66	11.8	11.8	1.0	131.93	864.18	47	1.0	265.9	899.49	12.5	11.8	47	10.37	3.00	1.73	119.3	895.47	2659.1	169.6	1933.3	**1063.65**	**644.44**
12.50	15.50	14.00	3.00	13.00	20.37	10.37	134.81	11.31	11.8	11.8	1.0	318.64	1182.81	47	1.0	531.8	1431.26	15.5	10.2	57	10.37	2.53	1.28	150.4	1019.62	3633.7	220.5	2834.6	**1453.48**	**944.87**
15.50	17.00	16.25	1.50	14.50	20.37	10.37	158.14	5.66	10.2	10.2	1.0	160.97	1343.78	57	1.0	322.5	1753.71	17.0	24.7	8	9.63	9.78	10.55	165.9	1987.10	5084.6	246.0	3343.5	**2033.84**	**1114.49**
17.00	18.50	17.75	1.50	16.00	19.63	9.63	173.14	5.66	24.7	24.7	1.0	450.50	1794.28	8	1.0	45.3	1798.97	18.5	12.0	48	10.10	3.06	1.79	165.9	1075.11	4668.4	271.4	3864.7	**1867.35**	**1288.23**
18.50	21.50	20.00	3.00	19.00	20.10	10.10	173.14	11.31	12.0	12.0	1.0	416.38	2210.66	48	1.0	543.1	2342.06	21.5	12.0	48	10.10	3.06	1.79	165.9	1075.11	5627.8	322.3	4875.0	**2251.13**	**1625.02**
21.50	23.00	22.25	1.50	20.50	20.10	10.10	173.14	5.66	12.0	12.0	1.0	208.19	2418.86	48	1.0	271.5	2613.60	23.0	11.3	44	10.30	2.85	1.59	165.9	994.59	6027.0	347.8	5380.2	**2410.82**	**1793.41**
23.00	24.50	23.75	1.50	22.00	20.30	10.30	173.14	5.66	11.3	11.3	1.0	195.72	2614.57	44	1.0	248.9	2862.51	24.5	8.2	65	10.30	2.15	0.94	165.9	1071.33	6548.4	373.2	5850.3	**2619.37**	**1950.10**
24.50	26.00	25.25	1.50	23.50	20.30	10.30	173.14	5.66	8.2	8.2	1.0	141.14	2755.71	65	1.0	367.7	3230.23	26.0	8.2	65	10.40	2.15	0.94	165.9	1071.39	7057.3	398.7	6384.6	**2822.93**	**2128.20**
26.00	27.50	26.75	1.50	25.00	20.40	10.40	173.14	5.66	8.2	8.2	1.0	141.14	2896.86	65	1.0	367.7	3597.94	27.5	8.2	65	10.40	2.15	0.94	165.9	1071.39	7566.2	424.1	6918.9	**3026.48**	**2306.31**
27.50	29.00	28.25	1.50	26.50	20.40	10.40	173.14	5.66	8.2	8.2	1.0	141.14	3038.00	65	1.0	367.7	3965.66	29.0	14.0	30	10.40	3.65	2.36	165.9	1007.36	8011.0	449.6	7453.2	**3204.41**	**2484.41**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
29.00	30.00	29.50	1.00	27.50	20.40	10.40	173.14	3.77	14.0	14.0	1.0	162.81	3200.81	30	1.0	113.1	4078.80	30.0	14.0	30	9.05	3.65	2.36	165.9	1005.19	8284.8	466.5	7746.1	**3313.92**	**2582.04**
30.00	30.50	30.25	0.50	28.00	19.05	9.05	173.14	1.89	14.0	14.0	1.0	81.40	3282.21	30	1.0	56.6	4135.37	30.5	10.3	48	9.07	2.56	1.31	165.9	977.05	8394.6	475.0	7892.6	**3357.85**	**2630.86**
30.50	32.00	31.25	1.50	29.50	19.07	9.07	173.14	5.66	10.3	10.3	1.0	178.00	3460.21	48	1.0	271.5	4406.91	32.0	8.2	68	10.36	2.15	0.94	165.9	1101.91	8969.0	500.5	8367.6	**3587.61**	**2789.19**
32.00	32.50	32.25	0.50	30.00	20.36	10.36	173.14	1.89	8.2	8.2	1.0	47.05	3507.25	68	1.0	128.2	4535.14	32.5	8.2	68	10.36	2.15	0.94	165.9	1101.91	9144.3	508.9	8551.3	**3657.72**	**2850.45**
32.50	33.50	33.00	1.00	31.00	20.36	10.36	173.14	3.77	8.2	8.2	1.0	94.10	3601.35	68	1.0	256.5	4791.60	33.5	8.2	68	7.93	2.15	0.94	165.9	1100.36	9493.3	525.9	8918.9	**3797.32**	**2972.95**
33.50	35.00	34.25	1.50	32.50	17.93	7.93	173.14	5.66	8.2	8.2	1.0	141.14	3742.49	68	1.0	384.7	5176.29	35.0	12.0	48	8.37	3.06	1.79	165.9	1073.01	9991.8	551.3	9470.1	**3996.72**	**3156.71**
35.00	36.50	35.75	1.50	34.00	18.37	8.37	173.14	5.66	12.0	12.0	1.0	208.19	3950.68	48	1.0	271.5	5447.83	36.5	12.0	48	9.23	3.06	1.79	165.9	1074.06	10472.6	576.8	9975.3	**4189.03**	**3325.10**
36.50	37.50	37.00	1.00	35.00	19.23	9.23	173.14	3.77	12.0	12.0	1.0	138.79	4089.48	48	1.0	181.0	5628.86	37.5	8.0	58	9.23	2.11	0.91	165.9	992.41	10710.7	593.8	10312.1	**4284.30**	**3437.37**
37.50	38.00	37.75	0.50	35.50	19.23	9.23	173.14	1.89	8.0	8.0	1.0	45.88	4135.36	58	1.0	109.4	5738.23	38.0	8.0	58	8.66	2.11	0.91	165.9	992.06	10865.7	602.2	10475.8	**4346.26**	**3491.94**
38.00	40.00	39.00	2.00	37.50	18.66	8.66	173.14	7.54	8.0	8.0	1.0	183.54	4318.90	58	1.0	437.5	6175.71	40.0	8.0	58	8.66	2.11	0.91	165.9	992.06	11486.7	636.2	11130.8	**4594.67**	**3710.26**
BORE NO: P70, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.39	10.39	28.57	1.89	24.5	24.5	1.0	24.55	0	7	1.0	13.2	0	3.0	15.0	16	10.39	3.94	2.65	31.2	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	20.39	10.39	36.37	3.77	15.0	15.0	1.0	36.75	0	16	1.0	60.3	0	4.0	28.5	3	8.60	17.88	18.94	41.6	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	5.00	4.50	1.00	2.50	18.60	8.60	45.86	3.77	28.5	28.5	1.0	93.91	0	3	1.0	11.3	0	5.0	26.1	0	8.60	12.48	13.41	50.2	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	18.60	8.60	54.46	3.77	26.1	26.1	1.0	100.62	0	0	1.0	0.0	0	6.0	26.8	0	8.60	14.05	15.03	58.8	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	8.00	7.00	2.00	5.50	18.60	8.60	67.36	7.54	26.8	26.8	1.0	256.65	0	0	1.0	0.0	0	8.0	29.0	0	10.38	19.01	20.10	76.0	0	0.0	93.3	93.3	**0.00**	**31.10**
8.00	9.00	8.50	1.00	6.50	20.38	10.38	81.15	3.77	29.0	29.0	1.0	169.65	0	0	1.0	0.0	0	9.0	29.0	0	10.38	19.01	20.10	86.3	1998.42	1998.4	110.3	110.3	**799.37**	**36.76**
9.00	10.00	9.50	1.00	7.50	20.38	10.38	91.53	3.77	29.0	29.0	1.0	191.35	191.35	0	1.0	0.0	0.00	10.0	25.8	8	10.38	11.80	12.72	96.7	1462.58	1653.9	127.2	318.6	**661.57**	**106.19**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
10.00	11.00	10.50	1.00	8.50	20.38	10.38	101.91	3.77	25.8	25.8	1.0	185.80	377.15	8	1.0	30.2	30.17	11.0	25.8	8	10.38	11.80	12.72	107.1	1601.18	2008.5	144.2	551.5	**803.40**	**183.84**
11.00	12.00	11.50	1.00	9.50	20.38	10.38	112.29	3.77	25.8	25.8	1.0	204.72	581.87	8	1.0	30.2	60.34	12.0	11.9	50	10.38	3.03	1.76	117.5	924.13	1566.3	161.2	803.4	**626.54**	**267.79**
12.00	13.00	12.50	1.00	10.50	20.38	10.38	122.67	3.77	11.9	11.9	1.0	97.49	679.37	50	1.0	188.6	248.91	13.0	8.1	46	10.60	2.13	0.93	127.9	782.93	1711.2	178.1	1106.4	**684.48**	**368.80**
13.00	14.50	13.75	1.50	12.00	20.60	10.60	135.81	5.66	8.1	8.1	1.0	109.34	788.71	46	1.0	260.2	509.14	14.5	9.6	48	10.60	2.40	1.16	143.8	887.16	2185.0	203.6	1501.4	**874.00**	**500.48**
14.50	16.00	15.25	1.50	13.50	20.60	10.60	151.71	5.66	9.6	9.6	1.0	145.16	933.87	48	1.0	271.5	780.69	16.0	9.6	48	10.60	2.40	1.16	159.7	930.30	2644.9	229.0	1943.6	**1057.94**	**647.86**
16.00	17.50	16.75	1.50	15.00	20.60	10.60	167.61	5.66	9.6	9.6	1.0	160.37	1094.25	48	1.0	271.5	1052.23	17.5	9.6	48	10.60	2.40	1.16	175.6	973.44	3119.9	254.5	2400.9	**1247.96**	**800.31**
17.50	19.00	18.25	1.50	16.50	20.60	10.60	167.61	5.66	9.6	9.6	1.0	160.37	1254.62	48	1.0	271.5	1323.77	19.0	27.2	0	10.69	14.95	15.95	175.6	3086.15	5664.5	279.9	2858.3	**2265.82**	**952.77**
19.00	20.50	19.75	1.50	18.00	20.69	10.69	167.61	5.66	27.2	27.2	1.0	487.31	1741.93	0	1.0	0.0	1323.77	20.5	9.5	56	9.87	2.38	1.14	175.6	1050.65	4116.3	305.4	3371.1	**1646.54**	**1123.69**
20.50	23.50	22.00	3.00	21.00	19.87	9.87	167.61	11.31	9.5	9.5	1.0	317.35	2059.27	56	1.0	633.6	1957.37	23.5	10.2	59	10.33	2.53	1.28	175.6	1112.05	5128.7	356.3	4372.9	**2051.48**	**1457.63**
23.50	26.50	25.00	3.00	24.00	20.33	10.33	167.61	11.31	10.2	10.2	1.0	341.21	2400.49	59	1.0	667.5	2624.91	26.5	10.2	59	10.33	2.53	1.28	175.6	1112.05	6137.5	407.2	5432.6	**2454.98**	**1810.85**
26.50	27.50	27.00	1.00	25.00	20.33	10.33	167.61	3.77	10.2	10.2	1.0	113.74	2514.23	59	1.0	222.5	2847.43	27.5	8.2	54	10.33	2.15	0.94	175.6	982.75	6344.4	424.1	5785.8	**2537.76**	**1928.59**
27.50	28.00	27.75	0.50	25.50	20.33	10.33	167.61	1.89	8.2	8.2	1.0	45.55	2559.77	54	1.0	101.8	2949.26	28.0	8.2	54	10.40	2.15	0.94	175.6	982.80	6491.8	432.6	5941.6	**2596.73**	**1980.54**
28.00	29.50	28.75	1.50	27.00	20.40	10.40	167.61	5.66	8.2	8.2	1.0	136.64	2696.41	54	1.0	305.5	3254.74	29.5	8.2	54	10.40	2.15	0.94	175.6	982.80	6933.9	458.0	6409.2	**2773.58**	**2136.40**
29.50	30.00	29.75	0.50	27.50	20.40	10.40	167.61	1.89	8.2	8.2	1.0	45.55	2741.95	54	1.0	101.8	3356.57	30.0	8.2	54	10.40	2.15	0.94	175.6	982.80	7081.3	466.5	6565.1	**2832.53**	**2188.35**
30.00	31.00	30.50	1.00	28.50	20.40	10.40	167.61	3.77	8.2	8.2	1.0	91.09	2833.04	54	1.0	203.7	3560.23	31.0	13.0	60	10.40	3.35	2.08	175.6	1291.06	7684.3	483.5	6876.8	**3073.74**	**2292.25**
31.00	32.50	31.75	1.50	30.00	20.40	10.40	167.61	5.66	13.0	13.0	1.0	218.91	3051.95	60	1.0	339.4	3899.66	32.5	13.5	60	9.60	3.50	2.22	175.6	1320.66	8272.3	508.9	7460.5	**3308.91**	**2486.85**
32.50	34.00	33.25	1.50	31.50	19.60	9.60	167.61	5.66	13.5	13.5	1.0	227.64	3279.59	60	1.0	339.4	4239.09	34.0	27.4	0	9.60	15.40	16.41	175.6	3166.81	10685.5	534.4	8053.1	**4274.19**	**2684.35**
34.00	35.00	34.50	1.00	32.50	19.60	9.60	167.61	3.77	27.4	27.4	1.0	327.66	3607.26	0	1.0	0.0	4239.09	35.0	27.4	0	9.60	15.40	16.41	175.6	3166.81	11013.2	551.3	8397.7	**4405.26**	**2799.23**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
35.00	35.50	35.25	0.50	33.00	19.60	9.60	167.61	1.89	27.4	27.4	1.0	163.83	3771.09	0	1.0	0.0	4239.09	35.5	27.4	0	9.60	15.40	16.41	175.6	3166.81	11177.0	559.8	8570.0	**4470.79**	**2856.67**
35.50	37.00	36.25	1.50	34.50	19.60	9.60	167.61	5.66	27.4	27.4	1.0	491.50	4262.59	0	1.0	0.0	4239.09	37.0	23.4	0	9.60	8.85	9.12	175.6	1816.97	10318.6	585.3	9087.0	**4127.46**	**3028.98**
37.00	37.50	37.25	0.50	35.00	19.60	9.60	167.61	1.89	23.4	23.4	1.0	136.77	4399.36	0	1.0	0.0	4239.09	37.5	23.0	0	9.26	8.56	8.68	175.6	1754.89	10393.3	593.8	9232.2	**4157.34**	**3077.40**
37.50	38.50	38.00	1.00	36.00	19.26	9.26	167.61	3.77	23.0	23.0	1.0	268.32	4667.68	0	1.0	0.0	4239.09	38.5	21.0	0	9.14	7.12	6.49	175.6	1454.53	10361.3	610.7	9517.5	**4144.52**	**3172.50**
38.50	40.00	39.25	1.50	37.50	19.14	9.14	167.61	5.66	21.0	21.0	1.0	363.98	5031.66	0	1.0	0.0	4239.09	40.0	21.0	0	9.14	7.12	6.49	175.6	1454.53	10725.3	636.2	9906.9	**4290.11**	**3302.31**
BORE NO: P71, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	18.58	8.58	23.60	1.89	11.2	11.2	1.0	8.81	0	41	1.0	77.3	0	3.0	11.2	41	8.58	2.82	1.56	25.7	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	18.58	8.58	30.03	3.77	11.2	11.2	1.0	22.43	0	41	1.0	154.6	0	4.0	11.2	41	8.58	2.82	1.56	34.3	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	5.00	4.50	1.00	2.50	18.58	8.58	38.61	3.77	11.2	11.2	1.0	28.83	0	41	1.0	154.6	0	5.0	28.4	0	10.06	17.66	18.71	42.9	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	20.06	10.06	47.93	3.77	28.4	28.4	1.0	97.74	0	0	1.0	0.0	0	6.0	25.4	0	10.06	10.90	11.80	53.0	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	7.00	6.50	1.00	4.50	20.06	10.06	57.99	3.77	25.4	25.4	1.0	103.85	0	0	1.0	0.0	0	7.0	28.6	0	9.38	18.11	19.17	63.0	0	0.0	76.3	76.3	**0.00**	**25.45**
7.00	9.00	8.00	2.00	6.50	19.38	9.38	72.40	7.54	28.6	28.6	1.0	297.74	0	0	1.0	0.0	0	9.0	9.2	50	9.38	2.33	1.10	81.8	731.35	731.3	110.3	110.3	**292.54**	**36.76**
9.00	10.00	9.50	1.00	7.50	19.38	9.38	86.47	3.77	9.2	9.2	1.0	52.82	52.82	50	1.0	188.6	188.57	10.0	9.2	50	9.38	2.33	1.10	91.2	756.03	997.4	127.2	368.6	**398.97**	**122.88**
10.00	11.00	10.50	1.00	8.50	19.38	9.38	95.85	3.77	9.2	9.2	1.0	58.55	111.37	50	1.0	188.6	377.14	11.0	24.8	11	9.88	9.86	10.66	100.5	1304.67	1793.2	144.2	632.7	**717.27**	**210.90**
11.00	12.50	11.75	1.50	10.00	19.88	9.88	107.95	5.66	24.8	24.8	1.0	282.18	393.55	11	1.0	62.2	439.37	12.5	24.8	11	9.88	9.86	10.66	115.4	1469.93	2302.8	169.6	1002.6	**921.14**	**334.19**
12.50	14.00	13.25	1.50	11.50	19.88	9.88	122.77	5.66	24.8	24.8	1.0	320.92	714.46	11	1.0	62.2	501.60	14.0	9.2	58	10.96	2.33	1.10	130.2	941.36	2157.4	195.1	1411.2	**862.97**	**470.39**
14.00	15.50	14.75	1.50	13.00	20.96	10.96	138.40	5.66	9.2	9.2	1.0	126.81	841.27	58	1.0	328.1	829.71	15.5	9.2	58	10.96	2.33	1.10	146.6	984.63	2655.6	220.5	1891.5	**1062.25**	**630.51**
15.50	17.00	16.25	1.50	14.50	20.96	10.96	154.84	5.66	9.2	9.2	1.0	141.87	983.15	58	1.0	328.1	1157.83	17.0	27.2	0	9.61	14.95	15.95	163.1	2862.96	5003.9	246.0	2387.0	**2001.57**	**795.65**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
17.00	18.50	17.75	1.50	16.00	19.61	9.61	170.27	5.66	27.2	27.2	1.0	495.03	1478.18	0	1.0	0.0	1157.83	18.5	10.3	51	9.61	2.56	1.31	163.1	999.81	3635.8	271.4	2907.4	**1454.33**	**969.15**
18.50	20.00	19.25	1.50	17.50	19.61	9.61	170.27	5.66	10.3	10.3	1.0	175.05	1653.23	51	1.0	288.5	1446.34	20.0	10.3	51	10.63	2.56	1.31	163.1	1000.71	4100.3	296.9	3396.4	**1640.11**	**1132.15**
20.00	21.50	20.75	1.50	19.00	20.63	10.63	170.27	5.66	10.3	10.3	1.0	175.05	1828.27	51	1.0	288.5	1734.86	21.5	10.3	51	10.63	2.56	1.31	163.1	1000.71	4563.8	322.3	3885.5	**1825.54**	**1295.15**
21.50	23.00	22.25	1.50	20.50	20.63	10.63	170.27	5.66	10.3	10.3	1.0	175.05	2003.32	51	1.0	288.5	2023.37	23.0	18.5	32	10.63	5.64	4.57	163.1	1399.71	5426.4	347.8	4374.5	**2170.56**	**1458.16**
23.00	24.50	23.75	1.50	22.00	20.63	10.63	170.27	5.66	18.5	18.5	1.0	322.29	2325.61	32	1.0	181.0	2204.40	24.5	26.2	7	9.72	12.70	13.64	163.1	2504.77	7034.8	373.2	4903.2	**2813.91**	**1634.41**
24.50	27.50	26.00	3.00	25.00	19.72	9.72	170.27	11.31	26.2	26.2	1.0	947.93	3273.55	7	1.0	79.2	2283.60	27.5	9.0	75	9.72	2.29	1.07	163.1	1193.23	6750.4	424.1	5981.3	**2700.15**	**1993.75**
27.50	29.00	28.25	1.50	26.50	19.72	9.72	170.27	5.66	9.0	9.0	1.0	152.56	3426.11	75	1.0	424.3	2707.89	29.0	9.0	75	9.72	2.29	1.07	163.1	1193.23	7327.2	449.6	6583.6	**2930.89**	**2194.52**
29.00	30.00	29.50	1.00	27.50	19.72	9.72	170.27	3.77	9.0	9.0	1.0	101.71	3527.81	75	1.0	282.9	2990.74	30.0	9.5	50	10.73	2.38	1.14	163.1	956.56	7475.1	466.5	6985.1	**2990.05**	**2328.36**
30.00	30.50	30.25	0.50	28.00	20.73	10.73	170.27	1.89	9.5	9.5	1.0	53.73	3581.54	50	1.0	94.3	3085.03	30.5	9.5	50	9.11	2.38	1.14	163.1	955.30	7621.9	475.0	7141.6	**3048.75**	**2380.53**
30.50	32.00	31.25	1.50	29.50	19.11	9.11	170.27	5.66	9.5	9.5	1.0	161.19	3742.73	50	1.0	282.9	3367.89	32.0	8.5	56	9.22	2.20	0.99	163.1	982.31	8092.9	500.5	7611.1	**3237.17**	**2537.02**
32.00	32.50	32.25	0.50	30.00	19.22	9.22	170.27	1.89	8.5	8.5	1.0	47.99	3790.72	56	1.0	105.6	3473.49	32.5	8.5	56	9.22	2.20	0.99	163.1	982.31	8246.5	508.9	7773.1	**3298.61**	**2591.05**
32.50	33.50	33.00	1.00	31.00	19.22	9.22	170.27	3.77	8.5	8.5	1.0	95.97	3886.69	56	1.0	211.2	3684.69	33.5	8.3	78	10.16	2.16	0.96	163.1	1200.11	8771.5	525.9	8097.3	**3508.59**	**2699.09**
33.50	35.00	34.25	1.50	32.50	20.16	10.16	170.27	5.66	8.3	8.3	1.0	140.52	4027.21	78	1.0	441.3	4125.94	35.0	9.2	63	9.59	2.33	1.10	163.1	1077.79	9230.9	551.3	8704.5	**3692.37**	**2901.50**
35.00	36.50	35.75	1.50	34.00	19.59	9.59	170.27	5.66	9.2	9.2	1.0	156.01	4183.22	63	1.0	356.4	4482.34	36.5	9.2	63	9.35	2.33	1.10	163.1	1077.61	9743.2	576.8	9242.4	**3897.27**	**3080.79**
36.50	37.50	37.00	1.00	35.00	19.35	9.35	170.27	3.77	9.2	9.2	1.0	104.01	4287.22	63	1.0	237.6	4719.94	37.5	9.2	57	9.35	2.33	1.10	163.1	1016.51	10023.7	593.8	9600.9	**4009.47**	**3200.31**
37.50	38.00	37.75	0.50	35.50	19.35	9.35	170.27	1.89	9.2	9.2	1.0	52.00	4339.23	57	1.0	107.5	4827.43	38.0	9.2	57	9.59	2.33	1.10	163.1	1016.69	10183.3	602.2	9768.9	**4073.34**	**3256.30**
38.00	40.00	39.00	2.00	37.50	19.59	9.59	170.27	7.54	9.2	9.2	1.0	208.01	4547.24	57	1.0	429.9	5257.37	40.0	9.2	57	9.59	2.33	1.10	163.1	1016.69	10821.3	636.2	10440.8	**4328.52**	**3480.26**

BORE NO: P72, CUT OFF LENGTH: 2.50 m, Nc= 9

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
2.50	3.00	2.75	0.50	0.50	19.98	9.98	27.45	1.89	23.4	23.4	1.0	22.40	0	0	1.0	0.0	0	3.0	28.5	0	9.98	17.88	18.94	29.9	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.98	9.98	34.93	3.77	28.5	28.5	1.0	71.53	0	0	1.0	0.0	0	4.0	28.5	0	9.37	17.88	18.94	39.9	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	6.00	5.00	2.00	3.50	19.37	9.37	49.29	7.54	28.5	28.5	1.0	201.86	0	0	1.0	0.0	0	6.0	28.4	0	9.37	17.66	18.71	58.7	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	7.00	6.50	1.00	4.50	19.37	9.37	63.35	3.77	28.4	28.4	1.0	129.17	0	0	1.0	0.0	0	7.0	27.2	0	9.37	14.95	15.95	68.0	0	0.0	76.3	76.3	**0.00**	**25.45**
7.00	9.00	8.00	2.00	6.50	19.37	9.37	77.40	7.54	27.2	27.2	1.0	300.04	0	0	1.0	0.0	0	9.0	28.2	0	10.25	17.21	18.25	86.8	0	0.0	110.3	110.3	**0.00**	**36.76**
9.00	10.00	9.50	1.00	7.50	20.25	10.25	91.90	3.77	28.2	28.2	1.0	185.83	0	0	1.0	0.0	0	10.0	11.1	22	10.25	2.79	1.53	97.0	541.34	541.3	127.2	127.2	**216.53**	**42.41**
10.00	11.00	10.50	1.00	8.50	20.25	10.25	102.15	3.77	11.1	11.1	1.0	75.58	75.58	22	1.0	83.0	82.97	11.0	11.6	44	10.25	2.94	1.68	107.3	816.59	975.1	144.2	302.8	**390.06**	**100.92**
11.00	12.50	11.75	1.50	10.00	20.25	10.25	114.96	5.66	11.6	11.6	1.0	133.49	209.07	44	1.0	248.9	331.89	12.5	11.0	40	10.17	2.76	1.51	122.6	801.26	1342.2	169.6	710.6	**536.89**	**236.87**
12.50	15.50	14.00	3.00	13.00	20.17	10.17	137.90	11.31	11.0	11.0	1.0	303.28	512.35	40	1.0	452.6	784.46	15.5	8.1	40	10.17	2.13	0.93	153.2	782.47	2079.3	220.5	1517.4	**831.71**	**505.78**
15.50	17.00	16.25	1.50	14.50	20.17	10.17	160.78	5.66	8.1	8.1	1.0	129.45	641.80	40	1.0	226.3	1010.74	17.0	10.2	46	10.38	2.53	1.28	168.4	959.26	2611.8	246.0	1898.5	**1044.72**	**632.84**
17.00	18.50	17.75	1.50	16.00	20.38	10.38	176.20	5.66	10.2	10.2	1.0	179.35	821.15	46	1.0	260.2	1270.97	18.5	15.3	23	10.38	4.09	2.81	168.4	1032.90	3125.0	271.4	2363.6	**1250.01**	**787.85**
18.50	20.00	19.25	1.50	17.50	20.38	10.38	176.20	5.66	15.3	15.3	1.0	272.68	1093.83	23	1.0	130.1	1401.09	20.0	9.3	52	10.35	2.34	1.11	168.4	983.96	3478.9	296.9	2791.8	**1391.55**	**930.60**
20.00	21.50	20.75	1.50	19.00	20.35	10.35	176.20	5.66	9.3	9.3	1.0	163.23	1257.06	52	1.0	294.2	1695.26	21.5	9.3	52	10.35	2.34	1.11	168.4	983.96	3936.3	322.3	3274.6	**1574.51**	**1091.55**
21.50	23.00	22.25	1.50	20.50	20.35	10.35	176.20	5.66	9.3	9.3	1.0	163.23	1420.28	52	1.0	294.2	1989.43	23.0	29.6	0	10.35	20.36	21.48	168.4	4030.15	7439.9	347.8	3757.5	**2975.94**	**1252.50**
23.00	24.50	23.75	1.50	22.00	20.35	10.35	176.20	5.66	29.6	29.6	1.0	566.24	1986.52	0	1.0	0.0	1989.43	24.5	20.0	48	10.09	6.40	5.39	168.4	1745.18	5721.1	373.2	4349.2	**2288.45**	**1449.72**
24.50	26.00	25.25	1.50	23.50	20.09	10.09	176.20	5.66	20.0	20.0	1.0	362.79	2349.31	48	1.0	271.5	2260.97	26.0	9.5	53	10.09	2.38	1.14	168.4	1001.02	5611.3	398.7	5009.0	**2244.52**	**1669.65**
26.00	27.50	26.75	1.50	25.00	20.09	10.09	176.20	5.66	9.5	9.5	1.0	166.80	2516.11	53	1.0	299.8	2560.80	27.5	9.5	53	10.09	2.38	1.14	168.4	1001.02	6077.9	424.1	5501.0	**2431.17**	**1833.68**
27.50	29.00	28.25	1.50	26.50	20.09	10.09	176.20	5.66	9.5	9.5	1.0	166.80	2682.91	53	1.0	299.8	2860.63	29.0	25.2	0	10.21	10.45	11.34	168.4	2069.86	7613.4	449.6	5993.1	**3045.36**	**1997.70**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
29.00	30.00	29.50	1.00	27.50	20.21	10.21	176.20	3.77	25.2	25.2	1.0	312.69	2995.61	0	1.0	0.0	2860.63	30.0	25.2	0	10.21	10.45	11.34	168.4	2069.86	7926.1	466.5	6322.8	**3170.44**	**2107.59**
30.00	30.50	30.25	0.50	28.00	20.21	10.21	176.20	1.89	25.2	25.2	1.0	156.35	3151.95	0	1.0	0.0	2860.63	30.5	25.0	0	10.21	10.00	10.88	168.4	1980.85	7993.4	475.0	6487.6	**3197.37**	**2162.53**
30.50	32.50	31.50	2.00	30.00	20.21	10.21	176.20	7.54	25.0	25.0	1.0	619.73	3771.68	0	1.0	0.0	2860.63	32.5	21.5	15	9.11	7.48	7.04	168.4	1621.53	8253.8	508.9	7141.3	**3301.54**	**2380.42**
32.50	33.50	33.00	1.00	31.00	19.11	9.11	176.20	3.77	21.5	21.5	1.0	261.76	4033.44	15	1.0	56.6	2917.20	33.5	17.5	39	10.37	5.17	4.02	168.4	1410.54	8361.2	525.9	7476.5	**3344.47**	**2492.18**
33.50	35.00	34.25	1.50	32.50	20.37	10.37	176.20	5.66	17.5	17.5	1.0	314.28	4347.72	39	1.0	220.6	3137.83	35.0	14.3	48	10.37	3.74	2.45	168.4	1218.09	8703.6	551.3	8036.9	**3481.45**	**2678.97**
35.00	36.50	35.75	1.50	34.00	20.37	10.37	176.20	5.66	14.3	14.3	1.0	254.07	4601.79	48	1.0	271.5	3409.37	36.5	14.3	48	10.37	3.74	2.45	168.4	1218.09	9229.2	576.8	8588.0	**3691.70**	**2862.65**
36.50	37.50	37.00	1.00	35.00	20.37	10.37	176.20	3.77	14.3	14.3	1.0	169.38	4771.17	48	1.0	181.0	3590.40	37.5	14.3	48	10.37	3.74	2.45	168.4	1218.09	9579.7	593.8	8955.3	**3831.86**	**2985.11**
37.50	38.00	37.75	0.50	35.50	20.37	10.37	176.20	1.89	14.3	14.3	1.0	84.69	4855.86	48	1.0	90.5	3680.91	38.0	27.1	0	10.37	14.73	15.72	168.4	2917.17	11453.9	602.2	9139.0	**4581.58**	**3046.34**
38.00	40.00	39.00	2.00	37.50	20.37	10.37	176.20	7.54	27.1	27.1	1.0	680.09	5535.95	0	1.0	0.0	3680.91	40.0	18.0	0	10.37	5.42	4.29	168.4	1062.21	10279.1	636.2	9853.0	**4111.63**	**3284.35**
BORE NO: P73, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	16.68	6.68	18.37	1.89	21.0	21.0	1.0	13.30	0	10	1.0	18.9	0	3.0	12.8	70	6.68	3.29	2.02	20.0	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	16.68	6.68	23.38	3.77	12.8	12.8	1.0	20.03	0	70	1.0	264.0	0	4.0	24.5	12	9.67	9.64	10.33	26.7	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	6.00	5.00	2.00	3.50	19.67	9.67	36.39	7.54	24.5	24.5	1.0	125.09	0	12	1.0	90.5	0	6.0	24.5	12	9.67	9.64	10.33	46.1	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	7.00	6.50	1.00	4.50	19.67	9.67	50.90	3.77	24.5	24.5	1.0	87.48	0	12	1.0	45.3	0	7.0	24.5	12	9.67	9.64	10.33	55.7	0	0.0	76.3	76.3	**0.00**	**25.45**
7.00	8.00	7.50	1.00	5.50	19.67	9.67	60.57	3.77	24.5	24.5	1.0	104.10	0	12	1.0	45.3	0	8.0	29.0	0	9.40	19.01	20.10	65.4	0	0.0	93.3	93.3	**0.00**	**31.10**
8.00	9.00	8.50	1.00	6.50	19.40	9.40	70.10	3.77	29.0	29.0	1.0	146.55	0	0	1.0	0.0	0	9.0	29.0	0	9.40	19.01	20.10	74.8	0	0.0	110.3	110.3	**0.00**	**36.76**
9.00	10.00	9.50	1.00	7.50	19.40	9.40	79.50	3.77	29.0	29.0	1.0	166.20	0	0	1.0	0.0	0	10.0	9.5	44	9.80	2.38	1.14	84.2	682.38	682.4	127.2	127.2	**272.95**	**42.41**
10.00	12.50	11.25	2.50	10.00	19.80	9.80	96.45	9.43	9.5	9.5	1.0	152.18	152.18	44	1.0	414.9	414.86	12.5	9.0	46	10.00	2.29	1.07	108.7	757.29	1324.3	169.6	736.7	**529.73**	**245.56**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m — Factor of Safety in Compression: 2.5 — Area of Pile: 1.13 m^2

Critical water table: 0.00 m — Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
12.50	15.50	14.00	3.00	13.00	20.00	10.00	123.70	11.31	9.0	9.0	1.0	221.67	373.85	46	1.0	520.5	935.31	15.5	9.0	46	10.00	2.29	1.07	138.7	835.02	2144.2	220.5	1529.7	**857.67**	**509.90**
15.50	17.00	16.25	1.50	14.50	20.00	10.00	146.20	5.66	9.0	9.0	1.0	131.00	504.85	46	1.0	260.2	1195.54	17.0	26.5	4	8.50	13.38	14.34	153.7	2449.87	4150.3	246.0	1946.4	**1660.10**	**648.79**
17.00	18.50	17.75	1.50	16.00	18.50	8.50	160.08	5.66	26.5	26.5	1.0	451.50	956.35	4	1.0	22.6	1218.17	18.5	26.5	4	8.10	13.38	14.34	153.7	2445.98	4620.5	271.4	2446.0	**1848.20**	**815.32**
18.50	21.50	20.00	3.00	19.00	18.10	8.10	160.08	11.31	26.5	26.5	1.0	903.00	1859.34	4	1.0	45.3	1263.43	21.5	11.5	42	8.10	2.91	1.65	153.7	942.97	4065.7	322.3	3445.1	**1626.30**	**1148.37**
21.50	23.00	22.25	1.50	20.50	18.10	8.10	160.08	5.66	11.5	11.5	1.0	184.24	2043.58	42	1.0	237.6	1501.03	23.0	8.0	62	8.10	2.11	0.91	153.7	1003.28	4547.9	347.8	3892.4	**1819.16**	**1297.46**
23.00	24.50	23.75	1.50	22.00	18.10	8.10	160.08	5.66	8.0	8.0	1.0	127.27	2170.85	62	1.0	350.7	1851.77	24.5	29.0	0	9.37	19.01	20.10	153.7	3433.26	7455.9	373.2	4395.8	**2982.36**	**1465.28**
24.50	26.00	25.25	1.50	23.50	19.37	9.37	160.08	5.66	29.0	29.0	1.0	501.96	2672.82	0	1.0	0.0	1851.77	26.0	7.5	38	9.37	2.02	0.84	153.7	743.54	5268.1	398.7	4923.3	**2107.25**	**1641.09**
26.00	27.50	26.75	1.50	25.00	19.37	9.37	160.08	5.66	7.5	7.5	1.0	119.22	2792.04	38	1.0	215.0	2066.74	27.5	7.5	38	9.37	2.02	0.84	153.7	743.54	5602.3	424.1	5282.9	**2240.93**	**1760.96**
27.50	29.00	28.25	1.50	26.50	19.37	9.37	160.08	5.66	7.5	7.5	1.0	119.22	2911.26	38	1.0	215.0	2281.71	29.0	28.5	0	9.37	17.88	18.94	153.7	3230.13	8423.1	449.6	5642.5	**3369.24**	**1880.84**
29.00	30.00	29.50	1.00	27.50	19.37	9.37	160.08	3.77	28.5	28.5	1.0	327.79	3239.05	0	1.0	0.0	2281.71	30.0	28.5	0	9.37	17.88	18.94	153.7	3230.13	8750.9	466.5	5987.3	**3500.36**	**1995.76**
30.00	30.50	30.25	0.50	28.00	19.37	9.37	160.08	1.89	28.5	28.5	1.0	163.89	3402.94	0	1.0	0.0	2281.71	30.5	7.5	50	9.37	2.02	0.84	153.7	865.73	6550.4	475.0	6159.7	**2620.15**	**2053.22**
30.50	32.00	31.25	1.50	29.50	19.37	9.37	160.08	5.66	7.5	7.5	1.0	119.22	3522.16	50	1.0	282.9	2564.57	32.0	29.0	0	9.37	19.01	20.10	153.7	3433.26	9520.0	500.5	6587.2	**3808.00**	**2195.73**
32.00	32.50	32.25	0.50	30.00	19.37	9.37	160.08	1.89	29.0	29.0	1.0	167.32	3689.48	0	1.0	0.0	2564.57	32.5	29.0	0	10.08	19.01	20.10	153.7	3442.95	9697.0	508.9	6763.0	**3878.80**	**2254.33**
32.50	33.50	33.00	1.00	31.00	20.08	10.08	160.08	3.77	29.0	29.0	1.0	334.64	4024.12	0	1.0	0.0	2564.57	33.5	8.5	53	10.08	2.20	0.99	153.7	929.04	7517.7	525.9	7114.6	**3007.09**	**2371.53**
33.50	35.00	34.25	1.50	32.50	20.08	10.08	160.08	5.66	8.5	8.5	1.0	135.34	4159.46	53	1.0	299.8	2864.40	35.0	8.5	53	10.08	2.20	0.99	153.7	929.04	7952.9	551.3	7575.2	**3181.16**	**2525.07**
35.00	36.50	35.75	1.50	34.00	20.08	10.08	160.08	5.66	8.5	8.5	1.0	135.34	4294.80	53	1.0	299.8	3164.23	36.5	8.5	53	10.08	2.20	0.99	153.7	929.04	8388.1	576.8	8035.8	**3355.23**	**2678.61**
36.50	37.50	37.00	1.00	35.00	20.08	10.08	160.08	3.77	8.5	8.5	1.0	90.23	4385.02	53	1.0	199.9	3364.11	37.5	10.5	72	10.08	2.62	1.36	153.7	1197.59	8946.7	593.8	8342.9	**3578.69**	**2780.97**
37.50	38.00	37.75	0.50	35.50	20.08	10.08	160.08	1.89	10.5	10.5	1.0	55.95	4440.97	72	1.0	135.8	3499.89	38.0	10.5	72	8.28	2.62	1.36	153.7	1195.92	9136.8	602.2	8543.1	**3654.71**	**2847.70**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								φ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	φ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
38.00	40.00	39.00	2.00	37.50	18.28	8.28	160.08	7.54	10.5	10.5	1.0	223.78	4664.75	72	1.0	543.1	4042.97	40.0	10.5	72	8.28	2.62	1.36	153.7	1195.92	9903.6	636.2	9343.9	**3961.46**	**3114.63**
BORE NO: P74, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.63	9.63	26.48	1.89	23.9	23.9	1.0	22.13	0	0	1.0	0.0	0	3.0	12.8	24	9.63	3.29	2.02	28.9	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.63	9.63	33.71	3.77	12.8	12.8	1.0	28.88	0	24	1.0	90.5	0	4.0	12.4	24	9.63	3.17	1.91	38.5	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	5.00	4.50	1.00	2.50	19.63	9.63	43.34	3.77	12.4	12.4	1.0	35.93	0	24	1.0	90.5	0	5.0	26.9	6	9.52	14.28	15.26	48.2	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	19.52	9.52	52.91	3.77	26.9	26.9	1.0	101.24	0	6	1.0	22.6	0	6.0	28.9	6	9.52	18.78	19.87	57.7	0	0.0	59.4	59.4	**0.00**	**19.79**
6.00	7.00	6.50	1.00	4.50	19.52	9.52	62.43	3.77	28.9	28.9	1.0	129.98	0	6	1.0	22.6	0	7.0	28.9	2	9.44	18.78	19.87	67.2	0	0.0	76.3	76.3	**0.00**	**25.45**
7.00	9.00	8.00	2.00	6.50	19.44	9.44	76.63	7.54	28.9	28.9	1.0	319.08	0	2	1.0	15.1	0	9.0	28.9	2	9.44	18.78	19.87	86.1	0	0.0	110.3	110.3	**0.00**	**36.76**
9.00	10.00	9.50	1.00	7.50	19.44	9.44	90.79	3.77	28.9	28.9	1.0	189.02	0	2	1.0	7.5	0	10.0	10.2	24	9.44	2.53	1.28	95.5	0	0.0	127.2	127.2	**0.00**	**42.41**
10.00	11.00	10.50	1.00	8.50	19.44	9.44	100.23	3.77	10.2	10.2	1.0	68.01	0	24	1.0	90.5	0	11.0	26.3	7	9.67	12.93	13.88	105.0	0	0.0	144.2	144.2	**0.00**	**48.07**
11.00	12.50	11.75	1.50	10.00	19.67	9.67	112.20	5.66	26.3	26.3	1.0	313.71	0	7	1.0	39.6	0	12.5	12.0	30	9.67	3.06	1.79	119.5	0	0.0	169.6	169.6	**0.00**	**56.55**
12.50	14.00	13.25	1.50	11.50	19.67	9.67	126.71	5.66	12.0	12.0	1.0	152.36	0	30	1.0	169.7	0	14.0	27.1	0	9.83	14.73	15.72	134.0	0	0.0	195.1	195.1	**0.00**	**65.03**
14.00	15.50	14.75	1.50	13.00	19.83	9.83	141.33	5.66	27.1	27.1	1.0	409.14	0	0	1.0	0.0	0	15.5	11.7	52	10.31	2.97	1.71	148.7	1041.12	1041.1	220.5	220.5	**416.45**	**73.51**
15.50	18.50	17.00	3.00	16.00	20.31	10.31	164.17	11.31	11.7	11.7	1.0	384.66	384.66	52	1.0	588.3	588.34	18.5	26.9	0	10.31	14.28	15.26	148.7	2509.15	3482.2	271.4	1244.4	**1392.86**	**414.81**
18.50	20.00	19.25	1.50	17.50	20.31	10.31	164.17	5.66	26.9	26.9	1.0	471.17	855.84	0	1.0	0.0	588.34	20.0	11.7	56	10.31	2.97	1.71	148.7	1081.85	2526.0	296.9	1741.1	**1010.41**	**580.35**
20.00	21.50	20.75	1.50	19.00	20.31	10.31	164.17	5.66	11.7	11.7	1.0	192.33	1048.17	56	1.0	316.8	905.14	21.5	10.0	56	8.86	2.47	1.22	148.7	993.15	2946.5	322.3	2275.6	**1178.59**	**758.55**
21.50	23.00	22.25	1.50	20.50	18.86	8.86	164.17	5.66	10.0	10.0	1.0	163.76	1211.93	56	1.0	316.8	1221.94	23.0	8.2	58	8.59	2.15	0.94	148.7	957.17	3391.0	347.8	2781.6	**1356.41**	**927.22**
23.00	24.50	23.75	1.50	22.00	18.59	8.59	164.17	5.66	8.2	8.2	1.0	133.83	1345.76	58	1.0	328.1	1550.06	24.5	7.0	81	10.87	1.93	0.76	148.7	1155.13	4050.9	373.2	3269.0	**1620.38**	**1089.68**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
24.50	26.00	25.25	1.50	23.50	20.87	10.87	164.17	5.66	7.0	7.0	1.0	114.03	1459.79	81	1.0	458.2	2008.29	26.0	7.0	81	8.59	1.93	0.76	148.7	1153.95	4622.0	398.7	3866.7	**1848.81**	**1288.92**
26.00	27.50	26.75	1.50	25.00	18.59	8.59	164.17	5.66	7.0	7.0	1.0	114.03	1573.83	81	1.0	458.2	2466.51	27.5	7.0	81	10.54	1.93	0.76	148.7	1154.96	5195.3	424.1	4464.5	**2078.12**	**1488.15**
27.50	29.00	28.25	1.50	26.50	20.54	10.54	164.17	5.66	7.0	7.0	1.0	114.03	1687.86	81	1.0	458.2	2924.74	29.0	18.0	26	8.62	5.42	4.29	148.7	1201.12	5813.7	449.6	5062.2	**2325.49**	**1687.39**
29.00	30.00	29.50	1.00	27.50	18.62	8.62	164.17	3.77	18.0	18.0	1.0	201.18	1889.04	26	1.0	98.1	3022.80	30.0	18.0	26	8.62	5.42	4.29	148.7	1201.12	6113.0	466.5	5378.4	**2445.18**	**1792.79**
30.00	30.50	30.25	0.50	28.00	18.62	8.62	164.17	1.89	18.0	18.0	1.0	100.59	1989.63	26	1.0	49.0	3071.83	30.5	18.0	26	9.41	5.42	4.29	148.7	1203.42	6264.9	475.0	5536.5	**2505.95**	**1845.49**
30.50	32.00	31.25	1.50	29.50	19.41	9.41	164.17	5.66	18.0	18.0	1.0	301.76	2291.39	26	1.0	147.1	3218.91	32.0	8.0	63	9.36	2.11	0.91	148.7	1002.32	6512.6	500.5	6010.8	**2605.05**	**2003.59**
32.00	32.50	32.25	0.50	30.00	19.36	9.36	164.17	1.89	8.0	8.0	1.0	43.51	2334.90	63	1.0	118.8	3337.71	32.5	8.0	63	9.36	2.11	0.91	148.7	1002.32	6674.9	508.9	6181.6	**2669.97**	**2060.52**
32.50	33.50	33.00	1.00	31.00	19.36	9.36	164.17	3.77	8.0	8.0	1.0	87.02	2421.92	63	1.0	237.6	3575.31	33.5	4.5	0	9.29	1.51	0.41	148.7	257.12	6254.3	525.9	6523.1	**2501.74**	**2174.38**
33.50	35.00	34.25	1.50	32.50	19.29	9.29	164.17	5.66	4.5	4.5	1.0	73.09	2495.01	0	1.0	0.0	3575.31	35.0	12.0	25	9.63	3.06	1.79	148.7	780.79	6851.1	551.3	6621.7	**2740.45**	**2207.22**
35.00	36.50	35.75	1.50	34.00	19.63	9.63	164.17	5.66	12.0	12.0	1.0	197.41	2692.42	25	1.0	141.4	3716.74	36.5	9.1	53	8.70	2.31	1.08	148.7	934.40	7343.6	576.8	6986.0	**2937.42**	**2328.65**
36.50	37.50	37.00	1.00	35.00	18.70	8.70	164.17	3.77	9.1	9.1	1.0	99.17	2791.59	53	1.0	199.9	3916.63	37.5	9.1	53	8.70	2.31	1.08	148.7	934.40	7642.6	593.8	7302.0	**3057.05**	**2433.99**
37.50	38.00	37.75	0.50	35.50	18.70	8.70	164.17	1.89	9.1	9.1	1.0	49.59	2841.18	53	1.0	99.9	4016.57	38.0	9.1	53	8.96	2.31	1.08	148.7	934.59	7792.3	602.2	7460.0	**3116.93**	**2486.66**
38.00	40.00	39.00	2.00	37.50	18.96	8.96	164.17	7.54	9.1	9.1	1.0	198.35	3039.52	53	1.0	399.8	4416.34	40.0	9.1	53	8.96	1.93	1.08	148.7	870.99	8326.9	636.2	8092.0	**3330.74**	**2697.35**
BORE NO: P75, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.69	9.69	26.65	1.89	23.4	23.4	1.0	21.74	0	0	1.0	0.0	0	3.0	25.8	6	9.69	11.80	12.72	29.1	532.95	533.0	8.5	8.5	**213.18**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.69	9.69	33.92	3.77	25.8	25.8	1.0	61.83	61.83	6	1.0	22.6	22.63	4.0	25.8	6	9.69	11.80	12.72	38.8	662.34	746.8	25.4	109.9	**298.72**	**36.64**
4.00	5.00	4.50	1.00	2.50	19.69	9.69	43.61	3.77	25.8	25.8	1.0	79.50	141.33	6	1.0	22.6	45.26	5.0	25.8	6	9.76	11.80	12.72	48.5	792.33	978.9	42.4	229.0	**391.57**	**76.33**
5.00	6.00	5.50	1.00	3.50	19.76	9.76	53.33	3.77	25.8	25.8	1.0	97.23	238.56	6	1.0	22.6	67.89	6.0	25.8	6	9.76	11.80	12.72	58.2	922.65	1229.1	59.4	365.8	**491.64**	**121.94**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
6.00	7.00	6.50	1.00	4.50	19.76	9.76	63.09	3.77	25.8	25.8	1.0	115.02	353.59	6	1.0	22.6	90.51	7.0	25.7	2	10.89	11.58	12.49	68.0	1002.98	1447.1	76.3	520.4	**578.83**	**173.48**
7.00	9.00	8.00	2.00	6.50	20.89	10.89	78.86	7.54	25.7	25.7	1.0	286.27	639.86	2	1.0	15.1	105.60	9.0	24.6	2	10.89	9.71	10.44	89.8	1083.76	1829.2	110.3	855.7	**731.69**	**285.24**
9.00	10.00	9.50	1.00	7.50	20.89	10.89	95.20	3.77	24.6	24.6	1.0	164.37	804.23	2	1.0	7.5	113.14	10.0	13.5	24	9.80	3.50	2.22	100.6	657.70	1575.1	127.2	1044.6	**630.03**	**348.20**
10.00	12.50	11.25	2.50	10.00	19.80	9.80	112.89	9.43	13.5	13.5	1.0	255.54	1059.77	24	1.0	226.3	339.43	12.5	13.5	24	9.80	3.50	2.22	125.1	754.72	2153.9	169.6	1568.8	**861.57**	**522.95**
12.50	14.00	13.25	1.50	11.50	19.80	9.80	132.49	5.66	13.5	13.5	1.0	179.94	1239.71	24	1.0	135.8	475.20	14.0	8.2	62	10.26	2.15	0.94	139.8	977.44	2692.4	195.1	1910.0	**1076.94**	**636.67**
14.00	15.50	14.75	1.50	13.00	20.26	10.26	147.54	5.66	8.2	8.2	1.0	120.27	1359.98	62	1.0	350.7	825.94	15.5	8.2	62	10.26	2.15	0.94	155.2	1014.81	3200.7	220.5	2406.5	**1280.29**	**802.16**
15.50	17.00	16.25	1.50	14.50	20.26	10.26	162.93	5.66	8.2	8.2	1.0	132.82	1492.80	62	1.0	350.7	1176.69	17.0	26.7	0	9.48	13.83	14.80	170.6	2764.69	5434.2	246.0	2915.5	**2173.67**	**971.82**
17.00	18.50	17.75	1.50	16.00	19.48	9.48	177.73	5.66	26.7	26.7	1.0	505.69	1998.49	0	1.0	0.0	1176.69	18.5	31.0	0	9.48	26.30	27.53	170.6	5253.62	8428.8	271.4	3446.6	**3371.52**	**1148.87**
18.50	21.50	20.00	3.00	19.00	19.48	9.48	177.73	11.31	31.0	31.0	1.1	1268.68	3267.16	0	1.0	0.0	1176.69	21.5	9.3	56	10.41	2.34	1.11	170.6	1030.60	5474.4	322.3	4766.2	**2189.78**	**1588.73**
21.50	24.50	23.00	3.00	22.00	20.41	10.41	177.73	11.31	9.3	9.3	1.0	329.30	3596.46	56	1.0	633.6	1810.29	24.5	27.0	0	10.41	14.50	15.49	170.6	2909.33	8316.1	373.2	5780.0	**3326.43**	**1926.66**
24.50	26.00	25.25	1.50	23.50	20.41	10.41	177.73	5.66	27.0	27.0	1.0	512.30	4108.76	0	1.0	0.0	1810.29	26.0	24.3	5	10.41	9.50	10.11	170.6	1955.52	7874.6	398.7	6317.7	**3149.83**	**2105.90**
26.00	27.50	26.75	1.50	25.00	20.41	10.41	177.73	5.66	24.3	24.3	1.0	453.98	4562.73	5	1.0	28.3	1838.57	27.5	10.5	28	9.64	2.62	1.36	170.6	799.24	7200.5	424.1	6825.4	**2880.22**	**2275.14**
27.50	29.00	28.25	1.50	26.50	19.64	9.64	177.73	5.66	10.5	10.5	1.0	186.35	4749.08	28	1.0	158.4	1996.97	29.0	28.7	0	9.64	18.33	19.40	170.6	3665.89	10411.9	449.6	7195.6	**4164.78**	**2398.54**
29.00	30.00	29.50	1.00	27.50	19.64	9.64	177.73	3.77	28.7	28.7	1.0	366.98	5116.06	0	1.0	0.0	1996.97	30.0	28.0	0	9.64	16.76	17.79	170.6	3351.03	10464.1	466.5	7579.6	**4185.62**	**2526.52**
30.00	30.50	30.25	0.50	28.00	19.64	9.64	177.73	1.89	28.0	28.0	1.0	178.20	5294.26	0	1.0	0.0	1996.97	30.5	7.0	70	9.64	1.93	0.76	170.6	1090.34	8381.6	475.0	7766.2	**3352.63**	**2588.75**
30.50	32.00	31.25	1.50	29.50	19.64	9.64	177.73	5.66	7.0	7.0	1.0	123.45	5417.71	70	1.0	396.0	2392.97	32.0	27.6	0	9.86	15.85	16.87	170.6	3173.63	10984.3	500.5	8311.1	**4393.73**	**2770.38**
32.00	32.50	32.25	0.50	30.00	19.86	9.86	177.73	1.89	27.6	27.6	1.0	175.21	5592.92	0	1.0	0.0	2392.97	32.5	27.6	0	9.86	15.85	16.87	170.6	3173.63	11159.5	508.9	8494.8	**4463.81**	**2831.61**
32.50	33.50	33.00	1.00	31.00	19.86	9.86	177.73	3.77	27.6	27.6	1.0	350.42	5943.35	0	1.0	0.0	2392.97	33.5	7.2	74	9.86	1.97	0.79	170.6	1138.34	9474.7	525.9	8862.2	**3789.86**	**2954.07**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
33.50	35.00	34.25	1.50	32.50	19.86	9.86	177.73	5.66	7.2	7.2	1.0	127.02	6070.36	74	1.0	418.6	2811.60	35.0	16.2	43	9.86	4.53	3.31	170.6	1334.57	10216.5	551.3	9433.3	**4086.61**	**3144.44**
35.00	36.50	35.75	1.50	34.00	19.86	9.86	177.73	5.66	16.2	16.2	1.0	292.11	6362.47	43	1.0	243.3	3054.86	36.5	28.1	0	9.00	16.98	18.02	170.6	3388.18	12805.5	576.8	9994.1	**5122.20**	**3331.38**
36.50	37.50	37.00	1.00	35.00	19.00	9.00	177.73	3.77	28.1	28.1	1.0	357.90	6720.38	0	1.0	0.0	3054.86	37.5	28.8	0	9.00	18.56	19.64	170.6	3702.34	13477.6	593.8	10369.0	**5391.03**	**3456.33**
37.50	38.00	37.75	0.50	35.50	19.00	9.00	177.73	1.89	28.8	28.8	1.0	184.25	6904.63	0	1.0	0.0	3054.86	38.0	29.2	0	8.87	19.46	20.56	170.6	3880.04	13839.5	602.2	10561.7	**5535.81**	**3520.58**
38.00	40.00	39.00	2.00	37.50	18.87	8.87	177.73	7.54	29.2	29.2	1.0	749.23	7653.86	0	1.0	0.0	3054.86	40.0	29.2	0	8.87	19.46	20.56	170.6	3880.04	14588.8	636.2	11344.9	**5835.50**	**3781.63**
BORE NO: P76, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	16.08	6.08	16.72	1.89	15.0	15.0	1.0	8.45	8.45	41	1.0	77.3	77.31	3.0	12.4	50	9.18	3.17	1.91	18.2	586.54	672.3	8.5	94.2	**268.92**	**31.41**
3.00	5.00	4.00	2.00	2.50	19.18	9.18	27.42	7.54	12.4	12.4	1.0	45.47	53.92	50	1.0	377.1	454.46	5.0	10.5	47	9.18	2.62	1.36	36.6	595.46	1103.8	42.4	550.8	**441.54**	**183.60**
5.00	6.00	5.50	1.00	3.50	19.18	9.18	41.19	3.77	10.5	10.5	1.0	28.79	82.71	47	1.0	177.3	631.71	6.0	10.5	47	9.18	2.62	1.36	45.8	622.64	1337.1	59.4	773.8	**534.83**	**257.93**
6.00	7.00	6.50	1.00	4.50	19.18	9.18	50.37	3.77	10.5	10.5	1.0	35.21	117.92	47	1.0	177.3	808.97	7.0	10.5	47	10.30	2.62	1.36	55.0	650.86	1577.8	76.3	1003.2	**631.10**	**334.41**
7.00	8.00	7.50	1.00	5.50	20.30	10.30	60.11	3.77	10.5	10.5	1.0	42.02	159.94	47	1.0	177.3	986.23	8.0	10.5	47	10.30	2.62	1.36	65.3	681.36	1827.5	93.3	1239.5	**731.01**	**413.16**
8.00	9.00	8.50	1.00	6.50	20.30	10.30	70.41	3.77	10.5	10.5	1.0	49.22	209.15	47	1.0	177.3	1163.49	9.0	9.0	50	10.30	2.29	1.07	75.6	712.37	2085.0	110.3	1482.9	**834.00**	**494.30**
9.00	10.00	9.50	1.00	7.50	20.30	10.30	80.71	3.77	9.0	9.0	1.0	48.21	257.36	50	1.0	188.6	1352.06	10.0	26.5	9	9.60	13.38	14.34	85.9	1484.66	3094.1	127.2	1736.7	**1237.63**	**578.89**
10.00	11.00	10.50	1.00	8.50	19.60	9.60	90.66	3.77	26.5	26.5	1.0	170.47	427.84	9	1.0	33.9	1386.00	11.0	27.0	12	9.60	14.50	15.49	95.5	1789.63	3603.5	144.2	1958.0	**1441.39**	**652.68**
11.00	12.00	11.50	1.00	9.50	19.60	9.60	100.26	3.77	27.0	27.0	1.0	192.66	620.50	12	1.0	45.3	1431.26	12.0	27.0	12	10.30	14.50	15.49	105.1	1954.53	4006.3	161.2	2212.9	**1602.51**	**737.64**
12.00	14.50	13.25	2.50	12.00	20.30	10.30	117.94	9.43	27.0	27.0	1.0	566.57	1187.07	12	1.0	113.1	1544.40	14.5	12.5	38	10.40	3.20	1.94	130.8	874.81	3606.3	203.6	2935.0	**1442.51**	**978.35**
14.50	17.50	16.00	3.00	15.00	20.40	10.40	146.41	11.31	12.5	12.5	1.0	367.24	1554.32	38	1.0	429.9	1974.34	17.5	16.8	32	10.40	4.83	3.64	162.0	1236.07	4764.7	254.5	3783.1	**1905.89**	**1261.04**
17.50	19.00	18.25	1.50	16.50	20.40	10.40	146.41	5.66	16.8	16.8	1.0	250.07	1804.38	32	1.0	181.0	2155.37	19.0	7.6	68	10.40	2.04	0.85	162.0	1072.01	5031.8	279.9	4239.7	**2012.71**	**1413.22**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
19.00	20.50	19.75	1.50	18.00	20.40	10.40	146.41	5.66	7.6	7.6	1.0	110.51	1914.90	68	1.0	384.7	2540.06	20.5	15.3	78	9.80	4.09	2.81	162.0	1562.25	6017.2	305.4	4760.3	**2406.88**	**1586.77**
20.50	23.50	22.00	3.00	21.00	19.80	9.80	146.41	11.31	15.3	15.3	1.0	453.17	2368.07	78	1.0	882.5	3422.57	23.5	15.3	78	9.80	4.09	2.81	162.0	1562.25	7352.9	356.3	6146.9	**2941.16**	**2048.97**
23.50	25.00	24.25	1.50	22.50	19.80	9.80	146.41	5.66	15.3	15.3	1.0	226.59	2594.66	78	1.0	441.3	3863.83	25.0	28.3	0	9.80	17.43	18.48	162.0	3318.17	9776.7	381.7	6840.2	**3910.66**	**2280.06**
25.00	26.50	25.75	1.50	24.00	19.80	9.80	146.41	5.66	28.3	28.3	1.0	445.97	3040.63	0	1.0	0.0	3863.83	26.5	11.2	54	9.80	2.82	1.56	162.0	1077.70	7982.2	407.2	7311.6	**3192.86**	**2437.20**
26.50	27.50	27.00	1.00	25.00	19.80	9.80	146.41	3.77	11.2	11.2	1.0	109.33	3149.96	54	1.0	203.7	4067.49	27.5	12.5	60	10.80	3.20	1.94	162.0	1212.46	8429.9	424.1	7641.6	**3371.96**	**2547.19**
27.50	29.50	28.50	2.00	27.00	20.80	10.80	146.41	7.54	12.5	12.5	1.0	244.83	3394.79	60	1.0	452.6	4520.06	29.5	12.5	60	10.80	3.20	1.94	162.0	1212.46	9127.3	458.0	8372.9	**3650.92**	**2790.96**
29.50	30.00	29.75	0.50	27.50	20.80	10.80	146.41	1.89	12.5	12.5	1.0	61.21	3456.00	60	1.0	113.1	4633.20	30.0	10.0	50	10.80	2.47	1.22	162.0	970.85	9060.0	466.5	8555.7	**3624.02**	**2851.91**
30.00	31.00	30.50	1.00	28.50	20.80	10.80	146.41	3.77	10.0	10.0	1.0	97.36	3553.36	50	1.0	188.6	4821.77	31.0	18.0	7	10.80	5.42	4.29	162.0	1095.53	9470.7	483.5	8858.6	**3788.27**	**2952.88**
31.00	32.50	31.75	1.50	30.00	20.80	10.80	146.41	5.66	18.0	18.0	1.0	269.12	3822.48	7	1.0	39.6	4861.37	32.5	23.5	7	9.55	8.92	9.23	162.0	1766.20	10450.1	508.9	9192.8	**4180.02**	**3064.26**
32.50	34.00	33.25	1.50	31.50	19.55	9.55	146.41	5.66	23.5	23.5	1.0	360.14	4182.62	7	1.0	39.6	4900.97	34.0	21.5	7	9.55	7.48	7.04	162.0	1488.01	10571.6	534.4	9618.0	**4228.64**	**3205.99**
34.00	35.00	34.50	1.00	32.50	19.55	9.55	146.41	3.77	21.5	21.5	1.0	217.51	4400.13	7	1.0	26.4	4927.37	35.0	21.5	20	9.55	7.48	7.04	162.0	1620.38	10947.9	551.3	9878.8	**4379.15**	**3292.95**
35.00	35.50	35.25	0.50	33.00	19.55	9.55	146.41	1.89	21.5	21.5	1.0	108.75	4508.88	20	1.0	37.7	4965.09	35.5	21.5	20	9.55	7.48	7.04	162.0	1620.38	11094.4	559.8	10033.8	**4437.74**	**3344.60**
35.50	37.00	36.25	1.50	34.50	19.55	9.55	146.41	5.66	21.5	21.5	1.0	326.26	4835.14	20	1.0	113.1	5078.23	37.0	20.5	48	9.55	6.76	5.94	162.0	1766.41	11679.8	585.3	10498.7	**4671.91**	**3499.55**
37.00	37.50	37.25	0.50	35.00	19.55	9.55	146.41	1.89	20.5	20.5	1.0	103.22	4938.37	48	1.0	90.5	5168.74	37.5	20.5	48	8.99	6.76	5.94	162.0	1764.15	11871.3	593.8	10700.9	**4748.50**	**3566.96**
37.50	38.50	38.00	1.00	36.00	18.99	8.99	146.41	3.77	20.5	20.5	1.0	206.45	5144.82	48	1.0	181.0	5349.77	38.5	14.3	52	9.13	3.74	2.45	162.0	1229.69	11724.3	610.7	11105.3	**4689.71**	**3701.77**
38.50	40.00	39.25	1.50	37.50	19.13	9.13	146.41	5.66	14.3	14.3	1.0	211.12	5355.94	52	1.0	294.2	5643.94	40.0	10.2	54	9.13	2.53	1.28	162.0	1021.33	12021.2	636.2	11636.1	**4808.48**	**3878.68**
BORE NO: P77, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	18.20	8.20	22.55	1.89	12.9	12.9	1.0	9.74	9.74	28	1.0	52.8	52.80	3.0	10.0	37	8.20	2.47	1.22	24.6	452.30	514.8	8.5	71.0	**205.94**	**23.67**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								φ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	φ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
3.00	4.00	3.50	1.00	1.50	18.20	8.20	28.70	3.77	10.0	10.0	1.0	19.09	28.82	37	1.0	139.5	192.34	4.0	23.6	18	9.99	8.99	9.34	32.8	580.35	801.5	25.4	246.6	**320.61**	**82.20**
4.00	5.00	4.50	1.00	2.50	19.99	9.99	37.80	3.77	23.6	23.6	1.0	62.27	91.10	18	1.0	67.9	260.23	5.0	25.5	13	9.99	11.13	12.03	42.8	752.63	1104.0	42.4	393.7	**441.58**	**131.25**
5.00	6.00	5.50	1.00	3.50	19.99	9.99	47.79	3.77	25.5	25.5	1.0	85.96	177.06	13	1.0	49.0	309.26	6.0	25.5	13	9.80	11.13	12.03	52.8	876.83	1363.1	59.4	545.7	**545.26**	**181.90**
6.00	8.00	7.00	2.00	5.50	19.80	9.80	62.58	7.54	25.5	25.5	1.0	225.15	402.21	13	1.0	98.1	407.31	8.0	12.5	38	9.80	3.20	1.94	72.4	662.21	1471.7	93.3	902.8	**588.69**	**300.94**
8.00	9.00	8.50	1.00	6.50	19.80	9.80	77.28	3.77	12.5	12.5	1.0	64.61	466.82	38	1.0	143.3	550.63	9.0	12.5	38	9.80	3.20	1.94	82.2	697.73	1715.2	110.3	1127.7	**686.07**	**375.91**
9.00	10.00	9.50	1.00	7.50	19.80	9.80	87.08	3.77	12.5	12.5	1.0	72.81	539.63	38	1.0	143.3	693.94	10.0	12.5	38	11.20	3.20	1.94	92.0	735.10	1968.7	127.2	1360.8	**787.47**	**453.60**
10.00	11.00	10.50	1.00	8.50	21.20	11.20	97.58	3.77	12.5	12.5	1.0	81.59	621.22	38	1.0	143.3	837.26	11.0	24.2	18	11.20	9.42	10.00	103.2	1359.50	2818.0	144.2	1602.7	**1127.19**	**534.22**
11.00	12.00	11.50	1.00	9.50	21.20	11.20	108.78	3.77	24.2	24.2	1.0	184.38	805.59	18	1.0	67.9	905.14	12.0	7.1	72	10.40	1.95	0.77	114.4	990.72	2701.5	161.2	1871.9	**1080.58**	**623.97**
12.00	14.50	13.25	2.50	12.00	20.40	10.40	127.38	9.43	7.1	7.1	1.0	149.59	955.19	72	1.0	678.9	1584.00	14.5	28.0	0	10.40	16.76	17.79	140.4	2786.92	5326.1	203.6	2742.8	**2130.44**	**914.25**
14.50	16.00	15.25	1.50	13.50	20.40	10.40	148.18	5.66	28.0	28.0	1.0	445.72	1400.91	0	1.0	0.0	1584.00	16.0	13.2	37	10.40	3.41	2.14	156.0	993.64	3978.5	229.0	3213.9	**1591.42**	**1071.31**
16.00	17.50	16.75	1.50	15.00	20.40	10.40	163.78	5.66	13.2	13.2	1.0	217.31	1618.22	37	1.0	209.3	1793.31	17.5	18.0	37	10.00	5.42	4.29	171.6	1457.33	4868.9	254.5	3666.0	**1947.54**	**1222.00**
17.50	19.00	18.25	1.50	16.50	20.00	10.00	163.78	5.66	18.0	18.0	1.0	301.05	1919.27	37	1.0	209.3	2002.63	19.0	11.6	56	10.00	2.94	1.68	171.6	1152.45	5074.3	279.9	4201.8	**2029.74**	**1400.60**
19.00	20.50	19.75	1.50	18.00	20.00	10.00	163.78	5.66	11.6	11.6	1.0	190.19	2109.46	56	1.0	316.8	2319.43	20.5	17.6	40	10.00	5.22	4.07	171.6	1448.18	5877.1	305.4	4734.2	**2350.83**	**1578.08**
20.50	22.00	21.25	1.50	19.50	20.00	10.00	163.78	5.66	17.6	17.6	1.0	293.91	2403.37	40	1.0	226.3	2545.71	22.0	12.5	44	10.60	3.20	1.94	171.6	1083.96	6033.0	330.8	5279.9	**2413.22**	**1759.96**
22.00	23.50	22.75	1.50	21.00	20.60	10.60	163.78	5.66	12.5	12.5	1.0	205.41	2608.77	44	1.0	248.9	2794.63	23.5	12.5	44	10.60	3.20	1.94	171.6	1083.96	6487.4	356.3	5759.7	**2594.95**	**1919.89**
23.50	25.00	24.25	1.50	22.50	20.60	10.60	163.78	5.66	12.5	12.5	1.0	205.41	2814.18	44	1.0	248.9	3043.54	25.0	25.6	0	9.25	11.35	12.26	171.6	2280.60	8138.3	381.7	6239.4	**3255.33**	**2079.81**
25.00	26.50	25.75	1.50	24.00	19.25	9.25	163.78	5.66	25.6	25.6	1.0	443.92	3258.10	0	1.0	0.0	3043.54	26.5	25.6	0	9.25	11.35	12.26	171.6	2280.60	8582.2	407.2	6708.8	**3432.90**	**2236.26**
26.50	27.50	27.00	1.00	25.00	19.25	9.25	163.78	3.77	25.6	25.6	1.0	295.94	3554.04	0	1.0	0.0	3043.54	27.5	25.6	0	9.25	11.35	12.26	171.6	2280.60	8878.2	424.1	7021.7	**3551.28**	**2340.57**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
27.50	28.00	27.75	0.50	25.50	19.25	9.25	163.78	1.89	25.6	25.6	1.0	147.97	3702.01	0	1.0	0.0	3043.54	28.0	10.1	59	10.60	2.50	1.25	171.6	1094.98	7840.5	432.6	7178.2	**3136.22**	**2392.72**
28.00	29.50	28.75	1.50	27.00	20.60	10.60	163.78	5.66	10.1	10.1	1.0	165.04	3867.05	59	1.0	333.8	3377.31	29.5	23.0	10	10.60	8.56	8.68	171.6	1826.07	9070.4	458.0	7702.4	**3628.18**	**2567.47**
29.50	30.00	29.75	0.50	27.50	20.60	10.60	163.78	1.89	23.0	23.0	1.0	131.10	3998.15	10	1.0	18.9	3396.17	30.0	23.0	10	10.60	8.56	8.68	171.6	1826.07	9220.4	466.5	7860.8	**3688.16**	**2620.28**
30.00	31.00	30.50	1.00	28.50	20.60	10.60	163.78	3.77	23.0	23.0	1.0	262.19	4260.34	10	1.0	37.7	3433.89	31.0	22.5	0	10.60	8.20	8.14	171.6	1650.41	9344.6	483.5	8177.7	**3737.85**	**2725.91**
31.00	32.50	31.75	1.50	30.00	20.60	10.60	163.78	5.66	22.5	22.5	1.0	383.78	4644.12	0	1.0	0.0	3433.89	32.5	15.5	48	10.33	4.19	2.92	171.6	1321.91	9399.9	508.9	8586.9	**3759.97**	**2862.31**
32.50	34.00	33.25	1.50	31.50	20.33	10.33	163.78	5.66	15.5	15.5	1.0	256.95	4901.07	48	1.0	271.5	3705.43	34.0	24.3	0	10.33	9.50	10.11	171.6	1914.37	10520.9	534.4	9140.9	**4208.35**	**3046.96**
34.00	35.00	34.50	1.00	32.50	20.33	10.33	163.78	3.77	24.3	24.3	1.0	278.90	5179.96	0	1.0	0.0	3705.43	35.0	24.3	0	10.33	9.50	10.11	171.6	1914.37	10799.8	551.3	9436.7	**4319.91**	**3145.58**
35.00	35.50	35.25	0.50	33.00	20.33	10.33	163.78	1.89	24.3	24.3	1.0	139.45	5319.41	0	1.0	0.0	3705.43	35.5	24.0	15	10.33	9.28	9.78	171.6	2022.87	11047.7	559.8	9584.7	**4419.08**	**3194.89**
35.50	37.00	36.25	1.50	34.50	20.33	10.33	163.78	5.66	24.0	24.0	1.0	412.52	5731.93	15	1.0	84.9	3790.29	37.0	13.1	35	10.33	3.38	2.11	171.6	1027.33	10549.5	585.3	10107.5	**4219.82**	**3369.16**
37.00	37.50	37.25	0.50	35.00	20.33	10.33	163.78	1.89	13.1	13.1	1.0	71.87	5803.80	35	1.0	66.0	3856.29	37.5	13.8	44	9.70	3.59	2.31	171.6	1160.16	10820.2	593.8	10253.8	**4328.10**	**3417.95**
37.50	38.50	38.00	1.00	36.00	19.70	9.70	163.78	3.77	13.8	13.8	1.0	151.72	5955.52	44	1.0	165.9	4022.23	38.5	14.5	48	8.63	3.80	2.51	171.6	1240.19	11217.9	610.7	10588.5	**4487.17**	**3529.49**
38.50	40.00	39.25	1.50	37.50	18.63	8.63	163.78	5.66	14.5	14.5	1.0	239.62	6195.13	48	1.0	271.5	4293.77	40.0	14.5	48	8.63	3.80	2.51	171.6	1240.19	11729.1	636.2	11125.1	**4691.64**	**3708.36**
BORE NO: P78, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.70	9.70	26.68	1.89	22.5	22.5	1.0	20.84	0	17	1.0	32.1	0	3.0	22.5	17	9.70	8.20	8.14	29.1	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.70	9.70	33.95	3.77	22.5	22.5	1.0	53.04	0	17	1.0	64.1	0	4.0	12.4	19	9.70	3.17	1.91	38.8	0	0.0	25.4	25.4	**0.00**	**8.48**
4.00	5.00	4.50	1.00	2.50	19.70	9.70	43.65	3.77	12.4	12.4	1.0	36.19	0	19	1.0	71.7	0	5.0	24.2	16	9.90	9.42	10.00	48.5	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	19.90	9.90	53.45	3.77	24.2	24.2	1.0	90.59	0	16	1.0	60.3	0	6.0	24.6	0	9.90	9.71	10.44	58.4	711.89	711.9	59.4	59.4	**284.76**	**19.79**
6.00	7.00	6.50	1.00	4.50	19.90	9.90	63.35	3.77	24.6	24.6	1.0	109.39	109.39	0	1.0	0.0	0.00	7.0	11.5	40	10.48	2.91	1.65	68.3	644.00	753.4	76.3	185.7	**301.35**	**61.91**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m) From	Layers (m) To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi: ϕ	δ	Ki	Qi	ΣQi	Ultimate Shaft Cohesion Quc= Σα.c.Asi: c	α	α.c.Asi	ΣQi	Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ): Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
7.00	9.00	8.00	2.00	6.50	20.48	10.48	78.78	7.54	11.5	11.5	1.0	120.90	230.28	40	1.0	301.7	301.71	9.0	10.5	44	10.48	2.62	1.36	89.3	722.04	1254.0	110.3	642.3	**501.61**	**214.09**
9.00	10.00	9.50	1.00	7.50	20.48	10.48	94.50	3.77	10.5	10.5	1.0	66.05	296.34	44	1.0	165.9	467.66	10.0	10.5	44	10.48	2.62	1.36	99.7	753.07	1517.1	127.2	891.2	**606.82**	**297.08**
10.00	11.00	10.50	1.00	8.50	20.48	10.48	104.98	3.77	10.5	10.5	1.0	73.38	369.72	44	1.0	165.9	633.60	11.0	10.5	44	10.24	2.62	1.36	110.2	783.88	1787.2	144.2	1147.5	**714.88**	**382.51**
11.00	12.50	11.75	1.50	10.00	20.24	10.24	117.90	5.66	10.5	10.5	1.0	123.62	493.33	44	1.0	248.9	882.51	12.5	7.0	54	10.24	1.93	0.76	125.6	829.37	2205.2	169.6	1545.5	**882.09**	**515.17**
12.50	14.00	13.25	1.50	11.50	20.24	10.24	133.26	5.66	7.0	7.0	1.0	92.56	585.90	54	1.0	305.5	1188.00	14.0	25.2	13	9.90	10.45	11.34	140.9	1875.05	3648.9	195.1	1969.0	**1459.58**	**656.33**
14.00	15.50	14.75	1.50	13.00	19.90	9.90	148.37	5.66	25.2	25.2	1.0	394.95	980.85	13	1.0	73.5	1261.54	15.5	24.6	15	10.40	9.71	10.44	155.8	1938.34	4180.7	220.5	2462.9	**1672.30**	**820.98**
15.50	18.50	17.00	3.00	16.00	20.40	10.40	171.39	11.31	24.6	24.6	1.0	887.81	1868.67	15	1.0	169.7	1431.26	18.5	24.0	15	10.40	9.28	9.78	155.8	1857.55	5157.5	271.4	3571.4	**2062.99**	**1190.45**
18.50	20.00	19.25	1.50	17.50	20.40	10.40	171.39	5.66	24.0	24.0	1.0	431.68	2300.35	15	1.0	84.9	1516.11	20.0	11.0	48	9.60	2.76	1.51	155.8	985.79	4802.3	296.9	4113.3	**1920.90**	**1371.12**
20.00	21.50	20.75	1.50	19.00	19.60	9.60	171.39	5.66	11.0	11.0	1.0	188.47	2488.82	48	1.0	271.5	1787.66	21.5	11.0	48	9.60	2.76	1.51	155.8	985.79	5262.3	322.3	4598.8	**2104.91**	**1532.93**
21.50	23.00	22.25	1.50	20.50	19.60	9.60	171.39	5.66	11.0	11.0	1.0	188.47	2677.29	48	1.0	271.5	2059.20	23.0	13.5	35	9.60	3.50	2.22	155.8	987.80	5724.3	347.8	5084.3	**2289.72**	**1694.75**
23.00	24.50	23.75	1.50	22.00	19.60	9.60	171.39	5.66	13.5	13.5	1.0	232.78	2910.06	35	1.0	198.0	2257.20	24.5	13.5	35	9.80	3.50	2.22	155.8	988.10	6155.4	373.2	5540.5	**2462.15**	**1846.83**
24.50	26.00	25.25	1.50	23.50	19.80	9.80	171.39	5.66	13.5	13.5	1.0	232.78	3142.84	35	1.0	198.0	2455.20	26.0	26.0	7	9.80	12.25	13.18	155.8	2318.58	7916.6	398.7	5996.7	**3166.64**	**1998.90**
26.00	27.50	26.75	1.50	25.00	19.80	9.80	171.39	5.66	26.0	26.0	1.0	472.89	3615.73	7	1.0	39.6	2494.80	27.5	23.5	46	9.80	8.92	9.23	155.8	2102.12	8212.7	424.1	6534.6	**3285.06**	**2178.22**
27.50	29.00	28.25	1.50	26.50	19.80	9.80	171.39	5.66	23.5	23.5	1.0	421.58	4037.31	46	1.0	260.2	2755.03	29.0	29.2	0	9.80	19.46	20.56	155.8	3566.53	10358.9	449.6	7241.9	**4143.55**	**2413.97**
29.00	30.00	29.50	1.00	27.50	19.80	9.80	171.39	3.77	29.2	29.2	1.0	361.25	4398.57	0	1.0	0.0	2755.03	30.0	30.0	0	10.05	21.26	22.40	155.8	3900.14	11053.7	466.5	7620.1	**4421.49**	**2540.04**
30.00	30.50	30.25	0.50	28.00	20.05	10.05	171.39	1.89	30.0	30.0	1.0	186.60	4585.16	0	1.0	0.0	2755.03	30.5	29.6	0	10.05	20.36	21.48	155.8	3735.08	11075.3	475.0	7815.2	**4430.11**	**2605.07**
30.50	32.00	31.25	1.50	29.50	20.05	10.05	171.39	5.66	29.6	29.6	1.0	550.80	5135.96	0	1.0	0.0	2755.03	32.0	29.6	0	10.05	20.36	21.48	155.8	3735.08	11626.1	500.5	8391.4	**4650.43**	**2797.15**
32.00	32.50	32.25	0.50	30.00	20.05	10.05	171.39	1.89	29.6	29.6	1.0	183.60	5319.56	0	1.0	0.0	2755.03	32.5	29.6	0	10.05	20.36	21.48	155.8	3735.08	11809.7	508.9	8583.5	**4723.87**	**2861.17**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m) From	Layers (m) To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi: ϕ	δ	Ki	Qi	ΣQi	Ultimate Shaft Cohesion Quc= Σα.c.Asi: c	α	α.c.Asi	ΣQi	Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ): Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
32.50	33.50	33.00	1.00	31.00	20.05	10.05	171.39	3.77	29.6	29.6	1.0	367.20	5686.76	0	1.0	0.0	2755.03	33.5	24.5	46	10.05	9.64	10.33	155.8	2238.09	10679.9	525.9	8967.7	**4271.95**	**2989.23**
33.50	35.00	34.25	1.50	32.50	20.05	10.05	171.39	5.66	24.5	24.5	1.0	441.86	6128.62	46	1.0	260.2	3015.26	35.0	27.1	5	10.05	14.73	15.72	155.8	2754.36	11898.2	551.3	9695.2	**4759.30**	**3231.74**
35.00	36.50	35.75	1.50	34.00	20.05	10.05	171.39	5.66	27.1	27.1	1.0	496.16	6624.78	5	1.0	28.3	3043.54	36.5	27.1	5	9.25	14.73	15.72	155.8	2745.83	12414.1	576.8	10245.1	**4965.66**	**3415.04**
36.50	37.50	37.00	1.00	35.00	19.25	9.25	171.39	3.77	27.1	27.1	1.0	330.77	6955.55	5	1.0	18.9	3062.40	37.5	26.0	10	9.25	12.25	13.18	155.8	2344.20	12362.1	593.8	10611.7	**4944.86**	**3537.24**
37.50	38.00	37.75	0.50	35.50	19.25	9.25	171.39	1.89	26.0	26.0	1.0	157.63	7113.18	10	1.0	18.9	3081.26	38.0	15.3	53	9.05	4.09	2.81	155.8	1277.48	11471.9	602.2	10796.7	**4588.77**	**3598.89**
38.00	40.00	39.00	2.00	37.50	19.05	9.05	171.39	7.54	15.3	15.3	1.0	353.66	7466.84	53	1.0	399.8	3481.03	40.0	15.3	53	9.05	4.09	2.81	155.8	1277.48	12225.4	636.2	11584.0	**4890.14**	**3861.35**
BORE NO: P79, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	18.44	8.44	23.21	1.89	23.5	23.5	1.0	19.03	19.03	9	1.0	17.0	16.97	3.0	23.5	9	9.60	8.92	9.23	25.3	407.36	443.4	8.5	44.5	**177.34**	**14.83**
3.00	5.00	4.00	2.00	2.50	19.60	9.60	34.92	7.54	23.5	23.5	1.0	114.53	133.56	9	1.0	67.9	84.86	5.0	8.6	42	9.60	2.22	1.00	44.5	545.95	764.4	42.4	260.8	**305.75**	**86.94**
5.00	6.00	5.50	1.00	3.50	19.60	9.60	49.32	3.77	8.6	8.6	1.0	28.13	161.69	42	1.0	158.4	243.26	6.0	8.6	42	9.60	2.22	1.00	54.1	570.04	975.0	59.4	464.3	**389.99**	**154.77**
6.00	7.00	6.50	1.00	4.50	19.60	9.60	58.92	3.77	8.6	8.6	1.0	33.61	195.30	42	1.0	158.4	401.66	7.0	13.0	51	10.10	3.35	2.08	63.7	775.09	1372.0	76.3	673.3	**548.82**	**224.43**
7.00	8.00	7.50	1.00	5.50	20.10	10.10	68.77	3.77	13.0	13.0	1.0	59.88	255.17	51	1.0	192.3	594.00	8.0	10.3	41	10.10	2.56	1.31	73.8	640.12	1489.3	93.3	942.5	**595.72**	**314.16**
8.00	9.00	8.50	1.00	6.50	20.10	10.10	78.87	3.77	10.3	10.3	1.0	54.06	309.23	41	1.0	154.6	748.63	9.0	10.3	40	8.80	2.56	1.31	83.9	658.01	1715.9	110.3	1168.1	**686.35**	**389.38**
9.00	11.00	10.00	2.00	8.50	18.80	8.80	92.72	7.54	10.3	10.3	1.0	127.10	436.33	40	1.0	301.7	1050.34	11.0	23.8	21	8.80	9.14	9.56	101.5	1320.35	2807.0	144.2	1630.9	**1122.81**	**543.62**
11.00	12.00	11.50	1.00	9.50	18.80	8.80	105.92	3.77	23.8	23.8	1.0	176.19	612.52	21	1.0	79.2	1129.54	12.0	23.8	21	8.80	9.14	9.56	110.3	1411.31	3153.4	161.2	1903.2	**1261.35**	**634.41**
12.00	13.00	12.50	1.00	10.50	18.80	8.80	114.72	3.77	23.8	23.8	1.0	190.83	803.34	21	1.0	79.2	1208.74	13.0	12.5	38	9.00	3.20	1.94	119.1	830.59	2842.7	178.1	2190.2	**1137.07**	**730.07**
13.00	14.50	13.75	1.50	12.00	19.00	9.00	125.87	5.66	12.5	12.5	1.0	157.86	961.20	38	1.0	215.0	1423.71	14.5	11.9	38	9.00	3.03	1.76	132.6	852.16	3237.1	203.6	2588.5	**1294.83**	**862.83**
14.50	16.00	15.25	1.50	13.50	19.00	9.00	139.37	5.66	11.9	11.9	1.0	166.15	1127.35	38	1.0	215.0	1638.69	16.0	11.9	38	10.20	3.03	1.76	146.1	899.86	3665.9	229.0	2995.1	**1466.36**	**998.35**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								φ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	φ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
16.00	17.50	16.75	1.50	15.00	20.20	10.20	153.77	5.66	11.9	11.9	1.0	183.32	1310.67	38	1.0	215.0	1853.66	17.5	24.3	0	10.20	9.50	10.11	161.4	1804.32	4968.6	254.5	3418.8	**1987.46**	**1139.60**
17.50	19.00	18.25	1.50	16.50	20.20	10.20	153.77	5.66	24.3	24.3	1.0	392.77	1703.44	0	1.0	0.0	1853.66	19.0	26.2	0	8.10	12.70	13.64	161.4	2394.91	5952.0	279.9	3837.0	**2380.81**	**1279.00**
19.00	20.50	19.75	1.50	18.00	18.10	8.10	153.77	5.66	26.2	26.2	1.0	428.04	2131.49	0	1.0	0.0	1853.66	20.5	26.0	7	9.82	12.25	13.18	161.4	2396.80	6381.9	305.4	4290.5	**2552.78**	**1430.17**
20.50	23.50	22.00	3.00	21.00	19.82	9.82	153.77	11.31	26.0	26.0	1.0	848.56	2980.04	7	1.0	79.2	1932.86	23.5	12.5	54	9.80	3.20	1.94	161.4	1147.91	6060.8	356.3	5269.2	**2424.32**	**1756.38**
23.50	26.50	25.00	3.00	24.00	19.80	9.80	153.77	11.31	12.5	12.5	1.0	385.70	3365.75	54	1.0	611.0	2543.83	26.5	11.3	66	9.80	2.85	1.59	161.4	1203.57	7113.1	407.2	6316.7	**2845.26**	**2105.57**
26.50	27.50	27.00	1.00	25.00	19.80	9.80	153.77	3.77	11.3	11.3	1.0	115.88	3481.63	66	1.0	248.9	2792.74	27.5	10.0	69	9.80	2.47	1.22	161.4	1161.84	7436.2	424.1	6698.5	**2974.48**	**2232.83**
27.50	29.50	28.50	2.00	27.00	19.80	9.80	153.77	7.54	10.0	10.0	1.0	204.52	3686.14	69	1.0	520.5	3313.20	29.5	27.6	0	8.93	15.85	16.87	161.4	2997.94	9997.3	458.0	7457.4	**3998.91**	**2485.80**
29.50	30.00	29.75	0.50	27.50	18.93	8.93	153.77	1.89	27.6	27.6	1.0	151.59	3837.73	0	1.0	0.0	3313.20	30.0	27.6	0	9.78	15.85	16.87	161.4	3007.68	10158.6	466.5	7617.5	**4063.44**	**2539.15**
30.00	31.00	30.50	1.00	28.50	19.78	9.78	153.77	3.77	27.6	27.6	1.0	303.18	4140.91	0	1.0	0.0	3313.20	31.0	24.8	0	9.78	9.86	10.66	161.4	1870.83	9324.9	483.5	7937.6	**3729.98**	**2645.87**
31.00	32.50	31.75	1.50	30.00	19.78	9.78	153.77	5.66	24.8	24.8	1.0	401.95	4542.86	0	1.0	0.0	3313.20	32.5	27.0	10	9.78	14.50	15.49	161.4	2853.56	10709.6	508.9	8365.0	**4283.85**	**2788.33**
32.50	35.00	33.75	2.50	32.50	19.78	9.78	153.77	9.43	27.0	27.0	1.0	738.73	5281.59	10	1.0	94.3	3407.49	35.0	27.4	10	9.78	15.40	16.41	161.4	3024.19	11713.3	551.3	9240.4	**4685.31**	**3080.14**
35.00	35.50	35.25	0.50	33.00	19.78	9.78	153.77	1.89	27.4	27.4	1.0	150.30	5431.89	10	1.0	18.9	3426.34	35.5	26.3	10	9.78	12.93	13.88	161.4	2554.96	11413.2	559.8	9418.1	**4565.28**	**3139.36**
35.50	37.50	36.50	2.00	35.00	19.78	9.78	153.77	7.54	26.3	26.3	1.0	573.24	6005.14	10	1.0	75.4	3501.77	37.5	11.5	49	8.82	2.91	1.65	161.4	1040.48	10547.4	593.8	10100.7	**4218.96**	**3366.89**
37.50	38.50	38.00	1.00	36.00	18.82	8.82	153.77	3.77	11.5	11.5	1.0	117.99	6123.12	49	1.0	184.8	3686.57	38.5	7.5	60	8.29	2.02	0.84	161.4	984.59	10794.3	610.7	10420.4	**4317.72**	**3473.47**
38.50	40.00	39.25	1.50	37.50	18.29	8.29	153.77	5.66	7.5	7.5	1.0	114.52	6237.65	60	1.0	339.4	4026.00	40.0	7.5	60	8.29	2.02	0.84	161.4	984.59	11248.2	636.2	10899.8	**4499.30**	**3633.27**
BORE NO: P80, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.8	10.80	29.70	1.89	12.3	12.3	1.0	12.21	0	29	1.0	54.7	0	3.0	28.4	2	9.64	17.66	18.71	32.4	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.50	19.6	9.64	42.04	7.54	28.4	28.4	1.0	171.46	0	2	1.0	15.1	0	5.0	7.2	41	9.64	1.97	0.79	51.7	537.62	537.6	42.4	42.4	**215.05**	**14.14**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
5.00	6.00	5.50	1.00	3.50	19.6	9.64	56.50	3.77	7.2	7.2	1.0	26.92	26.92	41	1.0	154.6	154.63	6.0	11.9	21	9.64	3.03	1.76	61.3	435.50	617.0	59.4	240.9	**246.82**	**80.31**
6.00	7.00	6.50	1.00	4.50	19.6	9.64	66.14	3.77	11.9	11.9	1.0	52.57	79.48	21	1.0	79.2	233.83	7.0	29.2	2	9.65	19.46	20.56	71.0	1717.24	2030.6	76.3	389.7	**812.22**	**129.88**
7.00	8.00	7.50	1.00	5.50	19.7	9.65	75.79	3.77	29.2	29.2	1.0	159.74	239.22	2	1.0	7.5	241.37	8.0	9.5	42	9.65	2.38	1.14	80.6	652.23	1132.8	93.3	573.9	**453.13**	**191.30**
8.00	9.00	8.50	1.00	6.50	19.7	9.65	85.44	3.77	9.5	9.5	1.0	53.92	293.14	42	1.0	158.4	399.77	9.0	9.5	42	9.65	2.38	1.14	90.3	678.22	1371.1	110.3	803.2	**548.45**	**267.73**
9.00	10.00	9.50	1.00	7.50	19.7	9.65	95.09	3.77	9.5	9.5	1.0	60.01	353.15	42	1.0	158.4	558.17	10.0	9.5	42	10.04	2.38	1.14	99.9	704.51	1615.8	127.2	1038.6	**646.33**	**346.19**
10.00	11.00	10.50	1.00	8.50	20.0	10.04	104.93	3.77	9.5	9.5	1.0	66.22	419.38	42	1.0	158.4	716.57	11.0	9.5	42	10.04	2.38	1.14	110.0	731.54	1867.5	144.2	1280.1	**747.00**	**426.72**
11.00	12.00	11.50	1.00	9.50	20.0	10.04	114.97	3.77	9.5	9.5	1.0	72.56	491.94	42	1.0	158.4	874.97	12.0	8.2	54	10.41	2.15	0.94	120.0	847.88	2214.8	161.2	1528.1	**885.91**	**509.36**
12.00	14.50	13.25	2.50	12.00	20.4	10.41	133.00	9.43	8.2	8.2	1.0	180.71	672.64	54	1.0	509.1	1384.11	14.5	8.2	54	10.41	2.15	0.94	146.0	911.07	2967.8	203.6	2260.3	**1187.13**	**753.44**
14.50	16.00	15.25	1.50	13.50	20.4	10.41	153.82	5.66	8.2	8.2	1.0	125.40	798.04	54	1.0	305.5	1689.60	16.0	10.3	52	10.12	2.56	1.31	161.6	1006.30	3493.9	229.0	2716.7	**1397.58**	**905.55**
16.00	17.50	16.75	1.50	15.00	20.1	10.12	169.22	5.66	10.3	10.3	1.0	173.97	972.01	52	1.0	294.2	1983.77	17.5	10.3	52	10.12	2.56	1.31	176.8	1050.24	4006.0	254.5	3210.3	**1602.41**	**1070.08**
17.50	19.00	18.25	1.50	16.50	20.1	10.12	169.22	5.66	10.3	10.3	1.0	173.97	1145.98	52	1.0	294.2	2277.94	19.0	27.8	0	9.60	16.31	17.33	176.8	3374.80	6798.7	279.9	3703.8	**2719.49**	**1234.61**
19.00	20.50	19.75	1.50	18.00	19.6	9.60	169.22	5.66	27.8	27.8	1.0	504.73	1650.71	0	1.0	0.0	2277.94	20.5	27.0	0	9.60	14.50	15.49	176.8	3002.39	6931.0	305.4	4234.0	**2772.42**	**1411.34**
20.50	22.00	21.25	1.50	19.50	19.6	9.60	169.22	5.66	27.0	27.0	1.0	487.77	2138.48	0	1.0	0.0	2277.94	22.0	9.5	47	9.89	2.38	1.14	176.8	962.38	5378.8	330.8	4747.2	**2151.52**	**1582.41**
22.00	23.50	22.75	1.50	21.00	19.9	9.89	169.22	5.66	9.5	9.5	1.0	160.20	2298.68	47	1.0	265.9	2543.83	23.5	9.5	47	9.89	2.38	1.14	176.8	962.38	5804.9	356.3	5198.8	**2321.96**	**1732.92**
23.50	25.00	24.25	1.50	22.50	19.9	9.89	169.22	5.66	9.5	9.5	1.0	160.20	2458.88	47	1.0	265.9	2809.71	25.0	14.0	32	9.89	3.65	2.36	176.8	1071.90	6340.5	381.7	5650.3	**2536.20**	**1883.43**
25.00	26.50	25.75	1.50	24.00	19.9	9.89	169.22	5.66	14.0	14.0	1.0	238.68	2697.56	32	1.0	181.0	2990.74	26.5	15.5	32	9.24	4.19	2.92	176.8	1181.59	6869.9	407.2	6095.5	**2747.96**	**2031.82**
26.50	27.50	27.00	1.00	25.00	19.2	9.24	169.22	3.77	15.5	15.5	1.0	176.99	2874.55	32	1.0	120.7	3111.43	27.5	15.5	32	9.24	4.19	2.92	176.8	1181.59	7167.6	424.1	6410.1	**2867.03**	**2136.70**
27.50	28.00	27.75	0.50	25.50	19.2	9.24	169.22	1.89	15.5	15.5	1.0	88.49	2963.04	32	1.0	60.3	3171.77	28.0	24.5	7	8.97	9.64	10.33	176.8	2062.65	8197.5	432.6	6567.4	**3278.99**	**2189.14**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								φ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	φ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
28.00	29.50	28.75	1.50	27.00	19.0	8.97	169.22	5.66	24.5	24.5	1.0	436.27	3399.31	7	1.0	39.6	3211.37	29.5	24.5	7	9.01	9.64	10.33	176.8	2062.93	8673.6	458.0	7068.7	**3469.44**	**2356.24**
29.50	30.00	29.75	0.50	27.50	19.0	9.01	169.22	1.89	24.5	24.5	1.0	145.42	3544.73	7	1.0	13.2	3224.57	30.0	24.5	7	9.01	9.64	10.33	176.8	2062.93	8832.2	466.5	7235.8	**3532.89**	**2411.94**
30.00	31.00	30.50	1.00	28.50	19.0	9.01	169.22	3.77	24.5	24.5	1.0	290.85	3835.58	7	1.0	26.4	3250.97	31.0	19.5	30	9.08	6.13	5.12	176.8	1564.11	8650.7	483.5	7570.0	**3460.26**	**2523.35**
31.00	32.50	31.75	1.50	30.00	19.1	9.08	169.22	5.66	19.5	19.5	1.0	339.00	4174.57	30	1.0	169.7	3420.69	32.5	10.0	45	8.59	2.47	1.22	176.8	959.46	8554.7	508.9	8104.2	**3421.89**	**2701.40**
32.50	34.00	33.25	1.50	31.50	18.6	8.59	169.22	5.66	10.0	10.0	1.0	168.80	4343.37	45	1.0	254.6	3675.26	34.0	18.0	48	9.27	5.42	4.29	176.8	1599.26	9617.9	534.4	8553.0	**3847.16**	**2851.00**
34.00	35.00	34.50	1.00	32.50	19.3	9.27	169.22	3.77	18.0	18.0	1.0	207.36	4550.74	48	1.0	181.0	3856.29	35.0	18.0	48	9.27	5.42	4.29	176.8	1599.26	10006.3	551.3	8958.4	**4002.51**	**2986.12**
35.00	35.50	35.25	0.50	33.00	19.3	9.27	169.22	1.89	18.0	18.0	1.0	103.68	4654.42	48	1.0	90.5	3946.80	35.5	22.5	15	9.14	8.20	8.14	176.8	1843.61	10444.8	559.8	9161.1	**4177.93**	**3053.68**
35.50	37.00	36.25	1.50	34.50	19.1	9.14	169.22	5.66	22.5	22.5	1.0	396.53	5050.95	15	1.0	84.9	4031.66	37.0	22.5	15	9.52	8.20	8.14	176.8	1845.71	10928.3	585.3	9667.9	**4371.33**	**3222.63**
37.00	37.50	37.25	0.50	35.00	19.5	9.52	169.22	1.89	22.5	22.5	1.0	132.18	5183.12	15	1.0	28.3	4059.94	37.5	22.5	15	9.52	8.20	8.14	176.8	1845.71	11088.8	593.8	9836.8	**4435.51**	**3278.94**
37.50	38.50	38.00	1.00	36.00	19.5	9.52	169.22	3.77	22.5	22.5	1.0	264.35	5447.47	15	1.0	56.6	4116.51	38.5	22.5	15	9.41	8.20	8.14	176.8	1845.10	11409.1	610.7	10174.7	**4563.64**	**3391.57**
38.50	40.00	39.25	1.50	37.50	19.4	9.41	169.22	5.66	22.5	22.5	1.0	396.53	5844.00	15	1.0	84.9	4201.37	40.0	22.5	15	9.41	8.20	8.14	176.8	1845.10	11890.5	636.2	10681.5	**4756.19**	**3560.51**

APPENDIX-H

TABLE 3: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1000 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Depth of Fixity (m)	Allowable Load capacity of pile(kN)
P61	1.00	2.50	0.00	35	29580399	0.0491	22	3128	3.41	6.50	1.90	1.94	0.005	6.64	38
P62	1.00	2.50	0.00	35	29580399	0.0491	21	2984	3.45	0.00	0.00	2.23	0.005	7.69	192
P63	1.00	2.50	0.00	35	29580399	0.0491	12	1688	3.86	0.00	0.00	2.23	0.005	8.61	136
P64	1.00	2.50	0.00	35	29580399	0.0491	17	2408	3.60	0.50	0.14	2.21	0.005	7.95	144
P65	1.00	2.50	0.00	35	29580399	0.0491	17	2408	3.60	2.50	0.69	2.13	0.005	7.65	83
P66	1.00	2.50	0.00	35	29580399	0.0491	20	2840	3.48	5.50	1.58	1.99	0.005	6.94	45
P67	1.00	2.50	0.00	35	29580399	0.0491	18	2552	3.56	3.50	0.98	2.08	0.005	7.41	67
P68	1.00	2.50	0.00	35	29580399	0.0491	17	2408	3.60	0.50	0.14	2.21	0.005	7.95	144
P69	1.00	2.50	0.00	35	29580399	0.0491	14	1976	3.74	0.50	0.13	2.21	0.005	8.27	129
P70	1.00	2.50	0.00	35	29580399	0.0491	15	2120	3.69	6.50	1.76	1.97	0.005	7.26	33
P71	1.00	2.50	0.00	35	29580399	0.0491	21	2984	3.45	6.50	1.89	1.95	0.005	6.71	38
P72	1.00	2.50	0.00	35	29580399	0.0491	12	1688	3.86	7.50	1.94	1.94	0.005	7.49	26
P73	1.00	2.50	0.00	35	29580399	0.0491	19	2696	3.52	7.50	2.13	1.93	0.005	6.78	30
P74	1.00	2.50	0.00	35	29580399	0.0491	26	3704	3.30	13.00	3.94	1.88	0.005	6.21	12
P75	1.00	2.50	0.00	35	29580399	0.0491	14	1976	3.74	0.50	0.13	2.21	0.005	8.27	129
P76	1.00	2.50	0.00	35	29580399	0.0491	11	1544	3.93	0.00	0.00	2.23	0.005	8.77	129
P77	1.00	2.50	0.00	35	29580399	0.0491	18	2552	3.56	0.00	0.00	2.23	0.005	7.93	175
P78	1.00	2.50	0.00	35	29580399	0.0491	16	2264	3.64	3.50	0.96	2.09	0.005	7.60	64
P79	1.00	2.50	0.00	35	29580399	0.0491	10	1400	4.01	0.00	0.00	2.23	0.005	8.94	122
P80	1.00	2.50	0.00	35	29580399	0.0491	19	2696	3.52	2.50	0.71	2.12	0.005	7.47	88

APPENDIX-H

TABLE 4: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1200 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Depth of Fixity (m)	Allowable Load capacity of pile(kN)
P61	1.20	2.50	0.00	35	29580399	0.1018	22	3128	3.95	6.50	1.65	1.98	0.005	7.84	61
P62	1.20	2.50	0.00	35	29580399	0.1018	22	3128	3.95	0.00	0.00	2.23	0.005	8.81	264
P63	1.20	2.50	0.00	35	29580399	0.1018	13	1832	4.40	0.00	0.00	2.23	0.005	9.81	192
P64	1.20	2.50	0.00	35	29580399	0.1018	19	2696	4.07	0.50	0.12	2.21	0.005	9.00	211
P65	1.20	2.50	0.00	35	29580399	0.1018	17	2408	4.16	2.50	0.60	2.14	0.005	8.91	122
P66	1.20	2.50	0.00	35	29580399	0.1018	20	2840	4.03	5.50	1.37	2.03	0.005	8.16	71
P67	1.20	2.50	0.00	35	29580399	0.1018	17	2408	4.16	3.50	0.84	2.10	0.005	8.76	98
P68	1.20	2.50	0.00	35	29580399	0.1018	17	2408	4.16	0.50	0.12	2.21	0.005	9.21	197
P69	1.20	2.50	0.00	35	29580399	0.1018	14	1976	4.33	0.50	0.12	2.21	0.005	9.58	176
P70	1.20	2.50	0.00	35	29580399	0.1018	15	2120	4.27	6.50	1.52	2.00	0.005	8.55	53
P71	1.20	2.50	0.00	35	29580399	0.1018	22	3128	3.95	6.50	1.65	1.98	0.005	7.84	61
P72	1.20	2.50	0.00	35	29580399	0.1018	13	1832	4.40	7.50	1.71	1.97	0.005	8.68	43
P73	1.20	2.50	0.00	35	29580399	0.1018	20	2840	4.03	7.50	1.86	1.95	0.005	7.86	50
P74	1.20	2.50	0.00	35	29580399	0.1018	27	3848	3.79	13.00	3.43	1.89	0.005	7.18	22
P75	1.20	2.50	0.00	35	29580399	0.1018	15	2120	4.27	0.50	0.12	2.21	0.005	9.45	183
P76	1.20	2.50	0.00	35	29580399	0.1018	10	1400	4.64	0.00	0.00	2.23	0.005	10.35	163
P77	1.20	2.50	0.00	35	29580399	0.1018	18	2552	4.11	0.00	0.00	2.23	0.005	9.18	234
P78	1.20	2.50	0.00	35	29580399	0.1018	16	2264	4.21	3.50	0.83	2.11	0.005	8.87	95
P79	1.20	2.50	0.00	35	29580399	0.1018	11	1544	4.55	0.00	0.00	2.23	0.005	10.15	173
P80	1.20	2.50	0.00	35	29580399	0.1018	20	2840	4.03	2.50	0.62	2.14	0.005	8.61	132

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
P61	0.50	SM	42	5.00	10.60	5.00	5.60	1.00	0.294	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.657	Liquefiable
	1.00	CI	67	5.00	21.20	10.00	11.20	0.99	0.293	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
	2.00	CI	67	5.00	42.40	20.00	22.40	0.98	0.291	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
	3.00	CL	76	6.00	63.60	30.00	33.60	0.98	0.289	1.70	10.20	5.00	1.20	17.24	0.18	1.00	-	-	Non-liquefiable
	5.00	SM	37	15.00	106.00	50.00	56.00	0.96	0.284	1.34	20.04	5.00	1.20	29.05	0.41	1.00	0.492	1.734	Non-liquefiable
	6.00	SM	37	21.00	127.20	60.00	67.20	0.95	0.282	1.22	25.62	5.00	1.20	35.74	0.52	1.00	0.620	2.201	Non-liquefiable
	8.00	SM	16	15.00	148.00	80.00	68.00	0.94	0.319	1.21	18.19	2.77	1.05	21.94	0.24	1.00	0.288	0.902	Liquefiable
	9.00	CL	90	25.00	166.50	90.00	76.50	0.93	0.316	1.14	28.58	5.00	1.20	39.30	0.52	1.00	-	-	Non-liquefiable
	10.00	CL-ML	94	25.00	201.00	100.00	101.00	0.91	0.282	1.00	24.88	5.00	1.20	34.85	0.52	1.00	-	-	Non-liquefiable
	11.00	CL-ML	94	24.00	221.10	110.00	111.10	0.88	0.273	0.95	22.77	5.00	1.20	32.32	0.52	1.00	-	-	Non-liquefiable
	12.00	CL-ML	94	28.00	241.20	120.00	121.20	0.85	0.265	0.91	25.43	5.00	1.20	35.52	0.52	1.00	-	-	Non-liquefiable
	13.00	CL	79	28.00	265.20	130.00	135.20	0.83	0.253	0.86	24.08	5.00	1.20	33.90	0.52	1.00	-	-	Non-liquefiable
	14.50	CL	79	32.00	295.80	145.00	150.80	0.79	0.241	0.81	26.06	5.00	1.20	36.27	0.52	1.00	-	-	Non-liquefiable
	17.50	CL	81	25.00	367.50	175.00	192.50	0.71	0.210	0.72	18.02	5.00	1.20	26.62	0.33	0.81	-	-	Non-liquefiable
	19.00	CL-ML	74	25.00	400.90	190.00	210.90	0.67	0.198	0.69	17.21	5.00	1.20	25.66	0.31	0.79	-	-	Non-liquefiable
	20.50	CL-ML	74	52.00	432.55	205.00	227.55	0.63	0.186	0.66	34.47	5.00	1.20	46.37	0.52	0.76	-	-	Non-liquefiable
	22.00	CL	70	52.00	455.40	220.00	235.40	0.59	0.177	0.65	33.89	5.00	1.20	45.67	0.52	0.77	-	-	Non-liquefiable
	23.50	CL	70	58.00	486.45	235.00	251.45	0.56	0.169	0.63	36.58	5.00	1.20	48.89	0.52	0.75	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	25.00	ML	89	58.00	505.00	250.00	255.00	0.56	0.173	0.63	36.32	5.00	1.20	48.59	0.52	0.79	0.490	2.833	Non-liquefiable
	26.50	ML	89	50.00	535.30	265.00	270.30	0.56	0.173	0.61	30.41	5.00	1.20	41.49	0.52	0.78	0.484	2.797	Non-liquefiable
	28.00	MI	93	50.00	588.00	280.00	308.00	0.56	0.167	0.57	28.49	5.00	1.20	39.19	0.52	0.79	-	-	Non-liquefiable
	29.50	ML	54	68.00	619.50	295.00	324.50	0.56	0.167	0.56	37.75	5.00	1.20	50.30	0.52	0.78	0.484	2.901	Non-liquefiable
	31.00	CL	73	74.00	651.00	310.00	341.00	0.56	0.167	0.54	40.07	5.00	1.20	53.09	0.52	0.77	-	-	Non-liquefiable
	32.50	CL	73	61.00	682.50	325.00	357.50	0.56	0.167	0.53	32.26	5.00	1.20	43.71	0.52	0.76	-	-	Non-liquefiable
	34.00	CL	73	85.00	714.00	340.00	374.00	0.56	0.167	0.52	43.95	5.00	1.20	57.74	0.52	0.75	-	-	Non-liquefiable
	35.50	CL	73	64.00	745.50	355.00	390.50	0.56	0.167	0.51	32.39	5.00	1.20	43.86	0.52	0.74	-	-	Non-liquefiable
	37.00	CL	84	83.00	777.00	370.00	407.00	0.56	0.167	0.50	41.14	5.00	1.20	54.37	0.52	0.74	-	-	Non-liquefiable
	38.50	CL	85	89.00	808.50	385.00	423.50	0.56	0.167	0.49	43.25	5.00	1.20	56.90	0.52	0.73	-	-	Non-liquefiable
	40.00	CL	85	101.00	840.00	400.00	440.00	0.56	0.167	0.48	48.15	5.00	1.20	62.78	0.52	0.72	-	-	Non-liquefiable
P62	0.50	SM	39	5.00	9.90	5.00	4.90	1.00	0.314	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.616	Liquefiable
	1.00	CI	86	5.00	19.80	10.00	9.80	0.99	0.313	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
	2.00	CL	65	5.00	39.60	20.00	19.60	0.98	0.310	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
	3.00	CL	70	16.00	59.40	30.00	29.40	0.98	0.308	1.70	27.20	5.00	1.20	37.64	0.52	1.00	-	-	Non-liquefiable
	4.00	SM	31	25.00	79.20	40.00	39.20	0.97	0.306	1.60	39.93	4.77	1.16	51.19	0.52	1.00	0.620	2.030	Non-liquefiable
	6.00	SM	29	30.00	114.00	60.00	54.00	0.95	0.314	1.36	40.82	4.64	1.15	51.43	0.52	1.00	0.620	1.974	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	7.00	SM	29	36.00	133.00	70.00	63.00	0.95	0.312	1.26	45.36	4.64	1.15	56.62	0.52	1.00	0.620	1.990	Non-liquefiable
	9.00	ML	85	19.00	171.00	90.00	81.00	0.93	0.307	1.11	21.11	5.00	1.20	30.33	0.49	1.00	0.588	1.917	Non-liquefiable
	10.00	ML	85	25.00	190.00	100.00	90.00	0.91	0.299	1.05	26.35	5.00	1.20	36.62	0.52	1.00	0.620	2.076	Non-liquefiable
	11.00	CL-ML	77	25.00	199.10	110.00	89.10	0.88	0.307	1.06	26.49	5.00	1.20	36.78	0.52	1.00	-	-	Non-liquefiable
	12.50	CL-ML	77	28.00	226.25	125.00	101.25	0.84	0.293	0.99	27.83	5.00	1.20	38.39	0.52	1.00	-	-	Non-liquefiable
	14.00	CL	70	28.00	271.60	140.00	131.60	0.80	0.258	0.87	24.41	5.00	1.20	34.29	0.52	1.00	-	-	Non-liquefiable
	15.50	CL-ML	72	33.00	300.70	155.00	145.70	0.76	0.245	0.83	27.34	5.00	1.20	37.81	0.52	0.96	-	-	Non-liquefiable
	17.00	CL	61	33.00	357.00	170.00	187.00	0.72	0.214	0.73	24.13	5.00	1.20	33.96	0.52	0.85	-	-	Non-liquefiable
	18.50	CL	61	36.00	388.50	185.00	203.50	0.68	0.203	0.70	25.24	5.00	1.20	35.28	0.52	0.81	-	-	Non-liquefiable
	21.50	CL	69	39.00	447.20	215.00	232.20	0.60	0.180	0.66	25.59	5.00	1.20	35.71	0.52	0.75	-	-	Non-liquefiable
	24.50	CL	72	62.00	453.25	245.00	208.25	0.56	0.190	0.69	42.96	5.00	1.20	56.56	0.52	0.94	-	-	Non-liquefiable
	26.00	ML	72	62.00	499.20	260.00	239.20	0.56	0.182	0.65	40.09	5.00	1.20	53.11	0.52	0.86	0.533	2.926	Non-liquefiable
	27.50	CL	81	50.00	528.00	275.00	253.00	0.56	0.182	0.63	31.43	5.00	1.20	42.72	0.52	0.86	-	-	Non-liquefiable
	30.50	SM	49	56.00	585.60	305.00	280.60	0.56	0.182	0.60	33.43	5.00	1.20	45.12	0.52	0.84	0.521	2.858	Non-liquefiable
	33.50	ML	52	62.00	643.20	335.00	308.20	0.56	0.182	0.57	35.32	5.00	1.20	47.38	0.52	0.83	0.515	2.824	Non-liquefiable
	36.50	CL-ML	69	69.00	700.80	365.00	335.80	0.56	0.182	0.55	37.65	5.00	1.20	50.18	0.52	0.82	-	-	Non-liquefiable
	38.00	ML	54	69.00	729.60	380.00	349.60	0.56	0.182	0.53	36.90	5.00	1.20	49.28	0.52	0.82	0.509	2.790	Non-liquefiable
	40.00	CL	83	62.00	768.00	400.00	368.00	0.56	0.182	0.52	32.32	5.00	1.20	43.78	0.52	0.81	-	-	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	0.50	ML	78	3.00	8.90	5.00	3.90	1.00	0.355	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.41	Liquefiable
	1.00	CI	68	3.00	17.80	10.00	7.80	0.99	0.353	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
	2.00	CI	68	3.00	35.60	20.00	15.60	0.98	0.351	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
	3.00	CI	68	6.00	53.40	30.00	23.40	0.98	0.348	1.70	10.20	5.00	1.20	17.24	0.18	1.00	-	-	Non-liquefiable
	5.00	CI	64	12.00	91.00	50.00	41.00	0.96	0.333	1.56	18.74	5.00	1.20	27.49	0.35	1.00	-	-	Non-liquefiable
	6.00	SM	48	18.00	109.20	60.00	49.20	0.95	0.330	1.43	25.66	5.00	1.20	35.79	0.52	1.00	0.620	1.88	Non-liquefiable
	8.00	SP-ML	11	26.00	145.60	80.00	65.60	0.94	0.325	1.23	32.10	1.21	1.03	34.16	0.52	1.00	0.620	1.91	Non-liquefiable
	9.00	SP-ML	11	31.00	163.80	90.00	73.80	0.93	0.322	1.16	36.09	1.21	1.03	38.25	0.52	1.00	0.620	1.92	Non-liquefiable
P63	10.00	CL-ML	85	31.00	192.00	100.00	92.00	0.91	0.295	1.04	32.32	5.00	1.20	43.78	0.52	1.00	-	-	Non-liquefiable
	11.00	CL-ML	85	37.00	211.20	110.00	101.20	0.88	0.287	0.99	36.78	5.00	1.20	49.14	0.52	1.00	-	-	Non-liquefiable
	12.00	CL-ML	85	41.00	230.40	120.00	110.40	0.85	0.278	0.95	39.02	5.00	1.20	51.83	0.52	1.00	-	-	Non-liquefiable
	13.00	CL	78	41.00	248.30	130.00	118.30	0.83	0.271	0.92	37.70	5.00	1.20	50.23	0.52	1.00	-	-	Non-liquefiable
	14.50	CL	78	32.00	276.95	145.00	131.95	0.79	0.258	0.87	27.86	5.00	1.20	38.43	0.52	1.00	-	-	Non-liquefiable
	17.50	CL	83	44.00	357.00	175.00	182.00	0.71	0.216	0.74	32.61	5.00	1.20	44.14	0.52	0.86	-	-	Non-liquefiable
	19.00	ML	56	44.00	355.30	190.00	165.30	0.67	0.224	0.78	34.22	5.00	1.20	46.07	0.52	0.77	0.478	2.14	Non-liquefiable
	20.50	CL	85	49.00	383.35	205.00	178.35	0.63	0.210	0.75	36.69	5.00	1.20	49.03	0.52	0.75	-	-	Non-liquefiable
	23.50	CL	83	42.00	495.85	235.00	260.85	0.56	0.166	0.62	26.00	5.00	1.20	36.21	0.52	0.78	-	-	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	26.50	CL	80	46.00	553.85	265.00	288.85	0.56	0.167	0.59	27.07	5.00	1.20	37.48	0.52	0.71	-	-	Non-liquefiable
	28.00	ML	55	46.00	498.40	280.00	218.40	0.56	0.199	0.68	31.13	5.00	1.20	42.35	0.52	0.87	0.540	2.71	Non-liquefiable
	29.50	MI	85	49.00	525.10	295.00	230.10	0.56	0.199	0.66	32.30	5.00	1.20	43.76	0.52	0.87	-	-	Non-liquefiable
	31.00	MI	85	52.00	551.80	310.00	241.80	0.56	0.199	0.64	33.44	5.00	1.20	45.13	0.52	0.86	-	-	Non-liquefiable
	32.50	MI	85	57.00	578.50	325.00	253.50	0.56	0.199	0.63	35.80	5.00	1.20	47.96	0.52	0.86	-	-	Non-liquefiable
	34.00	CL-ML	63	57.00	605.20	340.00	265.20	0.56	0.199	0.61	35.00	5.00	1.20	47.00	0.52	0.86	-	-	Non-liquefiable
	35.50	CL-ML	62	58.00	631.90	355.00	276.90	0.56	0.199	0.60	34.86	5.00	1.20	46.83	0.52	0.85	-	-	Non-liquefiable
	37.00	MI	89	58.00	658.60	370.00	288.60	0.56	0.199	0.59	34.14	5.00	1.20	45.97	0.52	0.85	-	-	Non-liquefiable
	38.50	MI	89	60.00	685.30	385.00	300.30	0.56	0.199	0.58	34.62	5.00	1.20	46.55	0.52	0.85	-	-	Non-liquefiable
	40.00	CL	83	65.00	712.00	400.00	312.00	0.56	0.199	0.57	36.80	5.00	1.20	49.16	0.52	0.84	-	-	Non-liquefiable
P64	0.50	ML	55	4.00	10.50	5.00	5.50	1.00	0.297	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.571	Liquefiable
P64	1.00	CL	63	4.00	21.00	10.00	11.00	0.99	0.296	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
P64	2.00	ML	54	4.00	42.00	20.00	22.00	0.98	0.293	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.578	Liquefiable
P64	3.00	ML	56	13.00	63.00	30.00	33.00	0.98	0.291	1.70	22.10	5.00	1.20	31.52	0.52	1.00	0.620	2.131	Non-liquefiable
P64	4.00	SM	31	20.00	84.00	40.00	44.00	0.97	0.289	1.51	30.15	4.77	1.16	39.82	0.52	1.00	0.620	2.148	Non-liquefiable
P64	6.00	SM	31	13.00	126.00	60.00	66.00	0.95	0.284	1.23	16.00	4.77	1.16	23.37	0.26	1.00	0.314	1.103	Non-liquefiable
P64	7.00	SM	30	15.00	147.00	70.00	77.00	0.95	0.282	1.14	17.09	4.71	1.15	24.44	0.28	1.00	0.335	1.190	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	9.00	CL	84	24.00	172.80	90.00	82.80	0.93	0.303	1.10	26.38	5.00	1.20	36.65	0.52	1.00	-	-	Non-liquefiable
	10.00	CL	84	31.00	192.00	100.00	92.00	0.91	0.295	1.04	32.32	5.00	1.20	43.78	0.52	1.00	-	-	Non-liquefiable
	12.50	CL	80	27.00	245.00	125.00	120.00	0.84	0.268	0.91	24.65	5.00	1.20	34.58	0.52	1.00	-	-	Non-liquefiable
	15.50	CL	82	32.00	306.90	155.00	151.90	0.76	0.240	0.81	25.96	5.00	1.20	36.16	0.52	0.88	-	-	Non-liquefiable
	17.00	SM	45	32.00	307.70	170.00	137.70	0.72	0.251	0.85	27.27	5.00	1.20	37.72	0.52	0.90	0.558	2.224	Non-liquefiable
	18.50	CL-ML	61	29.00	334.85	185.00	149.85	0.68	0.237	0.82	23.69	5.00	1.20	33.43	0.52	0.90	-	-	Non-liquefiable
	20.00	CL	83	29.00	396.00	200.00	196.00	0.64	0.202	0.71	20.71	5.00	1.20	29.86	0.46	0.82	-	-	Non-liquefiable
	21.50	CL	83	33.00	425.70	215.00	210.70	0.60	0.189	0.69	22.73	5.00	1.20	32.28	0.52	0.81	-	-	Non-liquefiable
	24.50	CL	80	66.00	470.40	245.00	225.40	0.56	0.182	0.67	43.96	5.00	1.20	57.75	0.52	0.82	-	-	Non-liquefiable
	26.00	CL-ML	61	66.00	499.20	260.00	239.20	0.56	0.182	0.65	42.67	5.00	1.20	56.21	0.52	0.81	-	-	Non-liquefiable
	27.50	CL-ML	85	56.00	528.00	275.00	253.00	0.56	0.182	0.63	35.21	5.00	1.20	47.25	0.52	0.80	-	-	Non-liquefiable
	29.00	SM	45	56.00	568.40	290.00	278.40	0.56	0.178	0.60	33.56	5.00	1.20	45.27	0.52	0.71	0.440	2.469	Non-liquefiable
	30.50	SM	45	59.00	597.80	305.00	292.80	0.56	0.178	0.58	34.48	5.00	1.20	46.38	0.52	0.70	0.434	2.435	Non-liquefiable
	32.00	CL-ML	81	59.00	627.20	320.00	307.20	0.56	0.178	0.57	33.66	5.00	1.20	45.39	0.52	0.69	-	-	Non-liquefiable
	33.50	CL	86	63.00	656.60	335.00	321.60	0.56	0.178	0.56	35.13	5.00	1.20	47.16	0.52	0.68	-	-	Non-liquefiable
	36.50	CL	86	67.00	715.40	365.00	350.40	0.56	0.178	0.53	35.79	5.00	1.20	47.95	0.52	0.66	-	-	Non-liquefiable
	40.00	CL-ML	79	83.00	784.00	400.00	384.00	0.56	0.178	0.51	42.36	5.00	1.20	55.83	0.52	0.64	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
P65	0.50	ML	59	5.00	10.05	5.00	5.05	1.00	0.309	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.625	Liquefiable
	1.00	CL	52	5.00	20.10	10.00	10.10	0.99	0.308	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
	2.00	SM	42	5.00	40.20	20.00	20.20	0.98	0.306	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.632	Liquefiable
	3.00	CL	54	10.00	60.30	30.00	30.30	0.98	0.303	1.70	17.00	5.00	1.20	25.40	0.30	1.00	-	-	Non-liquefiable
	4.00	SM	18	10.00	76.40	40.00	36.40	0.97	0.317	1.66	16.57	3.23	1.07	20.91	0.23	1.00	0.271	0.853	Liquefiable
	5.00	SM	18	15.00	95.50	50.00	45.50	0.96	0.315	1.48	22.24	3.23	1.07	26.95	0.34	1.00	0.402	1.276	Non-liquefiable
	6.00	SM	18	20.00	114.60	60.00	54.60	0.95	0.312	1.35	27.07	3.23	1.07	32.10	0.52	1.00	0.620	1.985	Non-liquefiable
	8.00	SM	20	25.00	160.00	80.00	80.00	0.94	0.293	1.12	27.95	3.61	1.08	33.79	0.52	1.00	0.620	2.118	Non-liquefiable
	9.00	ML	77	16.00	180.00	90.00	90.00	0.93	0.291	1.05	16.87	5.00	1.20	25.24	0.30	1.00	0.354	1.218	Non-liquefiable
	11.00	ML	87	16.00	215.60	110.00	105.60	0.88	0.280	0.97	15.57	5.00	1.20	23.68	0.27	1.00	0.320	1.140	Non-liquefiable
	12.00	CL	87	17.00	235.20	120.00	115.20	0.85	0.272	0.93	15.84	5.00	1.20	24.01	0.27	1.00	-	-	Non-liquefiable
	14.50	CL	84	30.00	291.45	145.00	146.45	0.79	0.244	0.83	24.79	5.00	1.20	34.75	0.52	1.00	-	-	Non-liquefiable
	17.50	CL	84	23.00	351.75	175.00	176.75	0.71	0.219	0.75	17.30	5.00	1.20	25.76	0.31	0.86	-	-	Non-liquefiable
	20.50	CL	87	27.00	412.05	205.00	207.05	0.63	0.195	0.69	18.76	5.00	1.20	27.52	0.35	0.81	-	-	Non-liquefiable
	23.50	CL	72	52.00	467.65	235.00	232.65	0.56	0.176	0.66	34.09	5.00	1.20	45.91	0.52	0.77	-	-	Non-liquefiable
	26.50	ML	73	41.00	556.50	265.00	291.50	0.56	0.167	0.59	24.01	5.00	1.20	33.82	0.52	0.74	0.459	2.752	Non-liquefiable
	28.00	CL	72	41.00	582.40	280.00	302.40	0.56	0.168	0.58	23.58	5.00	1.20	33.29	0.52	0.69	-	-	Non-liquefiable
	29.50	CL	72	22.00	613.60	295.00	318.60	0.56	0.168	0.56	12.33	5.00	1.20	19.79	0.21	0.67	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	32.50	CL	54	50.00	682.50	325.00	357.50	0.56	0.167	0.53	26.44	5.00	1.20	36.73	0.52	0.62	-	-	Non-liquefiable
	35.50	CL	79	59.00	745.50	355.00	390.50	0.56	0.167	0.51	29.86	5.00	1.20	40.83	0.52	0.60	-	-	Non-liquefiable
	38.50	ML	69	44.00	808.50	385.00	423.50	0.56	0.167	0.49	21.38	5.00	1.20	30.66	0.52	0.57	0.354	2.120	Non-liquefiable
	40.00	CL-ML	77	56.00	840.00	400.00	440.00	0.56	0.167	0.48	26.70	5.00	1.20	37.04	0.52	0.56	-	-	Non-liquefiable
P66	0.50	ML	53	6.00	9.65	5.00	4.65	0.56	0.181	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	1.207	Non-liquefiable
P66	1.00	SM	36	6.00	19.30	10.00	9.30	0.56	0.181	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	1.207	Non-liquefiable
P66	2.00	ML	52	6.00	38.60	20.00	18.60	0.56	0.181	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	1.207	Non-liquefiable
P66	3.00	ML	52	4.00	57.90	30.00	27.90	0.56	0.181	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.935	Liquefiable
P66	4.00	CL	53	4.00	81.20	40.00	41.20	0.56	0.172	1.56	6.23	5.00	1.20	12.48	0.14	1.00	-	-	Non-liquefiable
P66	5.00	SM	21	14.00	101.50	50.00	51.50	0.56	0.172	1.39	19.51	3.78	1.09	24.97	0.29	1.00	0.347	2.018	Non-liquefiable
P66	6.00	SM	21	8.00	121.80	60.00	61.80	0.56	0.172	1.27	10.18	3.78	1.09	14.83	0.16	1.00	0.189	1.097	Non-liquefiable
P66	7.00	SP-ML	9	8.00	142.10	70.00	72.10	0.56	0.172	1.18	9.42	0.56	1.02	10.14	0.11	1.00	0.136	0.792	Liquefiable
P66	8.00	SM	15	46.00	162.40	80.00	82.40	0.56	0.172	1.10	50.68	2.50	1.05	55.61	0.52	1.00	0.620	3.603	Non-liquefiable
P66	9.00	CL	74	15.00	182.70	90.00	92.70	0.56	0.172	1.04	15.58	5.00	1.20	23.70	0.27	1.00	-	-	Non-liquefiable
P66	10.00	ML	80	15.00	203.00	100.00	103.00	0.56	0.172	0.99	14.78	5.00	1.20	22.74	0.25	1.00	0.302	1.752	Non-liquefiable
P66	11.00	ML	80	23.00	223.30	110.00	113.30	0.56	0.172	0.94	21.61	5.00	1.20	30.93	0.52	1.00	0.620	3.603	Non-liquefiable
P66	12.00	CL	90	22.00	243.60	120.00	123.60	0.56	0.172	0.90	19.79	5.00	1.20	28.75	0.40	1.00	-	-	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	14.50	CL	90	14.00	291.45	145.00	146.45	0.56	0.174	0.83	11.57	5.00	1.20	18.88	0.20	1.00	-	-	Non-liquefiable
	17.50	CL	65	57.00	378.00	175.00	203.00	0.56	0.163	0.70	40.01	5.00	1.20	53.01	0.52	0.82	-	-	Non-liquefiable
	19.00	CL-ML	52	57.00	406.60	190.00	216.60	0.56	0.164	0.68	38.73	5.00	1.20	51.48	0.52	0.79	-	-	Non-liquefiable
	20.50	CL-ML	52	64.00	438.70	205.00	233.70	0.56	0.164	0.65	41.86	5.00	1.20	55.24	0.52	0.76	-	-	Non-liquefiable
	22.00	ML	55	58.00	470.80	220.00	250.80	0.56	0.164	0.63	36.62	5.00	1.20	48.95	0.52	0.73	0.453	2.761	Non-liquefiable
	23.50	CL	85	63.00	502.90	235.00	267.90	0.56	0.164	0.61	38.49	5.00	1.20	51.19	0.52	0.71	-	-	Non-liquefiable
	26.50	CL	88	52.00	535.30	265.00	270.30	0.56	0.173	0.61	31.63	5.00	1.20	42.95	0.52	0.69	-	-	Non-liquefiable
	29.50	CL	81	49.00	595.90	295.00	300.90	0.56	0.173	0.58	28.25	5.00	1.20	38.90	0.52	0.66	-	-	Non-liquefiable
	32.50	CL-ML	68	59.00	637.00	325.00	312.00	0.56	0.178	0.57	33.40	5.00	1.20	45.08	0.52	0.70	-	-	Non-liquefiable
	35.50	CL-ML	58	57.00	695.80	355.00	340.80	0.56	0.178	0.54	30.88	5.00	1.20	42.05	0.52	0.69	-	-	Non-liquefiable
	38.50	CL	78	60.00	754.60	385.00	369.60	0.56	0.178	0.52	31.21	5.00	1.20	42.45	0.52	0.67	-	-	Non-liquefiable
	40.00	CL	78	73.00	784.00	400.00	384.00	0.56	0.178	0.51	37.25	5.00	1.20	49.70	0.52	0.66	-	-	Non-liquefiable
	0.50	ML	54	8.00	10.05	5.00	5.05	1.00	0.309	1.70	13.60	5.00	1.20	21.32	0.23	1.00	0.277	0.897	Liquefiable
	1.00	CL	63	8.00	20.10	10.00	10.10	0.99	0.308	1.70	13.60	5.00	1.20	21.32	0.23	1.00	-	-	Non-liquefiable
P67	2.00	CL-ML	56	8.00	40.20	20.00	20.20	0.98	0.306	1.70	13.60	5.00	1.20	21.32	0.23	1.00	-	-	Non-liquefiable
	3.00	ML	69	5.00	60.30	30.00	30.30	0.98	0.303	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.637	Liquefiable
	4.00	SM	18	7.00	80.40	40.00	40.40	0.97	0.301	1.57	11.01	3.23	1.07	14.98	0.16	1.00	0.191	0.633	Liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	6.00	SM	18	20.00	120.60	60.00	60.60	0.95	0.296	1.28	25.69	3.23	1.07	30.63	0.52	1.00	0.619	2.090	Non-liquefiable
	7.00	SM	15	22.00	140.70	70.00	70.70	0.95	0.294	1.19	26.16	2.50	1.05	29.92	0.46	1.00	0.551	1.876	Non-liquefiable
	9.00	CL	84	14.00	180.90	90.00	90.90	0.93	0.289	1.05	14.68	5.00	1.20	22.62	0.25	1.00	-	-	Non-liquefiable
	10.00	CL	84	21.00	201.00	100.00	101.00	0.91	0.282	1.00	20.90	5.00	1.20	30.07	0.47	1.00	-	-	Non-liquefiable
	11.00	CL-ML	75	21.00	220.00	110.00	110.00	0.88	0.275	0.95	20.02	5.00	1.20	29.03	0.41	1.00	-	-	Non-liquefiable
	12.50	CL-ML	75	18.00	250.00	125.00	125.00	0.84	0.262	0.89	16.10	5.00	1.20	24.32	0.28	1.00	-	-	Non-liquefiable
	14.00	CL	82	18.00	289.80	140.00	149.80	0.80	0.241	0.82	14.71	5.00	1.20	22.65	0.25	1.00	-	-	Non-liquefiable
	15.50	CL	82	25.00	320.85	155.00	165.85	0.76	0.229	0.78	19.41	5.00	1.20	28.30	0.38	0.87	-	-	Non-liquefiable
	18.50	ML	55	27.00	381.10	185.00	196.10	0.68	0.206	0.71	19.28	5.00	1.20	28.14	0.37	0.78	0.348	1.690	Non-liquefiable
	20.00	SM	15	27.00	412.00	200.00	212.00	0.64	0.194	0.69	18.54	2.50	1.05	21.93	0.24	0.75	0.216	1.111	Non-liquefiable
	21.50	CL	84	36.00	442.90	215.00	227.90	0.60	0.182	0.66	23.85	5.00	1.20	33.62	0.52	0.73	-	-	Non-liquefiable
	24.50	CL	81	51.00	509.60	245.00	264.60	0.56	0.168	0.61	31.35	5.00	1.20	42.62	0.52	0.70	-	-	Non-liquefiable
	27.50	ML	96	57.00	572.00	275.00	297.00	0.56	0.168	0.58	33.07	5.00	1.20	44.69	0.52	0.66	0.409	2.433	Non-liquefiable
	29.00	CL	66	57.00	614.80	290.00	324.80	0.56	0.165	0.55	31.63	5.00	1.20	42.95	0.52	0.64	-	-	Non-liquefiable
	30.50	CL-ML	79	65.00	646.60	305.00	341.60	0.56	0.165	0.54	35.17	5.00	1.20	47.20	0.52	0.63	-	-	Non-liquefiable
	32.00	SM	25	65.00	678.40	320.00	358.40	0.56	0.165	0.53	34.33	4.29	1.12	42.57	0.52	0.62	0.385	2.326	Non-liquefiable
	33.50	SM	25	73.00	710.20	335.00	375.20	0.56	0.165	0.52	37.69	4.29	1.12	46.31	0.52	0.60	0.372	2.251	Non-liquefiable
	35.00	CL	63	79.00	742.00	350.00	392.00	0.56	0.165	0.51	39.90	5.00	1.20	52.88	0.52	0.59	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 | **Earthquake Zone= IV** | **amax/g=0.24** | **K(alpha)= 1.00** | **MSF= 1.193** | **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	36.50	SM	32	86.00	773.80	365.00	408.80	0.56	0.165	0.49	42.53	4.83	1.17	54.64	0.52	0.58	0.360	2.176	Non-liquefiable
	38.00	SM	32	88.00	805.60	380.00	425.60	0.56	0.165	0.48	42.66	4.83	1.17	54.78	0.52	0.57	0.354	2.138	Non-liquefiable
	40.00	SM	32	92.00	848.00	400.00	448.00	0.56	0.165	0.47	43.47	4.83	1.17	55.73	0.52	0.55	0.341	2.063	Non-liquefiable
P68	0.50	SM	39	5	9.80	5.00	4.80	1.00	0.317	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.609	Liquefiable
	1.00	CL-ML	52	5	19.60	10.00	9.60	0.99	0.316	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
	2.00	SM-SC	47	5	39.20	20.00	19.20	0.98	0.314	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.616	Liquefiable
	3.00	SM	39	12	58.80	30.00	28.80	0.98	0.311	1.70	20.40	5.00	1.20	29.48	0.44	1.00	0.519	1.667	Non-liquefiable
	4.00	SM	39	16	78.40	40.00	38.40	0.97	0.309	1.61	25.82	5.00	1.20	35.98	0.52	1.00	0.620	2.009	Non-liquefiable
	6.00	SM	24	20	117.60	60.00	57.60	0.95	0.304	1.32	26.35	4.18	1.11	33.37	0.52	1.00	0.620	2.041	Non-liquefiable
	7.00	SM	24	18	137.20	70.00	67.20	0.95	0.301	1.22	21.96	4.18	1.11	28.50	0.39	1.00	0.463	1.537	Non-liquefiable
	9.00	SM	24	20	176.40	90.00	86.40	0.93	0.297	1.08	21.52	4.18	1.11	28.01	0.37	1.00	0.441	1.488	Non-liquefiable
	10.00	SM	24	16	193.00	100.00	93.00	0.91	0.294	1.04	16.59	4.18	1.11	22.56	0.25	1.00	0.298	1.016	Non-liquefiable
	11.00	CL	84	16	212.30	110.00	102.30	0.88	0.285	0.99	15.82	5.00	1.20	23.98	0.27	1.00	-	-	Non-liquefiable
	12.50	CL	84	27	252.50	125.00	127.50	0.84	0.260	0.89	23.91	5.00	1.20	33.69	0.52	1.00	-	-	Non-liquefiable
	15.50	CL	94	28	313.10	155.00	158.10	0.76	0.235	0.80	22.27	5.00	1.20	31.72	0.52	0.86	-	-	Non-liquefiable
	18.50	CL	84	37	377.40	185.00	192.40	0.68	0.208	0.72	26.67	5.00	1.20	37.01	0.52	0.80	-	-	Non-liquefiable
	21.50	CL	91	32	434.30	215.00	219.30	0.60	0.185	0.68	21.61	5.00	1.20	30.93	0.52	0.78	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 | Earthquake Zone= IV | amax/g=0.24 | K(alpha)= 1.00 | MSF= 1.193 | Critical Water Table (m)=0.00 m

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	24.50	CL	89	39	497.35	245.00	252.35	0.56	0.172	0.63	24.55	5.00	1.20	34.46	0.52	0.76	-	-	Non-liquefiable
	27.50	CL	91	52	566.50	275.00	291.50	0.56	0.170	0.59	30.46	5.00	1.20	41.55	0.52	0.77	-	-	Non-liquefiable
	29.00	CL	92	54	588.70	290.00	298.70	0.56	0.172	0.58	31.24	5.00	1.20	42.49	0.52	0.76	-	-	Non-liquefiable
	30.50	CL	92	61	619.15	305.00	314.15	0.56	0.172	0.56	34.42	5.00	1.20	46.30	0.52	0.76	-	-	Non-liquefiable
	32.00	CL	92	67	649.60	320.00	329.60	0.56	0.172	0.55	36.90	5.00	1.20	49.29	0.52	0.75	-	-	Non-liquefiable
	33.50	SM-SC	43	72	680.05	335.00	345.05	0.56	0.172	0.54	38.76	5.00	1.20	51.51	0.52	0.74	0.458	2.660	Non-liquefiable
	35.00	SM-SC	43	77	710.50	350.00	360.50	0.56	0.172	0.53	40.55	5.00	1.20	53.67	0.52	0.73	0.453	2.632	Non-liquefiable
	36.50	CL	77	52	740.95	365.00	375.95	0.56	0.172	0.52	26.82	5.00	1.20	37.18	0.52	0.72	-	-	Non-liquefiable
	38.00	CL	77	64	771.40	380.00	391.40	0.56	0.172	0.51	32.35	5.00	1.20	43.82	0.52	0.72	-	-	Non-liquefiable
	40.00	CL	79	101	812.00	400.00	412.00	0.56	0.172	0.49	49.76	5.00	1.20	64.71	0.52	0.71	-	-	Non-liquefiable
P69	0.50	SM	47	4	9.70	5.00	4.70	1.00	0.321	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.528	Liquefiable
P69	1.00	CL-ML	57	4	19.40	10.00	9.40	0.99	0.319	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
P69	2.00	SM	46	4	38.80	20.00	18.80	0.98	0.317	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.534	Liquefiable
P69	3.00	CL-ML	64	10	58.20	30.00	28.20	0.98	0.315	1.70	17.00	5.00	1.20	25.40	0.30	1.00	-	-	Non-liquefiable
P69	4.00	CL-ML	64	12	77.60	40.00	37.60	0.97	0.312	1.63	19.57	5.00	1.20	28.48	0.39	1.00	-	-	Non-liquefiable
P69	5.00	SM	31	12	97.00	50.00	47.00	0.96	0.310	1.46	17.50	4.77	1.16	25.12	0.29	1.00	0.351	1.133	Non-liquefiable
P69	6.00	SM	28	15	115.80	60.00	55.80	0.95	0.309	1.34	20.08	4.56	1.14	27.42	0.35	1.00	0.418	1.353	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	7.00	SM	28	17	135.10	70.00	65.10	0.95	0.306	1.24	21.07	4.56	1.14	28.54	0.39	1.00	0.465	1.519	Non-liquefiable
	9.00	CL-ML	84	15	173.70	90.00	83.70	0.93	0.301	1.09	16.40	5.00	1.20	24.67	0.29	1.00	-	-	Non-liquefiable
	10.00	CL-ML	84	12	196.00	100.00	96.00	0.91	0.289	1.02	12.25	5.00	1.20	19.70	0.21	1.00	-	-	Non-liquefiable
	11.00	CL	87	12	215.60	110.00	105.60	0.88	0.280	0.97	11.68	5.00	1.20	19.01	0.20	1.00	-	-	Non-liquefiable
	12.50	CL	87	18	252.50	125.00	127.50	0.84	0.260	0.89	15.94	5.00	1.20	24.13	0.28	1.00	-	-	Non-liquefiable
	15.50	CL	85	27	313.10	155.00	158.10	0.76	0.235	0.80	21.47	5.00	1.20	30.77	0.52	0.87	-	-	Non-liquefiable
	17.00	CL-ML	64	27	346.80	170.00	176.80	0.72	0.220	0.75	20.31	5.00	1.20	29.37	0.43	0.87	-	-	Non-liquefiable
	18.50	CL	81	44	362.60	185.00	177.60	0.68	0.217	0.75	33.02	5.00	1.20	44.62	0.52	0.87	-	-	Non-liquefiable
	21.50	CL	84	35	421.40	215.00	206.40	0.60	0.191	0.70	24.36	5.00	1.20	34.23	0.52	0.77	-	-	Non-liquefiable
	23.00	CL-ML	72	35	462.30	230.00	232.30	0.56	0.174	0.66	22.96	5.00	1.20	32.56	0.52	0.76	-	-	Non-liquefiable
	24.50	CL	86	43	497.35	245.00	252.35	0.56	0.172	0.63	27.07	5.00	1.20	37.48	0.52	0.74	-	-	Non-liquefiable
	26.00	MI	91	43	527.80	260.00	267.80	0.56	0.172	0.61	26.28	5.00	1.20	36.53	0.52	0.81	-	-	Non-liquefiable
	27.50	MI	91	51	561.00	275.00	286.00	0.56	0.171	0.59	30.16	5.00	1.20	41.19	0.52	0.80	-	-	Non-liquefiable
	29.00	CL-ML	72	60	591.60	290.00	301.60	0.56	0.171	0.58	34.55	5.00	1.20	46.46	0.52	0.79	-	-	Non-liquefiable
	30.50	CL	84	73	622.20	305.00	317.20	0.56	0.171	0.56	40.99	5.00	1.20	54.19	0.52	0.78	-	-	Non-liquefiable
	32.00	CI	94	64	652.80	320.00	332.80	0.56	0.171	0.55	35.08	5.00	1.20	47.10	0.52	0.77	-	-	Non-liquefiable
	33.50	CL	84	67	683.40	335.00	348.40	0.56	0.171	0.54	35.90	5.00	1.20	48.07	0.52	0.77	-	-	Non-liquefiable
	35.00	CL	84	75	714.00	350.00	364.00	0.56	0.171	0.52	39.31	5.00	1.20	52.17	0.52	0.76	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	36.50	CL	84	92	744.60	365.00	379.60	0.56	0.171	0.51	47.22	5.00	1.20	61.66	0.52	0.75	-	-	Non-liquefiable
	38.00	CL	91	84	775.20	380.00	395.20	0.56	0.171	0.50	42.25	5.00	1.20	55.71	0.52	0.75	-	-	Non-liquefiable
	40.00	CL	91	113	816.00	400.00	416.00	0.56	0.171	0.49	55.40	5.00	1.20	71.48	0.52	0.74	-	-	Non-liquefiable
P70	0.50	ML	69	3.00	10.20	5.00	5.20	1.00	0.305	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.48	Liquefiable
P70	1.00	CL	61	3.00	20.40	10.00	10.40	0.99	0.304	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
P70	2.00	CL	64	3.00	40.80	20.00	20.80	0.98	0.301	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
P70	3.00	CL-ML	60	7.00	61.20	30.00	31.20	0.98	0.299	1.70	11.90	5.00	1.20	19.28	0.21	1.00	-	-	Non-liquefiable
P70	4.00	SM	39	7.00	74.40	40.00	34.40	0.97	0.327	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.75	Liquefiable
P70	5.00	SM	33	10.00	93.00	50.00	43.00	0.96	0.324	1.52	15.25	4.88	1.18	22.87	0.25	1.00	0.304	0.94	Liquefiable
P70	6.00	SM	33	8.00	111.60	60.00	51.60	0.95	0.322	1.39	11.14	4.88	1.18	18.02	0.19	1.00	0.229	0.71	Liquefiable
P70	8.00	SM	26	14.00	148.80	80.00	68.80	0.94	0.317	1.21	16.88	4.39	1.12	23.34	0.26	1.00	0.313	0.99	Liquefiable
P70	9.00	SM	26	17.00	167.40	90.00	77.40	0.93	0.314	1.14	19.32	4.39	1.12	26.08	0.31	1.00	0.376	1.20	Non-liquefiable
P70	10.00	ML	72	17.00	204.00	100.00	104.00	0.91	0.278	0.98	16.67	5.00	1.20	25.00	0.29	1.00	0.348	1.25	Non-liquefiable
P70	11.00	ML	72	18.00	224.40	110.00	114.40	0.88	0.269	0.93	16.83	5.00	1.20	25.19	0.30	1.00	0.353	1.31	Non-liquefiable
P70	12.00	ML	72	15.00	244.80	120.00	124.80	0.85	0.261	0.90	13.43	5.00	1.20	21.11	0.23	1.00	0.274	1.05	Non-liquefiable
P70	13.00	CL	86	15.00	267.80	130.00	137.80	0.83	0.251	0.85	12.78	5.00	1.20	20.33	0.22	1.00	-	-	Non-liquefiable
P70	14.50	ML	89	15.00	298.70	145.00	153.70	0.79	0.239	0.81	12.10	5.00	1.20	19.52	0.21	1.00	0.250	1.05	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	16.00	CL	51	15.00	329.60	160.00	169.60	0.75	0.226	0.77	11.52	5.00	1.20	18.82	0.20	0.86	-	-	Non-liquefiable
	17.50	CL	67	18.00	360.50	175.00	185.50	0.71	0.214	0.73	13.22	5.00	1.20	20.86	0.23	0.83	-	-	Non-liquefiable
	19.00	SC	50	18.00	393.30	190.00	203.30	0.67	0.201	0.70	12.62	5.00	1.20	20.15	0.22	0.79	0.205	1.02	Non-liquefiable
	20.50	CL	59	20.00	424.35	205.00	219.35	0.63	0.189	0.68	13.50	5.00	1.20	21.20	0.23	0.77	-	-	Non-liquefiable
	23.50	CL	83	27.00	467.65	235.00	232.65	0.56	0.176	0.66	17.70	5.00	1.20	26.24	0.32	0.80	-	-	Non-liquefiable
	26.50	MI	97	31.00	537.95	265.00	272.95	0.56	0.172	0.61	18.76	5.00	1.20	27.52	0.35	0.72	-	-	Non-liquefiable
	28.00	CI	84	31.00	571.20	280.00	291.20	0.56	0.171	0.59	18.17	5.00	1.20	26.80	0.33	0.72	-	-	Non-liquefiable
	29.50	CI	84	28.00	601.80	295.00	306.80	0.56	0.171	0.57	15.99	5.00	1.20	24.18	0.28	0.71	-	-	Non-liquefiable
	31.00	CL	74	28.00	632.40	310.00	322.40	0.56	0.171	0.56	15.59	5.00	1.20	23.71	0.27	0.69	-	-	Non-liquefiable
	32.50	CL	73	36.00	663.00	325.00	338.00	0.56	0.171	0.54	19.58	5.00	1.20	28.50	0.39	0.68	-	-	Non-liquefiable
	34.00	SM	49	36.00	666.40	340.00	326.40	0.56	0.178	0.55	19.93	5.00	1.20	28.91	0.41	0.71	0.344	1.93	Non-liquefiable
	35.50	SM	49	55.00	695.80	355.00	340.80	0.56	0.178	0.54	29.79	5.00	1.20	40.75	0.52	0.70	0.434	2.43	Non-liquefiable
	37.00	ML	62	55.00	725.20	370.00	355.20	0.56	0.178	0.53	29.18	5.00	1.20	40.02	0.52	0.69	0.428	2.40	Non-liquefiable
	38.50	ML	58	65.00	754.60	385.00	369.60	0.56	0.178	0.52	33.81	5.00	1.20	45.57	0.52	0.69	0.428	2.40	Non-liquefiable
	40.00	ML	58	72.00	784.00	400.00	384.00	0.56	0.178	0.51	36.74	5.00	1.20	49.09	0.52	0.68	0.422	2.37	Non-liquefiable
P71	0.50	ML	55	3	9.30	5.00	4.30	1.00	0.336	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.437	Liquefiable
	1.00	ML	51	3	18.60	10.00	8.60	0.99	0.335	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.439	Liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	2.00	CL-ML	80	3	37.20	20.00	17.20	0.98	0.332	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
	3.00	CL	80	5	55.80	30.00	25.80	0.98	0.330	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
	4.00	CL	80	9	74.40	40.00	34.40	0.97	0.327	1.70	15.30	5.00	1.20	23.36	0.26	1.00	-	-	Non-liquefiable
	5.00	SM	36	9	93.00	50.00	43.00	0.96	0.324	1.52	13.72	5.00	1.20	21.47	0.23	1.00	0.280	0.862	Liquefiable
	6.00	SM	36	7	120.60	60.00	60.60	0.95	0.296	1.28	8.99	5.00	1.20	15.79	0.17	1.00	0.200	0.677	Liquefiable
	7.00	SM	36	10	140.70	70.00	70.70	0.95	0.294	1.19	11.89	5.00	1.20	19.27	0.21	1.00	0.246	0.838	Liquefiable
	9.00	CL	86	19	180.90	90.00	90.90	0.93	0.289	1.05	19.93	5.00	1.20	28.91	0.41	1.00	-	-	Non-liquefiable
	10.00	CL	86	22	194.00	100.00	94.00	0.91	0.292	1.03	22.69	5.00	1.20	32.23	0.52	1.00	-	-	Non-liquefiable
	11.00	ML	78	22	213.40	110.00	103.40	0.88	0.283	0.98	21.64	5.00	1.20	30.96	0.52	1.00	0.620	2.188	Non-liquefiable
	12.50	ML	78	27	248.75	125.00	123.75	0.84	0.263	0.90	24.27	5.00	1.20	34.13	0.52	1.00	0.620	2.354	Non-liquefiable
	14.00	CL	86	27	278.60	140.00	138.60	0.80	0.251	0.85	22.93	5.00	1.20	32.52	0.52	1.00	-	-	Non-liquefiable
	15.50	CL	86	31	325.50	155.00	170.50	0.76	0.226	0.77	23.74	5.00	1.20	33.49	0.52	0.87	-	-	Non-liquefiable
	17.00	ML	53	31	357.00	170.00	187.00	0.72	0.214	0.73	22.67	5.00	1.20	32.20	0.52	0.79	0.491	2.291	Non-liquefiable
	18.50	CL-ML	66	38	362.60	185.00	177.60	0.68	0.217	0.75	28.51	5.00	1.20	39.22	0.52	0.81	-	-	Non-liquefiable
	20.00	CL	85	38	392.00	200.00	192.00	0.64	0.204	0.72	27.42	5.00	1.20	37.91	0.52	0.80	-	-	Non-liquefiable
	21.50	CL	85	39	442.90	215.00	227.90	0.60	0.182	0.66	25.83	5.00	1.20	36.00	0.52	0.76	-	-	Non-liquefiable
	23.00	ML	59	39	473.80	230.00	243.80	0.56	0.170	0.64	24.98	5.00	1.20	34.97	0.52	0.74	0.460	2.708	Non-liquefiable
	24.50	CL-ML	82	42	504.70	245.00	259.70	0.56	0.170	0.62	26.06	5.00	1.20	36.27	0.52	0.73	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	27.50	MI	92	54	566.50	275.00	291.50	0.56	0.170	0.59	31.63	5.00	1.20	42.95	0.52	0.73	-	-	Non-liquefiable
	29.00	MI	92	56	571.30	290.00	281.30	0.56	0.177	0.60	33.39	5.00	1.20	45.07	0.52	0.74	-	-	Non-liquefiable
	30.50	CL	83	55	600.85	305.00	295.85	0.56	0.177	0.58	31.98	5.00	1.20	43.37	0.52	0.73	-	-	Non-liquefiable
	32.00	CL	83	59	630.40	320.00	310.40	0.56	0.177	0.57	33.49	5.00	1.20	45.19	0.52	0.72	-	-	Non-liquefiable
	33.50	CI	91	58	659.95	335.00	324.95	0.56	0.177	0.55	32.18	5.00	1.20	43.61	0.52	0.71	-	-	Non-liquefiable
	35.00	CL	86	61	689.50	350.00	339.50	0.56	0.177	0.54	33.11	5.00	1.20	44.73	0.52	0.70	-	-	Non-liquefiable
	36.50	CL	86	62	719.05	365.00	354.05	0.56	0.177	0.53	32.95	5.00	1.20	44.54	0.52	0.69	-	-	Non-liquefiable
	38.00	CL	84	61	748.60	380.00	368.60	0.56	0.177	0.52	31.77	5.00	1.20	43.13	0.52	0.68	-	-	Non-liquefiable
	40.00	CL	84	66	788.00	400.00	388.00	0.56	0.177	0.51	33.51	5.00	1.20	45.21	0.52	0.67	-	-	Non-liquefiable
P72	0.50	CL-ML	63	4	10.00	5.00	5.00	1.00	0.311	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
	1.00	CL-ML	63	4	20.00	10.00	10.00	0.99	0.310	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
	2.00	SM-SC	49	4	40.00	20.00	20.00	0.98	0.307	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.552	Liquefiable
	3.00	SM	40	7	60.00	30.00	30.00	0.98	0.305	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.808	Liquefiable
	4.00	SM	40	13	80.00	40.00	40.00	0.97	0.302	1.58	20.55	5.00	1.20	29.67	0.45	1.00	0.532	1.758	Non-liquefiable
	6.00	SM	30	15	120.00	60.00	60.00	0.95	0.298	1.29	19.36	4.71	1.15	27.06	0.34	1.00	0.406	1.362	Non-liquefiable
	7.00	SM	30	17	135.80	70.00	65.80	0.95	0.305	1.23	20.96	4.71	1.15	28.90	0.41	1.00	0.484	1.587	Non-liquefiable
	9.00	SM	24	6	174.60	90.00	84.60	0.93	0.300	1.09	6.52	4.18	1.11	11.40	0.13	1.00	0.150	0.500	Liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 | Earthquake Zone= IV | amax/g=0.24 | K(alpha)= 1.00 | MSF= 1.193 | Critical Water Table (m)=0.00 m

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	10.00	ML	74	15	194.00	100.00	94.00	0.91	0.292	1.03	15.47	5.00	1.20	23.57	0.27	1.00	0.317	1.087	Non-liquefiable
	11.00	CL-ML	83	15	213.40	110.00	103.40	0.88	0.283	0.98	14.75	5.00	1.20	22.70	0.25	1.00	-	-	Non-liquefiable
	12.50	CL-ML	83	12	252.50	125.00	127.50	0.84	0.260	0.89	10.63	5.00	1.20	17.75	0.19	1.00	-	-	Non-liquefiable
	15.50	CL-ML	82	16	313.10	155.00	158.10	0.76	0.235	0.80	12.72	5.00	1.20	20.27	0.22	0.87	-	-	Non-liquefiable
	17.00	CL	76	16	343.40	170.00	173.40	0.72	0.222	0.76	12.15	5.00	1.20	19.58	0.21	0.85	-	-	Non-liquefiable
	18.50	ML	53	20	377.40	185.00	192.40	0.68	0.208	0.72	14.42	5.00	1.20	22.30	0.25	0.82	0.241	1.160	Non-liquefiable
	20.00	CL	81	20	408.00	200.00	208.00	0.64	0.196	0.69	13.87	5.00	1.20	21.64	0.24	0.81	-	-	Non-liquefiable
	21.50	CL	63	33	436.45	215.00	221.45	0.60	0.184	0.67	22.18	5.00	1.20	31.61	0.52	0.79	-	-	Non-liquefiable
	23.00	SM	46	33	466.90	230.00	236.90	0.56	0.172	0.65	21.44	5.00	1.20	30.73	0.52	0.78	0.481	2.797	Non-liquefiable
	24.50	CL-ML	60	52	497.35	245.00	252.35	0.56	0.172	0.63	32.73	5.00	1.20	44.28	0.52	0.76	-	-	Non-liquefiable
	26.00	CL	78	52	527.80	260.00	267.80	0.56	0.172	0.61	31.78	5.00	1.20	43.13	0.52	0.81	-	-	Non-liquefiable
	27.50	CL	78	34	552.75	275.00	277.75	0.56	0.174	0.60	20.40	5.00	1.20	29.48	0.44	0.80	-	-	Non-liquefiable
	29.00	ML	54	34	582.90	290.00	292.90	0.56	0.174	0.58	19.87	5.00	1.20	28.84	0.40	0.69	0.330	1.898	Non-liquefiable
	30.50	ML	57	50	616.10	305.00	311.10	0.56	0.173	0.57	28.35	5.00	1.20	39.02	0.52	0.67	0.417	2.410	Non-liquefiable
	33.50	CL-ML	65	56	676.70	335.00	341.70	0.56	0.173	0.54	30.29	5.00	1.20	41.35	0.52	0.65	-	-	Non-liquefiable
	35.00	CL	70	59	707.00	350.00	357.00	0.56	0.173	0.53	31.23	5.00	1.20	42.47	0.52	0.64	-	-	Non-liquefiable
	36.50	CL	70	46	737.30	365.00	372.30	0.56	0.173	0.52	23.84	5.00	1.20	33.61	0.52	0.63	-	-	Non-liquefiable
	38.00	CL-ML	64	46	767.60	380.00	387.60	0.56	0.173	0.51	23.37	5.00	1.20	33.04	0.52	0.61	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	40.00	CL-ML	64	60	816.00	400.00	416.00	0.56	0.171	0.49	29.42	5.00	1.20	40.30	0.52	0.59	-	-	Non-liquefiable
P73	0.50	ML	62	9.00	8.35	5.00	3.35	1.00	0.387	1.70	15.30	5.00	1.20	23.36	0.26	1.00	0.313	0.809	Liquefiable
	1.00	CL	81	9.00	16.70	10.00	6.70	0.99	0.386	1.70	15.30	5.00	1.20	23.36	0.26	1.00	-	-	Non-liquefiable
	3.00	CL	66	13.00	50.10	30.00	20.10	0.98	0.380	1.70	22.10	5.00	1.20	31.52	0.52	1.00	-	-	Non-liquefiable
	4.00	CL	66	16.00	66.80	40.00	26.80	0.97	0.377	1.70	27.20	5.00	1.20	37.64	0.52	1.00	-	-	Non-liquefiable
	6.00	CL	93	14.00	118.20	60.00	58.20	0.95	0.302	1.31	18.35	5.00	1.20	27.02	0.34	1.00	-	-	Non-liquefiable
	7.00	CL	94	18.00	137.90	70.00	67.90	0.95	0.300	1.21	21.84	5.00	1.20	31.21	0.52	1.00	-	-	Non-liquefiable
	8.00	SM	20	18.00	155.20	80.00	75.20	0.94	0.302	1.15	20.76	3.61	1.08	26.02	0.31	1.00	0.374	1.238	Non-liquefiable
	9.00	SM	37	12.00	174.60	90.00	84.60	0.93	0.300	1.09	13.05	5.00	1.20	20.66	0.22	1.00	0.267	0.890	Liquefiable
	10.00	CL	80	19.00	194.00	100.00	94.00	0.91	0.292	1.03	19.60	5.00	1.20	28.52	0.39	1.00	-	-	Non-liquefiable
	12.50	CL	94	14.00	247.50	125.00	122.50	0.84	0.265	0.90	12.65	5.00	1.20	20.18	0.22	1.00	-	-	Non-liquefiable
	15.50	CL	87	26.00	310.00	155.00	155.00	0.76	0.237	0.80	20.88	5.00	1.20	30.06	0.47	0.91	-	-	Non-liquefiable
	17.00	ML	60	26.00	314.50	170.00	144.50	0.72	0.244	0.83	21.63	5.00	1.20	30.95	0.52	0.85	0.527	2.156	Non-liquefiable
	18.50	ML	60	33.00	342.25	185.00	157.25	0.68	0.231	0.80	26.32	5.00	1.20	36.58	0.52	0.84	0.521	2.256	Non-liquefiable
	21.50	ML	86	54.00	389.15	215.00	174.15	0.60	0.209	0.76	40.92	5.00	1.20	54.10	0.52	0.87	0.540	2.580	Non-liquefiable
	23.00	CL	84	61.00	416.30	230.00	186.30	0.56	0.195	0.73	44.69	5.00	1.20	58.63	0.52	0.86	-	-	Non-liquefiable
	24.50	SM	47	64.00	443.45	245.00	198.45	0.56	0.195	0.71	45.43	5.00	1.20	59.52	0.52	0.85	0.527	2.701	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	26.00	CL-ML	89	58.00	470.60	260.00	210.60	0.56	0.195	0.69	39.97	5.00	1.20	52.96	0.52	0.84	-	-	Non-liquefiable
	27.50	CL-ML	89	52.00	497.75	275.00	222.75	0.56	0.195	0.67	34.84	5.00	1.20	46.81	0.52	0.84	-	-	Non-liquefiable
	29.00	SM	29	51.00	562.60	290.00	272.60	0.56	0.180	0.61	30.89	4.64	1.15	40.04	0.52	0.82	0.509	2.821	Non-liquefiable
	30.50	CL	93	55.00	591.70	305.00	286.70	0.56	0.180	0.59	32.48	5.00	1.20	43.98	0.52	0.81	-	-	Non-liquefiable
	32.00	SM	44	58.00	620.80	320.00	300.80	0.56	0.180	0.58	33.44	5.00	1.20	45.13	0.52	0.80	0.496	2.753	Non-liquefiable
	33.50	CL	85	62.00	649.90	335.00	314.90	0.56	0.180	0.56	34.94	5.00	1.20	46.93	0.52	0.79	-	-	Non-liquefiable
	35.00	CL	85	59.00	703.50	350.00	353.50	0.56	0.174	0.53	31.38	5.00	1.20	42.66	0.52	0.65	-	-	Non-liquefiable
	36.50	CL	79	64.00	733.65	365.00	368.65	0.56	0.174	0.52	33.33	5.00	1.20	45.00	0.52	0.64	-	-	Non-liquefiable
	38.00	CL	79	72.00	763.80	380.00	383.80	0.56	0.174	0.51	36.75	5.00	1.20	49.10	0.52	0.63	-	-	Non-liquefiable
	40.00	CL	79	102.00	804.00	400.00	404.00	0.56	0.174	0.50	50.75	5.00	1.20	65.90	0.52	0.62	-	-	Non-liquefiable
P74	0.50	SM	45	6	9.80	5.00	4.80	1.00	0.317	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.690	Liquefiable
P74	1.00	CL	55	6	19.60	10.00	9.60	0.99	0.316	1.70	10.20	5.00	1.20	17.24	0.18	1.00	-	-	Non-liquefiable
P74	2.00	SM	46	6	39.20	20.00	19.20	0.98	0.314	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.698	Liquefiable
P74	3.00	CL-ML	70	5	58.80	30.00	28.80	0.98	0.311	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
P74	4.00	ML	67	11	78.40	40.00	38.40	0.97	0.309	1.61	17.75	5.00	1.20	26.30	0.32	1.00	0.382	1.237	Non-liquefiable
P74	5.00	SM	44	11	98.00	50.00	48.00	0.96	0.306	1.44	15.88	5.00	1.20	24.05	0.27	1.00	0.327	1.068	Non-liquefiable
P74	6.00	SM	32	18	117.00	60.00	57.00	0.95	0.306	1.32	23.84	4.83	1.17	32.75	0.52	1.00	0.620	2.030	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	7.00	SM	32	19	136.50	70.00	66.50	0.95	0.303	1.23	23.30	4.83	1.17	32.11	0.52	1.00	0.620	2.047	Non-liquefiable
	9.00	SM	24	23	175.50	90.00	85.50	0.93	0.298	1.08	24.87	4.18	1.11	31.73	0.52	1.00	0.620	2.080	Non-liquefiable
	10.00	CL-ML	76	17	194.00	100.00	94.00	0.91	0.292	1.03	17.53	5.00	1.20	26.04	0.31	1.00	-	-	Non-liquefiable
	11.00	ML	51	17	213.40	110.00	103.40	0.88	0.283	0.98	16.72	5.00	1.20	25.06	0.29	1.00	0.350	1.233	Non-liquefiable
	12.50	CL-ML	68	14	246.25	125.00	121.25	0.84	0.266	0.91	12.71	5.00	1.20	20.26	0.22	1.00	-	-	Non-liquefiable
	14.00	SM	39	14	275.80	140.00	135.80	0.80	0.254	0.86	12.01	5.00	1.20	19.42	0.21	1.00	0.248	0.980	Liquefiable
	15.50	CL	79	21	306.90	155.00	151.90	0.76	0.240	0.81	17.04	5.00	1.20	25.45	0.30	0.86	-	-	Non-liquefiable
	18.50	SM	45	29	366.30	185.00	181.30	0.68	0.214	0.74	21.54	5.00	1.20	30.85	0.52	0.80	0.498	2.322	Non-liquefiable
	20.00	CL	82	29	406.00	200.00	206.00	0.64	0.197	0.70	20.21	5.00	1.20	29.25	0.42	0.77	-	-	Non-liquefiable
	21.50	CL	92	55	436.45	215.00	221.45	0.60	0.184	0.67	36.96	5.00	1.20	49.35	0.52	0.75	-	-	Non-liquefiable
	23.00	CL	92	50	466.90	230.00	236.90	0.56	0.172	0.65	32.49	5.00	1.20	43.98	0.52	0.73	-	-	Non-liquefiable
	24.50	MI	94	59	497.35	245.00	252.35	0.56	0.172	0.63	37.14	5.00	1.20	49.57	0.52	0.71	-	-	Non-liquefiable
	26.00	MI	94	50	527.80	260.00	267.80	0.56	0.172	0.61	30.55	5.00	1.20	41.66	0.52	0.69	-	-	Non-liquefiable
	27.50	MI	94	45	558.25	275.00	283.25	0.56	0.172	0.59	26.74	5.00	1.20	37.09	0.52	0.68	-	-	Non-liquefiable
	29.00	CL-ML	64	55	588.70	290.00	298.70	0.56	0.172	0.58	31.82	5.00	1.20	43.19	0.52	0.67	-	-	Non-liquefiable
	30.50	CL-ML	64	51	619.15	305.00	314.15	0.56	0.172	0.56	28.77	5.00	1.20	39.53	0.52	0.65	-	-	Non-liquefiable
	32.00	CL	91	53	649.60	320.00	329.60	0.56	0.172	0.55	29.19	5.00	1.20	40.03	0.52	0.64	-	-	Non-liquefiable
	33.50	CL	91	58	680.05	335.00	345.05	0.56	0.172	0.54	31.22	5.00	1.20	42.47	0.52	0.63	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	35.00	CL-ML	76	60	710.50	350.00	360.50	0.56	0.172	0.53	31.60	5.00	1.20	42.92	0.52	0.62	-	-	Non-liquefiable
	36.50	CL	86	57	740.95	365.00	375.95	0.56	0.172	0.52	29.40	5.00	1.20	40.28	0.52	0.61	-	-	Non-liquefiable
	38.00	CL	86	69	771.40	380.00	391.40	0.56	0.172	0.51	34.88	5.00	1.20	46.85	0.52	0.60	-	-	Non-liquefiable
	40.00	CL	86	75	812.00	400.00	412.00	0.56	0.172	0.49	36.95	5.00	1.20	49.34	0.52	0.59	-	-	Non-liquefiable
P75	0.50	SM	44	3	9.85	5.00	4.85	1.00	0.316	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.465	Liquefiable
P75	1.00	CL-ML	51	3	19.70	10.00	9.70	0.99	0.314	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
P75	2.00	SM-SC	49	3	39.40	20.00	19.40	0.98	0.312	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.471	Liquefiable
P75	3.00	CL-ML	80	7	59.10	30.00	29.10	0.98	0.310	1.70	11.90	5.00	1.20	19.28	0.21	1.00	-	-	Non-liquefiable
P75	4.00	CL-ML	71	12	78.80	40.00	38.80	0.97	0.307	1.61	19.26	5.00	1.20	28.12	0.37	1.00	-	-	Non-liquefiable
P75	5.00	ML	64	12	98.50	50.00	48.50	0.96	0.305	1.44	17.23	5.00	1.20	25.68	0.31	1.00	0.365	1.197	Non-liquefiable
P75	6.00	ML	64	14	118.80	60.00	58.80	0.95	0.301	1.30	18.26	5.00	1.20	26.91	0.34	1.00	0.401	1.332	Non-liquefiable
P75	7.00	SM	44	17	138.60	70.00	68.60	0.95	0.298	1.21	20.53	5.00	1.20	29.63	0.44	1.00	0.529	1.774	Non-liquefiable
P75	9.00	CL-ML	80	21	178.20	90.00	88.20	0.93	0.293	1.06	22.36	5.00	1.20	31.83	0.52	1.00	-	-	Non-liquefiable
P75	10.00	CL-ML	80	23	209.00	100.00	109.00	0.91	0.271	0.96	22.03	5.00	1.20	31.44	0.52	1.00	-	-	Non-liquefiable
P75	12.50	CL-ML	64	18	261.25	125.00	136.25	0.84	0.251	0.86	15.42	5.00	1.20	23.50	0.27	1.00	-	-	Non-liquefiable
P75	14.00	CL	88	18	277.20	140.00	137.20	0.80	0.252	0.85	15.37	5.00	1.20	23.44	0.26	1.00	-	-	Non-liquefiable
P75	15.50	CL	88	25	314.65	155.00	159.65	0.76	0.234	0.79	19.79	5.00	1.20	28.74	0.40	0.90	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	17.00	SM	46	25	345.10	170.00	175.10	0.72	0.221	0.76	18.89	5.00	1.20	27.67	0.36	0.83	0.354	1.597	Non-liquefiable
	18.50	SM	39	30	360.75	185.00	175.75	0.68	0.218	0.75	22.63	5.00	1.20	32.16	0.52	0.83	0.512	2.353	Non-liquefiable
	21.50	CL	87	38	419.25	215.00	204.25	0.60	0.192	0.70	26.59	5.00	1.20	36.91	0.52	0.79	-	-	Non-liquefiable
	24.50	SM	47	36	477.75	245.00	232.75	0.56	0.179	0.66	23.60	5.00	1.20	33.32	0.52	0.75	0.465	2.596	Non-liquefiable
	26.00	ML	55	36	530.40	260.00	270.40	0.56	0.171	0.61	21.89	5.00	1.20	31.27	0.52	0.71	0.442	2.581	Non-liquefiable
	27.50	CL-ML	78	42	561.00	275.00	286.00	0.56	0.171	0.59	24.84	5.00	1.20	34.80	0.52	0.70	-	-	Non-liquefiable
	29.00	SM	44	42	591.60	290.00	301.60	0.56	0.171	0.58	24.18	5.00	1.20	34.02	0.52	0.74	0.458	2.672	Non-liquefiable
	30.50	MI	94	44	597.80	305.00	292.80	0.56	0.178	0.58	25.71	5.00	1.20	35.86	0.52	0.74	-	-	Non-liquefiable
	32.00	SM	43	44	627.20	320.00	307.20	0.56	0.178	0.57	25.10	5.00	1.20	35.12	0.52	0.73	0.456	2.554	Non-liquefiable
	33.50	CL	90	52	666.65	335.00	331.65	0.56	0.176	0.55	28.55	5.00	1.20	39.26	0.52	0.72	-	-	Non-liquefiable
	35.00	CL-ML	64	56	696.50	350.00	346.50	0.56	0.176	0.54	30.08	5.00	1.20	41.10	0.52	0.71	-	-	Non-liquefiable
	36.50	SM	46	52	726.35	365.00	361.35	0.56	0.176	0.53	27.36	5.00	1.20	37.83	0.52	0.70	0.436	2.481	Non-liquefiable
	38.00	SM	46	58	756.20	380.00	376.20	0.56	0.176	0.52	29.90	5.00	1.20	40.88	0.52	0.69	0.431	2.454	Non-liquefiable
	40.00	SM	49	64	796.00	400.00	396.00	0.56	0.176	0.50	32.16	5.00	1.20	43.59	0.52	0.68	0.425	2.420	Non-liquefiable
P76	0.50	ML	53	5.00	8.05	5.00	3.05	1.00	0.410	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.471	Liquefiable
P76	1.00	SM	50	5.00	16.10	10.00	6.10	0.99	0.409	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.473	Liquefiable
P76	2.00	CL	60	5.00	32.20	20.00	12.20	0.98	0.405	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	3.00	CL	60	10.00	48.30	30.00	18.30	0.98	0.402	1.70	17.00	5.00	1.20	25.40	0.30	1.00	-	-	Non-liquefiable
	5.00	CL	79	9.00	96.00	50.00	46.00	0.96	0.313	1.47	13.27	5.00	1.20	20.92	0.23	1.00	-	-	Non-liquefiable
	6.00	CL-ML	82	13.00	115.20	60.00	55.20	0.95	0.311	1.35	17.50	5.00	1.20	26.00	0.31	1.00	-	-	Non-liquefiable
	7.00	CL	81	13.00	142.10	70.00	72.10	0.95	0.291	1.18	15.31	5.00	1.20	23.37	0.26	1.00	-	-	Non-liquefiable
	8.00	CL	81	8.00	162.40	80.00	82.40	0.94	0.289	1.10	8.81	5.00	1.20	15.58	0.17	1.00	-	-	Non-liquefiable
	9.00	CL	75	10.00	182.70	90.00	92.70	0.93	0.286	1.04	10.39	5.00	1.20	17.46	0.19	1.00	-	-	Non-liquefiable
	10.00	CL-ML	90	10.00	196.00	100.00	96.00	0.91	0.289	1.02	10.21	5.00	1.20	17.25	0.18	1.00	-	-	Non-liquefiable
	11.00	CL	74	22.00	215.60	110.00	105.60	0.88	0.280	0.97	21.41	5.00	1.20	30.69	0.52	1.00	-	-	Non-liquefiable
	12.00	CL	74	25.00	235.20	120.00	115.20	0.85	0.272	0.93	23.29	5.00	1.20	32.95	0.52	1.00	-	-	Non-liquefiable
	14.50	CL	56	22.00	294.35	145.00	149.35	0.79	0.242	0.82	18.00	5.00	1.20	26.60	0.33	1.00	-	-	Non-liquefiable
	17.50	ML	58	27.00	357.00	175.00	182.00	0.71	0.216	0.74	20.01	5.00	1.20	29.02	0.41	0.82	0.402	1.859	Non-liquefiable
	19.00	CL-ML	84	27.00	387.60	190.00	197.60	0.67	0.204	0.71	19.21	5.00	1.20	28.05	0.37	0.79	-	-	Non-liquefiable
	20.50	CL-ML	84	32.00	418.20	205.00	213.20	0.63	0.192	0.68	21.92	5.00	1.20	31.30	0.52	0.76	-	-	Non-liquefiable
	23.50	CL-ML	66	42.00	479.40	235.00	244.40	0.56	0.171	0.64	26.87	5.00	1.20	37.24	0.52	0.71	-	-	Non-liquefiable
	25.00	SM	50	42.00	495.00	250.00	245.00	0.56	0.176	0.64	26.83	5.00	1.20	37.20	0.52	0.74	0.459	2.601	Non-liquefiable
	26.50	CL	70	61.00	524.70	265.00	259.70	0.56	0.176	0.62	37.85	5.00	1.20	50.42	0.52	0.72	-	-	Non-liquefiable
	29.50	MI	92	51.00	613.60	295.00	318.60	0.56	0.168	0.56	28.57	5.00	1.20	39.29	0.52	0.71	-	-	Non-liquefiable
	31.00	ML	60	53.00	644.80	310.00	334.80	0.56	0.168	0.55	28.97	5.00	1.20	39.76	0.52	0.70	0.434	2.581	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	32.50	ML	60	51.00	676.00	325.00	351.00	0.56	0.168	0.53	27.22	5.00	1.20	37.67	0.52	0.68	0.422	2.507	Non-liquefiable
	34.00	ML	57	63.00	663.00	340.00	323.00	0.56	0.179	0.56	35.05	5.00	1.20	47.06	0.52	0.70	0.434	2.422	Non-liquefiable
	35.50	ML	57	73.00	692.25	355.00	337.25	0.56	0.179	0.54	39.75	5.00	1.20	52.70	0.52	0.69	0.428	2.387	Non-liquefiable
	37.00	CL	59	74.00	721.50	370.00	351.50	0.56	0.179	0.53	39.47	5.00	1.20	52.36	0.52	0.68	-	-	Non-liquefiable
	38.50	CL	59	83.00	750.75	385.00	365.75	0.56	0.179	0.52	43.40	5.00	1.20	57.08	0.52	0.68	-	-	Non-liquefiable
	40.00	CL	84	87.00	780.00	400.00	380.00	0.56	0.179	0.51	44.63	5.00	1.20	58.56	0.52	0.67	-	-	Non-liquefiable
P77	0.50	ML	57	5.00	9.10	5.00	4.10	1.00	0.345	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.560	Liquefiable
P77	2.00	CL	53	5.00	36.40	20.00	16.40	0.98	0.341	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
P77	3.00	CL	75	9.00	54.60	30.00	24.60	0.98	0.338	1.70	15.30	5.00	1.20	23.36	0.26	1.00	-	-	Non-liquefiable
P77	4.00	MI	94	9.00	80.00	40.00	40.00	0.97	0.302	1.58	14.23	5.00	1.20	22.08	0.24	1.00	-	-	Non-liquefiable
P77	5.00	ML	70	18.00	100.00	50.00	50.00	0.96	0.300	1.41	25.46	5.00	1.20	35.55	0.52	1.00	0.620	2.067	Non-liquefiable
P77	6.00	CL	86	28.00	120.00	60.00	60.00	0.95	0.298	1.29	36.15	5.00	1.20	48.38	0.52	1.00	-	-	Non-liquefiable
P77	8.00	CL	82	26.00	158.40	80.00	78.40	0.94	0.296	1.13	29.36	5.00	1.20	40.24	0.52	1.00	-	-	Non-liquefiable
P77	9.00	CL	91	30.00	178.20	90.00	88.20	0.93	0.293	1.06	31.94	5.00	1.20	43.33	0.52	1.00	-	-	Non-liquefiable
P77	10.00	CL-ML	81	30.00	212.00	100.00	112.00	0.91	0.268	0.94	28.35	5.00	1.20	39.02	0.52	1.00	-	-	Non-liquefiable
P77	11.00	CL	90	22.00	233.20	110.00	123.20	0.88	0.260	0.90	19.82	5.00	1.20	28.78	0.40	1.00	-	-	Non-liquefiable
P77	12.00	CL	90	27.00	254.40	120.00	134.40	0.85	0.252	0.86	23.29	5.00	1.20	32.95	0.52	1.00	-	-	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	14.50	SM	41	31.00	295.80	145.00	150.80	0.79	0.241	0.81	25.24	5.00	1.20	35.29	0.52	1.00	0.620	2.576	Non-liquefiable
	16.00	ML	67	31.00	326.40	160.00	166.40	0.75	0.229	0.78	24.03	5.00	1.20	33.84	0.52	0.87	0.540	2.361	Non-liquefiable
	17.50	ML	55	35.00	357.00	175.00	182.00	0.71	0.216	0.74	25.94	5.00	1.20	36.13	0.52	0.84	0.521	2.409	Non-liquefiable
	19.00	CL	85	35.00	380.00	190.00	190.00	0.67	0.208	0.73	25.39	5.00	1.20	35.47	0.52	0.83	-	-	Non-liquefiable
	20.50	ML	61	41.00	410.00	205.00	205.00	0.63	0.196	0.70	28.64	5.00	1.20	39.36	0.52	0.81	0.502	2.570	Non-liquefiable
	22.00	CL	59	41.00	453.20	220.00	233.20	0.59	0.178	0.65	26.85	5.00	1.20	37.22	0.52	0.76	-	-	Non-liquefiable
	23.50	CL	59	45.00	484.10	235.00	249.10	0.56	0.170	0.63	28.51	5.00	1.20	39.21	0.52	0.74	-	-	Non-liquefiable
	25.00	SM	45	45.00	482.50	250.00	232.50	0.56	0.181	0.66	29.51	5.00	1.20	40.41	0.52	0.69	0.428	2.361	Non-liquefiable
	26.50	SM	45	44.00	511.45	265.00	246.45	0.56	0.181	0.64	28.03	5.00	1.20	38.63	0.52	0.68	0.422	2.327	Non-liquefiable
	28.00	MI	86	44.00	576.80	280.00	296.80	0.56	0.170	0.58	25.54	5.00	1.20	35.65	0.52	0.83	-	-	Non-liquefiable
	29.50	CL	54	100.00	607.70	295.00	312.70	0.56	0.170	0.57	56.55	5.00	1.20	72.86	0.52	0.82	-	-	Non-liquefiable
	31.00	ML	55	97.00	638.60	310.00	328.60	0.56	0.170	0.55	53.51	5.00	1.20	69.21	0.52	0.81	0.502	2.960	Non-liquefiable
	32.50	CL	69	86.00	669.50	325.00	344.50	0.56	0.170	0.54	46.33	5.00	1.20	60.60	0.52	0.80	-	-	Non-liquefiable
	34.00	ML	61	95.00	690.20	340.00	350.20	0.56	0.172	0.53	50.77	5.00	1.20	65.92	0.52	0.64	0.397	2.306	Non-liquefiable
	35.50	ML	61	63.00	720.65	355.00	365.65	0.56	0.172	0.52	32.95	5.00	1.20	44.54	0.52	0.63	0.391	2.270	Non-liquefiable
	37.00	ML	71	45.00	751.10	370.00	381.10	0.56	0.172	0.51	23.05	5.00	1.20	32.66	0.52	0.62	0.385	2.234	Non-liquefiable
	38.50	ML	71	64.00	781.55	385.00	396.55	0.56	0.172	0.50	32.14	5.00	1.20	43.57	0.52	0.61	0.378	2.198	Non-liquefiable
	40.00	CL	84	93.00	812.00	400.00	412.00	0.56	0.172	0.49	45.82	5.00	1.20	59.98	0.52	0.60	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	$K_σ$	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
P78	0.50	ML	61	8.00	9.85	5.00	4.85	1.00	0.316	1.70	13.60	5.00	1.20	21.32	0.23	1.00	0.277	0.879	Liquefiable
	1.00	ML	61	8.00	19.70	10.00	9.70	0.99	0.314	1.70	13.60	5.00	1.20	21.32	0.23	1.00	0.277	0.882	Liquefiable
	3.00	ML	67	10.00	59.10	30.00	29.10	0.98	0.310	1.70	17.00	5.00	1.20	25.40	0.30	1.00	0.358	1.156	Non-liquefiable
	4.00	ML	67	9.00	78.80	40.00	38.80	0.97	0.307	1.61	14.45	5.00	1.20	22.34	0.25	1.00	0.295	0.959	Liquefiable
	5.00	SM-SC	49	9.00	99.50	50.00	49.50	0.96	0.302	1.42	12.79	5.00	1.20	20.35	0.22	1.00	0.262	0.869	Liquefiable
	6.00	SM-SC	49	14.00	119.40	60.00	59.40	0.95	0.299	1.30	18.16	5.00	1.20	26.80	0.33	1.00	0.397	1.327	Non-liquefiable
	7.00	CL	77	12.00	139.30	70.00	69.30	0.95	0.297	1.20	14.41	5.00	1.20	22.30	0.25	1.00	-	-	Non-liquefiable
	9.00	CL-ML	91	31.00	184.50	90.00	94.50	0.93	0.284	1.03	31.89	5.00	1.20	43.27	0.52	1.00	-	-	Non-liquefiable
	10.00	CL	86	16.00	205.00	100.00	105.00	0.91	0.276	0.98	15.61	5.00	1.20	23.74	0.27	1.00	-	-	Non-liquefiable
	11.00	CL-ML	82	16.00	222.20	110.00	112.20	0.88	0.272	0.94	15.11	5.00	1.20	23.13	0.26	1.00	-	-	Non-liquefiable
	12.50	CL	86	18.00	252.50	125.00	127.50	0.84	0.260	0.89	15.94	5.00	1.20	24.13	0.28	1.00	-	-	Non-liquefiable
	14.00	CL-ML	81	18.00	278.60	140.00	138.60	0.80	0.251	0.85	15.29	5.00	1.20	23.35	0.26	1.00	-	-	Non-liquefiable
	15.50	CL-ML	81	28.00	308.45	155.00	153.45	0.76	0.238	0.81	22.60	5.00	1.20	32.12	0.52	0.90	-	-	Non-liquefiable
	18.50	CL-ML	78	27.00	377.40	185.00	192.40	0.68	0.208	0.72	19.47	5.00	1.20	28.36	0.38	0.84	-	-	Non-liquefiable
	20.00	CL	77	27.00	392.00	200.00	192.00	0.64	0.204	0.72	19.49	5.00	1.20	28.38	0.38	0.88	-	-	Non-liquefiable
	21.50	CL	84	33.00	421.40	215.00	206.40	0.60	0.191	0.70	22.97	5.00	1.20	32.56	0.52	0.87	-	-	Non-liquefiable
	23.00	ML	70	33.00	450.80	230.00	220.80	0.56	0.178	0.67	22.21	5.00	1.20	31.65	0.52	0.86	0.533	2.991	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	24.50	ML	70	37.00	480.20	245.00	235.20	0.56	0.178	0.65	24.13	5.00	1.20	33.95	0.52	0.86	0.533	2.991	Non-liquefiable
	26.00	CL-ML	53	37.00	514.80	260.00	254.80	0.56	0.176	0.63	23.18	5.00	1.20	32.82	0.52	0.76	-	-	Non-liquefiable
	27.50	CL-ML	53	55.00	544.50	275.00	269.50	0.56	0.176	0.61	33.50	5.00	1.20	45.20	0.52	0.75	-	-	Non-liquefiable
	29.00	SM	43	59.00	574.20	290.00	284.20	0.56	0.176	0.59	35.00	5.00	1.20	47.00	0.52	0.74	0.459	2.601	Non-liquefiable
	30.50	CL-ML	62	69.00	603.90	305.00	298.90	0.56	0.176	0.58	39.91	5.00	1.20	52.89	0.52	0.73	-	-	Non-liquefiable
	32.00	ML	51	75.00	643.20	320.00	323.20	0.56	0.174	0.56	41.72	5.00	1.20	55.06	0.52	0.69	0.428	2.462	Non-liquefiable
	33.50	ML	51	68.00	673.35	335.00	338.35	0.56	0.174	0.54	36.97	5.00	1.20	49.36	0.52	0.68	0.422	2.426	Non-liquefiable
	35.00	CL-ML	62	64.00	703.50	350.00	353.50	0.56	0.174	0.53	34.04	5.00	1.20	45.85	0.52	0.67	-	-	Non-liquefiable
	36.50	CL-ML	62	72.00	733.65	365.00	368.65	0.56	0.174	0.52	37.50	5.00	1.20	50.00	0.52	0.66	-	-	Non-liquefiable
	38.00	CL-ML	62	78.00	763.80	380.00	383.80	0.56	0.174	0.51	39.81	5.00	1.20	52.78	0.52	0.65	-	-	Non-liquefiable
	40.00	CL	70	88.00	804.00	400.00	404.00	0.56	0.174	0.50	43.78	5.00	1.20	57.54	0.52	0.64	-	-	Non-liquefiable
P79	0.50	SM	39	4.00	9.20	5.00	4.20	1.00	0.340	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.498	Liquefiable
P79	1.00	CL	59	4.00	18.40	10.00	8.40	0.99	0.339	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
P79	2.00	CL	59	4.00	36.80	20.00	16.80	0.98	0.336	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
P79	3.00	CL	78	8.00	55.20	30.00	25.20	0.98	0.334	1.70	13.60	5.00	1.20	21.32	0.23	1.00	-	-	Non-liquefiable
P79	5.00	CL	87	9.00	98.00	50.00	48.00	0.96	0.306	1.44	12.99	5.00	1.20	20.59	0.22	1.00	-	-	Non-liquefiable
P79	6.00	CL	87	12.00	117.60	60.00	57.60	0.95	0.304	1.32	15.81	5.00	1.20	23.97	0.27	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden (N_1)60	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content (N_1)60CS	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	7.00	CL-ML	65	12.00	140.70	70.00	70.70	0.95	0.294	1.19	14.27	5.00	1.20	22.13	0.24	1.00	-	-	Non-liquefiable
	8.00	CL	87	26.00	160.80	80.00	80.80	0.94	0.291	1.11	28.92	5.00	1.20	39.71	0.52	1.00	-	-	Non-liquefiable
	9.00	CL	87	23.00	180.90	90.00	90.90	0.93	0.289	1.05	24.12	5.00	1.20	33.95	0.52	1.00	-	-	Non-liquefiable
	11.00	CL	77	16.00	206.80	110.00	96.80	0.88	0.293	1.02	16.26	5.00	1.20	24.51	0.28	1.00	-	-	Non-liquefiable
	12.00	CL	77	19.00	225.60	120.00	105.60	0.85	0.284	0.97	18.49	5.00	1.20	27.19	0.34	1.00	-	-	Non-liquefiable
	13.00	CL-ML	90	19.00	247.00	130.00	117.00	0.83	0.272	0.92	17.57	5.00	1.20	26.08	0.31	1.00	-	-	Non-liquefiable
	14.50	CL	83	22.00	275.50	145.00	130.50	0.79	0.259	0.88	19.26	5.00	1.20	28.11	0.37	1.00	-	-	Non-liquefiable
	16.00	ML	75	22.00	323.20	160.00	163.20	0.75	0.231	0.78	17.22	5.00	1.20	25.67	0.31	0.89	0.324	1.406	Non-liquefiable
	17.50	ML	55	36.00	353.50	175.00	178.50	0.71	0.218	0.75	26.95	5.00	1.20	37.33	0.52	0.86	0.533	2.443	Non-liquefiable
	19.00	SM	43	36.00	343.90	190.00	153.90	0.67	0.232	0.81	29.02	5.00	1.20	39.82	0.52	0.87	0.540	2.322	Non-liquefiable
	20.50	CL	83	51.00	371.05	205.00	166.05	0.63	0.218	0.78	39.58	5.00	1.20	52.49	0.52	0.86	-	-	Non-liquefiable
	23.50	CL	81	40.00	465.30	235.00	230.30	0.56	0.176	0.66	26.36	5.00	1.20	36.63	0.52	0.81	-	-	Non-liquefiable
	26.50	CL	84	38.00	524.70	265.00	259.70	0.56	0.176	0.62	23.58	5.00	1.20	33.30	0.52	0.72	-	-	Non-liquefiable
	29.50	SM	41	38.00	584.10	295.00	289.10	0.56	0.176	0.59	22.35	5.00	1.20	31.82	0.52	0.69	0.428	2.425	Non-liquefiable
	31.00	ML	63	38.00	613.80	310.00	303.80	0.56	0.176	0.57	21.80	5.00	1.20	31.16	0.52	0.68	0.422	2.390	Non-liquefiable
	32.50	CL-ML	74	43.00	643.50	325.00	318.50	0.56	0.176	0.56	24.09	5.00	1.20	33.91	0.52	0.67	-	-	Non-liquefiable
	35.50	CL	77	53.00	702.90	355.00	347.90	0.56	0.176	0.54	28.42	5.00	1.20	39.10	0.52	0.63	-	-	Non-liquefiable
	38.50	CL	85	58.00	762.30	385.00	377.30	0.56	0.176	0.51	29.86	5.00	1.20	40.83	0.52	0.61	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	40.00	CL	85	64.00	792.00	400.00	392.00	0.56	0.176	0.51	32.32	5.00	1.20	43.79	0.52	0.61	-	-	Non-liquefiable
P80	0.50	CL-ML	61	5	10.40	5.00	5.40	1.00	0.299	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
	2.00	CL	65	5	41.60	20.00	21.60	0.98	0.296	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
	3.00	SM	42	8	62.40	30.00	32.40	0.98	0.294	1.70	13.60	5.00	1.20	21.32	0.23	1.00	0.277	0.945	Liquefiable
	5.00	CL	84	14	104.00	50.00	54.00	0.96	0.289	1.36	19.05	5.00	1.20	27.86	0.36	1.00	-	-	Non-liquefiable
	6.00	ML	72	13	117.60	60.00	57.60	0.95	0.304	1.32	17.13	5.00	1.20	25.55	0.30	1.00	0.362	1.190	Non-liquefiable
	7.00	SM	49	13	137.20	70.00	67.20	0.95	0.301	1.22	15.86	5.00	1.20	24.03	0.27	1.00	0.327	1.084	Non-liquefiable
	8.00	CL-ML	86	24	156.80	80.00	76.80	0.94	0.299	1.14	27.39	5.00	1.20	37.86	0.52	1.00	-	-	Non-liquefiable
	9.00	CL-ML	86	35	176.40	90.00	86.40	0.93	0.297	1.08	37.65	5.00	1.20	50.18	0.52	1.00	-	-	Non-liquefiable
	10.00	CL	93	35	196.00	100.00	96.00	0.91	0.289	1.02	35.72	5.00	1.20	47.87	0.52	1.00	-	-	Non-liquefiable
	11.00	ML	84	37	220.00	110.00	110.00	0.88	0.275	0.95	35.28	5.00	1.20	47.33	0.52	1.00	0.620	2.258	Non-liquefiable
	12.00	CL	89	23	240.00	120.00	120.00	0.85	0.266	0.91	21.00	5.00	1.20	30.20	0.48	1.00	-	-	Non-liquefiable
	14.50	CL	87	30	290.00	145.00	145.00	0.79	0.245	0.83	24.91	5.00	1.20	34.90	0.52	1.00	-	-	Non-liquefiable
	16.00	SC	47	30	326.40	160.00	166.40	0.75	0.229	0.78	23.26	5.00	1.20	32.91	0.52	0.83	0.517	2.261	Non-liquefiable
	17.50	SC	47	46	351.75	175.00	176.75	0.71	0.219	0.75	34.60	5.00	1.20	46.52	0.52	0.82	0.506	2.304	Non-liquefiable
	19.00	SM	40	46	381.90	190.00	191.90	0.67	0.207	0.72	33.21	5.00	1.20	44.85	0.52	0.84	0.522	2.521	Non-liquefiable
	20.50	SM-SC	50	49	401.80	205.00	196.80	0.63	0.200	0.71	34.93	5.00	1.20	46.91	0.52	0.84	0.518	2.597	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	22.00	CL	51	49	431.20	220.00	211.20	0.59	0.187	0.69	33.72	5.00	1.20	45.46	0.52	0.82	-	-	Non-liquefiable
	23.50	CL	51	65	467.65	235.00	232.65	0.56	0.176	0.66	42.61	5.00	1.20	56.14	0.52	0.80	-	-	Non-liquefiable
	25.00	CL-ML	81	77	497.50	250.00	247.50	0.56	0.176	0.64	48.94	5.00	1.20	63.73	0.52	0.79	-	-	Non-liquefiable
	26.50	CL-ML	69	85	527.35	265.00	262.35	0.56	0.176	0.62	52.48	5.00	1.20	67.97	0.52	0.77	-	-	Non-liquefiable
	28.00	ML	51	101	557.20	280.00	277.20	0.56	0.176	0.60	60.66	5.00	1.20	77.80	0.52	0.76	0.473	2.693	Non-liquefiable
	29.50	ML	51	51	587.05	295.00	292.05	0.56	0.176	0.59	29.84	5.00	1.20	40.81	0.52	0.75	0.466	2.656	Non-liquefiable
	31.00	CL-ML	61	63	616.90	310.00	306.90	0.56	0.176	0.57	35.96	5.00	1.20	48.15	0.52	0.74	-	-	Non-liquefiable
	32.50	CL	85	72	646.75	325.00	321.75	0.56	0.176	0.56	40.14	5.00	1.20	53.17	0.52	0.73	-	-	Non-liquefiable
	34.00	ML	64	77	676.60	340.00	336.60	0.56	0.176	0.55	41.97	5.00	1.20	55.36	0.52	0.72	0.449	2.557	Non-liquefiable
	35.50	CL-ML	55	80	706.45	355.00	351.45	0.56	0.176	0.53	42.67	5.00	1.20	56.21	0.52	0.72	-	-	Non-liquefiable
	37.00	CL-ML	55	88	736.30	370.00	366.30	0.56	0.176	0.52	45.98	5.00	1.20	60.18	0.52	0.71	-	-	Non-liquefiable
	38.50	CL-ML	55	85	766.15	385.00	381.15	0.56	0.176	0.51	43.54	5.00	1.20	57.25	0.52	0.70	-	-	Non-liquefiable
	40.00	CL-ML	64	91	796.00	400.00	396.00	0.56	0.176	0.50	45.73	5.00	1.20	59.88	0.52	0.69	-	-	Non-liquefiable

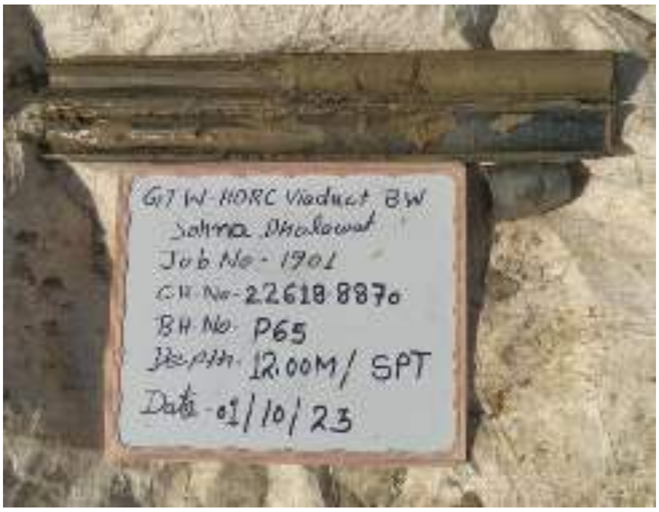
APPENDIX-I
SITE PHOTOGRAPHS

 SPT sample at depth 9.00 m	 UDS at depth 28.00 m
 SPT at depth 15.50 m	 SPT sample at depth 33.50 m

APPENDIX-I
SITE PHOTOGRAPHS

 UDS at depth 19.00 m	 SPT at depth 32.50 m
 SPT at depth 12.50 m	 SPT sample at depth 33.00 m

APPENDIX-I
SITE PHOTOGRAPHS



SPT sample at depth 12.00 m


SPT at depth 23.50 m


SPT at depth 8.00 m


UDS at depth 28.00 m

APPENDIX-I
SITE PHOTOGRAPHS

SPT at depth 6.00 m

SPT sample at depth 30.50 m

SPT sample at depth 6.00 m

SPT at depth 12.50 m

APPENDIX-I
SITE PHOTOGRAPHS

UDS at depth 23.00 m

SPT sample at depth 33.50 m

SPT sample at depth 12.00 m

SPT at depth 8.00 m

APPENDIX-I
SITE PHOTOGRAPHS

SPT sample at depth 12.50 m


SPT at depth 12.50 m

SPT sample at depth 40.00 m

APPENDIX-I
SITE PHOTOGRAPHS

SPT at depth 6.00 m

SPT sample at depth 27.50 m

SPT sample at depth 3.00 m

SPT sample at depth 21.50 m

APPENDIX-I
SITE PHOTOGRAPHS

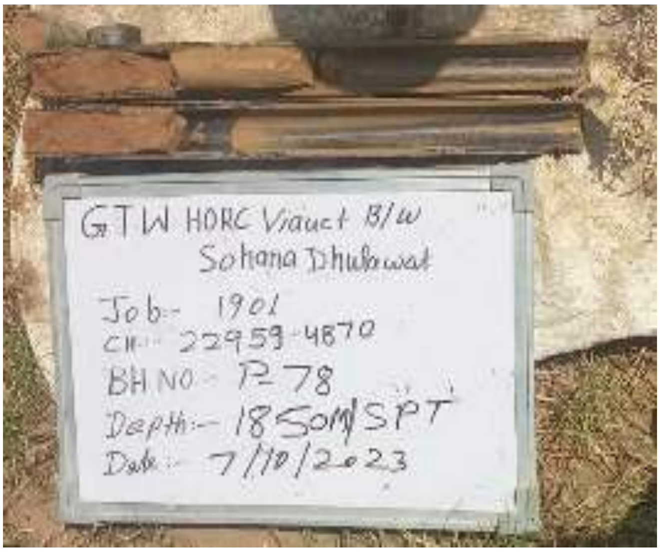
SPT sample at depth 32.00 m


UDS at depth 10.00 m


SPT sample at depth 29.50 m


SPT at depth 12.50 m

APPENDIX-I
SITE PHOTOGRAPHS



SPT sample at depth 18.50 m


SPT at depth 23.50 m

SPT sample at depth 29.50 m

SPT sample at depth 31.00 m

APPENDIX-J
LABORATORY PHOTOGRAPHS

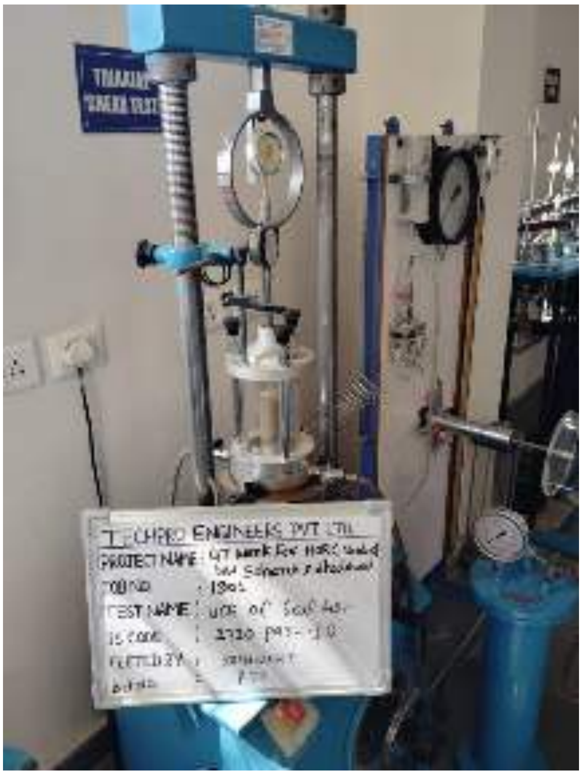
Water content test

Atterbergs' limit test

Triaxial test

Grain size analysis

APPENDIX-J
LABORATORY PHOTOGRAPHS

 Direct shear test	 UCS test soil
 Moisture content test	 Grain size analysis

APPENDIX-K
CHART 1: FIELD BORELOG CHARTS (P61)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/003
Date of Issue:	01.04.2018
Rev No:	R03
Rev Date:	28.12.2021

Project Name:	GT For HORC Viaduct Between Sohana Dhulawat Station	Project Code:	1901
Coordinate:	N: 3119493.892 E: 701210.312	Location/ Chainage:	22514.0870
Method of Drilling:	Percussion	Drilling Equipment:	Bhawarlal
Bore No.:	P61		
Casing Lowered (M):	28.00	Bentonite Unit:	x
Standard Sampler:	yes	Barrel Type:	NA
Ground Elevation:	RL-191.635	Date: From	27/9/23 to 30/09/2023
Water Table (M):	1.52 M		

Day-Date	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
27/9/23	0.00	0.50	0.50	DS	SX	Collected										Non cohesive soil
"	1.00	1.45	0.45	U	—	Received										do
"	2.00	2.45	0.45	D/P	—	3	3	2	5	—						Non cohesive soil with
"	3.00	3.45	0.45	D/P	—	3	3	3	6	-						cohesive soil brown
"	4.00	4.45	0.45	U	—	Received										do
"	5.00	5.45	0.45	D/P	—	5	7	8	15	—	—	—	—	—	—	Non cohesive soil
28/9/23	6.00	6.45	0.45	DP	SX	6	8	13	21							Non cohesive soil
"	7.00	7.45	0.45	U	"	Received										do
"	8.00	8.45	0.45	DP	"	5	6	9	15							Non cohesive soil
"	9.00	9.45	0.45	DP	"	9	11	14	25							cohesive soil
"	10.00	10.45	0.45	U	"	Received										do
"	11.00	11.45	0.45	DP	"	7	11	13	24							cohesive soil
"	12.00	12.45	0.45	DP	"	8	13	15	28							do
"	13.00	13.45	0.45	U	"	Received										do
"	14.50	14.95	0.45	DP	"	9	15	17	32							cohesive soil
"	16.00	16.45	0.45	U	"	Received										do
"	17.50	17.95	0.45	DP	"	7	11	14	25							cohesive soil
"	19.00	19.45	0.45	U	"	Received										do
"	20.50	20.95	0.45	DP	"	11	20	32	52							do
"	22.00	22.45	0.45	U	"	Received										Non cohesive soil
"	23.50	23.95	0.45	DP	"	12	23	35	58							cohesive soil
"	25.00	25.45	0.45	U	"	Received										do
29/9/23	26.50	26.95	0.45	DP	SX	12	23	27	50							cohesive soil
	28.00	28.45	0.45	U	"	Received										"

Supervisor

E-in-C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 2: FIELD BORELOG CHARTS (P61)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No	GT/ 003
		Date of Issue	01.04.2018
		Rev. No.:	R03
		Rev. Date:	24.12.2021

Project Name:	G.T. for HORC Viaduct between Sohana Dhulawat station	Project Code:	1901
Coordinate: N: 3119497892	E: 7012101312	Location/ Chainage:	22514.0270
Method of Drilling: Percussion	Drilling Equipment: Powerwinch	Bore No.:	P61
Casing Lowered (M): 29.00 ; Bentonite Used: ×	Standard Sampler: yes	Barrel Type:	NA
Ground Elevation: RL-191.635	Date: From 27/09/23 to 30/09/2023	Water Table (M):	1.52

Day/Date	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
29/9/23	29.50	29.95	0.45	DP	SX	18	32	36	68							Non cohesive soil
"	31.00	31.45	0.45	DP	"	17	35	39	74							Non cohesive soil with Gravel
"	32.50	32.95	0.45	DP	"	15	28	33	61							Non cohesive soil
"	34.50	34.95	0.45	DP	"	17	35	50	85							do
30/9/23	35.50	35.95	0.45	DP	"	12	27	37	64							do
"	37.50	37.95	0.45	DP	"	15	31	52	83							cohesive soil with Gravel
"	38.50	38.95	0.45	DP	"	17	34	55	89							do
	40.00	40.35	0.35	DP	"	25	65	36	101							cohesive soil with Gravel

Jitender Parashar

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100). Sampler means SPT sampler

APPENDIX-K
CHART 3: FIELD BORELOG CHARTS (P62)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc. No.	[illegible]
Date of Issue:	01.04.2018
Rev. No.	P03
Rev. Date:	28.12.2021

Project Name: GT work for HORC viaduct B/w Sohana & Dhulawat Section				Project Code:	1901
Coordinate:	N: 3119515.583	E: 7011195.421		Location/ Chainage:	92540 - 2370
Method of Drilling:	Percussion	Drilling Equipment:	Power winch	Bore No.:	P62
Casing Lowered (M):	[illegible]	Bentonite Used:	No	Standard Sampler: Yes	Barrel Type: N/A
Ground Elevation:	R.L. [illegible]	Date: From 28/9/2023 to 1/10/2023		Water Table (M):	1.50

Day/Date	Depth/RUN (m) From	To	Length (m)	Nature of sample	Hole Size	SPT 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	CR (%)	RQD (%)	Water Losses (%)	Color of Return Water	Description
28/9	0.50	0.50	0.50	D	SX	Collected				—	—	—	—	—	—	Brownish cohesive soil
"	1.00	1.45	0.45	DP	—	1	2	3	5	—	—	—	—	—	—	do
"	2.00	2.45	0.45	U	—	Received				—	—	—	—	—	—	Brownish cohesive soil with gravels
"	3.00	3.45	0.45	DP	—	4	6	10	16	—	—	—	—	—	—	
"	4.00	4.45	0.45	DP	—	7	11	14	25	—	—	—	—	—	—	do
"	5.00	5.45	0.45	U	—	Received				—	—	—	—	—	—	do
"	6.00	6.45	0.45	DP	—	9	14	16	30	—	—	—	—	—	—	do
"	7.00	7.45	0.45	DP	—	8	17	19	36	—	—	—	—	—	—	do
"	8.00	8.45	0.45	U	—	Slipped				—	—	—	—	—	—	do/DS collected
"	9.00	9.45	0.45	DP	—	5	8	11	19	—	—	—	—	—	—	Brownish yellow non cohesive soil
"	10.00	10.45	0.45	DP	—	7	10	15	25	—	—	—	—	—	—	do
29/9	11.00	11.45	0.45	U	—	Received				—	—	—	—	—	—	do
"	12.50	12.95	0.45	DP	—	6	11	17	28	—	—	—	—	—	—	do
"	14.00	14.45	0.45	U	—	Received				—	—	—	—	—	—	do
"	15.50	15.45	0.45	DP	—	8	15	18	33	—	—	—	—	—	—	do
"	17.00	17.45	0.45	U	—	Received				—	—	—	—	—	—	do
"	18.50	18.95	0.45	DP	—	9	17	19	36	—	—	—	—	—	—	Brownish yellow non cohesive soil with gravels
"	20.00	20.45	0.45	U	—	Received				—	—	—	—	—	—	
"	21.50	21.95	0.45	DP	—	9	18	21	39	—	—	—	—	—	—	do
"	23.00	23.45	0.45	U	—	Received				—	—	—	—	—	—	Brownish cohesive soil with gravels
"	24.50	24.95	0.45	DP	—	11	29	[illegible]	67	—	—	—	—	—	—	do
1/10	26.00	26.45	0.45	U	—	Received				—	—	—	—	—	—	Cohesive soil
"	27.50	27.95	0.45	DP	—	16	23	27	50	—	—	—	—	—	—	do
"	29.00	29.45	0.45	U	—	Slipped				—	—	—	—	—	—	do/DS collected

Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 4: FIELD BORELOG CHARTS (P62)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/003
		Date of Issue	02.04.2018
		Rev No:	R03
		Rev Date	28.12.2021

Project Name:	GI work for HORC Viaduct B/w Sohana & Dhulawat station	Project Code:	1901
Coordinate:	N: 3119515.583 E: 701195.421	Location/ Chainage:	22540+[illegible]
Method of Drilling:	Percussion	Drilling Equipment:	Percussion
Bore No.:	P62		
Casing Lowered (M):	[illegible] m	Bentonite Used:	NO
Standard Sampler:	Yes	Barrel Type:	N/A
Ground Elevation:	R-[illegible]91.61	Date: From	[illegible] to [illegible]
Water Table (M):	1.50		

Day/Date	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
[illegible]	38.55	39.05	0.45	DP	SX	13	25	31	56	-	-	-	-	-	-	Cohesive soil
[illegible]	[illegible]	[illegible]	0.45	U	-	Slipped				-	-	-	-	-	-	-- do / US collected
"	[illegible]	[illegible]	0.45	DP	-	15	28	34	62	-	-	-	-	-	-	Cohesive soil with [illegible]
"	[illegible]	[illegible]	0.45	U	-	Slipped				-	-	-	-	-	-	-- do / US collected
"	[illegible]	[illegible]	0.45	DP	-	19	32	37	69	-	-	-				-- do --
"	[illegible]	[illegible]	0.45	U	-	Slipped				-	-	-	-	-	-	-- do --
"	[illegible]	[illegible]	0.45	DP		20	29	33	62	-	-	-	-	-	-	Non cohesive silt with Gravel

[illegible]

Supervisor

Abbreviation Used : U- Undisturbed Sample. C- Core Sample, D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

E-in-C

APPENDIX-K
CHART 5: FIELD BORELOG CHARTS (P63)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2019
		Rev. No:	R03
		Rev. Date:	28.12.2021

Project Name:	Civil work for HORC Viaduct B/w Sohana & Dhulawat Section	Project Code:	1901
Coordinate:	N: 3119531.582 E: 701180.991	Location/ Chainage:	22564.4270
Method of Drilling:	Percussion	Drilling Equipment:	Power winch
Bore No.:	P-63		
Casing Lowered (M):	22.00	Bentonite Used:	No
Standard Sampler:	YES	Barrel Type:	N/A
Ground Elevation:	RL=191.645	Date: From	2/10/2023 to 3/10/2023
Water Table (M):	1.50		

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
2/10	0.00	0.50	0.50	D	SX	Collected				—	—	—	—	—	—	cohesive soil
"	1.00	1.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	2.00	2.45	0.45	DP	—	1	1	2	3	—	—	—	—	—	—	— do —
"	3.00	3.45	0.45	DP	—	2	2	4	6	—	—	—	—	—	—	— do —
"	4.00	4.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	5.00	5.45	0.45	DP	—	3	5	7	12	—	—	—	—	—	—	Non cohesive soil
"	6.00	6.45	0.45	DP	—	3	7	11	18	—	—	—	—	—	—	— do —
"	7.00	7.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do/DS collected
"	8.00	8.45	0.45	DP	—	5	10	16	26	—	—	—	—	—	—	Non cohesive soil with gravels
"	9.00	9.45	0.45	DP	—	7	12	19	31	—	—	—	—	—	—	— do —
"	10.00	10.45	0.45	U	—	Received				—	—	—	—	—	—	cohesive soil
"	11.00	11.45	0.45	DP	—	8	15	22	37	—	—	—	—	—	—	— do —
"	12.00	12.45	0.45	DP	—	7	18	23	41	—	—	—	—	—	—	— do —
"	13.00	13.45	0.45	U	—	Received				—	—	—	—	—	—	cohesive soil with gravels
"	14.50	14.95	0.45	DP	—	9	15	17	32	—	—	—	—	—	—	— do —
"	16.00	16.45	0.45	U	—	Received				—	—	—	—	—	—	cohesive soil
"	17.50	17.95	0.45	DP	—	8	20	24	44	—	—	—	—	—	—	— do —
"	19.00	19.45	0.45	U	—	Received				—	—	—	—	—	—	Non cohesive soil
"	20.50	20.95	0.45	DP	—	11	19	30	49	—	—	—	—	—	—	— do —
"	22.00	22.45	0.45	U	—	Received				—	—	—	—	—	—	cohesive soil with no gravel
"	23.50	23.95	0.45	DP	—	9	17	25	42	—	—	—	—	—	—	— do —
"	25.00	25.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
3/10	26.50	26.95	0.45	DP	—	11	20	26	46	—	—	—	—	—	—	— do —
"	28.00	28.45	0.45	U	—	Received				—	—	—	—	—	—	— do —

Supervisor

M&VE
Exe. R&S
HP/E/S/[illegible] 2023

E - In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 6: FIELD BORELOG CHARTS (P63)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	24.12.2021

Project Name: Geotechnical HORC Viaduct B/w Sohana Dhulawat station	Project Code: 1901
Coordinate: N: 3119537.582 E: 701180.991	Location/ Chainage: 22568-9270
Method of Drilling: Percussion	Drilling Equipment: Percussion
Bore No.:	P 63
Casing Lowered (M): 29.00	Bentonite Used: No
Standard Sampler:	Yes
Barrel Type:	N/A
Ground Elevation: RL-191.645	Date: From 2/10/2023 to 3/10/2023
Water Table (M):	1.50

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
2/10/23	29.50	29.95	0.45	DP	SX	10	21	28	49	–	–	–	–	–	–	Cohesive soil with gravels
"	31.00	31.45	0.45	DP	–	15	22	30	52	–	–	–	–	–	–	— do —
"	32.50	32.95	0.45	DP	–	15	25	32	57	–	–	–	–	–	–	— do —
"	34.00	34.45	0.45	U	–	Slipped				–	–	–	–	–	–	Non cohesive soil
"	35.50	35.95	0.45	DP	–	12	28	30	58	–	–	–	–	–	–	— do —
"	37.00	37.45	0.45	U	–	Slipped				–	–	–	–	–	–	— do —
"	38.50	38.95	0.45	DP	–	10	27	33	60	–	–	–	–	–	–	— do —
"	40.00	40.45	0.45	DP	–	12	28	37	65	–	–	–	–	–	–	Non cohesive soil

03/10/2023
Geotech Engr. MGC

Supervisor

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

E - in - C

APPENDIX-K
CHART 7: FIELD BORELOG CHARTS (P64)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GT- for HORC viaduct b/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119559.218	E: 701167.064	Location/ Chainage:	22592.6870	
Method of Drilling:	Percussion	Drilling Equipment	Power winch	Bore No.:	P64
Casing Lowered (M):	22.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L - 191.726	Date: From 28/9/23 to 30/9/23		Water Table (M):	1.60

Day Date	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
28/9/23	0.0	0.50	0.50	DS	SX	–	Recevid									NON cohesive Soil
"	1.00	1.45	0.45	DP	"	2	2	2	4							cohesiv soil
"	2.00	2.45	0.45	U	"	–	Recevid									— do —
"	3.00	3.45	0.45	DP	"	6	6	7	13							NON cohesive soil
"	4.00	4.45	0.45	DP	"	7	9	11	20							— do —
"	5.00	5.45	0.45	U	"	Slipped			–							— do —
"	6.00	6.45	0.45	DP	"	3	5	8	13							— do —
"	7.00	7.45	0.45	DP	"	4	6	9	15							— do —
"	8.00	8.45	0.45	U	"	–	Recevid									— do —
29/9/23	9.00	9.45	0.45	DP	"	9	10	14	24							cohesive soil
"	10.00	10.45	0.45	DP	"	10	14	17	31							— do —
"	11.00	11.45	0.45	U	"	–	Recevid									— do —
"	12.50	12.95	0.45	DP	"	6	12	15	27							— do —
"	14.00	14.45	0.45	U	"	–	Recevid									NON cohesive soil with Gravel
"	15.50	15.95	0.45	DP	"	8	14	18	32							— do —
"	17.00	17.45	0.45	U	"	Recevid			–							— do —
"	18.50	18.95	0.45	DP	"	6	13	16	29							— do —
"	20.00	20.45	0.45	U	"	Recevid										— do
"	21.50	21.95	0.45	DP	"	9	14	19	33							cohesive soil with Gravel
"	23.00	23.45	0.45	U	"	Receved			–							— do
"	24.50	24.95	0.45	DP	"	10	24	42	66							NON cohesive soil with Gravel
"	26.00	26.45	0.45	U	"	Slipped			–							— do —
"	27.50	27.95	0.45	DP	"	12	26	30	56							— do —
"	29.00	29.45	0.45	U	"	Receved			–							— do —

Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 8: FIELD BORELOG CHARTS (P64)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	TT/ 003
		Date of Issue	07.04.2018
		Rev No.:	R03
		Rev Date:	28.12.2021

Project Name:	G.T. for HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119559.818	E: 701161.064		Location/ Chainage:	22592.6870
Method of Drilling:	Percussion	Drilling Equipment	Power winch	Bore No.:	P64
Casing Lowered (M):	22.40	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	RL-190.725	Date: From 28/9/23 to 30/9/23		Water Table (M):	1.60

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
"	30.50	30.95	0.45	DP	SX	10	26	33	59							Non cohesive soil with Gravel
26	32.00	32.45	0.45	U	"	Slipped			-							
28	33.50	33.95	0.45	DP	"	12	28	35	63							— do
"	35.00	35.45	0.45	U	"	Slipped			-							Non cohesive soil
"	36.50	36.95	0.45	DP	"	10	29	38	67							— do
"	38.00	38.45	0.45	U	"	Slipped										— do
"	40.00	40.45	0.45	DP	"	14	32	51	83							Non cohesive soil

Jitender Parashar

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 9: FIELD BORELOG CHARTS (P65)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date:	28.12.2021

Project Name:	GI for HORC viaduct b/w Sohana Dhulawat station			**Project Code:**	1901
Coordinate:	N: 3119582.405	E: 701153.57	**Location/ Chainage:** 22612.2870		
Method of Drilling:	Percussion	**Drilling Equipment:**	Power winch	**Bore No.:**	P65
Casing Lowered (M):	20.00	**Bentonite Used:** NO	**Standard Sampler:** Yes	**Barrel Type:**	N/A
Ground Elevation:	RL-191.825	**Date: From** 1/10/23 **to** 2/10/23		**Water Table (M):**	2.60

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
DUC 1/10/23	0.0	0.50	0.50	D.S.	3x	-	Received									Non cohesive soil
"	1.00	1.45	0.45	U	"	-	Received									— do —
"	2.00	2.45	0.45	DP	"	2	2	3	5							cohesive soil
"	3.00	3.45	0.45	DP	"	2	5	5	10							— do —
"	4.00	4.45	0.45	U	"	-	Received									Non cohesive soil
"	5.00	5.45	0.45	DP	"	3	7	8	15							— do —
"	6.00	6.45	0.45	DP	"	4	9	11	20							— do —
"	7.00	7.45	0.45	U	"	-	Received									— do —
"	8.00	8.45	0.45	DP	"	6	10	15	25							— do —
"	9.00	9.45	0.45	DP	"	4	7	9	16							— do —
"	10.00	10.45	0.45	U	"	-	Received									— do —
"	11.00	11.45	0.45	DP	"	5	6	10	16							Non cohesive soil
"	12.00	12.45	0.45	DP	"	5	6	11	17							with Gravel
"	13.00	13.45	0.45	U	"	-	Received									— do —
"	14.50	14.95	0.45	DP	"	6	12	18	30							— do —
"	16.00	16.45	0.45	U	"	Slipped			-							— do —
"	17.50	17.95	0.45	DP	"	6	10	13	23							— do —
"	19.00	19.45	0.45	U	"	-	Slipped		-							— do —
"	20.50	20.95	0.45	DP	"	6	11	16	27							— do —
"	22.00	22.45	0.45	U	"	Received			-							— do —
2/10/23	23.50	23.95	0.45	DP	"	10	22	30	52							— do —
"	25.00	25.45	0.45	U	"	-	Received									— do —
"	26.50	26.95	0.45	DP	"	11	17	24	41							— do —
"	28.00	28.45	0.45	U	"	-	Received		-							— do —

Supervisor   E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 10: FIELD BORELOG CHARTS (P65)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	OT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GI for HORC viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119582.405	E: 701153.57	Location/ Chainage: 22618.8870		
Method of Drilling:	Percussion	Drilling Equipment	Power winch	Bore No.:	P65
Casing Lowered (M):	20.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	RL-191.825	Date: From 1/10/23 to 2/10/23		Water Table (M):	1.60

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
"	29.50	29.95	0.45	DP	SX	6	10	12	22							cohesive soil
"	31.00	31.45	0.45	U	"	-	Recovered									- do -
"	32.50	32.95	0.45	DP	"	10	21	29	50							NON cohesive soil with Gravel soil
"	34.00	34.45	0.45	U	"	Slipped			-							
"	35.50	35.95	0.45	DP	"	13	26	33	59							- do -
"	37.00	37.45	0.45	U	"	-	Slipped									- do -
"	38.50	38.95	0.45	DP	"	9	16	28	44							NON Cohesive Soil
"	40.00	40.45	0.45	DP	"	10	21	35	56							- do -

Supervisor E - in - C

Techpro Engineers Pvt. Ltd.

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 11: FIELD BORELOG CHARTS (P66)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	OT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	003
		Rev. Date:	28.12.2021

Project Name: GI for HORC Viaduct b/w Sohana Dhulawat 5/9/19		Project Code:	1901
Coordinate: N: 3119605.336	E: 760140.518	Location/ Chainage:	32145.0870
Method of Drilling: Percussion	Drilling Equipment: Bramerich	Bore No.:	P66
Casing Lowered (M): 19.50 Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation: RL-191.818	Date: From 28/09/23 to 30/9/23	Water Table (M):	1.50 m

Day/Date	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
28/9/23	0.00	0.50	0.50	DS	SX	Collected										Non-cohesive soil
"	1.00	1.45	0.45	U	"	Received										— do —
"	2.00	2.45	0.45	DP	"	1	2	4	6							Non-cohesive soil with kankar
"	3.00	3.45	0.45	DP	"	1	2	2	4							— do —
"	4.00	4.45	0.45	U	"	Received										— do —
"	5.00	5.45	0.45	DP	"	3	6	8	14							Non-cohesive soil
"	6.00	6.45	0.45	DP	"	2	2	6	8							— do —
"	7.00	7.45	0.45	U	"	Slipped										— do — Collected DS
"	8.00	8.45	0.45	DP	"	10	18	28	46							Cohesive soil with kankar
"	9.00	9.45	0.45	DP	"	3	7	8	15							— do —
"	10.00	10.45	0.45	U	"	Received										— do —
"	11.00	11.45	0.45	DP	"	9	11	12	23							— do —
"	12.00	12.45	0.45	DP	"	7	8	14	22							— do —
"	13.00	13.45	0.45	U	"	Received										Non-cohesive soil with kankar
29/9/23	14.00	14.45	0.45	DP	"	4	6	8	14							— do —
"	16.00	16.45	0.45	U	"	Received										— do —
"	17.50	17.95	0.45	DP	"	11	25	32	57							— do —
"	19.00	19.45	0.45	U	"	Received										— do —
"	20.00	20.45	0.45	DP	"	12	30	34	64							— do —
"	22.50	22.95	0.45	U	"	10	19	31	50							— do —
"	23.00	23.45	0.45	DP	"	15	30	33	63							— do —
"	25.50	25.95	0.45	U	"	Received										Cohesive soil with kankar
"	26.50	26.95	0.45	DP	"	14	12	40	52							— do —
"	28.50	28.95	0.45	U	"	Slipped										— do — Collected DS

Nitesh
Supervisor

Jitender Parmar

SE - Client
E - In - C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 12: FIELD BORELOG CHARTS (P66)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	[illegible]
		Date of Issue:	01.04.2018
		Rev No:	00
		Rev. Date:	28.12.2020

Project Name:	SI for HORC Viaduct B/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119665.396	E: 701110.518	Location/ Chainage: [illegible]		
Method of Drilling:	Percussion	Drilling Equipment:	Percussion [illegible]	Bore No:	P66
Casing Lowered (M):	1.50	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L.- 191.839	Date: From [illegible] to [illegible]		Water Table (M):	1.50

Day/Date	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
2019 [illegible]	29.45	29.90	0.45	DP	150	9	15	26	41							Concrete [illegible] compacted clayey silt with [illegible]
"	30.50	30.95	0.45	U	"	Refused										
"	32.00	32.45	0.45	DP	"	18	27	30	57							—do—
"	34.00	34.45	0.45	U	"	slipped										—do— collected [illegible]
"	35.50	35.95	0.45	DP	"	14	22	31	53							—do—
"	37.00	37.45	0.45	U	"	slipped										—do— sampled DS
"	38.50	38.95	0.45	DP	"	21	31	29	60							—do—
"	40.00	40.45	0.45	DP	"	19	33	[illegible]	[illegible]							—do—

Nitesh
Supervisor

E - In - C

Abbreviation Used: U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 13: FIELD BORELOG CHARTS (P67)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No	GT/ 003
		Date of Issue	01.04.2018
		Rev. No.	R03
		Rev. Date	28.12.2021

Project Name:	SI for HORC Viaduct b/w Sohana Dhulawat			Project Code:	1901
Coordinate:	N: 3119628.472	E: 701187.908		Location/ Chainage:	22677.2870
Method of Drilling:	Percussion	Drilling Equipment	Tripod winch	Bore No.:	077
Casing Lowered (M):	13.00	Bentonite Used:	Yes	Standard Sampler:	Yes
Barrel Type:	NA				
Ground Elevation:	R.L-191.985	Date: From 26/09/23 to 01/10/23		Water Table (M):	1.00

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
26/09/23	0.00	0.50	0.50	D.S	SX	collected										Non-cohesive soil
"	1.00	1.45	0.45	DP	"	2	3	5	8							— do —
"	2.00	2.45	0.45	U	"	Received										Non-cohesive soil with gravel
"	3.00	3.45	0.45	DP	"	1	2	3	5							— do —
"	4.00	4.45	0.45	DP	"	2	3	4	7							Non-cohesive soil
"	5.00	5.45	0.45	U	"	slipped										— do — D.S collected
"	6.00	6.45	0.45	DP	"	5	9	11	20							Non-cohesive soil
1/10/23	7.00	7.45	0.45	DP	"	6	10	18	28							— do —
"	8.00	8.45	0.45	U	"	slipped										— do — D.S collected
"	9.00	9.45	0.45	DP	"	5	6	8	14							Cohesive soil with gravel
"	10.00	10.45	0.45	DP	"	7	9	12	21							— do —
"	11.00	11.45	0.45	U	"	Received										— do —
"	12.00	12.45	0.45	DP	"	5	7	11	18							— do —
"	14.00	14.45	0.45	U	"	Received										Cohesive soil
"	15.00	15.45	0.45	DP	"	8	10	15	25							— do —
"	17.00	17.45	0.45	U	"	Received										— do —
"	18.00	18.45	0.45	DP	"	7	10	17	27							Non-cohesive soil
"	20.00	20.45	0.45	U	"	slipped										— do — D.S collected
2/10/23	21.00	21.45	0.45	DP	"	8	16	20	36							— do —
"	23.00	23.45	0.45	U	"	Received										Non-cohesive soil with gravel
"	24.00	24.45	0.45	DP	"	8	18	33	51							— do —
"	26.00	26.45	0.45	U	"	slipped										— do — D.S collected
"	27.00	27.45	0.45	DP	"	10	21	36	57							Cohesive soil with gravel
"	29.00	29.45	0.45	U	"	Received										Non-cohesive soil with gravel

Nitesh
Supervisor

E-in-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 14: FIELD BORELOG CHARTS (P67)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003	Date of Issue:	01.04.2018
Rev No:	R03	Rev Date:	24.12.2021

Project Name:	[illegible] Viaduct b/w Sohana Dhulawat [illegible]			Project Code:	1901
Coordinate:	N: 3110123.479	E: 701184.900	Location/ Chainage: [illegible]		
Method of Drilling:	Percussion	Drilling Equipment:	Mechanical	Bore No.:	P67
Casing Lowered (M):	17 cm	Bentonite Used: Yes	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-191.985	Date: From 26/9/23 to 27/9/23		Water Table (M):	[illegible]

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
27/9/23	30.00	30.45	0.45	DP	SY	12	27	38	65							Non-cohesive soil with [illegible]
"	32.00	32.45	0.45	U	"	Slipped										— do —
"	33.50	33.95	0.45	DP	"	21	33	40	73							— do —
"	35.00	35.45	0.45	U	"	23	36	43	79							— do —
"	36.00	36.45	0.45	DP	"	27	39	47	86							— do —
"	38.00	38.45	0.45	U	"	25	37	51	88							— do —
"	40.00	40.45	0.45	DP	"	27	38	54	92							— do —

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 15: FIELD BORELOG CHARTS (P68)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No:	R03
		Rev. Date.:	28.12.2021

Project Name: GTW FOR HORC Viaduct B/W Sohana Dhulawat Station				Project Code:	1901
Coordinate:	N: 3119651866	E: 701115.947	Location/ Chainage: Manual Trip 22677.4870		
Method of Drilling:	Rotary	Drilling Equipment: Mechanical Hydraulic		Bore No.:	P-68
Casing Lowered (M):	—	Bentonite Used: NA	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L-191.917	Date: From 03/11/23 to 06/11/2023		Water Table (M):	1.60m

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
3/10/23	0.00	0.50	0.50	D	SX	collected				—	—	—	—	—	—	Non cohesive soil
"	1.00	1.45	0.45	DP	"	2	2	3	5	—	—	—	—	—	—	do
"	2.00	2.45	0.45	U	"	Received				—	—	—	—	—	—	do
"	3.00	3.45	0.45	DP	"	3	5	7	12	—	—	—	—	—	—	do
"	4.00	4.45	0.45	DP	"	5	8	8	16	—	—	—	—	—	—	do
"	5.00	5.45	0.45	U/D	"	slipped				—	—	—	—	—	—	Non cohesive soil with Gravel
"	6.00	6.45	0.45	DP	"	4	9	11	20	—	—	—	—	—	—	do
"	7.00	7.45	0.45	DP	"	5	8	10	18	—	—	—	—	—	—	do
"	8.00	8.45	0.45	U	"	Received				—	—	—	—	—	—	do
"	9.00	9.45	0.45	DP	"	6	9	11	20	—	—	—	—	—	—	do
"	10.00	10.45	0.45	DP	SX	6	7	9	16	—	—	—	—	—	—	do
"	11.00	11.45	0.45	U	"	Received				—	—	—	—	—	—	Cohesive soil with Gravel
"	12.50	12.95	0.45	DP	"	8	10	17	27	—	—	—	—	—	—	do
4/10/23	14.00	14.45	0.45	U	"	Received				—	—	—	—	—	—	cohesive soil with Gravel
"	15.50	15.95	0.45	DP	"	9	12	16	28	—	—	—	—	—	—	cohesive soil
"	17.00	17.45	0.45	U	"	Received				—	—	—	—	—	—	cohesive soil with Gravel
"	18.50	18.95	0.45	DP	"	11	17	20	37	—	—	—	—	—	—	do
"	20.00	20.45	0.45	U	"	Received				—	—	—	—	—	—	do
"	21.50	21.95	0.45	DP	SX	8	15	17	32	—	—	—	—	—	—	do
"	23.00	23.45	0.45	U	"	Received				—	—	—	—	—	—	Non cohesive soil.
"	24.50	24.95	0.45	DP	"	9	19	20	39	—	—	—	—	—	—	cohesive soil
"	26.00	26.45	0.45	U	"	Received				—	—	—	—	—	—	do
5/10/23	27.50	27.95	0.45	DP	"	11	25	27	52	—	—	—	—	—	—	do
"	29.00	29.45	0.45	DP	"	13	24	30	54	—	—	—	—	—	—	do

Supervisor

Techpro Engineers Pvt. Ltd.

Engg. Civil

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 16: FIELD BORELOG CHARTS (P68)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GTW FOR HORC Viaduct B/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119651.866	E: 701115.947	Location/ Chainage:	22097.4870	
Method of Drilling:	Rotary	Drilling Equipment:	Mounted Fly Hydrolic	Bore No.:	P-68
Casing Lowered (M):	X / Bentonite Used: NA	Standard Sampler:	Yes.	Barrel Type:	NA
Ground Elevation:	R.L-191.917	Date: From 3/11/23 to 6/11/23		Water Table (M):	1.60

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
5 10/23	30.50	30.95	0.45	DP	5x	14	26	35	61	–	–	–	–	–	–	cohesive soil.
"	32.00	32.45	0.45	DP	"	17	30	37	67	–	–	–	–	–	–	do
"	33.50	33.95	0.45	DP	"	14	32	40	72	–	–	–	–	–	–	Non cohesive soil.
"	35.00	35.45	0.45	DP	"	21	35	42	77	–	–	–	–	–	–	do
"	36.50	36.95	0.45	DP	"	17	25	27	52	–	–	–	–	–	–	cohesive soil.
6 10/23	38.00	38.45	0.45	DP	"	23	29	35	64	–	–	–	–	–	–	do
"	40.00	40.30	0.30	DP	"	29	101	–	101	–	–	–	–	–	–	cohesive soil with Gravel

Supervisor

Techpro Engineers Pvt. Ltd.

SE-Civil

E-in-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 17: FIELD BORELOG CHARTS (P69)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date.:	28.12.2021

Project Name:	GTW For HORC Viaduct B/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119675469	E: 701104 421	Location/ Chainage: 22723·6870		
Method of Drilling:	Rotary	Drilling Equipment: Hydraulic		Bore No.:	P-69
Casing Lowered (M):	—	Bentonite Used: NA	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	RL-191·999	Date: From 3/11/23 to 5/11/23		Water Table (M):	1·70

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
3/11/23	0.00	0.50	0.50	D	SX	collected				—	—	—	—	—	—	Non Cohesive soil
"	1.00	1.45	0.45	DP	"	1	2	2	4	—	—	—	—	—	—	do
"	2.00	2.45	0.45	U	"	Received				—	—	—	—	—	—	do
4/11/23	3.00	3.45	0.45	DP	"	3	4	6	10	—	—	—	—	—	—	Cohesive soil with Gravel
"	4.00	4.45	0.45	DP	"	4	5	7	12	—	—	—	—	—	—	do
"	5.00	5.45	0.45	U	"	Received				—	—	—	—	—	—	Non cohesive soil
"	6.00	6.45	0.45	DP	"	3	6	9	15	—	—	—	—	—	—	do
"	7.00	7.45	0.45	DP	"	4	8	9	17	—	—	—	—	—	—	do
5/11/23	8.00	8.45	0.45	U	SX	Received				—	—	—	—	—	—	do
"	9.00	9.45	0.45	DP	"	4	6	9	15	—	—	—	—	—	—	Cohesive soil
"	10.00	10.45	0.45	DP	"	4	5	7	12	—	—	—	—	—	—	do
"	11.00	11.45	0.45	U	"	Received				—	—	—	—	—	—	do
"	12.50	12.95	0.45	DP	"	5	7	11	18	—	—	—	—	—	—	do
"	14.00	14.45	0.45	U	"	Received				—	—	—	—	—	—	do
"	15.50	15.95	0.45	DP	"	7	12	15	27	—	—	—	—	—	—	do
"	17.00	17.45	0.45	U	SX	Received				—	—	—	—	—	—	Cohesive soil
"	18.50	18.95	0.45	DP	"	11	20	24	44	—	—	—	—	—	—	Cohesive soil with Gravel
"	20.00	20.45	0.45	U	"	Received				—	—	—	—			Cohesive soil
"	21.50	21.95	0.45	DP	"	7	14	21	35	—	—	—	—			do
"	23.00	23.45	0.45	U	"	Received				—	—	—	—			Non cohesive soil
"	24.50	24.95	0.45	DP	"	14	20	23	43	—	—	—	—			do
"	26.00	26.45	0.45	U	"	Received				—	—	—	—			Cohesive soil
"	27.50	27.95	0.45	DP	"	17	23	28	51	—	—	—	—			do
"	29.00	29.45	0.45	DP	"	19	25	35	60	—	—	—	—			Non cohesive soil

Supervisor — Techpro Engineers Pvt. Ltd. Kanpur — E-in-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 18: FIELD BORELOG CHARTS (P69)

TECHPRO ENGINEERS PVT. LTD. — BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	003
Rev. Date:	28.12.2021

Project Name:	GTW FOR HORC Viaduct B/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119675·469	E: 701104·421	Location/ Chainage: 22723·6870		
Method of Drilling:	Rotary	Drilling Equipment: Automatic Hydraulic		Bore No.:	P-69
Casing Lowered (M):	— Bentonite Used: NA	Standard Sampler: Yes		Barrel Type:	NA
Ground Elevation:	R.L-191.999	Date: From 3/11/23 to 6/11/23		Water Table (M):	1·70

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
6/11/23	30·50	30·95	0·45	DP	Sx	25	35	38	73	—	—	—	—	—	-	Non cohesive soil
"	32·00	32·45	0·45	DP	"	15	25	39	64	—	—	—	—	—	-	cohesive soil with Gravel
"	33·50	33·95	0·45	DP	"	19	29	38	67	—	—	—	—	—	—	do
"	35·00	35·45	0·45	DP	"	21	32	43	75	—	—	—	-	-	—	do
"	36·50	36·95	0·45	DP	"	27	42	50	92	—	—	—	—	—	—	Non cohesive soil with Gravel
"	38·00	38·45	0·45	DP	"	24	39	45	84	—	—	-	-	-	-	cohesive Soil with Gravel
"	40·00	40·45	0·45	DP	"	20	39	74	113	—	—	-	—	—	-	do

Supervisor E - In - C
S.E. Civil

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 19: FIELD BORELOG CHARTS (P70)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date:	28.12.2021

Project Name: GT work for HORC Viaduct b/w Sohana Dhulawat station		**Project Code:**	1901
Coordinate: N: 2107699.349	E: 666699.375	**Location/ Chainage:**	23749.0870
Method of Drilling: Percussion	**Drilling Equipment:** Percussion	**Bore No.:**	P70
Casing Lowered (M): 30.00 · **Bentonite Used:** NO	**Standard Sampler:** Yes	**Barrel Type:**	N/A
Ground Elevation: RL-192.161	**Date: From** 3/11/23 **to** 5/11/23	**Water Table (M):**	1.66 M

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
3/11/23	0.0	1.5	1.5	DS	6"	Collected										Non-cohesive soil
"	1.50	1.95	0.45	U		Received										— do —
"	2.00	2.45	0.45	DP		1	1	2	3							— do —
"	3.00	3.45	0.45	DP		2	3	4	7							— do —
"	4.00	4.45	0.45	U		Received										— do —
"	5.00	5.45	0.45	DP		2	4	6	10							— do —
"	6.00	6.45	0.45	DP		3	3	5	8							— do —
"	7.00	7.45	0.45	U		Slipped										— do — DS collected
"	8.00	8.45	0.45	DP		5	6	8	14							— do —
"	9.00	9.45	0.45	DP		5	7	10	17							— do —
"	10.00	10.45	0.45	U		Received										Cohesive soil with gravel
"	[illegible]	[illegible]	0.45	DP		4	7	11	18							— do —
"	[illegible]	[illegible]	0.45	DP		3	6	9	15							— do —
"	[illegible]	[illegible]	0.45	U		Received										— do —
"	[illegible]	[illegible]	0.45	DP		3	5	10	15							— do —
4/11/23	[illegible]	[illegible]	0.45	U		Received										— do —
"	[illegible]	[illegible]	0.45	DP		5	8	10	18							— do —
"	[illegible]	[illegible]	0.45	U		Received										— do —
"	[illegible]	[illegible]	0.45	DP		7	9	11	20							— do —
"	[illegible]	[illegible]	0.45	U		Received										— do —
"	[illegible]	[illegible]	0.45	DP		9	13	14	27							— do —
"	[illegible]	[illegible]	0.45	U		Received										— do —
"	[illegible]	[illegible]	0.45	DP		16	14	17	31							— do —
"	[illegible]	[illegible]	0.45	U		Received										— do —

Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 20: FIELD BORELOG CHARTS (P70)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	Soil work for HORC Viaduct b/w Sohana Dhulawat			Project Code:	1901
Coordinate:	N: 3119677.349	E: 401893.375		Location/ Chainage:	[illegible]
Method of Drilling:	Percussion	Drilling Equipment:	[illegible]	Bore No.:	P70
Casing Lowered (M):	30 M / Bentonite Used: N/A	Standard Sampler:	Yes	Barrel Type:	N/A
Ground Elevation:	RL-193.461	Date: From 3/1/23 to 5/1/23		Water Table (M):	[illegible]

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C.R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
"	[illegible]	[illegible]	0.45	NP	5"	9	12	16	28							— do —
"	[illegible]	[illegible]	0.45	U		slipped										[illegible]
"	[illegible]	[illegible]	0.45	SP		11	15	21	36							— do —
"	[illegible]	[illegible]	0.45	U		slipped										— do — [illegible]
"	[illegible]	[illegible]	0.45	SP		18	23	32	55							— do —
"	[illegible]	[illegible]	0.45	U		slipped										— do —
5/1/23	[illegible]	[illegible]	0.45	SP		15	30	35	65							— do —
"	[illegible]	[illegible]	0.45	SP		15	32	46	78							— do —

[illegible]

Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 21: FIELD BORELOG CHARTS (P71)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119723.456	E: 701088.034	Location/ Chainage: 22776.0870		
Method of Drilling:	Percussion	Drilling Equipment:	Manual Powerwinch	Bore No.:	P71
Casing Lowered (M):	18.00 / Bentonite Used: NO	Standard Sampler:	Yes	Barrel Type:	N/A
Ground Elevation:	R.L-192.387	Date: From 3/11/23	to 5/11/23	Water Table (M):	1.70

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
3/11/23	0.00	0.50	0.50	DS	SX	collected										Non-cohesive soil
"	1.00	1.45	0.45	DP	"	1	1	2	3							— do —
"	2.00	2.45	0.45	U	"	slipped										-do- DS collected
"	3.00	3.45	0.45	DP	"	2	2	3	5							Non-cohesive soil
"	4.00	4.45	0.45	DP	"	3	4	5	9							— do —
"	5.00	5.45	0.45	U	"	slipped										-do- DS collected
"	6.00	6.45	0.45	DP	"	3	3	4	7							Non-cohesive soil
"	7.00	7.45	0.45	DP	"	4	4	6	10							— do —
"	8.00	8.45	0.45	U	"	Received										— do —
"	9.00	9.45	0.45	DP	"	6	9	10	19							— do —
"	10.00	10.45	0.45	DP	"	7	10	12	22							— do —
"	11.00	11.45	0.45	U	"	Received										Cohesive soil with gravel
"	12.50	12.95	0.45	DP	"	10	12	15	27							— do —
4/11/23	14.00	14.45	0.45	U	"	Received										— do —
"	15.50	15.95	0.45	DP	"	10	14	17	31							— do —
"	17.00	17.45	0.45	U	"	Received										— do —
"	18.50	18.95	0.45	DP	"	19	17	21	38							— do —
"	20.00	20.45	0.45	U	"	slipped										-do- DS collected
"	21.50	21.95	0.45	DP	"	12	16	23	39							Non-cohesive soil
"	23.00	23.45	0.45	U	"	slipped										-do- DS collected
"	24.50	24.95	0.45	DP	"	16	22	20	42							Non-cohesive soil
"	26.00	26.45	0.45	U	"	Received										— do —
"	27.50	27.95	0.45	DP	"	19	23	31	54							— do —
"	29.00	29.45	0.45	DP	"	20	24	32	56							— do —

Nitesh
Supervisor

E-in-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 22: FIELD BORELOG CHARTS (P71)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date.:	28.12.2021

Project Name: RITES-HORC Viaduct b/w Sohana Dhulawat station — Project Code: 1901
Coordinate: N: 3119723.456 E: 701082.834 — Location/ Chainage: 22776.0870
Method of Drilling: Percussion — Drilling Equipment: Manual Percussion — Bore No.: P71
Casing Lowered (M): 18.00 — Bentonite Used: NO — Standard Sampler: Yes — Barrel Type: N/A
Ground Elevation: RL-192.287 — Date: From 3/11/23 to 5/11/23 — Water Table (M): 1.70

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
4/11/23	30.50	30.95	0.45	DP	SX	20	25	30	55							Non-cohesive-soil
"	32.00	32.45	0.45	DP	"	23	26	33	59							— do —
"	33.50	33.95	0.45	DP	"	22	25	33	58							— do —
"	35.00	35.45	0.45	DP	"	24	29	32	61							— do —
5/11/23	36.50	36.95	0.45	DP	"	23	27	35	62							— do —
"	38.00	38.45	0.45	DP	"	25	28	33	61							— do —
"	40.00	40.45	0.45	DP	"	25	29	37	66							— do —

Nitesh
Supervisor

Techpro Engineers

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

E - In - C

APPENDIX-K
CHART 23: FIELD BORELOG CHARTS (P72)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GTK-HORC Viaduct b/w Sohana Dhulawat station	Project Code:	1901
Coordinate:	N:3119747.802 E:701072.794	Location/ Chainage:	22802.2870
Method of Drilling:	Percussion; Drilling Equipment: Tripod winch	Bore No.:	P72
Casing Lowered (M):	30.00; Bentonite Used: NC; Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L.-192.289; Date: From 5/11/23 to 7/11/23	Water Table (M):	1.60

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
5/11/23	0.00	0.50	0.50	DS	SX	collected										Non-cohesive soil
"	1.00	1.45	0.45	DP	"	1	2	2	4							— do —
"	2.00	2.45	0.45	U	"	Received										Non-cohesive soil with gravel
"	3.00	3.45	0.45	DP	"	2	3	4	7							— do —
"	4.00	4.45	0.45	DP	"	4	6	7	13							— do —
"	5.00	5.45	0.45	U	"	Received										— do —
"	6.00	6.45	0.45	DP	"	5	6	9	15							Non-cohesive soil
"	7.00	7.45	0.45	DP	"	4	6	11	17							— do —
"	8.00	8.45	0.45	U	"	slipped										— do —
"	9.00	9.45	0.45	DP	"	2	3	3	6							— do —
"	10.00	10.45	0.45	DP	"	4	7	8	15							— do —
"	11.00	11.45	0.45	U	"	Received										cohesive soil
"	12.50	12.95	0.45	DP	"	4	6	6	12							— do —
"	14.00	14.45	0.45	U	"	Received										— do —
"	15.50	15.95	0.45	DP	"	6	7	9	16							— do —
"	17.00	17.45	0.45	U	"	Received										— do —
"	18.50	18.95	0.45	DP	"	7	9	11	20							— do —
"	20.00	20.45	0.45	U	"	Received										cohesive soil with gravel
6/11/23	21.50	21.95	0.45	DP	"	8	15	18	33							— do —
"	23.00	23.45	0.45	U	"	slipped										— do —
"	24.50	24.95	0.45	DP	"	14	24	28	52							Non-cohesive soil
"	26.00	26.45	0.45	U	"	Received										cohesive soil
"	27.50	27.95	0.45	DP	"	16	16	18	34							— do —
"	29.00	29.45	0.45	U	"	slipped										Non-cohesive soil

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test N > 100), Sampler means SPT sampler

APPENDIX-K

CHART 24: FIELD BORELOG CHARTS (P72)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date.:	28.12.2021

Project Name:	GTI-HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119747.802	E: 701072.794	Location/ Chainage: 28802-2870		
Method of Drilling:	Percussion	Drilling Equipment	Percussion	Bore No.:	P72
Casing Lowered (M):	30.00	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-192.289	Date: From 5/11/23	to 7/11/23	Water Table (M):	1.60

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
6/11/23	30.50	30.95	0.45	DP	SX	13	23	27	50							Non-cohesive soil
"	32.00	32.45	0.45	DP	"	slipped										— do —
"	33.50	33.95	0.45	DP	"	15	26	30	56							— do —
"	35.00	35.45	0.45	DP	"	17	27	32	59							— do —
7/11/23	36.50	36.95	0.45	DP	"	14	20	26	46							— do —
"	38.00	38.45	0.45	DP	"	slipped										— do —
"	40.00	40.45	0.45	DP	"	20	26	34	60							— do —

Supervisor

Engr.-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 25: FIELD BORELOG CHARTS (P73)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GT FOR HORC Viaduct Between Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119772 71	E: 761065 285	Location/ Chainage: 22828.4870		
Method of Drilling:	Percussion	Drilling Equipment:	Power winch	Bore No.:	P.73
Casing Lowered (M):	29.00 Bentonite Used: NA	Standard Sampler:	Yes.	Barrel Type:	NA
Ground Elevation:	RL-192.387	Date: From	02/10/23 to 04/10/23	Water Table (M):	1.85

Day/Date	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
2/10/23	0.00	0.50	0.50	DS	SX	Collected										Non cohesive soil
"	1.00	1.45	0.45	DP	"	3	4	5	9							do
"	2.00	2.45	0.45	U	"	Received										do
3/10/23	3.00	3.45	0.45	DP	"	4	5	8	13							cohesive soil with Gravel
"	4.00	4.45	0.45	DP	"	5	7	9	16							do
"	5.00	5.45	0.45	U	"	Received										do
"	6.00	6.45	0.45	DP	"	4	5	9	14							Cohesive soil
"	7.00	7.45	0.45	DP	"	3	6	12	18							do
"	8.00	8.45	0.45	U	"	Received										Gray Non cohesive soil
"	9.00	9.45	0.45	DP	"	4	5	7	12							do
"	10.00	10.45	0.45	DP	"	5	9	10	19							cohesive soil
"	11.00	11.45	0.45	U	"	Received										do
"	12.50	12.95	0.45	DP	"	3	5	9	14							do
"	14.00	14.45	0.45	U	"	Received										do
"	15.50	15.95	0.45	DP	"	7	11	15	26							do
"	17.00	17.45	0.45	U	"	Received										do
"	18.50	18.95	0.45	DP	"	9	14	19	33							Non cohesive soil
"	20.00	20.45	0.45	U	"	Received										cohesive soil with Gravel
"	21.50	21.95	0.45	DP	"	11	22	32	54							do
"	23.00	23.45	0.45	DP	"	13	24	37	61							Non cohesive soil
4/10/23	24.50	24.95	0.45	DP	SX	15	27	37	64							do
"	26.00	26.45	0.45	DP	"	14	28	30	58							do
"	27.50	27.95	0.45	DP	"	13	25	27	52							do
"	29.00	29.45	0.45	DP	"	10	23	28	51							do

Supervisor

E - in - C
04/10/23

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K

CHART 26: FIELD BORELOG CHARTS (P73)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date:	28.12.2021
Project Code:	1901

Project Name:	GT-For HORC Viaduct between Sohana-Dhulawat Station				
Coordinate:	N: 3119772.31	E: 702063.245	Location/ Chainage:	77832-4470	
Method of Drilling:	Percussion	Drilling Equipment:	Percussion	Bore No.:	P73
Casing Lowered (M):	29.00	Bentonite Used: N.A	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	RL-192.397	Date: From 23/10/23 to 24/10/23		Water Table (M):	1.85

Day/Date	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
24/10/23	30.50	30.95	0.45	DP	SX	9	25	30	55							non cohesive soil
"	32.00	32.45	0.45	DP	"	11	27	31	58							cohesive soil
"	33.50	33.95	0.45	DP	"	12	29	33	62							do
"	35.00	35.45	0.45	DP	"	10	24	35	59							do
"	36.50	36.95	0.45	DP	"	14	29	35	64							do
"	38.00	38.45	0.45	DP	"	17	32	40	72							cohesive soil
"	40.00	40.45	0.45	DP	"	34	40	42	82							do

Supervisor

Shameem Ahmad

SNE: HYD

04/11/23

Techpro Engineers Pvt. Ltd.

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 27: FIELD BORELOG CHARTS (P74)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	G-T TW HoRC Viaduct b/w Sohna & Dhulawal Station	Project Code:	1901
Coordinate:	N: 3119797.076 E: 701054.272	Location/ Chainage:	22854.6870
Method of Drilling:	Rotary; Drilling Equipment: Automatic Hydraulic	Bore No.:	P74
Casing Lowered (M):	20.00; Bentonite Used: Not; Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	RL-192.472; Date: From 04/11/2023 to 06/11/2023	Water Table (M):	2.45

Day / Date	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
04/11/23	0.00	0.50	0.50	DS	Sx	Collected										Non-Cohesive Soil
"	1.00	1.45	0.45	DP	"	2	3	3	6							—do—
"	2.00	2.45	0.45	U	"	Received										—do—
"	3.00	3.45	0.45	DP	"	2	2	3	5							—do—
"	4.00	4.45	0.45	DP	"	3	5	6	11							—do—
"	5.00	5.45	0.45	U	"	Received										—do—
"	6.00	6.45	0.45	DP	"	5	8	10	18							—do—
"	7.00	7.45	0.45	DP	"	4	7	12	19							—do—
"	8.00	8.45	0.45	U	"	Received										—do—
"	9.00	9.45	0.45	DP	"	6	10	13	23							—do—
"	10.00	10.45	0.45	DP	"	5	7	10	17							Non-Cohesive Soil+Gravel
05/11/23	11.00	11.45	0.45	U	"	Received										—do—
"	12.50	12.95	0.45	DP	"	4	6	8	14							Cohesive Soil
"	14.00	14.45	0.45	U	"	Slipped										—do— + DS Collected
"	15.50	15.95	0.45	DP	"	7	8	13	21							Cohesive Soil + Gravel
"	17.00	17.45	0.45	U	"	Received										—do—
"	18.5	18.95	0.45	DP	"	10	13	16	29							Non-Cohesive Soil
"	20.00	20.45	0.45	U	"	Slipped										—do— + DS Collected
"	21.50	21.95	0.45	DP	"	12	23	32	55							Cohesive Soil with gravel
"	23.00	23.45	0.45	DP	"	11	20	30	50							—do—
"	24.50	24.95	0.45	DP	"	13	24	35	59							Cohesive Soil
"	26.00	26.45	0.45	DP	"	9	22	28	50							—do—
"	27.50	27.95	0.45	DP	"	10	20	25	45							—do—
"	29.00	29.45	0.45	DP	"	9	25	30	55							Non-Cohesive Soil

Rahul
Supervisor

Techpro Engineers Pvt. Ltd.

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

E-in-C

APPENDIX-K
CHART 28: FIELD BORELOG CHARTS (P74)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW HORC Viaduct b/w Sohna & Dhulawat Station	Project Code:	1901
Coordinate:	N: 3119797.076 E: 701054.272	Location/ Chainage:	22854.6870
Method of Drilling:	Rotary	Drilling Equipment:	Auto N P Hydraulic
Casing Lowered (M):	30.00 Bentonite Used: Not	Standard Sampler:	Yes
Bore No.:	P-74	Barrel Type:	N.A
Ground Elevation:	RL-192.472 Date: From 04/11/2023 to 06/11/2023	Water Table (M):	2.45

Day Date	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
"	30.50	30.95	0.45	DP	Sx	10	22	29	51							Non-Cohesive Soil
04/11/23	32.00	32.45	0.45	DP	"	12	25	28	53							Cohesive Soil with gravel
"	33.50	33.95	0.45	DP	"	11	22	31	53							—do—
"	35.00	35.45	0.45	DP	"	13	26	34	60							—do—
"	36.50	36.95	0.45	DP	"	13	25	32	57							—do—
"	38.00	38.45	0.45	DP	"	15	30	39	69							—do—
"	40.00	40.45	0.45	DP	"	20	35	40	75							—do—

Supervisor

Techpro Engineers Pvt. Ltd.

In-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K

CHART 29: FIELD BORELOG CHARTS (P75)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/003
Date of Issue:	01.04.2018
Rev. No:	R03
Rev. Date:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119821.943	E: 701045.81	Location/ Chainage: 22880.8870	Bore No.:	P-75
Method of Drilling:	Percussion	Drilling Equipment:	Manual Percuss winch		
Casing Lowered (M):	18.00	Bentonite Used: N/C	Standard Sampler: YCS	Barrel Type:	N/A
Ground Elevation:	RL-192.565	Date: From 5/11/23	to 7/11/23	Water Table (M):	1.80

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
5/11/23	0.00	0.50	0.50	DS	SX	collected										Non-cohesive soil
"	1.00	1.45	0.45	DP	"	1	1	2	3							— do —
"	2.00	2.45	0.45	U	"	Received										Non-cohesive soil with gravel
"	3.00	3.45	0.45	DP	"	2	3	4	7							— do —
"	4.00	4.45	0.45	DP	"	4	5	7	12							— do —
"	5.00	5.45	0.45	U	"	Received										— do —
"	6.00	6.45	0.45	DP	"	4	6	8	14							Non-cohesive soil
"	7.00	7.45	0.45	DP	"	6	8	9	17							— do —
"	8.00	8.45	0.45	U	"	slipped										-do- DS collected
"	9.00	9.45	0.45	DP	"	5	10	11	21							Non-cohesive soil
"	10.00	10.45	0.45	DP	"	5	11	12	23							— do —
"	11.00	11.45	0.45	U	"	Received										— do —
6/11/23	12.50	12.95	0.45	DP	"	6	8	10	18							Cohesive soil with gravel
"	14.00	14.45	0.45	U	"	slipped										-do- DS collected
"	15.50	15.95	0.45	DP	"	7	11	14	25							Cohesive soil with gravel
"	17.00	17.45	0.45	U	"	slipped										Non-cohesive soil with gravel - DS
"	18.50	18.95	0.45	DP	"	11	14	16	30							Non-cohesive soil with gravel
"	20.00	20.45	0.45	U	"	slipped										— do DS collected
"	21.50	21.95	0.45	DP	"	12	17	21	38							Non cohesive soil with gravel
"	23.00	23.45	0.45	U	"	Received										— do —
"	24.50	24.95	0.45	DP	"	13	16	20	36							Non cohesive soil
"	26.00	26.45	0.45	U	"	slipped										-do- DS collected
"	27.50	27.95	0.45	DP	"	14	19	23	42							Non-cohesive soil
"	29.00	29.45	0.45	U	"	Received										— do —

Nitesh
Supervisor

E - In - C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 30: FIELD BORELOG CHARTS (P75)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	OT/001
Date of Issue:	01.04.2018
Rev. No.:	R01
Rev. Date:	28.12.2021

Project Name:	(JTL)-HORC Viaduct b/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119891.943	E: 701045.81	Location/ Chainage:	22000.0070	
Method of Drilling:	Percussion	Drilling Equipment:	Manual Rig Power winch	Bore No.:	P75
Casing Lowered (M):	18.00	Bentonite Used: NO	Standard Sampler: 7CS	Barrel Type:	N/A
Ground Elevation:	R.L-192.565	Date: From 5/11/23 to 7/11/23		Water Table (M):	1.80

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
5/11/23	30.50	30.95	0.45	DP	SX	16	20	24	44							Non-cohesive soil
"	32.00	32.45	0.45	U	"	Received										— do —
"	33.50	33.95	0.45	DP	"	20	25	27	52							— do —
7/11/23	35.00	35.45	0.45	DP	"	22	26	30	56							— do —
"	36.50	36.95	0.45	DP	"	20	24	28	52							— do —
"	38.00	38.45	0.45	DP	"	25	27	31	58							— do —
"	40.00	40.45	0.45	DP	"	24	29	35	64							— do —

Nitesh

Supervisor

Techpro Engineers Pvt. Ltd.

E In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 31: FIELD BORELOG CHARTS (P76)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No.	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GT For HORC Between Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119847.024	E: 701037.86	Location/ Chainage: 22907.0870		
Method of Drilling:	Percussion	Drilling Equipment:	Power winch	Bore No.:	P-76
Casing Lowered (M):	30.00	Bentonite Used: NA	Standard Sampler: Yes.	Barrel Type:	NA
Ground Elevation:	R.L- 192.717	Date: From 4/10/23 to 6/10/23		Water Table (M):	3.65

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
4/10/23	0.00	0.50	0.50	D	SX	collected										Noncohesive soil
"	1.00	1.45	0.45	U	"	Received										do
"	2.00	2.45	0.45	DP	"	1	2	3	5							cohesive soil
"	3.00	3.45	0.45	DP	"	3	4	6	10							do
"	4.00	4.45	0.45	U	"	Received										do
"	5.00	5.45	0.45	DP	"	2	4	5	9							Cohesive soil
"	6.00	6.45	0.45	DP	"	3	5	8	13							do
5/10/23	7.00	7.45	0.45	U	SX	Received										do
"	8.00	8.45	0.45	DP	"	2	3	5	8							cohesive soil with Gravel
"	9.00	9.45	0.45	DP	"	3	3	7	10							do
"	10.00	10.45	0.45	U	"	Received										Cohesive soil
"	11.00	11.45	0.45	DP	"	6	10	12	22							do
"	12.00	12.45	0.45	DP	"	6	12	13	25							do
"	13.00	13.45	0.45	U	"	Received										do
"	14.50	14.95	0.45	DP	"	5	8	14	22							cohesive soil
"	16.00	16.45	0.45	U	"	Received										do
"	17.50	17.95	0.45	DP	"	6	11	16	27							Non cohesive soil
"	19.00	19.45	0.45	U	"	slipped										do
"	20.50	20.95	0.45	DP	"	8	15	17	32							Non cohesive soil with Gravel
"	22.00	22.45	0.45	U	"	slipped										
"	23.50	23.95	0.45	DP	"	11	20	22	42							cohesive soil with Gravel
"	25.00	25.45	0.45	U	"	Received										Cohesive soil.
"	26.50	26.95	0.45	DP	"	13	22	39	61							Non cohesive soil
6/10/23	28.00	28.45	0.45	U		Received										do

Supervisor E - In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 32: FIELD BORELOG CHARTS (P76)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No.	GT/003
		Date of Issue	01.04.2018
		Rev. No.	R00
		Rev. Date:	28.12.2021

Project Name:	GT for HORC Between Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119847.024	E: 701037.86	Location/ Chainage: 22907.0870		
Method of Drilling:	Percussion	Drilling Equipment:	Power winch	Bore No.:	P76
Casing Lowered (M):	36.00	Bentonite Used: NA	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L. 192.717	Date: From 4/10/23 to 6/10/23		Water Table (M):	2.55

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
6/10/23	29.50	29.95	0.45	DP	SX	10	22	29	51							cohesive soil.
"	31.00	31.45	0.45	DP	"	15	23	30	53							Non cohesive soil
"	32.50	32.95	0.45	DP	"	13	25	26	51							-do-
"	34.00	34.45	0.45	DP	"	15	28	35	63							Non cohesive soil.
"	35.50	35.95	0.45	DP	"	16	33	40	73							-do-
"	37.00	37.45	0.45	DP	"	18	35	39	74							Non cohesive soil
"	38.50	38.95	0.45	DP	"	20	38	45	83							cohesive soil with Gravel
"	40.00	40.45	0.45	DP		25	32	55	87							Non cohesive soil.

Supervisor E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 33: FIELD BORELOG CHARTS (P77)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GT For HORC Viaduct between Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119872.31	E: 720430.427	Location/ Chainage: 22933.2870		
Method of Drilling:	Percussion	Drilling Equipment: Percussion		Bore No.:	P77
Casing Lowered (M):	25.00	Bentonite Used: NA	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L-192.676	Date: From 07/10/23 to 09/10/2023		Water Table (M):	2.62

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
7/10/23	0.00	0.50	0.50	D	SX	collected										Non cohesive soil
"	1.00	1.45	0.45	U	"	Received										do
"	2.00	2.45	0.45	DP	"	1	2	3	5							cohesive soil
"	3.00	3.45	0.45	DP	"	3	4	5	9							cohesive soil with Gravel
"	4.00	4.45	0.45	U	"	Received										cohesive soil
"	5.00	5.45	0.45	DP	"	5	8	10	18							cohesive soil with Gravel
8/10/23	6.00	6.45	0.45	DP	"	8	12	16	28							cohesive soil
"	7.00	7.45	0.45	U	"	Received										cohesive soil
"	8.00	8.45	0.45	DP	"	7	9	17	26							do
"	9.00	9.45	0.45	DP	"	8	13	17	30							cohesive soil with Gravel
"	10.00	10.45	0.45	U	"	Received										do
"	11.00	11.45	0.45	DP	"	7	10	12	22							cohesive soil
"	12.00	12.45	0.45	DP	"	8	12	15	27							do
"	13.00	13.45	0.45	U	"	Received										cohesive soil
"	14.50	14.95	0.45	DP	"	7	13	18	31							Non cohesive soil
"	16.00	16.45	0.45	U	"	Slipped										DS-Non cohesive soil
"	17.50	17.95	0.45	DP	"	9	15	20	35							Non cohesive soil
"	19.00	19.45	0.45	U	"	Received										do
"	20.50	20.95	0.45	DP	"	9	16	25	41							Non cohesive soil with Gravel
"	22.00	22.45	0.45	U	"	Received										do
"	23.50	23.95	0.45	DP	"	12	18	27	45							do
"	25.00	25.45	0.45	U	"	Received										Non cohesive soil
"	26.50	26.95	0.45	DP	"	11	18	26	44							Non cohesive soil
9/10/23	28.00	28.45	0.45	U	"	Received										do

Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 34: FIELD BORELOG CHARTS (P77)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No:	R03
Rev. Date:	28.12.2021

Project Name:	GI For HORC Viaduct between Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119872.31	E: 741050.427	Location/ Chainage:	22933.2876	
Method of Drilling:	Auto Rotary	Drilling Equipment:	Power winch	Bore No.:	P-77
Casing Lowered (M): 29.00	Bentonite Used: NA	Standard Sampler:	Yes	Barrel Type:	NA
Ground Elevation:	RL-192.676	Date: From 07/10/23 to 9/10/23		Water Table (M):	2.62

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
9/10/23	29.50	29.95	0.45	DP	SX	19	40	60	100							cohesive soil with Gravel
"	31.00	31.45	0.45	DP	"	19	42	55	97							Non cohesive soil
"	32.50	32.95	0.45	DP	"	19	40	46	96							cohesive soil with Gravel
"	34.00	34.45	0.45	DP	"	21	43	52	95							Non cohesive soil
"	35.50	35.95	0.45	DP	"	11	22	41	63							do
"	37.00	37.45	0.45	DP	"	7	14	31	45							do
"	38.50	38.95	0.45	DP	"	14	29	35	64							Non cohesive soil.
"	40.00	40.45	0.45	DP	"	19	35	58	93							cohesive soil with Gravel

Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 35: FIELD BORELOG CHARTS (P78)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No:	R03
		Rev. Date:	28.12.2021

Project Name:	GT For HORC Viaduct between Sohana Dhulawat Station	Project Code:	1901
Coordinate: N: 3117397.704	E: 701023.541	Location/ Chainage:	22957.4870
Method of Drilling: Percussion	Drilling Equipment: Tripod winch	Bore No.:	P-78
Casing Lowered (M): 24.50	Bentonite Used: NA	Standard Sampler: Yes	Barrel Type: NA
Ground Elevation: R.L. 193.331	Date: From 6/10/23 to 8/10/23	Water Table (M):	2.60

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
6/10/23	0.00	0.50	0.50	D	SX	collected										Non cohesive soil
"	1.00	1.45	0.45	DP	"	2	3	5	8							do
"	2.00	2.45	0.45	U	"	Received										do
"	3.00	3.45	0.45	DP	"	3	4	6	10							do
"	4.00	4.45	0.45	DP	"	2	3	6	9							cohesive soil
"	5.00	5.45	0.45	U	"	Received										do
"	6.00	6.45	0.45	DP	"	4	6	8	14							Non cohesive soil
"	7.50	7.95	0.45	DP	"	3	5	7	12							cohesive soil with Gravel
"	8.00	8.45	0.45	U	"	Received										do
7/10/23	9.00	9.45	0.45	DP	"	12	14	17	31							Non cohesive soil
"	10.50	10.95	0.45	DP	"	4	6	10	16							cohesive soil with Gravel
"	11.50	11.95	0.45	U	"	Received										do
"	12.50	12.95	0.45	DP	"	5	7	11	18							cohesive soil with Gravel
"	14.00	14.45	0.45	U	"	Received										cohesive soil
"	15.50	15.95	0.45	DP	"	9	13	15	28							do
"	17.00	17.45	0.45	U	"	Received										do
"	18.50	18.95	0.45	DP	"	11	12	15	27							Non cohesive soil
"	20.00	20.45	0.45	U	"	Received										cohesive soil
"	21.50	21.95	0.45	DP	"	9	15	18	33							do
"	23.00	23.45	0.45	U	"	Slipped										Non cohesive soil
8/10/23	24.50	24.95	0.45	DP	"	12	17	20	37							do
"	26.00	26.45	0.45	U	"	Received										Non cohesive soil
"	27.50	27.95	0.45	DP	"	13	26	29	55							do
"	29.00	29.45	0.45	DP	"	[illegible]	[illegible]	32	54							do

Supervisor

Techpro Engineers Pvt. Ltd.

E - In - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 36: FIELD BORELOG CHARTS (P78)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date	28.12.2021

Project Name:	GI for HORC Viaduct between Sohana Dhulawat station			Project Code:	1901
Coordinate: N:	3119897.704	E:	701923.541	Location/ Chainage:	2.2959-4870
Method of Drilling:	Percussion	Drilling Equipment	Rotary rig	Bore No.:	P78
Casing Lowered (M):	29.50	Bentonite Used: NA	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	G.L -192.721	Date: From 6/10/23	to 8/10/23	Water Table (M):	2.60

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
8/10/23	30.00	30.45	0.45	DP	5"	11	31	33	69							Non cohesive soil
"	32.00	32.45	0.45	DP	"	13	33	42	75							— do —
"	33.50	33.95	0.45	DP	"	11	31	37	68							— do —
"	35.00	35.45	0.45	DP	"	12	29	35	64							cohesive soil
"	36.50	36.95	0.45	DP	"	14	33	39	72							— do —
"	38.00	38.45	0.45	DP	"	17	35	43	78							— do —
"	40.00	40.45	0.45	DP	"	19	38	50	88							cohesive soil

Supervisor E - In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 37: FIELD BORELOG CHARTS (P79)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date.:	28.12.2021

Project Name: GI for HORC Viaduct b/w Sohana Dhulawat Station		Project Code:	1901
Coordinate: N: 3119923.228	E: 701017.19	Location/ Chainage:	22985.6870
Method of Drilling: Percussion	Drilling Equipment: Power winch	Bore No.:	P79
Casing Lowered (M): 20.00 / Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation: RL-192.898	Date: From 3/10/23 to 5/10/23	Water Table (M):	21.20

Day / Date	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
3/10/23	0.0	0.50	0.50	DS	SX	Received			–							Non cohesive soil
	1.00	1.45	0.45	U	"	Received			–							– do –
"	2.00	2.45	0.45	DP	"	1	2	2	4							– do –
"	3.00	3.45	0.45	DP	"	2	3	5	8							– do –
"	4.00	4.45	0.45	U	"	Received			–							– do –
"	5.00	5.45	0.45	DP	"	2	3	6	9							Non cohesive soil
"	6.00	6.45	0.45	DP	"	3	4	8	12							– do –
"	7.00	7.45	0.45	U	"	Received										– do –
"	8.00	8.45	0.45	DP	"	7	11	15	26							– do –
"	9.00	9.45	0.45	DP	"	9	13	19	32							– do –
"	10.00	10.45	0.45	U	"	Received										– do –
"	11.00	11.45	0.45	DP	"	5	7	9	16							– do –
5/10/23	13.00	13.45	0.45	DP	"	6	8	11	19							Non cohesive soil
"	13.00	13.45	0.45	U	"	Received										– do –
"	14.00	14.45	0.45	DP	"	4	9	13	22							– do –
"	16.00	16.45	0.45	U	"	– Received										– do –
"	17.00	17.45	0.45	DP	"	8	12	24	36							– do
"	19.00	19.45	0.45	U	"	Received										Cohesive soil
"	20.00	20.45	0.45	DP	"	7	28	23	51							– do –
"	22.00	22.45	0.45	U	"	Received										– do –
"	23.00	23.45	0.45	DP	"	8	15	25	[illegible]							Cohesive soil with Kankar
"	25.00	25.45	0.45	U	"	Received										Cohesive soil
"	26.00	26.45	0.45	DP	"	3	18	30	[illegible]							– do –
"	28.00	28.45	0.45	U	"	Slipped										– do –

Supervisor — E-In-C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 38: FIELD BORELOG CHARTS (P79)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R10
		Rev. Date:	28.12.2021

Project Name:	G.T. for HORC Viaduct b/w Sohana Dhulawat stations			Project Code:	1901
Coordinate:	N: 3119993.237	E: 701017.19	Location/ Chainage: 39985.5570		
Method of Drilling:	Percussion	Drilling Equipment	Percussion	Bore No.:	P79
Casing Lowered (M):	20.00	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-193.898	Date: From 3/10/23 to 4/10/23		Water Table (M):	2.25

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
4/10/23	30.0	30.45	0.45	DP	NX	8	15	23	38							Non cohesive soil
"	31.0	31.45	0.45	U	"	slipped										— do —
"	32.0	32.45	0.45	DP	"	15	17	26	43							— do —
"	34.0	34.45	0.45	U	"	slipped										Non cohesive soil with nodules
"	35.0	35.45	0.45	DP	"	19	23	30	53							— do —
"	[illegible]	[illegible]	0.45	U	"	slipped										Non cohesive soil
"	[illegible]	[illegible]	0.45	DP	"	16	26	32	58							— do —
"	[illegible]	[illegible]	0.45	DP	"	10	28	36	64							— do —

Supervisor

E - In - C

Abbreviation Used: U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 39: FIELD BORELOG CHARTS (P80)

Manual

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01 04 2018
		Rev No.:	R03
		Rev Date:	28 12 2021

Project Name:	GTW FOR HORC Viaduct between Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119948.898	E: 701011.378		Location/ Chainage:	23011.8870
Method of Drilling:	Rotary	Drilling Equipment:	Hydrolic	Bore No.:	P80
Casing Lowered (M):	20.0 / Bentonite Used: NA	Standard Sampler:	yes	Barrel Type:	NA
Ground Elevation:	R.L-193.042	Date: From 21/10/23	to 24/10/23	Water Table (M):	2.35 m

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
21/10/23	0.00	0.50	0.50	D	SX	collected				—	—	—	—	—	—	Non cohesive soil
"	1.00	1.45	0.45	U	"	Received				—	—	—	—	—	—	do
"	2.00	2.45	0.45	DP	"	2	2	3	5	—	—	—	—	—	—	do
"	3.00	3.45	0.45	DP	"	3	3	5	8	—	—	—	—	—	—	do
"	4.00	4.45	0.45	U	"	Received				—	—	—	—	—	—	cohesive soil with Gravel
"	5.00	5.45	0.45	DP	"	4	5	9	14	—	—	—	—	—	—	cohesive soil
"	6.00	6.45	0.45	DP	"	3	5	8	13	—	—	—	—	—	—	do
"	7.00	7.45	0.45	U	"	Received				—	—	—	—	—	—	do
"	8.00	8.45	0.45	DP	"	7	10	14	24	—	—	—	—	—	—	do
"	9.00	9.45	0.45	DP	"	6	11	24	35	—	—	—	—	—	—	do
"	10.00	10.45	0.45	U	"	Received				—	—	—	—	—	—	cohesive soil
"	11.00	11.45	0.45	DP	"	7	12	25	37	—	—	—	—	—	—	Non cohesive soil
"	12.00	12.45	0.45	DP	"	8	11	12	23	—	—	—	—	—	—	cohesive soil
22/10/23	13.00	13.45	0.45	U	"	Received				—	—	—	—	—	—	cohesive soil
"	14.50	14.95	0.45	DP	"	8	12	18	30	—	—	—	—	—	—	do
"	16.00	16.45	0.45	U	"	Received				—	—	—	—	—	—	do
"	17.50	17.95	0.45	DP	"	12	20	26	46	—	—	—	—	—	—	do
"	19.00	19.45	0.45	U	"	Received				—	—	—	—	—	—	Non cohesive soil
"	20.50	20.95	0.45	DP	"	15	22	27	49	—	—	—	—	—	—	do
"	22.00	22.45	0.45	U	"	Received				—	—	—	—	—	—	cohesive soil with Gravel
"	23.50	23.95	0.45	DP	"	20	30	35	65	—	—	—	—	—	—	do
"	25.00	25.45	0.45	UDP	"	17	35	42	77	—	—	—	—	—	—	Non cohesive soil
"	26.50	26.95	0.45	DP	"	19	38	47	85	—	—	—	—	—	—	do
"	28.00	28.45	0.45	U	"	28	45	56	101	—	—	—	—	—	—	do

Supervisor | E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 40: FIELD BORELOG CHARTS (P80)

Manual

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GTW FOR HORC Viaduct between Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119948.898	E: 701011.378		Location/ Chainage:	23011.8570
Method of Drilling:	Rotary	Drilling Equipment:	Rotary	Bore No.:	P80
Casing Lowered (M):	20.00	Bentonite Used: NA	Standard Sampler: Yes.	Barrel Type:	NA
Ground Elevation:	RL-193.042	Date: From 21/10/23	to 24/10/23	Water Table (M):	2.35 m

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
23/10/23	29.50	29.95	0.45	DP	SX	16	24	27	51	–	–	–	–	–	–	Non cohesive soil
"	31.00	31.45	0.45	DP	"	15	28	35	63	–	–	–	–	–	–	do
"	32.50	32.95	0.45	DP	"	12	32	40	72	–	–	–	–	–	–	do
"	34.00	34.45	0.45	DP	"	22	34	43	77	–	–	–	–	–	–	do
24/10/23	35.50	35.95	0.45	DP	"	20	36	44	80	–	–	–	–	–	–	do
"	37.00	37.45	0.45	DP	"	23	38	50	88	–	–	–	–	–	–	Cohesive soil
"	38.50	38.95	0.45	DP	"	25	37	48	85	–	–	–	–	–	–	do
"	40.00	40.45	0.45	DP	"	28	39	52	91	–	–	–	–	–	–	do

Supervisor

Techpro Engineers Pvt. Ltd.

Exm - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

End of Report

Report No: 1901-HORC-V

Report No.: 1901-HORC-V Date: Nov 2nd; 2023

GEOTECHNICAL INVESTIGATION REPORT

ULR No.: TC916923000000032P
REVISION-R1

AT THE SITE FOR

HORC VIADUCT BETWEEN SOHANA & DHULAWAT STATIONS OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT, HARYANA

FROM BOREHOLES P81 TO P100

CLIENT

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.

Plot No. 143, 5th floor RailTel tower, Sector-44,
Gurugram, Haryana 122003

GENERAL CONSULTANTS

RITES-SMEC JV

Gurugram, Haryana

GEOTECHNICAL CONSULTANTS

TECHPRO ENGINEERS PVT. LTD.

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G T ROAD, KANPUR-209 217, Phone: 9793209918

e-mail: info@techproindia.com

TC-9169

REVISION NOTES

REVISION NO.	DATE	DESCRIPTION
R1	09.12.23	• Vertical and Lateral pile load capacity in Table 1 to 4 of Appendix-H and recommendations revised. • Lithological profile added in Appendix-C. • Field bore log charts added in Appendix-K.

REPORT FORMAT

Report No.	Bore included	Total Number of Bores
1901-HORC-I	A1 to P20	21
1901-HORC-II	P21 to P40	20
1901-HORC-III	P41 to P60	20
1901-HORC-IV	P61 to P80	20
1901-HORC-V	P81 to P100	20
1901-HORC-VI	P101 to P113	13
1901-HORC-VII	P114A to P133A	20
1901-HORC-VIII	P134A to A2A	16
1901-HORC-IX	P114B to P133B	20
1901-HORC-X	P134B to A2B	16

TABLE OF CONTENTS

APPENDICES

National Accreditation Board for
Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

TECHPRO ENGINEERS PVT. LTD. (LABORATORY DIVISION)

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G.T. ROAD, KANPUR, UTTAR PRADESH, INDIA

in the field of

TESTING

Certificate Number: TC-9169

Issue Date: 23/12/2022 Valid Until: 22/12/2024

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Identity : Techpro Engineers Private Limited

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

114, Ram Ganga Housing Society, Naramau, G T Road, Kanpur-209 217
Tel.: 9793209918, e-mail: info@techproindia.com
Web site: www.techproindia.com

Nov 2nd; 2023

ACKNOWLEDGEMENTS

We are pleased to submit the part-5 of the report of Geotechnical investigation, conducted for the boreholes P81 to P100 for the design of foundations for HORC Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) project in the state of Haryana, India.

We hereby, convey our sincere thanks to Mr. Neeraj Bhandari (CPM/South) and Mr. Raju Solanki (DGM/C/South), HRIDCL for trust and support during the investigation. We also acknowledge our thanks to Mr. Uma Maheshwara Rao B, DGM/C/West, HRIDCL for awarding the said work to us. We are also grateful Mr. Ravindra Dutta Upadhyay (Geotech Expert), Mr. PS Gautam & Mr. Jitender Parashar, Site Engineer from the RITES- SMEC JV and Mohd. Ishak (Executive/Civil) from HRIDCL, for their help rendered during and prior to the investigation work.

We are also thankful to our staff members for conducting field and laboratory test, preparing sketches, and typing the report.

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech. (Civil), M.Tech.
Principal Consultant &
Managing Director

1. INTRODUCTION:

Haryana Rail Infrastructure Development Corporation Ltd. (HRIDC) and Ministry of Railways, Govt. of India has come together to form a new company namely Haryana Orbital Rail Corporation Limited (HORCL), to design and construction of new BG line from Palwal to Sonipat named Haryana Orbital Rail Corridor (HORC), in the state of Haryana, India. In this connection, a Geotechnical investigation has been planned for the design of foundations of Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) Project in the state of Haryana. The work of conducting the detailed Geotechnical Investigation has been awarded to us by HRIDC, through work order No. HRIDC/HORC/GTI/211/2023-2024/Vol-0 dated 02-09-2023, which includes investigation in field, laboratory testing of disturbed and undisturbed samples, collected from the field, and submission of the geotechnical **investigation** test report.

A geotechnical investigation was carried out, with the locations, planned by the client. Purpose of the investigation is to determine the nature and properties of soil and rock strata across the bore holes and representing them through log sections showing the levels, nature, and properties of various strata up to a sufficient depth below the founding level, proneness of site to artesian conditions, seismic disturbance and other engineering properties of soil and rock strata.

This part -5 of the report includes the detailed methodology of investigation, collection of samples, field and laboratory test result including their interpretation/ analysis, recommendations on the properties of soils and rock required for design of foundation and suggesting suitable type and depth of foundation with allowable bearing capacity for safe and strong foundations for the Bore Hole numbers P81 to P100.

2. SCOPE OF WORK:

For the design of foundation of viaduct, it is required to determine the allowable bearing capacity together with necessary engineering characteristics of underlying soil & rock strata. In general, the geotechnical investigation has been planned as per IS:1892-2021 and further extended to IS: 1904, IS:2911 (part-1/Sec 2) & IRC 78:2014 for planning the laboratory testing and computing the allowable bearing capacity, hence the scope of work is as follows:

2.1. Mobilisation of all tools & plants along with accessories, materials, labours etc. at site of work for drilling and testing work, including setting up boring and shifting to different bore holes point etc.

2.2. Exploratory drilling of 150 mm diameter bore holes through soil deposits and 75 mm in rock within the proposed alignment upto the required depth.

2.3. Collection of disturbed soil samples at an interval of 3.00 meter in all the bore holes.

2.4. Collection of undisturbed soil samples at every 3.00 m interval or at change of stratum from all the boreholes.

2.5. To conduct Standard Penetration Test (SPT) at an interval of 3.00 m or noticeable change of stratum in soil deposits in all bore holes.

2.6. Collection of rock core samples and preserving them in core boxes.

2.7. To collect ground water sample on completion of bore holes.

2.8. To record the ground water table in all the bore holes.

2.9. Transporting all the disturbed, undisturbed soil and rock core samples collected during the field investigation to our NABL accredited Geotech Engineering laboratory at Kanpur.

2.10. To conduct the laboratory tests on all the soil and rock core samples collected during field investigation for determination of their engineering characteristics.

2.11. To compile of field and laboratory test results, working out the allowable bearing capacity and preparing the report including detailed recommendations and necessary precautions.

3. GEOLOGICAL INFORMATION OF THE REGION:

3.1. Geography:

The project location is in the bordering area of Gurugram and Nuh (recent old name-Mewat), districts in the Indian state of Haryana. The stretch of the alignment of the proposed corridor starts from southmost part of Gurugram in the town of Sohna and ends at Dhulawat, which is a village lying at the north of Nuh district.

Haryana is a state located in the northern part of India. Gurugram is among one

of the districts in Haryana which is also the part of National Capital Region (30km south of New Delhi). It lies at an elevation of 217 m above msl. Sohna is a small town located 25km in the south of Gurugram. Sohna is well known for its hot water springs and famous Shiva temple. Sohna is located in between 28°15' N latitude and 77°40' E longitude at the elevation of 212.14m above msl. Mewat district is located at 28 °12′ N latitude, 77 °3′ E longitude, at the south of Gurugram at an elevation of 199 m above msl. The location is bordered by Rewari district on west and Faridabad & Palwal district on the east.

3.2. Geology:

The Gurugram district is having of almost flat topography, however, in the north-eastern part small isolated hillocks of Precambrian rocks are exposed. Small hill ranges which are part of the Aravali and Mangar Bani ranges exists in the district. The major part of district is underlain by Quaternary alluvium consisting of sand, clay and silt. The alluvial plain is formed by the Sahibi river which is a tributary of River Yamuna. Soils of the Gurgaon district is classified as tropical and brown soils, existing in the north western extreme, northern and north eastern parts of the district and water logged and salt affected soils in the southern parts of the district. The soils are medium textured loamy sand is the average texture in Gurgaon and Sohna blocks.

3.3. Rainfall and Climate:

The area has hot semi-arid type of climate characterising extreme dryness of the air except in the monsoon season. Intense hot summer and cold winters. The total annual rainfall in the region is about 596 mm, of which 75 to 80% is because of the south-west monsoon.

3.4. Seismicity:

The site under consideration exists in the district of Gurugram and Mewat which lies in the Seismic Zone IV (high damage risk zone), as per the current seismic zonation map of India (IS 1893-2016): RA 2021 and have a zone factor of 0.24 for design basis earthquake. The region is surrounded by many in-homogeneities in the form of faults and ridges like Sohna Fault, Moradabad Fault, Delhi-Moradabad Fault, Delhi-Haridwar ridge, junction of Aravalli and Alluvium near Delhi. The Sohna fault line lies between the Delhi ridge and Sohna town and falls between the Arjangarh and

Manesar outcrops. All the developed area in Gurugram comes within 200 km of the fault line. The Sohna fault line is located at the junction between the hard rock terrain of the Aravalli hills and the sandy formation of the Yamuna River and is currently inactive from several years and is capable of a disastrous earthquake.

The project location has been marked in Fig.1 Seismic zone map of India.

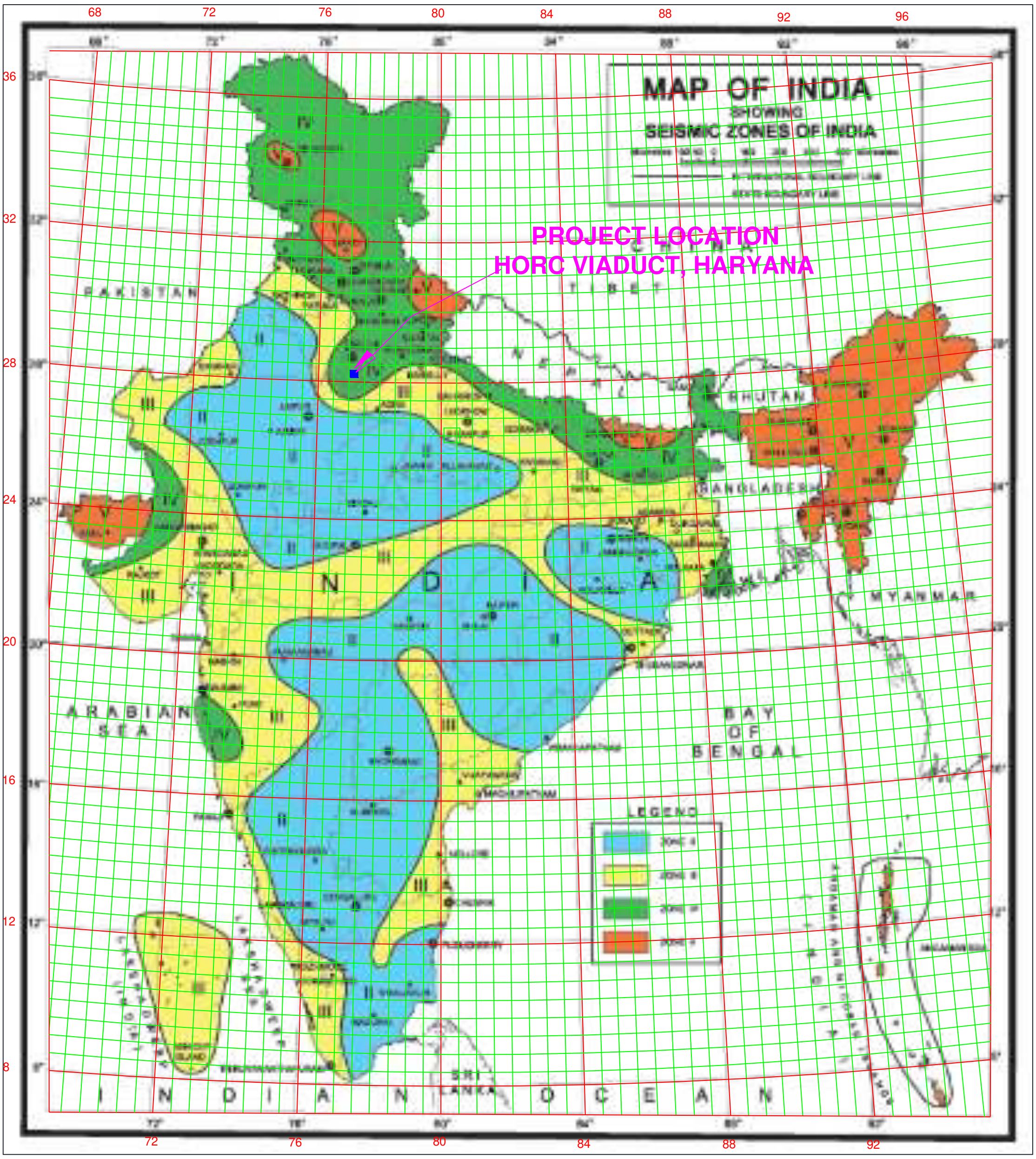


Fig.1: Seismic Zone Map of India

4. FIELD INVES TIGATION:

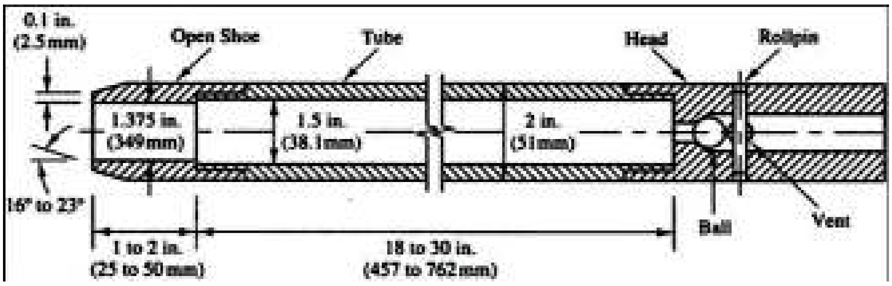
The field investigation work at this site was carried out from Oct 5th; 2023 to Oct 12th; 2023 and Oct 21st; 2023 to Oct 30th; 2023. The following investigation

work was carried out:

4.1. **Twenty number** of **boreholes** (marked as P81 to P100) of diameter 150 mm in soil were made within the proposed alignment for conducting Standard Penetration Test and collection of disturbed and undisturbed samples. The boreholes were progressed using power operated winch machine under **percussion** method of drilling. Casing was used to keep the borehole stable. The records of achieved depth of bore holes have been given in Para No. 6, the details of drilled bores along with depth of casing used have been reported in Appendix B. Locations of boreholes have been reported in “TEST LOCATION PLAN” in Appendix A.

4.2. **Standard Penetration Tests** were conducted at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth, as per the procedure in IS: 2131-1981-(RA: 2021) in all the bore holes. The **standard SPT sampler** (without liner and with no space for liner) and **auto-trip hammer** of standard weight of 63.50 kg have been used to perform the test.

For conducting the test, the bottom of the borehole was properly cleaned, and split spoon sampler was properly seated in position in the borehole. The split spoon sampler resting on the bottom of borehole was allowed to sink under its own weight; then the sampler was allowed to penetrate 15 cm with the blows of the hammer 63.50 kg weight falling free through 75cm, thereafter the split spoon sampler was further driven by another 15 cm. For the 3rd and final drive, the sampler was further allowed to penetrate 15 cm. The number of blows required to get each 15 cm of penetration, was recorded. The first 15 cm of drive is seating drive.



Structure of SPT Sampler

The total blows of penetration for the second and third 15 cm of penetration is termed the penetration resistance N. The N’ values are indicative of the compactness/ relative density of cohesion less soils and consistency of cohesive soils.

In case the blows count of SPT in soil (including the number of blows of seating) exceeds 100, the corresponding penetration was recorded and this particular test at that depth stopped. If the total penetration is more than the seating penetration of 15 cm, then breakup of blow counts for 15 cm seating penetration and for remaining portion of penetration is also given.

SPT 'N' values are correlated with non-cohesive stratum as per BS: 5930 (1999) – for sandy strata and with consistency of cohesive stratum.

Correlation For Clay/Plastic Silt		**Correlation For Sand/Non-Plastic Silt**	
Consistency of clays	**Penetration Value**	**Relative Density of sand**	**Penetration Value**
Very Soft	0 to 2 Blows	Very loose	0 to 4 Blows
Soft	3 to 4 Blows	Loose	5 to 10 Blows
Medium Stiff	5 to 8 Blows	Medium	11 to 30 Blows
Stiff	9 to 16 Blows	Dense	31 to 50 Blows
Very Stiff	17 to 32 Blows	Very Dense	Above 50
Hard	Above 32		

In this method, the sampler acts as a probe and the driving energy is supplied by the fall of the drop weight. The values of 'N' depend on the compactness or relative density of the material. In hard formations, the testing is discontinued if 'N' value is found to be more than 100. It is termed as 'Refusal'. Refusal is also recorded when SPT blow count records 50 or more for any of the single drive of 15 cm.

'N' value depends upon degree of saturation and over burden pressure of the formation. Silty fine sand and fine sand below the water table develop pore water pressure depending on the in-situ void ratio which in turn affects the effective stress. This change in effective stress influences the 'N' value considerably.

Depth of overburden affects the SPT values in none to low cohesive soils and hence need correction. The SPT value after the overburden correction, N' is as follows:

$$N' = 0.77x \log (2000/q) \times N$$

Where, q= Overburden Pressure (kN/m^2) and N = observed SPT value

N' is corrected further for dilatancy in case of saturated fine sands and silts for the values of N' greater than 15.

Modified value after dilatancy correction N" = 15+ (N'-15)/2

Soil samples obtained from split spoon sampler were collected in the polythene bags of suitable size. These samples were property sealed, labelled, and carefully transported to the laboratory for testing. The results have been reported in Table 1 to 20 of Appendix B under the title "SUMMARY OF TEST RESULTS".

4.3. Disturbed soil samples were collected at 0.50 metre, then at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth and at significant change of stratum. Soil from cutting edge of SPT samplers and retained in split spoon, used for Standard Penetration Tests was taken as disturbed samples. These samples were placed without delay in adequately sealed polythene bags. Where the collection of disturbed soil samples could not be collected from SPT samples, Shelby tubes were driven and retained soil samples were obtained. The laboratory tests were conducted on the collected soil samples and reported in Table 1 to 20 of Appendix-B under the title "SUMMARY OF TEST RESULTS".

4.4. Undisturbed soil samples were collected in accordance with IS: 2132-1986-(RA: 2021) at an interval of 3.00 metre or at change of stratum, starting from the depth of 1.00 or 2.00 m, by using 100 mm dia. and 450 mm long MS tubes provided with sampler head with ball check arrangement. However, the some of the samples could not be extracted due to the partial penetration or slippage during the evacuation.

Moreover, collection of Undisturbed samples in very hard cohesive soils/ dense granular soils/gravels/ cobbles/ pebbles/ boulders, refusal strata is practically not possible and such collected samples will not truly represent the undisturbed conditions.

Immediately after taking undisturbed sample in the tube, the adopter head was removed along with the disturbed material. The visible ends of the samples shall then be trimmed off any wet disturbed soil. The ends will then be coated alternately with four layers of molten wax. More molten wax will then be added to give a total thickness of not less than 25 mm. The laboratory test results have been reported in Table 1 to 20 of Appendix-B.

4.5. The **ground water table** in the borehole was allowed to stabilize and measured after 8, 16, 24 and 48 hours after completion of the bore hole. It was ensured that last two reading were identical. The records of ground water table have been given in Para No.6.

4.6. **Ground water samples** were collected from borehole as per IS: 6935-1973-(RA:2019) for chemical analysis to determine aggressiveness in relation to attack on concrete / reinforcement including determination of pH value.

5. LABORATORY TESTS:

The following laboratory tests were conducted to determine the engineering characteristics of sub-soils:

5.1. **Field moisture contents** were determined by oven drying method as per IS: 2720 (part II)-1973-(RA: 2020). The results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.2. **Bulk density** of soil strata was obtained using Shelby tubes in accordance with IS 2720 (part XXIX)-1975-(RA: 2020). The results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.3. **Mechanical sieve analysis** test was performed in accordance with IS: 2720 (Part IV) – 1985-(RA: 2020), for the purpose of identification by grain size analysis, on coarse part of the soil samples and the results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.4. **Particle size analysis** test by **Hydrometer method** were performed in accordance with IS: 2720 (Part IV) -1985-(RA: 2020) on the part of soil samples obtained after the sieve analysis. The results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.5. **Atterbergs' limits tests** were performed in accordance with IS: 2720 (part V)-1985-(RA: 2020) and results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.6. **Specific gravity tests** were performed in accordance with IS 2720 (part III-sec. 1) -1980-(RA: 2021) and the results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.7. Consolidation tests were performed on cohesive soil samples in accordance with IS: 2720 (part XV)-1965-(RA: 2021). The results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.8. Direct shear tests were performed as per IS: 2720 (part XIII)-1986-(RA: 2021), on the undisturbed soil samples obtained during the field investigation. The results and the density of samples have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.9. Tri-axial Compression Test under Unconsolidated Un-drained (UU) condition as per IS: 2720 (Part-XI)-1993-(RA: 2021) were performed on the selected undisturbed soil samples, obtained during the field investigation. The results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.10. Unconfined Compressive strength tests were performed in accordance with IS 2720 (Part-X) -1991-(RA:2020) on selected undisturbed soil samples and the results have been reported in Table 21 of Appendix B

5.11. Shrinkage Limit tests were performed in accordance with IS 2720 (part-VI) -1972-(RA: 2021) and the results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

5.12. Free Swell Index were performed in accordance with IS 2720 (part-XL) -1977-(RA: 2021) and the results have been reported in Table 1 to 20: "SUMMARY OF TEST RESULTS" of Appendix B.

6. GROUND WATER TABLE:

The water table at this site was encountered during the drilling operation up to the depth of investigation.

Borehole No.	Chainage	Global Co-ordinates (UTM format)		Reduced Level (m)	Depth of Borehole (m)	Water table (m)
		Easting	Northing			
P81	23038.087	701006.108	3119974.676	193.105	40.00	2.40
P82	23064.287	701001.381	3120000.559	193.262	40.00	2.30
P83	23090.487	700997.207	3120026.492	193.307	40.00	1.20
P84	23116.687	700993.573	3120052.551	193.358	40.00	1.70

Borehole No.	Chainage	Global Co-ordinates (UTM format)		Reduced Level (m)	Depth of Borehole (m)	Water table (m)
		Easting	Northing			
P85	23142.887	700990.491	3120078.652	193.345	40.00	2.20
P86	23169.087	700987.956	3120104.840	193.548	40.00	1.20
P87	23195.287	700985.969	3120131.106	193.452	40.00	1.20
P88	23221.487	700984.542	3120157.378	193.536	40.00	1.70
P89	23247.687	700983.655	3120183.668	193.530	40.00	1.90
P90	23273.887	700983.219	3120209.933	193.532	40.00	1.60
P91	23300.087	700983.157	3120236.169	193.954	40.00	1.80
P92	23326.287	700983.302	3120262.393	193.930	40.00	1.90
P93	23352.487	700983.613	3120288.593	193.956	40.00	1.40
P94	23378.687	700983.967	3120314.829	193.960	40.00	1.60
P95	23404.887	700984.323	3120341.027	193.924	40.00	1.20
P96	23431.087	700984.677	3120367.185	193.961	40.00	1.20
P97	23457.287	700985.033	3120393.383	193.010	40.00	1.80
P98	23483.487	700985.388	3120419.581	193.030	40.00	1.05
P99	23509.687	700985.744	3120445.778	193.271	40.00	1.00
P100	23535.887	700986.099	3120471.976	193.996	40.00	1.30

7. DESCRIPTION OF STRATA:

The classification of soil stratum has been done with the help of soil characteristics obtained in laboratory tests as per IS 1498-1970-(RA:2021). The classification of rock masses has been done based on RMR as per IS: 4464-1985, IS: 13365-1. The detailed nature of the strata has been reported in Table 1 to 20: “SUMMARY OF TEST RESULTS” of Appendix-B and represented through Lithological plots in Appendix-C.

The strata exhibited in all the bore hole, is predominantly comprising of inorganic silty clays of low plasticity and inorganic silts of non to low plastic category. Silty sands were encountered at variable depth and thickness in most of the boreholes. Inorganic silts of intermediate plasticity were also found at some depths and thickness in some of the boreholes.

8. SAFE BEARING CAPACITY COMPUTATIONS:

For the construction of viaducts, deep foundation **(Bored Cast-In-Situ RCC piles)** have been considered for computation of load bearing capacity of the underlying soil strata. The computation of load bearing capacity of bored cast-in-situ RCC piles have been done as per IS 2911 (part-1, section-2)-2010-(RA: 2020) with due consideration of effects of liquefaction.

8.1. Design Parameters:

Factor of safety in compression	=	2.50
Factor of safety in tension	=	3.00
Depth of critical water table	=	0.00 m
Diameter of pile	=	1.00 & 1.20 m
Cut off length	=	2.50 m
Type of pile head consider	=	Fixed

8.2. Computation of friction along pile stem:

$Q_{uf} = \sum K_i . P_{di} . \tan\delta_i . A_{si}$

where,

Q_{uf} = Ultimate shaft friction (kN/m^2)

K_i = Coefficient of earth pressure at mid-depth of ith layer

P_{di} = Effective overburden pressure at mid-depth of ith layer (kN/m^2)

A_{si} = Surface area of pile stem in ith layer (m^2)

δ_i = Angle of wall friction between pile and soil of ith layer (= ϕ) (degree)

ϕ_i = Angle of internal friction of soil in ith layer (degree)

$\sum$ = Sum of all layers up to ith layer

8.3. Computation of Cohesion along the stem of pile:

$Q_{uc} = \sum \alpha_i . c_i . A_{si}$

Where,

c_i = Cohesion in ith layer

A_{si} = Surface area of pile stem in i^{th} layer (m^2)

α_i = Adhesion factor for i^{th} layer of soil depending of consistency of soils

$\sum$ = Sum of cohesion of all layers considered

8.4. Computation of end bearing resistance:

$Q_{ub} = A_p\,(c.Nc + q.Nq + 0.5.\,\gamma.B.N\gamma)$

Where,

A_p = Area of the pile toe (m^2)

c = cohesion of soils at pile toe (kN/m^2)

γ = Effective Unit weight of soils at pile toe (kN/m^3)

B = Diameter of pile (m)

q = Effective overburden pressure at pile toe (kN/m^2)

N_c = Bearing Capacity Factor (Recommended equal to 9)

Nq, Nγ = Bearing Capacity Factor

8.5. Lateral load capacity of piles in soils:

$Q_u = 12.E.I.\delta/(L_1+L_f)^3$

where,

Q_u = Ultimate lateral load capacity of pile (kN)

δ = Permissible deflection (m) = 5 mm

E = Young Modulus of pile material (kN/m^2)

I = Moment of Inertia of the pile cross section (m^4)

L_1 = Cantilever Length of pile (m)

L_f = Length of fixity (m)

Detailed calculations of pile load carrying capacity in compression & uplift in soil have been reported in **Table-1 to 2** of **Appendix-H.**

Pile lateral Load capacity has been given in **Table-3 to 4** of **Appendix-H**.

9. LIQUEFACTION ANALYSIS:

Liquefaction is the sudden loss of shear strength of the loose fine sands due to earthquake-induced vibration under saturated conditions. Liquefaction generally takes place in loose fine sands (fines < 10 %, D_{60}= 0.20 mm to 1.0 mm and C_u between 2 to 5) with N value less than 15. In case of soil strata having N>15, liquefaction of soil will not take place normally.

The present site falls in **seismic zone – IV.** Considering the history of past earthquakes and available seismic data, an earthquake of **magnitude 7.0** having peak ground acceleration **a_{max}= 0.24 g** is considered in the present analysis.

Preliminary assessment of liquefaction potential of foundation strata is made by simplified approach proposed by IS: 1893 (part-1)-2016-(RA: 2021) from the data obtained in Standard Penetration Test.

In this method, cyclic shear stress likely to be induced in the foundation strata by Design Basis Earthquake is first evaluated. Next threshold cyclic shear stress, which is good enough to cause liquefaction, is determined from SPT data and the empirical relations. Finally, comparison of these two stresses is used in the estimation of liquefaction susceptibility of the foundation strata.

Cyclic Stress Ratio (CSR):

The equivalent average of shear stress likely to be induced in the foundation material due to an earthquake is calculated by using the equations

Cyclic Resistance Ratio (CRR):

It expresses capacity of soil to resist liquefaction. CRR is determined using correlation between corrected blow count $(N_1)_{60}$ and CRR for earthquake of magnitude 7.5. $(N_1)_{60}$ is the SPT blow count corrected to an effective overburden pressure of 100 kPa and to hammer energy efficiency of 60 %.

Following variable have been adopted in calculation of N_{60} (SPT value for 60% efficiency)

Energy correction to SPT values:

C_{60} = 1.00 (energy efficiency factor)

Design Earthquake Base:

Earthquake zone = IV

Magnitude of earthquake = 7

Seismic Zone factor = 0.24

Status of Liquefaction:

The value of CSR and CRR are computed at different depth and then the ratio of CRR to CSR to get the factor of safety towards the susceptibility of the stratum towards liquefaction potential.

If factor of safety:

< 1.00 : Stratum is to be considered as liquefiable

> 1.20 : Non-Liquefiable

The detailed calculations of liquefaction, have been reported in **Table-5** of **Appendix-H.**

10. RECOMMENDATIONS:

Keeping in mind, the field test results, laboratory test results and IS codes of practice the following recommendations are hereby made:

10.1. **Bored Cast-In-Situ RCC Piles** of diameter 1000 and 1200 mm have been adopted for SBC computations of foundation for Viaduct.

10.2. **Cut off length** of piles have been considered as 2.50 m from the existing ground level for the purpose of computation of SBC.

10.3. **Pile length** recommended in the table below, shall be measured **after the cut-off depth.**

10.4. **Allowable load carrying capacity** of pile corresponding to the length and diameter of pile shall be read from the tables below:

10.4.1. For Pile diameter = 1000 mm

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P81	25.00	2200	1700	65
	27.50	2550	1900	
	30.00	2650	2100	
	32.50	2900	2300	
	35.00	3350	2550	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P82	25.00	2100	1600	45
	27.50	2350	1800	
	30.00	2600	2050	
	32.50	2850	2250	
	35.00	3100	2500	
P83	25.00	2100	1600	40
	27.50	2350	1850	
	30.00	2650	2100	
	32.50	2900	2300	
	35.00	3100	2550	
P84	25.00	2800	1800	155
	27.50	3050	2000	
	30.00	3300	2200	
	32.50	3500	2400	
	35.00	3750	2650	
P85	25.00	2100	1550	40
	27.50	2250	1750	
	30.00	2400	1950	
	32.50	2600	2100	
	35.00	2850	2300	
P86	25.00	2200	1650	70
	27.50	2350	1800	
	30.00	2600	2000	
	32.50	2850	2250	
	35.00	3100	2500	
P87	25.00	2400	1650	40
	27.50	2950	1800	
	30.00	3200	2050	
	32.50	3400	2250	
	35.00	3600	2450	
P88	25.00	2500	1950	100
	27.50	2700	2150	
	30.00	2950	2350	
	32.50	3600	2550	
	35.00	3950	2750	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P89	25.00	2400	1450	35
	27.50	2200	1650	
	30.00	2350	1900	
	32.50	2600	2050	
	35.00	2850	2300	
P90	25.00	2500	1700	75
	27.50	2350	1850	
	30.00	2550	2050	
	32.50	2800	2250	
	35.00	3650	2400	
P91	25.00	2200	1650	55
	27.50	2500	1900	
	30.00	2700	2100	
	32.50	2900	2350	
	35.00	3300	2550	
P92	25.00	2150	1650	45
	27.50	2400	1900	
	30.00	2600	2100	
	32.50	2800	2250	
	35.00	3150	2500	
P93	25.00	3000	1700	105
	27.50	2400	1900	
	30.00	2650	2100	
	32.50	2950	2300	
	35.00	3200	2550	
P94	25.00	2350	1800	55
	27.50	2550	2050	
	30.00	3100	2250	
	32.50	3300	2500	
	35.00	3450	2750	
P95	25.00	1900	1550	45
	27.50	2450	1650	
	30.00	2400	1850	
	32.50	2900	2100	
	35.00	2900	2300	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P96	25.00	2700	1550	40
	27.50	2250	1750	
	30.00	2950	1950	
	32.50	3400	2200	
	35.00	3050	2450	
P97	25.00	2000	1500	40
	27.50	2600	1750	
	30.00	2600	1900	
	32.50	2850	2100	
	35.00	3250	2300	
P98	25.00	2000	1500	50
	27.50	3050	1700	
	30.00	3800	1950	
	32.50	3950	2200	
	35.00	4000	2450	
P99	25.00	2700	1750	160
	27.50	2750	1950	
	30.00	3000	2150	
	32.50	3200	2350	
	35.00	3650	2550	
P100	25.00	2700	1650	65
	27.50	2900	1850	
	30.00	3100	2050	
	32.50	3350	2250	
	35.00	3600	2450	

** Indicates Grade of Concrete*

10.4.2. For Pile diameter = 1200 mm

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P81	25.00	2950	2200	100
	27.50	3400	2500	
	30.00	3550	2750	
	32.50	3800	3050	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	35.00	4550	3350	
P82	25.00	2700	2050	75
	27.50	3050	2350	
	30.00	3400	2600	
	32.50	3700	2900	
	35.00	4050	3200	
P83	25.00	2650	2050	65
	27.50	3000	2300	
	30.00	3400	2600	
	32.50	3700	2900	
	35.00	4000	3200	
P84	25.00	4100	2300	215
	27.50	4500	2650	
	30.00	4800	2950	
	32.50	5200	3300	
	35.00	5550	3600	
P85	25.00	2800	2000	65
	27.50	2950	2300	
	30.00	3200	2500	
	32.50	3450	2750	
	35.00	3800	3000	
P86	25.00	3050	2200	105
	27.50	3300	2400	
	30.00	3550	2700	
	32.50	3850	3000	
	35.00	4200	3350	
P87	25.00	3350	2100	70
	27.50	4200	2400	
	30.00	4550	2700	
	32.50	4850	3000	
	35.00	5200	3300	
P88	25.00	3300	2550	140
	27.50	3600	2800	
	30.00	3900	3100	
	32.50	5100	3350	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	35.00	5550	3650	
P89	25.00	3500	1950	60
	27.50	3000	2200	
	30.00	3200	2500	
	32.50	3500	2750	
	35.00	3800	3050	
P90	25.00	3550	2200	115
	27.50	3150	2450	
	30.00	3450	2700	
	32.50	3750	2950	
	35.00	5200	3200	
P91	25.00	2950	2100	85
	27.50	3300	2400	
	30.00	3500	2700	
	32.50	3850	3000	
	35.00	4400	3300	
P92	25.00	2800	2100	75
	27.50	3100	2400	
	30.00	3350	2650	
	32.50	3650	2900	
	35.00	4050	3200	
P93	25.00	4300	2150	150
	27.50	3200	2450	
	30.00	3500	2750	
	32.50	3900	3000	
	35.00	4250	3300	
P94	25.00	3000	2250	85
	27.50	3300	2550	
	30.00	4100	2850	
	32.50	4300	3200	
	35.00	4450	3500	
P95	25.00	2400	1950	70
	27.50	3350	2100	
	30.00	3100	2400	
	32.50	3900	2700	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	35.00	3800	3000	
P96	25.00	3950	2050	65
	27.50	3050	2350	
	30.00	4200	2600	
	32.50	4900	2950	
	35.00	4100	3250	
P97	25.00	2700	1950	60
	27.50	3650	2200	
	30.00	3600	2500	
	32.50	3900	2750	
	35.00	4550	3000	
P98	25.00	2650	1950	75
	27.50	4450	2250	
	30.00	5750	2600	
	32.50	5900	3000	
	35.00	5950	3300	
P99	25.00	3800	2300	220
	27.50	3900	2600	
	30.00	4200	2900	
	32.50	4500	3150	
	35.00	5200	3450	
P100	25.00	3900	2200	100
	27.50	4250	2500	
	30.00	4450	2800	
	32.50	4900	3100	
	35.00	5300	3350	

** Indicates Grade of Concrete*

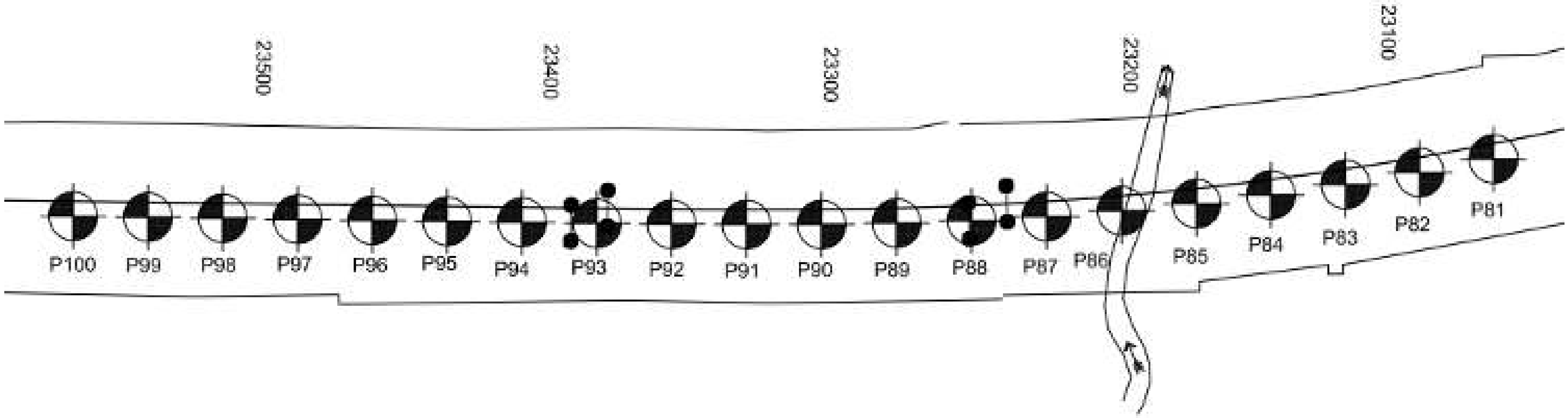
10.5. Liquefaction Potential: All the bore holes have been analysed for Liquefaction potential as per IS: 1893 (part-1)-2016-(RA: 2021) with Seismic Zone IV, earthquake intensity of 7.0 on Richter scale and critical ground water table at existing ground level. Out of which several boreholes show the potential at various depths mentioned in the table below:

Bore No.	Liquefiable depth zone (meter)
P81	Top 4.00 & 5.00 to 6.00
P82	Top 1.00 & 7.00 to 8.00
P83	Top 6.00 & 7.00 to 9.00
P84	Top 1.00
P85	1.00 to 2.00 & 6.00 to 8.00
P86	3.00 to 6.00
P87	3.00 to 8.00
P88	Top 1.00 & 3.00 to 4.00
P89	Top 1.00 ,3.00 to 7.00 & 8.00 to 9.00
P90	Top 1.00 & 3.00 to 5.00
P91	Top 1.00 & 3.00 to 7.00
P92	Top 1.00 & 3.00 to 7.00
P93	Top 4.00
P94	Top 1.00 & 5.00 to 6.00
P95	2.00 to 5.00 & 7.00 to 8.00
P96	Top 1.00, 2.00 to 4.00 & 6.00 to 8.00
P97	3.00 to 6.00 & 7.00 to 8.00
P98	Top 5.00 & 6.00 to 7.00
P99	1.00 to 3.00
P100	1.00 to 3.00 & 5.00 to 6.00

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech.(Civil), M.Tech.
Principal Consultant &
Managing Director

APPENDIX-A
TEST LOCATION PLAN



APPENDIX "B"

TABLE 1: SUMMARY OF TEST RESULTS

Bore No : P81	**Ground Elevation : RL 193.105 m**	**Method of drilling: Percussion**	**Depth of Water-table: 2.40 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 21/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23038.087	**Casing Lowered : 22.00 m**	**Ending Date : 23/10/2023**	**Hammer type : Rope-pulley**

<table>
<tr><th colspan="10">FIELD TEST RESULT</th><th colspan="34">LABORATORY TEST RESULT</th></tr>
<tr><th rowspan="2">RL in Meter</th><th rowspan="2">Depth Below NGL (Meter)</th><th rowspan="2">Nature of Sample</th><th rowspan="2">Sample Reference No.</th><th colspan="5">SPT Test Result</th><th rowspan="2">Soil Classification</th><th colspan="6">Grain Size Analysis</th><th colspan="7">Index Property</th><th colspan="3">Shear Strength Parameters</th><th colspan="3">Consolidation Characteristic</th><th colspan="3">Shrinkage</th><th colspan="12">Test on Rock Specimen</th></tr>
<tr><th>N1 (Seating Drive)</th><th>N2 (First Drive)</th><th>N3 (Second Drive)</th><th>Observed SPT</th><th>N (Corrected)</th><th>Gravel (%)</th><th>Coarse Sand (%)</th><th>Medium Sand (%)</th><th>Fine Sand (%)</th><th>Silt (%)</th><th>Clay (%)</th><th>Moisture Content (%)</th><th>Bulk Density (gm/cc)</th><th>Dry Density (gm/cc)</th><th>Liquid Limit (%)</th><th>Plastic Limit (%)</th><th>Plastic Index (%)</th><th>Specific Gravity</th><th>Type of Test</th><th>Cohesion (kN/m^2)</th><th>Angle of Friction</th><th>Compression Index</th><th>Initial Void Ratio</th><th>Pre-consolidation Pressure (Kg/cm^2)</th><th>Free Swell Index</th><th>Shrinkage Limit</th><th>Swell Pressure</th><th>Core Recovery %</th><th>R.Q.D %</th><th>Density (gm /cc)</th><th>Specific gravity</th><th>Moisture content (%)</th><th>Water absorption (%)</th><th>Point load Index</th><th>U.C.S (MPa)</th><th>Porosity</th><th>Hardness</th><th>Modulus of Elasticity</th><th>Cerchar Abrasive Index</th></tr>
<tr><th colspan="32">Classification of ROCK</th><th colspan="12">Classification of SOIL</th></tr>
<tr><td></td><td>0.50</td><td>D</td><td>1</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>SM</td><td>0</td><td>0</td><td>0</td><td>54</td><td>46</td><td>0</td><td>6.62</td><td>-</td><td>-</td><td colspan="3">Non Plastic</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="12">Silty Sands</td></tr>
<tr><td></td><td>1.00</td><td>U</td><td>2</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>SM-SC</td><td>0</td><td>0</td><td>1</td><td>52</td><td>42</td><td>5</td><td>14.23</td><td>1.88</td><td>1.65</td><td>26.0</td><td>21.0</td><td>5.0</td><td>2.65</td><td>DST</td><td>3.0</td><td>26.3</td><td>-</td><td>0.606</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="12" rowspan="2">Silty Sands with clay binder</td></tr>
<tr><td></td><td>2.00</td><td>D</td><td>3</td><td>1</td><td>1</td><td>1</td><td>2</td><td>2.66</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>19.07</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td></td><td>3.00</td><td>D</td><td>4</td><td>2</td><td>3</td><td>4</td><td>7</td><td>8.61</td><td>ML</td><td>0</td><td>0</td><td>1</td><td>44</td><td>55</td><td>0</td><td>17.19</td><td>-</td><td>-</td><td colspan="3">Non Plastic</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="12">Inorganic Silts of low plasticity</td></tr>
<tr><td></td><td>4.00</td><td>U</td><td>5</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>CL-ML</td><td>1</td><td>1</td><td>3</td><td>28</td><td>59</td><td>8</td><td>17.28</td><td>2.02</td><td>1.72</td><td>26.0</td><td>19.5</td><td>6.5</td><td>2.67</td><td>UU</td><td>44.0</td><td>11.5</td><td>-</td><td>0.552</td><td>-</td><td>8</td><td>17</td><td>-</td><td colspan="12">Inorganic Silty Clays of low plasticity</td></tr>
<tr><td></td><td>5.00</td><td>D</td><td>6</td><td>2</td><td>3</td><td>5</td><td>8</td><td>8.93</td><td>ML</td><td>0</td><td>0</td><td>1</td><td>34</td><td>60</td><td>5</td><td>18.95</td><td>-</td><td>-</td><td>25.0</td><td>21.0</td><td>4.0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="12" rowspan="2">Inorganic Silts of low plasticity</td></tr>
<tr><td></td><td>6.00</td><td>D</td><td>7</td><td>3</td><td>6</td><td>8</td><td>14</td><td>15.00</td><td>ML</td><td>0</td><td>0</td><td>1</td><td>48</td><td>51</td><td>0</td><td>16.11</td><td>-</td><td>-</td><td colspan="3">Non Plastic</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td></td><td>7.00</td><td>U</td><td>8</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>CL-ML</td><td>7</td><td>5</td><td>4</td><td>16</td><td>60</td><td>8</td><td>19.93</td><td>2.03</td><td>1.69</td><td>27.5</td><td>21.5</td><td>6.0</td><td>2.66</td><td>UU</td><td>48.0</td><td>12.7</td><td>0.114</td><td>0.574</td><td>-</td><td>-</td><td>20</td><td>-</td><td colspan="12">Inorganic Silty Clays of low plasticity</td></tr>
<tr><td></td><td>8.00</td><td>D</td><td>9</td><td>5</td><td>7</td><td>9</td><td>16</td><td>16.00</td><td>CL</td><td>3</td><td>1</td><td>1</td><td>10</td><td>77</td><td>8</td><td>22.37</td><td>-</td><td>-</td><td>28.0</td><td>20.5</td><td>7.5</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="12" rowspan="2">Inorganic clays of low plasticity</td></tr>
<tr><td></td><td>9.00</td><td>D</td><td>10</td><td>6</td><td>9</td><td>10</td><td>19</td><td>19.00</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>20.65</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td></td><td>10.00</td><td>U</td><td>11</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>ML</td><td>2</td><td>1</td><td>2</td><td>7</td><td>81</td><td>7</td><td>19.47</td><td>2.02</td><td>1.69</td><td>29.5</td><td>23.5</td><td>6.0</td><td>2.66</td><td>UU</td><td>45.0</td><td>11.0</td><td>-</td><td>0.574</td><td>-</td><td>8</td><td>21</td><td>-</td><td colspan="12" rowspan="2">Inorganic Silts of low plasticity</td></tr>
<tr><td></td><td>11.00</td><td>D</td><td>12</td><td>6</td><td>10</td><td>11</td><td>21</td><td>17.04</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>19.32</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td></td><td>12.00</td><td>D</td><td>13</td><td>7</td><td>11</td><td>13</td><td>24</td><td>24.00</td><td>CL</td><td>1</td><td>1</td><td>0</td><td>8</td><td>79</td><td>11</td><td>23.20</td><td>-</td><td>-</td><td>31.0</td><td>21.0</td><td>10.0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="12" rowspan="3">Inorganic clays of low plasticity</td></tr>
<tr><td></td><td>13.00</td><td>U</td><td>14</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>21.18</td><td>2.04</td><td>1.68</td><td>-</td><td>-</td><td>-</td><td>2.67</td><td>UU</td><td>53.0</td><td>9.5</td><td>-</td><td>0.589</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td></td><td>14.50</td><td>D</td><td>15</td><td>8</td><td>12</td><td>17</td><td>29</td><td>29.00</td><td>CL</td><td>1</td><td>0</td><td>1</td><td>24</td><td>66</td><td>8</td><td>19.77</td><td>-</td><td>-</td><td>27.0</td><td>19.0</td><td>8.0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td></td><td>16.00</td><td>U</td><td>16</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>SC</td><td>5</td><td>0</td><td>1</td><td>46</td><td>41</td><td>7</td><td>17.25</td><td>1.98</td><td>1.69</td><td>26.5</td><td>19.0</td><td>7.5</td><td>2.66</td><td>DST</td><td>5.0</td><td>27.5</td><td>-</td><td>0.574</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="12">Clayey Sands</td></tr>
<tr><td></td><td>17.50</td><td>D</td><td>17</td><td>7</td><td>13</td><td>15</td><td>28</td><td>28.00</td><td>CL</td><td>3</td><td>2</td><td>1</td><td>18</td><td>66</td><td>10</td><td>21.79</td><td>-</td><td>-</td><td>29.0</td><td>20.0</td><td>9.0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="12">Inorganic clays of low plasticity</td></tr>
</table>

APPENDIX "B"
TABLE 1: SUMMARY OF TEST RESULTS

Bore No : P81	**Ground Elevation : RL 193.105 m**	**Method of drilling: Percussion**	**Depth of Water-table: 2.40 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 21/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23038.087	**Casing Lowered : 22.00 m**	**Ending Date : 23/10/2023**	**Hammer type : Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
Classification of ROCK																																Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL-ML	7	2	2	25	56	8	14.60	2.04	1.78	26.5	20.0	6.5	2.66	UU	44.0	12.2	-	0.494	-	-	-	-	Inorganic Silty Clays of low plasticity											
	20.50	D	19	15	24	54	78	35.77	-	-	-	-	-	-	-	19.75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	D	20	-	-	-	-	-	-	-	-	-	-	-	-	17.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.50	D	21	20	40	62	R	-	CL-ML	7	1	2	10	73	7	21.87	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-												
	25.00	D	22	7	32	40	72	31.51	ML	2	0	0	8	85	5	24.21	-	-	27.0	22.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	26.50	D	23	15	23	32	55	25.40	CL-ML	1	1	2	22	67	7	17.69	-	-	26.0	19.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	28.00	D	24	17	32	35	67	28.74	ML	0	0	1	26	73	0	23.67	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	29.50	D	25	21	45	50	95	36.93	ML	0	1	1	34	64	0	18.69	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	15	22	30	52	23.22	CL-ML	2	2	2	20	68	6	21.29	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	32.50	D	27	17	25	35	60	25.22	-	-	-	-	-	-	-	20.77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	16	27	36	63	63.00	CL	2	1	0	14	74	9	15.35	-	-	29.0	20.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	35.50	D	29	18	30	34	64	25.67	CL-ML	3	2	2	38	50	5	11.35	-	-	25.0	20.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	37.00	D	30	21	35	42	77	28.93	-	-	-	-	-	-	-	14.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	23	37	48	85	30.64	CL-ML	1	2	2	32	57	6	21.02	-	-	26.0	19.5	6.5	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	27	42	50	92	32.09	-	-	-	-	-	-	-	11.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No : P82	**Ground Elevation : RL 193.262 m**	**Method of drilling: Percussion**	**Depth of Water-table: 2.30 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 05/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23064.287	**Casing Lowered : 18.00 m**	**Ending Date : 07/10/2023**	**Hammer type : Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen												
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL												
	0.50	D	1	-	-	-	-	-	ML	0	0	1	42	57	0	12.48	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity												
	1.00	U	2	-	-	-	-	-	CL-ML	2	1	1	32	58	6	14.53	1.82	1.59	26.0	19.5	6.5	2.66	UU	35.0	12.2	-	0.673	-	-	-	-	Inorganic Silty Clays of low plasticity												
	2.00	D	3	1	1	2	3	4.02	-	-	-	-	-	-	-	17.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	3.00	D	4	1	2	3	5	6.25	-	-	-	-	-	-	-	18.82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	4.00	U	5	-	-	-	-	-	CL-ML	2	2	1	22	67	6	18.93	2.04	1.72	27.0	21.0	6.0	2.66	UU	44.0	10.8	0.132	0.551	-	8	17	-													
	5.00	D	6	2	3	5	8	9.03	-	-	-	-	-	-	-	16.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	6.00	D	7	3	4	7	11	11.89	-	-	-	-	-	-	-	22.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	7.00	U	8	-	-	-	-	-	ML	0	0	1	48	51	0	18.25	1.86	1.57	Non-Plastic			2.63	DST	3.0	27.5	-	0.672	-	-	-	-	Inorganic Silts of low plasticity												
	8.00	D	9	5	7	10	17	16.13	-	-	-	-	-	-	-	19.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	9.00	D	10	6	7	11	18	16.38	-	-	-	-	-	-	-	18.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	10.00	D	11	-	-	-	-	-	CL-ML	2	1	1	32	60	4	17.31	-	-	24.5	19.0	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity												
	11.00	D	12	8	10	14	24	24.00	CL	0	0	1	22	70	7	23.37	-	-	26.5	19.0	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity												
	12.00	D	13	9	12	17	29	29.00	CL	1	1	1	14	73	10	19.22	-	-	28.0	19.5	8.5	-	-	-	-	-	-	-	-	-	-													
	13.00	U	14	-	-	-	-	-	-	-	-	-	-	-	-	17.70	2.10	1.78	-	-	-	2.68	UU	55.0	9.0	-	0.502	-	-	-	-													
	14.50	D	15	12	15	18	33	33.00	CL	7	4	5	11	60	13	18.60	-	-	31.5	19.0	12.5	-	-	-	-	-	-	-	-	-	-													
	16.00	U	16	-	-	-	-	-	CL	2	1	2	18	67	10	18.24	2.05	1.73	28.5	18.5	10.0	2.68	UU	52.0	10.5	-	0.546	-	8	13	-													
	17.50	D	17	11	17	20	37	37.00	-	-	-	-	-	-	-	15.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No : P82	**Ground Elevation : RL 193.262 m**	**Method of drilling: Percussion**	**Depth of Water-table: 2.30 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 05/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23064.287	**Casing Lowered : 18.00 m**	**Ending Date : 07/10/2023**	**Hammer type : Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL	2	1	2	16	69	10	20.09	2.08	1.73	27.5	18.5	9.0	2.67	UU	51.0	10.6	-	0.542	-	-	-	-												
	20.50	D	19	13	20	21	41	41.00	-	-	-	-	-	-	-	17.78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	CL-ML	4	2	2	29	58	5	18.76	2.07	1.74	24.0	19.5	4.5	2.65	DST	12.0	24.5	-	0.520	-	-	-	-	Inorganic Silty Clays of low plasticity											
	23.50	D	21	15	23	25	48	48.00	CL	2	1	2	10	71	14	18.27	-	-	32.0	19.0	13.0	-	-	-	-	-	-	-	-	-	-												
	25.00	D	22	-	-	-	-	-	CL	1	1	2	25	63	8	19.33	-	-	27.5	19.5	8.0	-	-	-	-	-	-	-	-	-	-												
	26.50	D	23	15	24	27	51	51.00	CL	0	0	1	14	73	12	17.81	-	-	29.0	19.0	10.0	-	-	-	-	-	-	-	-	-	-												
	28.00	U	24	-	-	-	-	-	-	-	-	-	-	-	-	17.40	2.08	1.77	-	-	-	2.68	UU	55.0	9.5	-	0.513	-	-	-	-	Inorganic clays of low plasticity											
	29.50	D	25	14	25	30	55	55.00	-	-	-	-	-	-	-	14.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	U	26	-	-	-	-	-	CL	3	1	2	22	60	12	17.46	2.05	1.75	29.5	18.5	11.0	2.68	UU	56.0	10.5	-	-	-	-	-	-												
	32.50	D	27	17	28	32	60	60.00	-	-	-	-	-	-	-	17.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	19	31	36	67	67.00	MI	1	1	1	5	75	17	30.71	-	-	40.0	28.5	11.5	-	-	-	-	-	-	-	-	-	-												
	35.50	D	29	22	34	37	71	71.00	MI	1	1	1	4	75	18	29.23	-	-	42.0	28.0	14.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	37.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	27.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	25	36	39	75	75.00	MI	1	1	2	5	72	19	25.75	-	-	44.0	28.5	15.5	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	28	39	42	81	28.32	CL	2	1	1	32	57	7	15.97	-	-	26.5	19.5	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 3: SUMMARY OF TEST RESULTS

Bore No : P83	**Ground Elevation : RL 193.307 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.20 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 23/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23090.487	**Casing Lowered : 21.00 m**	**Ending Date : 27/10/2023**	**Hammer type : Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	1	52	47	0	6.26	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	D	2	1	2	3	5	7.71	-	-	-	-	-	-	-	16.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	2.00	U	3	-	-	-	-	-	SM	0	0	1	53	46	0	16.27	1.99	1.71	Non-Plastic			2.65	DST	6.0	26.8	-	0.550	-	-	-	-												
	3.00	D	4	1	2	4	6	7.77	-	-	-	-	-	-	-	16.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	2	3	4	7	8.56	ML	1	0	1	40	58	0	20.70	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	5.00	U	6	-	-	-	-	-	ML	0	1	0	29	64	6	17.81	2.01	1.71	25.0	21.0	4.0	2.66	DST	10.0	24.8	-	0.556	-	-	-	-												
	6.00	D	7	6	9	30	39	29.19	SM	0	0	0	56	44	0	17.94	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	7.00	D	8	2	2	6	8	8.55	-	-	-	-	-	-	-	17.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	U	9	-	-	-	-	-	ML	0	0	1	48	51	0	19.28	1.98	1.66	Non-Plastic			2.64	DST	0.0	28.6	-	0.590	-	-	-	-	Inorganic Silts of low plasticity											
	9.00	D	10	9	14	18	32	23.45	-	-	-	-	-	-	-	18.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	10	15	19	34	23.92	CL	1	0	1	8	83	7	20.20	-	-	29.0	22.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	11.00	U	12	-	-	-	-	-	CL	2	0	2	5	80	11	20.90	2.03	1.68	31.0	21.5	9.5	2.68	UU	58.0	8.9	0.106	0.595	-	0	22	-												
	12.50	D	13	9	14	18	32	21.84	CL-ML	1	1	0	24	69	5	19.81	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	14.00	U	14	-	-	-	-	-	CL	2	1	2	28	56	11	19.13	2.01	1.69	26.5	17.5	9.0	2.67	UU	52.0	9.5	-	0.580	-	0	15	-	Inorganic clays of low plasticity											
	15.50	D	15	9	17	21	38	38.00	-	-	-	-	-	-	-	13.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	D	16	-	-	-	-	-	CL	1	1	2	23	63	10	20.45	-	-	27.0	17.0	10.0	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 3: SUMMARY OF TEST RESULTS

Bore No : P83	**Ground Elevation : RL 193.307 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.20 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 23/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23090.487	**Casing Lowered : 21.00 m**	**Ending Date : 27/10/2023**	**Hammer type : Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	8	18	23	41	41.00	-	-	-	-	-	-	-	18.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	20.00	U	18	-	-	-	-	-	CL	0	1	1	6	82	10	20.33	1.98	1.65	31.0	22.5	8.5	2.67	UU	48.0	10.2	-	0.623	-	-	21	-	Inorganic clays of low plasticity											
	21.50	D	19	14	24	25	49	49.00	-	-	-	-	-	-	-	15.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.00	U	20	-	-	-	-	-	ML	8	3	2	14	62	11	16.87	1.84	1.57	32.0	24.0	8.0	2.68	UU	55.0	9.6	-	0.703	-	-	-	-	Inorganic Silts of low plasticity											
	24.50	D	21	15	20	30	50	24.83	CL-ML	1	1	1	24	68	5	23.08	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	26.00	D	22	-	-	-	-	-	CL-ML	1	1	0	14	76	8	24.65	-	-	27.0	20.5	6.5	-	-	-	-	-	-	-	-	-	-												
	27.50	D	23	17	19	28	47	47.00	MI	2	1	0	5	80	12	24.98	-	-	37.0	27.0	10.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	29.00	D	24	-	-	-	-	-	-	-	-	-	-	-	-	27.09	2.14	1.68	-	-	-	2.68	RUU	62.0	8.1	-	0.595	-	-	-	-												
	30.50	D	25	18	21	26	47	21.91	CL-ML	3	2	2	27	60	6	14.82	-	-	27.0	20.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	32.00	D	26	-	-	-	-	-	CL	2	1	2	24	64	7	17.21	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	33.50	D	27	16	22	28	50	22.04	-	-	-	-	-	-	-	17.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	35.00	D	28	-	-	-	-	-	CL	1	1	1	21	68	8	19.10	2.06	1.73	28.0	20.5	7.5	2.67	RUU	47.0	12.8	-	0.543	-	-	-	-												
	36.50	D	29	18	26	29	55	55.00	-	-	-	-	-	-	-	19.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	20	28	30	58	23.13	CL-ML	2	1	0	20	71	6	20.65	-	-	26.0	20.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	40.00	D	31	18	30	31	61	23.48	-	-	-	-	-	-	-	20.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 4: SUMMARY OF TEST RESULTS

Bore No : P84	Ground Elevation : RL 193.358	Method of drilling :Percussion	Depth of Water-table: 1.70 m
Diameter of Bore Hole : 150 mm	Bore Retained using : Casing	Starting Date : 23/10/2023	SPT Sampler: Standard
Location / Chainage : 23116.687	Casing Lowered : 18.00 m	Ending Date : 26/10/2023	Hammer type : Rope-pulley

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	1	47	52	0	7.39	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	D	2	3	3	4	7	10.78	CL	0	0	1	38	54	7	19.61	-	-	26.0	19.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	2.00	U	3	-	-	-	-	-	CL-ML	2	1	1	45	44	7	18.26	2.00	1.69	25.5	19.5	6.0	2.66	DST	8.0	26.5	-	0.574	-	6	18	-	Inorganic Silty Clays of low plasticity											
	3.00	D	4	2	4	5	9	11.29	ML	0	0	0	48	52	0	17.62	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	4.00	D	5	3	6	8	14	15.83	-	-	-	-	-	-	-	20.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	5.00	U	6	-	-	-	-	-	CL-ML	0	1	1	34	58	6	17.12	1.99	1.70	25.0	19.5	5.5	2.66	DST	10.0	25.0	-	0.565	-	0	18	-	Inorganic Silty Clays of low plasticity											
	6.00	D	7	3	10	12	22	19.49	-	-	-	-	-	-	-	17.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	4	11	13	24	20.10	ML	0	0	1	46	53	0	17.75	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	8.00	U	9	-	-	-	-	-	ML	1	0	1	10	80	8	21.25	2.01	1.66	29.0	22.5	6.5	2.67	UU	45.0	10.2	0.108	0.608	-	0	20	-												
	9.00	D	10	5	8	11	19	16.80	-	-	-	-	-	-	-	20.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	8	13	15	28	20.79	-	-	-	-	-	-	-	19.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL-ML	1	0	1	38	55	5	19.49	1.99	1.67	26.0	21.0	5.0	2.66	DST	6.0	27.0	-	0.598	-	-	-	-	Inorganic Silty Clays of low plasticity											
	12.50	D	13	7	10	17	27	19.45	CL-ML	3	0	2	22	66	7	21.13	-	-	28.0	22.0	6.0	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL-ML	4	1	2	23	61	9	17.51	2.01	1.71	27.5	21.5	6.0	2.67	UU	48.0	11.2	-	0.561	-	-	-	-												
	15.50	D	15	9	14	16	30	30.00	CL	0	0	1	16	72	11	17.65	-	-	30.0	20.0	10.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	17.00	U	16	-	-	-	-	-	CL-ML	3	1	1	24	64	7	20.72	1.81	1.50	27.0	20.5	6.5	2.66	DST	7.0	26.7	-	0.773	-	-	-	-	Inorganic Silty Clays of low plasticity											

APPENDIX "B"
TABLE 4: SUMMARY OF TEST RESULTS

Bore No : P84	**Ground Elevation : RL 193.358**	**Method of drilling :Percussion**	**Depth of Water-table: 1.70 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 23/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23116.687	**Casing Lowered : 18.00 m**	**Ending Date : 26/10/2023**	**Hammer type : Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																						
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %, R.Q.D %, Density (gm /cc), Specific gravity, Moisture content (%), Water absorption (%), Point load Index, U.C.S (MPa), Porosity, Hardness, Modulus of Elasticity, Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL
	18.50	D	17	11	15	16	31	19.53	-	-	-	-	-	-	-	20.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity
	20.00	D	18	-	-	-	-	-	CL	1	1	2	18	70	8	17.64	-	-	27.0	20.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity
	21.50	D	19	12	17	20	37	20.96	-	-	-	-	-	-	-	22.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	23.00	U	20	-	-	-	-	-	CL	3	6	6	9	64	12	18.38	2.02	1.71	32.0	22.0	10.0	2.68	UU	56.0	9.5	-	0.567	-	-	-	-	
	24.50	D	21	9	18	22	40	21.20	ML	1	1	0	34	60	4	22.63	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity
	26.00	D	22	-	-	-	-	-	CL	0	0	1	14	77	8	21.59	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity
	27.50	D	23	13	21	27	48	23.00	SM	0	0	0	55	45	0	19.55	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands
	29.00	D	24	-	-	-	-	-	ML	0	0	1	48	51	0	19.28	2.06	1.73	Non-Plastic			2.65	RDST	4.0	29.1	-	0.532	-	-	-	-	Inorganic Silts of low plasticity
	30.50	D	25	10	18	24	42	20.33	SM	4	3	5	39	49	0	17.59	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands
	32.00	D	26	-	-	-	-	-	ML	0	0	1	48	51	0	20.34	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity
	33.50	D	27	12	19	23	42	19.68	-	-	-	-	-	-	-	19.58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	35.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	18.80	2.04	1.72	-	-	-	-	RDST	2.0	28.7	-	-	-	-	-	-	
	36.50	D	29	14	20	26	46	20.19	ML	1	0	1	45	53	0	20.01	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	
	38.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	19.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	40.00	D	31	17	24	28	52	21.14	-	-	-	-	-	-	-	19.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed samples.

APPENDIX "B"
TABLE 5: SUMMARY OF TEST RESULTS

Bore No : P85	**Ground Elevation : RL 193.345 m**	**Method of drilling :Percussion**	**Depth of Water-table: 2.20 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 05/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23142.887	**Casing Lowered : 21.00 m**	**Ending Date : 07/10/2023**	**Hammer type : Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	CL	2	1	1	18	69	9	13.98	-	-	27.5	19.0	8.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	1.00	U	2	-	-	-	-	-	ML	0	0	1	32	62	5	14.41	1.94	1.70	24.0	20.0	4.0	2.65	DST	17	24.6	-	0.559	-	-	-	-	Inorganic Silts of low plasticity											
	2.00	D	3	1	2	2	4	5.27	CL-ML	0	0	1	37	55	7	18.07	-	-	25.0	19.0	6.0	-	-	-	-	-	-	-	0	15	-	Inorganic Silty Clays of low plasticity											
	3.00	D	4	2	3	3	6	7.39	-	-	-	-	-	-	-	18.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	-	-	-	-	-	CL	0	0	1	32	59	8	20.54	-	-	27.5	20.0	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	5.00	D	6	3	4	7	11	12.49	ML	0	0	0	38	62	0	18.36	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	6.00	D	7	2	4	7	11	12.03	-	-	-	-	-	-	-	17.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	U	8	-	-	-	-	-	SM	0	0	0	72	28	0	20.29	1.90	1.58	Non-Plastic			2.63	DST	3	28.5	-	0.665	-	-	-	-	Silty Sands											
	8.00	D	9	4	6	8	14	14.31	ML	1	0	1	17	73	8	20.24	-	-	29.0	23.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	9.00	D	10	5	7	10	17	15.93	-	-	-	-	-	-	-	21.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL-ML	0	1	0	7	86	6	19.25	1.99	1.67	24.0	19.0	5.0	2.66	DST	13	24.5	-	0.594	-	-	-	-	Inorganic Silty Clays of low plasticity											
	11.00	D	12	7	13	15	28	20.56	-	-	-	-	-	-	-	19.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	6	9	11	20	16.57	-	-	-	-	-	-	-	22.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL-ML	3	1	2	30	56	8	18.42	1.97	1.66	27.0	20.5	6.5	2.66	DST	15	26.5	-	0.599	-	17	18	-												
	14.50	D	15	8	8	14	22	16.86	-	-	-	-	-	-	-	20.78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	1	1	1	10	76	11	22.07	2.09	1.71	29.5	19.0	10.5	2.67	UU	46	10.2	-	0.560	-	-	-	-	Inorganic clays of low plasticity											
	17.50	D	17	6	13	24	37	37.00	-	-	-	-	-	-	-	23.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 5: SUMMARY OF TEST RESULTS

Bore No : P85	**Ground Elevation : RL 193.345 m**	**Method of drilling :Percussion**	**Depth of Water-table: 2.20 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 05/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23142.887	**Casing Lowered : 21.00 m**	**Ending Date : 07/10/2023**	**Hammer type : Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen												
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index	
																							Classification of ROCK									Classification of SOIL												
	19.00	U	18	-	-	-	-	-	CL	5	2	2	11	71	9	18.11	2.04	1.73	28.0	19.0	9.0	2.67	UU	48	11.5	-	0.546	-	-	-	-													
	20.50	D	19	8	11	32	43	43.00	-	-	-	-	-	-	-	16.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	22.00	U	20	-	-	-	-	-	CL	16	7	6	9	51	11	16.41	2.07	1.78	31.0	21.0	10.0	2.68	UU	54	10.6	-	0.507	-	-	-	-	Inorganic clays of low plasticity												
	23.50	D	21	6	10	17	27	27.00	CL	4	3	4	11	65	13	21.19	-	-	32.0	20.0	12.0	-	-	-	-	-	-	-	-	-	-													
	25.00	U	22	-	-	-	-	-	CL	10	2	1	29	51	7	16.01	1.98	1.71	26.0	19.0	7.0	2.66	DST	13	25.0	-	0.559	-	-	-	-													
	26.50	D	23	7	18	29	47	22.88	ML	0	1	1	38	60	0	18.33	-	-		Non-Plastic		-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity												
	28.00	U	24	-	-	-	-	-	MI	0	0	0	10	77	13	33.06	2.10	1.58	42.0	30.5	11.5	2.70	UU	60	8.5	-	0.709	-	-	-	-	Inorganic Silts of Intermediate plasticity												
	29.50	D	25	10	30	36	66	66.00	-	-	-	-	-	-	-	32.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	31.00	D	26	-	-	-	-	-	CL-ML	1	1	0	34	59	5	21.82	-	-	25.0	19.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity												
	32.50	D	27	14	27	33	60	25.13	CL	0	1	0	12	80	7	27.96	-	-	26.0	19.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity												
	34.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	14.38	1.99	1.74	-	-	-	2.67	RUU	44	9.1	-	0.534	-	-	-	-													
	35.50	D	29	16	28	36	64	25.42	ML	2	1	2	37	58	0	16.28	-	-		Non-Plastic		-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity												
	37.00	D	30	-	-	-	-	-	CL	0	0	1	22	71	6	21.06	-	-	26.0	19.0	7.0	-	-	-	-	-	-	-	-	-	-													
	38.50	D	31	18	30	38	68	68.00	CL	4	3	3	9	70	11	21.42	-	-	29.5	19.0	10.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity												
	40.00	D	32	18	32	40	72	72.00	-	-	-	-	-	-	-	24.47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed samples.

APPENDIX "B"

TABLE 6: SUMMARY OF TEST RESULTS

Bore No : P86	**Ground Elevation : RL 193.548 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.20 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 23/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23169.087	**Casing Lowered : 18.00 m**	**Ending Date : 26/10/2023**	**Hammer type : Auto-trip**

FIELD TEST RESULT									LABORATORY TEST RESULT																							
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery % / R.Q.D % / Density (gm /cc) / Specific gravity / Moisture content (%) / Water absorption (%) / Point load Index / U.C.S (MPa) / Porosity / Hardness / Modulus of Elasticity / Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL
	0.50	D	1	-	-	-	-	-	CL-ML	0	0	1	38	55	6	11.64	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity
	1.00	D	2	2	3	4	7	7.00	CL	0	0	1	42	49	8	16.06	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity
	2.00	D	3	-	-	-	-	-	-	-	-	-	-	-	-	18.47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3.00	D	4	2	2	4	6	8.01	ML	0	0	1	46	53	0	18.89	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity
	4.00	D	5	2	3	5	8	10.06	-	-	-	-	-	-	-	17.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	5.00	U	6	-	-	-	-	-	ML	0	0	0	41	59	0	19.01	1.96	1.65	Non-Plastic			2.64	DST	8.0	25.7	-	0.600	-	-	-	-	
	6.00	D	7	3	5	8	13	14.85	-	-	-	-	-	-	-	16.81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	7.00	D	8	8	15	21	36	27.23	CL	0	0	1	18	74	7	19.65	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity
	8.00	U	9	-	-	-	-	-	CL-ML	0	0	1	27	67	5	19.29	1.97	1.65	26.0	21.0	5.0	2.66	DST	10.0	25.5	-	0.612	-	-	-	-	Inorganic Silty Clays of low plasticity
	9.00	D	10	7	13	18	31	23.31	-	-	-	-	-	-	-	20.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	10.00	D	11	9	12	15	27	20.83	-	-	-	-	-	-	-	20.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	11.00	U	12	-	-	-	-	-	ML	2	0	1	7	84	6	19.14	1.90	1.59	27.0	22.0	5.0	2.66	DST	11.0	25.2	0.102	0.669	-	0	21	-	Inorganic Silts of low plasticity
	12.50	D	13	8	8	15	23	23.00	CL	2	1	1	12	72	12	18.00	-	-	31.0	21.5	9.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity
	14.00	U	14	-	-	-	-	-	CL	4	3	2	14	67	10	16.70	2.02	1.73	29.0	20.5	8.5	2.67	UU	51.0	10.5	-	0.543	-	8	20	-	
	15.50	D	15	6	7	12	19	19.00	-	-	-	-	-	-	-	20.47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	17.00	U	16	-	-	-	-	-	ML	6	3	3	28	54	6	17.67	1.97	1.67	25.0	21.0	4.0	2.65	DST	5.0	27.0	-	0.587	-	-	-	-	Inorganic Silts of low plasticity

Soil investigation for HORC Viaduct between Sohana & Dhulawat stations, Haryana

APPENDIX "B"
TABLE 6: SUMMARY OF TEST RESULTS

Bore No : P86	**Ground Elevation : RL 193.548 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.20 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 23/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23169.087	**Casing Lowered : 18.00 m**	**Ending Date : 26/10/2023**	**Hammer type : Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	6	12	18	30	30.00	CL	8	4	5	20	56	7	15.78	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	20.00	D	18	-	-	-	-	-	-	-	-	-	-	-	-	15.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	21.50	D	19	10	19	30	49	49.00	CL	2	1	0	24	65	8	18.96	-	-	28.0	20.0	8.0	-	-	-	-	-	-	-	-	-	-												
	23.00	U	20	-	-	-	-	-	CL	3	2	1	14	69	11	15.20	2.01	1.74	31.0	21.0	10.0	2.68	UU	53.0	9.4	-	0.537	-	-	-	-												
	24.50	D	21	13	18	26	44	44.00	-	-	-	-	-	-	-	18.78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	U	22	-	-	-	-	-	CL-ML	4	1	2	29	58	6	13.12	1.89	1.67	26.0	21.0	5.0	2.65	DST	4.0	27.1	-	0.587	-	-	-	-	Inorganic Silty Clays of low plasticity											
	27.50	D	23	11	21	28	49	23.80	ML	0	0	0	10	84	6	20.75	-	-	27.0	23.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	29.00	D	24	-	-	-	-	-	ML	0	0	1	42	57	0	17.75	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	30.50	D	25	12	22	30	52	24.00	SM	2	1	2	47	48	0	17.28	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	32.00	D	26	15	25	26	51	23.31	CL	4	2	1	22	63	8	17.96	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	33.50	D	27	18	23	25	48	48.00	CL	2	1	2	8	75	12	14.78	-	-	32.0	21.0	11.0	-	-	-	-	-	-	-	-	-	-												
	35.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	18.80	2.06	1.73	-	-	-	2.67	RUU	67.0	9.3	-	0.543	-	-	-	-												
	36.50	D	29	17	20	27	47	47.00	CL	6	3	4	22	58	7	20.10	-	-	28.0	20.0	8.0	-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	19.62	2.08	1.74	-	-	-	-	RUU	49.0	13.1	-	-	-	-	-	-												
	40.00	D	31	20	24	30	54	54.00	-	-	-	-	-	-	-	19.67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 7: SUMMARY OF TEST RESULTS

Bore No : P87	**Ground Elevation : RL 193.452 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.26 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using : Casing**	**Starting Date : 25/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23195.287	**Casing Lowered : 20.00 m**	**Ending Date : 27/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen												
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL												
	0.50	D	1	-	-	-	-	-	CL-ML	0	0	1	27	67	5	19.73	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity												
	1.00	U	2	-	-	-	-	-	CL	1	0	1	40	48	10	18.65	2.01	1.69	27.0	18.5	8.5	2.68	UU	51.0	12.5	-	0.586	-	8	17	-	Inorganic clays of low plasticity												
	2.00	D	3	2	3	3	6	6.00	-	-	-	-	-	-	-	21.37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	3.00	D	4	2	2	4	6	7.72	ML	0	1	1	47	51	0	17.78	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity												
	4.00	U	5	-	-	-	-	-	SM	1	1	1	48	49	0	16.97	1.96	1.68	Non-Plastic			2.64	DST	4.0	27.5	-	0.576	-	-	-	-	Silty Sands												
	5.00	D	6	3	4	5	9	10.46	-	-	-	-	-	-	-	18.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	6.00	D	7	3	5	4	9	10.02	-	-	-	-	-	-	-	17.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	7.00	U	8	-	-	-	-	-	SM	1	0	1	58	40	0	18.36	1.99	1.68	Non-Plastic			2.63	DST	0.0	29.0	-	0.565	-	-	-	-													
	8.00	D	9	4	4	6	10	10.00	CL	7	6	5	17	53	12	15.57	-	-	31.0	21.0	10.0	-	-	-	-	-	-	-	19	17	-	Inorganic clays of low plasticity												
	9.00	D	10	6	12	19	31	22.97	CL-ML	2	1	0	27	64	6	22.13	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity												
	10.00	D	11	-	-	-	-	-	SM	0	0	1	52	47	0	18.44	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands												
	11.00	D	12	6	8	12	20	16.93	CL-ML	0	0	1	18	76	5	18.32	-	-	26.0	20.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity												
	12.00	D	13	8	11	15	26	19.42	-	-	-	-	-	-	-	22.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	13.00	U	14	-	-	-	-	-	CL	7	6	8	7	61	11	18.50	1.98	1.67	30.0	21.0	9.0	2.67	UU	53.0	11.5	0.112	0.599	-	-	-	-	Inorganic clays of low plasticity												
	14.50	D	15	8	15	18	33	33.00	-	-	-	-	-	-	-	17.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	16.00	U	16	-	-	-	-	-	CL-ML	1	1	0	42	50	6	17.91	1.95	1.65	25.0	20.0	5.0	2.66	DST	6.0	26.8	-	0.612	-	-	-	-	Inorganic Silty Clays of low plasticity												
	17.50	D	17	6	12	16	28	28.00	CL	0	0	1	14	76	9	15.87	-	-	29.0	21.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity												

APPENDIX "B"
TABLE 7: SUMMARY OF TEST RESULTS

Bore No : P87	**Ground Elevation : RL 193.452 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.26 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using : Casing**	**Starting Date : 25/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23195.287	**Casing Lowered : 20.00 m**	**Ending Date : 27/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL	3	2	1	12	69	13	19.63	2.11	1.76	31.0	21.5	9.5	2.67	UU	56.0	9.5	-	0.517	-	-	-	-	Inorganic clays of low plasticity											
	20.50	D	19	6	16	22	38	38.00	-	-	-	-	-	-	-	15.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	ML	8	2	2	14	66	8	18.32	2.00	1.69	30.5	23.0	7.5	2.66	UU	42.0	11.5	-	0.574	-	-	-	-	Inorganic Silts of low plasticity											
	23.50	D	21	12	18	15	33	33.00	CL	4	2	2	14	66	12	16.29	-	-	31.0	21.0	10.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	25.00	U	22	-	-	-	-	-	ML	2	0	0	35	59	4	18.06	1.95	1.65	24.0	20.0	4.0	2.63	DST	7.0	26.5	-	0.594	-	-	-	-	Inorganic Silts of low plasticity											
	26.50	D	23	8	15	27	42	21.48	ML	2	0	0	47	51	0	19.93	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	-	-	-	-	-	-	-	-	-	-	-	-	18.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.50	D	25	12	21	28	49	22.91	ML	0	0	1	24	70	5	21.71	-	-	23.0	19.0	4.0	-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	-	-	-	-	-	ML	0	0	1	42	57	0	18.48	2.05	1.73	Non-Plastic			2.65	RDST	0.0	29.3	-	0.532	-	-	-	-												
	32.50	D	27	15	20	25	45	20.92	-	-	-	-	-	-	-	18.65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	-	-	-	-	-	ML	0	0	2	45	53	0	17.24	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	35.50	D	29	16	21	27	48	21.08	-	-	-	-	-	-	-	17.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	19.24	2.07	1.74	-	-	-	-	RDST	0.0	28.7	-	-	-	-	-	-												
	38.50	D	31	18	24	29	53	21.75	ML	0	1	1	46	52	0	19.27	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	20	26	31	57	22.45	-	-	-	-	-	-	-	20.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"

TABLE 8: SUMMARY OF TEST RESULTS

Bore No : P88	**Ground Elevation : RL 193.536 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.70 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 05/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23211.487	**Casing Lowered : 18.00 m**	**Ending Date : 07/10/2023**	**Hammer type : Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	0	36	60	4	10.84	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	D	2	1	2	3	5	5.00	CL	0	0	2	22	63	13	20.02	-	-	32.0	19.0	13.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	2.00	U	3	-	-	-	-	-	CL	0	0	1	47	44	8	21.19	1.99	1.64	27.5	20.0	7.5	2.66	DST	18.0	24.2	0.165	0.620	-	8	14	-												
	3.00	D	4	1	2	5	7	8.80	SM	1	1	3	62	33	0	18.04	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	D	5	2	3	6	9	10.73	CL-ML	0	1	2	32	59	6	18.91	-	-	25.5	19.5	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	5.00	U	6	-	-	-	-	-	-	-	-	-	-	-	-	12.23	1.89	1.68	-	-	-	2.66	DST	16.0	23.6	-	0.583	-	-	-	-												
	6.00	D	7	5	6	7	13	14.31	CL-ML	7	6	3	24	55	5	19.37	-	-	25.0	20.0	5.0	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	6	8	9	17	16.54	CL	2	2	1	18	70	7	21.03	-	-	27.0	20.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	8.00	D	9	-	-	-	-	-	-	-	-	-	-	-	-	22.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	6	8	10	18	16.50	SM	0	0	1	63	36	0	16.64	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	10.00	D	11	7	10	11	21	17.65	-	-	-	-	-	-	-	16.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL	1	1	1	19	71	7	23.97	2.07	1.67	26.5	19.5	7.0	2.66	DST	16.0	25.3	-	0.593	-	9	16	-	Inorganic clays of low plasticity											
	12.50	D	13	8	11	13	24	24.00	CL	0	0	1	12	78	9	22.71	-	-	27.0	19.0	8.0	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL	2	5	4	16	62	11	18.00	2.08	1.76	29.5	18.5	11.0	2.67	UU	54.0	10.6	-	0.515	-	-	15	-												
	15.50	D	15	5	10	16	26	26.00	-	-	-	-	-	-	-	18.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	D	16	-	-	-	-	-	CL	0	1	2	22	68	7	19.89	-	-	26.0	19.0	7.0	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 8: SUMMARY OF TEST RESULTS

Bore No : P88	**Ground Elevation : RL 193.536 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.70 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 05/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23211.487	**Casing Lowered : 18.00 m**	**Ending Date : 07/10/2023**	**Hammer type : Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	4	8	10	18	18.00	CL	0	1	1	34	55	9	18.05	-	-	28.5	20.0	8.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	20.00	D	18	-	-	-	-	-	-	-	-	-	-	-	-	25.60	2.08	1.66	-	-	-	2.67	RDST	15.0	25.9	-	0.608	-	-	-	-												
	21.50	D	19	7	10	12	22	22.00	-	-	-	-	-	-	-	25.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.00	D	20	-	-	-	-	-	CL	0	1	2	16	70	11	18.07	-	-	29.5	18.5	11.0	-	-	-	-	-	-	-	-	-	-												
	24.50	D	21	10	15	20	35	19.37	CL	4	8	9	14	56	9	20.46	-	-	27.5	20.5	7.0	-	-	-	-	-	-	-	-	-	-												
	26.00	U	22	-	-	-	-	-	SM	0	1	2	57	40	0	21.94	1.93	1.58	Non-Plastic			2.65	DST	8.0	24.5	-	0.677	-	-	-	-	Silty Sands											
	27.50	D	23	11	16	21	37	19.42	CL	0	1	1	22	68	8	20.87	-	-	27.0	20.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	29.00	U	24	-	-	-	-	-	ML	1	0	2	29	63	5	18.90	2.04	1.72	23.0	19.0	4.0	2.66	UU	38.0	13.8	-	0.550	-	-	-	-	Inorganic Silts of low plasticity											
	30.50	D	25	15	20	28	48	22.15	-	-	-	-	-	-	-	20.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.00	U	26	-	-	-	-	-	CL	1	2	3	27	60	7	18.90	2.05	1.72	27.0	20.0	7.0	2.66	UU	40.0	13.4	-	0.547	-	-	-	-	Inorganic clays of low plasticity											
	33.50	D	27	16	21	29	50	21.99	ML	0	0	2	35	59	4	20.73	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	35.00	D	28	-	-	-	-	-	SM	0	1	2	54	43	0	18.78	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	36.50	D	29	18	25	30	55	22.76	SM	0	1	3	56	40	0	18.29	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	18.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	20	29	33	62	23.80	CL-ML	0	0	1	25	68	6	24.46	-	-	26.0	19.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"

TABLE 9: SUMMARY OF TEST RESULTS

Bore No : P89	**Ground Elevation : RL 193.530 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.90 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using : Casing**	**Starting Date : 25/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23247.687	**Casing Lowered : 20.00 m**	**Ending Date : 27/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																						
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %, R.Q.D %, Density (gm/cc), Specific gravity, Moisture content (%), Water absorption (%), Point load Index, U.C.S (MPa), Porosity, Hardness, Modulus of Elasticity, Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL
	0.50	D	1	-	-	-	-	-	ML	0	0	1	46	48	5	7.35	-	-	26.0	22.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity
	1.00	U	2	-	-	-	-	-	CL	0	1	2	43	43	11	17.30	2.02	1.72	28.0	18.5	9.5	2.66	UU	47.0	11.5	-	0.547	-	-	16	-	Inorganic clays of low plasticity
	2.00	D	3	1	2	2	4	4.00	-	-	-	-	-	-	-	21.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3.00	D	4	1	2	3	5	6.18	SM	3	2	1	53	41	0	17.80	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands
	4.00	U	5	-	-	-	-	-	SM	1	1	1	56	41	0	19.02	1.95	1.64	Non-Plastic			2.63	DST	2.0	27.5	-	0.604	-	-	-	-	
	5.00	D	6	2	2	3	5	5.64	-	-	-	-	-	-	-	17.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	6.00	D	7	2	3	4	7	7.59	-	-	-	-	-	-	-	18.37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	7.00	D	8	-	-	-	-	-	CL-ML	1	1	0	34	57	7	20.40	1.94	1.61	27.0	20.5	6.5	-	RDST	4.0	23.9	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity
	8.00	D	9	3	4	5	9	9.11	ML	7	6	4	29	50	4	14.16	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity
	9.00	D	10	9	13	14	27	20.75	CL	2	1	0	22	68	7	21.26	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity
	10.00	U	11	-	-	-	-	-	-	-	-	-	-	-	-	20.81	1.94	1.60	-	-	-	2.65	DST	5.0	27.4	-	0.652	-	-	-	-	
	11.00	D	12	5	9	10	19	19.00	CL	1	1	0	20	70	8	23.24	-	-	29.0	20.5	8.5	-	-	-	-	-	-	-	-	-	-	
	12.00	D	13	5	9	12	21	21.00	-	-	-	-	-	-	-	22.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	13.00	D	14	-	-	-	-	-	CL	1	1	0	17	70	11	23.48	-	-	30.0	20.5	9.5	-	-	-	-	-	-	-	-	-	-	
	14.50	D	15	4	8	11	19	19.00	-	-	-	-	-	-	-	19.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	16.00	U	16	-	-	-	-	-	SM	3	2	2	51	42	0	19.19	1.93	1.62	Non-Plastic			2.64	DST	3.0	28.2	-	0.630	-	-	-	-	Silty Sands
	17.50	D	17	6	10	13	23	16.64	CL-ML	2	1	1	44	47	5	19.65	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity

APPENDIX "B"
TABLE 9: SUMMARY OF TEST RESULTS

Bore No : P89	**Ground Elevation : RL 193.530 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.90 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using : Casing**	**Starting Date : 25/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23247.687	**Casing Lowered : 20.00 m**	**Ending Date : 27/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL	7	2	2	7	72	10	17.36	2.01	1.71	31.5	21.5	10.0	2.68	UU	58.0	8.2	-	0.567	-	7	20	-	Inorganic clays of low plasticity											
	20.50	D	19	13	19	21	40	40.00	-	-	-	-	-	-	-	18.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	CL	11	5	3	11	59	11	19.65	2.03	1.70	30.0	21.0	9.0	2.68	UU	59.0	9.5	-	0.576	-	-	19	-												
	23.50	D	21	12	19	20	39	39.00	-	-	-	-	-	-	-	16.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	SM	0	1	0	54	45	0	19.80	1.96	1.64	Non-Plastic			2.63	DST	2.0	28.1	-	0.604	-	-	-	-	Silty Sands											
	26.50	D	23	12	20	22	42	21.41	-	-	-	-	-	-	-	17.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	-	-	-	-	-	CL-ML	0	0	1	32	62	5	21.47	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	29.50	D	25	12	25	27	52	23.82	-	-	-	-	-	-	-	18.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	U	26	-	-	-	-	-	SM-SC	10	6	6	28	41	9	14.72	2.02	1.76	25.5	19.5	6.0	2.67	UU	46.0	11.1	-	0.520	-	-	-	-	Silty Sands with clay binder											
	32.50	D	27	1	15	21	36	18.23	-	-	-	-	-	-	-	15.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	-	-	-	-	-	SM-SC	5	4	4	38	44	5	18.77	-	-	24.0	19.0	5.0	-	-	-	-	-	-	-	-	-	-												
	35.50	D	29	14	17	24	41	19.09	CL	6	2	2	22	60	8	17.74	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	37.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	19.54	2.07	1.73	-	-	-	2.67	RUU	50.0	10.3	-	0.543	-	-	-	-												
	38.50	D	31	17	24	29	53	21.75	-	-	-	-	-	-	-	17.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	20	28	31	59	22.97	CL-ML	1	1	2	32	58	6	19.40	-	-	27.0	21.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 10: SUMMARY OF TEST RESULTS

Bore No : P90	**Ground Elevation : RL 193.532 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.60 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date : 25/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23273.887	**Casing Lowered: 23.00 m**	**Ending Date: 27/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	1	40	59	0	9.10	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	U	2	-	-	-	-	-	CL-ML	0	0	0	31	62	7	14.95	1.99	1.73	28.0	21.5	6.5	2.66	UU	38.0	11.2	0.102	0.538	-	-	-	-	Inorganic Silty Clays of low plasticity											
	2.00	D	3	1	2	2	4	4.00	CL	2	1	1	7	77	12	20.71	-	-	32.0	21.0	11.0	-	-	-	-	-	-	-	8	18	-	Inorganic clays of low plasticity											
	3.00	D	4	2	3	3	6	7.58	ML	0	0	1	44	55	0	17.73	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	4.00	U	5	-	-	-	-	-	SM	1	1	1	59	38	0	18.43	1.96	1.66	Non-Plastic			2.64	DST	0.0	29.2	-	0.595	-	-	-	-	Silty Sands											
	5.00	D	6	4	7	8	15	16.10	-	-	-	-	-	-	-	19.75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	3	8	10	18	17.40	-	-	-	-	-	-	-	18.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	U	8	-	-	-	-	-	ML	0	1	1	8	85	5	21.66	1.94	1.59	24.0	20.0	4.0	2.65	DST	7.0	26.0	-	0.662	-	-	-	-	Inorganic Silts of low plasticity											
	8.00	D	9	3	5	7	12	12.30	CL-ML	4	2	2	11	74	7	19.82	-	-	28.0	21.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	9.00	D	10	4	6	9	15	14.90	-	-	-	-	-	-	-	20.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	6	2	3	6	75	8	17.89	2.01	1.70	28.0	21.0	7.0	2.66	UU	44.0	9.5	-	0.561	-	0	19	-	Inorganic clays of low plasticity											
	11.00	D	12	5	7	10	17	15.43	CL-ML	0	0	1	10	84	5	22.83	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	12.00	D	13	4	8	11	19	16.11	-	-	-	-	-	-	-	22.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL-ML	1	0	2	6	84	7	23.76	2.03	1.64	27.0	20.5	6.5	2.66	UU	42.0	10.5	-	0.622	-	-	-	-												
	14.50	D	15	6	8	13	21	21.00	CL	4	2	3	8	72	11	18.37	-	-	30.0	20.5	9.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	16.00	U	16	-	-	-	-	-	ML	0	0	1	40	53	6	18.98	1.94	1.63	27.0	22.0	5.0	2.65	DST	7.0	27.3	-	0.626	-	-	-	-	Inorganic Silts of low plasticity											
	17.50	D	17	8	10	15	25	25.00	CL	3	2	2	24	60	9	18.66	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											

APPENDIX "B"
TABLE 10: SUMMARY OF TEST RESULTS

Bore No : P90	**Ground Elevation : RL 193.532 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.60 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date : 25/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23273.887	**Casing Lowered: 23.00 m**	**Ending Date: 27/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL-ML	2	1	2	18	69	8	19.23	2.03	1.70	27.0	20.5	6.5	2.66	UU	42.0	11.0	-	0.565	-	-	-	-	Inorganic Silty Clays of low plasticity											
	20.50	D	19	7	13	19	32	19.37	-	-	-	-	-	-	-	19.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	CL	5	1	2	18	63	11	20.47	2.04	1.69	31.0	21.0	10.0	2.67	UU	55.0	9.2	-	0.580	-	-	20	-	Inorganic clays of low plasticity											
	23.50	D	21	9	15	21	36	36.00	-	-	-	-	-	-	-	17.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	SM	2	1	1	58	38	0	18.75	1.91	1.61	Non-Plastic			2.64	DST	0.0	29.7	-	0.640	-	-	-	-	Silty Sands											
	26.50	D	23	10	18	23	41	21.07	-	-	-	-	-	-	-	19.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	-	-	-	-	-	ML	2	1	1	42	49	5	19.92	-	-	27.0	22.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	29.50	D	25	15	20	35	55	24.82	ML	0	0	0	18	82	0	20.68	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	17	22	37	59	25.62	ML	3	0	0	3	88	6	23.68	-	-	27.0	22.0	5.0	-	-	-	-	-	-	-	-	-	-												
	32.50	D	27	20	27	39	66	27.24	CL-ML	2	2	1	24	64	7	16.26	-	-	28.0	22.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	34.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	15.73	2.05	1.77	-	-	-	2.66	RUU	40.0	12.1	-	0.503	-	-	-	-												
	35.50	D	29	18	25	37	62	25.11	CL-ML	9	1	2	32	50	6	21.04	-	-	27.5	21.0	6.5	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	16.81	2.03	1.74	-	-	-	-	RDST	5.0	29.1	-	-	-	-	-	-												
	38.50	D	31	15	22	31	53	21.83	CL	2	1	1	34	54	8	15.04	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	40.00	D	32	16	24	32	56	22.28	-	-	-	-	-	-	-	20.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 11: SUMMARY OF TEST RESULTS

Bore No : P91	Ground Elevation : RL 193.953 m	Method of drilling :Percussion	Depth of Water-table: 1.80 m
Diameter of Bore Hole : 150 mm	Bore Retained using : Casing	Starting Date : 07/10/2023	SPT Sampler: Standard
Location / Chainage : 23300.087	Casing Lowered : 22.00 m	Ending Date : 09/10/2023	Hammer type : Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	1	44	55	0	13.32	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	U	2	-	-	-	-	-	CL-ML	0	0	1	36	57	6	17.32	1.95	1.66	25.0	19.5	5.5	2.66	DST	14.0	23.4	-	0.602	-	0	15	-	Inorganic Silty Clays of low plasticity											
	2.00	D	3	1	2	2	4	5.34	CL-ML	0	0	1	32	60	7	18.18	-	-	26.0	20.0	6.0	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	2	3	4	7	8.81	ML	2	1	1	40	56	0	16.87	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	4.00	U	5	-	-	-	-	-	ML	0	1	1	37	61	0	17.84	1.97	1.67	Non-Plastic			2.63	DST	3.0	26.6	-	0.575	-	-	-	-												
	5.00	D	6	3	4	5	9	10.28	-	-	-	-	-	-	-	18.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	4	5	6	11	12.06	-	-	-	-	-	-	-	17.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	-	-	-	-	-	CL	2	1	2	28	60	7	17.09	-	-	27.0	19.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	8.00	D	9	3	6	6	12	12.00	-	-	-	-	-	-	-	20.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	3	10	17	27	27.00	CL	2	1	2	27	61	7	19.42	-	-	27.5	19.5	8.0	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	2	1	1	15	73	8	22.94	2.06	1.68	29.0	21.0	8.0	2.66	UU	44.0	11.5	0.142	0.587	-	8	18	-												
	11.00	D	12	6	9	12	21	21.00	CL	1	1	2	13	75	8	22.52	-	-	29.5	21.5	8.0	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	5	10	14	24	24.00	-	-	-	-	-	-	-	23.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	6	2	2	11	66	13	18.99	2.10	1.76	32.0	21.5	10.5	2.67	UU	53.0	9.5	-	0.513	-	-	-	-												
	14.50	D	15	5	9	10	19	19.00	CL	4	2	2	10	68	14	19.48	-	-	32.0	21.0	11.0	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	3	1	2	16	67	11	14.82	2.08	1.81	29.5	19.5	10.0	2.67	UU	57.0	10.5	-	0.474	-	-	-	-												
	17.50	D	17	8	25	33	58	58.00	CL	4	2	2	15	65	12	18.94	-	-	30.0	19.0	11.0	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"

TABLE 11: SUMMARY OF TEST RESULTS

Bore No : P91	Ground Elevation : RL 193.953 m	Method of drilling :Percussion	Depth of Water-table: 1.80 m
Diameter of Bore Hole : 150 mm	Bore Retained using : Casing	Starting Date : 07/10/2023	SPT Sampler: Standard
Location / Chainage : 23300.087	Casing Lowered : 22.00 m	Ending Date : 09/10/2023	Hammer type : Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL	7	3	3	11	63	13	14.33	2.19	1.92	32.0	19.5	12.5	2.68	UU	55.0	9.5	-	0.399	-	17	18	-												
	20.50	D	19	6	24	41	65	65.00	-	-	-	-	-	-	-	18.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	CL	2	3	3	18	64	10	14.40	1.98	1.73	29.0	21.0	8.0	2.66	DST	16.0	23.5	-	0.538	-	-	-	-	Inorganic clays of low plasticity											
	23.50	D	21	9	25	43	68	68.00	CL	3	2	2	21	63	9	19.69	-	-	29.0	21.5	7.5	-	-	-	-	-	-	-	-	-	-												
	25.00	D	22	-	-	-	-	-	-	-	-	-	-	-	-	20.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.50	D	23	9	14	26	40	20.40	CL-ML	0	2	2	40	51	5	20.60	-	-	24.0	19.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	28.00	U	24	-	-	-	-	-	MI	1	1	1	6	74	17	22.73	2.02	1.65	42.0	27.5	14.5	2.69	UU	61.0	8.5	-	0.634	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	29.50	D	25	6	11	29	40	19.73	ML	1	1	1	42	55	0	20.02	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	31.00	D	26	-	-	-	-	-	CL	0	1	1	35	57	6	17.82	-	-	26.5	19.0	7.5	-	-	-	-	-	-	-	-	-	-												
	32.50	D	27	10	18	24	42	42.00	CL	2	2	2	11	71	12	14.19	-	-	31.0	18.5	12.5	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	17.46	2.02	1.72	-	-	-	2.68	RUU	58.0	10.2	-	0.558	-	-	-	-												
	35.50	D	29	12	19	26	45	45.00	-	-	-	-	-	-	-	17.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	37.00	D	30	-	-	-	-	-	CL	4	2	1	27	55	11	18.45	-	-	29.0	19.0	10.0	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	16	26	30	56	56.00	-	-	-	-	-	-	-	17.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	20	28	33	61	61.00	CL	2	1	1	24	63	9	18.30	-	-	30.0	21.5	8.5	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 12: SUMMARY OF TEST RESULTS

Bore No : P92	**Ground Elevation : RL 193.93 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.90 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 09/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23326.287	**Casing Lowered : 22.00 m**	**Ending Date : 11/10/2023**	**Hammer type : Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	0	46	54	0	7.41	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	D	2	-	-	-	-	-	CL-ML	0	0	1	38	55	6	19.35	-	-	26.5	20.5	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	2.00	D	3	1	1	2	3	4.03	CL-ML	0	0	1	44	49	6	18.85	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	2	2	3	5	6.33	SM-SC	4	2	2	42	45	5	17.54	-	-	25.5	20.5	5.0	-	-	-	-	-	-	-	-	-	-	Silty Sands with clay binder											
	4.00	U	5	-	-	-	-	-	ML	0	0	0	34	66	0	14.10	1.96	1.72	Non-Plastic			2.65	DST	9.0	26.5	-	0.543	-	-	-	-	Inorganic Silts of low plasticity											
	5.00	D	6	2	3	5	8	9.18	-	-	-	-	-	-	-	16.54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	2	4	7	11	12.12	ML	0	0	1	48	51	0	19.20	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	7.00	U	8	-	-	-	-	-	CL	6	2	2	12	71	7	17.21	1.96	1.67	27.5	19.5	8.0	2.66	DST	13.0	25.5	-	0.593	-	-	-	-	Inorganic clays of low plasticity											
	8.00	D	9	5	6	11	17	17.00	-	-	-	-	-	-	-	21.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	6	6	12	18	18.00	-	-	-	-	-	-	-	20.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	1	0	0	8	83	8	20.71	2.07	1.71	28.0	20.0	8.0	2.66	UU	42.0	12.2	0.142	0.551	-	9	15	-												
	11.00	D	12	4	8	8	16	16.00	-	-	-	-	-	-	-	21.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	3	4	4	8	8.00	CL	6	2	3	12	63	14	20.13	-	-	34.0	22.0	12.0	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	8	6	5	8	60	13	19.29	2.04	1.71	31.5	21.5	10.0	2.67	UU	53.0	9.5	-	0.561	-	19	18	-												
	14.50	D	15	5	5	7	12	12.00	-	-	-	-	-	-	-	19.67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	3	2	3	15	67	10	16.77	2.06	1.76	28.0	19.5	8.5	2.66	UU	50.0	10.2	-	0.511	-	-	-	-												
	17.50	D	17	6	10	15	25	17.28	CL-ML	6	2	4	15	66	7	18.55	-	-	26.5	20.5	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											

APPENDIX "B"

TABLE 12: SUMMARY OF TEST RESULTS

Bore No : P92	**Ground Elevation : RL 193.93 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.90 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 09/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23326.287	**Casing Lowered : 22.00 m**	**Ending Date : 11/10/2023**	**Hammer type : Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL	8	6	7	16	54	9	17.05	2.03	1.73	28.0	19.0	9.0	2.67	UU	55.0	11.0	-	0.539	-	-	-	-	Inorganic clays of low plasticity											
	20.50	D	19	7	12	18	30	30.00	-	-	-	-	-	-	-	19.69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	CL	7	3	4	19	54	13	15.89	2.01	1.73	31.0	19.5	11.5	2.68	UU	59.0	11.5	-	0.545	-	-	14	-												
	23.50	D	21	8	21	27	48	48.00	-	-	-	-	-	-	-	22.58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	CL	5	5	6	11	60	13	16.21	2.04	1.76	32.0	21.0	11.0	2.67	UU	53.0	10.3	-	0.520	-	16	18	-												
	26.50	D	23	9	19	29	48	48.00	-	-	-	-	-	-	-	17.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	-	-	-	-	-	CL	3	2	2	14	68	11	18.79	-	-	31.0	21.0	10.0	-	-	-	-	-	-	-	-	-	-												
	29.50	D	25	6	12	27	39	39.00	-	-	-	-	-	-	-	16.82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	-	-	-	-	-	CL	0	1	1	12	77	9	18.89	-	-	29.0	21.5	7.5	-	-	-	-	-	-	-	-	-	-												
	32.50	D	27	12	26	28	54	23.42	CL	0	1	3	14	74	8	17.61	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	17.26	2.05	1.75	-	-	-	2.67	RUU	45.0	10.8	-	0.526	-	-	-	-												
	35.50	D	29	12	19	29	48	48.00	CL	2	1	1	16	70	10	18.81	-	-	31.0	20.5	10.5	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	17.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	14	20	30	50	50.00	-	-	-	-	-	-	-	17.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	17	28	36	64	24.34	SM	0	0	1	52	47	0	21.35	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample

APPENDIX "B"
TABLE 13: SUMMARY OF TEST RESULTS

Bore No : P93	**Ground Elevation : RL 193.956 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.40 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using : Casing**	**Starting Date : 26/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23352.487	**Casing Lowered : 20.00 m**	**Ending Date : 29/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	1	48	46	5	10.67	-	-	25.0	21.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	U	2	-	-	-	-	-	SM-SC	0	0	0	51	44	5	9.99	1.94	1.76	26.0	21.5	4.5	2.65	DST	4.0	26.5	-	0.506	-	-	-	-	Silty Sands with clay binder											
	2.00	D	3	2	3	3	6	8.25	-	-	-	-	-	-	-	8.97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	2	2	3	5	6.46	SM	3	2	1	47	47	0	17.24	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	U	5	-	-	-	-	-	CL-ML	1	0	1	41	51	6	20.05	1.97	1.64	26.0	21.0	5.0	2.66	DST	6.0	25.8	0.113	0.622	-	-	-	-	Inorganic Silty Clays of low plasticity											
	5.00	D	6	4	6	8	14	15.65	CL-ML	1	0	1	35	56	7	16.97	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	3	5	7	12	13.39	CL-ML	0	1	1	28	63	7	19.05	-	-	27.5	21.5	6.0	-	-	-	-	-	-	-	0	20	-												
	7.00	D	8	-	-	-	-	-	-	-	-	-	-	-	-	18.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	8	11	15	26	21.02	SM	0	0	0	58	42	0	19.01	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	9.00	D	10	4	7	12	19	17.03	CL-ML	0	1	1	35	58	5	16.74	-	-	25.5	20.0	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	10.00	U	11	-	-	-	-	-	CL-ML	0	1	1	38	54	6	18.12	2.04	1.73	25.0	20.0	5.0	2.65	DST	7.0	26.5	-	0.532	-	-	-	-												
	11.00	D	12	7	6	12	18	15.95	CL-ML	0	0	1	22	69	8	23.54	-	-	28.0	21.5	6.5	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	4	6	10	16	16.00	CL	2	1	1	11	75	10	20.75	-	-	30.0	22.0	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	13.00	U	14	-	-	-	-	-	CL	3	1	1	9	75	11	23.96	2.01	1.62	30.0	21.5	8.5	2.67	UU	52.0	9.5	-	0.648	-	8	20	-												
	14.50	D	15	9	12	17	29	19.86	CL-ML	4	2	1	15	71	7	16.59	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	16.00	U	16	-	-	-	-	-	-	-	-	-	-	-	-	15.93	2.02	1.74	-	-	-	2.66	UU	56.0	11.5	-	0.529	-	-	-	-												
	17.50	D	17	8	12	17	29	19.00	-	-	-	-	-	-	-	19.54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 13: SUMMARY OF TEST RESULTS

Bore No : P93	**Ground Elevation : RL 193.956 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.40 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using : Casing**	**Starting Date : 26/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23352.487	**Casing Lowered : 20.00 m**	**Ending Date : 29/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	CL	5	2	1	13	67	12	19.31	1.86	1.56	31.0	21.5	9.5	2.67	UU	55.0	8.7	-	0.712	-	-	-	-												
	20.50	D	19	8	14	18	32	32.00	-	-	-	-	-	-	-	19.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	CL	12	3	3	26	45	11	20.88	1.97	1.63	30.0	20.0	10.0	2.67	UU	57.0	8.5	-	0.638	-	-	-	-	Inorganic clays of low plasticity											
	23.50	D	21	10	20	25	45	45.00	CL	6	1	3	18	62	10	18.39	-	-	29.0	20.0	9.0	-	-	-	-	-	-	-	-	-	-												
	25.00	D	22	-	-	-	-	-	SM	0	0	1	52	47	0	18.39	2.08	1.76		Non-Plastic		2.65	RDST	2.0	28.8	-	0.506	-	-	-	-												
	26.50	D	23	14	26	28	54	25.44	-	-	-	-	-	-	-	22.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Silty Sands											
	28.00	D	24	16	30	33	63	27.83	-	-	-	-	-	-	-	21.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.50	D	25	15	29	30	59	26.11	CL	3	1	1	28	59	8	16.31	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	16	26	29	55	24.46	-	-	-	-	-	-	-	15.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.50	D	27	17	28	31	59	25.29	-	-	-	-	-	-	-	17.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	15	30	40	70	70.00	CL	1	1	1	30	57	10	16.43	-	-	29.0	21.0	8.0	-	-	-	-	-	-	-	-	-	-												
	35.50	D	29	18	33	45	78	78.00	-	-	-	-	-	-	-	18.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	37.00	D	30	20	30	39	69	69.00	-	-	-	-	-	-	-	17.76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	21	23	37	60	60.00	CL	3	1	1	32	52	11	18.33	-	-	31.0	21.5	9.5	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	25	30	40	70	70.00	-	-	-	-	-	-	-	18.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"

TABLE 14: SUMMARY OF TEST RESULTS

Bore No : P94	**Ground Elevation : RL 193.994 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.60 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 07/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23378.687	**Casing Lowered : 20.00 m**	**Ending Date : 09/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	0	35	65	0	12.08	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	D	2	1	1	1	2	3.07	ML	0	0	0	32	63	5	18.00	-	-	26.0	22.0	4.0	-	-	-	-	-	-	-	-	-	-												
	2.00	U	3	-	-	-	-	-	CL-ML	1	1	1	25	65	7	17.53	2.04	1.74	27.0	20.5	6.5	2.67	DST	16.0	23.6	-	0.538	-	9	18	-	Inorganic Silty Clays of low plasticity											
	3.00	D	4	1	1	2	3	3.76	-	-	-	-	-	-	-	18.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	2	2	4	6	7.12	-	-	-	-	-	-	-	18.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	5.00	U	6	-	-	-	-	-	ML	4	2	1	34	55	4	16.89	1.95	1.67	26.0	22.0	4.0	2.66	DST	13.0	25.0	-	0.593	-	-	-	-	Inorganic Silts of low plasticity											
	6.00	D	7	2	3	5	8	8.73	CL-ML	3	2	2	33	55	5	16.89	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	7.00	D	8	3	3	6	9	9.46	-	-	-	-	-	-	-	15.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	U	9	-	-	-	-	-	CL-ML	1	2	2	32	56	7	17.49	2.03	1.73	27.0	21.0	6.0	2.66	DST	17.0	23.5	0.140	0.540	-	8	20	-												
	9.00	D	10	4	5	9	14	13.72	CL	5	3	2	22	59	9	17.22	-	-	29.0	22.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	10.00	D	11	5	7	10	17	15.57	-	-	-	-	-	-	-	14.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	D	12	-	-	-	-	-	CL-ML	6	2	1	18	65	8	20.58	-	-	28.0	21.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	12.50	D	13	3	8	11	19	15.91	-	-	-	-	-	-	-	21.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL	2	1	1	14	73	9	19.95	1.99	1.66	29.0	21.5	7.5	2.67	UU	47.0	11.2	-	0.609	-	-	-	-	Inorganic clays of low plasticity											
	15.50	D	15	5	11	15	26	26.00	-	-	-	-	-	-	-	20.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	U	16	-	-	-	-	-	CL	3	1	1	28	58	9	15.32	2.07	1.80	29.0	22.0	7.0	2.67	UU	45.0	13.0	-	0.487	-	-	-	-												

APPENDIX "B"

TABLE 14: SUMMARY OF TEST RESULTS

Bore No : P94	**Ground Elevation : RL 193.994 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.60 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 07/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23378.687	**Casing Lowered : 20.00 m**	**Ending Date : 09/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT									LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	18.50	D	17	7	10	12	22	15.90	-	-	-	-	-	-	-	16.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	20.00	U	18	-	-	-	-	-	CL-ML	4	2	2	17	69	6	18.63	2.16	1.82	26.0	19.5	6.5	2.66	DST	16.0	24.0	-	0.462	-	-	-	-	Inorganic Silty Clays of low plasticity											
	21.50	D	19	7	11	14	25	25.00	CL	2	1	1	27	59	10	17.10	-	-	31.0	21.5	9.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	23.00	U	20	-	-	-	-	-	CL	2	1	2	18	69	8	16.45	1.98	1.70	30.0	21.0	9.0	2.67	UU	49.0	11.5	-	0.571	-	-	-	-												
	24.50	D	21	10	13	18	31	31.00	CL	0	0	1	14	73	12	16.63	-	-	30.0	19.5	10.5	-	-	-	-	-	-	-	-	-	-												
	26.00	U	22	-	-	-	-	-	CL	4	2	1	22	63	8	15.83	2.06	1.78	27.5	19.5	8.0	2.68	UU	51.0	13.5	-	0.507	-	-	-	-												
	27.50	D	23	12	17	22	39	39.00	-	-	-	-	-	-	-	11.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.00	U	24	-	-	-	-	-	CL	4	2	1	14	67	12	17.53	2.07	1.76	31.5	20.0	11.5	2.67	UU	51.0	10.2	-	0.516	-	-	-	-												
	30.50	D	25	13	19	25	44	20.72	ML	0	1	1	45	53	0	17.84	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	32.00	D	26	-	-	-	-	-	-	-	-	-	-	-	-	21.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	33.50	D	27	16	24	33	57	57.00	CL	4	2	3	11	69	11	18.23	-	-	30.0	21.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	35.00	D	28	-	-	-	-	-	CL-ML	2	1	2	32	58	5	18.92	2.10	1.77	26.0	21.0	5.0	2.66	RDST	8.0	28.9	-	0.503	-	-	-	-	Inorganic Silty Clays of low plasticity											
	36.50	D	29	21	28	39	67	67.00	MI	1	1	1	9	73	15	24.01	-	-	39.0	26.0	13.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of Intermediate plasticity											
	38.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	13.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	24	33	46	79	79.00	CL	1	1	2	10	72	14	17.07	-	-	33.5	20.5	13.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"

TABLE 15: SUMMARY OF TEST RESULTS

Bore No: P95	**Ground Elevation: RL 193.924 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.20 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 27/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 23404.887	**Casing Lowered: 18.00 m**	**Ending Date: 29/10/2023**	**Hammer type: Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	CL-ML	0	0	1	46	48	5	10.64	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	1.00	D	2	1	2	2	4	6.20	-	-	-	-	-	-	-	19.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	2.00	U	3	-	-	-	-	-	SM-SC	0	0	0	51	44	5	20.67	1.94	1.61	26.5	21.0	5.5	2.64	DST	3.0	28.0	-	0.640	-	-	-	-	Silty Sands with clay binder											
	3.00	D	4	2	3	4	7	9.14	-	-	-	-	-	-	-	19.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	3	3	4	7	8.65	SM	0	0	1	55	44	0	17.40	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	5.00	U	6	-	-	-	-	-	CL-ML	3	2	1	40	47	7	20.48	1.96	1.63	27.0	20.5	6.5	2.66	DST	4.0	27.5	-	0.632	-	-	-	-	Inorganic Silty Clays of low plasticity											
	6.00	D	7	4	7	9	16	16.51	SM	0	0	1	54	45	0	17.50	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	7.00	D	8	4	5	6	11	11.90	-	-	-	-	-	-	-	17.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	U	9	-	-	-	-	-	CL	2	1	1	32	56	8	17.12	2.02	1.72	28.0	21.0	7.0	2.66	UU	45.0	10.7	0.105	0.542	-	8	20	-	Inorganic clays of low plasticity											
	9.00	D	10	8	10	14	24	19.56	-	-	-	-	-	-	-	20.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	9	12	16	28	28.00	CL	0	1	1	10	78	10	20.00	-	-	29.0	21.0	8.0	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL	1	1	1	8	78	11	23.09	2.03	1.65	30.0	21.0	9.0	2.67	UU	52.0	9.5	-	0.618	-	-	-	-												
	12.50	D	13	5	6	9	15	15.00	-	-	-	-	-	-	-	24.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL	3	1	1	14	70	11	20.68	1.94	1.61	29.0	20.5	8.5	2.67	UU	53.0	9.0	-	0.658	-	0	19	-												
	15.50	D	15	7	11	14	25	25.00	-	-	-	-	-	-	-	18.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	D	16	-	-	-	-	-	-	-	-	-	-	-	-	20.47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	18.50	D	17	8	15	20	35	21.20	CL-ML	0	0	1	35	59	5	19.00	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											

APPENDIX "B"
TABLE 15: SUMMARY OF TEST RESULTS

Bore No: P95	**Ground Elevation: RL 193.924 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.20 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 27/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 23404.887	**Casing Lowered: 18.00 m**	**Ending Date: 29/10/2023**	**Hammer type: Rope-pulley**

FIELD TEST RESULT									LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	20.00	U	18	-	-	-	-	-	CL	10	5	3	9	63	10	17.91	1.97	1.67	30.0	21.0	9.0	2.67	UU	49.0	10.2	-	0.599	-	-	-	-	Inorganic clays of low plasticity											
	21.50	D	19	14	20	26	46	46.00	-	-	-	-	-	-	-	20.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.00	D	20	-	-	-	-	-	CL-ML	2	1	1	14	74	8	20.32	2.08	1.73	27.0	20.5	6.5	-	RUU	40.0	9.4	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	24.50	D	21	16	21	27	48	24.07	-	-	-	-	-	-	-	13.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	D	22	-	-	-	-	-	CL-ML	0	0	1	32	60	7	19.55	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-												
	27.50	D	23	17	20	25	45	22.18	ML	4	2	1	12	76	5	25.73	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	29.00	U	24	-	-	-	-	-	ML	6	1	1	25	62	5	19.63	2.01	1.68	24.5	20.5	4.0	2.65	DST	6.0	26.7	-	0.577	-	-	-	-												
	30.50	D	25	14	23	29	52	23.59	CL-ML	2	1	2	40	49	6	19.99	-	-	27.0	20.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	32.00	D	26	13	30	37	67	67.00	CL	5	2	1	13	67	12	18.58	-	-	29.0	20.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	33.50	D	27	15	31	36	67	67.00	-	-	-	-	-	-	-	18.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	35.00	D	28	13	29	35	64	25.94	SM	0	1	1	52	46	0	21.35	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	36.50	D	29	12	25	33	58	58.00	CL	2	1	1	16	70	10	22.32	-	-	29.0	20.5	8.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	38.00	D	30	12	26	30	56	56.00	-	-	-	-	-	-	-	21.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	14	26	32	58	58.00	CL	1	1	2	12	75	9	24.35	-	-	28.5	20.5	8.0	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 16: SUMMARY OF TEST RESULTS

Bore No : P96	**Ground Elevation : RL 193.961 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.20 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using : Casing**	**Starting Date : 28/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23431.087	**Casing Lowered : 21.00 m**	**Ending Date : 30/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	1	42	57	0	14.85	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	D	2	1	1	2	3	4.61	CL-ML	0	0	1	46	49	4	19.45	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	2.00	U	3	-	-	-	-	-	SM	9	1	1	54	35	0	14.71	2.02	1.76	Non-Plastic			2.63	DST	3.0	27.5	-	0.494	-	-	-	-	Silty Sands											
	3.00	D	4	2	2	3	5	6.44	-	-	-	-	-	-	-	16.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	1	1	3	4	4.86	CL-ML	0	0	1	38	55	6	19.46	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	5.00	D	6	-	-	-	-	-	-	-	-	-	-	-	-	19.10	1.94	1.63	-	-	-	2.66	RDST	5.0	24.3	-	0.632	-	-	-	-												
	6.00	D	7	3	4	6	10	11.14	SM	0	1	0	57	42	0	17.17	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	7.00	D	8	3	4	7	11	11.80	-	-	-	-	-	-	-	18.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	D	9	-	-	-	-	-	CL	0	1	1	13	77	8	20.42	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	9.00	D	10	4	6	8	14	14.11	-	-	-	-	-	-	-	19.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	5	7	9	16	15.30	-	-	-	-	-	-	-	18.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL	2	0	1	7	82	8	22.45	2.02	1.65	29.0	21.5	7.5	2.66	UU	42.0	10.5	-	0.612	-	9	20	-												
	12.50	D	13	5	8	10	18	18.00	-	-	-	-	-	-	-	21.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL-ML	1	1	0	18	71	9	20.92	2.01	1.66	27.0	20.5	6.5	2.66	UU	40.0	11.2	-	0.602	-	-	-	-	Inorganic Silty Clays of low plasticity											
	15.50	D	15	6	10	14	24	17.53	-	-	-	-	-	-	-	17.58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	U	16	-	-	-	-	-	SM	2	1	2	55	40	0	17.75	2.03	1.72	Non-Plastic			2.63	DST	2.0	28.0	-	0.529	-	-	-	-	Silty Sands											
	18.50	D	17	10	17	22	39	22.69	-	-	-	-	-	-	-	19.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"

TABLE 16: SUMMARY OF TEST RESULTS

Bore No : P96	**Ground Elevation : RL 193.961 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.20 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using : Casing**	**Starting Date : 28/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23431.087	**Casing Lowered : 21.00 m**	**Ending Date : 30/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	20.00	D	18	-	-	-	-	-	CL-ML	2	1	1	27	62	7	19.69	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	21.50	D	19	12	19	24	43	23.22	-	-	-	-	-	-	-	19.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.00	U	20	-	-	-	-	-	CL	4	1	2	22	60	11	23.47	1.99	1.61	30.0	22.0	8.0	2.67	UU	49.0	9.4	-	0.658	-	-	-	-	Inorganic clays of low plasticity											
	24.50	D	21	14	21	24	45	45.00	-	-	-	-	-	-	-	24.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	D	22	-	-	-	-	-	SM	1	1	0	55	43	0	18.06	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	27.50	D	23	12	24	28	52	24.35	-	-	-	-	-	-	-	19.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.00	D	24	-	-	-	-	-	CL-ML	2	2	2	34	53	7	23.23	2.13	1.73	27.0	20.5	6.5	2.66	RUU	42.0	12.1	-	0.538	-	-	-	-	Inorganic Silty Clays of low plasticity											
	30.50	D	25	14	25	30	55	24.29	-	-	-	-	-	-	-	18.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.00	D	26	16	26	33	59	25.01	SM	0	0	1	50	49	0	19.36	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	33.50	D	27	15	21	29	50	21.95	CL-ML	1	1	1	37	53	7	22.82	-	-	27.5	21.0	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	35.00	D	28	-	-	-	-	-	SM	1	1	1	50	47	0	17.96	2.09	1.77	Non-Plastic			2.65	RDST	5.0	29.3	-	0.497	-	-	-	-	Silty Sands											
	36.50	D	29	17	24	29	53	22.03	CL	1	1	0	18	72	8	11.90	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	38.00	D	30	19	30	32	62	24.07	-	-	-	-	-	-	-	12.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	22	33	36	69	25.41	CL-ML	1	1	2	14	75	7	22.31	-	-	27.0	20.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

Soil investigation for HORC Viaduct between Sohana & Dhulawat stations, Haryana

APPENDIX "B"
TABLE 17: SUMMARY OF TEST RESULTS

Bore No : P97	**Ground Elevation : RL 194.016 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.80 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 08/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23457.287	**Casing Lowered : 19.00 m**	**Ending Date : 10/10/2023**	**Hammer type : Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	SPT Test Result					Soil Classification	Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
				N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)		Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK										Classification of SOIL											
	0.50	D	1	-	-	-	-	-	CL-ML	2	1	1	34	57	5	12.14	-	-	25.5	20.5	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	1.00	D	2	-	-	-	-	-	-	-	-	-	-	-	-	19.37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	2.00	D	3	1	1	2	3	3.00	CL	2	1	2	35	52	8	20.38	-	-	27.5	19.5	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	3.00	D	4	2	3	4	7	8.87	ML	1	1	1	40	53	4	16.19	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	4.00	U	5	-	-	-	-	-	SM	5	1	0	53	41	0	13.75	1.99	1.75	Non-Plastic			2.64	DST	7.0	27.0	-	0.509	-	-	-	-	Silty Sands											
	5.00	D	6	3	4	6	10	11.46	-	-	-	-	-	-	-	19.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	3	5	7	12	13.18	-	-	-	-	-	-	-	18.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	U	8	-	-	-	-	-	ML	3	1	1	44	47	4	18.74	2.01	1.69	24.0	20.0	4.0	2.65	DST	10.0	26.0	-	0.568	-	-	-	-	Inorganic Silts of low plasticity											
	8.00	D	9	4	6	8	14	14.26	CL	2	1	1	39	49	8	19.47	-	-	28.0	21.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	9.00	D	10	5	9	14	23	18.83	-	-	-	-	-	-	-	23.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	0	1	1	2	88	8	18.31	2.03	1.72	29.0	22.0	7.0	2.66	UU	44.0	11.5	0.146	0.547	-	0	20	-												
	11.00	D	12	3	5	6	11	10.17	-	-	-	-	-	-	-	21.81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	5	6	8	14	14.00	CL	3	2	1	6	77	11	19.52	-	-	29.0	20.0	9.0	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	-	-	-	-	-	-	-	20.94	2.06	1.70	-	-	-	2.67	UU	51.0	9.5	-	0.571	-	-	-	-												
	14.50	D	15	6	8	9	17	17.00	CL	6	2	2	11	69	10	19.15	-	-	27.0	19.5	7.5	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	0	1	2	46	44	7	17.23	1.98	1.69	28.0	20.0	8.0	2.66	DST	8.0	26.5	-	0.574	-	7	17	-												
	17.50	D	17	7	9	11	20	20.00	CL	3	2	2	15	66	12	21.10	-	-	30.0	21.0	9.0	-	-	-	-	-	-	-	-	-	-												

Soil investigation for HORC Viaduct between Sohana & Dhulawat stations, Haryana

APPENDIX "B"
TABLE 17: SUMMARY OF TEST RESULTS

Bore No : P97	**Ground Elevation : RL 194.016 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.80 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 08/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23457.287	**Casing Lowered : 19.00 m**	**Ending Date : 10/10/2023**	**Hammer type : Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen												
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL												
	19.00	D	18	-	-	-	-	-	-	-	-	-	-	-	-	20.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity												
	20.50	D	19	3	10	15	25	25.00	CL	6	3	5	8	66	12	22.98	-	-	31.0	21.0	10.0	-	-	-	-	-	-	-	-	-	-													
	22.00	D	20	-	-	-	-	-	-	-	-	-	-	-	-	21.88	2.10	1.72	-	-	-	-	RUU	44.0	11.3	-	-	-	-	-	-													
	23.50	D	21	8	16	27	43	43.00	CL	9	7	6	6	59	13	15.36	-	-	33.0	22.0	11.0	2.67	-	-	-	-	-	-	8	18	-													
	25.00	D	22	-	-	-	-	-	-	-	-	-	-	-	-	20.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	26.50	D	23	7	14	25	39	20.17	CL-ML	2	1	2	26	61	8	22.81	-	-	28.0	21.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity												
	28.00	D	24	-	-	-	-	-	-	-	-	-	-	-	-	15.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	29.50	D	25	15	37	40	77	31.19	SM	0	1	1	50	48	0	19.16	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands												
	31.00	U	26	-	-	-	-	-	SM	0	1	1	51	47	0	19.56	2.03	1.70	Non-Plastic			2.63	DST	7.0	26.8	-	0.547	-	-	-	-													
	32.50	D	27	16	33	39	72	28.53	ML	0	1	2	44	53	0	20.29	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity												
	34.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	17.46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	35.50	D	29	15	35	38	73	27.64	ML	0	0	0	38	58	4	19.00	-	-	25.0	21.0	4.0	-	-	-	-	-	-	-	-	-	-													
	37.00	U	30	-	-	-	-	-	-	-	-	-	-	-	-	19.60	2.18	1.82	-	-	-	2.65	DST	10.0	26.5	-	-	-	-	-	-													
	38.50	D	31	17	34	37	71	26.05	CL-ML	0	0	1	35	59	5	19.50	-	-	25.0	20.5	4.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity												
	40.00	D	32	20	32	39	71	25.56	SM	1	1	1	52	45	0	18.21	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 18: SUMMARY OF TEST RESULTS

Bore No : P98	**Ground Elevation : RL 193.030 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.09 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using : Casing**	**Starting Date : 28/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23483.487	**Casing Lowered : 21.00 m**	**Ending Date : 30/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	1	46	53	0	16.54	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	U	2	-	-	-	-	-	SM	0	1	1	52	46	0	15.67	1.92	1.66	Non-Plastic			2.62	DST	1.0	27.5	-	0.578	-	-	-	-	Silty Sands											
	2.00	D	3	1	1	2	3	4.24	SM	5	2	3	42	48	0	18.82	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	1	2	2	4	5.28	-	-	-	-	-	-	-	19.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	U	5	-	-	-	-	-	SM	0	1	1	54	44	0	16.65	1.95	1.67	Non-Plastic			2.63	DST	2.0	27.3	-	0.575	-	-	-	-												
	5.00	D	6	2	3	3	6	7.12	CL-ML	3	1	1	36	54	5	17.55	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	6.00	D	7	2	3	5	8	9.09	ML	0	0	1	47	52	0	17.45	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	7.00	U	8	-	-	-	-	-	CL-ML	7	3	3	34	46	7	18.81	1.98	1.67	28.0	21.5	6.5	2.66	DST	8.0	25.7	-	0.593	-	9	20	-	Inorganic Silty Clays of low plasticity											
	8.00	D	9	4	5	7	12	12.00	CL	2	1	1	18	68	10	19.54	-	-	29.0	21.0	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	9.00	D	10	3	6	9	15	15.00	-	-	-	-	-	-	-	17.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	2	1	1	14	71	11	23.34	1.96	1.59	30.0	20.5	9.5	2.66	UU	47.0	9.5	0.110	0.673	-	-	-	-												
	11.00	D	12	5	8	10	18	18.00	-	-	-	-	-	-	-	24.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	6	9	12	21	21.00	-	-	-	-	-	-	-	21.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	8	4	4	11	63	10	17.85	2.02	1.71	30.0	20.5	9.5	2.67	UU	53.0	9.2	-	0.561	-	-	-	-												
	14.50	D	15	6	10	15	25	18.31	CL-ML	2	1	1	24	64	8	20.63	-	-	27.5	21.0	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	16.00	U	16	-	-	-	-	-	CL-ML	1	1	0	32	57	9	17.63	2.05	1.74	28.0	22.0	6.0	2.66	UU	43.0	10.3	-	0.529	-	-	-	-												
	17.50	D	17	5	9	12	21	15.91	-	-	-	-	-	-	-	17.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 18: SUMMARY OF TEST RESULTS

Bore No : P98	**Ground Elevation : RL 193.030 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.09 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using : Casing**	**Starting Date : 28/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23483.487	**Casing Lowered : 21.00 m**	**Ending Date : 30/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	SM	3	10	25	26	36	0	11.35	1.95	1.75	Non-Plastic			2.60	DST	0.0	36.0	-	0.486	-	-	-	-	Silty Sands											
	20.50	D	19	8	13	17	30	18.79	CL-ML	3	3	2	24	63	5	15.21	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	22.00	D	20	-	-	-	-	-	ML	0	0	1	45	54	0	14.47	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	23.50	D	21	10	16	21	37	20.64	CL-ML	4	1	0	22	66	7	20.92	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	CL-ML	2	1	1	28	62	6	20.16	1.95	1.62	27.0	21.0	6.0	2.66	UU	40.0	11.5	-	0.642	-	-	-	-	Inorganic Silty Clays of low plasticity											
	26.50	D	23	11	18	24	42	21.63	-	-	-	-	-	-	-	20.13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	U	24	-	-	-	-	-	SM	0	0	1	57	42	0	19.85	1.98	1.65	Non-Plastic			2.62	DST	4.0	28.5	-	0.588	-	-	-	-												
	29.50	D	25	14	23	31	54	24.73	-	-	-	-	-	-	-	19.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	16	25	33	58	25.54	SM	0	0	1	68	31	0	20.71	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	32.50	D	27	15	28	34	62	26.24	-	-	-	-	-	-	-	19.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	-	-	-	-	-	-	-	-	-	-	-	-	19.33	2.11	1.77	-	-	-	2.63	RDST	0.0	31.3	-	0.486	-	-	-	-	Silty Sands											
	35.50	D	29	13	26	32	58	24.09	SM	0	1	1	58	40	0	15.37	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	SM	4	2	2	52	40	0	16.37	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	15	27	33	60	23.97	-	-	-	-	-	-	-	16.76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	15	29	33	62	24.16	-	-	-	-	-	-	-	18.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"

TABLE 19: SUMMARY OF TEST RESULTS

Bore No : P99	**Ground Elevation : RL 193.271 m**	**Method of drilling :Percussion**	**Depth of Water-table: 1.00 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 09/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23509.687	**Casing Lowered : 19.00 m**	**Ending Date : 12/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	CL	0	0	1	42	50	7	17.93	-	-	27.5	20.5	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	1.00	U	2	-	-	-	-	-	SM-SC	0	0	0	54	40	6	17.44	2.07	1.76	26.5	21.0	5.5	2.65	DST	10.5	27.5	-	0.506	-	-	-	-	Silty Sands with clay binder											
	2.00	D	3	2	2	3	5	6.95	-	-	-	-	-	-	-	18.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	3	5	8	13	15.90	SM	1	1	0	54	44	0	17.66	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	U	5	-	-	-	-	-	ML	1	1	0	46	45	7	18.05	1.98	1.68	27.0	22.0	5.0	2.66	DST	11.0	26.0	-	0.583	-	-	-	-	Inorganic Silts of low plasticity											
	5.00	D	6	6	8	9	17	17.39	ML	1	2	0	28	64	5	21.30	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	5	9	12	21	19.20	SM	0	0	1	52	47	0	18.19	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	7.00	D	8	-	-	-	-	-	CL-ML	0	1	1	44	47	7	20.83	-	-	26.5	20.5	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	8.00	D	9	7	10	15	25	25.00	CL	1	1	1	6	83	8	17.19	-	-	27.5	19.5	8.0	2.67	-	-	-	-	-	-	-	13	-	Inorganic clays of low plasticity											
	9.00	D	10	9	13	18	31	31.00	-	-	-	-	-	-	-	20.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	-	-	-	-	-	CL	1	1	2	10	79	7	20.69	2.05	1.70	27.0	19.5	7.5	-	RUU	47.0	9.6	-	-	-	-	-	-												
	11.00	D	12	5	9	11	20	20.00	-	-	-	-	-	-	-	20.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	3	5	6	11	11.00	CL	2	1	3	12	73	9	22.29	-	-	28.0	20.0	8.0	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	3	2	2	15	66	12	15.94	2.02	1.74	30.0	19.0	11.0	2.67	UU	55.0	11.0	0.167	0.534	-	-	-	-												
	14.50	D	15	6	8	12	20	20.00	CL	2	1	2	13	69	13	20.67	-	-	31.5	19.0	12.5	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	CL	1	1	1	45	43	9	16.21	1.98	1.70	26.0	18.0	8.0	2.66	DST	7.0	27.5	-	0.565	-	0	15	-												
	17.50	D	17	3	8	10	18	18.00	CL	2	1	1	32	54	10	19.48	-	-	28.0	19.0	9.0	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"

TABLE 19: SUMMARY OF TEST RESULTS

Bore No : P99	Ground Elevation : RL 193.271 m	Method of drilling :Percussion	Depth of Water-table: 1.00 m
Diameter of Bore Hole : 150 mm	Bore Retained using : Casing	Starting Date : 09/10/2023	SPT Sampler: Standard
Location / Chainage : 23509.687	Casing Lowered : 19.00 m	Ending Date : 12/10/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	SM	0	0	1	50	49	0	20.06	1.99	1.66	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	20.50	D	19	4	7	12	19	14.15	-	-	-	-	-	-	-	19.46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	CL	5	3	4	23	58	7	22.95	2.02	1.64	28.0	20.0	8.0	2.66	DST	12.0	26.5	-	0.622	-	-	-	-	Inorganic clays of low plasticity											
	23.50	D	21	7	12	18	30	18.01	CL-ML	3	2	1	34	53	7	15.55	-	-	26.5	20.5	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	25.00	D	22	-	-	-	-	-	SM	0	0	1	52	47	0	17.65	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	26.50	D	23	14	20	28	48	23.39	-	-	-	-	-	-	-	18.69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	U	24	-	-	-	-	-	CL	5	1	1	35	51	7	20.12	2.01	1.67	26.5	19.5	7.0	2.66	DST	13.0	25.5	-	0.593	-	-	-	-	Inorganic clays of low plasticity											
	29.50	D	25	14	17	22	39	39.00	CL	5	2	2	24	58	9	16.61	-	-	28.0	20.5	7.5	-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	-	-	-	-	-	ML	0	0	1	44	55	0	17.83	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	32.50	D	27	16	19	24	43	20.29	-	-	-	-	-	-	-	19.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	-	-	-	-	-	ML	0	1	1	41	57	0	18.52	2.04	1.72	Non-Plastic			2.65	RDST	5.0	25.4	-	0.541	-	-	-	-												
	35.50	D	29	20	26	30	56	23.33	-	-	-	-	-	-	-	21.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	SM	0	0	2	51	47	0	18.21	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	38.50	D	31	21	26	32	58	23.22	-	-	-	-	-	-	-	18.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	18	30	34	64	24.50	-	-	-	-	-	-	-	16.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 20: SUMMARY OF TEST RESULTS

Bore No : P100	Ground Elevation : RL 193.996 m	Method of drilling: Percussion	Depth of Water-table: 1.30 m
Diameter of Bore Hole: 150 mm	Bore Retained using : Casing	Starting Date : 28/10/2023	SPT Sampler: Standard
Location / Chainage : 23535.887	Casing Lowered : 24.00 m	Ending Date : 30/10/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	CL-ML	0	0	1	48	47	4	16.94	-	-	24.5	20.0	4.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	1.00	U	2	-	-	-	-	-	ML	0	1	1	47	48	3	18.23	2.01	1.70	24.0	20.0	4.0	2.65	DST	3.0	28.5	-	0.559	-	-	-	-	Inorganic Silts of low plasticity											
	2.00	D	3	1	2	2	4	5.48	-	-	-	-	-	-	-	18.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	2	3	3	6	7.69	CL-ML	0	0	0	42	52	6	18.58	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	4.00	D	5	-	-	-	-	-	-	-	-	-	-	-	-	18.55	1.87	1.58	-	-	-	2.65	RDST	6.0	24.5	-	0.677	-	-	-	-												
	5.00	D	6	2	3	5	8	9.35	ML	1	0	1	46	52	0	16.80	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	6.00	D	7	5	7	9	16	16.49	SM	0	0	1	60	39	0	20.22	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	7.00	D	8	-	-	-	-	-	-	-	-	-	-	-	-	20.56	2.00	1.66	-	-	-	-	RDST	0.0	28.9	-	-	-	-	-	-												
	8.00	D	9	6	7	13	20	17.89	CL-ML	0	1	0	16	76	7	20.62	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	9.00	D	10	8	10	13	23	19.04	-	-	-	-	-	-	-	23.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	2	1	0	13	76	8	20.51	1.98	1.64	29.0	21.5	7.5	2.66	UU	43.0	11.5	0.154	0.622	-	-	-	-	Inorganic clays of low plasticity											
	11.00	D	12	7	11	13	24	18.82	ML	1	0	0	10	82	7	19.70	-	-	30.0	23.5	6.5	-	-	-	-	-	-	-	-	19	-	Inorganic Silts of low plasticity											
	12.00	D	13	8	13	18	31	21.72	-	-	-	-	-	-	-	20.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	D	14	-	-	-	-	-	-	-	-	-	-	-	-	22.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.50	D	15	5	8	10	18	18.00	CL	4	2	1	9	75	9	17.31	-	-	29.0	21.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	16.00	U	16	-	-	-	-	-	SM-SC	4	3	4	44	40	5	15.52	2.01	1.74	25.0	20.0	5.0	2.66	UU	49.0	15.1	-	0.529	-	-	-	-	Silty Sands with clay binder											
	17.50	D	17	12	20	27	47	26.23	-	-	-	-	-	-	-	17.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 20: SUMMARY OF TEST RESULTS

Bore No : P100	**Ground Elevation : RL 193.996 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.30 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using : Casing**	**Starting Date : 28/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23535.887	**Casing Lowered : 24.00 m**	**Ending Date : 30/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																															
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	SM	1	1	1	56	41	0	19.79	2.00	1.67	Non-Plastic			2.64	DST	3.0	30.1	-	0.581	-	-	-	-	Silty Sands											
	20.50	D	19	7	15	22	37	21.32	ML	6	3	4	34	48	5	17.34	-	-	27.0	22.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	22.00	U	20	-	-	-	-	-	CL	3	2	3	20	59	13	16.35	1.95	1.68	33.5	22.0	11.5	2.67	UU	57.0	10.5	-	0.589	-	-	18	-	Inorganic clays of low plasticity											
	23.50	D	21	7	12	18	30	30.00	-	-	-	-	-	-	-	20.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	SM	1	0	0	52	47	0	19.63	1.95	1.63	Non-Plastic			2.64	DST	2.0	27.9	-	0.620	-	-	-	-	Silty Sands											
	26.50	D	23	8	15	23	38	20.19	-	-	-	-	-	-	-	18.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	-	-	-	-	-	SM	0	0	1	56	43	0	19.81	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	29.50	D	25	18	21	23	44	21.37	-	-	-	-	-	-	-	18.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	-	-	-	-	-	ML	1	1	1	46	51	0	18.97	2.07	1.74	Non-Plastic			2.65	RDST	2.0	27.8	-	0.523	-	-	-	-	Inorganic Silts of low plasticity											
	32.50	D	27	15	30	24	54	23.61	-	-	-	-	-	-	-	17.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	14	24	26	50	22.03	SM	1	0	1	48	50	0	18.30	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	35.50	D	29	12	13	16	29	15.71	SM	1	1	0	54	44	0	18.08	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	17.84	2.06	1.75	-	-	-	2.65	RDST	0.0	28.8	-	0.514	-	-	-	-												
	38.50	D	31	18	24	23	47	20.16	SM	0	0	1	53	46	0	17.53	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	15	28	30	58	22.74	-	-	-	-	-	-	-	17.97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX-B
TABLE 21: UCS TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	UCS (kg/cm²)
P81	4.00	0.49
	7.00	0.56
	10.00	0.51
	13.00	0.61
	19.00	0.48
P82	1.00	0.64
	4.00	0.59
	13.00	0.76
	16.00	0.69
	19.00	0.72
	28.00	0.74
	31.00	0.71
P83	11.00	0.69
	14.00	0.62
	20.00	0.57
	23.00	0.60
P84	8.00	0.50
	14.00	0.55
	23.00	0.63
P85	16.00	0.76
	19.00	0.68
	22.00	0.74
	28.00	0.62
P86	14.00	0.59
	23.00	0.62
P87	1.00	0.56
	13.00	0.62
	19.00	0.65
	22.00	0.47
P88	14.00	0.59
	29.00	0.50

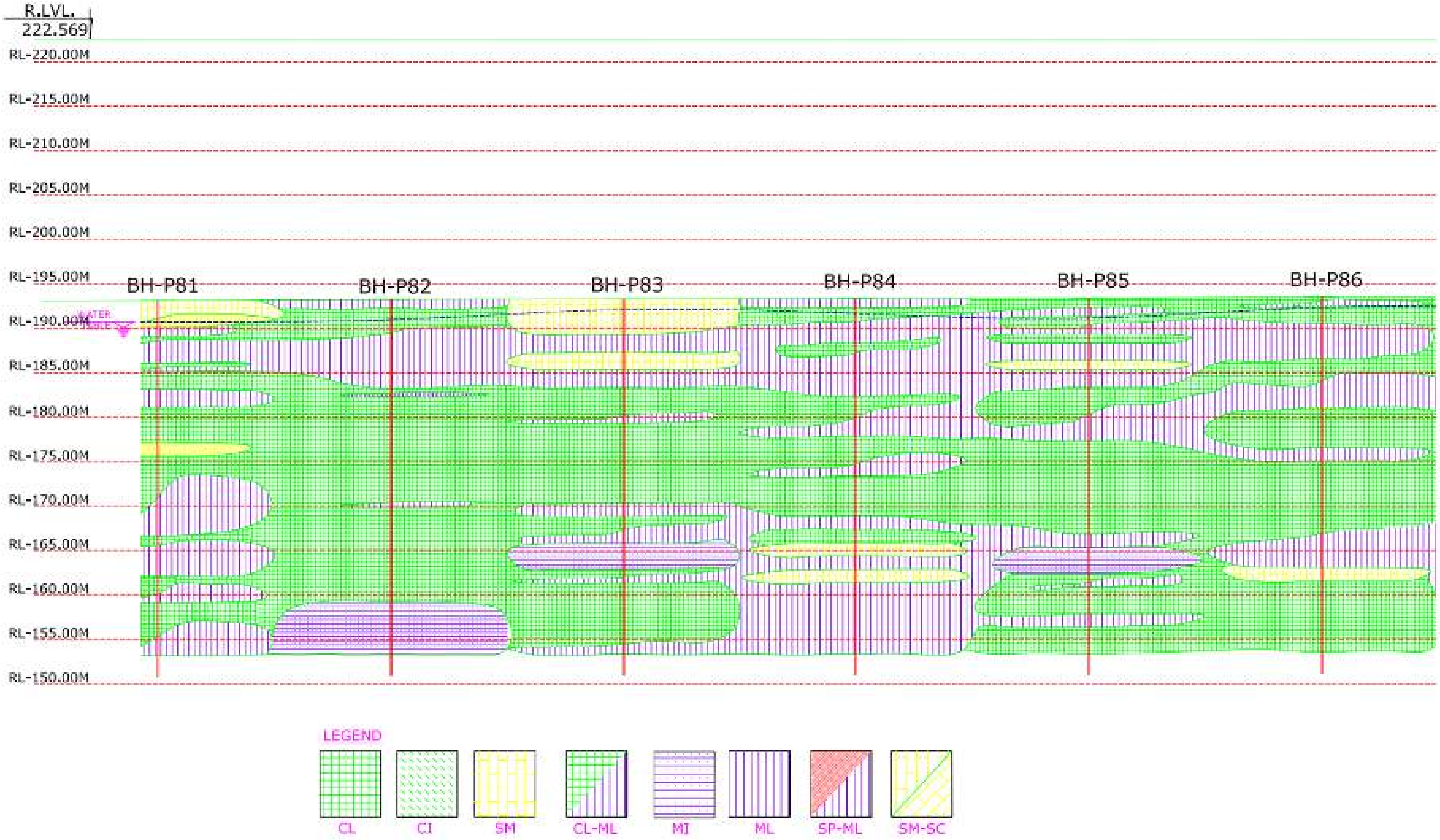
APPENDIX-B
TABLE 21: UCS TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	UCS (kg/cm²)
	32.00	0.53
P89	1.00	0.52
	19.00	0.66
	22.00	0.68
	31.00	0.51
P90	1.00	0.42
	10.00	0.48
	13.00	0.44
	19.00	0.42
	22.00	0.62
P91	10.00	0.71
	13.00	0.82
	16.00	0.78
	19.00	0.86
	28.00	0.69
P92	10.00	0.79
	13.00	0.81
	16.00	0.74
	19.00	0.70
	22.00	0.81
	25.00	0.73
P93	13.00	0.63
	16.00	0.65
	19.00	0.58
	22.00	0.62
P94	14.00	0.57
	17.00	0.64
	23.00	0.55
	26.00	0.66
	29.00	0.66
P95	8.00	0.48

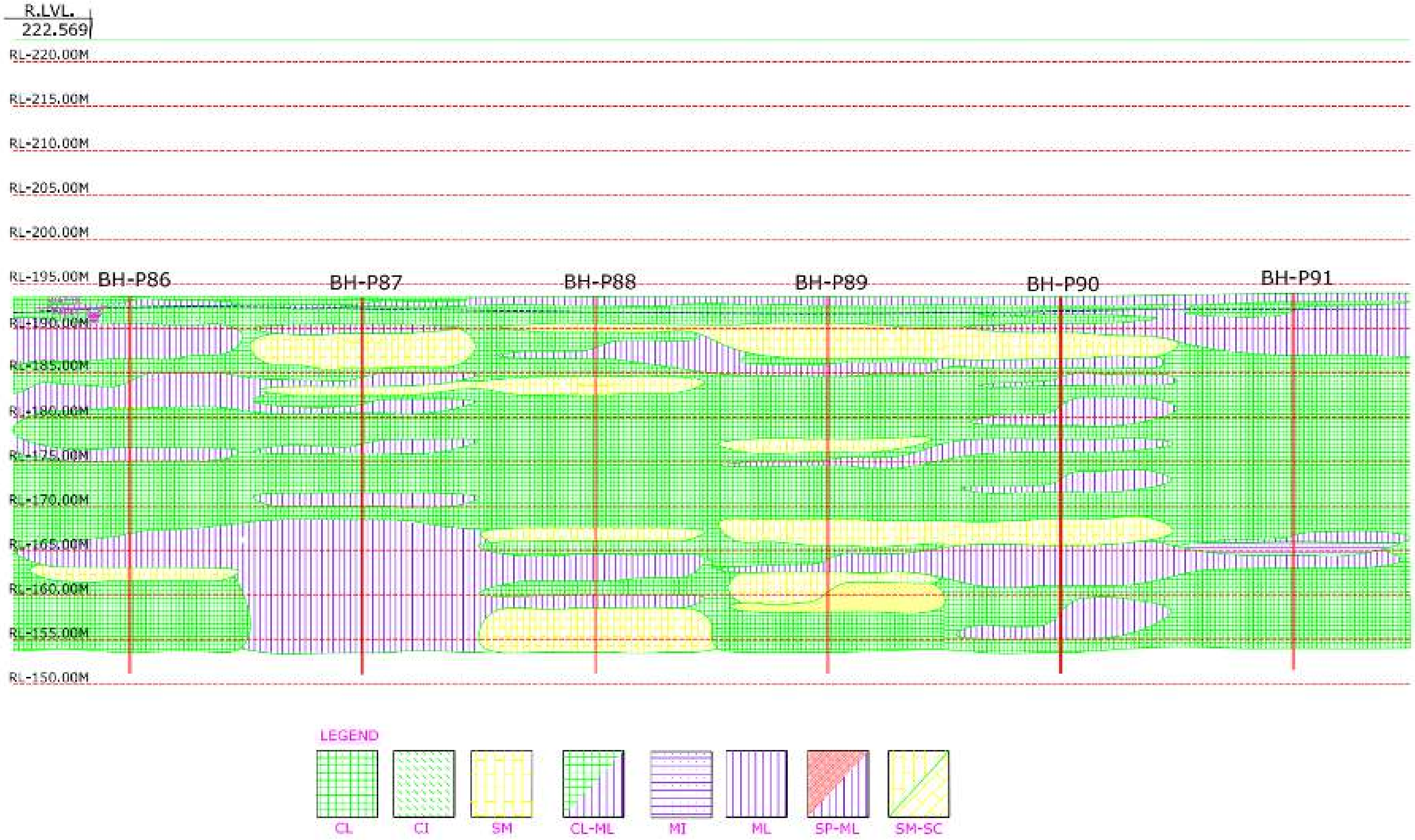
APPENDIX-B
TABLE 21: UCS TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	UCS (kg/cm²)
	11.00	0.59
	14.00	0.61
	20.00	0.56
P96	11.00	0.57
	14.00	0.51
	23.00	0.68
P97	10.00	0.69
	13.00	0.75
P98	10.00	0.53
	13.00	0.68
	16.00	0.59
	25.00	0.51
P99	13.00	0.82
P100	16.00	0.48
	22.00	0.49

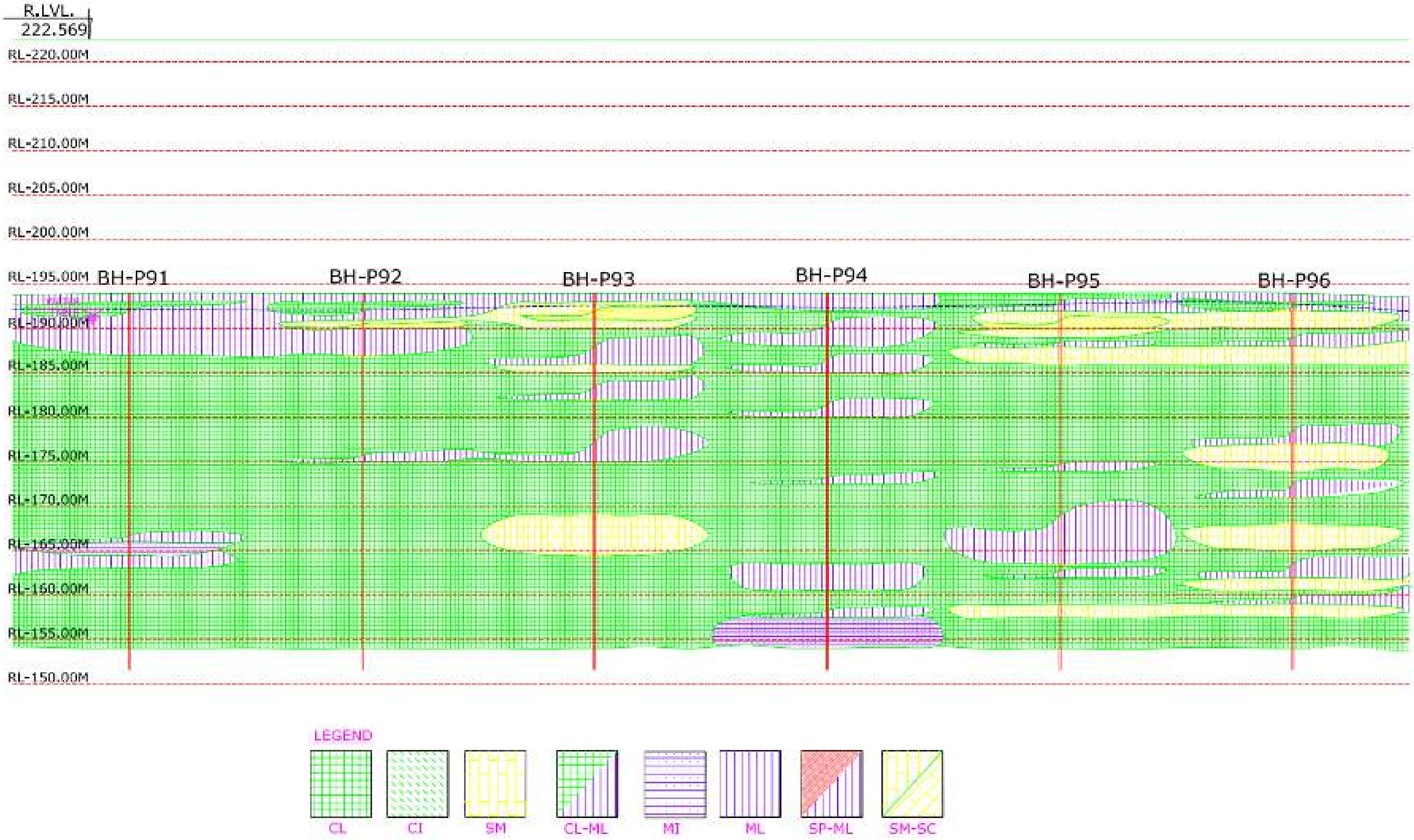
APPENDIX-C
PLOT 1: LITHOLOGICAL PROFILE-1



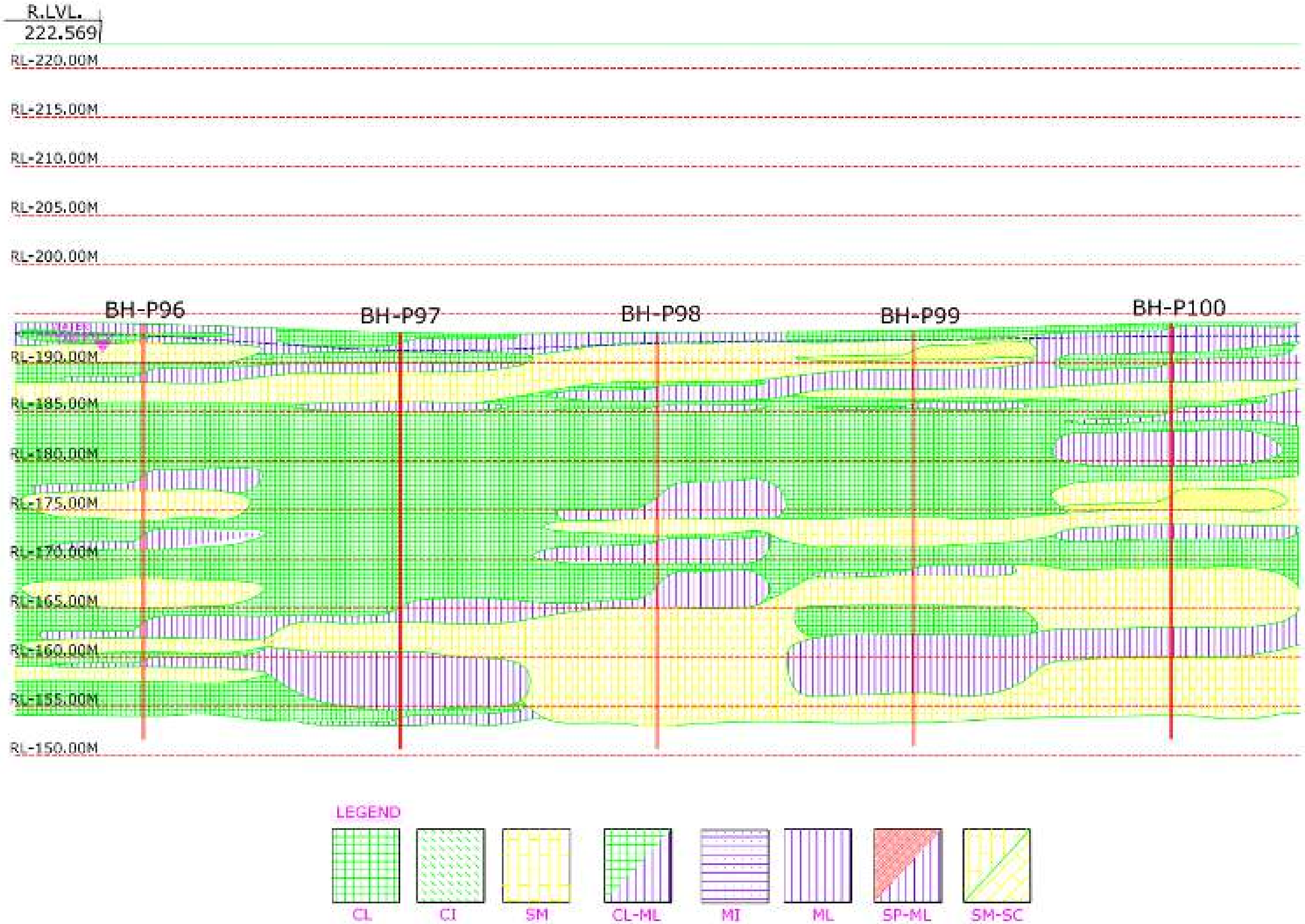
APPENDIX-C
PLOT 2: LITHOLOGICAL PROFILE-2



APPENDIX-C
PLOT 3: LITHOLOGICAL PROFILE-3



APPENDIX-C
PLOT 4: LITHOLOGICAL PROFILE-4



APPENDIX-C
PLOT 5: LITHOLOGICAL PLOTS

BH-P81-23038.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	U		-	-
Silty Sands with clay binder	SM-SC		2.00	D	2	-	-
Inorganic Silts of low plasticity	ML		3.00	D	7	-	-
Inorganic Silty Clays of low plasticity	CL-ML		4.00	U		-	-
			5.00	D	8	-	-
Inorganic Silts of low plasticity	ML		6.00	D	14	-	-
Inorganic Silty Clays of low plasticity	CL-ML		7.00	U		-	-
			8.00	D	16	-	-
Inorganic clays of low plasticity	CL		9.00	D	19	-	-
			10.00	U		-	-
Inorganic Silts of low plasticity	ML		11.00	D	21	-	-
			12.00	D	24	-	-
			13.00	U		-	-
Inorganic clays of low plasticity	CL		14.50	D	29	-	-
			16.00	U		-	-
Clayey Sands	SC						
Inorganic clays of low plasticity	CL		17.50	D	28	-	-
Inorganic Silty Clays of low plasticity	CL-ML		19.00	U		-	-
			20.00	D	78	-	-

BH-P81-23038.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.50	D	78	-	-
Inorganic Silty Clays of low plasticity	CL-ML		22.00	D		-	-
			23.50	D	102	-	-
			25.00	D	72	-	-
Inorganic Silts of low plasticity	ML						
			26.50	D	55	-	-
Inorganic Silty Clays of low plasticity	CL-ML		28.00	D	67	-	-
Inorganic Silts of low plasticity	ML		29.50	D	95	-	-
			31.00	D	52	-	-
Inorganic Silty Clays of low plasticity	CL-ML		32.50	D	60	-	-
			34.00	D	63	-	-
Inorganic clays of low plasticity	CL		35.50	D	64	-	-
			37.00	D	77	-	-
Inorganic Silty Clays of low plasticity	CL-ML		38.50	D	85	-	-
			40.00	D	92	-	-

APPENDIX-C
PLOT 6: LITHOLOGICAL PLOTS

BH-P82-23064.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		2.00	D	3	-	-
			3.00	D	5	-	-
			4.00	U		-	-
			5.00	D	8	-	-
			6.00	D	11	-	-
			7.00	U		-	-
Inorganic Silts of low plasticity	ML		8.00	D	17	-	-
			9.00	D	18	-	-
Inorganic Silty Clays of low plasticity	CL-ML		10.00	D		-	-
			11.00	D	24	-	-
Inorganic clays of low plasticity	CL		12.00	D	29	-	-
			13.00	U		-	-
			14.50	D	33	-	-
			16.00	U		-	-
			17.50	D	37	-	-
			19.00	U		-	-
			20.00	D	41	-	-

BH-P82-23064.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.50	D	41	-	-
			22.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		23.50	D	48	-	-
Inorganic clays of low plasticity	CL		25.00	D		-	-
			26.50	D	51	-	-
			28.00	U		-	-
			29.50	D	55	-	-
			31.00	U		-	-
			32.50	D	60	-	-
Inorganic Silts of intermediate plasticity	MI		34.00	D	67	-	-
			35.50	D	71	-	-
			37.00	D		-	-
			38.50	D	75	-	-
			40.00	D	81	-	-

APPENDIX-C
PLOT 7: LITHOLOGICAL PLOTS

BH-P83-23090.487

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			0.50	D		-	-
			1.00	D	5	-	-
Silty Sands	SM		2.00	U		-	-
			3.00	D	6	-	-
			4.00	D	7	-	-
Inorganic Silts of low plasticity	ML		5.00	U		-	-
			6.00	D	39	-	-
Silty Sands	SM		7.00	D	8	-	-
			8.00	U		-	-
Inorganic Silts of low plasticity	ML		9.00	D	32	-	-
			10.00	D	34	-	-
Inorganic clays of low plasticity	CL		11.00	U		-	-
			12.50	D	32	-	-
Inorganic Silty Clays of low plasticity	CL-ML						
			14.00	U		-	-
			15.50	D	38	-	-
Inorganic clays of low plasticity	CL		17.00	D		-	-
			18.50	D	41	-	-
			20.00	U		-	-

BH-P83-23090.487

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	U		-	-
Inorganic clays of low plasticity	CL		21.50	D	49	-	-
			23.00	U		-	-
Inorganic Silts of low plasticity	ML						
			24.50	D	50	-	-
Inorganic Silty Clays of low plasticity	CL-ML		26.00	D		-	-
			27.50	D	47	-	-
Inorganic Silts of Intermediate plasticity	MI		29.00	D		-	-
			30.50	D	47	-	-
Inorganic Silty Clays of low plasticity	CL-ML						
			32.00	D		-	-
			33.50	D	50	-	-
Inorganic clays of low plasticity	CL		35.00	D		-	-
			36.50	D	55	-	-
			38.00	D	58	-	-
Inorganic Silty Clays of low plasticity	CL-ML						
			40.00	D	61	-	-

APPENDIX-C

PLOT 8: LITHOLOGICAL PLOTS

BH-P84-23116.687

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
Inorganic clays of low plasticity	CL		1.00	D	7	-	-
Inorganic Silty Clays of low plasticity	CL-ML		2.00	U		-	-
			3.00	D	9	-	-
Inorganic Silts of low plasticity	ML		4.00	D	14	-	-
			5.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		6.00	D	22	-	-
			7.00	D	24	-	-
			8.00	U		-	-
Inorganic Silts of low plasticity	ML		9.00	D	19	-	-
			10.00	D	28	-	-
			11.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		12.50	D	27	-	-
			14.00	U		-	-
Inorganic clays of low plasticity	CL		15.50	D	30	-	-
			17.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		18.50	D	31	-	-
			20.00	D		-	-

BH-P84-23116.687

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	D		-	-
Inorganic clays of low plasticity	CL		21.50	D	37	-	-
			23.00	U		-	-
Inorganic Silts of low plasticity	ML		24.50	D	40	-	-
Inorganic clays of low plasticity	CL		26.00	D		-	-
Silty Sands	SM		27.50	D	48	-	-
Inorganic Silts of low plasticity	ML		29.00	D		-	-
Silty Sands	SM		30.50	D	42	-	-
			32.00	D		-	-
			33.50	D	42	-	-
			35.00	D		-	-
Inorganic Silts of low plasticity	ML		36.50	D	46	-	-
			38.00	D		-	-
			40.00	D	52	-	-

APPENDIX-C
PLOT 9: LITHOLOGICAL PLOTS

BH-P85-23142.8870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		0.50	D		-	-
Inorganic Silts of low plasticity	ML		1.00	U		-	-
			2.00	D	4	-	-
Inorganic Silty Clays of low plasticity	CL-ML		3.00	D	6	-	-
Inorganic clays of low plasticity	CL		4.00	D		-	-
			5.00	D	11	-	-
Inorganic Silts of low plasticity	ML		6.00	D	11	-	-
Silty Sands	SM		7.00	U		-	-
			8.00	D	14	-	-
Inorganic Silts of low plasticity	ML		9.00	D	17	-	-
			10.00	U		-	-
			11.00	D	28	-	-
			12.00	D	20	-	-
Inorganic Silty Clays of low plasticity	CL-ML		13.00	U		-	-
			14.50	D	22	-	-
			16.00	U		-	-
Inorganic clays of low plasticity	CL		17.50	D	37	-	-
			19.00	U		-	-
			20.00	D	43	-	-

BH-P85-23142.8870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.50	D	43	-	-
			22.00	U		-	-
Inorganic clays of low plasticity	CL		23.50	D	27	-	-
			25.00	U		-	-
			26.50	D	47	-	-
Inorganic Silts of low plasticity	ML		28.00	U		-	-
Inorganic Silts of Intermediate plasticity	MI		29.50	D	66	-	-
			31.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		32.50	D	60	-	-
Inorganic clays of low plasticity	CL		34.00	D		-	-
			35.50	D	64	-	-
Inorganic Silts of low plasticity	ML		37.00	D		-	-
Inorganic clays of low plasticity	CI		38.50	D	68	-	-
			40.00	D	72	-	-

APPENDIX-C
PLOT 10: LITHOLOGICAL PLOTS

BH-P86-23169.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML		0.50	D		-	-
			1.00	D	7	-	-
Inorganic clays of low plasticity	CL		2.00	D		-	-
			3.00	D	6	-	-
			4.00	D	8	-	-
Inorganic Silts of low plasticity	ML		5.00	U		-	-
			6.00	D	13	-	-
Inorganic clays of low plasticity	CL		7.00	D	36	-	-
			8.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		9.00	D	31	-	-
			10.00	D	27	-	-
Inorganic Silts of low plasticity	ML		11.00	U		-	-
			12.50	D	23	-	-
Inorganic clays of low plasticity	CL		14.00	U		-	-
			15.50	D	19	-	-
Inorganic Silts of low plasticity	ML		17.00	U		-	-
			18.50	D	30	-	-
Inorganic clays of low plasticity	CL		20.00	D		-	-

BH-P86-23169.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	D		-	-
			21.50	D	49	-	-
Inorganic clays of low plasticity	CL		23.00	U		-	-
			24.50	D	44	-	-
			26.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		27.50	D	49	-	-
Inorganic Silts of low plasticity	ML		29.00	D		-	-
Silty Sands	SM		30.50	D	52	-	-
			32.00	D	51	-	-
			33.50	D	48	-	-
Inorganic clays of low plasticity	CL		35.00	D		-	-
			36.50	D	47	-	-
			38.00	D		-	-
			40.00	D	54	-	-

APPENDIX-C
PLOT 11: LITHOLOGICAL PLOTS

BH-P87-23195.287

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML		0.50	D		-	-
			1.00	U		-	-
Inorganic clays of low plasticity	CL		2.00	D	6	-	-
Inorganic Silts of low plasticity	ML		3.00	D	6	-	-
			4.00	U		-	-
Silty Sands	SM		5.00	D	9	-	-
			6.00	D	9	-	-
			7.00	U		-	-
Inorganic clays of low plasticity	CL		8.00	D	10	-	-
Inorganic Silty Clays of low plasticity	CL-ML		9.00	D	31	-	-
Silty Sands	SM		10.00	D		-	-
			11.00	D	20	-	-
Inorganic Silty Clays of low plasticity	CL-ML		12.00	D	26	-	-
			13.00	U		-	-
Inorganic clays of low plasticity	CL		14.50	D	33	-	-
			16.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		17.50	D	28	-	-
Inorganic clays of low plasticity	CL		19.00	U		-	-
			20.00	D	38	-	-

BH-P87-23195.287

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.50	D	38	-	-
Inorganic Silts of low plasticity	ML		22.00	U		-	-
Inorganic clays of low plasticity	CI		23.50	D	33	-	-
			25.00	U		-	-
			26.50	D	42	-	-
			28.00	D		-	-
			29.50	D	49	-	-
			31.00	D		-	-
Inorganic Silts of low plasticity	ML		32.50	D	45	-	-
			34.00	D		-	-
			35.50	D	48	-	-
			37.00	D		-	-
			38.50	D	53	-	-
			40.00	D	57	-	-

APPENDIX-C
PLOT 12: LITHOLOGICAL PLOTS

BH-P88-23211.4870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	D	5	-	-
Inorganic clays of low plasticity	CL		2.00	U		-	-
Silty Sands	SM		3.00	D	7	-	-
			4.00	D	9	-	-
Inorganic Silty Clays of low plasticity	CL-MI		5.00	U		-	-
			6.00	D	13	-	-
			7.00	D	17	-	-
Inorganic clays of low plasticity	CL		8.00	D		-	-
			9.00	D	18	-	-
Silty Sands	SM		10.00	D	21	-	-
			11.00	U		-	-
			12.50	D	24	-	-
			14.00	U		-	-
Inorganic clays of low plasticity	CL		15.50	D	26	-	-
			17.00	D		-	-
			18.50	D	18	-	-
			20.00	D		-	-

BH-P88-23211.4870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	D		-	-
			21.50	D	22	-	-
Inorganic clays of low plasticity	CL		23.00	D		-	-
			24.50	D	35	-	-
Silty Sands	SM		26.00	U		-	-
Inorganic clays of low plasticity	CL		27.50	D	37	-	-
			29.00	U		-	-
Inorganic Silts of low plasticity	ML		30.50	D	48	-	-
Inorganic clays of low plasticity	CL		32.00	U		-	-
Inorganic Silts of low plasticity	ML		33.50	D	50	-	-
			35.00	D		-	-
Silty Sands	SM		36.50	D	55	-	-
			38.00	D		-	-
			40.00	D	62	-	-

APPENDIX-C
PLOT 13: LITHOLOGICAL PLOTS

BH-P89-23247.687

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	U		-	-
Inorganic clays of low plasticity	CL		2.00	D	4	-	-
			3.00	D	5	-	-
			4.00	U		-	-
Silty Sands	SM		5.00	D	5	-	-
			6.00	D	7	-	-
Inorganic Silty Clays of low plasticity	CL-ML		7.00	D		-	-
Inorganic Silts of low plasticity	ML		8.00	D	9	-	-
			9.00	D	27	-	-
			10.00	U		-	-
			11.00	D	19	-	-
Inorganic clays of low plasticity	CL		12.00	D	21	-	-
			13.00	D		-	-
			14.50	D	19	-	-
Silty Sands	SM		16.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		17.50	D	23	-	-
Inorganic clays of low plasticity	CL		19.00	U		-	-
			20.00	D	40	-	-

BH-P89-23247.687

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.50	D	40	-	-
Inorganic clays of low plasticity	CL		22.00	U		-	-
			23.50	D	39	-	-
			25.00	U		-	-
Silty Sands	SM		26.50	D	42	-	-
			28.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		29.50	D	52	-	-
			31.00	U		-	-
Silty Sands with clay binder	SM-SC		32.50	D	36	-	-
			34.00	D		-	-
			35.50	D	41	-	-
Inorganic clays of low plasticity	CL		37.00	D		-	-
			38.50	D	53	-	-
			40.00	D	59	-	-

APPENDIX-C
PLOT 14: LITHOLOGICAL PLOTS

BH-P90-23273.887

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		1.00	U		-	-
Inorganic clays of low plasticity	CL		2.00	D	4	-	-
Inorganic Silts of low plasticity	ML		3.00	D	6	-	-
			4.00	U		-	-
Silty Sands	SM		5.00	D	15	-	-
			6.00	D	18	-	-
Inorganic Silts of low plasticity	ML		7.00	U		-	-
			8.00	D	12	-	-
Inorganic Silty Clays of low plasticity	CL-ML		9.00	D	15	-	-
Inorganic clays of low plasticity	CL		10.00	U		-	-
			11.00	D	17	-	-
Inorganic Silty Clays of low plasticity	CL-ML		12.00	D	19	-	-
			13.00	U		-	-
Inorganic clays of low plasticity	CL		14.50	D	21	-	-
Inorganic Silts of low plasticity	ML		16.00	U		-	-
Inorganic clays of low plasticity	CL		17.50	D	25	-	-
Inorganic Silty Clays of low plasticity	CL-ML		19.00	U		-	-
			20.00	D	32	-	-

BH-P90-23273.887

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML		20.50	D	32	-	-
			22.00	U		-	-
Inorganic clays of low plasticity	CL		23.50	D	36	-	-
Silty Sands	SM		25.00	U		-	-
			26.50	D	41	-	-
Inorganic Silts of low plasticity	ML		28.00	D		-	-
			29.50	D	55	-	-
			31.00	D	59	-	-
Inorganic Silty Clays of low plasticity	CL-ML		32.50	D	66	-	-
			34.00	D		-	-
			35.50	D	62	-	-
			37.00	D		-	-
Inorganic clays of low plasticity	CL		38.50	D	53	-	-
			40.00	D	56	-	-

APPENDIX-C

PLOT 15: LITHOLOGICAL PLOTS

BH-P91-23300.0870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		2.00	D	4	-	-
			3.00	D	7	-	-
			4.00	U		-	-
Inorganic Silts of low plasticity	ML		5.00	D	9	-	-
			6.00	D	11	-	-
			7.00	D		-	-
			8.00	D	12	-	-
			9.00	D	27	-	-
			10.00	U		-	-
			11.00	D	21	-	-
			12.00	D	24	-	-
			13.00	U		-	-
Inorganic clays of low plasticity	CL		14.50	D	19	-	-
			16.00	U		-	-
			17.50	D	58	-	-
			19.00	U		-	-
			20.00	D	65	-	-

BH-P91-23300.0870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.50	D	65	-	-
			22.00	U		-	-
Inorganic clays of low plasticity	CL		23.50	D	68	-	-
			25.00	D		-	-
			26.50	D	40	-	-
Inorganic Silty Clays of low plasticity	CL-ML						
			28.00	U		-	-
Inorganic Silts of intermediate plasticity	MI						
			29.50	D	40	-	-
Inorganic Silts of low plasticity	ML						
			31.00	D		-	-
			32.50	D	42	-	-
			34.00	D		-	-
Inorganic clays of low plasticity	CL		35.50	D	45	-	-
			37.00	D		-	-
			38.50	D	56	-	-
			40.00	D	61	-	-

APPENDIX-C
PLOT 16: LITHOLOGICAL PLOTS

BH-P92-23326.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		2.00	D	3	-	-
Silty Sands with clay binder	SM SC		3.00	D	5	-	-
			4.00	U		-	-
Inorganic Silts of low plasticity	ML		5.00	D	8	-	-
			6.00	D	11	-	-
			7.00	U		-	-
			8.00	D	17	-	-
			9.00	D	18	-	-
			10.00	U		-	-
			11.00	D	16	-	-
Inorganic clays of low plasticity	CL		12.00	D	8	-	-
			13.00	U		-	-
			14.50	D	12	-	-
			16.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		17.50	D	25	-	-
Inorganic clays of low plasticity	CL		19.00	U		-	-
			20.00	D	30	-	-

BH-P92-23326.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.50	D	30	-	-
			22.00	U		-	-
			23.50	D	48	-	-
			25.00	U		-	-
			26.50	D	48	-	-
			28.00	D		-	-
Inorganic clays of low plasticity	CL		29.50	D	39	-	-
			31.00	D		-	-
			32.50	D	54	-	-
			34.00	D		-	-
			35.50	D	48	-	-
			37.00	D		-	-
			38.50	D	50	-	-
			40.00	D	64	-	-

APPENDIX-C
PLOT 17: LITHOLOGICAL PLOTS

BH-P93-23352.487

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
Silty Sands with clay binder	SM-SC		1.00	U		-	-
			2.00	D	6	-	-
Silty Sands	SM		3.00	D	5	-	-
			4.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		5.00	D	14	-	-
			6.00	D	12	-	-
			7.00	D		-	-
Silty Sands	SM		8.00	D	26	-	-
			9.00	D	19	-	-
Inorganic Silty Clays of low plasticity	CL-ML		10.00	U		-	-
			11.00	D	18	-	-
			12.00	D	16	-	-
Inorganic clays of low plasticity	CL		13.00	U		-	-
			14.50	D	29	-	-
Inorganic Silty Clays of low plasticity	CL-ML		16.00	U		-	-
			17.50	D	29	-	-
Inorganic clays of low plasticity	CL		19.00	U		-	-
			20.00	D	32	-	-

BH-P93-23352.487

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.50	D	32	-	-
			22.00	U		-	-
			23.50	D	45	-	-
Silty Sands	SM		25.00	D		-	-
			26.50	D	54	-	-
			28.00	D	63	-	-
Inorganic clays of low plasticity	CL		29.50	D	59	-	-
			31.00	D	55	-	-
			32.50	D	59	-	-
			34.00	D	70	-	-
			35.50	D	78	-	-
			37.00	D	69	-	-
			38.50	D	60	-	-
			40.00	D	70	-	-

APPENDIX-C
PLOT 18: LITHOLOGICAL PLOTS

BH-P94-23378.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	D	2	-	-
			2.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		3.00	D	3	-	-
			4.00	D	6	-	-
Inorganic Silts of low plasticity	ML		5.00	U		-	-
			6.00	D	8	-	-
Inorganic Silty Clays of low plasticity	CL-ML		7.00	D	9	-	-
			8.00	U		-	-
			9.00	D	14	-	-
Inorganic clays of low plasticity	CL		10.00	D	17	-	-
			11.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		12.50	D	19	-	-
			14.00	U		-	-
			15.50	D	26	-	-
Inorganic clays of low plasticity	CL		17.00	U		-	-
			18.50	D	22	-	-
			20.00	U		-	-

BH-P94-23378.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML		20.00	U		-	-
			21.50	D	25	-	-
			23.00	U		-	-
			24.50	D	31	-	-
Inorganic clays of low plasticity	CL		26.00	U		-	-
			27.50	D	39	-	-
			29.00	U		-	-
			30.50	D	44	-	-
Inorganic Silts of low plasticity	ML		32.00	D		-	-
Inorganic clays of low plasticity	CL		33.50	D	57	-	-
Inorganic Silty Clays of low plasticity	CL-ML		35.00	D		-	-
			36.50	D	67	-	-
Inorganic Silts of Intermediate plasticity	MI		38.00	D		-	-
			40.00	D	79	-	-

APPENDIX-C
PLOT 19: LITHOLOGICAL PLOTS

BH-P95-23404.887

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML		0.50	D		-	-
			1.00	D	4	-	-
			2.00	U		-	-
Silty Sands with clay binder	SM-SC		3.00	D	7	-	-
Silty Sands	SM		4.00	D	7	-	-
Inorganic Silty Clays of low plasticity	CL-ML		5.00	U		-	-
Silty Sands	SM		6.00	D	16	-	-
			7.00	D	11	-	-
Inorganic clays of low plasticity	CL		8.00	U		-	-
			9.00	D	24	-	-
			10.00	D	28	-	-
			11.00	U		-	-
			12.50	D	15	-	-
			14.00	U		-	-
			15.50	D	25	-	-
			17.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		18.50	D	35	-	-
			20.00	U		-	-

BH-P95-23404.887

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.00	U		-	-
			21.50	D	46	-	-
			23.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		24.50	D	48	-	-
			26.00	D		-	-
Inorganic Silts of low plasticity	ML		27.50	D	45	-	-
			29.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		30.50	D	52	-	-
			32.00	D	67	-	-
Inorganic clays of low plasticity	CL		33.50	D	67	-	-
Silty Sands	SM		35.00	D	64	-	-
			36.50	D	58	-	-
Inorganic clays of low plasticity	CL		38.00	D	56	-	-
			40.00	D	58	-	-

APPENDIX-C
PLOT 20: LITHOLOGICAL PLOTS

BH-P96-23431.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		1.00	D	3	-	-
			2.00	U		-	-
Silty Sands	SM		3.00	D	5	-	-
			4.00	D	4	-	-
Inorganic Silty Clays of low plasticity	CL-ML		5.00	D		-	-
			6.00	D	10	-	-
Silty Sands	SM		7.00	D	11	-	-
			8.00	D		-	-
			9.00	D	14	-	-
			10.00	D	16	-	-
Inorganic clays of low plasticity	CI		11.00	U		-	-
			12.50	D	18	-	-
			14.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		15.50	D	24	-	-
			17.00	U		-	-
Silty Sands	SM		18.50	D	39	-	-
			20.00	D		-	-

BH-P96-23431.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		21.50	D	43	-	-
			23.00	U		-	-
Inorganic clays of low plasticity	CL		24.50	D	45	-	-
			26.00	D		-	-
Silty Sands	SM		27.50	D	52	-	-
			29.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		30.50	D	55	-	-
Silty Sands	SM		32.00	D	50	-	-
Inorganic Silty Clays of low plasticity	CL-ML		33.50	D	50	-	-
Silty Sands	SM		35.00	D		-	-
			36.50	D	53	-	-
Inorganic clays of low plasticity	CI		38.00	D	62	-	-
			40.00	D	69	-	-

APPENDIX-C
PLOT 21: LITHOLOGICAL PLOTS

BH-P97-23457.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML		0.50	D		-	-
			1.00	D		-	-
Inorganic clays of low plasticity	CL		2.00	D	3	-	-
Inorganic Silts of low plasticity	ML		3.00	D	7	-	-
			4.00	U		-	-
Silty Sands	SM		5.00	D	10	-	-
			6.00	D	12	-	-
Inorganic Silts of low plasticity	ML		7.00	U		-	-
			8.00	D	14	-	-
			9.00	D	23	-	-
			10.00	U		-	-
			11.00	D	11	-	-
			12.00	D	14	-	-
Inorganic clays of low plasticity	CL		13.00	U		-	-
			14.50	D	17	-	-
			16.00	U		-	-
			17.50	D	20	-	-
			19.00	D		-	-
			20.00	D	25	-	-

BH-P97-23457.2870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.50	D	25	-	-
			22.00	D		-	-
Inorganic clays of low plasticity	CL		23.50	D	43	-	-
			25.00	D		-	-
			26.50	D	39	-	-
Inorganic Silty Clays of low plasticity	CL-ML		28.00	D		-	-
			29.50	D	77	-	-
Silty Sands	SM		31.00	U		-	-
			32.50	D	77	-	-
			34.00	D		-	-
Inorganic Silts of low plasticity	ML		35.50	D	73	-	-
			37.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		38.50	D	71	-	-
			40.00	D	71	-	-

APPENDIX-C
PLOT 22: LITHOLOGICAL PLOTS

BH-P98-23483.487

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	U		-	-
Silty Sands	SM		2.00	D	3	-	-
			3.00	D	4	-	-
			4.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		5.00	D	6	-	-
Inorganic Silts of low plasticity	ML		6.00	D	8	-	-
Inorganic Silty Clays of low plasticity	CL-ML		7.00	U		-	-
Inorganic clays of low plasticity	CL		8.00	D	12	-	-
			9.00	D	15	-	-
			10.00	U		-	-
			11.00	D	18	-	-
			12.00	D	21	-	-
			13.00	U		-	-
			14.50	D	25	-	-
Inorganic Silty Clays of low plasticity	CL-ML		16.00	U		-	-
			17.50	D	21	-	-
Silty Sands	SM		19.00	U		-	-
			20.00	D	30	-	-

BH-P98-23483.487

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM						
Inorganic Silty Clays of low plasticity	CL-ML		20.50	D	30	-	-
Inorganic Silts of low plasticity	ML		22.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		23.50	D	37	-	-
			25.00	U		-	-
			26.50	D	42	-	-
Silty Sands	SM		28.00	U		-	-
			29.50	D	54	-	-
			31.00	D	58	-	-
			32.50	D	62	-	-
			34.00	D		-	-
			35.50	D	58	-	-
			37.00	D		-	-
			38.50	D	60	-	-
			40.00	D	62	-	-

APPENDIX-C
PLOT 23: LITHOLOGICAL PLOTS

BH-P99-23509.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		0.50	D		-	-
			1.00	U		-	-
Silty Sands with clay binder	SM-SC		2.00	D	5	-	-
Silty Sands	SM		3.00	D	13	-	-
			4.00	U		-	-
Inorganic Silts of low plasticity	ML		5.00	D	17	-	-
Silty Sands	SM		6.00	D	21	-	-
Inorganic Silty Clays of low plasticity	CL-ML		7.00	D		-	-
Inorganic clays of low plasticity	CL		8.00	D	25	-	-
			9.00	D	31	-	-
			10.00	D		-	-
			11.00	D	20	-	-
			12.00	D	11	-	-
			13.00	U		-	-
			14.50	D	20	-	-
			16.00	U		-	-
			17.50	D	18	-	-
Silty Sands	SM		19.00	U		-	-
			20.00	D	19	-	-

BH-P99-23509.6870

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		20.50	D	19	-	-
Inorganic clays of low plasticity	CL		22.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		23.50	D	30	-	-
Silty Sands	SM		25.00	D		-	-
			26.50	D	46	-	-
Inorganic clays of low plasticity	CL		28.00	U		-	-
			29.50	D	39	-	-
Inorganic Silts of low plasticity	ML		31.00	D		-	-
			32.50	D	43	-	-
			34.00	D		-	-
			35.50	D	56	-	-
Silty Sands	SM		37.00	D		-	-
			38.50	D	58	-	-
			40.00	D	64	-	-

APPENDIX-C
PLOT 24: LITHOLOGICAL PLOTS

BH-P100-23535.887

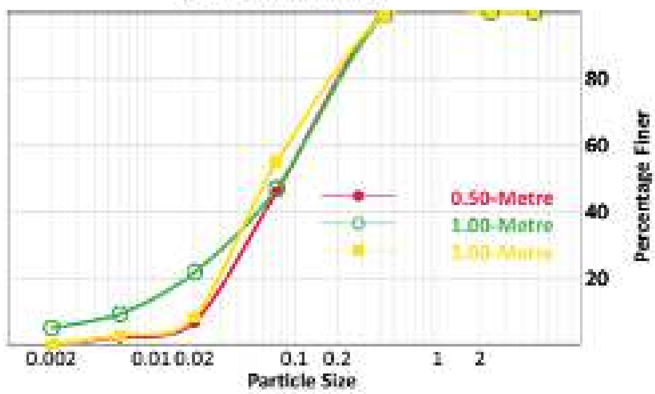
DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML		0.50	D		-	-
			1.00	U		-	-
Inorganic Silts of low plasticity	ML		2.00	D	4	-	-
			3.00	D	6	-	-
Inorganic Silty Clays of low plasticity	CL-ML		4.00	D		-	-
Inorganic Silts of low plasticity	ML		5.00	D	8	-	-
			6.00	D	16	-	-
Silty Sands	SM		7.00	D		-	-
			8.00	D	20	-	-
Inorganic Silty Clays of low plasticity	CL-ML		9.00	D	23	-	-
Inorganic clays of low plasticity	CI		10.00	U		-	-
			11.00	D	24	-	-
Inorganic Silts of low plasticity	ML		12.00	D	31	-	-
			13.00	D		-	-
Inorganic clays of low plasticity	CL		14.50	D	18	-	-
			16.00	U		-	-
Silty Sands with clay binder	SM-SC		17.50	D	47	-	-
Silty Sands	SM		19.00	U		-	-
			20.00	D	37	-	-

BH-P100-23535.887

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM						
Inorganic Silts of low plasticity	ML		20.50	D	37	-	-
			22.00	U		-	-
Inorganic clays of low plasticity	CI		23.50	D	30	-	-
			25.00	U		-	-
Silty Sands	SM		26.50	D	38	-	-
			28.00	D		-	-
			29.50	D	44	-	-
Inorganic Silts of low plasticity	ML		31.00	D		-	-
			32.50	D	54	-	-
Silty Sands	SM		34.00	D	50	-	-
			35.50	D	29	-	-
			37.00	D		-	-
			38.50	D	47	-	-
			40.00	D	58	-	-

APPENDIX-D
PLOT 1: GRAIN SIZE DISTRIBUTION PLOTS

BH- P81-CH.23038.087



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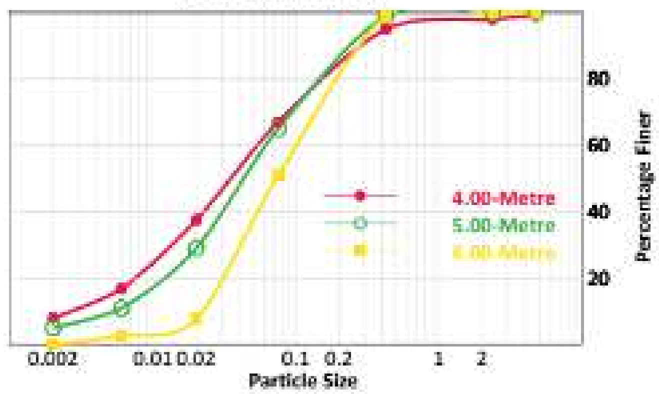

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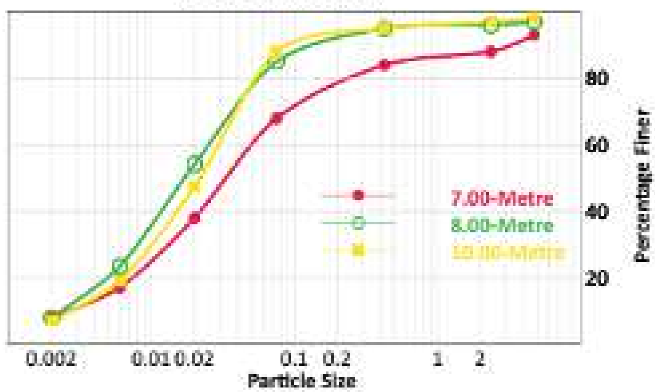
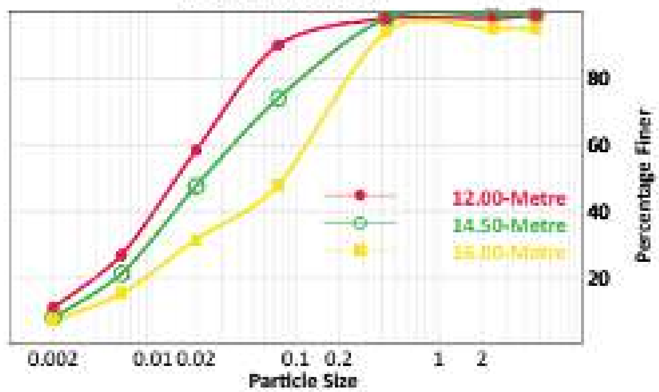


BH- P81-CH.23038.087



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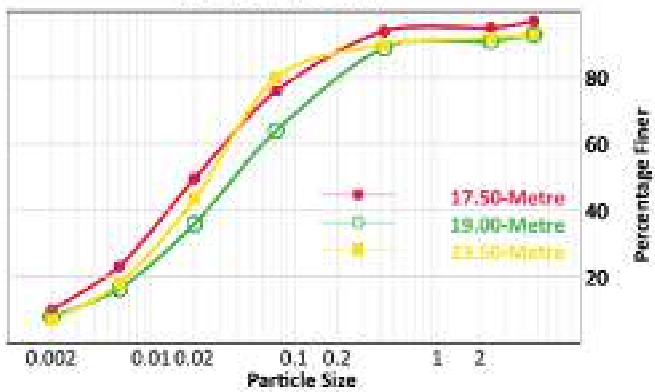

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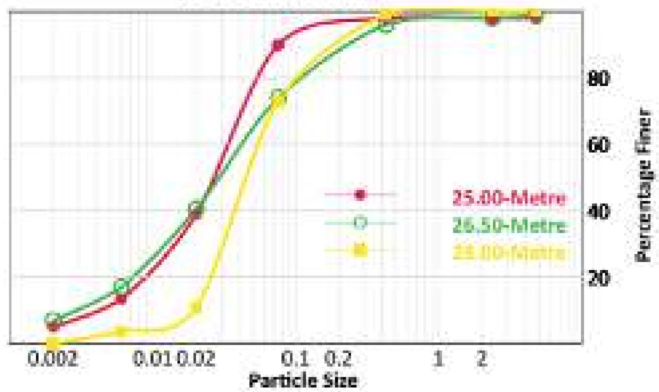

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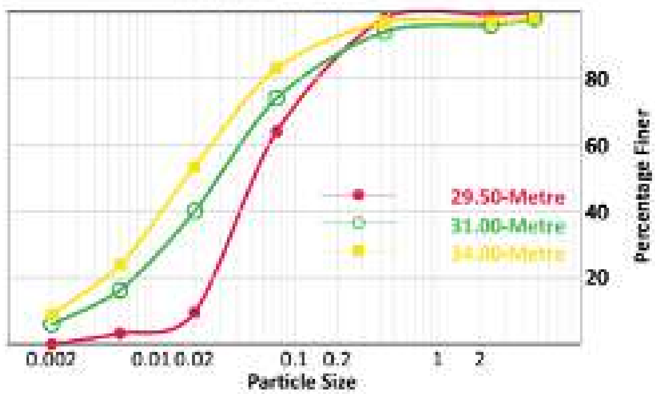

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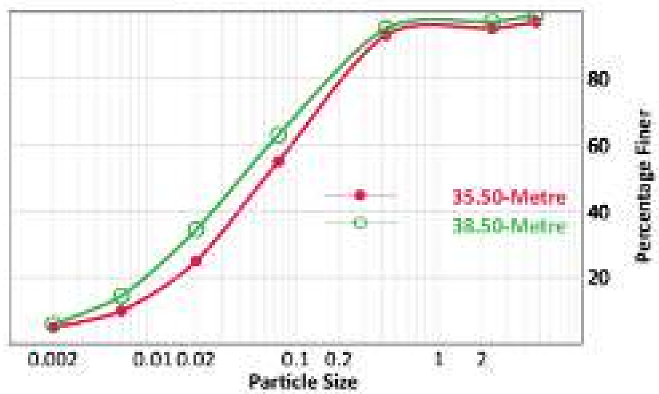
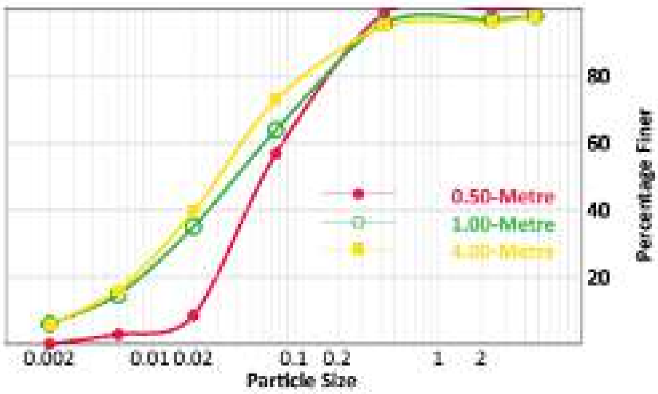


APPENDIX-D
PLOT 2: GRAIN SIZE DISTRIBUTION PLOTS

BH- P82-CH.23064.2870



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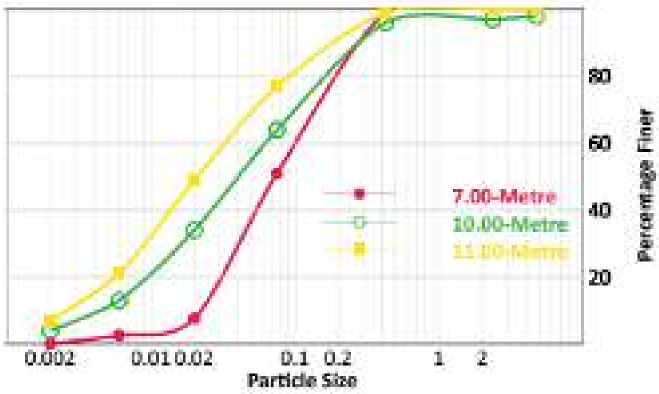

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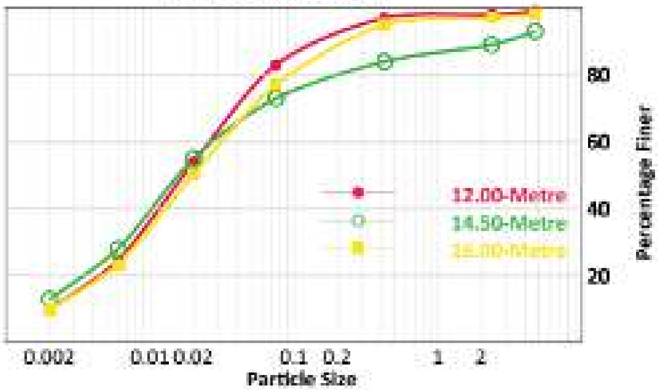

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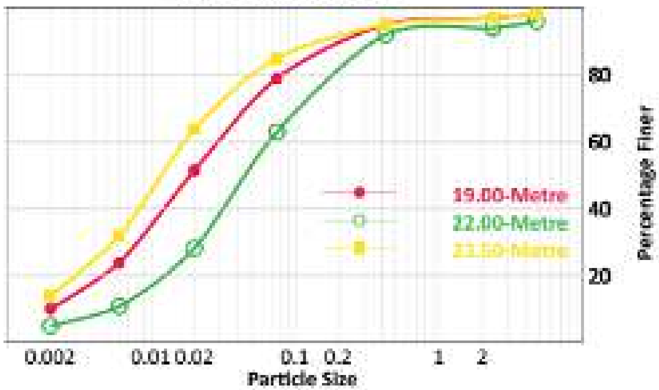

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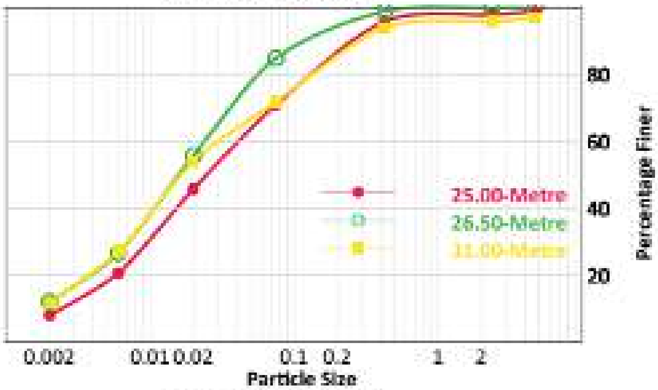

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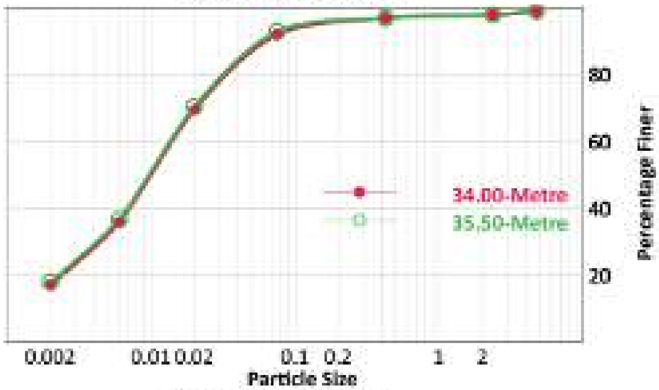

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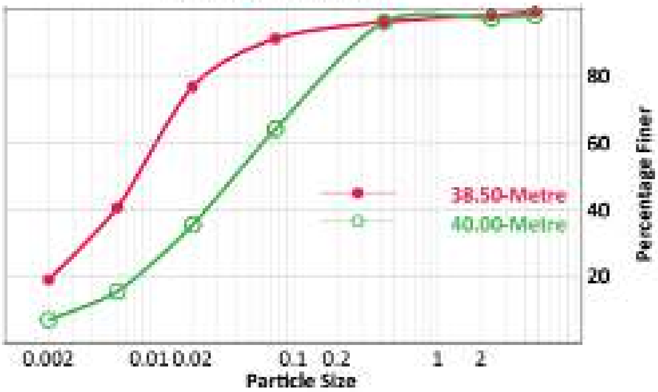
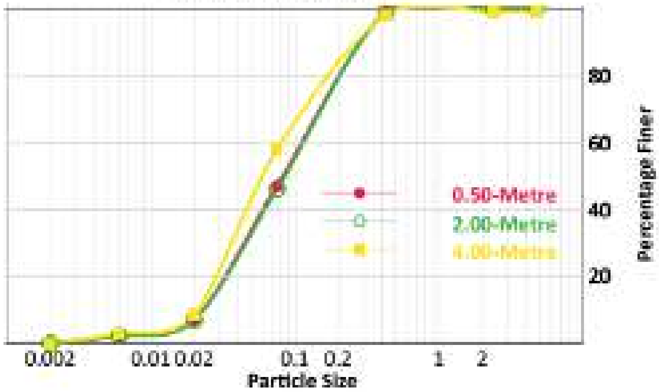
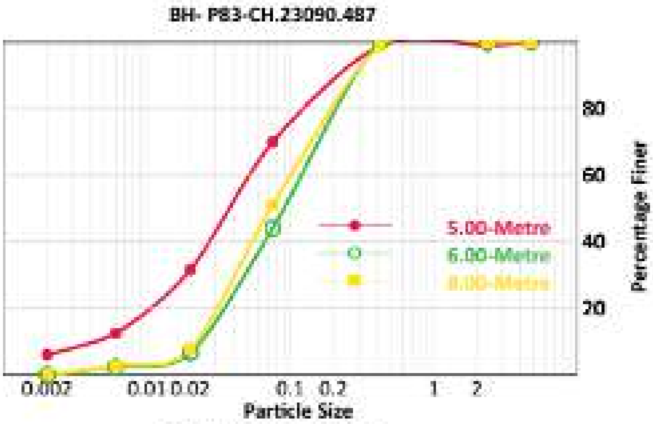
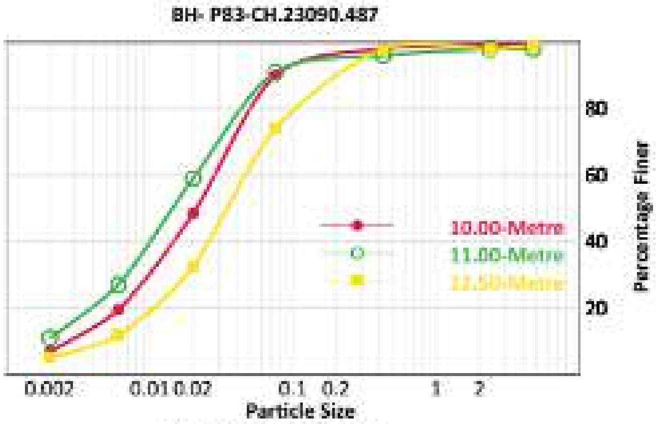


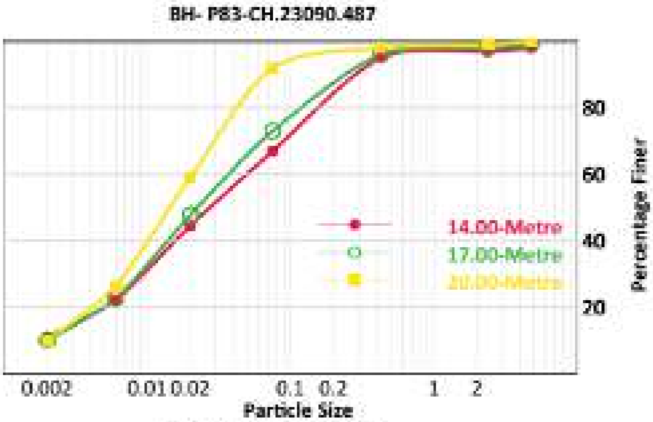
BH- P83-CH.23090.487

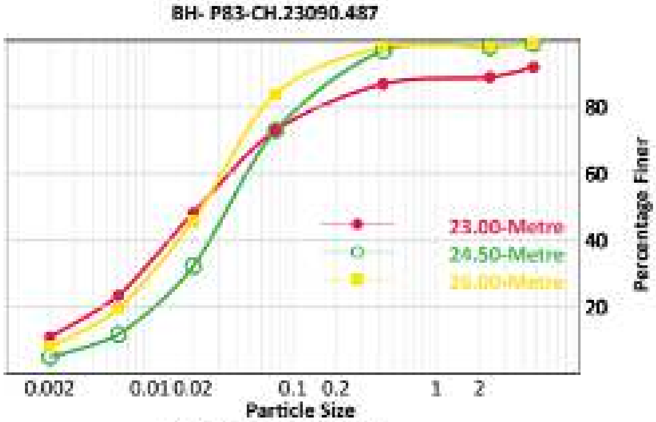


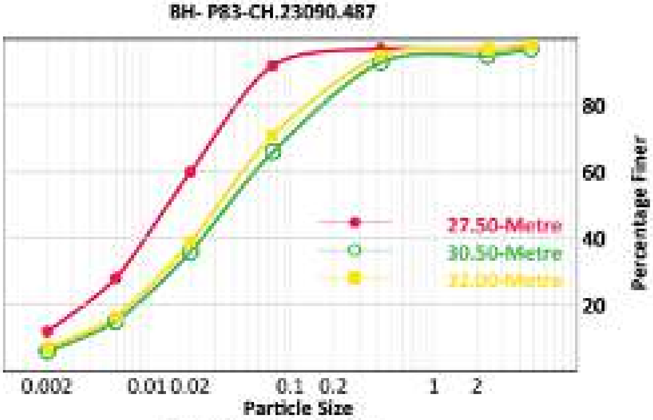
APPENDIX-D
PLOT 3: GRAIN SIZE DISTRIBUTION PLOTS

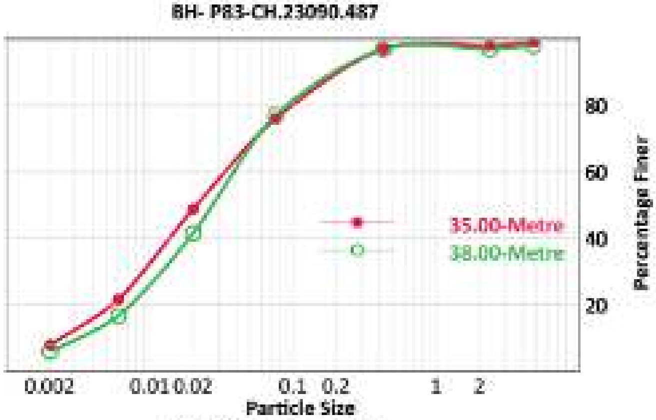


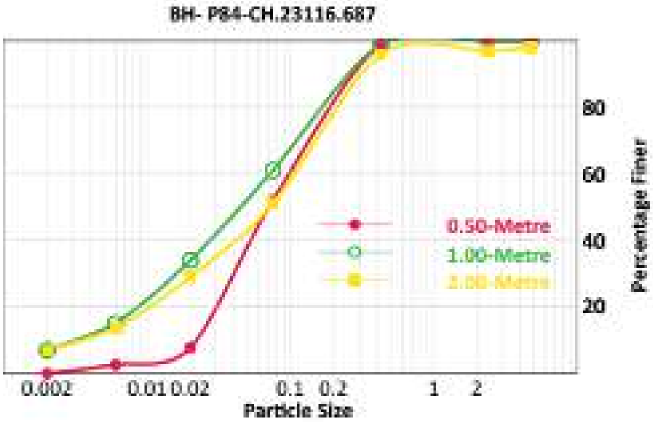


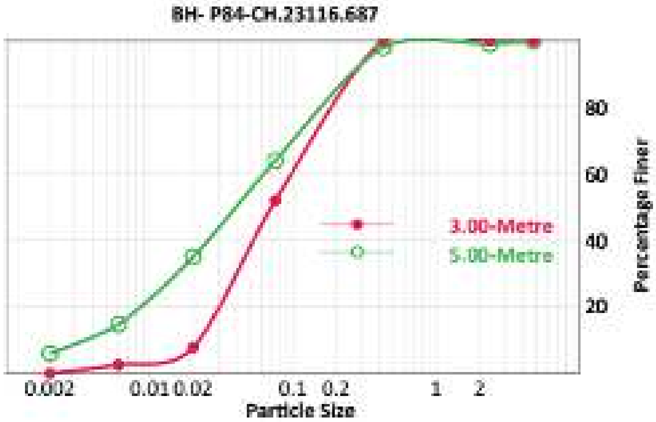




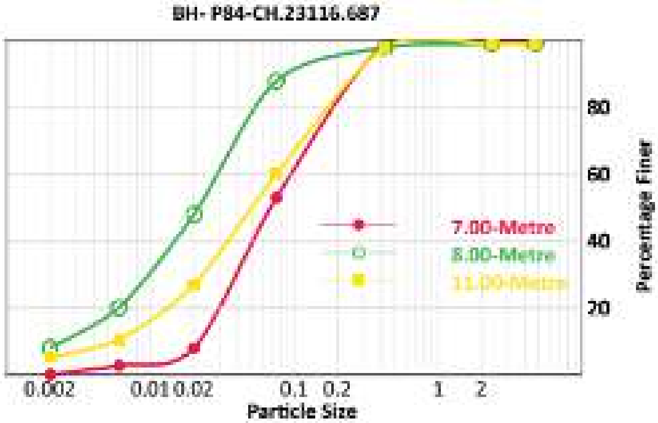


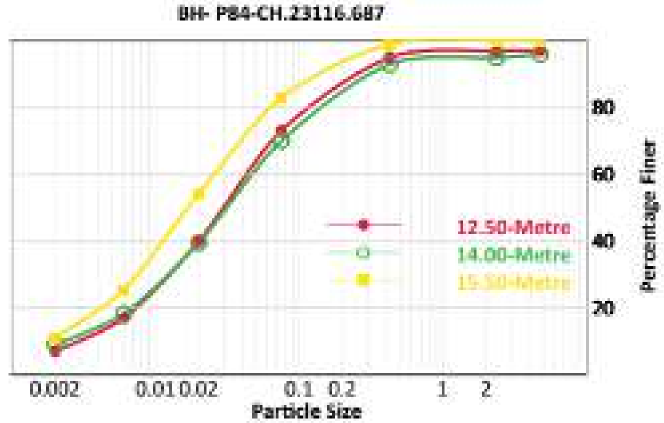


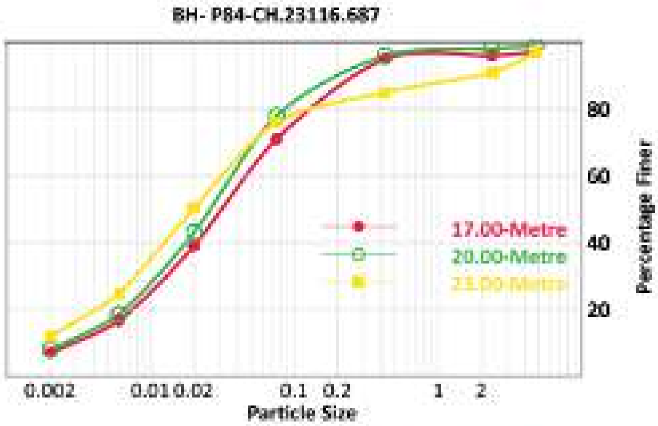


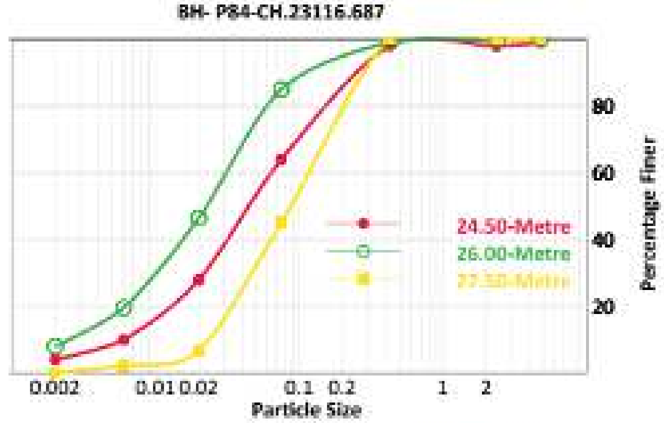


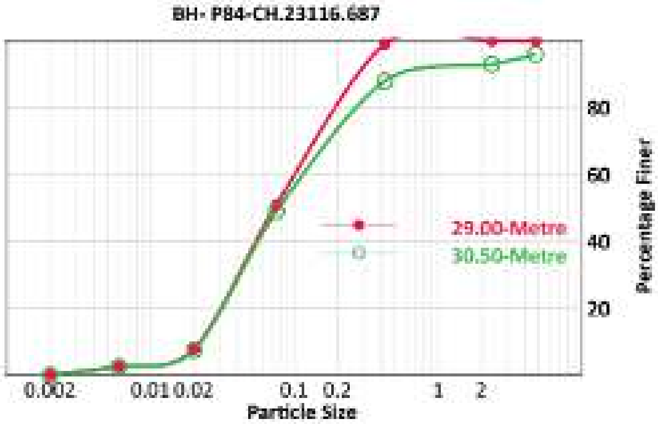
APPENDIX-D
PLOT 4: GRAIN SIZE DISTRIBUTION PLOTS

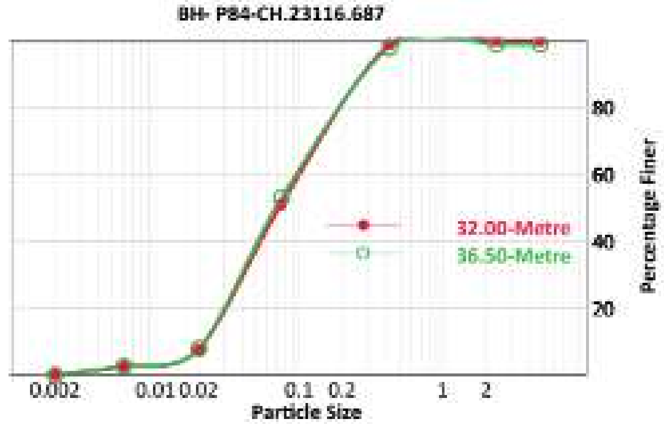


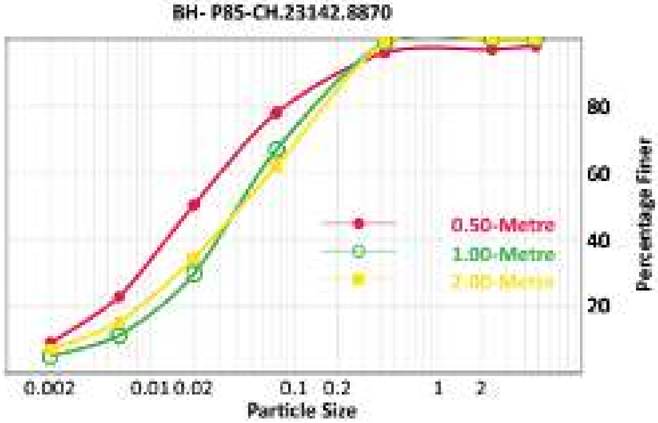


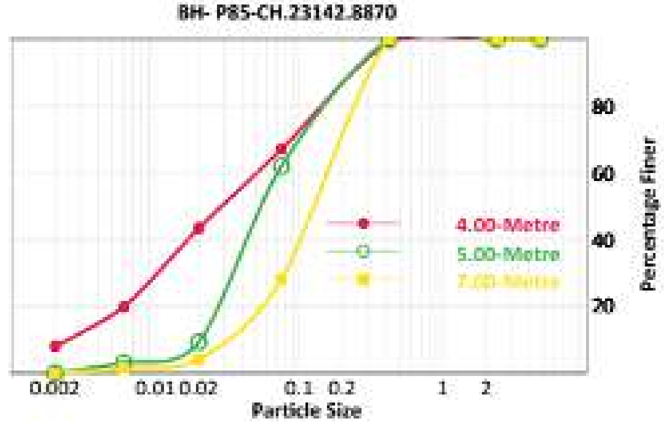




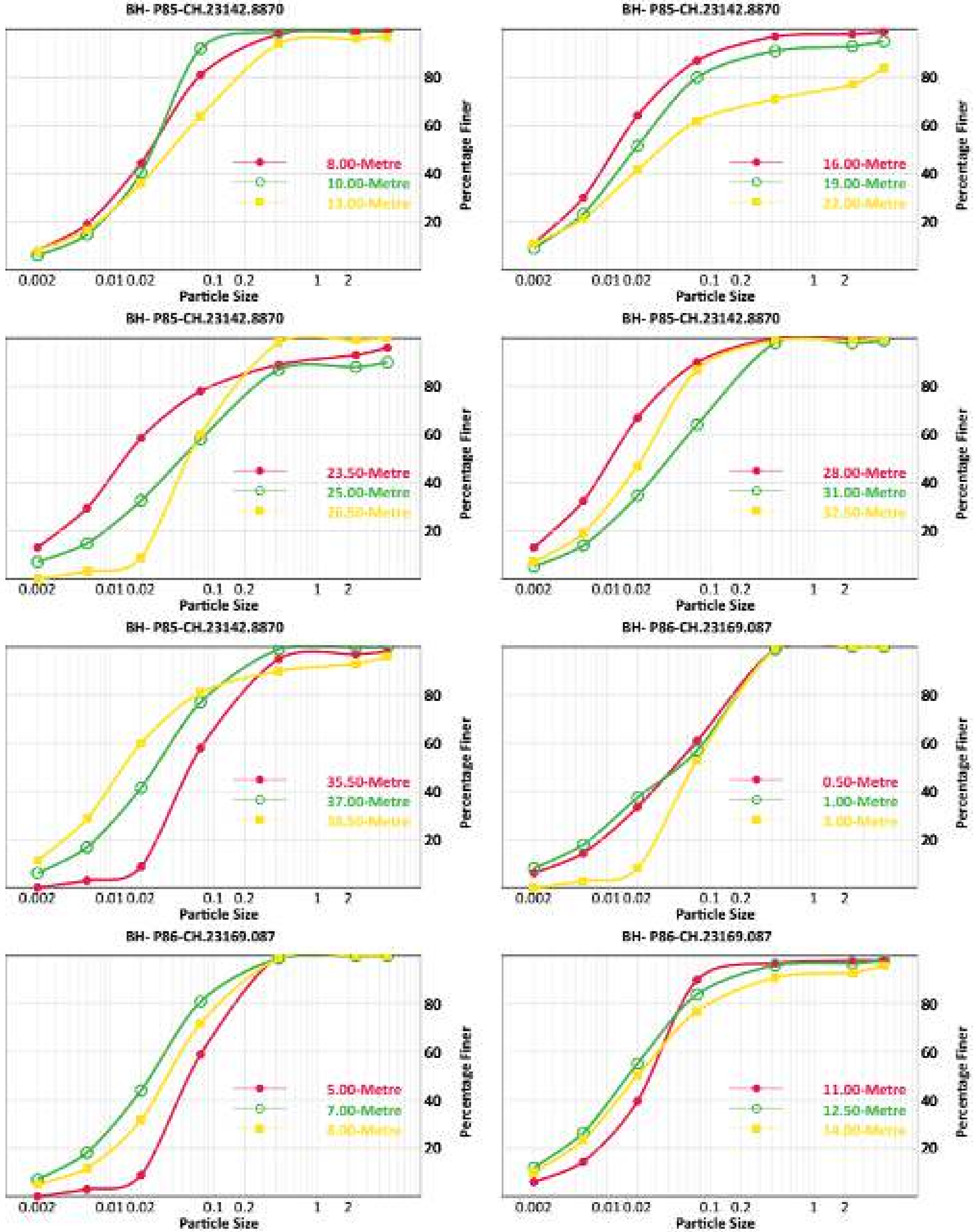








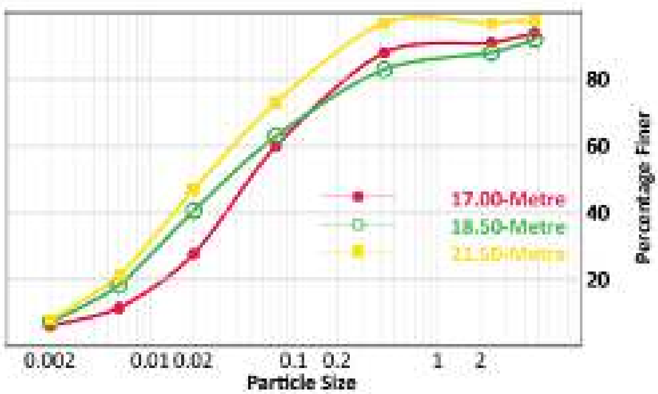
APPENDIX-D
PLOT 5: GRAIN SIZE DISTRIBUTION PLOTS



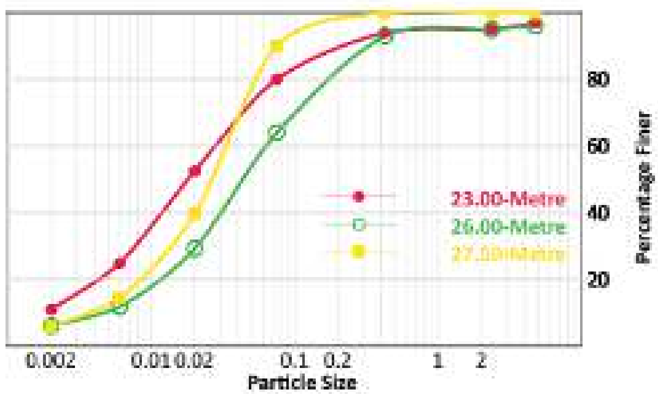
APPENDIX-D

PLOT 6: GRAIN SIZE DISTRIBUTION PLOTS

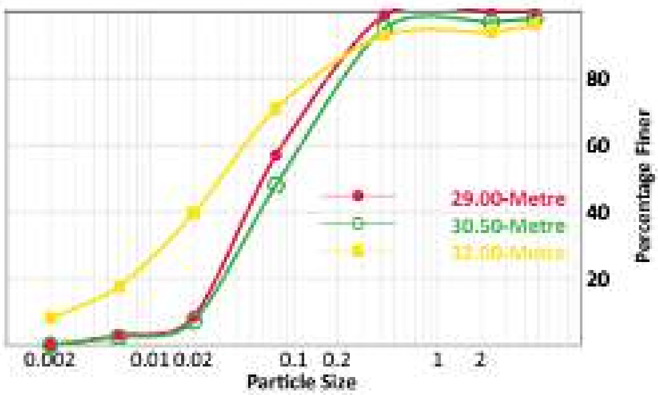
BH- P86-CH.23169.087



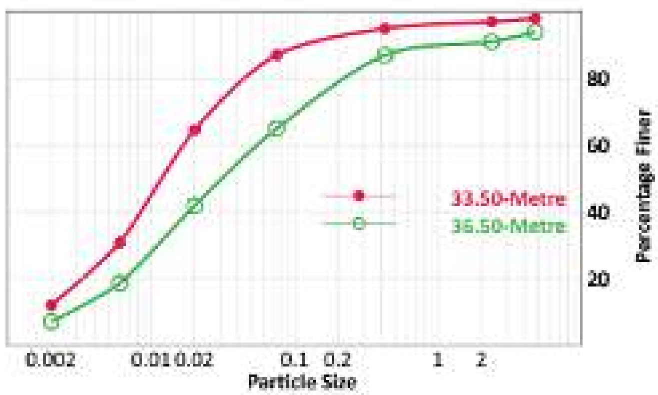
BH- P86-CH.23169.087



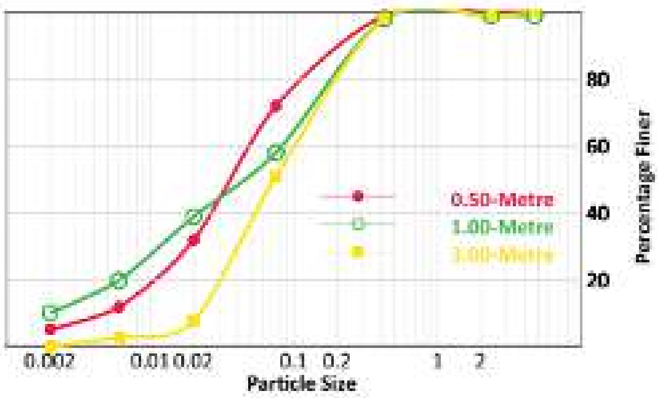
BH- P86-CH.23169.087



BH- P86-CH.23169.087



BH- P87-CH.23195.287



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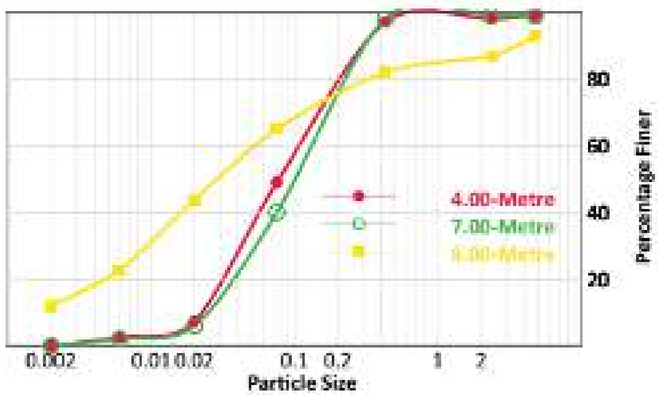

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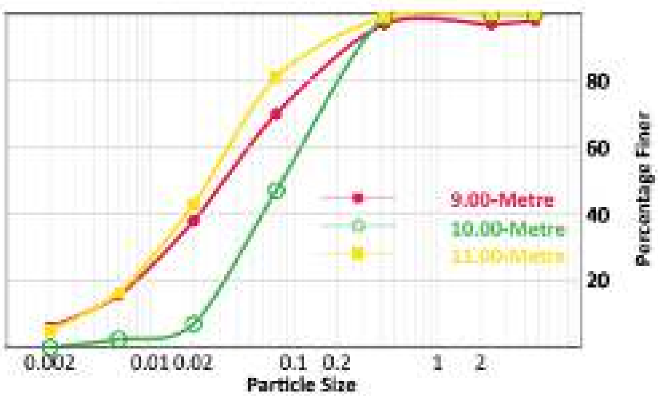

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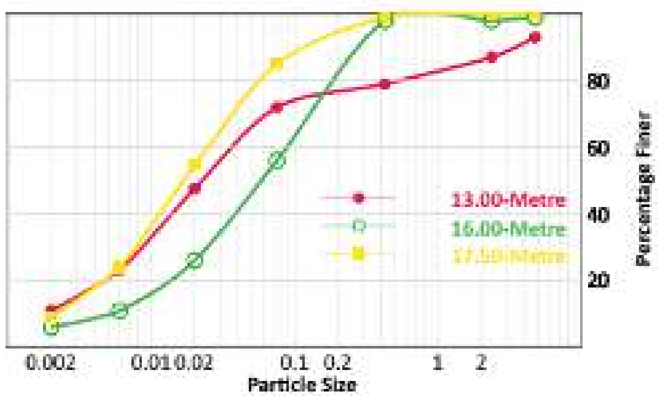
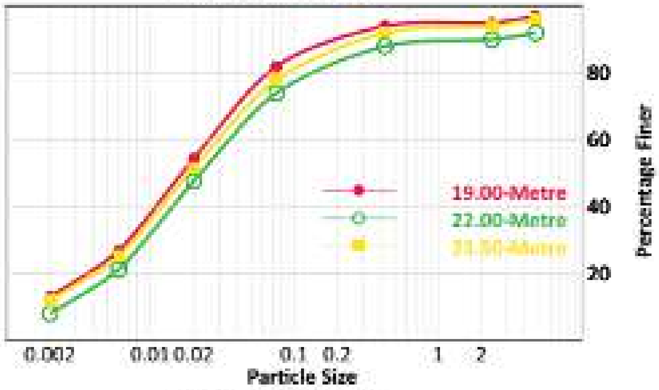


APPENDIX-D

PLOT 7: GRAIN SIZE DISTRIBUTION PLOTS

BH- P87-CH.23195.287



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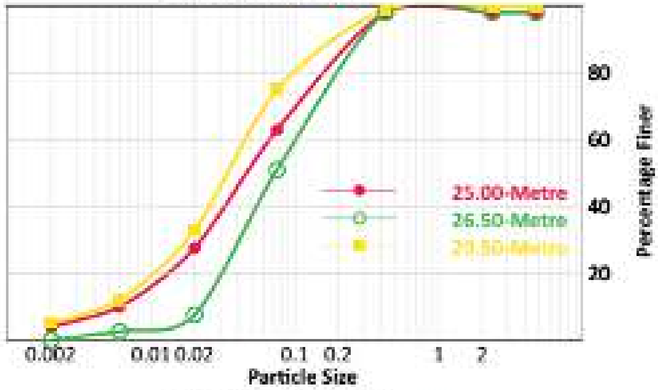

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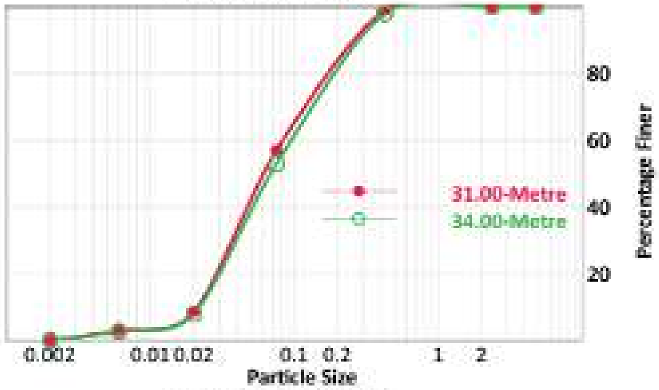
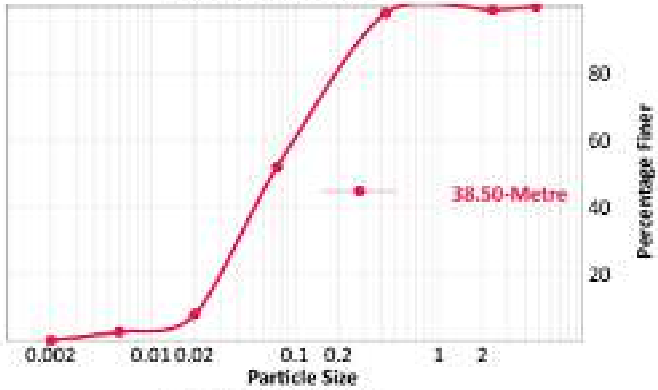
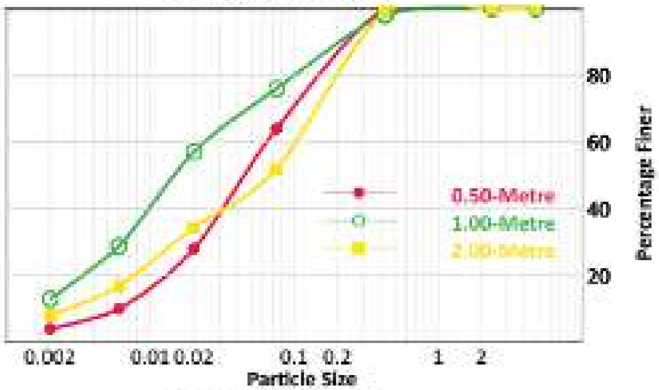


BH- P87-CH.23195.287



BH- P88-CH.23211.4870



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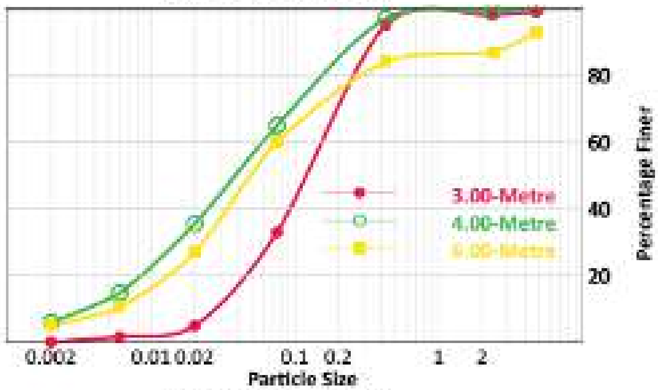

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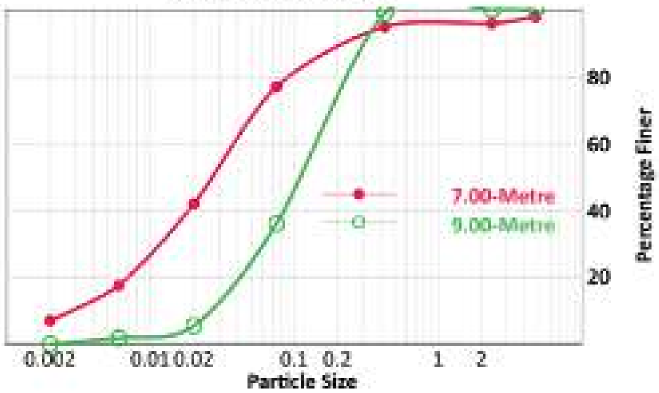

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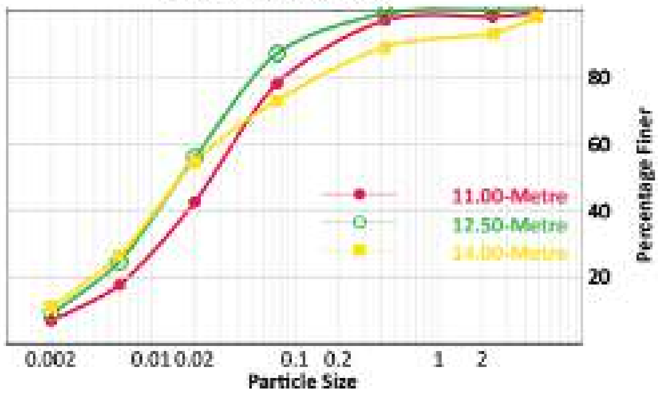
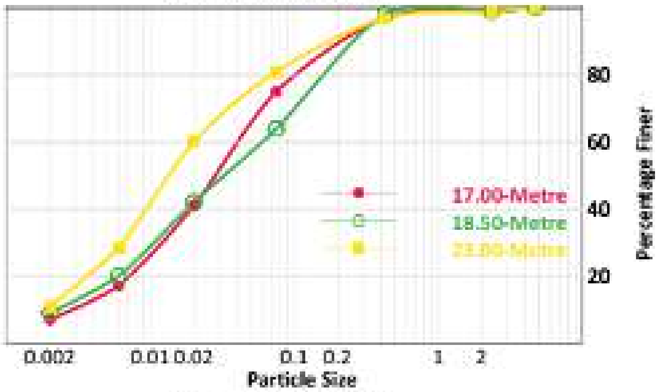


APPENDIX-D

PLOT 8: GRAIN SIZE DISTRIBUTION PLOTS

BH- P88-CH.23211.4870



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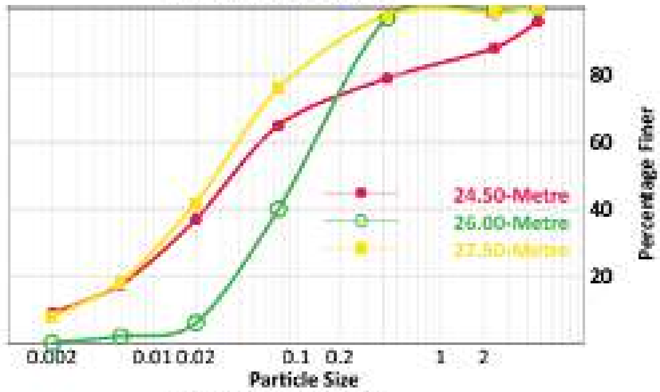

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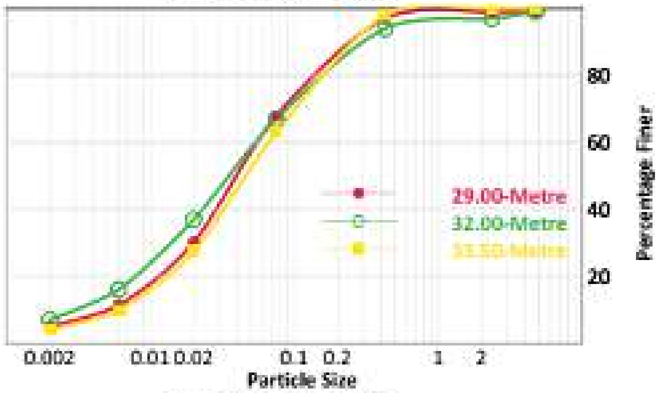
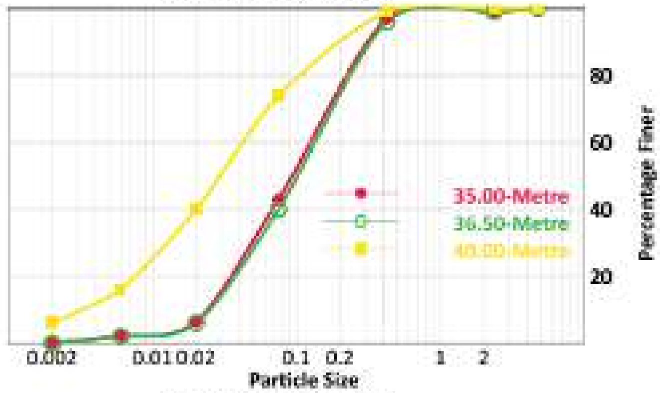
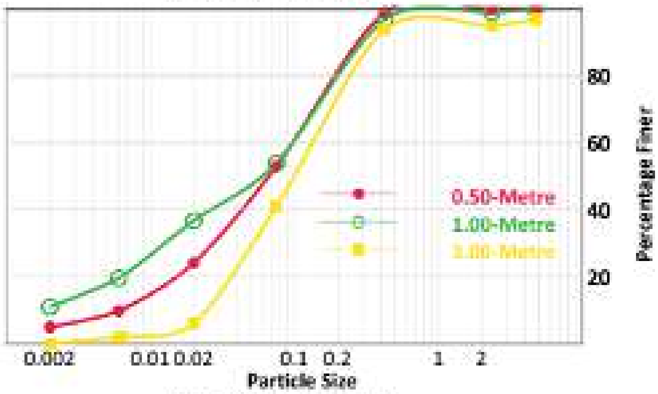


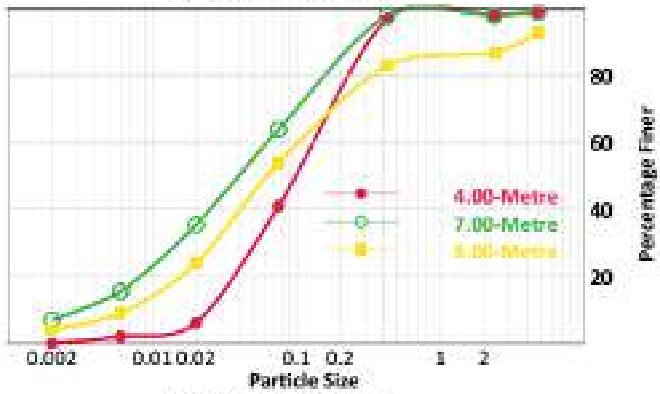
BH- P88-CH.23211.4870



BH- P89-CH.23247.687



BH- P89-CH.23247.687



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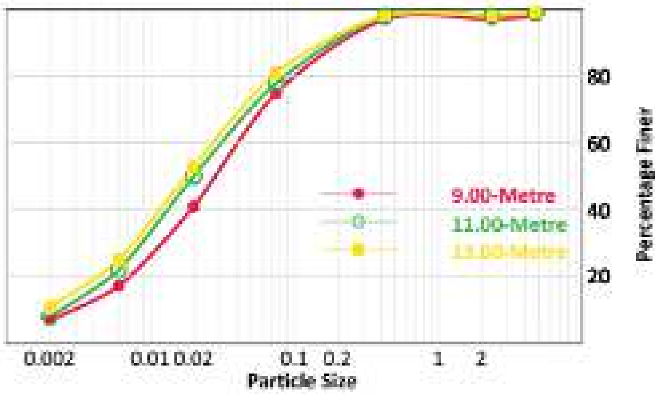

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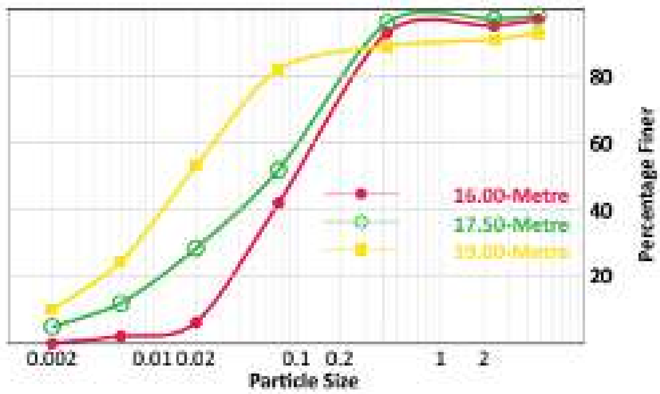
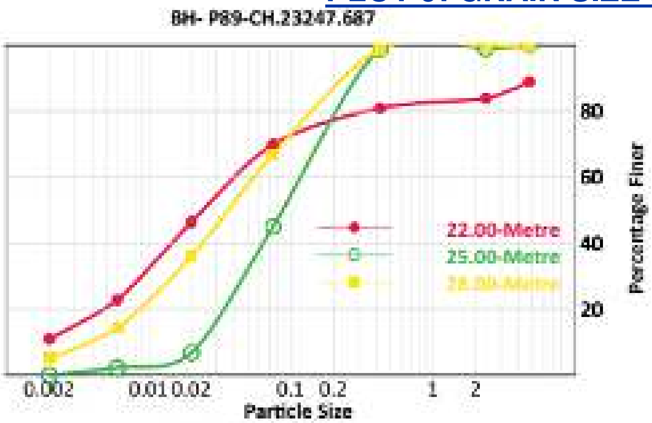
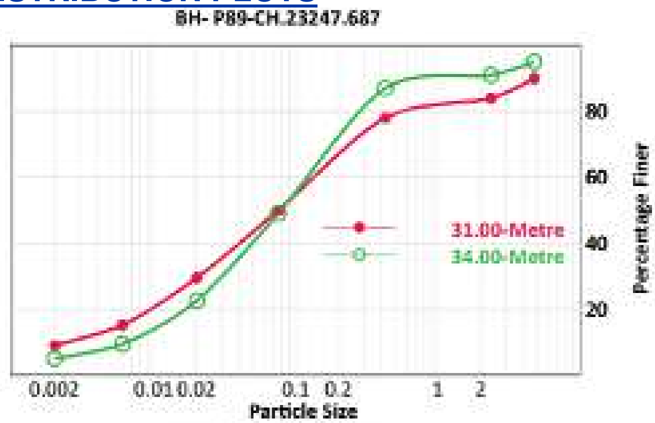
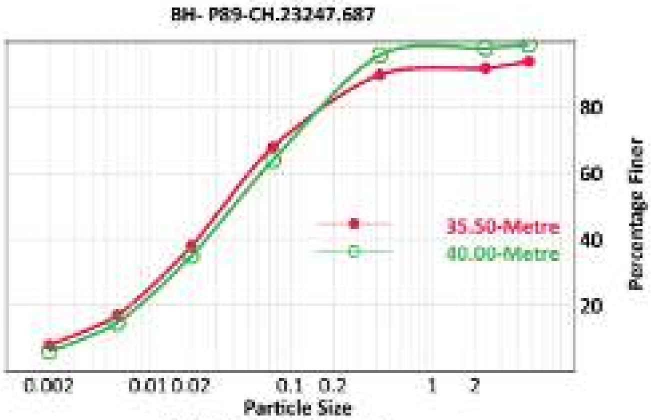
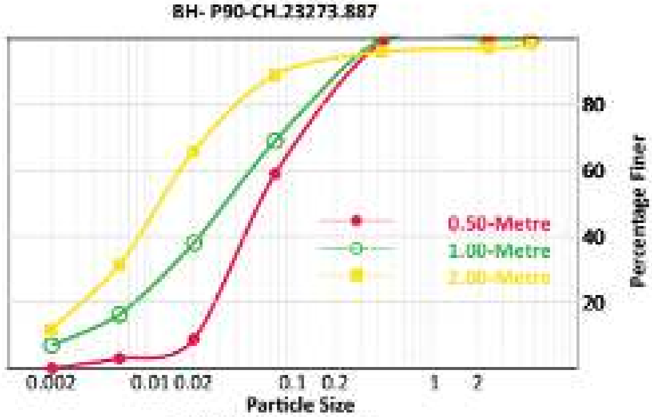


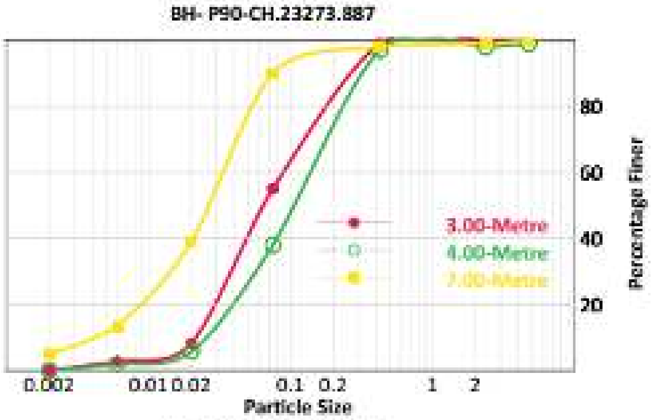
APPENDIX-D
PLOT 9: GRAIN SIZE DISTRIBUTION PLOTS

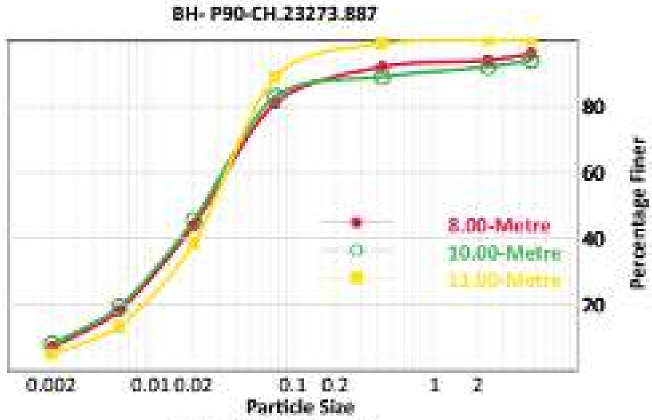


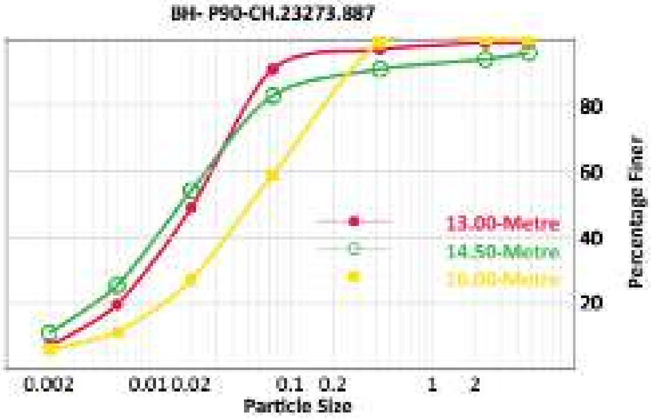


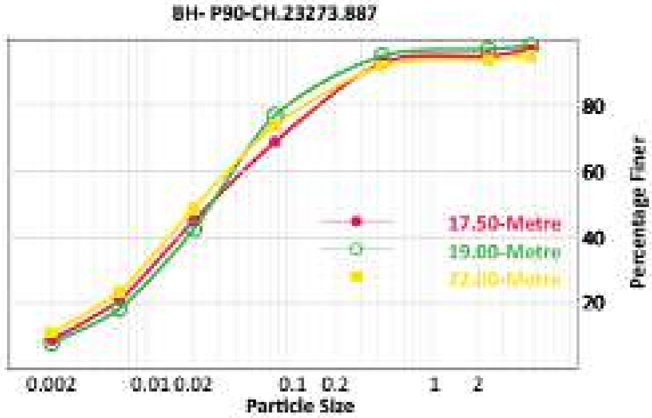






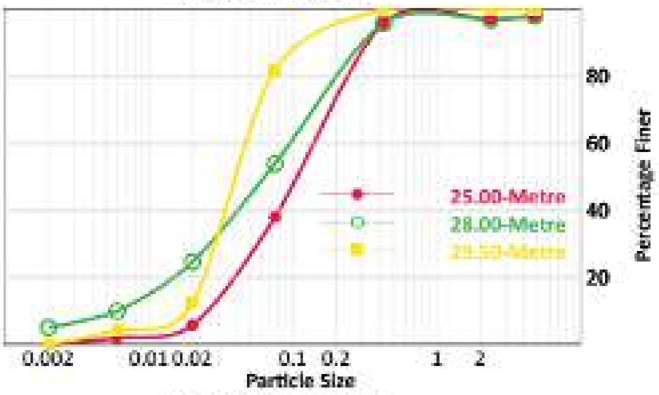




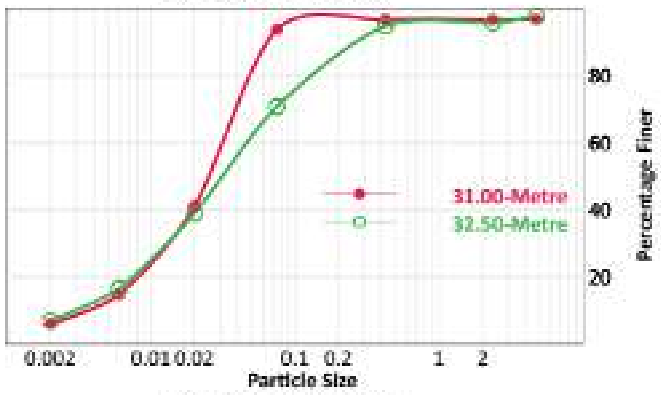


APPENDIX-D
PLOT 10: GRAIN SIZE DISTRIBUTION PLOTS

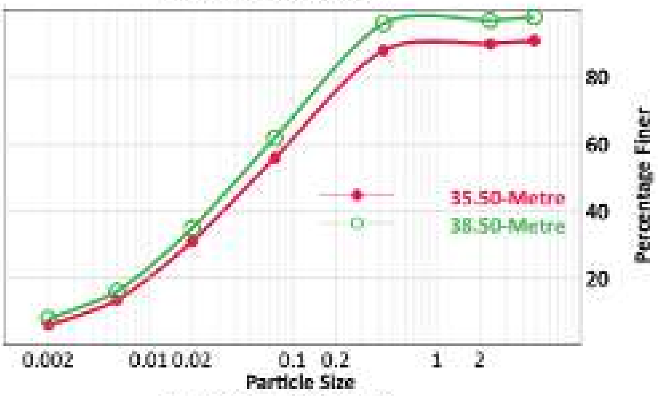
BH- P90-CH.23273.887



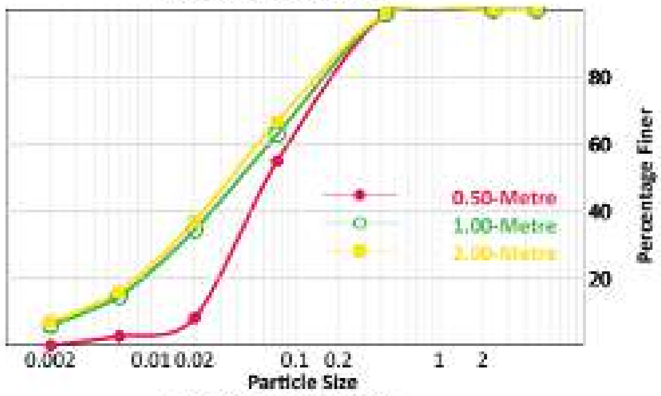
BH- P90-CH.23273.887



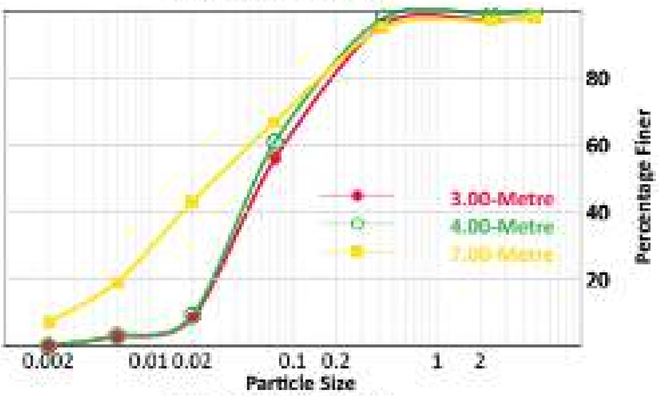
BH- P90-CH.23273.887



BH- P91-CH.23300.0870



BH- P91-CH.23300.0870



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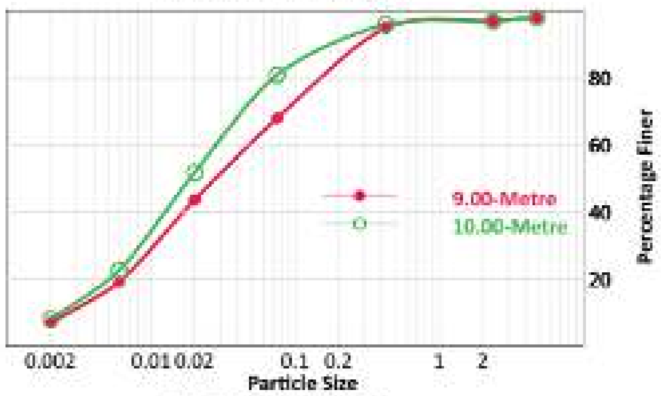

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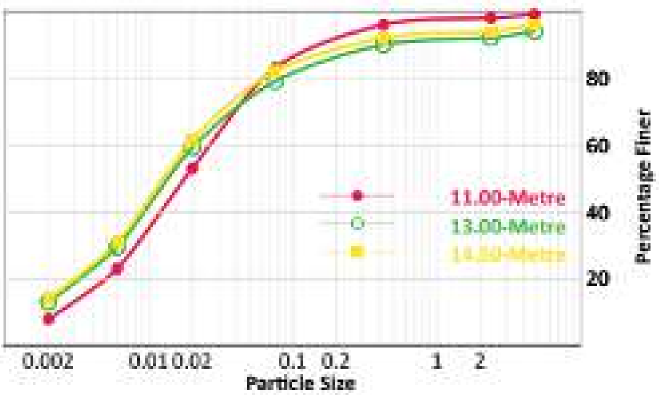

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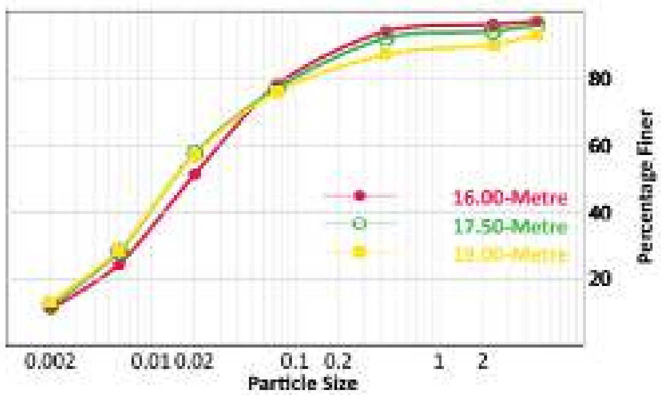
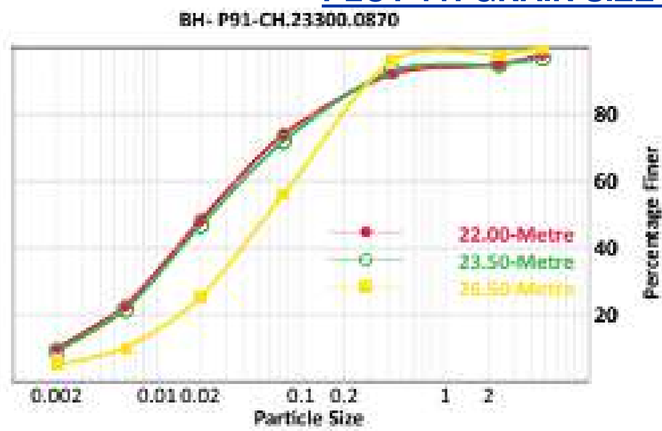
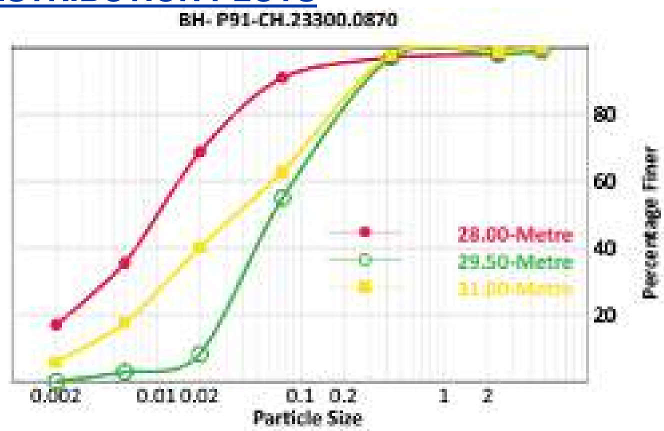
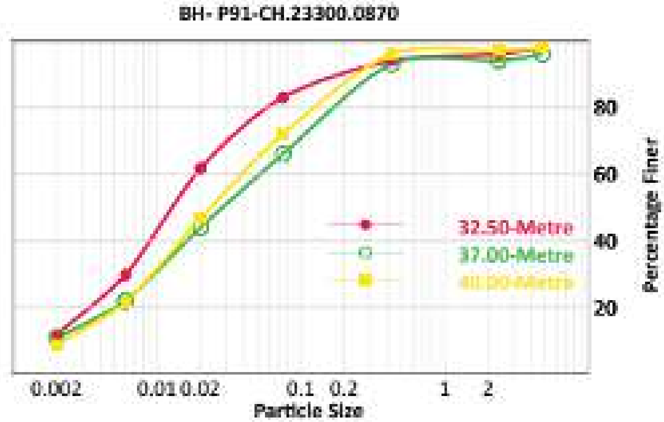
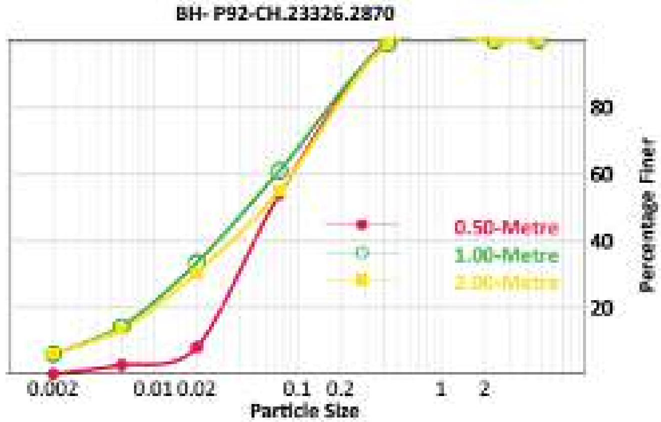


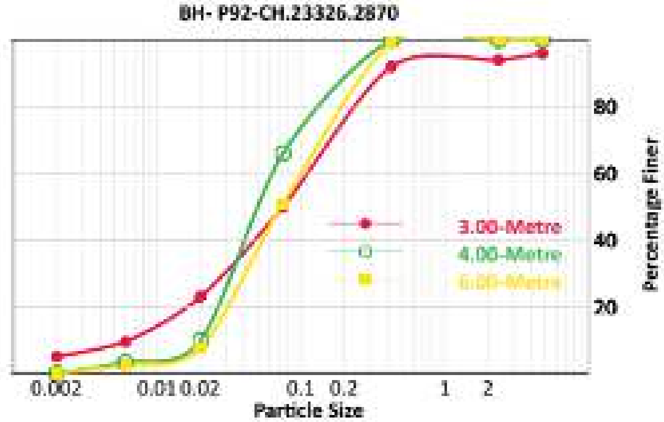
APPENDIX-D
PLOT 11: GRAIN SIZE DISTRIBUTION PLOTS

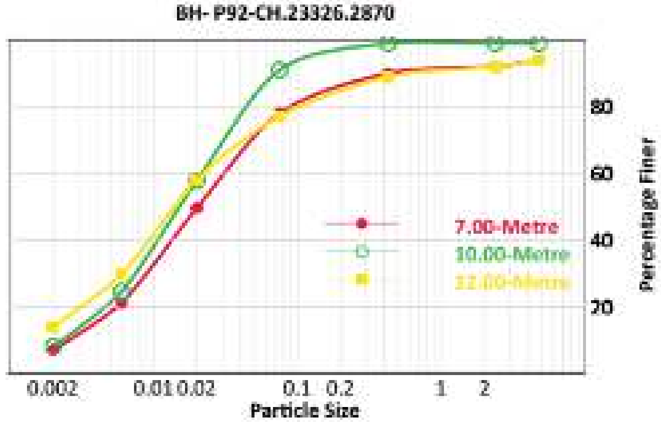


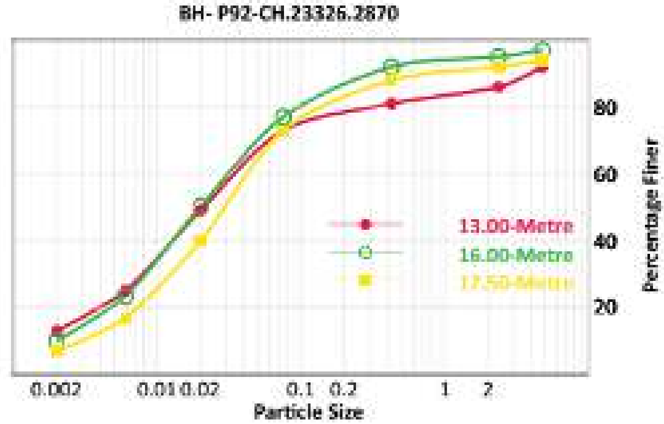


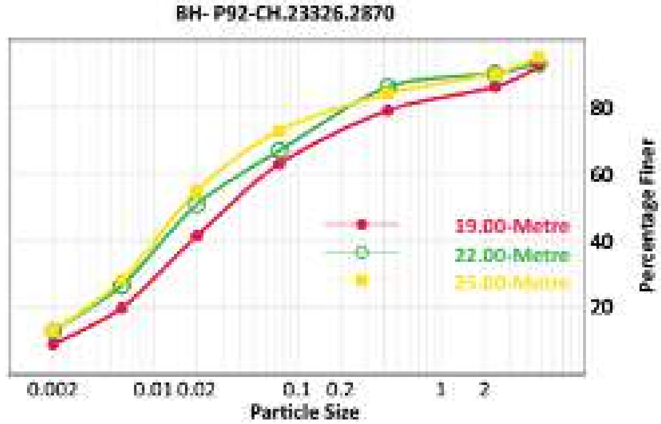




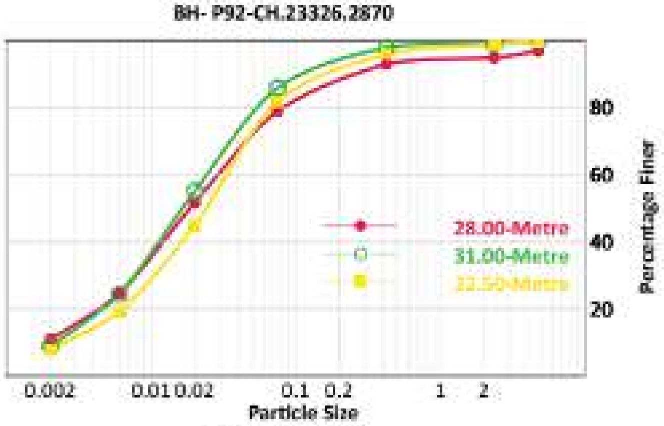


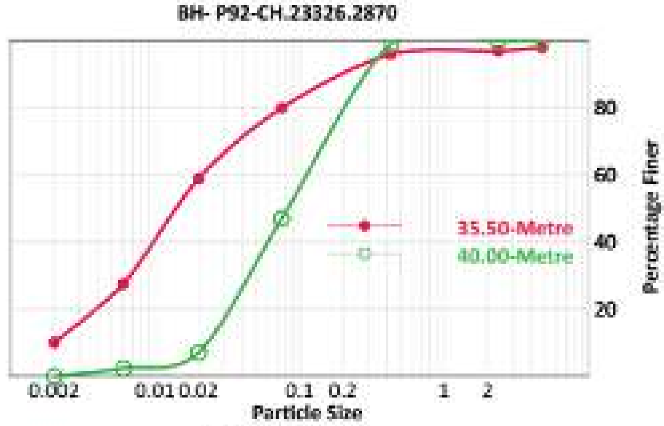


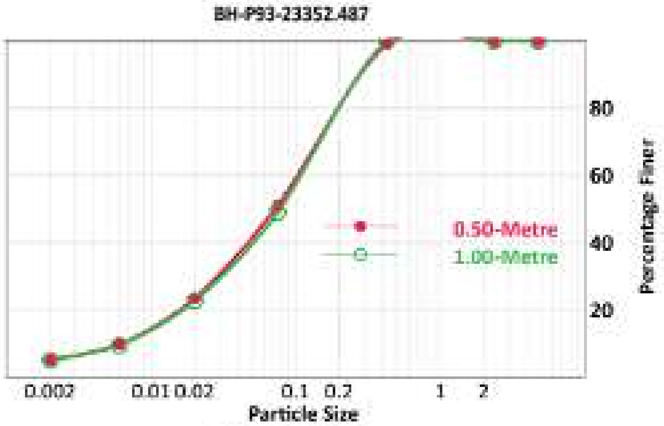


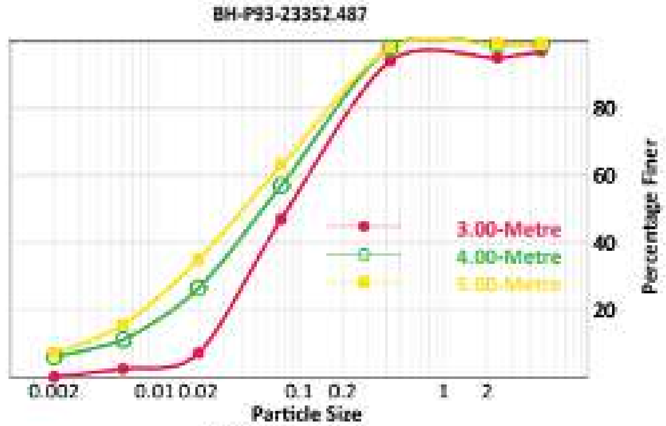


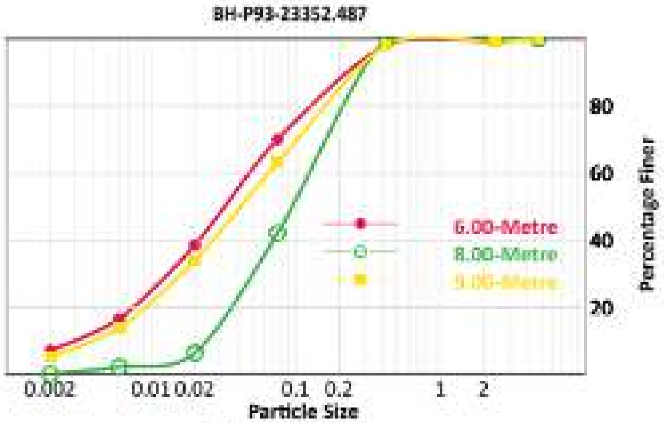
APPENDIX-D
PLOT 12: GRAIN SIZE DISTRIBUTION PLOTS

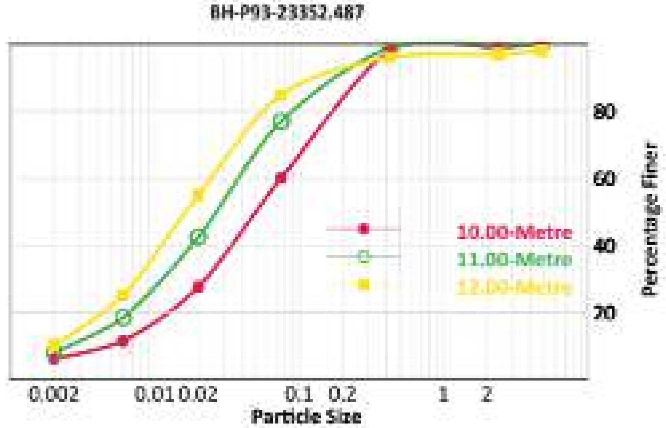


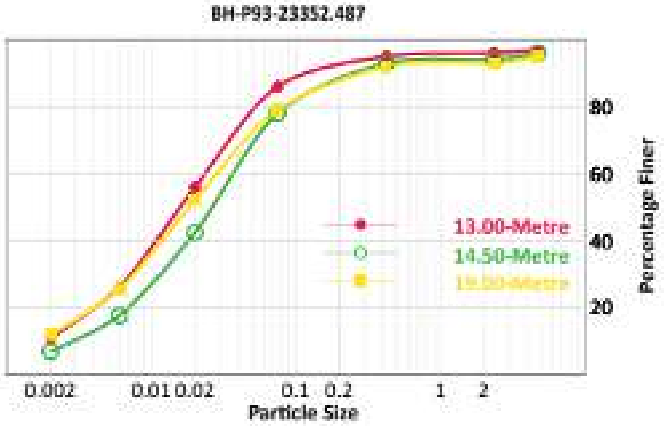


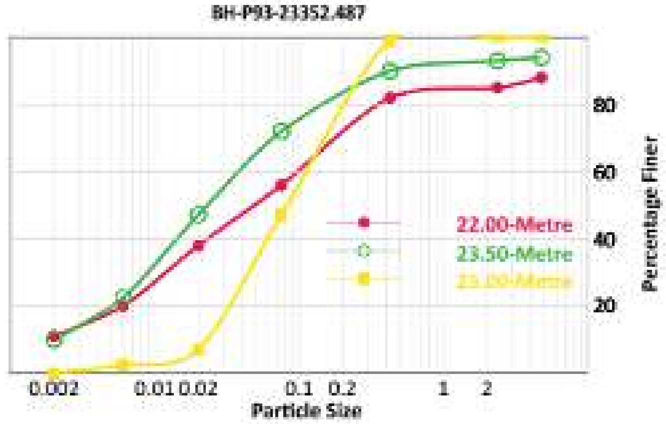








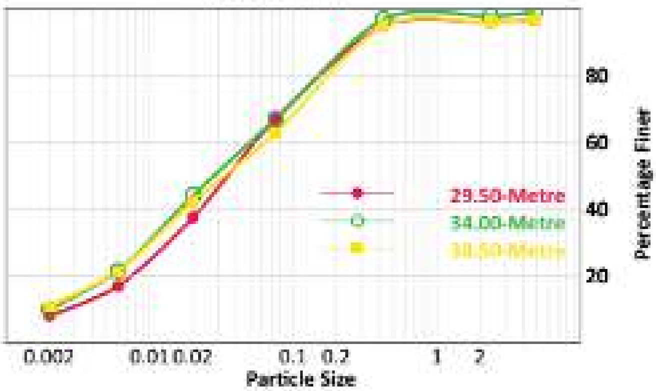




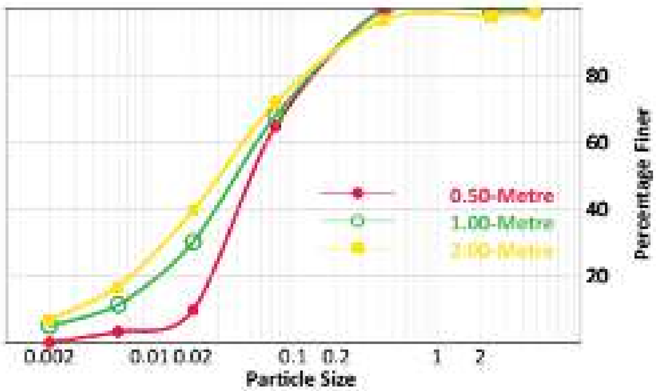
APPENDIX-D

PLOT 13: GRAIN SIZE DISTRIBUTION PLOTS

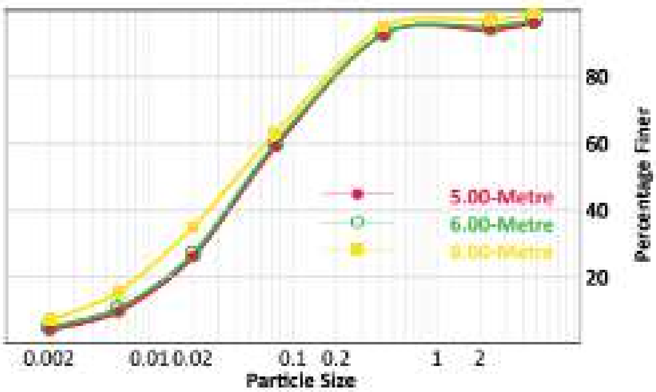
BH-P93-23352.487



BH- P94-CH.23378.6870



BH- P94-CH.23378.6870



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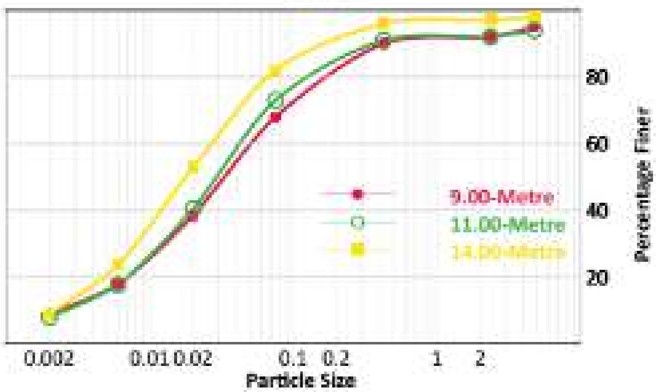

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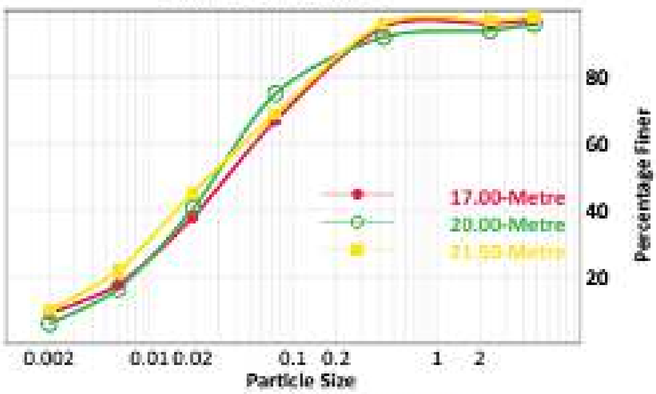
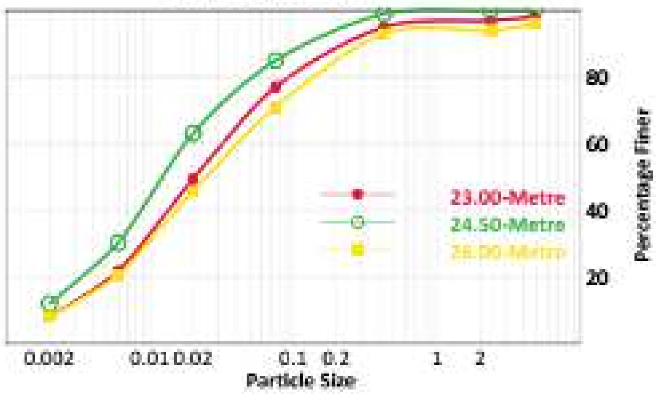
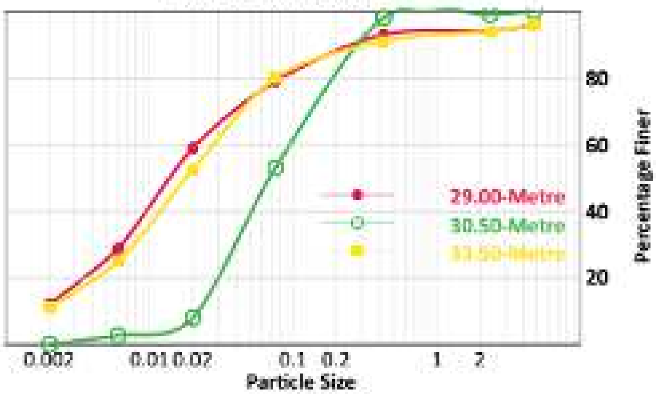


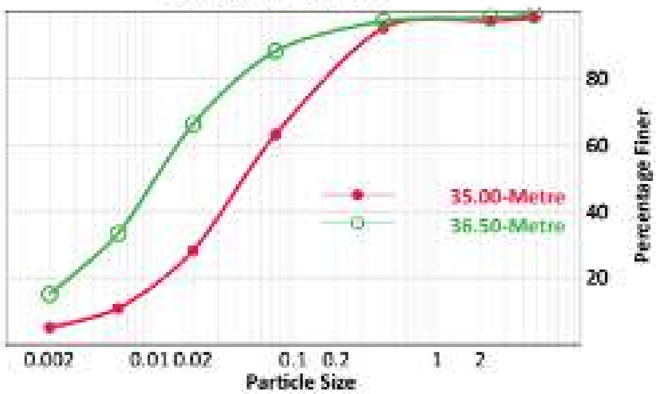
BH- P94-CH.23378.6870



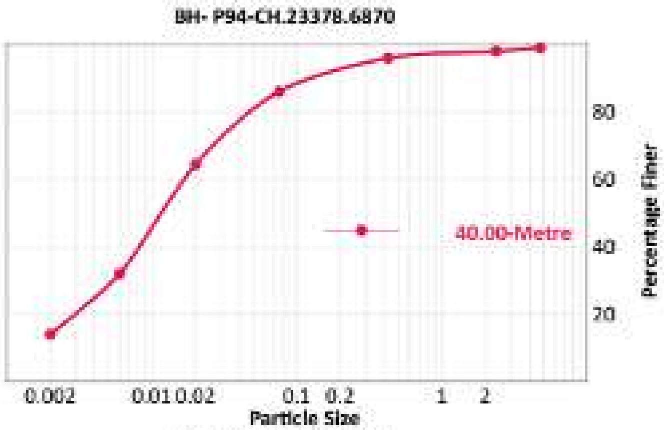
BH- P94-CH.23378.6870

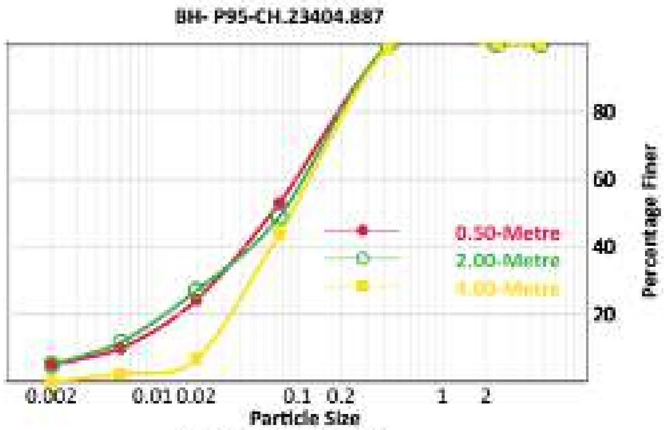


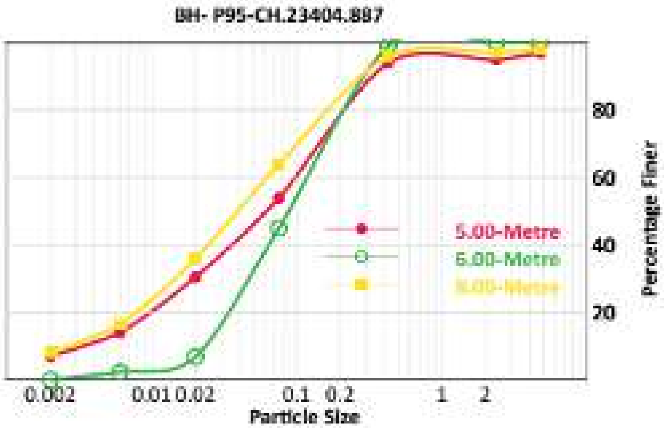
BH- P94-CH.23378.6870

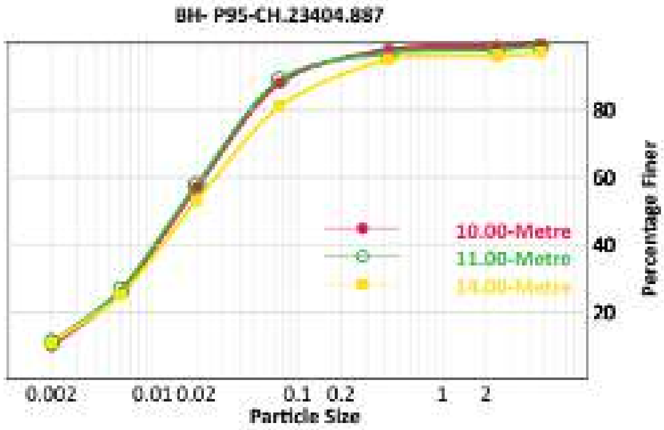


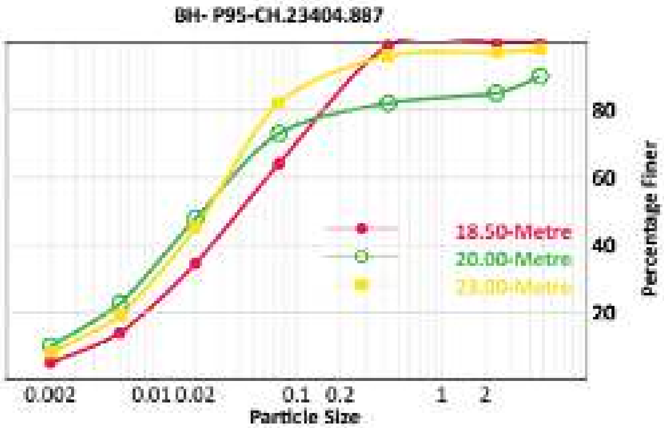
APPENDIX-D
PLOT 14: GRAIN SIZE DISTRIBUTION PLOTS

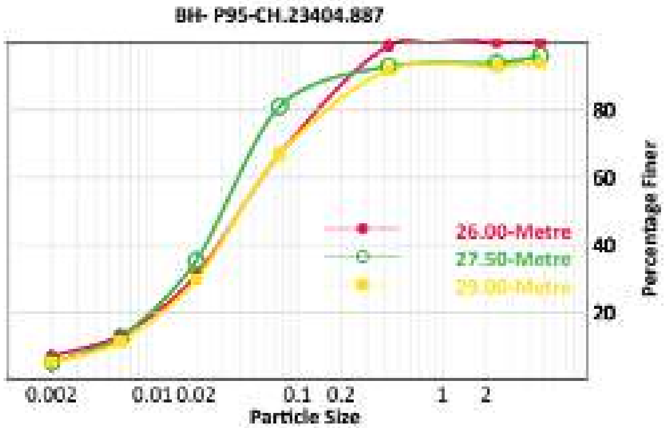


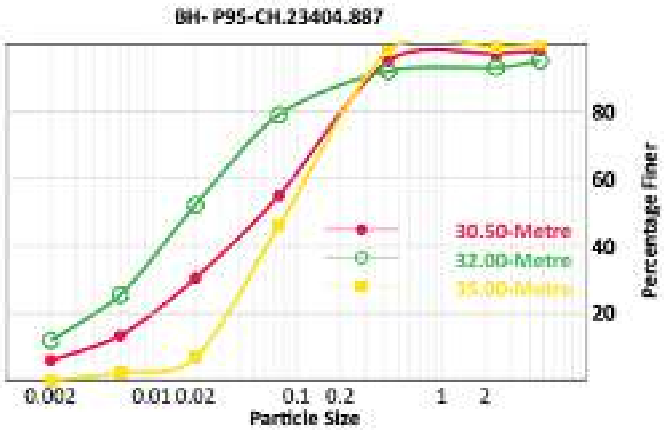


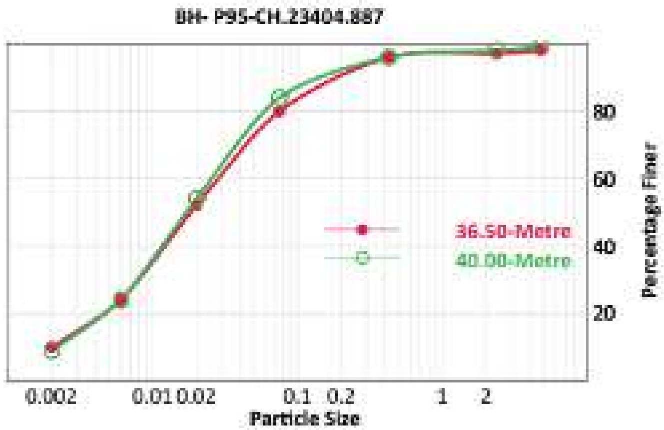




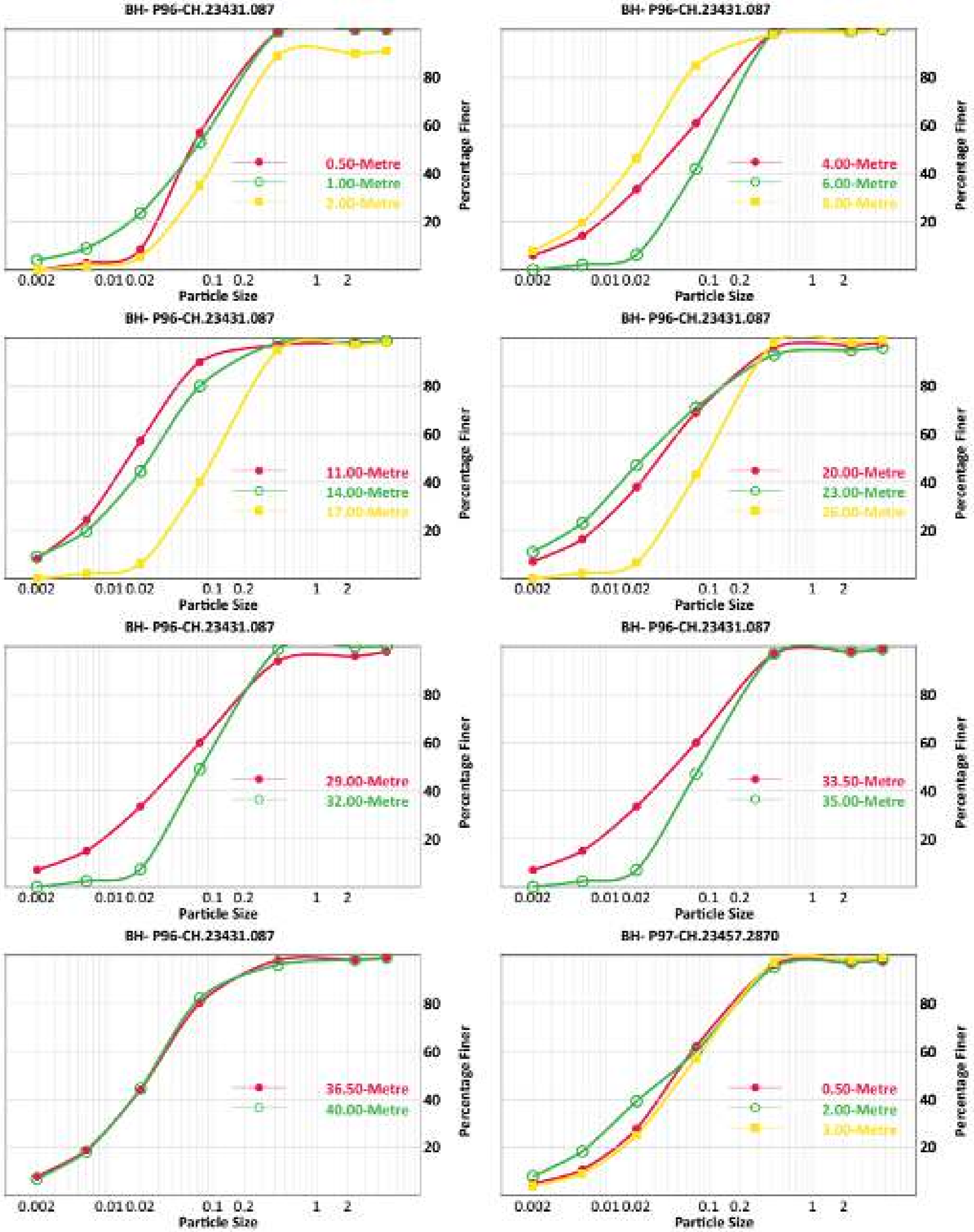






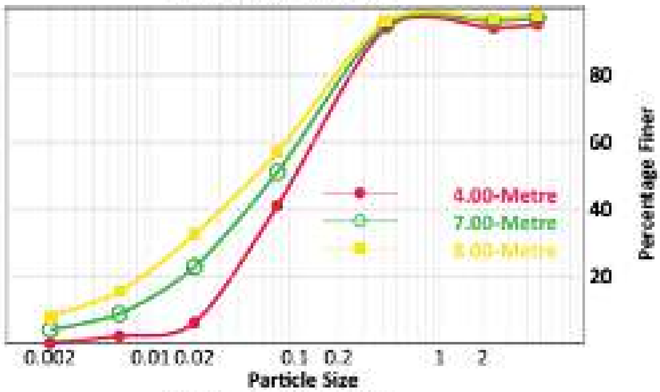


APPENDIX-D
PLOT 15: GRAIN SIZE DISTRIBUTION PLOTS

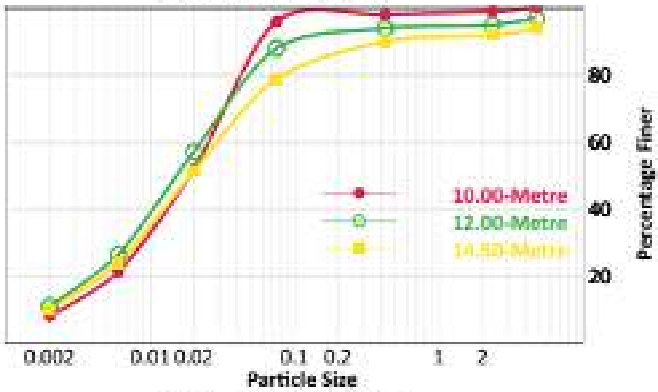


APPENDIX-D
PLOT 16: GRAIN SIZE DISTRIBUTION PLOTS

BH- P97-CH.23457.2870



BH- P97-CH.23457.2870



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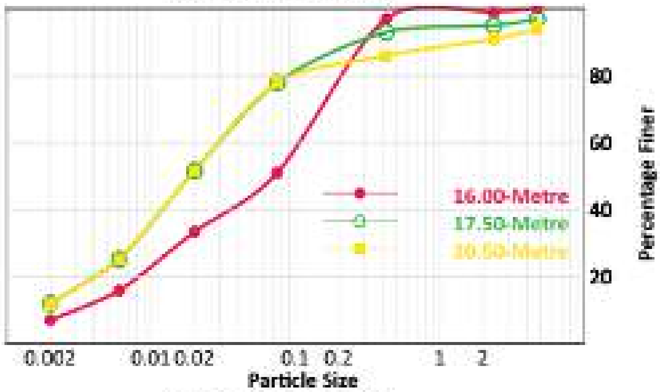

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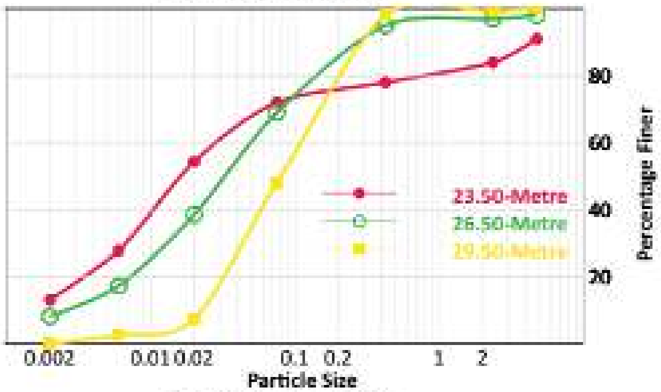

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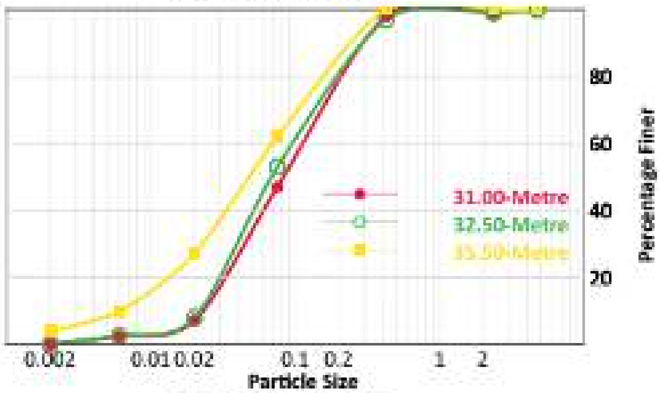

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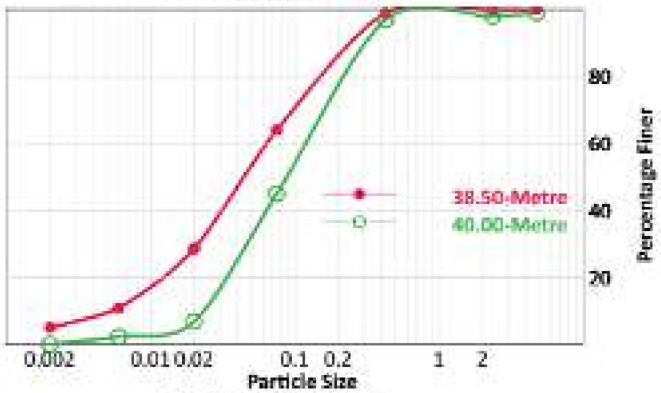
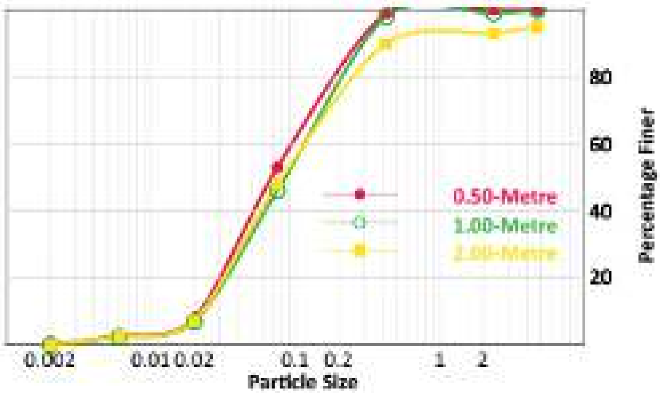


BH- P98-CH.23483.487



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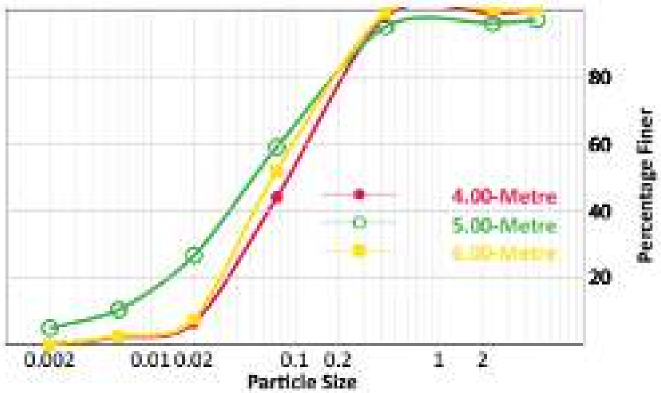
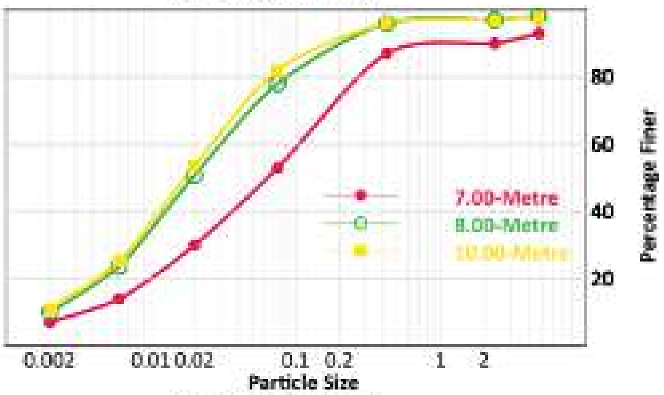


APPENDIX-D
PLOT 17: GRAIN SIZE DISTRIBUTION PLOTS

BH- P98-CH.23483.487



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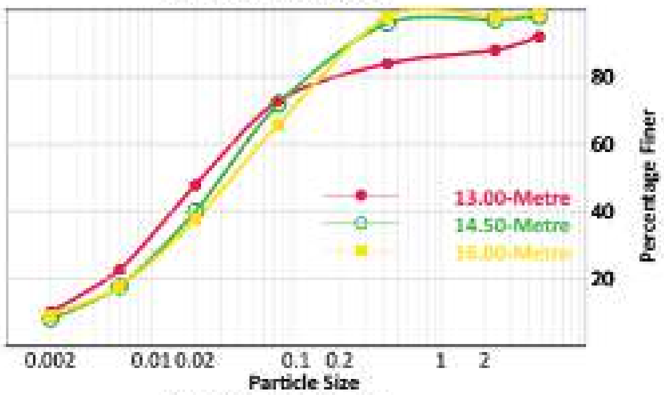

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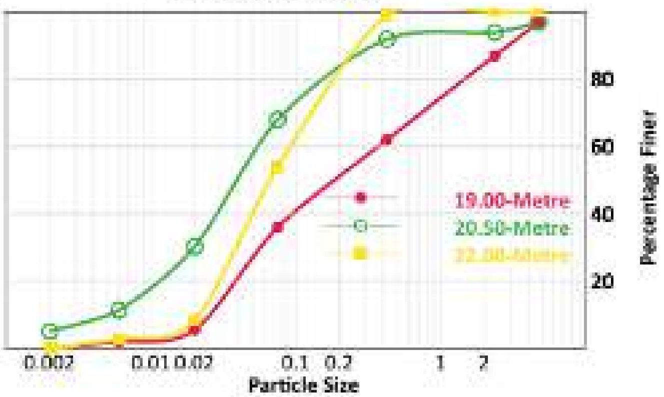

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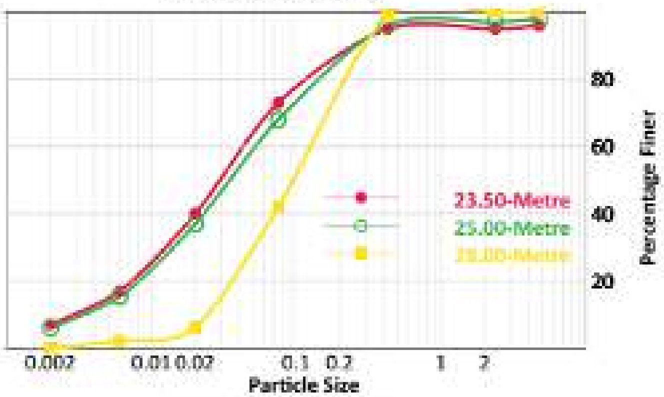
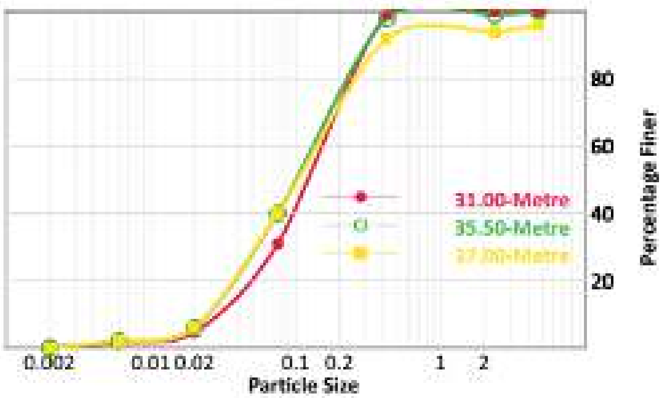
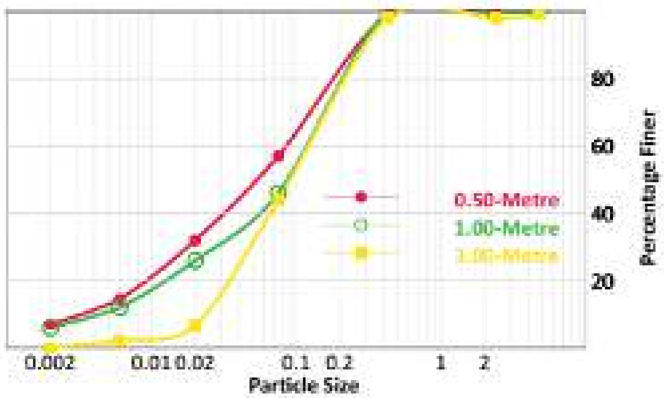


BH- P98-CH.23483.487



BH- P99-CH.23509.6870



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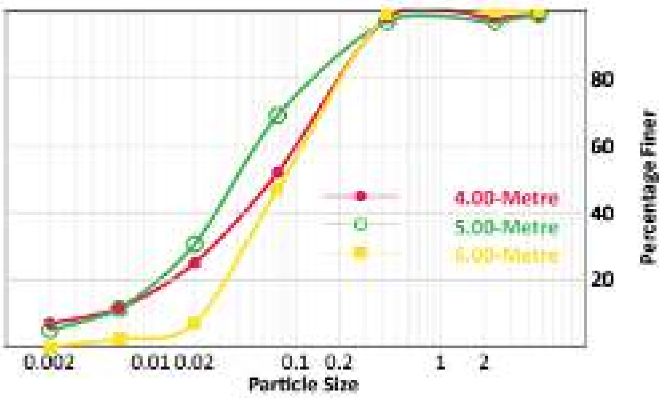

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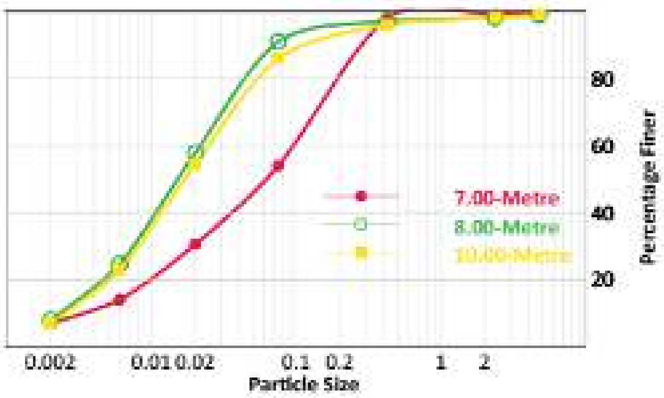
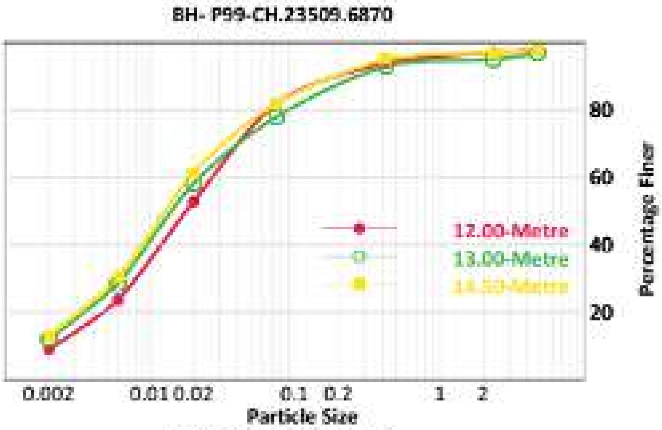
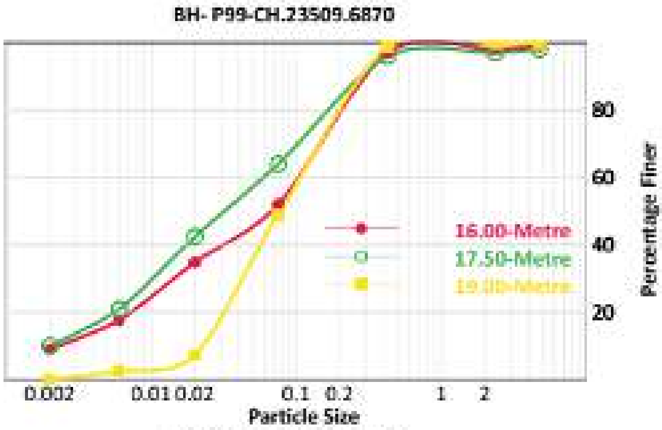
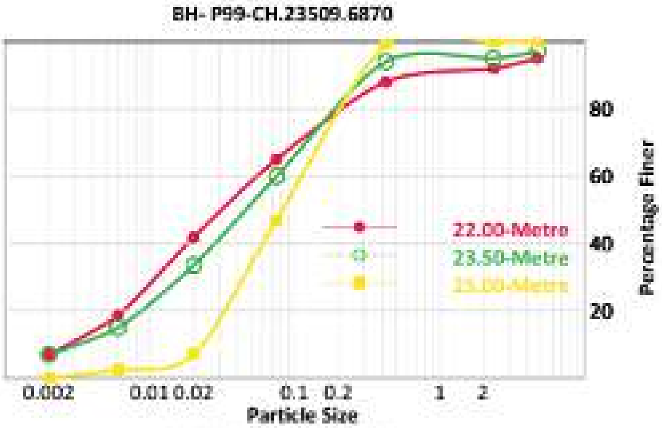


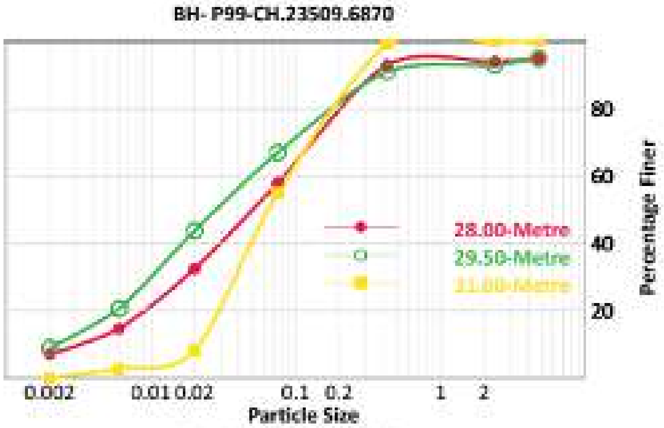
APPENDIX-D

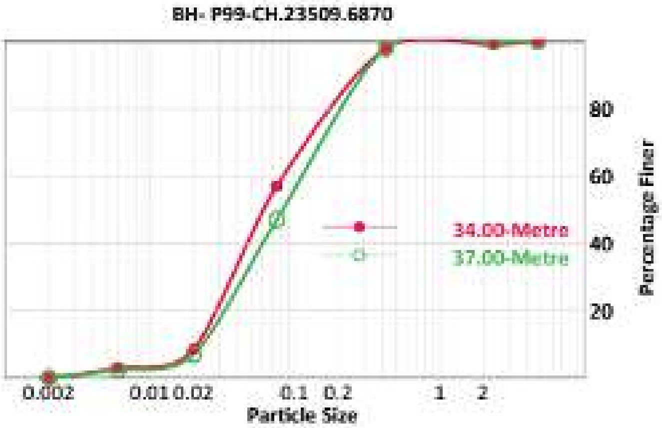
PLOT 18: GRAIN SIZE DISTRIBUTION PLOTS

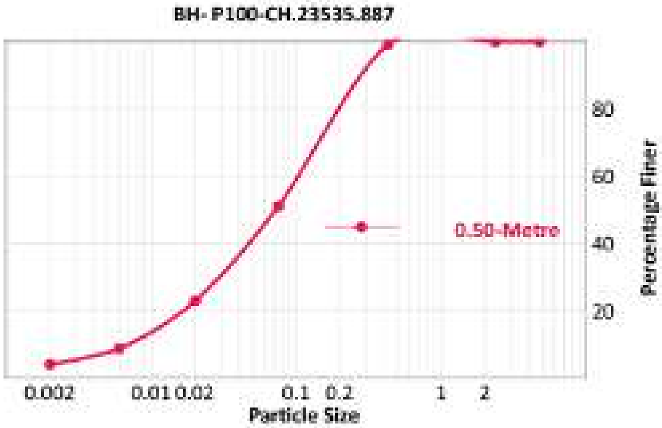


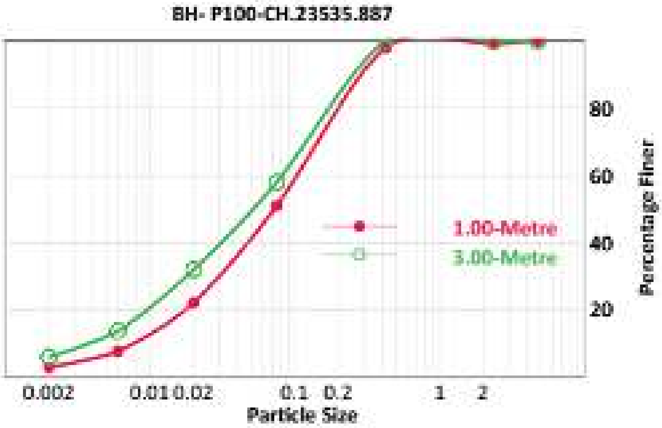


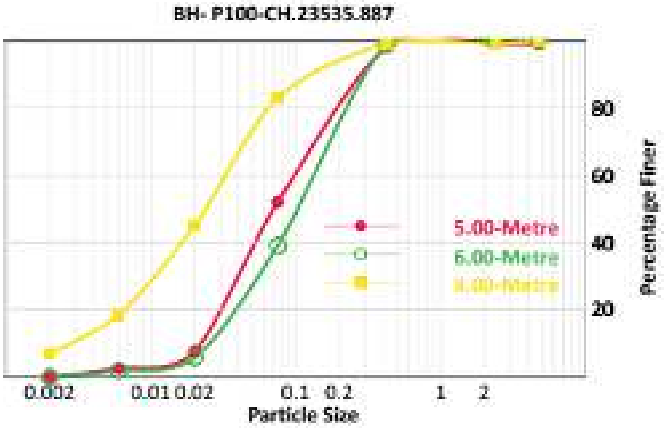




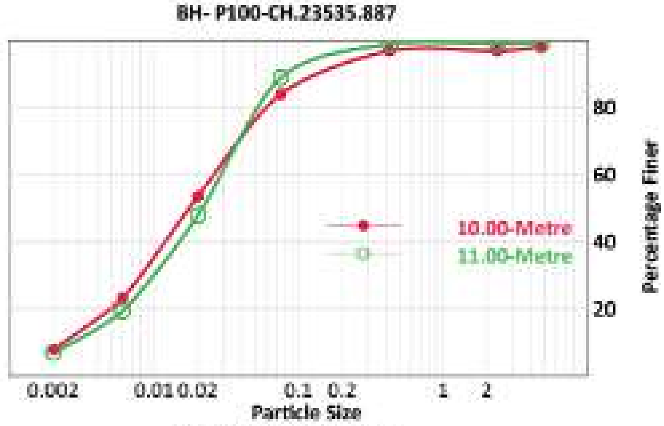


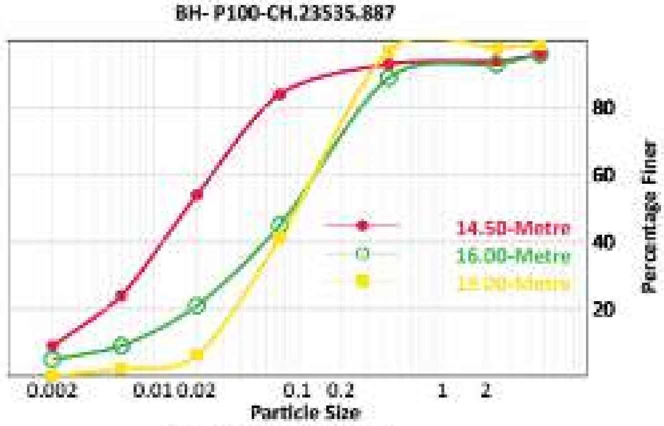


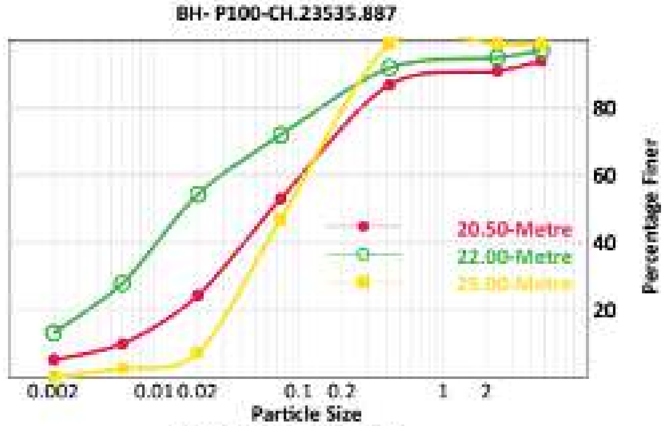


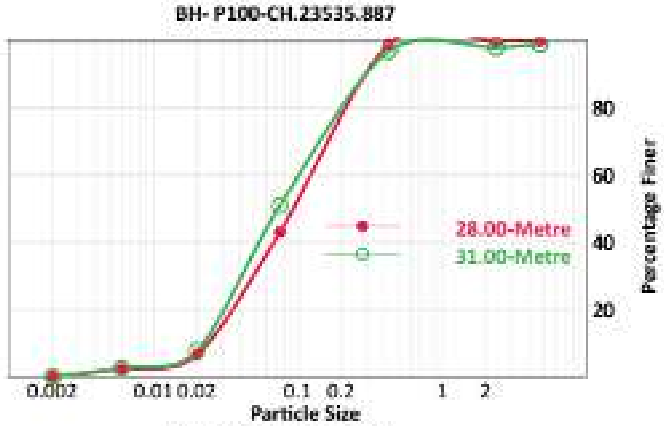


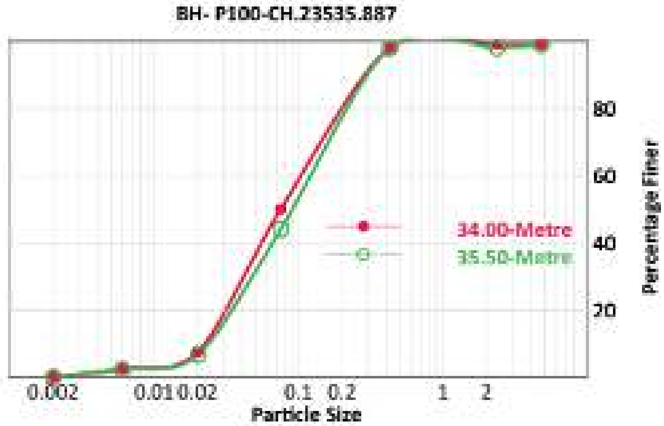
APPENDIX-D
PLOT 19: GRAIN SIZE DISTRIBUTION PLOTS

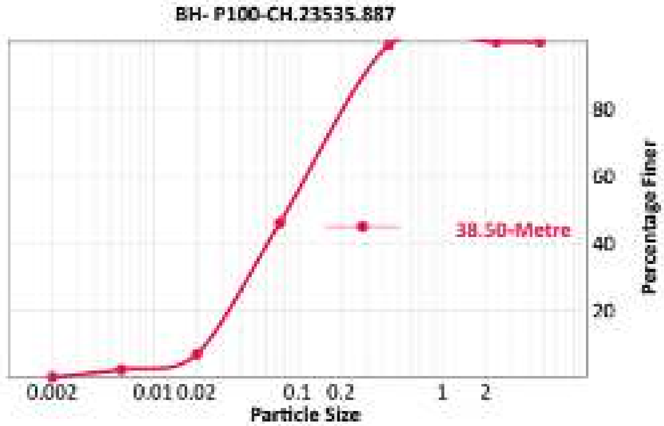




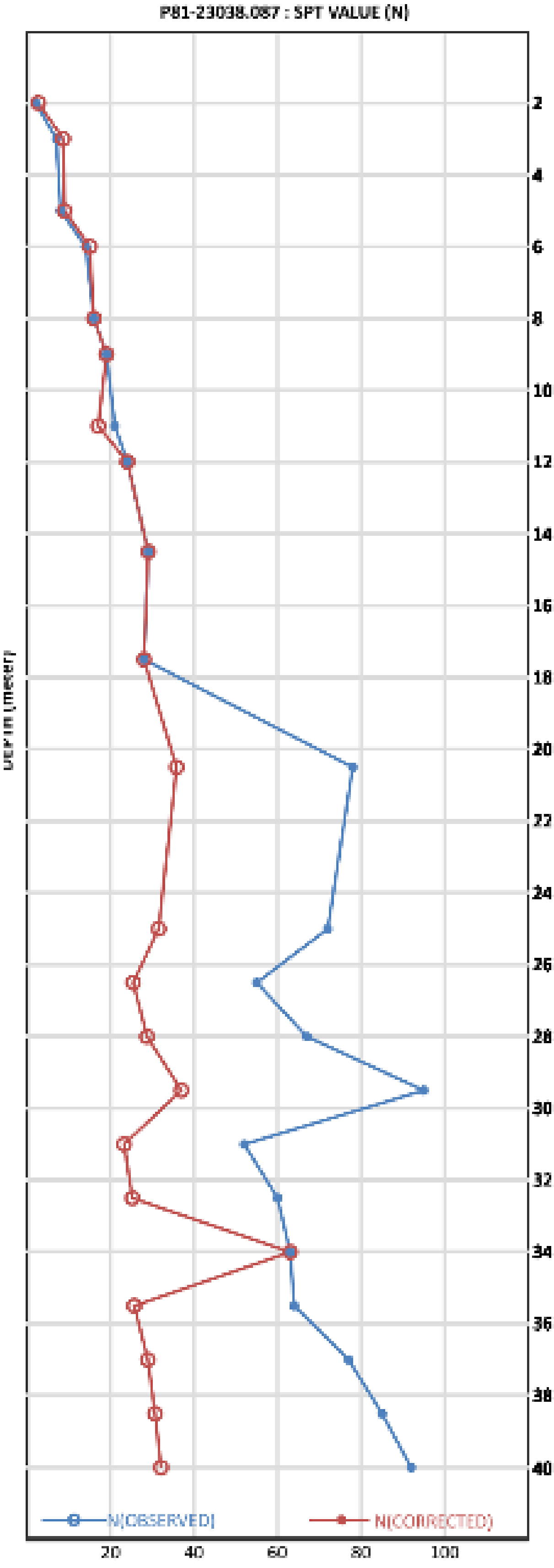


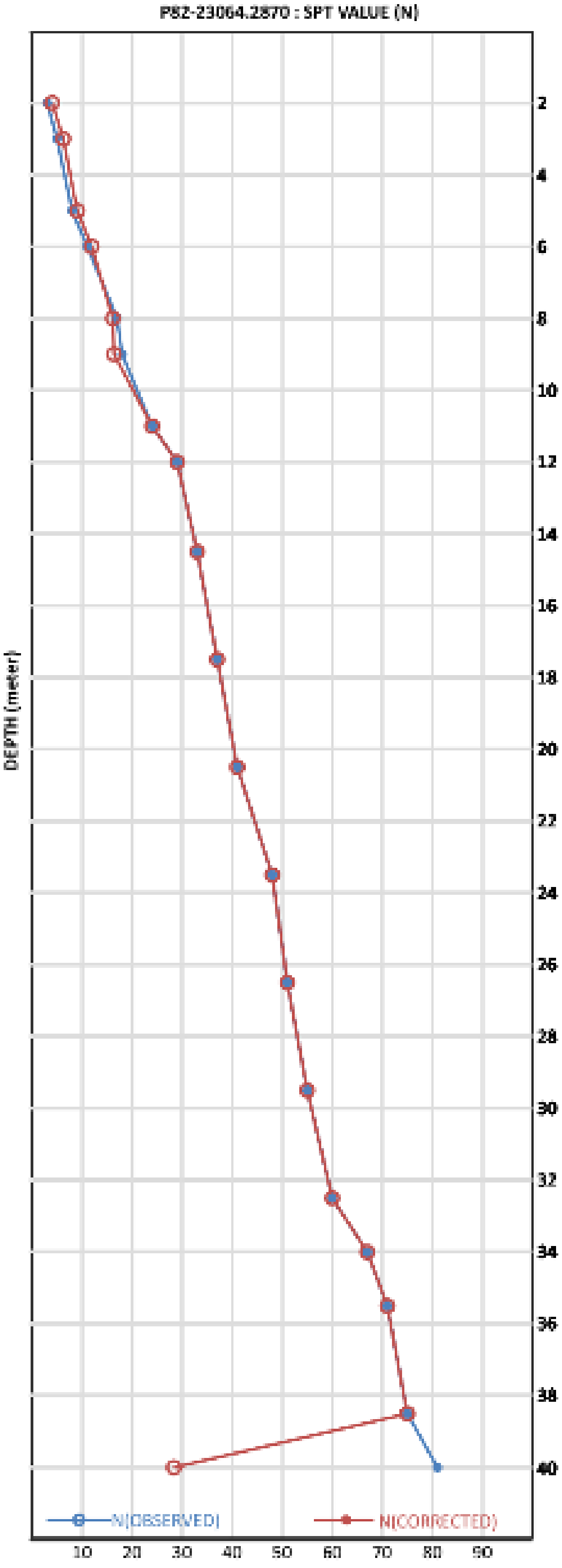




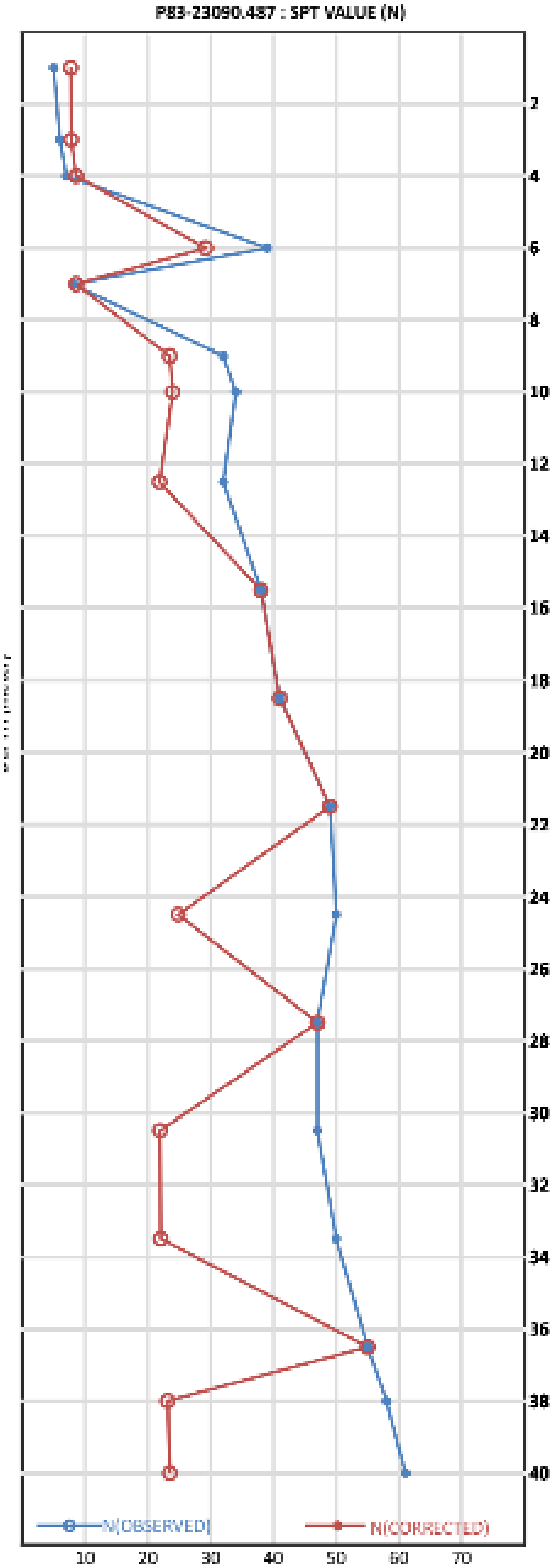


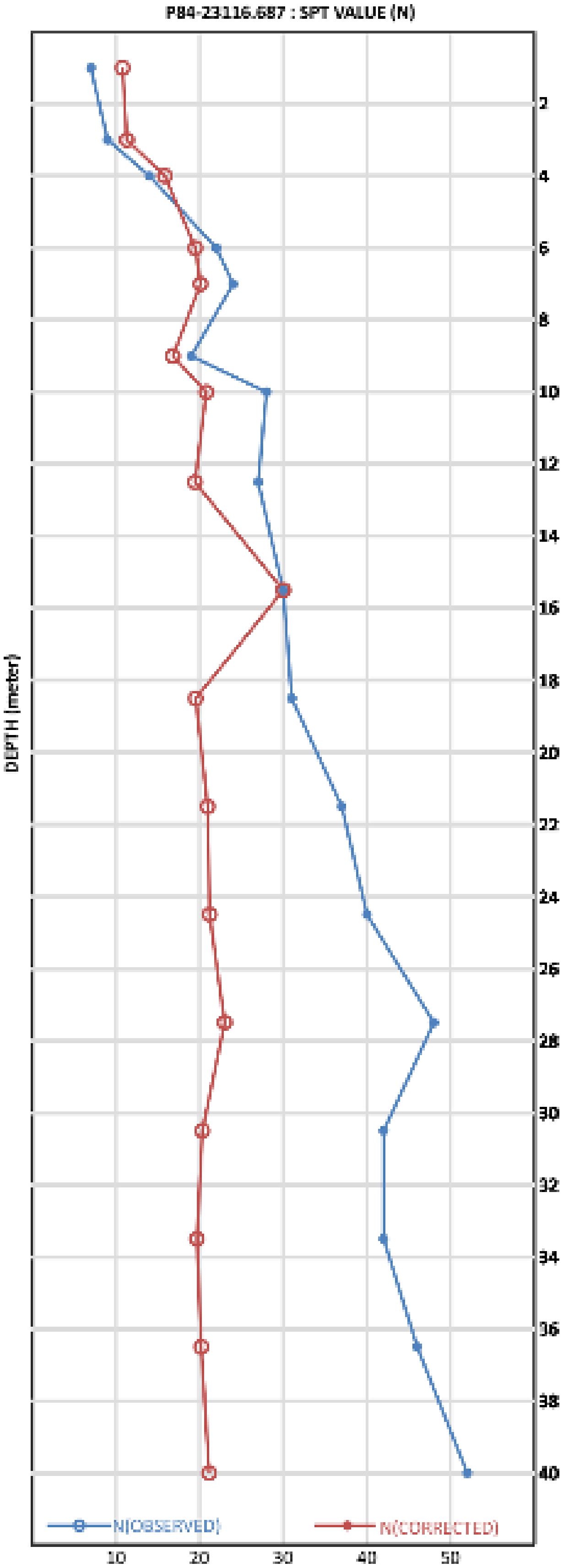
APPENDIX-E
PLOT 1: RECORDED SPT Vs CORRECTED SPT



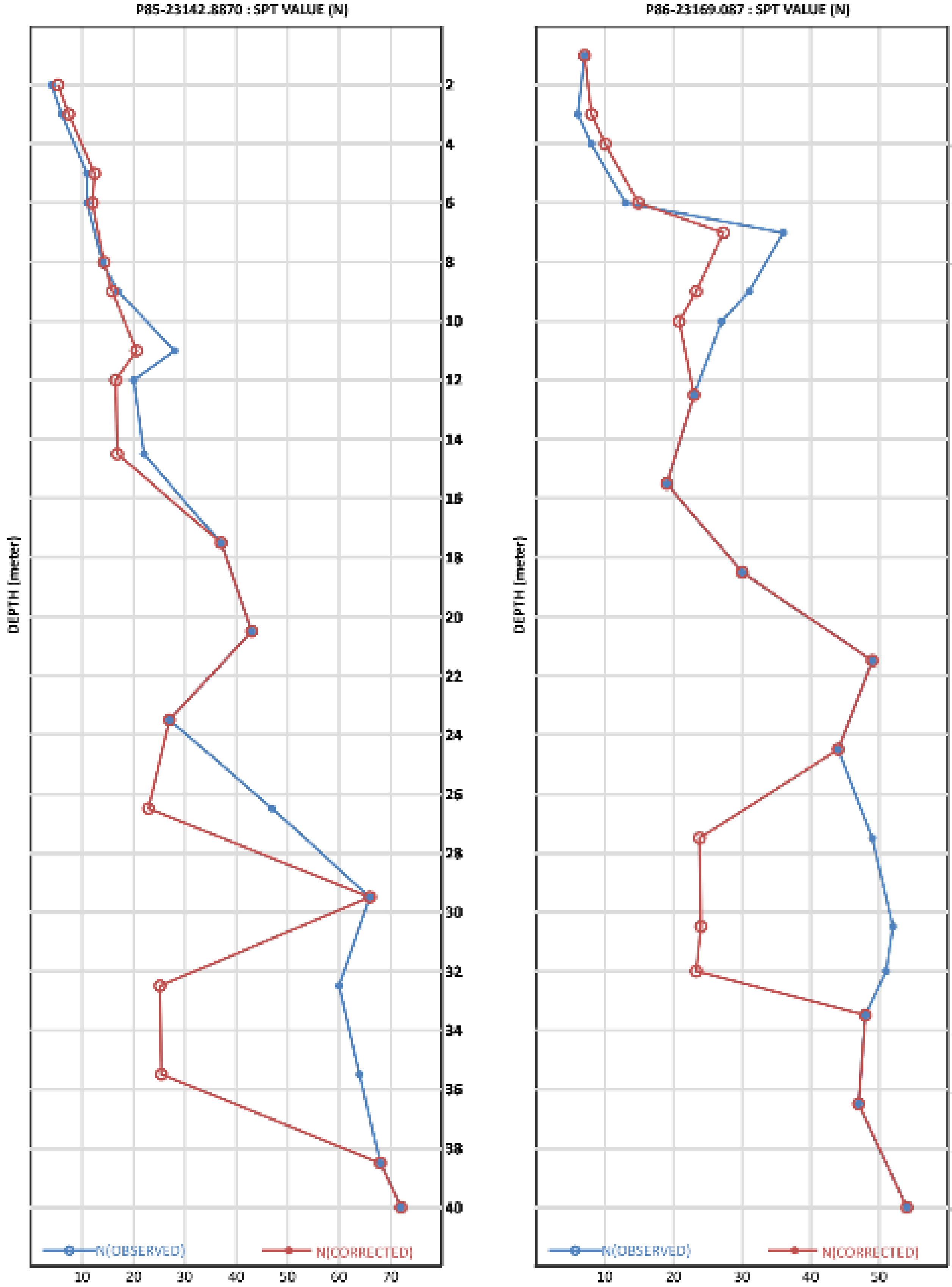


APPENDIX-E
PLOT 2: RECORDED SPT Vs CORRECTED SPT



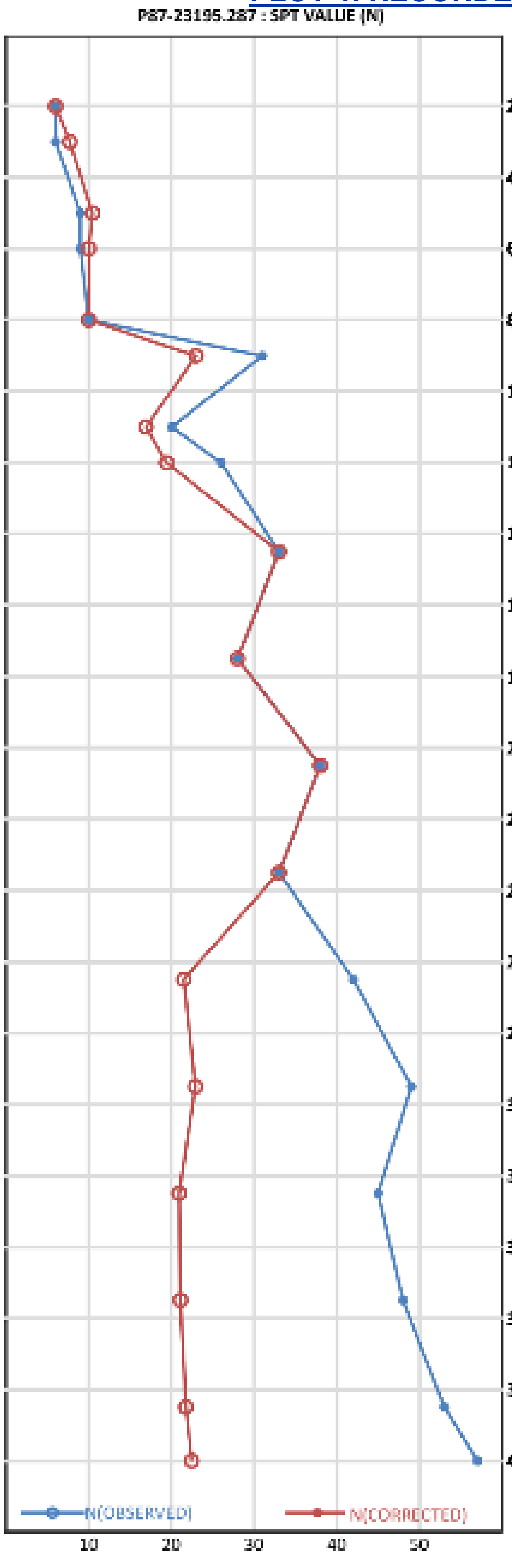


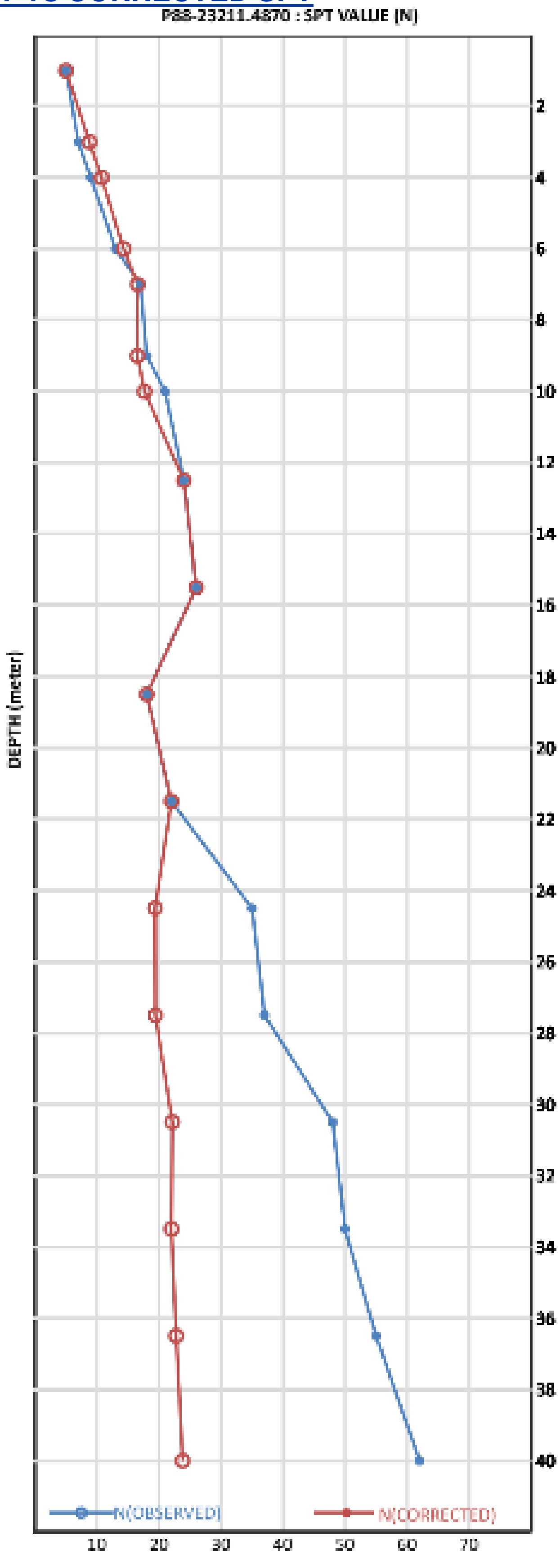
APPENDIX-E
PLOT 3: RECORDED SPT Vs CORRECTED SPT



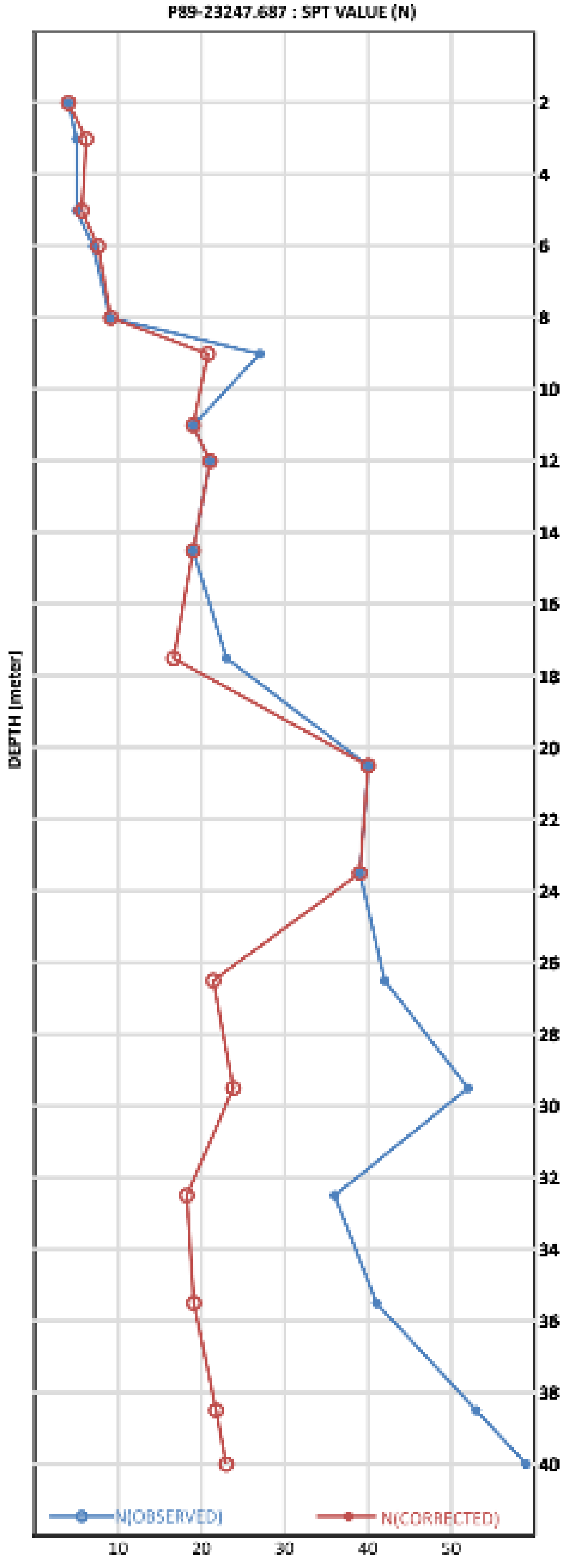
APPENDIX-E

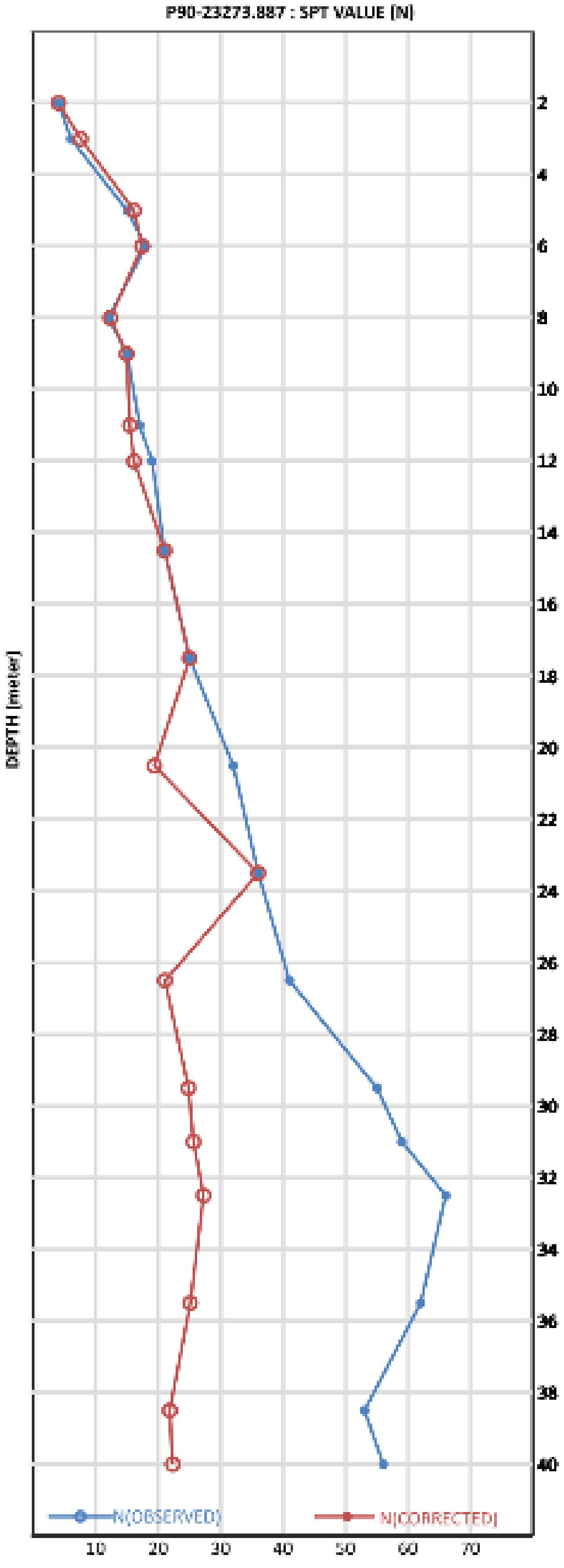
PLOT 4: RECORDED SPT Vs CORRECTED SPT





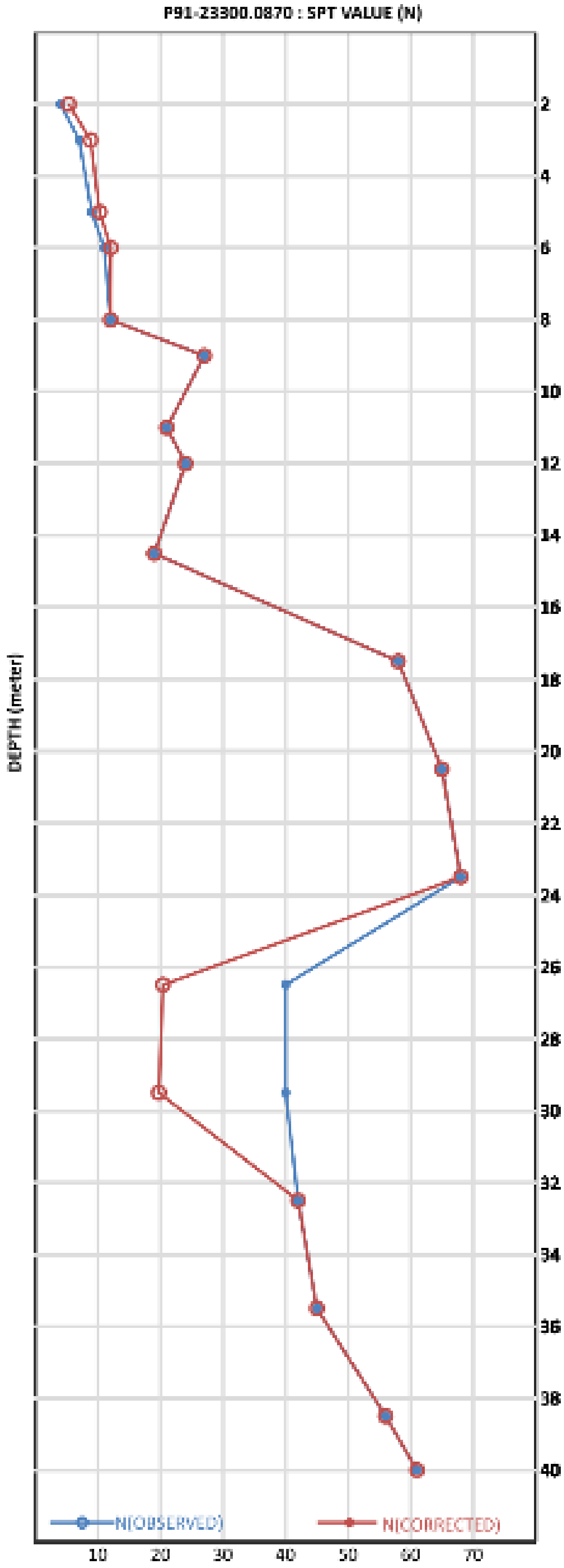
APPENDIX-E
PLOT 5: RECORDED SPT Vs CORRECTED SPT

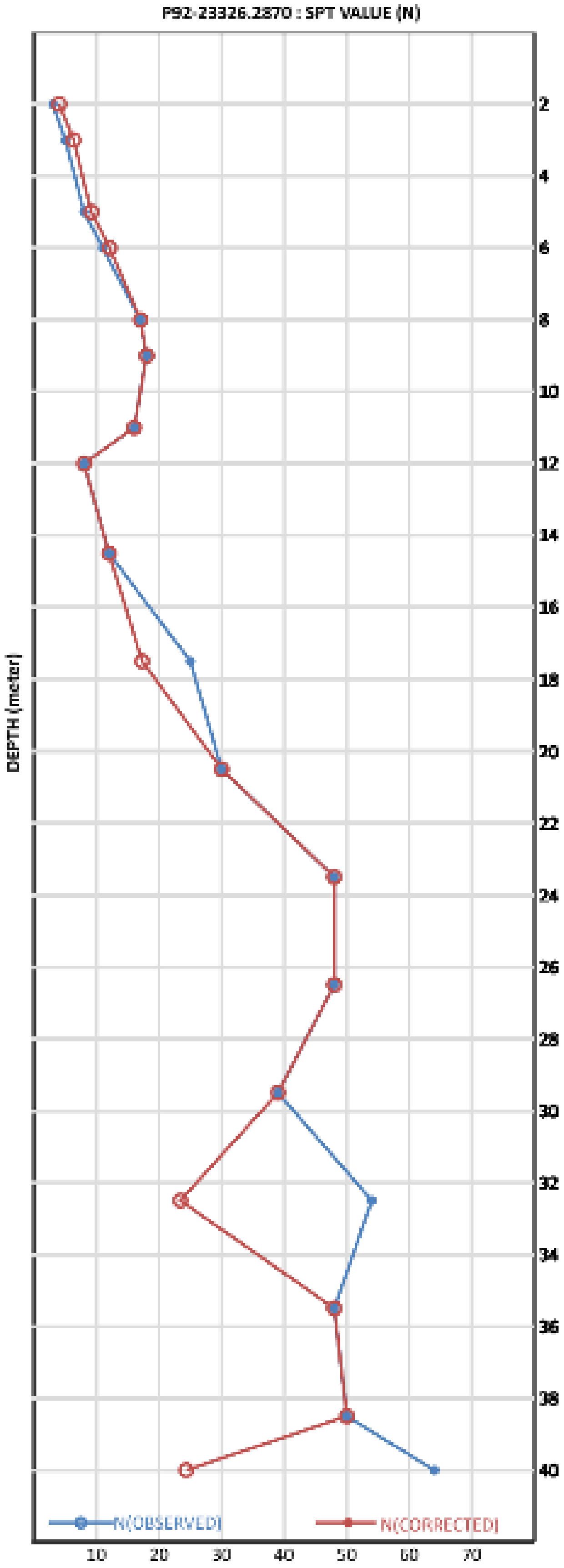




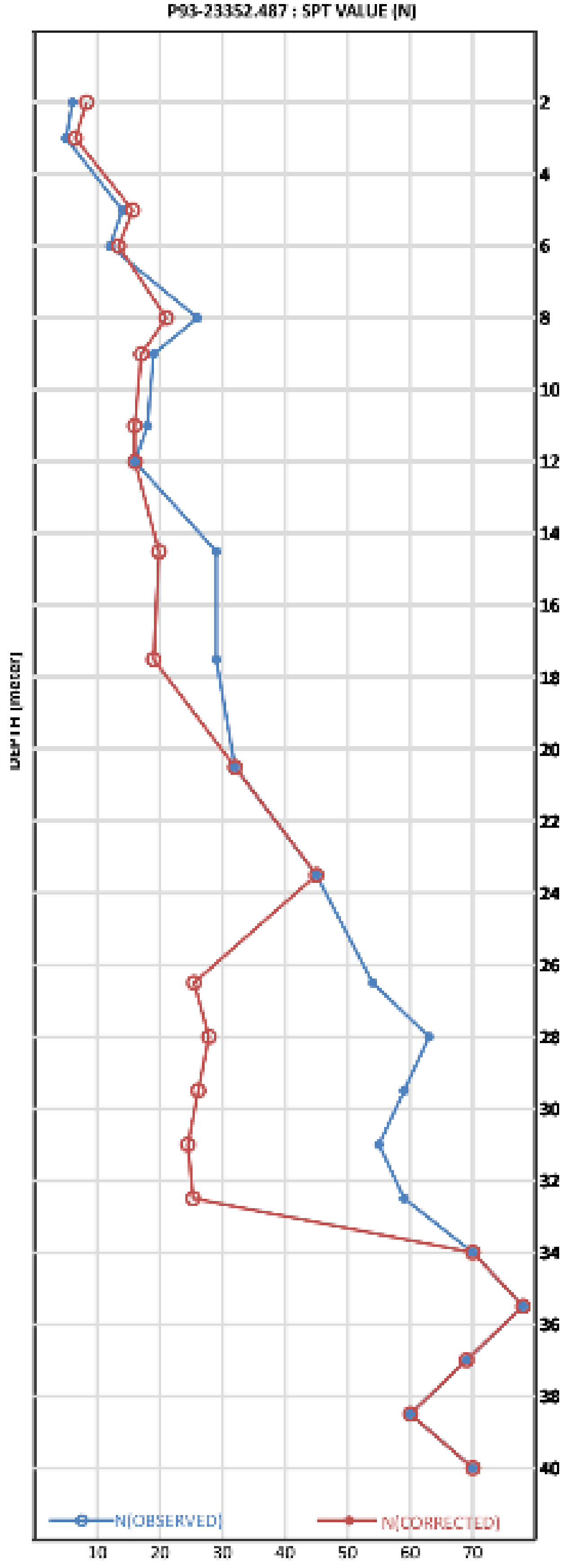
APPENDIX-E

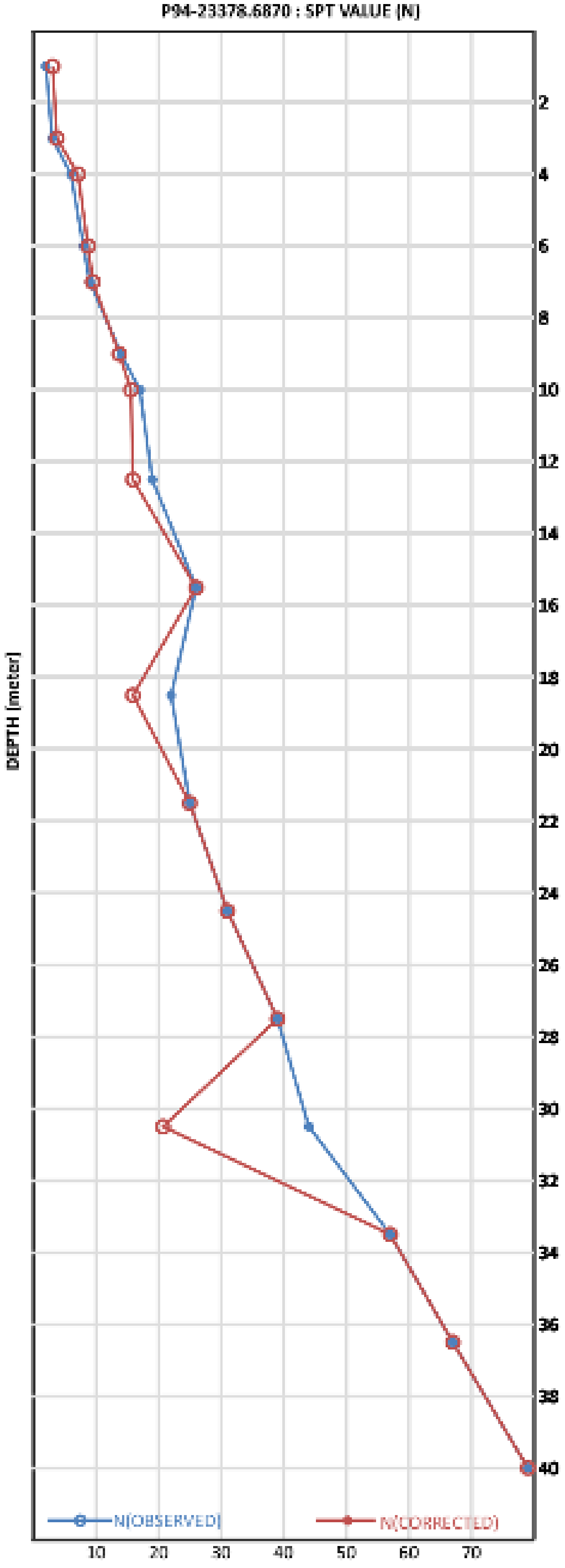
PLOT 6: RECORDED SPT Vs CORRECTED SPT



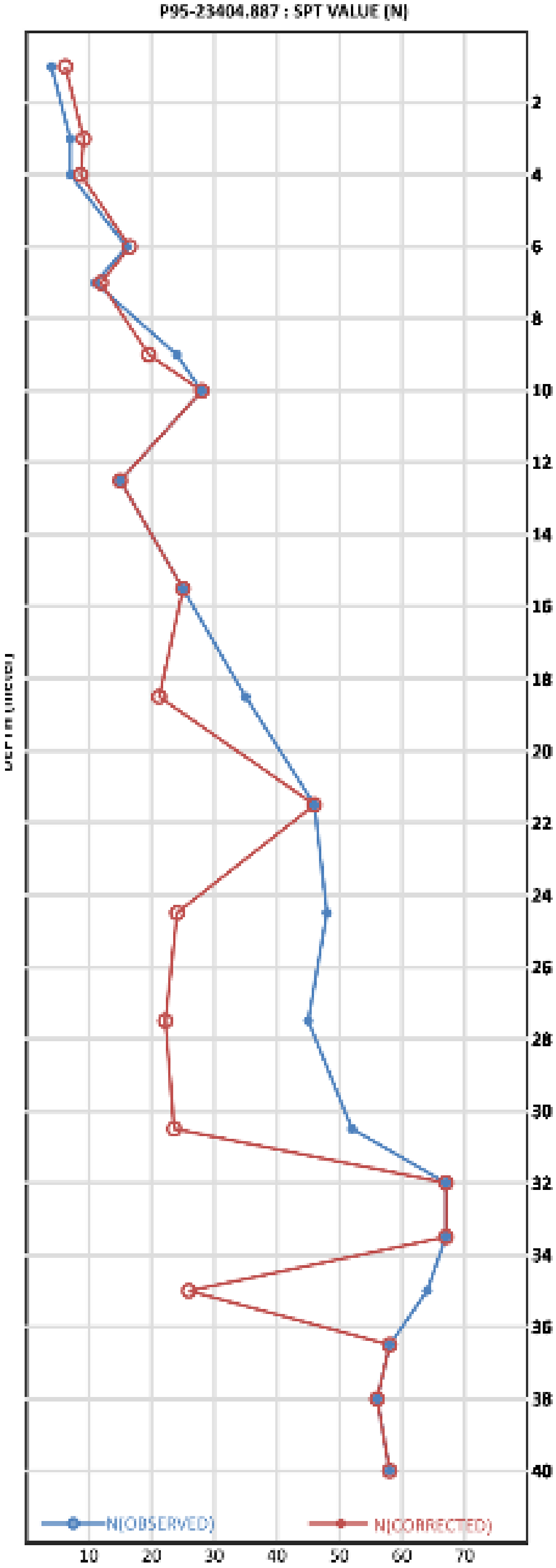


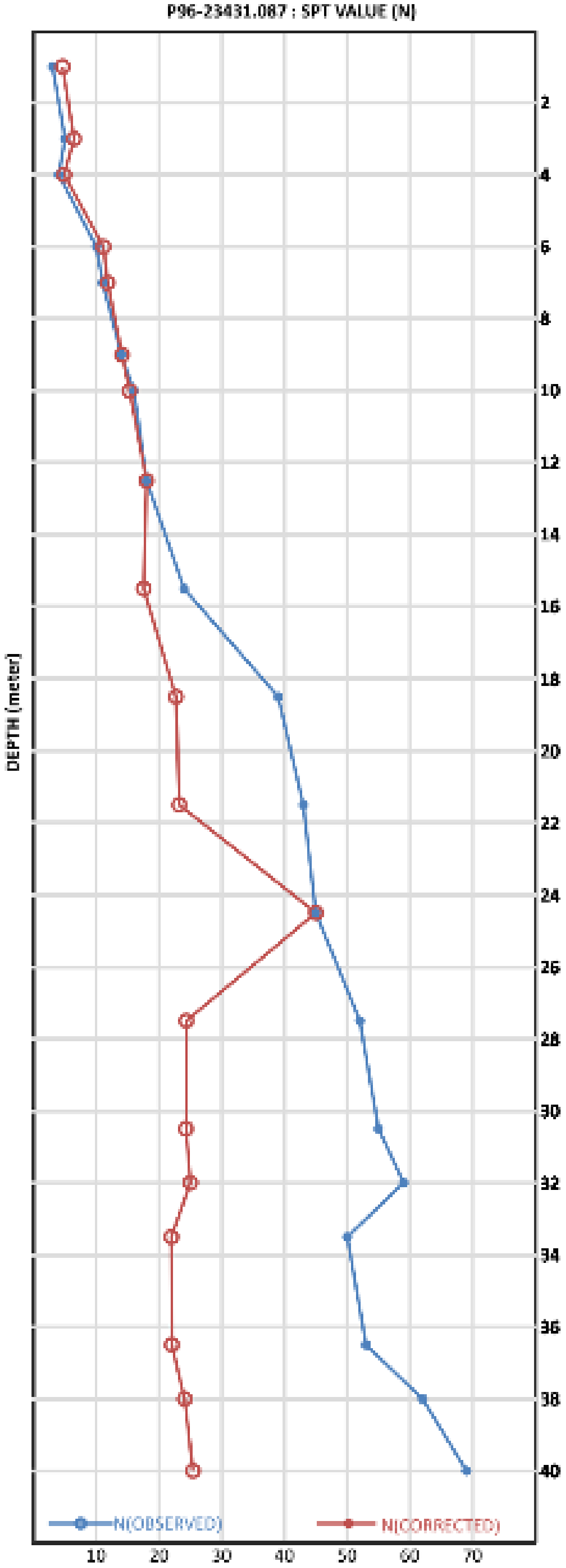
APPENDIX-E
PLOT 7: RECORDED SPT Vs CORRECTED SPT



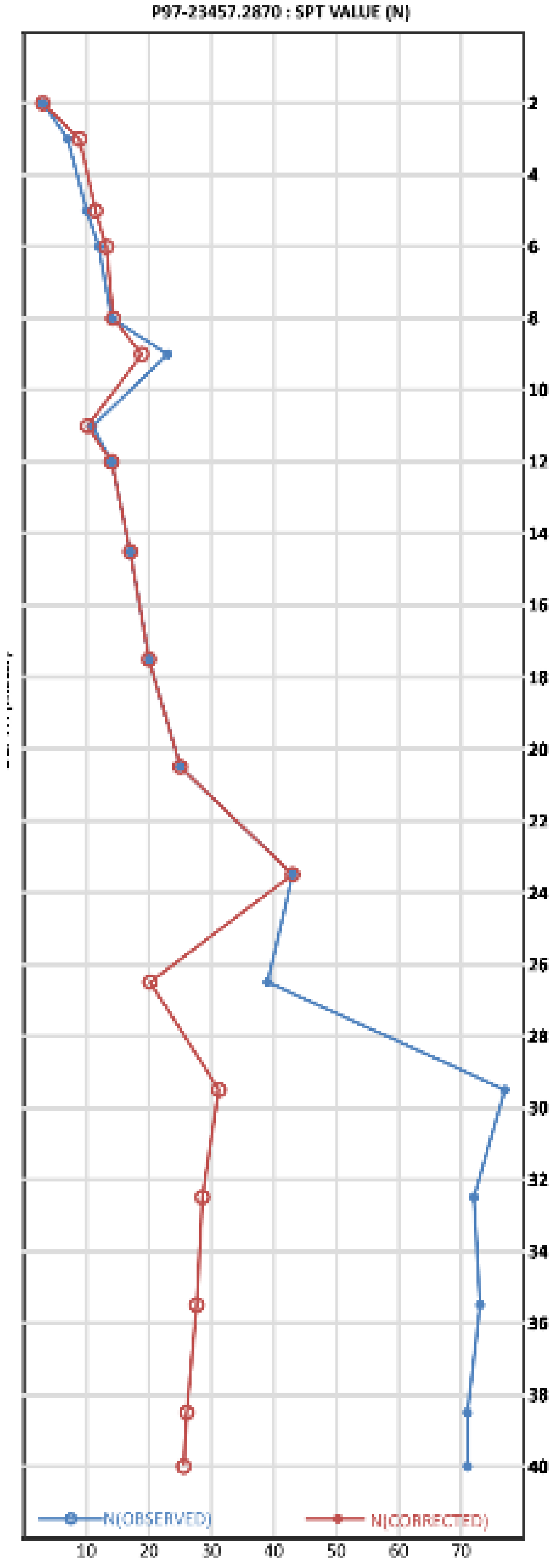


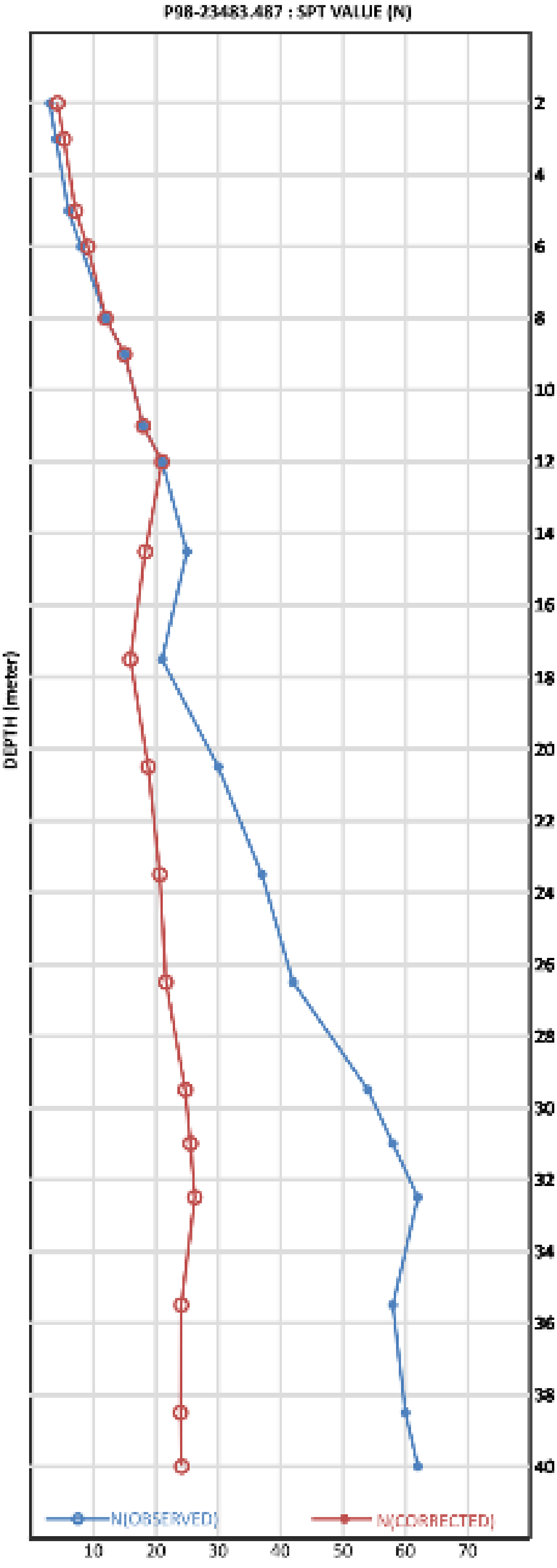
APPENDIX-E
PLOT 8: RECORDED SPT Vs CORRECTED SPT



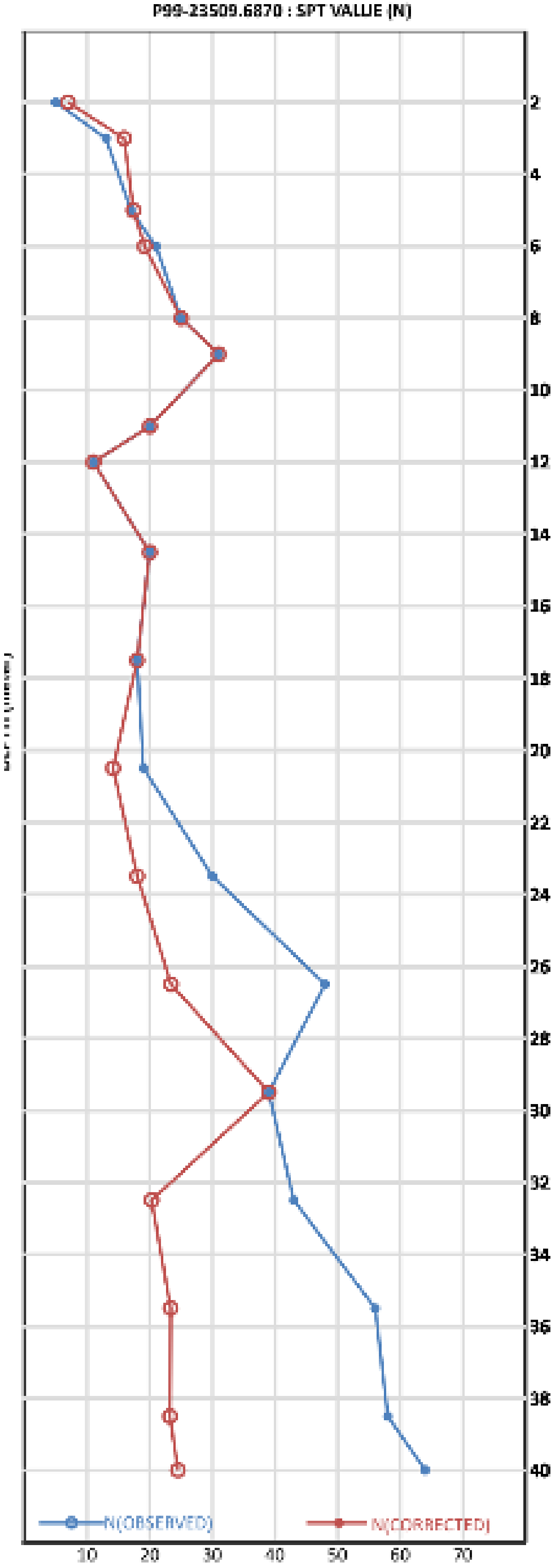


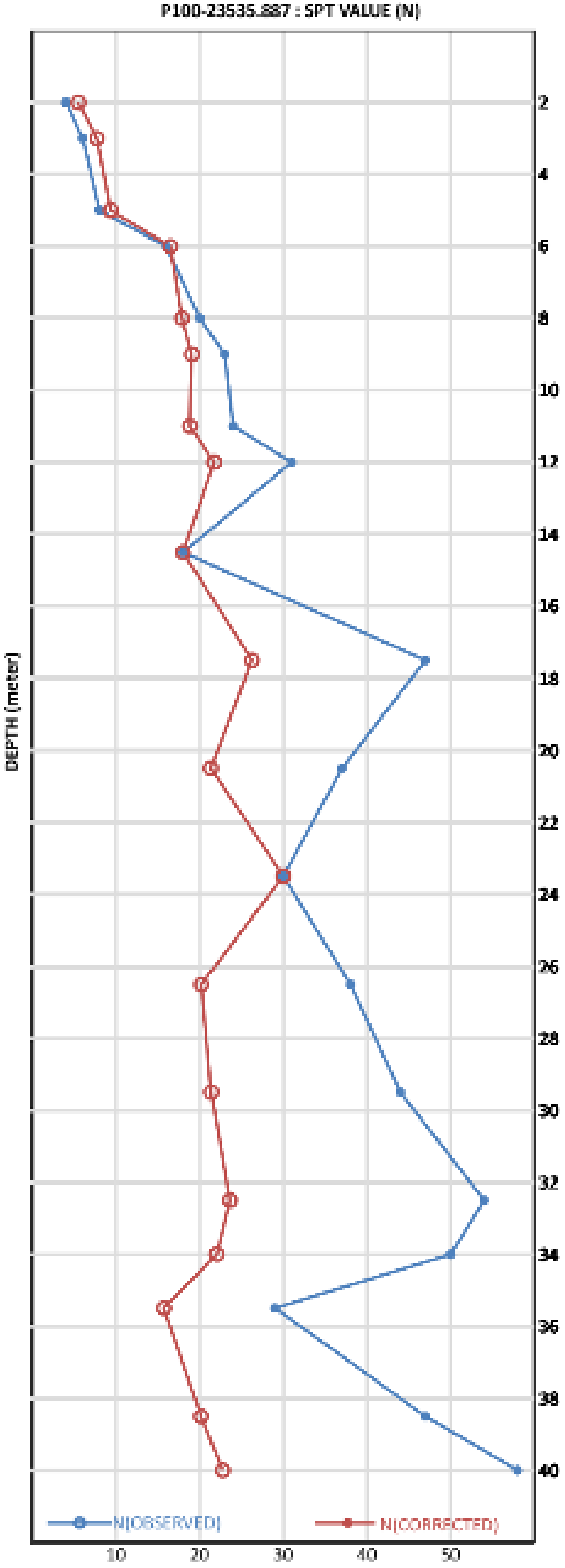
APPENDIX-E
PLOT 9: RECORDED SPT Vs CORRECTED SPT



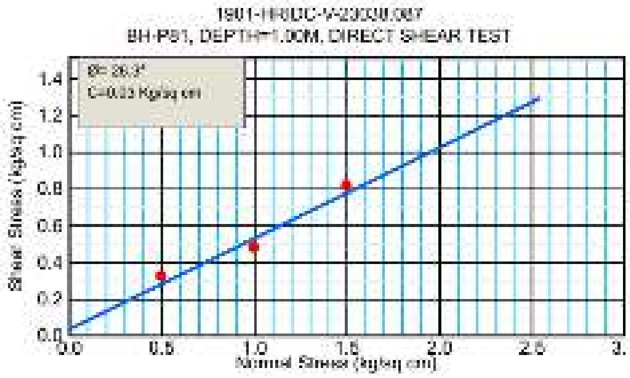


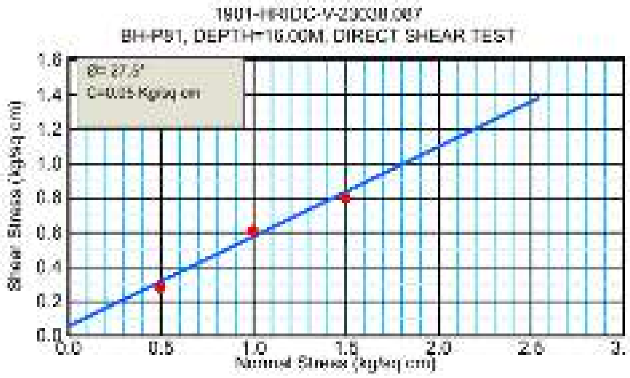
APPENDIX-E
PLOT 10: RECORDED SPT Vs CORRECTED SPT

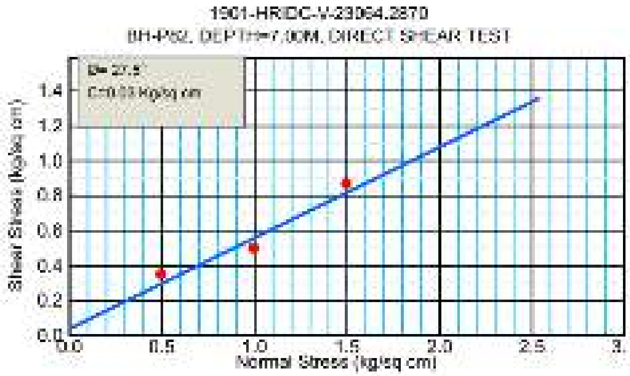


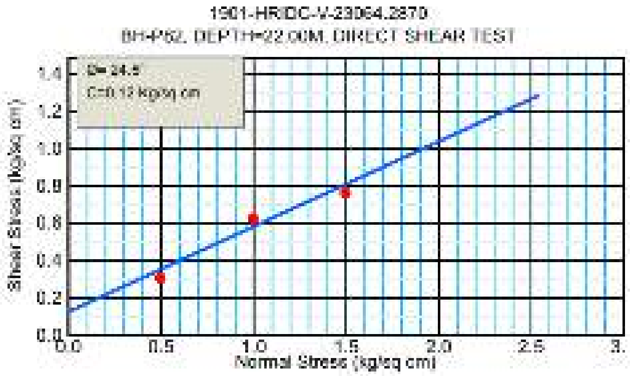


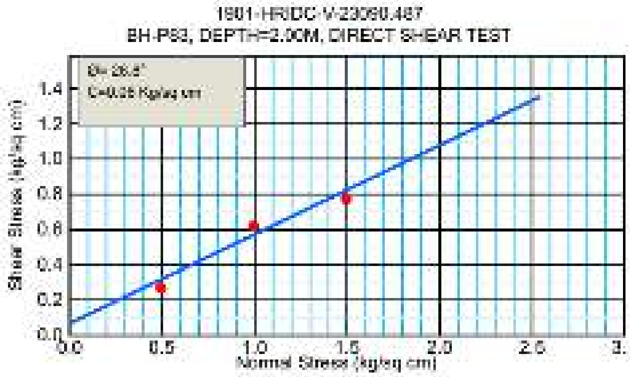
APPENDIX-F
GRAPH 1: DST GRAPH

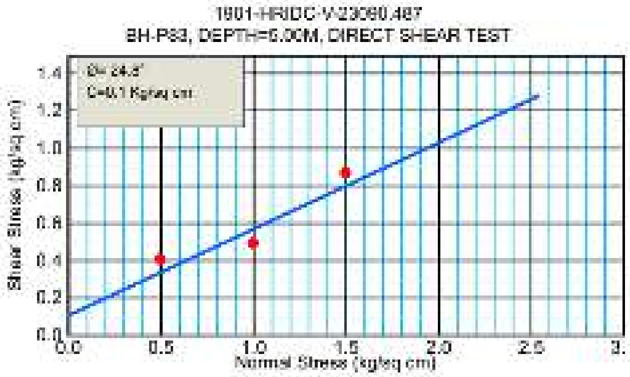


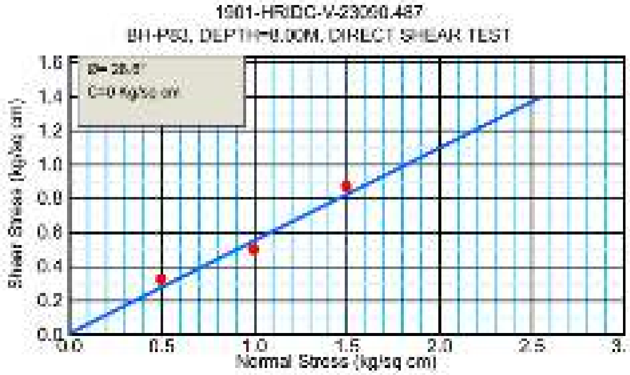


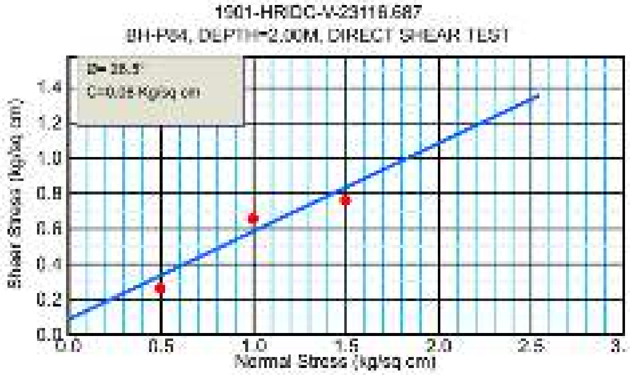




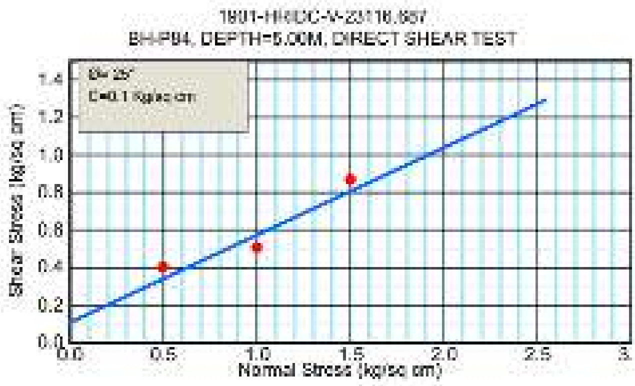


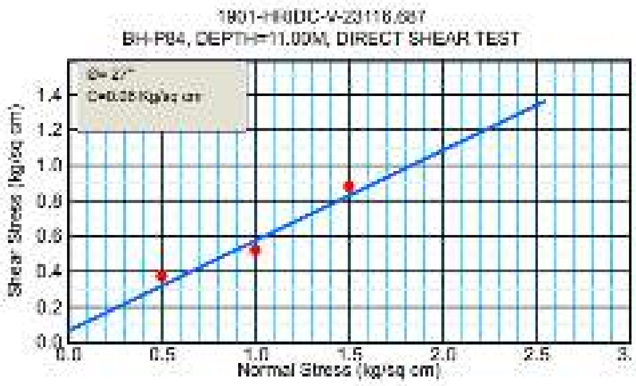


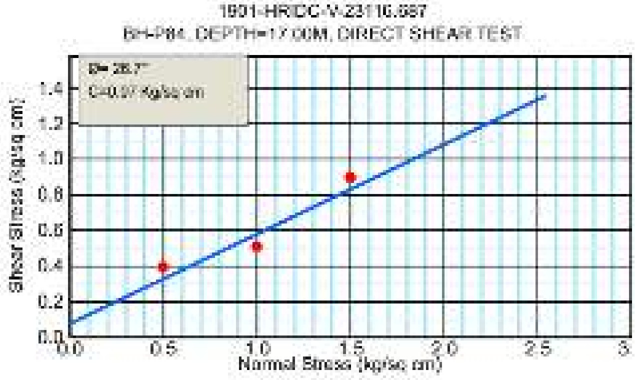


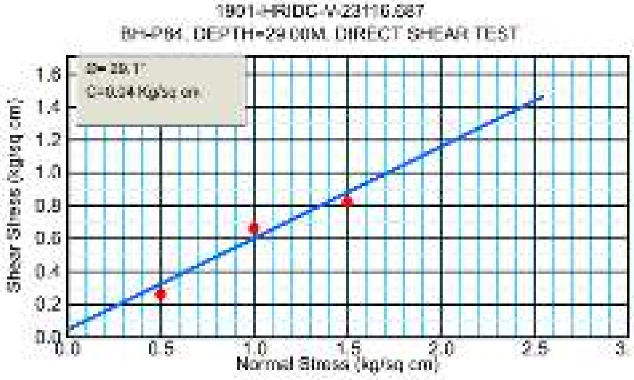


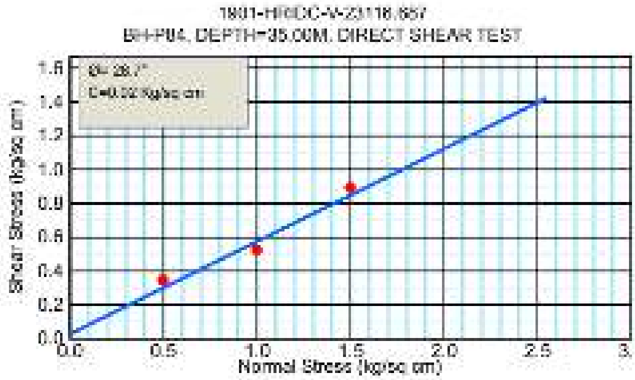
APPENDIX-F
GRAPH 2: DST GRAPH

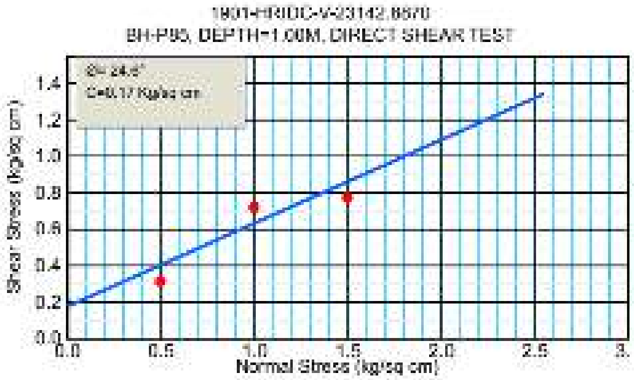


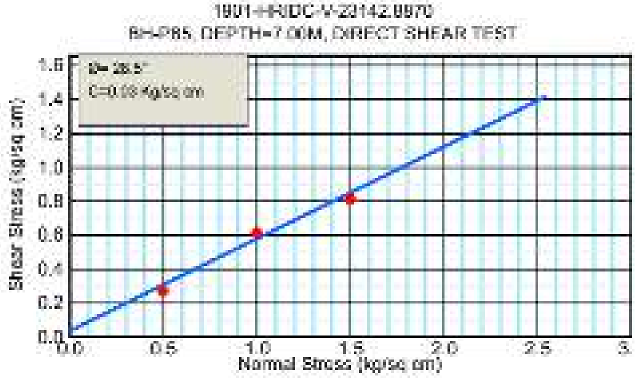


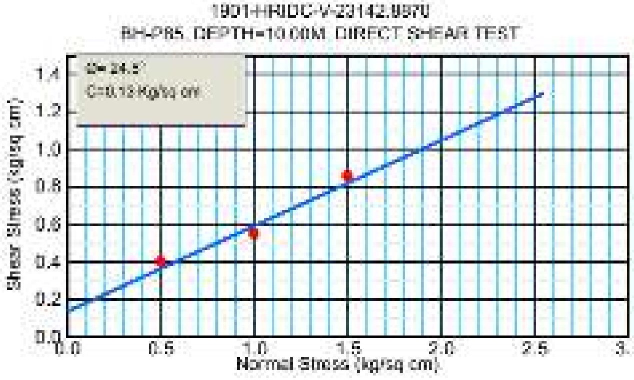




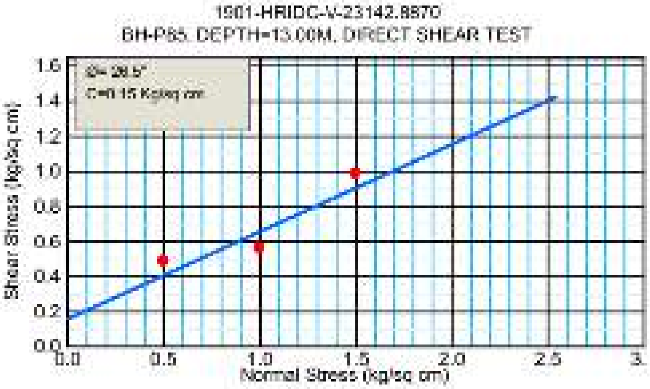


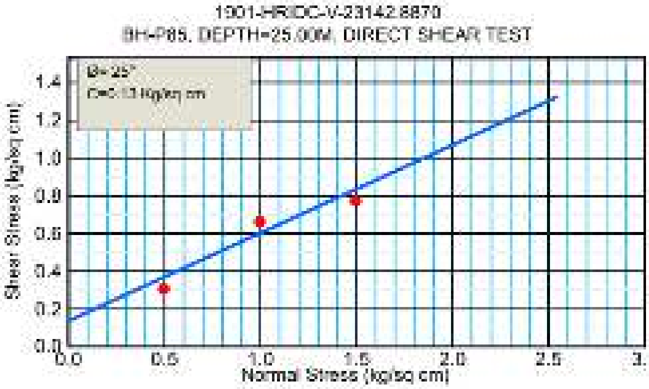


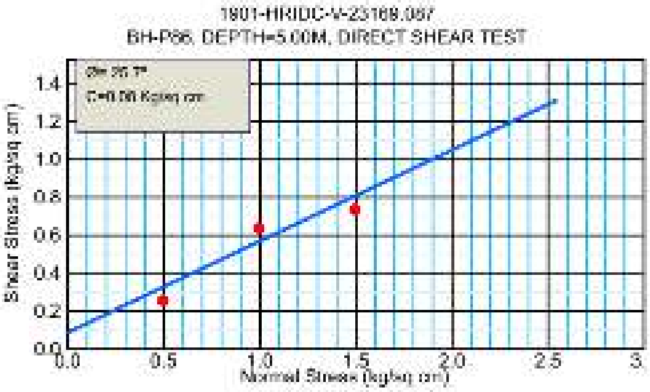


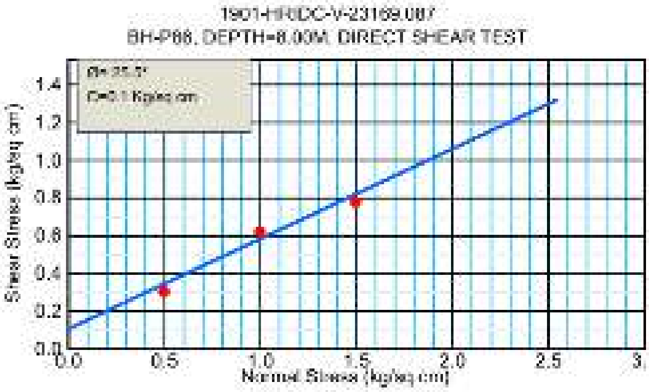


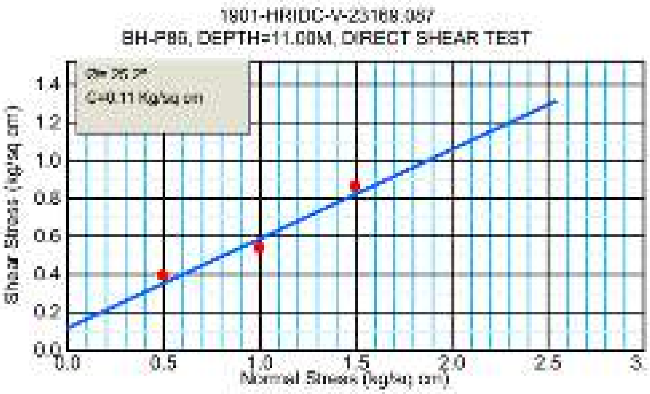
APPENDIX-F
GRAPH 3: DST GRAPH

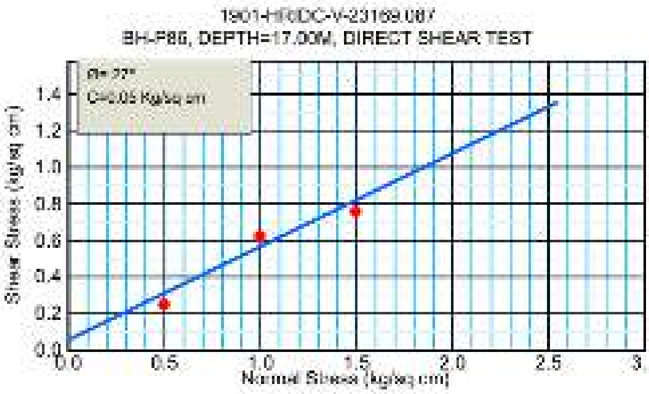


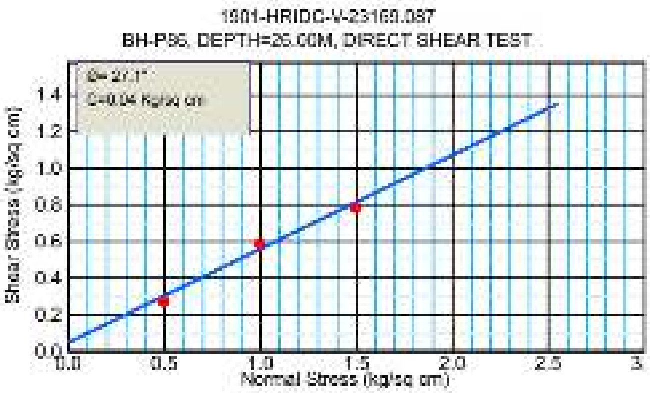


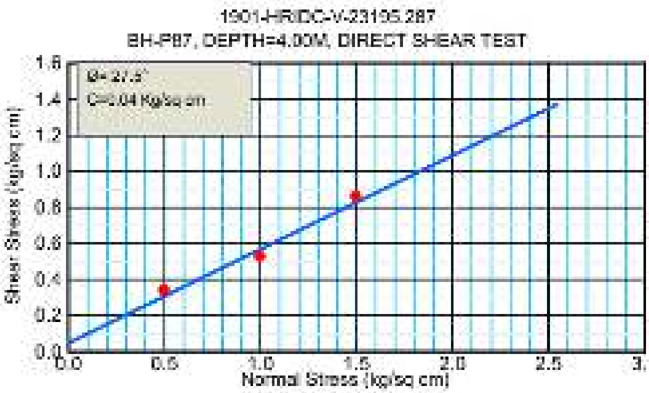




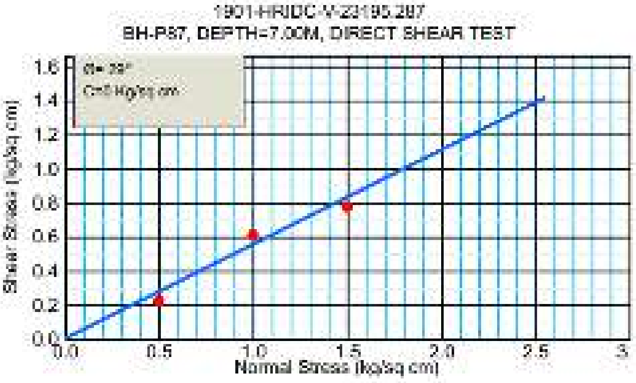


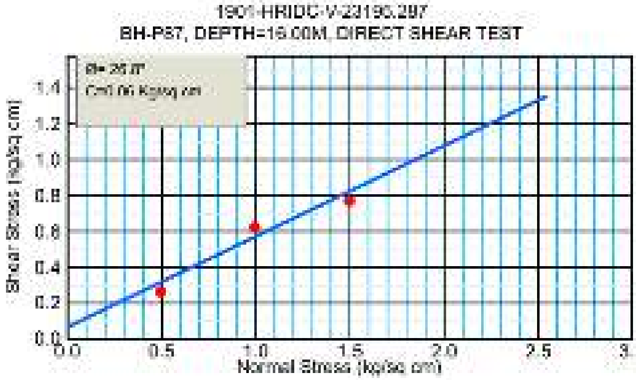


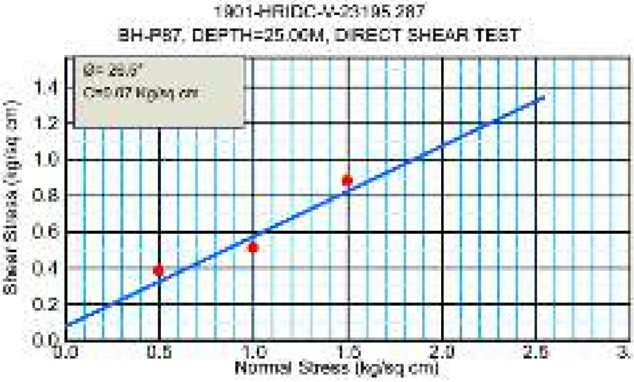


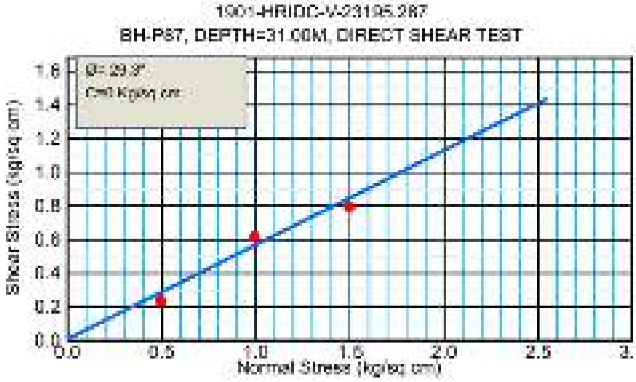


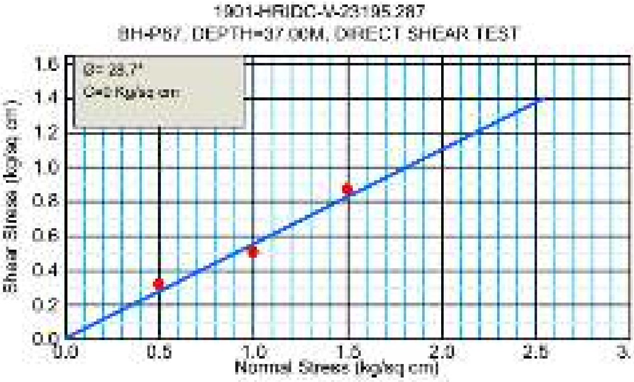
APPENDIX-F
GRAPH 4: DST GRAPH

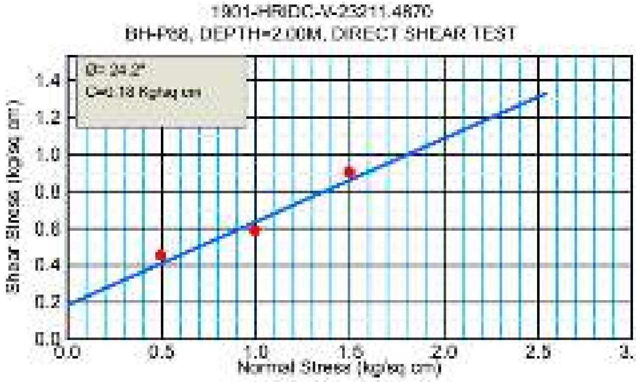


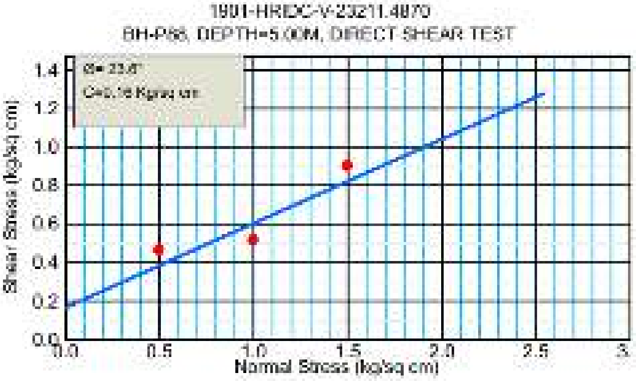


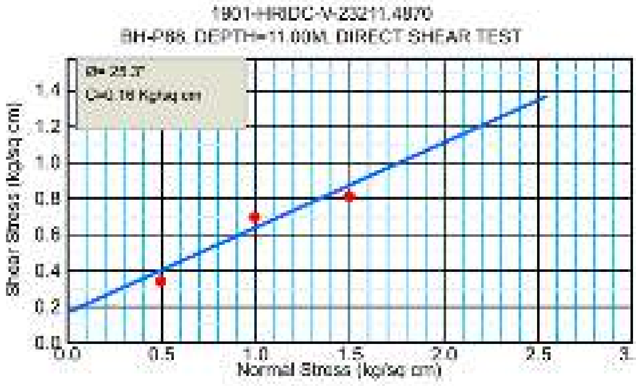




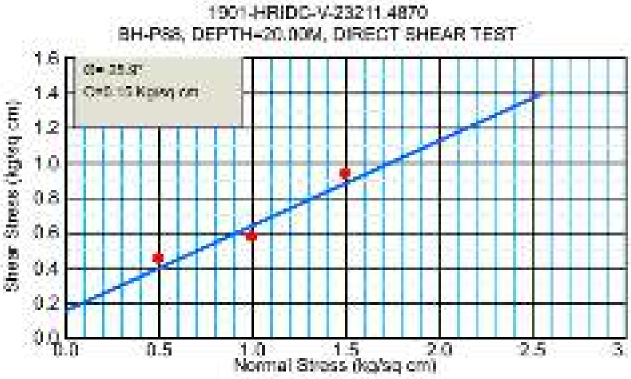


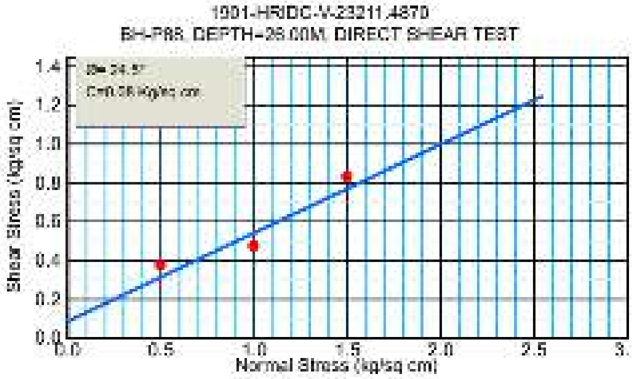


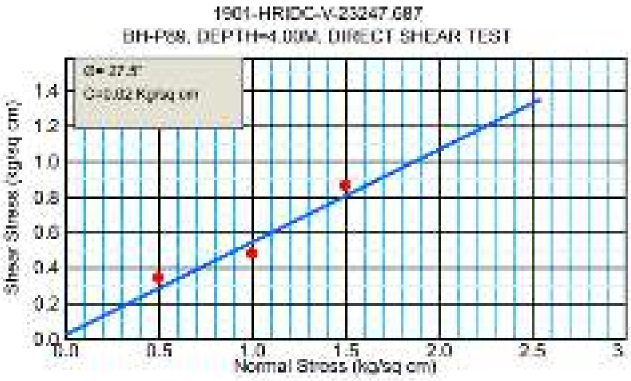


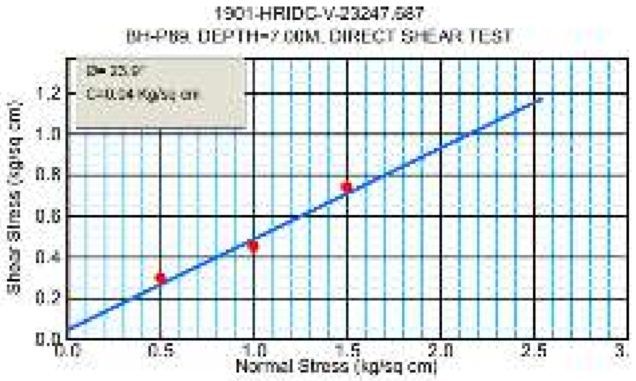


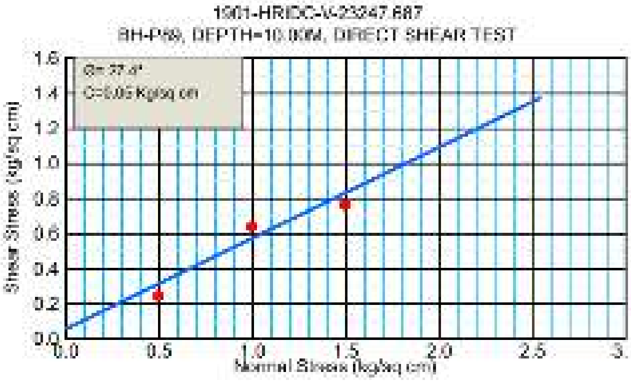
APPENDIX-F
GRAPH 5: DST GRAPH

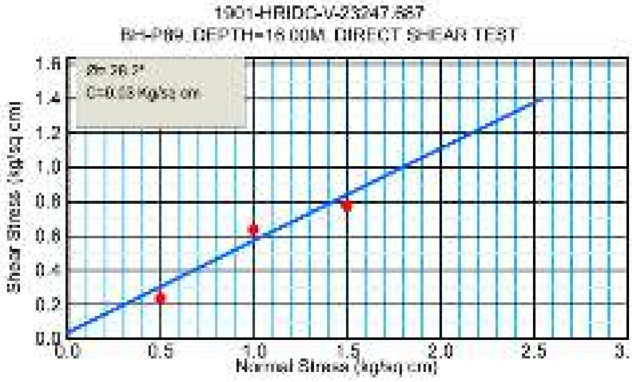


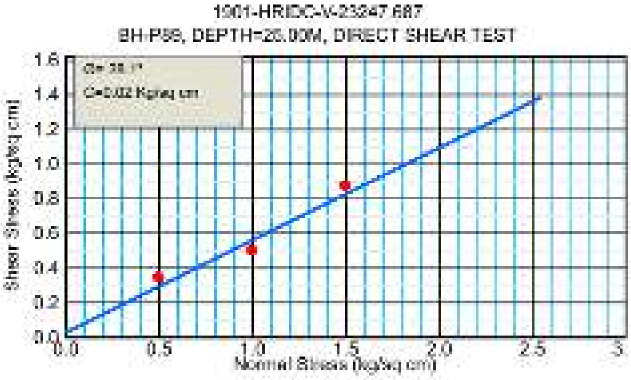


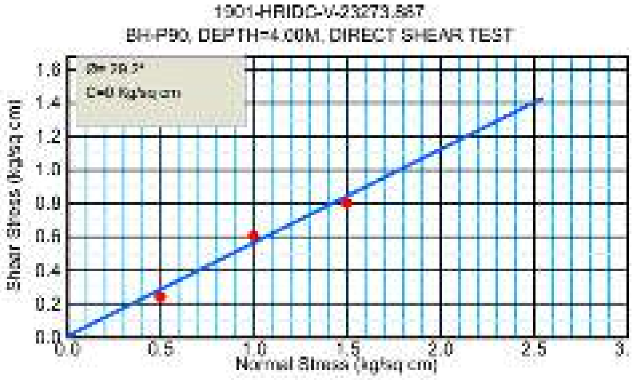




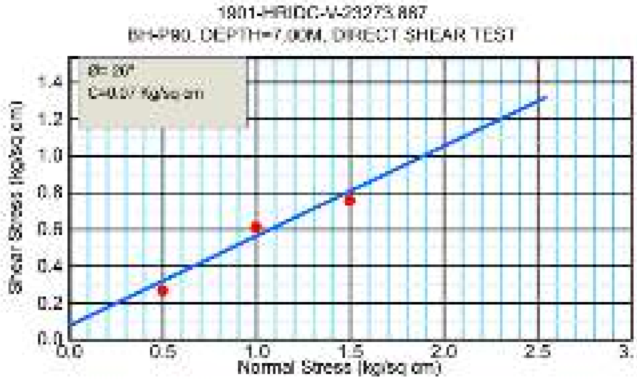


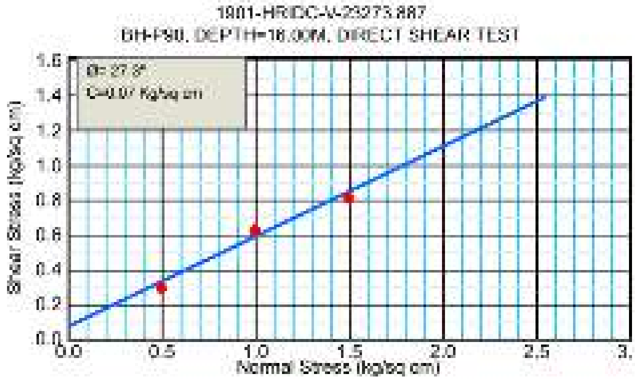


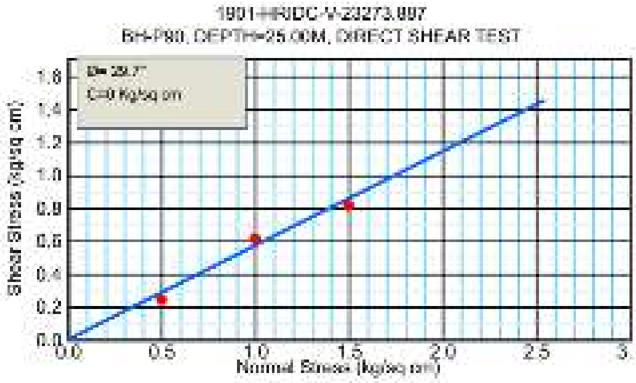


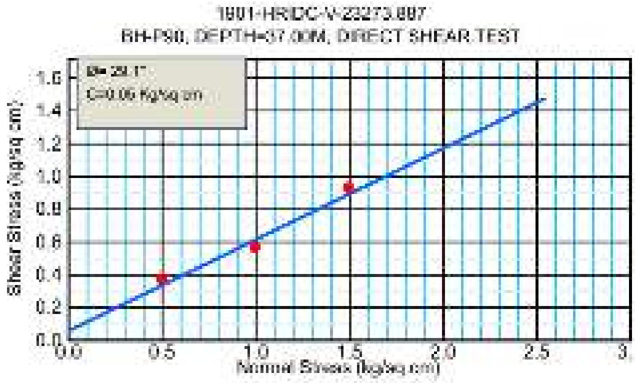


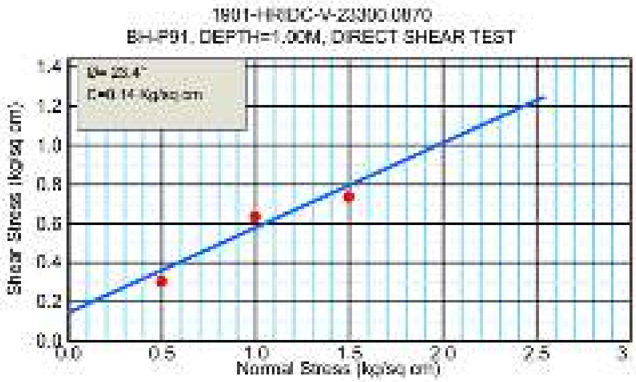
APPENDIX-F
GRAPH 6: DST GRAPH

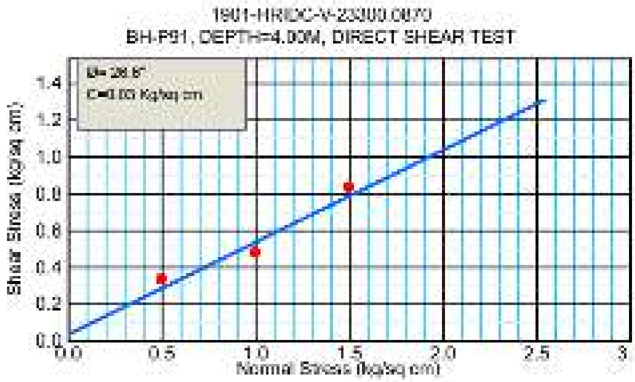


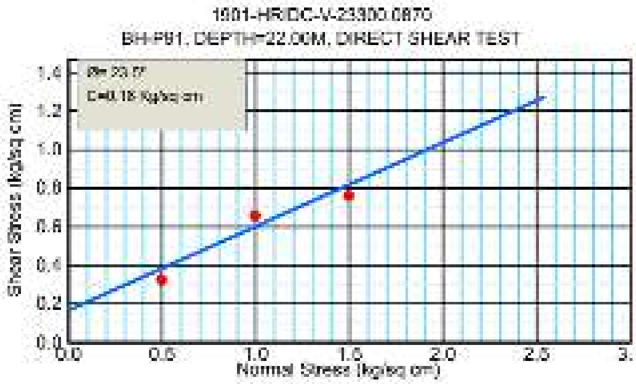


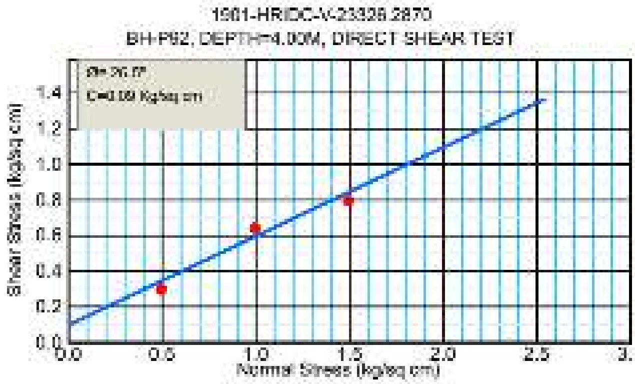








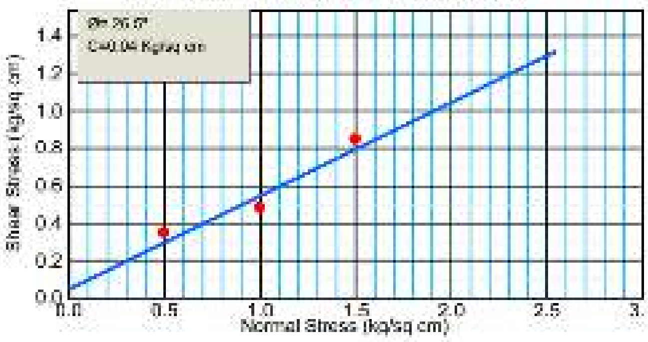




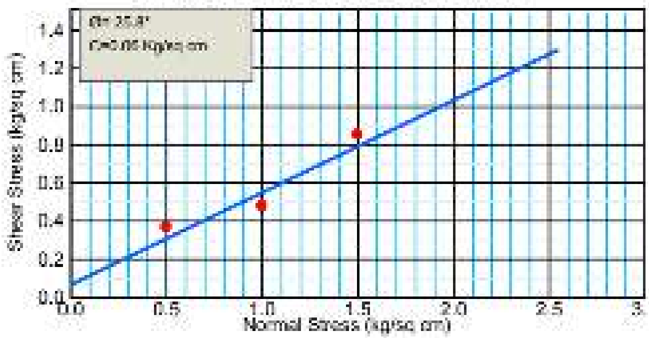
APPENDIX-F
GRAPH 7: DST GRAPH

1901-HRIDC-V-23326.2970
BH-P92, DEPTH=7.00M, DIRECT SHEAR TEST

1901-HRIDC-V-23352.487
BH-P93, DEPTH=1.00M, DIRECT SHEAR TEST



1901-HRIDC-V-23352.487
BH-P93, DEPTH=4.00M, DIRECT SHEAR TEST



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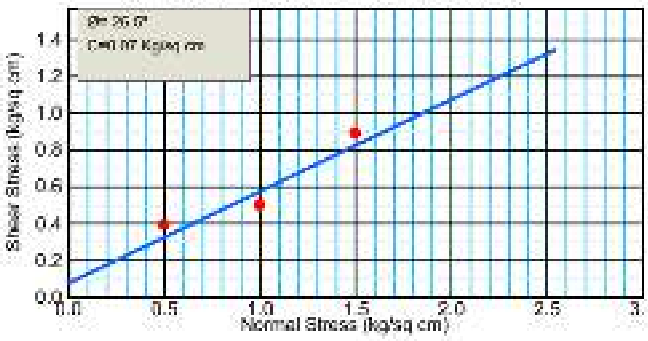
BH-P93, DEPTH=10.00M, DIRECT SHEAR TEST



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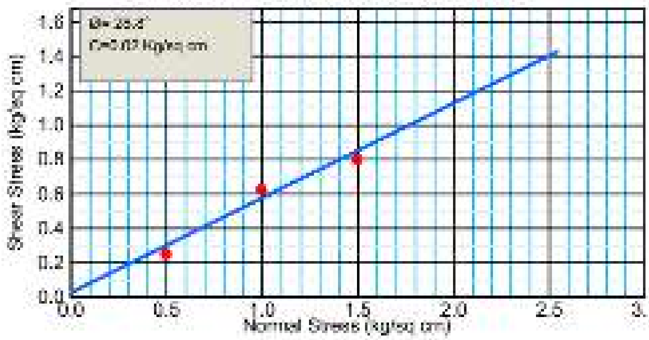
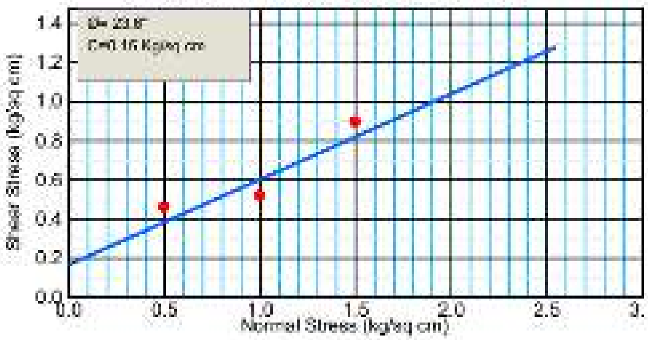
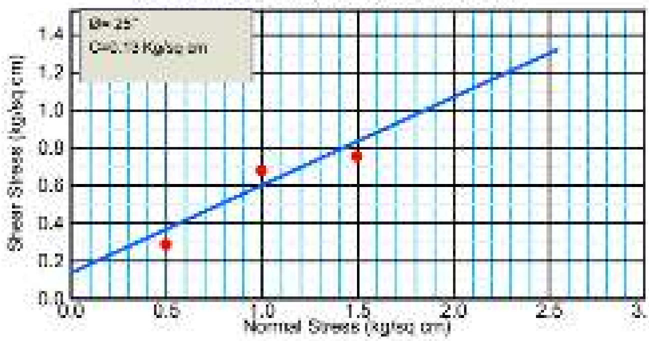
BH-P93, DEPTH=25.00M, DIRECT SHEAR TEST



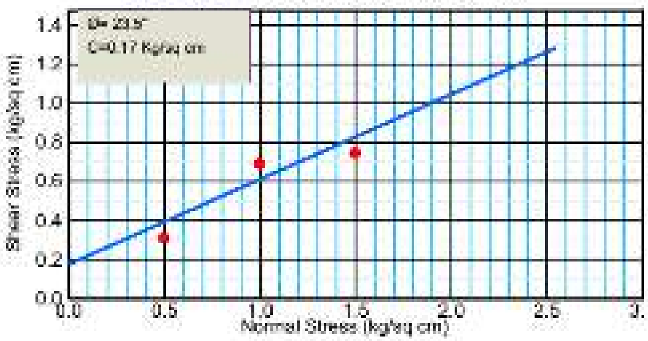
1901-HRIDC-V-23378.6870
BH-P94, DEPTH=2.00M, DIRECT SHEAR TEST



1901-HRIDC-V-23378.6870
BH-P94, DEPTH=5.00M, DIRECT SHEAR TEST

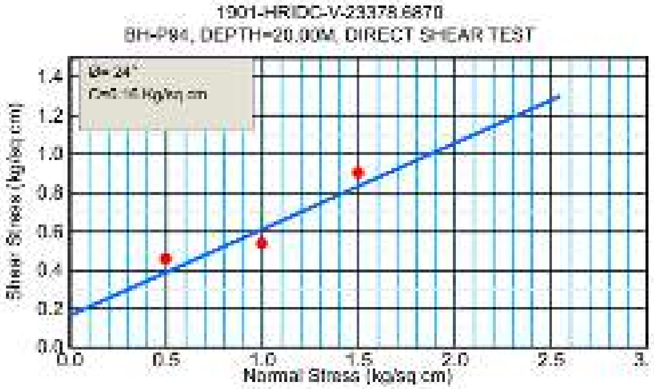


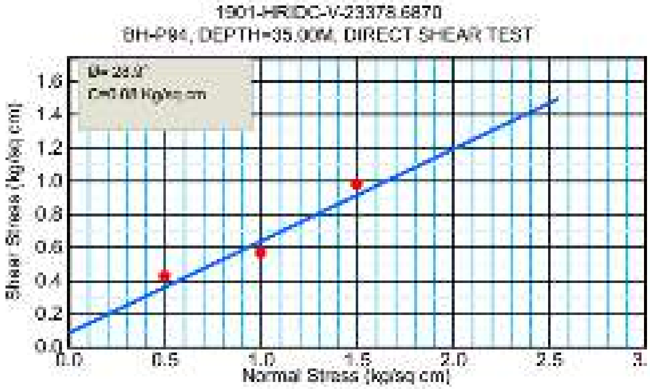
1901-HRIDC-V-23378.6870
BH-P94, DEPTH=8.00M, DIRECT SHEAR TEST

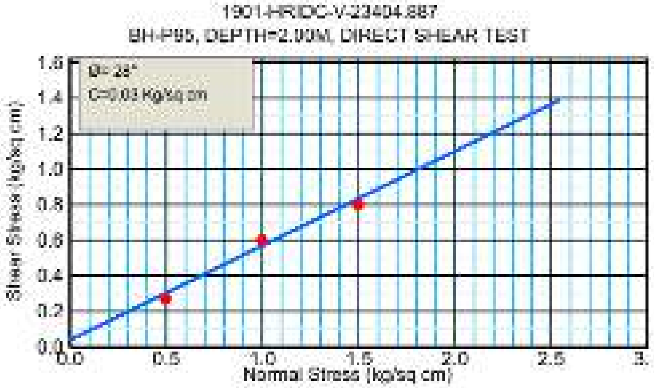


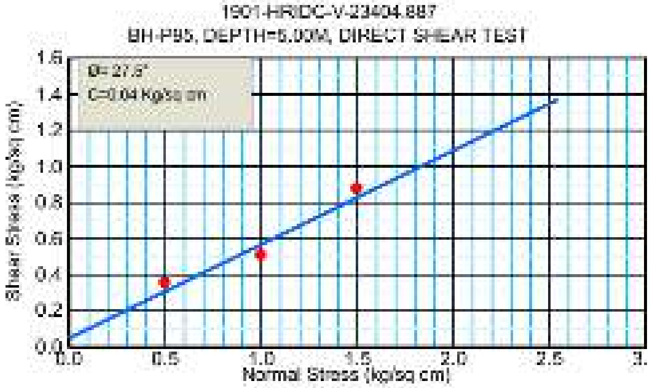
APPENDIX-F

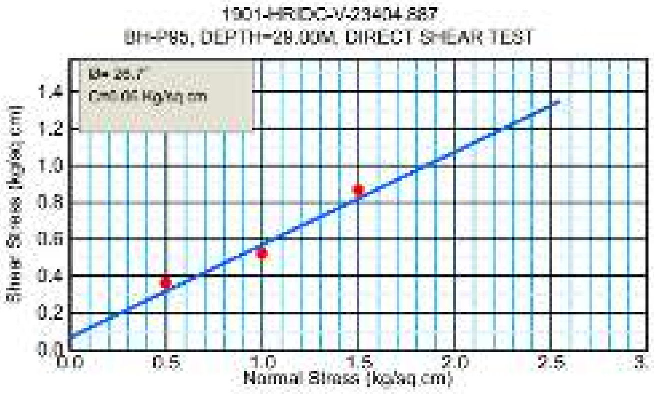
GRAPH 8: DST GRAPH

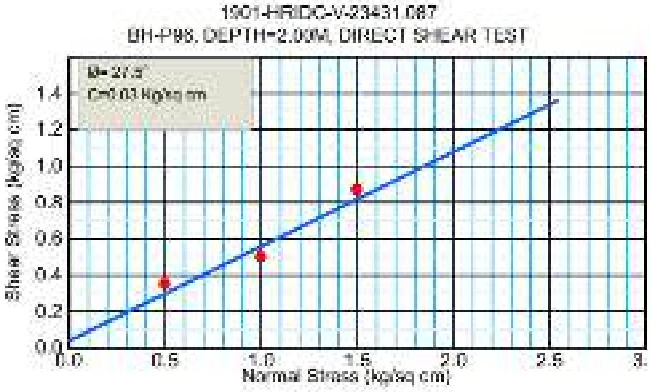


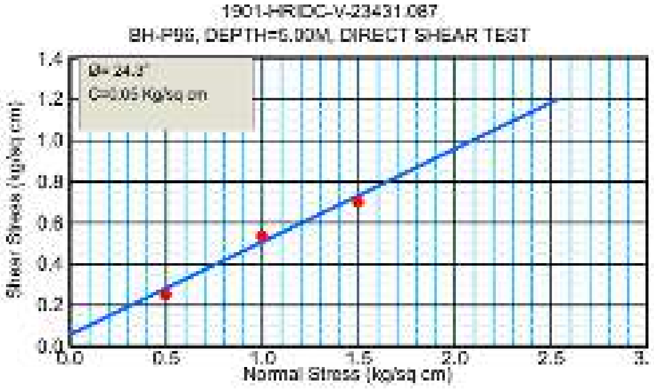


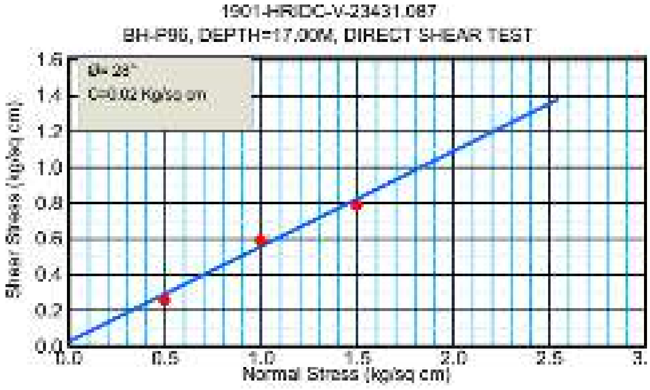








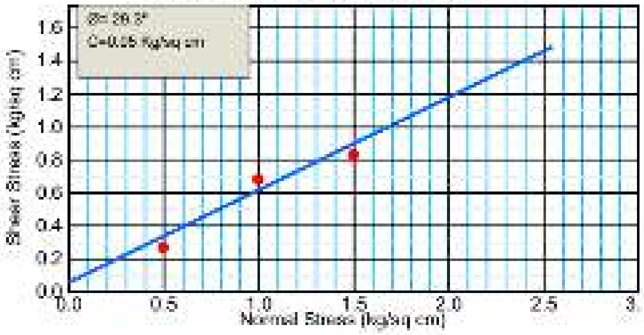




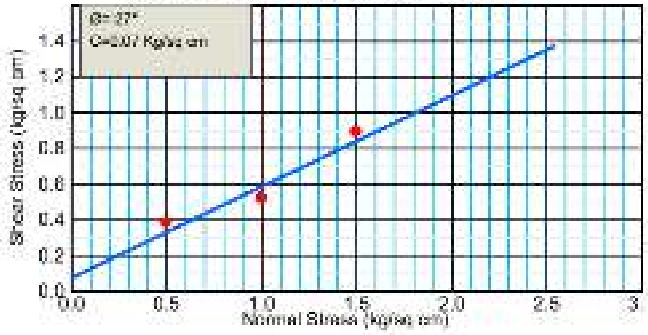
APPENDIX-F

GRAPH 9: DST GRAPH

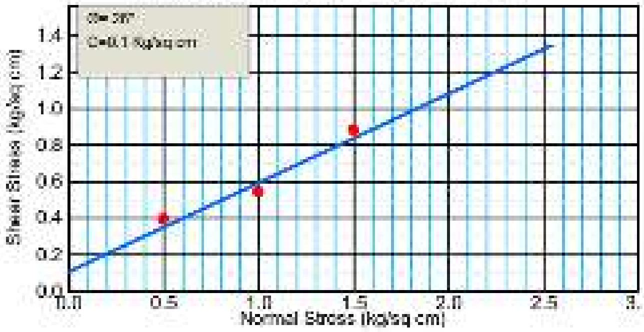
1901-HRIDC-V-23431.087
BH-P96, DEPTH=35.00M, DIRECT SHEAR TEST



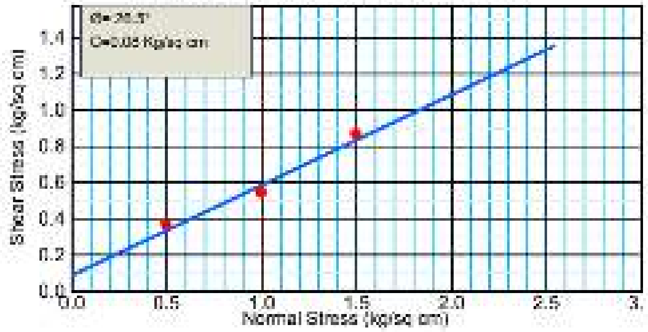
1901-HRIDC-V-23457.2870
BH-P97, DEPTH=4.00M, DIRECT SHEAR TEST



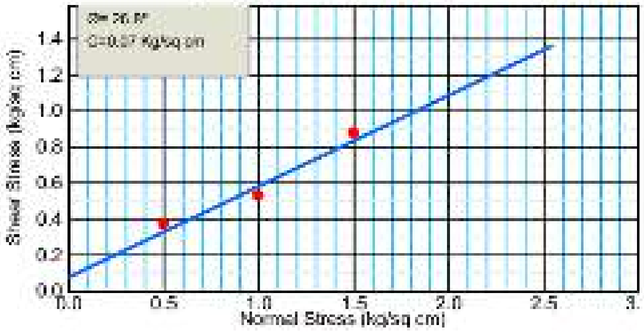
1901-HRIDC-V-23457.2870
BH-P97, DEPTH=7.00M, DIRECT SHEAR TEST



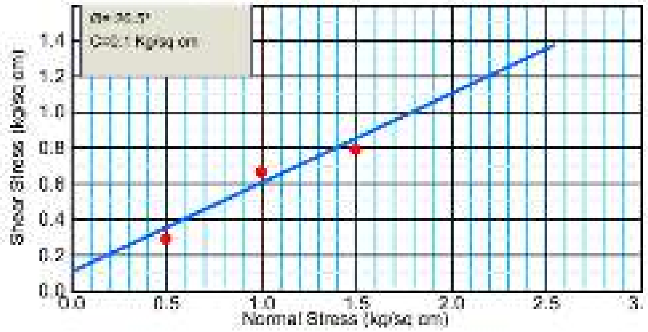
1901-HRIDC-V-23457.2870
BH-P97, DEPTH=16.00M, DIRECT SHEAR TEST



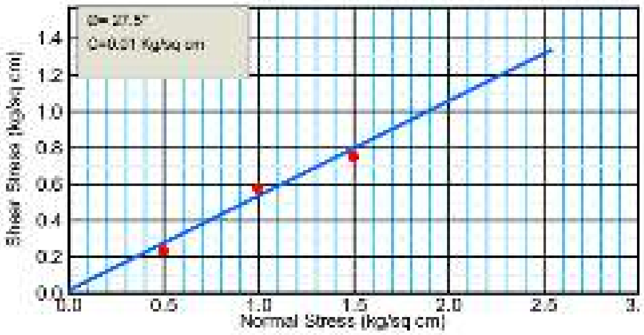
1901-HRIDC-V-23457.2870
BH-P97, DEPTH=31.00M, DIRECT SHEAR TEST



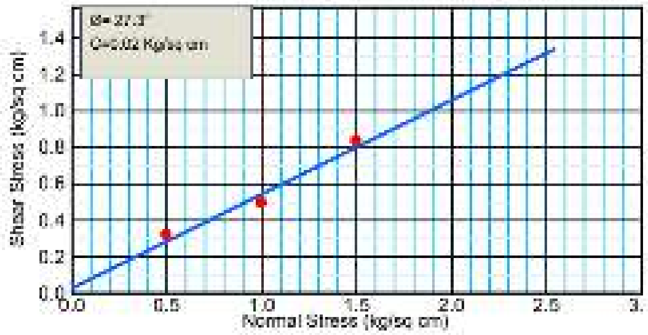
1901-HRIDC-V-23457.2870
BH-P97, DEPTH=37.00M, DIRECT SHEAR TEST



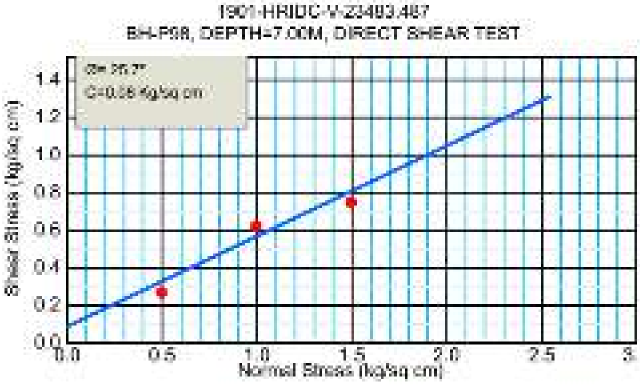
1901-HRIDC-V-23483.487
BH-P98, DEPTH=1.00M, DIRECT SHEAR TEST

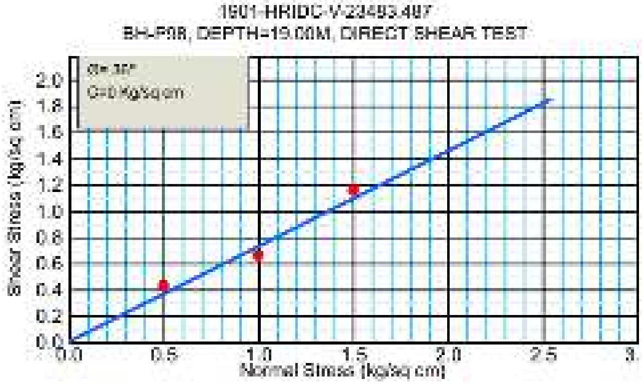


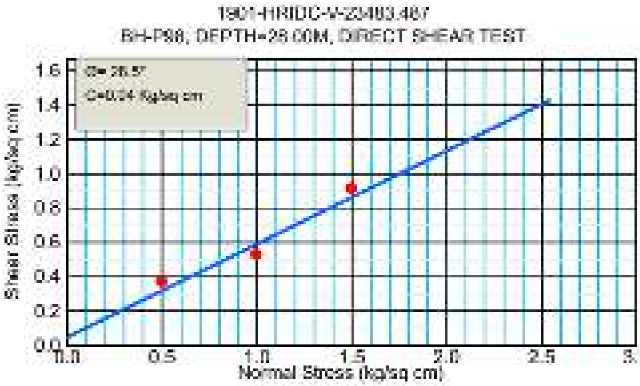
1901-HRIDC-V-23483.487
BH-P98, DEPTH=4.00M, DIRECT SHEAR TEST

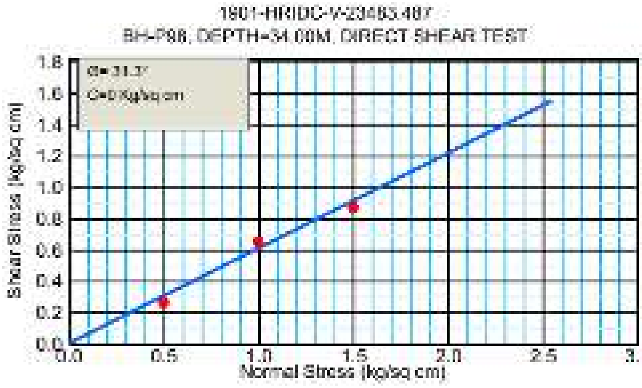


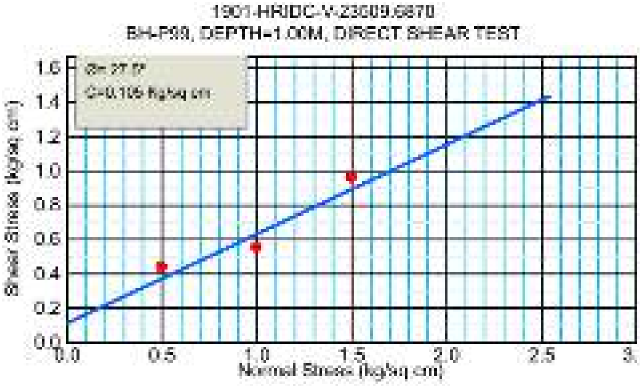
APPENDIX-F
GRAPH 10: DST GRAPH

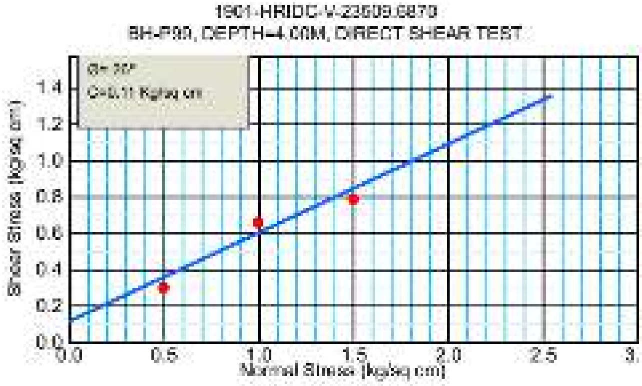


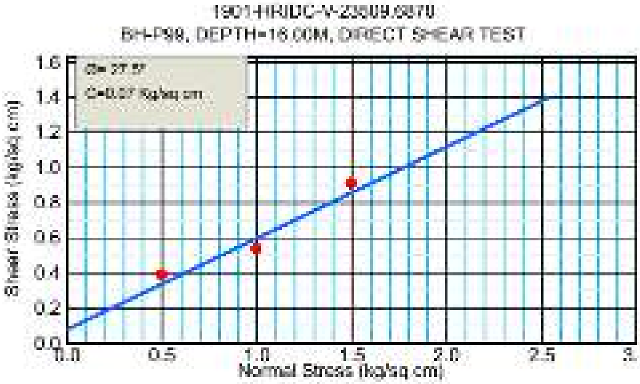


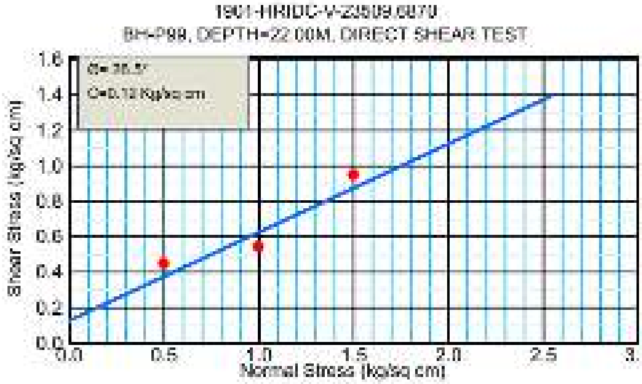




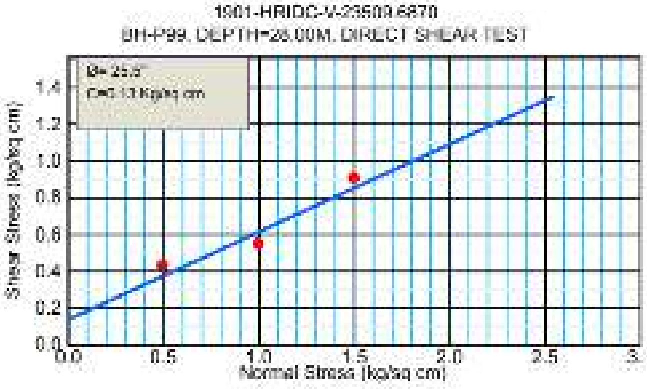


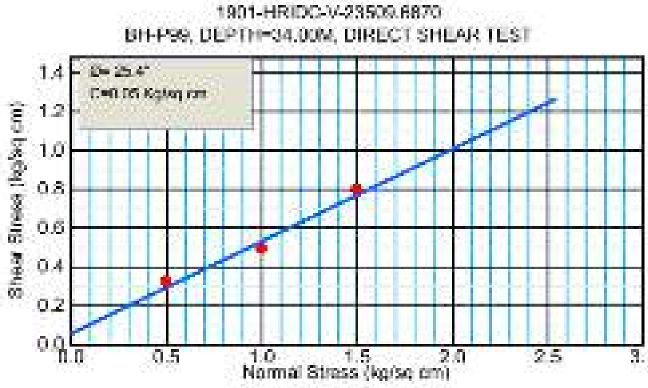


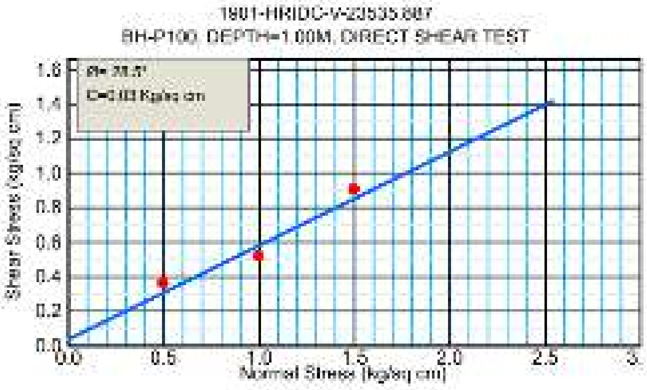


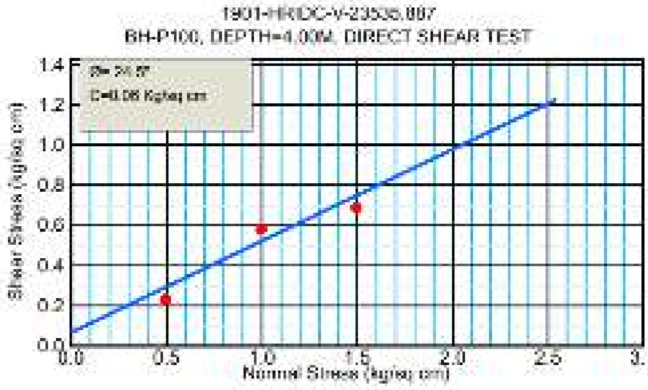


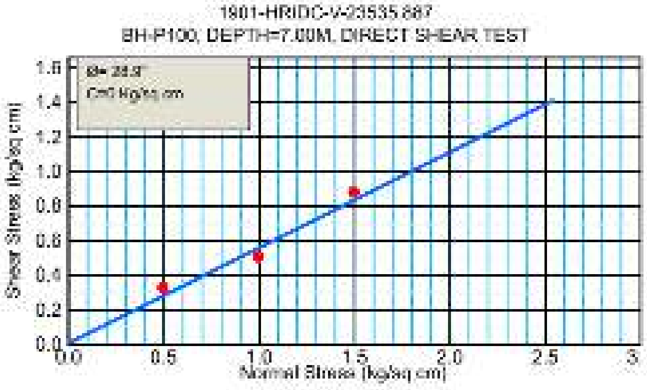
APPENDIX-F
GRAPH 11: DST GRAPH

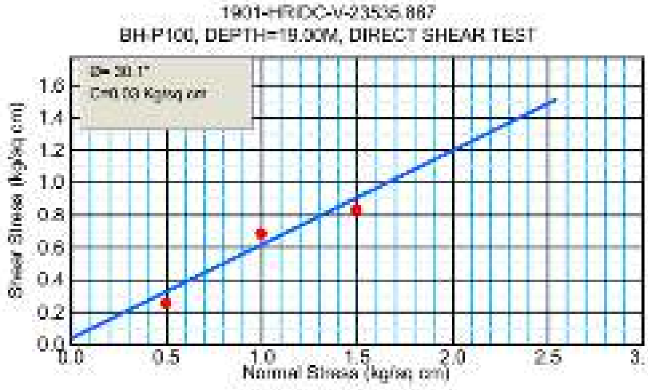




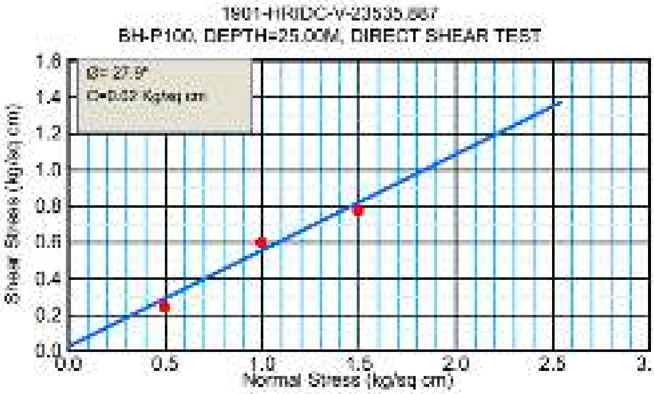


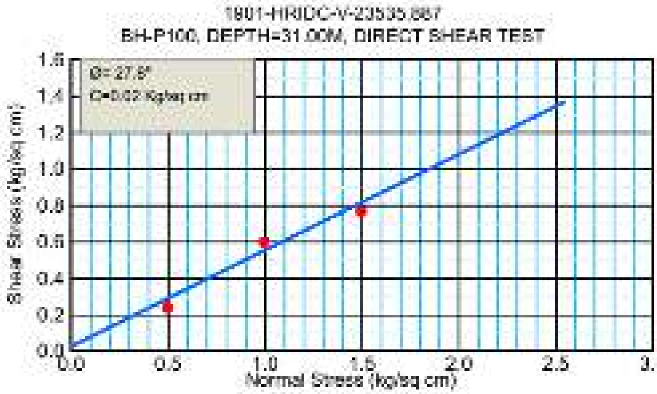


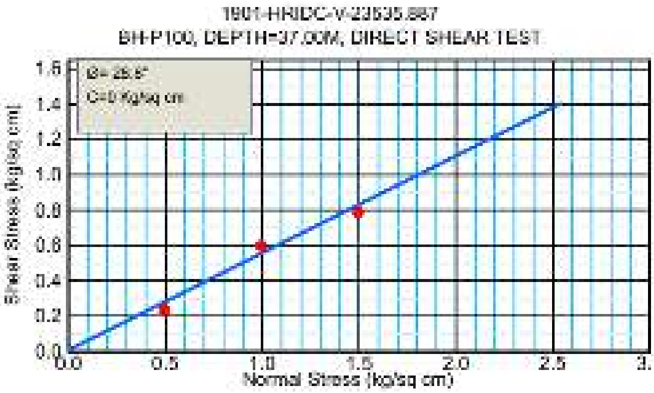




APPENDIX-F
GRAPH 12: DST GRAPH

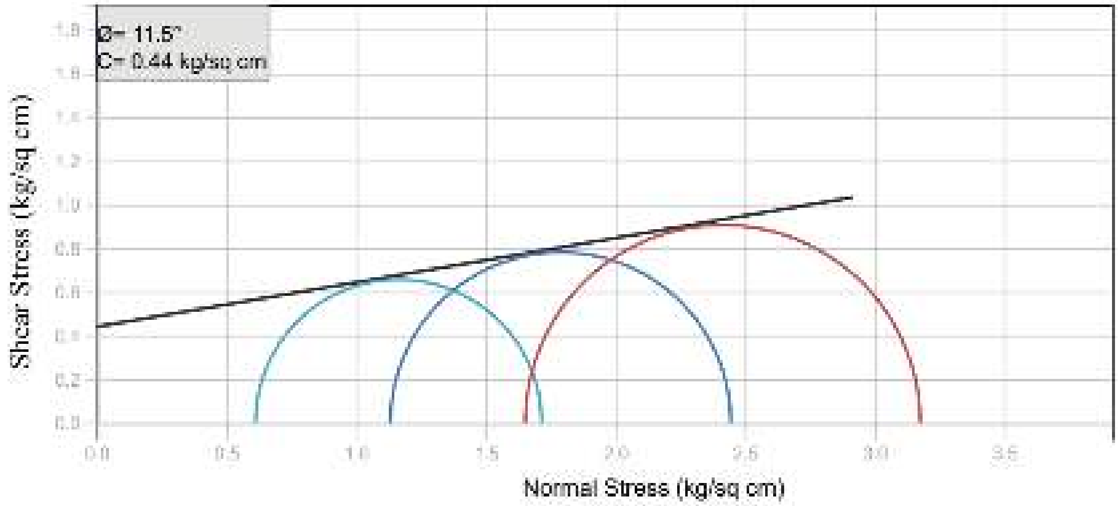






APPENDIX-G
GRAPH 1: UU GRAPH

1901-HRIDC-V-23038.087
BH-NO.P81, DEPTH-4.00M, TRIAXIAL GRAPH

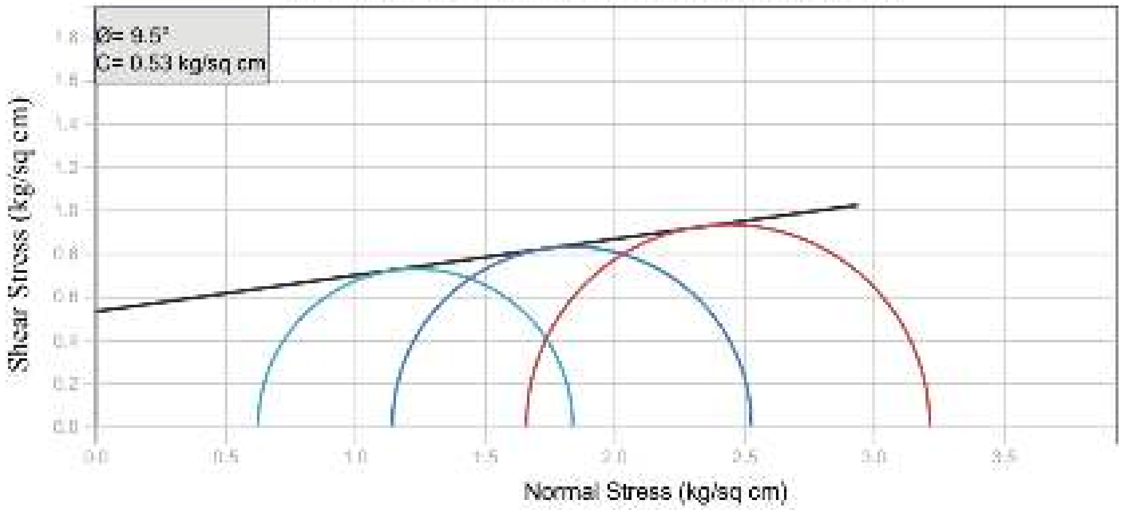


1901-HRIDC-V-23038.087
BH-NO.P81, DEPTH-7.00M, TRIAXIAL GRAPH

1901-HRIDC-V-23038.087
BH-NO.P81, DEPTH-10.00M, TRIAXIAL GRAPH

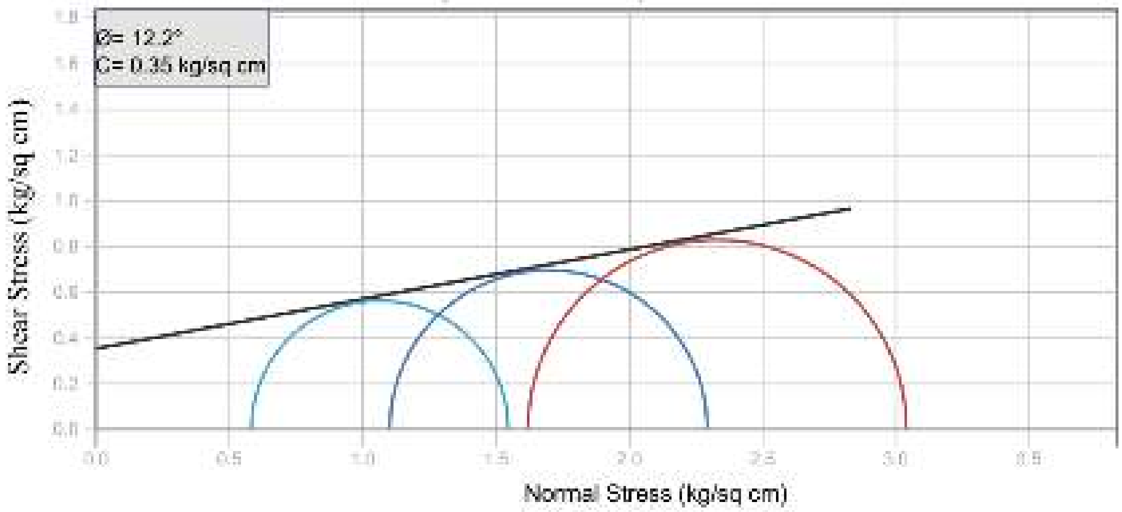
APPENDIX-G
GRAPH 2: UU GRAPH

1901-HRIDC-V-23038.087
BH-NO.P81, DEPTH-13.00M, TRIAXIAL GRAPH



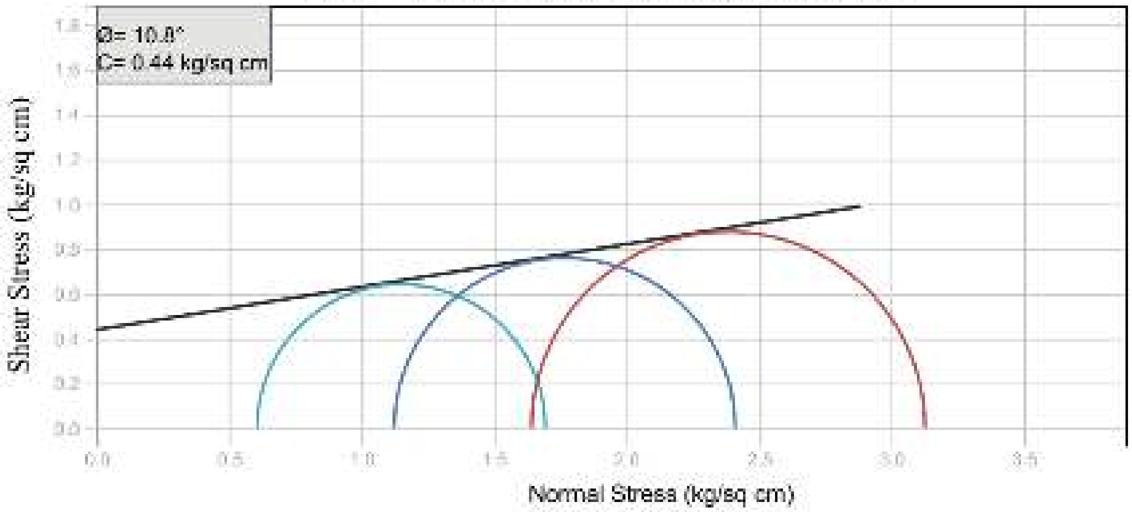
1901-HRIDC-V-23038.087
BH-NO.P81, DEPTH-19.00M, TRIAXIAL GRAPH

1901-HRIDC-V-23064.2870
BH-NO.P82, DEPTH-1.00M, TRIAXIAL GRAPH



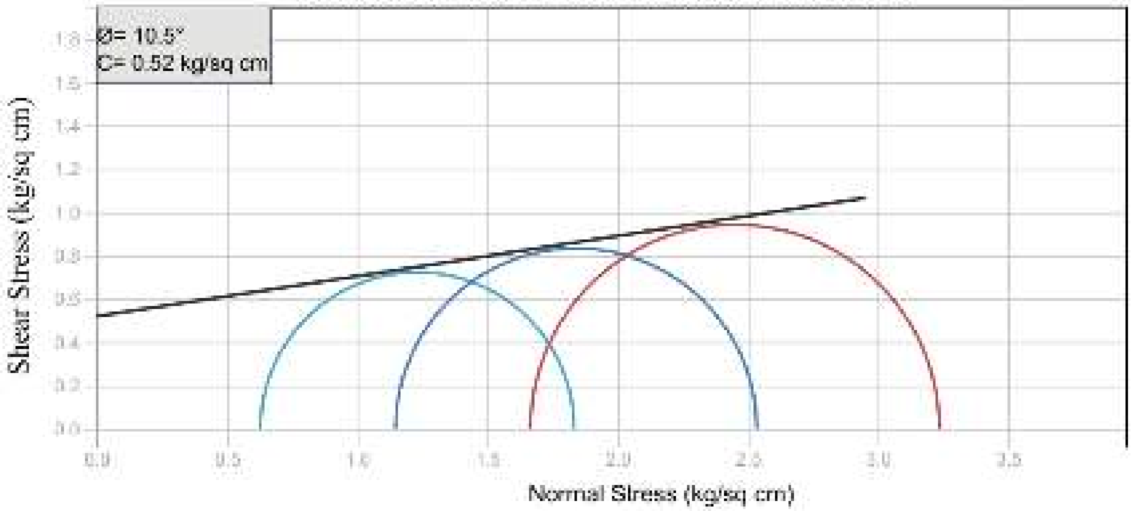
APPENDIX-G
GRAPH 3: UU GRAPH

1901-HRIDC-V-23064.2870
BH-NO.P82, DEPTH-4.00M, TRIAXIAL GRAPH



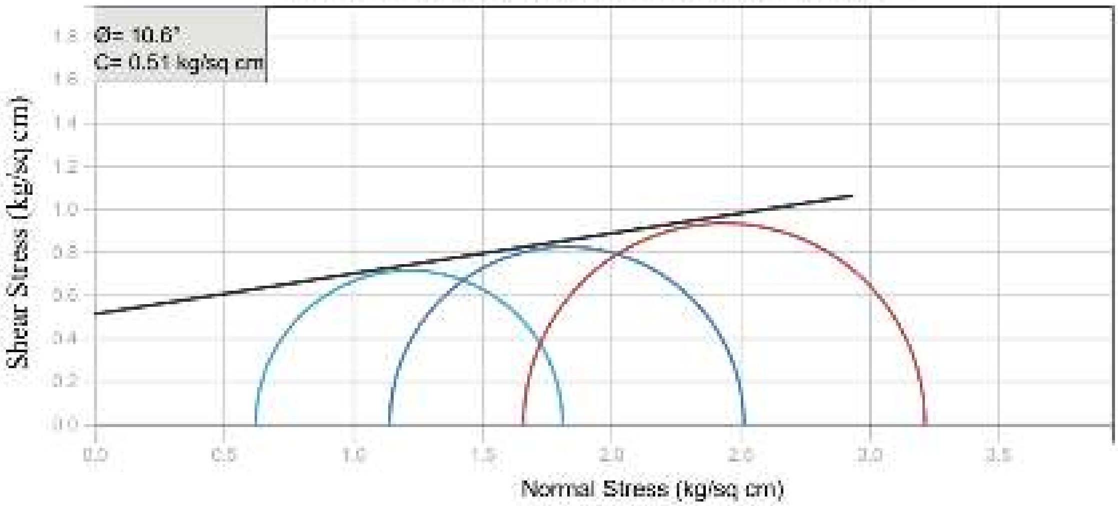
1901-HRIDC-V-23064.2870
BH-NO.P82, DEPTH-13.00M, TRIAXIAL GRAPH

1901-HRIDC-V-23064.2870
BH-NO.P82, DEPTH-16.00M, TRIAXIAL GRAPH

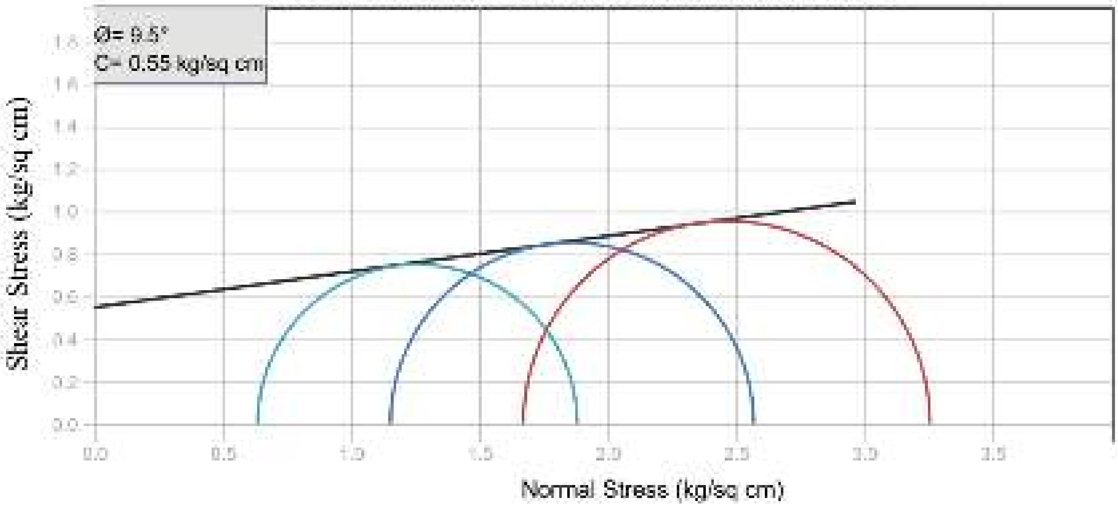


APPENDIX-G
GRAPH 4: UU GRAPH

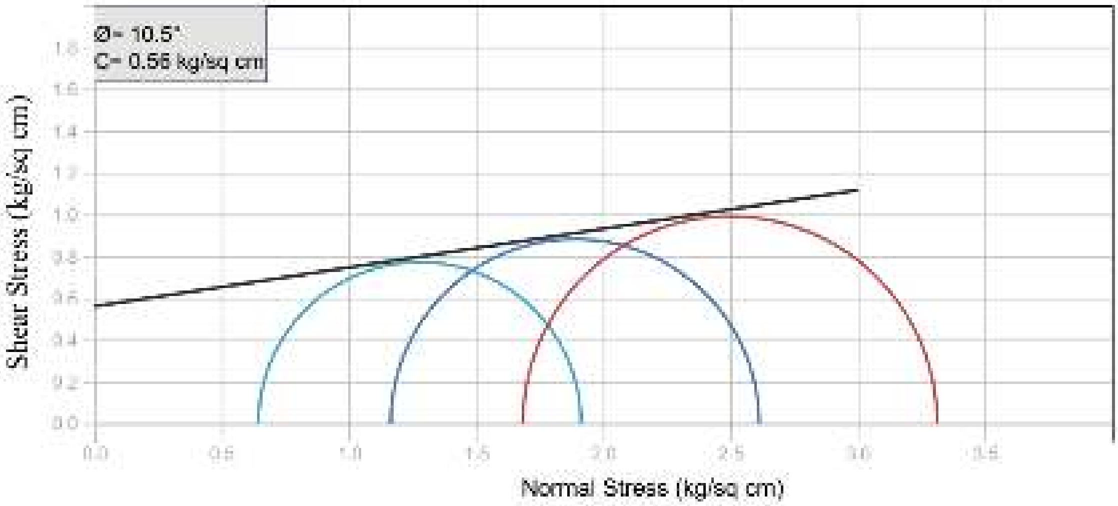
1901-HRIDC-V-23064.2870
BH-NO.P82, DEPTH-19.00M, TRIAXIAL GRAPH



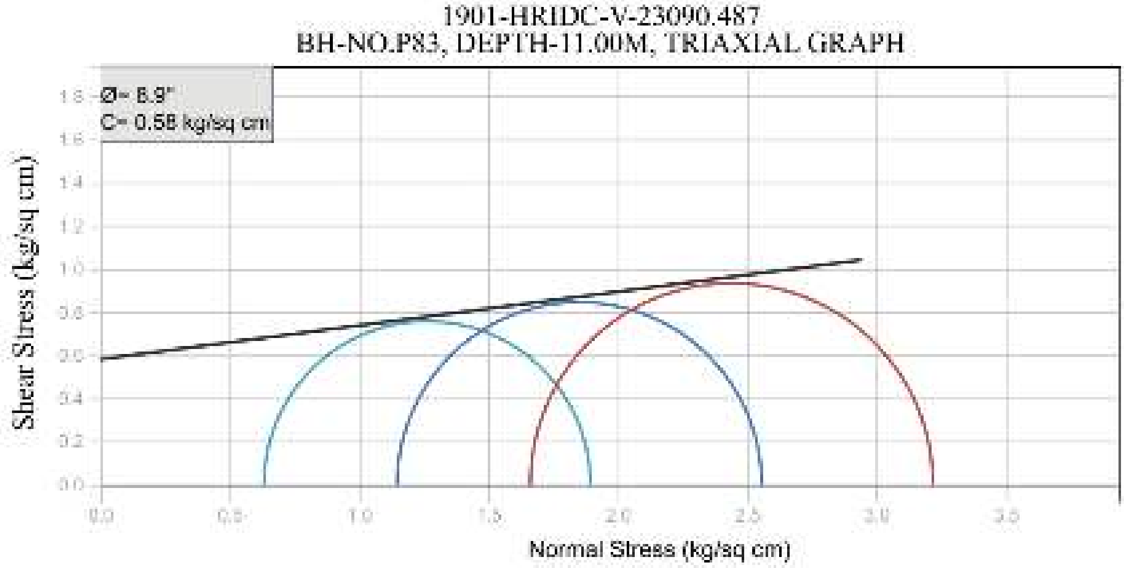
1901-HRIDC-V-23064.2870
BH-NO.P82, DEPTH-28.00M, TRIAXIAL GRAPH



1901-HRIDC-V-23064.2870
BH-NO.P82, DEPTH-31.00M, TRIAXIAL GRAPH



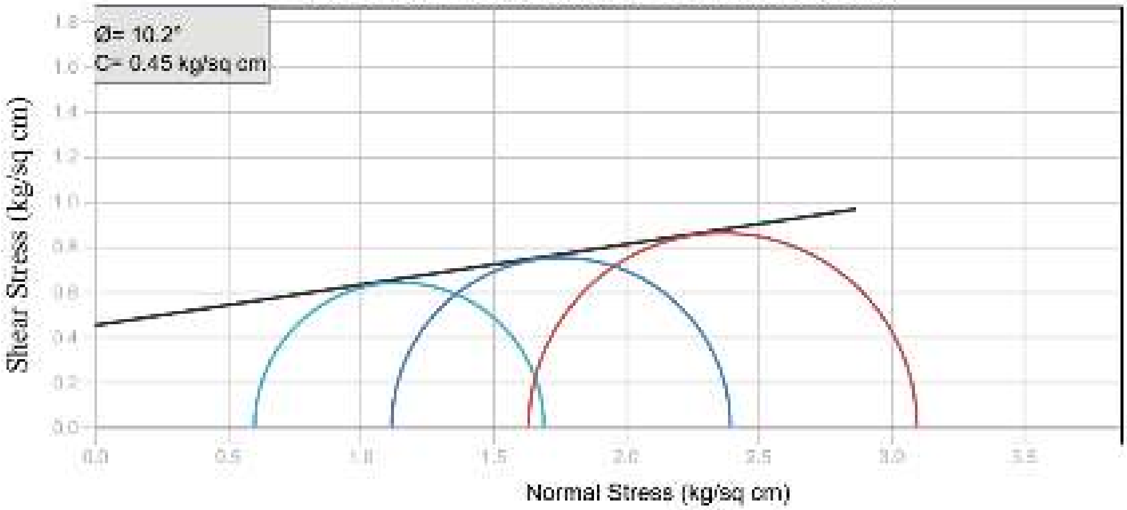
APPENDIX-G
GRAPH 5: UU GRAPH



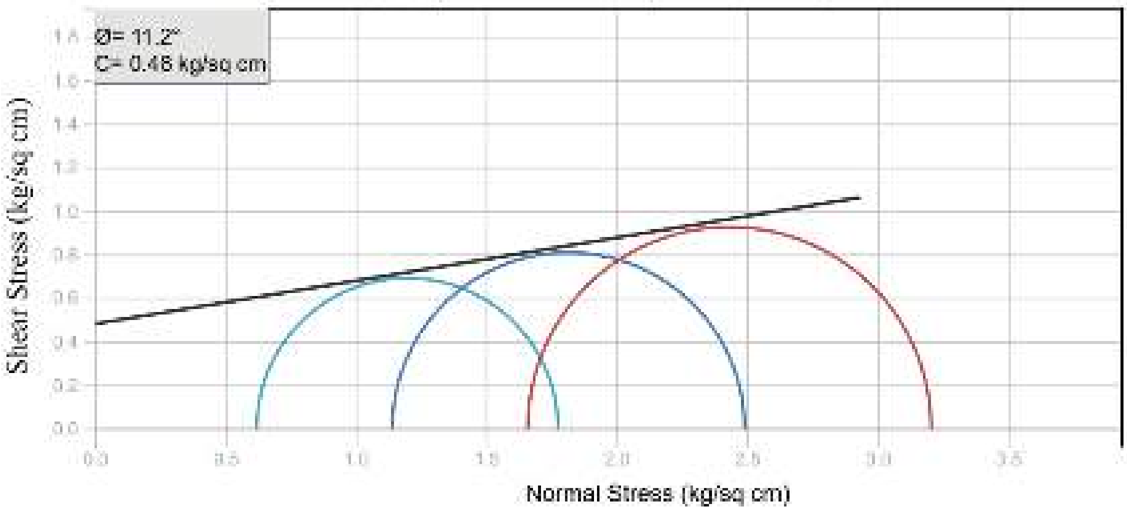
APPENDIX-G
GRAPH 6: UU GRAPH

1901-HRIDC-V-23090.487
BH-NO.P83, DEPTH-23.00M, TRIAXIAL GRAPH

1901-HRIDC-V-23116.687
BH-NO.P84, DEPTH-8.00M, TRIAXIAL GRAPH



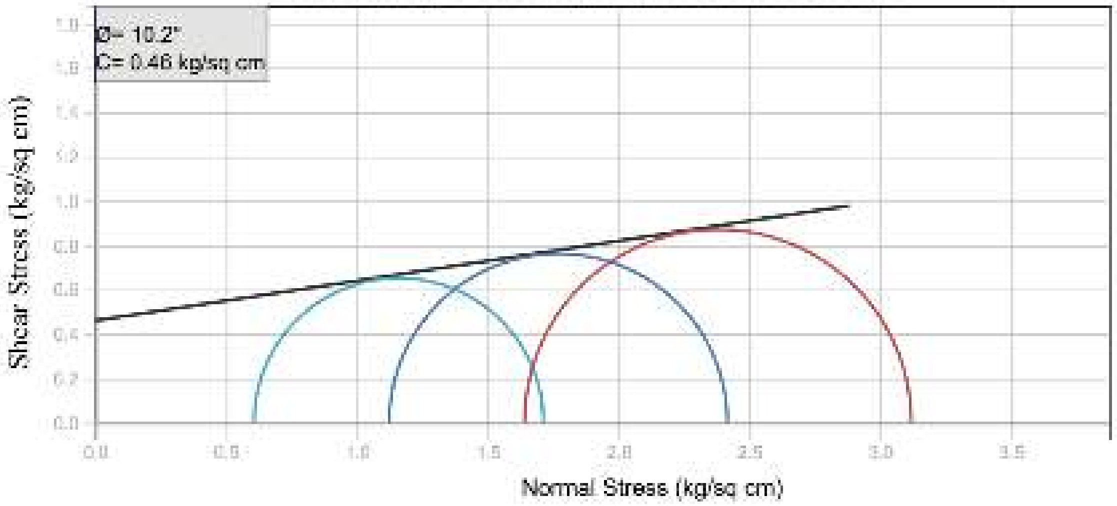
1901-HRIDC-V-23116.687
BH-NO.P84, DEPTH-14.00M, TRIAXIAL GRAPH



APPENDIX-G
GRAPH 7: UU GRAPH

1901-HRIDC-V-23116.687
BH-NO.P84, DEPTH-23.00M, TRIAXIAL GRAPH

1901-HRIDC-V-23142.8870
BH-NO.P85, DEPTH-16.00M, TRIAXIAL GRAPH



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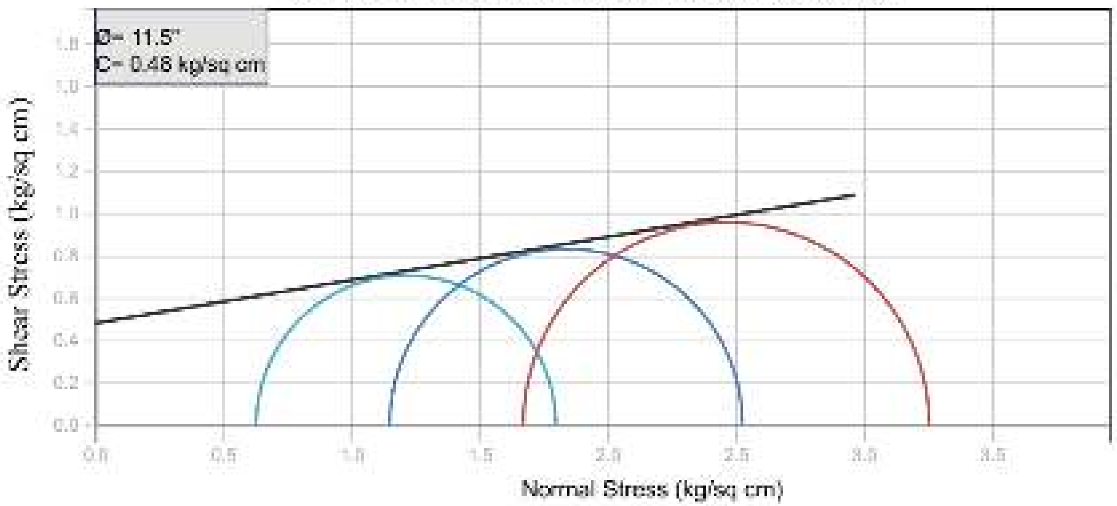
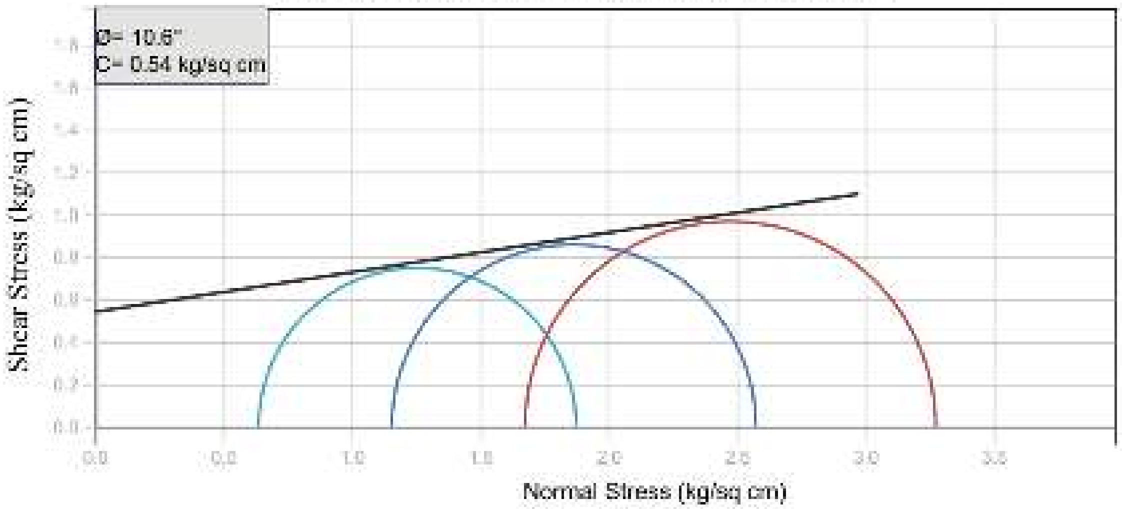
BH-NO.P85, DEPTH-19.00M, TRIAXIAL GRAPH



APPENDIX-G
GRAPH 8: UU GRAPH

1901-HRIDC-V-23142.8870
BH-NO.P85, DEPTH-22.00M, TRIAXIAL GRAPH



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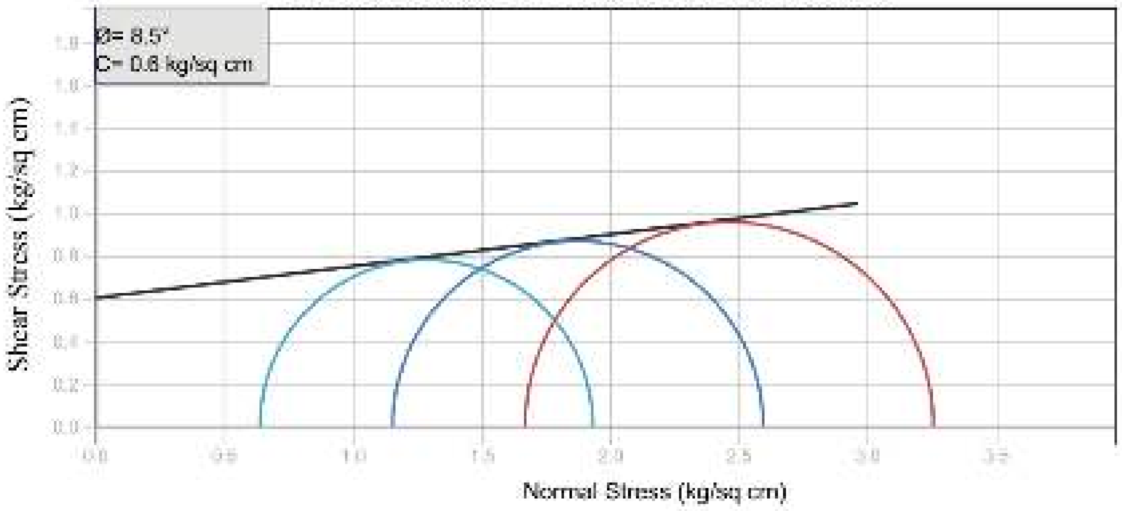
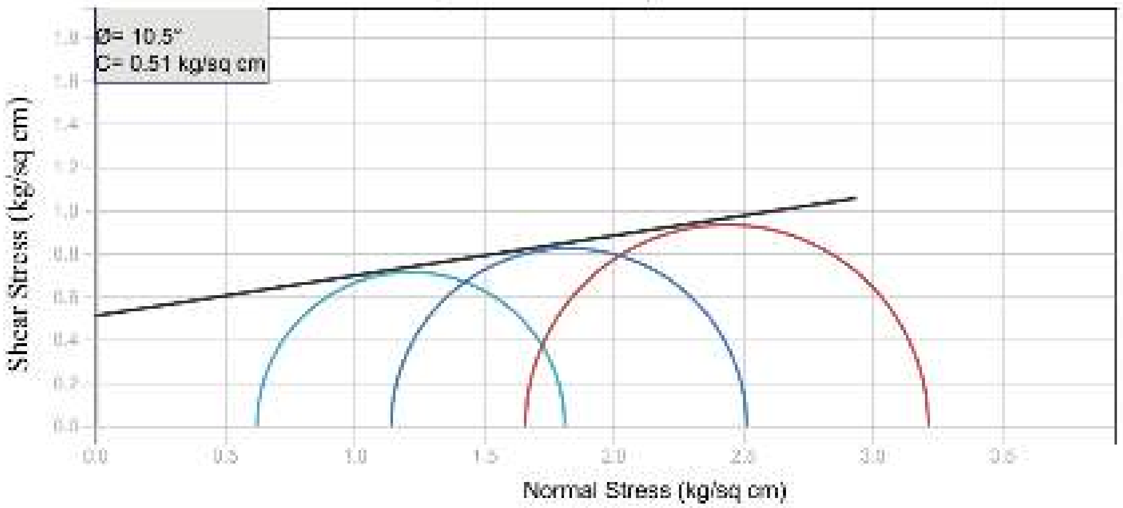
BH-NO.P85, DEPTH-28.00M, TRIAXIAL GRAPH

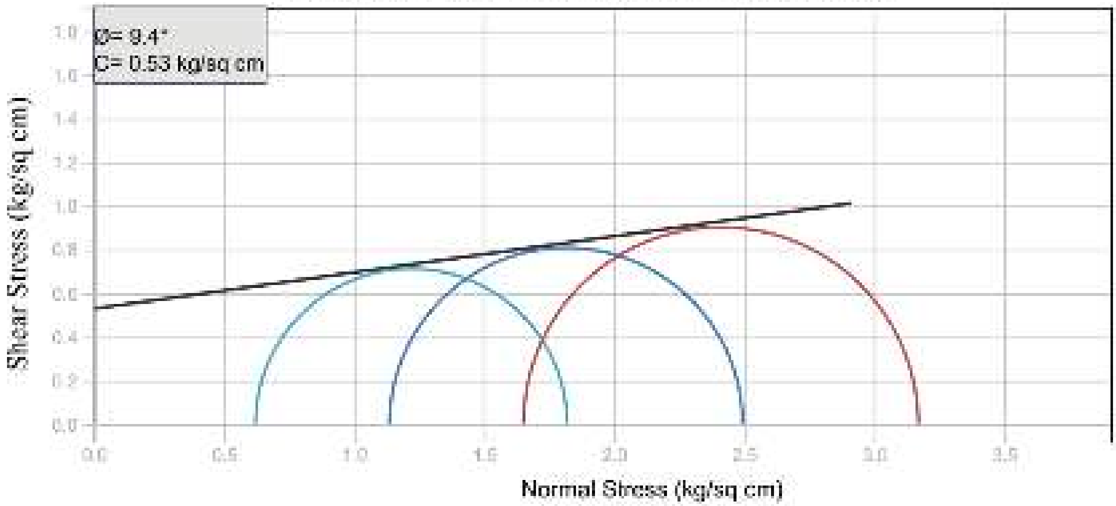


1901-HRIDC-V-23169.087
BH-NO.P86, DEPTH-14.00M, TRIAXIAL GRAPH



APPENDIX-G
GRAPH 9: UU GRAPH

1901-HRIDC-V-23169.087
BH-NO.P86, DEPTH-23.00M, TRIAXIAL GRAPH

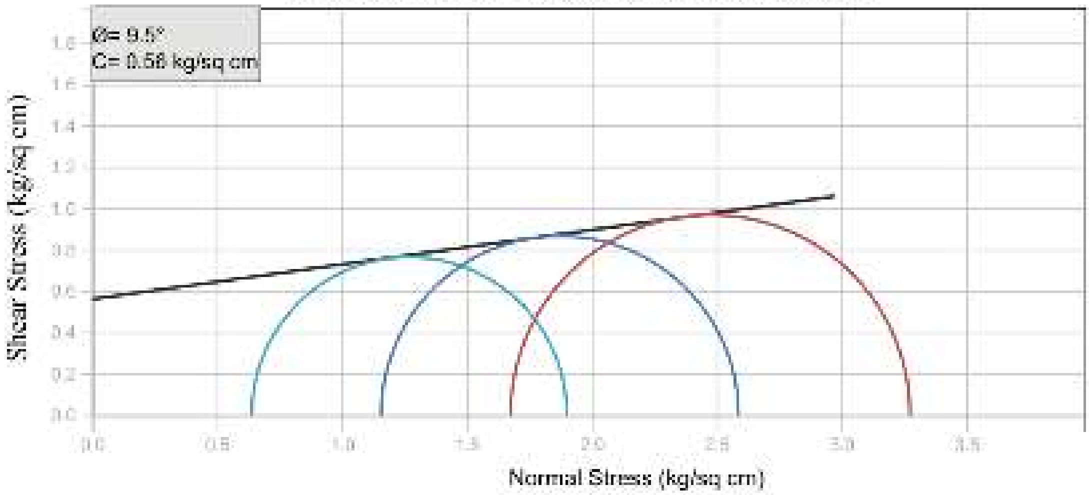


1901-HRIDC-V-23195.287
BH-NO.P87, DEPTH-1.00M, TRIAXIAL GRAPH

1901-HRIDC-V-23195.287
BH-NO.P87, DEPTH-13.00M, TRIAXIAL GRAPH

APPENDIX-G
GRAPH 10: UU GRAPH

1901-HRIDC-V-23195.287
BH-NO.P87, DEPTH-19.00M, TRIAXIAL GRAPH



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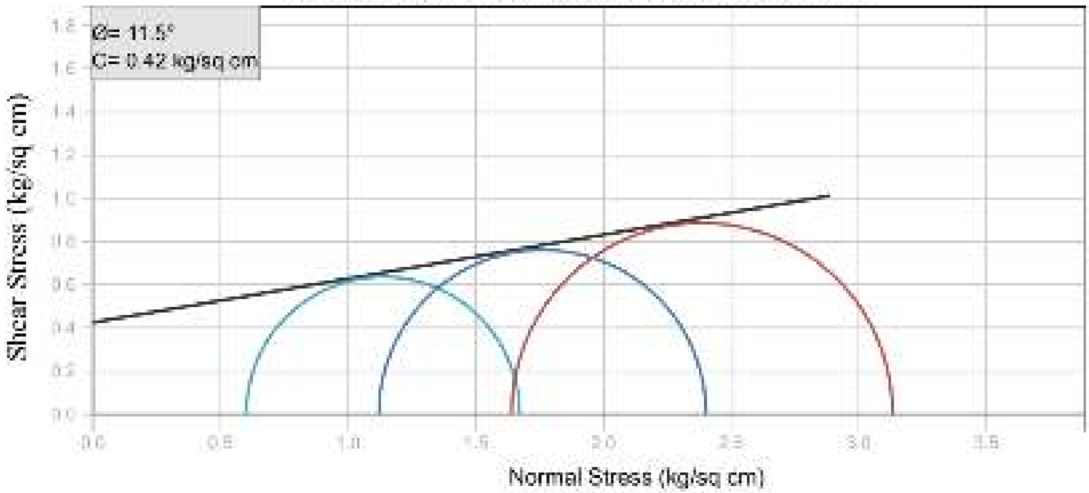
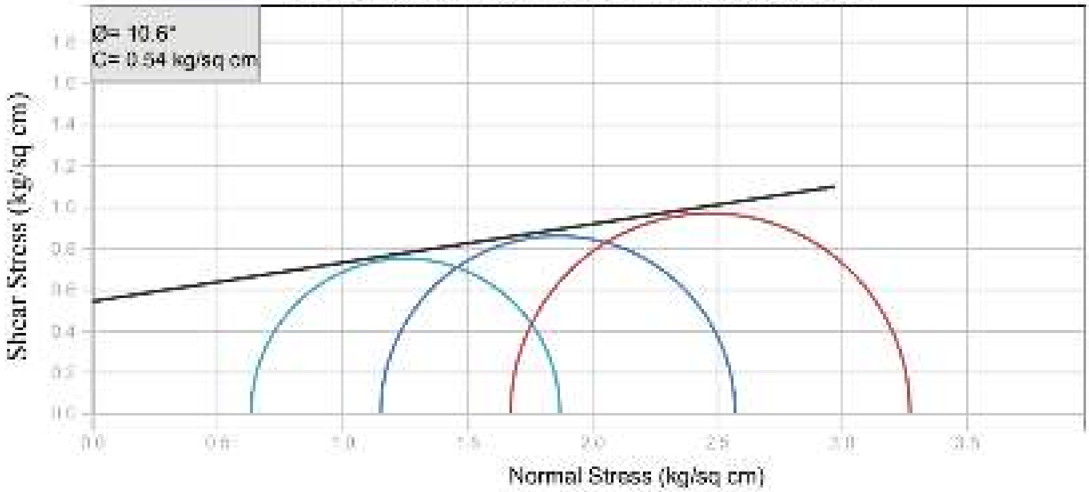
BH-NO.P87, DEPTH-22.00M, TRIAXIAL GRAPH



1901-HRIDC-V-23211.4870
BH-NO.P88, DEPTH-14.00M, TRIAXIAL GRAPH

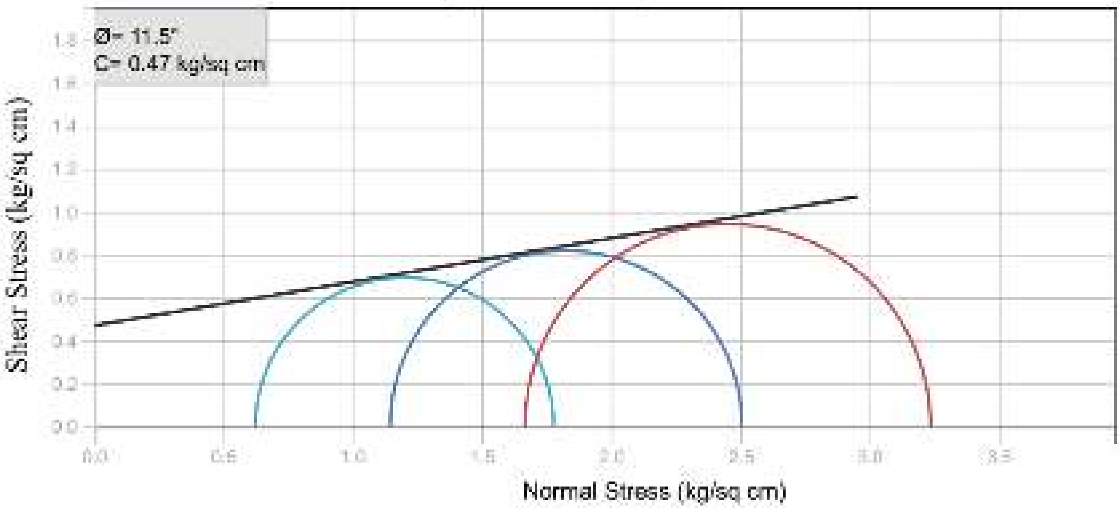


APPENDIX-G
GRAPH 11: UU GRAPH

1901-HRIDC-V-23211.4870
BH-NO.P88, DEPTH-29.00M, TRIAXIAL GRAPH

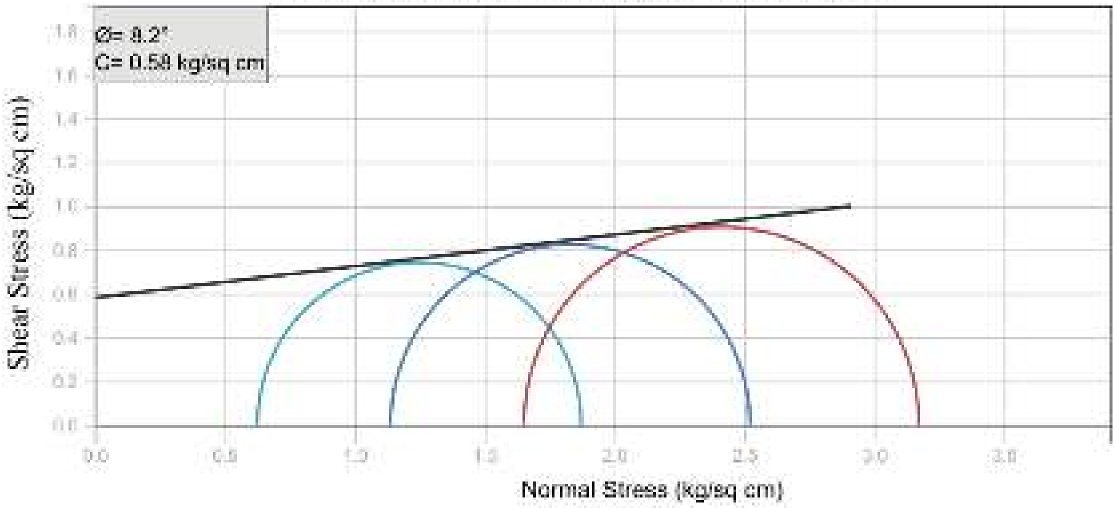
1901-HRIDC-V-23211.4870
BH-NO.P88, DEPTH-32.00M, TRIAXIAL GRAPH

1901-HRIDC-V-23247.687
BH-NO.P89, DEPTH-1.00M, TRIAXIAL GRAPH



APPENDIX-G
GRAPH 12: UU GRAPH

1901-HRIDC-V-23247.687
BH-NO.P89, DEPTH-19.00M, TRIAXIAL GRAPH



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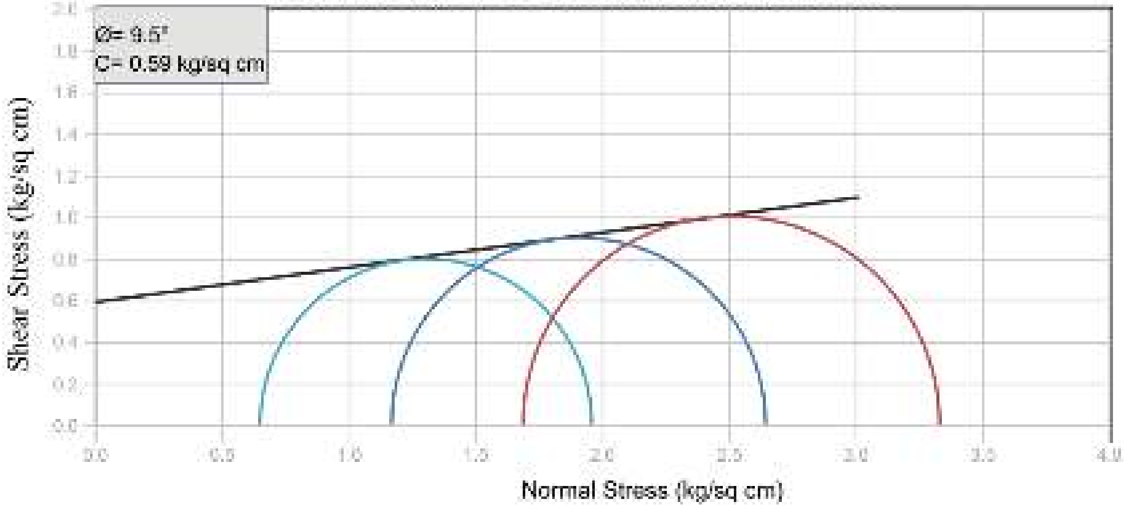
BH-NO.P89, DEPTH-22.00M, TRIAXIAL GRAPH



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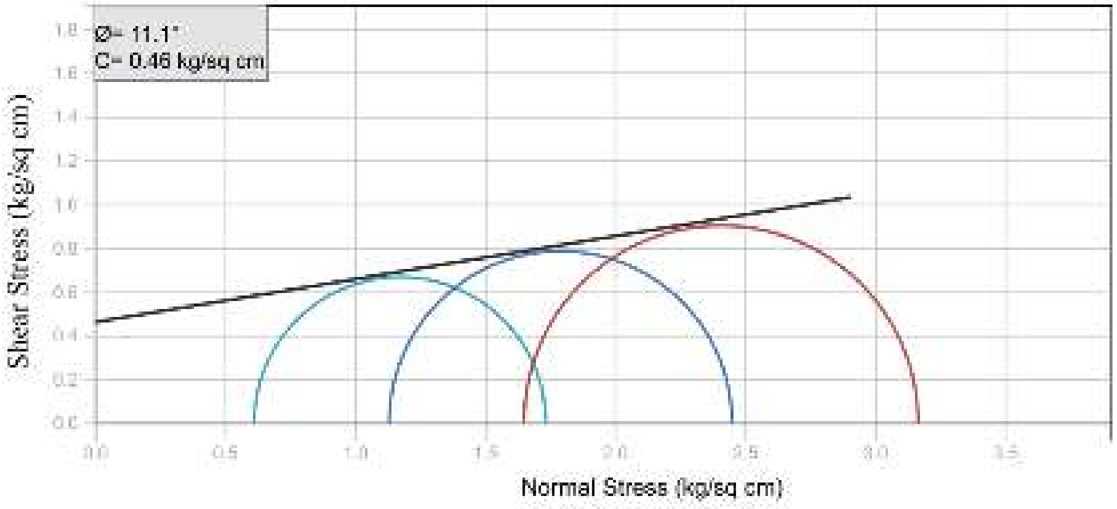
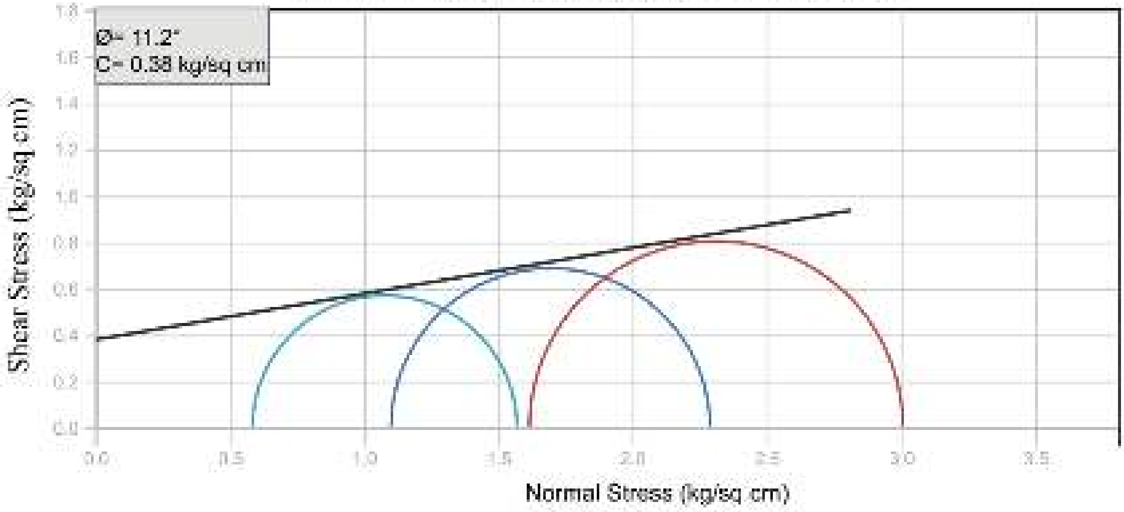
BH-NO.P89, DEPTH-31.00M, TRIAXIAL GRAPH



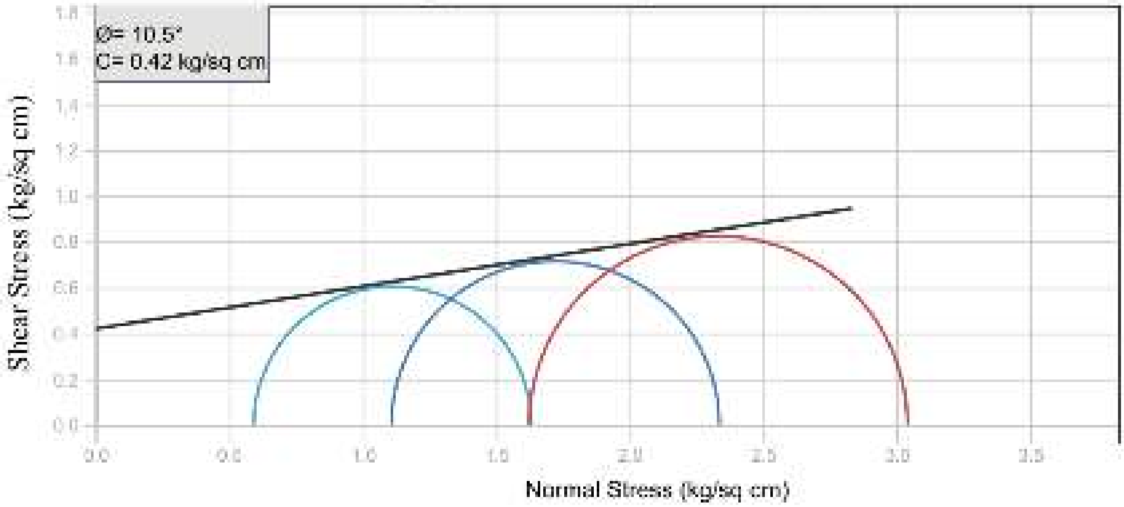
APPENDIX-G
GRAPH 13: UU GRAPH

1901-HRIDC-V-23273.887
BH-NO.P90, DEPTH-1.00M, TRIAXIAL GRAPH

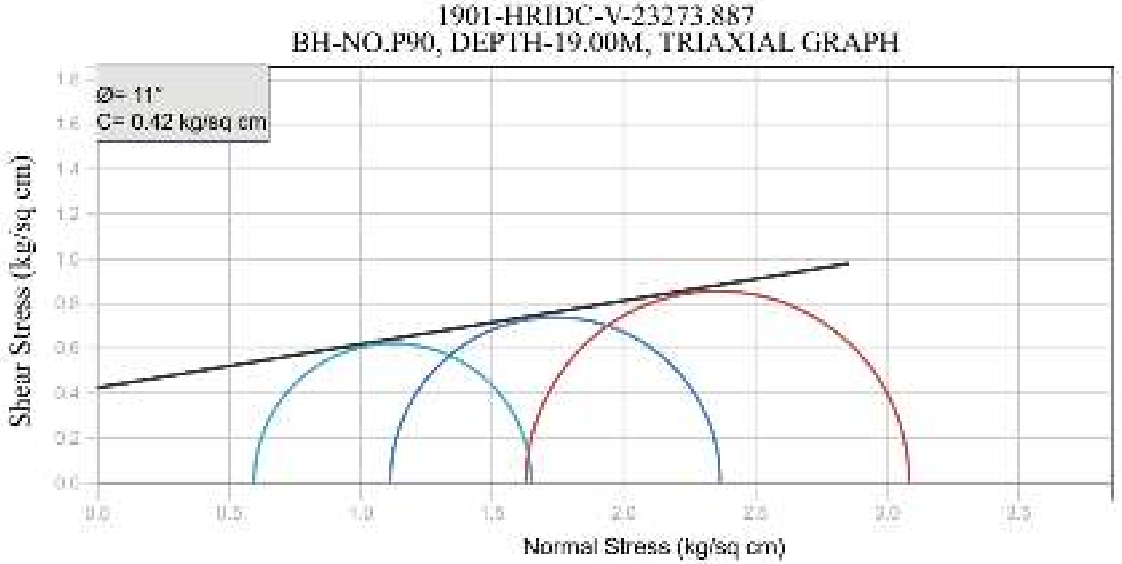


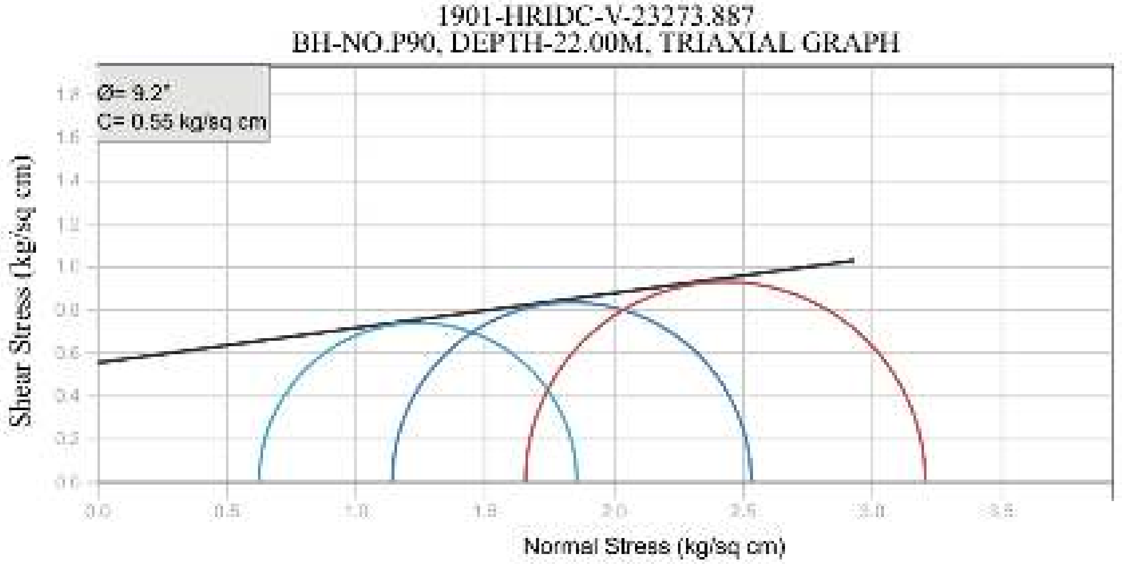
1901-HRIDC-V-23273.887
BH-NO.P90, DEPTH-10.00M, TRIAXIAL GRAPH

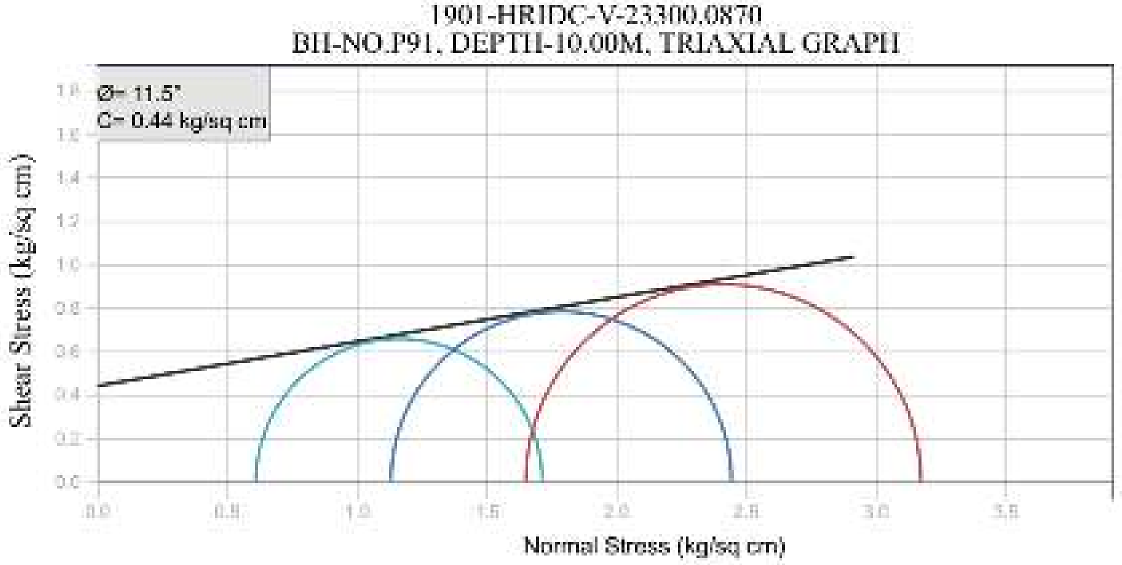
1901-HRIDC-V-23273.887
BH-NO.P90, DEPTH-13.00M, TRIAXIAL GRAPH



APPENDIX-G
GRAPH 14: UU GRAPH

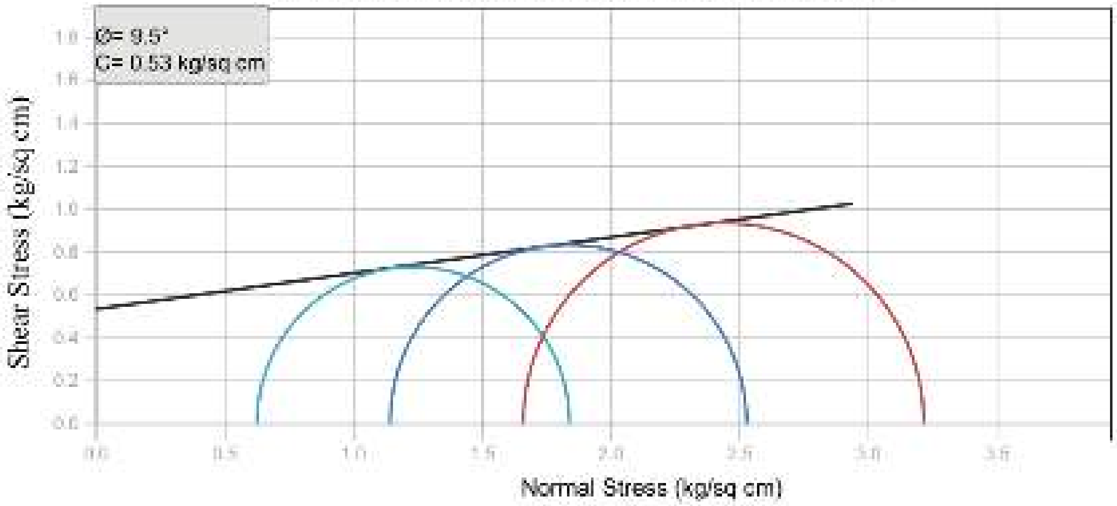




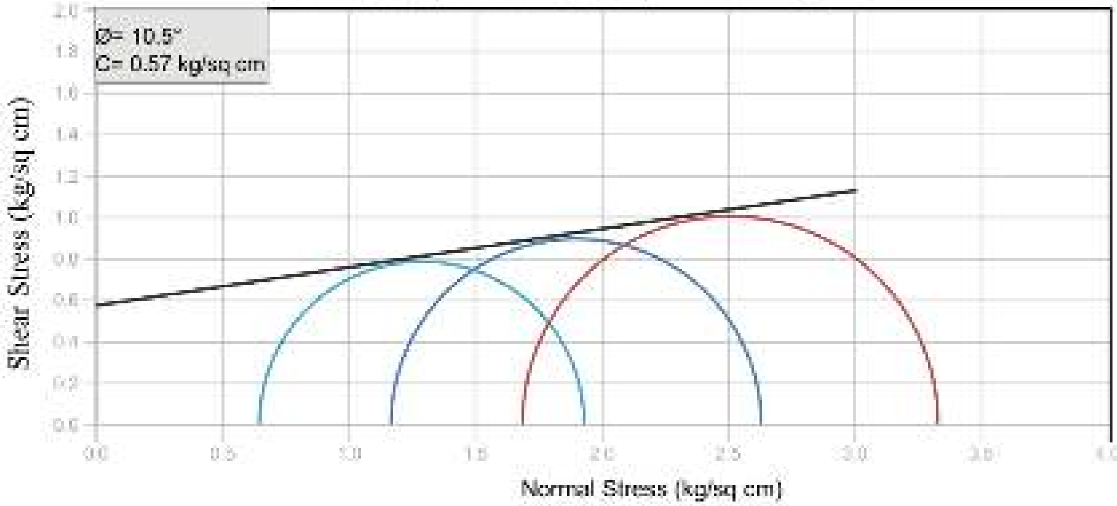


APPENDIX-G
GRAPH 15: UU GRAPH

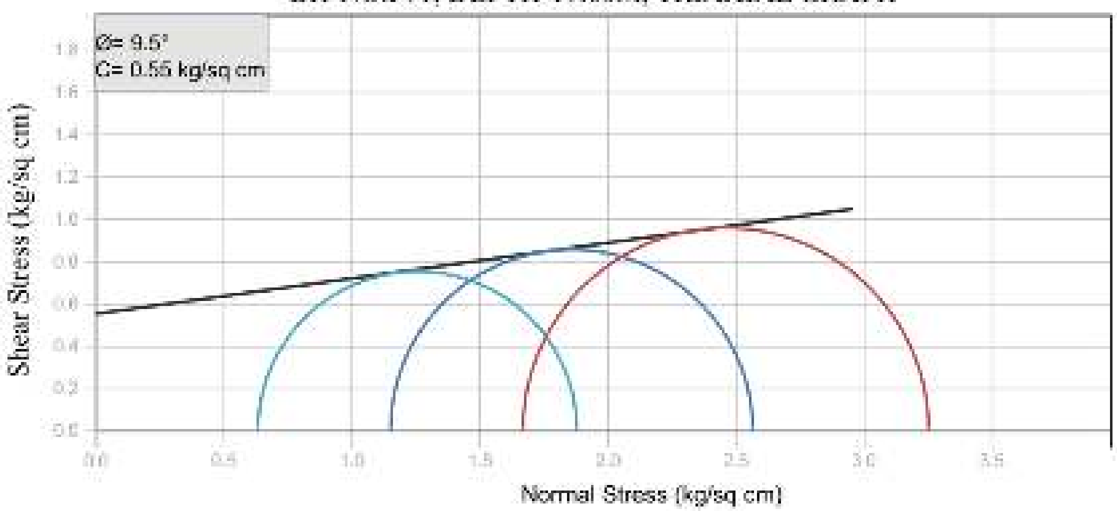
1901-HRIDC-V-23300.0870
BH-NO.P91, DEPTH-13.00M, TRIAXIAL GRAPH



1901-HRIDC-V-23300.0870
BH-NO.P91, DEPTH-16.00M, TRIAXIAL GRAPH

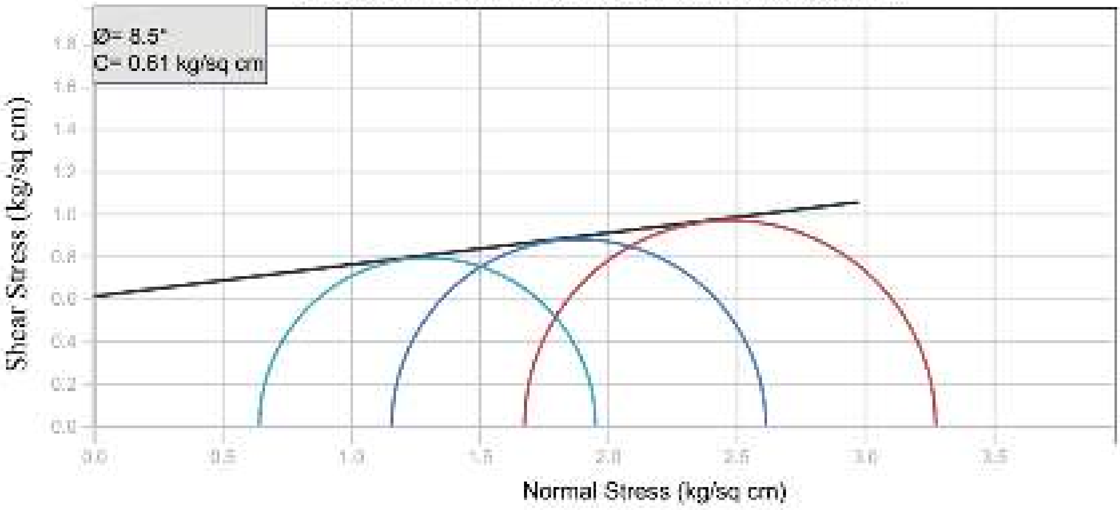


1901-HRIDC-V-23300.0870
BH-NO.P91, DEPTH-19.00M, TRIAXIAL GRAPH

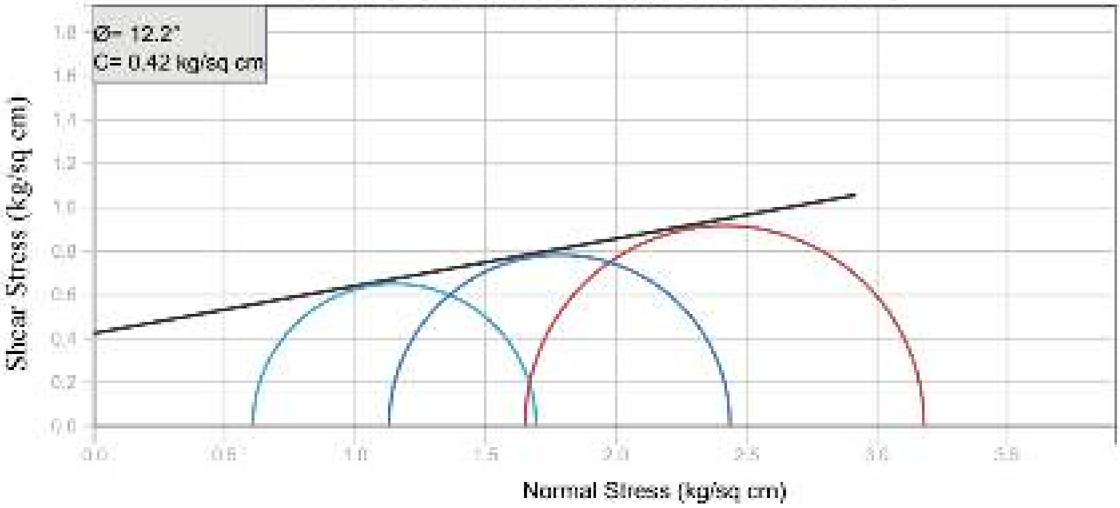


APPENDIX-G
GRAPH 16: UU GRAPH

1901-HRIDC-V-23300.0870
BH-NO.P91, DEPTH-28.00M, TRIAXIAL GRAPH



1901-HRIDC-V-23326.2870
BH-NO.P92, DEPTH-10.00M, TRIAXIAL GRAPH

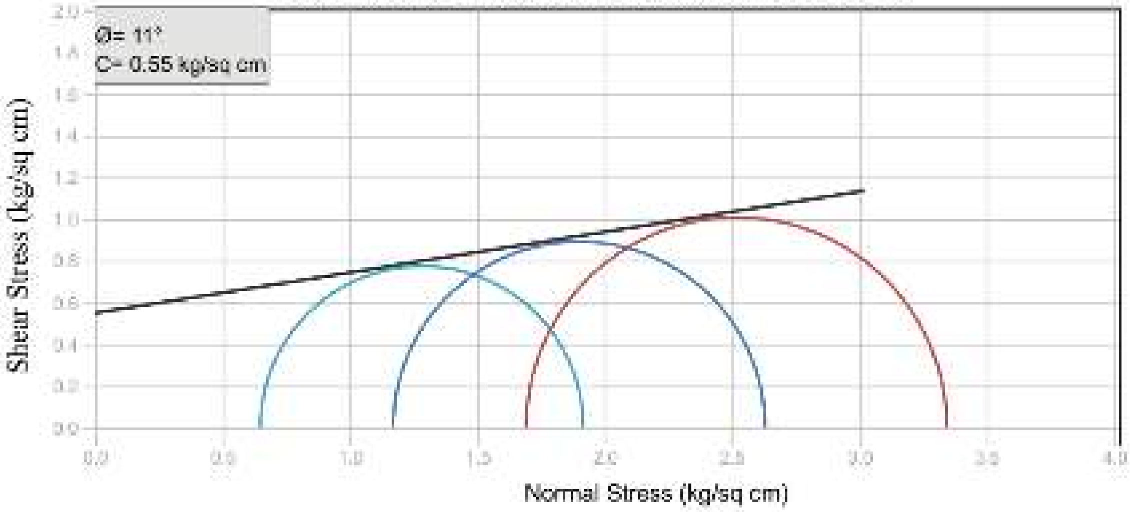


1901-HRIDC-V-23326.2870
BH-NO.P92, DEPTH-13.00M, TRIAXIAL GRAPH

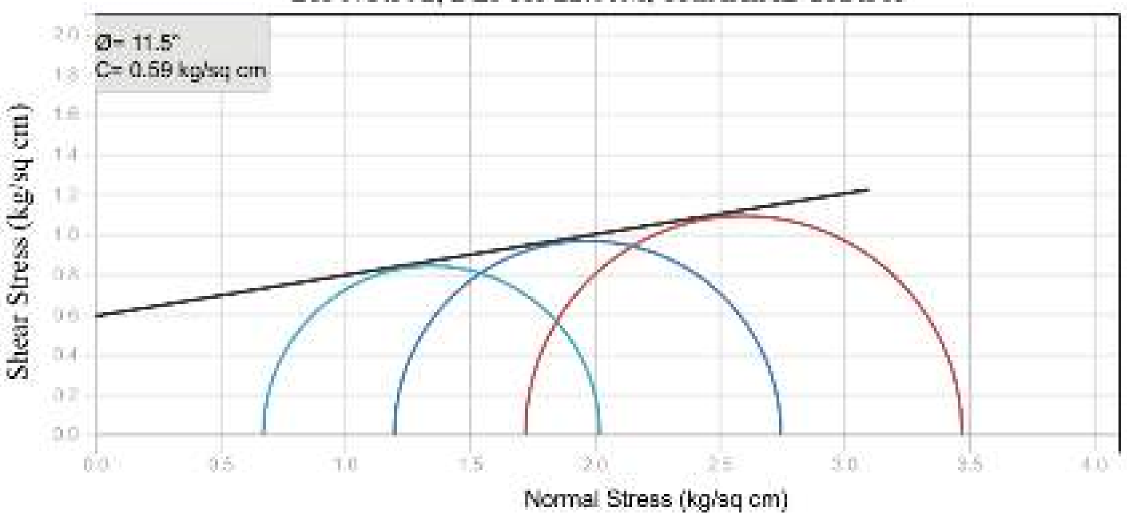
APPENDIX-G
GRAPH 17: UU GRAPH

1901-HRIDC-V-23326.2870
BH-NO.P92, DEPTH-16.00M, TRIAXIAL GRAPH

1901-HRIDC-V-23326.2870
BH-NO.P92, DEPTH-19.00M, TRIAXIAL GRAPH

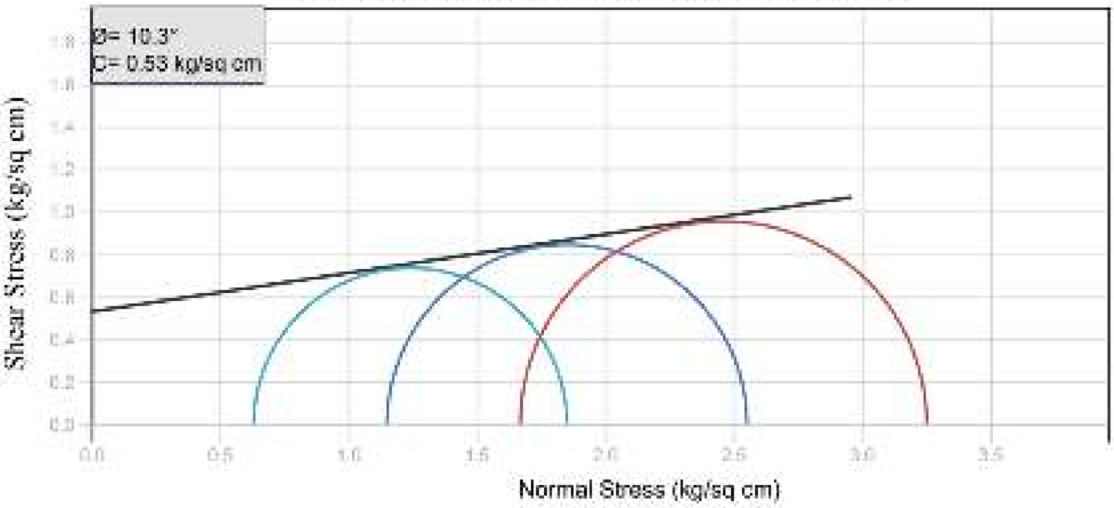


1901-HRIDC-V-23326.2870
BH-NO.P92, DEPTH-22.00M, TRIAXIAL GRAPH

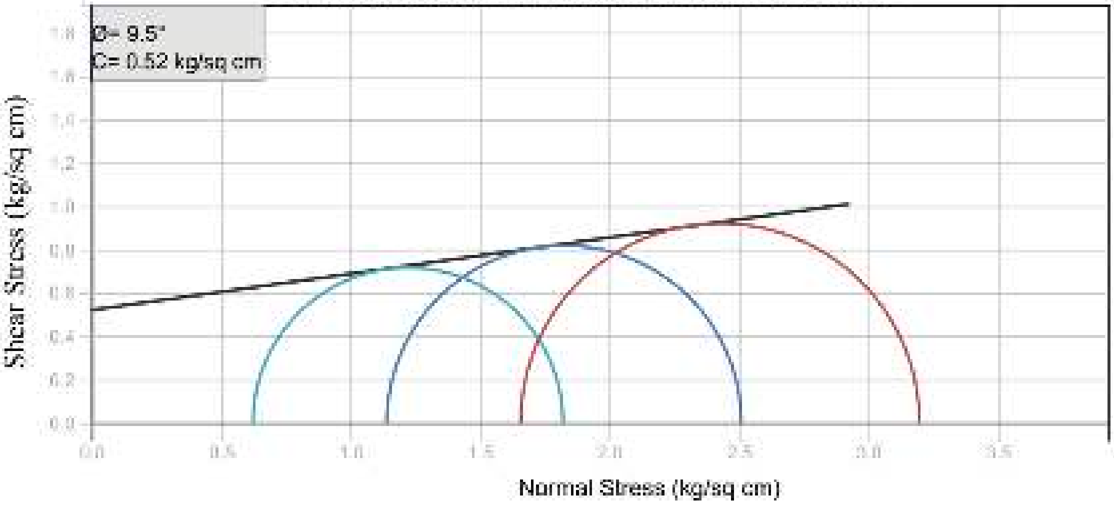


APPENDIX-G
GRAPH 18: UU GRAPH

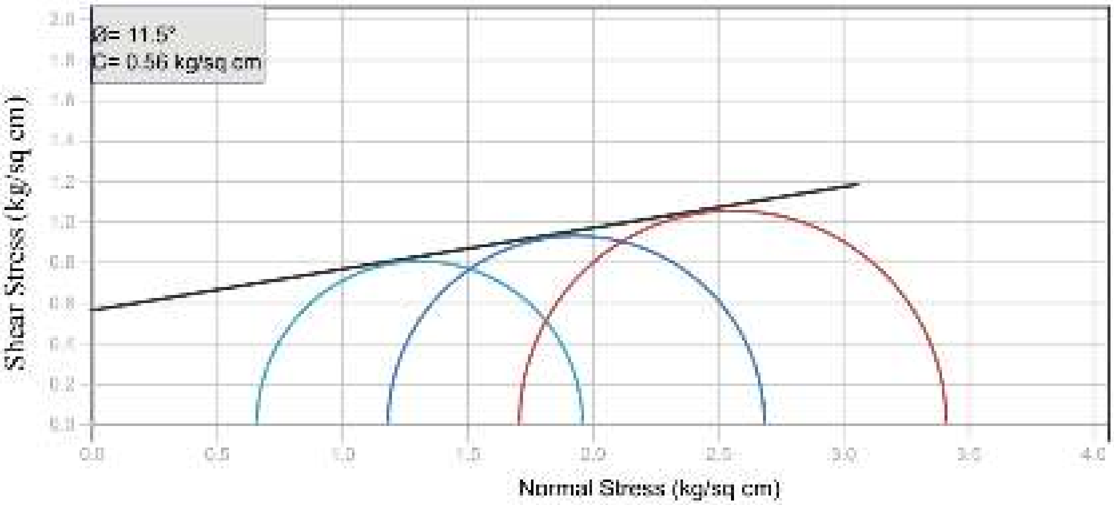
1901-HRIDC-V-23326.2870
BH-NO.P92, DEPTH-25.00M, TRIAXIAL GRAPH



1901-HRIDC-V-23352.487
BH-NO.P93, DEPTH-13.00M, TRIAXIAL GRAPH

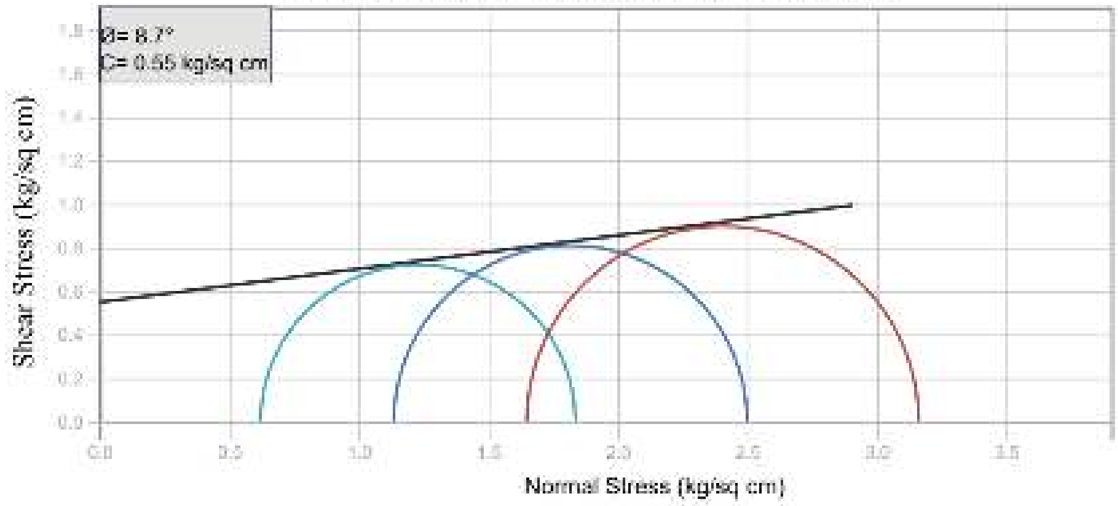


1901-HRIDC-V-23352.487
BH-NO.P93, DEPTH-16.00M, TRIAXIAL GRAPH

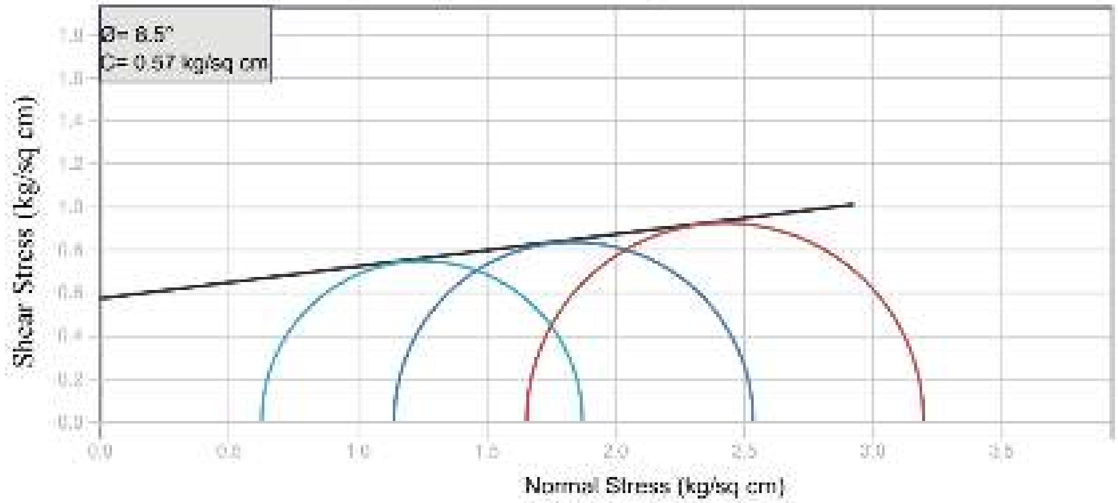


APPENDIX-G
GRAPH 19: UU GRAPH

1901-HRIDC-V-23352.487
BH-NO.P93, DEPTH-19.00M, TRIAXIAL GRAPH

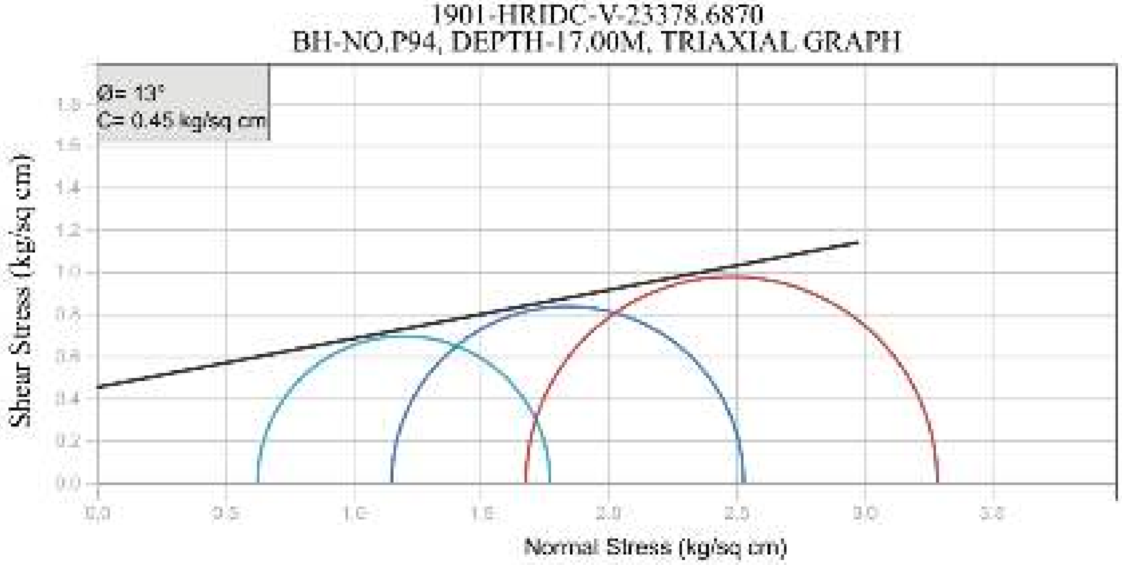


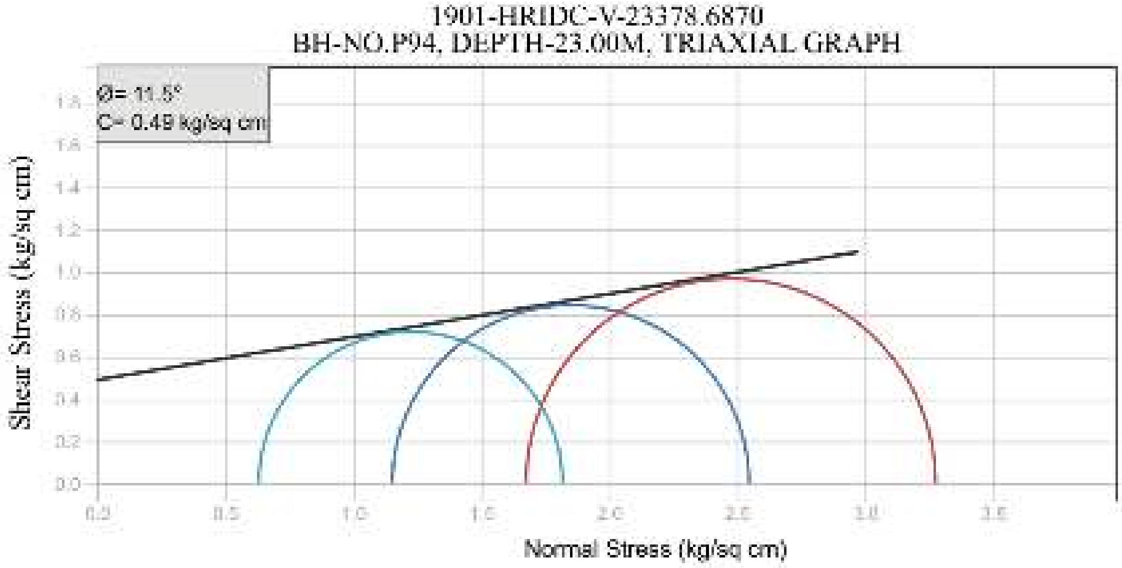
1901-HRIDC-V-23352.487
BH-NO.P93, DEPTH-22.00M, TRIAXIAL GRAPH

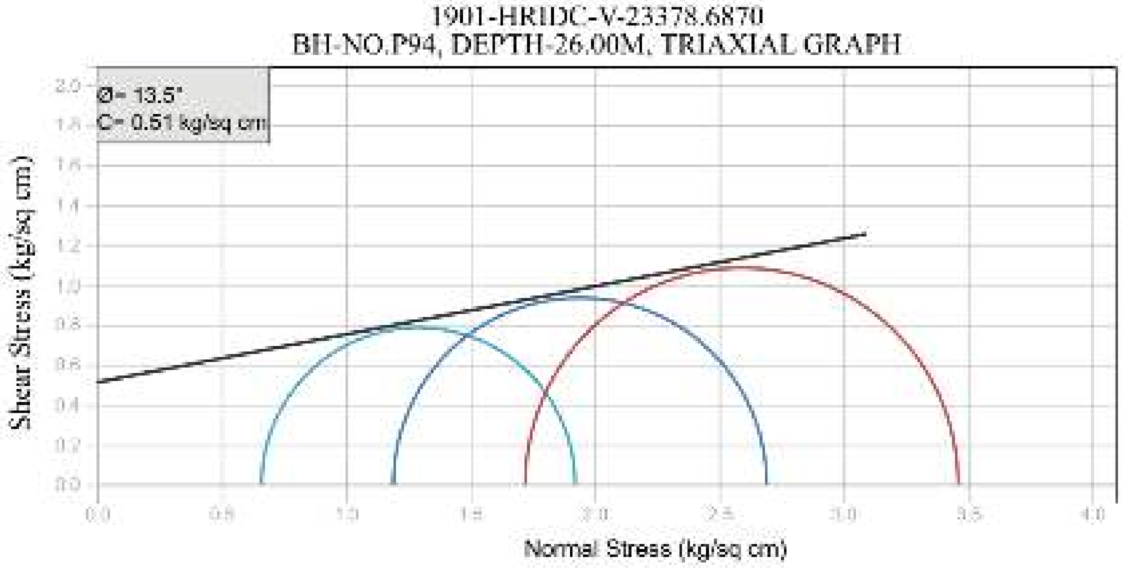


1901-HRIDC-V-23378.6870
BH-NO.P94, DEPTH-14.00M, TRIAXIAL GRAPH

APPENDIX-G
GRAPH 20: UU GRAPH



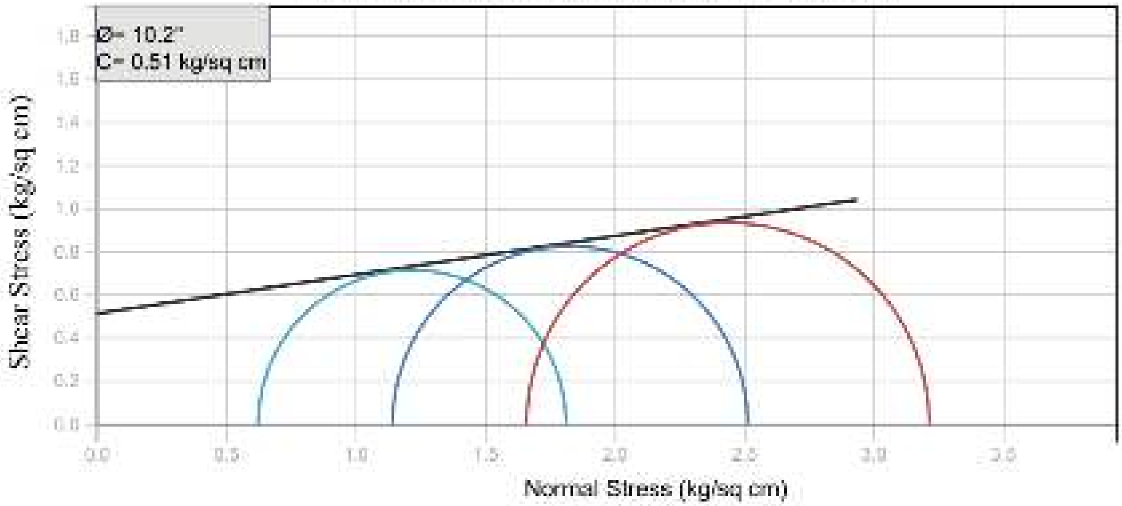




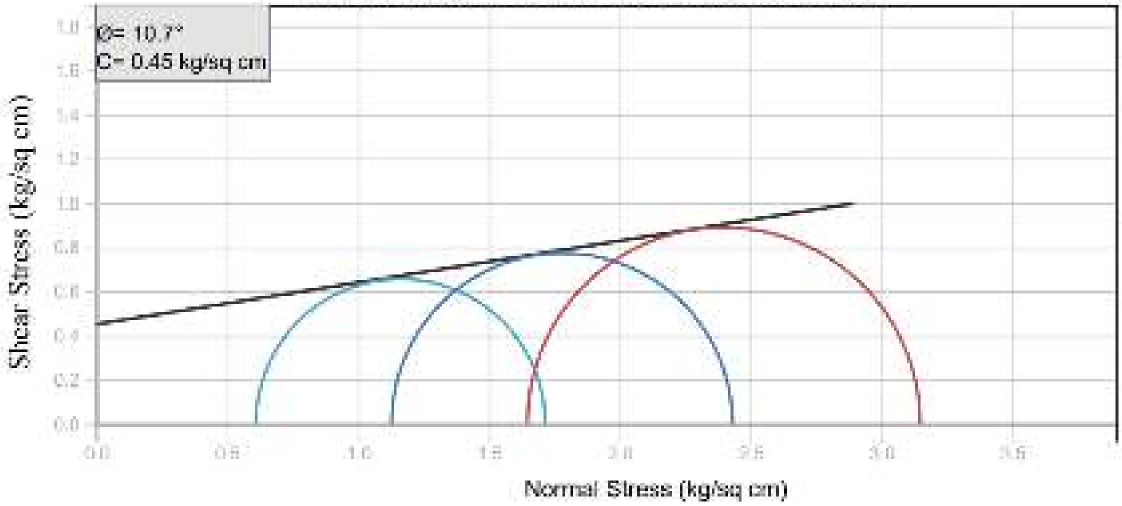
APPENDIX-G

GRAPH 21: UU GRAPH

1901-HRIDC-V-23378.6870
BH-NO.P94, DEPTH-29.00M, TRIAXIAL GRAPH



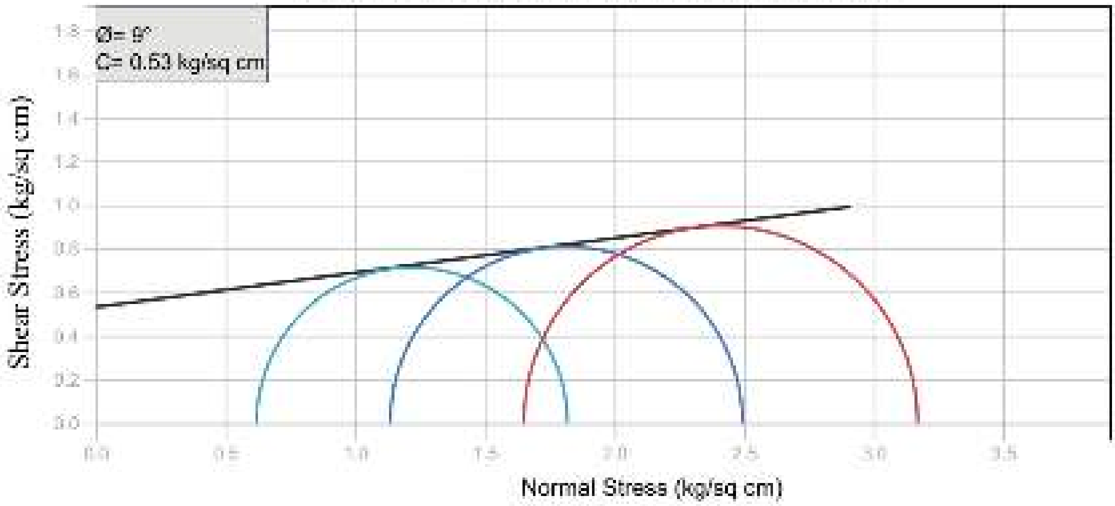
1901-HRIDC-V-23404.887
BH-NO.P95, DEPTH-8.00M, TRIAXIAL GRAPH



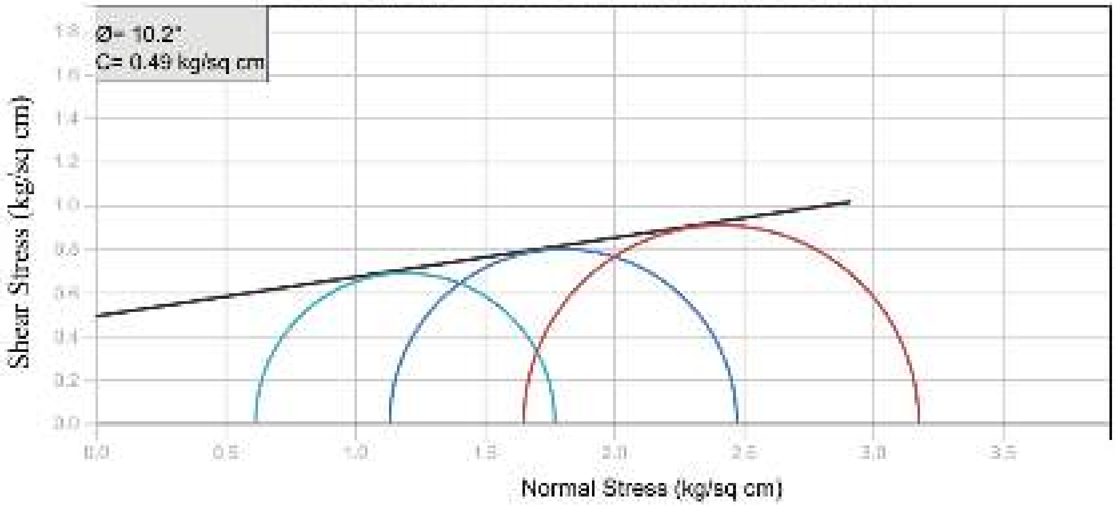
1901-HRIDC-V-23404.887
BH-NO.P95, DEPTH-11.00M, TRIAXIAL GRAPH

APPENDIX-G
GRAPH 22: UU GRAPH

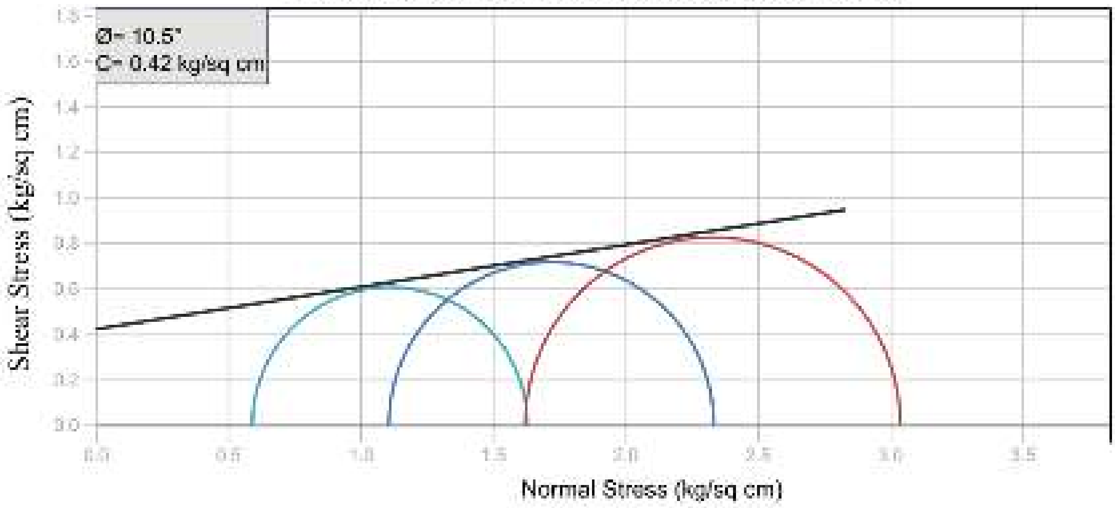
1901-HRIDC-V-23404.887
BH-NO.P95, DEPTH-14.00M, TRIAXIAL GRAPH



1901-HRIDC-V-23404.887
BH-NO.P95, DEPTH-20.00M, TRIAXIAL GRAPH

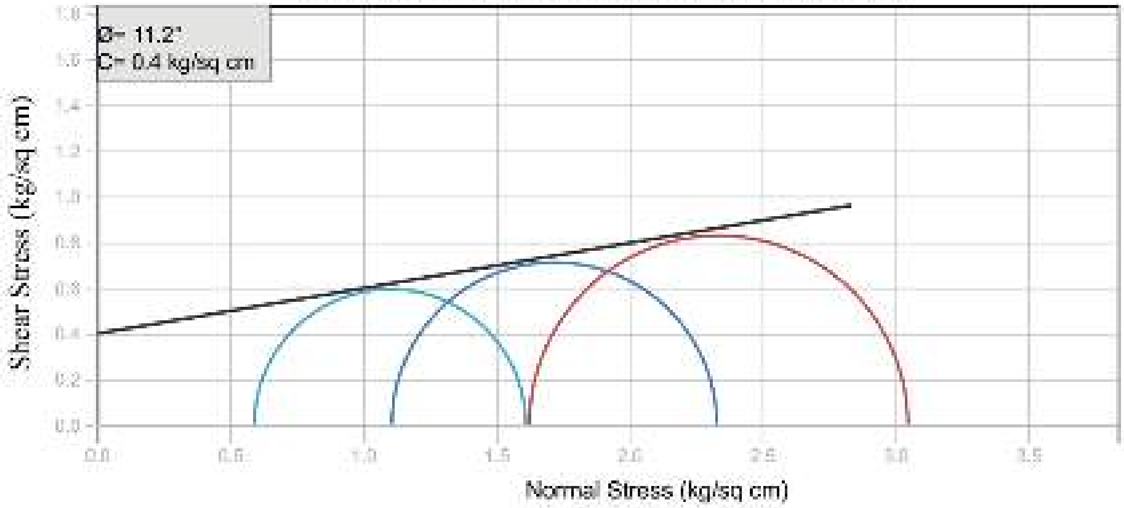


1901-HRIDC-V-23431.087
BH-NO.P96, DEPTH-11.00M, TRIAXIAL GRAPH

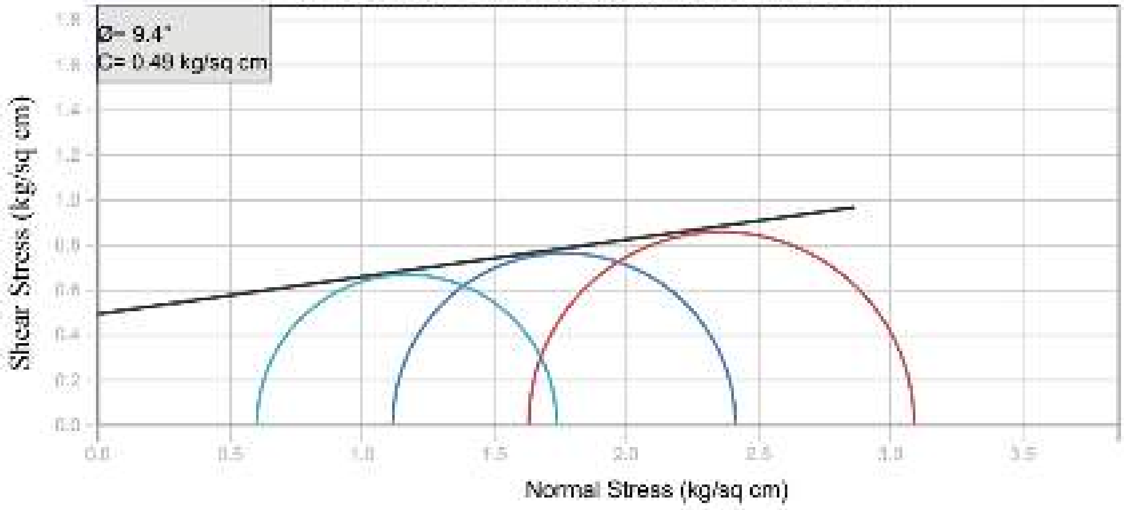


APPENDIX-G
GRAPH 23: UU GRAPH

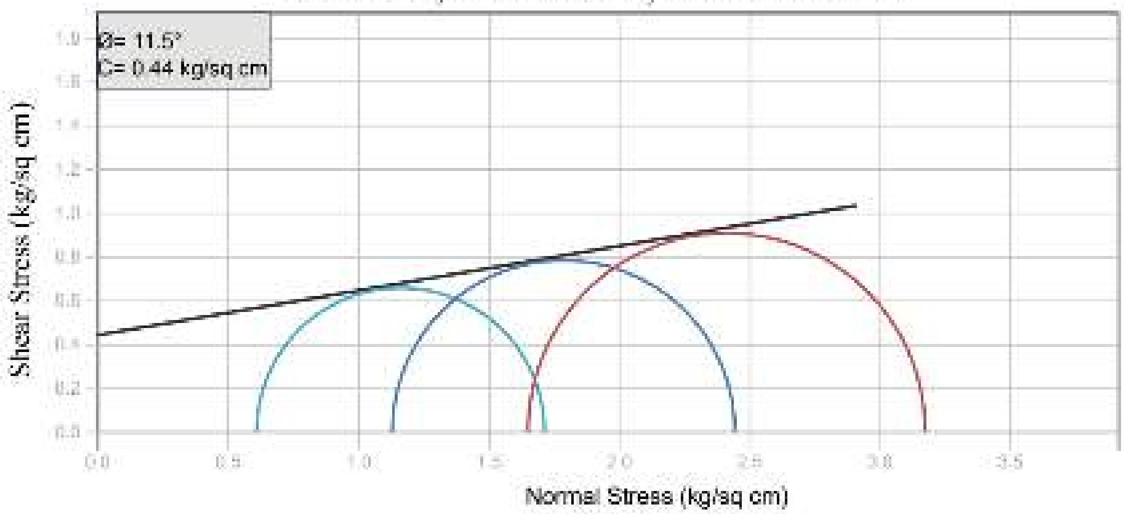
1901-HRIDC-V-23431.087
BH-NO.P96, DEPTH-14.00M, TRIAXIAL GRAPH



1901-HRIDC-V-23431.087
BH-NO.P96, DEPTH-23.00M, TRIAXIAL GRAPH

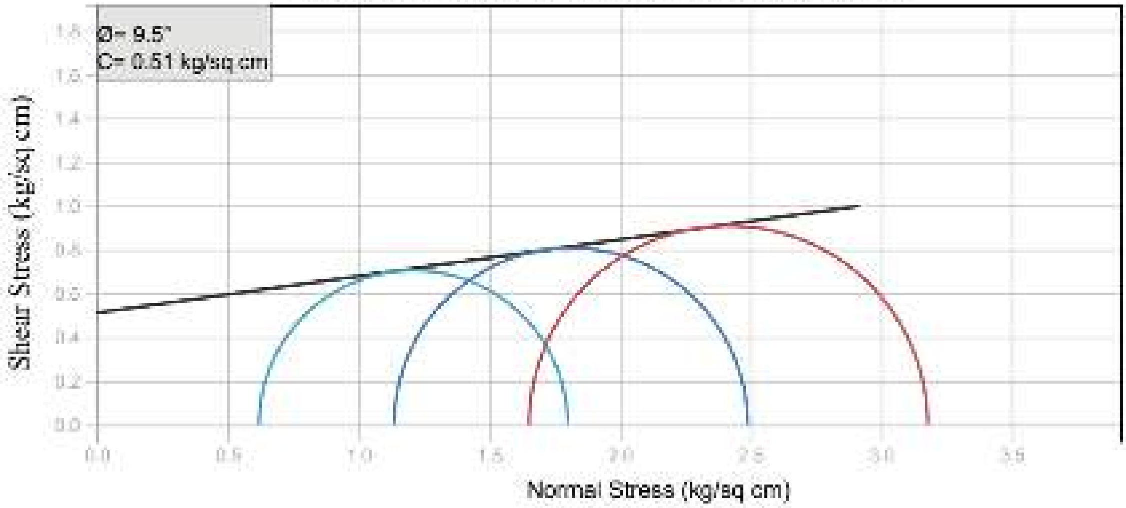


1901-HRIDC-V-23457.2870
BH-NO.P97, DEPTH-10.00M, TRIAXIAL GRAPH

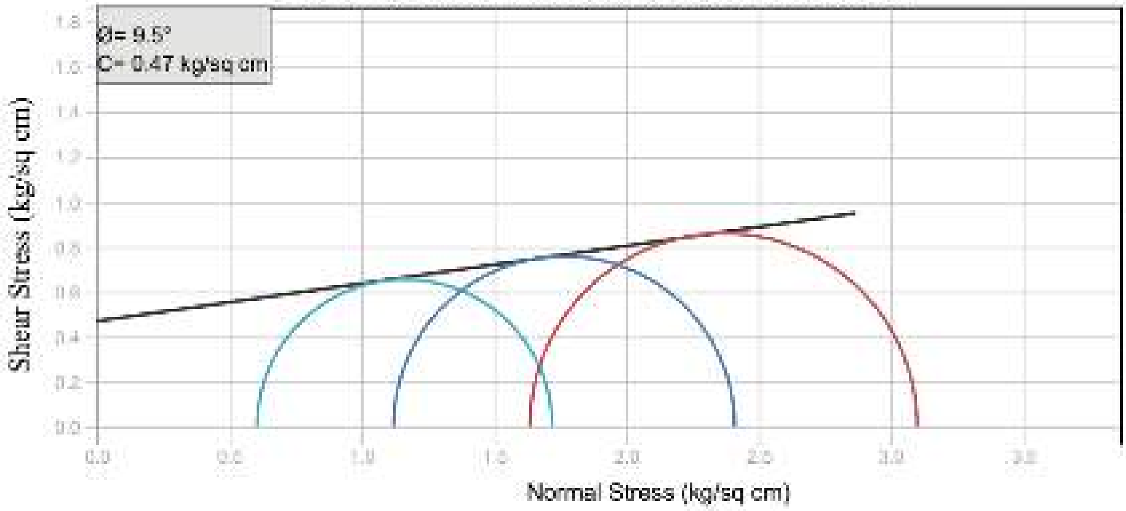


APPENDIX-G
GRAPH 24: UU GRAPH

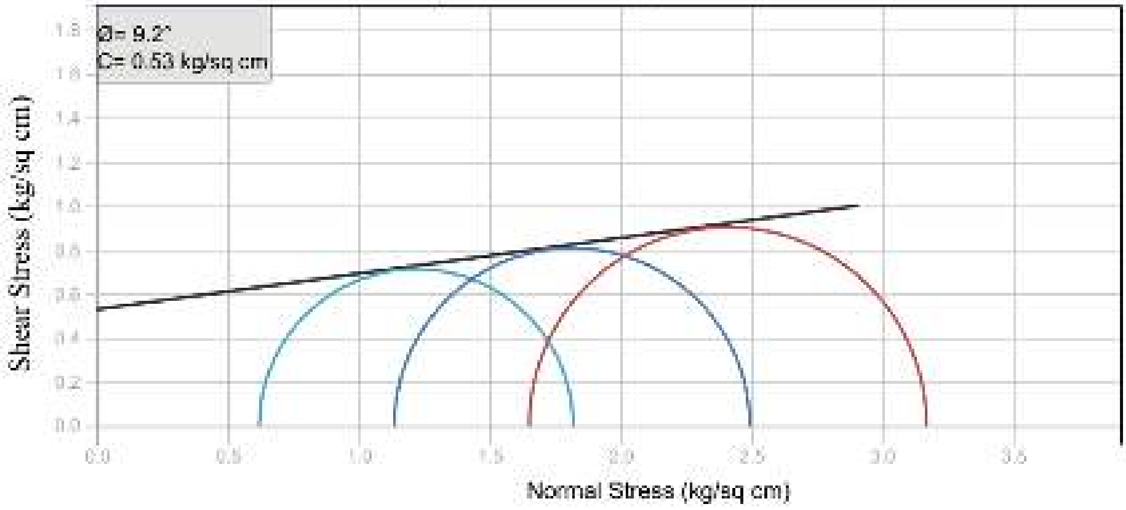
1901-HRIDC-V-23457.2870
BH-NO.P97, DEPTH-13.00M, TRIAXIAL GRAPH



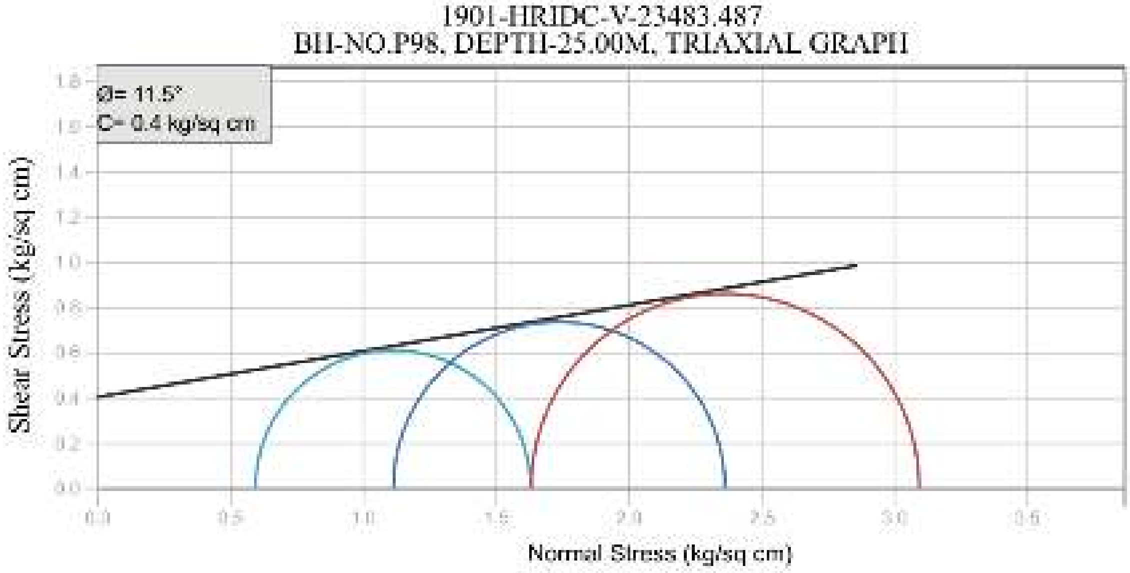
1901-HRIDC-V-23483.487
BH-NO.P98, DEPTH-10.00M, TRIAXIAL GRAPH

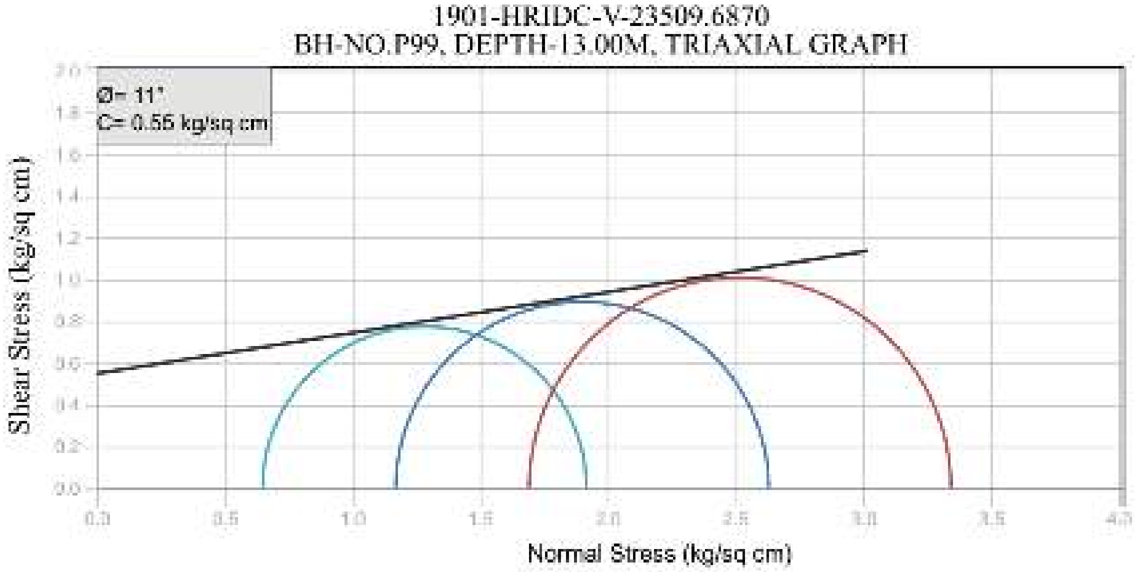


1901-HRIDC-V-23483.487
BH-NO.P98, DEPTH-13.00M, TRIAXIAL GRAPH



APPENDIX-G
GRAPH 25: UU GRAPH

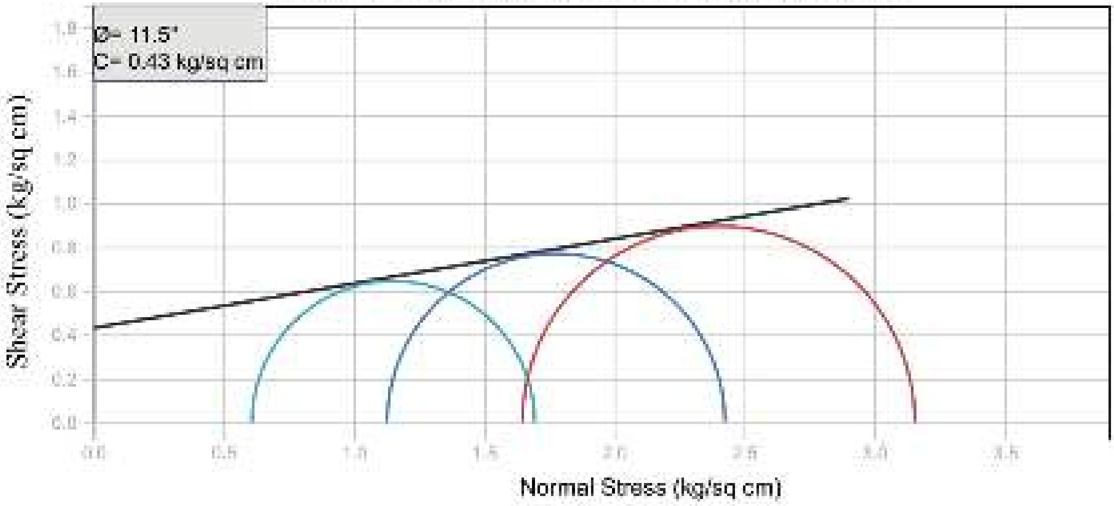




APPENDIX-G

GRAPH 26: UU GRAPH

1901-HRIDC-V-23535.887
BH-NO.P100, DEPTH-10.00M, TRIAXIAL GRAPH

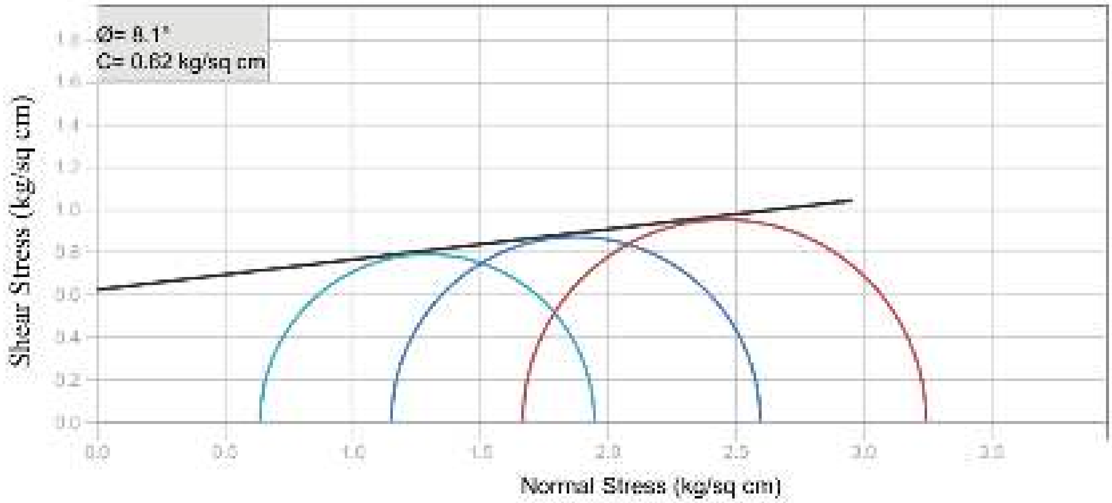


1901-HRIDC-V-23535.887
BH-NO.P100, DEPTH-16.00M, TRIAXIAL GRAPH

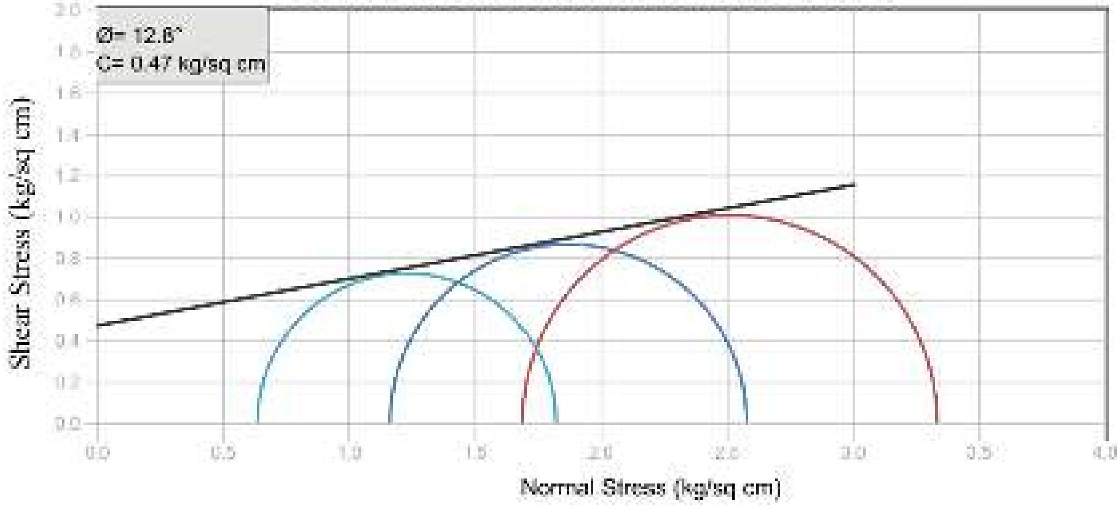
1901-HRIDC-V-23535.887
BH-NO.P100, DEPTH-22.00M, TRIAXIAL GRAPH

APPENDIX-G
GRAPH 27: RUU GRAPH

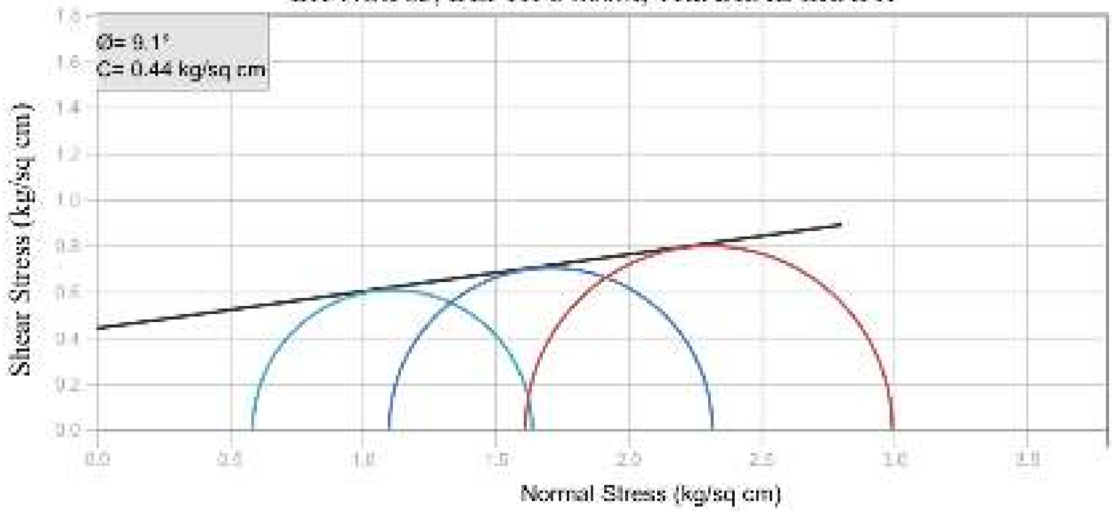
1901-HRIDC-V-23090.487
BH-NO.P83, DEPTH-29.00M, TRIAXIAL GRAPH



1901-HRIDC-V-23090.487
BH-NO.P83, DEPTH-35.00M, TRIAXIAL GRAPH



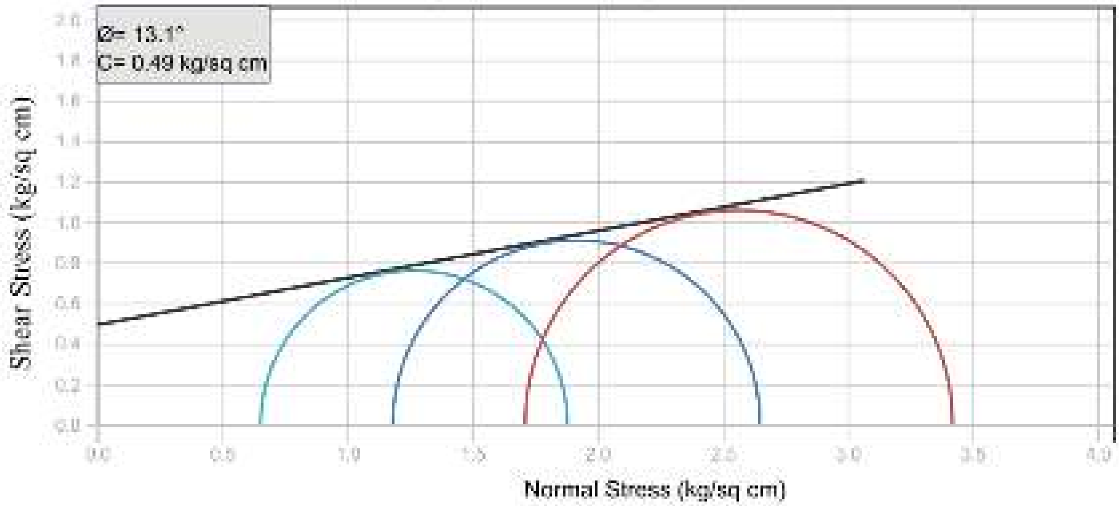
1901-HRIDC-V-23142.8870
BH-NO.P85, DEPTH-34.00M, TRIAXIAL GRAPH



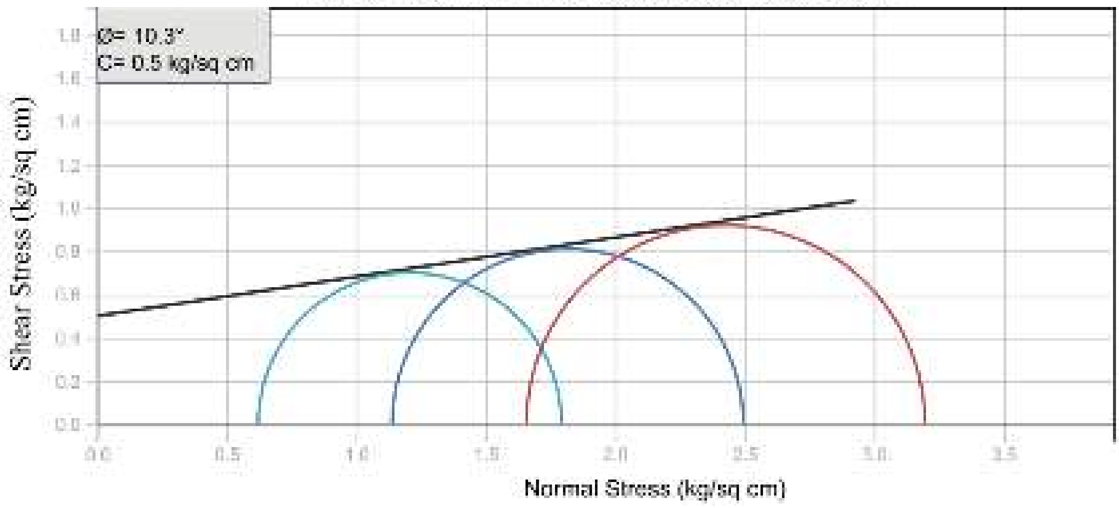
APPENDIX-G
GRAPH 28: RUU GRAPH

1901-HRIDC-V-23169.087
BH-NO.P86, DEPTH-35.00M, TRIAXIAL GRAPH

1901-HRIDC-V-23169.087
BH-NO.P86, DEPTH-38.00M, TRIAXIAL GRAPH



1901-HRIDC-V-23247.687
BH-NO.P89, DEPTH-37.00M, TRIAXIAL GRAPH



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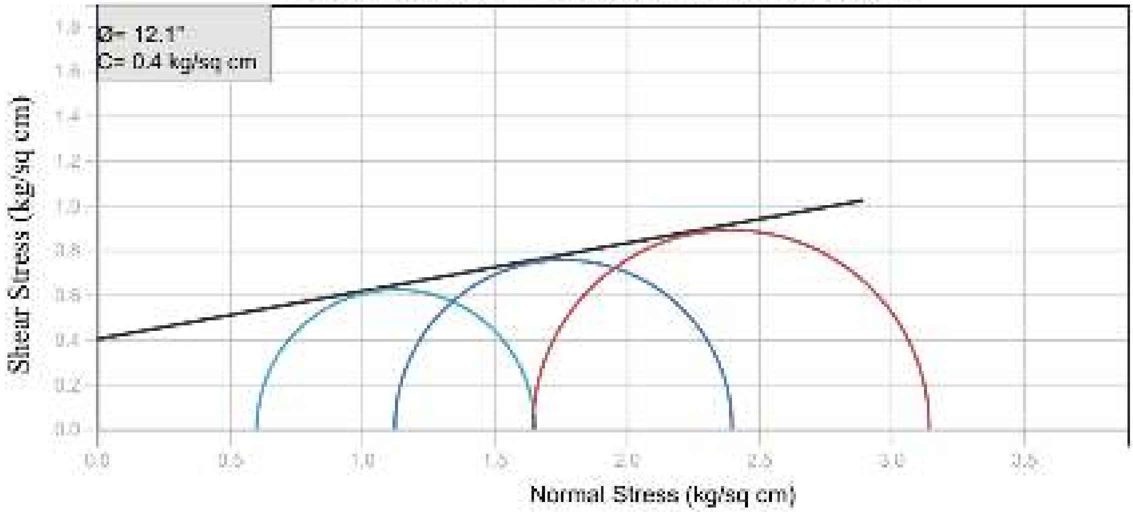
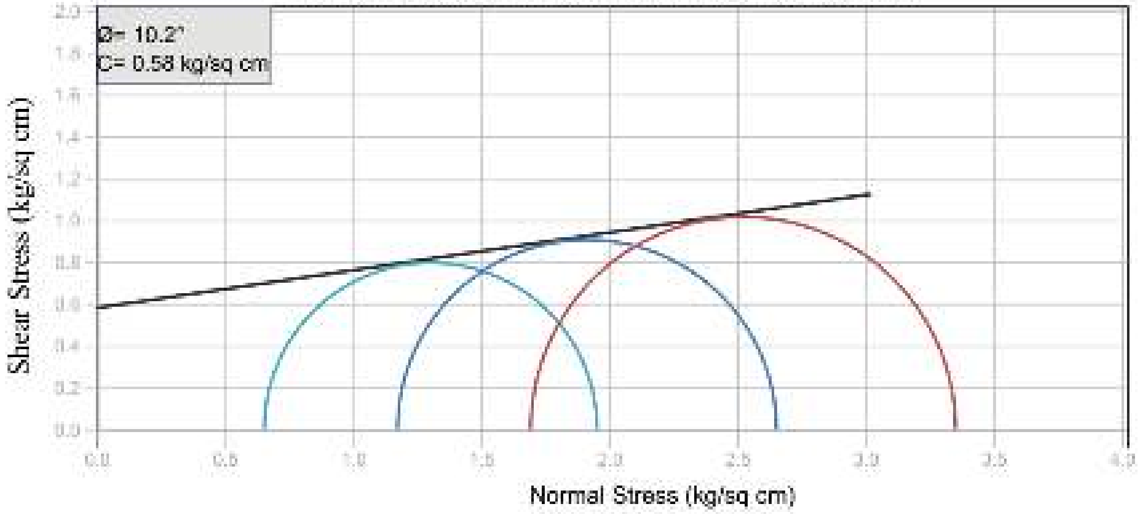
GRAPH 29: RUU GRAPH

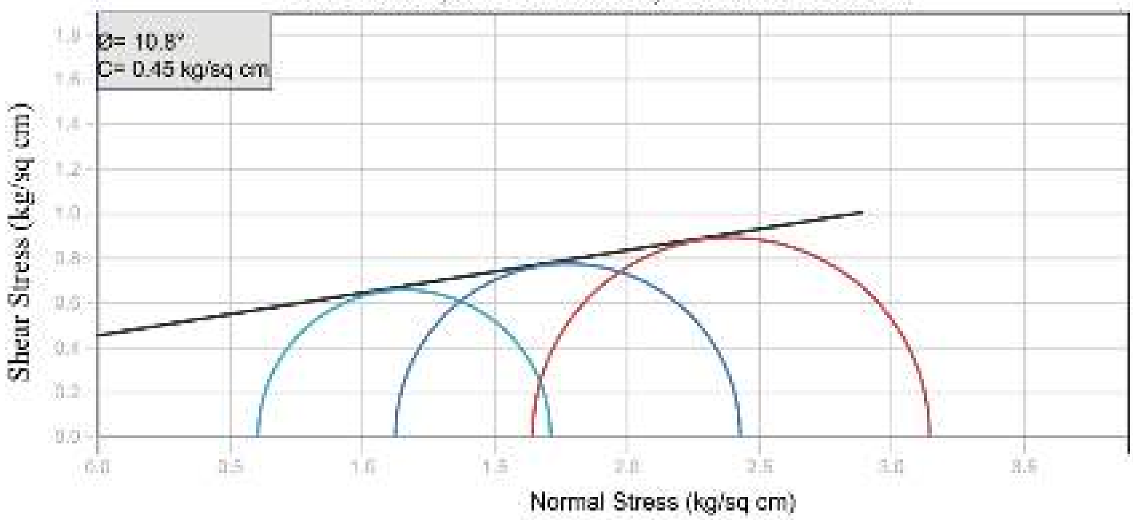
1901-HRIDC-V-23273.887
BH-NO.P90, DEPTH-34.00M, TRIAXIAL GRAPH



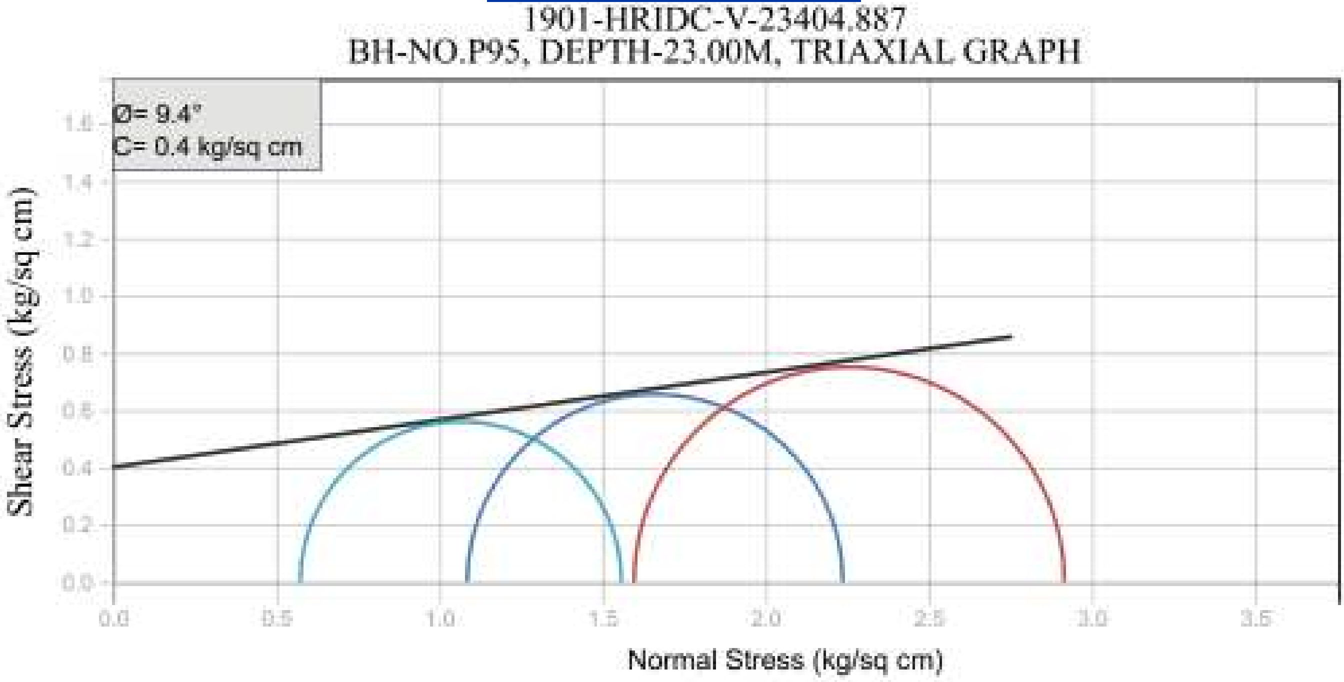
1901-HRIDC-V-23300.0870
BH-NO.P91, DEPTH-34.00M, TRIAXIAL GRAPH

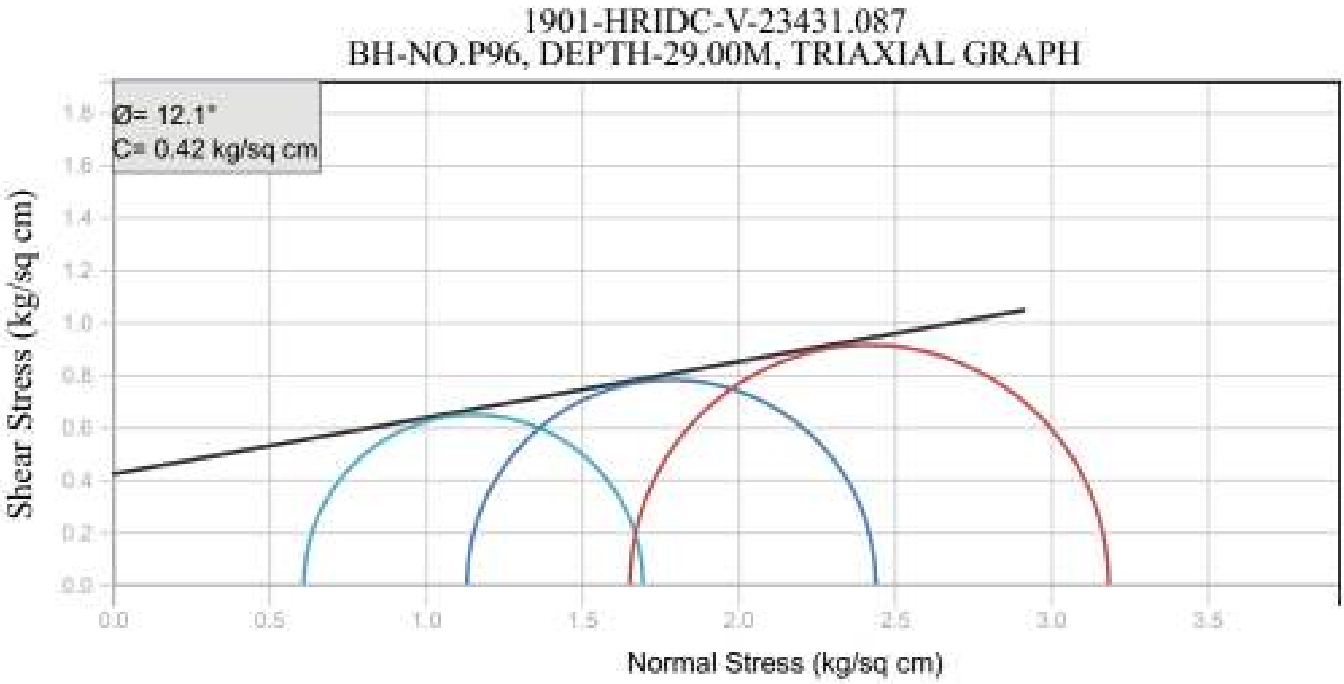


1901-HRIDC-V-23326.2870
BH-NO.P92, DEPTH-34.00M, TRIAXIAL GRAPH



APPENDIX-G
GRAPH 30: RUU GRAPH





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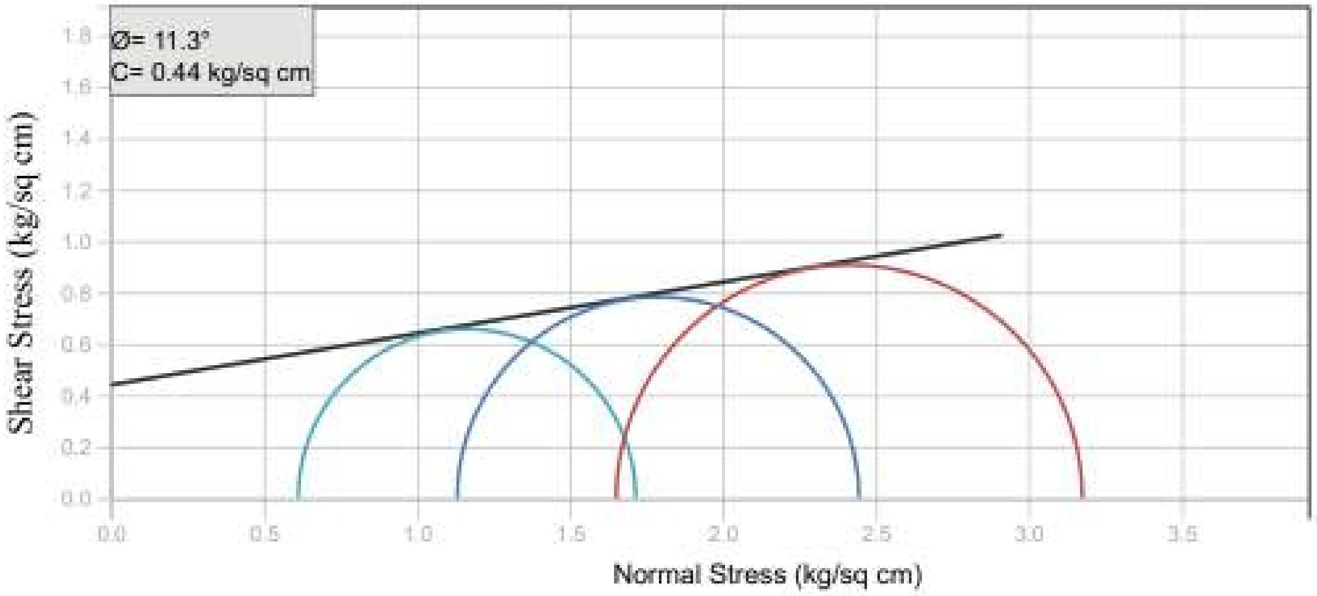
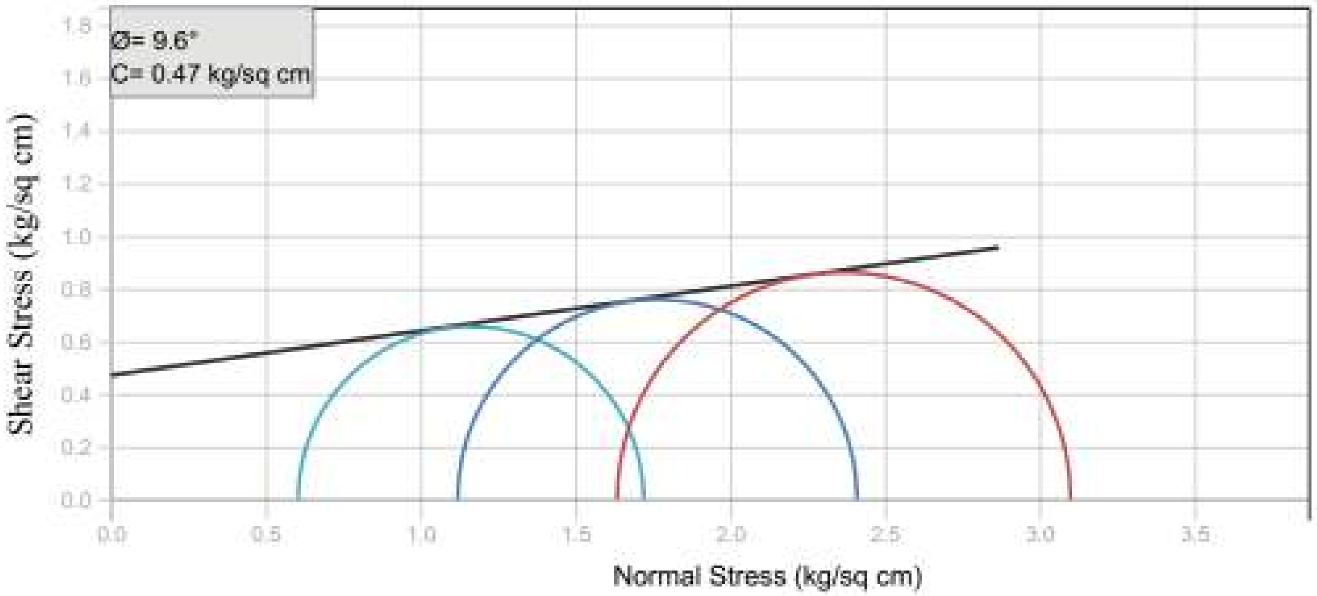
GRAPH 31: RUU GRAPH

1901-HRIDC-V-23457.2870
BH-NO.P97, DEPTH-22.00M, TRIAXIAL GRAPH



1901-HRIDC-V-23509.6870
BH-NO.P99, DEPTH-10.00M, TRIAXIAL GRAPH



APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: P81, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	18.85	8.85	24.34	1.57	26.3	26.3	1.0	18.90	0	3	1.0	4.7	0	3.0	23.6	0	8.85	8.99	9.34	26.6	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	18.85	8.85	30.98	3.14	23.6	23.6	1.0	42.53	0	0	1.0	0.0	0	4.0	11.5	44	10.17	2.91	1.65	35.4	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	20.17	10.17	40.49	3.14	11.5	11.5	1.0	25.89	0	44	1.0	138.3	0	5.0	12.7	48	10.17	3.26	1.99	45.6	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	20.17	10.17	50.66	3.14	12.7	12.7	1.0	35.88	0	48	1.0	150.9	0	6.0	12.7	48	10.17	3.26	1.99	55.7	490.3	490.3	41.3	41.3	**196.11**	**13.75**
6.00	7.00	6.50	1.00	4.50	20.17	10.17	60.83	3.14	12.7	12.7	1.0	43.08	43.08	48	1.0	150.9	150.86	7.0	12.7	48	10.27	3.26	1.99	65.9	516.4	710.4	53.0	247.0	**284.14**	**82.32**
7.00	8.00	7.50	1.00	5.50	20.27	10.27	71.05	3.14	12.7	12.7	1.0	50.32	93.40	48	1.0	150.9	301.71	8.0	11.0	45	10.27	2.76	1.51	76.2	489.7	884.8	64.8	459.9	**353.94**	**153.31**
8.00	9.00	8.50	1.00	6.50	20.27	10.27	81.32	3.14	11.0	11.0	1.0	49.68	143.08	45	1.0	141.4	443.14	9.0	11.0	45	10.27	2.76	1.51	86.5	512.0	1098.3	76.6	662.8	**439.30**	**220.94**
9.00	10.00	9.50	1.00	7.50	20.27	10.27	91.59	3.14	11.0	11.0	1.0	55.95	199.03	45	1.0	141.4	584.57	10.0	11.0	45	10.19	2.76	1.51	96.7	534.3	1317.9	88.4	872.0	**527.16**	**290.66**
10.00	11.00	10.50	1.00	8.50	20.19	10.19	101.82	3.14	11.0	11.0	1.0	62.20	261.23	45	1.0	141.4	726.00	11.0	11.0	45	10.19	2.76	1.51	106.9	556.4	1543.6	100.2	1087.4	**617.46**	**362.47**
11.00	12.00	11.50	1.00	9.50	20.19	10.19	112.01	3.14	11.0	11.0	1.0	68.42	329.65	45	1.0	141.4	867.43	12.0	9.5	55	10.36	2.38	1.14	117.1	612.6	1809.6	112.0	1309.0	**723.85**	**436.35**
12.00	14.50	13.25	2.50	12.00	20.36	10.36	130.05	7.86	9.5	9.5	1.0	170.99	500.65	55	1.0	432.1	1299.57	14.5	9.5	53	10.36	2.38	1.14	143.0	646.8	2447.1	141.4	1941.6	**978.83**	**647.22**
14.50	16.00	15.25	1.50	13.50	20.36	10.36	130.05	4.71	9.5	9.5	1.0	102.60	603.24	53	1.0	249.9	1549.43	16.0	27.5	0	9.82	15.63	16.64	143.0	1820.3	3973.0	159.1	2311.8	**1589.19**	**770.59**
16.00	17.50	16.75	1.50	15.00	19.82	9.82	130.05	4.71	27.5	27.5	1.0	319.16	922.40	0	1.0	0.0	1549.43	17.5	11.4	64	9.82	2.88	1.62	143.0	782.6	3254.4	176.8	2648.6	**1301.77**	**882.87**
17.50	19.00	18.25	1.50	16.50	19.82	9.82	130.05	4.71	11.4	11.4	1.0	123.62	1046.02	64	1.0	301.7	1851.14	19.0	12.2	44	10.40	3.12	1.85	143.0	668.8	3566.0	194.5	3091.6	**1426.40**	**1030.54**
19.00	20.50	19.75	1.50	18.00	20.40	10.40	130.05	4.71	12.2	12.2	1.0	132.56	1178.57	44	1.0	207.4	2058.57	20.5	12.2	44	10.40	3.12	1.85	143.0	668.8	3906.0	212.1	3449.3	**1562.40**	**1149.76**
20.50	23.50	22.00	3.00	21.00	20.40	10.40	130.05	9.43	12.2	12.2	1.0	265.11	1443.69	44	1.0	414.9	2473.43	23.5	10.0	44	9.50	2.47	1.22	143.0	593.2	4510.3	247.5	4164.6	**1804.13**	**1388.20**
23.50	25.00	24.25	1.50	22.50	19.50	9.50	130.05	4.71	10.0	10.0	1.0	108.10	1551.79	44	1.0	207.4	2680.86	25.0	13.0	48	9.87	3.35	2.08	143.0	723.9	4956.5	265.2	4497.8	**1982.61**	**1499.28**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
25.00	26.50	25.75	1.50	24.00	19.87	9.87	130.05	4.71	13.0	13.0	1.0	141.54	1693.33	48	1.0	226.3	2907.14	26.5	13.0	48	8.83	3.35	2.08	143.0	723.0	5323.5	282.9	4883.3	**2129.40**	**1627.78**
26.50	27.50	27.00	1.00	25.00	18.83	8.83	130.05	3.14	13.0	13.0	1.0	94.36	1787.70	48	1.0	150.9	3058.00	27.5	13.0	48	8.83	3.35	2.08	143.0	723.0	5568.7	294.6	5140.3	**2227.49**	**1713.45**
27.50	28.00	27.75	0.50	25.50	18.83	8.83	130.05	1.57	13.0	13.0	1.0	47.18	1834.88	48	1.0	75.4	3133.43	28.0	18.0	28	9.79	5.42	4.29	143.0	823.0	5791.3	300.5	5268.8	**2316.54**	**1756.28**
28.00	29.50	28.75	1.50	27.00	19.79	9.79	130.05	4.71	18.0	18.0	1.0	199.21	2034.08	28	1.0	132.0	3265.43	29.5	18.0	28	8.99	5.42	4.29	143.0	821.7	6121.2	318.2	5617.7	**2448.48**	**1872.58**
29.50	30.00	29.75	0.50	27.50	18.99	8.99	130.05	1.57	18.0	18.0	1.0	66.40	2100.49	28	1.0	44.0	3309.43	30.0	18.0	47	8.99	5.42	4.29	143.0	956.0	6366.0	324.1	5734.0	**2546.39**	**1911.34**
30.00	31.00	30.50	1.00	28.50	18.99	8.99	130.05	3.14	18.0	18.0	1.0	132.80	2233.29	47	1.0	147.7	3457.14	31.0	13.0	42	9.41	3.35	2.08	143.0	681.1	6371.5	335.9	6026.3	**2548.60**	**2008.77**
31.00	32.50	31.75	1.50	30.00	19.41	9.41	130.05	4.71	13.0	13.0	1.0	141.54	2374.83	42	1.0	198.0	3655.14	32.5	13.0	42	9.32	3.35	2.08	143.0	681.0	6711.0	353.6	6383.5	**2684.39**	**2127.85**
32.50	34.00	33.25	1.50	31.50	19.32	9.32	130.05	4.71	13.0	13.0	1.0	141.54	2516.38	42	1.0	198.0	3853.14	34.0	8.5	53	8.46	2.20	0.99	143.0	625.3	6994.8	371.3	6740.8	**2797.91**	**2246.92**
34.00	35.00	34.50	1.00	32.50	18.46	8.46	130.05	3.14	8.5	8.5	1.0	61.08	2577.46	53	1.0	166.6	4019.71	35.0	8.5	53	8.46	2.20	0.99	143.0	625.3	7222.4	383.0	6980.2	**2888.97**	**2326.74**
35.00	35.50	35.25	0.50	33.00	18.46	8.46	130.05	1.57	8.5	8.5	1.0	30.54	2608.00	53	1.0	83.3	4103.00	35.5	22.5	30	7.82	8.20	8.14	143.0	1158.5	7869.5	388.9	7099.9	**3147.79**	**2366.64**
35.50	37.00	36.25	1.50	34.50	17.82	7.82	130.05	4.71	22.5	22.5	1.0	253.95	2861.96	30	1.0	141.4	4244.43	37.0	22.5	30	8.29	8.20	8.14	143.0	1160.0	8266.3	406.6	7513.0	**3306.54**	**2504.33**
37.00	37.50	37.25	0.50	35.00	18.29	8.29	130.05	1.57	22.5	22.5	1.0	84.65	2946.61	30	1.0	47.1	4291.57	37.5	22.5	30	8.29	8.20	8.14	143.0	1160.0	8398.1	412.5	7650.7	**3359.26**	**2550.23**
37.50	38.50	38.00	1.00	36.00	18.29	8.29	130.05	3.14	22.5	22.5	1.0	169.30	3115.91	30	1.0	94.3	4385.86	38.5	18.5	38	9.36	5.64	4.57	143.0	919.4	8421.2	424.3	7926.0	**3368.48**	**2642.02**
38.50	40.00	39.25	1.50	37.50	19.36	9.36	130.05	4.71	18.5	18.5	1.0	205.14	3321.04	38	1.0	179.1	4565.00	40.0	18.5	38	9.36	5.64	4.57	143.0	919.4	8805.5	442.0	8328.0	**3522.19**	**2776.00**
BORE NO: P82, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	18.21	8.21	22.58	1.57	12.2	12.2	1.0	7.67	0	35	1.0	55.0	0	3.0	10.8	44	10.40	2.71	1.45	24.6	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.50	20.40	10.40	35.03	6.29	10.8	10.8	1.0	42.00	0	44	1.0	276.6	0	5.0	10.8	44	10.40	2.71	1.45	45.4	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	20.40	10.40	50.63	3.14	10.8	10.8	1.0	30.35	0	44	1.0	138.3	0	6.0	27.5	3	10.40	15.63	16.64	55.8	0	0.0	41.3	41.3	**0.00**	**13.75**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
6.00	7.00	6.50	1.00	4.50	20.40	10.40	61.03	3.14	27.5	27.5	1.0	99.85	0	3	1.0	9.4	0	7.0	27.5	3	8.60	15.63	16.64	66.2	0	0.0	53.0	53.0	**0.00**	**17.68**
7.00	8.00	7.50	1.00	5.50	18.60	8.60	70.53	3.14	27.5	27.5	1.0	115.39	0	3	1.0	9.4	0	8.0	15.9	29	8.60	4.38	3.14	74.8	473.4	473.4	64.8	64.8	**189.35**	**21.61**
8.00	9.00	8.50	1.00	6.50	18.60	8.60	79.13	3.14	15.9	15.9	1.0	70.84	70.84	29	1.0	91.1	91.14	9.0	15.9	29	8.60	4.38	3.14	83.4	503.0	665.0	76.6	238.6	**265.99**	**79.53**
9.00	10.00	9.50	1.00	7.50	18.60	8.60	87.73	3.14	15.9	15.9	1.0	78.54	149.38	29	1.0	91.1	182.29	10.0	18.0	55	8.60	5.42	4.29	92.0	795.1	1126.7	88.4	420.1	**450.69**	**140.02**
10.00	11.00	10.50	1.00	8.50	18.60	8.60	96.33	3.14	18.0	18.0	1.0	98.37	247.75	55	1.0	172.9	355.14	11.0	9.0	55	11.00	2.29	1.07	100.6	574.6	1177.5	100.2	703.1	**471.00**	**234.36**
11.00	12.00	11.50	1.00	9.50	21.00	11.00	106.13	3.14	9.0	9.0	1.0	52.83	300.58	55	1.0	172.9	528.00	12.0	9.0	55	11.00	2.29	1.07	111.6	594.4	1423.0	112.0	940.5	**569.19**	**313.52**
12.00	14.50	13.25	2.50	12.00	21.00	11.00	125.38	7.86	9.0	9.0	1.0	156.03	456.61	55	1.0	432.1	960.14	14.5	10.5	52	10.50	2.62	1.36	139.1	659.4	2076.2	141.4	1558.2	**830.47**	**519.39**
14.50	17.50	16.00	3.00	15.00	20.50	10.50	125.38	9.43	10.5	10.5	1.0	219.10	675.71	52	1.0	490.3	1450.43	17.5	10.6	51	10.80	2.65	1.39	139.1	655.8	2782.0	176.8	2302.9	**1112.79**	**767.64**
17.50	20.50	19.00	3.00	18.00	20.80	10.80	125.38	9.43	10.6	10.6	1.0	221.23	896.95	51	1.0	480.9	1931.29	20.5	10.5	51	10.80	2.62	1.36	139.1	652.5	3480.7	212.1	3040.4	**1392.30**	**1013.46**
20.50	22.00	21.25	1.50	19.50	20.80	10.80	125.38	4.71	10.5	10.5	1.0	109.55	1006.50	51	1.0	240.4	2171.71	22.0	24.5	12	10.70	9.64	10.33	139.1	1182.1	4360.3	229.8	3408.0	**1744.12**	**1136.01**
22.00	23.50	22.75	1.50	21.00	20.70	10.70	125.38	4.71	24.5	24.5	1.0	269.37	1275.87	12	1.0	56.6	2228.29	23.5	14.5	55	10.70	3.80	2.51	139.1	814.3	4318.5	247.5	3751.7	**1727.39**	**1250.55**
23.50	26.50	25.00	3.00	24.00	20.70	10.70	125.38	9.43	14.5	14.5	1.0	305.73	1581.59	55	1.0	518.6	2746.86	26.5	9.5	55	10.80	2.38	1.14	139.1	654.0	4982.4	282.9	4611.3	**1992.96**	**1537.10**
26.50	27.50	27.00	1.00	25.00	20.80	10.80	125.38	3.14	9.5	9.5	1.0	65.94	1647.53	55	1.0	172.9	2919.71	27.5	9.5	55	10.80	2.38	1.14	139.1	654.0	5221.2	294.6	4861.9	**2088.48**	**1620.63**
27.50	29.50	28.50	2.00	27.00	20.80	10.80	125.38	6.29	9.5	9.5	1.0	131.88	1779.42	55	1.0	345.7	3265.43	29.5	10.5	56	10.80	2.62	1.36	139.1	687.9	5732.7	318.2	5363.1	**2293.08**	**1787.69**
29.50	30.00	29.75	0.50	27.50	20.80	10.80	125.38	1.57	10.5	10.5	1.0	36.52	1815.93	56	1.0	88.0	3353.43	30.0	10.5	56	10.50	2.62	1.36	139.1	687.7	5857.1	324.1	5493.5	**2342.83**	**1831.16**
30.00	32.50	31.25	2.50	30.00	20.50	10.50	125.38	7.86	10.5	10.5	1.0	182.58	1998.52	56	1.0	440.0	3793.43	32.5	11.2	56	10.50	2.82	1.56	139.1	711.0	6503.0	353.6	6145.5	**2601.19**	**2048.51**
32.50	34.00	33.25	1.50	31.50	20.50	10.50	125.38	4.71	11.2	11.2	1.0	117.04	2115.55	56	1.0	264.0	4057.43	34.0	7.3	60	10.50	1.98	0.80	139.1	644.5	6817.5	371.3	6544.2	**2726.99**	**2181.41**
34.00	35.00	34.50	1.00	32.50	20.50	10.50	125.38	3.14	7.3	7.3	1.0	50.48	2166.03	60	1.0	188.6	4246.00	35.0	7.0	72	8.95	1.93	0.76	139.1	722.8	7134.8	383.0	6795.1	**2853.93**	**2265.02**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
35.00	35.50	35.25	0.50	33.00	18.95	8.95	125.38	1.57	7.0	7.0	1.0	24.19	2190.22	72	1.0	113.1	4359.14	35.5	7.0	72	10.68	1.93	0.76	139.1	723.3	7272.7	388.9	6938.3	**2909.07**	**2312.76**
35.50	37.50	36.50	2.00	35.00	20.68	10.68	125.38	6.29	7.0	7.0	1.0	96.77	2286.99	72	1.0	452.6	4811.71	37.5	7.0	72	10.68	1.93	0.76	139.1	723.3	7822.0	412.5	7511.2	**3128.80**	**2503.73**
37.50	38.50	38.00	1.00	36.00	20.68	10.68	125.38	3.14	7.0	7.0	1.0	48.38	2335.37	72	1.0	226.3	5038.00	38.5	7.0	72	10.12	1.93	0.76	139.1	723.1	8096.5	424.3	7797.7	**3238.60**	**2599.22**
38.50	40.00	39.25	1.50	37.50	20.12	10.12	125.38	4.71	7.0	7.0	1.0	72.58	2407.95	72	1.0	339.4	5377.43	40.0	11.2	42	10.12	2.82	1.56	139.1	611.8	8397.2	442.0	8227.3	**3358.87**	**2742.45**
BORE NO: P83, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.88	9.88	27.17	1.57	26.8	26.8	1.0	21.57	0	6	1.0	9.4	0	3.0	23.9	0	9.88	9.21	9.67	29.6	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.88	9.88	34.58	3.14	23.9	23.9	1.0	48.16	0	0	1.0	0.0	0	4.0	24.8	10	10.15	9.86	10.66	39.5	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	6.00	5.00	2.00	3.50	20.15	10.15	49.67	6.29	24.8	24.8	1.0	144.26	0	10	1.0	62.9	0	6.0	24.2	0	10.15	9.42	10.00	59.8	0	0.0	41.3	41.3	**0.00**	**13.75**
6.00	7.00	6.50	1.00	4.50	20.15	10.15	64.90	3.14	24.2	24.2	1.0	91.66	0	0	1.0	0.0	0	7.0	24.2	0	10.15	9.42	10.00	70.0	0	0.0	53.0	53.0	**0.00**	**17.68**
7.00	8.00	7.50	1.00	5.50	20.15	10.15	75.05	3.14	24.2	24.2	1.0	106.00	0	0	1.0	0.0	0	8.0	28.6	0	9.80	18.11	19.17	80.1	0	0.0	64.8	64.8	**0.00**	**21.61**
8.00	9.00	8.50	1.00	6.50	19.80	9.80	85.02	3.14	28.6	28.6	1.0	145.69	0	0	1.0	0.0	0	9.0	8.9	58	9.80	2.27	1.05	89.9	574.7	574.7	76.6	76.6	**229.88**	**25.54**
9.00	10.00	9.50	1.00	7.50	19.80	9.80	94.82	3.14	8.9	8.9	1.0	46.67	46.67	58	1.0	182.3	182.29	10.0	8.9	58	10.31	2.27	1.05	99.7	592.4	821.4	88.4	317.3	**328.55**	**105.78**
10.00	12.50	11.25	2.50	10.00	20.31	10.31	112.61	7.86	8.9	8.9	1.0	138.55	185.22	58	1.0	455.7	638.00	12.5	9.5	52	10.31	2.38	1.14	125.5	607.0	1430.2	117.9	941.1	**572.10**	**313.69**
12.50	14.00	13.25	1.50	11.50	20.31	10.31	133.23	4.71	9.5	9.5	1.0	105.10	290.32	52	1.0	245.1	883.14	14.0	9.5	52	10.13	2.38	1.14	141.0	635.9	1809.3	135.5	1309.0	**723.73**	**436.33**
14.00	15.50	14.75	1.50	13.00	20.13	10.13	148.56	4.71	9.5	9.5	1.0	117.20	407.52	52	1.0	245.1	1128.29	15.5	9.5	58	10.13	2.38	1.14	141.0	678.3	2214.1	153.2	1689.0	**885.64**	**563.01**
15.50	18.50	17.00	3.00	16.00	20.13	10.13	148.56	9.43	9.5	9.5	1.0	234.39	641.91	58	1.0	546.9	1675.14	18.5	10.2	58	9.79	2.53	1.28	141.0	695.1	3012.2	188.6	2505.6	**1204.87**	**835.21**
18.50	21.50	20.00	3.00	19.00	19.79	9.79	148.56	9.43	10.2	10.2	1.0	252.02	893.94	58	1.0	546.9	2222.00	21.5	10.2	48	9.79	2.53	1.28	141.0	624.4	3740.4	223.9	3339.9	**1496.14**	**1113.29**
21.50	23.00	22.25	1.50	20.50	19.79	9.79	148.56	4.71	10.2	10.2	1.0	126.01	1019.95	48	1.0	226.3	2448.29	23.0	9.6	55	8.40	2.40	1.16	141.0	658.3	4126.6	241.6	3709.8	**1650.63**	**1236.61**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
23.00	24.50	23.75	1.50	22.00	18.40	8.40	148.56	4.71	9.6	9.6	1.0	118.45	1138.40	55	1.0	259.3	2707.57	24.5	9.6	55	8.40	2.40	1.16	141.0	658.3	4504.3	259.3	4105.3	**1801.73**	**1368.42**
24.50	27.50	26.00	3.00	25.00	18.40	8.40	148.56	9.43	9.6	9.6	1.0	236.91	1375.31	55	1.0	518.6	3226.14	27.5	9.6	55	11.35	2.40	1.16	141.0	659.7	5261.1	294.6	4896.1	**2104.45**	**1632.03**
27.50	30.00	28.75	2.50	27.50	21.35	11.35	148.56	7.86	9.6	9.6	1.0	197.42	1572.73	55	1.0	432.1	3658.29	30.0	8.1	62	11.35	2.13	0.93	141.0	678.2	5909.3	324.1	5555.1	**2363.71**	**1851.71**
30.00	30.50	30.25	0.50	28.00	21.35	11.35	148.56	1.57	8.1	8.1	1.0	33.22	1605.96	62	1.0	97.4	3755.71	30.5	15.3	49	11.35	4.09	2.81	141.0	811.8	6173.4	330.0	5691.7	**2469.38**	**1897.22**
30.50	32.00	31.25	1.50	29.50	21.35	11.35	148.56	4.71	15.3	15.3	1.0	191.59	1797.55	49	1.0	231.0	3986.71	32.0	13.8	49	11.35	3.59	2.31	141.0	754.4	6538.7	347.7	6131.9	**2615.46**	**2043.98**
32.00	32.50	32.25	0.50	30.00	21.35	11.35	148.56	1.57	13.8	13.8	1.0	57.34	1854.89	49	1.0	77.0	4063.71	32.5	13.8	49	10.60	3.59	2.31	141.0	753.7	6672.3	353.6	6272.2	**2668.93**	**2090.73**
32.50	33.50	33.00	1.00	31.00	20.60	10.60	148.56	3.14	13.8	13.8	1.0	114.68	1969.57	49	1.0	154.0	4217.71	33.5	13.8	49	10.60	3.59	2.31	141.0	753.7	6941.0	365.4	6552.6	**2776.40**	**2184.21**
33.50	35.00	34.25	1.50	32.50	20.60	10.60	148.56	4.71	13.8	13.8	1.0	172.02	2141.59	49	1.0	231.0	4448.71	35.0	12.8	47	10.60	3.29	2.02	141.0	705.3	7295.6	383.0	6973.3	**2918.25**	**2324.45**
35.00	36.50	35.75	1.50	34.00	20.60	10.60	148.56	4.71	12.8	12.8	1.0	159.11	2300.70	47	1.0	221.6	4670.29	36.5	12.8	47	10.60	3.29	2.02	141.0	705.3	7676.3	400.7	7371.7	**3070.53**	**2457.23**
36.50	37.50	37.00	1.00	35.00	20.60	10.60	148.56	3.14	12.8	12.8	1.0	106.08	2406.78	47	1.0	147.7	4818.00	37.5	12.0	38	10.60	3.06	1.79	141.0	614.9	7839.6	412.5	7637.3	**3135.86**	**2545.76**
37.50	38.00	37.75	0.50	35.50	20.60	10.60	148.56	1.57	12.0	12.0	1.0	49.62	2456.40	38	1.0	59.7	4877.71	38.0	12.0	38	9.30	3.06	1.79	141.0	613.9	7948.1	418.4	7752.5	**3179.23**	**2584.17**
38.00	40.00	39.00	2.00	37.50	19.30	9.30	148.56	6.29	12.0	12.0	1.0	198.48	2654.88	38	1.0	238.9	5116.57	40.0	12.0	38	9.30	3.06	1.79	141.0	613.9	8385.4	442.0	8213.4	**3354.16**	**2737.81**
BORE NO: P84, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.99	9.99	27.47	1.57	26.5	26.5	1.0	21.52	21.52	8	1.0	12.6	12.57	3.0	25.0	10	9.99	10.00	10.88	30.0	348.9	383.0	5.9	40.0	**153.20**	**13.33**
3.00	4.00	3.50	1.00	1.50	19.99	9.99	34.97	3.14	25.0	25.0	1.0	51.24	72.77	10	1.0	31.4	44.00	4.0	25.0	10	9.99	10.00	10.88	40.0	427.4	544.2	17.7	134.4	**217.66**	**44.82**
4.00	5.00	4.50	1.00	2.50	19.99	9.99	44.96	3.14	25.0	25.0	1.0	65.88	138.65	10	1.0	31.4	75.43	5.0	25.0	10	9.91	10.00	10.88	50.0	505.5	719.6	29.5	243.5	**287.85**	**81.18**
5.00	6.00	5.50	1.00	3.50	19.91	9.91	54.91	3.14	25.0	25.0	1.0	80.47	219.12	10	1.0	31.4	106.86	6.0	25.0	10	9.91	10.00	10.88	59.9	583.4	909.4	41.3	367.2	**363.75**	**122.41**
6.00	7.00	6.50	1.00	4.50	19.91	9.91	64.82	3.14	25.0	25.0	1.0	94.99	314.10	10	1.0	31.4	138.29	7.0	10.2	45	10.13	2.53	1.28	69.8	461.9	914.3	53.0	505.4	**365.73**	**168.48**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
7.00	9.00	8.00	2.00	6.50	20.13	10.13	79.90	6.29	10.2	10.2	1.0	90.37	404.47	45	1.0	282.9	421.14	9.0	10.2	45	10.13	2.53	1.28	90.0	502.2	1327.8	76.6	902.2	**531.12**	**300.74**
9.00	10.00	9.50	1.00	7.50	20.13	10.13	95.10	3.14	10.2	10.2	1.0	53.78	458.24	45	1.0	141.4	562.57	10.0	10.2	45	10.13	2.53	1.28	100.2	522.3	1543.1	88.4	1109.2	**617.25**	**369.74**
10.00	11.00	10.50	1.00	8.50	20.13	10.13	105.23	3.14	10.2	10.2	1.0	59.50	517.75	45	1.0	141.4	704.00	11.0	27.0	0	9.90	14.50	15.49	110.3	1317.1	2538.8	100.2	1321.9	**1015.53**	**440.64**
11.00	12.50	11.75	1.50	10.00	19.90	9.90	117.72	4.71	27.0	27.0	1.0	282.76	800.51	0	1.0	0.0	704.00	12.5	27.0	0	10.09	14.50	15.49	125.1	1487.5	2992.0	117.9	1622.4	**1196.79**	**540.79**
12.50	15.50	14.00	3.00	13.00	20.09	10.09	140.28	9.43	27.0	27.0	1.0	673.89	1474.40	0	1.0	0.0	704.00	15.5	8.5	65	10.09	2.20	0.99	125.1	679.9	2858.3	153.2	2331.6	**1143.31**	**777.20**
15.50	17.00	16.25	1.50	14.50	20.09	10.09	140.28	4.71	8.5	8.5	1.0	98.83	1573.23	65	1.0	306.4	1010.43	17.0	26.7	0	8.11	13.83	14.80	125.1	1406.8	3990.5	170.9	2754.6	**1596.18**	**918.18**
17.00	18.50	17.75	1.50	16.00	18.11	8.11	140.28	4.71	26.7	26.7	1.0	332.60	1905.83	0	1.0	0.0	1010.43	18.5	26.7	0	8.11	13.83	14.80	125.1	1406.8	4323.1	188.6	3104.8	**1729.22**	**1034.94**
18.50	20.00	19.25	1.50	17.50	18.11	8.11	140.28	4.71	26.7	26.7	1.0	332.60	2238.43	0	1.0	0.0	1010.43	20.0	10.5	56	8.11	2.62	1.36	125.1	657.7	3906.5	206.3	3455.1	**1562.60**	**1151.70**
20.00	21.50	20.75	1.50	19.00	18.11	8.11	140.28	4.71	10.5	10.5	1.0	122.56	2360.99	56	1.0	264.0	1274.43	21.5	9.5	56	10.24	2.38	1.14	125.1	634.6	4270.0	223.9	3859.3	**1708.01**	**1286.45**
21.50	24.50	23.00	3.00	22.00	20.24	10.24	140.28	9.43	9.5	9.5	1.0	221.33	2582.32	56	1.0	528.0	1802.43	24.5	16.2	41	10.24	4.53	3.31	125.1	748.7	5133.4	259.3	4644.0	**2053.37**	**1548.01**
24.50	26.00	25.25	1.50	23.50	20.24	10.24	140.28	4.71	16.2	16.2	1.0	192.12	2774.44	41	1.0	193.3	1995.71	26.0	8.5	49	10.24	2.20	0.99	125.1	566.8	5336.9	277.0	5047.1	**2134.78**	**1682.37**
26.00	27.50	26.75	1.50	25.00	20.24	10.24	140.28	4.71	8.5	8.5	1.0	98.83	2873.27	49	1.0	231.0	2226.71	27.5	29.0	0	10.64	19.01	20.10	125.1	1952.9	7052.9	294.6	5394.6	**2821.16**	**1798.21**
27.50	29.00	28.25	1.50	26.50	20.64	10.64	140.28	4.71	29.0	29.0	1.0	366.56	3239.84	0	1.0	0.0	2226.71	29.0	29.0	0	10.64	19.01	20.10	125.1	1952.9	7419.5	312.3	5778.9	**2967.78**	**1926.29**
29.00	30.00	29.50	1.00	27.50	20.64	10.64	140.28	3.14	29.0	29.0	1.0	244.38	3484.21	0	1.0	0.0	2226.71	30.0	29.0	0	10.64	19.01	20.10	125.1	1952.9	7663.8	324.1	6035.0	**3065.53**	**2011.68**
30.00	30.50	30.25	0.50	28.00	20.64	10.64	140.28	1.57	29.0	29.0	1.0	122.19	3606.40	0	1.0	0.0	2226.71	30.5	29.0	0	10.64	19.01	20.10	125.1	1952.9	7786.0	330.0	6163.1	**3114.41**	**2054.37**
30.50	32.00	31.25	1.50	29.50	20.64	10.64	140.28	4.71	29.0	29.0	1.0	366.56	3972.96	0	1.0	0.0	2226.71	32.0	28.7	0	10.64	18.33	19.40	125.1	1883.6	8083.3	347.7	6547.4	**3233.31**	**2182.45**
32.00	32.50	32.25	0.50	30.00	20.64	10.64	140.28	1.57	28.7	28.7	1.0	120.68	4093.64	0	1.0	0.0	2226.71	32.5	28.7	0	10.43	18.33	19.40	125.1	1882.0	8202.4	353.6	6673.9	**3280.94**	**2224.64**
32.50	33.50	33.00	1.00	31.00	20.43	10.43	140.28	3.14	28.7	28.7	1.0	241.37	4335.01	0	1.0	0.0	2226.71	33.5	28.7	0	10.43	18.33	19.40	125.1	1882.0	8443.7	365.4	6927.1	**3377.49**	**2309.03**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
33.50	35.00	34.25	1.50	32.50	20.43	10.43	140.28	4.71	28.7	28.7	1.0	362.05	4697.06	0	1.0	0.0	2226.71	35.0	28.7	0	10.43	18.33	19.40	125.1	1882.0	8805.8	383.0	7306.8	**3522.31**	**2435.60**
35.00	36.50	35.75	1.50	34.00	20.43	10.43	140.28	4.71	28.7	28.7	1.0	362.05	5059.11	0	1.0	0.0	2226.71	36.5	28.7	0	10.43	18.33	19.40	125.1	1882.0	9167.8	400.7	7686.5	**3667.13**	**2562.18**
36.50	37.50	37.00	1.00	35.00	20.43	10.43	140.28	3.14	28.7	28.7	1.0	241.37	5300.47	0	1.0	0.0	2226.71	37.5	28.7	0	10.43	18.33	19.40	125.1	1882.0	9409.2	412.5	7939.7	**3763.67**	**2646.56**
37.50	40.00	38.75	2.50	37.50	20.43	10.43	140.28	7.86	28.7	28.7	1.0	603.42	5903.89	0	1.0	0.0	2226.71	40.0	28.7	0	10.43	18.33	19.40	125.1	1882.0	10012.6	442.0	8572.6	**4005.04**	**2857.52**
BORE NO: P85, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.45	9.45	25.99	1.57	13.3	13.3	1.0	9.65	0	27	1.0	42.4	0	3.0	13.3	27	9.45	3.44	2.16	28.4	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.45	9.45	33.08	3.14	13.3	13.3	1.0	24.57	0	27	1.0	84.9	0	4.0	12.4	46	9.45	3.17	1.91	37.8	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	19.45	9.45	42.53	3.14	12.4	12.4	1.0	29.38	0	46	1.0	144.6	0	5.0	14.3	22	9.00	3.74	2.45	47.3	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	19.00	9.00	51.75	3.14	14.3	14.3	1.0	41.46	0	22	1.0	69.1	0	6.0	14.3	22	9.00	3.74	2.45	56.3	0	0.0	41.3	41.3	**0.00**	**13.75**
6.00	7.00	6.50	1.00	4.50	19.00	9.00	60.75	3.14	14.3	14.3	1.0	48.67	0	22	1.0	69.1	0	7.0	28.5	3	9.00	17.88	18.94	65.3	0	0.0	53.0	53.0	**0.00**	**17.68**
7.00	8.00	7.50	1.00	5.50	19.00	9.00	69.75	3.14	28.5	28.5	1.0	119.02	0	3	1.0	9.4	0	8.0	24.5	13	9.00	9.64	10.33	74.3	690.8	690.8	64.8	64.8	**276.34**	**21.61**
8.00	9.00	8.50	1.00	6.50	19.00	9.00	78.75	3.14	24.5	24.5	1.0	112.79	112.79	13	1.0	40.9	40.86	9.0	24.5	13	9.00	9.64	10.33	83.3	759.0	912.7	76.6	230.3	**365.07**	**76.75**
9.00	10.00	9.50	1.00	7.50	19.00	9.00	87.75	3.14	24.5	24.5	1.0	125.68	238.48	13	1.0	40.9	81.71	10.0	24.5	13	9.90	9.64	10.33	92.3	830.8	1151.0	88.4	408.6	**460.41**	**136.19**
10.00	11.00	10.50	1.00	8.50	19.90	9.90	97.20	3.14	24.5	24.5	1.0	139.22	377.69	13	1.0	40.9	122.57	11.0	24.5	13	9.90	9.64	10.33	102.2	905.8	1406.1	100.2	600.4	**562.43**	**200.15**
11.00	12.00	11.50	1.00	9.50	19.90	9.90	107.10	3.14	24.5	24.5	1.0	153.40	531.09	13	1.0	40.9	163.43	12.0	26.5	15	9.70	13.38	14.34	112.1	1338.5	2033.0	112.0	806.5	**813.20**	**268.83**
12.00	14.50	13.25	2.50	12.00	19.70	9.70	124.18	7.86	26.5	26.5	1.0	486.45	1017.54	15	1.0	117.9	281.29	14.5	26.5	15	9.70	13.38	14.34	136.3	1593.4	2892.2	141.4	1440.3	**1156.88**	**480.08**
14.50	16.00	15.25	1.50	13.50	19.70	9.70	124.18	4.71	26.5	26.5	1.0	291.87	1309.40	15	1.0	70.7	352.00	16.0	10.2	46	10.90	2.53	1.28	136.3	601.6	2263.0	159.1	1820.5	**905.19**	**606.84**
16.00	17.50	16.75	1.50	15.00	20.90	10.90	124.18	4.71	10.2	10.2	1.0	105.33	1414.73	46	1.0	216.9	568.86	17.5	11.5	46	10.40	2.91	1.65	136.3	643.8	2627.4	176.8	2160.4	**1050.94**	**720.13**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
17.50	20.50	19.00	3.00	18.00	20.40	10.40	124.18	9.43	11.5	11.5	1.0	238.20	1652.93	46	1.0	433.7	1002.57	20.5	10.6	54	10.70	2.65	1.39	136.3	671.1	3326.6	212.1	2867.6	**1330.65**	**955.88**
20.50	23.50	22.00	3.00	21.00	20.70	10.70	124.18	9.43	10.6	10.6	1.0	219.11	1872.04	54	1.0	509.1	1511.71	23.5	10.6	54	9.80	2.65	1.39	136.3	670.6	4054.4	247.5	3631.3	**1621.75**	**1210.42**
23.50	26.50	25.00	3.00	24.00	19.80	9.80	124.18	9.43	10.6	10.6	1.0	219.11	2091.15	54	1.0	509.1	2020.86	26.5	18.0	40	9.80	5.42	4.29	136.3	879.4	4991.4	282.9	4394.9	**1996.56**	**1464.95**
26.50	27.50	27.00	1.00	25.00	19.80	9.80	124.18	3.14	18.0	18.0	1.0	126.80	2217.96	40	1.0	125.7	2146.57	27.5	18.0	40	9.80	5.42	4.29	136.3	879.4	5243.9	294.6	4659.2	**2097.57**	**1553.06**
27.50	28.00	27.75	0.50	25.50	19.80	9.80	124.18	1.57	18.0	18.0	1.0	63.40	2281.36	40	1.0	62.9	2209.43	28.0	8.5	60	11.02	2.20	0.99	136.3	664.2	5155.0	300.5	4791.3	**2061.98**	**1597.11**
28.00	29.50	28.75	1.50	27.00	21.02	11.02	124.18	4.71	8.5	8.5	1.0	87.49	2368.85	60	1.0	282.9	2492.29	29.5	8.5	60	11.02	2.20	0.99	136.3	664.2	5525.3	318.2	5179.3	**2210.12**	**1726.45**
29.50	30.00	29.75	0.50	27.50	21.02	11.02	124.18	1.57	8.5	8.5	1.0	29.16	2398.01	60	1.0	94.3	2586.57	30.0	8.5	60	11.02	2.20	0.99	136.3	664.2	5648.8	324.1	5308.7	**2259.50**	**1769.56**
30.00	31.00	30.50	1.00	28.50	21.02	11.02	124.18	3.14	8.5	8.5	1.0	58.33	2456.33	60	1.0	188.6	2775.14	31.0	9.0	40	11.02	2.29	1.07	136.3	532.7	5764.2	335.9	5567.4	**2305.68**	**1855.79**
31.00	32.50	31.75	1.50	30.00	21.02	11.02	124.18	4.71	9.0	9.0	1.0	92.72	2549.05	40	1.0	188.6	2963.71	32.5	9.1	44	9.90	2.31	1.08	136.3	562.5	6075.3	353.6	5866.3	**2430.11**	**1955.45**
32.50	35.00	33.75	2.50	32.50	19.90	9.90	124.18	7.86	9.1	9.1	1.0	156.28	2705.33	44	1.0	345.7	3309.43	35.0	9.1	44	9.90	2.31	1.08	136.3	562.5	6577.3	383.0	6397.8	**2630.91**	**2132.60**
35.00	35.50	35.25	0.50	33.00	19.90	9.90	124.18	1.57	9.1	9.1	1.0	31.26	2736.58	44	1.0	69.1	3378.57	35.5	21.0	26	9.90	7.12	6.49	136.3	971.6	7086.7	388.9	6504.1	**2834.70**	**2168.03**
35.50	37.00	36.25	1.50	34.50	19.90	9.90	124.18	4.71	21.0	21.0	1.0	224.71	2961.29	26	1.0	122.6	3501.14	37.0	11.5	44	9.90	2.91	1.65	136.3	629.3	7091.7	406.6	6869.0	**2836.70**	**2289.68**
37.00	37.50	37.25	0.50	35.00	19.90	9.90	124.18	1.57	11.5	11.5	1.0	39.70	3000.99	44	1.0	69.1	3570.29	37.5	11.5	44	8.60	2.91	1.65	136.3	628.5	7199.7	412.5	6983.8	**2879.90**	**2327.93**
37.50	38.50	38.00	1.00	36.00	18.60	8.60	124.18	3.14	11.5	11.5	1.0	79.40	3080.39	44	1.0	138.3	3708.57	38.5	9.5	56	9.43	2.38	1.14	136.3	655.1	7444.1	424.3	7213.3	**2977.63**	**2404.42**
38.50	40.00	39.25	1.50	37.50	19.43	9.43	124.18	4.71	9.5	9.5	1.0	97.96	3178.36	56	1.0	264.0	3972.57	40.0	9.5	56	9.43	2.38	1.14	136.3	655.1	7806.0	442.0	7592.9	**3122.42**	**2530.96**
BORE NO: P86, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.64	9.64	26.51	1.57	11.8	11.8	1.0	8.70	0	24	1.0	37.7	0	3.0	25.7	8	9.64	11.58	12.49	28.9	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.64	9.64	33.74	3.14	25.7	25.7	1.0	51.03	0	8	1.0	25.1	0	4.0	25.7	8	9.64	11.58	12.49	38.6	0	0.0	17.7	17.7	**0.00**	**5.89**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	∑Qi	c	α	α.c.Asi	∑Qi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
4.00	6.00	5.00	2.00	3.50	19.64	9.64	48.20	6.29	25.7	25.7	1.0	145.81	0	8	1.0	50.3	0	6.0	25.5	10	9.64	11.13	12.03	57.8	621.9	621.9	41.3	41.3	**248.76**	**13.75**
6.00	7.00	6.50	1.00	4.50	19.64	9.64	62.66	3.14	25.5	25.5	1.0	93.93	93.93	10	1.0	31.4	31.43	7.0	25.5	10	9.64	11.13	12.03	67.5	706.2	831.5	53.0	178.4	**332.62**	**59.47**
7.00	8.00	7.50	1.00	5.50	19.64	9.64	72.30	3.14	25.5	25.5	1.0	108.38	202.31	10	1.0	31.4	62.86	8.0	25.5	10	9.68	11.13	12.03	77.1	790.6	1055.8	64.8	330.0	**422.32**	**110.00**
8.00	9.00	8.50	1.00	6.50	19.68	9.68	81.96	3.14	25.5	25.5	1.0	122.86	325.18	10	1.0	31.4	94.29	9.0	25.2	11	9.68	10.45	11.34	86.8	833.6	1253.1	76.6	496.1	**501.24**	**165.36**
9.00	10.00	9.50	1.00	7.50	19.68	9.68	91.64	3.14	25.2	25.2	1.0	135.53	460.71	11	1.0	34.6	128.86	10.0	25.5	10	9.68	11.13	12.03	96.5	959.9	1549.4	88.4	678.0	**619.78**	**225.99**
10.00	11.00	10.50	1.00	8.50	19.68	9.68	101.32	3.14	25.5	25.5	1.0	151.89	612.59	10	1.0	31.4	160.29	11.0	25.2	11	8.99	10.45	11.34	106.2	989.5	1762.4	100.2	873.1	**704.96**	**291.02**
11.00	12.50	11.75	1.50	10.00	18.99	8.99	112.90	4.71	25.2	25.2	1.0	250.46	863.05	11	1.0	51.9	212.14	12.5	10.5	51	10.19	2.62	1.36	119.6	612.1	1687.3	117.9	1193.1	**674.92**	**397.68**
12.50	15.50	14.00	3.00	13.00	20.19	10.19	134.93	9.43	10.5	10.5	1.0	235.79	1098.84	51	1.0	480.9	693.00	15.5	10.5	51	10.19	2.62	1.36	119.6	612.1	2404.0	153.2	1945.1	**961.58**	**648.35**
15.50	17.00	16.25	1.50	14.50	20.19	10.19	134.93	4.71	10.5	10.5	1.0	117.89	1216.73	51	1.0	240.4	933.43	17.0	27.0	5	9.65	14.50	15.49	119.6	1457.5	3607.7	170.9	2321.1	**1443.08**	**773.68**
17.00	18.50	17.75	1.50	16.00	19.65	9.65	134.93	4.71	27.0	27.0	1.0	324.11	1540.84	5	1.0	23.6	957.00	18.5	13.5	50	9.65	3.50	2.22	119.6	691.0	3188.9	188.6	2686.4	**1275.54**	**895.47**
18.50	21.50	20.00	3.00	19.00	19.65	9.65	134.93	9.43	13.5	13.5	1.0	305.43	1846.27	50	1.0	471.4	1428.43	21.5	13.5	50	10.09	3.50	2.22	119.6	691.4	3966.1	223.9	3498.6	**1586.44**	**1166.21**
21.50	24.50	23.00	3.00	22.00	20.09	10.09	134.93	9.43	13.5	13.5	1.0	305.43	2151.70	50	1.0	471.4	1899.86	24.5	9.4	53	10.09	2.36	1.13	119.6	601.3	4652.9	259.3	4310.8	**1861.14**	**1436.95**
24.50	26.00	25.25	1.50	23.50	20.09	10.09	134.93	4.71	9.4	9.4	1.0	105.31	2257.00	53	1.0	249.9	2149.71	26.0	27.1	0	8.89	14.73	15.72	119.6	1439.5	5846.2	277.0	4683.7	**2338.50**	**1561.23**
26.00	27.50	26.75	1.50	25.00	18.89	8.89	134.93	4.71	27.1	27.1	1.0	325.51	2582.51	0	1.0	0.0	2149.71	27.5	21.5	0	8.89	7.48	7.04	119.6	727.7	5460.0	294.6	5026.9	**2183.99**	**1675.62**
27.50	30.00	28.75	2.50	27.50	18.89	8.89	134.93	7.86	21.5	21.5	1.0	417.61	3000.12	0	1.0	0.0	2149.71	30.0	21.5	0	9.32	7.48	7.04	119.6	728.9	5878.8	324.1	5473.9	**2351.51**	**1824.65**
30.00	30.50	30.25	0.50	28.00	19.32	9.32	134.93	1.57	21.5	21.5	1.0	83.52	3083.64	0	1.0	0.0	2149.71	30.5	28.5	0	10.55	17.88	18.94	119.6	1759.5	6992.9	330.0	5563.4	**2797.15**	**1854.45**
30.50	32.00	31.25	1.50	29.50	20.55	10.55	134.93	4.71	28.5	28.5	1.0	345.37	3429.01	0	1.0	0.0	2149.71	32.0	14.5	54	10.55	3.80	2.51	119.6	749.0	6327.7	347.7	5926.4	**2531.09**	**1975.47**
32.00	32.50	32.25	0.50	30.00	20.55	10.55	134.93	1.57	14.5	14.5	1.0	54.84	3483.85	54	1.0	84.9	2234.57	32.5	14.5	54	10.55	3.80	2.51	119.6	749.0	6467.4	353.6	6072.0	**2586.97**	**2024.00**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
32.50	33.50	33.00	1.00	31.00	20.55	10.55	134.93	3.14	14.5	14.5	1.0	109.67	3593.52	54	1.0	169.7	2404.29	33.5	9.3	67	10.55	2.34	1.11	119.6	698.7	6696.6	365.4	6363.2	**2678.62**	**2121.05**
33.50	35.00	34.25	1.50	32.50	20.55	10.55	134.93	4.71	9.3	9.3	1.0	104.17	3697.69	67	1.0	315.9	2720.14	35.0	9.3	67	10.55	2.34	1.11	119.6	698.7	7116.6	383.0	6800.9	**2846.63**	**2266.95**
35.00	36.50	35.75	1.50	34.00	20.55	10.55	134.93	4.71	9.3	9.3	1.0	104.17	3801.85	67	1.0	315.9	3036.00	36.5	13.1	49	10.55	3.38	2.11	119.6	673.0	7510.8	400.7	7238.6	**3004.33**	**2412.86**
36.50	37.50	37.00	1.00	35.00	20.55	10.55	134.93	3.14	13.1	13.1	1.0	98.68	3900.53	49	1.0	154.0	3190.00	37.5	13.1	49	10.81	3.38	2.11	119.6	673.2	7763.7	412.5	7503.0	**3105.49**	**2501.01**
37.50	40.00	38.75	2.50	37.50	20.81	10.81	134.93	7.86	13.1	13.1	1.0	246.71	4147.24	49	1.0	385.0	3575.00	40.0	13.1	49	10.81	3.38	2.11	119.6	673.2	8395.4	442.0	8164.2	**3358.17**	**2721.40**
BORE NO: P87, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.05	10.05	27.64	1.57	12.5	12.5	1.0	9.63	0	51	1.0	80.1	0	3.0	13.5	12	10.05	3.50	2.22	30.2	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	20.05	10.05	35.18	3.14	13.5	13.5	1.0	26.54	0	12	1.0	37.7	0	4.0	27.5	4	9.59	15.63	16.64	40.2	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	19.59	9.59	45.00	3.14	27.5	27.5	1.0	73.61	0	4	1.0	12.6	0	5.0	29.0	0	9.59	19.01	20.10	49.8	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	19.59	9.59	54.59	3.14	29.0	29.0	1.0	95.09	0	0	1.0	0.0	0	6.0	29.0	0	9.88	19.01	20.10	59.4	0	0.0	41.3	41.3	**0.00**	**13.75**
6.00	8.00	7.00	2.00	5.50	19.88	9.88	69.26	6.29	29.0	29.0	1.0	241.32	0	0	1.0	0.0	0	8.0	17.5	68	9.88	5.17	4.02	79.1	817.9	817.9	64.8	64.8	**327.18**	**21.61**
8.00	9.00	8.50	1.00	6.50	19.88	9.88	84.08	3.14	17.5	17.5	1.0	83.32	83.32	68	1.0	213.7	213.71	9.0	15.0	30	9.88	3.94	2.65	89.0	498.0	795.0	76.6	373.6	**318.02**	**124.55**
9.00	10.00	9.50	1.00	7.50	19.88	9.88	93.96	3.14	15.0	15.0	1.0	79.13	162.44	30	1.0	94.3	308.00	10.0	25.6	0	9.88	11.35	12.26	98.9	929.7	1400.1	88.4	558.8	**560.04**	**186.28**
10.00	11.00	10.50	1.00	8.50	19.88	9.88	103.84	3.14	25.6	25.6	1.0	156.36	318.81	0	1.0	0.0	308.00	11.0	11.5	53	9.79	2.91	1.65	108.8	629.9	1256.7	100.2	727.0	**502.70**	**242.33**
11.00	12.00	11.50	1.00	9.50	19.79	9.79	113.68	3.14	11.5	11.5	1.0	72.69	391.49	53	1.0	166.6	474.57	12.0	9.0	72	9.79	2.29	1.07	118.6	726.6	1592.6	112.0	978.0	**637.06**	**326.01**
12.00	13.00	12.50	1.00	10.50	19.79	9.79	123.47	3.14	9.0	9.0	1.0	61.46	452.95	72	1.0	226.3	700.86	13.0	11.5	53	9.79	2.91	1.65	128.4	674.7	1828.5	123.8	1277.6	**731.41**	**425.85**
13.00	14.50	13.75	1.50	12.00	19.79	9.79	135.70	4.71	11.5	11.5	1.0	130.16	583.11	53	1.0	249.9	950.71	14.5	11.5	53	9.79	2.91	1.65	143.0	708.3	2242.1	141.4	1675.3	**896.85**	**558.42**
14.50	16.00	15.25	1.50	13.50	19.79	9.79	135.70	4.71	11.5	11.5	1.0	130.16	713.26	53	1.0	249.9	1200.57	16.0	26.8	0	9.46	14.05	15.03	143.0	1635.3	3549.2	159.1	2072.9	**1419.67**	**690.98**

APPENDIX-H
TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
16.00	17.50	16.75	1.50	15.00	19.46	9.46	135.70	4.71	26.8	26.8	1.0	323.16	1036.42	0	1.0	0.0	1200.57	17.5	9.5	56	11.05	2.38	1.14	143.0	668.5	2905.4	176.8	2413.8	**1162.18**	**804.59**
17.50	20.50	19.00	3.00	18.00	21.05	11.05	135.70	9.43	9.5	9.5	1.0	214.11	1250.53	56	1.0	528.0	1728.57	20.5	9.5	56	11.05	2.38	1.14	143.0	668.5	3647.6	212.1	3191.2	**1459.02**	**1063.75**
20.50	22.00	21.25	1.50	19.50	21.05	11.05	135.70	4.71	9.5	9.5	1.0	107.06	1357.59	56	1.0	264.0	1992.57	22.0	11.5	42	10.00	2.91	1.65	143.0	630.7	3980.8	229.8	3580.0	**1592.33**	**1193.33**
22.00	23.50	22.75	1.50	21.00	20.00	10.00	135.70	4.71	11.5	11.5	1.0	130.16	1487.75	42	1.0	198.0	2190.57	23.5	11.0	68	10.00	2.76	1.51	143.0	797.4	4475.7	247.5	3925.8	**1790.30**	**1308.61**
23.50	25.00	24.25	1.50	22.50	20.00	10.00	135.70	4.71	11.0	11.0	1.0	124.35	1612.10	68	1.0	320.6	2511.14	25.0	26.5	0	9.48	13.38	14.34	143.0	1557.0	5680.2	265.2	4388.4	**2272.08**	**1462.81**
25.00	26.50	25.75	1.50	24.00	19.48	9.48	135.70	4.71	26.5	26.5	1.0	318.96	1931.06	0	1.0	0.0	2511.14	26.5	26.0	0	9.48	12.25	13.18	143.0	1426.1	5868.3	282.9	4725.1	**2347.33**	**1575.02**
26.50	27.50	27.00	1.00	25.00	19.48	9.48	135.70	3.14	26.0	26.0	1.0	208.01	2139.08	0	1.0	0.0	2511.14	27.5	26.0	0	9.48	12.25	13.18	143.0	1426.1	6076.3	294.6	4944.9	**2430.54**	**1648.29**
27.50	29.50	28.50	2.00	27.00	19.48	9.48	135.70	6.29	26.0	26.0	1.0	416.03	2555.11	0	1.0	0.0	2511.14	29.5	19.4	26	10.50	6.08	5.06	143.0	888.2	5954.4	318.2	5384.5	**2381.77**	**1794.82**
29.50	30.00	29.75	0.50	27.50	20.50	10.50	135.70	1.57	19.4	19.4	1.0	75.10	2630.20	26	1.0	40.9	2552.00	30.0	29.0	0	10.50	19.01	20.10	143.0	2219.2	7401.4	324.1	5506.3	**2960.56**	**1835.44**
30.00	32.50	31.25	2.50	30.00	20.50	10.50	135.70	7.86	29.0	29.0	1.0	591.02	3221.22	0	1.0	0.0	2552.00	32.5	29.0	0	10.50	19.01	20.10	143.0	2219.2	7992.4	353.6	6126.8	**3196.97**	**2042.27**
32.50	35.00	33.75	2.50	32.50	20.50	10.50	135.70	7.86	29.0	29.0	1.0	591.02	3812.25	0	1.0	0.0	2552.00	35.0	28.7	0	10.75	18.33	19.40	143.0	2142.3	8506.6	383.0	6747.3	**3402.63**	**2249.09**
35.00	35.50	35.25	0.50	33.00	20.75	10.75	135.70	1.57	28.7	28.7	1.0	116.75	3929.00	0	1.0	0.0	2552.00	35.5	28.7	0	10.75	18.33	19.40	143.0	2142.3	8623.3	388.9	6869.9	**3449.33**	**2289.98**
35.50	37.50	36.50	2.00	35.00	20.75	10.75	135.70	6.29	28.7	28.7	1.0	467.00	4395.99	0	1.0	0.0	2552.00	37.5	28.7	0	10.75	18.33	19.40	143.0	2142.3	9090.3	412.5	7360.5	**3636.13**	**2453.50**
37.50	38.50	38.00	1.00	36.00	20.75	10.75	135.70	3.14	28.7	28.7	1.0	233.50	4629.49	0	1.0	0.0	2552.00	38.5	28.7	0	10.75	18.33	19.40	143.0	2142.3	9323.8	424.3	7605.8	**3729.53**	**2535.26**
38.50	40.00	39.25	1.50	37.50	20.75	10.75	135.70	4.71	28.7	28.7	1.0	350.25	4979.74	0	1.0	0.0	2552.00	40.0	28.7	0	10.75	18.33	19.40	143.0	2142.3	9674.1	442.0	7973.7	**3869.63**	**2657.90**
BORE NO: P88, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.90	9.90	27.23	1.57	24.2	24.2	1.0	19.23	0	18	1.0	28.3	0	3.0	26.6	0	9.90	13.60	14.57	29.7	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.90	9.90	34.65	3.14	26.6	26.6	1.0	54.53	0	0	1.0	0.0	0	4.0	23.6	16	8.85	8.99	9.34	39.6	425.4	425.4	17.7	17.7	**170.16**	**5.89**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
4.00	6.00	5.00	2.00	3.50	18.85	8.85	48.45	6.29	23.6	23.6	1.0	133.05	133.05	16	1.0	100.6	100.57	6.0	23.6	16	8.85	8.99	9.34	57.3	550.5	784.1	41.3	274.9	**313.63**	**91.62**
6.00	7.00	6.50	1.00	4.50	18.85	8.85	61.73	3.14	23.6	23.6	1.0	84.75	217.80	16	1.0	50.3	150.86	7.0	9.8	58	8.85	2.43	1.19	66.2	540.8	909.4	53.0	421.7	**363.78**	**140.57**
7.00	9.00	8.00	2.00	6.50	18.85	8.85	75.00	6.29	9.8	9.8	1.0	81.43	299.23	58	1.0	364.6	515.43	9.0	27.9	0	10.70	16.53	17.56	83.9	1162.9	1977.6	76.6	891.3	**791.02**	**297.09**
9.00	10.00	9.50	1.00	7.50	20.70	10.70	89.20	3.14	27.9	27.9	1.0	148.43	447.67	0	1.0	0.0	515.43	10.0	27.9	0	10.70	16.53	17.56	94.6	1301.9	2265.0	88.4	1051.5	**905.98**	**350.50**
10.00	11.00	10.50	1.00	8.50	20.70	10.70	99.90	3.14	27.9	27.9	1.0	166.24	613.91	0	1.0	0.0	515.43	11.0	25.3	16	10.70	10.68	11.57	105.3	1044.6	2174.0	100.2	1229.5	**869.58**	**409.84**
11.00	12.50	11.75	1.50	10.00	20.70	10.70	113.28	4.71	25.3	25.3	1.0	252.43	866.33	16	1.0	75.4	590.86	12.5	25.3	16	10.80	10.68	11.57	121.3	1179.7	2636.9	117.9	1575.0	**1054.75**	**525.02**
12.50	15.50	14.00	3.00	13.00	20.80	10.80	137.50	9.43	25.3	25.3	1.0	612.82	1479.15	16	1.0	150.9	741.71	15.5	25.9	15	10.80	12.03	12.95	121.3	1307.3	3528.1	153.2	2374.1	**1411.25**	**791.36**
15.50	18.50	17.00	3.00	16.00	20.80	10.80	137.50	9.43	25.9	25.9	1.0	629.51	2108.66	15	1.0	141.4	883.14	18.5	25.9	15	10.85	12.03	12.95	121.3	1307.5	4299.3	188.6	3180.4	**1719.73**	**1060.13**
18.50	21.50	20.00	3.00	19.00	20.85	10.85	137.50	9.43	25.9	25.9	1.0	629.51	2738.18	15	1.0	141.4	1024.57	21.5	9.0	88	10.85	2.29	1.07	121.3	845.1	4607.8	223.9	3986.7	**1843.13**	**1328.89**
21.50	24.50	23.00	3.00	22.00	20.85	10.85	137.50	9.43	9.0	9.0	1.0	205.33	2943.51	88	1.0	829.7	1854.29	24.5	14.0	67	9.27	3.65	2.36	121.3	830.3	5628.1	259.3	5057.1	**2251.22**	**1685.69**
24.50	26.00	25.25	1.50	23.50	19.27	9.27	137.50	4.71	14.0	14.0	1.0	161.62	3105.13	67	1.0	315.9	2170.14	26.0	24.5	8	9.27	9.64	10.33	121.3	1013.0	6288.2	277.0	5552.2	**2515.29**	**1850.75**
26.00	27.50	26.75	1.50	25.00	19.27	9.27	137.50	4.71	24.5	24.5	1.0	295.41	3400.54	8	1.0	37.7	2207.86	27.5	13.8	38	9.27	3.59	2.31	121.3	619.3	6227.7	294.6	5903.0	**2491.06**	**1967.68**
27.50	29.00	28.25	1.50	26.50	19.27	9.27	137.50	4.71	13.8	13.8	1.0	159.22	3559.75	38	1.0	179.1	2387.00	29.0	13.8	38	10.40	3.59	2.31	121.3	620.3	6567.0	312.3	6259.1	**2626.82**	**2086.36**
29.00	30.00	29.50	1.00	27.50	20.40	10.40	137.50	3.14	13.8	13.8	1.0	106.14	3665.90	38	1.0	119.4	2506.43	30.0	13.8	39	10.40	3.59	2.31	121.3	627.4	6799.7	324.1	6496.4	**2719.88**	**2165.48**
30.00	30.50	30.25	0.50	28.00	20.40	10.40	137.50	1.57	13.8	13.8	1.0	53.07	3718.97	39	1.0	61.3	2567.71	30.5	13.4	39	10.40	3.47	2.19	121.3	615.5	6902.1	330.0	6616.7	**2760.86**	**2205.56**
30.50	32.00	31.25	1.50	29.50	20.40	10.40	137.50	4.71	13.4	13.4	1.0	154.43	3873.40	39	1.0	183.9	2751.57	32.0	13.4	40	10.45	3.47	2.19	121.3	622.6	7247.5	347.7	6972.6	**2899.02**	**2324.22**
32.00	32.50	32.25	0.50	30.00	20.45	10.45	137.50	1.57	13.4	13.4	1.0	51.48	3924.87	40	1.0	62.9	2814.43	32.5	13.4	40	10.45	3.47	2.19	121.3	622.6	7361.9	353.6	7092.9	**2944.75**	**2364.29**
32.50	33.50	33.00	1.00	31.00	20.45	10.45	137.50	3.14	13.4	13.4	1.0	102.95	4027.82	40	1.0	125.7	2940.14	33.5	16.7	39	10.45	4.78	3.58	121.3	745.7	7713.7	365.4	7333.3	**3085.47**	**2444.44**

APPENDIX-H
TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
33.50	35.00	34.25	1.50	32.50	20.45	10.45	137.50	4.71	16.7	16.7	1.0	194.47	4222.30	39	1.0	183.9	3124.00	35.0	28.2	0	10.45	17.21	18.25	121.3	1714.8	9061.1	383.0	7729.3	**3624.44**	**2576.44**
35.00	36.50	35.75	1.50	34.00	20.45	10.45	137.50	4.71	28.2	28.2	1.0	347.57	4569.87	0	1.0	0.0	3124.00	36.5	28.7	0	8.93	18.33	19.40	121.3	1815.3	9509.1	400.7	8094.6	**3803.65**	**2698.19**
36.50	37.50	37.00	1.00	35.00	18.93	8.93	137.50	3.14	28.7	28.7	1.0	236.59	4806.46	0	1.0	0.0	3124.00	37.5	29.2	0	8.93	19.46	20.56	121.3	1926.6	9857.1	412.5	8343.0	**3942.82**	**2780.99**
37.50	40.00	38.75	2.50	37.50	18.93	8.93	137.50	7.86	29.2	29.2	1.0	603.79	5410.25	0	1.0	0.0	3124.00	40.0	12.3	38	8.93	3.15	1.88	121.3	575.1	9109.3	442.0	8976.2	**3643.74**	**2992.07**
BORE NO: P89, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.18	10.18	28.00	1.57	11.5	11.5	1.0	8.95	0	47	1.0	73.9	0	3.0	27.5	2	9.52	15.63	16.64	30.5	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.50	19.52	9.52	40.06	6.29	27.5	27.5	1.0	131.08	0	2	1.0	12.6	0	5.0	27.5	2	9.52	15.63	16.64	49.6	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	19.52	9.52	54.34	3.14	27.5	27.5	1.0	88.90	0	2	1.0	6.3	0	6.0	24.6	0	9.52	9.71	10.44	59.1	0	0.0	41.3	41.3	**0.00**	**13.75**
6.00	7.00	6.50	1.00	4.50	19.52	9.52	63.86	3.14	24.6	24.6	1.0	91.89	0	0	1.0	0.0	0	7.0	23.9	4	9.38	9.21	9.67	68.6	0	0.0	53.0	53.0	**0.00**	**17.68**
7.00	8.00	7.50	1.00	5.50	19.38	9.38	73.31	3.14	23.9	23.9	1.0	102.10	0	4	1.0	12.6	0	8.0	23.9	4	9.38	9.21	9.67	78.0	0	0.0	64.8	64.8	**0.00**	**21.61**
8.00	9.00	8.50	1.00	6.50	19.38	9.38	82.69	3.14	23.9	23.9	1.0	115.16	0	4	1.0	12.6	0	9.0	27.4	5	9.38	15.40	16.41	87.4	1153.4	1153.4	76.6	76.6	**461.38**	**25.54**
9.00	11.00	10.00	2.00	8.50	19.38	9.38	96.76	6.29	27.4	27.4	1.0	315.26	315.26	5	1.0	31.4	31.43	11.0	27.4	5	9.38	15.40	16.41	106.1	1380.5	1727.2	100.2	446.9	**690.88**	**148.96**
11.00	12.00	11.50	1.00	9.50	19.38	9.38	110.83	3.14	27.4	27.4	1.0	180.55	495.82	5	1.0	15.7	47.14	12.0	9.0	57	9.38	2.29	1.07	115.5	614.9	1157.8	112.0	654.9	**463.13**	**218.31**
12.00	14.50	13.25	2.50	12.00	19.38	9.38	127.25	7.86	9.0	9.0	1.0	158.35	654.17	57	1.0	447.9	495.00	14.5	9.0	57	9.31	2.29	1.07	139.0	657.0	1806.2	141.4	1290.6	**722.47**	**430.20**
14.50	16.00	15.25	1.50	13.50	19.31	9.31	127.25	4.71	9.0	9.0	1.0	95.01	749.18	57	1.0	268.7	763.71	16.0	28.2	0	9.31	17.21	18.25	139.0	1945.5	3458.4	159.1	1672.0	**1383.36**	**557.33**
16.00	17.50	16.75	1.50	15.00	19.31	9.31	127.25	4.71	28.2	28.2	1.0	321.65	1070.82	0	1.0	0.0	763.71	17.5	15.6	29	9.31	4.24	2.98	139.0	678.4	2512.9	176.8	2011.3	**1005.18**	**670.44**
17.50	19.00	18.25	1.50	16.50	19.31	9.31	127.25	4.71	15.6	15.6	1.0	167.49	1238.31	29	1.0	136.7	900.43	19.0	8.2	58	10.07	2.15	0.94	139.0	648.2	2786.9	194.5	2333.2	**1114.77**	**777.73**
19.00	20.50	19.75	1.50	18.00	20.07	10.07	127.25	4.71	8.2	8.2	1.0	86.44	1324.75	58	1.0	273.4	1173.86	20.5	8.2	59	10.34	2.15	0.94	139.0	655.4	3154.0	212.1	2710.8	**1261.59**	**903.58**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
20.50	23.50	22.00	3.00	21.00	20.34	10.34	127.25	9.43	8.2	8.2	1.0	172.88	1497.64	59	1.0	556.3	1730.14	23.5	9.5	59	10.34	2.38	1.14	139.0	681.7	3909.5	247.5	3475.3	**1563.80**	**1158.43**
23.50	25.00	24.25	1.50	22.50	20.34	10.34	127.25	4.71	9.5	9.5	1.0	100.38	1598.02	59	1.0	278.1	2008.29	25.0	28.1	0	9.65	16.98	18.02	139.0	1922.5	5528.8	265.2	3871.5	**2211.52**	**1290.50**
25.00	26.50	25.75	1.50	24.00	19.65	9.65	127.25	4.71	28.1	28.1	1.0	320.30	1918.32	0	1.0	0.0	2008.29	26.5	28.1	0	9.65	16.98	18.02	139.0	1922.5	5849.1	282.9	4209.5	**2339.64**	**1403.16**
26.50	27.50	27.00	1.00	25.00	19.65	9.65	127.25	3.14	28.1	28.1	1.0	213.53	2131.86	0	1.0	0.0	2008.29	27.5	28.1	0	9.65	16.98	18.02	139.0	1922.5	6062.6	294.6	4434.8	**2425.05**	**1478.26**
27.50	28.00	27.75	0.50	25.50	19.65	9.65	127.25	1.57	28.1	28.1	1.0	106.77	2238.62	0	1.0	0.0	2008.29	28.0	16.5	38	9.65	4.68	3.47	139.0	792.7	5039.6	300.5	4547.4	**2015.83**	**1515.81**
28.00	29.50	28.75	1.50	27.00	19.65	9.65	127.25	4.71	16.5	16.5	1.0	177.69	2416.31	38	1.0	179.1	2187.43	29.5	16.5	38	10.15	4.68	3.47	139.0	793.4	5397.1	318.2	4922.0	**2158.84**	**1640.65**
29.50	30.00	29.75	0.50	27.50	20.15	10.15	127.25	1.57	16.5	16.5	1.0	59.23	2475.54	38	1.0	59.7	2247.14	30.0	16.5	38	10.15	4.68	3.47	139.0	793.4	5516.0	324.1	5046.8	**2206.42**	**1682.26**
30.00	31.00	30.50	1.00	28.50	20.15	10.15	127.25	3.14	16.5	16.5	1.0	118.46	2594.00	38	1.0	119.4	2366.57	31.0	11.1	46	10.15	2.79	1.53	139.0	636.4	5597.0	335.9	5296.5	**2238.80**	**1765.49**
31.00	32.50	31.75	1.50	30.00	20.15	10.15	127.25	4.71	11.1	11.1	1.0	117.69	2711.69	46	1.0	216.9	2583.43	32.5	11.1	46	10.15	2.79	1.53	139.0	636.4	5931.5	353.6	5648.7	**2372.62**	**1882.90**
32.50	35.00	33.75	2.50	32.50	20.15	10.15	127.25	7.86	11.1	11.1	1.0	196.15	2907.84	46	1.0	361.4	2944.86	35.0	11.1	46	10.68	2.79	1.53	139.0	636.7	6489.4	383.0	6235.7	**2595.77**	**2078.58**
35.00	35.50	35.25	0.50	33.00	20.68	10.68	127.25	1.57	11.1	11.1	1.0	39.23	2947.07	46	1.0	72.3	3017.14	35.5	12.8	55	10.68	3.29	2.02	139.0	756.8	6721.0	388.9	6353.1	**2688.41**	**2117.71**
35.50	37.50	36.50	2.00	35.00	20.68	10.68	127.25	6.29	12.8	12.8	1.0	181.72	3128.79	55	1.0	345.7	3362.86	37.5	10.3	50	10.68	2.56	1.31	139.0	638.4	7130.0	412.5	6904.1	**2852.01**	**2301.38**
37.50	38.50	38.00	1.00	36.00	20.68	10.68	127.25	3.14	10.3	10.3	1.0	72.68	3201.46	50	1.0	157.1	3520.00	38.5	10.3	50	10.68	2.56	1.31	139.0	638.4	7359.8	424.3	7145.7	**2943.94**	**2381.92**
38.50	40.00	39.25	1.50	37.50	20.68	10.68	127.25	4.71	10.3	10.3	1.0	109.01	3310.48	50	1.0	235.7	3755.71	40.0	16.0	31	10.68	4.43	3.20	139.0	716.6	7782.8	442.0	7508.2	**3113.10**	**2502.72**
BORE NO: P90, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.89	9.89	27.20	1.57	8.2	8.2	1.0	6.16	0	58	1.0	91.1	0	3.0	23.4	11	9.89	8.85	9.12	29.7	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.89	9.89	34.62	3.14	23.4	23.4	1.0	47.08	0	11	1.0	34.6	0	4.0	29.2	0	9.60	19.46	20.56	39.6	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	19.60	9.60	44.36	3.14	29.2	29.2	1.0	77.92	0	0	1.0	0.0	0	5.0	29.2	0	9.60	19.46	20.56	49.2	829.1	829.1	29.5	29.5	**331.64**	**9.82**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
5.00	6.00	5.50	1.00	3.50	19.60	9.60	53.96	3.14	29.2	29.2	1.0	94.78	94.78	0	1.0	0.0	0.00	6.0	27.3	0	9.60	15.18	16.18	58.8	761.8	856.6	41.3	136.0	**342.64**	**45.34**
6.00	7.00	6.50	1.00	4.50	19.60	9.60	63.56	3.14	27.3	27.3	1.0	103.10	197.88	0	1.0	0.0	0.00	7.0	26.0	7	9.40	12.25	13.18	68.4	756.3	954.1	53.0	250.9	**381.66**	**83.64**
7.00	8.00	7.50	1.00	5.50	19.40	9.40	73.06	3.14	26.0	26.0	1.0	111.99	309.88	7	1.0	22.0	22.00	8.0	9.5	44	9.40	2.38	1.14	77.8	460.8	792.7	64.8	396.7	**317.06**	**132.23**
8.00	9.00	8.50	1.00	6.50	19.40	9.40	82.46	3.14	9.5	9.5	1.0	43.37	353.24	44	1.0	138.3	160.29	9.0	9.5	44	9.40	2.38	1.14	87.2	478.4	991.9	76.6	590.1	**396.75**	**196.71**
9.00	10.00	9.50	1.00	7.50	19.40	9.40	91.86	3.14	9.5	9.5	1.0	48.31	401.56	44	1.0	138.3	298.57	10.0	9.5	44	10.09	2.38	1.14	96.6	496.2	1196.4	88.4	788.5	**478.55**	**262.84**
10.00	11.00	10.50	1.00	8.50	20.09	10.09	101.61	3.14	9.5	9.5	1.0	53.44	454.99	44	1.0	138.3	436.86	11.0	10.5	42	10.09	2.62	1.36	106.7	521.7	1413.5	100.2	992.0	**565.42**	**330.68**
11.00	12.00	11.50	1.00	9.50	20.09	10.09	111.70	3.14	10.5	10.5	1.0	65.06	520.06	42	1.0	132.0	568.86	12.0	11.0	63	10.30	2.76	1.51	116.7	705.1	1794.0	112.0	1200.9	**717.61**	**400.29**
12.00	14.50	13.25	2.50	12.00	20.30	10.30	129.62	7.86	11.0	11.0	1.0	197.96	718.01	63	1.0	495.0	1063.86	14.5	8.1	63	10.30	2.13	0.93	142.5	687.5	2469.4	141.4	1923.3	**987.75**	**641.10**
14.50	16.00	15.25	1.50	13.50	20.30	10.30	129.62	4.71	8.1	8.1	1.0	86.96	804.98	63	1.0	297.0	1360.86	16.0	27.3	0	9.39	15.18	16.18	142.5	1759.1	3924.9	159.1	2324.9	**1569.98**	**774.98**
16.00	17.50	16.75	1.50	15.00	19.39	9.39	129.62	4.71	27.3	27.3	1.0	315.38	1120.36	0	1.0	0.0	1360.86	17.5	12.4	54	9.39	3.17	1.91	142.5	744.3	3225.5	176.8	2658.0	**1290.22**	**886.00**
17.50	19.00	18.25	1.50	16.50	19.39	9.39	129.62	4.71	12.4	12.4	1.0	134.35	1254.71	54	1.0	254.6	1615.43	19.0	11.0	42	10.27	2.76	1.51	142.5	612.5	3482.7	194.5	3064.6	**1393.06**	**1021.53**
19.00	20.50	19.75	1.50	18.00	20.27	10.27	129.62	4.71	11.0	11.0	1.0	118.77	1373.48	42	1.0	198.0	1813.43	20.5	11.0	42	10.27	2.76	1.51	142.5	612.5	3799.4	212.1	3399.1	**1519.77**	**1133.02**
20.50	22.00	21.25	1.50	19.50	20.27	10.27	129.62	4.71	11.0	11.0	1.0	118.77	1492.26	42	1.0	198.0	2011.43	22.0	9.2	55	10.36	2.33	1.10	142.5	653.8	4157.5	229.8	3733.5	**1662.99**	**1244.50**
22.00	23.50	22.75	1.50	21.00	20.36	10.36	129.62	4.71	9.2	9.2	1.0	98.97	1591.22	55	1.0	259.3	2270.71	23.5	13.0	50	10.36	3.35	2.08	142.5	737.1	4599.0	247.5	4109.4	**1839.61**	**1369.81**
23.50	25.00	24.25	1.50	22.50	20.36	10.36	129.62	4.71	13.0	13.0	1.0	141.07	1732.29	50	1.0	235.7	2506.43	25.0	29.3	0	9.12	19.68	20.79	142.5	2278.1	6516.9	265.2	4503.9	**2606.74**	**1501.30**
25.00	26.50	25.75	1.50	24.00	19.12	9.12	129.62	4.71	29.3	29.3	1.0	342.90	2075.19	0	1.0	0.0	2506.43	26.5	29.3	0	9.12	19.68	20.79	142.5	2278.1	6859.8	282.9	4864.5	**2743.90**	**1621.49**
26.50	27.50	27.00	1.00	25.00	19.12	9.12	129.62	3.14	29.3	29.3	1.0	228.60	2303.79	0	1.0	0.0	2506.43	27.5	26.3	0	9.12	12.93	13.88	142.5	1497.0	6307.2	294.6	5104.9	**2522.90**	**1701.62**
27.50	28.00	27.75	0.50	25.50	19.12	9.12	129.62	1.57	26.3	26.3	1.0	100.67	2404.46	0	1.0	0.0	2506.43	28.0	23.0	0	9.12	8.56	8.68	142.5	989.5	5900.3	300.5	5211.4	**2360.14**	**1737.14**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	∑Qi	c	α	α.c.Asi	∑Qi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
28.00	29.50	28.75	1.50	27.00	19.12	9.12	129.62	4.71	23.0	23.0	1.0	259.37	2663.83	0	1.0	0.0	2506.43	29.5	9.0	48	9.31	2.29	1.07	142.5	599.7	5770.0	318.2	5488.5	**2307.99**	**1829.49**
29.50	30.00	29.75	0.50	27.50	19.31	9.31	129.62	1.57	9.0	9.0	1.0	32.26	2696.09	48	1.0	75.4	2581.86	30.0	9.0	48	10.48	2.29	1.07	142.5	600.2	5878.1	324.1	5602.1	**2351.26**	**1867.35**
30.00	31.00	30.50	1.00	28.50	20.48	10.48	129.62	3.14	9.0	9.0	1.0	64.52	2760.61	48	1.0	150.9	2732.71	31.0	8.3	48	10.48	2.16	0.96	142.5	585.6	6079.0	335.9	5829.2	**2431.59**	**1943.07**
31.00	32.50	31.75	1.50	30.00	20.48	10.48	129.62	4.71	8.3	8.3	1.0	89.14	2849.75	48	1.0	226.3	2959.00	32.5	12.1	40	10.48	3.09	1.82	142.5	636.0	6444.7	353.6	6162.3	**2577.89**	**2054.11**
32.50	35.00	33.75	2.50	32.50	20.48	10.48	129.62	7.86	12.1	12.1	1.0	218.33	3068.08	40	1.0	314.3	3273.29	35.0	12.1	40	10.48	3.09	1.82	142.5	636.0	6977.3	383.0	6724.4	**2790.94**	**2241.47**
35.00	35.50	35.25	0.50	33.00	20.48	10.48	129.62	1.57	12.1	12.1	1.0	43.67	3111.74	40	1.0	62.9	3336.14	35.5	12.1	40	10.48	3.09	1.82	142.5	636.0	7083.9	388.9	6836.8	**2833.55**	**2278.94**
35.50	37.50	36.50	2.00	35.00	20.48	10.48	129.62	6.29	12.1	12.1	1.0	174.66	3286.41	40	1.0	251.4	3587.57	37.5	29.1	5	10.32	19.23	20.33	142.5	2271.0	9145.0	412.5	7286.5	**3657.99**	**2428.83**
37.50	38.50	38.00	1.00	36.00	20.32	10.32	129.62	3.14	29.1	29.1	1.0	226.73	3513.14	5	1.0	15.7	3603.29	38.5	29.0	5	10.32	19.01	20.10	142.5	2244.9	9361.3	424.3	7540.7	**3744.51**	**2513.57**
38.50	40.00	39.25	1.50	37.50	20.32	10.32	129.62	4.71	29.0	29.0	1.0	338.71	3851.85	5	1.0	23.6	3626.86	40.0	17.1	89	10.32	4.97	3.80	142.5	1201.5	8680.3	442.0	7920.7	**3472.10**	**2640.22**
BORE NO: P91, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.48	9.48	26.07	1.57	26.6	26.6	1.0	20.51	0	3	1.0	4.7	0	3.0	26.6	3	9.68	13.60	14.57	28.4	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.50	19.68	9.68	38.12	6.29	26.6	26.6	1.0	119.99	0	3	1.0	18.9	0	5.0	26.6	3	9.68	13.60	14.57	47.8	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	19.68	9.68	52.64	3.14	26.6	26.6	1.0	82.85	0	3	1.0	9.4	0	6.0	14.6	23	9.68	3.82	2.54	57.5	0	0.0	41.3	41.3	**0.00**	**13.75**
6.00	7.00	6.50	1.00	4.50	19.68	9.68	62.32	3.14	14.6	14.6	1.0	51.02	0	23	1.0	72.3	0	7.0	12.4	48	9.68	3.17	1.91	67.2	514.2	514.2	53.0	53.0	**205.68**	**17.68**
7.00	8.00	7.50	1.00	5.50	19.68	9.68	72.00	3.14	12.4	12.4	1.0	49.75	49.75	48	1.0	150.9	150.86	8.0	11.5	44	10.60	2.91	1.65	76.8	493.8	694.4	64.8	265.4	**277.75**	**88.48**
8.00	9.00	8.50	1.00	6.50	20.60	10.60	82.14	3.14	11.5	11.5	1.0	52.52	102.27	44	1.0	138.3	289.14	9.0	11.5	44	10.60	2.91	1.65	87.4	518.0	909.4	76.6	468.0	**363.77**	**156.01**
9.00	11.00	10.00	2.00	8.50	20.60	10.60	98.04	6.29	11.5	11.5	1.0	125.38	227.65	44	1.0	276.6	565.71	11.0	11.5	44	10.60	2.91	1.65	108.6	566.5	1359.9	100.2	893.5	**543.94**	**297.85**
11.00	12.00	11.50	1.00	9.50	20.60	10.60	113.94	3.14	11.5	11.5	1.0	72.86	300.51	44	1.0	138.3	704.00	12.0	10.0	53	11.00	2.47	1.22	119.2	611.5	1616.0	112.0	1116.5	**646.39**	**372.16**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
12.00	14.50	13.25	2.50	12.00	21.00	11.00	132.99	7.86	10.0	10.0	1.0	184.25	484.76	53	1.0	416.4	1120.43	14.5	10.5	57	10.80	2.62	1.36	146.7	710.6	2315.8	141.4	1746.6	**926.31**	**582.20**
14.50	17.50	16.00	3.00	15.00	20.80	10.80	132.99	9.43	10.5	10.5	1.0	232.40	717.15	57	1.0	537.4	1657.86	17.5	9.5	55	11.90	2.38	1.14	146.7	668.7	3043.7	176.8	2551.8	**1217.47**	**850.60**
17.50	20.50	19.00	3.00	18.00	21.90	11.90	132.99	9.43	9.5	9.5	1.0	209.83	926.99	55	1.0	518.6	2176.43	20.5	9.5	55	9.79	2.38	1.14	146.7	667.7	3771.1	212.1	3315.6	**1508.46**	**1105.19**
20.50	23.50	22.00	3.00	21.00	19.79	9.79	132.99	9.43	9.5	9.5	1.0	209.83	1136.82	55	1.0	518.6	2695.00	23.5	23.0	16	9.79	8.56	8.68	146.7	1133.5	4965.3	247.5	4079.3	**1986.12**	**1359.77**
23.50	26.50	25.00	3.00	24.00	19.79	9.79	132.99	9.43	23.0	23.0	1.0	532.25	1669.07	16	1.0	150.9	2845.86	26.5	17.6	16	10.20	5.22	4.07	146.7	731.2	5246.1	282.9	4797.8	**2098.46**	**1599.26**
26.50	27.50	27.00	1.00	25.00	20.20	10.20	132.99	3.14	17.6	17.6	1.0	132.59	1801.66	16	1.0	50.3	2896.14	27.5	17.6	36	10.20	5.22	4.07	146.7	872.7	5570.4	294.6	4992.4	**2228.18**	**1664.15**
27.50	28.00	27.75	0.50	25.50	20.20	10.20	132.99	1.57	17.6	17.6	1.0	66.29	1867.95	36	1.0	56.6	2952.71	28.0	8.5	61	10.20	2.20	0.99	146.7	689.0	5509.6	300.5	5121.2	**2203.85**	**1707.07**
28.00	29.50	28.75	1.50	27.00	20.20	10.20	132.99	4.71	8.5	8.5	1.0	93.70	1961.65	61	1.0	287.6	3240.29	29.5	18.0	35	10.20	5.42	4.29	146.7	889.1	6091.1	318.2	5520.1	**2436.43**	**1840.05**
29.50	30.00	29.75	0.50	27.50	20.20	10.20	132.99	1.57	18.0	18.0	1.0	67.90	2029.55	35	1.0	55.0	3295.29	30.0	18.0	35	10.20	5.42	4.29	146.7	889.1	6214.0	324.1	5648.9	**2485.59**	**1882.98**
30.00	31.00	30.50	1.00	28.50	20.20	10.20	132.99	3.14	18.0	18.0	1.0	135.81	2165.36	35	1.0	110.0	3405.29	31.0	18.5	46	10.20	5.64	4.57	146.7	994.1	6564.7	335.9	5906.5	**2625.89**	**1968.85**
31.00	32.50	31.75	1.50	30.00	20.20	10.20	132.99	4.71	18.5	18.5	1.0	209.78	2375.13	46	1.0	216.9	3622.14	32.5	10.2	58	10.20	2.53	1.28	146.7	706.8	6704.1	353.6	6350.8	**2681.64**	**2116.95**
32.50	35.00	33.75	2.50	32.50	20.20	10.20	132.99	7.86	10.2	10.2	1.0	188.01	2563.14	58	1.0	455.7	4077.86	35.0	10.2	58	10.20	2.53	1.28	146.7	706.8	7347.8	383.0	7024.0	**2939.13**	**2341.35**
35.00	35.50	35.25	0.50	33.00	20.20	10.20	132.99	1.57	10.2	10.2	1.0	37.60	2600.75	58	1.0	91.1	4169.00	35.5	10.2	58	10.20	2.53	1.28	146.7	706.8	7476.6	388.9	7158.7	**2990.63**	**2386.22**
35.50	37.50	36.50	2.00	35.00	20.20	10.20	132.99	6.29	10.2	10.2	1.0	150.41	2751.16	58	1.0	364.6	4533.57	37.5	17.0	60	8.78	4.92	3.75	146.7	1004.9	8289.6	412.5	7697.2	**3315.86**	**2565.74**
37.50	38.50	38.00	1.00	36.00	18.78	8.78	132.99	3.14	17.0	17.0	1.0	127.79	2878.94	60	1.0	188.6	4722.14	38.5	17.0	50	8.83	4.92	3.75	146.7	934.3	8535.4	424.3	8025.4	**3414.15**	**2675.12**
38.50	40.00	39.25	1.50	37.50	18.83	8.83	132.99	4.71	17.0	17.0	1.0	191.68	3070.62	50	1.0	235.7	4957.86	40.0	17.0	50	8.83	4.92	3.75	146.7	934.3	8962.8	442.0	8470.4	**3585.10**	**2823.48**
BORE NO: P92, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.60	9.60	26.40	1.57	12.4	12.4	1.0	9.12	0	23	1.0	36.1	0	3.0	23.3	0	9.60	8.78	9.01	28.8	0	0.0	5.9	5.9	**0.00**	**1.96**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
3.00	4.00	3.50	1.00	1.50	19.60	9.60	33.60	3.14	23.3	23.3	1.0	45.48	0	0	1.0	0.0	0	4.0	26.5	9	9.60	13.38	14.34	38.4	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	19.60	9.60	43.20	3.14	26.5	26.5	1.0	67.69	0	9	1.0	28.3	0	5.0	26.5	9	9.60	13.38	14.34	48.0	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	19.60	9.60	52.80	3.14	26.5	26.5	1.0	82.74	0	9	1.0	28.3	0	6.0	25.5	13	9.60	11.13	12.03	57.6	0	0.0	41.3	41.3	**0.00**	**13.75**
6.00	7.00	6.50	1.00	4.50	19.60	9.60	62.40	3.14	25.5	25.5	1.0	93.54	0	13	1.0	40.9	0	7.0	25.5	13	9.57	11.13	12.03	67.2	724.6	724.6	53.0	53.0	**289.85**	**17.68**
7.00	8.00	7.50	1.00	5.50	19.57	9.57	71.99	3.14	25.5	25.5	1.0	107.91	107.91	13	1.0	40.9	40.86	8.0	25.5	13	9.57	11.13	12.03	76.8	808.3	957.0	64.8	213.6	**382.82**	**71.20**
8.00	9.00	8.50	1.00	6.50	19.57	9.57	81.56	3.14	25.5	25.5	1.0	122.26	230.17	13	1.0	40.9	81.71	9.0	12.2	42	10.70	3.12	1.85	86.3	516.2	828.1	76.6	388.5	**331.23**	**129.50**
9.00	11.00	10.00	2.00	8.50	20.70	10.70	97.04	6.29	12.2	12.2	1.0	131.88	362.05	42	1.0	264.0	345.71	11.0	12.2	42	10.70	3.12	1.85	107.7	568.6	1276.3	100.2	807.9	**510.54**	**269.31**
11.00	12.00	11.50	1.00	9.50	20.70	10.70	113.09	3.14	12.2	12.2	1.0	76.85	438.89	42	1.0	132.0	477.71	12.0	11.5	50	10.40	2.91	1.65	118.4	631.2	1547.8	112.0	1028.6	**619.12**	**342.86**
12.00	14.50	13.25	2.50	12.00	20.40	10.40	131.44	7.86	11.5	11.5	1.0	210.11	649.01	50	1.0	392.9	870.57	14.5	9.5	53	10.55	2.38	1.14	144.4	649.6	2169.2	141.4	1661.0	**867.68**	**553.67**
14.50	17.50	16.00	3.00	15.00	20.55	10.55	131.44	9.43	9.5	9.5	1.0	207.39	856.39	53	1.0	499.7	1370.29	17.5	10.2	50	10.55	2.53	1.28	144.4	645.9	2872.5	176.8	2403.5	**1149.01**	**801.15**
17.50	19.00	18.25	1.50	16.50	20.55	10.55	131.44	4.71	10.2	10.2	1.0	111.49	967.88	50	1.0	235.7	1606.00	19.0	11.0	55	10.30	2.76	1.51	144.4	708.7	3282.6	194.5	2768.3	**1313.04**	**922.78**
19.00	20.50	19.75	1.50	18.00	20.30	10.30	131.44	4.71	11.0	11.0	1.0	120.45	1088.33	55	1.0	259.3	1865.29	20.5	11.5	59	10.10	2.91	1.65	144.4	754.1	3707.7	212.1	3165.8	**1483.10**	**1055.25**
20.50	23.50	22.00	3.00	21.00	20.10	10.10	131.44	9.43	11.5	11.5	1.0	252.14	1340.47	59	1.0	556.3	2421.57	23.5	10.3	53	10.42	2.56	1.31	144.4	670.5	4432.5	247.5	4009.5	**1773.00**	**1336.51**
23.50	26.50	25.00	3.00	24.00	20.42	10.42	131.44	9.43	10.3	10.3	1.0	225.22	1565.68	53	1.0	499.7	2921.29	26.5	10.3	53	10.42	2.56	1.31	144.4	670.5	5157.4	282.9	4769.8	**2062.97**	**1589.94**
26.50	27.50	27.00	1.00	25.00	20.42	10.42	131.44	3.14	10.3	10.3	1.0	75.07	1640.76	53	1.0	166.6	3087.86	27.5	10.3	53	10.42	2.56	1.31	144.4	670.5	5399.1	294.6	5023.3	**2159.63**	**1674.42**
27.50	29.50	28.50	2.00	27.00	20.42	10.42	131.44	6.29	10.3	10.3	1.0	150.14	1790.90	53	1.0	333.1	3421.00	29.5	10.5	53	8.69	2.62	1.36	144.4	676.4	5888.3	318.2	5530.1	**2355.34**	**1843.37**
29.50	30.00	29.75	0.50	27.50	18.69	8.69	131.44	1.57	10.5	10.5	1.0	38.28	1829.18	53	1.0	83.3	3504.29	30.0	10.0	50	10.52	2.47	1.22	144.4	638.9	5972.4	324.1	5657.6	**2388.96**	**1885.86**
30.00	32.50	31.25	2.50	30.00	20.52	10.52	131.44	7.86	10.0	10.0	1.0	182.10	2011.28	50	1.0	392.9	3897.14	32.5	10.8	45	10.52	2.71	1.45	144.4	631.2	6539.6	353.6	6262.0	**2615.86**	**2087.33**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
32.50	35.00	33.75	2.50	32.50	20.52	10.52	131.44	7.86	10.8	10.8	1.0	197.01	2208.29	45	1.0	353.6	4250.71	35.0	10.8	45	10.52	2.71	1.45	144.4	631.2	7090.2	383.0	6842.0	**2836.09**	**2280.68**
35.00	35.50	35.25	0.50	33.00	20.52	10.52	131.44	1.57	10.8	10.8	1.0	39.40	2247.69	45	1.0	70.7	4321.43	35.5	10.1	65	10.52	2.50	1.25	144.4	748.5	7317.6	388.9	6958.0	**2927.03**	**2319.35**
35.50	37.50	36.50	2.00	35.00	20.52	10.52	131.44	6.29	10.1	10.1	1.0	147.17	2394.86	65	1.0	408.6	4730.00	37.5	10.1	65	9.61	2.50	1.25	144.4	748.0	7872.9	412.5	7537.4	**3149.15**	**2512.45**
37.50	38.50	38.00	1.00	36.00	19.61	9.61	131.44	3.14	10.1	10.1	1.0	73.58	2468.44	65	1.0	204.3	4934.29	38.5	10.1	65	8.74	2.50	1.25	144.4	747.6	8150.3	424.3	7827.0	**3260.12**	**2609.00**
38.50	40.00	39.25	1.50	37.50	18.74	8.74	131.44	4.71	10.1	10.1	1.0	110.38	2578.82	65	1.0	306.4	5240.71	40.0	26.3	0	8.74	12.93	13.88	144.4	1514.8	9334.3	442.0	8261.5	**3733.72**	**2753.83**
BORE NO: P93, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.36	9.36	25.74	1.57	23.4	23.4	1.0	17.50	0	0	1.0	0.0	0	3.0	23.7	0	9.36	9.06	9.45	28.1	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.36	9.36	32.76	3.14	23.7	23.7	1.0	45.20	0	0	1.0	0.0	0	4.0	25.8	6	9.69	11.80	12.72	37.4	438.0	438.0	17.7	17.7	**175.21**	**5.89**
4.00	5.00	4.50	1.00	2.50	19.69	9.69	42.29	3.14	25.8	25.8	1.0	64.24	64.24	6	1.0	18.9	18.86	5.0	25.8	6	9.69	11.80	12.72	47.1	527.9	611.0	29.5	112.6	**244.39**	**37.52**
5.00	6.00	5.50	1.00	3.50	19.69	9.69	51.98	3.14	25.8	25.8	1.0	78.97	143.21	6	1.0	18.9	37.71	6.0	25.8	6	9.69	11.80	12.72	56.8	617.7	798.7	41.3	222.2	**319.46**	**74.06**
6.00	8.00	7.00	2.00	5.50	19.69	9.69	66.51	6.29	25.8	25.8	1.0	202.10	345.31	6	1.0	37.7	75.43	8.0	26.7	0	10.43	13.83	14.80	76.2	888.5	1309.3	64.8	485.6	**523.71**	**161.85**
8.00	9.00	8.50	1.00	6.50	20.43	10.43	81.42	3.14	26.7	26.7	1.0	128.69	474.00	0	1.0	0.0	75.43	9.0	26.5	7	10.43	13.38	14.34	86.6	1018.8	1568.3	76.6	626.0	**627.30**	**208.68**
9.00	11.00	10.00	2.00	8.50	20.43	10.43	97.06	6.29	26.5	26.5	1.0	304.18	778.18	7	1.0	44.0	119.43	11.0	23.0	10	10.43	8.56	8.68	107.5	829.2	1726.9	100.2	997.8	**690.74**	**332.60**
11.00	12.00	11.50	1.00	9.50	20.43	10.43	112.71	3.14	23.0	23.0	1.0	150.36	928.54	10	1.0	31.4	150.86	12.0	9.5	52	10.08	2.38	1.14	117.9	592.8	1672.1	112.0	1191.4	**668.86**	**397.12**
12.00	14.50	13.25	2.50	12.00	20.08	10.08	130.52	7.86	9.5	9.5	1.0	171.61	1100.15	52	1.0	408.6	559.43	14.5	11.5	56	10.17	2.91	1.65	143.1	729.9	2389.5	141.4	1801.0	**955.81**	**600.34**
14.50	17.50	16.00	3.00	15.00	20.17	10.17	130.52	9.43	11.5	11.5	1.0	250.37	1350.52	56	1.0	528.0	1087.43	17.5	11.5	56	10.17	2.91	1.65	143.1	729.9	3167.9	176.8	2614.7	**1267.15**	**871.58**
17.50	19.00	18.25	1.50	16.50	20.17	10.17	130.52	4.71	11.5	11.5	1.0	125.19	1475.71	56	1.0	264.0	1351.43	19.0	8.7	55	8.61	2.24	1.02	143.1	643.8	3471.0	194.5	3021.6	**1388.38**	**1007.20**
19.00	20.50	19.75	1.50	18.00	18.61	8.61	130.52	4.71	8.7	8.7	1.0	94.16	1569.86	55	1.0	259.3	1610.71	20.5	8.7	55	9.70	2.24	1.02	143.1	644.3	3824.8	212.1	3392.7	**1529.93**	**1130.91**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
20.50	23.50	22.00	3.00	21.00	19.70	9.70	130.52	9.43	8.7	8.7	1.0	188.31	1758.17	55	1.0	518.6	2129.29	23.5	8.5	57	9.70	2.20	0.99	143.1	654.2	4541.7	247.5	4135.0	**1816.68**	**1378.32**
23.50	25.00	24.25	1.50	22.50	19.70	9.70	130.52	4.71	8.5	8.5	1.0	91.96	1850.13	57	1.0	268.7	2398.00	25.0	28.8	0	10.84	18.56	19.64	143.1	2170.4	6418.5	265.2	4513.3	**2567.42**	**1504.44**
25.00	26.50	25.75	1.50	24.00	20.84	10.84	130.52	4.71	28.8	28.8	1.0	338.27	2188.40	0	1.0	0.0	2398.00	26.5	28.0	0	10.84	16.76	17.79	143.1	1960.0	6546.4	282.9	4869.3	**2618.55**	**1623.09**
26.50	27.50	27.00	1.00	25.00	20.84	10.84	130.52	3.14	28.0	28.0	1.0	218.11	2406.51	0	1.0	0.0	2398.00	27.5	30.4	0	10.84	23.27	24.45	143.1	2721.4	7525.9	294.6	5099.2	**3010.35**	**1699.72**
27.50	28.00	27.75	0.50	25.50	20.84	10.84	130.52	1.57	30.4	30.4	1.0	122.74	2529.25	0	1.0	0.0	2398.00	28.0	29.8	0	10.84	20.81	21.94	143.1	2433.4	7360.7	300.5	5227.8	**2944.28**	**1742.60**
28.00	29.50	28.75	1.50	27.00	20.84	10.84	130.52	4.71	29.8	29.8	1.0	352.39	2881.64	0	1.0	0.0	2398.00	29.5	11.5	50	8.61	2.91	1.65	143.1	686.5	5966.1	318.2	5597.9	**2386.46**	**1865.95**
29.50	30.00	29.75	0.50	27.50	18.61	8.61	130.52	1.57	11.5	11.5	1.0	41.73	2923.37	50	1.0	78.6	2476.57	30.0	11.5	50	8.61	2.91	1.65	143.1	686.5	6086.4	324.1	5724.0	**2434.58**	**1908.02**
30.00	31.00	30.50	1.00	28.50	18.61	8.61	130.52	3.14	11.5	11.5	1.0	83.46	3006.83	50	1.0	157.1	2633.71	31.0	11.5	50	8.56	2.91	1.65	143.1	686.5	6327.0	335.9	5976.4	**2530.80**	**1992.15**
31.00	32.50	31.75	1.50	30.00	18.56	8.56	130.52	4.71	11.5	11.5	1.0	125.19	3132.01	50	1.0	235.7	2869.43	32.5	11.5	50	8.83	2.91	1.65	143.1	686.6	6688.1	353.6	6355.0	**2675.23**	**2118.34**
32.50	34.00	33.25	1.50	31.50	18.83	8.83	130.52	4.71	11.5	11.5	1.0	125.19	3257.20	50	1.0	235.7	3105.14	34.0	12.3	56	8.63	3.15	1.88	143.1	756.1	7118.4	371.3	6733.6	**2847.37**	**2244.53**
34.00	35.00	34.50	1.00	32.50	18.63	8.63	130.52	3.14	12.3	12.3	1.0	89.44	3346.64	56	1.0	176.0	3281.14	35.0	12.3	56	8.63	3.15	1.88	143.1	756.1	7383.9	383.0	7010.8	**2953.55**	**2336.94**
35.00	35.50	35.25	0.50	33.00	18.63	8.63	130.52	1.57	12.3	12.3	1.0	44.72	3391.36	56	1.0	88.0	3369.14	35.5	12.3	56	8.93	3.15	1.88	143.1	756.3	7516.8	388.9	7149.4	**3006.73**	**2383.14**
35.50	37.00	36.25	1.50	34.50	18.93	8.93	130.52	4.71	12.3	12.3	1.0	134.16	3525.52	56	1.0	264.0	3633.14	37.0	12.3	56	8.84	3.15	1.88	143.1	756.2	7914.9	406.6	7565.3	**3165.96**	**2521.76**
37.00	37.50	37.25	0.50	35.00	18.84	8.84	130.52	1.57	12.3	12.3	1.0	44.72	3570.24	56	1.0	88.0	3721.14	37.5	12.3	63	8.84	3.15	1.88	143.1	805.7	8097.1	412.5	7703.9	**3238.85**	**2567.96**
37.50	38.50	38.00	1.00	36.00	18.84	8.84	130.52	3.14	12.3	12.3	1.0	89.44	3659.68	63	1.0	198.0	3919.14	38.5	12.3	63	8.93	3.15	1.88	143.1	805.8	8384.6	424.3	8003.1	**3353.85**	**2667.70**
38.50	40.00	39.25	1.50	37.50	18.93	8.93	130.52	4.71	12.3	12.3	1.0	134.16	3793.84	63	1.0	297.0	4216.14	40.0	12.3	63	8.93	3.15	1.88	143.1	805.8	8815.8	442.0	8451.9	**3526.32**	**2817.31**
BORE NO: P94, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.40	10.40	28.60	1.57	11.2	11.2	1.0	8.90	0	14	1.0	22.0	0	3.0	25.0	13	10.40	10.00	10.88	31.2	0	0.0	5.9	5.9	**0.00**	**1.96**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 0.79 m^2

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
3.00	4.00	3.50	1.00	1.50	20.40	10.40	36.40	3.14	25.0	25.0	1.0	53.35	0	13	1.0	40.9	0	4.0	25.0	13	10.40	10.00	10.88	41.6	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	20.40	10.40	46.80	3.14	25.0	25.0	1.0	68.59	0	13	1.0	40.9	0	5.0	25.0	13	9.52	10.00	10.88	52.0	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	19.52	9.52	56.76	3.14	25.0	25.0	1.0	83.18	0	13	1.0	40.9	0	6.0	23.5	17	9.52	8.92	9.23	61.5	585.9	585.9	41.3	41.3	**234.37**	**13.75**
6.00	7.00	6.50	1.00	4.50	19.52	9.52	66.28	3.14	23.5	23.5	1.0	90.58	90.58	17	1.0	53.4	53.43	7.0	23.5	17	10.30	8.92	9.23	71.0	655.5	799.5	53.0	197.0	**319.79**	**65.68**
7.00	9.00	8.00	2.00	6.50	20.30	10.30	81.34	6.29	23.5	23.5	1.0	222.31	312.89	17	1.0	106.9	160.29	9.0	23.5	17	10.30	8.92	9.23	91.6	799.8	1273.0	76.6	549.8	**509.20**	**183.26**
9.00	10.00	9.50	1.00	7.50	20.30	10.30	96.79	3.14	23.5	23.5	1.0	132.27	445.15	17	1.0	53.4	213.71	10.0	12.0	54	10.30	3.06	1.79	101.9	634.0	1292.9	88.4	747.3	**517.16**	**249.09**
10.00	11.00	10.50	1.00	8.50	20.30	10.30	107.09	3.14	12.0	12.0	1.0	71.54	516.69	54	1.0	169.7	383.43	11.0	11.5	56	10.30	2.91	1.65	112.2	659.4	1559.5	100.2	1000.3	**623.81**	**333.43**
11.00	12.50	11.75	1.50	10.00	20.30	10.30	119.97	4.71	11.5	11.5	1.0	115.06	631.76	56	1.0	264.0	647.43	12.5	11.5	56	9.90	2.91	1.65	127.7	694.5	1973.7	117.9	1397.0	**789.46**	**465.68**
12.50	14.00	13.25	1.50	11.50	19.90	9.90	135.12	4.71	11.5	11.5	1.0	129.59	761.35	56	1.0	264.0	911.43	14.0	11.2	47	9.90	2.82	1.56	142.5	654.6	2327.4	135.5	1808.3	**930.94**	**602.77**
14.00	15.50	14.75	1.50	13.00	19.90	9.90	149.97	4.71	11.2	11.2	1.0	139.99	901.34	47	1.0	221.6	1133.00	15.5	11.2	47	10.70	2.82	1.56	142.5	655.1	2689.4	153.2	2187.5	**1075.76**	**729.18**
15.50	18.50	17.00	3.00	16.00	20.70	10.70	149.97	9.43	11.2	11.2	1.0	279.97	1181.31	47	1.0	443.1	1576.14	18.5	13.0	45	10.70	3.35	2.08	142.5	702.1	3459.6	188.6	2946.0	**1383.83**	**982.01**
18.50	20.00	19.25	1.50	17.50	20.70	10.70	149.97	4.71	13.0	13.0	1.0	163.22	1344.52	45	1.0	212.1	1788.29	20.0	24.0	16	11.59	9.28	9.78	142.5	1197.0	4329.8	206.3	3339.1	**1731.93**	**1113.02**
20.00	21.50	20.75	1.50	19.00	21.59	11.59	149.97	4.71	24.0	24.0	1.0	314.77	1659.29	16	1.0	75.4	1863.71	21.5	11.5	49	9.80	2.91	1.65	142.5	678.9	4201.9	223.9	3746.9	**1680.75**	**1248.98**
21.50	24.50	23.00	3.00	22.00	19.80	9.80	149.97	9.43	11.5	11.5	1.0	287.67	1946.96	49	1.0	462.0	2325.71	24.5	13.5	51	10.59	3.50	2.22	142.5	761.9	5034.5	259.3	4532.0	**2013.82**	**1510.65**
24.50	27.50	26.00	3.00	25.00	20.59	10.59	149.97	9.43	13.5	13.5	1.0	339.46	2286.42	51	1.0	480.9	2806.57	27.5	14.5	51	10.59	3.80	2.51	142.5	796.1	5889.1	294.6	5387.6	**2355.64**	**1795.88**
27.50	30.00	28.75	2.50	27.50	20.59	10.59	149.97	7.86	14.5	14.5	1.0	304.73	2591.15	51	1.0	400.7	3207.29	30.0	9.5	51	10.70	2.38	1.14	142.5	632.0	6430.4	324.1	6122.5	**2572.17**	**2040.85**
30.00	30.50	30.25	0.50	28.00	20.70	10.70	149.97	1.57	9.5	9.5	1.0	39.44	2630.59	51	1.0	80.1	3287.43	30.5	18.8	37	10.70	5.78	4.73	142.5	928.6	6846.6	330.0	6248.0	**2738.65**	**2082.67**
30.50	32.50	31.50	2.00	30.00	20.70	10.70	149.97	6.29	18.8	18.8	1.0	320.90	2951.49	37	1.0	232.6	3520.00	32.5	23.5	48	11.05	8.92	9.23	142.5	1378.5	7850.0	353.6	6825.1	**3140.00**	**2275.02**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
32.50	33.50	33.00	1.00	31.00	21.05	11.05	149.97	3.14	23.5	23.5	1.0	204.94	3156.42	48	1.0	150.9	3670.86	33.5	10.0	50	11.05	2.47	1.22	142.5	635.5	7462.8	365.4	7192.6	**2985.11**	**2397.55**
33.50	35.00	34.25	1.50	32.50	21.05	11.05	149.97	4.71	10.0	10.0	1.0	124.66	3281.08	50	1.0	235.7	3906.57	35.0	23.0	8	11.05	8.56	8.68	142.5	1053.0	8240.6	383.0	7570.7	**3296.24**	**2523.56**
35.00	36.50	35.75	1.50	34.00	21.05	11.05	149.97	4.71	28.9	28.9	1.0	390.27	3671.36	8	1.0	37.7	3944.29	36.5	9.0	68	11.05	2.29	1.07	142.5	742.0	8357.6	400.7	8016.4	**3343.04**	**2672.12**
36.50	37.50	37.00	1.00	35.00	21.05	11.05	149.97	3.14	9.0	9.0	1.0	74.65	3746.01	68	1.0	213.7	4158.00	37.5	9.0	68	11.05	2.29	1.07	142.5	742.0	8646.0	412.5	8316.5	**3458.38**	**2772.17**
37.50	40.00	38.75	2.50	37.50	21.05	11.05	149.97	7.86	9.0	9.0	1.0	186.62	3932.63	68	1.0	534.3	4692.29	40.0	6.0	125	11.05	1.75	0.60	142.5	1082.5	9707.5	442.0	9066.9	**3882.98**	**3022.29**
BORE NO: P95, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.43	9.43	25.93	1.57	28.0	28.0	1.0	21.67	0	3	1.0	4.7	0	3.0	23.4	0	9.43	8.85	9.12	28.3	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.43	9.43	33.01	3.14	23.4	23.4	1.0	44.89	0	0	1.0	0.0	0	4.0	24.2	0	9.43	9.42	10.00	37.7	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	19.43	9.43	42.44	3.14	24.2	24.2	1.0	59.94	0	0	1.0	0.0	0	5.0	27.5	4	9.64	15.63	16.64	47.2	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	19.64	9.64	51.97	3.14	27.5	27.5	1.0	85.03	0	4	1.0	12.6	0	6.0	24.2	0	9.64	9.42	10.00	56.8	0	0.0	41.3	41.3	**0.00**	**13.75**
6.00	7.00	6.50	1.00	4.50	19.64	9.64	61.61	3.14	24.2	24.2	1.0	87.02	0	0	1.0	0.0	0	7.0	24.2	0	9.64	9.42	10.00	66.4	0	0.0	53.0	53.0	**0.00**	**17.68**
7.00	8.00	7.50	1.00	5.50	19.64	9.64	71.25	3.14	24.2	24.2	1.0	100.64	0	0	1.0	0.0	0	8.0	10.7	45	10.20	2.68	1.42	76.1	483.8	483.8	64.8	64.8	**193.53**	**21.61**
8.00	9.00	8.50	1.00	6.50	20.20	10.20	81.17	3.14	10.7	10.7	1.0	48.20	48.20	45	1.0	141.4	141.43	9.0	9.5	52	10.20	2.38	1.14	86.3	533.6	723.3	76.6	266.2	**289.30**	**88.75**
9.00	10.00	9.50	1.00	7.50	20.20	10.20	91.37	3.14	9.5	9.5	1.0	48.05	96.26	52	1.0	163.4	304.86	10.0	9.5	52	10.31	2.38	1.14	96.5	552.7	953.9	88.4	489.5	**381.54**	**163.17**
10.00	12.50	11.25	2.50	10.00	20.31	10.31	109.36	7.86	9.5	9.5	1.0	143.79	240.04	52	1.0	408.6	713.43	12.5	9.5	52	9.43	2.38	1.14	122.2	600.5	1554.0	117.9	1071.3	**621.61**	**357.11**
12.50	15.50	14.00	3.00	13.00	19.43	9.43	136.39	9.43	9.5	9.5	1.0	215.20	455.24	52	1.0	490.3	1203.71	15.5	9.0	53	9.43	2.29	1.07	122.2	598.7	2257.6	153.2	1812.2	**903.06**	**604.06**
15.50	18.50	17.00	3.00	16.00	19.43	9.43	136.39	9.43	9.0	9.0	1.0	203.68	658.92	53	1.0	499.7	1703.43	18.5	9.0	53	9.69	2.29	1.07	122.2	598.8	2961.1	188.6	2550.9	**1184.46**	**850.31**
18.50	20.00	19.25	1.50	17.50	19.69	9.69	136.39	4.71	9.0	9.0	1.0	101.84	760.76	53	1.0	249.9	1953.29	20.0	10.2	49	9.69	2.53	1.28	122.2	594.3	3308.3	206.3	2920.3	**1323.32**	**973.43**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
20.00	21.50	20.75	1.50	19.00	19.69	9.69	136.39	4.71	10.2	10.2	1.0	115.69	876.45	49	1.0	231.0	2184.29	21.5	10.2	49	9.69	2.53	1.28	122.2	594.3	3655.0	223.9	3284.7	**1461.99**	**1094.89**
21.50	23.00	22.25	1.50	20.50	19.69	9.69	136.39	4.71	10.2	10.2	1.0	115.69	992.14	49	1.0	231.0	2415.29	23.0	9.4	40	10.82	2.36	1.13	122.2	514.5	3921.9	241.6	3649.0	**1568.78**	**1216.34**
23.00	24.50	23.75	1.50	22.00	20.82	10.82	136.39	4.71	9.4	9.4	1.0	106.44	1098.58	40	1.0	188.6	2603.86	24.5	9.4	44	10.82	2.36	1.13	122.2	542.8	4245.2	259.3	3961.7	**1698.10**	**1320.57**
24.50	27.50	26.00	3.00	25.00	20.82	10.82	136.39	9.43	9.4	9.4	1.0	212.89	1311.47	44	1.0	414.9	3018.71	27.5	9.5	26	10.10	2.38	1.14	122.2	417.0	4747.2	294.6	4624.8	**1898.87**	**1541.61**
27.50	30.00	28.75	2.50	27.50	20.10	10.10	136.39	7.86	9.5	9.5	1.0	179.33	1490.80	26	1.0	204.3	3223.00	30.0	26.7	0	10.10	13.83	14.80	122.2	1386.9	6100.7	324.1	5037.9	**2440.28**	**1679.30**
30.00	30.50	30.25	0.50	28.00	20.10	10.10	136.39	1.57	26.7	26.7	1.0	107.80	1598.60	0	1.0	0.0	3223.00	30.5	26.7	0	10.10	13.83	14.80	122.2	1386.9	6208.5	330.0	5151.6	**2483.40**	**1717.20**
30.50	32.00	31.25	1.50	29.50	20.10	10.10	136.39	4.71	26.7	26.7	1.0	323.39	1921.98	0	1.0	0.0	3223.00	32.0	10.5	63	10.10	2.62	1.36	122.2	702.3	5847.3	347.7	5492.7	**2338.90**	**1830.89**
32.00	32.50	32.25	0.50	30.00	20.10	10.10	136.39	1.57	10.5	10.5	1.0	39.72	1961.71	63	1.0	99.0	3322.00	32.5	10.5	63	8.97	2.62	1.36	122.2	701.7	5985.4	353.6	5637.3	**2394.15**	**1879.09**
32.50	33.50	33.00	1.00	31.00	18.97	8.97	136.39	3.14	10.5	10.5	1.0	79.45	2041.15	63	1.0	198.0	3520.00	33.5	10.5	63	8.97	2.62	1.36	122.2	701.7	6262.8	365.4	5926.5	**2505.13**	**1975.50**
33.50	35.00	34.25	1.50	32.50	18.97	8.97	136.39	4.71	10.5	10.5	1.0	119.17	2160.32	63	1.0	297.0	3817.00	35.0	26.1	0	9.42	12.48	13.41	122.2	1248.1	7225.4	383.0	6360.4	**2890.15**	**2120.12**
35.00	36.50	35.75	1.50	34.00	19.42	9.42	136.39	4.71	26.1	26.1	1.0	314.99	2475.32	0	1.0	0.0	3817.00	36.5	13.2	56	9.57	3.41	2.14	122.2	731.6	7023.9	400.7	6693.0	**2809.55**	**2231.01**
36.50	37.50	37.00	1.00	35.00	19.57	9.57	136.39	3.14	13.2	13.2	1.0	100.54	2575.86	56	1.0	176.0	3993.00	37.5	13.2	56	9.57	3.41	2.14	122.2	731.6	7300.4	412.5	6981.4	**2920.16**	**2327.12**
37.50	38.00	37.75	0.50	35.50	19.57	9.57	136.39	1.57	13.2	13.2	1.0	50.27	2626.13	56	1.0	88.0	4081.00	38.0	10.0	55	9.51	2.47	1.22	122.2	630.7	7337.9	418.4	7125.5	**2935.14**	**2375.17**
38.00	40.00	39.00	2.00	37.50	19.51	9.51	136.39	6.29	10.0	10.0	1.0	151.17	2777.29	55	1.0	345.7	4426.71	40.0	10.0	55	9.51	2.47	1.22	122.2	630.7	7834.7	442.0	7646.0	**3133.89**	**2548.66**
BORE NO: P96, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.19	10.19	28.02	1.57	27.5	27.5	1.0	22.92	0	3	1.0	4.7	0	3.0	25.5	0	10.19	11.13	12.03	30.6	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	20.19	10.19	35.67	3.14	25.5	25.5	1.0	53.46	0	0	1.0	0.0	0	4.0	24.3	5	9.41	9.50	10.11	40.8	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	6.00	5.00	2.00	3.50	19.41	9.41	50.17	6.29	24.3	24.3	1.0	142.39	0	5	1.0	31.4	0	6.0	24.7	0	9.41	9.78	10.55	59.6	0	0.0	41.3	41.3	**0.00**	**13.75**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m) From	Layers (m) To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi: ϕ	δ	Ki	Qi	ΣQi	Ultimate Shaft Cohesion Quc= Σα.c.Asi: c	α	α.c.Asi	ΣQi	Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ): Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
6.00	7.00	6.50	1.00	4.50	19.41	9.41	64.29	3.14	24.7	24.7	1.0	92.93	0	0	1.0	0.0	0	7.0	24.7	0	9.41	9.78	10.55	69.0	0	0.0	53.0	53.0	**0.00**	**17.68**
7.00	8.00	7.50	1.00	5.50	19.41	9.41	73.70	3.14	24.7	24.7	1.0	106.53	0	0	1.0	0.0	0	8.0	10.5	42	9.41	2.62	1.36	78.4	463.2	463.2	64.8	64.8	**185.30**	**21.61**
8.00	9.00	8.50	1.00	6.50	19.41	9.41	83.11	3.14	10.5	10.5	1.0	48.41	48.41	42	1.0	132.0	132.00	9.0	10.5	42	10.20	2.62	1.36	87.8	483.0	663.4	76.6	257.0	**265.37**	**85.67**
9.00	10.00	9.50	1.00	7.50	20.20	10.20	92.91	3.14	10.5	10.5	1.0	54.12	102.53	42	1.0	132.0	264.00	10.0	10.5	42	10.20	2.62	1.36	98.0	504.0	870.5	88.4	454.9	**348.21**	**151.64**
10.00	12.50	11.25	2.50	10.00	20.20	10.20	110.76	7.86	10.5	10.5	1.0	161.29	263.82	42	1.0	330.0	594.00	12.5	11.2	54	10.20	2.82	1.56	123.5	662.1	1519.9	117.9	975.7	**607.95**	**325.23**
12.50	14.00	13.25	1.50	11.50	20.20	10.20	131.16	4.71	11.2	11.2	1.0	122.43	386.25	54	1.0	254.6	848.57	14.0	11.2	40	10.07	2.82	1.56	138.8	596.9	1831.7	135.5	1370.4	**732.69**	**456.79**
14.00	15.50	14.75	1.50	13.00	20.07	10.07	146.36	4.71	11.2	11.2	1.0	136.62	522.87	40	1.0	188.6	1037.14	15.5	11.2	40	10.07	2.82	1.56	138.8	596.9	2156.9	153.2	1713.2	**862.77**	**571.08**
15.50	17.00	16.25	1.50	14.50	20.07	10.07	146.36	4.71	11.2	11.2	1.0	136.62	659.50	40	1.0	188.6	1225.71	17.0	28.0	0	10.25	16.76	17.79	138.8	1899.1	3784.3	170.9	2056.1	**1513.73**	**685.37**
17.00	18.50	17.75	1.50	16.00	20.25	10.25	146.36	4.71	28.0	28.0	1.0	366.88	1026.37	0	1.0	0.0	1225.71	18.5	28.0	0	10.25	16.76	17.79	138.8	1899.1	4151.2	188.6	2440.7	**1660.48**	**813.55**
18.50	20.00	19.25	1.50	17.50	20.25	10.25	146.36	4.71	28.0	28.0	1.0	366.88	1393.25	0	1.0	0.0	1225.71	20.0	15.5	32	10.25	4.19	2.92	138.8	694.6	3313.6	206.3	2825.2	**1325.43**	**941.74**
20.00	21.50	20.75	1.50	19.00	20.25	10.25	146.36	4.71	15.5	15.5	1.0	191.35	1584.60	32	1.0	150.9	1376.57	21.5	15.5	32	9.88	4.19	2.92	138.8	694.2	3655.4	223.9	3185.1	**1462.14**	**1061.70**
21.50	23.00	22.25	1.50	20.50	19.88	9.88	146.36	4.71	15.5	15.5	1.0	191.35	1775.96	32	1.0	150.9	1527.43	23.0	9.4	49	9.88	2.36	1.13	138.8	608.5	3911.9	241.6	3545.0	**1564.75**	**1181.66**
23.00	24.50	23.75	1.50	22.00	19.88	9.88	146.36	4.71	9.4	9.4	1.0	114.23	1890.18	49	1.0	231.0	1758.43	24.5	9.4	49	9.88	2.36	1.13	138.8	608.5	4257.1	259.3	3907.9	**1702.84**	**1302.63**
24.50	26.00	25.25	1.50	23.50	19.88	9.88	146.36	4.71	9.4	9.4	1.0	114.23	2004.41	49	1.0	231.0	1989.43	26.0	29.8	0	9.88	20.81	21.94	138.8	2354.7	6348.5	277.0	4270.8	**2539.42**	**1423.60**
26.00	27.50	26.75	1.50	25.00	19.88	9.88	146.36	4.71	29.8	29.8	1.0	395.16	2399.57	0	1.0	0.0	1989.43	27.5	29.8	0	11.32	20.81	21.94	138.8	2367.1	6756.1	294.6	4683.6	**2702.45**	**1561.22**
27.50	29.00	28.25	1.50	26.50	21.32	11.32	146.36	4.71	29.8	29.8	1.0	395.16	2794.74	0	1.0	0.0	1989.43	29.0	12.1	42	11.32	3.09	1.82	138.8	641.8	5426.0	312.3	5096.5	**2170.39**	**1698.83**
29.00	30.00	29.50	1.00	27.50	21.32	11.32	146.36	3.14	12.1	12.1	1.0	98.61	2893.35	42	1.0	132.0	2121.43	30.0	12.1	42	11.32	3.09	1.82	138.8	641.8	5656.6	324.1	5338.9	**2262.63**	**1779.63**
30.00	30.50	30.25	0.50	28.00	21.32	11.32	146.36	1.57	12.1	12.1	1.0	49.31	2942.66	42	1.0	66.0	2187.43	30.5	12.1	42	11.32	3.09	1.82	138.8	641.8	5771.9	330.0	5460.1	**2308.76**	**1820.03**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
30.50	32.00	31.25	1.50	29.50	21.32	11.32	146.36	4.71	12.1	12.1	1.0	147.92	3090.58	42	1.0	198.0	2385.43	32.0	29.1	0	11.32	19.23	20.33	138.8	2188.0	7664.0	347.7	5823.7	**3065.61**	**1941.23**
32.00	32.50	32.25	0.50	30.00	21.32	11.32	146.36	1.57	29.1	29.1	1.0	128.02	3218.60	0	1.0	0.0	2385.43	32.5	27.6	0	10.88	15.85	16.87	138.8	1801.3	7405.4	353.6	5957.6	**2962.14**	**1985.87**
32.50	33.50	33.00	1.00	31.00	20.88	10.88	146.36	3.14	27.6	27.6	1.0	240.48	3459.08	0	1.0	0.0	2385.43	33.5	18.0	39	10.88	5.42	4.29	138.8	884.8	6729.3	365.4	6209.9	**2691.74**	**2069.95**
33.50	35.00	34.25	1.50	32.50	20.88	10.88	146.36	4.71	18.0	18.0	1.0	224.19	3683.27	39	1.0	183.9	2569.29	35.0	29.3	5	10.88	19.68	20.79	138.8	2271.0	8523.5	383.0	6635.6	**3409.40**	**2211.86**
35.00	36.50	35.75	1.50	34.00	20.88	10.88	146.36	4.71	29.3	29.3	1.0	387.21	4070.48	5	1.0	23.6	2592.86	36.5	12.6	48	10.88	3.23	1.96	138.8	700.5	7363.8	400.7	7064.0	**2945.51**	**2354.68**
36.50	37.50	37.00	1.00	35.00	20.88	10.88	146.36	3.14	12.6	12.6	1.0	102.82	4173.30	48	1.0	150.9	2743.71	37.5	12.6	48	10.88	3.23	1.96	138.8	700.5	7617.5	412.5	7329.5	**3046.99**	**2443.17**
37.50	38.00	37.75	0.50	35.50	20.88	10.88	146.36	1.57	12.6	12.6	1.0	51.41	4224.71	48	1.0	75.4	2819.14	38.0	10.0	45	8.03	2.47	1.22	138.8	591.5	7635.3	418.4	7462.2	**3054.12**	**2487.42**
38.00	40.00	39.00	2.00	37.50	18.03	8.03	146.36	6.29	10.0	10.0	1.0	162.22	4386.93	45	1.0	282.9	3102.00	40.0	10.0	45	8.03	2.47	1.22	138.8	591.5	8080.4	442.0	7930.9	**3232.15**	**2643.63**
BORE NO: P97, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.91	9.91	27.25	1.57	15.0	15.0	1.0	11.48	0	32	1.0	50.3	0	3.0	12.9	16	9.91	3.32	2.05	29.7	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.91	9.91	34.69	3.14	12.9	12.9	1.0	24.97	0	16	1.0	50.3	0	4.0	27.0	7	9.91	14.50	15.49	39.6	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	19.91	9.91	44.60	3.14	27.0	27.0	1.0	71.41	0	7	1.0	22.0	0	5.0	27.0	7	9.91	14.50	15.49	49.6	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	19.91	9.91	54.51	3.14	27.0	27.0	1.0	87.28	0	7	1.0	22.0	0	6.0	25.8	0	9.91	11.80	12.72	59.5	0	0.0	41.3	41.3	**0.00**	**13.75**
6.00	7.00	6.50	1.00	4.50	19.91	9.91	64.42	3.14	25.8	25.8	1.0	97.87	0	0	1.0	0.0	0	7.0	26.0	10	10.07	12.25	13.18	69.4	0	0.0	53.0	53.0	**0.00**	**17.68**
7.00	8.00	7.50	1.00	5.50	20.07	10.07	74.41	3.14	26.0	26.0	1.0	114.05	0	10	1.0	31.4	0	8.0	11.5	44	10.07	2.91	1.65	79.4	499.4	499.4	64.8	64.8	**199.75**	**21.61**
8.00	9.00	8.50	1.00	6.50	20.07	10.07	84.48	3.14	11.5	11.5	1.0	54.02	54.02	44	1.0	138.3	138.29	9.0	11.5	44	10.35	2.91	1.65	89.5	522.6	714.9	76.6	268.9	**285.95**	**89.64**
9.00	11.00	10.00	2.00	8.50	20.35	10.35	99.86	6.29	11.5	11.5	1.0	127.71	181.72	44	1.0	276.6	414.86	11.0	9.5	51	10.35	2.38	1.14	110.2	571.4	1168.0	100.2	696.8	**467.18**	**232.25**
11.00	12.00	11.50	1.00	9.50	20.35	10.35	115.39	3.14	9.5	9.5	1.0	60.68	242.41	51	1.0	160.3	575.14	12.0	9.0	51	10.56	2.29	1.07	120.6	582.0	1399.5	112.0	929.5	**559.81**	**309.84**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Factor of Safety in Compression: 2.5
Area of Pile: 0.79 m^2
Critical water table: 0.00 m
Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
12.00	14.50	13.25	2.50	12.00	20.56	10.56	133.76	7.86	9.0	9.0	1.0	166.46	408.86	51	1.0	400.7	975.86	14.5	9.0	50	9.81	2.29	1.07	147.0	622.1	2006.8	141.4	1526.1	**802.73**	**508.72**
14.50	17.50	16.00	3.00	15.00	19.81	9.81	133.76	9.43	9.0	9.0	1.0	199.75	608.61	50	1.0	471.4	1447.29	17.5	11.0	44	9.81	2.76	1.51	147.0	636.1	2692.0	176.8	2232.7	**1076.80**	**744.23**
17.50	20.50	19.00	3.00	18.00	19.81	9.81	133.76	9.43	11.0	11.0	1.0	245.15	853.76	44	1.0	414.9	1862.14	20.5	11.3	44	10.96	2.85	1.59	147.0	647.3	3363.2	212.1	2928.0	**1345.29**	**976.01**
20.50	23.50	22.00	3.00	21.00	20.96	10.96	133.76	9.43	11.3	11.3	1.0	252.01	1105.76	44	1.0	414.9	2277.00	23.5	12.6	44	10.96	3.23	1.96	147.0	692.9	4075.7	247.5	3630.3	**1630.28**	**1210.09**
23.50	26.50	25.00	3.00	24.00	20.96	10.96	133.76	9.43	12.6	12.6	1.0	281.90	1387.67	44	1.0	414.9	2691.86	26.5	15.5	39	9.65	4.19	2.92	147.0	770.2	4849.7	282.9	4362.4	**1939.90**	**1454.13**
26.50	27.50	27.00	1.00	25.00	19.65	9.65	133.76	3.14	15.5	15.5	1.0	116.58	1504.25	39	1.0	122.6	2814.43	27.5	15.5	39	10.33	4.19	2.92	147.0	771.0	5089.7	294.6	4613.3	**2035.87**	**1537.77**
27.50	29.50	28.50	2.00	27.00	20.33	10.33	133.76	6.29	15.5	15.5	1.0	233.17	1737.42	39	1.0	245.1	3059.57	29.5	26.8	0	10.33	14.05	15.03	147.0	1683.7	6480.7	318.2	5115.2	**2592.28**	**1705.07**
29.50	30.00	29.75	0.50	27.50	20.33	10.33	133.76	1.57	26.8	26.8	1.0	106.18	1843.60	0	1.0	0.0	3059.57	30.0	26.8	0	10.33	14.05	15.03	147.0	1683.7	6586.9	324.1	5227.3	**2634.75**	**1742.42**
30.00	32.50	31.25	2.50	30.00	20.33	10.33	133.76	7.86	26.8	26.8	1.0	530.88	2374.48	0	1.0	0.0	3059.57	32.5	23.5	10	10.33	8.92	9.23	147.0	1138.2	6572.2	353.6	5787.6	**2628.89**	**1929.21**
32.50	35.00	33.75	2.50	32.50	20.33	10.33	133.76	7.86	23.5	23.5	1.0	456.98	2831.46	10	1.0	78.6	3138.14	35.0	23.5	10	11.77	8.92	9.23	147.0	1143.4	7113.0	383.0	6352.6	**2845.19**	**2117.54**
35.00	35.50	35.25	0.50	33.00	21.77	11.77	133.76	1.57	23.5	23.5	1.0	91.40	2922.85	10	1.0	15.7	3153.86	35.5	23.0	10	11.77	8.56	8.68	147.0	1099.3	7176.0	388.9	6465.6	**2870.39**	**2155.21**
35.50	37.50	36.50	2.00	35.00	21.77	11.77	133.76	6.29	23.0	23.0	1.0	356.89	3279.74	10	1.0	62.9	3216.71	37.5	26.5	10	11.77	13.38	14.34	147.0	1681.7	8178.2	412.5	6909.0	**3271.27**	**2302.98**
37.50	38.50	38.00	1.00	36.00	21.77	11.77	133.76	3.14	26.5	26.5	1.0	209.60	3489.34	10	1.0	31.4	3248.14	38.5	26.0	10	11.77	12.25	13.18	147.0	1546.4	8283.9	424.3	7161.8	**3313.55**	**2387.26**
38.50	40.00	39.25	1.50	37.50	21.77	11.77	133.76	4.71	26.0	26.0	1.0	307.56	3796.89	10	1.0	47.1	3295.29	40.0	18.0	47	11.77	5.42	4.29	147.0	977.6	8069.8	442.0	7534.1	**3227.91**	**2511.38**
BORE NO: P98, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.20	9.20	25.30	1.57	27.3	27.3	1.0	20.52	0	2	1.0	3.1	0	3.0	27.3	2	9.48	15.18	16.18	27.6	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.50	19.48	9.48	37.08	6.29	27.3	27.3	1.0	120.30	0	2	1.0	12.6	0	5.0	25.7	8	9.48	11.58	12.49	46.6	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	19.48	9.48	51.30	3.14	25.7	25.7	1.0	77.59	0	8	1.0	25.1	0	6.0	25.7	8	9.48	11.58	12.49	56.0	0	0.0	41.3	41.3	**0.00**	**13.75**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
6.00	7.00	6.50	1.00	4.50	19.48	9.48	60.78	3.14	25.7	25.7	1.0	91.93	0	8	1.0	25.1	0	7.0	25.7	8	9.84	11.58	12.49	65.5	700.8	700.8	53.0	53.0	**280.33**	**17.68**
7.00	8.00	7.50	1.00	5.50	19.84	9.84	70.44	3.14	25.7	25.7	1.0	106.54	106.54	8	1.0	25.1	25.14	8.0	9.5	47	9.84	2.38	1.14	75.4	477.7	609.4	64.8	196.5	**243.75**	**65.50**
8.00	9.00	8.50	1.00	6.50	19.84	9.84	80.28	3.14	9.5	9.5	1.0	42.22	148.77	47	1.0	147.7	172.86	9.0	9.5	47	9.61	2.38	1.14	85.2	496.0	817.6	76.6	398.2	**327.05**	**132.74**
9.00	11.00	10.00	2.00	8.50	19.61	9.61	94.81	6.29	9.5	9.5	1.0	99.73	248.49	47	1.0	295.4	468.29	11.0	9.2	53	9.61	2.33	1.10	104.4	569.8	1286.5	100.2	817.0	**514.62**	**272.32**
11.00	12.00	11.50	1.00	9.50	19.61	9.61	109.23	3.14	9.2	9.2	1.0	55.60	304.09	53	1.0	166.6	634.86	12.0	9.2	53	10.15	2.33	1.10	114.0	587.6	1526.5	112.0	1050.9	**610.60**	**350.30**
12.00	14.50	13.25	2.50	12.00	20.15	10.15	126.72	7.86	9.2	9.2	1.0	161.26	465.35	53	1.0	416.4	1051.29	14.5	10.3	43	10.47	2.56	1.31	139.4	589.6	2106.3	141.4	1658.1	**842.51**	**552.69**
14.50	17.50	16.00	3.00	15.00	20.47	10.47	126.72	9.43	10.3	10.3	1.0	217.13	682.48	43	1.0	405.4	1456.71	17.5	10.3	43	10.47	2.56	1.31	139.4	589.6	2728.8	176.8	2316.0	**1091.54**	**771.99**
17.50	19.00	18.25	1.50	16.50	20.47	10.47	126.72	4.71	10.3	10.3	1.0	108.56	791.04	43	1.0	202.7	1659.43	19.0	28.4	0	9.49	17.66	18.71	139.4	2003.7	4454.2	194.5	2644.9	**1781.68**	**881.64**
19.00	20.50	19.75	1.50	18.00	19.49	9.49	126.72	4.71	28.4	28.4	1.0	323.00	1114.04	0	1.0	0.0	1659.43	20.5	12.8	34	9.49	3.29	2.02	139.4	608.5	3382.0	212.1	2985.6	**1352.79**	**995.20**
20.50	22.00	21.25	1.50	19.50	19.49	9.49	126.72	4.71	12.8	12.8	1.0	135.72	1249.76	34	1.0	160.3	1819.71	22.0	20.7	39	9.49	6.90	6.16	139.4	1055.0	4124.4	229.8	3299.3	**1649.78**	**1099.77**
22.00	23.50	22.75	1.50	21.00	19.49	9.49	126.72	4.71	20.7	20.7	1.0	225.73	1475.50	39	1.0	183.9	2003.57	23.5	11.5	40	9.47	2.91	1.65	139.4	607.8	4086.9	247.5	3726.6	**1634.76**	**1242.19**
23.50	26.50	25.00	3.00	24.00	19.47	9.47	126.72	9.43	11.5	11.5	1.0	243.08	1718.57	40	1.0	377.1	2380.71	26.5	11.5	40	9.47	2.91	1.65	139.4	607.8	4707.1	282.9	4382.1	**1882.85**	**1460.72**
26.50	27.50	27.00	1.00	25.00	19.47	9.47	126.72	3.14	11.5	11.5	1.0	81.03	1799.60	40	1.0	125.7	2506.43	27.5	14.4	40	9.47	3.77	2.48	139.4	704.6	5010.6	294.6	4600.7	**2004.24**	**1533.56**
27.50	28.00	27.75	0.50	25.50	19.47	9.47	126.72	1.57	14.4	14.4	1.0	51.13	1850.73	40	1.0	62.9	2569.29	28.0	28.5	4	9.78	17.88	18.94	139.4	2059.7	6479.7	300.5	4720.5	**2591.88**	**1573.52**
28.00	29.50	28.75	1.50	27.00	19.78	9.78	126.72	4.71	28.5	28.5	1.0	324.35	2175.08	4	1.0	18.9	2588.14	29.5	30.2	0	9.78	22.27	23.43	139.4	2529.0	7292.2	318.2	5081.4	**2916.87**	**1693.81**
29.50	30.00	29.75	0.50	27.50	19.78	9.78	126.72	1.57	30.2	30.2	1.0	117.05	2292.13	0	1.0	0.0	2588.14	30.0	30.6	0	9.78	24.28	25.48	139.4	2757.5	7637.8	324.1	5204.4	**3055.13**	**1734.79**
30.00	31.00	30.50	1.00	28.50	19.78	9.78	126.72	3.14	30.6	30.6	1.0	242.59	2534.73	0	1.0	0.0	2588.14	31.0	32.8	0	9.78	35.36	36.75	139.4	4014.8	9137.6	335.9	5458.8	**3655.05**	**1819.59**
31.00	32.50	31.75	1.50	30.00	19.78	9.78	126.72	4.71	32.8	32.8	1.1	438.88	2973.61	0	1.0	0.0	2588.14	32.5	32.8	0	11.12	35.36	36.75	139.4	4034.1	9595.9	353.6	5915.3	**3838.34**	**1971.78**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
32.50	35.00	33.75	2.50	32.50	21.12	11.12	126.72	7.86	32.8	32.8	1.1	731.47	3705.09	0	1.0	0.0	2588.14	35.0	32.0	0	11.12	31.33	32.65	139.4	3574.8	9868.0	383.0	6676.3	**3947.20**	**2225.42**
35.00	35.50	35.25	0.50	33.00	21.12	11.12	126.72	1.57	32.0	32.0	1.1	136.87	3841.96	0	1.0	0.0	2588.14	35.5	31.3	0	11.12	27.81	29.06	139.4	3172.9	9603.0	388.9	6819.0	**3841.19**	**2273.01**
35.50	37.50	36.50	2.00	35.00	21.12	11.12	126.72	6.29	31.3	31.3	1.1	515.76	4357.72	0	1.0	0.0	2588.14	37.5	31.3	0	8.46	27.81	29.06	139.4	3142.5	10088.4	412.5	7358.4	**4035.34**	**2452.79**
37.50	38.50	38.00	1.00	36.00	18.46	8.46	126.72	3.14	31.3	31.3	1.1	257.88	4615.60	0	1.0	0.0	2588.14	38.5	30.3	0	8.68	22.77	23.94	139.4	2575.8	9779.5	424.3	7628.0	**3911.81**	**2542.68**
38.50	40.00	39.25	1.50	37.50	18.68	8.68	126.72	4.71	30.3	30.3	1.0	354.32	4969.92	0	1.0	0.0	2588.14	40.0	30.3	0	8.68	22.77	23.94	139.4	2575.8	10133.8	442.0	8000.0	**4053.53**	**2666.68**
BORE NO: P99, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.67	10.67	29.34	1.57	27.5	27.5	1.0	24.00	0	11	1.0	17.3	0	3.0	26.1	0	10.67	12.48	13.41	32.0	370.0	370.0	5.9	5.9	**148.02**	**1.96**
3.00	4.00	3.50	1.00	1.50	20.67	10.67	37.35	3.14	26.1	26.1	1.0	57.50	57.50	0	1.0	0.0	0.00	4.0	26.0	11	9.83	12.25	13.18	42.7	539.6	597.1	17.7	75.2	**238.82**	**25.06**
4.00	5.00	4.50	1.00	2.50	19.83	9.83	47.60	3.14	26.0	26.0	1.0	72.96	130.46	11	1.0	34.6	34.57	5.0	26.0	11	9.83	12.25	13.18	52.5	634.2	799.2	29.5	194.5	**319.69**	**64.83**
5.00	6.00	5.50	1.00	3.50	19.83	9.83	57.43	3.14	26.0	26.0	1.0	88.03	218.48	11	1.0	34.6	69.14	6.0	26.5	0	9.83	13.38	14.34	62.3	710.6	998.3	41.3	328.9	**399.30**	**109.62**
6.00	7.00	6.50	1.00	4.50	19.83	9.83	67.26	3.14	26.5	26.5	1.0	105.39	323.87	0	1.0	0.0	69.14	7.0	23.0	15	9.83	8.56	8.68	72.2	625.0	1018.0	53.0	446.0	**407.21**	**148.68**
7.00	8.00	7.50	1.00	5.50	19.83	9.83	77.09	3.14	23.0	23.0	1.0	102.84	426.70	15	1.0	47.1	116.29	8.0	9.6	47	10.52	2.40	1.16	82.0	491.6	1034.6	64.8	607.8	**413.85**	**202.60**
8.00	9.00	8.50	1.00	6.50	20.52	10.52	87.26	3.14	9.6	9.6	1.0	46.39	473.09	47	1.0	147.7	264.00	9.0	9.6	47	10.52	2.40	1.16	92.5	511.5	1248.6	76.6	813.7	**499.42**	**271.23**
9.00	11.00	10.00	2.00	8.50	20.52	10.52	103.04	6.29	9.6	9.6	1.0	109.55	582.64	47	1.0	295.4	559.43	11.0	9.6	46	10.52	2.40	1.16	113.6	544.0	1686.1	100.2	1242.2	**674.44**	**414.08**
11.00	12.00	11.50	1.00	9.50	20.52	10.52	118.82	3.14	9.6	9.6	1.0	63.16	645.80	46	1.0	144.6	704.00	12.0	11.0	50	10.17	2.76	1.51	124.1	629.1	1978.9	112.0	1461.8	**791.54**	**487.25**
12.00	14.50	13.25	2.50	12.00	20.17	10.17	136.79	7.86	11.0	11.0	1.0	208.92	854.72	50	1.0	392.9	1096.86	14.5	11.0	55	9.76	2.76	1.51	149.5	719.4	2671.0	141.4	2093.0	**1068.38**	**697.67**
14.50	17.50	16.00	3.00	15.00	19.76	9.76	136.79	9.43	11.0	11.0	1.0	250.70	1105.42	55	1.0	518.6	1615.43	17.5	27.5	7	9.76	15.63	16.64	149.5	1949.3	4670.2	176.8	2897.6	**1868.06**	**965.88**
17.50	19.00	18.25	1.50	16.50	19.76	9.76	136.79	4.71	27.5	27.5	1.0	335.70	1441.12	7	1.0	33.0	1648.43	19.0	24.8	0	9.93	9.86	10.66	149.5	1199.4	4288.9	194.5	3284.0	**1715.56**	**1094.67**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
19.00	20.50	19.75	1.50	18.00	19.93	9.93	136.79	4.71	24.8	24.8	1.0	297.98	1739.10	0	1.0	0.0	1648.43	20.5	24.8	0	9.93	9.86	10.66	149.5	1199.4	4586.9	212.1	3599.7	**1834.75**	**1199.89**
20.50	22.00	21.25	1.50	19.50	19.93	9.93	136.79	4.71	24.8	24.8	1.0	297.98	2037.08	0	1.0	0.0	1648.43	22.0	26.5	12	10.16	13.38	14.34	149.5	1713.6	5399.1	229.8	3915.3	**2159.62**	**1305.11**
22.00	23.50	22.75	1.50	21.00	20.16	10.16	136.79	4.71	26.5	26.5	1.0	321.52	2358.60	12	1.0	56.6	1705.00	23.5	26.0	12	10.16	12.25	13.18	149.5	1576.7	5640.3	247.5	4311.1	**2256.12**	**1437.03**
23.50	25.00	24.25	1.50	22.50	20.16	10.16	136.79	4.71	26.0	26.0	1.0	314.53	2673.13	12	1.0	56.6	1761.57	25.0	27.0	0	10.16	14.50	15.49	149.5	1765.6	6200.3	265.2	4699.9	**2480.10**	**1566.63**
25.00	26.50	25.75	1.50	24.00	20.16	10.16	136.79	4.71	27.0	27.0	1.0	328.58	3001.71	0	1.0	0.0	1761.57	26.5	27.0	0	10.06	14.50	15.49	149.5	1764.9	6528.2	282.9	5046.1	**2611.29**	**1682.05**
26.50	27.50	27.00	1.00	25.00	20.06	10.06	136.79	3.14	27.0	27.0	1.0	219.05	3220.77	0	1.0	0.0	1761.57	27.5	27.0	0	10.06	14.50	15.49	149.5	1764.9	6747.3	294.6	5277.0	**2698.91**	**1758.99**
27.50	28.00	27.75	0.50	25.50	20.06	10.06	136.79	1.57	27.0	27.0	1.0	109.53	3330.29	0	1.0	0.0	1761.57	28.0	25.5	13	10.06	11.13	12.03	149.5	1446.4	6538.3	300.5	5392.4	**2615.32**	**1797.47**
28.00	29.50	28.75	1.50	27.00	20.06	10.06	136.79	4.71	25.5	25.5	1.0	307.59	3637.88	13	1.0	61.3	1822.86	29.5	25.0	13	10.06	10.00	10.88	149.5	1309.6	6770.4	318.2	5779.0	**2708.14**	**1926.32**
29.50	30.00	29.75	0.50	27.50	20.06	10.06	136.79	1.57	25.0	25.0	1.0	100.24	3738.12	13	1.0	20.4	1843.29	30.0	25.4	5	10.06	10.90	11.80	149.5	1362.5	6943.9	324.1	5905.5	**2777.56**	**1968.51**
30.00	31.00	30.50	1.00	28.50	20.06	10.06	136.79	3.14	25.4	25.4	1.0	204.14	3942.26	5	1.0	15.7	1859.00	31.0	25.4	5	10.06	10.90	11.80	149.5	1362.5	7163.8	335.9	6137.2	**2865.50**	**2045.72**
31.00	32.50	31.75	1.50	30.00	20.06	10.06	136.79	4.71	25.4	25.4	1.0	306.21	4248.47	5	1.0	23.6	1882.57	32.5	25.4	5	10.39	10.90	11.80	149.5	1364.0	7495.1	353.6	6484.6	**2998.03**	**2161.54**
32.50	35.00	33.75	2.50	32.50	20.39	10.39	136.79	7.86	25.4	25.4	1.0	510.35	4758.83	5	1.0	39.3	1921.86	35.0	25.4	5	10.39	10.90	11.80	149.5	1364.0	8044.7	383.0	7063.7	**3217.88**	**2354.57**
35.00	35.50	35.25	0.50	33.00	20.39	10.39	136.79	1.57	25.4	25.4	1.0	102.07	4860.90	5	1.0	7.9	1929.71	35.5	25.6	5	10.39	11.35	12.26	149.5	1418.8	8209.4	388.9	7179.5	**3283.77**	**2393.18**
35.50	37.00	36.25	1.50	34.50	20.39	10.39	136.79	4.71	25.6	25.6	1.0	308.97	5169.87	5	1.0	23.6	1953.29	37.0	27.7	0	10.39	16.08	17.10	149.5	1958.7	9081.9	406.6	7529.8	**3632.75**	**2509.92**
37.00	37.50	37.25	0.50	35.00	20.39	10.39	136.79	1.57	27.7	27.7	1.0	112.86	5282.73	0	1.0	0.0	1953.29	37.5	27.7	0	9.43	16.08	17.10	149.5	1952.3	9188.3	412.5	7648.5	**3675.31**	**2549.50**
37.50	38.50	38.00	1.00	36.00	19.43	9.43	136.79	3.14	27.7	27.7	1.0	225.71	5508.44	0	1.0	0.0	1953.29	38.5	28.2	0	8.89	17.21	18.25	149.5	2084.9	9546.6	424.3	7886.0	**3818.66**	**2628.67**
38.50	40.00	39.25	1.50	37.50	18.89	8.89	136.79	4.71	28.2	28.2	1.0	345.78	5854.22	0	1.0	0.0	1953.29	40.0	28.2	0	8.89	17.21	18.25	149.5	2084.9	9892.4	442.0	8249.5	**3956.97**	**2749.82**

BORE NO: P100, CUT OFF LENGTH: 2.50 m, Nc= 9

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
2.50	3.00	2.75	0.50	0.50	20.10	10.10	27.78	1.57	28.5	28.5	1.0	23.70	0	0	1.0	0.0	0	3.0	24.5	6	8.73	9.64	10.33	30.3	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.50	18.73	8.73	39.03	6.29	24.5	24.5	1.0	111.80	0	6	1.0	37.7	0	5.0	24.5	6	8.73	9.64	10.33	47.8	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	18.73	8.73	52.13	3.14	24.5	24.5	1.0	74.66	0	6	1.0	18.9	0	6.0	28.9	0	10.01	18.78	19.87	56.5	911.8	911.8	41.3	41.3	**364.71**	**13.75**
6.00	8.00	7.00	2.00	5.50	20.01	10.01	66.50	6.29	28.9	28.9	1.0	230.75	230.75	0	1.0	0.0	0.00	8.0	11.5	43	10.01	2.91	1.65	76.5	485.6	716.3	64.8	295.6	**286.52**	**98.52**
8.00	9.00	8.50	1.00	6.50	20.01	10.01	81.52	3.14	11.5	11.5	1.0	52.12	282.87	43	1.0	135.1	135.14	9.0	11.5	43	10.01	2.91	1.65	86.5	508.4	926.5	76.6	494.6	**370.58**	**164.87**
9.00	10.00	9.50	1.00	7.50	20.01	10.01	91.53	3.14	11.5	11.5	1.0	58.52	341.39	43	1.0	135.1	270.29	10.0	11.5	43	9.76	2.91	1.65	96.5	531.2	1142.9	88.4	700.1	**457.14**	**233.36**
10.00	11.00	10.50	1.00	8.50	19.76	9.76	101.41	3.14	11.5	11.5	1.0	64.84	406.24	43	1.0	135.1	405.43	11.0	11.5	43	9.76	2.91	1.65	106.3	553.5	1365.2	100.2	911.8	**546.07**	**303.95**
11.00	12.00	11.50	1.00	9.50	19.76	9.76	111.17	3.14	11.5	11.5	1.0	71.08	477.32	43	1.0	135.1	540.57	12.0	11.5	43	9.76	2.91	1.65	116.1	575.8	1593.7	112.0	1129.9	**637.49**	**376.62**
12.00	14.50	13.25	2.50	12.00	19.76	9.76	128.25	7.86	11.5	11.5	1.0	205.01	682.34	43	1.0	337.9	878.43	14.5	9.6	54	10.10	2.40	1.16	140.5	651.1	2211.8	141.4	1702.2	**884.74**	**567.40**
14.50	16.00	15.25	1.50	13.50	20.10	10.10	128.25	4.71	9.6	9.6	1.0	102.26	784.60	54	1.0	254.6	1133.00	16.0	15.1	49	10.10	3.99	2.70	140.5	797.5	2715.1	159.1	2076.7	**1086.02**	**692.24**
16.00	17.50	16.75	1.50	15.00	20.10	10.10	128.25	4.71	15.1	15.1	1.0	163.14	947.73	49	1.0	231.0	1364.00	17.5	15.1	49	10.10	3.99	2.70	140.5	797.5	3109.2	176.8	2488.5	**1243.68**	**829.51**
17.50	19.00	18.25	1.50	16.50	20.10	10.10	128.25	4.71	15.1	15.1	1.0	163.14	1110.87	49	1.0	231.0	1595.00	19.0	28.8	0	10.00	18.56	19.64	140.5	2125.0	4830.9	194.5	2900.3	**1932.35**	**966.78**
19.00	20.50	19.75	1.50	18.00	20.00	10.00	128.25	4.71	28.8	28.8	1.0	332.39	1443.25	0	1.0	0.0	1595.00	20.5	21.2	41	10.00	7.26	6.71	140.5	1117.9	4156.1	212.1	3250.4	**1662.46**	**1083.47**
20.50	22.00	21.25	1.50	19.50	20.00	10.00	128.25	4.71	21.2	21.2	1.0	234.51	1677.77	41	1.0	193.3	1788.29	22.0	10.5	57	9.55	2.62	1.36	140.5	697.0	4163.0	229.8	3695.9	**1665.21**	**1231.96**
22.00	23.50	22.75	1.50	21.00	19.55	9.55	128.25	4.71	10.5	10.5	1.0	112.06	1789.82	57	1.0	268.7	2057.00	23.5	10.5	57	9.55	2.62	1.36	140.5	697.0	4543.8	247.5	4094.3	**1817.52**	**1364.77**
23.50	25.00	24.25	1.50	22.50	19.55	9.55	128.25	4.71	10.5	10.5	1.0	112.06	1901.88	57	1.0	268.7	2325.71	25.0	27.3	0	9.50	15.18	16.18	140.5	1735.5	5963.1	265.2	4492.8	**2385.23**	**1497.59**
25.00	26.50	25.75	1.50	24.00	19.50	9.50	128.25	4.71	27.3	27.3	1.0	312.06	2213.94	0	1.0	0.0	2325.71	26.5	27.3	0	9.50	15.18	16.18	140.5	1735.5	6275.1	282.9	4822.5	**2510.06**	**1607.50**
26.50	27.50	27.00	1.00	25.00	19.50	9.50	128.25	3.14	27.3	27.3	1.0	208.04	2421.98	0	1.0	0.0	2325.71	27.5	28.4	0	9.50	17.66	18.71	140.5	2018.3	6766.0	294.6	5042.3	**2706.40**	**1680.78**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
27.50	29.50	28.50	2.00	27.00	19.50	9.50	128.25	6.29	28.4	28.4	1.0	435.88	2857.86	0	1.0	0.0	2325.71	29.5	28.4	0	10.70	17.66	18.71	140.5	2027.1	7210.7	318.2	5501.8	**2884.28**	**1833.93**
29.50	30.00	29.75	0.50	27.50	20.70	10.70	128.25	1.57	28.4	28.4	1.0	108.97	2966.83	0	1.0	0.0	2325.71	30.0	28.4	0	10.70	17.66	18.71	140.5	2027.1	7319.7	324.1	5616.7	**2927.87**	**1872.22**
30.00	31.00	30.50	1.00	28.50	20.70	10.70	128.25	3.14	28.4	28.4	1.0	217.94	3184.77	0	1.0	0.0	2325.71	31.0	27.8	2	10.70	16.31	17.33	140.5	1886.3	7396.8	335.9	5846.4	**2958.73**	**1948.79**
31.00	32.50	31.75	1.50	30.00	20.70	10.70	128.25	4.71	27.8	27.8	1.0	318.77	3503.55	2	1.0	9.4	2335.14	32.5	27.8	0	10.70	16.31	17.33	140.5	1872.2	7710.9	353.6	6192.3	**3084.36**	**2064.09**
32.50	34.00	33.25	1.50	31.50	20.70	10.70	128.25	4.71	27.8	27.8	1.0	318.77	3822.32	0	1.0	0.0	2335.14	34.0	28.5	0	10.70	17.88	18.94	140.5	2052.9	8210.4	371.3	6528.7	**3284.16**	**2176.24**
34.00	35.00	34.50	1.00	32.50	20.70	10.70	128.25	3.14	28.5	28.5	1.0	218.85	4041.17	0	1.0	0.0	2335.14	35.0	28.5	0	10.62	17.88	18.94	140.5	2052.3	8428.7	383.0	6759.3	**3371.46**	**2253.12**
35.00	35.50	35.25	0.50	33.00	20.62	10.62	128.25	1.57	28.5	28.5	1.0	109.42	4150.59	0	1.0	0.0	2335.14	35.5	28.5	0	10.62	17.88	18.94	140.5	2052.3	8538.1	388.9	6874.7	**3415.23**	**2291.56**
35.50	37.50	36.50	2.00	35.00	20.62	10.62	128.25	6.29	28.5	28.5	1.0	437.70	4588.29	0	1.0	0.0	2335.14	37.5	28.8	0	10.62	18.56	19.64	140.5	2129.8	9053.2	412.5	7335.9	**3621.29**	**2445.31**
37.50	38.50	38.00	1.00	36.00	20.62	10.62	128.25	3.14	28.8	28.8	1.0	221.59	4809.88	0	1.0	0.0	2335.14	38.5	28.6	0	10.62	18.11	19.17	140.5	2078.2	9223.2	424.3	7569.3	**3689.27**	**2523.10**
38.50	40.00	39.25	1.50	37.50	20.62	10.62	128.25	4.71	28.6	28.6	1.0	329.64	5139.53	0	1.0	0.0	2335.14	40.0	28.6	0	10.62	18.11	19.17	140.5	2078.2	9552.8	442.0	7916.6	**3821.13**	**2638.88**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Factor of Safety in Compression: 2.5
Area of Pile: 1.13 m^2
Critical water table: 0.00 m
Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: P81, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	18.85	8.85	24.34	1.89	26.3	26.3	1.0	22.68	0	3	1.0	5.7	0	3.0	23.6	0	8.85	8.99	9.34	26.6	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	18.85	8.85	30.98	3.77	23.6	23.6	1.0	51.04	0	0	1.0	0.0	0	4.0	11.5	44	10.17	2.91	1.65	35.4	0	0.0	25.5	25.5	**0.00**	**8.49**
4.00	5.00	4.50	1.00	2.50	20.17	10.17	40.49	3.77	11.5	11.5	1.0	31.06	0	44	1.0	165.9	0	5.0	12.7	48	10.17	3.26	1.99	45.6	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	20.17	10.17	50.66	3.77	12.7	12.7	1.0	43.05	0	48	1.0	181.0	0	6.0	12.7	48	10.17	3.26	1.99	55.7	708.3	708.3	59.4	59.4	**283.31**	**19.80**
6.00	7.00	6.50	1.00	4.50	20.17	10.17	60.83	3.77	12.7	12.7	1.0	51.70	51.70	48	1.0	181.0	181.03	7.0	12.7	48	10.27	3.26	1.99	65.9	746.0	978.7	76.4	309.1	**391.47**	**103.03**
7.00	8.00	7.50	1.00	5.50	20.27	10.27	71.05	3.77	12.7	12.7	1.0	60.38	112.08	48	1.0	181.0	362.06	8.0	11.0	45	10.27	2.76	1.51	76.2	707.0	1181.1	93.3	567.5	**472.44**	**189.16**
8.00	9.00	8.50	1.00	6.50	20.27	10.27	81.32	3.77	11.0	11.0	1.0	59.61	171.69	45	1.0	169.7	531.77	9.0	11.0	45	10.27	2.76	1.51	86.5	739.1	1442.5	110.3	813.8	**577.02**	**271.26**
9.00	10.00	9.50	1.00	7.50	20.27	10.27	91.59	3.77	11.0	11.0	1.0	67.14	238.83	45	1.0	169.7	701.49	10.0	11.0	45	10.19	2.76	1.51	96.7	771.1	1711.4	127.3	1067.6	**684.57**	**355.87**
10.00	11.00	10.50	1.00	8.50	20.19	10.19	101.82	3.77	11.0	11.0	1.0	74.64	313.47	45	1.0	169.7	871.20	11.0	11.0	45	10.19	2.76	1.51	106.9	803.0	1987.7	144.3	1328.9	**795.06**	**442.98**
11.00	12.00	11.50	1.00	9.50	20.19	10.19	112.01	3.77	11.0	11.0	1.0	82.11	395.58	45	1.0	169.7	1040.91	12.0	9.5	55	10.36	2.38	1.14	117.1	883.4	2319.9	161.2	1597.7	**927.97**	**532.57**
12.00	14.50	13.25	2.50	12.00	20.36	10.36	130.05	9.43	9.5	9.5	1.0	205.19	600.77	55	1.0	518.6	1559.49	14.5	9.5	53	10.36	2.38	1.14	143.0	932.8	3093.1	203.7	2363.9	**1237.22**	**787.97**
14.50	16.00	15.25	1.50	13.50	20.36	10.36	150.77	5.66	9.5	9.5	1.0	142.73	743.51	53	1.0	299.8	1859.31	16.0	27.5	0	9.82	15.63	16.64	158.5	2914.5	5517.4	229.1	2831.9	**2206.95**	**943.98**
16.00	17.50	16.75	1.50	15.00	19.82	9.82	165.91	5.66	27.5	27.5	1.0	488.58	1232.08	0	1.0	0.0	1859.31	17.5	11.4	64	9.82	2.88	1.62	173.3	1227.4	4318.8	254.6	3346.0	**1727.53**	**1115.32**
17.50	19.00	18.25	1.50	16.50	19.82	9.82	165.91	5.66	11.4	11.4	1.0	189.24	1421.33	64	1.0	362.1	2221.37	19.0	12.2	44	10.40	3.12	1.85	173.3	1072.0	4714.7	280.0	3922.7	**1885.90**	**1307.58**
19.00	20.50	19.75	1.50	18.00	20.40	10.40	165.91	5.66	12.2	12.2	1.0	202.92	1624.25	44	1.0	248.9	2470.29	20.5	12.2	44	10.40	3.12	1.85	173.3	1072.0	5166.6	305.5	4400.0	**2066.63**	**1466.67**
20.50	23.50	22.00	3.00	21.00	20.40	10.40	165.91	11.31	12.2	12.2	1.0	405.84	2030.09	44	1.0	497.8	2968.11	23.5	10.0	44	9.50	2.47	1.22	173.3	940.1	5938.3	356.4	5354.6	**2375.34**	**1784.87**
23.50	25.00	24.25	1.50	22.50	19.50	9.50	165.91	5.66	10.0	10.0	1.0	165.49	2195.58	44	1.0	248.9	3217.03	25.0	13.0	48	9.87	3.35	2.08	173.3	1159.4	6572.1	381.9	5794.5	**2628.82**	**1931.49**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
25.00	26.50	25.75	1.50	24.00	19.87	9.87	165.91	5.66	13.0	13.0	1.0	216.68	2412.26	48	1.0	271.5	3488.57	26.5	13.0	48	8.83	3.35	2.08	173.3	1158.0	7058.8	407.3	6308.1	**2823.52**	**2102.72**
26.50	27.50	27.00	1.00	25.00	18.83	8.83	165.91	3.77	13.0	13.0	1.0	144.45	2556.72	48	1.0	181.0	3669.60	27.5	13.0	48	8.83	3.35	2.08	173.3	1158.0	7384.3	424.3	6650.6	**2953.72**	**2216.87**
27.50	28.00	27.75	0.50	25.50	18.83	8.83	165.91	1.89	13.0	13.0	1.0	72.23	2628.94	48	1.0	90.5	3760.11	28.0	18.0	28	9.79	5.42	4.29	173.3	1375.4	7764.5	432.8	6821.8	**3105.79**	**2273.94**
28.00	29.50	28.75	1.50	27.00	19.79	9.79	165.91	5.66	18.0	18.0	1.0	304.95	2933.90	28	1.0	158.4	3918.51	29.5	18.0	28	8.99	5.42	4.29	173.3	1373.1	8225.5	458.2	7310.6	**3290.20**	**2436.88**
29.50	30.00	29.75	0.50	27.50	18.99	8.99	165.91	1.89	18.0	18.0	1.0	101.65	3035.55	28	1.0	52.8	3971.31	30.0	18.0	47	8.99	5.42	4.29	173.3	1566.6	8573.4	466.7	7473.6	**3429.37**	**2491.19**
30.00	31.00	30.50	1.00	28.50	18.99	8.99	165.91	3.77	18.0	18.0	1.0	203.30	3238.85	47	1.0	177.3	4148.57	31.0	13.0	42	9.41	3.35	2.08	173.3	1097.7	8485.1	483.7	7871.1	**3394.05**	**2623.70**
31.00	32.50	31.75	1.50	30.00	19.41	9.41	165.91	5.66	13.0	13.0	1.0	216.68	3455.53	42	1.0	237.6	4386.17	32.5	13.0	42	9.32	3.35	2.08	173.3	1097.6	8939.3	509.1	8350.8	**3575.71**	**2783.62**
32.50	34.00	33.25	1.50	31.50	19.32	9.32	165.91	5.66	13.0	13.0	1.0	216.68	3672.21	42	1.0	237.6	4623.77	34.0	8.5	53	8.46	2.20	0.99	173.3	976.7	9272.6	534.6	8830.6	**3709.06**	**2943.53**
34.00	35.00	34.50	1.00	32.50	18.46	8.46	165.91	3.77	8.5	8.5	1.0	93.51	3765.72	53	1.0	199.9	4823.66	35.0	8.5	53	8.46	2.20	0.99	173.3	976.7	9566.0	551.6	9141.0	**3826.42**	**3046.98**
35.00	35.50	35.25	0.50	33.00	18.46	8.46	165.91	1.89	8.5	8.5	1.0	46.76	3812.48	53	1.0	99.9	4923.60	35.5	22.5	30	7.82	8.20	8.14	173.3	1956.2	10692.3	560.1	9296.1	**4276.92**	**3098.71**
35.50	37.00	36.25	1.50	34.50	17.82	7.82	165.91	5.66	22.5	22.5	1.0	388.76	4201.24	30	1.0	169.7	5093.31	37.0	22.5	30	8.29	8.20	8.14	173.3	1958.8	11253.4	585.5	9880.1	**4501.35**	**3293.36**
37.00	37.50	37.25	0.50	35.00	18.29	8.29	165.91	1.89	22.5	22.5	1.0	129.59	4330.82	30	1.0	56.6	5149.89	37.5	22.5	30	8.29	8.20	8.14	173.3	1958.8	11439.5	594.0	10074.7	**4575.81**	**3358.24**
37.50	38.50	38.00	1.00	36.00	18.29	8.29	165.91	3.77	22.5	22.5	1.0	259.17	4590.00	30	1.0	113.1	5263.03	38.5	18.5	38	9.36	5.64	4.57	173.3	1522.0	11375.1	611.0	10464.0	**4550.03**	**3488.00**
38.50	40.00	39.25	1.50	37.50	19.36	9.36	165.91	5.66	18.5	18.5	1.0	314.03	4904.03	38	1.0	215.0	5478.00	40.0	18.5	38	9.36	5.64	4.57	173.3	1522.0	11904.1	636.4	11018.5	**4761.63**	**3672.82**
BORE NO: P82, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	18.21	8.21	22.58	1.89	12.2	12.2	1.0	9.20	0	35	1.0	66.0	0	3.0	10.8	44	10.40	2.71	1.45	24.6	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.50	20.40	10.40	35.03	7.54	10.8	10.8	1.0	50.40	0	44	1.0	331.9	0	5.0	10.8	44	10.40	2.71	1.45	45.4	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	20.40	10.40	50.63	3.77	10.8	10.8	1.0	36.43	0	44	1.0	165.9	0	6.0	27.5	3	10.40	15.63	16.64	55.8	0	0.0	59.4	59.4	**0.00**	**19.80**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
6.00	7.00	6.50	1.00	4.50	20.40	10.40	61.03	3.77	27.5	27.5	1.0	119.82	0	3	1.0	11.3	0	7.0	27.5	3	8.60	15.63	16.64	66.2	0	0.0	76.4	76.4	**0.00**	**25.46**
7.00	8.00	7.50	1.00	5.50	18.60	8.60	70.53	3.77	27.5	27.5	1.0	138.47	0	3	1.0	11.3	0	8.0	15.9	29	8.60	4.38	3.14	74.8	684.7	684.7	93.3	93.3	**273.89**	**31.11**
8.00	9.00	8.50	1.00	6.50	18.60	8.60	79.13	3.77	15.9	15.9	1.0	85.01	85.01	29	1.0	109.4	109.37	9.0	15.9	29	8.60	4.38	3.14	83.4	727.4	921.8	110.3	304.7	**368.70**	**101.57**
9.00	10.00	9.50	1.00	7.50	18.60	8.60	87.73	3.77	15.9	15.9	1.0	94.25	179.26	29	1.0	109.4	218.74	10.0	18.0	55	8.60	5.42	4.29	92.0	1149.1	1547.1	127.3	525.3	**618.83**	**175.10**
10.00	11.00	10.50	1.00	8.50	18.60	8.60	96.33	3.77	18.0	18.0	1.0	118.04	297.30	55	1.0	207.4	426.17	11.0	9.0	55	11.00	2.29	1.07	100.6	828.7	1552.2	144.3	867.7	**620.89**	**289.24**
11.00	12.00	11.50	1.00	9.50	21.00	11.00	106.13	3.77	9.0	9.0	1.0	63.40	360.70	55	1.0	207.4	633.60	12.0	9.0	55	11.00	2.29	1.07	111.6	857.2	1851.5	161.2	1155.5	**740.62**	**385.18**
12.00	14.50	13.25	2.50	12.00	21.00	11.00	125.38	9.43	9.0	9.0	1.0	187.23	547.93	55	1.0	518.6	1152.17	14.5	10.5	52	10.50	2.62	1.36	139.1	951.2	2651.3	203.7	1903.8	**1060.51**	**634.59**
14.50	17.50	16.00	3.00	15.00	20.50	10.50	154.88	11.31	10.5	10.5	1.0	324.78	872.72	52	1.0	588.3	1740.51	17.5	10.6	51	10.80	2.65	1.39	170.6	1040.4	3653.7	254.6	2867.8	**1461.46**	**955.93**
17.50	20.50	19.00	3.00	18.00	20.80	10.80	154.88	11.31	10.6	10.6	1.0	327.94	1200.66	51	1.0	577.0	2317.54	20.5	10.5	51	10.80	2.62	1.36	170.6	1034.5	4552.7	305.5	3823.7	**1821.10**	**1274.56**
20.50	22.00	21.25	1.50	19.50	20.80	10.80	154.88	5.66	10.5	10.5	1.0	162.39	1363.05	51	1.0	288.5	2606.06	22.0	24.5	12	10.70	9.64	10.33	170.6	2058.3	6027.4	330.9	4300.0	**2410.96**	**1433.35**
22.00	23.50	22.75	1.50	21.00	20.70	10.70	154.88	5.66	24.5	24.5	1.0	399.30	1762.35	12	1.0	67.9	2673.94	23.5	14.5	55	10.70	3.80	2.51	170.6	1310.9	5747.2	356.4	4792.7	**2298.88**	**1597.56**
23.50	26.50	25.00	3.00	24.00	20.70	10.70	154.88	11.31	14.5	14.5	1.0	453.19	2215.54	55	1.0	622.3	3296.23	26.5	9.5	55	10.80	2.38	1.14	170.6	1027.9	6539.7	407.3	5919.1	**2615.87**	**1973.03**
26.50	27.50	27.00	1.00	25.00	20.80	10.80	154.88	3.77	9.5	9.5	1.0	97.75	2313.29	55	1.0	207.4	3503.66	27.5	9.5	55	10.80	2.38	1.14	170.6	1027.9	6844.9	424.3	6241.2	**2737.94**	**2080.41**
27.50	29.50	28.50	2.00	27.00	20.80	10.80	154.88	7.54	9.5	9.5	1.0	195.50	2508.78	55	1.0	414.9	3918.51	29.5	10.5	56	10.80	2.62	1.36	170.6	1085.5	7512.8	458.2	6885.5	**3005.10**	**2295.17**
29.50	30.00	29.75	0.50	27.50	20.80	10.80	154.88	1.89	10.5	10.5	1.0	54.13	2562.91	56	1.0	105.6	4024.11	30.0	10.5	56	10.50	2.62	1.36	170.6	1085.2	7672.2	466.7	7053.7	**3068.88**	**2351.25**
30.00	32.50	31.25	2.50	30.00	20.50	10.50	154.88	9.43	10.5	10.5	1.0	270.65	2833.56	56	1.0	528.0	4552.11	32.5	11.2	56	10.50	2.82	1.56	170.6	1126.3	8512.0	509.1	7894.8	**3404.81**	**2631.61**
32.50	34.00	33.25	1.50	31.50	20.50	10.50	154.88	5.66	11.2	11.2	1.0	173.49	3007.05	56	1.0	316.8	4868.91	34.0	7.3	60	10.50	1.98	0.80	170.6	999.7	8875.7	534.6	8410.6	**3550.28**	**2803.52**
34.00	35.00	34.50	1.00	32.50	20.50	10.50	154.88	3.77	7.3	7.3	1.0	74.83	3081.88	60	1.0	226.3	5095.20	35.0	7.0	72	8.95	1.93	0.76	170.6	1110.4	9287.4	551.6	8728.6	**3714.98**	**2909.55**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
35.00	35.50	35.25	0.50	33.00	18.95	8.95	154.88	1.89	7.0	7.0	1.0	35.86	3117.74	72	1.0	135.8	5230.97	35.5	7.0	72	10.68	1.93	0.76	170.6	1111.3	9460.0	560.1	8908.8	**3783.99**	**2969.59**
35.50	37.50	36.50	2.00	35.00	20.68	10.68	154.88	7.54	7.0	7.0	1.0	143.44	3261.18	72	1.0	543.1	5774.06	37.5	7.0	72	10.68	1.93	0.76	170.6	1111.3	10146.5	594.0	9629.2	**4058.60**	**3209.75**
37.50	38.50	38.00	1.00	36.00	20.68	10.68	154.88	3.77	7.0	7.0	1.0	71.72	3332.90	72	1.0	271.5	6045.60	38.5	7.0	72	10.12	1.93	0.76	170.6	1111.0	10489.5	611.0	9989.5	**4195.79**	**3329.82**
38.50	40.00	39.25	1.50	37.50	20.12	10.12	154.88	5.66	7.0	7.0	1.0	107.58	3440.48	72	1.0	407.3	6452.91	40.0	11.2	42	10.12	2.82	1.56	170.6	983.4	10876.8	636.4	10529.8	**4350.71**	**3509.94**
BORE NO: P83, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.88	9.88	27.17	1.89	26.8	26.8	1.0	25.88	0	6	1.0	11.3	0	3.0	23.9	0	9.88	9.21	9.67	29.6	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.88	9.88	34.58	3.77	23.9	23.9	1.0	57.79	0	0	1.0	0.0	0	4.0	24.8	10	10.15	9.86	10.66	39.5	0	0.0	25.5	25.5	**0.00**	**8.49**
4.00	6.00	5.00	2.00	3.50	20.15	10.15	49.67	7.54	24.8	24.8	1.0	173.11	0	10	1.0	75.4	0	6.0	24.2	0	10.15	9.42	10.00	59.8	0	0.0	59.4	59.4	**0.00**	**19.80**
6.00	7.00	6.50	1.00	4.50	20.15	10.15	64.90	3.77	24.2	24.2	1.0	109.99	0	0	1.0	0.0	0	7.0	24.2	0	10.15	9.42	10.00	70.0	0	0.0	76.4	76.4	**0.00**	**25.46**
7.00	8.00	7.50	1.00	5.50	20.15	10.15	75.05	3.77	24.2	24.2	1.0	127.20	0	0	1.0	0.0	0	8.0	28.6	0	9.80	18.11	19.17	80.1	0	0.0	93.3	93.3	**0.00**	**31.11**
8.00	9.00	8.50	1.00	6.50	19.80	9.80	85.02	3.77	28.6	28.6	1.0	174.82	0	0	1.0	0.0	0	9.0	8.9	58	9.80	2.27	1.05	89.9	828.7	828.7	110.3	110.3	**331.50**	**36.77**
9.00	10.00	9.50	1.00	7.50	19.80	9.80	94.82	3.77	8.9	8.9	1.0	56.00	56.00	58	1.0	218.7	218.74	10.0	8.9	58	10.31	2.27	1.05	99.7	854.3	1129.0	127.3	402.0	**451.62**	**134.01**
10.00	12.50	11.25	2.50	10.00	20.31	10.31	112.61	9.43	8.9	8.9	1.0	166.26	222.26	58	1.0	546.9	765.60	12.5	9.5	52	10.31	2.38	1.14	125.5	875.4	1863.3	169.7	1157.6	**745.32**	**385.86**
12.50	14.00	13.25	1.50	11.50	20.31	10.31	133.23	5.66	9.5	9.5	1.0	126.12	348.39	52	1.0	294.2	1059.77	14.0	9.5	52	10.13	2.38	1.14	141.0	916.9	2325.1	195.2	1603.3	**930.04**	**534.44**
14.00	15.50	14.75	1.50	13.00	20.13	10.13	148.56	5.66	9.5	9.5	1.0	140.64	489.02	52	1.0	294.2	1353.94	15.5	9.5	58	10.13	2.38	1.14	156.2	1019.0	2861.9	220.6	2063.6	**1144.77**	**687.86**
15.50	18.50	17.00	3.00	16.00	20.13	10.13	171.35	11.31	9.5	9.5	1.0	324.43	813.45	58	1.0	656.2	2010.17	18.5	10.2	58	9.79	2.53	1.28	156.2	1045.9	3869.5	271.5	3095.2	**1547.80**	**1031.72**
18.50	21.50	20.00	3.00	19.00	19.79	9.79	171.35	11.31	10.2	10.2	1.0	348.83	1162.28	58	1.0	656.2	2666.40	21.5	10.2	48	9.79	2.53	1.28	156.2	944.0	4772.7	322.5	4151.1	**1909.09**	**1383.71**
21.50	23.00	22.25	1.50	20.50	19.79	9.79	171.35	5.66	10.2	10.2	1.0	174.41	1336.69	48	1.0	271.5	2937.94	23.0	9.6	55	8.40	2.40	1.16	156.2	990.3	5265.0	347.9	4622.5	**2105.99**	**1540.85**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
23.00	24.50	23.75	1.50	22.00	18.40	8.40	171.35	5.66	9.6	9.6	1.0	163.95	1500.65	55	1.0	311.1	3249.09	24.5	9.6	55	8.40	2.40	1.16	156.2	990.3	5740.1	373.4	5123.1	**2296.03**	**1707.70**
24.50	27.50	26.00	3.00	25.00	18.40	8.40	171.35	11.31	9.6	9.6	1.0	327.91	1828.55	55	1.0	622.3	3871.37	27.5	9.6	55	11.35	2.40	1.16	156.2	992.7	6692.6	424.3	6124.2	**2677.03**	**2041.40**
27.50	30.00	28.75	2.50	27.50	21.35	11.35	171.35	9.43	9.6	9.6	1.0	273.26	2101.81	55	1.0	518.6	4389.94	30.0	8.1	62	11.35	2.13	0.93	156.2	1014.5	7506.2	466.7	6958.5	**3002.48**	**2319.49**
30.00	30.50	30.25	0.50	28.00	21.35	11.35	171.35	1.89	8.1	8.1	1.0	45.99	2147.79	62	1.0	116.9	4506.86	30.5	15.3	49	11.35	4.09	2.81	156.2	1242.8	7897.5	475.2	7129.9	**3158.99**	**2376.62**
30.50	32.00	31.25	1.50	29.50	21.35	11.35	171.35	5.66	15.3	15.3	1.0	265.18	2412.98	49	1.0	277.2	4784.06	32.0	13.8	49	11.35	3.59	2.31	156.2	1151.0	8348.0	500.7	7697.7	**3339.22**	**2565.90**
32.00	32.50	32.25	0.50	30.00	21.35	11.35	171.35	1.89	13.8	13.8	1.0	79.37	2492.34	49	1.0	92.4	4876.46	32.5	13.8	49	10.60	3.59	2.31	156.2	1149.8	8518.6	509.1	7877.9	**3407.45**	**2625.98**
32.50	33.50	33.00	1.00	31.00	20.60	10.60	171.35	3.77	13.8	13.8	1.0	158.73	2651.07	49	1.0	184.8	5061.26	33.5	13.8	49	10.60	3.59	2.31	156.2	1149.8	8862.2	526.1	8238.4	**3544.87**	**2746.15**
33.50	35.00	34.25	1.50	32.50	20.60	10.60	171.35	5.66	13.8	13.8	1.0	238.10	2889.17	49	1.0	277.2	5338.46	35.0	12.8	47	10.60	3.29	2.02	156.2	1074.7	9302.3	551.6	8779.2	**3720.93**	**2926.40**
35.00	36.50	35.75	1.50	34.00	20.60	10.60	171.35	5.66	12.8	12.8	1.0	220.23	3109.40	47	1.0	265.9	5604.34	36.5	12.8	47	10.60	3.29	2.02	156.2	1074.7	9788.4	577.0	9290.8	**3915.37**	**3096.92**
36.50	37.50	37.00	1.00	35.00	20.60	10.60	171.35	3.77	12.8	12.8	1.0	146.82	3256.22	47	1.0	177.3	5781.60	37.5	12.0	38	10.60	3.06	1.79	156.2	940.1	9977.9	594.0	9631.8	**3991.18**	**3210.61**
37.50	38.00	37.75	0.50	35.50	20.60	10.60	171.35	1.89	12.0	12.0	1.0	68.68	3324.90	38	1.0	71.7	5853.26	38.0	12.0	38	9.30	3.06	1.79	156.2	938.5	10116.7	602.5	9780.6	**4046.68**	**3260.22**
38.00	40.00	39.00	2.00	37.50	19.30	9.30	171.35	7.54	12.0	12.0	1.0	274.72	3599.63	38	1.0	286.6	6139.89	40.0	12.0	38	9.30	3.06	1.79	156.2	938.5	10678.1	636.4	10375.9	**4271.22**	**3458.65**
BORE NO: P84, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.99	9.99	27.47	1.89	26.5	26.5	1.0	25.83	25.83	8	1.0	15.1	15.09	3.0	25.0	10	9.99	10.00	10.88	30.0	514.7	555.6	8.5	49.4	**222.25**	**16.47**
3.00	4.00	3.50	1.00	1.50	19.99	9.99	34.97	3.77	25.0	25.0	1.0	61.49	87.32	10	1.0	37.7	52.80	4.0	25.0	10	9.99	10.00	10.88	40.0	627.7	767.9	25.5	165.6	**307.14**	**55.19**
4.00	5.00	4.50	1.00	2.50	19.99	9.99	44.96	3.77	25.0	25.0	1.0	79.06	166.38	10	1.0	37.7	90.51	5.0	25.0	10	9.91	10.00	10.88	50.0	740.2	997.1	42.4	299.3	**398.83**	**99.77**
5.00	6.00	5.50	1.00	3.50	19.91	9.91	54.91	3.77	25.0	25.0	1.0	96.56	262.94	10	1.0	37.7	128.23	6.0	25.0	10	9.91	10.00	10.88	59.9	852.3	1243.5	59.4	450.6	**497.39**	**150.19**
6.00	7.00	6.50	1.00	4.50	19.91	9.91	64.82	3.77	25.0	25.0	1.0	113.99	376.93	10	1.0	37.7	165.94	7.0	10.2	45	10.13	2.53	1.28	69.8	666.6	1209.5	76.4	619.2	**483.80**	**206.41**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Factor of Safety in Compression: 2.5
Area of Pile: 1.13 m^2
Critical water table: 0.00 m
Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
7.00	9.00	8.00	2.00	6.50	20.13	10.13	79.90	7.54	10.2	10.2	1.0	108.44	485.36	45	1.0	339.4	505.37	9.0	10.2	45	10.13	2.53	1.28	90.0	724.6	1715.3	110.3	1101.0	**686.13**	**367.02**
9.00	10.00	9.50	1.00	7.50	20.13	10.13	95.10	3.77	10.2	10.2	1.0	64.53	549.89	45	1.0	169.7	675.09	10.0	10.2	45	10.13	2.53	1.28	100.2	753.6	1978.6	127.3	1352.3	**791.43**	**450.76**
10.00	11.00	10.50	1.00	8.50	20.13	10.13	105.23	3.77	10.2	10.2	1.0	71.40	621.30	45	1.0	169.7	844.80	11.0	27.0	0	9.90	14.50	15.49	110.3	1914.0	3380.0	144.3	1610.4	**1352.02**	**536.79**
11.00	12.50	11.75	1.50	10.00	19.90	9.90	117.72	5.66	27.0	27.0	1.0	339.31	960.61	0	1.0	0.0	844.80	12.5	27.0	0	10.09	14.50	15.49	125.1	2159.6	3965.0	169.7	1975.1	**1586.02**	**658.37**
12.50	15.50	14.00	3.00	13.00	20.09	10.09	140.28	11.31	27.0	27.0	1.0	808.67	1769.28	0	1.0	0.0	844.80	15.5	8.5	65	10.09	2.20	0.99	155.4	1055.5	3669.6	220.6	2834.7	**1467.83**	**944.90**
15.50	17.00	16.25	1.50	14.50	20.09	10.09	162.98	5.66	8.5	8.5	1.0	137.79	1907.07	65	1.0	367.7	1212.51	17.0	26.7	0	8.11	13.83	14.80	170.5	2749.8	5869.3	246.1	3365.7	**2347.74**	**1121.89**
17.00	18.50	17.75	1.50	16.00	18.11	8.11	176.63	5.66	26.7	26.7	1.0	502.55	2409.62	0	1.0	0.0	1212.51	18.5	26.7	0	8.11	13.83	14.80	170.5	2749.8	6371.9	271.5	3893.7	**2548.76**	**1297.89**
18.50	20.00	19.25	1.50	17.50	18.11	8.11	176.63	5.66	26.7	26.7	1.0	502.55	2912.17	0	1.0	0.0	1212.51	20.0	10.5	56	8.11	2.62	1.36	170.5	1082.7	5207.4	297.0	4421.7	**2082.96**	**1473.89**
20.00	21.50	20.75	1.50	19.00	18.11	8.11	176.63	5.66	10.5	10.5	1.0	185.19	3097.36	56	1.0	316.8	1529.31	21.5	9.5	56	10.24	2.38	1.14	170.5	1037.4	5664.1	322.5	4949.1	**2265.64**	**1649.71**
21.50	24.50	23.00	3.00	22.00	20.24	10.24	176.63	11.31	9.5	9.5	1.0	334.42	3431.78	56	1.0	633.6	2162.91	24.5	16.2	41	10.24	4.53	3.31	170.5	1314.7	6909.4	373.4	5968.1	**2763.75**	**1989.36**
24.50	26.00	25.25	1.50	23.50	20.24	10.24	176.63	5.66	16.2	16.2	1.0	290.30	3722.08	41	1.0	231.9	2394.86	26.0	8.5	49	10.24	2.20	0.99	170.5	930.3	7047.3	398.8	6515.8	**2818.91**	**2171.92**
26.00	27.50	26.75	1.50	25.00	20.24	10.24	176.63	5.66	8.5	8.5	1.0	149.33	3871.41	49	1.0	277.2	2672.06	27.5	29.0	0	10.64	19.01	20.10	170.5	3812.9	10356.3	424.3	6967.8	**4142.53**	**2322.58**
27.50	29.00	28.25	1.50	26.50	20.64	10.64	176.63	5.66	29.0	29.0	1.0	553.87	4425.28	0	1.0	0.0	2672.06	29.0	29.0	0	10.64	19.01	20.10	170.5	3812.9	10910.2	449.7	7547.1	**4364.08**	**2515.69**
29.00	30.00	29.50	1.00	27.50	20.64	10.64	176.63	3.77	29.0	29.0	1.0	369.25	4794.53	0	1.0	0.0	2672.06	30.0	29.0	0	10.64	19.01	20.10	170.5	3812.9	11279.4	466.7	7933.3	**4511.78**	**2644.43**
30.00	30.50	30.25	0.50	28.00	20.64	10.64	176.63	1.89	29.0	29.0	1.0	184.62	4979.15	0	1.0	0.0	2672.06	30.5	29.0	0	10.64	19.01	20.10	170.5	3812.9	11464.1	475.2	8126.4	**4585.62**	**2708.80**
30.50	32.00	31.25	1.50	29.50	20.64	10.64	176.63	5.66	29.0	29.0	1.0	553.87	5533.02	0	1.0	0.0	2672.06	32.0	28.7	0	10.64	18.33	19.40	170.5	3677.5	11882.6	500.7	8705.7	**4753.03**	**2901.91**
32.00	32.50	32.25	0.50	30.00	20.64	10.64	176.63	1.89	28.7	28.7	1.0	182.35	5715.37	0	1.0	0.0	2672.06	32.5	28.7	0	10.43	18.33	19.40	170.5	3674.7	12062.2	509.1	8896.6	**4824.87**	**2965.52**
32.50	33.50	33.00	1.00	31.00	20.43	10.43	176.63	3.77	28.7	28.7	1.0	364.70	6080.07	0	1.0	0.0	2672.06	33.5	28.7	0	10.43	18.33	19.40	170.5	3674.7	12426.9	526.1	9278.2	**4970.75**	**3092.75**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
33.50	35.00	34.25	1.50	32.50	20.43	10.43	176.63	5.66	28.7	28.7	1.0	547.05	6627.12	0	1.0	0.0	2672.06	35.0	28.7	0	10.43	18.33	19.40	170.5	3674.7	12973.9	551.6	9850.7	**5189.57**	**3283.58**
35.00	36.50	35.75	1.50	34.00	20.43	10.43	176.63	5.66	28.7	28.7	1.0	547.05	7174.17	0	1.0	0.0	2672.06	36.5	28.7	0	10.43	18.33	19.40	170.5	3674.7	13521.0	577.0	10423.3	**5408.39**	**3474.42**
36.50	37.50	37.00	1.00	35.00	20.43	10.43	176.63	3.77	28.7	28.7	1.0	364.70	7538.87	0	1.0	0.0	2672.06	37.5	28.7	0	10.43	18.33	19.40	170.5	3674.7	13885.7	594.0	10804.9	**5554.27**	**3601.64**
37.50	40.00	38.75	2.50	37.50	20.43	10.43	176.63	9.43	28.7	28.7	1.0	911.75	8450.62	0	1.0	0.0	2672.06	40.0	28.7	0	10.43	18.33	19.40	170.5	3674.7	14797.4	636.4	11759.1	**5918.97**	**3919.70**
BORE NO: P85, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.45	9.45	25.99	1.89	13.3	13.3	1.0	11.58	0	27	1.0	50.9	0	3.0	13.3	27	9.45	3.44	2.16	28.4	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.45	9.45	33.08	3.77	13.3	13.3	1.0	29.49	0	27	1.0	101.8	0	4.0	12.4	46	9.45	3.17	1.91	37.8	0	0.0	25.5	25.5	**0.00**	**8.49**
4.00	5.00	4.50	1.00	2.50	19.45	9.45	42.53	3.77	12.4	12.4	1.0	35.26	0	46	1.0	173.5	0	5.0	14.3	22	9.00	3.74	2.45	47.3	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	19.00	9.00	51.75	3.77	14.3	14.3	1.0	49.75	0	22	1.0	83.0	0	6.0	14.3	22	9.00	3.74	2.45	56.3	0	0.0	59.4	59.4	**0.00**	**19.80**
6.00	7.00	6.50	1.00	4.50	19.00	9.00	60.75	3.77	14.3	14.3	1.0	58.40	0	22	1.0	83.0	0	7.0	28.5	3	9.00	17.88	18.94	65.3	0	0.0	76.4	76.4	**0.00**	**25.46**
7.00	8.00	7.50	1.00	5.50	19.00	9.00	69.75	3.77	28.5	28.5	1.0	142.83	0	3	1.0	11.3	0	8.0	24.5	13	9.00	9.64	10.33	74.3	1005.3	1005.3	93.3	93.3	**402.14**	**31.11**
8.00	9.00	8.50	1.00	6.50	19.00	9.00	78.75	3.77	24.5	24.5	1.0	135.35	135.35	13	1.0	49.0	49.03	9.0	24.5	13	9.00	9.64	10.33	83.3	1103.5	1287.9	110.3	294.7	**515.15**	**98.23**
9.00	10.00	9.50	1.00	7.50	19.00	9.00	87.75	3.77	24.5	24.5	1.0	150.82	286.17	13	1.0	49.0	98.06	10.0	24.5	13	9.90	9.64	10.33	92.3	1208.0	1592.2	127.3	511.5	**636.88**	**170.50**
10.00	11.00	10.50	1.00	8.50	19.90	9.90	97.20	3.77	24.5	24.5	1.0	167.06	453.23	13	1.0	49.0	147.09	11.0	24.5	13	9.90	9.64	10.33	102.2	1316.0	1916.3	144.3	744.6	**766.51**	**248.19**
11.00	12.00	11.50	1.00	9.50	19.90	9.90	107.10	3.77	24.5	24.5	1.0	184.08	637.31	13	1.0	49.0	196.11	12.0	26.5	15	9.70	13.38	14.34	112.1	1943.1	2776.6	161.2	994.7	**1110.63**	**331.55**
12.00	14.50	13.25	2.50	12.00	19.70	9.70	124.18	9.43	26.5	26.5	1.0	583.74	1221.04	15	1.0	141.4	337.54	14.5	26.5	15	9.70	13.38	14.34	136.3	2310.2	3868.8	203.7	1762.2	**1547.51**	**587.41**
14.50	16.00	15.25	1.50	13.50	19.70	9.70	143.58	5.66	26.5	26.5	1.0	404.96	1626.00	15	1.0	84.9	422.40	16.0	10.2	46	10.90	2.53	1.28	150.9	909.5	2957.9	229.1	2277.5	**1183.15**	**759.17**
16.00	17.50	16.75	1.50	15.00	20.90	10.90	159.03	5.66	10.2	10.2	1.0	161.87	1787.87	46	1.0	260.2	682.63	17.5	11.5	46	10.40	2.91	1.65	167.2	1030.7	3501.2	254.6	2725.1	**1400.50**	**908.36**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
17.50	20.50	19.00	3.00	18.00	20.40	10.40	159.03	11.31	11.5	11.5	1.0	366.06	2153.94	46	1.0	520.5	1203.09	20.5	10.6	54	10.70	2.65	1.39	167.2	1060.6	4417.6	305.5	3662.5	**1767.05**	**1220.84**
20.50	23.50	22.00	3.00	21.00	20.70	10.70	159.03	11.31	10.6	10.6	1.0	336.72	2490.66	54	1.0	611.0	1814.06	23.5	10.6	54	9.80	2.65	1.39	167.2	1059.8	5364.5	356.4	4661.1	**2145.79**	**1553.70**
23.50	26.50	25.00	3.00	24.00	19.80	9.80	159.03	11.31	10.6	10.6	1.0	336.72	2827.38	54	1.0	611.0	2425.03	26.5	18.0	40	9.80	5.42	4.29	167.2	1460.5	6712.9	407.3	5659.7	**2685.14**	**1886.57**
26.50	27.50	27.00	1.00	25.00	19.80	9.80	159.03	3.77	18.0	18.0	1.0	194.87	3022.25	40	1.0	150.9	2575.89	27.5	18.0	40	9.80	5.42	4.29	167.2	1460.5	7058.6	424.3	6022.4	**2823.43**	**2007.47**
27.50	28.00	27.75	0.50	25.50	19.80	9.80	159.03	1.89	18.0	18.0	1.0	97.44	3119.68	40	1.0	75.4	2651.31	28.0	8.5	60	11.02	2.20	0.99	167.2	1034.6	6805.6	432.8	6203.8	**2722.22**	**2067.92**
28.00	29.50	28.75	1.50	27.00	21.02	11.02	159.03	5.66	8.5	8.5	1.0	134.45	3254.13	60	1.0	339.4	2990.74	29.5	8.5	60	11.02	2.20	0.99	167.2	1034.6	7279.4	458.2	6703.1	**2911.77**	**2234.37**
29.50	30.00	29.75	0.50	27.50	21.02	11.02	159.03	1.89	8.5	8.5	1.0	44.82	3298.95	60	1.0	113.1	3103.89	30.0	8.5	60	11.02	2.20	0.99	167.2	1034.6	7437.4	466.7	6869.6	**2974.96**	**2289.85**
30.00	31.00	30.50	1.00	28.50	21.02	11.02	159.03	3.77	8.5	8.5	1.0	89.63	3388.58	60	1.0	226.3	3330.17	31.0	9.0	40	11.02	2.29	1.07	167.2	848.5	7567.3	483.7	7202.4	**3026.90**	**2400.81**
31.00	32.50	31.75	1.50	30.00	21.02	11.02	159.03	5.66	9.0	9.0	1.0	142.49	3531.07	40	1.0	226.3	3556.46	32.5	9.1	44	9.90	2.31	1.08	167.2	891.9	7979.5	509.1	7596.7	**3191.78**	**2532.22**
32.50	35.00	33.75	2.50	32.50	19.90	9.90	159.03	9.43	9.1	9.1	1.0	240.16	3771.23	44	1.0	414.9	3971.31	35.0	9.1	44	9.90	2.31	1.08	167.2	891.9	8634.5	551.6	8294.1	**3453.79**	**2764.71**
35.00	35.50	35.25	0.50	33.00	19.90	9.90	159.03	1.89	9.1	9.1	1.0	48.03	3819.27	44	1.0	83.0	4054.29	35.5	21.0	26	9.90	7.12	6.49	167.2	1655.3	9528.8	560.1	8433.6	**3811.53**	**2811.20**
35.50	37.00	36.25	1.50	34.50	19.90	9.90	159.03	5.66	21.0	21.0	1.0	345.33	4164.60	26	1.0	147.1	4201.37	37.0	11.5	44	9.90	2.91	1.65	167.2	1009.8	9375.8	585.5	8951.5	**3750.32**	**2983.83**
37.00	37.50	37.25	0.50	35.00	19.90	9.90	159.03	1.89	11.5	11.5	1.0	61.01	4225.61	44	1.0	83.0	4284.34	37.5	11.5	44	8.60	2.91	1.65	167.2	1008.4	9518.3	594.0	9104.0	**3807.33**	**3034.65**
37.50	38.50	38.00	1.00	36.00	18.60	8.60	159.03	3.77	11.5	11.5	1.0	122.02	4347.63	44	1.0	165.9	4450.29	38.5	9.5	56	9.43	2.38	1.14	167.2	1027.8	9825.7	611.0	9408.9	**3930.28**	**3136.30**
38.50	40.00	39.25	1.50	37.50	19.43	9.43	159.03	5.66	9.5	9.5	1.0	150.55	4498.18	56	1.0	316.8	4767.09	40.0	9.5	56	9.43	2.38	1.14	167.2	1027.8	10293.1	636.4	9901.7	**4117.22**	**3300.56**
BORE NO: P86, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.64	9.64	26.51	1.89	11.8	11.8	1.0	10.44	0	24	1.0	45.3	0	3.0	25.7	8	9.64	11.58	12.49	28.9	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.64	9.64	33.74	3.77	25.7	25.7	1.0	61.24	0	8	1.0	30.2	0	4.0	25.7	8	9.64	11.58	12.49	38.6	0	0.0	25.5	25.5	**0.00**	**8.49**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
4.00	6.00	5.00	2.00	3.50	19.64	9.64	48.20	7.54	25.7	25.7	1.0	174.97	0	8	1.0	60.3	0	6.0	25.5	10	9.64	11.13	12.03	57.8	908.7	908.7	59.4	59.4	**363.47**	**19.80**
6.00	7.00	6.50	1.00	4.50	19.64	9.64	62.66	3.77	25.5	25.5	1.0	112.72	112.72	10	1.0	37.7	37.71	7.0	25.5	10	9.64	11.13	12.03	67.5	1030.0	1180.5	76.4	226.8	**472.18**	**75.60**
7.00	8.00	7.50	1.00	5.50	19.64	9.64	72.30	3.77	25.5	25.5	1.0	130.06	242.78	10	1.0	37.7	75.43	8.0	25.5	10	9.68	11.13	12.03	77.1	1151.7	1469.9	93.3	411.5	**587.96**	**137.18**
8.00	9.00	8.50	1.00	6.50	19.68	9.68	81.96	3.77	25.5	25.5	1.0	147.44	390.21	10	1.0	37.7	113.14	9.0	25.2	11	9.68	10.45	11.34	86.8	1212.8	1716.2	110.3	613.7	**686.48**	**204.56**
9.00	10.00	9.50	1.00	7.50	19.68	9.68	91.64	3.77	25.2	25.2	1.0	162.63	552.85	11	1.0	41.5	154.63	10.0	25.5	10	9.68	11.13	12.03	96.5	1395.4	2102.9	127.3	834.8	**841.15**	**278.25**
10.00	11.00	10.50	1.00	8.50	19.68	9.68	101.32	3.77	25.5	25.5	1.0	182.26	735.11	10	1.0	37.7	192.34	11.0	25.2	11	8.99	10.45	11.34	106.2	1436.4	2363.9	144.3	1071.7	**945.56**	**357.24**
11.00	12.50	11.75	1.50	10.00	18.99	8.99	112.90	5.66	25.2	25.2	1.0	300.55	1035.66	11	1.0	62.2	254.57	12.5	10.5	51	10.19	2.62	1.36	119.6	883.0	2173.2	169.7	1459.9	**869.30**	**486.65**
12.50	15.50	14.00	3.00	13.00	20.19	10.19	134.93	11.31	10.5	10.5	1.0	282.95	1318.61	51	1.0	577.0	831.60	15.5	10.5	51	10.19	2.62	1.36	150.2	973.5	3123.7	220.6	2370.8	**1249.50**	**790.28**
15.50	17.00	16.25	1.50	14.50	20.19	10.19	157.86	5.66	10.5	10.5	1.0	165.51	1484.12	51	1.0	288.5	1120.11	17.0	27.0	5	9.65	14.50	15.49	165.5	2868.2	5472.5	246.1	2850.3	**2188.99**	**950.11**
17.00	18.50	17.75	1.50	16.00	19.65	9.65	172.74	5.66	27.0	27.0	1.0	497.91	1982.03	5	1.0	28.3	1148.40	18.5	13.5	50	9.65	3.50	2.22	165.5	1179.1	4309.5	271.5	3402.0	**1723.80**	**1133.99**
18.50	21.50	20.00	3.00	19.00	19.65	9.65	172.74	11.31	13.5	13.5	1.0	469.21	2451.24	50	1.0	565.7	1714.11	21.5	13.5	50	10.09	3.50	2.22	165.5	1179.7	5345.1	322.5	4487.8	**2138.03**	**1495.94**
21.50	24.50	23.00	3.00	22.00	20.09	10.09	172.74	11.31	13.5	13.5	1.0	469.21	2920.45	50	1.0	565.7	2279.83	24.5	9.4	53	10.09	2.36	1.13	165.5	989.7	6190.0	373.4	5573.6	**2475.99**	**1857.88**
24.50	26.00	25.25	1.50	23.50	20.09	10.09	172.74	5.66	9.4	9.4	1.0	161.77	3082.22	53	1.0	299.8	2579.66	26.0	27.1	0	8.89	14.73	15.72	165.5	2852.9	8514.8	398.8	6060.7	**3405.91**	**2020.24**
26.00	27.50	26.75	1.50	25.00	18.89	8.89	172.74	5.66	27.1	27.1	1.0	500.06	3582.28	0	1.0	0.0	2579.66	27.5	21.5	0	8.89	7.48	7.04	165.5	1443.1	7605.0	424.3	6586.2	**3042.02**	**2195.41**
27.50	30.00	28.75	2.50	27.50	18.89	8.89	172.74	9.43	21.5	21.5	1.0	641.55	4223.83	0	1.0	0.0	2579.66	30.0	21.5	0	9.32	7.48	7.04	165.5	1445.2	8248.7	466.7	7270.2	**3299.46**	**2423.40**
30.00	30.50	30.25	0.50	28.00	19.32	9.32	172.74	1.89	21.5	21.5	1.0	128.31	4352.14	0	1.0	0.0	2579.66	30.5	28.5	0	10.55	17.88	18.94	165.5	3484.0	10415.8	475.2	7407.0	**4166.34**	**2469.00**
30.50	32.00	31.25	1.50	29.50	20.55	10.55	172.74	5.66	28.5	28.5	1.0	530.58	4882.72	0	1.0	0.0	2579.66	32.0	14.5	54	10.55	3.80	2.51	165.5	1278.4	8740.8	500.7	7963.0	**3496.33**	**2654.34**
32.00	32.50	32.25	0.50	30.00	20.55	10.55	172.74	1.89	14.5	14.5	1.0	84.24	4966.96	54	1.0	101.8	2681.49	32.5	14.5	54	10.55	3.80	2.51	165.5	1278.4	8926.9	509.1	8157.6	**3570.76**	**2719.20**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
32.50	33.50	33.00	1.00	31.00	20.55	10.55	172.74	3.77	14.5	14.5	1.0	168.48	5135.44	54	1.0	203.7	2885.14	33.5	9.3	67	10.55	2.34	1.11	165.5	1129.1	9149.7	526.1	8546.7	**3659.89**	**2848.90**
33.50	35.00	34.25	1.50	32.50	20.55	10.55	172.74	5.66	9.3	9.3	1.0	160.02	5295.46	67	1.0	379.0	3264.17	35.0	9.3	67	10.55	2.34	1.11	165.5	1129.1	9688.8	551.6	9111.2	**3875.51**	**3037.07**
35.00	36.50	35.75	1.50	34.00	20.55	10.55	172.74	5.66	9.3	9.3	1.0	160.02	5455.48	67	1.0	379.0	3643.20	36.5	13.1	49	10.55	3.38	2.11	165.5	1147.0	10245.6	577.0	9675.7	**4098.26**	**3225.24**
36.50	37.50	37.00	1.00	35.00	20.55	10.55	172.74	3.77	13.1	13.1	1.0	151.60	5607.08	49	1.0	184.8	3828.00	37.5	13.1	49	10.81	3.38	2.11	165.5	1147.3	10582.4	594.0	10029.1	**4232.97**	**3343.03**
37.50	40.00	38.75	2.50	37.50	20.81	10.81	172.74	9.43	13.1	13.1	1.0	379.00	5986.09	49	1.0	462.0	4290.00	40.0	13.1	49	10.81	3.38	2.11	165.5	1147.3	11423.4	636.4	10912.5	**4569.37**	**3637.51**
BORE NO: P87, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.05	10.05	27.64	1.89	12.5	12.5	1.0	11.55	0	51	1.0	96.2	0	3.0	13.5	12	10.05	3.50	2.22	30.2	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	20.05	10.05	35.18	3.77	13.5	13.5	1.0	31.85	0	12	1.0	45.3	0	4.0	27.5	4	9.59	15.63	16.64	40.2	0	0.0	25.5	25.5	**0.00**	**8.49**
4.00	5.00	4.50	1.00	2.50	19.59	9.59	45.00	3.77	27.5	27.5	1.0	88.34	0	4	1.0	15.1	0	5.0	29.0	0	9.59	19.01	20.10	49.8	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	19.59	9.59	54.59	3.77	29.0	29.0	1.0	114.11	0	0	1.0	0.0	0	6.0	29.0	0	9.88	19.01	20.10	59.4	0	0.0	59.4	59.4	**0.00**	**19.80**
6.00	8.00	7.00	2.00	5.50	19.88	9.88	69.26	7.54	29.0	29.0	1.0	289.58	0	0	1.0	0.0	0	8.0	17.5	68	9.88	5.17	4.02	79.1	1182.3	1182.3	93.3	93.3	**472.93**	**31.11**
8.00	9.00	8.50	1.00	6.50	19.88	9.88	84.08	3.77	17.5	17.5	1.0	99.98	99.98	68	1.0	256.5	256.46	9.0	15.0	30	9.88	3.94	2.65	89.0	720.1	1076.5	110.3	466.8	**430.61**	**155.58**
9.00	10.00	9.50	1.00	7.50	19.88	9.88	93.96	3.77	15.0	15.0	1.0	94.95	194.93	30	1.0	113.1	369.60	10.0	25.6	0	9.88	11.35	12.26	98.9	1352.4	1917.0	127.3	691.8	**766.78**	**230.61**
10.00	11.00	10.50	1.00	8.50	19.88	9.88	103.84	3.77	25.6	25.6	1.0	187.64	382.57	0	1.0	0.0	369.60	11.0	11.5	53	9.79	2.91	1.65	108.8	908.9	1661.1	144.3	896.4	**664.44**	**298.81**
11.00	12.00	11.50	1.00	9.50	19.79	9.79	113.68	3.77	11.5	11.5	1.0	87.22	469.79	53	1.0	199.9	569.49	12.0	9.0	72	9.79	2.29	1.07	118.6	1047.5	2086.7	161.2	1200.5	**834.70**	**400.17**
12.00	13.00	12.50	1.00	10.50	19.79	9.79	123.47	3.77	9.0	9.0	1.0	73.75	543.54	72	1.0	271.5	841.03	13.0	11.5	53	9.79	2.91	1.65	128.4	973.4	2358.0	178.2	1562.8	**943.19**	**520.92**
13.00	14.50	13.75	1.50	12.00	19.79	9.79	135.70	5.66	11.5	11.5	1.0	156.19	699.73	53	1.0	299.8	1140.86	14.5	11.5	53	9.79	2.91	1.65	143.0	1021.8	2862.4	203.7	2044.2	**1144.95**	**681.41**
14.50	16.00	15.25	1.50	13.50	19.79	9.79	150.39	5.66	11.5	11.5	1.0	173.09	872.82	53	1.0	299.8	1440.69	16.0	26.8	0	9.46	14.05	15.03	157.7	2604.5	4918.0	229.1	2542.6	**1967.20**	**847.54**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
16.00	17.50	16.75	1.50	15.00	19.46	9.46	164.83	5.66	26.8	26.8	1.0	471.01	1343.83	0	1.0	0.0	1440.69	17.5	9.5	56	11.05	2.38	1.14	171.9	1041.8	3826.3	254.6	3039.1	**1530.51**	**1013.03**
17.50	20.50	19.00	3.00	18.00	21.05	11.05	164.83	11.31	9.5	9.5	1.0	312.07	1655.90	56	1.0	633.6	2074.29	20.5	9.5	56	11.05	2.38	1.14	171.9	1041.8	4771.9	305.5	4035.7	**1908.78**	**1345.22**
20.50	22.00	21.25	1.50	19.50	21.05	11.05	164.83	5.66	9.5	9.5	1.0	156.04	1811.94	56	1.0	316.8	2391.09	22.0	11.5	42	10.00	2.91	1.65	171.9	1005.1	5208.1	330.9	4534.0	**2083.25**	**1511.32**
22.00	23.50	22.75	1.50	21.00	20.00	10.00	164.83	5.66	11.5	11.5	1.0	189.71	2001.65	42	1.0	237.6	2628.69	23.5	11.0	68	10.00	2.76	1.51	171.9	1240.3	5870.6	356.4	4986.7	**2348.25**	**1662.24**
23.50	25.00	24.25	1.50	22.50	20.00	10.00	164.83	5.66	11.0	11.0	1.0	181.25	2182.89	68	1.0	384.7	3013.37	25.0	26.5	0	9.48	13.38	14.34	171.9	2694.5	7890.7	381.9	5578.1	**3156.29**	**1859.37**
25.00	26.50	25.75	1.50	24.00	19.48	9.48	164.83	5.66	26.5	26.5	1.0	464.90	2647.79	0	1.0	0.0	3013.37	26.5	26.0	0	9.48	12.25	13.18	171.9	2468.0	8129.2	407.3	6068.5	**3251.68**	**2022.83**
26.50	27.50	27.00	1.00	25.00	19.48	9.48	164.83	3.77	26.0	26.0	1.0	303.19	2950.98	0	1.0	0.0	3013.37	27.5	26.0	0	9.48	12.25	13.18	171.9	2468.0	8432.4	424.3	6388.6	**3372.95**	**2129.54**
27.50	29.50	28.50	2.00	27.00	19.48	9.48	164.83	7.54	26.0	26.0	1.0	606.37	3557.35	0	1.0	0.0	3013.37	29.5	19.4	26	10.50	6.08	5.06	171.9	1483.6	8054.4	458.2	7029.0	**3221.74**	**2342.98**
29.50	30.00	29.75	0.50	27.50	20.50	10.50	164.83	1.89	19.4	19.4	1.0	109.45	3666.81	26	1.0	49.0	3062.40	30.0	29.0	0	10.50	19.01	20.10	171.9	3840.5	10569.7	466.7	7195.9	**4227.89**	**2398.64**
30.00	32.50	31.25	2.50	30.00	20.50	10.50	164.83	9.43	29.0	29.0	1.0	861.43	4528.24	0	1.0	0.0	3062.40	32.5	29.0	0	10.50	19.01	20.10	171.9	3840.5	11431.2	509.1	8099.8	**4572.46**	**2699.93**
32.50	35.00	33.75	2.50	32.50	20.50	10.50	164.83	9.43	29.0	29.0	1.0	861.43	5389.67	0	1.0	0.0	3062.40	35.0	28.7	0	10.75	18.33	19.40	171.9	3707.5	12159.5	551.6	9003.6	**4863.82**	**3001.21**
35.00	35.50	35.25	0.50	33.00	20.75	10.75	164.83	1.89	28.7	28.7	1.0	170.17	5559.83	0	1.0	0.0	3062.40	35.5	28.7	0	10.75	18.33	19.40	171.9	3707.5	12329.7	560.1	9182.3	**4931.88**	**3060.76**
35.50	37.50	36.50	2.00	35.00	20.75	10.75	164.83	7.54	28.7	28.7	1.0	680.66	6240.49	0	1.0	0.0	3062.40	37.5	28.7	0	10.75	18.33	19.40	171.9	3707.5	13010.4	594.0	9896.9	**5204.15**	**3298.96**
37.50	38.50	38.00	1.00	36.00	20.75	10.75	164.83	3.77	28.7	28.7	1.0	340.33	6580.82	0	1.0	0.0	3062.40	38.5	28.7	0	10.75	18.33	19.40	171.9	3707.5	13350.7	611.0	10254.2	**5340.28**	**3418.07**
38.50	40.00	39.25	1.50	37.50	20.75	10.75	164.83	5.66	28.7	28.7	1.0	510.50	7091.32	0	1.0	0.0	3062.40	40.0	28.7	0	10.75	18.33	19.40	171.9	3707.5	13861.2	636.4	10790.1	**5544.48**	**3596.72**
BORE NO: P88, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.90	9.90	27.23	1.89	24.2	24.2	1.0	23.07	0	18	1.0	33.9	0	3.0	26.6	0	9.90	13.60	14.57	29.7	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.90	9.90	34.65	3.77	26.6	26.6	1.0	65.44	0	0	1.0	0.0	0	4.0	23.6	16	8.85	8.99	9.34	39.6	621.9	621.9	25.5	25.5	**248.78**	**8.49**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
4.00	6.00	5.00	2.00	3.50	18.85	8.85	48.45	7.54	23.6	23.6	1.0	159.66	159.66	16	1.0	120.7	120.69	6.0	23.6	16	8.85	8.99	9.34	57.3	802.0	1082.4	59.4	339.7	**432.95**	**113.25**
6.00	7.00	6.50	1.00	4.50	18.85	8.85	61.73	3.77	23.6	23.6	1.0	101.70	261.37	16	1.0	60.3	181.03	7.0	9.8	58	8.85	2.43	1.19	66.2	779.9	1222.3	76.4	518.8	**488.93**	**172.92**
7.00	9.00	8.00	2.00	6.50	18.85	8.85	75.00	7.54	9.8	9.8	1.0	97.72	359.08	58	1.0	437.5	618.51	9.0	27.9	0	10.70	16.53	17.56	83.9	1695.8	2673.4	110.3	1087.9	**1069.37**	**362.64**
9.00	10.00	9.50	1.00	7.50	20.70	10.70	89.20	3.77	27.9	27.9	1.0	178.12	537.20	0	1.0	0.0	618.51	10.0	27.9	0	10.70	16.53	17.56	94.6	1895.9	3051.7	127.3	1283.0	**1220.66**	**427.67**
10.00	11.00	10.50	1.00	8.50	20.70	10.70	99.90	3.77	27.9	27.9	1.0	199.49	736.69	0	1.0	0.0	618.51	11.0	25.3	16	10.70	10.68	11.57	105.3	1518.3	2873.5	144.3	1499.5	**1149.38**	**499.82**
11.00	12.50	11.75	1.50	10.00	20.70	10.70	113.28	5.66	25.3	25.3	1.0	302.91	1039.60	16	1.0	90.5	709.03	12.5	25.3	16	10.80	10.68	11.57	121.3	1712.9	3461.5	169.7	1918.3	**1384.61**	**639.45**
12.50	15.50	14.00	3.00	13.00	20.80	10.80	137.50	11.31	25.3	25.3	1.0	735.38	1774.98	16	1.0	181.0	890.06	15.5	25.9	15	10.80	12.03	12.95	153.7	2339.2	5004.2	220.6	2885.7	**2001.68**	**961.89**
15.50	18.50	17.00	3.00	16.00	20.80	10.80	169.90	11.31	25.9	25.9	1.0	933.42	2708.40	15	1.0	169.7	1059.77	18.5	25.9	15	10.85	12.03	12.95	153.7	2339.6	6107.8	271.5	4039.7	**2443.11**	**1346.57**
18.50	21.50	20.00	3.00	19.00	20.85	10.85	169.90	11.31	25.9	25.9	1.0	933.42	3641.82	15	1.0	169.7	1229.49	21.5	9.0	88	10.85	2.29	1.07	153.7	1302.2	6173.5	322.5	5193.8	**2469.39**	**1731.25**
21.50	24.50	23.00	3.00	22.00	20.85	10.85	169.90	11.31	9.0	9.0	1.0	304.46	3946.28	88	1.0	995.7	2225.14	24.5	14.0	67	9.27	3.65	2.36	153.7	1331.9	7503.3	373.4	6544.8	**3001.32**	**2181.60**
24.50	26.00	25.25	1.50	23.50	19.27	9.27	169.90	5.66	14.0	14.0	1.0	239.64	4185.92	67	1.0	379.0	2604.17	26.0	24.5	8	9.27	9.64	10.33	153.7	1822.9	8613.0	398.8	7188.9	**3445.19**	**2396.31**
26.00	27.50	26.75	1.50	25.00	19.27	9.27	169.90	5.66	24.5	24.5	1.0	438.02	4623.94	8	1.0	45.3	2649.43	27.5	13.8	38	9.27	3.59	2.31	153.7	1025.8	8299.1	424.3	7697.7	**3319.66**	**2565.89**
27.50	29.00	28.25	1.50	26.50	19.27	9.27	169.90	5.66	13.8	13.8	1.0	236.08	4860.02	38	1.0	215.0	2864.40	29.0	13.8	38	10.40	3.59	2.31	153.7	1027.5	8752.0	449.7	8174.2	**3500.78**	**2724.72**
29.00	30.00	29.50	1.00	27.50	20.40	10.40	169.90	3.77	13.8	13.8	1.0	157.39	5017.41	38	1.0	143.3	3007.71	30.0	13.8	39	10.40	3.59	2.31	153.7	1037.7	9062.8	466.7	8491.8	**3625.14**	**2830.61**
30.00	30.50	30.25	0.50	28.00	20.40	10.40	169.90	1.89	13.8	13.8	1.0	78.69	5096.10	39	1.0	73.5	3081.26	30.5	13.4	39	10.40	3.47	2.19	153.7	1016.0	9193.4	475.2	8652.6	**3677.36**	**2884.19**
30.50	32.00	31.25	1.50	29.50	20.40	10.40	169.90	5.66	13.4	13.4	1.0	228.98	5325.08	39	1.0	220.6	3301.89	32.0	13.4	40	10.45	3.47	2.19	153.7	1026.3	9653.3	500.7	9127.6	**3861.31**	**3042.54**
32.00	32.50	32.25	0.50	30.00	20.45	10.45	169.90	1.89	13.4	13.4	1.0	76.33	5401.41	40	1.0	75.4	3377.31	32.5	13.4	40	10.45	3.47	2.19	153.7	1026.3	9805.0	509.1	9287.9	**3922.01**	**3095.95**
32.50	33.50	33.00	1.00	31.00	20.45	10.45	169.90	3.77	13.4	13.4	1.0	152.65	5554.06	40	1.0	150.9	3528.17	33.5	16.7	39	10.45	4.78	3.58	153.7	1253.2	10335.4	526.1	9608.3	**4134.16**	**3202.78**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
33.50	35.00	34.25	1.50	32.50	20.45	10.45	169.90	5.66	16.7	16.7	1.0	288.36	5842.42	39	1.0	220.6	3748.80	35.0	28.2	0	10.45	17.21	18.25	153.7	3121.6	12712.9	551.6	10142.8	**5085.14**	**3380.93**
35.00	36.50	35.75	1.50	34.00	20.45	10.45	169.90	5.66	28.2	28.2	1.0	515.36	6357.78	0	1.0	0.0	3748.80	36.5	28.7	0	8.93	18.33	19.40	153.7	3305.6	13412.2	577.0	10683.6	**5364.87**	**3561.20**
36.50	37.50	37.00	1.00	35.00	18.93	8.93	169.90	3.77	28.7	28.7	1.0	350.81	6708.59	0	1.0	0.0	3748.80	37.5	29.2	0	8.93	19.46	20.56	153.7	3508.4	13965.8	594.0	11051.4	**5586.31**	**3683.80**
37.50	40.00	38.75	2.50	37.50	18.93	8.93	169.90	9.43	29.2	29.2	1.0	895.28	7603.87	0	1.0	0.0	3748.80	40.0	12.3	38	8.93	3.15	1.88	153.7	945.4	12298.0	636.4	11989.1	**4919.21**	**3996.37**
BORE NO: P89, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.18	10.18	28.00	1.89	11.5	11.5	1.0	10.74	0	47	1.0	88.6	0	3.0	27.5	2	9.52	15.63	16.64	30.5	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.50	19.52	9.52	40.06	7.54	27.5	27.5	1.0	157.30	0	2	1.0	15.1	0	5.0	27.5	2	9.52	15.63	16.64	49.6	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	19.52	9.52	54.34	3.77	27.5	27.5	1.0	106.68	0	2	1.0	7.5	0	6.0	24.6	0	9.52	9.71	10.44	59.1	0	0.0	59.4	59.4	**0.00**	**19.80**
6.00	7.00	6.50	1.00	4.50	19.52	9.52	63.86	3.77	24.6	24.6	1.0	110.27	0	0	1.0	0.0	0	7.0	23.9	4	9.38	9.21	9.67	68.6	0	0.0	76.4	76.4	**0.00**	**25.46**
7.00	8.00	7.50	1.00	5.50	19.38	9.38	73.31	3.77	23.9	23.9	1.0	122.52	0	4	1.0	15.1	0	8.0	23.9	4	9.38	9.21	9.67	78.0	0	0.0	93.3	93.3	**0.00**	**31.11**
8.00	9.00	8.50	1.00	6.50	19.38	9.38	82.69	3.77	23.9	23.9	1.0	138.20	0	4	1.0	15.1	0	9.0	27.4	5	9.38	15.40	16.41	87.4	1678.4	1678.4	110.3	110.3	**671.35**	**36.77**
9.00	11.00	10.00	2.00	8.50	19.38	9.38	96.76	7.54	27.4	27.4	1.0	378.32	378.32	5	1.0	37.7	37.71	11.0	27.4	5	9.38	15.40	16.41	106.1	2005.3	2421.4	144.3	560.3	**968.55**	**186.76**
11.00	12.00	11.50	1.00	9.50	19.38	9.38	110.83	3.77	27.4	27.4	1.0	216.66	594.98	5	1.0	18.9	56.57	12.0	9.0	57	9.38	2.29	1.07	115.5	886.5	1538.1	161.2	812.8	**615.23**	**270.93**
12.00	14.50	13.25	2.50	12.00	19.38	9.38	127.25	9.43	9.0	9.0	1.0	190.02	785.00	57	1.0	537.4	594.00	14.5	9.0	57	9.31	2.29	1.07	139.0	947.2	2326.2	203.7	1582.7	**930.49**	**527.55**
14.50	16.00	15.25	1.50	13.50	19.31	9.31	145.95	5.66	9.0	9.0	1.0	130.77	915.77	57	1.0	322.5	916.46	16.0	28.2	0	9.31	17.21	18.25	152.9	3092.6	4924.8	229.1	2061.3	**1969.94**	**687.12**
16.00	17.50	16.75	1.50	15.00	19.31	9.31	159.92	5.66	28.2	28.2	1.0	485.08	1400.86	0	1.0	0.0	916.46	17.5	15.6	29	9.31	4.24	2.98	166.9	1113.9	3431.2	254.6	2571.9	**1372.48**	**857.30**
17.50	19.00	18.25	1.50	16.50	19.31	9.31	159.92	5.66	15.6	15.6	1.0	252.59	1653.45	29	1.0	164.1	1080.51	19.0	8.2	58	10.07	2.15	0.94	166.9	1002.3	3736.3	280.0	3014.0	**1494.50**	**1004.66**
19.00	20.50	19.75	1.50	18.00	20.07	10.07	159.92	5.66	8.2	8.2	1.0	130.37	1783.81	58	1.0	328.1	1408.63	20.5	8.2	59	10.34	2.15	0.94	166.9	1012.6	4205.1	305.5	3497.9	**1682.04**	**1165.98**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
20.50	23.50	22.00	3.00	21.00	20.34	10.34	159.92	11.31	8.2	8.2	1.0	260.73	2044.55	59	1.0	667.5	2076.17	23.5	9.5	59	10.34	2.38	1.14	166.9	1058.2	5179.0	356.4	4477.1	**2071.58**	**1492.37**
23.50	25.00	24.25	1.50	22.50	20.34	10.34	159.92	5.66	9.5	9.5	1.0	151.39	2195.94	59	1.0	333.8	2409.94	25.0	28.1	0	9.65	16.98	18.02	166.9	3324.7	7930.5	381.9	4987.7	**3172.22**	**1662.58**
25.00	26.50	25.75	1.50	24.00	19.65	9.65	159.92	5.66	28.1	28.1	1.0	483.05	2678.99	0	1.0	0.0	2409.94	26.5	28.1	0	9.65	16.98	18.02	166.9	3324.7	8413.6	407.3	5496.2	**3365.44**	**1832.08**
26.50	27.50	27.00	1.00	25.00	19.65	9.65	159.92	3.77	28.1	28.1	1.0	322.03	3001.02	0	1.0	0.0	2409.94	27.5	28.1	0	9.65	16.98	18.02	166.9	3324.7	8735.6	424.3	5835.3	**3494.25**	**1945.08**
27.50	28.00	27.75	0.50	25.50	19.65	9.65	159.92	1.89	28.1	28.1	1.0	161.02	3162.04	0	1.0	0.0	2409.94	28.0	16.5	38	9.65	4.68	3.47	166.9	1293.1	6865.0	432.8	6004.8	**2746.02**	**2001.58**
28.00	29.50	28.75	1.50	27.00	19.65	9.65	159.92	5.66	16.5	16.5	1.0	267.98	3430.02	38	1.0	215.0	2624.91	29.5	16.5	38	10.15	4.68	3.47	166.9	1294.2	7349.2	458.2	6513.2	**2939.67**	**2171.05**
29.50	30.00	29.75	0.50	27.50	20.15	10.15	159.92	1.89	16.5	16.5	1.0	89.33	3519.34	38	1.0	71.7	2696.57	30.0	16.5	38	10.15	4.68	3.47	166.9	1294.2	7510.2	466.7	6682.6	**3004.06**	**2227.54**
30.00	31.00	30.50	1.00	28.50	20.15	10.15	159.92	3.77	16.5	16.5	1.0	178.65	3697.99	38	1.0	143.3	2839.89	31.0	11.1	46	10.15	2.79	1.53	166.9	1006.5	7544.4	483.7	7021.6	**3017.74**	**2340.52**
31.00	32.50	31.75	1.50	30.00	20.15	10.15	159.92	5.66	11.1	11.1	1.0	177.49	3875.49	46	1.0	260.2	3100.11	32.5	11.1	46	10.15	2.79	1.53	166.9	1006.5	7982.1	509.1	7484.7	**3192.83**	**2494.91**
32.50	35.00	33.75	2.50	32.50	20.15	10.15	159.92	9.43	11.1	11.1	1.0	295.82	4171.30	46	1.0	433.7	3533.83	35.0	11.1	46	10.68	2.79	1.53	166.9	1007.0	8712.2	551.6	8256.7	**3484.86**	**2752.23**
35.00	35.50	35.25	0.50	33.00	20.68	10.68	159.92	1.89	11.1	11.1	1.0	59.16	4230.47	46	1.0	86.7	3620.57	35.5	12.8	55	10.68	3.29	2.02	166.9	1196.3	9047.3	560.1	8411.1	**3618.93**	**2803.70**
35.50	37.50	36.50	2.00	35.00	20.68	10.68	159.92	7.54	12.8	12.8	1.0	274.05	4504.52	55	1.0	414.9	4035.43	37.5	10.3	50	10.68	2.56	1.31	166.9	1001.7	9541.6	594.0	9133.9	**3816.65**	**3044.65**
37.50	38.50	38.00	1.00	36.00	20.68	10.68	159.92	3.77	10.3	10.3	1.0	109.61	4614.12	50	1.0	188.6	4224.00	38.5	10.3	50	10.68	2.56	1.31	166.9	1001.7	9839.8	611.0	9449.1	**3935.92**	**3149.70**
38.50	40.00	39.25	1.50	37.50	20.68	10.68	159.92	5.66	10.3	10.3	1.0	164.41	4778.53	50	1.0	282.9	4506.86	40.0	16.0	31	10.68	4.43	3.20	166.9	1175.8	10461.2	636.4	9921.8	**4184.46**	**3307.27**
BORE NO: P90, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.89	9.89	27.20	1.89	8.2	8.2	1.0	7.39	0	58	1.0	109.4	0	3.0	23.4	11	9.89	8.85	9.12	29.7	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.89	9.89	34.62	3.77	23.4	23.4	1.0	56.49	0	11	1.0	41.5	0	4.0	29.2	0	9.60	19.46	20.56	39.6	0	0.0	25.5	25.5	**0.00**	**8.49**
4.00	5.00	4.50	1.00	2.50	19.60	9.60	44.36	3.77	29.2	29.2	1.0	93.50	0	0	1.0	0.0	0	5.0	29.2	0	9.60	19.46	20.56	49.2	1216.2	1216.2	42.4	42.4	**486.50**	**14.14**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
5.00	6.00	5.50	1.00	3.50	19.60	9.60	53.96	3.77	29.2	29.2	1.0	113.74	113.74	0	1.0	0.0	0.00	6.0	27.3	0	9.60	15.18	16.18	58.8	1114.6	1228.3	59.4	173.1	**491.34**	**57.71**
6.00	7.00	6.50	1.00	4.50	19.60	9.60	63.56	3.77	27.3	27.3	1.0	123.72	237.46	0	1.0	0.0	0.00	7.0	26.0	7	9.40	12.25	13.18	68.4	1103.0	1340.5	76.4	313.8	**536.20**	**104.61**
7.00	8.00	7.50	1.00	5.50	19.40	9.40	73.06	3.77	26.0	26.0	1.0	134.39	371.85	7	1.0	26.4	26.40	8.0	9.5	44	9.40	2.38	1.14	77.8	664.7	1063.0	93.3	491.6	**425.19**	**163.86**
8.00	9.00	8.50	1.00	6.50	19.40	9.40	82.46	3.77	9.5	9.5	1.0	52.04	423.89	44	1.0	165.9	192.34	9.0	9.5	44	9.40	2.38	1.14	87.2	690.0	1306.3	110.3	726.5	**522.51**	**242.18**
9.00	10.00	9.50	1.00	7.50	19.40	9.40	91.86	3.77	9.5	9.5	1.0	57.97	481.87	44	1.0	165.9	358.29	10.0	9.5	44	10.09	2.38	1.14	96.6	715.9	1556.0	127.3	967.4	**622.42**	**322.48**
10.00	11.00	10.50	1.00	8.50	20.09	10.09	101.61	3.77	9.5	9.5	1.0	64.13	545.99	44	1.0	165.9	524.23	11.0	10.5	42	10.09	2.62	1.36	106.7	752.8	1823.0	144.3	1214.5	**729.21**	**404.83**
11.00	12.00	11.50	1.00	9.50	20.09	10.09	111.70	3.77	10.5	10.5	1.0	78.07	624.07	42	1.0	158.4	682.63	12.0	11.0	63	10.30	2.76	1.51	116.7	1017.1	2323.8	161.2	1467.9	**929.53**	**489.31**
12.00	14.50	13.25	2.50	12.00	20.30	10.30	129.62	9.43	11.0	11.0	1.0	237.55	861.62	63	1.0	594.0	1276.63	14.5	8.1	63	10.30	2.13	0.93	142.5	991.1	3129.3	203.7	2341.9	**1251.73**	**780.63**
14.50	16.00	15.25	1.50	13.50	20.30	10.30	150.22	5.66	8.1	8.1	1.0	120.94	982.56	63	1.0	356.4	1633.03	16.0	27.3	0	9.39	15.18	16.18	157.9	2815.7	5431.2	229.1	2844.7	**2172.50**	**948.23**
16.00	17.50	16.75	1.50	15.00	19.39	9.39	164.98	5.66	27.3	27.3	1.0	481.73	1464.29	0	1.0	0.0	1633.03	17.5	12.4	54	9.39	3.17	1.91	172.0	1180.0	4277.3	254.6	3351.9	**1710.91**	**1117.30**
17.50	19.00	18.25	1.50	16.50	19.39	9.39	164.98	5.66	12.4	12.4	1.0	205.21	1669.49	54	1.0	305.5	1938.51	19.0	11.0	42	10.27	2.76	1.51	172.0	976.1	4584.2	280.0	3888.0	**1833.66**	**1296.01**
19.00	20.50	19.75	1.50	18.00	20.27	10.27	164.98	5.66	11.0	11.0	1.0	181.42	1850.91	42	1.0	237.6	2176.11	20.5	11.0	42	10.27	2.76	1.51	172.0	976.1	5003.2	305.5	4332.5	**2001.27**	**1444.17**
20.50	22.00	21.25	1.50	19.50	20.27	10.27	164.98	5.66	11.0	11.0	1.0	181.42	2032.33	42	1.0	237.6	2413.71	22.0	9.2	55	10.36	2.33	1.10	172.0	1020.5	5466.5	330.9	4777.0	**2186.61**	**1592.33**
22.00	23.50	22.75	1.50	21.00	20.36	10.36	164.98	5.66	9.2	9.2	1.0	151.17	2183.50	55	1.0	311.1	2724.86	23.5	13.0	50	10.36	3.35	2.08	172.0	1175.8	6084.1	356.4	5264.8	**2433.66**	**1754.92**
23.50	25.00	24.25	1.50	22.50	20.36	10.36	164.98	5.66	13.0	13.0	1.0	215.48	2398.98	50	1.0	282.9	3007.71	25.0	29.3	0	9.12	19.68	20.79	172.0	3959.7	9366.4	381.9	5788.5	**3746.56**	**1929.52**
25.00	26.50	25.75	1.50	24.00	19.12	9.12	164.98	5.66	29.3	29.3	1.0	523.76	2922.74	0	1.0	0.0	3007.71	26.5	29.3	0	9.12	19.68	20.79	172.0	3959.7	9890.2	407.3	6337.8	**3956.07**	**2112.59**
26.50	27.50	27.00	1.00	25.00	19.12	9.12	164.98	3.77	29.3	29.3	1.0	349.17	3271.91	0	1.0	0.0	3007.71	27.5	26.3	0	9.12	12.93	13.88	172.0	2602.0	8881.7	424.3	6703.9	**3552.66**	**2234.64**
27.50	28.00	27.75	0.50	25.50	19.12	9.12	164.98	1.89	26.3	26.3	1.0	153.76	3425.67	0	1.0	0.0	3007.71	28.0	23.0	0	9.12	8.56	8.68	172.0	1719.8	8153.2	432.8	6866.2	**3261.29**	**2288.72**

APPENDIX-H
TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
28.00	29.50	28.75	1.50	27.00	19.12	9.12	164.98	5.66	23.0	23.0	1.0	396.17	3821.84	0	1.0	0.0	3007.71	29.5	9.0	48	9.31	2.29	1.07	172.0	941.2	7770.8	458.2	7287.8	**3108.31**	**2429.26**
29.50	30.00	29.75	0.50	27.50	19.31	9.31	164.98	1.89	9.0	9.0	1.0	49.27	3871.12	48	1.0	90.5	3098.23	30.0	9.0	48	10.48	2.29	1.07	172.0	942.1	7911.4	466.7	7436.1	**3164.57**	**2478.69**
30.00	31.00	30.50	1.00	28.50	20.48	10.48	164.98	3.77	9.0	9.0	1.0	98.55	3969.67	48	1.0	181.0	3279.26	31.0	8.3	48	10.48	2.16	0.96	172.0	916.8	8165.7	483.7	7732.6	**3266.28**	**2577.54**
31.00	32.50	31.75	1.50	30.00	20.48	10.48	164.98	5.66	8.3	8.3	1.0	136.16	4105.83	48	1.0	271.5	3550.80	32.5	12.1	40	10.48	3.09	1.82	172.0	1021.1	8677.8	509.1	8165.8	**3471.11**	**2721.92**
32.50	35.00	33.75	2.50	32.50	20.48	10.48	164.98	9.43	12.1	12.1	1.0	333.48	4439.31	40	1.0	377.1	3927.94	35.0	12.1	40	10.48	3.09	1.82	172.0	1021.1	9388.4	551.6	8918.8	**3755.36**	**2972.94**
35.00	35.50	35.25	0.50	33.00	20.48	10.48	164.98	1.89	12.1	12.1	1.0	66.70	4506.00	40	1.0	75.4	4003.37	35.5	12.1	40	10.48	3.09	1.82	172.0	1021.1	9530.5	560.1	9069.4	**3812.21**	**3023.14**
35.50	37.50	36.50	2.00	35.00	20.48	10.48	164.98	7.54	12.1	12.1	1.0	266.78	4772.79	40	1.0	301.7	4305.09	37.5	29.1	5	10.32	19.23	20.33	172.0	3936.7	13014.6	594.0	9671.9	**5205.82**	**3223.96**
37.50	38.50	38.00	1.00	36.00	20.32	10.32	164.98	3.77	29.1	29.1	1.0	346.32	5119.11	5	1.0	18.9	4323.94	38.5	29.0	5	10.32	19.01	20.10	172.0	3891.2	13334.3	611.0	10054.0	**5333.71**	**3351.34**
38.50	40.00	39.25	1.50	37.50	20.32	10.32	164.98	5.66	29.0	29.0	1.0	517.35	5636.47	5	1.0	28.3	4352.23	40.0	17.1	89	10.32	4.97	3.80	172.0	1900.9	11889.5	636.4	10625.1	**4755.82**	**3541.71**
BORE NO: P91, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.48	9.48	26.07	1.89	26.6	26.6	1.0	24.62	0	3	1.0	5.7	0	3.0	26.6	3	9.68	13.60	14.57	28.4	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.50	19.68	9.68	38.12	7.54	26.6	26.6	1.0	143.99	0	3	1.0	22.6	0	5.0	26.6	3	9.68	13.60	14.57	47.8	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	19.68	9.68	52.64	3.77	26.6	26.6	1.0	99.42	0	3	1.0	11.3	0	6.0	14.6	23	9.68	3.82	2.54	57.5	0	0.0	59.4	59.4	**0.00**	**19.80**
6.00	7.00	6.50	1.00	4.50	19.68	9.68	62.32	3.77	14.6	14.6	1.0	61.22	0	23	1.0	86.7	0	7.0	12.4	48	9.68	3.17	1.91	67.2	742.5	742.5	76.4	76.4	**297.02**	**25.46**
7.00	8.00	7.50	1.00	5.50	19.68	9.68	72.00	3.77	12.4	12.4	1.0	59.70	59.70	48	1.0	181.0	181.03	8.0	11.5	44	10.60	2.91	1.65	76.8	713.0	953.7	93.3	334.1	**381.49**	**111.36**
8.00	9.00	8.50	1.00	6.50	20.60	10.60	82.14	3.77	11.5	11.5	1.0	63.03	122.73	44	1.0	165.9	346.97	9.0	11.5	44	10.60	2.91	1.65	87.4	747.9	1217.6	110.3	580.0	**487.04**	**193.34**
9.00	11.00	10.00	2.00	8.50	20.60	10.60	98.04	7.54	11.5	11.5	1.0	150.45	273.18	44	1.0	331.9	678.86	11.0	11.5	44	10.60	2.91	1.65	108.6	817.7	1769.8	144.3	1096.3	**707.91**	**365.43**
11.00	12.00	11.50	1.00	9.50	20.60	10.60	113.94	3.77	11.5	11.5	1.0	87.43	360.61	44	1.0	165.9	844.80	12.0	10.0	53	11.00	2.47	1.22	119.2	882.0	2087.4	161.2	1366.6	**834.98**	**455.55**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
12.00	14.50	13.25	2.50	12.00	21.00	11.00	132.99	9.43	10.0	10.0	1.0	221.10	581.71	53	1.0	499.7	1344.51	14.5	10.5	57	10.80	2.62	1.36	146.7	1024.9	2951.1	203.7	2129.9	**1180.45**	**709.96**
14.50	17.50	16.00	3.00	15.00	20.80	10.80	162.94	11.31	10.5	10.5	1.0	341.68	923.39	57	1.0	644.9	1989.43	17.5	9.5	55	11.90	2.38	1.14	179.1	1051.7	3964.5	254.6	3167.4	**1585.80**	**1055.80**
17.50	20.50	19.00	3.00	18.00	21.90	11.90	162.94	11.31	9.5	9.5	1.0	308.50	1231.89	55	1.0	622.3	2611.71	20.5	9.5	55	9.79	2.38	1.14	179.1	1050.0	4893.6	305.5	4149.1	**1957.46**	**1383.03**
20.50	23.50	22.00	3.00	21.00	19.79	9.79	162.94	11.31	9.5	9.5	1.0	308.50	1540.40	55	1.0	622.3	3234.00	23.5	23.0	16	9.79	8.56	8.68	179.1	1955.6	6730.0	356.4	5130.8	**2692.01**	**1710.27**
23.50	26.50	25.00	3.00	24.00	19.79	9.79	162.94	11.31	23.0	23.0	1.0	782.54	2322.94	16	1.0	181.0	3415.03	26.5	17.6	16	10.20	5.22	4.07	179.1	1249.0	6987.0	407.3	6145.3	**2794.78**	**2048.43**
26.50	27.50	27.00	1.00	25.00	20.20	10.20	162.94	3.77	17.6	17.6	1.0	194.94	2517.87	16	1.0	60.3	3475.37	27.5	17.6	36	10.20	5.22	4.07	179.1	1452.6	7445.9	424.3	6417.5	**2978.36**	**2139.18**
27.50	28.00	27.75	0.50	25.50	20.20	10.20	162.94	1.89	17.6	17.6	1.0	97.47	2615.34	36	1.0	67.9	3543.26	28.0	8.5	61	10.20	2.20	0.99	179.1	1073.9	7232.5	432.8	6591.4	**2893.00**	**2197.12**
28.00	29.50	28.75	1.50	27.00	20.20	10.20	162.94	5.66	8.5	8.5	1.0	137.76	2753.10	61	1.0	345.1	3888.34	29.5	18.0	35	10.20	5.42	4.29	179.1	1483.9	8125.3	458.2	7099.7	**3250.13**	**2366.56**
29.50	30.00	29.75	0.50	27.50	20.20	10.20	162.94	1.89	18.0	18.0	1.0	99.83	2852.94	35	1.0	66.0	3954.34	30.0	18.0	35	10.20	5.42	4.29	179.1	1483.9	8291.1	466.7	7274.0	**3316.46**	**2424.66**
30.00	31.00	30.50	1.00	28.50	20.20	10.20	162.94	3.77	18.0	18.0	1.0	199.67	3052.60	35	1.0	132.0	4086.34	31.0	18.5	46	10.20	5.64	4.57	179.1	1643.6	8782.5	483.7	7622.6	**3513.01**	**2540.88**
31.00	32.50	31.75	1.50	30.00	20.20	10.20	162.94	5.66	18.5	18.5	1.0	308.42	3361.03	46	1.0	260.2	4346.57	32.5	10.2	58	10.20	2.53	1.28	179.1	1112.0	8819.6	509.1	8216.7	**3527.84**	**2738.91**
32.50	35.00	33.75	2.50	32.50	20.20	10.20	162.94	9.43	10.2	10.2	1.0	276.42	3637.45	58	1.0	546.9	4893.43	35.0	10.2	58	10.20	2.53	1.28	179.1	1112.0	9642.9	551.6	9082.4	**3857.15**	**3027.48**
35.00	35.50	35.25	0.50	33.00	20.20	10.20	162.94	1.89	10.2	10.2	1.0	55.28	3692.73	58	1.0	109.4	5002.80	35.5	10.2	58	10.20	2.53	1.28	179.1	1112.0	9807.5	560.1	9255.6	**3923.01**	**3085.20**
35.50	37.50	36.50	2.00	35.00	20.20	10.20	162.94	7.54	10.2	10.2	1.0	221.14	3913.87	58	1.0	437.5	5440.29	37.5	17.0	60	8.78	4.92	3.75	179.1	1631.3	10985.5	594.0	9948.2	**4394.19**	**3316.05**
37.50	38.50	38.00	1.00	36.00	18.78	8.78	162.94	3.77	17.0	17.0	1.0	187.88	4101.75	60	1.0	226.3	5666.57	38.5	17.0	50	8.83	4.92	3.75	179.1	1529.6	11297.9	611.0	10379.3	**4519.17**	**3459.76**
38.50	40.00	39.25	1.50	37.50	18.83	8.83	162.94	5.66	17.0	17.0	1.0	281.81	4383.56	50	1.0	282.9	5949.43	40.0	17.0	50	8.83	4.92	3.75	179.1	1529.6	11862.6	636.4	10969.4	**4745.04**	**3656.47**
BORE NO: P92, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.60	9.60	26.40	1.89	12.4	12.4	1.0	10.95	0	23	1.0	43.4	0	3.0	23.3	0	9.60	8.78	9.01	28.8	0	0.0	8.5	8.5	**0.00**	**2.83**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Factor of Safety in Compression: 2.5
Area of Pile: 1.13 m^2
Critical water table: 0.00 m
Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
3.00	4.00	3.50	1.00	1.50	19.60	9.60	33.60	3.77	23.3	23.3	1.0	54.57	0	0	1.0	0.0	0	4.0	26.5	9	9.60	13.38	14.34	38.4	0	0.0	25.5	25.5	**0.00**	**8.49**
4.00	5.00	4.50	1.00	2.50	19.60	9.60	43.20	3.77	26.5	26.5	1.0	81.23	0	9	1.0	33.9	0	5.0	26.5	9	9.60	13.38	14.34	48.0	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	19.60	9.60	52.80	3.77	26.5	26.5	1.0	99.28	0	9	1.0	33.9	0	6.0	25.5	13	9.60	11.13	12.03	57.6	0	0.0	59.4	59.4	**0.00**	**19.80**
6.00	7.00	6.50	1.00	4.50	19.60	9.60	62.40	3.77	25.5	25.5	1.0	112.25	0	13	1.0	49.0	0	7.0	25.5	13	9.57	11.13	12.03	67.2	1056.5	1056.5	76.4	76.4	**422.59**	**25.46**
7.00	8.00	7.50	1.00	5.50	19.57	9.57	71.99	3.77	25.5	25.5	1.0	129.49	129.49	13	1.0	49.0	49.03	8.0	25.5	13	9.57	11.13	12.03	76.8	1176.9	1355.5	93.3	271.9	**542.19**	**90.62**
8.00	9.00	8.50	1.00	6.50	19.57	9.57	81.56	3.77	25.5	25.5	1.0	146.71	276.20	13	1.0	49.0	98.06	9.0	12.2	42	10.70	3.12	1.85	86.3	745.5	1119.8	110.3	484.6	**447.92**	**161.52**
9.00	11.00	10.00	2.00	8.50	20.70	10.70	97.04	7.54	12.2	12.2	1.0	158.26	434.46	42	1.0	316.8	414.86	11.0	12.2	42	10.70	3.12	1.85	107.7	821.0	1670.3	144.3	993.6	**668.13**	**331.19**
11.00	12.00	11.50	1.00	9.50	20.70	10.70	113.09	3.77	12.2	12.2	1.0	92.21	526.67	42	1.0	158.4	573.26	12.0	11.5	50	10.40	2.91	1.65	118.4	910.9	2010.8	161.2	1261.2	**804.32**	**420.39**
12.00	14.50	13.25	2.50	12.00	20.40	10.40	131.44	9.43	11.5	11.5	1.0	252.14	778.81	50	1.0	471.4	1044.69	14.5	9.5	53	10.55	2.38	1.14	144.4	936.8	2760.3	203.7	2027.1	**1104.13**	**675.72**
14.50	17.50	16.00	3.00	15.00	20.55	10.55	160.27	11.31	9.5	9.5	1.0	303.44	1082.25	53	1.0	599.7	1644.34	17.5	10.2	50	10.55	2.53	1.28	176.1	1022.1	3748.7	254.6	2981.2	**1499.48**	**993.72**
17.50	19.00	18.25	1.50	16.50	20.55	10.55	160.27	5.66	10.2	10.2	1.0	163.13	1245.38	50	1.0	282.9	1927.20	19.0	11.0	55	10.30	2.76	1.51	176.1	1121.3	4293.8	280.0	3452.6	**1717.54**	**1150.87**
19.00	20.50	19.75	1.50	18.00	20.30	10.30	160.27	5.66	11.0	11.0	1.0	176.23	1421.61	55	1.0	311.1	2238.34	20.5	11.5	59	10.10	2.91	1.65	176.1	1192.1	4852.0	305.5	3965.4	**1940.81**	**1321.81**
20.50	23.50	22.00	3.00	21.00	20.10	10.10	160.27	11.31	11.5	11.5	1.0	368.92	1790.53	59	1.0	667.5	2905.89	23.5	10.3	53	10.42	2.56	1.31	176.1	1058.6	5755.0	356.4	5052.8	**2302.01**	**1684.27**
23.50	26.50	25.00	3.00	24.00	20.42	10.42	160.27	11.31	10.3	10.3	1.0	329.53	2120.06	53	1.0	599.7	3505.54	26.5	10.3	53	10.42	2.56	1.31	176.1	1058.6	6684.2	407.3	6032.9	**2673.68**	**2010.97**
26.50	27.50	27.00	1.00	25.00	20.42	10.42	160.27	3.77	10.3	10.3	1.0	109.84	2229.90	53	1.0	199.9	3705.43	27.5	10.3	53	10.42	2.56	1.31	176.1	1058.6	6993.9	424.3	6359.6	**2797.57**	**2119.87**
27.50	29.50	28.50	2.00	27.00	20.42	10.42	160.27	7.54	10.3	10.3	1.0	219.69	2449.59	53	1.0	399.8	4105.20	29.5	10.5	53	8.69	2.62	1.36	176.1	1069.1	7623.9	458.2	7013.0	**3049.56**	**2337.67**
29.50	30.00	29.75	0.50	27.50	18.69	8.69	160.27	1.89	10.5	10.5	1.0	56.01	2505.60	53	1.0	99.9	4205.14	30.0	10.0	50	10.52	2.47	1.22	176.1	1010.0	7720.7	466.7	7177.5	**3088.28**	**2392.49**
30.00	32.50	31.25	2.50	30.00	20.52	10.52	160.27	9.43	10.0	10.0	1.0	266.44	2772.04	50	1.0	471.4	4676.57	32.5	10.8	45	10.52	2.71	1.45	176.1	1007.5	8456.2	509.1	7957.8	**3382.46**	**2652.58**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
32.50	35.00	33.75	2.50	32.50	20.52	10.52	160.27	9.43	10.8	10.8	1.0	288.25	3060.29	45	1.0	424.3	5100.86	35.0	10.8	45	10.52	2.71	1.45	176.1	1007.5	9168.7	551.6	8712.7	**3667.48**	**2904.24**
35.00	35.50	35.25	0.50	33.00	20.52	10.52	160.27	1.89	10.8	10.8	1.0	57.65	3117.94	45	1.0	84.9	5185.71	35.5	10.1	65	10.52	2.50	1.25	176.1	1168.8	9472.4	560.1	8863.7	**3788.97**	**2954.57**
35.50	37.50	36.50	2.00	35.00	20.52	10.52	160.27	7.54	10.1	10.1	1.0	215.33	3333.27	65	1.0	490.3	5676.00	37.5	10.1	65	9.61	2.50	1.25	176.1	1168.0	10177.3	594.0	9603.3	**4070.91**	**3201.09**
37.50	38.50	38.00	1.00	36.00	19.61	9.61	160.27	3.77	10.1	10.1	1.0	107.67	3440.94	65	1.0	245.1	5921.14	38.5	10.1	65	8.74	2.50	1.25	176.1	1167.3	10529.3	611.0	9973.1	**4211.74**	**3324.35**
38.50	40.00	39.25	1.50	37.50	18.74	8.74	160.27	5.66	10.1	10.1	1.0	161.50	3602.44	65	1.0	367.7	6288.86	40.0	26.3	0	8.74	12.93	13.88	176.1	2657.9	12549.2	636.4	10527.7	**5019.68**	**3509.24**
BORE NO: P93, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.36	9.36	25.74	1.89	23.4	23.4	1.0	21.00	0	0	1.0	0.0	0	3.0	23.7	0	9.36	9.06	9.45	28.1	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.36	9.36	32.76	3.77	23.7	23.7	1.0	54.24	0	0	1.0	0.0	0	4.0	25.8	6	9.69	11.80	12.72	37.4	644.7	644.7	25.5	25.5	**257.89**	**8.49**
4.00	5.00	4.50	1.00	2.50	19.69	9.69	42.29	3.77	25.8	25.8	1.0	77.09	77.09	6	1.0	22.6	22.63	5.0	25.8	6	9.69	11.80	12.72	47.1	774.1	873.8	42.4	142.2	**349.53**	**47.38**
5.00	6.00	5.50	1.00	3.50	19.69	9.69	51.98	3.77	25.8	25.8	1.0	94.76	171.85	6	1.0	22.6	45.26	6.0	25.8	6	9.69	11.80	12.72	56.8	903.5	1120.6	59.4	276.5	**448.24**	**92.17**
6.00	8.00	7.00	2.00	5.50	19.69	9.69	66.51	7.54	25.8	25.8	1.0	242.52	414.37	6	1.0	45.3	90.51	8.0	26.7	0	10.43	13.83	14.80	76.2	1297.0	1801.9	93.3	598.2	**720.74**	**199.41**
8.00	9.00	8.50	1.00	6.50	20.43	10.43	81.42	3.77	26.7	26.7	1.0	154.43	568.80	0	1.0	0.0	90.51	9.0	26.5	7	10.43	13.38	14.34	86.6	1484.0	2143.3	110.3	769.6	**857.34**	**256.54**
9.00	11.00	10.00	2.00	8.50	20.43	10.43	97.06	7.54	26.5	26.5	1.0	365.02	933.82	7	1.0	52.8	143.31	11.0	23.0	10	10.43	8.56	8.68	107.5	1204.4	2281.5	144.3	1221.4	**912.60**	**407.13**
11.00	12.00	11.50	1.00	9.50	20.43	10.43	112.71	3.77	23.0	23.0	1.0	180.43	1114.25	10	1.0	37.7	181.03	12.0	9.5	52	10.08	2.38	1.14	117.9	854.9	2150.1	161.2	1456.5	**860.06**	**485.50**
12.00	14.50	13.25	2.50	12.00	20.08	10.08	130.52	9.43	9.5	9.5	1.0	205.93	1320.18	52	1.0	490.3	671.31	14.5	11.5	56	10.17	2.91	1.65	143.1	1053.0	3044.5	203.7	2195.2	**1217.80**	**731.72**
14.50	17.50	16.00	3.00	15.00	20.17	10.17	158.38	11.31	11.5	11.5	1.0	364.57	1684.75	56	1.0	633.6	1304.91	17.5	11.5	56	10.17	2.91	1.65	173.6	1153.5	4143.2	254.6	3244.2	**1657.26**	**1081.41**
17.50	19.00	18.25	1.50	16.50	20.17	10.17	158.38	5.66	11.5	11.5	1.0	182.28	1867.03	56	1.0	316.8	1621.71	19.0	8.7	55	8.61	2.24	1.02	173.6	1005.3	4494.0	280.0	3768.8	**1797.61**	**1256.26**
19.00	20.50	19.75	1.50	18.00	18.61	8.61	158.38	5.66	8.7	8.7	1.0	137.10	2004.13	55	1.0	311.1	1932.86	20.5	8.7	55	9.70	2.24	1.02	173.6	1006.0	4943.0	305.5	4242.5	**1977.21**	**1414.16**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
20.50	23.50	22.00	3.00	21.00	19.70	9.70	158.38	11.31	8.7	8.7	1.0	274.20	2278.33	55	1.0	622.3	2555.14	23.5	8.5	57	9.70	2.20	0.99	173.6	1019.1	5852.6	356.4	5189.9	**2341.04**	**1729.96**
23.50	25.00	24.25	1.50	22.50	19.70	9.70	158.38	5.66	8.5	8.5	1.0	133.90	2412.23	57	1.0	322.5	2877.60	25.0	28.8	0	10.84	18.56	19.64	173.6	3790.1	9079.9	381.9	5671.7	**3631.96**	**1890.56**
25.00	26.50	25.75	1.50	24.00	20.84	10.84	158.38	5.66	28.8	28.8	1.0	492.55	2904.78	0	1.0	0.0	2877.60	26.5	28.0	0	10.84	16.76	17.79	173.6	3422.6	9205.0	407.3	6189.7	**3681.99**	**2063.23**
26.50	27.50	27.00	1.00	25.00	20.84	10.84	158.38	3.77	28.0	28.0	1.0	317.59	3222.37	0	1.0	0.0	2877.60	27.5	30.4	0	10.84	23.27	24.45	173.6	4752.2	10852.2	424.3	6524.3	**4340.87**	**2174.75**
27.50	28.00	27.75	0.50	25.50	20.84	10.84	158.38	1.89	30.4	30.4	1.0	178.72	3401.09	0	1.0	0.0	2877.60	28.0	29.8	0	10.84	20.81	21.94	173.6	4249.4	10528.1	432.8	6711.5	**4211.24**	**2237.15**
28.00	29.50	28.75	1.50	27.00	20.84	10.84	158.38	5.66	29.8	29.8	1.0	513.12	3914.21	0	1.0	0.0	2877.60	29.5	11.5	50	8.61	2.91	1.65	173.6	1090.6	7882.5	458.2	7250.0	**3152.98**	**2416.68**
29.50	30.00	29.75	0.50	27.50	18.61	8.61	158.38	1.89	11.5	11.5	1.0	60.76	3974.97	50	1.0	94.3	2971.89	30.0	11.5	50	8.61	2.91	1.65	173.6	1090.6	8037.5	466.7	7413.6	**3215.00**	**2471.19**
30.00	31.00	30.50	1.00	28.50	18.61	8.61	158.38	3.77	11.5	11.5	1.0	121.52	4096.49	50	1.0	188.6	3160.46	31.0	11.5	50	8.56	2.91	1.65	173.6	1090.6	8347.5	483.7	7740.6	**3339.02**	**2580.21**
31.00	32.50	31.75	1.50	30.00	18.56	8.56	158.38	5.66	11.5	11.5	1.0	182.28	4278.77	50	1.0	282.9	3443.31	32.5	11.5	50	8.83	2.91	1.65	173.6	1090.9	8813.0	509.1	8231.2	**3525.19**	**2743.74**
32.50	34.00	33.25	1.50	31.50	18.83	8.83	158.38	5.66	11.5	11.5	1.0	182.28	4461.06	50	1.0	282.9	3726.17	34.0	12.3	56	8.63	3.15	1.88	173.6	1199.2	9386.4	534.6	8721.8	**3754.57**	**2907.28**
34.00	35.00	34.50	1.00	32.50	18.63	8.63	158.38	3.77	12.3	12.3	1.0	130.23	4591.29	56	1.0	211.2	3937.37	35.0	12.3	56	8.63	3.15	1.88	173.6	1199.2	9727.9	551.6	9080.2	**3891.14**	**3026.74**
35.00	35.50	35.25	0.50	33.00	18.63	8.63	158.38	1.89	12.3	12.3	1.0	65.12	4656.41	56	1.0	105.6	4042.97	35.5	12.3	56	8.93	3.15	1.88	173.6	1199.6	9899.0	560.1	9259.4	**3959.58**	**3086.48**
35.50	37.00	36.25	1.50	34.50	18.93	8.93	158.38	5.66	12.3	12.3	1.0	195.35	4851.76	56	1.0	316.8	4359.77	37.0	12.3	56	8.84	3.15	1.88	173.6	1199.5	10411.0	585.5	9797.0	**4164.40**	**3265.68**
37.00	37.50	37.25	0.50	35.00	18.84	8.84	158.38	1.89	12.3	12.3	1.0	65.12	4916.87	56	1.0	105.6	4465.37	37.5	12.3	63	8.84	3.15	1.88	173.6	1270.7	10653.0	594.0	9976.2	**4261.19**	**3325.41**
37.50	38.50	38.00	1.00	36.00	18.84	8.84	158.38	3.77	12.3	12.3	1.0	130.23	5047.10	63	1.0	237.6	4702.97	38.5	12.3	63	8.93	3.15	1.88	173.6	1270.9	11020.9	611.0	10361.0	**4408.37**	**3453.68**
38.50	40.00	39.25	1.50	37.50	18.93	8.93	158.38	5.66	12.3	12.3	1.0	195.35	5242.45	63	1.0	356.4	5059.37	40.0	12.3	63	8.93	3.15	1.88	173.6	1270.9	11572.7	636.4	10938.3	**4629.07**	**3646.08**
BORE NO: P94, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.40	10.40	28.60	1.89	11.2	11.2	1.0	10.68	0	14	1.0	26.4	0	3.0	25.0	13	10.40	10.00	10.88	31.2	0	0.0	8.5	8.5	**0.00**	**2.83**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
3.00	4.00	3.50	1.00	1.50	20.40	10.40	36.40	3.77	25.0	25.0	1.0	64.01	0	13	1.0	49.0	0	4.0	25.0	13	10.40	10.00	10.88	41.6	0	0.0	25.5	25.5	**0.00**	**8.49**
4.00	5.00	4.50	1.00	2.50	20.40	10.40	46.80	3.77	25.0	25.0	1.0	82.30	0	13	1.0	49.0	0	5.0	25.0	13	9.52	10.00	10.88	52.0	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	19.52	9.52	56.76	3.77	25.0	25.0	1.0	99.82	0	13	1.0	49.0	0	6.0	23.5	17	9.52	8.92	9.23	61.5	853.7	853.7	59.4	59.4	**341.46**	**19.80**
6.00	7.00	6.50	1.00	4.50	19.52	9.52	66.28	3.77	23.5	23.5	1.0	108.69	108.69	17	1.0	64.1	64.11	7.0	23.5	17	10.30	8.92	9.23	71.0	954.6	1127.4	76.4	249.2	**450.97**	**83.06**
7.00	9.00	8.00	2.00	6.50	20.30	10.30	81.34	7.54	23.5	23.5	1.0	266.77	375.46	17	1.0	128.2	192.34	9.0	23.5	17	10.30	8.92	9.23	91.6	1162.5	1730.3	110.3	678.1	**692.13**	**226.04**
9.00	10.00	9.50	1.00	7.50	20.30	10.30	96.79	3.77	23.5	23.5	1.0	158.72	534.19	17	1.0	64.1	256.46	10.0	12.0	54	10.30	3.06	1.79	101.9	915.1	1705.8	127.3	917.9	**682.30**	**305.98**
10.00	11.00	10.50	1.00	8.50	20.30	10.30	107.09	3.77	12.0	12.0	1.0	85.85	620.03	54	1.0	203.7	460.11	11.0	11.5	56	10.30	2.91	1.65	112.2	951.4	2031.6	144.3	1224.4	**812.64**	**408.13**
11.00	12.50	11.75	1.50	10.00	20.30	10.30	119.97	5.66	11.5	11.5	1.0	138.07	758.11	56	1.0	316.8	776.91	12.5	11.5	56	9.90	2.91	1.65	127.7	1001.9	2536.9	169.7	1704.7	**1014.76**	**568.25**
12.50	14.00	13.25	1.50	11.50	19.90	9.90	135.12	5.66	11.5	11.5	1.0	155.51	913.62	56	1.0	316.8	1093.71	14.0	11.2	47	9.90	2.82	1.56	142.5	944.3	2951.7	195.2	2202.5	**1180.67**	**734.17**
14.00	15.50	14.75	1.50	13.00	19.90	9.90	149.97	5.66	11.2	11.2	1.0	167.98	1081.60	47	1.0	265.9	1359.60	15.5	11.2	47	10.70	2.82	1.56	157.4	992.6	3433.8	220.6	2661.8	**1373.53**	**887.28**
15.50	18.50	17.00	3.00	16.00	20.70	10.70	173.44	11.31	11.2	11.2	1.0	388.56	1470.16	47	1.0	531.8	1891.37	18.5	13.0	45	10.70	3.35	2.08	157.4	1069.9	4431.4	271.5	3633.1	**1772.56**	**1211.02**
18.50	20.00	19.25	1.50	17.50	20.70	10.70	173.44	5.66	13.0	13.0	1.0	226.52	1696.68	45	1.0	254.6	2145.94	20.0	24.0	16	11.59	9.28	9.78	157.4	1892.4	5735.1	297.0	4139.6	**2294.02**	**1379.87**
20.00	21.50	20.75	1.50	19.00	21.59	11.59	173.44	5.66	24.0	24.0	1.0	436.85	2133.53	16	1.0	90.5	2236.46	21.5	11.5	49	9.80	2.91	1.65	157.4	1028.3	5398.3	322.5	4692.4	**2159.32**	**1564.15**
21.50	24.50	23.00	3.00	22.00	19.80	9.80	173.44	11.31	11.5	11.5	1.0	399.24	2532.77	49	1.0	554.4	2790.86	24.5	13.5	51	10.59	3.50	2.22	157.4	1158.6	6482.2	373.4	5697.0	**2592.87**	**1899.00**
24.50	27.50	26.00	3.00	25.00	20.59	10.59	173.44	11.31	13.5	13.5	1.0	471.12	3003.89	51	1.0	577.0	3367.89	27.5	14.5	51	10.59	3.80	2.51	157.4	1213.1	7584.9	424.3	6796.1	**3033.97**	**2265.35**
27.50	30.00	28.75	2.50	27.50	20.59	10.59	173.44	9.43	14.5	14.5	1.0	422.92	3426.81	51	1.0	480.9	3848.74	30.0	9.5	51	10.70	2.38	1.14	157.4	951.4	8227.0	466.7	7742.3	**3290.80**	**2580.75**
30.00	30.50	30.25	0.50	28.00	20.70	10.70	173.44	1.89	9.5	9.5	1.0	54.73	3481.54	51	1.0	96.2	3944.91	30.5	18.8	37	10.70	5.78	4.73	157.4	1440.0	8866.4	475.2	7901.7	**3546.58**	**2633.88**
30.50	32.50	31.50	2.00	30.00	20.70	10.70	173.44	7.54	18.8	18.8	1.0	445.36	3926.90	37	1.0	279.1	4224.00	32.5	23.5	48	11.05	8.92	9.23	157.4	2146.5	10297.4	509.1	8660.0	**4118.95**	**2886.68**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
32.50	33.50	33.00	1.00	31.00	21.05	11.05	173.44	3.77	23.5	23.5	1.0	284.42	4211.31	48	1.0	181.0	4405.03	33.5	10.0	50	11.05	2.47	1.22	157.4	958.1	9574.5	526.1	9142.5	**3829.79**	**3047.49**
33.50	35.00	34.25	1.50	32.50	21.05	11.05	173.44	5.66	10.0	10.0	1.0	173.01	4384.32	50	1.0	282.9	4687.89	35.0	23.0	8	11.05	8.56	8.68	157.4	1670.9	10743.1	551.6	9623.8	**4297.26**	**3207.93**
35.00	36.50	35.75	1.50	34.00	21.05	11.05	173.44	5.66	28.9	28.9	1.0	541.64	4925.96	8	1.0	45.3	4733.14	36.5	9.0	68	11.05	2.29	1.07	157.4	1108.2	10767.3	577.0	10236.1	**4306.93**	**3412.04**
36.50	37.50	37.00	1.00	35.00	21.05	11.05	173.44	3.77	9.0	9.0	1.0	103.60	5029.56	68	1.0	256.5	4989.60	37.5	9.0	68	11.05	2.29	1.07	157.4	1108.2	11127.4	594.0	10613.2	**4450.95**	**3537.72**
37.50	40.00	38.75	2.50	37.50	21.05	11.05	173.44	9.43	9.0	9.0	1.0	259.00	5288.57	68	1.0	641.1	5630.74	40.0	6.0	125	11.05	1.75	0.60	157.4	1589.0	12508.3	636.4	11555.7	**5003.33**	**3851.91**
BORE NO: P95, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.43	9.43	25.93	1.89	28.0	28.0	1.0	26.00	0	3	1.0	5.7	0	3.0	23.4	0	9.43	8.85	9.12	28.3	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.43	9.43	33.01	3.77	23.4	23.4	1.0	53.87	0	0	1.0	0.0	0	4.0	24.2	0	9.43	9.42	10.00	37.7	0	0.0	25.5	25.5	**0.00**	**8.49**
4.00	5.00	4.50	1.00	2.50	19.43	9.43	42.44	3.77	24.2	24.2	1.0	71.93	0	0	1.0	0.0	0	5.0	27.5	4	9.64	15.63	16.64	47.2	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	19.64	9.64	51.97	3.77	27.5	27.5	1.0	102.03	0	4	1.0	15.1	0	6.0	24.2	0	9.64	9.42	10.00	56.8	0	0.0	59.4	59.4	**0.00**	**19.80**
6.00	7.00	6.50	1.00	4.50	19.64	9.64	61.61	3.77	24.2	24.2	1.0	104.43	0	0	1.0	0.0	0	7.0	24.2	0	9.64	9.42	10.00	66.4	0	0.0	76.4	76.4	**0.00**	**25.46**
7.00	8.00	7.50	1.00	5.50	19.64	9.64	71.25	3.77	24.2	24.2	1.0	120.76	0	0	1.0	0.0	0	8.0	10.7	45	10.20	2.68	1.42	76.1	698.4	698.4	93.3	93.3	**279.35**	**31.11**
8.00	9.00	8.50	1.00	6.50	20.20	10.20	81.17	3.77	10.7	10.7	1.0	57.84	57.84	45	1.0	169.7	169.71	9.0	9.5	52	10.20	2.38	1.14	86.3	769.7	997.3	110.3	337.9	**398.92**	**112.62**
9.00	10.00	9.50	1.00	7.50	20.20	10.20	91.37	3.77	9.5	9.5	1.0	57.67	115.51	52	1.0	196.1	365.83	10.0	9.5	52	10.31	2.38	1.14	96.5	797.3	1278.6	127.3	608.6	**511.45**	**202.87**
10.00	12.50	11.25	2.50	10.00	20.31	10.31	109.36	9.43	9.5	9.5	1.0	172.54	288.05	52	1.0	490.3	856.11	12.5	9.5	52	9.43	2.38	1.14	122.2	866.0	2010.2	169.7	1313.9	**804.07**	**437.96**
12.50	15.50	14.00	3.00	13.00	19.43	9.43	136.39	11.31	9.5	9.5	1.0	258.24	546.29	52	1.0	588.3	1444.46	15.5	9.0	53	9.43	2.29	1.07	150.5	936.5	2927.3	220.6	2211.4	**1170.92**	**737.12**
15.50	18.50	17.00	3.00	16.00	19.43	9.43	164.68	11.31	9.0	9.0	1.0	295.11	841.40	53	1.0	599.7	2044.11	18.5	9.0	53	9.69	2.29	1.07	150.5	936.7	3822.2	271.5	3157.1	**1528.90**	**1052.35**
18.50	20.00	19.25	1.50	17.50	19.69	9.69	164.68	5.66	9.0	9.0	1.0	147.55	988.95	53	1.0	299.8	2343.94	20.0	10.2	49	9.69	2.53	1.28	150.5	938.1	4271.0	297.0	3629.9	**1708.38**	**1209.96**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
20.00	21.50	20.75	1.50	19.00	19.69	9.69	164.68	5.66	10.2	10.2	1.0	167.62	1156.57	49	1.0	277.2	2621.14	21.5	10.2	49	9.69	2.53	1.28	150.5	938.1	4715.8	322.5	4100.2	**1886.31**	**1366.72**
21.50	23.00	22.25	1.50	20.50	19.69	9.69	164.68	5.66	10.2	10.2	1.0	167.62	1324.20	49	1.0	277.2	2898.34	23.0	9.4	40	10.82	2.36	1.13	150.5	817.9	5040.4	347.9	4570.5	**2016.17**	**1523.49**
23.00	24.50	23.75	1.50	22.00	20.82	10.82	164.68	5.66	9.4	9.4	1.0	154.23	1478.43	40	1.0	226.3	3124.63	24.5	9.4	44	10.82	2.36	1.13	150.5	858.6	5461.7	373.4	4976.4	**2184.67**	**1658.81**
24.50	27.50	26.00	3.00	25.00	20.82	10.82	164.68	11.31	9.4	9.4	1.0	308.46	1786.88	44	1.0	497.8	3622.46	27.5	9.5	26	10.10	2.38	1.14	150.5	678.0	6087.3	424.3	5833.6	**2434.92**	**1944.54**
27.50	30.00	28.75	2.50	27.50	20.10	10.10	164.68	9.43	9.5	9.5	1.0	259.83	2046.72	26	1.0	245.1	3867.60	30.0	26.7	0	10.10	13.83	14.80	150.5	2456.7	8371.0	466.7	6381.0	**3348.40**	**2127.01**
30.00	30.50	30.25	0.50	28.00	20.10	10.10	164.68	1.89	26.7	26.7	1.0	156.19	2202.90	0	1.0	0.0	3867.60	30.5	26.7	0	10.10	13.83	14.80	150.5	2456.7	8527.2	475.2	6545.7	**3410.87**	**2181.90**
30.50	32.00	31.25	1.50	29.50	20.10	10.10	164.68	5.66	26.7	26.7	1.0	468.56	2671.46	0	1.0	0.0	3867.60	32.0	10.5	63	10.10	2.62	1.36	150.5	1096.6	7635.6	500.7	7039.7	**3054.26**	**2346.57**
32.00	32.50	32.25	0.50	30.00	20.10	10.10	164.68	1.89	10.5	10.5	1.0	57.56	2729.01	63	1.0	118.8	3986.40	32.5	10.5	63	8.97	2.62	1.36	150.5	1095.5	7811.0	509.1	7224.6	**3124.38**	**2408.19**
32.50	33.50	33.00	1.00	31.00	18.97	8.97	164.68	3.77	10.5	10.5	1.0	115.11	2844.12	63	1.0	237.6	4224.00	33.5	10.5	63	8.97	2.62	1.36	150.5	1095.5	8163.7	526.1	7594.2	**3265.47**	**2531.41**
33.50	35.00	34.25	1.50	32.50	18.97	8.97	164.68	5.66	10.5	10.5	1.0	172.67	3016.79	63	1.0	356.4	4580.40	35.0	26.1	0	9.42	12.48	13.41	150.5	2210.9	9808.1	551.6	8148.8	**3923.23**	**2716.25**
35.00	36.50	35.75	1.50	34.00	19.42	9.42	164.68	5.66	26.1	26.1	1.0	456.40	3473.18	0	1.0	0.0	4580.40	36.5	13.2	56	9.57	3.41	2.14	150.5	1164.9	9218.5	577.0	8630.6	**3687.39**	**2876.87**
36.50	37.50	37.00	1.00	35.00	19.57	9.57	164.68	3.77	13.2	13.2	1.0	145.67	3618.86	56	1.0	211.2	4791.60	37.5	13.2	56	9.57	3.41	2.14	150.5	1164.9	9575.4	594.0	9004.5	**3830.14**	**3001.49**
37.50	38.00	37.75	0.50	35.50	19.57	9.57	164.68	1.89	13.2	13.2	1.0	72.84	3691.69	56	1.0	105.6	4897.20	38.0	10.0	55	9.51	2.47	1.22	150.5	988.6	9577.5	602.5	9191.4	**3831.01**	**3063.79**
38.00	40.00	39.00	2.00	37.50	19.51	9.51	164.68	7.54	10.0	10.0	1.0	219.03	3910.72	55	1.0	414.9	5312.06	40.0	10.0	55	9.51	2.47	1.22	150.5	988.6	10211.4	636.4	9859.2	**4084.56**	**3286.40**
BORE NO: P96, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.19	10.19	28.02	1.89	27.5	27.5	1.0	27.51	0	3	1.0	5.7	0	3.0	25.5	0	10.19	11.13	12.03	30.6	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	20.19	10.19	35.67	3.77	25.5	25.5	1.0	64.16	0	0	1.0	0.0	0	4.0	24.3	5	9.41	9.50	10.11	40.8	0	0.0	25.5	25.5	**0.00**	**8.49**
4.00	6.00	5.00	2.00	3.50	19.41	9.41	50.17	7.54	24.3	24.3	1.0	170.87	0	5	1.0	37.7	0	6.0	24.7	0	9.41	9.78	10.55	59.6	0	0.0	59.4	59.4	**0.00**	**19.80**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
6.00	7.00	6.50	1.00	4.50	19.41	9.41	64.29	3.77	24.7	24.7	1.0	111.51	0	0	1.0	0.0	0	7.0	24.7	0	9.41	9.78	10.55	69.0	0	0.0	76.4	76.4	**0.00**	**25.46**
7.00	8.00	7.50	1.00	5.50	19.41	9.41	73.70	3.77	24.7	24.7	1.0	127.84	0	0	1.0	0.0	0	8.0	10.5	42	9.41	2.62	1.36	78.4	668.5	668.5	93.3	93.3	**267.41**	**31.11**
8.00	9.00	8.50	1.00	6.50	19.41	9.41	83.11	3.77	10.5	10.5	1.0	58.09	58.09	42	1.0	158.4	158.40	9.0	10.5	42	10.20	2.62	1.36	87.8	697.1	913.6	110.3	326.8	**365.44**	**108.93**
9.00	10.00	9.50	1.00	7.50	20.20	10.20	92.91	3.77	10.5	10.5	1.0	64.94	123.03	42	1.0	158.4	316.80	10.0	10.5	42	10.20	2.62	1.36	98.0	727.3	1167.2	127.3	567.1	**466.86**	**189.04**
10.00	12.50	11.25	2.50	10.00	20.20	10.20	110.76	9.43	10.5	10.5	1.0	193.55	316.58	42	1.0	396.0	712.80	12.5	11.2	54	10.20	2.82	1.56	123.5	955.2	1984.5	169.7	1199.1	**793.82**	**399.70**
12.50	14.00	13.25	1.50	11.50	20.20	10.20	131.16	5.66	11.2	11.2	1.0	146.92	463.50	54	1.0	305.5	1018.29	14.0	11.2	40	10.07	2.82	1.56	138.8	861.3	2343.1	195.2	1677.0	**937.25**	**558.99**
14.00	15.50	14.75	1.50	13.00	20.07	10.07	146.36	5.66	11.2	11.2	1.0	163.95	627.45	40	1.0	226.3	1244.57	15.5	11.2	40	10.07	2.82	1.56	153.9	909.6	2781.6	220.6	2092.6	**1112.64**	**697.55**
15.50	17.00	16.25	1.50	14.50	20.07	10.07	161.47	5.66	11.2	11.2	1.0	180.87	808.32	40	1.0	226.3	1470.86	17.0	28.0	0	10.25	16.76	17.79	169.0	3328.1	5607.2	246.1	2525.3	**2242.90**	**841.75**
17.00	18.50	17.75	1.50	16.00	20.25	10.25	176.71	5.66	28.0	28.0	1.0	531.53	1339.85	0	1.0	0.0	1470.86	18.5	28.0	0	10.25	16.76	17.79	169.0	3328.1	6138.8	271.5	3082.2	**2455.51**	**1027.42**
18.50	20.00	19.25	1.50	17.50	20.25	10.25	176.71	5.66	28.0	28.0	1.0	531.53	1871.37	0	1.0	0.0	1470.86	20.0	15.5	32	10.25	4.19	2.92	169.0	1146.7	4488.9	297.0	3639.2	**1795.57**	**1213.08**
20.00	21.50	20.75	1.50	19.00	20.25	10.25	176.71	5.66	15.5	15.5	1.0	277.23	2148.60	32	1.0	181.0	1651.89	21.5	15.5	32	9.88	4.19	2.92	169.0	1146.0	4946.5	322.5	4122.9	**1978.58**	**1374.32**
21.50	23.00	22.25	1.50	20.50	19.88	9.88	176.71	5.66	15.5	15.5	1.0	277.23	2425.83	32	1.0	181.0	1832.91	23.0	9.4	49	9.88	2.36	1.13	169.0	958.2	5217.0	347.9	4606.7	**2086.79**	**1535.55**
23.00	24.50	23.75	1.50	22.00	19.88	9.88	176.71	5.66	9.4	9.4	1.0	165.49	2591.33	49	1.0	277.2	2110.11	24.5	9.4	49	9.88	2.36	1.13	169.0	958.2	5659.7	373.4	5074.8	**2263.86**	**1691.60**
24.50	26.00	25.25	1.50	23.50	19.88	9.88	176.71	5.66	9.4	9.4	1.0	165.49	2756.82	49	1.0	277.2	2387.31	26.0	29.8	0	9.88	20.81	21.94	169.0	4126.6	9270.7	398.8	5543.0	**3708.28**	**1847.65**
26.00	27.50	26.75	1.50	25.00	19.88	9.88	176.71	5.66	29.8	29.8	1.0	572.51	3329.33	0	1.0	0.0	2387.31	27.5	29.8	0	11.32	20.81	21.94	169.0	4148.0	9864.7	424.3	6140.9	**3945.86**	**2046.98**
27.50	29.00	28.25	1.50	26.50	21.32	11.32	176.71	5.66	29.8	29.8	1.0	572.51	3901.84	0	1.0	0.0	2387.31	29.0	12.1	42	11.32	3.09	1.82	169.0	1032.0	7321.2	449.7	6738.9	**2928.48**	**2246.30**
29.00	30.00	29.50	1.00	27.50	21.32	11.32	176.71	3.77	12.1	12.1	1.0	142.87	4044.71	42	1.0	158.4	2545.71	30.0	12.1	42	11.32	3.09	1.82	169.0	1032.0	7622.5	466.7	7057.1	**3048.99**	**2352.38**
30.00	30.50	30.25	0.50	28.00	21.32	11.32	176.71	1.89	12.1	12.1	1.0	71.44	4116.15	42	1.0	79.2	2624.91	30.5	12.1	42	11.32	3.09	1.82	169.0	1032.0	7773.1	475.2	7216.3	**3109.24**	**2405.42**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
30.50	32.00	31.25	1.50	29.50	21.32	11.32	176.71	5.66	12.1	12.1	1.0	214.31	4330.46	42	1.0	237.6	2862.51	32.0	29.1	0	11.32	19.23	20.33	169.0	3834.2	11027.1	500.7	7693.6	**4410.86**	**2564.54**
32.00	32.50	32.25	0.50	30.00	21.32	11.32	176.71	1.89	29.1	29.1	1.0	185.47	4515.92	0	1.0	0.0	2862.51	32.5	27.6	0	10.88	15.85	16.87	169.0	3156.6	10535.1	509.1	7887.6	**4214.02**	**2629.19**
32.50	33.50	33.00	1.00	31.00	20.88	10.88	176.71	3.77	27.6	27.6	1.0	348.41	4864.33	0	1.0	0.0	2862.51	33.5	18.0	39	10.88	5.42	4.29	169.0	1464.6	9191.4	526.1	8253.0	**3676.57**	**2750.99**
33.50	35.00	34.25	1.50	32.50	20.88	10.88	176.71	5.66	18.0	18.0	1.0	324.81	5189.14	39	1.0	220.6	3083.14	35.0	29.3	5	10.88	19.68	20.79	169.0	3968.5	12240.8	551.6	8823.9	**4896.33**	**2941.28**
35.00	36.50	35.75	1.50	34.00	20.88	10.88	176.71	5.66	29.3	29.3	1.0	560.98	5750.12	5	1.0	28.3	3111.43	36.5	12.6	48	10.88	3.23	1.96	169.0	1121.6	9983.1	577.0	9438.6	**3993.25**	**3146.19**
36.50	37.50	37.00	1.00	35.00	20.88	10.88	176.71	3.77	12.6	12.6	1.0	148.97	5899.09	48	1.0	181.0	3292.46	37.5	12.6	48	10.88	3.23	1.96	169.0	1121.6	10313.1	594.0	9785.5	**4125.25**	**3261.85**
37.50	38.00	37.75	0.50	35.50	20.88	10.88	176.71	1.89	12.6	12.6	1.0	74.48	5973.57	48	1.0	90.5	3382.97	38.0	10.0	45	8.03	2.47	1.22	169.0	937.2	10293.8	602.5	9959.0	**4117.51**	**3319.68**
38.00	40.00	39.00	2.00	37.50	18.03	8.03	176.71	7.54	10.0	10.0	1.0	235.02	6208.60	45	1.0	339.4	3722.40	40.0	10.0	45	8.03	2.47	1.22	169.0	937.2	10868.2	636.4	10567.4	**4347.29**	**3522.47**
BORE NO: P97, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.91	9.91	27.25	1.89	15.0	15.0	1.0	13.77	0	32	1.0	60.3	0	3.0	12.9	16	9.91	3.32	2.05	29.7	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.91	9.91	34.69	3.77	12.9	12.9	1.0	29.96	0	16	1.0	60.3	0	4.0	27.0	7	9.91	14.50	15.49	39.6	0	0.0	25.5	25.5	**0.00**	**8.49**
4.00	5.00	4.50	1.00	2.50	19.91	9.91	44.60	3.77	27.0	27.0	1.0	85.70	0	7	1.0	26.4	0	5.0	27.0	7	9.91	14.50	15.49	49.6	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	19.91	9.91	54.51	3.77	27.0	27.0	1.0	104.74	0	7	1.0	26.4	0	6.0	25.8	0	9.91	11.80	12.72	59.5	0	0.0	59.4	59.4	**0.00**	**19.80**
6.00	7.00	6.50	1.00	4.50	19.91	9.91	64.42	3.77	25.8	25.8	1.0	117.44	0	0	1.0	0.0	0	7.0	26.0	10	10.07	12.25	13.18	69.4	0	0.0	76.4	76.4	**0.00**	**25.46**
7.00	8.00	7.50	1.00	5.50	20.07	10.07	74.41	3.77	26.0	26.0	1.0	136.86	0	10	1.0	37.7	0	8.0	11.5	44	10.07	2.91	1.65	79.4	721.0	721.0	93.3	93.3	**288.38**	**31.11**
8.00	9.00	8.50	1.00	6.50	20.07	10.07	84.48	3.77	11.5	11.5	1.0	64.82	64.82	44	1.0	165.9	165.94	9.0	11.5	44	10.35	2.91	1.65	89.5	754.4	985.2	110.3	341.1	**394.08**	**113.69**
9.00	11.00	10.00	2.00	8.50	20.35	10.35	99.86	7.54	11.5	11.5	1.0	153.25	218.06	44	1.0	331.9	497.83	11.0	9.5	51	10.35	2.38	1.14	110.2	824.1	1540.0	144.3	860.2	**616.01**	**286.72**
11.00	12.00	11.50	1.00	9.50	20.35	10.35	115.39	3.77	9.5	9.5	1.0	72.82	290.89	51	1.0	192.3	690.17	12.0	9.0	51	10.56	2.29	1.07	120.6	839.3	1820.4	161.2	1142.3	**728.16**	**380.76**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
12.00	14.50	13.25	2.50	12.00	20.56	10.56	133.76	9.43	9.0	9.0	1.0	199.75	490.64	51	1.0	480.9	1171.03	14.5	9.0	50	9.81	2.29	1.07	147.0	897.0	2558.7	203.7	1865.3	**1023.47**	**621.77**
14.50	17.50	16.00	3.00	15.00	19.81	9.81	161.68	11.31	9.0	9.0	1.0	289.72	780.36	50	1.0	565.7	1736.74	17.5	11.0	44	9.81	2.76	1.51	176.4	1009.7	3526.8	254.6	2771.7	**1410.72**	**923.89**
17.50	20.50	19.00	3.00	18.00	19.81	9.81	161.68	11.31	11.0	11.0	1.0	355.57	1135.93	44	1.0	497.8	2234.57	20.5	11.3	44	10.96	2.85	1.59	176.4	1029.1	4399.6	305.5	3676.0	**1759.84**	**1225.33**
20.50	23.50	22.00	3.00	21.00	20.96	10.96	161.68	11.31	11.3	11.3	1.0	365.52	1501.44	44	1.0	497.8	2732.40	23.5	12.6	44	10.96	3.23	1.96	176.4	1107.9	5341.8	356.4	4590.2	**2136.70**	**1530.08**
23.50	26.50	25.00	3.00	24.00	20.96	10.96	161.68	11.31	12.6	12.6	1.0	408.88	1910.33	44	1.0	497.8	3230.23	26.5	15.5	39	9.65	4.19	2.92	176.4	1251.7	6392.3	407.3	5547.9	**2556.90**	**1849.29**
26.50	27.50	27.00	1.00	25.00	19.65	9.65	161.68	3.77	15.5	15.5	1.0	169.10	2079.42	39	1.0	147.1	3377.31	27.5	15.5	39	10.33	4.19	2.92	176.4	1253.0	6709.8	424.3	5881.0	**2683.91**	**1960.34**
27.50	29.50	28.50	2.00	27.00	20.33	10.33	161.68	7.54	15.5	15.5	1.0	338.19	2417.62	39	1.0	294.2	3671.49	29.5	26.8	0	10.33	14.05	15.03	176.4	2910.1	8999.2	458.2	6547.3	**3599.67**	**2182.44**
29.50	30.00	29.75	0.50	27.50	20.33	10.33	161.68	1.89	26.8	26.8	1.0	154.00	2571.62	0	1.0	0.0	3671.49	30.0	26.8	0	10.33	14.05	15.03	176.4	2910.1	9153.2	466.7	6709.8	**3661.27**	**2236.61**
30.00	32.50	31.25	2.50	30.00	20.33	10.33	161.68	9.43	26.8	26.8	1.0	770.01	3341.63	0	1.0	0.0	3671.49	32.5	23.5	10	10.33	8.92	9.23	176.4	1946.8	8959.9	509.1	7522.3	**3583.95**	**2507.42**
32.50	35.00	33.75	2.50	32.50	20.33	10.33	161.68	9.43	23.5	23.5	1.0	662.81	4004.45	10	1.0	94.3	3765.77	35.0	23.5	10	11.77	8.92	9.23	176.4	1955.8	9726.0	551.6	8321.8	**3890.40**	**2773.93**
35.00	35.50	35.25	0.50	33.00	21.77	11.77	161.68	1.89	23.5	23.5	1.0	132.56	4137.01	10	1.0	18.9	3784.63	35.5	23.0	10	11.77	8.56	8.68	176.4	1879.6	9801.2	560.1	8481.7	**3920.48**	**2827.23**
35.50	37.50	36.50	2.00	35.00	21.77	11.77	161.68	7.54	23.0	23.0	1.0	517.64	4654.65	10	1.0	75.4	3860.06	37.5	26.5	10	11.77	13.38	14.34	176.4	2886.2	11400.9	594.0	9108.7	**4560.38**	**3036.24**
37.50	38.50	38.00	1.00	36.00	21.77	11.77	161.68	3.77	26.5	26.5	1.0	304.01	4958.66	10	1.0	37.7	3897.77	38.5	26.0	10	11.77	12.25	13.18	176.4	2652.3	11508.7	611.0	9467.4	**4603.50**	**3155.80**
38.50	40.00	39.25	1.50	37.50	21.77	11.77	161.68	5.66	26.0	26.0	1.0	446.09	5404.75	10	1.0	56.6	3954.34	40.0	18.0	47	11.77	5.42	4.29	176.4	1593.8	10952.9	636.4	9995.5	**4381.15**	**3331.84**
BORE NO: P98, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.20	9.20	25.30	1.89	27.3	27.3	1.0	24.62	0	2	1.0	3.8	0	3.0	27.3	2	9.48	15.18	16.18	27.6	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.50	19.48	9.48	37.08	7.54	27.3	27.3	1.0	144.36	0	2	1.0	15.1	0	5.0	25.7	8	9.48	11.58	12.49	46.6	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	19.48	9.48	51.30	3.77	25.7	25.7	1.0	93.11	0	8	1.0	30.2	0	6.0	25.7	8	9.48	11.58	12.49	56.0	0	0.0	59.4	59.4	**0.00**	**19.80**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
6.00	7.00	6.50	1.00	4.50	19.48	9.48	60.78	3.77	25.7	25.7	1.0	110.32	0	8	1.0	30.2	0	7.0	25.7	8	9.84	11.58	12.49	65.5	1023.1	1023.1	76.4	76.4	**409.23**	**25.46**
7.00	8.00	7.50	1.00	5.50	19.84	9.84	70.44	3.77	25.7	25.7	1.0	127.85	127.85	8	1.0	30.2	30.17	8.0	9.5	47	9.84	2.38	1.14	75.4	689.2	847.2	93.3	251.4	**338.87**	**83.79**
8.00	9.00	8.50	1.00	6.50	19.84	9.84	80.28	3.77	9.5	9.5	1.0	50.67	178.52	47	1.0	177.3	207.43	9.0	9.5	47	9.61	2.38	1.14	85.2	715.5	1101.4	110.3	496.3	**440.57**	**165.42**
9.00	11.00	10.00	2.00	8.50	19.61	9.61	94.81	7.54	9.5	9.5	1.0	119.67	298.19	47	1.0	354.5	561.94	11.0	9.2	53	9.61	2.33	1.10	104.4	821.6	1681.8	144.3	1004.4	**672.71**	**334.80**
11.00	12.00	11.50	1.00	9.50	19.61	9.61	109.23	3.77	9.2	9.2	1.0	66.72	364.91	53	1.0	199.9	761.83	12.0	9.2	53	10.15	2.33	1.10	114.0	847.3	1974.1	161.2	1288.0	**789.63**	**429.32**
12.00	14.50	13.25	2.50	12.00	20.15	10.15	126.72	9.43	9.2	9.2	1.0	193.51	558.42	53	1.0	499.7	1261.54	14.5	10.3	43	10.47	2.56	1.31	139.4	850.6	2670.6	203.7	2023.6	**1068.24**	**674.54**
14.50	17.50	16.00	3.00	15.00	20.47	10.47	155.11	11.31	10.3	10.3	1.0	318.93	877.35	43	1.0	486.5	1748.06	17.5	10.3	43	10.47	2.56	1.31	170.8	941.6	3567.0	254.6	2880.0	**1426.79**	**959.99**
17.50	19.00	18.25	1.50	16.50	20.47	10.47	155.11	5.66	10.3	10.3	1.0	159.47	1036.82	43	1.0	243.3	1991.31	19.0	28.4	0	9.49	17.66	18.71	170.8	3532.9	6561.1	280.0	3308.2	**2624.43**	**1102.72**
19.00	20.50	19.75	1.50	18.00	19.49	9.49	155.11	5.66	28.4	28.4	1.0	474.45	1511.27	0	1.0	0.0	1991.31	20.5	12.8	34	9.49	3.29	2.02	170.8	995.4	4498.0	305.5	3808.1	**1799.19**	**1269.36**
20.50	22.00	21.25	1.50	19.50	19.49	9.49	155.11	5.66	12.8	12.8	1.0	199.36	1710.63	34	1.0	192.3	2183.66	22.0	20.7	39	9.49	6.90	6.16	170.8	1771.1	5665.4	330.9	4225.2	**2266.16**	**1408.41**
22.00	23.50	22.75	1.50	21.00	19.49	9.49	155.11	5.66	20.7	20.7	1.0	331.57	2042.20	39	1.0	220.6	2404.29	23.5	11.5	40	9.47	2.91	1.65	170.8	980.5	5427.0	356.4	4802.9	**2170.80**	**1600.96**
23.50	26.50	25.00	3.00	24.00	19.47	9.47	155.11	11.31	11.5	11.5	1.0	357.05	2399.25	40	1.0	452.6	2856.86	26.5	11.5	40	9.47	2.91	1.65	170.8	980.5	6236.6	407.3	5663.4	**2494.65**	**1887.81**
26.50	27.50	27.00	1.00	25.00	19.47	9.47	155.11	3.77	11.5	11.5	1.0	119.02	2518.27	40	1.0	150.9	3007.71	27.5	14.4	40	9.47	3.77	2.48	170.8	1151.1	6677.1	424.3	5950.3	**2670.83**	**1983.42**
27.50	28.00	27.75	0.50	25.50	19.47	9.47	155.11	1.89	14.4	14.4	1.0	75.10	2593.36	40	1.0	75.4	3083.14	28.0	28.5	4	9.78	17.88	18.94	170.8	3622.4	9298.9	432.8	6109.3	**3719.57**	**2036.43**
28.00	29.50	28.75	1.50	27.00	19.78	9.78	155.11	5.66	28.5	28.5	1.0	476.43	3069.80	4	1.0	22.6	3105.77	29.5	30.2	0	9.78	22.27	23.43	170.8	4459.0	10634.5	458.2	6633.8	**4253.81**	**2211.27**
29.50	30.00	29.75	0.50	27.50	19.78	9.78	155.11	1.89	30.2	30.2	1.0	171.94	3241.73	0	1.0	0.0	3105.77	30.0	30.6	0	9.78	24.28	25.48	170.8	4862.0	11209.5	466.7	6814.2	**4483.80**	**2271.41**
30.00	31.00	30.50	1.00	28.50	19.78	9.78	155.11	3.77	30.6	30.6	1.0	356.34	3598.07	0	1.0	0.0	3105.77	31.0	32.8	0	9.78	35.36	36.75	170.8	7078.7	13782.5	483.7	7187.5	**5513.02**	**2395.84**
31.00	32.50	31.75	1.50	30.00	19.78	9.78	155.11	5.66	32.8	32.8	1.1	644.67	4242.74	0	1.0	0.0	3105.77	32.5	32.8	0	11.12	35.36	36.75	170.8	7112.1	14460.6	509.1	7857.7	**5784.26**	**2619.22**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
32.50	35.00	33.75	2.50	32.50	21.12	11.12	155.11	9.43	32.8	32.8	1.1	1074.44	5317.18	0	1.0	0.0	3105.77	35.0	32.0	0	11.12	31.33	32.65	170.8	6302.3	14725.3	551.6	8974.5	**5890.11**	**2991.51**
35.00	35.50	35.25	0.50	33.00	21.12	11.12	155.11	1.89	32.0	32.0	1.1	201.05	5518.23	0	1.0	0.0	3105.77	35.5	31.3	0	11.12	27.81	29.06	170.8	5593.7	14217.8	560.1	9184.1	**5687.10**	**3061.35**
35.50	37.50	36.50	2.00	35.00	21.12	11.12	155.11	7.54	31.3	31.3	1.1	757.59	6275.82	0	1.0	0.0	3105.77	37.5	31.3	0	8.46	27.81	29.06	170.8	5541.3	14922.9	594.0	9975.6	**5969.14**	**3325.20**
37.50	38.50	38.00	1.00	36.00	18.46	8.46	155.11	3.77	31.3	31.3	1.1	378.80	6654.62	0	1.0	0.0	3105.77	38.5	30.3	0	8.68	22.77	23.94	170.8	4541.8	14302.2	611.0	10371.4	**5720.89**	**3457.12**
38.50	40.00	39.25	1.50	37.50	18.68	8.68	155.11	5.66	30.3	30.3	1.0	520.45	7175.07	0	1.0	0.0	3105.77	40.0	30.3	0	8.68	22.77	23.94	170.8	4541.8	14822.7	636.4	10917.3	**5929.07**	**3639.09**
BORE NO: P99, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.67	10.67	29.34	1.89	27.5	27.5	1.0	28.80	0	11	1.0	20.7	0	3.0	26.1	0	10.67	12.48	13.41	32.0	549.0	549.0	8.5	8.5	**219.62**	**2.83**
3.00	4.00	3.50	1.00	1.50	20.67	10.67	37.35	3.77	26.1	26.1	1.0	69.00	69.00	0	1.0	0.0	0.00	4.0	26.0	11	9.83	12.25	13.18	42.7	791.6	860.6	25.5	94.5	**344.25**	**31.49**
4.00	5.00	4.50	1.00	2.50	19.83	9.83	47.60	3.77	26.0	26.0	1.0	87.55	156.55	11	1.0	41.5	41.49	5.0	26.0	11	9.83	12.25	13.18	52.5	927.9	1125.9	42.4	240.5	**450.37**	**80.15**
5.00	6.00	5.50	1.00	3.50	19.83	9.83	57.43	3.77	26.0	26.0	1.0	105.63	262.18	11	1.0	41.5	82.97	6.0	26.5	0	9.83	13.38	14.34	62.3	1039.3	1384.4	59.4	404.5	**553.76**	**134.85**
6.00	7.00	6.50	1.00	4.50	19.83	9.83	67.26	3.77	26.5	26.5	1.0	126.46	388.64	0	1.0	0.0	82.97	7.0	23.0	15	9.83	8.56	8.68	72.2	909.7	1381.3	76.4	548.0	**552.51**	**182.66**
7.00	8.00	7.50	1.00	5.50	19.83	9.83	77.09	3.77	23.0	23.0	1.0	123.40	512.05	15	1.0	56.6	139.54	8.0	9.6	47	10.52	2.40	1.16	82.0	709.3	1360.9	93.3	744.9	**544.37**	**248.31**
8.00	9.00	8.50	1.00	6.50	20.52	10.52	87.26	3.77	9.6	9.6	1.0	55.66	567.71	47	1.0	177.3	316.80	9.0	9.6	47	10.52	2.40	1.16	92.5	737.9	1622.4	110.3	994.8	**648.96**	**331.61**
9.00	11.00	10.00	2.00	8.50	20.52	10.52	103.04	7.54	9.6	9.6	1.0	131.46	699.16	47	1.0	354.5	671.31	11.0	9.6	46	10.52	2.40	1.16	113.6	784.8	2155.3	144.3	1514.7	**862.11**	**504.91**
11.00	12.00	11.50	1.00	9.50	20.52	10.52	118.82	3.77	9.6	9.6	1.0	75.79	774.96	46	1.0	173.5	844.80	12.0	11.0	50	10.17	2.76	1.51	124.1	907.6	2527.3	161.2	1781.0	**1010.93**	**593.66**
12.00	14.50	13.25	2.50	12.00	20.17	10.17	136.79	9.43	11.0	11.0	1.0	250.70	1025.66	50	1.0	471.4	1316.23	14.5	11.0	55	9.76	2.76	1.51	149.5	1037.6	3379.5	203.7	2545.5	**1351.79**	**848.52**
14.50	17.50	16.00	3.00	15.00	19.76	9.76	164.15	11.31	11.0	11.0	1.0	361.00	1386.66	55	1.0	622.3	1938.51	17.5	27.5	7	9.76	15.63	16.64	178.8	3343.2	6668.3	254.6	3579.7	**2667.33**	**1193.25**
17.50	19.00	18.25	1.50	16.50	19.76	9.76	164.15	5.66	27.5	27.5	1.0	483.39	1870.06	7	1.0	39.6	1978.11	19.0	24.8	0	9.93	9.86	10.66	178.8	2065.6	5913.7	280.0	4128.2	**2365.49**	**1376.07**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Factor of Safety in Compression: 2.5
Area of Pile: 1.13 m^2
Critical water table: 0.00 m
Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
19.00	20.50	19.75	1.50	18.00	19.93	9.93	164.15	5.66	24.8	24.8	1.0	429.07	2299.12	0	1.0	0.0	1978.11	20.5	24.8	0	9.93	9.86	10.66	178.8	2065.6	6342.8	305.5	4582.7	**2537.12**	**1527.57**
20.50	22.00	21.25	1.50	19.50	19.93	9.93	164.15	5.66	24.8	24.8	1.0	429.07	2728.19	0	1.0	0.0	1978.11	22.0	26.5	12	10.16	13.38	14.34	178.8	2927.2	7633.5	330.9	5037.3	**3053.39**	**1679.08**
22.00	23.50	22.75	1.50	21.00	20.16	10.16	164.15	5.66	26.5	26.5	1.0	462.98	3191.17	12	1.0	67.9	2046.00	23.5	26.0	12	10.16	12.25	13.18	178.8	2691.5	7928.6	356.4	5593.6	**3171.46**	**1864.52**
23.50	25.00	24.25	1.50	22.50	20.16	10.16	164.15	5.66	26.0	26.0	1.0	452.90	3644.08	12	1.0	67.9	2113.89	25.0	27.0	0	10.16	14.50	15.49	178.8	3040.7	8798.7	381.9	6139.8	**3519.46**	**2046.61**
25.00	26.50	25.75	1.50	24.00	20.16	10.16	164.15	5.66	27.0	27.0	1.0	473.14	4117.22	0	1.0	0.0	2113.89	26.5	27.0	0	10.06	14.50	15.49	178.8	3039.6	9270.7	407.3	6638.4	**3708.30**	**2212.81**
26.50	27.50	27.00	1.00	25.00	20.06	10.06	164.15	3.77	27.0	27.0	1.0	315.43	4432.65	0	1.0	0.0	2113.89	27.5	27.0	0	10.06	14.50	15.49	178.8	3039.6	9586.2	424.3	6970.8	**3834.47**	**2323.61**
27.50	28.00	27.75	0.50	25.50	20.06	10.06	164.15	1.89	27.0	27.0	1.0	157.71	4590.36	0	1.0	0.0	2113.89	28.0	25.5	13	10.06	11.13	12.03	178.8	2465.1	9169.4	432.8	7137.0	**3667.75**	**2379.01**
28.00	29.50	28.75	1.50	27.00	20.06	10.06	164.15	5.66	25.5	25.5	1.0	442.92	5033.28	13	1.0	73.5	2187.43	29.5	25.0	13	10.06	10.00	10.88	178.8	2229.5	9450.2	458.2	7678.9	**3780.08**	**2559.64**
29.50	30.00	29.75	0.50	27.50	20.06	10.06	164.15	1.89	25.0	25.0	1.0	144.34	5177.61	13	1.0	24.5	2211.94	30.0	25.4	5	10.06	10.90	11.80	178.8	2336.5	9726.1	466.7	7856.3	**3890.44**	**2618.76**
30.00	31.00	30.50	1.00	28.50	20.06	10.06	164.15	3.77	25.4	25.4	1.0	293.95	5471.56	5	1.0	18.9	2230.80	31.0	25.4	5	10.06	10.90	11.80	178.8	2336.5	10038.9	483.7	8186.0	**4015.56**	**2728.68**
31.00	32.50	31.75	1.50	30.00	20.06	10.06	164.15	5.66	25.4	25.4	1.0	440.93	5912.49	5	1.0	28.3	2259.09	32.5	25.4	5	10.39	10.90	11.80	178.8	2339.2	10510.8	509.1	8680.7	**4204.31**	**2893.57**
32.50	35.00	33.75	2.50	32.50	20.39	10.39	164.15	9.43	25.4	25.4	1.0	734.88	6647.37	5	1.0	47.1	2306.23	35.0	25.4	5	10.39	10.90	11.80	178.8	2339.2	11292.8	551.6	9505.2	**4517.12**	**3168.39**
35.00	35.50	35.25	0.50	33.00	20.39	10.39	164.15	1.89	25.4	25.4	1.0	146.98	6794.35	5	1.0	9.4	2315.66	35.5	25.6	5	10.39	11.35	12.26	178.8	2433.5	11543.5	560.1	9670.1	**4617.42**	**3223.35**
35.50	37.00	36.25	1.50	34.50	20.39	10.39	164.15	5.66	25.6	25.6	1.0	444.91	7239.25	5	1.0	28.3	2343.94	37.0	27.7	0	10.39	16.08	17.10	178.8	3373.3	12956.5	585.5	10168.7	**5182.62**	**3389.57**
37.00	37.50	37.25	0.50	35.00	20.39	10.39	164.15	1.89	27.7	27.7	1.0	162.51	7401.76	0	1.0	0.0	2343.94	37.5	27.7	0	9.43	16.08	17.10	178.8	3362.2	13107.9	594.0	10339.7	**5243.16**	**3446.57**
37.50	38.50	38.00	1.00	36.00	19.43	9.43	164.15	3.77	27.7	27.7	1.0	325.01	7726.78	0	1.0	0.0	2343.94	38.5	28.2	0	8.89	17.21	18.25	178.8	3590.6	13661.4	611.0	10681.7	**5464.55**	**3560.56**
38.50	40.00	39.25	1.50	37.50	18.89	8.89	164.15	5.66	28.2	28.2	1.0	497.91	8224.68	0	1.0	0.0	2343.94	40.0	28.2	0	8.89	17.21	18.25	178.8	3590.6	14159.3	636.4	11205.1	**5663.71**	**3735.02**
BORE NO: P100, CUT OFF LENGTH: 2.50 m, Nc= 9																														

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Factor of Safety in Compression: 2.5
Area of Pile: 1.13 m^2
Critical water table: 0.00 m
Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
2.50	3.00	2.75	0.50	0.50	20.10	10.10	27.78	1.89	28.5	28.5	1.0	28.44	0	0	1.0	0.0	0	3.0	24.5	6	8.73	9.64	10.33	30.3	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.50	18.73	8.73	39.03	7.54	24.5	24.5	1.0	134.16	0	6	1.0	45.3	0	5.0	24.5	6	8.73	9.64	10.33	47.8	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	18.73	8.73	52.13	3.77	24.5	24.5	1.0	89.59	0	6	1.0	22.6	0	6.0	28.9	0	10.01	18.78	19.87	56.5	1335.5	1335.5	59.4	59.4	**534.18**	**19.80**
6.00	8.00	7.00	2.00	5.50	20.01	10.01	66.50	7.54	28.9	28.9	1.0	276.90	276.90	0	1.0	0.0	0.00	8.0	11.5	43	10.01	2.91	1.65	76.5	701.1	978.0	93.3	370.2	**391.18**	**123.41**
8.00	9.00	8.50	1.00	6.50	20.01	10.01	81.52	3.77	11.5	11.5	1.0	62.55	339.45	43	1.0	162.2	162.17	9.0	11.5	43	10.01	2.91	1.65	86.5	734.0	1235.6	110.3	611.9	**494.26**	**203.98**
9.00	10.00	9.50	1.00	7.50	20.01	10.01	91.53	3.77	11.5	11.5	1.0	70.23	409.67	43	1.0	162.2	324.34	10.0	11.5	43	9.76	2.91	1.65	96.5	766.7	1500.7	127.3	861.3	**600.29**	**287.10**
10.00	11.00	10.50	1.00	8.50	19.76	9.76	101.41	3.77	11.5	11.5	1.0	77.81	487.49	43	1.0	162.2	486.51	11.0	11.5	43	9.76	2.91	1.65	106.3	798.9	1772.9	144.3	1118.3	**709.15**	**372.75**
11.00	12.00	11.50	1.00	9.50	19.76	9.76	111.17	3.77	11.5	11.5	1.0	85.30	572.79	43	1.0	162.2	648.69	12.0	11.5	43	9.76	2.91	1.65	116.1	831.0	2052.5	161.2	1382.7	**820.99**	**460.90**
12.00	14.50	13.25	2.50	12.00	19.76	9.76	128.25	9.43	11.5	11.5	1.0	246.02	818.80	43	1.0	405.4	1054.11	14.5	9.6	54	10.10	2.40	1.16	140.5	938.9	2811.8	203.7	2076.6	**1124.72**	**692.19**
14.50	16.00	15.25	1.50	13.50	20.10	10.10	148.03	5.66	9.6	9.6	1.0	141.64	960.44	54	1.0	305.5	1359.60	16.0	15.1	49	10.10	3.99	2.70	155.6	1219.8	3539.8	229.1	2549.2	**1415.94**	**849.72**
16.00	17.50	16.75	1.50	15.00	20.10	10.10	163.18	5.66	15.1	15.1	1.0	249.07	1209.51	49	1.0	277.2	1636.80	17.5	15.1	49	10.10	3.99	2.70	170.8	1288.2	4134.5	254.6	3100.9	**1653.80**	**1033.63**
17.50	19.00	18.25	1.50	16.50	20.10	10.10	163.18	5.66	15.1	15.1	1.0	249.07	1458.58	49	1.0	277.2	1914.00	19.0	28.8	0	10.00	18.56	19.64	170.8	3718.4	7091.0	280.0	3652.6	**2836.39**	**1217.54**
19.00	20.50	19.75	1.50	18.00	20.00	10.00	163.18	5.66	28.8	28.8	1.0	507.48	1966.07	0	1.0	0.0	1914.00	20.5	21.2	41	10.00	7.26	6.71	170.8	1866.4	5746.4	305.5	4185.6	**2298.58**	**1395.18**
20.50	22.00	21.25	1.50	19.50	20.00	10.00	163.18	5.66	21.2	21.2	1.0	358.05	2324.11	41	1.0	231.9	2145.94	22.0	10.5	57	9.55	2.62	1.36	170.8	1094.8	5564.9	330.9	4801.0	**2225.96**	**1600.33**
22.00	23.50	22.75	1.50	21.00	19.55	9.55	163.18	5.66	10.5	10.5	1.0	171.09	2495.20	57	1.0	322.5	2468.40	23.5	10.5	57	9.55	2.62	1.36	170.8	1094.8	6058.4	356.4	5320.0	**2423.38**	**1773.33**
23.50	25.00	24.25	1.50	22.50	19.55	9.55	163.18	5.66	10.5	10.5	1.0	171.09	2666.29	57	1.0	322.5	2790.86	25.0	27.3	0	9.50	15.18	16.18	170.8	3036.9	8494.0	381.9	5839.0	**3397.61**	**1946.33**
25.00	26.50	25.75	1.50	24.00	19.50	9.50	163.18	5.66	27.3	27.3	1.0	476.45	3142.74	0	1.0	0.0	2790.86	26.5	27.3	0	9.50	15.18	16.18	170.8	3036.9	8970.5	407.3	6340.9	**3588.19**	**2113.64**
26.50	27.50	27.00	1.00	25.00	19.50	9.50	163.18	3.77	27.3	27.3	1.0	317.63	3460.37	0	1.0	0.0	2790.86	27.5	28.4	0	9.50	17.66	18.71	170.8	3531.8	9783.0	424.3	6675.5	**3913.20**	**2225.17**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
27.50	29.50	28.50	2.00	27.00	19.50	9.50	163.18	7.54	28.4	28.4	1.0	665.49	4125.87	0	1.0	0.0	2790.86	29.5	28.4	0	10.70	17.66	18.71	170.8	3547.0	10463.7	458.2	7375.0	**4185.49**	**2458.32**
29.50	30.00	29.75	0.50	27.50	20.70	10.70	163.18	1.89	28.4	28.4	1.0	166.37	4292.24	0	1.0	0.0	2790.86	30.0	28.4	0	10.70	17.66	18.71	170.8	3547.0	10630.1	466.7	7549.8	**4252.04**	**2516.60**
30.00	31.00	30.50	1.00	28.50	20.70	10.70	163.18	3.77	28.4	28.4	1.0	332.75	4624.99	0	1.0	0.0	2790.86	31.0	27.8	2	10.70	16.31	17.33	170.8	3296.3	10712.1	483.7	7899.5	**4284.86**	**2633.18**
31.00	32.50	31.75	1.50	30.00	20.70	10.70	163.18	5.66	27.8	27.8	1.0	486.70	5111.68	2	1.0	11.3	2802.17	32.5	27.8	0	10.70	16.31	17.33	170.8	3275.9	11189.8	509.1	8423.0	**4475.92**	**2807.67**
32.50	34.00	33.25	1.50	31.50	20.70	10.70	163.18	5.66	27.8	27.8	1.0	486.70	5598.38	0	1.0	0.0	2802.17	34.0	28.5	0	10.70	17.88	18.94	170.8	3592.2	11992.7	534.6	8935.2	**4797.10**	**2978.38**
34.00	35.00	34.50	1.00	32.50	20.70	10.70	163.18	3.77	28.5	28.5	1.0	334.14	5932.52	0	1.0	0.0	2802.17	35.0	28.5	0	10.62	17.88	18.94	170.8	3591.2	12325.9	551.6	9286.3	**4930.34**	**3095.42**
35.00	35.50	35.25	0.50	33.00	20.62	10.62	163.18	1.89	28.5	28.5	1.0	167.07	6099.59	0	1.0	0.0	2802.17	35.5	28.5	0	10.62	17.88	18.94	170.8	3591.2	12492.9	560.1	9461.8	**4997.17**	**3153.94**
35.50	37.50	36.50	2.00	35.00	20.62	10.62	163.18	7.54	28.5	28.5	1.0	668.27	6767.86	0	1.0	0.0	2802.17	37.5	28.8	0	10.62	18.56	19.64	170.8	3726.7	13296.7	594.0	10164.0	**5318.68**	**3388.01**
37.50	38.50	38.00	1.00	36.00	20.62	10.62	163.18	3.77	28.8	28.8	1.0	338.32	7106.18	0	1.0	0.0	2802.17	38.5	28.6	0	10.62	18.11	19.17	170.8	3636.3	13544.7	611.0	10519.3	**5417.87**	**3506.44**
38.50	40.00	39.25	1.50	37.50	20.62	10.62	163.18	5.66	28.6	28.6	1.0	503.29	7609.47	0	1.0	0.0	2802.17	40.0	28.6	0	10.62	18.11	19.17	170.8	3636.3	14048.0	636.4	11048.1	**5619.19**	**3682.69**

APPENDIX-H

TABLE 3: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1000 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young' s Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Depth of Fixity (m)	Allowable Load capacity of pile(kN)
P81	1.00	2.50	0.00	35	29580399	0.0491	18	2552	3.56	3.50	0.98	2.08	0.005	7.41	67
P82	1.00	2.50	0.00	35	29580399	0.0491	21	2984	3.45	5.50	1.60	1.99	0.005	6.86	46
P83	1.00	2.50	0.00	35	29580399	0.0491	23	3272	3.38	6.50	1.92	1.94	0.005	6.57	39
P84	1.00	2.50	0.00	35	29580399	0.0491	15	2120	3.69	0.00	0.00	2.23	0.005	8.23	156
P85	1.00	2.50	0.00	35	29580399	0.0491	16	2264	3.64	5.50	1.51	2.00	0.005	7.30	42
P86	1.00	2.50	0.00	35	29580399	0.0491	21	2984	3.45	3.50	1.02	2.08	0.005	7.16	72
P87	1.00	2.50	0.00	35	29580399	0.0491	18	2552	3.56	5.50	1.55	2.00	0.005	7.11	43
P88	1.00	2.50	0.00	35	29580399	0.0491	15	2120	3.69	1.50	0.41	2.17	0.005	8.01	101
P89	1.00	2.50	0.00	35	29580399	0.0491	20	2840	3.48	6.50	1.87	1.95	0.005	6.79	37
P90	1.00	2.50	0.00	35	29580399	0.0491	15	2120	3.69	2.50	0.68	2.13	0.005	7.86	78
P91	1.00	2.50	0.00	35	29580399	0.0491	21	2984	3.45	4.50	1.31	2.03	0.005	7.01	57
P92	1.00	2.50	0.00	35	29580399	0.0491	14	1976	3.74	4.50	1.20	2.05	0.005	7.67	48
P93	1.00	2.50	0.00	35	29580399	0.0491	16	2264	3.64	1.50	0.41	2.17	0.005	7.90	105
P94	1.00	2.50	0.00	35	29580399	0.0491	12	1688	3.86	3.50	0.91	2.09	0.005	8.09	56
P95	1.00	2.50	0.00	35	29580399	0.0491	20	2840	3.48	5.50	1.58	1.99	0.005	6.94	45
P96	1.00	2.50	0.00	35	29580399	0.0491	15	2120	3.69	5.50	1.49	2.01	0.005	7.41	41
P97	1.00	2.50	0.00	35	29580399	0.0491	14	1976	3.74	5.50	1.47	2.01	0.005	7.52	39
P98	1.00	2.50	0.00	35	29580399	0.0491	16	2264	3.64	4.50	1.24	2.04	0.005	7.45	51
P99	1.00	2.50	0.00	35	29580399	0.0491	21	2984	3.45	0.50	0.15	2.21	0.005	7.61	163
P100	1.00	2.50	0.00	35	29580399	0.0491	18	2552	3.56	3.50	0.98	2.08	0.005	7.41	67

APPENDIX-H

TABLE 4: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1200 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Depth of Fixity (m)	Allowable Load capacity of pile(kN)
P81	1.20	2.50	0.00	35	29580399	0.1018	18	2552	4.11	3.50	0.85	2.10	0.005	8.65	101
P82	1.20	2.50	0.00	35	29580399	0.1018	23	3272	3.92	5.50	1.40	2.02	0.005	7.91	75
P83	1.20	2.50	0.00	35	29580399	0.1018	26	3704	3.82	6.50	1.70	1.97	0.005	7.54	65
P84	1.20	2.50	0.00	35	29580399	0.1018	16	2264	4.21	0.00	0.00	2.23	0.005	9.40	218
P85	1.20	2.50	0.00	35	29580399	0.1018	17	2408	4.16	5.50	1.32	2.03	0.005	8.46	66
P86	1.20	2.50	0.00	35	29580399	0.1018	21	2984	3.99	3.50	0.88	2.10	0.005	8.37	108
P87	1.20	2.50	0.00	35	29580399	0.1018	20	2840	4.03	5.50	1.37	2.03	0.005	8.16	71
P88	1.20	2.50	0.00	35	29580399	0.1018	15	2120	4.27	1.50	0.35	2.18	0.005	9.30	143
P89	1.20	2.50	0.00	35	29580399	0.1018	20	2840	4.03	6.50	1.61	1.99	0.005	8.01	59
P90	1.20	2.50	0.00	35	29580399	0.1018	15	2120	4.27	2.50	0.59	2.14	0.005	9.15	114
P91	1.20	2.50	0.00	35	29580399	0.1018	21	2984	3.99	4.50	1.13	2.06	0.005	8.22	88
P92	1.20	2.50	0.00	35	29580399	0.1018	14	1976	4.33	4.50	1.04	2.07	0.005	8.98	74
P93	1.20	2.50	0.00	35	29580399	0.1018	16	2264	4.21	1.50	0.36	2.18	0.005	9.17	149
P94	1.20	2.50	0.00	35	29580399	0.1018	13	1832	4.40	3.50	0.80	2.11	0.005	9.28	87
P95	1.20	2.50	0.00	35	29580399	0.1018	21	2984	3.99	5.50	1.38	2.02	0.005	8.07	72
P96	1.20	2.50	0.00	35	29580399	0.1018	16	2264	4.21	5.50	1.30	2.03	0.005	8.57	65
P97	1.20	2.50	0.00	35	29580399	0.1018	15	2120	4.27	5.50	1.29	2.04	0.005	8.70	63
P98	1.20	2.50	0.00	35	29580399	0.1018	16	2264	4.21	4.50	1.07	2.07	0.005	8.72	78
P99	1.20	2.50	0.00	35	29580399	0.1018	21	2984	3.99	0.50	0.13	2.21	0.005	8.82	223
P100	1.20	2.50	0.00	35	29580399	0.1018	18	2552	4.11	3.50	0.85	2.10	0.005	8.65	101

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
P81	0.50	SM	46	2	9.40	5.00	4.40	1.00	0.332	1.70	3.40	5.00	1.20	9.08	0.11	1.00	0.125	0.378	Liquefiable
	1.00	SM-SC	47	2	18.80	10.00	8.80	0.99	0.331	1.70	3.40	5.00	1.20	9.08	0.11	1.00	0.125	0.379	Liquefiable
	2.00	SM-SC	47	2	37.60	20.00	17.60	0.98	0.328	1.70	3.40	5.00	1.20	9.08	0.11	1.00	0.125	0.382	Liquefiable
	3.00	ML	55	7	56.40	30.00	26.40	0.98	0.326	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.757	Liquefiable
	4.00	CL-ML	67	7	75.20	40.00	35.20	0.97	0.323	1.69	11.80	5.00	1.20	19.16	0.21	1.00	-	-	Non-liquefiable
	5.00	ML	65	8	101.00	50.00	51.00	0.96	0.297	1.40	11.20	5.00	1.20	18.44	0.20	1.00	0.235	0.790	Liquefiable
	6.00	ML	51	14	121.20	60.00	61.20	0.95	0.295	1.28	17.90	5.00	1.20	26.48	0.32	1.00	0.387	1.313	Non-liquefiable
	7.00	CL-ML	68	14	141.40	70.00	71.40	0.95	0.292	1.18	16.57	5.00	1.20	24.88	0.29	1.00	-	-	Non-liquefiable
	8.00	CL	85	16	162.40	80.00	82.40	0.94	0.289	1.10	17.63	5.00	1.20	26.15	0.32	1.00	-	-	Non-liquefiable
	9.00	CL	85	19	182.70	90.00	92.70	0.93	0.286	1.04	19.73	5.00	1.20	28.68	0.40	1.00	-	-	Non-liquefiable
	10.00	ML	88	19	203.00	100.00	103.00	0.91	0.279	0.99	18.72	5.00	1.20	27.47	0.35	1.00	0.420	1.505	Non-liquefiable
	11.00	ML	88	21	222.20	110.00	112.20	0.88	0.272	0.94	19.83	5.00	1.20	28.79	0.40	1.00	0.478	1.757	Non-liquefiable
	12.00	CL	90	24	242.40	120.00	122.40	0.85	0.264	0.90	21.69	5.00	1.20	31.03	0.52	1.00	-	-	Non-liquefiable
	14.50	CL	74	29	292.90	145.00	147.90	0.79	0.243	0.82	23.85	5.00	1.20	33.62	0.52	1.00	-	-	Non-liquefiable
	16.00	SC	48	29	326.40	160.00	166.40	0.75	0.229	0.78	22.48	5.00	1.20	31.98	0.52	0.85	0.527	2.306	Non-liquefiable
	17.50	CL	76	28	346.50	175.00	171.50	0.71	0.223	0.76	21.38	5.00	1.20	30.66	0.52	0.84	-	-	Non-liquefiable
	19.00	CL-ML	64	28	376.20	190.00	186.20	0.67	0.210	0.73	20.52	5.00	1.20	29.62	0.44	0.77	-	-	Non-liquefiable
	20.50	CL-ML	64	78	418.20	205.00	213.20	0.63	0.192	0.68	53.42	5.00	1.20	69.10	0.52	0.73	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 | **Earthquake Zone= IV** | **amax/g=0.24** | **K(alpha)= 1.00** | **MSF= 1.193** | **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	23.50	CL-ML	80	102	479.40	235.00	244.40	0.56	0.171	0.64	65.25	5.00	1.20	83.29	0.52	0.69	-	-	Non-liquefiable
	25.00	ML	90	72	510.00	250.00	260.00	0.56	0.171	0.62	44.65	5.00	1.20	58.58	0.52	0.67	0.415	2.423	Non-liquefiable
	26.50	CL-ML	74	55	540.60	265.00	275.60	0.56	0.171	0.60	33.13	5.00	1.20	44.76	0.52	0.65	-	-	Non-liquefiable
	28.00	ML	73	67	571.20	280.00	291.20	0.56	0.171	0.59	39.26	5.00	1.20	52.12	0.52	0.64	0.396	2.311	Non-liquefiable
	29.50	ML	64	95	601.80	295.00	306.80	0.56	0.171	0.57	54.24	5.00	1.20	70.08	0.52	0.62	0.387	2.261	Non-liquefiable
	31.00	CL-ML	74	52	632.40	310.00	322.40	0.56	0.171	0.56	28.96	5.00	1.20	39.75	0.52	0.61	-	-	Non-liquefiable
	32.50	CL-ML	74	60	663.00	325.00	338.00	0.56	0.171	0.54	32.64	5.00	1.20	44.16	0.52	0.60	-	-	Non-liquefiable
	34.00	CL	83	63	693.60	340.00	353.60	0.56	0.171	0.53	33.50	5.00	1.20	45.20	0.52	0.59	-	-	Non-liquefiable
	35.50	CL-ML	55	64	724.20	355.00	369.20	0.56	0.171	0.52	33.31	5.00	1.20	44.97	0.52	0.58	-	-	Non-liquefiable
	37.00	CL-ML	55	77	754.80	370.00	384.80	0.56	0.171	0.51	39.25	5.00	1.20	52.10	0.52	0.57	-	-	Non-liquefiable
	38.50	CL-ML	63	85	785.40	385.00	400.40	0.56	0.171	0.50	42.48	5.00	1.20	55.97	0.52	0.56	-	-	Non-liquefiable
	40.00	CL-ML	63	92	816.00	400.00	416.00	0.56	0.171	0.49	45.11	5.00	1.20	59.13	0.52	0.55	-	-	Non-liquefiable
P82	0.50	ML	57	3.00	9.10	5.00	4.10	1.00	0.345	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.426	Liquefiable
P82	1.00	CL-ML	64	3.00	18.20	10.00	8.20	0.99	0.344	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
P82	2.00	CL-ML	64	3.00	36.40	20.00	16.40	0.98	0.341	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
P82	3.00	CL-ML	64	5.00	54.60	30.00	24.60	0.98	0.338	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
P82	5.00	CL-ML	73	8.00	102.00	50.00	52.00	0.96	0.294	1.39	11.09	5.00	1.20	18.31	0.20	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	6.00	CL-ML	73	11.00	122.40	60.00	62.40	0.95	0.292	1.27	13.93	5.00	1.20	21.71	0.24	1.00	-	-	Non-liquefiable
	7.00	ML	51	11.00	130.20	70.00	60.20	0.95	0.319	1.29	14.18	5.00	1.20	22.01	0.24	1.00	0.289	0.905	Liquefiable
	8.00	ML	51	17.00	148.80	80.00	68.80	0.94	0.317	1.21	20.50	5.00	1.20	29.59	0.44	1.00	0.527	1.663	Non-liquefiable
	9.00	ML	51	18.00	167.40	90.00	77.40	0.93	0.314	1.14	20.46	5.00	1.20	29.55	0.44	1.00	0.524	1.667	Non-liquefiable
	10.00	CL-ML	64	18.00	186.00	100.00	86.00	0.91	0.306	1.08	19.41	5.00	1.20	28.29	0.38	1.00	-	-	Non-liquefiable
	11.00	CL	77	24.00	204.60	110.00	94.60	0.88	0.297	1.03	24.68	5.00	1.20	34.61	0.52	1.00	-	-	Non-liquefiable
	12.00	CL	83	29.00	223.20	120.00	103.20	0.85	0.288	0.98	28.55	5.00	1.20	39.26	0.52	1.00	-	-	Non-liquefiable
	14.50	CL	73	33.00	304.50	145.00	159.50	0.79	0.234	0.79	26.13	5.00	1.20	36.36	0.52	1.00	-	-	Non-liquefiable
	17.50	CL	77	37.00	358.75	175.00	183.75	0.71	0.215	0.74	27.30	5.00	1.20	37.75	0.52	0.85	-	-	Non-liquefiable
	20.50	CL	79	41.00	426.40	205.00	221.40	0.63	0.188	0.67	27.55	5.00	1.20	38.07	0.52	0.81	-	-	Non-liquefiable
	22.00	CL-ML	63	41.00	455.40	220.00	235.40	0.59	0.177	0.65	26.72	5.00	1.20	37.07	0.52	0.77	-	-	Non-liquefiable
	23.50	CL	85	48.00	486.45	235.00	251.45	0.56	0.169	0.63	30.27	5.00	1.20	41.32	0.52	0.74	-	-	Non-liquefiable
	26.50	CL	85	51.00	548.55	265.00	283.55	0.56	0.169	0.59	30.29	5.00	1.20	41.34	0.52	0.71	-	-	Non-liquefiable
	29.50	CL	85	55.00	613.60	295.00	318.60	0.56	0.168	0.56	30.81	5.00	1.20	41.98	0.52	0.67	-	-	Non-liquefiable
	32.50	CL	72	60.00	666.25	325.00	341.25	0.56	0.171	0.54	32.48	5.00	1.20	43.98	0.52	0.64	-	-	Non-liquefiable
	34.00	MI	92	60.00	697.00	340.00	357.00	0.56	0.171	0.53	31.76	5.00	1.20	43.11	0.52	0.63	-	-	Non-liquefiable
	35.50	MI	93	71.00	727.75	355.00	372.75	0.56	0.171	0.52	36.77	5.00	1.20	49.13	0.52	0.61	-	-	Non-liquefiable
	38.50	MI	91	75.00	789.25	385.00	404.25	0.56	0.171	0.50	37.30	5.00	1.20	49.76	0.52	0.59	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 | Earthquake Zone= IV | amax/g=0.24 | K(alpha)= 1.00 | MSF= 1.193 | Critical Water Table (m)=0.00 m

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	40.00	CL	64	81.00	820.00	400.00	420.00	0.56	0.171	0.49	39.52	5.00	1.20	52.43	0.52	0.59	-	-	Non-liquefiable
P83	0.50	SM	47	5	9.95	5.00	4.95	1.00	0.312	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.619	Liquefiable
	1.00	SM	47	5	19.90	10.00	9.90	0.99	0.311	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.621	Liquefiable
	3.00	SM	46	6	59.70	30.00	29.70	0.98	0.306	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.714	Liquefiable
	4.00	ML	58	7	79.60	40.00	39.60	0.97	0.304	1.59	11.12	5.00	1.20	18.35	0.20	1.00	0.233	0.768	Liquefiable
	6.00	SM	44	39	119.40	60.00	59.40	0.95	0.299	1.30	50.60	5.00	1.20	65.72	0.52	1.00	0.620	2.073	Non-liquefiable
	7.00	SM	44	8	140.70	70.00	70.70	0.95	0.294	1.19	9.51	5.00	1.20	16.42	0.17	1.00	0.208	0.709	Liquefiable
	8.00	ML	51	8	160.80	80.00	80.80	0.94	0.291	1.11	8.90	5.00	1.20	15.68	0.17	1.00	0.199	0.683	Liquefiable
	9.00	ML	51	32	178.20	90.00	88.20	0.93	0.293	1.06	34.07	5.00	1.20	45.89	0.52	1.00	0.620	2.113	Non-liquefiable
	10.00	CL	90	34	198.00	100.00	98.00	0.91	0.286	1.01	34.35	5.00	1.20	46.21	0.52	1.00	-	-	Non-liquefiable
	12.50	CL-ML	74	32	247.50	125.00	122.50	0.84	0.265	0.90	28.91	5.00	1.20	39.69	0.52	1.00	-	-	Non-liquefiable
	14.00	CL	67	32	284.20	140.00	144.20	0.80	0.246	0.83	26.65	5.00	1.20	36.98	0.52	1.00	-	-	Non-liquefiable
	15.50	CL	67	38	311.55	155.00	156.55	0.76	0.236	0.80	30.37	5.00	1.20	41.45	0.52	0.87	-	-	Non-liquefiable
	18.50	CL	73	41	371.85	185.00	186.85	0.68	0.211	0.73	29.99	5.00	1.20	40.99	0.52	0.82	-	-	Non-liquefiable
	21.50	CL	92	49	432.15	215.00	217.15	0.60	0.186	0.68	33.25	5.00	1.20	44.90	0.52	0.82	-	-	Non-liquefiable
	23.00	ML	73	49	455.40	230.00	225.40	0.56	0.176	0.67	32.64	5.00	1.20	44.17	0.52	0.88	0.545	3.089	Non-liquefiable
	24.50	CL-ML	73	50	450.80	245.00	205.80	0.56	0.191	0.70	34.85	5.00	1.20	46.82	0.52	0.89	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	27.50	MI	92	47	506.00	275.00	231.00	0.56	0.191	0.66	30.92	5.00	1.20	42.11	0.52	0.88	-	-	Non-liquefiable
	30.50	CL-ML	66	47	561.20	305.00	256.20	0.56	0.191	0.62	29.36	5.00	1.20	40.24	0.52	0.76	-	-	Non-liquefiable
	32.00	CL	71	47	684.80	320.00	364.80	0.56	0.164	0.52	24.61	5.00	1.20	34.53	0.52	0.68	-	-	Non-liquefiable
	33.50	CL	71	50	716.90	335.00	381.90	0.56	0.164	0.51	25.59	5.00	1.20	35.70	0.52	0.67	-	-	Non-liquefiable
	36.50	CL	76	55	781.10	365.00	416.10	0.56	0.164	0.49	26.96	5.00	1.20	37.36	0.52	0.60	-	-	Non-liquefiable
	38.00	CL-ML	77	58	782.80	380.00	402.80	0.56	0.170	0.50	28.90	5.00	1.20	39.68	0.52	0.61	-	-	Non-liquefiable
	40.00	CL-ML	77	61	824.00	400.00	424.00	0.56	0.170	0.49	29.62	5.00	1.20	40.55	0.52	0.60	-	-	Non-liquefiable
P84	0.50	ML	52	7	10.00	5.00	5.00	1.00	0.311	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.793	Liquefiable
P84	1.00	CL	61	7	20.00	10.00	10.00	0.99	0.310	1.70	11.90	5.00	1.20	19.28	0.21	1.00	-	-	Non-liquefiable
P84	2.00	CL-ML	51	7	40.00	20.00	20.00	0.98	0.307	1.70	11.90	5.00	1.20	19.28	0.21	1.00	-	-	Non-liquefiable
P84	3.00	ML	52	9	60.00	30.00	30.00	0.98	0.305	1.70	15.30	5.00	1.20	23.36	0.26	1.00	0.313	1.028	Non-liquefiable
P84	4.00	ML	52	14	80.00	40.00	40.00	0.97	0.302	1.58	22.14	5.00	1.20	31.56	0.52	1.00	0.620	2.051	Non-liquefiable
P84	5.00	CL-ML	64	14	100.00	50.00	50.00	0.96	0.300	1.41	19.80	5.00	1.20	28.76	0.40	1.00	-	-	Non-liquefiable
P84	6.00	CL-ML	64	22	119.40	60.00	59.40	0.95	0.299	1.30	28.54	5.00	1.20	39.25	0.52	1.00	-	-	Non-liquefiable
P84	7.00	ML	53	24	139.30	70.00	69.30	0.95	0.297	1.20	28.83	5.00	1.20	39.60	0.52	1.00	0.620	2.090	Non-liquefiable
P84	9.00	ML	88	19	179.10	90.00	89.10	0.93	0.292	1.06	20.13	5.00	1.20	29.15	0.42	1.00	0.498	1.707	Non-liquefiable
P84	10.00	ML	88	28	201.00	100.00	101.00	0.91	0.282	1.00	27.86	5.00	1.20	38.43	0.52	1.00	0.620	2.203	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 Earthquake Zone= IV amax/g=0.24 K(alpha)= 1.00 MSF= 1.193 Critical Water Table (m)=0.00 m

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	11.00	CL-ML	60	28	221.10	110.00	111.10	0.88	0.273	0.95	26.56	5.00	1.20	36.88	0.52	1.00	-	-	Non-liquefiable
	12.50	CL-ML	73	27	248.75	125.00	123.75	0.84	0.263	0.90	24.27	5.00	1.20	34.13	0.52	1.00	-	-	Non-liquefiable
	15.50	CL	83	30	308.45	155.00	153.45	0.76	0.238	0.81	24.22	5.00	1.20	34.06	0.52	0.87	-	-	Non-liquefiable
	17.00	CL-ML	71	30	341.70	170.00	171.70	0.72	0.224	0.76	22.89	5.00	1.20	32.47	0.52	0.96	-	-	Non-liquefiable
	18.50	CL-ML	71	31	334.85	185.00	149.85	0.68	0.237	0.82	25.32	5.00	1.20	35.39	0.52	0.97	-	-	Non-liquefiable
	20.00	CL	78	31	362.00	200.00	162.00	0.64	0.223	0.79	24.36	5.00	1.20	34.23	0.52	0.97	-	-	Non-liquefiable
	21.50	CL	78	37	389.15	215.00	174.15	0.60	0.209	0.76	28.04	5.00	1.20	38.65	0.52	0.96	-	-	Non-liquefiable
	24.50	ML	64	40	443.45	245.00	198.45	0.56	0.195	0.71	28.39	5.00	1.20	39.07	0.52	0.80	0.495	2.537	Non-liquefiable
	26.00	CL	85	40	525.20	260.00	265.20	0.56	0.173	0.61	24.56	5.00	1.20	34.48	0.52	0.73	-	-	Non-liquefiable
	27.50	SM	45	48	555.50	275.00	280.50	0.56	0.173	0.60	28.66	5.00	1.20	39.39	0.52	0.71	0.442	2.555	Non-liquefiable
	29.00	ML	51	48	585.80	290.00	295.80	0.56	0.173	0.58	27.91	5.00	1.20	38.49	0.52	0.67	0.414	2.394	Non-liquefiable
	30.50	SM	49	42	628.30	305.00	323.30	0.56	0.170	0.56	23.36	5.00	1.20	33.03	0.52	0.65	0.401	2.360	Non-liquefiable
	32.00	ML	51	42	659.20	320.00	339.20	0.56	0.170	0.54	22.80	5.00	1.20	32.37	0.52	0.63	0.394	2.318	Non-liquefiable
	33.50	ML	51	42	690.10	335.00	355.10	0.56	0.170	0.53	22.29	5.00	1.20	31.75	0.52	0.62	0.387	2.279	Non-liquefiable
	36.50	ML	53	46	751.90	365.00	386.90	0.56	0.170	0.51	23.39	5.00	1.20	33.06	0.52	0.60	0.375	2.207	Non-liquefiable
	40.00	ML	53	52	816.00	400.00	416.00	0.56	0.171	0.49	25.50	5.00	1.20	35.59	0.52	0.59	0.365	2.129	Non-liquefiable
P85	0.50	CL	78	4.00	9.70	5.00	4.70	1.00	0.321	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	1.00	ML	67	4.00	19.40	10.00	9.40	0.99	0.319	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.530	Liquefiable
	2.00	CL-ML	62	4.00	38.80	20.00	18.80	0.98	0.317	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
	3.00	CL-ML	62	6.00	58.20	30.00	28.20	0.98	0.315	1.70	10.20	5.00	1.20	17.24	0.18	1.00	-	-	Non-liquefiable
	4.00	CL	67	6.00	77.60	40.00	37.60	0.97	0.312	1.63	9.78	5.00	1.20	16.74	0.18	1.00	-	-	Non-liquefiable
	5.00	ML	62	11.00	97.00	50.00	47.00	0.96	0.310	1.46	16.05	5.00	1.20	24.25	0.28	1.00	0.331	1.070	Non-liquefiable
	6.00	ML	62	11.00	116.40	60.00	56.40	0.95	0.307	1.33	14.65	5.00	1.20	22.58	0.25	1.00	0.299	0.972	Liquefiable
	7.00	SM	28	11.00	133.00	70.00	63.00	0.95	0.312	1.26	13.86	4.56	1.14	20.33	0.22	1.00	0.262	0.840	Liquefiable
	8.00	ML	81	14.00	152.00	80.00	72.00	0.94	0.309	1.18	16.50	5.00	1.20	24.80	0.29	1.00	0.343	1.111	Non-liquefiable
	9.00	ML	81	17.00	171.00	90.00	81.00	0.93	0.307	1.11	18.89	5.00	1.20	27.67	0.36	1.00	0.427	1.394	Non-liquefiable
	10.00	CL-ML	92	17.00	199.00	100.00	99.00	0.91	0.284	1.01	17.09	5.00	1.20	25.50	0.30	1.00	-	-	Non-liquefiable
	11.00	CL-ML	92	28.00	218.90	110.00	108.90	0.88	0.276	0.96	26.83	5.00	1.20	37.20	0.52	1.00	-	-	Non-liquefiable
	12.00	CL-ML	92	20.00	238.80	120.00	118.80	0.85	0.268	0.92	18.35	5.00	1.20	27.02	0.34	1.00	-	-	Non-liquefiable
	14.50	CL-ML	64	22.00	285.65	145.00	140.65	0.79	0.249	0.84	18.55	5.00	1.20	27.26	0.35	1.00	-	-	Non-liquefiable
	16.00	CL	87	22.00	334.40	160.00	174.40	0.75	0.223	0.76	16.66	5.00	1.20	24.99	0.29	0.89	-	-	Non-liquefiable
	17.50	CL	87	37.00	365.75	175.00	190.75	0.71	0.211	0.72	26.79	5.00	1.20	37.15	0.52	0.86	-	-	Non-liquefiable
	20.50	CL	80	43.00	418.20	205.00	213.20	0.63	0.192	0.68	29.45	5.00	1.20	40.34	0.52	0.79	-	-	Non-liquefiable
	23.50	CL	78	27.00	486.45	235.00	251.45	0.56	0.169	0.63	17.03	5.00	1.20	25.43	0.30	0.73	-	-	Non-liquefiable
	26.50	ML	60	47.00	524.70	265.00	259.70	0.56	0.176	0.62	29.16	5.00	1.20	40.00	0.52	0.72	0.447	2.531	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	28.00	MI	90	47.00	588.00	280.00	308.00	0.56	0.167	0.57	26.78	5.00	1.20	37.14	0.52	0.87	-	-	Non-liquefiable
	29.50	MI	90	66.00	619.50	295.00	324.50	0.56	0.167	0.56	36.64	5.00	1.20	48.97	0.52	0.86	-	-	Non-liquefiable
	31.00	CL-ML	64	66.00	651.00	310.00	341.00	0.56	0.167	0.54	35.74	5.00	1.20	47.89	0.52	0.86	-	-	Non-liquefiable
	32.50	CL	87	60.00	682.50	325.00	357.50	0.56	0.167	0.53	31.73	5.00	1.20	43.08	0.52	0.85	-	-	Non-liquefiable
	35.50	ML	58	64.00	706.45	355.00	351.45	0.56	0.176	0.53	34.14	5.00	1.20	45.97	0.52	0.62	0.385	2.190	Non-liquefiable
	37.00	CL	77	64.00	736.30	370.00	366.30	0.56	0.176	0.52	33.44	5.00	1.20	45.13	0.52	0.61	-	-	Non-liquefiable
	38.50	CL	81	68.00	766.15	385.00	381.15	0.56	0.176	0.51	34.83	5.00	1.20	46.80	0.52	0.60	-	-	Non-liquefiable
	40.00	CL	81	72.00	796.00	400.00	396.00	0.56	0.176	0.50	36.18	5.00	1.20	48.42	0.52	0.60	-	-	Non-liquefiable
	0.50	CL-ML	61	7	9.80	5.00	4.80	1.00	0.317	1.70	11.90	5.00	1.20	19.28	0.21	1.00	-	-	Non-liquefiable
	1.00	CL	57	7	19.60	10.00	9.60	0.99	0.316	1.70	11.90	5.00	1.20	19.28	0.21	1.00	-	-	Non-liquefiable
	3.00	ML	53	6	58.80	30.00	28.80	0.98	0.311	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.703	Liquefiable
	4.00	ML	53	8	78.40	40.00	38.40	0.97	0.309	1.61	12.91	5.00	1.20	20.49	0.22	1.00	0.264	0.856	Liquefiable
P86	6.00	ML	59	13	117.60	60.00	57.60	0.95	0.304	1.32	17.13	5.00	1.20	25.55	0.30	1.00	0.362	1.190	Non-liquefiable
	7.00	CL	81	36	137.20	70.00	67.20	0.95	0.301	1.22	43.92	5.00	1.20	57.70	0.52	1.00	-	-	Non-liquefiable
	8.00	CL-ML	72	36	156.80	80.00	76.80	0.94	0.299	1.14	41.08	5.00	1.20	54.30	0.52	1.00	-	-	Non-liquefiable
	9.00	CL-ML	72	31	177.30	90.00	87.30	0.93	0.295	1.07	33.18	5.00	1.20	44.81	0.52	1.00	-	-	Non-liquefiable
	10.00	CL-ML	72	27	197.00	100.00	97.00	0.91	0.287	1.02	27.41	5.00	1.20	37.90	0.52	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	11.00	ML	90	27	216.70	110.00	106.70	0.88	0.279	0.97	26.14	5.00	1.20	36.37	0.52	1.00	0.620	2.224	Non-liquefiable
	12.50	CL	84	23	237.50	125.00	112.50	0.84	0.277	0.94	21.68	5.00	1.20	31.02	0.52	1.00	-	-	Non-liquefiable
	15.50	CL	77	19	294.50	155.00	139.50	0.76	0.250	0.85	16.09	5.00	1.20	24.30	0.28	0.89	-	-	Non-liquefiable
	17.00	ML	60	19	343.40	170.00	173.40	0.72	0.222	0.76	14.43	5.00	1.20	22.31	0.25	0.85	0.249	1.118	Non-liquefiable
	18.50	CL	63	30	364.45	185.00	179.45	0.68	0.215	0.75	22.39	5.00	1.20	31.87	0.52	0.84	-	-	Non-liquefiable
	21.50	CL	73	49	423.55	215.00	208.55	0.60	0.190	0.69	33.93	5.00	1.20	45.72	0.52	0.80	-	-	Non-liquefiable
	24.50	CL	80	44	482.65	245.00	237.65	0.56	0.177	0.65	28.54	5.00	1.20	39.25	0.52	0.73	-	-	Non-liquefiable
	26.00	CL-ML	64	44	522.60	260.00	262.60	0.56	0.174	0.62	27.15	5.00	1.20	37.58	0.52	0.75	-	-	Non-liquefiable
	27.50	ML	90	49	519.75	275.00	244.75	0.56	0.185	0.64	31.32	5.00	1.20	42.59	0.52	0.76	0.473	2.548	Non-liquefiable
	30.50	SM	48	52	576.45	305.00	271.45	0.56	0.185	0.61	31.56	5.00	1.20	42.87	0.52	0.74	0.458	2.469	Non-liquefiable
	32.00	CL	71	51	604.80	320.00	284.80	0.56	0.185	0.59	30.22	5.00	1.20	41.26	0.52	0.73	-	-	Non-liquefiable
	33.50	CL	87	48	633.15	335.00	298.15	0.56	0.185	0.58	27.80	5.00	1.20	38.36	0.52	0.72	-	-	Non-liquefiable
	36.50	CL	65	47	689.85	365.00	324.85	0.56	0.185	0.55	26.08	5.00	1.20	36.29	0.52	0.66	-	-	Non-liquefiable
	40.00	CL	65	54	824.00	400.00	424.00	0.56	0.170	0.49	26.22	5.00	1.20	36.47	0.52	0.60	-	-	Non-liquefiable
P87	0.50	CL-ML	72	6	10.05	5.00	5.05	1.00	0.309	1.70	10.20	5.00	1.20	17.24	0.18	1.00	-	-	Non-liquefiable
P87	1.00	CL	58	6	20.10	10.00	10.10	0.99	0.308	1.70	10.20	5.00	1.20	17.24	0.18	1.00	-	-	Non-liquefiable
P87	2.00	CL	58	6	40.20	20.00	20.20	0.98	0.306	1.70	10.20	5.00	1.20	17.24	0.18	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 Earthquake Zone= IV amax/g=0.24 K(alpha)= 1.00 MSF= 1.193 Critical Water Table (m)=0.00 m

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	3.00	ML	51	6	60.30	30.00	30.30	0.98	0.303	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.721	Liquefiable
	4.00	SM	49	6	80.40	40.00	40.40	0.97	0.301	1.57	9.44	5.00	1.20	16.33	0.17	1.00	0.207	0.688	Liquefiable
	5.00	SM	49	9	98.00	50.00	48.00	0.96	0.306	1.44	12.99	5.00	1.20	20.59	0.22	1.00	0.266	0.868	Liquefiable
	6.00	SM	49	9	117.60	60.00	57.60	0.95	0.304	1.32	11.86	5.00	1.20	19.23	0.21	1.00	0.246	0.809	Liquefiable
	8.00	CL	65	10	156.80	80.00	76.80	0.94	0.299	1.14	11.41	5.00	1.20	18.69	0.20	1.00	-	-	Non-liquefiable
	9.00	CL-ML	70	31	179.10	90.00	89.10	0.93	0.292	1.06	32.84	5.00	1.20	44.41	0.52	1.00	-	-	Non-liquefiable
	10.00	SM	47	31	199.00	100.00	99.00	0.91	0.284	1.01	31.16	5.00	1.20	42.39	0.52	1.00	0.620	2.181	Non-liquefiable
	11.00	CL-ML	81	20	218.90	110.00	108.90	0.88	0.276	0.96	19.17	5.00	1.20	28.00	0.37	1.00	-	-	Non-liquefiable
	12.00	CL-ML	81	26	238.80	120.00	118.80	0.85	0.268	0.92	23.85	5.00	1.20	33.63	0.52	1.00	-	-	Non-liquefiable
	13.00	CL	72	26	258.70	130.00	128.70	0.83	0.259	0.88	22.92	5.00	1.20	32.50	0.52	1.00	-	-	Non-liquefiable
	14.50	CL	72	33	287.10	145.00	142.10	0.79	0.248	0.84	27.68	5.00	1.20	38.22	0.52	1.00	-	-	Non-liquefiable
	16.00	CL-ML	56	33	316.80	160.00	156.80	0.75	0.235	0.80	26.35	5.00	1.20	36.62	0.52	0.88	-	-	Non-liquefiable
	17.50	CL	85	28	341.25	175.00	166.25	0.71	0.226	0.78	21.72	5.00	1.20	31.06	0.52	0.87	-	-	Non-liquefiable
	20.50	CL	82	38	399.75	205.00	194.75	0.63	0.201	0.72	27.23	5.00	1.20	37.68	0.52	0.77	-	-	Non-liquefiable
	22.00	ML	74	38	464.20	220.00	244.20	0.59	0.174	0.64	24.32	5.00	1.20	34.18	0.52	0.75	0.466	2.679	Non-liquefiable
	23.50	CL	78	33	470.00	235.00	235.00	0.56	0.175	0.65	21.53	5.00	1.20	30.83	0.52	0.76	-	-	Non-liquefiable
	25.00	ML	63	33	500.00	250.00	250.00	0.56	0.175	0.63	20.87	5.00	1.20	30.05	0.47	0.76	0.429	2.453	Non-liquefiable
	26.50	ML	51	42	516.75	265.00	251.75	0.56	0.179	0.63	26.47	5.00	1.20	36.76	0.52	0.76	0.472	2.635	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	29.50	ML	75	49	575.25	295.00	280.25	0.56	0.179	0.60	29.27	5.00	1.20	40.12	0.52	0.74	0.458	2.553	Non-liquefiable
	32.50	ML	57	45	633.75	325.00	308.75	0.56	0.179	0.57	25.61	5.00	1.20	35.73	0.52	0.66	0.408	2.273	Non-liquefiable
	35.50	ML	53	48	727.75	355.00	372.75	0.56	0.171	0.52	24.86	5.00	1.20	34.83	0.52	0.61	0.380	2.228	Non-liquefiable
	38.50	ML	52	53	789.25	385.00	404.25	0.56	0.171	0.50	26.36	5.00	1.20	36.63	0.52	0.59	0.369	2.162	Non-liquefiable
	40.00	ML	52	57	828.00	400.00	428.00	0.56	0.169	0.48	27.55	5.00	1.20	38.06	0.52	0.58	0.361	2.136	Non-liquefiable
P88	0.50	ML	64	5.00	9.95	5.00	4.95	1.00	0.312	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.619	Liquefiable
	1.00	CL	76	5.00	19.90	10.00	9.90	0.99	0.311	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
	3.00	SM	33	7.00	59.70	30.00	29.70	0.98	0.306	1.70	11.90	4.88	1.18	18.92	0.20	1.00	0.241	0.788	Liquefiable
	4.00	CL-ML	65	9.00	79.60	40.00	39.60	0.97	0.304	1.59	14.30	5.00	1.20	22.16	0.24	1.00	-	-	Non-liquefiable
	6.00	CL-ML	60	13.00	113.40	60.00	53.40	0.95	0.316	1.37	17.79	5.00	1.20	26.35	0.32	1.00	-	-	Non-liquefiable
	7.00	CL	77	17.00	132.30	70.00	62.30	0.95	0.314	1.27	21.54	5.00	1.20	30.85	0.52	1.00	-	-	Non-liquefiable
	9.00	SM	36	18.00	170.10	90.00	80.10	0.93	0.308	1.12	20.11	5.00	1.20	29.13	0.42	1.00	0.497	1.612	Non-liquefiable
	10.00	SM	36	21.00	189.00	100.00	89.00	0.91	0.300	1.06	22.26	5.00	1.20	31.71	0.52	1.00	0.620	2.064	Non-liquefiable
	11.00	CL	78	21.00	227.70	110.00	117.70	0.88	0.266	0.92	19.36	5.00	1.20	28.23	0.38	1.00	-	-	Non-liquefiable
	12.50	CL	87	24.00	258.75	125.00	133.75	0.84	0.254	0.86	20.75	5.00	1.20	29.90	0.46	1.00	-	-	Non-liquefiable
	15.50	CL	73	26.00	322.40	155.00	167.40	0.76	0.228	0.77	20.10	5.00	1.20	29.11	0.42	0.88	-	-	Non-liquefiable
	18.50	CL	64	18.00	384.80	185.00	199.80	0.68	0.204	0.71	12.73	5.00	1.20	20.28	0.22	0.81	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	21.50	CL	64	22.00	447.20	215.00	232.20	0.60	0.180	0.66	14.44	5.00	1.20	22.32	0.25	0.83	-	-	Non-liquefiable
	24.50	CL	65	35.00	509.60	245.00	264.60	0.56	0.168	0.61	21.52	5.00	1.20	30.82	0.52	0.80	-	-	Non-liquefiable
	26.00	SM	40	35.00	501.80	260.00	241.80	0.56	0.181	0.64	22.51	5.00	1.20	32.01	0.52	0.82	0.509	2.806	Non-liquefiable
	27.50	CL	76	37.00	530.75	275.00	255.75	0.56	0.181	0.63	23.14	5.00	1.20	32.76	0.52	0.81	-	-	Non-liquefiable
	29.00	ML	68	37.00	591.60	290.00	301.60	0.56	0.171	0.58	21.31	5.00	1.20	30.57	0.51	0.70	0.428	2.500	Non-liquefiable
	30.50	ML	68	48.00	622.20	305.00	317.20	0.56	0.171	0.56	26.95	5.00	1.20	37.34	0.52	0.68	0.422	2.462	Non-liquefiable
	32.00	CL	67	48.00	656.00	320.00	336.00	0.56	0.171	0.55	26.19	5.00	1.20	36.42	0.52	0.67	-	-	Non-liquefiable
	33.50	ML	63	50.00	686.75	335.00	351.75	0.56	0.171	0.53	26.66	5.00	1.20	36.99	0.52	0.66	0.409	2.400	Non-liquefiable
	35.00	SM	43	50.00	717.50	350.00	367.50	0.56	0.171	0.52	26.08	5.00	1.20	36.30	0.52	0.65	0.403	2.364	Non-liquefiable
	36.50	SM	40	55.00	748.25	365.00	383.25	0.56	0.171	0.51	28.09	5.00	1.20	38.71	0.52	0.64	0.397	2.328	Non-liquefiable
	40.00	CL-ML	74	62.00	820.00	400.00	420.00	0.56	0.171	0.49	30.25	5.00	1.20	41.30	0.52	0.62	-	-	Non-liquefiable
P89	0.50	ML	53	4	10.10	5.00	5.10	1.00	0.308	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.551	Liquefiable
P89	1.00	CL	54	4	20.20	10.00	10.20	0.99	0.307	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
P89	2.00	CL	54	4	40.40	20.00	20.40	0.98	0.304	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
P89	3.00	SM	41	5	60.60	30.00	30.60	0.98	0.302	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.640	Liquefiable
P89	5.00	SM	41	5	101.00	50.00	51.00	0.96	0.297	1.40	7.00	5.00	1.20	13.40	0.14	1.00	0.172	0.580	Liquefiable
P89	6.00	SM	41	7	117.00	60.00	57.00	0.95	0.306	1.32	9.27	5.00	1.20	16.13	0.17	1.00	0.205	0.670	Liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	7.00	CL-ML	64	7	136.50	70.00	66.50	0.95	0.303	1.23	8.58	5.00	1.20	15.30	0.16	1.00	-	-	Non-liquefiable
	8.00	ML	54	9	155.20	80.00	75.20	0.94	0.302	1.15	10.38	5.00	1.20	17.45	0.19	1.00	0.222	0.733	Liquefiable
	9.00	CL	75	27	174.60	90.00	84.60	0.93	0.300	1.09	29.35	5.00	1.20	40.23	0.52	1.00	-	-	Non-liquefiable
	11.00	CL	78	19	213.40	110.00	103.40	0.88	0.283	0.98	18.69	5.00	1.20	27.42	0.35	1.00	-	-	Non-liquefiable
	12.00	CL	78	21	232.80	120.00	112.80	0.85	0.275	0.94	19.77	5.00	1.20	28.73	0.40	1.00	-	-	Non-liquefiable
	14.50	CL	81	19	281.30	145.00	136.30	0.79	0.253	0.86	16.27	5.00	1.20	24.53	0.28	1.00	-	-	Non-liquefiable
	16.00	SM	42	19	310.40	160.00	150.40	0.75	0.240	0.82	15.49	5.00	1.20	23.59	0.27	0.90	0.287	1.194	Non-liquefiable
	17.50	CL-ML	52	23	337.75	175.00	162.75	0.71	0.229	0.78	18.03	5.00	1.20	26.63	0.33	0.89	-	-	Non-liquefiable
	19.00	CL	82	23	366.70	190.00	176.70	0.67	0.216	0.75	17.30	5.00	1.20	25.76	0.31	0.83	-	-	Non-liquefiable
	20.50	CL	82	40	412.05	205.00	207.05	0.63	0.195	0.69	27.80	5.00	1.20	38.36	0.52	0.79	-	-	Non-liquefiable
	23.50	CL	70	39	472.35	235.00	237.35	0.56	0.174	0.65	25.31	5.00	1.20	35.38	0.52	0.76	-	-	Non-liquefiable
	25.00	SM	45	39	507.50	250.00	257.50	0.56	0.172	0.62	24.30	5.00	1.20	34.16	0.52	0.77	0.475	2.758	Non-liquefiable
	26.50	SM	45	42	519.40	265.00	254.40	0.56	0.178	0.63	26.33	5.00	1.20	36.60	0.52	0.77	0.476	2.672	Non-liquefiable
	28.00	CL-ML	67	42	548.80	280.00	268.80	0.56	0.178	0.61	25.62	5.00	1.20	35.74	0.52	0.76	-	-	Non-liquefiable
	29.50	CL-ML	67	52	578.20	295.00	283.20	0.56	0.178	0.59	30.90	5.00	1.20	42.08	0.52	0.75	-	-	Non-liquefiable
	31.00	SM-SC	50	52	607.60	310.00	297.60	0.56	0.178	0.58	30.14	5.00	1.20	41.17	0.52	0.66	0.406	2.279	Non-liquefiable
	32.50	SM-SC	50	36	656.50	325.00	331.50	0.56	0.173	0.55	19.77	5.00	1.20	28.73	0.40	0.63	0.298	1.724	Non-liquefiable
	35.50	CL	68	41	717.10	355.00	362.10	0.56	0.173	0.53	21.55	5.00	1.20	30.86	0.52	0.61	-	-	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	38.50	CL	68	53	777.70	385.00	392.70	0.56	0.173	0.50	26.75	5.00	1.20	37.09	0.52	0.61	-	-	Non-liquefiable
	40.00	CL-ML	64	59	828.00	400.00	428.00	0.56	0.169	0.48	28.52	5.00	1.20	39.22	0.52	0.59	-	-	Non-liquefiable
P90	0.50	ML	59	4	9.95	5.00	4.95	1.00	0.312	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.542	Liquefiable
P90	1.00	CL-ML	69	4	19.90	10.00	9.90	0.99	0.311	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
P90	2.00	CL	89	4	39.80	20.00	19.80	0.98	0.309	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
P90	3.00	ML	55	6	59.70	30.00	29.70	0.98	0.306	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.714	Liquefiable
P90	4.00	SM	38	6	79.60	40.00	39.60	0.97	0.304	1.59	9.53	5.00	1.20	16.44	0.17	1.00	0.209	0.686	Liquefiable
P90	5.00	SM	38	15	98.00	50.00	48.00	0.96	0.306	1.44	21.65	5.00	1.20	30.98	0.52	1.00	0.620	2.025	Non-liquefiable
P90	6.00	SM	38	18	117.60	60.00	57.60	0.95	0.304	1.32	23.72	5.00	1.20	33.46	0.52	1.00	0.620	2.041	Non-liquefiable
P90	7.00	ML	90	18	137.20	70.00	67.20	0.95	0.301	1.22	21.96	5.00	1.20	31.35	0.52	1.00	0.620	2.058	Non-liquefiable
P90	8.00	CL-ML	81	12	155.20	80.00	75.20	0.94	0.302	1.15	13.84	5.00	1.20	21.61	0.24	1.00	-	-	Non-liquefiable
P90	9.00	CL-ML	81	15	174.60	90.00	84.60	0.93	0.300	1.09	16.31	5.00	1.20	24.57	0.28	1.00	-	-	Non-liquefiable
P90	10.00	CL	83	15	194.00	100.00	94.00	0.91	0.292	1.03	15.47	5.00	1.20	23.57	0.27	1.00	-	-	Non-liquefiable
P90	11.00	CL-ML	89	17	221.10	110.00	111.10	0.88	0.273	0.95	16.13	5.00	1.20	24.35	0.28	1.00	-	-	Non-liquefiable
P90	12.00	CL-ML	89	19	241.20	120.00	121.20	0.85	0.265	0.91	17.26	5.00	1.20	25.71	0.31	1.00	-	-	Non-liquefiable
P90	14.50	CL	83	21	291.45	145.00	146.45	0.79	0.244	0.83	17.35	5.00	1.20	25.82	0.31	1.00	-	-	Non-liquefiable
P90	16.00	ML	59	21	324.80	160.00	164.80	0.75	0.230	0.78	16.36	5.00	1.20	24.63	0.28	0.88	0.299	1.302	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	17.50	CL	69	25	339.50	175.00	164.50	0.71	0.228	0.78	19.49	5.00	1.20	28.39	0.38	0.88	-	-	Non-liquefiable
	19.00	CL-ML	77	25	368.60	190.00	178.60	0.67	0.215	0.75	18.71	5.00	1.20	27.45	0.35	0.83	-	-	Non-liquefiable
	20.50	CL-ML	77	32	416.15	205.00	211.15	0.63	0.193	0.69	22.02	5.00	1.20	31.43	0.52	0.78	-	-	Non-liquefiable
	22.00	CL	74	32	446.60	220.00	226.60	0.59	0.180	0.66	21.26	5.00	1.20	30.51	0.51	0.77	-	-	Non-liquefiable
	23.50	CL	74	36	479.40	235.00	244.40	0.56	0.171	0.64	23.03	5.00	1.20	32.63	0.52	0.76	-	-	Non-liquefiable
	25.00	SM	38	36	510.00	250.00	260.00	0.56	0.171	0.62	22.33	5.00	1.20	31.79	0.52	0.80	0.494	2.885	Non-liquefiable
	26.50	SM	38	41	506.15	265.00	241.15	0.56	0.183	0.64	26.40	5.00	1.20	36.68	0.52	0.81	0.503	2.745	Non-liquefiable
	28.00	ML	54	41	534.80	280.00	254.80	0.56	0.183	0.63	25.69	5.00	1.20	35.82	0.52	0.80	0.497	2.709	Non-liquefiable
	29.50	ML	82	55	563.45	295.00	268.45	0.56	0.183	0.61	33.57	5.00	1.20	45.28	0.52	0.79	0.491	2.676	Non-liquefiable
	31.00	ML	94	59	592.10	310.00	282.10	0.56	0.183	0.60	35.13	5.00	1.20	47.15	0.52	0.78	0.485	2.645	Non-liquefiable
	32.50	CL-ML	71	66	620.75	325.00	295.75	0.56	0.183	0.58	38.38	5.00	1.20	51.05	0.52	0.77	-	-	Non-liquefiable
	35.50	CL-ML	56	62	678.05	355.00	323.05	0.56	0.183	0.56	34.50	5.00	1.20	46.39	0.52	0.62	-	-	Non-liquefiable
	38.50	CL	62	53	789.25	385.00	404.25	0.56	0.171	0.50	26.36	5.00	1.20	36.63	0.52	0.56	-	-	Non-liquefiable
	40.00	CL	62	56	812.00	400.00	412.00	0.56	0.172	0.49	27.59	5.00	1.20	38.11	0.52	0.56	-	-	Non-liquefiable
	0.50	ML	55	4.00	9.75	5.00	4.75	1.00	0.319	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.531	Liquefiable
P91	1.00	CL-ML	63	4.00	19.50	10.00	9.50	0.99	0.318	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
	2.00	CL-ML	67	4.00	39.00	20.00	19.00	0.98	0.315	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 Earthquake Zone= IV amax/g=0.24 K(alpha)= 1.00 MSF= 1.193 Critical Water Table (m)=0.00 m

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	3.00	ML	56	7.00	58.50	30.00	28.50	0.98	0.313	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.788	Liquefiable
	5.00	ML	61	9.00	98.50	50.00	48.50	0.96	0.305	1.44	12.92	5.00	1.20	20.51	0.22	1.00	0.265	0.868	Liquefiable
	6.00	ML	61	11.00	118.20	60.00	58.20	0.95	0.302	1.31	14.42	5.00	1.20	22.30	0.25	1.00	0.294	0.972	Liquefiable
	7.00	CL	67	11.00	137.90	70.00	67.90	0.95	0.300	1.21	13.35	5.00	1.20	21.02	0.23	1.00	-	-	Non-liquefiable
	8.00	CL	67	12.00	157.60	80.00	77.60	0.94	0.297	1.14	13.62	5.00	1.20	21.35	0.23	1.00	-	-	Non-liquefiable
	9.00	CL	68	27.00	177.30	90.00	87.30	0.93	0.295	1.07	28.90	5.00	1.20	39.68	0.52	1.00	-	-	Non-liquefiable
	11.00	CL	83	21.00	226.60	110.00	116.60	0.88	0.267	0.93	19.45	5.00	1.20	28.34	0.38	1.00	-	-	Non-liquefiable
	12.00	CL	83	24.00	247.20	120.00	127.20	0.85	0.259	0.89	21.28	5.00	1.20	30.54	0.51	1.00	-	-	Non-liquefiable
	14.50	CL	82	19.00	304.50	145.00	159.50	0.79	0.234	0.79	15.04	5.00	1.20	23.05	0.26	1.00	-	-	Non-liquefiable
	17.50	CL	77	58.00	364.00	175.00	189.00	0.71	0.212	0.73	42.19	5.00	1.20	55.63	0.52	0.80	-	-	Non-liquefiable
	20.50	CL	76	65.00	448.95	205.00	243.95	0.63	0.180	0.64	41.62	5.00	1.20	54.94	0.52	0.74	-	-	Non-liquefiable
	23.50	CL	72	68.00	465.30	235.00	230.30	0.56	0.176	0.66	44.81	5.00	1.20	58.77	0.52	0.72	-	-	Non-liquefiable
	26.50	CL-ML	56	40.00	524.70	265.00	259.70	0.56	0.176	0.62	24.82	5.00	1.20	34.79	0.52	0.69	-	-	Non-liquefiable
	28.00	MI	91	40.00	565.60	280.00	285.60	0.56	0.173	0.59	23.67	5.00	1.20	33.40	0.52	0.78	-	-	Non-liquefiable
	29.50	ML	55	40.00	595.90	295.00	300.90	0.56	0.173	0.58	23.06	5.00	1.20	32.67	0.52	0.77	0.478	2.761	Non-liquefiable
	31.00	CL	63	40.00	626.20	310.00	316.20	0.56	0.173	0.56	22.49	5.00	1.20	31.99	0.52	0.76	-	-	Non-liquefiable
	32.50	CL	83	42.00	656.50	325.00	331.50	0.56	0.173	0.55	23.07	5.00	1.20	32.68	0.52	0.75	-	-	Non-liquefiable
	35.50	CL	83	45.00	717.10	355.00	362.10	0.56	0.173	0.53	23.65	5.00	1.20	33.38	0.52	0.65	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 | Earthquake Zone= IV | amax/g=0.24 | K(alpha)= 1.00 | MSF= 1.193 | Critical Water Table (m)=0.00 m

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	38.50	CL	66	56.00	777.70	385.00	392.70	0.56	0.173	0.50	28.26	5.00	1.20	38.91	0.52	0.63	-	-	Non-liquefiable
	40.00	CL	72	61.00	808.00	400.00	408.00	0.56	0.173	0.50	30.20	5.00	1.20	41.24	0.52	0.62	-	-	Non-liquefiable
P92	0.50	ML	54	3.00	9.80	5.00	4.80	1.00	0.317	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.463	Liquefiable
	1.00	CL-ML	61	3.00	19.60	10.00	9.60	0.99	0.316	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
	2.00	CL-ML	55	3.00	39.20	20.00	19.20	0.98	0.314	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
	3.00	SM-SC	50	5.00	58.80	30.00	28.80	0.98	0.311	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.621	Liquefiable
	4.00	ML	66	5.00	78.40	40.00	38.40	0.97	0.309	1.61	8.07	5.00	1.20	14.68	0.16	1.00	0.187	0.606	Liquefiable
	5.00	ML	66	8.00	98.00	50.00	48.00	0.96	0.306	1.44	11.55	5.00	1.20	18.86	0.20	1.00	0.240	0.785	Liquefiable
	6.00	ML	51	11.00	117.60	60.00	57.60	0.95	0.304	1.32	14.49	5.00	1.20	22.39	0.25	1.00	0.295	0.972	Liquefiable
	7.00	CL	78	11.00	137.20	70.00	67.20	0.95	0.301	1.22	13.42	5.00	1.20	21.10	0.23	1.00	-	-	Non-liquefiable
	8.00	CL	78	17.00	156.80	80.00	76.80	0.94	0.299	1.14	19.40	5.00	1.20	28.28	0.38	1.00	-	-	Non-liquefiable
	9.00	CL	78	18.00	176.40	90.00	86.40	0.93	0.297	1.08	19.36	5.00	1.20	28.24	0.38	1.00	-	-	Non-liquefiable
	11.00	CL	91	16.00	227.70	110.00	117.70	0.88	0.266	0.92	14.75	5.00	1.20	22.70	0.25	1.00	-	-	Non-liquefiable
	12.00	CL	77	8.00	248.40	120.00	128.40	0.85	0.258	0.88	7.06	5.00	1.20	13.47	0.15	1.00	-	-	Non-liquefiable
	14.50	CL	73	12.00	295.80	145.00	150.80	0.79	0.241	0.81	9.77	5.00	1.20	16.73	0.18	1.00	-	-	Non-liquefiable
	17.50	CL-ML	73	25.00	360.50	175.00	185.50	0.71	0.214	0.73	18.36	5.00	1.20	27.03	0.34	0.82	-	-	Non-liquefiable
	19.00	CL	63	25.00	385.70	190.00	195.70	0.67	0.205	0.71	17.87	5.00	1.20	26.44	0.32	0.80	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 | **Earthquake Zone= IV** | **amax/g=0.24** | **K(alpha)= 1.00** | **MSF= 1.193** | **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	20.50	CL	63	30.00	416.15	205.00	211.15	0.63	0.193	0.69	20.65	5.00	1.20	29.77	0.45	0.78	-	-	Non-liquefiable
	23.50	CL	67	48.00	472.35	235.00	237.35	0.56	0.174	0.65	31.16	5.00	1.20	42.39	0.52	0.74	-	-	Non-liquefiable
	26.50	CL	73	48.00	540.60	265.00	275.60	0.56	0.171	0.60	28.91	5.00	1.20	39.70	0.52	0.69	-	-	Non-liquefiable
	29.50	CL	79	39.00	601.80	295.00	306.80	0.56	0.171	0.57	22.27	5.00	1.20	31.72	0.52	0.66	-	-	Non-liquefiable
	32.50	CL	82	54.00	663.00	325.00	338.00	0.56	0.171	0.54	29.37	5.00	1.20	40.25	0.52	0.64	-	-	Non-liquefiable
	35.50	CL	80	48.00	727.75	355.00	372.75	0.56	0.171	0.52	24.86	5.00	1.20	34.83	0.52	0.62	-	-	Non-liquefiable
	38.50	CL	80	50.00	789.25	385.00	404.25	0.56	0.171	0.50	24.87	5.00	1.20	34.84	0.52	0.61	-	-	Non-liquefiable
	40.00	SM	47	64.00	820.00	400.00	420.00	0.56	0.171	0.49	31.23	5.00	1.20	42.47	0.52	0.60	0.372	2.182	Non-liquefiable
P93	0.50	ML	51	6	9.70	5.00	4.70	1.00	0.321	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.682	Liquefiable
P93	1.00	SM-SC	49	6	19.40	10.00	9.40	0.99	0.319	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.685	Liquefiable
P93	2.00	SM-SC	49	6	38.80	20.00	18.80	0.98	0.317	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.690	Liquefiable
P93	3.00	SM	47	5	58.20	30.00	28.20	0.98	0.315	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.615	Liquefiable
P93	4.00	CL-ML	57	5	77.60	40.00	37.60	0.97	0.312	1.63	8.15	5.00	1.20	14.78	0.16	1.00	-	-	Non-liquefiable
P93	5.00	CL-ML	63	14	98.50	50.00	48.50	0.96	0.305	1.44	20.10	5.00	1.20	29.12	0.42	1.00	-	-	Non-liquefiable
P93	6.00	CL-ML	70	12	118.20	60.00	58.20	0.95	0.302	1.31	15.73	5.00	1.20	23.88	0.27	1.00	-	-	Non-liquefiable
P93	8.00	SM	42	26	157.60	80.00	77.60	0.94	0.297	1.14	29.51	5.00	1.20	40.42	0.52	1.00	0.620	2.085	Non-liquefiable
P93	9.00	CL-ML	63	19	177.30	90.00	87.30	0.93	0.295	1.07	20.34	5.00	1.20	29.40	0.43	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	11.00	CL-ML	77	18	216.70	110.00	106.70	0.88	0.279	0.97	17.43	5.00	1.20	25.91	0.31	1.00	-	-	Non-liquefiable
	12.00	CL	85	16	244.80	120.00	124.80	0.85	0.261	0.90	14.32	5.00	1.20	22.19	0.24	1.00	-	-	Non-liquefiable
	14.50	CL-ML	78	29	295.80	145.00	150.80	0.79	0.241	0.81	23.62	5.00	1.20	33.34	0.52	1.00	-	-	Non-liquefiable
	17.50	CL-ML	78	29	351.75	175.00	176.75	0.71	0.219	0.75	21.81	5.00	1.20	31.18	0.52	0.81	-	-	Non-liquefiable
	19.00	CL	79	29	383.80	190.00	193.80	0.67	0.206	0.72	20.83	5.00	1.20	30.00	0.47	0.91	-	-	Non-liquefiable
	20.50	CL	79	32	381.30	205.00	176.30	0.63	0.211	0.75	24.10	5.00	1.20	33.92	0.52	0.92	-	-	Non-liquefiable
	23.50	CL	72	45	437.10	235.00	202.10	0.56	0.189	0.70	31.65	5.00	1.20	42.98	0.52	0.84	-	-	Non-liquefiable
	25.00	SM	47	45	492.50	250.00	242.50	0.56	0.177	0.64	28.90	5.00	1.20	39.68	0.52	0.70	0.433	2.442	Non-liquefiable
	26.50	SM	47	54	551.20	265.00	286.20	0.56	0.168	0.59	31.92	5.00	1.20	43.30	0.52	0.65	0.405	2.408	Non-liquefiable
	28.00	SM	47	63	582.40	280.00	302.40	0.56	0.168	0.58	36.23	5.00	1.20	48.47	0.52	0.64	0.396	2.355	Non-liquefiable
	29.50	CL	67	59	613.60	295.00	318.60	0.56	0.168	0.56	33.05	5.00	1.20	44.67	0.52	0.63	-	-	Non-liquefiable
	31.00	CL	67	55	644.80	310.00	334.80	0.56	0.168	0.55	30.06	5.00	1.20	41.07	0.52	0.61	-	-	Non-liquefiable
	32.50	CL	67	59	676.00	325.00	351.00	0.56	0.168	0.53	31.49	5.00	1.20	42.79	0.52	0.60	-	-	Non-liquefiable
	34.00	CL	67	70	707.20	340.00	367.20	0.56	0.168	0.52	36.53	5.00	1.20	48.84	0.52	0.59	-	-	Non-liquefiable
	35.50	CL	67	78	738.40	355.00	383.40	0.56	0.168	0.51	39.84	5.00	1.20	52.80	0.52	0.58	-	-	Non-liquefiable
	37.00	CL	67	69	769.60	370.00	399.60	0.56	0.168	0.50	34.52	5.00	1.20	46.42	0.52	0.57	-	-	Non-liquefiable
	38.50	CL	63	60	800.80	385.00	415.80	0.56	0.168	0.49	29.42	5.00	1.20	40.31	0.52	0.56	-	-	Non-liquefiable
	40.00	CL	63	70	832.00	400.00	432.00	0.56	0.168	0.48	33.68	5.00	1.20	45.41	0.52	0.55	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
P94	0.50	ML	65	2.00	10.20	5.00	5.20	1.00	0.305	1.70	3.40	5.00	1.20	9.08	0.11	1.00	0.125	0.411	Liquefiable
	1.00	ML	68	2.00	20.40	10.00	10.40	0.99	0.304	1.70	3.40	5.00	1.20	9.08	0.11	1.00	0.125	0.413	Liquefiable
	2.00	CL-ML	72	2.00	40.80	20.00	20.80	0.98	0.301	1.70	3.40	5.00	1.20	9.08	0.11	1.00	-	-	Non-liquefiable
	3.00	CL-ML	72	3.00	61.20	30.00	31.20	0.98	0.299	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
	4.00	CL-ML	72	6.00	81.60	40.00	41.60	0.97	0.297	1.55	9.30	5.00	1.20	16.16	0.17	1.00	-	-	Non-liquefiable
	5.00	ML	59	6.00	97.50	50.00	47.50	0.96	0.308	1.45	8.71	5.00	1.20	15.45	0.16	1.00	0.196	0.64	Liquefiable
	6.00	CL-ML	60	8.00	117.00	60.00	57.00	0.95	0.306	1.32	10.60	5.00	1.20	17.72	0.19	1.00	-	-	Non-liquefiable
	7.00	CL-ML	60	9.00	136.50	70.00	66.50	0.95	0.303	1.23	11.04	5.00	1.20	18.24	0.19	1.00	-	-	Non-liquefiable
	9.00	CL	68	14.00	182.70	90.00	92.70	0.93	0.286	1.04	14.54	5.00	1.20	22.45	0.25	1.00	-	-	Non-liquefiable
	10.00	CL	68	17.00	203.00	100.00	103.00	0.91	0.279	0.99	16.75	5.00	1.20	25.10	0.29	1.00	-	-	Non-liquefiable
	11.00	CL-ML	73	17.00	223.30	110.00	113.30	0.88	0.271	0.94	15.97	5.00	1.20	24.17	0.28	1.00	-	-	Non-liquefiable
	12.50	CL-ML	73	19.00	253.75	125.00	128.75	0.84	0.258	0.88	16.74	5.00	1.20	25.09	0.29	1.00	-	-	Non-liquefiable
	14.00	CL	82	19.00	278.60	140.00	138.60	0.80	0.251	0.85	16.14	5.00	1.20	24.37	0.28	1.00	-	-	Non-liquefiable
	15.50	CL	82	26.00	308.45	155.00	153.45	0.76	0.238	0.81	20.99	5.00	1.20	30.19	0.48	0.88	-	-	Non-liquefiable
	18.50	CL	67	22.00	382.95	185.00	197.95	0.68	0.205	0.71	15.64	5.00	1.20	23.76	0.27	0.79	-	-	Non-liquefiable
	20.00	CL-ML	75	22.00	432.00	200.00	232.00	0.64	0.186	0.66	14.44	5.00	1.20	22.33	0.25	0.77	-	-	Non-liquefiable
	21.50	CL	69	25.00	464.40	215.00	249.40	0.60	0.174	0.63	15.83	5.00	1.20	24.00	0.27	0.75	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 Earthquake Zone= IV a_{max}/g=0.24 K(alpha)= 1.00 MSF= 1.193 Critical Water Table (m)=0.00 m

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	24.50	CL	85	31.00	485.10	245.00	240.10	0.56	0.176	0.65	20.01	5.00	1.20	29.01	0.41	0.74	-	-	Non-liquefiable
	27.50	CL	71	39.00	566.50	275.00	291.50	0.56	0.170	0.59	22.84	5.00	1.20	32.41	0.52	0.67	-	-	Non-liquefiable
	30.50	ML	53	44.00	631.35	305.00	326.35	0.56	0.169	0.55	24.36	5.00	1.20	34.23	0.52	0.65	0.403	2.39	Non-liquefiable
	33.50	CL	80	57.00	693.45	335.00	358.45	0.56	0.169	0.53	30.11	5.00	1.20	41.13	0.52	0.63	-	-	Non-liquefiable
	35.00	CL-ML	63	57.00	735.00	350.00	385.00	0.56	0.167	0.51	29.05	5.00	1.20	39.86	0.52	0.61	-	-	Non-liquefiable
	36.50	MI	88	67.00	766.50	365.00	401.50	0.56	0.167	0.50	33.44	5.00	1.20	45.12	0.52	0.60	-	-	Non-liquefiable
	40.00	CL	86	79.00	840.00	400.00	440.00	0.56	0.167	0.48	37.66	5.00	1.20	50.19	0.52	0.58	-	-	Non-liquefiable
P95	0.50	CL-ML	53	4	9.70	5.00	4.70	1.00	0.321	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
	1.00	CL-ML	53	4	19.40	10.00	9.40	0.99	0.319	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
	2.00	SM-SC	49	4	38.80	20.00	18.80	0.98	0.317	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.534	Liquefiable
	3.00	SM-SC	49	7	58.20	30.00	28.20	0.98	0.315	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.783	Liquefiable
	4.00	SM	44	7	77.60	40.00	37.60	0.97	0.312	1.63	11.42	5.00	1.20	18.70	0.20	1.00	0.238	0.764	Liquefiable
	5.00	CL-ML	54	7	97.00	50.00	47.00	0.96	0.310	1.46	10.21	5.00	1.20	17.25	0.18	1.00	-	-	Non-liquefiable
	6.00	SM	45	16	117.60	60.00	57.60	0.95	0.304	1.32	21.08	5.00	1.20	30.30	0.49	1.00	0.584	1.923	Non-liquefiable
	7.00	SM	45	11	137.20	70.00	67.20	0.95	0.301	1.22	13.42	5.00	1.20	21.10	0.23	1.00	0.274	0.909	Liquefiable
	8.00	CL	64	11	156.80	80.00	76.80	0.94	0.299	1.14	12.55	5.00	1.20	20.06	0.22	1.00	-	-	Non-liquefiable
	9.00	CL	64	24	181.80	90.00	91.80	0.93	0.288	1.04	25.05	5.00	1.20	35.06	0.52	1.00	-	-	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	10.00	CL	88	28	202.00	100.00	102.00	0.91	0.280	0.99	27.72	5.00	1.20	38.27	0.52	1.00	-	-	Non-liquefiable
	12.50	CL	89	15	252.50	125.00	127.50	0.84	0.260	0.89	13.28	5.00	1.20	20.94	0.23	1.00	-	-	Non-liquefiable
	15.50	CL	81	25	314.65	155.00	159.65	0.76	0.234	0.79	19.79	5.00	1.20	28.74	0.40	0.90	-	-	Non-liquefiable
	18.50	CL-ML	64	35	358.90	185.00	173.90	0.68	0.219	0.76	26.54	5.00	1.20	36.85	0.52	0.89	-	-	Non-liquefiable
	20.00	CL	73	35	388.00	200.00	188.00	0.64	0.206	0.73	25.53	5.00	1.20	35.63	0.52	0.83	-	-	Non-liquefiable
	21.50	CL	73	46	423.55	215.00	208.55	0.60	0.190	0.69	31.85	5.00	1.20	43.22	0.52	0.81	-	-	Non-liquefiable
	23.00	CL-ML	82	46	453.10	230.00	223.10	0.56	0.177	0.67	30.80	5.00	1.20	41.96	0.52	0.79	-	-	Non-liquefiable
	24.50	CL-ML	82	48	509.60	245.00	264.60	0.56	0.168	0.61	29.51	5.00	1.20	40.41	0.52	0.76	-	-	Non-liquefiable
	27.50	ML	81	45	572.00	275.00	297.00	0.56	0.168	0.58	26.11	5.00	1.20	36.33	0.52	0.73	0.453	2.693	Non-liquefiable
	30.50	CL-ML	55	52	634.40	305.00	329.40	0.56	0.168	0.55	28.65	5.00	1.20	39.38	0.52	0.69	-	-	Non-liquefiable
	32.00	CL	79	67	643.20	320.00	323.20	0.56	0.174	0.56	37.27	5.00	1.20	49.72	0.52	0.69	-	-	Non-liquefiable
	33.50	CL	79	67	673.35	335.00	338.35	0.56	0.174	0.54	36.42	5.00	1.20	48.71	0.52	0.68	-	-	Non-liquefiable
	35.00	SM	46	64	703.50	350.00	353.50	0.56	0.174	0.53	34.04	5.00	1.20	45.85	0.52	0.67	0.416	2.393	Non-liquefiable
	36.50	CL	80	58	733.65	365.00	368.65	0.56	0.174	0.52	30.21	5.00	1.20	41.25	0.52	0.66	-	-	Non-liquefiable
	38.00	CL	80	56	763.80	380.00	383.80	0.56	0.174	0.51	28.58	5.00	1.20	39.30	0.52	0.65	-	-	Non-liquefiable
	40.00	CL	84	58	804.00	400.00	404.00	0.56	0.174	0.50	28.86	5.00	1.20	39.63	0.52	0.64	-	-	Non-liquefiable
P96	0.50	ML	57	3	10.10	5.00	5.10	1.00	0.308	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.477	Liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	1.00	CL-ML	53	3	20.20	10.00	10.20	0.99	0.307	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
	2.00	SM	35	3	40.40	20.00	20.40	0.98	0.304	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.483	Liquefiable
	3.00	SM	35	5	60.60	30.00	30.60	0.98	0.302	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.640	Liquefiable
	4.00	CL-ML	61	4	80.80	40.00	40.80	0.97	0.299	1.57	6.26	5.00	1.20	12.51	0.14	1.00	-	-	Non-liquefiable
	6.00	SM	42	10	121.20	60.00	61.20	0.95	0.295	1.28	12.78	5.00	1.20	20.34	0.22	1.00	0.262	0.889	Liquefiable
	7.00	SM	42	11	135.80	70.00	65.80	0.95	0.305	1.23	13.56	5.00	1.20	21.27	0.23	1.00	0.277	0.908	Liquefiable
	8.00	CL	85	11	155.20	80.00	75.20	0.94	0.302	1.15	12.68	5.00	1.20	20.22	0.22	1.00	-	-	Non-liquefiable
	9.00	CL	85	14	174.60	90.00	84.60	0.93	0.300	1.09	15.22	5.00	1.20	23.27	0.26	1.00	-	-	Non-liquefiable
	10.00	CL	85	16	194.00	100.00	94.00	0.91	0.292	1.03	16.50	5.00	1.20	24.80	0.29	1.00	-	-	Non-liquefiable
	12.50	CL	90	18	242.50	125.00	117.50	0.84	0.271	0.92	16.61	5.00	1.20	24.93	0.29	1.00	-	-	Non-liquefiable
	14.00	CL-ML	80	18	282.80	140.00	142.80	0.80	0.247	0.84	15.06	5.00	1.20	23.08	0.26	1.00	-	-	Non-liquefiable
	15.50	CL-ML	80	24	311.55	155.00	156.55	0.76	0.236	0.80	19.18	5.00	1.20	28.02	0.37	0.88	-	-	Non-liquefiable
	17.00	SM	40	24	341.70	170.00	171.70	0.72	0.224	0.76	18.32	5.00	1.20	26.98	0.34	0.82	0.329	1.470	Non-liquefiable
	18.50	SM	40	39	375.55	185.00	190.55	0.68	0.209	0.72	28.25	5.00	1.20	38.90	0.52	0.78	0.487	2.327	Non-liquefiable
	20.00	CL-ML	69	39	406.00	200.00	206.00	0.64	0.197	0.70	27.17	5.00	1.20	37.61	0.52	0.76	-	-	Non-liquefiable
	21.50	CL-ML	69	43	436.45	215.00	221.45	0.60	0.184	0.67	28.90	5.00	1.20	39.67	0.52	0.74	-	-	Non-liquefiable
	23.00	CL	71	43	466.90	230.00	236.90	0.56	0.172	0.65	27.94	5.00	1.20	38.52	0.52	0.83	-	-	Non-liquefiable
	24.50	CL	71	45	487.55	245.00	242.55	0.56	0.176	0.64	28.89	5.00	1.20	39.67	0.52	0.83	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	26.00	SM	43	45	517.40	260.00	257.40	0.56	0.176	0.62	28.05	5.00	1.20	38.66	0.52	0.82	0.506	2.883	Non-liquefiable
	27.50	SM	43	52	547.25	275.00	272.25	0.56	0.176	0.61	31.52	5.00	1.20	42.82	0.52	0.81	0.500	2.848	Non-liquefiable
	29.00	CL-ML	60	52	577.10	290.00	287.10	0.56	0.176	0.59	30.69	5.00	1.20	41.83	0.52	0.68	-	-	Non-liquefiable
	30.50	CL-ML	60	55	649.65	305.00	344.65	0.56	0.165	0.54	29.63	5.00	1.20	40.55	0.52	0.64	-	-	Non-liquefiable
	32.00	SM	49	59	681.60	320.00	361.60	0.56	0.165	0.53	31.03	5.00	1.20	42.23	0.52	0.63	0.388	2.356	Non-liquefiable
	33.50	CL-ML	60	50	713.55	335.00	378.55	0.56	0.165	0.51	25.70	5.00	1.20	35.84	0.52	0.62	-	-	Non-liquefiable
	35.00	SM	47	50	745.50	350.00	395.50	0.56	0.165	0.50	25.14	5.00	1.20	35.17	0.52	0.56	0.350	2.125	Non-liquefiable
	36.50	CL	80	53	762.85	365.00	397.85	0.56	0.167	0.50	26.57	5.00	1.20	36.89	0.52	0.56	-	-	Non-liquefiable
	38.00	CL	80	62	794.20	380.00	414.20	0.56	0.167	0.49	30.46	5.00	1.20	41.56	0.52	0.55	-	-	Non-liquefiable
	40.00	CL-ML	82	69	836.00	400.00	436.00	0.56	0.167	0.48	33.05	5.00	1.20	44.65	0.52	0.54	-	-	Non-liquefiable
P97	0.50	CL-ML	62	3.00	9.95	5.00	4.95	1.00	0.312	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
P97	2.00	CL	60	3.00	39.80	20.00	19.80	0.98	0.309	1.70	5.10	5.00	1.20	11.12	0.12	1.00	-	-	Non-liquefiable
P97	3.00	ML	57	7.00	59.70	30.00	29.70	0.98	0.306	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.804	Liquefiable
P97	4.00	SM	41	7.00	79.60	40.00	39.60	0.97	0.304	1.59	11.12	5.00	1.20	18.35	0.20	1.00	0.233	0.768	Liquefiable
P97	5.00	SM	41	10.00	99.50	50.00	49.50	0.96	0.302	1.42	14.21	5.00	1.20	22.06	0.24	1.00	0.290	0.960	Liquefiable
P97	6.00	SM	41	12.00	119.40	60.00	59.40	0.95	0.299	1.30	15.57	5.00	1.20	23.68	0.27	1.00	0.320	1.068	Non-liquefiable
P97	7.00	ML	51	12.00	140.70	70.00	70.70	0.95	0.294	1.19	14.27	5.00	1.20	22.13	0.24	1.00	0.291	0.990	Liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	8.00	CL	57	14.00	160.80	80.00	80.80	0.94	0.291	1.11	15.57	5.00	1.20	23.69	0.27	1.00	-	-	Non-liquefiable
	9.00	CL	57	23.00	180.90	90.00	90.90	0.93	0.289	1.05	24.12	5.00	1.20	33.95	0.52	1.00	-	-	Non-liquefiable
	11.00	CL	96	11.00	223.30	110.00	113.30	0.88	0.271	0.94	10.33	5.00	1.20	17.40	0.19	1.00	-	-	Non-liquefiable
	12.00	CL	88	14.00	243.60	120.00	123.60	0.85	0.262	0.90	12.59	5.00	1.20	20.11	0.22	1.00	-	-	Non-liquefiable
	14.50	CL	79	17.00	298.70	145.00	153.70	0.79	0.239	0.81	13.71	5.00	1.20	21.45	0.23	1.00	-	-	Non-liquefiable
	17.50	CL	78	20.00	346.50	175.00	171.50	0.71	0.223	0.76	15.27	5.00	1.20	23.33	0.26	0.83	-	-	Non-liquefiable
	20.50	CL	78	25.00	405.90	205.00	200.90	0.63	0.198	0.71	17.64	5.00	1.20	26.17	0.32	0.79	-	-	Non-liquefiable
	23.50	CL	72	43.00	493.50	235.00	258.50	0.56	0.167	0.62	26.74	5.00	1.20	37.09	0.52	0.78	-	-	Non-liquefiable
	26.50	CL-ML	69	39.00	556.50	265.00	291.50	0.56	0.167	0.59	22.84	5.00	1.20	32.41	0.52	0.75	-	-	Non-liquefiable
	29.50	SM	48	77.00	619.50	295.00	324.50	0.56	0.167	0.56	42.74	5.00	1.20	56.29	0.52	0.72	0.447	2.678	Non-liquefiable
	32.50	ML	53	72.00	659.75	325.00	334.75	0.56	0.172	0.55	39.35	5.00	1.20	52.22	0.52	0.66	0.409	2.378	Non-liquefiable
	35.50	ML	62	73.00	720.65	355.00	365.65	0.56	0.172	0.52	38.18	5.00	1.20	50.81	0.52	0.64	0.397	2.306	Non-liquefiable
	38.50	CL-ML	64	71.00	839.30	385.00	454.30	0.56	0.161	0.47	33.31	5.00	1.20	44.97	0.52	0.65	-	-	Non-liquefiable
	40.00	SM	45	71.00	872.00	400.00	472.00	0.56	0.161	0.46	32.68	5.00	1.20	44.22	0.52	0.64	0.397	2.460	Non-liquefiable
	0.50	ML	53	3	9.60	5.00	4.60	1.00	0.324	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.453	Liquefiable
P98	1.00	SM	46	3	19.20	10.00	9.20	0.99	0.323	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.455	Liquefiable
	2.00	SM	48	3	38.40	20.00	18.40	0.98	0.321	1.70	5.10	5.00	1.20	11.12	0.12	1.00	0.147	0.458	Liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	3.00	SM	48	4	57.60	30.00	27.60	0.98	0.318	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.533	Liquefiable
	5.00	CL-ML	59	6	96.00	50.00	46.00	0.96	0.313	1.47	8.85	5.00	1.20	15.62	0.17	1.00	-	-	Non-liquefiable
	6.00	ML	52	8	117.00	60.00	57.00	0.95	0.306	1.32	10.60	5.00	1.20	17.72	0.19	1.00	0.225	0.736	Liquefiable
	7.00	CL-ML	53	8	136.50	70.00	66.50	0.95	0.303	1.23	9.81	5.00	1.20	16.77	0.18	1.00	-	-	Non-liquefiable
	8.00	CL	78	12	158.40	80.00	78.40	0.94	0.296	1.13	13.55	5.00	1.20	21.26	0.23	1.00	-	-	Non-liquefiable
	9.00	CL	78	15	178.20	90.00	88.20	0.93	0.293	1.06	15.97	5.00	1.20	24.17	0.28	1.00	-	-	Non-liquefiable
	11.00	CL	82	18	217.80	110.00	107.80	0.88	0.277	0.96	17.34	5.00	1.20	25.80	0.31	1.00	-	-	Non-liquefiable
	12.00	CL	82	21	235.20	120.00	115.20	0.85	0.272	0.93	19.57	5.00	1.20	28.48	0.39	1.00	-	-	Non-liquefiable
	14.50	CL-ML	72	25	284.20	145.00	139.20	0.79	0.251	0.85	21.19	5.00	1.20	30.43	0.50	1.00	-	-	Non-liquefiable
	17.50	CL-ML	66	21	353.50	175.00	178.50	0.71	0.218	0.75	15.72	5.00	1.20	23.86	0.27	0.80	-	-	Non-liquefiable
	19.00	SM	36	21	389.50	190.00	199.50	0.67	0.203	0.71	14.87	5.00	1.20	22.84	0.25	0.74	0.226	1.111	Non-liquefiable
	20.50	CL-ML	68	30	399.75	205.00	194.75	0.63	0.201	0.72	21.50	5.00	1.20	30.80	0.52	0.75	-	-	Non-liquefiable
	22.00	ML	54	30	429.00	220.00	209.00	0.59	0.188	0.69	20.75	5.00	1.20	29.90	0.46	0.73	0.400	2.132	Non-liquefiable
	23.50	CL-ML	73	37	458.25	235.00	223.25	0.56	0.179	0.67	24.76	5.00	1.20	34.72	0.52	0.71	-	-	Non-liquefiable
	26.50	CL-ML	68	42	516.75	265.00	251.75	0.56	0.179	0.63	26.47	5.00	1.20	36.76	0.52	0.80	-	-	Non-liquefiable
	28.00	SM	42	42	546.00	280.00	266.00	0.56	0.179	0.61	25.75	5.00	1.20	35.90	0.52	0.74	0.461	2.573	Non-liquefiable
	29.50	SM	42	54	584.10	295.00	289.10	0.56	0.176	0.59	31.76	5.00	1.20	43.11	0.52	0.73	0.450	2.549	Non-liquefiable
	31.00	SM	31	58	613.80	310.00	303.80	0.56	0.176	0.57	33.28	4.77	1.16	43.46	0.52	0.71	0.443	2.511	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	32.50	SM	31	62	643.50	325.00	318.50	0.56	0.176	0.56	34.74	4.77	1.16	45.16	0.52	0.70	0.437	2.476	Non-liquefiable
	35.50	SM	40	58	702.90	355.00	347.90	0.56	0.176	0.54	31.10	5.00	1.20	42.31	0.52	0.59	0.363	2.056	Non-liquefiable
	38.50	SM	40	60	812.35	385.00	427.35	0.56	0.166	0.48	29.02	5.00	1.20	39.83	0.52	0.54	0.332	2.000	Non-liquefiable
	40.00	SM	40	62	844.00	400.00	444.00	0.56	0.166	0.47	29.42	5.00	1.20	40.31	0.52	0.53	0.327	1.968	Non-liquefiable
P99	0.50	CL	57	5.00	10.35	5.00	5.35	1.00	0.301	1.70	8.50	5.00	1.20	15.20	0.16	1.00	-	-	Non-liquefiable
P99	1.00	SM-SC	46	5.00	20.70	10.00	10.70	0.99	0.299	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.645	Liquefiable
P99	2.00	SM-SC	46	5.00	41.40	20.00	21.40	0.98	0.297	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.650	Liquefiable
P99	3.00	SM	44	13.00	62.10	30.00	32.10	0.98	0.295	1.70	22.10	5.00	1.20	31.52	0.52	1.00	0.620	2.103	Non-liquefiable
P99	4.00	ML	52	13.00	79.20	40.00	39.20	0.97	0.306	1.60	20.76	5.00	1.20	29.92	0.46	1.00	0.551	1.803	Non-liquefiable
P99	5.00	ML	69	17.00	99.00	50.00	49.00	0.96	0.303	1.43	24.29	5.00	1.20	34.14	0.52	1.00	0.620	2.046	Non-liquefiable
P99	6.00	SM	47	21.00	118.80	60.00	58.80	0.95	0.301	1.30	27.39	5.00	1.20	37.86	0.52	1.00	0.620	2.063	Non-liquefiable
P99	7.00	CL-ML	54	21.00	138.60	70.00	68.60	0.95	0.298	1.21	25.35	5.00	1.20	35.43	0.52	1.00	-	-	Non-liquefiable
P99	8.00	CL	91	25.00	158.40	80.00	78.40	0.94	0.296	1.13	28.23	5.00	1.20	38.88	0.52	1.00	-	-	Non-liquefiable
P99	9.00	CL	91	31.00	178.20	90.00	88.20	0.93	0.293	1.06	33.01	5.00	1.20	44.61	0.52	1.00	-	-	Non-liquefiable
P99	11.00	CL	86	20.00	225.50	110.00	115.50	0.88	0.268	0.93	18.61	5.00	1.20	27.33	0.35	1.00	-	-	Non-liquefiable
P99	12.00	CL	82	11.00	246.00	120.00	126.00	0.85	0.260	0.89	9.80	5.00	1.20	16.76	0.18	1.00	-	-	Non-liquefiable
P99	14.50	CL	82	20.00	292.90	145.00	147.90	0.79	0.243	0.82	16.45	5.00	1.20	24.73	0.29	1.00	-	-	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	17.50	CL	64	18.00	346.50	175.00	171.50	0.71	0.223	0.76	13.74	5.00	1.20	21.49	0.23	0.82	-	-	Non-liquefiable
	19.00	SM	49	18.00	378.10	190.00	188.10	0.67	0.209	0.73	13.12	5.00	1.20	20.75	0.22	0.80	0.215	1.027	Non-liquefiable
	20.50	SM	49	19.00	407.95	205.00	202.95	0.63	0.197	0.70	13.34	5.00	1.20	21.00	0.23	0.78	0.212	1.081	Non-liquefiable
	22.00	CL	65	19.00	444.40	220.00	224.40	0.59	0.181	0.67	12.68	5.00	1.20	20.22	0.22	0.82	-	-	Non-liquefiable
	23.50	CL-ML	60	30.00	474.70	235.00	239.70	0.56	0.173	0.65	19.38	5.00	1.20	28.25	0.38	0.80	-	-	Non-liquefiable
	25.00	SM	47	30.00	505.00	250.00	255.00	0.56	0.173	0.63	18.79	5.00	1.20	27.54	0.35	0.79	0.334	1.931	Non-liquefiable
	26.50	SM	47	48.00	535.30	265.00	270.30	0.56	0.173	0.61	29.20	5.00	1.20	40.03	0.52	0.78	0.484	2.797	Non-liquefiable
	28.00	CL	58	48.00	562.80	280.00	282.80	0.56	0.174	0.59	28.54	5.00	1.20	39.25	0.52	0.74	-	-	Non-liquefiable
	29.50	CL	67	39.00	592.95	295.00	297.95	0.56	0.174	0.58	22.59	5.00	1.20	32.11	0.52	0.72	-	-	Non-liquefiable
	31.00	ML	55	39.00	623.10	310.00	313.10	0.56	0.174	0.57	22.04	5.00	1.20	31.45	0.52	0.71	0.440	2.533	Non-liquefiable
	32.50	ML	55	43.00	653.25	325.00	328.25	0.56	0.174	0.55	23.73	5.00	1.20	33.48	0.52	0.70	0.434	2.498	Non-liquefiable
	35.50	ML	57	56.00	724.20	355.00	369.20	0.56	0.171	0.52	29.14	5.00	1.20	39.97	0.52	0.64	0.397	2.317	Non-liquefiable
	37.00	SM	47	56.00	754.80	370.00	384.80	0.56	0.171	0.51	28.55	5.00	1.20	39.26	0.52	0.63	0.391	2.281	Non-liquefiable
	38.50	SM	47	58.00	785.40	385.00	400.40	0.56	0.171	0.50	28.99	5.00	1.20	39.78	0.52	0.62	0.385	2.244	Non-liquefiable
	40.00	SM	47	64.00	816.00	400.00	416.00	0.56	0.171	0.49	31.38	5.00	1.20	42.65	0.52	0.61	0.378	2.208	Non-liquefiable
P100	0.50	CL-ML	51	4	10.05	5.00	5.05	1.00	0.309	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
	1.00	ML	51	4	20.10	10.00	10.10	0.99	0.308	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.550	Liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	2.00	ML	51	4	40.20	20.00	20.20	0.98	0.306	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.554	Liquefiable
	3.00	CL-ML	58	6	60.30	30.00	30.30	0.98	0.303	1.70	10.20	5.00	1.20	17.24	0.18	1.00	-	-	Non-liquefiable
	5.00	ML	52	8	100.50	50.00	50.50	0.96	0.299	1.41	11.26	5.00	1.20	18.51	0.20	1.00	0.236	0.789	Liquefiable
	6.00	SM	39	16	112.20	60.00	52.20	0.95	0.320	1.38	22.15	5.00	1.20	31.57	0.52	1.00	0.620	1.939	Non-liquefiable
	8.00	CL-ML	83	20	149.60	80.00	69.60	0.94	0.315	1.20	23.97	5.00	1.20	33.77	0.52	1.00	-	-	Non-liquefiable
	9.00	CL-ML	83	23	180.00	90.00	90.00	0.93	0.291	1.05	24.24	5.00	1.20	34.09	0.52	1.00	-	-	Non-liquefiable
	10.00	CL	84	23	200.00	100.00	100.00	0.91	0.283	1.00	23.00	5.00	1.20	32.60	0.52	1.00	-	-	Non-liquefiable
	11.00	ML	89	24	217.80	110.00	107.80	0.88	0.277	0.96	23.12	5.00	1.20	32.74	0.52	1.00	0.620	2.235	Non-liquefiable
	12.00	ML	89	31	237.60	120.00	117.60	0.85	0.269	0.92	28.59	5.00	1.20	39.30	0.52	1.00	0.620	2.305	Non-liquefiable
	14.50	CL	84	18	287.10	145.00	142.10	0.79	0.248	0.84	15.10	5.00	1.20	23.12	0.26	1.00	-	-	Non-liquefiable
	16.00	SM-SC	45	18	316.80	160.00	156.80	0.75	0.235	0.80	14.37	5.00	1.20	22.25	0.25	0.84	0.247	1.051	Non-liquefiable
	17.50	SM-SC	45	47	351.75	175.00	176.75	0.71	0.219	0.75	35.35	5.00	1.20	47.42	0.52	0.81	0.501	2.281	Non-liquefiable
	19.00	SM	41	47	381.90	190.00	191.90	0.67	0.207	0.72	33.93	5.00	1.20	45.71	0.52	0.82	0.506	2.446	Non-liquefiable
	20.50	ML	53	37	410.00	205.00	205.00	0.63	0.196	0.70	25.84	5.00	1.20	36.01	0.52	0.80	0.496	2.537	Non-liquefiable
	22.00	CL	72	37	440.00	220.00	220.00	0.59	0.183	0.67	24.95	5.00	1.20	34.93	0.52	0.79	-	-	Non-liquefiable
	23.50	CL	72	30	458.25	235.00	223.25	0.56	0.179	0.67	20.08	5.00	1.20	29.09	0.41	0.79	-	-	Non-liquefiable
	25.00	SM	47	30	487.50	250.00	237.50	0.56	0.179	0.65	19.47	5.00	1.20	28.36	0.38	0.80	0.364	2.030	Non-liquefiable
	26.50	SM	47	38	516.75	265.00	251.75	0.56	0.179	0.63	23.95	5.00	1.20	33.74	0.52	0.78	0.487	2.715	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	29.50	SM	43	44	575.25	295.00	280.25	0.56	0.179	0.60	26.28	5.00	1.20	36.54	0.52	0.76	0.473	2.640	Non-liquefiable
	31.00	ML	51	44	604.50	310.00	294.50	0.56	0.179	0.58	25.64	5.00	1.20	35.77	0.52	0.66	0.410	2.286	Non-liquefiable
	32.50	ML	51	54	672.75	325.00	347.75	0.56	0.169	0.54	28.96	5.00	1.20	39.75	0.52	0.62	0.384	2.275	Non-liquefiable
	34.00	SM	50	50	703.80	340.00	363.80	0.56	0.169	0.52	26.21	5.00	1.20	36.46	0.52	0.61	0.378	2.236	Non-liquefiable
	35.50	SM	44	29	734.85	355.00	379.85	0.56	0.169	0.51	14.88	5.00	1.20	22.86	0.25	0.60	0.182	1.077	Non-liquefiable
	38.50	SM	46	47	796.95	385.00	411.95	0.56	0.169	0.49	23.16	5.00	1.20	32.79	0.52	0.57	0.355	2.098	Non-liquefiable
	40.00	SM	46	58	824.00	400.00	424.00	0.56	0.170	0.49	28.17	5.00	1.20	38.80	0.52	0.57	0.351	2.065	Non-liquefiable

APPENDIX-I
SITE PHOTOGRAPHS


SPT at depth 29.50m


SPT at depth 2.00 m

SPT sample at depth 14.50 m

SPT sample at depth 15.50m

APPENDIX-I
SITE PHOTOGRAPHS

UDS at depth 13.00 m

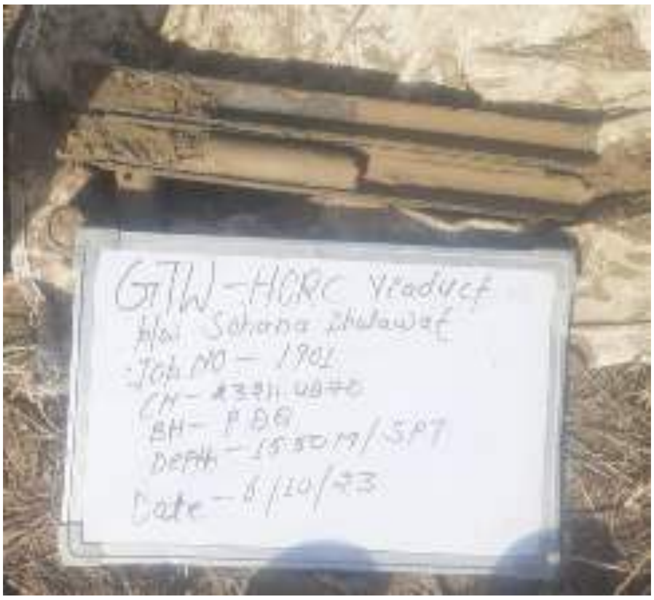
SPT at depth 35.50 m


SPT at depth 12.50 m

SPT sample at depth 30.50 m

APPENDIX-I
SITE PHOTOGRAPHS

SPT at depth 23.50m



SPT sample at depth 15.50 m


SPT at depth 33.50 m

UDS at depth 13.00m

APPENDIX-I
SITE PHOTOGRAPHS


UDS at depth 13.00 m

SPT at depth 6.00 m

SPT sample at depth 29.50 m


SPT at depth 17.50 m

APPENDIX-I
SITE PHOTOGRAPHS

SPT at depth 9.00 m

UDS at depth 14.00 m

SPT sample at depth 21.50 m

APPENDIX-I
SITE PHOTOGRAPHS

SPT sample at depth 24.50 m

SPT at depth 30.50 m


SPT at depth 23.50 m


SPT at depth 26.50 m

APPENDIX-I
SITE PHOTOGRAPHS

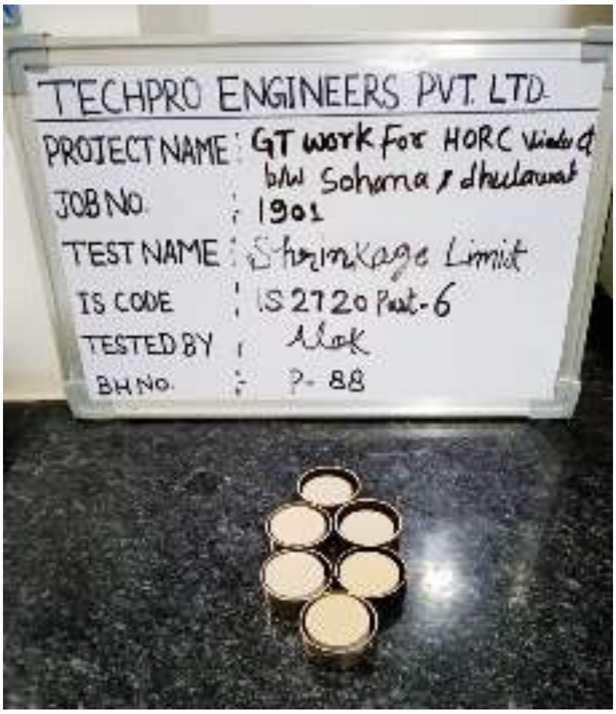
SPT sample at depth 38.50 m


SPT at depth 14.50 m

SPT sample at depth 23.50 m

APPENDIX-J
LABORATORY PHOTOGRAPHS

Water content test



Shrinkage limit test

UCS test of soil

Atterbergs' limit test

APPENDIX-J
LABORATORY PHOTOGRAPHS

Free swell index test

Atterbergs' limit test

Shrinkage limit

Triaxial test

APPENDIX-K
CHART 1: FIELD BORE LOG CHARTS (P81)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GTW FOR HORC Viaduct between Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3119974.676	E: 701006.108	Location/ Chainage: 23038.0570	Bore No.:	P-81
Method of Drilling:	Percussion	Drilling Equipment:	Manually Power winch		
Casing Lowered (M):	22.00	Bentonite Used: NA	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	RL-193.105	Date: From 21/10/23 to 23/10/23		Water Table (M):	2.40 M

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
21/10/23	0.00	0.50	0.50	D	SX	collected				–	–	–	–	–	–	Non cohesive soil
"	1.00	1.45	0.45	U	"	Received				–	–	–	–	–	–	do
"	2.00	2.45	0.45	DP	"	1	1	1	2	–	–	–	–	–	–	do
"	3.00	3.45	0.45	DP	"	2	3	4	7	–	–	–	–	–	–	do
"	4.00	4.45	0.45	U	"	Received				–	–	–	–	–	–	Non cohesive soil
"	5.00	5.45	0.45	DP	"	2	3	5	8	–	–	–	–	–	–	do
"	6.00	6.45	0.45	DP	"	3	6	8	14	–	–	–	–	–	–	do
"	7.00	7.45	0.45	U	"	Received				–	–	–	–	–	–	cohesive soil
"	8.00	8.45	0.45	DP	"	5	7	9	16	–	–	–	–	–	–	cohesive soil with gravel
"	9.00	9.45	0.45	DP	"	6	9	10	19	–	–	–	–	–	–	cohesive soil
"	10.00	10.45	0.45	U	"	Received				–	–	–	–	–	–	do
"	11.00	11.45	0.45	DP	"	6	10	11	21	–	–	–	–	–	–	cohesive soil
"	12.50	12.45	0.45	DP	"	7	11	13	24	–	–	–	–	–	–	do
"	13.50	13.45	0.45	U	"	Received				–	–	–	–	–	–	do
"	14.50	14.95	0.45	DP	"	8	12	17	29	–	–	–	–	–	–	do
"	16.00	16.45	0.45	U	"	Received				–	–	–	–	–	–	cohesive soil
"	17.50	17.95	0.45	DP	"	7	13	15	28	–	–	–	–	–	–	do
"	19.00	19.45	0.45	U	"	Received				–	–	–	–	–	–	cohesive soil
"	20.50	20.95	0.45	DP	"	15	24	54	78	–	–	–	–	–	–	do
"	22.00	22.45	0.45	UDS	"	sidipped				–	–	–	–	–	–	Non cohesive soil
"	23.50	23.95	0.45	DP	"	20	40	62	102	–	–	–	–	–	–	do
22/10/23	25.00	25.45	0.45	UDP	"	17	32	40	72	–	–	–	–	–	–	do
"	26.50	26.95	0.45	DP	"	15	23	32	55	–	–	–	–	–	–	do
"	28.00	28.45	0.45	UDP	"	[illegible]	32	35	67	–	–	–	–	–	–	do

Supervisor E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test N > 100), Sampler means SPT sampler

APPENDIX-K
CHART 2: FIELD BORE LOG CHARTS (P81)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date.:	28.12.2021

Project Name:	GTIV FOR HORC Viaduct between Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3119974.696	E: 701006.108	Location/ Chainage: 230380870		
Method of Drilling:	Percussion	Drilling Equipment:	Powerwinch	Bore No.:	P.81
Casing Lowered (M):	22.00	Bentonite Used: NA	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L-193.105	Date: From 21/10/23	to 23/10/23	Water Table (M):	2.40M

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
22/10/23	29.50	29.95	0.45	DP	SX	21	45	50	95	–	–	–	–	–	–	Non cohesive soil with Gravel
"	31.00	31.45	0.45	DP	"	15	22	30	52	–	–	–	–	–	–	do
"	32.50	32.95	0.45	DP	"	17	25	35	60	–	–	–	–	–	–	do
"	34.00	34.45	0.45	DP	"	16	27	36	63	–	–	–	–	–	–	cohesive soil with Gravel
23/10/23	35.50	35.95	0.45	DP	"	18	30	34	64	–	–	–	–	–	–	do
"	37.00	37.45	0.45	DP	"	21	35	42	77	–	–	–	–	–	–	do
"	38.50	38.95	0.45	DP	"	23	37	48	85	–	–	–	–	–	–	Non cohesive soil.
"	40.00	40.45	0.45	DP	"	27	42	50	92	–	–	–	–	–	–	cohesive soil.

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

Techpro Engineers Pvt. Ltd.

APPENDIX-K
CHART 3: FIELD BORE LOG CHARTS (P82)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No.	GT/003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	24.12.2021

Project Name:	GT work for HORC Viaduct B/w Sohana & Dhulawat Section	Project Code:	1901
Coordinate: N: 3120000.559	E: 701001.381	Location/ Chainage:	23069.2870
Method of Drilling: Percussion	Drilling Equipment: Power rig	Bore No.:	P-82
Casing Lowered (M): 18.m / Bentonite Used: Not	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation: RL-193.262	Date: From 5/10/2023 to 7/10/2023	Water Table (M):	2.30

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
5/10/23	.00	.550	.550	DS	SX	Collected				—	—	—	—	—	—	Cohesive soil
"	1.00	1.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	2.00	2.45	0.45	DP	—	1	1	2	3	—	—	—	—	—	—	Non cohesive soil
"	3.00	3.45	0.45	DP	—	1	2	3	5	—	—	—	—	—	—	— do —
"	4.00	4.45	0.45	U	—	Received				—	—	—	—	—	—	cohesive soil with
"	5.00	5.45	0.45	DP	—	2	3	5	8	—	—	—	—	—	—	Gravels
"	6.00	6.45	0.45	DP	—	3	4	7	11	—	—	—	—	—	—	Non cohesive soil
6/10/23	7.00	7.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	8.00	8.45	0.45	DP	—	5	7	10	17	—	—	—	—	—	—	— do —
"	9.00	9.45	0.45	DP	—	6	7	11	18	—	—	—	—	—	—	— do —
"	10.00	10.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do / DS collected
"	11.00	11.45	0.45	DP	—	8	10	14	24	—	—	—	—	—	—	Cohesive soil with Gravels
"	12.00	12.45	0.45	DP	—	9	12	17	29	—	—	—	—	—	—	— do —
"	13.00	13.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	14.50	14.95	0.45	DP	—	12	15	18	33	—	—	—	—	—	—	— do —
"	16.00	16.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	17.50	17.95	0.45	DP	—	11	17	20	37	—	—	—	—	—	—	Non cohesive soil
"	19.00	19.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	20.50	20.95	0.45	DP	—	13	20	21	41	—	—	—	—	—	—	— do —
"	22.00	22.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	23.50	23.95	0.45	DP	—	15	23	25	48	—	—	—	—	—	—	— do —
"	25.00	25.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do —
"	26.50	26.95	0.45	DP	—	15	24	27	51	—	—	—	—	—	—	— do —
"	28.00	28.45	0.45	U	—	Received				—	—	—	—	—	—	— do —

Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 4: FIELD BORE LOG CHARTS (P82)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No	QT/009
		Date of Issue	01 04 2018
		Rev No	003
		Rev Date	24 12 2021

Project Name:	Gatikom Kansrbne HORC Viaduct B/w Sohana & Dhulawat station	Project Code:	1901
Coordinate:	N: 3120000.559 / E: 701001.381	Location/ Chainage:	23060 - 2370
Method of Drilling:	Percussion / Drilling Equipment: Power winch	Bore No.:	P82
Casing Lowered (M):	18.0 / Bentonite Used: Yes / Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	[illegible] / Date: From 5/10/2023 to 9/10/2023	Water Table (M):	2.30

Day	Depth/RUN (m) From	To	Length (m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD (%)	Water Losses (%)	Color of Return Water	Description
[illegible]	29.50	29.95	0.45	DP	SX	14	25	30	55	—	—	—	—	—	—	Non cohesive soil
"	31.00	31.48	0.48	U	"	Recovered				—	—	—	—	—	—	— do —
[illegible]	32.50	32.95	0.45	DP	"	17	25	32	60	—	—	—	—	—	—	— do —
"	34.00	34.45	0.45	DP	"	19	31	36	67	—	—	—	—	—	—	— do —
"	35.50	35.95	0.45	DP	"	22	34	37	71	—	—	—	—	—	—	Non coheisve soil
"	37.00	37.45	0.45	U	"	SLIPPED				—	—	—	—	—	—	— do —
"	38.50	38.95	0.45	DP	"	25	36	39	75	—	—	—	—	—	—	— do —
"	40.00	40.45	0.45	DP	"	28	39	42	81	—	—	—	—	—	—	Non coheisve soil

Supervisor | E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 5: FIELD BORE LOG CHARTS (P83)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GT(W)-HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N:3120026.499	E:700997.207	Location/ Chainage: 23090.4870		
Method of Drilling:	Percussion	Drilling Equipment	Manual + Power winch	Bore No.:	P83
Casing Lowered (M):	21.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-193.307	Date: From 23/10/23 to 27/10/23		Water Table (M):	1.90

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
23/10/23	0.00	0.50	0.50	DS	SX	collected										Non-cohesive soil
"	1.00	1.45	0.45	DP	"	1	2	3	5							— do —
"	2.00	2.45	0.45	U	"	Received										— do —
"	3.00	3.45	0.45	DP	"	1	2	4	6							— do —
"	4.00	4.45	0.45	DP	"	2	3	4	7							— do —
"	5.00	5.45	0.45	U	"	Received										— do —
"	6.00	6.45	0.45	DP	"	6	9	30	39							— do —
"	7.00	7.45	0.45	DP	"	2	2	6	8							— do —
"	8.00	8.45	0.45	U	"	Received										— do —
"	9.00	9.45	0.45	DP	"	9	14	18	32							— do —
"	10.00	10.45	0.45	DP	"	10	15	19	34							— do —
"	11.00	11.45	0.45	U	"	Received										— do —
"	12.50	12.95	0.45	DP	"	9	14	18	32							— do —
"	14.00	14.45	0.45	U	"	Received										Cohesive soil with gravel
25/10/23	15.50	15.95	0.45	DP	"	9	17	21	38							— do —
"	17.00	17.45	0.45	U	"	slipped										— do - DS collected
"	18.50	18.95	0.45	DP	"	8	18	23	41							Cohesive soil with gravel
"	20.00	20.45	0.45	U	"	Received										— do —
"	21.50	21.95	0.45	DP	"	14	24	25	49							— do —
"	23.00	23.45	0.45	U	"	Received										— do —
"	24.50	24.95	0.45	DP	"	15	20	30	50							Non-cohesive soil with gravel
"	26.00	26.45	0.45	U	"	slipped										-do- DS collected
"	27.50	27.95	0.45	DP	"	17	19	24	43							Non-cohesive soil
"	29.00	29.45	0.45	U	"	slipped										-do- DS collected

Nitesh

Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K

CHART 6: FIELD BORE LOG CHARTS (P83)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R00
		Rev. Date.:	28.12.2021

Project Name:	GT(I)-HORC Viaduct b/w Sohana Dhulawat station	Project Code:	1901
Coordinate:	N:23090·4870 E:700997·207	Location/ Chainage:	23090·4870
Method of Drilling:	Percussion; Drilling Equipment: Manual + Power winch	Bore No.:	P83
Casing Lowered (M):	21.00; Bentonite Used: NO; Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-193·307; Date: From 23/10/23 to 27/10/23	Water Table (M):	1.20

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
26/10/23	30.50	30.95	0.45	DP	Sx	18	21	26	47							Non-cohesive soil
"	32.00	32.45	0.45	U	"	slipped										-do- DS collected
27/10/23	33.50	33.95	0.45	DP	"	16	22	28	50							Non-cohesive soil
"	35.00	35.45	0.45	U	"	slipped										-do- DS collected
"	36.50	36.95	0.45	DP	"	18	26	29	55							Non-cohesive soil
"	38.00	38.45	0.45	DP	"	20	28	30	58							— do —
"	40.00	40.45	0.45	DP	"	18	30	31	61							— do —

Nilesh
Supervisor

Techpro Engineers Pvt. Ltd.

E - In - C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 7: FIELD BORE LOG CHARTS (P 84)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/003
		Date of Issue:	01.04.2018
		Rev. No:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N:3120052.551	E:700993.573	Location/ Chainage: 23116.6070		
Method of Drilling:	Percussion	Drilling Equipment	Mechanical power winch	Bore No.:	P84
Casing Lowered (M):	18.00 Bentonite Used: NO	Standard Sampler :	Yes	Barrel Type :	N/A
Ground Elevation:	RL-193.358	Date: From 23/10/23 to 26/10/23		Water Table (M):	1.70

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
23/10/23	0.00	0.50	0.50	DS	SX	collected										Non-cohesive soil
''	1.00	1.45	0.45	DP	''	3	3	4	7							— do —
''	2.00	2.45	0.45	U	''	Received										— do —
''	3.00	3.45	0.45	DP	''	2	4	5	9							— do —
''	4.00	4.45	0.45	DP	''	3	6	8	14							— do —
''	5.00	5.45	0.45	U	''	Received										Non-cohesive soil with gravel
''	6.00	6.45	0.45	DP	''	3	10	12	22							Non-cohesive soil with gravel
''	7.00	7.45	0.45	DP	''	4	11	13	24							— do —
''	8.00	8.45	0.45	U	''	Received										— do —
''	9.00	9.45	0.45	DP	''	5	8	11	19							— do —
''	10.00	10.45	0.45	DP	''	8	13	15	28							— do —
''	11.00	11.45	0.45	U	''	Received										— do —
''	12.50	12.95	0.45	DP	''	7	10	17	27							— do —
25/10/23	14.00	14.45	0.45	U	''	Received										cohesive soil with gravel
''	15.50	15.95	0.45	DP	''	9	14	16	30							— do —
''	17.00	17.45	0.45	U	''	Received										— do —
''	18.50	18.95	0.45	DP	''	11	15	16	31							— do —
''	20.00	20.45	0.45	U	''	slipped										-do- DS collected
''	21.50	21.95	0.45	DP	''	12	17	20	37							cohesive soil
''	23.00	23.45	0.45	U	''	Received										— do —
''	24.50	24.95	0.45	DP	''	9	18	22	40							— do —
''	26.00	26.45	0.45	U	''	slipped										-do- DS collected
''	27.50	27.95	0.45	DP	''	13	21	27	48							Non-cohesive soil
''	29.00	29.45	0.45	U	''	slipped										-do- DS collected

Supervisor Engineer-in-C

Abbreviation used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 8: FIELD BORE LOG CHARTS (P 84)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat station	Project Code:	1901
Coordinate:	N: 3120059.551 E: 700993.573	Location/ Chainage:	93116.6870
Method of Drilling:	Percussion	Drilling Equipment: Manual + Percussion	Bore No.: P84
Casing Lowered (M):	18.00 Bentonite Used: No	Standard Sampler: Yes	Barrel Type: N/A
Ground Elevation:	R.L-193.358	Date: From 23/10/23 to 26/10/23	Water Table (M): 1.70

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
25/10/23	30.50	30.95	0.45	DP	SX	10	18	24	42							Non-cohesive soil
"	32.00	32.45	0.45	U	"	slipped										-do- DS collected
"	33.50	33.95	0.45	DP	"	12	19	23	42							Non-cohesive soil
26/10/23	35.00	35.45	0.45	U	"	slipped										-do- DS collected
"	36.50	36.95	0.45	DP	"	14	20	26	46							Non-cohesive soil
"	38.00	38.45	0.45	U	"	slipped										-do- DS collected
"	40.00	40.45	0.45	DP	"	17	24	28	52							Non-cohesive soil

Nitesh

Supervisor

Techpro Engineers Pvt. Ltd. Kanpur

SE - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 9: FIELD BORE LOG CHARTS (P 85)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date.:	28.12.2021

Project Name:	GT work for HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3130070.653	E: 700996.491	Location/ Chainage: 23142.8070		
Method of Drilling:	Percussion	Drilling Equipment:	Power winch	Bore No.:	P85
Casing Lowered (M):	3.0	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-193.345	Date: From 5/10/23 to 7/10/23		Water Table (M):	2.20

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
5/10/23	0.00	0.50	0.50	DS	6"	Received										Non-cohesive soil
"	1.00	1.45	0.45	U	"	Received										— do —
"	2.00	2.45	0.45	DP	"	1	2	2	4							— do —
"	3.00	3.45	0.45	DP	"	2	3	3	6							— do —
"	4.00	4.45	0.45	U	"	slipped										— do —
"	5.00	5.45	0.45	DP	"	3	4	7	11							— do —
"	6.00	6.45	0.45	DP	"	2	4	7	11							— do —
"	7.00	7.45	0.45	U	"	Received										— do —
"	8.00	8.45	0.45	DP	"	4	6	8	14							— do —
"	9.00	9.45	0.45	DP	"	5	7	10	17							— do —
"	10.00	10.45	0.45	U	"	Received										Cohesive soil
"	11.00	11.45	0.45	DP	"	7	13	15	28							— do —
"	12.00	12.45	0.45	DP	"	6	9	11	20							— do —
"	13.00	13.45	0.45	U	"	Received										— do —
6/10/23	14.50	14.95	0.45	DP	"	8	8	14	22							Cohesive soil with kankar
"	16.00	16.45	0.45	U	"	Received										— do —
"	17.50	17.95	0.45	DP	"	6	13	24	37							— do —
"	19.00	19.45	0.45	U	"	Received										— do —
"	20.50	20.95	0.45	DP	"	8	11	32	43							— do —
"	22.00	22.45	0.45	U	"	Received										— do —
"	23.50	23.95	0.45	DP	"	6	10	17	27							— do —
"	25.00	25.45	0.45	U	"	Received										— do —
"	26.50	26.95	0.45	DP	"	7	18	31	49							— do —
"	28.00	28.45	0.45	U	"	Received										— do —

Supervisor E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 10: FIELD BORE LOG CHARTS (P 85)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No:	R01
		Rev. Date:	28.12.2021

Project Name:	SI work for HORC Viaduct b/w Sohana Dhulawat station	Project Code:	1901
Coordinate:	N: 3162098.652 E: 705990.491	Location/ Chainage:	23142.0070
Method of Drilling:	Percussion	Drilling Equipment:	Tripod winch
Bore No.:	P85	Casing Lowered (M):	31.0
Bentonite Used:	No	Standard Sampler:	Yes
Barrel Type:	N/A	Ground Elevation:	R.L- 193.345
Date: From	6/11/23 to 7/11/23	Water Table (M):	2.20

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
6/11/23	33.50	33.95	0.45	DP	SX	18	30	36	66							—do—
"	34.00	34.45	0.45	"	"	slipped										non-cohesive soil
"	35.00	35.45	0.45	DP	"	14	27	33	60							—do—
"	34.50	34.95	0.45	CL	"	slipped										—do—
"	35.50	36.45	0.45	DP	"	15	23	36	59							—do—
7/11/23	37.00	37.45	0.45	"	"	slipped										—do—
"	38.00	38.45	0.45	DP	"	18	30	38	68							—do—
"	40.00	40.45	0.45	DP	"	18	33	40	73							—do—

Supervisor

E - In - C

Abbreviation Used: U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 11: FIELD BORE LOG CHARTS (P 86)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/008
		Date of Issue:	01.04.2018
		Rev. No.:	003
		Rev. Date:	28.12.2021

Project Name:	GTW-HORC Viaduct B/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3120104.84	E: 700987.356	Location/ Chainage: 23149.0870		
Method of Drilling:	Percussion	Drilling Equipment:	Auger/Percussion	Bore No.:	P-86
Casing Lowered (M):	10	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	RL-193.548	Date: From 25/10/22 to 26/10/22		Water Table (M):	1.20

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
25/10/22	0.0	0.50	0.50	DS	SX	Collected				–	–	–	–	–	–	Non Cohesive Soil
"	1.00	1.45	0.45	DP	"	2	3	4	7	-	-	-	-	-	-	– do –
"	2.00	2.45	0.45	U	"	Slipped				-	–	-	-	-	-	Non Cohesive Soil with Gravel
"	3.00	3.45	0.45	DP	"	2	2	4	6	-	-	–	-	–	–	– do –
"	4.00	4.45	0.45	DP	"	2	3	5	8	–	-	–	-	-	–	Non Cohesive Soil
"	5.00	5.45	0.45	U	"	Received				-	–	–	–	–	–	– do –
"	6.00	6.45	0.45	DP	"	3	5	8	13	-	–	–	–	-	–	– do –
"	7.00	7.45	0.45	DP	"	8	15	21	36	–	–	–	-	–	-	Cohesive Soil with gravel
"	8.00	8.45	0.45	U	"	Received				-	–	–	–	–	–	– do –
"	9.00	9.45	0.45	DP	"	7	13	18	31	–	-	–	–	-	–	– do –
"	10.00	10.45	0.45	DP	"	9	12	15	27	–	–	–	-	–	–	– do –
"	11.00	11.45	0.45	U	"	Received				–	-	–	-	–	–	Non Cohesive Soil
"	12.50	12.95	0.45	DP	"	8	8	15	23	–	–	–	-	–	–	– do –
"	14.00	14.45	0.45	U	"	Received				–	–	–	–	–	–	Cohesive Soil with gravel
"	15.50	15.95	0.45	DP	"	6	7	12	19	-	–	-	–	–	-	– do –
"	17.00	17.45	0.45	U	"	Received				–	-	-	-	-	–	– do –
"	18.50	18.95	0.45	DP	"	6	12	18	30	–	-	–	–	-	-	– do –
"	20.00	20.45	0.45	U	"	Slipped				–	-	-	-	-	-	– do –
26/10/22	21.50	21.95	0.45	DP	"	10	19	20	39	-	–	–	-	-	–	Cohesive Soil with gravel
"	23.00	23.45	0.45	U	"	Received				-	-	-	-	-	-	– do –
"	24.50	24.95	0.45	DP	"	13	18	26	44	–	-	-	-	-	-	– do –
"	26.00	26.45	0.45	U	"	Received				–	-	-	-	-	-	– do –
"	27.50	27.95	0.45	DP	"	11	23	26	49	-	-	-	-	-	-	Non Cohesive Soil
"	29.00	29.45	0.45	U	"	Slipped				-	-	-	-	-	-	– do –

Supervisor E - in - C

Abbreviation Used: U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 12: FIELD BORE LOG CHARTS (P 86)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	OT/ 003
Date of Issue:	01.04.2018
Rev No.:	R03
Rev. Date:	28.12.2021

Project Name:	GTPO for Viaduct Btw Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 312 9101.84	E: 700983.966	Location/ Chainage: 83169.0870		
Method of Drilling:	Percussion	Drilling Equipment:	Auger + Percussion	Bore No.:	P86
Casing Lowered (M): 18	Bentonite Used: No	Standard Sampler:	Yes	Barrel Type:	NX
Ground Elevation:	RL-193.548	Date: From 30/10/22 to 31/10/22		Water Table (M):	1.30

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C.R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
"	30.50	30.95	0.45	DP	Sx	12	22	30	52	–	–	–	–	–	–	Non Cohesive Soil
"	32.00	32.45	0.45	DP	"	15	25	26	51	–	–	–	–	–	–	- do -
"	33.50	33.95	0.45	DP	"	18	23	25	48	–	–	–	–	–	–	- do -
31/10/22	35.00	35.45	0.45	U	"	[illegible]				–	–	–	–	–	–	Cohesive Soil with gravel
"	36.50	36.95	0.45	DP	"	17	20	27	47	–	–	–	–	–	–	- do -
"	38.00	38.45	0.45	U	"	[illegible]				–	–	–	–	–	–	- do -
"	40.00	40.45	0.45	DP	"	20	24	30	54	–	–	–	–	–	–	- do -

Supervisor E - in - C

Abbreviation Used :- U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 13: FIELD BORE LOG CHARTS (P 87)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW for HORC Viaduct B/W Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3120131.106	E: 700985.969	Location/ Chainage: 23195.2870		
Method of Drilling:	Percussion	Drilling Equipment:	Automatic Percussion	Bore No.:	P-87
Casing Lowered (M):	20.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	RL-193.452	Date: From 25/10/22 to 27/10/22		Water Table (M):	1.20

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
25/10	0.00	0.50	0.50	DS	SY	Collected				-	-	-	-	-	-	Non Cohesive Soil
"	1.00	1.45	0.45	U	"	Received				-	-	-	-	-	-	- do -
"	2.00	2.45	0.45	DP	"	2	3	3	6	-	-	-	-	-	-	- do -
"	3.00	3.45	0.45	DP	"	9	2	4	6	-	-	-	-	-	-	- do -
"	4.00	4.45	0.45	U	"	Received				-	-	-	-	-	-	Non Cohesive Soil with gravel
"	5.00	5.45	0.45	DP	"	3	4	5	9	-	-	-	-	-	-	Non Cohesive Soil
"	6.00	6.45	0.45	DP	"	3	5	4	9	-	-	-	-	-	-	- do -
"	7.00	7.45	0.45	U	"	Received				-	-	-	-	-	-	- do -
"	8.00	8.45	0.45	DP	"	4	4	6	10	-	-	-	-	-	-	- do -
"	9.00	9.45	0.45	DP	"	6	12	19	31	-	-	-	-	-	-	Cohesive Soil with gravel
"	10.00	10.45	0.45	U	"	Slipped				-	-	-	-	-	-	- do -
"	11.00	11.45	0.45	DP	"	6	8	12	20	-	-	-	-	-	-	- do -
"	12.00	12.45	0.45	DP	"	8	11	15	26	-	-	-	-	-	-	do -
"	13.00	13.45	0.45	U	"	Received				-	-	-	-	-	-	do -
"	14.50	14.95	0.45	DP	"	8	15	18	33	-	-	-	-	-	-	Cohesive Soil with gravel
"	16.00	16.45	0.45	U	"	Received				-	-	-	-	-	-	- do -
"	17.50	17.95	0.45	DP	"	6	12	16	28	-	-	-	-	-	-	- do -
"	19.00	19.45	0.45	U	"	Received				-	-	-	-	-	-	Cohesive Soil with gravel
26/10/22	20.50	20.95	0.45	DP	"	8	16	22	38	-	-	-	-	-	-	- do -
"	22.00	22.45	0.45	U	"	Received				-	-	-	-	-	-	- do -
"	23.50	23.95	0.45	DP	"	12	18	15	33	-	-	-	-	-	-	- do -
"	25.00	25.45	0.45	U	"	Received				-	-	-	-	-	-	- do -
"	26.50	26.95	0.45	DP	"	8	15	22	42	-	-	-	-	-	-	Non Cohesive Soil with gravel
"	28.00	28.45	0.45	U	"	Slipped				-	-	-	-	-	-	- do -

Supervisor

E - in - C

Abbreviation Used: U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 14: FIELD BORE LOG CHARTS (P 87)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev No.:	R03
Rev. Date:	28.12.2021

Project Name:	GTW Horc viaduct Btw Sohana dhulawat station	Project Code:	1901
Coordinate: N: 3120131.106	E: 700985.969	Location/ Chainage:	57195.2870
Method of Drilling: Percussion	Drilling Equipment: Auto rig/Percussion	Bore No.:	P-87
Casing Lowered (M): 20.00 / Bentonite Used: NO	Standard Sampler: YES	Barrel Type:	N/A
Ground Elevation: R.L-193.452	Date: From 25/10/23 to 27/10/23	Water Table (M):	N/A

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
26/10/23	29.50	29.95	0.45	DP	9"	12	21	28	49	-	-	-	-	-	-	Non Cohesive Soil with gravel
"	31.00	31.45	0.45	U	"	Slipped			-	-	-	-	-	-	-	- do -
"	32.50	32.95	0.45	DP	"	15	20	25	45	-	-	-	-	-	-	- do -
"	34.00	34.45	0.45	U	"	Slipped			-	-	-	-	-	-	-	- do -
"	35.50	35.95	0.45	DP	"	16	21	27	48	-	-	-	-	-	-	- do -
27/10/23	37.00	37.45	0.45	U	"	Slipped				-	-	-	-	-	-	- do -
"	38.50	38.95	0.45	DP	"	18	24	29	53	-	-	-	-	-	-	- do -
"	40.00	40.45	0.45	DP	"	20	26	31	57	-	-	-	-	-	-	Non Cohesive Soil

Supervisor

E - in - C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 15: FIELD BORE LOG CHARTS (P 88)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date:	28.12.2021

Project Name:	GT/W-HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3120157.378	E: 700904.548	Location/ Chainage: 22911.4870		
Method of Drilling:	Percussion	Drilling Equipment: Percussion rig		Bore No.:	P88
Casing Lowered (M):	18.00	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	RL-193.536	Date: From 5/1/23	to 7/1/23	Water Table (M):	1.40

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
5/1/23	0.00	0.50	0.50	DS	SY	Collected										Non-cohesive soil
"	1.00	1.45	0.45	DP	"	1	2	3	5							-do-
"	2.00	2.45	0.45	U	"	Received										-do-
"	3.00	3.45	0.45	DP	"	1	2	5	7							-do-
"	4.00	4.45	0.45	DP	"	2	3	6	9							-do-
"	5.00	5.45	0.45	U	"	Received										Non-cohesive soil with gravel
"	6.00	6.45	0.45	DP	"	5	6	7	13							-do-
6/1/23	7.00	7.45	0.45	DP	"	1	8	9	17							-do-
"	8.00	8.45	0.45	U	"	slipped										-do- DS collected
"	9.00	9.45	0.45	DP	"	6	8	10	18							-do-
"	10.00	10.45	0.45	DP	"	7	10	11	21							-do-
"	11.00	11.45	0.45	U	"	Received										-do-
"	12.50	12.95	0.45	DP	"	8	11	13	24							-do-
"	14.00	14.45	0.45	U	"	Received										-do-
"	15.50	15.95	0.45	DP	"	5	10	16	26							-do-
"	17.00	17.45	0.45	U	"	slipped										Cohesive soil with gravel (DS collected)
"	18.50	18.95	0.45	DP	"	4	8	10	18							-do-
7/1/23	20.00	20.45	0.45	U	"	slipped										-do- (DS collected)
"	21.50	21.95	0.45	DP	"	7	10	12	22							-do-
"	23.00	23.45	0.45	U	"	slipped										-do-
"	24.50	24.95	0.45	DP	"	10	15	20	35							-do-
"	26.00	26.45	0.45	U	"	Received										-do-
"	27.50	27.95	0.45	DP	"	11	16	21	37							-do-
"	29.00	29.45	0.45	U	"	Received										Non-cohesive soil with gravel

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Supervisor

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E-in-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 16: FIELD BORE LOG CHARTS (P 88)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No:	R03
Rev. Date:	28.12.2021

Project Name:	GT-HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3120157.378	E: 700984.542	Location/ Chainage: 23311.4070		
Method of Drilling:	Percussion	Drilling Equipment: Manual		Bore No.:	P 88
Casing Lowered (M):	10M	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-193.536	Date: From 5/10/23 to 7/10/23		Water Table (M):	1.70M

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
7/10/23	32.50	32.95	0.45	DS	SX	15	20	28	48							Non-cohesive soil with gravel
"	33.00	33.45	0.45	U	"	Received										— do —
"	33.50	33.95	0.45	DS	"	16	21	29	50							— do —
"	35.00	35.45	0.45	U	"	slipped										— do — DS collected
"	36.50	36.95	0.45	DS	"	18	25	30	55							— do —
"	38.00	38.45	0.45	U	"	slipped										— do —
"	40.00	40.45	0.45	DS	"	20	29	33	62							— do —

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Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 17: FIELD BORE LOG CHARTS (P 89)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name: G/T for HORC Viaduct b/w Sohna Dhulawat station		Project Code:	1901
Coordinate: N: 3120189.668	E: 700983.655	Location/ Chainage:	23247.6870
Method of Drilling: Percussion	Drilling Equipment: Automatic Percussion	Bore No.:	P 89
Casing Lowered (M): 20.00 / Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation: RL-193.53	Date: From 25/10/23 to 27/10/23	Water Table (M):	1.90

Day / Date	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
25/10/23	0.0	0.50	0.50	DS	SX	Received										Non cohesvie soil
	1.00	1.45	0.45	U	"	Received										— do —
"	2.00	2.45	0.45	DP	"	1	2	2	4							— do —
"	3.00	3.45	0.45	DP	"	1	2	3	5							— do —
"	4.00	4.45	0.45	U	"	Received										— do —
"	5.00	5.45	0.45	DP	"	2	2	3	5							— do —
"	6.00	6.45	0.45	DP	"	2	3	4	7							Non cohesvie soil
"	7.00	7.45	0.45	U	"	Slipped										— do —
"	8.00	8.45	0.45	DP	"	3	4	5	9							— do —
"	9.00	9.45	0.45	DP	"	9	13	14	27							— do —
"	10.00	10.45	0.45	U	"	Received										— do —
"	11.00	11.45	0.45	DP	"	5	9	10	19							— do —
"	12.00	12.45	0.45	DP	"	5	9	12	21							— do —
"	13.00	13.45	0.45	U	"	Slipped										— do —
"	14.50	14.95	0.45	DP	"	7	8	11	19							Cohesvie Soil with
"	16.00	16.45	0.45	U	"	Received										Gravel Soil
26/10/23	17.50	17.95	0.45	DP	"	6	10	13	23							— do —
	19.00	19.45	0.45	U	"	Received										— do —
"	20.50	20.95	0.45	DP	"	13	19	21	40							— do —
"	22.00	22.45	0.45	U	"	Received										— do —
"	23.50	23.95	0.45	DP	"	12	19	20	39							— do —
"	25.00	25.45	0.45	U	"	Received										Non cohesvie soil
"	26.00	26.95	0.45	DP	"	12	20	22	42							— do —
"	28.00	28.45	0.45	"	"	Slipped										— do —

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Supervisor

Techpro Engineers

E - in - C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 18: FIELD BORE LOG CHARTS (P 89)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GIT for HORC viaduct b/w sohna Dhulawat station			Project Code:	1901
Coordinate:	N: 3120183.668	E: 700783.655	Location/ Chainage: 23247.687-0		
Method of Drilling:	Percussion	Drilling Equipment	Automatic Powerwinch	Bore No.:	P 89
Casing Lowered (M):	20.00 Bentonite Used: NO	Standard Sampler :	Yes	Barrel Type :	N/A
Ground Elevation:	R.L-193.53	Date: From 25/10/22 to 27/10/22		Water Table (M):	1.90

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
25/10/22	29.50	29.95	0.45	DP	SX	13	25	27	52							Cohesive soil with
"	31.00	31.45	0.45	U	"	Recovered										Gravel soil
"	32.50	32.95	0.45	DP	"	11	15	21	36							-do-
"	34.00	34.45	0.45	U	"	Slipped										-do-
"	35.50	35.95	0.45	DP	"	14	17	24	41							Non Cohesive Soil
27/10/22	37.00	37.45	0.45	U	"	Slipped										-do-
"	38.50	38.95	0.45	DP	"	17	24	29	53							-do-
"	40.00	40.45	0.45	DP	"	20	28	31	59							-do-

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 19: FIELD BORE LOG CHARTS (P 90)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GT.W for HORC Viaduct B/w Sohna Dhulawat station			Project Code:	
Coordinate:	N: 3120209.933	E: 700983.219		Location/ Chainage:	23273.8870
Method of Drilling:	Percussion	Drilling Equipment:	Automated power rig	Bore No.:	P-90
Casing Lowered (M):	23.01	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	RL-193.532	Date: From 25/10/2023	to 27/10/2023	Water Table (M):	1.60 m

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
25/10/23	0.00	0.50	0.50	D	SX	Collected				-	–	–	–	–	-	Non cohesive soil
〃	1.00	1.45	0.45	U	–	Received				-	–					cohesive soil
〃	2.00	2.45	0.45	DP	–	1	2	2	4	–	–	–	–	–	-	—do—
〃	3.00	3.45	0.45	DP	–	2	3	3	6	–	–	–	–	–	-	Non cohesive soil
〃	4.00	4.45	0.45	U	–	Received				–	–	–	-	–	-	Non cohesive soil
〃	5.00	5.45	0.45	DP	–	4	7	8	15	–	–	–	–	-	-	—do—
〃	6.00	6.45	0.45	DP	–	3	8	10	18	–	–	–	–	-	–	—do—
〃	7.00	7.45	0.45	U	–	Received				–	–	–	–	–	–	cohesive soil with gravel
〃	8.00	8.45	0.45	DP	–	3	5	7	12	–	–	–	–	–	–	—do—
〃	9.00	9.45	0.45	DP	–	4	6	9	15	–	–	–	–	–	–	—do—
〃	10.00	10.45	0.45	U	–	Received				–	–	–	–	–	–	—do—
〃	11.00	11.45	0.45	DP	–	5	7	10	17	-	–	–	–	–	–	cohesive soil
〃	12.00	12.45	0.45	DP	–	4	8	11	19	–	–	–	–	–	–	—do—
〃	13.00	13.45	0.45	U	–	Received				–	–	–	–	–	–	cohesive soil with gravel
〃	14.50	14.95	0.45	DP	–	6	8	13	21	–	–	–	–	–	–	—do—
〃	16.00	16.45	0.45	U	–	Received				–	–	–	–	–	–	—do—
〃	17.50	17.95	0.45	DP	–	8	10	15	25	–	–	–	–	–	-	—do—
〃	19.00	19.45	0.45	U	–	Received				–	–	–	–	–	–	—do—
〃	20.50	20.95	0.45	DP	–	7	13	19	32	–	–	–	–	–	–	—do—
26/10/23	22.00	22.45	0.45	U	–	Received				–	–	–	–	–	–	—do—
〃	23.50	23.95	0.45	DP	–	9	15	21	36	–	–	–	–	–	–	—do—
〃	25.00	25.45	0.45	U	–	Received				–	–	–	–	–	–	Non cohesive soil
〃	26.50	26.95	0.45	DP	–	10	18	23	41	–	–	–	–	–	–	—do—
〃	28.00	28.45	0.45	U	–	Slipped				–	–	–	–	–	–	—do—

Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 20: FIELD BORE LOG CHARTS (P 90)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date.:	28.12.2021

Project Name:	GT. LO. for HORC viaduct B/w Sohana Dhullawat station			Project Code:	1901
Coordinate:	N: 3120209.933	E: 700983.219		Location/ Chainage:	23273.8876
Method of Drilling:	Percussion	Drilling Equipment:	Autotript + Power winch	Bore No.:	P.90
Casing Lowered (M):	23.m, Bentonite Used: No	Standard Sampler :	Yes	Barrel Type :	N/A
Ground Elevation:	R.L-193.532	Date: From 23/10/2023 to 27/10/2023		Water Table (M):	1.60.m

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
26/10/23	29.50	29.95	0.45	DP	SX	15	20	35	55	–	–	–	–	–	–	Non cohesive soil
"	31.00	31.45	0.45	DP	–	17	22	37	59	–	–	–	–	–	–	cohesive soil
"	32.50	32.95	0.45	DP	–	20	27	39	66	–	–	–	–	–	–	— do —
"	34.00	34.45	0.45	U	–	Slipped				–	–	–	–	–	–	Non cohesive Soil
"	35.50	35.95	0.45	DP	–	18	25	37	62	–	–	–	–	–	–	— do —
"	37.00	37.45	0.45	U	–	Slipped				–	–	–	–	–	–	— do —
27/10/23	38.50	38.95	0.45	DP	–	15	22	31	53	–	–	–	–	–	–	— do —
"	40.00	40.45	0.45	DP	–	16	24	32	56	–	–	–	–	–	–	Non cohesive soil

Supervisor

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E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 21: FIELD BORE LOG CHARTS (P 91)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No	GT/ 003
Date of Issue	01 04 2018
Rev. No.	R03
Rev. Date	24 12 2021

Project Name:	GT work for HORC viaduct b/w Sohana Dhulawat station	Project Code:	1901
Coordinate:	N: 3106236.169 E: 710073.1531	Location/ Chainage:	23300-0270
Method of Drilling:	Percussion	Drilling Equipment:	Power winch
Bore No.:	P 91		
Casing Lowered (M):	15.00	Bentonite Used:	NO
Standard Sampler:	Yes	Barrel Type:	N/A
Ground Elevation:	RL-193.953	Date: From	7/10/23 to 9/10/23
Water Table (M):	1.80		

Day Date	Depth/RUN (m) From	Depth/RUN (m) To	Length (m)	Nature of sample	Hole Size	SPT 0-15cm	SPT 15-30cm	SPT 30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD (%)	Water Losses (%)	Color of Return Water	Description
7 to 9/10/23	0.0	0.50	0.50	DS	SX	Received										Non cohesive soil
"	1.00	1.45	0.45	U	"	Received										—do—
"	2.0	2.45	0.45	DP	"	1	2	2	4							—do—
"	3.0	3.45	0.45	DP	"	2	3	4	7							—do—
"	4.0	4.45	0.45	U	"	Received										—do—
"	5.0	5.45	0.45	DP	"	3	4	5	9							—do—
"	6.0	6.45	0.45	DP	"	4	5	6	11							—do—
"	7.0	7.45	0.45	U	"	Slipped										—do—
"	8.0	8.45	0.45	DP	"	3	6	6	12							—do—
"	9.0	9.45	0.45	DP	"	3	10	17	[illegible]							—do—
"	10.0	10.45	0.45	U	"	Received										Non cohesive soil
"	11.0	11.45	0.45	DP	"	6	9	12	21							with gravel soil
"	12.0	12.45	0.45	DP	"	5	10	14	24							—do—
"	13.0	13.45	0.45	U	"	Received										—do—
"	14.50	14.95	0.45	DP	"	5	9	10	19							—do—
"	16.0	16.45	0.45	U	"	Received										Cohesive soil with
"	17.0	17.45	0.45	DP	"	8	23	33	32							Gravel soil
"	19.0	19.45	0.45	U	"	Received										Non cohesive
"	20.5	20.95	0.45	DP	"	6	25	40	65							with gravel soil
"	22.0	22.45	0.45	U	"	Received										—do—
"	23.5	23.95	0.45	DP	"	9	23	43	68							—do—
"	25.0	25.45	0.45	U	"	Slipped										—do—
"	26.50	26.95	0.45	DP	"	7	[illegible]	26	40							—do—
"	28.0	28.45	0.45	U	"	Received										—do—

Supervisor

E-in-C

Abbreviation Used: U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 22: FIELD BORE LOG CHARTS (P 91)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No	GT/ 003
Date of Issue	01.04.2018
Rev. No	R03
Rev. Date:	28.12.2021

Project Name:	Soil investigation for HORC viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3120236.169	E: 700983.152	Location/ Chainage: 23300.527 C	Bore No.:	P91
Method of Drilling:	Percussion	Drilling Equipment:	Power winch	Barrel Type:	N/A
Casing Lowered (M):	22.00	Bentonite Used: NO	Standard Sampler: Yes	Water Table (M):	1.80
Ground Elevation:	RL-193.953	Date: From 11/10/22 to 11/10/22			

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
5/10/22	[illegible]	31.45	0.45	DP	SX	6	11	29	40							Non cohesive soil with
"	31.0	31.45	0.45	U	"	Slipped										gravel soil
"	32.5	32.95	0.45	DP	"	10	18	24	42							Cohesive soil with
"	34.0	34.45	0.45	U	"	Slipped										gravel soil
"	35.5	35.95	0.45	DP	"	12	19	26	45							—do—
6/10/22	37.0	37.45	0.45	U	"	Slipped										—do—
"	38.5	38.95	0.45	DP	"	16	26	30	56							Non cohesive soil
"	40.0	40.45	0.45	DP	"	20	28	33	61							—do—

Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 23: FIELD BORE LOG CHARTS (P 92)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/003
Date of Issue:	01.04.2018
Rev. No:	R03
Rev. Date:	28.12.2021

Project Name: GT-HORC Viaduct b/w Sohana Dhulawat station
Project Code: 1901
Coordinate: N: 3130262.393 E: 700983.302
Location/ Chainage: 23326.3670
Method of Drilling: Percussion
Drilling Equipment: Powerwinch
Bore No.: P92
Casing Lowered (M): 22.00
Bentonite Used: NO
Standard Sampler: Yes
Barrel Type: N/A
Ground Elevation: RL-193.93
Date: From 9/10/23 to 11/10/23
Water Table (M): 1.90

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
9/10/23	0.00	0.50	0.50	DS	SX	Received										Non-cohesive soil
"	1.00	1.45	0.45	DP(U)	"	slipped										-do-
"	2.00	2.45	0.45	DP	"	1	1	2	3							-do-
"	3.00	3.45	0.45	DP	"	2	2	3	5							-do-
"	4.00	4.45	0.45	U	"	Received										-do-
"	5.00	5.45	0.45	DP	"	2	3	5	8							-do-
"	6.00	6.45	0.45	DP	"	2	4	7	11							-do-
"	7.00	7.45	0.45	U	"	Received										Non-cohesive soil with gravel
"	8.00	8.45	0.45	DP	"	5	6	11	17							-do-
"	9.00	9.45	0.45	DP	"	6	6	12	18							-do-
"	10.00	10.45	0.45	U	"	Received										-do-
"	11.00	11.45	0.45	DP	"	4	8	8	16							-do-
"	12.00	12.45	0.45	DP	"	3	4	4	8							cohesive soil with gravel
"	13.00	13.45	0.45	U	"	Received										-do-
"	14.50	14.95	0.45	DP	"	5	5	7	12							-do-
"	16.00	16.45	0.45	U	"	Received										-do-
"	17.50	17.95	0.45	DP	"	6	10	15	25							-do-
"	19.00	19.45	0.45	U	"	Received										Non-cohesive soil with gravel
"	20.50	20.95	0.45	DP	"	7	12	18	30							-do-
"	22.00	22.45	0.45	U	"	Received										-do-
11/10/23	23.50	23.95	0.45	DP	"	8	21	27	48							cohesive soil with gravel
"	25.00	25.45	0.45	U	"	Received										-do-
"	26.50	26.95	0.45	DP	"	9	19	29	48							-do-
"	28.00	28.45	0.45	U	"	slipped										-do-

Supervisor

E - in - C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 24: FIELD BORE LOG CHARTS (P 92)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue	01.04.2018
Rev. No.	R03
Rev. Date	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3180262.393	E: 700983.302	Location/ Chainage: 93326.3070		
Method of Drilling:	Percussion	Drilling Equipment:	Power winch	Bore No.:	P92
Casing Lowered (M):	22.00	Bentonite Used: No	Standard Sampler: Yes	Barrel Type :	N/A
Ground Elevation:	RL-193.97	Date: From 9/10/23	to 11/10/23	Water Table (M):	1.90

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
10/10/23	29.50	29.95	0.45	DP	5"	6	12	27	39							—do—
"	31.00	31.45	0.45	U	"	slipped										Non-cohesive soil
"	32.50	32.95	0.45	DP	"	19	26	28	54							—do—
"	34.00	34.45	0.45	U	"	slipped										—do—
"	35.50	35.95	0.45	DP	"	19	19	29	48							Cohesive soil with Gravel
11/10/23	37.00	37.45	0.45	U	"	slipped										—do—
"	38.50	38.95	0.45	DP	"	17	20	30	50							Non-cohesive soil
"	40.00	40.45	0.45	DP	"	17	28	36	64							—do—
"																

Supervisor

E-in-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

Techpro Engineers Pvt. Ltd.

APPENDIX-K
CHART 25: FIELD BORE LOG CHARTS (P 93)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No	GT/ 003
Date of Issue	01.04.2018
Rev. No	R03
Rev. Date	28.12.2021

Project Name: Geo-tech for Horc viaduct Btwl. Sohana Dhulawat Station		Project Code:	1901
Coordinate: N: 3120200.593	E: 700967.617	Location/ Chainage:	23557.4870
Method of Drilling: Percussion	Drilling Equipment: Auger/Percussion rig	Bore No.:	P-93
Casing Lowered (M): 25 / Bentonite Used: NO	Standard Sampler: yes	Barrel Type:	NA
Ground Elevation: R.L-193.956	Date: From 26/10/23 to 29/10/23	Water Table (M):	1.40

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
26/10/23	0.00	0.50	0.50	DS	SX	Collected	-			-	-	-	-	-	-	Non Cohesive Soil
"	1.00	1.45	0.45	U	"	Received	-			-	-	-	-	-	-	do
"	2.00	2.45	0.45	DP	"	2	3	3	6	-	-	-	-	-	-	do
"	3.00	3.45	0.45	DP	"	2	2	3	5	-	-	-	-	-	-	do
"	4.00	4.45	0.45	U	"	Received				-	-	-	-	-	-	do
27/10/23	5.00	5.45	0.45	DP	"	4	6	8	14	-	-	-	-	-	-	do
"	6.00	6.45	0.45	DP	"	3	5	7	12	-	-	-	-	-	-	do
"	7.00	7.45	0.45	U	"	Slipped	-			-	-	-	-	-	-	do
"	8.00	8.45	0.45	DP	"	8	11	15	26	-	-	-	-	-	-	Cohesive Soil
"	9.00	9.45	0.45	DP	"	4	7	12	19	-	-	-	-	-	-	do
"	10.00	10.45	0.45	U	"	Received				-	-	-	-	-	-	do
"	11.00	11.45	0.45	DP	"	7	6	12	18	-	-	-	-	-	-	do
"	12.00	12.45	0.45	DP	"	4	6	16	16	-	-	-	-	-	-	do
"	13.00	13.45	0.45	U	"	Received				-	-	-	-	-	-	do
"	14.50	14.95	0.45	DP	"	9	12	17	29	-	-	-	-	-	-	Non Cohesive Soil
"	16.00	16.45	0.45	U	"	Received				-	-	-	-	-	-	do with gravel
"	17.50	17.95	0.45	DP	"	8	12	17	29	-	-	-	-	-	-	do
"	19.00	19.45	0.45	U	"	Received				-	-	-	-	-	-	do
"	20.50	20.95	0.45	DP	"	8	14	18	32	-	-	-	-	-	-	do
"	22.00	22.45	0.45	U	"	Received				-	-	-	-	-	-	do
"	23.50	23.95	0.45	DP	"	10	20	25	45	-	-	-	-	-	-	do
28/10/23	25.00	25.45	0.45	U	"	Slipped	-			-	-	-	-	-	-	do
"	26.50	26.95	0.45	DP	"	14	26	28	54	-	-	-	-	-	-	do
"	28.00	28.45	0.45	DP	"	16	30	33	63	-	-	-	-	-	-	do

Supervisor — E-in-C

Abbreviation Used :U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 26: FIELD BORE LOG CHARTS (P 93)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 001
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GTW For Horc viaduct B/W Sohana Dhulawat Stn			Project Code:	1901
Coordinate:	N: 3120288.593	E: 700983.613		Location/ Chainage:	23352.4870
Method of Drilling:	Percussion	Drilling Equipment	Auto Trip + Bucket winch	Bore No.:	P.93
Casing Lowered (M):	20	Bentonite Used: No	Standard Sampler : Yes	Barrel Type :	NA
Ground Elevation:	R.L-193.956	Date: From 26/10/23	to 29/10/23	Water Table (M):	1.40

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
28/10/23	29.50	29.95	0.45	DP	SK	15	29	30	59	–	–	–	–	–	–	Non Cohesive Soil with gravel
"	31.00	31.45	0.45	DP	"	16	26	29	55	–	–	–	–	–	–	– do –
"	32.50	32.95	0.45	DP	"	17	28	31	59	–	–	–	–	–	–	– do –
"	34.00	34.45	0.45	DP	"	15	30	40	70	–	–	–	–	–	–	– do –
"	35.50	35.95	0.45	DP	"	18	33	45	78	–	–	–	–	–	–	– do –
"	37.00	37.45	0.45	DP	"	20	30	39	69	–	–	–	–	–	–	– do –
29/10/23	38.50	38.95	0.45	DP	"	21	23	37	60	–	–	–	–	–	–	– do –
"	40.00	40.45	0.45	DP	"	25	30	40	70	–	–	–	–	–	–	– do –

Supervisor | E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 27: FIELD BORE LOG CHARTS (P 94)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	Civil work for HORC Viaduct B/w Sohana & Dhulawat Station			Project Code:	1901
Coordinate:	N: 3120319.820	E: 700983.967	Location/ Chainage: 23378-68770		
Method of Drilling:	Percussion	Drilling Equipment:	Power winch	Bore No.: ~~P-93~~	P-94
Casing Lowered (M):	20.m / Bentonite Used: No	Standard Sampler:	Yes	Barrel Type:	N/A
Ground Elevation:	RL-193.999	Date: From 7/10/2023 to 9/10/2023		Water Table (M):	1.60 m

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
7/10/23	0.00	0.50	0.5	DS	SX	Collected				—	—	—	—	—	—	Cohesive Soil
''	1.00	1.45	0.45	DP	"	1	1	1	2	—	—	—	—	—	—	Non cohesive soil
''	2.50	2.95	0.45	U	—	Received				—	—	—	—	—	—	— do —
''	3.00	3.45	0.45	DP	—	1	1	2	3	—	—	—	—	—	—	— do —
''	4.00	4.45	0.45	DP	—	2	2	4	6	—	—	—	—	—	—	— do —
''	5.00	5.45	0.45	U	—	Received				—	—	—	—	—	—	Cohesive soil
''	6.00	6.45	0.45	DP	—	2	3	5	8	—	—	—	—	—	—	Non cohesive soil
8/10/23	7.00	7.45	0.45	DP	—	3	3	6	9	—	—	—	—	—	—	— do —
''	8.00	8.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
''	9.00	9.45	0.45	DP	—	4	5	9	14	—	—	—	—	—	—	Cohesive soil with gravels
''	10.00	10.45	0.45	DP	—	5	7	10	17	—	—	—	—	—	—	— do —
''	11.00	11.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do — DS collected
''	12.50	12.95	0.45	DP	—	3	8	11	19	—	—	—	—	—	—	— do —
''	14.00	14.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
''	15.50	15.95	0.45	DP	—	5	11	15	26	—	—	—	—	—	—	— do —
''	17.00	17.45	0.45	U	—	Received				—	—	—	—	—	—	Cohesive Soil
''	18.50	18.95	0.45	DP	—	7	10	12	22	—	—	—	—	—	—	— do —
''	20.00	20.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
''	21.50	21.95	0.45	DP	—	7	11	14	25	—	—	—	—	—	—	— do —
''	23.00	23.45	0.45	U	—	Received										Cohesive soil with gravels
''	24.50	24.95	0.45	DP	-	10	13	18	31							— do —
''	26.00	26.45	0.45	U	-	Received										Non cohesive soil
''	27.50	27.95	0.45	DP	-	12	14	23	30							— do —
9/10/23	29.00	29.45	0.45	U		Received										— do —

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 28: FIELD BORE LOG CHARTS (P 94)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/001
		Date of Issue:	01.04.2018
		Rev. No:	R03
		Rev. Date:	28.12.2021

Project Name:	Intercity HORC viaduct B/w Sohana & Dhulawat station	Project Code:	1901
Coordinate:	N: 3120314.825 E: 700983.967	Location/ Chainage:	23378-6870
Method of Drilling:	Percussion	Drilling Equipment:	Power winch
Bore No.:	P-94		
Casing Lowered (M):	20.50	Bentonite Used:	No
Standard Sampler:	Yes	Barrel Type:	N/A
Ground Elevation:	RL-193.935	Date: From	7/12/2023 to 9/10/2023
Water Table (M):	1.60 m		

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
7/12/23	30.50	30.95	0.45	DP	SX	13	19	25	44	—	—	—	—	—	—	Non cohesive Soil
"	32.00	32.45	0.45	U	—	Sampler collected				—	—	—	—	—	—	— do —
"	33.50	33.95	0.45	DP	—	16	24	33	57	—	—	—	—	—	—	Cohesive soil with kankars
"	35.00	35.45	0.45	U	—	Sampler collected				—	—	—	—	—	—	— do —
"	36.50	36.95	0.45	DP	—	21	28	39	67	—	—	—	—	—	—	— do —
"	38.00	38.45	0.45	U	—	Sampler collected				—	—	—	—	—	—	Non cohesive Soil
"	40.00	40.95	0.45	DP	—	24	33	46	79	—	—	—	—	—	—	Cohesive soil with kankars

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 29: FIELD BORE LOG CHARTS (P 95)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/003
		Date of Issue:	01.04.2018
		Rev. No.:	003
		Rev. Date.:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N:3120341.027	E:700984.323	Location/ Chainage: 23404.8870		
Method of Drilling:	Percussion	Drilling Equipment:	Manual Powerwinch	Boro No.:	P95
Casing Lowered (M):	18.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-193.925	Date: From 27/10/23	to 29/10/23	Water Table (M):	1.20

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
27/10/23	0.00	0.50	0.50	DS	SX	collected										Non-cohesive soil
〃	1.00	1.45	0.45	DP	〃	1	2	2	4							—do—
〃	2.00	2.45	0.45	U	〃	Received										—do—
〃	3.00	3.45	0.45	DP	〃	2	3	4	7							—do—
〃	4.00	4.45	0.45	DP	〃	3	3	4	7							—do—
〃	5.00	5.45	0.45	U	〃	Received										—do—
〃	6.00	6.45	0.45	DP	〃	4	7	9	16							—do—
〃	7.00	7.45	0.45	DP	〃	4	5	6	11							Non-cohesive soil with gravel
〃	8.00	8.45	0.45	U	〃	Received										—do—
〃	9.00	9.45	0.45	DP	〃	8	10	14	24							Non-cohesive soil
〃	10.00	10.45	0.45	DP	〃	9	12	16	28							—do—
〃	11.00	11.45	0.45	U	〃	Received										—do—
〃	12.50	12.95	0.45	DP	〃	5	6	9	15							—do—
〃	14.00	14.45	0.45	U	〃	Received										Cohesive soil with gravel
〃	15.50	15.95	0.45	DP	〃	7	11	14	25							—do—
〃	17.00	17.45	0.45	U	〃	slipped										—do—
〃	18.50	18.95	0.45	DP	〃	8	15	20	35							—do—
28/10/23	20.00	20.45	0.45	U	〃	Received										—do—
〃	21.50	21.95	0.45	DP	〃	14	20	26	46							Non-cohesive soil
〃	23.00	23.45	0.45	U	〃	slipped										-do- DS collected
〃	24.50	24.95	0.45	DP	〃	16	21	27	48							Non-cohesive soil
〃	26.00	26.45	0.45	U	〃	slipped										-do- DS collected
〃	27.50	27.95	0.45	DP	〃	17	20	25	45							Non-cohesive soil
〃	29.00	29.45	0.45	U	〃	Received										—do—

Nitesh
Supervisor

E-In-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 30: FIELD BORE LOG CHARTS (P 95)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No.	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3120341.027	E: 700984.323	Location/ Chainage: 23404.0870		
Method of Drilling:	Percussion	Drilling Equipment:	Manual Power winch	Bore No.:	P 95
Casing Lowered (M):	18.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-193.924	Date: From 27/10/23 to 29/10/23		Water Table (M):	1.20

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
28/10/23	30.50	30.95	0.45	DP	SX	14	23	29	52							Non-cohesive soil with gravel
〃	32.00	32.45	0.45	DP	〃	13	30	37	67							— do —
〃	33.50	33.95	0.45	DP	〃	15	31	36	67							Non-cohesive soil
〃	35.00	35.45	0.45	DP	〃	13	29	35	64							— do —
〃	36.50	36.95	0.45	DP	〃	12	25	33	58							— do —
29/10/23	38.00	38.45	0.45	DP	〃	12	26	30	56							— do —
〃	40.00	40.45	0.45	DP	〃	14	26	32	58							— do —

Nitesh
Supervisor

E-in-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 31: FIELD BORE LOG CHARTS (P 96)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1906
Coordinate:	N: 3120367.185	E: 700984.677	Location/ Chainage: 23431.0870		
Method of Drilling:	Percussion	Drilling Equipment:	Automatic Power winch	Bore No.:	P 96
Casing Lowered (M):	9.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-193.961	Date: From 22/10/23 to 30/10/23		Water Table (M):	1.20

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
22/10/23	0.0	0.50	0.50	DS	SX	Received										Non cohesive soil
	1.00	1.45	0.45	DP	"	1	1	2	3							— do —
"	2.00	2.45	0.45	U	"	Received										— do —
"	3.00	3.45	0.45	DP	"	2	2	3	5							— do —
"	4.00	4.45	0.45	DP	"	1	1	3	4							— do —
"	5.00	5.45	0.45	U	"	Slipped										Non cohesive soil
"	6.00	6.45	0.45	DP	"	3	4	6	10							— do
"	7.00	7.45	0.45	DP	"	3	4	7	11							— do —
"	8.00	8.45	0.45	U	"	Slipped										— do —
"	9.00	9.45	0.45	DP	"	4	6	8	14							— do —
"	10.0	10.45	0.45	DP	"	5	7	9	16							— do —
"	11.00	11.45	0.45	U	"	Received										Non cohesive soil
"	12.50	12.95	0.45	DP	"	5	8	10	18							with Gravel soil
"	14.00	14.45	0.45	U	"	Received										— do —
"	15.50	15.95	0.45	DP	"	6	10	14	24							— do —
"	17.00	17.45	0.45	U	"	Received										— do —
"	18.50	18.95	0.45	DP	"	10	17	22	39							— do —
"	20.00	20.45	0.45	U	"	Slipped										— do —
"	21.50	21.95	0.45	DP	"	12	19	24	43							cohesive soil with
29/10/23	23.00	23.45	0.45	U	"	Received										Gravel soil
	24.50	24.95	0.45	DP	"	14	21	24	45							— do —
"	26.00	26.45	0.45	U	"	Slipped										— do —
"	27.50	27.95	0.45	DP	"	12	24	28	52							— do —
"	29.00	29.45	0.45	U	"	Slipped										— do —

Supervisor — E-in-C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 32: FIELD BORE LOG CHARTS (P 96)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc Nr	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW- HORC viaduct b/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3120367.185	E: 700984.677	Location/ Chainage: 22,431.0870		
Method of Drilling:	Percussion	Drilling Equipment	Automatic Powerwinch	Bore No.:	P96
Casing Lowered (M):	91.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	RL-193.961	Date: From 28/10/23 to 30/10/23		Water Table (M):	1.20

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
29/10/23	30.50	30.95	0.45	DP	SX	14	25	30	55							Non cohesive soil
"	32.00	32.45	0.45	DP	"	16	26	33	59							— do —
"	33.50	33.95	0.45	DP	"	15	21	29	50							— do —
"	35.00	35.45	0.45	U	"	Slipped										Non cohesive soil
30/10/23	36.50	36.95	0.45	DP	"	17	24	29	53							with gravel soil
"	38.00	38.45	0.45	DP	"	19	30	32	62							— do —
"	40.00	40.45	0.45	DP	"	22	33	36	69							— do —

Supervisor

E-in-C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 33: FIELD BORE LOG CHARTS (P 97)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No	GT/003
Date of Issue	01.04.2018
Rev No:	R01
Rev. Date:	28.12.2021

Project Name:	GTPL-HORC Viaduct b/w Sohana Dhulawat station
Project Code:	1701
Coordinate:	N: 3120393.383 E: 700905.033
Location/ Chainage:	23457.2870
Method of Drilling:	Percussion
Drilling Equipment:	Powerwinch
Bore No.:	P97
Casing Lowered (M):	19m
Bentonite Used:	No
Standard Sampler:	Yes
Barrel Type:	N/A
Ground Elevation:	RL-194.016
Date: From	8/11/23 to 10/11/23
Water Table (M):	1.90

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
8/11/23	0.00	0.50	0.50	DS	SX	collected										Non-cohesive soil
"	1.00	1.45	0.45	U	"	slipped										-do- D.S collected
"	2.00	2.45	0.45	DP	"	1	1	2	3							Non-cohesive soil
"	3.00	3.45	0.45	DP	"	2	3	4	7							Non-cohesive soil with gravel
"	4.00	4.45	0.45	U	"	Received										-do-
"	5.00	5.45	0.45	DP	"	3	4	6	10							-do-
"	6.00	6.45	0.45	DP	"	3	5	7	12							-do-
"	7.00	7.45	0.45	U	"	Received										-do-
"	8.00	8.45	0.45	DP	"	4	6	8	14							-do-
"	9.00	9.45	0.45	DP	"	5	9	14	23							-do-
"	10.00	10.45	0.45	U	"	Received										-do-
"	11.00	11.45	0.45	DP	"	3	5	6	11							-do-
"	12.00	12.45	0.45	DP	"	5	6	8	14							-do-
"	13.00	13.45	0.45	U	"	Received										-do-
9/11/23	14.50	14.95	0.45	DP	"	6	8	9	17							-do-
"	16.00	16.45	0.45	U	"	Received										Cohesive soil with gravel
"	17.50	17.95	0.45	DP	"	7	9	11	20							-do-
"	19.00	19.45	0.45	U	"	slipped										-do- D.S
"	20.50	20.95	0.45	DP	"	3	10	15	25							Cohesive soil with gravel
"	22.00	22.45	0.45	U	"	slipped										-do- D.S collected
"	23.50	23.95	0.45	DP	"	8	16	27	43							-do-
"	25.00	25.45	0.45	U	"	slipped										-do- D.S collected
10/11/23	26.50	26.95	0.45	DP	"	7	14	25	39							-do-
"	28.00	28.45	0.45	U	"	slipped										-do- D.S collected

Nilesh
Supervisor

Techpro Engineers Pvt. Ltd.

C.E.-In-C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 34: FIELD BORE LOG CHARTS (P 97)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No.	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.	R03
		Rev. Date:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3120393.283	E: 700085.033	Location/ Chainage: 33457.3870		
Method of Drilling:	Percussion	Drilling Equipment:	Power Winch	Bore No.:	P97
Casing Lowered (M):	19.17, Bentonite Used: N/O	Standard Sampler:	Yes	Barrel Type:	N/A
Ground Elevation:	R.L-194.016	Date: From 8/10/23	to 10/10/23	Water Table (M):	1.80

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C.R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
10/10/23	29.50	29.95	0.45	DP	SX	15	37	40	77							Non-cohesive soil
"	31.00	31.45	0.45	U	"	Received										— do —
"	32.50	32.95	0.45	DP	"	18	33	39	72							— do —
"	34.00	34.45	0.45	U	"	slipped										— do - DS collected
"	35.50	35.95	0.45	DP	"	15	35	38	73							— do —
"	37.00	37.45	0.45	U	"	Received										— do —
"	38.50	38.95	0.45	DP	"	17	34	37	71							— do —
"	40.00	40.45	0.45	DP	"	20	32	39	71							— do —

Supervisor

Techpro Engineers Pvt. Ltd.

Engineer

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 35: FIELD BORE LOG CHARTS (P 98)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	S.I. for HORC Viaduct B/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3120419, 581	E: 700985,388	Location/ Chainage: 23483.4870		
Method of Drilling:	Percussion	Drilling Equipment:	Automatic/ Power winch	Bore No.:	P-98
Casing Lowered (M):	21.m, Bentonite Used: No	Standard Sampler:	Yes	Barrel Type:	N/A
Ground Elevation:	R.L-193.03	Date: From 28\10\2023 to 30/10/23		Water Table (M):	9-05

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
28/10/23	0.00	0.50	0.54	D	SX	Collected				—	—	—	—	—	—	Noncohesive soil
"	1.00	1.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	2.00	2.45	0.45	DP	—	1	1	2	3	—	—	—	—	—	—	Noncohesive soil with gravel
"	3.00	3.45	0.45	DP	—	1	2	2	4	—	—	—	—	—	—	— do —
"	4.00	4.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	5.00	5.45	0.45	DP	—	2	3	3	6	—	—	—	—	—	—	Non cohesive soil
"	6.00	6.45	0.45	DP	—	2	3	5	8	—	—	—	—	—	—	— do —
"	7.00	7.45	0.45	U	—	Received				—	—	—	—	—	—	cohesive soil with gravel
"	8.00	8.45	0.45	DP	—	4	5	7	12	—	—	—	—	—	—	— do —
"	9.00	9.45	0.45	DP	—	3	6	9	15	—	—	—	—	—	—	— do —
"	10.00	10.45	0.45	U	—	Received				—	—	—	—	—	—	cohesive soil
"	11.00	11.45	0.45	DP	—	5	8	10	18	—	—	—	—	—	—	— do —
"	12.00	12.45	0.45	DP	—	6	9	12	21	—	—	—	—	—	—	cohesive soil
"	13.00	13.45	0.45	U	—	Received				—	—	—	—	—	—	cohesive soil with gravel
"	14.50	14.95	0.45	DP	—	6	10	15	25	—	—	—	—	—	—	— do —
"	16.00	16.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	17.50	17.95	0.45	DP	—	5	9	12	21	—	—	—	—	—	—	— do —
"	19.00	19.45	0.45	U	—	Received				—	—	—	—	—	—	(Noncohesive) cohesive soil gravel
"	20.50	20.95	0.45	DP	—	8	13	17	30	—	—	—	—	—	—	cohesive soil
"	22.00	22.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do —
"	23.50	23.95	0.45	DP	—	10	16	21	37	—	—	—	—	—	—	— do —
"	25.00	25.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
30/10/23	26.00	26.45	0.45	DP	—	11	18	24	42	—	—	—	—	—	—	— do —
"	28.00	28.45	0.45	U	—	Received				—	—	—	—	—	—	Noncohesive soil

Supervisor

Techpro Engineers Pvt. Ltd.

E-in-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 36: FIELD BORE LOG CHARTS (P 98)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/003
Date of Issue	01.04.2018
Rev No.:	R03
Rev Date	28.12.2021

Project Name: Gtwo for HORC Viaduct B/w Sohana Dhulawat station | Project Code: 1901

Coordinate: N: 3120419.581 | E: 70098 5.388 | Location/ Chainage: 23483.4870

Method of Drilling: Percussion | Drilling Equipment: Auto lift + Power winch | Bore No.: P-98

Casing Lowered (M): 21.M | Bentonite Used: No | Standard Sampler: Yes | Barrel Type: N/A

Ground Elevation: R.L- 193.03 | Date: From 28/11/2023 to 30/11/23 | Water Table (M): 21.05

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
29/11/23	29.50	29.95	0.45	DP	SX	14	23	31	54	–	–	–	–	–	–	Non cohesive Soil
"	31.00	31.45	0.45	DP	–	16	25	33	58	–	–	–	–	–	–	– do –
"	32.50	32.95	0.45	DP	–	15	28	34	62	–	–	–	–	–	–	– do –
"	34.00	34.45	0.45	U	–	slipped				–	–	–	–	–	–	Non cohesive Soil
"	35.50	35.95	0.45	DP	–	13	26	32	58	–	–	–	–	–	–	– do –
30/11/23	37.00	37.45	0.45	U	–	slipped				–	–	–	–	–	–	– do –
"	38.50	38.95	0.45	DP	–	15	27	33	60	–	–	–	–	–	–	– do –
"	40.00	40.45	0.45	DP	–	15	29	33	62	–	–	–	–	–	–	Non cohesive Soil

Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 37: FIELD BORE LOG CHARTS (P 99)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No.	GT/003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GT For HORC Viaduct Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3150145.778	E: 700385.444	Location/ Chainage: 33509.000		
Method of Drilling:	Percussion	Drilling Equipment:	Percussion Winch	Bore No.:	P99
Casing Lowered (M):	12.00	Bentonite Used: NA	Standard Sampler: SPS	Barrel Type:	NA
Ground Elevation:	RL-193.231	Date: From 9/10/23 to 12/10/23		Water Table (M):	15.50m

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C.R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
9-10-23	0.00	0.50	0.50	D	9"	Collected				–	–	–	–	–	–	Non Cohesive Soil
"	1.00	1.45	0.45	U	"	Received				–	–	–	–	–	–	– do –
"	2.00	2.45	0.45	DP	"	2	2	3	5		–	–	–	–	–	Cohesive Soil
10-10-23	3.00	3.45	0.45	DP	"	3	5	8	13		–	–	–	–	–	– do –
"	4.00	4.45	0.45	U	"	Received				–	–	–	–	–	–	Non Cohesive Soil
"	5.00	5.45	0.45	DP	"	6	8	9	17		–	–	–	–	–	– do –
"	6.00	6.45	0.45	DP	"	5	9	12	21		–	–	–	–	–	– do –
"	7.00	7.45	0.45	U	"	Slipped				–	–	–	–	–	–	– do –
"	8.00	8.45	0.45	DP	"	7	10	15	25		–	–	–	–	–	Cohesive Soil
"	9.00	9.45	0.45	DP	"	9	13	18	31		–	–	–	–	–	– do –
"	10.00	10.45	0.45	U	"	Slipped				–	–	–	–	–	–	– do –
"	11.00	11.45	0.45	DP	"	5	9	11	20		–	–	–	–	–	– do –
"	12.00	12.45	0.45	DP	"	3	5	6	11		–	–	–	–	–	– do –
"	13.00	13.45	0.45	U	"	Received				–	–	–	–	–	–	Cohesive Soil with gravel
"	14.50	14.95	0.45	DP	"	6	8	12	20		–	–	–	–	–	– do –
"	16.00	16.45	0.45	U	"	Received				–	–	–	–	–	–	– do –
"	17.50	17.95	0.45	DP	"	3	8	10	18		–	–	–	–	–	Non Cohesive Soil
"	19.00	19.45	0.45	U	"	Received				–	–	–	–	–	–	– do –
"	20.50	20.95	0.45	DP	"	4	7	12	19		–	–	–	–	–	– do –
11-10-23	22.00	22.45	0.45	U	"	Received				–	–	–	–	–	–	Cohesive Soil with gravel
"	23.50	23.95	0.45	DP	"	7	12	18	30	–	–	–	–	–	–	
"	25.00	25.45	0.45	U	"	Slipped				–	–	–	–	–	–	– do –
12-10-23	26.50	26.95	0.45	DP	"	14	20	28	48	–	–	–	–	–	–	– do –
"	28.00	28.45	0.45	U	"	Received				–	–	–	–	–	–	– do –

Supervisor

E - in - C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K

CHART 38: FIELD BORE LOG CHARTS (P 99)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	003
Rev. Date	28.12.2021

Project Name: Girder HORC Viaduct Sohana Dhulawat station
Project Code: 1901

Coordinate: N: 3120045.338 E: 300985.399
Location/ Chainage: 23509.6870

Method of Drilling: Percussion
Drilling Equipment: Manual Winch
Bore No.: P 99

Casing Lowered (M): 9.00
Bentonite Used: NO
Standard Sampler: YES
Barrel Type: NA

Ground Elevation: R.L - 193.371
Date: From 9/10/2025 to 15/10/2025
Water Table (M): 1.50m

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
15/10/25	29.50	29.95	0.45	DP	SX	14	17	22	39	–	–	–	–	–	–	Non Cohesive Soil
"	31.00	31.45	0.45	U	"	Slipped			–	–	–	–	–	–	–	With Gravel
"	32.50	32.95	0.45	DP	"	16	19	24	43	–	–	–	–	–	–	– do –
"	34.00	34.45	0.45	U	"	Slipped			–	–	–	–	–	–	–	– do –
"	35.50	35.95	0.45	DP	"	20	26	30	56	–	–	–	–	–	–	– do –
"	37.00	37.45	0.45	U	"	Slipped			–	–	–	–	–	–	–	– do –
"	38.50	38.95	0.45	DP	"	21	26	32	58	–	–	–	–	–	–	– do –
"	40.00	40.45	0.45	DP	"	18	30	34	64	–	–	–	–	–	–	– do –

Supervisor   E - In - C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample, D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 39: FIELD BORE LOG CHARTS (P 100)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GTW FOR HORC Viaduct B/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3120471.976	E: 700986.099	Location/ Chainage: 23535.8870		
Method of Drilling:	Percussion	Drilling Equipment:	Autobrik Power winch	Bore No.:	P-100
Casing Lowered (M):	24.0M	Bentonite Used: NA	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L – 193.596	Date: From 28/10/23 to 30/10/23		Water Table (M):	1.30

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
28/10/23	0.00	0.50	0.50	D	SX	collected				-	-	-	-	-	-	Non Cohesive soil
"	1.00	1.45	0.45	U	"	Received				-	-	-	-	-	-	do
"	2.00	2.45	0.45	DP	"	1	2	2	4	-	-	-	-	-	-	do
"	3.00	3.45	0.45	DP	"	2	3	3	6	-	-	-	-	-	-	do
"	4.00	4.45	0.45	UDS	"	slipped				-	-	-	-	-	-	do
"	5.00	5.45	0.45	DP	"	2	3	5	8	-	-	-	-	-	-	Non cohesive soil
"	6.00	6.45	0.45	DP	"	5	7	9	16	-	-	-	-	-	-	do
"	7.00	7.45	0.45	U	"	slipped				-	-	-	-	-	-	do
"	8.00	8.45	0.45	DP	"	6	7	13	20	-	-	-	-	-	-	do
"	9.00	9.45	0.45	DP	"	8	10	13	23	-	-	-	-	-	-	do
"	10.00	10.45	0.45	U	"	Received				-	-	-	-	-	-	Cohesive soil
"	11.00	11.45	0.45	DP	"	7	11	13	24	-	-	-	-	-	-	do
"	12.00	12.45	0.45	DP	"	8	13	18	31	-	-	-	-	-	-	do
"	13.00	13.45	0.45	UD	"	slipped				-	-	-	-	-	-	do
"	14.50	14.95	0.45	DP	"	5	8	10	18	-	-	-	-	-	-	Non cohesive soil
"	16.00	16.45	0.45	U	"	Received				-	-	-	-	-	-	do
"	17.50	17.95	0.45	DP	"	12	20	27	47	-	-	-	-	-	-	Non cohesive soil with Gravel
"	19.00	19.45	0.45	U	"	Received				-	-	-	-	-	-	do
"	20.50	20.95	0.45	DP	"	7	15	22	37	-	-	-	-	-	-	do
"	22.00	22.45	0.45	U	"	Received				-	-	-	-	-	-	do
29/10/23	23.50	23.95	0.45	DP	"	7	12	18	30	-	-	-	-	-	-	do
"	25.00	25.45	0.45	U	"	Received				-	-	-	-	-	-	Non Cohesive soil
"	26.50	26.95	0.45	DP	"	8	15	23	38	-	-	-	-	-	-	do
"	28.00	28.45	0.45	UD	"	slipped				-	-	-	-	-	-	do

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 40: FIELD BORE LOG CHARTS (P 100)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GTW FOR HORC Viaduct B/w Sohana Dhulawat station	Project Code:	1901
Coordinate:	N: 3120471.976 E: 700986.699	Location/ Chainage:	23535.8870
Method of Drilling:	Percussion; Drilling Equipment: Auger & Manually	Bore No.:	P-100
Casing Lowered (M):	24.2 M; Bentonite Used: NA; Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	RL-193.996; Date: From 29/10/23 to 30/10/23	Water Table (M):	1.30

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
29-10-23	29.50	29.95	0.45	DP	SX	18	21	23	44	—	—	—	—	—	—	Non cohesive soil.
	31.00	31.45	0.45	U/D	"	slipped				—	—	—	—	—	—	do
	32.50	32.95	0.45	DP	"	15	30	24	54	—	—	—	—	—	—	Non cohesive soil with Gravel
	34.00	34.45	0.45	U	"	14	24	26	50	—	—	—	—	—	—	do
30-10-23	35.50	35.95	0.45	DP	"	12	13	16	29	—	—	—	—		—	do
	37.00	37.45	0.45	UP	"	slipped -				—	—	—	—	—	—	— do —
	38.50	38.95	0.45	DP	"	18	24	23	47	—	—	—	—	—	—	— do —
	40.00	40.45	0.45	DP	"	15	28	30	58	—	—	—	—	—	—	— do —

Supervisor: [illegible]   E-in-C

Abbreviation Used :- U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

End of Report

Report No: 1901-HORC-VI

Report No.: 1901-HORC-VI

Date: Nov 30th; 2023

GEOTECHNICAL INVESTIGATION REPORT

ULR No.: TC916923000000032P
REVISION-R2

AT THE SITE FOR

HORC VIADUCT BETWEEN SOHANA & DHULAWAT STATIONS OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT, HARYANA

FROM BOREHOLES P101 TO P113

CLIENT

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.

Plot No. 143, 5th floor RailTel tower, Sector-44,
Gurugram, Haryana 122003

GENERAL CONSULTANTS

RITES-SMEC JV

Gurugram, Haryana

GEOTECHNICAL CONSULTANTS

TECHPRO ENGINEERS PVT. LTD.

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G T ROAD, KANPUR-209 217, Phone: 9793209918

e-mail: info@techproindia.com

TC-9169

REVISION NOTES

REVISION NO.	DATE	DESCRIPTION
R1	09.12.2023	• Vertical and Lateral pile load capacity in Table 1 to 4 of Appendix-H and recommendations revised. • Field bore log charts added in Appendix-K.
R2	12.12.2023	• Lithological profile added in Appendix-C.

REPORT FORMAT

Report No.	Bore included	Total Number of Bores
1901-HORC-I	A1 to P20	21
1901-HORC-II	P21 to P40	20
1901-HORC-III	P41 to P60	20
1901-HORC-IV	P61 to P80	20
1901-HORC-V	P81 to P100	20
1901-HORC-VI	P101 to P113	13
1901-HORC-VII	P114A to P133A	20
1901-HORC-VIII	P134A to A2A	16
1901-HORC-IX	P114B to P133B	20
1901-HORC-X	P134B to A2B	16

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APPENDICES

National Accreditation Board for
Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

TECHPRO ENGINEERS PVT. LTD. (LABORATORY DIVISION)

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G.T. ROAD, KANPUR, UTTAR PRADESH, INDIA

in the field of

TESTING

Certificate Number: TC-9169

Issue Date: 23/12/2022 Valid Until: 22/12/2024

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Identity : Techpro Engineers Private Limited

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

TECHPRO ENGINEERS PVT. LTD.
114, Ram Ganga Housing Society, Naramau, G T Road, Kanpur-209 217
Tel.: 9793209918, e-mail: info@techproindia.com
Web site: www.techproindia.com

Nov 30th; 2023

ACKNOWLEDGEMENTS

We are pleased to submit the part-6 of the report of Geotechnical investigation, conducted for the boreholes P101 to P113 for the design of foundations for HORC Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) project in the state of Haryana, India.

We hereby, convey our sincere thanks to Mr. Neeraj Bhandari (CPM/South) and Mr. Raju Solanki (DGM/C/South), HRIDCL for trust and support during the investigation. We also acknowledge our thanks to Mr. Uma Maheshwara Rao B, DGM/C/West, HRIDCL for awarding the said work to us. We are also grateful Mr. Ravindra Dutta Upadhyay (Geotech Expert), Mr. PS Gautam & Mr. Jitender Parashar, Site Engineer from the RITES- SMEC JV and Mohd. Ishak (Executive/Civil) from HRIDCL, for their help rendered during and prior to the investigation work.

We are also thankful to our staff members for conducting field and laboratory test, preparing sketches, and typing the report.

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech. (Civil), M.Tech.
Principal Consultant &
Managing Director

1. INTRODUCTION:

Haryana Rail Infrastructure Development Corporation Ltd. (HRIDC) and Ministry of Railways, Govt. of India has come together to form a new company namely Haryana Orbital Rail Corporation Limited (HORCL), to design and construction of new BG line from Palwal to Sonipat named Haryana Orbital Rail Corridor (HORC), in the state of Haryana, India. In this connection, a Geotechnical investigation has been planned for the design of foundations of Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) Project in the state of Haryana. The work of conducting the detailed Geotechnical Investigation has been awarded to us by HRIDC, through work order No. HRIDC/HORC/GTI/211/2023-2024/Vol-0 dated 02-09-2023, which includes investigation in field, laboratory testing of disturbed and undisturbed samples, collected from the field, and submission of the geotechnical **investigation** test report.

A geotechnical investigation was carried out, with the locations, planned by the client. Purpose of the investigation is to determine the nature and properties of soil and rock strata across the bore holes and representing them through log sections showing the levels, nature, and properties of various strata up to a sufficient depth below the founding level, proneness of site to artesian conditions, seismic disturbance and other engineering properties of soil and rock strata.

This part -6 of the report includes the detailed methodology of investigation, collection of samples, field and laboratory test result including their interpretation/ analysis, recommendations on the properties of soils and rock required for design of foundation and suggesting suitable type and depth of foundation with allowable bearing capacity for safe and strong foundations for the Bore Hole numbers P101 to P113.

2. SCOPE OF WORK:

For the design of foundation of viaduct, it is required to determine the allowable bearing capacity together with necessary engineering characteristics of underlying soil & rock strata. In general, the geotechnical investigation has been planned as per IS:1892-2021 and further extended to IS: 1904, IS:2911 (part-1/Sec 2) & IRC 78:2014 for planning the laboratory testing and computing the allowable bearing capacity, hence the scope of work is as follows:

2.1. Mobilisation of all tools & plants along with accessories, materials, labours etc. at site of work for drilling and testing work, including setting up boring and shifting to different bore holes point etc.

2.2. Exploratory drilling of 150 mm diameter bore holes through soil deposits and 75 mm in rock within the proposed alignment upto the required depth.

2.3. Collection of disturbed soil samples at an interval of 3.00 meter in all the bore holes.

2.4. Collection of undisturbed soil samples at every 3.00 m interval or at change of stratum from all the boreholes.

2.5. To conduct Standard Penetration Test (SPT) at an interval of 3.00 m or noticeable change of stratum in soil deposits in all bore holes.

2.6. Collection of rock core samples and preserving them in core boxes.

2.7. To collect ground water sample on completion of bore holes.

2.8. To record the ground water table in all the bore holes.

2.9. Transporting all the disturbed, undisturbed soil and rock core samples collected during the field investigation to our NABL accredited Geotech Engineering laboratory at Kanpur.

2.10. To conduct the laboratory tests on all the soil and rock core samples collected during field investigation for determination of their engineering characteristics.

2.11. To compile of field and laboratory test results, working out the allowable bearing capacity and preparing the report including detailed recommendations and necessary precautions.

3. GEOLOGICAL INFORMATION OF THE REGION:

3.1. Geography:

The project location is in the bordering area of Gurugram and Nuh (recent old name-Mewat), districts in the Indian state of Haryana. The stretch of the alignment of the proposed corridor starts from southmost part of Gurugram in the town of Sohna and ends at Dhulawat, which is a village lying at the north of Nuh district.

Haryana is a state located in the northern part of India. Gurugram is among one

of the districts in Haryana which is also the part of National Capital Region (30km south of New Delhi). It lies at an elevation of 217 m above msl. Sohna is a small town located 25km in the south of Gurugram. Sohna is well known for its hot water springs and famous Shiva temple. Sohna is located in between 28°15’ N latitude and 77°40' E longitude at the elevation of 212.14m above msl. Mewat district is located at 28 °12′ N latitude, 77 °3′ E longitude, at the south of Gurugram at an elevation of 199 m above msl. The location is bordered by Rewari district on west and Faridabad & Palwal district on the east.

3.2. Geology:

The Gurugram district is having of almost flat topography, however, in the north-eastern part small isolated hillocks of Precambrian rocks are exposed. Small hill ranges which are part of the Aravali and Mangar Bani ranges exists in the district. The major part of district is underlain by Quaternary alluvium consisting of sand, clay and silt. The alluvial plain is formed by the Sahibi river which is a tributary of River Yamuna. Soils of the Gurgaon district is classified as tropical and brown soils, existing in the north western extreme, northern and north eastern parts of the district and water logged and salt affected soils in the southern parts of the district. The soils are medium textured loamy sand is the average texture in Gurgaon and Sohna blocks.

3.3. Rainfall and Climate:

The area has hot semi-arid type of climate characterising extreme dryness of the air except in the monsoon season. Intense hot summer and cold winters. The total annual rainfall in the region is about 596 mm, of which 75 to 80% is because of the south-west monsoon.

3.4. Seismicity:

The site under consideration exists in the district of Gurugram and Mewat which lies in the Seismic Zone IV (high damage risk zone), as per the current seismic zonation map of India (IS 1893-2016): RA 2021 and have a zone factor of 0.24 for design basis earthquake. The region is surrounded by many in-homogeneities in the form of faults and ridges like Sohna Fault, Moradabad Fault, Delhi-Moradabad Fault, Delhi-Haridwar ridge, junction of Aravalli and Alluvium near Delhi. The Sohna fault line lies between the Delhi ridge and Sohna town and falls between the Arjangarh and

Manesar outcrops. All the developed area in Gurugram comes within 200 km of the fault line. The Sohna fault line is located at the junction between the hard rock terrain of the Aravalli hills and the sandy formation of the Yamuna River and is currently inactive from several years and is capable of a disastrous earthquake.

The project location has been marked in Fig.1 Seismic zone map of India.

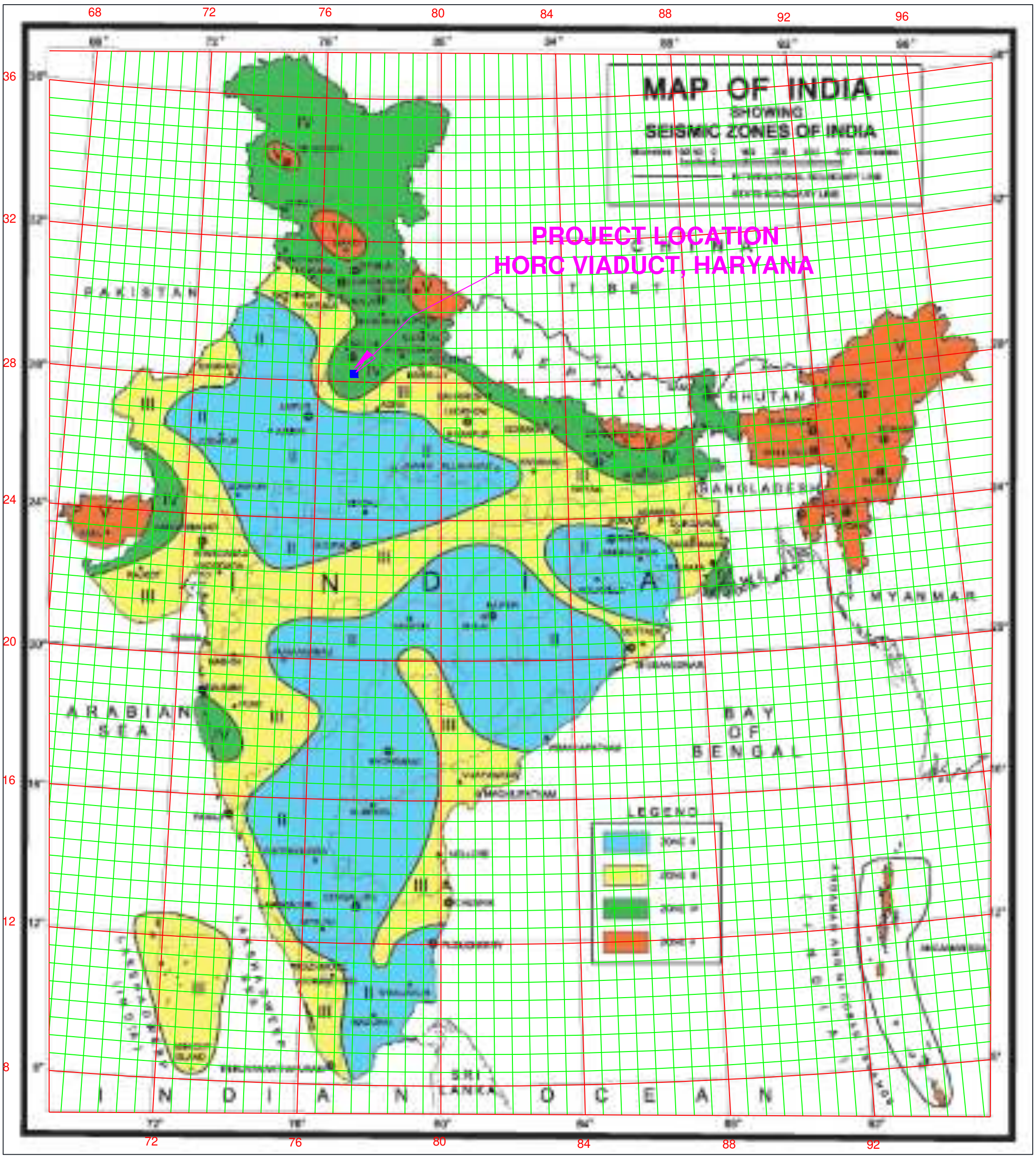


Fig.1: Seismic Zone Map of India

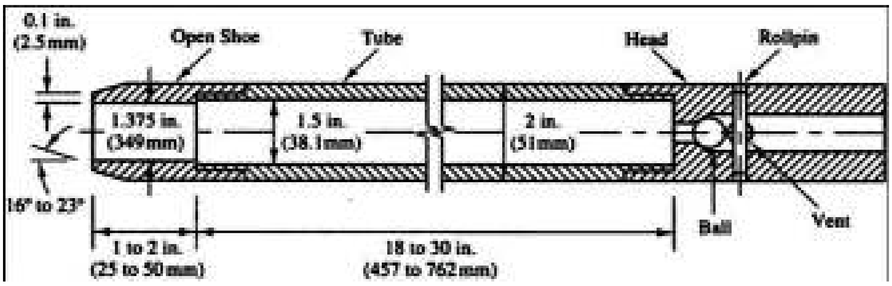
4. FIELD INVESTIGATION:

The field investigation work at this site was carried out from Oct 11th; 2023 to Nov 2nd; 2023. The following investigation work was carried out:

4.1. Seven number of **boreholes** (marked as P101, P102, P103, P104, P105, P106, P111) of diameter 150 mm in soil were made within the proposed alignment for conducting Standard Penetration Test and collection of disturbed and undisturbed samples. The boreholes were progressed using power operated winch and hydraulic rig machine under percussion and rotary method of drilling respectively. Casing was used to keep the borehole stable. The records of achieved depth of bore holes have been given in Para No. 6, the details of drilled bores along with depth of casing used have been reported in Appendix B. Locations of boreholes have been reported in “TEST LOCATION PLAN” in Appendix A.

4.2. Standard Penetration Tests were conducted at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth, as per the procedure in IS: 2131-1981-(RA: 2021) in all the bore holes. The **standard SPT sampler** (without liner and with no space for liner) and **auto-trip & rope-pulley driven hammer** of standard weight of 63.50 kg have been used to perform the test.

For conducting the test, the bottom of the borehole was properly cleaned, and split spoon sampler was properly seated in position in the borehole. The split spoon sampler resting on the bottom of borehole was allowed to sink under its own weight; then the sampler was allowed to penetrate 15 cm with the blows of the hammer 63.50 kg weight falling free through 75cm, thereafter the split spoon sampler was further driven by another 15 cm. For the 3rd and final drive, the sampler was further allowed to penetrate 15 cm. The number of blows required to get each 15 cm of penetration, was recorded. The first 15 cm of drive is seating drive.



Structure of SPT Sampler

The total blows of penetration for the second and third 15 cm of penetration is termed the penetration resistance N. The N’ values are indicative of the compactness/ relative density of cohesion less soils and consistency of cohesive soils.

In case the blows count of SPT in soil (including the number of blows of seating) exceeds 100, the corresponding penetration was recorded and this particular test at that depth stopped. If the total penetration is more than the seating penetration of 15 cm, then breakup of blow counts for 15 cm seating penetration and for remaining portion of penetration is also given.

SPT 'N' values are correlated with non-cohesive stratum as per BS: 5930 (1999) – for sandy strata and with consistency of cohesive stratum.

Correlation For Clay/Plastic Silt		Correlation For Sand/Non-Plastic Silt	
Consistency of clays	**Penetration Value**	**Relative Density of sand**	**Penetration Value**
Very Soft	0 to 2 Blows	Very loose	0 to 4 Blows
Soft	3 to 4 Blows	Loose	5 to 10 Blows
Medium Stiff	5 to 8 Blows	Medium	11 to 30 Blows
Stiff	9 to 16 Blows	Dense	31 to 50 Blows
Very Stiff	17 to 32 Blows	Very Dense	Above 50
Hard	Above 32		

In this method, the sampler acts as a probe and the driving energy is supplied by the fall of the drop weight. The values of 'N' depend on the compactness or relative density of the material. In hard formations, the testing is discontinued if 'N' value is found to be more than 100. It is termed as 'Refusal'. Refusal is also recorded when SPT blow count records 50 or more for any of the single drive of 15 cm.

'N' value depends upon degree of saturation and over burden pressure of the formation. Silty fine sand and fine sand below the water table develop pore water pressure depending on the in-situ void ratio which in turn affects the effective stress. This change in effective stress influences the 'N' value considerably.

Depth of overburden affects the SPT values in none to low cohesive soils and hence need correction. The SPT value after the overburden correction, N' is as follows:

$$N' = 0.77x \log (2000/q) \times N$$

Where, q= Overburden Pressure (kN/m^2) and N = observed SPT value

N' is corrected further for dilatancy in case of saturated fine sands and silts for the values of N' greater than 15.

Modified value after dilatancy correction N" = 15+ (N'-15)/2

Soil samples obtained from split spoon sampler were collected in the polythene bags of suitable size. These samples were property sealed, labelled, and carefully transported to the laboratory for testing. The results have been reported in Table 1 to 7 of Appendix B under the title "SUMMARY OF TEST RESULTS".

4.3. **Disturbed soil samples** were collected at 0.50 metre, then at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth and at significant change of stratum. Soil from cutting edge of SPT samplers and retained in split spoon, used for Standard Penetration Tests was taken as disturbed samples. These samples were placed without delay in adequately sealed polythene bags. Where the collection of disturbed soil samples could not be collected from SPT samples, Shelby tubes were driven and retained soil samples were obtained. The laboratory tests were conducted on the collected soil samples and reported in Table 1 to 7 of Appendix-B under the title "SUMMARY OF TEST RESULTS".

4.4. **Undisturbed soil samples** were collected in accordance with IS: 2132-1986-(RA: 2021) at an interval of 3.00 metre or at change of stratum, starting from the depth of 1.00 or 2.00 m, by using 100 mm dia. and 450 mm long MS tubes provided with sampler head with ball check arrangement. However, the some of the samples could not be extracted due to the partial penetration or slippage during the evacuation.

Moreover, collection of Undisturbed samples in very hard cohesive soils/ dense granular soils/gravels/ cobbles/ pebbles/ boulders, refusal strata is practically not possible and such collected samples will not truly represent the undisturbed conditions.

Immediately after taking undisturbed sample in the tube, the adopter head was removed along with the disturbed material. The visible ends of the samples shall then be trimmed off any wet disturbed soil. The ends will then be coated alternately with four layers of molten wax. More molten wax will then be added to give a total thickness of not less than 25 mm. The laboratory test results have been reported in Table 1 to 7 of Appendix-B.

4.5. The **ground water table** in the borehole was allowed to stabilize and measured after 8, 16, 24 and 48 hours after completion of the bore hole. It was ensured that last two reading were identical. The records of ground water table have been given in Para No.6.

4.6. **Ground water samples** were collected from borehole as per IS: 6935-1973-(RA:2019) for chemical analysis to determine aggressiveness in relation to attack on concrete / reinforcement including determination of pH value.

5. LABORATORY TESTS:

The following laboratory tests were conducted to determine the engineering characteristics of sub-soils:

5.1. **Field moisture contents** were determined by oven drying method as per IS: 2720 (part II)-1973-(RA: 2020). The results have been reported in Table 1 to 7: "SUMMARY OF TEST RESULTS" of Appendix B.

5.2. **Bulk density** of soil strata was obtained using Shelby tubes in accordance with IS 2720 (part XXIX)-1975-(RA: 2020). The results have been reported in Table 1 to 7: "SUMMARY OF TEST RESULTS" of Appendix B.

5.3. **Mechanical sieve analysis** test was performed in accordance with IS: 2720 (Part IV) – 1985-(RA: 2020), for the purpose of identification by grain size analysis, on coarse part of the soil samples and the results have been reported in Table 1 to 7: "SUMMARY OF TEST RESULTS" of Appendix B.

5.4. **Particle size analysis** test by **Hydrometer method** were performed in accordance with IS: 2720 (Part IV) -1985-(RA: 2020) on the part of soil samples obtained after the sieve analysis. The results have been reported in Table 1 to 7: "SUMMARY OF TEST RESULTS" of Appendix B.

5.5. **Atterbergs' limits tests** were performed in accordance with IS: 2720 (part V)-1985-(RA: 2020) and results have been reported in Table 1 to 7: "SUMMARY OF TEST RESULTS" of Appendix B.

5.6. **Specific gravity tests** were performed in accordance with IS 2720 (part III-sec. 1) -1980-(RA: 2021) and the results have been reported in Table 1 to 7: "SUMMARY OF TEST RESULTS" of Appendix B.

5.7. Consolidation tests were performed on cohesive soil samples in accordance with IS: 2720 (part XV)-1965-(RA: 2021). The results have been reported in Table 1 to 7: "SUMMARY OF TEST RESULTS" of Appendix B.

5.8. Direct shear tests were performed as per IS: 2720 (part XIII)-1986-(RA: 2021), on the undisturbed soil samples obtained during the field investigation. The results and the density of samples have been reported in Table 1 to 7: "SUMMARY OF TEST RESULTS" of Appendix B.

5.9. Tri-axial Compression Test under Unconsolidated Un-drained (UU) condition as per IS: 2720 (Part-XI)-1993-(RA: 2021) were performed on the selected undisturbed soil samples, obtained during the field investigation. The results have been reported in Table 1 to 7: "SUMMARY OF TEST RESULTS" of Appendix B.

5.10. Unconfined Compressive strength tests were performed in accordance with IS 2720 (Part-X) -1991-(RA:2020) on selected undisturbed soil samples and the results have been reported in Table 8 of Appendix B.

5.11. Shrinkage Limit tests were performed in accordance with IS 2720 (part-VI) -1972-(RA: 2021) and the results have been reported in Table 1 to 7: "SUMMARY OF TEST RESULTS" of Appendix B.

5.12. Free Swell Index were performed in accordance with IS 2720 (part-XL) -1977-(RA: 2021) and the results have been reported in Table 1 to 7: "SUMMARY OF TEST RESULTS" of Appendix B.

6. GROUND WATER TABLE:

The water table at this site was encountered during the drilling operation up to the depth of investigation.

Borehole No.	Chainage	Global Co-ordinates (UTM format)		Reduced Level (m)	Depth of Borehole (m)	Water table (m)
		Easting	Northing			
P101	23562.087	700986.455	3120498.173	193.949	40.00	1.30
P102	23588.287	700986.810	3120524.371	194.023	40.00	1.00
P103	23614.487	700987.165	3120550.568	194.050	40.00	0.50
P104	23640.687	700987.521	3120576.766	194.067	40.00	1.20

Borehole No.	Chainage	Global Co-ordinates (UTM format)		Reduced Level (m)	Depth of Borehole (m)	Water table (m)
		Easting	Northing			
P105	23666.887	700987.876	3120602.953	193.916	40.00	1.30
P106	23693.087	700988.231	3120629.123	194.696	40.00	0.60
P111	23830.447	700989.842	3120766.590	194.745	40.00	1.30

7. DESCRIPTION OF STRATA:

The classification of soil stratum has been done with the help of soil characteristics obtained in laboratory tests as per IS 1498-1970-(RA:2021). The classification of rock masses has been done based on RMR as per IS: 4464-1985, IS: 13365-1. The detailed nature of the strata has been reported in Table 1 to 7: "SUMMARY OF TEST RESULTS" of Appendix-B and represented through Lithological plots in Appendix-C.

The strata exhibited in all the bore hole, is predominantly comprising of inorganic silty clays of low plasticity and inorganic silts of non to low plastic category. Silty sands and silty sands containing clay binders were also encountered at variable depths and thickness. Inorganic silty clays of intermediate plastic category was found as exception in borehole P101 at the depth of 22.00 to 25.00 meters and in borehole P105 at the depth of 12.00 to 13.00 meters.

8. SAFE BEARING CAPACITY COMPUTATIONS:

For the construction of viaducts, deep foundation **(Bored Cast-In-Situ RCC piles)** have been considered for computation of load bearing capacity of the underlying soil strata. The computation of load bearing capacity of bored cast-in-situ RCC piles have been done as per IS 2911 (part-1, section-2)-2010-(RA: 2020) with due consideration of effects of liquefaction.

8.1. Design Parameters:

Factor of safety in compression = 2.50

Factor of safety in tension = 3.00

Depth of critical water table = 0.00 m

Diameter of pile = 1.00 & 1.20 m

Cut off length	=	2.50 m
Type of pile head consider	=	Fixed

8.2. Computation of friction along pile stem:

$Q_{uf} = \sum K_i.P_{di}.\tan\delta_i.A_{si}$

where,

Q_{uf}	=	Ultimate shaft friction (kN/m^2)
K_i	=	Coefficient of earth pressure at mid-depth of ith layer
P_{di}	=	Effective overburden pressure at mid-depth of ith layer (kN/m^2)
A_{si}	=	Surface area of pile stem in ith layer (m^2)
δ_i	=	Angle of wall friction between pile and soil of ith layer (= ϕ) (degree)
ϕ_i	=	Angle of internal friction of soil in ith layer (degree)
$\sum$	=	Sum of all layers up to ith layer

8.3. Computation of Cohesion along the stem of pile:

$Q_{uc} = \sum \alpha_i.c_i.A_{si}$

Where,

c_i	=	Cohesion in ith layer
A_{si}	=	Surface area of pile stem in ith layer (m^2)
α_i	=	Adhesion factor for ith layer of soil depending of consistency of soils
$\sum$	=	Sum of cohesion of all layers considered

8.4. Computation of end bearing resistance:

$Q_{ub} = A_p\,(c.N_c + q.N_q + 0.5.\gamma.B.N_\gamma)$

Where,

A_p	=	Area of the pile toe (m^2)
c	=	cohesion of soils at pile toe (kN/m^2)
γ	=	Effective Unit weight of soils at pile toe (kN/m^3)
B	=	Diameter of pile (m)

q = Effective overburden pressure at pile toe (kN/m^2)

N_c = Bearing Capacity Factor (Recommended equal to 9)

N_q, N_γ = Bearing Capacity Factor

8.5. Lateral load capacity of piles in soils:

$$Q_u = 12.E.I.\delta/(L_1+L_f)^3$$

where,

Q_u = Ultimate lateral load capacity of pile (kN)

δ = Permissible deflection (m) = 5 mm

E = Young Modulus of pile material (kN/m^2)

I = Moment of Inertia of the pile cross section (m^4)

L_1 = Cantilever Length of pile (m)

L_f = Length of fixity (m)

Detailed calculations of pile load carrying capacity in compression & uplift in soil have been reported in **Table-1 to 2** of **Appendix-H.**

Pile lateral Load capacity has been given in **Table-3 to 4** of **Appendix-H**.

9. LIQUEFACTION ANALYSIS:

Liquefaction is the sudden loss of shear strength of the loose fine sands due to earthquake-induced vibration under saturated conditions. Liquefaction generally takes place in loose fine sands (fines < 10 %, D_{60}= 0.20 mm to 1.0 mm and C_u between 2 to 5) with N value less than 15. In case of soil strata having N>15, liquefaction of soil will not take place normally.

The present site falls in **seismic zone – IV.** Considering the history of past earthquakes and available seismic data, an earthquake of **magnitude 7.0** having peak ground acceleration **a_{max}= 0.24 g** is considered in the present analysis.

Preliminary assessment of liquefaction potential of foundation strata is made by simplified approach proposed by IS: 1893 (part-1)-2016-(RA: 2021) from the data obtained in Standard Penetration Test.

In this method, cyclic shear stress likely to be induced in the foundation strata by Design Basis Earthquake is first evaluated. Next threshold cyclic shear stress, which is good enough to cause liquefaction, is determined from SPT data and the empirical relations. Finally, comparison of these two stresses is used in the estimation of liquefaction susceptibility of the foundation strata.

Cyclic Stress Ratio (CSR):

The equivalent average of shear stress likely to be induced in the foundation material due to an earthquake is calculated by using the equations

Cyclic Resistance Ratio (CRR):

It expresses capacity of soil to resist liquefaction. CRR is determined using correlation between corrected blow count $(N_1)_{60}$ and CRR for earthquake of magnitude 7.5. $(N_1)_{60}$ is the SPT blow count corrected to an effective overburden pressure of 100 kPa and to hammer energy efficiency of 60 %.

Following variable have been adopted in calculation of N_{60} (SPT value for 60% efficiency)

Energy correction to SPT values:

C_{60} = 1.00 (energy efficiency factor)

Design Earthquake Base:

Earthquake zone = IV

Magnitude of earthquake = 7

Seismic Zone factor = 0.24

Status of Liquefaction:

The value of CSR and CRR are computed at different depth and then the ratio of CRR to CSR to get the factor of safety towards the susceptibility of the stratum towards liquefaction potential.

If factor of safety:

$<$ 1.00 : Stratum is to be considered as liquefiable

$>$ 1.20 : Non-Liquefiable

The detailed calculations of liquefaction, have been reported in **Table-5** of **Appendix-H.**

10. RECOMMENDATIONS:

Keeping in mind, the field test results, laboratory test results and IS codes of practice the following recommendations are hereby made:

10.1. **Bored Cast-In-Situ RCC Piles** of diameter 1000 and 1200 mm have been adopted for SBC computations of foundation for Viaduct.

10.2. **Cut off length** of piles have been considered as 2.50 m from the existing ground level for the purpose of computation of SBC.

10.3. **Pile length** recommended in the table below, shall be measured **after the cut-off depth.**

10.4. **Allowable load carrying capacity** of pile corresponding to the length and diameter of pile shall be read from the tables below:

10.4.1. For Pile diameter = 1000 mm

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P101	25.00	2900	1750	85
	27.50	2900	1950	
	30.00	2750	2150	
	32.50	3000	2400	
	35.00	4000	2600	
P102	25.00	2500	1600	40
	27.50	2700	1800	
	30.00	3100	2000	
	32.50	3800	2250	
	35.00	4050	2500	
P103	25.00	3200	1800	110
	27.50	3500	2100	
	30.00	3300	2350	
	32.50	3300	2600	
	35.00	3650	2850	
P104	25.00	3000	1850	75
	27.50	3750	2050	
	30.00	4200	2300	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	32.50	4400	2550	
	35.00	4350	2800	
P105	25.00	2150	1150	15
	27.50	2650	1350	
	30.00	2050	1600	
	32.50	2600	1800	
	35.00	3150	2000	
P106	25.00	2750	1850	85
	27.50	2650	2000	
	30.00	2850	2250	
	32.50	3050	2450	
	35.00	3300	2650	
P111	25.00	3650	2050	140
	27.50	4000	2300	
	30.00	4300	2550	
	32.50	4700	2850	
	35.00	5050	3100	

** Indicates Grade of Concrete*

10.4.2. For Pile diameter = 1200 mm

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P101	25.00	4250	2350	130
	27.50	4250	2650	
	30.00	3850	2950	
	32.50	4150	3250	
	35.00	5850	3600	
P102	25.00	3950	2200	65
	27.50	4150	2500	
	30.00	4900	2800	
	32.50	6100	3200	
	35.00	6500	3600	
P103	25.00	5000	2450	155
	27.50	5500	2850	

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
	30.00	4900	3200	
	32.50	4600	3550	
	35.00	5150	3900	
P104	25.00	4400	2450	115
	27.50	5600	2800	
	30.00	6350	3150	
	32.50	6600	3550	
	35.00	6450	3950	
P105	25.00	3200	1500	25
	27.50	3950	1800	
	30.00	2750	2100	
	32.50	3700	2400	
	35.00	4550	2650	
P106	25.00	3950	2500	130
	27.50	3700	2750	
	30.00	3900	3050	
	32.50	4200	3350	
	35.00	4550	3600	
P111	25.00	5500	2700	215
	27.50	5950	3100	
	30.00	6400	3500	
	32.50	7050	3900	
	35.00	7550	4300	

** Indicates Grade of Concrete*

10.5. Liquefaction Potential: All the bore holes have been analysed for Liquefaction potential as per IS: 1893 (part-1)-2016-(RA: 2021) with Seismic Zone IV, earthquake intensity of 7.0 on Richter scale and critical ground water table at existing ground level. Out of which several boreholes show the potential at various depths mentioned in the table below:

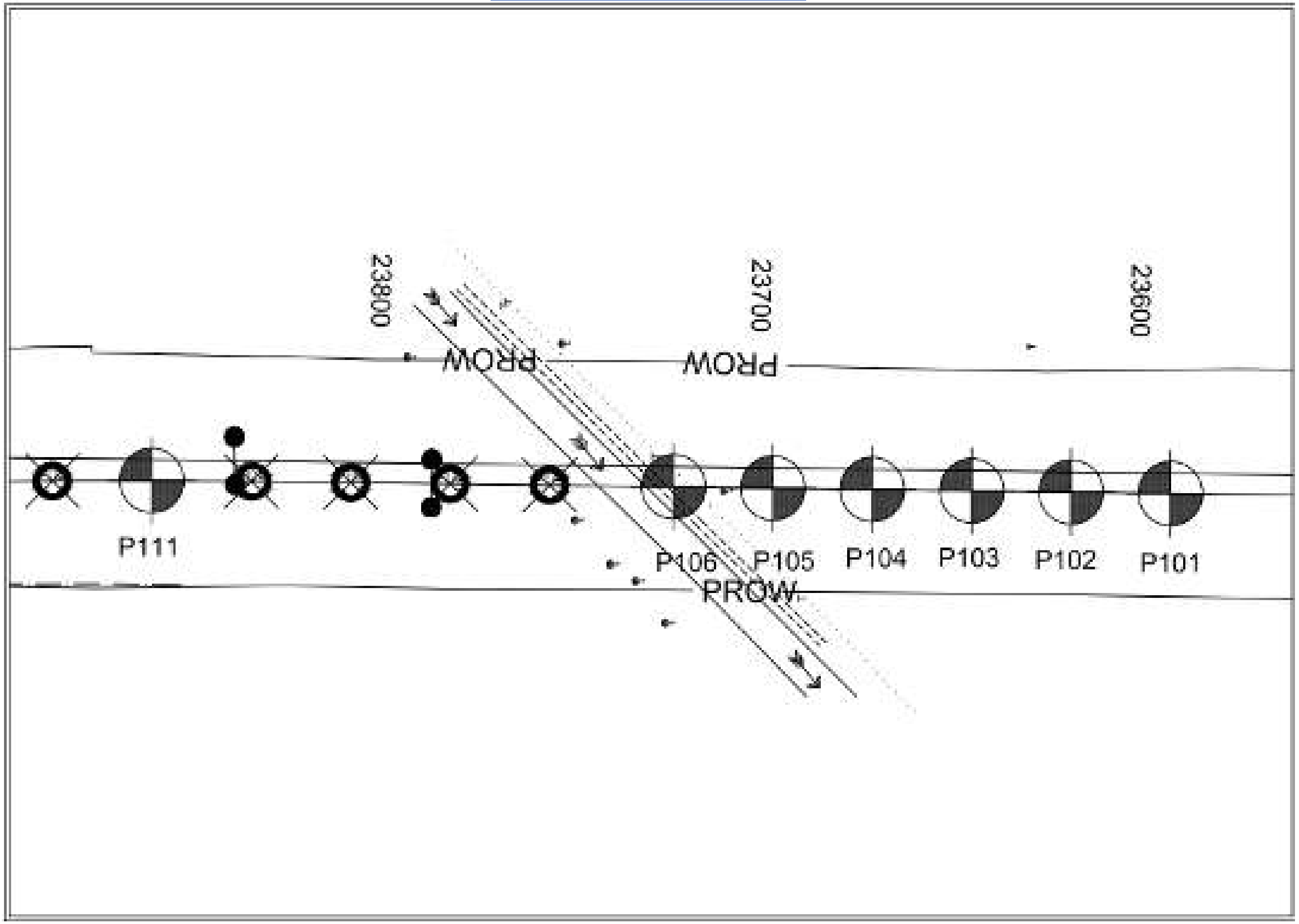
Bore No.	Liquefiable depth zone (meter)
P101	Top 5.00
P102	Top 3.00, 4.00 to 6.00 & 7.00 to 8.00

Bore No.	Liquefiable depth zone (meter)
P103	Top 4.00
P104	Top 5.00
P105	3.00 to 4.00, 5.00 to 9.00 & 13.00 to 14.50
P106	None
P111	None

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech.(Civil), M.Tech.
Principal Consultant &
Managing Director

APPENDIX-A
TEST LOCATION PLAN



APPENDIX "B"
TABLE 1: SUMMARY OF TEST RESULTS

Bore No: P101	Ground Elevation: RL 193.949 m	Method of drilling: Percussion	Depth of Water-table: 1.30 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 28/10/2023	SPT Sampler: Standard
Location / Chainage: 23562.087	Casing Lowered: 21.50 m	Ending Date: 30/10/2023	Hammer type: Rope-pulley driven

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	0	47	49	4	16.22	-	-	26.0	22.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	U	2	-	-	-	-	-	SM-SC	0	0	1	49	44	6	20.85	2.03	1.68	27.0	21.5	5.5	2.65	-	-	-	-	0.577	-	-	-	-	Silty Sands with clay binder											
	2.00	D	3	2	3	4	7	9.57	-	-	-	-	-	-	-	16.30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	2	2	2	4	5.11	SM	6	2	3	49	40	0	16.91	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	D	5	-	-	-	-	-	ML	0	0	0	48	46	6	20.15	1.96	1.63	25.0	21.0	4.0	2.65	RDST	8.0	26.6	-	0.626	-	-	-	-	Inorganic Silts of low plasticity											
	5.00	D	6	4	5	7	12	13.87	SM	0	0	1	52	47	0	20.06	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	6.00	D	7	6	8	11	19	18.03	CL-ML	1	1	0	20	73	5	22.59	-	-	28.0	22.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	7.00	U	8	-	-	-	-	-	ML	1	0	0	14	76	9	21.95	2.06	1.69	30.0	23.0	7.0	2.67	UU	48.0	9.5	0.151	0.580	-	-	-	-	Inorganic Silts of low plasticity											
	8.00	D	9	9	8	13	21	18.24	-	-	-	-	-	-	-	21.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	8	12	16	28	21.32	ML	0	0	1	18	76	5	21.81	-	-	25.0	21.0	4.0	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	-	-	-	-	-	-	-	22.89	2.04	1.66	-	-	-	2.65	DST	6.0	26.0	-	0.596	-	-	-	-												
	11.00	D	12	8	13	17	30	21.40	CL	0	0	0	8	84	8	21.29	-	-	29.5	22.5	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	12.00	D	13	7	12	16	28	20.10	-	-	-	-	-	-	-	20.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	-	-	-	-	-	-	-	19.35	2.05	1.72	-	-	-	2.66	UU	45.0	9.5	-	0.547	-	-	-	-												
	14.50	D	15	5	7	12	19	15.48	CL-ML	1	0	1	11	78	9	18.60	-	-	28.0	21.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	16.00	U	16	-	-	-	-	-	SM-SC	1	0	1	50	40	8	16.75	2.05	1.76	26.5	19.5	7.0	2.66	UU	43.0	13.0	-	0.511	-	9	16	-	Silty Sands with clay binder											
	17.50	D	17	8	15	23	38	22.33	-	-	-	-	-	-	-	19.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 1: SUMMARY OF TEST RESULTS

Bore No: P101	**Ground Elevation: RL 193.949 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.30 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 28/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 23562.087	**Casing Lowered: 21.50 m**	**Ending Date: 30/10/2023**	**Hammer type: Rope-pulley driven**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	SM	0	1	1	57	41	0	19.58	1.89	1.58	Non-Plastic			2.62	DST	0.0	32.1	-	0.658	-	-	-	-	Silty Sands											
	20.50	D	19	14	20	24	44	23.73	-	-	-	-	-	-	-	20.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	U	20	-	-	-	-	-	CI	7	5	5	14	53	16	20.18	1.97	1.64	38.5	23.0	15.5	2.68	UU	47.0	13.0	-	0.634	-	8	19	-	Inorganic clays of Intermediate plasticity											
	23.50	D	21	13	21	23	44	44.00	-	-	-	-	-	-	-	22.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	D	22	-	-	-	-	-	ML	0	0	1	42	53	4	19.36	2.01	1.68	25.0	21.0	4.0	2.66	RDST	7.0	29.6	-	0.583	-	-	-	-	Inorganic Silts of low plasticity											
	26.50	D	23	14	21	25	46	22.63	-	-	-	-	-	-	-	17.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	-	-	-	-	-	ML	1	1	0	38	53	7	17.36	-	-	29.0	22.5	6.5	-	-	-	-	-	-	-	-	-	-												
	29.50	D	25	14	28	48	76	31.36	ML	0	0	1	48	51	0	17.03	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	31.00	D	26	13	21	24	45	45.00	CL	4	6	8	26	44	12	17.18	-	-	32.0	20.0	12.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	32.50	D	27	18	21	23	44	44.00	-	-	-	-	-	-	-	14.67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	-	-	-	-	-	CL	2	1	2	22	64	9	18.75	2.04	1.72	30.0	22.0	8.0	2.67	RUU	49.0	12.3	-	0.552	-	-	-	-												
	35.50	D	29	15	23	24	47	20.85	SM	1	0	2	47	50	0	17.04	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	37.00	D	30	-	-	-	-	-	CL-ML	0	0	0	47	48	5	18.42	2.05	1.73	26.0	20.5	5.5	2.66	RDST	5.0	30.0	-	0.538	-	-	-	-	Inorganic Silty Clays of low plasticity											
	38.50	D	31	12	24	28	52	21.55	-	-	-	-	-	-	-	20.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	16	23	25	48	20.16	CL-ML	0	0	1	42	53	4	14.65	-	-	25.0	20.5	4.5	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No: P102	**Ground Elevation: RL 194.023 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.00 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 29/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 23588.287	**Casing Lowered: 24.00 m**	**Ending Date: 02/11/2023**	**Hammer type: Rope-pulley driven**

RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	1	50	49	0	15.33	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	D	2	1	2	2	4	6.18	SM-SC	0	0	1	54	41	4	18.29	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Silty Sands with clay binder											
	2.00	U	3	-	-	-	-	-	SM-SC	0	0	0	56	40	4	14.21	1.96	1.72	25.0	21.0	4.0	2.63	DST	11.0	27.2	-	0.529	-	-	-	-												
	3.00	D	4	3	5	8	13	16.06	SM	0	0	0	60	40	0	19.41	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	D	5	3	3	4	7	8.70	SM	3	1	2	55	39	0	16.15	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	5.00	D	6	-	-	-	-	-	-	-	-	-	-	-	-	17.82	1.89	1.60	-	-	-	-	RDST	0.0	27.0	-	-	-	-	-	-												
	6.00	D	7	4	6	9	15	16.05	SM	0	0	1	75	24	0	20.43	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	4	4	6	10	10.97	-	-	-	-	-	-	-	23.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	U	9	-	-	-	-	-	CL	4	0	2	11	71	12	17.09	1.96	1.67	31.0	20.0	11.0	2.67	UU	53.0	10.2	0.158	0.599	-	-	-	-	Inorganic clays of low plasticity											
	9.00	D	10	7	9	11	20	20.00	CL	6	1	2	9	72	10	18.48	-	-	30.0	21.0	9.0	-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	7	8	10	18	18.00	CL	1	0	0	7	83	9	21.53	-	-	29.5	21.5	8.0	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	ML	1	0	1	6	85	7	18.55	1.99	1.68	29.0	23.5	5.5	2.66	UU	42.0	12.5	-	0.583	-	0	22	-	Inorganic Silts of low plasticity											
	12.50	D	13	5	7	9	16	16.00	CL	3	1	2	11	72	11	18.40	-	-	29.0	20.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	14.00	U	14	-	-	-	-	-	CL	9	3	2	16	60	10	17.28	2.00	1.71	28.0	20.0	8.0	2.67	UU	44.0	12.9	-	0.566	-	-	-	-												
	15.50	D	15	7	13	15	28	19.37	CL-ML	0	1	1	42	50	6	16.22	-	-	27.0	21.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	17.00	D	16	-	-	-	-	-	SM	1	1	0	70	28	0	17.89	2.06	1.75	Non-Plastic			-	RDST	0.0	30.1	-	-	-	-	-	-	Silty Sands											
	18.50	D	17	10	12	16	28	18.51	CL	6	2	2	14	68	8	18.88	-	-	29.0	22.0	7.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No: P102	Ground Elevation: RL 194.023 m	Method of drilling: Percussion	Depth of Water-table: 1.00 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 29/10/2023	SPT Sampler: Standard
Location / Chainage: 23588.287	Casing Lowered: 24.00 m	Ending Date: 02/11/2023	Hammer type: Rope-pulley driven

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	20.00	D	18	-	-	-	-	-	SM	0	0	0	62	38	0	16.87	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	21.50	D	19	15	21	23	44	23.69	SM	3	1	1	61	34	0	18.77	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	23.00	D	20	-	-	-	-	-	ML	1	1	1	45	52	0	18.23	2.03	1.72	Non-Plastic			2.65	RDST	3.0	29.6	-	0.541	-	-	-	-	Inorganic Silts of low plasticity											
	24.50	D	21	14	22	28	50	24.80	SM	1	1	1	50	47	0	18.71	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	26.00	D	22	-	-	-	-	-	-	-	-	-	-	-	-	18.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	27.50	D	23	18	21	30	51	24.27	-	-	-	-	-	-	-	19.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.00	D	24	-	-	-	-	-	SM	2	1	1	49	47	0	16.05	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	30.50	D	25	16	20	28	48	22.41	-	-	-	-	-	-	-	19.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.00	D	26	-	-	-	-	-	-	-	-	-	-	-	-	19.32	2.06	1.73	-	-	-	2.65	RDST	0.0	30.2	-	0.532	-	-	-	-												
	33.50	D	27	17	22	29	51	22.52	SM	1	2	2	69	26	0	19.61	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	35.00	D	28	19	23	33	56	23.56	-	-	-	-	-	-	-	18.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	36.50	D	29	19	24	31	55	22.94	-	-	-	-	-	-	-	18.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	20	26	30	56	22.89	ML	1	2	1	40	56	0	18.33	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	40.00	D	31	20	30	36	66	25.15	-	-	-	-	-	-	-	17.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed samples.

APPENDIX "B"
TABLE 3: SUMMARY OF TEST RESULTS

Bore No: P103	**Ground Elevation: RL 194.05 m**	**Method of drilling: Percussion**	**Depth of Water-table: 0.50 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 11/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 23614.487	**Casing Lowered: 27.00 m**	**Ending Date: 13/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	1	54	45	0	15.68	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	1.00	D	2	1	2	3	5	8.18	-	-	-	-	-	-	-	15.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	2.00	U	3	-	-	-	-	-	SM	0	0	0	57	43	0	18.33	2.00	1.69	Non-Plastic			2.63	DST	2.0	28.5	-	0.556	-	-	-	-	Silty Sands											
	3.00	D	4	2	3	4	7	9.47	-	-	-	-	-	-	-	16.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	4	5	7	12	15.11	-	-	-	-	-	-	-	17.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	5.00	U	6	-	-	-	-	-	SM-SC	1	0	1	52	40	6	19.12	2.01	1.69	26.5	21.5	5.0	2.65	DST	4.0	26.5	-	0.571	-	0	15	-	Silty Sands with clay binder											
	6.00	D	7	5	7	9	16	16.66	SM	0	0	1	58	41	0	21.11	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	7.00	D	8	6	9	11	20	20.00	CL	0	0	1	14	77	8	21.70	-	-	29.0	21.0	8.0	-	-	-	-	-	-	-	-	-	-												
	8.00	U	9	-	-	-	-	-	CL	5	1	1	18	66	9	21.16	2.06	1.70	30.0	22.0	8.0	2.66	UU	49.0	10.5	0.156	0.565	-	17	18	-												
	9.00	D	10	5	8	11	19	19.00	-	-	-	-	-	-	-	22.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	D	11	5	9	13	22	22.00	-	-	-	-	-	-	-	20.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	11.00	U	12	-	-	-	-	-	CL	4	0	2	6	81	7	20.57	1.98	1.64	29.5	22.0	7.5	2.66	DST	14.0	24.4	-	0.622	-	-	-	-												
	12.50	D	13	7	8	9	17	17.00	-	-	-	-	-	-	-	21.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL	3	0	1	7	83	6	20.77	2.06	1.71	29.0	21.0	8.0	2.66	UU	52.0	9.5	-	0.560	-	-	-	-												
	15.50	D	15	11	16	20	36	22.58	SM	6	2	1	41	50	0	17.14	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	17.00	U	16	-	-	-	-	-	CL	7	3	3	22	55	10	19.14	2.07	1.74	29.0	19.5	9.5	2.66	UU	54.0	10.5	-	0.531	-	9	17	-	Inorganic clays of low plasticity											
	18.50	D	17	8	12	15	27	18.00	SM	3	2	4	58	33	0	16.47	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											

APPENDIX "B"
TABLE 3: SUMMARY OF TEST RESULTS

Bore No: P103	**Ground Elevation: RL 194.05 m**	**Method of drilling: Percussion**	**Depth of Water-table: 0.50 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 11/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 23614.487	**Casing Lowered: 27.00 m**	**Ending Date: 13/10/2023**	**Hammer type: Auto-trip**

RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
																							Classification of ROCK									Classification of SOIL											
	20.00	U	18	-	-	-	-	-	CL	5	2	2	24	57	10	21.93	2.04	1.67	29.0	19.5	9.5	2.67	UU	51.0	11.0	-	0.596	-	-	-	-	Inorganic clays of low plasticity											
	21.50	D	19	9	19	25	44	44.00	CL	6	3	4	8	67	12	18.01	-	-	32.0	21.0	11.0	-	-	-	-	-	-	-	-	-	-												
	23.00	U	20	-	-	-	-	-	SM	0	1	2	53	44	0	19.33	1.96	1.64	Non-Plastic			2.64	DST	2.0	27.5	-	0.610	-	-	-	-	Silty Sands											
	24.50	D	21	10	23	42	65	29.87	-	-	-	-	-	-	-	18.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.00	D	22	10	24	43	67	29.95	SM	0	1	1	55	43	0	17.90	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	27.50	D	23	13	26	45	71	30.70	-	-	-	-	-	-	-	19.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.00	D	24	13	25	46	71	30.17	SM	0	0	1	57	42	0	16.44	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	30.50	D	25	14	25	45	70	29.33	-	-	-	-	-	-	-	18.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.00	D	26	16	28	47	75	30.36	ML	0	1	1	44	54	0	18.54	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	33.50	D	27	16	28	47	75	75.00	CL	3	2	2	18	63	12	17.00	-	-	32.0	20.5	11.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	35.00	D	28	15	26	46	72	72.00	CL	8	2	2	24	52	12	17.65	-	-	31.5	21.0	10.5	-	-	-	-	-	-	-	-	-	-												
	36.50	D	29	16	27	46	73	73.00	-	-	-	-	-	-	-	14.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	17	28	47	75	75.00	CL	3	1	2	30	54	10	20.82	-	-	30.0	18.5	11.5	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	19	34	48	82	82.00	-	-	-	-	-	-	-	14.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 4: SUMMARY OF TEST RESULTS

Bore No: P104	**Ground Elevation: RL 194.067 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.20 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 30/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 23640.687	**Casing Lowered: 18.00 m**	**Ending Date: 02/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	0	55	45	0	18.84	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	U	2	-	-	-	-	-	SM-SC	0	0	0	57	38	5	18.90	1.98	1.67	26.0	20.5	5.5	2.65	DST	8.0	24.0	-	0.592	-	-	-	-	Silty Sands with clay binder											
	2.00	D	3	2	2	2	4	5.55	SM	3	2	2	60	33	0	18.11	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	3.00	D	4	2	2	4	6	7.78	-	-	-	-	-	-	-	16.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	-	-	-	-	-	SM	2	1	2	54	41	0	18.93	1.90	1.60	Non-Plastic			-	DST	0.0	25.4	-	-	-	-	-	-												
	5.00	D	6	3	5	7	12	14.11	-	-	-	-	-	-	-	20.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	3	3	7	10	10.00	CL	5	2	1	19	63	10	20.87	-	-	29.0	20.5	8.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	7.00	U	8	-	-	-	-	-	CL	2	1	2	16	68	11	20.73	2.10	1.74	30.0	21.0	9.0	2.67	UU	50.0	11.1	0.145	0.534	-	10	20	-												
	8.00	D	9	7	8	10	18	16.82	CL-ML	0	0	1	20	72	7	21.83	-	-	28.0	22.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	9.00	D	10	6	10	12	22	22.00	CL	0	0	1	7	84	8	19.99	-	-	30.0	22.0	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	10.00	U	11	-	-	-	-	-	CL	1	1	0	8	81	9	22.58	2.03	1.66	29.0	21.5	7.5	2.66	UU	41.0	11.6	-	0.602	-	8	21	-												
	11.00	D	12	5	6	9	15	15.00	CL	1	0	2	10	74	13	20.33	-	-	34.0	21.0	13.0	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	6	9	13	22	22.00	CL	2	1	0	17	72	8	17.46	-	-	30.0	22.0	8.0	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	-	-	-	-	-	-	-	16.94	1.99	1.70	-	-	-	2.66	DST	11.0	25.6	-	0.565	-	-	-	-												
	14.50	D	15	6	12	16	28	28.00	-	-	-	-	-	-	-	16.47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	SM	5	2	2	44	47	0	13.21	2.02	1.78	Non-Plastic			2.63	DST	8.0	26.5	-	0.478	-	-	-	-	Silty Sands											
	17.50	D	17	8	15	20	35	21.35	SM	2	1	1	47	49	0	19.87	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 4: SUMMARY OF TEST RESULTS

Bore No: P104	Ground Elevation: RL 194.067 m	Method of drilling: Percussion	Depth of Water-table: 1.20 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 30/10/2023	SPT Sampler: Standard
Location / Chainage: 23640.687	Casing Lowered: 18.00 m	Ending Date: 02/11/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																		
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen												
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index	
																									Classification of ROCK							Classification of SOIL												
	19.00	D	18	-	-	-	-	-	CL-ML	1	0	1	32	60	6	19.68	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-													
	20.50	D	19	10	16	23	39	21.98	-	-	-	-	-	-	-	17.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity												
	22.00	U	20	-	-	-	-	-	CL-ML	3	1	1	25	63	7	20.07	1.98	1.65	27.0	20.5	6.5	2.66	DST	9.0	25.5	-	0.612	-	-	-	-													
	23.50	D	21	13	18	24	42	22.20	ML	1	1	0	44	54	0	16.84	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity												
	25.00	U	22	-	-	-	-	-	SM	0	1	1	59	39	0	18.05	2.01	1.70	Non-Plastic			2.63	DST	4.0	28.0	-	0.547	-	-	-	-													
	26.50	D	23	13	15	30	45	22.38	-	-	-	-	-	-	-	18.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	28.00	U	24	-	-	-	-	-	SM	0	0	1	64	35	0	20.18	1.97	1.64	Non-Plastic			2.62	DST	2.0	29.1	-	0.598	-	-	-	-													
	29.50	D	25	13	27	31	58	25.71	SM	0	0	0	62	38	0	18.28	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-													
	31.00	D	26	18	31	32	63	26.79	-	-	-	-	-	-	-	20.75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	32.50	D	27	13	28	38	66	27.25	SM	0	1	0	72	27	0	19.33	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands												
	34.00	D	28	14	24	32	56	23.87	-	-	-	-	-	-	-	20.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	35.50	D	29	13	18	35	53	22.65	-	-	-	-	-	-	-	20.47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	37.00	D	30	18	28	35	63	25.11	SM	0	0	1	69	30	0	20.14	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-													
	38.50	D	31	12	19	29	48	20.63	-	-	-	-	-	-	-	20.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
	40.00	D	32	17	21	31	52	21.42	SM	0	0	2	65	33	0	18.95	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-													

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"

TABLE 5: SUMMARY OF TEST RESULTS

Bore No: P105	**Ground Elevation: RL 193.916 m**	**Method of drilling: Percussion**	**Depth of Water-table: 1.30 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 30/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 23666.887	**Casing Lowered: 20.00 m**	**Ending Date: 02/11/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	CL-ML	0	0	1	47	46	6	17.64	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-												
	1.00	D	2	-	-	-	-	-	CL-ML	0	1	1	44	48	6	19.19	1.97	1.65	26.0	20.5	5.5	2.65	-	-	-	-	0.606	-	-	-	-	Inorganic Silty Clays of low plasticity											
	2.00	D	3	2	2	2	4	5.52	-	-	-	-	-	-	-	18.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	2	3	3	6	7.75	SM	2	1	1	60	36	0	19.20	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	U	5	-	-	-	-	-	CL-ML	1	1	0	42	51	5	16.36	2.02	1.74	26.0	21.0	5.0	2.65	DST	2.0	28.6	-	0.523	-	-	-	-	Inorganic Silty Clays of low plasticity											
	5.00	D	6	3	3	4	7	8.11	SM	0	1	1	53	45	0	18.33	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	3	4	6	10	11.08	SM	0	0	1	69	30	0	21.07	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	7.00	D	8	-	-	-	-	-	-	-	-	-	-	-	-	19.58	1.94	1.62	-	-	-	-	RDST	0.0	28.5	-	-	-	-	-	-												
	8.00	D	9	3	5	7	12	12.38	ML	2	1	0	35	57	5	19.04	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	9.00	D	10	4	6	9	15	14.98	-	-	-	-	-	-	-	19.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	0	1	0	14	76	9	20.99	2.01	1.66	28.0	21.0	7.0	2.66	UU	46.0	10.2	-	0.602	-	-	-	-	Inorganic clays of low plasticity											
	11.00	D	12	3	4	4	8	8.00	CL	2	1	2	9	73	13	18.78	-	-	34.0	21.0	13.0	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	4	6	8	14	14.00	CI	4	3	5	16	57	15	19.22	-	-	38.0	24.0	14.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of Intermediate plasticity											
	13.00	U	14	-	-	-	-	-	ML	2	1	1	18	66	12	20.25	2.00	1.66	34.0	24.0	10.0	2.68	UU	62.0	9.5	0.163	0.614	-	-	-	-												
	14.50	D	15	9	9	12	21	16.46	ML	1	1	0	25	65	8	18.36	-	-	30.0	23.0	7.0	-	-	-	-	-	-	-	-	-	-												
	16.00	D	16	-	-	-	-	-	-	-	-	-	-	-	-	17.73	1.97	1.67	-	-	-	2.67	RUU	45.0	12.8	-	0.599	-	-	-	-	Inorganic Silts of low plasticity											
	17.50	D	17	9	14	19	33	20.64	ML	0	0	1	45	54	0	20.54	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 5: SUMMARY OF TEST RESULTS

Bore No: P105	Ground Elevation: RL 193.916 m	Method of drilling: Percussion	Depth of Water-table: 1.30 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 30/10/2023	SPT Sampler: Standard
Location / Chainage: 23666.887	Casing Lowered: 20.00 m	Ending Date: 02/11/2023	Hammer type: Auto-trip

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	D	18	-	-	-	-	-	CL-ML	3	1	0	35	55	6	18.46	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	20.50	D	19	13	20	26	46	46.00	CL	0	0	0	14	76	10	17.20	-	-	31.5	23.0	8.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	22.00	U	20	-	-	-	-	-	CL	0	1	0	12	75	12	17.81	2.05	1.74	31.0	22.0	9.0	2.67	UU	48.0	11.2	-	0.534	-	-	-	-												
	23.50	D	21	8	15	23	38	38.00	-	-	-	-	-	-	-	19.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	ML	1	1	0	32	59	7	19.99	2.06	1.72	27.0	22.0	5.0	2.66	UU	45.0	10.5	-	0.547	-	-	-	-	Inorganic Silts of low plasticity											
	26.50	D	23	18	25	25	50	23.94	SM	0	0	0	55	45	0	18.72	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	28.00	U	24	-	-	-	-	-	CL	0	0	1	12	77	10	20.09	2.10	1.75	32.0	23.0	9.0	2.67	-	-	-	-	0.526	-	-	-	-	Inorganic clays of low plasticity											
	29.50	D	25	15	24	26	50	23.01	SM	1	0	1	65	33	0	19.86	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	31.00	U	26	-	-	-	-	-	-	-	-	-	-	-	-	16.97	2.08	1.78	-	-	-	2.63	DST	0.0	30.7	-	0.478	-	-	-	-												
	32.50	D	27	11	21	32	53	53.00	CL	0	1	1	12	74	12	16.59	-	-	33.0	22.0	11.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	34.00	D	28	14	24	28	52	22.37	ML	2	1	0	40	57	0	17.24	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	35.50	D	29	18	28	30	58	23.74	SM	0	0	1	55	44	0	16.99	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	37.00	D	30	13	21	28	49	20.94	-	-	-	-	-	-	-	16.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	17	26	35	61	23.89	SM	0	1	1	52	46	0	17.84	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	18	28	32	60	23.30	-	-	-	-	-	-	-	17.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample

APPENDIX "B"
TABLE 6: SUMMARY OF TEST RESULTS

Bore No: P106	**Ground Elevation: RL 194.696 m**	**Method of drilling: Percussion**	**Depth of Water-table: 0.60 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 11/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 23693.087	**Casing Lowered: 20.00 m**	**Ending Date: 13/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	0	55	45	0	6.38	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	U	2	-	-	-	-	-	SM	0	0	0	59	41	0	18.50	1.90	1.60	Non-Plastic			2.64	DST	3.0	27.5	-	0.647	-	-	-	-												
	2.00	D	3	1	1	1	2	2.00	CL	0	1	2	37	53	7	17.80	-	-	27.0	19.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	3.00	D	4	1	1	2	3	3.00	-	-	-	-	-	-	-	18.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	U	5	-	-	-	-	-	CL	0	0	1	44	45	10	21.52	1.82	1.50	28.0	20.0	8.0	2.67	UU	45.0	12.5	0.193	0.783	-	17	16	-												
	5.00	D	6	2	2	5	7	8.66	SM	0	0	2	59	39	0	17.69	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	6.00	D	7	2	3	6	9	10.68	-	-	-	-	-	-	-	18.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	-	-	-	-	-	CL-ML	0	0	1	44	48	7	23.04	1.98	1.61	26.5	20.0	6.5	2.66	RUU	39.0	12.8	-	0.652	-	-	-	-	Inorganic Silty Clays of low plasticity											
	8.00	D	9	4	4	6	10	10.88	CL-ML	0	1	1	16	75	7	20.11	-	-	25.0	19.5	5.5	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	3	6	9	15	15.36	-	-	-	-	-	-	-	21.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	1	1	1	8	77	12	18.03	2.06	1.75	32.0	21.5	10.5	2.67	UU	54.0	8.5	-	0.530	-	9	18	-	Inorganic clays of low plasticity											
	11.00	D	12	8	13	18	31	31.00	-	-	-	-	-	-	-	18.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	10	15	21	36	36.00	-	-	-	-	-	-	-	16.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	14	-	-	-	-	-	CL	6	2	4	11	66	11	20.43	2.05	1.70	31.0	20.5	10.5	2.67	UU	52.0	9.0	-	0.571	-	-	-	-												
	14.50	D	15	5	9	10	19	19.00	-	-	-	-	-	-	-	19.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	16.00	U	16	-	-	-	-	-	ML	3	1	1	42	47	6	16.17	1.98	1.70	24.0	20.0	4.0	2.66	DST	8.0	25.5	-	0.561	-	-	-	-	Inorganic Silts of low plasticity											
	17.50	D	17	8	14	17	31	20.15	SM	0	0	0	52	48	0	17.25	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											

APPENDIX "B"
TABLE 6: SUMMARY OF TEST RESULTS

Bore No: P106	**Ground Elevation: RL 194.696 m**	**Method of drilling: Percussion**	**Depth of Water-table: 0.60 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 11/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 23693.087	**Casing Lowered: 20.00 m**	**Ending Date: 13/10/2023**	**Hammer type: Auto-trip**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	U	18	-	-	-	-	-	SM	2	1	1	53	43	0	19.18	1.92	1.61	Non-Plastic			2.64	DST	4.0	26.5	-	0.640	-	-	-	-	Silty Sands											
	20.50	D	19	12	16	20	36	21.30	-	-	-	-	-	-	-	19.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	D	20	-	-	-	-	-	ML	1	1	1	38	59	0	20.34	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	23.50	D	21	13	18	23	41	22.29	-	-	-	-	-	-	-	17.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	U	22	-	-	-	-	-	ML	0	0	0	48	52	0	18.42	1.98	1.67	Non-Plastic			2.63	DST	7.0	27.0	-	0.573	-	-	-	-												
	26.50	D	23	15	27	39	66	29.98	-	-	-	-	-	-	-	17.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	-	-	-	-	-	-	-	-	-	-	-	-	19.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	29.50	D	25	11	22	31	53	24.74	CL-ML	13	4	5	16	55	7	14.63	-	-	25.0	18.5	6.5	-	-	-	-	-	-	-	8	14	-	Inorganic Silty Clays of low plasticity											
	31.00	D	26	14	31	45	76	76.00	CL	7	2	3	10	67	11	17.83	-	-	31.0	22.0	9.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	32.50	D	27	13	29	40	69	69.00	-	-	-	-	-	-	-	16.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	-	-	-	-	-	CL	2	2	3	14	70	9	18.50	2.01	1.70	29.0	19.5	9.5	2.67	RUU	55.0	11.2	-	0.571	-	-	-	-												
	35.50	D	29	15	32	43	75	75.00	-	-	-	-	-	-	-	17.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	-	-	-	-	-	-	-	-	-	-	-	-	18.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.50	D	31	16	33	40	73	73.00	CL	1	2	3	7	75	12	16.29	-	-	30.0	19.0	11.0	-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	14	35	44	79	79.00	-	-	-	-	-	-	-	14.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 7: SUMMARY OF TEST RESULTS

Bore No: P111	**Ground Elevation: RL 194.745 m**	**Method of drilling: Rotary**	**Depth of Water-table: 1.30 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 18/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 23830.447	**Casing Lowered: 15.00 m**	**Ending Date: 21/10/2023**	**Hammer type: Rope-pulley driven**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	CL-ML	0	0	1	48	46	5	14.48	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	1.00	D	2	1	2	2	4	6.16	-	-	-	-	-	-	-	14.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	2.00	U	3	-	-	-	-	-	-	-	-	-	-	-	-	18.60	2.00	1.69	-	-	-	2.63	DST	7.0	26.5	-	0.556	-	-	-	-												
	3.00	D	4	4	5	5	10	12.83	SM	1	1	2	54	42	0	15.60	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	4.00	D	5	6	7	7	14	15.99	-	-	-	-	-	-	-	16.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	5.00	U	6	-	-	-	-	-	CL	2	2	2	20	66	8	19.11	1.97	1.65	27.5	20.5	7.0	2.67	UU	46.0	11.2	0.145	0.618	-	9	18	-	Inorganic clays of low plasticity											
	6.00	D	7	4	5	6	11	12.20	-	-	-	-	-	-	-	19.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	10	14	16	30	23.51	SM	2	3	3	47	45	0	18.89	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	8.00	U	9	-	-	-	-	-	SM	3	6	16	42	33	0	16.86	1.98	1.70	Non-Plastic			2.63	DST	0.0	29.5	-	0.551	-	-	-	-												
	9.00	D	10	10	13	18	31	31.00	CL	5	3	7	11	64	10	21.19	-	-	29.0	21.0	8.0	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	10.00	D	11	13	20	24	44	44.00	CL	1	1	1	5	80	12	19.87	-	-	31.0	20.5	10.5	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL	7	10	9	16	48	10	16.42	2.01	1.73	29.0	20.0	9.0	2.66	UU	48.0	11.5	-	0.538	-	17	16	-												
	12.50	D	13	7	12	15	27	27.00	CL	3	2	4	12	71	8	21.13	-	-	28.0	20.0	8.0	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL	4	4	6	8	66	12	21.13	2.05	1.69	32.0	21.0	11.0	2.68	UU	58.0	9.5	-	0.586	-	-	-	-												
	15.50	D	15	10	17	20	37	37.00	SC	4	8	12	30	36	10	16.10	-	-	28.0	18.5	9.5	-	-	-	-	-	-	-	-	-	-	Clayey Sands											
	17.00	U	16	-	-	-	-	-	SC	5	7	11	30	35	12	17.69	2.03	1.72	30.0	20.0	10.0	2.67	UU	56.0	10.4	-	0.548	-	0	18	-												
	18.50	D	17	9	18	22	40	22.93	CL-ML	2	1	3	40	48	6	14.98	-	-	26.0	21.5	4.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											

Soil investigation for HORC Viaduct between Sohana & Dhulawat stations, Haryana

APPENDIX "B"
TABLE 7: SUMMARY OF TEST RESULTS

Bore No: P111	**Ground Elevation: RL 194.745 m**	**Method of drilling: Rotary**	**Depth of Water-table: 1.30 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 18/10/2023**	**SPT Sampler: Standard**
Location / Chainage: 23830.447	**Casing Lowered: 15.00 m**	**Ending Date: 21/10/2023**	**Hammer type: Rope-pulley driven**

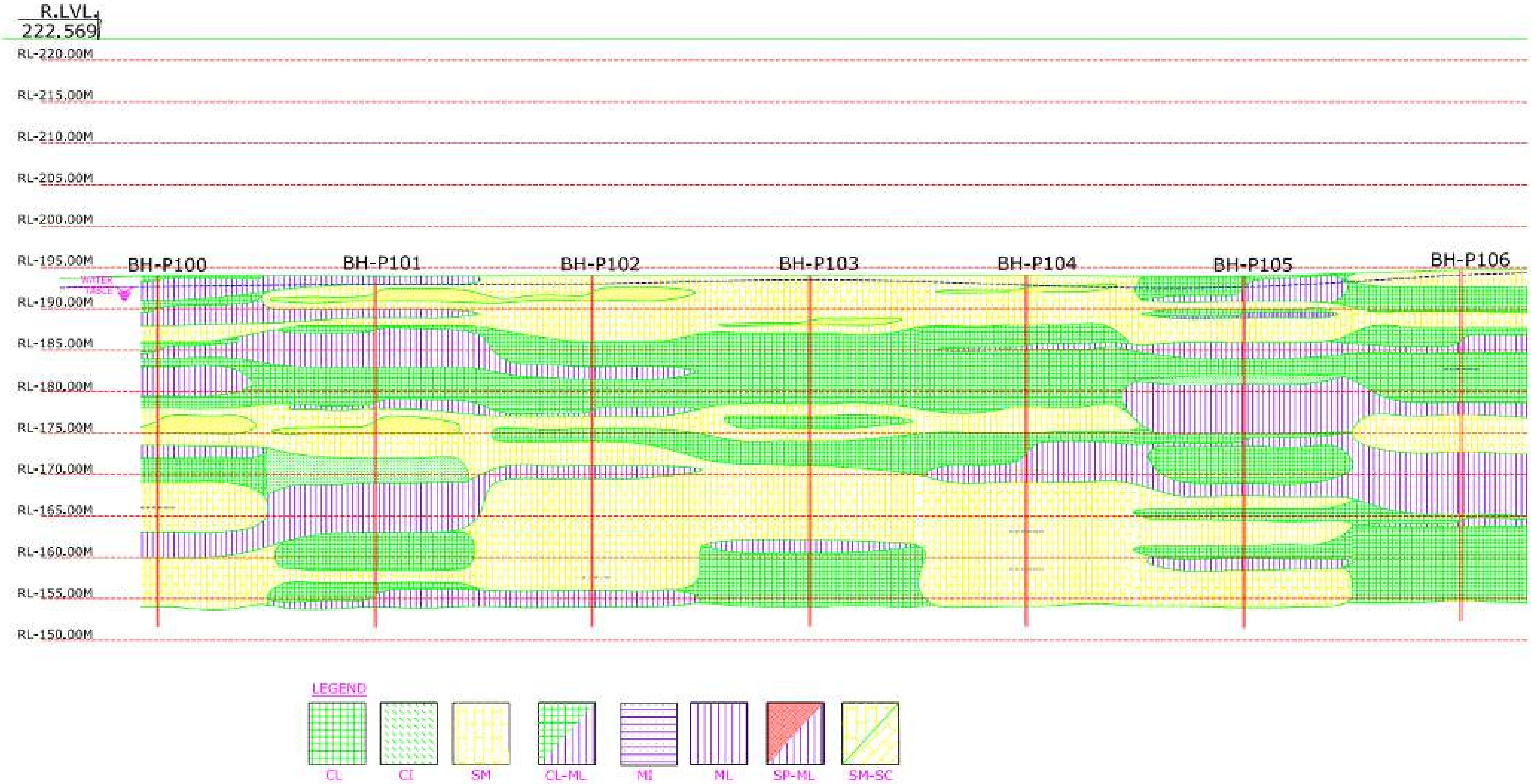
FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	20.00	D	18	-	-	-	-	-	SM	0	0	2	63	35	0	19.54	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	21.50	D	19	13	24	30	54	26.98	-	-	-	-	-	-	-	11.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.00	D	20	-	-	-	-	-	SM	2	2	12	54	30	0	16.85	2.07	1.77	Non-Plastic			2.65	RDST	0.0	32.3	-	0.497	-	-	-	-												
	24.50	D	21	14	26	31	57	26.82	SM	7	10	8	28	47	0	13.14	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	26.00	D	22	16	35	51	86	35.81	SM	4	8	18	34	36	0	13.14	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	27.50	D	23	15	36	49	85	34.88	SM	8	8	8	39	37	0	12.75	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	29.00	D	24	16	38	50	88	35.22	-	-	-	-	-	-	-	15.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	30.50	D	25	14	33	46	79	31.85	-	-	-	-	-	-	-	14.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.00	D	26	15	36	47	83	32.50	SM	1	1	3	58	37	0	18.96	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	33.50	D	27	16	37	45	82	31.65	-	-	-	-	-	-	-	18.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	35.00	D	28	18	39	48	87	87.00	SC	8	7	13	38	27	7	17.66	-	-	28.0	20.0	8.0	-	-	-	-	-	-	-	-	-	-	Clayey Sands											
	36.50	D	29	17	40	45	85	85.00	-	-	-	-	-	-	-	17.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	16	42	46	88	88.00	CL	4	4	7	24	50	11	16.60	-	-	30.0	19.5	10.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	40.00	D	31	37	55	-	R	-	SC	0	10	14	34	34	8	16.52	-	-	29.0	20.0	9.0	-	-	-	-	-	-	-	-	-	-	Clayey Sands											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

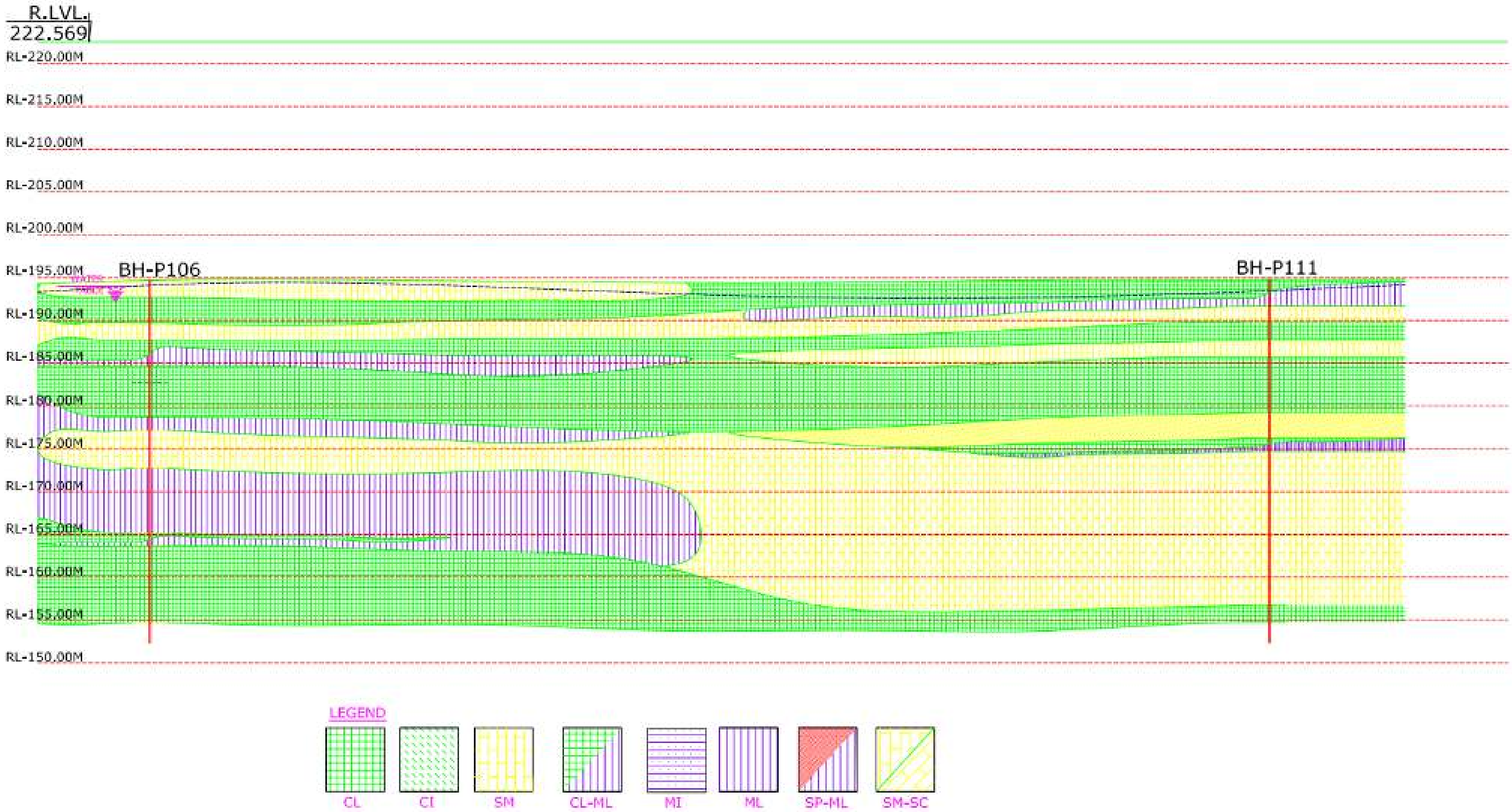
APPENDIX-B
TABLE 8: UCS TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	UCS (kg/cm²)
P101	16.00	0.56
	22.00	0.44
P102	11.00	0.52
	14.00	0.46
P103	8.00	0.59
	14.00	0.64
	17.00	0.66
	20.00	0.63
P104	7.00	0.60
	10.00	0.49
P105	10.00	0.61
	13.00	0.70
	22.00	0.63
	25.00	0.57
P106	4.00	0.53
	10.00	0.66
	13.00	0.60
P111	5.00	0.69
	11.00	0.72
	14.00	0.86
	17.00	0.79

APPENDIX-C
PLOT 1: LITHOLOGICAL PROFILE-01



APPENDIX-C
PLOT 2: LITHOLOGICAL PROFILE-02



APPENDIX-C
PLOT 3: LITHOLOGICAL PLOTS

BH-P101-23562.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	U		-	-
Silty Sands with clay binder	SM-SC		2.00	D	7	-	-
Silty Sands	SM		3.00	D	4	-	-
Inorganic Silts of low plasticity	ML		4.00	D		-	-
Silty Sands	SM		5.00	D	12	-	-
Inorganic Silty Clays of low plasticity	CL-ML		6.00	D	19	-	-
Inorganic Silts of low plasticity	ML		7.00	U		-	-
			8.00	D	21	-	-
			9.00	D	28	-	-
			10.00	U		-	-
Inorganic clays of low plasticity	CL		11.00	D	30	-	-
			12.00	D	28	-	-
			13.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		14.50	D	19	-	-
			16.00	U		-	-
Silty Sands with clay binder	SM-SC		17.50	D	38	-	-
Silty Sands	SM		19.00	U		-	-
			20.00	D	44	-	-

BH-P101-23562.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		20.50	D	44	-	-
			22.00	U		-	-
Inorganic clays of intermediate plasticity	CI		23.50	D	44	-	-
			25.00	D		-	-
Inorganic Silts of low plasticity	ML		26.50	D	46	-	-
			28.00	D		-	-
			29.50	D	76	-	-
Inorganic clays of low plasticity	CL		31.00	D	45	-	-
			32.50	D	44	-	-
			34.00	D		-	-
Silty Sands	SM		35.50	D	47	-	-
Inorganic Silty Clays of low plasticity	CL-ML		37.00	D		-	-
			38.50	D	52	-	-
			40.00	D	48	-	-

APPENDIX-C

PLOT 4: LITHOLOGICAL PLOTS

BH-P102-23588.287

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	D	4	-	-
Silty Sands with clay binder	SM-SC		2.00	U		-	-
			3.00	D	13	-	-
			4.00	D	7	-	-
Silty Sands	SM		5.00	D		-	-
			6.00	D	15	-	-
			7.00	D	10	-	-
			8.00	U		-	-
Inorganic clays of low plasticity	CL		9.00	D	20	-	-
			10.00	D	18	-	-
Inorganic Silts of low plasticity	ML		11.00	U		-	-
			12.50	D	16	-	-
Inorganic clays of low plasticity	CL		14.00	U		-	-
Inorganic Silty Clays of low plasticity	CI-MI		15.50	D	28	-	-
Silty Sands	SM		17.00	D		-	-
Inorganic clays of low plasticity	CL		18.50	D	28	-	-
			20.00	D		-	-

BH-P102-23588.287

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.00	D		-	-
Silty Sands	SM		21.50	D	44	-	-
Inorganic Silts of low plasticity	ML		23.00	D		-	-
			24.50	D	50	-	-
			26.00	D		-	-
			27.50	D	51	-	-
			29.00	D		-	-
Silty Sands	SM		30.50	D	48	-	-
			32.00	D		-	-
			33.50	D	51	-	-
			35.00	D	56	-	-
			36.50	D	55	-	-
Inorganic Silts of low plasticity	ML		38.00	D	56	-	-
			40.00	D	66	-	-

APPENDIX-C
PLOT 5: LITHOLOGICAL PLOTS

BH-P103-23614.487

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	D	5	-	-
			2.00	U		-	-
			3.00	D	7	-	-
			4.00	D	12	-	-
Silty Sands with clay binder	SM-SC		5.00	U		-	-
Silty Sands	SM		6.00	D	16	-	-
Inorganic clays of low plasticity	CL		7.00	D	20	-	-
			8.00	U		-	-
			9.00	D	19	-	-
			10.00	D	22	-	-
			11.00	U		-	-
			12.50	D	17	-	-
			14.00	U		-	-
Silty Sands	SM		15.50	D	36	-	-
Inorganic clays of low plasticity	CL		17.00	U		-	-
Silty Sands	SM		18.50	D	27	-	-
			20.00	U		-	-

BH-P103-23614.487

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.00	U		-	-
			21.50	D	44	-	-
Silty Sands	SM		23.00	U		-	-
			24.50	D	65	-	-
			26.00	D	67	-	-
			27.50	D	71	-	-
			29.00	D	71	-	-
			30.50	D	70	-	-
Inorganic Silts of low plasticity	ML		32.00	D	75	-	-
Inorganic clays of low plasticity	CL		33.50	D	75	-	-
			35.00	D	72	-	-
			36.50	D	73	-	-
			38.00	D	75	-	-
			40.00	D	82	-	-

APPENDIX-C
PLOT 6: LITHOLOGICAL PLOTS

BH-P104-23640.687

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
Silty Sands with clay binder	SM-SC (WATER LVL)		1.00	U		-	-
			2.00	D	4	-	-
			3.00	D	6	-	-
Silty Sands	SM		4.00	D		-	-
			5.00	D	12	-	-
			6.00	D	10	-	-
Inorganic clays of low plasticity	CL		7.00	U		-	-
Inorganic Silty Clays of low plasticity	CL-ML		8.00	D	18	-	-
			9.00	D	22	-	-
			10.00	U		-	-
			11.00	D	15	-	-
Inorganic clays of low plasticity	CL		12.00	D	22	-	-
			13.00	U		-	-
			14.50	D	28	-	-
			16.00	U		-	-
Silty Sands	SM		17.50	D	35	-	-
Inorganic Silty Clays of low plasticity	CL-ML		19.00	D		-	-
			20.00	D	39	-	-

BH-P104-23640.687

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
			20.50	D	39	-	-
Inorganic Silty Clays of low plasticity	CL-ML		22.00	U		-	-
Inorganic Silts of low plasticity	ML		23.50	D	42	-	-
			25.00	U		-	-
			26.50	D	45	-	-
			28.00	U		-	-
			29.50	D	58	-	-
			31.00	D	63	-	-
Silty Sands	SM		32.50	D	66	-	-
			34.00	D	56	-	-
			35.50	D	53	-	-
			37.00	D	63	-	-
			38.50	D	48	-	-
			40.00	D	52	-	-

APPENDIX-C
PLOT 7: LITHOLOGICAL PLOTS

BH-P105-23666.887

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML		0.50	D		-	-
			1.00	D		-	-
			2.00	D	4	-	-
Silty Sands	SM		3.00	D	6	-	-
Inorganic Silty Clays of low plasticity	CL-ML		4.00	U		-	-
Silty Sands	SM		5.00	D	7	-	-
			6.00	D	10	-	-
			7.00	D		-	-
Inorganic Silts of low plasticity	ML		8.00	D	12	-	-
			9.00	D	15	-	-
Inorganic clays of low plasticity	CL		10.00	U		-	-
			11.00	D	8	-	-
Inorganic clays of intermediate plasticity	CI		12.00	D	14	-	-
Inorganic Silts of low plasticity	ML		13.00	U		-	-
			14.50	D	21	-	-
			16.00	D		-	-
			17.50	D	33	-	-
Inorganic Silty Clays of low plasticity	CL-ML		19.00	D		-	-
			20.00	D	46	-	-

BH-P105-23666.887

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML						
Inorganic clays of low plasticity	CL		20.50	D	46	-	-
			22.00	U		-	-
			23.50	D	38	-	-
Inorganic Silts of low plasticity	ML		25.00	U		-	-
Silty Sands	SM		26.50	D	50	-	-
Inorganic clays of low plasticity	CL		28.00	U		-	-
Silty Sands	SM		29.50	D	50	-	-
			31.00	U		-	-
Inorganic clays of low plasticity	CL		32.50	D	53	-	-
Inorganic Silts of low plasticity	ML		34.00	D	52	-	-
Silty Sands	SM		35.50	D	58	-	-
			37.00	D	49	-	-
			38.50	D	61	-	-
			40.00	D	60	-	-

APPENDIX-C

PLOT 8: LITHOLOGICAL PLOTS

BH-P106-23693.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	U		-	-
Inorganic clays of low plasticity	CL		2.00	D	2	-	-
			3.00	D	3	-	-
			4.00	U		-	-
Silty Sands	SM		5.00	D	7	-	-
			6.00	D	9	-	-
Inorganic Silty Clays of low plasticity	CL-ML		7.00	D		-	-
			8.00	D	10	-	-
			9.00	D	15	-	-
Inorganic clays of low plasticity	CL		10.00	U		-	-
			11.00	D	31	-	-
			12.00	D	36	-	-
			13.00	U		-	-
			14.50	D	19	-	-
Inorganic Silts of low plasticity	ML		16.00	U		-	-
Silty Sands	SM		17.50	D	31	-	-
			19.00	U		-	-
			20.00	D	36	-	-

BH-P106-23693.087

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		20.50	D	36	-	-
Inorganic Silts of low plasticity	ML		22.00	D		-	-
			23.50	D	41	-	-
			25.00	U		-	-
			26.50	D	66	-	-
			28.00	D		-	-
Inorganic Silty Clays of low plasticity	CL-ML		29.50	D	53	-	-
Inorganic clays of low plasticity	CL		31.00	D	76	-	-
			32.50	D	69	-	-
			34.00	D		-	-
			35.50	D	75	-	-
			37.00	D		-	-
			38.50	D	73	-	-
			40.00	D	79	-	-

APPENDIX-C
PLOT 9: LITHOLOGICAL PLOTS

BH-P111-23830.447

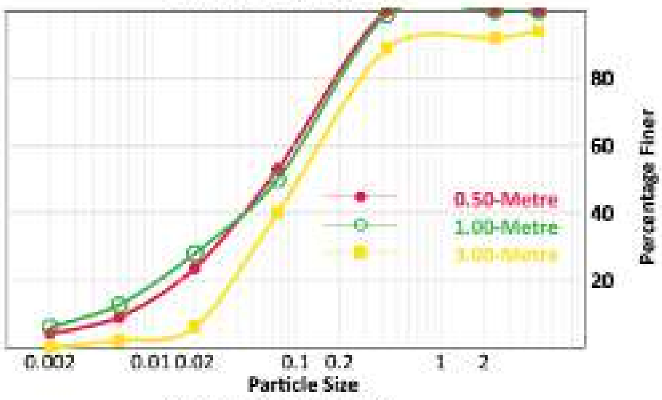
DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-MI		0.50	D		-	-
			1.00	D	4	-	-
			2.00	U		-	-
			3.00	D	10	-	-
Silty Sands	SM		4.00	D	14	-	-
			5.00	U		-	-
Inorganic clays of low plasticity	CL		6.00	D	11	-	-
			7.00	D	30	-	-
Silty Sands	SM		8.00	U		-	-
			9.00	D	31	-	-
Inorganic clays of low plasticity	CL		10.00	D	44	-	-
			11.00	U		-	-
			12.50	D	27	-	-
			14.00	U		-	-
			15.50	D	37	-	-
Clayey Sands	SC		17.00	U		-	-
			18.50	D	40	-	-
Inorganic Silty Clays of low plasticity	CL-ML		20.00	D		-	-

BH-P111-23830.447

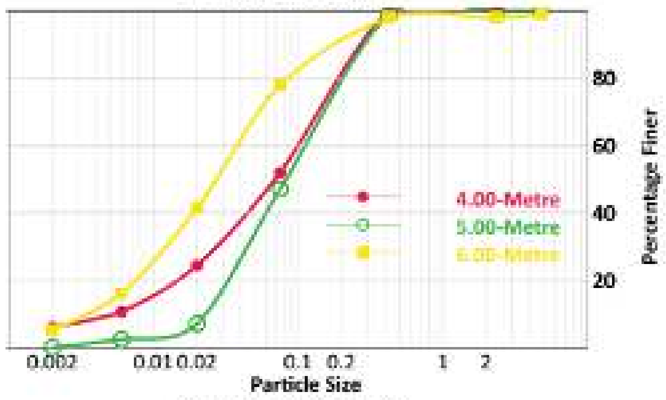
DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		20.00	D		-	-
			21.50	D	54	-	-
			23.00	D		-	-
			24.50	D	57	-	-
			26.00	D	86	-	-
			27.50	D	85	-	-
			29.00	D	88	-	-
			30.50	D	79	-	-
			32.00	D	83	-	-
			33.50	D	82	-	-
			35.00	D	87	-	-
Clayey Sands	SC		36.50	D	85	-	-
			38.00	D	88	-	-
Inorganic clays of low plasticity	CL		40.00	D	R	-	-

APPENDIX-D
PLOT 1: GRAIN SIZE DISTRIBUTION PLOTS

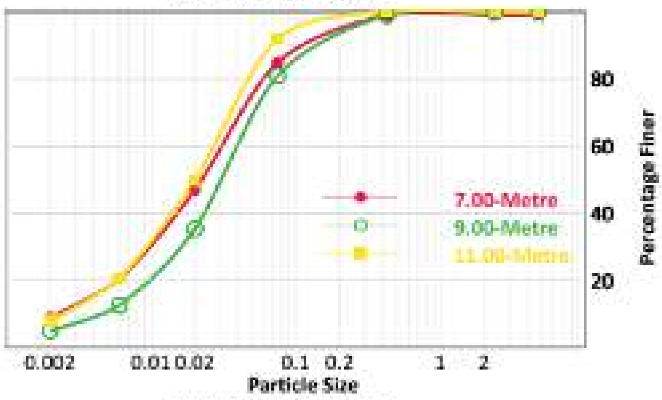
BH- P101-CH.23562.087



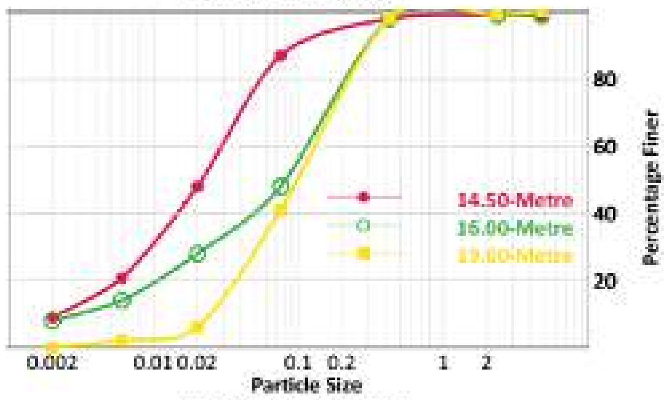
BH- P101-CH.23562.087



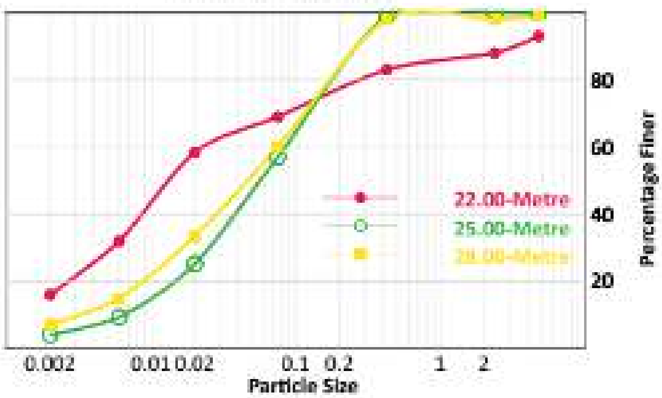
BH- P101-CH.23562.087



BH- P101-CH.23562.087



BH- P101-CH.23562.087



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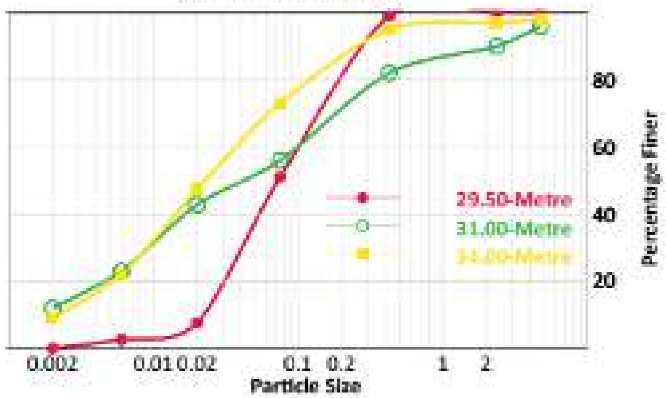
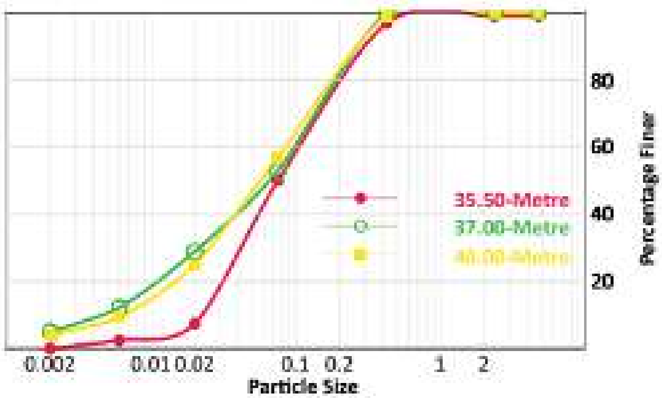
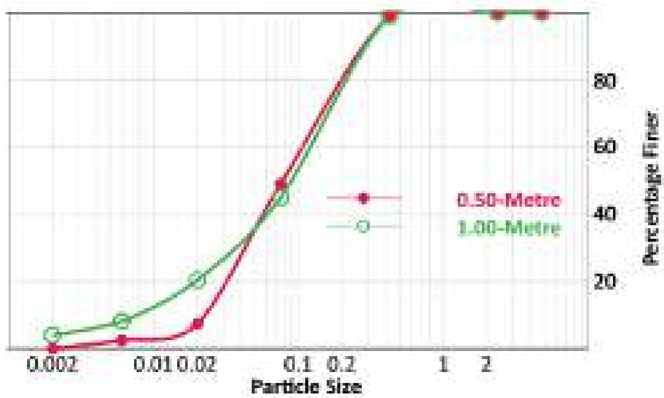


BH- P101-CH.23562.087

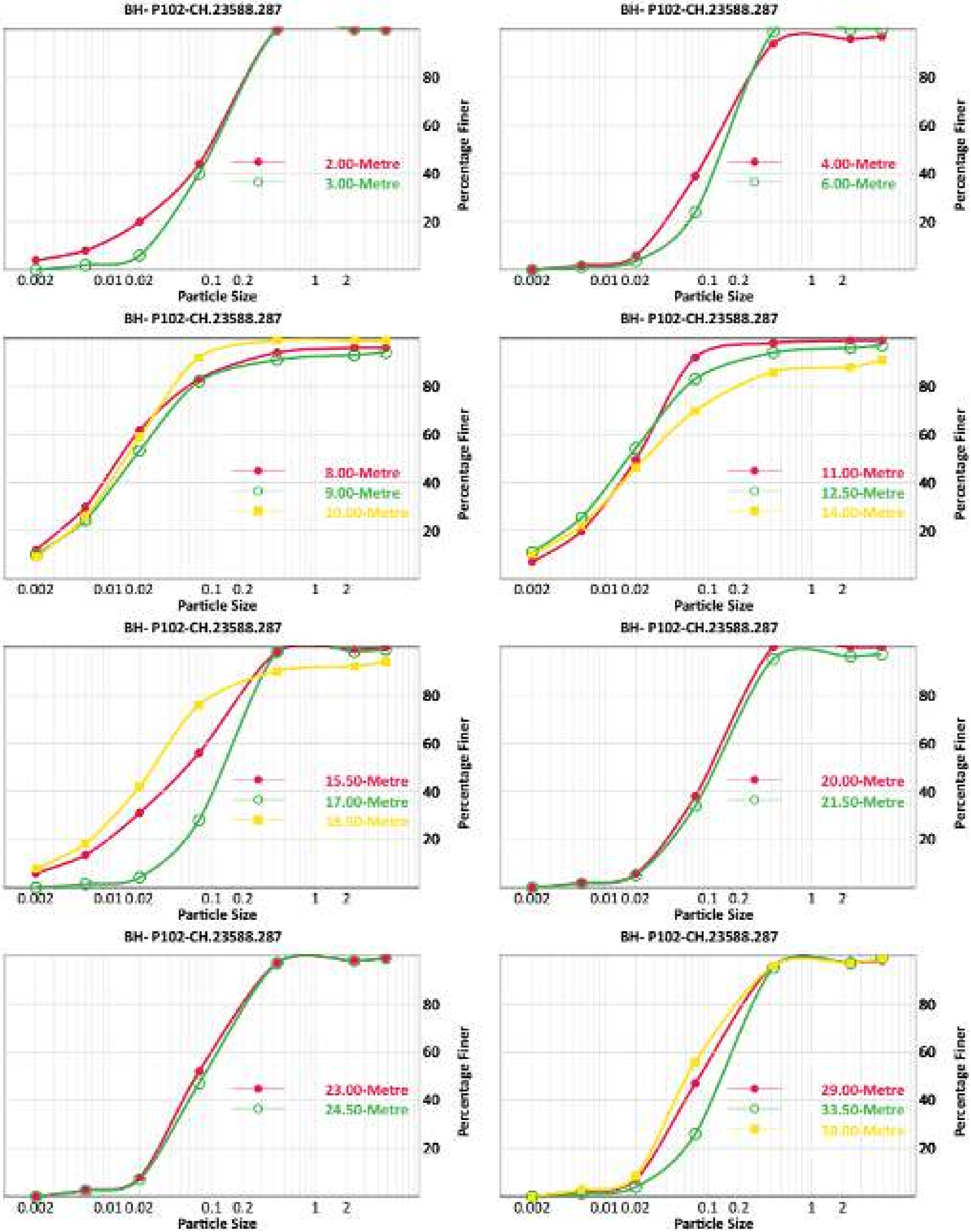


BH- P102-CH.23588.287

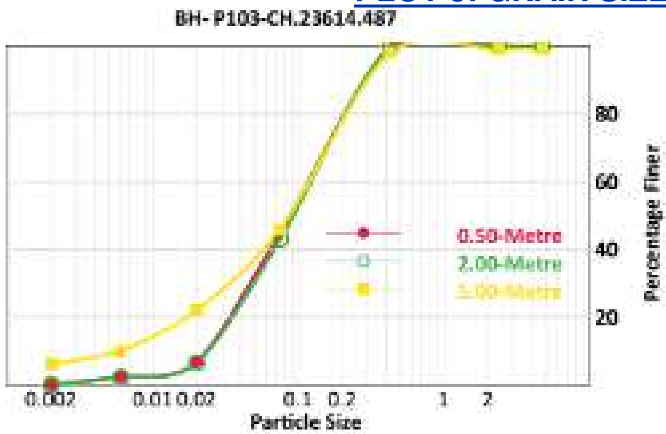


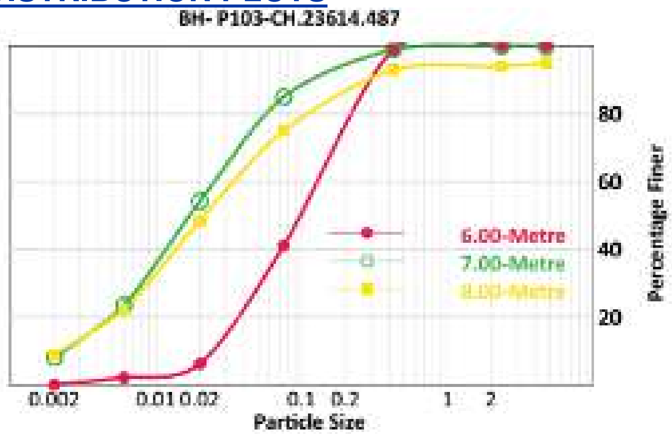
APPENDIX-D

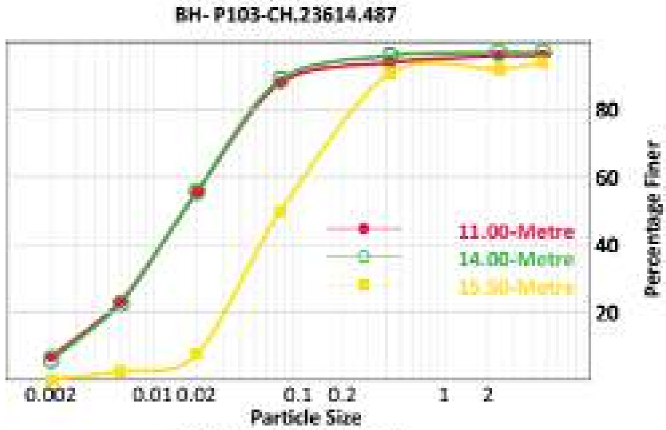
PLOT 2: GRAIN SIZE DISTRIBUTION PLOTS

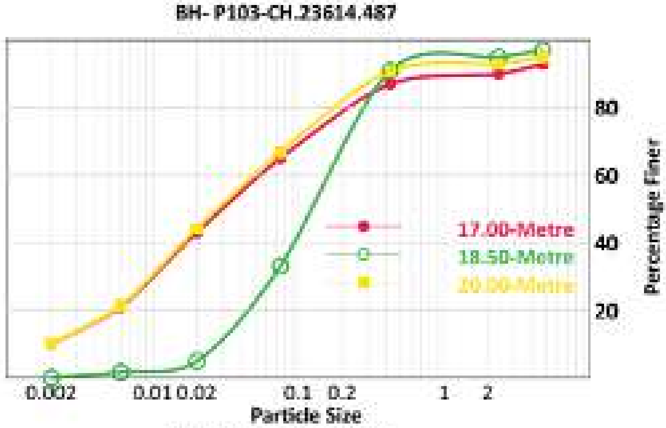


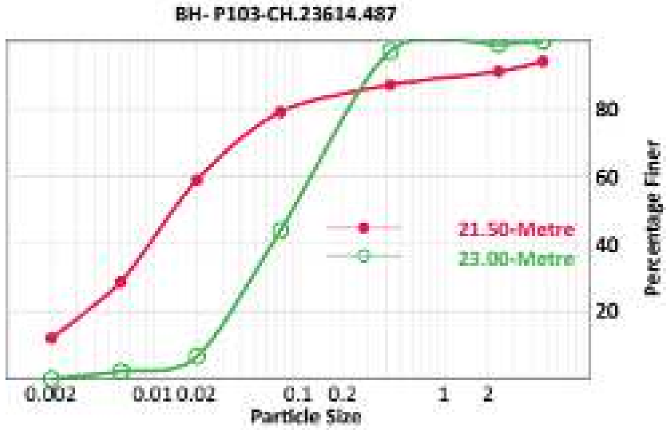
APPENDIX-D
PLOT 3: GRAIN SIZE DISTRIBUTION PLOTS

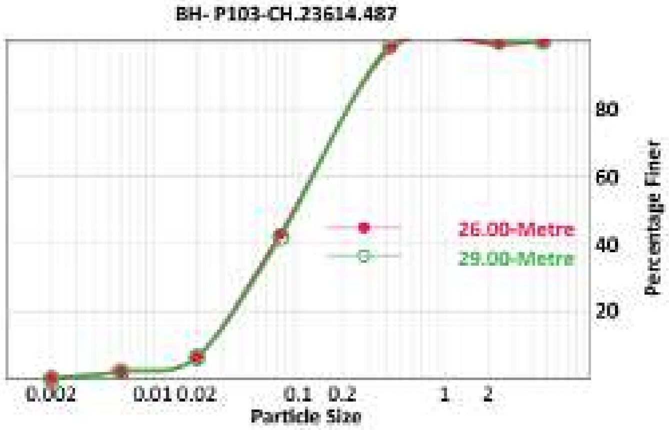


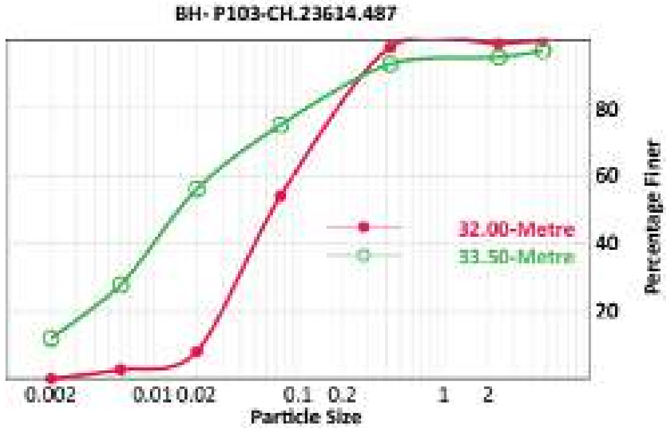


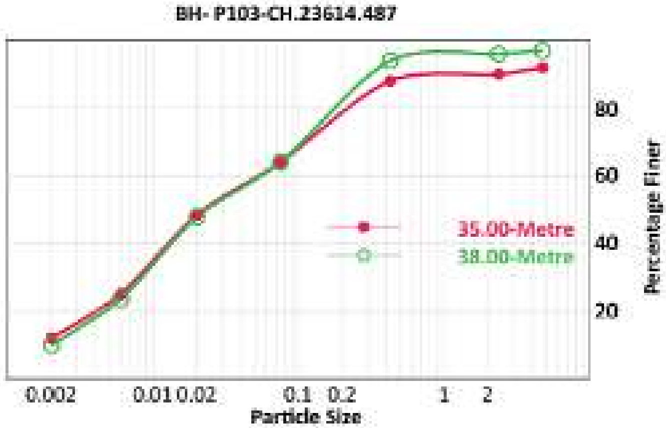




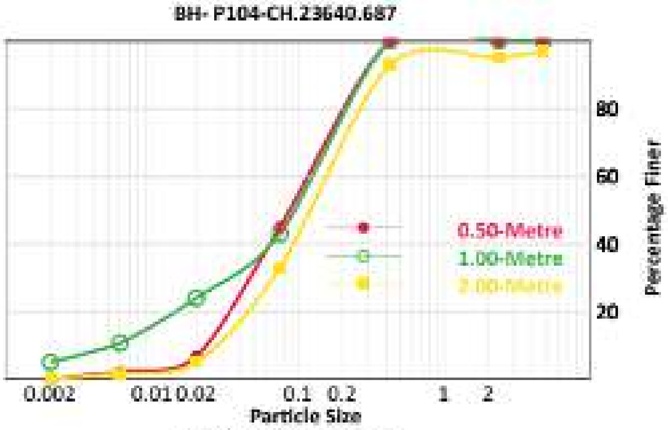


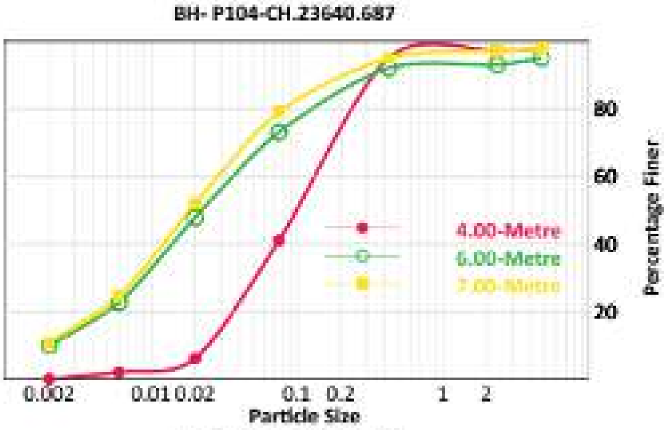


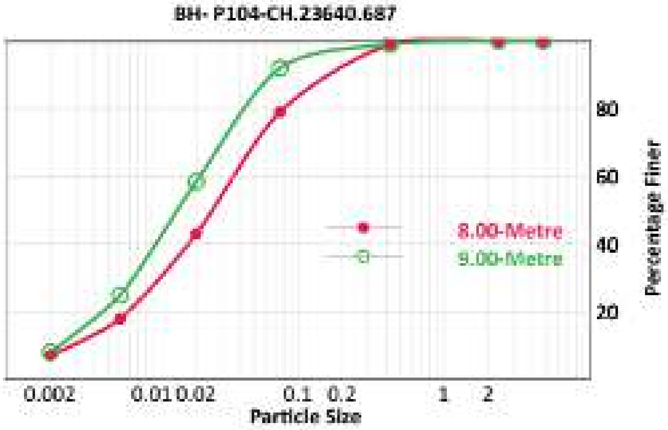


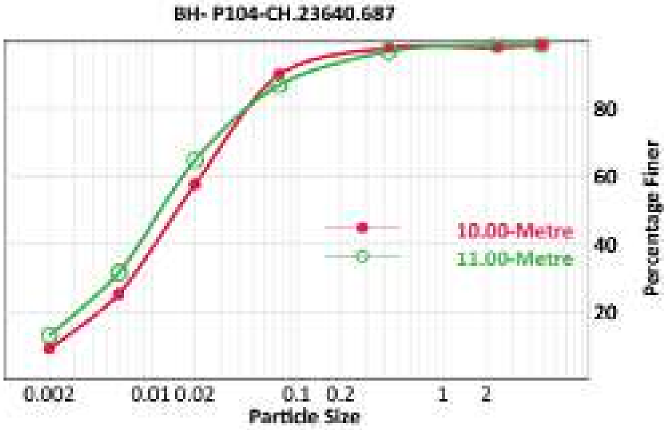


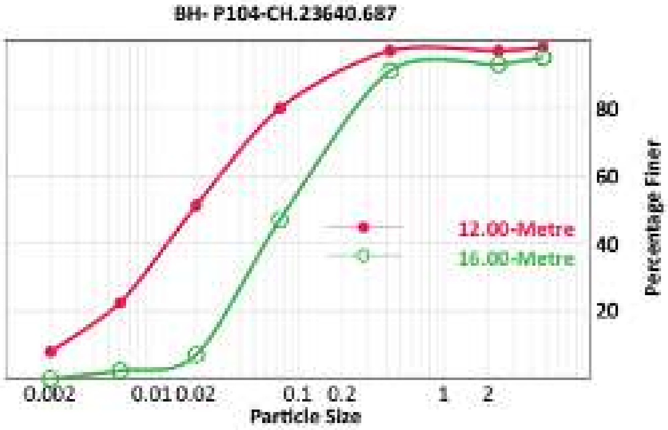
APPENDIX-D
PLOT 4: GRAIN SIZE DISTRIBUTION PLOTS

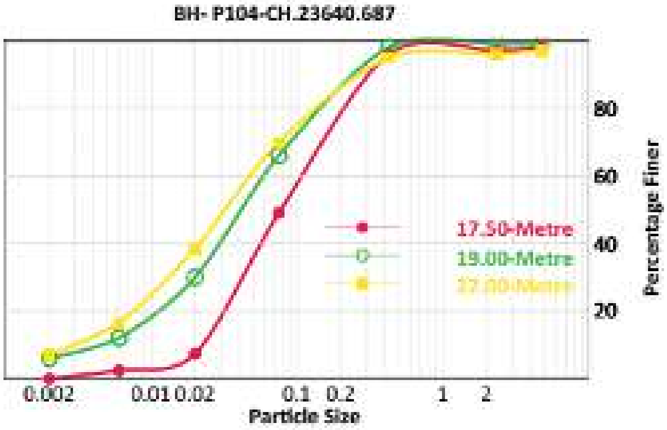


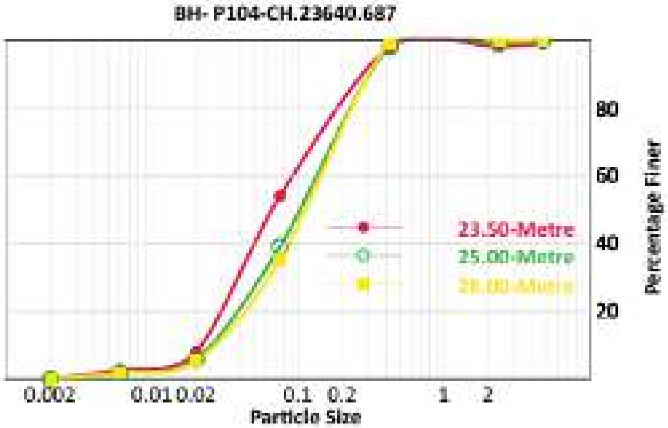


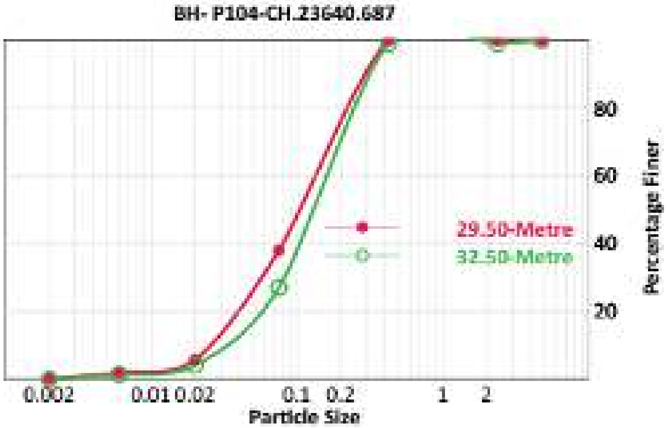






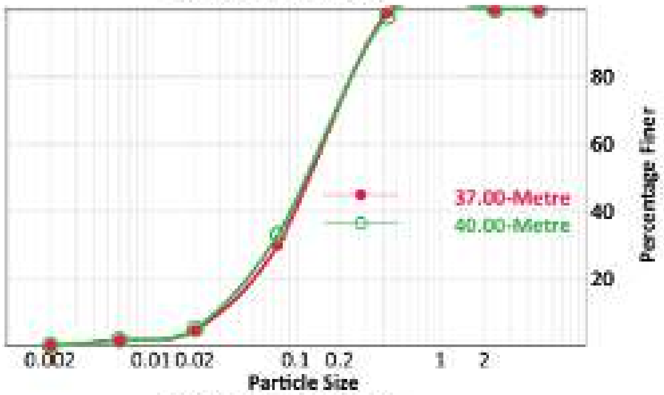




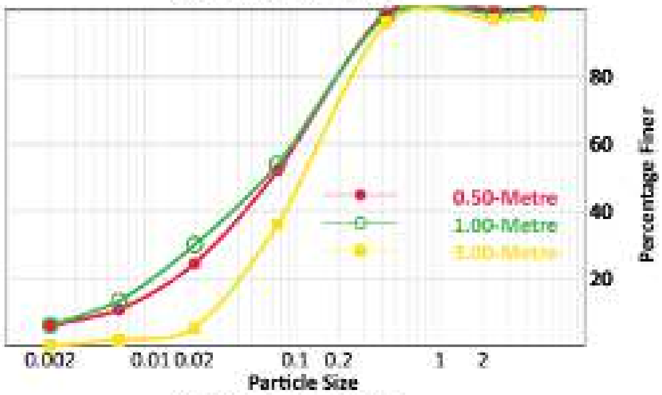


APPENDIX-D
PLOT 5: GRAIN SIZE DISTRIBUTION PLOTS

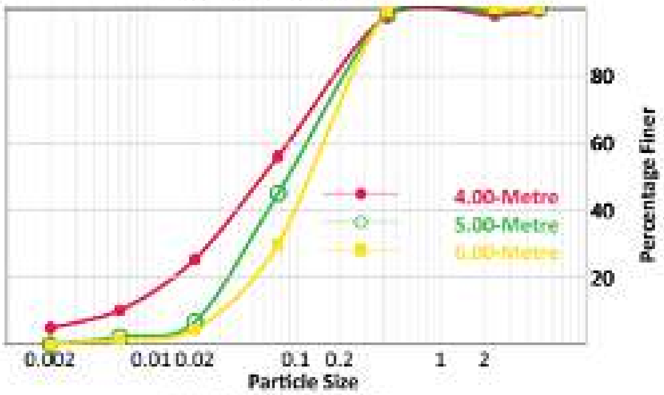
BH- P104-CH.23640.687



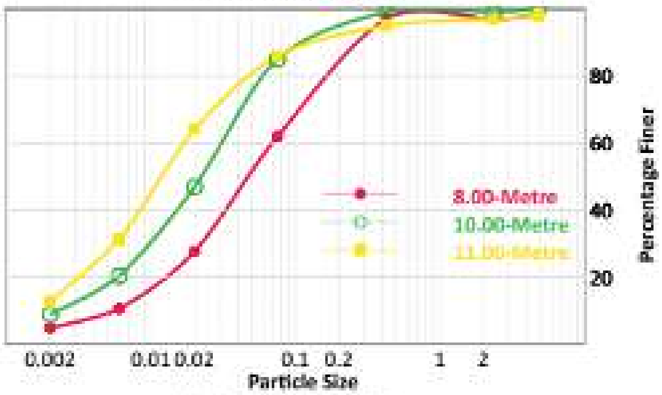
BH- P105-CH.23666.887



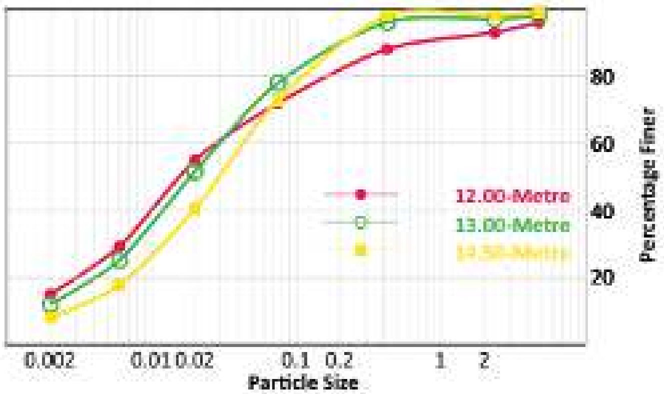
BH- P105-CH.23666.887



BH- P105-CH.23666.887



BH- P105-CH.23666.887



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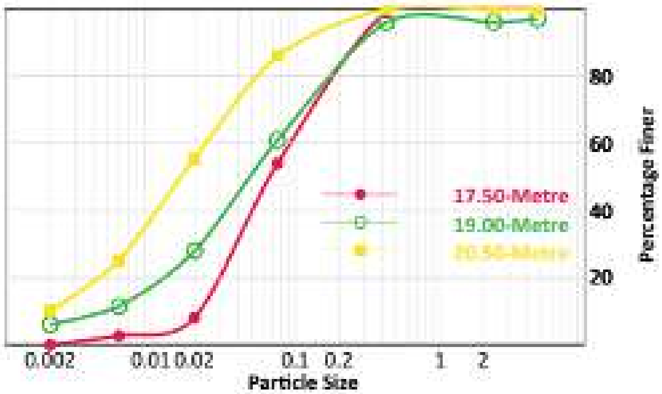
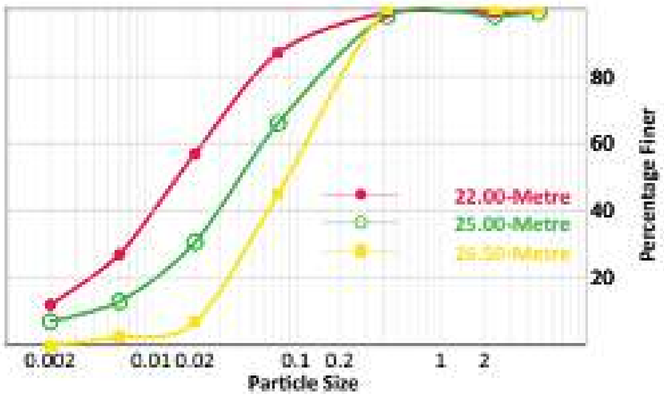
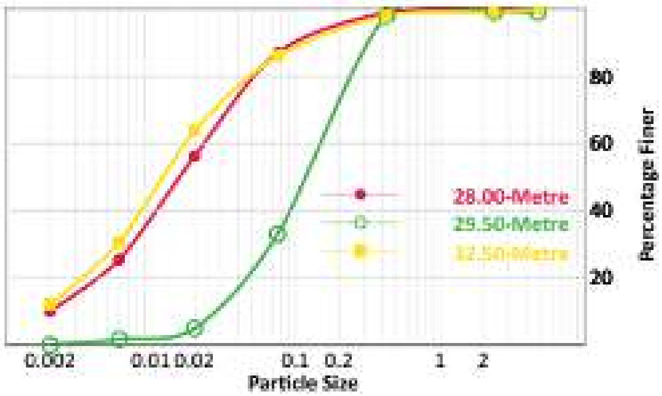


BH- P105-CH.23666.887



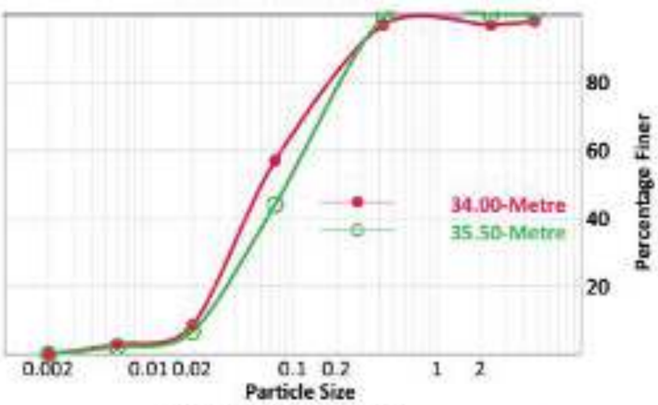
BH- P105-CH.23666.887



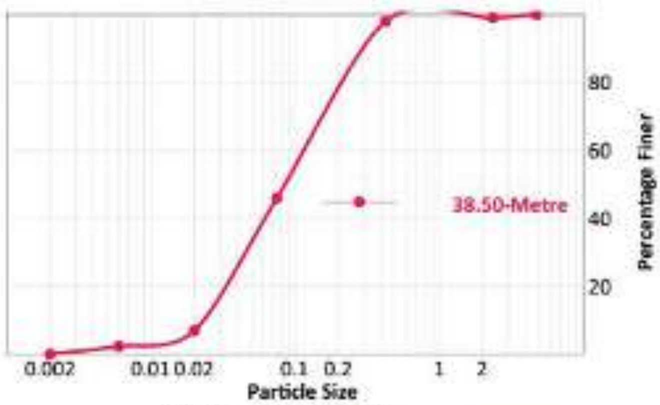
APPENDIX-D

PLOT 6: GRAIN SIZE DISTRIBUTION PLOTS

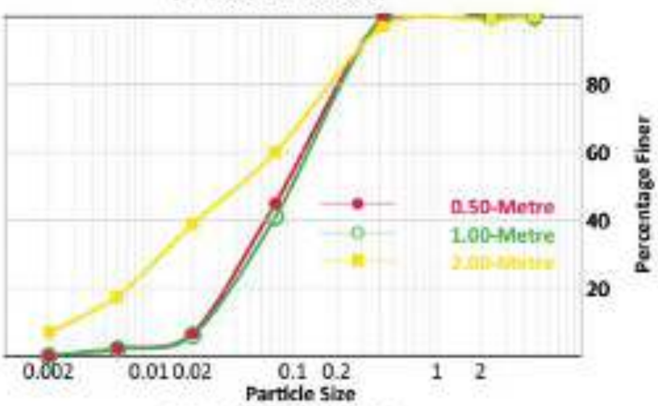
BH- P105-CH.23666.887



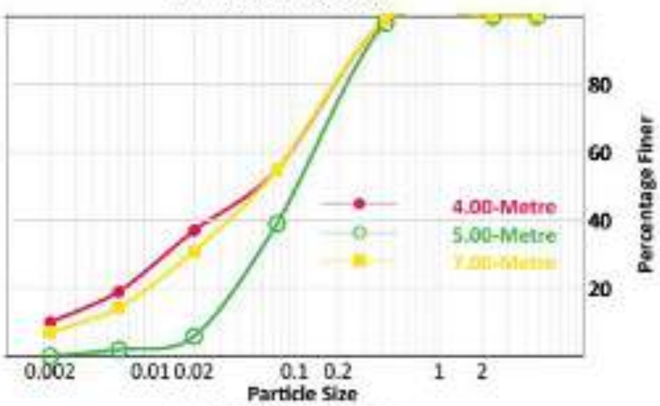
BH- P105-CH.23666.887



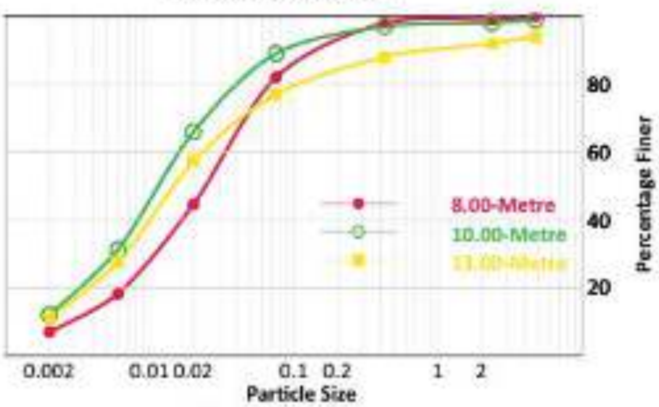
BH- P106-CH.23693.087



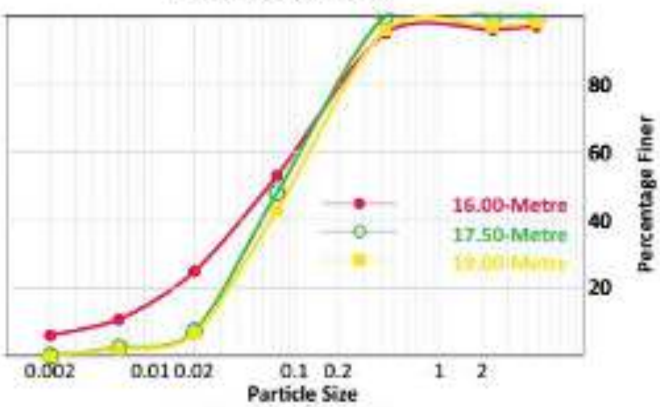
BH- P106-CH.23693.087



BH- P106-CH.23693.087



BH- P106-CH.23693.087



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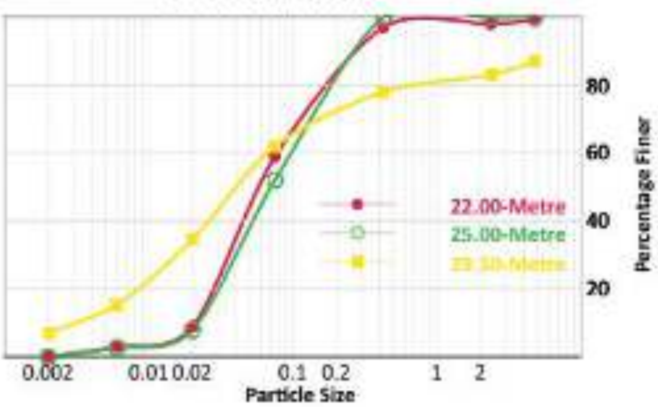
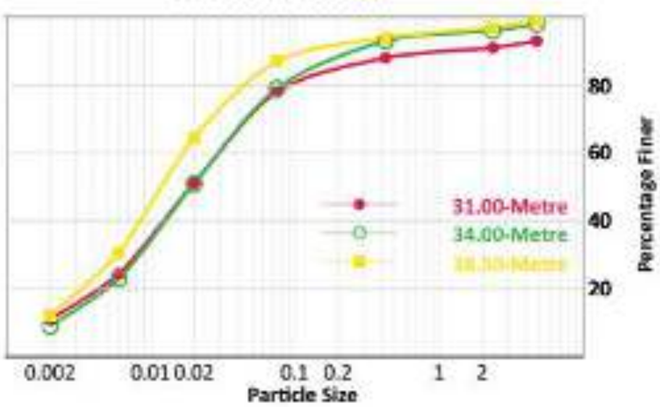
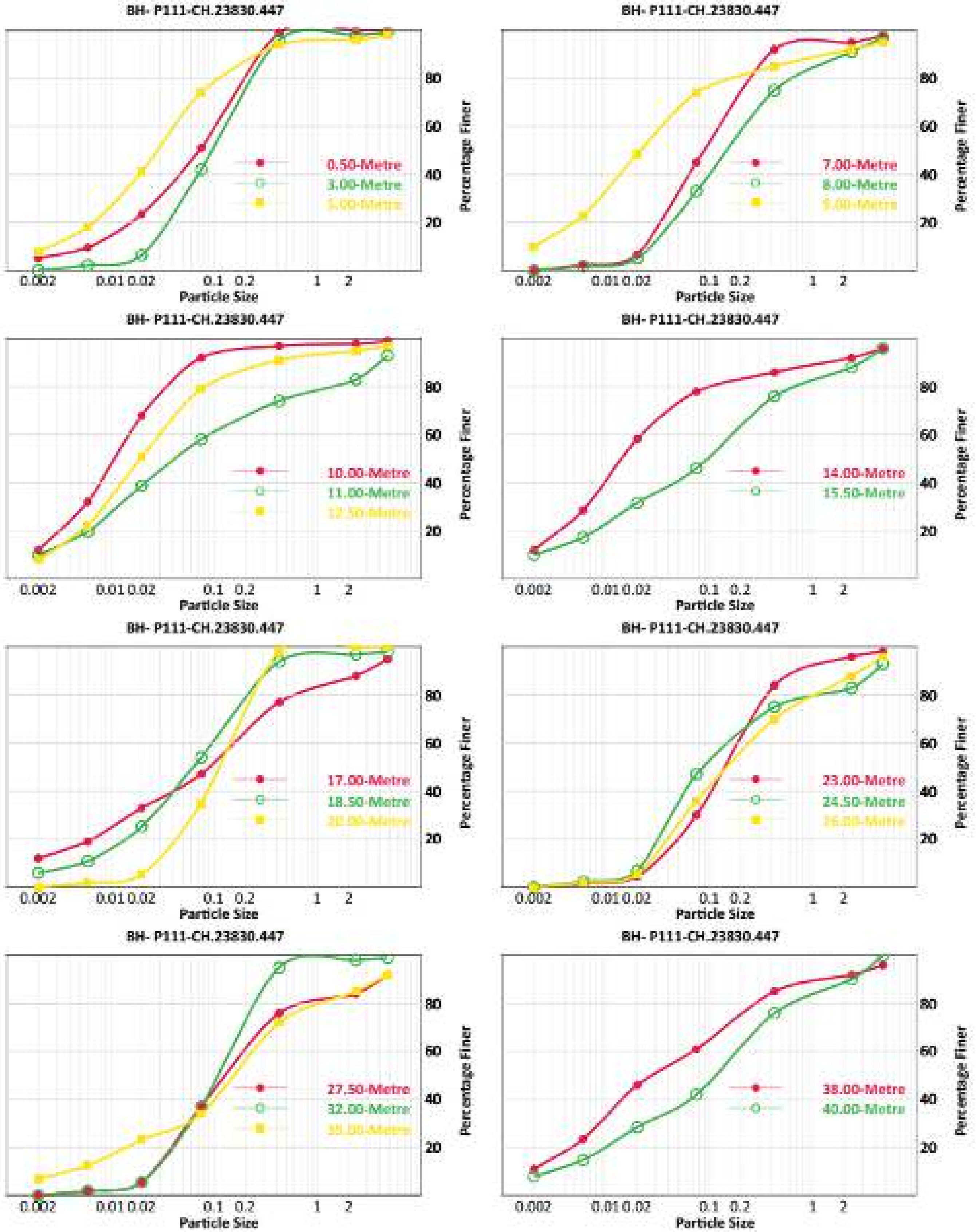


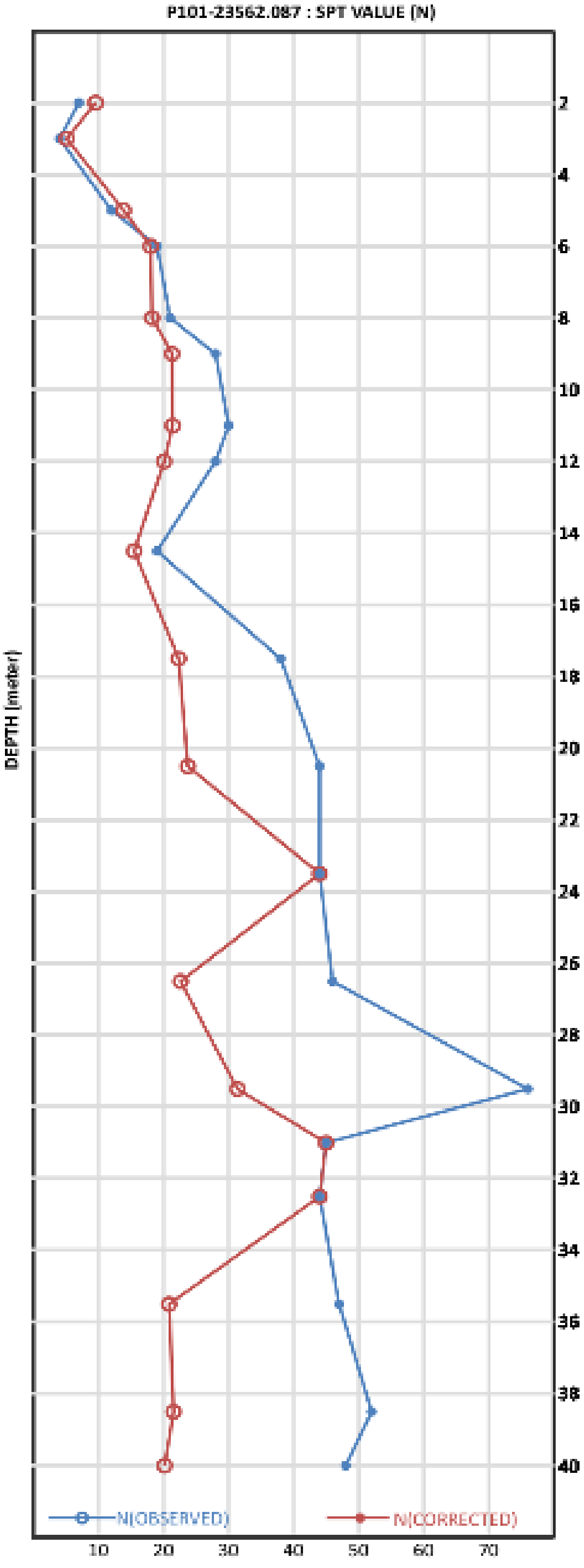
BH- P106-CH.23693.087

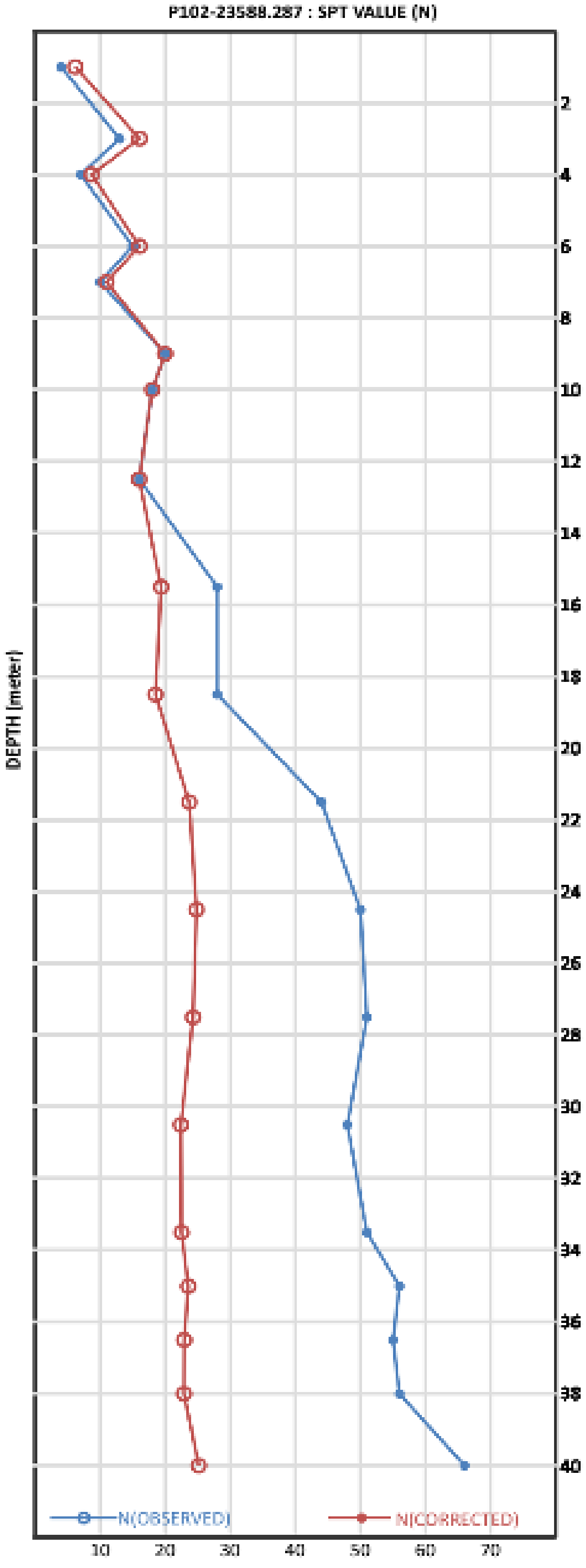


APPENDIX-D
PLOT 7: GRAIN SIZE DISTRIBUTION PLOTS

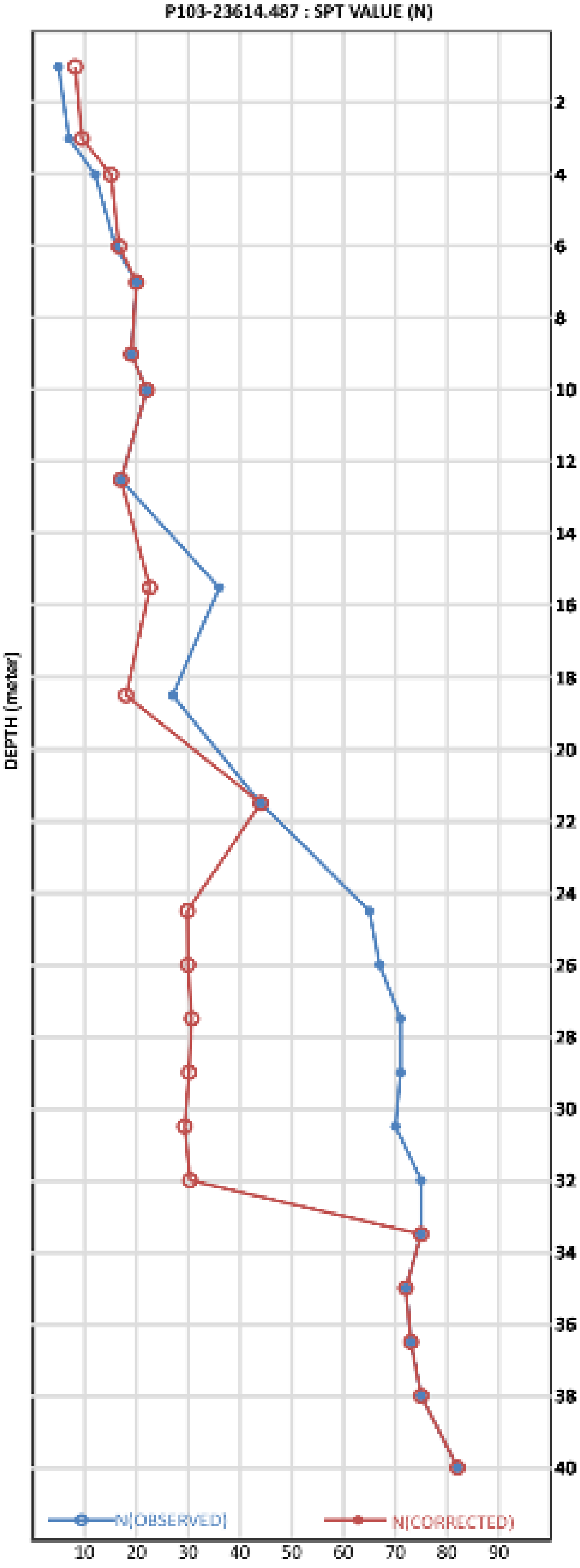


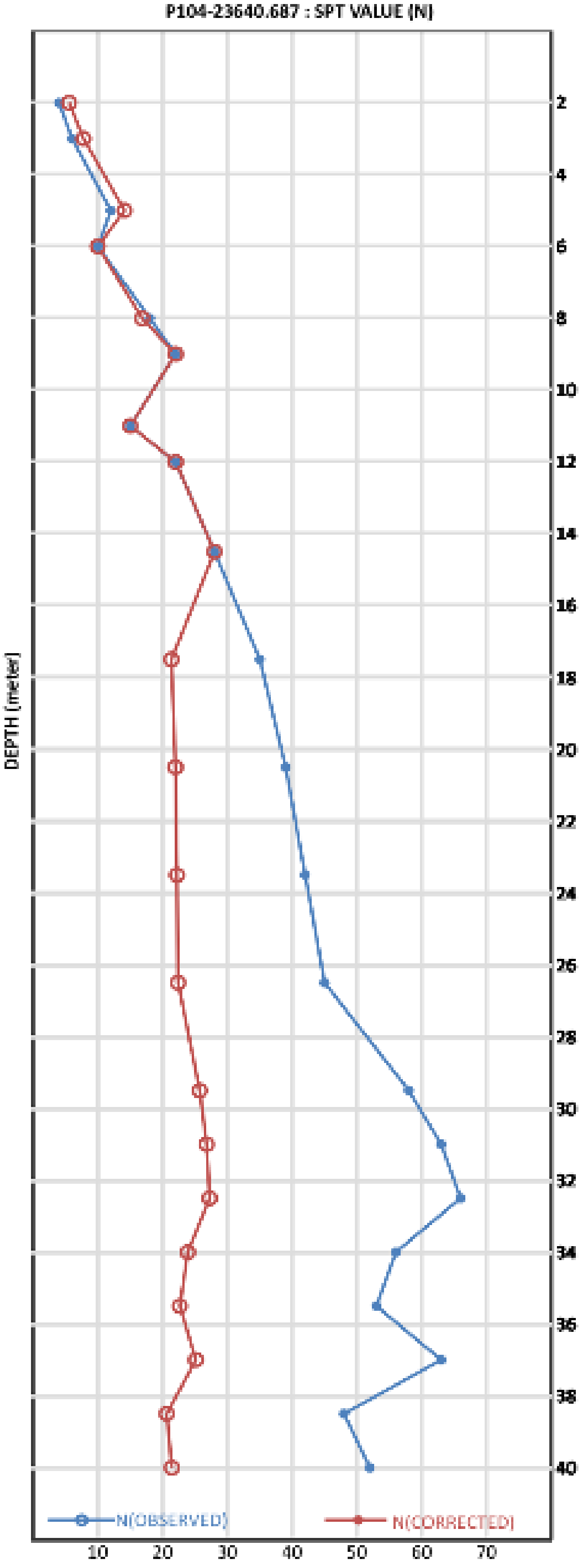
APPENDIX-E
PLOT 1: RECORDED SPT Vs CORRECTED SPT



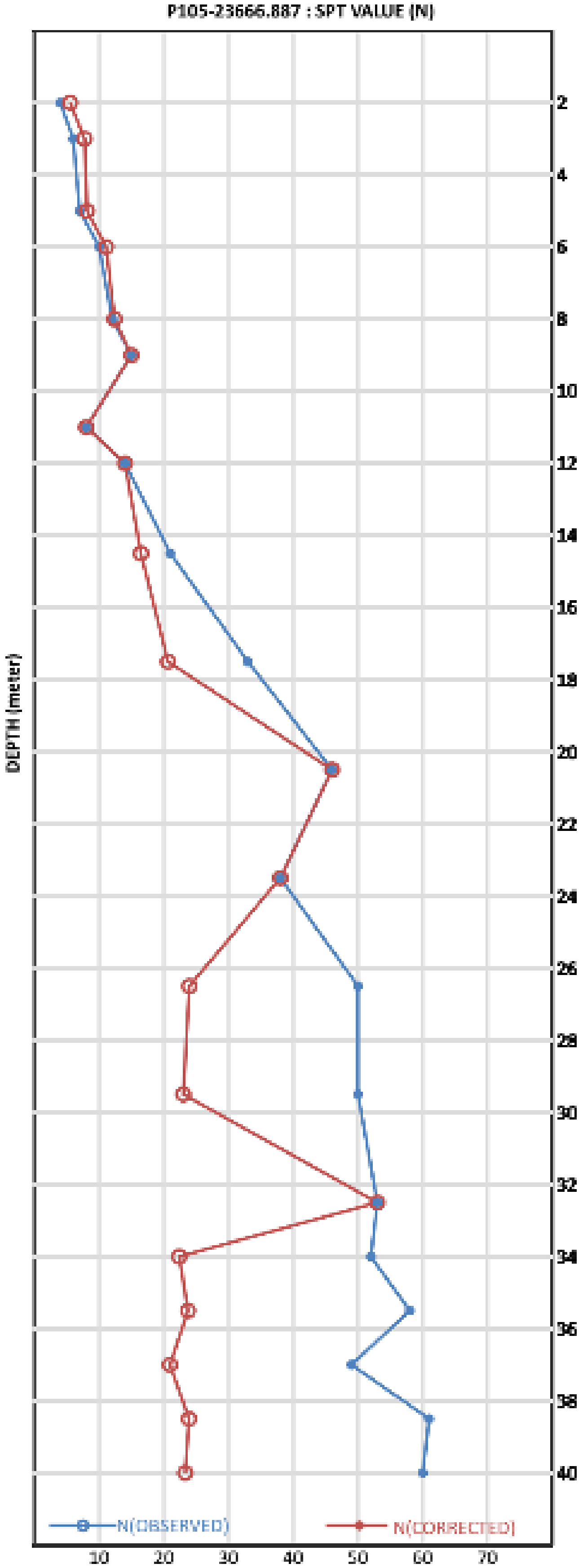


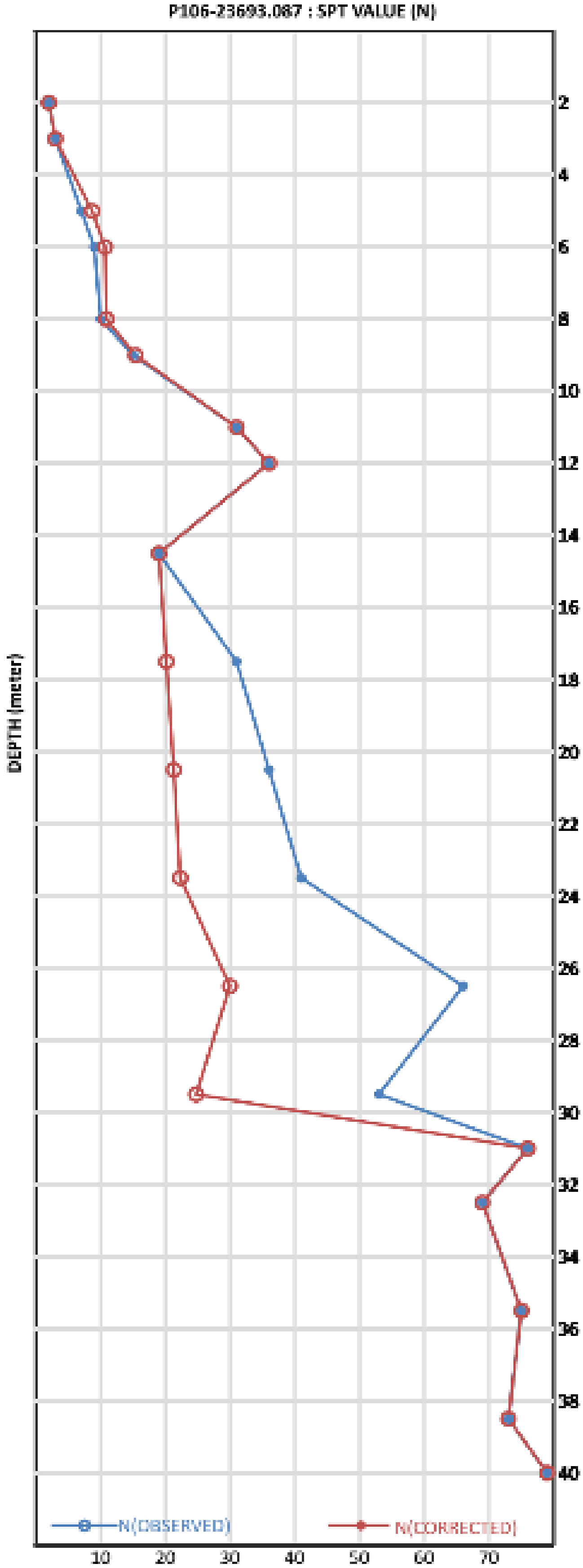
APPENDIX-E
PLOT 2: RECORDED SPT Vs CORRECTED SPT





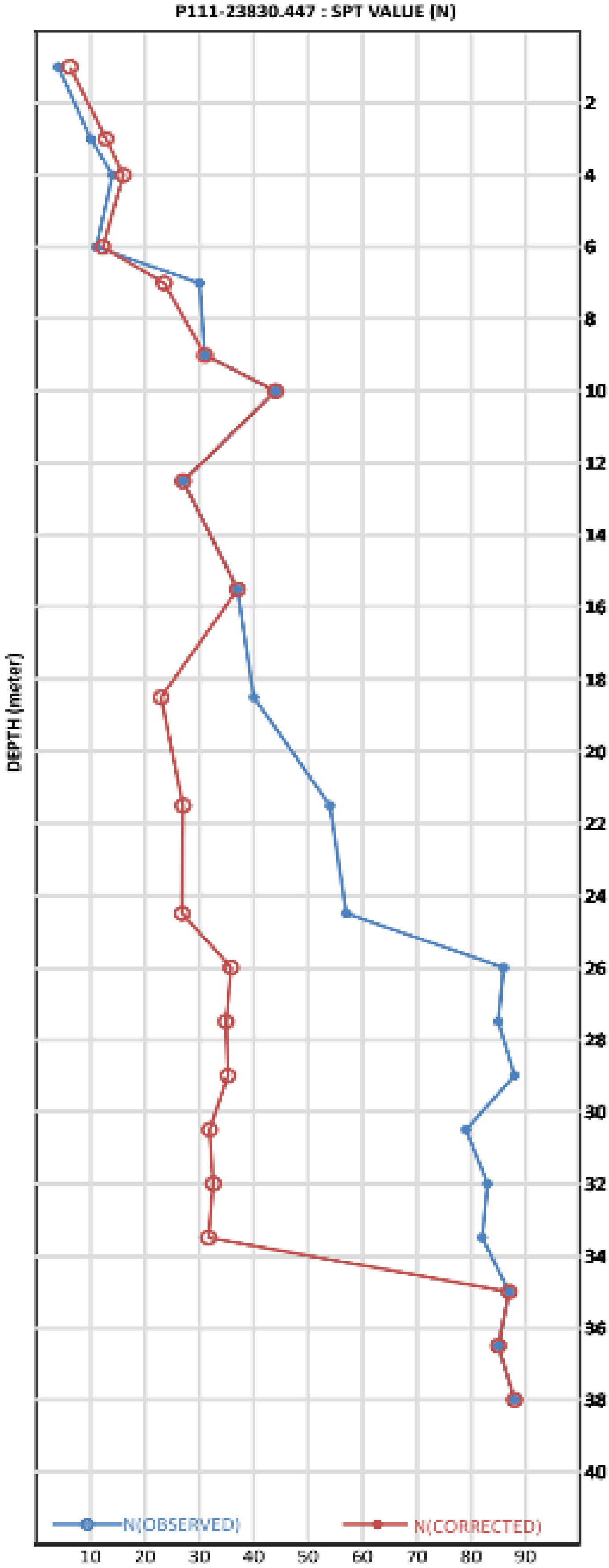
APPENDIX-E
PLOT 3: RECORDED SPT Vs CORRECTED SPT





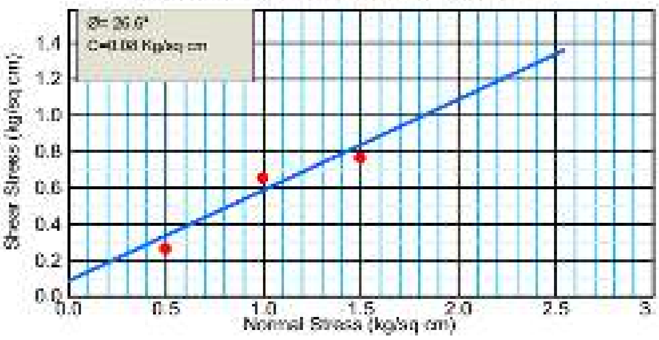
APPENDIX-E

PLOT 4: RECORDED SPT Vs CORRECTED SPT

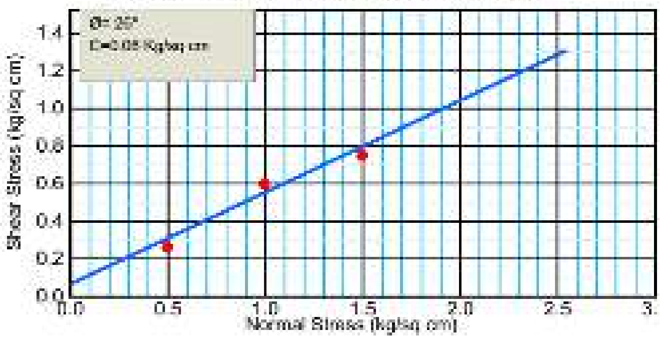


APPENDIX-F
GRAPH 1: DST GRAPH

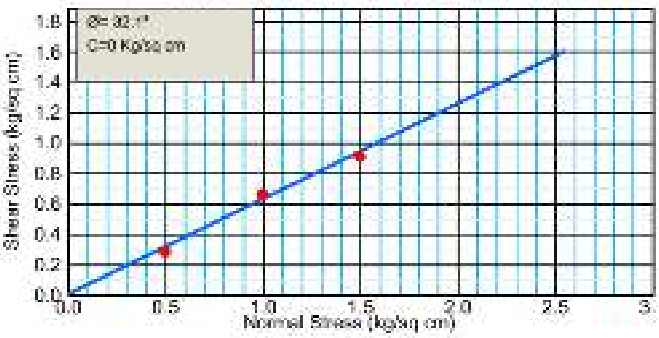
1901-HRIDC-VI-23582.087
BH-P101, DEPTH=4.00M, DIRECT SHEAR TEST



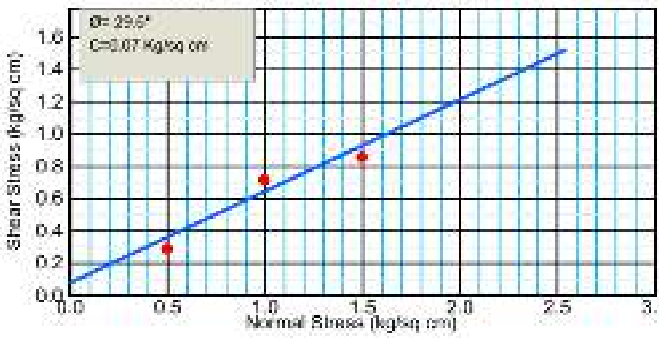
1901-HRIDC-VI-23582.087
BH-P101, DEPTH=10.00M, DIRECT SHEAR TEST



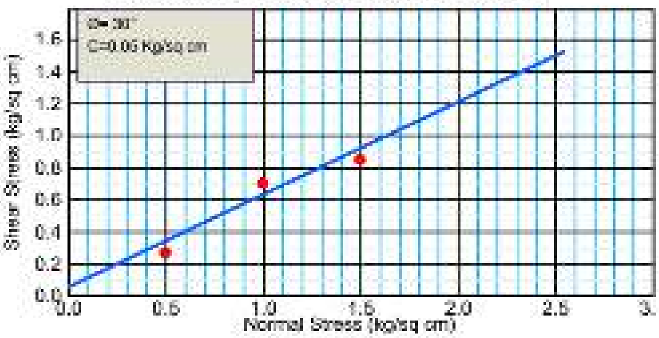
1901-HRIDC-VI-23582.087
BH-P101, DEPTH=19.00M, DIRECT SHEAR TEST



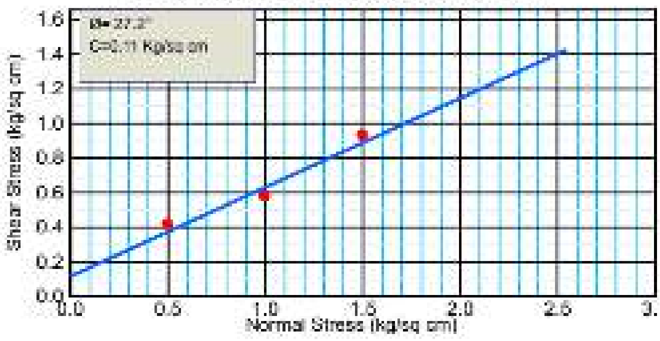
1901-HRIDC-VI-23582.087
BH-P101, DEPTH=25.00M, DIRECT SHEAR TEST



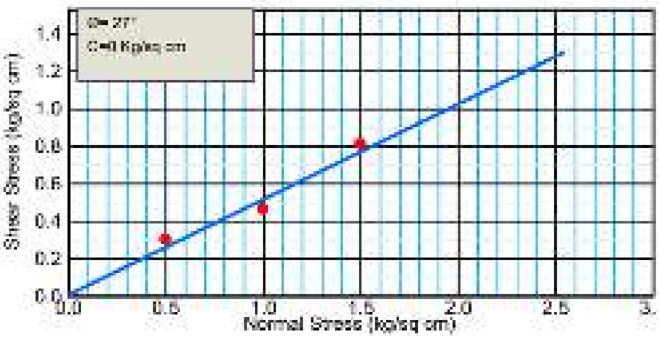
1901-HRIDC-VI-23582.087
BH-P101, DEPTH=37.00M, DIRECT SHEAR TEST



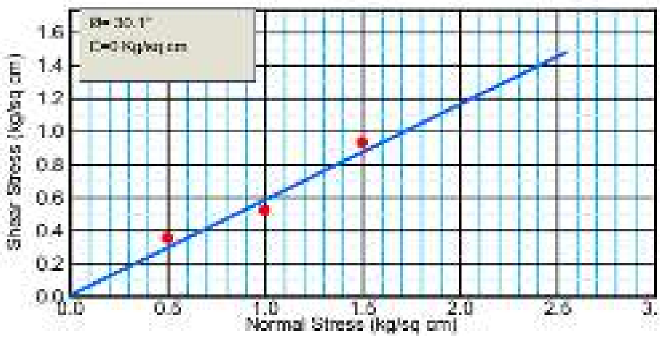
1901-HRIDC-VI-23588.287
BH-P102, DEPTH=2.00M, DIRECT SHEAR TEST



1901-HRIDC-VI-23588.287
BH-P102, DEPTH=5.00M, DIRECT SHEAR TEST



1901-HRIDC-VI-23588.287
BH-P102, DEPTH=17.00M, DIRECT SHEAR TEST

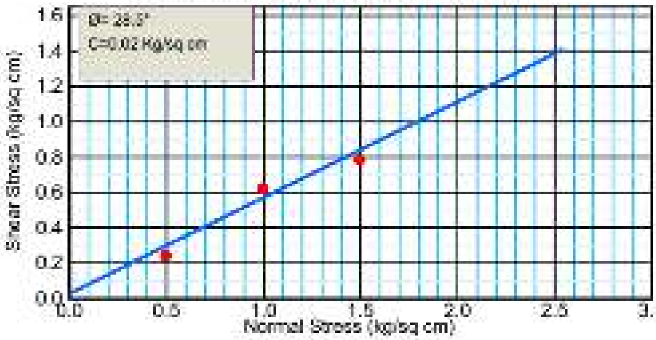


APPENDIX-F
GRAPH 2: DST GRAPH

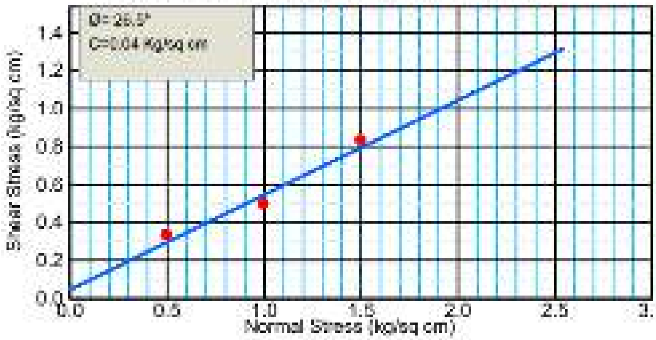
1901-HRIDC-VI-23588.287
BH-P102, DEPTH=23.00M, DIRECT SHEAR TEST

1901-HRIDC-VI-23588.287
BH-P102, DEPTH=32.00M, DIRECT SHEAR TEST

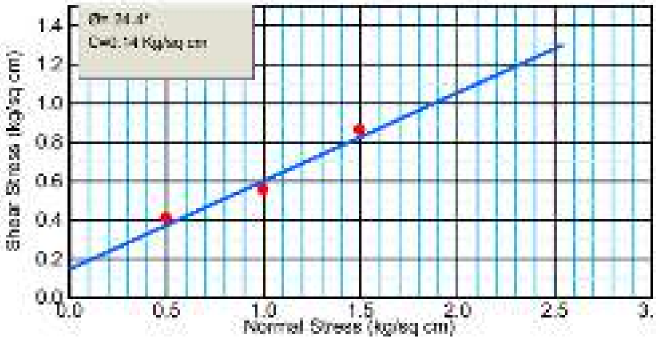
1901-HRIDC-VI-23614.487
BH-P103, DEPTH=2.00M, DIRECT SHEAR TEST



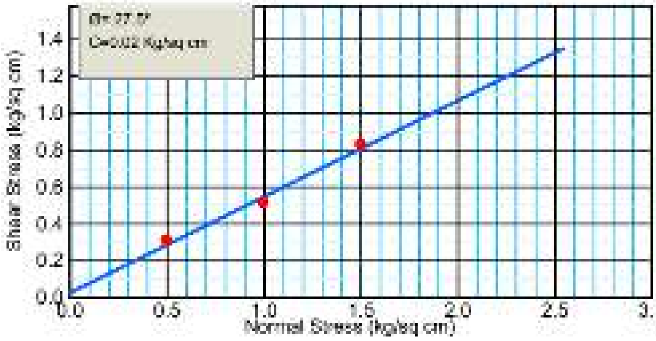
1901-HRIDC-VI-23614.487
BH-P103, DEPTH=5.00M, DIRECT SHEAR TEST



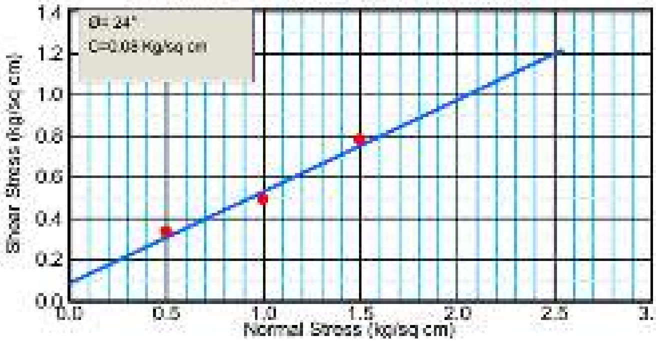
1901-HRIDC-VI-23614.487
BH-P103, DEPTH=11.00M, DIRECT SHEAR TEST



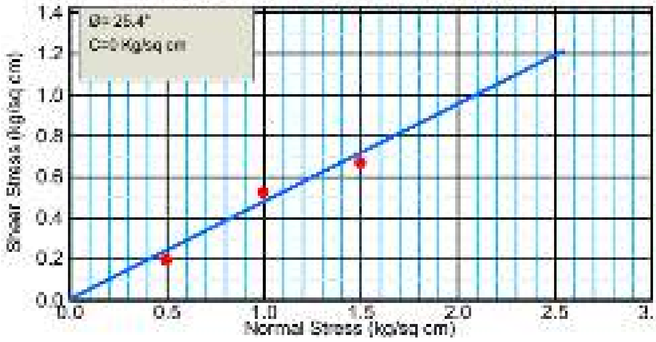
1901-HRIDC-VI-23614.487
BH-P103, DEPTH=23.00M, DIRECT SHEAR TEST



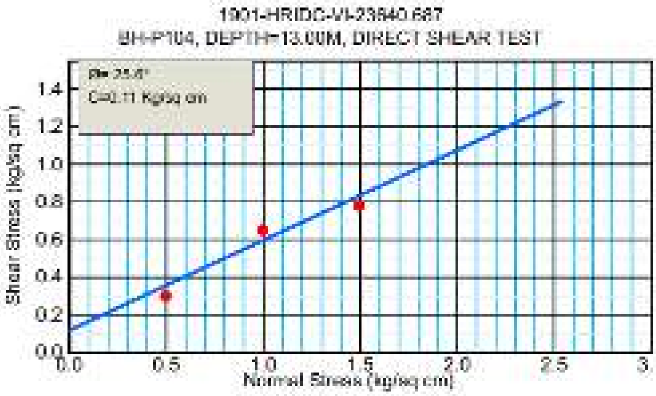
1901-HRIDC-VI-23640.687
BH-P104, DEPTH=1.00M, DIRECT SHEAR TEST

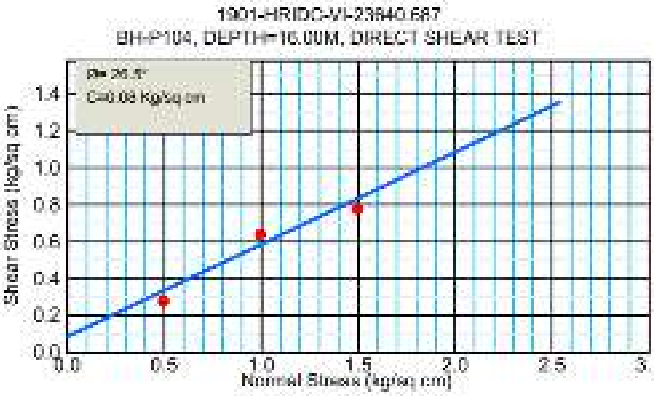


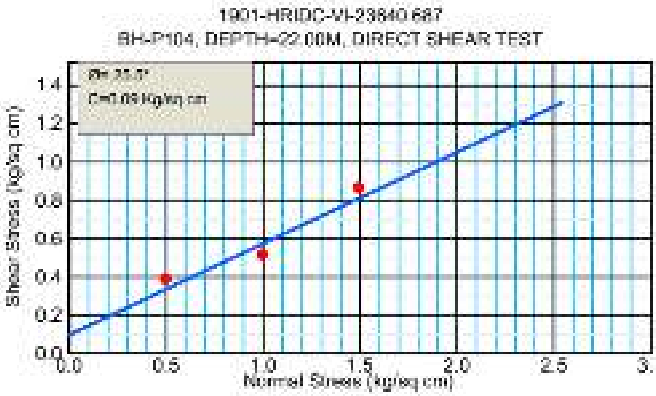
1901-HRIDC-VI-23640.687
BH-P104, DEPTH=4.00M, DIRECT SHEAR TEST

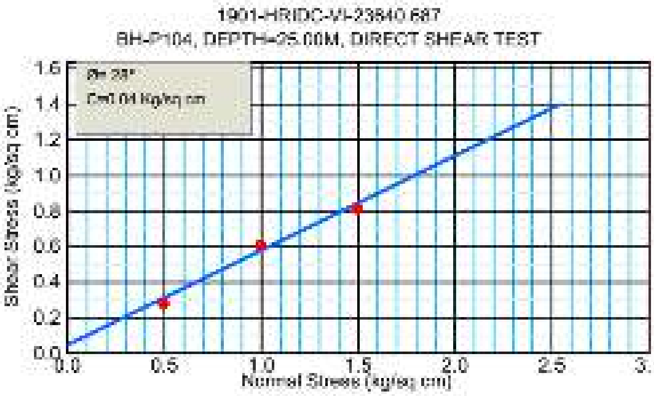


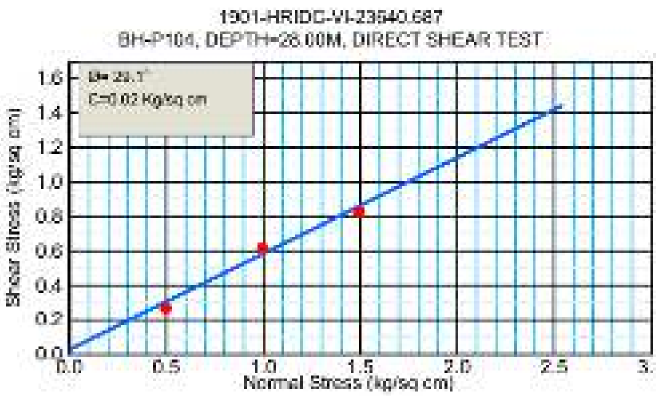
APPENDIX-F
GRAPH 3: DST GRAPH

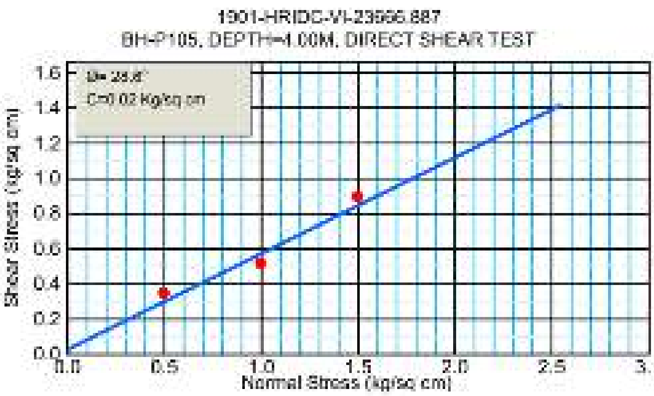


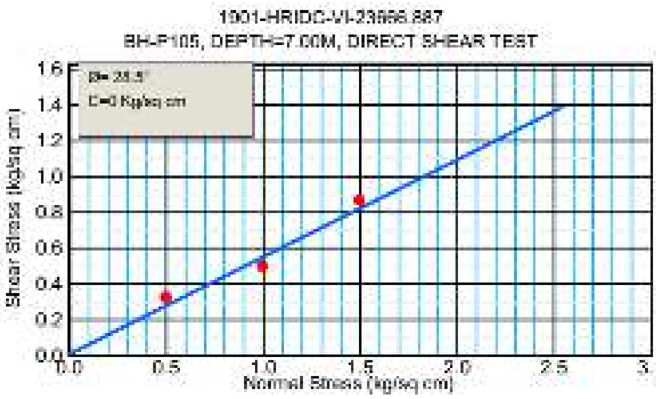


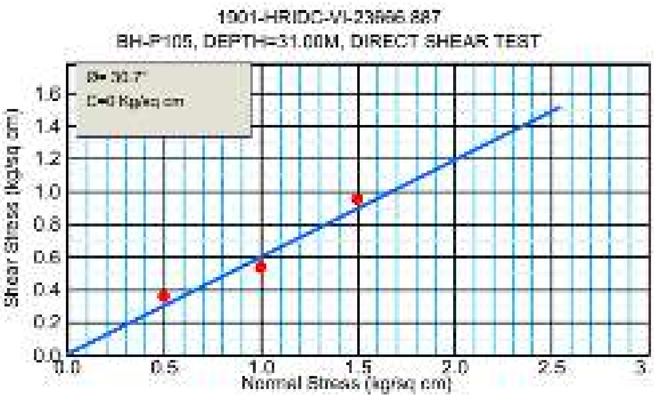






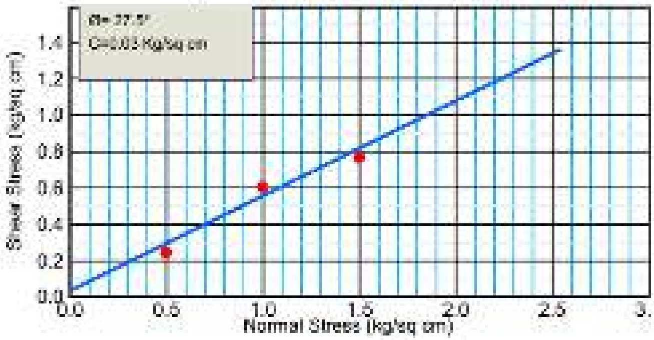




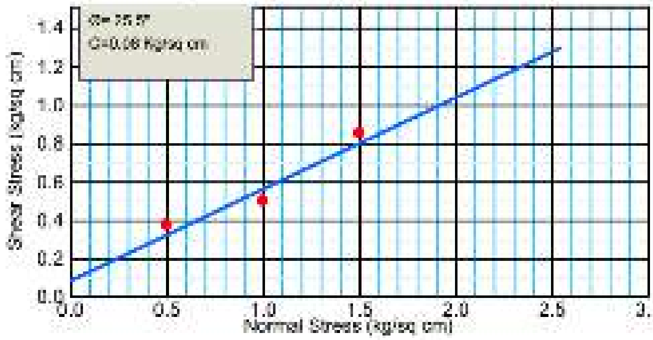


APPENDIX-F
GRAPH 4: DST GRAPH

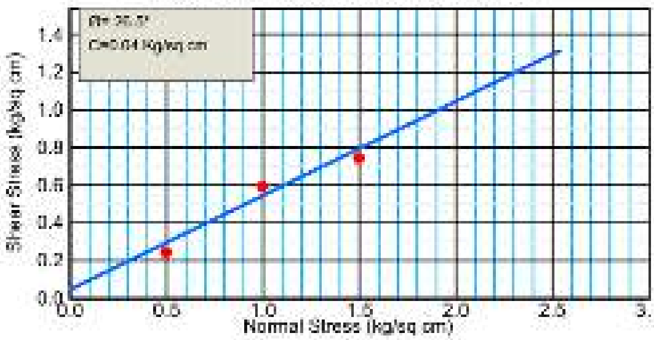
1901-HRIDC-VI-23693.087
BH-P106, DEPTH=1.00M, DIRECT SHEAR TEST



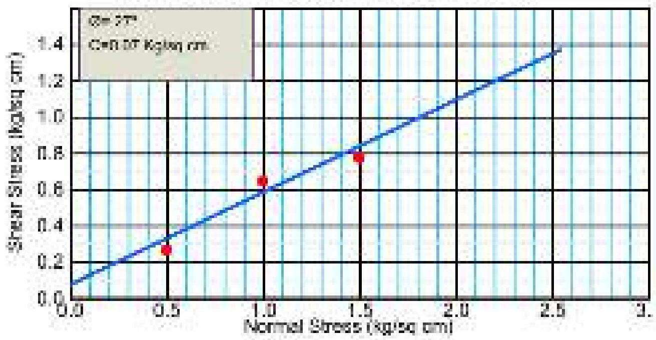
1901-HRIDC-VI-23693.087
BH-P106, DEPTH=16.00M, DIRECT SHEAR TEST



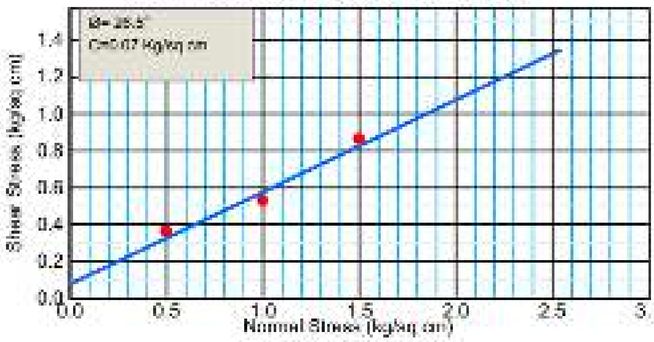
1901-HRIDC-VI-23693.087
BH-P108, DEPTH=19.00M, DIRECT SHEAR TEST



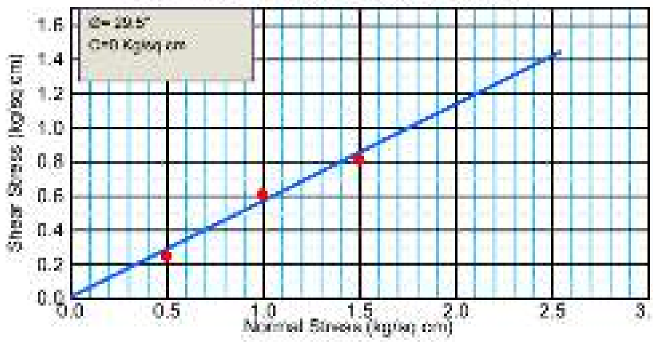
1901-HRIDC-VI-23693.087
BH-P106, DEPTH=25.00M, DIRECT SHEAR TEST



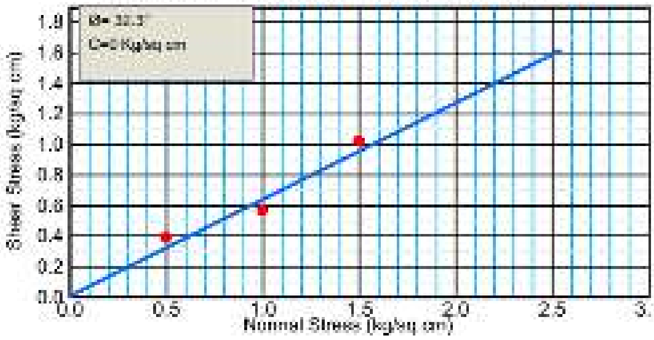
1901-HRIDC-VI-23830.447
BH-P111, DEPTH=2.00M, DIRECT SHEAR TEST



1901-HRIDC-VI-23830.447
BH-P111, DEPTH=8.00M, DIRECT SHEAR TEST

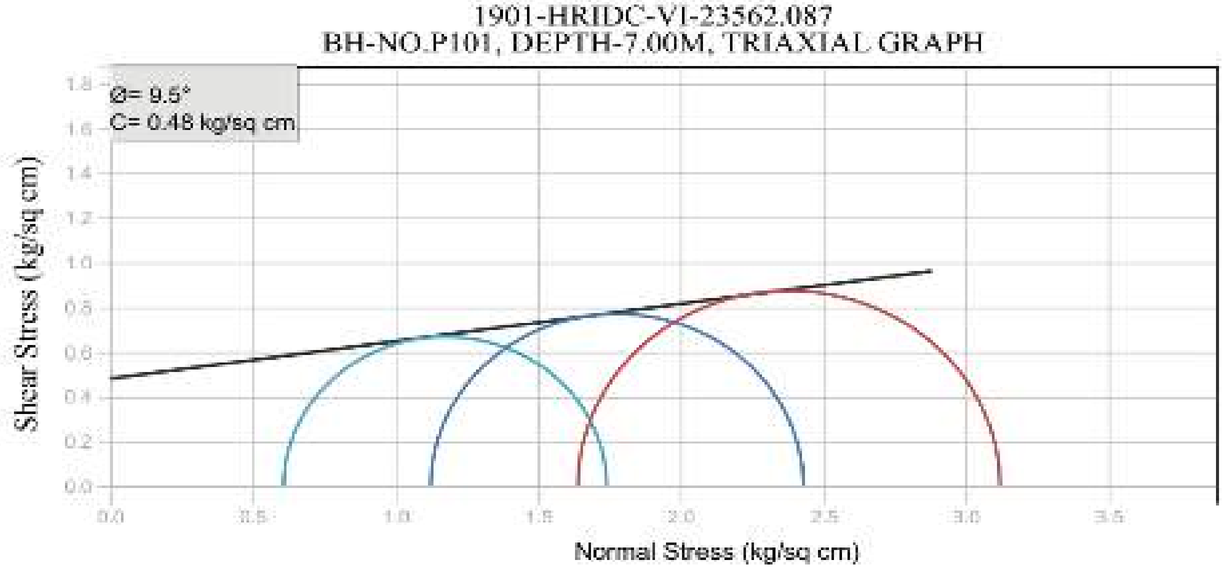


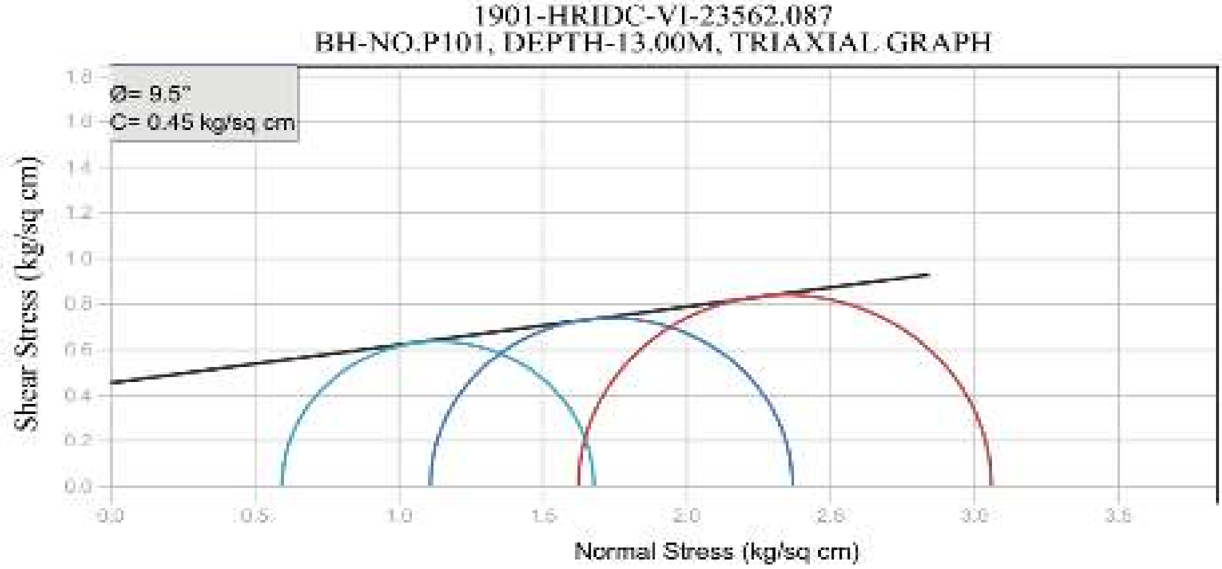
1901-HRIDC-VI-23830.447
BH-P111, DEPTH=23.00M, DIRECT SHEAR TEST

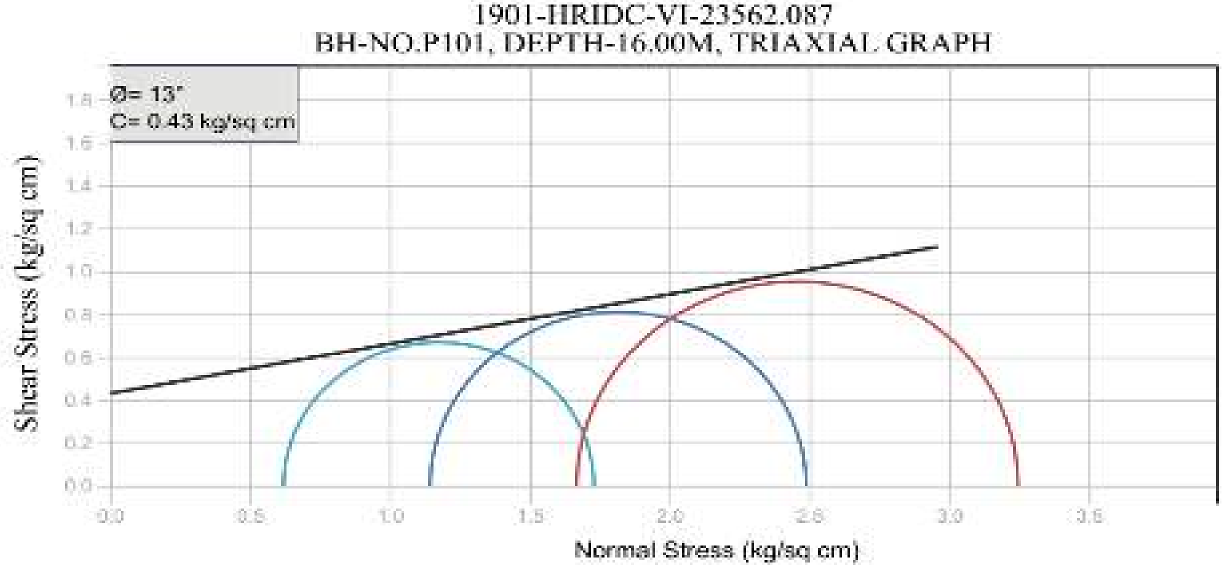


APPENDIX-G

GRAPH 1: UU GRAPH

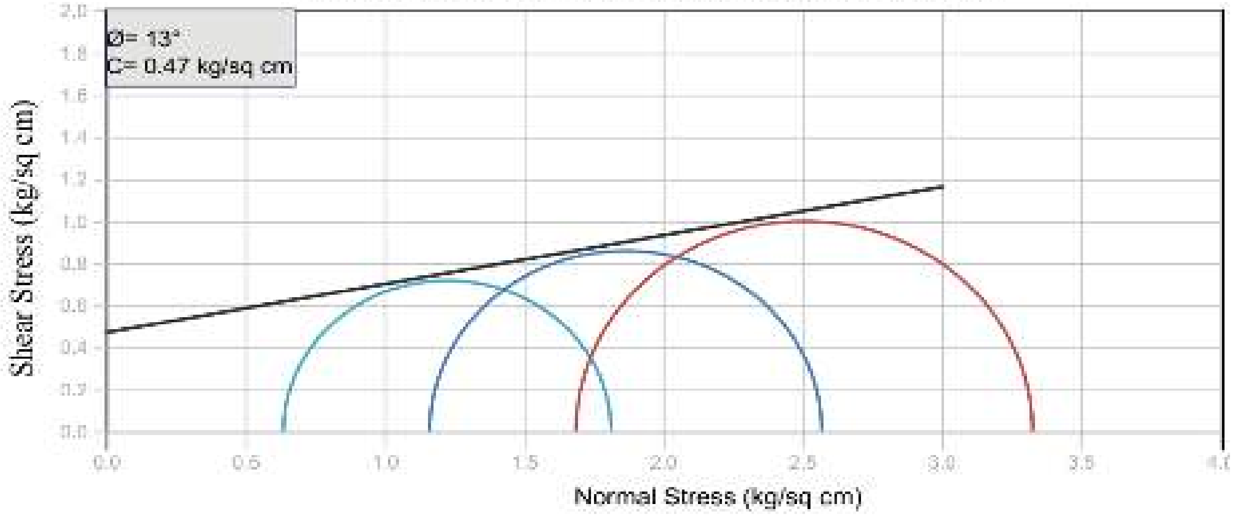




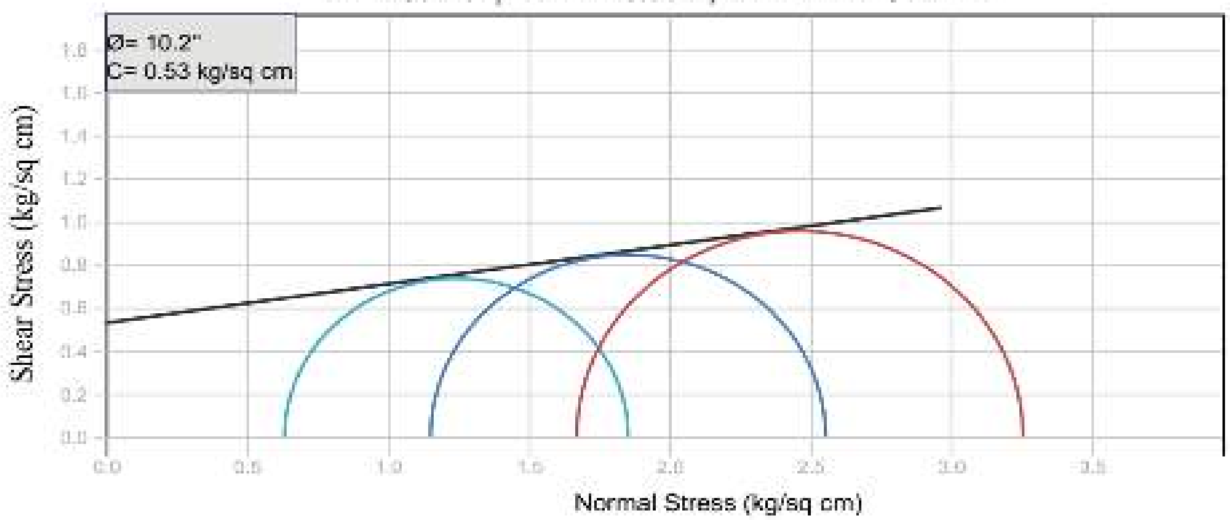


APPENDIX-G
GRAPH 2: UU GRAPH

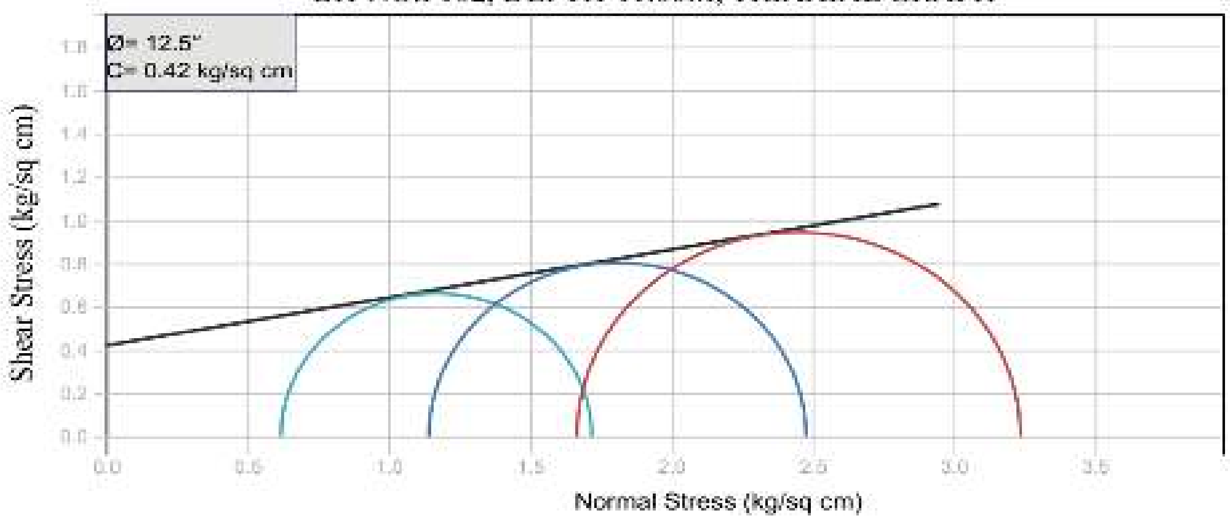
1901-HRIDC-VI-23562.087
BH-NO.P101, DEPTH-22.00M, TRIAXIAL GRAPH



1901-HRIDC-VI-23588.287
BH-NO.P102, DEPTH-8.00M, TRIAXIAL GRAPH



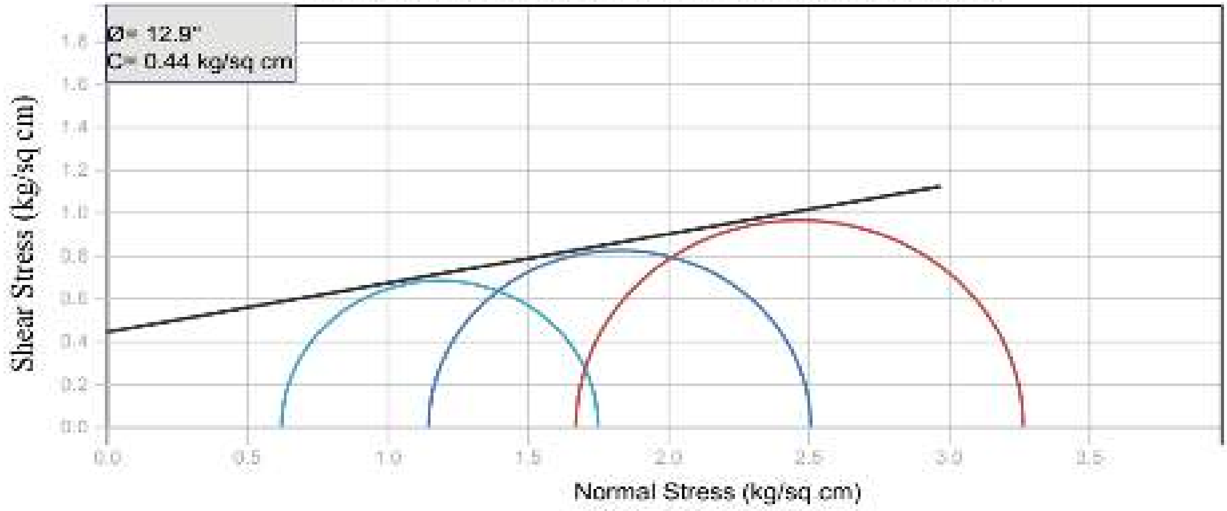
1901-HRIDC-VI-23588.287
BH-NO.P102, DEPTH-11.00M, TRIAXIAL GRAPH



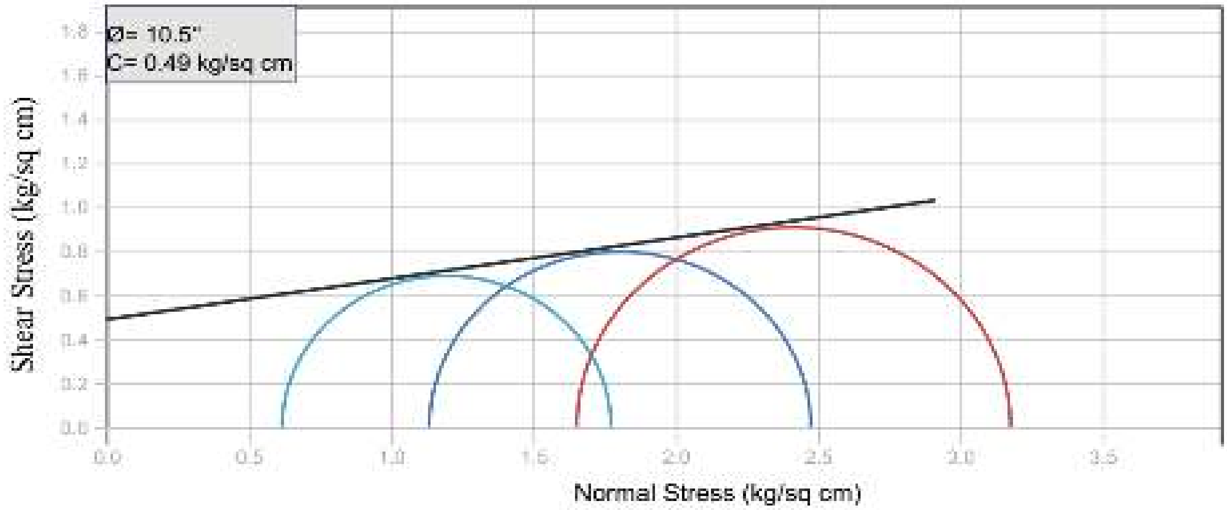
APPENDIX-G

GRAPH 3: UU GRAPH

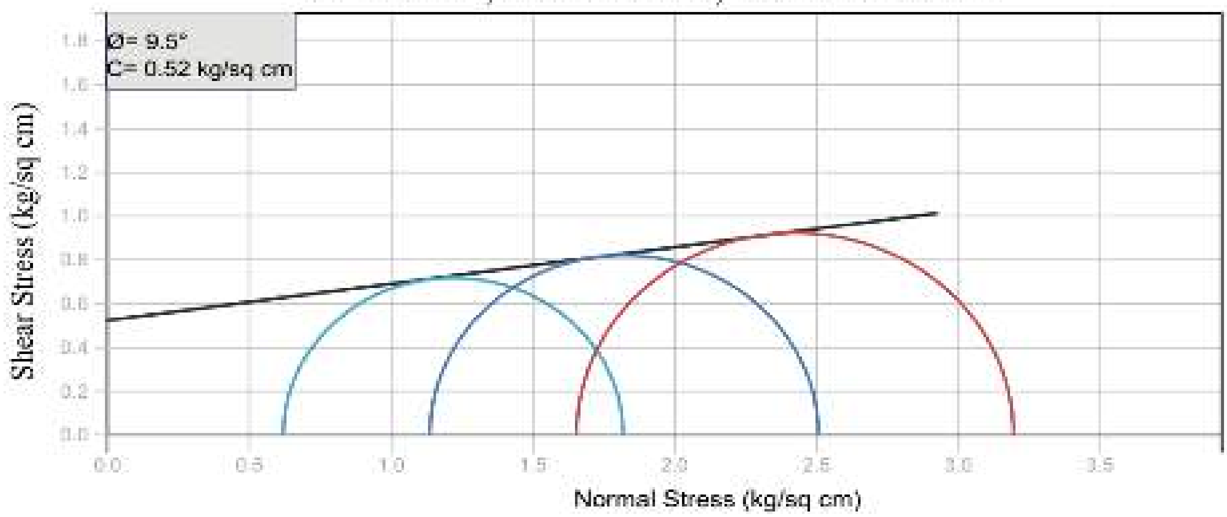
1901-HRIDC-VI-23588.287
BH-NO.P102, DEPTH-14.00M, TRIAXIAL GRAPH



1901-HRIDC-VI-23614.487
BH-NO.P103, DEPTH-8.00M, TRIAXIAL GRAPH



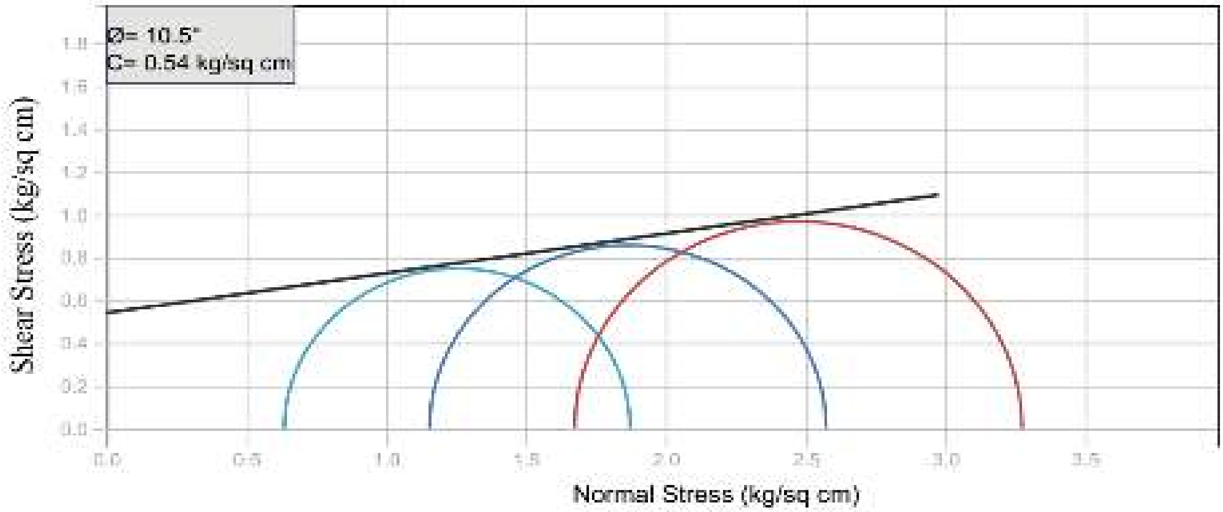
1901-HRIDC-VI-23614.487
BH-NO.P103, DEPTH-14.00M, TRIAXIAL GRAPH



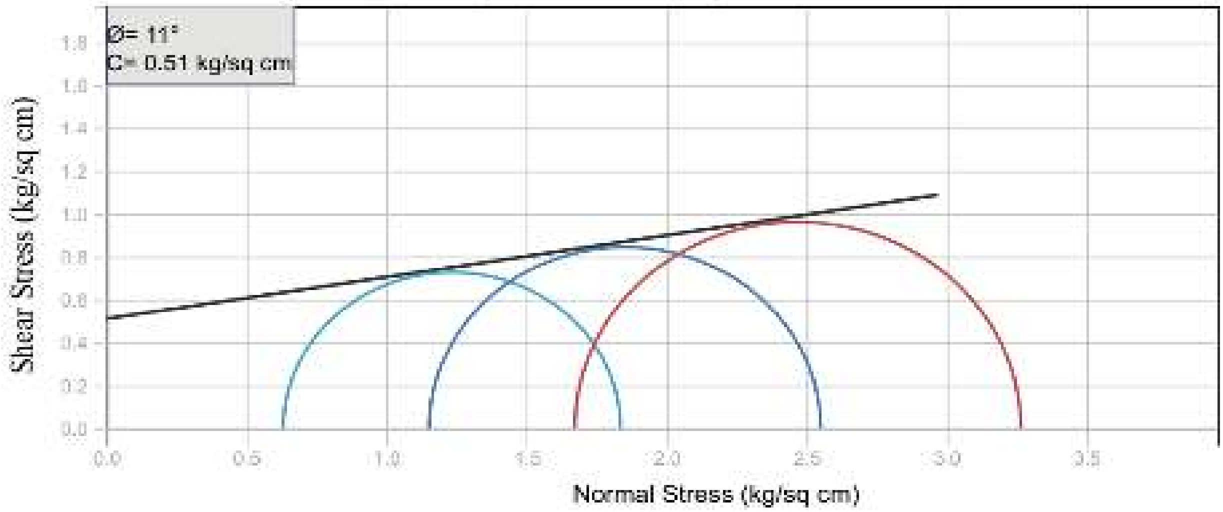
APPENDIX-G

GRAPH 4: UU GRAPH

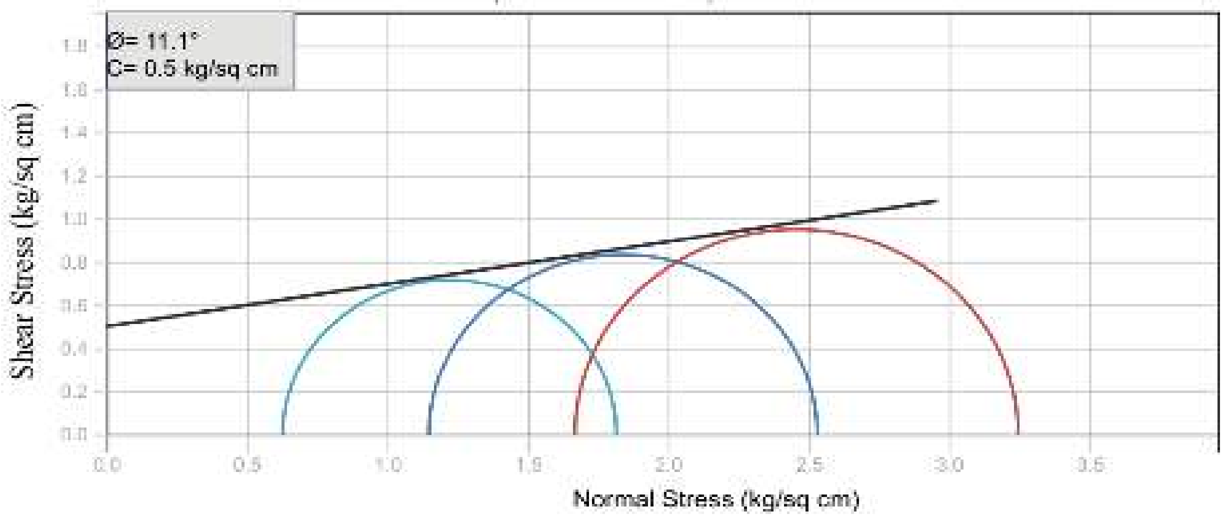
1901-HRIDC-VI-23614.487
BH-NO.P103, DEPTH-17.00M, TRIAXIAL GRAPH



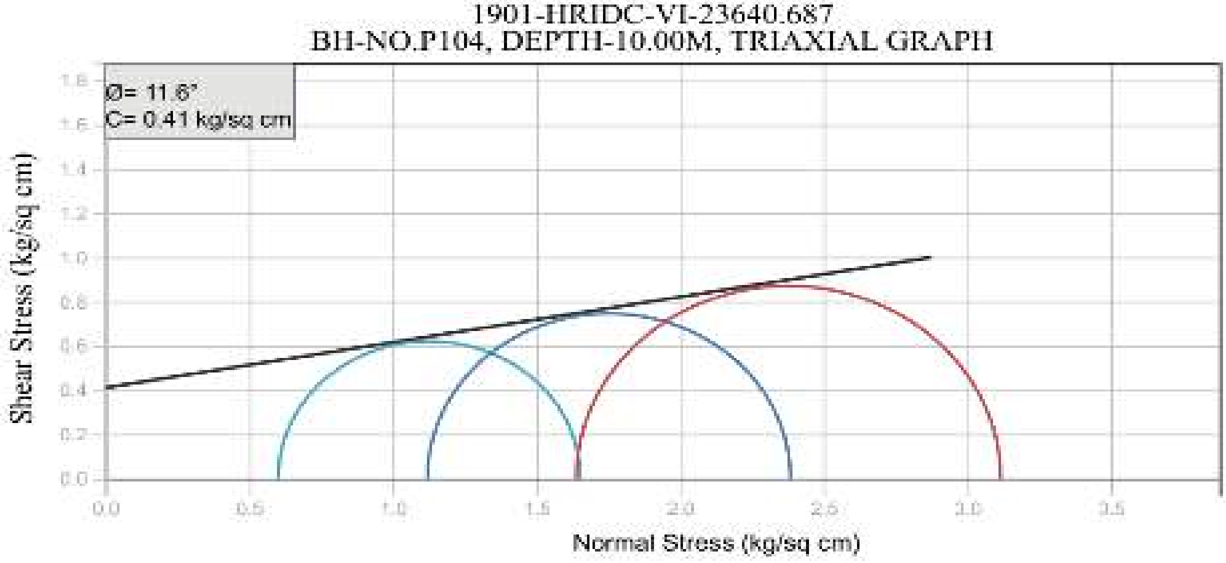
1901-HRIDC-VI-23614.487
BH-NO.P103, DEPTH-20.00M, TRIAXIAL GRAPH

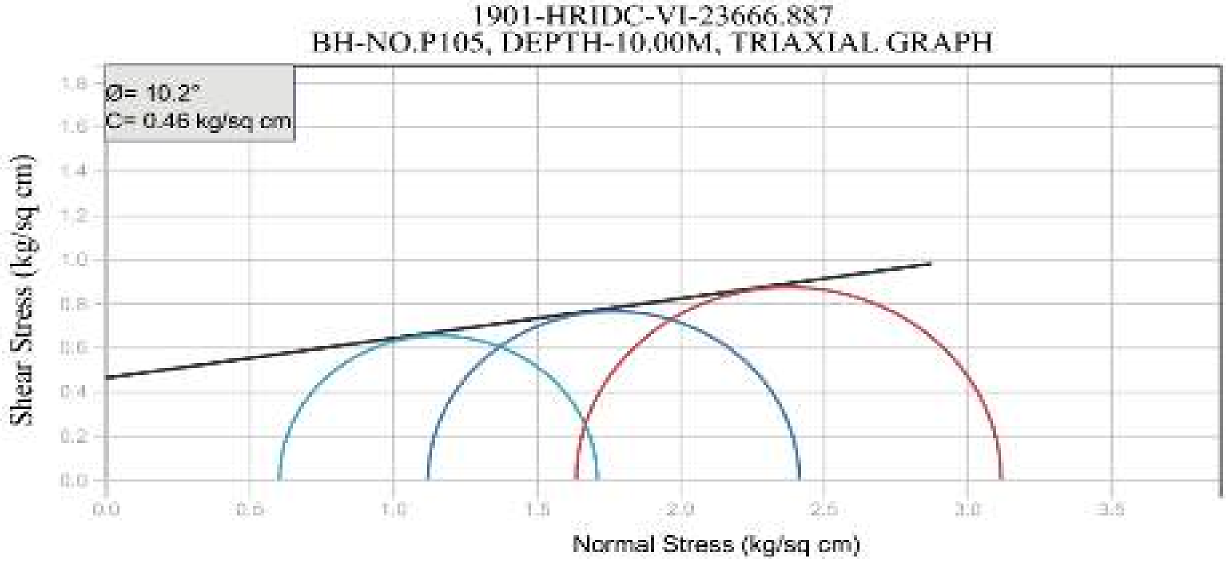


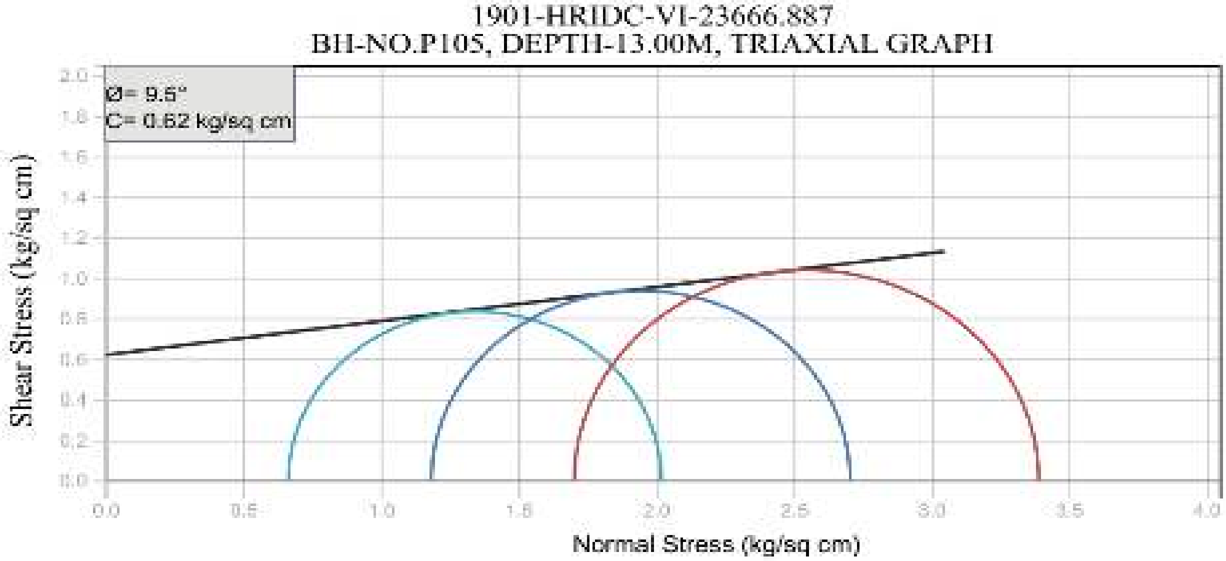
1901-HRIDC-VI-23640.687
BH-NO.P104, DEPTH-7.00M, TRIAXIAL GRAPH



APPENDIX-G
GRAPH 5: UU GRAPH



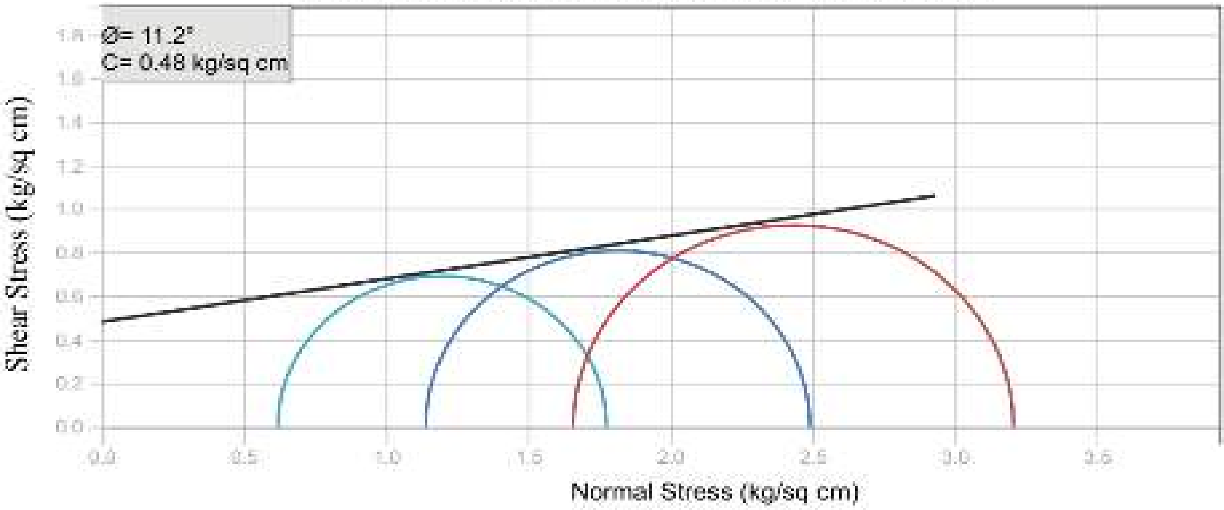




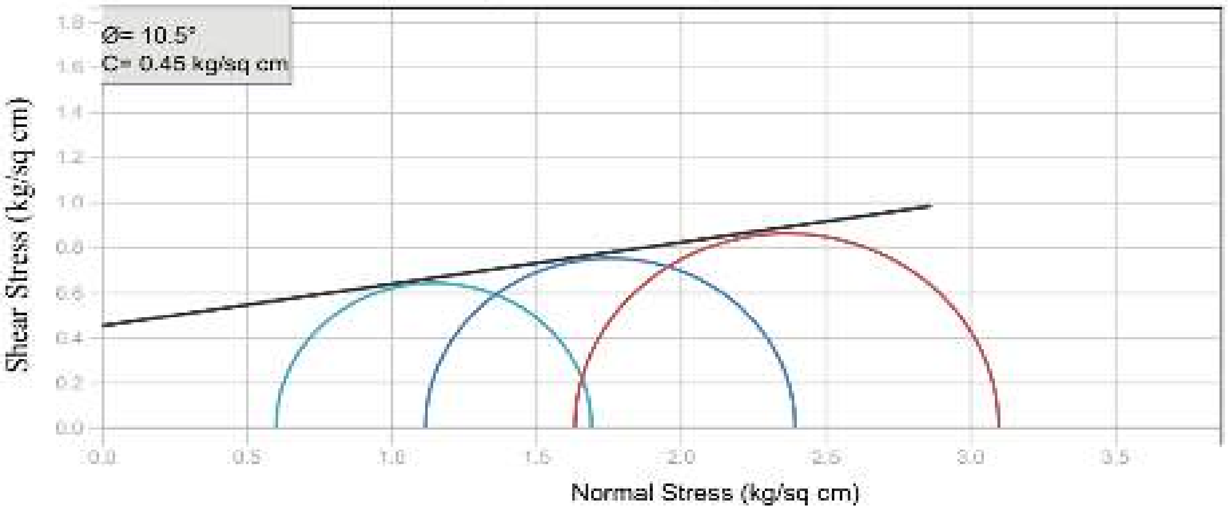
APPENDIX-G

GRAPH 6: UU GRAPH

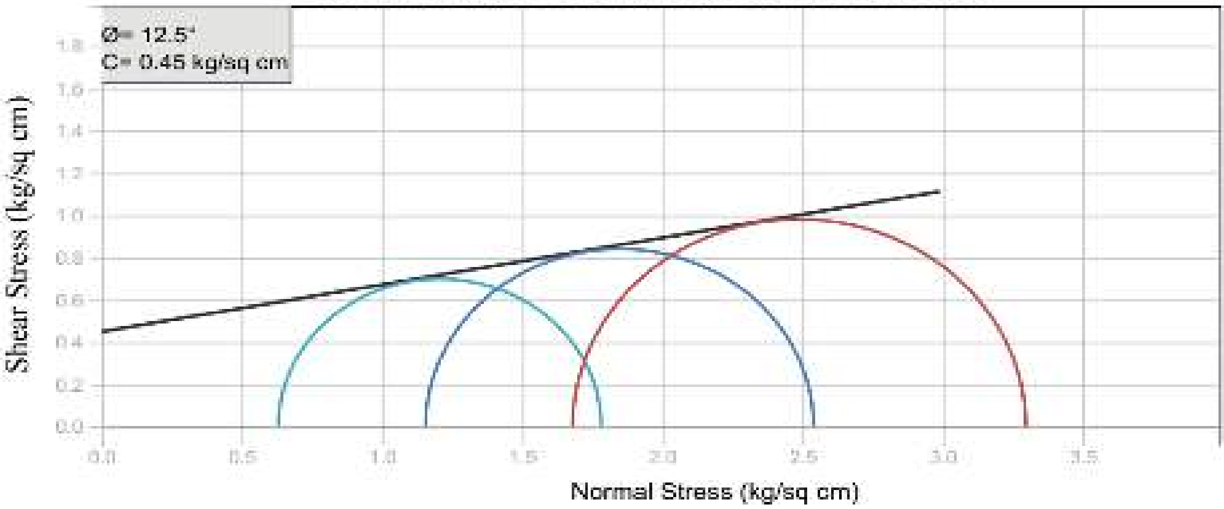
1901-HRIDC-VI-23666.887
BH-NO.P105, DEPTH-22.00M, TRIAXIAL GRAPH



1901-HRIDC-VI-23666.887
BH-NO.P105, DEPTH-25.00M, TRIAXIAL GRAPH



1901-HRIDC-VI-23693.087
BH-NO.P106, DEPTH-4.00M, TRIAXIAL GRAPH

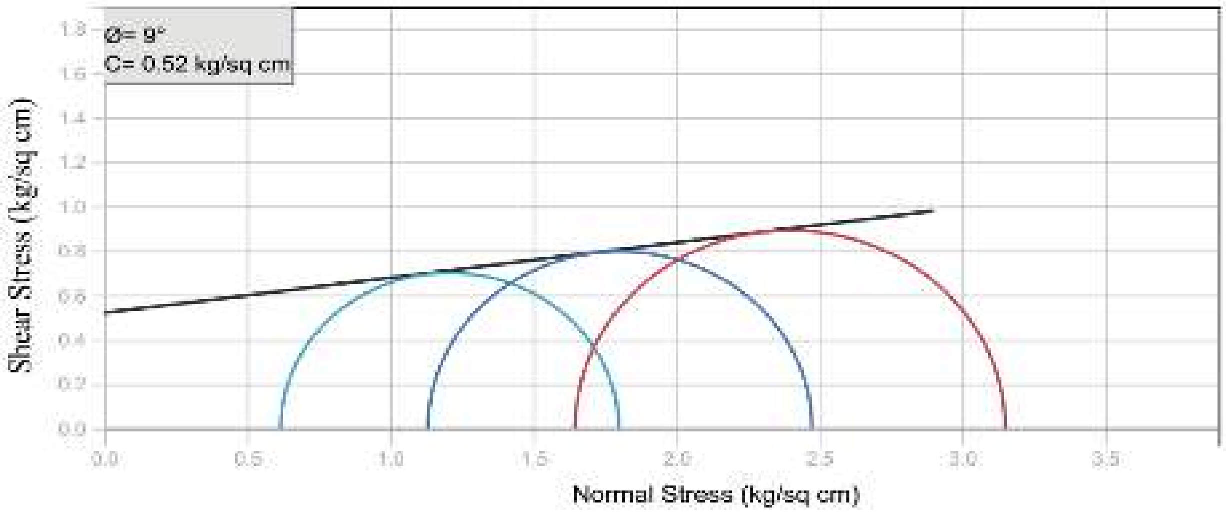


APPENDIX-G

GRAPH 7: UU GRAPH

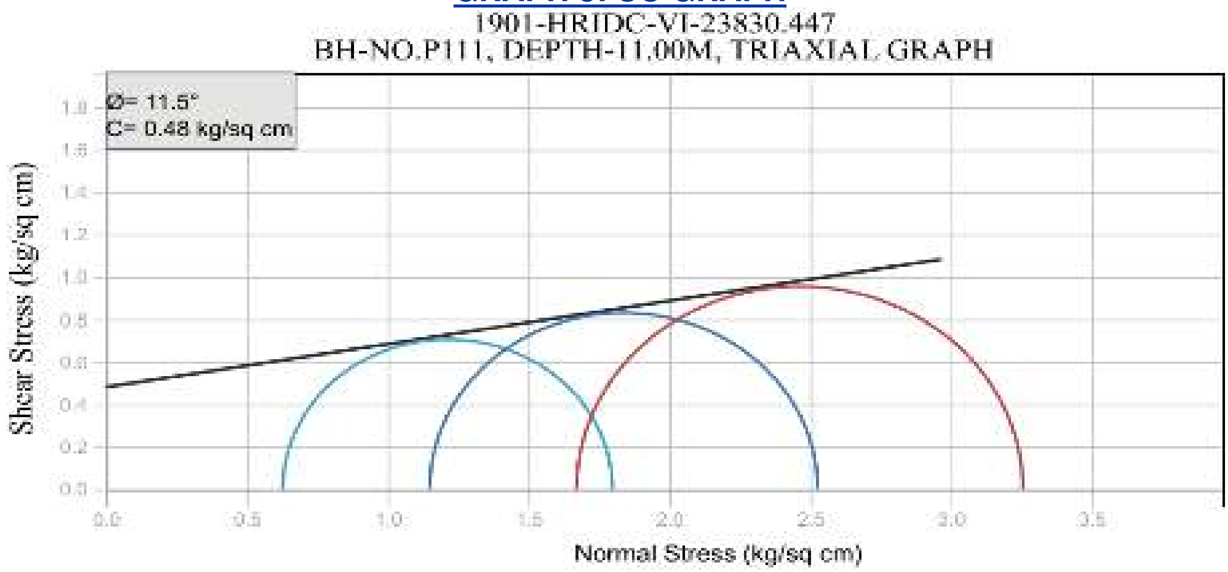
1901-HRIDC-VI-23693.087
BH-NO.P106, DEPTH-10.00M, TRIAXIAL GRAPH

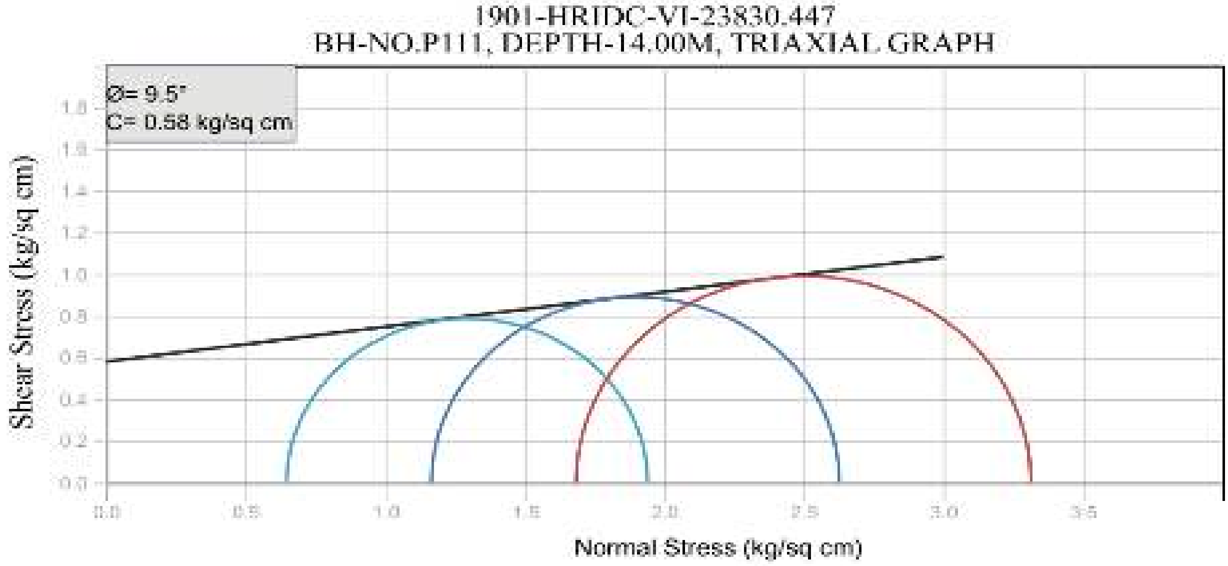
1901-HRIDC-VI-23693.087
BH-NO.P106, DEPTH-13.00M, TRIAXIAL GRAPH

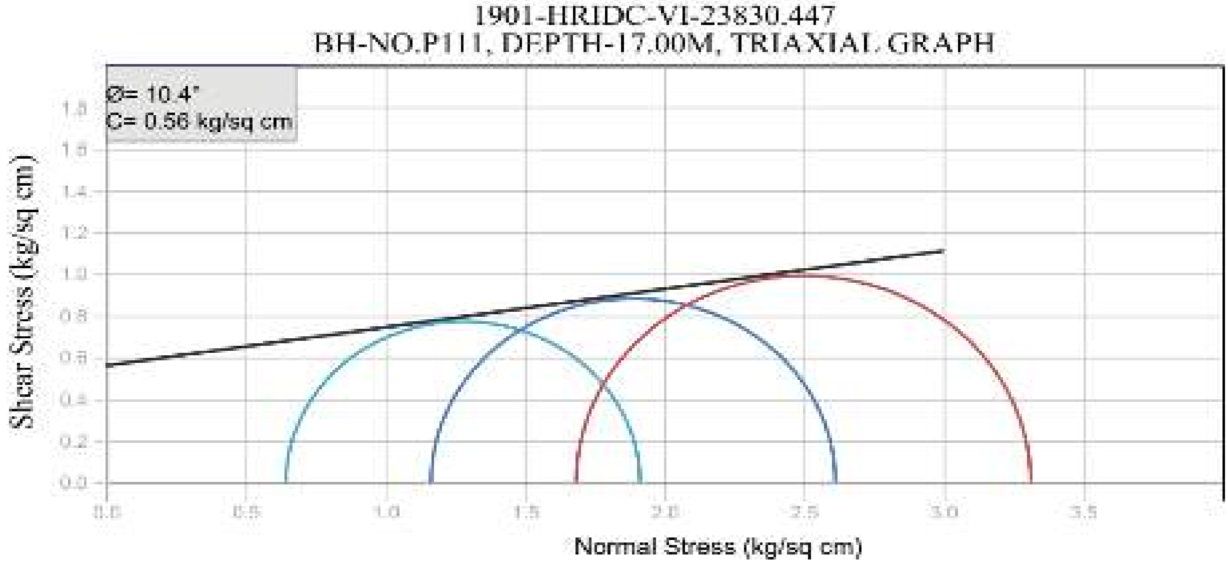


1901-HRIDC-VI-23830.447
BH-NO.P111, DEPTH-5.00M, TRIAXIAL GRAPH

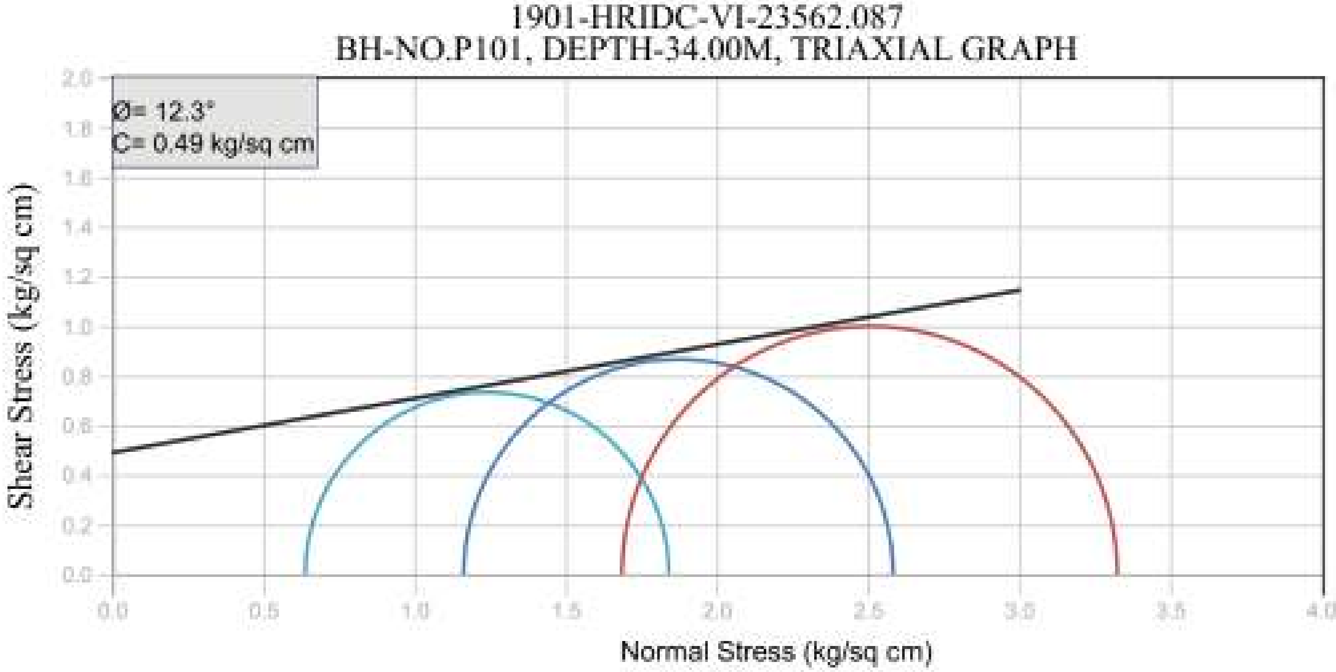
APPENDIX-G
GRAPH 8: UU GRAPH

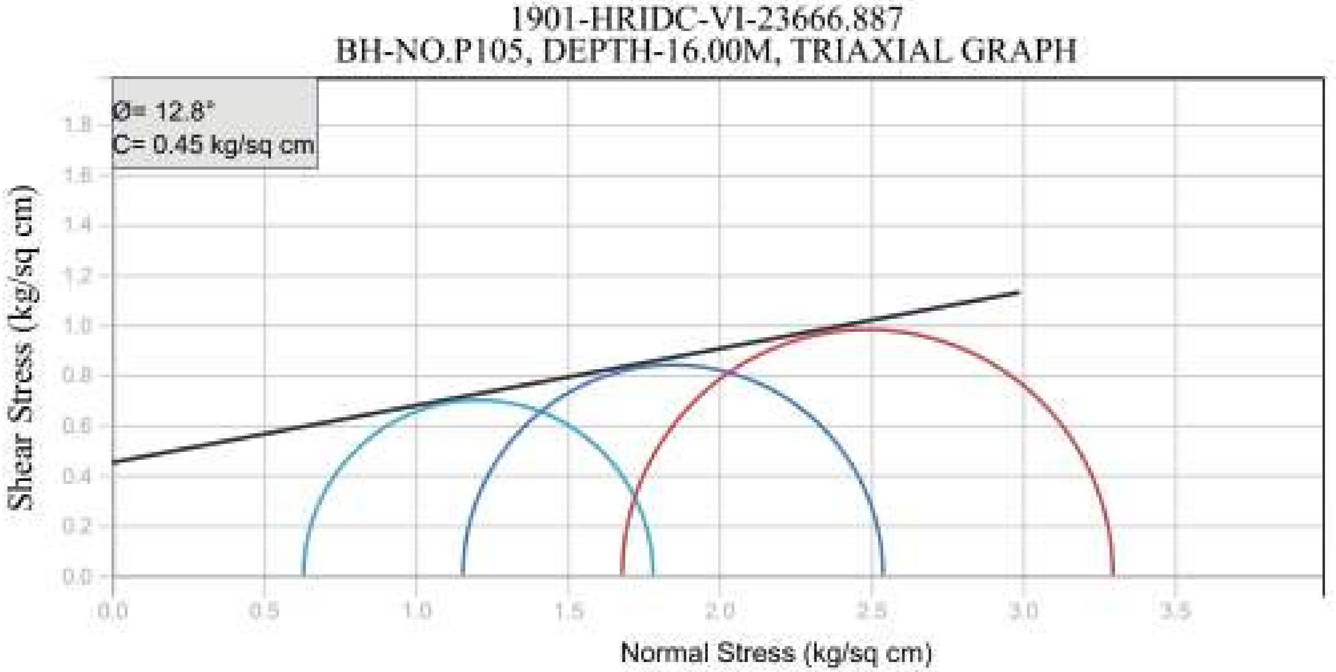




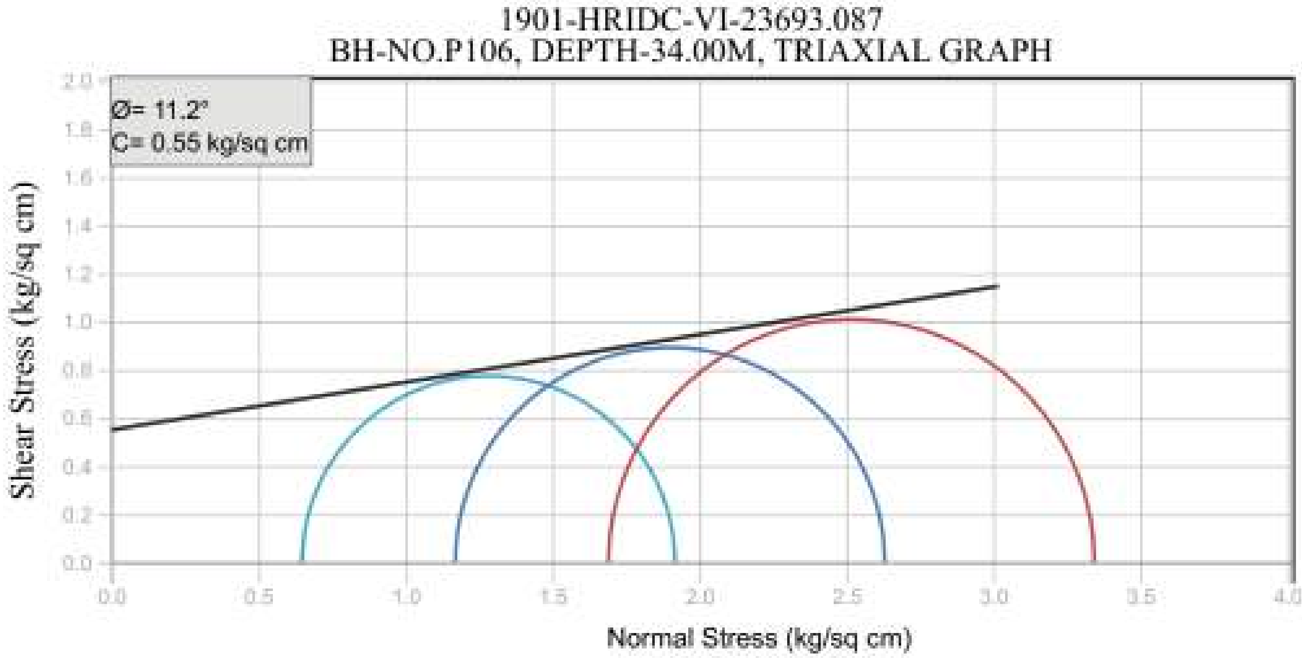


APPENDIX-G
GRAPH 9: RUU GRAPH





APPENDIX-G
GRAPH 10: RUU GRAPH



APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: P101, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.30	10.30	28.33	1.57	23.3	23.3	1.0	19.17	0	0	1.0	0.0	0	3.0	24.8	0	10.30	9.86	10.66	30.9	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	20.30	10.30	36.05	3.14	24.8	24.8	1.0	52.35	0	0	1.0	0.0	0	4.0	26.6	8	9.58	13.60	14.57	41.2	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	19.58	9.58	45.99	3.14	26.6	26.6	1.0	72.38	0	8	1.0	25.1	0	5.0	26.3	0	9.58	12.93	13.88	50.8	568.0	568.0	29.5	29.5	**227.20**	**9.82**
5.00	6.00	5.50	1.00	3.50	19.58	9.58	55.57	3.14	26.3	26.3	1.0	86.32	86.32	0	1.0	0.0	0.00	6.0	9.5	48	9.58	2.38	1.14	60.4	456.6	542.9	41.3	127.6	**217.17**	**42.52**
6.00	7.00	6.50	1.00	4.50	19.58	9.58	65.15	3.14	9.5	9.5	1.0	34.26	120.58	48	1.0	150.9	150.86	7.0	9.5	48	10.61	2.38	1.14	69.9	475.0	746.4	53.0	324.5	**298.57**	**108.16**
7.00	8.00	7.50	1.00	5.50	20.61	10.61	75.25	3.14	9.5	9.5	1.0	39.57	160.16	48	1.0	150.9	301.71	8.0	26.0	6	10.61	12.25	13.18	80.6	872.8	1334.7	64.8	526.7	**533.87**	**175.56**
8.00	9.00	8.50	1.00	6.50	20.61	10.61	85.86	3.14	26.0	26.0	1.0	131.60	291.76	6	1.0	18.9	320.57	9.0	26.0	6	10.40	12.25	13.18	91.2	973.8	1586.2	76.6	688.9	**634.47**	**229.65**
9.00	11.00	10.00	2.00	8.50	20.40	10.40	101.56	6.29	26.0	26.0	1.0	311.36	603.12	6	1.0	37.7	358.29	11.0	9.5	45	10.40	2.38	1.14	112.0	532.2	1493.7	100.2	1061.6	**597.46**	**353.86**
11.00	12.00	11.50	1.00	9.50	20.40	10.40	117.16	3.14	9.5	9.5	1.0	61.62	664.74	45	1.0	141.4	499.71	12.0	9.5	45	10.53	2.38	1.14	122.4	551.8	1716.2	112.0	1276.4	**686.48**	**425.47**
12.00	14.50	13.25	2.50	12.00	20.53	10.53	135.52	7.86	9.5	9.5	1.0	178.19	842.93	45	1.0	353.6	853.29	14.5	9.5	45	10.53	2.38	1.14	148.7	601.0	2297.2	141.4	1837.6	**918.88**	**612.55**
14.50	16.00	15.25	1.50	13.50	20.53	10.53	135.52	4.71	9.5	9.5	1.0	106.91	949.84	45	1.0	212.1	1065.43	16.0	13.0	43	10.55	3.35	2.08	148.7	704.0	2719.3	159.1	2174.4	**1087.72**	**724.79**
16.00	17.50	16.75	1.50	15.00	20.55	10.55	135.52	4.71	13.0	13.0	1.0	147.50	1097.34	43	1.0	202.7	1268.14	17.5	13.0	43	10.55	3.35	2.08	148.7	704.0	3069.5	176.8	2542.3	**1227.81**	**847.42**
17.50	19.00	18.25	1.50	16.50	20.55	10.55	135.52	4.71	13.0	13.0	1.0	147.50	1244.84	43	1.0	202.7	1470.86	19.0	32.1	0	8.89	31.84	33.16	148.7	3835.3	6551.0	194.5	2910.2	**2620.39**	**970.05**
19.00	20.50	19.75	1.50	18.00	18.89	8.89	135.52	4.71	32.1	32.1	1.1	442.86	1687.70	0	1.0	0.0	1470.86	20.5	32.1	0	8.89	31.84	33.16	148.7	3835.3	6993.8	212.1	3370.7	**2797.53**	**1123.57**
20.50	22.00	21.25	1.50	19.50	18.89	8.89	135.52	4.71	32.1	32.1	1.1	442.86	2130.55	0	1.0	0.0	1470.86	22.0	13.0	47	9.71	3.35	2.08	148.7	731.6	4333.1	229.8	3831.2	**1733.22**	**1277.08**
22.00	23.50	22.75	1.50	21.00	19.71	9.71	135.52	4.71	13.0	13.0	1.0	147.50	2278.05	47	1.0	221.6	1692.43	23.5	13.0	47	9.71	3.35	2.08	148.7	731.6	4702.1	247.5	4218.0	**1880.85**	**1405.99**
23.50	25.00	24.25	1.50	22.50	19.71	9.71	135.52	4.71	13.0	13.0	1.0	147.50	2425.55	47	1.0	221.6	1914.00	25.0	29.6	0	10.05	20.36	21.48	148.7	2463.2	6802.7	265.2	4604.7	**2721.10**	**1534.91**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
25.00	26.50	25.75	1.50	24.00	20.05	10.05	135.52	4.71	29.6	29.6	1.0	362.94	2788.49	0	1.0	0.0	1914.00	26.5	29.0	0	10.05	19.01	20.10	148.7	2299.9	7002.4	282.9	4985.4	**2800.95**	**1661.78**
26.50	27.50	27.00	1.00	25.00	20.05	10.05	135.52	3.14	29.0	29.0	1.0	236.10	3024.59	0	1.0	0.0	1914.00	27.5	29.0	0	10.05	19.01	20.10	148.7	2299.9	7238.5	294.6	5233.2	**2895.39**	**1744.41**
27.50	29.50	28.50	2.00	27.00	20.05	10.05	135.52	6.29	29.0	29.0	1.0	472.19	3496.78	0	1.0	0.0	1914.00	29.5	27.2	0	8.72	14.95	15.95	148.7	1801.6	7212.4	318.2	5729.0	**2884.97**	**1909.67**
29.50	30.00	29.75	0.50	27.50	18.72	8.72	135.52	1.57	27.2	27.2	1.0	109.45	3606.23	0	1.0	0.0	1914.00	30.0	27.2	0	10.43	14.95	15.95	148.7	1812.4	7332.6	324.1	5844.3	**2933.04**	**1948.11**
30.00	31.00	30.50	1.00	28.50	20.43	10.43	135.52	3.14	27.2	27.2	1.0	218.90	3825.13	0	1.0	0.0	1914.00	31.0	12.8	56	10.43	3.29	2.02	148.7	788.8	6527.9	335.9	6075.0	**2611.18**	**2025.01**
31.00	32.50	31.75	1.50	30.00	20.43	10.43	135.52	4.71	12.8	12.8	1.0	145.15	3970.28	56	1.0	264.0	2178.00	32.5	12.8	56	10.43	3.29	2.02	148.7	788.8	6937.1	353.6	6501.9	**2774.84**	**2167.28**
32.50	35.00	33.75	2.50	32.50	20.43	10.43	135.52	7.86	12.8	12.8	1.0	241.92	4212.20	56	1.0	440.0	2618.00	35.0	12.3	49	10.43	3.15	1.88	148.7	721.7	7551.9	383.0	7213.2	**3020.75**	**2404.41**
35.00	35.50	35.25	0.50	33.00	20.43	10.43	135.52	1.57	12.3	12.3	1.0	46.43	4258.63	49	1.0	77.0	2695.00	35.5	30.0	0	10.43	21.26	22.40	148.7	2575.4	9529.0	388.9	7342.6	**3811.62**	**2447.52**
35.50	37.00	36.25	1.50	34.50	20.43	10.43	135.52	4.71	30.0	30.0	1.0	368.86	4627.50	0	1.0	0.0	2695.00	37.0	30.0	0	10.49	21.26	22.40	148.7	2575.9	9898.4	406.6	7729.1	**3959.37**	**2576.37**
37.00	37.50	37.25	0.50	35.00	20.49	10.49	135.52	1.57	30.0	30.0	1.0	122.95	4750.45	0	1.0	0.0	2695.00	37.5	30.0	0	10.49	21.26	22.40	148.7	2575.9	10021.4	412.5	7858.0	**4008.55**	**2619.32**
37.50	38.50	38.00	1.00	36.00	20.49	10.49	135.52	3.14	30.0	30.0	1.0	245.91	4996.36	0	1.0	0.0	2695.00	38.5	30.0	0	10.49	21.26	22.40	148.7	2575.9	10267.3	424.3	8115.6	**4106.92**	**2705.22**
38.50	40.00	39.25	1.50	37.50	20.49	10.49	135.52	4.71	30.0	30.0	1.0	368.86	5365.23	0	1.0	0.0	2695.00	40.0	30.0	0	10.49	21.26	22.40	148.7	2575.9	10636.2	442.0	8502.2	**4254.46**	**2834.06**
BORE NO: P102, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.64	9.64	26.51	1.57	27.2	27.2	1.0	21.41	0	11	1.0	17.3	0	3.0	24.8	0	9.64	9.86	10.66	28.9	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.64	9.64	33.74	3.14	24.8	24.8	1.0	49.00	0	0	1.0	0.0	0	4.0	27.0	0	8.85	14.50	15.49	38.6	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	6.00	5.00	2.00	3.50	18.85	8.85	47.41	6.29	27.0	27.0	1.0	151.84	0	0	1.0	0.0	0	6.0	27.2	0	8.85	14.95	15.95	56.3	0	0.0	41.3	41.3	**0.00**	**13.75**
6.00	7.00	6.50	1.00	4.50	18.85	8.85	60.69	3.14	27.2	27.2	1.0	98.02	0	0	1.0	0.0	0	7.0	27.2	0	8.85	14.95	15.95	65.1	0	0.0	53.0	53.0	**0.00**	**17.68**
7.00	8.00	7.50	1.00	5.50	18.85	8.85	69.54	3.14	27.2	27.2	1.0	112.31	0	0	1.0	0.0	0	8.0	10.2	53	9.55	2.53	1.28	74.0	526.5	526.5	64.8	64.8	**210.61**	**21.61**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
8.00	9.00	8.50	1.00	6.50	19.55	9.55	78.74	3.14	10.2	10.2	1.0	44.52	44.52	53	1.0	166.6	166.57	9.0	10.2	53	9.55	2.53	1.28	83.5	545.5	756.6	76.6	287.7	**302.64**	**95.90**
9.00	10.00	9.50	1.00	7.50	19.55	9.55	88.29	3.14	10.2	10.2	1.0	49.92	94.45	53	1.0	166.6	333.14	10.0	12.5	42	9.55	3.20	1.94	93.1	538.5	966.1	88.4	516.0	**386.45**	**171.99**
10.00	11.00	10.50	1.00	8.50	19.55	9.55	97.84	3.14	12.5	12.5	1.0	68.17	162.62	42	1.0	132.0	465.14	11.0	12.5	42	9.92	3.20	1.94	102.6	562.9	1190.6	100.2	727.9	**476.24**	**242.65**
11.00	12.50	11.75	1.50	10.00	19.92	9.92	110.05	4.71	12.5	12.5	1.0	115.02	277.63	42	1.0	198.0	663.14	12.5	12.5	44	10.00	3.20	1.94	117.5	614.5	1555.3	117.9	1058.6	**622.12**	**352.88**
12.50	15.50	14.00	3.00	13.00	20.00	10.00	132.49	9.43	12.5	12.5	1.0	276.94	554.57	44	1.0	414.9	1078.00	15.5	12.9	44	10.00	3.32	2.05	117.5	625.7	2258.3	153.2	1785.8	**903.33**	**595.26**
15.50	17.00	16.25	1.50	14.50	20.00	10.00	132.49	4.71	12.9	12.9	1.0	143.05	697.62	44	1.0	207.4	1285.43	17.0	29.7	0	10.63	20.58	21.71	117.5	1990.8	3973.9	170.9	2153.9	**1589.55**	**717.98**
17.00	18.50	17.75	1.50	16.00	20.63	10.63	132.49	4.71	29.7	29.7	1.0	356.26	1053.89	0	1.0	0.0	1285.43	18.5	10.8	45	10.63	2.71	1.45	117.5	574.0	2913.3	188.6	2527.9	**1165.32**	**842.63**
18.50	20.00	19.25	1.50	17.50	20.63	10.63	132.49	4.71	10.8	10.8	1.0	119.15	1173.03	45	1.0	212.1	1497.57	20.0	30.5	0	10.63	23.78	24.96	117.5	2299.3	4969.9	206.3	2876.9	**1987.96**	**958.95**
20.00	21.50	20.75	1.50	19.00	20.63	10.63	132.49	4.71	30.5	30.5	1.0	377.11	1550.15	0	1.0	0.0	1497.57	21.5	31.2	0	10.34	27.30	28.55	117.5	2636.5	5684.3	223.9	3271.6	**2273.71**	**1090.55**
21.50	23.00	22.25	1.50	20.50	20.34	10.34	132.49	4.71	31.2	31.2	1.1	400.96	1951.11	0	1.0	0.0	1497.57	23.0	29.6	3	10.34	20.36	21.48	117.5	1987.9	5436.5	241.6	3690.3	**2174.61**	**1230.10**
23.00	24.50	23.75	1.50	22.00	20.34	10.34	132.49	4.71	29.6	29.6	1.0	354.82	2305.93	3	1.0	14.1	1511.71	24.5	29.0	0	10.34	19.01	20.10	117.5	1836.3	5653.9	259.3	4076.9	**2261.58**	**1358.98**
24.50	27.50	26.00	3.00	25.00	20.34	10.34	132.49	9.43	29.0	29.0	1.0	692.44	2998.37	0	1.0	0.0	1511.71	27.5	29.0	0	10.64	19.01	20.10	117.5	1838.7	6348.7	294.6	4804.7	**2539.50**	**1601.58**
27.50	30.00	28.75	2.50	27.50	20.64	10.64	132.49	7.86	29.0	29.0	1.0	577.03	3575.40	0	1.0	0.0	1511.71	30.0	28.2	0	10.64	17.21	18.25	117.5	1664.7	6751.8	324.1	5411.2	**2700.71**	**1803.74**
30.00	30.50	30.25	0.50	28.00	20.64	10.64	132.49	1.57	28.2	28.2	1.0	111.64	3687.04	0	1.0	0.0	1511.71	30.5	28.2	0	10.64	17.21	18.25	117.5	1664.7	6863.4	330.0	5528.8	**2745.36**	**1842.92**
30.50	32.50	31.50	2.00	30.00	20.64	10.64	132.49	6.29	28.2	28.2	1.0	446.54	4133.58	0	1.0	0.0	1511.71	32.5	30.2	0	10.64	22.27	23.43	117.5	2153.5	7798.8	353.6	5998.9	**3119.50**	**1999.62**
32.50	33.50	33.00	1.00	31.00	20.64	10.64	132.49	3.14	30.2	30.2	1.0	244.77	4378.35	0	1.0	0.0	1511.71	33.5	32.7	0	10.64	34.86	36.24	117.5	3369.6	9259.7	365.4	6255.4	**3703.86**	**2085.14**
33.50	35.00	34.25	1.50	32.50	20.64	10.64	132.49	4.71	32.7	32.7	1.1	455.12	4833.46	0	1.0	0.0	1511.71	35.0	32.2	0	10.64	32.34	33.68	117.5	3126.4	9471.5	383.0	6728.2	**3788.62**	**2242.74**
35.00	36.50	35.75	1.50	34.00	20.64	10.64	132.49	4.71	32.2	32.2	1.1	436.60	5270.06	0	1.0	0.0	1511.71	36.5	32.2	0	8.88	32.34	33.68	117.5	3103.1	9884.9	400.7	7182.5	**3953.94**	**2394.16**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
36.50	37.50	37.00	1.00	35.00	18.88	8.88	132.49	3.14	32.2	32.2	1.1	291.06	5561.12	0	1.0	0.0	1511.71	37.5	32.2	0	8.88	32.34	33.68	117.5	3103.1	10175.9	412.5	7485.3	**4070.37**	**2495.11**
37.50	38.00	37.75	0.50	35.50	18.88	8.88	132.49	1.57	32.2	32.2	1.1	145.53	5706.65	0	1.0	0.0	1511.71	38.0	25.2	10	8.93	10.45	11.34	117.5	1075.2	8293.6	418.4	7636.8	**3317.43**	**2545.59**
38.00	40.00	39.00	2.00	37.50	18.93	8.93	132.49	6.29	25.2	25.2	1.0	391.88	6098.54	10	1.0	62.9	1574.57	40.0	25.2	10	8.93	10.45	11.34	117.5	1075.2	8748.3	442.0	8115.1	**3499.33**	**2705.02**
BORE NO: P103, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.00	10.00	27.50	1.57	24.3	24.3	1.0	19.51	0	0	1.0	0.0	0	3.0	26.5	4	10.00	13.38	14.34	30.0	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	20.00	10.00	35.00	3.14	26.5	26.5	1.0	54.84	0	4	1.0	12.6	0	4.0	26.5	4	10.00	13.38	14.34	40.0	505.1	505.1	17.7	17.7	**202.02**	**5.89**
4.00	5.00	4.50	1.00	2.50	20.00	10.00	45.00	3.14	26.5	26.5	1.0	70.51	70.51	4	1.0	12.6	12.57	5.0	26.5	4	10.10	13.38	14.34	50.0	610.7	693.8	29.5	112.5	**277.53**	**37.52**
5.00	6.00	5.50	1.00	3.50	20.10	10.10	55.05	3.14	26.5	26.5	1.0	86.26	156.78	4	1.0	12.6	25.14	6.0	26.5	4	10.10	13.38	14.34	60.1	716.9	898.8	41.3	223.2	**359.52**	**74.39**
6.00	7.00	6.50	1.00	4.50	20.10	10.10	65.15	3.14	26.5	26.5	1.0	102.09	258.86	4	1.0	12.6	37.71	7.0	10.5	49	10.60	2.62	1.36	70.2	496.5	793.1	53.0	349.6	**317.24**	**116.54**
7.00	9.00	8.00	2.00	6.50	20.60	10.60	80.80	6.29	10.5	10.5	1.0	94.13	352.99	49	1.0	308.0	345.71	9.0	10.5	49	10.60	2.62	1.36	91.4	540.1	1238.8	76.6	775.3	**495.53**	**258.44**
9.00	10.00	9.50	1.00	7.50	20.60	10.60	96.70	3.14	10.5	10.5	1.0	56.33	409.32	49	1.0	154.0	499.71	10.0	24.4	14	9.77	9.57	10.22	102.0	905.0	1814.1	88.4	997.4	**725.63**	**332.48**
10.00	12.50	11.25	2.50	10.00	19.77	9.77	114.21	7.86	24.4	24.4	1.0	407.07	816.39	14	1.0	110.0	609.71	12.5	24.4	14	10.59	9.57	10.22	126.4	1092.0	2518.1	117.9	1544.0	**1007.22**	**514.65**
12.50	15.50	14.00	3.00	13.00	20.59	10.59	142.31	9.43	24.4	24.4	1.0	608.66	1425.05	14	1.0	132.0	741.71	15.5	27.9	0	10.59	16.53	17.56	126.4	1715.1	3881.9	153.2	2320.0	**1552.75**	**773.33**
15.50	17.00	16.25	1.50	14.50	20.59	10.59	142.31	4.71	27.9	27.9	1.0	355.22	1780.27	0	1.0	0.0	741.71	17.0	10.5	54	10.69	2.62	1.36	126.4	647.5	3169.5	170.9	2692.9	**1267.81**	**897.63**
17.00	18.50	17.75	1.50	16.00	20.69	10.69	142.31	4.71	10.5	10.5	1.0	124.34	1904.61	54	1.0	254.6	996.29	18.5	28.6	0	10.69	18.11	19.17	126.4	1879.2	4780.0	188.6	3089.5	**1912.02**	**1029.82**
18.50	20.00	19.25	1.50	17.50	20.69	10.69	142.31	4.71	28.6	28.6	1.0	365.78	2270.39	0	1.0	0.0	996.29	20.0	11.0	51	10.40	2.76	1.51	126.4	641.4	3908.0	206.3	3472.9	**1563.21**	**1157.64**
20.00	21.50	20.75	1.50	19.00	20.40	10.40	142.31	4.71	11.0	11.0	1.0	130.41	2400.80	51	1.0	240.4	1236.71	21.5	11.0	51	10.40	2.76	1.51	126.4	641.4	4278.9	223.9	3861.4	**1711.55**	**1287.15**
21.50	23.00	22.25	1.50	20.50	20.40	10.40	142.31	4.71	11.0	11.0	1.0	130.41	2531.21	51	1.0	240.4	1477.14	23.0	27.5	2	9.57	15.63	16.64	126.4	1629.3	5637.6	241.6	4250.0	**2255.05**	**1416.65**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
23.00	24.50	23.75	1.50	22.00	19.57	9.57	142.31	4.71	27.5	27.5	1.0	349.24	2880.45	2	1.0	9.4	1486.57	24.5	31.0	0	9.57	26.30	27.53	126.4	2715.7	7082.7	259.3	4626.3	**2833.08**	**1542.10**
24.50	26.00	25.25	1.50	23.50	19.57	9.57	142.31	4.71	31.0	31.0	1.1	423.27	3303.72	0	1.0	0.0	1486.57	26.0	31.2	0	9.57	27.30	28.55	126.4	2819.6	7609.9	277.0	5067.3	**3043.96**	**1689.08**
26.00	27.50	26.75	1.50	25.00	19.57	9.57	142.31	4.71	31.2	31.2	1.1	430.68	3734.40	0	1.0	0.0	1486.57	27.5	31.2	0	9.13	27.30	28.55	126.4	2814.7	8035.6	294.6	5515.6	**3214.26**	**1838.54**
27.50	29.00	28.25	1.50	26.50	19.13	9.13	142.31	4.71	31.2	31.2	1.1	430.68	4165.09	0	1.0	0.0	1486.57	29.0	31.4	0	8.63	28.31	29.58	126.4	2912.6	8564.3	312.3	5964.0	**3425.71**	**1987.99**
29.00	30.00	29.50	1.00	27.50	18.63	8.63	142.31	3.14	31.4	31.4	1.1	292.12	4457.21	0	1.0	0.0	1486.57	30.0	31.4	0	8.63	28.31	29.58	126.4	2912.6	8856.4	324.1	6267.9	**3542.55**	**2089.29**
30.00	30.50	30.25	0.50	28.00	18.63	8.63	142.31	1.57	31.4	31.4	1.1	146.06	4603.27	0	1.0	0.0	1486.57	30.5	31.4	0	8.99	28.31	29.58	126.4	2916.8	9006.6	330.0	6419.8	**3602.65**	**2139.95**
30.50	32.00	31.25	1.50	29.50	18.99	8.99	142.31	4.71	31.4	31.4	1.1	438.18	5041.44	0	1.0	0.0	1486.57	32.0	27.0	18	8.97	14.50	15.49	126.4	1622.6	8150.6	347.7	6875.7	**3260.24**	**2291.90**
32.00	32.50	32.25	0.50	30.00	18.97	8.97	142.31	1.57	27.0	27.0	1.0	113.95	5155.39	18	1.0	28.3	1514.86	32.5	27.0	18	8.97	14.50	15.49	126.4	1622.6	8292.8	353.6	7023.8	**3317.13**	**2341.27**
32.50	33.50	33.00	1.00	31.00	18.97	8.97	142.31	3.14	27.0	27.0	1.0	227.89	5383.28	18	1.0	56.6	1571.43	33.5	12.5	60	8.72	3.20	1.94	126.4	749.2	7703.9	365.4	7320.1	**3081.56**	**2440.02**
33.50	35.00	34.25	1.50	32.50	18.72	8.72	142.31	4.71	12.5	12.5	1.0	148.73	5532.01	60	1.0	282.9	1854.29	35.0	14.0	60	8.82	3.65	2.36	126.4	795.0	8181.3	383.0	7769.3	**3272.54**	**2589.78**
35.00	36.50	35.75	1.50	34.00	18.82	8.82	142.31	4.71	14.0	14.0	1.0	167.27	5699.28	60	1.0	282.9	2137.14	36.5	14.0	60	8.34	3.65	2.36	126.4	794.6	8631.0	400.7	8237.1	**3452.41**	**2745.71**
36.50	37.50	37.00	1.00	35.00	18.34	8.34	142.31	3.14	14.0	14.0	1.0	111.51	5810.80	60	1.0	188.6	2325.71	37.5	18.0	60	8.34	5.42	4.29	126.4	976.3	9112.9	412.5	8549.0	**3645.14**	**2849.67**
37.50	38.00	37.75	0.50	35.50	18.34	8.34	142.31	1.57	18.0	18.0	1.0	72.66	5883.46	60	1.0	94.3	2420.00	38.0	18.0	60	8.72	5.42	4.29	126.4	977.0	9280.4	418.4	8721.9	**3712.18**	**2907.28**
38.00	40.00	39.00	2.00	37.50	18.72	8.72	142.31	6.29	18.0	18.0	1.0	290.65	6174.11	60	1.0	377.1	2797.14	40.0	18.0	125	8.72	5.42	4.29	126.4	1436.6	10407.9	442.0	9413.2	**4163.15**	**3137.74**
BORE NO: P104, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.80	9.80	26.95	1.57	25.8	25.8	1.0	20.47	0	0	1.0	0.0	0	3.0	25.4	0	9.03	10.90	11.80	29.4	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	5.00	4.00	2.00	2.50	19.03	9.03	38.43	6.29	25.4	25.4	1.0	114.70	0	0	1.0	0.0	0	5.0	24.6	0	9.03	9.71	10.44	47.5	399.2	399.2	29.5	29.5	**159.68**	**9.82**
5.00	6.00	5.50	1.00	3.50	19.03	9.03	51.98	3.14	24.6	24.6	1.0	74.79	74.79	0	1.0	0.0	0.00	6.0	11.1	50	11.01	2.79	1.53	56.5	484.2	559.0	41.3	116.0	**223.59**	**38.68**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
6.00	8.00	7.00	2.00	5.50	21.01	11.01	67.50	6.29	11.1	11.1	1.0	83.24	158.03	50	1.0	314.3	314.29	8.0	11.6	41	11.01	2.94	1.68	78.5	478.6	950.9	64.8	537.1	**380.35**	**179.05**
8.00	9.00	8.50	1.00	6.50	21.01	11.01	84.02	3.14	11.6	11.6	1.0	54.20	212.23	41	1.0	128.9	443.14	9.0	11.6	41	10.35	2.94	1.68	89.5	503.6	1158.9	76.6	732.0	**463.58**	**243.99**
9.00	11.00	10.00	2.00	8.50	20.35	10.35	99.87	6.29	11.6	11.6	1.0	128.86	341.09	41	1.0	257.7	700.86	11.0	6.2	86	10.35	1.79	0.63	110.2	765.4	1807.3	100.2	1142.1	**722.94**	**380.71**
11.00	12.00	11.50	1.00	9.50	20.35	10.35	115.40	3.14	6.2	6.2	1.0	39.40	380.49	86	1.0	270.3	971.14	12.0	10.0	84	9.88	2.47	1.22	120.6	832.7	2184.4	112.0	1463.6	**873.74**	**487.87**
12.00	14.50	13.25	2.50	12.00	19.88	9.88	132.92	7.86	10.0	10.0	1.0	184.15	564.64	84	1.0	660.0	1631.14	14.5	10.0	42	9.88	2.47	1.22	145.3	583.7	2779.4	141.4	2337.2	**1111.78**	**779.07**
14.50	16.00	15.25	1.50	13.50	19.88	9.88	132.92	4.71	10.0	10.0	1.0	110.49	675.13	42	1.0	198.0	1829.14	16.0	27.7	0	10.15	16.08	17.10	145.3	1903.6	4407.9	159.1	2663.4	**1763.14**	**887.79**
16.00	17.50	16.75	1.50	15.00	20.15	10.15	132.92	4.71	27.7	27.7	1.0	328.98	1004.11	0	1.0	0.0	1829.14	17.5	27.4	0	10.15	15.40	16.41	145.3	1823.7	4657.0	176.8	3010.0	**1862.79**	**1003.35**
17.50	19.00	18.25	1.50	16.50	20.15	10.15	132.92	4.71	27.4	27.4	1.0	324.81	1328.92	0	1.0	0.0	1829.14	19.0	15.3	43	10.15	4.09	2.81	145.3	781.9	3939.9	194.5	3352.5	**1575.97**	**1117.51**
19.00	20.50	19.75	1.50	18.00	20.15	10.15	132.92	4.71	15.3	15.3	1.0	171.42	1500.35	43	1.0	202.7	2031.86	20.5	25.5	9	9.81	11.13	12.03	145.3	1379.9	4912.1	212.1	3744.3	**1964.86**	**1248.12**
20.50	23.50	22.00	3.00	21.00	19.81	9.81	132.92	9.43	25.5	25.5	1.0	597.77	2098.12	9	1.0	84.9	2116.71	23.5	20.7	44	9.81	6.90	6.16	145.3	1122.9	5337.7	247.5	4462.3	**2135.09**	**1487.44**
23.50	25.00	24.25	1.50	22.50	19.81	9.81	132.92	4.71	20.7	20.7	1.0	236.78	2334.90	44	1.0	207.4	2324.14	25.0	29.6	0	10.07	20.36	21.48	145.3	2408.7	7067.8	265.2	4924.2	**2827.11**	**1641.41**
25.00	26.50	25.75	1.50	24.00	20.07	10.07	132.92	4.71	29.6	29.6	1.0	355.97	2690.87	0	1.0	0.0	2324.14	26.5	29.6	0	10.07	20.36	21.48	145.3	2408.7	7423.7	282.9	5297.9	**2969.50**	**1765.96**
26.50	27.50	27.00	1.00	25.00	20.07	10.07	132.92	3.14	29.6	29.6	1.0	237.31	2928.18	0	1.0	0.0	2324.14	27.5	29.1	2	9.71	19.23	20.33	145.3	2286.9	7539.3	294.6	5547.0	**3015.70**	**1848.99**
27.50	29.50	28.50	2.00	27.00	19.71	9.71	132.92	6.29	29.1	29.1	1.0	465.03	3393.21	2	1.0	12.6	2336.71	29.5	31.3	0	9.71	27.81	29.06	145.3	3284.9	9014.8	318.2	6048.1	**3605.94**	**2016.05**
29.50	30.00	29.75	0.50	27.50	19.71	9.71	132.92	1.57	31.3	31.3	1.1	135.25	3528.47	0	1.0	0.0	2336.71	30.0	31.7	0	9.71	29.82	31.11	145.3	3522.7	9387.9	324.1	6189.3	**3755.16**	**2063.10**
30.00	31.00	30.50	1.00	28.50	19.71	9.71	132.92	3.14	31.7	31.7	1.1	279.94	3808.40	0	1.0	0.0	2336.71	31.0	31.9	0	9.71	30.83	32.14	145.3	3641.6	9786.8	335.9	6481.0	**3914.70**	**2160.34**
31.00	32.50	31.75	1.50	30.00	19.71	9.71	132.92	4.71	31.9	31.9	1.1	427.09	4235.50	0	1.0	0.0	2336.71	32.5	32.5	0	9.09	33.85	35.22	145.3	3989.8	10562.0	353.6	6925.8	**4224.79**	**2308.59**
32.50	34.00	33.25	1.50	31.50	19.09	9.09	132.92	4.71	32.5	32.5	1.1	449.10	4684.60	0	1.0	0.0	2336.71	34.0	32.5	0	9.26	33.85	35.22	145.3	3992.1	11013.4	371.3	7392.6	**4405.38**	**2464.19**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
34.00	35.00	34.50	1.00	32.50	19.26	9.26	132.92	3.14	32.5	32.5	1.1	299.40	4984.00	0	1.0	0.0	2336.71	35.0	32.0	0	9.26	31.33	32.65	145.3	3695.3	11016.0	383.0	7703.8	**4406.41**	**2567.92**
35.00	35.50	35.25	0.50	33.00	19.26	9.26	132.92	1.57	32.0	32.0	1.1	143.57	5127.57	0	1.0	0.0	2336.71	35.5	33.2	0	9.28	37.38	38.80	145.3	4408.0	11872.3	388.9	7853.2	**4748.90**	**2617.74**
35.50	37.00	36.25	1.50	34.50	19.28	9.28	132.92	4.71	33.2	33.2	1.2	475.66	5603.23	0	1.0	0.0	2336.71	37.0	32.6	0	9.22	34.36	35.73	145.3	4050.9	11990.9	406.6	8346.6	**4796.35**	**2782.18**
37.00	37.50	37.25	0.50	35.00	19.22	9.22	132.92	1.57	32.6	32.6	1.1	150.95	5754.18	0	1.0	0.0	2336.71	37.5	30.5	0	9.22	23.78	24.96	145.3	2804.5	10895.4	412.5	8503.4	**4358.15**	**2834.46**
37.50	38.50	38.00	1.00	36.00	19.22	9.22	132.92	3.14	30.5	30.5	1.0	252.22	6006.40	0	1.0	0.0	2336.71	38.5	30.7	0	9.29	24.79	25.99	145.3	2923.9	11267.0	424.3	8767.4	**4506.81**	**2922.47**
38.50	40.00	39.25	1.50	37.50	19.29	9.29	132.92	4.71	30.7	30.7	1.0	385.08	6391.49	0	1.0	0.0	2336.71	40.0	30.7	0	9.29	24.79	25.99	145.3	2923.9	11652.1	442.0	9170.2	**4660.84**	**3056.72**
BORE NO: P105, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.67	9.67	26.59	1.57	12.7	12.7	1.0	9.42	0	23	1.0	36.1	0	3.0	25.4	0	9.67	10.90	11.80	29.0	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.67	9.67	33.85	3.14	25.4	25.4	1.0	50.51	0	0	1.0	0.0	0	4.0	28.6	2	10.25	18.11	19.17	38.7	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	20.25	10.25	43.81	3.14	28.6	28.6	1.0	75.06	0	2	1.0	6.3	0	5.0	28.5	0	10.25	17.88	18.94	48.9	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	20.25	10.25	54.06	3.14	28.5	28.5	1.0	92.24	0	0	1.0	0.0	0	6.0	28.5	0	9.37	17.88	18.94	59.2	0	0.0	41.3	41.3	**0.00**	**13.75**
6.00	8.00	7.00	2.00	5.50	19.37	9.37	68.55	6.29	28.5	28.5	1.0	233.95	0	0	1.0	0.0	0	8.0	10.2	46	9.37	2.53	1.28	77.9	0	0.0	64.8	64.8	**0.00**	**21.61**
8.00	9.00	8.50	1.00	6.50	19.37	9.37	82.61	3.14	10.2	10.2	1.0	46.71	0	46	1.0	144.6	0	9.0	14.3	23	9.37	3.74	2.45	87.3	0	0.0	76.6	76.6	**0.00**	**25.54**
9.00	10.00	9.50	1.00	7.50	19.37	9.37	91.98	3.14	14.3	14.3	1.0	73.68	0	23	1.0	72.3	0	10.0	6.8	24	10.08	1.89	0.73	96.7	0	0.0	88.4	88.4	**0.00**	**29.46**
10.00	11.00	10.50	1.00	8.50	20.08	10.08	101.70	3.14	6.8	6.8	1.0	38.11	0	24	1.0	75.4	0	11.0	9.5	62	10.08	2.38	1.14	106.7	0	0.0	100.2	100.2	**0.00**	**33.39**
11.00	12.00	11.50	1.00	9.50	20.08	10.08	111.78	3.14	9.5	9.5	1.0	58.79	0	62	1.0	194.9	0	12.0	11.9	55	10.08	3.03	1.76	116.8	0	0.0	112.0	112.0	**0.00**	**37.32**
12.00	13.00	12.50	1.00	10.50	20.08	10.08	121.86	3.14	11.9	11.9	1.0	80.71	0	55	1.0	172.9	0	13.0	9.4	54	9.96	2.36	1.13	126.9	0	0.0	123.8	123.8	**0.00**	**41.25**
13.00	14.50	13.75	1.50	12.00	19.96	9.96	134.37	4.71	9.4	9.4	1.0	104.87	0	54	1.0	254.6	0	14.5	12.8	45	9.66	3.29	2.02	141.8	692.7	692.7	141.4	141.4	**277.09**	**47.14**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
14.50	17.50	16.00	3.00	15.00	19.66	9.66	134.37	9.43	12.8	12.8	1.0	287.84	287.84	45	1.0	424.3	424.29	17.5	20.7	39	9.66	6.90	6.16	141.8	1068.6	1780.7	176.8	888.9	**712.28**	**296.30**
17.50	19.00	18.25	1.50	16.50	19.66	9.66	134.37	4.71	20.7	20.7	1.0	239.36	527.20	39	1.0	183.9	608.14	19.0	19.5	48	9.66	6.13	5.12	141.8	1042.5	2177.8	194.5	1329.8	**871.12**	**443.27**
19.00	20.50	19.75	1.50	18.00	19.66	9.66	134.37	4.71	19.5	19.5	1.0	224.32	751.52	48	1.0	226.3	834.43	20.5	11.2	48	10.50	2.82	1.56	141.8	660.5	2246.4	212.1	1798.1	**898.57**	**599.36**
20.50	23.50	22.00	3.00	21.00	20.50	10.50	134.37	9.43	11.2	11.2	1.0	250.86	1002.38	48	1.0	452.6	1287.00	23.5	11.2	48	10.50	2.82	1.56	141.8	660.5	2949.8	247.5	2536.9	**1179.94**	**845.63**
23.50	25.00	24.25	1.50	22.50	20.50	10.50	134.37	4.71	11.2	11.2	1.0	125.43	1127.80	48	1.0	226.3	1513.29	25.0	10.5	45	10.64	2.62	1.36	141.8	615.6	3256.7	265.2	2906.3	**1302.66**	**968.76**
25.00	26.50	25.75	1.50	24.00	20.64	10.64	134.37	4.71	10.5	10.5	1.0	117.40	1245.21	45	1.0	212.1	1725.43	26.5	29.2	0	10.64	19.46	20.56	141.8	2254.4	5225.1	282.9	3253.5	**2090.03**	**1084.50**
26.50	27.50	27.00	1.00	25.00	20.64	10.64	134.37	3.14	29.2	29.2	1.0	236.02	1481.23	0	1.0	0.0	1725.43	27.5	29.2	0	10.64	19.46	20.56	141.8	2254.4	5461.1	294.6	3501.3	**2184.44**	**1167.10**
27.50	28.00	27.75	0.50	25.50	20.64	10.64	134.37	1.57	29.2	29.2	1.0	118.01	1599.24	0	1.0	0.0	1725.43	28.0	11.0	48	11.02	2.76	1.51	141.8	654.0	3978.7	300.5	3625.2	**1591.46**	**1208.40**
28.00	29.50	28.75	1.50	27.00	21.02	11.02	134.37	4.71	11.0	11.0	1.0	123.13	1722.37	48	1.0	226.3	1951.71	29.5	30.0	0	11.02	21.26	22.40	141.8	2466.3	6140.3	318.2	3992.3	**2456.14**	**1330.77**
29.50	30.00	29.75	0.50	27.50	21.02	11.02	134.37	1.57	30.0	30.0	1.0	121.91	1844.28	0	1.0	0.0	1951.71	30.0	30.7	0	10.82	24.79	25.99	141.8	2872.7	6668.7	324.1	4120.1	**2667.49**	**1373.37**
30.00	32.50	31.25	2.50	30.00	20.82	10.82	134.37	7.86	30.7	30.7	1.0	648.81	2493.09	0	1.0	0.0	1951.71	32.5	10.3	55	10.82	2.56	1.31	141.8	679.6	5124.4	353.6	4798.4	**2049.75**	**1599.46**
32.50	34.00	33.25	1.50	31.50	20.82	10.82	134.37	4.71	10.3	10.3	1.0	115.12	2608.20	55	1.0	259.3	2211.00	34.0	25.2	15	10.82	10.45	11.34	141.8	1318.9	6138.1	371.3	5190.5	**2455.25**	**1730.15**
34.00	35.00	34.50	1.00	32.50	20.82	10.82	134.37	3.14	25.2	25.2	1.0	198.72	2806.93	15	1.0	47.1	2258.14	35.0	26.0	15	8.76	12.25	13.18	141.8	1516.9	6581.9	383.0	5448.1	**2632.77**	**1816.03**
35.00	35.50	35.25	0.50	33.00	18.76	8.76	134.37	1.57	26.0	26.0	1.0	102.99	2909.91	15	1.0	23.6	2281.71	35.5	28.0	0	8.72	16.76	17.79	141.8	1928.3	7119.9	388.9	5580.6	**2847.97**	**1860.19**
35.50	37.00	36.25	1.50	34.50	18.72	8.72	134.37	4.71	28.0	28.0	1.0	336.82	3246.73	0	1.0	0.0	2281.71	37.0	28.0	0	8.62	16.76	17.79	141.8	1927.6	7456.0	406.6	5935.0	**2982.42**	**1978.35**
37.00	37.50	37.25	0.50	35.00	18.62	8.62	134.37	1.57	28.0	28.0	1.0	112.27	3359.00	0	1.0	0.0	2281.71	37.5	29.4	0	8.62	19.91	21.02	141.8	2289.9	7930.6	412.5	6053.2	**3172.24**	**2017.74**
37.50	38.50	38.00	1.00	36.00	18.62	8.62	134.37	3.14	29.4	29.4	1.0	237.96	3596.96	0	1.0	0.0	2281.71	38.5	29.0	0	8.85	19.01	20.10	141.8	2188.2	8066.9	424.3	6303.0	**3226.74**	**2100.99**
38.50	40.00	39.25	1.50	37.50	18.85	8.85	134.37	4.71	29.0	29.0	1.0	351.13	3948.09	0	1.0	0.0	2281.71	40.0	29.0	0	8.85	19.01	20.10	141.8	2188.2	8418.0	442.0	6671.8	**3367.20**	**2223.92**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: P106, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.00	9.00	24.75	1.57	14.0	14.0	1.0	9.70	9.70	9	1.0	14.1	14.14	3.0	12.5	45	8.20	3.20	1.94	27.0	392.4	416.3	5.9	29.7	**166.50**	**9.91**
3.00	5.00	4.00	2.00	2.50	18.20	8.20	35.20	6.29	12.5	12.5	1.0	49.05	58.75	45	1.0	282.9	297.00	5.0	24.9	0	8.20	9.93	10.77	43.4	373.2	729.0	29.5	385.2	**291.60**	**128.40**
5.00	6.00	5.50	1.00	3.50	18.20	8.20	47.50	3.14	24.9	24.9	1.0	69.30	128.04	0	1.0	0.0	297.00	6.0	24.9	0	8.20	9.93	10.77	51.6	437.2	862.2	41.3	466.3	**344.90**	**155.43**
6.00	7.00	6.50	1.00	4.50	18.20	8.20	55.70	3.14	24.9	24.9	1.0	81.26	209.30	0	1.0	0.0	297.00	7.0	12.8	39	9.81	3.29	2.02	59.8	438.2	944.5	53.0	559.3	**377.81**	**186.45**
7.00	8.00	7.50	1.00	5.50	19.81	9.81	64.71	3.14	12.8	12.8	1.0	46.20	255.51	39	1.0	122.6	419.57	8.0	8.6	47	9.81	2.22	1.00	69.6	457.5	1132.6	64.8	739.9	**453.05**	**246.63**
8.00	9.00	8.50	1.00	6.50	19.81	9.81	74.52	3.14	8.6	8.6	1.0	35.42	290.92	47	1.0	147.7	567.29	9.0	8.6	47	9.81	2.22	1.00	79.4	474.6	1332.8	76.6	934.8	**533.14**	**311.61**
9.00	10.00	9.50	1.00	7.50	19.81	9.81	84.33	3.14	8.6	8.6	1.0	40.08	331.00	47	1.0	147.7	715.00	10.0	8.5	54	10.60	2.20	0.99	89.2	540.2	1586.2	88.4	1134.4	**634.49**	**378.13**
10.00	11.00	10.50	1.00	8.50	20.60	10.60	94.53	3.14	8.5	8.5	1.0	44.40	375.41	54	1.0	169.7	884.71	11.0	9.0	52	10.60	2.29	1.07	99.8	551.8	1811.9	100.2	1360.3	**724.76**	**453.43**
11.00	12.00	11.50	1.00	9.50	20.60	10.60	105.13	3.14	9.0	9.0	1.0	52.33	427.74	52	1.0	163.4	1048.14	12.0	9.8	74	10.47	2.43	1.19	110.4	739.4	2215.2	112.0	1587.8	**886.10**	**529.28**
12.00	14.50	13.25	2.50	12.00	20.47	10.47	123.52	7.86	9.8	9.8	1.0	167.63	595.37	74	1.0	581.4	1629.57	14.5	9.8	74	10.47	2.43	1.19	136.6	789.4	3014.4	141.4	2366.4	**1205.75**	**788.79**
14.50	16.00	15.25	1.50	13.50	20.47	10.47	123.52	4.71	9.8	9.8	1.0	100.58	695.95	74	1.0	348.9	1978.43	16.0	21.2	38	9.80	7.26	6.71	136.6	1074.2	3748.6	159.1	2833.5	**1499.43**	**944.50**
16.00	17.50	16.75	1.50	15.00	19.80	9.80	123.52	4.71	21.2	21.2	1.0	225.86	921.81	38	1.0	179.1	2157.57	17.5	26.5	4	9.19	13.38	14.34	136.6	1515.9	4595.3	176.8	3256.2	**1838.12**	**1085.39**
17.50	20.50	19.00	3.00	18.00	19.19	9.19	123.52	9.43	26.5	26.5	1.0	580.64	1502.45	4	1.0	37.7	2195.29	20.5	28.4	0	9.19	17.66	18.71	136.6	1962.7	5660.4	212.1	3909.9	**2264.17**	**1303.29**
20.50	22.00	21.25	1.50	19.50	19.19	9.19	123.52	4.71	28.4	28.4	1.0	314.85	1817.30	0	1.0	0.0	2195.29	22.0	18.5	44	9.19	5.64	4.57	136.6	933.2	4945.8	229.8	4242.4	**1978.32**	**1414.14**
22.00	23.50	22.75	1.50	21.00	19.19	9.19	123.52	4.71	18.5	18.5	1.0	194.83	2012.13	44	1.0	207.4	2402.71	23.5	27.0	7	9.80	14.50	15.49	136.6	1665.9	6080.7	247.5	4662.3	**2432.28**	**1554.12**
23.50	26.50	25.00	3.00	24.00	19.80	9.80	123.52	9.43	27.0	27.0	1.0	593.39	2605.52	7	1.0	66.0	2468.71	26.5	27.0	0	9.80	14.50	15.49	136.6	1616.4	6690.6	282.9	5357.1	**2676.24**	**1785.70**
26.50	27.50	27.00	1.00	25.00	19.80	9.80	123.52	3.14	27.0	27.0	1.0	197.80	2803.32	0	1.0	0.0	2468.71	27.5	27.0	0	9.80	14.50	15.49	136.6	1616.4	6888.4	294.6	5566.7	**2755.36**	**1855.56**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
27.50	29.50	28.50	2.00	27.00	19.80	9.80	123.52	6.29	27.0	27.0	1.0	395.59	3198.91	0	1.0	0.0	2468.71	29.5	17.3	40	8.34	5.07	3.91	136.6	840.0	6507.6	318.2	5985.8	**2603.06**	**1995.28**
29.50	30.00	29.75	0.50	27.50	18.34	8.34	123.52	1.57	17.3	17.3	1.0	60.46	3259.37	40	1.0	62.9	2531.57	30.0	17.0	40	10.15	4.92	3.75	136.6	826.3	6617.2	324.1	6115.0	**2646.90**	**2038.35**
30.00	31.00	30.50	1.00	28.50	20.15	10.15	123.52	3.14	17.0	17.0	1.0	118.68	3378.05	40	1.0	125.7	2657.29	31.0	11.2	55	10.15	2.82	1.56	136.6	698.1	6733.5	335.9	6371.2	**2693.39**	**2123.74**
31.00	32.50	31.75	1.50	30.00	20.15	10.15	123.52	4.71	11.2	11.2	1.0	115.30	3493.35	55	1.0	259.3	2916.57	32.5	11.2	55	10.15	2.82	1.56	136.6	698.1	7108.1	353.6	6763.5	**2843.22**	**2254.50**
32.50	35.00	33.75	2.50	32.50	20.15	10.15	123.52	7.86	11.2	11.2	1.0	192.16	3685.51	55	1.0	432.1	3348.71	35.0	10.5	55	10.15	2.62	1.36	136.6	675.3	7709.5	383.0	7417.3	**3083.79**	**2472.42**
35.00	35.50	35.25	0.50	33.00	20.15	10.15	123.52	1.57	10.5	10.5	1.0	35.97	3721.49	55	1.0	86.4	3435.14	35.5	10.5	55	10.15	2.62	1.36	136.6	675.3	7831.9	388.9	7545.6	**3132.75**	**2515.19**
35.50	37.50	36.50	2.00	35.00	20.15	10.15	123.52	6.29	10.5	10.5	1.0	143.90	3865.38	55	1.0	345.7	3780.86	37.5	10.5	55	8.76	2.62	1.36	136.6	674.5	8320.8	412.5	8058.7	**3328.30**	**2686.25**
37.50	38.50	38.00	1.00	36.00	18.76	8.76	123.52	3.14	10.5	10.5	1.0	71.95	3937.33	55	1.0	172.9	3953.71	38.5	10.0	60	8.61	2.47	1.22	136.6	693.5	8584.6	424.3	8315.3	**3433.83**	**2771.78**
38.50	40.00	39.25	1.50	37.50	18.61	8.61	123.52	4.71	10.0	10.0	1.0	102.67	4040.01	60	1.0	282.9	4236.57	40.0	10.0	60	8.61	2.47	1.22	136.6	693.5	8970.1	442.0	8718.5	**3588.04**	**2906.18**
BORE NO: P111, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.04	10.04	27.61	1.57	26.5	26.5	1.0	21.63	21.63	7	1.0	11.0	11.00	3.0	25.9	0	10.04	12.03	12.95	30.1	335.7	368.3	5.9	38.5	**147.34**	**12.84**
3.00	4.00	3.50	1.00	1.50	20.04	10.04	35.14	3.14	25.9	25.9	1.0	53.63	75.26	0	1.0	0.0	11.00	4.0	25.9	0	10.04	12.03	12.95	40.2	430.6	516.8	17.7	103.9	**206.74**	**34.65**
4.00	5.00	4.50	1.00	2.50	20.04	10.04	45.18	3.14	25.9	25.9	1.0	68.95	144.21	0	1.0	0.0	11.00	5.0	11.1	37	9.65	2.79	1.53	50.2	377.6	532.8	29.5	184.7	**213.14**	**61.56**
5.00	6.00	5.50	1.00	3.50	19.65	9.65	55.03	3.14	11.1	11.1	1.0	33.93	178.14	37	1.0	116.3	127.29	6.0	11.2	46	9.65	2.82	1.56	59.9	464.0	769.4	41.3	346.7	**307.75**	**115.56**
6.00	7.00	6.50	1.00	4.50	19.65	9.65	64.68	3.14	11.2	11.2	1.0	40.25	218.38	46	1.0	144.6	271.86	7.0	29.5	0	9.81	20.13	21.25	69.5	1181.3	1671.6	53.0	543.3	**668.63**	**181.09**
7.00	9.00	8.00	2.00	6.50	19.81	9.81	79.31	6.29	29.5	29.5	1.0	282.05	500.43	0	1.0	0.0	271.86	9.0	13.0	48	9.81	3.35	2.08	89.1	582.0	1354.3	76.6	848.9	**541.72**	**282.97**
9.00	10.00	9.50	1.00	7.50	19.81	9.81	94.03	3.14	13.0	13.0	1.0	68.22	568.66	48	1.0	150.9	422.71	10.0	11.0	50	10.14	2.76	1.51	98.9	574.4	1565.8	88.4	1079.8	**626.32**	**359.92**
10.00	12.50	11.25	2.50	10.00	20.14	10.14	111.61	7.86	11.0	11.0	1.0	170.45	739.11	50	1.0	392.9	815.57	12.5	9.5	58	10.47	2.38	1.14	124.3	647.2	2201.9	117.9	1672.5	**880.77**	**557.51**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
12.50	15.50	14.00	3.00	13.00	20.47	10.47	139.99	9.43	9.5	9.5	1.0	220.87	959.98	58	1.0	546.9	1362.43	15.5	10.4	56	10.30	2.59	1.33	124.3	654.1	2976.5	153.2	2475.6	**1190.59**	**825.21**
15.50	18.50	17.00	3.00	16.00	20.30	10.30	139.99	9.43	10.4	10.4	1.0	242.24	1202.22	56	1.0	528.0	1890.43	18.5	23.0	46	10.30	8.56	8.68	124.3	1196.3	4288.9	188.6	3281.2	**1715.58**	**1093.74**
18.50	20.00	19.25	1.50	17.50	20.30	10.30	139.99	4.71	23.0	23.0	1.0	280.12	1482.34	46	1.0	216.9	2107.29	20.0	32.3	0	10.30	32.85	34.19	124.3	3345.7	6935.3	206.3	3795.9	**2774.12**	**1265.29**
20.00	21.50	20.75	1.50	19.00	20.30	10.30	139.99	4.71	32.3	32.3	1.1	465.17	1947.51	0	1.0	0.0	2107.29	21.5	32.3	0	10.68	32.85	34.19	124.3	3350.8	7405.6	223.9	4278.7	**2962.23**	**1426.24**
21.50	24.50	23.00	3.00	22.00	20.68	10.68	139.99	9.43	32.3	32.3	1.1	930.33	2877.84	0	1.0	0.0	2107.29	24.5	30.4	0	10.68	23.27	24.45	124.3	2375.3	7360.4	259.3	5244.4	**2944.17**	**1748.14**
24.50	26.00	25.25	1.50	23.50	20.68	10.68	139.99	4.71	30.4	30.4	1.0	394.92	3272.76	0	1.0	0.0	2107.29	26.0	32.5	0	10.68	33.85	35.22	124.3	3453.5	8833.5	277.0	5657.0	**3533.40**	**1885.67**
26.00	27.50	26.75	1.50	25.00	20.68	10.68	139.99	4.71	32.5	32.5	1.1	472.97	3745.73	0	1.0	0.0	2107.29	27.5	32.3	0	8.04	32.85	34.19	124.3	3315.3	9168.3	294.6	6147.7	**3667.34**	**2049.22**
27.50	29.00	28.25	1.50	26.50	18.04	8.04	139.99	4.71	32.3	32.3	1.1	465.17	4210.90	0	1.0	0.0	2107.29	29.0	32.3	0	8.40	32.85	34.19	124.3	3320.2	9638.3	312.3	6630.5	**3855.34**	**2210.17**
29.00	30.00	29.50	1.00	27.50	18.40	8.40	139.99	3.14	32.3	32.3	1.1	310.11	4521.01	0	1.0	0.0	2107.29	30.0	32.3	0	8.40	32.85	34.19	124.3	3320.2	9948.5	324.1	6952.4	**3979.38**	**2317.47**
30.00	30.50	30.25	0.50	28.00	18.40	8.40	139.99	1.57	32.3	32.3	1.1	155.06	4676.07	0	1.0	0.0	2107.29	30.5	32.3	0	8.39	32.85	34.19	124.3	3320.0	10103.4	330.0	7113.4	**4041.35**	**2371.12**
30.50	32.00	31.25	1.50	29.50	18.39	8.39	139.99	4.71	32.3	32.3	1.1	465.17	5141.24	0	1.0	0.0	2107.29	32.0	32.3	0	9.03	32.85	34.19	124.3	3328.6	10577.1	347.7	7596.2	**4230.85**	**2532.07**
32.00	32.50	32.25	0.50	30.00	19.03	9.03	139.99	1.57	32.3	32.3	1.1	155.06	5296.29	0	1.0	0.0	2107.29	32.5	32.3	0	9.03	32.85	34.19	124.3	3328.6	10732.2	353.6	7757.1	**4292.88**	**2585.72**
32.50	33.50	33.00	1.00	31.00	19.03	9.03	139.99	3.14	32.3	32.3	1.1	310.11	5606.40	0	1.0	0.0	2107.29	33.5	32.3	0	8.99	32.85	34.19	124.3	3328.1	11041.8	365.4	8079.0	**4416.71**	**2693.01**
33.50	35.00	34.25	1.50	32.50	18.99	8.99	139.99	4.71	32.3	32.3	1.1	465.17	6071.57	0	1.0	0.0	2107.29	35.0	32.9	0	8.83	35.87	37.27	124.3	3631.7	11810.6	383.0	8561.9	**4724.24**	**2853.96**
35.00	36.50	35.75	1.50	34.00	18.83	8.83	139.99	4.71	32.9	32.9	1.1	488.83	6560.40	0	1.0	0.0	2107.29	36.5	32.9	0	8.85	35.87	37.27	124.3	3632.0	12299.7	400.7	9068.4	**4919.89**	**3022.80**
36.50	37.50	37.00	1.00	35.00	18.85	8.85	139.99	3.14	32.9	32.9	1.1	325.89	6886.29	0	1.0	0.0	2107.29	37.5	32.9	0	8.85	35.87	37.27	124.3	3632.0	12625.6	412.5	9406.1	**5050.24**	**3135.36**
37.50	38.00	37.75	0.50	35.50	18.85	8.85	139.99	1.57	32.9	32.9	1.1	162.94	7049.23	0	1.0	0.0	2107.29	38.0	19.5	45	8.66	6.13	5.12	124.3	934.6	10091.1	418.4	9574.9	**4036.45**	**3191.64**
38.00	40.00	39.00	2.00	37.50	18.66	8.66	139.99	6.29	19.5	19.5	1.0	311.59	7360.82	45	1.0	282.9	2390.14	40.0	19.0	45	8.61	5.87	4.84	124.3	907.6	10658.6	442.0	10192.9	**4263.42**	**3397.64**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								φ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	φ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: P101 CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.30	10.30	28.33	1.89	23.3	23.3	1.0	23.00	0	0	1.0	0.0	0	3.0	24.8	0	10.30	9.86	10.66	30.9	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	20.30	10.30	36.05	3.77	24.8	24.8	1.0	62.82	0	0	1.0	0.0	0	4.0	26.6	8	9.58	13.60	14.57	41.2	0	0.0	25.5	25.5	**0.00**	**8.49**
4.00	5.00	4.50	1.00	2.50	19.58	9.58	45.99	3.77	26.6	26.6	1.0	86.86	0	8	1.0	30.2	0	5.0	26.3	0	9.58	12.93	13.88	50.8	833.0	833.0	42.4	42.4	**333.19**	**14.14**
5.00	6.00	5.50	1.00	3.50	19.58	9.58	55.57	3.77	26.3	26.3	1.0	103.58	103.58	0	1.0	0.0	0.00	6.0	9.5	48	9.58	2.38	1.14	60.4	658.7	762.3	59.4	163.0	**304.93**	**54.33**
6.00	7.00	6.50	1.00	4.50	19.58	9.58	65.15	3.77	9.5	9.5	1.0	41.12	144.70	48	1.0	181.0	181.03	7.0	9.5	48	10.61	2.38	1.14	69.9	685.3	1011.1	76.4	402.1	**404.43**	**134.03**
7.00	8.00	7.50	1.00	5.50	20.61	10.61	75.25	3.77	9.5	9.5	1.0	47.49	192.19	48	1.0	181.0	362.06	8.0	26.0	6	10.61	12.25	13.18	80.6	1272.7	1826.9	93.3	647.6	**730.76**	**215.86**
8.00	9.00	8.50	1.00	6.50	20.61	10.61	85.86	3.77	26.0	26.0	1.0	157.93	350.11	6	1.0	22.6	384.69	9.0	26.0	6	10.40	12.25	13.18	91.2	1417.9	2152.6	110.3	845.1	**861.06**	**281.70**
9.00	11.00	10.00	2.00	8.50	20.40	10.40	101.56	7.54	26.0	26.0	1.0	373.63	723.74	6	1.0	45.3	429.94	11.0	9.5	45	10.40	2.38	1.14	112.0	767.8	1921.5	144.3	1297.9	**768.59**	**432.65**
11.00	12.00	11.50	1.00	9.50	20.40	10.40	117.16	3.77	9.5	9.5	1.0	73.94	797.68	45	1.0	169.7	599.66	12.0	9.5	45	10.53	2.38	1.14	122.4	795.9	2193.2	161.2	1558.6	**877.29**	**519.52**
12.00	14.50	13.25	2.50	12.00	20.53	10.53	135.52	9.43	9.5	9.5	1.0	213.83	1011.51	45	1.0	424.3	1023.94	14.5	9.5	45	10.53	2.38	1.14	148.7	866.8	2902.2	203.7	2239.1	**1160.89**	**746.37**
14.50	16.00	15.25	1.50	13.50	20.53	10.53	156.58	5.66	9.5	9.5	1.0	148.23	1159.74	45	1.0	254.6	1278.51	16.0	13.0	43	10.55	3.35	2.08	164.5	1076.2	3514.4	229.1	2667.4	**1405.77**	**889.12**
16.00	17.50	16.75	1.50	15.00	20.55	10.55	172.39	5.66	13.0	13.0	1.0	225.15	1384.90	43	1.0	243.3	1521.77	17.5	13.0	43	10.55	3.35	2.08	180.3	1136.2	4042.8	254.6	3161.2	**1617.13**	**1053.75**
17.50	19.00	18.25	1.50	16.50	20.55	10.55	172.39	5.66	13.0	13.0	1.0	225.15	1610.05	43	1.0	243.3	1765.03	19.0	32.1	0	8.89	31.84	33.16	180.3	6695.2	10070.3	280.0	3655.1	**4028.11**	**1218.37**
19.00	20.50	19.75	1.50	18.00	18.89	8.89	172.39	5.66	32.1	32.1	1.1	676.01	2286.06	0	1.0	0.0	1765.03	20.5	32.1	0	8.89	31.84	33.16	180.3	6695.2	10746.3	305.5	4356.6	**4298.52**	**1452.19**
20.50	22.00	21.25	1.50	19.50	18.89	8.89	172.39	5.66	32.1	32.1	1.1	676.01	2962.07	0	1.0	0.0	1765.03	22.0	13.0	47	9.71	3.35	2.08	180.3	1175.7	5902.8	330.9	5058.0	**2361.12**	**1686.01**
22.00	23.50	22.75	1.50	21.00	19.71	9.71	172.39	5.66	13.0	13.0	1.0	225.15	3187.22	47	1.0	265.9	2030.91	23.5	13.0	47	9.71	3.35	2.08	180.3	1175.7	6393.8	356.4	5574.5	**2557.53**	**1858.18**
23.50	25.00	24.25	1.50	22.50	19.71	9.71	172.39	5.66	13.0	13.0	1.0	225.15	3412.38	47	1.0	265.9	2296.80	25.0	29.6	0	10.05	20.36	21.48	180.3	4299.8	10008.9	381.9	6091.0	**4003.58**	**2030.34**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								φ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	φ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
25.00	26.50	25.75	1.50	24.00	20.05	10.05	172.39	5.66	29.6	29.6	1.0	554.02	3966.40	0	1.0	0.0	2296.80	26.5	29.0	0	10.05	19.01	20.10	180.3	4014.7	10277.9	407.3	6670.5	**4111.16**	**2223.50**
26.50	27.50	27.00	1.00	25.00	20.05	10.05	172.39	3.77	29.0	29.0	1.0	360.39	4326.79	0	1.0	0.0	2296.80	27.5	29.0	0	10.05	19.01	20.10	180.3	4014.7	10638.3	424.3	7047.9	**4255.32**	**2349.29**
27.50	29.50	28.50	2.00	27.00	20.05	10.05	172.39	7.54	29.0	29.0	1.0	720.79	5047.57	0	1.0	0.0	2296.80	29.5	27.2	0	8.72	14.95	15.95	180.3	3145.1	10489.5	458.2	7802.6	**4195.79**	**2600.87**
29.50	30.00	29.75	0.50	27.50	18.72	8.72	172.39	1.89	27.2	27.2	1.0	167.07	5214.64	0	1.0	0.0	2296.80	30.0	27.2	0	10.43	14.95	15.95	180.3	3163.6	10675.1	466.7	7978.2	**4270.02**	**2659.39**
30.00	31.00	30.50	1.00	28.50	20.43	10.43	172.39	3.77	27.2	27.2	1.0	334.14	5548.78	0	1.0	0.0	2296.80	31.0	12.8	56	10.43	3.29	2.02	180.3	1256.0	9101.6	483.7	8329.3	**3640.65**	**2776.42**
31.00	32.50	31.75	1.50	30.00	20.43	10.43	172.39	5.66	12.8	12.8	1.0	221.57	5770.36	56	1.0	316.8	2613.60	32.5	12.8	56	10.43	3.29	2.02	180.3	1256.0	9640.0	509.1	8893.1	**3856.00**	**2964.37**
32.50	35.00	33.75	2.50	32.50	20.43	10.43	172.39	9.43	12.8	12.8	1.0	369.29	6139.64	56	1.0	528.0	3141.60	35.0	12.3	49	10.43	3.15	1.88	180.3	1154.0	10435.2	551.6	9832.8	**4174.08**	**3277.60**
35.00	35.50	35.25	0.50	33.00	20.43	10.43	172.39	1.89	12.3	12.3	1.0	70.88	6210.52	49	1.0	92.4	3234.00	35.5	30.0	0	10.43	21.26	22.40	180.3	4495.6	13940.1	560.1	10004.6	**5576.05**	**3334.86**
35.50	37.00	36.25	1.50	34.50	20.43	10.43	172.39	5.66	30.0	30.0	1.0	563.06	6773.58	0	1.0	0.0	3234.00	37.0	30.0	0	10.49	21.26	22.40	180.3	4496.5	14504.1	585.5	10593.1	**5801.63**	**3531.03**
37.00	37.50	37.25	0.50	35.00	20.49	10.49	172.39	1.89	30.0	30.0	1.0	187.69	6961.27	0	1.0	0.0	3234.00	37.5	30.0	0	10.49	21.26	22.40	180.3	4496.5	14691.8	594.0	10789.3	**5876.71**	**3596.42**
37.50	38.50	38.00	1.00	36.00	20.49	10.49	172.39	3.77	30.0	30.0	1.0	375.37	7336.64	0	1.0	0.0	3234.00	38.5	30.0	0	10.49	21.26	22.40	180.3	4496.5	15067.1	611.0	11181.6	**6026.86**	**3727.20**
38.50	40.00	39.25	1.50	37.50	20.49	10.49	172.39	5.66	30.0	30.0	1.0	563.06	7899.70	0	1.0	0.0	3234.00	40.0	30.0	0	10.49	21.26	22.40	180.3	4496.5	15630.2	636.4	11770.1	**6252.08**	**3923.38**
BORE NO: P102, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.64	9.64	26.51	1.89	27.2	27.2	1.0	25.69	0	11	1.0	20.7	0	3.0	24.8	0	9.64	9.86	10.66	28.9	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.64	9.64	33.74	3.77	24.8	24.8	1.0	58.80	0	0	1.0	0.0	0	4.0	27.0	0	8.85	14.50	15.49	38.6	0	0.0	25.5	25.5	**0.00**	**8.49**
4.00	6.00	5.00	2.00	3.50	18.85	8.85	47.41	7.54	27.0	27.0	1.0	182.21	0	0	1.0	0.0	0	6.0	27.2	0	8.85	14.95	15.95	56.3	0	0.0	59.4	59.4	**0.00**	**19.80**
6.00	7.00	6.50	1.00	4.50	18.85	8.85	60.69	3.77	27.2	27.2	1.0	117.62	0	0	1.0	0.0	0	7.0	27.2	0	8.85	14.95	15.95	65.1	0	0.0	76.4	76.4	**0.00**	**25.46**
7.00	8.00	7.50	1.00	5.50	18.85	8.85	69.54	3.77	27.2	27.2	1.0	134.78	0	0	1.0	0.0	0	8.0	10.2	53	9.55	2.53	1.28	74.0	759.6	759.6	93.3	93.3	**303.83**	**31.11**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
8.00	9.00	8.50	1.00	6.50	19.55	9.55	78.74	3.77	10.2	10.2	1.0	53.43	53.43	53	1.0	199.9	199.89	9.0	10.2	53	9.55	2.53	1.28	83.5	786.9	1040.2	110.3	363.6	**416.09**	**121.21**
9.00	10.00	9.50	1.00	7.50	19.55	9.55	88.29	3.77	10.2	10.2	1.0	59.91	113.34	53	1.0	199.9	399.77	10.0	12.5	42	9.55	3.20	1.94	93.1	777.6	1290.7	127.3	640.4	**516.27**	**213.46**
10.00	11.00	10.50	1.00	8.50	19.55	9.55	97.84	3.77	12.5	12.5	1.0	81.80	195.14	42	1.0	158.4	558.17	11.0	12.5	42	9.92	3.20	1.94	102.6	812.7	1566.0	144.3	897.6	**626.40**	**299.19**
11.00	12.50	11.75	1.50	10.00	19.92	9.92	110.05	5.66	12.5	12.5	1.0	138.02	333.16	42	1.0	237.6	795.77	12.5	12.5	44	10.00	3.20	1.94	117.5	887.1	2016.0	169.7	1298.6	**806.41**	**432.88**
12.50	15.50	14.00	3.00	13.00	20.00	10.00	132.49	11.31	12.5	12.5	1.0	332.33	665.49	44	1.0	497.8	1293.60	15.5	12.9	44	10.00	3.32	2.05	147.5	1016.1	2975.2	220.6	2179.7	**1190.08**	**726.57**
15.50	17.00	16.25	1.50	14.50	20.00	10.00	154.99	5.66	12.9	12.9	1.0	200.81	866.30	44	1.0	248.9	1542.51	17.0	29.7	0	10.63	20.58	21.71	162.5	3940.9	6349.7	246.1	2654.9	**2539.90**	**884.97**
17.00	18.50	17.75	1.50	16.00	20.63	10.63	170.46	5.66	29.7	29.7	1.0	550.04	1416.34	0	1.0	0.0	1542.51	18.5	10.8	45	10.63	2.71	1.45	162.5	966.0	3924.9	271.5	3230.4	**1569.95**	**1076.80**
18.50	20.00	19.25	1.50	17.50	20.63	10.63	170.46	5.66	10.8	10.8	1.0	183.96	1600.30	45	1.0	254.6	1797.09	20.0	30.5	0	10.63	23.78	24.96	162.5	4551.7	7949.1	297.0	3694.4	**3179.62**	**1231.46**
20.00	21.50	20.75	1.50	19.00	20.63	10.63	170.46	5.66	30.5	30.5	1.0	582.24	2182.53	0	1.0	0.0	1797.09	21.5	31.2	0	10.34	27.30	28.55	162.5	5220.2	9199.8	322.5	4302.1	**3679.94**	**1434.03**
21.50	23.00	22.25	1.50	20.50	20.34	10.34	170.46	5.66	31.2	31.2	1.1	619.06	2801.60	0	1.0	0.0	1797.09	23.0	29.6	3	10.34	20.36	21.48	162.5	3924.2	8522.9	347.9	4946.6	**3409.15**	**1648.87**
23.00	24.50	23.75	1.50	22.00	20.34	10.34	170.46	5.66	29.6	29.6	1.0	547.82	3349.41	3	1.0	17.0	1814.06	24.5	29.0	0	10.34	19.01	20.10	162.5	3635.5	8799.0	373.4	5536.8	**3519.60**	**1845.61**
24.50	27.50	26.00	3.00	25.00	20.34	10.34	170.46	11.31	29.0	29.0	1.0	1069.07	4418.49	0	1.0	0.0	1814.06	27.5	29.0	0	10.64	19.01	20.10	162.5	3639.6	9872.2	424.3	6656.8	**3948.87**	**2218.94**
27.50	30.00	28.75	2.50	27.50	20.64	10.64	170.46	9.43	29.0	29.0	1.0	890.90	5309.38	0	1.0	0.0	1814.06	30.0	28.2	0	10.64	17.21	18.25	162.5	3295.1	10418.5	466.7	7590.2	**4167.42**	**2530.05**
30.00	30.50	30.25	0.50	28.00	20.64	10.64	170.46	1.89	28.2	28.2	1.0	172.36	5481.74	0	1.0	0.0	1814.06	30.5	28.2	0	10.64	17.21	18.25	162.5	3295.1	10590.9	475.2	7771.0	**4236.36**	**2590.33**
30.50	32.50	31.50	2.00	30.00	20.64	10.64	170.46	7.54	28.2	28.2	1.0	689.43	6171.16	0	1.0	0.0	1814.06	32.5	30.2	0	10.64	22.27	23.43	162.5	4262.9	12248.1	509.1	8494.4	**4899.25**	**2831.45**
32.50	33.50	33.00	1.00	31.00	20.64	10.64	170.46	3.77	30.2	30.2	1.0	377.91	6549.07	0	1.0	0.0	1814.06	33.5	32.7	0	10.64	34.86	36.24	162.5	6670.7	15033.9	526.1	8889.2	**6013.55**	**2963.08**
33.50	35.00	34.25	1.50	32.50	20.64	10.64	170.46	5.66	32.7	32.7	1.1	702.67	7251.74	0	1.0	0.0	1814.06	35.0	32.2	0	10.64	32.34	33.68	162.5	6189.2	15255.0	551.6	9617.4	**6101.99**	**3205.79**
35.00	36.50	35.75	1.50	34.00	20.64	10.64	170.46	5.66	32.2	32.2	1.1	674.07	7925.81	0	1.0	0.0	1814.06	36.5	32.2	0	8.88	32.34	33.68	162.5	6148.9	15888.8	577.0	10316.9	**6355.52**	**3438.97**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								φ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	φ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
36.50	37.50	37.00	1.00	35.00	18.88	8.88	170.46	3.77	32.2	32.2	1.1	449.38	8375.19	0	1.0	0.0	1814.06	37.5	32.2	0	8.88	32.34	33.68	162.5	6148.9	16338.2	594.0	10783.3	**6535.27**	**3594.42**
37.50	38.00	37.75	0.50	35.50	18.88	8.88	170.46	1.89	32.2	32.2	1.1	224.69	8599.88	0	1.0	0.0	1814.06	38.0	25.2	10	8.93	10.45	11.34	162.5	2091.8	12505.8	602.5	11016.4	**5002.31**	**3672.14**
38.00	40.00	39.00	2.00	37.50	18.93	8.93	170.46	7.54	25.2	25.2	1.0	605.04	9204.92	10	1.0	75.4	1889.49	40.0	25.2	10	8.93	10.45	11.34	162.5	2091.8	13186.2	636.4	11730.8	**5274.50**	**3910.28**
BORE NO: P103, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.00	10.00	27.50	1.89	24.3	24.3	1.0	23.41	0	0	1.0	0.0	0	3.0	26.5	4	10.00	13.38	14.34	30.0	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	20.00	10.00	35.00	3.77	26.5	26.5	1.0	65.81	0	4	1.0	15.1	0	4.0	26.5	4	10.00	13.38	14.34	40.0	743.5	743.5	25.5	25.5	**297.40**	**8.49**
4.00	5.00	4.50	1.00	2.50	20.00	10.00	45.00	3.77	26.5	26.5	1.0	84.62	84.62	4	1.0	15.1	15.09	5.0	26.5	4	10.10	13.38	14.34	50.0	895.8	995.5	42.4	142.1	**398.21**	**47.38**
5.00	6.00	5.50	1.00	3.50	20.10	10.10	55.05	3.77	26.5	26.5	1.0	103.51	188.13	4	1.0	15.1	30.17	6.0	26.5	4	10.10	13.38	14.34	60.1	1048.7	1267.0	59.4	277.7	**506.80**	**92.57**
6.00	7.00	6.50	1.00	4.50	20.10	10.10	65.15	3.77	26.5	26.5	1.0	122.51	310.64	4	1.0	15.1	45.26	7.0	10.5	49	10.60	2.62	1.36	70.2	716.6	1072.5	76.4	432.3	**429.01**	**144.09**
7.00	9.00	8.00	2.00	6.50	20.60	10.60	80.80	7.54	10.5	10.5	1.0	112.96	423.59	49	1.0	369.6	414.86	9.0	10.5	49	10.60	2.62	1.36	91.4	779.4	1617.8	110.3	948.8	**647.14**	**316.25**
9.00	10.00	9.50	1.00	7.50	20.60	10.60	96.70	3.77	10.5	10.5	1.0	67.59	491.19	49	1.0	184.8	599.66	10.0	24.4	14	9.77	9.57	10.22	102.0	1314.6	2405.4	127.3	1218.1	**962.16**	**406.04**
10.00	12.50	11.25	2.50	10.00	19.77	9.77	114.21	9.43	24.4	24.4	1.0	488.49	979.67	14	1.0	132.0	731.66	12.5	24.4	14	10.59	9.57	10.22	126.4	1584.7	3296.0	169.7	1881.0	**1318.39**	**627.01**
12.50	15.50	14.00	3.00	13.00	20.59	10.59	142.31	11.31	24.4	24.4	1.0	730.39	1710.06	14	1.0	158.4	890.06	15.5	27.9	0	10.59	16.53	17.56	158.2	3085.0	5685.1	220.6	2820.7	**2274.04**	**940.25**
15.50	17.00	16.25	1.50	14.50	20.59	10.59	166.14	5.66	27.9	27.9	1.0	497.63	2207.69	0	1.0	0.0	890.06	17.0	10.5	54	10.69	2.62	1.36	174.1	1075.2	4173.0	246.1	3343.8	**1669.18**	**1114.61**
17.00	18.50	17.75	1.50	16.00	20.69	10.69	182.10	5.66	10.5	10.5	1.0	190.93	2398.62	54	1.0	305.5	1195.54	18.5	28.6	0	10.69	18.11	19.17	174.1	3705.5	7299.6	271.5	3865.7	**2919.85**	**1288.57**
18.50	20.00	19.25	1.50	17.50	20.69	10.69	182.10	5.66	28.6	28.6	1.0	561.66	2960.28	0	1.0	0.0	1195.54	20.0	11.0	51	10.40	2.76	1.51	174.1	1074.4	5230.2	297.0	4452.8	**2092.07**	**1484.27**
20.00	21.50	20.75	1.50	19.00	20.40	10.40	182.10	5.66	11.0	11.0	1.0	200.24	3160.52	51	1.0	288.5	1484.06	21.5	11.0	51	10.40	2.76	1.51	174.1	1074.4	5718.9	322.5	4967.0	**2287.57**	**1655.68**
21.50	23.00	22.25	1.50	20.50	20.40	10.40	182.10	5.66	11.0	11.0	1.0	200.24	3360.76	51	1.0	288.5	1772.57	23.0	27.5	2	9.57	15.63	16.64	174.1	3206.9	8340.2	347.9	5481.2	**3336.09**	**1827.08**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
23.00	24.50	23.75	1.50	22.00	19.57	9.57	182.10	5.66	27.5	27.5	1.0	536.26	3897.02	2	1.0	11.3	1783.89	24.5	31.0	0	9.57	26.30	27.53	174.1	5358.3	11039.2	373.4	6054.3	**4415.66**	**2018.09**
24.50	26.00	25.25	1.50	23.50	19.57	9.57	182.10	5.66	31.0	31.0	1.1	649.93	4546.95	0	1.0	0.0	1783.89	26.0	31.2	0	9.57	27.30	28.55	174.1	5563.3	11894.2	398.8	6729.7	**4757.67**	**2243.22**
26.00	27.50	26.75	1.50	25.00	19.57	9.57	182.10	5.66	31.2	31.2	1.1	661.31	5208.26	0	1.0	0.0	1783.89	27.5	31.2	0	9.13	27.30	28.55	174.1	5554.8	12547.0	424.3	7416.4	**5018.79**	**2472.15**
27.50	29.00	28.25	1.50	26.50	19.13	9.13	182.10	5.66	31.2	31.2	1.1	661.31	5869.58	0	1.0	0.0	1783.89	29.0	31.4	0	8.63	28.31	29.58	174.1	5749.6	13403.0	449.7	8103.2	**5361.21**	**2701.07**
29.00	30.00	29.50	1.00	27.50	18.63	8.63	182.10	3.77	31.4	31.4	1.1	448.55	6318.13	0	1.0	0.0	1783.89	30.0	31.4	0	8.63	28.31	29.58	174.1	5749.6	13851.6	466.7	8568.7	**5540.63**	**2856.24**
30.00	30.50	30.25	0.50	28.00	18.63	8.63	182.10	1.89	31.4	31.4	1.1	224.27	6542.40	0	1.0	0.0	1783.89	30.5	31.4	0	8.99	28.31	29.58	174.1	5756.8	14083.1	475.2	8801.5	**5633.23**	**2933.83**
30.50	32.00	31.25	1.50	29.50	18.99	8.99	182.10	5.66	31.4	31.4	1.1	672.82	7215.23	0	1.0	0.0	1783.89	32.0	27.0	18	8.97	14.50	15.49	174.1	3134.3	12133.4	500.7	9499.8	**4853.35**	**3166.59**
32.00	32.50	32.25	0.50	30.00	18.97	8.97	182.10	1.89	27.0	27.0	1.0	174.96	7390.19	18	1.0	33.9	1817.83	32.5	27.0	18	8.97	14.50	15.49	174.1	3134.3	12342.3	509.1	9717.2	**4936.91**	**3239.05**
32.50	33.50	33.00	1.00	31.00	18.97	8.97	182.10	3.77	27.0	27.0	1.0	349.93	7740.12	18	1.0	67.9	1885.71	33.5	12.5	60	8.72	3.20	1.94	174.1	1253.5	10879.3	526.1	10151.9	**4351.73**	**3383.98**
33.50	35.00	34.25	1.50	32.50	18.72	8.72	182.10	5.66	12.5	12.5	1.0	228.38	7968.49	60	1.0	339.4	2225.14	35.0	14.0	60	8.82	3.65	2.36	174.1	1344.0	11537.7	551.6	10745.2	**4615.07**	**3581.74**
35.00	36.50	35.75	1.50	34.00	18.82	8.82	182.10	5.66	14.0	14.0	1.0	256.85	8225.34	60	1.0	339.4	2564.57	36.5	14.0	60	8.34	3.65	2.36	174.1	1343.3	12133.2	577.0	11366.9	**4853.27**	**3788.98**
36.50	37.50	37.00	1.00	35.00	18.34	8.34	182.10	3.77	14.0	14.0	1.0	171.23	8396.57	60	1.0	226.3	2790.86	37.5	18.0	60	8.34	5.42	4.29	174.1	1702.0	12889.4	594.0	11781.4	**5155.78**	**3927.14**
37.50	38.00	37.75	0.50	35.50	18.34	8.34	182.10	1.89	18.0	18.0	1.0	111.57	8508.14	60	1.0	113.1	2904.00	38.0	18.0	60	8.72	5.42	4.29	174.1	1703.1	13115.3	602.5	12014.6	**5246.11**	**4004.88**
38.00	40.00	39.00	2.00	37.50	18.72	8.72	182.10	7.54	18.0	18.0	1.0	446.29	8954.43	60	1.0	452.6	3356.57	40.0	18.0	125	8.72	5.42	4.29	174.1	2365.0	14676.0	636.4	12947.4	**5870.40**	**4315.81**
BORE NO: P104, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.80	9.80	26.95	1.89	25.8	25.8	1.0	24.57	0	0	1.0	0.0	0	3.0	25.4	0	9.03	10.90	11.80	29.4	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	5.00	4.00	2.00	2.50	19.03	9.03	38.43	7.54	25.4	25.4	1.0	137.64	0	0	1.0	0.0	0	5.0	24.6	0	9.03	9.71	10.44	47.5	585.5	585.5	42.4	42.4	**234.21**	**14.14**
5.00	6.00	5.50	1.00	3.50	19.03	9.03	51.98	3.77	24.6	24.6	1.0	89.74	89.74	0	1.0	0.0	0.00	6.0	11.1	50	11.01	2.79	1.53	56.5	699.2	788.9	59.4	149.1	**315.56**	**49.71**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
6.00	8.00	7.00	2.00	5.50	21.01	11.01	67.50	7.54	11.1	11.1	1.0	99.89	189.63	50	1.0	377.1	377.14	8.0	11.6	41	11.01	2.94	1.68	78.5	691.2	1258.0	93.3	660.1	**503.20**	**220.04**
8.00	9.00	8.50	1.00	6.50	21.01	11.01	84.02	3.77	11.6	11.6	1.0	65.04	254.68	41	1.0	154.6	531.77	9.0	11.6	41	10.35	2.94	1.68	89.5	727.1	1513.6	110.3	896.8	**605.42**	**298.92**
9.00	11.00	10.00	2.00	8.50	20.35	10.35	99.87	7.54	11.6	11.6	1.0	154.63	409.31	41	1.0	309.3	841.03	11.0	6.2	86	10.35	1.79	0.63	110.2	1102.9	2353.2	144.3	1394.6	**941.30**	**464.86**
11.00	12.00	11.50	1.00	9.50	20.35	10.35	115.40	3.77	6.2	6.2	1.0	47.28	456.59	86	1.0	324.3	1165.37	12.0	10.0	84	9.88	2.47	1.22	120.6	1200.5	2822.4	161.2	1783.2	**1128.98**	**594.40**
12.00	14.50	13.25	2.50	12.00	19.88	9.88	132.92	9.43	10.0	10.0	1.0	220.98	677.57	84	1.0	792.0	1957.37	14.5	10.0	42	9.88	2.47	1.22	145.3	841.8	3476.8	203.7	2838.6	**1390.71**	**946.20**
14.50	16.00	15.25	1.50	13.50	19.88	9.88	152.68	5.66	10.0	10.0	1.0	152.30	829.87	42	1.0	237.6	2194.97	16.0	27.7	0	10.15	16.08	17.10	160.1	3030.4	6055.3	229.1	3254.0	**2422.11**	**1084.65**
16.00	17.50	16.75	1.50	15.00	20.15	10.15	167.70	5.66	27.7	27.7	1.0	498.09	1327.95	0	1.0	0.0	2194.97	17.5	27.4	0	10.15	15.40	16.41	175.3	3168.7	6691.6	254.6	3777.5	**2676.64**	**1259.17**
17.50	19.00	18.25	1.50	16.50	20.15	10.15	167.70	5.66	27.4	27.4	1.0	491.77	1819.72	0	1.0	0.0	2194.97	19.0	15.3	43	10.15	4.09	2.81	175.3	1268.1	5282.8	280.0	4294.7	**2113.10**	**1431.57**
19.00	20.50	19.75	1.50	18.00	20.15	10.15	167.70	5.66	15.3	15.3	1.0	259.54	2079.26	43	1.0	243.3	2438.23	20.5	25.5	9	9.81	11.13	12.03	175.3	2378.7	6896.2	305.5	4823.0	**2758.47**	**1607.66**
20.50	23.50	22.00	3.00	21.00	19.81	9.81	167.70	11.31	25.5	25.5	1.0	905.03	2984.29	9	1.0	101.8	2540.06	23.5	20.7	44	9.81	6.90	6.16	175.3	1858.5	7382.9	356.4	5880.7	**2953.14**	**1960.25**
23.50	25.00	24.25	1.50	22.50	19.81	9.81	167.70	5.66	20.7	20.7	1.0	358.49	3342.78	44	1.0	248.9	2788.97	25.0	29.6	0	10.07	20.36	21.48	175.3	4185.1	10316.9	381.9	6513.6	**4126.75**	**2171.20**
25.00	26.50	25.75	1.50	24.00	20.07	10.07	167.70	5.66	29.6	29.6	1.0	538.95	3881.73	0	1.0	0.0	2788.97	26.5	29.6	0	10.07	20.36	21.48	175.3	4185.1	10855.8	407.3	7078.0	**4342.33**	**2359.34**
26.50	27.50	27.00	1.00	25.00	20.07	10.07	167.70	3.77	29.6	29.6	1.0	359.30	4241.03	0	1.0	0.0	2788.97	27.5	29.1	2	9.71	19.23	20.33	175.3	3969.3	10999.3	424.3	7454.3	**4399.72**	**2484.76**
27.50	29.50	28.50	2.00	27.00	19.71	9.71	167.70	7.54	29.1	29.1	1.0	704.07	4945.09	2	1.0	15.1	2804.06	29.5	31.3	0	9.71	27.81	29.06	175.3	5707.5	13456.7	458.2	8207.4	**5382.66**	**2735.79**
29.50	30.00	29.75	0.50	27.50	19.71	9.71	167.70	1.89	31.3	31.3	1.1	204.77	5149.86	0	1.0	0.0	2804.06	30.0	31.7	0	9.71	29.82	31.11	175.3	6120.7	14074.6	466.7	8420.6	**5629.85**	**2806.88**
30.00	31.00	30.50	1.00	28.50	19.71	9.71	167.70	3.77	31.7	31.7	1.1	423.83	5573.69	0	1.0	0.0	2804.06	31.0	31.9	0	9.71	30.83	32.14	175.3	6327.3	14705.1	483.7	8861.4	**5882.02**	**2953.81**
31.00	32.50	31.75	1.50	30.00	19.71	9.71	167.70	5.66	31.9	31.9	1.1	646.62	6220.32	0	1.0	0.0	2804.06	32.5	32.5	0	9.09	33.85	35.22	175.3	6932.3	15956.7	509.1	9533.5	**6382.66**	**3177.84**
32.50	34.00	33.25	1.50	31.50	19.09	9.09	167.70	5.66	32.5	32.5	1.1	679.95	6900.27	0	1.0	0.0	2804.06	34.0	32.5	0	9.26	33.85	35.22	175.3	6936.3	16640.7	534.6	10238.9	**6656.27**	**3412.98**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								φ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	φ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
34.00	35.00	34.50	1.00	32.50	19.26	9.26	167.70	3.77	32.5	32.5	1.1	453.30	7353.57	0	1.0	0.0	2804.06	35.0	32.0	0	9.26	31.33	32.65	175.3	6420.6	16578.3	551.6	10709.2	**6631.30**	**3569.73**
35.00	35.50	35.25	0.50	33.00	19.26	9.26	167.70	1.89	32.0	32.0	1.1	217.37	7570.94	0	1.0	0.0	2804.06	35.5	33.2	0	9.28	37.38	38.80	175.3	7658.9	18033.9	560.1	10935.1	**7213.55**	**3645.02**
35.50	37.00	36.25	1.50	34.50	19.28	9.28	167.70	5.66	33.2	33.2	1.2	720.15	8291.09	0	1.0	0.0	2804.06	37.0	32.6	0	9.22	34.36	35.73	175.3	7038.5	18133.7	585.5	11680.7	**7253.47**	**3893.55**
37.00	37.50	37.25	0.50	35.00	19.22	9.22	167.70	1.89	32.6	32.6	1.1	228.53	8519.63	0	1.0	0.0	2804.06	37.5	30.5	0	9.22	23.78	24.96	175.3	4872.8	16196.5	594.0	11917.7	**6478.60**	**3972.56**
37.50	38.50	38.00	1.00	36.00	19.22	9.22	167.70	3.77	30.5	30.5	1.0	381.87	8901.50	0	1.0	0.0	2804.06	38.5	30.7	0	9.29	24.79	25.99	175.3	5080.3	16785.9	611.0	12316.5	**6714.34**	**4105.51**
38.50	40.00	39.25	1.50	37.50	19.29	9.29	167.70	5.66	30.7	30.7	1.0	583.02	9484.52	0	1.0	0.0	2804.06	40.0	30.7	0	9.29	24.79	25.99	175.3	5080.3	17368.9	636.4	12925.0	**6947.55**	**4308.34**
BORE NO: P105, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.67	9.67	26.59	1.89	12.7	12.7	1.0	11.30	0	23	1.0	43.4	0	3.0	25.4	0	9.67	10.90	11.80	29.0	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.67	9.67	33.85	3.77	25.4	25.4	1.0	60.61	0	0	1.0	0.0	0	4.0	28.6	2	10.25	18.11	19.17	38.7	0	0.0	25.5	25.5	**0.00**	**8.49**
4.00	5.00	4.50	1.00	2.50	20.25	10.25	43.81	3.77	28.6	28.6	1.0	90.07	0	2	1.0	7.5	0	5.0	28.5	0	10.25	17.88	18.94	48.9	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	20.25	10.25	54.06	3.77	28.5	28.5	1.0	110.69	0	0	1.0	0.0	0	6.0	28.5	0	9.37	17.88	18.94	59.2	0	0.0	59.4	59.4	**0.00**	**19.80**
6.00	8.00	7.00	2.00	5.50	19.37	9.37	68.55	7.54	28.5	28.5	1.0	280.74	0	0	1.0	0.0	0	8.0	10.2	46	9.37	2.53	1.28	77.9	0	0.0	93.3	93.3	**0.00**	**31.11**
8.00	9.00	8.50	1.00	6.50	19.37	9.37	82.61	3.77	10.2	10.2	1.0	56.05	0	46	1.0	173.5	0	9.0	14.3	23	9.37	3.74	2.45	87.3	0	0.0	110.3	110.3	**0.00**	**36.77**
9.00	10.00	9.50	1.00	7.50	19.37	9.37	91.98	3.77	14.3	14.3	1.0	88.42	0	23	1.0	86.7	0	10.0	6.8	24	10.08	1.89	0.73	96.7	0	0.0	127.3	127.3	**0.00**	**42.43**
10.00	11.00	10.50	1.00	8.50	20.08	10.08	101.70	3.77	6.8	6.8	1.0	45.74	0	24	1.0	90.5	0	11.0	9.5	62	10.08	2.38	1.14	106.7	0	0.0	144.3	144.3	**0.00**	**48.09**
11.00	12.00	11.50	1.00	9.50	20.08	10.08	111.78	3.77	9.5	9.5	1.0	70.55	0	62	1.0	233.8	0	12.0	11.9	55	10.08	3.03	1.76	116.8	0	0.0	161.2	161.2	**0.00**	**53.74**
12.00	13.00	12.50	1.00	10.50	20.08	10.08	121.86	3.77	11.9	11.9	1.0	96.85	0	55	1.0	207.4	0	13.0	9.4	54	9.96	2.36	1.13	126.9	0	0.0	178.2	178.2	**0.00**	**59.40**
13.00	14.50	13.75	1.50	12.00	19.96	9.96	134.37	5.66	9.4	9.4	1.0	125.84	0	54	1.0	305.5	0	14.5	12.8	45	9.66	3.29	2.02	141.8	999.7	999.7	203.7	203.7	**399.89**	**67.89**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
14.50	17.50	16.00	3.00	15.00	19.66	9.66	156.33	11.31	12.8	12.8	1.0	401.85	401.85	45	1.0	509.1	509.14	17.5	20.7	39	9.66	6.90	6.16	170.8	1771.9	2682.9	254.6	1165.6	**1073.14**	**388.52**
17.50	19.00	18.25	1.50	16.50	19.66	9.66	156.33	5.66	20.7	20.7	1.0	334.18	736.03	39	1.0	220.6	729.77	19.0	19.5	48	9.66	6.13	5.12	170.8	1707.8	3173.7	280.0	1745.8	**1269.46**	**581.94**
19.00	20.50	19.75	1.50	18.00	19.66	9.66	156.33	5.66	19.5	19.5	1.0	313.18	1049.21	48	1.0	271.5	1001.31	20.5	11.2	48	10.50	2.82	1.56	170.8	1045.5	3096.0	305.5	2356.0	**1238.40**	**785.34**
20.50	23.50	22.00	3.00	21.00	20.50	10.50	156.33	11.31	11.2	11.2	1.0	350.22	1399.43	48	1.0	543.1	1544.40	23.5	11.2	48	10.50	2.82	1.56	170.8	1045.5	3989.3	356.4	3300.2	**1595.73**	**1100.08**
23.50	25.00	24.25	1.50	22.50	20.50	10.50	156.33	5.66	11.2	11.2	1.0	175.11	1574.55	48	1.0	271.5	1815.94	25.0	10.5	45	10.64	2.62	1.36	170.8	973.9	4364.4	381.9	3772.3	**1745.74**	**1257.45**
25.00	26.50	25.75	1.50	24.00	20.64	10.64	156.33	5.66	10.5	10.5	1.0	163.91	1738.46	45	1.0	254.6	2070.51	26.5	29.2	0	10.64	19.46	20.56	170.8	3909.1	7718.1	407.3	4216.3	**3087.25**	**1405.43**
26.50	27.50	27.00	1.00	25.00	20.64	10.64	156.33	3.77	29.2	29.2	1.0	329.51	2067.96	0	1.0	0.0	2070.51	27.5	29.2	0	10.64	19.46	20.56	170.8	3909.1	8047.6	424.3	4562.8	**3219.05**	**1520.92**
27.50	28.00	27.75	0.50	25.50	20.64	10.64	156.33	1.89	29.2	29.2	1.0	164.75	2232.72	0	1.0	0.0	2070.51	28.0	11.0	48	11.02	2.76	1.51	170.8	1034.2	5337.5	432.8	4736.0	**2134.99**	**1578.67**
28.00	29.50	28.75	1.50	27.00	21.02	11.02	156.33	5.66	11.0	11.0	1.0	171.91	2404.63	48	1.0	271.5	2342.06	29.5	30.0	0	11.02	21.26	22.40	170.8	4276.4	9023.1	458.2	5204.9	**3609.24**	**1734.97**
29.50	30.00	29.75	0.50	27.50	21.02	11.02	156.33	1.89	30.0	30.0	1.0	170.20	2574.82	0	1.0	0.0	2342.06	30.0	30.7	0	10.82	24.79	25.99	170.8	4981.2	9898.1	466.7	5383.6	**3959.25**	**1794.53**
30.00	32.50	31.25	2.50	30.00	20.82	10.82	156.33	9.43	30.7	30.7	1.0	905.81	3480.63	0	1.0	0.0	2342.06	32.5	10.3	55	10.82	2.56	1.31	170.8	1064.1	6886.8	509.1	6331.8	**2754.71**	**2110.61**
32.50	34.00	33.25	1.50	31.50	20.82	10.82	156.33	5.66	10.3	10.3	1.0	160.72	3641.35	55	1.0	311.1	2653.20	34.0	25.2	15	10.82	10.45	11.34	170.8	2255.8	8550.3	534.6	6829.2	**3420.14**	**2276.38**
34.00	35.00	34.50	1.00	32.50	20.82	10.82	156.33	3.77	25.2	25.2	1.0	277.44	3918.79	15	1.0	56.6	2709.77	35.0	26.0	15	8.76	12.25	13.18	170.8	2599.1	9227.6	551.6	7180.1	**3691.06**	**2393.38**
35.00	35.50	35.25	0.50	33.00	18.76	8.76	156.33	1.89	26.0	26.0	1.0	143.78	4062.57	15	1.0	28.3	2738.06	35.5	28.0	0	8.72	16.76	17.79	170.8	3343.7	10144.3	560.1	7360.7	**4057.74**	**2453.56**
35.50	37.00	36.25	1.50	34.50	18.72	8.72	156.33	5.66	28.0	28.0	1.0	470.23	4532.81	0	1.0	0.0	2738.06	37.0	28.0	0	8.62	16.76	17.79	170.8	3342.5	10613.4	585.5	7856.4	**4245.35**	**2618.79**
37.00	37.50	37.25	0.50	35.00	18.62	8.62	156.33	1.89	28.0	28.0	1.0	156.74	4689.55	0	1.0	0.0	2738.06	37.5	29.4	0	8.62	19.91	21.02	170.8	3970.7	11398.3	594.0	8021.6	**4559.32**	**2673.87**
37.50	38.50	38.00	1.00	36.00	18.62	8.62	156.33	3.77	29.4	29.4	1.0	332.22	5021.77	0	1.0	0.0	2738.06	38.5	29.0	0	8.85	19.01	20.10	170.8	3794.3	11554.2	611.0	8370.8	**4621.67**	**2790.27**
38.50	40.00	39.25	1.50	37.50	18.85	8.85	156.33	5.66	29.0	29.0	1.0	490.22	5511.99	0	1.0	0.0	2738.06	40.0	29.0	0	8.85	19.01	20.10	170.8	3794.3	12044.4	636.4	8886.5	**4817.76**	**2962.16**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: P106, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.00	9.00	24.75	1.89	14.0	14.0	1.0	11.64	11.64	9	1.0	17.0	16.97	3.0	12.5	45	8.20	3.20	1.94	27.0	566.9	595.5	8.5	37.1	**238.19**	**12.36**
3.00	5.00	4.00	2.00	2.50	18.20	8.20	35.20	7.54	12.5	12.5	1.0	58.86	70.50	45	1.0	339.4	356.40	5.0	24.9	0	8.20	9.93	10.77	43.4	547.5	974.4	42.4	469.3	**389.74**	**156.44**
5.00	6.00	5.50	1.00	3.50	18.20	8.20	47.50	3.77	24.9	24.9	1.0	83.16	153.65	0	1.0	0.0	356.40	6.0	24.9	0	8.20	9.93	10.77	51.6	639.6	1149.6	59.4	569.5	**459.85**	**189.82**
6.00	7.00	6.50	1.00	4.50	18.20	8.20	55.70	3.77	24.9	24.9	1.0	97.51	251.16	0	1.0	0.0	356.40	7.0	12.8	39	9.81	3.29	2.02	59.8	633.3	1240.9	76.4	683.9	**496.34**	**227.98**
7.00	8.00	7.50	1.00	5.50	19.81	9.81	64.71	3.77	12.8	12.8	1.0	55.44	306.61	39	1.0	147.1	503.49	8.0	8.6	47	9.81	2.22	1.00	69.6	660.0	1470.1	93.3	903.4	**588.02**	**301.15**
8.00	9.00	8.50	1.00	6.50	19.81	9.81	74.52	3.77	8.6	8.6	1.0	42.50	349.11	47	1.0	177.3	680.74	9.0	8.6	47	9.81	2.22	1.00	79.4	684.6	1714.4	110.3	1140.2	**685.78**	**380.06**
9.00	10.00	9.50	1.00	7.50	19.81	9.81	84.33	3.77	8.6	8.6	1.0	48.10	397.20	47	1.0	177.3	858.00	10.0	8.5	54	10.60	2.20	0.99	89.2	779.1	2034.3	127.3	1382.5	**813.72**	**460.83**
10.00	11.00	10.50	1.00	8.50	20.60	10.60	94.53	3.77	8.5	8.5	1.0	53.28	450.49	54	1.0	203.7	1061.66	11.0	9.0	52	10.60	2.29	1.07	99.8	795.8	2308.0	144.3	1656.4	**923.19**	**552.13**
11.00	12.00	11.50	1.00	9.50	20.60	10.60	105.13	3.77	9.0	9.0	1.0	62.80	513.28	52	1.0	196.1	1257.77	12.0	9.8	74	10.47	2.43	1.19	110.4	1066.1	2837.2	161.2	1932.3	**1134.86**	**644.09**
12.00	14.50	13.25	2.50	12.00	20.47	10.47	123.52	9.43	9.8	9.8	1.0	201.16	714.44	74	1.0	697.7	1955.49	14.5	9.8	74	10.47	2.43	1.19	136.6	1138.2	3808.1	203.7	2873.6	**1523.24**	**957.86**
14.50	16.00	15.25	1.50	13.50	20.47	10.47	144.46	5.66	9.8	9.8	1.0	141.16	855.60	74	1.0	418.6	2374.11	16.0	21.2	38	9.80	7.26	6.71	152.3	1683.4	4913.1	229.1	3458.8	**1965.23**	**1152.94**
16.00	17.50	16.75	1.50	15.00	19.80	9.80	159.66	5.66	21.2	21.2	1.0	350.34	1205.94	38	1.0	215.0	2589.09	17.5	26.5	4	9.19	13.38	14.34	167.0	2658.0	6453.1	254.6	4049.6	**2581.23**	**1349.87**
17.50	20.50	19.00	3.00	18.00	19.19	9.19	159.66	11.31	26.5	26.5	1.0	900.66	2106.60	4	1.0	45.3	2634.34	20.5	28.4	0	9.19	17.66	18.71	167.0	3453.1	8194.1	305.5	5046.4	**3277.62**	**1682.14**
20.50	22.00	21.25	1.50	19.50	19.19	9.19	159.66	5.66	28.4	28.4	1.0	488.37	2594.96	0	1.0	0.0	2634.34	22.0	18.5	44	9.19	5.64	4.57	167.0	1542.7	6772.0	330.9	5560.2	**2708.79**	**1853.42**
22.00	23.50	22.75	1.50	21.00	19.19	9.19	159.66	5.66	18.5	18.5	1.0	302.21	2897.18	44	1.0	248.9	2883.26	23.5	27.0	7	9.80	14.50	15.49	167.0	2915.0	8695.4	356.4	6136.8	**3478.16**	**2045.61**
23.50	26.50	25.00	3.00	24.00	19.80	9.80	159.66	11.31	27.0	27.0	1.0	920.43	3817.60	7	1.0	79.2	2962.46	26.5	27.0	0	9.80	14.50	15.49	167.0	2843.7	9623.7	407.3	7187.4	**3849.50**	**2395.79**
26.50	27.50	27.00	1.00	25.00	19.80	9.80	159.66	3.77	27.0	27.0	1.0	306.81	4124.41	0	1.0	0.0	2962.46	27.5	27.0	0	9.80	14.50	15.49	167.0	2843.7	9930.5	424.3	7511.2	**3972.22**	**2503.72**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
27.50	29.50	28.50	2.00	27.00	19.80	9.80	159.66	7.54	27.0	27.0	1.0	613.62	4738.03	0	1.0	0.0	2962.46	29.5	17.3	40	8.34	5.07	3.91	167.0	1387.8	9088.3	458.2	8158.7	**3635.31**	**2719.57**
29.50	30.00	29.75	0.50	27.50	18.34	8.34	159.66	1.89	17.3	17.3	1.0	93.77	4831.80	40	1.0	75.4	3037.89	30.0	17.0	40	10.15	4.92	3.75	167.0	1363.6	9233.3	466.7	8336.4	**3693.30**	**2778.80**
30.00	31.00	30.50	1.00	28.50	20.15	10.15	159.66	3.77	17.0	17.0	1.0	184.09	5015.90	40	1.0	150.9	3188.74	31.0	11.2	55	10.15	2.82	1.56	167.0	1104.2	9308.9	483.7	8688.3	**3723.55**	**2896.11**
31.00	32.50	31.75	1.50	30.00	20.15	10.15	159.66	5.66	11.2	11.2	1.0	178.84	5194.74	55	1.0	311.1	3499.89	32.5	11.2	55	10.15	2.82	1.56	167.0	1104.2	9798.9	509.1	9203.8	**3919.54**	**3067.92**
32.50	35.00	33.75	2.50	32.50	20.15	10.15	159.66	9.43	11.2	11.2	1.0	298.07	5492.81	55	1.0	518.6	4018.46	35.0	10.5	55	10.15	2.62	1.36	167.0	1064.0	10575.2	551.6	10062.8	**4230.09**	**3354.28**
35.00	35.50	35.25	0.50	33.00	20.15	10.15	159.66	1.89	10.5	10.5	1.0	55.80	5548.61	55	1.0	103.7	4122.17	35.5	10.5	55	10.15	2.62	1.36	167.0	1064.0	10734.7	560.1	10230.8	**4293.90**	**3410.28**
35.50	37.50	36.50	2.00	35.00	20.15	10.15	159.66	7.54	10.5	10.5	1.0	223.20	5771.81	55	1.0	414.9	4537.03	37.5	10.5	55	8.76	2.62	1.36	167.0	1062.7	11371.5	594.0	10902.8	**4548.61**	**3634.28**
37.50	38.50	38.00	1.00	36.00	18.76	8.76	159.66	3.77	10.5	10.5	1.0	111.60	5883.42	55	1.0	207.4	4744.46	38.5	10.0	60	8.61	2.47	1.22	167.0	1084.8	11712.7	611.0	11238.8	**4685.08**	**3746.28**
38.50	40.00	39.25	1.50	37.50	18.61	8.61	159.66	5.66	10.0	10.0	1.0	159.26	6042.68	60	1.0	339.4	5083.89	40.0	10.0	60	8.61	2.47	1.22	167.0	1084.8	12211.4	636.4	11763.0	**4884.56**	**3921.00**
BORE NO: P111, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	20.04	10.04	27.61	1.89	26.5	26.5	1.0	25.96	25.96	7	1.0	13.2	13.20	3.0	25.9	0	10.04	12.03	12.95	30.1	498.1	537.3	8.5	47.6	**214.92**	**15.88**
3.00	4.00	3.50	1.00	1.50	20.04	10.04	35.14	3.77	25.9	25.9	1.0	64.35	90.31	0	1.0	0.0	13.20	4.0	25.9	0	10.04	12.03	12.95	40.2	634.8	738.3	25.5	129.0	**295.31**	**42.99**
4.00	5.00	4.50	1.00	2.50	20.04	10.04	45.18	3.77	25.9	25.9	1.0	82.74	173.05	0	1.0	0.0	13.20	5.0	11.1	37	9.65	2.79	1.53	50.2	545.5	731.7	42.4	228.7	**292.69**	**76.23**
5.00	6.00	5.50	1.00	3.50	19.65	9.65	55.03	3.77	11.1	11.1	1.0	40.71	213.76	37	1.0	139.5	152.74	6.0	11.2	46	9.65	2.82	1.56	59.9	669.8	1036.3	59.4	425.9	**414.52**	**141.97**
6.00	7.00	6.50	1.00	4.50	19.65	9.65	64.68	3.77	11.2	11.2	1.0	48.30	262.06	46	1.0	173.5	326.23	7.0	29.5	0	9.81	20.13	21.25	69.5	1724.7	2313.0	76.4	664.7	**925.19**	**221.55**
7.00	9.00	8.00	2.00	6.50	19.81	9.81	79.31	7.54	29.5	29.5	1.0	338.46	600.52	0	1.0	0.0	326.23	9.0	13.0	48	9.81	3.35	2.08	89.1	840.4	1767.2	110.3	1037.1	**706.86**	**345.69**
9.00	10.00	9.50	1.00	7.50	19.81	9.81	94.03	3.77	13.0	13.0	1.0	81.87	682.39	48	1.0	181.0	507.26	10.0	11.0	50	10.14	2.76	1.51	98.9	828.9	2018.5	127.3	1316.9	**807.41**	**438.98**
10.00	12.50	11.25	2.50	10.00	20.14	10.14	111.61	9.43	11.0	11.0	1.0	204.54	886.93	50	1.0	471.4	978.69	12.5	9.5	58	10.47	2.38	1.14	124.3	933.4	2799.0	169.7	2035.3	**1119.60**	**678.44**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
12.50	15.50	14.00	3.00	13.00	20.47	10.47	139.99	11.31	9.5	9.5	1.0	265.04	1151.97	58	1.0	656.2	1634.91	15.5	10.4	56	10.30	2.59	1.33	155.7	1035.4	3822.3	220.6	3007.5	**1528.91**	**1002.50**
15.50	18.50	17.00	3.00	16.00	20.30	10.30	171.14	11.31	10.4	10.4	1.0	355.38	1507.35	56	1.0	633.6	2268.51	18.5	23.0	46	10.30	8.56	8.68	155.7	2037.0	5812.9	271.5	4047.4	**2325.14**	**1349.14**
18.50	20.00	19.25	1.50	17.50	20.30	10.30	171.14	5.66	23.0	23.0	1.0	410.96	1918.31	46	1.0	260.2	2528.74	20.0	32.3	0	10.30	32.85	34.19	155.7	6024.9	10471.9	297.0	4744.1	**4188.78**	**1581.35**
20.00	21.50	20.75	1.50	19.00	20.30	10.30	171.14	5.66	32.3	32.3	1.1	682.43	2600.75	0	1.0	0.0	2528.74	21.5	32.3	0	10.68	32.85	34.19	155.7	6033.7	11163.2	322.5	5451.9	**4465.28**	**1817.32**
21.50	24.50	23.00	3.00	22.00	20.68	10.68	171.14	11.31	32.3	32.3	1.1	1364.87	3965.61	0	1.0	0.0	2528.74	24.5	30.4	0	10.68	23.27	24.45	155.7	4277.1	10771.5	373.4	6867.7	**4308.59**	**2289.24**
24.50	26.00	25.25	1.50	23.50	20.68	10.68	171.14	5.66	30.4	30.4	1.0	579.38	4544.99	0	1.0	0.0	2528.74	26.0	32.5	0	10.68	33.85	35.22	155.7	6218.6	13292.3	398.8	7472.6	**5316.94**	**2490.85**
26.00	27.50	26.75	1.50	25.00	20.68	10.68	171.14	5.66	32.5	32.5	1.1	693.89	5238.88	0	1.0	0.0	2528.74	27.5	32.3	0	8.04	32.85	34.19	155.7	5972.4	13740.1	424.3	8191.9	**5496.02**	**2730.64**
27.50	29.00	28.25	1.50	26.50	18.04	8.04	171.14	5.66	32.3	32.3	1.1	682.43	5921.31	0	1.0	0.0	2528.74	29.0	32.3	0	8.40	32.85	34.19	155.7	5980.8	14430.8	449.7	8899.8	**5772.34**	**2966.60**
29.00	30.00	29.50	1.00	27.50	18.40	8.40	171.14	3.77	32.3	32.3	1.1	454.96	6376.27	0	1.0	0.0	2528.74	30.0	32.3	0	8.40	32.85	34.19	155.7	5980.8	14885.8	466.7	9371.7	**5954.32**	**3123.91**
30.00	30.50	30.25	0.50	28.00	18.40	8.40	171.14	1.89	32.3	32.3	1.1	227.48	6603.74	0	1.0	0.0	2528.74	30.5	32.3	0	8.39	32.85	34.19	155.7	5980.6	15113.0	475.2	9607.7	**6045.22**	**3202.56**
30.50	32.00	31.25	1.50	29.50	18.39	8.39	171.14	5.66	32.3	32.3	1.1	682.43	7286.18	0	1.0	0.0	2528.74	32.0	32.3	0	9.03	32.85	34.19	155.7	5995.4	15810.3	500.7	10315.6	**6324.13**	**3438.53**
32.00	32.50	32.25	0.50	30.00	19.03	9.03	171.14	1.89	32.3	32.3	1.1	227.48	7513.66	0	1.0	0.0	2528.74	32.5	32.3	0	9.03	32.85	34.19	155.7	5995.4	16037.8	509.1	10551.5	**6415.12**	**3517.18**
32.50	33.50	33.00	1.00	31.00	19.03	9.03	171.14	3.77	32.3	32.3	1.1	454.96	7968.61	0	1.0	0.0	2528.74	33.5	32.3	0	8.99	32.85	34.19	155.7	5994.5	16491.8	526.1	11023.5	**6596.73**	**3674.49**
33.50	35.00	34.25	1.50	32.50	18.99	8.99	171.14	5.66	32.3	32.3	1.1	682.43	8651.04	0	1.0	0.0	2528.74	35.0	32.9	0	8.83	35.87	37.27	155.7	6541.6	17721.4	551.6	11731.4	**7088.56**	**3910.45**
35.00	36.50	35.75	1.50	34.00	18.83	8.83	171.14	5.66	32.9	32.9	1.1	717.15	9368.19	0	1.0	0.0	2528.74	36.5	32.9	0	8.85	35.87	37.27	155.7	6542.1	18439.1	577.0	12474.0	**7375.62**	**4157.99**
36.50	37.50	37.00	1.00	35.00	18.85	8.85	171.14	3.77	32.9	32.9	1.1	478.10	9846.30	0	1.0	0.0	2528.74	37.5	32.9	0	8.85	35.87	37.27	155.7	6542.1	18917.2	594.0	12969.0	**7566.87**	**4323.01**
37.50	38.00	37.75	0.50	35.50	18.85	8.85	171.14	1.89	32.9	32.9	1.1	239.05	10085.35	0	1.0	0.0	2528.74	38.0	19.5	45	8.66	6.13	5.12	155.7	1568.8	14182.9	602.5	13216.6	**5673.16**	**4405.52**
38.00	40.00	39.00	2.00	37.50	18.66	8.66	171.14	7.54	19.5	19.5	1.0	457.13	10542.47	45	1.0	339.4	2868.17	40.0	19.0	45	8.61	5.87	4.84	155.7	1520.2	14930.8	636.4	14047.1	**5972.33**	**4682.36**

APPENDIX-H

TABLE 3: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1000 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Depth of Fixity (m)	Allowable Load capacity of pile(kN)
P101	1.00	2.50	0.00	35	29580399	0.0491	19	2696	3.52	2.50	0.71	2.12	0.005	7.47	88
P102	1.00	2.50	0.00	35	29580399	0.0491	18	2552	3.56	5.50	1.55	2.00	0.005	7.11	43
P103	1.00	2.50	0.00	35	29580399	0.0491	18	2552	3.56	1.50	0.42	2.17	0.005	7.71	112
P104	1.00	2.50	0.00	35	29580399	0.0491	15	2120	3.69	2.50	0.68	2.13	0.005	7.86	78
P105	1.00	2.50	0.00	35	29580399	0.0491	24	3416	3.35	12.00	3.58	1.89	0.005	6.34	14
P106	1.00	2.50	0.00	35	29580399	0.0491	7	800	4.49	0.00	0.00	2.23	0.005	10.00	87
P111	1.00	2.50	0.00	35	29580399	0.0491	13	1832	3.80	0.00	0.00	2.23	0.005	8.47	143

APPENDIX-H

TABLE 4: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1200 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Depth of Fixity (m)	Allowable Load capacity of pile(kN)
P101	1.20	2.50	0.00	35	29580399	0.1018	19	2696	4.07	2.50	0.61	2.14	0.005	8.70	129
P102	1.20	2.50	0.00	35	29580399	0.1018	18	2552	4.11	5.50	1.34	2.03	0.005	8.35	68
P103	1.20	2.50	0.00	35	29580399	0.1018	18	2552	4.11	1.50	0.36	2.18	0.005	8.95	158
P104	1.20	2.50	0.00	35	29580399	0.1018	16	2264	4.21	2.50	0.59	2.14	0.005	9.02	118
P105	1.20	2.50	0.00	35	29580399	0.1018	25	3560	3.85	12.00	3.12	1.90	0.005	7.32	25
P106	1.20	2.50	0.00	35	29580399	0.1018	8	1000	4.96	0.00	0.00	2.23	0.005	11.07	133
P111	1.20	2.50	0.00	35	29580399	0.1018	16	2264	4.21	0.00	0.00	2.23	0.005	9.40	218

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
P101	0.50	ML	53	7	10.15	5.00	5.15	1.00	0.306	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.805	Liquefiable
	1.00	SM-SC	50	7	20.30	10.00	10.30	0.99	0.305	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.808	Liquefiable
	2.00	SM-SC	50	7	40.60	20.00	20.60	0.98	0.303	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.814	Liquefiable
	3.00	SM	40	4	60.90	30.00	30.90	0.98	0.300	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.564	Liquefiable
	4.00	ML	52	4	81.20	40.00	41.20	0.97	0.298	1.56	6.23	5.00	1.20	12.48	0.14	1.00	0.162	0.543	Liquefiable
	5.00	SM	47	12	98.00	50.00	48.00	0.96	0.306	1.44	17.32	5.00	1.20	25.78	0.31	1.00	0.368	1.200	Non-liquefiable
	6.00	CL-ML	78	19	117.60	60.00	57.60	0.95	0.304	1.32	25.03	5.00	1.20	35.04	0.52	1.00	-	-	Non-liquefiable
	7.00	ML	85	19	137.20	70.00	67.20	0.95	0.301	1.22	23.18	5.00	1.20	32.81	0.52	1.00	0.620	2.058	Non-liquefiable
	8.00	ML	85	21	164.80	80.00	84.80	0.94	0.285	1.09	22.80	5.00	1.20	32.37	0.52	1.00	0.620	2.179	Non-liquefiable
	9.00	ML	81	28	185.40	90.00	95.40	0.93	0.282	1.02	28.67	5.00	1.20	39.40	0.52	1.00	0.620	2.197	Non-liquefiable
	11.00	CL	92	30	226.60	110.00	116.60	0.88	0.267	0.93	27.78	5.00	1.20	38.34	0.52	1.00	-	-	Non-liquefiable
	12.00	CL	92	28	244.80	120.00	124.80	0.85	0.261	0.90	25.06	5.00	1.20	35.08	0.52	1.00	-	-	Non-liquefiable
	14.50	CL-ML	87	19	295.80	145.00	150.80	0.79	0.241	0.81	15.47	5.00	1.20	23.57	0.27	1.00	-	-	Non-liquefiable
	16.00	SM-SC	48	19	328.00	160.00	168.00	0.75	0.227	0.77	14.66	5.00	1.20	22.59	0.25	0.81	0.243	1.069	Non-liquefiable
	17.50	SM-SC	48	38	358.75	175.00	183.75	0.71	0.215	0.74	28.03	5.00	1.20	38.64	0.52	0.78	0.487	2.261	Non-liquefiable
	19.00	SM	41	38	389.50	190.00	199.50	0.67	0.203	0.71	26.90	5.00	1.20	37.28	0.52	0.86	0.535	2.633	Non-liquefiable
	20.50	SM	41	44	387.45	205.00	182.45	0.63	0.208	0.74	32.57	5.00	1.20	44.09	0.52	0.88	0.545	2.625	Non-liquefiable
	22.00	CI	69	44	415.80	220.00	195.80	0.59	0.194	0.71	31.44	5.00	1.20	42.73	0.52	0.85	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	23.50	CI	69	44	462.95	235.00	227.95	0.56	0.177	0.66	29.14	5.00	1.20	39.97	0.52	0.82	-	-	Non-liquefiable
	25.00	ML	57	44	492.50	250.00	242.50	0.56	0.177	0.64	28.26	5.00	1.20	38.91	0.52	0.76	0.472	2.660	Non-liquefiable
	26.50	ML	57	46	532.65	265.00	267.65	0.56	0.174	0.61	28.12	5.00	1.20	38.74	0.52	0.74	0.458	2.633	Non-liquefiable
	29.50	ML	51	76	592.95	295.00	297.95	0.56	0.174	0.58	44.03	5.00	1.20	57.84	0.52	0.71	0.443	2.547	Non-liquefiable
	31.00	CL	56	45	623.10	310.00	313.10	0.56	0.174	0.57	25.43	5.00	1.20	35.52	0.52	0.70	-	-	Non-liquefiable
	32.50	CL	56	44	653.25	325.00	328.25	0.56	0.174	0.55	24.29	5.00	1.20	34.14	0.52	0.69	-	-	Non-liquefiable
	35.50	SM	50	47	713.55	355.00	358.55	0.56	0.174	0.53	24.82	5.00	1.20	34.79	0.52	0.64	0.398	2.289	Non-liquefiable
	37.00	CL-ML	53	47	754.80	370.00	384.80	0.56	0.171	0.51	23.96	5.00	1.20	33.75	0.52	0.61	-	-	Non-liquefiable
	38.50	CL-ML	53	52	789.25	385.00	404.25	0.56	0.171	0.50	25.86	5.00	1.20	36.04	0.52	0.60	-	-	Non-liquefiable
	40.00	CL-ML	57	48	820.00	400.00	420.00	0.56	0.171	0.49	23.42	5.00	1.20	33.11	0.52	0.59	-	-	Non-liquefiable
	0.50	SM	49	4	9.80	5.00	4.80	1.00	0.317	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.534	Liquefiable
	1.00	SM-SC	45	4	19.60	10.00	9.60	0.99	0.316	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.536	Liquefiable
	3.00	SM	40	13	58.80	30.00	28.80	0.98	0.311	1.70	22.10	5.00	1.20	31.52	0.52	1.00	0.620	1.993	Non-liquefiable
P102	4.00	SM	39	7	78.40	40.00	38.40	0.97	0.309	1.61	11.30	5.00	1.20	18.56	0.20	1.00	0.236	0.765	Liquefiable
	6.00	SM	24	15	117.60	60.00	57.60	0.95	0.304	1.32	19.76	4.18	1.11	26.07	0.31	1.00	0.375	1.235	Non-liquefiable
	7.00	SM	24	10	132.30	70.00	62.30	0.95	0.314	1.27	12.67	4.18	1.11	18.21	0.19	1.00	0.232	0.739	Liquefiable
	8.00	CL	83	10	151.20	80.00	71.20	0.94	0.311	1.19	11.85	5.00	1.20	19.22	0.21	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	9.00	CL	82	20	176.40	90.00	86.40	0.93	0.297	1.08	21.52	5.00	1.20	30.82	0.52	1.00	-	-	Non-liquefiable
	10.00	CL	92	18	196.00	100.00	96.00	0.91	0.289	1.02	18.37	5.00	1.20	27.05	0.34	1.00	-	-	Non-liquefiable
	11.00	ML	92	18	215.60	110.00	105.60	0.88	0.280	0.97	17.52	5.00	1.20	26.02	0.31	1.00	0.374	1.334	Non-liquefiable
	12.50	CL	83	16	248.75	125.00	123.75	0.84	0.263	0.90	14.38	5.00	1.20	22.26	0.25	1.00	-	-	Non-liquefiable
	15.50	CL-ML	56	28	308.45	155.00	153.45	0.76	0.238	0.81	22.60	5.00	1.20	32.12	0.52	0.87	-	-	Non-liquefiable
	17.00	SM	28	28	340.00	170.00	170.00	0.72	0.225	0.77	21.48	4.56	1.14	29.00	0.41	0.84	0.411	1.829	Non-liquefiable
	18.50	CL	76	28	381.10	185.00	196.10	0.68	0.206	0.71	19.99	5.00	1.20	28.99	0.41	0.80	-	-	Non-liquefiable
	20.00	SM	38	28	412.00	200.00	212.00	0.64	0.194	0.69	19.23	5.00	1.20	28.08	0.37	0.78	0.347	1.786	Non-liquefiable
	21.50	SM	34	44	442.90	215.00	227.90	0.60	0.182	0.66	29.15	4.93	1.19	39.56	0.52	0.76	0.473	2.598	Non-liquefiable
	23.00	ML	52	44	473.80	230.00	243.80	0.56	0.170	0.64	28.18	5.00	1.20	38.82	0.52	0.72	0.450	2.648	Non-liquefiable
	24.50	SM	47	50	497.35	245.00	252.35	0.56	0.172	0.63	31.48	5.00	1.20	42.77	0.52	0.72	0.444	2.579	Non-liquefiable
	27.50	SM	47	51	558.25	275.00	283.25	0.56	0.172	0.59	30.30	5.00	1.20	41.36	0.52	0.69	0.426	2.474	Non-liquefiable
	30.50	SM	47	48	619.15	305.00	314.15	0.56	0.172	0.56	27.08	5.00	1.20	37.50	0.52	0.66	0.410	2.383	Non-liquefiable
	33.50	SM	26	51	680.05	335.00	345.05	0.56	0.172	0.54	27.46	4.39	1.12	35.21	0.52	0.63	0.391	2.271	Non-liquefiable
	35.00	SM	26	56	721.00	350.00	371.00	0.56	0.170	0.52	29.07	4.39	1.12	37.03	0.52	0.61	0.381	2.242	Non-liquefiable
	36.50	SM	26	55	751.90	365.00	386.90	0.56	0.170	0.51	27.96	4.39	1.12	35.78	0.52	0.60	0.375	2.207	Non-liquefiable
	38.00	ML	56	56	782.80	380.00	402.80	0.56	0.170	0.50	27.90	5.00	1.20	38.48	0.52	0.60	0.369	2.175	Non-liquefiable
	40.00	ML	56	66	824.00	400.00	424.00	0.56	0.170	0.49	32.05	5.00	1.20	43.46	0.52	0.58	0.362	2.133	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
P103	0.50	SM	45	5	10.00	5.00	5.00	1.00	0.311	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.622	Liquefiable
	1.00	SM	45	5	20.00	10.00	10.00	0.99	0.310	1.70	8.50	5.00	1.20	15.20	0.16	1.00	0.193	0.624	Liquefiable
	3.00	SM	43	7	60.00	30.00	30.00	0.98	0.305	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.808	Liquefiable
	4.00	SM	43	12	80.00	40.00	40.00	0.97	0.302	1.58	18.97	5.00	1.20	27.77	0.36	1.00	0.431	1.426	Non-liquefiable
	5.00	SM-SC	46	12	100.00	50.00	50.00	0.96	0.300	1.41	16.97	5.00	1.20	25.36	0.30	1.00	0.357	1.190	Non-liquefiable
	6.00	SM	41	16	120.60	60.00	60.60	0.95	0.296	1.28	20.55	5.00	1.20	29.66	0.45	1.00	0.532	1.795	Non-liquefiable
	7.00	CL	85	20	140.70	70.00	70.70	0.95	0.294	1.19	23.79	5.00	1.20	33.54	0.52	1.00	-	-	Non-liquefiable
	9.00	CL	75	19	180.90	90.00	90.90	0.93	0.289	1.05	19.93	5.00	1.20	28.91	0.41	1.00	-	-	Non-liquefiable
	10.00	CL	75	22	206.00	100.00	106.00	0.91	0.275	0.97	21.37	5.00	1.20	30.64	0.52	1.00	-	-	Non-liquefiable
	12.50	CL	88	17	257.50	125.00	132.50	0.84	0.255	0.87	14.77	5.00	1.20	22.72	0.25	1.00	-	-	Non-liquefiable
	15.50	SM	50	36	306.90	155.00	151.90	0.76	0.240	0.81	29.21	5.00	1.20	40.05	0.52	0.87	0.539	2.248	Non-liquefiable
	17.00	CL	65	36	350.20	170.00	180.20	0.72	0.218	0.74	26.82	5.00	1.20	37.18	0.52	0.80	-	-	Non-liquefiable
	18.50	SM	33	27	382.95	185.00	197.95	0.68	0.205	0.71	19.19	4.88	1.18	27.52	0.35	0.77	0.327	1.592	Non-liquefiable
	20.00	CL	67	27	414.00	200.00	214.00	0.64	0.193	0.68	18.46	5.00	1.20	27.15	0.34	0.80	-	-	Non-liquefiable
	21.50	CL	79	44	438.60	215.00	223.60	0.60	0.184	0.67	29.43	5.00	1.20	40.31	0.52	0.79	-	-	Non-liquefiable
	23.00	SM	44	44	469.20	230.00	239.20	0.56	0.171	0.65	28.45	5.00	1.20	39.14	0.52	0.79	0.488	2.848	Non-liquefiable
	24.50	SM	44	65	480.20	245.00	235.20	0.56	0.178	0.65	42.38	5.00	1.20	55.86	0.52	0.79	0.490	2.749	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	26.00	SM	43	67	509.60	260.00	249.60	0.56	0.178	0.63	42.41	5.00	1.20	55.89	0.52	0.78	0.482	2.705	Non-liquefiable
	27.50	SM	43	71	539.00	275.00	264.00	0.56	0.178	0.62	43.70	5.00	1.20	57.44	0.52	0.77	0.475	2.663	Non-liquefiable
	29.00	SM	42	71	568.40	290.00	278.40	0.56	0.178	0.60	42.55	5.00	1.20	56.06	0.52	0.75	0.468	2.625	Non-liquefiable
	30.50	SM	42	70	597.80	305.00	292.80	0.56	0.178	0.58	40.91	5.00	1.20	54.09	0.52	0.74	0.462	2.588	Non-liquefiable
	32.00	ML	54	75	627.20	320.00	307.20	0.56	0.178	0.57	42.79	5.00	1.20	56.35	0.52	0.73	0.456	2.554	Non-liquefiable
	33.50	CL	75	75	656.60	335.00	321.60	0.56	0.178	0.56	41.82	5.00	1.20	55.19	0.52	0.73	-	-	Non-liquefiable
	35.00	CL	64	72	686.00	350.00	336.00	0.56	0.178	0.55	39.28	5.00	1.20	52.14	0.52	0.72	-	-	Non-liquefiable
	36.50	CL	64	73	715.40	365.00	350.40	0.56	0.178	0.53	39.00	5.00	1.20	51.80	0.52	0.71	-	-	Non-liquefiable
	38.00	CL	64	75	744.80	380.00	364.80	0.56	0.178	0.52	39.27	5.00	1.20	52.12	0.52	0.70	-	-	Non-liquefiable
	40.00	CL	64	82	784.00	400.00	384.00	0.56	0.178	0.51	41.85	5.00	1.20	55.21	0.52	0.69	-	-	Non-liquefiable
P104	0.50	SM	45	4	9.90	5.00	4.90	1.00	0.314	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.540	Liquefiable
P104	1.00	SM-SC	43	4	19.80	10.00	9.80	0.99	0.313	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.542	Liquefiable
P104	2.00	SM	33	4	39.60	20.00	19.60	0.98	0.310	1.70	6.80	4.88	1.18	12.90	0.14	1.00	0.167	0.537	Liquefiable
P104	3.00	SM	33	6	59.40	30.00	29.40	0.98	0.308	1.70	10.20	4.88	1.18	16.91	0.18	1.00	0.215	0.697	Liquefiable
P104	5.00	SM	41	12	99.00	50.00	49.00	0.96	0.303	1.43	17.14	5.00	1.20	25.57	0.30	1.00	0.362	1.195	Non-liquefiable
P104	6.00	CL	73	10	114.00	60.00	54.00	0.95	0.314	1.36	13.61	5.00	1.20	21.33	0.23	1.00	-	-	Non-liquefiable
P104	8.00	CL-ML	79	18	152.00	80.00	72.00	0.94	0.309	1.18	21.21	5.00	1.20	30.46	0.50	1.00	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	9.00	CL	92	22	189.00	90.00	99.00	0.93	0.277	1.01	22.11	5.00	1.20	31.53	0.52	1.00	-	-	Non-liquefiable
	11.00	CL	87	15	231.00	110.00	121.00	0.88	0.262	0.91	13.64	5.00	1.20	21.36	0.23	1.00	-	-	Non-liquefiable
	12.00	CL	80	22	243.60	120.00	123.60	0.85	0.262	0.90	19.79	5.00	1.20	28.75	0.40	1.00	-	-	Non-liquefiable
	14.50	CL	80	28	294.35	145.00	149.35	0.79	0.242	0.82	22.91	5.00	1.20	32.49	0.52	1.00	-	-	Non-liquefiable
	16.00	SM	47	28	318.40	160.00	158.40	0.75	0.234	0.79	22.25	5.00	1.20	31.70	0.52	0.82	0.507	2.163	Non-liquefiable
	17.50	SM	49	35	353.50	175.00	178.50	0.71	0.218	0.75	26.20	5.00	1.20	36.44	0.52	0.77	0.481	2.201	Non-liquefiable
	19.00	CL-ML	66	35	383.80	190.00	193.80	0.67	0.206	0.72	25.14	5.00	1.20	35.17	0.52	0.75	-	-	Non-liquefiable
	20.50	CL-ML	66	39	414.10	205.00	209.10	0.63	0.194	0.69	26.97	5.00	1.20	37.36	0.52	0.72	-	-	Non-liquefiable
	23.50	ML	54	42	474.70	235.00	239.70	0.56	0.173	0.65	27.13	5.00	1.20	37.55	0.52	0.79	0.489	2.826	Non-liquefiable
	25.00	SM	39	42	495.00	250.00	245.00	0.56	0.176	0.64	26.83	5.00	1.20	37.20	0.52	0.73	0.452	2.560	Non-liquefiable
	26.50	SM	39	45	532.65	265.00	267.65	0.56	0.174	0.61	27.51	5.00	1.20	38.01	0.52	0.71	0.438	2.519	Non-liquefiable
	29.50	SM	38	58	592.95	295.00	297.95	0.56	0.174	0.58	33.60	5.00	1.20	45.32	0.52	0.73	0.452	2.600	Non-liquefiable
	31.00	SM	38	63	610.70	310.00	300.70	0.56	0.177	0.58	36.33	5.00	1.20	48.60	0.52	0.73	0.451	2.541	Non-liquefiable
	32.50	SM	27	66	640.25	325.00	315.25	0.56	0.177	0.56	37.17	4.48	1.13	46.49	0.52	0.72	0.445	2.506	Non-liquefiable
	34.00	SM	27	56	669.80	340.00	329.80	0.56	0.177	0.55	30.84	4.48	1.13	39.33	0.52	0.71	0.439	2.474	Non-liquefiable
	35.50	SM	27	53	699.35	355.00	344.35	0.56	0.177	0.54	28.56	4.48	1.13	36.76	0.52	0.70	0.433	2.443	Non-liquefiable
	37.00	SM	30	63	728.90	370.00	358.90	0.56	0.177	0.53	33.25	4.71	1.15	43.09	0.52	0.69	0.428	2.414	Non-liquefiable
	38.50	SM	30	48	758.45	385.00	373.45	0.56	0.177	0.52	24.84	4.71	1.15	33.38	0.52	0.68	0.423	2.386	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	40.00	SM	33	52	788.00	400.00	388.00	0.56	0.177	0.51	26.40	4.88	1.18	36.02	0.52	0.69	0.427	2.408	Non-liquefiable
P105	0.50	CL-ML	52	4	9.85	5.00	4.85	1.00	0.316	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
	2.00	CL-ML	54	4	39.40	20.00	19.40	0.98	0.312	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
	3.00	SM	36	6	59.10	30.00	29.10	0.98	0.310	1.70	10.20	5.00	1.20	17.24	0.18	1.00	0.219	0.707	Liquefiable
	4.00	CL-ML	56	6	78.80	40.00	38.80	0.97	0.307	1.61	9.63	5.00	1.20	16.56	0.18	1.00	-	-	Non-liquefiable
	5.00	SM	45	7	101.00	50.00	51.00	0.96	0.297	1.40	9.80	5.00	1.20	16.76	0.18	1.00	0.213	0.716	Liquefiable
	6.00	SM	30	10	121.20	60.00	61.20	0.95	0.295	1.28	12.78	4.71	1.15	19.46	0.21	1.00	0.249	0.845	Liquefiable
	8.00	ML	62	12	161.60	80.00	81.60	0.94	0.290	1.11	13.28	5.00	1.20	20.94	0.23	1.00	0.271	0.935	Liquefiable
	9.00	ML	62	15	174.60	90.00	84.60	0.93	0.300	1.09	16.31	5.00	1.20	24.57	0.28	1.00	0.338	1.128	Non-liquefiable
	10.00	CL	85	15	194.00	100.00	94.00	0.91	0.292	1.03	15.47	5.00	1.20	23.57	0.27	1.00	-	-	Non-liquefiable
	11.00	CL	86	8	221.10	110.00	111.10	0.88	0.273	0.95	7.59	5.00	1.20	14.11	0.15	1.00	-	-	Non-liquefiable
	12.00	CI	72	14	241.20	120.00	121.20	0.85	0.265	0.91	12.72	5.00	1.20	20.26	0.22	1.00	-	-	Non-liquefiable
	13.00	ML	78	14	261.30	130.00	131.30	0.83	0.257	0.87	12.22	5.00	1.20	19.66	0.21	1.00	0.252	0.981	Liquefiable
	14.50	ML	73	21	290.00	145.00	145.00	0.79	0.245	0.83	17.44	5.00	1.20	25.93	0.31	1.00	0.372	1.513	Non-liquefiable
	17.50	ML	54	33	350.00	175.00	175.00	0.71	0.221	0.76	24.95	5.00	1.20	34.93	0.52	0.85	0.528	2.393	Non-liquefiable
	19.00	CL-ML	61	33	374.30	190.00	184.30	0.67	0.211	0.74	24.31	5.00	1.20	34.17	0.52	0.84	-	-	Non-liquefiable
	20.50	CL	86	46	403.85	205.00	198.85	0.63	0.199	0.71	32.62	5.00	1.20	44.14	0.52	0.82	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **a_{max}/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	23.50	CL	87	38	462.95	235.00	227.95	0.56	0.177	0.66	25.17	5.00	1.20	35.20	0.52	0.74	-	-	Non-liquefiable
	25.00	ML	66	38	512.50	250.00	262.50	0.56	0.171	0.62	23.45	5.00	1.20	33.14	0.52	0.71	0.441	2.585	Non-liquefiable
	26.50	SM	45	50	545.90	265.00	280.90	0.56	0.170	0.60	29.83	5.00	1.20	40.80	0.52	0.69	0.430	2.536	Non-liquefiable
	28.00	CL	87	50	576.80	280.00	296.80	0.56	0.170	0.58	29.02	5.00	1.20	39.83	0.52	0.66	-	-	Non-liquefiable
	29.50	SM	33	50	619.50	295.00	324.50	0.56	0.167	0.56	27.76	4.88	1.18	37.62	0.52	0.64	0.397	2.378	Non-liquefiable
	32.50	CL	86	53	682.50	325.00	357.50	0.56	0.167	0.53	28.03	5.00	1.20	38.64	0.52	0.57	-	-	Non-liquefiable
	34.00	ML	57	52	707.20	340.00	367.20	0.56	0.168	0.52	27.14	5.00	1.20	37.56	0.52	0.56	0.350	2.080	Non-liquefiable
	35.50	SM	44	58	738.40	355.00	383.40	0.56	0.168	0.51	29.62	5.00	1.20	40.55	0.52	0.55	0.343	2.041	Non-liquefiable
	37.00	SM	44	49	769.60	370.00	399.60	0.56	0.168	0.50	24.51	5.00	1.20	34.41	0.52	0.54	0.337	2.004	Non-liquefiable
	38.50	SM	46	61	800.80	385.00	415.80	0.56	0.168	0.49	29.91	5.00	1.20	40.90	0.52	0.53	0.331	1.970	Non-liquefiable
	40.00	SM	46	60	832.00	400.00	432.00	0.56	0.168	0.48	28.87	5.00	1.20	39.64	0.52	0.53	0.326	1.937	Non-liquefiable
P106	0.50	SM	45	2	9.50	5.00	4.50	0.56	0.184	1.70	3.40	5.00	1.20	9.08	0.11	2.03	0.255	1.382	Non-liquefiable
P106	2.00	CL	60	2	38.00	20.00	18.00	0.56	0.184	1.70	3.40	5.00	1.20	9.08	0.11	1.48	-	-	Non-liquefiable
P106	3.00	CL	60	3	57.00	30.00	27.00	0.56	0.184	1.70	5.10	5.00	1.20	11.12	0.12	1.35	-	-	Non-liquefiable
P106	5.00	SM	39	7	95.00	50.00	45.00	0.56	0.184	1.49	10.43	5.00	1.20	17.52	0.19	1.05	0.233	1.264	Non-liquefiable
P106	6.00	SM	39	9	109.20	60.00	49.20	0.56	0.194	1.43	12.83	5.00	1.20	20.40	0.22	1.04	0.274	1.414	Non-liquefiable
P106	7.00	CL-ML	55	9	127.40	70.00	57.40	0.56	0.194	1.32	11.88	5.00	1.20	19.26	0.21	1.13	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	8.00	CL-ML	82	10	158.40	80.00	78.40	0.56	0.176	1.13	11.29	5.00	1.20	18.55	0.20	1.06	-	-	Non-liquefiable
	9.00	CL-ML	82	15	178.20	90.00	88.20	0.56	0.176	1.06	15.97	5.00	1.20	24.17	0.28	1.03	-	-	Non-liquefiable
	10.00	CL	89	15	198.00	100.00	98.00	0.56	0.176	1.01	15.15	5.00	1.20	23.18	0.26	1.01	-	-	Non-liquefiable
	11.00	CL	89	31	226.60	110.00	116.60	0.56	0.170	0.93	28.71	5.00	1.20	39.45	0.52	0.94	-	-	Non-liquefiable
	12.00	CL	89	36	247.20	120.00	127.20	0.56	0.170	0.89	31.92	5.00	1.20	43.30	0.52	0.91	-	-	Non-liquefiable
	14.50	CL	77	19	298.70	145.00	153.70	0.56	0.170	0.81	15.33	5.00	1.20	23.39	0.26	0.87	-	-	Non-liquefiable
	16.00	ML	53	19	328.00	160.00	168.00	0.56	0.171	0.77	14.66	5.00	1.20	22.59	0.25	0.84	0.251	1.473	Non-liquefiable
	17.50	SM	48	31	346.50	175.00	171.50	0.56	0.176	0.76	23.67	5.00	1.20	33.41	0.52	0.83	0.517	2.932	Non-liquefiable
	20.50	SM	43	36	405.90	205.00	200.90	0.56	0.176	0.71	25.40	5.00	1.20	35.48	0.52	0.85	0.526	2.978	Non-liquefiable
	22.00	ML	59	36	422.40	220.00	202.40	0.56	0.182	0.70	25.30	5.00	1.20	35.37	0.52	0.85	0.525	2.878	Non-liquefiable
	23.50	ML	59	41	451.20	235.00	216.20	0.56	0.182	0.68	27.88	5.00	1.20	38.46	0.52	0.83	0.516	2.833	Non-liquefiable
	26.50	ML	52	66	508.80	265.00	243.80	0.56	0.182	0.64	42.27	5.00	1.20	55.72	0.52	0.75	0.466	2.555	Non-liquefiable
	29.50	CL-ML	62	53	584.10	295.00	289.10	0.56	0.176	0.59	31.17	5.00	1.20	42.41	0.52	0.71	-	-	Non-liquefiable
	31.00	CL	78	76	613.80	310.00	303.80	0.56	0.176	0.57	43.60	5.00	1.20	57.32	0.52	0.70	-	-	Non-liquefiable
	32.50	CL	78	69	643.50	325.00	318.50	0.56	0.176	0.56	38.66	5.00	1.20	51.40	0.52	0.69	-	-	Non-liquefiable
	35.50	CL	79	75	702.90	355.00	347.90	0.56	0.176	0.54	40.21	5.00	1.20	53.25	0.52	0.67	-	-	Non-liquefiable
	38.50	CL	87	73	773.85	385.00	388.85	0.56	0.174	0.51	37.02	5.00	1.20	49.42	0.52	0.64	-	-	Non-liquefiable
	40.00	CL	87	79	804.00	400.00	404.00	0.56	0.174	0.50	39.30	5.00	1.20	52.16	0.52	0.64	-	-	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
P111	0.50	CL-ML	51	4	10.00	5.00	5.00	1.00	0.311	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
	1.00	CL-ML	51	4	20.00	10.00	10.00	0.99	0.310	1.70	6.80	5.00	1.20	13.16	0.14	1.00	-	-	Non-liquefiable
	3.00	SM	42	10	60.00	30.00	30.00	0.98	0.305	1.70	17.00	5.00	1.20	25.40	0.30	1.00	0.358	1.174	Non-liquefiable
	4.00	SM	42	14	80.00	40.00	40.00	0.97	0.302	1.58	22.14	5.00	1.20	31.56	0.52	1.00	0.620	2.051	Non-liquefiable
	5.00	CL	74	14	100.00	50.00	50.00	0.96	0.300	1.41	19.80	5.00	1.20	28.76	0.40	1.00	-	-	Non-liquefiable
	6.00	CL	74	11	118.20	60.00	58.20	0.95	0.302	1.31	14.42	5.00	1.20	22.30	0.25	1.00	-	-	Non-liquefiable
	7.00	SM	45	30	137.90	70.00	67.90	0.95	0.300	1.21	36.41	5.00	1.20	48.69	0.52	1.00	0.620	2.068	Non-liquefiable
	9.00	CL	74	31	177.30	90.00	87.30	0.93	0.295	1.07	33.18	5.00	1.20	44.81	0.52	1.00	-	-	Non-liquefiable
	10.00	CL	92	44	198.00	100.00	98.00	0.91	0.286	1.01	44.45	5.00	1.20	58.34	0.52	1.00	-	-	Non-liquefiable
	12.50	CL	79	27	247.50	125.00	122.50	0.84	0.265	0.90	24.39	5.00	1.20	34.27	0.52	1.00	-	-	Non-liquefiable
	15.50	SC	46	37	311.55	155.00	156.55	0.76	0.236	0.80	29.57	5.00	1.20	40.49	0.52	0.87	0.541	2.292	Non-liquefiable
	18.50	CL-ML	54	40	379.25	185.00	194.25	0.68	0.207	0.72	28.70	5.00	1.20	39.44	0.52	0.79	-	-	Non-liquefiable
	20.00	SM	35	40	406.00	200.00	206.00	0.64	0.197	0.70	27.87	5.00	1.20	38.44	0.52	0.78	0.481	2.443	Non-liquefiable
	21.50	SM	35	54	436.45	215.00	221.45	0.60	0.184	0.67	36.29	5.00	1.20	48.54	0.52	0.76	0.469	2.541	Non-liquefiable
	24.50	SM	47	57	497.35	245.00	252.35	0.56	0.172	0.63	35.88	5.00	1.20	48.06	0.52	0.68	0.422	2.451	Non-liquefiable
	26.00	SM	36	86	538.20	260.00	278.20	0.56	0.169	0.60	51.56	5.00	1.20	66.87	0.52	0.65	0.405	2.398	Non-liquefiable
	27.50	SM	37	85	569.25	275.00	294.25	0.56	0.169	0.58	49.55	5.00	1.20	64.46	0.52	0.64	0.396	2.342	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	29.00	SM	37	88	600.30	290.00	310.30	0.56	0.169	0.57	49.96	5.00	1.20	64.95	0.52	0.62	0.387	2.291	Non-liquefiable
	30.50	SM	37	79	631.35	305.00	326.35	0.56	0.169	0.55	43.73	5.00	1.20	57.48	0.52	0.61	0.379	2.243	Non-liquefiable
	32.00	SM	37	83	662.40	320.00	342.40	0.56	0.169	0.54	44.86	5.00	1.20	58.83	0.52	0.60	0.372	2.199	Non-liquefiable
	33.50	SM	37	82	693.45	335.00	358.45	0.56	0.169	0.53	43.31	5.00	1.20	56.97	0.52	0.59	0.365	2.157	Non-liquefiable
	35.00	SC	34	87	724.50	350.00	374.50	0.56	0.169	0.52	44.96	4.93	1.19	58.35	0.52	0.58	0.358	2.119	Non-liquefiable
	36.50	SC	34	85	755.55	365.00	390.55	0.56	0.169	0.51	43.01	4.93	1.19	56.04	0.52	0.57	0.352	2.082	Non-liquefiable
	38.00	CL	61	88	786.60	380.00	406.60	0.56	0.169	0.50	43.64	5.00	1.20	57.37	0.52	0.56	-	-	Non-liquefiable
	40.00	SC	42	100	828.00	400.00	428.00	0.56	0.169	0.48	48.34	5.00	1.20	63.00	0.52	0.55	0.339	2.004	Non-liquefiable

APPENDIX-I
SITE PHOTOGRAPHS

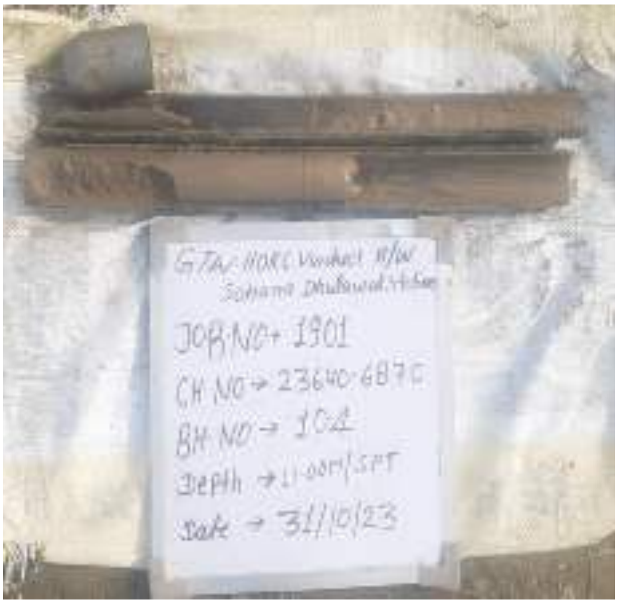
UDS sample at depth 7.00 m

SPT sample at depth 21.50 m

SPT sample at depth 26.00 m


SPT at depth 36.50 m

APPENDIX-I
SITE PHOTOGRAPHS



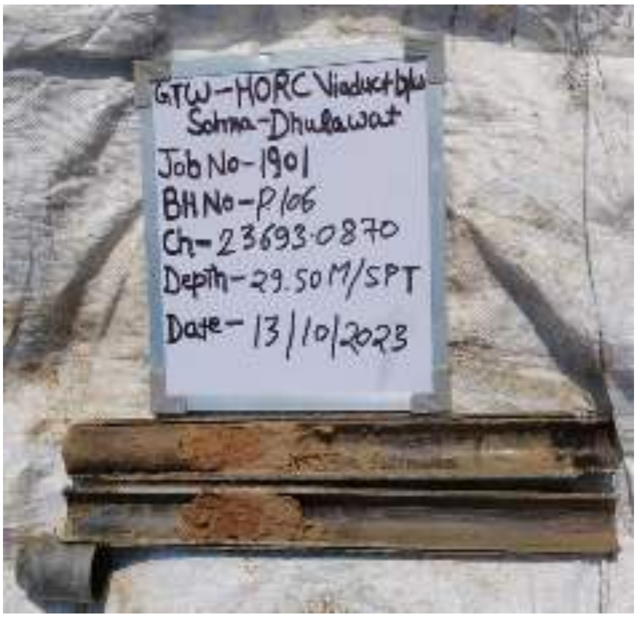
SPT sample at depth 11.00 m

UDS sample at depth 4.00 m

SPT at depth 11.00 m

SPT at depth 14.50m

APPENDIX-I
SITE PHOTOGRAPHS



SPT sample at depth 29.50 m

UDS at depth 11.00m

SPT sample at depth 32.00 m

APPENDIX-J
LABORATORY PHOTOGRAPHS

Water content test

Free Swell Index Test

Atterberg's limit test

APPENDIX-J
LABORATORY PHOTOGRAPHS

UCS of soil test

Shrinkage limit test

Direct Shear Test

Tri-axial Test

APPENDIX-K
CHART 1: FIELD BORELOG CHARTS (P 101)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GTI For HORC Viaduct B/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3120498.173	E: 700986.455	Location/ Chainage: 23562.0870		
Method of Drilling:	Percussion	Drilling Equipment:	Manually	Bore No.:	P-101
Casing Lowered (M):	21.00M	Bentonite Used: NA	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L-193.949	Date: From 28/10/23 to 30/10/23		Water Table (M):	1.30

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
28-10-23	0.00	0.50	0.50	D	Sx	collected				—	—	—	—	—	—	Non cohesive soil
"	1.00	1.45	0.45	U	"	Received				—	—	—	—	—	—	do
"	2.00	2.45	0.45	DP	"	1	3	4	7	—	—	—	—	—	—	do
"	3.00	3.45	0.45	DP	"	2	2	2	4	—	—	—	—	—	—	do
"	4.00	4.45	0.45	UD	"	slipped				—	—	—	—	—	—	Non cohesive soil
"	5.00	5.45	0.45	DP	"	4	5	7	12	—	—	—	—	—	—	do
"	6.00	6.45	0.45	DP	"	6	8	11	19	—	—	—	—	—	—	do
"	7.00	7.45	0.45	U	"	Received				—	—	—	—	—	—	Non cohesive soil
"	8.00	8.45	0.45	DP	"	9	8	13	21	—	—	—	—	—	—	do
"	9.00	9.45	0.45	DP	"	8	12	16	28	—	—	—	—	—	—	do
"	10.00	10.45	0.45	U	"	Received				—	—	—	—	—	—	do
"	11.00	11.45	0.45	DP	"	8	13	17	30	—	—	—	—	—	—	do
"	12.00	12.45	0.45	DP	"	7	12	16	28	—	—	—	—	—	—	do
"	13.00	13.45	0.45	U	"	Received				—	—	—	—	—	—	do
"	14.50	15.95	0.45	DP	"	5	7	12	19	—	—	—	—	—	—	Cohesive soil with Gravel
"	16.00	16.45	0.45	U	"	Received				—	—	—	—	—	—	do
"	17.50	17.95	0.45	DP	"	8	15	23	38	—	—	—	—	—	—	do
"	19.00	19.45	0.45	U	"	Received				—	—	—	—	—	—	do
"	20.50	20.95	0.45	DP	"	14	20	24	44	—	—	—	—	—	—	do
"	22.00	22.45	0.45	U	"	Received				—	—	—	—	—	—	Non cohesive soil with Gravel
"	23.50	23.95	0.45	DP	"	13	21	23	44	—	—	—	—	—	—	do
29-10-23	25.00	25.45	0.45	UD	"	slipped				—	—	—	—	—	—	do
"	26.50	26.95	0.45	DP	"	11	21	25	46	—	—	—	—	—	—	do
"	28.00	28.45	0.45	UD	"	slipped				—	—	—	—	—	—	do

Supervisor [signature] Techpro Engineers Pvt. Ltd. E-in-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 2: FIELD BORELOG CHARTS (P 101)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW for HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3120408.173	E: 700986.455	Location/ Chainage: 23562.0870		
Method of Drilling:	Percussion	Drilling Equipment:	Manual Auger winch	Bore No.:	P-101
Casing Lowered (M):	21.50 m	Bentonite Used: NA	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L-193.949	Date: From 29/10/23	to 30/10/23	Water Table (M):	1.30

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
29/10/23	2950	2995	0.45	DP	SX	14	28	48	76	—	—	—	—	—	—	Non cohesive soil with gravel
"	3100	3145	0.45	UDP	"	13	21	24	45	—	—	—	—	—	—	do
"	3250	3295	0.45	DP	"	18	21	23	44	—	—	—	—	—	—	do
"	3400	3445	0.45	"	"	slipped				—	—	—	—	—	—	do
"	3550	3595	0.45	DP	"	15	23	24	47	—	—	—	—	—	—	do
"	3700	3745	0.45	U	"	slipped				—	—	—	—	—	—	do
30/10/23	3850	3895	0.45	DP	"	12	24	28	52	—	—	—	—	—	—	-do-
"	4000	4045	0.45	DP	"	16	23	25	48	—	—	—	—	—	—	-do-

Supervisor Lokhav

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 3: FIELD BORELOG CHARTS (P 102)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GTJ-HORC Viaduct b/w Sohana Dhulawat Station	Project Code:	1901
Coordinate:	N: 3120524.371 E: 700986.81	Location/ Chainage:	23588.2870
Method of Drilling:	Percussion	Drilling Equipment:	Manual Power Winch
Bore No.:	P 102		
Casing Lowered (M):	2.00	Bentonite Used:	NO
Standard Sampler:	Yes	Barrel Type:	N/A
Ground Elevation:	R.L-194.023	Date: From	29/10/23 to 8/10/23
Water Table (M):	1.00		

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
29/10/23	0.0	0.50	0.50	DS	SX	Received										Non Cohesive Soil
	1.00	1.45	0.45	DP	"	1	2	2	4							-do-
"	2.00	2.45	0.45	U	"	Received										-do-
"	3.50	3.95	0.45	DP	"	3	5	8	13							-do-
"	4.00	4.45	0.45	DP	"	3	3	4	7							-do-
"	5.00	5.45	0.45	U	"	Slipped										-do-
"	6.00	6.45	0.45	DP	"	4	6	9	15							-do-
"	7.00	7.45	0.45	DP	"	4	4	6	10							Non cohesive Soil
"	8.00	8.45	0.45	U	"	Received										-do-
"	9.00	9.45	0.45	DP	"	7	9	11	20							-do-
"	10.00	10.45	0.45	DP	"	7	8	10	18							-do-
"	11.00	11.45	0.45	U	"	Received										-do-
"	12.50	12.95	0.45	DP	"	5	7	9	16							-do-
"	14.00	14.45	0.45	U	"	Received										-do-
"	15.50	15.95	0.45	DP	"	7	13	15	28							-do-
"	17.00	17.45	0.45	U	"	Slipped										-do-
"	18.50	18.95	0.45	DP	"	10	12	16	28							-do-
3/10/23	20.00	20.45	0.45	U	"	Slipped										-do-
"	21.50	21.95	0.45	DP	"	15	21	23	44							Non cohesive soil
"	23.00	23.45	0.45	U	"	Slipped										-do-
1/10/23	24.50	24.95	0.45	DP	"	14	22	28	50							-do-
"	26.00	26.45	0.45	U	"	Slipped										-do-
"	27.50	27.95	0.45	DP	"	18	21	30	51							-do-
"	29.00	29.45	0.45	U	"	Slipped										-do-

Nitesh

Supervisor

E-in-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K

CHART 4: FIELD BORELOG CHARTS (P 102)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	G/W-HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3105524.371	E: 700986.81	Location/ Chainage: 23588.2870		
Method of Drilling:	Percussion	Drilling Equipment	Manual Powerwinch	Bore No.:	P102
Casing Lowered (M):	24.00	Bentonite Used: NO	Standard Sampler : Yes	Barrel Type :	N/A
Ground Elevation:	R.L-194.023	Date: From 30/10/23 to 2/10/23		Water Table (M):	1.00

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
1/10/23	30.00	30.45	0.45	DP	SX	16	20	26	46							Non cohesive soil
"	32.00	32.45	0.45	U	"	Skipped										— do —
"	33.50	33.95	0.45	DP	"	17	22	29	51							— do —
"	35.00	35.45	0.45	DP	"	19	23	33	56							— do —
2/10/23	36.50	36.95	0.45	DP	"	19	24	31	55							— do —
"	38.00	38.45	0.45	DP	"	20	26	30	56							— do —
"	40.00	40.45	0.45	DP	"	20	30	36	66							— do —

Nitesh

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 5: FIELD BORELOG CHARTS (P 103)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name: GT For HORC Viaduct Sohana Dhulawat Station | Project Code: 1901

Coordinate: N: 3120550.568 E: 700987.163 | Location/ Chainage: 23610+670

Method of Drilling: Percussion | Drilling Equipment: Tripod winch | Bore No.: R103

Casing Lowered (M): 27.00 | Bentonite Used: NA | Standard Sampler: Yes | Barrel Type: NA

Ground Elevation: RL-194.05 | Date: From 11/10/23 to 12/10/23 | Water Table (M): 0.50 M

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
11/10/23	0.00	0.50	0.50	D	150	collected										Non cohesive soil
"	1.00	1.45	0.45	DP	"	1	2	3	5							do
"	2.00	2.45	0.45	U	"	Received										do
"	3.00	3.45	0.45	DP	"	2	3	4	7							Non cohesive soil
"	4.00	4.45	0.45	DP	"	4	5	7	12							do
"	5.00	5.45	0.45	U	"	Received										do
"	6.00	6.45	0.45	DP	"	5	7	9	16							cohesive soil
"	7.00	7.45	0.45	DP	"	6	9	11	20							do
"	8.00	8.45	0.45	U	"	Received										do
"	9.00	9.45	0.45	DP	"	5	5	11	19							do
"	10.00	10.45	0.45	DP	"	5	9	13	22							do
"	11.00	11.45	0.45	U	"	Received										cohesive soil
"	12.50	12.95	0.45	DP	"	7	8	9	17							do
"	14.00	14.45	0.45	U	"	Received										do
"	15.50	15.95	0.45	DP	"	11	16	20	36							Non cohesive soil
"	17.00	17.45	0.45	U	"	Received										cohesive soil
"	18.50	18.95	0.45	DP	"	8	12	15	27							Noncohesive soil
12/10/23	20.00	20.45	0.45	U	"	Received										Cohesive soil
"	21.50	21.95	0.45	DP	"	9	19	25	44							cohesive soil with Gravel
"	23.00	23.45	0.45	U	"	Received										Cohesive soil.
"	24.50	24.95	0.45	DP	"	10	23	42	65							Non cohesive soil
"	26.00	26.45	0.45	U/DP	"	10	24	43	67							Non cohesive soil with Gravel
"	27.50	27.95	0.45	DP	"	13	26	45	71							do
"	29.00	[illegible]	[illegible]	DP	"	13	25	46	71							do

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Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal [illegible] Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 6: FIELD BORELOG CHARTS (P 103)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No	GT/ 003
		Date of Issue	01.04.2018
		Rev No	R03
		Rev Date	28.12.2021

Project Name:	GT For HORC Viaduct between Sohana/Dhulawat Haryana			Project Code:	1901
Coordinate:	N: 3120550.568	E: 700987.165		Location/ Chainage:	23C1/4 4870
Method of Drilling:	Percussion	Drilling Equipment:	Percussion	Bore No.:	P 103
Casing Lowered (M):	27.00	Bentonite Used: N/A	Standard Sampler: Yes.	Barrel Type:	N/A
Ground Elevation:	RL-194.05	Date: From 11/10/23 to 13/10/23		Water Table (M):	0.50 M

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
	30.00	30.45	0.45	DP	Sx	14	25	45	70							Non cohesive soil with Gravel
15/10/23	32.00	32.45	0.45	DP	"	16	28	47	75							do
"	33.50	33.95	0.45	DP	"	16	28	47	75							cohesive soil with Gravel
"	35.00	35.45	0.45	DP	"	15	26	46	72							do
"	36.50	36.95	0.45	DP	"	16	27	46	73							do
"	38.00	38.45	0.45	DP	"	17	28	47	75							do
"	40.00	40.45	0.45	DP	"	17	34	48	82							cohesive soil with Gravel

Supervisor

Techpro Engineers Pvt. Ltd.

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test N > 100), Sampler means SPT sampler

B-In-C

APPENDIX-K
CHART 7: FIELD BORELOG CHARTS (P 104)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/003
		Date of Issue:	01.04.2018
		Rev No.:	R03
		Rev Date:	28.12.2021

Project Name:	G.T.I.D for Horc viaduct B/W Sohana Dhulawat station	Project Code:	
Coordinate:	N: 3120576.766 E: 700987.521	Location/ Chainage:	23640.6870
Method of Drilling:	Percussion	Drilling Equipment:	Auger/Hand Winch
Casing Lowered (M):	18 Bentonite Used: NO	Bore No.:	R 104
Ground Elevation:	R.L-194.067	Standard Sampler: Yes	Barrel Type: NA
Date: From	30/10/23 to 2/11/23	Water Table (M):	1.20

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
30/10/23	0.00	0.50	0.50	DS	Sx	Collected				-	-	—	—	—	—	Non Cohesive Soil
"	1.00	1.45	0.45	U	"	Received				—	—	—	—	—	—	— do —
"	2.00	2.45	0.45	DP	"	2	2	2	4	—	—	—	—	—	—	— do —
"	3.00	3.45	0.45	DP	"	2	2	4	6	—	—	—	—	—	—	— do —
"	4.00	4.45	0.45	U	"	Slipped				—	—	—	—	—	—	— do —
"	5.00	5.45	0.45	DP	"	3	5	7	12	—	—	—	—	—	—	— do —
"	6.00	6.45	0.45	DP	"	3	3	7	10	—	—	—	—	—	—	— do —
"	7.00	7.45	0.45	U	"	Received				—	—	—	—	—	—	Cohesive Soil with
"	8.00	8.45	0.45	DP	"	7	8	10	18	—	—	—	—	—	—	— do — Gravel
"	9.00	9.45	0.45	DP	"	6	10	12	22	—	—	—	—	—	—	— do —
31/10/23	10.00	10.45	0.45	U	"	Received				—	—	—	—	—	—	— do —
"	11.00	11.45	0.45	DP	"	5	6	9	15	—	—	—	—	—	—	Non Cohesive Soil
"	12.00	12.45	0.45	DP	"	6	9	13	22	—	—	—	—	—	—	— do —
"	13.50	13.95	0.45	U	"	Received				—	—	—	—	—	—	— do —
"	14.50	14.95	0.45	DP	"	6	12	16	28	—	—	—	—	—	—	— do —
"	16.00	16.45	0.45	U	"	Received				—	—	—	—	—	—	— do —
"	17.50	17.95	0.45	DP	"	8	15	20	35	—	—	—	—	—	—	Non Cohesive Soil
"	19.00	19.45	0.45	U	"	Slipped				—	—	—	—	—	—	— do —
"	20.50	20.95	0.45	DP	"	10	16	23	39	—	—	—	—	—	—	— do —
"	22.00	22.45	0.45	U	"	Received				—	—	—	—	—	—	Non Cohesive Soil
"	23.50	23.95	0.45	DP	"	13	18	24	42	—	—	—	—	—	—	with Gravel
1/11/23	25.00	25.45	0.45	U	"	Received				—	—	—	—	—	—	— do —
"	26.50	26.95	0.45	DP	"	13	15	30	45	—	—	—	—	—	—	— do —
"	28.00	28.45	0.45	U	"	Received				—	—	—	—	—	—	— do —

Supervisor Lakhey

E - In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 8: FIELD BORELOG CHARTS (P 104)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date.:	28.12.2021

Project Name:	GTW-Co Horc Viaduct Blw Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3120576.766	E: 700987.521		Location/ Chainage:	93600.6870
Method of Drilling:	Percussion	Drilling Equipment	Auger P Rotary Winch	Bore No.:	P. 104
Casing Lowered (M):	18	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L-194.067	Date: From 30/10/23 to 2/11/23		Water Table (M):	1.20

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
01-11-23	29.50	29.95	0.45	DP	8r	13	27	31	58	—	—	—	—	—	—	Non Cohesive Soil
"	31.00	31.45	0.45	DP	"	18	31	32	63	—	—	—	—	—	—	with Gravel
"	32.50	32.95	0.45	DP	"	13	28	38	66	—	—	—	—	—	—	- do -
2-11-23	34.00	34.45	0.45	DP	"	14	24	32	56	—	—	—	—	—	—	Non Cohesive Soil
"	35.50	35.95	0.45	DP	"	13	18	35	53	—	—	—	—	—	—	- do -
"	37.00	37.45	0.45	DP	"	18	28	35	63	—	—	—	—	—	—	- do -
"	38.50	38.95	0.45	DP	"	12	19	29	48	—	—	—	—	—	—	- do -
"	40.00	40.45	0.45	DP	"	17	21	31	52	—	—	—	—	—	—	- do -

Supervisor Lakhan

CE - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 9: FIELD BORELOG CHARTS (P 105)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No:	R03
		Rev. Date:	28.12.2021

Project Name:	GTI for HORC Viaduct B/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3120602.953	E: 700987.876	Location/ Chainage: 93666.8870		
Method of Drilling:	Percussion	Drilling Equipment	Automatic Winch	Bore No.:	P-105
Casing Lowered (M):	2.00	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L - 193.916	Date: From 30/10/23 to 02/11/23		Water Table (M):	1.20

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
30/10/23	0.00	0.50	0.50	DS	150	Collected										Non Cohesive Soil
	1.00	1.45	0.45	U	"	Slipped										- do -
	2.00	2.45	0.45	DP	"	2	2	2	4							- do -
	3.00	3.45	0.45	DP	"	2	3	3	6							- do -
	4.00	4.45	0.45	U	"	Received										Non Cohesive Soil
	5.00	5.45	0.45	DP	"	3	3	4	7							with gravel
	6.00	6.45	0.45	DP	"	3	4	6	10							- do -
	7.00	7.45	0.45	U	"	Slipped										- do -
	8.00	8.45	0.45	DP	"	3	5	7	12							- do -
31/10/23	9.00	9.45	0.45	DP	"	4	6	9	15							- do -
	10.00	10.45	0.45	U	"	Received										- do -
	11.00	11.45	0.45	DP	"	3	4	4	8							Non Cohesive Soil with
	12.00	12.45	0.45	DP	"	4	6	8	14							- do - Gravel
	13.00	13.45	0.45	U	"	Received										- do -
	14.50	14.95	0.45	DP	"	9	9	12	21							- do -
	16.00	16.45	0.45	U	"	Slipped										- do -
	17.50	17.95	0.45	DP	"	9	14	19	33							- do -
	19.00	19.45	0.45	U	"	Slipped										- do -
	20.50	20.95	0.45	DP	"	13	20	26	46							- do -
	22.00	22.45	0.45	U	"	Received										- do -
	23.50	23.95	0.45	DP	"	8	15	23	38							- do -
	25.00	25.45	0.45	U	"	Received										- do -
1/11/23	26.50	26.95	0.45	DP	"	18	25	25	50							Non Cohesive Soil
	28.00	28.45	0.45	U	"	Received										- do -

Supervisor Lakey

SE-In-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 10: FIELD BORELOG CHARTS (P 105)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	OT/ 003
Date of Issue:	01.04.2018
Rev. No:	R03
Rev. Date:	28.12.2021

Project Name: GTW for HORC viaduct B/W Sohana Dhulawat station — Project Code: 1901
Coordinate: N: 3120602.953 — E: 707987.876 — Location/ Chainage: 23666.8870
Method of Drilling: Percussion — Drilling Equipment: Automatic Rig — Bore No.: P-105
Casing Lowered (M): 20.00 — Bentonite Used: NO — Standard Sampler: Yes — Barrel Type: NQ
Ground Elevation: R.L-193.916 — Date: From 30/10/23 to 2/11/23 — Water Table (M): 1.30

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
1/11/23	29.50	29.95	0.45	DP	3X	15	24	26	50	-						Non Cohesive Soil
"	31.00	31.45	0.45	"	"	Received										- do -
"	32.50	32.95	0.45	DP	"	11	21	32	53							- do -
"	34.00	34.45	0.45	DP	"	14	24	28	52							- do -
2/11/23	35.50	35.95	0.45	DP	"	18	28	30	58							- do -
"	37.00	37.45	0.45	DP	"	13	21	28	49							- do -
"	38.50	38.95	0.45	DP	"	17	26	35	61							- do -
"	40.00	40.45	0.45	DP	"	18	28	32	60							- do -

Supervisor: Jabby

E-in-C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test.
R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 11: FIELD BORELOG CHARTS (P 106)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue	01 04 2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	Civil work for HORC viaduct B/w Sohana & Dhulawat Station			Project Code:	1901
Coordinate:	N: 3120629.123	E: 700988.231	Location/ Chainage: 23693+087.0		
Method of Drilling:	Percussion	Drilling Equipment:	Power winch	Bore No.:	P 106
Casing Lowered (M):	20 m	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L - 194.696	Date: From 11/10/2023 to 18/10/2023		Water Table (M):	0.60 m

Day	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
11/10/23	0.00	0.50	0.50	DS	SX	Collected				—	—	—	—	—	—	Non cohesive soil
"	1.00	1.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	2.00	2.45	0.45	DP	—	1	1	1	2	—	—	—	—	—	—	— do —
12/10/23	3.00	3.45	0.45	DP	—	1	1	2	3	—	—	—	—	—	—	cohesive soil
"	4.00	4.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	5.00	5.45	0.45	DP	—	2	2	5	7	—	—	—	—	—	—	— do —
"	6.00	6.45	0.45	DP	—	2	3	6	9	—	—	—	—	—	—	Non cohesive soil
"	7.00	7.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do / DS collect
"	8.00	8.45	0.45	DP	—	4	4	6	10	—	—	—	—	—	—	— do —
"	9.00	9.45	0.45	DP	—	3	6	9	15	—	—	—	—	—	—	Non cohesive soil with gravels
"	10.00	10.45	0.45	U	—	Received				—	—	—	—	—	—	cohesive soil
"	11.00	11.45	0.45	DP	—	8	13	18	31	—	—	—	—	—	—	cohesive soil
"	12.00	12.45	0.45	DP	—	10	15	21	36	—	—	—	—	—	—	— do —
"	13.00	13.45	0.45	U	—	Received				—	—	—	—	—	—	cohesive soil with gravel
"	14.50	14.95	0.45	DP	—	5	7	12	19	—	—	—	—	—	—	— do —
"	16.00	16.45	0.45	U	—	Received				—	—	—	—	—	—	Non cohesive soil with gravel
"	17.50	17.95	0.45	DP	—	8	14	17	31	—	—	—	—	—	—	— do —
"	19.00	19.45	0.45	U	—	Received				—	—	—	—	—	—	Non cohesive soil with
"	20.50	20.95	0.45	DP	—	12	16	20	36	—	—	—	—	—	—	— do —
"	22.00	22.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do / DS collect
"	23.50	23.95	0.45	DP	—	13	18	23	41	—	—	—	—	—	—	— do —
"	25.00	25.45	0.45	U	—	Received				—	—	—	—	—	—	— do —
"	26.50	26.95	0.45	DP	—	15	27	29	56	—	—	—	—	—	—	Non cohesive soil
13/10/23	28.00	28.45	0.45	U	—	Slipped				—	—	—	—	—	—	— do —

Supervisor

E-in-C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 12: FIELD BORELOG CHARTS (P 106)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date:	28.12.2021

Project Name:	Geotech for HORC Viaduct B/w Sohana & Dhulawat Station			Project Code:	1901
Coordinate:	N: 3140629.153	E: 700789.131	Location/ Chainage: 28609-0870		
Method of Drilling:	Percussion	Drilling Equipment:	[illegible]	Bore No.:	P 106
Casing Lowered (M): 20.m	Bentonite Used: ON	Standard Sampler:	Yes	Barrel Type:	NX
Ground Elevation:	R.L.- 194.696	Date: From [illegible] to 15/12/2025		Water Table (M):	0.60 m

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
[illegible]	29.50	29.95	0.45	DP	SX	11	22	31	53	—	—	—	—	—	—	cohesive soil with [illegible]
"	31.00	31.45	0.45	DP	—	14	31	45	76	—	—	—	—	—	—	—do—
"	32.50	32.95	0.45	DP	—	13	29	40	69	—	—	—	—	—	—	cohesive soil with [illegible]
"	34.00	34.45	0.45	U	—	slipped				—	—	—	—	—	—	—do—
"	35.50	35.95	0.45	DP		15	33	43	75	—	—	—	—	—	—	—do—
"	37.00	37.45	0.45	U		slipped				—	—	—	—	—	—	—do—
"	38.50	38.95	0.45	DP		16	33	40	73	—	—	—	—	—	—	—do—
"	40.00	40.45	0.45	DP		14	35	44	79	—	—	—	—	—	—	cohesive soil

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 13: FIELD BORELOG CHARTS (P 111)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2015
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	G.T. Work for HORC Viaduct b/w Sohna & Dhulawat Station			Project Code:	1901
Coordinate:	N: 3120766.59	E: 700989.842	Location/ Chainage: 23830-4470		
Method of Drilling:	Rotary	Drilling Equipment:	Manual Hydraulic	Bore No.:	P-111
Casing Lowered (M):	15.0	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	RL-194.745	Date: From 18/10/23	to 21/10/23	Water Table (M):	1.30

Day / Date	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
18/10/23	0.00	0.50	0.50	DS	Sx	Collected										Non-Cohesive Soil.
"	1.00	1.45	0.45	DP	"	1	2	2	4							—do—
19/10/23	2.00	2.45	0.45	U	"	Received										—do+ Gravel.
"	3.00	3.45	0.45	DP	"	4	5	5	10							—do—
"	4.00	4.45	0.45	DP	"	6	7	7	14							—do—
"	5.00	5.45	0.45	U	"	Received.										Cohesive Soil with Gravel
"	6.00	6.45	0.45	DP	"	4	5	6	11							—do—
"	7.00	7.45	0.45	DP	"	10	14	16	30							—do—
"	8.00	8.45	0.45	U	"	Received										—do—
"	9.00	9.45	0.45	DP	"	10	13	18	31							—do—
"	10.00	10.45	0.45	DP	"	13	20	24	44							—do—
"	11.00	11.45	0.45	U	"	Received										—do—
"	12.50	12.95	0.45	DP	"	7	12	15	27							Cohesive Soil
"	14.00	14.45	0.45	U	"	Received.										Cohesive Soil with Gravel
"	15.50	15.95	0.45	DP	"	10	17	20	37							—do—
"	17.00	17.45	0.45	U	"	Received.										—do—
"	18.50	18.95	0.45	DP	"	9	18	22	40							—do—
20/10/23	20.00	20.45	0.45	U	"	Slipped.										Non-Cohesive Soil.
"	21.50	21.95	0.45	DP	"	13	24	30	54							Non Cohesive Soil with Gravel
"	23.00	23.45	0.45	U	"	Slipped										—do— (DS collected)
"	24.50	24.95	0.45	DP	"	14	26	31	57							Cohesive Soil with Gravel
"	26.00	26.45	0.45	DP	"	16	35	51	86							Non-Cohesive Soil with Gravel
"	27.50	27.95	0.45	DP	"	15	36	49	85							—do—
"	29.00	29.45	0.45	DP	"	16	38	50	88							—do—

Rajat
Supervisor

Pawan 21/10/23

Techpro Engineers

E - In - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 14: FIELD BORELOG CHARTS (P 111)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	003
Rev. Date:	28.12.2021

Project Name:	G.T. Works for HORC Viaduct b/w Sohana & Dhulawat Station			Project Code:	1901
Coordinate:	N: 3130766.59	E: 700989.842	Location/ Chainage: 23830.4470		
Method of Drilling:	Rotary	Drilling Equipment:	Manual/ Hydraulic	Bore No.:	P-111
Casing Lowered (M):	15.0	Bentonite Used: No	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R.L-194.745	Date: From 18/10/23, to 21/10/23		Water Table (M):	1.30

Day Date	Depth/RUN (m) From	To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
21/10/23	30.50	30.95	0.45	DP	Sx.	19	33	46	79							Cohesive Soil with Gravel
"	32.00	32.45	0.45	DP	"	15	36	47	83							Non-cohesive Soil with Gravel
"	33.55	33.95	0.45	DP	"	16	37	45	82							—do—
"	35.00	35.45	0.45	DP	"	18	39	50	89							Cohesive Soil with Gravel
"	36.50	36.95	0.45	DP	"	17	40	45	85							—do—
"	38.00	38.45	0.45	DP	"	16	42	46	88							—do—
"	40.00	40.20	0.20	DP	"	37	55	-	R							—do—

Rajesh 21/10/23
Supervisor

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100). Sampler means SPT sampler

E-in-C

End of Report

Report No: 1901-HORC-VII

Report No.: 1901-HORC-VII Date: Dec 05th; 2023

GEOTECHNICAL INVESTIGATION REPORT

ULR No.: TC916923000000032P
REVISION-R1

AT THE SITE FOR

HORC VIADUCT BETWEEN SOHANA & DHULAWAT STATIONS OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT, HARYANA

FROM BOREHOLES P114A to P133A

CLIENT

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.

Plot No. 143, 5th floor RailTel tower, Sector-44,
Gurugram, Haryana 122003

GENERAL CONSULTANTS

RITES-SMEC JV

Gurugram, Haryana

GEOTECHNICAL CONSULTANTS

TECHPRO ENGINEERS PVT. LTD.

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G T ROAD, KANPUR-209 217, Phone: 9793209918

e-mail: info@techproindia.com

TC-9169

REVISION NOTES

REVISION NO.	DATE	DESCRIPTION
R1	12.12.2023	• Lithological profile added in Appendix-C.

REPORT FORMAT

Report No.	Bore included	Total Number of Bores
1901-HORC-I	A1 to P20	21
1901-HORC-II	P21 to P40	20
1901-HORC-III	P41 to P60	20
1901-HORC-IV	P61 to P80	20
1901-HORC-V	P114A to P133A	20
1901-HORC-VI	P101 to P113	13
1901-HORC-VII	P114A to P133A	20
1901-HORC-VIII	P134A to A2A	16
1901-HORC-IX	P114B to P133B	20
1901-HORC-X	P134B to A2B	16

TABLE OF CONTENTS

APPENDICES

National Accreditation Board for
Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

TECHPRO ENGINEERS PVT. LTD. (LABORATORY DIVISION)

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G.T. ROAD, KANPUR, UTTAR PRADESH, INDIA

in the field of

TESTING

Certificate Number: TC-9169

Issue Date: 23/12/2022 Valid Until: 22/12/2024

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Identity : Techpro Engineers Private Limited

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

Dec 05th; 2023

ACKNOWLEDGEMENTS

We are pleased to submit the part-7 of the report of Geotechnical investigation, conducted for the boreholes P114A to P133A for the design of foundations for HORC Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) project in the state of Haryana, India.

We hereby, convey our sincere thanks to Mr. Neeraj Bhandari (CPM/South) and Mr. Raju Solanki (DGM/C/South), HRIDCL for trust and support during the investigation. We also acknowledge our thanks to Mr. Uma Maheshwara Rao B, DGM/C/West, HRIDCL for awarding the said work to us. We are also grateful Mr. Ravindra Dutta Upadhyay (Geotech Expert), Mr. PS Gautam & Mr. Jitender Parashar, Site Engineer from the RITES- SMEC JV and Mohd. Ishak (Executive/Civil) from HRIDCL, for their help rendered during and prior to the investigation work.

We are also thankful to our staff members for conducting field and laboratory test, preparing sketches, and typing the report.

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech. (Civil), M.Tech.
Principal Consultant &
Managing Director

1. INTRODUCTION:

Haryana Rail Infrastructure Development Corporation Ltd. (HRIDC) and Ministry of Railways, Govt. of India has come together to form a new company namely Haryana Orbital Rail Corporation Limited (HORCL), to design and construction of new BG line from Palwal to Sonipat named Haryana Orbital Rail Corridor (HORC), in the state of Haryana, India. In this connection, a Geotechnical investigation has been planned for the design of foundations of Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) Project in the state of Haryana. The work of conducting the detailed Geotechnical Investigation has been awarded to us by HRIDC, through work order No. HRIDC/HORC/GTI/211/2023-2024/Vol-0 dated 02-09-2023, which includes investigation in field, laboratory testing of disturbed and undisturbed samples, collected from the field, and submission of the geotechnical **investigation** test report.

A geotechnical investigation was carried out, with the locations, planned by the client. Purpose of the investigation is to determine the nature and properties of soil and rock strata across the bore holes and representing them through log sections showing the levels, nature, and properties of various strata up to a sufficient depth below the founding level, proneness of site to artesian conditions, seismic disturbance and other engineering properties of soil and rock strata.

This part -7 of the report includes the detailed methodology of investigation, collection of samples, field and laboratory test result including their interpretation/ analysis, recommendations on the properties of soils and rock required for design of foundation and suggesting suitable type and depth of foundation with allowable bearing capacity for safe and strong foundations for the Bore Hole numbers P114A to P133A.

2. SCOPE OF WORK:

For the design of foundation of viaduct, it is required to determine the allowable bearing capacity together with necessary engineering characteristics of underlying soil & rock strata. In general, the geotechnical investigation has been planned as per IS:1892-2021 and further extended to IS: 1904, IS:2911 (part-1/Sec 2) & IRC 78:2014 for planning the laboratory testing and computing the allowable bearing capacity, hence the scope of work is as follows:

2.1. Mobilisation of all tools & plants along with accessories, materials, labours etc. at site of work for drilling and testing work, including setting up boring and shifting to different bore holes point etc.

2.2. Exploratory drilling of 150 mm diameter bore holes through soil deposits and 75 mm in rock within the proposed alignment upto the required depth.

2.3. Collection of disturbed soil samples at an interval of 3.00 meter in all the bore holes.

2.4. Collection of undisturbed soil samples at every 3.00 m interval or at change of stratum from all the boreholes.

2.5. To conduct Standard Penetration Test (SPT) at an interval of 3.00 m or noticeable change of stratum in soil deposits in all bore holes.

2.6. Collection of rock core samples and preserving them in core boxes.

2.7. To collect ground water sample on completion of bore holes.

2.8. To record the ground water table in all the bore holes.

2.9. Transporting all the disturbed, undisturbed soil and rock core samples collected during the field investigation to our NABL accredited Geotech Engineering laboratory at Kanpur.

2.10. To conduct the laboratory tests on all the soil and rock core samples collected during field investigation for determination of their engineering characteristics.

2.11. To compile of field and laboratory test results, working out the allowable bearing capacity and preparing the report including detailed recommendations and necessary precautions.

3. GEOLOGICAL INFORMATION OF THE REGION:

3.1. Geography:

The project location is in the bordering area of Gurugram and Nuh (recent old name-Mewat), districts in the Indian state of Haryana. The stretch of the alignment of the proposed corridor starts from southmost part of Gurugram in the town of Sohna and ends at Dhulawat, which is a village lying at the north of Nuh district.

Haryana is a state located in the northern part of India. Gurugram is among one

of the districts in Haryana which is also the part of National Capital Region (30km south of New Delhi). It lies at an elevation of 217 m above msl. Sohna is a small town located 25km in the south of Gurugram. Sohna is well known for its hot water springs and famous Shiva temple. Sohna is located in between 28°15’ N latitude and 77°40' E longitude at the elevation of 212.14m above msl. Mewat district is located at 28 °12′ N latitude, 77 °3′ E longitude, at the south of Gurugram at an elevation of 199 m above msl. The location is bordered by Rewari district on west and Faridabad & Palwal district on the east.

3.2. Geology:

The Gurugram district is having of almost flat topography, however, in the north-eastern part small isolated hillocks of Precambrian rocks are exposed. Small hill ranges which are part of the Aravali and Mangar Bani ranges exists in the district. The major part of district is underlain by Quaternary alluvium consisting of sand, clay and silt. The alluvial plain is formed by the Sahibi river which is a tributary of River Yamuna. Soils of the Gurgaon district is classified as tropical and brown soils, existing in the north western extreme, northern and north eastern parts of the district and water logged and salt affected soils in the southern parts of the district. The soils are medium textured loamy sand is the average texture in Gurgaon and Sohna blocks.

3.3. Rainfall and Climate:

The area has hot semi-arid type of climate characterising extreme dryness of the air except in the monsoon season. Intense hot summer and cold winters. The total annual rainfall in the region is about 596 mm, of which 75 to 80% is because of the south-west monsoon.

3.4. Seismicity:

The site under consideration exists in the district of Gurugram and Mewat which lies in the Seismic Zone IV (high damage risk zone), as per the current seismic zonation map of India (IS 1893-2016): RA 2021 and have a zone factor of 0.24 for design basis earthquake. The region is surrounded by many in-homogeneities in the form of faults and ridges like Sohna Fault, Moradabad Fault, Delhi-Moradabad Fault, Delhi-Haridwar ridge, junction of Aravalli and Alluvium near Delhi. The Sohna fault line lies between the Delhi ridge and Sohna town and falls between the Arjangarh and

Manesar outcrops. All the developed area in Gurugram comes within 200 km of the fault line. The Sohna fault line is located at the junction between the hard rock terrain of the Aravalli hills and the sandy formation of the Yamuna River and is currently inactive from several years and is capable of a disastrous earthquake.

The project location has been marked in Fig.1 Seismic zone map of India.

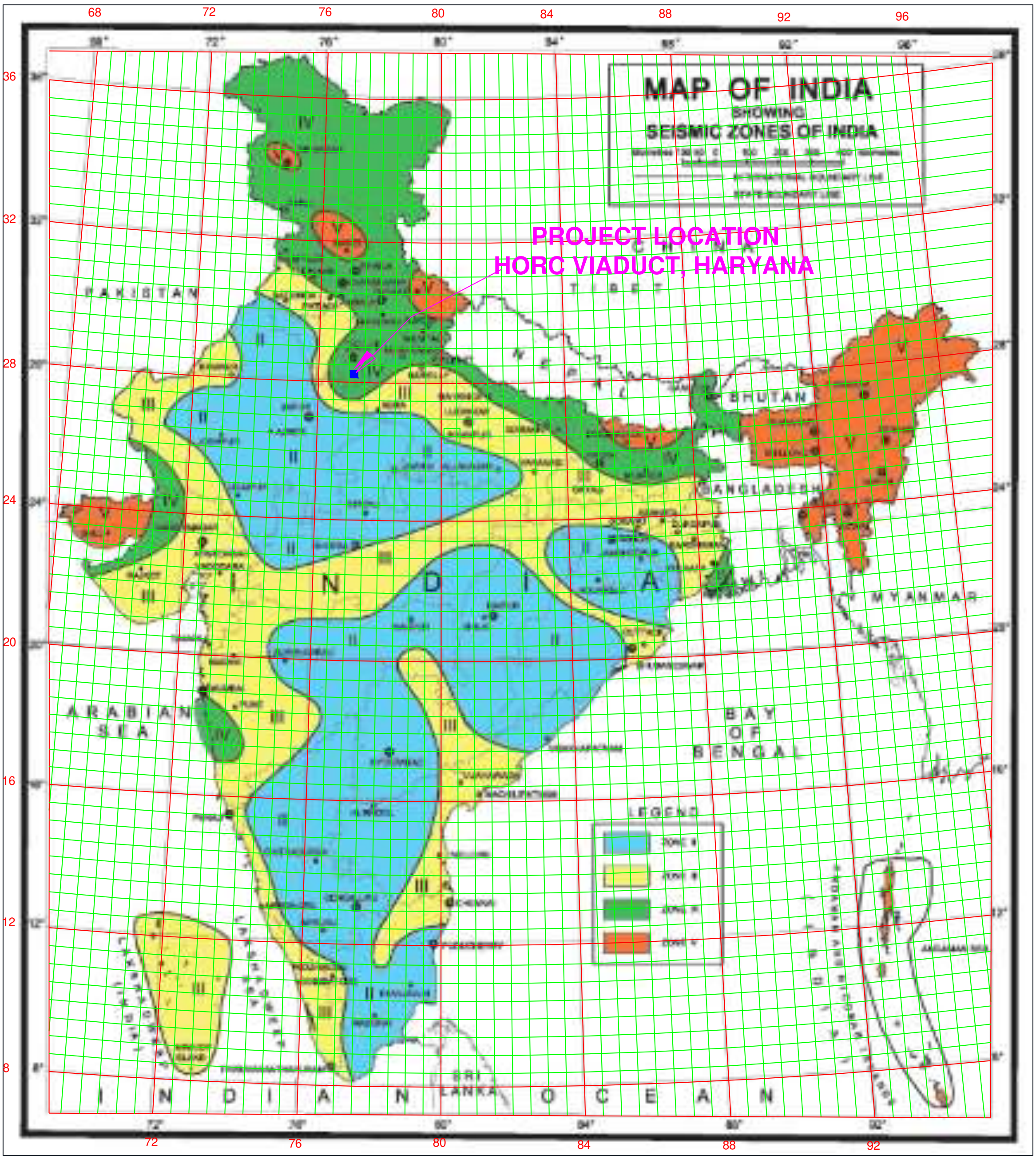


Fig.1: Seismic Zone Map of India

4. FIELD INVES TIGATION:

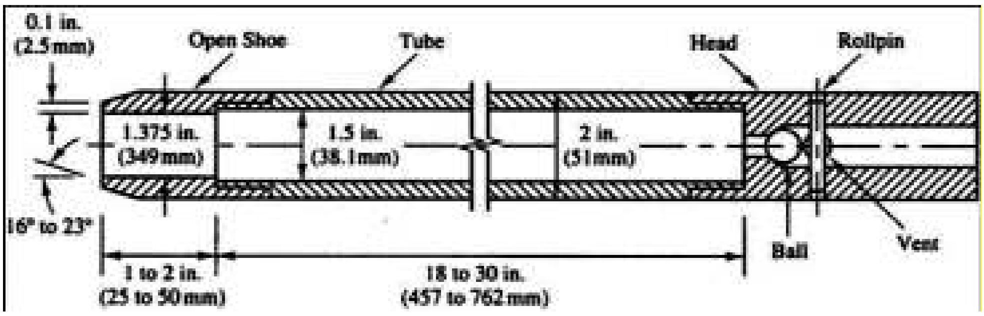
The field investigation work at this site was carried out from Oct

31st; 2023 to Nov 3rd; 2023 and Nov 18th ;2023 to Nov 21st ;2023. The following investigation work was carried out:

4.1. **Twenty** numbers of borehole were proposed to be made at this stretch, out of which two number of **boreholes** (marked as 116A and 120A) of diameter 150 mm in soil were made for conducting Standard Penetration Test and collection of disturbed and undisturbed samples. The boreholes were progressed using power operated winch machine under **percussion** method of drilling. Casing was used to keep the borehole stable and Bentonite was also used as drilling mud to help prevent wall collapse of boreholes at deeper depth. The records of achieved depth of bore holes have been given in Para No. 6, the details of drilled bores along with depth of casing used have been reported in Appendix B. Locations of boreholes have been reported in "TEST LOCATION PLAN" in Appendix A.

4.2. **Standard Penetration Tests** were conducted at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth, as per the procedure in IS: 2131-1981-(RA: 2021) in all the bore holes. The **standard SPT sampler** (without liner and with no space for liner) and **rope-pulley driven hammer** of standard weight of 63.50 kg have been used to perform the test.

For conducting the test, the bottom of the borehole was properly cleaned, and split spoon sampler was properly seated in position in the borehole. The split spoon sampler resting on the bottom of borehole was allowed to sink under its own weight; then the sampler was allowed to penetrate 15 cm with the blows of the hammer 63.50 kg weight falling free through 75cm, thereafter the split spoon sampler was further driven by another 15 cm. For the 3rd and final drive, the sampler was further allowed to penetrate 15 cm. The number of blows required to get each 15 cm of penetration, was recorded. The first 15 cm of drive is seating drive.



Structure of SPT Sampler

The total blows of penetration for the second and third 15 cm of penetration is termed the penetration resistance N. The N' values are indicative of the compactness/ relative density of cohesion less soils and consistency of cohesive soils.

In case the blows count of SPT in soil (including the number of blows of seating) exceeds 100, the corresponding penetration was recorded and this particular test at that depth stopped. If the total penetration is more than the seating penetration of 15 cm, then breakup of blow counts for 15 cm seating penetration and for remaining portion of penetration is also given.

SPT 'N' values are correlated with non-cohesive stratum as per BS: 5930 (1999) – for sandy strata and with consistency of cohesive stratum.

Correlation For Clay/Plastic Silt		Correlation For Sand/Non-Plastic Silt	
Consistency of clays	**Penetration Value**	**Relative Density of sand**	**Penetration Value**
Very Soft	0 to 2 Blows	Very loose	0 to 4 Blows
Soft	3 to 4 Blows	Loose	5 to 10 Blows
Medium Stiff	5 to 8 Blows	Medium	11 to 30 Blows
Stiff	9 to 16 Blows	Dense	31 to 50 Blows
Very Stiff	17 to 32 Blows	Very Dense	Above 50
Hard	Above 32		

In this method, the sampler acts as a probe and the driving energy is supplied by the fall of the drop weight. The values of 'N' depend on the compactness or relative density of the material. In hard formations, the testing is discontinued if 'N' value is found to be more than 100. It is termed as 'Refusal'. Refusal is also recorded when SPT blow count records 50 or more for any of the single drive of 15 cm.

'N' value depends upon degree of saturation and over burden pressure of the formation. Silty fine sand and fine sand below the water table develop pore water pressure depending on the in-situ void ratio which in turn affects the effective stress. This change in effective stress influences the 'N' value considerably.

Depth of overburden affects the SPT values in none to low cohesive soils and hence need correction. The SPT value after the overburden correction, N' is as follows:

$$N' = 0.77 \times \log (2000/q) \times N$$

Where, q= Overburden Pressure (kN/m^2) and N = observed SPT value

N' is corrected further for dilatancy in case of saturated fine sands and silts for the values of N' greater than 15.

Modified value after dilatancy correction N" = 15+ (N'-15)/2

Soil samples obtained from split spoon sampler were collected in the polythene bags of suitable size. These samples were property sealed, labelled, and carefully transported to the laboratory for testing. The results have been reported in Table 1 and 2 of Appendix B under the title "SUMMARY OF TEST RESULTS".

4.3. **Disturbed soil samples** were collected at 0.50 metre, then at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth and at significant change of stratum. Soil from cutting edge of SPT samplers and retained in split spoon, used for Standard Penetration Tests was taken as disturbed samples. These samples were placed without delay in adequately sealed polythene bags. Where the collection of disturbed soil samples could not be collected from SPT samples, Shelby tubes were driven and retained soil samples were obtained. The laboratory tests were conducted on the collected soil samples and reported in Table 1 and 2 of Appendix-B under the title "SUMMARY OF TEST RESULTS".

4.4. **Undisturbed soil samples** were collected in accordance with IS: 2132-1986-(RA: 2021) at an interval of 3.00 metre or at change of stratum, starting from the depth of 1.00 or 2.00 m, by using 100 mm dia. and 450 mm long MS tubes provided with sampler head with ball check arrangement. However, the some of the samples could not be extracted due to the partial penetration or slippage during the evacuation.

Moreover, collection of Undisturbed samples in very hard cohesive soils/ dense granular soils/gravels/ cobbles/ pebbles/ boulders, refusal strata is practically not possible and such collected samples will not truly represent the undisturbed conditions.

Immediately after taking undisturbed sample in the tube, the adopter head was removed along with the disturbed material. The visible ends of the samples shall then be trimmed off any wet disturbed soil. The ends will then be coated alternately with four layers of molten wax. More molten wax will then be added to give a total thickness of not less than 25 mm. The laboratory test results have been reported in Table 1 and

2 of Appendix-B.

4.5. The **ground water table** in the borehole was allowed to stabilize and measured after 8, 16, 24 and 48 hours after completion of the bore hole. It was ensured that last two reading were identical. The records of ground water table have been given in Para No.6.

4.6. **Ground water samples** were collected from borehole as per IS: 6935-1973-(RA:2019) for chemical analysis to determine aggressiveness in relation to attack on concrete / reinforcement including determination of pH value.

5. LABORATORY TESTS:

The following laboratory tests were conducted to determine the engineering characteristics of sub-soils:

5.1. **Field moisture contents** were determined by oven drying method as per IS: 2720 (part II)-1973-(RA: 2020). The results have been reported in Table 1 and 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.2. **Bulk density** of soil strata was obtained using Shelby tubes in accordance with IS 2720 (part XXIX)-1975-(RA: 2020). The results have been reported in Table 1 and 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.3. **Mechanical sieve analysis** test was performed in accordance with IS: 2720 (Part IV) – 1985-(RA: 2020), for the purpose of identification by grain size analysis, on coarse part of the soil samples and the results have been reported in Table 1 and 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.4. **Particle size analysis** test by **Hydrometer method** were performed in accordance with IS: 2720 (Part IV) -1985-(RA: 2020) on the part of soil samples obtained after the sieve analysis. The results have been reported in Table 1 and 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.5. **Atterbergs' limits tests** were performed in accordance with IS: 2720 (part V)-1985-(RA: 2020) and results have been reported in Table 1 and 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.6. **Specific gravity tests** were performed in accordance with IS 2720 (part III-sec. 1) -

1980-(RA: 2021) and the results have been reported in Table 1 and 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.7. **Consolidation tests** were performed on cohesive soil samples in accordance with IS: 2720 (part XV)-1965-(RA: 2021). The results have been reported in Table 1 and 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.8. **Direct shear tests** were performed as per IS: 2720 (part XIII)-1986-(RA: 2021), on the undisturbed soil samples obtained during the field investigation. The results and the density of samples have been reported in Table 1 and 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.9. **Tri-axial Compression Test** under Unconsolidated Un-drained (UU) condition as per IS: 2720 (Part-XI)-1993-(RA: 2021) were performed on the selected undisturbed soil samples, obtained during the field investigation. The results have been reported in Table 1 and 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.10. **Unconfined Compressive strength tests** were performed in accordance with IS 2720 (Part-X) -1991-(RA:2020) on selected undisturbed soil samples and the results have been reported in Table 3 of Appendix B.

5.11. **Shrinkage Limit tests** were performed in accordance with IS 2720 (part-VI) -1972-(RA: 2021) and the results have been reported in Table 1 and 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.12. **Free Swell Index** were performed in accordance with IS 2720 (part-XL) -1977-(RA: 2021) and the results have been reported in Table 1 and 2: “SUMMARY OF TEST RESULTS” of Appendix B.

6. GROUND WATER TABLE:

The water table at this site was encountered during the drilling operation up to the depth of investigation.

Borehole No.	Chainage	Global Co-ordinates (UTM format)		Reduced Level (m)	Depth of Borehole (m)	Water table (m)
		Easting	Northing			
P116A	23961.447	700986.631	3120897.53	195.485	40.00	1.90

Borehole No.	Chainage	Global Co-ordinates (UTM format)		Reduced Level (m)	Depth of Borehole (m)	Water table (m)
		Easting	Northing			
P120A	24066.247	700978.032	3121001.95	196.008	40.00	5.00

7. DESCRIPTION OF STRATA:

The classification of soil stratum has been done with the help of soil characteristics obtained in laboratory tests as per IS 1498-1970-(RA:2021). The classification of rock masses has been done based on RMR as per IS: 4464-1985, IS: 13365-1. The detailed nature of the strata has been reported in Table 1: "SUMMARY OF TEST RESULTS" of Appendix-B and represented through Lithological plots in Appendix-C.

The strata exhibited in both the bore holes, is predominantly comprising of inorganic silty clays of low plasticity and inorganic silts of non to low plastic category. Silty sands were encountered at varying depth and thickness.

8. SAFE BEARING CAPACITY COMPUTATIONS:

For the construction of viaducts, deep foundation **(Bored Cast-In-Situ RCC piles)** have been considered for computation of load bearing capacity of the underlying soil strata. The computation of load bearing capacity of bored cast-in-situ RCC piles have been done as per IS 2911 (part-1, section-2)-2010-(RA: 2020) with due consideration of effects of liquefaction.

8.1. Design Parameters:

Factor of safety in Compression	=	2.50
Factor of safety in Tension	=	3.00
Depth of critical water table	=	0.00 m
Diameter of pile	=	1.00 & 1.20 m
Cut off length	=	2.50 m
Type of pile head consider	=	Fixed

8.2. Computation of friction along pile stem:

$$Q_{uf} = \sum K_i . P_{di} . \tan\delta_i . A_{si}$$

where,

Q_{uf} = Ultimate shaft friction (kN/m^2)

K_i = Coefficient of earth pressure at mid-depth of i^{th} layer

P_{di} = Effective overburden pressure at mid-depth of i^{th} layer (kN/m^2)

A_{si} = Surface area of pile stem in i^{th} layer (m^2)

δ_i = Angle of wall friction between pile and soil of i^{th} layer (= ϕ) (degree)

ϕ_i = Angle of internal friction of soil in i^{th} layer (degree)

$\sum$ = Sum of all layers up to i^{th} layer

8.3. Computation of Cohesion along the stem of pile:

$Q_{uc} = \sum \alpha_i . c_i . A_{si}$

Where,

c_i = Cohesion in i^{th} layer

A_{si} = Surface area of pile stem in i^{th} layer (m^2)

α_i = Adhesion factor for i^{th} layer of soil depending of consistency of soils

$\sum$ = Sum of cohesion of all layers considered

8.4. Computation of end bearing resistance:

$Q_{ub} = A_p\,(c.Nc + q.Nq + 0.5.\,\gamma.B.N\gamma)$

Where,

A_p = Area of the pile toe (m^2)

c = cohesion of soils at pile toe (kN/m^2)

γ = Effective Unit weight of soils at pile toe (kN/m^3)

B = Diameter of pile (m)

q = Effective overburden pressure at pile toe (kN/m^2)

N_c = Bearing Capacity Factor (Recommended equal to 9)

Nq, $N\gamma$ = Bearing Capacity Factor

8.5. Lateral load capacity of piles in soils:

$Q_u = 12.E.I.\delta/(L_1+L_f)^3$

where,

Q_u = Ultimate lateral load capacity of pile (kN)

δ = Permissible deflection (m) = 5 mm

E = Young Modulus of pile material (kN/m^2)

I = Moment of Inertia of the pile cross section (m^4)

L_1 = Cantilever Length of pile (m)

L_f = Length of fixity (m)

Detailed calculations of pile load carrying capacity in compression & uplift in soil have been reported in **Table-1 to 2** of **Appendix-H.**

Pile lateral Load capacity has been given in **Table-3 to 4** of **Appendix-H**.

9. LIQUEFACTION ANALYSIS:

Liquefaction is the sudden loss of shear strength of the loose fine sands due to earthquake-induced vibration under saturated conditions. Liquefaction generally takes place in loose fine sands (fines < 10 %, D_{60}= 0.20 mm to 1.0 mm and C_u between 2 to 5) with N value less than 15. In case of soil strata having N>15, liquefaction of soil will not take place normally.

The present site falls in **seismic zone – IV.** Considering the history of past earthquakes and available seismic data, an earthquake of **magnitude 7.0** having peak ground acceleration **a_{max}= 0.24 g** is considered in the present analysis.

Preliminary assessment of liquefaction potential of foundation strata is made by simplified approach proposed by IS: 1893 (part-1)-2016-(RA: 2021) from the data obtained in Standard Penetration Test.

In this method, cyclic shear stress likely to be induced in the foundation strata by Design Basis Earthquake is first evaluated. Next threshold cyclic shear stress, which is good enough to cause liquefaction, is determined from SPT data and the empirical relations. Finally, comparison of these two stresses is used in the estimation of liquefaction susceptibility of the foundation strata.

Cyclic Stress Ratio (CSR):

The equivalent average of shear stress likely to be induced in the foundation material due to an earthquake is calculated by using the equations

Cyclic Resistance Ratio (CRR):

It expresses capacity of soil to resist liquefaction. CRR is determined using correlation between corrected blow count $(N_1)_{60}$ and CRR for earthquake of magnitude 7.5. $(N_1)_{60}$ is the SPT blow count corrected to an effective overburden pressure of 100 kPa and to hammer energy efficiency of 60 %.

Following variable have been adopted in calculation of N_{60} (SPT value for 60% efficiency)

Energy correction to SPT values:

C_{60} = 1.00 (energy efficiency factor)

Design Earthquake Base:

Earthquake zone	= IV
Magnitude of earthquake	= 7
Seismic Zone factor	= 0.24

Status of Liquefaction:

The value of CSR and CRR are computed at different depth and then the ratio of CRR to CSR to get the factor of safety towards the susceptibility of the stratum towards liquefaction potential.

If factor of safety:

$<$ 1.00 : Stratum is to be considered as liquefiable

$>$ 1.20 : Non-Liquefiable

The detailed calculations of liquefaction, have been reported in **Table-5** of **Appendix-H.**

10. RECOMMENDATIONS:

Keeping in mind, the field test results, laboratory test results and IS codes of practice the following recommendations are hereby made:

10.1. Bored Cast-In-Situ RCC Piles of diameter 1000 and 1200 mm have been adopted for SBC computations of foundation for Viaduct.

10.2. **Cut off length** of piles have been considered as 2.50 m from the existing ground level for the purpose of computation of SBC.

10.3. **Pile length** recommended in the table below, shall be measured **after the cut-off depth.**

10.4. **Allowable load carrying capacity** of pile corresponding to the length and diameter of pile shall be read from the tables below:

10.4.1. For Pile diameter = 1000 mm

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P116A	25.00	2650	1550	65
	27.50	2700	1800	
	30.00	3550	2050	
	32.50	3800	2300	
	35.00	4000	2550	
P120A	25.00	2650	1650	55
	27.50	2850	1850	
	30.00	3100	2050	
	32.50	3600	2300	
	35.00	3700	2500	

** Indicates Grade of Concrete*

10.4.2. For Pile diameter = 1200 mm

Borehole No.	Pile Length (m)	Load carrying Capacity (kN)		
		Compression	Uplift	Lateral Concrete M35*
P116A	25.00	4050	2100	95
	27.50	4000	2450	
	30.00	5600	2850	
	32.50	5950	3200	
	35.00	6300	3600	
P120A	25.00	4050	2150	85
	27.50	4300	2500	
	30.00	4600	2800	
	32.50	5500	3150	
	35.00	5600	3500	

** Indicates Grade of Concrete*

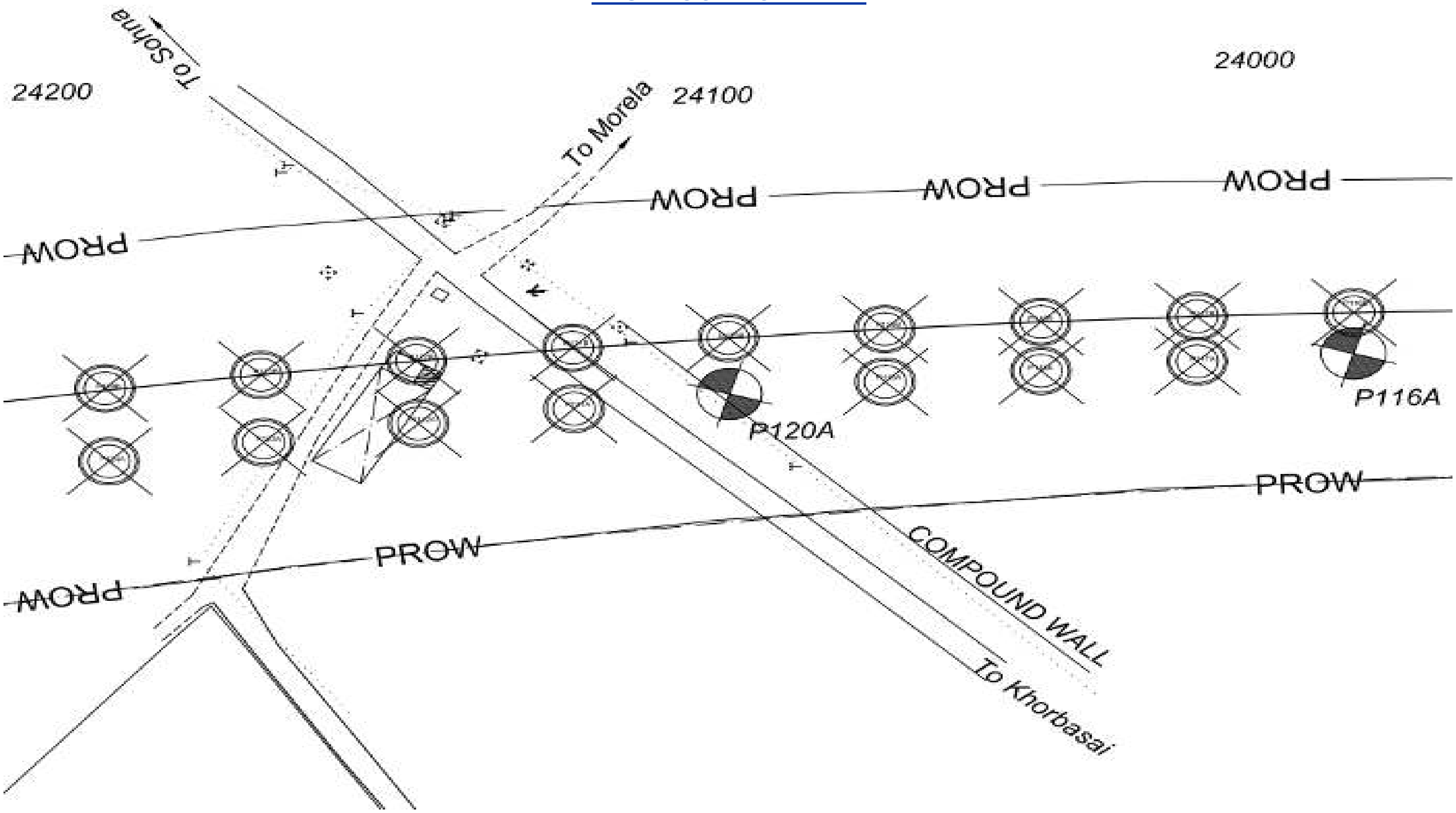
10.5. Liquefaction Potential: All the bore holes have been analysed for Liquefaction potential as per IS: 1893 (part-1)-2016-(RA: 2021) with Seismic Zone IV, earthquake intensity of 7.0 on Richter scale and critical ground water table at existing ground level. Out of which several boreholes show the potential at various depths mentioned in the table below:

Bore No.	Liquefiable depth zone (meter)
P116A	Top 4.00 & 5.00 to 6.00
P120A	Top 3.00 & 6.00 to 7.00

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech.(Civil), M.Tech.
Principal Consultant &
Managing Director

APPENDIX-A
TEST LOCATION PLAN



APPENDIX "B"
TABLE 1: SUMMARY OF TEST RESULTS

Bore No : P116A	**Ground Elevation : RL 195.485 m**	**Method of drilling :Percussion**	**Depth of Water : 1.90 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 31/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23961.447	**Casing Lowered : 24.00 m**	**Ending Date : 3/11/2023**	**Hammer type: Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	1	52	47	0	10.69	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	1.00	D	2	1	2	2	4	6.19	-	-	-	-	-	-	-	10.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	2.00	U	3	-	-	-	-	-	SM	1	0	0	53	46	0	10.24	1.96	1.78	Non Plastic			2.62	DST	4.0	27.2	-	0.472	-	-	-	-												
	3.00	D	4	2	3	4	7	8.74	-	-	-	-	-	-	-	18.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	3	4	5	9	10.68	CL-ML	0	0	1	31	63	5	19.54	-	-	25.0	20.5	4.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	5.00	U	6	-	-	-	-	-	ML	5	1	1	23	64	6	20.57	1.94	1.61	24.0	20.0	4.0	2.65	DST	7.0	25.2	0.114	0.646	-	0	20	-	Inorganic Silts of low plasticity											
	6.00	D	7	5	11	14	25	21.15	-	-	-	-	-	-	-	19.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	6	12	15	27	21.72	CL-ML	3	2	2	37	51	5	20.67	-	-	25.0	20.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	8.00	D	9	-	-	-	-	-	-	-	-	-	-	-	-	21.02	2.05	1.69	-	-	-	-	RDST	4.0	26.4	-	-	-	-	-	-												
	9.00	D	10	4	7	9	16	15.34	SM-SC	5	2	3	42	44	4	19.56	-	-	24.0	20.0	4.0	-	-	-	-	-	-	-	-	-	-	Silty Sands with clay binder											
	10.00	D	11	5	9	10	19	16.52	-	-	-	-	-	-	-	23.58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL-ML	1	0	3	8	79	9	23.33	2.02	1.64	28.5	22.0	6.5	2.66	UU	44.0	8.2	-	0.622	-	0	20	-	Inorganic Silty Clays of low plasticity											
	12.50	D	13	5	7	9	16	14.13	-	-	-	-	-	-	-	22.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	U	14	-	-	-	-	-	CL-ML	3	2	1	12	75	7	19.66	1.99	1.66	27.0	21.0	6.0	2.65	UU	40.0	10.2	-	0.596	-	-	-	-												
	15.50	D	15	8	15	21	36	22.26	ML	5	2	3	27	58	5	18.58	-	-	26.0	22.0	4.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	17.00	U	16	-	-	-	-	-	CL	7	3	2	9	68	11	19.16	2.05	1.72	27.0	20.0	7.0	2.67	UU	53.0	10.5	-	0.552	-	-	16	-	Inorganic clays of low plasticity											
	18.50	D	17	16	36	53	89	41.49	SM	0	0	1	54	45	0	20.44	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											

APPENDIX "B"
TABLE 1: SUMMARY OF TEST RESULTS

Bore No : P116A	**Ground Elevation : RL 195.485 m**	**Method of drilling :Percussion**	**Depth of Water : 1.90 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 31/10/2023**	**SPT Sampler: Standard**
Location / Chainage : 23961.447	**Casing Lowered : 24.00 m**	**Ending Date : 3/11/2023**	**Hammer type: Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	20.00	D	18	13	24	28	52	26.71	CL-ML	2	1	1	18	70	8	20.82	-	-	28.0	21.5	6.5	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	21.50	D	19	15	26	32	58	28.33	-	-	-	-	-	-	-	20.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.00	D	20	11	23	31	54	26.34	CL-ML	0	1	1	32	60	6	24.60	-	-	26.0	20.5	5.5	-	-	-	-	-	-	-	-	-	-												
	24.50	D	21	13	25	35	60	27.91	SM	0	0	0	58	42	0	17.99	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	26.00	D	22	24	32	42	74	32.04	-	-	-	-	-	-	-	19.65	-	-	-	-	-	2.65	-	-	-	-	-	-	-	-	-												
	27.50	D	23	23	30	43	73	31.13	SM	2	1	1	47	49	0	17.64	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	29.00	D	24	26	33	45	78	32.18	ML	4	2	3	40	51	0	16.00	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	30.50	D	25	27	37	43	80	32.22	SM	1	1	1	57	40	0	19.87	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	32.00	D	26	30	34	40	74	29.84	-	-	-	-	-	-	-	19.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	33.50	D	27	29	31	42	73	29.02	SM	0	1	2	52	45	0	21.74	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	35.00	D	28	32	35	44	79	30.27	SM	0	0	0	59	41	0	19.77	-	-	Non Plastic			2.65	-	-	-	-	-	-	-	-	-												
	36.50	D	29	33	36	42	78	29.50	-	-	-	-	-	-	-	18.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	30	32	40	72	27.37	SM	0	0	2	64	34	0	19.42	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	28	30	39	69	26.01	-	-	-	-	-	-	-	19.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No : P120A	**Ground Elevation : RL 196.008 m**	**Method of drilling :Percussion**	**Depth of Water : 5.00 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 18/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 24066.247	**Casing Lowered : 21.00 m**	**Ending Date : 21/11/2023**	**Hammer type: Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	ML	0	0	1	44	55	0	3.81	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	1.00	D	2	2	3	4	7	10.83	-	-	-	-	-	-	-	4.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	2.00	U	3	-	-	-	-	-	SM	4	2	2	47	45	0	11.08	1.96	1.76	Non Plastic			2.65	DST	3.0	26.5	-	0.506	-	-	-	-	Silty Sands											
	3.00	D	4	5	7	8	15	17.70	ML	3	0	1	35	61	0	11.70	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	4.00	D	5	3	5	6	11	11.92	-	-	-	-	-	-	-	11.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	5.00	U	6	-	-	-	-	-	ML	1	1	0	38	60	0	21.09	1.99	1.64	Non Plastic			2.64	DST	6.0	25.7	-	0.610	-	-	-	-												
	6.00	D	7	4	5	6	11	10.74	ML	0	1	2	30	67	0	19.71	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	7.00	D	8	4	6	8	14	13.26	-	-	-	-	-	-	-	20.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	8.00	U	9	-	-	-	-	-	CL	5	2	2	14	68	9	28.01	2.00	1.56	28.0	20.5	7.5	2.67	UU	44.0	12.3	0.135	0.712	-	10	18	-	Inorganic clays of low plasticity											
	9.00	D	10	5	10	18	28	20.03	CL	2	1	2	10	77	8	27.44	-	-	27.5	20.5	7.0	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	6	13	20	33	21.88	-	-	-	-	-	-	-	22.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	11.00	U	12	-	-	-	-	-	CL	6	3	3	9	68	11	22.40	2.06	1.68	29.0	20.5	8.5	2.68	UU	52.0	9.2	-	0.595	-	14	16	-												
	12.50	D	13	6	9	13	22	22.00	-	-	-	-	-	-	-	23.81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	14.00	D	14	-	-	-	-	-	-	-	-	-	-	-	-	22.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	15.50	D	15	10	12	13	25	17.02	CL-ML	7	2	1	22	61	7	18.24	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	17.00	U	16	-	-	-	-	-	CL	4	2	1	11	73	9	17.63	2.03	1.73	28.0	20.0	8.0	2.67	UU	48.0	11.7	-	0.543	-	-	-	-	Inorganic clays of low plasticity											
	18.50	D	17	12	14	18	32	32.00	-	-	-	-	-	-	-	15.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No : P120A	**Ground Elevation : RL 196.008 m**	**Method of drilling :Percussion**	**Depth of Water : 5.00 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 18/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 24066.247	**Casing Lowered : 21.00 m**	**Ending Date : 21/11/2023**	**Hammer type: Rope-pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	20.00	D	18	-	-	-	-	-	CL	12	4	4	14	56	10	15.43	1.99	1.72	29.0	22.0	7.0	-	RUU	43.0	12.1	-	-	-	-	-	-	Inorganic clays of low plasticity											
	21.50	D	19	13	15	21	36	36.00	CL	3	1	1	6	77	12	18.43	-	-	29.0	19.5	9.5	-	-	-	-	-	-	-	-	-	-												
	23.00	D	20	-	-	-	-	-	-	-	-	-	-	-	-	21.32	2.07	1.71	-	-	-	-	RUU	64.0	8.7	-	-	-	-	-	-												
	24.50	D	21	14	17	23	40	20.23	SM	0	0	0	55	45	0	20.70	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	26.00	D	22	-	-	-	-	-	-	-	-	-	-	-	-	20.13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	27.50	D	23	16	20	25	45	21.17	SM	0	0	1	62	37	0	21.07	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	29.00	U	24	-	-	-	-	-	SM	1	1	0	58	40	0	20.14	1.91	1.59	Non Plastic			2.61	DST	1.0	29.4	-	0.642	-	-	-	-												
	30.50	D	25	17	21	27	48	21.43	SM	0	1	2	55	42	0	20.30	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	32.00	D	26	-	-	-	-	-	-	-	-	-	-	-	-	21.00	2.09	1.73	-	-	-	-	RDST	0.0	28.6	-	-	-	-	-	-												
	33.50	D	27	22	30	36	66	25.67	SM	0	0	1	54	45	0	20.63	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	35.00	D	28	27	33	38	71	26.55	-	-	-	-	-	-	-	18.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	36.50	D	29	29	35	40	75	27.22	SM	4	2	1	44	49	0	17.73	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	38.00	D	30	28	32	42	74	26.58	-	-	-	-	-	-	-	15.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	31	46	56	-	R	-	CL-ML	4	2	2	24	61	7	14.68	-	-	26.0	20.0	6.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX-B

TABLE 3: UCS TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	UCS (kg/cm^2)
P116A	11.00	0.62
	14.00	0.49
	17.00	0.66
P120A	8.00	0.48
	11.00	0.59
	17.00	0.53

APPENDIX-C
PLOT 1: LITHOLOGICAL PROFILE-01

APPENDIX-C
PLOT 2: LITHOLOGICAL PLOTS

BH-P116A-23961.447

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands			0.50	D		-	-
			1.00	D	4	-	-
			2.00	U		-	-
			3.00	D	7	-	-
Inorganic Silty Clays of low plasticity	CL-ML		4.00	D	9	-	-
Inorganic Silts of low plasticity	ML		5.00	U		-	-
			6.00	D	25	-	-
Inorganic Silty Clays of low plasticity	CL-ML		7.00	D	27	-	-
			8.00	D		-	-
Silty Sands with clay binder	SM-SC		9.00	D	16	-	-
			10.00	D	19	-	-
Inorganic Silty Clays of low plasticity	CL-ML		11.00	U		-	-
			12.50	D	16	-	-
			14.00	U		-	-
Inorganic Silts of low plasticity	ML		15.50	D	36	-	-
Inorganic clays of low plasticity	CL		17.00	U		-	-
Silty Sands	SM		18.50	D	89	-	-
			20.00	D	52	-	-

BH-P116A-23961.447

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silty Clays of low plasticity	CL-ML		20.00	D	52	-	-
			21.50	D	58	-	-
			23.00	D	54	-	-
Silty Sands	SM		24.50	D	60	-	-
			26.00	D	74	-	-
			27.50	D	73	-	-
Inorganic Silts of low plasticity	ML		29.00	D	78	-	-
Silty Sands	SM		30.50	D	80	-	-
			32.00	D	74	-	-
			33.50	D	71	-	-
			35.00	D	79	-	-
			36.50	D	78	-	-
			38.00	D	72	-	-
			40.00	D	69	-	-

APPENDIX-C
PLOT 3: LITHOLOGICAL PLOTS

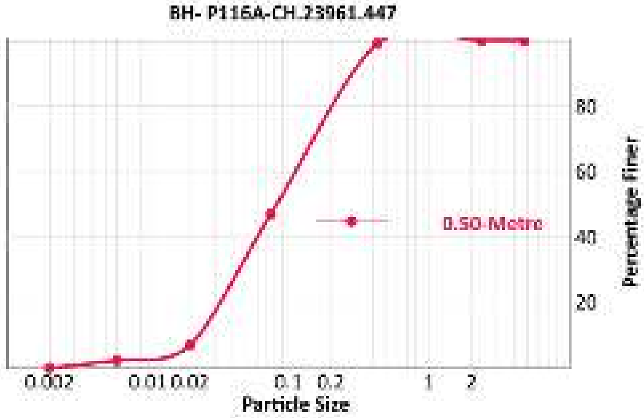
BH-P120A-24066.247

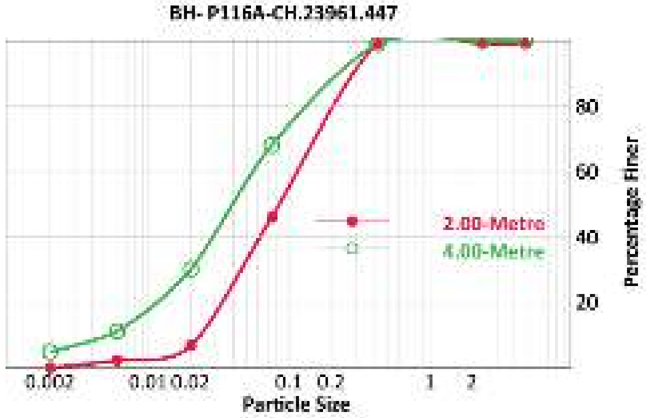
DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic Silts of low plasticity	ML		0.50	D		-	-
			1.00	D	7	-	-
Silty Sands	SM		2.00	U		-	-
Inorganic Silts of low plasticity	ML		3.00	D	15	-	-
			4.00	D	11	-	-
			5.00	U		-	-
			6.00	D	11	-	-
			7.00	D	14	-	-
			8.00	U		-	-
Inorganic clays of low plasticity	CL		9.00	D	28	-	-
			10.00	U	33	-	-
			11.00	U		-	-
			12.50	D	22	-	-
			14.00	D		-	-
			15.50	D	25	-	-
Inorganic Silty Clays of low plasticity	CL-ML		17.00	U		-	-
Inorganic clays of low plasticity	CL		18.50	D	32	-	-
			20.00	D		-	-

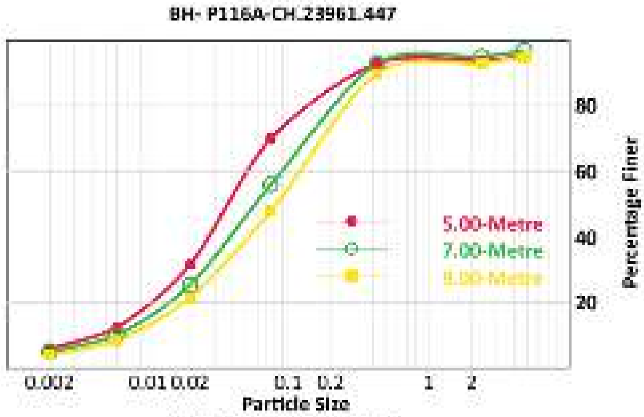
BH-P120A-24066.247

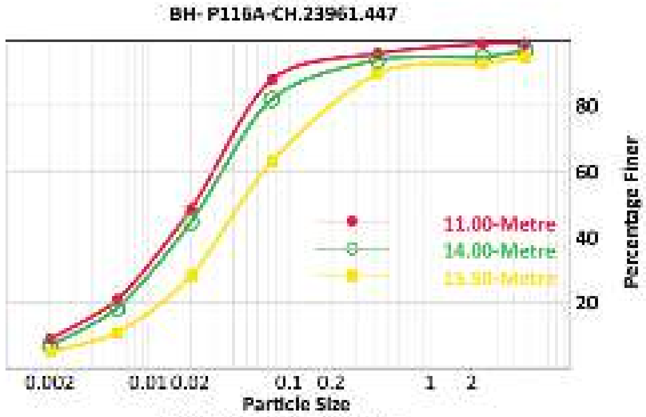
DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.00	D		-	-
			21.50	D	36	-	-
			23.00	D		-	-
Silty Sands	SM		24.50	D	40	-	-
			26.00	D		-	-
			27.50	D	45	-	-
			29.00	U		-	-
			30.50	D	48	-	-
			32.00	D		-	-
			33.50	D	66	-	-
			35.00	D	71	-	-
			36.50	D	75	-	-
			38.00	D	74	-	-
			40.00	D	R	-	-

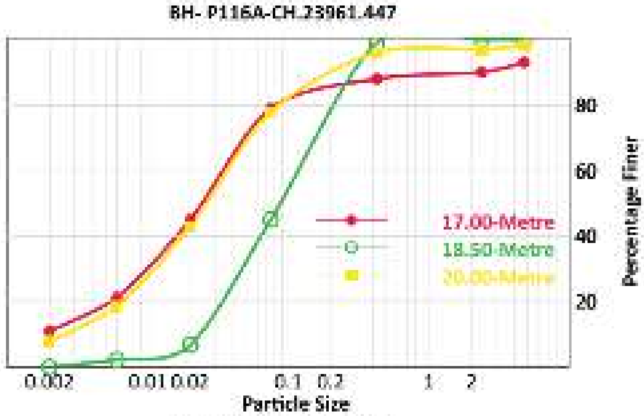
APPENDIX-D
PLOT 1: GRAIN SIZE DISTRIBUTION PLOTS

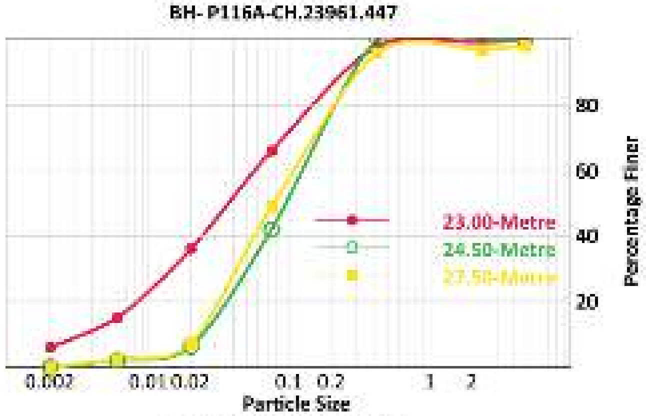


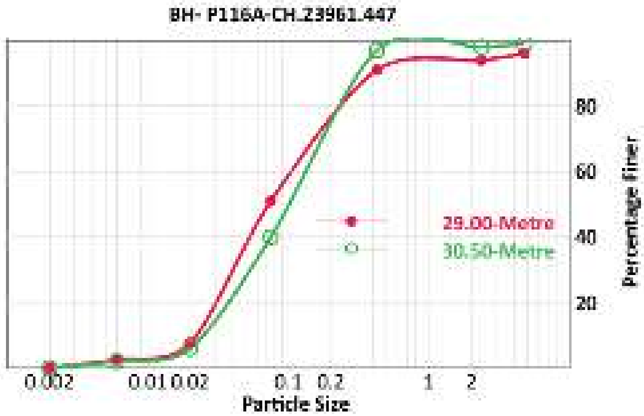


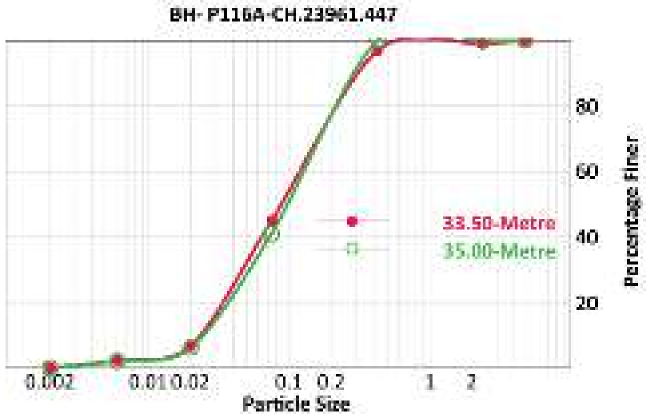












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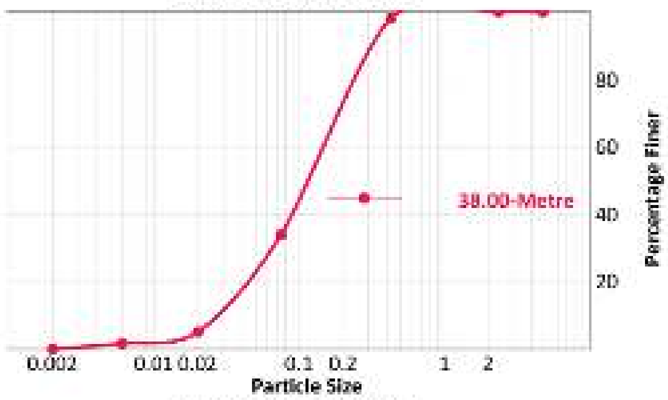
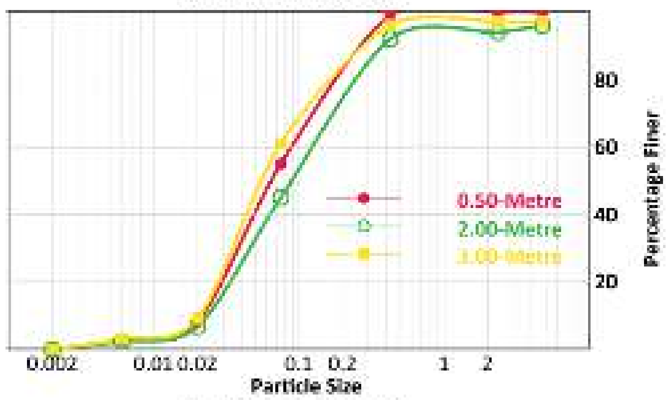
APPENDIX-D
PLOT 2: GRAIN SIZE DISTRIBUTION PLOTS

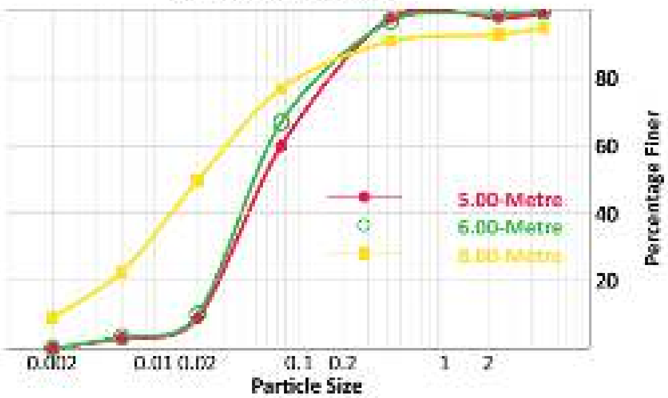
BH- P116A-CH.23961.447



BH- P120A-CH.24066.247



BH- P120A-CH.24066.247



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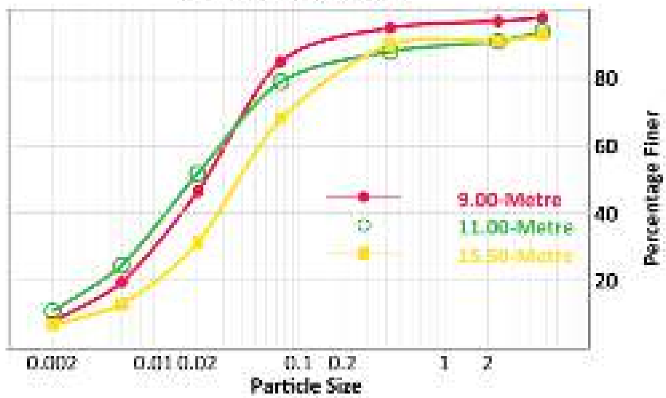

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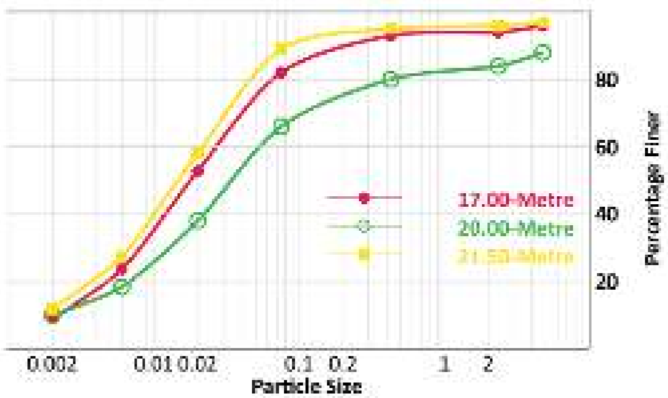

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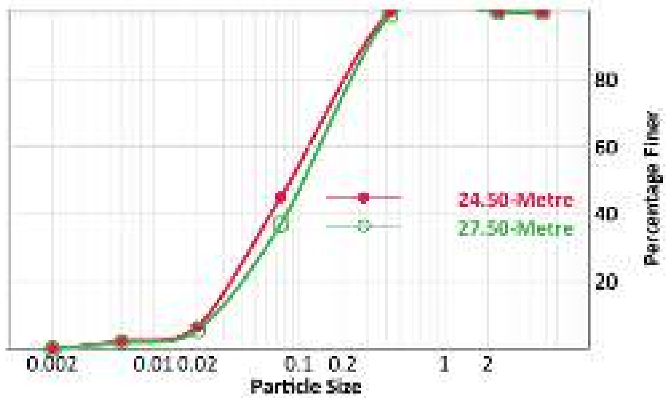

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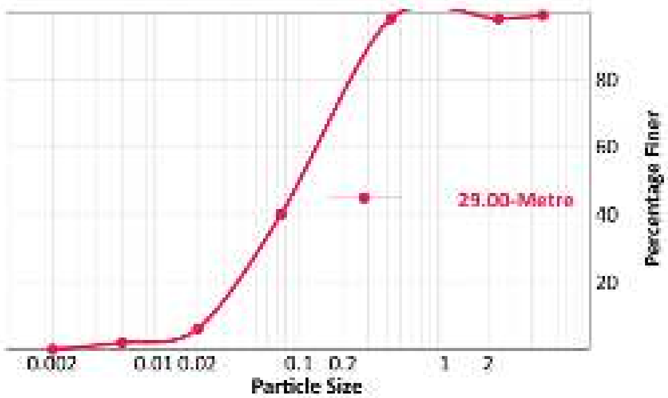
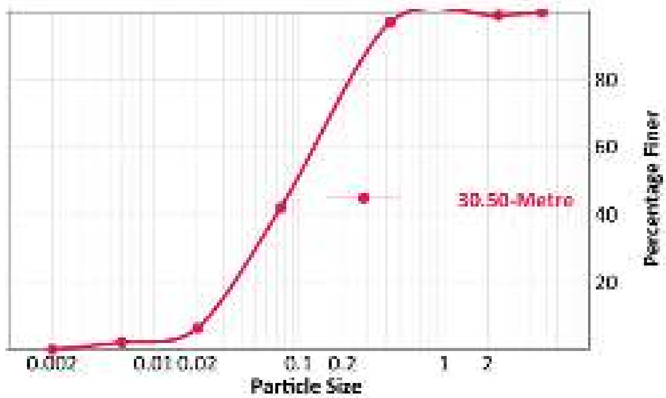
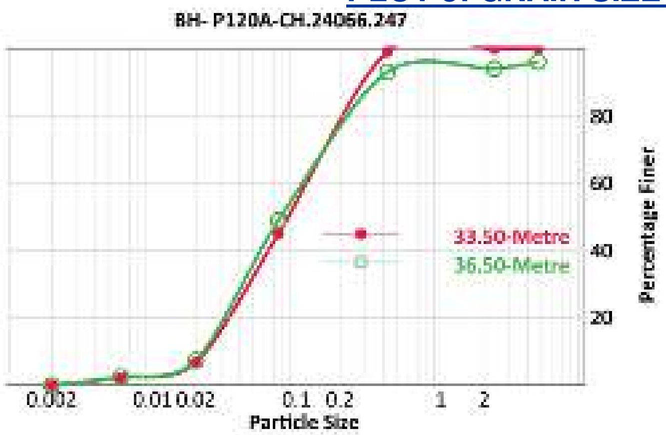


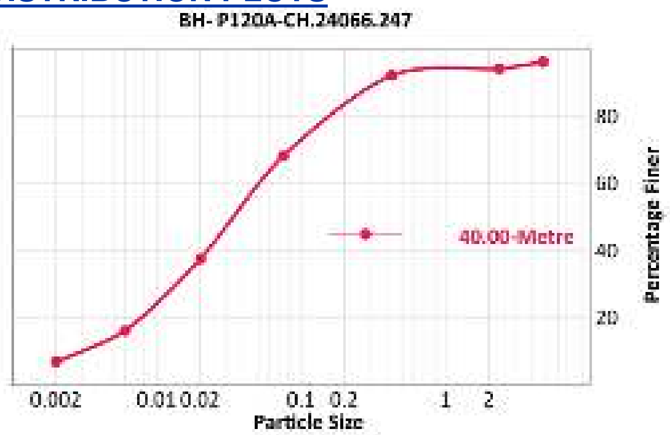
BH- P120A-CH.24066.247



APPENDIX-D

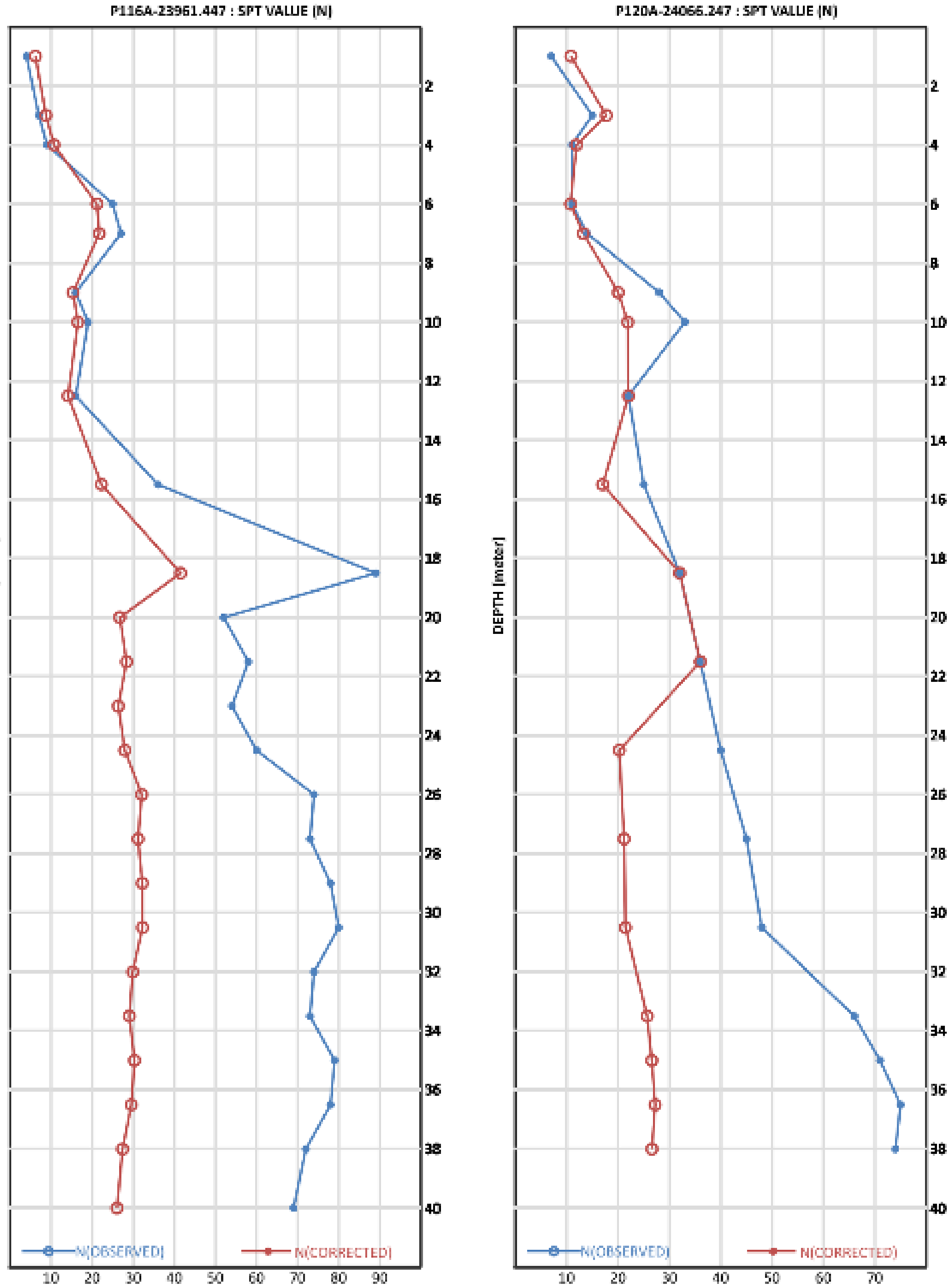
PLOT 3: GRAIN SIZE DISTRIBUTION PLOTS



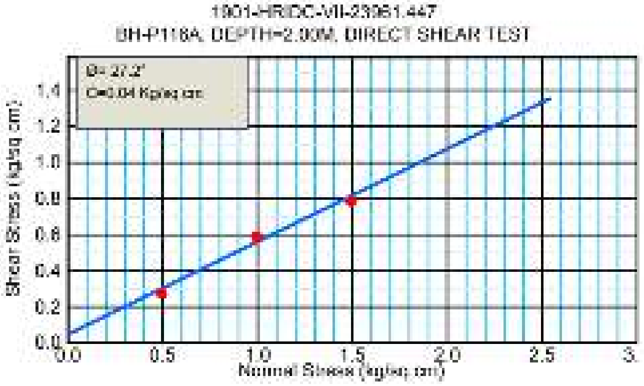


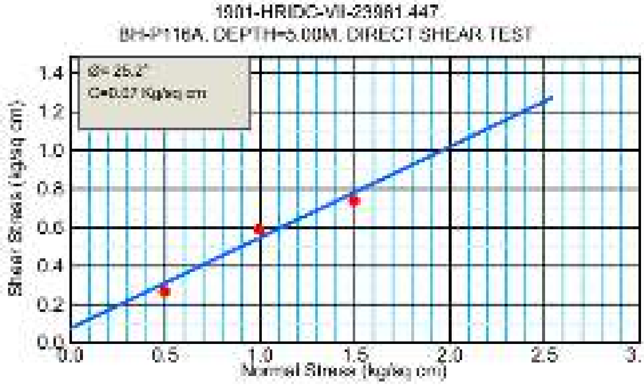
APPENDIX-E

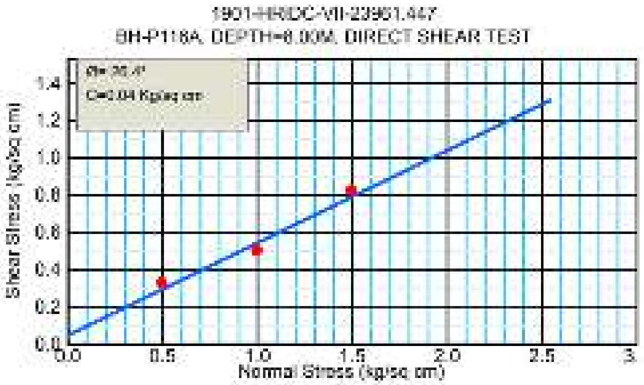
PLOT 1: RECORDED SPT Vs CORRECTED SPT

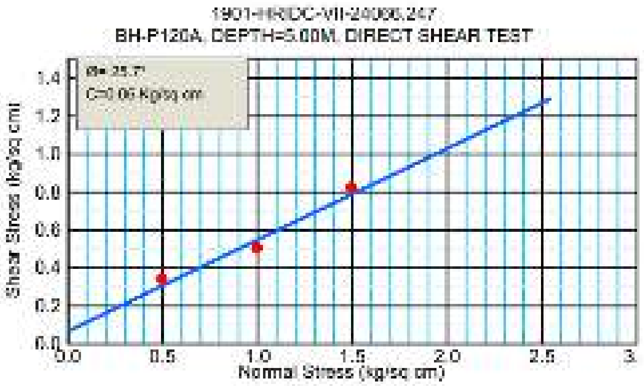


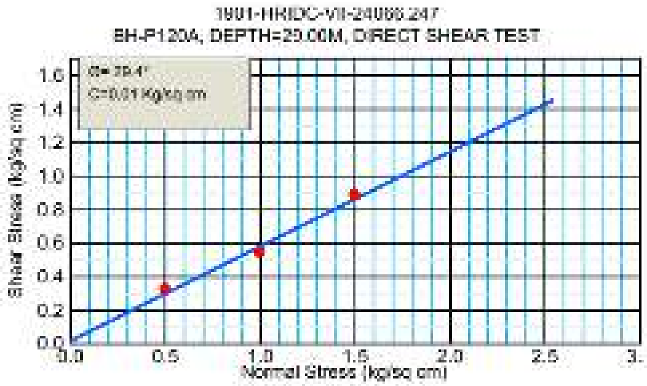
APPENDIX-F
GRAPH 1: DST GRAPH

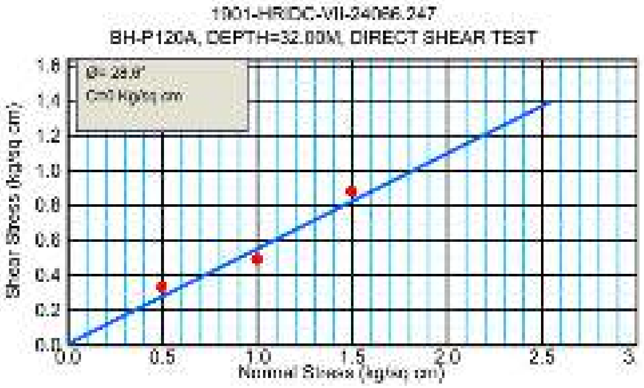




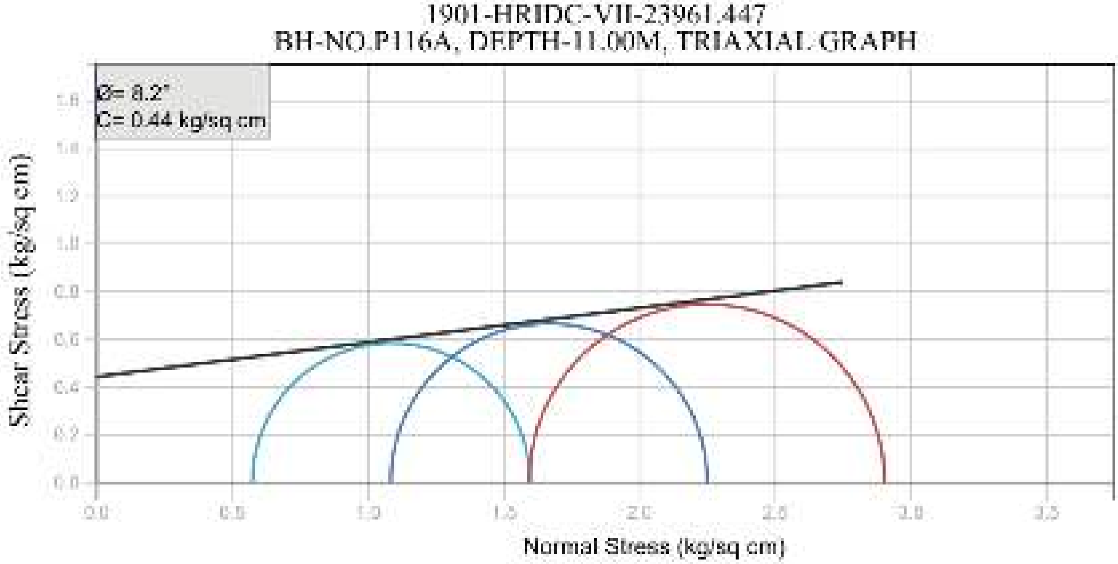


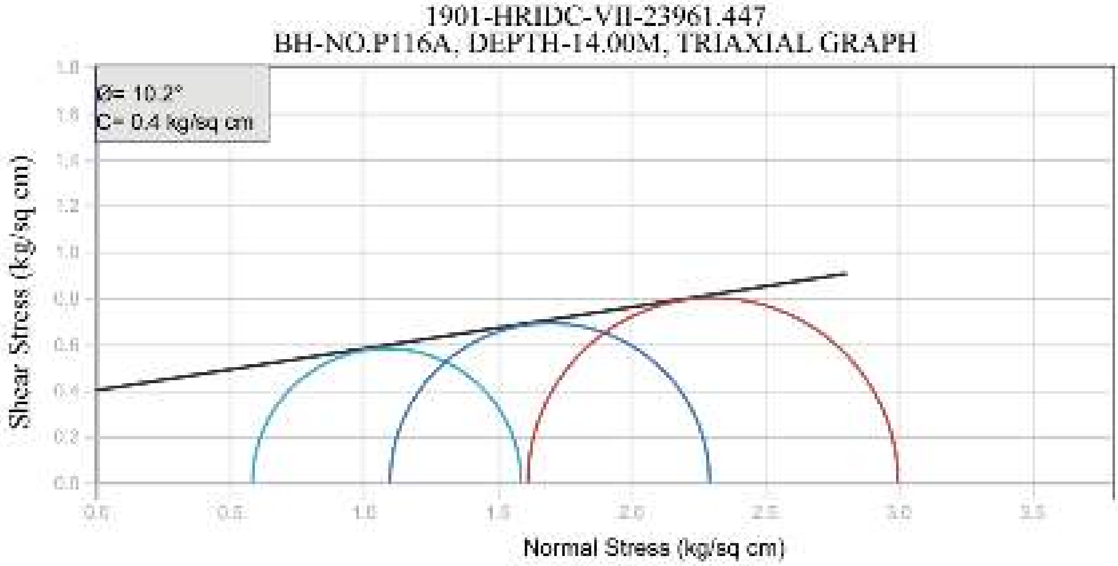


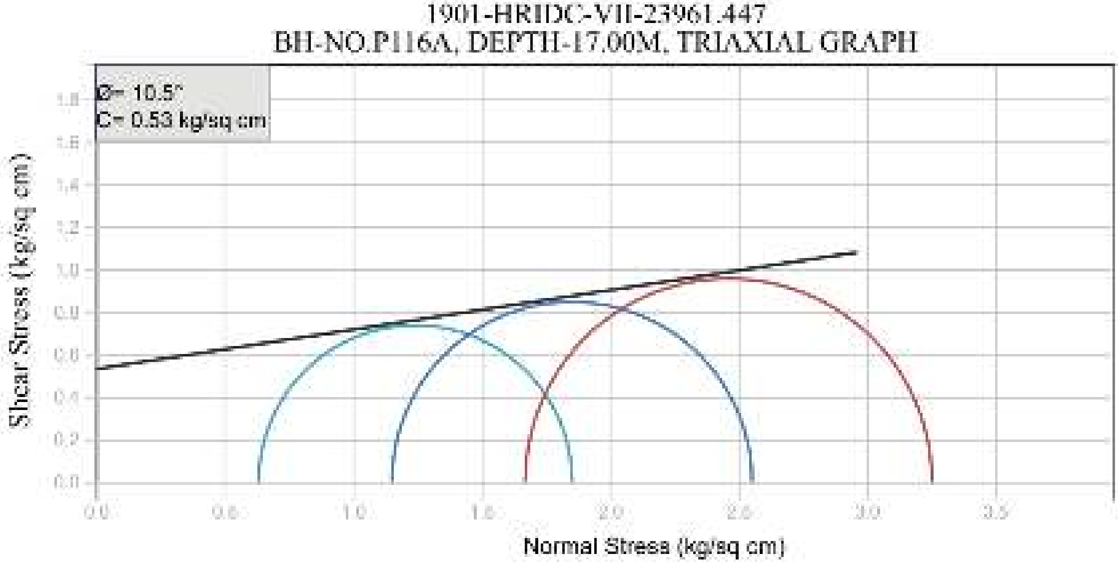




APPENDIX-G
GRAPH 1: UU GRAPH

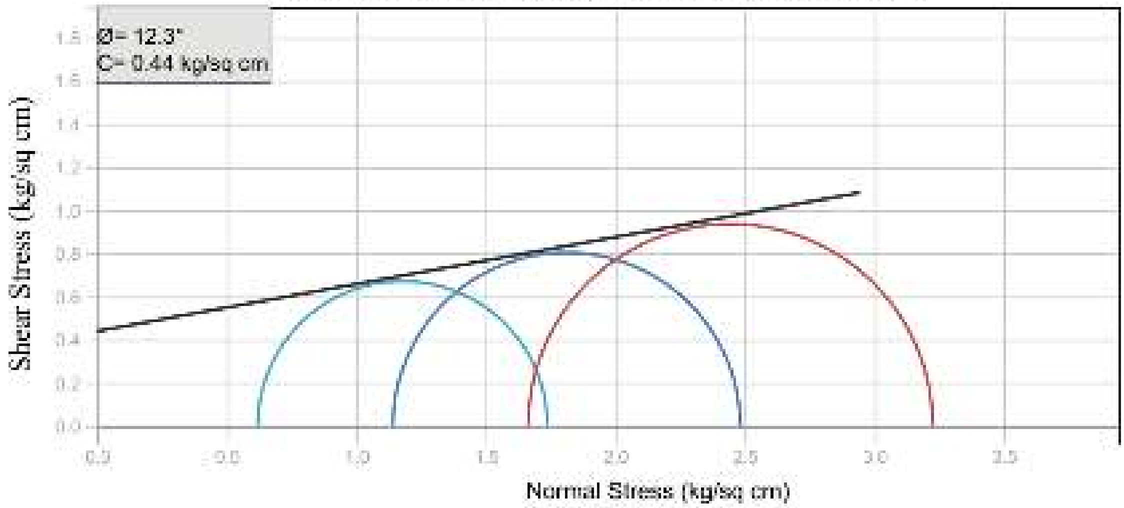




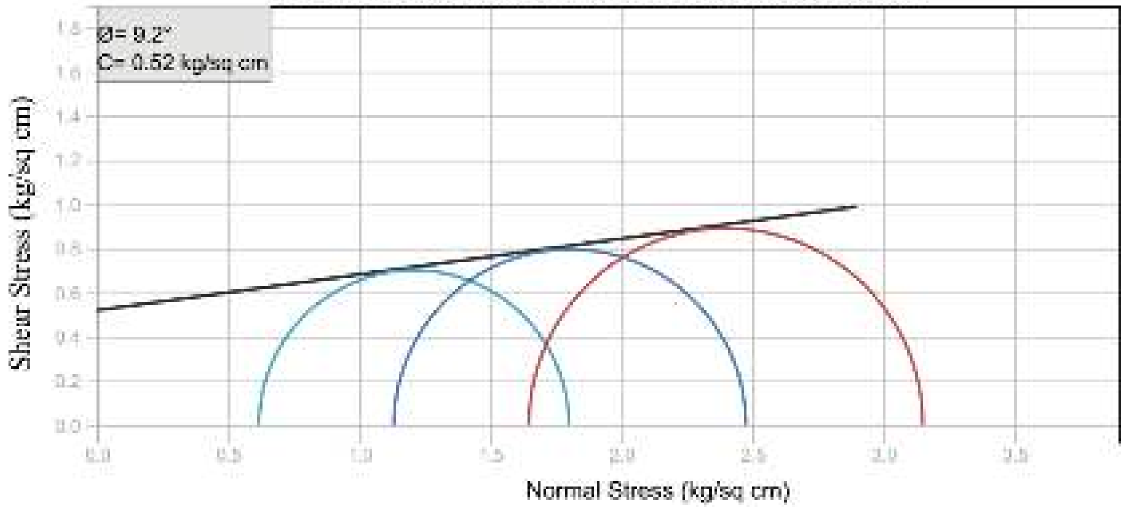


APPENDIX-G
GRAPH 2: UU GRAPH

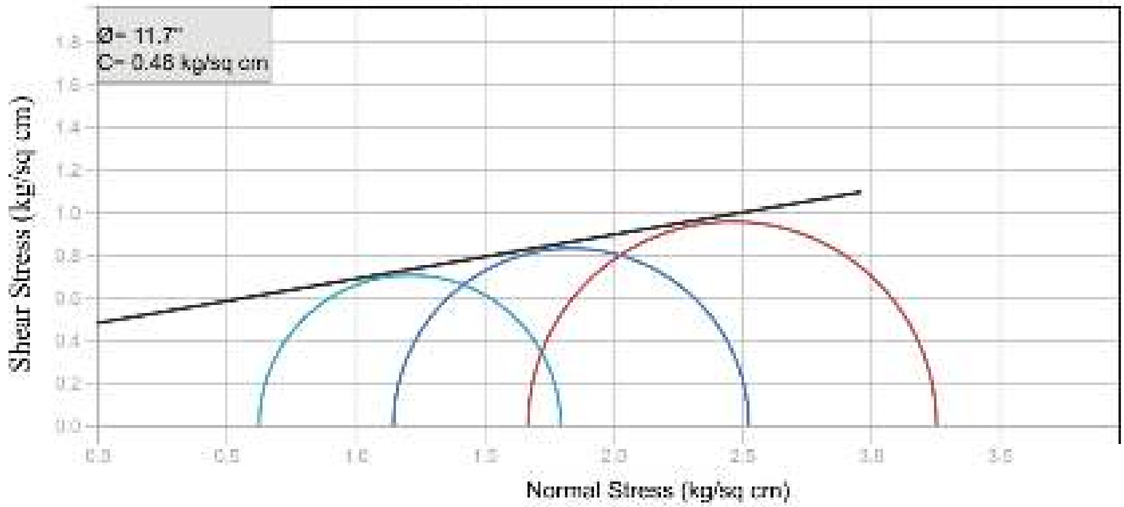
1901-HRIDC-VII-24066.247
BH-NO.P120A, DEPTH-8.00M, TRIAXIAL GRAPH



1901-HRIDC-VII-24066.247
BH-NO.P120A, DEPTH-11.00M, TRIAXIAL GRAPH

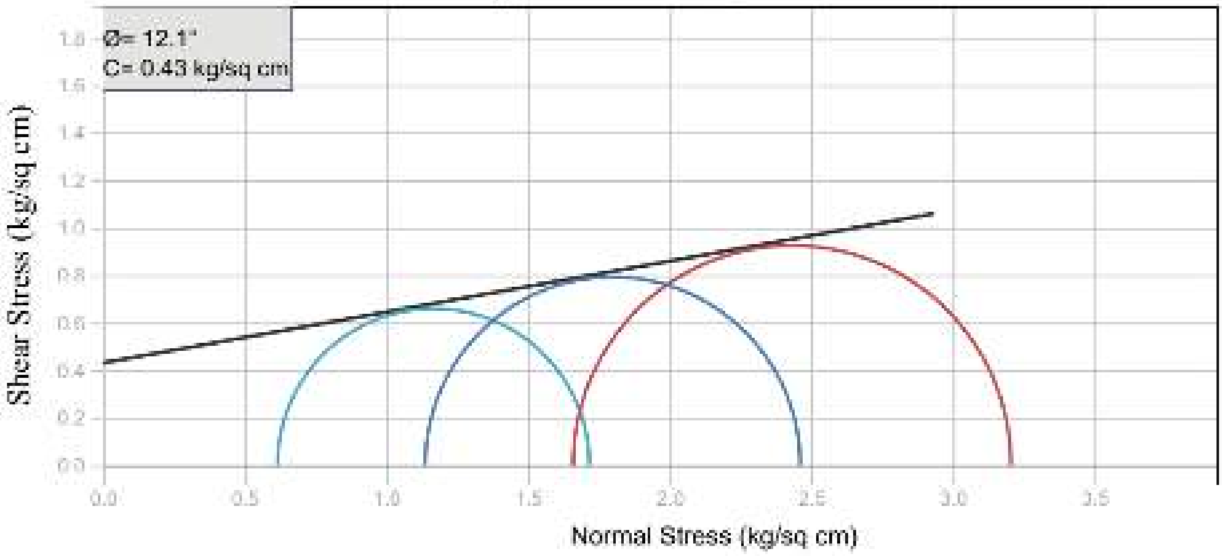


1901-HRIDC-VII-24066.247
BH-NO.P120A, DEPTH-17.00M, TRIAXIAL GRAPH

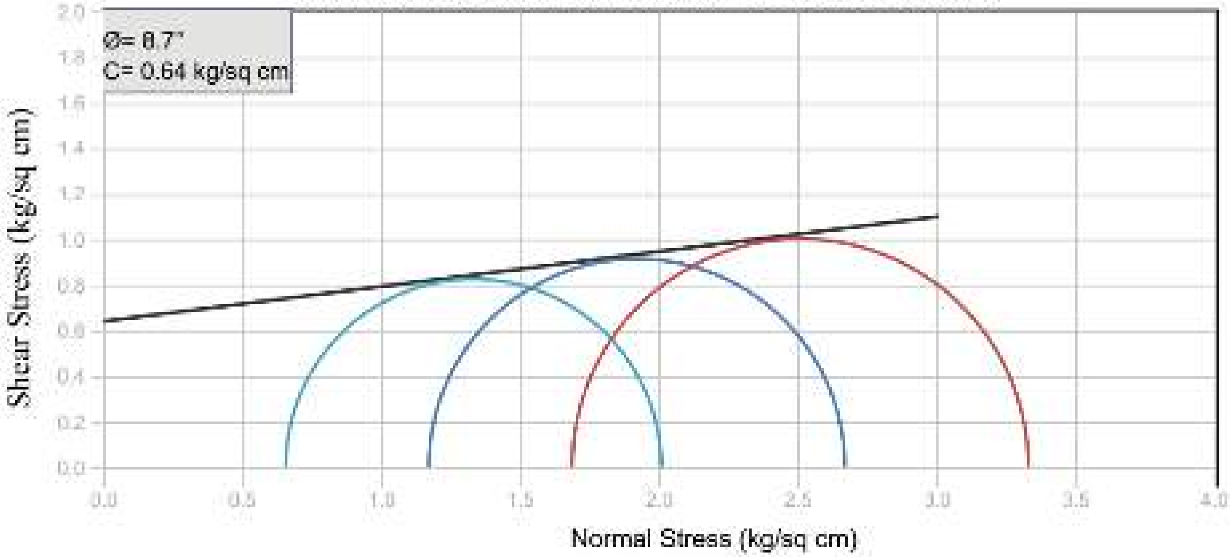


APPENDIX-G
GRAPH 3: RUU GRAPH

1901-HRIDC-VII-24066.247
BH-NO.P120A, DEPTH-20.00M, TRIAXIAL GRAPH



1901-HRIDC-VII-24066.247
BH-NO.P120A, DEPTH-23.00M, TRIAXIAL GRAPH



APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: P116A, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.62	9.62	26.46	1.57	27.2	27.2	1.0	21.37	0	4	1.0	6.3	0	3.0	25.2	0	9.62	10.45	11.34	28.9	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.62	9.62	33.67	3.14	25.2	25.2	1.0	49.80	0	0	1.0	0.0	0	4.0	25.2	7	9.62	10.45	11.34	38.5	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	5.00	4.50	1.00	2.50	19.62	9.62	43.29	3.14	25.2	25.2	1.0	64.02	0	7	1.0	22.0	0	5.0	25.2	7	9.41	10.45	11.34	48.1	0	0.0	29.5	29.5	**0.00**	**9.82**
5.00	6.00	5.50	1.00	3.50	19.41	9.41	52.81	3.14	25.2	25.2	1.0	78.09	0	7	1.0	22.0	0	6.0	26.4	4	9.41	13.15	14.11	57.5	674.8	674.8	41.3	41.3	**269.90**	**13.75**
6.00	7.00	6.50	1.00	4.50	19.41	9.41	62.22	3.14	26.4	26.4	1.0	97.06	97.06	4	1.0	12.6	12.57	7.0	26.4	4	10.45	13.15	14.11	66.9	777.8	887.4	53.0	162.7	**354.96**	**54.22**
7.00	9.00	8.00	2.00	6.50	20.45	10.45	77.37	6.29	26.4	26.4	1.0	241.41	338.48	4	1.0	25.1	37.71	9.0	25.4	0	10.45	10.90	11.80	87.8	800.6	1176.8	76.6	452.8	**470.72**	**150.93**
9.00	10.00	9.50	1.00	7.50	20.45	10.45	93.05	3.14	25.4	25.4	1.0	138.85	477.33	0	1.0	0.0	37.71	10.0	25.4	0	10.45	10.90	11.80	98.3	890.1	1405.2	88.4	603.4	**562.07**	**201.15**
10.00	11.00	10.50	1.00	8.50	20.45	10.45	103.50	3.14	25.4	25.4	1.0	154.45	631.78	0	1.0	0.0	37.71	11.0	8.2	44	10.23	2.15	0.94	108.7	498.2	1167.7	100.2	769.7	**467.10**	**256.56**
11.00	12.50	11.75	1.50	10.00	20.23	10.23	116.39	4.71	8.2	8.2	1.0	79.07	710.85	44	1.0	207.4	245.14	12.5	8.2	44	9.86	2.15	0.94	124.1	524.0	1480.0	117.9	1073.9	**591.99**	**357.95**
12.50	15.50	14.00	3.00	13.00	19.86	9.86	138.86	9.43	8.2	8.2	1.0	188.66	899.51	44	1.0	414.9	660.00	15.5	16.7	24	9.86	4.78	3.58	124.1	649.2	2208.7	153.2	1712.7	**883.48**	**570.91**
15.50	17.00	16.25	1.50	14.50	19.86	9.86	138.86	4.71	16.7	16.7	1.0	196.39	1095.90	24	1.0	113.1	773.14	17.0	10.5	53	10.50	2.62	1.36	124.1	635.5	2504.6	170.9	2039.9	**1001.82**	**679.98**
17.00	18.50	17.75	1.50	16.00	20.50	10.50	138.86	4.71	10.5	10.5	1.0	121.32	1217.22	53	1.0	249.9	1023.00	18.5	30.4	0	10.50	23.27	24.45	124.1	2369.6	4609.9	188.6	2428.8	**1843.95**	**809.60**
18.50	20.00	19.25	1.50	17.50	20.50	10.50	138.86	4.71	30.4	30.4	1.0	391.73	1608.96	0	1.0	0.0	1023.00	20.0	11.0	38	10.50	2.76	1.51	124.1	544.4	3176.3	206.3	2838.2	**1270.53**	**946.07**
20.00	21.50	20.75	1.50	19.00	20.50	10.50	138.86	4.71	11.0	11.0	1.0	127.24	1736.20	38	1.0	179.1	1202.14	21.5	11.0	38	9.26	2.76	1.51	124.1	543.6	3482.0	223.9	3162.3	**1392.79**	**1054.09**
21.50	23.00	22.25	1.50	20.50	19.26	9.26	138.86	4.71	11.0	11.0	1.0	127.24	1863.44	38	1.0	179.1	1381.29	23.0	17.0	32	9.94	4.92	3.75	124.1	720.9	3965.6	241.6	3486.3	**1586.25**	**1162.11**
23.00	24.50	23.75	1.50	22.00	19.94	9.94	138.86	4.71	17.0	17.0	1.0	200.13	2063.57	32	1.0	150.9	1532.14	24.5	31.4	0	8.88	28.31	29.58	124.1	2863.0	6458.7	259.3	3855.0	**2583.49**	**1285.00**
24.50	26.00	25.25	1.50	23.50	18.88	8.88	138.86	4.71	31.4	31.4	1.1	427.54	2491.11	0	1.0	0.0	1532.14	26.0	31.4	0	9.14	28.31	29.58	124.1	2866.0	6889.3	277.0	4300.2	**2755.72**	**1433.41**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
26.00	27.50	26.75	1.50	25.00	19.14	9.14	138.86	4.71	31.4	31.4	1.1	427.54	2918.66	0	1.0	0.0	1532.14	27.5	30.0	0	8.82	21.26	22.40	124.1	2150.0	6600.8	294.6	4745.4	**2640.31**	**1581.81**
27.50	29.00	28.25	1.50	26.50	18.82	8.82	138.86	4.71	30.0	30.0	1.0	377.93	3296.59	0	1.0	0.0	1532.14	29.0	27.4	10	8.56	15.40	16.41	124.1	1627.5	6456.3	312.3	5141.1	**2582.50**	**1713.68**
29.00	30.00	29.50	1.00	27.50	18.56	8.56	138.86	3.14	27.4	27.4	1.0	226.21	3522.80	10	1.0	31.4	1563.57	30.0	27.4	10	8.56	15.40	16.41	124.1	1627.5	6713.9	324.1	5410.5	**2685.56**	**1803.49**
30.00	30.50	30.25	0.50	28.00	18.56	8.56	138.86	1.57	27.4	27.4	1.0	113.10	3635.90	10	1.0	15.7	1579.29	30.5	31.8	0	9.18	30.33	31.63	124.1	3070.3	8285.5	330.0	5545.2	**3314.20**	**1848.40**
30.50	32.00	31.25	1.50	29.50	19.18	9.18	138.86	4.71	31.8	31.8	1.1	442.40	4078.30	0	1.0	0.0	1579.29	32.0	31.8	0	9.12	30.33	31.63	124.1	3069.6	8727.2	347.7	6005.3	**3490.86**	**2001.76**
32.00	32.50	32.25	0.50	30.00	19.12	9.12	138.86	1.57	31.8	31.8	1.1	147.47	4225.77	0	1.0	0.0	1579.29	32.5	31.8	0	9.12	30.33	31.63	124.1	3069.6	8874.6	353.6	6158.6	**3549.85**	**2052.88**
32.50	33.50	33.00	1.00	31.00	19.12	9.12	138.86	3.14	31.8	31.8	1.1	294.93	4520.70	0	1.0	0.0	1579.29	33.5	30.8	0	9.48	25.29	26.50	124.1	2563.9	8663.9	365.4	6465.3	**3465.56**	**2155.11**
33.50	35.00	34.25	1.50	32.50	19.48	9.48	138.86	4.71	30.8	30.8	1.0	405.83	4926.53	0	1.0	0.0	1579.29	35.0	31.6	0	9.16	29.32	30.60	124.1	2968.2	9474.0	383.0	6888.9	**3789.59**	**2296.28**
35.00	36.50	35.75	1.50	34.00	19.16	9.16	138.86	4.71	31.6	31.6	1.1	434.93	5361.46	0	1.0	0.0	1579.29	36.5	31.6	0	9.02	29.32	30.60	124.1	2966.5	9907.2	400.7	7341.5	**3962.89**	**2447.15**
36.50	37.50	37.00	1.00	35.00	19.02	9.02	138.86	3.14	31.6	31.6	1.1	289.95	5651.42	0	1.0	0.0	1579.29	37.5	31.4	0	9.02	28.31	29.58	124.1	2864.6	10095.3	412.5	7643.2	**4038.14**	**2547.73**
37.50	38.00	37.75	0.50	35.50	19.02	9.02	138.86	1.57	31.4	31.4	1.1	142.51	5793.93	0	1.0	0.0	1579.29	38.0	32.0	0	9.11	31.33	32.65	124.1	3171.3	10544.5	418.4	7791.6	**4217.82**	**2597.20**
38.00	40.00	39.00	2.00	37.50	19.11	9.11	138.86	6.29	32.0	32.0	1.1	599.93	6393.86	0	1.0	0.0	1579.29	40.0	30.0	0	10.49	21.26	22.40	124.1	2164.7	10137.8	442.0	8415.1	**4055.13**	**2805.04**
BORE NO: P120A, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.55	9.55	26.26	1.57	26.5	26.5	1.0	20.58	0	3	1.0	4.7	0	3.0	25.7	6	9.55	11.58	12.49	28.7	0	0.0	5.9	5.9	**0.00**	**1.96**
3.00	4.00	3.50	1.00	1.50	19.55	9.55	33.43	3.14	25.7	25.7	1.0	50.56	0	6	1.0	18.9	0	4.0	25.7	6	9.86	11.58	12.49	38.2	0	0.0	17.7	17.7	**0.00**	**5.89**
4.00	6.00	5.00	2.00	3.50	19.86	9.86	48.06	6.29	25.7	25.7	1.0	145.39	0	6	1.0	37.7	0	6.0	25.7	6	9.86	11.58	12.49	57.9	0	0.0	41.3	41.3	**0.00**	**13.75**
6.00	7.00	6.50	1.00	4.50	19.86	9.86	62.85	3.14	25.7	25.7	1.0	95.06	0	6	1.0	18.9	0	7.0	25.7	6	9.86	11.58	12.49	67.8	707.3	707.3	53.0	53.0	**282.93**	**17.68**
7.00	8.00	7.50	1.00	5.50	19.86	9.86	72.71	3.14	25.7	25.7	1.0	109.98	109.98	6	1.0	18.9	18.86	8.0	12.3	44	9.97	3.15	1.88	77.6	510.4	639.2	64.8	193.7	**255.69**	**64.55**

APPENDIX-H

TABLE 1: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
8.00	9.00	8.50	1.00	6.50	19.97	9.97	82.63	3.14	12.3	12.3	1.0	56.62	166.60	44	1.0	138.3	157.14	9.0	9.2	52	9.97	2.33	1.10	87.6	532.1	855.9	76.6	400.3	**342.35**	**133.45**
9.00	10.00	9.50	1.00	7.50	19.97	9.97	92.60	3.14	9.2	9.2	1.0	47.13	213.73	52	1.0	163.4	320.57	10.0	9.2	52	10.56	2.33	1.10	97.6	550.6	1084.9	88.4	622.7	**433.96**	**207.57**
10.00	12.50	11.25	2.50	10.00	20.56	10.56	110.78	7.86	9.2	9.2	1.0	140.98	354.71	52	1.0	408.6	729.14	12.5	9.2	52	10.56	2.33	1.10	124.0	598.8	1682.7	117.9	1201.7	**673.08**	**400.57**
12.50	15.50	14.00	3.00	13.00	20.56	10.56	139.82	9.43	9.2	9.2	1.0	213.52	568.23	52	1.0	490.3	1219.43	15.5	12.0	29	10.35	3.06	1.79	124.0	510.2	2297.9	153.2	1940.9	**919.16**	**646.96**
15.50	17.00	16.25	1.50	14.50	20.35	10.35	139.82	4.71	12.0	12.0	1.0	140.11	708.33	29	1.0	136.7	1356.14	17.0	11.7	48	10.35	2.97	1.71	124.0	635.7	2700.1	170.9	2235.4	**1080.06**	**745.12**
17.00	18.50	17.75	1.50	16.00	20.35	10.35	139.82	4.71	11.7	11.7	1.0	136.50	844.84	48	1.0	226.3	1582.43	18.5	11.7	48	9.85	2.97	1.71	124.0	635.3	3062.6	188.6	2615.8	**1225.04**	**871.95**
18.50	21.50	20.00	3.00	19.00	19.85	9.85	139.82	9.43	11.7	11.7	1.0	273.01	1117.84	48	1.0	452.6	2035.00	21.5	8.7	64	10.75	2.24	1.02	124.0	674.7	3827.5	223.9	3376.8	**1531.01**	**1125.59**
21.50	24.50	23.00	3.00	22.00	20.75	10.75	139.82	9.43	8.7	8.7	1.0	201.73	1319.57	64	1.0	603.4	2638.43	24.5	28.1	0	10.75	16.98	18.02	124.0	1730.3	5688.3	259.3	4217.3	**2275.31**	**1405.76**
24.50	27.50	26.00	3.00	25.00	20.75	10.75	139.82	9.43	28.1	28.1	1.0	703.91	2023.48	0	1.0	0.0	2638.43	27.5	29.5	0	9.10	20.13	21.25	124.0	2037.2	6699.1	294.6	4956.6	**2679.66**	**1652.18**
27.50	30.00	28.75	2.50	27.50	19.10	9.10	139.82	7.86	29.5	29.5	1.0	621.55	2645.03	0	1.0	0.0	2638.43	30.0	29.0	0	9.10	19.01	20.10	124.0	1923.4	7206.9	324.1	5607.6	**2882.76**	**1869.19**
30.00	30.50	30.25	0.50	28.00	19.10	9.10	139.82	1.57	29.0	29.0	1.0	121.79	2766.82	0	1.0	0.0	2638.43	30.5	28.6	0	9.10	18.11	19.17	124.0	1832.4	7237.6	330.0	5735.3	**2895.06**	**1911.75**
30.50	32.50	31.50	2.00	30.00	19.10	9.10	139.82	6.29	28.6	28.6	1.0	479.17	3246.00	0	1.0	0.0	2638.43	32.5	28.6	0	10.93	18.11	19.17	124.0	1846.2	7730.6	353.6	6238.0	**3092.24**	**2079.33**
32.50	33.50	33.00	1.00	31.00	20.93	10.93	139.82	3.14	28.6	28.6	1.0	239.59	3485.58	0	1.0	0.0	2638.43	33.5	30.4	0	10.93	23.27	24.45	124.0	2372.2	8496.2	365.4	6489.4	**3398.49**	**2163.12**
33.50	35.00	34.25	1.50	32.50	20.93	10.93	139.82	4.71	30.4	30.4	1.0	394.46	3880.04	0	1.0	0.0	2638.43	35.0	30.6	0	10.93	24.28	25.48	124.0	2474.8	8993.2	383.0	6901.5	**3597.29**	**2300.50**
35.00	36.50	35.75	1.50	34.00	20.93	10.93	139.82	4.71	30.6	30.6	1.0	401.52	4281.56	0	1.0	0.0	2638.43	36.5	29.8	0	8.84	20.81	21.94	124.0	2103.3	9023.3	400.7	7320.7	**3609.30**	**2440.23**
36.50	37.50	37.00	1.00	35.00	18.84	8.84	139.82	3.14	29.8	29.8	1.0	251.67	4533.22	0	1.0	0.0	2638.43	37.5	29.6	0	8.84	20.36	21.48	124.0	2057.8	9229.4	412.5	7584.2	**3691.78**	**2528.05**
37.50	38.00	37.75	0.50	35.50	18.84	8.84	139.82	1.57	29.6	29.6	1.0	124.82	4658.04	0	1.0	0.0	2638.43	38.0	30.0	0	8.48	21.26	22.40	124.0	2145.6	9442.0	418.4	7714.9	**3776.82**	**2571.62**
38.00	40.00	39.00	2.00	37.50	18.48	8.48	139.82	6.29	30.0	30.0	1.0	507.42	5165.45	0	1.0	0.0	2638.43	40.0	0.0	0	0.00	1.00	0.00	124.0	97.4	7901.3	442.0	8245.8	**3160.52**	**2748.62**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. N_γ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	N_γ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
BORE NO: P116A, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.62	9.62	26.46	1.89	27.2	27.2	1.0	25.64	0	4	1.0	7.5	0	3.0	25.2	0	9.62	10.45	11.34	28.9	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.62	9.62	33.67	3.77	25.2	25.2	1.0	59.75	0	0	1.0	0.0	0	4.0	25.2	7	9.62	10.45	11.34	38.5	0	0.0	25.5	25.5	**0.00**	**8.49**
4.00	5.00	4.50	1.00	2.50	19.62	9.62	43.29	3.77	25.2	25.2	1.0	76.83	0	7	1.0	26.4	0	5.0	25.2	7	9.41	10.45	11.34	48.1	0	0.0	42.4	42.4	**0.00**	**14.14**
5.00	6.00	5.50	1.00	3.50	19.41	9.41	52.81	3.77	25.2	25.2	1.0	93.71	0	7	1.0	26.4	0	6.0	26.4	4	9.41	13.15	14.11	57.5	986.7	986.7	59.4	59.4	**394.66**	**19.80**
6.00	7.00	6.50	1.00	4.50	19.41	9.41	62.22	3.77	26.4	26.4	1.0	116.48	116.48	4	1.0	15.1	15.09	7.0	26.4	4	10.45	13.15	14.11	66.9	1136.7	1268.2	76.4	207.9	**507.29**	**69.31**
7.00	9.00	8.00	2.00	6.50	20.45	10.45	77.37	7.54	26.4	26.4	1.0	289.70	406.17	4	1.0	30.2	45.26	9.0	25.4	0	10.45	10.90	11.80	87.8	1166.8	1618.3	110.3	561.7	**647.31**	**187.25**
9.00	10.00	9.50	1.00	7.50	20.45	10.45	93.05	3.77	25.4	25.4	1.0	166.63	572.80	0	1.0	0.0	45.26	10.0	25.4	0	10.45	10.90	11.80	98.3	1295.7	1913.8	127.3	745.3	**765.51**	**248.45**
10.00	11.00	10.50	1.00	8.50	20.45	10.45	103.50	3.77	25.4	25.4	1.0	185.34	758.14	0	1.0	0.0	45.26	11.0	8.2	44	10.23	2.15	0.94	108.7	718.6	1522.0	144.3	947.7	**608.79**	**315.88**
11.00	12.50	11.75	1.50	10.00	20.23	10.23	116.39	5.66	8.2	8.2	1.0	94.88	853.02	44	1.0	248.9	294.17	12.5	8.2	44	9.86	2.15	0.94	124.1	755.6	1902.8	169.7	1316.9	**761.11**	**438.97**
12.50	15.50	14.00	3.00	13.00	19.86	9.86	138.86	11.31	8.2	8.2	1.0	226.39	1079.41	44	1.0	497.8	792.00	15.5	16.7	24	9.86	4.78	3.58	153.6	1098.7	2970.1	220.6	2092.0	**1188.04**	**697.35**
15.50	17.00	16.25	1.50	14.50	19.86	9.86	161.04	5.66	16.7	16.7	1.0	273.32	1352.73	24	1.0	135.8	927.77	17.0	10.5	53	10.50	2.62	1.36	168.4	1048.1	3328.6	246.1	2526.6	**1331.46**	**842.20**
17.00	18.50	17.75	1.50	16.00	20.50	10.50	176.31	5.66	10.5	10.5	1.0	184.86	1537.59	53	1.0	299.8	1227.60	18.5	30.4	0	10.50	23.27	24.45	168.4	4609.8	7374.9	271.5	3036.7	**2949.98**	**1012.25**
18.50	20.00	19.25	1.50	17.50	20.50	10.50	176.31	5.66	30.4	30.4	1.0	596.88	2134.47	0	1.0	0.0	1227.60	20.0	11.0	38	10.50	2.76	1.51	168.4	924.4	4286.5	297.0	3659.1	**1714.60**	**1219.69**
20.00	21.50	20.75	1.50	19.00	20.50	10.50	176.31	5.66	11.0	11.0	1.0	193.88	2328.35	38	1.0	215.0	1442.57	21.5	11.0	38	9.26	2.76	1.51	168.4	923.2	4694.1	322.5	4093.4	**1877.63**	**1364.46**
21.50	23.00	22.25	1.50	20.50	19.26	9.26	176.31	5.66	11.0	11.0	1.0	193.88	2522.23	38	1.0	215.0	1657.54	23.0	17.0	32	9.94	4.92	3.75	168.4	1289.5	5469.3	347.9	4527.7	**2187.71**	**1509.23**
23.00	24.50	23.75	1.50	22.00	19.94	9.94	176.31	5.66	17.0	17.0	1.0	304.94	2827.17	32	1.0	181.0	1838.57	24.5	31.4	0	8.88	28.31	29.58	168.4	5573.8	10239.5	373.4	5039.1	**4095.80**	**1679.70**
24.50	26.00	25.25	1.50	23.50	18.88	8.88	176.31	5.66	31.4	31.4	1.1	651.44	3478.61	0	1.0	0.0	1838.57	26.0	31.4	0	9.14	28.31	29.58	168.4	5579.0	10896.2	398.8	5716.0	**4358.46**	**1905.34**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
26.00	27.50	26.75	1.50	25.00	19.14	9.14	176.31	5.66	31.4	31.4	1.1	651.44	4130.05	0	1.0	0.0	1838.57	27.5	30.0	0	8.82	21.26	22.40	168.4	4185.6	10154.2	424.3	6392.9	**4061.69**	**2130.97**
27.50	29.00	28.25	1.50	26.50	18.82	8.82	176.31	5.66	30.0	30.0	1.0	575.86	4705.90	0	1.0	0.0	1838.57	29.0	27.4	10	8.56	15.40	16.41	168.4	3132.9	9677.3	449.7	6994.2	**3870.94**	**2331.41**
29.00	30.00	29.50	1.00	27.50	18.56	8.56	176.31	3.77	27.4	27.4	1.0	344.67	5050.57	10	1.0	37.7	1876.29	30.0	27.4	10	8.56	15.40	16.41	168.4	3132.9	10059.7	466.7	7393.6	**4023.89**	**2464.52**
30.00	30.50	30.25	0.50	28.00	18.56	8.56	176.31	1.89	27.4	27.4	1.0	172.34	5222.91	10	1.0	18.9	1895.14	30.5	31.8	0	9.18	30.33	31.63	168.4	5976.6	13094.6	475.2	7593.3	**5237.85**	**2531.08**
30.50	32.00	31.25	1.50	29.50	19.18	9.18	176.31	5.66	31.8	31.8	1.1	674.08	5896.99	0	1.0	0.0	1895.14	32.0	31.8	0	9.12	30.33	31.63	168.4	5975.3	13767.4	500.7	8292.8	**5506.96**	**2764.26**
32.00	32.50	32.25	0.50	30.00	19.12	9.12	176.31	1.89	31.8	31.8	1.1	224.69	6121.68	0	1.0	0.0	1895.14	32.5	31.8	0	9.12	30.33	31.63	168.4	5975.3	13992.1	509.1	8526.0	**5596.84**	**2841.99**
32.50	33.50	33.00	1.00	31.00	19.12	9.12	176.31	3.77	31.8	31.8	1.1	449.39	6571.07	0	1.0	0.0	1895.14	33.5	30.8	0	9.48	25.29	26.50	168.4	4990.0	13456.2	526.1	8992.3	**5382.49**	**2997.44**
33.50	35.00	34.25	1.50	32.50	19.48	9.48	176.31	5.66	30.8	30.8	1.0	618.36	7189.43	0	1.0	0.0	1895.14	35.0	31.6	0	9.16	29.32	30.60	168.4	5777.8	14862.3	551.6	9636.1	**5944.93**	**3212.05**
35.00	36.50	35.75	1.50	34.00	19.16	9.16	176.31	5.66	31.6	31.6	1.1	662.70	7852.13	0	1.0	0.0	1895.14	36.5	31.6	0	9.02	29.32	30.60	168.4	5774.8	15522.1	577.0	10324.3	**6208.85**	**3441.43**
36.50	37.50	37.00	1.00	35.00	19.02	9.02	176.31	3.77	31.6	31.6	1.1	441.80	8293.93	0	1.0	0.0	1895.14	37.5	31.4	0	9.02	28.31	29.58	168.4	5576.6	15765.6	594.0	10783.1	**6306.26**	**3594.36**
37.50	38.00	37.75	0.50	35.50	19.02	9.02	176.31	1.89	31.4	31.4	1.1	217.15	8511.07	0	1.0	0.0	1895.14	38.0	32.0	0	9.11	31.33	32.65	168.4	6173.4	16579.6	602.5	11008.7	**6631.85**	**3669.57**
38.00	40.00	39.00	2.00	37.50	19.11	9.11	176.31	7.54	32.0	32.0	1.1	914.10	9425.18	0	1.0	0.0	1895.14	40.0	30.0	0	10.49	21.26	22.40	168.4	4211.0	15531.3	636.4	11956.7	**6212.52**	**3985.58**
BORE NO: P120A, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	19.55	9.55	26.26	1.89	26.5	26.5	1.0	24.69	0	3	1.0	5.7	0	3.0	25.7	6	9.55	11.58	12.49	28.7	0	0.0	8.5	8.5	**0.00**	**2.83**
3.00	4.00	3.50	1.00	1.50	19.55	9.55	33.43	3.77	25.7	25.7	1.0	60.67	0	6	1.0	22.6	0	4.0	25.7	6	9.86	11.58	12.49	38.2	0	0.0	25.5	25.5	**0.00**	**8.49**
4.00	6.00	5.00	2.00	3.50	19.86	9.86	48.06	7.54	25.7	25.7	1.0	174.46	0	6	1.0	45.3	0	6.0	25.7	6	9.86	11.58	12.49	57.9	0	0.0	59.4	59.4	**0.00**	**19.80**
6.00	7.00	6.50	1.00	4.50	19.86	9.86	62.85	3.77	25.7	25.7	1.0	114.08	0	6	1.0	22.6	0	7.0	25.7	6	9.86	11.58	12.49	67.8	1032.5	1032.5	76.4	76.4	**412.99**	**25.46**
7.00	8.00	7.50	1.00	5.50	19.86	9.86	72.71	3.77	25.7	25.7	1.0	131.97	131.97	6	1.0	22.6	22.63	8.0	12.3	44	9.97	3.15	1.88	77.6	737.1	891.7	93.3	247.9	**356.67**	**82.65**

APPENDIX-H

TABLE 2: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ 'at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
8.00	9.00	8.50	1.00	6.50	19.97	9.97	82.63	3.77	12.3	12.3	1.0	67.94	199.92	44	1.0	165.9	188.57	9.0	9.2	52	9.97	2.33	1.10	87.6	767.5	1156.0	110.3	498.8	**462.39**	**166.27**
9.00	10.00	9.50	1.00	7.50	19.97	9.97	92.60	3.77	9.2	9.2	1.0	56.56	256.48	52	1.0	196.1	384.69	10.0	9.2	52	10.56	2.33	1.10	97.6	794.2	1435.3	127.3	768.4	**574.13**	**256.15**
10.00	12.50	11.25	2.50	10.00	20.56	10.56	110.78	9.43	9.2	9.2	1.0	169.17	425.65	52	1.0	490.3	874.97	12.5	9.2	52	10.56	2.33	1.10	124.0	863.6	2164.3	169.7	1470.3	**865.71**	**490.11**
12.50	15.50	14.00	3.00	13.00	20.56	10.56	139.82	11.31	9.2	9.2	1.0	256.22	681.87	52	1.0	588.3	1463.31	15.5	12.0	29	10.35	3.06	1.79	155.7	846.5	2991.6	220.6	2365.8	**1196.66**	**788.60**
15.50	17.00	16.25	1.50	14.50	20.35	10.35	163.42	5.66	12.0	12.0	1.0	196.51	878.38	29	1.0	164.1	1627.37	17.0	11.7	48	10.35	2.97	1.71	171.2	1076.0	3581.7	246.1	2751.8	**1432.69**	**917.28**
17.00	18.50	17.75	1.50	16.00	20.35	10.35	178.95	5.66	11.7	11.7	1.0	209.64	1088.02	48	1.0	271.5	1898.91	18.5	11.7	48	9.85	2.97	1.71	171.2	1075.4	4062.3	271.5	3258.5	**1624.93**	**1086.16**
18.50	21.50	20.00	3.00	19.00	19.85	9.85	178.95	11.31	11.7	11.7	1.0	419.29	1507.31	48	1.0	543.1	2442.00	21.5	8.7	64	10.75	2.24	1.02	171.2	1092.2	5041.5	322.5	4271.8	**2016.61**	**1423.92**
21.50	24.50	23.00	3.00	22.00	20.75	10.75	178.95	11.31	8.7	8.7	1.0	309.82	1817.13	64	1.0	724.1	3166.11	24.5	28.1	0	10.75	16.98	18.02	171.2	3420.4	8403.7	373.4	5356.6	**3361.48**	**1785.54**
24.50	27.50	26.00	3.00	25.00	20.75	10.75	178.95	11.31	28.1	28.1	1.0	1081.07	2898.20	0	1.0	0.0	3166.11	27.5	29.5	0	9.10	20.13	21.25	171.2	4030.8	10095.1	424.3	6488.6	**4038.05**	**2162.87**
27.50	30.00	28.75	2.50	27.50	19.10	9.10	178.95	9.43	29.5	29.5	1.0	954.58	3852.78	0	1.0	0.0	3166.11	30.0	29.0	0	9.10	19.01	20.10	171.2	3805.6	10824.5	466.7	7485.6	**4329.80**	**2495.20**
30.00	30.50	30.25	0.50	28.00	19.10	9.10	178.95	1.89	29.0	29.0	1.0	187.05	4039.83	0	1.0	0.0	3166.11	30.5	28.6	0	9.10	18.11	19.17	171.2	3625.5	10831.4	475.2	7681.1	**4332.56**	**2560.38**
30.50	32.50	31.50	2.00	30.00	19.10	9.10	178.95	7.54	28.6	28.6	1.0	735.92	4775.75	0	1.0	0.0	3166.11	32.5	28.6	0	10.93	18.11	19.17	171.2	3649.3	11591.1	509.1	8451.0	**4636.46**	**2817.00**
32.50	33.50	33.00	1.00	31.00	20.93	10.93	178.95	3.77	28.6	28.6	1.0	367.96	5143.71	0	1.0	0.0	3166.11	33.5	30.4	0	10.93	23.27	24.45	171.2	4689.3	12999.1	526.1	8835.9	**5199.65**	**2945.31**
33.50	35.00	34.25	1.50	32.50	20.93	10.93	178.95	5.66	30.4	30.4	1.0	605.81	5749.52	0	1.0	0.0	3166.11	35.0	30.6	0	10.93	24.28	25.48	171.2	4892.0	13807.7	551.6	9467.2	**5523.07**	**3155.74**
35.00	36.50	35.75	1.50	34.00	20.93	10.93	178.95	5.66	30.6	30.6	1.0	616.65	6366.17	0	1.0	0.0	3166.11	36.5	29.8	0	8.84	20.81	21.94	171.2	4162.0	13694.3	577.0	10109.3	**5477.73**	**3369.77**
36.50	37.50	37.00	1.00	35.00	18.84	8.84	178.95	3.77	29.8	29.8	1.0	386.51	6752.68	0	1.0	0.0	3166.11	37.5	29.6	0	8.84	20.36	21.48	171.2	4072.1	13990.9	594.0	10512.8	**5596.34**	**3504.27**
37.50	38.00	37.75	0.50	35.50	18.84	8.84	178.95	1.89	29.6	29.6	1.0	191.69	6944.38	0	1.0	0.0	3166.11	38.0	30.0	0	8.48	21.26	22.40	171.2	4246.6	14357.1	602.5	10713.0	**5742.83**	**3570.99**
38.00	40.00	39.00	2.00	37.50	18.48	8.48	178.95	7.54	30.0	30.0	1.0	779.29	7723.67	0	1.0	0.0	3166.11	40.0	0.0	0	0.00	1.00	0.00	171.2	193.7	11083.5	636.4	11526.2	**4433.39**	**3842.07**

APPENDIX-H

TABLE 3: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1000 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Depth of Fixity (m)	Allowable Load capacity of pile(kN)
P116A	1.00	2.50	0.00	35	29580399	0.0491	18	2552	3.56	3.50	0.98	2.08	0.005	7.41	67
P120A	1.00	2.50	0.00	35	29580399	0.0491	19	2696	3.52	4.50	1.28	2.04	0.005	7.17	55

APPENDIX-H

TABLE 4: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1200 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Depth of Fixity (m)	Allowable Load capacity of pile(kN)
P116A	1.20	2.50	0.00	35	29580399	0.1018	17	2408	4.16	3.50	0.84	2.10	0.005	8.76	98
P120A	1.20	2.50	0.00	35	29580399	0.1018	19	2696	4.07	4.50	1.11	2.06	0.005	8.40	84

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
P116A	0.50	SM	47	4	9.80	5.00	4.80	1.00	0.317	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.534	Liquefiable
	1.00	SM	47	4	19.60	10.00	9.60	0.99	0.316	1.70	6.80	5.00	1.20	13.16	0.14	1.00	0.169	0.536	Liquefiable
	3.00	SM	46	7	58.80	30.00	28.80	0.98	0.311	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.792	Liquefiable
	4.00	CL-ML	68	9	78.40	40.00	38.40	0.97	0.309	1.61	14.52	5.00	1.20	22.43	0.25	1.00	-	-	Non-liquefiable
	5.00	ML	70	9	98.00	50.00	48.00	0.96	0.306	1.44	12.99	5.00	1.20	20.59	0.22	1.00	0.266	0.868	Liquefiable
	6.00	ML	70	25	116.40	60.00	56.40	0.95	0.307	1.33	33.29	5.00	1.20	44.95	0.52	1.00	0.620	2.019	Non-liquefiable
	7.00	CL-ML	56	27	135.80	70.00	65.80	0.95	0.305	1.23	33.29	5.00	1.20	44.94	0.52	1.00	-	-	Non-liquefiable
	9.00	SM-SC	48	16	174.60	90.00	84.60	0.93	0.300	1.09	17.40	5.00	1.20	25.87	0.31	1.00	0.370	1.234	Non-liquefiable
	10.00	SM-SC	48	19	205.00	100.00	105.00	0.91	0.276	0.98	18.54	5.00	1.20	27.25	0.35	1.00	0.412	1.492	Non-liquefiable
	11.00	CL-ML	88	19	225.50	110.00	115.50	0.88	0.268	0.93	17.68	5.00	1.20	26.22	0.32	1.00	-	-	Non-liquefiable
	12.50	CL-ML	88	16	252.50	125.00	127.50	0.84	0.260	0.89	14.17	5.00	1.20	22.00	0.24	1.00	-	-	Non-liquefiable
	15.50	ML	63	36	313.10	155.00	158.10	0.76	0.235	0.80	28.63	5.00	1.20	39.36	0.52	0.87	0.542	2.310	Non-liquefiable
	17.00	CL	79	36	338.30	170.00	168.30	0.72	0.226	0.77	27.75	5.00	1.20	38.30	0.52	0.83	-	-	Non-liquefiable
	18.50	SM	45	89	379.25	185.00	194.25	0.68	0.207	0.72	63.86	5.00	1.20	81.63	0.52	0.79	0.492	2.377	Non-liquefiable
	20.00	CL-ML	78	52	410.00	200.00	210.00	0.64	0.195	0.69	35.88	5.00	1.20	48.06	0.52	0.77	-	-	Non-liquefiable
	21.50	CL-ML	78	58	440.75	215.00	225.75	0.60	0.183	0.67	38.60	5.00	1.20	51.32	0.52	0.75	-	-	Non-liquefiable
	23.00	CL-ML	66	54	471.50	230.00	241.50	0.56	0.171	0.64	34.75	5.00	1.20	46.70	0.52	0.74	-	-	Non-liquefiable
	24.50	SM	42	60	502.25	245.00	257.25	0.56	0.171	0.62	37.41	5.00	1.20	49.89	0.52	0.72	0.447	2.619	Non-liquefiable

APPENDIX-H

TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	26.00	SM	42	74	533.00	260.00	273.00	0.56	0.171	0.61	44.79	5.00	1.20	58.74	0.52	0.71	0.438	2.566	Non-liquefiable
	27.50	SM	49	73	563.75	275.00	288.75	0.56	0.171	0.59	42.96	5.00	1.20	56.55	0.52	0.69	0.429	2.516	Non-liquefiable
	29.00	ML	51	78	594.50	290.00	304.50	0.56	0.171	0.57	44.70	5.00	1.20	58.64	0.52	0.68	0.421	2.470	Non-liquefiable
	30.50	SM	40	80	625.25	305.00	320.25	0.56	0.171	0.56	44.70	5.00	1.20	58.64	0.52	0.67	0.414	2.427	Non-liquefiable
	32.00	SM	40	74	656.00	320.00	336.00	0.56	0.171	0.55	40.37	5.00	1.20	53.44	0.52	0.66	0.407	2.387	Non-liquefiable
	33.50	SM	45	73	686.75	335.00	351.75	0.56	0.171	0.53	38.92	5.00	1.20	51.71	0.52	0.65	0.401	2.349	Non-liquefiable
	35.00	SM	41	79	717.50	350.00	367.50	0.56	0.171	0.52	41.21	5.00	1.20	54.45	0.52	0.64	0.395	2.314	Non-liquefiable
	36.50	SM	41	78	748.25	365.00	383.25	0.56	0.171	0.51	39.84	5.00	1.20	52.81	0.52	0.63	0.389	2.280	Non-liquefiable
	38.00	SM	34	72	779.00	380.00	399.00	0.56	0.171	0.50	36.05	4.93	1.19	47.76	0.52	0.62	0.383	2.249	Non-liquefiable
	40.00	SM	34	69	820.00	400.00	420.00	0.56	0.171	0.49	33.67	4.93	1.19	44.94	0.52	0.61	0.377	2.209	Non-liquefiable
P120A	0.50	ML	55	7	9.80	5.00	4.80	1.00	0.317	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.777	Liquefiable
	1.00	ML	55	7	19.60	10.00	9.60	0.99	0.316	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.780	Liquefiable
	2.00	SM	45	7	39.20	20.00	19.20	0.98	0.314	1.70	11.90	5.00	1.20	19.28	0.21	1.00	0.246	0.786	Liquefiable
	3.00	ML	61	15	58.80	30.00	28.80	0.98	0.311	1.70	25.50	5.00	1.20	35.60	0.52	1.00	0.620	1.993	Non-liquefiable
	4.00	ML	61	11	78.40	40.00	38.40	0.97	0.309	1.61	17.75	5.00	1.20	26.30	0.32	1.00	0.382	1.237	Non-liquefiable
	6.00	ML	67	11	117.60	60.00	57.60	0.95	0.304	1.32	14.49	5.00	1.20	22.39	0.25	1.00	0.295	0.972	Liquefiable
	7.00	ML	67	14	139.30	70.00	69.30	0.95	0.297	1.20	16.82	5.00	1.20	25.18	0.30	1.00	0.352	1.188	Non-liquefiable

APPENDIX-H
TABLE 5: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	8.00	CL	77	14	159.20	80.00	79.20	0.94	0.294	1.12	15.73	5.00	1.20	23.88	0.27	1.00	-	-	Non-liquefiable
	9.00	CL	85	28	180.00	90.00	90.00	0.93	0.291	1.05	29.51	5.00	1.20	40.42	0.52	1.00	-	-	Non-liquefiable
	10.00	CL	85	33	200.00	100.00	100.00	0.91	0.283	1.00	33.00	5.00	1.20	44.60	0.52	1.00	-	-	Non-liquefiable
	12.50	CL	79	22	250.00	125.00	125.00	0.84	0.262	0.89	19.68	5.00	1.20	28.61	0.39	1.00	-	-	Non-liquefiable
	15.50	CL-ML	68	25	319.30	155.00	164.30	0.76	0.230	0.78	19.50	5.00	1.20	28.40	0.38	0.86	-	-	Non-liquefiable
	17.00	CL	82	25	350.20	170.00	180.20	0.72	0.218	0.74	18.62	5.00	1.20	27.35	0.35	0.81	-	-	Non-liquefiable
	18.50	CL	82	32	375.55	185.00	190.55	0.68	0.209	0.72	23.18	5.00	1.20	32.82	0.52	0.79	-	-	Non-liquefiable
	21.50	CL	89	36	436.45	215.00	221.45	0.60	0.184	0.67	24.19	5.00	1.20	34.03	0.52	0.75	-	-	Non-liquefiable
	24.50	SM	45	40	487.55	245.00	242.55	0.56	0.176	0.64	25.68	5.00	1.20	35.82	0.52	0.73	0.451	2.571	Non-liquefiable
	27.50	SM	37	45	569.25	275.00	294.25	0.56	0.169	0.58	26.23	5.00	1.20	36.48	0.52	0.68	0.421	2.492	Non-liquefiable
	30.50	SM	42	48	631.35	305.00	326.35	0.56	0.169	0.55	26.57	5.00	1.20	36.88	0.52	0.76	0.470	2.780	Non-liquefiable
	33.50	SM	45	66	639.85	335.00	304.85	0.56	0.183	0.57	37.80	5.00	1.20	50.36	0.52	0.77	0.477	2.604	Non-liquefiable
	35.00	SM	45	71	731.50	350.00	381.50	0.56	0.167	0.51	36.35	5.00	1.20	48.62	0.52	0.73	0.453	2.704	Non-liquefiable
	36.50	SM	49	75	762.85	365.00	397.85	0.56	0.167	0.50	37.60	5.00	1.20	50.12	0.52	0.72	0.448	2.677	Non-liquefiable
	38.00	SM	49	74	794.20	380.00	414.20	0.56	0.167	0.49	36.36	5.00	1.20	48.63	0.52	0.72	0.444	2.652	Non-liquefiable
	40.00	CL-ML	68	100	836.00	400.00	436.00	0.56	0.167	0.48	47.89	5.00	1.20	62.47	0.52	0.71	-	-	Non-liquefiable

APPENDIX-I
SITE PHOTOGRAPHS

UDS at depth 15.50 m

SPT sample at depth 20.00 m

SPT at depth 10.00 m

SPT sample at depth 21.50 m

APPENDIX-J
LABORATORY PHOTOGRAPHS

Atterberg's limit test

Shrinkage limit test

Tri-axial test

Direct shear test

APPENDIX-K
CHART 1: FIELD BORELOG CHARTS (P116A)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date.:	28.12.2021

Project Name: GTW-HORC Viaduct b/w Sohana Dhulawat station | Project Code: 1901

Coordinate: N: 3120897.53 | E: 700986.621 | Location/ Chainage: 23961.4470

Method of Drilling: Percussion | Drilling Equipment: Manual Powerwinch | Bore No.: P-116A

Casing Lowered (M): 24.00 | Bentonite Used: NO | Standard Sampler: Yes | Barrel Type: N/A

Ground Elevation: R.L-195.485 | Date: From 31/10/23 to 1/11/23 | Water Table (M): 1.90

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
31/10/23	0.00	0.50	0.50	D.S	SX	collected										Non-cohesive soil
"	1.00	1.45	0.45	DP	"	1	2	2	4							— do —
"	2.00	2.45	0.45	U	"	Received										— do —
"	3.00	3.45	0.45	DP	"	2	3	4	7							— do —
"	4.00	4.45	0.45	DP	"	3	4	5	9							— do —
"	5.00	5.45	0.45	U	"	Received										Non-cohesive soil with gravel
"	6.00	6.45	0.45	DP	"	5	11	14	25							— do —
"	7.00	7.45	0.45	DP	"	6	12	15	27							— do —
"	8.00	8.45	0.45	U	"	Slipped										cohesive soil
"	9.00	9.45	0.45	DP	"	4	7	9	16							cohesive soil with gravel
"	10.00	10.45	0.45	DP	"	5	9	10	19							— do —
"	11.00	11.45	0.45	U	"	Received										— do —
"	12.50	12.95	0.45	DP	"	5	7	9	16							— do —
"	14.00	14.45	0.45	U	"	Received										— do —
"	15.50	15.95	0.45	DP	"	8	15	21	36							Non-cohesive soil with gravel
"	17.00	17.45	0.45	U	"	Received										Non-cohesive soil
"	18.50	18.95	0.45	DP	"	16	36	53	89							— do —
"	20.00	20.45	0.45	DP	"	13	24	28	52							Cohesive soil with gravel
"	21.50	21.95	0.45	DP	"	15	26	32	58							— do —
"	23.00	23.45	0.45	DP	"	11	23	31	54							Non-cohesive soil
"	24.50	24.95	0.45	DP	"	13	25	35	60							— do —
"	26.00	26.45	0.45	DP	"	24	32	42	74							— do —
1/11/23	27.50	27.95	0.45	DP	"	23	30	43	73							— do —
"	29.00	29.45	0.45	DP	"	26	33	45	78							— do —

Nitesh

Supervisor

A.E - Civil

E - In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 2: FIELD BORELOG CHARTS (P116A)

TECHPRO ENGINEERS PVT. LTD. — **BORE/ DRILL LOG**

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N:3190897·53	E:700986·631	Location/ Chainage: 23961·4470		
Method of Drilling:	Percussion	Drilling Equipment: Manual Tripod winch		Bore No.:	P-116 A
Casing Lowered (M):	24.00	Bentonite Used: NO	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	R-L-195.485	Date: From 31/10/23	to 3/11/23	Water Table (M):	1.90

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
1/11/23	30.50	30.95	0.45	DP	150	37	37	43	80							Non-cohesive soil
"	32.00	32.45	0.45	DP	"	30	34	40	74							— do —
2/11/23	33.50	33.95	0.45	DP	"	29	31	42	73							— do —
"	35.00	35.45	0.45	DP	"	32	35	44	79							— do —
3/11/23	36.50	36.95	0.45	DP	"	33	36	42	78							— do —
"	38.00	38.45	0.45	DP	"	30	32	40	72							— do —
"	40.00	40.45	0.45	DP	"	28	30	39	69							— do —

Nitesh
Supervisor

E - In - C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 3: FIELD BORELOG CHARTS (P120A)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No	GT/003
		Date of Issue	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat station			Project Code:	1901
Coordinate:	N: 3181661.95	E: 700970.032	Location/ Chainage: 34166.347		
Method of Drilling:	Percussion	Drilling Equipment:	Mannual Powerwinch	Bore No.:	P120A
Casing Lowered (M): 21.00	Bentonite Used: Yes	Standard Sampler:	Yes	Barrel Type:	N/A
Ground Elevation:	R.L-196.008	Date: From 18/11/23 to 21/11/23		Water Table (M):	5.00M

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
18/11/23	0.00	0.50	0.50	DS	SX	collected										Non-cohesive soil
19	1.00	1.45	0.45	DP	"	2	3	4	7							— do —
"	2.00	2.45	0.45	U	"	Received										— do —
"	3.00	3.45	0.45	DP	"	5	7	8	15							Non-cohesive soil with gravel
"	4.00	4.45	0.45	DP	"	3	5	6	11							Non-cohesive soil
"	5.00	5.45	0.45	U	"	Received										— do —
"	6.00	6.45	0.45	DP	"	4	5	6	11							— do —
"	7.00	7.45	0.45	DP	"	4	6	8	14							— do —
"	8.00	8.45	0.45	U	"	Received										— do —
"	9.00	9.45	0.45	DP	"	5	10	18	28							Cohesive soil with gravel
"	10.00	10.45	0.45	DP	"	6	13	20	33							— do —
"	11.00	11.45	0.45	U	"	Received										— do —
20/11/23	12.50	12.95	0.45	DP	"	6	9	13	22							— do —
	14.00	14.45	0.45	U	"	slipped										-do- DS collected
	15.50	15.95	0.45	DP	"	10	12	13	25							Non-cohesive soil with gravel
"	17.00	17.45	0.45	U	"	Received										— do —
"	18.50	18.95	0.45	DP	"	12	14	18	32							— do —
"	20.00	20.45	0.45	U	"	slipped										-do- DS collected
"	21.50	21.95	0.45	DP	"	13	15	21	36							Non-cohesive soil with gravel
"	23.00	23.45	0.45	U	"	slipped										— do —
"	24.50	24.95	0.45	DP	"	14	17	23	40							Non-cohesive soil
"	26.00	26.45	0.45	U	"	slipped										-do- DS collected
"	27.50	27.95	0.45	DP	"	16	20	25	45							Non-cohesive soil
"	29.00	29.45	0.45	U	"	Received										— do —

Supervisor

Techpro Engineers Pvt. Ltd. Kanpur

E-in-C

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-K
CHART 4: FIELD BORELOG CHARTS (P120A)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTW-HORC Viaduct b/w Sohana Dhulawat station	Project Code:	1901
Coordinate:	N: 3121001.95 E: 700978.032	Location/ Chainage:	24066.247
Method of Drilling:	Percussion	Drilling Equipment:	Manual Percussion winch
Bore No.:	P120A		
Casing Lowered (M):	21.00	Bentonite Used:	Yes
Standard Sampler:	Yes	Barrel Type:	N/A
Ground Elevation:	RL-196.008	Date: From	20/11/23 to 21/11/23
Water Table (M):	5.00 m		

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
20th	30.50	30.95	0.45	DP	SX	17	21	27	48							Non-cohesive soil
"	32.00	32.45	0.45	U	"	slipped										-do- D.S collected
"	33.50	33.95	0.45	DP	"	29	30	36	66							Non-cohesive soil with gravel
"	35.00	35.45	0.45	DP	"	27	33	38	71							— do —
21st	36.50	36.95	0.45	DP	"	29	35	40	75							— do —
"	38.00	38.45	0.45	DP	"	28	32	42	74							— do —
"	40.00	40.45	0.45	DP	"	46	50	-	R							— do —

Nitesh
Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

Techpro Engineers Pvt. Ltd.

End of Report

Report No: 1901-HORC-VIII

Report No.: 1901-HORC-VIII

Date: Dec 05th; 2023

GEOTECHNICAL INVESTIGATION REPORT

ULR No.: TC916923000000032P
REVISION-R0

AT THE SITE FOR

HORC VIADUCT BETWEEN SOHANA & DHULAWAT STATIONS OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT, HARYANA

FROM BOREHOLES P134A TO A2A

CLIENT

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.

Plot No. 143, 5th floor RailTel tower, Sector-44,
Gurugram, Haryana 122003

GENERAL CONSULTANTS

RITES-SMEC JV

Gurugram, Haryana

GEOTECHNICAL CONSULTANTS

TECHPRO ENGINEERS PVT. LTD.

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G T ROAD, KANPUR-209 217, Phone: 9793209918

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TC-9169

114, Ram Ganga Housing Society, Naramau, G T Road, Kanpur-209 217
Tel.: 9793209918, e-mail: info@techproindia.com
Web site: www.techproindia.com

REPORT FORMAT

Report No.	Bore included	Total Number of Bores
1901-HORC-I	A1 to P20	21
1901-HORC-II	P21 to P40	20
1901-HORC-III	P41 to P60	20
1901-HORC-IV	P61 to P80	20
1901-HORC-V	P81 to P100	20
1901-HORC-VI	P101 to P113	13
1901-HORC-VII	P114A to P133A	20
1901-HORC-VIII	P134A to A2A	16
1901-HORC-IX	P114B to P133B	20
1901-HORC-X	P134B to A2B	16

TABLE OF CONTENTS

APPENDICES

National Accreditation Board for
Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

TECHPRO ENGINEERS PVT. LTD. (LABORATORY DIVISION)

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G.T. ROAD, KANPUR, UTTAR PRADESH, INDIA

in the field of

TESTING

Certificate Number: TC-9169

Issue Date: 23/12/2022 Valid Until: 22/12/2024

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Identity : Techpro Engineers Private Limited

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

Dec 05th; 2023

ACKNOWLEDGEMENTS

We are pleased to submit the part-8 of the report of Geotechnical investigation, conducted for the boreholes P134A to P148A and A2A for the design of foundations for HORC Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) project in the state of Haryana, India.

We hereby, convey our sincere thanks to Mr. Neeraj Bhandari (CPM/South) and Mr. Raju Solanki (DGM/C/South), HRIDCL for trust and support during the investigation. We also acknowledge our thanks to Mr. Uma Maheshwara Rao B, DGM/C/West, HRIDCL for awarding the said work to us. We are also grateful Mr. Ravindra Dutta Upadhyay (Geotech Expert), Mr. PS Gautam & Mr. Jitender Parashar, Site Engineer from the RITES- SMEC JV and Mohd. Ishak (Executive/Civil) from HRIDCL, for their help rendered during and prior to the investigation work.

We are also thankful to our staff members for conducting field and laboratory test, preparing sketches, and typing the report.

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech. (Civil), M.Tech.
Principal Consultant &
Managing Director

1. INTRODUCTION:

Haryana Rail Infrastructure Development Corporation Ltd. (HRIDC) and Ministry of Railways, Govt. of India has come together to form a new company namely Haryana Orbital Rail Corporation Limited (HORCL), to design and construction of new BG line from Palwal to Sonipat named Haryana Orbital Rail Corridor (HORC), in the state of Haryana, India. In this connection, a Geotechnical investigation has been planned for the design of foundations of Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) Project in the state of Haryana. The work of conducting the detailed Geotechnical Investigation has been awarded to us by HRIDC, through work order No. HRIDC/HORC/GTI/211/2023-2024/Vol-0 dated 02-09-2023, which includes investigation in field, laboratory testing of disturbed and undisturbed samples, collected from the field, and submission of the geotechnical **investigation** test report.

A geotechnical investigation was carried out, with the locations, planned by the client. Purpose of the investigation is to determine the nature and properties of soil and rock strata across the bore holes and representing them through log sections showing the levels, nature, and properties of various strata up to a sufficient depth below the founding level, proneness of site to artesian conditions, seismic disturbance and other engineering properties of soil and rock strata.

This part -8 of the report includes the detailed methodology of investigation, collection of samples, field and laboratory test result including their interpretation/ analysis, recommendations on the properties of soils and rock required for design of foundation and suggesting suitable type and depth of foundation with allowable bearing capacity for safe and strong foundations for the Bore Hole numbers P134A to P148A and A2A.

2. SCOPE OF WORK:

For the design of foundation of viaduct, it is required to determine the allowable bearing capacity together with necessary engineering characteristics of underlying soil & rock strata. In general, the geotechnical investigation has been planned as per IS:1892-2021 and further extended to IS: 1904, IS:2911 (part-1/Sec 2) & IRC 78:2014 for planning the laboratory testing and computing the allowable bearing capacity, hence the scope of work is as follows:

2.1. Mobilisation of all tools & plants along with accessories, materials, labours etc. at site of work for drilling and testing work, including setting up boring and shifting to different bore holes point etc.

2.2. Exploratory drilling of 150 mm diameter bore holes through soil deposits and 75 mm in rock within the proposed alignment upto the required depth.

2.3. Collection of disturbed soil samples at an interval of 3.00 meter in all the bore holes.

2.4. Collection of undisturbed soil samples at every 3.00 m interval or at change of stratum from all the boreholes.

2.5. To conduct Standard Penetration Test (SPT) at an interval of 3.00 m or noticeable change of stratum in soil deposits in all bore holes.

2.6. Collection of rock core samples and preserving them in core boxes.

2.7. To collect ground water sample on completion of bore holes.

2.8. To record the ground water table in all the bore holes.

2.9. Transporting all the disturbed, undisturbed soil and rock core samples collected during the field investigation to our NABL accredited Geotech Engineering laboratory at Kanpur.

2.10. To conduct the laboratory tests on all the soil and rock core samples collected during field investigation for determination of their engineering characteristics.

2.11. To compile of field and laboratory test results, working out the allowable bearing capacity and preparing the report including detailed recommendations and necessary precautions.

3. GEOLOGICAL INFORMATION OF THE REGION:

3.1. Geography:

The project location is in the bordering area of Gurugram and Nuh (recent old name-Mewat), districts in the Indian state of Haryana. The stretch of the alignment of the proposed corridor starts from southmost part of Gurugram in the town of Sohna and ends at Dhulawat, which is a village lying at the north of Nuh district.

Haryana is a state located in the northern part of India. Gurugram is among one

of the districts in Haryana which is also the part of National Capital Region (30km south of New Delhi). It lies at an elevation of 217 m above msl. Sohna is a small town located 25km in the south of Gurugram. Sohna is well known for its hot water springs and famous Shiva temple. Sohna is located in between 28°15’ N latitude and 77°40' E longitude at the elevation of 212.14m above msl. Mewat district is located at 28 °12′ N latitude, 77 °3′ E longitude, at the south of Gurugram at an elevation of 199 m above msl. The location is bordered by Rewari district on west and Faridabad & Palwal district on the east.

3.2. Geology:

The Gurugram district is having of almost flat topography, however, in the north-eastern part small isolated hillocks of Precambrian rocks are exposed. Small hill ranges which are part of the Aravali and Mangar Bani ranges exists in the district. The major part of district is underlain by Quaternary alluvium consisting of sand, clay and silt. The alluvial plain is formed by the Sahibi river which is a tributary of River Yamuna. Soils of the Gurgaon district is classified as tropical and brown soils, existing in the north western extreme, northern and north eastern parts of the district and water logged and salt affected soils in the southern parts of the district. The soils are medium textured loamy sand is the average texture in Gurgaon and Sohna blocks.

3.3. Rainfall and Climate:

The area has hot semi-arid type of climate characterising extreme dryness of the air except in the monsoon season. Intense hot summer and cold winters. The total annual rainfall in the region is about 596 mm, of which 75 to 80% is because of the south-west monsoon.

3.4. Seismicity:

The site under consideration exists in the district of Gurugram and Mewat which lies in the Seismic Zone IV (high damage risk zone), as per the current seismic zonation map of India (IS 1893-2016): RA 2021 and have a zone factor of 0.24 for design basis earthquake. The region is surrounded by many in-homogeneities in the form of faults and ridges like Sohna Fault, Moradabad Fault, Delhi-Moradabad Fault, Delhi-Haridwar ridge, junction of Aravalli and Alluvium near Delhi. The Sohna fault line lies between the Delhi ridge and Sohna town and falls between the Arjangarh and

Manesar outcrops. All the developed area in Gurugram comes within 200 km of the fault line. The Sohna fault line is located at the junction between the hard rock terrain of the Aravalli hills and the sandy formation of the Yamuna River and is currently inactive from several years and is capable of a disastrous earthquake.

The project location has been marked in Fig.1 Seismic zone map of India.

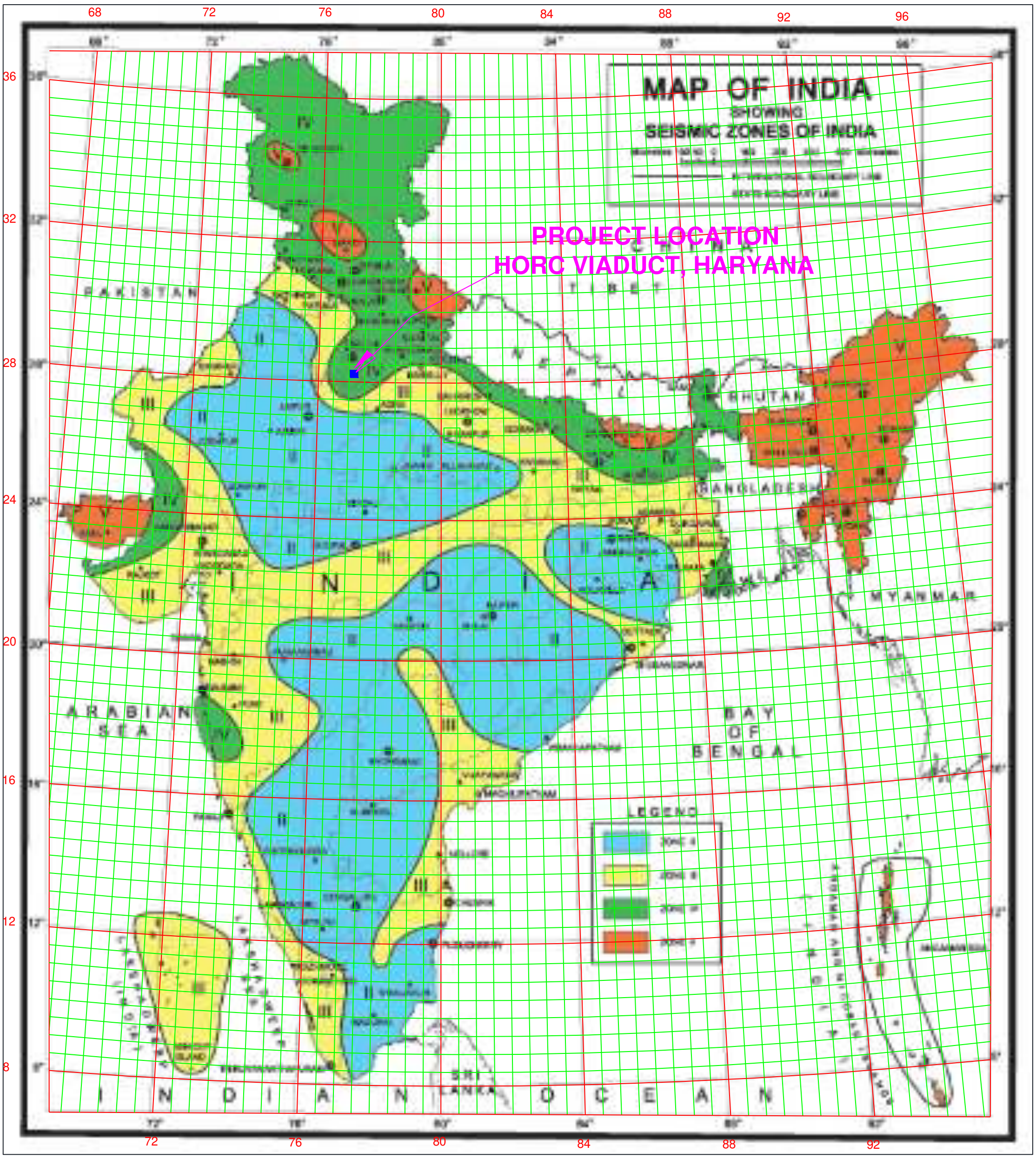


Fig.1: Seismic Zone Map of India

4. FIELD INVESTIGATION:

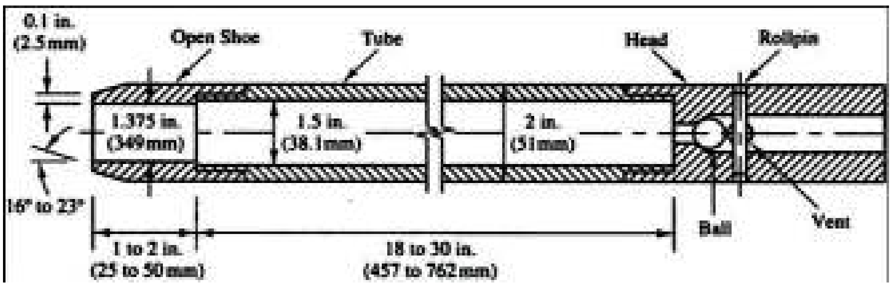
The field investigation work at this site was carried out from Nov 1st; 2023 to Nov 4th; 2023 & Nov 25th; 2023 to Nov 27th; 2023. The following investigation

work was carried out:

4.1. **Sixteen numbers** of boreholes were proposed to be made in this stretch, out of which **two number** of **borehole** (marked as P134A & P146A) of diameter 150 mm in soil and 75 mm in rock were made for conducting Standard Penetration Test and collection of disturbed, undisturbed soil and rock core samples. The borehole was progressed using hydraulic rig and power winch machine under **rotary** and **percussion** methods of drilling. Casing was used to keep the borehole stable and Bentonite was also used as drilling mud to help prevent wall collapse of boreholes at deeper depth. The records of achieved depth of bore holes have been given in Para No. 6, the details of drilled bores along with depth of casing used have been reported in Appendix B. Locations of boreholes have been reported in “TEST LOCATION PLAN” in Appendix A.

4.2. **Standard Penetration Tests** were conducted at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth, as per the procedure in IS: 2131-1981-(RA: 2021) in all the bore holes. The **standard SPT sampler** (without liner and with no space for liner) and **auto-trip hammer** of standard weight of 63.50 kg have been used to perform the test.

For conducting the test, the bottom of the borehole was properly cleaned, and split spoon sampler was properly seated in position in the borehole. The split spoon sampler resting on the bottom of borehole was allowed to sink under its own weight; then the sampler was allowed to penetrate 15 cm with the blows of the hammer 63.50 kg weight falling free through 75cm, thereafter the split spoon sampler was further driven by another 15 cm. For the 3rd and final drive, the sampler was further allowed to penetrate 15 cm. The number of blows required to get each 15 cm of penetration, was recorded. The first 15 cm of drive is seating drive.



Structure of SPT Sampler

The total blows of penetration for the second and third 15 cm of penetration is

termed the penetration resistance N. The N' values are indicative of the compactness/ relative density of cohesion less soils and consistency of cohesive soils.

In case the blows count of SPT in soil (including the number of blows of seating) exceeds 100, the corresponding penetration was recorded and this particular test at that depth stopped. If the total penetration is more than the seating penetration of 15 cm, then breakup of blow counts for 15 cm seating penetration and for remaining portion of penetration is also given.

SPT 'N' values are correlated with non-cohesive stratum as per BS: 5930 (1999) – for sandy strata and with consistency of cohesive stratum.

Correlation For Clay/Plastic Silt		Correlation For Sand/Non-Plastic Silt	
Consistency of clays	**Penetration Value**	**Relative Density of sand**	**Penetration Value**
Very Soft	0 to 2 Blows	Very loose	0 to 4 Blows
Soft	3 to 4 Blows	Loose	5 to 10 Blows
Medium Stiff	5 to 8 Blows	Medium	11 to 30 Blows
Stiff	9 to 16 Blows	Dense	31 to 50 Blows
Very Stiff	17 to 32 Blows	Very Dense	Above 50
Hard	Above 32		

In this method, the sampler acts as a probe and the driving energy is supplied by the fall of the drop weight. The values of 'N' depend on the compactness or relative density of the material. In hard formations, the testing is discontinued if 'N' value is found to be more than 100. It is termed as 'Refusal'. Refusal is also recorded when SPT blow count records 50 or more for any of the single drive of 15 cm.

'N' value depends upon degree of saturation and over burden pressure of the formation. Silty fine sand and fine sand below the water table develop pore water pressure depending on the in-situ void ratio which in turn affects the effective stress. This change in effective stress influences the 'N' value considerably.

Depth of overburden affects the SPT values in none to low cohesive soils and hence need correction. The SPT value after the overburden correction, N' is as follows:

$$N' = 0.77x \log(2000/q) \times N$$

Where, q= Overburden Pressure (kN/m^2) and N = observed SPT value

N' is corrected further for dilatancy in case of saturated fine sands and silts for the values of N' greater than 15.

Modified value after dilatancy correction N" = 15+ (N'-15)/2

Soil samples obtained from split spoon sampler were collected in the polythene bags of suitable size. These samples were property sealed, labelled, and carefully transported to the laboratory for testing. The results have been reported in Table 1 to 2 of Appendix B under the title "SUMMARY OF TEST RESULTS".

4.3. Disturbed soil samples were collected at 0.50 metre, then at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth and at significant change of stratum. Soil from cutting edge of SPT samplers and retained in split spoon, used for Standard Penetration Tests was taken as disturbed samples. These samples were placed without delay in adequately sealed polythene bags. Where the collection of disturbed soil samples could not be collected from SPT samples, Shelby tubes were driven and retained soil samples were obtained. The laboratory tests were conducted on the collected soil samples and reported in Table 1 to 2 of Appendix-B under the title "SUMMARY OF TEST RESULTS".

4.4. Undisturbed soil samples were collected in accordance with IS: 2132-1986-(RA: 2021) at an interval of 3.00 metre or at change of stratum, starting from the depth of 1.00 or 2.00 m, by using 100 mm dia. and 450 mm long MS tubes provided with sampler head with ball check arrangement. However, the some of the samples could not be extracted due to the partial penetration or slippage during the evacuation.

Moreover, collection of Undisturbed samples in very hard cohesive soils/ dense granular soils/gravels/ cobbles/ pebbles/ boulders, refusal strata is practically not possible and such collected samples will not truly represent the undisturbed conditions.

Immediately after taking undisturbed sample in the tube, the adopter head was removed along with the disturbed material. The visible ends of the samples shall then be trimmed off any wet disturbed soil. The ends will then be coated alternately with four layers of molten wax. More molten wax will then be added to give a total thickness

of not less than 25 mm. The laboratory test results have been reported in Table 1 to 2 of Appendix-B.

4.5. **Rock Core samples** recovered during the NX size drilling have been measured, numbered, and packed in core boxes. The Core Recovery (CR) and RQD information have been reported in Field bore log charts and Core Measurement Sheet and results have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B**.**

4.6. The **ground water table** in the borehole was allowed to stabilize and measured after 8, 16, 24 and 48 hours after completion of the bore hole. It was ensured that last two reading were identical. The records of ground water table have been given in Para No.6.

4.7. **Ground water samples** were collected from borehole as per IS: 6935-1973-(RA:2019) for chemical analysis to determine aggressiveness in relation to attack on concrete / reinforcement including determination of pH value.

5. LABORATORY TESTS:

The following laboratory tests were conducted to determine the engineering characteristics of sub-soils:

5.1. **Field moisture contents** were determined by oven drying method as per IS: 2720 (part II)-1973-(RA: 2020). The results have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.2. **Bulk density** of soil strata was obtained using Shelby tubes in accordance with IS 2720 (part XXIX)-1975-(RA: 2020). The results have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.3. **Mechanical sieve analysis** test was performed in accordance with IS: 2720 (Part IV) – 1985-(RA: 2020), for the purpose of identification by grain size analysis, on coarse part of the soil samples and the results have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.4. **Particle size analysis** test by **Hydrometer method** were performed in accordance with IS: 2720 (Part IV) -1985-(RA: 2020) on the part of soil samples obtained after the sieve analysis. The results have been reported in Table 1 to 2: "SUMMARY OF TEST

RESULTS" of Appendix B.

5.5. **Atterbergs' limits tests** were performed in accordance with IS: 2720 (part V)-1985-(RA: 2020) and results have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.6. **Specific gravity tests** were performed in accordance with IS 2720 (part III-sec. 1) -1980-(RA: 2021) and the results have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.7. **Consolidation tests** were performed on cohesive soil samples in accordance with IS: 2720 (part XV)-1965-(RA: 2021). The results have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.8. **Direct shear tests** were performed as per IS: 2720 (part XIII)-1986-(RA: 2021), on the undisturbed soil samples obtained during the field investigation. The results and the density of samples have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.9. **Tri-axial Compression Test** under Unconsolidated Un-drained (UU) condition as per IS: 2720 (Part-XI)-1993-(RA: 2021) were performed on the selected undisturbed soil samples, obtained during the field investigation. The results have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.10. **Unconfined Compressive strength tests** were performed in accordance with IS 2720 (Part-X) -1991-(RA:2020) on selected undisturbed soil samples and the results have been reported in Table 3 of Appendix B.

5.11. **Shrinkage Limit tests** were performed in accordance with IS 2720 (part-VI) -1972-(RA: 2021) and the results have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.12. **Free Swell Index** were performed in accordance with IS 2720 (part-XL) -1977-(RA: 2021) and the results have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.13. **Density test** on rock sample were performed in accordance with IS 13030-1991-(RA: 2021) and results have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.14. Water absorption and Porosity test on rock samples were performed in accordance with IS: 1124-1974-(RA:2017) and results have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.15. Hardness test on rock samples were performed in accordance with IS: 13630 (part-XIII) -2019 and results have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.16. Unconfined Compressive Strength tests on rock samples were performed in accordance with IS 9143-1979-(RA:2021) and results have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.17. Point load index tests on rock samples were performed in accordance with IS: 8764-1998-(RA:2019) and results have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B.

5.18. Cerchar Abrasive Index test on rock samples were performed in accordance with ASTM-D7625 and results have been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix B.

6. GROUND WATER TABLE:

The water table at this site was encountered during the drilling operation up to the depth of investigation.

Borehole No.	Chainage	Global Co-ordinates (UTM format)		Reduced level (m)	Depth of Borehole (m)	Water table (m)
		Easting	Northing			
P134A	24433.047	700904.347	3121360.768	200.107	40.00	9.20
P146A	24747.447	700789.522	3121563.095	207.274	12.50	9.10

7. DESCRIPTION OF STRATA:

The classification of soil stratum has been done with the help of soil characteristics obtained in laboratory tests as per IS 1498-1970-(RA:2021). The classification of rock masses has been done based on RMR as per IS: 4464-1985, IS: 13365-1. The detailed nature of the strata has been reported in Table 1 to 2: "SUMMARY

OF TEST RESULTS" of Appendix-B and represented through Lithological plots in Appendix-C.

The strata exhibited in the bore hole P134A is predominantly consisting of silty sands, with inorganic silty clays of low plastic category and inorganic silts of non to low plastic category. Borehole P146A is consists of slightly to highly weathered fine grained quartzite rock mass which the top covered with a small thickness of 0.50 m with silty sands, till the depth of investigation.

8. CLASSIFICATION CRITERIA OF ROCK MASSES:

Rock classification in terms of weathering, state of fractures and strength is carried out in the following manner based on IS: 4464-1985, IS: 13365-1. Tabulations given in below explain it briefly.

TERMS	DESCRIPTION	GRADE	GEOLOGIST INTERPRETATION
Fresh	No visible sign of rock material weathering; perhaps slight coloration on major discontinuity surfaces	I	CR > 90 %
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discoloured by weathering.	II	CR between 70 % to 90 %
Moderately Weathered	Less than half of the rock material is decomposed or disintegrated to a soil. Fresh or discoloured rock is present either as a continuous framework or as core-stones.	III	CR between 51 % to 70 %
Highly Weathered	More than half of the rock material is decomposed or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as core-stones.	IV	CR between 11 % to 50 %
Completely weathered	All rock material is decomposed and / or disintegrated to soil. The original mass structure is still largely intact.	V	CR between zero to 10 %
Residual Soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI	CR = Zero % But N > 50

CR indicate Core Recovery

It should be understood that all grades of weathering may not be seen in a given rock mass and that in some cases a particular grade may be present to a very small extent. Distribution of the various weathering grades of rock material in the rock mass may be related to the porosity of the rock material and the presence of open discontinuities of all types in the rock mass.

8.1 Relation between RQD and In-situ Rock quality:

Relation between RQD and In-situ Rock quality is further measured by frequency of natural joints in rock mass. Rock Quality Designation (RQD) is used to define state of fractures or massiveness of rock. Following table defines the quality of rock mass.

RQD classification	RQD (%)
Excellent	91 to 100
Good	76 to 90
Fair	51-75
Poor	25-50
Very Poor	0-25

8.2 Classification of Rock by Compressive Strength:

Rock type	Unconfined compressive strength (MPa)
Extremely strong	>200
Very Strong	100 to 200
Strong	50 to 100
Moderately Strong	12.5 to 50
Moderately Weak	5 to 12.5
Weak	1.25 to 5
Very weak	<1.25

9. SAFE BEARING CAPACITY COMPUTATIONS:

For the construction of viaducts, deep foundation proposed to be resting on soil and rock mass **(Bored Cast-In-Situ RCC piles** and **bored cast-in-situ rock socketed RCC piles)** have been considered for computation of load bearing capacity of the underlying strata. The computation of load bearing capacity of bored cast-in-situ RCC piles have been done as per IS 2911 (part-1, section-2)-2010-(RA: 2020), with due consideration of effects of liquefaction and rock socketed RCC piles as per IRC:78-2014

9.1. Pile Load Capacity in soils:

9.1.1. Design Parameters:

Factor of safety in Compression	=	2.50
Factor of safety in Tension	=	3.00
Depth of critical water table	=	0.00 m
Diameter of pile	=	1.00 & 1.20 m
Cut off length	=	2.50 m
Type of pile head consider	=	Fixed

9.1.2. Computation of friction along pile stem:

$Q_{uf} = \sum K_i . P_{di} . \tan\delta_i . A_{si}$

where,

Q_{uf} = Ultimate shaft friction (kN/m^2)

K_i = Coefficient of earth pressure at mid-depth of i^{th} layer

P_{di} = Effective overburden pressure at mid-depth of i^{th} layer (kN/m^2)

A_{si} = Surface area of pile stem in i^{th} layer (m^2)

δ_i = Angle of wall friction between pile and soil of i^{th} layer (= ϕ) (degree)

ϕ_i = Angle of internal friction of soil in i^{th} layer (degree)

$\sum$ = Sum of all layers up to i^{th} layer

9.1.3. Computation of Cohesion along the stem of pile:

$Q_{uc} = \sum \alpha_i . c_i . A_{si}$

Where,

c_i = Cohesion in i^{th} layer

A_{si} = Surface area of pile stem in i^{th} layer (m^2)

α_i = Adhesion factor for i^{th} layer of soil depending of consistency of soils

$\sum$ = Sum of cohesion of all layers considered

9.1.4. Computation of end bearing resistance:

$$Q_{ub} = A_p (c.Nc + q.Nq + 0.5.\gamma.B.N\gamma)$$

Where,

A_p = Area of the pile toe (m^2)

c = cohesion of soils at pile toe (kN/m^2)

γ = Effective Unit weight of soils at pile toe (kN/m^3)

B = Diameter of pile (m)

q = Effective overburden pressure at pile toe (kN/m^2)

N_c = Bearing Capacity Factor (Recommended equal to 9)

Nq, Nγ = Bearing Capacity Factor

9.1.5. Lateral load capacity of piles in soils:

$Q_u = 12.E.I.\delta/(L_1+L_f)^3$

where,

Q_u = Ultimate lateral load capacity of pile (kN)

δ = Permissible deflection (m) = 5 mm

E = Young Modulus of pile material (kN/m^2)

I = Moment of Inertia of the pile cross section (m^4)

L_1 = Cantilever Length of pile (m)

L_f = Length of fixity (m)

Detailed calculations of pile load carrying capacity in compression & uplift in soil have been reported in **Table-4 to 5** of **Appendix-I.**

Pile lateral Load capacity has been given in **Table-6 to 7** of **Appendix-I**.

9.2. Pile Load Capacity in rock:

Computations of the vertical load capacity of the piles in rock has been work out as per the method given in IRC:78-2014.

9.2.1. As per IRC:78-2014 (Method-1):

If the rock mass encountered at this site exhibits (CR+RQD)/2 > **30%**, Method 1 of IRC: 78-2014 shall be been used for computing the axial pile load capacity in rock formations.

$$Q_a = R_e/3 + R_{af}/6$$

where,

R_e = K_{sp} x D_f x q_c x A_b

R_{af} = C_{us} x A_s

D = Diameter of the pile (m)

Q_a = Allowable load capacity of pile socketed into rock (kN/m^2)

R_e = Ultimate end bearing capacity (kN/m^2)

R_{af} = Ultimate side socket shear capacity (kN/m^2)

K_{sp} = empirical value ranging from 0.3 to 1.2

L_s = Socket length of pile (m)

D_f = Depth factor =1 + 0.4 L_s/D (≤ 1.2)

q_c = average unconfined compressive strength below base of pile (up to 2D)

A_b = Area of pile base (mm^2)

A_s = Area of socket (mm^2)

C_{us} = Estimated average shear strength of rock along socket length (≤ 3.0 for M35 Concrete).

9.2.2. As per IRC:78-2014 (Method-2):

If the rock mass encountered at the site exhibits (CR+RQD)/2< **30%**, Method 2 of IRC: 78-2014 shall be been used for computing the axial pile load capacity in rock formations.

$$Q_a = R_e/3 + R_{af}/6$$

$$Q_t = R_{af}/6 + \text{Self weight of pile}$$

where,

R_e = C_{ub} x N_c x A_b

R_{af} = C_{us} x A_s

D = Diameter of the pile (m)

Q_a = Allowable load capacity of pile socketed into rock (kN)

Q_t = Allowable load capacity of pile in uplift (kN)

R_e = Ultimate end bearing capacity (kN/m^2)

R_{af} = Ultimate side socket shear capacity (kN/m^2)

C_{ub} = Average shear strength below base of pile tip for depth upto 2D

L_s = Socket length of pile (m)

N_c = Bearing Capacity factor = 9 (as per code)

A_b = Area of pile base (m^2)

A_s = Area of socket (m^2)

C_{us} = Shear strength along socket length (≤ 3.0 for M35 Concrete).

The detailed calculations of pile load carrying capacity in compression and uplift on rock based on method-1 of IRC:78-2014 have been reported in **Table-2 & 3** of **Appendix-I.**

9.3. Computation of RMR values:

A gross estimate of bearing capacity of completely or partially weathered rock masses have been done based on Rock Mass Rating (RMR). The estimation of RMR value of jointed rock masses have been worked out based on IS 13365 (part I). Rock Mass Rating parameters are reproduced from Annexure B of IS 13365 (part I) below for ready reference. The final RMR value of rock is referred from the Table 3 of IS code 12070.

9.3.1. Rating as per UCS

Description	Compressive Strength (MPa)	Rating	Basis
Exceptionally Strong	>250	15	UCS value data of specific borehole from laboratory test is used in RMR
Very Strong	100 to 250	12	
Strong	50 to 100	7	
Average	25 to 50	4	
Weak	10 to 25	2	
Very Weak	2 to 10	1	
Extremely Weak	<2	0	

9.3.2. Rating as per RQD

Description	RQD (%)	Rating	Basis
Excellent	91 to 100	20	RQD values of specific boreholes below given depth from relevant borehole are used in RMR.
Good	76 to 90	17	
Fair	51 to 75	13	
Poor	26 to 50	8	
Very Poor	0 to 25	3	

9.3.3. Rating as per Spacing of discontinuities

Description	Spacing (m)	Rating	Basis
Vey wide	>2	20	Spacing of discontinuities of specific borehole from field observations is used in RMR
Wide	0.6 to 2	15	
Moderate	0.2 to 0.6	10	
Close	0.06 to 0.2	8	
Very close	<0.06	5	

9.3.4. Rating as per Condition of discontinuities

Condition	Rating
Very rough and un-weathered rock wall rock, tight and discontinuous, no separation	30
rough and slightly weathered wall rock surface, separation < 1mm	25
slightly rough and moderately to highly weathered wall rock surface, separation< 1mm	20
Slickensides wall rock surface or 1-5mm thick gauge or1-5 mm wide opening, continuous discontinuity	10
Soft gauge> 5 mm thick or Separation > 5 mm	0

9.3.5. Rating as per Ground Water Conditions

General Description	Rating
Completely dry	15
Damp	10
Wet	7
Dripping	4
Flowing	0

9.3.6. Rating as per adjustment for discontinuity orientations

Strike and dip orientations of discontinuities	Very favourable	Favourable	Fair	Un-favourable	Very Un-favourable
Foundation	0	-2	-7	-15	-35

9.3.7. Net safe bearing pressures based on RMR as per Table 3 of IS:12070-1987-(RA: 2020)

Classification No.	I	II	III	IV	V
Rock Description	Very Good	Good	Fair	Poor	Very Poor
RMR	100-81	80-61	60-41	40-21	20-0
Q_{net} (t/m^2)	600-448	440-288	280-141	135-48	45-30

The results of Rock Mass Rating have been reported in **Table-1** of **Appendix-I.**

10. LIQUEFACTION ANALYSIS:

Liquefaction is the sudden loss of shear strength of the loose fine sands due to earthquake-induced vibration under saturated conditions. Liquefaction generally takes place in loose fine sands (fines < 10 %, D_{60}= 0.20 mm to 1.0 mm and C_u between 2 to 5) with N value less than 15. In case of soil strata having N>15, liquefaction of soil will not take place normally.

The present site falls in **seismic zone – IV.** Considering the history of past earthquakes and available seismic data, an earthquake of **magnitude 7.0** having peak ground acceleration **a_{max}= 0.24 g** is considered in the present analysis.

Preliminary assessment of liquefaction potential of foundation strata is made by simplified approach proposed by IS: 1893 (part-1)-2016-(RA: 2021) from the data obtained in Standard Penetration Test.

In this method, cyclic shear stress likely to be induced in the foundation strata by Design Basis Earthquake is first evaluated. Next threshold cyclic shear stress, which is good enough to cause liquefaction, is determined from SPT data and the empirical relations. Finally, comparison of these two stresses is used in the estimation of liquefaction susceptibility of the foundation strata.

Cyclic Stress Ratio (CSR):

The equivalent average of shear stress likely to be induced in the foundation material due to an earthquake is calculated by using the equations

Cyclic Resistance Ratio (CRR):

It expresses capacity of soil to resist liquefaction. CRR is determined using correlation between corrected blow count $(N_1)_{60}$ and CRR for earthquake of magnitude 7.5. $(N_1)_{60}$ is the SPT blow count corrected to an effective overburden pressure of 100 kPa and to hammer energy efficiency of 60 %.

Following variable have been adopted in calculation of N_{60} (SPT value for 60% efficiency)

Energy correction to SPT values:

C_{60} = 1.00 (energy efficiency factor)

Design Earthquake Base:

Earthquake zone	= IV
Magnitude of earthquake	= 7
Seismic Zone factor	= 0.24

Status of Liquefaction:

The value of CSR and CRR are computed at different depth and then the ratio of CRR to CSR to get the factor of safety towards the susceptibility of the stratum towards liquefaction potential.

If factor of safety:

$<$ 1.00 : Stratum is to be considered as liquefiable

$>$ 1.20 : Non-Liquefiable

The detailed calculations of liquefaction, have been reported in **Table-8** of **Appendix-I.**

11. RECOMMENDATIONS:

Keeping in mind, the field test results, laboratory test results and IS codes of practice the following recommendations are hereby made:

11.1. Bored Cast-In-Situ RCC Piles of diameter 1000 and 1200 mm have been adopted for

SBC computations of foundation for Viaduct.

11.2. Cut off length of piles have been considered as 2.50 m for piles in soil and 2.00 m for pile in rock from the existing ground level for the purpose of computation of SBC.

11.3. Pile length recommended in the table below, shall be measured **after the cut-off depth.**

11.4. Allowable load carrying capacity of pile corresponding to the length and diameter of pile shall be read from the tables below:

11.4.1. For Pile diameter = 1000 mm

Borehole No.	End bearing Strata type	Pile Length (m)	Rock Socket length (m)	Load carrying Capacity (kN)		
				Compression	Uplift	Lateral Concrete M35*
P134A	Soils	25.00	-	2450	1600	235
		27.50	-	2750	1750	
		30.00	-	2500	1950	
		32.50	-	3500	2150	
		35.00	-	2900	2300	
P146A	Rock	3.50	3.50	7650	3800	-

* *Indicates Grade of Concrete*

11.4.2. For Pile diameter = 1200 mm

Borehole No.	End bearing Strata type	Pile Length (m)	Rock Socket length (m)	Load carrying Capacity (kN)		
				Compression	Uplift	Lateral Concrete M35*
P134A	Soils	25.00	-	3700	2250	330
		27.50	-	4250	2500	
		30.00	-	3700	2800	
		32.50	-	5400	3100	
		35.00	-	4250	3350	
P146A	Rock	4.20	4.20	11400	5850	-

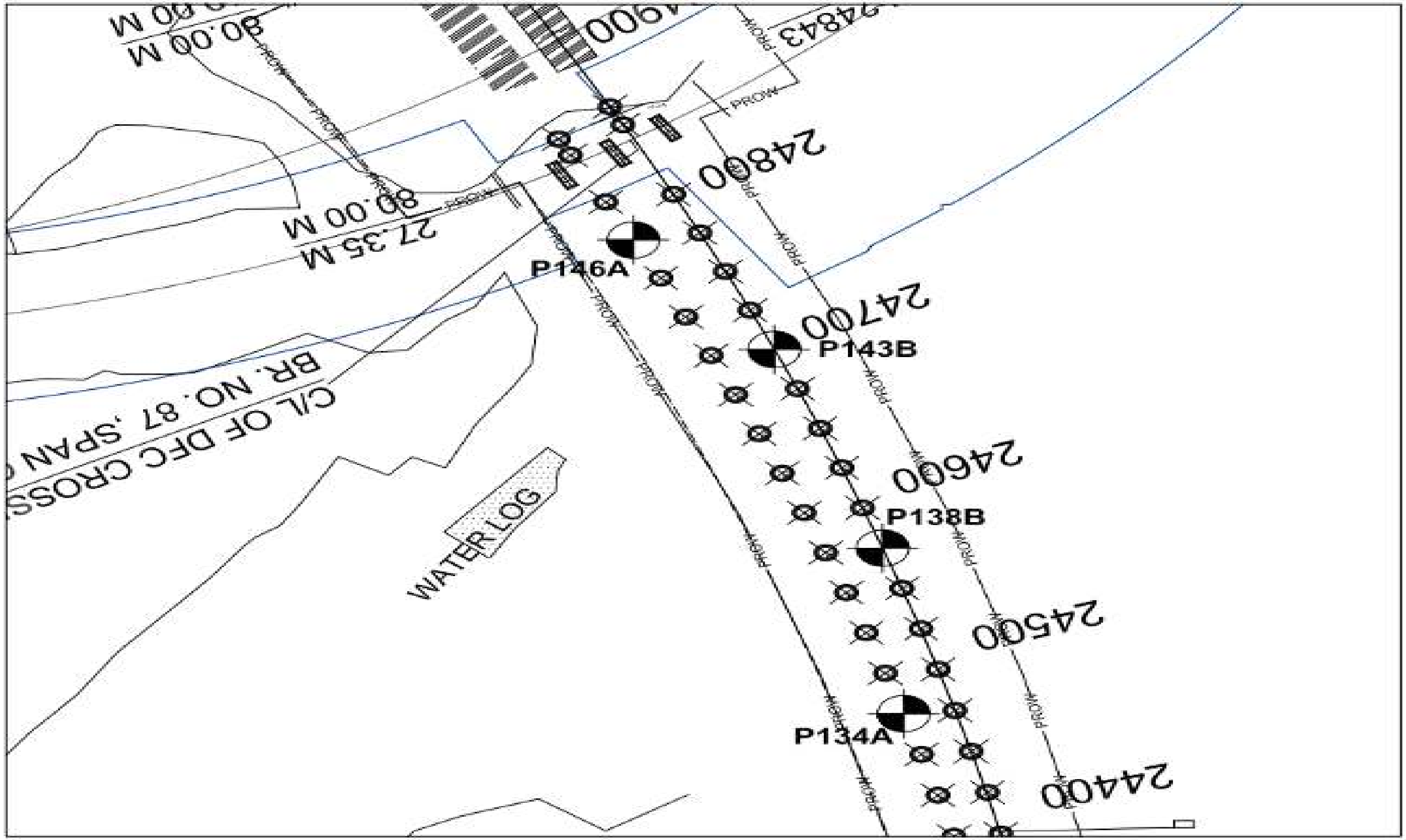
* *Indicates Grade of Concrete*

11.5. Liquefaction Potential: Both the bore holes have been analysed for Liquefaction potential as per IS: 1893 (part-1)-2016-(RA: 2021) with Seismic Zone IV, earthquake intensity of 7.0 on Richter scale and critical ground water table at existing ground level. Out of which none of the boreholes show the liquefaction potential.

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech.(Civil), M.Tech.
Principal Consultant &
Managing Director

APPENDIX-A
TEST LOCATION PLAN



APPENDIX "B"
TABLE 1: SUMMARY OF TEST RESULTS

Bore No : P134A	**Ground Elevation : RL 200.107 m**	**Method of drilling :Percussion**	**Depth of Water : 9.20 m**
Diameter of Bore Hole : 150 mm	**Bore Retained using : Casing**	**Starting Date : 25/11/2023**	**SPT Sampler: Standard**
Location / Chainage : 24433.047	**Casing Lowered : 17.00 m**	**Ending Date : 27/11/2023**	**Hammer type: Rope-pulley driven**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Correct N)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	0	82	18	0	2.26	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	1.00	U	2	-	-	-	-	-	SM	0	0	0	85	15	0	2.97	1.65	1.60	Non Plastic			2.61	DST	0.0	29.9	-	0.631	-	-	-	-												
	2.00	D	3	5	8	10	18	24.71	-	-	-	-	-	-	-	19.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	4	7	9	16	19.80	SM	0	0	1	72	27	0	13.19	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	4.00	U	5	-	-	-	-	-	-	-	-	-	-	-	-	20.66	1.93	1.60	-	-	-	2.61	DST	2.0	29.1	-	0.631	-	-	-	-	Silty Sands											
	5.00	D	6	8	14	20	34	35.51	SM	0	1	2	71	26	0	13.18	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	8	15	20	35	34.23	-	-	-	-	-	-	-	13.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	U	8	-	-	-	-	-	SM	0	0	0	72	28	0	18.50	1.82	1.54	Non Plastic			2.63	DST	2.0	30.2	-	0.708	-	-	-	-												
	8.00	D	9	9	16	22	38	33.45	-	-	-	-	-	-	-	21.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	8	15	25	40	40.00	CL	4	1	2	12	73	8	19.43	-	-	29.0	20.5	8.5	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	CL	3	1	3	14	67	12	20.42	2.01	1.67	31.5	21.5	10.0	2.68	UU	50.0	10.1	0.141	0.605	-	8	19	-												
	11.00	D	12	10	10	17	27	27.00	-	-	-	-	-	-	-	23.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	12.00	D	13	9	11	18	29	29.00	-	-	-	-	-	-	-	20.67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	U	15	-	-	-	-	-	CL	8	4	6	11	58	13	18.27	2.05	1.73	29.5	20.0	9.5	2.67	UU	61.0	14.7	-	0.543	-	7	19	-												
	14.50	D	16	7	10	16	26	17.08	ML	0	1	2	24	66	7	22.19	-	-	27.0	22.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	16.00	D	17	-	-	-	-	-	SM	2	1	1	66	30	0	20.02	2.08	1.73	Non Plastic			2.66	RDST	0.0	29.6	-	0.538	-	-	-	-												
	17.50	D	18	25	30	43	73	32.74	-	-	-	-	-	-	-	20.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Silty Sands											

APPENDIX "B"
TABLE 1: SUMMARY OF TEST RESULTS

Bore No : P134A	Ground Elevation : RL 200.107 m	Method of drilling :Percussion	Depth of Water : 9.20 m
Diameter of Bore Hole : 150 mm	Bore Retained using : Casing	Starting Date : 25/11/2023	SPT Sampler: Standard
Location / Chainage : 24433.047	Casing Lowered : 17.00 m	Ending Date : 27/11/2023	Hammer type: Rope-pulley driven

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Correct N)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	19.00	D	19	24	28	38	66	29.64	SM	5	2	2	67	24	0	19.41	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	20.50	D	20	13	25	38	63	28.13	-	-	-	-	-	-	-	17.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	D	21	16	28	35	63	27.64	-	-	-	-	-	-	-	18.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	23.50	D	22	18	30	40	70	29.35	SM	1	0	1	74	24	0	18.40	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	25.00	D	23	15	25	32	57	24.90	-	-	-	-	-	-	-	16.63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	26.50	D	24	18	30	39	69	28.08	SM	0	0	1	74	25	0	20.32	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	28.00	D	25	13	28	32	60	25.00	SM	4	1	1	53	41	0	19.21	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-												
	29.50	D	26	14	24	35	59	24.33	SM-SC	5	2	3	41	42	7	19.61	-	-	27.0	21.5	5.5	-	-	-	-	-	-	-	-	-	-	Silty Sands with clay binder											
	31.00	D	27	13	21	41	62	24.81	-	-	-	-	-	-	-	18.37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	32.50	D	28	18	40	45	85	85.00	CL	7	1	5	30	48	9	15.95	-	-	29.0	21.5	7.5	2.67	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	34.00	D	29	17	21	41	62	24.09	SM	0	0	0	82	18	0	20.72	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	35.50	D	30	18	25	32	57	22.44	CL-ML	3	1	2	28	60	6	18.88	-	-	26.0	21.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	37.00	D	31	13	21	38	59	22.64	ML	4	1	3	25	61	6	21.13	-	-	27.0	22.0	5.0	-	-	-	-	-	-	-	-	-	-	Inorganic Silts of low plasticity											
	38.50	D	32	15	25	38	63	23.34	-	-	-	-	-	-	-	19.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	40.00	D	33	18	23	32	55	21.05	SM	2	1	0	75	22	0	19.33	-	-	Non Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No: P146A	Ground Elevation: RL 207.274 m	Method of drilling: Rotary	Depth of Water: 9.10 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 01/11/2023	
Location / Chainage: 24747.447	Casing Lowered: 3.00	Ending Date: 04/09/2023	

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.00	D	1	-	-	-	-	-	SM	1	1	0	65	33	0	6.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Silty Sands											
	0.50	C	2	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	Highly weathered and very-poor quality quartzite Rock									35	0	2.59	2.73	0.05	0.59	-	-	0.15	-	-	-
	1.25	C	3	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-										33	0	-	2.53	-	0.94	7.85	-	-	8.00	-	2.70
	2.00	C	4	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-										33	13	-	-	-	-	-	80.25	-	-	-	-
	2.75	C	5	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-										31	13	2.62	-	0.13	-	5.66	-	0.22	-	-	-
	3.50	C	6	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	Moderately weathered and poor quality quartzite Rock									53	45	-	-	-	-	9.69	86.17	-	8.50	-	2.71
	4.25	C	7	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-										56	47	-	2.67	-	0.06	-	-	-	-	-	-
	5.00	C	8	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	Highly weathered and very-poor quality quartzite Rock									48	0	2.64	-	0.02	-	-	-	0.05	-	-	-
	5.75	C	9	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	Slightly weathered and Fair quality quartzite Rock									73	73	-	-	-	-	9.86	115.82	-	-	-	3.30
	6.50	C	10	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	Moderately weathered and very-poor quality quartzite Rock									51	13	-	2.76	-	0.08	-	-	-	8.50	-	-
	7.25	C	11	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-										56	16	2.66	2.65	0.14	0.33	-	-	0.40	-	-	-
	8.00	C	12	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-										53	19	2.56	-	0.14	-	-	74.44	1.53	-	-	3.20
	8.75	C	13	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	Moderately weathered and poor quality quartzite Rock									56	33	-	-	-	-	4.64	46.54	-	8.00	-	-
	9.50	C	14	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	Slightly weathered and poor quality quartzite Rock									73	31	2.45	2.59	0.08	0.11	-	91.28	0.64	-	-	3.70
	10.25	C	15	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	Moderately weathered and very-poor quality quartzite Rock									58	15	2.63	-	0.14	-	-	-	0.12	-	-	-

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No: P146A	Ground Elevation: RL 207.274 m	Method of drilling: Rotary	Depth of Water: 9.10 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 01/11/2023	
Location / Chainage: 24747.447	Casing Lowered: 3.00	Ending Date: 04/09/2023	

FIELD TEST RESULT										LABORATORY TEST RESULT																															
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	11.00	C	16	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	Moderately weathered and very-poor quality quartzite Rock									56	0	-	2.68	-	0.07	-	-	-	-	-	3.60
	12.50	C	17	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	Highly weathered and very- poor quality quartzite Rock									31	0	-	-	-	-	10.56	-	-	8.50	-	-

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX-B
TABLE 3: UCS TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	UCS (kg/cm^2)
P134A	10.00	0.54
	13.00	0.76

APPENDIX-C
PLOT 1: LITHOLOGICAL PROFILE-01

PROFILE SHEET IS TO BE AFFIX

APPENDIX-C
PLOT 2: LITHOLOGICAL PLOTS

BH-P134A-24433.047

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	U		-	-
			2.00	D	18	-	-
			3.00	D	16	-	-
			4.00	U		-	-
			5.00	D	34	-	-
			6.00	D	35	-	-
			7.00	U		-	-
			8.00	D	38	-	-
Inorganic clays of low plasticity	CL		9.00	D	40	-	-
			10.00	U		-	-
			11.00	D	27	-	-
			12.00	D	29	-	-
			13.00	U		-	-
Inorganic Silts of low plasticity	ML		14.50	D	26	-	-
Silty Sands	SM		16.00	D		-	-
			17.50	D	43	-	-
			19.00	D	66	-	-
			20.00	D	63	-	-

BH-P134A-24433.047

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		20.50	D	63	-	-
			22.00	D	63	-	-
			23.50	D	70	-	-
			25.00	D	57	-	-
			26.50	D	69	-	-
			28.00	D	60	-	-
Silty Sands with clay binder	SM-SC		29.50	D	50	-	-
			31.00	D	62	-	-
Inorganic clays of low plasticity	CL		32.50	D	85	-	-
Silty Sands	SM		34.00	D	62	-	-
Inorganic Silty Clays of low plasticity	CL-ML		35.50	D	57	-	-
Inorganic Silts of low plasticity	ML		37.00	D	59	-	-
			38.50	D	63	-	-
			40.00	D	55	-	-

APPENDIX-C
PLOT 3: LITHOLOGICAL PLOTS

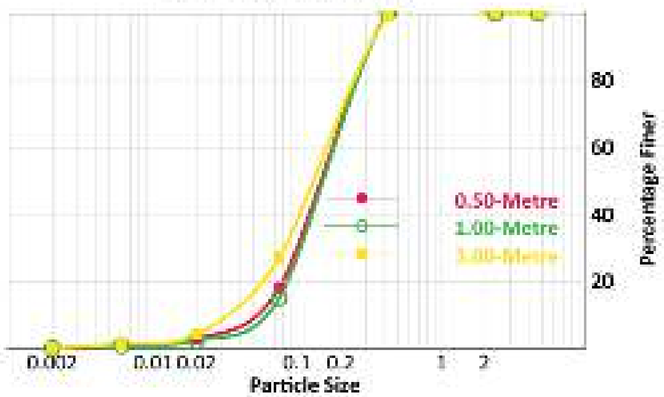
BH-P146A-24747.4470

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.00	D		-	-
Highly weathered and very poor quality Rock mass			0.50	C		35	0
			1.25	C		33	0
			2.00	C		33	13
			2.75	C		31	13
Moderately weathered and poor quality rock mass			3.50	C		53	45
			4.25	C		56	47
Highly weathered and very-poor quality rock mass			5.00	C		48	0
Slightly weathered and fair quality rock mass			5.75	C		73	73
Moderately weathered and very poor quality Rock mass			6.50	C		51	13
			7.25	C		56	16
			8.00	C		53	19
Moderately weathered and poor quality rock mass	WATER LVL		8.75	C		56	33
Slightly weathered and poor quality rock mass			9.50	C		73	31
Moderately weathered and very poor quality Rock mass			10.25	C		58	15
			11.00	C		56	0
Highly weathered and very-poor quality rock mass			12.50	C		31	0

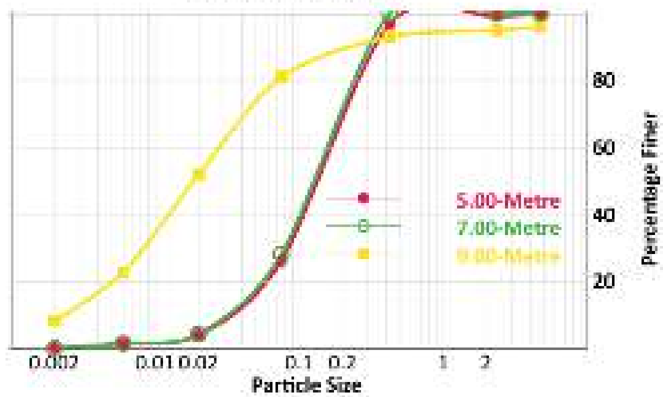
APPENDIX-D

PLOT 1: GRAIN SIZE DISTRIBUTION PLOTS

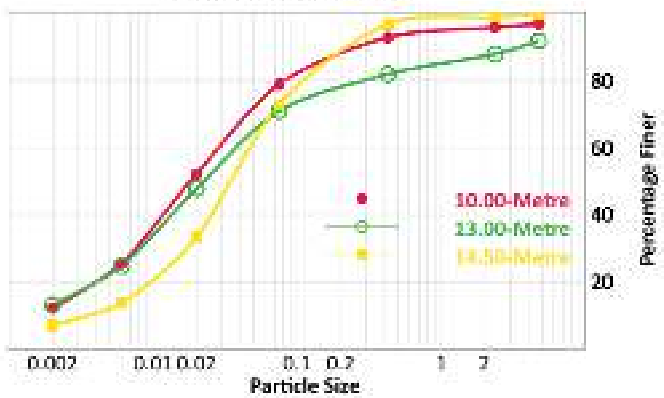
BH- P134A-CH.24433.047



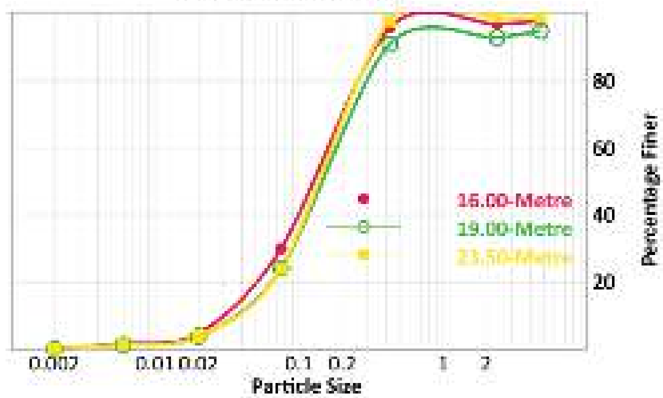
BH- P134A-CH.24433.047



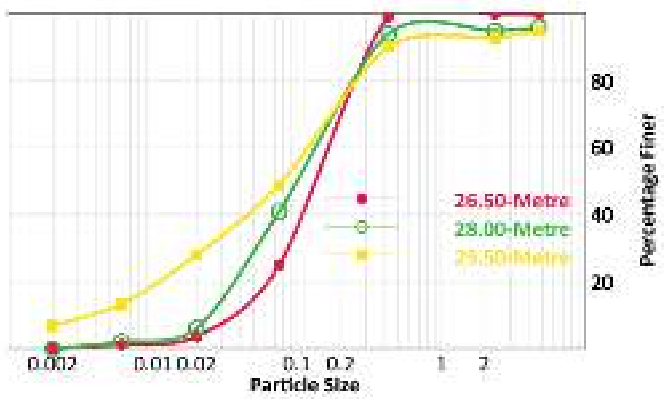
BH- P134A-CH.24433.047



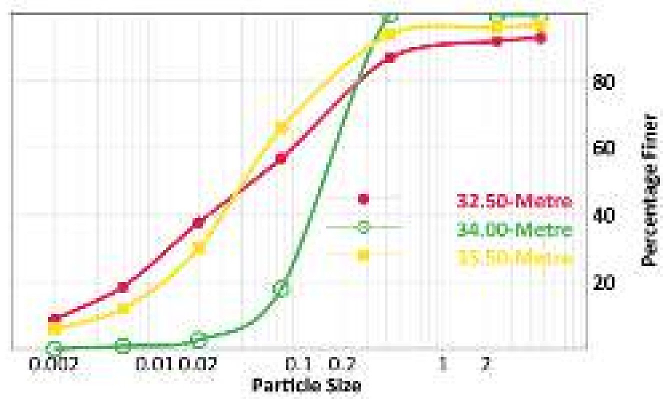
BH- P134A-CH.24433.047



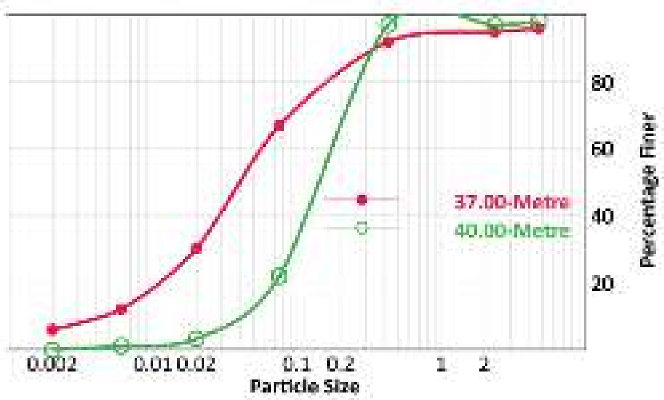
BH- P134A-CH.24433.047



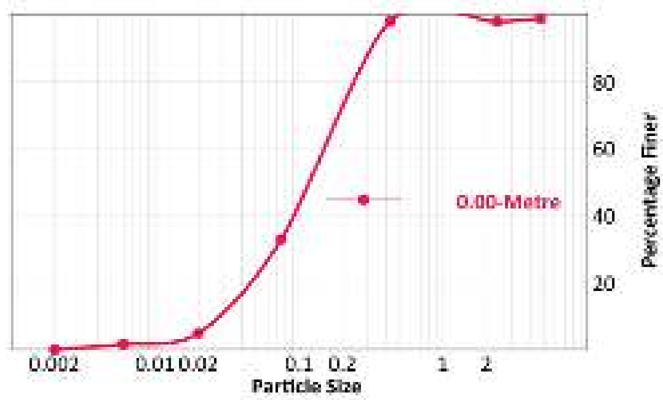
BH- P134A-CH.24433.047



BH- P134A-CH.24433.047

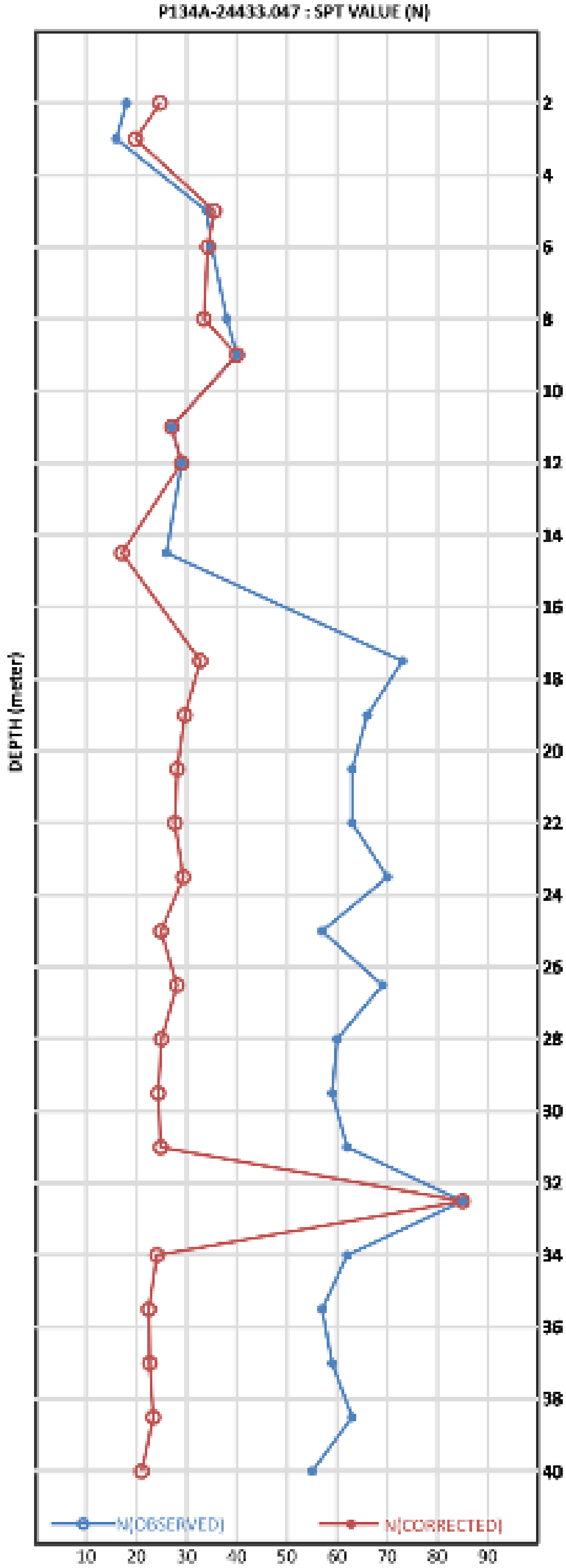


BH- P146A-CH.24747.447

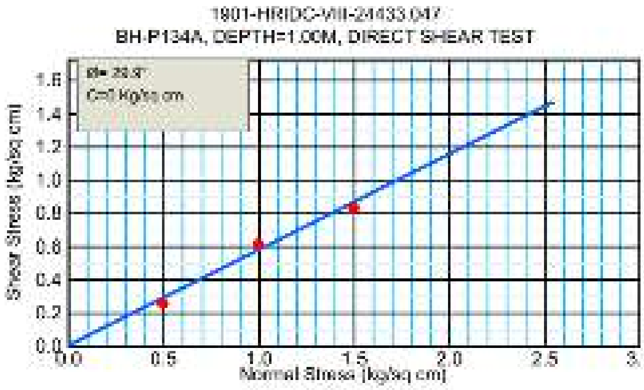


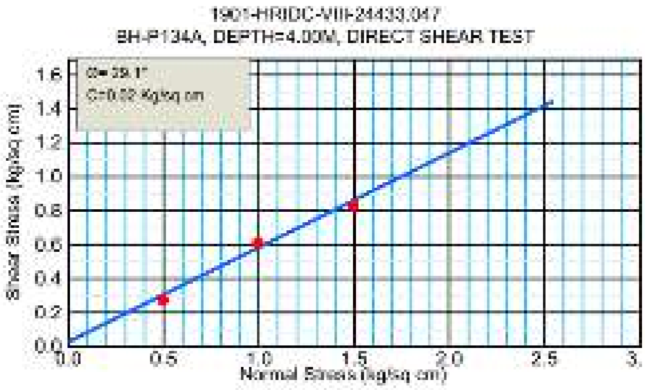
APPENDIX-E

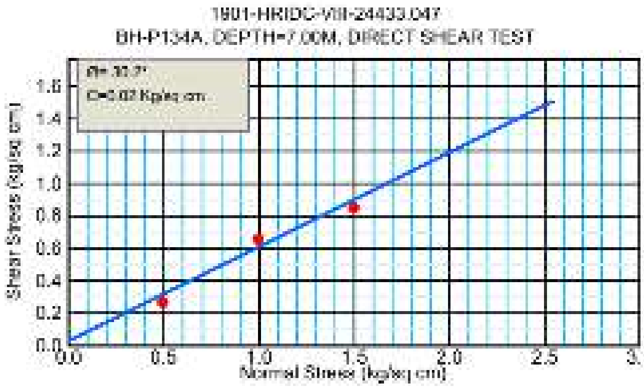
PLOT 1: RECORDED SPT Vs CORRECTED SPT (P134A)

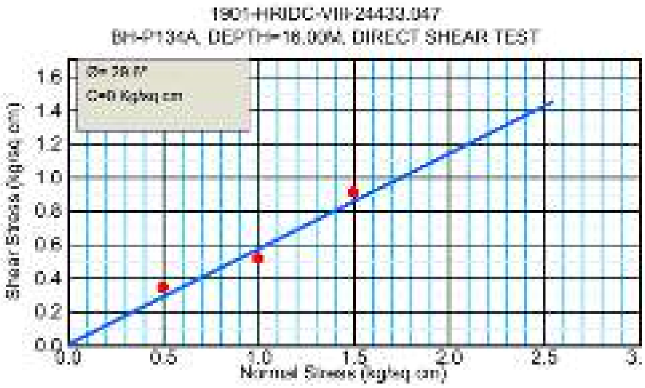


APPENDIX-F
GRAPH 1: DST GRAPH

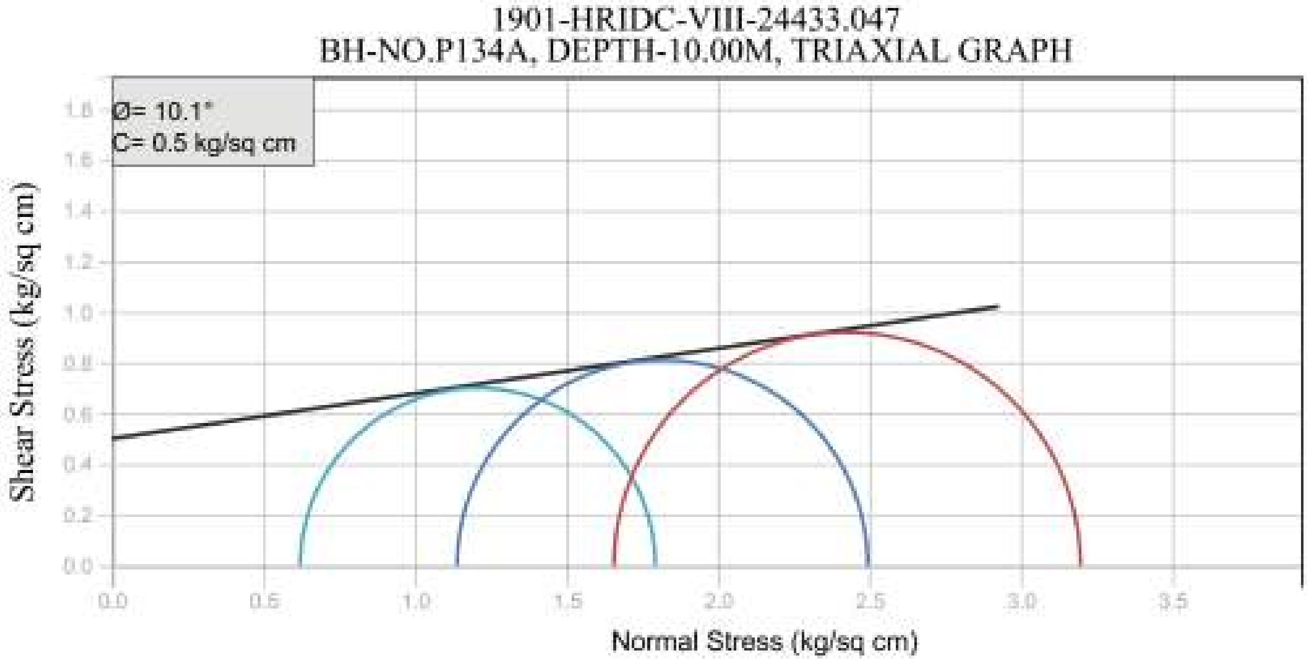


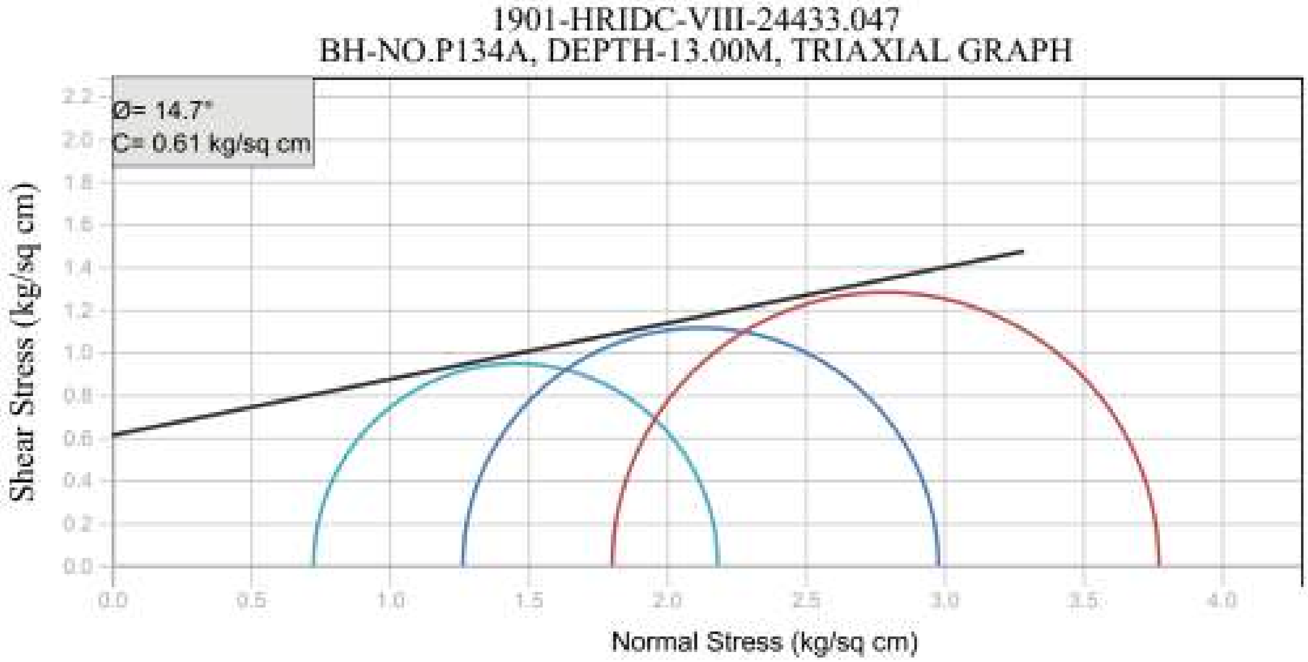




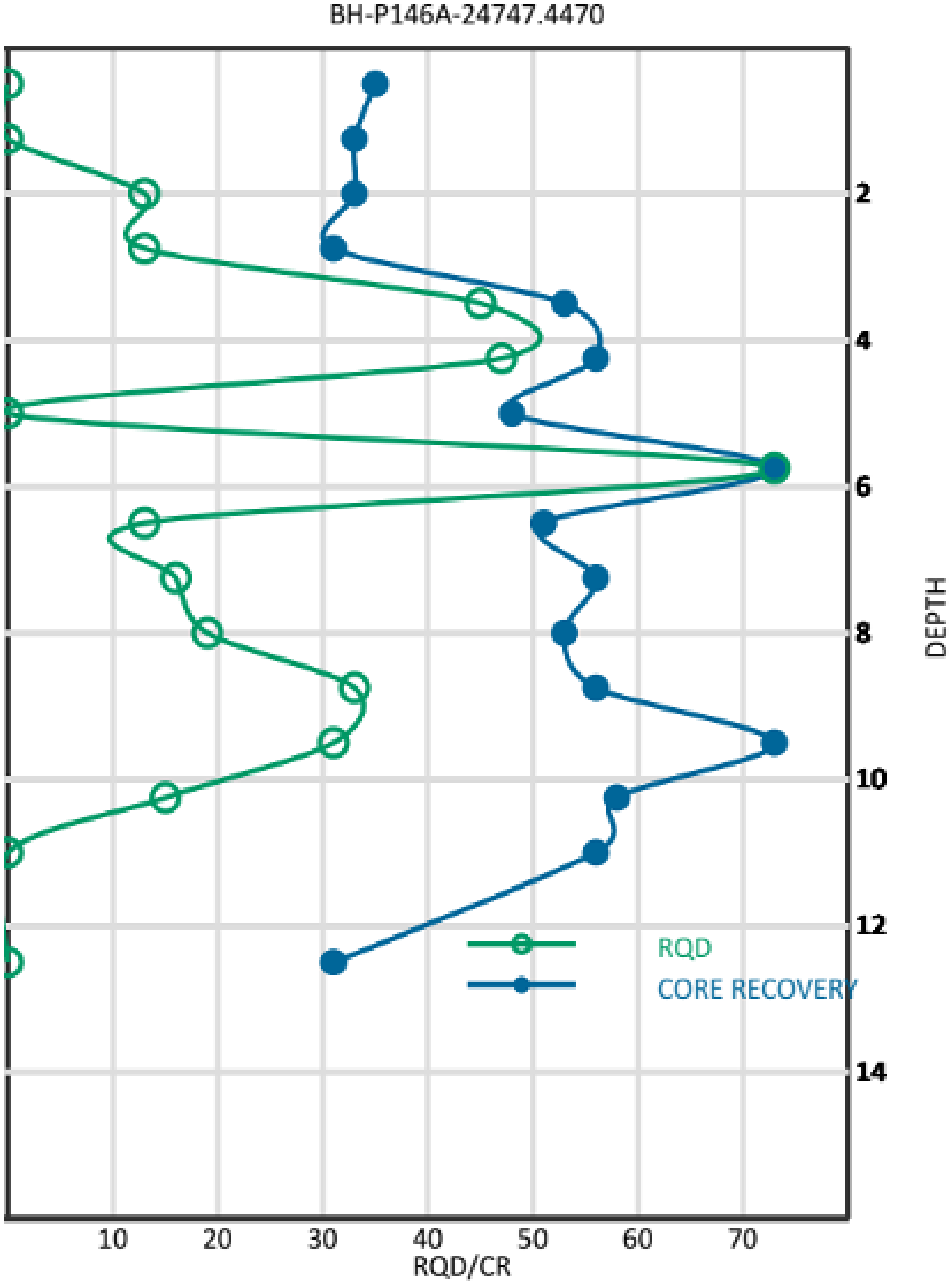


APPENDIX-G
GRAPH 1: UU GRAPH





APPENDIX-H
PLOT 1: CR Vs RQD PLOTS



APPENDIX-I
TABLE 1: RMR COMPUTATIONS

Bore Hole No.	Depth (m)	UCS Rating	RQD Rating	Spacing of Joint Rating	Condition of discontinuity	Ground Water Rating	Strike & Dip Orientation of Joint	RMR Value	Rock Class	Description
BH-P146A	0.50-1.25	7	3	8	20	10	-2	46	III	Fair
BH-P146A	1.25-2.00	7	3	8	20	10	-2	46	III	Fair
BH-P146A	2.00-2.75	7	3	5	20	10	-2	43	III	Fair
BH-P146A	2.75-3.50	7	3	8	20	10	-2	46	III	Fair
BH-P146A	3.50-4.25	7	8	8	20	10	-2	51	III	Fair
BH-P146A	4.25-5.00	7	8	8	20	10	-2	51	III	Fair
BH-P146A	5.00-5.75	7	3	8	20	10	-2	46	III	Fair
BH-P146A	5.75-6.50	12	13	8	20	10	-2	61	II	Good
BH-P146A	6.50-7.25	7	3	8	20	7	-7	38	IV	Poor
BH-P146A	7.25-8.00	7	3	8	20	7	-7	38	IV	Poor
BH-P146A	8.00-8.75	7	3	8	20	0	-7	31	IV	Poor
BH-P146A	8.75-9.50	4	8	8	20	0	-7	33	IV	Poor
BH-P146A	9.50-10.25	7	8	8	20	0	-7	36	IV	Poor
BH-P146A	10.25-11.00	4	3	8	20	0	-7	28	IV	Poor
BH-P146A	11.00-12.50	4	3	8	20	0	-7	28	IV	Poor
BH-P146A	12.50-13.25	4	3	5	20	0	-7	25	IV	Poor

APPENDIX-I

TABLE 2: VERTICAL PILE LOAD CAPACITY IN ROCK (Dia. 1000 mm)

Bore No.	Depth of Overburden Soil (m)	Diameter of pile (mm)	Socket Length Provided (L_s) mm	Design Socket Length (L_s<=6 D) mm	D_f	Overall Length of pile (m)	q_c (Mpa)	K_{sp}	Ab (Area of pile base) (mm^2)	q_{cs} (Mpa)	C_{us} (MPa)	As (Area of socket) (mm^2)	R_e (N)	R_{af} (N)	Allowable Pile end-bearing capacity Q_{ab} (kN)	Allowable Pile shaft friction Q_{af} (kN)	Pile self-weight (kN)	Allowable pile capacity in compression Q_a (kN)	Allowable pile capacity in uplift Q_t (kN)
P146A	0.50	1000	3500	3500	1.2	3.50	110	0.5	785398	83	2.05	10995574	53761626	22539251	17921	3757	69	7684	3825

APPENDIX-I

TABLE 3: VERTICAL PILE LOAD CAPACITY IN ROCK (Dia. 1200 mm)

Bore No.	Depth of Overburden Soil (m)	Diameter of pile (mm)	Socket Length Provided (L_s) mm	Design Socket Length (L_s<=6 D) mm	D_f	Overall Length of pile (m)	q_c (Mpa)	K_{sp}	Ab (Area of pile base) (mm^2)	q_{cs} (Mpa)	C_{us} (MPa)	As (Area of socket) (mm^2)	R_e (N)	R_{af} (N)	Allowable Pile end-bearing capacity Q_{ab} (kN)	Allowable Pile shaft friction Q_{af} (kN)	Pile self-weight (kN)	Allowable pile capacity in compression Q_a (kN)	Allowable pile capacity in uplift Q_t (kN)
P146A	0.50	1200	4200	4200	1.2	4.20	95	0.4	1130973	94	2.18	15833627	46138866	34540360	15380	5757	119	11412	5875

APPENDIX-I

TABLE 4: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m
Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0
Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: P134A, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	16.48	6.48	17.82	1.57	29.9	29.9	1.0	16.10	16.10	0	1.0	0.0	0.00	3.0	29.1	2	9.31	19.23	20.33	19.4	382.3	398.4	5.9	22.0	**159.34**	**7.33**
3.00	5.00	4.00	2.00	2.50	19.31	9.31	28.75	6.29	29.1	29.1	1.0	100.58	116.69	2	1.0	12.6	12.57	5.0	30.2	2	9.31	22.27	23.43	38.1	765.7	895.0	29.5	158.7	**357.98**	**52.91**
5.00	6.00	5.50	1.00	3.50	19.31	9.31	42.72	3.14	30.2	30.2	1.0	78.92	195.60	2	1.0	6.3	18.86	6.0	30.2	2	8.25	22.27	23.43	47.4	918.8	1133.3	41.3	255.7	**453.31**	**85.24**
6.00	8.00	7.00	2.00	5.50	18.25	8.25	55.62	6.29	30.2	30.2	1.0	205.51	401.12	2	1.0	12.6	31.43	8.0	30.2	2	8.25	22.27	23.43	63.9	1207.5	1640.0	64.8	497.4	**656.02**	**165.79**
8.00	9.00	8.50	1.00	6.50	18.25	8.25	68.00	3.14	30.2	30.2	1.0	125.62	526.73	2	1.0	6.3	37.71	9.0	10.1	50	10.11	2.50	1.25	72.1	500.2	1064.6	76.6	641.1	**425.84**	**213.69**
9.00	11.00	10.00	2.00	8.50	20.11	10.11	82.23	6.29	10.1	10.1	1.0	92.07	618.80	50	1.0	314.3	352.00	11.0	10.1	50	10.11	2.50	1.25	92.3	539.9	1510.7	100.2	1071.0	**604.27**	**356.99**
11.00	12.00	11.50	1.00	9.50	20.11	10.11	97.40	3.14	10.1	10.1	1.0	54.52	673.33	50	1.0	157.1	509.14	12.0	12.3	58	10.46	3.15	1.88	102.5	671.1	1853.5	112.0	1294.4	**741.42**	**431.48**
12.00	14.50	13.25	2.50	12.00	20.46	10.46	115.53	7.86	12.3	12.3	1.0	197.91	871.24	58	1.0	455.7	964.86	14.5	11.5	29	10.46	2.91	1.65	128.6	506.0	2342.1	141.4	1977.5	**936.83**	**659.17**
14.50	16.00	15.25	1.50	13.50	20.46	10.46	115.53	4.71	11.5	11.5	1.0	110.80	982.04	29	1.0	136.7	1101.57	16.0	29.6	0	10.76	20.36	21.48	128.6	2147.9	4231.5	159.1	2242.7	**1692.61**	**747.57**
16.00	17.50	16.75	1.50	15.00	20.76	10.76	115.53	4.71	29.6	29.6	1.0	309.39	1291.43	0	1.0	0.0	1101.57	17.5	30.8	0	10.76	25.29	26.50	128.6	2667.3	5060.3	176.8	2569.8	**2024.14**	**856.59**
17.50	19.00	18.25	1.50	16.50	20.76	10.76	115.53	4.71	30.8	30.8	1.0	337.64	1629.07	0	1.0	0.0	1101.57	19.0	30.1	0	10.76	21.76	22.91	128.6	2295.9	5026.5	194.5	2925.1	**2010.61**	**975.04**
19.00	20.50	19.75	1.50	18.00	20.76	10.76	115.53	4.71	30.1	30.1	1.0	317.28	1946.35	0	1.0	0.0	1101.57	20.5	29.9	0	8.81	21.03	22.17	128.6	2202.1	5250.0	212.1	3260.1	**2100.01**	**1086.69**
20.50	22.00	21.25	1.50	19.50	18.81	8.81	115.53	4.71	29.9	29.9	1.0	313.17	2259.52	0	1.0	0.0	1101.57	22.0	29.8	0	8.99	20.81	21.94	128.6	2180.1	5541.2	229.8	3590.9	**2216.48**	**1196.97**
22.00	23.50	22.75	1.50	21.00	18.99	8.99	115.53	4.71	29.8	29.8	1.0	311.91	2571.43	0	1.0	0.0	1101.57	23.5	30.1	0	8.94	21.76	22.91	128.6	2279.5	5952.5	247.5	3920.5	**2381.00**	**1306.83**
23.50	25.00	24.25	1.50	22.50	18.94	8.94	115.53	4.71	30.1	30.1	1.0	317.28	2888.71	0	1.0	0.0	1101.57	25.0	29.2	0	8.66	19.46	20.56	128.6	2036.0	6026.3	265.2	4255.5	**2410.52**	**1418.49**
25.00	26.50	25.75	1.50	24.00	18.66	8.66	115.53	4.71	29.2	29.2	1.0	304.38	3193.09	0	1.0	0.0	1101.57	26.5	29.9	0	9.25	21.03	22.17	128.6	2205.9	6500.6	282.9	4577.5	**2600.24**	**1525.84**
26.50	27.50	27.00	1.00	25.00	19.25	9.25	115.53	3.14	29.9	29.9	1.0	208.78	3401.87	0	1.0	0.0	1101.57	27.5	27.6	0	9.25	15.85	16.87	128.6	1663.3	6166.8	294.6	4798.1	**2466.71**	**1599.36**

APPENDIX-I

TABLE 4: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	∑Qi	c	α	α.c.Asi	∑Qi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
27.50	28.00	27.75	0.50	25.50	19.25	9.25	115.53	1.57	27.6	27.6	1.0	94.91	3496.77	0	1.0	0.0	1101.57	28.0	27.4	0	9.07	15.40	16.41	128.6	1615.0	6213.3	300.5	4898.9	**2485.34**	**1632.96**
28.00	29.50	28.75	1.50	27.00	19.07	9.07	115.53	4.71	27.4	27.4	1.0	282.30	3779.08	0	1.0	0.0	1101.57	29.5	27.4	0	9.14	15.40	16.41	128.6	1615.4	6496.1	318.2	5198.9	**2598.44**	**1732.95**
29.50	30.00	29.75	0.50	27.50	19.14	9.14	115.53	1.57	27.4	27.4	1.0	94.10	3873.18	0	1.0	0.0	1101.57	30.0	28.9	0	9.14	18.78	19.87	128.6	1969.2	6943.9	324.1	5298.9	**2777.56**	**1766.29**
30.00	31.00	30.50	1.00	28.50	19.14	9.14	115.53	3.14	28.9	28.9	1.0	200.43	4073.61	0	1.0	0.0	1101.57	31.0	30.0	0	8.94	21.26	22.40	128.6	2226.8	7402.0	335.9	5511.1	**2960.79**	**1837.02**
31.00	32.50	31.75	1.50	30.00	18.94	8.94	115.53	4.71	30.0	30.0	1.0	314.44	4388.04	0	1.0	0.0	1101.57	32.5	17.3	40	8.55	5.07	3.91	128.6	808.4	6298.1	353.6	5843.2	**2519.22**	**1947.73**
32.50	34.00	33.25	1.50	31.50	18.55	8.55	115.53	4.71	17.3	17.3	1.0	169.63	4557.67	40	1.0	188.6	1290.14	34.0	30.8	0	9.32	25.29	26.50	128.6	2652.4	8500.2	371.3	6219.1	**3400.07**	**2073.02**
34.00	35.00	34.50	1.00	32.50	19.32	9.32	115.53	3.14	30.8	30.8	1.0	225.10	4782.77	0	1.0	0.0	1290.14	35.0	30.8	0	9.32	25.29	26.50	128.6	2652.4	8725.3	383.0	6455.9	**3490.11**	**2151.98**
35.00	35.50	35.25	0.50	33.00	19.32	9.32	115.53	1.57	30.8	30.8	1.0	112.55	4895.32	0	1.0	0.0	1290.14	35.5	17.0	30	9.02	4.92	3.75	128.6	723.0	6908.4	388.9	6574.4	**2763.36**	**2191.46**
35.50	37.00	36.25	1.50	34.50	19.02	9.02	115.53	4.71	17.0	17.0	1.0	166.51	5061.82	30	1.0	141.4	1431.57	37.0	16.5	30	9.38	4.68	3.47	128.6	697.6	7191.0	406.6	6900.0	**2876.40**	**2300.00**
37.00	37.50	37.25	0.50	35.00	19.38	9.38	115.53	1.57	16.5	16.5	1.0	53.77	5115.60	30	1.0	47.1	1478.71	37.5	16.5	30	9.38	4.68	3.47	128.6	697.6	7291.9	412.5	7006.8	**2916.77**	**2335.60**
37.50	38.50	38.00	1.00	36.00	19.38	9.38	115.53	3.14	16.5	16.5	1.0	107.55	5223.15	30	1.0	94.3	1573.00	38.5	14.9	30	9.06	3.91	2.62	128.6	616.7	7412.8	424.3	7220.4	**2965.12**	**2406.81**
38.50	40.00	39.25	1.50	37.50	19.06	9.06	115.53	4.71	14.9	14.9	1.0	144.91	5368.06	30	1.0	141.4	1714.43	40.0	28.5	0	10.49	17.88	18.94	128.6	1884.9	8967.4	442.0	7524.5	**3586.95**	**2508.15**

APPENDIX-I

TABLE 5: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: P134A, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	16.48	6.48	17.82	1.89	29.9	29.9	1.0	19.32	19.32	0	1.0	0.0	0.00	3.0	29.1	2	9.31	19.23	20.33	19.4	571.9	591.2	8.5	27.8	**236.47**	**9.27**
3.00	5.00	4.00	2.00	2.50	19.31	9.31	28.75	7.54	29.1	29.1	1.0	120.70	140.02	2	1.0	15.1	15.09	5.0	30.2	2	9.31	22.27	23.43	38.1	1127.3	1282.4	42.4	197.5	**512.96**	**65.85**
5.00	6.00	5.50	1.00	3.50	19.31	9.31	42.72	3.77	30.2	30.2	1.0	94.70	234.72	2	1.0	7.5	22.63	6.0	30.2	2	8.25	22.27	23.43	47.4	1345.0	1602.3	59.4	316.8	**640.93**	**105.58**
6.00	8.00	7.00	2.00	5.50	18.25	8.25	55.62	7.54	30.2	30.2	1.0	246.62	481.34	2	1.0	15.1	37.71	8.0	30.2	2	8.25	22.27	23.43	63.9	1760.7	2279.7	93.3	612.4	**911.89**	**204.13**
8.00	9.00	8.50	1.00	6.50	18.25	8.25	68.00	3.77	30.2	30.2	1.0	150.74	632.08	2	1.0	7.5	45.26	9.0	10.1	50	10.11	2.50	1.25	72.1	721.7	1399.0	110.3	787.7	**559.60**	**262.55**
9.00	11.00	10.00	2.00	8.50	20.11	10.11	82.23	7.54	10.1	10.1	1.0	110.48	742.56	50	1.0	377.1	422.40	11.0	10.1	50	10.11	2.50	1.25	92.3	778.8	1943.8	144.3	1309.2	**777.52**	**436.41**
11.00	12.00	11.50	1.00	9.50	20.11	10.11	97.40	3.77	10.1	10.1	1.0	65.43	807.99	50	1.0	188.6	610.97	12.0	12.3	58	10.46	3.15	1.88	102.5	968.6	2387.5	161.2	1580.2	**955.01**	**526.73**
12.00	14.50	13.25	2.50	12.00	20.46	10.46	115.53	9.43	12.3	12.3	1.0	237.49	1045.49	58	1.0	546.9	1157.83	14.5	11.5	29	10.46	2.91	1.65	128.6	730.6	2933.9	203.7	2407.0	**1173.55**	**802.32**
14.50	16.00	15.25	1.50	13.50	20.46	10.46	136.45	5.66	11.5	11.5	1.0	157.04	1202.53	29	1.0	164.1	1321.89	16.0	29.6	0	10.76	20.36	21.48	144.3	3480.5	6004.9	229.1	2753.5	**2401.98**	**917.84**
16.00	17.50	16.75	1.50	15.00	20.76	10.76	152.36	5.66	29.6	29.6	1.0	489.64	1692.17	0	1.0	0.0	1321.89	17.5	30.8	0	10.76	25.29	26.50	160.4	4784.0	7798.0	254.6	3268.6	**3119.22**	**1089.54**
17.50	19.00	18.25	1.50	16.50	20.76	10.76	152.36	5.66	30.8	30.8	1.0	534.36	2226.53	0	1.0	0.0	1321.89	19.0	30.1	0	10.76	21.76	22.91	160.4	4117.7	7666.1	280.0	3828.4	**3066.46**	**1276.15**
19.00	20.50	19.75	1.50	18.00	20.76	10.76	152.36	5.66	30.1	30.1	1.0	502.14	2728.67	0	1.0	0.0	1321.89	20.5	29.9	0	8.81	21.03	22.17	160.4	3950.6	8001.2	305.5	4356.0	**3200.48**	**1452.01**
20.50	22.00	21.25	1.50	19.50	18.81	8.81	152.36	5.66	29.9	29.9	1.0	495.63	3224.29	0	1.0	0.0	1321.89	22.0	29.8	0	8.99	20.81	21.94	160.4	3911.1	8457.2	330.9	4877.1	**3382.90**	**1625.71**
22.00	23.50	22.75	1.50	21.00	18.99	8.99	152.36	5.66	29.8	29.8	1.0	493.63	3717.92	0	1.0	0.0	1321.89	23.5	30.1	0	8.94	21.76	22.91	160.4	4089.4	9129.2	356.4	5396.2	**3651.69**	**1798.74**
23.50	25.00	24.25	1.50	22.50	18.94	8.94	152.36	5.66	30.1	30.1	1.0	502.14	4220.06	0	1.0	0.0	1321.89	25.0	29.2	0	8.66	19.46	20.56	160.4	3652.8	9194.7	381.9	5923.8	**3677.89**	**1974.60**
25.00	26.50	25.75	1.50	24.00	18.66	8.66	152.36	5.66	29.2	29.2	1.0	481.71	4701.77	0	1.0	0.0	1321.89	26.5	29.9	0	9.25	21.03	22.17	160.4	3957.3	9980.9	407.3	6431.0	**3992.37**	**2143.66**
26.50	27.50	27.00	1.00	25.00	19.25	9.25	152.36	3.77	29.9	29.9	1.0	330.42	5032.19	0	1.0	0.0	1321.89	27.5	27.6	0	9.25	15.85	16.87	160.4	2983.8	9337.9	424.3	6778.4	**3735.17**	**2259.45**

APPENDIX-I

TABLE 5: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 1.13 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								φ	δ	Ki	Qi	∑Qi	c	α	α.c.Asi	∑Qi	Depth of Pile toe (m)	φ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
27.50	28.00	27.75	0.50	25.50	19.25	9.25	152.36	1.89	27.6	27.6	1.0	150.20	5182.39	0	1.0	0.0	1321.89	28.0	27.4	0	9.07	15.40	16.41	160.4	2897.2	9401.5	432.8	6937.0	**3760.59**	**2312.35**
28.00	29.50	28.75	1.50	27.00	19.07	9.07	152.36	5.66	27.4	27.4	1.0	446.78	5629.17	0	1.0	0.0	1321.89	29.5	27.4	0	9.14	15.40	16.41	160.4	2898.0	9849.0	458.2	7409.3	**3939.61**	**2469.76**
29.50	30.00	29.75	0.50	27.50	19.14	9.14	152.36	1.89	27.4	27.4	1.0	148.93	5778.09	0	1.0	0.0	1321.89	30.0	28.9	0	9.14	18.78	19.87	160.4	3532.6	10632.5	466.7	7566.7	**4253.01**	**2522.23**
30.00	31.00	30.50	1.00	28.50	19.14	9.14	152.36	3.77	28.9	28.9	1.0	317.20	6095.30	0	1.0	0.0	1321.89	31.0	30.0	0	8.94	21.26	22.40	160.4	3994.9	11412.1	483.7	7900.9	**4564.82**	**2633.62**
31.00	32.50	31.75	1.50	30.00	18.94	8.94	152.36	5.66	30.0	30.0	1.0	497.63	6592.93	0	1.0	0.0	1321.89	32.5	17.3	40	8.55	5.07	3.91	160.4	1350.6	9265.4	509.1	8424.0	**3706.16**	**2807.99**
32.50	34.00	33.25	1.50	31.50	18.55	8.55	152.36	5.66	17.3	17.3	1.0	268.46	6861.39	40	1.0	226.3	1548.17	34.0	30.8	0	9.32	25.29	26.50	160.4	4758.1	13167.6	534.6	8944.2	**5267.06**	**2981.39**
34.00	35.00	34.50	1.00	32.50	19.32	9.32	152.36	3.77	30.8	30.8	1.0	356.24	7217.63	0	1.0	0.0	1548.17	35.0	30.8	0	9.32	25.29	26.50	160.4	4758.1	13523.9	551.6	9317.4	**5409.56**	**3105.79**
35.00	35.50	35.25	0.50	33.00	19.32	9.32	152.36	1.89	30.8	30.8	1.0	178.12	7395.75	0	1.0	0.0	1548.17	35.5	17.0	30	9.02	4.92	3.75	160.4	1222.2	10166.1	560.1	9504.0	**4066.45**	**3167.99**
35.50	37.00	36.25	1.50	34.50	19.02	9.02	152.36	5.66	17.0	17.0	1.0	263.52	7659.27	30	1.0	169.7	1717.89	37.0	16.5	30	9.38	4.68	3.47	160.4	1176.7	10553.9	585.5	9962.7	**4221.55**	**3320.89**
37.00	37.50	37.25	0.50	35.00	19.38	9.38	152.36	1.89	16.5	16.5	1.0	85.10	7744.37	30	1.0	56.6	1774.46	37.5	16.5	30	9.38	4.68	3.47	160.4	1176.7	10695.5	594.0	10112.8	**4278.22**	**3370.94**
37.50	38.50	38.00	1.00	36.00	19.38	9.38	152.36	3.77	16.5	16.5	1.0	170.21	7914.58	30	1.0	113.1	1887.60	38.5	14.9	30	9.06	3.91	2.62	160.4	1031.5	10833.7	611.0	10413.1	**4333.48**	**3471.05**
38.50	40.00	39.25	1.50	37.50	19.06	9.06	152.36	5.66	14.9	14.9	1.0	229.34	8143.92	30	1.0	169.7	2057.31	40.0	28.5	0	10.49	17.88	18.94	160.4	3380.7	13581.9	636.4	10837.7	**5432.77**	**3612.55**

APPENDIX-I

TABLE 6: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1000 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Length of Fixity (m)	Allowable Load capacity of pile(kN)
P134A	1.00	2.50	0.00	35	29580399	0.0491	30	4280	3.21	0.00	0.00	2.23	0.005	7.15	238

APPENDIX-I

TABLE 7: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1200 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m²)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Length of fixity (m)	Allowable Load capacity of pile(kN)
P134A	1.20	2.50	0.00	35	29580399	0.1018	32	4568	3.66	0.00	0.00	2.23	0.005	8.17	332

APPENDIX-I
TABLE 8: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
P134A	0.50	SM	18	18	8.25	5.00	3.25	1.00	0.394	1.70	30.60	3.23	1.07	35.86	0.52	1.00	0.620	1.572	Non-liquefiable
	2.00	SM	15	18	33.00	20.00	13.00	0.98	0.390	1.70	30.60	2.50	1.05	34.57	0.52	1.00	0.620	1.591	Non-liquefiable
	3.00	SM	27	16	49.50	30.00	19.50	0.98	0.387	1.70	27.20	4.48	1.13	35.22	0.52	1.00	0.620	1.603	Non-liquefiable
	5.00	SM	26	34	82.50	50.00	32.50	0.96	0.381	1.70	57.80	4.39	1.12	69.27	0.52	1.00	0.620	1.629	Non-liquefiable
	6.00	SM	26	35	115.80	60.00	55.80	0.95	0.309	1.34	46.85	4.39	1.12	56.99	0.52	1.00	0.620	2.008	Non-liquefiable
	8.00	SM	28	38	154.40	80.00	74.40	0.94	0.304	1.16	44.06	4.56	1.14	54.70	0.52	1.00	0.620	2.041	Non-liquefiable
	9.00	CL	81	40	163.80	90.00	73.80	0.93	0.322	1.16	46.56	5.00	1.20	60.87	0.52	1.00	-	-	Non-liquefiable
	11.00	CL	79	27	200.20	110.00	90.20	0.88	0.305	1.05	28.43	5.00	1.20	39.11	0.52	1.00	-	-	Non-liquefiable
	12.00	CL	79	29	241.20	120.00	121.20	0.85	0.265	0.91	26.34	5.00	1.20	36.61	0.52	1.00	-	-	Non-liquefiable
	14.50	ML	73	26	291.45	145.00	146.45	0.79	0.244	0.83	21.48	5.00	1.20	30.78	0.52	1.00	0.620	2.539	Non-liquefiable
	16.00	SM	30	26	328.00	160.00	168.00	0.75	0.227	0.77	20.06	4.71	1.15	27.86	0.36	0.83	0.360	1.583	Non-liquefiable
	17.50	SM	30	73	364.00	175.00	189.00	0.71	0.212	0.73	53.10	4.71	1.15	66.00	0.52	0.79	0.492	2.315	Non-liquefiable
	19.00	SM	24	66	395.20	190.00	205.20	0.67	0.200	0.70	46.07	4.18	1.11	55.21	0.52	0.77	0.477	2.382	Non-liquefiable
	20.50	SM	24	63	426.40	205.00	221.40	0.63	0.188	0.67	42.34	4.18	1.11	51.07	0.52	0.75	0.464	2.465	Non-liquefiable
	22.00	SM	24	63	457.60	220.00	237.60	0.59	0.176	0.65	40.87	4.18	1.11	49.45	0.52	0.73	0.452	2.566	Non-liquefiable
	23.50	SM	24	70	488.80	235.00	253.80	0.56	0.168	0.63	43.94	4.18	1.11	52.85	0.52	0.71	0.441	2.624	Non-liquefiable
	25.00	SM	24	57	520.00	250.00	270.00	0.56	0.168	0.61	34.69	4.18	1.11	42.60	0.52	0.70	0.432	2.566	Non-liquefiable
	26.50	SM	25	69	551.20	265.00	286.20	0.56	0.168	0.59	40.79	4.29	1.12	49.77	0.52	0.68	0.423	2.512	Non-liquefiable

APPENDIX-I
TABLE 8: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	28.00	SM	41	60	582.40	280.00	302.40	0.56	0.168	0.58	34.50	5.00	1.20	46.40	0.52	0.67	0.414	2.462	Non-liquefiable
	29.50	SM-SC	49	59	613.60	295.00	318.60	0.56	0.168	0.56	33.05	5.00	1.20	44.67	0.52	0.66	0.406	2.415	Non-liquefiable
	31.00	SM-SC	49	62	644.80	310.00	334.80	0.56	0.168	0.55	33.88	5.00	1.20	45.66	0.52	0.64	0.399	2.372	Non-liquefiable
	32.50	CL	57	85	676.00	325.00	351.00	0.56	0.168	0.53	45.37	5.00	1.20	59.44	0.52	0.63	-	-	Non-liquefiable
	34.00	SM	18	62	707.20	340.00	367.20	0.56	0.168	0.52	32.35	3.23	1.07	37.74	0.52	0.62	0.386	2.293	Non-liquefiable
	35.50	CL-ML	66	57	738.40	355.00	383.40	0.56	0.168	0.51	29.11	5.00	1.20	39.93	0.52	0.61	-	-	Non-liquefiable
	37.00	ML	67	59	769.60	370.00	399.60	0.56	0.168	0.50	29.51	5.00	1.20	40.42	0.52	0.60	0.374	2.224	Non-liquefiable
	38.50	ML	67	63	800.80	385.00	415.80	0.56	0.168	0.49	30.90	5.00	1.20	42.07	0.52	0.59	0.369	2.192	Non-liquefiable
	40.00	SM	22	55	832.00	400.00	432.00	0.56	0.168	0.48	26.46	3.93	1.09	32.85	0.52	0.59	0.364	2.161	Non-liquefiable

APPENDIX-J
SITE PHOTOGRAPHS


SPT at depth 11.00 m


SPT at depth 38.50 m

Coring at depth 1.25 m


Coring at depth 9.50 m

APPENDIX-J
SITE PHOTOGRAPHS

Core box samples

APPENDIX-K
LABORATORY PHOTOGRAPHS

Dry density test of rock

UCS test of rock

Point load index test

Cerchar abrasive index test

APPENDIX-K
LABORATORY PHOTOGRAPHS

Atterbergs' Limit test

Tri-axial shear test

UCS of soil

APPENDIX-L
CHART 1: FIELD BORELOG CHART (P134A)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTI.O for HORC Viaduct B/w Sohana-Dhulawat Station			Project Code:	1901
Coordinate:	N: 3131360.768	E: 700904.947	Location/ Chainage: 94433.0430		
Method of Drilling:	Percussion	Drilling Equipment:	Auto trip Hammer	Bore No.:	P.134 A
Casing Lowered (M):	17.00	Bentonite Used: Yes	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L-200.107	Date: From 25/11/23 to 26/11/23		Water Table (M):	9.20

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
25/11/23	0.00	0.50	0.50	DS	9"	Collected										Non Cohesive Soil
"	1.00	1.45	0.45	U	"	Received										do
"	2.00	2.45	0.45	DP	"	5	8	10	18							do
"	3.00	3.45	0.45	DP	"	4	7	9	16							do
"	4.00	4.45	0.45	U	"	Received										do
"	5.00	5.45	0.45	DP	"	8	14	20	34							Non Cohesive Soil
"	6.00	6.45	0.45	DP	"	8	15	20	35							do
"	7.00	7.45	0.45	U	"	Received										do
"	8.00	8.45	0.45	DP	"	9	16	22	38							do
"	9.00	9.45	0.45	DP	"	8	15	25	40							Cohesive Soil with
"	10.00	10.45	0.45	U	"	Received										do Gravel
"	11.00	11.45	0.45	DP	"	10	10	17	27							do
"	12.00	12.45	0.45	DP	"	9	11	18	29							do
"	13.00	13.45	0.45	U	"	Received										do
"	14.50	14.95	0.45	DP	"	7	10	16	26							do
"	16.00	16.45	0.45	U	"	Slipped										Non Cohesive Soil
"	17.50	17.95	0.45	DP	"	25	30	43	73							do
"	19.00	19.45	0.45	DP	"	24	28	38	66							do
26/11/23	20.50	20.95	0.45	DP	"	13	25	38	63							do
"	22.00	22.45	0.45	DP	"	16	28	35	63							do
"	23.50	23.95	0.45	DP	"	18	30	40	70							do
"	25.00	25.45	0.45	DP	"	15	25	32	57							do
"	26.50	26.95	0.45	DP	"	18	30	39	69							do
"	28.00	28.45	0.45	DP	"	13	28	32	60							do

Supervisor

E - in - C

Abbreviation Used : U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-L

CHART 2: FIELD BORELOG CHART (P134A)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GT/ 003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date:	28.12.2021

Project Name:	GTI for HORC Viaduct B/w Sohana Dhulawat Station			Project Code:	1901
Coordinate:	N: 3181360.368	E: 700904.347		Location/ Chainage:	94433.0430
Method of Drilling:	Percussion	Drilling Equipment:	Auto trip Rotary winch	Bore No.:	P.134A
Casing Lowered (M):	17.00	Bentonite Used: Yes	Standard Sampler: Yes	Barrel Type:	NA
Ground Elevation:	R.L-200.167	Date: From 26/11/23 to 27/11/23		Water Table (M):	9.20

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
26/11/23	29.50	29.95	0.45	DP	NX	14	24	35	59							Non Cohesive Soil
"	31.00	31.45	0.45	DP	"	13	21	41	62							do
"	32.50	32.95	0.45	DP	"	18	40	45	85							do
"	34.00	34.45	0.45	DP	"	17	21	41	62							do
"	35.50	35.95	0.45	DP	"	18	25	32	57							do
"	37.00	37.45	0.45	DP	"	13	21	38	59							do
27/11/23	38.50	38.95	0.45	DP	"	15	25	38	63							do
"	40.00	40.45	0.45	DP	"	18	23	32	55							Non Cohesive Soil

Supervisor

E - in - C

Abbreviation Used :- U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-L
CHART 3: FIELD BORELOG CHART (P146A)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/003
Date of Issue:	01/04/2018
Rev. No.:	R03
Rev. Date:	28.12.2021

Project Name: GTW HORC Viaduct b/w Sohna & Dhulawat Station | Project Code: 1901

Coordinate: N: 3121563.095 E: 700789.522 | Location/ Chainage: 24747.4470

Method of Drilling: Rotary | Drilling Equipment: Hydraulic | Bore No.: P-146A

Casing Lowered (M): 3.00 | Bentonite Used: Not | Standard Sampler: Yes | Barrel Type: Double

Ground Elevation: RL-307.374 | Date: From 01/11/23 to 04/11/23 | Water Table (M): 9.10

Day / Date	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
1/11/23	0.00	0.50	0.50	DS	Sr	Collected				–	–	–	–	–	-	Non-Cohesive Soil
"	0.50	1.25	0.75	C	Nx	–	–	–	–	9:00	10:05	35	NIL	25	Light Brown	Light brown Fractured Quartzite Rock
"	1.25	2.00	0.75	C	"	–	–	–	–	10:20	11:30	33	NIL	20	"	——do——
"	2.00	2.75	0.75	C	"	–	–	–	–	11:50	12:35	33	13	15	"	——do——
"	2.75	3.50	0.75	C	"	–	–	–	–	12:55	1:40	31	13	25	"	——do——
"	3.50	4.25	0.75	C	"	–	–	–	–	2:10	2:35	53	45	25	"	——do——
"	4.25	5.00	0.75	C	"	–	–	–	–	3:30	4:30	56	47	35	"	——do——
"	5.00	5.75	0.75	C	"	–	–	–	–	4:50	5:45	48	NIL	45	"	——do——
"	5.75	6.50	0.75	C	"	–	–	–	–	6:00	7:00	73	73	45	"	Light brown Fractured Quartzite Rock
"	6.50	7.25	0.75	C	"	–	–	–	–	7:30	8:35	51	13	55	"	——do——
02/11/23	7.25	8.00	0.75	C	"	–	–	–	–	8:00	9:35	56	16	65	"	——do——
"	8.00	8.75	0.75	C	"	–	–	–	–	10:00	11:45	53	19	60	"	——do——
"	8.75	9.50	0.75	C	"	–	–	–	–	12:30	1:45	56	33	60	"	——do——
"	9.50	10.25	0.75	C	"	–	–	–	–	2:20	3:40	73	31	55	"	——do——
03/11/23	10.25	11.00	0.75	C	"	–	–	–	–	10:00	11:35	58	15	65	"	Light brown Fractured Quartzite Rock
"	11.00	12.50	0.75	C	"	–	–	–	–	11:50	1:15	56	NIL	70	"	——do——
"	12.50	13.25	0.75	C	"	–	–	–	–	2:00	3:30	31	NIL	70	"	——do——
"																

Supervisor

E-in-C

SE/Civil

Abbreviation Used: U- Undisturbed Sample. C- Core Sample. D- Disturbed Sample. P- Standard Penetration Test. R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-M
CHART 1: CORE MEASUREMENT SHEET (P146A)

TECHPRO ENGINEERS PVT. LTD.

CORE MEASUREMENT SHEET

Doc. No.:	GT005
Date of Issue:	01.04.2018
Rev. No.:	R00
Rev. Date:	Nil.

Project Name: G.T. Work for HORC Viaduct b/w Sohna & Dhulawat Station

Location: —

Date: 01/11/23 to 04/11/23

Str./ Chainage: 24747.9470

Project code: 1901

BH-No.: P-146A

Run (M) From	Run (M) To	Total Length (cm)	Core No. From	Core No. To	Core Number/ Length of core pieces (cm)								
0.50	1.25	26	1	4	1/7	2/8	3/6	4/5					
1.25	2.00	25	5	8	5/11	6/6	7/8						
2.00	2.75	25	9	14	9/4	10/3	11/2	12/3	13/3	14/10			
2.75	3.50	23	15	17	15/6	16/10	17/7						
3.50	4.25	40	18	20	18/12	19/22	20/6						
4.25	5.00	42	21	23	21/11	22/24	23/7						
5.00	5.75	36	24	29	24/7	25/4	26/3	27/3	28/5	29/9			
5.75	6.50	55	30	32	30/14	31/24	32/17						
6.50	7.25	38	33	39	33/5	34/5	35/5	36/4	37/5	38/4	39/10		
7.25	8.00	42	40	47	40/5	41/2	42/4	43/6	44/2	45/2	46/6	47/5	
8.00	8.75	40	48	55	48/2	49/3	50/4	51/3	52/4	53/3	54/5	55/6	
8.75	9.50	42	56	59	56/12	57/9	58/8	59/13					
9.50	10.25	55	60	66	60/11	61/8	62/8	63/7	64/5	65/4	66/12		
10.25	11.00	44	67	74	67/9	68/11	69/6	70/5	71/2	72/3	73/2	74/6	
11.00	12.50	42	75	83	75/9	76/5	77/5	78/7	79/4	80/3	81/2	82/4	83/3
12.50	13.25	23	84	88	84/3	85/4	86/3	87/5	88/8				

Supervisor:

Techpro Engineers Pvt Ltd • Kanpur •

E-in-C:

End of Report

Report No: 1901-HORC-X

Report No.: 1901-HORC-X Date: Oct 16th; 2023

GEOTECHNICAL INVESTIGATION REPORT

ULR No.: TC916923000000032P
REVISION-R1

AT THE SITE FOR

HORC VIADUCT BETWEEN SOHANA & DHULAWAT STATIONS OF HARYANA ORBITAL RAIL CORRIDOR (HORC) PROJECT, HARYANA

FROM BOREHOLES P134B TO A2B

CLIENT

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.

Plot No. 143, 5th floor RailTel tower, Sector-44,
Gurugram, Haryana 122003

GENERAL CONSULTANTS

RITES-SMEC JV

Gurugram, Haryana

GEOTECHNICAL CONSULTANTS

TECHPRO ENGINEERS PVT. LTD.

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G T ROAD, KANPUR-209 217, Phone: 9793209918

e-mail: info@techproindia.com

TC-9169

REVISION NOTES

REVISION NO.	DATE	DESCRIPTION
R1	11.12.23	• Test results, SBC computations and recommendations added for borehole P138B. • Field bore log charts added in Appendix-L and Core Measurement sheet added in Appendix-M.

REPORT FORMAT

Report No.	Bore included	Total Number of Bores
1901-HORC-I	A1 to P20	21
1901-HORC-II	P21 to P40	20
1901-HORC-III	P41 to P60	20
1901-HORC-IV	P61 to P80	20
1901-HORC-V	P81 to P100	20
1901-HORC-VI	P101 to P113	13
1901-HORC-VII	P114A to P133A	20
1901-HORC-VIII	P134A to A2A	16
1901-HORC-IX	P114B to P133B	20
1901-HORC-X	P134B to A2B	16

TABLE OF CONTENTS

114, Ram Ganga Housing Society, Naramau, G T Road, Kanpur-209 217
Tel.: 9793209918, e-mail: info@techproindia.com
Web site: www.techproindia.com

APPENDICES

National Accreditation Board for
Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

TECHPRO ENGINEERS PVT. LTD. (LABORATORY DIVISION)

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

114, RAM GANGA HOUSING SOCIETY, NARAMAU, G.T. ROAD, KANPUR, UTTAR PRADESH, INDIA

in the field of

TESTING

Certificate Number: TC-9169

Issue Date: 23/12/2022 Valid Until: 22/12/2024

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Identity : Techpro Engineers Private Limited

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

TECHPRO ENGINEERS PVT. LTD.
114, Ram Ganga Housing Society, Naramau, G T Road, Kanpur-209 217
Tel.: 9793209918, e-mail: info@techproindia.com
Web site: www.techproindia.com

Oct 16th; 2023

ACKNOWLEDGEMENTS

We are pleased to submit the part-10 of the report of Geotechnical investigation, conducted for the boreholes P134B to P148B and A2B for the design of foundations for HORC Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) project in the state of Haryana, India.

We hereby, convey our sincere thanks to Mr. Neeraj Bhandari (CPM/South) and Mr. Raju Solanki (DGM/C/South), HRIDCL for trust and support during the investigation. We also acknowledge our thanks to Mr. Uma Maheshwara Rao B, DGM/C/West, HRIDCL for awarding the said work to us. We are also grateful Mr. Ravindra Dutta Upadhyay (Geotech Expert), Mr. PS Gautam & Mr. Jitender Parashar, Site Engineer from the RITES- SMEC JV and Mohd. Ishak (Executive/Civil) from HRIDCL, for their help rendered during and prior to the investigation work.

We are also thankful to our staff members for conducting field and laboratory test, preparing sketches, and typing the report.

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech. (Civil), M.Tech.
Principal Consultant &
Managing Director

1. INTRODUCTION:

Haryana Rail Infrastructure Development Corporation Ltd. (HRIDC) and Ministry of Railways, Govt. of India has come together to form a new company namely Haryana Orbital Rail Corporation Limited (HORCL), to design and construction of new BG line from Palwal to Sonipat named Haryana Orbital Rail Corridor (HORC), in the state of Haryana, India. In this connection, a Geotechnical investigation has been planned for the design of foundations of Viaduct between Sohana & Dhulawat stations of Haryana Orbital Rail Corridor (HORC) Project in the state of Haryana. The work of conducting the detailed Geotechnical Investigation has been awarded to us by HRIDC, through work order No. HRIDC/HORC/GTI/211/2023-2024/Vol-0 dated 02-09-2023, which includes investigation in field, laboratory testing of disturbed and undisturbed samples, collected from the field, and submission of the geotechnical **investigation** test report.

A geotechnical investigation was carried out, with the locations, planned by the client. Purpose of the investigation is to determine the nature and properties of soil and rock strata across the bore holes and representing them through log sections showing the levels, nature, and properties of various strata up to a sufficient depth below the founding level, proneness of site to artesian conditions, seismic disturbance and other engineering properties of soil and rock strata.

This part -10 of the report includes the detailed methodology of investigation, collection of samples, field and laboratory test result including their interpretation/ analysis, recommendations on the properties of soils and rock required for design of foundation and suggesting suitable type and depth of foundation with allowable bearing capacity for safe and strong foundations for the Bore Hole numbers P134B to P148B and A2B.

2. SCOPE OF WORK:

For the design of foundation of viaduct, it is required to determine the allowable bearing capacity together with necessary engineering characteristics of underlying soil & rock strata. In general, the geotechnical investigation has been planned as per IS:1892-2021 and further extended to IS: 1904, IS:2911 (part-1/Sec 2) & IRC 78:2014 for planning the laboratory testing and computing the allowable bearing capacity, hence the scope of work is as follows:

2.1. Mobilisation of all tools & plants along with accessories, materials, labours etc. at site of work for drilling and testing work, including setting up boring and shifting to different bore holes point etc.

2.2. Exploratory drilling of 150 mm diameter bore holes through soil deposits and 75 mm in rock within the proposed alignment upto the required depth.

2.3. Collection of disturbed soil samples at an interval of 3.00 meter in all the bore holes.

2.4. Collection of undisturbed soil samples at every 3.00 m interval or at change of stratum from all the boreholes.

2.5. To conduct Standard Penetration Test (SPT) at an interval of 3.00 m or noticeable change of stratum in soil deposits in all bore holes.

2.6. Collection of rock core samples and preserving them in core boxes.

2.7. To collect ground water sample on completion of bore holes.

2.8. To record the ground water table in all the bore holes.

2.9. Transporting all the disturbed, undisturbed soil and rock core samples collected during the field investigation to our NABL accredited Geotech Engineering laboratory at Kanpur.

2.10. To conduct the laboratory tests on all the soil and rock core samples collected during field investigation for determination of their engineering characteristics.

2.11. To compile of field and laboratory test results, working out the allowable bearing capacity and preparing the report including detailed recommendations and necessary precautions.

3. GEOLOGICAL INFORMATION OF THE REGION:

3.1. Geography:

The project location is in the bordering area of Gurugram and Nuh (recent old name-Mewat), districts in the Indian state of Haryana. The stretch of the alignment of the proposed corridor starts from southmost part of Gurugram in the town of Sohna and ends at Dhulawat, which is a village lying at the north of Nuh district.

Haryana is a state located in the northern part of India. Gurugram is among one

of the districts in Haryana which is also the part of National Capital Region (30km south of New Delhi). It lies at an elevation of 217 m above msl. Sohna is a small town located 25km in the south of Gurugram. Sohna is well known for its hot water springs and famous Shiva temple. Sohna is located in between 28°15' N latitude and 77°40' E longitude at the elevation of 212.14m above msl. Mewat district is located at 28 °12′ N latitude, 77 °3′ E longitude, at the south of Gurugram at an elevation of 199 m above msl. The location is bordered by Rewari district on west and Faridabad & Palwal district on the east.

3.2. Geology:

The Gurugram district is having of almost flat topography, however, in the north-eastern part small isolated hillocks of Precambrian rocks are exposed. Small hill ranges which are part of the Aravali and Mangar Bani ranges exists in the district. The major part of district is underlain by Quaternary alluvium consisting of sand, clay and silt. The alluvial plain is formed by the Sahibi river which is a tributary of River Yamuna. Soils of the Gurgaon district is classified as tropical and brown soils, existing in the north western extreme, northern and north eastern parts of the district and water logged and salt affected soils in the southern parts of the district. The soils are medium textured loamy sand is the average texture in Gurgaon and Sohna blocks.

3.3. Rainfall and Climate:

The area has hot semi-arid type of climate characterising extreme dryness of the air except in the monsoon season. Intense hot summer and cold winters. The total annual rainfall in the region is about 596 mm, of which 75 to 80% is because of the south-west monsoon.

3.4. Seismicity:

The site under consideration exists in the district of Gurugram and Mewat which lies in the Seismic Zone IV (high damage risk zone), as per the current seismic zonation map of India (IS 1893-2016): RA 2021 and have a zone factor of 0.24 for design basis earthquake. The region is surrounded by many in-homogeneities in the form of faults and ridges like Sohna Fault, Moradabad Fault, Delhi-Moradabad Fault, Delhi-Haridwar ridge, junction of Aravalli and Alluvium near Delhi. The Sohna fault line lies between the Delhi ridge and Sohna town and falls between the Arjangarh and

Manesar outcrops. All the developed area in Gurugram comes within 200 km of the fault line. The Sohna fault line is located at the junction between the hard rock terrain of the Aravalli hills and the sandy formation of the Yamuna River and is currently inactive from several years and is capable of a disastrous earthquake.

The project location has been marked in Fig.1 Seismic zone map of India.

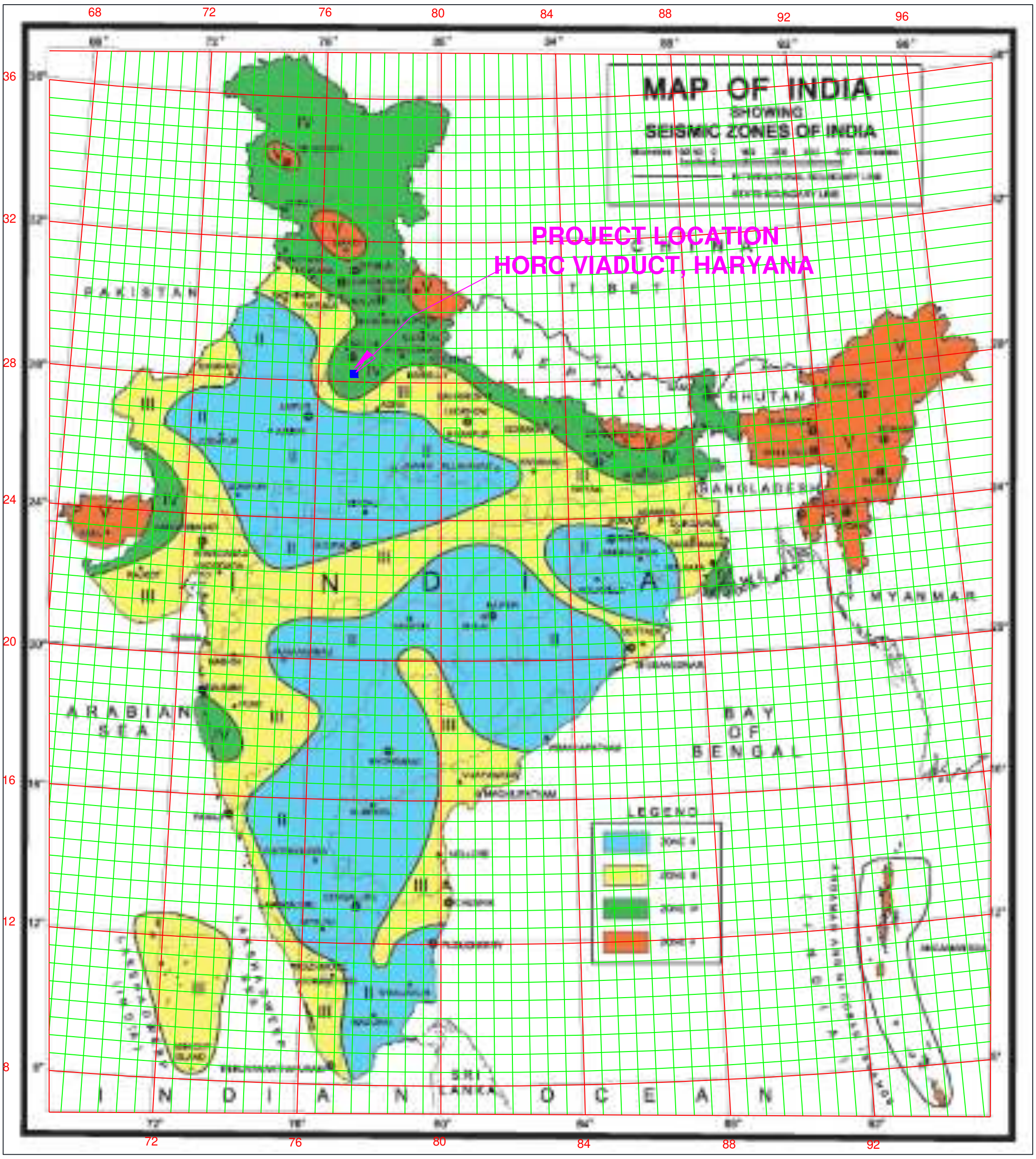


Fig.1: Seismic Zone Map of India

4. FIELD INVESTIGATION:

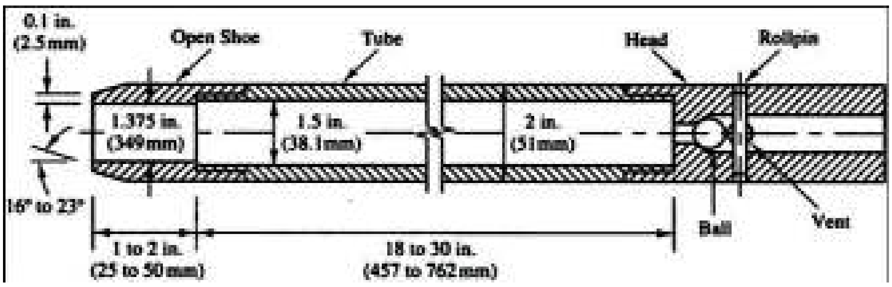
The field investigation work at this site was carried out from Sep 19th; 2023 to Sep 23rd; 2023 & Nov 26th; 2023 to Nov 28th; 2023. The following investigation

work was carried out:

4.1. **Sixteen** number of **boreholes** were proposed to be made at this stretch, out of which **two number** of boreholes (marked as P138B & P143B) of diameter 150 mm in soil and 75 mm in rock were made for conducting Standard Penetration Test and collection of disturbed, undisturbed soil and rock core samples. The boreholes were progressed using hydraulic rig and power winch machine under **rotary** and **percussion** methods of drilling. Casing was used to keep the borehole stable and Bentonite was also used as drilling mud to help prevent wall collapse of boreholes at deeper depth. The records of achieved depth of bore holes have been given in Para No. 6, the details of drilled bores along with depth of casing used have been reported in Appendix B. Locations of boreholes have been reported in "TEST LOCATION PLAN" in Appendix A.

4.2. **Standard Penetration Tests** were conducted at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth, as per the procedure in IS: 2131-1981-(RA: 2021) in all the bore holes. The **standard SPT sampler** (without liner and with no space for liner) and **rope-pulley driven hammer** of standard weight of 63.50 kg have been used to perform the test.

For conducting the test, the bottom of the borehole was properly cleaned, and split spoon sampler was properly seated in position in the borehole. The split spoon sampler resting on the bottom of borehole was allowed to sink under its own weight; then the sampler was allowed to penetrate 15 cm with the blows of the hammer 63.50 kg weight falling free through 75cm, thereafter the split spoon sampler was further driven by another 15 cm. For the 3rd and final drive, the sampler was further allowed to penetrate 15 cm. The number of blows required to get each 15 cm of penetration, was recorded. The first 15 cm of drive is seating drive.



Structure of SPT Sampler

The total blows of penetration for the second and third 15 cm of penetration is

termed the penetration resistance N. The N' values are indicative of the compactness/ relative density of cohesion less soils and consistency of cohesive soils.

In case the blows count of SPT in soil (including the number of blows of seating) exceeds 100, the corresponding penetration was recorded and this particular test at that depth stopped. If the total penetration is more than the seating penetration of 15 cm, then breakup of blow counts for 15 cm seating penetration and for remaining portion of penetration is also given.

SPT 'N' values are correlated with non-cohesive stratum as per BS: 5930 (1999) – for sandy strata and with consistency of cohesive stratum.

Correlation For Clay/Plastic Silt		Correlation For Sand/Non-Plastic Silt	
Consistency of clays	**Penetration Value**	**Relative Density of sand**	**Penetration Value**
Very Soft	0 to 2 Blows	Very loose	0 to 4 Blows
Soft	3 to 4 Blows	Loose	5 to 10 Blows
Medium Stiff	5 to 8 Blows	Medium	11 to 30 Blows
Stiff	9 to 16 Blows	Dense	31 to 50 Blows
Very Stiff	17 to 32 Blows	Very Dense	Above 50
Hard	Above 32		

In this method, the sampler acts as a probe and the driving energy is supplied by the fall of the drop weight. The values of 'N' depend on the compactness or relative density of the material. In hard formations, the testing is discontinued if 'N' value is found to be more than 100. It is termed as 'Refusal'. Refusal is also recorded when SPT blow count records 50 or more for any of the single drive of 15 cm.

'N' value depends upon degree of saturation and over burden pressure of the formation. Silty fine sand and fine sand below the water table develop pore water pressure depending on the in-situ void ratio which in turn affects the effective stress. This change in effective stress influences the 'N' value considerably.

Depth of overburden affects the SPT values in none to low cohesive soils and hence need correction. The SPT value after the overburden correction, N' is as follows:

$$N' = 0.77x \log (2000/q) \times N$$

Where, q= Overburden Pressure (kN/m^2) and N = observed SPT value

N' is corrected further for dilatancy in case of saturated fine sands and silts for the values of N' greater than 15.

Modified value after dilatancy correction N" = 15+ (N'-15)/2

Soil samples obtained from split spoon sampler were collected in the polythene bags of suitable size. These samples were property sealed, labelled, and carefully transported to the laboratory for testing. The results have been reported in Table 1 to 2 of Appendix B under the title "SUMMARY OF TEST RESULTS".

4.3. Disturbed soil samples were collected at 0.50 metre, then at 1.00 to 2.00 metre interval upto the depth of 12.00 meter and 3.00 metre interval, beyond 12.00 metre depth and at significant change of stratum. Soil from cutting edge of SPT samplers and retained in split spoon, used for Standard Penetration Tests was taken as disturbed samples. These samples were placed without delay in adequately sealed polythene bags. Where the collection of disturbed soil samples could not be collected from SPT samples, Shelby tubes were driven and retained soil samples were obtained. The laboratory tests were conducted on the collected soil samples and reported in Table 1 to 2 of Appendix-B under the title "SUMMARY OF TEST RESULTS".

4.4. Undisturbed soil samples were collected in accordance with IS: 2132-1986-(RA: 2021) at an interval of 3.00 metre or at change of stratum, starting from the depth of 1.00 or 2.00 m, by using 100 mm dia. and 450 mm long MS tubes provided with sampler head with ball check arrangement. However, the some of the samples could not be extracted due to the partial penetration or slippage during the evacuation.

Moreover, collection of Undisturbed samples in very hard cohesive soils/ dense granular soils/gravels/ cobbles/ pebbles/ boulders, refusal strata is practically not possible and such collected samples will not truly represent the undisturbed conditions.

Immediately after taking undisturbed sample in the tube, the adopter head was removed along with the disturbed material. The visible ends of the samples shall then be trimmed off any wet disturbed soil. The ends will then be coated alternately with four layers of molten wax. More molten wax will then be added to give a total thickness

of not less than 25 mm. The laboratory test results have been reported in Table 1 to 2 of Appendix-B.

4.5. **Rock Core samples** recovered during the NX size drilling have been measured, numbered, and packed in core boxes. The Core Recovery (CR) and RQD information have been reported in Field bore log charts and Core Measurement Sheet and results have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B**.**

4.6. The **ground water table** in the borehole was allowed to stabilize and measured after 8, 16, 24 and 48 hours after completion of the bore hole. It was ensured that last two reading were identical. The records of ground water table have been given in Para No.6.

4.7. **Ground water samples** were collected from borehole as per IS: 6935-1973-(RA:2019) for chemical analysis to determine aggressiveness in relation to attack on concrete / reinforcement including determination of pH value.

5. LABORATORY TESTS:

The following laboratory tests were conducted to determine the engineering characteristics of sub-soils:

5.1. **Field moisture contents** were determined by oven drying method as per IS: 2720 (part II)-1973-(RA: 2020). The results have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.2. **Bulk density** of soil strata was obtained using Shelby tubes in accordance with IS 2720 (part XXIX)-1975-(RA: 2020). The results have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.3. **Mechanical sieve analysis** test was performed in accordance with IS: 2720 (Part IV) – 1985-(RA: 2020), for the purpose of identification by grain size analysis, on coarse part of the soil samples and the results have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.4. **Particle size analysis** test by **Hydrometer method** were performed in accordance with IS: 2720 (Part IV) -1985-(RA: 2020) on the part of soil samples obtained after the sieve analysis. The results have been reported in Table 1 to 2: “SUMMARY OF TEST

RESULTS” of Appendix B.

5.5. **Atterbergs’ limits tests** were performed in accordance with IS: 2720 (part V)-1985-(RA: 2020) and results have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.6. **Specific gravity tests** were performed in accordance with IS 2720 (part III-sec. 1) -1980-(RA: 2021) and the results have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.7. **Consolidation tests** were performed on cohesive soil samples in accordance with IS: 2720 (part XV)-1965-(RA: 2021). The results have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.8. **Direct shear tests** were performed as per IS: 2720 (part XIII)-1986-(RA: 2021), on the undisturbed soil samples obtained during the field investigation. The results and the density of samples have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.9. **Tri-axial Compression Test** under Unconsolidated Un-drained (UU) condition as per IS: 2720 (Part-XI)-1993-(RA: 2021) were performed on the selected undisturbed soil samples, obtained during the field investigation. The results have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.10. **Unconfined Compressive strength tests** were performed in accordance with IS 2720 (Part-X) -1991-(RA:2020) on selected undisturbed soil samples and the results have been reported in Table 5 of Appendix B.

5.11. **Shrinkage Limit tests** were performed in accordance with IS 2720 (part-VI) -1972-(RA: 2021) and the results have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.12. **Free Swell Index** were performed in accordance with IS 2720 (part-XL) -1977-(RA: 2021) and the results have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.13. **Density test** on rock sample were performed in accordance with IS 13030-1991-(RA: 2021) and results have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.14. Water absorption and Porosity test on rock samples were performed in accordance with IS: 1124-1974-(RA:2017) and results have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.15. Hardness test on rock samples were performed in accordance with IS: 13630 (part-XIII) -2019 and results have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.16. Unconfined Compressive Strength tests on rock samples were performed in accordance with IS 9143-1979-(RA:2021) and results have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.17. Point load index tests on rock samples were performed in accordance with IS: 8764-1998-(RA:2019) and results have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.18. Cerchar Abrasive Index test on rock samples were performed in accordance with ASTM-D7625 and results have been reported in Table 1 to 2: “SUMMARY OF TEST RESULTS” of Appendix B.

5.19. Chemical analysis on soil samples was performed in accordance with IS: 2720 (Part-XXVI)-1987-(RA: 2021) for Ph value, IS: 2720 (Part-XXVII)-1977-(RA: 2020) for Sulphate & BS:1377-3-2018 for chlorides and results have been reported in Table 3 “CHEMICAL TEST ON SOIL SAMPLES” of Appendix B.

5.20. Chemical analysis on Ground Water sample was performed in accordance with IS: 3025 (Part-XI)-2022 for Ph value, IS: 3025 (Part-XXIV: Sec-1)-2022 for Sulphate & IS: 3025-(Part-XXXII)-1988-(RA: 2019) for chlorides and results have been reported in Table 4 “CHEMICAL TEST ON GROUND WATER SAMPLES” of Appendix B.

6. GROUND WATER TABLE:

The water table at this site was encountered during the drilling operation up to the depth of investigation.

Borehole No.	Chainage	Global Co-ordinates (UTM format)		Reduced level (m)	Depth of Borehole (m)	Water table (m)
		Easting	Northing			
P138B	24530.463	700895.449	3121462.977	209.246	40.00	18.00
P143B	24661.464	700849.414	3121585.595	205.068	40.00	14.40

7. DESCRIPTION OF STRATA:

The classification of soil stratum has been done with the help of soil characteristics obtained in laboratory tests as per IS 1498-1970-(RA:2021). The classification of rock masses has been done based on RMR as per IS: 4464-1985, IS: 13365-1. The detailed nature of the strata has been reported in Table 1 to 2: "SUMMARY OF TEST RESULTS" of Appendix-B and represented through Lithological plots in Appendix-C.

The strata exhibited in the bore hole, P138B is predominantly consisting of silty sands with inorganic silty clays of low plasticity. Borehole P143B consists of Silty sands upto the depth of 17.00 m. Inorganic silty clays of low plasticity were also encountered in between the depth of 10.00 to 11.30 metres. Rock mass encountered at the depth of 11.30 metres to 12.80 metres, and then after 17.05 metres to the depth of investigation. The rock mass is in various stage of weathering, i.e., highly to completely weathered and classified as **Quartzite**. The entire rock mass is of medium to fine grained, non-foliated, **Abrasion Index** and rock hardness falling in the range of **high to very high**.

8. CLASSIFICATION CRITERIA OF ROCK MASSES:

Rock classification in terms of weathering, state of fractures and strength is carried out in the following manner based on IS: 4464-1985, IS: 13365-1. Tabulations given in below explain it briefly.

TERMS	DESCRIPTION	GRADE	GEOLOGIST INTERPRETATION
Fresh	No visible sign of rock material weathering; perhaps slight coloration on major discontinuity surfaces	I	CR > 90 %

TERMS	DESCRIPTION	GRADE	GEOLOGIST INTERPRETATION
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discoloured by weathering.	II	CR between 70 % to 90 %
Moderately Weathered	Less than half of the rock material is decomposed or disintegrated to a soil. Fresh or discoloured rock is present either as a continuous framework or as core-stones.	III	CR between 51 % to 70 %
Highly Weathered	More than half of the rock material is decomposed or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as core-stones.	IV	CR between 11 % to 50 %
Completely weathered	All rock material is decomposed and / or disintegrated to soil. The original mass structure is still largely intact.	V	CR between zero to 10 %
Residual Soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI	CR = Zero % But N > 50

CR indicate Core Recovery

It should be understood that all grades of weathering may not be seen in a given rock mass and that in some cases a particular grade may be present to a very small extent. Distribution of the various weathering grades of rock material in the rock mass may be related to the porosity of the rock material and the presence of open discontinuities of all types in the rock mass.

8.1 Relation between RQD and In-situ Rock quality:

Relation between RQD and In-situ

Rock quality is further measured by frequency of natural joints in rock mass. Rock Quality Designation (RQD) is used to define state of fractures or massiveness of rock. Following table defines the quality of rock mass.

RQD classification	RQD (%)
Excellent	91 to 100
Good	76 to 90
Fair	51-75
Poor	25-50

RQD classification	RQD (%)
Very Poor	0-25

8.2 Classification of Rock by Compressive Strength:

Rock type	Unconfined compressive strength (MPa)
Extremely strong	>200
Very Strong	100 to 200
Strong	50 to 100
Moderately Strong	12.5 to 50
Moderately Weak	5 to 12.5
Weak	1.25 to 5
Very weak	<1.25

9. SAFE BEARING CAPACITY COMPUTATIONS:

For the construction of viaducts, deep foundation proposed to be resting on soil and rock mass **(Bored Cast-In-Situ RCC piles** and **bored cast-in-situ rock socketed RCC piles)** have been considered for computation of load bearing capacity of the underlying strata. The computation of load bearing capacity of bored cast-in-situ RCC piles have been done as per IS 2911 (part-1, section-2)-2010-(RA: 2020) and rock socketed RCC piles as per IRC:78-2014, with due consideration of effects of liquefaction.

9.1. Pile Load Capacity in soils:

9.1.1. Design Parameters:

Factor of safety in Compression	=	2.50
Factor of safety in Tension	=	3.00
Depth of critical water table	=	0.00 m
Diameter of pile	=	1.00 & 1.20 m
Cut off length	=	2.50 m
Type of pile head consider	=	Fixed

9.1.2. Computation of friction along pile stem:

$Q_{uf} = \sum K_i . P_{di} . \tan\delta_i . A_{si}$

where,

Q_{uf}	=	Ultimate shaft friction (kN/m^2)
K_i	=	Coefficient of earth pressure at mid-depth of i^{th} layer
P_{di}	=	Effective overburden pressure at mid-depth of i^{th} layer (kN/m^2)
A_{si}	=	Surface area of pile stem in i^{th} layer (m^2)
δ_i	=	Angle of wall friction between pile and soil of i^{th} layer (= ϕ) (degree)
ϕ_i	=	Angle of internal friction of soil in i^{th} layer (degree)
Σ	=	Sum of all layers up to i^{th} layer

9.1.3. Computation of Cohesion along the stem of pile:

$Q_{uc} = \sum \alpha_i . c_i . A_{si}$

where,

c_i	=	Cohesion in i^{th} layer
A_{si}	=	Surface area of pile stem in i^{th} layer (m^2)
α_i	=	Adhesion factor for i^{th} layer of soil depending of consistency of soils
Σ	=	Sum of cohesion of all layers considered

9.1.4. Computation of end bearing resistance:

$Q_{ub} = A_p (c.N_c + q.N_q + 0.5.\gamma.B.N_\gamma)$

where,

A_p	=	Area of the pile toe (m^2)
c	=	cohesion of soils at pile toe (kN/m^2)
γ	=	Effective Unit weight of soils at pile toe (kN/m^3)
B	=	Diameter of pile (m)
q	=	Effective overburden pressure at pile toe (kN/m^2)
N_c	=	Bearing Capacity Factor (Recommended equal to 9)
N_q, N_γ	=	Bearing Capacity Factor

9.1.5. Lateral load capacity of piles in soils:

$Q_u = 12.E.I.\delta/(L_1+L_f)^3$

where,

Q_u	=	Ultimate lateral load capacity of pile (kN)
δ	=	Permissible deflection (m) = 5 mm
E	=	Young Modulus of pile material (kN/m^2)
I	=	Moment of Inertia of the pile cross section (m^4)
L_1	=	Cantilever Length of pile (m)
L_f	=	Length of fixity (m)

Detailed calculations of pile load carrying capacity in compression & uplift in soil have been reported in **Table-3 to 4** of **Appendix-I.**

Pile lateral Load capacity has been given in **Table-5 to 6** of **Appendix-I**.

9.2. Pile Load Capacity in rock:

Computations of the vertical load capacity of the piles in rock has been work out as per the method given in IRC:78-2014.

9.2.1. As per IRC:78-2014:

Since the rock mass encountered at this site exhibits (CR+RQD)/2< **30%**, Method 2 of IRC: 78-2014 has been used for computing the axial pile load capacity in rock formations.

$$\mathbf{Q_a = R_e/3 + R_{af}/6}$$

$$\mathbf{Q_t = R_{af}/6 + \text{Self weight of pile}}$$

where,

R_e = C_{ub} x N_c x A_b

R_{af} = C_{us} x A_s

D = Diameter of the pile (m)

Q_a = Allowable load capacity of pile socketed into rock (kN)

Q_t = Allowable load capacity of pile in uplift (kN)

R_e = Ultimate end bearing capacity (kN/m^2)

R_{af} = Ultimate side socket shear capacity (kN/m^2)

C_{ub} = Average shear strength below base of pile tip for depth upto 2D

L_s = Socket length of pile (m)

N_c = Bearing Capacity factor = 9 (as per code)

A_b = Area of pile base (m^2)

A_s = Area of socket (m^2)

C_{us} = Shear strength along socket length (≤ 3.0 for M35 Concrete).

The detailed calculations of pile load carrying capacity in compression and uplift on rock based on method-2 of IRC: 78-2014 have been reported in **Table-2** of **Appendix-I.**

9.3. Computation of RMR values:

A gross estimate of bearing capacity of completely or partially weathered rock masses have been done based on Rock Mass Rating (RMR). The estimation of RMR value of jointed rock masses have been worked out based on IS 13365 (part I). Rock Mass Rating parameters are reproduced from Annexure B of IS 13365 (part I) below for ready reference. The final RMR value of rock is referred from the Table 3 of IS code 12070.

9.3.1. Rating as per UCS

Description	Compressive Strength (MPa)	Rating	Basis
Exceptionally Strong	>250	15	UCS value data of specific borehole from laboratory test is used in RMR
Very Strong	100 to 250	12	
Strong	50 to 100	7	
Average	25 to 50	4	
Weak	10 to 25	2	
Very Weak	2 to 10	1	
Extremely Weak	<2	0	

9.3.2. Rating as per RQD

Description	RQD (%)	Rating	Basis
Excellent	91 to 100	20	RQD values of specific boreholes below given depth from relevant borehole are used in RMR.
Good	76 to 90	17	
Fair	51 to 75	13	
Poor	26 to 50	8	
Very Poor	0 to 25	3	

9.3.3. Rating as per Spacing of discontinuities

Description	Spacing (m)	Rating	Basis
Vey wide	>2	20	Spacing of discontinuities of specific borehole from field observations is used in RMR
Wide	0.6 to 2	15	
Moderate	0.2 to 0.6	10	
Close	0.06 to 0.2	8	
Very close	<0.06	5	

9.3.4. Rating as per Condition of discontinuities

Condition	Rating
Very rough and un-weathered rock wall rock, tight and discontinuous, no separation	30
rough and slightly weathered wall rock surface, separation < 1mm	25
slightly rough and moderately to highly weathered wall rock surface, separation< 1mm	20
Slickensides wall rock surface or 1-5mm thick gauge or1-5 mm wide opening, continuous discontinuity	10
Soft gauge> 5 mm thick or Separation > 5 mm	0

9.3.5. Rating as per Ground Water Conditions

General Description	Rating
Completely dry	15
Damp	10
Wet	7

General Description	Rating
Dripping	4
Flowing	0

9.3.6. Rating as per adjustment for discontinuity orientations

Strike and dip orientations of discontinuities	Very favourable	Favourable	Fair	Un-favourable	Very Un-favourable
Foundation	0	-2	-7	-15	-35

9.3.7. Net safe bearing pressures based on RMR as per Table 3 of IS:12070-1987-(RA: 2020)

Classification No.	I	II	III	IV	V
Rock Description	Very Good	Good	Fair	Poor	Very Poor
RMR	100-81	80-61	60-41	40-21	20-0
Q_{net} (t/m^2)	600-448	440-288	280-141	135-48	45-30

The results of Rock Mass Rating have been reported in **Table-1** of **Appendix-I.**

10. LIQUEFACTION ANALYSIS:

Liquefaction is the sudden loss of shear strength of the loose fine sands due to earthquake-induced vibration under saturated conditions. Liquefaction generally takes place in loose fine sands (fines < 10 %, D_{60}= 0.20 mm to 1.0 mm and C_u between 2 to 5) with N value less than 15. In case of soil strata having N>15, liquefaction of soil will not take place normally.

The present site falls in **seismic zone – IV.** Considering the history of past earthquakes and available seismic data, an earthquake of **magnitude 7.0** having peak ground acceleration **a_{max}= 0.24 g** is considered in the present analysis.

Preliminary assessment of liquefaction potential of foundation strata is made by simplified approach proposed by IS: 1893 (part-1)-2016-(RA: 2021) from the data obtained in Standard Penetration Test.

In this method, cyclic shear stress likely to be induced in the foundation strata by Design Basis Earthquake is first evaluated. Next threshold cyclic shear stress, which is good enough to cause liquefaction, is determined from SPT data and the empirical relations. Finally, comparison of these two stresses is used in the estimation of liquefaction susceptibility of the foundation strata.

Cyclic Stress Ratio (CSR):

The equivalent average of shear stress likely to be induced in the foundation material due to an earthquake is calculated by using the equations

Cyclic Resistance Ratio (CRR):

It expresses capacity of soil to resist liquefaction. CRR is determined using correlation between corrected blow count $(N_1)_{60}$ and CRR for earthquake of magnitude 7.5. $(N_1)_{60}$ is the SPT blow count corrected to an effective overburden pressure of 100 kPa and to hammer energy efficiency of 60 %.

Following variable have been adopted in calculation of N_{60} (SPT value for 60% efficiency)

Energy correction to SPT values:

C_{60} = 1.00 (energy efficiency factor)

Design Earthquake Base:

Earthquake zone	= IV
Magnitude of earthquake	= 7
Seismic Zone factor	= 0.24

Status of Liquefaction:

The value of CSR and CRR are computed at different depth and then the ratio of CRR to CSR to get the factor of safety towards the susceptibility of the stratum towards liquefaction potential.

If factor of safety:

$<$ 1.00 : Stratum is to be considered as liquefiable

$>$ 1.20 : Non-Liquefiable

The detailed calculations of liquefaction, have been reported in **Table-7** of **Appendix-I.**

11. RECOMMENDATIONS:

Keeping in mind, the field test results, laboratory test results and IS codes of practice the following recommendations are hereby made:

11.1. **Bored Cast-In-Situ RCC Piles** of diameter 1000 and 1200 mm have been adopted for SBC computations of foundation for Viaduct.

11.2. **Cut off length** of piles have been considered as 2.50 m from the existing ground level for the purpose of computation of SBC.

11.3. **Pile length** recommended in the table below, shall be measured **after the cut-off depth.**

11.4. **Allowable load carrying capacity** of pile corresponding to the length and diameter of pile shall be read from the tables below:

11.4.1. For Pile diameter = 1000 mm

Borehole No.	End bearing Strata type	Pile Length (m)	Rock Socket length (m)	Load carrying Capacity (kN)		
				Compression	Uplift	Lateral Concrete M35*
P138B	Soil	25.00	-	2850	1500	165
		27.50		2150	1700	
		30.00		3300	1900	
		32.50		3450	2100	
		35.00		3600	2300	
P143B	Rock	18.00	3.50	4580	3250	315

** Indicates Grade of Concrete*

11.4.2. For Pile diameter = 1200 mm

Borehole No.	End bearing Strata type	Pile Length (m)	Rock Socket length (m)	Load carrying Capacity (kN)		
				Compression	Uplift	Lateral Concrete M35*
P138B	Soil	25.00	-	4400	2000	235
		27.50		2900	2250	
		30.00		4950	2550	

Borehole No.	End bearing Strata type	Pile Length (m)	Rock Socket length (m)	Load carrying Capacity (kN)		
				Compression	Uplift	Lateral Concrete M35*
		32.50		5250	2850	
		35.00		5350	3150	
P143B	Rock	18.70	4.20	6600	4750	435

* *Indicates Grade of Concrete*

11.5. Liquefaction Potential: Both the bore holes have been analysed for Liquefaction potential as per IS: 1893 (part-1)-2016-(RA: 2021) with Seismic Zone IV, earthquake intensity of 7.0 on Richter scale and critical ground water table at existing ground level. The details of liquefaction potential in various boreholes corresponding to depths has been mentioned in the table below:

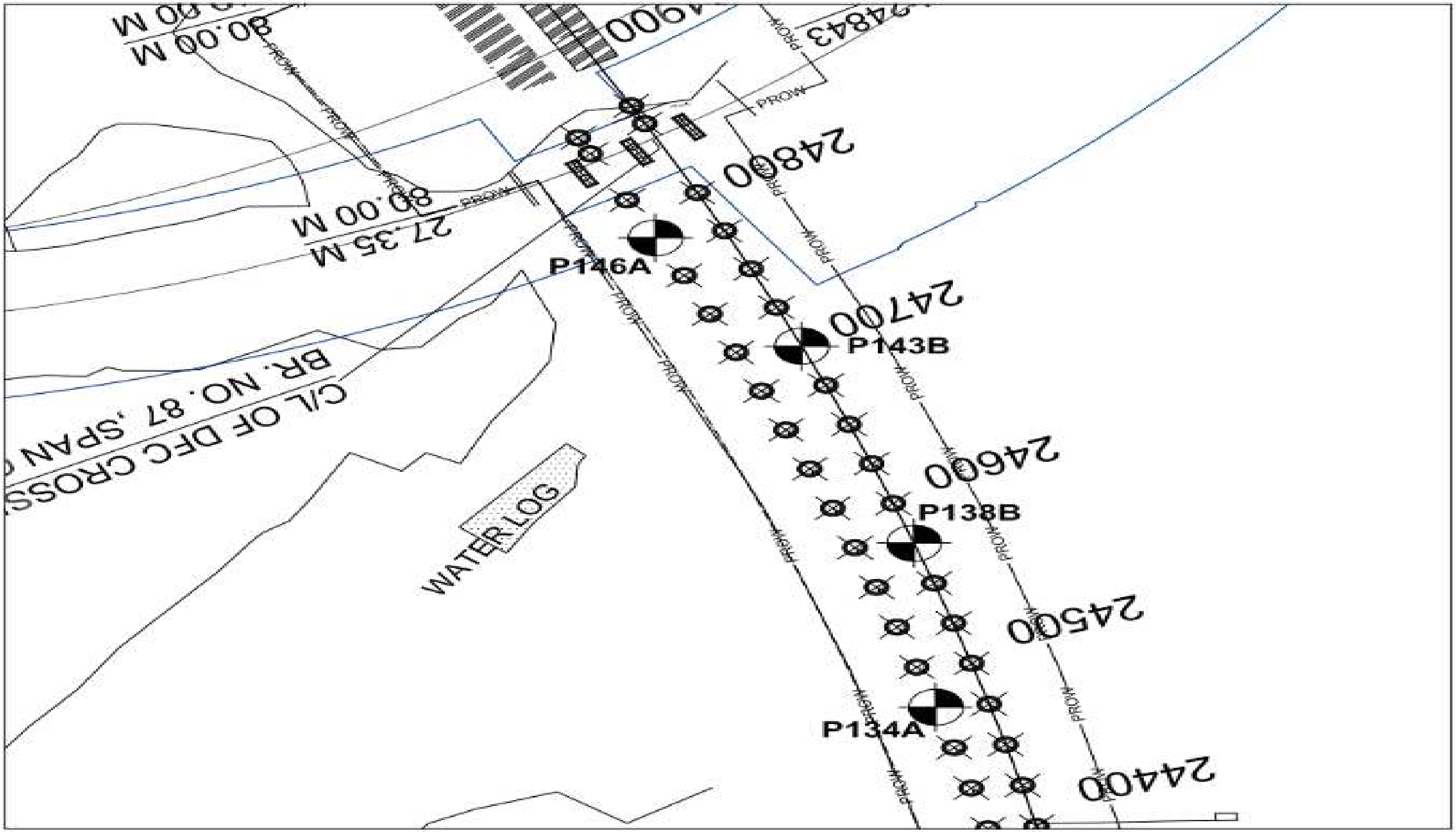
Bore No.	Liquefiable depth zone (meter)
P138B	Top 3.00
P143B	None

11.6. Type of cement to be used: Since, the effect of harmful chemical at the site are found within the permissible limits. So, Ordinary Portland Cement or Portland Pozzolana Cement may be used for all civil constructions.

for Techpro Engineers Pvt. Ltd.

(Arvind K. Garg)
B.Tech.(Civil), M.Tech.
Principal Consultant &
Managing Director

APPENDIX-A
TEST LOCATION PLAN



APPENDIX "B"
TABLE 1: SUMMARY OF TEST RESULTS

Bore No: P138B	**Ground Elevation: RL 209.246 m**	**Method of drilling: Percussion**	**Depth of Water: 18.00 m**
Diameter of Bore Hole: 150 mm	**Bore Retained using: Casing**	**Starting Date: 26/11/2023**	**SPT Sampler: Standard**
Location / Chainage: 24530.463	**Casing Lowered: 21.00 m**	**Ending Date: 28/11/2023**	**Hammer type: Rope & pulley**

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity (GPa)	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	0.50	D	1	-	-	-	-	-	SM	0	0	0	82	18	0	5.33	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	1.00	U	2	-	-	-	-	-	SM	0	1	0	81	18	0	4.61	1.69	1.62	Non-Plastic			2.61	DST	1.0	29.2	-	0.611	-	-	-	-												
	2.00	D	3	1	1	2	3	4.09	-	-	-	-	-	-	-	6.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	3.00	D	4	1	2	12	14	17.19	-	-	-	-	-	-	-	7.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	4.00	D	5	-	-	-	-	-	SM	0	0	0	87	13	0	12.15	1.84	1.64	Non-Plastic			-	RDST	0.0	29.6	-	-	-	-	-	-												
	5.00	D	6	4	7	10	17	17.78	SM	0	0	1	85	14	0	7.69	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	6.00	D	7	8	11	17	28	27.50	-	-	-	-	-	-	-	7.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	7.00	U	8	-	-	-	-	-	SM	0	0	0	83	17	0	13.23	1.95	1.72	Non-Plastic			2.60	DST	0.0	28.3	-	0.512	-	-	-	-	Silty Sands											
	8.00	D	9	9	13	20	33	28.96	-	-	-	-	-	-	-	22.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	9.00	D	10	8	12	19	31	25.90	-	-	-	-	-	-	-	22.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	10.00	U	11	-	-	-	-	-	SM	0	0	0	78	22	0	16.70	1.82	1.56	Non-Plastic			2.62	DST	5.0	28.4	-	0.679	-	-	-	-												
	11.00	D	12	12	25	30	55	42.27	SM	1	0	0	66	33	0	20.63	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	12.00	D	13	15	29	34	63	46.59	-	-	-	-	-	-	-	9.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	13.00	D	14	18	31	35	66	47.07	SM	0	1	2	60	37	0	12.32	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	14.50	D	15	17	23	28	51	34.41	-	-	-	-	-	-	-	20.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"
TABLE 1: SUMMARY OF TEST RESULTS

Bore No: P138B	Ground Elevation: RL 209.246 m	Method of drilling: Percussion	Depth of Water: 18.00 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 26/11/2023	SPT Sampler: Standard
Location / Chainage: 24530.463	Casing Lowered: 21.00 m	Ending Date: 28/11/2023	Hammer type: Rope & pulley

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity (GPa)	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	16.00	D	16	15	21	27	48	48.00	CL	3	3	2	13	69	10	15.49	-	-	30.0	20.5	9.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	17.50	D	17	13	24	25	49	49.00	-	-	-	-	-	-	-	16.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	19.00	U	18	-	-	-	-	-	CL	2	1	3	11	72	11	20.17	2.07	1.72	31.5	21.5	10.0	2.68	UU	52.0	11.8	-	0.558	-	9	20	-												
	20.50	D	19	16	27	31	58	58.00	-	-	-	-	-	-	-	16.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	22.00	D	20	17	29	36	65	25.62	SM	0	0	1	62	37	0	19.40	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	23.50	D	21	15	31	38	69	26.32	-	-	-	-	-	-	-	20.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	25.00	D	22	19	33	40	73	26.99	SM	0	1	2	57	40	0	19.43	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	26.50	D	23	21	44	57	R	-	-	-	-	-	-	-	-	18.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	28.00	D	24	24	50	61	R	-	CL-ML	3	1	4	20	64	8	19.19	-	-	28.0	21.5	6.5	2.67	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
	29.50	D	25	21	47	52	99	99.00	CL	3	2	2	16	68	9	20.26	-	-	29.0	21.5	7.5	-	-	-	-	-	-	-	-	-	-	Inorganic clays of low plasticity											
	31.00	D	26	23	46	54	R	-	SM	0	0	1	58	41	0	21.20	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-	Silty Sands											
	32.50	D	27	20	41	50	91	29.39	-	-	-	-	-	-	-	21.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	34.00	D	28	22	43	51	94	29.66	SM	0	1	1	56	42	0	20.29	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	35.50	D	29	19	40	48	88	27.83	SM	0	0	1	54	45	0	20.48	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	37.00	D	30	19	41	49	90	27.89	-	-	-	-	-	-	-	19.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

APPENDIX "B"

TABLE 1: SUMMARY OF TEST RESULTS

Bore No: P138B	Ground Elevation: RL 209.246 m	Method of drilling: Percussion	Depth of Water: 18.00 m
Diameter of Bore Hole: 150 mm	Bore Retained using: Casing	Starting Date: 26/11/2023	SPT Sampler: Standard
Location / Chainage: 24530.463	Casing Lowered: 21.00 m	Ending Date: 28/11/2023	Hammer type: Rope & pulley

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity (GPa)	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	38.50	D	31	24	44	50	94	28.39	SM	0	1	3	56	40	0	19.24	-	-	Non-Plastic			-	-	-	-	-	-	-	-	-	-												
	40.00	D	32	26	47	52	99	29.08	-	-	-	-	-	-	-	19.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No: P143B	**Ground Elevation: RL 205.068 m**	**Method of drilling: Rotary**	**Depth of Water-table: 14.40 m**
Diameter of Bore Hole: 150/75 mm	**Bore Retained using: Casing**	**Starting Date: 19/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 24661.464	**Casing Lowered: 12.00 m**	**Ending Date: 23/09/2023**	**Hammer type: Rope & pulley**

FIELD TEST RESULT

RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	SPT Test Result: N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification
	0.50	D	1	-	-	-	-	-	SM
	1.00	D	2	6	7	8	15	22.94	-
	2.00	U	3	-	-	-	-	-	SM
	3.00	D	4	6	8	14	22	25.56	-
	4.00	D	5	13	24	29	53	56.47	-
	5.00	D	6	18	32	38	70	69.56	SM
	6.00	D	7	11	30	33	63	59.10	-
	7.00	D	8	16	38	40	78	69.26	-
	8.00	D	9	24	69	-	R	-	-
	9.00	D	10	17	31	43	74	59.80	-
	10.00	D	11	19	40	45	85	65.84	CL-ML
	11.00	D	12	54	100	-	R	-	-
	11.30	C	13	-	-	-	-	-	
	12.05	C	14	-	-	-	-	-	
	12.80	D	15	8	9	20	29	20.16	SM

LABORATORY TEST RESULT

Depth Below NGL (Meter)	Grain Size Analysis: Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Index Property: Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity
0.50	0	1	1	68	30	0	5.52	-	-	Non-Plastic			-
1.00	-	-	-	-	-	-	21.97	-	-	-	-	-	-
2.00	0	0	0	87	13	0	23.01	2.07	1.68	Non-Plastic			2.63
3.00	-	-	-	-	-	-	22.63	-	-	-	-	-	-
4.00	-	-	-	-	-	-	23.26	-	-	-	-	-	-
5.00	0	0	0	84	16	0	23.60	-	-	Non-Plastic			-
6.00	-	-	-	-	-	-	16.01	-	-	-	-	-	-
7.00	-	-	-	-	-	-	22.30	-	-	-	-	-	-
8.00	-	-	-	-	-	-	21.78	-	-	-	-	-	-
9.00	-	-	-	-	-	-	18.89	-	-	-	-	-	-
10.00	0	1	1	30	63	5	17.71	-	-	23.0	18.0	5.0	-
11.00	-	-	-	-	-	-	17.98	-	-	-	-	-	-
11.30	-	-	-	-	-	-	-	-	-	-	-	-	-
12.05	-	-	-	-	-	-	-	-	-	-	-	-	-
12.80	0	1	1	62	36	0	20.06	-	-	Non-Plastic			-

Depth Below NGL (Meter)	Shear Strength Parameters: Type of Test	Cohesion (kN/m^2)	Angle of Friction	Consolidation Characteristic: Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Shrinkage: Free Swell Index	Shrinkage Limit	Swell Pressure	Test on Rock Specimen: Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity (GPa)	Cerchar Abrasive Index
	Classification of ROCK									Classification of SOIL											
0.50	-	-	-	-	-	-	-	-	-	Silty Sands											
1.00	-	-	-	-	-	-	-	-	-												
2.00	DST	2.0	28.4	-	0.565	-	-	-	-												
3.00	-	-	-	-	-	-	-	-	-												
4.00	-	-	-	-	-	-	-	-	-												
5.00	-	-	-	-	-	-	-	-	-												
6.00	-	-	-	-	-	-	-	-	-												
7.00	-	-	-	-	-	-	-	-	-												
8.00	-	-	-	-	-	-	-	-	-												
9.00	-	-	-	-	-	-	-	-	-												
10.00	-	-	-	-	-	-	-	-	-	Inorganic Silty Clays of low plasticity											
11.00	-	-	-	-	-	-	-	-	-												
11.30	Moderately weathered and poor-quality quartzite rock									57	47	2.58	2.69	0.02	0.30	10.82	124.98	0.31	9.00	-	3.90
12.05	Highly weathered and very-poor quality quartzite rock									19	0	-	-	-	-	-	-	-	-	-	-
12.80	-	-	-	-	-	-	-	-	-	Silty Sands											

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No: P143B	**Ground Elevation: RL 205.068 m**	**Method of drilling: Rotary**	**Depth of Water-table: 14.40 m**
Diameter of Bore Hole: 150/75 mm	**Bore Retained using: Casing**	**Starting Date: 19/09/2023**	**SPT Sampler: Standard**
Location / Chainage: 24661.464	**Casing Lowered: 12.00 m**	**Ending Date: 23/09/2023**	**Hammer type: Rope & pulley**

RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m²)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm²)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity (GPa)	Cerchar Abrasive Index
FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
																							Classification of ROCK									Classification of SOIL											
	14.00	D	16	10	12	25	37	24.62	-	-	-	-	-	-	-	21.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	15.50	D	17	36	50	52	R	-	-	-	-	-	-	-	-	20.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.00	D	18	60	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
	17.05	C	19	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	Highly weathered and very-poor quality quartzite rock									17	0	-	2.62	-	0.48	-	-	-	-	-	-
	17.75	C	20	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	Moderately weathered and very-poor quality quartzite rock									53	19	-	-	-	-	14.19	79.18	-	-	-	3.20
	18.50	C	21	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-										61	16	2.69	2.70	0.02	0.10	9.87	-	0.18	9.00	-	3.70
	19.25	C	22	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	Highly weathered and very-poor quality quartzite rock									36	13	-	-	-	-	3.78	-	-	-	-	-
	20.00	C	23	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-										36	24	-	-	-	-	6.60	97.30	-	8.50	-	-
	20.75	C	24	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-										41	0	2.70	-	0.03	-	-	-	0.37	8.50	-	4.00
	21.50	C	25	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-										35	0	2.69	2.74	0.10	0.19	-	-	0.86	-	-	-
	22.25	C	26	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	Completely Weathered Rock Mass									0	0	-	-	-	-	-	-	-	-	-	-
	23.00	D	27	100	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
	23.05	C	28	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-									0	0	-	-	-	-	-	-	-	-	-	-
	23.75	D	29	101	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
	23.81	C	30	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-									0	0	-	-	-	-	-	-	-	-	-	-

APPENDIX "B"
TABLE 2: SUMMARY OF TEST RESULTS

Bore No: P143B	Ground Elevation: RL 205.068 m	Method of drilling: Rotary	Depth of Water-table: 14.40 m
Diameter of Bore Hole: 150/75 mm	Bore Retained using: Casing	Starting Date: 19/09/2023	SPT Sampler: Standard
Location / Chainage: 24661.464	Casing Lowered: 12.00 m	Ending Date: 23/09/2023	Hammer type: Rope & pulley

FIELD TEST RESULT										LABORATORY TEST RESULT																																	
				SPT Test Result						Grain Size Analysis						Index Property							Shear Strength Parameters			Consolidation Characteristic			Shrinkage			Test on Rock Specimen											
RL in Meter	Depth Below NGL (Meter)	Nature of Sample	Sample Reference No.	N1 (Seating Drive)	N2 (First Drive)	N3 (Second Drive)	Observed SPT	N (Corrected)	Soil Classification	Gravel (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Specific Gravity	Type of Test	Cohesion (kN/m^2)	Angle of Friction	Compression Index	Initial Void Ratio	Pre-consolidation Pressure (Kg/cm^2)	Free Swell Index	Shrinkage Limit	Swell Pressure	Core Recovery %	R.Q.D %	Density (gm /cc)	Specific gravity	Moisture content (%)	Water absorption (%)	Point load Index	U.C.S (MPa)	Porosity	Hardness	Modulus of Elasticity (GPa)	Cerchar Abrasive Index
																							Classification of ROCK									Classification of SOIL											
	24.50	D	31	100	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
	24.54	C	32	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-									0	0	-	-	-	-	-	-	-	-	-	-
	25.25	D	33	102	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											

Notations: UU= Unconsolidated Undrained Tri-axial compression Test on Undisturbed Sample, DST=Direct Shear Test on Undisturbed samples, CU: Consolidated Undrained tri-axial compression test with measurement of pore water pressure, R=Refusal strata (SPT Value>=100), RUU, RCU & RDST indicates relevant test on remoulded samples, "-" indicates test not performed due to identical sample or irrelevant for the sample or not required, C= Rock Core sample, D= Disturbed sample, U= Undisturbed sample.

APPENDIX-B
TABLE 3: CHEMICAL TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	SULPHATE CONTENT AS SO_3 (%)	CHLORIDE CONTENT (%)	pH VALUE
P143B	2.00	0.069	0.069	8.43

APPENDIX-B
TABLE 4: CHEMICAL TEST ON GROUND WATER SAMPLES

BH No.	SULPHATE CONTENT AS SO_3 (mg/l)	CHLORIDE CONTENT (mg/l)	pH VALUE
P143B	98.760	307.905	7.20

APPENDIX-B
TABLE 5: UCS TEST ON SOIL SAMPLES

BH No.	DEPTH (m)	UCS (kg/cm^2)
P138B	19.00	0.62

APPENDIX-C
PLOT 1: LITHOLOGICAL PROFILE-01

PROFILE SHEET IS TO BE AFFIX

APPENDIX-C
PLOT 2: LITHOLOGICAL PLOTS

BH-P138B-24530.463

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Silty Sands	SM		0.50	D		-	-
			1.00	U		-	-
			2.00	D	3	-	-
			3.00	D	14	-	-
			4.00	D		-	-
			5.00	D	17	-	-
			6.00	D	28	-	-
			7.00	U		-	-
			8.00	D	33	-	-
			9.00	D	31	-	-
			10.00	U		-	-
			11.00	D	55	-	-
			12.00	D	63	-	-
			13.00	D	66	-	-
			14.50	D	51	-	-
			16.00	D	48	-	-
Inorganic clays of low plasticity			17.50	D	49	-	-
			19.00	U		-	-
			20.00	D	58	-	-

BH-P138B-24530.463

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	RQD
Inorganic clays of low plasticity	CL		20.50	D	58	-	-
Silty Sands	SM		22.00	D	65	-	-
			23.50	D	69	-	-
			25.00	D	73	-	-
			26.50	D	101	-	-
Inorganic Silty Clays of low plasticity	CL-ML		28.00	D	111	-	-
Inorganic clays of low plasticity	CL		29.50	D	99	-	-
Silty Sands	SM		31.00	D	100	-	-
			32.50	D	91	-	-
			34.00	D	94	-	-
			35.50	D	88	-	-
			37.00	D	90	-	-
			38.50	D	94	-	-
			40.00	D	99	-	-

APPENDIX-C
PLOT 3: LITHOLOGICAL PLOTS

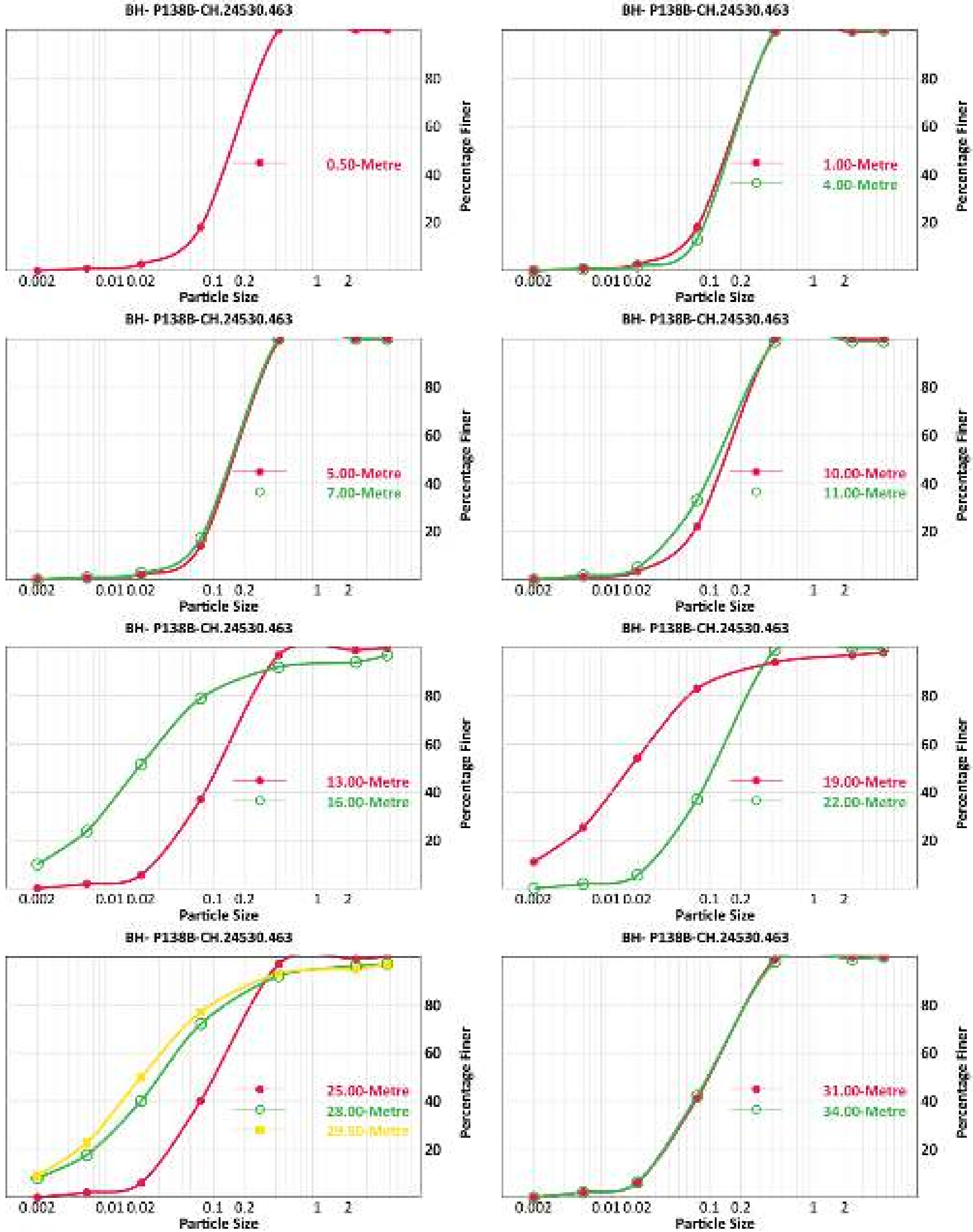
BH-P143B-24661.464

DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	ROQD
Silty Sands	SM		0.50	D		-	-
			1.00	D	15	-	-
			2.00	U		-	-
			3.00	D	22	-	-
			4.00	D	53	-	-
			5.00	D	70	-	-
			6.00	D	68	-	-
			7.00	D	78	-	-
			8.00	D	R	-	-
			9.00	D	74	-	-
Inorganic Silty Clays of low plasticity	CI-ML		10.00	D	85	-	-
			11.00	D	R	-	-
Moderately weathered and very poor quality Rock			11.30	C		57	47
Highly weathered and very poor quality Rock mass			12.05	C		19	0
Silty Sands	SM		12.80	D	29	-	-
			14.00	D	37	-	-
			15.50	D	R	-	-
Highly weathered and very poor quality Rock mass			17.00	D	R	17	0
Moderately weathered and very poor quality Rock			17.75	C		53	19
			18.50	C		61	16
Highly weathered and very poor quality Rock mass			19.25	C		36	13
			20.00	C		36	24

BH-P143B-24661.464

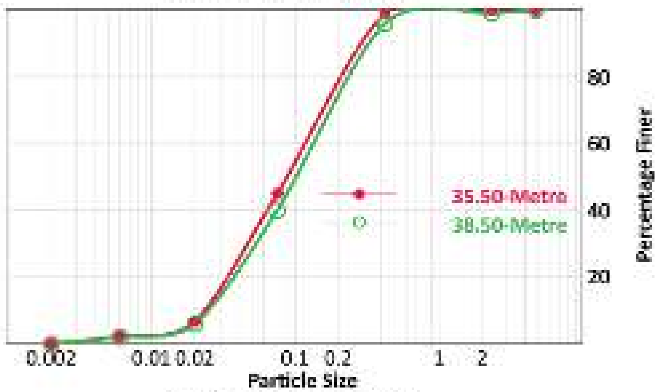
DESCRIPTION	I.S. GROUP	HATCH PATTERN	DEPTH	TYPE OF SAMPLE	OBSERVED SPT VALUE	CR	ROQD
Highly weathered and very poor quality Rock mass			20.00	C		36	24
			20.75	C		41	0
			21.50	C		35	0
			22.25	C		0	0
Completely Weathered Rock Mass			23.00	D	R	0	0
			23.35	D	R	0	0
			24.50	D	R	0	0
			25.25	D	R	-	-

APPENDIX-D
PLOT 1: GRAIN SIZE DISTRIBUTION PLOTS

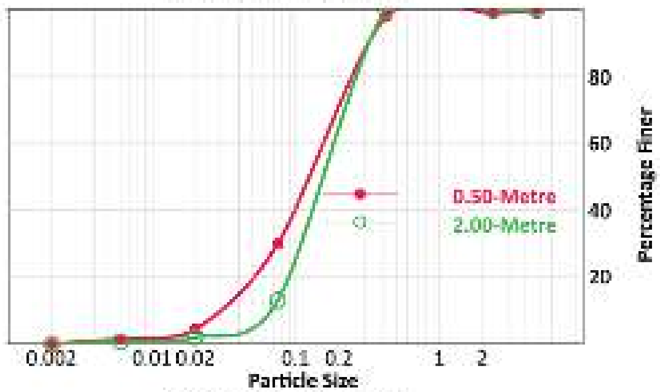


APPENDIX-D
PLOT 2: GRAIN SIZE DISTRIBUTION PLOTS

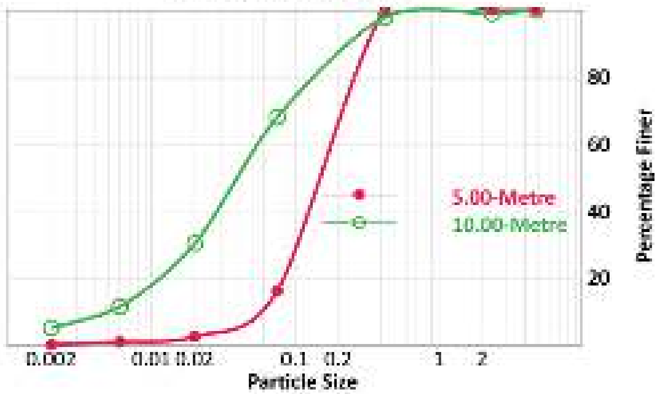
BH- P138B-CH.24530.463



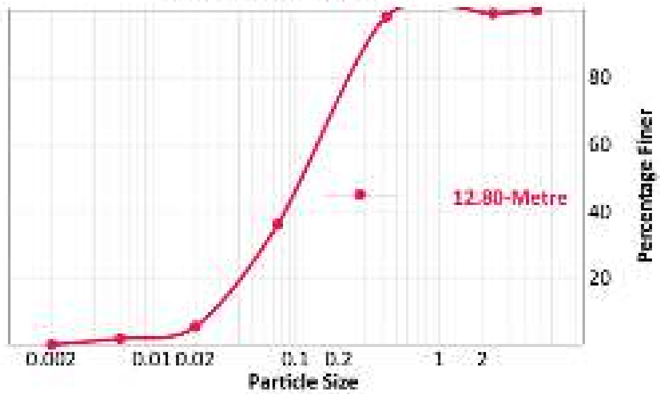
BH- P143B-CH.24661.464



BH- P143B-CH.24661.464

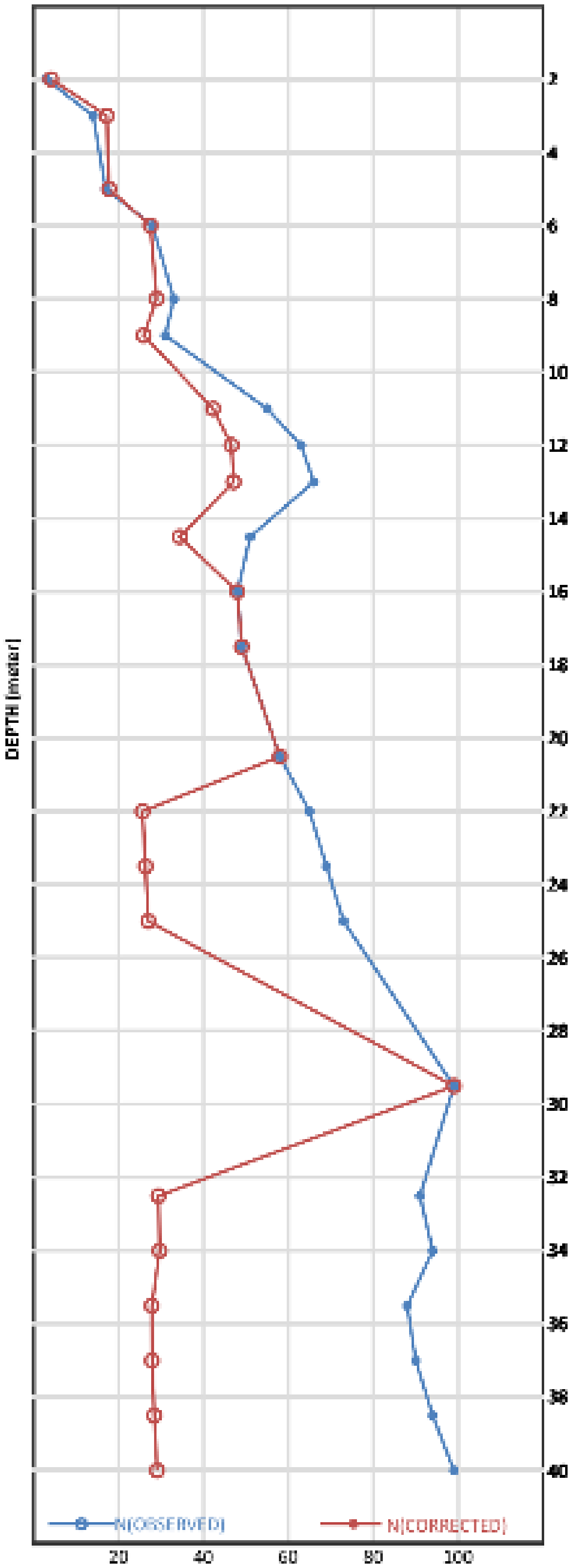


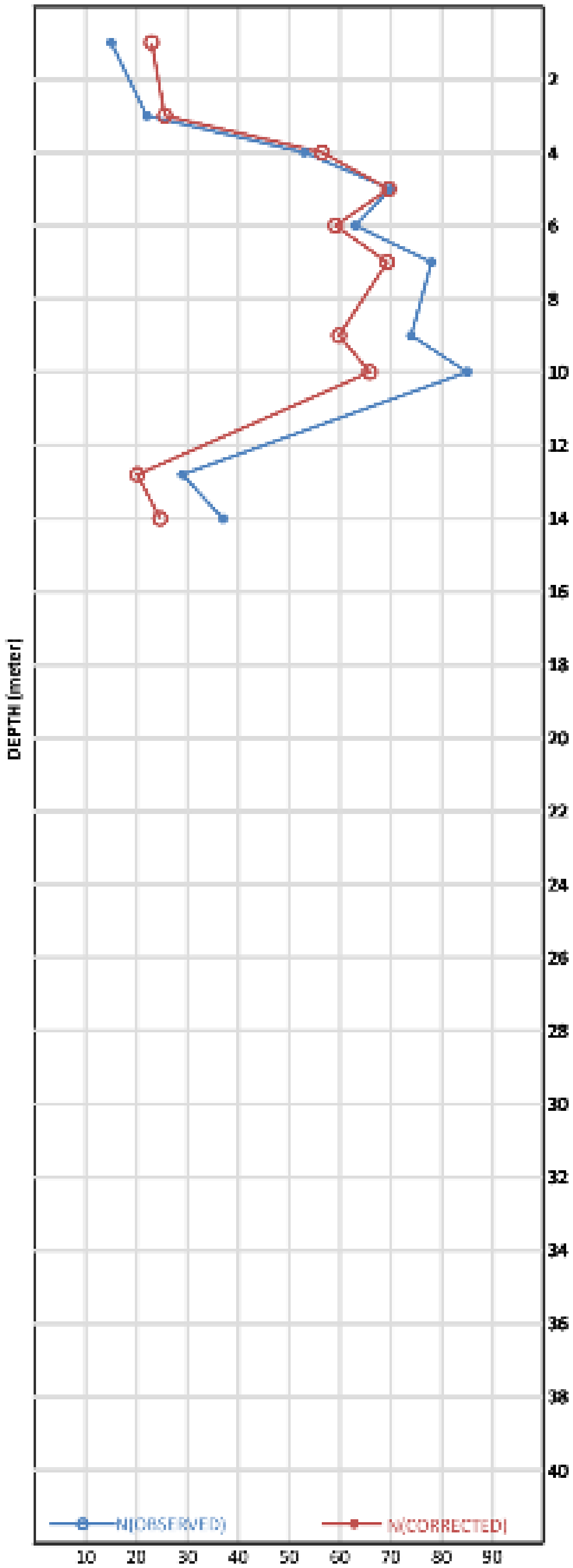
BH- P143B-CH.24661.464



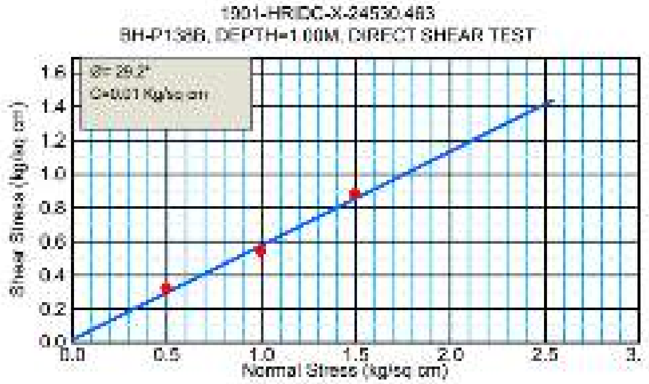
APPENDIX-E

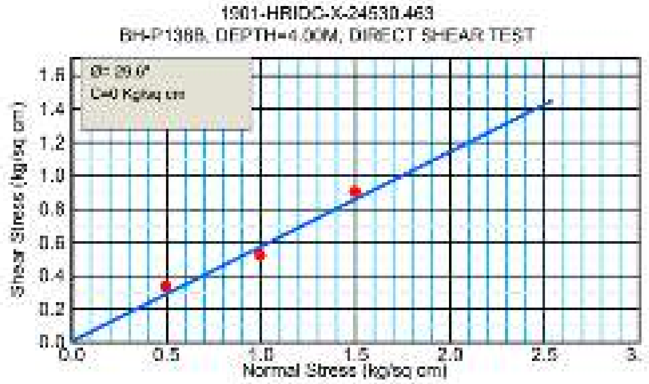
PLOT 1: RECORDED SPT Vs CORRECTED SPT (P138B & P143B)

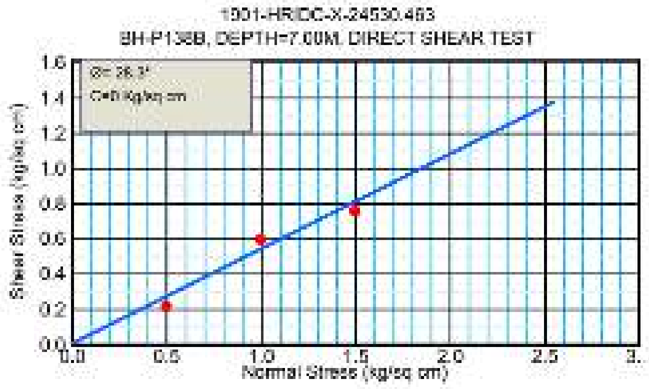


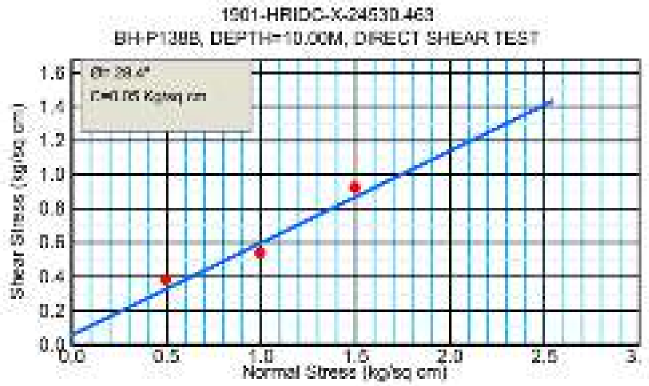


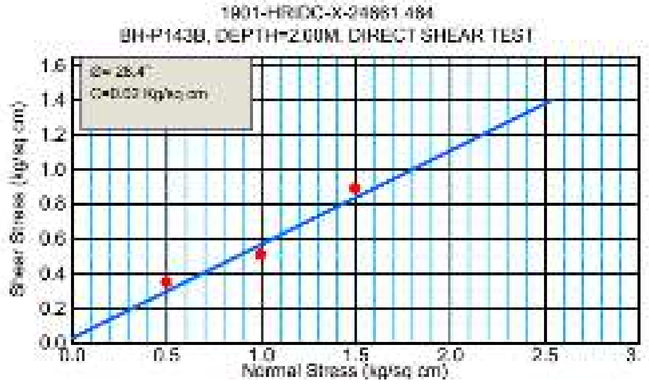
APPENDIX-F
GRAPH 1: DST GRAPH



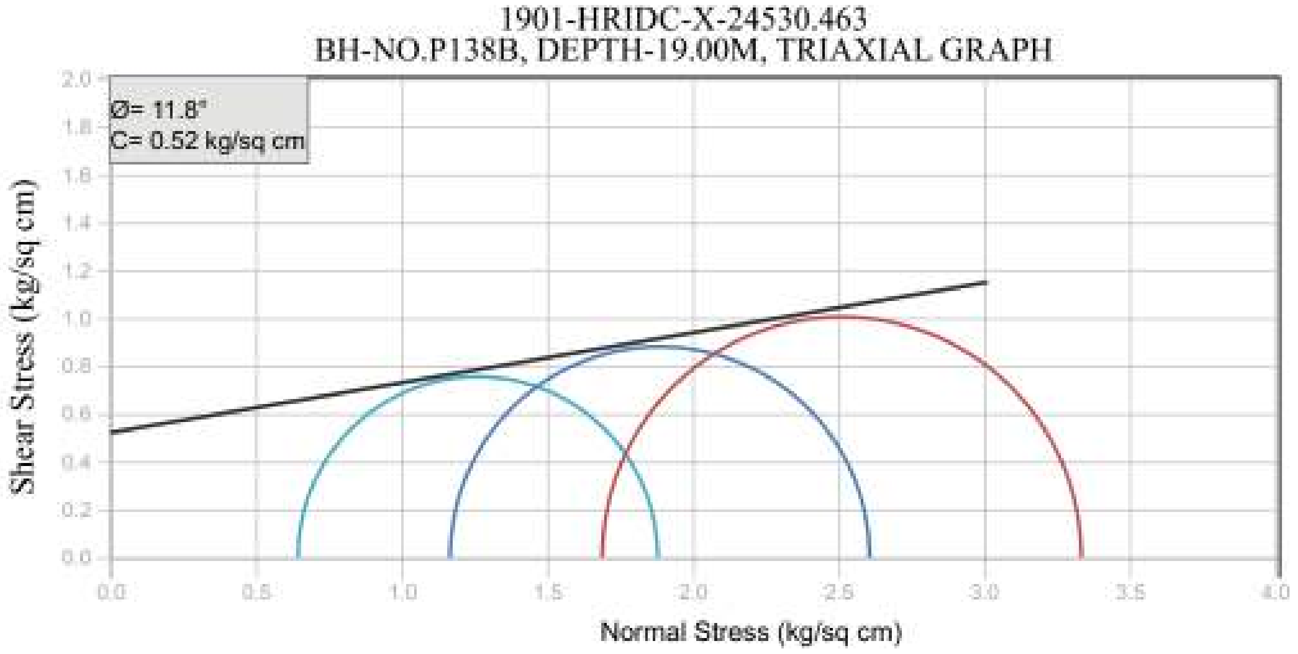




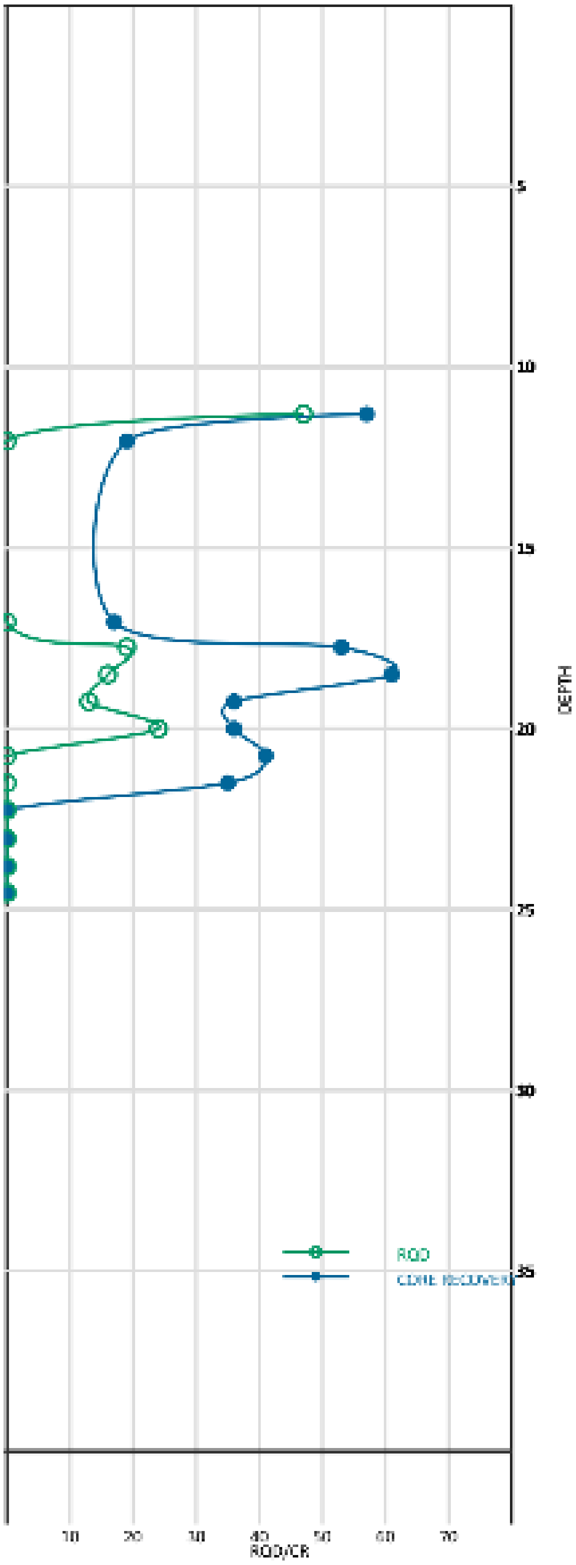




APPENDIX-G
GRAPH 1: UU GRAPH



APPENDIX-H
PLOT 1: CR Vs RQD PLOTS



APPENDIX-I
TABLE 1: RMR COMPUTATIONS

Bore Hole No.	Depth (m)	UCS Rating	RQD Rating	Spacing of Joint Rating	Condition of discontinuity	Ground Water Rating	Strike & Dip Orientation of Joint	RMR Value	Rock Class	Description
BH-P143B	11.30-12.05	12	8	10	20	7	-2	55	III	Fair
BH-P143B	12.05-12.80	12	3	8	20	7	-2	48	III	Fair
BH-P143B	17.05-17.75	7	3	5	20	0	-2	33	IV	Poor
BH-P143B	17.75-18.50	7	3	8	20	0	-2	36	IV	Poor
BH-P143B	18.50-19.25	7	3	8	20	0	-2	36	IV	Poor
BH-P143B	19.25-20.00	7	3	8	20	0	-2	36	IV	Poor
BH-P143B	20.00-20.75	7	3	8	20	0	-2	36	IV	Poor
BH-P143B	20.75-21.50	7	3	8	20	0	-2	36	IV	Poor
BH-P143B	21.50-22.25	7	3	8	20	0	-2	36	IV	Poor

APPENDIX-I

TABLE 2: VERTICAL PILE LOAD CAPACITY IN ROCK (IRC:78-2014/Method-2)

Bore No.	Dia of pile shaft (m)	Depth of overburden soil over rock bed (m)	Extrapolated SPT Value below rock socket	Extrapolated SPT Value along rock socket	Cut off length (m)	Socket length of pile (m)	Overall length of pile below cut-off length (m)	Shear strength of rock below pile tip (kN/m^2)	Average shear strength of rock in the socketed length of pile (kN/m^2)	Pile capacity in end bearing in rock (kN)	Pile load capacity due to shaft friction in rock (kN)	Self-weight of pile (kN)	Pile load capacity in compression (kN)	Pile load capacity in uplift (kN)
	B	**D**	**N_b**	**N_a**	**l**	**L_c**	**l**	**C_{ub}**	**C_{us}**	**Qb**	**Qf**	**W_s**	**Q_a**	**Qt**
P143B	1.00	17.00	100	175	2.50	3.5	18.00	700	1600	1649	2932	353	4581	3286
P143B	1.20	17.00	100	175	2.50	4.2	18.70	700	1600	2375	4222	529	6597	4751

APPENDIX-I

TABLE 3: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m | Factor of Safety in Compression: 2.5 | Area of Pile: 0.79 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)									Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)												
From	To	Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb	Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
BORE NO: P138B, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	16.95	6.95	19.11	1.57	29.6	29.6	1.0	17.06	0	0	1.0	0.0	0	3.0	29.2	0	8.39	19.46	20.56	20.9	386.5	386.5	5.9	5.9	**154.61**	**1.96**
3.00	5.00	4.00	2.00	2.50	18.39	8.39	29.24	6.29	29.2	29.2	1.0	102.72	102.72	0	1.0	0.0	0.00	5.0	29.6	0	8.39	20.36	21.48	37.6	672.7	775.4	29.5	132.2	**310.18**	**44.06**
5.00	6.00	5.50	1.00	3.50	18.39	8.39	41.83	3.14	29.6	29.6	1.0	74.67	177.39	0	1.0	0.0	0.00	6.0	28.3	0	9.48	17.43	18.48	46.0	699.1	876.5	41.3	218.6	**350.61**	**72.88**
6.00	8.00	7.00	2.00	5.50	19.48	9.48	55.50	6.29	28.3	28.3	1.0	187.84	365.23	0	1.0	0.0	0.00	8.0	28.3	0	9.48	17.43	18.48	65.0	958.8	1324.0	64.8	430.1	**529.61**	**143.35**
8.00	9.00	8.50	1.00	6.50	19.48	9.48	69.72	3.14	28.3	28.3	1.0	117.98	483.22	0	1.0	0.0	0.00	9.0	28.4	5	8.21	17.66	18.71	74.5	1128.7	1611.9	76.6	559.8	**644.76**	**186.61**
9.00	11.00	10.00	2.00	8.50	18.21	8.21	82.67	6.29	28.4	28.4	1.0	280.97	764.19	5	1.0	31.4	31.43	11.0	28.4	5	8.21	17.66	18.71	90.9	1356.5	2152.1	100.2	895.8	**860.84**	**298.60**
11.00	12.00	11.50	1.00	9.50	18.21	8.21	94.99	3.14	28.4	28.4	1.0	161.41	925.60	5	1.0	15.7	47.14	12.0	27.9	0	8.21	16.53	17.56	99.1	1343.7	2316.4	112.0	1084.7	**926.56**	**361.57**
12.00	13.00	12.50	1.00	10.50	18.21	8.21	103.20	3.14	27.9	27.9	1.0	171.72	1097.32	0	1.0	0.0	47.14	13.0	28.0	0	8.21	16.76	17.79	107.3	1470.0	2614.5	123.8	1268.2	**1045.79**	**422.74**
13.00	14.50	13.75	1.50	12.00	18.21	8.21	113.46	4.71	28.0	28.0	1.0	284.40	1381.72	0	1.0	0.0	47.14	14.5	28.0	0	10.67	16.76	17.79	119.6	1649.3	3078.2	141.4	1570.3	**1231.28**	**523.43**
14.50	16.00	15.25	1.50	13.50	20.67	10.67	113.46	4.71	28.0	28.0	1.0	284.40	1666.11	0	1.0	0.0	47.14	16.0	11.8	52	10.67	3.00	1.73	119.6	656.9	2370.1	159.1	1872.4	**948.05**	**624.12**
16.00	17.50	16.75	1.50	15.00	20.67	10.67	113.46	4.71	11.8	11.8	1.0	111.74	1777.85	52	1.0	245.1	292.29	17.5	11.8	52	10.67	3.00	1.73	119.6	656.9	2727.0	176.8	2246.9	**1090.80**	**748.97**
17.50	20.50	19.00	3.00	18.00	20.67	10.67	113.46	9.43	11.8	11.8	1.0	223.48	2001.33	52	1.0	490.3	782.57	20.5	11.8	52	10.67	3.00	1.73	119.6	656.9	3440.8	212.1	2996.0	**1376.31**	**998.68**
20.50	22.00	21.25	1.50	19.50	20.67	10.67	113.46	4.71	11.8	11.8	1.0	111.74	2113.07	52	1.0	245.1	1027.71	22.0	27.6	0	10.67	15.85	16.87	119.6	1560.8	4701.6	229.8	3370.6	**1880.64**	**1123.54**
22.00	23.50	22.75	1.50	21.00	20.67	10.67	113.46	4.71	27.6	27.6	1.0	279.62	2392.70	0	1.0	0.0	1027.71	23.5	27.8	0	9.23	16.31	17.33	119.6	1595.3	5015.7	247.5	3667.9	**2006.27**	**1222.64**
23.50	25.00	24.25	1.50	22.50	19.23	9.23	113.46	4.71	27.8	27.8	1.0	282.01	2674.70	0	1.0	0.0	1027.71	25.0	28.1	0	9.11	16.98	18.02	119.6	1660.4	5362.8	265.2	3967.6	**2145.14**	**1322.53**
25.00	26.50	25.75	1.50	24.00	19.11	9.11	113.46	4.71	28.1	28.1	1.0	285.59	2960.30	0	1.0	0.0	1027.71	26.5	31.8	0	9.02	30.33	31.63	119.6	2962.3	6950.3	282.9	4270.9	**2780.12**	**1423.62**
26.50	27.50	27.00	1.00	25.00	19.02	9.02	113.46	3.14	31.8	31.8	1.1	240.99	3201.28	0	1.0	0.0	1027.71	27.5	31.8	0	9.02	30.33	31.63	119.6	2962.3	7191.3	294.6	4523.6	**2876.52**	**1507.88**

APPENDIX-I

TABLE 3: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1000 mm)

Dia. Of Pile: 1.00 m
Critical water table: 0.00 m

Factor of Safety in Compression: 2.5
Factor of Safety in Tension: 3.0

Area of Pile: 0.79 m^2

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	∑Qi	c	α	α.c.Asi	∑Qi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
27.50	28.00	27.75	0.50	25.50	19.02	9.02	113.46	1.57	31.8	31.8	1.1	120.49	3321.78	0	1.0	0.0	1027.71	28.0	14.0	42	9.02	3.65	2.36	119.6	648.4	4997.9	300.5	4650.0	**1999.16**	**1550.01**
28.00	29.50	28.75	1.50	27.00	19.02	9.02	113.46	4.71	14.0	14.0	1.0	133.36	3455.14	42	1.0	198.0	1225.71	29.5	11.5	45	9.24	2.91	1.65	119.6	597.8	5278.6	318.2	4999.1	**2111.45**	**1666.36**
29.50	30.00	29.75	0.50	27.50	19.24	9.24	113.46	1.57	11.5	11.5	1.0	36.27	3491.41	45	1.0	70.7	1296.43	30.0	11.5	45	9.24	2.91	1.65	119.6	597.8	5385.6	324.1	5111.9	**2154.25**	**1703.98**
30.00	31.00	30.50	1.00	28.50	19.24	9.24	113.46	3.14	11.5	11.5	1.0	72.55	3563.96	45	1.0	141.4	1437.86	31.0	31.6	0	9.02	29.32	30.60	119.6	2864.0	7865.8	335.9	5337.7	**3146.31**	**1779.24**
31.00	32.50	31.75	1.50	30.00	19.02	9.02	113.46	4.71	31.6	31.6	1.1	355.38	3919.34	0	1.0	0.0	1437.86	32.5	31.6	0	9.40	29.32	30.60	119.6	2868.5	8225.7	353.6	5710.8	**3290.29**	**1903.59**
32.50	34.00	33.25	1.50	31.50	19.40	9.40	113.46	4.71	31.6	31.6	1.1	355.38	4274.72	0	1.0	0.0	1437.86	34.0	31.4	0	9.25	28.31	29.58	119.6	2768.3	8480.9	371.3	6083.8	**3392.36**	**2027.94**
34.00	35.00	34.50	1.00	32.50	19.25	9.25	113.46	3.14	31.4	31.4	1.1	232.89	4507.61	0	1.0	0.0	1437.86	35.0	31.4	0	9.25	28.31	29.58	119.6	2768.3	8713.8	383.0	6328.5	**3485.52**	**2109.50**
35.00	35.50	35.25	0.50	33.00	19.25	9.25	113.46	1.57	31.4	31.4	1.1	116.45	4624.06	0	1.0	0.0	1437.86	35.5	30.8	0	9.28	25.29	26.50	119.6	2473.4	8535.3	388.9	6450.8	**3414.13**	**2150.28**
35.50	37.00	36.25	1.50	34.50	19.28	9.28	113.46	4.71	30.8	30.8	1.0	331.60	4955.66	0	1.0	0.0	1437.86	37.0	30.8	0	9.11	25.29	26.50	119.6	2471.6	8865.1	406.6	6800.1	**3546.06**	**2266.71**
37.00	37.50	37.25	0.50	35.00	19.11	9.11	113.46	1.57	30.8	30.8	1.0	110.53	5066.19	0	1.0	0.0	1437.86	37.5	30.8	0	9.11	25.29	26.50	119.6	2471.6	8975.7	412.5	6916.5	**3590.27**	**2305.52**
37.50	38.50	38.00	1.00	36.00	19.11	9.11	113.46	3.14	30.8	30.8	1.0	221.07	5287.26	0	1.0	0.0	1437.86	38.5	31.8	0	9.08	30.33	31.63	119.6	2963.0	9688.2	424.3	7149.4	**3875.26**	**2383.13**
38.50	40.00	39.25	1.50	37.50	19.08	9.08	113.46	4.71	31.8	31.8	1.1	361.48	5648.74	0	1.0	0.0	1437.86	40.0	31.8	0	10.49	30.33	31.63	119.6	2980.6	10067.2	442.0	7528.6	**4026.86**	**2509.52**

APPENDIX-I

TABLE 4: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	ΣQi	c	α	α.c.Asi	ΣQi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
BORE NO: P138B, CUT OFF LENGTH: 2.50 m, Nc= 9																														
2.50	3.00	2.75	0.50	0.50	16.95	6.95	19.11	1.89	29.6	29.6	1.0	20.47	0	0	1.0	0.0	0	3.0	29.2	0	8.39	19.46	20.56	20.9	576.1	576.1	8.5	8.5	**230.44**	**2.83**
3.00	5.00	4.00	2.00	2.50	18.39	8.39	29.24	7.54	29.2	29.2	1.0	123.26	123.26	0	1.0	0.0	0.00	5.0	29.6	0	8.39	20.36	21.48	37.6	989.1	1112.4	42.4	165.7	**444.95**	**55.23**
5.00	6.00	5.50	1.00	3.50	18.39	8.39	41.83	3.77	29.6	29.6	1.0	89.61	212.87	0	1.0	0.0	0.00	6.0	28.3	0	9.48	17.43	18.48	46.0	1026.6	1239.4	59.4	272.3	**495.78**	**90.76**
6.00	8.00	7.00	2.00	5.50	19.48	9.48	55.50	7.54	28.3	28.3	1.0	225.41	438.28	0	1.0	0.0	0.00	8.0	28.3	0	9.48	17.43	18.48	65.0	1400.5	1838.8	93.3	531.6	**735.51**	**177.21**
8.00	9.00	8.50	1.00	6.50	19.48	9.48	69.72	3.77	28.3	28.3	1.0	141.58	579.86	0	1.0	0.0	0.00	9.0	28.4	5	8.21	17.66	18.71	74.5	1642.7	2222.6	110.3	690.2	**889.03**	**230.06**
9.00	11.00	10.00	2.00	8.50	18.21	8.21	82.67	7.54	28.4	28.4	1.0	337.16	917.02	5	1.0	37.7	37.71	11.0	28.4	5	8.21	17.66	18.71	90.9	1970.7	2925.5	144.3	1099.0	**1170.19**	**366.33**
11.00	12.00	11.50	1.00	9.50	18.21	8.21	94.99	3.77	28.4	28.4	1.0	193.69	1110.72	5	1.0	18.9	56.57	12.0	27.9	0	8.21	16.53	17.56	99.1	1951.2	3118.5	161.2	1328.5	**1247.38**	**442.84**
12.00	13.00	12.50	1.00	10.50	18.21	8.21	103.20	3.77	27.9	27.9	1.0	206.07	1316.78	0	1.0	0.0	56.57	13.0	28.0	0	8.21	16.76	17.79	107.3	2133.3	3506.7	178.2	1551.6	**1402.68**	**517.18**
13.00	14.50	13.75	1.50	12.00	18.21	8.21	113.46	5.66	28.0	28.0	1.0	341.28	1658.06	0	1.0	0.0	56.57	14.5	28.0	0	10.67	16.76	17.79	119.6	2396.5	4111.2	203.7	1918.3	**1644.46**	**639.43**
14.50	16.00	15.25	1.50	13.50	20.67	10.67	127.62	5.66	28.0	28.0	1.0	383.87	2041.93	0	1.0	0.0	56.57	16.0	11.8	52	10.67	3.00	1.73	135.6	1002.3	3100.8	229.1	2327.6	**1240.31**	**775.87**
16.00	17.50	16.75	1.50	15.00	20.67	10.67	143.62	5.66	11.8	11.8	1.0	169.74	2211.67	52	1.0	294.2	350.74	17.5	11.8	52	10.67	3.00	1.73	151.6	1056.6	3619.0	254.6	2817.0	**1447.60**	**938.99**
17.50	20.50	19.00	3.00	18.00	20.67	10.67	143.62	11.31	11.8	11.8	1.0	339.48	2551.14	52	1.0	588.3	939.09	20.5	11.8	52	10.67	3.00	1.73	151.6	1056.6	4546.8	305.5	3795.7	**1818.73**	**1265.24**
20.50	22.00	21.25	1.50	19.50	20.67	10.67	143.62	5.66	11.8	11.8	1.0	169.74	2720.88	52	1.0	294.2	1233.26	22.0	27.6	0	10.67	15.85	16.87	151.6	2842.2	6796.3	330.9	4285.1	**2718.52**	**1428.36**
22.00	23.50	22.75	1.50	21.00	20.67	10.67	143.62	5.66	27.6	27.6	1.0	424.76	3145.64	0	1.0	0.0	1233.26	23.5	27.8	0	9.23	16.31	17.33	151.6	2905.8	7284.7	356.4	4735.3	**2913.89**	**1578.43**
23.50	25.00	24.25	1.50	22.50	19.23	9.23	143.62	5.66	27.8	27.8	1.0	428.38	3574.02	0	1.0	0.0	1233.26	25.0	28.1	0	9.11	16.98	18.02	151.6	3024.6	7831.9	381.9	5189.1	**3132.74**	**1729.71**
25.00	26.50	25.75	1.50	24.00	19.11	9.11	143.62	5.66	28.1	28.1	1.0	433.83	4007.85	0	1.0	0.0	1233.26	26.5	31.8	0	9.02	30.33	31.63	151.6	5396.3	10637.4	407.3	5648.4	**4254.97**	**1882.81**
26.50	27.50	27.00	1.00	25.00	19.02	9.02	143.62	3.77	31.8	31.8	1.1	366.07	4373.92	0	1.0	0.0	1233.26	27.5	31.8	0	9.02	30.33	31.63	151.6	5396.3	11003.5	424.3	6031.5	**4401.40**	**2010.49**

APPENDIX-I

TABLE 4: COMPUTATION OF VERTICAL PILE LOAD CAPACITY (Dia.=1200 mm)

Dia. Of Pile: 1.20 m | Factor of Safety in Compression: 2.5 | Area of Pile: 1.13 m^2

Critical water table: 0.00 m | Factor of Safety in Tension: 3.0

Layers (m)		Mean depth (m)	Layer Thickness (m)	Length of Pile (m)	Bulk Unit Weight (kN/m^3)	Eff. Unit Weight (kN/m^3)	Effective Overburden at mid depth	Area of Pile Stem Asi (m^2)	Ultimate Shaft Friction Quf = ΣKi.Pdi.tan δ.Asi					Ultimate Shaft Cohesion Quc= Σα.c.Asi				Ultimate Bearing Resistance = Ap *(c.Nc +q.Nq+0.5. γ.B. Nγ)								Total Ultimate Load Capacity in Compression (kN)	Self-Weight of Pile (kN)	Total Ultimate load Capacity in Tension (kN)	Safe Load Capacity in Compression (kN)	Safe Load Capacity in Tension (kN)
From	To								ϕ	δ	Ki	Qi	∑Qi	c	α	α.c.Asi	∑Qi	Depth of Pile toe (m)	ϕ ' at pile toe	c at pile toe(kN/m2)	Eff. Unit Weight at pile toe (kN/m^3)	Nq	Nγ	q	Qb					
27.50	28.00	27.75	0.50	25.50	19.02	9.02	143.62	1.89	31.8	31.8	1.1	183.04	4556.96	0	1.0	0.0	1233.26	28.0	14.0	42	9.02	3.65	2.36	151.6	1068.3	6858.5	432.8	6223.0	**2743.42**	**2074.33**
28.00	29.50	28.75	1.50	27.00	19.02	9.02	143.62	5.66	14.0	14.0	1.0	202.58	4759.54	42	1.0	237.6	1470.86	29.5	11.5	45	9.24	2.91	1.65	151.6	968.0	7198.4	458.2	6688.6	**2879.34**	**2229.54**
29.50	30.00	29.75	0.50	27.50	19.24	9.24	143.62	1.89	11.5	11.5	1.0	55.10	4814.64	45	1.0	84.9	1555.71	30.0	11.5	45	9.24	2.91	1.65	151.6	968.0	7338.3	466.7	6837.1	**2935.33**	**2279.02**
30.00	31.00	30.50	1.00	28.50	19.24	9.24	143.62	3.77	11.5	11.5	1.0	110.20	4924.84	45	1.0	169.7	1725.43	31.0	31.6	0	9.02	29.32	30.60	151.6	5217.2	11867.5	483.7	7134.0	**4746.99**	**2377.98**
31.00	32.50	31.75	1.50	30.00	19.02	9.02	143.62	5.66	31.6	31.6	1.1	539.84	5464.68	0	1.0	0.0	1725.43	32.5	31.6	0	9.40	29.32	30.60	151.6	5225.1	12415.2	509.1	7699.2	**4966.08**	**2566.42**
32.50	34.00	33.25	1.50	31.50	19.40	9.40	143.62	5.66	31.6	31.6	1.1	539.84	6004.51	0	1.0	0.0	1725.43	34.0	31.4	0	9.25	28.31	29.58	151.6	5042.7	12772.7	534.6	8264.5	**5109.06**	**2754.85**
34.00	35.00	34.50	1.00	32.50	19.25	9.25	143.62	3.77	31.4	31.4	1.1	353.78	6358.29	0	1.0	0.0	1725.43	35.0	31.4	0	9.25	28.31	29.58	151.6	5042.7	13126.4	551.6	8635.3	**5250.57**	**2878.43**
35.00	35.50	35.25	0.50	33.00	19.25	9.25	143.62	1.89	31.4	31.4	1.1	176.89	6535.18	0	1.0	0.0	1725.43	35.5	30.8	0	9.28	25.29	26.50	151.6	4505.4	12766.0	560.1	8820.7	**5106.41**	**2940.22**
35.50	37.00	36.25	1.50	34.50	19.28	9.28	143.62	5.66	30.8	30.8	1.0	503.72	7038.89	0	1.0	0.0	1725.43	37.0	30.8	0	9.11	25.29	26.50	151.6	4502.4	13266.7	585.5	9349.8	**5306.68**	**3116.61**
37.00	37.50	37.25	0.50	35.00	19.11	9.11	143.62	1.89	30.8	30.8	1.0	167.91	7206.80	0	1.0	0.0	1725.43	37.5	30.8	0	9.11	25.29	26.50	151.6	4502.4	13434.6	594.0	9526.2	**5373.84**	**3175.41**
37.50	38.50	38.00	1.00	36.00	19.11	9.11	143.62	3.77	30.8	30.8	1.0	335.81	7542.61	0	1.0	0.0	1725.43	38.5	31.8	0	9.08	30.33	31.63	151.6	5397.6	14665.7	611.0	9879.0	**5866.26**	**3293.00**
38.50	40.00	39.25	1.50	37.50	19.08	9.08	143.62	5.66	31.8	31.8	1.1	549.11	8091.72	0	1.0	0.0	1725.43	40.0	31.8	0	10.49	30.33	31.63	151.6	5427.9	15245.0	636.4	10453.6	**6098.01**	**3484.52**

APPENDIX-I

TABLE 5: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1000 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Length of Fixity (m)	Allowable Load capacity of pile(kN)
P138B	1.00	2.50	0.00	35	29580399	0.0491	22	3128	3.41	0.50	0.15	2.21	0.005	7.54	168
P143B	1.00	2.50	0.00	35	29580399	0.0491	52	6831	2.92	0.00	0.00	2.23	0.005	6.51	315

APPENDIX-I

TABLE 6: COMPUTATION OF LATERAL PILE LOAD CAPACITY (Dia. 1200 mm)

Bore No.	Dia. of pile (m)	Cut-off length (m)	Scour depth (m)	Concrete Grade	Young's Modulus (kN/m^2)	Moment of Inertia (m^4)	Average SPT	Modulus of sub grade (k_1)	Stiffness Factor (T)	Cantilever length	L_1/T	L_f/T	Permissible deflection (m)	Length of fixity (m)	Allowable Load capacity of pile(kN)
P138B	1.20	2.50	0.00	35	29580399	0.1018	23	3272	3.92	0.50	0.13	2.21	0.005	8.66	235
P143B	1.20	2.50	0.00	35	29580399	0.1018	56	7262	3.34	0.00	0.00	2.23	0.005	7.44	438

APPENDIX-I

TABLE 7: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (µ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
P138B	0.50	SM	18	3	8.45	5.00	3.45	1.00	0.381	1.70	5.10	3.23	1.07	8.67	0.10	1.00	0.121	0.318	Liquefiable
	2.00	SM	18	3	33.80	20.00	13.80	0.98	0.376	1.70	5.10	3.23	1.07	8.67	0.10	1.00	0.121	0.322	Liquefiable
	3.00	SM	18	14	50.70	30.00	20.70	0.98	0.373	1.70	23.80	3.23	1.07	28.61	0.39	1.00	0.469	1.256	Non-liquefiable
	5.00	SM	14	17	84.50	50.00	34.50	0.96	0.367	1.70	28.90	2.20	1.04	32.33	0.52	1.00	0.620	1.688	Non-liquefiable
	6.00	SM	14	28	110.40	60.00	50.40	0.95	0.326	1.41	39.44	2.20	1.04	43.32	0.52	1.00	0.620	1.902	Non-liquefiable
	8.00	SM	17	33	147.20	80.00	67.20	0.94	0.321	1.22	40.26	3.01	1.06	45.69	0.52	1.00	0.620	1.933	Non-liquefiable
	9.00	SM	17	31	175.50	90.00	85.50	0.93	0.298	1.08	33.53	3.01	1.06	38.55	0.52	1.00	0.620	2.080	Non-liquefiable
	11.00	SM	33	55	214.50	110.00	104.50	0.88	0.282	0.98	53.80	4.88	1.18	68.35	0.52	1.00	0.620	2.200	Non-liquefiable
	12.00	SM	33	63	218.40	120.00	98.40	0.85	0.296	1.01	63.51	4.88	1.18	79.80	0.52	1.00	0.620	2.099	Non-liquefiable
	13.00	SM	37	66	236.60	130.00	106.60	0.83	0.286	0.97	63.92	5.00	1.20	81.71	0.52	1.00	0.620	2.166	Non-liquefiable
	14.50	SM	37	51	263.90	145.00	118.90	0.79	0.272	0.92	46.77	5.00	1.20	61.13	0.52	1.00	0.620	2.277	Non-liquefiable
	16.00	CL	79	48	291.20	160.00	131.20	0.75	0.259	0.87	41.91	5.00	1.20	55.29	0.52	0.95	-	-	Non-liquefiable
	17.50	CL	79	49	318.50	175.00	143.50	0.71	0.245	0.83	40.90	5.00	1.20	54.09	0.52	0.93	-	-	Non-liquefiable
	20.50	CL	83	58	373.10	205.00	168.10	0.63	0.217	0.77	44.73	5.00	1.20	58.68	0.52	0.84	-	-	Non-liquefiable
	22.00	SM	37	65	455.40	220.00	235.40	0.59	0.177	0.65	42.37	5.00	1.20	55.84	0.52	0.75	0.464	2.619	Non-liquefiable
	23.50	SM	37	69	486.45	235.00	251.45	0.56	0.169	0.63	43.51	5.00	1.20	57.22	0.52	0.73	0.453	2.683	Non-liquefiable
	25.00	SM	40	73	517.50	250.00	267.50	0.56	0.169	0.61	44.63	5.00	1.20	58.56	0.52	0.72	0.444	2.627	Non-liquefiable
	26.50	SM	40	101	548.55	265.00	283.55	0.56	0.169	0.59	59.98	5.00	1.20	76.98	0.52	0.70	0.435	2.575	Non-liquefiable

APPENDIX-I

TABLE 7: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 | Earthquake Zone= IV | amax/g=0.24 | K(alpha)= 1.00 | MSF= 1.193 | Critical Water Table (m)=0.00 m

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	28.00	CL-ML	72	111	579.60	280.00	299.60	0.56	0.169	0.58	64.13	5.00	1.20	81.95	0.52	0.69	-	-	Non-liquefiable
	29.50	CL	77	99	610.65	295.00	315.65	0.56	0.169	0.56	55.72	5.00	1.20	71.87	0.52	0.68	-	-	Non-liquefiable
	31.00	SM	41	100	641.70	310.00	331.70	0.56	0.169	0.55	54.91	5.00	1.20	70.89	0.52	0.67	0.413	2.442	Non-liquefiable
	32.50	SM	41	91	672.75	325.00	347.75	0.56	0.169	0.54	48.80	5.00	1.20	63.56	0.52	0.65	0.406	2.403	Non-liquefiable
	34.00	SM	42	94	703.80	340.00	363.80	0.56	0.169	0.52	49.28	5.00	1.20	64.14	0.52	0.64	0.400	2.366	Non-liquefiable
	35.50	SM	45	88	734.85	355.00	379.85	0.56	0.169	0.51	45.15	5.00	1.20	59.18	0.52	0.64	0.394	2.332	Non-liquefiable
	37.00	SM	45	90	765.90	370.00	395.90	0.56	0.169	0.50	45.23	5.00	1.20	59.28	0.52	0.63	0.388	2.299	Non-liquefiable
	38.50	SM	40	94	796.95	385.00	411.95	0.56	0.169	0.49	46.31	5.00	1.20	60.58	0.52	0.62	0.383	2.268	Non-liquefiable
	40.00	SM	40	99	828.00	400.00	428.00	0.56	0.169	0.48	47.85	5.00	1.20	62.42	0.52	0.61	0.378	2.239	Non-liquefiable
P143B	0.50	SM	30	15.00	10.35	5.00	5.35	1.00	0.301	1.70	25.50	4.71	1.15	34.14	0.52	1.00	0.620	2.063	Non-liquefiable
	1.00	SM	30	15.00	20.70	10.00	10.70	0.99	0.299	1.70	25.50	4.71	1.15	34.14	0.52	1.00	0.620	2.071	Non-liquefiable
	3.00	SM	13	22.00	62.10	30.00	32.10	0.98	0.295	1.70	37.40	1.89	1.04	40.67	0.52	1.00	0.620	2.103	Non-liquefiable
	4.00	SM	13	53.00	82.80	40.00	42.80	0.97	0.293	1.53	81.01	1.89	1.04	85.89	0.52	1.00	0.620	2.120	Non-liquefiable
	5.00	SM	16	70.00	103.50	50.00	53.50	0.96	0.290	1.37	95.70	2.77	1.05	103.64	0.52	1.00	0.620	2.137	Non-liquefiable
	6.00	SM	16	63.00	124.20	60.00	64.20	0.95	0.288	1.25	78.63	2.77	1.05	85.64	0.52	1.00	0.620	2.154	Non-liquefiable
	7.00	SM	16	78.00	144.90	70.00	74.90	0.95	0.286	1.16	90.13	2.77	1.05	97.76	0.52	1.00	0.620	2.171	Non-liquefiable
	8.00	SM	16	100.00	165.60	80.00	85.60	0.94	0.283	1.08	108.08	2.77	1.05	116.69	0.52	1.00	0.620	2.189	Non-liquefiable

APPENDIX-I
TABLE 7: LIQUEFACTION ANALYSIS

Magnitude of earthquake (Mw)=7 **Earthquake Zone= IV** **amax/g=0.24** **K(alpha)= 1.00** **MSF= 1.193** **Critical Water Table (m)=0.00 m**

BH No.	Depth (m)	Soil Type	Fines Content (FC), %	Corrected N Value N60	Total Overburden Stress (S_{v0}) kN/m^2	Pore Water Pressure (μ) kN/m^2	Effective Overburden Stress (S_{v0}'), kN/m^2	Stress Reduction Factor (r_d)	Cyclic Stress Ratio (CSR)	Overburden Correction factor (C_N)	Corrected SPT for Overburden $(N_1)_{60}$	Coefficient (α)	Coefficient (β)	Corrected SPT for fines content $(N_1)_{60CS}$	Cyclic Resistance Ratio ($CRR_{7.5}$)	K_σ	Cyclic Resistance Ratio (CRR)	Factor of Safety against Liquefaction (FS)	Status of Liquefaction
	9.00	SM	16	74.00	186.30	90.00	96.30	0.93	0.281	1.02	75.41	2.77	1.05	82.25	0.52	1.00	0.620	2.207	Non-liquefiable
	10.00	CL-ML	68	85.00	207.00	100.00	107.00	0.91	0.274	0.97	82.17	5.00	1.20	103.61	0.52	1.00	-	-	Non-liquefiable
	11.00	CL-ML	68	85.00	227.70	110.00	117.70	0.88	0.266	0.92	78.35	5.00	1.20	99.02	0.52	1.00	-	-	Non-liquefiable
	12.80	SM	36	29.00	264.96	128.00	136.96	0.83	0.251	0.85	24.78	5.00	1.20	34.74	0.52	1.00	0.620	2.469	Non-liquefiable
	14.00	SM	36	37.00	289.80	140.00	149.80	0.80	0.241	0.82	30.23	5.00	1.20	41.28	0.52	1.00	0.620	2.568	Non-liquefiable
	15.50	SM	36	100.00	320.85	155.00	165.85	0.76	0.229	0.78	77.65	5.00	1.20	98.18	0.52	0.87	0.540	2.352	Non-liquefiable
	17.00	SM	36	100.00	351.90	170.00	181.90	0.72	0.217	0.74	74.15	5.00	1.20	93.97	0.52	0.84	0.521	2.397	Non-liquefiable

APPENDIX-J
SITE PHOTOGRAPHS

SPT at depth 6.00 m

UDS at depth 7.00 m

SPT sample at depth 22.00 m

APPENDIX-J
SITE PHOTOGRAPHS

SPT sample at depth 4.00 m


SPT sample at depth 10.00 m


Coring at depth 17.75 m


Coring at depth 20.00 m

APPENDIX-K
LABORATORY PHOTOGRAPHS

Dry density test of rock

UCS test of rock

Cerchar abrasion test

APPENDIX-K
LABORATORY PHOTOGRAPHS

Atterbergs' limit test

Shrinkage limit test


Tri-axial shear test


Direct shear test

APPENDIX-L
CHART 1: FIELD BORELOG CHARTS (P138B)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No	GT/003
		Date of Issue:	01.04.2018
		Rev. No.:	R03
		Rev. Date.:	28.12.2021

Project Name:	for HORC viaduct b/w Sohana & Dhulawat station			Project Code:	1901
Coordinate:	N: 3131462.977	E: 700895.449	Location/ Chainage: 29530.463		
Method of Drilling:	Percussion	Drilling Equipment	Manual Bore winch	Bore No.:	P-138 B
Casing Lowered (M):	21.00 / Bentonite Used: Yes	Standard Sampler :	Yes	Barrel Type :	N/A
Ground Elevation:	RL-209.346	Date: From 26/11/2023 to 28/11/2023		Water Table (M):	18.01

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
[illegible]	0.00	0.50	0.50	D	SX	Collected				–	–	–	–	–	–	Non cohesive soil
"	1.00	1.45	0.45	U	–	Received				–	–	–	–	–	–	— do —
"	2.00	2.45	0.45	DP	–	1	1	2	3	–	–	–	–	–	–	— do —
"	3.00	3.45	0.45	DP	–	1	2	12	14	–	–	–	–	–	–	— do —
"	4.00	4.45	0.45	U	–	Slipped				–	–	–	–	–	–	— do —
"	5.00	5.45	0.45	DP	–	4	7	10	17	–	–	–	–	–	–	— do —
"	6.00	6.45	0.45	DP	–	8	11	17	28	–	–	–	–	–	–	— do —
"	7.00	7.45	0.45	U	–	Received				–	–	–	–	–	–	Non cohesive soil
"	8.00	8.45	0.45	DP	–	9	13	20	33	–	–	–	–	–	–	— do —
"	9.00	9.45	0.45	DP	–	8	12	19	31	–	–	–	–	–	–	— do —
"	10.00	10.45	0.45	U	–	Received				–	–	–	–	–	–	— do —
"	11.00	11.45	0.45	DP	–	12	25	30	55	–	–	–	–	–	–	— do —
"	12.00	12.45	0.45	DP	–	13	29	34	63	–	–	–	–	–	–	— do —
"	13.00	13.45	0.45	DP	–	18	31	35	66	–	–	–	–	–	–	— do —
"	14.50	14.95	0.45	DP	–	17	22	29	51	–	–	–	–	–	–	— do —
"	16.00	16.45	0.45	DP	–	15	21	27	48	–	–	–	–	–	–	Non cohesive soil with gravel
"	17.50	17.95	0.45	DP	–	13	24	25	49	–	–	–	–	–	–	cohesive soil with gravel
"	19.00	19.45	0.45	U	–	Received				–	–	–	–	–	–	— do —
"	20.50	20.95	0.45	DP	–	16	27	31	58	–	–	–	–	–	–	— do —
[illegible]	22.00	22.45	0.45	DP	–	17	29	36	65	–	–	–	–	–	–	Non cohesive soil
"	23.50	23.95	0.45	DP	–	15	31	38	69	–	–	–	–	–	–	— do —
"	25.00	25.45	0.45	DP	–	19	33	40	73	–	–	–	–	–	–	— do —
"	26.50	26.95	0.45	DP	–	21	44	57	101	–	–	–	–	–	–	cohesive soil
"	28.00	28.45	0.45	DP	–	24	50	61	111	–	–	–	–	–	–	— do —

Supervisor

E - In - C

Abbreviation Used: U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-L
CHART 2: FIELD BORELOG CHARTS (P138B)

TECHPRO ENGINEERS PVT. LTD.

BORE/ DRILL LOG

Doc No:	GT/ 003
Date of Issue:	01.04.2018
Rev. No.:	R03
Rev. Date:	28.12.2021

Project Name:	GTW - for HORC Viaduct B/w Sohana & Dhulawat station			Project Code:	1901
Coordinate:	N: 3121462.977	E: 700895.449	Location/ Chainage: 29520.463		
Method of Drilling:	Percussion	Drilling Equipment:	Manual / Power winch	Bore No.:	P-138B
Casing Lowered (M):	21.00	Bentonite Used: Yes	Standard Sampler: Yes	Barrel Type:	N/A
Ground Elevation:	RL- 209.246	Date: From 26/11/2023 to 25/11/2023		Water Table (M):	18.00

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
[illegible]	29.50	29.95	0.45	DP	SX	21	47	52	99	–	–	–	–	–	–	cohesive soil
"	31.00	31.45	0.45	DP	–	23	46	54	100	–	–	–	–	–	–	Non cohesive soil
"	32.50	32.95	0.45	DP	–	20	41	50	91	–	–	–	–	–	–	– do –
"	34.00	34.45	0.45	DP	–	22	43	51	94	–	–	–	–	–	–	– do –
"	35.50	35.95	0.45	DP	–	19	40	48	88	–	–	–	–	–	–	– do –
25/11/23	37.00	37.45	0.45	DP	–	19	41	49	90	–	–	–	–	–	–	– do –
"	38.50	38.95	0.45	DP	–	24	44	50	94	–	–	–	–	–	–	– do –
"	40.00	40.45	0.45	DP	–	26	47	52	99	–	–	–	–	–	–	Non cohesive soil

Supervisor

Abbreviation Used: U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler.

E - In - C

APPENDIX-L
CHART 3: FIELD BORELOG CHARTS (P143B)

TECHPRO ENGINEERS PVT. LTD. **BORE/ DRILL LOG**

Doc No	GT/009
Date of Issue	01.04.2018
Rev No	R01
Rev Date	28.12.2021

Project Name: GT For HORC Viaduct Between Sohana Dhulawat station — Project Code: 1901

Coordinate: N: 3121585.535 — E: 700097.404 — Location/ Chainage: 21661.469

Method of Drilling: Rotary — Drilling Equipment: Hydraulic — Bore No.: P143B

Casing Lowered (M): 12.00 M — Bentonite Used: Nil — Standard Sampler: Yes — Barrel Type: Double

Ground Elevation: RL- 205.668 — Date: From 19/09/23 to 22/09/23 — Water Table (M): 14.40 M

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	15-30cm	30-45cm	N Value	Run Time Start	Run Time End	CR (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
19/9/23	0.00	0.50	0.50	DS	SX	collected				-	-	-	-	-	-	Non cohesive soil
"	1.00	1.45	0.45	DP	"	6	7	8	15	-	-	-	-	-	-	do
"	2.00	2.45	0.45	U	"	Received				-	-	-	-	-	-	do
"	3.00	3.45	0.45	DP	"	6	8	14	22	-	-	-	-	-	-	do
"	4.00	4.45	0.45	DP	"	13	24	29	53	-	-	-	-	-	-	do
"	5.00	5.45	0.45	DP	"	18	32	38	70	-	-	-	-	-	-	do
20/9/23	6.00	6.45	0.45	DP	"	11	30	33	63	-	-	-	-	-	-	do
"	7.00	7.45	0.45	DP	"	16	38	40	78	-	-	-	-	-	-	do
"	8.00	8.29	0.29	DP	"	34	69	-	R	-	-	-	-	-	-	Non cohesive soil with gravel
"	9.00	9.45	0.45	DP	"	17	31	43	74	-	-	-	-	-	-	do
"	10.00	10.45	0.45	DP	NX	19	40	45	85	-	-	-	-	-	-	do
"	11.00	11.30	0.30	DP	"	54	100	-	R	-	-	-	-	-	-	do
21/9/23	11.30	12.05	0.75	C	"	-	-	-	-	9.00	10.00	57	47	50	Light brown	Light brown quartzite rock fractured
"	12.05	12.80	0.75	C	"	-	-	-	-	10.15	11.00	19	NIL	50	Light brown	do
"	12.80	13.25	0.45	DP	"	8	9	20	29	-	-	-	-	-	-	Non cohesive soil
"	14.00	14.45	0.45	DP	"	10	12	25	37			-	-		-	do
"	15.50	15.95	0.45	DP	"	36	50	52	R	-			-	-	-	do
"	17.00	17.05	0.05	DP	"	50	-	-	R	-	-			-	-	[illegible] quartzite rock [illegible]
"	17.00	17.75	0.75	C	"	-	-	-	-	11.10	12.00	17	NIL	60	Light brown	Light brown fractured quartzite rock
"	17.75	18.50	0.75	C	"	-			-	12.15	1.00	53	19	80	"	do
"	18.50	19.25	0.75	C	"	-	-		-	1.30	2.30	61	16	80	"	do
"	19.25	20.00	0.75	C	"					2.40	3.40	36	13	100	"	do
"	20.00	20.75	0.75	C	"					4.00	5.10	36	24	100	"	do
22/9/23	20.75	21.50	0.75	C	"	-			-	8.50	10.00	41	NIL	100	"	do

Supervisor 22/09/23 — E-in-C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-L
CHART 4: FIELD BORELOG CHARTS (P143B)

TECHPRO ENGINEERS PVT. LTD.	BORE/ DRILL LOG	Doc No:	GTI/ 003
		Date of Issue:	01 04 2018
		Rev No.	R00
		Rev Date:	28 12 2021

Project Name:	G.T. Work for HORC Viaduct between Sohana Dhulawat Station	Project Code:	1901
Coordinate:	N: 3121588.598 E: 720849.914	Location/ Chainage:	24661.464
Method of Drilling:	Rotary	Drilling Equipment:	Hydraulic
Bore No.:	P143B	Casing Lowered (M):	12.00
Bentonite Used:	Not	Standard Sampler:	Yes
Barrel Type:	Double	Ground Elevation:	RL 305.058
Date: From	19/09/23 to 23/09/2023	Water Table (M):	14.500

Day	Depth/RUN (m) From	Depth/RUN (m) To	Length(m)	Nature of sample	Hole Size	SPT Record 0-15cm	SPT Record 15-30cm	SPT Record 30-45cm	SPT Record N Value	Run Time Start	Run Time End	C R (%)	RQD(%)	Water Losses (%)	Color of Return Water	Description
22/9/23	21.50	22.25	0.75	C	NX	–	–	–	–	10:30	11:30	35	NIL	100		Light brown Fractured Quartzite Rock
23/9/23	22.25	23.00	0.75	C	"	–	–	–	–	8:50	9:50	NIL	NIL	100		Grey Highly weathered severely Rock in to sand
"	23.00	23.05	0.05	DP	"	100	–	–	R	–	–	–	–	–	–	
"	23.00	23.75	0.75	C	"	–	–	–	–	10:15	11:00	NIL	NIL	100		— do —
"	23.75	23.81	0.06	DP	"	100	–	–	R	–	–	–	–	–	–	
"	23.75	24.50	0.75	C	"	–	–	–	–	11:10	12:00	NIL	NIL	100		— do —
"	24.50	24.54	0.04	DP	"	100	–	–	R	–	–	–	–	–	–	
"	24.50	25.25	0.75	C	"	–	–	–	–	12:45	1:00	NIL	NIL	100		— do —
"	25.25	25.31	0.06	DP	"	102	–	–	R	–	–	–	–	–	–	

Verified by RS

23/09/23

Supervisor

E - In - C

Abbreviation Used : U- Undisturbed Sample, C- Core Sample, D- Disturbed Sample, P- Standard Penetration Test, R- Refusal (Standard Penetration Test (N) > 100), Sampler means SPT sampler

APPENDIX-M

CHART 1: CORE MEASUREMENT SHEET (P143B)

TECHPRO ENGINEERS PVT. LTD.

CORE MEASUREMENT SHEET

Doc. No.:	GT 007
Date of Issue:	01.01.2018
Rev. No.:	R00
Rev. Date:	NIL

Project Name: GT For HORC Viaduct between Sohana Dhulawat station

Project code: 1901

Location: —

Date: 21/9/23 23/9/23

Str/ Chainage: 24861.464

BH-No.: P143B

Run (M) From	Run (M) To	Total Length (cm)	Core No. From	Core No. To	Core Number/ Length of core pieces (cm)					
11.30	12.05	43	1	2	1/35	2/8				
12.05	12.90	14	3	5	3/4	4/2	5/8			
17.00	17.75	13	6	8	6/3	7/5	8/5			
17.75	18.50	40	9	13	9/8	10/7	11/14	12/10	13/3	
18.50	19.25	46	14	19	14/7	15/9	16/12	17/4	18/5	19/9
19.25	20.00	27	20	23	20/7	21/6	22/4	23/10		
20.00	20.75	27	24	25	24/9	25/18				
20.75	21.50	32	26	31	26/2	27/3	28/9	29/4	30/4	31/9
21.50	22.25	26	32	36	32/5	33/3	34/8	35/6	36/4	

Supervisor:

E-in-C:

End of Report