

FOUNDATION RECOMMENDATION  
**REPORT**

**PROJECT: CONSTRUCTION OF FACULTY BUILDING**  
IIT MADRAS CAMPUS, CHENNAI

**CLIENT: THE SUPERINTENDING ENGINEER**  
ENGINEERING UNIT, ADMIN BUILDING, 3RD FLOOR, IIT MADRAS, CHENNAI 600036

**REPORT NO: 1Z/IITM/FACULTY/GC/25/045**  
**DATE: 10 March 2026**



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Geotechnical Investigation, Interpretation, Design and Quality Control Management

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# **GEOTECHNICAL Solutions<sup>A1</sup>**

## **FOUNDATION RECOMMENDATION REPORT FOR CONSTRUCTION OF FACULTY BUILDING IIT MADRAS CAMPUS, CHENNAI**

**THE SUPERINTENDING ENGINEER**  
ENGINEERING UNIT, ADMIN BUILDING, 3RD FLOOR,  
IIT MADRAS, CHENNAI 600036

**10 March 2026**

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*Report on Foundation Recommendation for*  
**CONSTRUCTION OF NEW B+G+11 FACULTY BUILDING**  
**IIT MADRAS CAMPUS, CHENNAI**

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**Report on Foundation Recommendation for  
CONSTRUCTION OF NEW B+G+11 FACULTY BUILDING  
IIT MADRAS CAMPUS, CHENNAI**

**1 INTRODUCTION**

- 1.1 IIT Madras, Chennai, is constructing a new faculty building with one basement, ground floor and eleven upper floors at the location of the existing Materials Forming Laboratory building of two floors. The new construction will cover a total land area of 1145 Sqm, with a total floor area of 10765 Sqm. The basement floor level is at about 2.6m below the present ground level, taken as the setback level.
- 1.2 The Superintending Engineer of the IIT Engineering unit recommended a geotechnical investigation comprising five exploratory boreholes in the location of the new construction. Boreholes are located between the existing RCC structures. M/s VRR Engineering Consultancy, Chennai, conducted this investigation and submitted the factual report [013 / GTI / VRR / 2026 of 12<sup>th</sup> February 2026] for the five exploratory boreholes with relevant field and laboratory test results. The field investigation was carried out from 26 November 2025 to 12 December 2025.
- 1.3 I, Anirudhan I.V., Geotechnical Solutions, Chennai, am appointed to prepare the foundation recommendation report based on the factual report provided by M/s VRR Engineering Consultancy. This note provides the foundation recommendations for the proposed constructions.
- 1.4 Full raft foundation (wide elliptical strip and a connecting strip) over weathered disintegrated rock at about 3.5m to 4.0m depth below average ground level is recommended to support the RCC walls and columns (in MIVAN system). Alternatively, short piles having bearing in weathered rock are also recommended.

**2 INVESTIGATION DATA AND SUBSOIL PROFILE**

**2.1 Investigation Data**

- 2.1.1 The proposed new faculty building layout is presented in Figure 2.1 on the next page. The construction area is covered with a few existing structures. Five boreholes are sunk within the construction area based on available space. The average ground level is about +8.80m, with variations of the order of  $\pm 0.40$ m. The borehole locations are shown in Figure 2.2.
- 2.1.2 The bore log, summary of laboratory test results, rock strength data, and the photographs of soil and rock samples are presented in the factual report submitted by



## 2.2 Investigation Procedure

2.2.1 Exploratory boreholes were advanced from the existing ground level using the rotary drilling technique supplemented by bentonite mud circulation.

2.2.2 Standard Penetration Tests were conducted at regular depth intervals in the boreholes, and N values were recorded. These tests were carried out using the SPT hammer provided with an auto-trip mechanism. The expected energy level is roughly 65%. SPT N, thus recorded, is considered  $N_{60}$ . A winch and cathead device was used to lift the hammer at about 18 blows per minute.

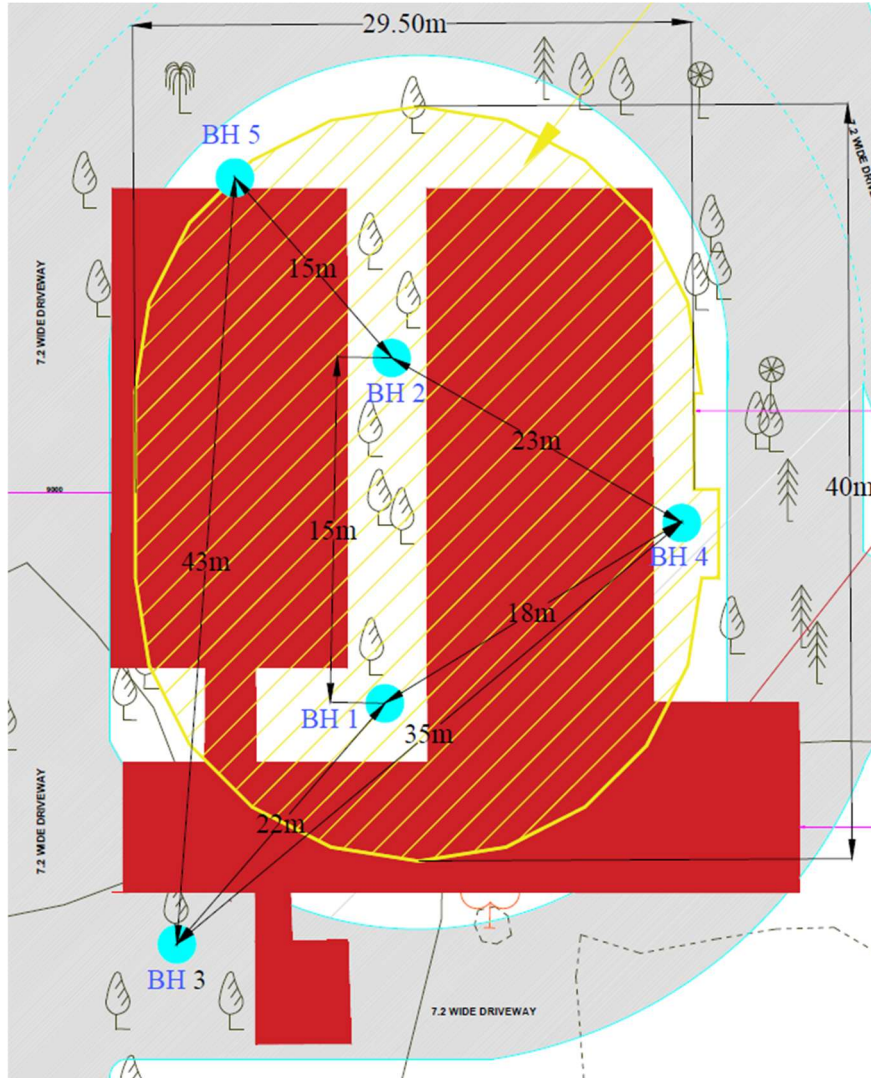


Fig. 2.2 Borehole locations with respect to the existing buildings

2.2.3 As per the factual report, all the field and laboratory tests were conducted according to the procedures stipulated in the relevant IS Codes<sup>1</sup>.

### 2.3 Investigation Data

2.3.1 Complete investigation data are available in the Factual Report submitted by VRR Engineering Consultancy, attached to this note as Annexure 1.

<sup>1</sup> Compendium of Indian Standards on Soil Engineering SP 36 (Part 1 and Part 2)

### 3 SITE TOPOGRAPHY, SUBSOIL PROFILE AND ENGINEERING PROPERTIES

#### 3.1 Site Topography

3.1.1 The Google Earth image presented in the factual report by VRR shows bushes and trees in the free space, and existing constructions in the location of the new construction. The ground level at borehole locations ranged from +8.439m RL to +9.104m RL, with an average of +8.80 m RL based on the topography records. The ground levels given in the Factual report differ by 4.8m, which may be because of a different reference TBM.

#### 3.2 Sub-soil Profile

3.2.1 Sub-soil profile comprises a 1.5m thick filled earth that contains debris, followed by clayey sand and sandy clay residual layers to a depth of 6.0m to 8.0m, below which weathered jointed charnockite rock is present. The SPT N is more than 100 below 3.0m except in the case of BH/3, in which SPN is more than 100 below 4.0m depth.

3.2.2 Table 3.1 The thickness and RL of different geological formations below ground

BH No	GL	Fill bottom		SPT Rebound		Weathered rock		RQD = zero bottom	
		Depth	RL	Depth	RL	Depth	RL	Depth	RL
BH/1	+8.752m	1.5m	+7.3m	3.0m	+5.8m	5.0m	+3.8m	7.0m	+0.3m
BH/2	+8.991m	1.5m	+7.5m	3.3m	+5.7m	6.0m	+3.0m	8.0m	- 0.5m
BH/3	+8.923m	1.5m	+7.4m	4.0m	+4.9m	11.0m	- 2.1m	12.0m	- 4.6m
BH/4	+8.439m	1.5m	+6.9m	1.5m	+6.9m	7.0m	+1.4m	7.0m	- 0.1m
BH/5	+9.104m	1.5m	+7.6m	3.0m	+6.1m	3.0m	+6.1m	6.0m	+1.6m

OB is loose overburden, w.d.r. is weathered disintegrated rock in the form of clayey sand, w.f.r. is weathered fractured rock and severely jointed rock with low RQD and below this layer, weathered jointed rock (w.j.r.) is present

3.2.3 The elevation of SPT rebound is in the range of +6.9m to +4.9m, 4.0m to 4.0m below the average ground level. The fully weathered rock with RQD zero extends to a highly variable depth of 6.0m to 12.0m (+1.60m to -4.6m).

#### 3.3 Groundwater Table

3.3.1 The boreholes recorded water at 1.5m to 1.55m below the working levels during the investigation. The groundwater table during the investigation is at about +7.4mRL.

3.3.2 The groundwater table is expected to be at the ground level during the rains, as experienced in recent years.

### 4 BEARING CAPACITY OF SOIL AND FOUNDATION

4.1 The proposed structure is a multistorey building with one basement, ground floor and eleven upper floors. The building is of uniform elliptical shape, with RCC walls and columns as the frame. The average load intensity at the foundation level of a B+G+11 institution building is roughly 250 kPa.

4.2 The minimum base width is roughly 28m while the height of the building is about 45m above the basement level. Since the H/B ratio is less than 2, overturning stability is not a concern. The width of the faculty rooms, along with the 2.0m corridor, is 6.2m.

4.3 ***Full Raft Foundation at +5.3m (app. 3.6m Below Average GL)***

4.3.1 A full raft foundation placed over dense weathered disintegrated rock with SPT rebound available below 3.0m depth in general and at about 4.0m locally is suitable to support the proposed building.

4.3.2 Weathered disintegrated rock with SPT rebound is present at this level. The minimum angle of shearing resistance  $\phi$  is  $40^\circ$ .

4.3.3 The safe bearing capacity of a full raft foundation resting over weathered disintegrated rock with SPT refusal is much larger than 400 kPa, as shown in **Appendix A**, which estimates the net safe bearing capacity of a 6.0m wide strip placed at a minimum embedment depth of 3.0m. This minimum depth is available here as the proposed structure has a basement up to 2.55m from the setback level.

4.3.4 Settlement of Full Raft: The weathered, disintegrated rock below the founding level recorded SPT rebound, suggesting a large modulus. The compression of 3.0m to 4.0m thick weathered disintegrated rock is not large, and the expected total settlement of the raft is 12mm to 15mm.

4.4 ***Rock Socketed Piles***

4.4.1 The jointed rock is present at varying depths of 6.0m to 12.0m at these borehole locations. The depth is 6.0m to 8.0m in four boreholes and 12m in one borehole. The length of bored cast-in-situ piles below the pile cut-off level is limited to 2.5m to 4.5m unless the piles are driven into jointed rock.

4.4.2 Rock socketed piles with a minimum socketing of twice the pile diameter are needed for realising good load carrying capacity. The pile length below the cut-off level is still limited to 3.5m to 6.5m for 500mm to 1000mm diameter piles. The safe compression capacity of piles with 2D socketing is recommended as the limiting structural capacity of the pile shaft of M30 concrete.

4.4.3 As per clause 6.5.1.1 of IS 14593: 1998, the safe compression capacity of rock socketed pile is estimated as illustrated in Figure 4.1. Both the boreholes recorded weathered jointed rock immediately below the residual sand layer. The unconfined compression strength tests reported UCS values of 17 to 88 MPa. Considering the variability in the weathering, the design UCS for the jointed rock is selected as 30 MPa.

$$Q_s = q_c N_j N_d A_p + q_c \pi D l_s \alpha \beta \quad \dots(1)$$

where

- $Q_s$  = safe load capacity of pile, in tonnes;  
 $q_c$  = uniaxial compressive strength of rock, T/m<sup>2</sup>;  
 $N_d$  = depth factor =  $0.8+0.2 l_s/D$ , limited to 2;  
 $A_p$  = area of pile toe,  $\pi D^2/4$ ;  
 $D$  = diameter of pile, in m;  
 $l_s$  = socket length into the rock, in m;  
 $\alpha$  = rock socket slide resistance reduction factor (Fig. 1);  
 $\beta$  = rock socket correction factor (Fig. 2); and  
 $N_j$  = values as per Fig. 2 of IS 12070 are applicable, when the spacing of discontinuity is greater than 300 mm and aperture (opening) of discontinuities less than 10 mm (15 mm if filled with soil or rock debris. Otherwise Table 4 of IS 12070 is applicable).

$\alpha$  values are given in Fig. 1 based on rock strength and values of  $\beta$  in Fig. 2 based on mass factor.

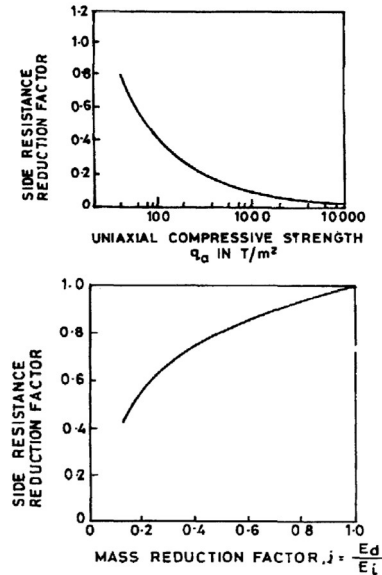


Fig. 4.1 Estimation of safe compression capacity for rock socketed piles

Table 4.1 presents the estimation of the safe compression capacity of rock-socketed piles with diameters of 500mm, 600mm, 750mm and 900mm. A socket length of twice the pile diameter in the jointed rock is assumed for all pile sizes.

Table. 4.1 Safe compression capacity for rock socketed piles of 500mm, 600mm, 750mm & 900mm diameter (socket length 2D).

Pile Dia	Socket length	Nd	qc1	Socket JR1	Base kN	Socket kN	Total* kN	Uplift kN
0.50m	2.00D	1.20	30MPa	1.00m	1060	471	1531	377
0.60m	2.00D	1.20	30MPa	1.20m	1527	679	2206	543
0.75m	2.00D	1.20	30MPa	1.50m	2386	1060	3446	848
0.90m	2.00D	1.20	30MPa	1.80m	3435	1527	4962	1222
Structural capacity Pile diameter, mm					0.50	0.60	0.75	0.90
Limiting compression capacity for M30 concrete					1473	2121	3313	4771
JR1 Jointed rock (Grade III), UCS qc1					qc for Grade III rock is taken as 30 MPa			

Nj for JR = 0.15

Nd is depth factor =  $0.8+0.2 l_s/D$

$\alpha$  for JR is 0.025

and  $\beta$  for JR is 0.4

\* Reported values are safe compression capacities with FoS = 6. The capacities shall be limited to the safe structural capacity recommended above.

The safe tension capacity is estimated as 80% of the socket resistance. Friction from overburden is also available (not added in the values).

Based on the above estimates, the recommended safe compression and tension capacities for 500mm, 600mm, 750mm and 900mm diameter piles with a socket

length of 2D are as follows.

- For 500mm diameter (M30)  
Safe compression capacity = 1470 kN  
Safe tension capacity = 400 kN\*
- For 600mm diameter (M30)  
Safe compression capacity = 2100 kN  
Safe tension capacity = 600 kN\*
- For 750mm diameter (M30)  
Safe compression capacity = 3300 kN  
Safe tension capacity = 900 kN\*
- For 900mm diameter (M30)  
Safe compression capacity = 4700 kN  
Safe tension capacity = 1300 kN\*

\* Including the self-weight.

The minimum concrete strength to achieve these capacities is M30. The safe compression capacities shall be limited to 25% of the concrete strength when the grade of concrete used in the pile construction is lower than M30.

- 4.4.4 **Lateral Capacity of Piles:** The length of pile below the cut-off level is 4.0m to 9.0m, making the piles relatively short and rigid. IS 2911 Part 1 (Sec 2) does not offer any procedure for estimating the safe lateral capacity of short piles. However, the possible depth of fixity is estimated from the sub-grade modulus procedure presented in IS 2911. A typical estimate is presented in **Appendix E**. The soil below the pile cutoff level is very dense sand with an angle of friction 42deg.
- 4.4.5 Table 4.2 presents the estimated fixity lengths and the corresponding shear, limiting the pile head deflection to 5mm. The depth of fixity is close to the pile length below the pile cut-off level, and the pile is expected to behave as a rigid short pile. The safe shear for short rigid piles is always larger than the elastic piles, and hence the estimation assuming long elastic piles is conservative.

Table 4.2 Summary of Lateral Capacity Estimation (IS 2911)

Pile diameter, mm	500	600	750	900
Free head Capacity for 5mm	61.1kN	81.7kN	116.8kN	156.4kN
Free head fixity length	2.7m	3.1m	3.7m	4.3m
Fixed head Capacity for 5mm	164.6kN	220.3kN	314.9kN	421.5kN
Fixed head fixity length	3.0m	3.5m	4.2m	4.9m

#### 4.5 ***Sulphate and Chloride in Soil and Groundwater***

- 4.5.1 The factual report records sulphate content (SO<sub>4</sub>) of the order of 320 ppm to 340 ppm. The SO<sub>3</sub> content is roughly 264 ppm, which is marginally above the normal limit of 200 ppm considered safe for foundation concrete. The 2:1 aqueous extract of the soil recorded 21 to 270 ppm sulphate (SO<sub>4</sub>).

- 4.5.2 The chloride content is 490ppm to 520 ppm, marginally high, compacted to the limit of 500 ppm.
- 4.5.3 Recommended to use a minimum cement content of 400 kg/cum, preferably with Portland pozzolana slag cement for the construction of foundation concrete.

## 5 CONCLUSIONS AND RECOMMENDATIONS

- 5.1 IIT Madras proposes to construct a new faculty building at the location of the existing Materials Forming Laboratory. The new faculty building will have a basement, ground floor and eleven upper floors. The average foundation load intensity for a B+G+11 institutional building may be about 250 kPa.
- 5.2 M/s VRR Engineering Consultancy, Chennai, conducted the soil investigation by drilling eight exploratory boreholes in the construction area as directed by the Superintending Engineer of the IIT Engineering unit. VRR Engineering submitted the factual report to the Engineering Unit of IIT Madras in February 2026.
- 5.3 The sub-soil profile comprises 2.5m to 4.0m thick overburden soil, followed by weathered disintegrated rock in the form of very dense gravelly soil. Weathered, fractured rock and jointed rock followed shortly after. The engineering properties of different soil layers are derived from the field and laboratory test results provided in the investigation report submitted by VRR Engineering Consultancy.
- 5.4 The ground level is uniform in the construction area. Based on the ground elevations in the borehole locations, the average ground elevation is +8.9m. A good part of the project area is covered with small trees apart from the existing structure.
- 5.5 Full raft foundation placed over weathered, disintegrated rock with SPT N more than 50 is recommended as the depth of bearing stratum is 2.5m to 3.0m below ground level in the maximum area for construction. The recommended minimum foundation level is +5.3m, 3.5m below average ground level.

### 5.6 *Foundation Recommendations*

#### 5.6.1 Option 1: Shallow Foundation at +5.30m

Recommended type of foundation	- Full raft
Depth of foundation	- about 3.5m below average ground level*
Type of formation at founding depth	- Weathered disintegrated rock (Clayey sand with SPT refusal) ^**
Net allowable bearing pressure	- 400 kN/m <sup>2</sup>
Expected settlement	- <15mm
Modulus of subgrade reaction	- 30,000 kN/m <sup>2</sup> /m

\* The minimum foundation elevation is +5.3m. The depth of weathered, disintegrated rock may vary across the construction area. The weathered rock may

be at 4.0m in some portions, where the loose soil below +5.30m RL shall be replaced with PCC.

^Groundwater lowering before excavation is necessary if the groundwater table is above the excavation level. Open dewatering from the foundation pit is NOT recommended. Excavation for open dewatering shall be made exclusively.

\*\* The soil at the foundation level is silty sand with gravel derived from weathered, disintegrated rock. The stratum shall be confirmed in all the foundation excavations.



- 5.7 The clayey sand from excavation can be reused for backfilling the excavations.
- 5.8 The sulphate content in soil and groundwater is marginally high. Recommended to use a minimum cement content of 400 kg/cum, preferably with Portland pozzolana slag cement for the construction of foundation concrete.

For **Geotechnical Solutions**



10 March 2026

A handwritten signature in blue ink, appearing to read "Anirudhan I. V.", written in a cursive style.

**Anirudhan I. V.**

BSc. Engg, M.Tech (Geotechnique), FIGS, Sr. PE  
CMDA Professional Registration No: GTE/19/08/036

## BEARING CAPACITY

## STRIP FOOTINGS AT 3.00M BELOW GL

Project:	Construction of New Faculty Building, IIT Madras						
Structure	B+G+11 RCC Frame - Mivan						
Net Ultimate Bearing Capacity		$= 0.5B\gamma'N_{\gamma}s_{\gamma}d_{\gamma}i_{\gamma}g_{\gamma} + \gamma'D(N_q-1)s_qd_qi_qg_q$					
Soil Data	Bearing Capacity Estimation using					IS Code 6403 -1981	
Reference Bore Hole	BH/01 to BH/05						
Type of Soil	Sand						
<u>Failure Case</u>							
Cohesion c	0.0	kN/m <sup>2</sup>	Local Shear failure when angle of friction is 28deg or less				
Bulk density above gwl	17.0	kN/m <sup>3</sup>	Angle of friction is adjusted to 0.67 tan(phi)				
Bulk density below gwl	19.0	kN/m <sup>3</sup>	General shear failure when angle of friction is 38deg or more				
Ground water table	1.00	m	Angle of friction is equal to original value				
			Intermediate case when 28deg < PHI <38deg				
Factor of safety	3.00		Angle of friction is interpolated				
<u>ESTIMATION 1</u>							
Depth of Foundation*	3.00	m	Angle of Friction $\phi$	40.0		deg	
Shape of Footing	Strip		Failure Case	General			
Width of Foundation	6.00	m	Design Angle of Friction	40.0		deg.	
			$N_i$	$s_i$	$d_i$	$i_i$	$N^{**}$ Ultimate
* depth of embedment			$N_c$	75.39	1.00	1.21	1.00 91.6 0.1
			$N_q$	64.26	1.00	1.11	1.00 70.0 2339.6
			$N_r$	109.52	1.00	1.11	1.00 121.3 3274.3
N** Product of bearing capacity factors and other correction factors			Total Ultimate Bearing capacity			5613.9 kN/m <sup>2</sup>	
			Net Safe Bearing Capacity			1871 kN/m <sup>2</sup>	
Note: If loading is eccentric, total load shall be estimated for corrected area = L' x B' where L'=L-2e <sub>l</sub> and B'= B-2e <sub>b</sub>			Geotechnical Solutions				
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**LATERAL CAPACITIES OF CAST-IN-SITU PILES****APPENDIX B**Varying Modulus Case (sand and soft clays)**FOR PILES WITH COL AT ABOUT 1.20M BELOW GL**Project: **Construction of New Faculty Building, IIT Madras**

Structure: B+G+11 RCC

Loading Type Normal

Type of pile - bored cast-in-situ piles

Length of pile, m = 6.0

Size of pile, mm = 500 600 750 900 900

Inner dia of pile, mm 0 0 0 0 0

Grade of Concrete M25  $t_{ck} = 25 \text{ N/mm}^2$ Elastic modulus of concrete  $E_c = 5000 \sqrt{f_{ck}} \text{ MPa}$ Soil below cut-off levelModulus from ☒ Terzaghi☐ Reese☐ IS 2911

Type of Soil

Fine to medium sand

Average corrected N over a length of 3D to 6D<sup>^</sup>

50

Coefficient of modulus variation  $\eta_h^*$ 15.00 MN/m<sup>3</sup>

From Terzaghi / Tomlinson

Ground water table is assumed at cutoff level or above

use 0.2MN/m<sup>3</sup> for liquefaction case  
use 0.3 to 0.7MN/m<sup>3</sup> for soft clay

Pile cut-off level

1.20 m below GL

Free standing pile length above COL

0.00 m

Length of pile below COL - L

4.8 m

Allowable deflection at pile head

5 mm

Load sharing factor recommended in case of groups

Load sharing between piles will have group effect, reducing the safe resistance of piles in the back rows

Single pile group - 1.0

Free head condition (conservative)

Two pile - along the pile alignment 1 &amp; 0.75

Two pile - perpendicular to the pile alignment 1.0 &amp; 1.0

Four pile group - 1.0 &amp; 0.75

Six piles in two rows - Longitudinal - 1.0, 0.75, and 0.50

All these as fixed head condition

**FREE HEADED PILES**

Pile Dia	$f_{ck}$ N/mm <sup>2</sup>	$E_c$ MN/m <sup>2</sup>	$I$ M <sup>4</sup>	$L$ m	$N^A$ Blows	$\eta_h^*$ MN/m <sup>3</sup>	$\eta$ 1/m	$\eta \times L$	$T$ m	$e$ m	$e/T$	$Z_f/T^{**}$ m	$Z_f$ m	$y$ m	$H$ kN
500	25	25000	0.003068	4.8	50	15.00	0.72	3.46	1.386	0.0	0.00	1.920	2.66	0.005	61.1
600	25	25000	0.006362	4.8	50	15.00	0.62	2.99	1.604	0.0	0.00	1.920	3.08	0.005	81.7
750	25	25000	0.015532	4.8	50	15.00	0.52	2.50	1.917	0.0	0.00	1.920	3.68	0.005	116.8
900	25	25000	0.032206	4.8	50	15.00	0.45	2.16	2.218	0.0	0.00	1.920	4.26	0.005	156.4

**FIXED HEADED PILES**

Pile Dia	$f_{ck}$ N/mm <sup>2</sup>	$E_c$ MN/m <sup>2</sup>	$I$ M <sup>4</sup>	$L$ m	$N$	$\eta_h^*$ MN/m <sup>3</sup>	$\eta$ 1/m	$\eta \times L$	$T$ m	$e$ m	$e/T$	$Z_f/T^{**}$ m	$Z_f$ m	$y$ m	$H$ kN
500	25	25000	0.003068	4.8	50	15.00	0.72	3.46	1.386	0.0	0.00	2.190	3.04	0.005	164.6
600	25	25000	0.006362	4.8	50	15.00	0.62	2.99	1.604	0.0	0.00	2.190	3.51	0.005	220.3
750	25	25000	0.015532	4.8	50	15.00	0.52	2.50	1.917	0.0	0.00	2.190	4.20	0.005	314.9
900	25	25000	0.032206	4.8	50	15.00	0.45	2.16	2.218	0.0	0.00	2.190	4.86	0.005	421.5

<sup>A</sup>N less than 1 is not to be used\*  $\eta_h$ , coefficient of modulus variation is read from Figure 6.20 of Tomlinson (M.J. Tomlinson, Pile Design and Construction Practice, 5th Ed\*\*  $Z_f/T$ , ratio between depth of fixity and T read from IS 2911 corresponding to the ratio  $e/T$ ,  $e$  being the free standing length $\eta_h$  for repeated loading condition in a loose / very soft soil is recommended as 0.3928 MN/m<sup>3</sup> as per IS 2911NOTE: The total depth of fixity below the pile head is sum of cantilever length  $e$  and  $Z_f$

ANNEXURE 1  
FACTUAL GEOTECHNICAL REPORT BY VRR ENGINEERING



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**Geotechnical & Structural Consultant**

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✓ Load Tests ✓ Structural Design ✓ DPR ✓ Survey ✓ Building Construction

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இருள்தீர எண்ணிச் செயல்

திருக்குறள்.

## **GEOTECHNICAL INVESTIGATION**

### **FACTUAL REPORT**

**NAME OF WORK :** GEOTECHNICAL INVESTIGATION FOR THE PROPOSED CONSTRUCTION OF FACULTY COMPLEX BY REPLACING THE EXISTING MFL BUILDING AT IIT MADRAS (BASEMENT + GROUND + 11 FLOORS).



**CLIENT :** The Superintending Engineer,  
Engineering Unit, IIT Madras Campus,  
Chennai – 600 113.

**REPORT NO :** 013 / GTI / VRR / 2026

**DATE :** 12<sup>th</sup> February 2026

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**GEOTECHNICAL INVESTIGATION FOR THE PROPOSED CONSTRUCTION OF FACULTY COMPLEX BY REPLACING THE EXISTING MFL BUILDING AT IIT MADRAS (BASEMENT + GROUND + 11 FLOORS).****1. INTRODUCTION**

The Superintending Engineer of IIT Madras has proposed to Construct of Faculty complex by replacing the existing MFL building at IIT Madras (Basement + Ground + 11 Floors) for obtaining the geotechnical / geological profile. Accordingly, the work was awarded to M/s VRR Engineering Consultancy, Chennai - 91. The Geotechnical Investigation was carried out during 26<sup>th</sup> November 2025 to 12<sup>th</sup> December 2025. This report presents the details of Geotechnical Investigation and results from field and lab test.

**2. REGIONAL GEOLOGY OF PROPOSED SITE**

The proposed site is located at IIT Madras. The IIT Madras is located at 12.99151° N and 80.23362° E on the Eastern part of Chennai City. The IIT Madras is surrounded by Thiruvanmiyur in the eastern side, Velacherry in the western side, Guindy in the norther side and Tharamani in the southern side. The top 5.00 m is soil followed by Charnockite rock. The encountered weathering profiles of the Charnockite are quite complex and irregular, showing frequent lateral and vertical variations. Based on the IS-4464 guidelines, six classes of weathering grade have been recognized: Grade VI (residual and colluvial soils), Grade V (completely weathered rock), Grade IV (highly weathered rock), Grade III (moderately weathered rock), Grade II (slightly weathered rock) and Grade I (fresh rock). Grade VI, includes soil sediments formed by the weathering processes in situ (residual deposits) and the soils made up of weathered material transported by slope processes (colluvium). The Charnockite rock samples encountered in IIT Madras are characterized by complex weathering profile, where Grade I (fresh rock), Grade II (slightly weathered rock), moderately weathered rocks (Grade III) and highly weathered rocks (Grade IV) prevail. The general weathering conditions are associated with intense fracturing along the joints, and normal fault planes. Thin and discontinuous horizons of completely weathered rocks are also observed.



The complex and irregular weathering grade of Charnockite rocks in IIT Madras may be due to the saline water intrusion in the fracture plane which leads to form soft infillings and mineralogical alteration in the bed rock profile.

### 3. SITE CONDITION AND INVESTIGATION PROGRAMME

The proposed site is located at IIT Madras. The number of boreholes has been decided as five. The Summary of Field Investigation is presented in Table 1 to 5. The field tests includes standard penetration test and obtaining soil samples through split spoon sampler, undisturbed sampling in soft to medium stiff cohesive soil (if occurred), identification of different soil layers, location of ground water table and complete logging of the borehole etc, Laboratory investigation consists of classification tests such as grain size distribution, Atterberg limits, specific gravity, free swell index, natural moisture content on soil samples and point load strength index, UCS test, water absorption, specific gravity tests on rock core samples. The applicability of field and laboratory tests are based on the quantity and type of soil samples (cohesion less and cohesive soil) and CR and RQD of the rock core samples.

### 4. GEOTECHNICAL INVESTIGATION PROCEDURE

The Drilling Rig with Auto-trip SPT Hammer was set up at specified borehole location. The boreholes were advanced from the existing ground level using rotary boring technique supplemented by Bentonite mud circulation. Mud circulation was used to stabilize the sides and bottom of the boreholes and then to bring the soil cuts to the surface. Bentonite slurry would also help to minimize the disturbance of the soil at the bottom of the borehole while drilling operation is in progress. In general, Rotary boring technique with bentonite mud circulation is found most suitable to make exploratory boreholes of diameter 100 mm to 150 mm (SP 36 Part II: 1988). Borehole was always kept full with the drilling mud so as to prevent any disturbance to the soil within the test zone.

Standard penetration tests were conducted at every 1.5 m interval up to 3.0 m depth beyond that 1.0 m interval is maintained in all the borehole locations. These tests were carried





out using winch and cathead device and the SPT hammer provided with auto-trip mechanism for which the expected energy level is in the range of 60% to 70%. The 'N' value resulting from this procedure may be considered as N<sub>60</sub>. Disturbed soil samples collected through the split spoon sampler were preserved and transported to the soil testing laboratory for detailed identification tests. Ground water levels were recorded at the end of each boring. Nx Size Core Barrel was used to drill in the rock stratum.

All field and laboratory tests were conducted as per the Indian Standard Testing Procedure (SP 36 Part I: 1987 & Part II: 1988). All the field test results recorded in the bore logs are illustrated in Annexure -2. The field 'N' values at different depths and samples were collected at these depths are mentioned in the bore logs. Laboratory test results (index and engineering properties) of soil samples collected through split spoon sampler and rock core samples retrieved through Nx Size Core Barrel are summarized in table A-1 to A-5 (Annexure-3) of this report. The Geotechnical Interpretative Data of soil and weathered rock layers with respect to SPT N-Value are summarized in table B-1 to B-5 (Annexure-4) of this report. The Uncertainties of various laboratory testing parameters are listed in Annexure – 6 of this Report.

**Table 1 : SUMMARY OF FIELD INVESTIGATION**

S.No.	Borehole No.	Total Drill Depth (m)	Field Investigation		GWL (m)	Field Co-ordinates	RL (m)
			Start Date	End Date			
1	BH – 1	11.0	26/11/2025	28/11/2025	1.50	E - 416612.513; N - 1436436.278	13.552
2	BH – 2	11.0	29/11/2025	04/12/2025	1.50	E - 416612.916; N - 1436451.918	13.791
3	BH – 3	15.0	05/12/2025	08/12/2025	1.60	E - 416600.965; N - 1436415.914	13.723
4	BH – 4	11.00	28/11/2025	04/12/2025	1.75	E - 416630.317; N - 1436436.086	13.239



S.No.	Borehole No.	Total Drill Depth (m)	Field Investigation		GWL (m)	Field Co-ordinates	RL (m)
			Start Date	End Date			
5	BH – 5	10.00	10/12/2025	12/12/2025	1.50	E - 416599.415; N - 1436459.533	13.904

## 5. METHODOLOGY ADOPTED IN LABORATORY INVESTIGATION

### 5.1 Index Tests

Natural moisture content of soil samples is measured as per IS: 2720 (Part 2) – 1973. Specific gravity test on soil samples are conducted using specific gravity bottle as per IS: 2720 (Part 3 / sec-1) – 1980. Grain size distribution analysis is performed as per IS: 2720 (part 4) – 1985 for all disturbed soil samples. As per IS: 2720 (Part 5) - 1985, the soil samples have been sieved through 425 micron IS sieve and used for determining Atterberg Limits of soils. Liquid limit test of soils is determined by using Casagrande apparatus as per IS: 2720 (Part 5) – 1985. Plastic limit test of soils is conducted by standard method (IS: 2720 (Part 5) - 1985). The shrinkage limit of the soil is determined as per the bureau of Indian standard procedure IS: 2720 (Part 6) – 1972. The free swell index test is determined as per IS: 2720 (Part 40) – 1972 expressed in percentage.

### 5.2 Laboratory Test on Rock Cores:

**Density & Specific Gravity:** Density & Specific Gravity of rock core samples are tested in the Laboratory as per IS: 2386 (Part-III).

**Water Absorption:** Water Absorption percentage of Rock core samples are tested in the Laboratory as per IS: 2386 (Part-III). **Porosity:** Porosity of Rock core samples is determined as per IS: 13030.

**Point Load Strength Index of Rock:** Rock core samples collected in various depths from different borehole has been shaped and tested in the laboratory as per IS: 8764 specifications. The reported value of the point strength index is  $I_{s(50)}$ .



**Unconfined Compressive Strength of Rock Materials:** Length of Rock core samples collected in various depths from different borehole are measured and when length of cores found more than two times of diameter of core then those cores are taken part in preparation of UCC test. The length of diameter ratio of cylindrical specimens has been kept minimum two times, cutting and polishing has been made in the lathe for conducting UCC test for soaked condition as per guidelines of clause no 3.3 of IS:9143. Test procedures, calculation and reporting UCC of rock cores are carried out as per guidelines of clause no. 4,5 & 6 of IS: 9143.

*The applicability of field and laboratory tests are based on the quantity and type of soil samples (cohesion less and cohesive soil) and CR and RQD of the rock core samples.*

## 6.0 SUMMARY

The Geotechnical Design parameters required to design the most suitable foundation system are furnished in this report for the Construction of Faculty complex by replacing the existing MFL building at IIT Madras (Basement + Ground + 11 Floors).

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### REFERENCES

- [1] SP 36 Part I: 1987, "Laboratory Testing on Soil for Civil Engineering Purpose", Compendium on Indian Standards on Soil Engineering, Bureau of Indian Standards.
- [2] SP 36 Part II: 1988, "Field Testing of Soils for Civil Engineering Purpose", Compendium on Indian Standards on Soil Engineering, Bureau of Indian Standards.
- [3] IS 8764-1998 "Method for Determination of Point Load Strength Index of Rocks"
- [4] IS 2911, Part 1 (2010), "Code of Practice for Design and Construction of Pile Foundations", Bureau of Indian Standards.
- [5] Varghese P.C., Foundation Engineering, Prentice – Hall of India Private Limited, New Delhi, 2005.
- [6] Bowles, J. (1997). *Foundation Analysis and Design*. 5<sup>th</sup> Ed., The McGraw-Hill Companies, Inc., New York, 308.
- [7] Cole, K.M. and Stroud, M.A. (1977), Rock Socket Piles at Coventry Point – Piles in Weak Rocks, Proc. Inst. of Civil Engineers, London.
- [8] Karl Terzaghi, Ralph B. Peck and Gholamrezra Mesri (1996), "Soil Mechanics in Engineering Practice", 3<sup>rd</sup> Edition, A Wiley Interscience Publication, John Wiley & Sons, Inc, New York.
- [9] IS 2911, Part 41 (1977), "Measurement of Swelling Pressure of Soils ", Bureau of Indian Standards.
- [10] IS 2911, Part 15 (1986), "Determination of Consolidation properties", Bureau of Indian Standards.

**Annexure - A-1**  
**Borehole Locations**


**Construction of Faculty complex by replacing the existing MFL building at IIT Madras  
(Basement + Ground + 11 Floors).**

<b>S.NO</b>	<b>CODE</b>	<b>EASTING</b>	<b>NORTHING</b>	<b>ELEVATION</b>
1	TBM 1	416651.720	1436462.725	13.392
2	TBM 2	416591.231	1436407.067	13.497
3	TBM 3	416609.743	1436463.016	13.831
4	BH 1	416612.513	1436436.278	13.552
5	BH 2	416612.916	1436451.918	13.791
6	BH 3	416600.965	1436415.914	13.723
7	BH 4	416630.317	1436436.086	13.239
8	BH 5	416599.415	1436459.533	13.904





# Location of Boreholes


## Legend


 BH -


TBM - 03


 BH - 05


 TBM - 01

 BH - 02

BH - 01 

BH - 04 

BH - 03 

 TBM - 02

Google Earth



Image © 2025 Airbus



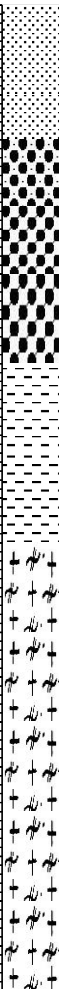








40 m

**Annexure - A-2**  
**Field Borelog Profile**



			IN-SITU GEOTECHNICAL BORE LOG				BORE-HOLE No.		BH-01	
							SHEET No.		(1/1)	
							BH Back Filled		✓	
Project:			Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras (Basement + Ground + 11 Floors).							
Co-ordinates:			N - 1436436.278, E - 416612.513		Started:		26/11/2025			
Location:			IITM Campus		Completed:		28/11/2025			
Elevation (RL):			13.552 m		Ground Water Level:		1.50 m			
Dia of Boring:			Px Size in Soil & Nx Size in Rock		Type of Core Barrel:		Nx Size Core Barrel			
Casing Depth:			1.00 m		Water Loss Depths :		-			
Type of Boring:			Rotary Rig - Auto Trip SPT		Total Drill Depth:		11.00 m (5.0 m - Soil with 6.0 m - Rock Stratum)			
Depth from EGL (m)	Log	Lithology	Description / Classification of Soil and Rock / Weathering Grade of Rock as per IS 4464 / Special Observations and Interpretations	Standard Penetration Test (SPT) / UDS / Core Drilling						Relative Density / Consistency of Soil / Strength of Rock
				0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)	
<div><div><div>00.00 0.50 1.00 1.50 2.00 2.25 2.50 3.00 3.50 4.00 4.50 5.00 5.50 6.00 6.50 7.00 7.50 8.00 8.50 9.00 9.50 10.00 10.50 11.00</div><div></div></div></div>										
0	0.00									
0.50										
1.00			Filled up Soil / Top Soil with Debris	-	-	-	-			-
1.50										
2.00			Brownish Sandy Clay with Calcium Matrix (CL)	3	4	6	10			Stiff
2.25										
2.50			Brownish Silty Sand (SM)	19	55 (4 cm) Rb		>100			Very Dense
3.00										
3.50			Brownish Silty Sand with Gravels (SM)	55 (8 cm) Rebound			>100			Very Dense
4.00										
4.50			Residual Soil - (Brownish Clayey Sand with Gravels)	57 (6 cm) Rebound			>100			Very Dense / Very Weak
5.00			Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	55 (4 cm) Rebound			>100			Very Dense
5.50										
6.00			Charnockite, Whitish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)					20.00	0	Hard / Weak
6.50										
7.00			Charnockite, Whitish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)					33.00	0	Hard / Weak
7.50										
8.00			Charnockite, Greyish, Medium Grained, Moderately Weathered Rock (Grade III)					73.00	50.00	Hard / Moderately Strong
8.50										
9.00			Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)					100.00	87.00	Hard / Strong
9.50										
10.00			Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)					95.00	95.00	Hard / Strong
10.50										
11.00			Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)					96.00	96.00	Hard / Strong

			IN-SITU GEOTECHNICAL BORE LOG					BORE-HOLE No.		BH-02	
								SHEET No.		(1/1)	
								BH Back Filled			
Project:			Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras (Basement + Ground + 11 Floors).								
Co-ordinates:			N - 1436451.918, E - 416612.916				Started:		29/11/2025		
Location:			IITM Campus				Completed:		04/12/2025		
Elevation (RL):			13.791				Ground Water Level:		1.50 m		
Dia of Boring:			Px Size in Soil & Nx Size in Rock				Type of Core Barrel:		Nx Size Core Barrel		
Casing Depth:			1.00 m				Water Loss Depths :		-		
Type of Boring:			Rotary Rig - Auto Trip SPT				Total Drill Depth:		11.00 m (6.0 m - Soil with 5.0 m - Rock Stratum)		
Depth from EGL (m)	Log	Lithology	Description / Classification of Soil and Rock / Weathering Grade of Rock as per IS 4464 / Special Observations and Interpretations	Standard Penetration Test (SPT) / UDS / Core Drilling						Relative Density / Consistency of Soil / Strength of Rock	
				0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)		
0      30      60      90      120      150											
0	0.00										
0.50											
1.00	1.00		Filled up Soil / Top Soil with Debris	-	-	-	-				-
1.50	1.50		Brownish Sand (SP)	4	4	6	10				Loose
2.25	2.00		Brownish Clayey Sand (SC)	7	9	52 <sub>(4 cm)</sub> Rb	>100				Very Dense
3.00	3.00		Brownish Clayey Sand (SC)	25	55 <sub>(9 cm)</sub> Rb		>100				Very Dense
4.00	4.00	Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	55 <sub>(1 cm)</sub> Rebound			>100				Very Dense / Very Weak	
5.00	5.00	Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	55 <sub>(1 cm)</sub> Rebound			>100				Very Dense / Very Weak	
6.00	6.00	Charnockite, Greyish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)	59 <sub>(1 cm)</sub> Rebound			>100		13.00	0	Hard / Weak	
7.00	7.00	Charnockite, Greyish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)						31.00	0	Hard / Weak	
8.00	8.00	Charnockite, Greyish, Medium Grained, Moderately Weathered Rock (Grade III)						33.00	27.00	Hard / Moderately Strong	
9.00	9.00	Charnockite, Greyish, Medium Grained, Moderately Weathered Rock (Grade III)						60.00	46.00	Hard / Moderately Strong	
10.00	10.00	Charnockite, Greyish, Medium Grained, Slightly Weathered Rock (Grade II)						100.00	76.00	Hard / Strong	
11.00	11.00										



## IN-SITU GEOTECHNICAL BORE LOG

BORE-HOLE No.

BH-03

SHEET No.

(1/1)

BH Back Filled

**Project:**

Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras (Basement + Ground + 11 Floors).

**Co-ordinates:**

N - 1436415.914, E - 416600.965

**Started:**

05/12/2025

**Location:**

IITM Campus

**Completed:**

08/12/2025

**Elevation (RL):**

13.723

**Ground Water Level:**

1.60 m

**Dia of Boring:**

Px Size in Soil &amp; Nx Size in Rock

**Type of Core Barrel:**

Nx Size Core Barrel

**Casing Depth:**

1.50 m

**Water Loss Depths :**

-



**Type of Boring:**

Rotary Rig - Auto Trip SPT

**Total Drill Depth:**

15.00 m (11.0 m - Soil with 4.0 m - Rock Stratum)

Depth from EGL (m)	Log	Lithology	Standard Penetration Test (SPT) / UDS / Core Drilling						Relative Density / Consistency of Soil / Strength of Rock
			0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)	
0.00									
0.50									
1.00		Filled up Soil / Top Soil with Debris	-	-	-	-			-
1.50									
2.00		Brownish Clayey Sand (SC)	2	3	5	8			Loose
2.25									
2.50		Brownish Clayey Sand (SC)	5	9	12	21			Medium Dense
3.00									
3.50		Brownish Clayey Sand (SC)	6	9	17	26			Medium Dense
4.00									
4.50		Brownish Silty Sand (SM)	55 (10 cm) Rebound			>100			Very Dense
5.00									
5.50		Brownish Silty Sand (SM)	55 (8 cm) Rebound			>100			Very Dense
6.00									
6.50		Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	55 (0 cm) Rebound			>100			Very Dense / Very Weak
7.00									
7.50		Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	55 (0 cm) Rebound			>100			Very Dense / Very Weak
8.00									
8.50		Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	55 (0 cm) Rebound			>100			Very Dense / Very Weak
9.00									
9.50		Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	55 (0 cm) Rebound			>100			Very Dense / Very Weak
10.00									
10.50		Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	55 (0 cm) Rebound			>100			Very Dense / Very Weak
11.00									
11.50		Charnockite, Greyish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)	55 (3 cm) Rebound			>100			Very Dense / Very Weak
12.00									
12.50		Charnockite, Greyish, Medium Grained, Moderately Weathered Rock (Grade III)					30.00	0	Hard / Weak
13.00									
13.50		Charnockite, Greyish, Medium Grained, Slightly Weathered Rock (Grade II)					78.00	49.00	Hard / Moderately Strong
14.00									
14.50		Charnockite, Greyish, Medium Grained, Slightly Weathered Rock (Grade II)					86.00	65.00	Hard / Strong
15.00									
15.50		Charnockite, Greyish, Medium Grained, Slightly Weathered Rock (Grade II)					88.00	69.00	Hard / Strong

			IN-SITU GEOTECHNICAL BORE LOG					BORE-HOLE No.		BH-04	
								SHEET No.		(1/1)	
								BH Back Filled			
Project:			Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras (Basement + Ground + 11 Floors).								
Co-ordinates:			N - 1436436.086, E - 416630.317				Started:		28/11/2025		
Location:			IITM Campus				Completed:		04/12/2025		
Elevation (RL):			13.239				Ground Water Level:		1.75 m		
Dia of Boring:			Px Size in Soil & Nx Size in Rock				Type of Core Barrel:		Nx Size Core Barrel		
Casing Depth:			1.50 m				Water Loss Depths :		-		
Type of Boring:			Rotary Rig - Auto Trip SPT				Total Drill Depth:		11.00 m (7.0 m - Soil with 4.0 m - Rock Stratum)		
Depth from EGL (m)	Log	Lithology	Description / Classification of Soil and Rock / Weathering Grade of Rock as per IS 4464 / Special Observations and Interpretations	Standard Penetration Test (SPT) / UDS / Core Drilling						Relative Density / Consistency of Soil / Strength of Rock	
				0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)		
0      30      60      90      120      150											
0.00											
0.50											
1.00			Filled up Soil / Top Soil with Debris	-	-	-	-			-	
1.50											
2.00			Brownish Silty Sand (SM)	55 (7 cm) Rebound			>100			Very Dense	
2.25											
2.50			Brownish Silty Sand with Gravels (SM)	57 (8 cm) Rebound			>100			Very Dense	
3.00											
3.50			Brownish Silty Sand (SM)	55 (5 cm) Rebound			>100			Very Dense	
4.00											
4.50			Brownish Silty Sand with Gravels (SP - SM)	61 (13 cm) Rebound			>100			Very Dense	
5.00											
5.50			Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	55 (0 cm) Rebound			>100			Very Dense / Very Weak	
6.00											
6.50			Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	55 (0 cm) Rebound			>100			Very Dense / Very Weak	
7.00				55 (0 cm) Rebound			>100				
7.50			Charnockite, Greyish, Medium Grained, Slightly Weathered Rock (Grade II)					80.00	59.00	Hard / Strong	
8.00											
8.50			Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)					89.00	89.00	Hard / Strong	
9.00											
9.50			Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)					100.00	100.00	Hard / Strong	
10.00											
10.50			Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)					100.00	93.00	Hard / Strong	
11.00											

## IN-SITU GEOTECHNICAL BORE LOG

BORE-HOLE No.

BH-05

SHEET No

(1/1)

BH Back Filled

**Project:**

Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras (Basement + Ground + 11 Floors).

**Co-ordinates:**

N - 1436459.533. E - 416599.415

**Started:**

10/12/2025

**Location:**

IITM Campus

**Completed:**

12/12/2025

Elevation (RL):

13.904

**Ground Water Level:**

1.50 m

**Dia of Boring:**

Px Size in Soil &amp; Nx Size in Rock

**Type of Core Barrel:**

Nx Size Core Barrel

**Casing Depth:**

1.50 m

**Water Loss Depths :**

	-	
--	---	--

Type of Boring:

Rotary Rtg - Auto Trip SPT

**Total Drill Depth:**

10.00 m (3.0 m - Soil with 7.0 m - Rock Stratum)

Depth from EGL (m)	Log	Lithology	Description / Classification of Soil and Rock / Weathering Grade of Rock as per IS 4464 / Special Observations and Interpretations	Standard Penetration Test (SPT) / UDS / Core Drilling						Relative Density / Consistency of Soil / Strength of Rock	
				0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)		
0      30    60    90    120    150											
0.00			Filled up Soil / Top Soil with Debris	-	-	-	-			-	
0.50											
1.00											
1.50			Brownish Clayey Sand (SC)	3	4	6	10			Loose	
2.00											
2.25			Brownish Clayey Sand with Gravels (SC)	8	39	55 <sub>(3 cm) Rb</sub>	>100			Very Dense	
2.50											
3.00			Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	55 <sub>(0 cm) Rebound</sub>			>100			Very Dense / Very Weak	
3.50			Charnockite, Greyish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)					20.00	0	Hard / Weak	
4.00											
4.50									28.00	0	Hard / Weak
5.00											
5.50									42.00	20.00	Hard / Weak
6.00											
6.50											
7.00			Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)					95.00	95.00	Hard / Strong	
7.50									89.00	89.00	Hard / Strong
8.00											
8.50									93.00	93.00	Hard / Strong
9.00											
9.50			Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)					100.00	100.00	Hard / Strong	
10.00											

**Annexure - A-3**  
**Laboratory Test Results**

Table A-1

Project : Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras (Basement + Ground + 11 Floors).

BH No: BH 01

Ground Water Table Depth (m): 1.50

## LABORATORY TEST RESULTS

Depth from EGL (m)	SPT 'N' Value	Soil Description / Classification	Index Properties					Specific Gravity	Grain Size Analysis (%)					
			Natural Moisture Content, %	Liquid Limit, %	Plastic Limit, %	Shrinkage Limit, %	Free Swell Index, %		Gravel	Coarse Sand	Medium Sand	Fine Sand	Fines	
													Silt	Clay
1.50	10	Brownish Sandy Clay with Calcium Matrix (CL)	19	30	15	10	20	2.61	0	3	11	33	53	
2.25	>100	Brownish Silty Sand (SM)	9	NP	NP	NP	NP	2.62	0	23	30	26	21	
3.00	>100	Brownish Silty Sand with Gravels (SM)	15	NP	NP	NP	NP	2.62	23	18	30	14	15	
4.00	>100	Brownish Clayey Sand with Gravels (SC) - Residual Soil	14	22	12	-	10	2.65	17	9	25	25	24	
Depth Range from EGL (m)	SPT 'N' Value	Classification of Rock / Weathering Grade of Rock as per IS 4464	Water Absorption, %	Bulk Unit Weight (kN/m³)	Porosity of Rock (%)			Soaked Strength of Rock (24 Hours Soaking)						
								UCS, Mpa	I <sub>s(50)</sub> Mpa	BT, Mpa				
5.00 - 6.00	-	Charnockite, Whitish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)	0.496	23.2	0.708		2.67	-	-	-				
6.00 - 7.00	-	Charnockite, Whitish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)	0.473	25.2	0.684		2.69	-	-	-				
7.00 - 8.00	-	Charnockite, Greyish, Medium Grained, Moderately Weathered Rock (Grade III)	0.426	26.9	0.657		2.74	42.86	3.61	-				
8.00 - 9.00	-	Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)	0.403	27.1	0.636		2.80	48.68	6.44	-				
9.00 - 10.00	-	Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)	0.394	27.7	0.619		2.77	64.85	11.61	-				
10.00 - 11.00	-	Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)	0.382	27.9	0.604		2.85	73.34	10.24	-				
EGL- Existing Ground level		UCS- Unconfined Compressive Strength		I <sub>s(50)</sub> - Point Load Strength Index			BT - Brazilian Tensile Strength Test							

Table A-2

Project : Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras (Basement + Ground + 11 Floors).

BH No: BH 02

Ground Water Table Depth (m): 1.50

## LABORATORY TEST RESULTS

Depth from EGL (m)	SPT 'N' Value	Soil Description / Classification	Index Properties					Specific Gravity	Grain Size Analysis (%)					
			Natural Moisture Content, %	Liquid Limit, %	Plastic Limit, %	Shrinkage Limit, %	Free Swell Index, %		Gravel	Coarse Sand	Medium Sand	Fine Sand	Fines	
													Silt	Clay
1.50	10	Brownish Sand (SP)	10	NP	NP	NP	NP	2.63	0	55	38	3	4	
2.25	>100	Brownish Clayey Sand (SC)	13	29	13	-	10	2.65	0	12	30	28	30	
3.00	>100	Brownish Clayey Sand (SC)	16	26	12	-	10	2.65	0	9	33	30	28	
Depth Range from EGL (m)	SPT 'N' Value	Classification of Rock / Weathering Grade of Rock as per IS 4464	Water Absorption, %	Bulk Unit Weight (kN/m³)	Porosity of Rock (%)			Soaked Strength of Rock (24 Hours Soaking)						
								UCS, Mpa		I <sub>s(50)</sub> Mpa	BT, Mpa			
6.00 - 7.00	-	Charnockite, Greyish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)	0.487	23.3	0.716		2.67	-		0.97	-			
7.00 - 8.00	-	Charnockite, Greyish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)	0.482	23.5	0.697		2.67	-		1.13	-			
8.00 - 9.00	-	ockite, Greyish, Medium Grained, Moderately Weathered Rock (Grade III)	0.476	24.4	0.683		2.69	-		-	-			
9.00 - 10.00	-	ockite, Greyish, Medium Grained, Moderately Weathered Rock (Grade III)	0.468	27.3	0.674		2.79	40.85		1.60	-			
10.00 - 11.00	-	Charnockite, Greyish, Medium Grained, Slightly Weathered Rock (Grade II)	0.443	26.9	0.653		2.75	35.79		3.87	-			
EGL- Existing Ground level			UCS- Unconfined Compressive Strength		I <sub>s(50)</sub> - Point Load Strength Index			BT - Brazilian Tensile Strength Test						



Table A-3

Project : Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras (Basement + Ground + 11 Floors).

BH No: BH 03

Ground Water Table Depth (m): 1.60

## LABORATORY TEST RESULTS

Depth from EGL (m)	SPT 'N' Value	Soil Description / Classification	Index Properties					Specific Gravity	Grain Size Analysis (%)					
			Natural Moisture Content, %	Liquid Limit, %	Plastic Limit, %	Shrinkage Limit, %	Free Swell Index, %		Gravel	Coarse Sand	Medium Sand	Fine Sand	Fines	
													Silt	Clay
1.50	8	Brownish Clayey Sand (SC)	19	30	14	-	20	2.65	0	4	25	22	49	
2.25	21	Brownish Clayey Sand (SC)	15	25	11	-	10	2.65	0	3	25	43	29	
3.00	26	Brownish Clayey Sand (SC)	15	28	12	-	10	2.65	0	15	26	28	31	
4.00	>100	Brownish Silty Sand (SM)	16	NP	NP	NP	NP	2.62	0	18	34	28	20	
5.00	>100	Brownish Silty Sand (SM)	15	NP	NP	NP	NP	2.62	0	35	28	20	17	
Depth Range from EGL (m)	SPT 'N' Value	Classification of Rock / Weathering Grade of Rock as per IS 4464	Water Absorption, %	Bulk Unit Weight (kN/m³)	Porosity of Rock (%)			Soaked Strength of Rock (24 Hours Soaking)						
								UCS, Mpa	I <sub>s(50)</sub> Mpa	BT, Mpa				
11.00 - 12.00	-	Charnockite, Greyish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)	0.476	23.2	0.682		2.67	-	1.01	-				
12.00 - 13.00	-	Charnockite, Greyish, Medium Grained, Moderately Weathered Rock (Grade III)	0.453	25.6	0.672		2.69	16.41	2.34	-				
13.00 - 14.00	-	Charnockite, Greyish, Medium Grained, Slightly Weathered Rock (Grade II)	0.446	25.9	0.658		2.70	29.43	5.16	-				
14.00 - 15.00	-	Charnockite, Greyish, Medium Grained, Slightly Weathered Rock (Grade II)	0.437	26.2	0.643		2.72	34.67	3.89	-				
EGL- Existing Ground level			UCS- Unconfined Compressive Strength		I <sub>s(50)</sub> - Point Load Strength Index			BT - Brazilian Tensile Strength Test						

Table A-4

Project : Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras (Basement + Ground + 11 Floors).

BH No: BH 04

Ground Water Table Depth (m): 1.75

## LABORATORY TEST RESULTS

Depth from EGL (m)	SPT 'N' Value	Soil Description / Classification	Index Properties					Specific Gravity	Grain Size Analysis (%)					
			Natural Moisture Content, %	Liquid Limit, %	Plastic Limit, %	Shrinkage Limit, %	Free Swell Index, %		Gravel	Coarse Sand	Medium Sand	Fine Sand	Fines	
													Silt	Clay
1.50	>100	Brownish Silty Sand (SM)	16	NP	NP	NP	NP	2.62	0	29	25	26	20	
2.25	>100	Brownish Silty Sand with Gravels (SM)	16	NP	NP	NP	NP	2.62	29	20	19	15	17	
3.00	>100	Brownish Silty Sand (SM)	13	NP	NP	NP	NP	2.62	0	33	26	23	18	
4.00	>100	Brownish Silty Sand with Gravels (SP - SM)	16	NP	NP	NP	NP	2.64	65	14	8	7	6	
Depth Range from EGL (m)	SPT 'N' Value	Classification of Rock / Weathering Grade of Rock as per IS 4464	Water Absorption, %	Bulk Unit Weight (kN/m <sup>3</sup> )	Porosity of Rock (%)		Soaked Strength of Rock (24 Hours Soaking)							
							UCS, Mpa	I <sub>s(50)</sub> Mpa	BT, Mpa					
7.00 - 8.00	-	Charnockite, Greyish, Medium Grained, Slightly Weathered Rock (Grade II)	0.432	26.6	0.657	2.77	51.51	-	-					
8.00 - 9.00	-	Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)	0.419	26.4	0.638	2.72	35.74	0.34	-					
9.00 - 10.00	-	Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)	0.406	27.4	0.621	2.82	63.01	10.25	-					
10.00 - 11.00	-	Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)	0.392	27.9	0.607	2.84	88.63	10.31	-					
EGL- Existing Ground level		UCS- Unconfined Compressive Strength		I <sub>s(50)</sub> - Point Load Strength Index			BT - Brazilian Tensile Strength Test							

Table A-5

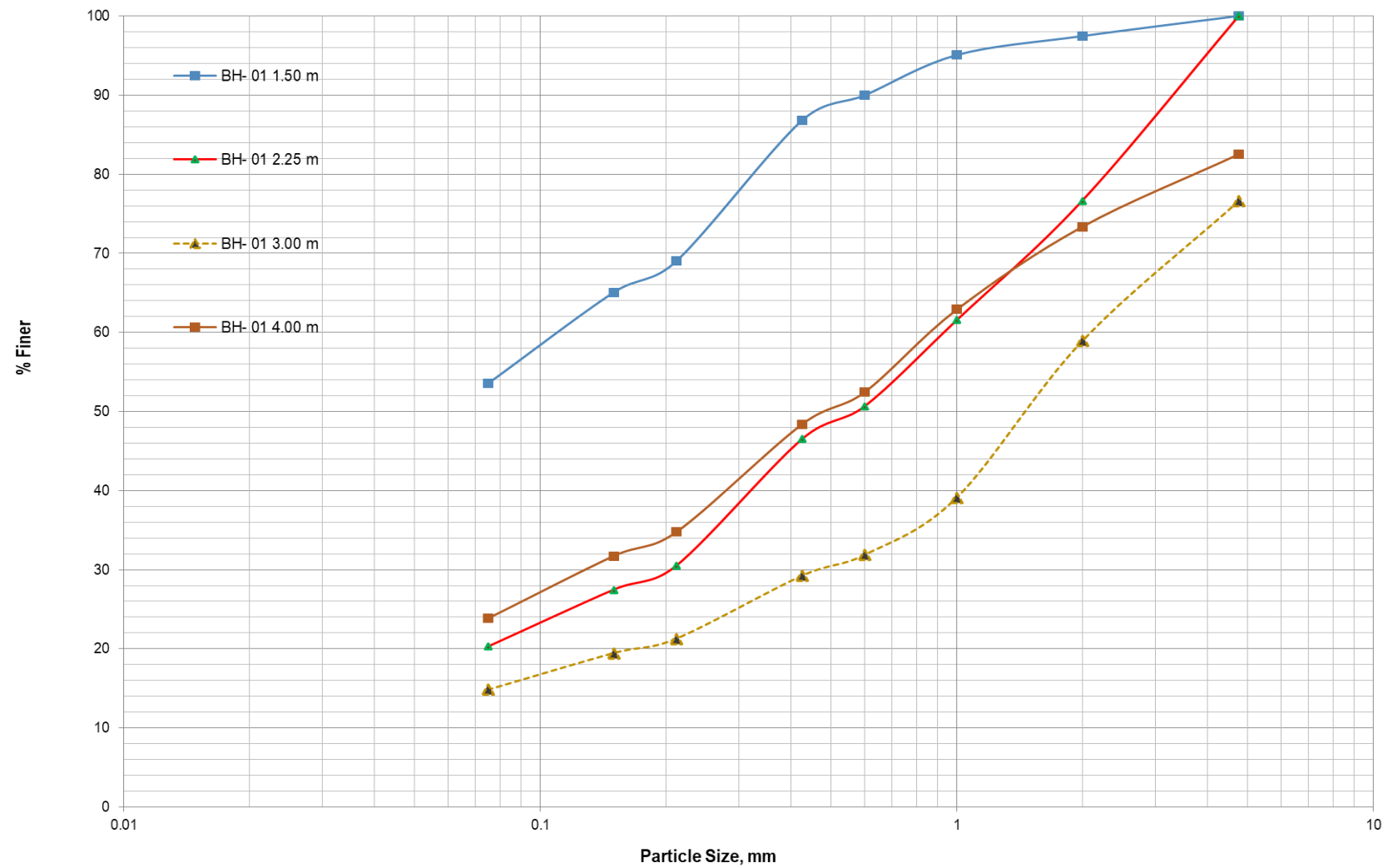
Project : Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras (Basement + Ground + 11 Floors).

BH No: BH 05

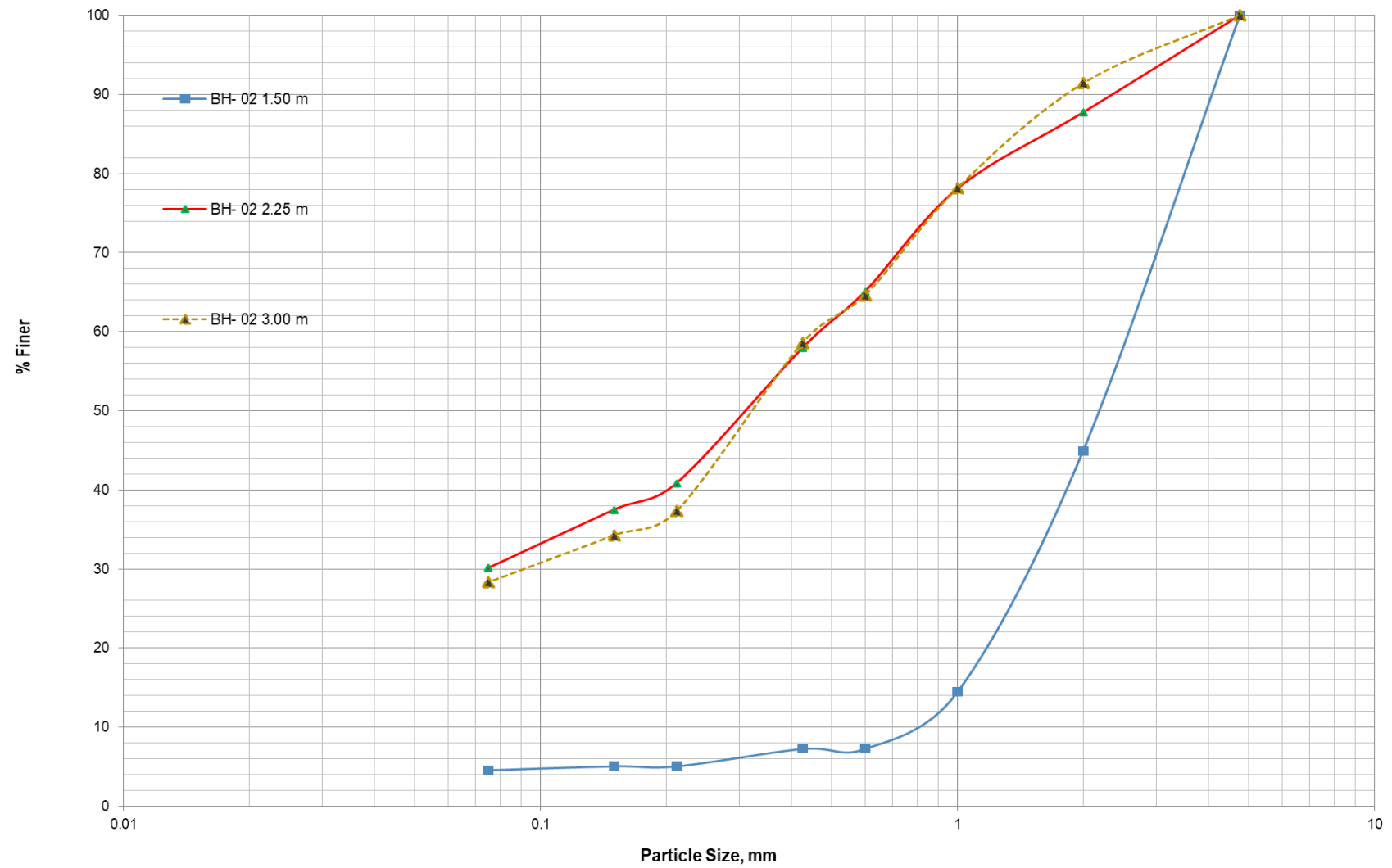
Ground Water Table Depth (m): 1.50

## LABORATORY TEST RESULTS

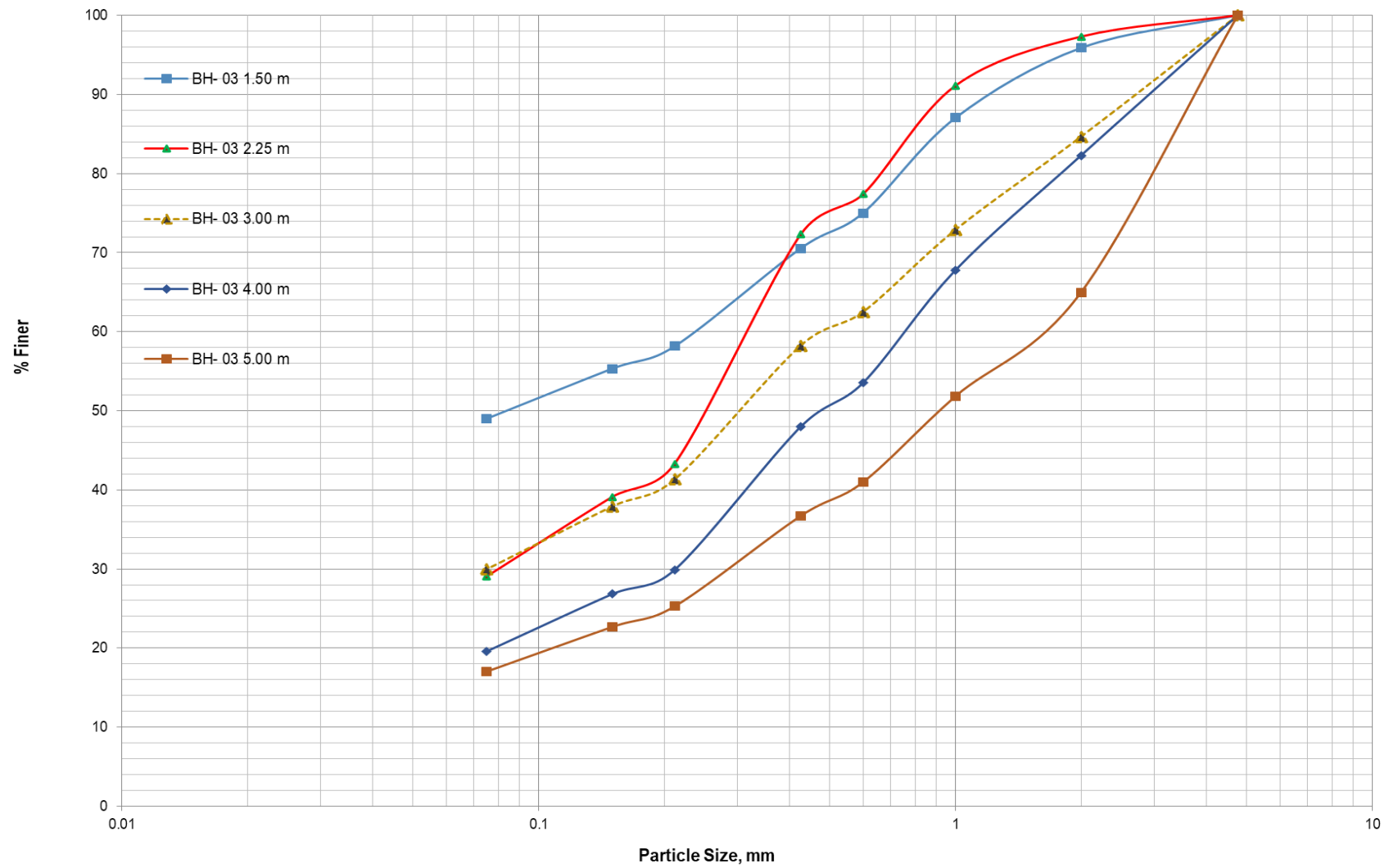
Depth from EGL (m)	SPT 'N' Value	Soil Description / Classification	Index Properties					Specific Gravity	Grain Size Analysis (%)						
			Natural Moisture Content, %	Liquid Limit, %	Plastic Limit, %	Shrinkage Limit, %	Free Swell Index, %		Gravel	Coarse Sand	Medium Sand	Fine Sand	Fines		
													Silt	Clay	
1.50	10	Brownish Clayey Sand (SC)	11.6		30	14	-	10	2.65	0	3	28	35	34	
2.25	>100	Brownish Clayey Sand with Gravels (SC)	16.7		23	11	-	30	2.65	24	14	21	15	26	
Depth Range from EGL (m)	SPT 'N' Value	Classification of Rock / Weathering Grade of Rock as per IS 4464	Water Absorption, %	Bulk Unit Weight (kN/m³)	Porosity of Rock (%)			Soaked Strength of Rock (24 Hours Soaking)							
								UCS, Mpa		I <sub>s(50)</sub> Mpa		BT, Mpa			
3.00 - 4.00	-	Charnockite, Greyish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)	0.507	22.9	0.719		2.67	-		-		-			
4.00 - 5.00	-	Charnockite, Greyish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)	0.496	23.4	0.703		2.67	-		-		-			
5.00 - 6.00	-	Charnockite, Greyish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)	0.473	25.1	0.691		2.69	-		-		-			
6.00 - 7.00	-	Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)	0.441	26.8	0.658		2.75	44.16		5.06		-			
7.00 - 8.00	-	Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)	0.417	26.4	0.643		2.72	39.48		4.19		-			
8.00 - 9.00	-	Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)	0.402	26.2	0.627		2.71	26.44		4.43		-			
9.00 - 10.00	-	Charnockite, Greyish, Medium Grained, Fresh and No Sign of Weathering (Grade I)	0.391	27.4	0.608		2.76	62.22		5.60		-			
EGL- Existing Ground level		UCS- Unconfined Compressive Strength		I <sub>s(50)</sub> - Point Load Strength Index			BT - Brazilian Tensile Strength Test								



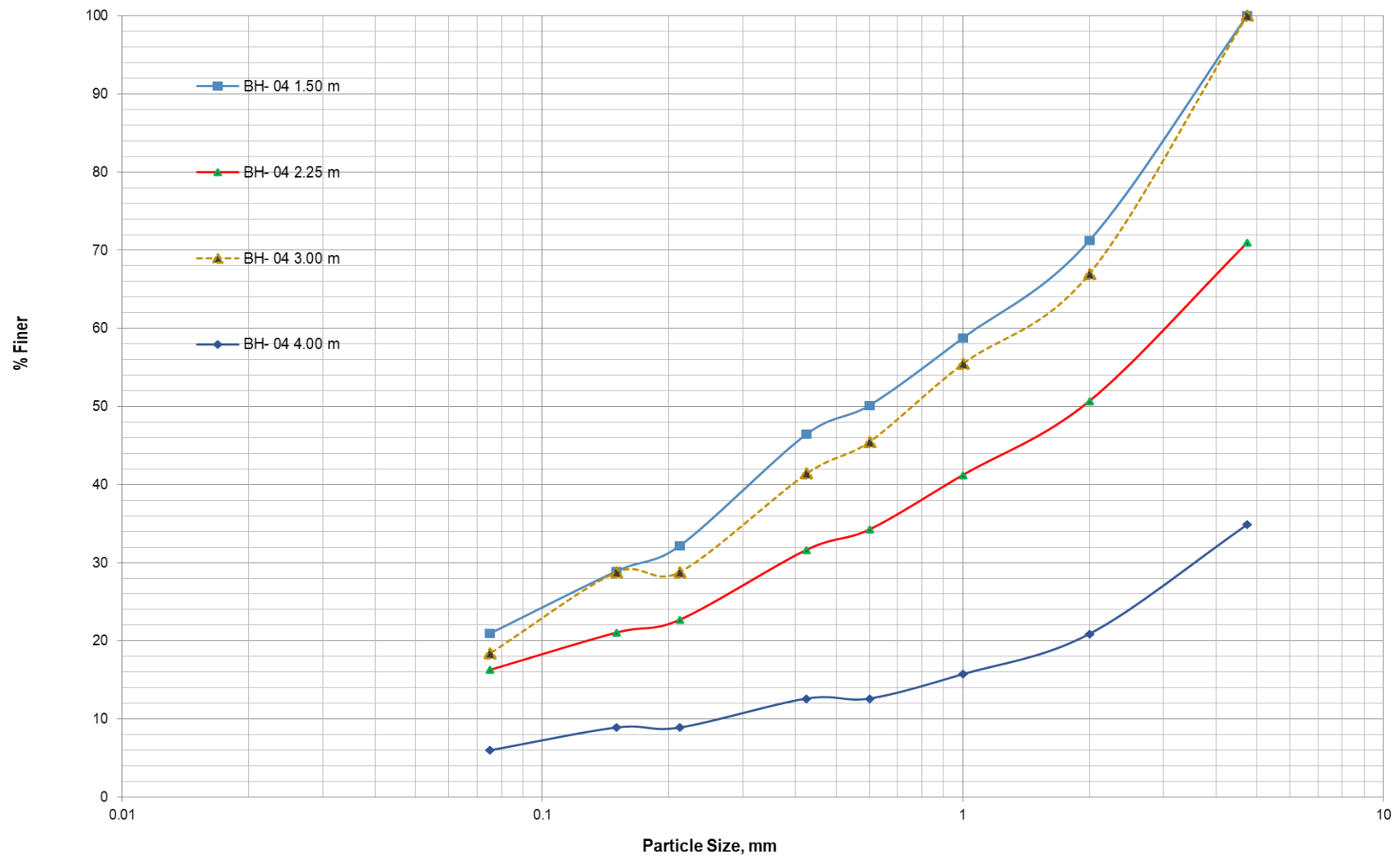
**Figure B-1 Grain Size Distribution Curves of Soil Samples encountered in BH-01 Location**



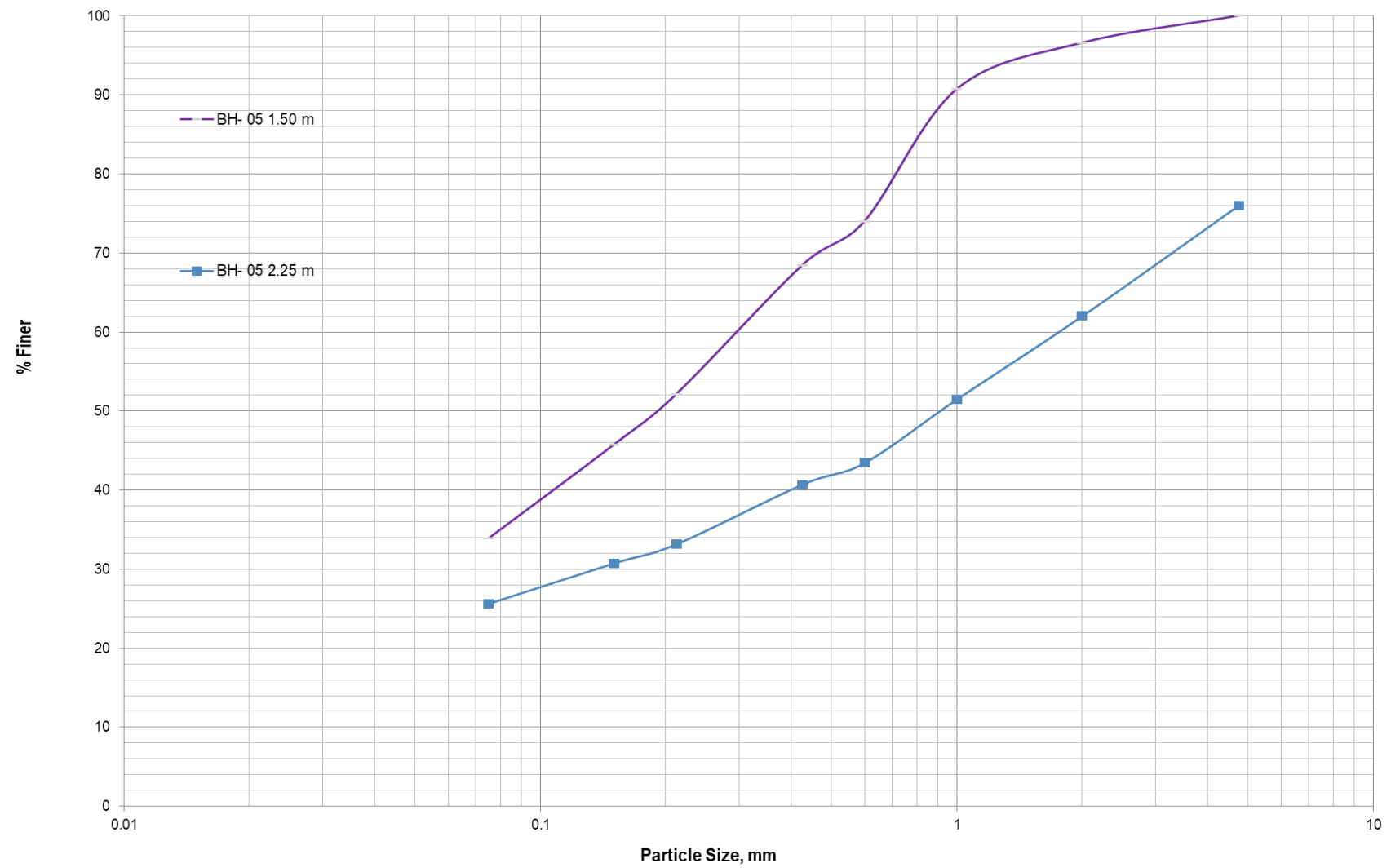
**Figure B-2 Grain Size Distribution Curves of Soil Samples encountered in BH-02 Location**



**Figure B-3 Grain Size Distribution Curves of Soil Samples encountered in BH-03 Location**



**Figure B-4 Grain Size Distribution Curves of Soil Samples encountered in BH-04 Location**



**Figure B-5 Grain Size Distribution Curves of Soil Samples encountered in BH-05 Location**



**Annexure - A-4**  
**GEOTECHNICAL INTERPRETATIVE DATA**

Table B-1					
Project : Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras (Basement + Ground + 11 Floors).					
BH No:	BH 01	Ground Water Table Depth (m):			1.50
GEOTECHNICAL INTERPRETATIVE DATA					
Depth from EGL (m)	SPT 'N' Value	Soil Description / Classification	Index Properties	Terzaghi and Peck (1974) - Shear Strength Parameters	
			Bulk Unit Weight (kN/m <sup>3</sup> ) - Table 3-4 Bowles, J. (1997)	Cohesion (c), kN/m <sup>2</sup>	Angle of Friction (Φ) in Degrees
1.50	10	Brownish Sandy Clay with Calcium Matrix (CL)	15.90	50.0	0
2.25	>100	Brownish Silty Sand (SM)	16.10	0	42.0
3.00	>100	Brownish Silty Sand with Gravels (SM)	16.80	0	42.0
4.00	>100	Brownish Clayey Sand with Gravels (SC) - Residual Soil	17.10	0	40.0
Depth Range from EGL (m)	SPT 'N' Value	Classification of Rock / Weathering Grade of Rock as per IS 4464	Shear Strength of Rock, c <sub>u</sub> (kN/m <sup>2</sup> ) as per Fig. 3 of IS 2911		
4.00 - 5.00	>100	Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	1000		
5.00 - 6.00	-	Charnockite, Whitish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)	2000		
6.00 - 7.00	-	Charnockite, Whitish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)	2000		

**Table B-2**

**Project : Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras  
(Basement + Ground + 11 Floors).**

<b>BH No:</b>	<b>BH 02</b>	<b>Ground Water Table Depth (m):</b>	<b>1.50</b>
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**GEOTECHNICAL INTERPRETATIVE DATA**

Depth from EGL (m)	SPT 'N' Value	Soil Description / Classification	Index Properties	Terzaghi and Peck (1974) - Shear Strength Parameters	
			Bulk Unit Weight ( $\text{kN/m}^3$ ) - Table 3-4 Bowles, J. (1997)	Cohesion (c), $\text{kN/m}^2$	Angle of Friction ( $\phi$ ) in Degrees
1.50	10	Brownish Sand (SP)	15.90	0	29.5
2.25	>100	Brownish Clayey Sand (SC)	16.60	0	40.0
3.00	>100	Brownish Clayey Sand (SC)	16.80	0	40.0
Depth Range from EGL (m)	SPT 'N' Value	Classification of Rock / Weathering Grade of Rock as per IS 4464	Shear Strength of Rock, $c_u$ ( $\text{kN/m}^2$ ) as per Fig. 3 of IS 2911		
3.00 - 4.00	>100	Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	1000		
4.00 - 5.00	>100	Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	1000		
5.00 - 6.00	>100	Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	1000		
8.00 - 9.00	-	ockite, Greyish, Medium Grained, Moderately Weathered Rock (Grade III)	4000		

**Table B-3**

**Project : Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras  
(Basement + Ground + 11 Floors).**

BH No:	BH 03	Ground Water Table Depth (m):			1.60
GEOTECHNICAL INTERPRETATIVE DATA					
Depth from EGL (m)	SPT 'N' Value	Soil Description / Classification	Index Properties	Terzaghi and Peck (1974) - Shear Strength Parameters	
			Bulk Unit Weight (kN/m <sup>3</sup> ) - Table 3-4 Bowles, J. (1997)	Cohesion (c), kN/m <sup>2</sup>	Angle of Friction (Φ) in Degrees
1.50	8	Brownish Clayey Sand (SC)	15.10	0	26.0
2.25	21	Brownish Clayey Sand (SC)	17.60	0	31.5
3.00	26	Brownish Clayey Sand (SC)	18.10	0	33.5
4.00	>100	Brownish Silty Sand (SM)	18.30	0	42.0
5.00	>100	Brownish Silty Sand (SM)	18.50	0	42.0
Depth Range from EGL (m)	SPT 'N' Value	Classification of Rock / Weathering Grade of Rock as per IS 4464	Shear Strength of Rock, c <sub>u</sub> (kN/m <sup>2</sup> ) as per Fig. 3 of IS 2911		
5.00 - 6.00	>100	Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	1000		
6.00 - 7.00	>100	Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	1000		
7.00 - 8.00	>100	Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	1000		
8.00 - 9.00	>100	Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	1000		

Depth Range from EGL (m)	SPT 'N' Value	Classification of Rock / Weathering Grade of Rock as per IS 4464	Shear Strength of Rock, $c_u$ (kN/m <sup>2</sup> ) as per Fig. 3 of IS 2911
9.00 - 10.00	>100	Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	1000
10.00 - 11.00	>100	Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	1000



**Table B-4**

**Project : Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras  
(Basement + Ground + 11 Floors).**

<b>BH No:</b>	<b>BH 04</b>	<b>Ground Water Table Depth (m):</b>	<b>1.75</b>
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**GEOTECHNICAL INTERPRETATIVE DATA**

Depth from EGL (m)	SPT 'N' Value	Soil Description / Classification	Index Properties	Terzaghi and Peck (1974) - Shear Strength Parameters	
			Bulk Unit Weight (kN/m <sup>3</sup> ) - Table 3-4 Bowles, J. (1997)	Cohesion (c), kN/m <sup>2</sup>	Angle of Friction (φ) in Degrees
1.50	>100	Brownish Silty Sand (SM)	16.80	0	42.0
2.25	>100	Brownish Silty Sand with Gravels (SM)	17.20	0	42.0
3.00	>100	Brownish Silty Sand (SM)	17.40	0	42.0
4.00	>100	Brownish Silty Sand with Gravels (SP - SM)	17.60	0	42.0
Depth Range from EGL (m)	SPT 'N' Value	Classification of Rock / Weathering Grade of Rock as per IS 4464	Shear Strength of Rock, c <sub>u</sub> (kN/m <sup>2</sup> ) as per Fig. 3 of IS 2911		
4.00 - 5.00	>100	Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	1000		
5.00 - 6.00	>100	Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	1000		
6.00 - 7.00	>100	Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	1000		

**Table B-5**

**Project : Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras  
(Basement + Ground + 11 Floors).**

<b>BH No:</b>	<b>BH 05</b>	<b>Ground Water Table Depth (m):</b>	<b>1.50</b>
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**GEOTECHNICAL INTERPRETATIVE DATA**

Depth from EGL (m)	SPT 'N' Value	Soil Description / Classification	Index Properties	Terzaghi and Peck (1974) - Shear Strength Parameters	
			Bulk Unit Weight ( $\text{kN/m}^3$ ) - Table 3-4 Bowles, J. (1997)	Cohesion (c), $\text{kN/m}^2$	Angle of Friction ( $\phi$ ) in Degrees
1.50	10	Brownish Clayey Sand (SC)	15.90	0	26.0
2.25	>100	Brownish Clayey Sand with Gravels (SC)	16.30	0	40.0
Depth Range from EGL (m)	SPT 'N' Value	Classification of Rock / Weathering Grade of Rock as per IS 4464	Shear Strength of Rock, $c_u$ ( $\text{kN/m}^2$ ) as per Fig. 3 of IS 2911		
2.25 - 3.00	>100	Brownish, Completely Weathered, Disintegrated and Decomposed Rock Materials	1000		
3.00 - 4.00	-	Charnockite, Greyish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)	2000		
4.00 - 5.00	-	Charnockite, Greyish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)	2000		
5.00 - 6.00	-	Charnockite, Greyish, Coarse to Medium Grained, Highly Weathered Rock (Grade IV)	2000		

**Annexure - A-5**  
**Chemical Test Results**



**Table C-1**

**Project : Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras (Basement + Ground + 11 Floors).**

**CHEMICAL TEST RESULTS OF SOIL SAMPLE (2:1 (Water : Soil Extract) as per IS 456:2000 (Table 4))**

<b>S.No.</b>	<b>Parameters</b>	<b>BH 01</b>	<b>BH 04</b>
1	pH	8.18	7.35
2	Total Dissolved Solids	1135 mg/l	1150 mg/l
3	Chloride (Cl)	990 mg/l	350 mg/l
4	Total Alkalinity (as CaCO <sub>3</sub> )	210 mg/l	190 mg/l
5	Sulphate (SO <sub>4</sub> )	370 mg/l	210 mg/l
6	Carbonate Hardness (as CaCO <sub>3</sub> )	180 mg/l	165 mg/l
7	Nitrate as (NO <sub>3</sub> )	18.75	22.5 mg/l

**Table C-2**

**Project : Geotechnical Investigation for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras (Basement + Ground + 11 Floors).**

**CHEMICAL TEST RESULTS OF BORE WATER SAMPLES**

<b>S.No.</b>	<b>Parameters</b>	<b>BH 01</b>	<b>BH 04</b>
1	pH value	7.25	7.55
2	Colour	20 Hazen	15 Hazen
3	Odour	Agreeable	Agreeable
4	Turbidity	270 NTU	350 NTU
5	Total Dissolved Solids	1420 mg/l	1500 mg/l
6	Total Hardness as CaCO <sub>3</sub>	250 mg/l	210 mg/l
7	Calcium as (Ca)	30 mg/l	15 mg/l
8	Magnesium (as Mg)	23.5 mg/l	11.9 mg/l
9	Chloride (as Cl)	520 mg/l	490 mg/l
10	Total Alkalinity as CaCO <sub>3</sub>	315 mg/l	385 mg/l
11	Electrical Conductivity	2450 $\mu$ S/cm	2320 $\mu$ S/cm
12	Carbonate Hardness as CaCO <sub>3</sub>	150 mg/l	110 mg/l
13	Non - Carbonate Hardness as CaCO <sub>3</sub>	-	-
13	Iron as Fe	35 mg/l	30 mg/l
14	Sulphate as SO <sub>4</sub>	340 mg/l	320 mg/l
15	Organic Solids	210 mg/l	330 mg/l
16	Inorganic Solids	1175 mg/l	1143 mg/l

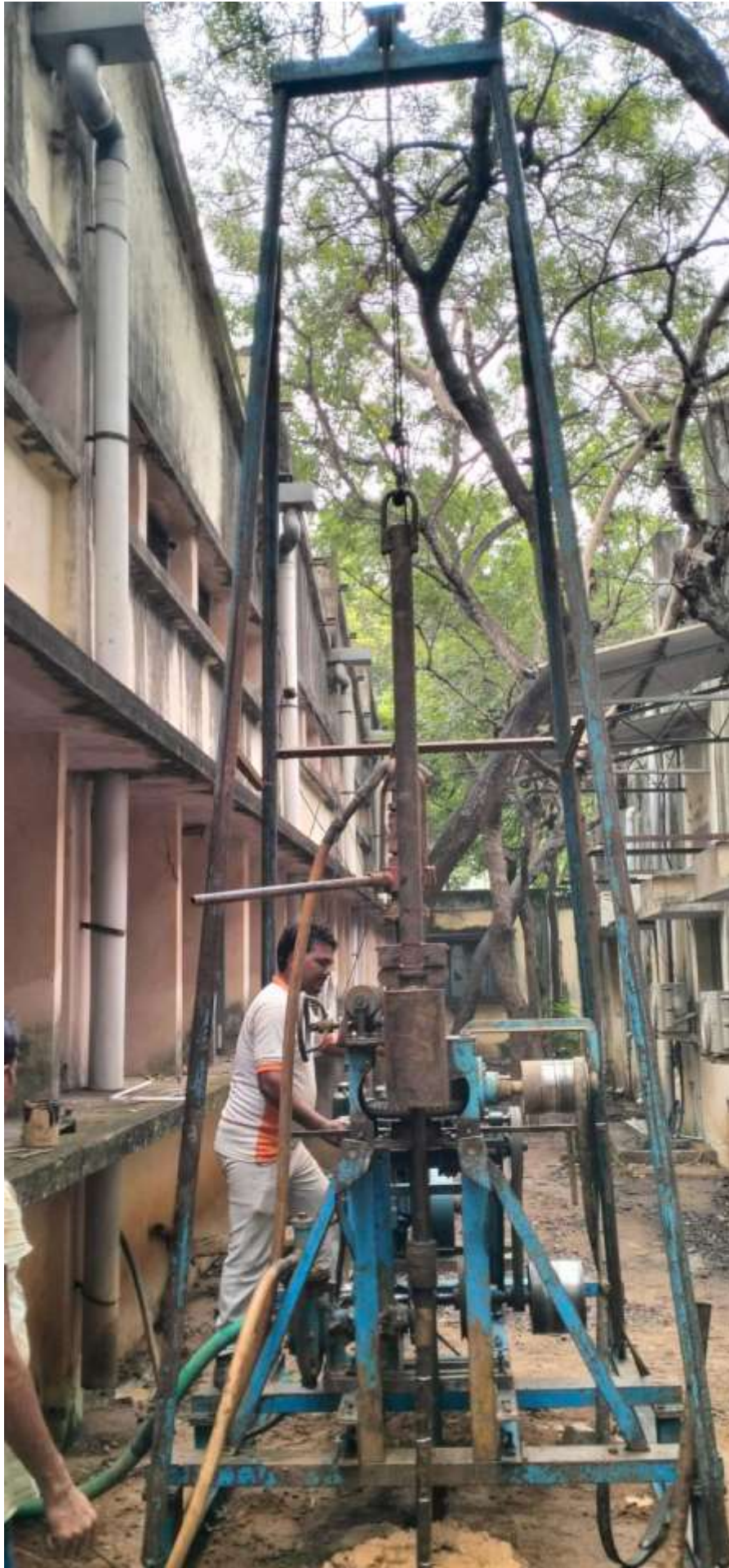
**Annexure - 6**  
**Site Photographs**











**Figure 1: SPT test is in progress for the Proposed Construction of Faculty complex by replacing the existing MFL building at IIT Madras (Basement + Ground + 11 Floors).**



**Figure 2 View of Soil/Rock Samples collected in BH - 01 Location, Box No: 01 of 01**



**Figure 3 View of Soil/Rock Samples collected in BH - 02 Location, Box No: 01 of 01**



**Figure 4 View of Soil/Rock Samples collected in BH - 03 Location, Box No: 01 of 01**





Figure 5 View of Soil/Rock Samples collected in BH - 04 Location, Box No: 01 of 01



Figure 6 View of Soil/Rock Samples collected in BH - 05 Location, Box No: 01 of 01

**View of Soil / Rock Samples Collected at Borehole Locations for the Proposed Construction of  
Faculty complex by replacing the existing MFL building at IIT Madras  
(Basement + Ground + 11 Floors).**

**Plate – 1 View of Soil/Rock Samples Collected in BH 01 Location**







Plate – 2 View of Soil/Rock Samples Collected in BH 02 Location







Plate – 3 View of Soil/Rock Samples Collected in BH 03 Location









Plate – 4 View of Soil/Rock Samples Collected in BH 04 Location





Plate – 5 View of Soil/Rock Samples Collected in BH 04 Location







## Annexure – 7

### Uncertainty Range for Lab Testing Parameters



### Uncertainty Range for Lab Testing Parameters

S.No	Product / Material of test	Specific Test Performed	Test Method	Range of testing / Limits of detection	UOM	(±) MU value	Uncertainty in (%)	Test Performed at
1	Soil	Water Content by Oven Dry Method	IS : 2720 (Part - 2) - 1973 (Reaffirmed in 2020)	3 to 180	%	1.81% @ 22.6%	8	Permanent Facility
2	Soil	Specific Gravity	IS 2720 (Part 3) – 1980 (Reaffirmed in 2021)	1.8 to 2.7	-	0.10 @ 2.57	4	Permanent Facility
3	Soil	Sieve Analysis	IS: 2720 (Part 4) – 1985 (Reaffirmed in 2020)	0.1 to 99	%	3.87% @ 55.3%	7	Permanent Facility
4	Soil	Hydrometer Analysis	IS: 2720 (Part 4) – 1985 (Reaffirmed in 2020)	1 to 99	%	4.42% @ 63.2%	7	Permanent Facility
5	Soil	Liquid Limit	IS: 2720 (Part 5) – 1985 (Reaffirmed in 2020)	5 to 180	%	7.22% @ 90.2%	8	Permanent Facility
6	Soil	Plastic Limit	IS: 2720 (Part 5) – 1985 (Reaffirmed in 2020)	0 to 90	%	2.89% @ 48.2%	6	Permanent Facility
7	Soil	Shrinkage Limit	IS: 2720 (Part 6) – 1972 (Reaffirmed in 2021)	2 to 60	%	0.82% @ 16.4%	5	Permanent Facility
8	Soil	Standard Proctor Compaction Test (Light Compaction)	IS: 2720 (Part 7) – 1980 (Reaffirmed in 2021)	1.3 to 2.2	g/cc	0.17 g/cc @ 2.1 g/cc	7	Permanent Facility
9	Soil	Modified Proctor Compaction Test (Heavy Compaction)	IS: 2720 (Part 8) – 1983 (Reaffirmed in 2020)	1.3 to 2.2	g/cc	0.17 g/cc @ 2.1 g/cc	7	Permanent Facility
10	Soil	Unconfined Compression Strength Parameters	IS : 2720 (Part 10) - 1991 (Reaffirmed in 2020)	0.025 to 1.8	N/mm <sup>2</sup>	0.04 N/mm <sup>2</sup> @ 0.52 N/mm <sup>2</sup>	7	Permanent Facility
11	Soil	Triaxial Shear Parameter (UU without Pore water Pressure) for Angle of Shearing Resistance	IS : 2720 (Part 11) - 1993 (Reaffirmed in 2021)	0.5 to 45	°	1.44° @ 16°	9	Permanent Facility
12	Soil	Triaxial Shear Parameter (UU without Pore water Pressure) for Cohesion Intercept	IS : 2720 (Part 11) - 1993 (Reaffirmed in 2021)	0.0125 to 0.9	N/mm <sup>2</sup>	0.01 N/mm <sup>2</sup> @ 0.075 N/mm <sup>2</sup>	9	Permanent Facility
13	Soil	Direct Shear test for Angle of Internal Friction	IS : 2720 (Part 13) - 1986 (Reaffirmed in 2021)	0.5 to 45	°	2.7° @ 30°	9	Permanent Facility
14	Soil	Direct Shear test for Cohesion	IS : 2720 (Part 13) - 1986 (Reaffirmed in 2021)	0.01 to 0.45	N/mm <sup>2</sup>	0.01 N/mm <sup>2</sup> @ 0.075 N/mm <sup>2</sup>	9	Permanent Facility
15	Soil	Consolidation Test Parameters	IS : 2720 (PART 15) - 1986 (Reaffirmed in 2021)	4.76 x 10 <sup>-5</sup> to 2.38	cm <sup>2</sup> / min	0.33 x 10 <sup>-4</sup> cm <sup>2</sup> /min @ 4.76 x 10 <sup>-4</sup> cm <sup>2</sup> /min	7	Permanent Facility

### Uncertainty Range for Lab Testing Parameters

S.No	Product / Material of test	Specific Test Performed	Test Method	Range of testing / Limits of detection	UOM	(±) MU value	Uncertainty in (%)	Test Performed at
16	Soil	California Bearing Ratio Parameter	IS : 2720 (Part 16) - 1987 (Reaffirmed in 2021)	1 to 80	%	0.42% @ 6%	7	Permanent Facility
17	Soil	Permeability test - Constant and Falling head method	IS : 2720 (Part 17 - 1986 (Reaffirmed in 2021)	0.0000001 to 100	cm/sec	4.09 cm/sec @ 58.4 cm/sec	7	Permanent Facility
18	Soil	Field Density by Sand Replacement Method	IS: 2720 (Part 28) – 1974 (Reaffirmed in 2020)	1.2 to 2.1	g/cc	0.11 g/cc @ 1.75 g/cc	6	Permanent Facility, Site Facility
19	Soil	Field Density by Core Cutter Method	IS: 2720 (PART 29) - 1975 (Reaffirmed in 2020)	1.2 to 2.1	g/cc	0.1 g/cc @ 1.710 g/cc	6	Permanent Facility, Site Facility
20	Soil	Free Swell Index	IS : 2720 (Part 40) - 2002 (Reaffirmed in 2021)	5 to 240	%	7.2% @ 90%	8	Permanent Facility
21	Rock	Point Load Strength Index	IS : 8764 - 1998 (Reaffirmed in 2019)	0.18 to 30	N/mm <sup>2</sup>	0.57 N/mm <sup>2</sup> @ 7.13 N/mm <sup>2</sup>	8	Permanent Facility
22	Rock	Tensile Strength by using Brazilian Apparatus	IS : 10082 - 1981 (Reaffirmed in 2021)	0.11 to 30	N/mm <sup>2</sup>	1.08 N/mm <sup>2</sup> @ 12.0 N/mm <sup>2</sup>	9	Permanent Facility
23	Stone	Apparent Porosity	IS : 1124 - 1974 (Reaffirmed in 2017)	0.1 to 30	%	0.05% @ 0.54%	9	Permanent Facility
24	Stone	Apparent Specific Gravity	IS : 1124 - 1974 (Reaffirmed in 2017)	2.2 to 3.3	-	0.19 @ 2.68	7	Permanent Facility
25	Stone	Water Absorption	IS : 1124 - 1974 (Reaffirmed in 2017)	0.1 to 9	%	0.04% @ 0.44%	9	Permanent Facility
26	Rock	Unconfined Compression Strength Parameters	IS : 9143 - 1979 (Reaffirmed in 2021)	0.47 to 400	N/mm <sup>2</sup>	5.4 N/mm <sup>2</sup> @ 60.01 N/mm <sup>2</sup>	9	Permanent Facility