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CLIENT		SRI SANKARA MATRIC HIGHER SECONDARY SCHOOL	
PROJECT		PROPOSED CONSTRUCTION OF SCHOOL BUILDING (G+03) AT NO. 60, THIRUPATHI MAIN ROAD, S.NO. 279/1 PART, 278/1, V.NO. 60, TANDALAM VILLAGE, ELLAPURAM UNION, UTHUKOTTAI TALUK, THIRUVALLUR DISTRICT	
TITLE		GEOTECHNICAL INVESTIGATION REPORT	
0	12-03-2026	GMEPL/SRI SANKARA MATRIC HIGHER SECONDARY SCHOOL/540/2025-26	
REV.	DATE	REPORT NUMBER	PREP. BY

DISCLAIMER

We've been asked to look into the ground and identify and quantify everything that mother nature has put there and predict how those materials will react to construction and long-term performance of a facility - and we may fall short of this lofty goal.

We have made reasonable and prudent conclusions but a cloud of uncertainty inherently looms over the project as per the pre and post facilities laid and their elemental behaviour on the mother soil.

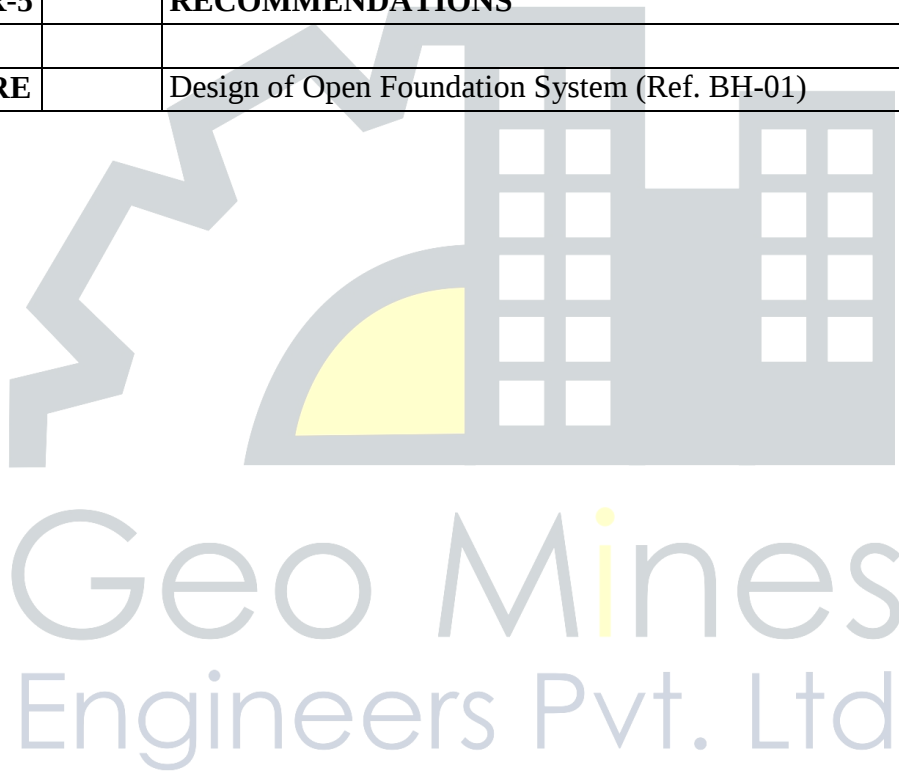
Also, the variable nature of soil strata and its varying characteristics may make the recommended foundation system disqualify and hence it's recommended that special care shall be taken by the owner during and after the construction is complete and during the run period of the building.



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CHAPTER-1

INTRODUCTION

1.0 Preamble

Sri Sankara Matric Higher Secondary School proposed to construct a **School Building (G+03)** at **No. 60, Thirupathi Main Road, S.No. 279/1 Part, 278/1, V.No. 60, Tandalam Village, Ellapuram Union, Uthukottai Taluk, Thiruvallur District.** For the purpose of designing the foundations, the responsibility of carrying out suitable soil investigations was entrusted to **M/s. Geo Mines ENGINEERS Pvt. Ltd., Chennai.**

This report contains the field and laboratory test results along with Design computations and recommendations for suitable foundation systems.

1.1 Scope of Work

- ❖ Sinking Three Standard Soil investigation bore holes of 150mm diameter up to a depth below existing ground level where $SPT > 100$ or as directed by the engineer-in-charge.
- ❖ Conducting Standard Penetration Test (SPT) at regular depth intervals.
- ❖ Collection of Split Spoon Samples or Disturbed Soil Samples
- ❖ Collection of water samples from each bore hole.
- ❖ Conducting relevant laboratory test results.

1.2 Structure of the Report

- ❖ Contents
- ❖ Introduction
- ❖ Investigation Methodology & Test Results
- ❖ Figures & Tables
- ❖ Sub-Surface Stratification
- ❖ Foundation Systems
- ❖ Recommendations
- ❖ Annexure (Design Computations)

CHAPTER-2

INVESTIGATION METHODOLOGY & TEST RESULTS

2.0 Field Testing:

2.1 Preamble:

Three standard soil investigation boreholes were put. The equipment used and the methodology adopted to carry out the fieldwork is described below.

2.2 Equipment Used and Method of Drilling:

2.2.1 Equipment Used

The equipment used for performing the drilling operations was a Calyx Rotary Drill Rig with direct mud circulation technique. The drill mud used was made out of Sodium Bentonite.

2.2.2 Methodology of drilling

In the soil strata, the drilling operations were carried out using special drill bits and cutters coupled with direct mud circulation.

2.3 In-Situ Strength Tests:

2.3.1 Standard Penetration Test:

Standard penetration tests were conducted at the borehole locations, in accordance with IS: 2131. The tests were conducted at every change of strata up to the depth of termination of the borehole as directed by the engineer-in-charge.

2.4. Collection of Samples:

2.4.1 Disturbed Soil Samples

The SPT-samples collected were used as disturbed soil samples. These samples were used for visual and physical identification and for conducting laboratory classification tests as per I.S.1498-1970.

2.4.2 Ground Water

For conducting suitable chemical tests, the ground water sample was collected from the respective borehole.

2.5 Summary of Field Work

The locations of the boreholes are shown in site plan given in Fig. 2.0. The soil profiles obtained at each location is shown in Figs. 2.1 to 2.3.

2.6 Laboratory Testing:

2.6.1 Coarse Grained Samples:

2.6.1.1 Grain size Analysis Tests:

On the coarse-grained soil samples, grain size distribution tests were conducted as per I.S.2720 (Part 4)-1985, to know the gradation characteristics and to classify them. These results are presented in Tables 2.1 to 2.3.

2.6.2 Fine Grained Samples:

2.6.2.1 Index Property – Free Swell Tests:

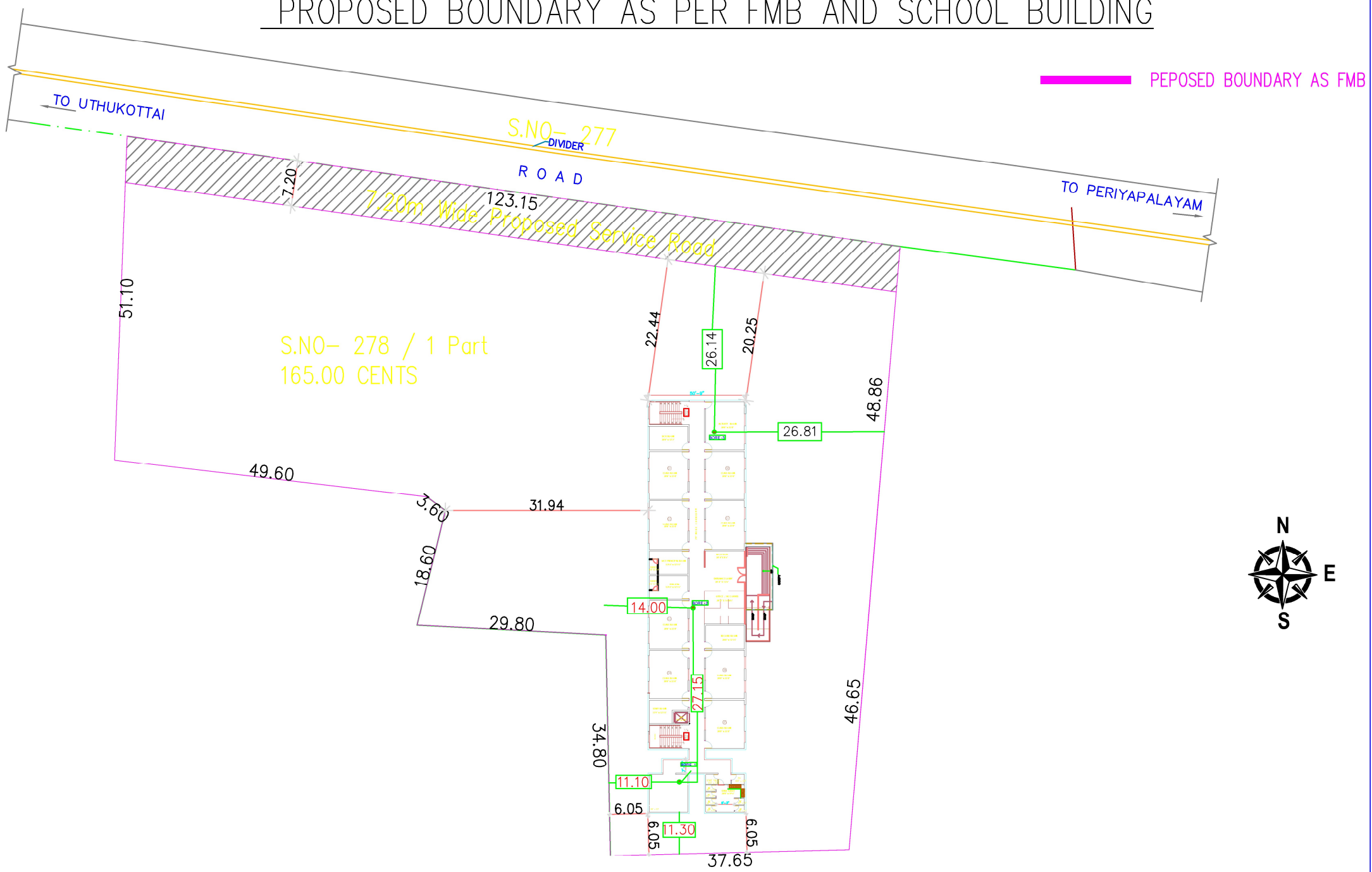
Atterberg Limits were carried out on fine grained soil samples to evaluate the limits of different consistency states. Generally Liquid limits, Plastic limits and Shrinkage Limits tests were conducted as per I.S.2720 (Part-5)-1985 and I.S.2720 (Part 6)-1972. On such type of soil strata encountered at the investigation locations, such tests were conducted and the test results are presented in Tables 2.1 to 2.3.

2.6.3 Chemical Analysis Tests:

2.6.3.1 Water Samples:

On representative water samples, chemical analysis tests were conducted to estimate pH, Chlorides and Sulphates. These results are presented in Table-2.4.

PROPOSED BOUNDARY AS PER FMB AND SCHOOL BUILDING





Project : Proposed Construction of School Building (G+03) at No. 60, Thirupathi Main Road, S.No. 279/1 Part, 278/1, V.No. 60, Tandalam Village, Ellapuram Union, Uthukottai Taluk, Thiruvallur District

Location: BH-01

Started On : 07/03/2026; Ended On : 07/03/2026 G.W.T: 1.00m below existing ground level

R.L. of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details			Cal Representation										Relative Density/Consistency	Type of Sample																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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Bore Hole Terminated at a depth of 9.20m below the existing ground level

Fig. 2.1 Soil Profile at BH-01 Location



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Location: BH-02

Started On : 08/03/2026; Ended On : 08/03/2026 G.W.T: 1.00m below existing ground level

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details			Cal Representation										Relative Density/Consistency	Type of Sample																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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Bore Hole Terminated at a depth of 9.20m below the existing ground level

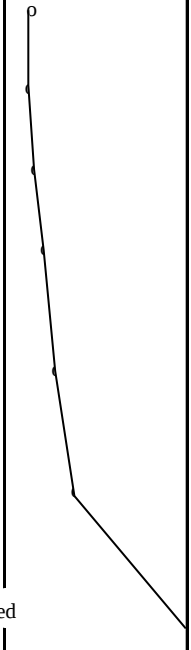
Fig. 2.2 Soil Profile at BH-02 Location



Project : Proposed Construction of School Building (G+03) at No. 60, Thirupathi Main Road, S.No. 279/1 Part, 278/1, V.No. 60, Tandalam Village, Ellapuram Union, Uthukottai Taluk, Thiruvallur District

Location: BH-03

Started On : 08/03/2026; Ended On : 08/03/2026 G.W.T: 1.00m below existing ground level

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details			Cal Representation										Relative Density/Consistency	Type of Sample					
				Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value															
G.W.T	↓		Greyish Stiff Silty Clay	1.50	6	7	7	14											Stiff	SS			
3.00				2.50	5	6	7	13												Stiff	SS		
4.00			Greyish Very Stiff Silty Clay	3.50	7	8	8	16												V.Stiff	SS		
			Yellowish Medium Dense Silty Fine to Medium Coarse Sand	4.50	8	10	11	21												M.Dense	SS		
7.00				6.00	9	11	16	27												M.Dense	SS		
8.50			Yellowish Dense Silty Fine to Medium Coarse Sand	7.50	12	17	20	37		Dense	SS												
9.20			Yellowish Very Dense Silty Fine to Medium Coarse Sand	9.00	SPT Hammer Rebounded						V.Dense	SS											

Bore Hole Terminated at a depth of 9.20m below the existing ground level

Fig. 2.3 Soil Profile at BH-03 Location

Table 2.1: Laboratory Test Results on the Soil Samples Collected from BH-01 Investigation Location																		
Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Natural Density (g/cc)	Clay					Relative Density/ Consistency	Sieve Analysis						IS-Classification
						LL (%)	PL (%)	PI	I _c	FS		Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	
0.00 to 4.00	11	SS	Silty Clay	31	1.51	53	28	25	0.88	9	Stiff	0	0	0	0	21	79	CH
4.00 to 7.00	23	SS	Silty Fine to Medium Coarse Sand	-	1.58	-	-	-	-	-	M.Dense	0	0	19	57	11	13	SM
7.00 to 8.50	33	SS	Silty Fine to Medium Coarse Sand	-	1.72	-	-	-	-	-	Dense	0	9	13	47	13	18	SM
8.50 to 9.20	>100	SS	Silty Fine to Medium Coarse Sand	-	1.83	-	-	-	-	-	V.Dense	0	21	25	42	12	0	SM

Table 2.2: Laboratory Test Results on the Soil Samples Collected from BH-02 Investigation Location																		
Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Natural Density (g/cc)	Clay					Relative Density/ Consistency	Sieve Analysis						IS-Classification
						LL (%)	PL (%)	PI	I _c	FS		Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	
0.00 to 3.00	11	SS	Silty Clay	30	1.52	51	26	25	0.84	8	Stiff	0	0	0	0	21	79	CH
3.00 to 4.00	19	SS	Silty Clay	27	1.58	46	31	15	1.27	-	V.Stiff	0	0	0	0	23	77	CI
4.00 to 7.00	25	SS	Silty Fine to Medium Coarse Sand	-	1.60	-	-	-	-	-	M.Dense	0	0	23	43	13	21	SM
7.00 to 8.50	34	SS	Silty Fine to Medium Coarse Sand	-	1.72	-	-	-	-	-	Dense	0	0	27	41	13	19	SM
8.50 to 9.20	>100	SS	Silty Fine to Medium Coarse Sand	-	1.84	-	-	-	-	-	V.Dense	0	18	25	38	19	0	SM

Table 2.3: Laboratory Test Results on the Soil Samples Collected from BH-03 Investigation Location																		
Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Natural Density (g/cc)	Clay					Relative Density/ Consistency	Sieve Analysis						IS-Classification
						LL (%)	PL (%)	PI	I _c	FS		Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	
0.00 to 3.00	13	SS	Silty Clay	28	1.53	48	26	22	0.91	6	Stiff	0	0	0	0	22	78	CH
3.00 to 4.00	16	SS	Silty Clay	27	1.61	46	29	17	1.12	-	V.Stiff	0	0	0	0	23	77	CI
4.00 to 7.00	24	SS	Silty Fine to Medium Coarse Sand	-	1.65	-	-	-	-	-	M.Dense	0	5	18	56	21	0	SM
7.00 to 8.50	37	SS	Silty Fine to Medium Coarse Sand	-	1.75	-	-	-	-	-	Dense	0	0	23	42	21	14	SM
8.50 to 9.20	>100	SS	Silty Fine to Medium Coarse Sand	-	1.84	-	-	-	-	-	V.Dense	0	15	27	44	14	0	SM



**Table 2.4: Chemical Analysis Results conducted on
Water Samples collected from BH-01 to BH-03**

Location	Depth of Sample below E.G.L. (m)	pH	Chlorides (ppm)	Sulphates (ppm)
BH-01	3.00	6.97	244.73	174.92
BH-02	3.00	6.98	230.04	164.42
BH-03	3.00	6.98	233.67	167.01

CHAPTER-3

SUB-SURFACE STRATIFICATION

3.0 Preamble

The sub surface stratification at borehole locations, with respect to foundation/geotechnical engineering application are derived based on the visual identification, laboratory classification tests and field in-situ strength tests. Further, the strength parameters are estimated based on the in-situ strength test results as per the following correlation.

- * **For Coarse Grained Samples, Ref. Fig.1, IS: 6403 to estimate Angle of Shearing Resistance.**
- * **For Fine Grained Samples, Ref. Terzaghi & Peck, 1948, to estimate Unconfined Compressive Strength.**

3.1 Sub Surface Stratification:

3.1.1 Soil Profile at BH-01 Location

(At BH-01 Location, as presented in Site plan)

- * **Layer-1 (from E.G.L to 4.00m depth)**

Type of Strata	Silty Clay
Colour	Greyish
Thickness of Layer	4.00m
SPT of the layer	11
Consistency	Stiff
Un-drained Cohesion, C_u	73.33kPa

- * **Layer-2 (from 4.00m to 7.00m depth)**

Type of Strata	Silty Fine to Medium Coarse Sand
Colour	Yellowish
Thickness of Layer	3.00m
SPT of the layer	23
Relative Density	Medium Dense
Angle of Shearing Resistance, ϕ	33.90°

- * **Layer-3 (from 7.00m to 8.50m depth)**

Type of Strata	Silty Fine to Medium Coarse Sand
Colour	Yellowish
Thickness of Layer	1.50m
SPT of the layer	33
Relative Density	Dense
Angle of Shearing Resistance, ϕ	36.825°

* **Layer-4 (from 8.50m to 9.20m depth)**

Type of Strata	Silty Fine to Medium Coarse Sand
Colour	Yellowish
Thickness of Layer	0.70m
SPT of the layer	>100
Relative Density	Very Dense
Angle of Shearing Resistance, ϕ	42.50°

Ground Water

Ground water table was encountered at a depth of 1.00m below the existing ground level during the first week of March 2026.

3.1.2 Soil Profile at BH-02 Location

(At BH-02 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 3.00m depth)**

Type of Strata	Silty Clay
Colour	Brownish
Thickness of Layer	3.00m
SPT of the layer	11
Consistency	Stiff
Un-drained Cohesion, Cu	73.33kPa

* **Layer-2 (from 3.00m to 4.00m depth)**

Type of Strata	Silty Clay
Colour	Brownish
Thickness of Layer	1.00m
SPT of the layer	19
Consistency	Very Stiff
Un-drained Cohesion, Cu	126.66kPa

* **Layer-3 (from 4.00m to 7.00m depth)**

Type of Strata	Silty Fine to Medium Coarse Sand
Colour	Yellowish
Thickness of Layer	3.00m
SPT of the layer	25
Relative Density	Medium Dense
Angle of Shearing Resistance, ϕ	34.50°

* **Layer-4 (from 7.00m to 8.50m depth)**

Type of Strata	Silty Fine to Medium Coarse Sand
Colour	Yellowish
Thickness of Layer	1.50m
SPT of the layer	34
Relative Density	Dense
Angle of Shearing Resistance, ϕ	37.10°

* **Layer-5 (from 8.50m to 9.20m depth)**

Type of Strata	Silty Fine to Medium Coarse Sand
Colour	Yellowish

Thickness of Layer	0.70m
SPT of the layer	>100
Relative Density	Very Dense
Angle of Shearing Resistance, ϕ	42.50°

Ground Water

Ground water table was encountered at a depth of 1.00m below the existing ground level during the second week of March 2026.

3.1.3 Soil Profile at BH-03 Location

(At BH-03 Location, as presented in Site plan)

* Layer-1 (from E.G.L to 3.00m depth)

Type of Strata	Silty Clay
Colour	Greyish
Thickness of Layer	3.00m
SPT of the layer	13
Consistency	Stiff
Un-drained Cohesion, Cu	86.66kPa

* Layer-2 (from 3.00m to 4.00m depth)

Type of Strata	Silty Clay
Colour	Greyish
Thickness of Layer	2.00m
SPT of the layer	16
Consistency	Very Stiff
Un-drained Cohesion, Cu	106.66kPa

* Layer-3 (from 4.00m to 7.00m depth)

Type of Strata	Silty Fine to Medium Coarse Sand
Colour	Yellowish
Thickness of Layer	3.00m
SPT of the layer	24
Relative Density	Medium Dense
Angle of Shearing Resistance, ϕ	34.20°

* Layer-4 (from 7.00m to 8.50m depth)

Type of Strata	Silty Fine to Medium Coarse Sand
Colour	Yellowish
Thickness of Layer	1.50m
SPT of the layer	37
Relative Density	Dense
Angle of Shearing Resistance, ϕ	37.925°

* Layer-5 (from 8.50m to 9.20m depth)

Type of Strata	Silty Fine to Medium Coarse Sand
Colour	Yellowish
Thickness of Layer	0.70m
SPT of the layer	>100
Relative Density	Very Dense

Angle of Shearing Resistance, ϕ 42.50°

Ground Water

Ground water table was encountered at a depth of 1.00m below the existing ground level during the second week of March 2026.



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CHAPTER-4

FOUNDATION SYSTEM

4.0 Preamble

The foundation system design is an interface between super structure and the sub soil bearing strata characteristics. A sound foundation system should be safe against bearing strata shear response under the super structure load intensity. Similarly, the stability of the foundation system is governed by the bearing strata deformation response under the super structure load intensity. In addition, as a combined system of super structure and foundation, the overall stability is also governed by the super structure arrangement.

Considering the above aspects of foundation design, the suitable type of foundation system with respect to the sub soil conditions encountered at the borehole locations is presented in the subsequent sections.

4.1 Bearing Strata Characteristics

From field investigations, it can be observed that the sub-soil strata encountered at shallow depths are uniformly stratified from type but possess varying shear strength characteristics, BH-01 being relatively weak from deformation considerations than that of other borehole locations and hence shall be considered as design borehole to determine the bearing strata and its safe bearing capacity.

Considering BH-01 as design borehole, it can further be envisaged that the highly plastic but **stiff** fine-grained soil strata encountered at shallow depths with reference to present existing ground level (EGL) will hold good to act as bearing strata from shear strength characteristics and deformation considerations for **presumptive but not limited to individual** column loads within 800kN.

If fine-grained soil strata encountered at shallow depths are considered as bearing strata, the safe bearing capacity of open foundation system will be a function of un-drained cohesive strength of the bearing strata.

Care shall be taken in locating the foundation system on such type of highly plastic fine-grained soil strata so that ordinate pressures resulting from its

volumetric change phenomenon during variations in seasonal moisture content variations do not impact on the structural system of foundation.

Considering the above, suitable foundation system is presented below.

4.2 Foundation System

4.2.1 Open Foundation System (Ref. BH-01)

*Considering the uniformity in sub-soil stratifications at shallow depths, shear strength and high plasticity characteristics of fine-grained soil strata encountered at shallow depths, open foundation system of **Isolated Column Footing** type located at a design depth of 2.20m below present existing ground level located over 0.30m thick well compacted CNS (Cohesive Non-Swelling) soil can be adopted.*

(CNS can be clean river sand or sand-gravels mix (1:2) or quarry dust or fly ash etc).

The safe bearing capacity of such type of open foundation system is presented below which can be adopted for foundation design purposes.

Type of Open Foundation System	Total Depth of Excavations below existing ground level (m)	Backfill with well compacted CNS (m)	Depth of Foundation below present existing ground level (m)	Safe Bearing Capacity (MT/m ²)	Elastic Settlements (mm)
Isolated Column Footing	2.50	0.30	2.20	14	42

The computations for above are annexed to this report.

CHAPTER-5

CONCLUSIONS & RECOMMENDATIONS

1. Open Foundation system presented in Clause 4.2.1, Chapter-IV can be adopted for foundation design purposes.
2. Safe bearing capacity of open foundation system is computed considering any rise in the ground water table up to or above the level of isolated column footing.
3. In no case, the least depth of foundation system can be less than 2.20m below present existing ground level located over 0.30m thick well compacted CNS Soil layer.
4. In case, ground water table is encountered within recommended depth of foundation system, provisions shall be made to continuously bail the water out of the foundation pits to keep the surfaces of pit consolidated dry.
5. **Excavated highly plastic fine-grained soil encountered at shallow depths shall be in no case used for back filling purposes.**
6. **No structural units can be in direct contact of highly plastic fine-grained soil strata encountered at shallow depths. A 0.30m thick CNS soil layer is recommended to be sand-witched in between.**

Other Recommendations

7. Suitable provisions to contain the lateral collapse of soil from the walls of excavated open foundation pits are recommended.
8. **It is recommended to connect the grade beams @ plinth level so that the structure can act as a single unit against any differential settlements in between the individual isolated column footings.**

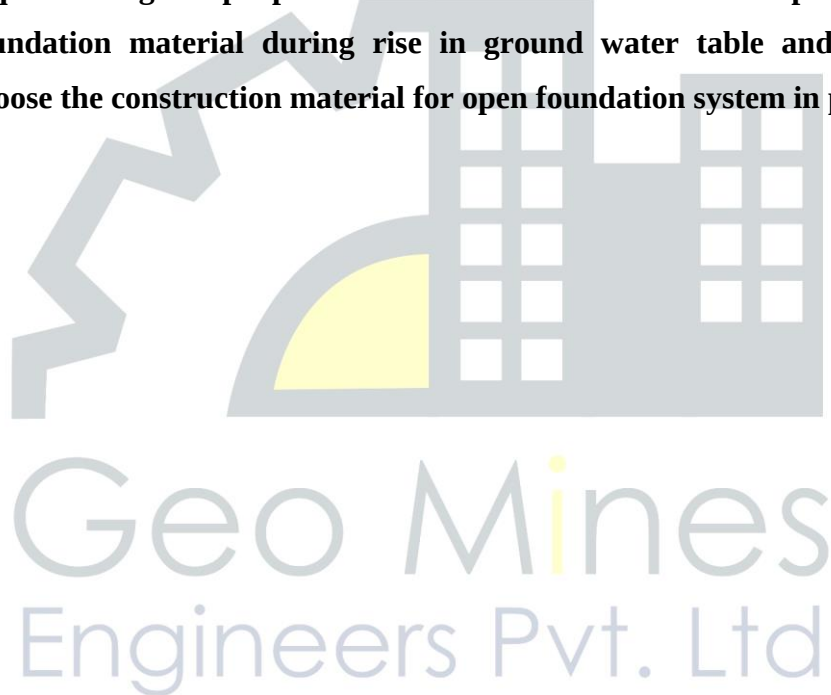
Exclusive

9. Open foundation system presented above will be conducive only if proper drainage arrangements are made to channel the run-off into the drains and hence containing any water seepage into the ground. Also, there shall not be

any underground plumbing line leakages which may lead to softening of highly plastic fine-grained soil recommended as bearing strata.

General

10. **CNS can be well graded coarse-grained soil like quarry dust or clean river sand or sand: gravels mix (1:2) or fly-ash that shall be well compacted to achieve more than 95% of proctor density parameters.**
11. **Although, the chlorides and sulphates present in the collected water samples are within the permissible limits, but recommended to extract the water samples at uniform interval of 10.00m and up to deeper levels from an open-well/dug-well and test for the chemical parameters as per the required usage or purpose and also to understand their impact on open foundation material during rise in ground water table and hence to choose the construction material for open foundation system in prior.**





DESIGN OF OPEN FOUNDATION SYSTEM (Ref. BH-01)

1 COMPUTATION OF BEARING CAPACITY AS PER IS:6403

1.1 Geometrical Data :

Type of Foundation System:	Isolated Column Footing
R.L of the top of Borehole (m):	0.00 m
Total Depth of Excavations below existing Ground Level (m) :	2.50 m
Recommended Thickness of CNS Back-Fill (m):	0.30 m
Effective Depth of Foundation below existing ground level (D_f):	2.20 m
Design Width of Foundation (B):	1.00 m
Thickness of Foundation (T) :	0.20 m

1.2 Soil Data :

Type of Bearing Strata :	Silty Clay
Design SPT-value of the Bearing Strata :	12
(considered based upon the density of the strata)	
Type of Shear Failure:	General
Undrained Cohesion, C_u :	80.00 kPa

1.3 Design Parameters:

Bulk Density of Soil above the foundation depth (γ_{bulk})	15.10 kN/m ³
Effective Overburden pressure at foundation level (q)	11.22 kPa
Water Table Correction Factor (w')	0.50

Bearing Capacity Factors:

$$N_c = 5.14$$

$$N_q = N/A$$

$$N_\gamma = N/A$$

Shape Factors:

$$S_c = 1.00$$

$$S_q = N/A$$

$$S_\gamma = N/A$$

Depth Factors :

$$D_c = 1.00$$

$$D_q = N/A$$

$$D_{\gamma} = N/A$$

Inclination Factor:

$$I_c = 1.00$$

$$I_q = N/A$$

$$I_{\gamma} = N/A$$

1.4 Ultimate Bearing Capacity (Q_u) :

$$Q_u = C_u * N_c * S_c * D_c * I_c + q * (N_q - 1) * S_q * D_q * I_q + 0.5 * B * \gamma * N_{\gamma} * S_{\gamma} * D_{\gamma} * I_{\gamma} * w'$$

$$Q_u = 411.20 \text{ kPa}$$

1.5 Safe Bearing Capacity (Q_{safe}) :

$$\text{Factor of Safety (F.S.) : } 2.50$$

$$Q_{safe} : 164.48 \text{ kPa}$$

$$\text{Recommended Safe Bearing Capacity: } 140.00 \text{ kPa}$$

1.6 Settlements

Since, the bearing strata are stiff fine-grained type, the settlements under the allowable safe bearing pressure 140kPa will be of immediate elastic nature. The elastic settlements corresponding to a safe bearing pressure of 140kPa and average SPT of 12 considering extent of pressure bulb below bottom level of footing are computed to be in the order of 42mm which is within the permissible limits of 50mm for isolated column footing as per I.S:1904.