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GEO TECHNICAL INVESTIGATION REPORT

CLIENT	:	**MRS. JAYABHARATHI**
NO.OF BH & DATE	:	**3 BH & 18.12.2023**
REPORT NO	:	**GTC/144/21/12/2023-24**
LOCATION		"LUXE" Proposed Construction of Stilt Floor + 4 floors +5th Floor part Residential Building (Height – 18.30m) with 18 Dwelling Units Availing Premium FSI at Plot No.5(Part), 6 & 7, 4th Cross Street, Logaiah Colony, Saligramam, Chennai comprised in T.S.No.29/1, Block No.36 of Saligramam Village, Within the Limits of Greater Chennai Corporation Zone - 10, Division 129.

Geo - Techno

Geo-Techno Consultants
No: 45, First Cross Street, V O C Nagar, Venkatapuram, Ambattur, Chennai-600053
Mobile: 9600160970 , E.Mail:-labgeotech@gmail.com, Website: www.justdial.com

GEO TECHNO CONSULTANTS CHENNAI

REPORT ON SOIL INVESTIGATION FOR THE PROPOSED CONSTRUCTION OF A STILT+5 FLOORS BUILDING

1.0 Introduction :

Geo Technical Investigation Report for "LUXE" Proposed Construction of Stilt Floor + 4 floors +5th Floor part Residential Building (Height – 18.30m) with 18 Dwelling Units Availing Premium FSI at Plot No.5(Part), 6 & 7, 4th Cross Street, Logaiah Colony, Saligramam, Chennai comprised in T.S.No.29/1, Block No.36 of Saligramam Village, Within the Limits of Greater Chennai Corporation Zone - 10, Division 129, measuring 7539 Sq.ft., in this context the client required to have soi1 investigations to understand the sub soi1 condition for construction of buildings and other structures. For the purpose of designing the foundations, the responsibility of carrying out suitable soil investigation has been entrusted to **M/s. GEO-TECHNO CONSULTANTS ,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 maximum 24.00m or as directed by the engineer-in-charge.
- Conducting Standard Penetration Test (SPT) at 1.5in regular depth intervals
- Collection of Split Spoon Samples or Disturbed Soil Samples
- Recording ground water levels if met
- Preparation and submission of a technical report containing the details of the test carried out.

Their analysis and recommendations regarding the foundation system to be adopted

Two copies of the report are to be submitted.



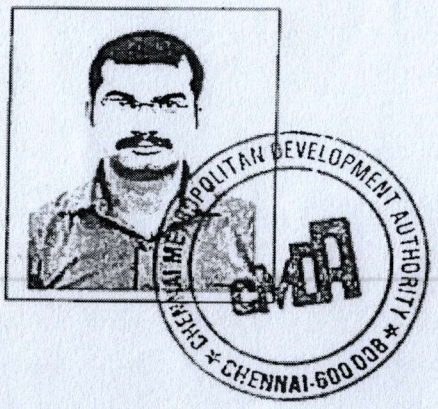
CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
'ThalamuthuNatarajan Building', No.1, Gandhi Irwin Road,
Egmore, Chennai-600 008.

PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that the **Thiru M. AMMAIAPPAN** has enrolled as **Registered Geo-Technical Engineer (RGTE)** with Chennai Metropolitan Development Authority (CMDA) who has the qualification of **M.E.,(Geo Technical Engg.)** and experience in the relevant field for **07 years**.

He has been given the Registration No.**GTE/2020/08/046** on **29.08.2020.** He shall be required to comply with the duties and responsibilities prescribed by the Government of Tamil Nadu in Part-V, "Registration of Professionals", Tamil Nadu Combined Development and Building Rules, 2019 approved vide G.O.(Ms) No.18 MAWS (MA1) Dept. dated 04.02.2019.

This Registration is valid upto **28.08.2025.**



25/09/20

(R.SHIVAKUMAR)

Member Secretary

Er. M.Ammaiappan, B.E., M.E(Geo Tech), (Ph.D)
Registered Geo Technical Engineer
CMDA - Reg. No : GTE/2020/08.046
Thirunullaivoyal, Chennai - 600 062.

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CHAPTER-2

INVESTIGATION METHODOLOGY & TEST RESULTS

1.2 Structure of the Report

- Contents
- Introduction
- Investigation Methodology & Test Results
- Figures & Tables
- Sub-Surface Stratification
- Foundation Systems
- Soil Profile
- Assessment of bearing capacity
- Bearing capacity calculation
- Recommendations

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 is a Rotary Galaxy Drill Rig using cutting augers with Diamond Bit with circulating bentonite slurry.

2.2.2 Methodology of drilling

In the soil strata, the drilling operations have been carried out using the rotating cutting augurs duly circulating the bentonite slurry to remove the cuttings to be collected at the top. The soil exploration consists of three stages i.e. boring, sampling and testing which includes both field and lab tests. The SPT sample were collected at every 1.50m depth. Samples were properly labeled for lab tests. Bore log particulars and location of bore holes are annexed with this report.

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2.3.1 In-Situ Strength Tests:

2.3.2 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 in-charge at site.

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.

2.5 Summary of Field Work

The soil profiles obtained at each location is shown in the tables attached.

2.6 Laboratory Testing:

2.6.1 Coarse Grained Samples:

2.6.1.1 Grain size Analysis Tests:

On the coarse grained 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.

2.6.2 Fine Grained Samples:

2.6.2.1 Index Property – Free Swell Tests:

Atterberg's 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 strata encountered at the investigation locations, such tests were conducted and the test results are presented in tables.

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CHAPTER-3

SUB-SURFACE STRATIFICATION

3.0 Preamble

The details of soil conditions encountered at the Bore Hole locations are presented in this chapter based on visual identification, laboratory and engineering characteristics derived from SPT-value correlation with strength parameters as described below.

* **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 The Structure:

As per the client's information proposed to construct for a Stilt+5 Residential building project.

3.2 Weather Condition:

Weather was hot and mostly cloud during field investigations which was carried out on 18.12.2023.

3.3 Ground Water Level:

Ground water level met at the depth of 3.00m during the drilling operation.

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3.4 3.4.1 Soil Profile at BH-01 Location

* Layer-1 (from E.G.L to 2.50m depth)

Type of Strata	Silty Clay
Colour	Brownish
Thickness of Layer	2.50m
SPT of the layer	10
Consistency	Stiff
Un-drained Cohesion, Cu	66.66kPa

* Layer-2 (from 2.50m to 5.50m depth)

Type of Strata	Silty Fine Sand
Colour	Brownish
Thickness of Layer	3.00m
SPT of the layer	09
Relative Density	Loose
Angle of Shearing Resistance, ϕ	29.80^0

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

Type of Strata	Silty Fine Sand
Colour	Greyish
Thickness of Layer	3.00m
SPT of the layer	09
Relative Density	Loose
Angle of Shearing Resistance, ϕ	29.80^0

* Layer-4 (from 7.00m to 10.00m depth)

Type of Strata	Silty Fine Sand
Colour	Greyish
Thickness of Layer	3.00m
SPT of the layer	17
Relative Density	Medium Dense
Angle of Shearing Resistance, ϕ	32.10^0

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3.5. **Soil Profile at BH-02 Location**

* **Layer-1 (from E.G.L to 2.50m depth)**

Type of Strata	Silty Clay
Colour	Brownish
Thickness of Layer	2.50m
SPT of the layer	07
Consistency	Medium Stiff
Un-drained Cohesion, Cu	46.66kPa

* **Layer-2 (from 2.50m to 5.50m depth)**

Type of Strata	Silty Fine Sand
Colour	Brownish
Thickness of Layer	3.00m
SPT of the layer	09
Relative Density	Loose
Angle of Shearing Resistance, ϕ	29.80^0

* **Layer-3 (from 5.50m to 10.00m depth)**

Type of Strata	Silty Fine Sand
Colour	Greyish
Thickness of Layer	4.50m
SPT of the layer	09
Relative Density	Loose
Angle of Shearing Resistance, ϕ	29.80^0

Ground Water

Ground water table was encountered at a depth of 3.00m below the existing ground level during the fourth week of December 2023.

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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-02 being relatively weak from deformation considerations and hence shall be considered as design borehole to determine the bearing strata and its safe bearing capacity.

From laboratory tests, it is pragmatic that the fine-grained strata encountered at shallow depths are highly plastic type and hence any open foundation system if located in such type of strata shall be either located over ground replaced surface or below the zone of desiccation (Normally, zone of desiccation extends up to a depth of 2.50m below natural ground level).

However, the fine-grained strata can be considered as bearing strata for nominal column loads within the range of 300kN to 400kN respectively.

If fine-grained 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 it.

Considering the above, suitable foundation system is presented below.

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4.2 Foundation System

4.2.1 Open Foundation System

Considering the non-uniformity in sub-soil stratifications at shallow depths, their shear strength characteristics and high plasticity nature of fine-grained soil encountered at shallow depths, open foundation system of Strip Footing type located at a design depth of 1.90m below existing ground level over 0.30m thick well compacted cohesive non-swelling (CNS) soil surface can be adopted.

Hence, the open excavations shall be carried out up to a depth of 2.20m below existing ground level and back-filled for 0.30m with well compacted CNS soil over which the Strip Footing can be located.

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 Open Excavations below Existing Ground Level (m)	Recommended CNS Back-Fill Thickness (m)	Depth of **Strip Footing** below Existing Ground Level (m)	Safe Bearing Capacity (t/m^2)	Elastic Settlements (mm)
Strip Footing	**2.20**	**0.30**	**1.90**	**07**	**48**

The computations for above are annexed to this report.

4.2.2 Deep Foundation System

In case, required structural foundation stresses are more than the safe bearing capacity presented in Clause 4.2.1, deep foundation system consisting of deep bored cast-in-situ piles can also be adopted.

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CHAPTER-5

CONCLUSION & RECOMMENDATION

1. Foundation systems presented in Clause 4.2.1 and 4.2.2, Chapter-IV can be adopted for foundation design purposes.

Open Foundation System

2. The safe bearing capacity of open foundation system is computed considering any rise in the ground water table up to or above the level of footing.
3. ***Care is taken in designing the type of open foundation system considering the uniformity in sub-soil stratifications at shallow depths, their shear strength characteristics and high plasticity nature of fine-grained soil.***
4. **No continuous single raft or mat shall be placed considering the underlying weak soil layers. (V.IMP)**
5. In case, ground water table is encountered within recommended depth of foundation system, provision shall be made to continuously bail the water out of the foundation pits to keep the surfaces of pit consolidated dry.
6. ***Hence, the open excavations shall be carried out up to a depth of 2.20m below existing ground level and back-filled for 0.30m with well compacted CNS soil over which the Strip Footing can be located.***

Deep Foundation System

7. *In case, required structural foundation stresses are more than the safe bearing capacity presented in Clause 4.2.1, deep foundation system consisting of deep bored cast-in-situ piles can be adopted*
8. *Deep Soil investigations are required to design the same.*

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Usage of Excavated Earth

9. **Excavated fine-grained soil encountered at shallow depths shall be in no case used for back filling purposes.**
10. **No structural units can be in direct contact of highly plastic fine-grained soil strata encountered at shallow depths. 0.20m thick well compacted CNS is recommended to be sand-witched in between.**

Type of CNS to Use

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

Other Recommendations

12. It is recommended to connect the grade beams against any differential settlements in between the individual footings.
13. As the chlorides and sulphates present in water sample are within the permissible limits, no special steel or cement is recommended to be used for foundation construction purposes.

5.1 Limitation:

This geo technical investigation has been carried out at locations in the site chosen by the client as per representing the entire site. The recommendations provided in this report are hence valid only for those test locations. However if there is any changes in sub-soil conditions and properties at places between or beyond the chosen test location , **Geo-Techno Consultants** may be contacted for further actions. If necessary fresh investigations will have to be carried out at such locations.

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3

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6.1 Soil Profile at BH-01 Location **G.W.L : 4.00**

Depth (m)	Description of Soil Stratigraphy	SPT - Details		Relative density / consistency
		Depth (m)	N-Value	
0.00m to 1.80m	Brownish Silty Sandy Clay	1.50	**10**	Med Stiff
1.80m To 10.50m	Black Greyish Silty Clay	3.00	**07**	Stiff
		4.50	**06**	
		6.00	**09**	
		7.50	**11**	
		9.00	**12**	
		10.50	**11**	

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6.2 Soil Profile at BH-02 Location **G.W.L : 5.00**

Depth (m)	Description of Soil Stratigraphy	SPT - Details		Relative density / consistency
		Depth (m)	N-Value	
0.00m to 1.50m	Brownish Silty Sandy Clay	1.50	**08**	Med Stiff
1.50m To 10.50m	Black Greyish Silty Clay	3.00	**05**	Stiff
		4.50	**07**	
		6.00	**10**	
		7.50	**12**	
		9.00	**11**	
		10.50	**12**	

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6.3 Soil Profile at BH-03 Location **G.W.L : 4.00**

Depth (m)	Description of Soil Stratigraphy	SPT - Details		Relative density / consistency
		Depth (m)	N-Value	
0.00m to 1.80m	Brownish Silty Sandy Clay	1.50	**12**	Med Stiff
1.80m To 19.00m	Black Greyish Silty Clay	3.00	**09**	Very Stiff
		4.50	**08**	
		6.00	**09**	
		7.50	**10**	
		9.00	**12**	
		10.50	**13**	
		12.00	**15**	
		14.00	**16**	
		16.00	**12**	
		18.00	**13**	

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19.00m To 21.00m	Black to Greyish Soft Clay	20.00	**02**	Very Soft
21.00m To 24.00m	Greyish to Blakc Stiff Silty Clay	22.00 24.00	**20** **35**	Med Hard
25.00m To 28.00m	Slated Rock	25.00	**>50**	Dense

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DESIGN OF OPEN FOUNDATION SYSTEM (Ref. BH-02)

1 COMPUTATION OF BEARING CAPACITY AS PER IS:6403

1.1 Geometrical Data :

Type of Foundation System:	Isolated Col. Footing	
R.L of the top of Borehole (m):	0.00	m
Depth of Open Foundation excavations below existing ground level (D_f):	2.20	m
Recommended Thickness of CNS back-fill:	0.30	m
Effective Depth of Foundation below existing ground level (D_f):	1.90	m
Width of Foundation (B):	1.50	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 :	7	
(considered based upon the density of the strata)		
Type of Shear Failure:	General	
Undrained Cohesion, Cu:	46.67	kPa

1.3 Design Parameters:

Bulk Density of Soil above the foundation detph (γ_{bulk})	16.00	kN/m^3
Effective Overburden pressure at foundation level (q)	11.40	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:

$S_c = 1.30$

$S_q = N/A$

$S_\gamma = N/A$

Depth Factors :

$D_c = 1.00$

$D_q = N/A$

D_γ = N/A

Inclination Factor:

I_c = 1.00

I_q = N/A

I_γ = N/A

1.4 Ultimate Bearing Capacity (Qu) :

$Qu = Cu*Nc*Sc*D_C*I_C+q*(Nq-1)*Sq*Dq*Iq + 0.5*B*\gamma*N\gamma*S\gamma*D\gamma*Ig*w'$

Q_u = 311.83 kPa

1.5 Safe Bearing Capacity (Qsafe) :

Factor of Safety (F.S.) :	2.50
Qsafe :	124.73 kPa
Recommended Safe Bearing Capacity:	70.00 kPa

1.6 Settlements

Since, the bearing strata are medium stiff fine-grained type, the settlements under the allowable safe bearing pressure 70kPa will be of immediate elastic nature. The elastic settlements corresponding to a safe bearing pressure of 70kPa and average SPT of 07 considering extent of pressure bulb below bottom level of footing are computed to be in the order of 48mm which is within the permissible limits of 50mm for Isolated Column Footings as per I.S:1904.

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DESIGN OF PILE FOUNDATION (Refer:BH-01)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Friction Pile-Bored CIS**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**380.0**	mm
Assumed R.L of E.G.L:	0.000	m
Length of pile below E.G.L.(l) :	**10.000**	m
R.L. of Bot. of Pile	-10.00	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 **Layer-I**

Type of Strata:	Silty Clay	
Average SPT of the strata,N:	10	
Bulk Density of the strata,γ:	17	kN/m^3
Undrained Cohesion, Cu:	66.66667	kPa
R.L of top of Strata:	0.00	m
R.L of bottom of Strata:	-2.50	m
Average Thickness of Strata,I_c:	2.50	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	17.50	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	8.75	kN/m^2
Adhesion Factor, α:	0.50	
Negative Skin Resistance of the pile,q_s:	99.48	kN
(q_s:α*Cu*pi()*d*Ic)		

1.2.1.2 **Layer-II**

Type of Strata:	Silty Sand	
Average SPT of the strata,N:	9	
Bulk Density of the strata,γ:	15	kN/m^3
Angle of Shearing Resistance,ϕ:	29.8	Deg.
R.L of top of Strata:	-2.50	m
R.L of bottom of Strata:	-5.50	m
Average Thickness of Strata,I_c:	3.00	m
Effective overburden pressure over the top of strata,σ_{top}:	17.50	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	32.50	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	25.00	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	51.28	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Silty Sand
Average SPT of the strata,N:	9

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Bulk Density of the strata,γ:	15	kN/m^3
Angle of Shearing Resistance,ϕ:	29.8	Deg.
R.L of top of Strata:	-5.50	m
R.L of bottom of Strata:	-8.50	m
Average Thickness of Strata,I_c:	3.00	m
Effective overburden pressure over the top of strata,σ_{top}:	32.50	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	47.50	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	40.00	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	82.04	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Silty Sand	
Average SPT of the strata,N:	15	
Bulk Density of the strata,γ:	15	kN/m^3
Angle of Shearing Resistance,ϕ:	31.5	Deg.
R.L of top of Strata:	-8.50	m
R.L of bottom of Strata:	-10.00	m
Average Thickness of Strata,I_c:	1.50	m
Effective overburden pressure over the top of strata,σ_{top}:	47.50	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	55.00	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	51.25	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	56.24	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

Ultimate Skin Resistance,q_s: 289.04 kN



1.2.2 Computation of End Bearing Resistance:

Ultimate End Bearing Resistance (Qp) Neglected for Friction Pile

1.3.0 **Ultimate Load Carrying Capacity (Qu=Qs+Q_p): 289.0 kN**

Safe Load Carrying Capacity (Qsafe =Qu/2.50): 115.6 kN

However, limit Q_{safe} to the structural capacity of pile: 110.0 kN

S.No.	Diameter of Pile (mm)	Safe Load Carrying Capacity (MT)	Safe Pull Out Capacity (MT)
1	380	11.0	11.0
2	400	12.0	12.0
3	450	13.0	13.0
4	500	15.0	15.0

DESIGN OF PILE FOUNDATION

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Pile — Bored Pile

1.1 Geometrical Data

Assumed Diameter of pile(D):	500.00	mm
Depth of Cutoff below E.G.L.	1.00	m
Length of pile below E.G.L.(l) :	24.00	m
Length of pile below Cutoff :	23.00	m

1.2 Vertical Load Carrying Capacity Design

1.2.1 Computation of Skin Resistance:

Layer-I

Type of Strata:	Clay	
Average SPT of the strata,N:	10.00	
Bulk Density of the strata,g:	18.00	kN/m^3
Undrained Shear Strength (Cu)	66.67	kPa
Depth of Top of Pile	0.00	m
Depth of bottom of Strata below E.G.L.:	21.00	m
Average Thickness of Strata,I_c:	21.00	m
Effective overburden pressure over the top of strata,s_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,s_{bottom}:	168.00	kN/m^2
Effective overburden pressure at the middle of the strata,s_{middle}:	84.00	kN/m^2
Adhesion Factor (Alpha)	0.70	
Skin Resistance of the pile,q_s: (Cu*pi*d*t1*Alpha)	1539.38	kN

Layer-II

Type of Strata:	Clay	
Corrected Average SPT of the strata,N:	27.00	
Bulk Density of the strata,g:	18.00	kN/m^3
Undrained Shear Strength (Cu)	180.00	kPa
Depth of top of Strata below E.G.L.:	21.00	m
Depth of bottom of Strata below E.G.L.:	25.00	m
Average Thickness of Strata,I_c:	4.00	m
Effective overburden pressure over the top of strata,s_{top}:	168.00	kN/m^2
Effective overburden pressure over the bottom of strata,s_{bottom}:	200.00	kN/m^2
Effective overburden pressure at the middle of the strata,s_{middle}:	184.00	kN/m^2
Adhesion Factor (Alpha)	0.30	
Skin Resistance of the pile,q_s: (Cu*pi*d*t1*Alpha)	339.29	kN
Ultimate Skin Resistance,q_{ult}:	**1878.67**	**kN**



1.2.2 Computation of End Bearing Resistance:

Type of Bearing Strata	Clay	
Cross-Sectional Area of pile,Ap:	0.20	m^2
SPT-value of the Bearing Strata (limited)	50.00	
Undrained Cohesion	333.50	kPa
Bearing Capacity Factor (Nc)	9.00	
Ultimate End Bearing Resistance (Qp)	**589.34**	**kN**

1.3.0 (Qp=Ap*Cu*Nc)

Ultimate Load Carrying Capacity (Qu=Qp)	**2468.02**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**987.21**	**kN**
Say Q_{safe}	**900.00**	**kN**

DESIGN OF PILE FOUNDATION

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Pile Bored Pile

1.1 Geometrical Data

Assumed Diameter of pile(D):	600.00	mm
Depth of Cutoff below E.G.L.	1.00	m
Length of pile below E.G.L.(l) :	24.00	m
Length of pile below Cutoff :	23.00	m

1.2 Vertical Load Carrying Capacity Design

1.2.1 Computation of Skin Resistance:

Layer-I

Type of Strata:	Clay	
Average SPT of the strata,N:	10.00	
Bulk Density of the strata,g:	18.00	kN/m^3
Undrained Shear Strength (Cu)	66.67	kPa
Depth of Top of Pile	0.00	m
Depth of bottom of Strata below E.G.L.:	21.00	m
Average Thickness of Strata,I_c:	21.00	m
Effective overburden pressure over the top of strata,s_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,s_{bottom}:	168.00	kN/m^2
Effective overburden pressure at the middle of the strata,s_{middle}:	84.00	kN/m^2
Adhesion Factor (Alpha)	0.70	
Skin Resistance of the pile,q_s: (Cu*pi*d*tl*Alpha)	1847.26	kN

Layer-II

Type of Strata:	Clay	
Corrected Average SPT of the strata,N:	27.00	
Bulk Density of the strata,g:	18.00	kN/m^3
Undrained Shear Strength (Cu)	180.00	kPa
Depth of top of Strata below E.G.L.:	21.00	m
Depth of bottom of Strata below E.G.L.:	25.00	m
Average Thickness of Strata,I_c:	4.00	m
Effective overburden pressure over the top of strata,s_{top}:	168.00	kN/m^2
Effective overburden pressure over the bottom of strata,s_{bottom}:	200.00	kN/m^2
Effective overburden pressure at the middle of the strata,s_{middle}:	184.00	kN/m^2
Adhesion Factor (Alpha)	0.30	
Skin Resistance of the pile,q_s: (Cu*pi*d*tl*Alpha)	407.15	kN
Ultimate Skin Resistance,q_{ult}:	**2254.41**	**kN**



1.2.2 Computation of End Bearing Resistance:

Type of Bearing Strata	Clay	
Cross-Sectional Area of pile,Ap:	0.28	m^2
SPT-value of the Bearing Strata (limited)	50.00	
Undrained Cohesion	333.50	kPa
Bearing Capacity Factor (Nc)	9.00	
Ultimate End Bearing Resistance (Qp)	**848.65**	**kN**
(Qp=Ap*Cu*Nc)		

1.3.0

Ultimate Load Carrying Capacity (Qu=Qp)	**3103.06**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1241.22**	**kN**
Say Q_{safe}	**1100.00**	**kN**

DESIGN OF PILE FOUNDATION

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Pile Bored Pile

1.1 Geometrical Data

Assumed Diameter of pile(D):	650.00	mm
Depth of Cutoff below E.G.L.	1.00	m
Length of pile below E.G.L.(l) :	24.00	m
Length of pile below Cutoff :	23.00	m

1.2 Vertical Load Carrying Capacity Design

1.2.1 Computation of Skin Resistance:

Layer-I

Type of Strata:	Clay	
Average SPT of the strata,N:	10.00	
Bulk Density of the strata,g:	18.00	kN/m^3
Undrained Shear Strength (Cu)	66.67	kPa
Depth of Top of Pile	0.00	m
Depth of bottom of Strata below E.G.L.:	21.00	m
Average Thickness of Strata,I_c:	21.00	m
Effective overburden pressure over the top of strata,s_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,s_{bottom}:	168.00	kN/m^2
Effective overburden pressure at the middle of the strata,s_{middle}:	84.00	kN/m^2
Adhesion Factor (Alpha)	0.70	
Skin Resistance of the pile,q_s: (Cu*pi*d*tl*Alpha)	2001.19	kN

Layer-II

Type of Strata:	Clay	
Corrected Average SPT of the strata,N:	27.00	
Bulk Density of the strata,g:	18.00	kN/m^3
Undrained Shear Strength (Cu)	180.00	kPa
Depth of top of Strata below E.G.L.:	21.00	m
Depth of bottom of Strata below E.G.L.:	25.00	m
Average Thickness of Strata,I_c:	4.00	m
Effective overburden pressure over the top of strata,s_{top}:	168.00	kN/m^2
Effective overburden pressure over the bottom of strata,s_{bottom}:	200.00	kN/m^2
Effective overburden pressure at the middle of the strata,s_{middle}:	184.00	kN/m^2
Adhesion Factor (Alpha)	0.30	
Skin Resistance of the pile,q_s: (Cu*pi*d*tl*Alpha)	441.08	kN
Ultimate Skin Resistance,q_{ult}:	**2442.27**	**kN**

1.2.2 Computation of End Bearing Resistance:

Type of Bearing Strata	Clay	
Cross-Sectional Area of pile,Ap:	0.33	m^2
SPT-value of the Bearing Strata (limited)	50.00	
Undrained Cohesion	333.50	kPa
Bearing Capacity Factor (Nc)	9.00	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*Cu*Nc)	**995.99**	**kN**

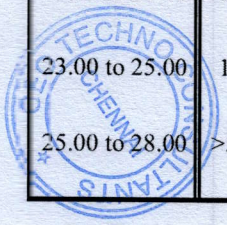
1.3.0

Ultimate Load Carrying Capacity (Qu=Qp)	**3438.26**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1375.31**	**kN**
Say Q_{safe}	**1200.00**	**kN**



Table 2.1: Laboratory Test Results on the Soil Samples

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 1.80	10	SS	Silty Sandy Clay	26	1.7	77	21	56	0.9	80	Stiff	0	0	0	12	11	77	CH
1.80 to 4.00	7	SS	Silty Clay	38	1.6	79	23	56	0.7	80	M.Stiff	0	0	0	0	12	88	CH
4.00 to 7.50	5	SS	Silty Clay	51	1.5	80	22	58	0.5	-	M.Stiff	0	0	0	0	19	81	CH
7.50 to 11.00	9	SS	Silty Clay	31	1.7	79	21	58	0.8	-	Stiff	0	0	0	0	21	79	CH
11.00 to 15.00	10	SS	Silty Clay	28	1.7	77	24	53	0.9	79	Stiff	0	0	0	0	23	77	CH
15.00 to 23.00	15	SS	Silty Clay	29	1.7	80	22	58	0.9	-	Stiff	0	0	0	0	21	79	CH
23.00 to 25.00	19	SS	Compacted Clay	25	1.8	85	28	57	1.1	-	V.Stiff	0	0	0	0	17	83	CH
25.00 to 28.00	>50	SS	Slate Rock	14	2.0	90	33	57	1.3	-	Hard	0	0	0	0	14	86	CH





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