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CLIENT	**ASSET TREE HOUSING, CHENNAI**
PROJECT	**PROPOSED CONSTRUCTION OF RESIDENTIAL APARTMENT (STILT+05) AT S.NO: 163/28, PLOT NO: 146, DEFENCE COLONY, 12TH CROSS STREET, NANDHAMBAKKAM VILLAGE, CHENNAI-600032, ALANDUR TALUK.**
TITLE	**GEOTECHNICAL INVESTIGATION REPORT**

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For Geo Mines Engineers Pvt. Ltd

Director

GEO MINES ENGINEERS (P) LTD. GMEPL Chennai

REV.	DATE	REPORT NUMBER	PREP. BY
0	04-08-2023	GMEPL/ASSET TREE HOUSING/247/2023-24	

DISCLAIMER

We've been asked to look into the ground and identify and quantify everything that mother nature has put thereand 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 it's 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

Asset Tree Housing, Chennai proposed to construct a **Residential Apartment (Stilt+05) at S.No: 163/28, Plot No:146, Defence Colony, 12th Cross Street, Nandambakkam Village, Alandur Taluk, Chennai-600032.**

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 Two Standard Soil investigation bore holes of 150mm diameter up to a depth of 12.00m below existing ground level 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:

Two 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 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 have been 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 samples were collected from the respective boreholes.

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 & 2.2.

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 & 2.2.

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. As no such type of soil strata encountered at the investigation locations, no such tests could be conducted.

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-2.3.

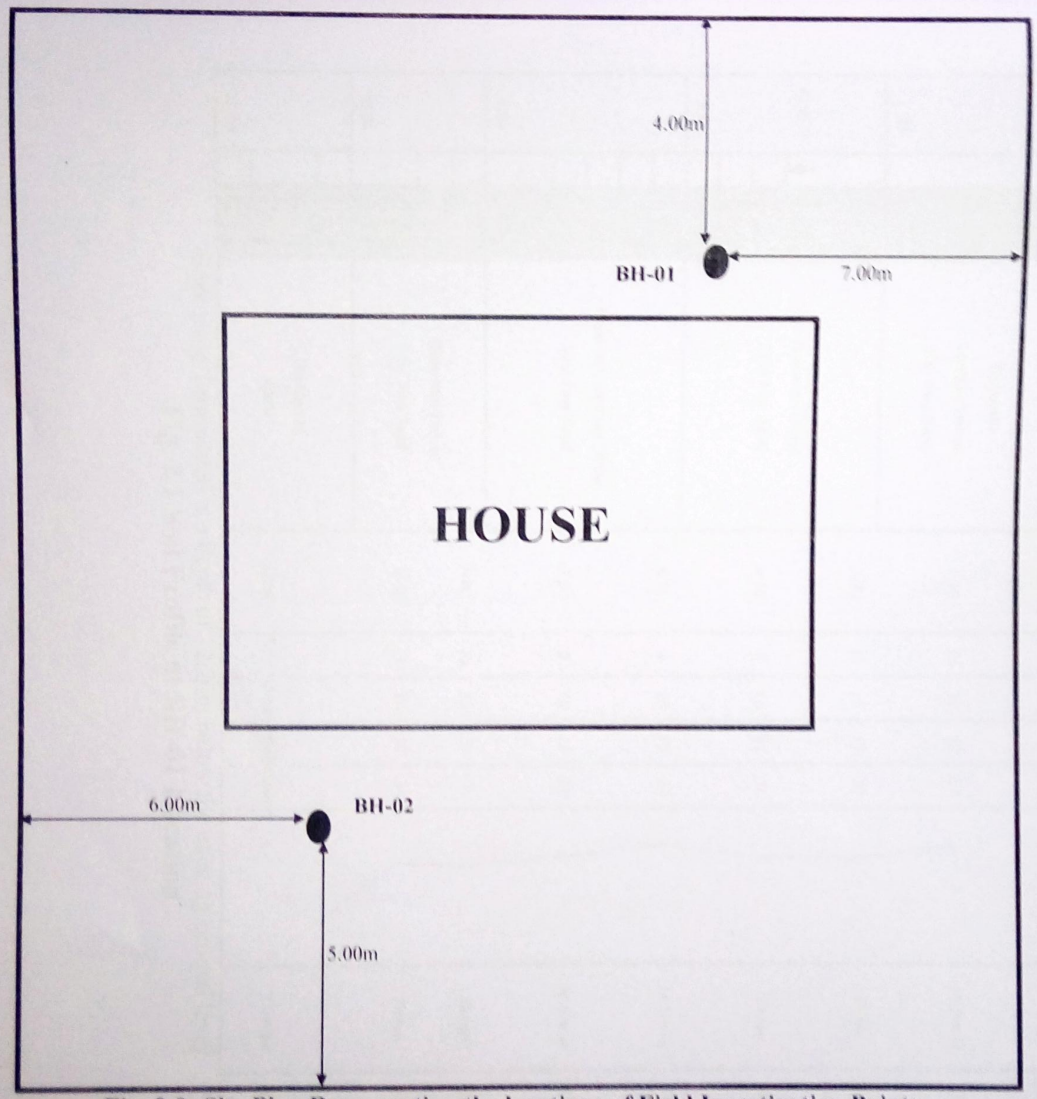


Fig. 2.0: Site Plan Representing the locations of Field Investigation Points

Project : Proposed Construction of Residential Apartment (Stilt+05) at S.No: 163/28, Plot No:146, Defence Colony, 12th Cross Street, Nandambakkam Village, Alandur Taluk, Chennai-600032.

Location: BH-01

Started On : 31/07/2023; Ended On : 31/07/2023 G.W.T: 4.00m below existing ground level

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details: Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value	ical Representation of 0 1 2 3 4 5 6 7 8 9	Relative Density/Consistency	Type of Sample
			Brownish Medium Dense Silty Fine Sand	1.50	10	12	12	24		M.Dense	SS
2.50				3.00	13	15	17	32		Dense	SS
G.W.T	↓		Brownish Dense Silty Fine Sand	4.50	8	14	17	31		Dense	SS
5.50				6.00	9	10	13	23		M.Dense	SS
			Brownish Medium Dense Silty Fine Sand	7.50	8	14	15	29		M.Dense	SS
8.50				9.00	10	16	20	36		Dense	SS
			Brownish Dense Silty Fine Sand	10.00	11	16	18	34		Dense	SS
10.50											
			Weathered Rock	12.00	SPT Hammer Rebounded					V.Dense	SS
12.20											

Bore Hole Terminated at a depth of 12.20m below the existing ground level

Fig. 2.1 Soil Profile at BH-01 Location

Project : Proposed Construction of Residential Apartment (Stilt+05) at S.No: 163/28, Plot No:146, Defence Colony, 12th Cross Street, Nandambakkam Village, Alandur Taluk, Chennai-600032.

Location: BH-02

Started On : 01/08/2023; Ended On : 01/08/2023 G.W.T: 4.00m below existing ground level

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details: Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value	ical Representation of 0 1 2 3 4 5 6 7 8 9	Relative Density/Consistency	Type of Sample
				1.50	8	10	15	25		M.Dense	SS
				3.00	10	15	15	30		M.Dense	SS
G.W.T			Brownish Medium Dense Silty Fine Sand	4.50	10	10	15	25		M.Dense	SS
				6.00	10	11	12	23		M.Dense	SS
				7.50	8	12	15	27		M.Dense	SS
				9.00	8	15	12	27		M.Dense	SS
9.50			Brownish Dense Silty Fine Sand	10.00	10	15	20	35		Dense	SS
10.50			Weathered Rock	12.00	SPT Hammer Rebounded					V.Dense	SS
12.20											

Bore Hole Terminated at a depth of 12.20m below the existing ground level

Fig. 2.2 Soil Profile at BH-02 Location

Table 2.1: Laboratory Test Results on the Soil Samples Collected from BH-01

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 2.50	24	SS	Silty Fine Sand	-	1.7	-	-	-	-	-	M.Dense	0	0	0	77	23	0	SM
2.50 to 5.50	31	SS	Silty Fine Sand	-	1.9	-	-	-	-	-	Dense	0	0	0	81	19	0	SM
5.50 to 8.50	26	SS	Silty Fine Sand	-	1.8	-	-	-	-	-	M.Dense	0	0	0	78	22	0	SM
8.50 to 10.50	35	SS	Silty Fine Sand	-	1.9	-	-	-	-	-	Dense	0	0	0	82	18	0	SM
10.50 to 12.20	>100	SS	Weathered Rock	-	2.0	-	-	-	-	-	V.Dense	31	19	25	22	3	0	SDR

Table 2.2: Laboratory Test Results on the Soil Samples Collected from BH-02

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 9.50	26	SS	Silty Fine Sand	-	1.8	-	-	-	-	-	M.Dense	0	0	0	78	22	0	SM
9.50 to 10.50	35	SS	Silty Fine Sand	-	1.9	-	-	-	-	-	Dense	0	0	4	80	16	0	SM
10.50 to 12.20	>100	SS	Weathered Rock	-	2.0	-	-	-	-	-	V.Dense	38	18	22	14	8	0	SDR

Table 2.3: Chemical Analysis Results conducted on Water Samples collected from BH-01 and BH-02

Location	Depth of Sample below E.G.L. (m)	pH	Chlorides (ppm)	Sulphates (ppm)
BH-01	4.50	6.87	300.13	142.81
BH-02	4.50	6.88	297.83	140.05

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 0.00m to 2.50m depth)**

Type of Strata	Silty Fine Sand
Colour	Brownish
Thickness of Layer	2.50m
SPT of the layer	24
Relative Density	Medium Dense
Angle of Shearing Resistance, ϕ	34.20^0

* **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	31
Relative Density	Dense
Angle of Shearing Resistance, ϕ	36.275^0

* **Layer-3 (from 5.50m to 8.50m depth)**

Type of Strata	Silty Fine Sand
Colour	Brownish
Thickness of Layer	3.00m
SPT of the layer	26
Relative Density	Medium Dense
Angle of Shearing Resistance, ϕ	34.80^0

* **Layer-4 (from 8.50m to 10.50m depth)**

Type of Strata	Silty Fine Sand

Colour	Brownish
Thickness of Layer	2.00m
SPT of the layer	35
Relative Density	Dense
Angle of Shearing Resistance, ϕ	37.375^0

* **Layer-5 (from 10.50m to 12.20m depth)**

Type of Strata	Weathered Rock
Colour	-
Thickness of Layer	1.70m
SPT of the layer	>100
Relative Density	Very Dense
Angle of Shearing Resistance, ϕ	42.50^0

Ground Water

Ground water table was encountered at a depth of 4.00m below the existing ground level during the last week of July 2023.

3.1.2 Soil Profile at BH-02 Location
(At BH-02 Location, as presented in Site plan)

* **Layer-1 (from 0.00m to 9.50m depth)**

Type of Strata	Silty Fine Sand
Colour	Brownish
Thickness of Layer	9.50m
SPT of the layer	26
Relative Density	Medium Dense
Angle of Shearing Resistance, ϕ	34.80^0

* **Layer-2 (from 9.50m to 10.50m depth)**

Type of Strata	Silty Fine Sand
Colour	Brownish
Thickness of Layer	1.00m
SPT of the layer	35
Relative Density	Dense
Angle of Shearing Resistance, ϕ	37.375^0

* **Layer-3 (from 10.50m to 12.20m depth)**

Type of Strata	Weathered Rock
Colour	-
Thickness of Layer	1.70m
SPT of the layer	>100
Relative Density	Very Dense
Angle of Shearing Resistance, ϕ	42.50^0

Ground Water

Ground water table was encountered at a depth of 4.00m below the existing ground level during the first week of August 2023.

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 coarse-grained type and good from both shear strength characteristics and deformation considerations to act as bearing strata for proposed impending loads from structure.

If coarse-grained soil strata encountered at shallow depths below existing ground level are considered as bearing strata, the safe bearing capacity of open foundation system will be a function of least dimension of footing and effective surcharge over the bearing strata.

Further, the Weathered Rock soil strata encountered below 10.50m depths from present existing ground level (Ref. BH-02) can also be considered as good end bearing strata for proposed impending loads from structure.

Considering the above, suitable foundation systems are presented below.

4.2 Foundation System

4.2.1 Open Foundation System (BH-02)

Considering the bearing strata characteristics, the open foundation system can be isolated column footing type located at a least depth of 2.20m below present existing ground level (E.G.L) can be adopted.

The safe bearing capacity of open foundation at least recommended depth of 2.20m below E.G.L is computed and presented below which can be adopted for foundation design purposes.

S. No.	Type of Open Foundation System	Total Depth of Excavations below Present Existing Ground Level (m)	Observed Thickness of Fill (m)	Depth of Isolated Column Footing below Natural Ground Level (m)	Type of Bearing Strata	Safe Bearing Capacity (MT/m^2)	Elastic Settlements <50mm (mm)
1	Isolated Column Footing	2.20	0.00	2.20	Silty Fine Sand	20	40

The computations for above are annexed to this report.

4.2.2 Deep Foundation System-12.00m Long Bored Cast-in-Situ Friction cum End Bearing Piles (Ref. BH-02)

In case, the impending foundation stresses are more than the recommended safe bearing capacity of the recommended soil bearing strata as presented in Clause 4.2.1 (above), deep foundation system consisting of 12.00m long bored cast-in-situ Friction cum End Bearing Piles can also be adopted.

Piles shall be drilled through DMC (direct mud circulation) technique.

For four different diameters, the safe load carrying capacities of 12.00m long bored cast-in-situ Friction cum End Bearing Piles are computed and presented below which can be adopted for foundation design purposes.

S. No	Type of Installation of Pile	Type of Pile Head Group	Length of Pile below Existing Ground Level (m)	Diameter of Pile (mm)	Safe Load Carrying Capacity (MT)	Safe Pull Out Capacity (MT)
1	Bored Cast-in-Situ	Fixed	12.00	400	50	30
2				450	60	33
3				500	70	37
4				550	80	41

The computations of safe load carrying capacity for 400mm diameter and 12.00m long bored cast-in-situ Friction cum End Bearing pile are annexed to this report.

CHAPTER5

CONCLUSIONS & RECOMMENDATIONS

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

OPEN FOUNDATION SYSTEM

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 footing.
3. Care shall be taken so that the ultimate bearing strata are none other than recommended **"Medium Dense Silty Fine Sand"** type.
4. Excavated coarse-grained soil encountered at shallow depths can be used for back filling purposes.

Open Foundation Depths & Foundations Restrictions (if any)

5. Depth of open excavations below present existing ground level shall be 2.20m.
6. Observed Thickness of filled up soil @ Site is 0.00m.
7. Depth of Isolated Column Footing below natural ground level will be 2.20m.

Other Recommendations

8. It is recommended to connect the grade beams so that the structure can act as a single unit against any differential settlements in between the individual footings.
9. Special provisions to contain any lateral collapse of soil from the walls excavated foundation pits are required up to the recommended depths of open foundation system.
10. In case, ground water table is encountered within the recommended depths of foundation system, the same shall be bailed out continuously to keep the sub-grade well consolidated.

Deep Foundation System

11. *Care shall be taken so that the ultimate end bearing soil strata are none other than recommended "Weathered Rock" type. The same shall be reaffirmed by*

our Geotechnical Engineer during foundation laying works are under progress.

12. Suitable pile load tests (as per I.S: 2911, part-IV) shall be performed to re-affirm the presented safe load carrying capacities and to arrive at the allowable load carrying capacities of piles under considerations and also sustainable as their structural capacities.
13. **Pile cap can be located on 0.30m thick well compacted existing ground surface.**
14. **Piles shall be grouped according to the column design load requirements.**
15. Safe load carrying capacities of piles shall be limited to their structural capacities.
16. Recommended Length of Pile shall be taken from pile cut-off level.

General

17. As the chlorides and sulphates present in water samples are within the permissible limits, no special steel or cement is recommended to be used for **open** foundation construction purposes.
18. **It is recommended to sample the water from an open well or dug well at different deeper level intervals and tested to arrive at the chemical parameters as per the requirements and to determine especially the chlorides and sulphates content to derive the cement and steel composition for deep foundation system.**

For Geo Mines Engineers Pvt Ltd

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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 Column Footing	
R.L of the top of Borehole (m):	0.00	m
Depth of Foundation below existing ground level (D_f):	2.20	m
Anticipated Depth of Soil Liquefaction:	0.00	m
Effective Depth of Foundation below natural ground level (D_f):	2.20	m
Design Width of Foundation (B):	1.00	m
Thickness of Foundation (T) :	0.25	m

1.2 Soil Data :

Type of Bearing Strata : Silty Fine Sand

Design SPT-value of the Bearing Strata : 25

(considered based upon the density of the strata)

Type of Shear Failure: General

Angle of Shearing Resistance - Limited to a Maximum of: 34.50 Deg.

1.3 Design Parameters:

Bulk Density of Soil above the foundation depth (γ_{bulk}) 15.50 kN/m^3

Effective Overburden pressure at foundation level (q) 12.10 kPa

Water Table Correction Factor (w') 0.50

Bearing Capacity Factors:

N_c = N/A

N_q = 31.81

N_γ = 45.47

Shape Factors:

S_c = N/A

S_q = 1.69

S_γ = 0.60

Depth Factors :

D_c = N/A

D_q = 1.00

$D_\gamma = 1.00$

Inclination Factor:

$I_c = N/A$

$I_q = 1.00$

$I_\gamma = 1.00$

1.4 Ultimate Bearing Capacity (Qu) :

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

$Q_u =$ 755.15 kPa

1.5 Safe Bearing Capacity (Qsafe) :

Factor of Safety (F.S.) :	2.50
Qsafe :	302.06 kPa
Recommended Safe Bearing Capacity:	200.00 kPa

1.6 Settlements

Since, the bearing strata are coarse-grained type, the settlements under the allowable safe bearing pressure 200kPa will be of immediate elastic nature. The elastic settlements corresponding to a safe bearing pressure of 200kPa and average SPT of 25 considering extent of pressure bulb below bottom level of footing are computed to be in the order of 40mm which is within the permissible limits of 50mm for isolated column footing as per I.S:1904.

DESIGN OF PILE FOUNDATION (Ref. BH-02)

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

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**400.0** mm
Assumed R.L of E.G.L:	0.000 m
Length of pile below E.G.L.(l) :	**12.000** m
R.L. of Bot. of Pile	-12.00 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 Fine Sand	
Average SPT of the strata,N:	26	
Bulk Density of the strata,γ:	18	kN/m^3
Angle of Shearing Resistance,ϕ:	34.8	Deg.
R.L of top of Strata:	0.00	m
R.L of bottom of Strata:	-9.50	m
Average Thickness of Strata,I_c:	9.50	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}:	76.00	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	38.00	kN/m^2
Coeff. Of Earth Pressure, k:	1.50	
Skin Resistance of the pile,q_s:	472.94	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

1.2.1.2

Layer-II

Type of Strata:	Silty Fine Sand	
Average SPT of the strata,N:	35	
Bulk Density of the strata,γ:	19	kN/m^3
Angle of Shearing Resistance,ϕ:	37.375	Deg.
R.L of top of Strata:	-9.50	m
R.L of bottom of Strata:	-10.50	m
Average Thickness of Strata,I_c:	1.00	m
Effective overburden pressure over the top of strata,σ_{top}:	76.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	85.00	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	80.50	kN/m^2
Coeff. Of Earth Pressure, k:	2.00	
Skin Resistance of the pile,q_s:	154.54	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

1.2.1.3

Layer-III

Type of Strata: Weathered Rock

Average SPT of the strata,N:	60	
Bulk Density of the strata,γ:	20	kN/m^3
Angle of Shearing Resistance,ϕ:	42.5	Deg.
R.L of top of Strata:	-10.50	m
R.L of bottom of Strata:	-11.00	m
Average Thickness of Strata,I_c:	0.50	m
Effective overburden pressure over the top of strata,σ_{top}:	85.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	90.00	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	87.50	kN/m^2
Coeff. Of Earth Pressure, k:	2.50	
Skin Resistance of the pile,q_s:	125.94	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		
Ultimate Skin Resistance,q_s:	**753.43**	**kN**

1.2.2 Computation of End Bearing Resistance:

Type of Bearing Strata	Weathered Rock	
Cross-Sectional Area of pile,Ap:	0.126	m^2
R.L of bottom of pile:	-12.00	
Minimum SPT-value of the Bearing Strata	60	
Angle of Shear Resistance, ϕ:	42.50	Deg.
Effective Overburden Pressure, q:	24.00	kPa
Bearing Capacity Factor(Nq)	220.00	
Ultimate End Bearing Resistance (Qp)	**663.5**	**kN**
(Qp=Ap*q*Nq)		

1.3.0	**Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)**	**1416.9** kN
	Safe Load Carrying Capacity (Qsafe =Qu/2.50)	**566.8** kN
	However, limit Q_{safe} to the structural capacity of pile:	**500.0** kN



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