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CLIENT	SREEROSH PROPERTIES (P) LTD. CHENNAI
PROJECT	PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING (STILT+05) AT DOOR NO: 67(28), EARLIER NO: 4A, TAYLORS ROAD, KILPAUK, CHENNAI-600010.COMPRISED IN O.S.NO: 272, R.S. NO:154/6 AS PER PATTA R.S NO: 154/183 OF BLOCK NO: 13, EGMORE VILLAGE, EGMORE TALUK
TITLE	GEOTECHNICAL INVESTIGATION REPORT

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For Geo Mines Engineers Pvt Ltd

Director

REV.	DATE	REPORT NUMBER	PREP. BY
0	18-12-2023	GMEPL/SREEROSH PROPERTIES (P) LTD/432/2023-24	

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.

GEOMINES ENGINEERS (P) LTD.
GMEPL
Chennai

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CHAPTER-1

INTRODUCTION

1.0 Preamble

Sreerosh Properties (P) Ltd, Chennai proposed to construct a **Residential Building (Stilt+05) at Door No: 67(28), Earlier No: 4A, Taylors Road, Kilpauk, Chennai-600010.Comprised in O.S.No: 272, R.S.No: 154/6 as per patta R.S.No: 154/183 of Block No: 13, Egmore Village, Egmore Taluk.** 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 20.00m 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 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 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. 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 & 2.2.

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.

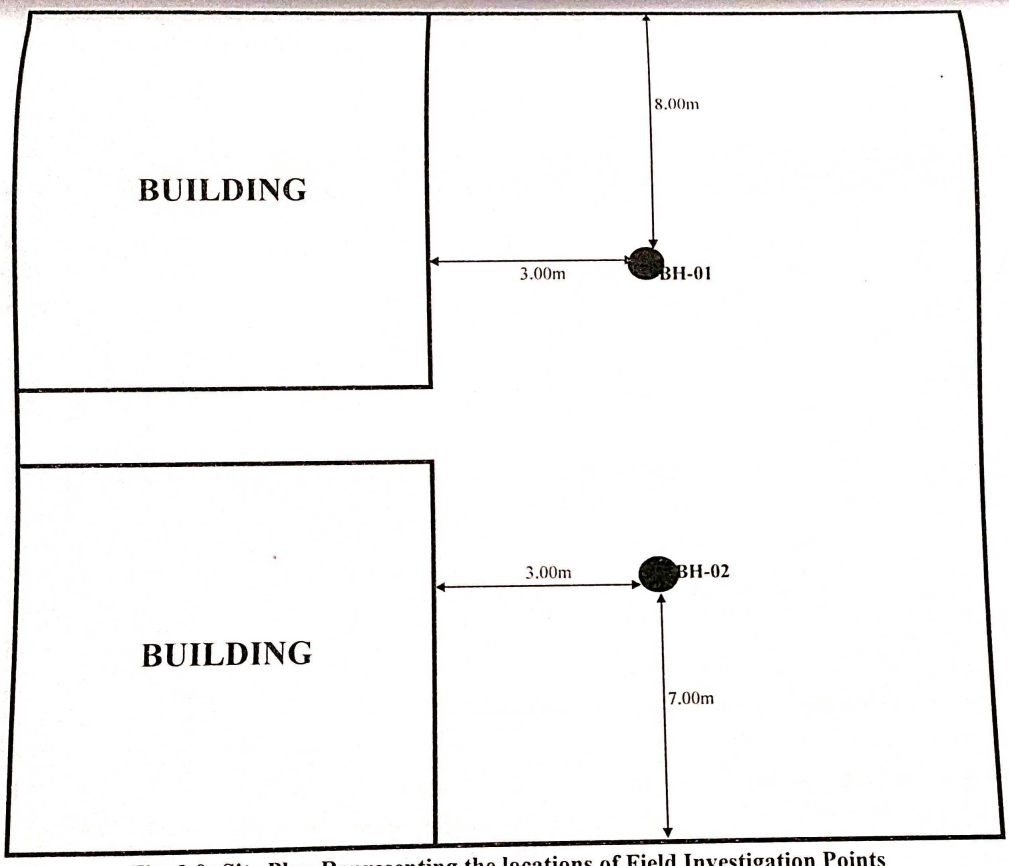


Fig. 2.0: Site Plan Representing the locations of Field Investigation Points

Project : Proposed Construction of Residential Building (Stilt+05) at Door No: 67(28), Earlier No: 4A, Taylors Road, Kilpauk, Chennai-600010.Comprised in O.S.No: 272, R.S.No: 154/6 as per patta R.S.No: 154/183 of Block No: 13, Egmore Village, Egmore Taluk

Location: BH-01

Started On : 13/12/2023; Ended On : 14/12/2023 G.W.T. 1.00m below existing ground level

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	Depth of SPT below E.G.L (m)	SPT - Details 0-15 cm	15-30 cm	30-45 cm	N-Value	Graphical Representation ## 1 2 3 4 5 6 7 8 9	Relative Density/Consistency	Type of Sample
G.W.T			Brownish Loose Silty Clayey Fine Sand	1.50	3	3	4	7		Loose	SS
				3.00	4	4	5	9		Loose	SS
4.00			Brownish Loose Silty Fine Sand	4.50	4	5	8	13		Loose	SS
5.50			Brownish Medium Dense Silty Fine Sand	6.00	5	7	9	16		M Dense	SS
7.00			Greyish Loose Silty Fine Sand	7.50	3	3	4	7		Loose	SS
				9.00	5	5	6	11		Loose	SS
11.00			Greyish Medium Dense Silty Fine Sand	10.00	5	6	6	12		Loose	SS
				12.00	8	10	12	22		M Dense	SS
15.00			Greyish Dense Silty Fine Sand	14.00	9	12	16	28		M Dense	SS
				16.00	11	14	19	33		Dense	SS
18.50			Greenish to Greyish Hard Silty Sandy Clay mixed with lime stone	18.00	12	17	23	40		Dense	SS
20.20				20.00	36	09cms Penetration for 50 Blows				Hard	SS

Bore Hole Terminated at a depth of 20.20m below the existing ground level

Fig. 2.1 Soil Profile at BH-01 Location

Project : Proposed Construction of Residential Building (Stilt+05) at Door No: 67(28), Earlier No: 4A, Taylors Road, Kilpauk, Chennai-600010.Comprised in O.S.No: 272, R.S.No: 154/6 as per patta R.S.No: 154/183 of Block No: 13, Egmore Village, Egmore Taluk.

Location: BH-02

Started On : 14/12/2023; Ended On : 15/12/2023 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: Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value	Graphical Representation ## 1 2 3 4 5 6 7 8 9	Relative Density/Consistency	Type of Sample
G.W.T			Brownish Loose Silty Clayey Fine Sand	1.50	3	3	4	7		Loose	SS
2.00				3.00	4	5	5	10		Loose	SS
			Brownish Loose Silty Fine Sand	4.50	5	5	8	13		Loose	SS
6.00				6.00	3	4	5	9		Loose	SS
				7.50	3	4	4	8		Loose	SS
			Greyish Loose Silty Fine Sand	9.00	2	2	3	5		Loose	SS
				10.00	2	3	3	6		Loose	SS
11.00											
			Greyish Medium Dense Silty Fine Sand	12.00	9	10	10	20		M Dense	SS
13.00											
				14.00	12	14	17	31		Dense	SS
			Greyish Dense Silty Clayey Fine Sand	16.00	15	17	22	39		Dense	SS
				18.00	18	22	24	46		Dense	SS
18.50											
			Greenish to Greyish Hard Silty Sandy Clay mixed with lime stone	20.00	32	98cms Penetration for 50 Blows				Hard	SS
20.20											

Bore Hole Terminated at a depth of 20.20m below the existing ground level

Fig. 2.2 Soil Profile at BH-02 Location

Table 2.1: Laboratory Test Result on the Soil Sample 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 4.00	8	SS	Silty Clayey Fine Sand	-	1.5	-	-	-	-	-	Loose	0	0	0	61	14	25	SM
4.00 to 5.50	13	SS	Silty Fine Sand	-	1.5	-	-	-	-	-	Loose	0	0	7	73	20	0	SM
5.50 to 7.00	16	SS	Silty Fine Sand	-	1.6	-	-	-	-	-	M.Dense	0	0	0	78	22	0	SM
7.00 to 11.00	10	SS	Silty Fine Sand	-	1.5	-	-	-	-	-	Loose	0	0	11	70	19	0	SM
11.00 to 15.00	25	SS	Silty Fine Sand	-	1.7	-	-	-	-	-	M.Dense	0	0	0	81	19	0	SM
15.00 to 18.50	36	SS	Silty Fine Sand	-	1.9	-	-	-	-	-	Dense	0	0	0	83	17	0	SM
18.50 to 20.20	>100	SS	Silty Sandy Clay mixed with lime stone	14	2.0	33	25	8	2.38	-	Hard	14	0	0	14	11	61	CL

Table 2.2: Laboratory Test Result on the Soil Sample 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 2.00	7	SS	Silty Clayey Fine Sand	-	1.5	-	-	-	-	-	Loose	0	0	0	69	13	18	SM
2.00 to 6.00	11	SS	Silty Fine Sand	-	1.5	-	-	-	-	-	Loose	0	0	11	68	21	0	SM
6.00 to 11.00	7	SS	Silty Fine Sand	-	1.5	-	-	-	-	-	Loose	0	0	6	66	28	0	SM
11.00 to 13.00	20	SS	Silty Fine Sand	-	1.6	-	-	-	-	-	M.Dense	0	0	0	83	17	0	SM
13.00 to 18.50	38	SS	Silty Clayey Fine Sand	-	1.9	-	-	-	-	-	Dense	0	0	0	70	13	17	SM
18.50 to 20.20	>100	SS	Silty Sandy Clay mixed with lime stone	15	2.0	34	25	9	2.11	-	Hard	19	0	0	13	19	49	CL

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

Location	Depth of Sample below E.G.L. (m)	pH	Chlorides (ppm)	Sulphates (ppm)
BH-01	3.00	6.89	309.22	193.82
BH-02	3.00	6.88	313.68	193.83

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 Clayey Fine Sand
Colour	Brownish
Thickness of Layer	4.00m
SPT of the layer	08
Relative Density	Loose
Angle of Shearing Resistance, ϕ	29.60^0

* **Layer-2 (from 4.00m to 5.50m depth)**

Type of Strata	Silty Fine Sand
Colour	Brownish
Thickness of Layer	1.50m
SPT of the layer	13
Relative Density	Loose
Angle of Shearing Resistance, ϕ	30.90^0

* **Layer-3 (from 5.50m to 7.00m depth)**

Type of Strata	Silty Fine Sand
Colour	Brownish
Thickness of Layer	1.50m
SPT of the layer	16
Relative Density	Medium Dense
Angle of Shearing Resistance, ϕ	31.80^0

* **Layer-4 (from 7.00m to 11.00m depth)**	
Type of Strata	Silty Fine Sand
Colour	Greyish
Thickness of Layer	4.00m
SPT of the layer	10
Relative Density	Loose
Angle of Shearing Resistance, ϕ	30.00^0
* **Layer-5 (from 11.00m to 15.00m depth)**	
Type of Strata	Silty Fine Sand
Colour	Greyish
Thickness of Layer	4.00m
SPT of the layer	25
Relative Density	Medium Dense
Angle of Shearing Resistance, ϕ	34.50^0
* **Layer-6 (from 15.00m to 18.50m depth)**	
Type of Strata	Silty Fine Sand
Colour	Greyish
Thickness of Layer	3.50m
SPT of the layer	36
Relative Density	Dense
Angle of Shearing Resistance, ϕ	37.65^0
* **Layer-7 (from 18.50m to 20.20m depth)**	
Type of Strata	Silty Sandy Clay mixed with lime stone
Colour	Greenish to Greyish
Thickness of Layer	1.70m
SPT of the layer	>100
Consistency	Hard
Un-drained Cohesion, Cu	666.66kPa

Ground Water

Ground water table was encountered at a depth of 1.00m below the existing ground level during the third week of December 2023.

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 2.00m depth)**	
Type of Strata	Silty Clayey Fine Sand
Colour	Brownish
Thickness of Layer	2.00m
SPT of the layer	07
Relative Density	Loose
Angle of Shearing Resistance, ϕ	29.40^0
* **Layer-2 (from 2.00m to 6.00m depth)**	
Type of Strata	Silty Fine Sand
Colour	Brownish
Thickness of Layer	4.00m
SPT of the layer	11
Relative Density	Loose

Angle of Shearing Resistance, ϕ	30.30^0
* **Layer-3 (from 6.00m to 11.00m depth)**	
Type of Strata	Silty Fine Sand
Colour	Greyish
Thickness of Layer	5.00m
SPT of the layer	07
Relative Density	Loose
Angle of Shearing Resistance, ϕ	29.40^0
* **Layer-4 (from 11.00m to 13.00m depth)**	
Type of Strata	Silty Fine Sand
Colour	Greyish
Thickness of Layer	2.00m
SPT of the layer	20
Relative Density	Medium Dense
Angle of Shearing Resistance, ϕ	33.00^0
* **Layer-5 (from 13.00m to 18.50m depth)**	
Type of Strata	Silty Clayey Fine Sand
Colour	Greyish
Thickness of Layer	5.50m
SPT of the layer	38
Relative Density	Dense
Angle of Shearing Resistance, ϕ	38.20^0
* **Layer-6 (from 18.50m to 20.20m depth)**	
Type of Strata	Silty Sandy Clay mixed with lime stone
Colour	Greenish to Greyish
Thickness of Layer	1.70m
SPT of the layer	>100
Consistency	Hard
Un-drained Cohesion, Cu	666.66kPa

Ground Water

Ground water table was encountered at a depth of 1.00m below the existing ground level during the third week of December 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 weak from both shear strength characteristics and deformation considerations and hence cannot be considered as bearing strata for proposed impending loads from structure.

However, the refusal soil strata (SPT>60) encountered below a uniform depth of 18.50m below existing ground level can be considered as good end bearing strata for proposed impending loads from structure.

Considering the above, suitable foundation system is presented below.

4.2. Foundation System

4.2.1 Deep Foundation System-20.00m Long Bored Cast-in-Situ Friction cum End Bearing Piles

Considering the weak shear strength characteristics of the sub-soil strata encountered at the investigation locations @ shallow depths, deep foundation system consisting of 20.00m long bored cast-in-situ Friction cum End Bearing Piles can be adopted.

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

For four different diameters, the safe load carrying capacities of 20.00m 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	20.00	500	80	68
2				550	90	75
3				600	100	81
4				650	110	88

The computations of safe load carrying capacity for 500mm diameter and 20.00m long bored cast-in-situ Friction cum End Bearing pile are annexed to this report.

CHAPTER-5

CONCLUSIONS & RECOMMENDATIONS

General

1. Deep foundation system presented in Clause 4.2.1, Chapter-IV can be adopted for foundation design purposes.

Design of Pile and Pile Load Test

2. Suitable pile load tests (as per I.S: 2911, part-IV) shall be performed to confirm the presented theoretical safe load carrying capacities and the same shall be taken as allowable load carrying capacities of piles under consideration and attached to detailed project report.
3. Test pile shall be loaded to 2.50 times of safe load carrying capacity of a particular diameter pile as presented in this soil Geotechnical report.
4. Pile load test shall be terminated at the total load for which the settlements of pile under testing is 2% of diameter of pile.
5. Allowable load carrying capacity of pile under consideration can be taken as $2/3^{rd}$ of total load for which the settlement of test pile are 2% of diameter of pile.

End Bearing Strata

6. *Care shall be taken so that the ultimate end bearing soil strata are none other than recommended refusal strata encountered in the form of "Silty Sandy Clay mixed with lime stone" type. The same shall be reaffirmed by our Geotechnical Engineer during foundation laying works are under progress.*

Miscellaneous

7. Pile cap could have been located over 0.30m thick well compacted ground replaced CNS (Cohesive Non-Swelling) soil surface.
8. Piles should be grouped according to the column design load requirements.
9. Allowable load carrying capacities of piles should have been limited to their structural capacities.

10. CNS can be non-plastic soil material like clean river sand or sand-gravels mix or M-Sand, etc. that shall be well compacted to achieve more than 95% of laboratory proctor density parameters.

Chemical Analysis and additional Recommendations

11. As the chlorides and sulphates present in the water samples are within the permissible limits, no special steel or cement is required to be used for open foundation construction purposes (if adopted). **However, it is recommended to sample the water samples at different intervals from an open well or borewell and test for the desired parameters as per the required usages and also to understand that the water can be used for deep foundation construction purposes.**

For Geo Mines Engineers Pvt Ltd

Director

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DESIGN OF PILE FOUNDATION (Refer BH-02)

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

1.0 Type of Installation of Pile

1.1 Geometrical Data

		Bored Cast in Situ
Assumed Diameter of pile(D):	500.0	mm
Assumed R.L of E.G.L:	0.000	m
Length of pile below E.G.L.(l) :	20.000	m
R.L. of Bot. of Pile	-20.00	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 Clayey Fine Sand	
Average SPT of the strata,N:	7	
Bulk Density of the strata,γ:	15	kN/m^3
Angle of Shearing Resistance,ϕ:	29.4	Deg.
R.L of top of Strata:	0.00	m
R.L of bottom of Strata:	-2.00	m
Average Thickness of Strata,I_c:	2.00	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}:	10.00	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	5.00	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	8.85	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:	11	
Bulk Density of the strata,γ:	15	kN/m^3
Angle of Shearing Resistance,ϕ:	30.3	Deg.
R.L of top of Strata:	-2.00	m
R.L of bottom of Strata:	-6.00	m
Average Thickness of Strata,I_c:	4.00	m
Effective overburden pressure over the top of strata,σ_{top}:	10.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	30.00	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	20.00	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	73.43	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

1.2.1.3

Layer-III

Type of Strata:	Silty Fine Sand	
Average SPT of the strata,N:	7	
Bulk Density of the strata,γ:	15	kN/m^3
Angle of Shearing Resistance,ϕ:	29.4	Deg.
R.L of top of Strata:	-6.00	m
R.L of bottom of Strata:	-11.00	m
Average Thickness of Strata,I_c:	5.00	m
Effective overburden pressure over the top of strata,σ_{top}:	30.00	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}:	42.50	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	188.08	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

1.2.1.4

Layer-IV

Type of Strata:	Silty Fine Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-11.00	m
R.L of bottom of Strata:	-13.00	m
Average Thickness of Strata,I_c:	2.00	m
Effective overburden pressure over the top of strata,σ_{top}:	55.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	67.00	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	61.00	kN/m^2
Coeff. Of Earth Pressure, k:	1.50	
Skin Resistance of the pile,q_s:	186.68	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

1.2.1.5

Layer-V

Type of Strata:	Silty Clayey Fine Sand	
Average SPT of the strata,N:	38	
Bulk Density of the strata,γ:	19	kN/m^3
Angle of Shearing Resistance,ϕ:	38.2	Deg.
R.L of top of Strata:	-13.00	m
R.L of bottom of Strata:	-18.50	m
Average Thickness of Strata,I_c:	5.50	m
Effective overburden pressure over the top of strata,σ_{top}:	67.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	116.50	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	91.75	kN/m^2
Coeff. Of Earth Pressure, k:	2.00	

Skin Resistance of the pile,q_s: 1247.53 kN
(q_s=σ*k*tanϕ* pi()*d*lc)

1.3.2 Computation of End Bearing Resistance:

Ultimate Skin Resistance,q_s: 1704.57 kN

Type of Bearing Strata: Silty Sandy Clay mixed with lime stone
Cross-Sectional Area of pile,Ap: 0.196 m^2
Minimum SPT-value of the Bearing Strata: -20.00
Undrained Cohesion, Cu=(q_u/2): 60 kPa
Bearing Capacity Factor(Nc): 9.00
Ultimate End Bearing Resistance (Qp): 706.9 kN
(Qp=Ap*Cu*Nc)

1.3.0 **Ultimate Load Carrying Capacity (Qu=Qp+Qs**: 2411.4 kN
Safe Load Carrying Capacity (Qsafe =Qu/2.5): 964.6 kN
However, limit Q_{safe} to the structural capacity of pile: 800.0 kN

Depth of fixity of Pile

Length of Pile

L_1 = 0 cm

[since the pile cast at ground level with fixed head]

Characteristic strength of Concrete (Assume) f_{ck} = 30 N/mm^2

Diameter of Pile D = 50 cm

Modulas of Elasticity of Concrete (E) $5000 \times \sqrt{f_{ck}} = 5000 \times \sqrt{30}$ N/mm^2

[As per IS 456 :2000 pg. no : 16]

= 273861.28 Kg/cm^2

Moment of Inertia of Pile (I) $\frac{\pi \times D^4}{64} = \frac{3.14 \times 45^4}{64}$ cm^4

= 306640.6 cm^4

K1 (constant) = 0.146 Kg/cm^2

[As per IS : 2911 (Part 1 / Sec 1) - appendix-B]

T (constant) = $\sqrt[5]{\frac{(E \times I)}{K1}}$

[As per IS : 2911 (Part 1 / Sec 1) - appendix-B, Cl.5.5.2]

= 224.89 cm

Hence L_1 / R = $\frac{L_1}{T}$

[As per IS : 2911 (Part 1 / Sec 1) - appendix-B, Cl.5.5.2]

= 0.0E+00

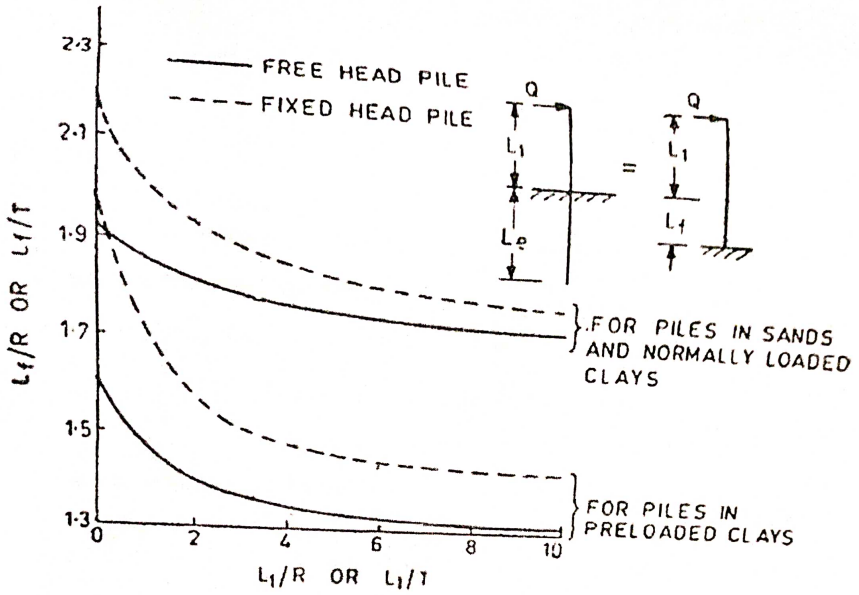


FIG. 2 DETERMINATION OF DEPTH FIXITY

For fixed head pile

$$\frac{L_1}{R} = 2.2$$

[As per IS : 2911 (Part 1 / Sec 1) - appendix-B, Cl.5.5.2 fig 2]

Length of fixity

L_f = 494.75 cm [As per IS : 2911 (Part 1 / Sec 1) - appendix-B, Cl.5.5.2]

= 4.95 m

Embedded Length

Le > 4 x R [As per IS : 2911 (Part 1 / Sec 1) - appendix-B, Cl.5.5.2]

> 9.0 m

Calculation of Lateral capacity of pile

(From IS:2911, Part 1 / Sec. 1, Cl.5.5.2 - Appendix A)

$$\text{Lateral capacity , } Q = \frac{12\,E\,I\,Y}{(L_1 + L_f)^3}$$ for Fixed Head Pile

Where ,

Y = Lateral deflection of pile = 5 mm (As per IS2911, part1 / sec.1)

Modulas of Elasticity of Concrete (E) = 273861.28 Kg/cm2

Moment of Inertia of Pile (I) = 306640.6 cm4

L1 + Lf = 0 + 454.76
= 494.7 cm
= 4.95 m

Safe Lateral Load Carrying Capacity

$$Q = \frac{12 \times 273861.28 \times 201186.9 \times 0.05}{454.8 \times 454.8 \times 454.8 \times 2.5}$$

= 1.4 MT

= 14 kN

S.No	Diameter of Pile (mm)	Depth of Fixity of Pile below Ground Level (m)	Safe Lateral Load Carrying Capacity (MT)
1	450	4.95	1.40
2	500	5.34	1.60
3	550	5.72	1.85
4	600	6.10	2.10



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