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GEO BUILD ENGINEERING INDIA PVT LTD

Plot No.53 & 54, Lakshmi Nagar, 5th Street, Madipakkam, Chennai-600091.
Website: www.geobuildengineering.in

GEOTECHNICAL INVESTIGATION REPORT

PROJECT: **GEOTECHNICAL INVESTIGATION REPORT FOR THE PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING (S+5) AT OLD NO: 24, NEW NO: 53, SECOND MAIN ROAD, RAJA ANNAMALAIPURAM, CHENNAI- 600 028.**

CLIENT: ***M/s. Swathi Builders,***

GBE/23-24/006	16.05.2023	Submission for Design of Foundation		
REV	DATE	Description	GT ENG.	P.G.T ENG.

TELANGANA BRANCH OFFICE:
No1, Fathimapur 1st Cross Street, Fathimapur, Kothur Mandal. Ranga Reddy Dist. Telangana -509325.
9791236504, 9791216286

KARNATAKA BRANCH OFFICE:
#01, Ground Floor, 1st Main Road, 2nd cross, Vinayaka Nagar, Bagalur Cross, Yelahanka, Bangalore - 560064.
9841213334,7871691757

KERALA BRANCH OFFICE:
T.C 21/1866 (1), Punartham, Nedumcade, Karamana, Trivandrum (Dist), Kerala -695002.
9092244333, 9739854231

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INTRODUCTION

This report presents the results of the geotechnical investigations carried out by Geo Build Engineering India Private Limited - Geotechnical & Foundation Engg Division. A detailed soil investigation was suggested by the client for obtaining the soil profile and recommendation of the most suitable foundation system for the proposed construction of the Residential Building. This report comprises the details of soil investigation, analysis of field and lab test results and recommendation of the most suitable foundation system. The site is for the Geotechnical Investigation report for the proposed construction of Residential Building (S+5 floors) at Old no; 24, New no: 53, Second main road, Raja Annamalaipuram, Chennai- 600 028.

This work was authorized by. *M/s. Swathi Builders,*

Standard Penetration Testing boreholes were drilled at the site up to a maximum depth of 32.5 m below existing ground level. The investigation consists of drilling two boreholes, soil sampling, field and laboratory testing and preparation of a Geotechnical Investigation report

The proposed site has plain terrain in which the borehole has been tested. The site was cleaned while the start of a geotechnical investigation. The total number of boreholes has been decided as two numbers as agreed by the Client and the Consultant. The borehole has been located in the maximum loaded area of the proposed site; the locations of the borehole were chosen by the Client. The location of a borehole is shown in the borehole location drawing. The nature of field tests includes standard penetration tests, disturbed sampling through split spoon sampler as per GBEI/QSP/08, identification of different soil layers and location of groundwater table complete logging of the borehole etc. The depth of the borehole terminated to a maximum depth of 32.5 m from EGL.

SCOPE OF WORK

The scope of this investigation is to:

i) To determine the probable subsurface conditions such as stratification, denseness or hardness of the strata, the position of the groundwater table etc.
ii) To give a probable range of safe bearing capacity for the structure. To accomplish these purposes, the study was conducted in the following phases.
iii) Drilling boreholes in order to determine site stratification and to collect disturbed & undisturbed soil samples for laboratory testing.
iv) Testing on selected soil samples in the laboratory to determine the physical and engineering properties of the soil samples.

v) Analysing all field and laboratory data in order to develop engineering recommendations for foundation design.

Two boreholes were drilled to a maximum depth of 32.5 m. Soil samples were collected for visual identification, classification and laboratory testing. The Key Plan of the borehole is presented in Appendix ~A~, the bore log subsoil profile is presented in Appendix ~B~, the laboratory test results are given in Appendix ~C~

EXPLORATION PROGRAM & TECHNIQUES

After the visual inspection of the site, the subsurface investigation was carried out as mentioned below:

Two exploration boreholes were drilled to a maximum depth of 32.5 m.

BH - 1 was started on 14.04.2023 and completed on 17.04.2023

BH - 2 was started on 17.04.2023 and completed on 18.04.2023.

Rotary drilling was performed using water as drilling fluid in the subsoil with a casing pipe to stabilize the borehole up to the required depth. Field testing and sampling were conducted in accordance with IS: 2131-1981. Standard Penetration Test (SPT) was performed on the subsoil. In this test, a standard split spoon length of about 450 mm and cutting-edge diameter of 51/35 mm initially penetrates the soil for 15cm to bypass the expected accumulated sludge at the bottom of the hole by means of a 63.5 kg (140 lb) hammer falling freely along with a guide from a height of 750 mm. The total number of rows of blows (N) required, advancing the spoon into the bore, for another two successive 15cm (a total of 30 cm) is recorded as a measure of the soil relative density or consistency as given in Table ~A~ Along with, for further drilling using NX impregnated Tungsten Carbide cutter to be used to a depth till Weathered rock and NX impregnated Diamond cutter to be used in case of hard rock.

The fieldwork was carried out under Geo Build Engineering India Pvt Ltd. and a representative from the client in accordance with Indian Standard mentioned earlier. The drilling rig was used for the exploration of a calyx rig with the hand-operated machine, so the SPT was done manually on inspection of our engineer.

Soil Conditions at the site for proposed buildings were explored by BH 1 and 2. Boring location details are presented on bore log. The boring's number and location was selected to cover the proposed built up area with due consideration to the presence of S+5 floors buildings. BH 1 and 2

were drilled in the front open space of the site. BH 1 and 2 were drilled 32.5 m and 10.5 m below EGL and terminated at confirmed hard strata weathered rock also SPT "N">= 100 in three successive tests. Borings were drilled beyond 32.5 m depth due to the presence of thick layers of loose and frim soil layers between 2.0 m to 3.0 m and 9.0 m to 21.0 m also SPT N Value as Very low. Tests were conducted to determine the pertinent index and engineering analyses to develop the required design data.

LABORATORY TESTING PROGRAM

All the extracted soil samples were brought to the Geotechnical & Materials Testing Laboratory of Geo Build Engineering for further examination in accordance with IS: 1498-1970. Collected samples were subjected to the following physical tests.

Disturbed soil samples (DS):

1. Natural Moisture Content (IS: 2720 Part 2)-1973
2. Atterberg Limits (IS: 2720 Part V — 1985
3. Grain Size Analysis (IS: 2720 Part IV — 1985)
4. Differential Free Swell Test (IS: 2720 part 40 -1977)
5. Specific gravity (IS: 2720 part 3/sec1)-1980

Undisturbed soil samples (UDS):

1. Unconfined Compression Test (IS 2720 (Part 10): 1991)
2. Direct Shear Test (IS-2720-PART-13-1986)
3. Tri-axial Shear Test (IS 2720-11 (1993)
4. Consolidation Test on Clay (IS:2720(Part 15)-1986)

LABORATORY TESTS ON ROCKS

1. Bulk Density
2. Point Load Test
3. Unconfined compressive strength
4. Brazilian Test

CHEMICAL ANALYSIS ON SOIL (IS 2720:P-26) AND WATER (IS 3025:P-11)

1. Sulphate Content (SO4)
2. Chloride Content (Cl)

3. pH Value

The laboratory test results are given in Appendix ~C~.

SUBSURFACE SOIL DESCRIPTION

Borehole no: 1

In the case of BH-1, Brownish Clay is followed by brownish weathered rock. The index and shear strength properties of soil collected at BH 1 in different depths were listed in the Laboratory test results. The borehole was terminated at 32.5 m depth from the existing ground level (EGL). The groundwater table was located at a depth of 3.5 m below the existing ground level. The stratum is firm at the top and very dense at a depth of 27.0 m. At a depth of 27.0 m to 32.5 m as rock strata the RQD-0% its indicated that the quality of rock very poor, So these rock strata treated as Gravel.

Borehole no: 2

In the case of BH-2, Brownish clay followed by blackish silty sand. The index and shear strength properties of soil collected at BH 2 in different depths were listed in the Laboratory test results. The borehole was terminated at 10.5 m depth from the existing ground level (EGL). The groundwater table was located at a depth of 3.5 m below the existing ground level. The stratum is firm at the top and very dense at a maximum depth of 10.5 m.

GROUNDWATER

A groundwater table was observed at the depth of 3.5 m for all the boreholes from the existing ground level during the time of field investigation. However, it will fluctuate due to seasonal variations and local sewerage disposal practices. Groundwater level at the ground surface is assumed in the design of the foundation to consider the worst conditions (submerged Conditions).

FOUNDATION RECOMMENDATIONS

Based on the borehole information and laboratory test results in addition to the nature of the structure, the recommendations for the proposed structure are given below The following is a summary of recommendations for a suitable type of foundation. One of the important aspects of any foundation system is to satisfy the settlement criteria apart from bearing capacity criteria. As per IS 8009 (part I) 1976 Sec 9.1.1 De Beer for the calculation of Immediate and Consolidation Settlement.

PILE FOUNDATION

Data from boring infer the presence of soil profiles with weak soil between 2.0 m to 3.0 m and 9.0 m to 21.0 m also SPT N Value as Very low. For the proposed building with expected column loads and encountered soil profiles building with a shallow Foundation will undergo high total settlements due to the consolidation of very soft clay and can experience sudden settlements in case of a design seismic event. Therefore, to minimize such problems it was recommended to provide a Tractor Mounted Direct Mud Circulation (DMC) Bored Cast In-Situ Pile foundation. This type of pile installation work will have low construction vibrations otherwise it may affect the existing adjacent building's foundations and also lead to objections from adjacent building owners. For this site it was recommended to provide 28.0 and 26.0 m total and effective length piles below EGL with a top 1-M pile cut-off for pile caps and tie beams. All piles should have at least 1.5-M embedment into hard stratum weathered rock with SPT "N" >> 100.

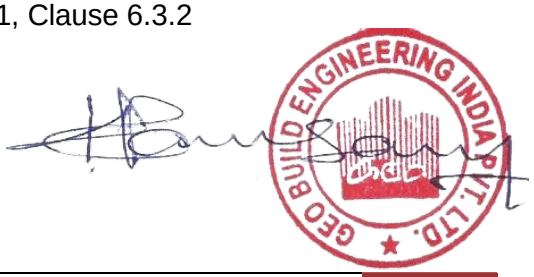
PILE CAPACITY SPECIFICATION				
Pile Length (m)	Effective Pile length below cut off level (m)	Pile diameter (mm)	Safe Load Carrying Capacity (kN)	Uplift Resistance (kN)
28	26	500	561	354
28	26	600	781	430
28	26	750	1231	549

Note:-

1. Pile Load Test must be conducted as per relevant IS Code to confirm the above-estimated pile capacities before completion of the installation of all piles.
2. Pile Installation must be done with extreme care to prevent "Necking" and "Buldging" problems due to the presence of thick very soft to soft clay layers
3. Groundwater level was assumed to rise to ground level in worst-case conditions.
4. Limiting AA. End Bearing Pressure in "Hard Rock" as per IRC code was 500 tons/m^2. Therefore q_b (all) is limited to 300 tons/m^2 in shale

UPLIFT CAPACITY

The uplift capacity of piles shall be considered as per IS 2911-1-1, Clause 6.3.2



PILE GROUPING

The group efficiency shall be worked out based on the number of Piles in a group. Piles shall have a minimum spacing of 2.5 times diameter centre to centre or a minimum of 1.5 times diameter as clear spacing in order to mobilise frictional resistance, which is a key factor in achieving better Pile capacities. Larger spacing is always preferable, in case of bored piles.

PILE TESTING

The group efficiency shall be worked out based on the number of Piles in a group. However, Pile load tests are recommended to observe the performance of the Piles and to re-confirm the theoretical Pile capacities. Load tests are to be carried out after a minimum period of 1 week after driving Pile.

Pile load tests should be conducted by loading up to 1.5 times the service load on the working Pile, while a minimum of two (2) times the service load on Pilot Piles. A pile load test can be conducted for a minimum of 2 % of the total number of piles for the project.

DESCRIPTION OF PILE SOCKETING

- The pile is to be socketed into a minimum depth of 1.5 D in solid rock or weathered rock or as per IS 14593:1998 standards.
- Extreme care should be taken to wash the base of a borehole clean before depositing concrete.
- In the case of socketing in the fractured rock or weak rocks, it is possible to develop the full structural capacity of the pile by providing greater penetration into such rocks in order to carry some load in shear between concrete and the rock.
- Apart from the calculation for pile carrying capacities, a pile load test is to be conducted for accurate results.
- Beyond the critical depth, the values of overburden pressure are constant but we are restricted to a depth to critical depth alone so that the shaft resistance is very less when compared to end resistance.
- The skin friction in a clay layer might be developed completely after a certain period of time.
- In this, pile depth and distance vary from various boreholes so that the pile carrying capacities are calculated separately.
- The pile carrying capacities significantly implies that frictional resistance is greater than end bearing resistance which implies that it is a Bored cast-in-situ -friction pile.

GENERAL GUIDELINES IN SOIL FILLING

If the foundation material is fine soil (clay and silt) it should be stiff. If the foundation soil is coarse-grained (sand or gravel) it should be dense. Soft, loose, compressible, or organic topsoil is not acceptable for foundation soil and in such cases, the existing weak soil should be replaced up to stiff or dense soil strata below the foundation with well compacted good quality granular soil. The minimum width of a replacement shall be the length of reinforcement plus 1 meter and this will ensure that the foundation soil has sufficient bearing capacity to withstand bearing pressures in both static and as well as seismic conditions. The foundation may be located on the compacted granular soil fill.

GENERAL COMMENTS

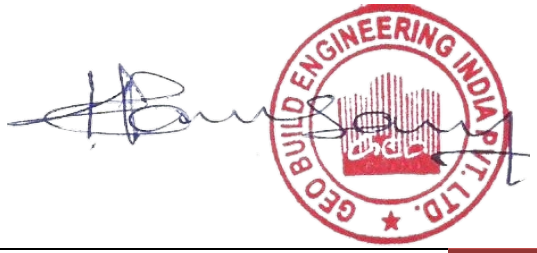
The recommendations for foundation design and construction are based on the information obtained from the boreholes drilled at the site. When foundation construction is underway, the recommendations of this report should be checked through field inspection, to validate the information for use during the construction stage. Any variation in underground conditions revealed by the borehole should be brought to our attention for alternate recommendations if needed. The Professional Services performed for the preparation of a report were accomplished in accordance with current and locally accepted geotechnical engineering principles and practices. The recommendations presented in this report are based upon the data obtained from the borings at the indicated locations and/or from other information discussed in this report. In the case of pile foundation, the pile must be rested on the harder rock stratum, if the depth of 1.00m is not strong the pile has to be advanced to till the harder rock stratum.

EXCAVATION

Excavation through the overburdened soil can be carried out by conventional equipment such as dozers and poclain excavators. Under-excavation shall not be done, thereby not disturbing the existing foundation. Since the proposed structure is nearby the existing building it should be careful that the existing foundation not be disturbed by any causes

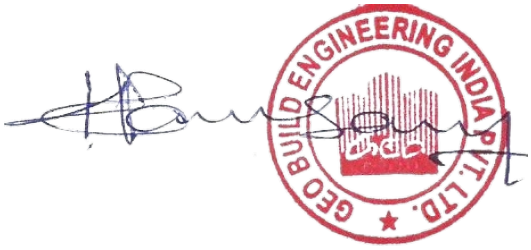
DRAINAGE

It is recommended to design an effective rainwater drainage system to get rid of the consequences of the rainwater percolation into these layers. The site should be graded so as to direct rainwater and water away from all planned structures.



FOUNDATIONS ON FILLS

In such cases, the foundations have to be built under controlled conditions with proper compaction that can be designed as a normal foundation. Uncontrolled fills should be excavated and they should be either refilled with controlled fill or foundation should commence from Natural ground level. The Report and SBC calculation were completely based on the boreholes terminated; apart from this, any weak layer encountered during excavations should also be reported to Geo build engineering India Pvt Ltd



CERTIFICATION

This report is issued with the design of Pile Foundation along with The Geotechnical Investigation report for the proposed construction of Residential Building (S+5 floors) at Old no; 24, New no: 53, Second main road, Raja Annamalaipuram, Chennai- 600 028. At this site, the number of a borehole (Two boreholes) and depth of exploration are also terminated to a maximum depth of 32.50 m. The report (Safe Bearing capacity) is mainly based on the investigation done in and around boreholes explored for Residential Building. The method to adopt a suitable method of Ground improvement techniques as per IS 13094:1992, before laying the foundation System. Enough care may be taken to design a suitable dewatering system while the construction of the foundation is in progress so that the bottom of the excavation and foundation layer shall be relatively dry. The water seeking trees around the proposed structure is also to be removed to avoid shrinkage cracks.

Yours Truly,

For GEO BUILD ENGINEERING INDIA PVT LTD

GEO BUILD ENGINEERING INDIA PVT. LTD.

Er.S.Sakthi Raja, M.E (Geotech)
(Senior Engineer - Design)
CMDA Reg No - GTE/19/04/018

Er.Ponnusamy.K, M.E (Geotech)
(Engineer - Design)

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 S.SAKTHI RAJA** has enrolled as **Registered Geo-Technical Engineer (RGTE)** with Chennai Metropolitan Development Authority (CMDA) who has the qualification of **M.E.,(Soil Mechanics & Foundation Engg.)** and experience in the relevant field for **7 years**.

He has been given the Registration No.**GTE/19/04/018** on **08.04.2019.** 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 **07.04.2024**.

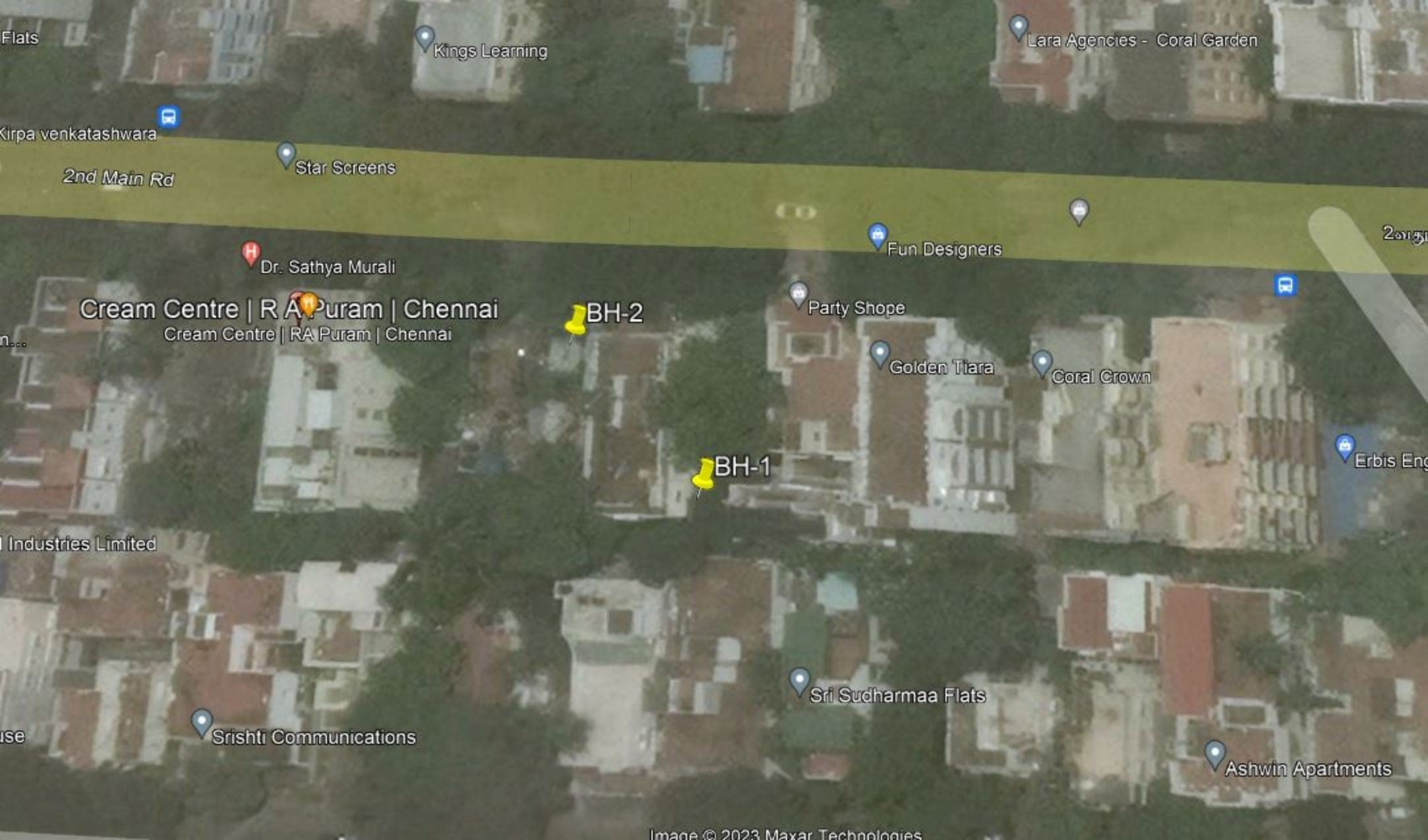


(R.SHIVAKUMAR)

GEO BUILD ENGINEERING INDIA PVT. LTD.

APPENDIX - A

KEY PLAN OF BORE HOLES


Flats
Kings Learning
Lara Agencies - Coral Garden
Kirpa venkatashwara
Star Screens
2nd Main Rd
Fun Designers
Dr. Sathya Murali
Cream Centre | R A Puram | Chennai
Cream Centre | RA Puram | Chennai
BH-2
Party Shope
Golden Tiara
Coral Crown
BH-1
Erbis Eng
Industries Limited
Sri Sudharmaa Flats
Srishti Communications
Ashwin Apartments
Image © 2023 Maxar Technologies

ISO/IEC 17025 Accredited Testing Laboratory
by NABL Vide Certificate No TC-8781

APPENDIX - B

BORE LOG & SUB SOIL PROFILE

SOIL BORE LOG PROFILE FOR BORE HOLE: 1

PROJECT: GEOTECHNICAL INVESTIGATION REPORT FOR THE PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING (S+5 FLOORS) AT RAJA ANNAMALAIPURAM, CHENNAI- 600 028.

BH NO	1	**Ground water level**	-3.5 m from EGL
Site	Raja annamalaipuram	**Reduced level**	0.0 m from Road Level
Día of boring	150 mm	**Date of starting**	14.04.2023
Type of boring	Rotary (Calyx) – Wash Boring	**Date of completion**	17.04.2023

Drilling Depth below EGL (m)	Ground water level	Soil Profile	Description / Classification of Soil	Depth of Samples Collected (m)	Standard Penetration Test (SPT) In cm				Relative Density / Consistency
					15	30	45	N	
1.0	-3.5 m		Brownish clay	1.0	2	2	3	5	Firm
2.0			Brownish clay	2.0	3	5	7	12	Stiff
3.0			Brownish clay	3.0	3	3	6	9	Stiff
4.0			Brownish silty sand	4.0	5	5	10	15	Medium
5.0			Brownish silty sand	5.0	7	10	9	19	Medium
6.0			Brownish silty sand	6.0	6	8	5	13	Medium
7.5			Blackish silty sand	7.5	5	7	8	15	Medium
9.0			Blackish silty sand	9.0	6	7	4	11	Medium
10.5			Blackish silty sand	10.5	2	2	3	5	Medium
12.0			Blackish clay	12.0	1	1	1	2	Soft
13.5			Blackish clay	13.5	3	2	2	4	Soft
15.0			Blackish clay	15.0	2	3	2	5	Firm
16.5			Blackish clay	16.5	1	1	2	3	Soft
18.0			Blackish clay	18.0	1	3	2	5	Soft
19.5			Blackish clayey sand	19.5	1	3	3	6	Loose
21.0			Blackish clay	21.0	1	1	2	3	Soft
22.5			Blackish silty sand	22.5	30	Hammer Rebound for 50 No of Blows With 10 cm		>50	Very dense
24.0			Blackish silty sand	24.0	Hammer Rebound for 50 No of Blows With 10 cm			>50	Very dense
25.5			Blackish silty sand	25.5	25	Hammer Rebound for 50 No of Blows With 10 cm		>50	Very dense

27.0			Blackish silty sand	27.0	Hammer Rebound for 50 No of Blows With 10 cm	>50	Very dense
27.0-28.0			Brownish weathered rock	28.0	CR-0%, RQD-0%	>100	-
28.0-29.5			Brownish weathered rock	29.5	CR-37%, RQD-0%	>100	-
29.5-31.0			Brownish weathered rock	31.0	CR-32.6%, RQD-0%	>100	-
31.0-32.5			Brownish weathered rock	32.5	CR-33.33%, RQD-0%	>100	-
Bore hole termination depth at = 32.5 m from Existing ground level							

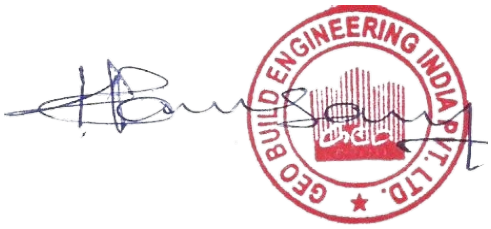
SOIL BORE LOG PROFILE FOR BORE HOLE: 2

PROJECT: GEOTECHNICAL INVESTIGATION REPORT FOR THE PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING (S+5 FLOORS) AT RAJA ANNAMALAIPURAM, CHENNAI- 600 028.

BH NO	2	**Ground water level**	-3.5 m from EGL
Site	Raja annamalaipuram	**Reduced level**	0.0 m from Road Level
Día of boring	150 mm	**Date of starting**	17.04.2023
Type of boring	Rotary (Calyx) – Wash Boring	**Date of completion**	18.04.2023

Drilling Depth below EGL (m)	Ground water level	Soil Profile	Description / Classification of Soil	Depth of Samples Collected (m)	Standard Penetration Test (SPT) In cm				Relative Density / Consistency
					15	30	45	N	
1.0	-3.5 m		Brownish clay	1.0	6	7	9	16	Very stiff
2.0			Brownish clay	2.0	3	6	8	14	Very stiff
3.0			Brownish clay	3.0	4	8	12	20	Very stiff
4.0			Brownish silty sand	4.0	7	9	12	21	Medium
5.0			Blackish clayey sand	5.0	8	10	15	25	Medium
6.0			Blackish silty sand	6.0	3	3	5	8	Loose
7.5			Blackish silty sand	7.5	4	6	11	17	Medium
9.0			Blackish silty sand	9.0	1	1	1	2	Very loose
10.5			Blackish silty sand	10.5	2	3	4	7	Loose

Bore hole termination depth at = 10.5 m from Existing ground level



APPENDIX - C

LABORATORY TEST RESULTS

TABLE NO: 1

LABORATORY TEST RESULTS

Client (^)	***M/s. Swathi Builders,***			**Project (^)**	**GEOTECHNICAL INVESTIGATION REPORT FOR THE PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING (S+5 FLOORS) AT RAJA ANNAMALAIPURAM, CHENNAI- 600 028.**								
Bore Hole No	1	Sampled date	17.04.2023		Tested Date	19.04.2023			Reporting Date	16.05.2023			
Depth (m)	Soil Description / Classification	Is classification	Index Properties					Specific Gravity	Grain Size Analysis (%) Wet / Dry				
			(NMC) %	Liquid Limit, %	Plastic Limit %	Plasticity Index	Free Swell Index %		Gravel %	Coarse Sand %	Medium Sand %	Fine Sand %	Silt & Clay %
1.0	Brownish clay	CI	20	33	20	13	30	2.69	3	0	3	31	63
2.0	Brownish clay	CI	22	32	20	12	30	2.68	1	1	1	42	55
3.0	Brownish clay	CI	29	45	22	23	50	2.71	0	0	6	6	88
4.0	Brownish silty sand	SP-SM	21	NON - PLASTIC			0	2.65	0	0	2	88	10
5.0	Brownish silty sand	SM	22				0	2.66	0	0	5	72	23
6.0	Brownish silty sand	SP-SM	17				0	2.65	2	3	56	32	7
7.5	Blackish silty sand	SP-SM	20				0	2.65	1	1	33	58	7
9.0	Blackish silty sand	SP-SM	12				0	2.65	1	1	35	55	8
10.5	Blackish silty sand	SM	21				0	2.65	1	1	5	81	12
12.0	Blackish clay	CI	46	40	18	22	30	2.70	0	0	14	14	72
13.5	Blackish clay	CH	64	62	34	28	50	2.72	0	0	0	2	98

15.0	Blackish clay	CH	58	65	27	38	50	2.72	0	0	2	2	96
16.5	Blackish clay	CI	52	47	22	25	50	2.72	0	0	2	2	96
18.0	Blackish clay	CI	44	33	16	17	40	2.69	0	0	16	23	61
19.5	Blackish clayey sand	SC	44	43	21	22	30	2.67	0	0	19	33	48
21.0	Blackish clay	CI	67	49	22	27	40	2.72	0	0	0	2	98
22.5	Blackish silty sand	SM	12	NON - PLASTIC			0	2.65	43	21	13	4	19
24.0	Blackish silty sand	SM	14				0	2.67	27	12	22	9	30
25.5	Blackish silty sand	SM	11				0	2.65	23	9	29	21	18
27.0	Blackish silty sand	SP-SM	7				0	2.65	67	10	13	3	7
27.0-28.0	Brownish weathered rock	-	CR-0%, RQD-0%										
28.0-29.5	Brownish weathered rock	-	CR-37%, RQD-0%										
29.5-31.0	Brownish weathered rock	-	CR-32.6%, RQD-0%										
31.0-32.5	Brownish weathered rock	-	CR-33.33%, RQD-0%										

Er. S. Sakthi Raja, M.E (Geotech)
(Technical Manager)

TABLE NO: 2

LABORATORY TEST RESULTS

Client (^)	***M/s. Swathi Builders,***	**Project (^)**	**GEOTECHNICAL INVESTIGATION REPORT FOR THE PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING (S+5 FLOORS) AT RAJA ANNAMALAIPURAM, CHENNAI- 600 028.**
Bore Hole No	2	Sampled date	Tested Date: 19-04-2023 / Reporting Date: 16-05-2023

Depth (m)	Soil Description / Classification	Is classification	Index Properties					Specific Gravity	Grain Size Analysis (%) Wet / Dry				
			(NMC) %	Liquid Limit, %	Plastic Limit %	Plasticity Index	Free Swell Index %		Gravel %	Coarse Sand %	Medium Sand %	Fine Sand %	Silt & Clay %
1.0	Brownish clay	CI	15	31	17	14	30	2.69	0	0	1	36	63
2.0	Brownish clay	CI	28	39	23	16	30	2.71	0	0	2	12	86
3.0	Brownish clay	CI	27	43	20	23	30	2.69	0	0	18	15	67
4.0	Brownish silty sand	SP-SM	25	NON - PLASTIC			0	2.65	0	0	1	88	11
5.0	Blackish clayey sand	SC	36	32	16	16	20	2.67	0	1	6	55	38
6.0	Blackish silty sand	SP-SM	19	NON - PLASTIC			0	2.65	2	1	13	78	6
7.5	Blackish silty sand	SP-SM	21				0	2.65	1	1	34	58	6
9.0	Blackish silty sand	SP-SM	23				0	2.65	0	1	16	73	10
10.5	Blackish silty sand	SP-SM	24				0	2.65	1	0	17	71	11

Er. S. Sakthi Raja, M.E (Geotech)
(Technical Manager)

APPENDIX - D

WATER TEST RESULTS

CLIENT: ***M/s. Swathi Builders,***

SITEADDRESS: Geotechnical Investigation report for the proposed construction of Residential Building (S+5 floors) at Old no; 24, New no: 53, Second main road, Raja Annamalaipuram, Chennai- 600 028.

Table: WATER TEST ANALYSIS

Chemical Analysis Results conducted on Water Sample collected from Boreholes					
Location	***pH***		***Chlorides (ppm)***	***Sulphates (ppm)***	***Colour & odor***
BH - 1	**7.96**		**277.25**	**582.4**	**Colourless & Odorless**
PERMISSIBLE VALUE	**<7**	**>7**	**2000**	**400**	**---**
	Acidic	**Alkaline**			

Description and recommendation of the chemical analysis

The Water sample has been collected from the borehole points we done during soil investigations.

The pH value is more than 7 so it indicates it has Basic content. The colour of sample is Crystal white (colourless) and with no odour.

Chloride in concrete is harmful and there is an increased risk of embedded steel being corroded. To minimize the chances of deterioration, the maximum total acid soluble Chloride content in the concrete at the time of placing for different type/use of concrete has been limited as per IS 456:2000 table no:1. Chlorides in water are more of a taste than a health concern, although high concentrations may be harmful to people with heart or kidney problems. Here the chlorides content in sample is less than permissible limit.

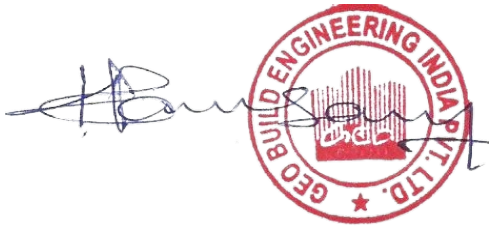
Sulphates are present in most cement and in some aggregates. Excessive amount of water-soluble sulphate can cause expansion and disruption of concrete. To prevent this the total water-soluble sulphate content of the concrete mix expressed as SO3 has been limited to 4% by mass of

cement; which is same as was provided in IS 456: 2000. Since the sulphate content in sample is higher than permissible limit it is not suitable for construction purposes. Overall, the Chlorides content is lesser than permissible limits but, the Sulphates (So3) content is more than the Permissible limit, so this water is not suitable for mixing concrete for RCC.

Reference as per IS 456:2000

Table 1 Permissible Limit for Solids
(*Clause* 5.4)

Sl No.		Tested as per	Permissible Limit, *Max*
i)	Organic	IS 3025 (Part 18)	200 mg/l
ii)	Inorganic	IS 3025 (Part 18)	3 000 mg/l
iii)	Sulphates (as SO_3)	IS 3025 (Part 24)	400 mg/l
iv)	Chlorides (as Cl)	IS 3025 (Part 32)	2 000 mg/l for concrete not containing embedded steel and 500 mg/l for reinforced concrete work
v)	Suspended matter	IS 3025 (Part 17)	2 000 mg/l



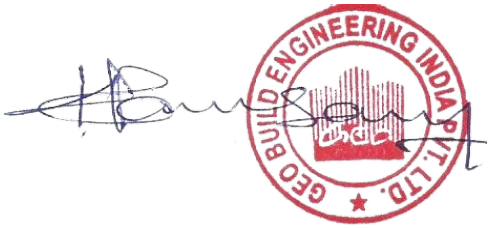
CERTIFICATION

The total no of pages in this report is 23; this report is issued by Geo Build Engineering India Pvt Ltd for the project, **Geotechnical Investigation report for the proposed construction of Residential Building (S+5 floors) at Old no; 24, New no: 53, Second main road, Raja Annamalaipuram, Chennai- 600 028.** All the above tests were done within our laboratory.

Yours Truly,

For GEO BUILD ENGINEERING INDIA PVT LTD





Er. S. Sakthi Raja, M. E (Geotech)
(Senior Engineer - Design)
CMDA Reg No - GTE/19/04/018

Er. Ponnusamy.K, M.E(Geotech)
(Engineer - Design)

NOTE:

1. The results enclosed are only related to the sample tested by us.

2. The report shall not be reproduced in full or part without written permission from Geo Build Engineering India Pvt Ltd.

3. All the lab related tested values are as per the standard conditions followed by the lab.

4 Symbol (^) indicates details given by client.

5. Samples will be disposed after 30 days from sample receipt date at lab.

6. Statement of conformity not reported, so Decision rule is not applicable

LIST OF METHOD USED AS FOLLOWED

➢ IS 2720 (Part 2);1973	Natural moisture content
➢ IS 2720 (Part 3);1980	Specific Gravity test on Soils
➢ IS 2720: Part 4 :1985	Grain size Analysis Dry Sieve Analysis
➢ IS 2720: Part 4 :1985	Grain size Analysis Wet Sieve Analysis
➢ IS 2720 (Part 5):1958	Liquid limit test
➢ IS 2720 (Part 5):1985	Plastic limit test
➢ IS 2720 (Part 7);1980	Proctor density-Light (standard) compaction
➢ IS 2720 (Part 8);1983	Proctor density-Heavy (modified) compaction
➢ IS 2720 (Part 16);1987	Laboratory California Bearing ratio
➢ IS 2720 (Part 28);1974	Dry density Determination by Sand Replacement method
➢ IS 2720 (Part 29);1975	Dry density Determination by Core cutter method
➢ IS 2720 (Part 40);1977	Free Swell Index
➢ Is 6403:1981	code of practice for determination of bearing capacity of shallow foundation
➢ IS:2911 -1980	code of practice for design and construction of pile foundation - part iii – Bored cast in situ pile
➢ Is 8009 (part I)-1878	code of practice for calculations of settlements of foundations
➢ IS 14593:1998	Pile foundation on Rock

GEO BUILD ENGINEERING INDIA PVT. LTD.

NOTE

ABBREVIATION:

WN	=	Natural Moisture content (%)
WL	=	Liquid limit (%)
WP	=	Plasticity Limit (%)
IP	=	Plasticity Index (%)
F.S.I	=	Free Swell Index (%)
IS	=	Indian Standard Classification
ML	=	Inorganic clay
CL	=	Low compressibility Clay of WL < 35%
CI	=	Inorganic Clay of 35% < WL <50%
CH	=	High Compressibility Clay of WL > 50%
SW	=	Well graded sand
SP	=	Poorly graded sand
SM	=	Silty Sand
GW	=	Well graded gravel
GP	=	Poorly graded gravel
SDR	=	Soft Disintegrated Rock
RQD	=	Rock Quality Designation
CR	=	Core recovery
RMR	=	Rock Mass Rating

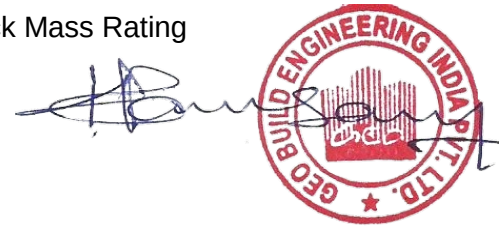


Table No: ~A~.

Correlations of SPT N values with Common properties of soils

A) Granular Soil

Standard Penetration No., SPT N	Description	Relative Density, Dr %	Approx. Angle of Internal Friction, Φ°	Approx. Rang of Most. Unit Wt,ɣ kN/m3
< 4	Very loose	< 20	< 29	11-16
4-10	Loose	20-40	29-30	14-18
10-30	Medium	40-60	30-36	17-20
30-50	Dense	60-80	36-41	17-22
> 50	Very Dense	> 80	> 41	20-29

B) Cohesive Soil

Standard Penetration No., SPT N	Description	Unconfined Compressive Strength, kPa	Approx. Rang of Most. Unit Wt.,,ɣ kN/m3
< 2	Very Soft	0-25	14.4-16
2-4	Soft	25-50	16-17.4
4-8	Firm (medium)	50-100	17.6-19.2
8-15	Stiff	100-200	19.2-20.8
15-30	Very Stiff	200-400	20.8-22.4
> 30	Hard	> 400	> 20

Note: These values are most appropriate values in general. However, the soil properties vary between sites to site and hence it shall be used only for guidance

GEO BUILD ENGINEERING INDIA PVT. LTD.

End of Report



our services doesn't just end there

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Compliance & Special Services

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Property Valuation & Cost Estimation

Guideline Value, Apartment Composite Value, Stamp Duty & Registration Fees Calculator, Building Value Calculator, Capital Gains Calculator, Area Unit Converter, Length Unit Converter

Ownership, Compliance & Legal Verification

Encumbrance Certificate (EC) Search, Find Your SRO, Temple Property Check, WAQF Property Check, View Patta/Chitta, View FMB, Patta Analyzer, EC Analyzer

Zoning & Land Use Analysis

Land Use Zone Finder, CRZ Zone Check, Aquifer Zone Check, CBA Check, EWS Check, Road Width Check, Proposed Road Widening Check, FSI Calculator

Property Documentation & Workflow Tools

Forms & Templates, Document Generator, Document Translation, Dictionary

Vastu & Property Management Tools

Home Vastu Shastra, Plot Vastu Shastra, Property Management

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3/350/2 Mettukuppam,
OMR Thoraipakkam,
Chennai, India

hello@verified.realestate
+91 9996 12 9996
www.verified.realestate