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PROJECT NAME

PROPOSED CONSTRUCTION OF COMMERICAL BUILDING (STILT+5 UPPER FLOORS) AT 3RD AVENUE, ANNA NAGAR, CHENNAI, TAMIL NADU.

CLIENT NAME

THE EXECUTIVE ENGINEER,
ANNA NAGAR DIVISION, TAMILNADU HOUSING BOARD,
CHENNAI-600 040.

TITLE

GEOTECHNICAL INVESTIGATION REPORT

PROJECT NO: GEC-JC-GT-1043/2019-2020

DATE: 14/03/2020

REPORT TEXT

CHAPTER-1

INTRODUCTION

1.0 Project Information Matrix

Nature of project	: Commercial Building (Stilt+5 Upper Floors)
Project Client	: **TAMIL NADU HOUSING BOARD,**
Project Location	: 3rd Avenue, Anna Nagar, Chennai.
Job Code	: JC-GT-1043

1.1 Scope Of Work

1.1.1 Field Work

- Conducting One soil investigation bore holes of 150 mm& NX diameter up to 26.0m depth or up to the refusal strata with SPT>100
- Conducting Standard Penetration Test (SPT) within the borehole at every 1.0m depth interval up to 5.0m and thereafter at every 1.5m depth interval up to 20.0m depth and thereafter at every 2.0m depth interval up to termination depth.
- Collection of soil samples and undisturbed samples from the clayey strata with SPT-value greater than 2 to less than 15 if met within the investigation depth
- Collection of water samples if groundwater table met within the investigation depth

1.1.2 Laboratory Work

- Natural Moisture Content
- Atterberg's limits
- Grain Size Analysis
- Chemical Analysis test on soil and water samples to give pH, Chlorides and Sulphates

1.2 Structure of the Report

- Contents
- Introduction
- Investigation Methodology & Test Results
- Geology &Sub-Surface Stratification
- Foundation System
- Recommendation
- Annexure

CHAPTER-2

INVESTIGATION METHODOLOGY & TEST RESULTS

2.0 Preamble:

One soil investigation boreholes were put as per the planning of the engineer in-charge and these locations are shown in Fig.2.0.The equipment used and the methodology adopted to carry out the fieldwork is described below.

2.1 Methodology of Field Work:

2.1.1 Equipment Used and Method of Drilling:

All the boreholes were sunk by conventional rotary drilling rigs. For borehole Methodology followed for boring conformed to IS: 1892 -2000. Boring was progressed by the cutting action of rotating bit with water circulation and stabilizing the side of the boreholes by using casing pipes/bentonite slurry up to required depth to prevent collapse of sidewall. Boring was continued by normal boring process using MS soil cutter in soil. However Tungsten Carbide (TC) bit drilling was resorted to drill in highly weathered rock stratum where the normal boring process became slow. Diamond Core (DC) bit drilling was adopted in moderately weathered rock formations where penetration using TC bit was became slow.

2.1.2 Standard Penetration Tests:

This is a field test to determine "Penetration Resistance of Stratum at the Test Depth". This has been conducted in the boreholes generally up to refusal depth using procedures described in IS: 2131- 2002. In this test, split spoon sampler (50.8 mm OD and 35 mm ID) has replaced driving bit. Sampler is then driven by dropping 63.5 kg hammer on top of driving collar with free fall of 75 cm. The length of sampler is 60 cm.

The tests were conducted at the depth intervals indicated in Chapter-1 (Sec.1.1.1).

2.1.3 Collection of Soil Samples:

2.1.3.1 Disturbed 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.

2.1.4 Collection of Ground Water Samples:

One representative water sample from each borehole was collected after 24 hours of completing the borehole if water table met within the investigated depth.

Note on Groundwater Table Record:

- Groundwater table observation in geotechnical report is predominantly to arrive at foundation design criteria and shall not be construed as design guidelines for the design of dewatering systems
- The groundwater level indicated in the bore logs is specific to the duration of investigation and intensity of the monsoon rains during the time of investigation.

Hence, the level shall be taken as guidelines only to plan the investigation for the dewatering system

- ❖ No foundation excavation or basement excavations if anticipated within the groundwater table zone shall be carried out without implementing groundwater lowering schemes

2.2 Laboratory testing:

2.2.1 On Coarse Grained Soil

On the representative samples, sieve analysis tests were conducted to arrive at grain size distribution. These tests were conducted as per I.S.2720 (part 4)-1985 and the results are presented in Tables-2.1. The graphical representation of grain size distribution curve for the representative samples in each bore is presented in Fig. 2.2.

2.2.2 On Fine Grained Soil

On the SPT sample index property tests were conducted to estimate consistency. These test results are presented in Tables-2.1. The graphical representation of hydrometer analyses curve for the representative samples in each bore is presented in Fig.2.3 to 2.5.

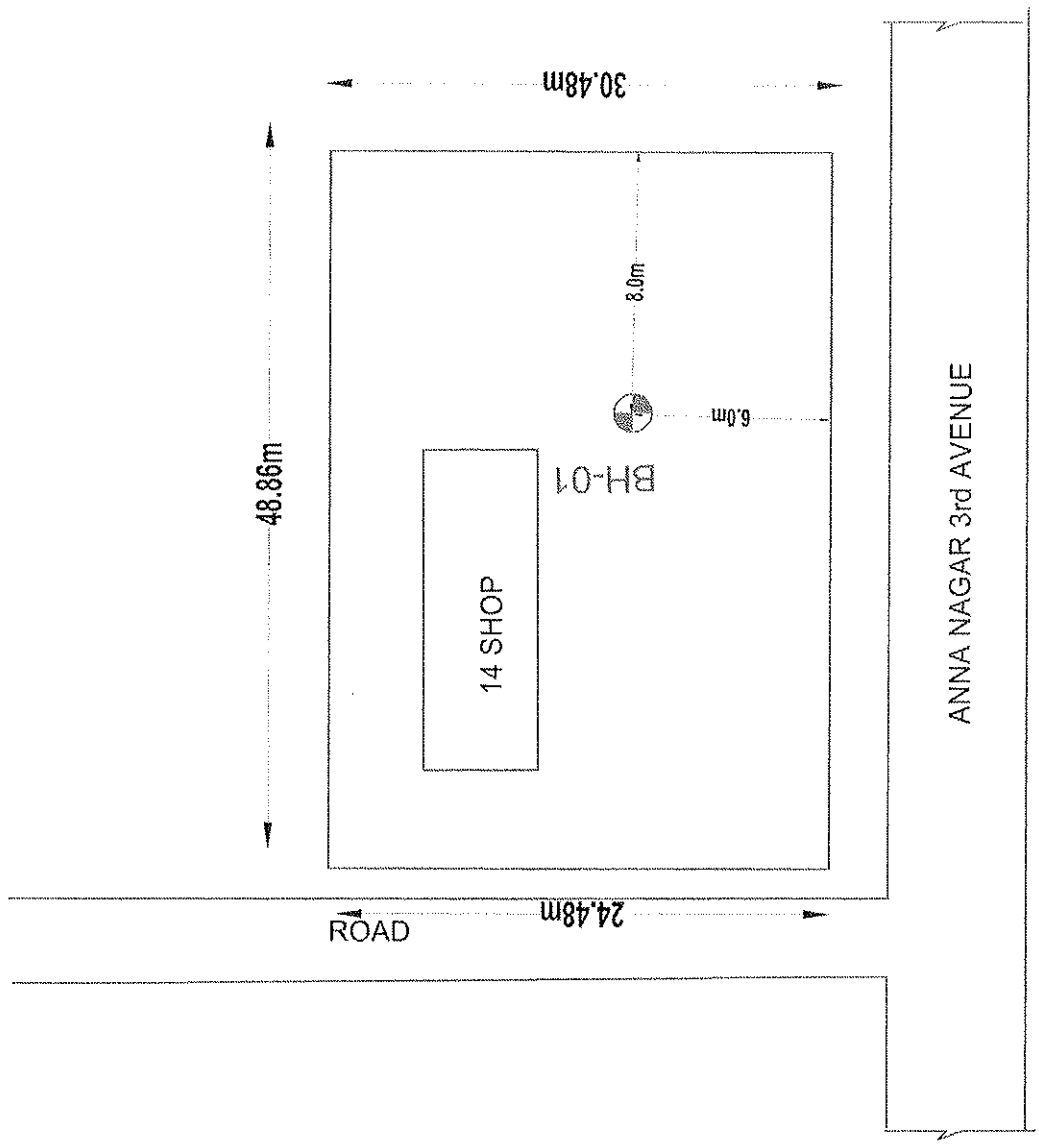
2.2.3 Chemical Analysis Tests

On representative soil and water samples chemical analysis tests were conducted to estimate pH, Chloride and Sulphates and these results are presented in Table - 2.2.

2.3 Summary:

The locations of the field investigation boreholes are shown in site plan given in Fig.2.0. The average sub soil profiles encountered at each location along with their classification and engineering properties are presented in Figs.2.1.

SITE PLAN



2.0 SITE PLAN SHOWING THE LOCATION OF FIELD INVESTIGATION POINTS AT 3RD AVENUE, ANNA NAGAR, CHENNAI.

SOIL PROFILE

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-01						
SHEET	1	OF	3				
PROJECT NAME	PROPOSED CONSTRUCTION OF COMMERICAL BUILDING					DIA OF BORE HOLE	150mm ✓ / NX
LOCATION	3rd Avenue, Anna Nagar,Chennai	MACHINE No.	CR-02	CHAINAGE (m)	-	BORE START DATE	20/02/2020
STRUCTURE	Stilt+5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	2102/2020
JOB CODE	JC-GT-1040	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	2

Depth below E.G.L. (m)	Drilling progress per metre: Date	Time: Hr.	Time: Min.	Type of Drill Bit (SC / TCB / DB)	Core Details: Total Core Recovery %	Core Details: R.Q.D %	SPT Details: Blows/cm. 0-15	SPT Details: Blows/cm. 15-30	SPT Details: Blows/cm. 30-45	SPT 'N' Value	Sample Details: Depth	Sample Details: No.	Sample Details: Type	Sample Details: RL (m)	Layer Data: Legend	Layer Data: No	Layer Data: Depth	Geotechnical Description
0	20/02/2020	13	17 To 13 21	SC	-	-										L1	0.6	**Filled Up Soil** (Old Building Materials)
1		13	31 To 13 36	SC	-	-	2	2	3	5	1.00 - 1.45	1	SS	-1.0				Brown,Moist,Medium Stiff,**Silty Clay(Cl)** Silty Clays of High plasticity
2		13	46 To 13 51	SC	-	-	2	4	3	7	2.00 - 2.45	2	SS	-2.0		L2	3.0	
3		13	58 To 14 03	SC	-	-	1	2	3	5	3.00 - 3.45	3	SS	-3.0				Brownish Grey,Moist,Medium Stiff,**Silty Clay (CH)** Silty Clays of High plasticity
4		14	12 To 14 14	SC	-	-	4	6	6	12	4.00 - 4.45	4	SS	-4.0		L3	4.0	
5		14	25 To 14 29	SC	-	-	7	6	7	13	5.00 - 5.45	5	SS	-5.0				
6							5	9	12	21	6.50 - 6.95	6	SS	-6.5				Brown,Moist,Medium Dense,Poorly Graded,**Silty Sand(SM)** Sand-Silt mixtures
7		14	42 To 14 45	SC	-	-												
8							6	7	8	15	8.00 - 8.45	7	SS	-8.0				
9		15	00 To 15 05	SC	-	-										L4	9.5	
10							3	2	1	3	9.50 - 9.95	8	SS	-9.5				
																	10.0	Grey,Moist,Very Loose,Poorly Graded, **Clayey Sand(SC)** Sand-Clay mixtures

CS - Core Sample	DS - Disturbed Sample	LOGGED	M.Raguram	PROJECT SITE DETAILS		REMARKS	
SS - Split Spoon Sample	SC - Soil Cutter	DATE	20/02/2020	GROUND LEVEL (m)	0.00		
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	K.Ramalingam	WATER TABLE (m)	3.20		
WS - Wash Sample	DB - Diamond Bit	DATE	11/03/2020	CASING DEPTH (m)	0.00		

SITE INVESTIGATION RECORD

PROJECT NAME	PROPOSED CONSTRUCTION OF COMMERICAL BUILDING					BORE HOLE No.	BH-01
						SHEET	2 OF 3
						DIA OF BORE HOLE	150mm ✓ / NX
LOCATION	3rd Avenue, Anna Nagar,Chennai	MACHINE No.	CR-02	CHAINAGE (m)	-	BORE START DATE	20/02/2020
STRUCTURE	Stilt+5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	2102/2020
JOB CODE	JC-GT-1040	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	2

Depth below E.G.L. (m)	Drilling progress per metre: Date	Time: Hr.	Time: Min.	Type of Drill Bit (SC / TCB / DB)	Core Details: Total Core Recovery %	Core Details: R.Q.D %	SPT Details: Blows/cm. 0-15	SPT Details: Blows/cm. 15-30	SPT Details: Blows/cm. 30-45	SPT 'N' Value	Sample Details: Depth	Sample Details: No.	Sample Details: Type	Sample Details: RL (m)	Layer Data: Legend	Layer Data: No	Layer Data: Depth	Geotechnical Description
11	20/02/2020	15	23															
		To																
		15	28	SC	-	-	6	6	7	13	11.00 / 11.45	9	SS	-11.0		L5	11.0	Grey,Moist,Very Loose,Poorly Graded, **Clayey Sand(SC)** Sand-Clay mixtures
		15	51															
		To																
12		15	57	SC	-	-	3	2	2	4	12.50 / 12.95	10	SS	-12.5		L6	12.5	Grey,Moist,Medium Dense,Poorly Graded,**Clayey Sand(SC)** Sand-Clay mixtures
		16	22															
		To																
13		16	27															
		16	52	SC	-	-	2	3	3	6	14.00 / 14.45	11	SS	-14.0				Grey,Moist,Loose,Poorly Graded,**Silty Sand(SM)** Sand-Silt mixtures
		To																
14		17	10															
	19/02/2020			SC	-	-	8	11	18	29	15.50 / 15.95	12	SS	-15.5		L7	17.0	
		08	25															
		To																
15		08	34															
							6	13	13	26	17.00 / 17.45	13	SS	-17.0				
		09	35															
		To																
16		09	48															Greenish Grey,Moist,Very Stiff to Hard,**Compacted Silty CLAY(CH)** Silty Clays of High plasticity
							3	6	9	15	18.50 / 18.95	14	SS	-18.5				
		10	30															
		To																
17		10	47															
							5	8	13	21	20.00 / 20.45	15	SS	-20.0			20.5	
18																		
19																		
20																		

CS - Core Sample	DS - Disturbed Sample	LOGGED	M.Raguram	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	20/02/2020	GROUND LEVEL (m)	0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	K.Ramalingam	WATER TABLE (m)	3.20	
WS - Wash Sample	DB - Diamond Bit	DATE	11/03/2020	CASING DEPTH (m)	0.00	

SITE INVESTIGATION RECORD

PROJECT NAME	PROPOSED CONSTRUCTION OF COMMERICAL BUILDING			BORE HOLE No.	BH-01
				SHEET	3 OF 3
LOCATION	3rd Avenue, Anna Nagar,Chennai	MACHINE No.	CR-02	DIA OF BORE HOLE	150mm ✓ / NX
STRUCTURE	Stilt+5 Upper Floors	DRILLING METHOD	Rotary	CHAINAGE (m)	-
JOB CODE	JC-GT-1040	FLUSHING MEDIUM	Bentonite	CO-ORDINATES N	-
				CO-ORDINATES E	-
				BORE START DATE	20/02/2020
				BORE END DATE	2102/2020
				TOTAL DRILL DAYS	2

Depth below E.G.L (m)	Drilling progress per metre: Date	Time: Hr.	Time: Min.	Type of Drill Bit (SC / TCB / DB)	Core Details: Total Core Recovery %	Core Details: R.Q.D %	SPT Details: Blows/cm. 0-15	SPT Details: Blows/cm. 15-30	SPT Details: Blows/cm. 30-45	SPT 'N' Value	Sample Details: Depth	Sample Details: No.	Sample Details: Type	Sample Details: RL (m)	Layer Data: Legend	Layer Data: No	Layer Data: Depth	Geotechnical Description
21	19/02/2020	12	10	SC	-	-												
		To																
		12	23															
22		12	57	SC	-	-	8	11	15	26	21.50 / 21.95	16	SS	-21.5		L8	21.5	Greenish Grey,Moist,Very Stiff to Hard,**Compacted Silty CLAY(CH)** Silty Clays of High plasticity
		To																
		13	16															
23		14	49	SC	-	-	9	12	17	29	23.00 / 23.45	17	SS	-23.0		L9	24.5	Brownish Grey,Moist,Medium Dense,Poorly Graded,**Silty Sand(SM)** Sand-Silt mixtures
		To																
24		14	55						8cm Penet. For 50 Blows									
		15	22	SC	-	-	15	33		>100	24.50 / 24.88	18	SS	-24.5				
25		To																
		15	41															
26							7cm Penet. For 50 Blows			>100	26.00 / 26.07	19	SS	-26.0		L10	26.1	Greenish Grey,Moist,Very Hard,**Compacted Clay (Shale)** (CI) Silty Clays of High plasticity
27																		
28																		
29																		
30																		

CS - Core Sample	DS - Disturbed Sample	LOGGED	M.Raguram	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	20/02/2020	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	K.Ramalingam	WATER TABLE (m) 3.20	
WS - Wash Sample	DB - Diamond Bit	DATE	11/03/2020	CASING DEPTH (m) 0.00	

Borehole terminated at 26 m depth below E.G.L

FIG.2.1 Sub Soil Profile at BH-01 Location

Grain Size Distribution Curves

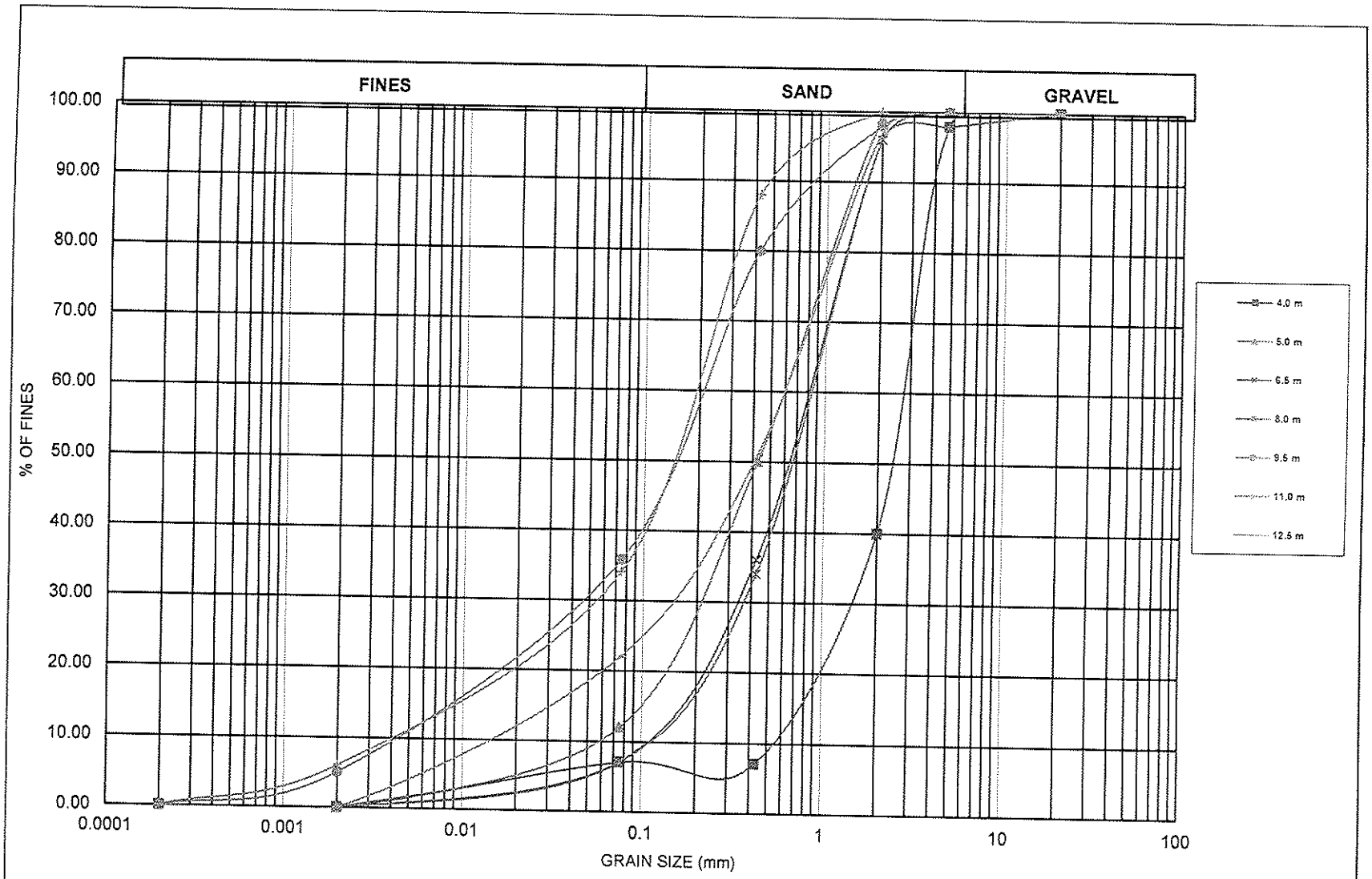


Fig. 2.2 GRAIN SIZE DISTRIBUTION CURVE - BH-01

HYDROMETER ANALYSIS CURVE

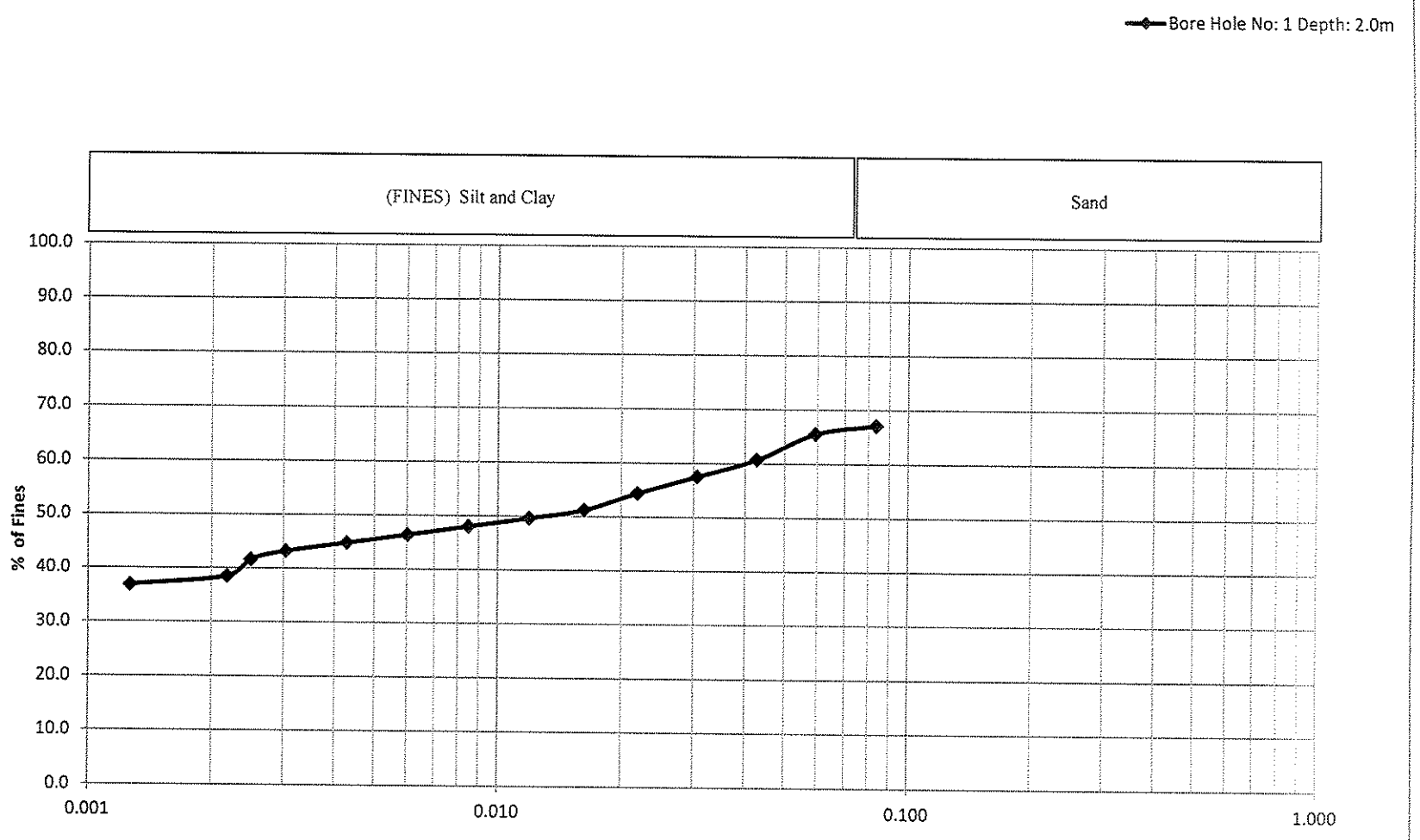


Fig 2.3 Hydrometer Analysis Master Curve

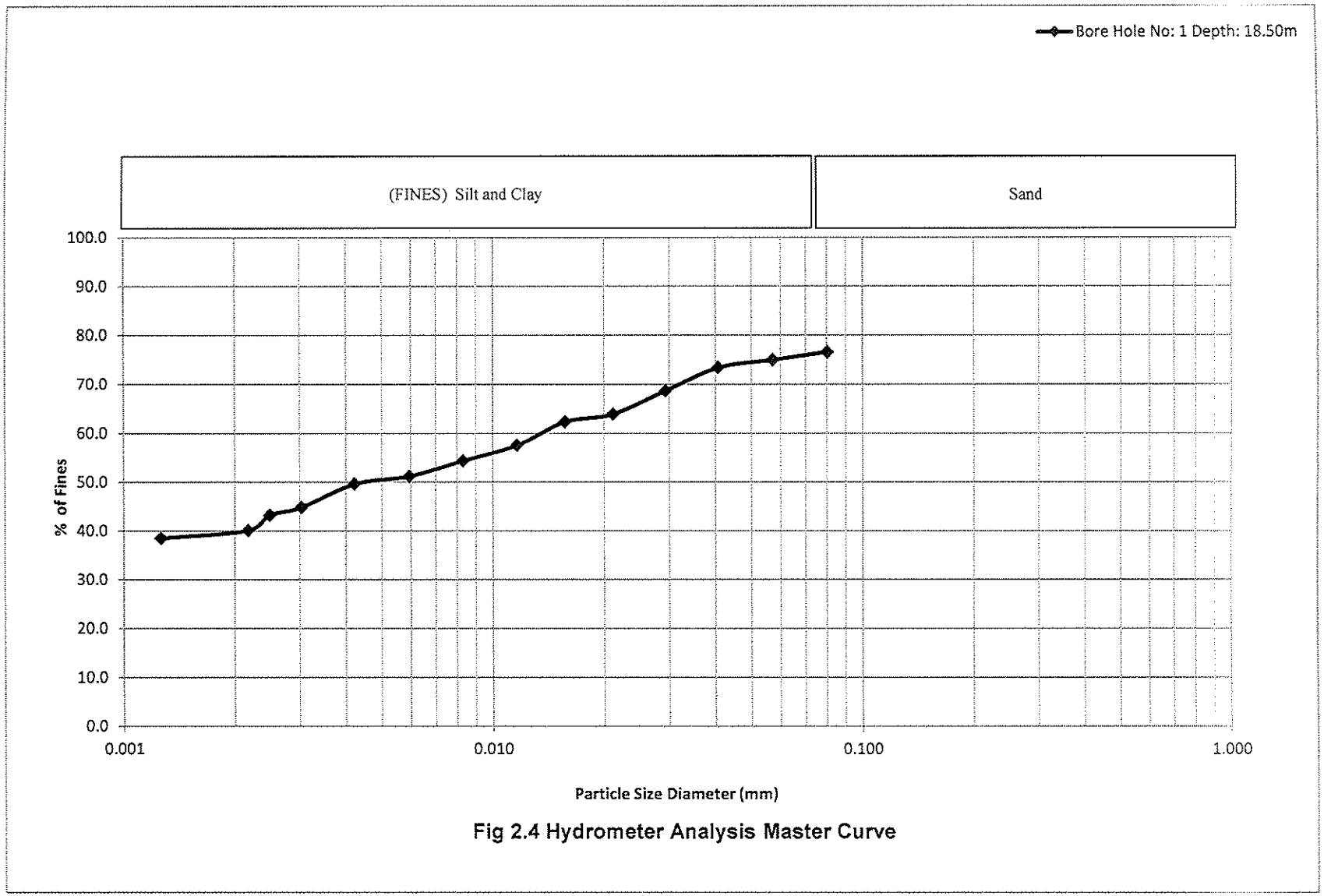


Fig 2.4 Hydrometer Analysis Master Curve

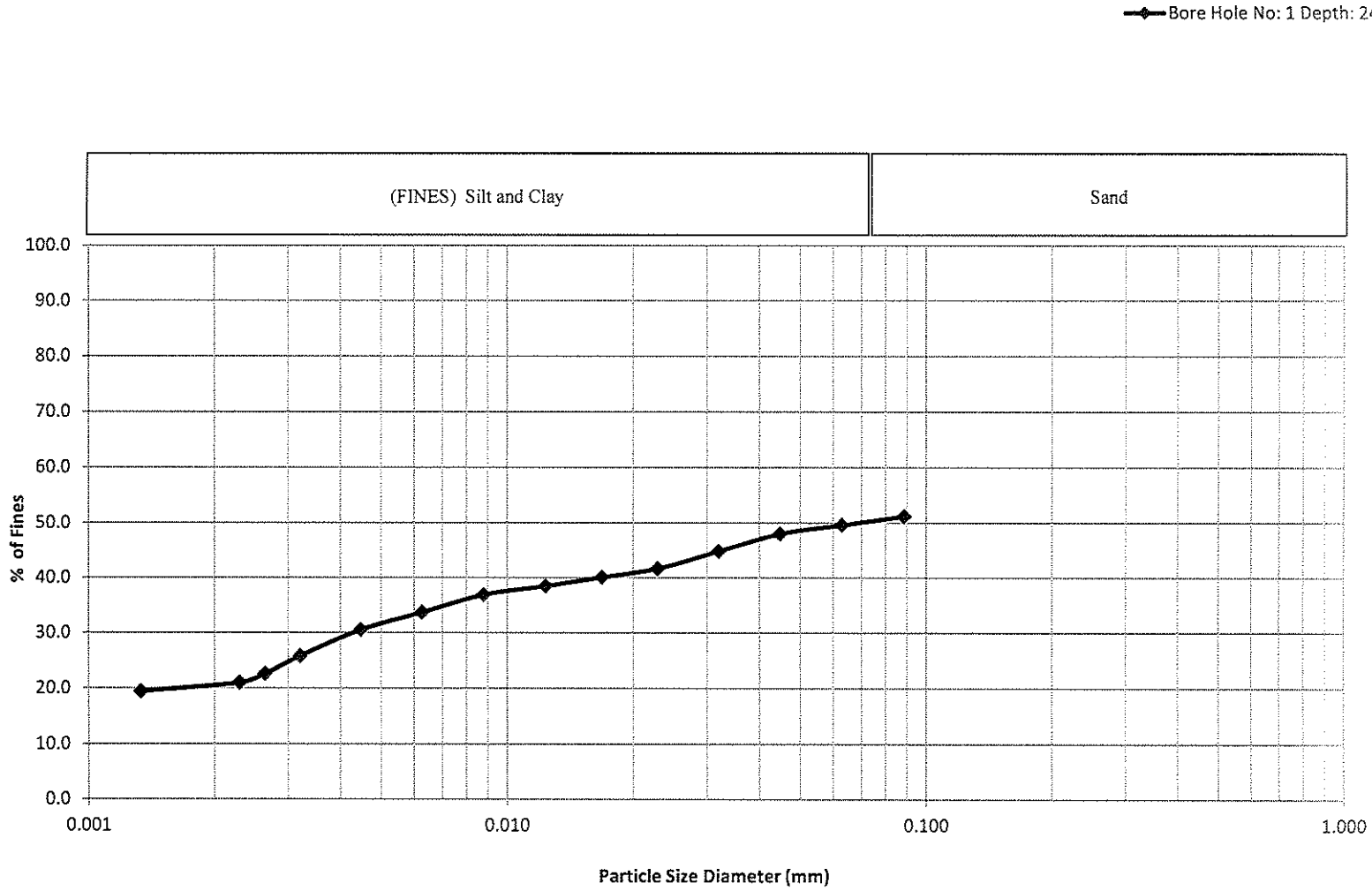


Fig 2.5 Hydrometer Analysis Master Curve

LABORATORY TEST RESULTS

Table-2.1 Laboratory Classification of Soil Samples from BH-01

Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	Sub Soil Classification																								
			Fine Grained (FG)										Coarse Grained (CG)														
			N.M.C(%)	L.L (%)	P.L (%)	I_P	I_C	Shrinkage (cm^3)	D.F.S (%)	Consistancy	Position With Respect to A-Aline	IS:Notation	Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	$C_U=D_{60}/D_{10}$	$C_c=D_{30}^2/(D_{10}xD_{60})$	Relative Density	IS-Notation	
																									Gravel	Sand
1.0	5	SS	31	48	21	27	0.63	14	87	M.Stiff	Above	CI	-	-	-	-	76	24	-	-	-	-	-	FG>50%	FG>50%	FG>50%
2.0	7	SS	35	51	26	25	0.64	13	54	M.Stiff	Above	CH	-	-	-	-	62	38	-	-	-	-	-	FG>50%	FG>50%	FG>50%
3.0	5	SS	35	54	25	29	0.66	13	42	M.Stiff	Above	CH	-	-	-	-	65	35	-	-	-	-	-	FG>50%	FG>50%	FG>50%
4.0	12	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	2	58	33	5	2	-	-	-	-	-	M.Dense	<50%	SP-SM
5.0	13	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	1	49	38	12	0	-	-	-	-	-	M.Dense	<50%	SP-SM
6.5	21	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	4	60	29	7	0	-	-	-	-	-	M.Dense	<50%	SP-SM
8.0	15	SS	-	-	-	-	-	-	-	CG>50%	-	-	2	2	62	27	7	0	-	-	-	-	-	M.Dense	<50%	SP-SM
9.5	3	SS	24	28	15	13	0.31	13	5	CG>50%	Above	-	0	2	18	41	34	5	-	-	-	-	-	V.Loose	<50%	SC
11.0	13	SS	18	37	15	22	0.86	13	14	CG>50%	Above	-	0	0	12	50	32	6	-	-	-	-	-	M.Dense	<50%	SC
12.5	4	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	3	46	29	22	0	-	-	-	-	-	V.Loose	<50%	SM
14.0	6	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	0	17	53	30	0	-	-	-	-	-	Loose	<50%	SM
15.5	29	SS	21	57	24	33	1.09	13	41	V.Stiff	Above	CH	-	-	-	-	65	35	-	-	-	-	-	FG>50%	FG>50%	FG>50%
17.0	26	SS	19	52	23	29	1.14	12	33	V.Stiff	Above	CH	-	-	-	-	69	31	-	-	-	-	-	FG>50%	FG>50%	FG>50%
18.5	15	SS	32	80	30	50	0.96	11	50	Stiff	Above	CH	-	-	-	-	60	40	-	-	-	-	-	FG>50%	FG>50%	FG>50%
20.0	21	SS	23	74	29	45	1.13	10	59	V.Stiff	Above	CH	-	-	-	-	57	43	-	-	-	-	-	FG>50%	FG>50%	FG>50%
21.5	26	SS	-	-	-	-	-	-	-	CG>50%	-	-	1	3	31	36	29	0	-	-	-	-	-	M.Dense	<50%	SM
23.0	29	SS	-	-	-	-	-	-	-	CG>50%	-	-	1	3	34	34	28	0	-	-	-	-	-	M.Dense	<50%	SM
24.5	>100	SS	17	42	21	21	1.19	14	4	Hard	Above	CI	-	-	-	-	79	21	-	-	-	-	-	FG>50%	FG>50%	FG>50%
26.0	>100	SS	21	45	26	19	1.26	15	7	Hard	Above	CI	-	-	-	-	81	19	-	-	-	-	-	FG>50%	FG>50%	FG>50%

FG = Fine Grained
CG = Coarse Grained
NMC= Nature Moisture Content
LL = Liquid Limit
PL = Plastic Limit
Ip = Plasticity Index
Ic = (LL-NMC)/Ip
SL = Shrinkage Limit
FS = Differential Free Swell Index
C_U = Uniformity Coefficient
C_C = Coefficient of Curvature
IP=LL-PL

LAB IN-CHARGE	M.PRAVEEN
REVIEWED BY	K.RAMALINGAM

Table-2.2 Results of Chemical Analysis									
SL No.	Bore HoleNo.	Water				Soil (2:1)			
		Depth of Sample (m)	pH	Chlorides (mg/l)	Sulphates (mg/l)	Depth of Sample (m)	pH	Chlorides (mg/l)	Sulphates (mg/l)
1	BH-01	3.20	7.36	334	415	3.0	7.34	318	395

CHAPTER-3

GEOLOGY & SUB-SURFACE STRATIFICATION

3.0 Preamble:

Geotechnical investigation carried out at a specific site provides location specific sub surface characteristics based on which the design of sub structures/foundations is generally carried out. However, the macro-level understanding of the sub surface is also needed for a comprehensive understanding of the sub structure/foundation response to naturally super imposed loads like earthquake forces etc., The macro level understanding of the sub surface is better provided through the knowledge of the Geology of the region. Since, it is beyond the scope of the present study to carry out geological investigation to establish the geology of the study region; published data are presented below along with the sub surface stratification observed through the direct borehole investigation carried out at the specified locations.

3.1 Geology of Study Area (based on the published data)

Geologically, the present site is located in a coastal region with sub surface consisting of sedimentary deposits. The top sedimentary deposit is under laid by upper Gondwana system, particularly lower stage of Sriperumpudur (Shale Formation).The formation mechanism of the sediments is chiefly due to transportation of surface water and marine deposition.

The above geological characteristics are also observed in the direct bore hole investigation, which confirms that the present site does not depict any surprising geological features that are different from that of the region.

3.2 DESIGN SUB SOIL PROFILE:(WRT Foundation Engineering Application)

The sub soil characteristics obtained at the test location are further processed to arrive at the design soil parameters required for the design of sub structure using the following shear strength correlations with respect to the Standard Penetration Test Values of different layers.

- For Coarse Grained Material, Ref. IS: 6403 to estimate Angle of Shearing Resistance (Reproduced and shown in Fig.A1)
- For Fine Grained Material, Ref. Terzaghi& Peck, 1948, to estimate Unconfined Compressive Strength (Reproduced and shown in Fig.A2)

Based on the above, the average design soil characteristics are given below:

REFERENCE BORE HOLE-BH:					01	Ref R.L. of G.L. (m):			0.00		
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(γ) kN/m^3	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C_u) kPa	(ϕ) Deg.
1	0.00	0.60	0.60	Filled Up Soil	-	-	-	-	-	-	-
2	0.60	3.00	2.40	Silty Clay	Brown	5	-	Medium Stiff	15	33	-
3	3.00	4.00	1.00	Silty Clay	Brownish Grey	8	-	Medium Stiff	16.5	53	-
4	4.00	9.50	5.50	Silty Sand	Brown	15	Medium Dense	-	17.5	-	31.5
5	9.50	11.00	1.50	Clayey Silty Sand	Grey	3	Very Loose	-	13	-	20.07
6	11.00	12.50	1.50	Clayey Silty Sand	Grey	13	Medium Dense	-	16.5	-	30.9
7	12.50	17.00	4.50	Silty Sand	Grey	5	Loose	-	14	-	20.37
8	17.00	21.50	4.50	Silty Clay	Greenish Grey	23	-	Very Stiff	20.5	153	-
9	21.50	24.50	3.00	Silty Sand	Brownish Grey	28	Medium Dense	-	19	-	35.4
10	24.50	26.00	1.50	Compacted Clay (Shale)	Greenish Grey	>100	-	Hard	21	400	-

❖ Note:-Bulk density given in SPT correlation

FOUNDATION SYSTEM

CHAPTER-4

FOUNDATION SYSTEM

4.0 Preamble:

In the design of foundation system, the stress-strain compatibility of the super structure, sub structure and the bearing strata should be satisfied both individually and as a combined system. In view of this, the following data are needed for the design of foundation system, defined in terms of the type of sub structure and the bearing strata characteristics.

- The super structure characteristics along with the loading pattern on the sub structure
- The sub soil characteristics that define the required substructure configuration for a safe transfer of super-structural loads to the bearing strata

Considering the above aspects of the foundation design, the suitable type of foundation system is presented below.

4.1 Proposed Structures

An understanding of the proposed construction and the order of loads on the foundations is needed for choosing the appropriate foundation system.

In the present case, the proposed structure is configured with Stilt and five upper floors, and is meant for commercial building occupancy. For this kind of structure, the column loads could vary between 1,800kN to 2,500 kN. The above mentioned loads have no bearing on the design of either sub or super structures and are mentioned just to provide an insight to choose an appropriate foundation system with respect to subsoil conditions.

4.2 Foundation System

For the kind of proposed structure and the sub soil conditions, it is not possible to adopt any kind of open foundation system from both shear and settlement considerations. Hence, it is advisable to adopt deep pile foundation system.

The piles can be installed by drilling with direct mud circulation technique **(Bored Cast In-situ Piles)** and the recommended safe load carrying capacity of bored cast in-situ piles in compression, tension and lateral for different depth and diameters is worked out as per IS 2911-Part-I-Section-2 and are presented in Table 4.1.

Typical computations are presented in Annexure

Table:- 4.1 Recommended Safe Load Carrying Capacities of Bored Cast-in Situ Piles								
Sl.No	Reference Bore hole No.	Length of Pile below E.G.L	Assumed Length of Cut-Off Below E.G.L	Length of Pile below Cut-off	Dia.of Pile in (mm)	SAFE LOAD CARRYING CAPACITY (kN)		
						Vertical Load Carrying Capacity	Pull Out Capacity	Lateral Load Carrying Capacity
1	BH-01	26.0	1.0	25.00	500	900	500	32
2					550	1000	550	35
3					600	1200	600	38
4					650	1300	700	41
5					750	1500	800	48
6					800	1800	900	51

RECOMMENDATIONS

CHAPTER-5

RECOMMENDATIONS

5.0 Recommendation for Bored Cast In-situ Pile Foundation:

- For the kind of sub soil conditions **Deep Bored Cast in situ piles** are recommended as the suitable foundation system.
- The allowable safe load carrying capacities of different diameters of piles as given in Table-4.1 can be adopted as provisional design loads, as the load carrying capacity of piles not only depends upon the sub soil properties, but also depends on the care and experience of installation piles.
- The theoretical load carrying estimates of piles shall be confirmed by conducting pile loads tests as per the guide lines laid down in IS: 2911-Part-IV.
- The boring shall be carried out using direct mud circulation prepared out of sodium bentonite.
- After reaching the borehole termination depth, the borehole shall be cleaned using mud circulation for a minimum period of 30min or till the return mud is relatively clear of soil particles.
- After ensuring the borehole is clean, the tremie pipe shall be lowered and concrete can be done.

5.1 Construction method statement of pile foundation:

- For the bored cast in situ piles, a guide casing of 2.0 to 3.0m length can be adopted
- The mud used shall be made out of sodium bentonite with minimum frees swell index of more than 300% and liquid limit more than 100%. The silt content in bentonite shall not more than 5%.
- The mud was prepared using sodium bentonite with a density of 1.10 to 1.15 g/cc.

5.2 General Recommendation:

- The chlorides and the sulphate levels are within the permissible limits as per the standards hence no special cement or reinforcement is required for the construction of sub structure.

5.3 Special Recommendations

- *Since, the depth of piles is more and the number being high, in order to assure quality, it is ideal to carry out Pile Integrity Tests on all the piles (apart from load tests on selected piles).*

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THE LANDLENS SUITE

Eight ways to know a piece of land before you pay for it.

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Ask anything about a property and get an answer grounded in live government records, with the sources shown.
/landlens/one

Verify My Land
Every record check run on one property and returned as a single report.
/landlens/verify-my-land

Legal Opinion
An advocate's written opinion on the title, built on the records we pull for it.
/landlens

One Map
Every layer on one map: the parcel, its boundary, zoning, water bodies and what sits around it.
/landlens/one/map

PriceMap
What land actually changed hands for around this plot, taken from the registered deeds.
/landlens/pricemap

Build Scope
What you are allowed to build here: floor space, height, coverage and setbacks.
/landlens/build-scope

Property Tracker
Watch a property and hear about it when something new is registered against it.
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- EC Analyzer
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- Seller background check
- Approval check by survey

Value and duty

What it is worth and what it costs to register.

- Guideline value by street
- Guideline value by survey
- Stamp duty and registration fees
- Capital gains
- Floor space index
- Area unit converter

Zoning and land use

What the plan says can happen on this land.

- Land use zone finder
- CMDA land use check
- Coastal regulation zone
- Master plan check
- Water bodies finder
- Airport height clearance

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Who holds it, and which office keeps the record.

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- Temple property check
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- RERA register

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