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'ThalamuthuNatarajan Building', No.1, Gandhi Irwin Road,
Egmore, Chennai-600 008.

PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that the **Dr. G. MANOJKUMAR** 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 **11years**.

He has been given the Registration No.**GTE/2019/03/012** Renewed on **21.03.2024.** 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 **20.03.2029**.

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21/3/24

(A. MEGANATHAN)
Superintendent

Gateway to Technology

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PROJECT

PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING (STILT+5 UPPER FLOORS) AT NO. 8(12), APPA GARDEN STREET, KILPAUK, CHENNAI – 600 010

CLIENT

CHITALE INFRA LLP,
NO-827, DHUN BUILDING,
ANNA SALAI, MOUNT ROAD,
CHENNAI - 600 002.

TITLE

GEOTECHNICAL INVESTIGATION REPORT

PROJECT NO: GEC-JC-GT-5055/2023-2024

DATE: 02/10/2023

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REPORT TEXT



CHAPTER-1

INTRODUCTION

1.0 Project Information Matrix

Nature of project	: Proposed Residential Building (Stilt+5 Upper Floors)
Project Client	: **M/s CHITALE INFRA LLP,**
Project Location	: No. 8(12), Appa Garden Street, Kilpauk, Chennai.
Job Code	: JC-GT-5055

1.1 Scope Of Work

1.1.1 Field Work

- Conducting two soil investigation bore holes of 150 mm up to 24.0m 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 after that 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

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CHAPTER-2

INVESTIGATION METHODOLOGY & TEST RESULTS

2.0 Preamble:

Two 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.

<u>Note on Groundwater Table Record:</u>

- 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.

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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 to 2.2. The graphical representation of grain size distribution curve for the representative samples in each bore is presented in Fig. 2.3 to 2.4.

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 to 2.2. The graphical representation of hydrometer analyses curve for the representative samples in each bore is presented in Fig.2.5 to 2.8.

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 - 2.3.

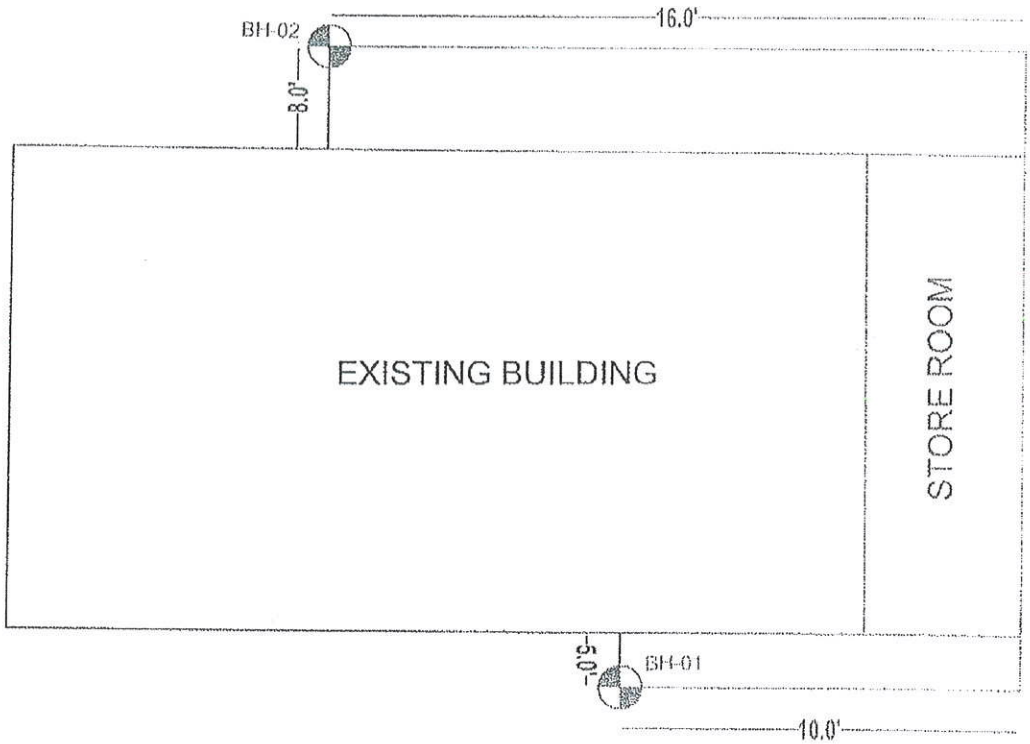
2.3 Summary:

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 to 2.2.

SITE PLAN

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GEO TECH ENGG.DIVISION



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2.0 SITE PLAN SHOWING THE LOCATION OF FIELD INVESTIGATION POINTS AT
APPA GARDEN STREET, KILPAUK, CHENNAI.

SOIL PROFILE



SITE INVESTIGATION RECORD

BORE HOLE No.	BH-01		
SHEET	1	OF	3
DIA OF BORE HOLE	150mm ✓ / NX		
BORE START DATE	21/09/2023		
BORE END DATE	23/09/2023		
TOTAL DRILL DAYS	3		

PROJECT NAME	PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING IN KILPAUK, CHENNAI.				
LOCATION	Kilpauk, Chennai.	MACHINE No.	CR-01	CHAINAGE (m)	-
STRUCTURE	Stilt+5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -
JOB CODE	GEC-JC-GT-5055	FLUSHING MEDIUM	Bentonite		E -

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	15-30	30-45	SPT 'N' Value	Sample Details: Depth	No.	Type	RL (m)	Layer Data: Legend	No	Depth	Geotechnical Description
1																L1	2.2	Filled Up Materials (Bricks and Sand)
2		10	36															
		To		SC	-	-												
		10	45															
3		11	03				10	12	15	27	3.00	1	SS	-3.0				
		To		SC	-	-					3.45							
		11	10															Brownish, Moist, Very Stiff, Silty CLAY (CI) Clays of Medium Plasticity
4		11	40				10	11	13	24	4.00	2	SS	-4.0				
		To		SC	-	-					4.45							
		11	58															
5	21/09/2023	12	33				23	26	16	42	5.00	3	SS	-5.0		L2	5.0	
		To		SC	-	-					5.45							
		12	46															Brownish, Moist, Dense, Poorly Graded, Silty SAND (SM) Sand-Silt Mixture
6																L3	6.5	
							5	7	13	20	6.50	4	SS	-6.5				
7		14	03								6.95							
		To		SC	-	-												Brownish, Moist, Medium Dense, Poorly Graded, Fine to Medium Grained SAND (SP)
		14	17															
8																L4	8.0	
							15	17	22	39	8.00	5	SS	-8.0				
		14	51								8.45							
		To		SC	-	-												
9		15	03															Brownish, Moist, Dense, Poorly Graded, SAND/Silty SAND (SP/SP-SM) Sand-Silt Mixture
							16	21	24	45	9.50	6	SS	-9.5				
10											9.95							

CS - Core Sample	DS - Disturbed Sample	LOGGED	C.CLINTON EMMANUEL	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	21/09/2023	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	JALEEL YASIN	WATER TABLE (m) 4.50	
WS - Wash Sample	DB - Diamond Bit	DATE	28/09/2023	CASING DEPTH (m) 0.00	

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SITE INVESTIGATION RECORD

BORE HOLE No.	BH-01						
SHEET	2	OF	3				
PROJECT NAME	PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING IN KILPAUK, CHENNAI.			DIA OF BORE HOLE	150mm ✓ / NX		
LOCATION	Kilpauk, Chennai.	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	21/09/2023
STRUCTURE	Stilt+5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	23/09/2023
JOB CODE	GEC-JC-GT-5055	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	3

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	21/09/2023	14	51 To 14 54	SC	-	-	14	19	23	42	11.00 / 11.45	7	SS	-11.0				Brownish, Moist, Dense, Poorly Graded, Silty SAND (SP-SM) Sand-Silt Mixture
12		16	36 To 16 40	SC	-	-	8cm Penet. For 50Blows			>100	12.50 / 12.58	8	SS	-12.5		L5	12.5	
13		17	40 To 17 51	SC	-	-	30	47	55	102	14.00 / 14.50	9	SS	-14.0				Yellowish, Moist, Very Dense, Poorly Graded, Silty SAND (SM) Sand-Silt Mixture
15		09	45 To 09 59	SC	-	-	19	27	30	57	15.50 / 15.95	10	SS	-15.5		L6	15.5	
16		10	48 To 11 09	SC	-	-	21	28	33	61	17.00 / 17.45	11	SS	-17.0				Yellowish/Brownish, Moist, Very Dense, Poorly Graded, Silty SAND (SM/SP-SM) Sand-Silt Mixture
18	22/09/2023	12	12 To 12 36	SC	-	-	26	27	32	59	18.50 / 18.95	12	SS	-18.5				
19		14	01 To 14 18	SC	-	-	15cm Penet. For 50Blows			>100	20.00 / 20.15	13	SS	-20.0		L7	20.0	
20																		Pale Greyish, Moist, Very Hard, Sandy Silty CLAY (CL) Clays of Low Plasticity

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CS - Core Sample	DS - Disturbed Sample	LOGGED	C.CLINTON EMMANUEL	PROJECT SITE DETAILS		REMARKS	
SS - Split Spoon Sample	SC - Soil Cutter	DATE	22/09/2023	GROUND LEVEL (m)	0.00		
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	JALEEL YASIN	WATER TABLE (m)	4.50		
WS - Wash Sample	DB - Diamond Bit	DATE	26/09/2023	CASING DEPTH (m)	0.00		

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-01		
SHEET	3	OF	3
DIA OF BORE HOLE	150mm ✓ / NX		
BORE START DATE	21/09/2023		
BORE END DATE	23/09/2023		
TOTAL DRILL DAYS	3		

PROJECT NAME	PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING IN KILPAUK, CHENNAI.						
LOCATION	Kilpauk, Chennai.	MACHINE No.	CR-01	CHAINAGE (m)	-		
STRUCTURE	Stilt+5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N	-	
JOB CODE	GEC-JC-GT-5055	FLUSHING MEDIUM	Bentonite		E	-	

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	Layer Data: Geotechnical Description
21	22/02/2023	17	11	SC	-	-										L8	21.0	Pale Greyish, Moist, Very Hard, Sandy Silty CLAY (CL) Clays of Low Plasticity
		To																
		17	28															
22							19	23	28	51	22.00	14	SS	-22.0				Pale Greyish, Moist, Very Hard, Silty CLAY (CH) Clays of High Plasticity
											22.45					L9	22.5	
23	23/09/2023	09	14	SC	-	-												Pale Brownish, Moist, Very Hard, Compacted Clay (SHALE) - Fragments of Shale
		To																
		09	38															
24							7cm Penet. For 50Blows			>100	24.00	15	SS	-24.0		L10	24.0	
											24.07							
25																		
26																		
27																		
28																		
29																		
30																		

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CS - Core Sample	DS - Disturbed Sample	LOGGED	C.CLINTON EMMANUEL	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	23/09/2023	GROUND LEVEL (m)	0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	JALEEL YASIN	WATER TABLE (m)	4.50	
WS - Wash Sample	DB - Diamond Bit	DATE	28/09/2023	CASING DEPTH (m)	0.00	

Borehole terminated at 24 m depth below E.G.L

FIG.2.1 Sub Soil Profile at BH-01 Location

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-02		
SHEET	1	OF	3
DIA OF BORE HOLE	150mm / NX		✓
BORE START DATE	23/09/2023		
BORE END DATE	25/09/2023		
TOTAL DRILL DAYS	3		

PROJECT NAME	PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING IN KILPAUK, CHENNAI.						
LOCATION	Kilpauk, Chennai.	MACHINE No.	CR-01	CHAINAGE (m)	-		
STRUCTURE	Stilt+5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N	-	
JOB CODE	GEC-JC-GT-5055	FLUSHING MEDIUM	Bentonite		E	-	

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
1	23/09/2023	17	08	SC	-	-												
		To																
		17	17															
2		17	44				7	6	5	11	2.00	1	SS	-2.0		L1	2.0	Filled Up Materials (Bricks and Sand)
		To		SC	-	-					2.45							
		17	58															
3		18	16				7	8	10	18	3.00	2	SS	-3.0		L2	3.0	Brownish, Moist, Stiff, Silty CLAY (Cl) Clays of Medium Plasticity
		To		SC	-	-					3.45							
		18	33															
4		19	18				9	11	13	24	4.00	3	SS	-4.0		L3	4.0	Brownish, Moist, Very Stiff, Silty CLAY (Cl) Clays of Medium Plasticity
		To		SC	-	-					4.45							
		19	31															
5		06	42				12	12	15	27	5.00	4	SS	-5.0				
		To		SC	-	-					5.45							
		06	59															
6	24/09/2023	07	27				6	8	11	19	6.50	5	SS	-6.5				Brownish, Moist, Medium Dense, Poorly Graded, Silty SAND/SAND (SM/SP) Sand-Silt Mixture
		To		SC	-	-					6.95							
7		07	40															
		08	03				9	11	16	27	8.00	6	SS	-8.0				
8		To		SC	-	-					8.45							
		08	20															
9																		
							11	16	19	35	9.50	7	SS	-9.5		L4	9.5	
10											9.95							Brownish, Moist, Dense, Poorly Graded, Silty SAND (SM) Sand-Silt Mixture

CS - Core Sample	DS - Disturbed Sample	LOGGED	C.CLINTON EMMANUEL	PROJECT SITE DETAILS		REMARKS	
SS - Split Spoon Sample	SC - Soil Cutter	DATE	24/09/2023	GROUND LEVEL (m)	0.00		
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	JALEEL YASIN	WATER TABLE (m)	4.50		
WS - Wash Sample	DB - Diamond Bit	DATE	28/09/2023	CASING DEPTH (m)	0.00		

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SITE INVESTIGATION RECORD

BORE HOLE No.	BH-02						
SHEET	2	OF	3				
PROJECT NAME	PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING IN KILPAUK, CHENNAI.					DIA OF BORE HOLE	150mm / NX ✓
LOCATION	Kilpauk, Chennai.	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	23/09/2023
STRUCTURE	Stilt+5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	25/09/2023
JOB CODE	GEC-JC-GT-5055	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	3

Depth below E.G.L. (m)	Date	Drilling progress per metre: 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	Blows/cm. 15-30	Blows/cm. 30-45	SPT 'N' Value	Sample Details: Depth	No.	Type	RL (m)	Layer Data: Legend	No	Depth	Geotechnical Description
11	24/09/2023	08	33 To 08 35	SC	-	-	15	20	24	44	11.00 / 11.45	8	SS	-11.0				Brownish, Moist, Dense, Poorly Graded, Silty SAND (SP-SM) Sand-Silt Mixture
12		08	52 To 08 59	SC	-	-	12cm Penet. For 50Blows			>100	12.50 / 12.62	9	SS	-12.5		L5	12.5	
13		09	16 To 09 20	SC	-	-	28	45	62	107	14.00 / 14.50	10	SS	-14.0				Yellowish, Moist, Very Dense, Poorly Graded, Silty SAND (SM) Sand-Silt Mixture
15		09	42 To 09 51	SC	-	-	20	29	34	63	15.50 / 15.95	11	SS	-15.5		L6	15.5	
16		10	13 To 10 20	SC	-	-	22	28	34	62	17.00 / 17.45	12	SS	-17.0				Brownish, Moist, Very Dense, Poorly Graded, Silty SAND (SM/SP-SM) Sand-Silt Mixture
18		10	43 To 10 52	SC	-	-	25	29	34	63	18.50 / 18.95	13	SS	-18.5				
19	25/09/2023	08	12 To 08 23	SC	-	-	12cm Penet. For 50Blows			>100	20.00 / 20.12	14	SS	-20.0		L7	20.0	
20																		Pale Greyish, Moist, Very Hard, Sandy Silty CLAY (CL) Clays of Low Plasticity

GEO ENGINEERING CONSULTANTS Chennai 600 042

CS - Core Sample	DS - Disturbed Sample	LOGGED	C.CLINTON EMMANUEL	PROJECT SITE DETAILS		REMARKS	
SS - Split Spoon Sample	SC - Soil Cutter	DATE	25/09/2023	GROUND LEVEL (m)	0.00		
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	JALEEL YASIN	WATER TABLE (m)	4.50		
WS - Wash Sample	DB - Diamond Bit	DATE	28/09/2023	CASING DEPTH (m)	0.00		

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-02						
SHEET	3	OF	3				
PROJECT NAME	PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING IN KILPAUK, CHENNAI.			DIA OF BORE HOLE	150mm	✓	
					NX		
LOCATION	Kilpauk, Chennai.	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	23/09/2023
STRUCTURE	Stilt+5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	25/09/2023
JOB CODE	GEC-JC-GT-5055	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	3

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	Layer Data: Geotechnical Description
21	25/09/2023	09	05	SC	-	-										L8	21.0	Pale Greyish, Moist, Very Hard, Sandy Silty CLAY (CL) Clays of Low Plasticity
		To																
		09	21															
22							20	26	29	55	22.00	15	SS	-22.0		L9	22.5	Pale Greyish, Moist, Very Hard, Silty CLAY (CH) Clays of High Plasticity
											22.45							
23		09	52	SC	-	-												Pale Brownish, Moist, Very Hard, Compacted Clay (SHALE) - Fragments of Shale
		To																
		10	14															
24							5cm Penet. For 50Blows			>100	24.00	16	SS	-24.0		L10	24.0	
											25.05							
25																		
26																		
27																		
28																		
29																		
30																		

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CS - Core Sample	DS - Disturbed Sample	LOGGED	C.CLINTON EMMANUEL	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	25/09/2023	GROUND LEVEL (m)	0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	JALEEL YASIN	WATER TABLE (m)	4.50	
WS - Wash Sample	DB - Diamond Bit	DATE	28/09/2023	CASING DEPTH (m)	0.00	

Borehole terminated at 24 m depth below E.G.L

FIG.2.2 Sub Soil Profile at BH-02 Location

Grain Size Distribution Curves



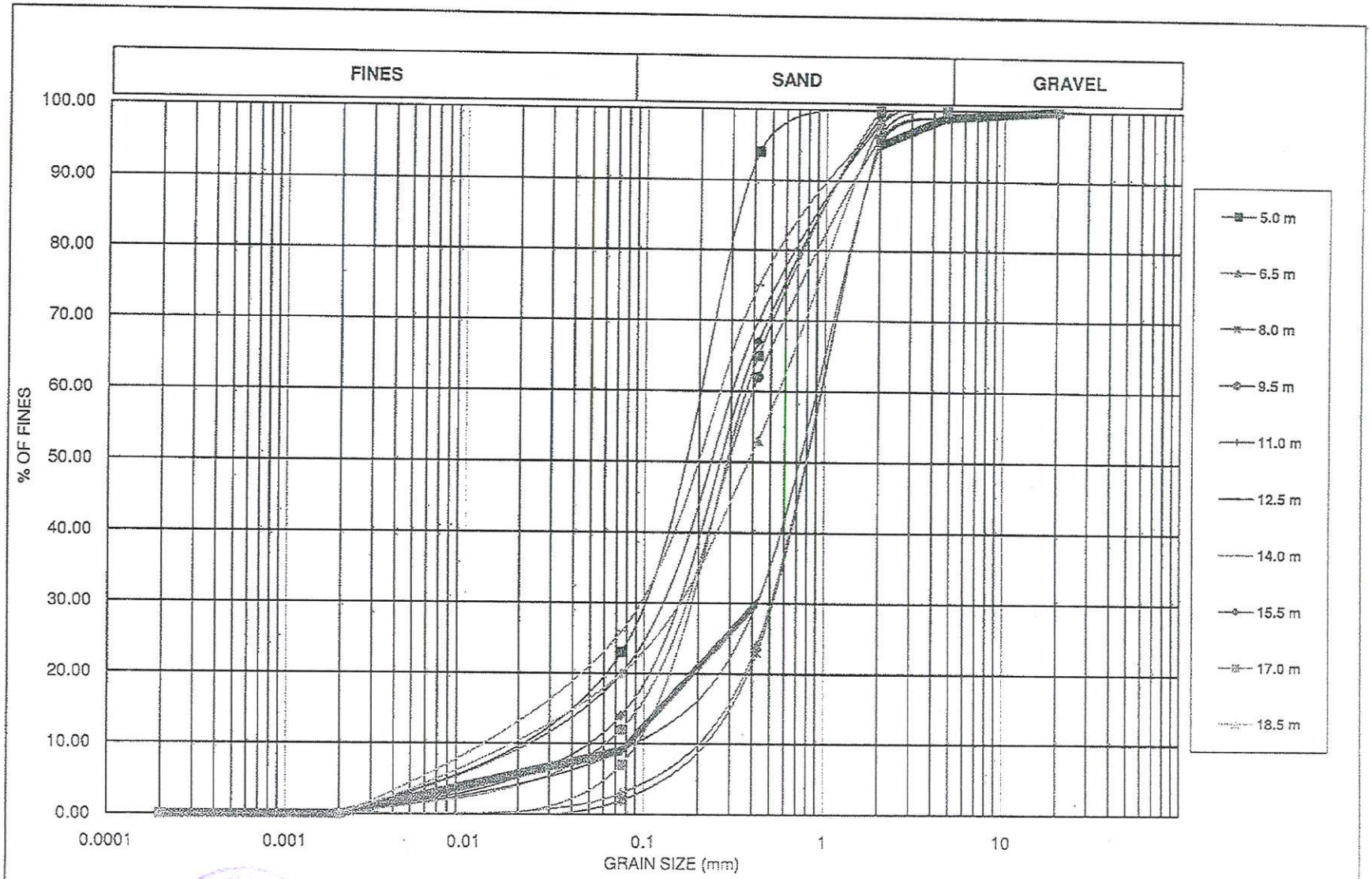


Fig. 2.3 GRAIN SIZE DISTRIBUTION CURVE - BH-01

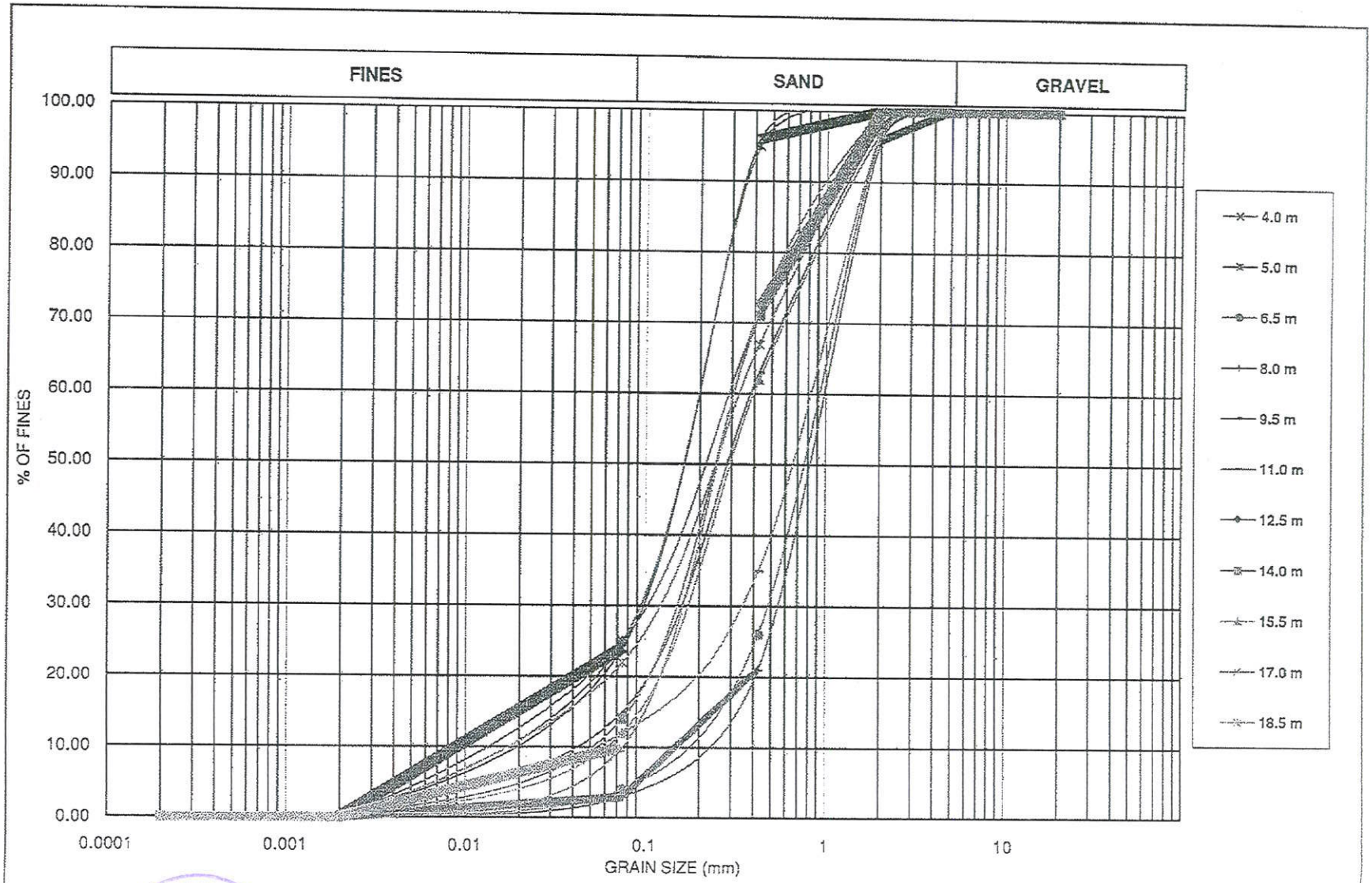


Fig. 2.4 GRAIN SIZE DISTRIBUTION CURVE - BH-02

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HYDROMETER ANALYSIS CURVE



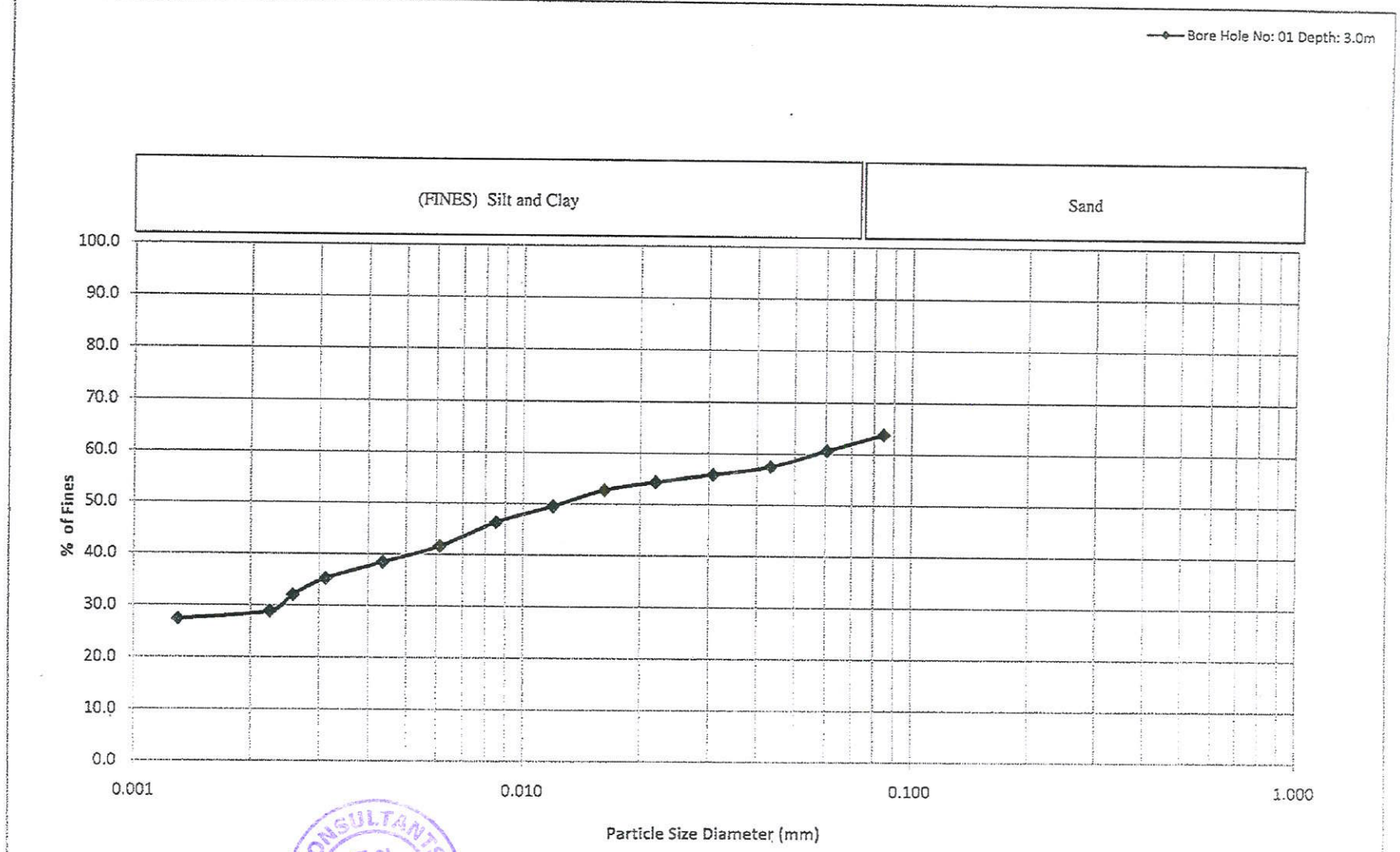


Fig 2.5 Hydrometer Analysis Master Curve

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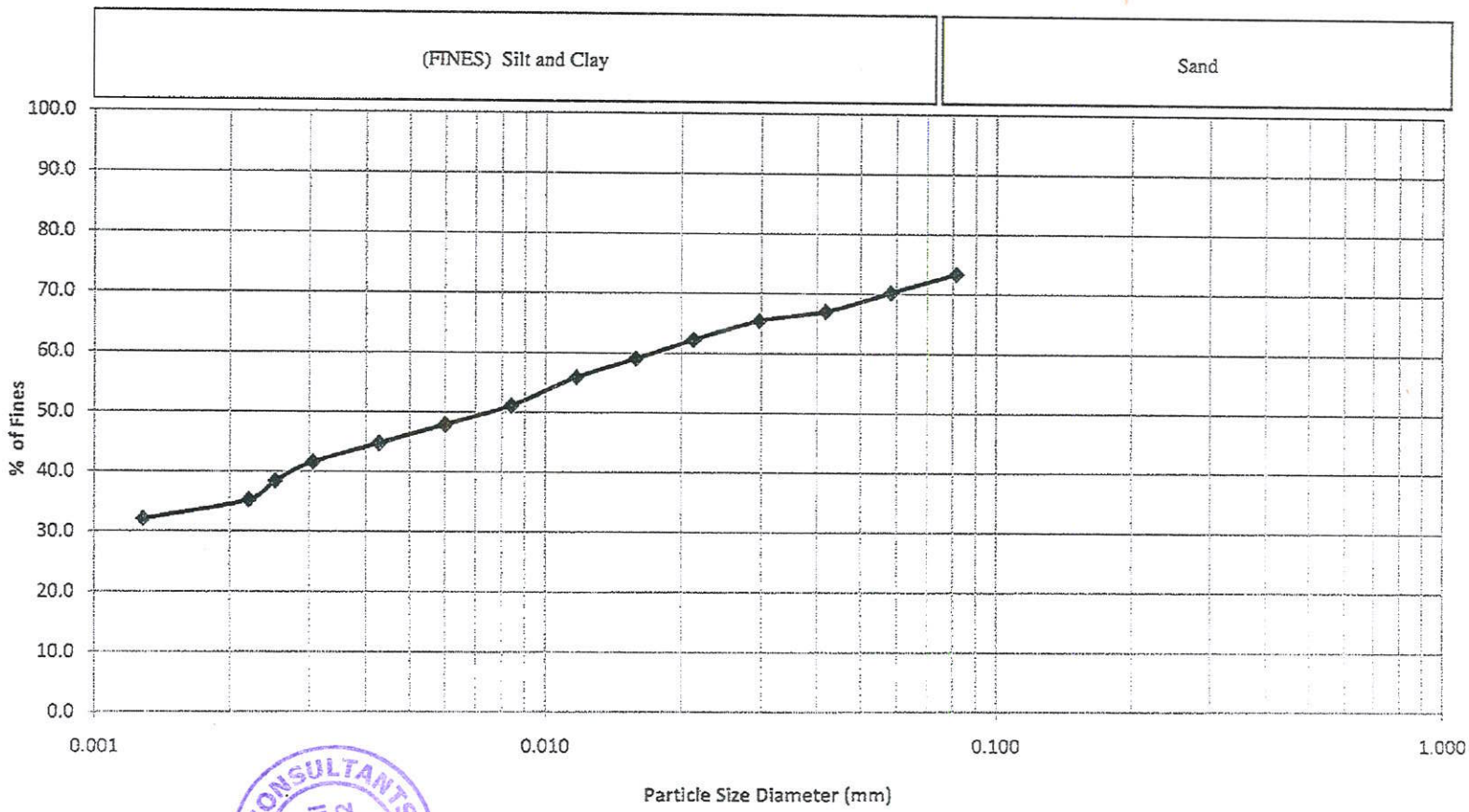


Fig 2.6 Hydrometer Analysis Master Curve

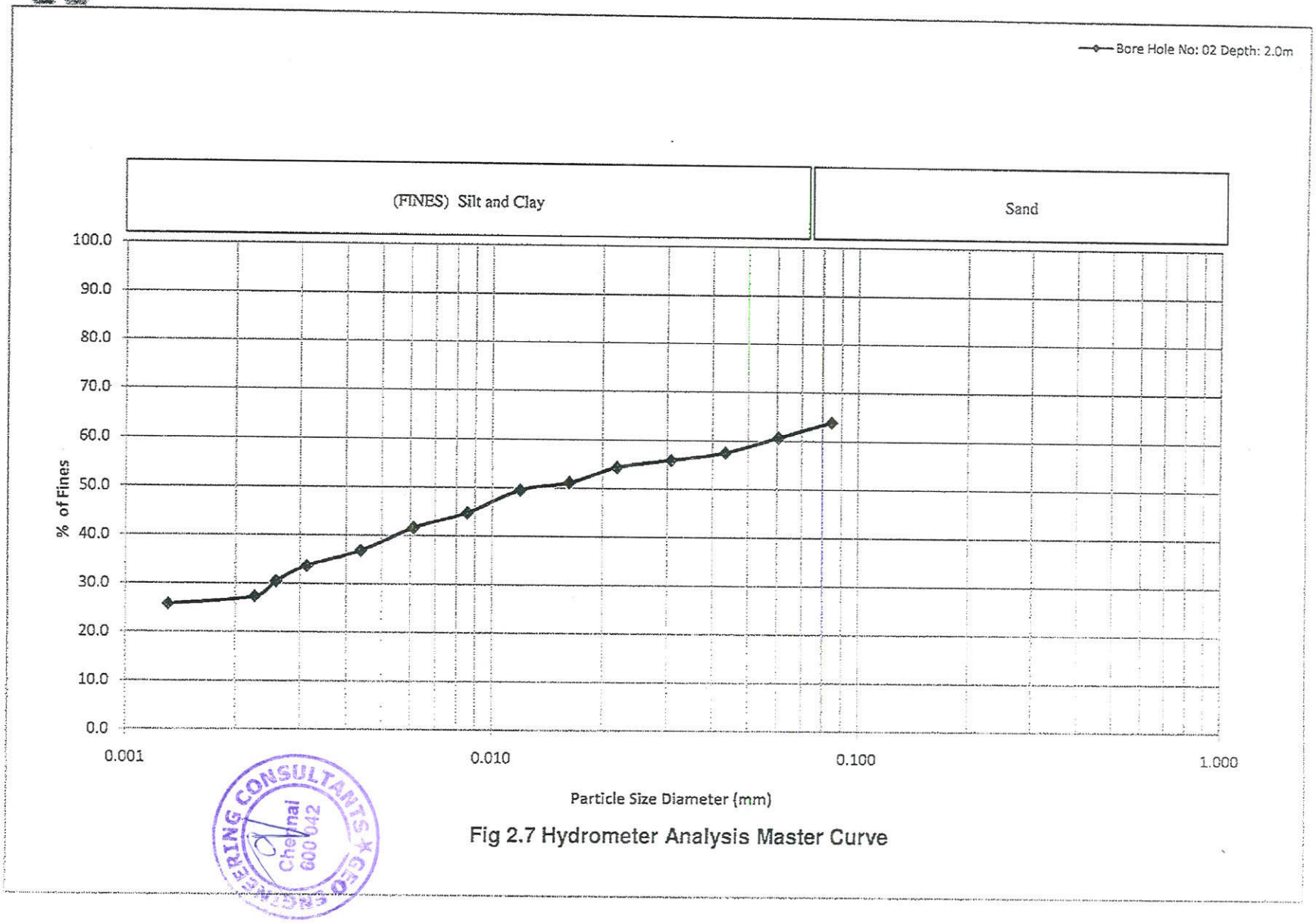


Fig 2.7 Hydrometer Analysis Master Curve

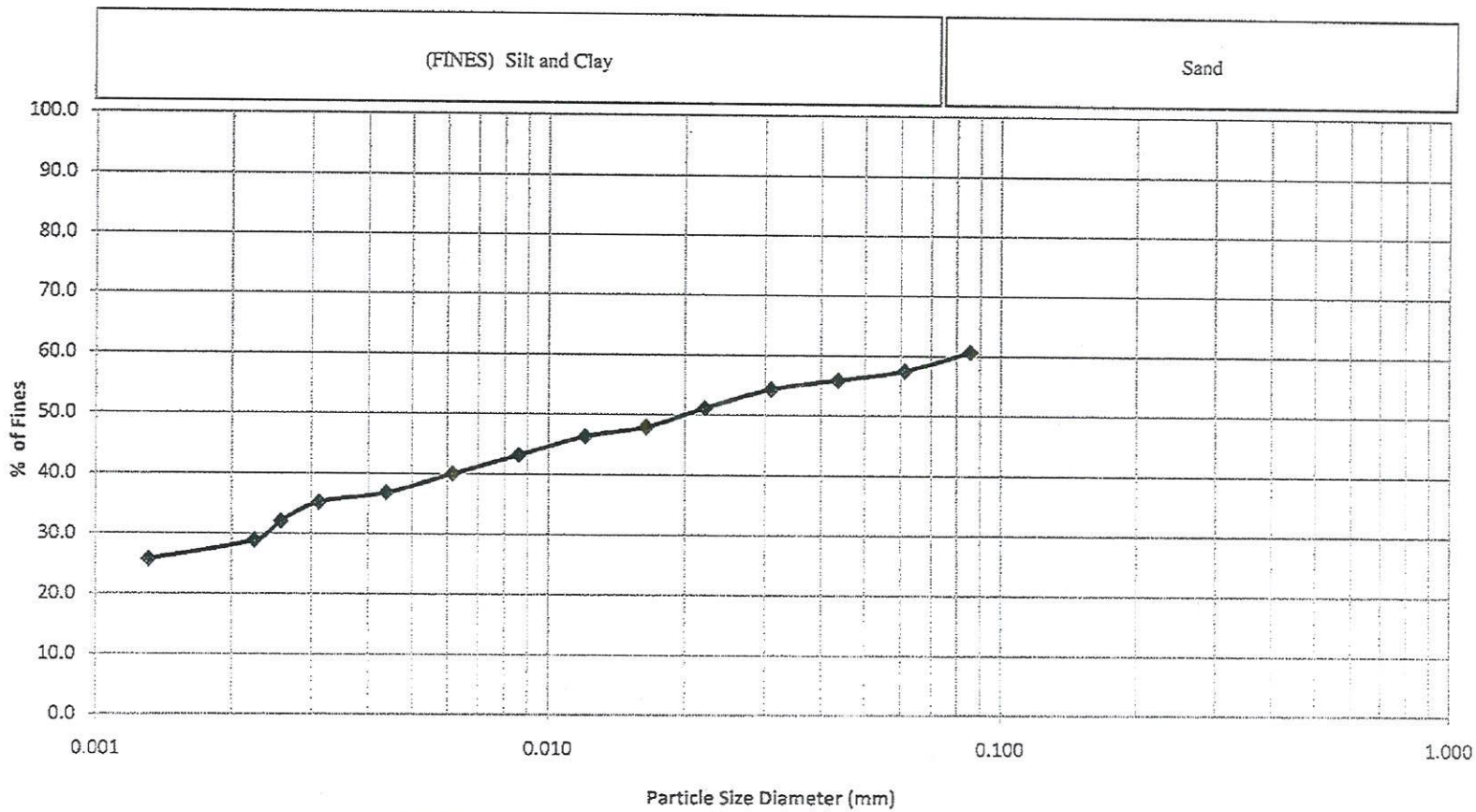


Fig 2.8 Hydrometer Analysis Master Curve

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)												IS-Notation		
			NMC(%)	LL (%)	PL (%)	I_p	Ic	SL (%)	FS (%)	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	Gravel	Sand
3.0	27	SS	21	47	23	24	1.08	13	47	V.Stiff	Above	CI	-	-	-	-	73	27	-	-	-	-	-	FG>50%	FG>50%	FG>50%
4.0	24	SS	20	44	22	22	1.09	13	54	V.Stiff	Above	CI	-	-	-	-	75	25	-	-	-	-	-	FG>50%	FG>50%	FG>50%
5.0	42	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	0	6	71	23	0	-	-	-	-	-	Dense	<50%	SM
6.5	20	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	4	72	21	3	0	-	-	-	-	-	M.Dense	<50%	SP
8.0	39	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	4	73	21	2	0	-	-	-	-	-	Dense	<50%	SP
9.5	45	SS	-	-	-	-	-	-	-	CG>50%	-	-	1	3	34	50	12	0	-	-	-	-	-	Dense	<50%	SP-SM
11.0	42	SS	-	-	-	-	-	-	-	CG>50%	-	-	1	4	65	21	9	0	-	-	-	-	-	Dense	<50%	SP-SM
12.5	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	2	28	50	20	0	-	-	-	-	-	V.Dense	<50%	SM
14.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	2	23	49	26	0	-	-	-	-	-	V.Dense	<50%	SM
15.5	57	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	1	32	53	14	0	-	-	-	-	-	V.Dense	<50%	SM
17.0	61	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	0	35	58	7	0	-	-	-	-	-	V.Dense	<50%	SP-SM
18.5	59	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	2	45	33	20	0	-	-	-	-	-	V.Dense	<50%	SM
20.0	>100	SS	12	33	17	16	1.31	16	36	Hard	Above	CL	0	0	14	26	45	15	-	-	-	-	-	FG>50%	FG>50%	FG>50%
22.0	51	SS	23	76	28	48	1.10	10	93	Hard	Above	CH	-	-	-	-	68	32	-	-	-	-	-	FG>50%	FG>50%	FG>50%
24.0	>100	SS	11	33	19	14	1.57	15	28	Hard	Above	CL	0	1	6	13	55	25	-	-	-	-	-	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 Frees Well Index
C_U = Uniformity Coefficient
C_C = Coefficient of Curvature
IP=LL-PL

LAB IN-CHARGE	M.PRAVEEN
REVIEWED BY	JALEEL YASIN

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Table-2.2 Laboratory Classification of Soil Samples from BH-02

Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	Sub Soil Classification																									
			Fine Grained (FG)									Coarse Grained (CG)												IS-Notation				
			NMC(%)	LL (%)	PL (%)	I_p	Ic	SL (%)	FS (%)	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	Gravel	Sand		
2.0	11	SS	26	45	23	22	0.86	13	42	Stiff	Above	CI	-	-	-	-	74	26	-	-	-	-	-	FG>50%	FG>50%	FG>50%		
3.0	18	SS	18	47	23	24	1.21	13	49	V.Stiff	Above	CI	-	-	-	-	75	25	-	-	-	-	-	FG>50%	FG>50%	FG>50%		
4.0	24	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	0	4	72	24	0	-	-	-	-	-	M.Dense	<50%	SM		
5.0	27	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	0	5	70	25	0	-	-	-	-	-	M.Dense	<50%	SM		
6.5	19	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	3	71	22	4	0	-	-	-	-	-	M.Dense	<50%	SP		
8.0	27	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	4	75	18	3	0	-	-	-	-	-	M.Dense	<50%	SP		
9.5	35	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	2	35	48	15	0	-	-	-	-	-	Dense	<50%	SM		
11.0	44	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	3	62	23	12	0	-	-	-	-	-	Dense	<50%	SP-SM		
12.5	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	3	32	48	17	0	-	-	-	-	-	V.Dense	<50%	SM		
14.0	107	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	2	27	46	25	0	-	-	-	-	-	V.Dense	<50%	SM		
15.5	63	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	3	35	50	12	0	-	-	-	-	-	V.Dense	<50%	SP-SM		
17.0	62	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	0	28	62	10	0	-	-	-	-	-	V.Dense	<50%	SP-SM		
18.5	63	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	1	32	45	22	0	-	-	-	-	-	V.Dense	<50%	SM		
20.0	>100	SS	11	30	16	14	1.36	17	31	Hard	Above	CL	0	0	12	32	42	14	-	-	-	-	-	FG>50%	FG>50%	FG>50%		
22.0	55	SS	20	68	26	42	1.14	11	75	Hard	Above	CH	-	-	-	-	70	30	-	-	-	-	-	FG>50%	FG>50%	FG>50%		
24.0	>100	SS	10	34	18	16	1.50	16	39	Hard	Above	CL	0	0	5	14	55	26	-	-	-	-	-	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 Frees Well Index
C_U = Uniformity Coefficient
C_C = Coefficient of Curvature
IP=LL-PL

LAB IN-CHARGE	M.PRAVEEN
REVIEWED BY	JALEEL YASIN

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Table-2.3 Results of Chemical Analysis									
SL No.	Bore HoleNo.	Water				Soil(2:1)			
		Depth of Sample (m)	pH	Chlorides (ppm)	Sulphates (ppm)	Depth of Sample (m)	pH	Chlorides (ppm)	Sulphates (ppm)
1	BH-01	4.50	7.38	396	445	3.0	7.37	405	462
2	BH-02	4.50	7.38	397	448	3.0	7.37	409	460

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:

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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	2.20	2.20	FilledUp Soil	-	-	-	-	-	-	-
2	2.20	5.00	2.80	Silty Clay	Brownish	26	-	Very Stiff	20.5	173	-
3	5.00	6.50	1.50	Silty Sand	Brownish	42	Dense	-	20	-	39.2
4	6.50	8.00	1.50	Sand	Brownish	20	Medium Dense	-	18	-	33
5	8.00	12.50	4.50	Silty Sand	Greyish	42	Dense	-	20	-	39.2
6	12.50	15.50	3.00	Silty Sand	Yellowish	>100	Very Dense	-	21	-	42.5
7	15.50	20.00	4.50	Silty Sand	Yellowish	59	Very Dense	-	20.5	-	42.35
8	20.00	21.00	1.00	Sandy Silty Clay	Brownish	>100	-	Hard	21	400	-
9	21.00	22.50	1.50	Silty Clay	Pale Greyish	51	-	Hard	22	340	-
10	22.50	24.00	1.50	Compacted Clay (Shale)	Pale Brownish	>100	-	Hard	22	400	-



REFERENCE BORE HOLE-BH:					02	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	2.00	2.00	FilledUp Soil	-	-	-	-	-	-	-
2	2.00	3.00	1.00	Silty Clay	Brownish	11	-	Stiff	18	73	-
3	3.00	4.00	1.00	Silty Clay	Brownish	18	-	Very Stiff	20	120	-
4	4.00	9.50	5.50	Silty Sand	Brownish	24	Medium Dense	-	18.5	-	34.2
5	9.50	12.50	3.00	Silty Sand	Greyish	10	Loose	-	15	-	30
6	12.50	15.50	3.00	Silty Sand	Yellowish	>100	Very Dense	-	21	-	42.5
7	15.50	20.00	4.50	Silty Sand	Yellowish	63	Very Dense	-	21	-	42.5
8	20.00	21.00	1.00	Sandy Silty Clay	Brownish	>100	-	Hard	21	400	-
9	21.00	22.50	1.50	Silty Clay	Pale Greyish	55	-	Hard	22	367	-
10	22.50	24.00	1.50	Compacted Clay (Shale)	Pale Brownish	>100	-	Hard	22	400	-

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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 residential use. For this kind of structure, the column loads could vary between 1500kN to 2500kN. 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

4.2.1 Option-I-Isolated Column Footings

For the kind of proposed structure and sub soil conditions, shallow foundation system coupled with soil replacement within the foundation trench can be adopted. The Isolated column footings can be located at a depth of 2.70m over a well compacted sand-gravel (1:1) mix or quarry dust of 300mm thickness laid in non-compacted layers of 150mm at optimum moisture content and compacted using a plate compactor or hand ramming technique. Thus the overall depth of foundation excavation will be 3.00m below the existing ground level. The schematic arrangement of foundation system is presented in Fig. 4.1.

The Isolated column footings can be designed for an allowable safe bearing pressure of 300kPa. Typical computation is presented in the annexure

4.2.2 Option-II-Deep pile foundation

In case of open foundation is not feasible, alternatively deep pile foundation system can be adopted. 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 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

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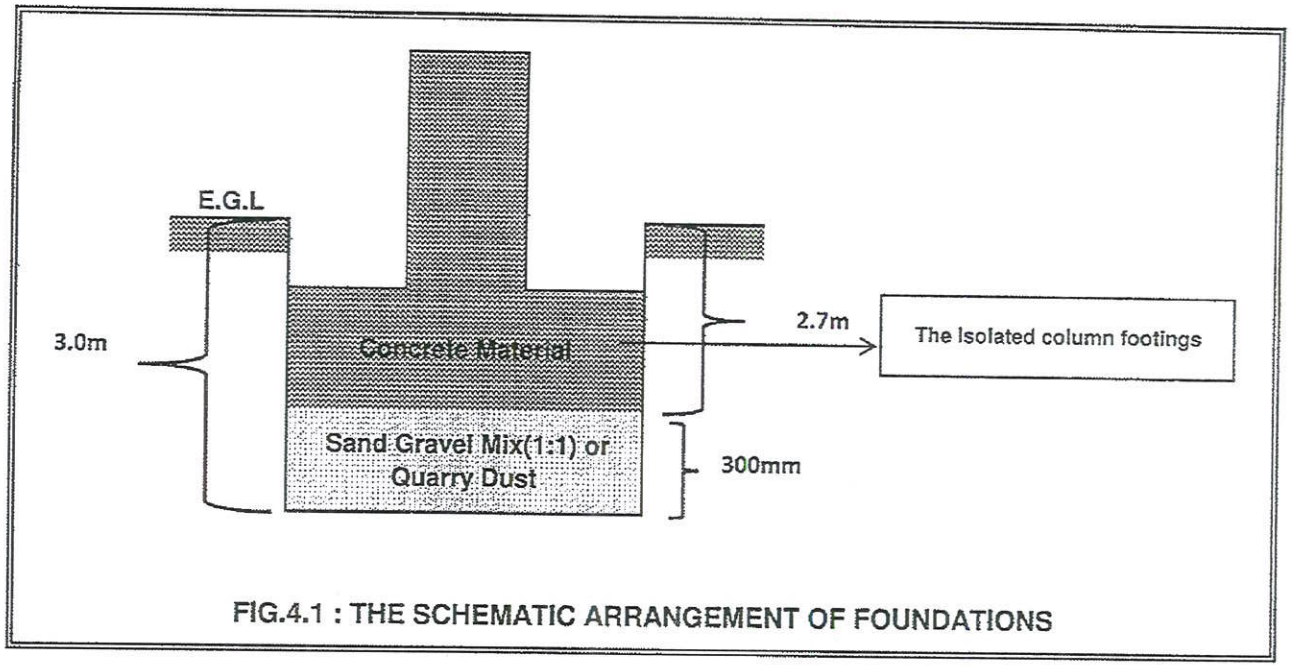


FIG.4.1 : THE SCHEMATIC ARRANGEMENT OF FOUNDATIONS

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	20.0	1.0	19.00	450	950	800	50
2					500	1200	950	55
3					550	1400	1050	65
4					600	1600	1150	70
5					650	1800	1250	75
6					750	2100	1400	85
7					800	2300	1500	95

RECOMMENDATIONS



RECOMMENDATIONS

5.0 Recommendation for shallow foundation

- For the kind of sub soil conditions open foundation system coupled with soil replacement type of ground improvement technique can be adopted.
- The depth of foundation excavation shall be 3.00m below the ground level and shall be back filled with either sand-gravel mix (1:1) or quarry dust of 300mm thickness laid in non-compacted layers of thickness not more than 150mm and compacted at optimum moisture content using a plate vibrator.
- The Isolated column footings can be located at 2.70m over the prepared bed and shall be designed for an allowable bearing pressure of 300 kPa.
- The back filling of foundation trenches shall be carried out using either sand/gravel or quarry dust.
- All columns shall be connected with grade beams in both the directions irrespective of wall layout
- The ground floor shall be minimum 1.0m above the natural ground and the plingth shall be filled with sand/gravel/quarry dust. This height is recommended to contain the influence of soil volume change on the flooring. In case, floor is not raised, the ground floor shall be constructed as a suspended R.C.C. slab.

5.1 Recommendation for Deep pile foundation system:

- If deep pile foundation system adopt, Bored Cast in situ piles are recommended as the suitable foundation system.
- The allowable safe load carrying capacities as per IS 2911-Part-I-Section-2 (2010) for different diameters of piles with two different approaches are 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.

5.2 Construction method statement of pile foundation:

- For the bored cast in situ piles, a guide casing of 2.0m 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.

5.3 General Recommendation:

- Since, chlorides and sulphates are well within the permissible limits, no special steel or cement is required for the construction of footings

FOR GEO ENGINEERING CONSULTANTS, CHENNAI

AUTHORIZED SIGNATORY

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ANNEXURE

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TYPICAL BEARING CAPACITY COMPUTATIONS FOR SHALLOW FOUNDATIONS

1.0 COMPUTATION OF BEARING CAPACITY AS PER IS:6403

1.1 Geometrical Data :

	Ref.BH-02	
Shape of the Foundation	Square	
Depth of Foundation Below E.G.L"Df" (m)	2.70	
Soil Replacement Thickness of CNS Layer (m)	0.30	
Total Depth of Foundation (m)	3.00	
Breadth of Footing "B" (m)	1.50	
Length of Footing "L" (m)	1.50	
B/L	1.00	
Inclination of Vertical Load with the Vertical (a)	0.00	

1.2 Soil Data :

Type of Effective Bearing Strata :	Clay	
Average Design SPT-value of the Bearing Strata	18.00	
Type of Shear Failure:	General	
Undrained Shear Strength (Cu)	120.00	kPa

1.3 Design Parameters:

Bulk Density of Soil above the foundation depth (γ_{bulk})	18.00	kN/m^3
Water Table Correction Factor (w')	0.50	
Effective Overburden pressure at foundation level (q)	21.60	kPa

Bearing Capacity Factors:

N_c = 5.14

N_q = -

N_g = -

Shape Factors:

S_c = 1.30

S_q = -

S_g = -

Depth Factors :

D_c = 1.36

D_q = -

D_g = -

Inclination Factor:

I_c = 1.00

I_q = -

I_g = -

1.4 Ultimate Bearing Capacity (Qu) :

Qu=Cu*Nc*Sc*Dc*Ic 1090.50 kPa

1.5 Safe Bearing Capacity (Qsafe) :

Factor of Safety (F.S.) : 2.50

Qsafe : 436.20 kPa

Say Q_{safe} 300 kPa



2 Computation of Settlement for Maximum Pressure and Size of Footing: (as per IS:8009-Part-I-Ref. Eq.11) (Elastic Analysis)

The immediate elastic settlement (S_i)= $qB(1-m^2)*I/E_s$

q= bearing pressure	300.00	kPa
Poission's Ratio (μ)	0.50	
Modulus of Elasticity (E_s)(Ref. Joseph E Bowels,1996,page316,Table5.6, Japanese design standards)		
Modulus of Elasticity (E_s)	60000.00	kPa
Size of footing considered for maximum settlement(m)	1.50	
Influence factor	1.00	
Rigidity Factor	1.00	
Elastic Settlement (DH_i)	5.63	mm
	<50	mm

ESTIMATION OF SAFE LOAD CARRYING CAPACITY OF BORED CAST-INSITU PILES

Type of Pile			Bored		Diameter of Pile			Length of Pile below E.G.L.(m)		20		As Per IS:2911-(P-I,S-2)-2010								
Reference Bore Hole			BH-01					500	mm	Surcharge Pressure		0	kPa							
Layer No.	Layer Thk. (m)			Type of Strata	Ave. SPT	(γ) kN/m^3		Shear Parameters		Effective Overburden Pressure (kPa)			Adhesion Factor (α)	Earth Pressure Coefficient (k)	Skin Friction (Q_f) kN					
	Top. R.L.	Bot. R.L.	Thickness			of Layer	Ave. upto Layer	(C_u) kPa	(ϕ) Deg.	At top of Layer	At Bot. of Layer	At Mid. of Layer								
1	0	1	1	Cut-Off Level																
2	1	3	2.0	Clay	26	19.0	19.0	-	34.8	0.0	18.0	9.0	-	1.2	qf	2	24.4			
3	3	5	2.0	Sand	40	20.0	19.5	-	38.8	18.0	38.0	28.0	-	1.4	qf	3	101.9			
4	5	6.5	1.5	Sand	20	18.0	19.0	-	33.0	38.0	50.0	44.0	-	1.2	qf	4	77.6			
5	6.5	12.5	6.0	Sand	35	19.5	18.8	-	37.4	50.0	107.0	78.5	-	1.4	qf	5	776.2			
6	12.5	15.5	3.0	Sand	45	20.0	19.8	-	39.9	107.0	137.0	122.0	-	1.5	qf	6	720.4			
7	15.5	20	4.5	Sand	50	20.5	20.3	-	41.0	137.0	184.3	160.6	-	1.5	qf	7	1480.5			

Summation of Positive Skin Resitance (kN) Q_f= 3180.96

Summation of Negative Skin Resistance (kN) -Qf= 0.00

Computation of End Bearing Resistance

		SPT	ϕ	C_u	N_q	N_c			
Bearing Stratum	Clay	50	-	233	-	9	Eff.Ht.of Overburden	8	m
							Effective Overburden Pressure	70.31	kN/m^2

End Bearing Resistance (kN) Q_p= 411.74

Ultimate Load Carrying Capacity (Q_{ult})	$Q_u=Q_f-Q_f+Q_p$ (kN)	3592.71
Safe Load Carrying Capacity (Q_{safe})	$Q_u/2.5$ (kN)	1437.08
Allowable Safe Load Carrying Capacity	$Q_{A\text{-}safe}$ (kN)	1200.00
Allowable Safe Pull out Capacity	$Q_{A\text{-}pull}$: Qf/3 (kN)	1060.32

Skin Resistance in Clay Layer is $\pi*d*T_l*C_u*\alpha$

Skin Resistance in Sand Layer is $\pi*d*T_l*q_l*K*Tan(\phi)$

End Bearing Resistance in Clay Layer is $\pi*d^2/4*C_u*N_c$

End Bearing Resistance in Sand Layer is $\pi*d^2/4*Q*N_q$

Where

Note: The End being is Sandy Clay modeld as Clay with restricted to SPT-value of 50 corresponding Cu Value Taken as 233 kPa.

Cu=Undrained Shear Strength of Clay

ϕ=Angle of Shearing Resistance

N_c=Bearing Capacity Factor = 9

K=Coef. Earth Pressure at Rest

q_l=Effecitve Overburden Pressure at middle of Layer

N_q=Bearing Capacity Factor, Ref. Fig.1 of IS: Code Refered above

Q (i.e) Effecitve Overburden Pressure at pile tip=Effective height of overburden X (γ-10)

d=Dia. Of Pile

α=Adhession Factor

T_l=Thickness of Layer

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LATERAL LOAD CARRYING CAPACITY OF BORED CAST- SITU PILES

Reference Bore Hole : BH-02

1.0 Geometrical Data

Type of Pile Head Considered		Fixed	
Diameter of Pile (d)	:	0.60	m
Free standing Length of Pile (e)	:	0	m
Length of Pile below E.G.L (Le)	:	20.0	m
Cut-Off Level From E.G.L	:	1.0	
Length of Pile below Cut-Off Level (Le)	:	19.0	m
Grade of Concrete (M)	:	25	MN/m^2
Young's Modulus of Concrete (E)	:	25000000	kN/m^2
Momemnt of Inertia (I)	:	0.006362	m^4

2.0 Determination of Depth of Fixity

Type of Soil Strata	:	Clay	
Ground Water Condition	:	Submerged	
Average Design SPT "N" Value	:	11	
K=((k1/1.5)*(0.3/B))			
(n can be read as η in the above and below equation in case of Sand)			
K1=	:	27000	kN/m^3
K=	:	9000	kN/m^2
R=	:	2.33	
L1/R	:	0.00	
Lf/R	:	2.20	
Depth of Fixity below Cut off (z_f)	:	5.13	m

3.0 Determincation of Lateral Load and Moment Carrying Capacity for 0.005 m Lateral Deflection:

Allowable Lateral Deflection (Y)	:	0.005	m
Lateral Load Carrying Capacity (H)= Y*12EI/(e+zf)^3	:	70.89	kN
Recommended Design Lateral Load carrying Capacity	:	71	**kN**
Fixed End Moment,M_F=H(e+z_f)/2		182	
Reduction Factor (L_1/T)	:	0.67	m
Actual Moment (Fixed End Moment/Reduction Factor),M_F		122	kN-m

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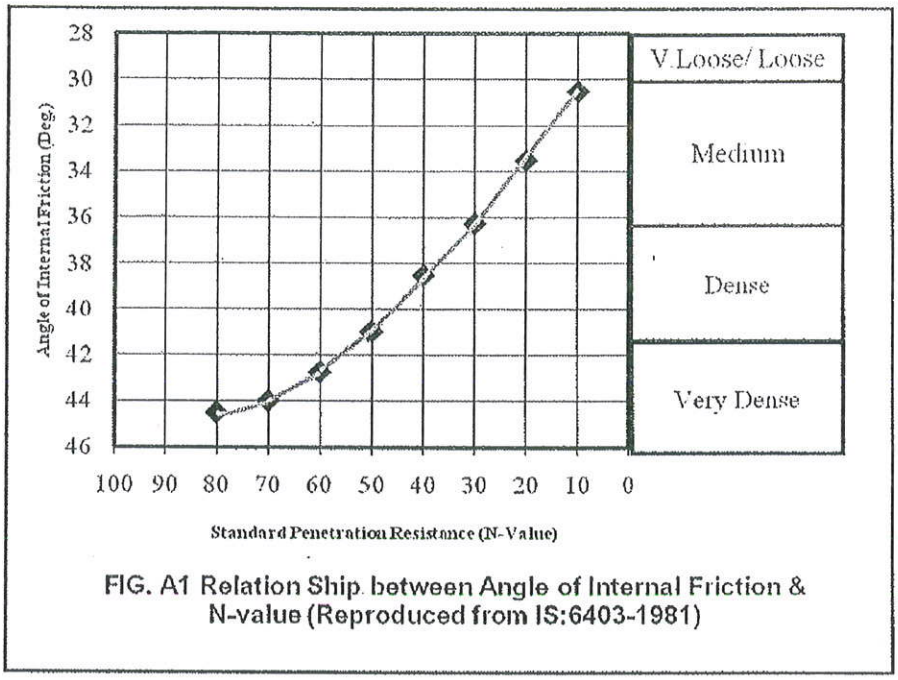


FIG. A1 Relation Ship between Angle of Internal Friction & N-value (Reproduced from IS:6403-1981)

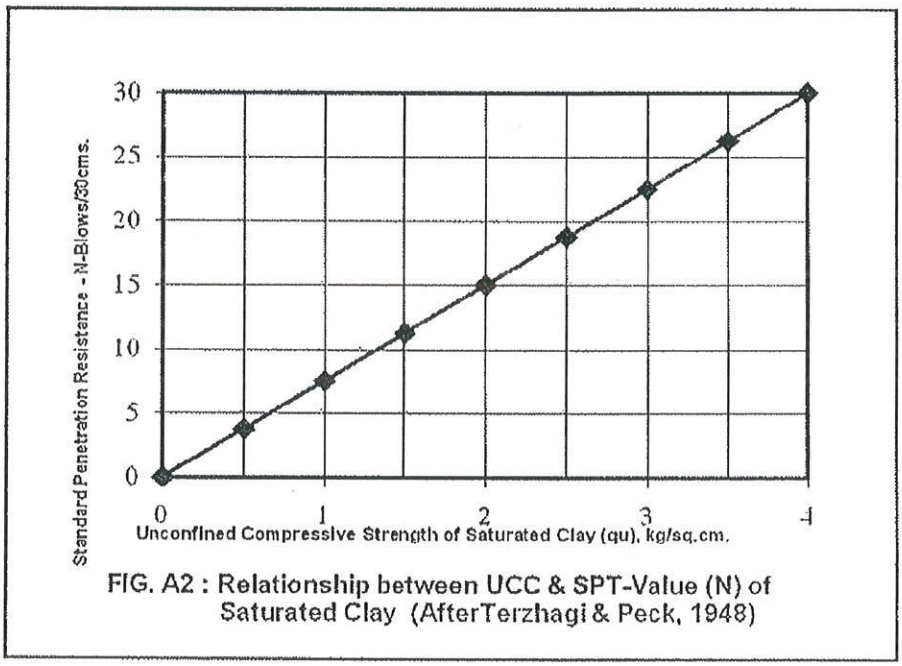


FIG. A2 : Relationship between UCC & SPT-Value (N) of Saturated Clay (AfterTerzhagi & Peck, 1948)

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