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NAME OF PROJECT

PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING CONSISTING OF STILT+ 5 UPPER FLOORS AT Plot NO.4 (PT) & 5, NEW DOOR NO.9, OLD DOOR NO.14, ANNA AVENUE, BAKTHACATCHALAM NAGAR EXTENSION, ADYAR, CHENNAI 600020, COMPRISED IN OLD S.NO.15/5 (PT) AND T.S.NO.46/4 & 46/27, BLOCK NO.16 OF PALLIPATTU VILLAGE WITHIN THE LIMIT OF GREATER CHENNAI CORPORATION

CLIENT

M/s CHAITANYA EASTLYN,
BANYAN VIEW – 3rd FLOOR,
NO-39, KARPAGAM GARDENS,
Ist MAIN ROAD, ADYAR,
CHENNAI 600 020

TITLE

GEOTECHNICAL INVESTIGATION REPORT

REPORT NO.: GT- 2516

Dr.C.VENKATA PRASAD
Registered Geotechnical Engineer (RGTE)
Registration No: GTE/19/03/003
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DATE	REVISON	DESCRIPTION		AUTHORISED SIGNATORY
28/02/2023	FIRST SUBMISSION	SUBMISSION OF GEOTECHNICAL REPORT	SIGN	
			DATE	28/02/2023
			DESIGNATION	MANAGING DIRECTOR
			NAME	**DR. C.V.PRASAD**

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REPORT TEXT

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CHAPTER-1

INTRODUCTION

1.0 PROJECT INFORMATION MATRIX:

Nature of Project	: **PROPOSED RESIDENTIAL BUILDING**
Structure	: **STILT + 5 UPPER FLOORS**
Project Owner	: **M/s CHAITANYA EASTLYN**
Project Location	: **ADYAR, CHENNAI**
Job Code	: **GT-2516**

1.1 SCOPE OF WORK:

1.1.1 FIELD WORK:

- Conducting two soil investigation bore holes of 150 mm diameter in Soil & Overburden.
- In case of rock formation NX Diameter with Core barrel shall be adopted to progress the drilling up the termination depth.
- Conducting Standard Penetration Test (SPT) within the borehole at:
  - Every 1.0m depth interval up to 6.0m.
  - From 6.0m to 12.0m SPT is conducted at every 1.5m depth interval
  - Beyond 12.0m and up to termination depth SPT is carried out at every 2.0m depth interval.
- Collection of disturbed soil samples at SPT location 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
- Consolidation test on undisturbed samples if applicable
- 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
- 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.

2.1.3.2 UNDISTURBED SAMPLES:

From the soft to stiff clay layer, representative undisturbed samples were collected. These samples were used primarily to establish the compressibility parameters to estimate the settlements of shallow foundation system wherever applicable.

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.

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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 & 2.2. The graphical representation of grainsize distribution curve for the representative samples in each bore is presented in Fig. 2.3 & 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 & 2.2. The graphical representation of hydrometer analyses curve for the representative samples in each bore is presented in Fig. 2.5 to 2.7.

2.2.3 CHEMICAL ANALYSIS TESTS:

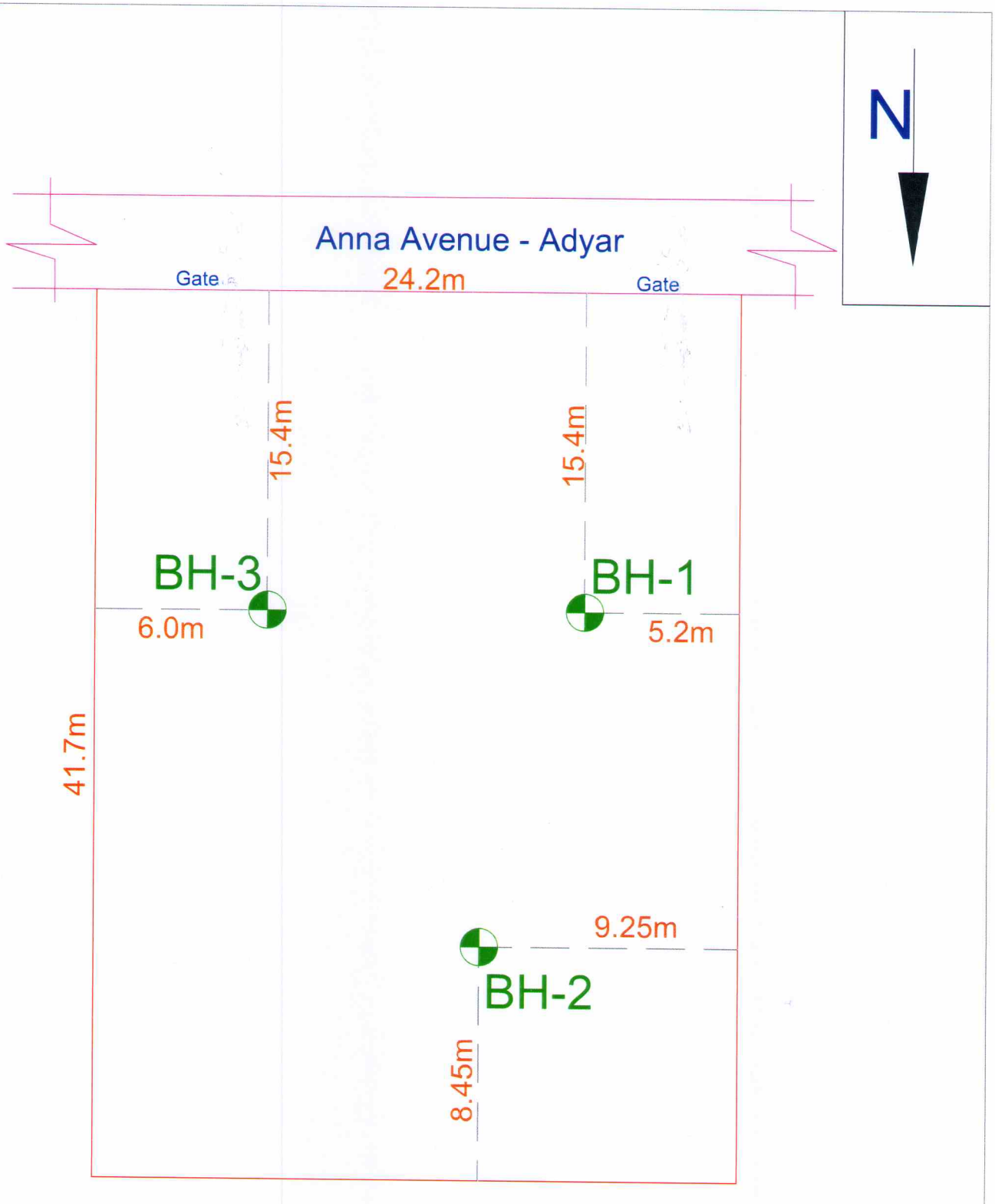
On representative soil and water samples chemical analysis tests were conducted to estimate pH, Chloride and Sulphates and these results are presented in Table - 2.3 & 2.4.

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 & 2.2.

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SITE PLAN



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FIG. 2.0 SITE PLAN SHOWING THE FIELD INVESTIGATION BOREHOLE LOCATION

SOIL PROFILES

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SITE INVESTIGATION RECORD

BORE HOLE No.	BH-01		
SHEET	1	OF	2
DIA OF BORE HOLE	150mm ✓		
	NX		
BORE START DATE	11/02/2023		
BORE END DATE	13/02/2023		
TOTAL DRILL DAYS	2		

PROJECT NAME	PROPOSED CONSTRUCTION OF A RESIDENTIAL BUILDING				
LOCATION	Adyar, Chennai	MACHINE No.	CR-06	CHAINAGE (m)	-
STRUCTURE	Stilt + 5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES N	-
JOB CODE	GT-2516	FLUSHING MEDIUM	Bentonite	CO-ORDINATES 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)
0	11/02/2023	11	07	SC	-	-								
		To												
		11	05				5	4	5	9	0.50	1	SS	-0.5
		11	16								0.95			
1		To		SC	-	-								
		11	17				3	4	5	9	1.25	2	SS	-1.3
		11	26								1.70			
		To		SC	-	-								
2		11	28				-	-	-	-	2.00	3	UDS	-2.0
		11	43											
		To		SC	-	-								
		11	45											
3							2	4	2	6	3.00	4	SS	-3.0
		11	56								3.45			
		To		SC	-	-								
		11	57											
4							6	7	9	16	4.00	5	SS	-4.0
		12	14								4.45			
		To		SC	-	-								
		12	15											
5							4	5	5	10	5.00	6	SS	-5.0
		12	27								5.45			
		To		SC	-	-								
		12	28											
6							8	4	5	9	6.00	7	SS	-6.0
		12	45								6.45			
		To		SC	-	-								
7		12	46											
							6	7	8	15	7.50	8	SS	-7.5
											7.95			
8		14	11	SC	-	-								
		To												
		14	12											
9							9	10	14	24	9.00	9	SS	-9.0
											9.45			
		14	41											
10		To		SC	-	-								
		14	42											

Layer Data

Legend	No	Depth	Geotechnical Description
	L1	2.0	Brown,Moist,Poorly Graded,Fine & Medium Grains Sands With Gravels Traces,Loose,**Silty SAND (SM) & Clayey Silty SAND (SC)** Filled Up @ 0.5m
	L2	4.0	Brown, Grey Brown,Moist,Medium Stiff/Loose,**Silty CLAY (CL) With Sand Lenses**
	L3	5.0	Grey,Moist,Poorly Graded,Fine & Medium Grains Sands,Medium Dense, **Silty SAND (SM)**
	L4	7.5	Grey,Moist,Poorly Graded,Fine & Medium Grains Sands,Loose,**Silty SAND (SM)**
			Grey,Brown Grey,Moist,Poorly Graded, Fine & Medium Grains Sands,Medium Dense,**Silty SAND (SM) & Poorly Graded SAND - Silty SAND (SP-SM)**

CS - Core Sample	DS - Disturbed Sample	LOGGED	K.Loganathan	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	11/02/2023	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	G.Sharmila	WATER TABLE (m) 2.30	
WS - Wash Sample	DB - Diamond Bit	DATE	14/02/2023	CASING DEPTH (m) 0.00	

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SITE INVESTIGATION RECORD

BORE HOLE No.	BH-01	SHEET	2 OF 2	DIA OF BORE HOLE	150mm ✓ / NX ✓
PROJECT NAME	PROPOSED CONSTRUCTION OF A RESIDENTIAL BUILDING				
LOCATION	Adyar, Chennai	MACHINE No.	CR-06	CHAINAGE (m)	-
STRUCTURE	Stilt + 5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -
JOB CODE	GT-2516	FLUSHING MEDIUM	Bentonite		E -
BORE START DATE	11/02/2023	BORE END DATE	13/02/2023	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	15-30	30-45	SPT 'N' Value	Sample Details: Depth	No.	Type	RL (m)	Layer Data: Legend	No	Depth	Geotechnical Description
10.50	11/02/2023						10	8	7	15	10.50 to 10.95	10	SS	-10.5				Grey,Brown Grey,Moist,Poorly Graded, Fine & Medium Grains Sands,Medium Dense,**Silty SAND (SM) & Poorly Graded SAND - Silty SAND (SP-SM)**
11	11/02/2023	15 To 15	10 To 11	SC	-	-												
12.00							9	13	17	30	12.00 to 12.45	11	SS	-12.0				
13		09 To 09	46 To 55	SC	-	-												
14.00	13/02/2023						SPT Hammer Rebound			>100	14.00	-	WS	-14.0		L5	14.0	
15	13/02/2023	10 To 10	28 To 45	DB	0	0												Grey Brown,Moist,Fine to Coarse Sand Size Particles With Gravels,Very Dense, **Residual Soil to Completely Weathered Rock - Grade W5 Rock Formation** Disintegrated Hypersthene Granitic Rock
16.00							4Cm Penet for 55 Blows			>100	16.00 to 16.04	12	SS	-16.0		L6	16.1	
17		11 To 12	16 To 00	DB	8	0												Grey Brown,Medium to Coarse Grain Structure,Highly Fractured & Disintegrated,Discoloured,**Highly Weathered Rock - Grade W4 Rock Formation** Disintegrated Hypersthene Granitic Rock
17.50							-	-	-	-	17.50	13	CS	-17.5		L7	17.5	

CS - Core Sample	DS - Disturbed Sample	LOGGED	K.Loganathan	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	13/02/2023	GROUND LEVEL (m)	0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	G.Sharmila	WATER TABLE (m)	2.30	
WS - Wash Sample	DB - Diamond Bit	DATE	14/02/2023	CASING DEPTH (m)	0.00	

Borehole terminated at 17.5 m depth below E.G.L

FIG.2.1 Sub Soil Profile at BH-01 Location

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SITE INVESTIGATION RECORD

BORE HOLE No.	BH-02						
SHEET	1	OF	2				
PROJECT NAME	PROPOSED CONSTRUCTION OF A RESIDENTIAL BUILDING			DIA OF BORE HOLE	150mm ✓		
					NX		
LOCATION	Adyar, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	09/02/2023
STRUCTURE	Stilt + 5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	10/02/2023
JOB CODE	GT-2516	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	Layer Data: Geotechnical Description
0	09/02/2023	12	18	SC	-	-												
		To																
		12	19				2	2	6	8	0.50	1	SS	-0.5				Grey,Moist,Poorly Graded,Fine & Medium Grains Sands,Loose, **Silty SAND (SM)** Top 0.5m Filled Up
		12	31								0.95							
1		To		SC	-	-										L1	1.3	
		12	32				3	3	6	9	1.25	2	SS	-1.3				
		12	47								1.70							
		To		SC	-	-												
2		12	48				3	4	4	8	2.00	3	SS	-2.0				
		14	07								2.45							
		To		SC	-	-												Brown,Moist,Stiff,**Silty CLAY (CI) & Silty CLAY (CH)** Clays of Medium & High Plasticity
3		14	09				-	-	-	-	3.00	4	UDS	-3.0				
		14	24															
		To		SC	-	-												
		14	25															
4		14	45				3	5	6	11	4.00	5	SS	-4.0		L2	4.0	
		To		SC	-	-					4.45							
		14	46															
5		15	06				3	5	7	12	5.00	6	SS	-5.0				
		To		SC	-	-					5.45							
		15	06															
6		15	21				2	4	6	10	6.00	7	SS	-6.0				
		To									6.45							Brown Grey,Grey,Moist,Fine & Medium Grains Sands,Medium Dense & Loose, **Silty SAND (SM) & Poorly Graded SAND (SP-SM)**
		15	22	SC	-	-												
7																		
							4	4	9	13	7.50	8	SS	-7.5				
											7.95							
8		15	40															
		To		SC	-	-												
		15	41															
9																L3	9.0	
							7	12	13	25	9.00	9	SS	-9.0				
											9.45							
		16	02															
		To		SC	-	-												Grey,Moist,Poorly Graded,Fine & Medium Grains Sands,Medium Dense, **Poorly Graded SAND - Silty SAND (SP-SM)**
10		16	03															

CS - Core Sample	DS - Disturbed Sample	LOGGED	K.Loganathan	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	09/02/2023	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	G.Sharmila	WATER TABLE (m) 0.00	
WS - Wash Sample	DB - Diamond Bit	DATE	10/02/2023	CASING DEPTH (m) 0.00	

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SITE INVESTIGATION RECORD

BORE HOLE No.	BH-02		
SHEET	2	OF	2
DIA OF BORE HOLE	150mm ✓		
	NX ✓		
BORE START DATE	09/02/2023		
BORE END DATE	10/02/2023		
TOTAL DRILL DAYS	2		

PROJECT NAME	PROPOSED CONSTRUCTION OF A RESIDENTIAL BUILDING						
LOCATION	Adyar, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-		
STRUCTURE	Stilt + 5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N	-	
JOB CODE	GT-2516	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
11	09/02/2023	16	42	SC	-	-	5	8	14	22	10.50	10	SS	-10.5				
		To									10.95							
		16	43															
12							10	12	16	28	12.00	11	SS	-12.0				Grey,Moist,Poorly Graded,Fine & Medium Grains Sands,Medium Dense, **Poorly Graded SAND - Silty SAND (SP-SM)**
											12.45							
13		10	15	SC	-	-												
		To																
		10	18															
14							17	37	10Cm Penet for 65Blows	>100	14.00	12	SS	-14.0		L4	14.0	
											14.40							
15	10/02/2023	10	55	SC	-	-												Grey Brown,Moist,Fine & Medium Grains Sand Size Particles,Traces of Coarse Sand & Gravels Mixture,Very Dense,**Residual Soil to Completely Weathered Rock - Grade W5 Rock Formation** Disintegrated Hypersthene Granitic Rock Formation
		To																
		110	08															
16							9Cm Penet for 60Blows			>100	16.00	13	SS	-16.0		L5	16.0	
											16.09							
		12	00															Brown Grey,Pink Shades,Fine & Medium Grains Sand Size Particles, Very Dense,**Completely Weathered Rock - Grade W5 Rock Formation** Disintegrated Hypersthene Granitic Rock Formation
17		To		DB	0	0												
		12	30															
							SPT Hammer Rebound			>100	17.50	-	WS	-17.5		L6	17.5	
18																		
19																		
20																		

CS - Core Sample	DS - Disturbed Sample	LOGGED	K.Loganathan
SS - Split Spoon Sample	SC - Soil Cutter	DATE	10/02/2023
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	G.Sharmila
WS - Wash Sample	DB - Diamond Bit	DATE	10/02/2023

PROJECT SITE DETAILS		REMARKS
GROUND LEVEL (m)	0.00	
WATER TABLE (m)	0.00	
CASING DEPTH (m)	0.00	

Borehole terminated at 17.5 m depth below E.G.L

FIG.2.2 Sub Soil Profile at BH-02 Location

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GRAIN SIZE DISTRIBUTION CURVE

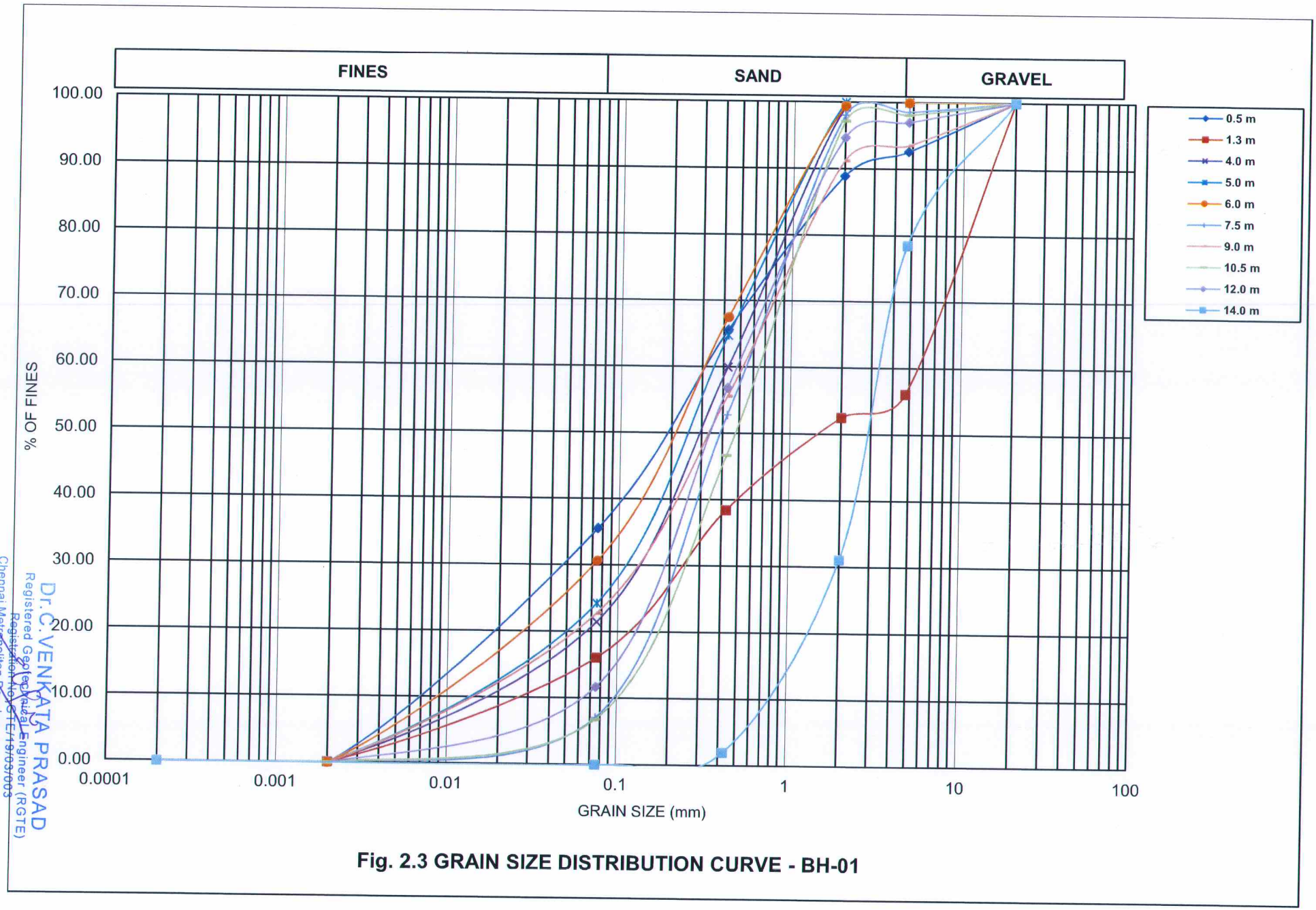


Fig. 2.3 GRAIN SIZE DISTRIBUTION CURVE - BH-01

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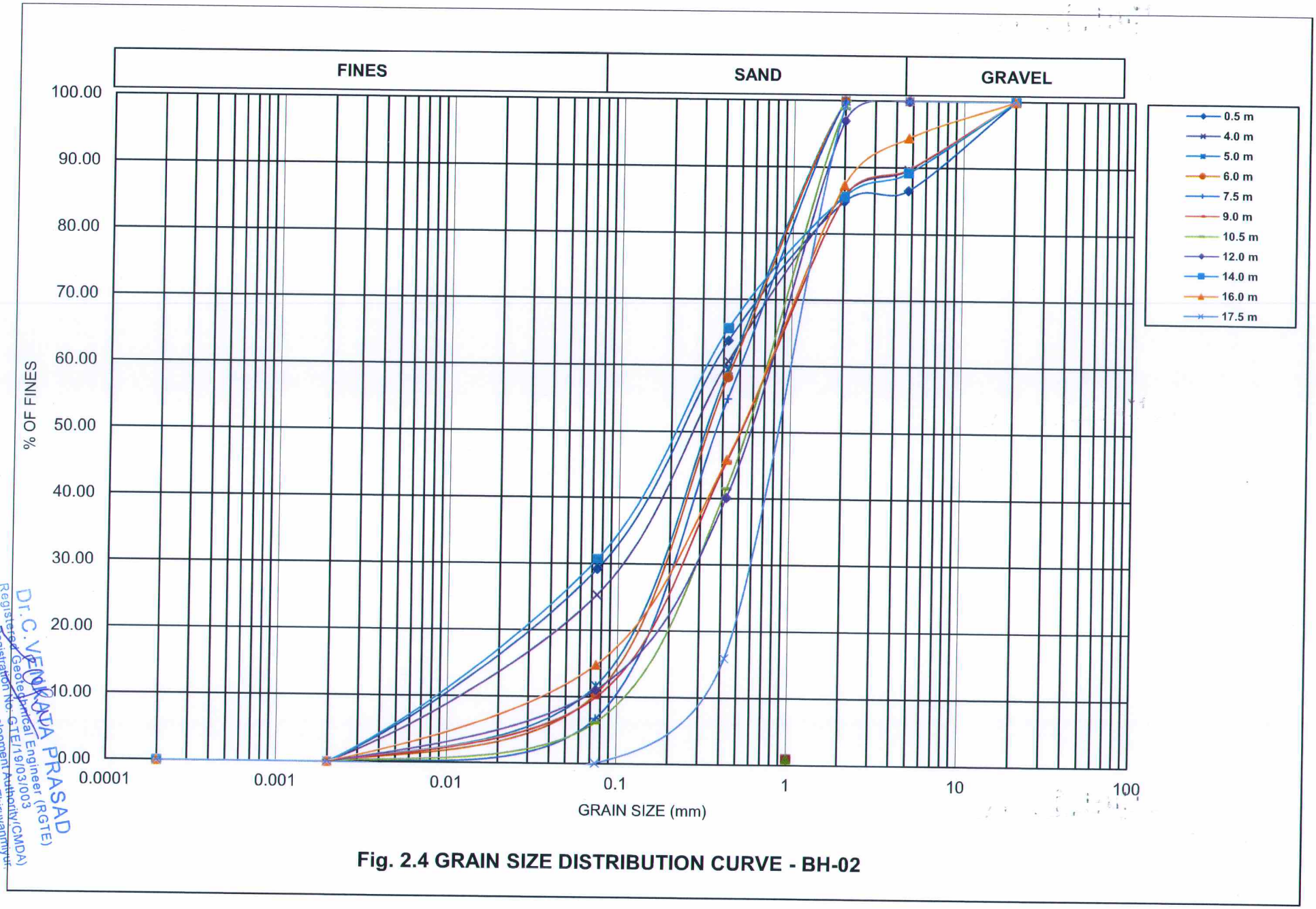


Fig. 2.4 GRAIN SIZE DISTRIBUTION CURVE - BH-02

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HYDROMETER ANALYSIS CURVE

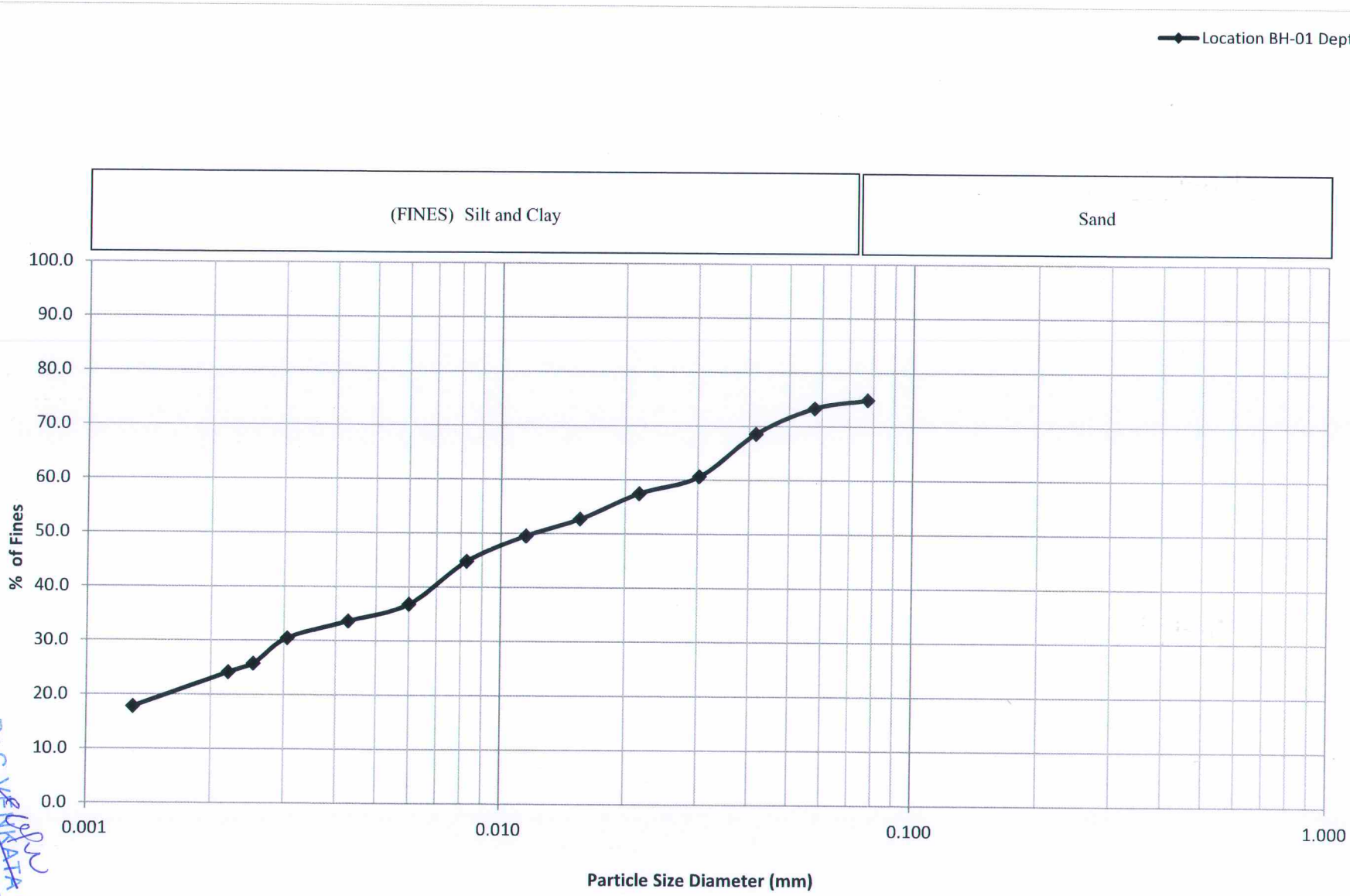


Fig 2.5 Hydrometer Analysis Master Curve

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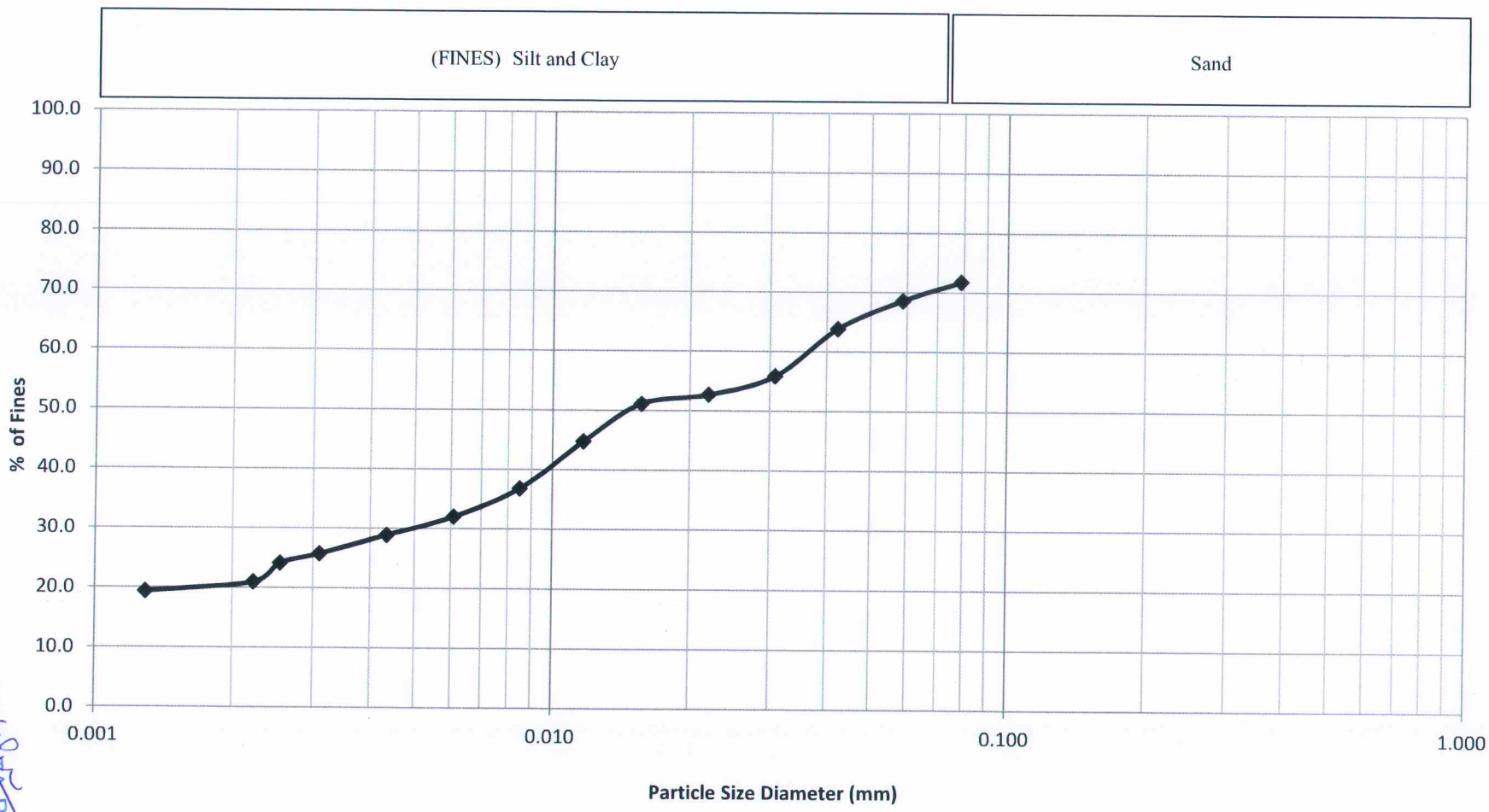


Fig 2.6 Hydrometer Analysis Master Curve

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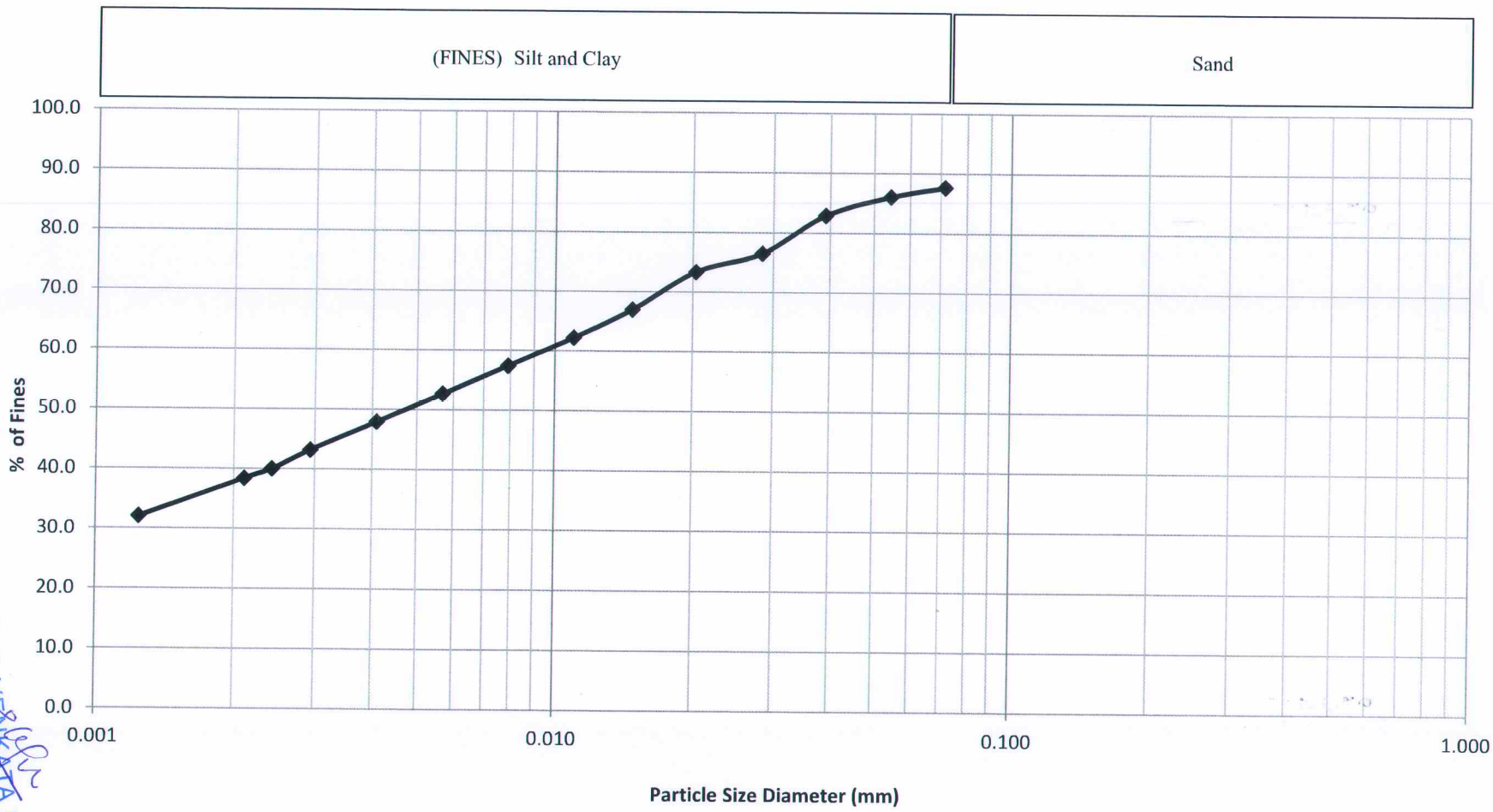


Fig 2.7 Hydrometer Analysis Master Curve

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LABORATORY TEST RESULTS

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LABORATORY TEST REPORT

GEOMARINE CONSULTANTS PVT LTD- GEOTECHNICAL LABORATORY
NO.11 2nd MAIN ROAD, KANNAPA NAGAR EXTN,
KOTTIVAKKAM, CHENNAI

Name & Address of the Customer	:	**M/s CHAITANYA EASTLYN**	**Customer Reference**	:	By Email
Sample Description	:	Soil Sample	**Period of Testing**	:	14/02/2023 to 24/02/2023
Source of Sample	:	Customer Supplied- Borehole No. BH-01	**Sample Identification Number**	:	SS/GMC/022023/613/BH-01
Sample Condition	:	Satisfactory	**Test Report No.**	:	GT-2516/BH-01
Test Method	:	As per Bureau of Indian Standards	**Report Date**	:	27/02/2023
Sample Receipt Date	:	13/02/2023	**Test Report Pages**	:	One Page

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

Sample Depth (m)	SPT- "N" Value	Type of Sample	Fine Grained (FG)										Coarse Grained (CG)												
			Moisture Content (%) AS PER IS 2720 (P-II) - 1973, RA-2015	LIQUID LIMIT (%) AS PER IS 2720 (P-V) - 1985, RA-2015	PLASTIC LIMIT (%) AS PER IS 2720 (P-V) - 1985, RA-2015	Plasticity Index (I_p= LL-PL)	Consistency Index (Ic=LL-NMC/I_p)	SHRINKAGE LIMIT (%) AS PER IS 2720 (P-VI) - 1972, RA-2011	FREE SWELL INDEX (%) AS PER IS 2720 (P-XL) - 1977, RA-2011	Consistancy	Position With Respect to A-Aline	IS:Notation	SPECIFIC GRAVITY AS PER IS 2720 (P-III, SEC-1) - 1980, RA-2010	GRAIN SIZE ANALYSIS AS PER IS 2720 (P-IV) - 1985, RA-2015						D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	Uniformity Co-Efficient $C_U=D_{60}/D_{10}$	Co-Efficient of Curvature $C_c=D_{30}^2/(D_{10}xD_{60})$	Relative Density	IS-Notation	
													Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)							Gravel	Sand
0.5	9	SS	17.0	-	-	-	-	-	8.3	CG>50%	-	-	-	7.3	3.7	23.3	30.1	35.6		-	-	-	-	-	Loose	<50%	SM
1.25	9	SS	22.9	45.0	22.2	22.7	1.0	25.2	23.1	CG>50%	Above	-	-	43.8	3.6	14.1	22.3	16.1		-	-	-	-	-	Loose	GC	<50%
2.0	-	UDS	19.2	26.6	16.8	9.8	0.8	17.3	0.0	-	Above	CL	-	0.0	0.0	3.0	28.2	52.1	16.6	-	-	-	-	-	FG>50%	FG>50%	FG>50%
3.0	6	SS	24.3	Clay Lenses					16.7	-	-	-	-	0.0	0.5	5.7	26.8	67.1		-	-	-	-	-	FG>50%	FG>50%	FG>50%
4.0	16	SS	19.4	-	-	-	-	-	-	CG>50%	-	-	-	0.0	0.7	39.3	38.5	21.5		-	-	-	-	-	M.Dense	<50%	SM
5.0	10	SS	20.4	-	-	-	-	-	-	CG>50%	-	-	2.65	0.0	0.0	35.2	40.5	24.3		-	-	-	-	-	Loose	<50%	SM
6.0	9	SS	17.0	-	-	-	-	-	-	CG>50%	-	-	-	0.0	0.6	31.9	36.9	30.7		-	-	-	-	-	Loose	<50%	SM
7.5	15	SS	18.8	-	-	-	-	-	-	CG>50%	-	-	-	1.4	0.5	45.3	45.8	7.1		-	-	-	-	-	M.Dense	<50%	SP-SM
9.0	24	SS	16.0	-	-	-	-	-	-	CG>50%	-	-	-	6.4	2.4	35.6	32.8	22.8		-	-	-	-	-	M.Dense	<50%	SM
10.5	15	SS	19.0	-	-	-	-	-	-	CG>50%	-	-	-	1.9	1.0	50.5	39.9	6.8		-	-	-	-	-	M.Dense	<50%	SP-SM
12.0	30	SS	16.3	-	-	-	-	-	-	CG>50%	-	-	2.63	3.0	2.3	37.9	45.2	11.7		-	-	-	-	-	M.Dense	<50%	SP-SM
14.0	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	-	21.5	47.4	29.1	2.0	0.0		-	-	-	-	-	V.Dense	<50%	SP
16.0	>100	SS	12.6	-	-	-	-	-	-	CG>50%	-	-	-	29.1	13.8	27.0	20.6	9.5		-	-	-	-	-	V.Dense	<50%	SP-SM

** END OF REPORT**

Terms and Conditions

(1) The test results furnished corresponds to the sample received

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(3) Any correction in this reports invalidates the reports

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Authorised Signatory

A. VINOTH
(Technical Manager)

GEOMARINE
THE SPIRIT OF ENGINEERING
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LABORATORY TEST REPORT

GEOMARINE CONSULTANTS PVT LTD- GEOTECHNICAL LABORATORY
NO.11 2nd MAIN ROAD, KANNAPA NAGAR EXTN,
KOTTIVAKKAM, CHENNAI

Name & Address of the Customer	:	**M/s CHAITANYA EASTLYN**	**Customer Reference**	:	By Email
Sample Description	:	Soil Sample	**Period of Testing**	:	14/02/2023 to 24/02/2023
Source of Sample	:	Customer Supplied- Borehole No. BH-02	**Sample Identification Number**	:	SS/GMC/022023/613/BH-02
Sample Condition	:	Satisfactory	**Test Report No.**	:	GT-2516/BH-02
Test Method	:	As per Bureau of Indian Standards	**Report Date**	:	25/02/2023
Sample Receipt Date	:	13/02/2023	**Test Report Pages**	:	One Page

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

Sample Depth (m)	SPT- "N" Value	Type of Sample	Fine Grained (FG)										Coarse Grained (CG)												
			Moisture Content (%) AS PER IS 2720 (P-II) - 1973, RA-2015	LIQUID LIMIT (%) AS PER IS 2720 (P-V) - 1985, RA-2015	PLASTIC LIMIT (%) AS PER IS 2720 (P-V) - 1985, RA-2015	Plasticity Index (I_p= LL-PL)	Consistency Index (Ic=LL-NMC/I_p)	SHRINKAGE LIMIT (%) AS PER IS 2720 (P-VI) - 1972, RA-2011	FREE SWELL INDEX (%) AS PER IS 2720 (P-XL) - 1977, RA-2011	Consistancy	Position With Respect to A-Aline	IS:Notation	SPECIFIC GRAVITY AS PER IS 2720 (P-III, SEC-1) - 1980, RA-2010	GRAIN SIZE ANALYSIS AS PER IS 2720 (P-IV) - 1985, RA-2015						D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	Uniformity Co-Efficient $C_U=D_{60}/D_{10}$	Co-Efficient of Curvature $C_c=D_{30}^2/(D_{10}xD_{60})$	Relative Density	IS-Notation	
													Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)							Gravel	Sand
0.5	8	SS	22.5	-	-	-	-	-	-	CG>50%	-	-	-	13.4	1.7	21.0	34.6	29.3		-	-	-	-	-	Loose	<50%	SM
1.25	9	SS	25.2	40.9	20.0	20.8	0.8	9.1	38.5	Stiff	Above	CI	-	-	-	-	-	79.1	20.9	-	-	-	-	-	FG>50%	FG>50%	FG>50%
2.0	8	SS	22.3	36.3	18.3	18.0	0.8	-	23.1	Stiff	Above	CI	-	-	-	-	-	100.0		-	-	-	-	-	FG>50%	FG>50%	FG>50%
3.0	-	UDS	29.6	60.2	30.3	30.0	1.0	13.0	14.3	Hard	Above	CH	-	1.7	1.2	3.2	15.5	48.3	30.2	-	-	-	-	-	FG>50%	FG>50%	FG>50%
4.0	11	SS	18.5	-	-	-	-	-	16.7	CG>50%	-	-	-	10.3	3.8	25.2	35.4			-	-	-	-	-	M.Dense	<50%	SP
5.0	12	SS	20.4	-	-	-	-	-	-	CG>50%	-	-	2.65	0.0	0.0	40.6	47.7	11.7		-	-	-	-	-	M.Dense	<50%	SP-SM
6.0	10	SS	18.8	-	-	-	-	-	-	CG>50%	-	-	-	0.0	0.0	41.7	47.8	10.5		-	-	-	-	-	Loose	<50%	SP-SM
7.5	13	SS	20.5	-	-	-	-	-	-	CG>50%	-	-	-	0.0	0.0	45.0	48.2	6.8		-	-	-	-	-	M.Dense	<50%	SP-SM
9.0	25	SS	17.1	-	-	-	-	-	-	CG>50%	-	-	-	10.3	4.2	40.0	35.6	10.0		-	-	-	-	-	M.Dense	<50%	SP-SM
10.5	22	SS	18.6	-	-	-	-	-	-	CG>50%	-	-	-	0.0	1.1	57.3	35.3	6.2		-	-	-	-	-	M.Dense	<50%	SP-SM
12.0	28	SS	14.9	-	-	-	-	-	-	CG>50%	-	-	2.65	0.0	3.0	56.9	29.1	11.1		-	-	-	-	-	M.Dense	<50%	SP-SM
14.0	>100	SS	18.7	-	-	-	-	-	-	CG>50%	-	-	-	10.8	3.6	19.9	35.0	30.8		-	-	-	-	-	V.Dense	<50%	SM
16.0	>100	SS	13.0	-	-	-	-	-	-	CG>50%	-	-	-	5.5	7.2	41.4	31.0	14.9		-	-	-	-	-	V.Dense	<50%	SM
17.5	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	-	0.0	0.8	83.3	15.9	0.1		-	-	-	-	-	V.Dense	<50%	SP

** END OF REPORT**

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Authorised Signatory

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CHEMICAL LABORATORY TEST RESULTS

GEOMARINE
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LABORATORY TEST REPORT
GEOMARINE CONSULTANTS PVT LTD- GEOTECHNICAL LABORATORY
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KOTTIVAKKAM, CHENNAI

Table 2.3 Result of Chemical Test

Name of the Customer: M/s CHAITANYA EASTLYN

Sample Identification Number: GMC/022023/613 **Customer Reference:** By Email

Source of Sample: Customer Supplied **Period of Testing:** 14/02/2023 to 24/02/2023

Sample Condition: Satisfactory **Report Date:** 25/02/2023

Sample Description: Water and Soil **Test Report No.:** GT-2516

Sample Receipt Date: '13/02/2023 **Test Report Pages:** One Page

S No.	SAMPLE REFERENCE NO	Water				SOIL		
		DEPTH OF SAMPLE (m)	pH AS PER IS 3025 (P-XI) - 2022	SULPHATES (mg/l) AS PER APHA 23rd Edn.2017-4500	CHLORIDES (mg/l) AS PER IS 3025(P-XXXII) - 1988, RA-2019	DEPTH OF SAMPLE (m)	pH AS PER IS 2720 (P-XXVI) - 1987, RA-2021	SULPHATES (mg/kg) AS PER IS 2720 (P-XXVII) - 1977, RA-2020
1.0	BH-01	2.30	6.97	131.2	144.1	3.00	7.34	38.5
2.0	BH-02	2.00	6.92	337.1	192.7	4.00	7.33	30.6

** END OF REPORT**

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Table-2.4 Results of Chemical Test for Chloride in Soil Sample			
SL No.	Bore HoleNo.	Soil (2:1)	
		Depth of Sample (m)	Chlorides (mg/kg)
1.0	BH-01	3.00	22.8
2.0	BH-02	4.00	13.1

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CHAPTER-3

GEOLOGY & SUB-SURFACE STRATIFICATION

3.0 PREAMBLE:

Geotechnical investigation carried out at a specific site provides location specific sub surface engineering characteristics. However, in major project sites where the construction activities spread over a very large area location specific sub surface strata characteristics are studied together with the geological mapping data.

This is required to incorporate the impact of any documented macro-level geological characteristics of the region on the foundation design, irrespective of the location specific sub surface strata characteristics.

In view on the above, though it is beyond the scope of the present study to carry out macro-level geological investigation the regional geology based on the published data is presented and discussed.

3.1 CLIMATE AND RAINFALL:

The study area receives the rain under the influence of both southeast and northeast monsoons. Predominantly northeast monsoon contributes rainfall and most of the precipitation occurs in the form of cyclonic storm caused due to the depressions in Bay of Bengal. The north east monsoon occurs between October & December. The southwest monsoon rainfall is highly erratic and summer rains are negligible.

The normal annual rainfall over the study area varies from 1100 mm to 1200mm.

3.2 GEOMORPHOLOGY:

Chennai district forms part of coastal plains of northern Tamil Nadu. Major part of the district is having flat topography with very gentle slope towards east. The altitudes of land surface vary from 10 m above MSL in the west to sea level in the east.

Fluvial, marine and erosional landforms are noticed in the district. Marine transgression and regressions and neo-tectonic activity during the recent past have influenced the morphology and resulted in various present landforms.

Meandering streams with small sand bars are present along the course of Adyar River. The pediment and buried pediment in Guindy area in and around the reserved forest, is the only area where the ecological system is less disturbed, while the other areas are completely disturbed by built up area with large-scale human interference and pollution.

3.3 GEOLOGY OF CHENNAI DISTRICT:

Chennai district is underlain by various geological formations from ancient Archaean to the Recent Alluvium. The geological formations of the district can be grouped into three units, namely

i) Archaean crystalline rocks

ii) Gondwana (Consolidated Clay/Clayey Silt) and Tertiary sediments and

iii) Recent Alluvium.

The Archaean crystalline rocks of the district comprise chiefly of Charnockite, gneisses and the associated basic and ultra-basic intrusive dykes.

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3.4 GEOLOGICAL ORDER OF THE STUDY AREA:

The stratigraphy of the study area can be classified as recent formation which is underlain by basement rock of meta-igneous origin (hypersthene granite/ Charnockite rock)

Deposits of Recent Age

---------- Eparchean Unconformity ----------

Archaean Basement Rock (Charnockite Rock / Hypersthene Granite)

3.5 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 BGL	Bottom BGL	Thickness							(C_u) kPa	(ϕ) Deg.
1.0	0.00	2.00	2.00	Silty Sand	Brown	9	Loose	-	14.5	-	29.8
2.0	2.00	4.00	2.00	Silty Clay	Brown	6	-	Medium Stiff	15.5	40	-
3.0	4.00	5.00	1.00	Silty Sand	Grey	16	Medium Dense	-	18	-	31.8
4.0	5.00	7.50	2.50	Silty Sand	Grey	10	Loose	-	15	-	30
5.0	7.50	14.00	6.50	Silty Sand	Grey	21	Medium Dense	-	18.5	-	33.3
6.0	14.00	16.10	2.10	Residual Soil to CWR	Grey Brown	>100	Very Dense	-	21	-	42.5
7.0	16.10	17.50	1.40	Highly Weathered Rock	Grey Brown	CRR 8%, RQD 0%					

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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 BGL	Bottom BGL	Thickness							(C_u) kPa	(ϕ) Deg.
1.0	0.00	1.30	1.30	Silty Sand	Grey	8	Loose	-	14.5	-	29.6
2.0	1.30	4.00	2.70	Silty Clay	Brown	9	-	Stiff	17	60	-
3.0	4.00	9.00	5.00	Silty Sand	Brown Grey	12	Medium Dense	-	16	-	30.6
4.0	9.00	14.00	5.00	Silty Sand	Grey	25	Medium Dense	-	18.5	-	34.5
5.0	14.00	16.00	2.00	Residual Soil to CWR	Grey Brown	>100	Very Dense	-	21	-	42.5
6.0	16.00	17.50	1.50	Completely Weathered Rock	Brown Grey	>100	Very Dense	-	21	-	42.5

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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 which is meant for residential occupancy. For this kind of structure, the column loads could vary between 1200 kN to 1800 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 SUB SOIL STRATIFICATION:

The sub soil stratum in the project location consists of the following geological succession:

Layer-I	0.0m to 2.0m	Loose, Clayey Sand
Layer-II	2.0m to 4.0m	Medium Stiff, Clay & Sand Lenses
Layer-III	4.0m to 7.5m/9.0m	Pred. Loose, Silty Sand
Layer-IV	7.5m/9.0m to 14.0m	Medium Dense, Silty Sand
Layer-V	14.0m to 16.0m	Very Dense, Residual Soil
Layer-VI	16.0m to TD	Very Dense, Completely to Highly Weathered Rock

4.3 FOUNDATION SYSTEM:

Taking into account of the superstructure configuration and 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 Insitu Piles)** and the recommended safe load carrying capacity of bored cast insitu piles in compression, tension and lateral for different diameters taken to depth of 16.0m below the existing ground level is worked out as per IS 2911-Part-I-Section-2 and are presented in Table 4.1.

Typical computations are presented in Annexure-I.

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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
1.0	BH-01	16.0	1.0	15.00	500	1150	350	35
2.0					550	1300	375	40
3.0					600	1700	400	45
4.0					650	1900	450	55
5.0					750	2500	500	70

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RECOMMENDATIONS

ANNEXURE-I

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

Type of Pile	Bored	Diameter of Pile		Length of Pile below G.L. (m)	16.0	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) Top. R.L.	Bot. R.L.	Thickness	Type of Strata	Ave. SPT	(γ) kN/m³ of Layer	(γ) kN/m³ Ave. upto Layer	Shear Parameters (C_u) kPa	Shear Parameters (ϕ) Deg.	Effective Overburden Pressure (kPa) At top of Layer	At Bot. of Layer	At Mid. of Layer	Adhesion Factor (α)	Earth Pressure Coefficient (k)	Skin Friction (Q_f) kN		
1.0	0.0	1.0	1.0	Cut-Off Level													
2.0	1.0	2.0	1.0	Clayey Sand	9	14.5	14.5	-	29.8	0.0	4.5	2.3	-	1.0	qf	2	2.0
3.0	2.0	4.0	2.0	Silty Clay	6	15.5	15.0	40	-	4.5	15.5	10.0	1.0	-	qf	3	125.7
4.0	4.0	5.0	1.0	Silty Sand	16	18.0	16.8	-	31.8	15.5	23.5	19.5	-	1.1	qf	4	20.7
5.0	5.0	7.5	2.5	Silty Sand	10	15.0	16.5	-	30.0	23.5	36.0	29.8	-	1.0	qf	5	67.5
6.0	7.5	14.0	6.5	Silty Sand	21	18.5	16.8	-	33.3	36.0	91.3	63.6	-	1.2	qf	6	498.1
7.0	14.0	16.0	2.0	Completely Weathered Rock	50	20.5	19.5	-	40.0	91.3	112.3	101.8	-	1.5	qf	7	402.3

Summation of Positive Skin Resitance (kN) Q_f= 1116.26

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

Computation of End Bearing Resistance

Bearing Stratum	Residual Soil	SPT	ϕ	C_u	N_q	N_c	Eff.Ht.of Overburden	8	m
		50	40.00	-	120.94	-	Effective Overburden Pressure	78.75	kN/m²

End Bearing Resistance (kN) Q_p= 1870.00

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

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

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

Cu=Undrained Shear Strength of Clay

ϕ=Angle of Shearing Resistance

N_c=Bearing Capacity Factor = 9

K=Coef. Earth Pressure at Rest

q_i=Effecitve Overburden Pressure at middle of Layer

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

d=Dia. Of Pile

α=Adhession Factor

T_i=Thickness of Layer

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

Ultimate Load Carrying Capacity (Q_{ult})	$Q_u=Q_f-Q_f+Q_p$ (kN)	2986.26
Safe Load Carrying Capacity (Q_{safe})	$Q_u/2.5$ (kN)	1194.50
Allowable Safe Load Carrying Capacity	$Q_{A\text{-}safe}$ (kN)	1194.50
Allowable Safe Pull out Capacity	$Q_{A\text{-}pull}$: Qf/3 (kN)	372.09

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

Type of Pile	Bored	Diameter of Pile			Length of Pile below G.L. (m)	16.0	As Per IS:2911-(P-I,S-2)-2010	
Reference Bore Hole	BH-02		500	mm	Surcharge Pressure	0	kPa	

Layer No.	Layer Thk. (m) Top. R.L.	Bot. R.L.	Thickness	Type of Strata	Ave. SPT	(γ) kN/m³ of Layer	Ave. upto Layer	Shear Parameters (C_u) kPa	(ϕ) Deg.	Effective Overburden Pressure (kPa) At top of Layer	At Bot. of Layer	At Mid. of Layer	Adhesion Factor (α)	Earth Pressure Coefficient (k)	Skin Friction (Q_f) kN		
1.0	0.0	1.0	1.0	Cut-Off Level													
2.0	1.0	4.0	3.0	Silty Clay	9	17.0	17.0	60	-	0.0	21.0	10.5	0.7	-	qf	2	206.4
3.0	4.0	9.0	5.0	Silty Sand	12	16.0	16.5	-	30.6	21.0	51.0	36.0	-	1.0	qf	3	172.3
4.0	9.0	14.0	5.0	Silty Sand	25	18.5	17.3	-	34.5	51.0	93.5	72.3	-	1.2	qf	4	478.9
5.0	14.0	16.0	2.0	Completely Weathered Rock	50	20.5	19.5	-	40.0	93.5	114.5	104.0	-	1.5	qf	5	411.2

Summation of Positive Skin Resitance (kN) Q_f= 1268.79

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

Computation of End Bearing Resistance

Bearing Stratum		SPT	ϕ	C_u	N_q	N_c			
	Residual Soil	50	40.00	-	120.94	-	Eff.Ht.of Overburden	8	m
							Effective Overburden Pressure	78.75	kN/m²

End Bearing Resistance (kN) Q_p= 1870.00

Skin Resistance in Clay Layer is $\pi*d*T_i*C_u*\alpha$	Ultimate Load Carrying Capacity (Q_{ult})	**$Q_u=Q_f-Q_f+Q_p$ (kN)** 3138.78
Skin Resistance in Sand Layer is $\pi*d*T_i*q_i*K*Tan(\phi)$	Safe Load Carrying Capacity (Q_{safe})	**$Q_u/2.5$ (kN)** 1255.51
End Bearing Resistance in Clay Layer is $\pi*d^2/4*C_u*N_c$	Allowable Safe Load Carrying Capacity	**$Q_{A\text{-}safe}$ (kN)** 1255.51
End Bearing Resistance in Sand Layer is $\pi*d^2/4*Q*N_q$	Allowable Safe Pull out Capacity	**$Q_{A\text{-}pull}$: Qf/3 (kN)** 422.93

Where

Cu=Undrained Shear Strength of Clay
ϕ=Angle of Shearing Resistance
N_c=Bearing Capacity Factor = 9
K=Coef. Earth Pressure at Rest
q_i=Effecitve Overburden Pressure at middle of Layer
N_q=Bearing Capacity Factor, Ref. Fig.1 of IS: Code Referred above
d=Dia. Of Pile
α=Adhession Factor
T_i=Thickness of Layer
Q (i.e) Effecitve Overburden Pressure at pile tip=Effective height of overburden X (γ-10)

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LATERAL LOAD CARRYING CAPACITY OF BORED CAST- SITU PILES

Reference Bore Hole : BH-01

1.0 Geometrical Data

Type of Pile Head Considered		Fixed	
Diameter of Pile (d)	:	0.50	m
Free standing Length of Pile (e)	:	0	m
Length of Pile below E.G.L (Le)	:	16.0	m
Cut-Off Level From E.G.L	:	1.0	
Length of Pile below Cut-Off Level (Le)	:	15.0	m
Grade of Concrete (M)	:	25	MN/m^2
Young's Modulus of Concrete (E)	:	25000000	kN/m^2
Momemnt of Inertia (I)	:	0.003068	m^4

2.0 Determination of Depth of Fixity

Type of Soil Strata	:	Sand	
Ground Water Condition	:	Submerged	
Design SPT "N" Value	:	10	
T=(EI/nh)1/5			
(n can be read as h in the above and below equation in case of Sand)			
nh=	:	1400	kN/m^3
In Case of Sand	:	-	kN/m^4
T=	:	2.23	m
L1/T	:	0.00	
Lf/T	:	2.20	
Depth of Fixity below Cut off (z_f)	:	4.90	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	:	39.13	kN
Recommended Design Lateral Load carrying Capacity	:	**35**	**kN**
Fixed End Moment,M_F=H(e+z_f)/2		96	
Reduction Factor (L_1/T)	:	0.83	m
Actual Moment (Fixed End Moment/Reduction Factor),M_F		**80**	kN-m

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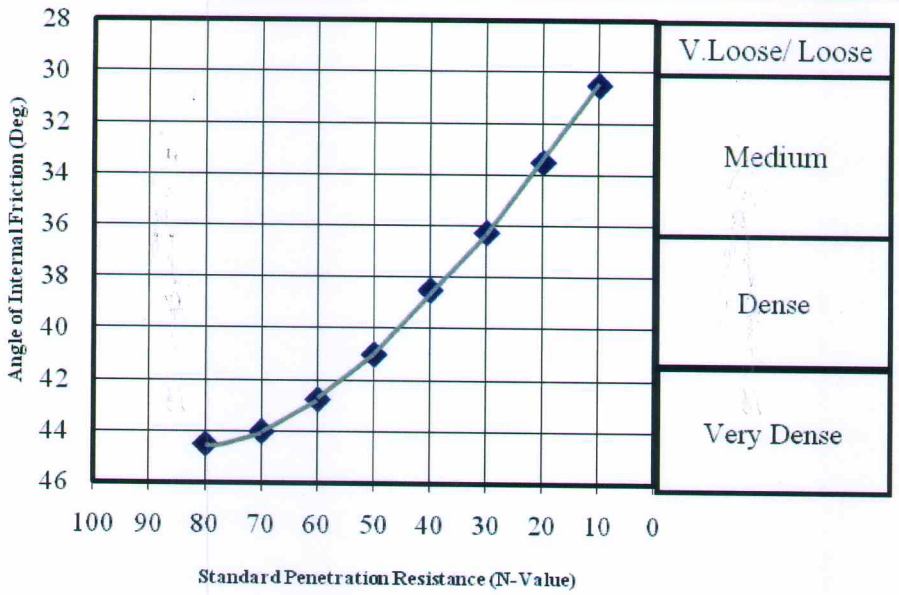


FIG. A1 Relation Ship between Angle of Internal Friction & N-value (Reproduced from IS:6403-1981)

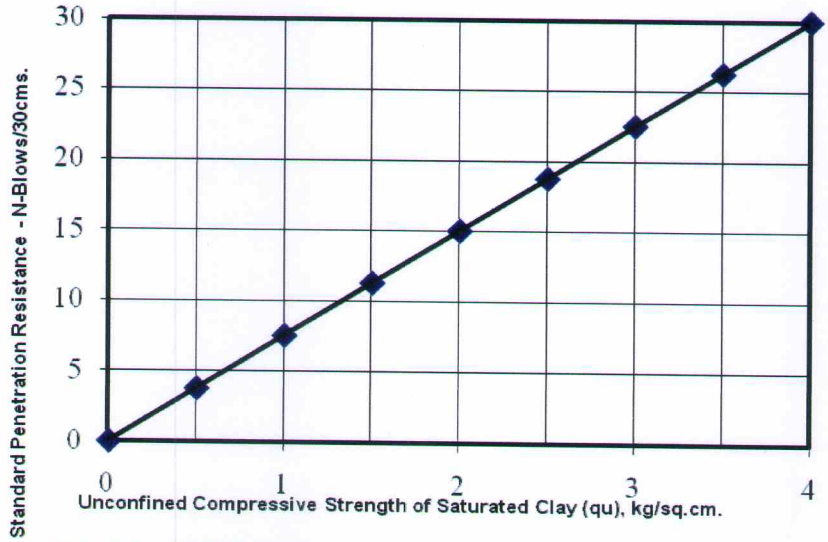


FIG. A2 : Relationship between UCC & SPT-Value (N) of Saturated Clay (AfterTerzhagi & Peck, 1948)

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CHAPTER-5

RECOMMENDATIONS

5.1 RECOMMENDATION FOR PILE FOUNDATION SYSTEM:

- For the kind of proposed structure 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 is 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 concreting can be done.

5.1.1 CONSTRUCTION METHOD STATEMENT OF PILE FOUNDATION:

- Adopt 2.0m deep guide casing in view of sub soil condition encountered in the investigation locations.
- The mud used shall be made out of sodium bentonite with minimum free 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 RECOMMENDATIONS:

- The chlorides content in ground water & soil-water extract is less than the permissible limit of 500 mg/l as per IS 456 Table 1.0. Hence no special steel is a requirement.
- Corresponding to the sulphate content in 2:1 Water-Soil extract and ground water use Table 4.0 of IS 456 Clause 2.0 for minimum cement content and maximum water cement ratio. Hence, ordinary Portland cement is suitable for the construction.

AUTHORISED SIGNATORY

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ANNEXURE-II

GEOMARINE
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SITE INVESTIGATION RECORD

BORE HOLE No.	01		
PAGE No.	01		
DIA OF BORE HOLE	150mm	4	
	100mm		
BORE START DATE	11/02/2023		
BORE END DATE	13/02/2023		
TOTAL DRILLING DAYS			

PROJECT NAME	CHAITANYA EASTLYN, ANNA AVENUE, ADYAR					
LOCATION		MACHINE No.	CR-06	CHAINAGE (m)		
STRUCTURE	Stilt + 5F	DRILLING METHOD	Rotary	CO-ORDINATES	N	
JOB CODE		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	Layer Data: Depth (m)	Geotechnical Description
0		10	07												Filled up Soil
		10	08	SC			5	4	5	9	0.50	1	SS		Brownish loose clayey Sand
1		11	16												
		11	17	SC			3	4	5	9	1.25	2	SS		Brownish stiff Silty Clay with Brick pieces.
		11	26												
2	11	11	28	SC			45 (cm) / 28 blow				2.00	3	UDS	2.20	Brownish Silty Clay
		11	43												
		11	45	SC			2	4	2	6	3.00	4	SS		Greyish Brown loose Sand with clay packets
3	/	11	56												
		11	57												
				SC			6	7	9	16	4.00	5	SS		Greyish Medium Dense Silty fine Sand
4		12	14												
		12	15												
5	02			SC			4	5	5	10	5.00	6	SS		Greyish Medium Dense Silty fine sand
		12	27												
		12	28												
6				SC			3	4	5	9	6.00	7	SS		Greyish Loose Silty fine Sand
7	/	12	45												
		12	46												
				SC			6	7	8	15	7.50	8	SS		Greyish Medium Dense Silty fine Sand
8	12														
		2	11												
		2	12												
9				SC			9	10	14	24	9.00	9	SS		Brownish Grey Medium Dense fine Sand with Sea Shells
10		2	41												
		2	42	SC			10	8	7	15	10.50	10	SS		Brownish Grey Medium Dense Silty fine Sand

CS - Core Sample	DS - Disturbed Sample	SUPERVISOR NAME	M. Loganathan	PROJECT SITE DETAILS	
SS - Split Spoon Sample	SC - Soil Cutter	SIGNATURE		GROUND LEVEL (m)	
UDS-Undisturbed Sample	TCB - Tungsten Carbide Bit	DATE	11/02/2023	WATER TABLE (m)	2.30
WS - Wash Sample	DB - Diamond Bit	CLIENT IN-CHARGE		CASING DEPTH (m)	

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SITE INVESTIGATION RECORD

BORE HOLE No.	01
PAGE No.	02
DIA OF BORE HOLE	150mm 4" / 100mm
BORE START DATE	11/02/2023
BORE END DATE	13/02/2023
TOTAL DRILLING DAYS	2

PROJECT NAME	CHAITHANYA EASTERN, ANNA AVENUE, ADYAR				
LOCATION		MACHINE No.	CR 06	CHAINAGE (m)	
STRUCTURE	S6/F + 5F	DRILLING METHOD	Rotary	CO-ORDINATES	N
JOB CODE		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	Layer Data: Depth (m)	Geotechnical Description
1	11/02	3	10												
		3	11												
2	12/02/23			SC			9	13	17	30	12.00	11	SS		Brownish Grey Medium Dense Silty fine sand
3		9	46												
		9	55												
4	13/02			SC			Hammer Rebound No / Pent				14.00	12	WS	WS	Greyish Brown very weak Completely Weathered Rock
				DB							15.50				
5		10	28								↓				
		10	45												
6	02			DB	0%	0%	4cm / 5 5 6 HR N > 100				16.00	13	SS + WS		Greyish Brown very weak completely Weathered Rock
7		11	16								↓				
		12	00												
8	02			DB	0%	0%					17.50	16	CS		Greyish Brown very weak completely Weathered Rock
9	Borehole Terminated at 17.50m Depth below in Col														
0															

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CS - Core Sample	DS - Disturbed Sample	SUPERVISOR NAME	Mr. Gopanakar	PROJECT SITE DETAILS	
SS - Split Spoon Sample	SC - Soil Cutter	SIGNATURE		GROUND LEVEL (m)	EGL
UDS-Undisturbed Sample	TCB - Tungsten Carbide Bit	DATE	13/02/2023	WATER TABLE (m)	2.30m
WS - Wash Sample	DB - Diamond Bit	CLIENT IN-CHARGE		CASING DEPTH (m)	—

GEOMARINE
THE SPIRIT OF ENGINEERING

SITE INVESTIGATION RECORD

BORE HOLE No.	02
PAGE No.	01
DIA OF BORE HOLE	150mm ✓ / 100mm
BORE START DATE	09/02/2023
BORE END DATE	10/02/2023
TOTAL DRILLING DAYS	2

PROJECT NAME	CHAITANYA EASTLYN - AMALA AVENUE, ADYAR				
LOCATION		MACHINE No.	CR-01	CHAINAGE (m)	
STRUCTURE	Stilt + 5F	DRILLING METHOD	Rotary	CO-ORDINATES	N
JOB CODE		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	Layer Data: Depth (m)	Layer Data: Geotechnical Description
0		12	16												Filled up Soil
		12	19	SC			2	2	6	8	0.50	1	SS		Greyish Loose sand with Pebbles.
1		12	31											1.0	
		12	32	SC			3	3	6	9	1.25	2	SS		Brownish Stiff Sandy Clay
	09	12	47												
2		12	48	SC			3	4	4	8	2.00	3	SS		Brownish Stiff Sandy Clay
		2	07												
		2	09												
3				SC			45cm/37b				3.00	4	UDS		Brownish Grey Sandy Clay
		2	24												
		2	25												
4	/			SC			3	5	6	11	4.00	5	SS		Brownish Grey Medium Dense Silty fine Sand with Sea Shells
		2	45												
		2	46												
5				SC			3	5	7	12	5.00	6	SS		Greyish Medium Dense fine Sand
	02	3	06												
		3	07												
6				SC			2	4	6	10	6.00	7	SS		Greyish Medium Dense Silty fine Sand
		3	21												
7		3	22												
	/			SC			4	4	9	13	7.50	8	SS		Greyish Medium Dense Silty fine Sand
8	ab 23														
		3	40												
		3	41												
9				SC			7	12	13	25	9.00	9	SS		Greyish Medium Dense Silty coarse to fine Sand
10		6	02												
		6	03	SC			5	8	14	22	10.50	10	SS		Brownish Grey Medium Dense M-coarse to fine Sand

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CS - Core Sample	DS - Disturbed Sample	SUPERVISOR NAME	Mr. Loganathan
SS - Split Spoon Sample	SC - Soil Cutter	SIGNATURE	
UDS-Undisturbed Sample	TCB - Tungsten Carbide Bit	DATE	09/02/2023
WS - Wash Sample	DB - Diamond Bit	CLIENT IN-CHARGE	

PROJECT SITE DETAILS	
GROUND LEVEL (m)	RL
WATER TABLE (m)	
CASING DEPTH (m)	

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SITE INVESTIGATION RECORD

BORE HOLE No.	02
PAGE No.	02
DIA OF BORE HOLE	150mm: 4 / 100mm:
BORE START DATE	09/02/2023
BORE END DATE	10/02/2023
TOTAL DRILLING DAYS	2

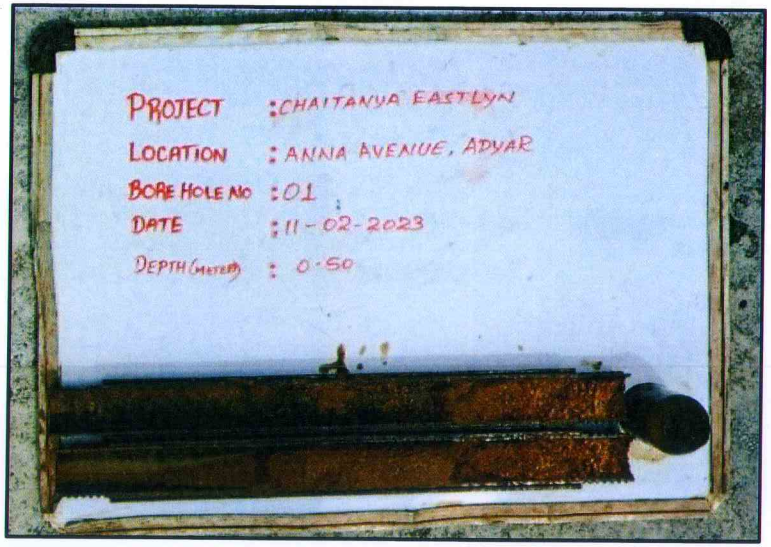
PROJECT NAME	CHAITANYA EASTLYN						
LOCATION		MACHINE No.	CR01	CHAINAGE (m)			
STRUCTURE	Stilt + 5F	DRILLING METHOD	Rotary	CO-ORDINATES	N		
JOB CODE		FLUSHING MEDIUM	Bentonite		E		

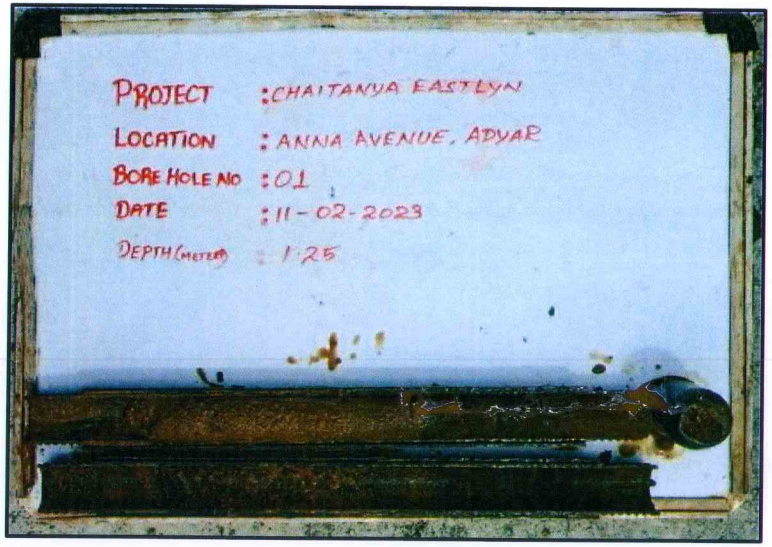
Depth below E.G.L. (m)	Drilling progress per metre: Date	Time: Hr.	Time: Min	Type of Drill Bit (SC / TCB / DB)	Core Details: Total Core Recovery %	Core Details: R.Q.D %	SPT Details: Blows/cm. 0-15	SPT Details: Blows/cm. 15-30	SPT Details: Blows/cm. 30-45	SPT 'N' Value	Sample Details: Depth	Sample Details: No.	Sample Details: Type	Layer Data: Depth (m)	Geotechnical Description
1	09/02/2023	4	42												
		4	43												
2				SC			10	12	16	28	12.00	11	SS		Brownish Grey Medium Dense fine to M. coarse Sand with Lime
		10	15												
3		10	18												
4				SC			17	37	10cm/65 blows HR N>100		14.00	12	SS	14.00	Greyish Brown very weak completely Weathered Rock
		10	55												
5		11	08												
6				SC			9cm/60 blows				16.00	13	SS		Pinkish Brown very weak completely Weathered Rock
		12	00												
7		12	30												
				DB	0%	0%	Hammer Refusal NLO / 5cm N>100				17.50	14	WS		Brownish very weak completely Weathered Rock
8															
9	Borehole Terminated at 17.50M Depth below m.G.L.														
0															

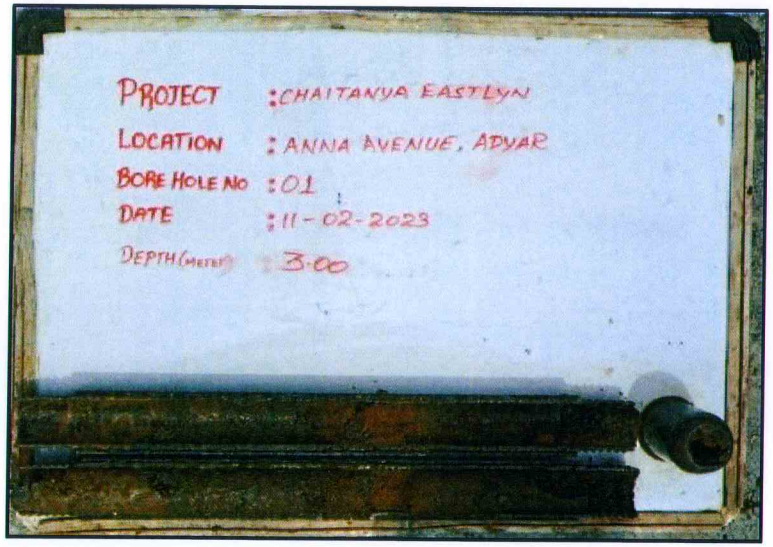
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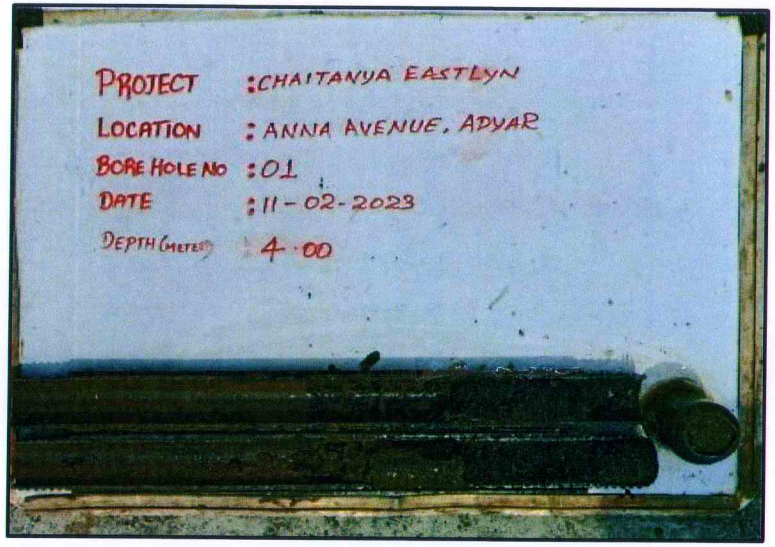
CS - Core Sample	DS - Disturbed Sample	SUPERVISOR NAME	M. Loganathan	PROJECT SITE DETAILS	
SS - Split Spoon Sample	SC - Soil Cutter	SIGNATURE		GROUND LEVEL (m)	EGL
UDS-Undisturbed Sample	TCB - Tungsten Carbide Bit	DATE	10/02/2023	WATER TABLE (m)	
WS - Wash Sample	DB - Diamond Bit	CLIENT IN-CHARGE		CASING DEPTH (m)	—

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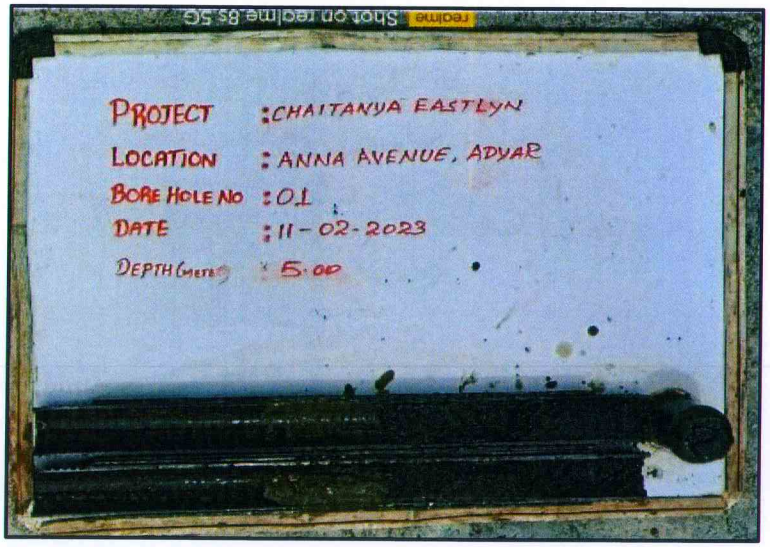


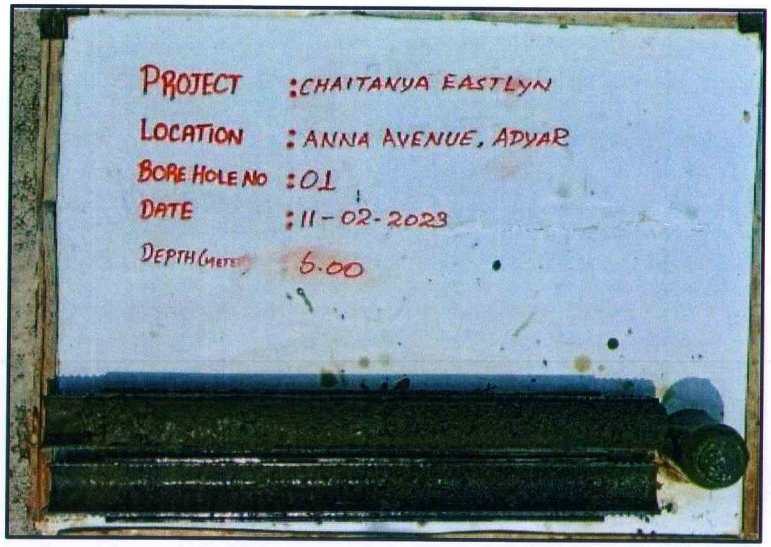


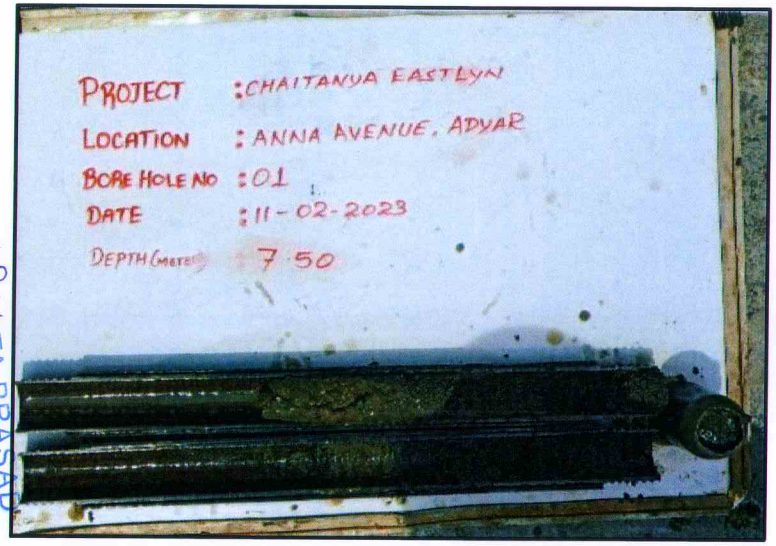


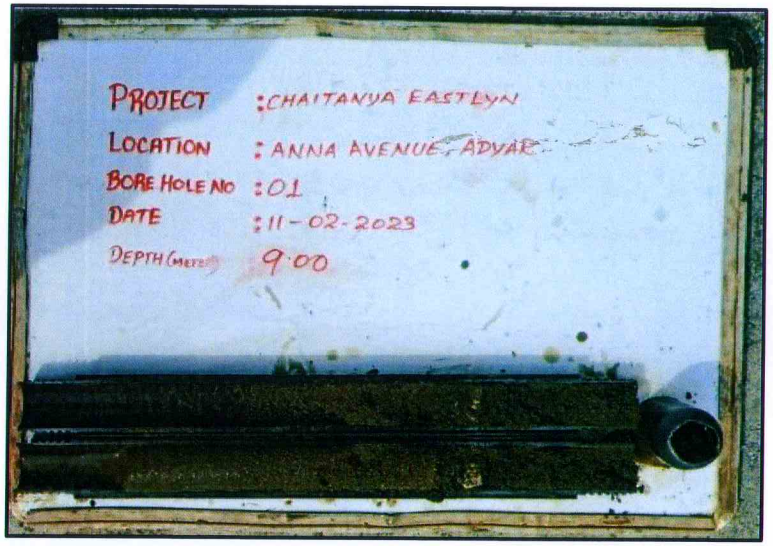
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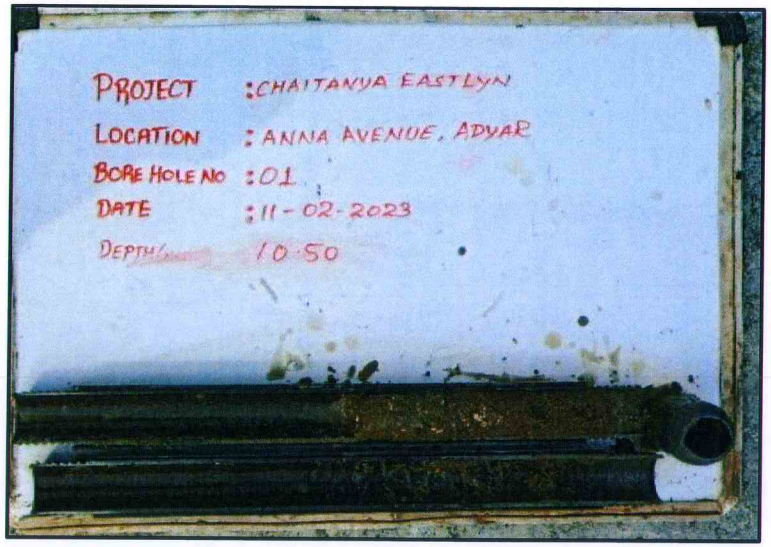


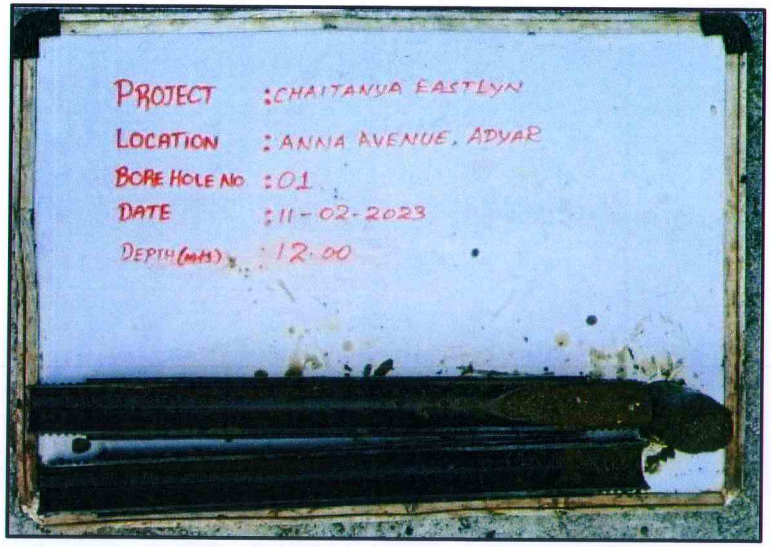


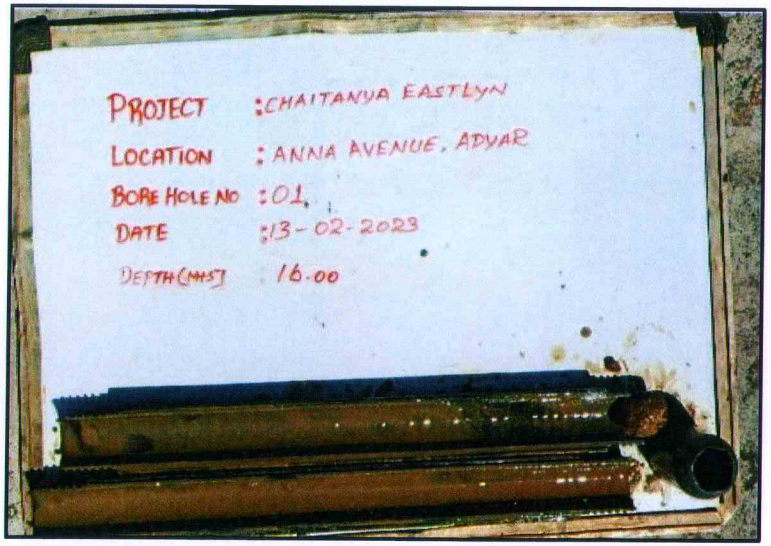


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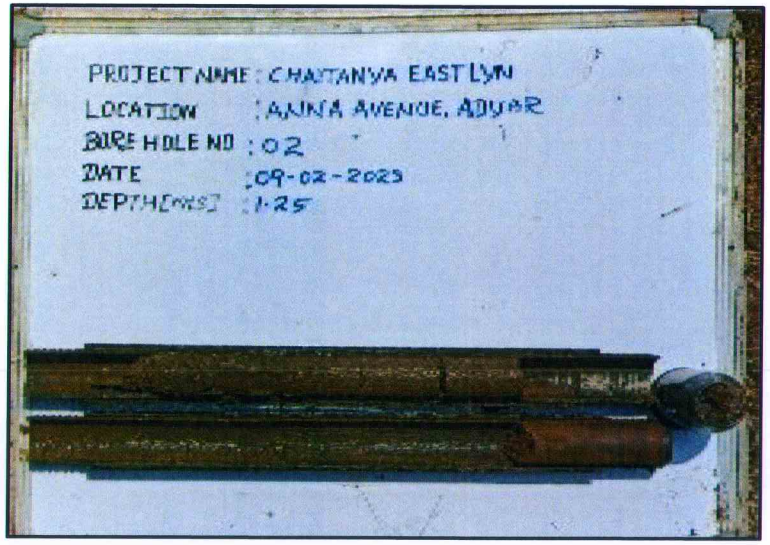


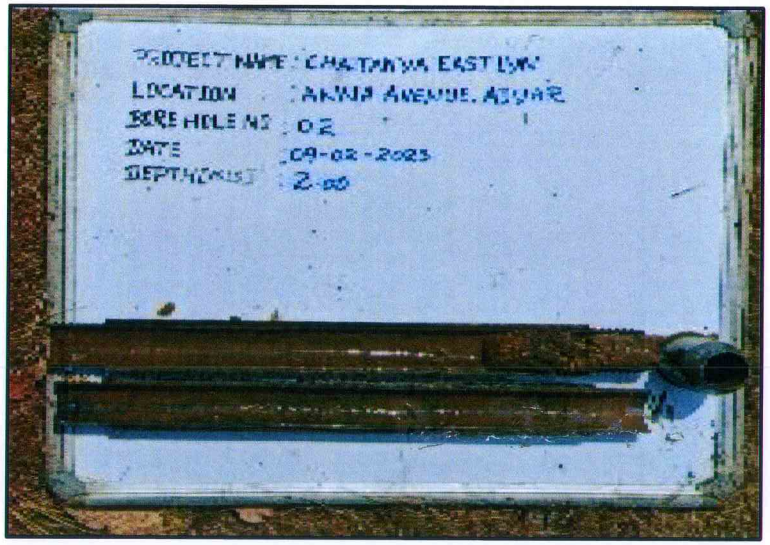


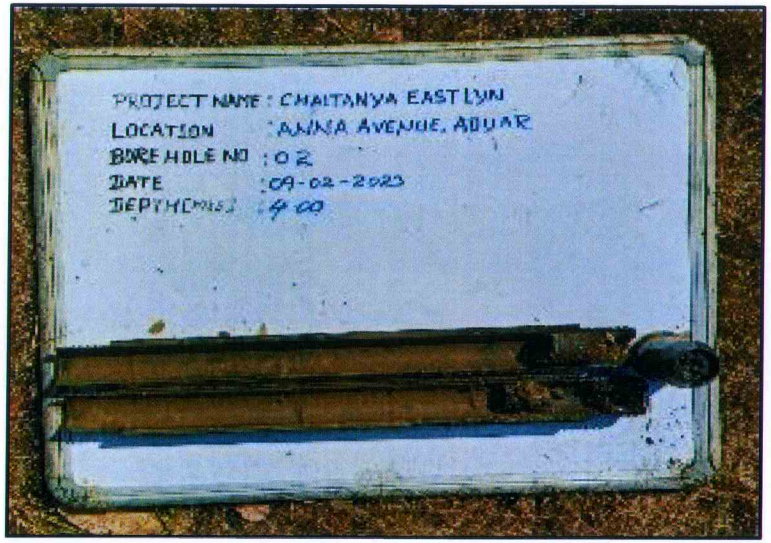


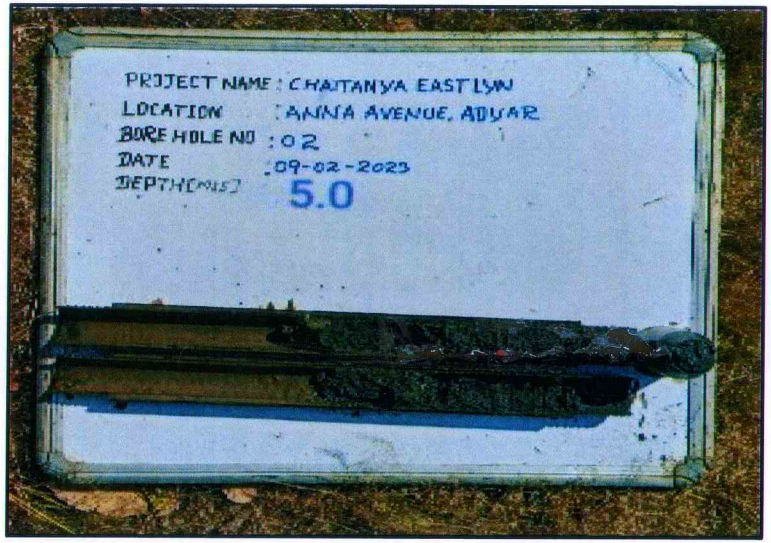
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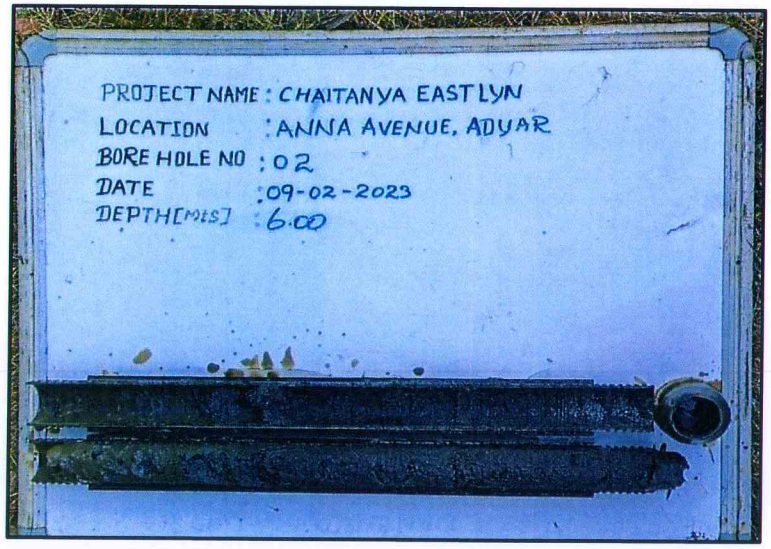


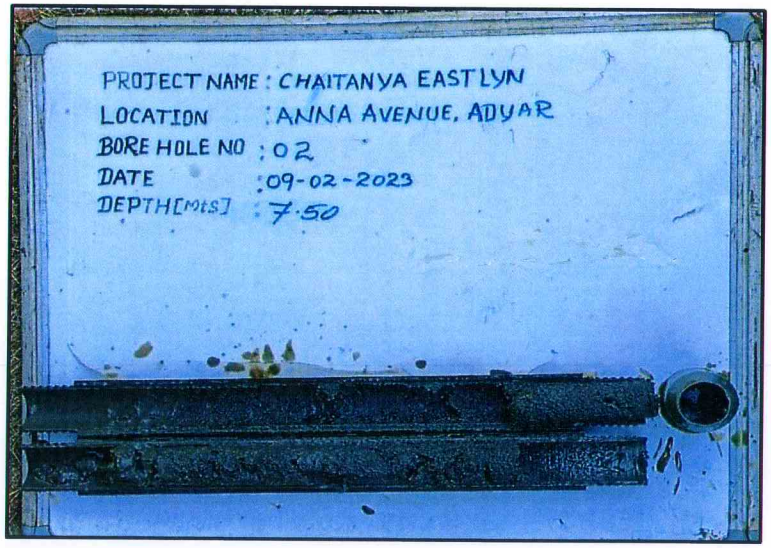


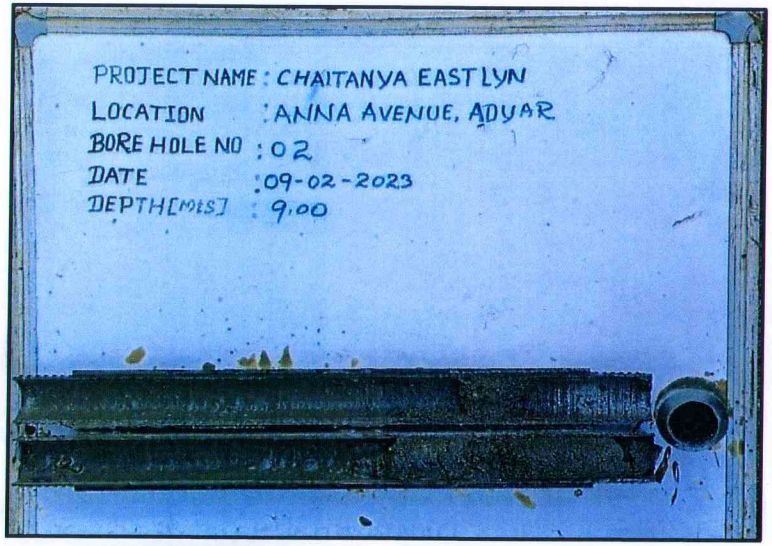


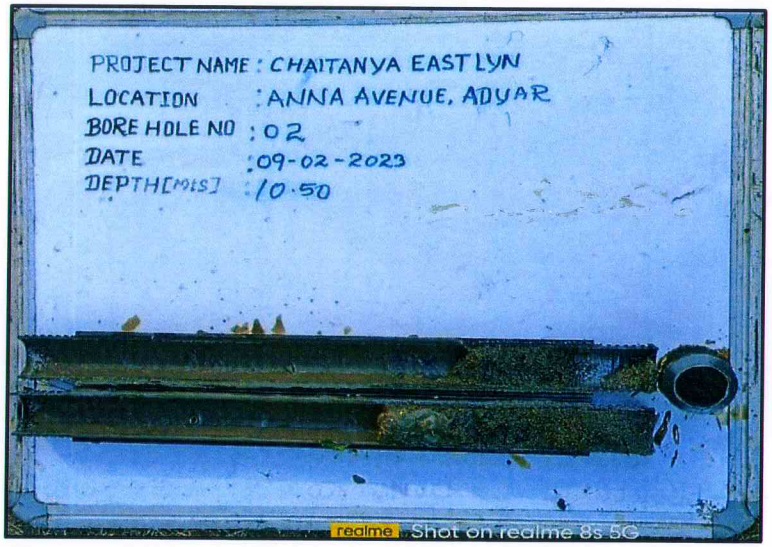
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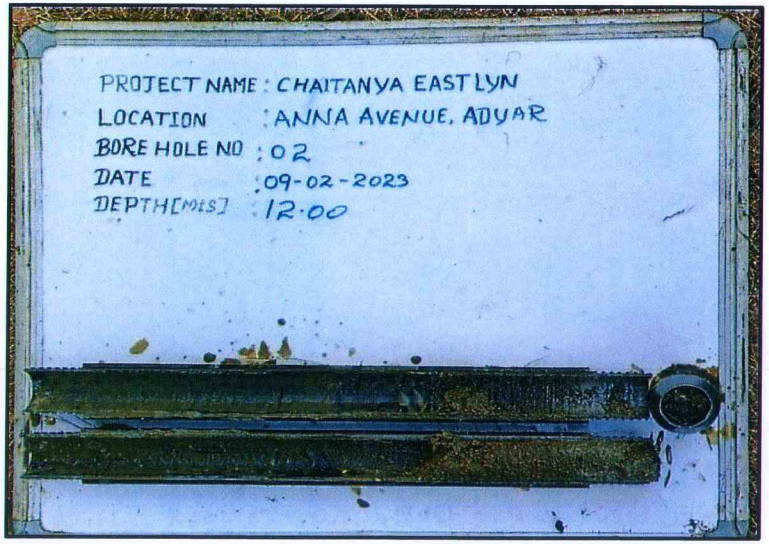




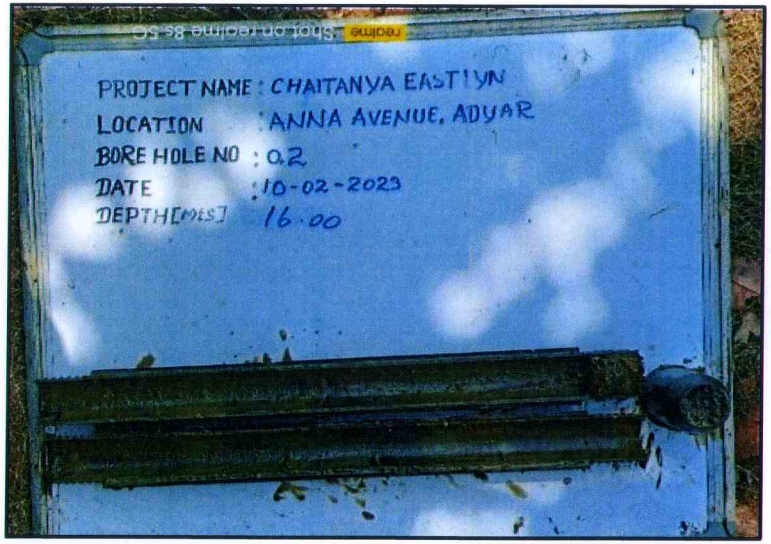


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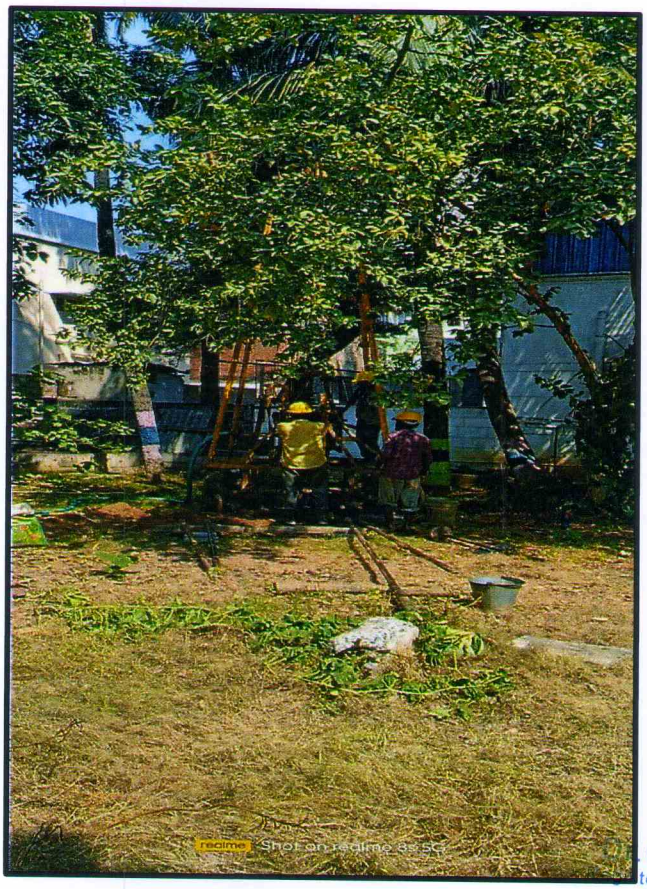




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