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PROJECT

PROPOSED CONSTRUCTION OF RESIDENTIAL ETICA MALARVIZHI APARTMENT (STILT+9 UPPER FLOORS) AT NO.149/96, KARPAGAM AVENUE, SANTHOME HIGH ROAD, MRC NAGAR, RAJA ANNAMALAIPURAM, CHENNAI.

CLIENT NAME

ETICA DEVELOPERS,
RAJA ANNAMALAIPURAM,
CHENNAI - 600 028

TITLE

GEOTECHNICAL INVESTIGATION REPORT

PROJECT NO: GEC-JC-GT-4094-A/2022-2023

REPORTING DATE: 18/01/2023

GEO ENGINEERING CONSULTANTS Chennai 600 042

For ETICA DEVELOPERS PVT. LTD.

Managing Director.

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REPORT TEXT

CHAPTER-1

INTRODUCTION

1.0 Project Information Matrix

Nature of project	: Proposed Residential Apartment (Stilt+9 Upper Floors)
Project Client	: M/s ETICA DEVELOPERS,
Project Location	: MRC Nagar, Chennai.
Job Code	: JC-GT-4084-A

1.1 Scope Of Work

1.1.1 Field Work

- Conducting four soil investigation bore holes of 150 mm & NX diameter up to 22.0m 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 interval up to 20.0m after that 2.0m interval up to the 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-2.1to 2.4. The graphical representation of grain size distribution curve for the representative samples in each bore is presented in Fig. 2.5 to 2.8.

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 2.4.

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 - 2.5.

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 2.4.

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SOIL PROFILE

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-01		
SHEET	1	OF	3
DIA OF BORE HOLE	150mm ✓ / NX		
BORE START DATE	07/01/2023		
BORE END DATE	08/01/2023		
TOTAL DRILL DAYS	2		

PROJECT NAME	PROPOSED CONSTRUCTION OF RESIDENTIAL APARTMENT BUILDING AT MRC AGAR						
LOCATION	MRC Nagar, Chennai	MACHINE No.	GPI-01	CHAINAGE (m)	-		
STRUCTURE	SNR +8 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N	-	
JOB CODE	GEC-JC-GT-4094-A	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	07/01/2023	11	05	SC	-	-										L1	1.0	Filled Up Soil Brownish Clayey Sand with Brick waste
		To																
		11	08															
2		11	20				3	4	4	8	2.00	2	SS	-2.0				
		To		SC	-	-					2.45							
		11	24															
3		11	40				3	4	5	9	3.00	3	SS	-3.0				
		To		SC	-	-					3.45							
		11	43															
4		11	50				2	3	5	8	4.00	4	SS	-4.0				
		To		SC	-	-					4.45							Brown/Black, Moist, Loose, Poorly Graded, Silty SAND (SP-SM), Sand -Silt Mixture
		11	53															
5		12	05				2	4	4	8	5.00	5	SS	-5.0				
		To		SC	-	-					5.45							
6		12	10															
		12	20				3	4	5	9	6.50	6	SS	-6.5				
7		To		SC	-	-					6.95							
		12	25															
8		12	43				6	8	10	18	8.00	7	SS	-8.0		L2	8.0	
		To		SC	-	-					8.45							Brownish, Moist, Medium Dense, Poorly Graded, Silty SAND (SP-SM), Sand -Silt Mixture
		13	50															
9							12	13 cm Penet.for 50 Blows		>100	9.50	8	SS	-9.5		L3	9.5	
											9.78							
10																		Brownish, Moist, Very Dense, Poorly Graded, Silty SAND (SP-SM), Sand -Silt Mixture

CS - Core Sample	DS - Disturbed Sample	LOGGED	M. RAJA	PROJECT SITE DETAILS		REMARKS	
SS - Split Spoon Sample	SC - Soil Cutter	DATE	07/01/2023	GROUND LEVEL (m)	0.00		
UDS - Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	JALEEL YASIN	WATER TABLE (m)	2.00		
WS - Wash Sample	DB - Diamond Bit	DATE	10/01/2023	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 APARTMENT BUILDING AT MRC AGAR					DIA OF BORE HOLE	150mm ✓ / NX
LOCATION	MRC Nagar, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	07/01/2023
STRUCTURE	Stilt +8 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	08/01/2023
JOB CODE	GEC-JC-GT-4094-A	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	2

Depth below E.G.L. (m)	Drilling progress per metre: Date	Time: Hr.	Time: Min.	Type of Drill Bit (SC / TCB / DB)	Core Details: Total Core Recovery %	Core Details: R.Q.D %	SPT Details: Blows/cm. 0-15	SPT Details: Blows/cm. 15-30	SPT Details: Blows/cm. 30-45	SPT 'N' Value	Sample Details: Depth	Sample Details: No.	Sample Details: Type	Sample Details: RL (m)	Layer Data: Legend	Layer Data: No	Layer Data: Depth	Geotechnical Description
11	07/01/2023	12	10 To 12 15	SC	-	-	16	13 cm Penet.for 50 Blows		>100	11.00 / 11.28	9	SS	-11.0		L4	11.5	Brownish, Moist,Very Dense, Poorly Graded, Silty SAND (SP-SM) Sand -Silt Mixture
12		14	45 To 14 50	SC	-	-	1	1	2	3	12.50 / 12.95	10	SS	-12.5				
13		15	20 To 15 25	SC	-	-	1	2	3	5	14.00 / 14.45	11	SS	-14.0				Greyish Black, Moist, Very Loose, Poorly Graded, Clayey SAND (SC) Sand-Clay Mixture
14		15	50 To 15 55	SC	-	-	4	8	12	20	15.50 / 15.95	12	SS	-15.5		L5	15.5	
15		16	20 To 16 25	SC	-	-	16	20	22	42	17.00 / 17.45	13	SS	-17.0		L6	17.0	Brownish, Moist, Medium Dense, Poorly Graded, Silty SAND (SM), Sand -Silt Mixture
16		16	50 To 16 55	SC	-	-	15	27	32	59	18.50 / 18.95	14	SS	-18.5				Brownish, Moist, Dense to Very Dense, Poorly Graded, Silty SAND (SP-SM), Sand -Silt Mixture
17		17	20 To 17 25	SC	-	-												
18																		
19																		
20							5 cm Penet.for 50 Blows			>100	20.00 / 20.05	15	SS	-20.0		L7	20.0	
																		Brownish Grey, Moist, Very Dense, Completely Weathered Rock

CS - Core Sample	DS - Disturbed Sample	LOGGED	M. RAJA	PROJECT SITE DETAILS		REMARKS	
SS - Split Spoon Sample	SC - Soil Cutter	DATE	07/01/2023	GROUND LEVEL (m)	0.00		
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	JALEEL YASIN	WATER TABLE (m)	2.00		
WS - Wash Sample	DB - Diamond Bit	DATE	10/01/2023	CASING DEPTH (m)	6.00		

For ETICA DEVELOPERS PVT. LTD.

Managing Director.

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-01						
SHEET	3	OF	3				
PROJECT NAME	PROPOSED CONSTRUCTION OF RESIDENTIAL APARTMENT BUILDING AT MRC AGAR			DIA OF BORE HOLE	150mm	✓	
					NX		
LOCATION	MRC Nagar, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	07/01/2023
STRUCTURE	Still +9 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	08/01/2023
JOB CODE	GEC-JC-GT-4094-A	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/6m: 0-15	15-30	30-45	SPT 'N' Value	Sample Details: Depth	No.	Type	RL (m)	Layer Data: Legend	No	Depth	Geotechnical Description
21	08/01/2023	08 To 10	30 00	DS	32	0										L8	20.5	Brownish Grey, Moist, Very Dense, Completely Weathered Rock
22							-	-	-	-	22.00	16	CS	-22.0		L9	22.0	Brownish Grey, Moderately Weathered Rock
23																		
24																		
25																		
26																		
27																		
28																		
29																		
30																		

CS - Core Sample	DS - Disturbed Sample	LOGGED	M. RAJA	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	08/01/2023	GROUND LEVEL (m)	0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	JALEEL YASIN	WATER TABLE (m)	2.00	
WS - Wash Sample	DB - Diamond Bit	DATE	18/01/2023	CASING DEPTH (m)	0.00	

Borehole terminated at 22 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 RESIDENTIAL APARTMENT BUILDING AT MRC AGAR			DIA OF BORE HOLE	150mm	✓	
					NX		
LOCATION	MRC Nagar, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	08/01/2023
STRUCTURE	Stilt +9 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES N	-	BORE END DATE	08/01/2023
JOB CODE	GEC-JC-GT-4094-A	FLUSHING MEDIUM	Bentonite	CO-ORDINATES E	-	TOTAL DRILL DAYS	1

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	08/01/2023	11	45	SC	-	-										L1	1.0	Filled Up Soil Brownish Clayey Sand with Brick waste
		To																
		11	50															
2		12	00	SC	-	-	3	4	4	8	2.00	2	SS	-2.0				
		To									2.45							
		12	03															
3		12	10	SC	-	-	2	4	5	9	3.00	3	SS	-3.0				
		To									3.45							
		12	14															
4		12	25	SC	-	-	3	5	6	11	4.00	4	SS	-4.0				Brownish, Moist, Loose to Medium Dense, Poorly Graded, Silty SAND (SP-SM), Sand -Silt Mixture
		To									4.45							
		12	30															
5		12	40	SC	-	-	2	3	3	6	5.00	5	SS	-5.0				
		To									5.45							
		12	47															
6																L2	6.5	
		14	02				2	5	7	12	6.50	6	SS	-6.5				
7		To		SC	-	-					6.95							
		14	08															
8		14	25	SC	-	-	5	10	13	23	8.00	7	SS	-8.0				Brownish, Moist, Medium Dense, Poorly Graded, Silty SAND (SP-SM), Sand -Silt Mixture
		To									8.45							
		14	30															
9																		
							8	12	16	28	9.50	8	SS	-9.5				
10											9.78					L3	10.0	

CS - Core Sample	DS - Disturbed Sample	LOGGED	M. RAJA	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	08/01/2023	GROUND LEVEL (m)	0.00	
UDS - Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	JALEEL YASIN	WATER TABLE (m)	2.00	
WS - Wash Sample	DB - Diamond Bit	DATE	10/01/2023	CASING DEPTH (m)	0.00	

For ETICA DEVELOPERS PVT. LTD.

Managing Director.

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-02						
SHEET	2	OF	2				
PROJECT NAME	PROPOSED CONSTRUCTION OF RESIDENTIAL APARTMENT BUILDING AT MRC AGAR			DIA OF BORE HOLE	150mm / NX	✓	
LOCATION	MRC Nagar, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	08/01/2023
STRUCTURE	Still +8 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	08/01/2023
JOB CODE	GEC-JC-GT-4264-A	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	1

Depth below E.G.L (m)	Drilling progress per metre: Date	Time: Hr.	Time: Min.	Core Details: Type of Drill Bit (SD / 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	08/01/2023	14	55	SC	-	-	16	17	13 cm Penetr.for 50 Blows	>100	11.00	9	SS	-11.0		L4	11.5	Brownish, Moist,Very Dense, Poorly Graded, Silty SAND (SP-SM) Sand -Silt Mixture
		To									11.42							
12		15	15															
		15	32	SC	-	-												
		To																
13		15	39				2	2	1	3	12.50	10	SS	-12.5				
											12.95							
		15	58															Greyish Black, Moist, Very Loose, Poorly Graded, Clayey SAND (SC) Sand-Clay Mixture
14		To		SC	-	-												
		16	02				1	2	2	4	14.00	11	SS	-14.0				
											14.45							
15		16	21															
		To		SC	-	-										L5	15.5	
		16	31				5	10	13	23	15.50	12	SS	-15.5				
16											15.95							Brownish, Moist, Medium Dense, Poorly Graded, Silty SAND (SM), Sand -Silt Mixture
		16	55															
		To		SC	-	-												
17		17	08				18	23	27	50	17.00	13	SS	-17.0		L6	17.0	
											17.45							
		17	30															
18		To		SC	-	-												
		17	37				15	23	22	45	18.50	14	SS	-18.5				Brownish, Moist, Dense, Poorly Graded, Silty SAND (SM), Sand -Silt Mixture
											18.95							
19																L7	19.5	
		17	58															
		To		SC	-	-												
20		18	10						2 cm Penetr.for 50 Blows	>100	20.00	15	SS	-20.0		L8	20.0	Brownish Gray, Moist, Very Dense, Completely Weathered Rock
											20.02							

CS - Core Sample	DS - Disturbed Sample	LOGGED	M.RAJA	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	08/01/2023	GROUND LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	JALEEL YASIN	WATER TABLE (m) 2.50	
WS - Wash Sample	DB - Diamond Bit	DATE	10/01/2023	CASING DEPTH (m) 0.00	

Borehole terminated at 20 m depth below E.G.L

FIG.2.2 Sub Soil Profile at BH-02 Location

For ETICA DEVELOPERS PVT. LTD.

Managing Director.

SITE INVESTIGATION RECORD

BORE HOLE No.: BH-03
SHEET: 1 OF 2

PROJECT NAME	PROPOSED CONSTRUCTION OF RESIDENTIAL APARTMENT BUILDING AT MRC AGAR					DIA OF BORE HOLE	150mm ✓ / NX
LOCATION	MRC Nagar, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	09/01/2023
STRUCTURE	Still +9 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	09/01/2023
JOB CODE	GEC-JC-GT-4094-A	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	1

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: Blow/cm. 0-15	SPT Details: Blow/cm. 15-30	SPT Details: Blow/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	09/01/2023	10	25 To 30	SC	-	-										L1	1.0	Filled Up Soil Brownish Clayey Sand with Brick waste
2		12	45 To 49	SC	-	-	4	5	6	11	2.00 2.45	2	SS	-2.0				
3		13	03 To 05	SC	-	-	9	10	9	19	3.00 3.45	3	SS	-3.0				Brownish/Grey, Moist, Medium Dense, Poorly Graded, Silty SAND (SP-SM), Sand -Silt Mixture
4		13	20 To 24	SC	-	-	4	5	7	12	4.00 4.45	4	SS	-4.0				
5		13	35 To 40	SC	-	-	2	3	3	6	5.00 5.45	5	SS	-5.0		L2	5.0	
6																L3	6.5	Grey, Moist, Loose, Poorly Graded, Silty SAND (SP-SM), Sand -Silt Mixture
7		13	50 To 53	SC	-	-	2	6	7	13	6.50 6.95	6	SS	-6.5				
8		14	03 To 06	SC	-	-	5	12	10	22	8.00 8.45	7	SS	-8.0				Brownish Grey, Moist, Medium Dense, Poorly Graded, Silty SAND (SP-SM), Sand -Silt Mixture
9							4	5	7	12	9.50 9.78	8	SS	-9.5				
10																		

CS - Core Sample	DS - Disturbed Sample	LOGGED	M. RAJA	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	09/01/2023	GROUND LEVEL (m) 0.00	
UDS - Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	JALEEL YASIN	WATER TABLE (m) 2.00	
WS - Wash Sample	DB - Diamond Bit	DATE	10/01/2023	CASING DEPTH (m) 0.00	

For ETICA DEVELOPERS PVT. LTD

Managing Director.

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-03						
SHEET	2	OF	2				
PROJECT NAME	PROPOSED CONSTRUCTION OF RESIDENTIAL APARTMENT BUILDING AT MRC AGAR			DIA OF BORE HOLE	150mm	✓	
					NX		
LOCATION	MRC Nagar, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	09/01/2023
STRUCTURE	Stilt +5 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	09/01/2023
JOB CODE	GEC-JC-GT-4004-A	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	1

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	15-30	30-45	SPT 'N' Value	Sample Details: Depth	No	Type	RL (m)	Layer Data: Legend	RL	Depth	Geotechnical Description
11	09/01/2023	14	50 To 14 57	SC	-	-	10	15	13	28	11.00 ↓ 11.42 ↓	9	SS	-11.0		L4	11.5	Brownish, Moist,Medium Dense, Poorly Graded, Silty SAND (SP-SM) Sand -Silt Mixture
12		15	25 To 15 35	SC	-	-	5	2	1	3	12.50 ↓ 12.95 ↓	10	SS	-12.5				
13		16	00 To 16 10	SC	-	-	1	2	1	3	14.00 ↓ 14.45 ↓	11	SS	-14.0				Greyish Black, Moist, Very Loose, Poorly Graded, Clayey SAND (SC) Sand-Clay Mixture
15		16	35 To 16 40	SC	-	-	4	7	10	17	15.50 ↓ 15.95 ↓	12	SS	-15.5		L5	15.5	
16																		Brownish, Moist, Medium Dense, Poorly Graded, Silty SAND (SM), Sand -Silt Mixture
17		17	05 To 17 15	SC	-	-	15	18	21	39	17.00 ↓ 17.45 ↓	13	SS	-17.0		L6	17.0	
18		17	43 To 17 52	SC	-	-	8	16	19	35	18.50 ↓ 18.95 ↓	14	SS	-18.5				Brownish, Moist, Dense, Poorly Graded, Silty SAND (SM), Sand -Silt Mixture
19																L7	19.5	
20		18	17 To 18 32	SC	-	-	6 cm Penetration 50 Blows			>100	20.00 ↓ 20.06 ↓	15	SS	-20.0		L8	20.0	Brownish Grey, Moist, Very Dense, Completely Weathered Rock

CS - Core Sample	DS - Disturbed Sample	LOGGED	M. RAJA	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	09/01/2023	GROUND LEVEL (m)	0.00	
UDS - Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	JALEEL YASIN	WATER TABLE (m)	2.00	
WS - Wash Sample	DB - Diamond Bit	DATE	16/01/2023	CASING DEPTH (m)	0.00	

Borehole terminated at 20 m depth below E.G.L

FIG.2.3 Sub Soil Profile at BH-03 Location

For ETICA DEVELOPERS PVT. LTD.

Managing Director.

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SITE INVESTIGATION RECORD

BORE HOLE No. BH-04

SHEET 1 OF 2

PROJECT NAME	PROPOSED CONSTRUCTION OF RESIDENTIAL APARTMENT BUILDING AT MRC AGAR					DIA OF BORE HOLE	310mm ✓ / NX
LOCATION	MRC Nagar, Chennai	MACHINE No.	CH-01	CHAINAGE (m)	-	BORE START DATE	10/01/2023
STRUCTURE	Stilt +9 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	10/01/2023
JOB CODE	GEC-JC-GT-4024-A	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	1

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
0																L1	1.0	Filled Up Soil Brownish Clayey Sand with Brick waste
1	10/01/2023	12	30	SC	-	-												
		To																
		12	34															
2		12	40				2	2	3	5	2.00	2	SS	-2.0				Brownish, Moist, Very Loose, Poorly Graded, Silty SAND (SM), Sand -Silt Mixture
		To		SC	-	-					2.45							
		12	45															
3		12	57				4	5	6	11	3.00	3	SS	-3.0		L2	3.0	
		To		SC	-	-					3.45							
		13	00															
4		13	13				3	4	4	8	4.00	4	SS	-4.0				
		To		SC	-	-					4.45							
		13	16															
5		13	27				3	5	7	12	5.00	5	SS	-5.0				
		To		SC	-	-					5.45							
		13	33															
6																		Brownish/Grey, Moist, Loose to Medium Dense, Poorly Graded, Silty SAND (SP-SM), Sand -Silt Mixture
		13	50				4	4	7	11	6.50	6	SS	-6.5				
7		To		SC	-	-					6.95							
		13	55															
8							5	3	6	9	8.00	7	SS	-8.0				
		14	10								8.45							
		To		SC	-	-												
9		14	15													L3	9.5	
							5	7	7	14	9.50	8	SS	-9.5				
10											9.78							Brownish, Moist, Medium Dense, Poorly Graded, Silty SAND (SP-SM), Sand -Silt Mixture

CS - Core Sample	DS - Disturbed Sample	LOGGED	M. RAJA	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	10/01/2023	GROUND LEVEL (m) 0.00	
UDS - Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	JALEEL YASIN	WATER TABLE (m) 2.00	
WS - Wash Sample	DB - Diamond Bit	DATE	18/01/2023	CASING DEPTH (m) 0.00	

For ETICA DEVELOPERS PVT. LTD

Managing Director.

SITE INVESTIGATION RECORD

BORE HOLE No.	BH-04						
SHEET	2	OF	3				
PROJECT NAME	PROPOSED CONSTRUCTION OF RESIDENTIAL APARTMENT BUILDING AT MRC AGAR					DIA OF BORE HOLE	150mm ✓ / NX
LOCATION	MRC Nagar, Chennai	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	10/01/2023
STRUCTURE	Stilt +9 Upper Floors	DRILLING METHOD	Rotary	CO-ORDINATES	N -	BORE END DATE	10/01/2023
JOB CODE	GEC-JC-CT-4084-A	FLUSHING MEDIUM	Bentonite		E -	TOTAL DRILL DAYS	1

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	10/01/2023	14	35 To 14 40	SC	-	-	12	10	13	23	11.00 / 11.42	9	SS	-11.0		L4	11.5	Brownish, Moist,Medium Dense, Poorly Graded, Silty SAND (SP-SM) Sand -Silt Mixture
12		15	00 To 15 09	SC	-	-	2	1	2	3	12.50 / 12.95	10	SS	-12.5				Greyish Black, Moist, Very Loose, Poorly Graded, Clayey SAND (SC) Sand-Clay Mixture
13		15	25 To 15 37	SC	-	-	1	7	5	12	14.00 / 14.45	11	SS	-14.0		L5	14.0	
14		16	10 To 16 20	SC	-	-	5	12	15	27	15.50 / 15.95	12	SS	-15.5				Brownish, Moist, Medium Dense, Poorly Graded, Silty SAND (SM), Sand -Silt Mixture
15		16	40 To 16 50	SC	-	-	15	26	22	47	17.00 / 17.45	13	SS	-17.0		L6	17.0	
16		15	15 To 17 20	SC	-	-	17	21	28	49	18.50 / 18.95	14	SS	-18.5				Brownish, Moist, Dense, Poorly Graded, Silty SAND (SP-SM), Sand -Silt Mixture
17		17	47 To 18 04	SC	-	-	3 cm Penet.for 50 Blows			>100	20.00 / 20.03	15	SS	-20.0		L7	19.5	
18																L8	20.0	Brownish Grey, Moist, Very Dense, Completely Weathered Rock
19																		
20																		

GS - Core Sample	DS - Disturbed Sample	LOGGED	M. RAJA	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	10/01/2023	GROUND LEVEL (m)	0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	JALEEL YASIN	WATER TABLE (m)	2.00	
WS - Wash Sample	DB - Diamond Bit	DATE	10/01/2023	CASING DEPTH (m)	0.00	

Borehole terminated at 20 m depth below E.G.L

FIG.2.4 Sub Soil Profile at BH-04 Location

For ETICA DEVELOPERS PVT. LTD.

Managing Director.

Grain Size Distribution Curves

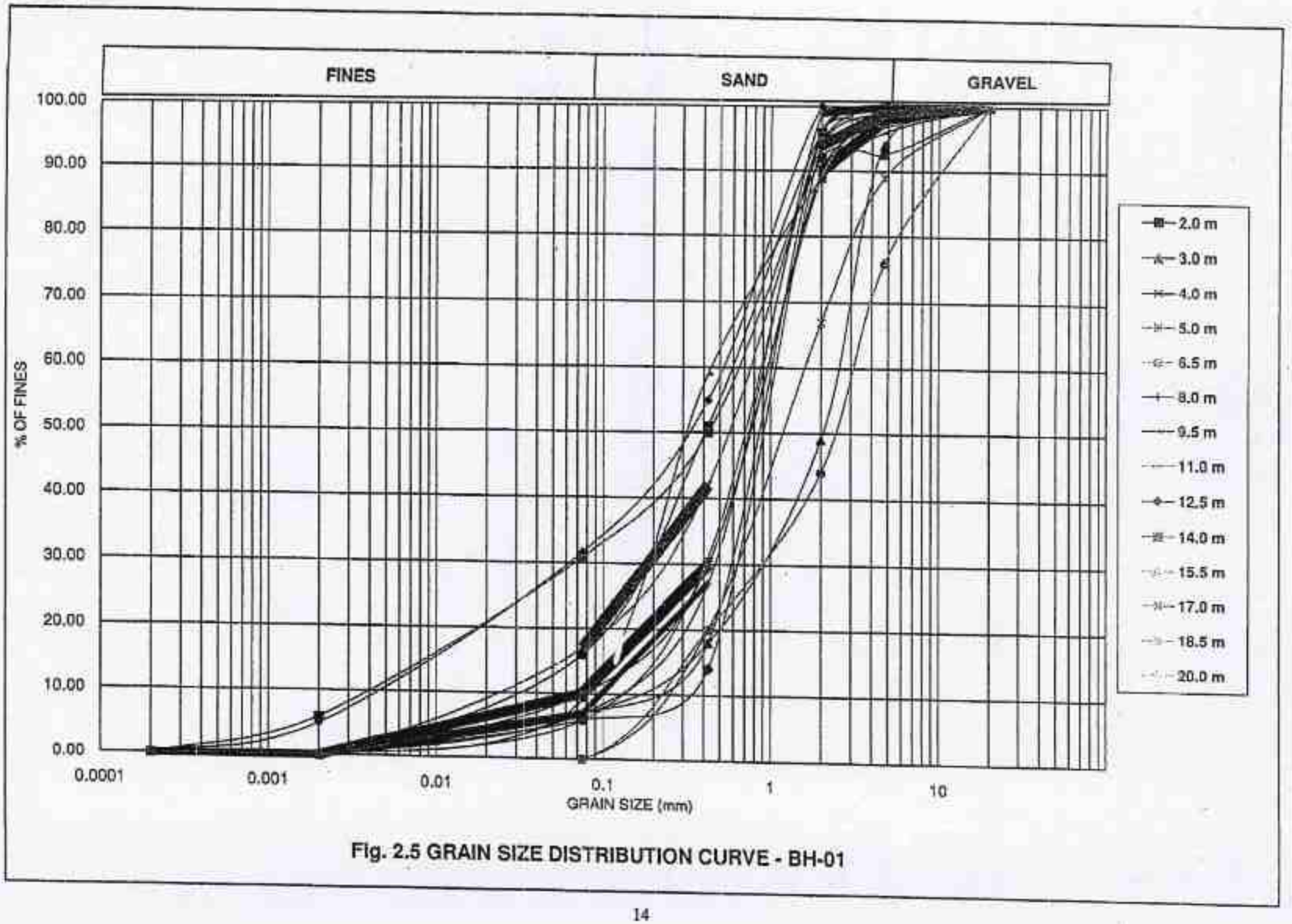


Fig. 2.5 GRAIN SIZE DISTRIBUTION CURVE - BH-01

For ETICA DEVELOPERS PVT. LTD.

Managing Director.

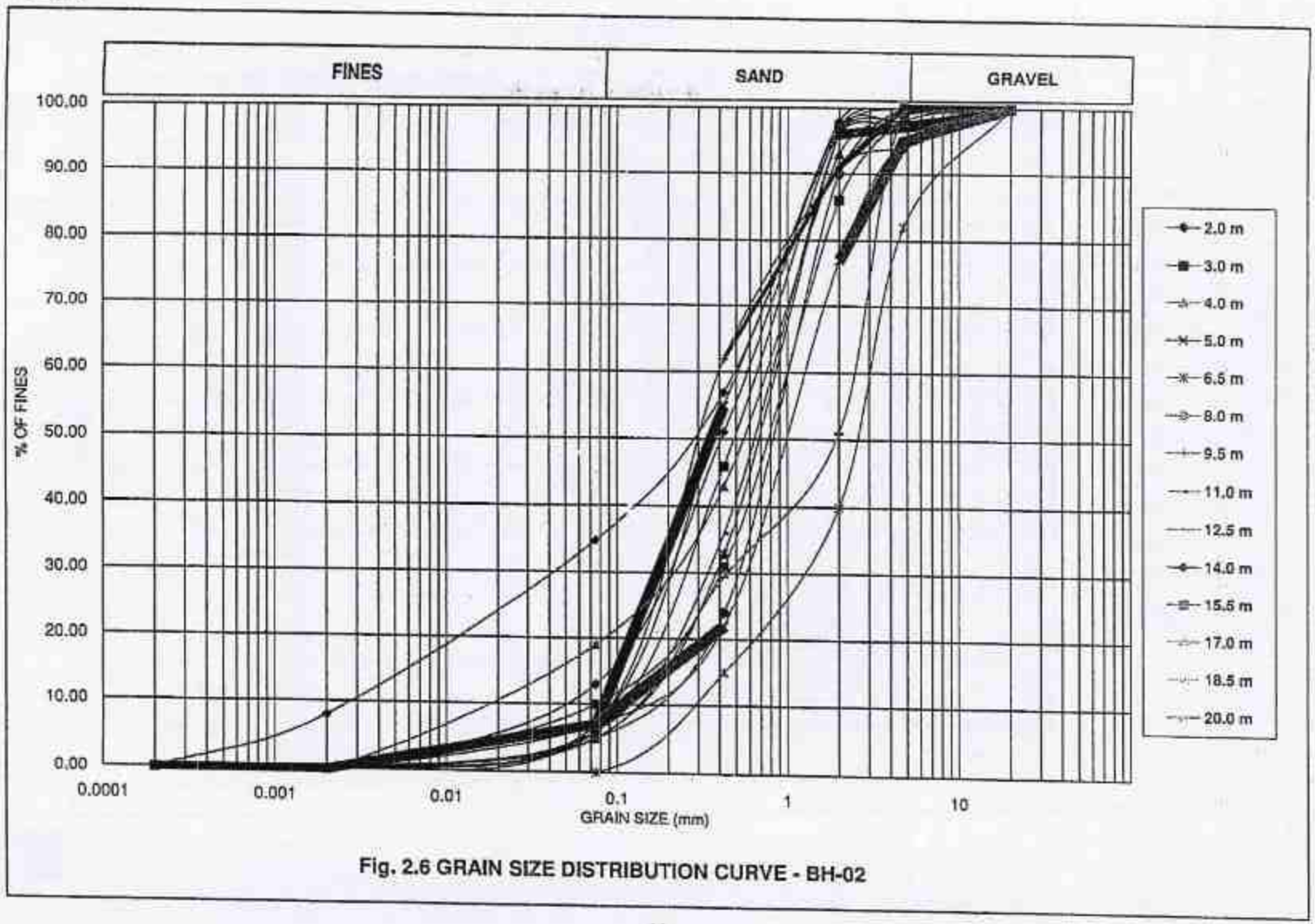


Fig. 2.6 GRAIN SIZE DISTRIBUTION CURVE - BH-02

For ETICA DEVELOPERS PVT. LTD.

Managing Director.

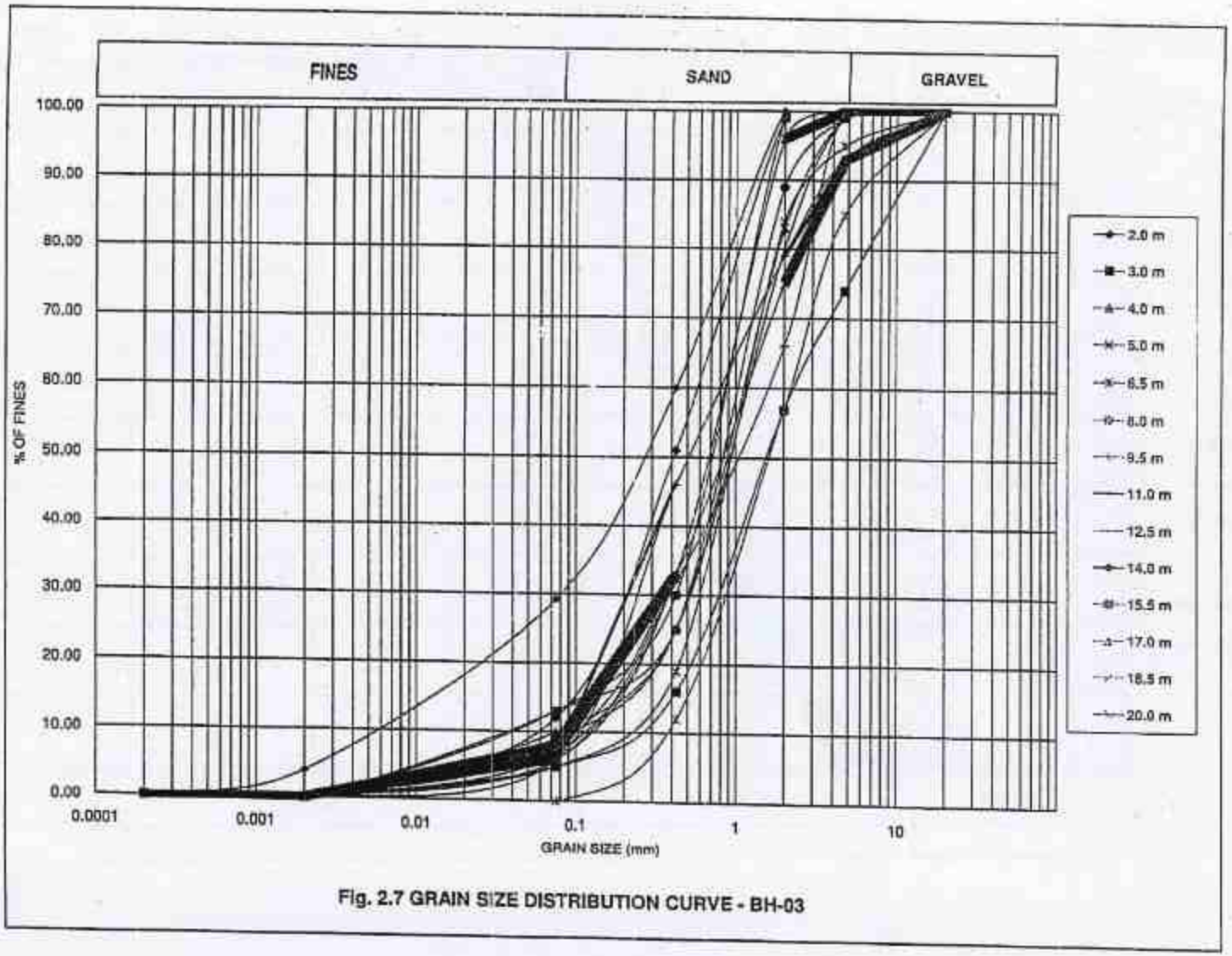


Fig. 2.7 GRAIN SIZE DISTRIBUTION CURVE - BH-03

For ETICA DEVELOPERS PVT. LTD.

Managing Director.

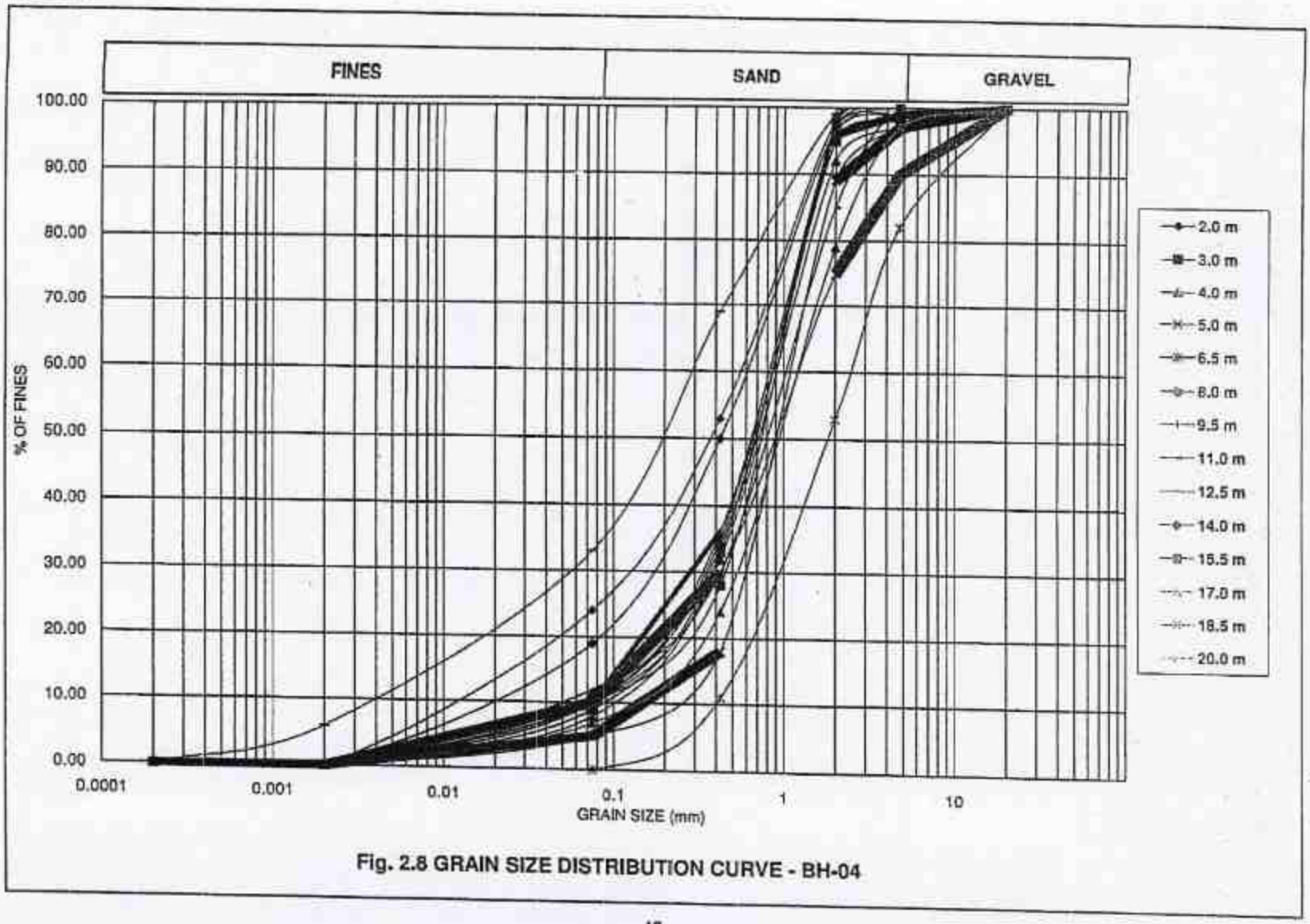


Fig. 2.8 GRAIN SIZE DISTRIBUTION CURVE - BH-04

For ETICA DEVELOPERS PVT. LTD.

Managing Director.

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 (%)	Ip	Ic	SL (%)	FS (%)	Consistancy	Position With Respect to A-Alina	IS-Notation	Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	$C_U=D_{60}/D_{10}$	$C_c=D_{30}^2/(D_{60}\times D_{10})$	Relative Density	Gravel	Sand
2.0	8	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	4	45	35	16	0	-	-	-	-	-	Loose	<50%	SM
3.0	9	SS	-	-	-	-	-	-	-	CG>50%	-	-	6	45	31	11	7	0	-	-	-	-	-	Loose	<50%	SP-SM
4.0	6	SS	-	-	-	-	-	-	-	CG>50%	-	-	2	8	60	20	10	0	-	-	-	-	-	Loose	<50%	SP-SM
5.0	6	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	4	78	11	7	0	-	-	-	-	-	Loose	<50%	SP-SM
6.5	6	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	6	80	8	6	0	-	-	-	-	-	Loose	<50%	SP-SM
8.0	16	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	1	72	20	7	0	-	-	-	-	-	M.Dense	<50%	SP-SM
9.5	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	4	7	30	50	9	0	-	-	-	-	-	V.Dense	<50%	SP-SM
11.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	3	1	65	25	6	0	-	-	-	-	-	V.Dense	<50%	SP-SM
12.5	3	SS	25	30	16	14	0.35	17	50	CG>50%	Above	-	0	0	45	20	30	5	-	-	-	-	-	V.Loose	<50%	SC
14.0	5	SS	20	31	18	15	0.73	18	48	CG>50%	Above	-	7	1	42	15	29	6	-	-	-	-	-	Loose	<50%	SC
15.5	20	SS	-	-	-	-	-	-	-	CG>50%	-	-	1	10	59	20	10	0	-	-	-	-	-	M.Dense	<50%	SP-SM
17.0	42	SS	-	-	-	-	-	-	-	CG>50%	-	-	1	5	52	25	17	0	-	-	-	-	-	Dense	<50%	SM
18.5	58	WS	-	-	-	-	-	-	-	CG>50%	-	-	11	22	47	20	0	0	-	-	-	-	-	V.Dense	<50%	SP
20.0	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	24	32	24	20	0	0	-	-	-	-	-	V.Dense	<50%	SP

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

For ETICA DEVELOPERS PVT. LTD.

Managing Director.

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	I_c	SL (%)	FS (%)	Consistency	Position With Respect to A-Aline	IS-Notation	Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D_{10} (mm)	D_{20}(mm)	D_{30} (mm)	$C_U=D_{60}/D_{10}$	$C_C=D_{30}^2/(D_{10}xD_{60})$	Relative Density	Gravel	Sand
2.0	8	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	2	47	38	13	0	-	-	-	-	-	Loose	<50%	SM
3.0	9	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	3	51	40	6	0	-	-	-	-	-	Loose	<50%	SP-SM
4.0	11	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	4	63	28	5	0	-	-	-	-	-	M.Dense	<50%	SP-SM
5.0	6	SS	-	-	-	-	-	-	-	CG>50%	-	-	3	1	41	48	7	0	-	-	-	-	-	Loose	<50%	SP-SM
6.5	12	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	4	63	28	5	0	-	-	-	-	-	M.Dense	<50%	SP-SM
8.0	23	SS	-	-	-	-	-	-	-	CG>50%	-	-	6	4	66	19	5	0	-	-	-	-	-	M.Dense	<50%	SP-SM
9.5	28	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	9	29	55	7	0	-	-	-	-	-	M.Dense	<50%	SP-SM
11.0	>100	SS	-	-	-	-	-	-	-	CG>50%	-	-	2	2	60	30	6	0	-	-	-	-	-	V.Dense	<50%	SP-SM
12.5	3	SS	26	33	17	16	0.44	17	72	CG>50%	Above	-	0	1	46	18	28	6	-	-	-	-	-	V.Loose	<50%	SC
14.0	4	SS	22	28	15	13	0.46	18	40	CG>50%	Above	-	2	1	40	17	32	8	-	-	-	-	-	V.Loose	<50%	SC
15.5	23	SS	-	-	-	-	-	-	-	CG>50%	-	-	2	12	55	21	10	0	-	-	-	-	-	M.Dense	<50%	SP-SM
17.0	50	SS	-	-	-	-	-	-	-	CG>50%	-	-	1	8	50	24	19	0	-	-	-	-	-	Dense	<50%	SM
18.5	45	SS	-	-	-	-	-	-	-	CG>50%	-	-	5	18	55	15	7	0	-	-	-	-	-	Dense	<50%	SP-SM
20.0	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	18	42	25	15	0	0	-	-	-	-	-	V.Dense	<50%	SP

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

For ETICA DEVELOPERS PVT. LTD.

Managing Director.

Table-2.3 Laboratory Classification of Soil Samples from BH-03

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)	$C_u=D_{60}/D_{10}$	$C_c=D_{30}^2/(D_{10}\times D_{60})$	Relative Density	Gravel	Sand
2.0	10	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	1	48	39	12	0	-	-	-	-	-	Loose	<50%	SP-SM
3.0	19	SS	-	-	-	-	-	-	-	CG>50%	-	-	26	17	41	11	5	0	-	-	-	-	-	M.Dense	<50%	SP-SM
4.0	12	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	4	63	27	6	0	-	-	-	-	-	M.Dense	<50%	SP-SM
5.0	6	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	4	63	26	7	0	-	-	-	-	-	Loose	<50%	SP-SM
6.5	13	SS	-	-	-	-	-	-	-	CG>50%	-	-	5	11	65	14	5	0	-	-	-	-	-	M.Dense	<50%	SP-SM
8.0	22	SS	-	-	-	-	-	-	-	CG>50%	-	-	1	10	64	16	9	0	-	-	-	-	-	M.Dense	<50%	SP-SM
9.5	9	SS	-	-	-	-	-	-	-	CG>50%	-	-	7	14	33	40	6	0	-	-	-	-	-	Loose	<50%	SP-SM
11.0	28	SS	-	-	-	-	-	-	-	CG>50%	-	-	1	19	55	12	13	0	-	-	-	-	-	M.Dense	<50%	SM
12.5	3	SS	25	32	16	16	0.44	16	55	CG>50%	Above	-	0	0	34	30	30	6	-	-	-	-	-	V.Loose	<50%	SC
14.0	3	SS	23	28	15	13	0.38	16	42	CG>50%	Above	-	0	0	40	28	28	4	-	-	-	-	-	V.Loose	<50%	SC
15.5	17	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	1	69	17	13	0	-	-	-	-	-	M.Dense	<50%	SM
17.0	39	SS	-	-	-	-	-	-	-	CG>50%	-	-	1	16	58	15	10	0	-	-	-	-	-	Dense	<50%	SP-SM
18.5	35	SS	-	-	-	-	-	-	-	CG>50%	-	-	7	18	42	25	6	0	-	-	-	-	-	Dense	<50%	SP-SM
20.0	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	15	28	45	12	0	0	-	-	-	-	-	V.Dense	<50%	SP

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

For ETICA DEVELOPERS PVT. LTD.

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Table-2.4 Laboratory Classification of Soil Samples from BH-04

Depth of Sample below E.G.L. (m)	S.P.T-Value	Type of Sample	Sub Soil Classification																										
			Fine Grained (FG)											Coarse Grained (CG)													IS-Notation	
			NMC(%)	LL (%)	PL (%)	I_P	I_C	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	5	SS	-	-	-	-	-	-	-	CG>50%	-	-	1	2	47	31	19	0	-	-	-	-	-	Loose	<50%	SM
3.0	11	SS	-	-	-	-	-	-	-	CG>50%	-	-	2	3	62	24	9	0	-	-	-	-	-	M.Dense	<50%	SP-SM
4.0	8	SS	-	-	-	-	-	-	-	CG>50%	-	-	3	5	60	24	8	0	-	-	-	-	-	Loose	<50%	SP-SM
5.0	12	SS	-	-	-	-	-	-	-	CG>50%	-	-	3	8	71	13	5	0	-	-	-	-	-	M.Dense	<50%	SP-SM
6.5	11	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	3	62	25	10	0	-	-	-	-	-	M.Dense	<50%	SP-SM
8.0	9	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	4	62	23	11	0	-	-	-	-	-	Loose	<50%	SP-SM
9.5	14	SS	-	-	-	-	-	-	-	CG>50%	-	-	1	3	60	26	10	0	-	-	-	-	-	M.Dense	<50%	SP-SM
11.0	23	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	15	55	18	12	0	-	-	-	-	-	M.Dense	<50%	SP-SM
12.5	3	SS	24	30	16	14	0.43	17	52	CG>50%	Above	-	0	1	30	32	31	6	-	-	-	-	-	V.Loose	<50%	SC
14.0	12	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	2	45	29	24	0	-	-	-	-	-	M.Dense	<50%	SM
15.5	27	SS	-	-	-	-	-	-	-	CG>50%	-	-	0	2	70	18	10	0	-	-	-	-	-	M.Dense	<50%	SP-SM
17.0	47	SS	-	-	-	-	-	-	-	CG>50%	-	-	3	16	55	17	7	0	-	-	-	-	-	Dense	<50%	SP-SM
18.5	49	SS	-	-	-	-	-	-	-	CG>50%	-	-	10	15	45	20	10	0	-	-	-	-	-	Dense	<50%	SP-SM
20.0	>100	WS	-	-	-	-	-	-	-	CG>50%	-	-	18	29	42	11	0	0	-	-	-	-	-	V.Dense	<50%	SP

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-2.5 Results of Chemical Analysis									
		Water				Soil (2:1)			
SL No.	Bore HoleNo.	Depth of Sample (m)	pH	Chlorides (ppm)	Sulphates (ppm)	Depth of Sample (m)	pH	Chlorides (ppm)	Sulphates (ppm)
1	BH-01	2.00	7.39	256	321	2.0	7.37	231	389
2	BH-03	2.00	7.39	248	318	2.0	7.37	228	375

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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 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/m³	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C_u) kPa	(ϕ) Deg.
1	0.00	1.00	1.00	Filled Up Soil	Brown	-	-	-	-	-	-
2	1.00	8.00	7.00	Silty Sand	Brown/Black	8	Loose	-	14.5	-	29.6
3	8.00	9.50	1.50	Silty Sand	Brown	18	Medium Dense	-	18	-	32.4
4	9.50	11.50	2.00	Silty Sand	Brownish	>100	Very Dense	-	21	-	42.5
5	11.50	15.50	4.00	Clayey Silty Sand	Greyish Bkack	4	Very Loose	-	13.5	-	20.22
6	15.50	17.00	1.50	Silty Sand	Brownish	20	Medium Dense	-	18	-	33
7	17.00	20.00	3.00	Silty Sand	Brownish	51	Very Dense	-	20.5	-	41.15
8	20.00	20.50	0.50	Completely Weathered Rock	Brownish Grey	>100	Very Dense	-	21	-	42.5
9	20.50	22.00	1.50	Modertely Weathered Rock	Brownish Grey	CRR-32%, 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/m³	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C_u) kPa	(ϕ) Deg.
1	0.00	1.00	1.00	Filled Up Soil	Brown	-	-	-	-	-	-
2	1.00	6.50	5.50	Silty Sand	Brown	9	Loose	-	14.5	-	29.8
3	6.50	10.00	3.50	Silty Sand	Brownish	21	Medium Dense	-	18.5	-	33.3
4	10.00	11.50	1.50	Silty Sand	Brownish	>100	Very Dense	-	21	-	42.5
5	11.50	15.50	4.00	Clayey Silty Sand	Greyish Bkack	4	Very Loose	-	13.5	-	20.22
6	15.50	17.00	1.50	Silty Sand	Brownish	23	Medium Dense	-	18.5	-	33.9
7	17.00	19.50	2.50	Silty Sand	Brownish	48	Dense	-	20	-	40.55
8	19.50	20.00	0.50	Completely Weathered Rock	Brownish Grey	>100	Very Dense	-	21	-	42.5

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REFERENCE BORE HOLE-BH:					03	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/m³	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C_u) kPa	(φ) Deg.
1	0.00	1.00	1.00	Filled Up Soil	Brown	-	-	-	-	-	-
2	1.00	5.00	4.00	Silty Sand	Brownish Grey	14	Medium Dense	-	17	-	31.2
3	5.00	6.50	1.50	Silty Sand	Grey	6	Loose	-	14.5	-	29.2
4	6.50	11.50	5.00	Silty Sand	Brownish	19	Medium Dense	-	18	-	32.7
5	11.50	15.50	4.00	Clayey Silty Sand	Greyish Bkack	3	Very Loose	-	13	-	20.07
6	15.50	17.00	1.50	Silty Sand	Brownish	17	Medium Dense	-	18	-	32.1
7	17.00	19.50	2.50	Silty Sand	Brownish	37	Dense	-	19.5	-	37.93
8	19.50	20.00	0.50	Completely Weathered Rock	Brownish Grey	>100	Very Dense	-	21	-	42.5

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REFERENCE BORE HOLE-BH:					04	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/m³	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C_u) kPa	(ϕ) Deg.
1	0.00	1.00	1.00	Filled Up Soil	Brown	-	-	-	-	-	-
2	1.00	3.00	2.00	Silty Sand	Brownish	5	Loose	-	14	-	20.37
3	3.00	9.50	6.50	Silty Sand	Brown/Grey	10	Loose	-	15	-	30
4	9.50	11.50	2.00	Silty Sand	Brownish	19	Medium Dense	-	18	-	32.7
5	11.50	14.00	2.50	Clayey Silty Sand	Greyish Bkack	3	Very Loose	-	13	-	20.07
6	14.00	17.00	3.00	Silty Sand	Brownish	20	Medium Dense	-	18	-	33
7	17.00	19.50	2.50	Silty Sand	Brownish	48	Dense	-	20	-	40.55
8	19.50	20.00	0.50	Completely Weathered Rock	Brownish 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 nine upper floors, and is meant for residential use. For this kind of structure, the column loads could vary between 2500kN to 4000kN. The above mentioned loads have no bearing on the design of either sub or super structures and are mentioned just to provide an insight to choose an appropriate foundation system with respect to subsoil conditions.

4.2 Foundation System

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

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

Typical computations are presented in Annexure

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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	BH-01	21.0	1.0	20.00	500	1200	500	30
2					550	1400	550	35
3					600	1600	600	40
4					650	1900	650	45
5					750	2500	750	60
6					800	3000	800	67
7					900	3500	900	80

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RECOMMENDATIONS

CHAPTER-5

RECOMMENDATIONS

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

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5.4 Special Recommendations

- Since, the sub soil strata are very loose to loose silty sand layer between top to 8.0m depth and Clayey Silty Sand layer between 11.50m & 15.50m depth below ground level. The loose layer will affect when the pile boring of sub soil is necking and bulging factor upon the installation of pile, due to Lateral soil expansion. Hence, in order to assure quality of the pile, it is ideal to carryout **pile integrity test** on all piles.

FOR GEO ENGINEERING CONSULTANTS, CHENNAI

GEO ENGINEERING CONSULTANTS Chennai 600 042

AUTHORIZED SIGNATORY

For ETICA DEVELOPERS PVT. LTD.

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ANNEXURE

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)	21	As Per IS:2911-(P-I,S-2)-2010
Reference Bore Hole	BH-01	600	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_s) kN		
1	0	1	1	Cut-Off Level													
2	1	8	7.0	Sand	8	14.5	14.5	-	29.6	0.0	31.5	15.8	-	1.0	qf	1	118.1
3	8	9.5	1.5	Sand	18	18.0	16.3	-	32.4	31.5	43.5	37.5	-	1.1	qf	2	75.5
4	9.5	11.5	2.0	Sand	50	20.5	19.3	-	41.0	43.5	64.5	54.0	-	1.5	qf	4	265.4
5	11.5	15.5	4.0	Sand	4	13.5	17.0	-	20.2	64.5	78.5	71.5	-	1.0	qf	5	196.6
6	15.5	17	1.5	Sand	20	18.0	15.8	-	33.0	78.5	90.5	84.5	-	1.2	qf	6	178.7
7	17	20	3.0	Sand	40	20.0	19.0	-	38.8	90.5	120.5	105.5	-	1.4	qf	7	690.9
8	20	21	1.0	Sand	50	20.5	20.3	-	42.5	120.5	131.0	125.8	-	1.5	qf	8	326.1

Summation of Positive Skin Resitance (kN) Q_f= 1653.35

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

Computation of End Bearing Resistance

		SPT	φ	C_u	N_q	N_c			
Bearing Stratum	Weathred Rock	60	40.33	-	135.50	-	Eff.Ht.of Overburden	9	m
							Effective Overburden Pressure	66.86	kN/m²

End Bearing Resistance (kN) Q_p= 2561.41

Ultimate Load Carrying Capacity (Q_{ult})	$Q_u=Q_f+Q_t+Q_p$ (kN)	4414.76
Safe Load Carrying Capacity (Q_{safe})	$Q_u/2.5$ (kN)	1765.91
Allowable Safe Load Carrying Capacity	Q_{A-safe} (kN)	1600.00
Allowable Safe Pull out Capacity	Q_{A-pull}: Qf/3 (kN)	617.78

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_q=Bearing Capacity Factor = f(φ)

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

K=Coef. Earth Pressure at Rest

q_i=Effective Overburden Pressure at middle of Layer

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

d=Dia. Of Pile

α=Adhesion Factor

T_i=Thickness of Layer

Note: The End being in Completely Weathered Rock modelled as Very Dense Sand with restricted to SPT-value of 60 corresponding phi angle 40.33

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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)	: 0.60	m
Free standing Length of Pile (e)	: 0	m
Length of Pile below E.G.L (Le)	: 21.0	m
Cut-Off Level From E.G.L	: 1.0	
Length of Pile below Cut-Off Level (Le)	: 20.0	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	: Sand	
Ground Water Condition	: Submerged	
Average Design SPT "N" Value	: 8	
T=(EI/nh)1/5		
(n can be read as η in the above and below equation in case of Sand)		
nh=	: 1000	kN/m^3
In Case of Sand	: -	kN/m^2
T=	: 2.76	
L1/T	: 0.00	
Li/T	: 2.20	
Depth of Fixity below Cut off (z_f)	: 6.06	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	: 42.80	kN	
Recommended Design Lateral Load carrying Capacity	: **42**	**kN**	
Fixed End Moment,M_F=H(e+z_f)/2	130		
Reduction Factor (L_1/T)	: 0.83	m	
Actual Moment (Fixed End Moment/Reduction Factor),M_F	**108**	kN-m	

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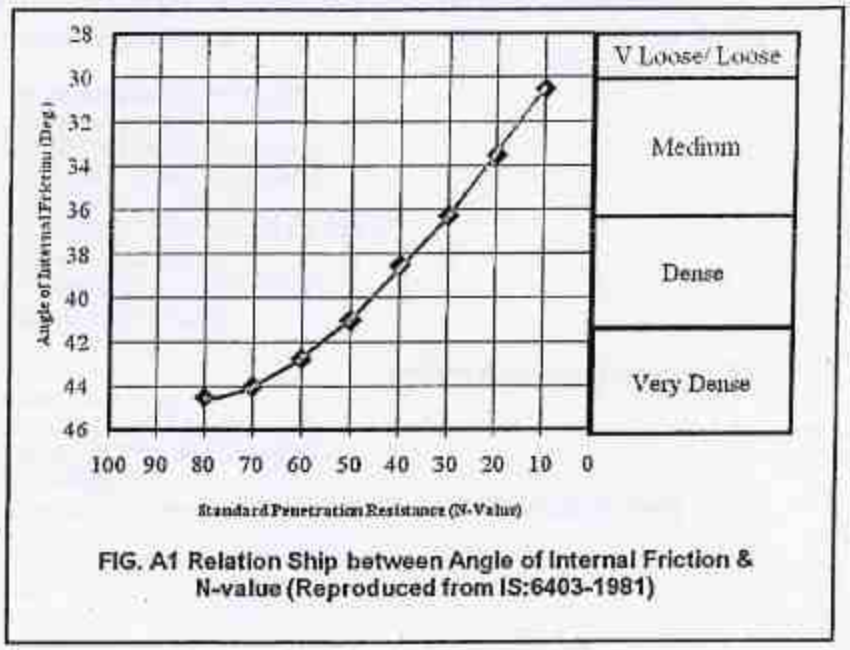


FIG. A1 Relation Ship between Angle of Internal Friction & N-value (Reproduced from IS:6403-1981)

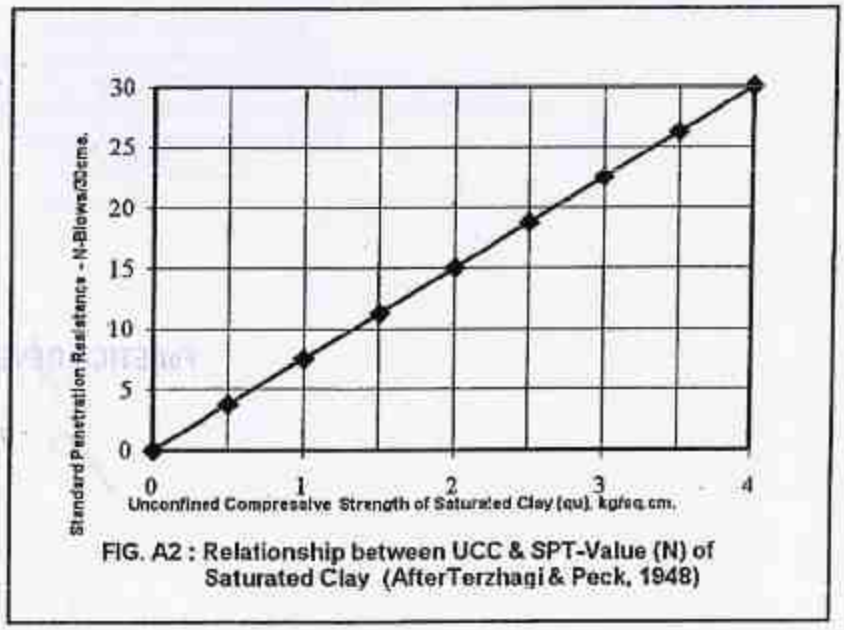


FIG. A2 : Relationship between UCC & SPT-Value (N) of Saturated Clay (AfterTerzhagi & Peck, 1948)

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

This report covers one part of the picture. These cover the rest, drawn from the same government records, for any property in Tamil Nadu.

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

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

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

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

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

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

Property Tracker
Watch a property and hear about it when something new is registered against it.
/landlens/property-tracker

Deal Room
Run the transaction in one place: documents, stamping, signatures and the parties.
/landlens/deal-room

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Twenty-four checks you can run yourself, at no cost.

Records and verification

The registers themselves, read for you.

- Encumbrance Certificate
- Patta and Chitta
- Field Measurement Sketch
- EC Analyzer
- Bank charge check
- Court case search
- Seller background check
- Approval check by survey

Value and duty

What it is worth and what it costs to register.

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

Zoning and land use

What the plan says can happen on this land.

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

Registers and directories

Who holds it, and which office keeps the record.

- Find your registering office
- Temple property check
- Waqf property check
- RERA register

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/tools

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/services

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