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SOIL EXPLORATION REPORT



PROJECT NO : 7386

PROJECT NAME : PROPOSED CONSTRUCTION OF GROUP HOUSING DEVELOPMENT WITH TWO BLOCKS STILT FLOOR + 5 FLOORS RESIDENTIAL BUILDING WITH (HEIGHT 18.30M) - TOTALLY 209 DWELLING UNITS AT THARAPAKKAM ROAD, GERUGAMBAKKAM, CHENNAI COMPRISED IN S.NO.446/1, 448/1A, 449/12B1, 450 & 451/2 OF GERUGAMBAKKAM VILLAGE WITHIN THE LIMITS OF KUNDRATHUR PANCHAYAT UNION"

1. INTRODUCTION

M/s. Sidharth Foundation & Housing Ltd are proposing to construct structures for Stilt + 5 floors, Girugambakkam, at the location shown in Fig.1 Soil Exploration work was referred to this firm by M/s. Sidharth Foundation & Housing Ltd, with a view to determining the soil properties of the area and to arrive at the most suitable foundation system for the proposed structure. For this purpose five boreholes were bored upto a depth of 13.0M below ground level. The boreholes were terminated after drilling for the required depth in the very dense disintegrated rock layer. The boreholes locations are given in Fig.1. The work comprised of conducting Standard Penetration Tests in the field and collecting samples for testing in the laboratory. The report presents the details of the work, analysis of test results and foundation recommendations made based on the analysis.

2. EXPLORATION TECHNIQUE

Rotary Drilling technique drilling was adopted for boring in this area. Casing pipes and bentonite slurry were used to protect the sides of the boreholes. Standard Penetration Tests were conducted at change of layers and at specified intervals. Disturbed samples were collected in plastic bags from all the layers for visual observation and classification tests. Undisturbed samples could be collected since the soil layers met with were essentially cohesionless in nature.

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NEW No: 98, (OLD No:109,) VELACHERY ROAD,
GUINDY, CHENNAI-600 032.

For F.S. ENGINEERS (P) LTD.

Director

3. SOIL PROFILE

The profile of the area as observed in the boreholes is given in Figs. 2 to 6. The top soil of 0.50 is non-uniform. The underlying layer is sandy clay upto 2.5 to 4.0M followed by slity clay, cemented sand with disintegrated rock appearing at depths varying from 11.0 to 12.0M below ground level. Water table was met with at depths varying from 2.50 to 2.80M below ground level at the time of exploration. No water table is present at the location (BH-1,3)

4. ANALYSIS OF TEST RESULTS

The various tests conducted are:

1. Standard Penetration Test
2. Determination of Liquid and Plastic Limits
3. Determination of Natural Moisture Content
4. Differential Free Swell test
5. Grain Size Analysis
6. Determination of Specific Gravity
7. Unconfined Compression Test
8. Determination of Bulk and Dry Densities
9. Consolidation Test

An analysis of the results of these tests were presented in this section of the report

4.1 Standard Penetration Test

These tests were conducted at change of layers and at specified intervals, commencing the test at 1.5 M below ground level. The results are presented graphically in Figs. 1 The relative density of the cohesionless layers and the consistency of the cohesive layers obtained from the N values are given in the borelogs.

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4.2 Determination of Liquid and Plastic Limit

The limit values of the cohesive layers were determined from the disturbed and undisturbed samples collected. The results are given in Table-1.

4.3 Determination of Natural Moisture Content

The natural moisture content of the cohesive soils were determined from the undisturbed samples collected. The results are given in Table-1

4.4 Differential Free Swell Test

This test was conducted by keeping equal volumes of dry powdered soil in water and in kerosene. The differential swell is given by,

$$Dfs = \frac{\text{Volume of soil in water} - \text{Volume of soil in kerosene}}{\text{Volume of soil in kerosene}}$$

The test was conducted on the samples collected from the silty clay layers. The results are given in Table-1. The differential swell noted for sandy clay layer 50 to 60% and silty clay layer 65 to 70%..

4.5 Grain Size Analysis

Combined sieve and hydrometer analyses were conducted on the various samples collected. The results are given in Table-1. Based on the proportion of the different soil constituents, the soil is classified using the Triangular Chart

4.6 Determination of Specific Gravity

The specific gravities of the soil grains were determined from the various samples collected. The results are given in Table-1. No abnormal value is noted in the test results.

4.7 Unconfined Compression Test

These tests were conducted on the undisturbed samples collected from cohesive layers. The samples were saturated before testing in the laboratory. The UCC value Q_u given in Table-2 could therefore be taken as the shear strength in the worst condition.

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4.8 Determination of Dry and Bulk Densities

The bulk and dry densities were determined from the undisturbed samples collected. The results are given in Table-2

4.9 Consolidation Test

These tests were conducted on the undisturbed samples collected from the cohesive layers. The values of void ratio and compression index C_c are given in Table-2. The e -log p curves are given in Fig. 7

5. FOUNDATION ANALYSIS

Due to the presence of highly expansive and consolidating silty and sandy clay layers present, shallow foundation are not feasible. Under-reamed piles are also not feasible, since the length of the piles is over 10M. Regular Pile foundation is recommended.

5.1 Regular Pile Foundation

The piles could be designed as end bearing piles with about 1M seating in the very dense disintegrated rock layer. The length of pile would be about 13M. The end bearing capacity of the pile could be computed using the formula,

$$Q_e = 4 \times N \times A_s \text{ Tonnes}$$

Where,

$$N = \text{Standard Penetration Test value}$$

$$A_s = \text{Area of cross-section of pile expressed in sq.ft}$$

When the pile are seated in the layer with $N > 50$ full structural capacity of the pile which is 50 kg/cm^2 for M-20 concrete would determine the allowable load.

The settlement of the pile foundations would be within 12mm.

M-20 concrete is recommended for pile foundation to counteract the harmful effect of chloride chemicals present in soil and water.

The floor slab should designed as structural slab connected to the piles foundation DMC method of piling is recommended to get proper pile seating.

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7. CONCLUSION

1. The area explored has got top soil of 0.50 is non-uniform. The underlying layer is sandy clay upto 2.5 to 4.0M followed by slity clay, cemented sand with disintegrated rock appearing at depths varying from 11.0 to 12.0M below ground level. Water table was met with at depths varying from 2.50 to 2.80M below ground level at the time of exploration. No water table is present at the location (BH-1,3)

2. For the proposed regular structure the shallow foundation, under-reamed piles are not fessible, A regular pile foundation is recommended with length pile of depth 13M.

3. The settlement of the pile foundation would be elastic in nature within 12mm.

4. Suggested procedure and construction should be adopted in the construction.

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CHENNAI – 600 032

For F.S. ENGINEERS (P) LTD.


Director
(Dr. A. Verghese Chummar)

Director

Dated: April 03rd, 2019

PN : 7386



Fig : 1

Director

F.S.ENGINEERS PRIVATE LIMITED
SOIL EXPLORATION AND FOUNDATION DESIGN DIVISION
FIELD BORE LOG



PROJECT : PROPOSED PROJECT STILT +5 FLOORS AT GERUGAMBAKKAM

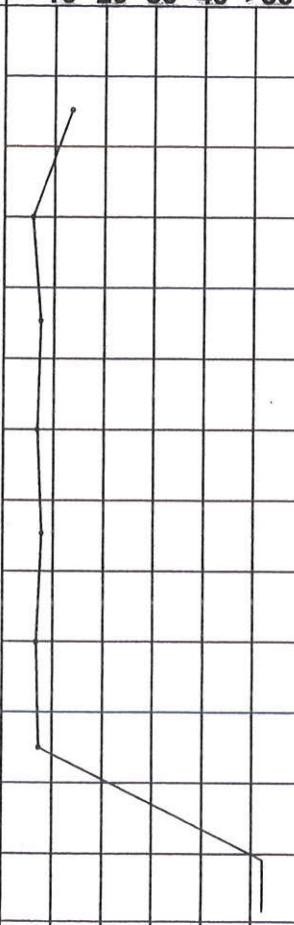
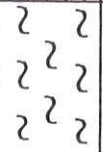
DATE OF COMMENCEMENT : 03.04.2019

BORE HOLE NO : 1

DATE OF COMPLETION : 03.04.2019

TYPE OF BORING : ROTARY DRILLING

G.W.L : 2.40 Mtr

DEPTH BELOW GL	SOIL PROFILE	DESCRIPTION OF SOIL	THICKNESS OF LAYER	DEPTH AT WHICH SAMPLES ARE COLLECTED		STANDARD PENETRATION TEST DATA				GRAPHICAL REPRESENTATION OF PENETRATION RESISTANCE
				D.S	U.D.S	DEPTH AT WHICH TEST CONDUCTED	N - VALUE	PENETRATION IN " CMS "	RELATIVE DENSITY CONSISTENCYB	
		TOP SOIL	0.50	0.50						10 20 30 40 >50
1		SANDY CLAY SC1 (Brown)	3.50	2.00	1.50	13	30	STIFF		
2					3.00	5	30	SOFT		
3					4.50	7	30	MEDIUM		
4					6.00	6	30	MEDIUM		
5		SILTY CLAY SLC2 (Dark Grey)	7.00	7.00	7.50	8	30	MEDIUM		
6					9.00	6	30	SOFT		
7					10.50	7	30	MEDIUM		
8										
9										
10										
11										
12		DISINTEGRATED ROCK DR1 (Whitish Grey)		11.00		12.00	>50	0	V.DENSE	
13.00				13.00	13.00		REBOUND			

REMARKS : ALL DIMENSIONS ARE IN METRES

Fig : 2

P N : 7386

→ END OF BORING

For F.S. ENGINEERS (P) LTD.

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FIELD BORE LOG



PROJECT : PROPOSED PROJECT STILT +5 FLOORS AT GERUGAMBAKKAM

DATE OF COMMENCEMENT : 27.03.2019

BORE HOLE NO : 2

DATE OF COMPLETION : 29.03.2019

TYPE OF BORING : ROTARY DRILLING

G.W.L : 2.80 Mtr

G.W.L : 2.80 Mtr										
DEPTH BELOW GL	SOIL PROFILE	DESCRIPTION OF SOIL	THICKNESS OF LAYER	DEPTH AT WHICH SAMPLES ARE COLLECTED		STANDARD PENETRATION TEST DATA				GRAPHICAL REPRESENTATION OF PENETRATION RESISTANCE
				D.S	U.D.S	DEPTH AT WHICH TEST CONDUCTED	N - VALUE	PENETRATION IN "CMS "	RELATIVE DENSITY CONSISTANCYD	
		TOP SOIL	0.50							10 20 30 40 >50
1		SANDY CLAY SC1 (Brown)	3.00	0.50	2.00	1.50	8	30	MEDIUM	
2						3.00	10	30	STIFF	
3						4.50	8	30	MEDIUM	
4		SILTY CLAY SLC2 (Dark Grey)	8.00	3.50	6.00	10	30	STIFF		
5					7.50	25	30	V.STIFF		
6					9.00	9	30	MEDIUM		
7					10.50	11	30	STIFF		
8					12.00	>50	10	V.DENSE		
9					13.00			REBOUND		
10		DISINTEGRATED ROCK DR1 (Whitish Grey)		11.50	12.00	>50	10	V.DENSE		
11					13.00					
12										
13.00										
REMARKS : ALL DIMENSIONS ARE IN METERS										

REMARKS : ALL DIMENSIONS ARE IN METRES

Fig : 3

P N : 7386

END OF BORING

For F.S. ENGINEERS (P) LTD.

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FIELD BORE LOG



PROJECT : PROPOSED PROJECT STILT +5 FLOORS AT GERUGAMBAKKAM
BORE HOLE NO : 3
TYPE OF BORING : ROTARY DRILLING

DATE OF COMMENCEMENT : 02.04.2019
DATE OF COMPLETION : 02.04.2019
G.W.L : 2.50 Mtr

G.W.L : 2.50 Mtr										
DEPTH BELOW GL	SOIL PROFILE	DESCRIPTION OF SOIL	THICKNESS OF LAYER	DEPTH AT WHICH SAMPLES ARE COLLECTED		STANDARD PENETRATION TEST DATA				GRAPHICAL REPRESENTATION OF PENETRATION RESISTANCE
				D.S	U.D.S	DEPTH AT WHICH TEST CONDUCTED	N - VALUE	PENETRATION IN " CMS "	RELATIVE DENSITY CONSISTENCY	
		TOP SOIL	0.50							10 20 30 40 >50
1		SANDY CLAY SC1 (Brown)	2.00	0.50		1.50	10	30	STIFF	
2				2.00						
3				2.50		3.00	8	30	MEDIUM	
4		SILTY CLAY SLC1 (Brown)	3.00			4.50	7	30	MEDIUM	
5										
6				5.50		6.00	6	30	SOFT	
7					7.00					
8						7.50	9	30	MEDIUM	
9		SILTY CLAY SLC2 (Dark Grey)	6.50			9.00	11	30	STIFF	
10						10.50	11	30	STIFF	
11										
12										
13.00		DISINTEGRATED ROCK DR1 (Whitish Grey)		12.00	12.00	>50	0	V.DENSE		
				13.00	13.00			REBOUND		
REMARKS : ALL DIMENSIONS ARE IN METRES										
END OF BORING										
Fig : 4										

REMARKS : ALL DIMENSIONS ARE IN METRES
 → END OF BORING

Fig : 4

For F.S. ENGINEERS (P) LTD N : 7386

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SOIL EXPLORATION AND FOUNDATION DESIGN DIVISION
FIELD BORE LOG



PROJECT : PROPOSED PROJECT STILT +5 FLOORS AT GERUGAMBAKKAM

DATE OF COMMENCEMENT : 01.04.2019

BORE HOLE NO : 4

DATE OF COMPLETION : 01.04.2019

TYPE OF BORING : ROTARY DRILLING

G.W.L. : 2.50 Mtr

G.W.L : 2.50 Mtr											
DEPTH BELOW GL	SOIL PROFILE	DESCRIPTION OF SOIL	THICKNESS OF LAYER	DEPTH AT WHICH SAMPLES ARE COLLECTED		STANDARD PENETRATION TEST DATA				GRAPHICAL REPRESENTATION OF PENETRATION RESISTANCE	
				D.S	U.D.S	DEPTH AT WHICH TEST CONDUCTED	N - VALUE	PENETRATION IN " CMS "	RELATIVE DENSITY CONSISTENCY		
		TOP SOIL	0.50							10 20 30 40 >50	
1		SILTY CLAY SLC1 (Brown)	10.00	0.50	7.00						
2						1.50	11	30	STIFF		
3						2.00					
4						3.00	11	30	STIFF		
5						4.50	6	30	SOFT		
6						6.00	9	30	MEDIUM		
7						7.50	9	30	MEDIUM		
8						9.00	7	30	MEDIUM		
9						10.50	37	30	DENSE		
10						12.00	>50	5	V.DENSE		
11		CEMENTED SAND CMS1 (Brown)	1.50	10.50		10.50	37	30	DENSE		
12		DISINTEGRATED ROCK DR1 (Whitish Grey)		12.00		12.00	>50	5	V.DENSE		
13.00				13.00		13.00			REBOUND		
REMARKS : ALL DIMENSIONS ARE IN METERS											

REMARKS : ALL DIMENSIONS ARE IN METRES
 END OF BORING

Fig : 5

For F.S. ENGINEERS (P) LTD 7386

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SOIL EXPLORATION AND FOUNDATION DESIGN DIVISION
FIELD BORE LOG



PROJECT : PROPOSED PROJECT STILT +5 FLOORS AT GERUGAMBAKKAM

DATE OF COMMENCEMENT : 31.03.2019

BORE HOLE NO : 5

DATE OF COMPLETION : 31.03.2019

TYPE OF BORING : ROTARY DRILLING

G.W.L : 2.60 Mtr

G.W.L : 2.60 Mtr										
DEPTH BELOW GL	SOIL PROFILE	DESCRIPTION OF SOIL	THICKNESS OF LAYER	DEPTH AT WHICH SAMPLES ARE COLLECTED		STANDARD PENETRATION TEST DATA				GRAPHICAL REPRESENTATION OF PENETRATION RESISTANCE
				D.S	U.D.S	DEPTH AT WHICH TEST CONDUCTED	N - VALUE	PENETRATION IN " CMS "	RELATIVE DENSITY CONSISTENCYD	
		TOP SOIL	0.50							10 20 30 40 >50
1		SANDY CLAY SC1 (Brown)	2.00	0.50	2.00	1.50	9	30	MEDIUM	
2										
3		SILTY CLAY SLC1 (Brown)	8.50	2.50		3.00	8	30	MEDIUM	
4										
5					4.50	10	30	STIFF		
6										
7					6.00	11	30	STIFF		
8					7.50	10	30	STIFF		
9					9.00	8	30	MEDIUM		
10					10.50	6	30	SOFT		
11										
12	CEMENTED SAND CMS1 (Brown)	1.00	11.00							
	DISINTEGRATED ROCK DR1 (Whitish Grey)		12.00		12.00	>50	15	V.DENSE		
13.00			13.00		13.00			REBOUND		
REMARKS : ALL DIMENSIONS ARE IN METRES										

REMARKS : ALL DIMENSIONS ARE IN METRES
 END OF BORING

Fig : 6

For F.S. ENGINEERS (P) LTD.

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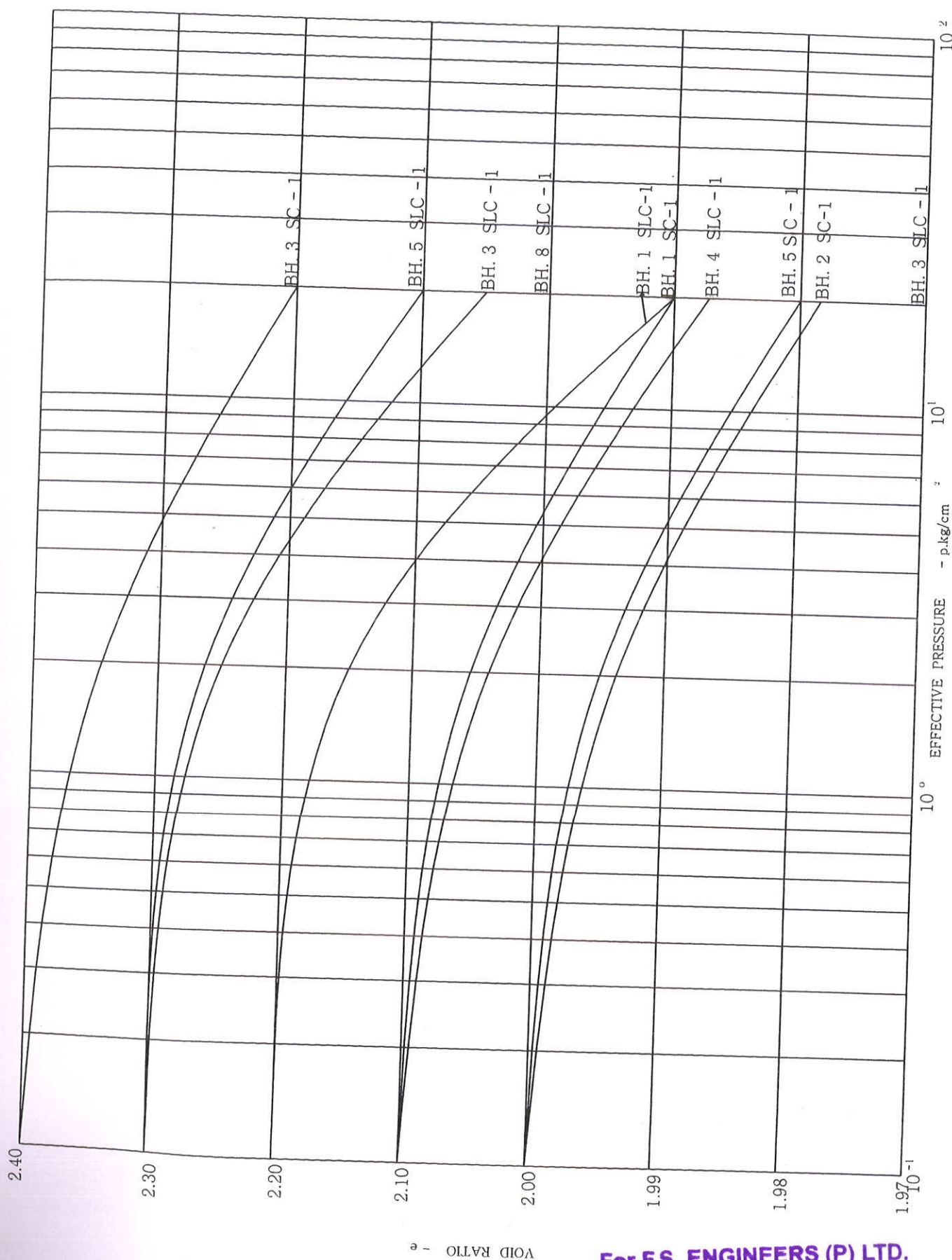
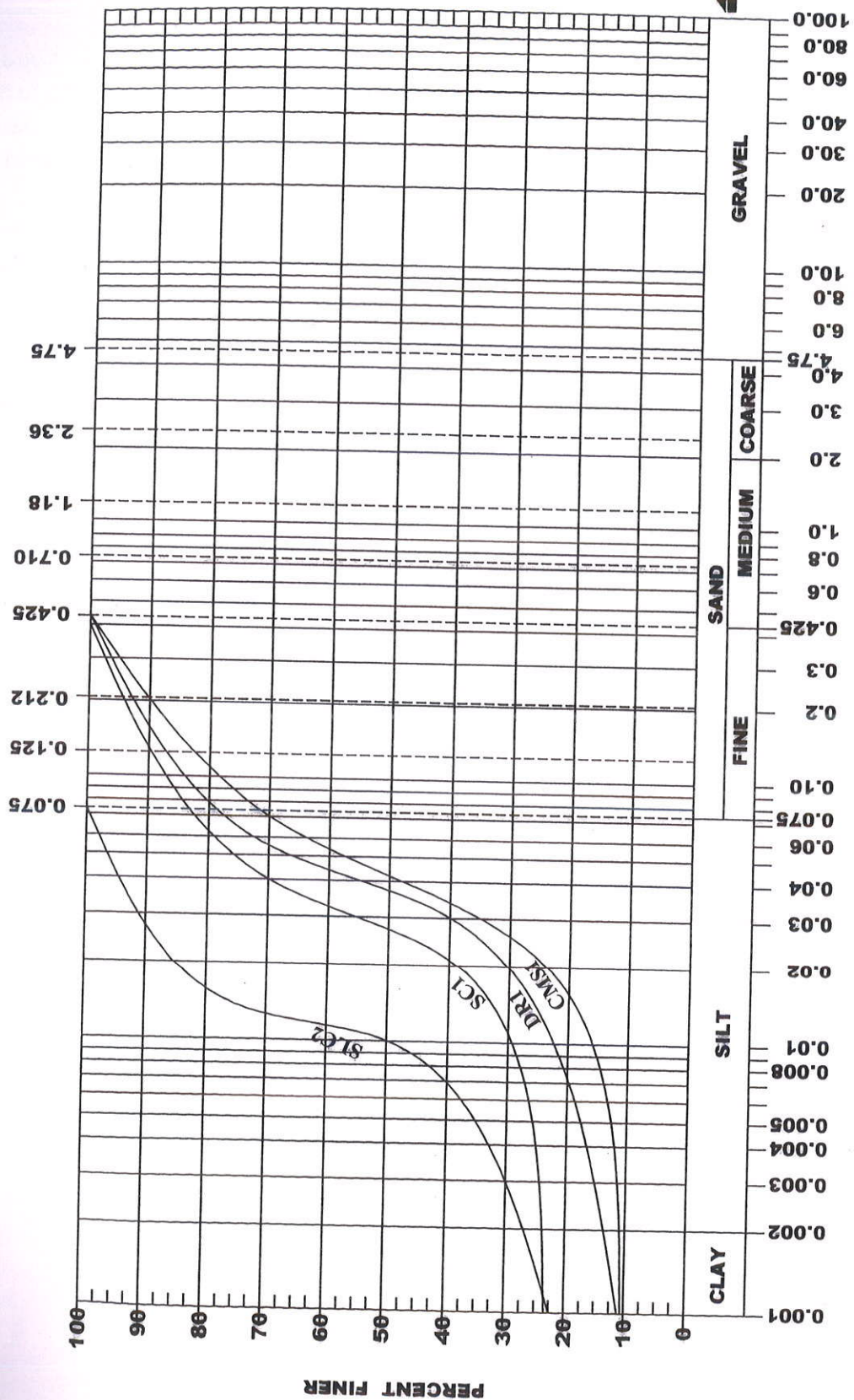


FIG. 7 e - log p curve

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PARTICLE SIZE IN mm.

FIG. 8 GRAIN SIZE DISTRIBUTION CURVE

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PROJECT : PROPOSED PROJECT STILT+5 FLOORE AT GERUGAMBAKKAM

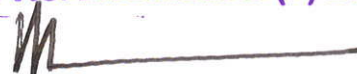
Sl.No	Depth	Layer	W _L	W _p	W _n	swell	Grain Size Distribution				Sp. Gr.
							Clay	Silt	Sand	Gravel	G
	M		%	%	%	%	%	%	%	%	
1	2	3	4	5	6	7	8	9	10	11	12
BH.1	0.00-0.50	TOP	-	-	-	-	-	-	-	-	-
	0.50-4.00	SC1	62	28	34	53	25	17	58	-	2.63
	4.00-11.00	SLC2	78	35	47	68	64	36	-	-	2.63
	11.00-13.00	DR2	-	-	-	-	9	14	77	-	2.64
BH.2							(not clay)				
	0.00-0.50	TOP	-	-	-	-	-	-	-	-	-
	0.50-3.50	SC1	60	27	32	58	28	20	52	-	2.63
	3.50-11.50	SLC2	-	-	-	65	67	33	-	-	2.63
BH.3	11.50-13.00	DR1	-	-	-	-	8	13	79	-	2.64
							(not clay)				
	0.00-0.50	TOP	-	-	-	-	-	-	-	-	-
	0.50-2.50	SC1	63	28	35	60	22	15	63	-	2.63
BH.4	2.50-5.50	SLC1	-	-	-	70	60	40	-	-	2.63
	5.50-12.00	SLC2	78	36	47	66	66	34	-	-	2.63
	12.00-13.00	DR2	-	-	-	-	8	13	79	-	2.64
							(not clay)				
BH.5	0.00-0.50	TOP	-	-	-	-	-	-	-	-	-
	0.50-10.50	SLC1	62	29	34	69	63	37	-	-	2.63
	10.50-12.00	CMS1	-	-	-	-	12	23	65	-	2.65
	12.00-13.00	DR1	-	-	-	-	13	10	77	-	2.64
BH.5	0.00-0.50	TOP	-	-	-	-	-	-	-	-	-
	0.50-2.50	SC1	60	26	33	55	30	19	51	-	2.63
	2.50-11.00	SLC1	79	37	46	70	64	36	-	-	2.63
	11.00-12.00	CMS1	-	-	-	-	8	25	67	-	2.65
	12.00-13.00	DR1	-	-	-	-	10 (not clay)	15	75	-	2.64

Lab table : 1

lab test result

PN : 7358

For F.S. ENGINEERS (P) LTD.



Director

PROJECT : PROPOSED PROJECT STILT+5 FLOORE AT GERUGAMBAKKAM

Uds Table

Bh No	Depth	Layer	Ucc Test Qu	NMC	Bulk Density	Dry Density	Consolidation Test	
	Mts		Kg/cm ²	%	gm/cc	gm/cc	e _o	C _c
1	2.00	SC1	0.50	34	2.50	1.86	2.10	0.20
1	7.00	SLC2	0.40	47	2.70	1.84	2.20	0.23
2	2.00	SC1	0.60	32	2.60	1.96	2.00	0.21
3	2.00	SC1	0.50	35	2.40	1.78	2.40	0.20
3	7.00	SLC1	0.30	47	2.50	1.70	2.30	0.24
4	2.00	SLC1	0.50	34	2.40	1.79	2.10	0.22
5	2.00	SC1	0.40	33	2.60	1.95	2.00	0.20
	7.00	SLC1	0.60	46	2.60	1.71	2.30	0.21

Table -2

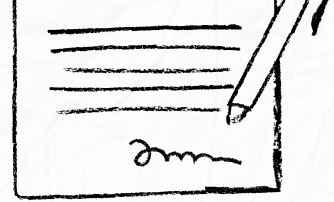
Laboratory Tests Results

PN : 7386

For F.S. ENGINEERS (P) LTD.



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our services doesn't just end there



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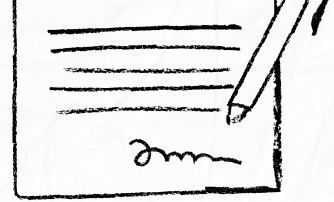
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