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SOIL EXPLORATION REPORT

PROJECT NO **5916**

PROJECT NAME Construction of Residential Building at Alwarthirunagar, Chennai for Sri Guha Residence.

1. INTRODUCTION

A residential building is proposed to be constructed at Survey no:115/2F & 115/2G Project situated on the plots bearing nos: 20&21 2nd main road Alwarthirunagar annexe,, Chennai – 600 087, for Sri Guha Residence. at the location shown in Fig.1. Soil Exploration work was referred to this firm by M/s. C.R.Narayana Rao, Consultants of the project, 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 four boreholes were bored up to a depth of 30.0 M below G.L. The boreholes were terminated in the very dense disintegrated rock layer after drilling for the required depth. The borehole 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 were collected in steel tubes from cohesive layers for shear and consolidation tests. .

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 5 The top soil of 0.5 M is non-uniform. The underlying layer is sandy silt/ gravelly soil upto 2 to 4 M The layer below is silty clay upto 11.5 to 26.5M with intermediary layers of clayey silt/ sand/silty sand with disintegrated rock appering at depths varying rom 25.5 to 26.5 M below ground level. No water table was met with in the boreholes at the time of exploration.

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. Determination of Free Swell test .....

5. Grain Size Analysis as per IS 2720 –Part-IV.....

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. 2 to 5 The relative density of the cohesionless layers and the consistency of the cohesive layers obtained from the N values are given in the bore logs.

For F.S. ENGINEERS (P) LTD.

P.N.5916

Director

4.2 Determination of Liquid and Plastic Limits

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 was 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 .The results are given in Table-1. The differential swell noted is over 65 % .in the silty clay layer.

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.

For F.S. ENGINEERS (P) LTD.

Director

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 Qu given in Table-2 could therefore be taken as the shear strength in the worst condition.

4.8 Determination of Bulk and Dry 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 Cc are given in Table-2. The e-log p curves are given in Fig. 7

5. FOUNDATION ANALYSIS

5.1 Shallow Foundations

For the proposed structure shallow foundations can be given only for unimportant structures like compound wall. The foundations can be placed at shallow depth of 1M depth.. The width of foundation should be 1M . The SBC that could be adopted is is 0.5 kg/cm^2 with settlement of 100mm. Construction joints should be given at adequate intervals.

Under-reamed pile foundation is also not feasible due to expansive and consolidating silty clay extends at deeper depths.

For all regular structures pile foundation is recommended.

For F.S. ENGINEERS (P) LTD.

Director

P.N.5916

5.2 Pile Foundation

Piles could be of length of about 28 M, with 1.5 M seating in the disintegrated rock layer with N value over 50 is recommended.

Piles could be designed as end bearing pile. The end bearing capacity of the piles could be computed using the formula,

Qe = 4 x N x As Tones

Where

N = Standard Penetration Test value

As = Area of cross –section of pile Expressed in sq.ft

When the piles are resting in the very dense disintegrated rock layer with N value over 50, it could be seen that the structural capacity of the pile would determine the allowable load. This could be taken as 50 kg/cm.^{2} for M-20 concrete

The silty clay would undergo settlement which would generate negative drag which would be worked out as 15% of the vertical load carrying capacity. This should be deducted from the pile capacity.

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

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

6. CONCLUSION

1. The area explored has got top soil of 0.5 M is non-uniform. The underlying layer is sandy silt/ gravelly soil upto 2 to 4 M The layer below is silty clay upto 11.5 to 26.5M with intermediary layers of clayey silt/ sand/silty sand with disintegrated rock appearing at depths varying rom 25.5 to 26.5 M below ground level. No water table was met with in the boreholes at the time of exploration.

For F.S. ENGINEERS (P) LTD.

P.N.591 Director

2. For the proposed structure shallow foundations can be given for unimportant structures like compound wall at 1.0M depth with an SBC of 0.5 kg/cm^2.

3. For all regular structures pile foundation is recommended with length of pile of about 28M, with 1.5M seating in the disintegrated rock layer, utilizing the full structural capacity of 50 kg/cm^2 for M-20 concrete with 15% reduction for negative drag..

4. The settlement of the pile foundation would be within 12mm.

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

For F.S. ENGINEERS (P) LTD.

Director

(Dr.A. Verghese Chummar)

Director

Dated: June 2nd 2014

F.S.ENGINEERS PVT LTD

NEW NO.98, VELACHERY ROAD

GUINDY

CHENNAI – 600 032

Project : Proposed Residential Building at Alwar Thiru Nagar .

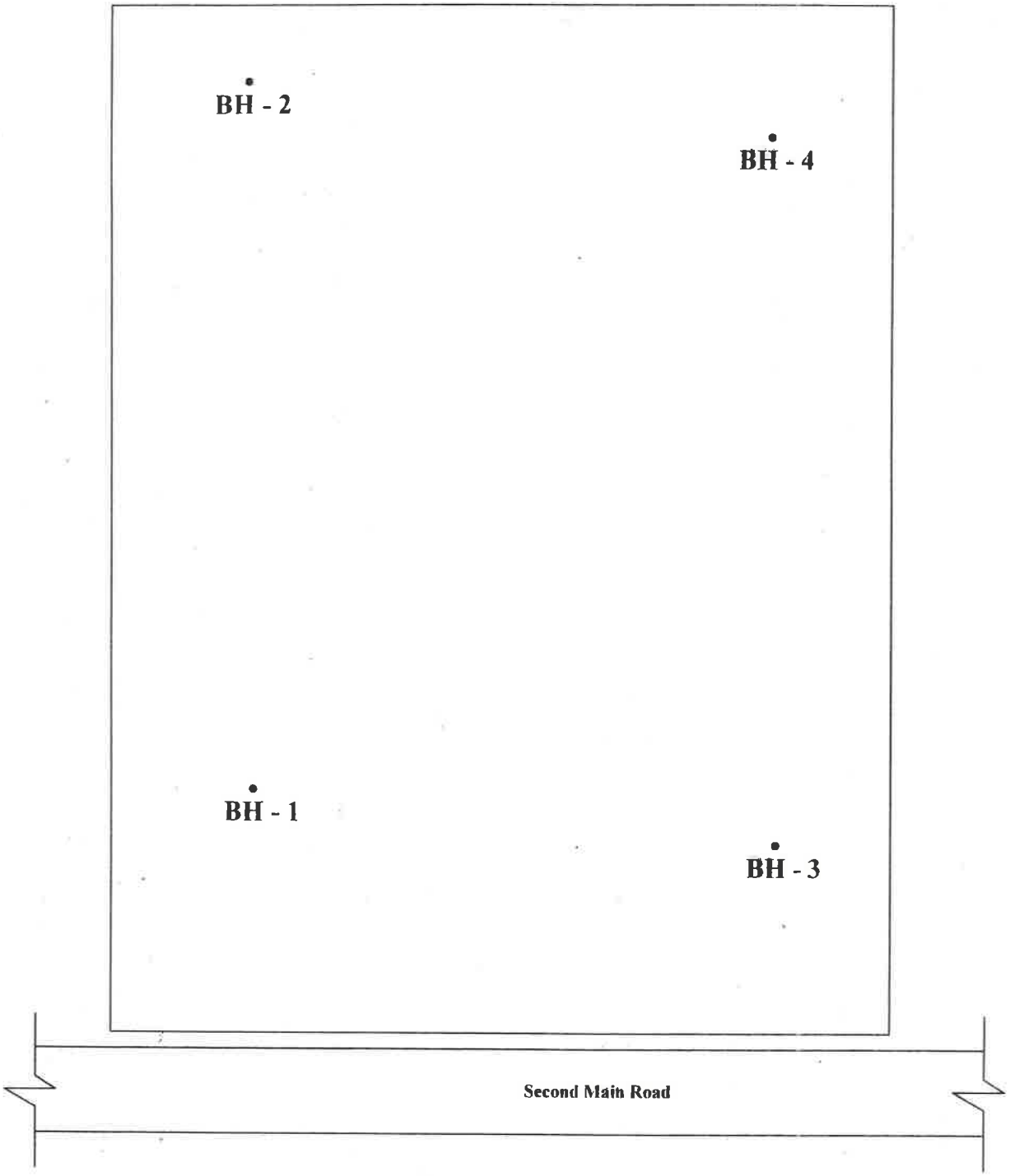


Fig - 1 SITE PLAN P N - 5916

For F.S. ENGINEERS (P) LTD.

Director

F.S.ENGINEERS PRIVATE LIMITED

SOIL EXPLORATION AND FOUNDATION DESIGN DIVISION

FIELD BORE LOG

PROJECT : RESIDENTIAL BUILDING AT ALWARTHIRU NAGAR .

DATE OF COMMENCEMENT : 23.04.14

BORE HOLE NO : 1

DATE OF COMPLETION : 26.04.14

TYPE OF BORING : ROTARY DRILLING

G.W.L : 6.00 Mts

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 CONSISTANCY	10 20 30 40 >50
		TOP SOIL TS	0.50	0.50						
2		SANDY SILT SSL1 (Brown)	3.50			1.50	13	30	MEDIUM	
4						3.00	15	30	MEDIUM	
		CLAYEY SILT CSL1 (Brownish Grey)	1.50	4.00		4.50	7	30	LOOSE	
6				5.50		6.00	7	30	MEDIUM	
8		SILTY CLAY SLC1 (Dark Grey)	6.00		7.00	7.50	9	30	STIFF	
10						9.00	11	30	STIFF	
12						10.50	12	30	STIFF	
		SAND S1 (Brown)	3.00	11.50		12.00	38	30	DENSE	
14						13.50	45	30	DENSE	
				14.50		15.00	7	30	MEDIUM	
16										
18					17.00	18.00	9	30	STIFF	
20		SILTY CLAY SLC1 (Dark Grey)	11.00							
22						21.00	12	30	STIFF	
24						24.00	12	30	STIFF	
26				25.50		26.00	34	30	DENSE	
28		DISINTEGRATED ROCK DR1 (Greyish Brown)				28.00	>50	0	V.DENSE	
30.00				30.00		30.00	>50	0	V.DENSE	

REMARKS : ALL DIMENSIONS ARE IN METRES

END OF BORING

Fig : 2

For F.S. ENGINEERS (P) LTD.

Director

P.N : 5916

F.S.ENGINEERS PRIVATE LIMITED

SOIL EXPLORATION AND FOUNDATION DESIGN DIVISION

FIELD BORE LOG

PROJECT : RESIDENTIAL BUILDING AT ALWARTHIRU NAGAR .

DATE OF COMMENCEMENT : 23.05.14

BORE HOLE NO : 2

DATE OF COMPLETION : 24.05.14

TYPE OF BORING : ROTARY DRILLING

G.W.L : 6.00 Mts

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 CONSISTANCY	10 20 30 40 >50
		TOP SOIL TS	0.50	0.50						
2		SANDY SILT SSL1 (Brown)	1.50	2.00		1.50	16	30	MEDIUM	
4		SILTY CLAY SLC1 (Dark Grey)	3.50			3.00	11	30	STIFF	
6				5.50	5.00	4.50	17	30	V.STIFF	
8		SILTY SAND SLS1 (Grey)	3.00			6.00	17	30	MEDIUM	
10		SILTY CLAY SLC1 (Dark Grey)	3.00	8.50		7.50	14	30	MEDIUM	
12						9.00	9	30	STIFF	
14		SAND S1 (Greyish Brown)	3.00	11.50		10.50	18	30	V.STIFF	
16				14.50		12.00	25	30	MEDIUM	
18					17.00	13.50	34	30	DENSE	
20		SILTY CLAY SLC1 (Dark Grey)	12.00			15.00	7	30	MEDIUM	
22						18.00	6	30	MEDIUM	
24						21.00	10	30	STIFF	
26				26.50		24.00	15	30	STIFF	
28		DISINTEGRATED ROCK DR1 (Greyish Brown)				27.00	>50	25	V.DENSE	
30.00				30.00		30.00	>50	28	V.DENSE	

REMARKS : ALL DIMENSIONS ARE IN METRES

END OF BORING

Fig : 3

PN : 5916

For F.S. ENGINEERS (P) LTD.

Director

F.S.ENGINEERS PRIVATE LIMITED

SOIL EXPLORATION AND FOUNDATION DESIGN DIVISION

FIELD BORE LOG

PROJECT : RESIDENTIAL BUILDING AT ALWARTHIRU NAGAR .

DATE OF COMMENCEMENT : 24.05.14

BORE HOLE NO : 3

DATE OF COMPLETION : 25.05.14

TYPE OF BORING : ROTARY DRILLING

G.W.L. : 6.00 Mts

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 CONSISTANCY	10 20 30 40 >50
		TOP SOIL TS	0.50	0.50						
2		SANDY SILT SSL1 (Brown)	2.00	2.50		1.50	13	30	MEDIUM	
						3.00	5	30	MEDIUM	
4						4.50	7	30	MEDIUM	
6						6.00	2	30	V.SOFT	
8						7.50	8	30	MEDIUM	
10						9.00	9	30	STIFF	
12						10.50	4	30	SOFT	
14		SILTY CLAY SLC1 (Dark Grey)	24.00			12.00	2	30	V.SOFT	
16						13.50	3	30	SOFT	
18						15.00	4	30	SOFT	
20						18.00	4	30	SOFT	
22						21.00	4	30	SOFT	
24					23.00	24.00	16	30	STIFF	
26				26.50		26.00	18	30	V.STIFF	
28		DISINTEGRATED ROCK DR1 (Greyish Brown)				27.00	>50	5	V.DENSE	
30.00				30.00		30.00	>50	1	V.DENSE	

REMARKS : ALL DIMENSIONS ARE IN METRES

END OF BORING

Fig : 4

P.N : 5916

For F.S. ENGINEERS (P) LTD.

Director

F.S.ENGINEERS PRIVATE LIMITED

SOIL EXPLORATION AND FOUNDATION DESIGN DIVISION

FIELD BORE LOG

PROJECT : RESIDENTIAL BUILDING AT ALWARTHIRU NAGAR .

DATE OF COMMENCEMENT : 26.05.14

BORE HOLE NO : 4

DATE OF COMPLETION : 27.05.14

TYPE OF BORING : ROTARY DRILLING

G.W.L : 6.00 Mts

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 CONSISTANCY	10 20 30 40 >50
		TOP SOIL TS	0.50	0.50						
2		GRAVELLY SOIL GS (Brown)	1.50	2.00		1.50	8	30	LOOSE	
4		SILTY CLAY SLC1 (Dark Grey)	2.00	4.00		3.00	6	30	MEDIUM	
6		SAND S1 (Brown)	1.50	5.50		4.50	26	30	MEDIUM	
8		SILTY CLAY SLC1 (Dark Grey)	11.00		7.00	6.00	11	30	STIFF	
10						7.50	13	30	STIFF	
12						9.00	7	30	MEDIUM	
14						10.50	6	30	MEDIUM	
16						12.00	6	30	MEDIUM	
18						13.50	7	30	MEDIUM	
20						15.00	4	30	SOFT	
22						18.00	4	30	SOFT	
24				23.50		21.00	5	30	MEDIUM	
26		SAND S1 (Brown)	2.50	26.00		24.00	48	30	DENSE	
28		DISINTEGRATED ROCK DR1 (Greyish Brown)		30.00		26.00	>50	30	V.DENSE	
30.00						28.00	>50	0	V.DENSE	
						30.00	>50	0	V.DENSE	

REMARKS : ALL DIMENSIONS ARE IN METRES

END OF BORING

Fig : 5

For F.S. ENGINEERS (P) LTD.

Director

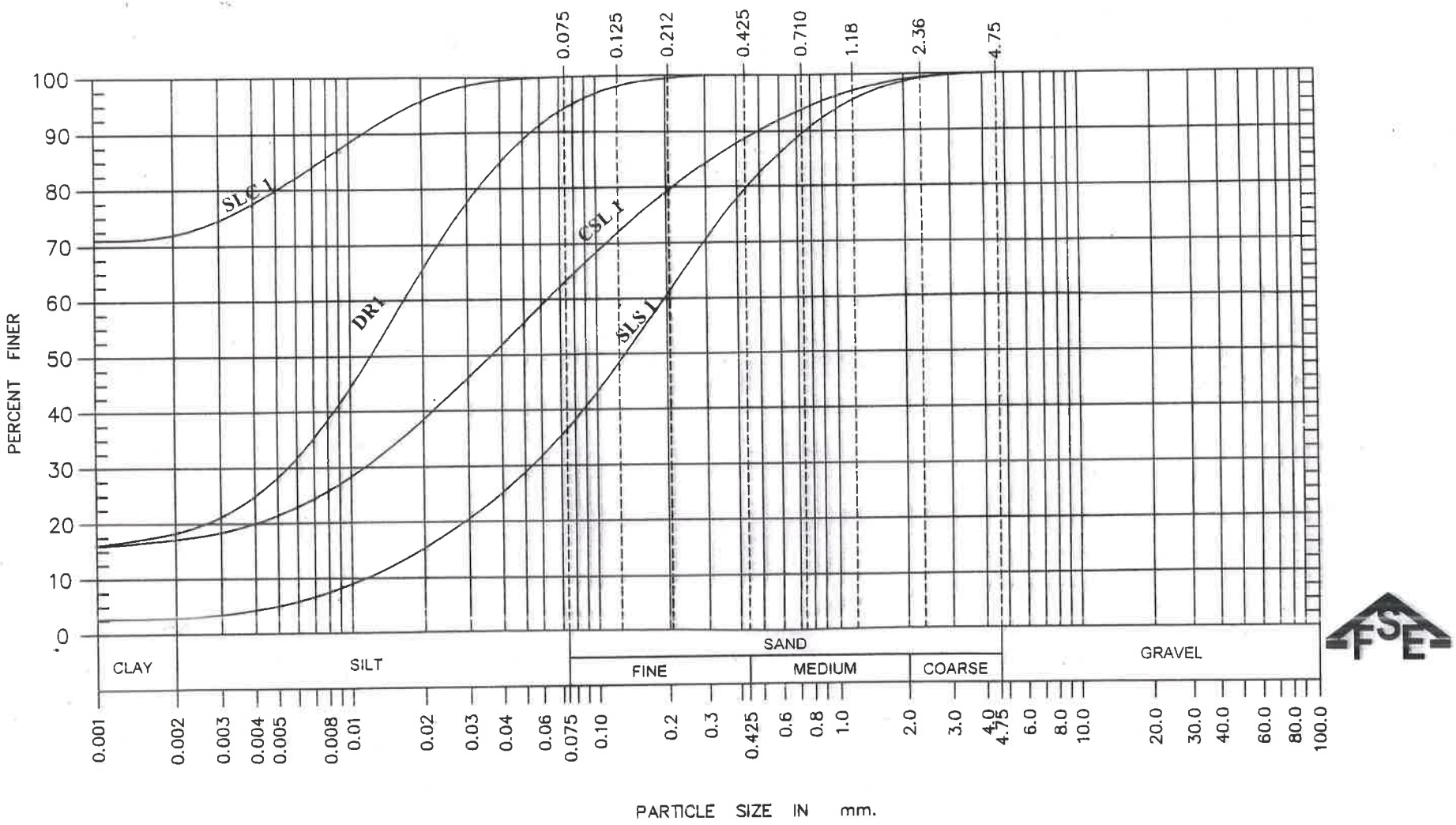


FIG. 6 GRAIN SIZE DISTRIBUTION CURVE

FOR F.S. ENGINEERS (P) LTD.

Director

PN : 5916

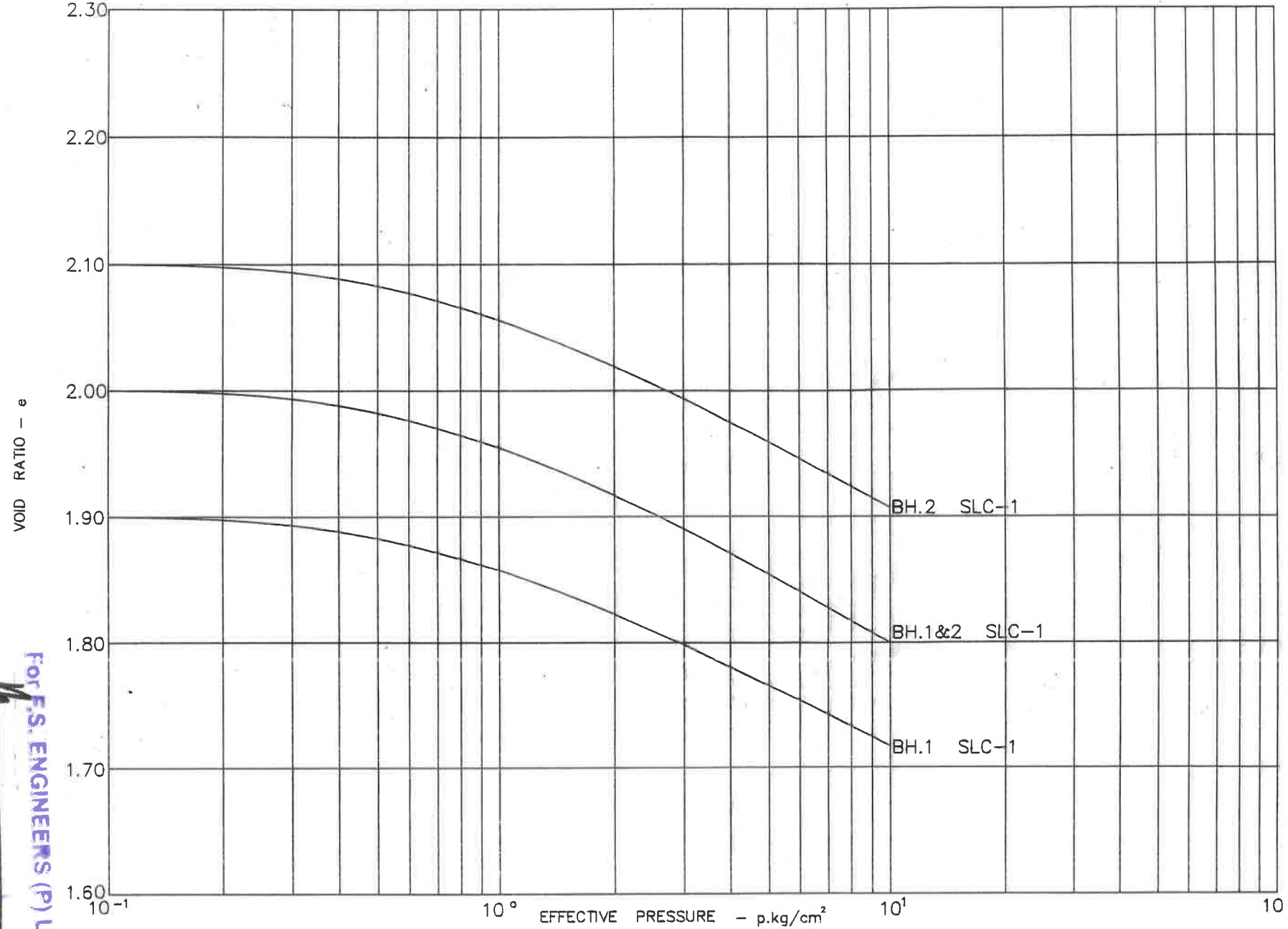


FIG. 7 e - log p curve

PN : 5916

For F.S. ENGINEERS (P) LTD.

Director

Project : Proposed Residential Building at Alwar Thirunagar .

Sl.No	Depth	Layer	W_l	W_p	W_n	Swell	Grain Size Distribution				Sp. Gr. G
							Clay	Silt	Sand	Gravel	
	M		%	%	%	%	%	%	%	%	
1	2	3	4	5	6	7	9	10	11	12	13
BH.1											
	0.00-0.50	TS	-	-	-	-	-	-	-	-	-
	0.50-4.00	SSL1	-	-	-	-	-	36	64	-	2.65
	4.00-5.50	CSL1	-	-	-	-	24	41	35	-	2.65
	5.50-11.50	SLC1	58	36	42	69	71	29	-	-	2.63
	11.50-14.50	S1	-	-	-	-	-	37	63	-	2.65
	14.50-25.50	SLC1	61	35	48	65	66	34	-	-	2.63
	25.50-30.00	DR1	-	-	-	-	16 (not clay)	48	36	-	2.65
BH.2											
	0.00-0.50	TS	-	-	-	-	-	-	-	-	-
	0.50-2.00	SSL1	-	-	-	-	-	43	57	-	2.65
	2.00-5.50	SLC1	63	38	43	70	65	35	-	-	2.63
	5.50-8.50	SLS1	-	-	-	-	-	64	36	-	2.65
	8.50-11.00	SLC1	60	35	46	68	70	30	-	-	2.63
	11.00-14.00	S1	-	-	-	-	-	4	96	-	2.65
	14.00-26.00	SLC1	60	36	42	65	68	32	-	-	2.63
	26.50-30.00	DR1	-	-	-	-	9 (not clay)	14	77	-	2.65
BH.3											
	0.00-0.50	TS	-	-	-	-	-	-	-	-	-
	0.50-2.50	SSL1	-	-	-	-	-	58	42	-	2.65
	2.50-26.50	SLC1	61	33	42	61	72	28	-	-	2.63
	26.50-30.00	DR1	-	-	-	-	5 (not clay)	14	81	-	2.65
BH.4											
	0.00-0.50	TS	-	-	-	-	-	-	-	-	-
	0.50-2.00	GS1	-	-	-	-	1	11	63	25	2.65
	2.00-4.00	SLC1	60	34	38	60	64	36	-	-	2.63
	4.00-5.50	S1	-	-	-	-	-	8	92	-	2.65
	5.50-23.50	SLC1	60	31	41	62	68	32	-	-	2.63
	23.50-26.00	S1	-	-	-	-	-	11	89	-	2.65
	26.00-30.00	DR1	-	-	-	-	11 (not clay)	24	65	-	2.65

Table – 1 **Lab Test Results** P N : 5916

For F.S. ENGINEERS (P) LTD.

Director

Project : Proposed Residential Building at Alwar Thirunagar .

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	7.00	SLC1	0.60	-	1.81	1.73	1.90	0.18
	17.00	SLC1	0.70	-	1.78	1.70	2.00	0.20
2	5.00	SLC1	1.40	-	1.80	1.73	2.10	0.19
	17.00	SLC1	0.40	-	1.79	1.72	2.00	0.20
3	23.00	SLC1	1.40	-	1.80	1.73	2.10	0.19
4	7.00	SLC1	1.20	-	1.78	1.71	1.90	0.17

Table-2 **Laboratory Tests Results** **PN : 5916**

For F.S. ENGINEERS (P) LTD.

Director

Our services go beyond

Buying & Selling Services

Property Buying Assistance, Property Selling Support, Market Price Analysis, Owner Outreach and Negotiation.

Legal & Documentation Services

Certified EC, Patta, legal opinions, property verification, due diligence, litigation solutions, and legal heir certificates.

Property Development & Approvals

Building plan approvals, construction, layout and sub-division approvals, zone conversion, and occupancy certification.

NRI & Investment Services

Escrow Services, Rentals, Litigation Solutions, Property Valuation and Property Management

Compliance & Special Services

Demolition, Vaasthu checks, regularization of unauthorized buildings, and office space solutions.

Smarter Tools, Stronger Decisions

Property Valuation & Cost Estimation

Guideline Value, Apartment Composite Value, Stamp Duty & Registration Fees Calculator, Building Value Calculator, Capital Gains Calculator, Area Unit Converter, Length Unit Converter

Ownership, Compliance & Legal Verification

Encumbrance Certificate (EC) Search, Find Your SRO, Temple Property Check, WAQF Property Check, View Patta/Chitta, View FMB, Patta Analyzer, EC Analyzer

Zoning & Land Use Analysis

Land Use Zone Finder, CRZ Zone Check, Aquifer Zone Check, CBA Check, EWS Check, Road Width Check, Proposed Road Widening Check, FSI Calculator

Property Documentation & Workflow Tools

Forms & Templates, Document Generator, Document Translation, Dictionary

Vastu & Property Management Tools

Home Vastu Shastra, Plot Vastu Shastra, Property Management

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