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REPORT

ON

SOIL INVESTIGATION FOR CONSTRUCTION OF RESIDENTIAL APARTMENT BUILDING AT FATHIMA NAGAR, WORAIYUR, TRICHY

Client

M/s. ABC Property Developers,
T.S. No. 72/2,
Pandamangalam Village,
Fathima Nagar,
Woraiyur,
Trichy

By

Time

Quality is Excellence

TIME INSTITUTE FOR MATERIALS TESTING
NO. 25, SANJEEVI NAGAR,
TRICHY - CHENNAI BYEPASS ROAD,
TIRUCHIRAPPALLI,
TAMIL NADU - 620 002.
PH: 0431 2401326

MAY 2024

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MAY 2024

Dr.S. Senthamil Kumar, ME,PH.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

SUMMARY

Project	:	Construction of Residential Apartment Building ABC Tulip Stilt Parking plus five Floors containing 20 units at M/s. ABC Property Developers, T.S. No. 72/2, Pandamangalam Village, Fathima Nagar, Woraiyur, Trichy
Project Reference	:	Time /27/ Soil Test / May 2024
Owner	:	M/s. ABC Property Developers, T.S. No. 72/2, Pandamangalam Village, Fathima Nagar, Woraiyur, Trichy
Type of Structure	:	R.C.C. Framed construction
Location	:	Fathima Nagar, Woraiyur, Trichy
Scope	:	Geotechnical investigation for the entire area of construction
Test conducted	:	Two explanatory bore hole up to 4.5m & 6m depth was made and conducted standard penetration tests at every 1.5m depth. The undisturbed soil samples were collected at every 1.5m depth for laboratory test.

FINDINGS

Soil at shallow depth	:	Fine sand with silt mixed exists up to 2m depth
Hard stratum	:	Medium Rock exist between 3.8m to 4.5m depth in bore hole 1 & Weathered rock exists between 5.5m to 6m depth in bore hole 2
Ground water table	:	Ground water table was not encountered during investigation up to 6m depth

Dr.S. Senthamil Kumar, ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

CONTENTS

1. INTRODUCTION ON SOIL TEST

1.1 – Introduction - 1
1.2 – Investigation Programme, Procedure and Data - 2
1.3 – Review of Field and Laboratory Results - 3

2. SOIL PROFILES

2.1 – Plan of Bore Hole 1 & 2 - 5
2.2 – Bore log details for Bore Hole 1 & 2 - 6
2.4 – Summary of Engineering Geo Properties for Bore hole 1 & 2 - 8
2.5 – Summary of Laboratory test results for Bore Hole 1 & 2 - 11
2.6 – Shear Parameters for different layers of Bore Hole 1 & 2 - 12

3. SIEVE ANALYSIS REPORT

3.1 – Sieve Analysis report of sample from Borehole No 1 & 2 - 13

4. CALCULATION OF SAFE BEARING CAPACITY OF THE SOIL

4.1 – Safe bearing capacity calculation based on settlement and Shear - 15
4.2 – Safe Bearing capacity of soil based on SPT values - 20
4.3 – Safe Bearing capacity of soil based on Shear Failure Criteria
Through Unconfined Compression Test (UCC) - 20
Through Direct Shear test - 21
4.4 – Comparison of safe bearing capacity of soil
Through shear and settlement - 22

5. RESULT

5.1 – Recommended safe bearing capacity values at different depths - 23

6. SOIL & ROCK SAMPLE PHOTOS

7. SITE PHOTOS

ANNEXURE

Dr.S. Senthamil Kumar, ME, Ph.D, FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

SOIL INVESTIGATION

American Global Standards
AIAO-BAR
ACCREDITED
ISO - 17025:2017
B.N. Krishnaswami, M.E., (Struct Engg.,) Ph.D.,
Former Faculty, NIT, Trichy

Time Institute for Materials Testing

टाइम इन्स्टिट्यूट चीज़े शोध केलिए

Soil & Structural Consultant, Construction Materials Testing Lab

Quality is Excellence

May 14, 2024

To

M/s. ABC Property Developers,
T.S. No. 72/2,
Pandamangalam Village,
Fathima Nagar,
Woraiyur,
Trichy

REPORT ON SOIL INVESTIGATION

(Ref: TIME/27/ SOIL TEST/ MAY 2024)

Sub: Soil Investigation for construction of Residential Apartment Building at Fathima Nagar, Woraiyur, Trichy – reg.,

Ref: Based on letter dated: 08.05.2024

1.1 Introduction:

It is proposed to construct a **Residential Apartment Building at Fathima Nagar, Woraiyur, Trichy.** A detailed soil investigation was suggested for estimating the safe bearing capacity of the soil, so that suitable type of foundation can be decided for the proposed structure. Time Institute for Materials Testing (TIME) has been requested to undertake the soil investigation at the proposed site. The study was carried out by TIME on **09.05.2024.** This report presents complete investigation data and discusses the results to recommend the bearing capacity values at different depths for the proposed structure.

Section 2 describes the soil profile and bore log details of two exploratory bore holes. Section 3 of this report gives the Grain size distribution curves and its analysis. Section 4 of this report presents the calculated safe Bearing capacity values of soil at various depths. Section 5 of this report reviews the test results and the recommended safe bearing capacity values for design of foundation. Section 6 of this report presents the Soil & Rock sample photos. Section 7 of this report presents site photo.

Dr.S. Senthamil Kumar, ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

25, Sanjeevi Nagar, Vinni Gardens, Trichy - Chennai Bye Pass Road, Trichy - 620 002. Tel: + 91 431 2401326,
Mob : + 91 94433 27936 Email : tmaterialstesting@yahoo.co.in, tmaterialstesting1@gmail.com Web: www.timeinstitute.net

1.2 Investigation Programme, Procedure and Data:

Investigation was carried out in two locations at the site through exploratory bore holes. Soil samples were collected from each bore hole at different depths for conducting laboratory test. Standard Penetration test was conducted at regular intervals and 'N' values were recorded. Undisturbed soil samples were collected and were preserved and transported to the laboratory for detailed identification tests. Based on the field and laboratory tests on the samples collected, the results are furnished in this report.

An exploratory bore hole was advanced from the existing ground level using truck mounted rotary drilling techniques supplemented by Betonies mud circulation. This drilling procedure with mud circulation is found most suitable for making exploratory bore hole. The mud circulation was employed through the drill rods and letting it out though the side jets provided in the cutting tool thus preventing any disturbance at the bore hole bottom. Mud circulation was used to stabilize the sides and the bottom of the bore hole, and then to bring the soil cuts to the surface. It is important to note that the mud jet is not used to cut the soils as in the case of wash boring technique. Use of drilling mud will also help in preventing the disturbance to the soil at the bore hole bottom during drilling operations. Diameter of the bore hole is about 150mm.

Bore hole was always kept full with the drilling mud so that a positive head is maintained in the bore hole thus preventing any disturbance to the soil within the test zone.

The field tests included Standard penetration test, Disturbed and undisturbed soil sampling, identification of different soil layers, Ground water table observation, complete logging of the bore hole, etc.

Laboratory investigation consisted of classification tests like grain size distribution analysis, determination of specific gravity etc. Unconfined Compression test and Direct shear was conducted on preserved soil samples. All the field and laboratory tests were conducted according to the procedures stipulated in relevant IS codes.

Dr.S. Senthamil Kumar,ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

1.3 Review of Field and Laboratory Results:

Sub soil Profile

The original ground level in the presently investigated area was plain terrain.

Bore Hole 1:

The soil below the existing ground level is Filled up soil. This layer is extended up to 0.5m depth. Fine sand with silt mixed exists from 0.5m to 2m depth. Clay with fine sand mixed exists from 2m to 3.8m depth. Below which Medium rock exists from 5m to 6m depth from the existing ground level. The soil stratification and its variation under present investigation are available in bore log details. The 'N' value is progressively increasing towards depth, due to the soil stratification.

Bore Hole 2:

The soil below the existing ground level is Filled up soil. This layer is extended up to 0.5m depth. Sand with clay mixed exists from 0.5m to 5m depth. Gravels exist from 5m to 5.5m depth. Below which weathered rock exists from 5.5m to 6m depth from the existing ground level. The soil stratification and its variation under present investigation are available in bore log details. The 'N' value is progressively increasing towards depth, due to the soil stratification.

Ground Water Table

Ground water table was not encountered during investigation up to 6m depth.

Shear Strength

Standard Penetration test blow counts 'N' is measured at different levels in the bore hole. Mainly these 'N' values are used to assess the shear strength of different soil layers.

Cohesive layers: The classification of 'N' values in moderate to high plasticity medium clay deposits developed by Terzaghi is used for estimating the unconfined compression strength and untrained shear strength of clay and sandy clay layers. The consistency between the N values and the liquidity index values is reviewed while assigning undrained shear strength for soft to medium clay layers.

Dr.S. Senthamil Kumar,ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

Non - Cohesive Layers: The sand layers towards depth are of residual type and suitable modifications are made to take care of the presence of plastic fines in the residual soil. Conventional method of estimating the angle of shearing resistance ϕ corresponding to the relative density and the grain size distribution as per the classification suggested by Peck and suitably modified by the R.K. Hough to account for the influence of grain size distribution is adopted here.

Laboratory Tests:

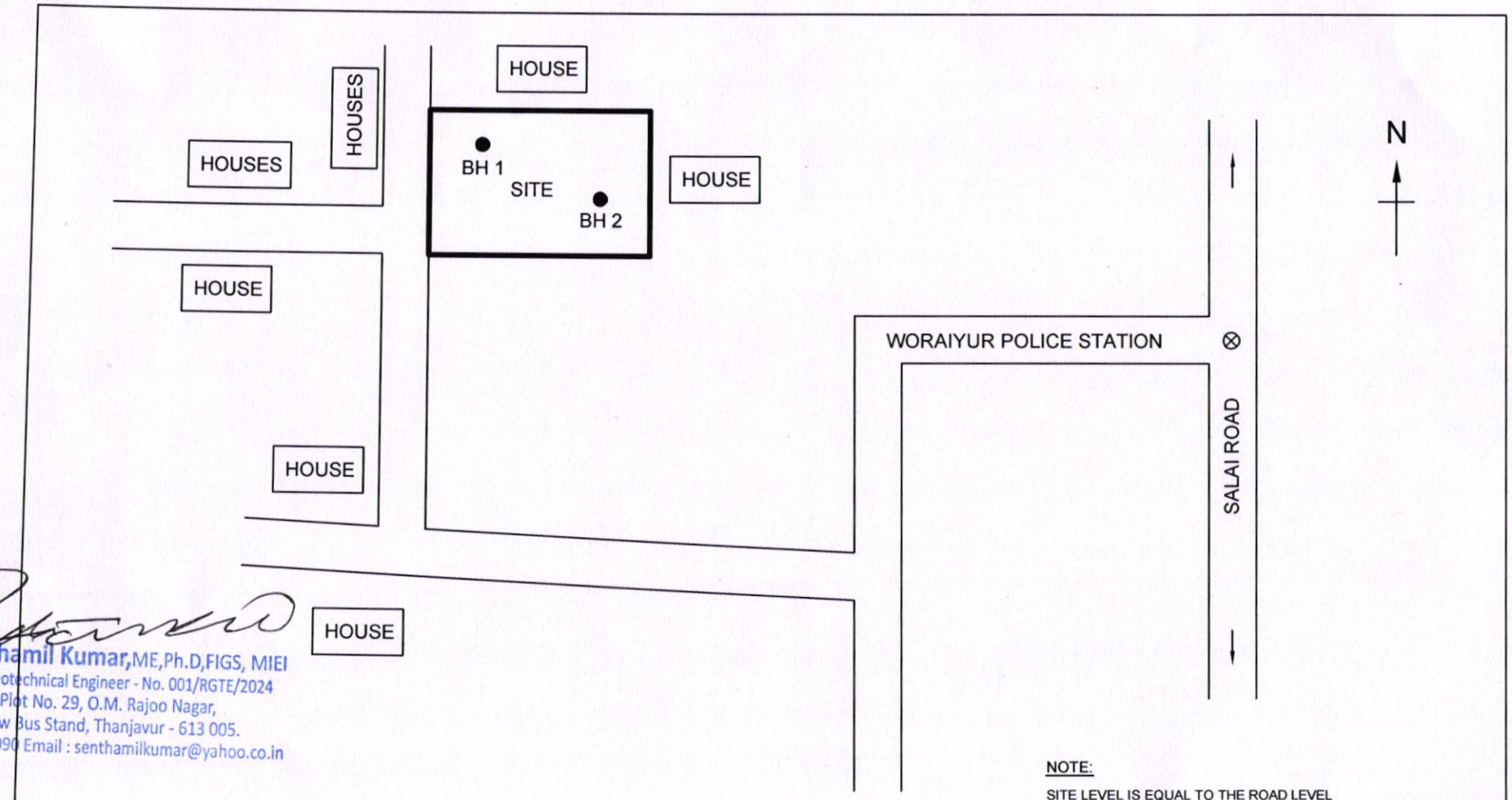
The Collected soil samples were tested as per relevant procedure in IS codes. The following parameters are evaluated.

1) **Natural Moisture Content**: This test is conducted in all disturbed samples to find the water content in soil samples as per **IS 2720 (Part 2): 1973**
2) **Specific Gravity:** This test is conducted in all disturbed soil samples to find specific gravity of soil as per **IS 2720 (Part 3): 1980**
3) **Density:** This test is conducted in all disturbed soil samples to find Bulk density and Dry density of soil as per **IS 2720 (Part 8): 1983**
4) **Sieve Analysis: This test is conducted to identify and classify the samples** as per **IS 2720 (Part 4) : 1985**
5) **Direct Shear Test:** This test conducted in coarse grained soil to find the angle of shearing resistance of the soil as per **IS 2720 (Part 13):1986**
6) **Unconfined Compression Test:** This test conducted in Clay soil to find Cohesion of the soil as per **IS 2720 (Part 10):1995**

14th May 2024

Dr.S. Senthamil Kumar,ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

SITE LOCATION PLAN



Dr.S. Senthamil Kumar, ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

LEGEND:

● BORE LOG LOCATION

⊗ SITE LOCATION

SITE PLAN

NOTE:

SITE LEVEL IS EQUAL TO THE ROAD LEVEL

CLIENT	M/s. ABC Property Developers, T.S. No. 72/2, Pandamangalam Village, Fathima Nagar, Woraiyur, Trichy		
SOIL CONSULTANT	TIME Institute for Materials Testing No 25, Sanjeevi Nagar, Trichy - Chennai Byepass road , Trichy - 620002. PHONE : 0431 - 2401326(OFF)		
DATE OF SURVEY	09.05.2024	TITLE PLAN OF BORE HOLE AND SITE DETAILS AT FATHIMA NAGAR, WORAIYUR, TRICHY	
SCALE	NTS	DRG.NO DRAWING - 01	REV. 0

BORE LOG DETAILS

2.2 BORE LOG DETAILS FOR BORE HOLE 1

Project : Report on soil investigation for Construction of Residential Apartment Building
Location : Fathima Nagar, Woraiyur, Trichy
Started on : 09.05.2024 **Ended on** : 09.05.2024
Depth of G.W.T : Nil
Type of Boring : Calyx drilling
Site Level : Equal to the road level

Lithology of Bore Hole			SPT Data					Graphical representation of penetration Resistance ('N' Value)
Depth below G.L. (m)	Profile	Soil Description	Depth of SPT (m)	0-15cm	15-30cm	30-45cm	N Value	0 20 40 60
0 - 0.5m		Filled up soil						
0.5m - 2m		Fine sand with silt mixed	1.5	3	5	5	10	
2m - 3.8m		Clay with fine sand mixed	3.0	3	4	4	8	
3.8m - 4.5m		Medium rock	4.5	Rebound			55	

Bore terminated at 4.5m depth from the existing ground level

Dr.S. Senthamil Kumar, ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

2.3 BORE LOG DETAILS FOR BORE HOLE 2

Project : Report on soil investigation for Construction of Residential Apartment Building
Location : Fathima Nagar, Woraiyur, Trichy
Started on : 09.05.2024 **Ended on** : 09.05.2024
Depth of G.W.T : Nil
Type of Boring : Calyx drilling
Site Level : Equal to the road level

Lithology of Bore Hole			SPT Data					Graphical representation of penetration Resistance ('N' Value)
Depth below G.L. (m)	Profile	Soil Description	Depth of SPT (m)	0-15cm	15-30cm	30-45cm	N Value	0 20 40 60
0 - 0.5m		Filled up soil						
0.5m - 5m		Sand with clay mixed	1.5	8	9	9	18	
			3.0	3	5	8	13	
			4.5	4	5	9	14	
5m - 5.5m		Gravels						
5.5m - 6m		Weathered rock	6.0	Rebound			50	

Bore terminated at 6m depth from the existing ground level

Dr.S. Senthamil Kumar, ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

2.4 Summary of Engineering Geo Properties

Natural Moisture Content:

The natural water content also called the natural moisture content is the ratio of the weight of water to the weight of the solids in a given mass of soil. This ratio is usually expressed as percentage.

$$W = [(W2-W3)/(W3-W1)] \times 100$$

Where,

W_1 = Weight of container gm

W_2 = Weight of container +wet soil gm

W_3 = Weight of container +dry soil

Bulk Density:

The total, or wet, density of soil, $_t$, is the ratio of the total mass of soil to its total volume and can be defined as follows:

$$\gamma_{bulk} = M / V$$

Where

M_t = Total Mass of soil

V_t = Total Volume

Dry Density:

The soil dry density, $_b$, is the ratio of the mass of the solid phase of the soil (i.e., dried soil) to its total volume (solid and pore volumes together) and is defined as follows:

$$\gamma_{dry} = M_b / V_b$$

Where

M_b = Total Mass of dried soil

V_b = Total Volume

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Specific gravity:

Specific gravity is the ratio of the weight of a given volume of a material at a standard temperature to the weight of an equal volume of distilled water at the same stated temperature.

The specific gravity G of the soil = $(W_2 - W_1) / [(W_4 - W_1)-(W_3-W_2)]$

Where

W_1 = Weight of density bottle
W_2 = Weight of density bottle + dry soil
W_3 = Weight of bottle + dry soil + water at temperature
W_4 = Weight of density bottle + Water

Void Ratio:

Soil void ratio (e) is the ratio of the volume of voids to the volume of solids:

$$e = (Vv) / (Vs)$$

Where
Vv is the volume of the voids (empty or filled with fluid),
Vs is the volume of solids.

Porosity:

Soil porosity (η) , which is defined as the ratio of the volume of voids to the total volume of the soil. The porosity and the void ratio are inter-related as follows:

$$\eta = (1 - (\gamma_d/G_s))*100$$

$$e = \eta/(1-\eta) \;\&\; \eta = e / (1+e)$$

Where
γ_d = Dry Density
G_s = Specific gravity

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Registered Geotechnical Engineer - No. 001/RGTE/2024
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Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

Summary of Engineering Geo Properties for Bore Holes 1 & 2

Bore hole No.	Depth (m)	Soil Description	Natural Moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/cc)	Specific gravity	Porosity (%)	Void Ratio
Bore Hole 1	1.5	Fine sand with silt mixed	19.58	1.87	1.56	2.62	40	0.68
	3.0	Clay with fine sand mixed	19.75	1.86	1.55	2.62	41	0.69
	4.5	Medium Rock	3.80	2.07	1.99	2.69	26	0.35
Bore Hole 2	1.5	Sand with clay mixed	18.65	1.88	1.58	2.62	40	0.65
	3.0		18.40	1.89	1.60	2.62	39	0.64
	4.5		18.28	1.90	1.61	2.62	39	0.63
	6.0	Weathered rock	5.10	2.05	1.95	2.68	27	0.37

Dr.S. Senthamil Kumar,ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

2.5 Summary of Laboratory Test Results for Bore Holes 1 & 2

Bore hole No.	Depth (m)	Soil Description	Atterberg limits			Gravel (%)	Coarse sand (%)	Medium Sand (%)	Fine sand (%)	Silt (%)	Clay (%)
			Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)						
Bore Hole 1	1.5	Fine sand with silt mixed	-	-	-	0.0	5.8	12.3	58.5	18.6	4.8
	3.0	Clay with fine sand mixed	32.6	24.3	8.3	0.0	5.3	9.7	36.1	6.5	42.4
Bore Hole 2	1.5	Sand with clay mixed	33.1	24.6	8.5	0.0	8.1	35.0	22.7	3.2	31.0
	3.0		33.4	24.7	8.7	0.0	8.7	36.5	21.1	4.5	29.2
	4.5		33.5	24.5	9.0	0.0	9.7	37.9	19.8	3.7	28.9

Dr.S. Senthamil Kumar,ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
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Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

2.6 Shear Strength Parameters for Different layers of Bore Holes 1 & 2

Bore Hole No.	Depth below G.L. (m)	Soil Description	N	Cohesion 'c' (t/m^2)	Shear Strength 'Ø' (in degrees)
Bore Hole 1	1.5	Fine sand with silt mixed	10	-	27.88
	3.0	Clay with fine sand mixed	8	3.49	27.36
	4.5	Medium Rock	55	-	35.05
Bore Hole 2	1.5	Sand with clay mixed	18	8.25	29.90
	3.0		13	5.54	28.39
	4.5		14	6.89	28.65
	6.0	Weathered rock	50	-	33.70

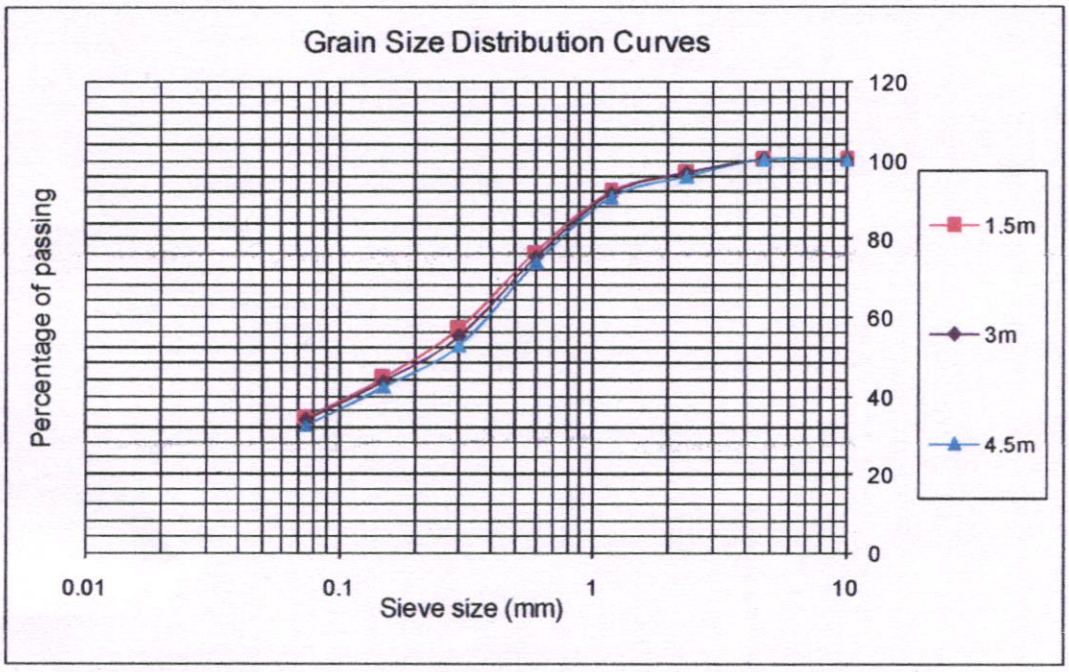
Dr.S. Senthamil Kumar,ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

GRAIN SIZE ANALYSIS

3.2 TEST REPORT ON SIEVE ANALYSIS OF SAMPLE

Bore Hole – 2 @ 1.5m to 4.5m

SIEVE SIZE	PERCENTAGE OF PASSING		
	1.5m Depth	3m Depth	4.5m Depth
10 mm	100	100	100
4.75 mm	100.0	100.0	100.0
2.36 mm	96.8	96.5	95.8
1.18 mm	91.9	91.3	90.3
600 micron	76.7	75.2	73.6
300 micron	56.9	54.8	52.4
150 micron	44.3	43.6	42.1
75 micron	34.2	33.7	32.6



Description	1.5m Depth	3m Depth	4.5m Depth
Fineness modulus	1.992	2.049	2.132

Observation:

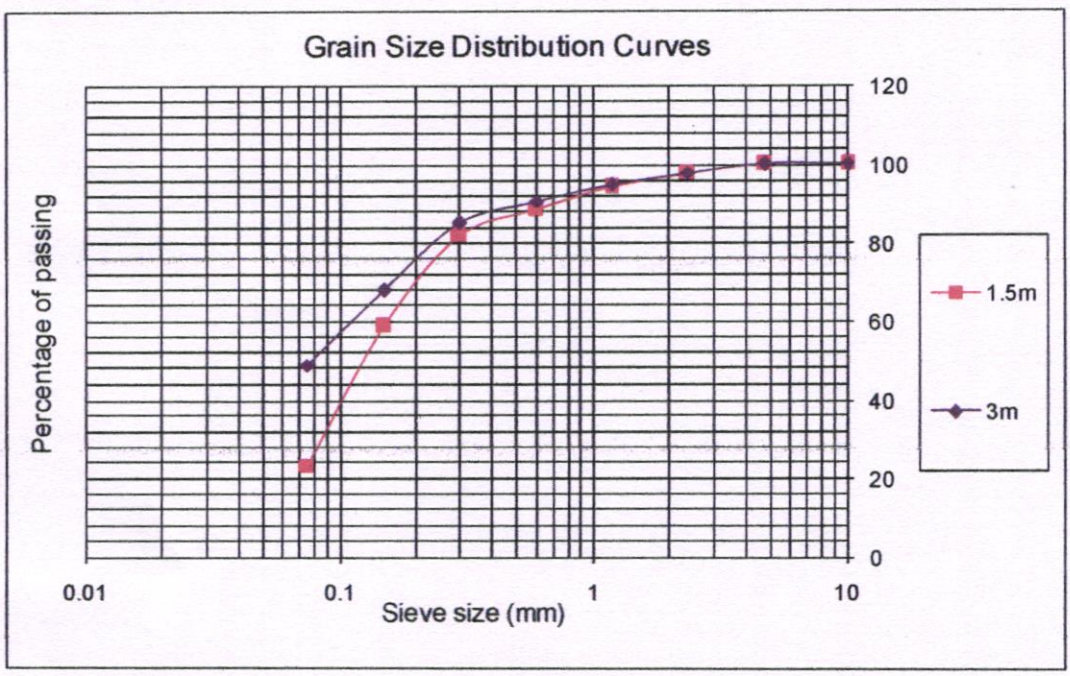
The inference from the graph shows that the Sand with clay mixed exists up to 4.5m depth.

Dr.S. Senthamil Kumar,ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

3.1 TEST REPORT ON SIEVE ANALYSIS OF SAMPLE

Bore Hole – 1 @ 1.5m & 3m

SIEVE SIZE	PERCENTAGE OF PASSING	
	1.5m Depth	3m Depth
10 mm	100	100
4.75 mm	100.0	100.0
2.36 mm	97.7	97.9
1.18 mm	94.2	94.7
600 micron	88.8	90.6
300 micron	81.9	85
150 micron	58.7	67.8
75 micron	23.4	48.9



Description	1.5m Depth	3m Depth
Fineness modulus	1.553	1.151

Observation:

The inference from the graph shows that the fine sand with silt mixed exists at 1.5m depth and clay with fine sand mixed exists at 3m depth.

Dr.S. Senthamil Kumar,ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
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Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

CALCULATION

OF

SAFE BEARING CAPACITY

4. CALCULATION OF SAFE BEARING CAPACITY

4.1 Safe bearing capacity calculation based on settlement and Shear

Safe Bearing Capacity calculations based on settlement consideration (SPT value):

Safe Bearing Capacity calculations for shallow foundation will vary based on the width of foundation.

For example, in the case of Individual footing such as isolated, combined etc., we are supposed to use the formula as mentioned below. (Using Teng's Modified formula)

$$q_{na} = 51.4 \times (N-3) \times \left(\frac{B+0.3}{2B}\right)^2 \times R_w \times C_d$$

Where,

q_{na}	=	Net safe bearing capacity of soil (kN/m^2) (for 2.5cm permissible settlement as per Terzhagi and Peck)
N	=	Corrected SPT values
B	=	Width of foundation (m) (let us assume 2m)
R_w	=	Correction factor for water table level
C_d	=	Correction factor for depth of embedment

For Bore Hole 1 @ 3m depth SPT 'N' Value = 8

$\Rightarrow$ **q_{na} = 51.4 x (8 - 3) x ((2 + 0.3)/(2 x 2))^2 x 0.5 x 1 = 42.48 kN/m^2**

$\therefore$ **q_{na} = 4.24 t/m^2**

Dr.S. Senthamil Kumar, ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

Safe Bearing Capacity calculations based on Unconfined Compression Test (UCC):

As Per IS 6403:1981

Net safe bearing capacity of the soil,

$$q_{ult} = C\,N_c\,S_c\,d_c\,i_c + q\,(N_q - 1)\,S_q\,d_q\,i_q + 0.5\,B\,\gamma\,N_\gamma\,S_\gamma\,d_\gamma\,i_\gamma\,W'$$

Where

C	=	Cohesion in Kgf/cm^2
N_c, N_q, N_γ	=	Bearing Capacity Factors
S_c, S_q, S_γ	=	Shape Factors
d_c, d_q, d_γ	=	Depth Factors
i_c, i_q, i_γ	=	Inclination Factors
q	=	Effective surcharge at the base level of foundation in Kgf/cm^2
	=	$\gamma \times d$
B	=	Width of footing, diameter of circular footing in cm
γ	=	Bulk unit weight of soil in Kgf/cm^3
W'	=	Correction factor for location of water table

At 3m depth (Bore Hole 1), the Soil profile is Clay with fine sand mixed

If	Φ	=	0 (assumed)
	N_c	=	5.14
	N_q	=	1
	N_γ	=	0 (Zero)
and Cohesion C		=	3.49 (based on laboratory test)

Applying these parameters in the equation No. 1

$$q_{ult} = C\,N_c\,S_c\,d_c\,i_c + q\,(N_q - 1)\,S_q\,d_q\,i_q + 0.5\,B\,\gamma\,N_\gamma\,S_\gamma\,d_\gamma\,i_\gamma\,W'$$
$$= C\,N_c\,S_c\,d_c\,i_c + q\,(1 - 1)\,S_q\,d_q\,i_q + 0.5\,B\,\gamma\,0\,S_\gamma\,d_\gamma\,i_\gamma\,W'$$
$$= C\,N_c\,S_c\,d_c\,i_c + 0 + 0$$

$$q_{ult} = C\,N_c\,S_c\,d_c\,i_c$$

Dr.S. Senthamil Kumar, ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

Where S_c = Shape factor which is equal to 1

d_c = $1 + 0.2 \frac{df}{B} \sqrt{Nq}$

= $1 + 0.2 \frac{2.6}{18} \sqrt{tan2(45+\emptyset/2)}$

= 1.028 (hence considered the minimum value as 1)

= 1

i_c = $(1 + \alpha/90)^2$

Where α = inclination of the load to the vertical in degree which is equal to zero

i_c = 1

Therefore q_{ult} = $C\ N_c\ S_c\ d_c\ i_c$

= 3.49 x 5.14 x 1 x 1 x 1

= 17.938 t/m^2

Applying factor of safety as 3

Then allowable bearing capacity

$q_{allowable}$ = 17.938 / 3

= 5.99 t/m^2

Safe Bearing Capacity calculations based on shear consideration (Direct Shear):

As Per IS 6403:1981

At 1.5m depth (Bore Hole 1)

Proving Ring capacity 200kg = 966.2 division

Area of the shear box = 6cm x 6cm = 36cm^2

Normal Stress (kg/cm^2)	No. of Division	Stress
0.5	23	0.132
1.0	69	0.397
1.5	115	0.661

Stress = Load / Area

= (200/966.2) * 23* (1/36) = 0.132

Ø = $\tan^{-1}$ (0.661-0.132) = 27.88°

Dr.S. Senthamil Kumar,ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

Net safe bearing capacity of the soil (for general shear failure as per IS 6403:1981)

$$q_{ult} = C N_c S_c d_c i_c + q (N_q - 1) S_q d_q i_q + 0.5 B \gamma N_\gamma S_\gamma d_\gamma i_\gamma W'$$

Where

C	=	Cohesion in t/m^2
N_c, Nq, N_γ	=	Bearing Capacity Factors (From Table 1 of IS 6403 – 1981)
S_c, S_q, S_γ	=	Shape Factors (From Table 2 of IS 6403 – 1981)
d_c, d_q, d_γ	=	Depth Factors
i_c, i_q, i_γ	=	Inclination Factors
q	=	Effective surcharge at the base level of foundation in t/m^2
B	=	Width of footing, diameter of circular footing in m
γ	=	Bulk unit weight of soil in t/m^3
W'	=	Correction factor for location of water table

At 1.5m depth (Bore hole 1), the Soil profile is Fine sand with silt mixed

If	C	=	0 (Since no Cohesion)
	Φ	=	27.88° (based on laboratory test)
Therefore	N_c	=	26.143;
	N_q	=	15.116;
	N_γ	=	17.512

Applying these parameters in the above equation

$$q_{ult} = C N_c S_c d_c i_c + q (N_q - 1) S_q d_q i_q + 0.5 B \gamma N_\gamma S_\gamma d_\gamma i_\gamma W'$$

Where C = 0 (Since no Cohesion)

Therefore, $q_{ult} = q (N_q - 1) S_q d_q i_q + 0.5 B \gamma N_\gamma S_\gamma d_\gamma i_\gamma W'$

Bearing Capacity calculation through shear density of soil 'γ'

There are two relationships of weight of soil to Volume of soil as

i) Total density or Bulk density

ii) Dry density

Therefore, Total Bulk density, $\gamma_t = \frac{\text{Total Weight of soil}}{\text{Total Volume of soil}} = \frac{W}{V}$

Dry Density $\gamma_d = W_s/V$; Whereas W_s = Total weight of solids

Dr.S. Senthamil Kumar,ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

In a particular case the **total density** will be known as **saturated density**, when the soil is saturated. Another density of soil will be known as submerged or buoyant density, γ_b when the soil is submerged in water.

$\gamma_b = \gamma_t - \gamma_w$

Where γ_w = Density of water = 1 g/cc or 1 t/m^3

Mostly soils submerged in water are saturated.

Hence $\gamma_{buoyant} = \gamma_{sat} - \gamma_w$

Based on the above equations,

$\gamma = \gamma_{sat} = 1.8$ t/m^3

d = 1.5m

Here, $\gamma_b = \gamma_{sat} - 1 = 1.8 - 1 = 0.8$ t/m^3

Therefore, $q = \gamma_b \times d = 0.8 \times 1.5 = 1.2$ t/m^2

$S_q = S_\gamma$ = Shape factor which is equal to 1

$d_q = d_\gamma = 1 + 0.1 \frac{df}{B} \sqrt{N\emptyset}$

= 1 (Minimum value of 1 can be taken)

i_q = inclination factor $(1 - \alpha/90)^2$

Where α = inclination of the load to the vertical in degree which is equal to zero

i_q = 1

B = Width of footing (2m)

W' = 0.5

Applying in the above equation

$q_{ult} = q (Nq - 1) S_q d_q i_q + 0.5 B \gamma N_\gamma S_\gamma d_\gamma i_\gamma W'$

$= 1.2 \times (15.116 - 1) \times 1 \times 1 \times 1 + 0.5 \times 2 \times 1.8 \times 17.512 \times 1 \times 1 \times 1 \times 0.5$

$= 32.70$ t/m^2

Applying factor of safety as 3

Then allowable bearing capacity

$q_{na} = 32.70 / 3$

$= 10.90$ t/m^2

Dr.S. Senthamil Kumar,ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

SAFE BEARING CAPACITY

RESULTS

4. Calculation of Safe bearing capacity of the soil:

4.2 Safe Bearing capacity of soil based on SPT values for Bore Holes 1 & 2

Bore Hole No.	Depth (m)	SPT value	Safe Bearing capacity of soil	
			KN/m^2	t/m^2
BH – 1	1.50	10	59.47	5.94
	3.00	8	42.48	4.24
	4.50	55	441.84	44.18
BH – 2	1.50	18	127.45	12.74
	3.00	13	84.97	8.49
	4.50	14	93.46	9.34
	6.00	50	399.36	39.93

4.3 Safe Bearing capacity of soil based on Shear Failure Criteria:

Through Unconfined Compression Test (UCC)

Bore Hole No.	Depth (m)	Max. Load (Div)	Max. Deformation (Div)	Cohesion (t/m^2)	Safe Bearing capacity of soil (t/m^2)
BH – 1	3.00	25	75	3.49	5.99
BH – 2	1.50	60	180	8.25	14.14
	3.00	40	135	5.54	9.49
	4.50	50	170	6.89	11.80

Dr.S. Senthamil Kumar, ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

Direct Shear test for Bore Hole 1 & 2

Bore Hole No.	Depth (m)	Normal Stress (kg/cm^2)	Division	Ø (in degrees)	Safe Bearing Capacity of Soil (t/m^2)
BH - 1	1.50	0.5 1.0 1.5	23 69 115	27.88°	10.90
	3.00	0.5 1.0 1.5	23 68 113	27.36°	15.55
	4.50	0.5 1.0 1.5	24 85 146	35.05°	53.72
BH - 2	1.50	0.5 1.0 1.5	23 73 123	29.90°	13.55
	3.00	0.5 1.0 1.5	23 70 117	28.39°	17.53
	4.50	0.5 1.0 1.5	23 71 118	28.65°	24.15
	6.00	0.5 1.0 1.5	24 82 140	33.70°	57.91

Dr.S. Senthamil Kumar, ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

4.4 Comparison of Safe bearing capacity of soil through Shear and Settlement consideration:

Bore Hole no.	Depth (m)	Safe Bearing Capacity (t/m^2)		
		Shear consideration		Settlement consideration
		(UCC)	(Direct Shear)	
BH – 1	1.50	---	10.90	5.94
	3.00	5.99	15.55	4.24
	4.50	---	53.72	44.18
BH – 2	1.50	14.14	13.55	12.74
	3.00	9.49	17.53	8.49
	4.50	11.80	24.15	9.34
	6.00	---	57.91	39.93

Dr.S. Senthamil Kumar,ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

5. Result:

5.1 Recommended Safe bearing capacity values at different depths

Considering the lesser value of the above, the Safe Bearing Capacity, values at different depths are recommended below:

Bore Hole	Depth (m)	Safe Bearing Capacity (t/m^2)
BH – 1	1.50	5.94
	3.00	4.24
	4.50	44.18
BH – 2	1.50	12.74
	3.00	8.49
	4.50	9.34
	6.00	39.93

The above test data and findings are relevant and applicable only for the soil conditions existing at the test site. Any change in the soil strata observed during excavation may be reported to the laboratory, which will redefine the safe bearing capacity of the soil.

Dr.S. Senthamil Kumar,ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

SOIL & ROCK SAMPLE PHOTOS

0



4.5m

Bore Hole No: 1

Depth : 0 to 4.5m

Dr.S. Senthamil Kumar,ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in



0 6m

Bore Hole No: 2

Depth : 0 to 6m

Dr.S. Senthamil Kumar, ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

SITE PHOTO



Fathima Nagar, Woraiyur, Trichy

Dr.S. Senthamil Kumar, ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

ANNEXURE

Time Institute for Materials Testing
Soil Division,
#25, Sanjeevi Nagar,
Trichy- Chennai Byepass road, Trichy - 620 002.
Phone: 0431 2401326
Fax: 0431 2401596
Email: tmaterialstesting@yahoo.co.in

Annexure - A

NATURAL MOISTURE CONTENT
(As per IS 2720 (Part - 2) - 1973)

Project Name : **Soil investigation for Construction of Residential Apartment Building at Fathima Nagar, Woraiyur, Trichy**

Bore Hole No. : **1**

Depth : **3m**

Trial	Wt of container (W) gm	Wt of container +wet soil (W_1) gm	Wt of container + Dry soil (W_2) gm	Wt of Water ($W_3 = W_1-W_2$) gm	Wt of Dry Soil ($W_4 = W_2-W$) gm	Water Content (%) = (W_3-W_4)*100
1	23.20	58.40	52.60	5.8	29.4	19.73
2	24.80	47.10	43.40	3.7	18.6	19.89
3	21.80	48.60	44.20	4.4	22.4	19.64

Natural Moisture Content = 19.75

Dr.S. Senthamil Kumar, ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

Time Institute for Materials Testing

#25, Sanjeevi Nagar,
Trichy- Chennai Byepass road, Trichy - 620 002.
Phone: 0431 2401326
Fax: 0431 2401596
Email: tmaterialstesting@yahoo.co.in

Annexure - B

SPECIFIC GRAVITY TEST
(As per IS 2720 (Part - 3) - 1980)

Project Name : **Soil investigation for Construction of Residential Apartment Building at Fathima Nagar, Woraiyur, Trichy**

Bore Hole No. : **1**

Depth : **3m**

Trial	Bottle Wt (W1) gm	Bottle + Sample (W2) gm	Bottle + Sample + Water (W3) gm	Bottle + Water (W4) gm	Specific Gravity
1	32.6	91.5	117.2	80.8	2.618
2	32.6	92.8	118.1	80.8	2.629
3	32.6	92.2	117.7	80.8	2.626

Specific gravity of Fine Aggregate = 2.62

Dr.S. Senthamil Kumar, ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

Time Institute for Materials Testing
Soil Division,
#25, Sanjeevi Nagar,
Trichy- Chennai Byepass road, Trichy - 620 002.
Phone: 0431 2401326
Fax: 0431 2401596
Email: tmaterialstesting@yahoo.co.in

Annexure - C

DENSITY CALCULATION

Project Name : **Soil investigation for Construction of Residential Apartment Building at Fathima Nagar, Woraiyur, Trichy**

Bore Hole No. : **1**

Depth : **3m**

Sl. No.	Description	Reading
1	Weight of Empty Box (gm)	630.00
2	Weight of Box + Soil (gm)	797.00
3	Weight of Soil (gm)	167.00
4	Volume of Box (cm^3)	90.00
5	**Bulk Density (gm/cm^3)**	**1.86**
6	Weight of Container (gm)	23.20
7	Weight of Container + Wet Soil (gm)	58.40
8	Weight of Container + Dry Soil (gm)	52.60
9	Moisture Content (%)	19.73
10	**Dry Density (gm/cm^3)**	**1.55**

Result

Bulk Density of Soil = 1.86

Dry Density of Soil = 1.55

Dr.S. Senthamil Kumar,ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

Time Institute for Materials Testing
Soil Division,
#25, Sanjeevi Nagar,
Trichy- Chennai Byepass road, Trichy - 620 002.
Phone: 0431 2401326
Fax: 0431 2401596
Email: tmaterialstesting@yahoo.co.in

Annexure - D

POROSITY & VOID RATIO

Project Name : **Soil investigation for Construction of Residential Apartment Building at Fathima Nagar, Woraiyur, Trichy**

Bore Hole No. : **1**

Depth : **3m**

Sl. No.	Description	Reading
1	Dry Density γ_d (gm/cm^3)	1.55
2	Specific gravity (G_s)	2.62
	Porosity (%)	(1 – (γd/Gs))*100
		(1-(1.55/2.62)) x 100 = 40.83
3	**Porosity (%)**	**41**
	Void Ratio, (e)	η/(1-η)
		0.4083/(1-0.4083)
4	**Void Ratio**	**0.69**

Dr.S. Senthamil Kumar,ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

Time Institute for Materials Testing
Soil Division,
#25, Sanjeevi Nagar,
Trichy- Chennai Byepass road, Trichy - 620 002.
Phone: 0431 2401326
Fax: 0431 2401596
Email: tmaterialstesting@yahoo.co.in

Quality is Excellence

Annexure - E

FINENESS MODULUS TEST

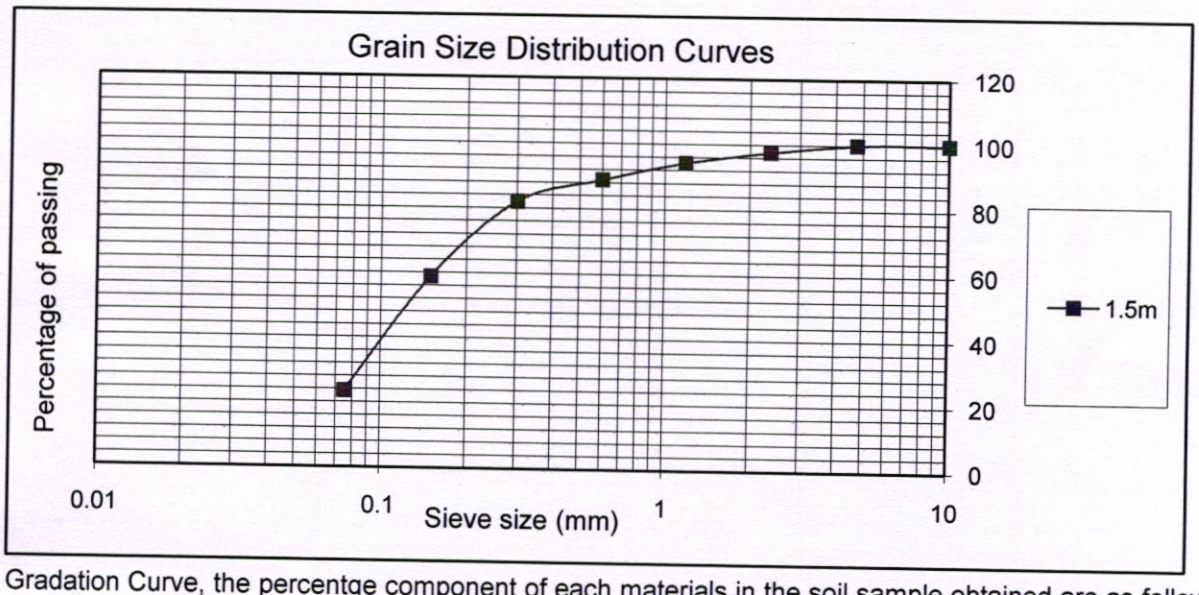
(As per IS 2720 (Part - 4) - 1985)

Project Name : **Soil investigation for Construction of Residential Apartment Building at Fathima Nagar, Woraiyur, Trichy**

Bore Hole No. : **1**

Depth : **1.5m**

Sieve size (mm)	Weight retained (gm)	Cumulative Weight retained (gm)	Percentage cumulative weight retained (gm)	Percentage of passing
10	0	0.0	0.0	100.0
4.75	0	0.0	0.0	100.0
2.36	2.3	2.3	2.3	97.7
1.18	3.5	5.8	5.8	94.2
0.6	5.4	11.2	11.2	88.8
0.3	6.9	18.1	18.1	81.9
0.15	23.2	41.3	41.3	58.7
0.075	35.3	76.6	76.6	23.4
Pan	23.4	100.0	100.0	0.0



Based on Gradation Curve, the percentge component of each materials in the soil sample obtained are as follows (As per IS 1498 - 1970).

Gravel (%)	0
Coarse Sand (%)	5.8
Medium Sand (%)	12.3
Fine sand (%)	58.5
Silt & Clay (%)	23.4

Dr.S. Senthamil Kumar, ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2024
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in

Time Institute for Materials Testing
Soil Division,
#25, Sanjeevi Nagar,
Trichy- Chennai Byepass road, Trichy - 620 002.
Phone: 0431 2401326
Fax: 0431 2401596
Email: tmaterialstesting@yahoo.co.in

Annexure - F

Direct Shear Test (IS 2720 - Part 13 -1986)

Bore Hole	1
Depth (m)	1.5m
Date of Test	13.05.2024

L.C. Of Dial Gauge	0.002
Proving ring Constant	0.206996
Area of the specimen (cm^2)	36

Trial 1

Normal Stress: 0.5 kg/cm^2

Horizontal Gauge Reading	Proving Ring Reading	Shear Deformation	Shear Stress (kg/cm^2)
0	0	0.00	0.000
50	9	0.50	0.052
100	11	1.00	0.063
150	13	1.50	0.075
200	15	2.00	0.086
250	17	2.50	0.098
300	19	3.00	0.109
350	21	3.50	0.121
400	23	4.00	0.132

Trial 2

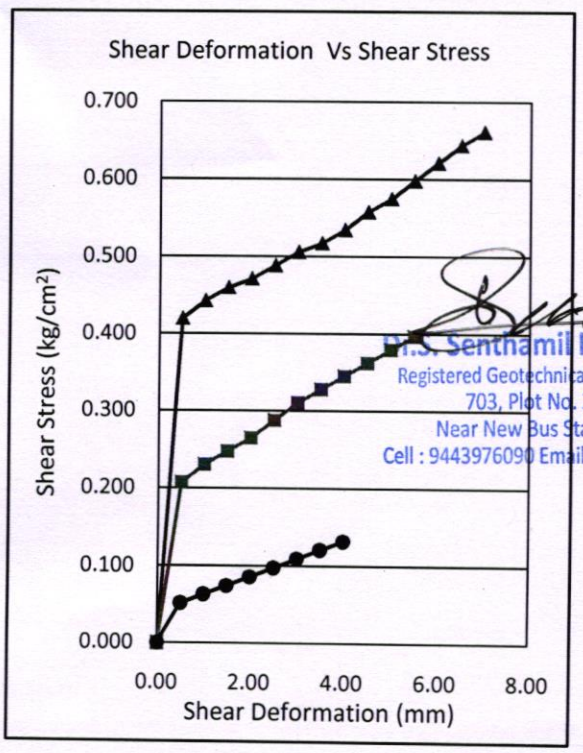
Normal Stress: 1 kg/cm^2

Horizontal Gauge Reading	Proving Ring Reading	Shear Deformation	Shear Stress (kg/cm^2)
0	0	0.00	0.000
50	36	0.50	0.207
100	40	1.00	0.230
150	43	1.50	0.247
200	46	2.00	0.264
250	50	2.50	0.287
300	54	3.00	0.310
350	57	3.50	0.328
400	60	4.00	0.345
450	63	4.50	0.362
500	66	5.00	0.379
550	69	5.50	0.397

Trial 3

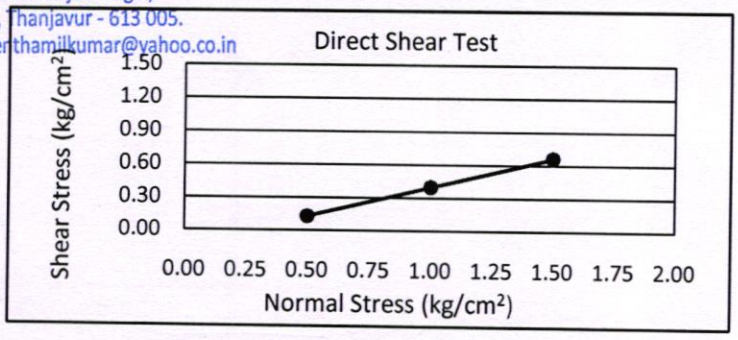
Normal Stress: 1.5 kg/cm^2

Horizontal Gauge Reading	Proving Ring Reading	Shear Deformation	Shear Stress (kg/cm^2)
0	0	0.00	0.000
50	73	0.50	0.420
100	77	1.00	0.443
150	80	1.50	0.460
200	82	2.00	0.471
250	85	2.50	0.489
300	88	3.00	0.506
350	90	3.50	0.517
400	93	4.00	0.535
450	97	4.50	0.558
500	100	5.00	0.575
550	104	5.50	0.598
600	108	6.00	0.621
650	112	6.50	0.644
700	115	7.00	0.661



Normal Stress (Kg/cm^2)	Proving Ring Reading at failure	Shear Stress (kg/cm^2)
0.50	23	0.132
1.00	69	0.397
1.50	115	0.661

Dr.S. Senthamil Kumar, ME,Ph.D,FIGS, MIEI
Registered Geotechnical Engineer - No. 001/RGTE/2021
703, Plot No. 29, O.M. Rajoo Nagar,
Near New Bus Stand, Thanjavur - 613 005.
Cell : 9443976090 Email : senthamilkumar@yahoo.co.in



$\emptyset = \tan^{-1} (0.661 - 0.132)$

Angle of Shearing Resistance ($\emptyset$) = 27.88 °



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



empowering your real estate decisions with smart tools

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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We're honored to be part of your real estate journey

3/350/2 Mettukuppam,
OMR Thoraipakkam,
Chennai, India

hello@verified.realestate
+91 9996 12 9996
www.verified.realestate