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(NABL accredited Laboratory as per ISO / IEC 17025-2017)

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SOIL INVESTIGATION REPORT

SOIL INVESTIGATION WORKS AND LABORATORY TESTING SERVICES FOR THE CONSTRUCTION OF **RESIDENTIAL BUILDING** **AT KARAIKUDI IN SIVAGANGAI DISTRICT.**

REPORT No: 71/ RB / GMC / 23-24	DATE : 22.06.2023	REV : 0

LOCATION : **SURVEY NO : 464,WARD NO.3,BLOCK NO.1,**
JAWAHAR STREET,
KARAIKUDI MUNICIPALITY, KARAIKUDI
DISTRICT : SIVAGANGAI

CLIENT : **Mr.N.SABARATHINAM,**
157/4,CHAIRMAN VELLAYAN STREET,
NEAR ST.MARY'S SCHOOL,DEVAKOTTAI-630302.

REPORT NO: 71/ RB /GMC/ 23-24 DATED: 22.06.2023

To

Mr.N.SABARATHINAM,

157/4,Chairman Vellayan Street,Near St.Mary'S School,Devakottai-630302.

Respected Sir,

Sub: Submission Soil investigation Report - Reg

Name of work: Conducting Sub soil investigation works for the Construction of **RESIDENTIAL BUILDING** at Karaikudi in Sivagangai District.

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We appreciate the opportunity of service to you on this project and trust this reports meet your needs at this time. This report summarizes the result of our investigation and contains geotechnical recommendations for design and construction of this project.

Based on the result of our geotechnical investigation, we believe that the proposed project is feasible from a geotechnical point of concern, provided the recommendations in this report are incorporated in the design and implemented during earthwork and construction of the project.

If you have any queries regarding this report, please contact us. We look forward to being of further assistance as construction begins.

No of Pages in this Report:

Respectfully submitted

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REPORT ON SUB-SOIL INVESTIGATION

1. INTRODUCTION:

Mr. N.SABARATHINAM, residing at 157/4,Chairman Vellayan Street, Near St.Mary'S School, Devakottai has proposed to construct a **RESIDENTIAL BUILDING** at Karaikudi in Sivagangai District. In order to get adequate data required for designing the foundations, he has conducted the sub-soil investigation and collects the samples to determine the foundation design parameters.

M/S.GEOMATRIX CONSULTANCY, Madurai, were entrusted with the work of conducting Sub-soil investigation, laboratory testing and preparing report with SBC Calculations and test results.

2. SCOPE OF WORK: The Scope of work includes the following:

- Making **three** boreholes of 150 mm dia using rotary driller to a depth of **10 m** or up to 1.00 m core drilling in hard rock whichever is met earlier.
- Conducting Standard penetration test as per **IS 2131-1981**(Reaffirmed 2002) at every **1.00 m /1.50m depth** intervals or change of soil strata and collecting disturbed /un disturbed soil samples.
- Conducting various laboratory tests on collected samples.
- Submitting recommendation for type and depth of foundation.
- Submitting report with SBC and settlement Calculations & laboratory test results in **two** hard copies.

3. LOCATION & DESCRIPTION OF STRUCTURE:

The proposed construction of **RESIDENTIAL BUILDING** located at **Survey No.464, Ward No.3,Block No.1,**Jawahar Street, Karaikudi Municiplaity, Karaikudi in Sivagangai District. As per the details issued by the client, the proposed construction is a RCC structure has **Stilt+3 floors** and the unit will be comprised reinforced concrete elements (Column, Beam, Slab & etc.).

4. SOIL INVESTIGATION:

The details of field investigation, tests carried out in the field & laboratory are presented as follows

4.1 FIELD SAMPLING: **Three** boreholes of 150 mm dia was made using Rotary drilling machine in this site on **22.06.2023.** SPT's was conducted at every 1.00 m / 1.50 m depth intervals and the disturbed and undisturbed samples were collected for identification and testing.

4.2 METHOD OF INVESTIGATION:

4.2.1 EXPLORATORY BORE HOLE:

Exploratory borehole was advanced using rotary washing method so that minimum disturbance is attributed to the soil below the boring depth. Borehole was always kept filled with drilling mud to prevent any negative hydrostatic pressure within the borehole. Boring through the soil was performed using TC bit & diamond drill bit with side jets for drilling mud. Standard penetration tests, disturbed sampling, field identification of soil & rock samples, etc., was carried out in these bore holes.

4.2.2 STANDARD PENETRATION TEST:

SPT was conducted at different depth in the borehole. SPT split spoon sampler of standard size was driven into the soil from borehole bottom using 63.5kg hammer falling from 75cm height. Blow counts for the penetration of every 15cm were recorded and the **N** is reported as the blow counts for 30cm penetration of the sampler leaving the first 15cm penetration as seating drive. SPT was conducted at a depth interval of 1.0m below the ground level.

4.2.3 SAMPLING IN BORE HOLES:

Soil collected in the SPT sampler is preserved in polythene covers and transported to laboratory. One more polythene cover was provided to prevent the loss of moisture during the transit period. Rock samples also collected using double tubes core Barrel and preserving in wooden core boxes and transported to laboratory to conduct various tests.

5. DESCRIPTION OF GROUND WATER TABLE:

Ground water table was not encountered at during investigation.

6. LABORATORY TESTS:

The collected soil samples were tested in **ISO 17025: 2017, NABL** Quality control Certified Laboratory as per relevant procedure in IS codes. The laboratory-testing scheme is so designed to obtain the design parameters for the foundations. The following parameters are evaluated:

- **Natural Moisture Content:** This test is conducted in all disturbed samples to find the water content in the soil samples as per **IS 2720 (Part 2) : 1973**
- **Specific Gravity:** This test is conducted in all disturbed soil samples to find Specific gravity of Soil as per **IS 2720 (Part 3) : 1980**
- **Sieve Analysis:** These test conducted to identify and classify the samples as per **IS 2720 (Part 4) : 1985**
- **Liquid Limit:** This test conducted in fine-grained soils to find the liquid Limit of the soil as per **IS 2720 (Part 5) : 1985**
- **Plastic Limit:** This test conducted in fine-grained soil to find plastic limit of the soil as per **IS 2720 (Part 5) : 1985**
- **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**
- **Unconfined Compression Test:** This test conducted in fine-grained soil to find Cohesion of the soil as per **IS 2720 (Part 10): 1991.** All the test results are presented in **Tables 1 to 3.**

7. DISCUSSION ON SOIL PROFILE:

Based on the field and Lab test results, it's concluded that,

In **BH-1** the sub soil profile consists of Red coloured **Gravel mixed with Sand** (0.00-1.04m) followed by **Soft Disintegrated Rock** (1.04-10.00m).In **BH-2** the sub soil profile consists of Red coloured **Gravel mixed with Sand** (0.00-1.06m) followed by **Soft Disintegrated Rock** (1.06-10.00m).In **BH-3** the sub soil profile consists of Red coloured **Gravel mixed with Sand** (0.00-1.04m) followed by **Soft Disintegrated Rock** (1.04-10.00m).The detailed Layer formations are presented in **Tables 1 to 3** and also in **Fig 2.**

8. ABSTRACT OF SBC CALCULATIONS: The summary of safe bearing capacity calculated is presented as follows:

BH No	Safe Bearing Capacity in kN / m2 at the depth of					
	1.50 m	1.80 m	2.10 m	2.40 m	2.70 m	3.00m
1	227.43	266.22	317.29	361.47	407.69	456.29
2	230.94	270.44	313.79	357.42	403.08	451.08
3	236.94	277.63	322.53	367.53	414.62	464.12
Recommended SBC in kN / m2	**227.00**	**266.00**	**313.00**	**357.00**	**403.00**	**451.00**

9. RECOMMENDATIONS: Based on the SBC and settlement calculations, site investigations the recommendations for foundation are as follows:

1) **ISOLATED COLUMN FOOTING** is recommended.
2) The recommended safe bearing capacities at every **0.30 m** interval from **1.50 m to 3.00 m** are presented above to design the foundation according to the load conditions and structural requirements.
3) For these Safe bearing capacity, the settlement also **within** the allowable limits (The SBC and Settlement calculations are presented at the end of this report)
4) Due to presence of Sand in the top layers, there are chances for **Soil sliding** occurs during earthwork excavation, Hence **proper precautions** will be followed during execution of foundation.
5) The foundation concrete shall be laid in dry condition if meets the water table during the execution.
6) The excavated soil for foundation is **suitable** for back filling.

Station: Madurai.

Date : 29.06.2023

LOCATION MAP

LOCATION :

SURVEY NO : 464,WARD NO.3,BLOCK

NO.1,JAWAHAR STREET,

KARAIKUDI MUNICIPALITY,KARAIKUDI

DISTRICT : SIVAGANGAI

GPS COORDINATES

BH-1 : N 10⁰ 04' 19.40", E 78⁰ 46' 19.74"

BH-2 : N 10⁰ 04' 19.42", E 78⁰ 46' 20.14"

BH-3 : N 10⁰ 04' 19.13", E 78⁰ 46' 20.33"

N

NOT TO SCALE

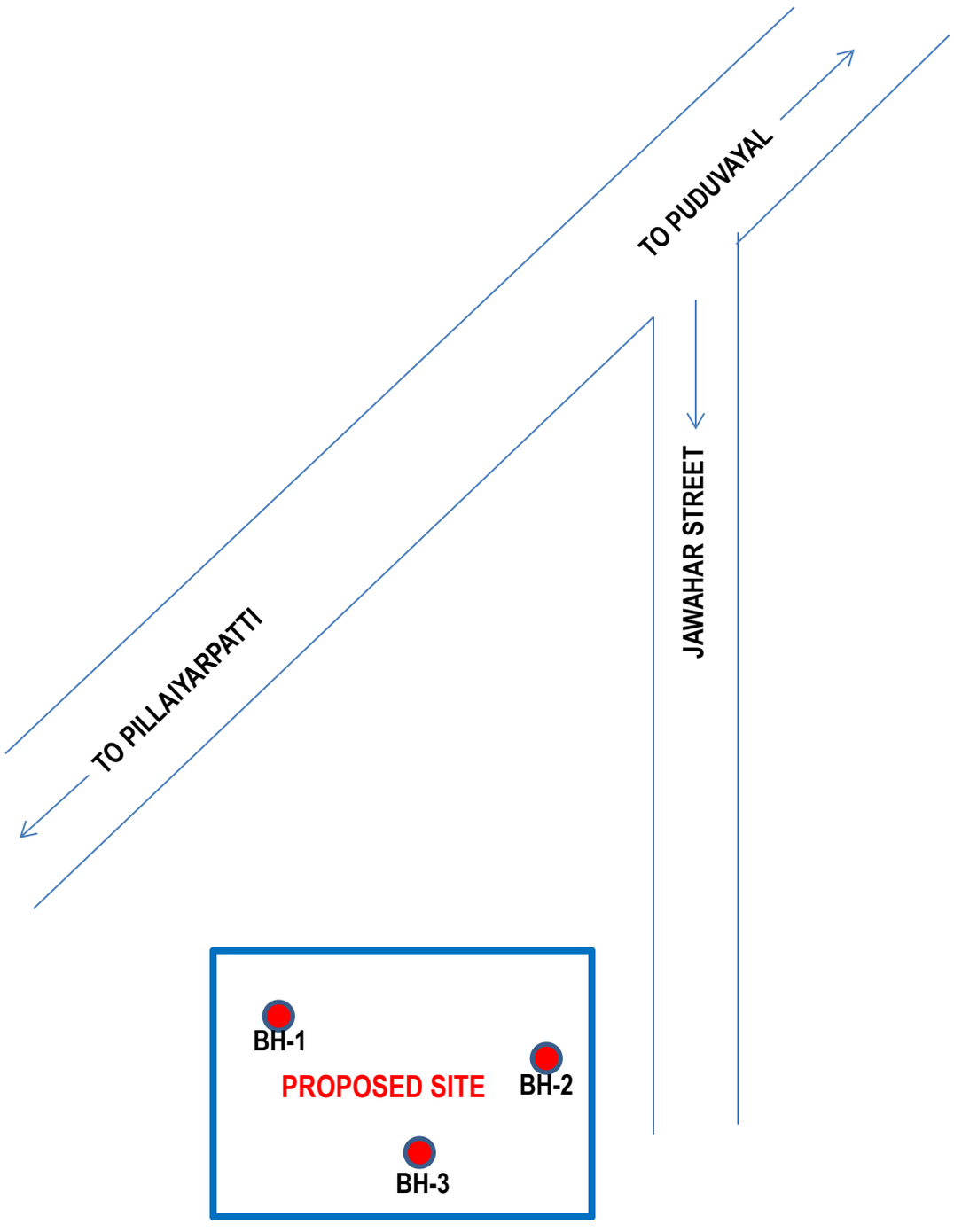


Fig 1 - PLAN SHOWING THE LOCATION OF BORE HOLES.

LEGEND :

— BORE HOLE LOCATION

PREPARED BY

GEOMATRIX CONSULTANCY

(An ISO- 17025 : 2017, NABL Certified Firm)

No.22, Thomas Street,

Narimedu, Madurai - 625 002.

TITLE OF PROJECT

CONSTRUCTION OF **RESIDENTIAL BUILDING** AT KARAIKUDI IN SIVAGANGAI DISTRICT.

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Geo-Tech Consultants & Engineers

Fig : 2A- VERTICAL SOIL PROFILE at BOREHOLE-1 LOCATION

Name of Project: Sub Soil Investigation for the Construction of RESIDENTIAL BUILDING at Karaikudi in Sivagangai District.

Report No	71/ RB/ 2023-24 Dt :22.06.2023	**Dia of Boring**	150 mm
Bore Hole No.	1	**Total depth**	10.00 m
Type of Boring	Rotary	**Depth of Water Table**	NOT ENCOUNTED
Started on	22.06.2023	**Co - ordinates**	N 10^0 04' 19.40"
Ended on	22.06.2023		E 78^0 46' 19.74"

BORELOG SHEET

Depth from Ground level	Soil Profiles	Description of Soil	Depth (m)	Type	15	30	45	N	Graphical Representation of SPT (N value) 0 10 20 30 40 50 60 70 80 90 100	Type of Samples
-1.00 m		Red coloured **Gravel mixed with Sand (filledup soil)**	1.00	SPT	4 cm for 50 blows			>100	100	DS
-1.04 m			1.04							
-2.00 m		**SOFT DISINTEGRATED ROCK (CR = 0%& RQD = 0%)**	2.00	SPT	6 cm for 50 blows			>100	100	WS
-3.00 m			3.00	SPT	4 cm for 50 blows			>100	100	WS
-4.00 m			4.00	SPT	2 cm for 50 blows			>100	100	WS
-5.50 m			5.50	SPT	SPT REBOUND (NO PENETRATION)			>100	100	WS
-7.00 m			7.00	SPT	SPT REBOUND (NO PENETRATION)			>100	100	WS
-8.50 m			8.50	SPT	SPT REBOUND (NO PENETRATION)			>100	100	WS
-10.00 m			10.00	SPT	SPT REBOUND (NO PENETRATION)			>100	100	WS

DS - Disturbed soil sample

WS -Washing Sample

CR = Core Recovary

RQD = Rock Quality Designation

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Fig : 2B- VERTICAL SOIL PROFILE at BOREHOLE-2 LOCATION

Name of Project: Sub Soil Investigation for the Construction of RESIDENTIAL BUILDING at Karaikudi in Sivagangai District.

Report No	71/ RB/ 2023-24 Dt :22.06.2023	**Dia of Boring**	150 mm
Bore Hole No.	2	**Total depth**	10.00 m
Type of Boring	Rotary	**Depth of Water Table**	NOT ENCOUNTED
Started on	22.06.2023	**Co - ordinates**	N 10° 04' 19.42"
Ended on	22.06.2023		E 78° 46' 20.14"

BORELOG SHEET

Depth from Ground level	Soil Profiles	Description of Soil	Depth (m)	Type	15	30	45	N	Graphical Representation of SPT (N value) 0 10 20 30 40 50 60 70 80 90 100	Type of Samples
-1.00 m		Red coloured **Gravel mixed with Sand (filledup soil)**	1.00	SPT	6 cm for 50 blows			>100	100	DS
-1.06 m			1.06							
-2.00 m		**SOFT DISINTEGRATED ROCK (CR = 0%& RQD = 0%)**	2.00	SPT	5 cm for 50 blows			>100	100	WS
-3.00 m			3.00	SPT	2 cm for 50 blows			>100	100	WS
-4.00 m			4.00	SPT	1 cm for 50 blows			>100	100	WS
-5.50 m			5.50	SPT	SPT REBOUND (NO PENETRATION)			>100	100	WS
-7.00 m			7.00	SPT	SPT REBOUND (NO PENETRATION)			>100	100	WS
-8.50 m			8.50	SPT	SPT REBOUND (NO PENETRATION)			>100	100	WS
-10.00 m			10.00	SPT	SPT REBOUND (NO PENETRATION)			>100	100	WS

DS - Disturbed soil sample

WS -Washing Sample

CR = Core Recovary

RQD = Rock Quality Designation

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Fig : 2B- VERTICAL SOIL PROFILE at BOREHOLE-2 LOCATION

Name of Project: Sub Soil Investigation for the Construction of RESIDENTIAL BUILDING at Karaikudi in Sivagangai District.

Report No	71/ RB/ 2023-24 Dt :22.06.2023	**Dia of Boring**	150 mm
Bore Hole No.	3	**Total depth**	10.00 m
Type of Boring	Rotary	**Depth of Water Table**	NOT ENCOUNTED
Started on	22.06.2023	**Co - ordinates**	N 10^0 04' 19.13"
Ended on	22.06.2023		E 78^0 46' 20.33"

BORELOG SHEET

Depth from Ground level	Soil Profiles	Description of Soil	Depth (m)	Type	15	30	45	N	Graphical Representation of SPT (N value)	Type of Samples
-1.00 m		Red coloured **Gravel mixed with Sand (filledup soil)**	1.00	SPT	4 cm for 50 blows			>100	100	DS
-1.04 m			1.04							
-2.00 m		**SOFT DISINTEGRATED ROCK (CR = 0%& RQD = 0%)**	2.00	SPT	2 cm for 50 blows			>100	100	WS
-3.00 m			3.00	SPT	1 cm for 50 blows			>100	100	WS
-4.00 m			4.00	SPT	SPT REBOUND (NO PENETRATION)			>100	100	WS
-5.50 m			5.50	SPT	SPT REBOUND (NO PENETRATION)			>100	100	WS
-7.00 m			7.00	SPT	SPT REBOUND (NO PENETRATION)			>100	100	WS
-8.50 m			8.50	SPT	SPT REBOUND (NO PENETRATION)			>100	100	WS
-10.00 m			10.00	SPT	SPT REBOUND (NO PENETRATION)			>100	100	WS

DS - Disturbed soil sample

WS -Washing Sample

CR = Core Recovary

RQD = Rock Quality Designation

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SUMMARY OF LAB TEST RESULTS

Report No:71/ RB/ 2023-24 Dt :22.06.2023

Name of Project: Sub Soil Investigation for the Construction of RESIDENTIAL BUILDING at Karaikudi in Sivagangai District.

TABLE-1

BH No : 1

Depth of soil (m)		Soil Description	Type of sample collected	IS Classification	Grain Size Analysis (%)					NMC	Index Properties (%)			Bulk Density (KN/m^3) γ_w	Dry Density (KN/m^3) γ_d	Porosity (%) n	Voids ratio (%) e	Specific Gravity	Cohesion "C" in (Kg/cm^2)	Angle of friction (ø)
From	To				Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt & Clay		Liquid Limit (W_L)	Plastic Limit (W_P)	Plasticity Index (I_P)							
0.00	1.04	Red coloured **Gravel mixed with Sand**	DS	GW	46.66	7.91	19.71	22.90	2.82	4	NP	NP	NP	18.21	17.51	0.35	0.53	2.68	0.00	34.00
1.04	2.00	**Sand mixed with Gravel (Pieces of Soft Disintegrated Rock)**	WS	SW	36.02	7.94	28.33	27.71	0.00	19	NP	NP	NP	19.36	16.27	0.39	0.64	2.66	0.00	36.00
2.00	3.00	**Gravel mixed with Sand (Pieces of Soft Disintegrated Rock)**	WS	GW	64.88	9.87	16.78	8.47	0.00	14	NP	NP	NP	19.42	17.04	0.36	0.56	2.65	0.00	36.00
3.00	4.00	**Gravel mixed with Sand (Pieces of Soft Disintegrated Rock)**	WS	GW	78.81	7.20	8.98	5.01	0.00	13	NP	NP	NP	19.45	17.21	0.36	0.55	2.67	0.00	36.00
4.00	5.50	**Gravel mixed with Sand (Pieces of Soft Disintegrated Rock)**	WS	GW	73.27	13.26	10.71	2.76	0.00	13	NP	NP	NP	19.63	17.37	0.35	0.55	2.69	0.00	36.00
5.50	7.00	**Gravel mixed with Sand (Pieces of Soft Disintegrated Rock)**	WS	GW	73.37	12.60	11.02	3.01	0.00	12	NP	NP	NP	19.78	17.66	0.34	0.52	2.68	0.00	37.00
7.00	8.50	**Gravel mixed with Sand (Pieces of Soft Disintegrated Rock)**	WS	GW	82.33	7.31	7.78	2.58	0.00	11	NP	NP	NP	19.82	17.86	0.33	0.49	2.66	0.00	38.00
8.50	10.00	**Gravel mixed with Sand (Pieces of Soft Disintegrated Rock)**	WS	GW	84.69	5.18	7.20	2.93	0.00	11	NP	NP	NP	19.93	17.95	0.33	0.49	2.67	0.00	21.00

DS = Disturbed Sample NMC = Natural Moisture Content NP = Non Plastic WS= Washing Sample

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SUMMARY OF LAB TEST RESULTS

Report No:71/ RB/ 2023-24 Dt :22.06.2023

Name of Project: Sub Soil Investigation for the Construction of RESIDENTIAL BUILDING at Karaikudi in Sivagangai District.

TABLE-2

BH No : 2

Depth of soil (m)		Soil Description	Type of sample collected	IS Classification	Grain Size Analysis (%)					NMC	Index Properties (%)			Bulk Density (KN/m^3) γ_w	Dry Density (KN/m^3) γ_d	Porosity (%) n	Voids ratio (%) e	Specific Gravity	Cohesion "C" in (Kg/cm^2)	Angle of friction (ø)
From	To				Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt & Clay		Liquid Limit (W_L)	Plastic Limit (W_P)	Plasticity Index (I_P)							
0.00	1.06	Red coloured **Gravel mixed with Sand**	DS	GW	21.03	4.99	36.00	30.34	7.64	5	NP	NP	NP	18.19	17.32	0.35	0.55	2.68	0.00	34.00
1.06	2.00	**Gravel mixed with Sand (Pieces of Soft Disintegrated Rock)**	WS	GW	64.03	13.21	14.17	8.59	0.00	11	NP	NP	NP	19.23	17.32	0.35	0.53	2.65	0.00	36.00
2.00	3.00	**Sand mixed with Gravel (Pieces of Soft Disintegrated Rock)**	WS	SW	49.93	37.20	11.34	1.53	0.00	7	NP	NP	NP	19.30	18.04	0.33	0.49	2.68	0.00	36.00
3.00	4.00	**Sand mixed with Gravel (Pieces of Soft Disintegrated Rock)**	WS	SW	44.53	39.29	13.19	2.52	0.47	8	NP	NP	NP	19.36	17.93	0.33	0.48	2.66	0.00	36.00
4.00	5.50	**Gravel mixed with Sand (Pieces of Soft Disintegrated Rock)**	WS	GW	59.84	31.20	7.86	1.10	0.00	8	NP	NP	NP	19.42	17.98	0.33	0.50	2.69	0.00	37.00
5.50	7.00	**Gravel mixed with Sand (Pieces of Soft Disintegrated Rock)**	WS	GW	59.13	31.11	8.38	1.38	0.00	9	NP	NP	NP	19.45	17.84	0.33	0.50	2.68	0.00	37.00
7.00	8.50	**Sand mixed with Gravel (Pieces of Soft Disintegrated Rock)**	WS	SW	48.85	35.87	13.30	1.98	0.00	8	NP	NP	NP	19.53	18.08	0.32	0.48	2.67	0.00	38.00
8.50	10.00	**Gravel mixed with Sand (Pieces of Soft Disintegrated Rock)**	WS	GW	53.46	38.78	7.29	0.47	0.00	5	NP	NP	NP	19.58	18.65	0.30	0.43	2.66	0.00	38.00

DS = Disturbed Sample NMC = Natural Moisture Content NP = Non Plastic WS= Washing Sample

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SUMMARY OF LAB TEST RESULTS

Report No:71/ RB/ 2023-24 Dt :22.06.2023

Name of Project: Sub Soil Investigation for the Construction of RESIDENTIAL BUILDING at Karaikudi in Sivagangai District.

TABLE-3

BH No : 3

Depth of soil (m)		Soil Description	Type of sample collected	IS Classification	Grain Size Analysis (%)					NMC	Index Properties (%)			Bulk Density (KN/m^3) γ_w	Dry Density (KN/m^3) γ_d	Porosity (%) n	Voids ratio (%) e	Specific Gravity	Cohesion "C" in (Kg/cm^2)	Angle of friction (ø)
From	To				Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt & Clay		Liquid Limit (W_L)	Plastic Limit (W_P)	Plasticity Index (I_P)							
0.00	1.04	Red coloured **Gravel mixed with Sand**	DS	GW	35.39	5.38	19.58	19.54	20.11	5	28.23	18.34	9.89	18.44	17.56	0.34	0.53	2.68	0.15	28.00
1.04	2.00	**Sand mixed with Gravel (Pieces of Soft Disintegrated Rock)**	DS	SW	48.99	23.98	19.51	7.52	0.00	11	NP	NP	NP	19.52	17.59	0.34	0.51	2.65	0.00	36.00
2.00	3.00	**Sand mixed with Gravel (Pieces of Soft Disintegrated Rock)**	WS	SW	35.03	33.19	26.52	5.26	0.00	13	NP	NP	NP	19.60	17.35	0.35	0.54	2.67	0.00	36.00
3.00	4.00	**Sand mixed with Gravel (Pieces of Soft Disintegrated Rock)**	WS	SW	46.81	36.30	14.60	2.29	0.00	7	NP	NP	NP	19.64	18.36	0.31	0.45	2.66	0.00	36.00
4.00	5.50	**Gravel mixed with Sand (Pieces of Soft Disintegrated Rock)**	WS	GW	52.13	28.87	15.32	3.68	0.00	8	NP	NP	NP	19.70	18.24	0.32	0.47	2.68	0.00	37.00
5.50	7.00	**Gravel mixed with Sand (Pieces of Soft Disintegrated Rock)**	WS	GW	61.21	20.89	13.55	4.35	0.00	8	NP	NP	NP	19.74	18.28	0.31	0.46	2.66	0.00	37.00
7.00	8.50	**Sand mixed with Gravel (Pieces of Soft Disintegrated Rock)**	WS	SW	23.68	47.07	28.15	1.10	0.00	7	NP	NP	NP	19.81	18.51	0.31	0.45	2.69	0.00	38.00
8.50	10.00	**Sand mixed with Gravel (Pieces of Soft Disintegrated Rock)**	WS	SW	23.27	51.64	24.32	0.77	0.00	5	NP	NP	NP	19.86	18.91	0.29	0.42	2.68	0.00	38.00

DS = Disturbed Sample NMC = Natural Moisture Content NP = Non Plastic WS= Washing Sample

GEOMATRIX CONSULTANCY
Geo-Tech. Consultants & Engineers

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

Report No:71/ RB/ 2023-24 Dt :22.06.2023

ANNEXURE - A

Name of Project: **Sub Soil Investigation for the Construction of RESIDENTIAL BUILDING at Karaikudi in Sivagangai District.**

BH. No	**3**		**3**		**3**	
Depth (m)	**0.50 m**		**1.00 m**		**2.00 m**	
Wt of Tare (W) gm	58.13	59.87	67.53	68.97	68.36	69.97
Tare + Wet Soil (W_1) gm	369.94	370.59	316.13	317.59	316.68	317.76
Tare + Dry Soil (W_2) gm	354.67	355.82	292.13	293.66	288.47	289.64
Wt of Water ($W_3 = W_1-W_2$) gm	15.27	14.77	24.00	23.93	28.21	28.12
Wt Dry Soil ($W_4 = W_2-W$) gm	296.54	295.95	224.60	224.69	220.11	219.67
Water Content (%) = (W_3 / W_4)*100	5.15	4.99	10.69	10.65	12.82	12.80
Average Water Content (%)	**5**		**11**		**13**	

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SPECIFIC GRAVITY TEST
(Test method as per IS 2720 (Part 3) - 1980)

Report No:71/ RB/ 2023-24 Dt :22.06.2023

ANNEXURE - B

Name of Project: Sub Soil Investigation for the Construction of RESIDENTIAL BUILDING at Karaikudi in Sivagangai District.

BH. No	**3**		**3**		**3**	
Depth (m)	**0.50 m**		**1.00 m**		**2.00 m**	
Bottle Number	1	2	1	2	1	2
Weight of empty Bottle (w_1) gm	55.49	55.49	55.49	55.49	55.49	55.49
Weight of bottle + Sample (w_2) gm	84.30	85.79	85.92	86.94	95.14	96.38
Weight of bottle + Sample + Water (w_3)gm	167.84	169.81	168.73	170.72	174.60	175.70
Weight of bottle + Water (w_4) gm	149.80	150.80	149.80	151.16	149.80	150.11
Specific Gravity = $(w_2 - w_1)/ (w_4 - w_1)-(w_3 - w_2)$	2.68	2.68	2.65	2.65	2.67	2.67
Average value for Specific Gravity	**2.68**		**2.65**		**2.67**	

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Report No:71/ RB/ 2023-24 Dt :22.06.2023

ANNEXURE - C

GRAIN SIZE ANALYSIS TEST

(Test method as per IS 2720 (Part 4) - 1985)

Name of Project: **Sub Soil Investigation for the Construction of RESIDENTIAL BUILDING at Karaikudi in Sivagangai District.**

Weight of Soil taken for analysis **Ws** : 100.00 g

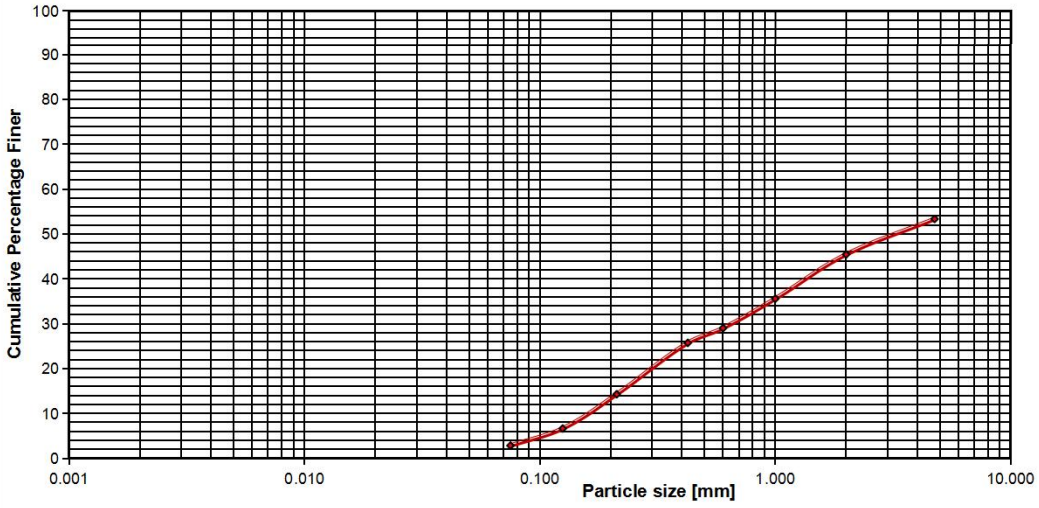
Weight of Soil more than 0.075mm IS Sieve : 97.18 g

Bore Hole No	1
Depth (m)	0.50 m

S.No.	Size of sieves	% Soil PSR % (1)	Cumulative % F % (2)	Average Sieve size (mm) (3)	Product of Columns (1) x (3)
1	4.750	46.66	53.34	4.750	221.64
2	2.000	7.91	45.43	3.375	26.70
3	1.000	9.86	35.57	1.500	14.79
4	0.600	6.56	29.01	0.800	5.25
5	0.425	3.29	25.72	0.513	1.69
6	0.212	11.45	14.27	0.319	3.65
7	0.125	7.64	6.63	0.181	1.38
8	0.075	3.81	2.82	0.113	0.43
9	passing 0.075				275.514

Average Particle Diameter = 2.8699

Clay	Silt			Sand			Gravel
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine



Soil description :Gravel mixed with Sand

Based on Gradation Curve, the following sizes of Material (as per **IS 1498 - 1970**) are obtained

Classification of soil	%
Gravel	46.66
Course Sand	7.91
Medium Sand	19.71
Fine Sand	22.90
Silt & Clay	2.82

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ANNEXURE - D

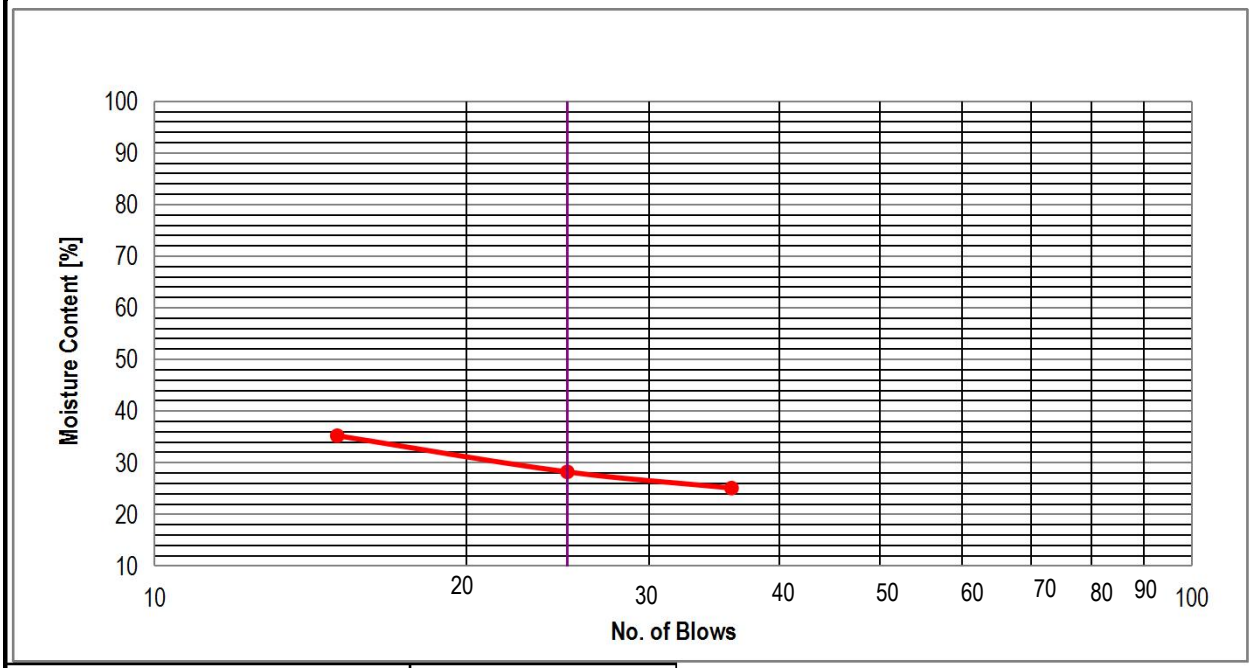
LIQUID LIMIT & PLASTIC LIMIT TEST

(Test method As per IS 2720 (Part 5) - 1985)

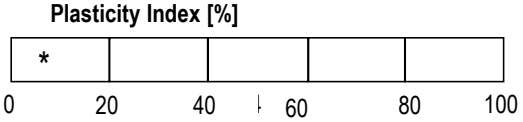
Name of Project: Sub Soil Investigation for the Construction of RESIDENTIAL BUILDING at Karaikudi in Sivagangai District.

Report No	71/ RB/ 2023-24 Dt :22.06.2023
Borehole No	3
Depth	0.50 m

Description			Liquid Limit			Plastic Limit	
No. of Blows	N		15	25	36		
Weight of Wet Specimen + Container	WSC	g	75.03	75.84	75.32	71.69	72.08
Weight of Dry Specimen + Container	WDC	g	72.31	73.48	73.22	70.66	71.10
Weight of Container	WC	g	64.59	65.12	64.85	65.02	65.78
Weight of Water	WW	g	2.72	2.36	2.10	1.03	0.98
Weight of Dry Specimen	WD	g	7.72	8.36	8.37	5.64	5.32
Moisture Content	W	%	35.23	28.23	25.09	18.26	18.42



Liquid Limit	W_L	:	28.23 %
Plastic Limit	W_P	:	18.34 %
Plasticity Index	I_P	:	9.89 %



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Report No:71/ RB/ 2023-24 Dt :22.06.2023

DIRECT SHEAR TEST
(Test method As per IS 2720 (Part 13) - 1986)

ANNEXURE: E

Name of Project: Sub Soil Investigation for the Construction of RESIDENTIAL BUILDING at Karaikudi in Sivagangai District.

Borehole No	3
Depth (m)	1.50 m
Date of Test	28.06.2023

L.C of Dial gauge	:	0.01
Proving Ring Constant	:	0.81421
Area of the Specimen	:	36

Trail-1
Normal Stress:0.5 kg/cm^2

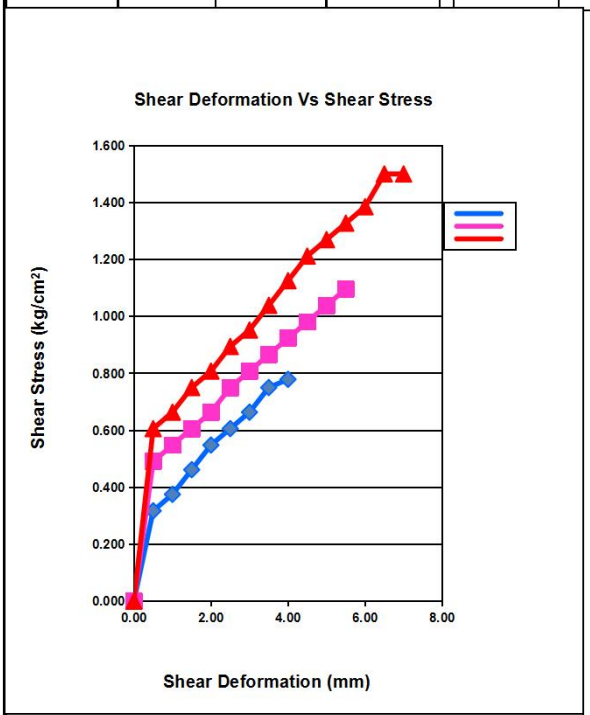
Horizontal Gauge Reading	Proving Ring Reading	Shear deformation	Shear Stress (kg/Cm^2)
0	0	0.00	0.000
50	14.031	0.50	0.317
100	16.5821	1.00	0.375
150	20.4088	1.50	0.462
200	24.2354	2.00	0.548
250	26.7865	2.50	0.606
300	29.3376	3.00	0.664
350	33.1642	3.50	0.750
400	34.4398	4.00	0.779

Trail-2
Normal Stress:1.0 kg/cm^2

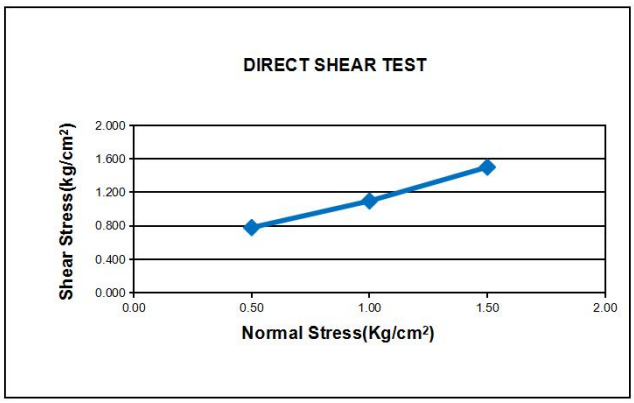
Horizontal Gauge Reading	Proving Ring Reading	Shear deformation	Shear Stress (kg/Cm^2)
0	0	0.00	0.000
50	21.6843	0.50	0.490
100	24.2354	1.00	0.548
150	26.7865	1.50	0.606
200	29.3376	2.00	0.664
250	33.1642	2.50	0.750
300	35.7153	3.00	0.808
350	38.2664	3.50	0.865
400	40.8175	4.00	0.923
450	43.3686	4.50	0.981
500	45.9197	5.00	1.039
550	48.4708	5.50	1.096

Trail-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	26.7865	0.50	0.606
100	29.3376	1.00	0.664
150	33.1642	1.50	0.750
200	35.7153	2.00	0.808
250	39.542	2.50	0.894
300	42.093	3.00	0.952
350	45.9197	3.50	1.039
400	49.7463	4.00	1.125
450	53.573	4.50	1.212
500	56.1241	5.00	1.269
550	58.6752	5.50	1.327
600	61.2263	6.00	1.385
650	66.3284	6.50	1.500
700	66.3284	7.00	1.500



Normal Stress (kg/cm^2)	Proving Ring reading at failure	Shear Stress (kg/cm^2)
0.50	34.43976703	0.779
1.00	48.47078323	1.096
1.50	66.32844021	1.500



1. Angle of Shearing Resistance (Φ) : 36 Degrees
2. Cohesion (C) : 0.00 Kg/cm^2

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Report No:71/ RB/ 2023-24 Dt :22.06.2023

ANNEXURE - F

DENSITY CALCULATIONS

Name of Project: Sub Soil Investigation for the Construction of RESIDENTIAL BUILDING at Karaikudi in Sivagangai District.

Bore Hole No	1
Depth (m)	0.50

Sl. No.	Description	Reading
1	Weight of Empty Box (gm)	3,393.00
2	Weight of Box + Soil (gm)	3,556.90
3	Weight of Soil (gm)	163.90
4	Volume of Box (cm^3)	90.00
5	Bulk Density (gm /cm^3)	1.821
6	Weight of Container (gm)	43.98
7	Weight of Container + Wet Soil (gm)	64.58
8	Weight of Container + Dry Soil (gm)	62.60
9	Moisture Content (%)	10.63
10	Dry Density (gm /cm^3)	1.646

RESULT

1 WET DENSITY OF SOIL = 1.821 t / m^3

2 DRY DENSITY OF SOIL = 1.646 t / m^3

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Report No:71/ RB/ 2023-24 Dt :22.06.2023

ANNEXURE - G

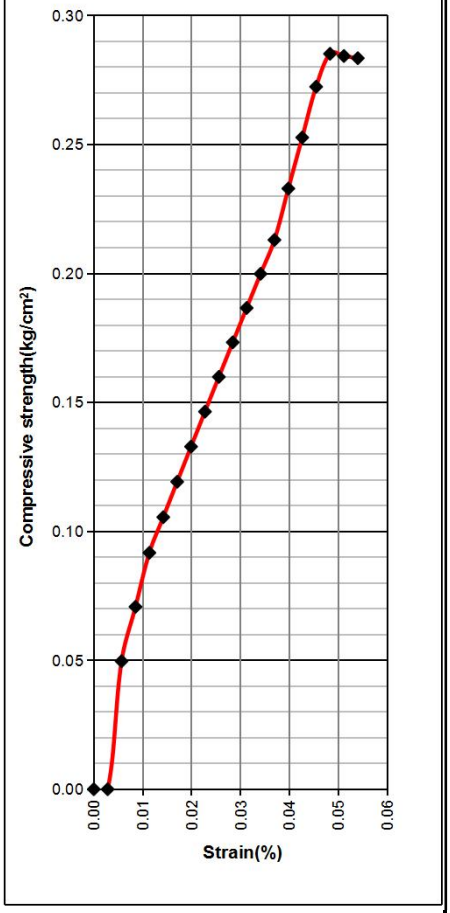
UNCONFINED COMPRESSION TEST
(Test method as per IS 2720 (Part 10) - 1995)

Name of Project: Sub Soil Investigation for the Construction of RESIDENTIAL BUILDING at Karaikudi in Sivagangai District.

Diameter	38 mm
Length	88 mm
Constant	0.31530

Bore Hole No	3
Depth (m)	0.50 m
Date of Test	28.06.2023

Deformation dial Reading	Axial deformation (mm)	Axial Strain (e)	Area (cm^2)	Proving Ring Readings	Axial force N (Kgf)	Compressive strength (kg/cm^2)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0.00	0.00	0.00	11.35	0.00	0.000	0.00
25.00	0.25	0.00	11.38	0.00	0.000	0.00
50.00	0.50	0.01	11.41	1.80	0.567	0.05
75.00	0.75	0.01	11.45	2.57	0.810	0.07
100.00	1.00	0.01	11.48	3.34	1.053	0.09
125.00	1.25	0.01	11.51	3.85	1.215	0.11
150.00	1.50	0.02	11.55	4.37	1.377	0.12
175.00	1.75	0.02	11.58	4.88	1.539	0.13
200.00	2.00	0.02	11.61	5.39	1.700	0.15
225.00	2.25	0.03	11.65	5.91	1.862	0.16
250.00	2.50	0.03	11.68	6.42	2.024	0.17
275.00	2.75	0.03	11.72	6.93	2.186	0.19
300.00	3.00	0.03	11.75	7.45	2.348	0.20
325.00	3.25	0.04	11.79	7.96	2.510	0.21
350.00	3.50	0.04	11.82	8.73	2.753	0.23
375.00	3.75	0.04	11.86	9.50	2.996	0.25
400.00	4.00	0.05	11.89	10.27	3.239	0.27
425.00	4.25	0.05	11.93	10.79	3.401	0.29
450.00	4.50	0.05	11.96	10.79	3.401	0.28
475.00	4.75	0.05	12.00	10.79	3.401	0.28



RESULTS			
qu	=	0.285	kg/cm^2
Cohesion = C =		0.150	kg/cm^2

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Name of Project: **Sub Soil Investigation for the Construction of RESIDENTIAL BUILDING at Karaikudi in Sivagangai District.**

Report No:71/ RB/ 2023-24	BH NO : 1	CALCULATION - 1

SAFE BEARING CAPACITY CALCULATIONS on SHALLOW FOUNDATIONS

TYPE OF FOOTING : SQUARE FOOTING

Length of footing	(Assumed Value)	L =	**1.50**	m
Breadth of footing	(Assumed Value)	B =	**1.50**	m
Foundation depth		D_f =	**3.00**	m
Correction Factor for Water Table		W' =	**0.50**	
Unit weight of soil		γ_{soil} =	**1.942**	T/m^3
Cohension		"C" =	**0.00**	T/m^2
Angle of shearing resistance(general shear)	φ =		**36.00°**	
Angle of shearing resistance(Local shear)	φ' =		**25.77°**	(Tan^{-1} (2/3 * tanφ)
Safety factor		F =	**3.00**	
Effective Surcharge of Soil above Footing Base		q =	**2.83**	T/m^2

Type of soil = **Soft Disintegrated Rock**

Mode of failure = **Combined (GSF & LSF) Shear Failure**

Ground Water Table level (Assumed for worst Case - at the Ground level) = **0** m From NGL

The Bearing Capacity Factors are Given by the following equations

For GENERAL SHEAR FAILURE

$Nq = \tan^2 (45° + Ø/2) (e^{\pi \tan Ø})$ = 37.75

$Nc = (Nq - 1) \cot Ø$ = 50.59

$N\gamma = 2 (Nq + 1) \tan Ø$ = 56.31

For LOCAL SHEAR FAILURE

$N'q = \tan^2 (45° + Ø'/2) (e^{\pi \tan Ø'})$ = 11.57

$N'c = (Nq - 1) \cot Ø'$ = 21.89

$N'\gamma = 2 (Nq + 1) \tan Ø'$ = 12.13

The Shape Factors

Shape of Footing	S_c	S_q	S_γ
CONTINUOUS STRIP FOOTING	1.0	1.0	1.0
SQUARE FOOTING	1.3	1.2	0.8
RECTANGULAR FOOTING	1+0.2B/L	1+0.2B/L	1-0.4B/L

SQUARE FOOTING	
S_c =	1.300
S_q =	1.200
S_γ =	0.800

The Depth Factor

d_c =	1 + 0.2 D_f / B x tan (45° + Ø'/2) =	1.785
$d_q = d_\gamma$ =	1 for Ø'<10° =	1.000
$d_q = d_\gamma$ =	1+0.1D_f/Bxtan(45°+Ø'/2) for Ø'>10° =	1.393

The Inclination Factor

$i_c = i_q$ = 1 - α /90)^2 = 1.00 i_γ = 1 - α / Ø)^2 1.00

α = Inclination of the load to the vertical in degress = **0**

Net Ultimate Bearing Capacity, **qd** = ((cxNcxScxdcxic) + (qx(Nq -1)xSqxDqxIq) + (0.5xBxγxNγxSγxDγxIγxW')+ (2/3) (cxN'cxScxdcxic) + (qx(N'q -1)xSqxDqxIq) + (0.5xBxγxN'γxSγxDγxIγxW'))/"2

= **139.54** **T/sq.m**

SAFE BEARING CAPACITY :

SBC = qd / F.s = **46.51 T/sq.m** or **456.29 kN/m^2**

SETTLEMENT CALCULATIONS AS PER IS-8009-(part-1) 1998

Q_s = Pressure, S_i = Immediate settlement I = Influence factor

B = width of foundation μ = Poisson's ratio E_s= Elastic Modulus

For,

Soft Disintegrated Rock

E_s= 136200 kN/m^2

(or) E_s= 13620.00 t/m^2

S_i = Immediate settlement = I*Qs*B(1-μ^2) / Es

= 0.95*46.51*(1.5*(1-0.25^2))/13620

S_i= 0.0046 m

0.0046 x1000

Settlement = **5 mm** < **50 mm** **Hence SAFE**

The Max Allowable Differential Settlement for **Sand & Gravel is 50mm** and for **Silt & Clay is 75mm.**

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Name of Project: **Sub Soil Investigation for the Construction of RESIDENTIAL BUILDING at Karaikudi in Sivagangai District.**

Report No:71/ RB/ 2023-24	BH NO : 2	CALCULATION - 2

SAFE BEARING CAPACITY CALCULATIONS on SHALLOW FOUNDATIONS

TYPE OF FOOTING : SQUARE FOOTING

Length of footing	(Assumed Value)	L =	**1.50**	m
Breadth of footing	(Assumed Value)	B =	**1.50**	m
Foundation depth		D_f =	**3.00**	m
Correction Factor for Water Table		W' =	**0.50**	
Unit weight of soil		γ_{soil} =	**1.930**	T/m^3
Cohension		"C" =	**0.00**	T/m^2
Angle of shearing resistance(general shear)	φ =		**36.00°**	
Angle of shearing resistance(Local shear)	φ' =		**25.77°**	(Tan^{-1} (2/3 * tanφ)
Safety factor		F =	**3.00**	
Effective Surcharge of Soil above Footing Base		q =	**2.79**	T/m^2

Type of soil = **Soft Disintegrated Rock**

Mode of failure = **Combined (GSF & LSF) Shear Failure**

Ground Water Table level (Assumed for worst Case - at the Ground level) = **0** m From NGL

The Bearing Capacity Factors are Given by the following equations

For GENERAL SHEAR FAILURE

$Nq = \tan^2 (45° + Ø/2) (e^{\pi \tan Ø})$ = 37.75

$Nc = (Nq - 1) \cot Ø$ = 50.59

$N\gamma = 2 (Nq + 1) \tan Ø$ = 56.31

For LOCAL SHEAR FAILURE

$N'q = \tan^2 (45° + Ø'/2) (e^{\pi \tan Ø'})$ = 11.57

$N'c = (Nq - 1) \cot Ø'$ = 21.89

$N'\gamma = 2 (Nq + 1) \tan Ø'$ = 12.13

The Shape Factors

Shape of Footing	S_c	S_q	S_γ
CONTINUOUS STRIP FOOTING	1.0	1.0	1.0
SQUARE FOOTING	1.3	1.2	0.8
RECTANGULAR FOOTING	1+0.2B/L	1+0.2B/L	1-0.4B/L

SQUARE FOOTING	
S_c =	1.300
S_q =	1.200
S_γ =	0.800

The Depth Factor

d_c =	1 + 0.2 D_f / B x tan (45° + Ø'/2) =	1.785
$d_q = d_\gamma$ =	1 for Ø'<10° =	1.000
$d_q = d_\gamma$ =	1+0.1D_f/Bxtan(45°+Ø'/2) for Ø'>10° =	1.393

The Inclination Factor

$i_c = i_q$ = 1 - α /90)^2 = 1.00 i_γ = 1 - α / Ø)^2 1.00

α = Inclination of the load to the vertical in degress = **0**

Net Ultimate Bearing Capacity, **qd** = ((cxNcxScxdcxic) + (qx(Nq -1)xSqxDqxIq) + (0.5xBxγxNγxSγxDγxIγxW')+ (2/3) (cxN'cxScxdcxic) + (qx(N'q -1)xSqxDqxIq) + (0.5xBxγxN'γxSγxDγxIγxW'))/"2

= **137.94** **T/sq.m**

SAFE BEARING CAPACITY :

SBC = qd / F.s = **45.98 T/sq.m** or **451.08 kN/m^2**

SETTLEMENT CALCULATIONS AS PER IS-8009-(part-1) 1998

Q_s = Pressure, S_i = Immediate settlement I = Influence factor

B = width of foundation μ = Poisson's ratio E_s= Elastic Modulus

For,

Soft Disintegrated Rock

E_s= 136200 kN/m^2

(or) E_s= 13620.00 t/m^2

S_i = Immediate settlement = I*Qs*B(1-μ^2) / Es

= 0.95*45.98*(1.5*(1-0.25^2))/13620

S_i= 0.0045 m

0.0045 x1000

Settlement = **5 mm** < **50 mm** **Hence SAFE**

The Max Allowable Differential Settlement for **Sand & Gravel is 50mm** and for **Silt & Clay is 75mm.**

GEOMATRIX CONSULTANCY

Geo-Tech. Consultants & Engineers

Name of Project: **Sub Soil Investigation for the Construction of RESIDENTIAL BUILDING at Karaikudi in Sivagangai District.**

Report No:71/ RB/ 2023-24	BH NO : 3	CALCULATION - 3

SAFE BEARING CAPACITY CALCULATIONS on SHALLOW FOUNDATIONS

TYPE OF FOOTING : SQUARE FOOTING

Length of footing	(Assumed Value)	L =	**1.50**	m
Breadth of footing	(Assumed Value)	B =	**1.50**	m
Foundation depth		D_f =	**3.00**	m
Correction Factor for Water Table		W' =	**0.50**	
Unit weight of soil		γ_{soil} =	**1.960**	T/m^3
Cohension		"C" =	**0.00**	T/m^2
Angle of shearing resistance(general shear)	φ =		**36.00°**	
Angle of shearing resistance(Local shear)	φ' =		**25.77°**	(Tan^{-1} (2/3 * tanφ)
Safety factor		F =	**3.00**	
Effective Surcharge of Soil above Footing Base		q =	**2.88**	T/m^2

Type of soil = **Soft Disintegrated Rock**

Mode of failure = **Combined (GSF & LSF) Shear Failure**

Ground Water Table level (Assumed for worst Case - at the Ground level) = **0** m From NGL

The Bearing Capacity Factors are Given by the following equations

For GENERAL SHEAR FAILURE

$Nq = \tan^2 (45° + Ø/2) (e^{\pi \tan Ø})$ = 37.75

Nc= (Nq -1) Cot Ø = 50.59

Nγ = 2 (Nq +1) tan Ø = 56.31

For LOCAL SHEAR FAILURE

$N'q = \tan^2 (45° + Ø'/2) (e^{\pi \tan Ø'})$ = 11.57

N'c= (Nq -1) Cot Ø' = 21.89

N'γ = 2 (Nq +1) tan Ø' = 12.13

The Shape Factors

Shape of Footing	S_c	S_q	S_γ
CONTINUOUS STRIP FOOTING	1.0	1.0	1.0
SQUARE FOOTING	1.3	1.2	0.8
RECTANGULAR FOOTING	1+0.2B/L	1+0.2B/L	1-0.4B/L

SQUARE FOOTING	
S_c =	1.300
S_q =	1.200
S_γ =	0.800

The Depth Factor

d_c =	1 + 0.2 D_f / B x tan (45° + Ø'/2) =	1.785
$d_q = d_\gamma$ =	1 for Ø'<10° =	1.000
$d_q = d_\gamma$ =	1+0.1D_f/Bxtan(45°+Ø'/2) for Ø'>10° =	1.393

The Inclination Factor

$i_c = i_q$ = 1 - α /90)^2 = 1.00 i_γ = 1 - α / Ø)^2 1.00

α = Inclination of the load to the vertical in degress = **0**

Net Ultimate Bearing Capacity, **qd** = ((cxNcxScxdcxic) + (qx(Nq -1)xSqxDqxIq) + (0.5xBxγxNγxSγxDγxIγxW')+ (2/3) (cxN'cxScxdcxic) + (qx(N'q -1)xSqxDqxIq) + (0.5xBxγxN'γxSγxDγxIγxW'))/"2

= **141.93** **T/sq.m**

SAFE BEARING CAPACITY :

SBC = qd / F.s = **47.31 T/sq.m** or **464.12 kN/m^2**

SETTLEMENT CALCULATIONS AS PER IS-8009-(part-1) 1998

Q_s = Pressure, S_i = Immediate settlement I = Influence factor

B = width of foundation μ = Poisson's ratio E_s= Elastic Modulus

For,

Soft Disintegrated Rock

E_s= 136200 kN/m^2

(or) E_s= 13620.00 t/m^2

S_i = Immediate settlement = $I*Qs*B(1-\mu^2) / Es$

= 0.95*47.31*(1.5*(1-0.25^2))/13620

S_i= 0.0046 m

0.0046 x1000

Settlement = **5 mm** < **50 mm** **Hence SAFE**

The Max Allowable Differential Settlement for **Sand & Gravel is 50mm** and for **Silt & Clay is 75mm.**

BOREHOLE-1 SITE PHOTOS:





BOREHOLE-2 SITE PHOTOS:





BOREHOLE-3 SITE PHOTOS:





O/o. DEPUTY DIRECTOR OF TOWN AND COUNTRY PLANNING,
CHENGALPATTU REGION,
No.124, Municipal Commercial Complex, G.S.T.Raod, Chengalpattu - 603 001
E-mail : ddcglregion@gmail.com, Phone : 044 - 27422144

PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that **Mr. K.GANAPATHI** has enrolled as **Registered Geo-Technical Engineer (RGTE)** with Deputy Director of Town and Country Planning, Chengalpattu Region who has the qualification of **M.E (Soil mechanics and foundation Engg.)** and experience in the relevant field for **06 years**.

He has been given the Registration No. **CGLRGN/RGTE/2019/08/012** on **02.08.19**. He shall be required to comply with the duties and responsibilities prescribed by the Government of Tamil Nadu is Part V, "Registration of Professionals", Tamil Nadu Combined Development and Building Rules, 2019 approved vide G.O.(Ms) No.18 MAWS (MA1) Dept. Dated 04.02.2019.

This Registration is valid upto **01.08.2024**.

Deputy Director,
Chengalpattu Region





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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

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