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VENI GEO TECHNOLOGY
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REPORT ON SOIL INVESTIGATION FOR PROPOSED CONSTRUCTION OF A COMMERCIAL SHOP BUILDING AT S.F.NO: 7/1 & 7/8 AT KIZH ANAIKARAI VILLAGE & PANCHAYAT UNION, TIRUVANNAMALAI TALUK, TIRUVANNAMALAI DISTRICT, TAMIL NADU.

Prepared for

Mr. RANGANATHAN





Report Ref No:	**VGT/23-24/RPT/GT-534**
Revision No:	**0/FEBRUARY/2024**
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B. LABORATORY TEST RESULTS

C. SBC CALCULATIONS FOR SHALLOW FOUNDATIONS

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RAMESH BABU MAJJI M.Tech.,
Registered Geo-Technical Engineer

INTRODUCTION

1.0 Introduction:

This report presents the results of Preliminary Geotechnical Investigation carried out at the site of the Proposed Construction of a Commercial Shop Building at S.F.No: 7/1 & 7/8 at Kizh Anaikarai Village & Panchayat Union, Tiruvannamalai Taluk, Tiruvannamalai District, Tamil Nadu.

This proposed project carried out for Mr. RANGANATHAN, Tiruvannamalai District and Preliminary Geotechnical Investigation done by M/s. VENI GEO TECHNOLOGY, Chennai-49.

M/s. VENI GEO TECHNOLOGY carried out the investigation, field tests, sampling and laboratory testing under the instruction of consultant and Client. This report contains the field and laboratory test results along with Design computations and recommendations for suitable foundation systems.

RAMESH BABU MAJJI M.Tech.,
Registered Geo-Technical Engineer

1.1 Scope of Work:

- Client preferred, conducting Three (3) Soil investigation boreholes of 100mm diameter up to 5.00m-6.00m depth from the existing ground level or where the getting SPT N value is ≥100 as directed by the engineer-in-charge.
- Conducting Standard Penetration Test (SPT) at regular depth intervals.
- Collection of Split Spoon Samples or Disturbed Soil Samples Conducting relevant laboratory test results Recommend the Suitable foundation.

METHODOLOGY OF INVESTIGATION

2.0 Methodology of Investigation:

Three standard soil investigation borehole were tested. The equipment used and the methodology adopted to carry out the field work is described below.



2.1 Equipment Used

The equipment used for performing the drilling operations is a Calyx Rotary Drill Rig using cutting augers with circulating bentonite slurry.

2.2 Method of Drilling

In the soil strata, the drilling operations have been carried out using the rotating cutting augurs duly circulating the bentonite slurry to remove the cuttings to be collected at the top.

2.3 Standard Penetration Test (SPT)

SPT's were conducted as per IS 2131-1981. Disturbed Samples were collected through Split Spoon Sampler at 1.0m and 1.50m interval or wherever the Strata changed as directed by the engineer-in-charge.

The split spoon sampler resting on the bottom of bore hole is allowed to sink under its own weight, and then the split spoon sampler is seated 15cm with the blows of hammer falling through 750mm. The driving assembly consists of a driving head and a 63.5 kg weight.

It is ensured that the energy of the falling weight is not reduced by friction between the drive weight and the guides or between ropes. The rods to which the sampler is attached for driving are straight, tightly coupled and straight in alignment. Thereafter the split spoon sampler is further driven by 30cm. The number of blows required to drive each 15cm penetration is recorded. The first 15cm of drive considered as seating drive. The total blows required for the second and third 15cm penetration is termed as a penetration resistance - N value. The N-values for each bore hole are given in bore logs.

2.4 Collection of Samples

2.4.1 Disturbed Soil Samples

In all boreholes, disturbed soil samples were taken at every 1m and 1.50m interval and at significant change of stratum (or as per specified). Soil from cutting edge of undisturbed samplers and from split spoon sampler used for standard penetration tests was taken as disturbed samples. These samples were placed without delay in adequately sealed polythene bags. These samples were used for visual and physical identification and for conducting laboratory classification tests as per I.S.1498-1970.

2.5 Ground Water Table (GWT)

Based on the measurements in the completed boreholes, groundwater was met at 2.00m-2.50m depth during the period of our field investigation (12th February 2024). Fluctuations may occur in measured water levels due to seasonal variations in rainfall and surface evaporation rates.

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KAMESH BABU MAJJI M.Tech.,
Registered Geo-Technical Engineer

2.6 Laboratory Testing

2.6.1 Grain size Analysis Tests:

On the coarse grained samples, grain size distribution tests were conducted as per I.S.2720 (Part 4)-1985, to know the gradation characteristics and to classify them. These results are presented in tables.

2.6.2 Moisture Content:

On the soil samples, Moisture Content tests were conducted as per I.S.2720 (Part 2 & 29)-1985, to know the water content ratio in the soil samples. These results are presented in tables.

2.6.3 Atterberg's Limits

Atterberg's Limits were carried out on fine grained soil samples to evaluate the limits of different consistency states. Generally Liquid limits, Plastic limits and Shrinkage Limits tests were conducted as per I.S.2720 (Part-5)-1985 and I.S.2720 (Part 6)-1972. On such type of strata encountered at the investigation locations, such tests were conducted and the test results are presented in tables.

3.0 STRATIGRAPHY

Based on the exploratory boring information, the following subsoil profile was inferred up to final depth of boreholes:

Borehole No.	Depth (m)		Strata Description	SPT 'N' Value
	From	To		
BH-01	0.00	4.50	Medium Dense Silty Sand	12-20
	4.50	6.00	Very Dense Silty Sand	>50->100
BH-02	0.00	2.50	Loose Silty Sand	10
	2.50	4.50	Medium Dense to Dense Silty Sand	22-40
	4.50	5.80	Very Dense Silty Sand	>100
BH-03	0.00	2.00	Medium Dense Silty Sand	12
	2.00	5.00	Very Dense Silty Sand	>50->100

The boreholes logs are shown in Annexes.

DISCUSSION ON FIELD AND LABORATORY TESTS

4.0 Discussion on Field and Laboratory Tests:

Sub soil Stratification: The field data and laboratory classification reveal in general, the proposed site is having Silty Sand as a major layer up to depth of investigation.

Standard Penetration Test:

This test was conducted during the course of investigation work. From the bore logs it is inferred that the SPT 'N' value increases with depth. Depth Vs N value graph is shown in Bore log.

4.1 Bearing Strata Characteristics

At the investigation location, it can be observed that the sub-soil strata are uniformly stratified with little variations.

The sub-soil stratum at the borehole location (BH-01 to BH-03) is Loose Silty Sand up to 2.50m depth and below this, Medium Dense Silty Sand up to 4.50m depth. Beyond this, Very Dense Silty Sand followed by completely weathered rock formations is encountered up to the termination depth of boreholes.

Considering the above, the suitable foundation system for the proposed structure is described below.

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5.0 FOUNDATION RECOMMENDATIONS

KAMESH BABU MAJJI M.Tech.,
Registered Geo-Technical Engineer

5.1 General

A suitable foundation for any structure should have an adequate factor of safety against exceeding the bearing capacity of the supporting soils. Also the vertical movements due to compression of the soils should be within tolerable limits for the structure. We consider that foundation designed in accordance with the recommendations herein will satisfy these criteria.

5.2 Foundation Type and Depth

We understand that the Building shall have commercial shop building. In our opinion, open foundations are feasible foundations to support structural loads.

5.3 Net Allowable Bearing Pressure

The following values of net allowable bearing pressure for open foundations (approx. footing size 2.0m X 2.0m):

Foundation Embedment Depth, m	Recommended Net Allowable Bearing Pressure, T/m^2
	Total Settlement 40mm
1.50	8.0
2.00	11.0
2.50	15.0
3.00	18.0

The above values include a bearing safety factor of 2.5. Net bearing pressures for foundations at intermediate depth may be interpolated linearly between values given above.

In order that foundation perform adequately, it is essential to ensure that there is no seepage of water from external sources into the effective soil mass.

5.4 Foundation Level Preparation

All loose soils should be removed and the exposed foundation bearing surface should be watered and compacted properly using rammers/rollers. Over the soil, the murrum layer should be placed and compacted thoroughly.

The surface should then be protected from disturbances due to construction activities so that the foundations may bear on the natural undisturbed ground. We recommend the placement of a 75mm to 100mm thick "blinding layer" of lean concrete to facilitate placement of reinforcing steel and to protect the soils from disturbance.

In case mechanical means like excavators are deployed for excavations, the excavations should be carried out up to 0.5m above the proposed level. The last 0.5m depth of excavation should be carried out manually, so that the founding soils are not disturbed/loosened.

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CONCLUSIONS & RECOMMENDATIONS

6.0 CONCLUSIONS & RECOMMENDATIONS:

For Shallow Foundation

- ✓ Based on the BH-01 sub-soil strata at shallow depths and the bearing strata characteristics, it would be advisable to adopt isolated square column footing of size 2.00m X 2.00m located **at the depth of 2.00m below the existing ground level adopting a loading intensity of 11.0 t/m². (OR)** to adopt isolated square column footing of size 2.00m X 2.00m located **at the depth of 2.50m below the existing ground level adopting a loading intensity of 15.0 t/m²**

- ✓ In case, the ground water table is encountered within recommended depth of foundation system, provision shall be made to continuously bail the water out of the foundation pits to keep the surfaces of pit consolidated dry.

- ✓ Excavated coarse-grained soil can be used for back filling purposes. Strictly Clay Soil shall be in no case used for backfilling purposes.

- ✓ Backfilling of the foundation excavation should be done with granular Soil and it should be compacted properly to achieve proper densification to avoid settlements in flooring. Exposed bottom surface of the foundation excavation must be properly compacted with the heavy duty mechanical vibrator to compact the exposed surface that gets loosened by mechanical excavation activities this is to minimize the settlements that can arise if the loosened soil in foundation excavation is not removed or compacted.

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- ✓ Excavated sand soil from the site can be used for backfilling and site filling purposes. Foundations should be placed on natural soil and not on old foundations or filled up Soils.

- ✓ This Report and Recommendation is given based on the BH-01 to BH-03 Sub-Soil properties obtained in drilled holes. Make sure there is similar soil properties elsewhere while digging. If any change in soil characters/properties while digging in proposed construction area, it is advisable to conduct the SPT test at that location for the confirmation of soil bearing capacity.

- ✓ This conclusion is based on the soil stratum observed at the drilled location(s) and any deviation if observed during execution has to be brought to our notice for further suggestions.

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For VENI GEO TECHNOLOGY
Chennai-49

ANNEXURE-1

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BORE LOG-1

Soil Test Report at Kizh Anaikarai,Tiruvannamalai District
Report No: VGT/23-24/RPT/GT-534
Date: 17.02.2024

Client Name :	**Mr.Ranganathan**		
Project Name :	**Proposed Construction of a Commercial Shop Building**		
Project Location :	**S.F.No: 7/1 & 7/8 at Kizh Anaikarai Village & Panchayat Union, Tiruvannamalai Taluk, Tiruvannamalai District, Tamil Nadu.**		
Bore Hole No :	**1**	**Ground Water Level (EGL):**	**2.50m (During Drilling)**
Started On :	**12-02-2024**	**Drilling Method :**	**Calyx Rotary Drill Rig**
Ended On :	**12-02-2024**	**Dia of Borehole :**	**100mm**

Depth of Top of Layer (m)	Sample Type	Soil profile	Engineering Description of Soil	Thickness of Layer (m)	SPT - Details: Depth of SPT (m)	0-15 cm	15-30 cm	30-45 cm	N-Value	Relative density / consistency	Graphical representation of penetration resistance (0 20 40 60 80 100)
EGL				**0.00**							
	SPT Soil Samples (SS)		Top Soil	3.00							
			Brown Fine Silty Sand		1.00	5	5	7	**12**	Medium Dense	
					2.00	6	6	7	**13**	Medium Dense	
3.00											
			Light Brown Silty Sand with traces of few Gravel	1.50	3.00	8	9	11	**20**	Medium Dense	
4.50											
			Light Greyish Brown Silty Sand with Gravel (Murrum Type)	1.40	4.50	26	50#		**>50**	Very Dense	# 50 blows for 11cm penetration & Rebound
5.90											
			Brown Weathered Rock (SDR)	0.10	6.00	50#			**>100**	Very Dense	# 50 blows for 0cm penetration & Complete Rebound
6.00											

Bore Hole terminated at 6.00m from EGL Due to Refusal Stratum

*__SPT__-Standard Penetration Test

***EGL**-Existing Ground Level

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Registered Geo-Technical Engineer

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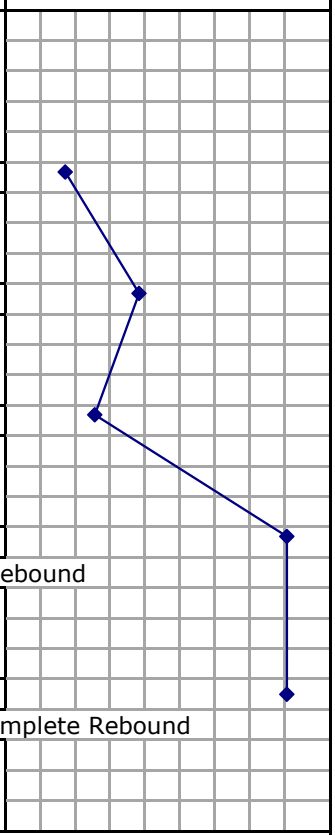
BORE LOG-2

Soil Test Report at Kizh Anaikarai,Tiruvannamalai District
Report No: VGT/23-24/RPT/GT-534
Date: 17.02.2024

Client Name :	**Mr.Ranganathan**		
Project Name :	**Proposed Construction of a Commercial Shop Building**		
Project Location :	**S.F.No: 7/1 & 7/8 at Kizh Anaikarai Village & Panchayat Union, Tiruvannamalai Taluk, Tiruvannamalai District, Tamil Nadu.**		
Bore Hole No :	**2**	**Ground Water Level (EGL):**	**2.20m (During Drilling)**
Started On :	**12-02-2024**	**Drilling Method :**	**Calyx Rotary Drill Rig**
Ended On :	**12-02-2024**	**Dia of Borehole :**	**100mm**

Depth of Top of Layer (m)	Sample Type	Soil profile	Engineering Description of Soil	Thickness of Layer (m)	SPT - Details: Depth of SPT (m)	0-15 cm	15-30 cm	30-45 cm	N-Value	Relative density / consistency
EGL				**0.00**						
	SPT Soil Samples (SS)		Top Soil	2.50						
			Brown Fine Silty Sand		1.50	3	4	6	**10**	Loose
2.50										
			Brown Fine Silty Sand with Few Gravel	2.00	2.50	10	18	22	**40**	Dense
			Light Brown Silty Sand with traces of few Gravel		3.50	6	8	14	**22**	Medium Dense
4.50										
			Light Greyish to Whitish Silty Sand with Gravel (Murrum Type)	1.20	4.50	50#			**>100**	Very Dense
						# 50 blows for 10cm penetration & Rebound				
5.70										
			Brown Weathered Rock (SDR)	0.10	5.80	50#			**>100**	Very Dense
						# 50 blows for 0cm penetration & Complete Rebound				
5.80										

Graphical representation of penetration resistance



Bore Hole terminated at 5.80m from EGL Due to Refusal Stratum

*SPT-Standard Penetration Test

***EGL**-Existing Ground Level

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BORE LOG-3

Soil Test Report at Kizh Anaikarai,Tiruvannamalai District
Report No: VGT/23-24/RPT/GT-534
Date: 17.02.2024

Client Name :	**Mr.Ranganathan**		
Project Name :	**Proposed Construction of a Commercial Shop Building**		
Project Location :	**S.F.No: 7/1 & 7/8 at Kizh Anaikarai Village & Panchayat Union, Tiruvannamalai Taluk, Tiruvannamalai District, Tamil Nadu.**		
Bore Hole No :	**3**	**Ground Water Level (EGL):**	**2.00m (During Drilling)**
Started On :	**12-02-2024**	**Drilling Method :**	**Calyx Rotary Drill Rig**
Ended On :	**12-02-2024**	**Dia of Borehole :**	**100mm**

Depth of Top of Layer (m)	Sample Type	Soil profile	Engineering Description of Soil	Thickness of Layer (m)	SPT - Details: Depth of SPT (m)	0-15 cm	15-30 cm	30-45 cm	N-Value	Relative density / consistency	Graphical representation of penetration resistance
EGL				**0.00**							0 20 40 60 80 100
	SPT Soil Samples (SS)		Top Soil	2.00							
			Brown Fine Silty Sand with Clay Mix		1.00	4	5	7	**12**	Medium Dense	
2.00											
			Light Brownish to Whitish Fine Silty Sand with Gravel (Murrum Type)	2.90	2.00	10	25	28	**>50**	Very Dense	
					3.00	50#			**>100**	Very Dense	
						# 50 blows for 5cm penetration & Rebound					
			Light Brown Silty Sand with traces of few Gravel (Murrum Type)		4.50	50#			**>100**	Very Dense	
4.90						# 50 blows for 9cm penetration & Rebound					
			Brown Weathered Rock (SDR)	0.10	5.00	50#			**>100**	Very Dense	
5.00						# 50 blows for 0cm penetration & Complete Rebound					

Bore Hole terminated at 5.00m from EGL Due to Refusal Stratum

*SPT-Standard Penetration Test

***EGL**-Existing Ground Level

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Table of Laboratory Test Results

Soil Test Report at Kizh Anaikarai, Tiruvannamalai District
Report No: VGT/23-24/RPT/GT-534
Date: 17.02.2024

Client Name :	**Mr.Ranganathan**
Project Name :	**Proposed Construction of a Commercial Shop Building**
Project Location :	**S.F.No: 7/1 & 7/8 at Kizh Anaikarai Village & Panchayat Union, Tiruvannamalai Taluk, Tiruvannamalai District, Tamil Nadu.**

Bore Hole No	Depth (m)		Type of Soil	Grain Size Analysis (Particle Retained in IS Sieve) %					Atterberg Limits			IS Classification	Natural Moisture Content %	Free swell (%)	Remarks
	From	To		4.75 mm	2.00 mm	0.425 mm	0.075 mm	Fines	LL	PL	PI				
BH 1	0.00	3.00	Silty Sand	0.00	0.65	23.91	54.83	20.61	Non Plastic			SM	13.82		
	3.00	4.50	Silty Sand	8.43	2.91	31.28	40.13	17.25	Non Plastic			SM	11.95		
	4.50	6.00	Silty Sand	12.14	4.10	32.75	38.29	12.72	Non Plastic			SM	8.23		
	Below 6.00m		**Weathered Rock formations**												
BH 2	0.00	2.50	Silty Sand	0.00	0.00	25.52	56.28	18.20	Non Plastic			SM	15.39		
	2.50	4.50	Silty Sand	10.13	4.98	30.84	40.12	13.93	Non Plastic			SM	12.02		
	4.50	5.80	Silty Sand	13.32	5.26	31.90	38.25	11.27	Non Plastic			SM	9.12		
	Below 5.80m		**Weathered Rock formations**												
BH 3	0.00	2.00	Silty Sand	0.00	0.00	28.42	52.18	19.40	Non Plastic			SM	18.21		
	2.00	3.00	Silty Sand	7.32	2.04	30.23	45.28	15.13	Non Plastic			SM	13.19		
	3.00	5.00	Silty Sand	15.91	5.85	31.62	35.91	10.71	Non Plastic			SM	7.84		
	Below 5.00m		**Weathered Rock formations**												

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Report Ref No: VGT/23-24/RPT/GT-534
Date: 17.02.2024

BEARING CAPACITY ANALYSIS FOR SHALLOW FOUNDATIONS

Analysis as per IS 6403-1981

Name of the Client : Mr.Ranganathan
Project Name : Proposed Construction of a Commercial Shop Building
Location : S.F.No: 7/1 & 7/8 at Kizh Anaikarai Village & Panchayat Union, Tiruvannamalai Taluk, Tiruvannamalai District, Tamil Nadu.

The bearing capacity equation is as follows :

$$q_{net\ safe} = (1/FS)\{cN_cS_cd_ci_c + qN_q - 1)S_qd_qi_q + 0.5B\gamma N_\gamma S_\gamma d_\gamma i_\gamma R_w\}$$

Where,

qnet safe = safe net bearing capacity
q = overburden pressure
Υ = Bulk density of soil below founding level
Rw = Water table correction factor
Nc,Nq,Nγ = Bearing capacity factors, which are a function of Φ
Sc,Sq,Sγ = Shape factors
dc,dq,dγ = Depth factors
ic,iq,iγ = Inclination factors
c= cohesion intercept
B= Foundation width
FS = Factor of safety

Soil Parameters :

c = **0.00** T/m² Φ = **30.1** degrees General Shear Failure
c' = **0.00** T/m² Φ' = **21.1** degrees Local Shear Failure

Bearing capacity factors

General Shear Failure : Nc = **30.38** Nq = **18.61** Nγ = **22.74**
Local Shear Failure : Nc' = **15.95** Nq' = **7.16** Nγ' = **6.31**
Factor of Safety = **2.5** as per IS 1904-1986 ic,iq,iγ = **1**

Bulk Density Profile

Depth, m		Υ
From	To	T/m3
0.0	2.0	1.75
2.0	6.0	1.85

Design Water Table depth = **0.00** m

Rw factor: Constant value **(V)** for worst condition or calculate **(C)** based on WT Depth ? : **C**

Depth factor to be considered ? YES

For computation of Depth Factor, depth below GL to be ignored to account for loose soils,poorly compacted backfill above foundation, scour etc. = **1.5** m

FAILURE CRITERIA : AVERAGE OF LOCAL & GENERAL SHEAR FAILURE

Foundation Size		Foundation Shape	Depth, m	Rw	Shape Factors			Depth factors (GSF)			Depth factors (LSF)			qnet safe, T/m²		Safe Net Bearing Capacity T/m²
B, m	L, m				Sc	Sq	Sγ	dc	dq	dγ	d'c	d'q	d'γ	GSF	LSF	
2.00	**2.00**	Square	**1.50**	0.50	1.30	1.20	0.80	1.04	1.02	1.02	1.03	1.02	1.02	12.1	3.7	**7.9**
2.00	**2.00**	Square	**2.00**	0.50	1.30	1.20	0.80	1.06	1.03	1.03	1.04	1.02	1.02	17.4	5.5	**11.4**
2.00	**2.00**	Square	**2.50**	0.50	1.30	1.20	0.80	1.07	1.04	1.04	1.05	1.03	1.03	22.7	7.4	**15.0**
2.00	**2.00**	Square	**3.00**	0.50	1.30	1.20	0.80	1.09	1.04	1.04	1.06	1.03	1.03	27.3	8.9	**18.1**

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Report Ref No: VGT/23-24/RPT/GT-534
Date: 17.02.2024

Settlement Analysis for Shallow Foundations
Elastic Settlement Computed From Theory of Elasticity

Analysis as per IS : 8009 Part 1 - 1976, Clause 9.2

Client Name : Mr.Ranganathan
Project Name : Proposed Construction of a Commercial Shop Building
Location : S.F.No: 7/1 & 7/8 at Kizh Anaikarai Village & Panchayat Union, Tiruvannamalai Taluk, Tiruvannamalai District, Tamil Nadu.

Total settlement computed as equal to elastic/immediate settlement.
No consolidation settlement - analysis valid for granular soils,weathered rocks, hard clays & cohesive soils above water table

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ELASTIC / IMMEDIATE SETTLEMENT

$$Si = \frac{q\ B'\ (1-\mu^2)\ I}{E}\ df\ dY$$

Reference : Foundation Analysis & Design by J.E.Bowles fifth edition (1996)

where

B= Foundation width B' = B/2 L' = L/2 μ = Poisson's Ratio
q= Applied Bearing Pressure E = Modulus of Elasticity
df= Fox's Depth factor dY = Rigidity factor
I = Influence factor at corner of rectangular loaded area(B' x L'), computed from theory of elasticity using Steinbrenner's factors

Settlement at centre of footing of size B x L = 4 x Settlement at corner of area B' x L'

Poisson's Ratio : 0.33

Is Rigid Layer met ? N

Layer No.	Depth, m		Soil Classification	Modulus of Elasticity,T/m²
	From	to		
1	0.0	2.5	Loose Silty Sand	500
2	2.5	4.5	Medium Dense Silty Sand	700
3	4.5	6.0	Very Dense Silty Sand	1200

Fox's Depth Factor to be considered ? Y

Depth to be ignored in Depth Factor Computation for loose soils, poorly compacted backfill, scour etc. = 1.5 m

Foundation Width (B), m	Foundation Length (L), m	Embedment Depth (D),m	**Applied Bearing Pressure T/m²**	Rigidity Factor, dr	Fox's Depth Factor	M = L'/B'	N = H/B'	Influence Factor	E(weighted ave.) T/m²	**Elastic Settlement mm**	Mod. Of Subgrade Reaction (k), kN/m3
2.00	2.00	1.50	**8.00**	1.00	0.94	1.00	10.00	0.506	822	**16.5**	4848
2.00	2.00	2.00	**11.00**	1.00	0.85	1.00	10.00	0.506	863	**19.6**	5612
2.00	2.00	2.50	**15.00**	1.00	0.78	1.00	10.00	0.506	914	**23.1**	6494
2.00	2.00	3.00	**18.00**	1.00	0.73	1.00	10.00	0.506	983	**24.1**	7469



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