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Study on soil investigation practices and design of foundation for a residential construction work

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Abstract -

To ensure the safety of a building, it is imperative to have a geotechnical or soil investigation report that explains the specifics of the underlying soil. It provides a comprehensive understanding of soil properties and how they respond to different situations. Standards and guidelines for conducting soil investigations are in place in India, however there is no legislation dictating whether or not a soil report must be produced. This study is to raise awareness of the current local government administrative building construction system as well as the degree of knowledge about soil investigation and its necessity among a few local contractors. An interview with the local government, a survey of a small number of contractors, and some recommendations, such as concentrating more on.

1.INTRODUCTION

1.1 Geotechnical/ soil investigation

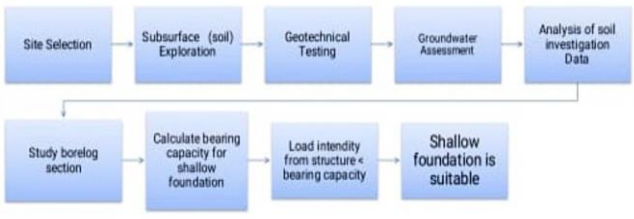
Prior to construction, a soil study, also known as geotechnical work, is conducted to better understand the soil. It is a collection of techniques for analyzing and comprehending the subsurface profile, site circumstances, and soil characteristics. One way to analyze the state of the soil and determine the necessary foundation is through soil testing, which is done as part of the geotechnical research. In the realm of construction, soil analysis and classification are carried out to assess the soil's bearing capacity to a particular degree (IS 1498, 1970). Soil study has several applications, such as reducing uncertainty in foundation design, determining settlement, evaluating stability, and so forth.

1.2 Methods of Soil Investigation

1. Borehole Logging
2. Soil sampling
3. Standard Penetration Test
4. Bearing capacity and Safe bearing capacity
5. Settlement pressure
6. Design of shallow foundation

2. RESEARCH METHODOLOGY

The planned investigation will map out the subsurface stratification of the proposed project site, gather soil samples for laboratory testing to uncover engineering attributes like shear strength, and classify the subsurface stratum according to basic engineering principles in order to derive the parameters for the foundation design.



3. RESULT AND ANALYSIS

3.1)

a) Load calculation

- Wall load = 147.451 Kn
- Column load = 60.24kN
- Load on beam = 688.5Kn

- Total slab load = 450Kn
- Total load on one column = 1351.201Kn
- Total load on foundation = 51355.638Kn

b) Calculation of bearing capacity(q_{nu}), safe bearing capacity(q_{ns}) and settlement pressure(q_{np}).

BH	N	qns kN/m²	qns kN/m² =qnu/3	qnp kN/m²
BH_1	12	1048	349.33	201.6
BH_2	13	1160.5	386.88	226.8
BH_3	14	1282	427.33	252.0
BH_4	15	1412.5	470.83	277.2
BH_5	16	1552	517.33	302.4
BH_6	17	1858	619.33	352.8
BH_7	18	2200	733.33	403.2
BH_8	20	2578	859.33	453.6
BH_9	24	2992	997.33	504.0

c) Design of Shallow Foundation

To find- size of footing

Step 1- Load on footing

Load on footing (W_f)= 1486K

Factored Load on footing (W_u)= 2229 Kn

Step 2- Area of footing

Area of footing (A_f) = 6 m²

Step 3- Size of footing

L= 3.0 m , B= 2.0m

Step 4- Upward soil pressure

P= 338 kN/m²

Step 5- Depth of footing for bending moment

Critical section for bending moment criteria is

Considered on the face of the column

M_x= 571.22 kN. m

M_y= 397.1 kN. m

Maximum bending moment

M_{max} = 571.22 kN.m

Limiting moment of resistance

Mu_{lim} = 0.138 fcd bd^2

d = 719.3 mm

Overall depth (D) = 779mm

Effective depth (d)= 719mm

Step 6 –check for depth in one way shear (beam shear)

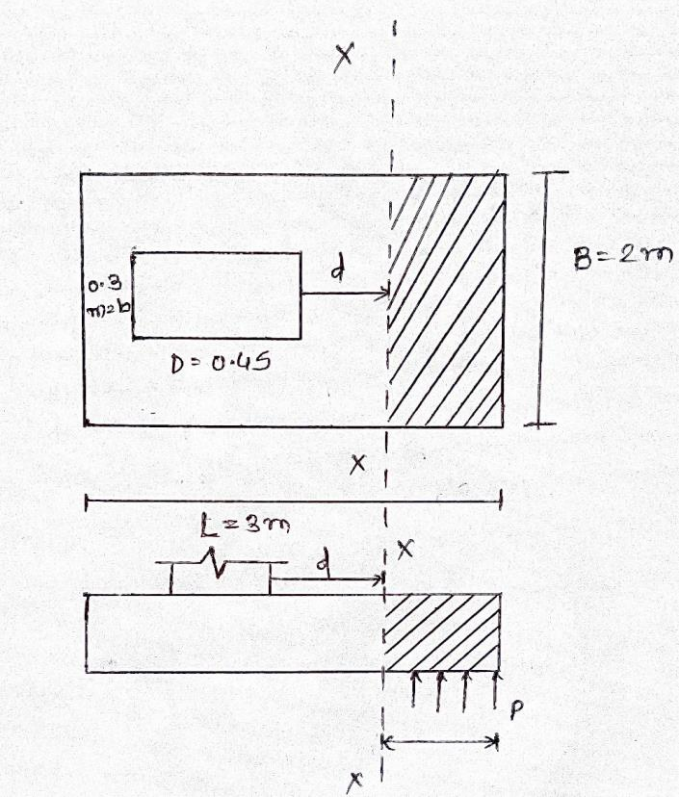


Fig no. 3.1.1 shear force at critical section

Shear force at critical section

V_u= 676(1.3-d)

K_s= 1

τ_c =1.12

τ_v= 1120 kN/m²

d = 0.301m

d = 301mm < 719mm

Therefore, depth of footing provided is safe in one way shear

Step 7- check for depth in two way shear

(punching shear)

Critical section for two way shear is considered at distance d/2 from the periphery of the column face

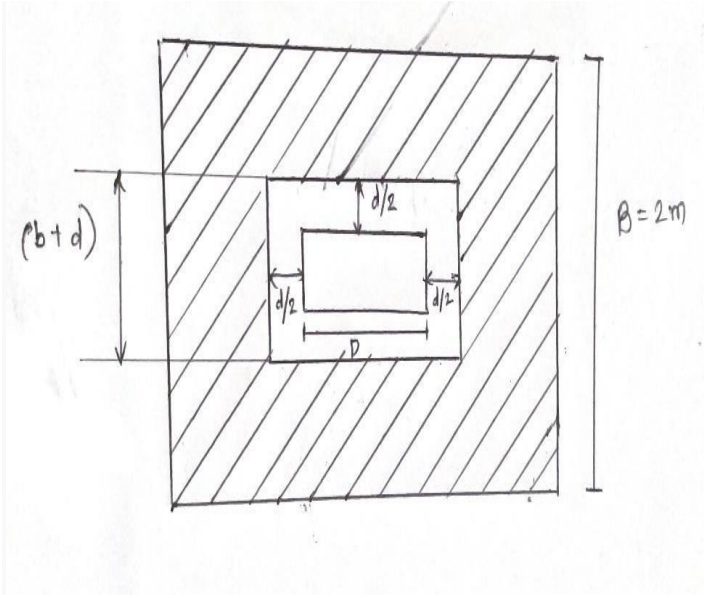
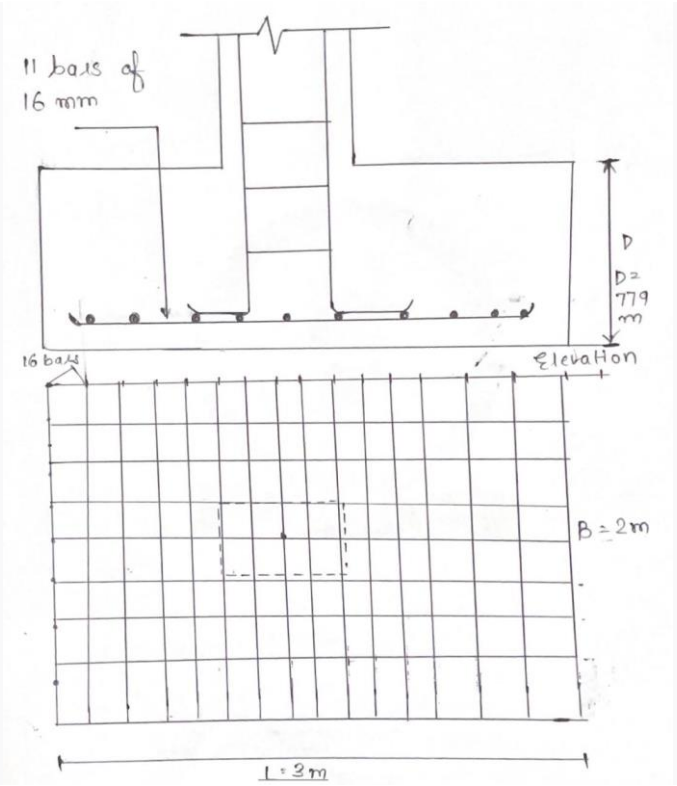


fig no. 3.1.2 shear resistance by concrete

V_u = uplift pressure x shaded area
= p[BL – (b+d)(D+d)]
=338[2x3-(0.23+d)(0.4+d)].....(iii)
Shear resistance by concrete
$V_u = \tau_c b_o d$
= 1.26+4d.....(iv)
Equating (iii) and (iv)
d = 0.33m < 0.719m
therefore, safe in two way shear

Step 8-
Reinforcement (Mu)= 571.22 kN/m
A_{stx}= 1406.19 mm^2
Number of bars for 16 mm bars
Area of one bar = 201mm^2
n= 12 bars
provide 12 bars of 16 mm along long direction
to find in short direction –
Mu= 397.1kN.m
A_{sty} =2169.07mm^2
Area of one bar= 201mm^2
n = 11 bars
provide 11 bars of 16mm along short direction



3.2) Footing analysis in STADDPRO

1) Node formation.
2) Assigning the node's fix support and creating support.
3) To load a primary load, select "dead load" as the loading type and add a load scenario.
4) Add the nodal load in the fy direction to get 1351.20 KN.
5) Select the load 1351.201 and then attach it to the newly constructed node. After applying UDL to the portal frame, we had a result of 1351.201 KN.

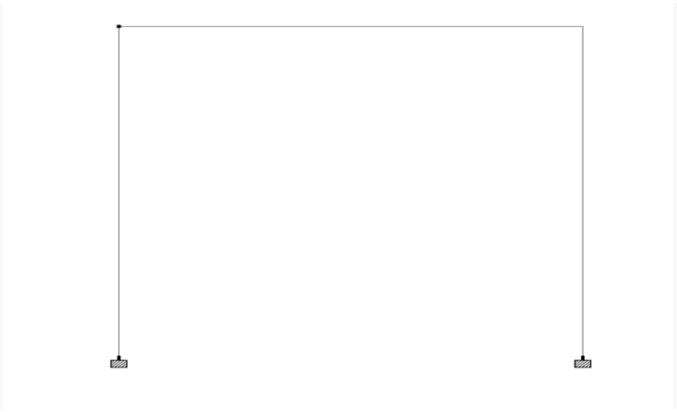


Fig no. 3.2.1 Model of frame

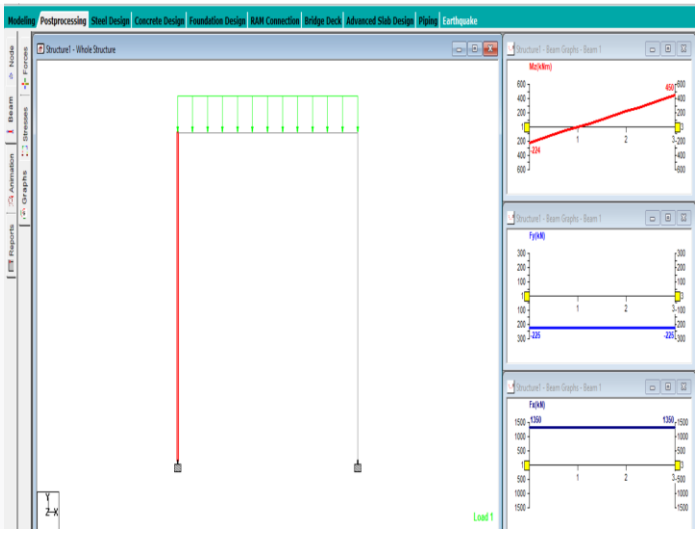


Fig no. 3.3.2 Result of frame

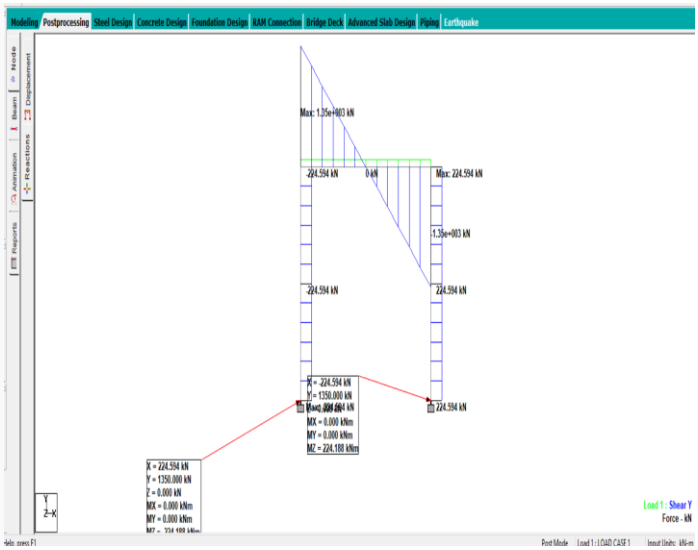


Fig no. 3.2.3 Shear force diagram

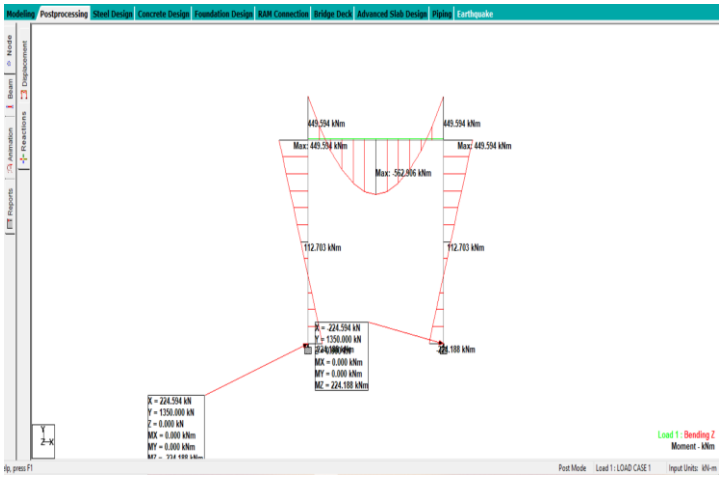


Fig no. 3.2.4 Bending moment diagram

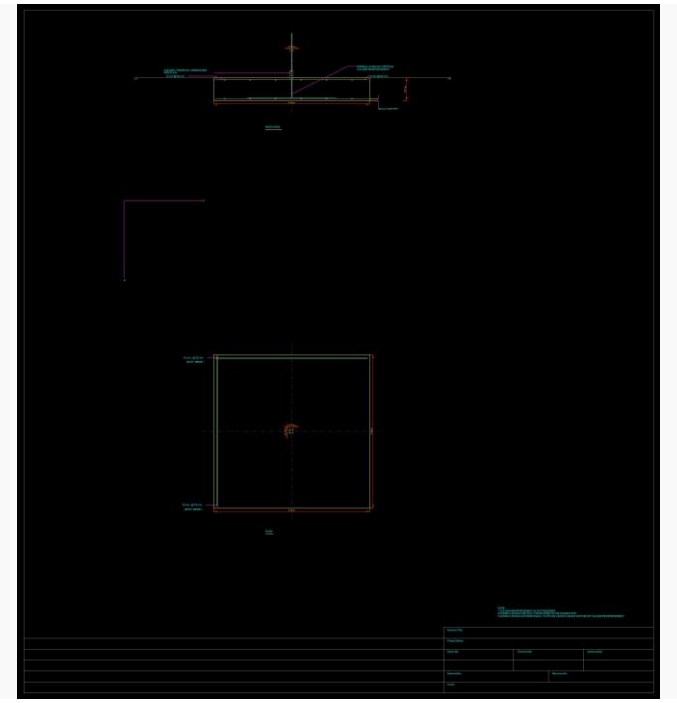


Fig no. 3.2.5 Footing

3.3) Final Result

After carefully calculating the results manually as well as on STADDPRO we have got equal results which is 1351.201 KN. The study on soil investigation practices and design of foundations for residential construction work likely aims to understand the correlation between soil characteristics, foundation design, and construction outcomes. It may involve evaluating various soil testing methods, analyzing soil properties, and proposing optimized foundation designs to ensure structural integrity and stability for residential buildings. The results could inform best practices for engineers and builders to follow during the planning and construction phases.

4. CONCLUSIONS

The main conclusions and consequences of a study on soil investigation techniques and foundation design for residential construction work are usually summed up in the study's conclusion. It may consist of:

1. The significance of conducting a complete soil research to ascertain the characteristics of the soil, its bearing capacity, and any possible hazards such slope instability or settling.

2. The importance of selecting a foundation design that takes into account local codes, building loads, and soil conditions.

3. The demand for collaboration between structural, soil, and architectural experts to guarantee that the foundation design satisfies performance and safety standards.

4. Suggestions for additional study or advancements in methods of soil analysis or foundation design.

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