Tutorials for

Foundation Engineering (Program Elective) (3160613)

B.E. Semester 6 (Civil)

Directorate of Technical Education
Gandhinagar, Gujarat

APPLIED MECHANICS DEPARTMENT

Shantilal Shah Engineering College, Bhavnagar

Even Semester. Term Dates: 10/01/2024 to 30/04/2024

Tutorial- I

Foundation Classification and Soil exploration/investigation

	Answer the following	Mapped With
1	Describe salient features of good sub-soil investigation report.	CO1, CO2
2	Draw neat labelled diagram of spilt spoon sampler and also mention its uses in geotechnical engineering.	CO1, CO2
3	Differentiate between static cone penetration test and dynamic cone penetration test.	CO1, CO2
4	Mention the factors that affects sample disturbance.	CO1, CO2
5	Describe various methods of drilling holes for sub surface investigation.	CO1, CO2
6	Differentiate between disturbed samples and undisturbed samples.	CO1, CO2
7	Explain Standard Penetration Test in detail (with neat sketches). Also mention significance of test results in geotechnical engineering.	CO1, CO2
8	Whether the following statements are true or false. I. The samples collected from wash water of wash boring are disturbed samples. II. The standard penetration test is more useful for cohesion less soil than cohesive soil. III. A boring log indicates different strata along the depth of a bore hole. IV. Geophysical methods are useful for preliminary investigations.	CO1, CO2
9	The field N value in a deposit of fully submerged fine sand was 40 at a depth of 6 m. The average saturated unit weight of the soil is 19 kN/m^3.Calculate the corrected N value as per IS:2131-1981.	CO1, CO2
10	Enlist various types of foundation. Discuss their suitability as per site conditions?	CO1, CO2
11	Two samplers have area ratios of 10.9% and 21%. Which do you recommend for better soil sampling and why?	CO1, CO2
12	A sampling tube and the cutting edge have the following dimensions. (i) Inside diameter of cutting edge= 68 mm (ii) Inside diameter of sampling tube = 70mm (iii) Outside diameter of cutting edge = 74 mm (iv) Outside diameter of sampling tube = 72 mm Determine the inside clearance, outside clearance and area ratio	CO1, CO2

Tutorial- II

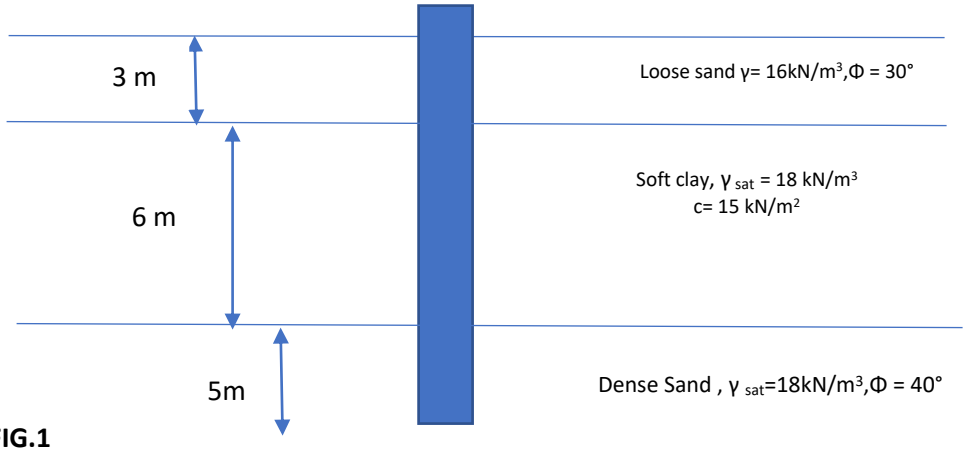
Shallow Foundation

<table>
<tr><th></th><th>Answer the following</th><th>Mapped With</th></tr>
<tr><td>1</td><td>Differentiate between Shallow foundation and Deep foundation.</td><td>CO1, CO2</td></tr>
<tr><td>2.</td><td>Define the following terms: Presumptive bearing capacity, Ultimate bearing capacity, Punching shear failure, Allowable soil Pressure, Net safe bearing capacity</td><td>CO1, CO2</td></tr>
<tr><td>3</td><td>Enlist the assumptions made in derivation of Terzaghi’s bearing capacity theory. Also derive the relation for determining bearing capacity of soil.</td><td>CO1, CO2</td></tr>
<tr><td>4</td><td>Describe Skempton’s analysis for bearing capacity of cohesive soils.</td><td>CO1, CO2</td></tr>
<tr><td>5</td><td>A square footing is designed to carry a load of 500kN.If the depth of foundation is 1.5 m, determine the suitable size of foundation with a factor of safety of 3.0. The water table is at foundation level. Take $\Phi = 25°$, $\gamma = 16$ kN/m^3, $\gamma sat = 19$ kN/m^3, c= 20kN/m^2. Use Terzaghi’s theory.</td><td>CO1, CO2</td></tr>
<tr><td>6</td><td>A strip footing 2m wide carries a load intensity of 400 kN/m^2 at a depth of 1.2 m in sand. The saturated unit weight of sand is 19.5 kN/m^3 and unit weight above water table is 16.8 kN/m^3, and having angle of shearing resistance is 35˚.Determine the factor of safety with respect to shear failure for the following cases of location of water table:
i. Water table is 4m below G.L
ii. Water table is 1.2 m below G.L
iii. Water table is 2.5 m below G.L
iv. Water table is 0.5 m below G.L
v. Water table is at G.L itself.
Use Terzaghi’s theory</td><td>CO1, CO2</td></tr>
<tr><td>7</td><td>A strip footing of 2m width is founded at a depth of 4 m below the ground surface. Determine the net ultimate bearing capacity, using (a) Terzaghi’s Theory, (b) Skempton’s Equation, (c) IS Code method. The soil is clay (c= 10 kN/m^2,$\Phi = 0$) take $\gamma = 20$ kN/m^3</td><td>CO1, CO2</td></tr>
<tr><td>8</td><td>Discuss different types of settlements which can occur in foundation.</td><td>CO1, CO2</td></tr>
<tr><td>9</td><td>The load settlement curve data from a plate load test on a sandy soil are as under:
<table>
<tr><td>Load(t/m^2)</td><td>10</td><td>20</td><td>30</td><td>40</td><td>50</td><td>60</td><td>70</td><td>80</td></tr>
<tr><td>Settlement(mm)</td><td>4.5</td><td>10</td><td>15.5</td><td>22</td><td>29</td><td>38.5</td><td>50</td><td>64</td></tr>
</table>
The size of the plate used was 0.3m*0.3m. Determine the size of the square column footing to carry a net load of 250 t with a maximum settlement of 25 mm.</td><td>CO1, CO2</td></tr>
<tr><td>10</td><td>A rectangular footing has a size of 1.8m *3m has to transmit the load of a column at a depth of 1.5m. Calculate the safe load which the footing can carry at a factor of safety of 3 against shear failure. Use IS code method. The soil has following</td><td>CO1, CO2</td></tr>
</table>

	properties: n=40%, G=2.67, w=15%, c=8 kN/m^2, ϕ=32.5˚.	
11	Discuss the effect of water table on bearing capacity of soil.	CO1, CO2
12	Draw the contact pressure distribution diagram for rigid and flexible footings on sand and clayey soils. Also discuss its significance in designing of shallow foundation.	CO1, CO2
13	Name different types of pavements. Explain their salient characteristics.	CO1, CO2
14	A square footing fails by general shear failure in a cohesion less soil having Φ= 35° under an ultimate load of Q_{ult}=380 kN. The footing is placed at a depth of 2m below the ground level. Given Nq=41.4, Nγ= 41.4, γ=17 kN/m^3.Determine the size of footing. Water table is found at greater depth. (use Terzaghi's Theory.)	CO1, CO2
15	Describe plate load test. What are its limitation and use?	CO1, CO2

Tutorial- III

Pile Classifications & Load Transfer Principle of Pile foundation

	Answer the following:	Mapped With
1	Discuss various types of pile foundations.	CO1, CO3
2	Discuss different methods for the installations of piles.	CO1, CO3
3	Enlist the conditions were pile foundations are more suitable than shallow foundation.	CO1, CO3
4	Determine the allowable pile load capacity of the 40 cm diameter driven concrete pile as shown in fig. 1  **FIG.1**	CO1, CO3
5	Discuss the procedure of estimate group capacity of piles in(a) sand (b) clay?	CO1, CO3
6	Whether the following statements are true or false. (a) Pile foundations are more economical than shallow foundation for moderate loads. (b) The load carrying capacity of bored pile is smaller than that of an equivalent driven pile. (c)The group efficiency of the piles can be more than 100%. (d)The most reliable method for determining the load carrying capacity of a pile is the load test.	CO1, CO3
7	The design capacity of a pile 400kN, with a factor of safety of 4. What should be the average penetration of the pile for the last few blows? (b) How many blows would be required for the last one meter for the design capacity to be achieved? Use following data: Energy rating = 35000kNcm Efficiency of hammer = 0.80 Cross-sectional area of pile = 100 cm^2 Young's modulus of pile material=$2x10^8$ kN/m^2 Length of pile=10m Use all three Dynamic formulas.	CO1, CO3

Tutorial – IV

Foundations on problematic soil & Introduction to Geosynthetics

	Answer the following:	Mapped With
1	Explain the general characteristics of expansive soil? Explain the laboratory method to identify expansive soil.	CO1, CO5
2	Define the term expansive soil. Give typical ranges of values of liquid limit, plasticity index, shrinkage limit and percent of minus 2 micron fraction for the black cotton soil.	CO1, CO5
3	Enlist the engineering tests usually conducted to assess the swelling potential of an expansive soil?	CO1, CO5
4	Define the term 'free swell', 'differential free swell', 'swelling pressure', field moisture content' and 'equilibrium moisture content'.	CO1, CO5
5	Describe the field conditions that generally favor swelling in an expansive soil?	CO1, CO5
6	List the typical damage that a structure resting on an expansive soil is likely to suffer.	CO1, CO5
7	Explain the basic approaches used to reduce or prevent the effects of swelling on structure?	CO1, CO5
8	Explain concept of CNS layer.	CO1, CO5
9	Enlist different types of foundations provided in expansive soils and explain them.	CO1, CO5
10	Describe the treatment of collapsible soils.	CO1, CO5
11	Give applications of Geosynthetics in roads.	CO1, CO5
12	Explain drainage function of Geosynthetics.	CO1, CO5
13	Write short note on: Under reamed piles in expansive soils.	CO1, CO5
14	Describe use of Geosynthetics in retaining walls.	CO1, CO5
15	Classify geotextile materials. What are the basic functions performed by geotextiles?	CO1, CO5

Tutorial – V

Retaining walls and Diaphragm walls

	Answer the following:	Mapped With
1	Explain the types of retaining walls with neat sketches.	CO1, CO4
2	Describe the different modes of failure of retaining walls?	CO1, CO4
3	Discuss drainage of back fill in retaining walls.	CO1, CO4
4	Draw a neat sketch of gravity retaining wall showing forces acting on it. Explain stability checks for gravity retaining wall.	CO1, CO4
5	What is sheet pile wall? Where it is used? Describe types of sheet pile walls. Enlist forces acting on sheet pile wall.	CO1, CO4
6	Give basic difference between cantilever retaining wall and counter fort retaining wall.	CO1, CO4
7	List various methods of construction of diaphragm wall and explain them.	CO1, CO4
8	Explain construction method of sheet pile wall.	CO1, CO4
9	Describe alternate panel method of construction of diaphragm wall.	CO1, CO4
10	A retaining wall, 6 m high, retains dry sand with an angle of friction of 30° and unit weight of 16.2 kN/m^3. Determine the earth pressure at rest. If the water table rises to the top of the wall, determine the increase in the thrust on the wall. Assume the submerged unit weight of sand as 10 kN/m^3.	CO1, CO4
11	The Rankine formula of active earth pressure for a vertical wall and a level fill is much better known than the general form and sometimes it is used even when it does not apply. Determine the percentage error introduced by assuming a level fill when the angle of surcharge actually equals 20°. Assume a friction angle of 35° and the wall vertical. Comment of the use of the erroneous result.	CO1, CO4

References:

- Soil Mechanics and Foundation Engineering; Dr. K.R. Arora; Standard Publishers Distributors, New Delhi, Year 2010
- Soil Mechanics and Foundation Engineering; B.C.Punamia; Laxmi Publication Pvt. Ltd., New Delhi, Year 2010
- Basic and applied soil mechanics; Gopal Ranjan, Rao A.S.R.; New age int. (p) ltd
- Soil Mechanics and Foundation Engineering, S.K.Garg, Khanna Publishers, New Delhi, Year-2005
- Soil Mechanics and Foundation Engineering, P.Purushothama Raj, Pearson India Education Services Pvt. Ltd., Noida, Year-2013
- Relevant IS Codes

Note: Last Date of Submission of Tutorials

Tutorial No.	Tutorial Name	Last Date of Submission
Tutorial I	Foundation Classification and Soil exploration/investigation	**23/02/2024**
Tutorial II	Shallow Foundation	**22/03/2024**
Tutorial III	Pile Classifications & Load Transfer Principle of Pile foundation	**05/04/2024**
Tutorial IV	Foundations on problematic soil & Introduction to Geosynthetics	**19/04/2024**
Tutorial V	Retaining walls and Diaphragm walls	**26/04/2024**

Note: Attach the print of respective tutorials while submitting the tutorials.

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