

**Course Code: CE364****Course Name: ADVANCED FOUNDATION ENGINEERING**

Max. Marks: 100

Duration: 3 Hours

***Graph paper to be supplied*****PART A*****Answer any two full questions, each carries 15 marks.***

Marks

- 1 a) A strip footing 1.2 m wide is loaded at a depth of 1.5 m in non-cohesive soil having corrected N value 20. Water table is at a depth of 2 m below the ground surface. Determine the safe bearing capacity using Teng's equation for a FS3. (7)
- b) A footing of size 2m x 2m rest with its base at a depth of 1.5m from the ground surface. The footing carries a load of 2000kN. The soil stratum from 1.5m to 9m is soft clay with  $C_c = 0.27$  and  $e_o = 1.08$ . The clay stratum is normally consolidated. Compute the settlement of clay layer if the soil from the surface is saturated and has a unit weight of  $20\text{kN/m}^3$ . Assume load spreading of 2 vertical to 1 horizontal. (8)
- 2 a) A water tank foundation has a footing of size 6 x 6m, founded at a depth of 3m below ground level in a medium dense sand stratum of great depth. The corrected average SPT value obtained from the site investigation is 22. The foundation is subjected to a vertical load at an eccentricity of B/10 along one of the axes. Estimate the ultimate load,  $Q_{ult}$  by IS code method. Given that  $\phi = 30^\circ$ ,  $c = 0$ ,  $\gamma = 18.5\text{kN/m}^3$ ,  $N_c = 30.14$ ,  $N_q = 18.4$ ,  $N_\gamma = 22.4$ . (12)
- b) List the different methods of analyses of raft foundations? Explain the any one method in detail. (3)
- 3 a) Explain the effect of water table on the bearing capacity of soil. (5)
- b) A footing 4m x 2m in plan, transmits a pressure of  $150\text{ kN/m}^2$  on a cohesive soil having  $E = 6 \times 10^4\text{ kN/m}^2$  and  $\mu = 0.50$ . Determine the immediate settlement of the (5)

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footing at the centre, assuming it to be (i) a flexible footing (ii) a rigid footing.

Given that  $I_f = 1.52$  for a flexible footing and 1.20 for a rigid footing.

- c) Explain the concept of floating foundation with neat sketch. (5)

### PART B

*Answer any two full questions, each carries 15 marks.*

- 4 a) A 12m long 300mm diameter pile is driven in a uniform deposit of sand ( $\phi = 40^\circ$ ). The water table is at a great depth and not likely to rise. The average dry unit weight of sand is  $18\text{kN/m}^3$ . Take  $N_q = 137$ . Calculate the safe load capacity of the pile with a factor of safety of 2.5. Use IS code method.  $K=2$  and  $\delta=\phi$  (10)

- b) What are undreamed piles? What are the applications of under reamed piles? (5)

- 5 a) A concrete pile of 45 cm diameter is driven through a system of layered soils. (8)  
The length of the pile is 15m. The following data are available. The water table is close to the ground surface.

**Top layer 1:** Soft clay, thickness = 9m, unit cohesion  $C_u = 30\text{kN/m}^2$  and adhesion factor  $\alpha = 0.90$ .

**Layer 2:** Medium stiff, thickness = 4m,  $C_u = 50\text{kN/m}^2$  and  $\alpha = 0.75$ .

**Layer 3:** Stiff stratum extends to a great depth,  $C_u = 110\text{kN/m}^2$  and  $\alpha = 0.50$ .

Compute  $Q_u$  and  $Q_a$  with factor of safety 2.5.

- b) Write the detailed procedure to separate point resistance and skin friction resistance from the cyclic pile load test data. (7)
- 6 a) The following data refers to a pile load test carried out on a 300mm diameter and 10 m long pile. (12)

Load on pile top (kN)	150	200	250	300	400	500	600
Total settlement of pile top (mm)	1.45	2.25	2.75	3.6	5.75	10.75	30
Net settlement of pile top (mm)	0.40	0.65	0.80	1.0	1.70	5.25	22.80

Plot the load settlement curve and estimate the allowable load of the pile as per Indian Standard Code of Practice.

- b) Differentiate between CRP and MLT related to pile load testing. (3)

**PART C**

*Answer any two full questions, each carries 20 marks.*

- 7 a) What are the permissible limits of tilts and shifts? Describe any four methods to prevent tilts and shifts. (8)
- b) With the help of neat sketch explain different components and functions of well foundation. (6)
- c) List the steps involved in well sinking. (6)
- 8 a) A group of 9 piles 400mm diameter and 12m long is arranged in a square pattern is installed in a medium to dense sandy deposit of 13m thickness below which a normally consolidated clay deposit of 3m thickness is found. The pile group carries a load of 1800kN in which 60% of the load is taken by skin friction. Estimate the consolidation settlement of the clay layer, if it has got a liquid limit of 55%, initial void ratio of 1.1. Water table is at ground level.  $\gamma_{\text{sat}} = 18.5 \text{ kN/m}^3$  for sand and  $20 \text{ kN/m}^3$  for clay. (15)
- b) List the different methods of construction of drilled piers and explain any one method in detail. (5)
- 9 a) A square pile group consisting of 16 piles of 40 cm diameter passes through two layers of compressible soils. The thicknesses of the layers are :  $L_1 = 2.5 \text{ m}$  and  $L_2 = 3 \text{ m}$ . The piles are spaced at 100 cm center to center. The properties of the fill material are: top fill  $c_u = 25 \text{ kN/m}^2$ ; the bottom fill (peat),  $c_u = 30 \text{ kN/m}^2$ . Assume  $\gamma = 14 \text{ kN/m}^3$  for both the fill materials. Compute the negative frictional load on the pile group. Take adhesion factor 1. (10)
- b) With the help of equations define the terms thickness of well steining and grip length. (5)
- c) Explain with a neat sketch, the basis of analysis of lateral stability of well foundations. (5)

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