COURSE CODE (CREDITS): 18B11CE514(3)   MAX. MARKS: 35

COURSE NAME: Foundation Engineering

COURSE INSTRUCTOR: Dr. Saurabh Rawat   MAX. TIME: 2 Hours

Note: All questions are compulsory. Marks are indicated against each question in square brackets. Assume data as per IS codes wherever necessary.
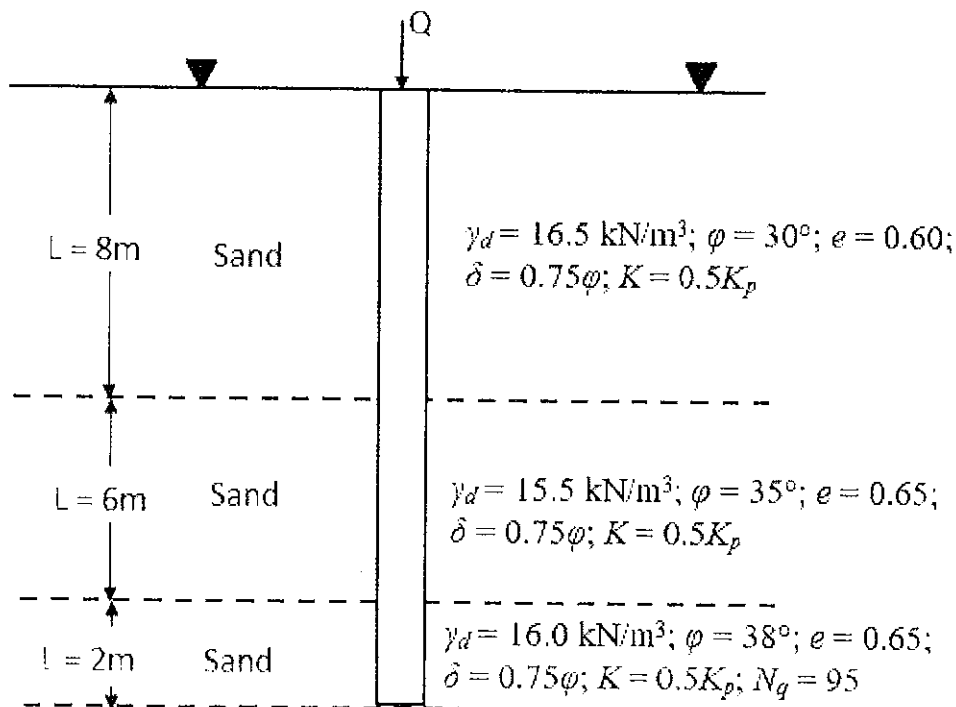
Q1. A reinforced concrete pile weighing 30kN (with dolly) is driven by a drop hammer weighing 40 kN and having an effective fall of 0.8 m. The average set per blow is 1.4 cm. The total temporary elastic compression is 1.8 cm. Assuming the coefficient of restitution as 0.25 and a factor of safety of 2, determine:

a) The ultimate bearing capacity

b) The allowable load for the pile.   (CO - 5) [3+2=5]

Q2. A concrete pile of 45 cm diameter is driven to a depth of 16 m through a layered system of sandy soil (c = 0). The following data are available as shown in the profile below:

L = 8m	Sand	γ_d = 16.5 kN/m³; φ = 30°; e = 0.60; δ = 0.75φ; K = 0.5K_p
L = 6m	Sand	γ_d = 15.5 kN/m³; φ = 35°; e = 0.65; δ = 0.75φ; K = 0.5K_p
L = 2m	Sand	γ_d = 16.0 kN/m³; φ = 38°; e = 0.65; δ = 0.75φ; K = 0.5K_p; N_q = 95

Calculate the value of Q_{up} and Q_{ap} with F_s = 2.5.   (CO - 5) [4+1= 5]

Q3. In reference to field testing of piles, explain the difference between an 'initial pile test' and 'routine test'. Also define the basis on which the piles are classified as 'test pile' and 'working pile'. State the IS code of practice for Pile load test and describe the criteria for allowable load on single and group of piles. $(CO - 5)$ $[1+1+1+1= 4]$

Q4. A square footing 1.2 m × 1.2 m rests at a depth of 1 m in a saturated clay layer 4m deep. The clay ($\varphi = 0$) is normally consolidated, having an unconfined compressive strength of 40 kN/m^2. The soil has a liquid limit of 30%, $\gamma_{sat} = 17.8$ kN/m^3, $w = 28\%$. $e_0 = 0.75$ and $G = 2.68$. Determine the load which the footing can carry safely with a factor of safety of 3 against shear. Also, determine the settlement if the footing is located with this safe load. Use Terzaghi's analysis for bearing capacity.

$$(CO - 1; CO - 2; CO - 3; CO - 4) [2 + 3 = 5]$$

Q5. A pile group consists of 9 friction piles of 30 cm diameter and 10 m length are driven in clay having the following properties: $c_u = 100$ kN/m^2, $\gamma = 20$ kN/m^3. The 3 × 3 pile group has a plan area of 1.8 × 1.8 m with c/c pile spacing of 0.75 m. Determine:

a) The efficiency of the pile group

b) The safe load for the group with Fs = 3 and $\alpha = 0.6$

$$(CO - 3; CO - 4; CO - 5) [3 + 3 = 6]$$

Q6. A retaining wall 6 m high supports earth with its face vertical. The earth is cohesionless with particle specific gravity of 2.65, $\varphi = 35°$, and porosity 40.5%. The earth surface is horizontal and level with the top of the wall. Determine the earth thrust and its line of action on the wall if the earth is waterlogged to level 2.5 m below the top surface. Neglect the wall friction. $(CO - 1; CO - 2) [2 + 2 = 4]$

Q7. Consider the following site condition:

      Layer 1: Fill soil of thickness L_1 and unit weight γ_1

      Layer 2: Soft clay of thickness L_2 and unit weight γ_2

      Layer 3: Stiff clay of thickness L_3 and unit weight γ_3

You are required to design a group of 'n' piles for the site. Kindly explain with the help of a diagram the mechanism of load transfer for the following site condition, expressions to be used and selection criteria for the design load. Take P_g = perimeter of the pile group; A_g = area of the pile group within perimeter P_g and τ = shear strength of the soil along P_g. $(CO - 1; CO - 2; CO - 4; CO - 5) [3 + 2 + 1 = 6]$