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Code : 011722

B.Tech. 7th Semester Exam., 2014

FOUNDATION ENGINEERING

Time : 3 hours *Full Marks* : 70

Instructions :

(i) Marks are indicated in the right side margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

(iv) Question No 1 is compulsory.

(v) Assume any suitable data, if required.

1. Choose the correct answer any *seven* of the following : 14

(a) The standard penetration test is useful to measure

(i) shear strength of soft clay

(ii) shear strength of sand

(iii) consistency of clay

(iv) None of the above

(b) The bearing capacity of soil supporting a footing of size 3 m × 3 m will not be affected by the presence of water table located at a depth below the base of footing of

(i) 1·0 m

(ii) 1·5 m

(iii) 3·0 m

(iv) 6·0 m

(c) A pile foundation is used when

(i) the loads are heavy

(ii) the soil stratum near ground surface is weak

Both *(i)* and *(ii)*

(iv) Neither *(i)* nor *(ii)*

(d) The negative skin friction on a pile develops when the

(i) soil in which it is driven is sandy soil

(ii) soil surrounding it settles more than pile

(iii) groundwater table rises

(iv) soil near the tip is clay

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(e) The group efficiency of driven piles in sand at a close spacing may be
  (i) equal to 100%
  (ii) greater than 100%
  (iii) well below 100%
  (iv) None of the above

(f) Pneumatic caissons are used where the soil flow into the excavated area of an open caisson is
  (i) faster than it can be removed
  (ii) slower than it can be removed
  (iii) negligible
  (iv) zero

(g) The floating caissons generally
  (i) have greater load-carrying capacity than open caissons
  (ii) have greater depth below the ground surface than open caissons
  (iii) are less expensive than open caissons
  (iv) have poorer quality of construction than open caissons

(h) The frequency of a system increases with
  (i) an increase in stiffness of system
  (ii) a decrease in the mass of system
  (iii) Both (i) and (ii)
  (iv) Neither (i) nor (ii)

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(i) For most soils, the limiting amplitude for low-speed machines is usually
  (i) 0·1 mm
  (ii) 0·2 mm
  (iii) 0·5 mm
  (iv) 1·0 mm

(j) For diesel engines, the ratio of foundation mass to engine mass is
  (i) less than 2·0
  (ii) between 2·0 and 3·0
  (iii) between 3·0 and 4·0
  (iv) greater than 4·0

2. (a) Define the net and gross safe bearing capacity and net safe settlement pressure. 6

(b) Determine the allowable gross load and the net allowable load for a square footing of 2·5 m side and with a depth of foundation of 1·5 m. Use Terzaghi's theory and assume local shear failure. Take a factor of safety of 3·0. The soil at site has $\gamma = 18\ kN/m^3$, $c = 15\ kN/m^2$ and $\varphi = 30°$. The values of bearing capacity factors are $N_c = 19{\cdot}0$, $N_q = 8{\cdot}3$, $N_\gamma = 5{\cdot}7$. 8

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3. *(a)* What are different types of settlement which can occur in a foundation? 7

(b) A rectangular footing (4 m × 2 m) exerts a pressure of 100 kN/m^2 on a cohesive soil ($E_s = 5 \times 10^4$ kN/m^2 and $\mu = 0.50$). Determine the immediate settlement at the centre, assuming *(i)* the footing is flexible, $I = 1.53$ and *(ii)* the footing is rigid, $I = 1.2$. 7

4. *(a)* What are the conditions where a pile foundation is more suitable than a shallow foundation? 5

(b) A pile group consists of 9 friction piles of 30 cm diameter and 10 m length driven in clay ($C_u = 100$ kN/m^2, $\gamma = 20$ kN/m^3). Centre-to-centre spacing between piles is 0.75 m, there are 3 piles in each row. Determine the safe load for the group (FS = 3, $\alpha = 0.6$). 9

5. *(a)* Define caisson. What are different types of caisson? 6

(b) Determine the outside diameter of an open caisson to be sunk through 40 m of sand and water to bedrock if the allowable bearing capacity is 2000 kN/m^2. The caisson receives a load of 50 MN from superstructure. The mantle friction is 30 kN/m^2. Test the feasibility of sinking. 8

6. *(a)* What are the components of a well foundation? What are their uses? 6

(b) A circular well of 6 m external diameter and 4 m internal diameter is embedded to a depth of 15 m below the maximum scour level in a sandy soil deposit. The well is subjected to a horizontal force of 800 kN acting at a height of 8 m above the scour level. Determine the allowable total equivalent resisting force due to earth pressure, assuming *(i)* the rotation is about a point above the base and *(ii)* the rotation is at the base. Take $\gamma_{sub} = 20$ kN/m^3, $\Phi = 30°$, factor of safety for passive resistance = 2. Use Terzaghi's analysis, $K_p = 3.0$ and $K_a = 0.333$. 8

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7. *(a)* Explain the terms natural frequency, free vibration, resonance and damping. 6

(b) Determine the coefficient of uniform compression if a vibration test on a block 1·5 m × 1·5 m × 1·5 m gave a resonance frequency of 40 Hz in the vertical direction. The mass of the oscillator used was 75 kg. 8

8. *(a)* What is meant by vibration isolation? How is it done? 7

(b) What is negative skin friction? What is its effect on the pile? 7

9. Design a square reinforced concrete footing for the column load of 1000 kN, allowable soil pressure = 200 kN/m^2 and the size of the column 0·4 m × 0·4 m. 14

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