011722 Foundation Engineering 2015

Time : 3 hours   **Full Marks** : **70**

Instructions :

(i) *The marks are indicated in the right-hand 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. Answer any *seven* questions from the following :   2×7=14

   (a) For an undisturbed sample, the area ratio of the samples should be
      (i) zero
      (ii) 10% or less
      (iii) 10% to 20%
      (iv) more than 20%

   (b) In-situ vane shear test is used to measure shear strength of
      (i) very soft and sensitive clays
      (ii) stiff and fissured clays
      (iii) sandy soils
      (iv) All of the above

AK16/375   (*Turn Over*)

   (c) Single-sheet pile cofferdams are suitable up to a height of
      (i) 5 m
      (ii) 10 m
      (iii) 15 m
      (iv) more than 15 m

   (d) A shallow foundation is usually defined as s foundation which has
      (i) depth less than 0·6 m
      (ii) depth less than its width
      (iii) depth less than 1·0 m
      (iv) None of the above

   (e) The allowable soil pressure for foundations in cohesive soils is generally controlled by
      (i) settlements
      (ii) bearing capacity
      (iii) Both (i) and (ii)
      (iv) Neither (i) nor (ii)

   (f) Trapezoidal combined footings are required when
      (i) space outside exterior column is limited
      (ii) exterior column is heavier
      (iii) Both (i) and (ii)
      (iv) Neither (i) nor (ii)

AK16/375   (*Continued*)

(g) The load-carrying capacity of a pile depends upon the

    (i) skin friction

    (ii) point resistance

    (iii) Both (i) and (ii)

    (iv) Neither (i) nor (ii)

(h) 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

(i) The maximum depth of a pneumatic caisson is usually limited to

    (i) 10 m

    (ii) 20 m

    (iii) 80 m

    (iv) 40 m

(j) 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

2. Describe various methods of drilling holes for subsurface investigation and where it is used.   14

3. (a) Differentiate between the general shear failure and the local shear failure.   5

    (b) A square foundation $1·5 \text{ m} \times 1·5 \text{ m}$ is located at a depth D_f of $0·7$ m in sand material having $\phi' = 30°$ and $\gamma = 18 \text{ kN/m}^3$. Assume that the one-way load eccentricity $e = 0·15$ m. Determine the ultimate load, Q_{ult}.

    For $\phi' = 30°$, $N_q = 18·4$ and $N_\gamma = 22·4$.   9

4. (a) Discuss the sharing of loads in a pile group.   5

    (b) A 40 cm diameter pile, 12 m long, has a bell of 2·5 m diameter and 1 m height. If the soil has $\phi' = 25°$, $c_u = 25 \text{ kN/m}^2$ and $\gamma = 18 \text{ kN/m}^3$, estimate the allowable pull out resistance (FS = 3). Take the value of $H/B_1 = 3·0$ and $s_f = 1·3$.   9

5. (a) What are the general criteria for design of machine foundation?   6

(6)

(b) A 3·5 Mg vertical compressor foundation system is operated at 40 Hz. The soil at the site is medium stiff clay ($C_u = 4 \times 10^4$ kN/m^3). Determine the natural frequency and the magnitude factor, assuming $m_s = 0.3\, m_f$. The base area is 3 m^2. Take $D = 0$.   8

6. (a) What do you understand by grip length? What is its importance in well foundation?   6

(b) A circular well of 5 m external diameter and 3 m internal diameter is embedded to a depth of 12 m below the maximum scour level in a sandy soil deposit. The well is subjected to a horizontal force of 600 kN acting at a height of 6 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

7. Check the stability of a floating caisson 10·5 m high and having a rectangular base 20 m × 9 m. The weight of the caisson is 9 MN and its centre of gravity is 4·0 m above the base. If the caisson is unstable, how would you make it stable? Take unit weight of water as 10·25 kN/m.   14

8. (a) What is a cofferdam? Name the different types of cofferdams.   6

(b) Determine the ultimate bearing capacity of a strip footing, 1·5 m wide and having the depth of foundation of 1·0 m. Use Terzaghi's theory and assume general shear failure. Take $\phi = 30°$, $\gamma = 18$ kN/m^3, and $c' = 15$ kN/m^2, $N_c = 37.2$, $N_q = 22.5$, $N_\gamma = 19.7$.   8

9. Design a square reinforced concrete footing for the column load of 1000 kN, allowable soil pressure = 250 kN/m^2 and the size of the column 0·4 m × 0·4 m.   14

★ ★ ★