B.E. (CE) Part-IV 7th Semester Examination, 2007

Foundation Engineering (CE 703)

Time : 3 hours **Full Marks : 100**

Answers to different halves to be written in separate answer-scripts.

FIRST HALF

Attempt Q. No. 1 and any two from the rest

1. (a) Distinguish between general and local shear failures of shallow foundations with the help of net sketches of typical load-settlement curves for each case.

(b) Briefly discuss the effect of foundation width on the ultimate bearing capacity of a shallow foundation in (i) clay (ii) sand.

(c) A square footing of width 2.5 m is to be founded at a depth of 1.2 m below G.L. The subsoil consists of loose to medium sand, which is overlain by a 0.8 m thick layer of filled up soil (γ=15.5 kN/m^3). The average properties of sand are: c=0, φ=25°, γ=17.8 kN/m^3. Determine the ultimate and safe bearing capacities of the footing. Use Terzaghi's equation. The factor of safety may be taken as 3.0. The values of bearing capacity factors φ=25° are given below:

N_c= 25.1, N_q= 12.7, N_γ = 9.7, N_c'= 14.8, N_q'= 5.6, N_γ'= 3.2 **[18]**

2. (a) Discuss the effects of submergence on the bearing capacity of a shallow foundation.

(b) A square footing of 2 m width is placed at 1 m below G.L. in a deep bed of homogeneous clay for which the average properties are as follows:

moist density=17.5 kN/m^3
saturated density=18.3 kN/m^3
specific gravity of solids=2.72
moisture content below water table=31%
liquid limit=48%

The column supported by the footing has to carry a gross load of 250 kN, inclusive of the weight of the column. Estimate the probable consolidation settlement of the footing by dividing the consolidating layer of soil into at least two sub-layers of suitable thickness. Given, the oedometer correction factor=0.85 and the depth correction factor=0.8. **[16]**

3 (a) How can you estimate the settlement of shallow footings founded in (i) clay (ii) sand, from the results of a plate load test?

(b) Two identical columns of a building, each having a cross-section of 250 mm x 250 mm and spaced at a centre-to-centre distance of 4.5 m from each other, are to be supported by a combined footing. The gross loads on the columns (inclusive of their self-weights) are 480 and 730 kN. Due to space restrictions, the footing can not be projected beyond a distance of 0.6 m from the outer edge of the column carrying the greater load. Proportion a suitable trapezoidal footing for the columns. The allowable bearing pressure may be taken as 65 kN/m^2. **[16]**

4(a) Draw typical sectional plan and vertical cross-section of a strap footing. Under what circumstances are such footings adopted?

(b) Enumerate, with neat sketches, various types of machine foundations.

(c) Derive an expression for the natural frequency of an ideal spring-mass system subjected undergoing a free vibration with damping. [16]

5(a) Briefly describe the block vibration test. How the results of this test are useful in designing a machine foundation?

(b) A machine operating at 1800 rpm is to be supported by a concrete block of dimensions 2.5 m x 2.5 m x 1.2 m (H). The weight of the machine is 7.5 kN. A block vibration test was performed at the site with an oscillator weighing 45 kg being supported by a cubical concrete block having a width of 0.70 m. Resonance occurred when the operating frequency of the oscillator reached 1000 rpm. Determine the natural frequency and the frequency ratio of the prototype machine foundation. [16]

SECOND HALF

(Answer Q.No.6 and TWO from the rest.)

6. (a) Enumerate the types of piles used in construction practices based on their installation techniques.

(b) A 400 mm diameter circular pile of 20 m long is driven into a deposit of medium dense sand ($\phi = 36°$, $N_\gamma = 40$ and $N_q = 42$). The unit weight of sand is 15 kN/m^3 . What is the allowable load assuming a factor of safety of 3? Assume the lateral earth pressure coefficient is 0.65.

(c) Discuss efficiency of pile group. [18]

7. (a) Explain the factors to be considered while assuming the spacing of piles in a pile group for design of pile foundation.

(b) A square group of 16 piles extends between 2 m to 16 m in a deposit of 20 m thick stiff clay overlying rock. The piles are 0.5 m in diameter and are spaced at 1 m c/c in the group. The undrained shear strength of the clay at the pile base level is 180 kPa and the average values of undrained shear strength over the depth of the pile is 120 kPa. The adhesion factor is 0.45. Estimate the capacity of the pile group considering an overall factor of safety equal to 3 against shear failure. [16]

8. (a) Explain the pile load test briefly.

(b) A group of 25 piles (300 mm diameter) has to support a vertical axial load of 2500 kN. The piles are driven into clay and have a length of 12 m. The thickness of clay stratum is 16 m. The clay is followed by rock. The clay is normally consolidated and has a liquid limit of 60. Its specific gravity is 2.70. The water table is at the ground surface itself. Compute the settlement of the pile group. [16]

9. (a) Enumerate the types of well foundation along with their advantages and disadvantages.

(b) A circular well of 5 m external diameter and steining thickness of 1.2 m is used as a foundation for a bridge pier in a sandy stratum . The submerged unit weight of sand is 10 kN/m^3 and the angle of shearing resistance is 33°. The well is subjected to a horizontal force of 550 kN and a total moment of 5000 kN-m at the scour level. Find out the depth of the well below scour level from stability consideration. **[16]**

10. (a) Explain the precautions and the remedial measures to be used to take care tilt and shift of well foundation during construction.

(b) Deduce the expression for grip length of well foundation in cohesive soils. **[16]**
