BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
II Semester 2022-2023
Course: CE F429 DESIGN OF FOUNDATION SYSTEM
Comprehensive Examination (OPEN BOOK)
Duration:3 Hours Dated: 12-05-2023 Max. Marks: 45

Q1. Find vertical settlement, rotation and horizontal displacement of a rectangular footing (12 m x 24 m) subjected to a moment of 45000 kN-m, horizontal load=3000 kN and vertical load = 12500 kN at the center of footing base. Moment is acting about an axis parallel to short side and passing through center of footing base. Horizontal load is parallel to long side. The soil parameters are G_S = 15.7 MPa, υ = 0.26. **[6 Marks]**

Q2. A rectangular footing 2.5 m x 5 m (designed for the column whose center coincides with the center of footing) is subjected to biaxial moments of My=331.5 kN-m (about an axis parallel to 2.5 m side and axis is passing through CG of footing) and Mx = 153 kN-m (about an axis parallel to 6 m side and axis is passing through CG of footing) as well as vertical load of 204 kN. Assess whether the footing is under tension or compression. Find the maximum pressure below foundation under applied loads. **[3 Marks]**

Q.3 Draw the pressure distribution at the base of ring foundation for a water tank. The foundation has been subjected to vertical load (P) of 4800 kN and and Moment (M) of 6000 kN-m due to wind load. Outer and inner diameters of the ring foundation are 10 m, and 6 m respectively. Net allowable bearing pressure q_{all} is 118 kPa as IS codes. Check safety of foundation. If foundation is unsafe, make it safe by changing inner diameter of foundation. Draw pressure distribution after changing inner diameter. **[6 marks]**

Q4.A reinforced concrete (M35 grade) bored pile 1 m diameter in section constructed into a submerged sand to a depth of 5.5 m. given: design SPT value 16. The submerged unit weight of the soil is 8.75 kN/m3. A lateral load of 250 kN is applied on the pile head at ground level. (a) If pile is free, compute the lateral deflection at ground level under applied load. Find the maximum moment in the pile and its location also. (b) If pile head is fixed, compute the lateral deflection at ground level under applied load. Find the maximum moment in the pile and its location also. **[7marks]**

Q5. A concrete foundation (unit weight = 24 kN/m^3) supporting a machine is 6 m x 3 m in plan and is subjected to a sinusoidal vibrating force (vertical) having an amplitude of 75 kN (not frequency dependent). The operating frequency is 2000 rpm. The weight of the machine and foundation is 500 kN. The soil properties are unit weight = 16 kN/ m3, soil shear modulus G applicable for foundation = 15MPa, and Poisson' ratio = 0.25. Determine the amplitude of vertical vibration at operating frequency using elastic half space theory by including damping as per ACI351.3R-2018. Check design is safe or not? **[4 marks]**

Q6. A bridge retaining wall 7 m high is inclined 10° (away from back fill) to vertical and retains an inclined dry backfill (i = 10°) with following properties. γ = 17 kN/m^3, $\emptyset$' = 30°, c'=14 kPa. There is superimposed load intensity of 20 kPa on the backfill. Assume A_h=0.15, Av=0.075. Find static and seismic earth pressure with point of application. Draw neat sketches showing all components with point of application. Use IS1893-(Part3) 2014. **[6M]**

Q7. Find the safe thickness of the isolated rectangular footing by one-way shear (assume 0.5% steel), two-way shear and flexure for the column (size 400 mm x 600 mm) subjected to a factored axial force of Vu = 1200 kN and factored moment of Mu = 1000 kNm. Assuming 4 m length and 3 m width of foundation is worked out safe and the center of column coincides with the center of footing. Take M 25 grade concrete and 18 mm bars of Fe 500 grade steel for both footing and column. Assume 12 m dia bar for short span flexure reinforcement. Assume clear cover 50mm. Design and detail flexural reinforcement in both directions. Draw neat sketch showing all detailing. **[8 marks]**

Q8. Determine the immediate settlement under a rigid R.C.C. foundation of 12 m x 6 m size resting on clay layer at a depth of 2m from ground level and transmitting a pressure of 60 kPa. After detailed site investigation it is found that top 4 m (from ground level) clay layer is having E =40 MPa after that there is a 6 m thick clay layer having E =12.5Mpa and μ =0.4, below which a rough rigid rock mass exist. **[4 marks]**

Q9. What are the shortcomings for design of tie-beam in IS1893 and IS4326? and what are the suggested guidelines to address these shortcomings? **[3 marks]**

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