BIRLA INSITUTE OF TECHNOLOGY AND SCIENCE, PILANI (RAJ.)
FIRST SEMESTER, 2023-2024
CE G620 ADVANCED FOUNDATIONS ENGINEERING
COMPREHENSIVE EXAMINATION (Closed Book)
Duration: 180 minutes Dated: 15-12-2023 Max. Marks: 35

Only Formulae Sheet, tables, charts, graphs, IS and IRC codes are Allowed.

Q1. Discuss need and necessity of Pile load test. What are the recommendations of IS2911 for need and necessity of pile load test and why? What is the role of structural engineer related to pile load test, explain briefly. **[2 Marks]**

Q2. What is the lowest cost testing procedure for finding safe bearing capacity and settlement of shallow foundation/combine footings with width ranging from 2 m to 5 m resting on dry deep deposit of loose to medium dense sand and why? List various tests (lab/field) to be performed and provide details of data/parameters from these tests will be used**. [2 marks]**

Q3. What are guidelines for accounting traffic load for design of retaining walls and abutments? In which case traffic load may be neglected? Why point of application of earth pressure due to dry backfill is recommended at a height of 0.42 times height of backfill soil? Explain. **[2 marks]**

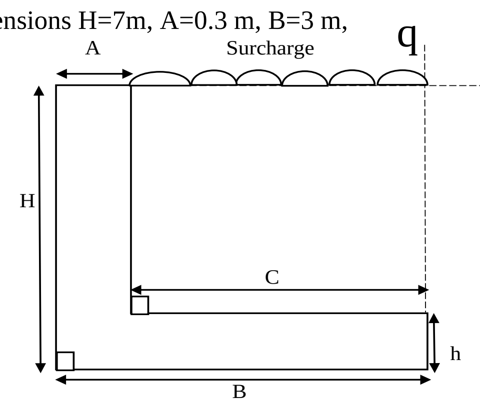
Q4. A free head reinforced concrete (M40) pile 2 m diameter in section is constructed into a dry sand to a depth of 6 m. The sand is in a dry state with design SPT value of 14. A lateral load of 300 kN and moment 6000 kN-m is applied on the pile at ground level. (a)Compute the lateral deflection of the pile at ground level (b) Find maximum moment in pile and its location. At what depth moment will become zero. The unit weight of the soil is 18 kN/m^3 . To reduce deflection, structural engineering provided fixed head condition, calculate reduction in deflection. **[6 marks]**

Q5. 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 12m side and passing through center of footing base. Horizontal load is parallel to 24 m side and passing through center of footing base. The soil parameters are G_S = 15.7 MPa, υ = 0.26. **[5 Marks]**

Q6. Find the safe thickness of the isolated rectangular footing by one-way shear (assume 0.25% steel), two-way shear and flexure for the column (size 400 mm x 400 mm) subjected to a factored axial force of P_u = 1800 kN and factored moment of M_u = 1260 kNm due to earthquake. Assuming 3.5 m length and 3.0 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 Fe 500 grade steel for both footing and column. Assume 20 mm dia bar for long reinforcement and 16 mm for short direction. Assume 75 mm clear cover. Design and detail flexural reinforcement in both directions. Draw neat sketch showing all detailing. Use N for force, mm for dimension, N/mm^2 for pressure. **[8 marks]**

Q7. A rectangular footing 2.5 x 5 m (designed for the column whose center coincides with the center of footing) is subjected to biaxial moments of My=1397 kN-m (about an axis parallel to2.5 m side and axis is passing through CG of footing) and Mx = 167 kN-m (about an axis parallel to 5 m side and axis is passing through CG of footing) as well as vertical load of 1330 kN. Assess whether the footing is under uplift or full compression. Find maximum pressure and contact area of footing. Draw the properly dimensioned plan of the foundation (with suitable depiction of zero pressure line) and pressure distribution. **[5 Marks]**

Q8. A L shape reinforced concrete retaining wall situated in sesimic zone V is having dimensions H=7m, A=0.3 m, B=3 m, h=0.4m. Surcharge q=18 kPa imposed due to traffic load. Draw pressure distribution at base taking into account the earthquake forces. Backfill is dry sand having unit weight γ = 18 kN/m^3, c'=0, Φ' = 38˚. Soil below retaining wall base is same as backfill. Allowable bearing pressure = 250 kPa. Use IRC 6-2017.Take $Ka)_{static}$=0.21659, $Ka)_{dyn}$=0.35248. **[6 marks]**



Q9. A radar antenna concrete foundation (unit weight = 24 kN/m^3) supporting a machine is 15.2 m dia. and 2.5 m high and is subjected to a sinusoidal vibrating force (torsional about vertical axis) having an amplitude of 250 kN-m. The mass moment of inertia of the tower about the vertical axis is 13000000 kg-m^2. The soil properties are unit weight = 17.6 kN/ m^3, shear modulus = 135,000 kPa, and Poisson' ratio = 0.25. Determine resonating frequency for torsional mode and angular deflection at resonance using elastic half space theory including damping. **[6 marks]**

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