BIRLA INSITUTE OF TECHNOLOGY AND SCIENCE, PILANI (RAJ.)
FIRST SEMESTER, 2022-2023
CE G620 ADVANCED FOUNDATIONS ENGINEERING
COMPREHENSIVE EXAMINATION (Closed Book)
Duration: 180 minutes Dated: 24-12-2022 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 role of structural engineer related to pile load test, explain briefly. **[2 Marks]**

Q2. What are the criterion given in IS 4998:2015 for rigid foundation analysis of chimney foundations? **[2 Marks]**

Q3. What are the guidelines for design of tie-beam in IS1893 and IS4326? What are the shortcomings and suggested guidelines to address these shortcomings? **[3 marks]**

Q4. Which is most suitable anti-liquefaction measures for new industry away from existing habitation and why? Which technique is most suitable for a new multi-storey building in urban environment with environment protection and why? **[2 Marks]**

Q5. As per IS1893-part1-2016, allowable pressure of soil to be increased by 50% for Type A soil for earthquake load combinations, do you think these guidelines are appropriate as per recent developments for evaluation of seismic bearing capacity? Justify your answer. What are your recommendations to improve these guidelines? **[2 marks]**

Q6. Find vertical settlement, rotation and horizontal displacement of a rectangular footing (12 m x 12 m) subjected to a moment of 45000 kN-m, horizontal load=3000 kN and vertical load = 12500 kN at the center of footing base. The soil parameters are G_S = 15.7 MPa, υ = 0.26. **[5 Marks]**

Q.7 Find the optimum dimensions of ring foundation for a water tank, with vertical load of 10000 kN (including foundation self-weight) and a moment of 2500 kN-m due to wind load. Diameter of ring beam is 10 m. Take allowable soil pressure 100 kPa obtained as per IS 6403 and 8009-Part 1. **[3 marks]**

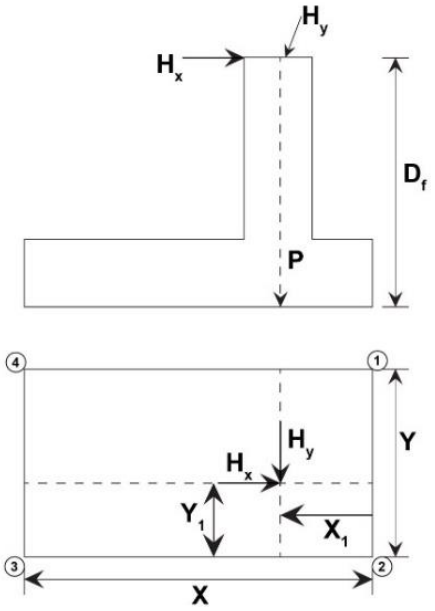
Q8. Design and detail a precast driven reinforced concrete circular pile (diameter = 0.5 m, Length = 15 m) subjected to a factored compressive load of 900 kN and a factored moment of 90 kN-m. Use M25 mix concrete and Fe 415 grade steel. Assume d'/ D=0.15. Transverse reinforcement spacing less than 75 is not permitted. Use minimum possible size of longitudinal and lateral reinforcements. Assume other data suitably as per Indian Standard. Draw neat sketch showing all details. **[5 marks]**

Q9. Consider a 2m diameter and 15 m long reinforced concrete pile of M35 grade. The bored pile is subjected to lateral load of 100 KN at 4m above the ground line. The pile head is free to rotate. The bored pile is embedded in a uniform clay deposit with undrained shear strength of 102 kPa.

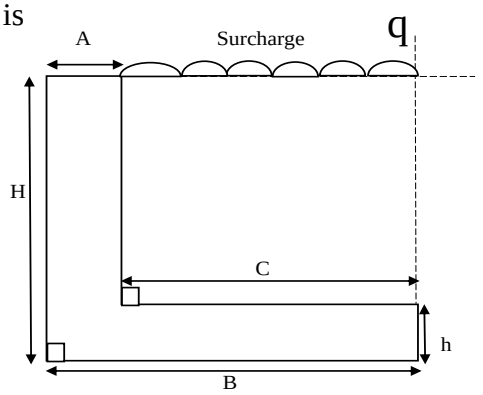
a. Determine the deflection of the pile head at ground level caused by the applied load.
b. Determine the ultimate resistance of the pile. **[4 marks]**

Q10. 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 due to earthquake. Assuming 3.75 m length and 2.55 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 415 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]**

Q11. An isolated footing X= 5 m and Y= 4 m is designed for the column whose center coincides with the center of footing (X=2 X_1 and Y= 2Y_1) is subjected to horizontal forces at height of D_f = 2m from base of footing as shown in figure (not to the scale) Hx = 900 kN and H_Y = 300 kN, as well as vertical load P = 2100 kN. Uplifting of footing is allowed. Find pressure at corner 1, 2, 3 and 4 at base of footing. Draw the pressure distribution at the base. If uplifting occurs, draw zero pressure line. **[5 marks]**



Q12. 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. Calculate the factor of safety with respect to sliding taking into account the earthquake forces. Backfill dray sand 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. **[4 marks]**



Q13. A concrete foundation (unit weight = 24 kN/m^3) supporting a machine is 3.5 m x 2.5 m in plan and is subjected to a sinusoidal vibrating force (vertical) having an amplitude of 50 kN (not frequency dependent). The operating frequency is 2000 rpm. The weight of the machine and foundation is 400 kN. The soil properties are unit weight = 16 kN/ m3, soil shear modulus G applicable for foundation = 16000 kPa, 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]**

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