BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
I Semester 2023-2024
Course: CE F419 GEOTECHNICAL EARTHQUAKE ENG. AND MACHINE FOUNDATION
Mid Semester Examination
Duration: 90 min. Dated: 13-10-2023 Max. Marks: 30 Weightage :30%

PART A CLOSED BOOK

Q1. Why allowable bearing pressure (determined as per IS:6403, IS:1888 for static loads) is increased up to 50% as per IS1904, when considering dynamic forces such as due to wind and earthquake in addition to dead load and live load? Is dynamic bearing capacity (due to earthquake loading) of soil less or more compare to static bearing capacity? And why? As per IS: 2974 (Part I) – 1982, permissible soil stress below the machine foundations shall not exceed 80 percent of the allowable bearing pressure. Are these two codes (IS1904 and 2974) contradicting each other? Explain by numerical example to justify specific percentage increase or decrease in allowable bearing pressure. **[4 marks]**

Q2. What is the importance of strain for dynamic properties of soil such as shear modulus and damping in context of machine foundations and seismic analysis of foundations? Draw neat figures/ to explain. Shear modulus obtained by SPT correlation correspond to high strain or low strain, explain. **[3 Marks]**

Q3. Is it necessary to include earthquake forces in proportioning shallow foundations? Explain concept behind neglecting and/ or including earthquake forces. Justify your answer by sample numerical data. **[3 marks]**

PART B OPEN BOOK(you are allowed to start part B in new sheet after submitting part A only)

Q4. A vertical vibration test was conducted on a 1.5 m x 0.75 m x 0.7 m high concrete block in open pit having depth 2 m which equal to anticipated depth of actual foundation (size 3.5 x 3 x 3 m high). Test was repeated at different setting(θ) of eccentricities. Assume mass of oscillator and motor 100 kg.

S.No.	θ(Deg)	f_{nz}(cps)	Amplitude at resonance (mm)
(1)	(2)	(3)	(4)
1	25	38.5	0.0375
2	50	37.5	0.069
3	75	37	0.0975
4	125	36.7	0.182

Soil is sandy with ϕ = 35 degree, Poisson's ratio = 0.35, moist and saturated unit weight γ= 18 and 20 kN/m^3 respectively. The water table is at 3 m from G.L. Mean effective confining stress at a depth of half the width below test block and actual foundation is 30 kPa and 70 kPa respectively. Find value of coefficient of elastic uniform compression for design of actual foundation. Take limiting vertical amplitude as 150 microns. Apply all corrections. **[7 marks]**

Q5. A 2.5 m wide square footing is placed at depth of 1 m in seismic zone V (take k_h = 0.18 and k_v = 0.09 for zone V) is to be checked for bearing failure. Soil investigation report shows soil is poorly graded sand SP (unit weight = 18 kN/m^3, Poison's ratio = 0.35) with a design SPT N value as 36 and corresponding angle of internal friction 37 degree. Find the safe seismic bearing capacity using Budhu and Al-Karni method. Compare the results with guidelines in Indian seismic code (1893: Part 1-2016) and IS 1904. Give your comments on adequacy of Indian codes. Assume water table is very deep. What will be the change in results if it is in Zone II and comparison with IS 1893-part1-2016 guidelines, discuss? **[7 marks]**

Q6. A hospital is to be constructed near a river in Zone III. Site is loose sandy soil (having 4% fines) with $N_1)_{60}$ value of 9 only. It is proposed to improve soil to ensure safety against liquefaction. Find value of $N_1)_{60}$ after soil improvement for no liquefaction as per IS 1893-part1-2016 (Youd et al. approach) at a depth of 2 m from ground level. Expected moment magnitude (Mw) is 7. Assume water table at ground level and unit weight of saturated sandy soil is 18 kN/m^3. Is this value matching with screening criterion given in IS 1893-part1-2016? Comment on adequacy of screening criterion given in IS 1893-part1-2016 based on similarity (or discrepancy) of results. What are most appropriate liquefaction screening guidelines as per Indian code of practices. **[7Marks**]

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