BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE PILANI

First Semester 2023-24
CE F313 (Foundation Engineering) Mid-Semester Examination (Open Book)
Date: October 9, 2023

Duration: 90 mins (2:00 PM to 3:30 PM) **Max. Marks: 70** (+10 bonus)

1) Plot the variation of active pressure and hydrostatic pressure on the retaining wall shown below. Estimate active pressure using Rankine's theory and draw the pressure distribution diagram (mark all relevant depth and pressure values). Determine the total lateral force on the wall. **[20]**

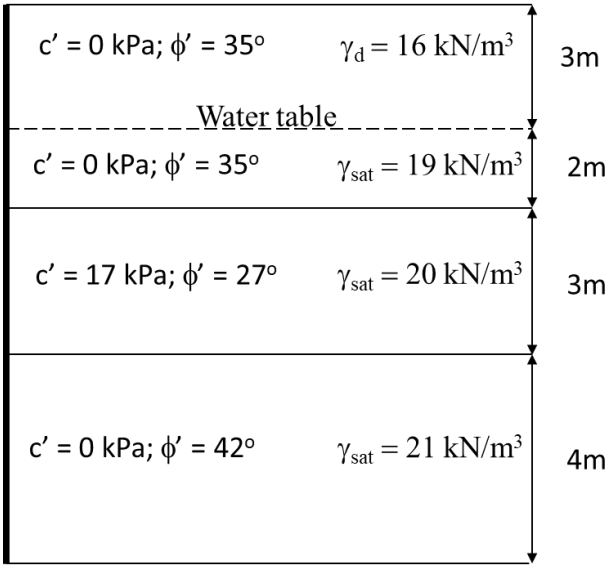

Figure is not drawn to scale.

2) Uncorrected blow counts for SPT conducted at a proposed construction site are provided below. The water table was not encountered while augering and performing the tests. Determine the allowable bearing capacity of a 2 m wide strip footing, assuming that the footing is to be placed at the minimum possible depth below the ground surface where the sand is not in loose/very loose state. Calculate the allowable bearing capacity as per IS code, considering permissible settlement of 25 mm. Assume unit weight of soil is 16 kN/m^3. **[20]**

	Number of blows (uncorrected)		
Depth at which SPT was performed (m)	0 to 6 in.	6 to 12 in.	12 to 18 in.
1	2	3	2
2	2	2	3
3	2	3	4
4	5	6	6
5	14	13	18
5.5	12	22	43
6.5	15	28	30
7.5	33	44	> 50

3) The maximum and minimum void ratios of a sandy soil were 0.9 and 0.4. The saturated water content of the soil was 17% and the specific gravity of soil solids was 2.65. A CU triaxial test was performed on a specimen compacted at field density. The specimen was saturated and then consolidated while using back pressure of 100 kPa and cell pressure of 140 kPa. During the shearing phase, the deviatoric stress at failure was found to be 100 kPa and the pore water pressure transducer read 112.2 kPa. Assuming the water table to be at the ground surface, determine the net safe bearing capacity of a 1 m x 1 m square footing placed at a depth of 4 m below the ground surface, considering a FOS of 3. Use Terzaghi's bearing capacity theory (and not using IS code recommendations). **[20]**

4) What are the major differences between Terzaghi's and general bearing capacity theories? **[5]**

5) Provide explanations/reasonings for the settlement profile expected for a typical flexible footing resting on sand. **[2]**

6) While using Coulomb's method to estimate lateral earth force, why do we search for the maximum active force and minimum passive force among the different trial wedges? **[3]**

7) A 6 m high gravity retaining wall, having cross section shaped like a trapezium with top width of 0.5 m and bottom width of 3 m, will be constructed. The surface of the wall, which will be in contact with the retained soil, will be vertical. The backfill surface will be horizontal, and it is expected to carry a uniformly distributed vertical surcharge stress. Assuming that the backfill and foundation soils will be dry, determine the vertical surcharge stress that can be imposed on the backfill to have FOS of 2 against sliding. The unit weight, effective cohesion, and effective friction angle of the backfill soil and foundation soil are 19 kN/m^3, 50 kPa, and 25^o and 18 kN/m^3, 0 kPa and 35^o, respectively. Unit weight of concrete is 24 kN/m^3. Ignore the contribution of passive force that might be mobilized due to the 1 m soil layer that will be in contact with the front face of the wall. [Bonus 10]