S 9073

Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2006.

Fourth Semester

Civil Engineering

CE 240 — SOIL MECHANICS

Three hours   Maximum : 100 marks

Answer ALL questions.

Use of Taylor's Stability chart is permitted.

PART A — (10 × 2 = 20 marks)

1. If uniformity coefficient of a soil is twice its coefficient of curvature, find the ratio between D_{60} and D_{30}.

2. Why does dry density of soil decrease with increase in water content, when the soil is compacted on the wet side of optimum?

3. The depth of water in river was 10 m, 15 m and 8 m during the months of February, July and December respectively of a particular year. The average saturated unit weight of the soil is 19.81 kN/m³. Assuming that a river bed level does not change, find the effective stress at a depth of 10 m below the riverbed during February, July and December respectively.

4. The discharge and seepage velocities of a soil are 1×10^{-3} cm/s and 2×10^{-3} cm/s. Find the void ratio of the soil.

5. Say true or false and justify your answer : As per Boussinesq's stress distribution theory, greater the modulus of elasticity of soil, less is the additional vertical stress at a given point when all other factors remain the same.

6. Find the ratio between the time for 100% consolidation and that for 50% consolidation, for a consolidating stratum.

7. Find the angle made by failure plane with major principal plane using Mohr's circle and strength envelope.

8. The unconfined compressive strength of a saturated clay is 200 kPa. If a cell pressure of 100 kPa is maintained on a similar specimen of clay in unconsolidated undrained test, find the deviator stress at which the sample will fail.

9. What is the maximum depth of temporary vertical cut that can be made in a purely cohesive soil of unconfined compressive strength 32 kPa and unit weight 16 kN/m³. Taylor's stability number for this case is 0.261.

10. Say true or false and justify your answer. The side slopes of a canal are more critical when their is a sudden drawdown rather than when the canal is running full.

PART B — (5 × 16 = 80 marks)

11. (a) (i) The mass of soil specimen coated with thin layer of paraffin wax is 690.6 g and the mass of soil alone is 683 g. When the paraffin-coated specimen is immersed in water, it displaces 350 cc of water. The specific gravity of solids of the soil is 2.7 and that of wax is 0.89. Find the void ratio and degree of saturation if it has got water content of 17%. (10)

    (ii) Find the ratio between compactive energy used in Standard Proctor Compaction test and that in modified Proctor Compaction test. (6)

Or

    (b) (i) A partially saturated sample of soil has a volume of 60cc and mass of 92 g. The sample is dried in an oven and its dried mass is 73.8 g. If the specific gravity of solids be 2.62, find the degree of saturation, water content and void ratio. (6)

    (ii) A soil has a liquid limit of 45%, plastic limit of 20% and flow index of 50%. Determine its toughness index. If the natural water content is 25%, find its consistency index and comment on the state of its consistency. Also, classify the soil as per BIS if the fraction passing through 75-micron sieve is 60%. (10)

12. (a) (i) Calculate the coefficient of permeability of a soil sample 60 mm in height and 5000 m² in cross sectional area, if a quantity of water equal to 450 cc passed down in 10 minutes under an effective constant head of 400 mm. On oven drying ; the test specimen had a mass of 495 g. Taking the specific gravity of solids as 2.65, calculate the seepage velocity of water during the test. (10)

    (ii) Explain the uses of flownet. (6)

Or

A bed of sand consists of three horizontal layers of equal thickness. The value of coefficient of permeability for the upper and lower layers is 1×10^{-3} mm/s and of the middle layer is 0.1 mm/s. What is the ratio of effective permeability of the bed in the horizontal direction to that in the vertical direction? Derive the equations used, if any. (11)

(ii) If during a permeability test on a soil sample with a falling head permeameter, equal time intervals are noted for drops of head from h_1 and h_2 and again h_2 to h_3, find the relationship between h_1, h_2 and h_3. (5)

(i) The plan of a large circular raft foundation is 20 m in diameter. The central 10 m-diameter area transmits a pressure of 80 kPa and the outer annular area transmits a pressure 0f 200 kPa at the base of the foundation. Find the intensity of vertical stress induced at a point 6 m below the base of the foundation at the centre of the loaded area. (6)

(ii) A stratum of clay with an average liquid limit of 45% is 6m thick. Its surface is located at a depth of 8m below the ground surface. The natural water content of the clay is 40% and specific gravity of solids is 2.7. Between ground surface and the clay, the subsoil consists of fine sand. The water table is at a depth of 4m below the ground surface. The average submerged unit weight of sand is 10.5 kN/m³ and the unit weight of sand above the water table is 17 kN/m³. The weight of the building that will be constructed on the sand above the clay increases the average overburden stress on the clay by 40 kPa. Estimate the probable settlement of the clay layer. (10)

Or

(b) (i) A 10 m thick bed of sand is underlain by a layer of clay of thickness 6 m. The water table that was originally at the ground surface is lowered by drainage to a depth of 4m, whereupon the degree of saturation above the lowered water table reduces to 20%. Determine the change in magnitude of the vertical effective pressure at the middle of the clay layer due to lowering of water table. The saturated unit weights of sand and clay are respectively 20.6 kN/m³ and 17.66 kN/m³ and the dry unit weight of sand 16.68 kN/m³. (10)

(ii) Explain how coefficient of consolidation is determined based on $\sqrt{t}$ vs dial reading method. (6)

4. (a) (i) The sand in a deep deposit has an angle of internal friction of 40°, a dry unit weight of 19.5 kN/m³ and saturated unit weight of 21 kN/m³. If the water table is at a depth of 1.5 m from ground level, what is the shearing resistance of the soil to sliding along a horizontal plane at a depth of 3 m from the ground level? Assume the sand to be dry above the water table. (4)

(ii) The results to triaxial tests conducted on three samples of a soil are given below :

Trial No.	1	2	3
Cell Pressure, kPa	100	200	400
Deviator stress at failure, kPa	280	350	490

Find the shear strength parameters of the soil. (12)

Or

(b) (i) State under what condition the field vane shear test are preferred. (4)

(ii) Two identical specimens of a soil were tested in a triaxial apparatus. First specimen failed at a deviator stress of 770 kPa when the cell pressure was 200 kPa, while the second specimen failed at a deviator stress of 1370 kPa under a cell pressure of 400 kPa. Determine the shear strength parameters.

Also, find the deviator stress at failure when the cell pressure was 600 kPa.

If the same soil is tested in a direct shear apparatus, estimate the shear stress at which the sample will fail under a normal stress of 600 kPa. (12)

15. (a) (i) Prove from the first principles that factor of safety of an infinite slope made of cohesionless soil is independent of height of the embankment and hence find the factor of safety for an infinite slope of cohesionless soil of angle of internal friction of 40°, if the slope angle is 30°. (10)

(ii) Explain with sketches the different ways by which a finite slope may fail. (6)

Or

(b) (i) A proposed cutting in a homogeneous cohesive soil will have a slope angle of 25° and will be 8.0 m deep. Using Taylor's Stability numbers, determine the factor of safety with respect to shear failure if the undrained cohesion, angle of internal friction and unit weight of the soil are respectively 50 kPa, 0° and 19 kN/m^3 if the hard stratum is far below.

If the hard stratum is at a depth of 12 m from the surface, what will be the factor of safety? (10)

(ii) Explain how slope stability analysis on finite slope made of purely cohesive soil is carried out using method of slices. (6)

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