Question Paper Code : P 1140

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2009.

Fourth Semester

(Regulation 2004)

Civil Engineering

CE 1251 — MECHANICS OF SOILS

(Common to B.E. (Part-Time) Third Semester Regulation 2005)

Time : Three hours   Maximum : 100 marks

Use of Taylor's stability chart is permitted.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. If volume of voids is equal to the volume of solids in a soil sample, find void ratio and porosity.

2. Distinguish between relative density and relative compaction.

3. Say true or false and justify your answer: Coefficient of permeability of a soil is independent of temperature.

4. A stratum consisting of fine sand is 2 m thick. Under what head of water, flowing in an upward direction, will a quick sand condition develop. Take specific gravity of solids and void ratio as 2.68 and 0.6 respectively.

5. A circular area of diameter 5 m is subjected to uniformly distributed load. Find the depth of the point along the central line of the loaded area that has vertical stress equal to 30% of the applied loading intensity

6. The ultimate consolidation settlement of a clay layer under one-way drainage is 100 mm. Find its ultimate consolidation settlement under two way drainage.

7. What is meant by 'progressive shear failure'? In which test does it occur?

8. In an undrained triaxial test on a sample of saturated clay the all round pressure is maintained at 100 kPa. The UCC strength is 352 kPa. At what vertical applied stress in addition to the all round pressure, should the sample fail?

9. Find the factor of safety of an infinite slope having an slope angle of 30°. The slope consists of cohesionless soil with angle of internal friction 36°.

10. What are the three critical conditions for which the stability analysis of an earth dam is carried out?

PART B — (5 × 16 = 80 marks)

11. (a) (i) A clay sample having its natural moisture content weighs 0.29 N. After ovendrying, the weight reduced to 0.22 N. Prior to ovendrying, the sample was immersed into mercury and the weight of the displaced mercury was found to be 3.24 N. If the specific gravity of solids be 2.68, find (1) moisture content (2) bulk unit weight (3) dry unit weight (4) void ratio (5) degree of saturation (6) porosity. (12)

    (ii) What is meant by 'Zero air voids line'? What is its significance? (4)

Or

    (b) (i) At 40.2% of moisture content, a soil sample is found to be fully saturated. If the unit weight is 18 kN/m³, determine the void ratio, porosity and specific gravity of soil grains of the sample. (7)

    (ii) The plastic limit of soil is 25% and its plasticity index is 8%. When the soil is oven dried from its state at plastic limit, the volume change is 25% of its volume at plastic limit. Similarly the corresponding volume change from the liquid limit to the dry state is 34% of its volume at liquid limit. Determine the shrinkage limit and shrinkage ratio. (9)

12. (a) (i) A sand stratum is 8 m thick. The water table is at 1 m below ground level. The specific gravity of solids and average void ratio of the sand are 2.7 and 0.7 respectively. The capillary rise above the water table is 1 m. Draw the diagrams showing the variation of total stress, neutral stress and effective stress for the sand stratum. (10)

    (ii) Water is flowing at a rate of 0.05 cc/s in an upward direction through a fine sand sample whose coefficient of permeability is 2×10^{-3} cm/s. The sample thickness is 12 cm and cross sectional area is 50 cm². Find the effective pressure at the middle and bottom sections of the sample, if the saturated unit weight of sand is 19.4 kN/m³. (6)

Or

    (b) (i) A sand deposit 10 m thick overlies an impermeable soil. A vertical sheet pile penetrates half way into the sand deposit. The water level on one side of the wall is 2.5 m and on the other side 0.5 m above the ground level. The sand stratum has a vertical permeability of 1.42 m/day and a horizontal permeability that equals 8 times the permeability in the vertical direction. A flow net construction reveals that there are 12 flow channels and 26 potential drops. Determine the seepage flow per day. Derive the equation used, if any. (12)

2

P 1140

(ii) A 100 mm long specimen is subjected to a variable head permeability test in which the initial head of 360 mm drops to 120 mm in 15 minutes. Determine the coefficient of permeability, if the diameter of the standpipe is 1/10th of the specimen (4)

13. (a) (i) A rectangular area 2 m × 4 m carries a uniformly distributed load of 100 kPa at the ground surface. Find the vertical pressure at 10 m below one of the corners of the loaded area by equivalent point load approach. (Divide the total area into four area units). (6)

(ii) Subsurface exploration at the site of proposed building reveals the existence of 2.4 m thick layer of soft clay below a stratum of coarse sand which is 4 m thick and extends from the ground surface upto the top of the clay layer. The ground water table is at 2.5 m below the ground surface. Laboratory tests indicate the natural water content of the clay as 40%, average liquid limit as 45% and specific gravity of solids as 2.75. The unit weight of the sand above and below water table is respectively 17.8 kN/m³ and 21 kN/m³. Estimate the probable settlement of the building, if its construction will increase average vertical pressure on the clay layer by 71 kPa. (10)

Or

(b) (i) A square footing of size 2 m carrying a load of 1000 kN is laid on a sandy soil of thickness 4 m at a depth of 1 m below ground level. The water table is at 2 m from the ground level. The unit weight of sand above and below water table is 16 kN/m² and 19.81 kN/m³ respectively. The sand is underlain by a clayey layer of thickness 3 m. The natural water content, specific gravity of solids and liquid limit of the clay are 40%, 2.7 and 60% respectively. The clay is underlain by rock. Find the consolidation settlement of the clay layer. There is a geological evidence that the clay is normally consolidated. Use 2 : 1 dispersion method to estimate the stress increase in the clay layer. (12)

(ii) Distinguish between normally consolidated and over consolidated clays. (4)

14. (a) (i) Following are the results of a shear box test on a soil.

Normal stress, kPa	25	75	150	250
Shear stress at failure, kPa	60	80	105	145

Determine the shear strength parameters. If a specimen of the same soil is tested in a triaxial apparatus, find the deviator stress at which the sample will fail under a cell pressure of 100 kPa. (12)

(ii) 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)

Or

(b) (i) Enlighten the statement : c and Φ are not fundamental parameters but are only mathematical parameters of a soil. (6)

(ii) Describe the state of soil samples A to D when the Mohr circles describing their state of stresses are as follows : for A, the Mohr circle is a dot on the normal stress axis, for B, the Mohr circle is too small to touch the strength envelope, for C, the Mohr circle is tangential to strength envelope and for D, the Mohr circle is so large that part of the circle is above the strength envelope. Also for the sample C, find the angle made by the failure plane with respect to major principal plane. (10)

15. (a) (i) An embankment 10 m high is inclined at angle of 40° to the horizontal. A slip circle method analysis gives the following forces per running metre.

Σ Shearing forces = 450 kN

Σ Normal forces = 873.2 kN

Σ Neutral forces = 218.2 kN.

The length of the failure arc is 22 cm. Soil tests in the laboratory indicate that angle of internal friction is 15° and cohesion is 20 kPa.

Find the factor of safety with respect to Shear strength and Cohesion respectively. (8)

(ii) Explain the friction circle method of slope stability analysis for a c − Φ soil. (8)

Or

(b) (i) An infinite slope with a slope angle of 30° is 5 m high. The soil has cohesion of 30 kPa, angle of internal friction of 20° and unit weight of 19 kN/m³. Find the factor of safety with respect to cohesion. Derive the equation used if any. (12)

(ii) A temporary trench with vertical sides is to be excavated in a purely cohesive soil with unit weight of 19 kN/m³ and cohesion of 25 kPa. Determine the initial depth upto which the trench can be excavated without any lateral support. (4)

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4