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D 4083

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2008.

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. The dry density and density at 50% saturation of a soil are 1.7 g/cc and 1.9 g/cc respectively. Find its porosity.
2. Calculate the total compactive energy imparted to soil per unit volume in light compaction test conducted as per IS 2720 (Part 7).
3. Prove that the top of capillary fringe is subjected to suction pressure.
4. Find the critical hydraulic gradient of a saturated sand with moisture content of 40 % and specific gravity of solids of 2.7.
5. State the assumptions made in Boussinesq's stress distribution theory.
6. What is the influence of coefficient of permeability on the rate of settlement?
7. Say true or false and justify your answer: In a drained triaxial test, the failure plane is the plane of maximum shear stress.
8. A purely cohesive soil sample of cohesion 25 kPa is subjected to a cell pressure of 100 kPa in a triaxial test. Will the sample fail by shear? Justify your answer.

9. What are the different ways in which a finite slope may fail?
10. Say true or false and justify your answer: The factor of safety of an infinite slope made of cohesionless soil is Independent of the height of the embankment.

PART B — (5 × 16 = 80 marks)

11. (a) (i) The specific gravity of a dry soil is 1.7. When it is allowed to soak up in water, expand and get saturated, its specific gravity increases to 1.82 at a moisture content of 38%. Determine the specific gravity of solids of the soil and its shrinkage limit. (10)
- (ii) Explain the influence of water content and compactive effort on the compaction of soils (6)

Or

- (b) (i) A 1000 cc container was just filled with sand in its loosest possible state and then the container was filled at the densest possible state. The dry masses of sand occupying the container space were 1520 g and 1830g respectively. The sand in-situ has a void ratio of 0.64. If the specific gravity of solids 2.65, find the relative density. (6)
- (ii) The Atterberg limits of a soil are liquid limit 52%, plastic limit 30% and shrinkage limit 18%. If the specimen of soil shrinks from a volume of 39.5 cm³ at the liquid limit to a volume of 24.2 cm³ at the shrinkage limit, calculate the specific gravity of solids. Also, classify the soil as per BIS if the fraction passing through 75-micron sieve is 60%. (10)
12. (a) (i) A 3 m thick sandy stratum has a coefficient of permeability of 3×10^{-2} m/s. A separate test gave a porosity of 40% and bulk unit weight of 20.6 kN/m³ at a moisture content of 31%. Determine the head at which upward seepage will cause a quicksand condition. Also find the discharge velocity and seepage velocity under quicksand condition. (8)
- (ii) Derive the equation for determining the seepage flow through a flow net having N_f flow channels and N_q equipotential drops. The coefficient of permeability of the medium and loss of head are respectively K and h. (8)

Or

- (b) (i) A 10 m thick bed of sand is underlain by a layer of clay of thickness 6m. 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/m^3 and 17.66 kN/m^3 and the dry unit weight of sand 16.68 kN/m^3 . (10)
- (ii) In a falling head permeameter test, the hydraulic head at $t=0$ is 400 mm and drops 10 mm in 3.5 minutes. It is desired to run the test until this head is 200 mm. How much longer must the test continue? (6)
13. (a) (i) In a clay deposit, it is proposed to adopt a circular raft foundation of diameter 5m for an oil tank at a depth of 1 m below ground level. If the foundation is subjected to a loading intensity of 50 kPa, find the vertical stresses along the vertical line passing through the centre of the foundation at depths 2m, 5m, 10m, 50m and 100m from the ground level. (10)
- (ii) The thickness of a saturated specimen of clay under consolidation pressure of 100kPa is 22.12 mm and its water content is 14%. On increase of the consolidation pressure to 200kPa, the specimen thickness decreases by 1.28mm. Determine the compression index of the soil. Take specific gravity of solids as 2.7. (6)

Or

- (b) (i) A layer of clay 2m thick, undergoing consolidation beneath a building, caused a settlement of 25mm in 100 days after the weight of the building had been added. Laboratory results indicated that this corresponds to 25% consolidation of the clay layer. Find the time of consolidation for 50mm, 90mm and 100mm consolidation of the same layer. (10)
- (ii) Explain how coefficient of consolidation is determined based on $\log t$ vs dial reading method. (6)

14. (a) Following are the results of Consolidated Drained triaxial test conducted on two specimens of the same soil. The diameter and length of the samples are respectively 38mm and 85mm. Find the shear strength parameters of the soil.

Specimen No.	1	2
Cell Pressure, kPa	100	200
Deviator load at failure, N	488	788
Decrease in volume at failure, cm ³	8.0	12.0
Axial Compression at failure, mm	5.0	7.0

Or

- (b) (i) Discuss the limitations of direct shear test (6)
- (ii) A direct shear test was conducted on a 60mm × 60mm sample of cohesionless sand. The normal load was 360 N. The failure occurred at a shear load of 180N. Find the angle of internal friction. Also, locate the principal planes and find the principal stresses. (10)

15. (a) (i) An infinite slope of soil having cohesion of 30-kPa and unit weight of 18 kN/m³ and angle of internal friction of 20° has a slope angle of 30°. Determine the critical height of the slope. Derive the equation used, if any. (10)
- (ii) Derive as per the method of slices, the expression for factor of safety for a trial slip circle of radius 'R', weight 'W' and length of arc 'L'. The cohesion of the purely cohesive, soil is 'c' and the perpendicular distance of line of action of the weight of the slice from the centre of the circle is 'x'. (6)

Or

- (b) (i) A proposed cutting in a homogeneous cohesive soil (undrained cohesion: 45 kPa angle of internal friction: 0° and unit weight 19 kN/m³) will have a slope angle of 25° and will be 8.0 m deep. Using Taylor's stability chart, determine the factor of safety against shear failure when hard stratum is encountered
- (1) at a large depth
- (2) at a depth of 12 m from ground level (10)
- (ii) A canal of side slopes 1:1 is proposed in a soil of undrained strength parameters of 15° and 12 kPa and void ratio of 1.0 and specific gravity of solids of 2.65 to a depth of 5 m below the ground surface. Using Taylor's stability chart; find the factor of safety with respect to cohesion against shear failure of the bank when there is sudden drawdown of water in the canal. (6)