B 210

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2005.

Fourth Semester

Civil Engineering

CE 240 — SOIL MECHANICS

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. The dry density of a soil and its specific gravity of solids are respectively 18 kN/m^3 and 2.7. Find the moisture content required to have 100% saturation of the soil.

2. If the liquidity index of a soil is zero, find its consistency index.

3. Distinguish between discharge velocity and seepage velocity.

4. The critical hydraulic gradient of a sandy soil having specific gravity of solids of 2.7 is 1.0. Find its porosity.

5. The pressure at the base of a square footing of size 2m is 150 kPa. Using 63.5° dispersion method, find the depth at which the vertical pressure is 50 kPa.

6. The water level in a lake was lowered from a level of 20 m to 12 m. The lakebed is saturated clay. Will the lowering of water level cause consolidation settlement of the lake bed sediments? Justify your answer.

7. What is the assumption that is to be made to take cohesion of a soil sample as one half of its unconfined compressive strength?

8. A purely cohesive soil sample of undrained cohesion 25 kPa is subjected to a cell pressure of 100 kPa in a UU triaxial test. Will the sample fail? Why?

9. Say true or false and justify your answer. The factor of safety of an infinite slope of cohesionless soil is independent of the height of the embankment.

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

PART B — (5 × 16 = 80 marks)

11. (i) An infinite slope of soil having a cohesion of 30 kPa, unit weight of 18 kN/m^3 and angle of internal friction of 20° has a slope of angle of 30°. Determine the critical height of the slope. Derive the equation used, if any. (9)

(ii) Explain how factor of safety is obtained for a finite slope made of purely cohesive soil by total stress method. (7)

12. (a) (i) A 1000 cm^3 core cutter weighing 9.46 N was used to find out the in-situ unit weight of soil in an embankment. The weight of core cutter with in-situ soil was noted to be 27.7 N. Laboratory tests on the sample indicated water content of 10% and specific gravity of solids of 2.63. Determine the bulk unit weight, dry unit weight, void ratio and degree of saturation. Also calculate the saturated unit weight and the corresponding water content if the embankment is saturated during rain without change in volume. (10)

(ii) The Atterberg limits of a soil sample are liquid limit 56%, Plastic limit 30% and Shrinkage limit 15%. If the specimen of this soil shrinks from a volume of 10 cc at liquid limit to 5.94 cc when oven dried, calculate shrinkage ratio and specific gravity of solids. (6)

Or

(b) (i) The following data are obtained from laboratory tests on two soil samples :

	Percentage finer	
Particle size, mm	Sample A	Sample B
4.75	100	100
2.00	95	100
0.425	82	48
0.075	75	25
Atterberg limits		
Liquid limit, %	48	28
Plastic limit, %	24	24

Classify the sample A and sample B Based on BIS. (10)

(ii) Explain the factors influencing the compaction of soil. (6)

13. (a) (i) A soil sample of height 60 mm and area of cross section of 10000 mm^2 was subjected to falling head permeability test. In a time interval of 5 minutes, the head dropped from 600 mm to 200 mm. If the cross sectional area of the standpipe is 200 mm^2, compute the coefficient of permeability of the soil sample. Derive the equation used, if any. If the same sample is subjected to a constant head of 180 mm, calculate the quantity of water collected in one hour after flowing through the sample. (12)

(ii) State the properties of flow net. (4)

Or

(b) (i) Explain the factors influencing the coefficient of permeability. (10)

(ii) Derive the equation for discharge through a flownet having N_f flow channels and N_q equipotential drops. The coefficient of permeability and loss of head can be taken as k and h respectively. (6)

14. (a) (i) A layer of fine sand 3 m in thickness rests on a bed of soft clay and the water table is at a depth of 2 m below the ground level. The porosity of sand is 50% and the degree of saturation of the sand above the water table is 60% and the specific gravity of solids is 2.7. The specific gravity of solids and water content of the clay are 2.72 and 40% respectively. Determine the effective stress at a depth of 7 m from the ground level. (7)

(ii) Two clay specimens A and B of thickness 20 mm and 30 mm have void ratios of 0.68 and 0.72 respectively under a pressure of 200 kPa. If the void ratios of the specimens are 0.55 and 0.65 respectively when the pressure was increased to 350 kPa, find the ratio of coefficient of permeability of two specimens if the time required by the specimen B to reach given degree of consolidation is three times that required by specimen A. (9)

Or

(b) (i) An elevated structure is supported on a tower with four legs. The legs rest on piers located at the corners of a square of side 7 m. If the value of vertical stress increment due to this loading (considering 4 equal concentrated loads) is 25 kPa, at a point 8 m below the centre of the structure, what will be the stress increment at 10 m below on of the legs? (11)

(ii) Explain the procedure of determining preconsolidation pressure from e–log p curve as suggested by Casagrande. (5)

15. (a) (i) What are the limitations of direct shear test? (4)

(ii) Keeping minor principal stress constant as 200 kPa, the major principal stress on a cylindrical specimen of soil was increased till failure occurred. If the cohesion and angle of internal friction of the soil were 250 kPa and 20° respectively, calculate the addition vertical stress at failure and shear and normal stresses along the failure plane. Also, locate the failure plane. (12)

Or

(b) (i) Derive the relation among minor principal stress, major principal stress and shear strength parameters at incipient failure condition. (8)

(ii) A cohesionless soil has an angle of internal friction of 30°. If a specimen of the soil is subjected to major and minor principal stresses of 200 kPa and 150 kPa respectively, will the specimen fail? Why? On another specimen of the same soil, a minor principal stress of 100 kPa is imposed and the major principal stress is steadily increased. Can the specimen sustain a major principal stress of 400 kPa? Why? (8)

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