

T 8087

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2006.

Fourth Semester

Civil Engineering

CE 1251 — MECHANICS OF SOILS

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

(Regulation 2004)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the three most common clay minerals? Which one usually causes the most problems for engineers?
2. List various factors affecting compaction.
3. The internal diameter of a tube is 0.1 mm. What will be the maximum capillary rise when it is held vertical with bottom end dipped in pure water taken in a trough? Take surface tension of water = 72.8×10^{-6} kN/m.
4. Write short explanatory notes on Quick sand condition.
5. What is Newmarks influence chart?
6. Define preconsolidation pressure. In what ways is its determination important in soil engineering?
7. Write the Mohr-Coulomb failure criterion for soils and explain the terms involved.
8. List the merits and demerits of triaxial test.

9. A cutting is to be made in clay for which the cohesion is 350 kN/m^2 ; Bulk unit weight is 20 kN/m^3 . Find the maximum depth for a cutting of side slope 1.5 to 1. Factor of safety to be 1.5. Take the stability number as 0.17.
10. Mention different modes of slope failure.

PART B — ($5 \times 16 = 80$ marks)

11. (a) A moist soil sample weighs 3.52 N . After drying in an oven, its weight is reduced to 2.9 N . The specific gravity of solids and the mass specific gravity are, respectively, 2.65 and 1.85. Determine the water content, void ratio, porosity and the degree of saturation. (16)

Or

- (b) A soil sample is found to have the following properties. Classify the soil according to I.S. classification system. Passing 75μ sieve = 10%; Passing 4.75 mm sieve = 70%; Uniformity coefficient = 8; Coefficient of curvature = 2.8; Plasticity Index = 4. (16)

12. (a) (i) Bring out the effect of compaction on various Engineering properties of soils. (6)
- (ii) In a falling head permeability test the length and area of cross section of soil specimen are 0.17 m and $21.8 \times 10^{-4} \text{ m}^2$ respectively. Calculate the time required for the head to drop from 0.25 m to 0.10 m . The area of cross section of stand pipe is $2.0 \times 10^{-4} \text{ m}^2$. The sample has three layers with permeabilities $3 \times 10^{-5} \text{ m/sec}$ for first 0.06 m , $4 \times 10^{-5} \text{ m/sec}$ for second 0.06 m and $6 \times 10^{-5} \text{ m/sec}$ for the third 0.05 m thickness. Assume the flow is taking place perpendicular to the bedding plane. (10)

Or

- (b) (i) In a site reclamation project, 2.5 m of graded fill ($\gamma = 22 \text{ kN/m}^3$) were laid in compacted layers over an existing layer of silty clay ($\gamma = 18 \text{ kN/m}^3$) which was 3 m thick. This was underlain by a 2 m thick layer of gravel ($\gamma = 20 \text{ kN/m}^3$). Assuming that the water table remains at the surface of the silty clay draw the effective stress profiles for case (1) before the fill is placed and case (2) after the fill has been placed. (10)
- (ii) Define flow net. Discuss briefly its uses. (6)

A rectangular foundation $1.5 \text{ m} \times 3.5 \text{ m}$ transmits a uniform pressure of 350 kN/m^2 to the underlying soil. Determine the vertical stress at a depth of 1.5 m below a point within the loaded area 1.0 m away from short edge and 0.5 m away from long edge. Use equivalent point load method. (10)

(ii) Compare Boussinesq and Westergaard theories of stress distribution in soil media. (6)

Or

(i) Write Terzaghi's one dimensional equation stating clearly the assumptions made and explain the terms involved. (8)

(ii) A 1 cm thick laboratory soil sample reaches 60% consolidation in 33 seconds under double drainage condition. Find how much time will be required for a 10 m thick layer in the field to reach the same degree of consolidation if it has drainage face on one side only. (8)

(a) (i) A cylinder of soil fails under an axial vertical stress of 160 kN/m^2 , when it is laterally unconfined. The failure plane makes an angle of 50° with the horizontal. Calculate the value of cohesion and the angle of internal friction of the soil. (6)

(ii) In a vane shear test conducted in a soft clay deposit failure occurred at a torque of 42 Nm . Afterwards the vane was allowed to rotate rapidly and the test was repeated in the remoulded soil. The torque at failure in the remoulded soil was 17 Nm . Calculate the sensitivity of soil. In both cases the vane was pushed completely inside soil. The height of vane and diameter across blades are 100 mm and 80 mm respectively. (10)

Or

(b) (i) What is stress path? Sketch different types of stress paths that can be obtained in a triaxial compression test. (8)

(ii) The results of a direct shear test on a $60 \text{ mm} \times 60 \text{ mm}$ specimen are given below. Determine shear strength parameters. (8)

Normal load, N	300	400	500	600
Shear force at failure, N	195	263	324	399

15. (a) (i) A slope of very large extent of soil with properties $c' = 0$ and $\phi' = 32^\circ$ is likely to be subjected to seepage parallel to the slope with water level at the surface. Determine the maximum angle of slope for a factor of safety of 1.5 treating it as an infinite slope. For this angle of slope what will be the factor of safety if the water level were to come down well below the surface? The saturated unit weight of soil is 20 kN/m^3 . (8)
- (ii) Discuss the friction circle method for the stability analysis of slopes. Can this method be used for purely cohesive soil? (8)

Or

- (b) (i) An embankment 10 m high is inclined at 35° to the horizontal. A stability analysis by the method of slices gave the following forces: Total normal force = 900 kN; Total tangential force = 420 kN; Total neutral force = 200 kN. If the length of the failure arc is 23 m, find the factor of safety with respect to shear strength. The soil has $c = 20 \text{ kN/m}^2$ and $\phi = 15^\circ$. (10)
- (ii) Discuss the various methods for improving the stability of slopes. (6)