Code : 011615

B.Tech 6th Semester Exam., 2019

SOIL AND ROCK MECHANICS

Time : 3 hours   Full Marks : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are **NINE** questions in this paper.

(iii) Attempt **FIVE** questions in all.

(iv) Question No. **1** is compulsory.

1. Choose the correct answer (any *seven*) :   2×7=14

   (a) The main advantage of direct shear test is

      (i) low equipment cost

      (ii) accuracy of test result

      (iii) simple test procedure

      (iv) applicability to all soil types

   (b) The unconfined compressive strength of saturated clay sample is 54 kPa. The value of cohesion for the clay is

      (i) 0   (ii) 13·5 kPa

      (iii) 27·0 kPa   (iv) 54·0 kPa

   (c) The active earth pressure is the _____ lateral pressure exerted by the backfill on the wall, when the wall moves away from the backfill.

      (i) zero

      (ii) maximum

      (iii) minimum

      (iv) Any of the above

   (d) If $\alpha = 45 + (\phi/2)$, the coefficient of active and passive earth pressure as per Rankine's theory is

      (i) $\tan^2\alpha$, $\cot^2\alpha$

      (ii) $\cot^2\alpha$, $\tan^2\alpha$

      (iii) 0, $\cot^2\alpha$

      (iv) $\tan^2\alpha$, 0

   (e) When the base of an embankment is stronger than the embankment soil, the failure occurs by

      (i) base failure

      (ii) slope failure

      (iii) toe failure

      (iv) translational failure

(f) Friction circle method cannot be applied to

    (i) c-φ soil

    (ii) cohesionless soil

    (iii) pure cohesive soil

    (iv) None of the above

(g) For a certain slope, the stability number was found to be 0·015 when $H = 6·0$ m. What is the stability number when the height is reduced by 50%?

    (i) 0·0075

    (ii) 0·023

    (iii) 0·015

    (iv) 0·030

(h) The typical range for the uniaxial compressive strength of rock is

    (i) 1–400 kPa

    (ii) 1–400 MPa

    (iii) 1–400 GPa

    (iv) None of the above

(i) A rock is differentiated from a soil when its uniaxial compressive strength is more than

    (i) 100 MPa

    (ii) 10 MPa

    (iii) 1 MPa

    (iv) Cannot say

(j) The porosity range of limestone is

    (i) 50% to 75%

    (ii) 20% to 50%

    (iii) 10% to 40%

    (iv) 1% to 20%

2. (a) Explain the Mohr-Coulomb strength envelope. Sketch the stress-strain relationship for dense and loose sand. 7

(b) A cylindrical soil specimen having a cohesion of 80 kPa and an angle of internal friction of 21° is subjected to a cell pressure of 100 kPa in a triaxial apparatus. Compute the maximum deviator stress at which the sample will fail and angle made by the failure plane with the axis of the specimen. 7

3. (a) What are the assumptions in Coulomb's theory? Compare Rankine's theory and Coulomb's theory. 7

(b) A retaining wall with a vertical back, 8 m high, supports a sand soil with $\phi = 30°$. Calculate the total active thrust on the wall, if—

   (i) the water table is below the base of the wall ($\gamma = 16$ kN/m^3);

   (ii) the water table rises up to ground ($\gamma_{sat} = 20$ kN/m^3).

Also draw the earth pressure diagrams. 7

4. (a) Discuss with neat sketches the various types of slope failures. List the factors affecting the factor of safety of an infinite slope in a clay soil. 7

(b) Find the factor of safety of a slope of infinite extent having a slope angle 25°. The slope is made of cohesive soil. The soil made of clay having $c' = 30$ kN/m^2, $\phi' = 20°$, $e = 0.65$, $G = 2.7$ and under the following conditions : 7

   (i) When the soil is dry

   (ii) When water seeps parallel to the surface of the slope

   (iii) When the slope is submerged

5. Define rock bolt. Explain the application of various types of rock bolts. 14

6. (a) What is the purpose of rock mass classification? Enumerate the various factors that affect discontinuity. 7

(b) Define intact rock. Write a note on engineering properties of intact rock. 7

7. Check the stability of the following retaining wall against overturning and sliding :

The wall is a regular trapezoidal in section, has top width of 0·5 m, a bottom width of 4 m and is 6 m high. The soil's unit weight is 17·8 kN/m^3 and angle of internal friction is 35°. Take the coefficient of internal friction between the soil and the wall material as 0·45 and the unit weight of the wall material as 24 kN/m^3. 14

8. (a) What is weathering? Describe the different processes of weathering. 7

(b) In a 1500 mm rock core run, the following rock pieces were recovered from a borehole :

   53 mm, 108 mm, 125 mm, 75 mm, 148 mm, 310 mm, 75 mm, 155 mm and 140 mm

Find the RQD and the rock recovery ratio. Also classify the rock. 7

9. Write short notes on any *four* of the following : $3\frac{1}{2} \times 4 = 14$

(a) Friction circle method

(b) Taylor's stability number

(c) Gravity-type retaining wall

(d) Process of grouting

(e) Rock quality designation (RQD)

(f) Point load strength test

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