

2017

CIVIL ENGINEERING PAPER - I

Time Allowed : 3 Hours

Full Marks : 200

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be written either in English or in Bengali but all answers must be in one and the same language.

All notations/symbols have their usual meanings, unless otherwise specified.

Group-A

Answer any four questions.

1. (a) For a given site the subsoil is homogeneous sand having 10 m thick stratum. The dry density of the sand is $15.5 KN/m^3$ and its angle of internal friction is 32°. Initially the groundwater table is at 6.5 m below the ground level.

   (i) Determine the shear strength of the sand on a horizontal plane passing through its middle.

   (ii) Find the percentage change in the shear strength if the ground water table rises to a level of 1.5 m below the ground level during mansoon.

   Assume the void ratio to be unchanged, and the specific gravity of solids as 2.68. 12+13

   (b) A falling-head permeability test was conducted on a sample of clean, uniform, silty soil. 75 seconds were required to lower the head from 100 cm to 80 cm. The sample was 4 cm in diameter and 22 cm long. Calculate the coefficient of permeability of the sand. Area of stand pipe = $1.4 cm^2$. 10

2. (a) The time required for 50% consolidation of a 25-mm-thick clay layer, drained at both top and bottom, in the laboratory is 2 min 20 sec. How long, in days, will it take for a 3 m thick clay layer of the same clay in the field under the same pressure increment to reach 50% consolidation ? In the field, there is a rock layer at the bottom of the clay. 15

   (b) A soil sample has a porosity of 40%. The specific gravity of solids is 2.70. Calculate (a) void ratio, and (b) dry density. 5+5

   (c) A vertical concentrated load of 40 KN acts at a point on the ground surface. Determine the vertical stress intensities due to this load at the following points :

   (i) At a depth of 2.5 m below GL on the line of action of the load ;

   (ii) At a depth of 1.5 m below GL and a radial distance of 3 m from the line of action of the load. 5+5

3. (a) A bar of length 25 cm has varying cross-section. It carries a load of 14 KN. Find the extension if the cross-section is given by $\left(6 + \frac{x^2}{100}\right) cm^2$, where x is the distance from one end in cm. Take E = $200 GN/m^2$. Neglect weight of the bar. 25

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(b) A meterial has a Young's Modulus of 1.25×10^5 N/mm^2 and a poisson's ratio of 0.25. Calculate the modulus of Rigidity and the Bulk Modulus. 5+5

4. Draw S.F. and B.M. diagrams for a beam AB of length L, simply supported at ends and with end couples M_A and M_B acting at ends A and B respectively. Find also the algebraic equations for the deflection and slope for the beam. What are the slopes at ends and deflection at the centre ? Where will the maximum deflection occur on the beam ? Take flexural rigidity of the beam as EI. 35

5. (a) A retaining wall 6 m high supports earth with its face vertical. The earth is cohesionless with particles specific gravity of 2.69, angle of internal friction 35° and porosity 40.5%. The earth surface is horizontal and level with the top of the wall. Determine the earth thrust and its line of action on the wall, if the earth is water logged to level 2.5 m below the top surface. Neglect wall friction - Draw the pressure diagrams. 15

(b) A square footing 2.5 m x 2.5 m is built in a homogeneous bed of sand of unit weight 20 KN/m^3 and having an angle of shearing resistance of 36°. The depth of the base of the footing is 1.5 m below the ground surface. Calculate the safe load that can be carried by the footing with a factor of safety of 3 against complete shear failure. Use Terzaghi's analysis. 10

(c) A wooden pile is being driven with a drop hammer weighing 20 KN and having a free fall of 1.0 m. The penetration in the last blow is 5 mm. Determine the load carrying capacity of the pile according to the Engineering News Formula. 10

Group-B

Answer any four questions

6. A beam of span l is fixed at one end and simply supported at the other end. It carries a uniformly distributed load of w per unit run over the whole span. Find the reaction at the simply supported end, by the principle of least work. 15

7. A rectangular, singly reinforced beam, 300 mm wide and 500 mm effective depth is used as a simply supported beam over an effective span of 6 m. The reinforcement consists of 4 bars of 20 mm diameter each. If the beam carries a load of 12 KN/m, inclusive of the self-weight, determine the stresses developed in concrete and steel. Take m = 19 15

8. (a) Prove that the product of 'Degree of saturation ' and 'Void ratio' is equal to that of 'Water content' and 'Specific gravity of solids' 6

(b) A sail is at void ratio of 0.90 with specific gravity of solids particles of 2.70.

(i) Can the water content be determined from this information ? If so, find it, If Not, why not ?

(ii) If the water content cannot be determined, can the upper and lower limits be determined ? If so, find them. 9

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9. The following data refer to a tensile test conducted on a mild steel bar :

(i) Diameter of the steel bar = 30 mm,
(ii) Gauge length = 200 mm,
(iii) Extension at a load of 100 KN = 0.139 mm
(iv) Load at elastic limit = 230 KN,
(v) Maximum load = 360 KN
(vi) Total extension = 56 mm,
(vii) Diameter of the rod at failure = 22.25 mm

Calculate (a) The Young's Modulus, (b) The stress at elastic limit, (c) The percentage elongation, and (d) The percentage decrease in area. 4x3+3

10. What is workability of concrete ? How is it measured ? Describe the method. 15