

Time Allowed : 3 Hours

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 given 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 - AAnswer any four questions

1. (a) A footing 2m square, rests on a soft clay soil, with its base at a depth of 1.5m from ground surface. The clay stratum is 3.5m thick and is underlain by a firm sand stratum. The clay soil has LL = 30%, G = 2.7, water content at saturation = 40%, cohesion =  $0.5 \text{ kg./cm}^2$  ( $\phi = 0$ ). It is found that the clay stratum is normally consolidated. Compute the settlement that would result if the load intensity equal to safe bearing of soil were allowed to act on the footing. Natural water table is quite close to the ground surface. For given conditions, bearing capacity factor ( $N_c$ ) is obtained as 6.9. Take factor of safety as 3. Assume load spread of 2(vertical) to 1(horizontal). 20
- (b) A vertical bank was formed during the excavation of a soil having  $\phi = 15^\circ$  and unit weight of  $1800 \text{ kg/m}^3$ . When the depth of excavation reached 5.5 m, the bank failed. What was the approximate value of the cohesion of the clay? 15
2. (a) At a given site the subsoil consists of a 10m thick homogeneous sand stratum. The dry density of the sand is  $15.5 \text{ kN/m}^3$  and its angle of internal friction is  $32^\circ$ . The specific gravity of solids is 2.68. Initially the ground water table is at 6.5m below the ground level.
- (i) Determine the shear strength of the sand on horizontal plane through its middle; and
- (ii) Find the percent change in the shear strength if the ground water table rises to a level of 1.5m below GL during monsoon. Assume the void ratio to remain unchanged. 5 + 10
- (b) The following results were obtained from a standard proctor test : Given that, the internal diameter and height of the mould were 10cm and 12.7cm respectively. The mass of the empty mould = 1.89 kg. and G = 2.68.

No. of Test	1	2	3	4	5	6
Mass of mould and soil (g)	3526	3711	3797	3906	3924	3882
Water content (%)	8.33	10.40	12.23	16.20	17.92	20.39

Plot the compaction curve. Hence determine the optimum moisture content and maximum dry density of the soil. 10

- (c) A vertical concentrated force of 40 kN is acting 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 2.5m below GL on the line of action of the load; and
- (ii) At a depth of 1.5m below GL and a radial distance of 3m.

3. (a) A continuous beam ABC (Fig.1) is simply supported at A, B and C. The support C is yielding and settles at the rate of 3 mm per 1000 kg.  $EI = 8 \times 10^{10} \text{ kg.cm}^2$ . Analyse the beam and draw bending moment and shear force diagrams. 25
  - (b) Enumerate the Castigliano's theorems explaining their uses. 10
4. (a) Design a cantilever beam with a clear span of 3m which carries a superimposed load of 15 kN/m. Its depth varies from 500 mm at the fixed end to 150 mm at the free end. Show reinforcements with a neat sketch. Use M 15 mix and mild steel. 20
  - (b) Design a rectangular beam section subjected to a moment of 60 kN.m. Take M 20 mix and Fe415 grade steel. 15
5. (a) Differentiate between disturbed, undisturbed and representative samples. Also discuss the uses to which such samples can be put to, respectively. 3x3+6
  - (b) Explain the 'seismic refraction method' for sketching the general ground profile at a given site. 10
  - (c) A sampling tube has an outer diameter of 75 mm and wall thickness of 1.7 mm. Find the area ratio of the tube, and comment on whether the tube could be used for obtaining undisturbed soil samples. 10

GROUP - B

Answer any four questions

6. Two straight rods, one made of steel and the other of brass hang vertically. Each rod is 1 m long. The rods support a rigid bar horizontally. When a load of 25 kN is placed at 40cm from the steel rod on the horizontal bar, the deflection of the two vertical rods are found to be equal. The centre to centre distance of the steel and brass rods is 1 m. If the area of steel rod is 3 cm<sup>2</sup>, find (a) the area of the other rod, (b) stresses in the rods, and (c) strains in the rods. Take  $E_s = 200 \times 10^6 \text{ kN/m}^2$  and  $E_b = 85 \times 10^6 \text{ kN/m}^2$ . 3 x 5
7. A simply supported beam is loaded by the couple of 10 kN.m, as shown in Fig.2. Draw the shearing force and bending moment diagrams due to this loading. 7 + 8
8. In a 16 pile group, the pile diameter is 45 cm and centre to centre spacing of the square group is 1.5m. If  $C=50 \text{ kN/m}^2$ , determine whether the failure would occur with the piles acting individually, or as a group? Neglect bearing at the tip of the piles. All piles are 10 m long. Take  $m=0.7$  for shear mobilisation around each pile. 15
9. The Atterberg limits of a clay soil are :  $LL=52\%$ ,  $PL=30\%$  and  $SL=18\%$ . If the specimen of this soil shrinks from a volume of  $39.5 \text{ cm}^3$  at the liquid limit to a volume of  $24.2 \text{ cm}^3$  at the shrinkage limit, calculate the true specific gravity. 15
10. A 10 m thick layer of stiff saturated clay is underlain by a layer of sand. The sand is under artesian pressure, as shown in Fig. 3. Calculate the maximum depth of cut H that can be made in the clay. 15

NOTE : Please find the figures in the next page.

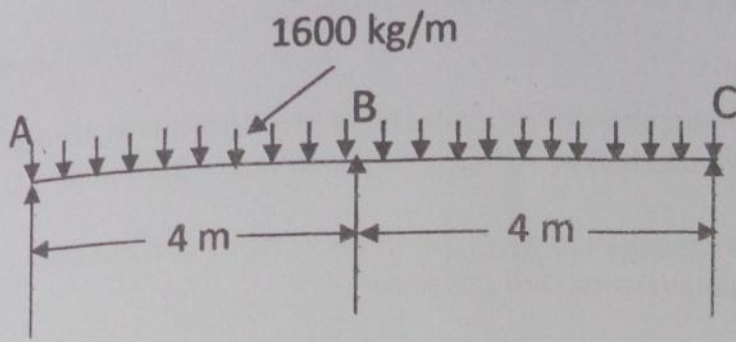


Fig. 1

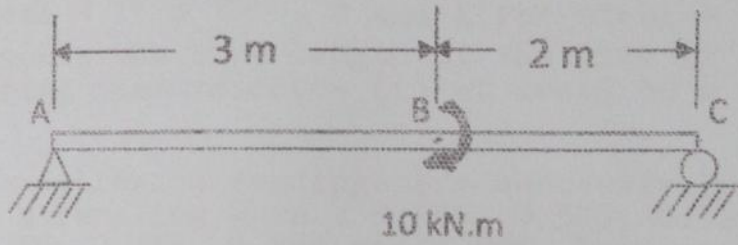


Fig. 2

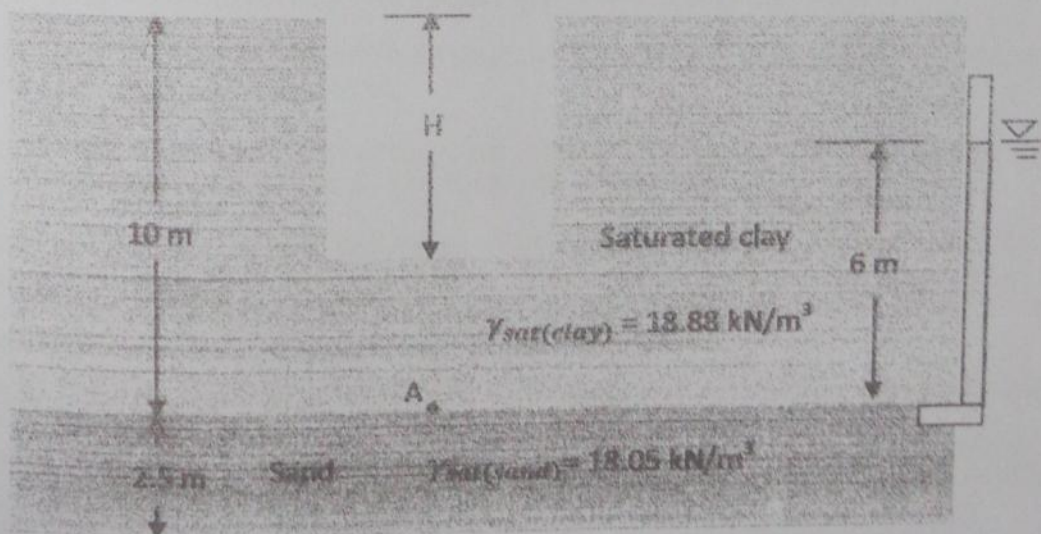


Fig. 3