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ET-502(A)

00844

B.Tech. Civil (Construction Management) / (Water Resources Engineering)

Term-End Examination

June, 2011

ET-502(A) : STRENGTH OF MATERIALS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer **any five** questions. All questions carry **equal** marks.*

1. The aluminium tube C E is pinned at C and E. The cable is attached to pins at C and E and passes over a smooth pulley at D. Determine (a) the cross-sectional area of the tube if permissible stress in tube is 255 N/mm^2 (compression) and (b) the diameter of pin at C if permissible shearing stress is 700 N/mm^2, (see Fig. 1) **14**

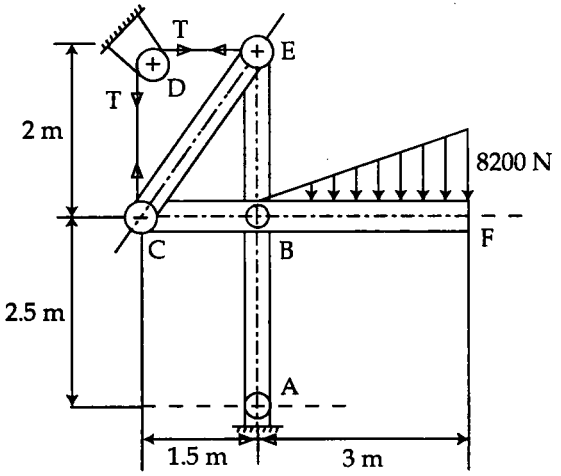

Fig. 1

2. Calculate the change in length of the bar shown in Fig. 2. Assume $E = 2.1 \times 10^5$ MPa. Compare the elongation with the bar of uniform diameter of 100 mm, loaded in the same manner as in Fig. 2. **14**

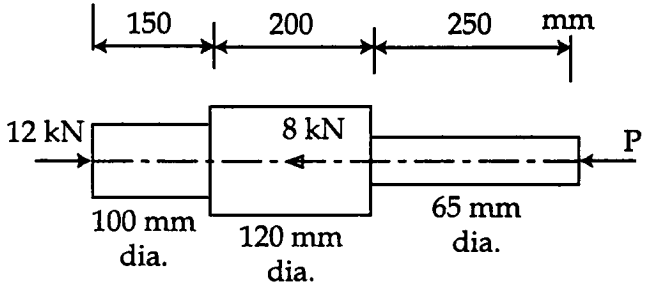

Fig. 2

3. Fig. 3 shows beams A and B loaded by a single concentrated load 10 kN and supported at ends of beam A. If width of both beam cross-sections (rectangular) is 30 mm, find depth of sections of A and B if both are made in the same material which has allowable bending stress of 90 N/mm^2. **14**

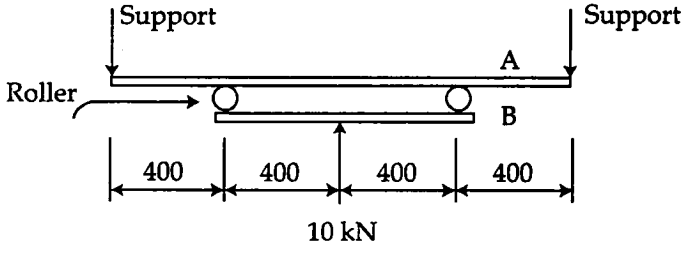

Fig. 3

4. An overhanging beam is shown in Fig. 4. The length of the beam between supports is loaded by a u.d.l of 1 kN/m and overhang carries two concentrated loads of 4 kN and 7 kN. Draw B.M.D and S.F.D. **14**

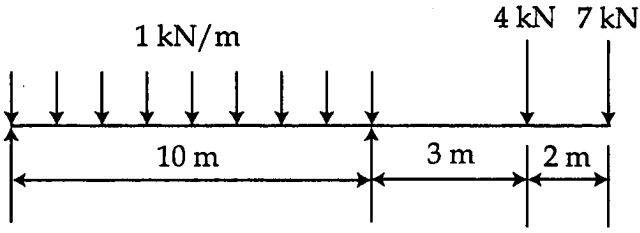

Fig. 4

5. A C.I column of 200 mm outside diameter and 160 mm inside diameter carries a central axial load of 800 kN and a load of 68.7 kN at 325 mm from the axis as shown in Fig. 5. If permissible stress in tension and compression for C.I are respectively 31 N/mm^2 and 121 N/mm^2, check if the cylinder is safe. **14**

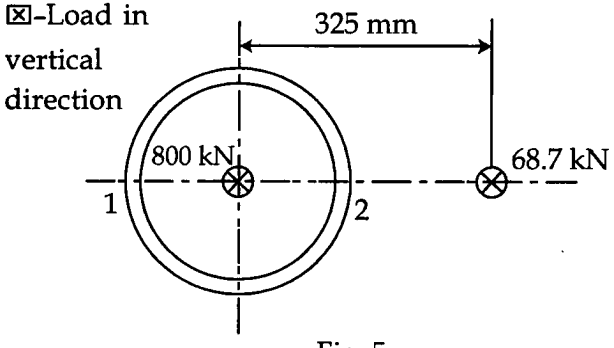

Fig. 5

6. (a) Three shafts of diameters d_1, d_2 and d_3 are jointed rigidly at two sections and two end sections are free. The lengths of three shafts are l_1, l_2 and l_3 respectively. They are made of three materials with moduli of rigidity as G_1, G_2 and G_3. Show that the stiffness of composite shaft, k is related to individual stiffnesses as $\frac{1}{k} = \frac{1}{k_1} + \frac{1}{k_2} + \frac{1}{k_3}$. k_1, k_2 and k_3 are individual shaft stiffnesses of three jointed shafts. What do you call this connection ? 6

(b) A hollow steel shaft of outer and inner diameters of 50 and 35 mm respectively is connected rigidly to a solid bronze shaft of 35 mm diameter. The steel shaft is 2 m long while bronze shaft is 1 m long. The composite is held rigidly between two supports. A torque of 0.6π kN m is applied on the composite shaft at the junction of steel and bronze. Calculate the maximum shearing stress in steel and bronze. 8

$G_{steel} = 70 \times 10^3$ N/mm^2, $G_{bronze} = 40 \times 10^3$ Nmm^2

7. (a) A thin pressure vessel of diameter D and thickness t, is subjected to internal pressure p. Write expressions for hoop and longitudinal strains. Find diametral strain. Find expression for volumetric strain. 7

(b) Propane is stored in a tank of diameter 3.16 m and length 7 m. The thickness of steel plate from which tank is made is 25 mm. What volume of propane gas (at atmospheric pressure) can be stored in the tank at a pressure of 1.75 MPa ? Will the tank be safe at this pressure ? 7

For Steel : $E = 2.1 \times 10^5$ N/mm^2, UTS = 500 N/mm^2 $\nu = 0.28$

8. The state of stress at a point in the body of a material is shown in Fig. 6. Determine : 14

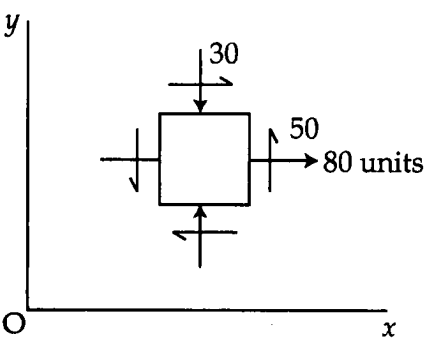

Fig. 6

(a) Principal stresses

(b) Maximum shearing stress

(c) Orientation of principal axes, principal planes and stresses.

(d) Orientation of plane carrying maximum shearing stress and direct stress on this plane.
