III Sem B.E. CIVIL (New Course)

WINTER 2014

STRENGTH OF MATERIALS

1. (a) Derive the Relation between E, G & μ

E = Modulus of Elasticity

G = Moduler of Rigidity

μ = Poissons Ratio. (5)

(b) A spherical shell of 300 mm diameter with a wall thickness of 8 mm in filled with a fluid at atmospheric pressure. If an additional 6000 mm^3 of the fluid is pumped into the shell, find the pressure exerted by the fluid on the wall of the sphere. Find also the hoop stress induced.

Take $E = 2 \times 10^5$ N/mm^2 & Poisson's ratio = 0.3 (8)

OR

2. (a) Prove that following expression for the cylindrical rod : "Volumetric strain equals to strain of the length plus twice the strain of the diameter." (5)

(b) A flat bar of steel 20mm wide and 5 mm thick is placed between two aluminum bars each 20 mm wide & 7.5 mm thick to form a composite bar of 20 mm x 20 mm. There bars are fastened together at their ends. When the temp, of each is 20°C, find the stresses in each when the temperature of the whole assembly is raised to 70°C.

$\alpha_s = 12 \times 10^{-5}/°c$, $E_s = 2.1 \times 10^5$ N/mm^2

$\alpha_a = 24 \times 10^{-5}/°c$, E_{al}, $= 0.7 \times 10^5$ n/mm^2. (8)

3. (a) Explain the relation between rate of loading, S. F and B.M. at a cross section. (3)

(b) The Shear Force diagram is given in figure 1. Draw BMD and load diagram, stating values of all important positions. (10)

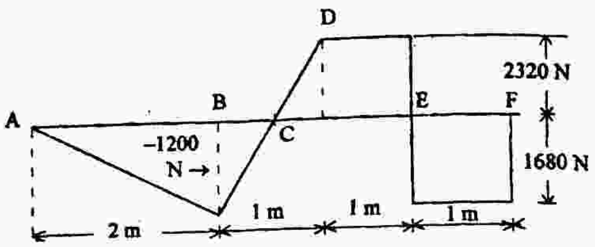


Fig.1

OR

4. A beam ACBD carries a u.d.l. of intensity w kN/m over AC and 20 kN point load at D. It is supported at A & B. BD is overhang. AC = CB =4 m, BD = 2m. Calculate the value of w, S0 that bending movement at C is 50 kN-M. Draw SFD & BMD for this beam for the calculated value of W. Locate the point of contraflexure, if any. Also locate the maximum B.M. values. (13)

5. (a) Enlist the asumptions in Theory of Simple Bending. (3)

(b) A rectangular section is replaced by I-section of same area as shown in fig.-2 for a beam of uniform section. Find the ratio of resistance to bending for the two sections. The material is the same and is able to take the same maximum bending stress. (10)

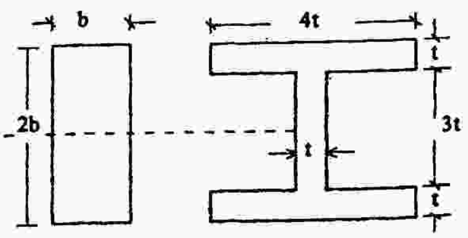


Fig. 2

OR

6. (a) Drive the Bending Stress Formula. (6)

(b) A 30 cm x 16 cm rolled steel joint of I-section has flanges 11 mm thick & web 8 mm thick. Find the safe uniformly distributed load that this section will carry over a span of 5 m if the permissible stress is limited to 120 N/mm^2. (7)

7. (a) Show that a hollow circular shaft whose inner diameter is half the outer diameter has a torsional strength equal to $^{15}/_{16}$ of that of a solid shaft of the same outside diameter. (6)

(b) A rigid bar, hinged at one end, is supported by two identical springs as shown in fig. 3. Each spring consists of 20 turns of 6 mm wire having a mean diameter of 125 mm. Compute the maximum stress in the spring. (7)

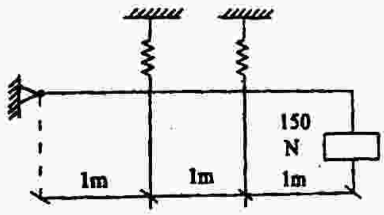


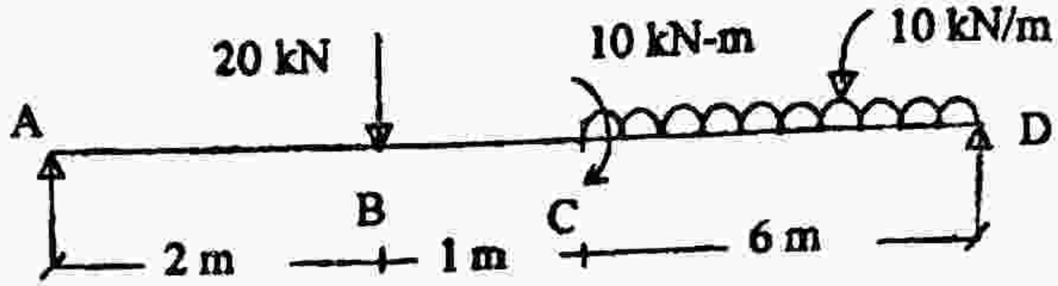
Fig. 3

OR

8. A stepped steel shaft consists of a hollow shaft 2 m long with an outside diameter of 100 mm and inside diameter of 75 mm rigidly attached to a solid shaft 1m long & of 75 mm diameter. Determine the maximum torque that can be applied without exceeding a shearing stress of 70N/ mm2 or a twist of 2.5° in a length of 3.0 m. Assume $G=8.5\times10^4 N/mm^2$. (13)

9. A simply supported beam having a span of 9 m is loaded as shown Fig. 4. Calculate the deflection of beam at mid point CD.

$E = 200 \times 10^3 N/mm^2$; $I = 270 \times 10^6 mm^4$.



(14)

Fig. 4

OR

10. A simply supported beam of uniform flexural rigidity & span 6 m carries an uniformly distributed load of 10 kN/m over a span of 4m from the right support. Calculate :

(i) Maximum deflection in the beam,

(ii) Slope of support sections. (14)

11. Explain the term shear centre. Find the shear stress distribution and position of shear centre for a channel placed with its outer arms (flanges) horizontal. The overall depth is 25 cm with Hange outer dimensions as 10.5 cm. The thickness of the section is 1 cm throughout. A shear force of 60 kN acts through the shear centre. Neglect the minor shear forces. (14)

OR

12. (a) Define principle planes, principal stresses and obliquity. Show that there are two mutually perpendicular planes along which the greatest stress occurs. (8)

(b) Calculate the shear centre of a thin walled channel section. Also illustrate shear flow. (6)