Total No. of Questions—**12**] [Total No. of Printed Pages—**8**

[3662]-103

S.E. (Civil) (I Sem.) EXAMINATION, 2009

STRENGTH OF MATERIALS

(2008 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from Section I and three question from Section II.

(*ii*) Figures to the right indicate full marks.

(*iii*) Answers of the two Sections must be written in separate answer-books.

(*iv*) Neat diagrams must be drawn wherever necessary.

(*v*) Assume suitable data wherever necessary.

SECTION I

1. (*a*) A bar of cross-section 8 mm × 8 mm is subjected axial pull of 10 kN. The lateral dimensions of the bar are found to be reduced by 2×10^{-3} mm. Find Poisson's ratio and modulus of elasticity assuming G = 80 GPa. [8]

(*b*) Three wires are supporting a load of 40 kN. The cross-sectional area of each wire is 150 mm^2. If the length of wires are adjusted so as to share the load equally at 20°C, find the stress in each wire at 50°C temperature. (Refer Fig. 1) : Take : $E_{steel} = 2 \times 10^5$ MPa, $\alpha_{steel} = 12 \times 10^{-6}$/°C, $E_{copper} = 1 \times 10^5$ MPa, $\alpha_{copper} = 18 \times 10^{-6}$/°C. [8]

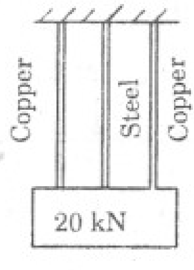


Fig. 1

Or

2. (*a*) The following observations were made during a tensile test on a mild steel specimen 30 mm diameter and 200 mm long :

(*i*) Load at limit of proportionality = 40 kN

(*ii*) Corresponding extension = 0.054 mm

(*iii*) Yield point load = 90 kN

(*iv*) Ultimate load = 140 kN

(*v*) Length of specimen at fracture = 241 mm

Determine :

(1) Young's modulus of elasticity

(2) Yield stress

(3) Ultimate stress

(4) Percentage elongation. [8]

(*b*) Calculate the support reactions and moment of the junction B of the member loaded as shown in Fig. 2. Take E = 200 GPa, Dia. = 25 mm : [8]

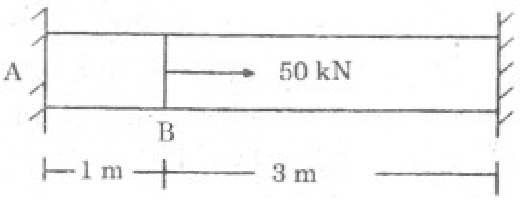


Fig. 2

3. (*a*) Draw S.F.D. and BMD for the beam shown Fig. 3. Indicate the numerical values at all important sections. Find the position of contra flexure, magnitude and position of maximum BM : [9]

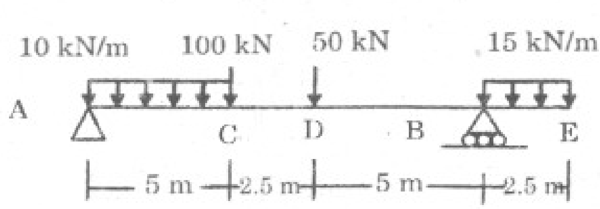


Fig. 3

(*b*) Draw the bending moment diagram and loading diagram from given shear force diagram if beam is subjected to a moment at a distance 2 m from A. (Refer Fig. 4). [9]

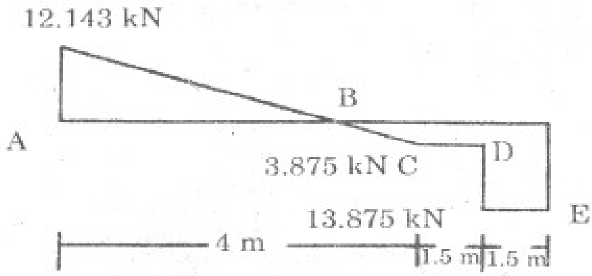


Fig. 4

Or

4. (*a*) Draw S.F.D and BMD for the beam shown in Fig. 5. Indicate the numerical values at all important sections. Find the positions of contra flexure, magnitude and position of maximum BM : [9]

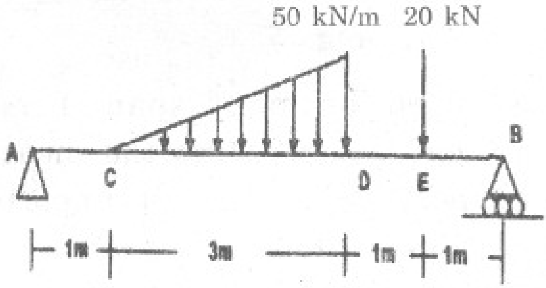


Fig. 5

(*b*) Beam ABCD is supported at B and E and has overhangs AB and EF. The BMD for the beam is as shown in Fig. 6. Draw the shear force diagram and loading diagram. [9]

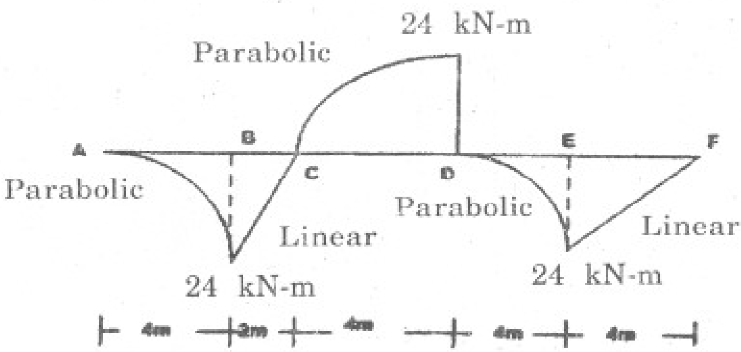


Fig. 6

5. (*a*) The cross-section of a simply supported beam of 5 m span is as shown in Fig. 7. If permissible stresses are 100 MPa in compression and 40 MPa in tension. Find safe UDL the beam can carry. [8]

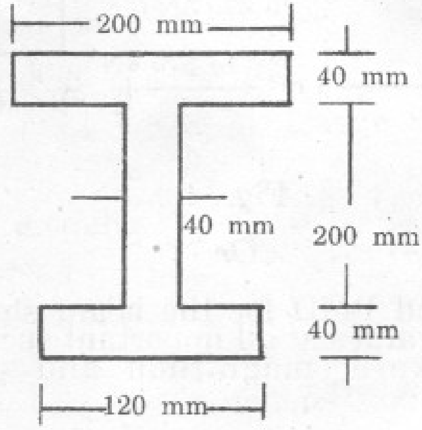


Fig. 7

(*b*) A simply supported beam of span 4 m carries UDL of 80 kN/mover the entire span. Draw the shear stress distribution diagram at support indicating all important values. Refer Fig. 8. [8]

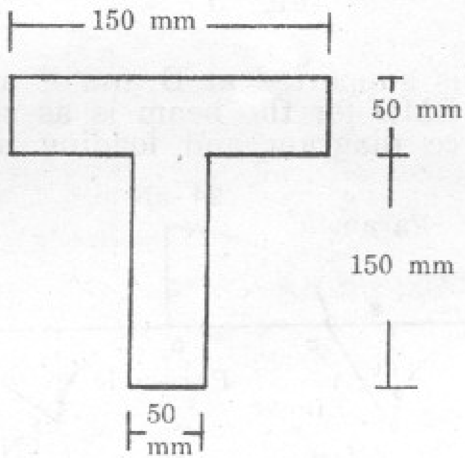


Fig. 8

Or

6. (*a*) A timber joint 120 mm wide and 200 mm deep is reinforced by steel plates. Both steel plates are 120 mm wide. The top plate is 16 mm thick. The bottom plate is 10 mm thick. If the permissible bending stresses in timber and steel are 8.0 N/mm^2 and 140 N/mm^2 respectively, find the moment of resistance. The modular ratio is 15. [8]

(*b*) A wooden beam is prepared by connecting three pieces as shown in Fig. 9. If the cross-section of the beam is subjected to maximum shear force of 100 kN, determine the spacing of the connectors assuming their shear strength to be 15 kN. [8]

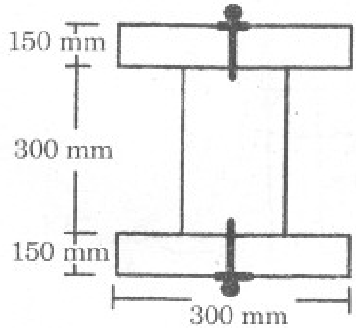
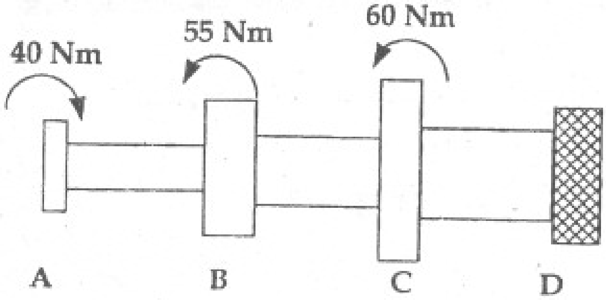


Fig. 9

SECTION II

7. (*a*) A stepped circular solid shaft ABCD, is subjected to torques as shown in Fig. 10. Which part of the shaft will be subjected to the maximum sharing stress ? Also determine its magnitude : [8]



Φ_{AB} = 12 mm, Φ_{BC} = 16 mm Φ_{CD} = 20 mm

Fig. 10

(*b*) Derive the expression for the stress induced due to gradually applied load, suddenly applied load and impact. [8]

Or

8\. (*a*) The oil rig at A has just started to drill for oil on the ocean floor at a depth of 1500 m. Knowing that, the top of the 200 mm diameter steel drill pipe rotates through two complete revolutions before the drill bit at B starts to operate. Determine the maximum shearing stress caused in the pipe by torsion. (Fig. 11) Take G = 77 GPa. [8]

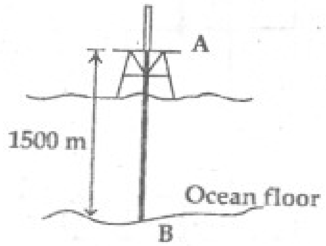


Fig. 11

(*b*) Determine the strain energy of the prismatic beam AB for the loading as shown in Fig. 12. Take E = 200 GPa. [8]

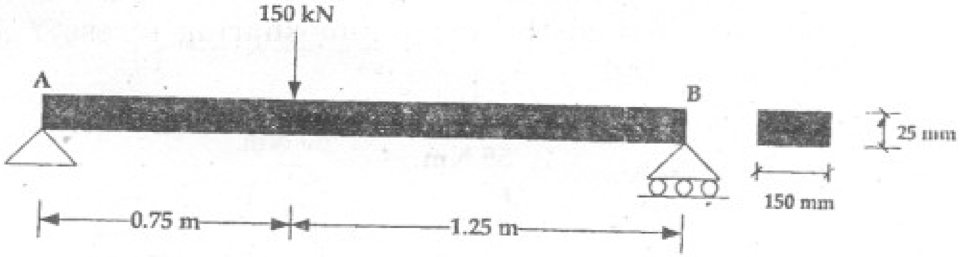


Fig. 12

9\. (*a*) A point in a strained material is subjected to principal stresses of 120 MPa (tensile) and 65 MPa (compressive). Using Mohr's circle, determine the normal and shearing stresses on a plane at an angle of 20° to the axis of tensile stress. Also determine the maximum shear stress and the inclination of the plane on which normal stress is zero and the magnitude of shear stress on this plane. [9]

(b) Derive the expression for principal stresses and principal plane for a solid circular shaft of diameter D, subjected to combined torsion and bending effects. [9]

Or

10. (a) For the stress condition on an element as shown in Fig. 13 determine the principal planes and stresses. Also determine the maximum shear stress and the planes on which they act. [9]

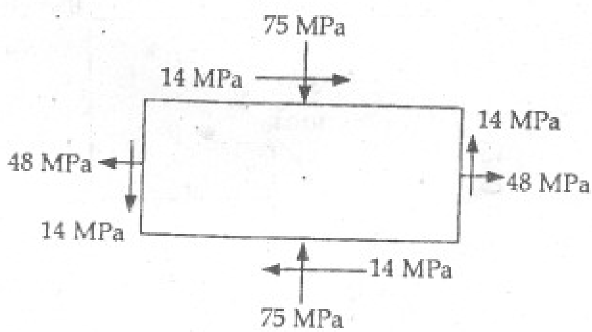


Fig. 13

(b) Find the diameter of a solid shaft if is subjected to a bending moment of 4 kN-m and a twisting moment of 3 kN-m. The maximum principal stress is 70 MPa and maximum shear stress is 30 MPa. [9]

11. (*a*) Compare the critical loads given by the Euler's and Rankine's formula for a circular column of 40 mm diameter and 2000 mm long. Take yield stress as 300 MPa. Rankine's constant a = 1/7500 and E = 200 GPa. [8]

(*b*) Obtain the kern of a rectangular and circular section. [8]

Or

12. (*a*) Determine the slenderness ratio at which the Euler's formula for a fixed end can be used. Take E = 200 GPa and proportionality limit = 250 MPa. [8]

(*b*) The rectangular footing shown in Fig. 14 supports a load P = 750 kN. Neglecting the self weight of the footing, determine the stresses developed at A,B,C and D. [8]

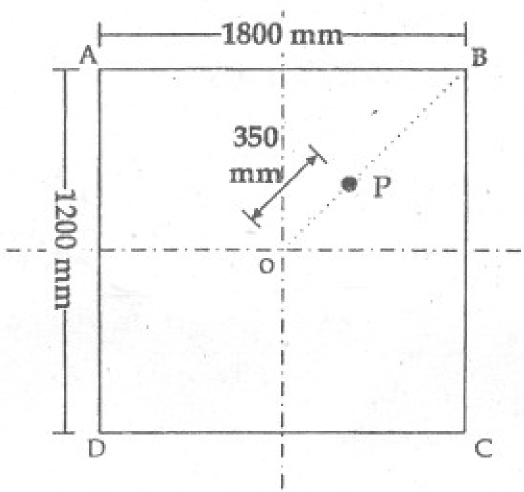


Fig. 14