VIII a) Derive the elastic torsion formulas for a hollow shaft of inner and outer radii C_1 and C_2. (15)

b) Write a note on the super position method used for a structure. (5)

IX A 2m long pin-ended column of square cross section is to be made of Douglas fir. Assuming E = 13 GPa, σ_{all}, allowable stress = 12 MPa for compression parallel to the grain, and using a factor of 2.5 in computing Euler's critical load for buckling, determine the size of the cross section if the column is to safety support a) a 100 kN load b) a 200 kN load. (20)

OR

X a) Derive expressions for hoop stress and longitudinal stress for a thin - walled pressure vessel. (10)

b) Write down the Lame's equation for a thick cylinder. (10)

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SS

ME

Code No. BTS 004(D)

B.Tech. Degree III Semester Examination in Mechanical Engineering, January 2001

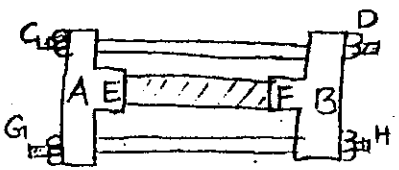
ME 304 MECHANICS OF SOLIDS

Time: 3 Hours *Max. Marks: 100*

I a) Derive an expression for strain energy for a rod BC of length 'ℓ' and uniform cross-sectional area 'A' which is attached at B to a fixed support and subjected at C to a slowly increasing axial load P. (8)

b) The rigid castings A and B shown in Fig.1 are connected by two 18mm-diameter steel bolts CD and GH and are in contact with the ends of a 36mm diameter aluminium rod EF. Each bolt is single threaded with a pitch of 2mm, and after being singly fitted, the nuts at D and H are both tightened one-quarter of a turn. Knowing that E is 200 GPa for steel and 70 GPa for aluminum, determine the normal stress in the rod. (12)

Fig.1



OR

II a) Derive a general expression for temperature stress for a rod fixed at both ends whose temperature is raised by t°. (5)

(P.T.O)

b) The 10mm diameter rod CE and the 15mm diameter rod DF are attached to the rigid bar ABCD as shown in Fig.2 knowing that the rods are made of aluminum and using E = 70 GPa, determine a) the force in each rod caused by the loading shown, b) the corresponding deflection at point A. (15)

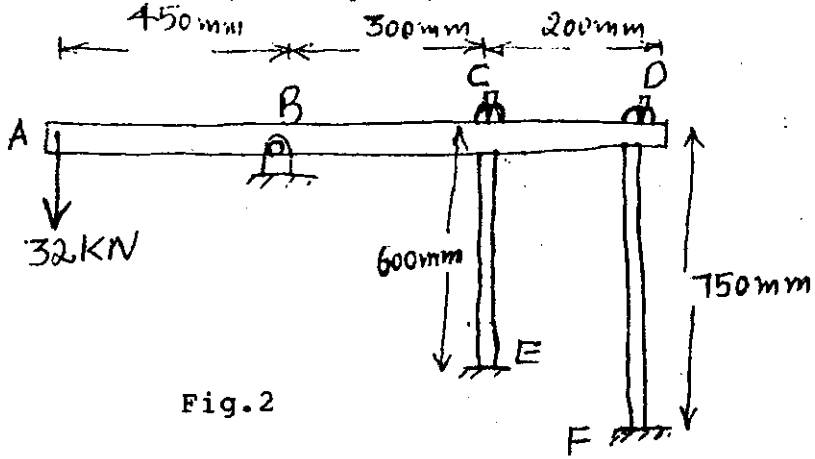
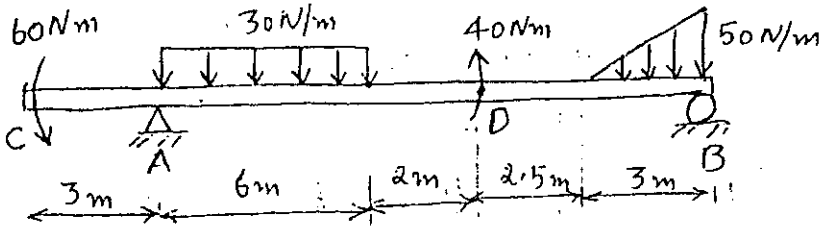


Fig.2

III Draw the Shear Force and Bending Moment diagrams for the loaded beam shown in Fig.3. (20)



OR

IV a) Draw the Shear Force and Bending Moment diagrams for the loaded beam shown in Fig.4. (8)

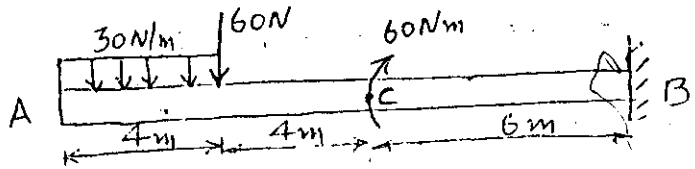


Fig.4

Contd...3

b) A machine part a T-shaped cross section is acted upon its plane of symmetry by the single force shown in Fig.5. Determine a) the maximum compressive stress at section n-n b) the maximum shearing stress. (12)

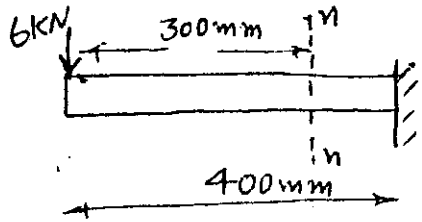


Fig.5

V Determine the slope and deflection at end B of the prismatic cantilever beam AB when it is loaded as shown in Fig.6, knowing that the flexural rigidity of the beam is EI = 10 MN m^2. Use Moment - Area method. (20)

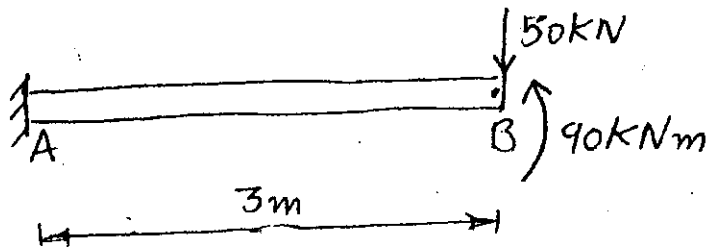


Fig.6

OR

VI Determine the reaction at the supports for the prismatic beam and loading shown in Fig.7. (20)

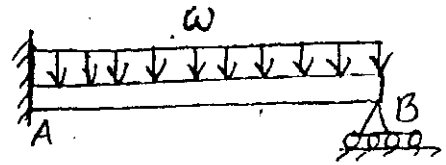


Fig.7

VII A shaft consisting of a steel tube of 50mm outer diameter is to transmit 100KW of power while rotating at a frequency of 20 Hz. Determine the tube thickness which should be used if the shearing stress is not to exceed 60 MPa. (20)

OR

Contd...4