GX483

Ollscoil na hÉireann, Gaillimh
National University of Ireland, Galway

FIRST SEMESTER EXAMINATIONS 2000

SECOND ENGINEERING EXAMINATION

STRENGTH OF MATERIALS

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Time allowed : ***2 hours***
Attempt *three* questions

1. Explain clearly what is meant by the terms " statically indeterminate structure" and "compatibility equations".

A compound bar is made up of a bar of area A_1 and modulus of elasticity E_1 and a concentric tube of area A_2 and modulus of elasticity E_2, as shown in Figure 1. Assuming that the end caps are rigid and that the assembly is initially stress free, determine the forces in the bar and tube due to the application of an axial compressive load P.

Assuming the following values for the geometric and material properties, calculate the stress in the tube when P = 25kN. $A_1 = 490\ mm^2$; $A_2 = 650\ mm^2$; $E_1 = 200$ GPa ; $E_2 = 120$ GPa.

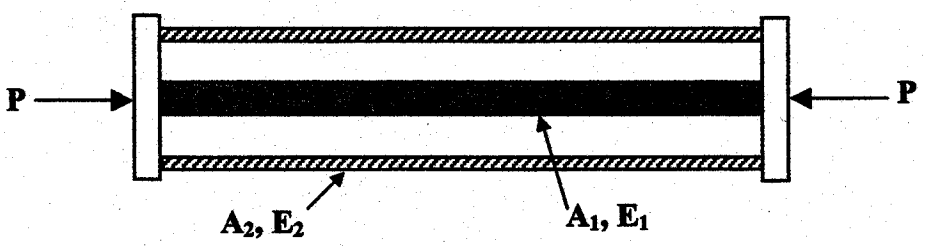

Figure 1

p.t.o.

2. Stating your assumptions clearly and defining the symbols, derive the torsion formula for circular shafts

$$\frac{T}{J} = \frac{G\theta}{L} = \frac{\tau}{R}$$

A solid brass shaft having a diameter of 50mm and a length of 400mm is subjected to a torque, which results in a maximum shear stress in the shaft of 80 MPa. Find the value of this torque and also the relative rotation of the two ends of the shaft in degrees. G = 40 GPa.

3. Stating your assumptions clearly and defining all the symbols, derive the following expression for the volumetric strain in a thin walled spherical pressure vessel.

$$\frac{\Delta V}{V} = 3\varepsilon_h = \frac{3pr}{2tE}(1-\nu)$$

A steel spherical pressure vessel having an internal diameter of 2.0m and a wall thickness of 10mm is initially just filled with water. Determine the additional volume of water which must be pumped in to raise the pressure to 10 MPa. For the steel, E=207GPa and $\nu = 0.3$. The bulk modulus of water is 2.3 GPa.

4. A 200mm deep symmetrical I-beam carries a point load at the center of a simply supported span. The resulting shear stress and bending stress distributions are shown in Figure 2.

Use Mohr's Circle method to determine the principal stresses at the junction of the web and the top flange.

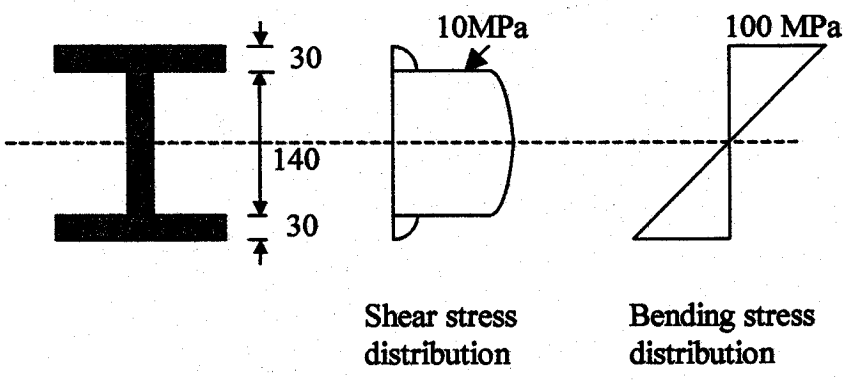

Figure 2