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ET-502(A)

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

Term-End Examination

00285

June, 2013

ET-502(A) : STRENGTH OF MATERIALS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer **any five** questions. All questions carry equal marks. Use of scientific calculator is **permitted**.*

1. (a) A rod, 150 cm long and of 2.0 cm diameter, is subjected to an axial pull of 20 kN. If the modulus of elasticity of the material of the rod is 2×10^5 N/mm^2; determine : 7

(i) the stress,

(ii) the strain, and

(iii) the elongation of the rod.

(b) An axial pull of 35000 N is acting on a bar consisting of three lengths as shown in Figure 1. If the Young's Modulus $= 2.1 \times 10^5$ N/mm^2, determine : 7

(i) Stresses in each section and

(ii) total extension of the bar.

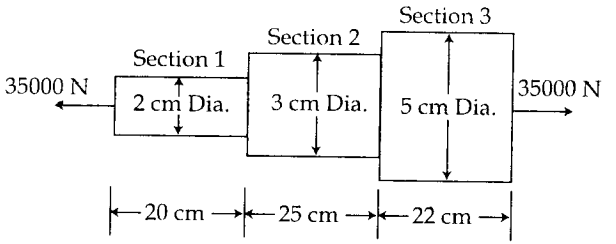

Figure - 1

2. (a) A rod is 2 m long at a temperature of 10°C. Find the expansion of the rod, when the temperature is raised to 80°C. If this expansion is prevented, find the stress induced in the material of the rod. Take. $E = 1.0 \times 10^5 MN/m^2$ and $\alpha = 0.000012$ per degree centigrade. 7

(b) A metallic bar 300 mm × 100mm × 40 mm is subjected to a force of 5 kN (tensile), 6kN (tensile) and 4 kN (tensile) 7

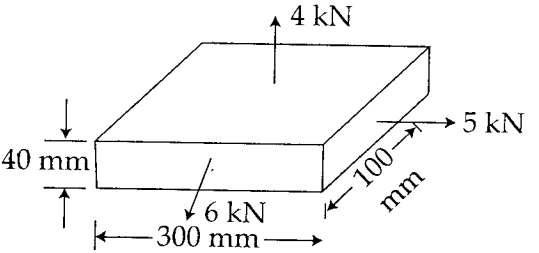

Figure - 2

along x, y and z directions respectively. Determine the change in the volume of the block. Take $E = 2 \times 10^5$ N/mm^2 and Poisson's ratio = 0.25.

3. (a) At a point in a strained material the principal stresses are 100 N/mm^2, (tensile) and 60 N/mm^2 (compressive). Determine the normal stress, shear stress, and resultant stress on a plane inclined at 50° to the axis of major principle stress. Also determine the maximum shear stress at the point. 7

(b) Direct stresses of 120 N/mm^2 tensile and 90 N/mm^2 compression exist on two perpendicular planes at a certain point in a body. They are also accompanies by shear stress on the planes. The greatest principle stress at the point due to these is 150 N/mm^2. 7

(i) What must be the magnitude of the shearing stresses on the two planes ?

(ii) What will be the maximum shearing stress at the point ?

4. (a) A bar of uniform cross - section 'A', and length 'L' hangs vertically, subjected to its own weight. 7

Prove that the strain energy stored within the bar is given by :

$$U = \frac{A \times \rho^2 \times L^3}{6\,E}$$ Where E = Modulus of Elasticity ρ = Weight per unit volume of the bar.

(b) A solid shaft of 150 mm diameter is used to transmit torque. Find the maximum torque transmitted by the shaft if the maximum shear stress induced to the shaft is 45 N/mm^2. 7

8. (a) A solid steel shaft has to transmit 75 kW at 200 rpm. Taking allowable shear stress as 70 N/mm^2, find suitable diameter for the shaft, if the maximum torque transmitted at each revolution exceeds the mean by 30%. 7

(b) A cylindrical shell 3 m long which is closed at the ends has an internal diameter of 1 m and a wall thickness of 15 cm. Calculate the circumferential and longitudinal stresses induced, if it is subjected to an internal pressure of 1.5 N/mm^2. 7

(b) A cage weighing 60 kN is attached to the end of a steel wire rope. It is lowered down a mine shaft with a constant velocity of 1 m/sec. What is the maximum stress produced in the rope when its supporting drum is suddenly jammed ? The free length of the rope at the moment of jamming is 15 m, its net cross - sectional area is 25 cm^2 and $E = 2 \times 10^5$ N/mm^2. The self weight of the wire rope may be neglected. 7

5. (a) A simply supported beam of length 6 m, 7

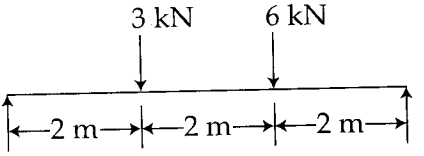

Figure - 3

Carries point load of 3 kN and 6 kN at distances of 2 m, and 4 m from the left end. Draw the shear force and bending moment diagrams for the beam.

(b) Draw the shear force and bending moment diagrams for the over - hanging beam carrying uniformly distributed load of 2 kN/m over the entire length as shown in Figure 4. Also locate the point of contraflexture. 7

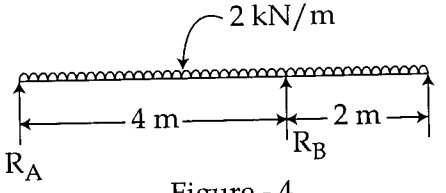

Figure - 4

6. (a) A steel plate of width 120 mm and of thickness 20 mm is bent into a circular arc of radius 10 m. Determine the maximum stress induced and the bending moment which will produce the maximum stress. Take $E = 2 \times 10^5$ N/mm^2. 7

(b) A reactangular beam 100 mm wide and 250 mm deep is subjected to a maximum shear force of 50 kN. 7

Determine :

(i) Average shear stress,

(ii) Maximum shear stress, and

(iii) Shear stress at a distance of 25 mm above the neutral axis.

7. (a) A pin jointed truss of 9m is loaded as shown in Figure 5. Find the forces in the members of the truss. 7

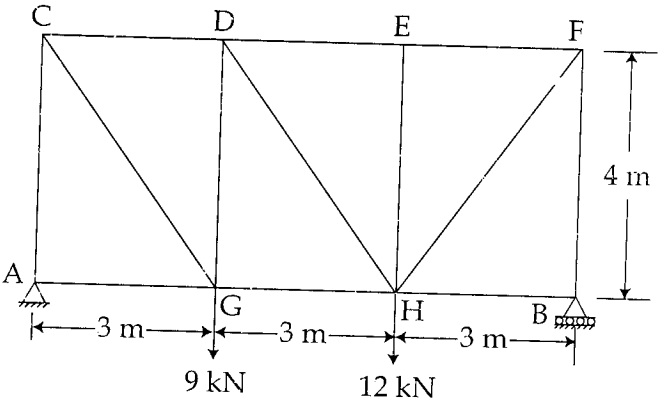

Figure - 5