Code : 011406

B.Tech 4th Semester Exam., 2015

MECHANICS OF SOLID—I

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No. **1** is compulsory.*

1. Choose the correct option of the following (any *seven*) : 2×7=14

(a) The total area under the stress-strain curve of a mild steel specimen tested up to failure under tension is a measure of its

(i) breaking strength

(ii) resilience

(iii) stiffness

(iv) toughness

(b) For a Poisson's ratio 0·4 for a material, the ratio of the shear modulus to modulus of rigidity is

(i) 5/14

(ii) 5/7

(iii) 7/5

(iv) 14/5

(c) If a body is acted upon by pure shear stresses on two perpendicular planes, the planes inclined at 45° are subjected to stresses

(i) normal only

(ii) shear only

(iii) normal and shear both

(iv) None of the above

(d) The bending moment for a certain portion of the beam, is constant, for that section, the shear force would be

(i) constant

(ii) zero

(iii) increasing

(iv) decreasing

(e) The strength of a beam depends upon

(i) modulus of elasticity

(ii) bending moment

(iii) section modulus

(iv) radius of curvature

(f) Shear stress variation across a rectangular section is

(i) hyperbolic

(ii) parabolic

(iii) linearly

(iv) constant

(g) Maximum deflection of a cantilever having a uniformly distributed load is

(i) $\frac{wl^4}{2EI}$

(ii) $\frac{wl^4}{4EI}$

(iii) $\frac{wl^4}{8EI}$

(iv) $\frac{wl^4}{24EI}$

(h) Torsional rigidity is the product of

(i) polar moment of inertia of modulus of rigidity

(ii) modulus of rigidity and modulus of elasticity

(iii) polar moment of inertia and modulus of elasticity

(iv) None of the above

(i) A circular shaft is subjected to a twisting moment T and a bending moment M. The ratio of maximum bending stress to maximum shear stress is given by

(i) $\frac{M}{T}$

(ii) $\frac{2T}{M}$

(iii) $\frac{M}{2T}$

(iv) $\frac{2M}{T}$

(j) Strain energy stored in a body due to suddenly applied load compared to when applied slowly is

(i) half

(ii) twice

(iii) four times

(iv) eight times

2. The concrete post of 300 mm × 300 mm is reinforced axially with four symmetrically placed steel bar, each of cross-section area 900 mm^2. *(a)* Compute the stress in each material when the 1000 kN axial load is applied. The modulli of elasticity are 200 GPa for steel and 14 GPa for concrete, *(b)* compute the maximum safe-axial load that may be applied if allowable stresses of steel is 120 MPa and for concrete is 6 MPa. 14

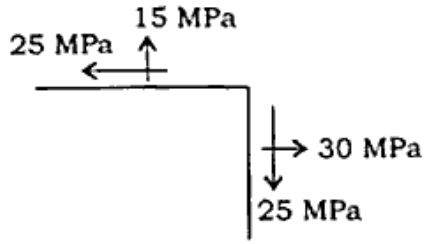
3. Two parallel walls, 6 metres apart, are joined together by a steel rod of 25 mm diameter at a temperature of 80 °C passing through washer and nuts at each end. Calculate the pull exerted by the rod when it has cooled to 22 °C, *(a)* if the walls do not yield and *(b)* if the total yield together at the two ends is 1·5 mm. $E = 200$ GPa, $\alpha = 11 \times 10^{-6}$/°C.

4. The stresses on two perpendicular planes through a point in a body are 30 MPa and 15 MPa both tensile along with a shear stress of 25 MPa as shown in figure below, find—

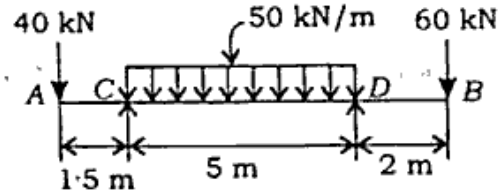
(a) the magnitude and direction of principal stresses;

(b) the planes of maximum shear stress;

(c) the normal and shear stresses on the planes of maximum shearing stress. 14

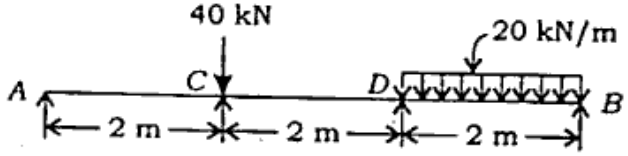


5. Draw shear force and bending moment diagram for a beam as shown in figure below, and locate point of contraflexure if any : 14



6. A water main of 500 mm internal diameter and 20 mm thick is running full. The water main is of cast iron and is supported at two points 10 m apart. Find the maximum stress in the metal. The cast iron and water weigh 72 kN/m^3 and 10 kN/m^3 respectively. 14

7. Find the maximum deflection and the maximum slope for a beam loaded as shown in figure given below. Take flexural rigidity $EI = 15 \times 10^9$ kN-mm^2 : 14



8. A hollow shaft of diameter ratio 3/8 is required to transmit 600 kW at 110 r.p.m., the maximum torque being 20% greater than the mean. The shear stress is not to exceed 63 MPa and the twist in a length of 3 m not to exceed 1·4°. Calculate the maximum external diameter at these conditions. Take modulus of rigidity = 84 GPa. 14

9. (a) Define strain energy, resilience and proof resilience. 6

(b) Find an expression for the strain energy due to bending for a beam of length l, simply supported at the ends and carrying a uniformly distributed load w/unit run over whole of its span if flexural rigidity EI is constant throughout the length. 8

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