B.E.(with Credits)-Regular-Semester 2012-Civil Engineering Sem III

CL302 - Strength of Material

P. Pages : 4 **GUG/S/18/3677**

Time : Three Hours Max. Marks : 80

Notes : 1. All questions carry equal marks.
2. Answer **all** questions.
3. Assume suitable data wherever necessary.
4. Illustrate your answers wherever necessary with the help of neat sketches.

1. a) Derive the relation between modulus of elasticity (E), Poisson's ratio (ν), Modulus of rigidity (G) and Bulk modulus (k). **6**

b) A bronze bar is fastened between a steel bar and an aluminium bar as shown in fig. (1) Axial loads are applied at the positions indicated. Find the largest value of P that will not exceed an overall deformation of 3.0 mm, or the following stresses. 140MPa in steel, 120MPa in bronze, and 80MPa in aluminium. Assume that the assembly is suitably braced to prevent buckling. Use $E_{st} = 200\,GPa$, $E_{al} = 70\,GPa$, and $E_{br} = 83\,GPa$ **10**

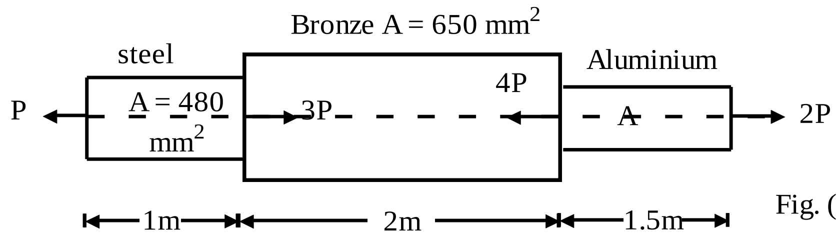

Fig. (1)

OR

2. a) A solid aluminium shaft of 80mm diameter its concentrically in a hollow steel tube. Compute the minimum internal diameter of the steel tube so that no contact pressure exists when the aluminium shaft carries an axial compressive load of 400 kN. Assume $\nu = 1/3$ and $E_{al} = 70\,GPa$. **8**

b) Compute the total elongation caused by an axial load of 100 kN applied to a flat bar 20 mm thick, tapering from a width of 120 mm to 40 mm in a length of 10 m as shown in Fig. 2. Assume E = 200 GPa. **8**

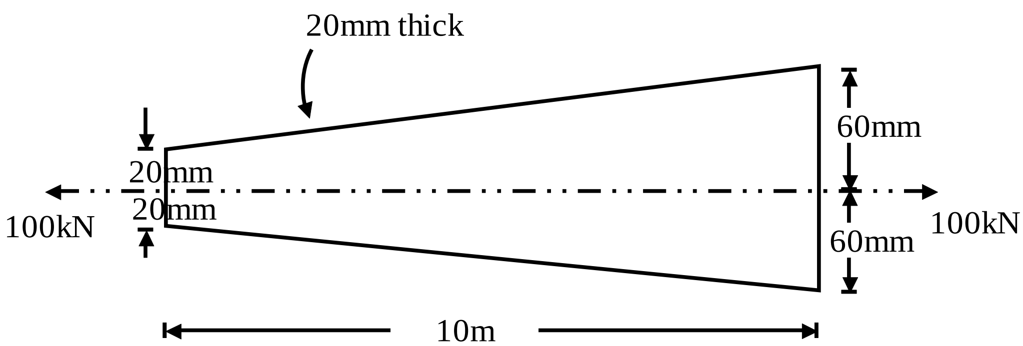

Fig. 2

3. a) What is point of contra flexure? Explain the step by step procedure to locate it? **4**

b) For the beam loaded and supported as shown in fig. (3), Draw shear force and bending moment diagram indicating all values. **12**

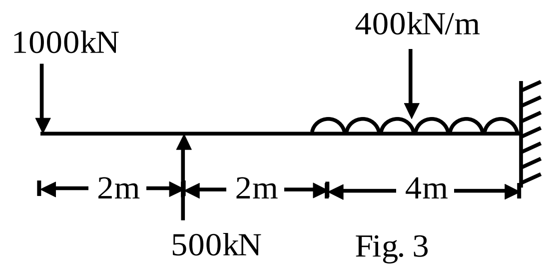

Fig. 3

OR

4. Construct the load diagram and Bending moment diagram from the given shear force diagram as shown in fig. (4) **16**

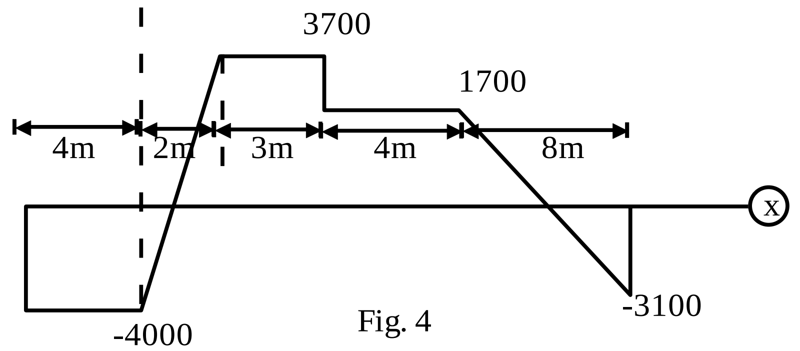

Fig. 4

5. A cantilever beam carries the force and couple as shown in fig. (5) a, b. Determine the maximum tensile and compressive bending stresses developed in the beam. **16**

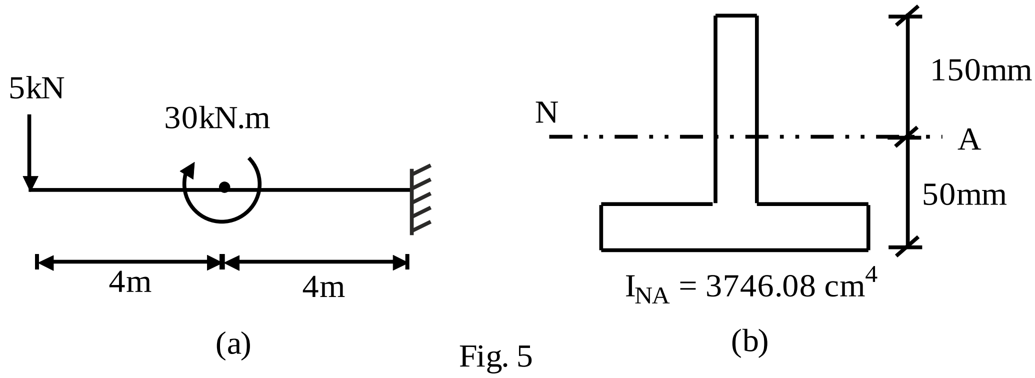

Fig. 5

OR

6. The T section shown in fig. (6) is the cross section of a beam formed by joining two rectangular pieces of wood together. The beam is subjected to a maximum shearing force of 60kN. Show that the NA is 34mm from the top and that $I_{NA} = 10.57 \times 10^6 mm^4$. Using these values. Determine the shearing stress **16**

a) At the neutral axis and

b) At the junction between the two pieces of wood and then draw shear stress distribution curve.

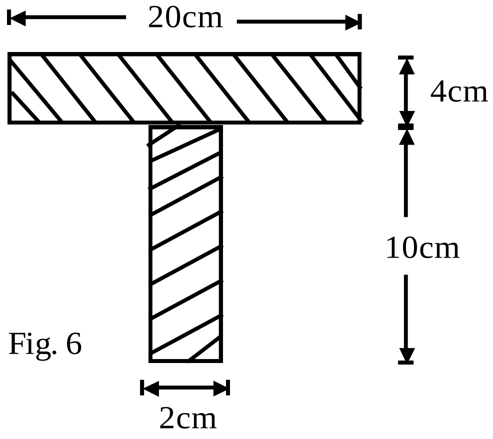

Fig. 6

7. For the beam shown in fig. (7) Determine the value of $EI\delta$ midway between the supports and at the left end. **16**

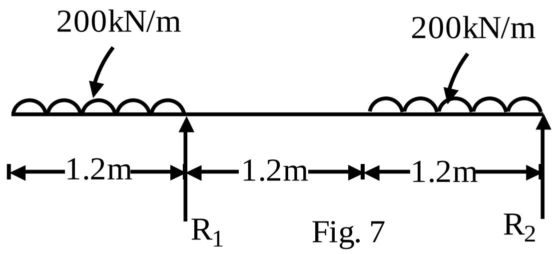

Fig. 7

OR

8. a) A steel propeller shaft is to transmit 4.5MW at 3Hz without exceeding a shearing stress of 50MPa or twisting through more than 1° in a length of 26 diameters. Compute the proper diameter if G = 83GPa. **8**

b) Show that a hollow circular shaft whose inner diameter is half the outer diameter has a torsional strength equal to 15/16 of that of a solid shaft of the same outside diameter. **8**

9. a) An element in plane stress is subjected to stresses as shown in fig. 8. Determine **12**

i) The stresses acting on an element rotated through an angle of 41°

ii) The principal stresses

iii) maximum shear stresses. Show all results on sketches of properly oriented elements.

b) Explain Mohr's circle method for locating principal plane. **4**

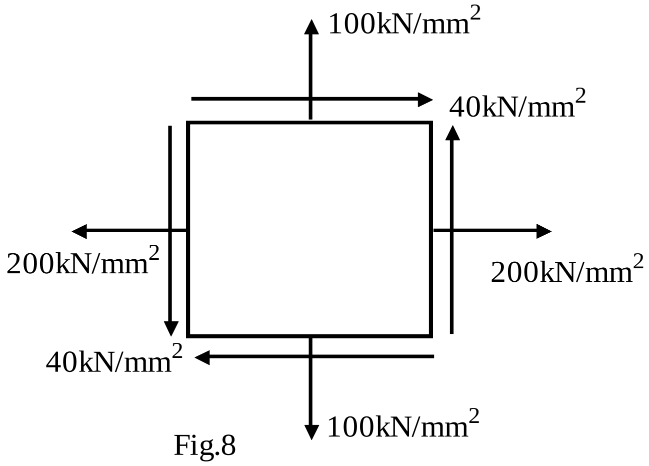

Fig. 8

OR

10. a) Explain concept of shear center of thin walled section. **6**

b) Explain theory of combined bending and torsion. **5**

c) Derive the formula for maximum shearing stress of an element subjected to two dimensional state of stress with tangential stresses above both sides. **5**

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