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Question Paper Code : 50535

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Fourth Semester

Civil Engineering

CE 3402 — STRENGTH OF MATERIALS

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Outline principal planes.
2. Mention the relation between the elastic constants.
3. List any four assumptions made in the theory of bending.
4. Comment on the shear force and bending moment diagrams for different types of loading.
5. What is the slope at the ends of a simply supported beam carrying udl throughout the span?
6. List any four methods to determine deflection of beams.
7. Recall fixed end moments.
8. What are indeterminate beams?
9. Define shear centre.
10. Mention any two applications of theories of failure.

PART B — (5 × 13 = 65 marks)

11. (a) A circular steel bar ABCD, rigidly fixed at A and D is subjected to axial loads of 50 kN and 100 kN at B and C as shown in Fig. Q.11(a). Find the loads shared by each part of the bar and displacements of the points B and C. Take E for steel as 200 GPa.

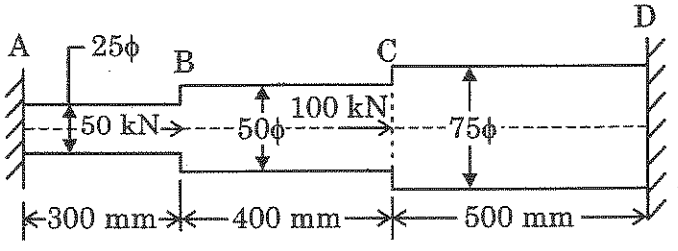

Fig. Q. 11(a)

Or

(b) A solid steel shaft of 60 mm diameter is to be replaced by a hollow steel shaft of the same material with internal diameter equal to three fourth of external diameter. Find the diameters of the hollow shaft and saving in material, if the maximum allowable shear stress is the same for both shafts.

12. (a) A beam is loaded as shown in Fig. Q. 12(a). Construct the shear force and bending moments diagrams for the beam and mark the values of the important ordinates.

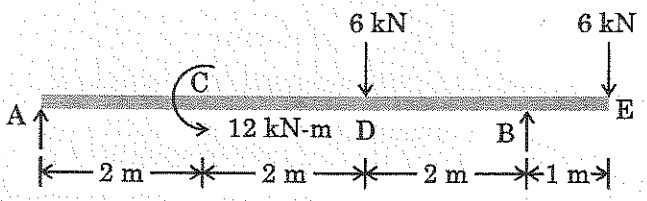

Fig. Q. 12(a)

Or

(b) A rectangular beam, simply supported over a span of 4m, is carrying a udl of 50 kN/m. Find the dimensions of the beam, if the depth is 2.5 times its width. Take maximum bending stress in the beam section as 60 MPa.

13. (a) Using the Conjugate beam method, find the mid span deflection of the beam shown in Fig. Q. 13(a). Take E = 200 GPa and I = 200×10^{-4} m^4.

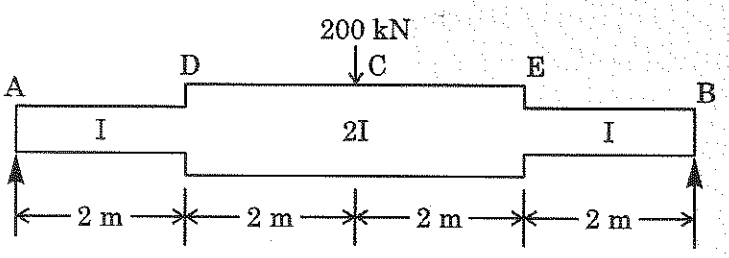

Fig. Q. 13(a)

Or

(b) A beam AB of span 8 m is simply supported at the ends. It carries a uniformly distributed of 30 kN/m over its entire length and a concentrated load of 60 kN at 3 m from support A. Determine the location and magnitude of the maximum deflection in the beam by Macaulay's method. Take E = 200 GPa and I = 80×10^{-4} m^4.

14. (a) Analyse the continuous beam shown in Fig. Q. 14(a) using the Theorem of three moments.

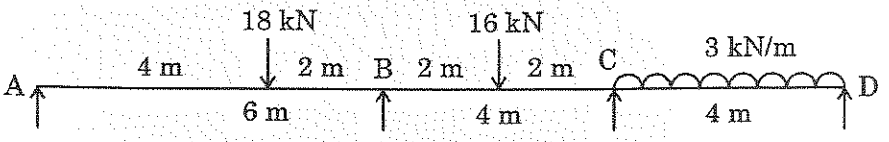

Fig. Q. 14(a)

Or

(b) A fixed beam of 6 m span supports two point loads of 300 kN each at 2 m from each end. Find the fixing moments at the ends and draw the B.M. and S.F. diagrams. Find also the central deflection. Take $I = 9 \times 10^8$ mm^4 and E = 200 GPa.

15. (a) A thick walled closed end cylinder is made of an Al-alloy (E = 72 GPa, l/m = 0.33). has an inside diameter of 200 mm and outside diameter of 800 mm. The cylinder is subjected to internal fluid pressure of 150 MPa. Determine the principal stresses and maximum shear stress at a point on the inside surface of the cylinder. Also determine the increase in inside diameter due to fluid pressure.

Or

(b) A cylindrical shell made of mild steel plate and 1.2 m in diameter is to be subjected to an internal pressure of 1.5 MN/m^2. If the material yields at 200 MN/m^2, calculate the thickness of the plate on the basis of the following three theories, assuming a factor of safety 3 in each case.

(i) Maximum principal stress theory; (4)

(ii) Maximum shear stress theory; and (4)

(iii) Maximum shear strain energy theory. (5)

PART C — (1 × 15 = 15 marks)

16. (a) At a point in a material under stress shown in Fig. Q. 16(a), the intensity of the resultant stress on a certain plane is 50 MPa (tensile) and is inclined at 30° to the normal of that plane. The stress on a plane at right angles to this has a normal tensile component of intensity of 30 MPa. Find :

(i) The resultant stress on the second plane;

(ii) The principal planes and stresses;

(iii) The plane of maximum shear and its intensity.

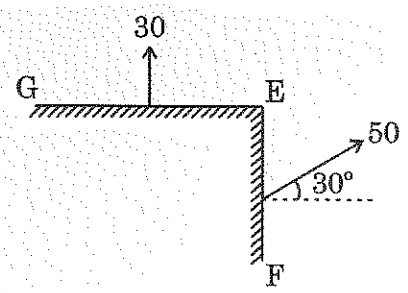

Fig. Q. 16(a)

Or

(b) A beam of T section shown in Fig. Q. 16(b) is 2.5 m in length and is simply supported at the ends. It carries a load of 3.2 kN inclined at 20° to the vertical and passing through the centroid of the section. If E = 200 GPa, Calculate :

(i) Maximum tensile stress; (3)

(ii) Maximum compressive stress; (4)

(iii) Deflection due to the load; and (4)

(iv) Position of the neutral axis. (4)

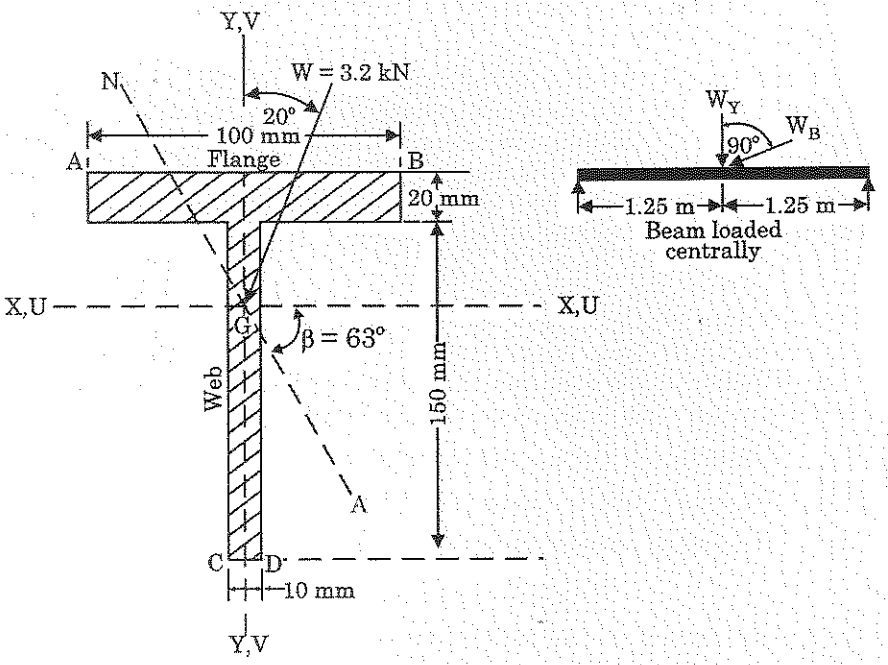

Fig. Q. 16(b)