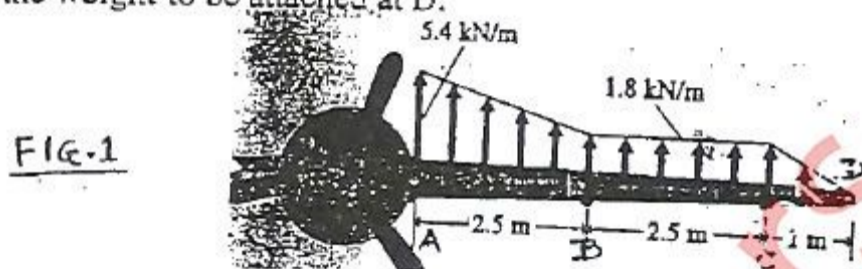


(3 Hours)

80 MARKS

INSTRUCTIONS: 1. Question number 1 is COMPULSORY. 2. Attempt any THREE from the remaining. 3. Each full question carries EQUAL marks. 4) ASSUME any suitable data, if needed.

1. A) Fig. 1 shows the approximate distribution of forces that act on an airplane wing (including the lift force & the wing weight). End A is a fixed end. Calculate the bending moment at A. Drawing the BMD is not needed. A design engineer finds that the Bending Moment at A is too large. He asks you to attach a weight at point D to reduce the BM at A by 50%. Find the weight to be attached at D. (04 M)



- B) A nylon thread is subjected to 10 N. tension force. Knowing that $E = 3.4$ GPa & that the length of the thread increases by 1.1%, determine: (i) the stress in the thread (ii) the diameter of the thread. (04 M)
- C) What are the assumptions made in the Theory of Pure Torsion? (04 M)
- D) A cylindrical shell is 3 m long & has 1.2 m internal diameter. It is subjected to an internal fluid pressure of 2 MPa. If the shell thickness is 10 mm, find the hoop stress & longitudinal stress. (04 M)
- E) A steel bar having (45 mm X 45 mm) C/S & 5 m long is subjected to an axial pull of 170 kN. Find the strain energy stored in the bar. Also, determine the extension of the bar. Take $E = 200$ GPa. (04M)

2. A) A S/S beam has a span of 9 m & carries a UDL of 1600 N/m over the entire span. It is T section with flange dimensions (120 mm X 20 mm) & web dimensions (100 mm X 25 mm). Overall depth of section = 120 mm. Calculate the maximum shear stress. Draw the Shear Stress Distribution Diagram. (10 M)

- B) Draw Shear Force Diagram & Bending Moment Diagram for the beam shown in fig. 2. Locate the Point of Contra flexure, if any. (10 M)

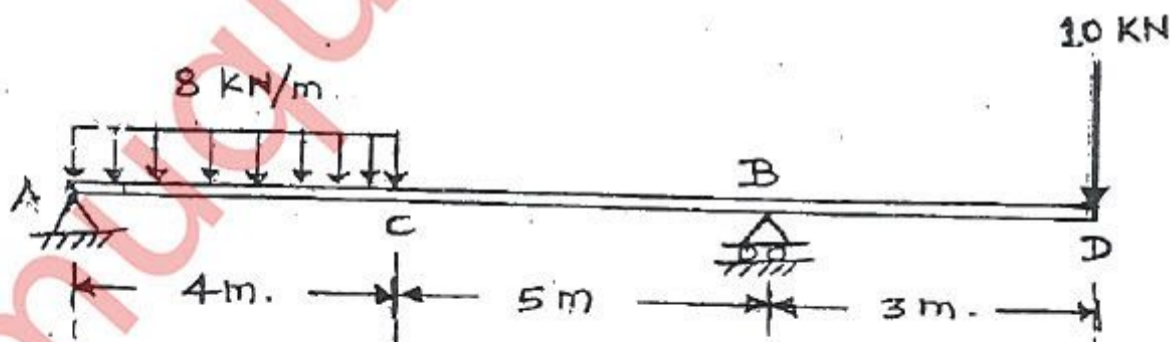


FIG.2

Page 1 of 3

3. A) The beam is to be used to support the machine, which exerts the forces of 30 kN & 40 kN (fig. 3). If the Maximum Bending Stress is not to exceed 155 MPa, determine the required width (b) of the flanges. (10 M)

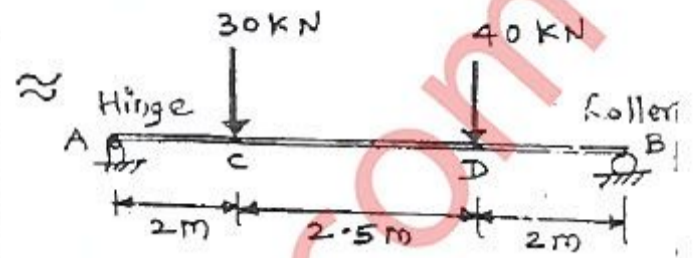
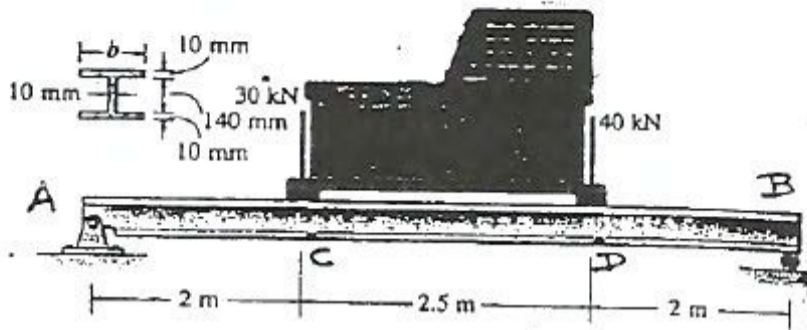


FIG-3

- B) The masonry pier (fig. 4) is subjected to the 800 kN load. If $x = 0.25$ m & $y = 0.5$ m, find the resultant stress intensities at each corner A, B, C & D. Neglect the weight of the pier. (10 M)

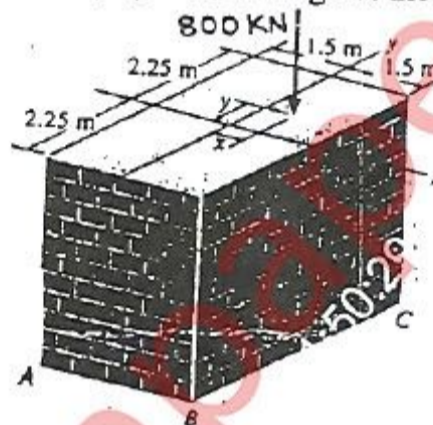


FIG-4

4. A) The thin walled cylindrical pressure vessel of inner diameter (d) & thickness (t) is subjected to an internal fluid pressure (p). If $E =$ Young's modulus & $\mu =$ Poisson's ratio, find the strains in the circumferential & longitudinal directions. Using these results, compute the increase in diameter & length of a steel pressure vessel filled with air & having an internal pressure of 16 MPa. The vessel is 3 m long & has an inner radius of 0.5 m & a thickness of 9 mm (fig. 5). $E = 200$ GPa & $\mu = 0.3$. (06 M)

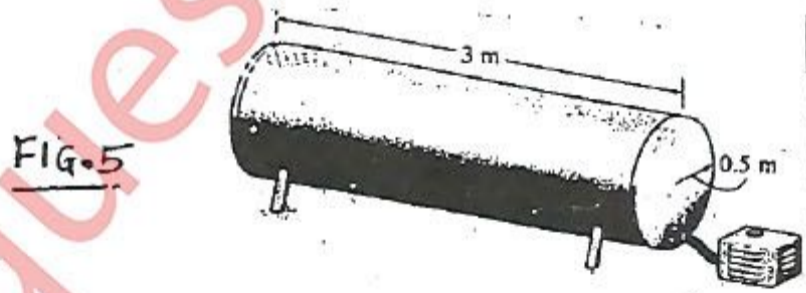


FIG-5

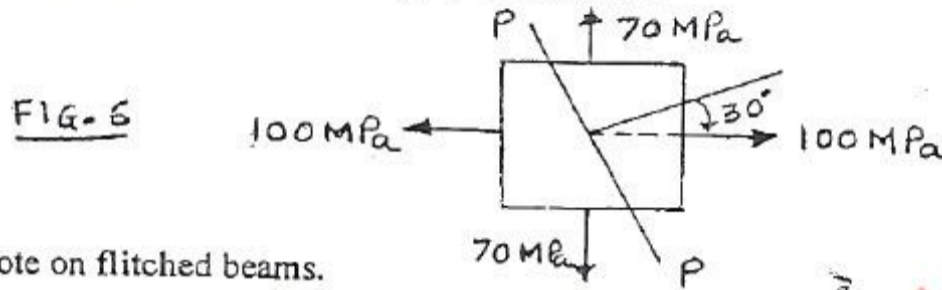
- B) Write a note on temperature stresses. (04 M)

- C) A column of height 12 m is fixed at both the ends. Its C/S is a symmetrical I-section. Flanges are (100 mm X 15 mm) & web is (130 mm X 15 mm). Find the factor of safety with respect to buckling for an axial load of 17 kN. Use Euler's theory. (10 M)

$$E = 2 \times 10^5 \text{ N/mm}^2$$

5. A) Determine the maximum torque that can be applied safely to a solid shaft of diameter 270 mm. The permissible angle of twist = 1.3 degrees in a length of 5.8 m & the shear stress is not to exceed 60 MPa. Take Modulus of Rigidity $G = 90 \text{ MPa}$. (06 M)

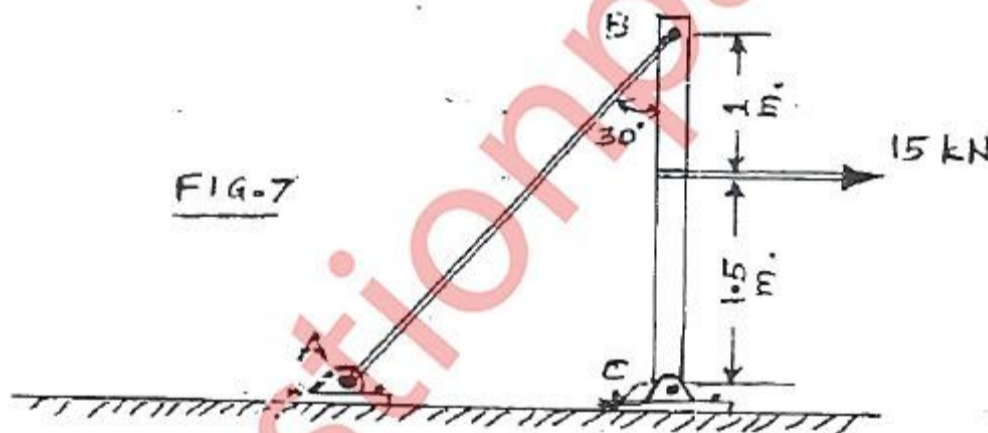
- B) An element in a stressed body is subjected to normal stresses on mutually perpendicular directions (fig. 6). Determine the normal, tangential & resultant stresses on a plane P-P inclined as shown. Either use analytical method or graphical method. (10 M)



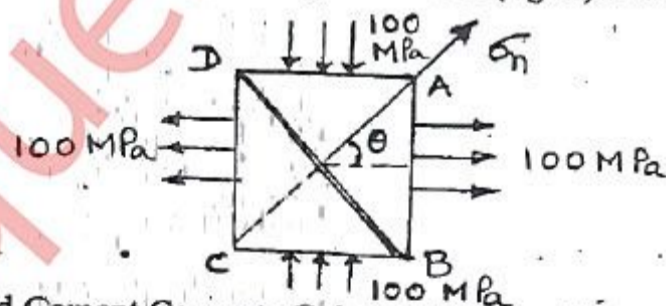
- C) Write a note on flitched beams. (04 M)

6. A) A bar is subjected to a tensile load of 55 kN. Bar diameter = 31 mm, Gauge length = 300 mm, extension = 0.115 mm, change in diameter = 0.00367 mm. Find: Poisson's ratio, Young's modulus, bulk modulus & modulus of rigidity. (05 M)

- B) The pole (fig. 7) is supported by a pin at C & a steel guy wire AB. If the wire has a diameter of 5 mm, determine how much it stretches when a horizontal force of 15 kN acts on the pole. $E_{\text{wire}} = 200 \text{ GPa}$. (05 M)



- C) A square element is subjected to Principal Stresses (fig. 8). Find the intensity of normal stress on plane BD? (05 M)



- D) A short, Reinforced Cement Concrete Column (600 mm X 600 mm) has 8 steel rods of 25 mm diameter as reinforcement. Find the stresses in steel & concrete & the elastic shortening of the column if $E = 200000 \text{ MPa}$ for steel & 10000 MPa for concrete. Load on column = 3000 kN & length = 3 m. (05 M)