

(3 Hours)

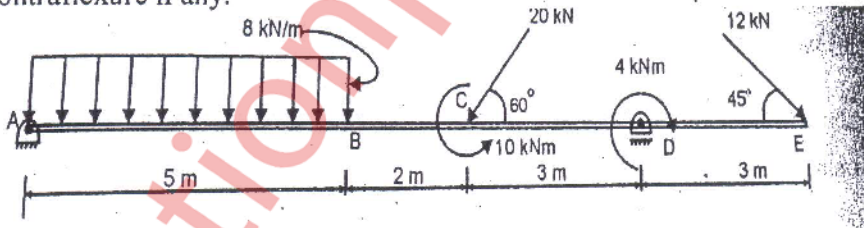
[ Total Marks : 80

- N.B. : (1) Question No. 1 is compulsory.  
 (2) Solve three question from remaining five.  
 (3) Assume suitable data wherever necessary.

Q.1. Solve any Four Questions : 20

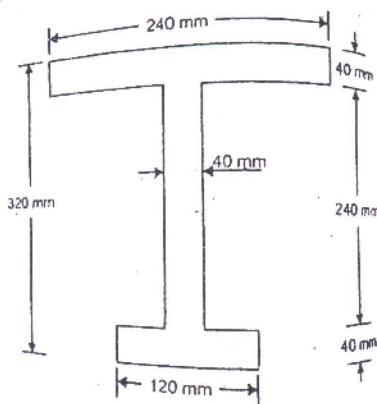
- A Write a short note on Macaulays Method  
 B What are the characteristics of bending Moment and What do you mean by point of contraflexure  
 C Prove that  $\frac{f_b}{y} = \frac{M}{I} = \frac{E}{R}$   
 D What is equivalent length of column ? Give the ratio of equivalent length and actual length of column with various end condition  
 E What is the length of 5 mm diameter aluminium wire so that it can be twisted through one complete revolution without exceeding shear stress of 42 MN/m<sup>2</sup> Modulus of rigidity G= 27 GN/m<sup>2</sup>  
 F Derive an expression for elongation due to self weight of bar

Q. 2. A Draw SFD, BMD and AFD for the following beam and also show the point of contraflexure if any. 12



B Find the Euler crushing load for a hollow cylinder cast iron column 200 mm external diameter and 25 mm thick, if it is 6 m long and hinged at both ends. Take  $E = 1.2 \times 10^5 \text{ N/mm}^2$ . Compare the load with the crushing load as given by Rankine formula, taking  $f_c = 550 \text{ N/mm}^2$  and  $a = 1/1600$  08

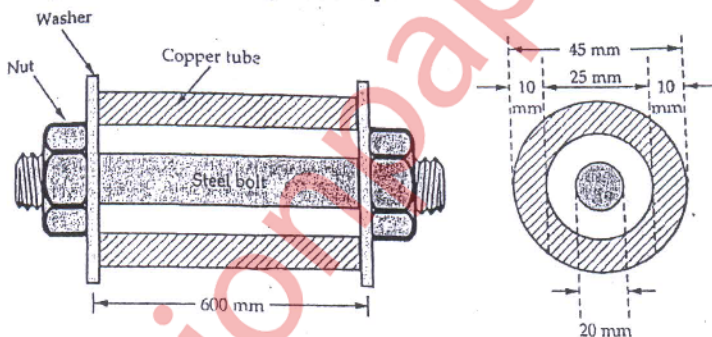
Q. 3. A A cast iron bracket subjected to bending banding has a C/S of I shape with unequal flanges. If the section is subjected to shear force of 120 KN, Draw shear force distribution diagram over the depth of section 10



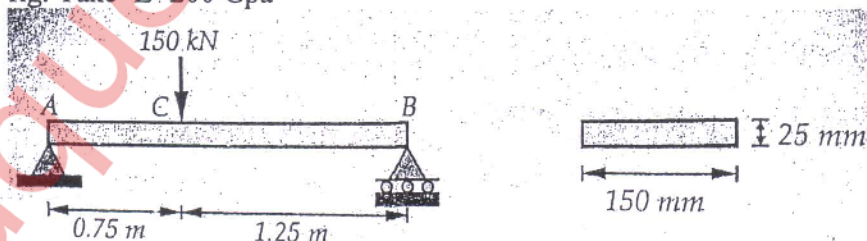
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- B A Hollow shaft with diameter ratio of  $\frac{3}{8}$  is required to transmit 500 KW at 100 RPM, the maximum torque being 20 % greater than mean. The maximum shear stress is not exceed  $60 \text{ N/mm}^2$  and the twist in the length of 3 m is not exceed  $1.4^\circ$ . Calculate the minimum diameter required for the shaft.  $C=84 \text{ N/mm}^2$

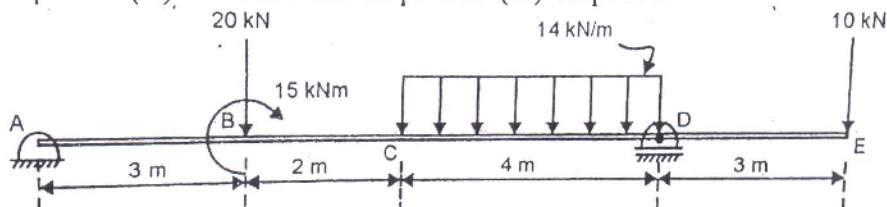
- Q.4. A A wooden beam 250mm x 150 mm has a steel strap 10 mm x 150 mm fixed at the top and the bottom. The beam is subjected to bending moment of 5 KN-m around the horizontal axis. Determine the stress in the steel and wood.  $E_s=200 \text{ GPa}$ ,  $E_w=20 \text{ GPa}$
- B A Steel bolt of 20 mm diameter passes centrally through a copper tube of internal diameter 25 mm and thickness 10 mm. The tube is 600 mm long and is closed by rigid washer of negligible thickness and fastened by nuts threaded on the bolt. Find the stresses in the bolt & tube when one of the nuts is tightened by the one quarter of the turn relative to other. The pitch of the thread is 2 mm. Take  $E_s=200 \text{ GPa}$  and  $E_c=100 \text{ GPa}$



- Q.5. A Determine the strain energy of prismatic beam AB for the loading as shown in fig. Take  $E=200 \text{ GPa}$



- B A horizontal beam is loaded and supported as shown in fig. Determine (i) Slope at A (ii) Deflection and Slope at B (iii) Slope at D



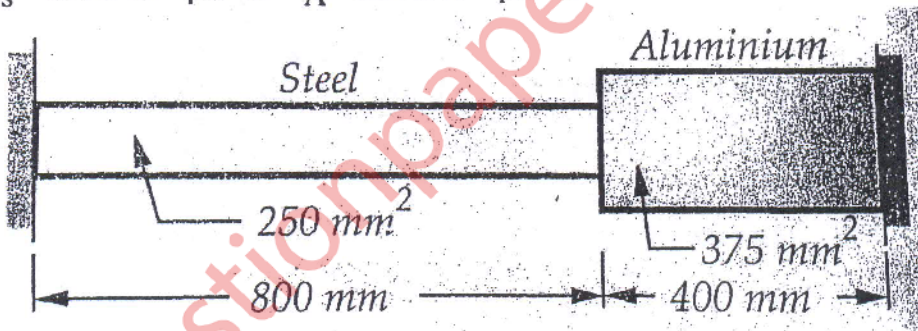
Q.6 A The Composite bar consisting of steel and aluminium components shown in fig 10  
Is connected to two grip at a temperature of  $60^\circ\text{C}$ . Find the stresses in the  
two rods, when the temperature, falls to  $20^\circ\text{C}$

( I ) If the ends does not yield

(II) If the ends yield by 0.25 mm

Take :  $E_s = 2 \times 10^5 \text{ N/mm}^2$ ,  $E_A = 0.70 \times 10^5 \text{ N/mm}^2$ .

$\alpha_s = 1.17 \times 10^{-5} \text{ per } ^\circ\text{C}$   $\alpha_A = 2.34 \times 10^{-5} \text{ per } ^\circ\text{C}$



B A cylindrical shell 800 mm in diameter and 3 m long is having 10 mm metal thickness. If the shell is subjected to an internal pressure of  $2.5 \text{ N/mm}^2$

Determine (i) The change in diameter

( ii) The change in length

( iii) The change in volume

Assume the modulus of elasticity and poissions ratio of the material of the shell as  $200 \text{ KN/mm}^2$  and 0.25 respectively