College of Engineering Pune

Civil Engineering Department, Applied Mechanics Division

(CE 203) Strength of Materials

S. Y. B. Tech. (Civil) 27th November 2012

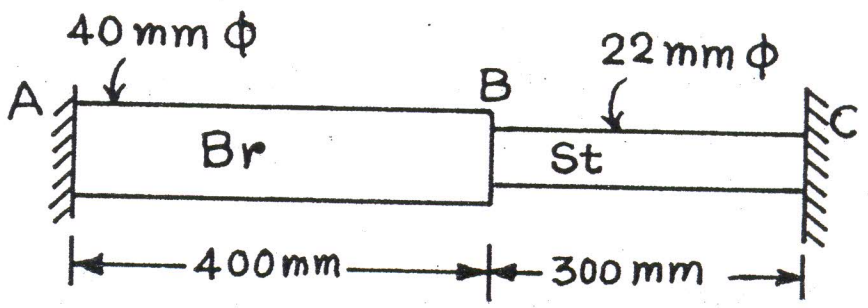
Time: 10 am to 1 pm **End Semester Examination** Max. Marks: 100

Instructions:

1. Solve all questions.
2. Make necessary assumptions and assume suitable data wherever required and state it clearly.

Q.1 (a) A bar of steel is 38 mm in diameter and 450 mm long. A tensile load of 100 kN is found to stretch the bar by 0.2 mm. The same bar when subjected to a torque of 1.27 kNm is found to twist through 1.922^0. Determine the values of the four elastic constants of the material. (10)

Q.1 (b) A compound bar consists of a brass portion AB of diameter 40 mm and a steel portion BC of diameter 22 mm. The supports A and C are rigid. If the temperature of the bar is raised through 140^0C, find (i) the force exerted on the supports and (ii) the relative movement of the junction B. Refer Fig.1(b) (08)



$\alpha_{Br} = 20 \times 10^{-6}/^0C$. $\alpha_{st} = 11 \times 10^{-6}/^0C$.

$E_{Br} = 85$ GPa. $E_s = 210$ GPa.

Fig.1 (b)

Q.2 (a) Plot Shear Force and Bending Moment diagrams for the beam loaded as shown in Fig.2 (a).

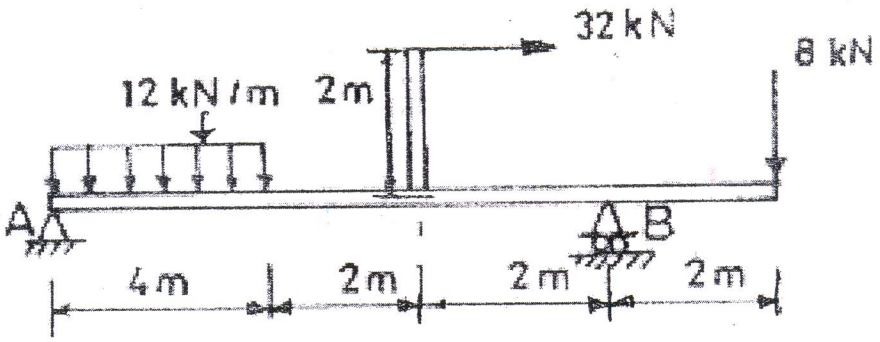


Fig.2 (a) (10)

Q.2 (b) A mild steel column of T-section as shown in Fig.2 (b) carries a compressive load of 100 kN at point 'A'. Calculate the maximum and minimum stress intensities induced in the section. (08)

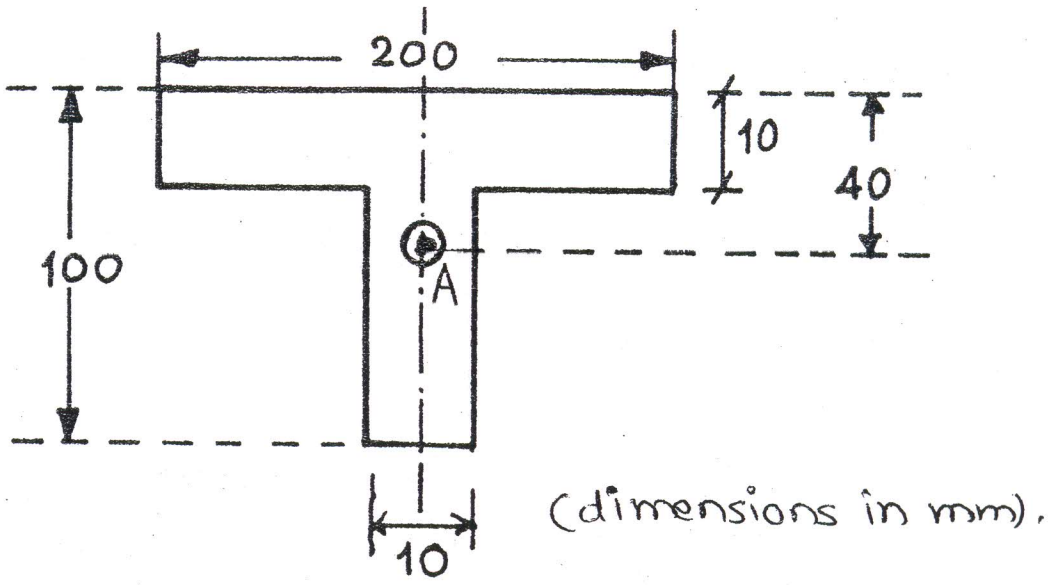


Fig.2 (b)

Q.3. (a) A girder of symmetrical I-section has a web 600 mm × 12.5 mm and flanges 300 mm × 25 mm. The girder is subjected at a bending moment of 300 kNm and a shearing force of 1000 kN at a particular section. Calculate how much of the shearing force is carried by the web, and how much of the bending moment is carried by the flanges. (08)

Q.3. (b) A hollow shaft is subjected to torque of 300 kNm and bending moment of 150 kNm. Internal diameter of the shaft is 0.75 times the external diameter. If the maximum shear stress is not to exceed 100 MPa, find the external and internal diameters of the shaft. (08)

Q.4 (a) A plate is subjected to two mutually perpendicular stresses, one compressive of 45 N/mm^2, on the vertical planes and the other tensile of 75 N/mm^2 on the horizontal planes. The shearing stress, parallel to these directions is 45 N/mm^2. It acts in anticlockwise sense on the horizontal planes and in the clockwise sense on the vertical planes. Find the principal stresses and strains, taking Poisson's ratio as 0.3 and E = 200 GPa. (08)

Q.4 (b) A block 100 mm × 50 mm × 7.5 mm thick is subjected to uniformly distributed stress field as shown in Fig.4 (b). Compute the normal stress and shear stress developed along plane BD. Also find the maximum shear stress and the corresponding plane. (08)

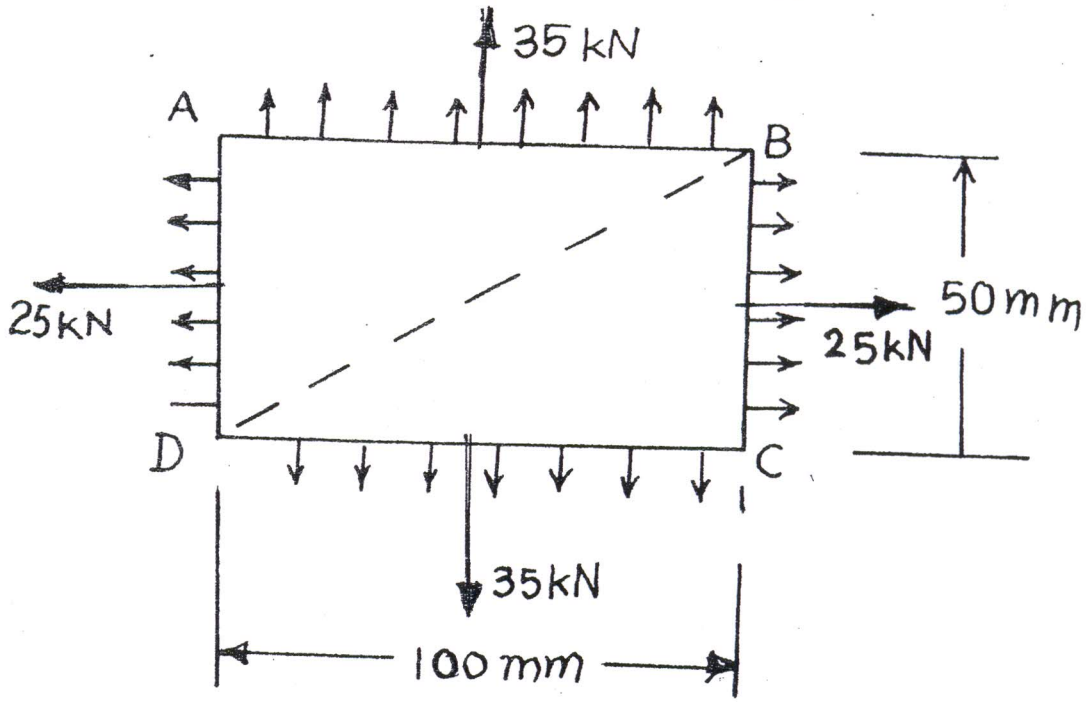


Fig.4 (b)

Q.5 (a) A column of symmetric cross section shown in Fig.5 (a) is fixed at one end and hinged at the other end. If the buckling load given by Rankine's formula is 1000 kN, find the actual length of the column. Also find the buckling load by Euler's formula. Assume crushing stress = 300 MPa, E = 200 GPa and Rankine's constant a = 1/7500. (10)

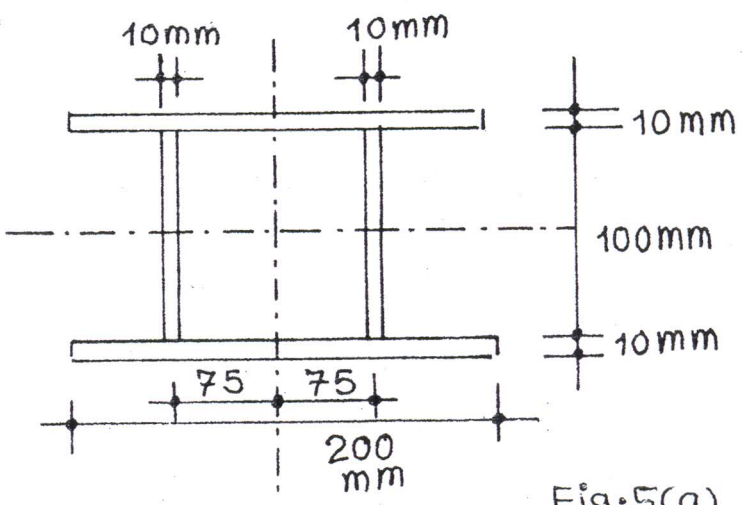


Fig.5(a).

Q.5 (b) Explain the concept of effective length of columns, with different end conditions. Compare Euler's failure load in each case. Draw neat sketches. (06)

Q.6 (a) For the beam shown in Fig.6 (a), find the maximum deflection. E = 200 GPa and I = 12 $\times 10^6$ mm^4. Use Macaulay's method. (08)

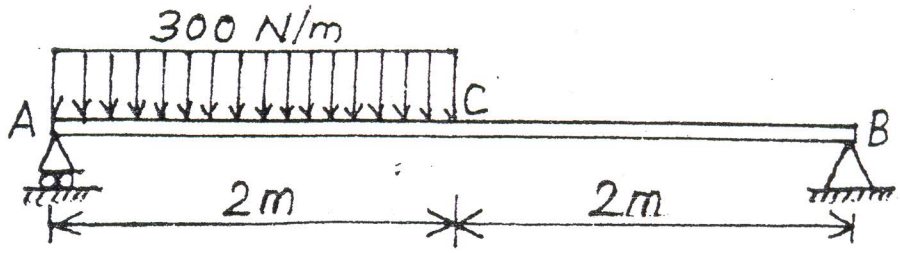


Fig.6 (a)

Q.6 (b) For the non-prismatic beam shown in Fig.6 (b), find the slope at each support and deflection at the center. Use Conjugate Beam method. (08)

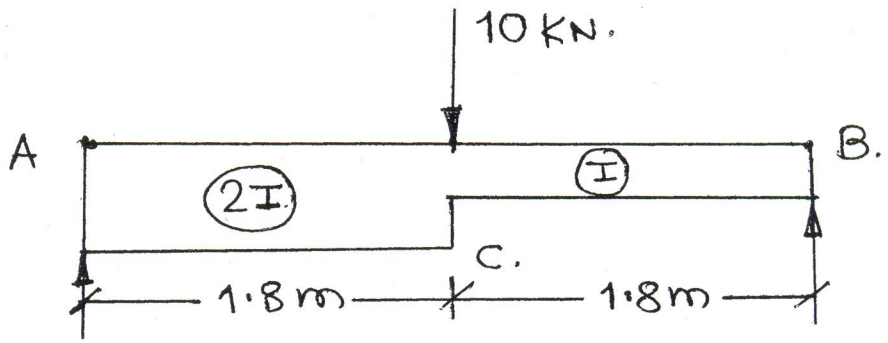


Fig.6 (b)

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Best wishes!!