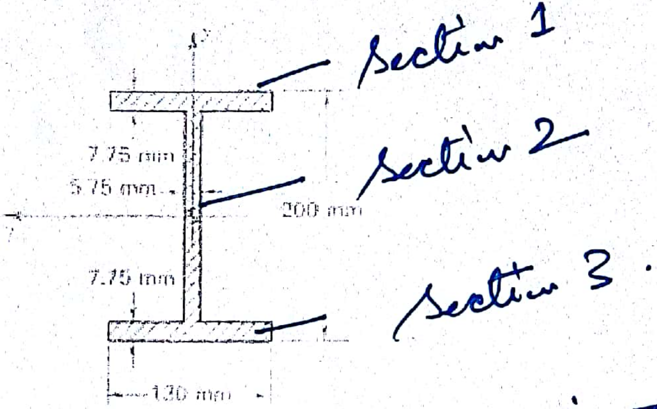
Name: ______________________ Roll no. ____________

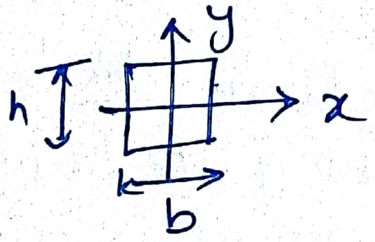
Department of Aerospace Engineering, Indian Institute of Technology, Madras.

AS 2010: Basic strength of materials. Quiz 10

1. Calculate the second moment of area, I_{zz} for the section illustated.



Given c/s is Symmetric about axis, zz



; $I_{xx} = \frac{bh^3}{12}$; $I_{yy} = \frac{hb^3}{12}$

So; use the parallel axis theorem to find out the, I_{zz}

$$I_{zz} = 2\left[\frac{130 \times 7.75^3}{12} + 130 \times 7.75 \times \left(100 - \frac{7.75}{2}\right)^2\right] + \left[\frac{5.75 \times (200 - 2 \times 7.75)^3}{12}\right]$$

$$= 2 \times 18.6287 \times 10^6 \, mm^4 + 3.00937 \times 10^6 \, mm^4$$

$$I_{zz} = 21.638 \times 10^6 \, mm^4$$

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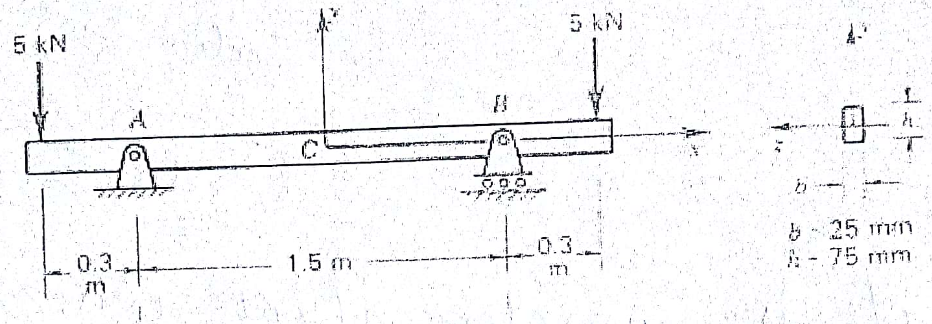
AS 2010: Basic strength of materials. Quiz 10

2. A steel beam ($E = 200$ GPa) is pinned at supports A and B and loaded as shown. Determine (i) the bending moment at the mid-point between the two supports, and (ii) the maximum tensile stress developed at that section.



$\Sigma F_y = 0$; $V_A + V_B = 10$ kN

$V_A = V_B = 5$ kN ; ∵ due to symmetric loading

Moment @ point C, i.e. – mid point of the beam

$M_C = 5 \times \left(0.3 + \frac{1.5}{2}\right) - 5 \times \frac{1.5}{2}$

(i) $M_C = 1.5$ kN-m

(ii) From Bending equation ; $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$

$\sigma_{max} = \frac{M}{I} \times y_{max}$; $y_{max} = \pm h/2$

$= \frac{1.5 \times 10^3 \times \left(\frac{75 \times 10^{-3}}{2}\right)}{8.789 \times 10^{-7}}$; where, $I = \frac{bh^3}{12} = \frac{25 \times 75^3}{12} = 8.789 \times 10^{-7}$ m

$\sigma_{max} = 64$ MPa

for max compressive stress, take $y_{max} = (-h/2)$.

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