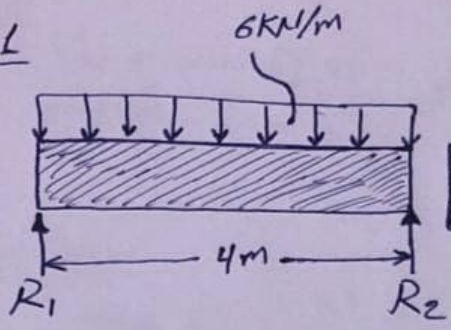
Murtadha Al-Masoudy

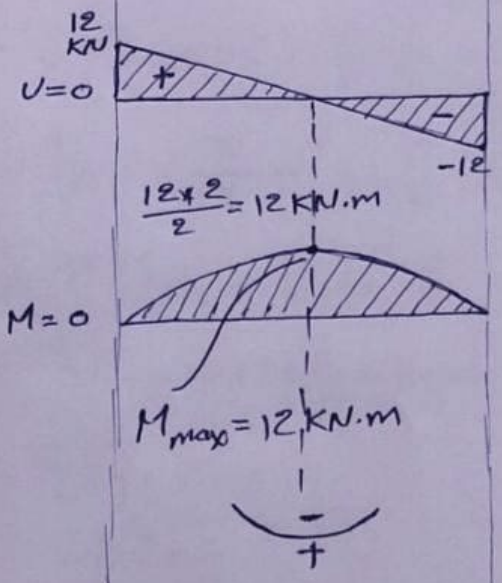
Bending stress

Ex.1



1- Find the magnitude and location of the max. bending tensile and compressive stress.

2- At section ① find the stress at 20mm from the top of the beam section



Solution:

① $R_1 = R_2 = \frac{6*4}{2} = \boxed{12\ KN}$

$\because \sigma_b = \frac{M.y}{I_{N.A}} \Rightarrow \therefore I_{N.A} = \frac{b.h^3}{12}$

$= \frac{(0.05).(0.1)^3}{12}$

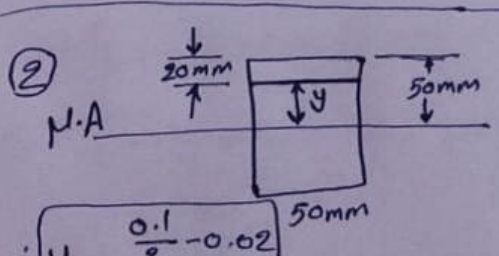
$\therefore \boxed{I_{N.A} = 4.167*10^{-6}\ m^4}$

$y = y_{max} = \frac{h}{2} = \frac{0.1}{2}$

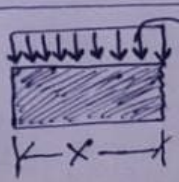
$M_{max} = 12\ KN.m$

$\therefore \sigma_{b\ max.} = \frac{12*10^3 * \frac{0.1}{2}}{4.167*10^{-6}} = \boxed{144\ MPa}$

②



$\therefore y_{①} = \frac{0.1}{2} - 0.02 = \boxed{0.03\ m}$



$M_{x=1} = 12X - 6X\frac{X}{2}$

at $x = 1$

$\therefore \boxed{M = 9\ KN.m}$

$\therefore \sigma_{b)_{x=1}} = \frac{M.y}{I_{N.A}}$

$\therefore \sigma_{b)_{x=1}} = \frac{9*10^3 * 0.03}{4.167*10^{-6}}$

$= \boxed{64\ MPa}$ Comp.

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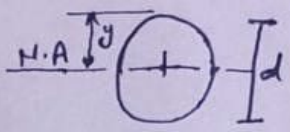
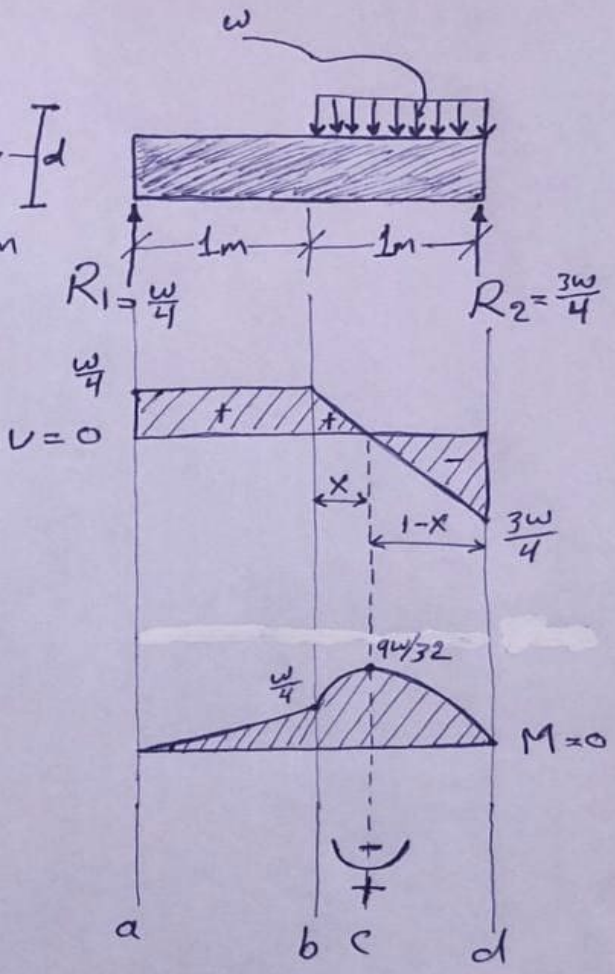
Ex. 2

For a max. σ_b of 60MPa, Find w?



d=40mm



Solution:

$$\text{max. } \sigma_b = \frac{M.y}{I_{N.A}}$$

- $y = y_{max.} = C = \frac{d}{2} = \boxed{0.02\ m}$

- $I_{N.A} = \frac{\pi}{64} d^4 = \frac{\pi}{64}(0.04)^4\ m^4$

* $\Sigma M_{R_2} = \text{Zero}$ ↺

$$2R_1 = w * 1 * \frac{1}{2} \Rightarrow \boxed{R_1 = \frac{w}{4}}$$

$\Sigma F_y = \text{Zero}$

$$\therefore \boxed{R_2 = \frac{3w}{4}}$$

$\therefore M_a = \text{Zero}$

$M_b = \frac{w}{4} * 1 = \frac{w}{4}\ KN.m$

$M_c = \frac{w}{4} + \frac{\frac{w}{4} * \frac{1}{4}}{2} = \frac{w}{4} + \frac{w}{32}$

$= \frac{9w}{32}$

$M_d = \frac{9w}{32} - \frac{\frac{3w}{4} * (1-x)}{2}$

$= \text{Zero}$

تشابه مثلثات

$$\frac{\frac{3w}{4}}{1-x} = \frac{\frac{w}{4}}{x}$$

$$\therefore \boxed{x = \frac{1}{4}\ m}$$

$\therefore M_{max} = \frac{9w}{32}$ at sec. C

$$\therefore \sigma_b)_{max.} = \frac{\frac{9w}{32} * 0.02}{I_{N.A}}$$

$$60 * 10^6 = \frac{\frac{9w}{32} * 0.02}{I_{N.A}}$$

$\therefore \boxed{w = \_\_\_}\ KN/m$.

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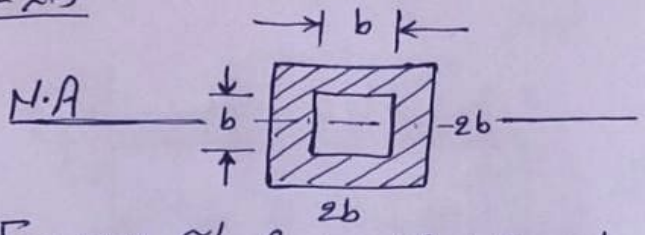
Ex.3



For max σ_b of 10MPa; Find b ?

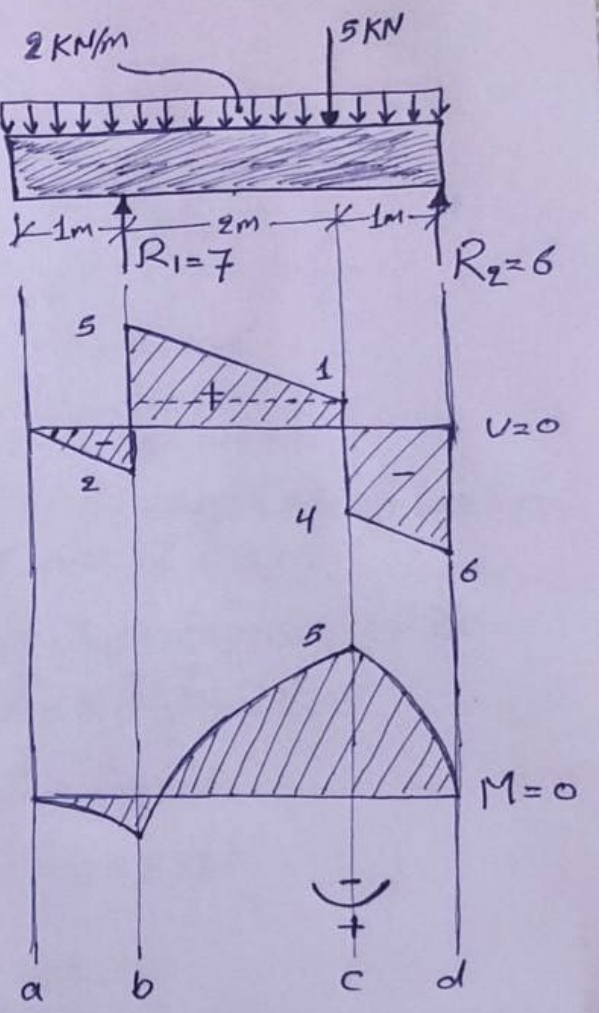
Solution:-

$$\sigma_b = \frac{M.y}{I_{N.A}}$$

$$y = y_{max} = c = \frac{2b}{2} = b$$

$$I = \frac{b.h^3}{12} = \frac{(2b)\cdot(2b)^3}{12} - \frac{b.b^3}{12}$$

$$\therefore I_{NA} = \frac{15b^4}{12}$$



M_a = Zero

$$M_b = \frac{-2*1}{2} = -1\ KN.m$$

$$M_c = -1 + \left[1*2 + \frac{(5-1)*2}{2}\right]$$

$$= 5\ KN.m$$

$$M_d = 5 - \left[4*1 + \frac{(6-4)*(1)}{2}\right]$$

= Zero.

$$\therefore \boxed{M_{max.} = 5\ KN.m}$$

$$\therefore \sigma_b = \frac{M.y}{I_{N.A}}$$

$$10*10^6 = \frac{(5*10^3)*(\frac{2b}{2})}{I_{N.A}}$$

$$\therefore \boxed{b = \checkmark}\ m.$$

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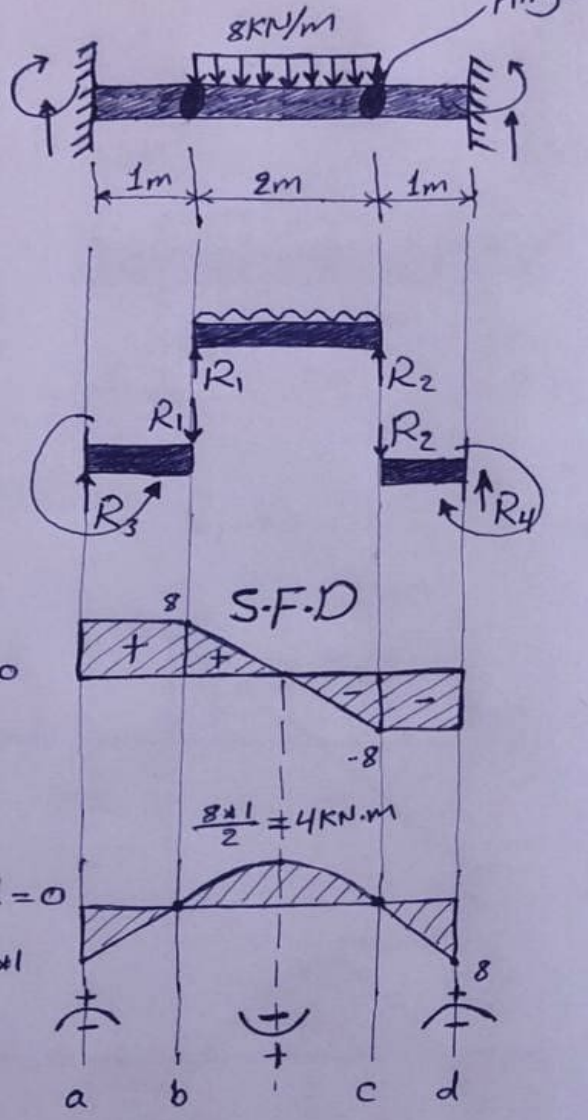
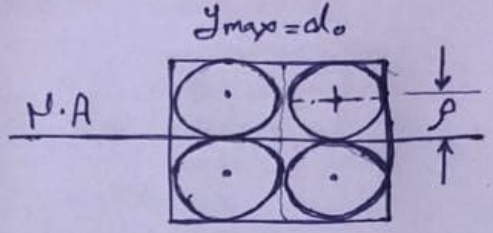
Ex.4



$M_{max.} = 8\ KN.m$

Four tubes



$d_o = 100\ mm$
$d_i = 80\ mm$

- Find the magnitude & location of Max. σ_b (Ten.)

$$R_1 = R_2 = \frac{8*2}{2} = 8KN$$

$R_1 = R_3 = 8KN.$

$R_2 = R_4 = 8KN.$

$$\sigma_b = \frac{M.y}{I_{N.A}}$$

$$I = I_o + A\rho^2$$

$$I_{N.A} = \frac{\pi}{64}(d_o^4 - d_i^4) + \frac{\pi}{4}(d_o^4 - d_i^4)*\left(\frac{d_o}{2}\right)^2$$

∴ at sec. a & b

$$\sigma_b = \frac{(8*10^3)(d_o)}{I_{N.A}}$$

$\sigma_b = \_\_\_ MPa$