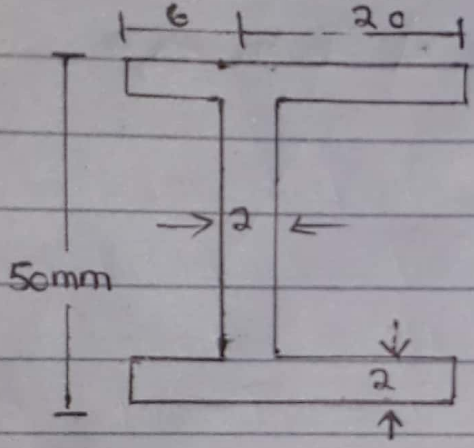
Question :- 01 (A)

Determine the Location of the shear Stress for the beams having the Cross-Sectional ......... ?




Required :-

Location of Shear Stress.

Solution :-

$$e = \frac{t_f h^2 b^2}{4I} \quad - (1)$$

And,

$$I = 2\left(\frac{bh^3}{12} + Ay^2\right) + \left(\frac{bh^3}{12} + Ay^2\right)$$

$$= 2\left(\frac{26(2)^3}{12} + (26\times2)(25)^2\right) + \left(\frac{2(50)^3}{12} + 0\right)$$

$I = 2(32517.33) + 20833$

$I = 53350.66\, mm^4 + 32517.33$

$I = 85867.99\, mm^4$

Now put the value of I in eq 1,

$$e = \frac{2(50)^2(26)^2}{4(85867.99)}$$

$e = 9.8406$ mm

Result :-

Hence $e = 9.8406$ mm

Question :- 1 (PART B)

Determine the thickness of wall of water tank Constructed ....... ?

Given that :-

$h = 26ft \times 12$

Tangential stress = 6000 psi

Specific weight = $62.4\ lb/ft^3 = 62.4/12^3$

Diameter = d = $22ft \times 12$

Required :-

Thickness , t = ?

Solution :-

As,

$$\sigma_t = \frac{PD}{2t} \quad -① $$

where pressure exerted by water ,

$$P = \gamma h$$

$$\sigma_t = \frac{\gamma h D}{2t}$$

$$t = \frac{\gamma h D}{2\sigma_t}$$

$$t = \frac{(0.036)(312)(264)}{6000 \times 2}$$

$$t = 0.247''$$

$$t = 0.0205\ ft$$

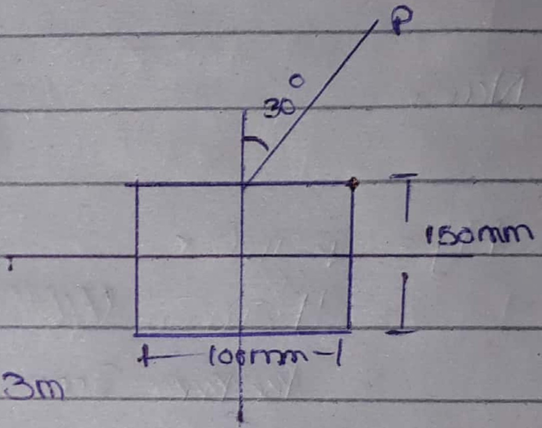
Result :-

Hence thickness , $t = 0.0205\ ft$

Question:- 02 (A)

The 100 by 150 mm wooden beam shown In figure 2 ....... of the Beam.

Given :-




Load = 4kN

$\theta = 30^\circ$

Length of Span = 3m

Required :-

$$\sigma_x = \frac{M_x y}{I_x}$$ (Bending Stress)

$$\sigma_y = \frac{M_y x}{I_y}$$ (Bending stress)

Location of Neutral Axis = ?

Solution :-

$$\sigma = -\sigma_x + \sigma_y$$

Now for $M_x$,

$M_x = P\cos\theta$
$= 4\times10^3 \cos(30^\circ)$
$= 4\times10^3 \times 0.866$
$= 3.46\times10^3$

Now,

$M_y = P\sin\theta$
$= 4\times10^3 \sin 30^\circ$
$= 2000$

Now,

$$I_x = \frac{bh^3}{12}$$

$$I_x = \frac{0.1(0.15)^3}{12}$$

$$I_x = 2.8125\times10^{-5}\,m^4$$

$$I_y = \frac{hb^3}{12}$$

$$= \frac{0.15(0.1)^3}{12}$$

$$I_y = 1.25\times10^{-5}\,m^4$$

so,

$$\sigma_x = \frac{M_x}{I_x}$$

$$= \frac{259.8}{2.8125 \times 10^{-5}}$$

$$\sigma_x = 9.237 \ MNm^{-2}$$

$$\sigma_y = \frac{M_y}{I_y}$$

$$\sigma_y = \frac{100}{1.25 \times 10^{-5}}$$

$$\sigma_y = 8 \ MNm^{-2}$$

Now, Total Bending stress

$$\sigma = -\sigma_x + \sigma_y$$

$$\sigma = -9.237 + 8$$

$$\sigma = -1.237 \ MNm^{-2}$$

Hence the ~~the~~ total Bending Stress is Negative which is in Compression.

Now for Neutral Axis of unSymetrical Bending.

$$\tan\alpha = \frac{I_x}{I_y} \cdot \frac{M_y}{M_x}$$

$$\tan\alpha = \frac{2.8125 \times 10^{-5}}{1.25 \times 10^{-5}} \times \frac{3.46 \times 10^{3}}{2 \times 10^{3}}$$

$$\tan\alpha = 3.8925$$

$$\alpha = \tan^{-1}(3.8925)$$

$$\alpha = 75.59^\circ$$

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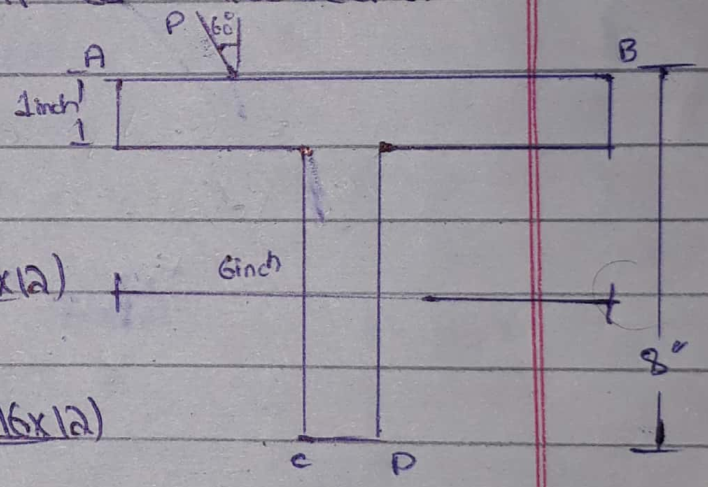
Question:- 02 (B)

The T Section shown in the figure :- 03 is the Cross-Section of a ...... ....... beam ?

Solution:-

The maximum moment at Mid Section is,




$$M = \frac{PL}{4}$$

$$M_x = \frac{(P\cos\theta)(16\times12)}{4}$$

$$M_y = \frac{(P\sin60^\circ)(16\times12)}{4}$$

Now we have to find stresses at A, B, C and D.

At point (A) :-

$$\sigma_A = \frac{M_x y}{I_x} + \frac{M_y x}{I_y}$$

$$\sigma_A = \frac{-48\,P\cos60^\circ(3.07)}{112.6} - \frac{(48\,P\sin60^\circ)(3)}{18.7}$$

$$\sigma_A = -0.654P - 6.6P$$

$$= -7.2P \text{ (Compression)}$$

Scanned with CamScanner

and Compression $\leq$ 12000 psi

$12000 = -7.25\,P$

$P = 1655.1$ lb

Point (B) :-

$$\sigma_B = \frac{-48P\cos 60(3.07)}{112.6} + \frac{(48P\sin 60^\circ)(3)}{18.7}$$

$= -0.654P + 6.6P$

$= 6.01P$ Tension

& Tension $\leq$ 5000 psi

$5000 = 6.01P$

$$P = \frac{5000}{6.01}$$

$P = 831.94$ lb

Minimum value of $P = 831.94$ lb

Point (c) :-

$$\sigma_c = +\frac{(48P\cos 60^\circ)(3.07)}{112.6} + \frac{(48P\sin 60)(3)}{18.7}$$

$= 0.654P + 6.6P = 7.25P$

& Tension $\leq$ 5000 psi

$5000 = 7.25P$

$P = 689.65$ lb

point (D) :-

$$\sigma_D = +\frac{(48p\cos 60^\circ)(3.07)}{1.26} - \left(\frac{48p(\sin 60^\circ)(3)}{18.7}\right)$$

$$\sigma_D = + 0.654p - 6.6p$$

$$= -5.946p \text{ (compression)}$$

and Compression $\leq$ 12000 psi

$$12000 = -5.946p$$

$$p = 2018.16 \text{ lb}$$

So, we have Considered Minimum value of p,

$$p = 689.65 \text{ lb.}$$

Question :- 03

A 10ft long strut braced in the middle has ------ and $E = 10.3 \times 10^6$ ?

Given Data :-

Length , $L = 10ft$
Breadth , $b = 0.75''$
Height , $h = 2''$
Factor of Safety $= 2$
$E = 10.3 \times 10^6$

Required Data :-

Safe Load , $P_{safe} = ?$

Solution :-

Case :- 1

Strut column act as hinged column about an axis perpendicular to the 2inch dimension then,

$$I = I_x = \frac{(0.75)(2)^3}{12} = 0.5 \text{ in}^4$$

$L_e = L$ (for Hinged Ended Column)

$$P_{cr} = \frac{n^2 E I \pi^2}{L_e^2}$$

$$P_{cr} = \frac{(1)^2 (10.3 \times 10^6)(0.5)(3.14)^2}{(10 \times 12)^2}$$

$P_{cr} = 3526.17$ lb

$$P_{safe} = \frac{P_{cr}}{\text{factor of safety}}$$

$$P_{safe} = \frac{3526.17}{2}$$

$P_{safe} = 1763.08$ lb

Case II :-

Column act as a fixed end about axis parallel to 2 inch. i.e y-axis.

$$I = I_y = \frac{(2)(0.75)^3}{12}$$

$I_y = 0.07 \text{ in}^4$

Now for fixed Ended,

$L_e = L/2$

$$P_{cr} = \frac{n^2 E I \pi^2}{L_e^2}$$

$$P_{cr} = \frac{(1)^2 (10.3 \times 10^6)(0.07)(3.14)^2}{(120/2)^2}$$

$P_{cr}$ = 1974.65 lb

For Psafe :-

$$P_{safe} = \frac{P_{cr}}{\text{factor of safety}}$$

$$P_{safe} = \frac{1974.65}{2}$$

$P_{safe}$ = 987.32 lb

In both Case we take Smaller value of Psafe.

$P_{safe}$ = 987.32 < 1763.08

# FINAL TERM (SEMESTER 4)

NAME :- MUHAMMAD TALHA

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SECTION :- "B"

SUBMITTED TO SIR SAQIB

SUBJECT :- MOS (II)

DATE :- 23-June 2020

DEPARTMENT :- CIVIL ENGINEERING