Date:

Day: M T W T F S S

ID: 7379

Name :-

FAHAD M. IRSHAD

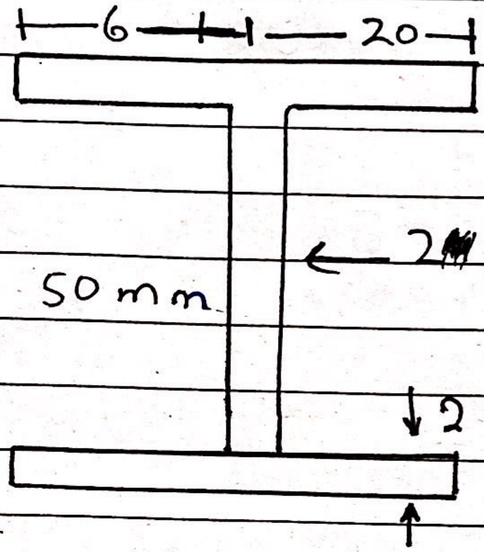
SUBJECT :-

MOS-II

Department :-

BE(Civil)

Q1 (a) :- Determine the location of the shear center for the beam having the cross section .... calculations should be based on the centerline dimensions.



Required :- location of shear centre.

Sol :-

As we know

$$e = \frac{t_f h^2 b^2}{4I}$$

and :.

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

$$= 2\left[\frac{26(2)^3}{12} + (20\times2)(25)^2\right] + \left[\frac{2(50)^3}{12} + 0\right]$$

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$$I = 50034.66 + 20833$$

$$I = 70867.99\,mm^4$$

$$e = \frac{2(50)^2(25)^2}{4(70867.99)} = 11.02\,mm$$

So shear centre $e = 11.02\,mm$

Q1 (b) :- Determine the thickness of the wall
. . . .
the specific weight of water is 62.4 Lb/ft^3.

Data :-

=> H = 26 ft

assume diameter =

D = 22 ft

=> tangential stress = 600 lb/ft^3

=> specific weight of water

tank = 62.4 lb / ft^3

we have to find the thickness = ?

Solution :-

The pressure develope by water = $P = \gamma h$

$$\sigma_t = \frac{PD}{2t}$$

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

$$2t \times \sigma_t = \gamma h D$$

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

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

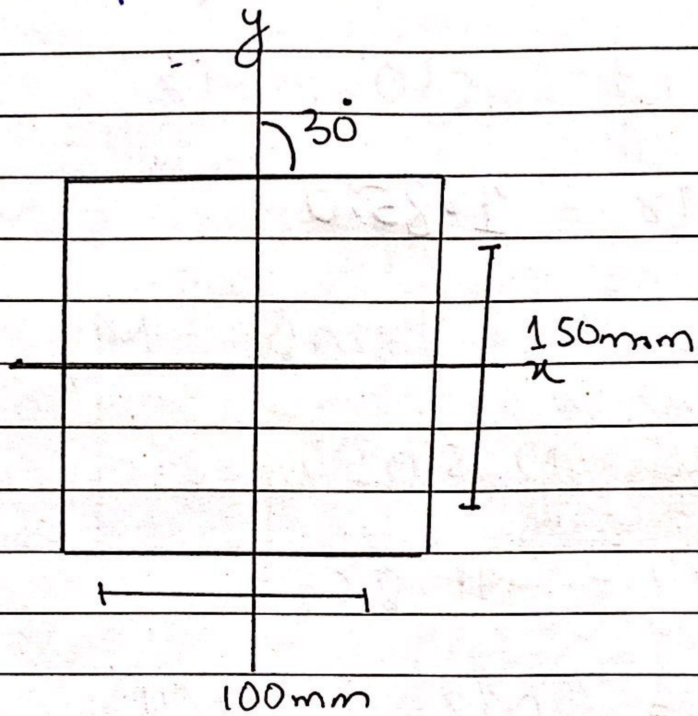
$$t = \frac{\frac{(62.4)}{(12)^3} \times (26 \times 12) \times (22 \times 12)}{6000 \times 2}$$

$$\boxed{t = 0.24''}$$

Q2(a) :- The 100 by 150mm wooden beam shown in figure 2

. . . .

. . . . Neglect the weight of the beam.



Moment of inertia

$$I_z = \frac{bh^3}{12} = \frac{0.1(0.15)^3}{12} = I_z = 2.8125 \times 10^{-5}$$

Now

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

$$I_y = 1.25 \times 10^{-5}$$

$$\sigma = \frac{M_z y}{I_z} + \frac{M_y z}{I_y}$$

ate:

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$$\sigma = \frac{M\cos\theta}{I_z} + \frac{M\sin\theta}{I_y}$$

$M = \cos\theta = P\cos\theta = M_z$

$= 12\cos 30^\circ = M_z$

$M_z = 108510$

$M\sin\theta = P\sin\theta = M_y$

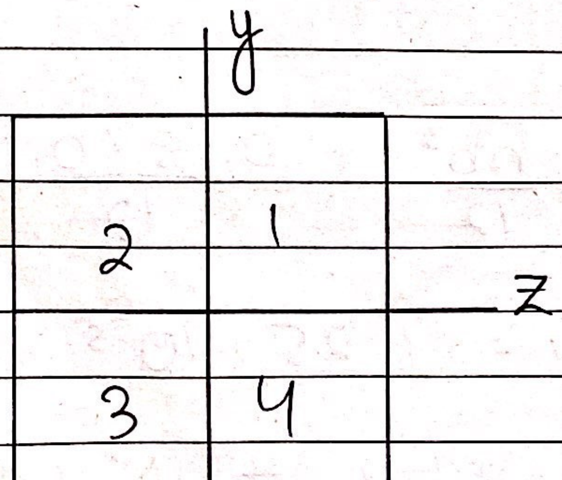
$M_y = 12\sin 30.$

$M_y = -11.8563$

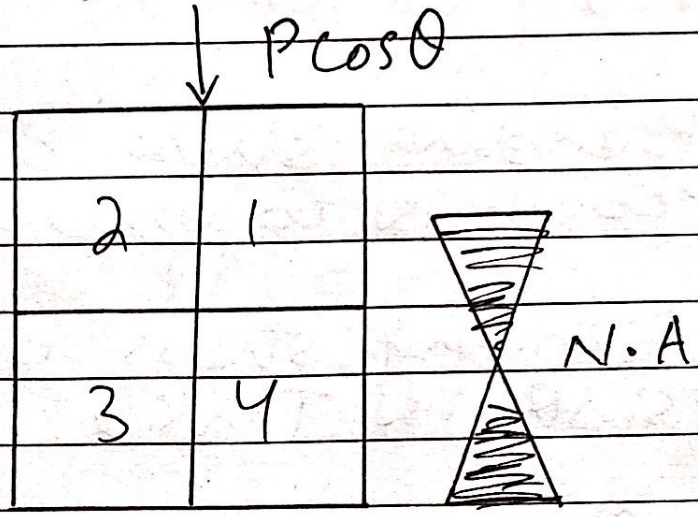
$$\sigma = \left(\frac{M_z}{I_z}\right) + \left(\frac{M_y}{I_y}\right)$$

$$\sigma = \frac{1.851}{2.812\times10^{-5}} + \frac{(-11.8563)}{1.25\times10^{-5}} = 882628 \ Nm^2$$

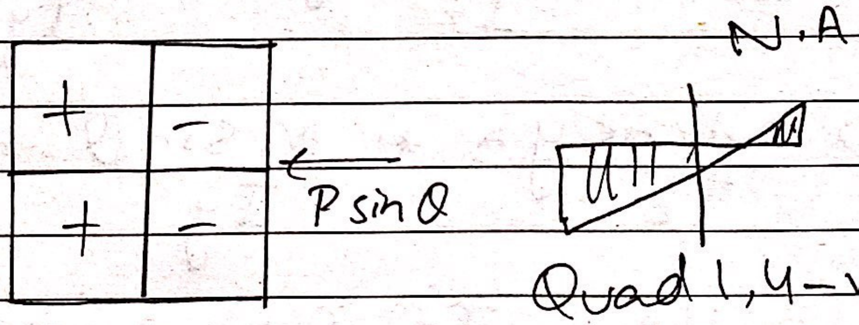
Sign Convention.



If we take compression as negative and tension as positive and the beam is a simply supported.



Quadrant 1, 2 -ve.
Quadrant 3, 4 +ve



Quad 1, 4 -ve
Quad 2, 3 +ve

In case of an symmetrical loading the Neutral axis lies at an angle of α. The Principal axis and the algebraic sum of stress at N.A is zero.

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$$\sigma = \frac{M\cos\theta}{I_z} y + \frac{M\sin\theta}{I_y} z$$

Let consider a point "A" on N.A lies in Quadrant 2, where

- Bending stress due to $P\cos\theta$ is compressive.
- Bending stress due to $P\sin\theta$ is Tensile.

eq (1) $\Rightarrow 0 = -\frac{M\cos y_A}{I_z} + \frac{M\sin\theta\, z_A}{I_y}$

$$\Rightarrow 0 = -\frac{M\cos}{I_z} y_A + \frac{M\sin\theta}{I_y} z_A$$

$$\Rightarrow \frac{M\cos y_A}{I_z} + \frac{M\sin\theta}{I_y} z_A$$

$$\Rightarrow \frac{y_A}{z_A} = \frac{I_z}{I_y} \frac{\sin\theta}{\cos\theta} \Rightarrow \tan\alpha = \frac{I_z}{I_y}\tan\theta$$

eq (2)

Now put values of I_z, I_y and θ in eq - (2)

$$\tan\alpha = \frac{I_z}{I_y}\tan 30$$

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$\Rightarrow \tan\alpha = \dfrac{2.8125 \times 10^{-5} (\tan 30^\circ)}{1.25 \times 10^{-5}}$

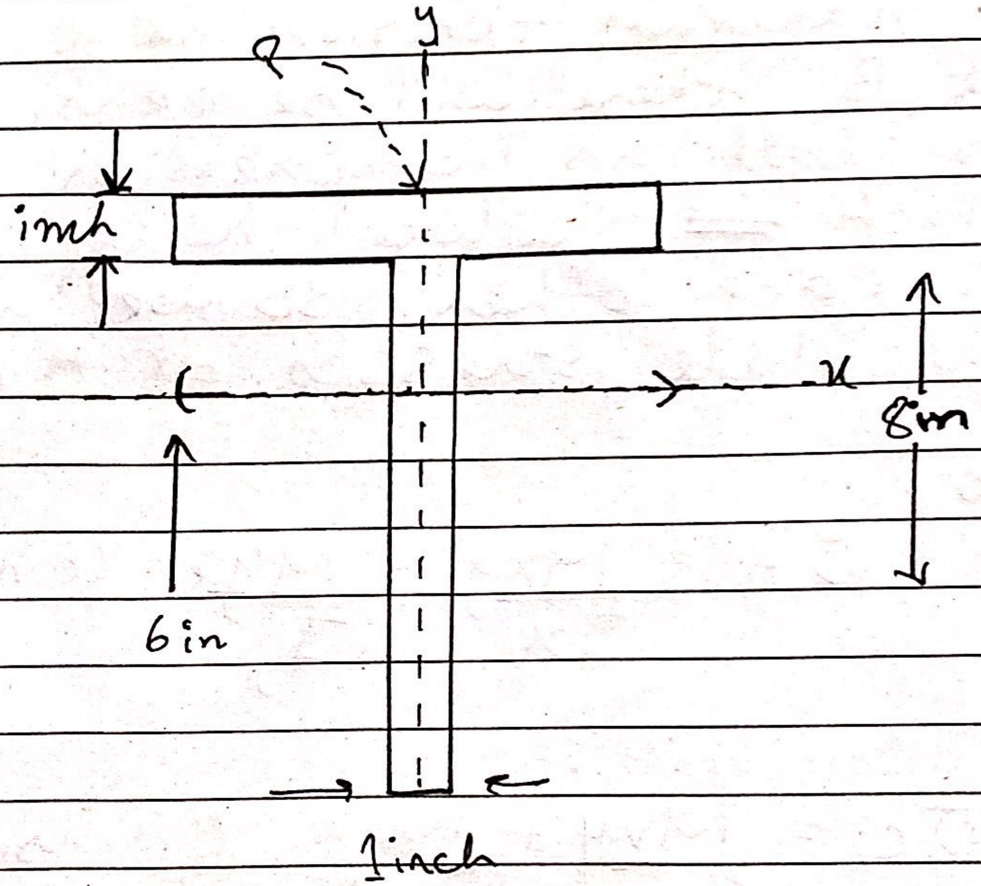
$\tan\alpha = -14.4129$

$\alpha = \tan^{-1}(-14.4129)$

$\alpha = 1.5^\circ$

$\alpha = 1^\circ 30' 5''.$

Q2 (b) :- The T section shown in figure 3 is the cross section of a simply ---- ------ ----- --- what is the maximum load that will not overstress the beam?



Given:-

$L = 16 ft$

$I_x = 112.6 in^4$.

$I_y = 18.7 in^4$

$\sigma_c = 12000 psi$.

$\sigma_t = 5000 psi$

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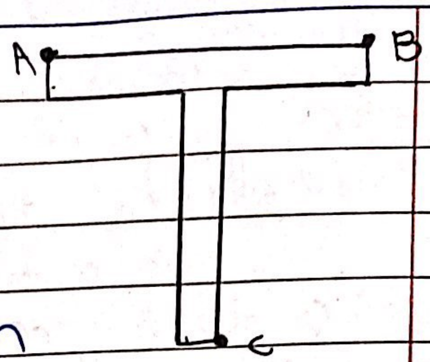


Solution :-

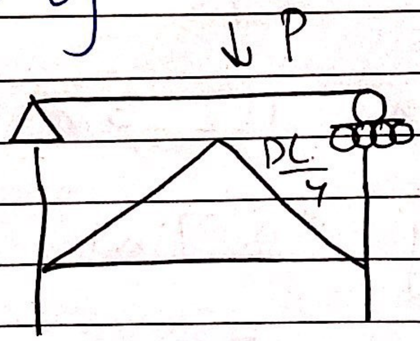
By looking to the figure, we can judge that maximum compression would occur on A & maximum tension at C. at B there will be tension as well as compression, which ~~we~~ reduce the effects of each other. So we will calculate stresses. at A & C.

So,

$$\sigma A = \frac{M_x y}{I_x} + \frac{M_y x}{I_y} \cdot \text{(comp)}$$

$$\sigma c = \frac{M_x y}{I_x} + \frac{M_y x}{I_y} \text{ (Tension.}$$

Now M_x & M_y



So,

$$M_x = \frac{P \cos 60 \times (16 \times 12)}{4}$$

$$\boxed{M_x = 48P\cos 60^\circ}$$

$$M_y \quad \frac{P\sin 60 \, (16\times12)}{4}$$

$$\boxed{M_y = 48P\sin 60}$$

Now

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

$$\Rightarrow 12000 = \frac{48P\cos 60^\circ \times 3.07}{112.6} + \frac{48P\sin 60^\circ \times 3}{18.7}$$

Solving the equation.

$$\Rightarrow \boxed{P = 1638.6\ lb}$$

Now

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

$$5000 = \frac{48P\cos 60 \times (5.93)}{112.6} + \frac{48\sin 60 \times 0.5}{18.7}$$

Solving the equation.

$$\boxed{P = 2104.9\ lb}$$

$$\boxed{\text{So the maximum load P applied should be 1638.6 lb}}$$

Q3:. A 10ft long strut braced in the middle has a rectangular ....
Determine the safe load P about using a factor of safety of 2 and $E = 10.3 \times 10^6$

Given data :-

Length "L" = 10 ft

As both sides are hinged
So
$$L_e = L$$

$$E = 10.3 \times 10^6$$

Factor of safety = 2

$$b = 0.75 \text{ inch}$$
$$h = 2 \text{ inch}$$

Required data :-
Determine safe load?

Solution :- As

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

As we know that $I = A r^2$

$$I = Ar^2$$

$$r = \sqrt{\frac{I}{A}}$$

$$r = \sqrt{\frac{hb^3/12}{bh}} \Rightarrow \sqrt{\frac{b^2}{12}}$$

$$r = \frac{b}{2\sqrt{3}} \Rightarrow \frac{0.75}{2\sqrt{3}}$$

$$r = 0.216 \text{ inch}$$

$$P_{cr} = \frac{\pi^2 EA}{(l_e/r)^2}$$

$$\Rightarrow \frac{(3.14)^2 (10.3 \times 10^6)(1.5)}{\left(\frac{10}{0.216}\right)^2}$$

$$\boxed{P_{cr} = 853.8343}$$

$$\text{Safe load} = \frac{\text{Crippling land}}{\text{factor of safety}}$$

$$\Rightarrow \frac{853.8343}{2}$$

$$\boxed{\text{Safe load} \Rightarrow 426.917}$$

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For fixed ended column

$$Le = L/2 = 10/2$$

$$Le = 5ft$$

$$Pcr = \frac{\pi^2 EA}{(Le/r)^2} \Rightarrow \frac{(3.14)^2 \times (10.3\times10^6)(1.5)}{\left(\frac{10}{0.216}\right)^2}$$

$$Pcr = 1974.207$$

$$\text{Safe Load} = \frac{Pcr}{\text{Factor of safety}}$$

$$= \frac{1974.207}{2}$$

$$= \boxed{987.103} \quad \text{Ans.}$$