I.D :- 7278

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PAPER :- Mas II

SUBMITTED To :-
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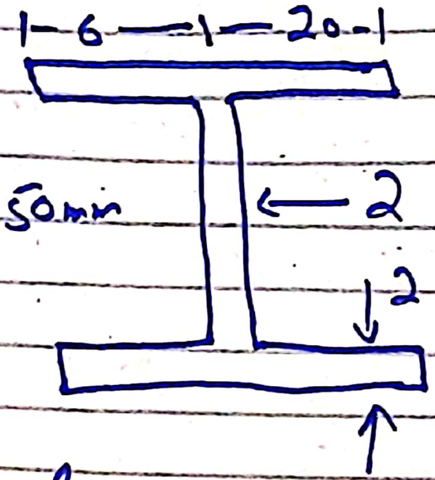
Q 1
(a)



Required:-

location of shear center

Sol:-

As we know that

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

&

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

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

$$I = 50034.66 + 20833$$

$$I = 70867.99 \text{ mm}^4$$

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

So shear center $e = 11.02$ mm

Q No 1
Part (b)

GIVEN DATA :-

$\Rightarrow H = 26 ft$

$\Rightarrow$ assume diameter
$D = 22 ft$

$\Rightarrow$ tangential stress $= 600\ lb/ft^2$

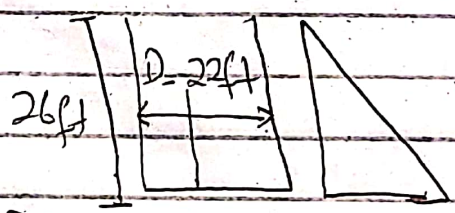
$\Rightarrow$ Specific weight of water tank = tank $= 62.4\ lb/ft^3$

we have to find thinkness = ?

SOLUTION :-

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

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



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

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

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

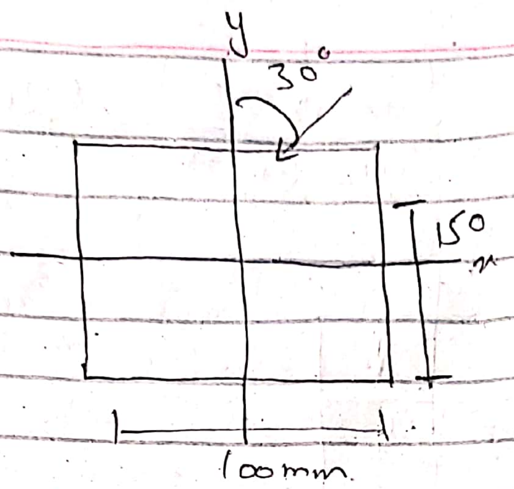
$$t = \frac{\gamma h D}{\sigma_t \times 2}$$

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

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

Scanned with CamScanner

Q 2 (a)



Moment of Inertia

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

Now

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

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

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

where

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

$$= 12\cos 6\theta = M_z$$

$$M_z = 1.8510$$

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

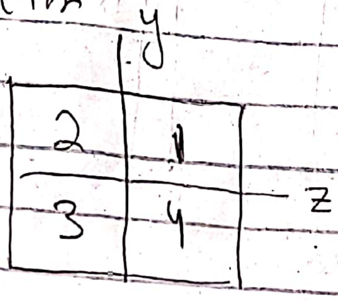
$$M_y = -11.8563$$

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

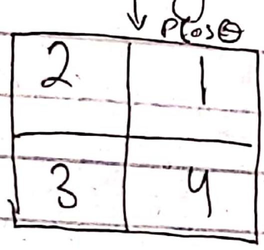
Scanned with CamScanner

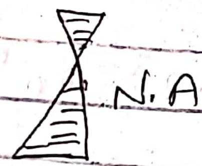
$$\sigma = \left(\frac{1.851}{2.812\times10^{?}}\right) + \left(\frac{-11.8563}{1.25\times10^{-5}}\right) = 825628\ Nm^{2}$$

Sign convention

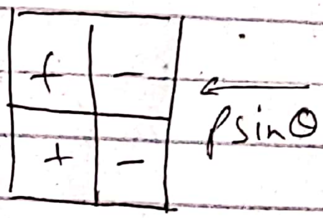


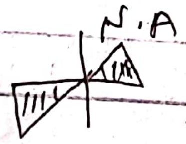
If we have compression as negative & tension as positive & the beam in a simply supported.





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





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

Case of unsymmetrical loading the neutral axis lies of an angle of α The Principle axis & the algebric sum of stress at N.A is zero

$$\sigma = \frac{M\cos y}{I_z} + \frac{M_s \sin\theta}{I_y} z \longrightarrow (1)$$

in the case N.A passes through 2,4 , 2°

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

let consider point "A" on N/A lies Quadrant 2, where

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

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

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

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

$\frac{y_A}{z_A} = \frac{I_z}{I_y} \frac{\sin\theta}{\cos\theta} = \tan\alpha \; \frac{I_z}{I_y} \tan\theta$ ⑪

Now put value of I_z, I_y & θ in eq ⑪

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

$\tan\alpha = -14.4129$

$\alpha = \tan^{-1}(1-4.4129)$

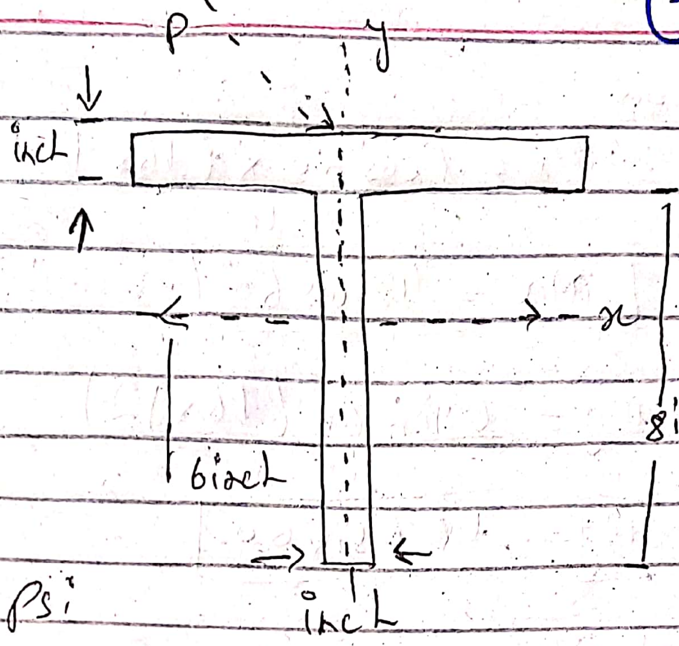
$\alpha = 1.5^\circ$

$\alpha = 1^\circ 3' 05''$

Q2 (b)

Ans (b)

GIVEN :-



$L = 16\,ft$

$I_x = 11.26\,in^4$

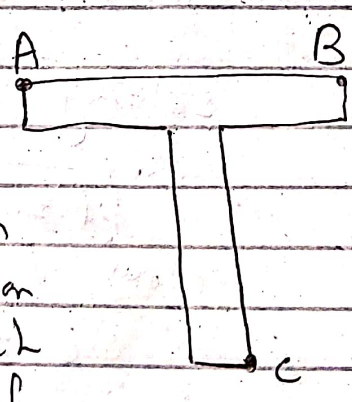
$I_y = 18.7\,in^4$

$\sigma_c = 12000\,psi$

$\sigma_t = 5000\,psi$

Sol :-

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

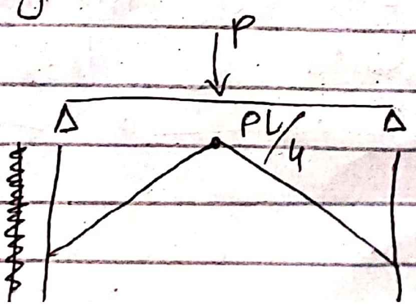


So

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

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

Now M_x & M_y



So

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

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

$$M_y = \frac{P\sin 60 \, (16 \times 12)}{4}$$

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

Now

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

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

Solving the equation

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

Now

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

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

Solving equation

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

So the maximum load P applied should be 1638.6 lb.

Q No 3

GIVEN DATA:—

length $L = 10ft$

As both sides are hinged

So

$le = L$

$E = 10.3 \times 10^6$

factor of safety $= 2$

$b = 0.75$ inch

$h = 2$ inch

Req:—

Determine safe load = ?

Sol:—

As

$$P_{cr} = \frac{\pi^2 EI}{le^2}$$

As we know that $I = Ar^2$

$I = Ar^2$

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

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

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

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

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

$$\Rightarrow \frac{(3.14)^2 (10.3 \times 10^6)(1.5)}{\left(\frac{10}{.01216}\right)^2}$$

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

$$\text{safe load} = \frac{\text{Crippling load}}{\text{factor of saftey}}$$

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

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

- for fixed ended column

$$le = l/2 = 10/2$$

$$\boxed{le = 5ft}$$

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

$$= \frac{(3.14) \times (10.3 \times 10^6)(1.5)}{\left(\frac{60}{.0216}\right)^2}$$

$$\boxed{P_{cr} = 1974.207}$$

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

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

$$\boxed{= 987.103}$$

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