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SECTION : "A" Civil Deptt.

SUBJECT : MOs II

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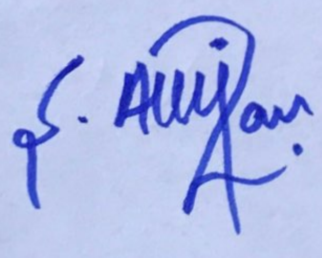
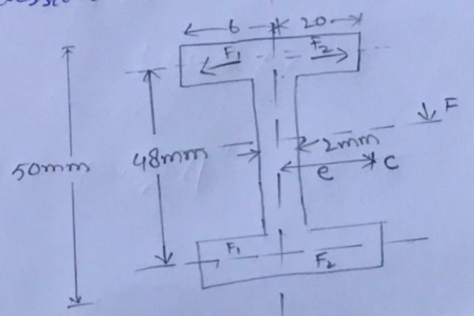
STUDENT SIGn :



DATE : 23-June-2020

Question No 1st :
Part "A" Determine the location of Shear Centre for the beams having the Cross Sectional diamension Shown in the figure I. All members are to be Considered Thin walled and calulations Should be bassed on the Centerline diamenssion.



Required : location of Shear Centre.

Solution: As we know that

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

and:

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

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

$$I = 5034.66 + 20833$$

$$\boxed{I = 70867.98\,mm^4}$$

$$e = \frac{2(50)^2(25)^2}{4(70867.98)}$$

$$\Rightarrow 11.02\,mm$$

So Shear Centre $\boxed{e = 11.02\,mm}$

Question NO 1st part "b"

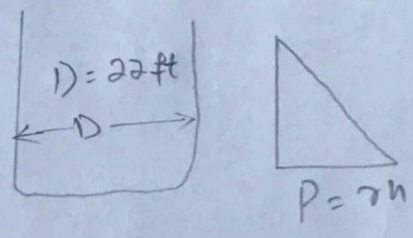
Given:

- $H = 26$ ft
- Assume diameter $= D = 22$ ft
- tengential stress $= 600$ lb/ft^3
- Specific weight of water tank $= 62.4$ lb/ft^3

Required: Find the thikness = ?

Solution:

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



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

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

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

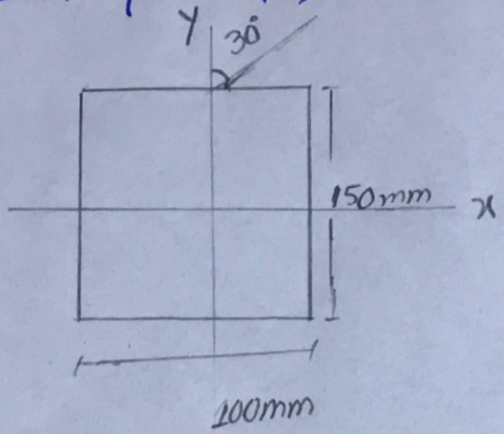
$$2t = \frac{\gamma h D}{\sigma_t}$$

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

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

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

Question No 2nd part (a)



MOMENT OF INERTIA :

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

$$I_z = 2.8125 \times 10^{-5}$$

NOW!

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

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

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

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

Where

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

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

$M_z = 1.8510$

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

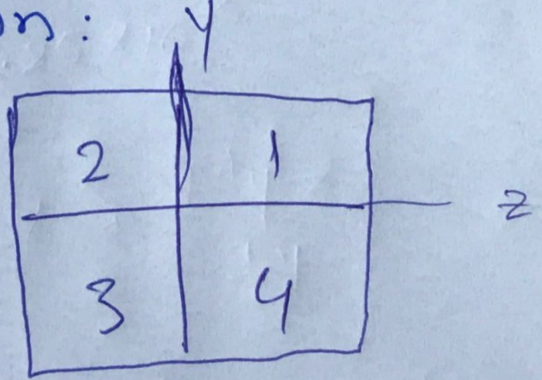
$M_y = 12\sin 30$

$M_y = -11.8563$

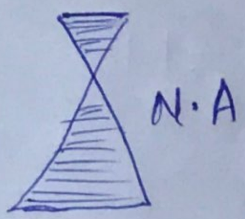
$$\sigma = \left(\frac{M_z}{I_z}\right) + \left(\frac{M_y}{I_y}\right)$$

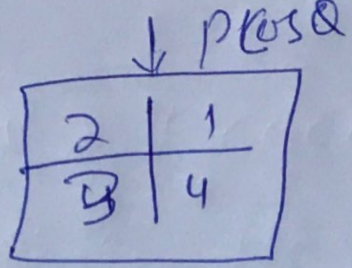
$$\sigma = \frac{1.8510}{2.812\times10^{-5}} + \left(\frac{-11.8563}{1.25\times10^{-5}}\right) = 882628 \ \mathrm{Nm^2}$$

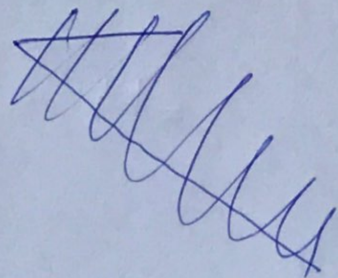
Sign Convention:



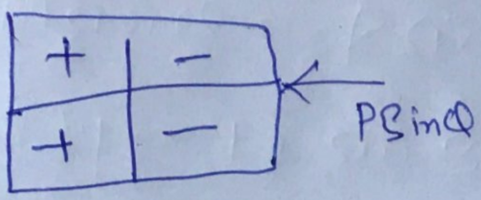
If we take Compression as negative and tenssion as positive and the beam is a Simply Supported.







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



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

Incase of symatrical loading the neutral axis lies of an angle of "α" the principal axis and the algebric sum of stress at N.A is zero.

$$\sigma = \frac{M \cos Q \, y}{I_z} + \frac{M \sin Q}{I_y} \quad — (*)$$

In This ~~process~~ case N.A passes through

2, 4, 2cm

$$\sigma = \frac{M \cos Q}{I_z} Y + \frac{M \sin Q}{I_y} z$$

let Consider a point A on N.A lies in Quadrant 3, Where

- Bending Stress due to $P\cos\theta$ is Compressive

and

- Bending stress due to $P\sin\theta$ Tensile

$$Eq\ (*) = 0 = -\frac{M\cos\theta}{I_z} y_A + \frac{M\sin\theta}{I_y} z_A$$

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

$$\frac{y_A}{z_A} = \frac{I_z}{I_y}\frac{\sin\theta}{\cos\theta} = \tan\alpha = \frac{I_z}{I_y}\tan\theta \quad \text{—} (**)$$

NOW! put the value of I_z, I_y and θ in eq (**)

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

$$\tan\alpha = \frac{2.8125\times10^{-5}}{1.25\times10^{-5}}(\tan 30^\circ)$$

$$\tan\alpha = -14.4129.$$

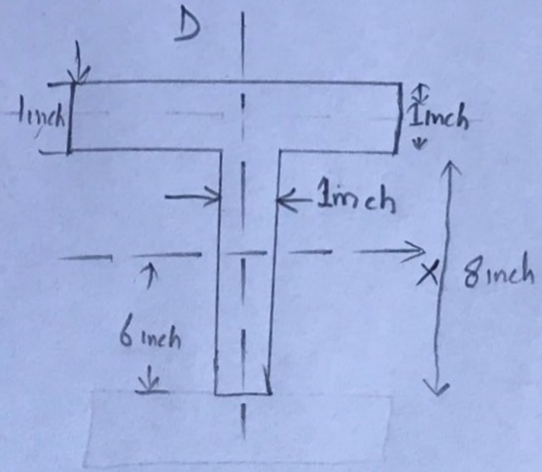
$$\alpha = \tan^{-1}(-14.4129)$$

$$\alpha = 1.5^\circ$$

$$\boxed{\alpha = 1^\circ 30' 5''}$$

Question NO 2nd
Part NO "B"

Given:



$L = 16\,ft$

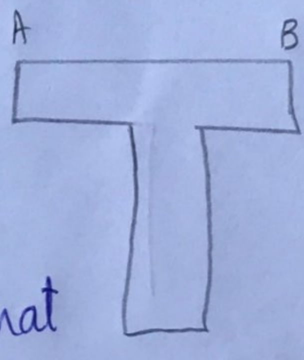
$I_x = 112.6\ inch^4$

$I_y = 18.7\ inch^4$

$\sigma_c = 12000\ psi$

$\sigma_t = 5000\ psi$

Solution:



By given figure we can judge that maximum compression would accure an a actual maximum tenssion c at B there will tenssion as well as compression which will reduced that effect of each other

Sol:

We we will Calculate stress at A & C.

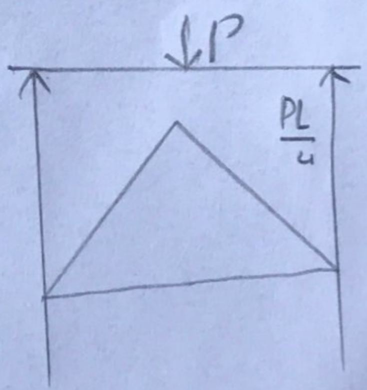
So Now!

$$SA = \frac{M_x y}{I_x} + \frac{M_y x}{I_y} \text{ comp.}$$

$$Sc = \frac{M_x y}{I_x} + \frac{M_y x}{I_y} \text{ (Tension)}$$

NOW Mx & My

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



* $\boxed{M_x = 48 P\cos 60}$

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

$$M_y = 48p \sin 60$$

$$\delta A = \frac{M x y}{I x} + \frac{M y x}{I y}$$

$$1200 = \frac{48 P \cos 60^\circ \times 3.07}{112.6} + \frac{48 p \sin 60 \times 3}{18.7}$$

Solving the Equation

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

NOW!

$$\delta c = \frac{M x y}{I x} + \frac{M y x}{I y}$$

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

Solving the Equation.

$$P = 2104.9 lb$$

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

Question no 3rd:

Given =· $L = 10\,ft$

· As both Sides are hinged

so! $L_e = L$

· $E = 10.3 \times 10^6$

· Factor of Safety = 2

· $b = 0.75$ inch

· $h = 2$ inch.

Required data:

Determine Safe load = ?

Solution: As

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

As we know that $I = Ar^2$

$$I = Ar^2$$

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

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

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

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

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

$$\Rightarrow \frac{(3.14)^2(10.3\times10^6)(1.5)}{(10/0.216)^2}$$

$$P_{cr} = 853.8343$$

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

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

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

$\Rightarrow$ For Fixed ended column

$$L_e = L/_2 = 10/_2$$

$$L_e = 5 ft$$

$$P_{cr} = \frac{\pi^2 EA}{(L_e/r)^2} = \frac{(3.14) \times (10.3 \times 10^6)(1.5)}{(60/0.210)^2}$$

$$P_{cr} = 1874.207$$

$$\text{Safe load} = \frac{P_{cr}}{\text{Factor of safety}}$$

$$\text{Safe load} = \frac{1874.207}{2} = 987.103$$

So! safe load as $= \boxed{987.103}$

Ans