NAME # SHAHKAR SALEEM

ID # 7943

SECTION # B

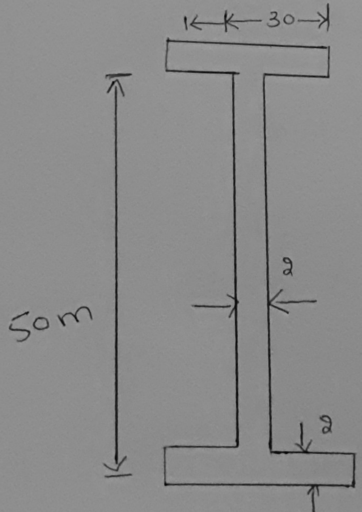
SUBJECT # MOS II

DATE # 23-JUN-2020

Question # 1

Part # A

Determine the location of the shear center for the beams having the cross sectional dimensions shown in figure 1. All member are to be considered thin walled and calculation should be based on the centerline dimensions.



Solution :-

As we know that

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

and

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

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

$$I = 50034.66 + 20833$$

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

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

$$e = 11.02\ mm$$

So shear center $e = 11.02\ mm$

Question # 1
Part # B

Given data :-

$H = 26 ft$

=) I assume diameter
$D = 22 ft$

tangential stress = $600 lb/ft^3$

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

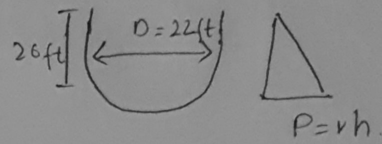
Required data:-

we have to find
the thickness = ?

Solution:-

The pressure develope by water = $P = rh$

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



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

$$2t \times \sigma_t = rhD$$

$$2t = \frac{rhD}{\sigma t}$$

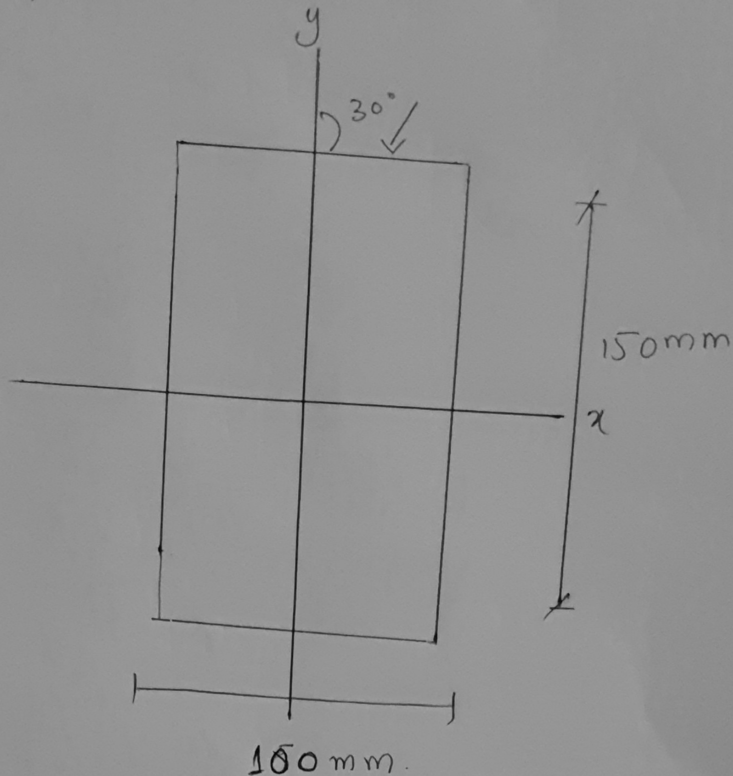
$$t = \frac{rhD}{\sigma_t \times 2}$$

$$t = \frac{\frac{(62.4)}{(12)^3} \times (26\times12) \times (22\times12)}{600\times 2}$$

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

Question # 2

Part # A



Solution

Moment of interia :-

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

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

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

Now

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

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

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

$$\sigma = \frac{M_z Y}{I_z} + \frac{M_Y Z}{I_y}$$

$$\sigma = \frac{M \cos\Phi}{I_z} + \frac{M \sin\Phi}{I_Y}$$

Where

$$M = \cos\Phi = P\cos\Phi = M_z$$

$$= 18 \cos 30^\circ = M_z$$

$$M_z = 1.8510$$

$$M \sin\Phi = P \sin\Phi = M_y$$

$$M_y = 12 \sin 30^\circ$$

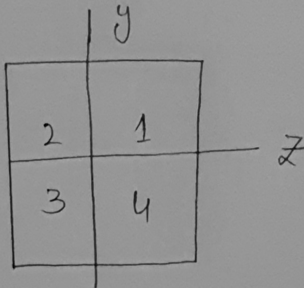
$$M_y = -11.8563$$

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

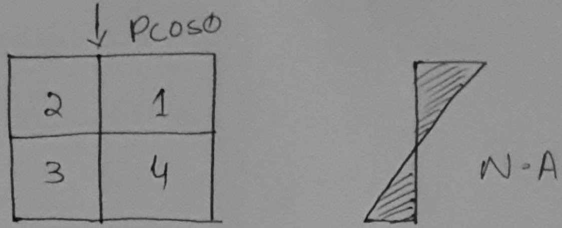
$$\sigma = \frac{1.851}{2.812 \times 10^{-5}} + \frac{(-11.8563)}{1.25 \times 10^{-5}} \Big)$$

$$\sigma = 8.82678 \ Nm^2$$

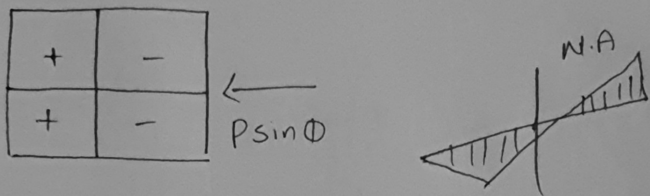
Sign Convection.



If we take Compression as negative and tension as positive and the beam is a Simple Supported.



Quadrant 1, 2 —ve
Quadrant 3, 4 +ve



Quad 1, 4 −ve
Quad 2, 3 +ve.

In case of unsymetrical loading the neutral axis lies of an angle of "α" the principle axis and the algebric ~~Sum~~ sum of stress at N.A is zero.

$$\sigma = \frac{M\cos\phi\, y}{I_z} + \frac{(M\sin\phi)\, z}{I_y} \quad \text{——} \ (1)$$

In this case, N.A passes through 2, 4 so

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

let Consider a point "A" on N.A lies in Quadrant 2, where

→ Bending stress due to $P\cos\phi$ is Compressive

and

→ Bending stress due to $P\sin\phi$ is Tensile.

equ (1) ⇒ $$0 = \frac{-M\cos\phi\, y_A}{I_z} + \frac{M\sin\phi\, z_A}{I_y}$$

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

$$\frac{y_A}{z_A} = \frac{I_z}{y_z} \frac{\sin\phi}{\cos\phi}$$

$$\Rightarrow \quad \tan\alpha = \frac{I_z}{I_y} \tan\phi \quad \text{— (ii)}$$

Now we put values of I_z, I_y and ϕ in equ (ii).

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

$$\tan\alpha = \frac{3.8125 \times 10^{-5}}{1.25 \times 10^{-5}} (\tan 30^\circ)$$

$$\tan\alpha = -14.4129$$

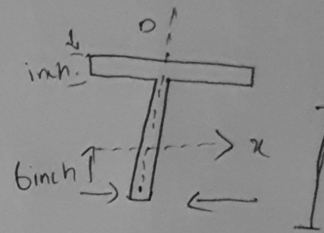
$$\alpha = \tan^{-1}(-14.4129)$$

$$\alpha = 1.5^\circ$$

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

Question # 2

Part # B



Given

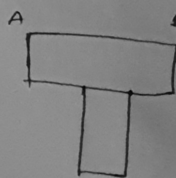
$L = 16 ft$

$I_x = 112.6 inch^4$

$I_y = 18.7 inch^4$

$S_c = 1200 psi$

$S_t = 5000 psi$



Solution:

By looking figure we can judge that maximum compression would occure on a and maximum tension C at B there will tension as well as compression which will reduce that effect of each otle so we will calculate stress at A and C

so.

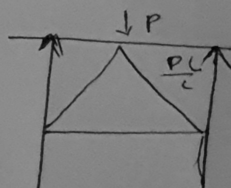
$$\delta A = \frac{M_x\, y}{I_x} + \frac{M_y\, x}{I_y} \rightarrow \text{comp.}$$

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

Now M_x and M_y

so

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



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

$$M_Y = \frac{P\sin 60^\circ (16\times 2)}{4}$$

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

Now

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

$$\Rightarrow \quad 1200 = \frac{48P\cos 60^\circ \times 3.07}{112.6} + \frac{480P\sin 60 \times 30}{18.7}$$

Solving the equation

$P = 1638.6$ lb.

Now

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

$$5000 = 40P\cos 60 \times (5.93) + \frac{40P\sin 60 \times 0.5}{18.7}$$

solving the equation

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

For case # 1

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

So the maximum load P applied should 1638.6 lb.

Question # 3

(15)

Solution :-

Given data :-

Length "L" = 10ft

As bothside 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

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

As we know that $I = Ar^2$

$$I = Ar^2$$

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

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

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

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

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

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

(17)

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

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

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

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

for fixed ended Colum

$$le = L/2 = 10/2$$

$$le = 5ft$$

$$P_{cr} = \frac{\pi^2 EA}{(le/r)^2} \Rightarrow \frac{(3.14)^2 \times (10.3 \times 10^6)(15)}{(60/62.16)^2}$$

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

(18).

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

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

$$\boxed{= 987.103}$$