=> HARIS IQBAL

=> 7926 (A)

=> MOS (II)

=> Final Paper

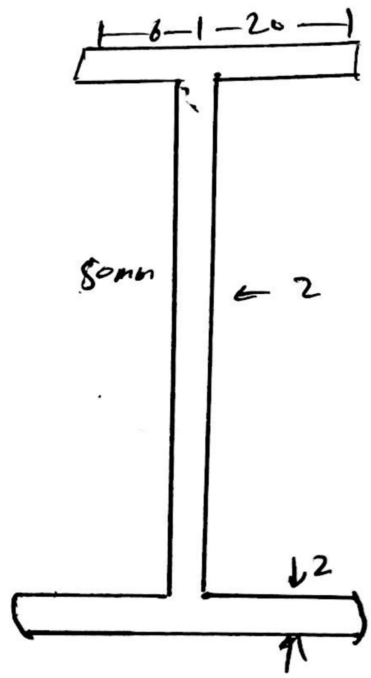
=> SIR SAQIB Shah.

Haris IQBAL
7926 (A)

Question # 1

Part # A

Figure



Required:

Location of shear center:

Solution!

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

and:

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

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

$$I = 50034.66 + 20833$$

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

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

$$e = 11.02\text{mm}$$

=> Question = 1

Part # B

DATA:-

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

=> $H = 26 ft$

=> I assume diameter
$D = 22ft$

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

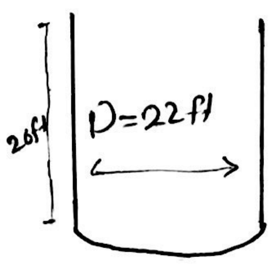
Required:-

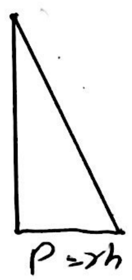
we have to find the thickness

Solution:-

Pressure develope by water = $P = \gamma h$

Putting values.





$$6t = \frac{PD}{26}$$

$$6t = \frac{PD}{2t} \Rightarrow \frac{\gamma h D}{2t}$$

$$\Rightarrow 2t \,\alpha\, 6t = \gamma h D$$

$$\Rightarrow 2t = \frac{\gamma h D}{6t}$$

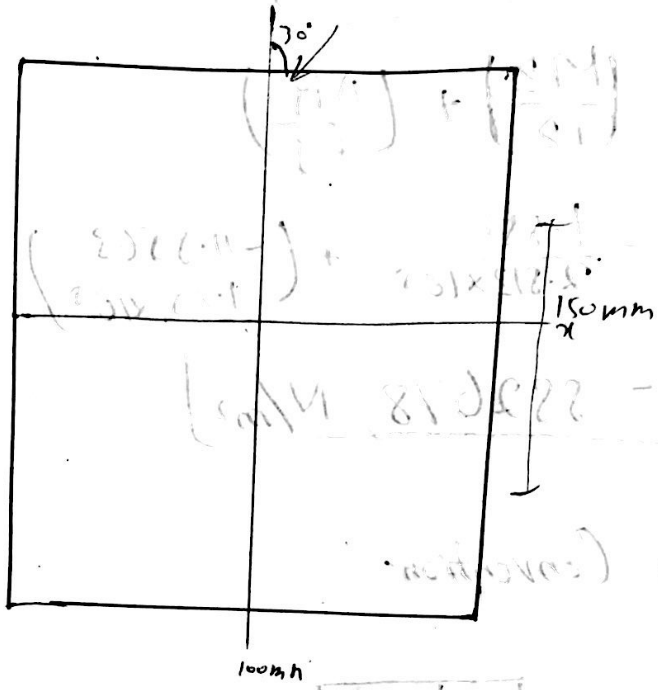
$$\Rightarrow t = \frac{\gamma h D}{6t \times 2}$$

$$\Rightarrow t = \frac{(62.4) \times (26 \times 12)(22 \times 12)}{600 \alpha 2}$$

$$= t = 0.24''$$

=> Question => 2

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:

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

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

$$6 = \frac{M_z Y}{I_z} + \frac{M_y Z}{I_y}$$

$$6 = \frac{M\cos\theta}{I_z} + \frac{M\sin\alpha}{I_y}$$

where

$$M_z \cos\theta = P\cos\alpha = M_Z$$

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

$$\boxed{M_Z = 1.8510}$$

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

$12 \sin 30^\circ$

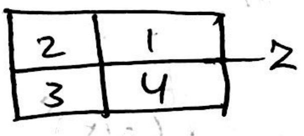
$$\boxed{M_y = -11.8563}$$

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

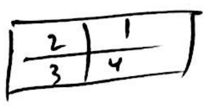
$$\sigma = \frac{1.851}{2.812 \times 10^{-5}} + \left(\frac{-11.8563}{1.25 \times 10^{-5}}\right)$$

$$\boxed{\sigma = 882678 \ N/m^2}$$

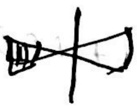
Sign Convention.



* if we take compression as negative and tension as positive and the beam is simply supported.



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



Quadrant 1, 4 - ive
2 3 + ive

③

$$6 = \frac{M\cos y}{I_z} + \frac{M\sin\alpha}{I_y} \cdot z \quad \text{--- (1)}$$

in this case N.A passes through (2, 4)

$$\therefore 6 = \frac{M\cos\alpha}{I_Z} y + \frac{M\sin\alpha\, z}{I_y}$$

Let consider a point "A" on NA lies in Quadrant 2 where

- Bending stress due to $P\cos\alpha$ is compression
- Bending stress due to $P\sin\alpha$ is tensile.

eq (1)

$$0 = \frac{-M\cos\alpha\, y_A}{I_Z} + \frac{M\sin\alpha\, z_A}{I_y}$$

$$= \frac{M\cos\alpha\, y_A}{I_Z} = \frac{M\sin\alpha\, z_A}{I_y}$$

$$\frac{y_A}{z_A} = \frac{I_Z \sin\alpha}{I_y \cos\alpha}$$

$$\tan\alpha = \frac{I_z}{I_y} \tan\alpha \quad \text{--- (2)}$$

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

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

$$\Rightarrow \frac{2.8125 \times 10^{-5}}{1.25 \times 10^{-5}} \tan 30^\circ$$

$$\Rightarrow \tan \alpha = -14.4129$$

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

$$\alpha = 1.5^\circ$$

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

Ans

Question :- 2
Part :- B

Given Data!

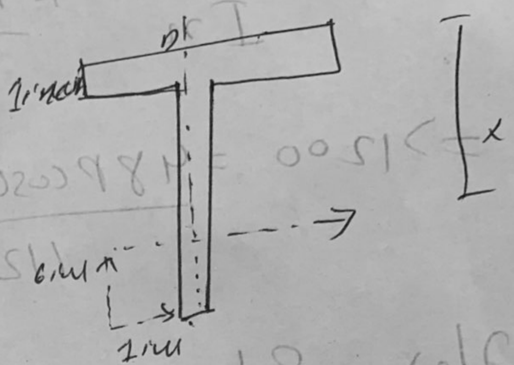
length $= L = 16 ft$

$I_x = 112.6$ inch^4

$I_y = 18.7$ inch^4

$f_c = 12000$ psi

$f_t = 5000$ psi



⇒ **Solution**

In fig we note the maximum compression would occur on a and maximum tension as well as compression which will be reduce the effect of each other so we will calculate stress at t and C

$$f_A = \frac{M_x y}{I_x} + \frac{M_y x}{I_y} \quad \text{(compression)}$$

$$f_C = \frac{M_x y}{I_x} + \frac{M_y \cancel{x}}{I_y} \quad \text{(tension)}$$

$M_x = ?$

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

$$M_x = 48 P \cos 60$$

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

$$M_y = 48 P \sin 60$$

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Now

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

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

After solving it

$P = 1638.6\,lb$

Now

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

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

$p = 2104.9\,lb$

$\Rightarrow$ Maximum load applied should be 1638.6lb.

Question: 3

(1)

Given data:

Length of column $= L = 10N$

$E = 10.3 \times 10^6$

Breadth $= b = 0.75$

height $= h = 2$

Factor of Safety $= 2$

Required:

Safe load $= ?$

when

- both ends hinged
- both ends fixed.

So:

For hinged columns

$Le = L$

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

$$P_{critical} = \frac{n^2 E I \pi^2}{Le^2} = \frac{1^2(10.3 \times 10^6)(0.5)\pi^2}{(10 \times 12)^2}$$

$$\Rightarrow P_{cr} = \frac{50776940}{14400} = 3526.176\ lb$$

$$\Rightarrow P_{cr} = 3526.176\ lb$$

$$\text{Safe load} = P_{safe} = \frac{P_{cr}}{\text{Factor of safty}} = \frac{3526176}{2}$$

$$\boxed{P_{safe} = 1763.088\ lb}$$

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1. When both ends fixed in this case $L_e = \frac{L}{2}$

$= L_e = 5ft$

$$I = I_y = \frac{2 \times (0.75)^3}{12} = 0.07 \, in^4$$

$$\Rightarrow P_{cr} = \frac{n^2 E I \pi^2}{L_e^2} = \frac{(1)^2 (10.3 \times 10^6)(0.07)(3.14)^2}{(5 \times 12)^2}$$

$$P_{cr} = \frac{7108771.6}{60^2}$$

$\Rightarrow P_{cr} = 1974.65812 \rightarrow$

$\Rightarrow$ So, Safe Load

$$P_{safe load} = \frac{1974.658}{2}$$

$$\Rightarrow \boxed{P_{safe} = 987.3293 \, lb}$$