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Section A

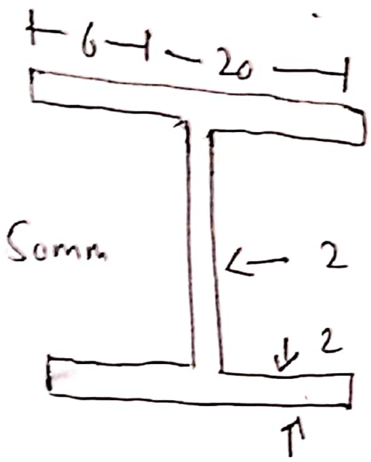
Semister 4th

Subject Mos II

Department Civil engineering

Question 01 (1)

Part (a)



Required: location of shear centre;

Sol:

As we know

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

and

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

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

$$I = 50034.66 + 20833$$

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

$$e = \frac{2(50)^2(26)^2}{4(70867.99)} = \boxed{11.02m}$$

(2)

Queston No 01

Part (b)

Data: $H = 26\ ft$

⇒ I assume diameter

$D = 22\ ft$

⇒ tangential stress $= 600\ lb/ft^3$

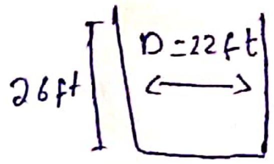
⇒ Specific weight of water tank $= 62.4\ lb/ft^3$

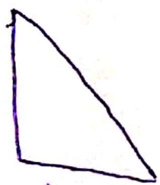
we have to find the thickness

Thickness = ?

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

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





P = γh

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

(2)

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

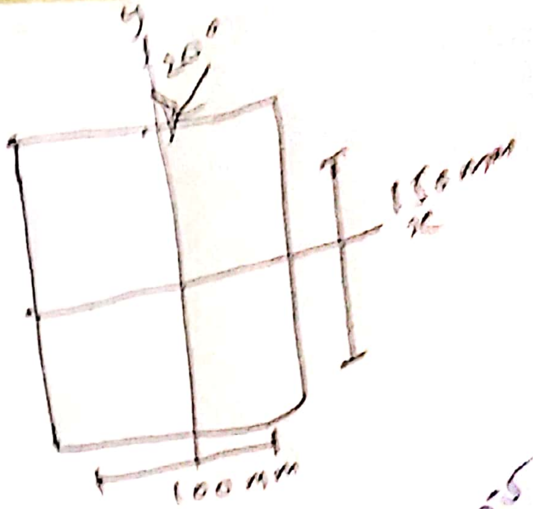
$$2t = \frac{\gamma h D}{\sigma_t}$$

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

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

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

Q2 Part (a) (4')



Moment of Inertia:

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

Now

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

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

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

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

where

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

$$= 12\cos 60^\circ = M_z$$

$$M_z = 1.8510$$

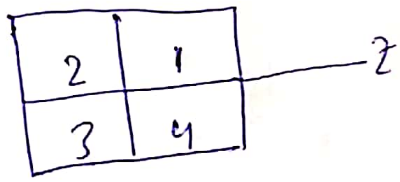
$M \sin\theta = P \sin\theta = M_y$

$M_y = -11.8563$

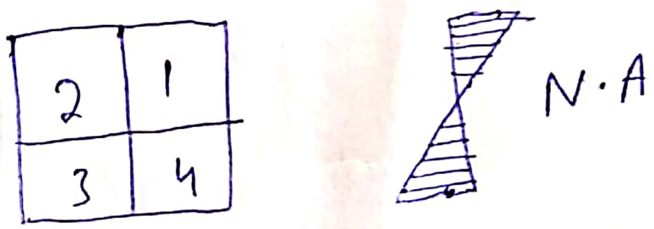
$$\sigma = \left(\frac{M_z}{I_z}\right) + \left(\frac{M_y}{I_y}\right)$$

$$\sigma = \frac{1.851}{2.812 \times 10^{-5}} + \left(\frac{-11.8563}{1.25 \times 10^{-5}}\right) = 882678 \ N/M^2$$

Sign Convention



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



Quadrant 1,2 -ive

Quadrant 3,4 +ive

(6)

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

$$6 = \frac{M\cos\theta\, y}{I z} + \frac{M\sin\theta\, z}{I y} \quad \text{—— (1)}$$

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

$$6 = \frac{M\cos\theta\, y}{I z} + \frac{M\sin\theta\, z}{I y}$$

Let consider point 'A' on N.A lies in quadrants, where

- Bending stress due to P Cosθ is compressive and
- Bending stress due to P sinα is tensile

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

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

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

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

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

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

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

$\tan\alpha = -14.4129$

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

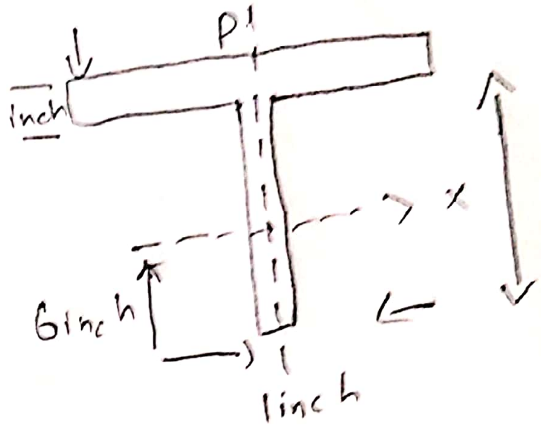
$\alpha = 1.5^\circ$

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

Q No 02

Part 'B'

Given:



$L = 16ft$

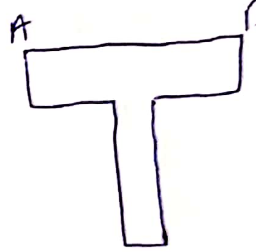
$Ix = 112.6 \text{ inch}^4$

$Iy = 18.7 \text{ in}^4$

$Se = 12000 \text{ psi}$

$St = 5000 \text{ psi}$

Solution:



By figure we can judge that maximum compression would occure on a axial maximum tension c at B There will tension as well a compression which will reduce that effect of each other So we will calculate stress at A and c.

So

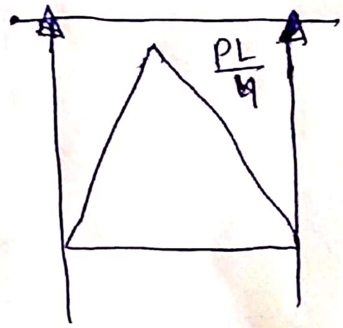
$$S_A = \frac{M_x y}{I_x} + \frac{M_y x}{I_y} \text{ (compression)}$$

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

Now M_x and M_y

So

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



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

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

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

Now

$$SA = \frac{Mx\,y}{Ix} + \frac{My\,x}{Iy}$$

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

$$\frac{48P \sin 60 \times 3}{18.7}$$

Solving the equation

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

Now

$$SC = \frac{Mx\,y}{Ix} + \frac{My\,x}{Iy}$$

$$5000 = 48P \cos 60 \times (5.93 ft) -$$

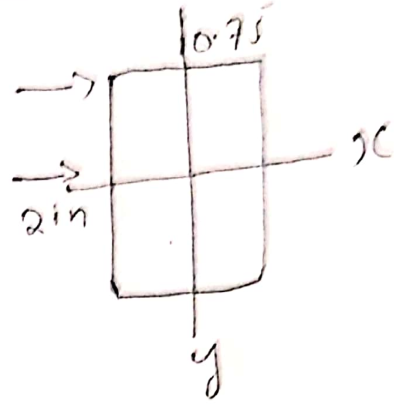
$$\frac{48P \sin 60 \times 0.5}{18.7}$$

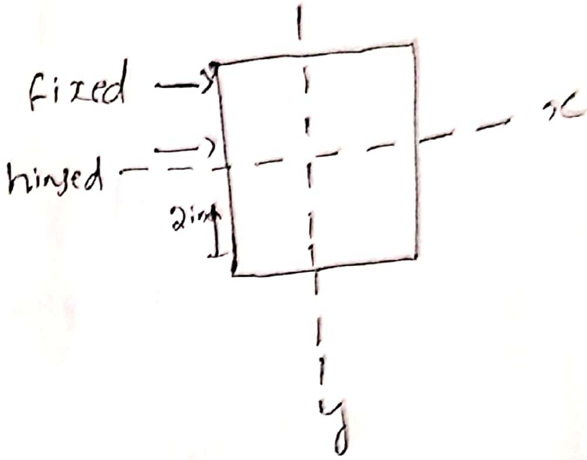
Solving the equation

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

So the maximum load P applied should 1638.6 lb

Question No (2)





Given Data:

Length = 10ft
Breath = 0.75"
height = 2"
factor of safety = 2
E = 10.3×10^6

Required Data:

Safe load = ?

Sol:

Question No (3)

Case 1:

Struct column act as a hinged column about an axis perpendicular to the 2in dimension then

$I = I_x = (3/4)(2)^3 = 0.5\ in^4$

$L_e = L$ (for hinged ended column)

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

$$P_{cr} = \frac{(1)^2 (10.3 \times 10^6)(0.5)(3.14)^2}{(10 \times 12)^2}$$

$\Rightarrow P_{cr} = 3526.17$

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

$$P_{safe} = \frac{3526.17}{2}$$

$\Rightarrow P_{safe} = 1767.08$

Case II :

Column act as a fixed end about axis parallel to 2in i.e y axis

$$I = I_y = \frac{(2)(0.75)^3}{12}$$

$$\Rightarrow I_y = 0.07 \text{ in}^4$$

Now for fixed ended

$$L_e = L/2$$

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

$$\Rightarrow P_{cr} = \frac{(1)^2 (10.3 \times 10^6)(0.07)(3.14)^2}{(120/2)}$$

$$\Rightarrow \boxed{P_{cr} = 1974.65 \text{ lb}}$$

~~For~~ ~~Safe~~

For Safe :

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

$$P_{safe} = \frac{1974.65}{2}$$

$$\Rightarrow P_{safe} = 987.32 \text{ lb}$$

In both cases we take Smaller value of P_{safe}

$$\boxed{P_{safe} = 987.32 < 1763.07}$$