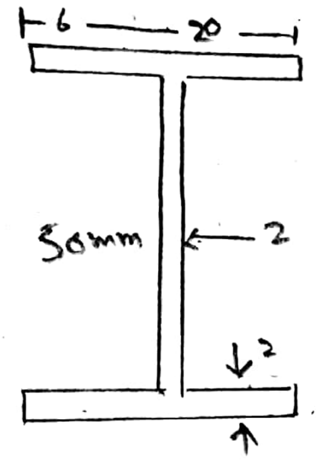
I.D # 7493
Subject # MOS II

Answer #01 (a)



Required

Location of Shear centre

Solution:-

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

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

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

$$I = 50034.66 + 20833$$

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

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

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

Answer No 1 (b)

Given Data :-

$H = 26\ ft$

$D = 22\ ft$

tangential stress $= 600\ lb/ft$

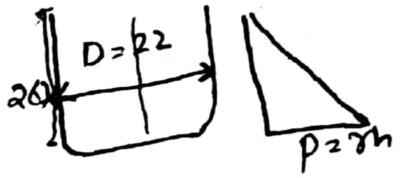
specific weight of water tank $= 62.4\ lb/ft^3$

Solution:-

The Pressure develope by water

$$P = \gamma h$$

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



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

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

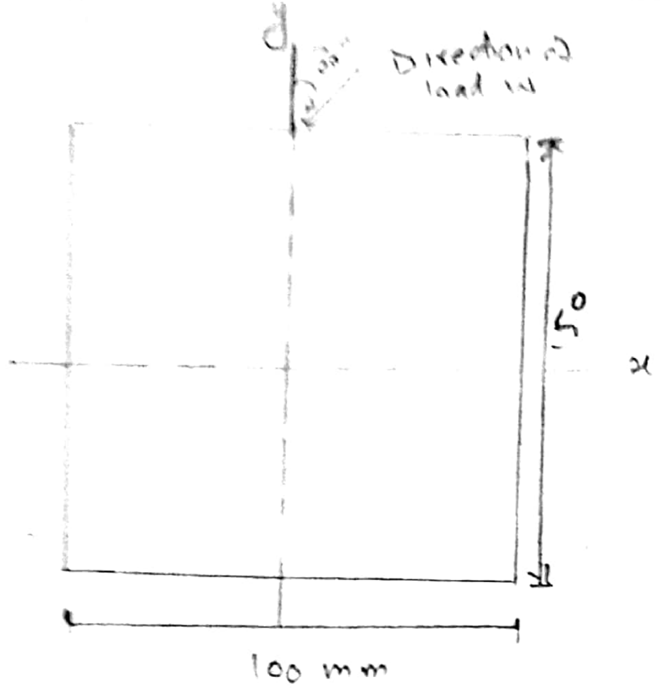
$$2t = \frac{\gamma h D}{\sigma_t}$$

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

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

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

Answer # 2(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

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

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

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

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

where;

$$M = \cos Q = P \cos Q = M_z$$

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

$$M_z = 1.8510$$

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

$$M_y = 12 \sin 30$$

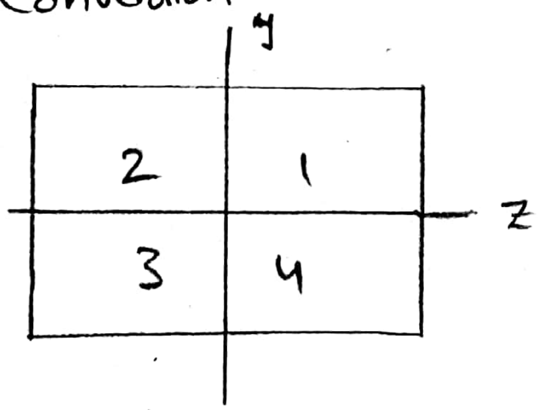
$$M_y = -11.8563$$

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

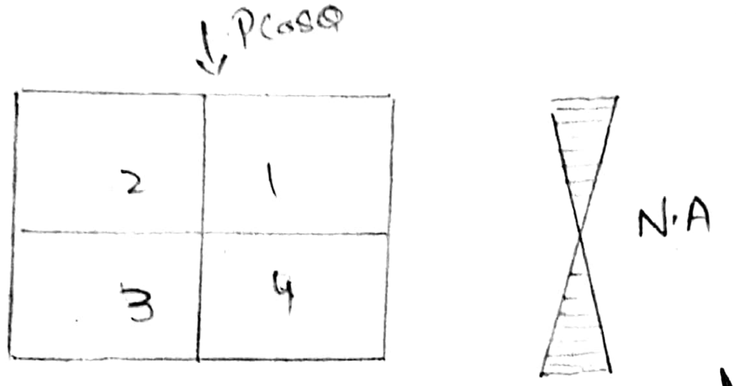
$$\sigma = \frac{1.851}{2.812\times10^{-5}} + \left(\frac{-11.8563}{1.25\times10^{-5}}\right)$$

$$= 882678 \ N\,m^2$$

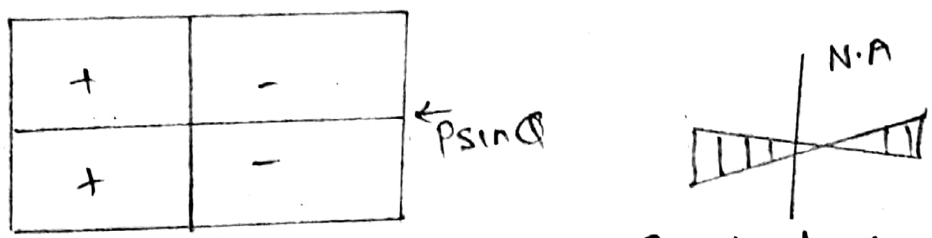
Sign Convention



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



Quadrant 1,2 – ve
Quadrant 3,4 +ve



Quadrant 1,4 –ve
Quadrant 2,3 +ve

Case of unsymmetrical loading the Neutral axis lies at an angle of α. The principle axis and the algebric sum of stress at N.A is zero.

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

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

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

Let consider a Point A on N.A lies in Quadrant 2;

where.

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

$$O = -\frac{M\cos\theta}{I_Z} y_A + \frac{M\sin\theta}{I_Y} z_A$$

$$O = \frac{-M\cos\theta}{I_Z} y_A + \frac{M\sin\theta}{I_Y} z_A$$

$$\frac{M\cos y_A}{I_Z} + M\frac{\sin\theta}{I_Y} z_A$$

$$\frac{y_A}{z_A} = \frac{I_Z}{I_Y}\frac{\sin\theta}{\cos\theta} = \tan\alpha = \frac{I_Z}{I_Y}\tan\theta$$

Now put the values of I_z, I_y & θ in eq (11)

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

$$\tan\alpha = -14.4129$$

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

$$\alpha = 1.5^\circ$$

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

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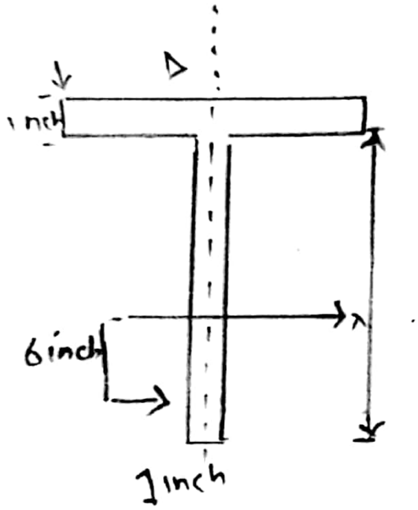
Answer No 2 (b)

Given Data:-



$L = 16ft$

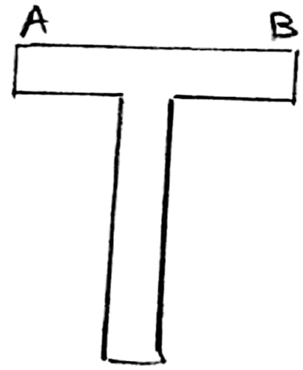
$I_x = 112.6 \text{ inch}^4$

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

$S_c = 12000 \text{ psi}$

$S_t = 5000 \text{ Psi}$

Solution:-

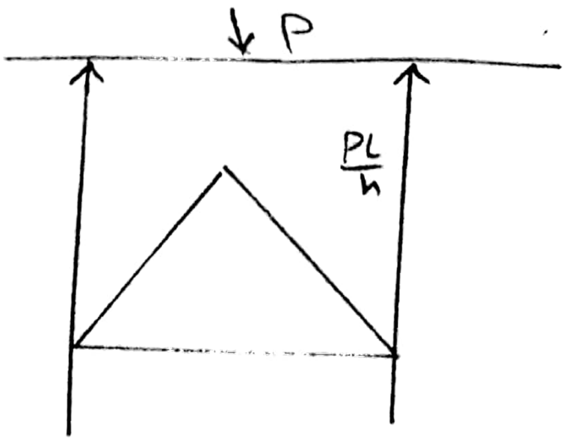


By looking figure we can Judge that Maximum compression would accure on a maximum tension C at B. There will tension as well a compression which will reduce that effect of each other.

So.

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

Now M_x and M_y



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

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

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

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

Now

$$SA = \frac{Mxy}{Ix} + \frac{Myx}{Iy}$$

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

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

Now

$$\delta_c = \frac{Mxy}{Ix} + \frac{Myx}{Iy}$$

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

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

So the Maximum load P applied should 1638.6 lb.

Answer #03

Given Data :-

$L = 10\,ft$

As bothside are hinged.

So $Le = L$

$E = 10.3 \times 10^6$

Factor of safety = 2

$b = 0.75$ inch

$h = 2$ inch

Required Data :- Determine safe load.

Solution :-

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

we know that $I = Ar^2$

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

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

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

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

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

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

$$\boxed{Pcr = 853.8343}$$

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

$$= \frac{853.8343}{2}$$

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

<u>For</u> <u>Fixed</u> <u>ended</u> <u>colomn</u>

$$Le = L/2 = 10/2$$

$$Le = 5 \text{ ft}$$

$$Pcr = \frac{\pi^2 EA}{(Le/r)^2} \Rightarrow \frac{(3.14)^2 \times (10.3 \times 10^6)(1.5)}{(60/2.16)^2}$$

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

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

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

$$\boxed{987.103}$$ — Ans