NAME:- HAMAD-UR-RAHMAN.

ID:- 7669

Subject:- Mechanics of Solid-2

Submitted to:- Engr. Muhammad Saqib

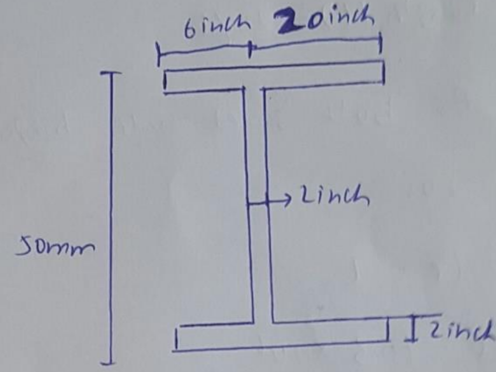
Date:- 23/06/2020.

Q2) A):. Given Data:-

Required :-

Location of Shear Center

As we know that,



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

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

$$I = 2\left[\frac{26(2)^3}{12} + (20\times2)(25)^2\right) + \left[\frac{2(50)^3}{12} + 0\right]$$

$$I = 50034.86 + 20833$$

$$\boxed{I = 70867.99\,mm^4}$$

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

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

So Shear Center $(e) = 11.02\,mm$ Answer

Q1) b):. Given Data:.

$h = 26 ft$

or

$h = 312$ inches.

$\sigma_t = 6000 psi$

$\gamma_w = 62.4 \, lb/ft^3$

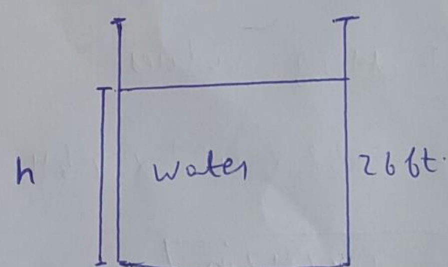
or

$\gamma_w = 0.036 \, lb/in^3$.

Diameter $(D) = 22 ft$

Required:.

Thickness $(t) = ?$



Water Tank.

we know that,

$P = \gamma h$ (for water)

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

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

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

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

$$\boxed{t = 9.38 \times 10^{-4} D}$$

Dia (D) = 22ft or $22 \times 12 = 264$ in.

we know that,

$t = 9.38 \times 10^{-4} D.$

Putting values

$t = 9.38 \times 10^{-4} \times 264$

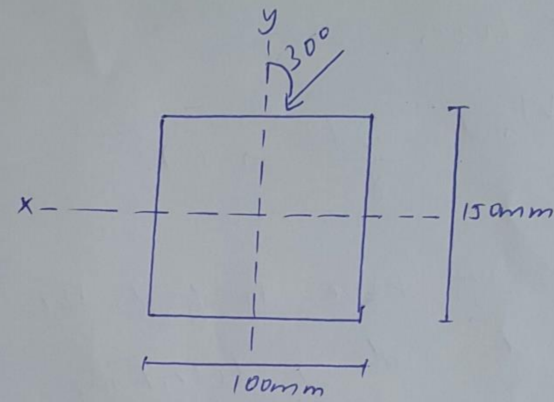
$\boxed{t = 0.247 \text{ in.}}$ Answer.

QNo:- 2(A):.

Given Data:-

$w = 4 KN/m$

$L = 3m$



Required:-

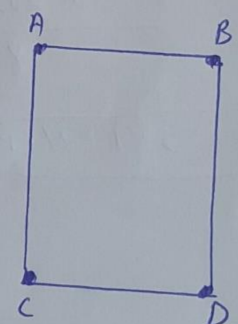
Maximum Bending Stress = ?

Sol:-

As the Bending Moment is maximum at extreme, so we could find stresses at A, B, C, D.

we know that,

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



We have to find M_x and M_y.

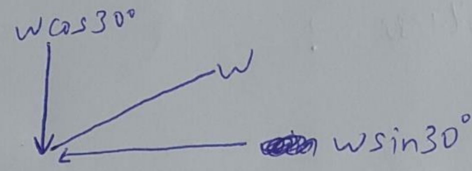
As per given data, the M_x and M_y should be found at the mid.

For simply supported,

we have,

$$M_{mid} = \frac{wl^2}{8} \rightarrow (i).$$

Now we have to find the components of w in x and y directions.



So,
$$Mx = \frac{(w\cos 30°) \times l^2}{8}$$

$$Mx = \frac{(4 \times \cos 30) \times 3}{8}$$

$$\boxed{Mx = 3.9 \text{ KN-m}}$$

Now,

$$My = \frac{(4 \times \sin 30) \times 3^2}{8}$$

$$\boxed{My = 2.25 \text{ KN-m}}$$

Mx is causing compression at A and B &

tension at C and D.

My is causing compression at B & D and

tension at A & C.

Now,

I_x & I_y.

$$I_x = \frac{bh^3}{12} = \frac{0.1 \times 0.15^3}{12} = 2.815 \times 10^{-5} \, m^4$$

$$I_y = \frac{bh^3}{12} = \frac{0.15 \times 0.1^3}{12} = 1.25 \times 10^{-5} \, m^4$$

→ Now Stresses at Extreme fibers.

$$\sigma_x = \frac{M_x y}{I_x} = \frac{3.9 \times 0.075}{2.815 \times 10^{-5}}$$

$$\boxed{\sigma_x = 10390.7 \, KN/m^2}$$

$$\sigma_y = \frac{2.25 \times 0.05}{1.25 \times 10^{-5}}$$

$$\boxed{\sigma_y = 9000\ KN/m^2}$$

Now, (taking tension +ve).

$$\text{Stress at } A = \frac{M_x y}{I_x} \mp \frac{M_y x}{I_y}$$

$$= -10390.7 + 9000$$

$$= -1390.7\ KN/m^2 \text{ (comp)}$$

At B,
$$= \frac{M_x y}{I_x} + \frac{M_y x}{I_y}.$$

$$= -10390.7 - 9000$$

$$\boxed{\sigma \text{ at } B = -19390.7\ KN/m^2} \text{ (comp)}.$$

Now,

$$\text{Stresses At } C = \frac{M_x y}{I_x} + \frac{M_y x}{I_y}$$

$$= 10390.7 + 9000$$

$$\boxed{= 19390.7\ KN/m^2} \text{ (Tension)}.$$

Stresses At D. $= \frac{M_x y}{I_x} + \frac{M_y x}{I_y}$

$= 10390.7 - 9000$

$\boxed{= 1390.7 \, KN/m^2}$ (Tension)

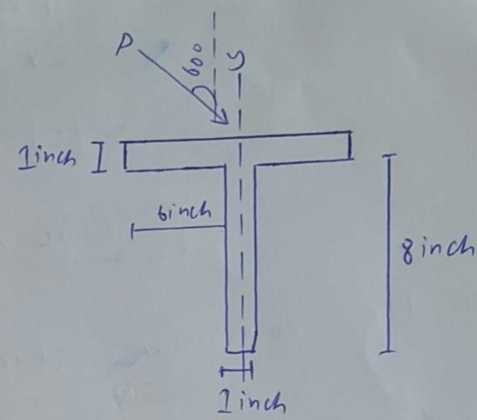
So the maximum stresses are on B and C.

B is under compression of 19390.7 KN/m²

And C is under tension of the same value.

QNo:. 2(B):

Given Data:-



$l = 16ft$

$I_x = 112 \cdot 6 in^4$

$I_y = 18 \cdot 7 in^4$

$\sigma_c = 12000psi$

$\sigma_t = 5000psi$

Sol:-

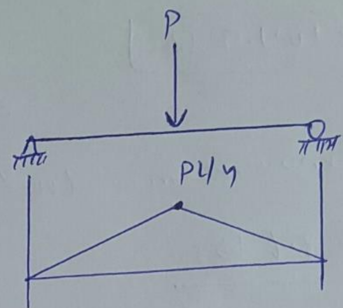
From figure, we know that maximum compression would occur on A and maximum tension at C. At B there will be tension as well as compression which will reduce the effect of each others. So, we will calculate stresses at A and C.

So,

$$\sigma_A = \frac{M_x y}{I_x} + \frac{M_y x}{I_y} \quad (comp)$$

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

Now M_x and M_y:-



So,

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

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

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

$$\boxed{M_y = 48P\sin 60^\circ}$$

Now,

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

$$12000 = \frac{48P\cos 60^\circ \times 3.07}{112.6} + \frac{48P\sin 60^\circ \times 3}{18.7}$$

Solving the Equation.

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

Now,

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

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

Solving the equation,

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

So the maximum load P applied should be 1638.6 lbs.

Q No. 3)

Q.No:. 3):. Given Data:.

Length $(L) = 10ft$

As both sides are hinged

so,

$L_e = L$

$E = 10.3 \times 10^6$

$FOS = 2$

$b = 0.75$ inch

$h = 2$ inch

Required:

Determine safe load:-?

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

we know that,

$$I = Ar^2$$

or

$$r = \sqrt{\frac{I}{A}} \qquad r = \frac{\sqrt{\frac{bh^3}{12}}}{bh} \Rightarrow \sqrt{\frac{b^2}{12}}$$

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

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

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

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

$$\boxed{Pu = 853.8343}$$

$$\text{Safe load} = \frac{\text{Crippling load}}{F.O.S.}$$

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

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

(4) For Fixed Ended Column:

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

$$Le = 5ft.$$

$$P_u = \frac{\pi^2 E A}{(l/k)^2} = \frac{(3.14)^2 \times (10.3 \times 10^6)(1.5)}{(60/16)^2}$$

$$\boxed{P_u = 1974.207}$$

$$\text{Safe load} = \frac{P_u}{F.O.S.}$$

$$\text{Safe load} = \frac{1974.207}{2}$$

$$\boxed{\text{Safe load} = 987.103}$$ Answer.