NAME SOHAIL AHMED

ID 7907

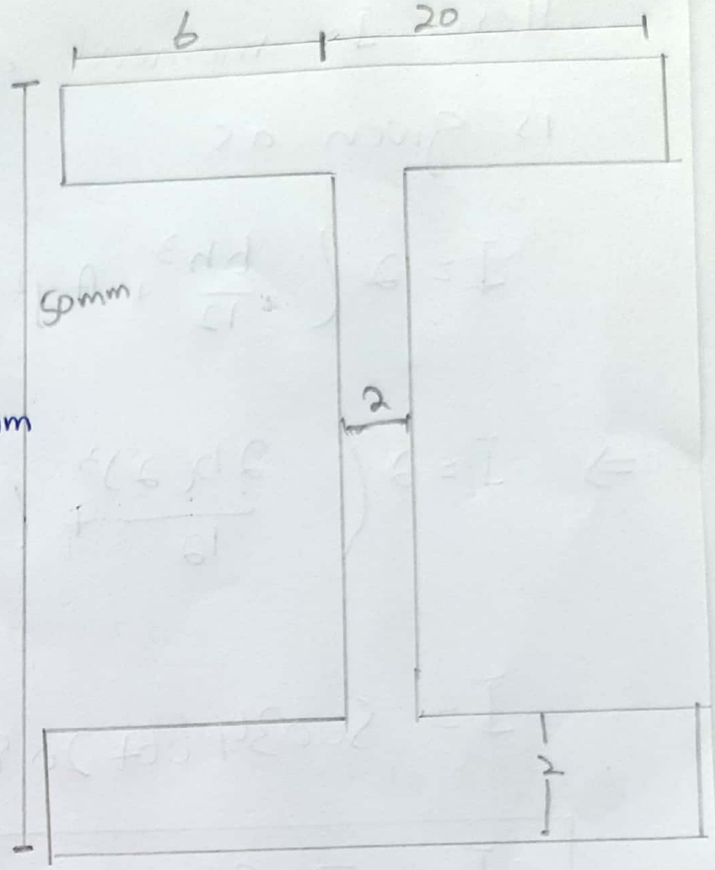
SECTION A

PAPER MOS II

DATE 23-6-2020

ANSWER TO QUESTION 1

PART A.



Given that

Height of Section $h = 50mm$

Thickness $= b = 20+6$

$b = 26mm$

$T_f = 2mm$

REQUIRED

Shear Center?

As we know that

For unsymmerical member, the Shear Center is some distance away from the Geometrical Center.

→ This distance is called ecentricity which is given as

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

Here I = moment of interia & is given as

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

$$\Rightarrow I = 2\left(\frac{2b(2)^3}{12} + (20\times 2)(25)^2\right) + \left(\frac{2(50)^3}{12} + 0\right)$$

$$I = 50034.66 + 20833$$

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

Now equation (1) $\rightarrow$

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

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

$$\boxed{e = 11.0234\,mm}$$

So, Shear Center is 11.0234 mm away from Geometrical Center.

ANSWER TO QUESTION NO 1 :-

PART B :-

GIVEN DATA

Height 26 ft

Tengential stress = 6000 psi

Specific weight of water = 62.4 lb/ft^3

REQUIRED DATA:

Thickness of wall of water tank : t = ?

SOLUTION:

As we know

Prenure is equal to

$$P = \gamma h$$

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

$$t = \frac{\gamma h D}{26t}$$

Putting the values, we get.

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

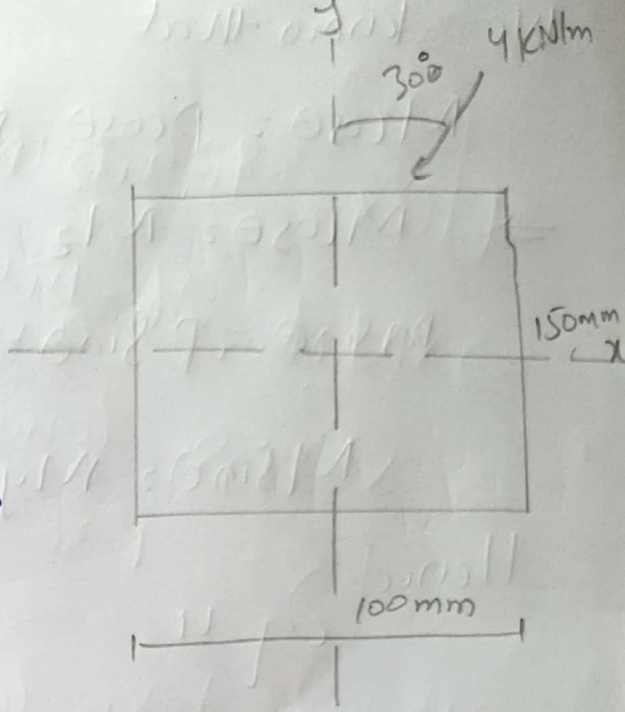
$$t = \frac{\frac{62.4}{(12)^3}(26 \times 12 \times 22 \times 12)}{2(6000)}$$

$$t = 0.24 \text{ inch}$$ Ans.

(P5)

ANSWER TO QUESTION NO 2:

PART A



GIVEN DATA

$b = 100\,mm$

$h = 150\,mm$

load $= P = 4\,KN/m$

Length of Beam $= 3\,m$

REQUIRED

Bending Stress = ?

N.A = ?

Now,

$$\delta = \frac{M_z Y}{I_z} + \frac{M_y Z}{I_y} \qquad \therefore M_z = M\cos\theta, \quad M_y = M\sin\theta$$

$$\delta = \frac{M\cos\theta}{I_z} + \frac{M\sin\theta}{I_y} \rightarrow (a)$$

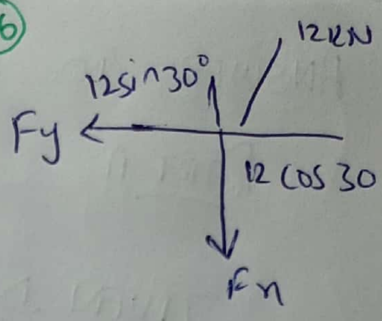
Now, moment about x-axis

$M_z = -11.8563 \times 3$

$M_z = -35.57\,N.m$

$M_y = 6.851 \times 3$

$\Rightarrow M_y = 5.55\,N.m$



We know that

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

$$\Rightarrow M\cos\theta = M_z$$

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

$$M\sin\theta = M_y$$

Hence

eq 4

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

Now moment of Interia

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

$$I_z = 2.8125 \times 10^{-5} \text{ inu}^4$$

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

$$I_y = 1.25 \times 10^{-15}$$

eq (4)

$$\sigma = \frac{1.851}{2.812 \times 10^{-5}} + \frac{-11.8563}{11.85 \times 10^{-6}}$$

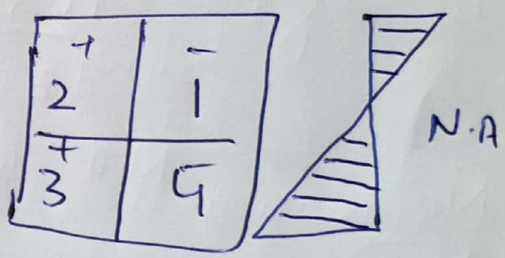
$$\boxed{\delta = 882678\,Nm^2}$$

P7

⇒ Natural axis (N.A):
Sign convection are

2	1
4	3

⇒ if we take compresion as negative & tension as positive, then beam is simply supported.



In this case: Natural axis passes 2 & 4 quadrant.

→ In unsymmetrical loading cases the neutral axis lies on angle of 'α' which is given by

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

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

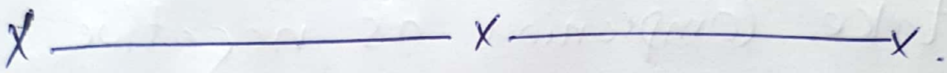
→

$\tan\alpha = 14.4124$

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

$\Rightarrow \alpha = 1.5^\circ$

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



ANSWER TO QUESTION NO 2:

PART B

GIVEN DATA:

$L = 16\ ft$

$I_x = 112.6\ in^4$

$I_y = 18.7\ in^4$

$\delta_c = 12000\ psi$

$\delta_t = 5000\ psi$

SOLUTION:

By Seeing to the figure, we can judge that maximum Compresion would occure on A & maximum tension at C.

At B there will be taken as well as Compresion, which will reduce the effects of each other

So, we will Calculate Strenes at A & C.

So,

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

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

Now M_x & M_y

So

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

$$M_x = 48P\cos 60^\circ$$

$$M_y = \frac{\cancel{48}\cdot P\sin 60(16\times 12)}{4}$$

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

Now

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

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

By Solving the equation.

So

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

Now

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

$$8000 = \frac{48P\cos 60 \times (5.93)}{112.6} + \frac{48P\sin 60 \times 0.5}{18.7}$$

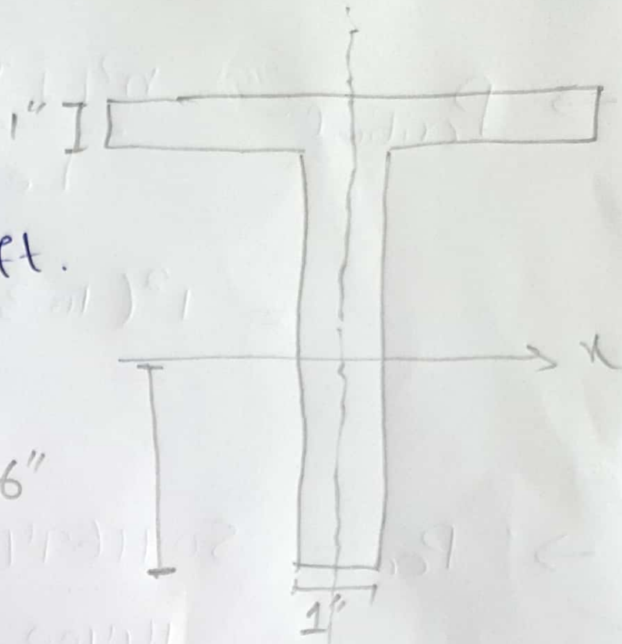
Solving the equation

$\boxed{P = 2104.9 lb}$

So the maximum load of P applied should be 1638.6 lb.

ANSWER TO QUESTION NO 3: (P12)

GIVEN DATA:



Length of Column = $L = 10$ ft.

$E = 10.3 \times 10^6$

breadth $b = 0.75$

height $= h = 2$

factor of Safety = 2

REQUIRED

→ Safe load = ?

When

- Both end hinged
→ Both end fixed.

So,

⇒ For hinged Column

effective length = $L_e = L$

$$I = I_x = \frac{bh^3}{12}$$

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

$I_x = 0.5 in^4$

$\rightarrow P_{critical} = \frac{n^2 E I \pi^2}{Le^2}$

$= \frac{1^2 (10.3 \times 10^6)(.5)\pi^2}{(10 \times 12)^2}$

$\rightarrow P_{cr} = \frac{50776940}{14400}$

$= 3526.176 lb$

Safe load $= P_{safe} = \frac{P_{cr}}{\text{factor of Safety}}$

$= \frac{3526176}{2}$

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

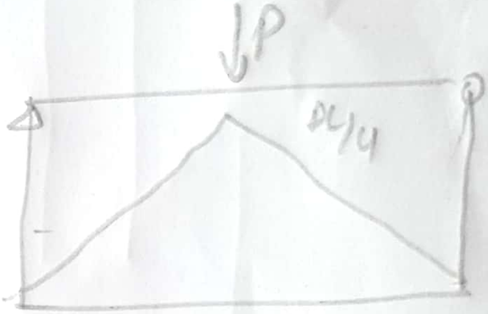
$\rightarrow$ when Both ends fixed In this Case $Le = \frac{L}{2}$

$Le = 5 ft.$

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

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

$$= \frac{(1)^2 (10.3 \times 10^6)(0.07)(3.14)^2}{(5 \times 12)^2}$$



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

$$P_{cr} = \frac{1974.658}{2}$$

So, Safe load

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

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

X ———————— X ———————— X.