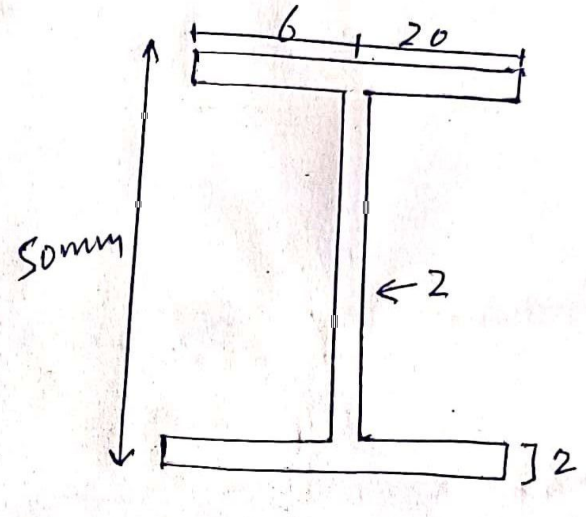
NAME ABD UR. REHMAN

Section A.

I.D 7892

SUBJECT MOS 2

⇒ Question 1
Part 1



⇒ Location of Shear Center = ?

Solution:

As we know.

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

And

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

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

$$I = 50034.66 + 20833$$

$$I = 70867.99\ mm^4$$

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

⇒ Question No 1

PART (B)

Data:-

⇒ $H = 26\ ft$, we assumed

& $D = 22\ ft$.

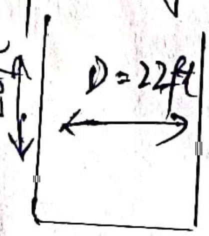
⇒ Specific weight of water tank.
$= 62.4\ lb/ft^3$.

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

⇒ thickness = ?

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

$$\sigma_t = PD/2t$$



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

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

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

③

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

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

$$\Rightarrow \quad t = 0.24''$$

⇒ QNo 2.

④

PART (A) :-

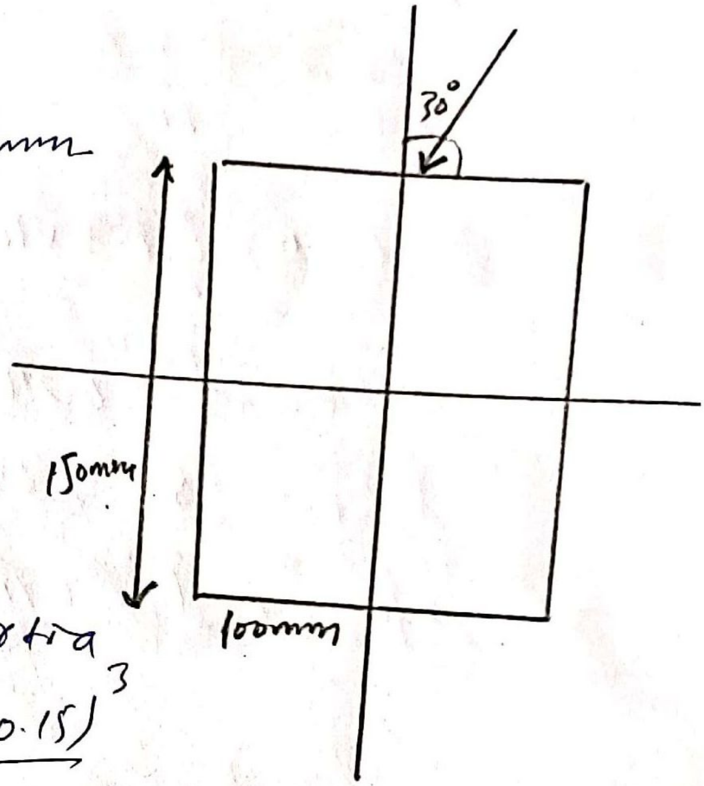
Given Data :-

⇒ wooden Beam = 150×100 mm

⇒ load = 4K.

⇒ span = 3m

⇒ Maximum Bending Stress = ?



⇒ Moment of Inertia

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

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

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

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

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

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

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

$$= 12\cos 30°$$

$$M_z = 1.8510$$

(5)

$M \sin\theta = P \sin\theta = M_Y$

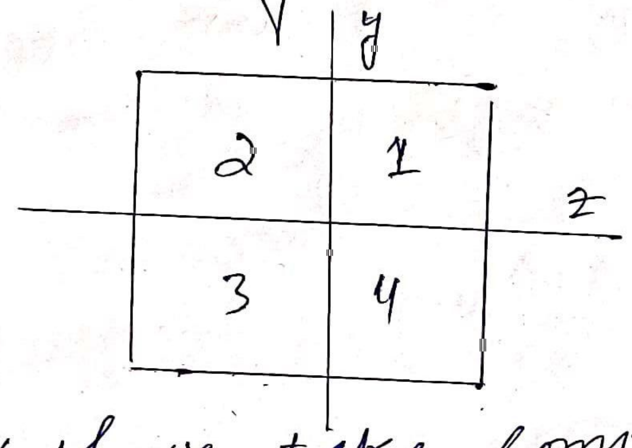
$\Rightarrow 12 \sin 30^\circ$

$M_Y = -11.856$

$\sigma = \left(\frac{M_Z}{I_Z}\right) + \left(\frac{M_Y}{I_Y}\right) \Rightarrow \frac{1.851}{2.812 \times 10^{-5}} + \left(\frac{-11.856}{1.25 \times 10^{-5}}\right)$

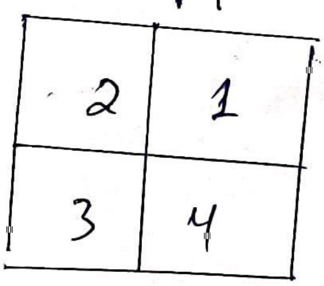
$\sigma = 882678 \ N/m^2$

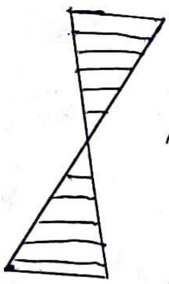
Sign Convention



* If we take compression as negative and tension as positive and the Beam is simply supported.

$\downarrow P\cos\theta$



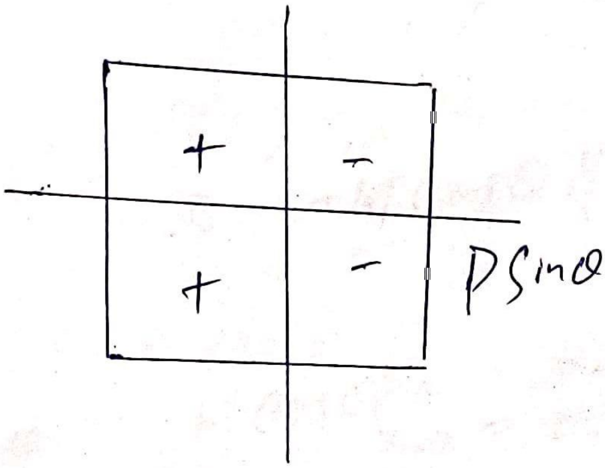


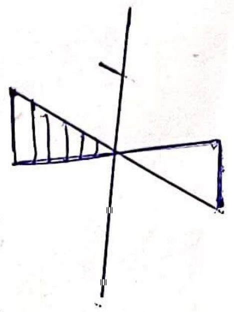
N.A

Quadrant

1.2 -ive

3.4 +ive.





Quadrant
1·4 -ive
2·3 +ive

In case of unsemetrical loading. the Neutral axis lies of an angle of "X". The principle axis and the algebric sum of stress at N·A is zero.

$$6 = \left(\frac{M\cos\theta}{I_z} + y\right) + \left(\frac{M\sin\theta}{I_y} - z\right) \rightarrow ①.$$

In this case N·A passes through 2,4 Quadrants.

$$6 = \frac{M\cos\theta}{I_z}\cdot y + \frac{M\sin\theta\cdot z}{I_y}$$

let consider a point "A" on N·A lies in Quadrant 2, where

- Bending stress due to Pcosθ is compressive
- Bending stress due to Psinθ is tensile.

eq ①

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

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

$$y_A/z_A = \frac{I_z \sin\theta}{I_y \cos\theta}.$$

$$\tan\alpha = \frac{I_z}{I_y}\tan\theta \longrightarrow ②.$$

Now put values of I_z. I_y and θ in eq ②

$$\tan\alpha = \cancel{\frac{I_z}{I_y}}\tan 30^\circ$$

$$\Rightarrow \frac{2.8125\times10^{-5}}{1.25\times10^{-5}}\tan 30^\circ.$$

$$\tan\alpha = -14.4129$$

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

$$\alpha = 1.5^\circ$$

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

⇒ **Question No 2**
Part B

Given Data:-

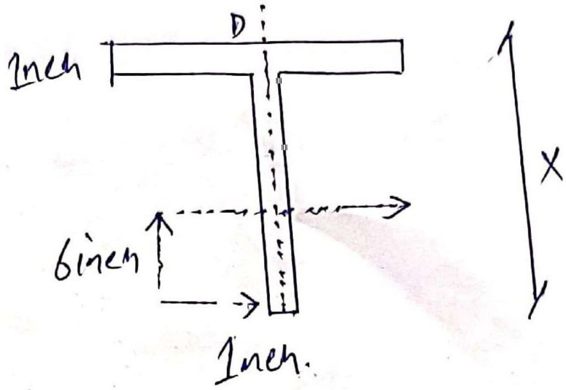
Length $= L = 16 ft$

$I_x = 112.6\ inch^4$

$I_y = 18.7\ inch^4$

$\delta_c = 12000\ psi$

$\delta_t = 5000\ psi$



⇒ **Solution:.**

By looking at figure we can judge that maximum compression would accure on a axi compression e at B. Then maximum tension e at B. There will be tension as well as compression which will ~~be~~ redu the effect of each other So will calculate stress at A and

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

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

$Mx = ?$

$$\Rightarrow Mx = \frac{P\cos 60 \times (16\times12)}{4}$$

$$Mx = 48P\cos 60.$$

$$\Rightarrow My = \frac{P\sin 60 (16\times12)}{4}$$

$$My = 48P\sin 60$$

Now

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

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

After Solving it.

$P = 1638.6$ lb.

Now

$$f_C = \frac{Mxy}{Ix} + \frac{Myx}{Iy}.$$

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

After Solving it.

$P = 2104.9$ lb.

So the maximum load "P" Applied should be 1638.6 lb.

⇒ **Question No 3**

Given Data :-

⇒ length "L" = 10 ft

Both Sides are hinged

$Le = L$

⇒ $E = 10.3 \times 10^6$

⇒ factor of saftey = 2

⇒ b = 0.75 inch

⇒ h = 2 inch

⇒ Safe load = ? At hinged And fixed = ?

⇒ **Solution :-**

(A) for hinged Columns

$Le = L$

$$I = I_x = \frac{(0.75)(2)^3}{12} = 0.5 \text{ inch}^4.$$

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

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

$$\text{Safe load} = \frac{P_{cr}}{\text{factor of Safety}} = \frac{3526.176}{2}$$

$= 1763.088$ lb Ans.

(B) (11)

for fixed ended

$L_e = L/2 \Rightarrow 10/2 = 5ft.$

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

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

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

$P_{cr} = 1974.658 \, lb$

$\text{Safe load} = \frac{1974.658}{2} = 987.3293 \, lb.$