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PAPER	:	MOS II
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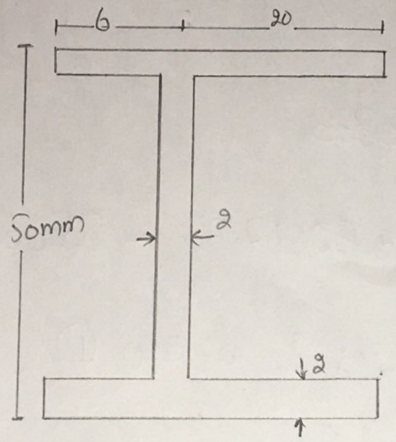
QUESTION No.1 (a)

Determine the location of the shear Center-- -------- based on the Centerline dimensions.



GIVEN DATA:

Height, h = 50mm

Breath, b = 26m

REQUIRED DATA:

We have to find the location of Shear Center.

SOLUTION:

As we know this

$$e = \frac{t_f h^2 b^2}{4I} \quad \text{①}$$

First we have to find "I"

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

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

$$\Rightarrow I = 2(32517.33) + 20833$$

$$\Rightarrow I = 53350.66\,mm^4 + 32517.33 = 85867.99\,mm^4$$

Now put the value of I in eqn ①

$$\Rightarrow e = \frac{2(50)^2(26)^2}{4(85867.99)}$$

$$\Rightarrow \boxed{e = 9.8406\ mm}$$

RESULT:

Hence $e = 9.8406\,mm$

QUESTION No. 1 (b)

Determine the thickness of the wall - - - - - - -

- - - - - weight of water is 62.4 lb/ft^3

GIVEN DATA:

$h = 26ft = 26\times12 = 312$ inch

Tangental Stress = 6000 Psi

Specific weight = $62.4\ lb/ft^3 = 62.4 \times \frac{1}{(12)^3}$

$= 0.036\ lb/inch$

Diameter, $D = 22ft = 22 \times 12 = 264$ inches.

REQUIRED DATA:

Thickness, $t = ?$

SOLUTION:

As

$$\sigma_t = \frac{PD}{2t} \quad \text{—①}$$

Where Pressure exerted by water is

$P = \gamma h$

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

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

$$\Rightarrow t = \frac{(0.036)(312)(264)}{6000 \times 2}$$

$$\Rightarrow t = 0.247''$$

$$\Rightarrow \boxed{t = 0.0205 \text{ ft}}$$

RESULT:

Hence thickness, $t = 0.0205$ ft.

QUESTION No. 2(a)

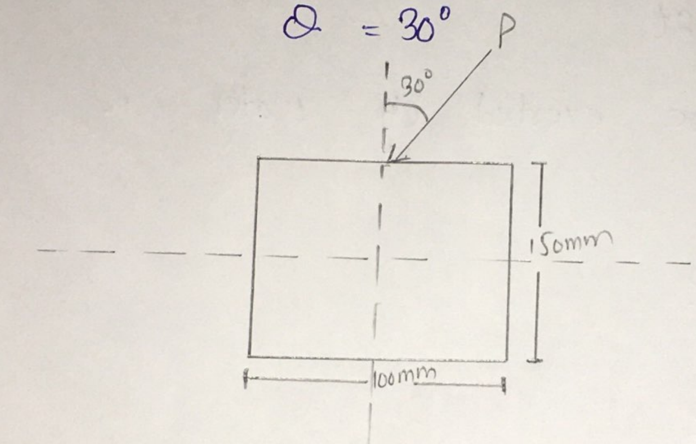
The 100 by 150 mm wooden beam - - - -
- - - - Neglect the weight of the beam.

GIVEN DATA:

Load, $P = 4KN$

Length, $L = 3m$

$\theta = 30°$



REQUIRED DATA:

Bending stress, $\sigma = ?$

Location of neutral axis, $\alpha = ?$

SOLUTION:

Now as we know that

$$\sigma = \sigma_x + \sigma_y \quad —①$$

$$\sigma_x = \frac{M_x y}{I_x} \quad —②$$

Now First we find the M_x

$M_x = P\cos\theta$

$\Rightarrow M_x = 4\times10^3\cos(30^\circ)$

$\Rightarrow \boxed{M_x = 3.46}\times10^3$

Now $I_x = \dfrac{bh^3}{12}$

$\Rightarrow I_x = \dfrac{0.1(0.15)^3}{12}$

$\Rightarrow \boxed{I_x = 2.8125\times10^{-5}\,m^4}$

Now Put values in equ ②

$\sigma_x = \dfrac{3.46\times0.075\times10^3}{2.8125\times10^{-5}}$

$\Rightarrow \boxed{\sigma_x = 9.237\ MNm^{-2}}$

Now

$\sigma_y = \dfrac{M_y x}{I_y}$ —③

$M_y = P\sin\theta$

$\Rightarrow M_y = 4\times10^3\sin30^\circ$

$\Rightarrow \boxed{M_y = 2000}$

Now $I_y = \dfrac{hb^3}{12}$

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

$$\Rightarrow \boxed{I_y = 1.25 \times 10^{-5}\ m^4}$$

Now Putting values in equ ③

$$\sigma_y = \frac{2000 \times 0.05}{1.25 \times 10^{-5}}$$

$$\Rightarrow \sigma_y = 8 \times 10^6$$

$$\Rightarrow \boxed{\sigma_y = 8\ MNm^{-2}}$$

Now Putting values in equ ①

$$\sigma = -\sigma_x + \sigma_y$$

$$\Rightarrow \sigma = -9.237 + 8$$

$$\Rightarrow \boxed{\sigma = -1.237\ MNm^{-2}}$$ (Compression)

Now For Neutral axis of unsymetrical Bending.

$$\tan\alpha = \frac{I_x}{I_y} \cdot \frac{M_x}{M_y}$$

$$\Rightarrow \tan\alpha = \frac{2.8125 \times 10^{-5}}{1.25 \times 10^{-5}} \times \frac{3.46 \times 10^3}{2 \times 10^3}$$

$$\Rightarrow \alpha = \tan^{-1}(3.8925)$$

$$\Rightarrow \boxed{\alpha = 75.59^\circ}$$

RESULT:

Hence $\sigma = -1.237$ (compression)

$\alpha = 75.59^\circ$

QUESTION No. 2(b)

GIVEN DATA:

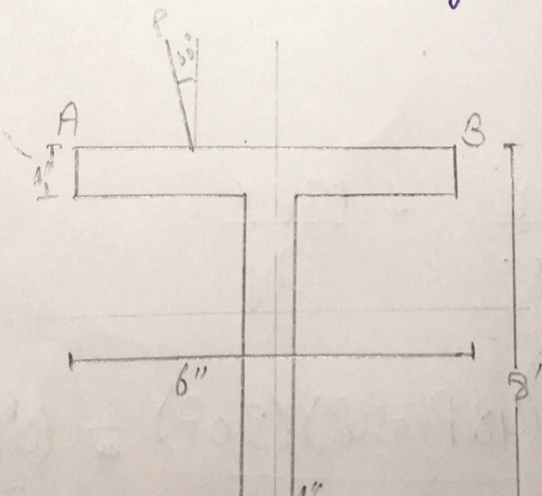
length, $L = 16ft.$

$I_x = 112.6\ in^4$

$I_y = 18.7$

Compressive Strength = 1200psi

Tensile Strength = 5000 Psi



REQUIRED DATA:

Maximom load, $P = ?$

SOLUTION:

As we know that

$$M = \frac{PL}{4}$$

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

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

Now we have to find stresses at A, B, C and D.

At POINT A:

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

$$\Rightarrow \sigma_A = -\frac{(48P\cos 60^\circ)(3.07)}{112.6} - \frac{(48P\sin 60^\circ)(3.0)}{18.7}$$

$$\Rightarrow \sigma_A = -0.654P - 6.6P$$

$$\Rightarrow \sigma_A = -7.2P \text{ (compression)}$$

& Compression $\le$ 12000 Psi

$$12000 = -7.25P$$

$$\Rightarrow \boxed{P = 1655.11 lb}$$

At POINT B:

$$\sigma_B = -\frac{(48P\cos 60°)(3.07)}{112.6} + \frac{(48P\sin 60°)(3.0)}{18.7}$$

$$\Rightarrow \sigma_B = -0.654P + 6.6P$$

$$\Rightarrow \sigma_B = 6.01P \quad (\text{Tension})$$

& Tension $\le$ 5000 Psi

$$5000 = 6.01P$$

$$\Rightarrow \boxed{P = 831.94 lb}$$

We have consider Minimum value of P.

$$\text{So } \boxed{P = 831.94 lb}$$

At Point C:

$$\sigma_C = +\frac{(48P\cos 60°)(3.07)}{112.6} + \frac{(48P\sin 60°)(3)}{18.7}$$

$\Rightarrow \sigma_C = +0.654P + 6.6P$

$\Rightarrow \sigma_C = 7.25P$ (Tension)

& Tension $\leq$ 5000 Psi

$5000 = 7.25P$

$\Rightarrow \boxed{P = 689.65\,lb}$

At Point D:

$$\sigma_D = +\frac{(48P\cos 60^\circ)(3.07)}{112.6} - \frac{(48P\sin 60^\circ)(3)}{18.7}$$

$\Rightarrow \sigma_D = +0.654P - 6.6P$

$\Rightarrow \sigma_D = -5.946P$ (Compression)

& Compression $\leq$ 12000 Psi

$\Rightarrow 12000 = -5.946P$

$\Rightarrow \boxed{P = 2018.16\,lb}$

So we have consider Minimum value of P so;

$\boxed{P = 689.65\,lb}$

QUESTION No.3

GIVEN DATA:

length, $l = 10ft$

Breath, $b = 0.75''$

height, $h = 2''$

Factor of safety $= 2$

$E = 10.3 \times 10^6$ Psi

REQUIRED DATA:

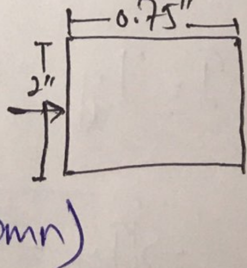
Safe load, $P_{safe} = ?$

SOLUTION:

CASE I:

Strut column act as hinged column about an axis perpendicular to the 2" dimension then

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



$l_e = L$ (For hinged ended column)

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

$$\Rightarrow P_{cr} = (1)^2 \frac{(10.3\times10^6)(0.5)(3.14)^2}{(10\times12)^2}$$

$$\Rightarrow \boxed{P_{cr} = 3526.7 lb}$$

For Psafe:

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

$$\Rightarrow P_{safe} = \frac{3526.7}{2}$$

$$\Rightarrow \boxed{P_{safe} = 1763.68 lb}$$

CASE II:

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

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

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

For Fixed ended column

$$l_e = L/2$$

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

$$\Rightarrow P_{cr} = \frac{(1)^2 (10.3\times10^6)(0.07)(3.14)^2}{(120/2)^2}$$

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

For Psafe:

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

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

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

In both cases we take smaller value of Psafe.

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