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Section :- A

ID :- 7906

Subject :- MOS — II

Date :- 23 Jun 2020

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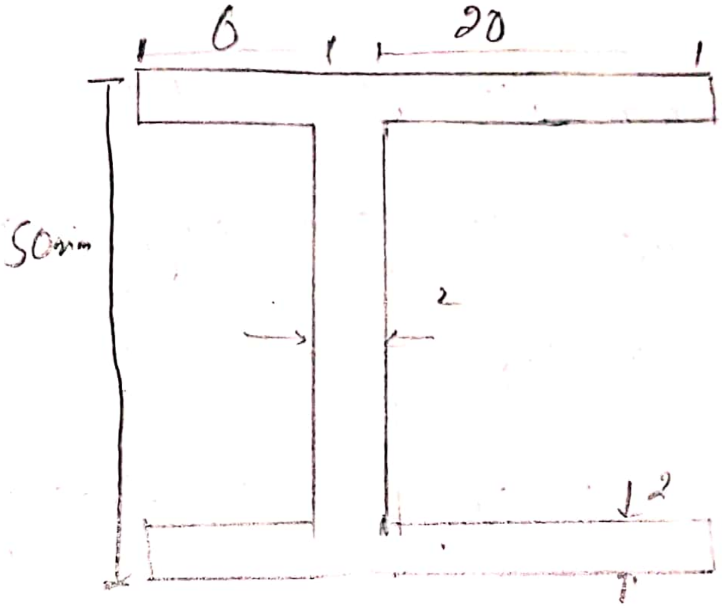
2 ⟶

(Q No 1)(CLO2)(15)

Solution:-



As Given that

Height of section = 50 mm.

Thickness = b = 20+6

b = 26 mm

So, T_f = 2mm.

Required:-

Shear Centre = ?

As we know that

For unsymmetrical members, the shear Centre is at some distance away from that geometrical center.

This distance is called eccentricity which is given as;

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

Here I = moment of Inertia and is given as

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

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

$I = 50034.66 + 20833$

$I = 70867.99 \ mm^4$

Now eq ① $\Rightarrow$

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

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

$e = 11.0234 mm$

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Shear Center is 11.0234 mm away from geometrical center.

Question # 01 part(b).

Answer:-

Given data:-

Height $= h = 20ft$

assumed diameter $= 22ft$

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

Tangential Stress $= 600 lb/ft$

Required data:-

Thickness of walls of water tank $= ?$

Solution:-

The pressure develop by water is given as

$P = \gamma h$

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

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

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

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

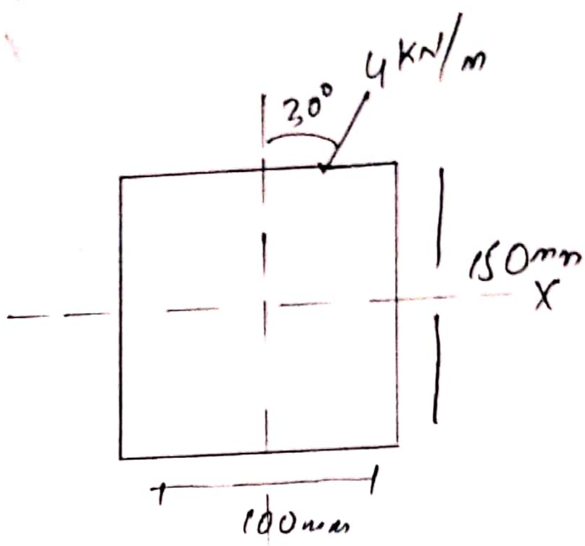
$t = \dfrac{\gamma h D}{\sigma_t \times 2}$

Put values

$t = \dfrac{\left(\frac{62.4}{(12)^3}\right) \times (26 \times 12) \times (22 \times 12)}{600 \times 2}$

$t = \dfrac{270.4}{1200} \Rightarrow \boxed{t = 0.2253''}$

Question No#02(a).



Given data:-

$b = 100mm$

$h = 150mm$

load $= P = 4 kN/m$

Length of Beam $= 3m$

Required:-

Bending Stress = ?

N.A = ?

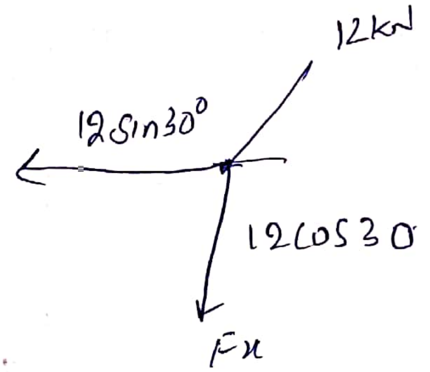
Now we know that

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

$\therefore M_z = M\cos\theta$

$M_y = M\sin\theta.$

$$\Rightarrow \delta = \frac{M\cos\theta}{I_z} + \frac{M\sin\theta}{I_y} \longrightarrow (1)$$



Now

moment about x-axis

$M_z = -11.8566 \times 3$

$M_z = -35.57$ Nm

$M_y = 1.851 \times 3$

$M_y = 5.55$ N.m.

we know.

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

$\Rightarrow M\cos\theta = M_z$

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

$M \sin\theta = M_y$

Hence eq (1) $\Rightarrow$

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

Now moment of inertia.

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

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

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

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

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eq ⓐ ⇒

$$\delta = \frac{1.851}{2.812\times10^{-5}} + \frac{-11.8563}{11.25\times10^{-6}}$$

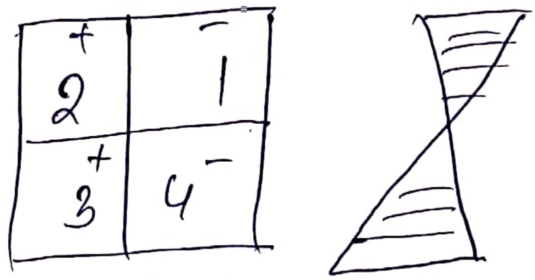
$$\boxed{\delta = 882678\ N/m^2}$$

Natral Aaxis (N.A):-

Sign convection are.

2	1
4	3

⇒ If we take compression as negative. and tension as positive, then beam is simply supported



In this case neutral axis pass 2 and 4.

Quadrant

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

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

$$\tan\alpha = \frac{2.3125\times10^{-5}}{1.25\times10^{-3}}(\tan 30^0).$$

$$\tan\alpha = 14.4124.$$

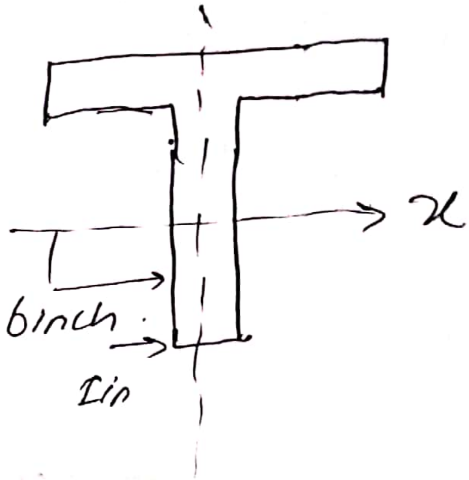
$$\alpha = \tan^{-1}(-14.4129)$$

$$\boxed{\alpha = 1^0 30' 5''}$$

Question #02(b).

Solution:

Given data:



Length of beam

$L = 16ft$

$I_x = 112.6 in^4$

$I_y = 18.7 in^4$

$\delta_c = 12000 psi$

$\delta_t = 6000 psi$

From given figure the maximum compression would occur on "a" and maximum tension at B.

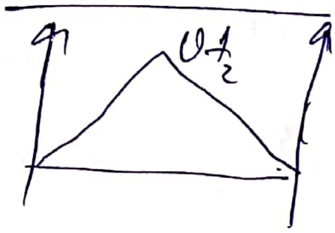
The tension and Compression will reduce the effect of each other so stress should be calculated at 'A' and 'C'.

So, $$\delta_A = \frac{m_x y}{I_x} + \frac{m_y x}{I_y} \text{ (Compression)}$$

$$\delta_C = \frac{m_x y}{I_x} + \frac{m_y x}{I_y} \text{ (Tension).}$$

So, $$m_x = \frac{P\cos(60^\circ)(16\times12)}{4}.$$

$$\boxed{m_x = 48\cos 60^\circ}$$



$$m_y = \frac{P\sin(60^\circ)(16\times12)}{4}$$

$$\boxed{My = 48 \cdot \sin 60^\circ}$$

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

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

$$P = 1638.626$$

and

$$\delta_C = \frac{Mxy}{Iz} + \frac{Myx}{Iy}$$

$$5000 = \frac{48 P \cos 60^\circ \times (595)}{18.7}$$

$$\Rightarrow P = 2104.916$$

So, the maximum load 'P' which can be applied should not be greater than 1638.626.

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QUESTION #03

Given data:-

length = 10ft

$E = 10.3 \times 10^6$

$b = 0.75$

$h = 2$

Factor of Safty = 2.

Required:

a) Safe load at hinged = ?

b) Safe load at Fixed = ?

Solution:

a) For hinged Column.

$l_e = L$

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

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

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

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

$$P \text{ safe load} = \frac{P_{cr}}{\text{Factor of safty}} = \frac{3526176}{2} = 1763.088\,lb$$

Strut at column :-

$l_e = L/2$ (For Fixed ended)

(17)

$$Le = \frac{10}{2} = 5ft$$

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

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

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

$$Pcr = 1974.6532 lb$$

$$P_{safe\ load} = \frac{1974.652}{2}$$

$$P_{safe\ load} = 987.32\ lb$$