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Subject :- MOSII - Theory

Program :- (BEC)

Exam :- Final Terms

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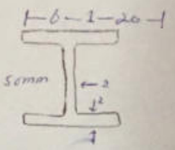
→ Question # 01 page # 1

→ Part # (a)

→




→ Requider

location of share center:

→ Sol

As we know that

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

and

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

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

$$I = 50034.66 + 20833$$

$$I = 70867.99\,mm^4$$

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

→ So sheare center $e = 11.02\,mm$.

Question # 1

Part # (b)

* Data:-

⇒ H = 26 ft

⇒ I assume diameter

D = 22 ft

⇒ Tangential stress = 600 lb/ft²

⇒ Specific weight of water tank = 62.4 lb/ft³

we have to find the thickness = ?

③

*Solution:-*

The pressure develope by water

$= P = \gamma h$

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

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

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

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

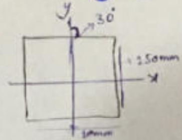
$t = \frac{\left(\frac{62.4}{(12)^3}\right) \times (26 \times 12) \times (22 \times 12)}{6000 \times 2}$

$t = 0.24$

⊛ Question # 02

⊛ Part # (a)

⊛ Diagram :-




⊛ Momount of Inertia:-

$I_z = \frac{bh^3}{12} = \frac{0.15\,(2.1)^3}{12} = I_z = 2.8126\times10^{-5}$

Now $I_y = \frac{bh^3}{12} = \frac{0.15\,(2.1)^3}{12}$

$I_y = 1.25\times10^{-5}$

$\sigma = \frac{M_z y}{I_z} + \frac{M_y z}{I_y}$

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

where

$m = \cos\alpha = P\cos\theta = m_z$

$= 12\cos 30° = m_z$

$m_z = 1.8510$

$m\sin\theta = P\sin\theta = m_y$

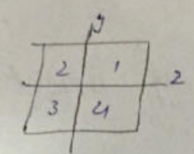
$m_y = 12\sin 30$

$m_y = -11.8563$

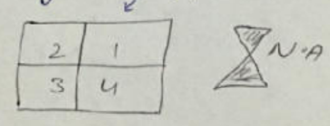
$\sigma = \left(\frac{mz}{Iz}\right) + \left(\frac{my}{Iy}\right)$

$\sigma = \frac{1.851}{2.812\times10^{-5}} + \left(\frac{-11.8563}{1.25\times10^{-5}}\right) = \frac{882678}{N/m^2}$

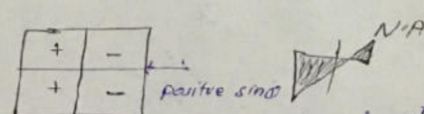
Sign convention




→ If we take compression as negative and tension as a positive and the beam is a simply supported plase.




Quadrant 1,2 -ve.
Quadrant 3,4 +ve




Quadrant 1, 4 -ve
Quadrant 2, 3 +ve

→ was of un symetrical loading the neutral axis rus of an angle of 'α' of the principal axis and the algabric sum of stress at N.A is zero.

$$\sigma = \frac{m\cos\theta y}{I_z} + \frac{m\sin\theta z}{I_y} \rightarrow (i)$$

→ In this case, N.A passes through 2, 4, 30

$$\sigma = \frac{m\cos\theta}{I} y + \frac{m\sin\theta z}{I_y}$$

→ let consider a point A on N.A lies in Quadrants, where,

- Bending stress due to P case is compressles

→ (x) Bending and stress due to $P \sin\phi$ is tensile

$$eq(i) \Rightarrow 0 = -\frac{m\cos\phi\, y_A}{I_z} + \frac{m\sin\phi}{I_y} z_A$$

$$\rightarrow 0 = \frac{-m\cos\phi\, y_A}{I_z} + \frac{m\sin\phi}{I_y} z_A$$

$$\rightarrow 0 = \frac{m\cos\phi\, y_A}{I_z} + \frac{m\sin\phi}{I_y} z_A$$

$$\Rightarrow \frac{y_A}{z_A} = \frac{I_z}{I_y}\frac{\sin\phi}{\cos\phi} \Rightarrow \tan\alpha = \frac{I_z}{I_y}\tan\phi \quad (ii)$$

Now put values of $I_z$, $I_y$ and $\phi$ in eq (ii)

$$\tan\alpha = \frac{I_z}{I_y}\tan 30$$

$$\Rightarrow \tan\alpha = \frac{3\cdot 8125\times 10^{-5}}{1\cdot 25\times 10^{-5}}\tan 30^\circ$$

(8)

(6)

$\longrightarrow$ $\tan\alpha = -14.4129$

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

$\alpha = 1.5^{\circ}$

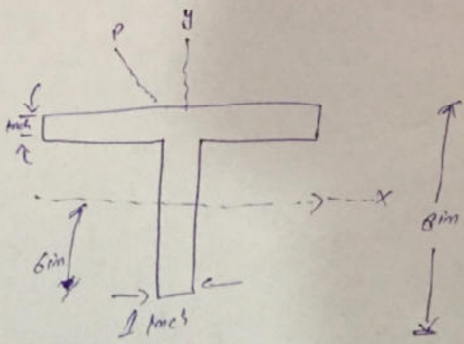
$\alpha = 1^{\circ}30'5''$

Q #02 (9)

part B''

Ans:-

Given data:




$l = 16 ft$

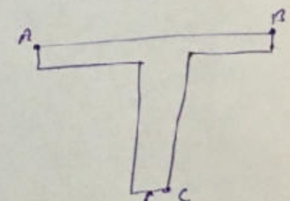
$I_x = 112.6 in^4$

$I_y = 18.7 in^4$

$\sigma_c = 12000 psi$

$\sigma_t = 5000 psi$

Sol:- By looking to the figure we can judge that maximum compression would occur on A so maximum tension at pt C at B there will be tension as were as compression which will reduced the effect of each other so we will calculate stresses.



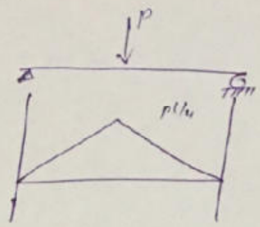

At A & C

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

$\sigma_C = M_x y / I_x + M_y x / I_y$ (Tension)

(b)

Now $m_x$ & $m_y$




so

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

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

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

$$m_y = 48P\sin 60$$

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 equations

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

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

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

So the maximum load P applied should be 1638.6 lb

Q #03 (11)

Ans:-

Given data:-

length $l = 10ft$

As both side are hinged

so, $le = l$

$E = 10.3 \times 10^6$

Factor of safety = 2

$b = 0.75$ inch

$h = 2$ inch.

Req:- Determine safe load. ?.

Sol:- As

$$Pcr = \frac{\pi^2 EI}{le^2}$$

As we know that.

$I = Ar^2$

$r = \sqrt{I/A}$

$$r = \sqrt{\frac{hb^3}{12} / bh} = \sqrt{b^2/12}$$

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

$r = 0.216$ inch

$$P_{cr} = \frac{\pi^2 EA}{(le/r)^2}$$

$$= \frac{(3.14)^2 (10.3\times10^6)(1.5)}{(10/0.216)^2}$$

$P_{cr} = 853.8343$

$$\text{safe load} = \frac{\text{Crippling load}}{\text{factor of safety}}$$

$$\Rightarrow \frac{853.8343}{2}$$

safe load = 426.917

For fixed ended column

$le = l/2 = 10/2$

$le = 5ft$

$$P_{cr} = \frac{\pi^2 EA}{(le/r)^2} = \frac{(3.14)^2 \times (10.3\times10^6)(1.5)}{10/(0.216)^2}$$

(13)

$$\boxed{P_{cr} = 1974.207}$$

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

$$= \frac{1974.207}{2}$$

$$\boxed{= 987.103}$$