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PAPER :- MOS II

SUBMITTED TO :-

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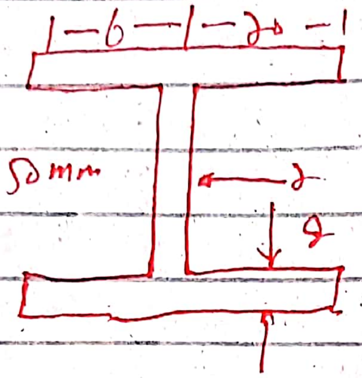
Pg (1)

Q No: 1 (a)



Required location of Shear Centre

Sol: As we know that

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

and

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

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

$$I = 50084.66 + 20833$$

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

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

So Shear Center $\boxed{e = 11.02\,mm}$

Q No 4 part (b)

Given data

⇒ $H = 26\,ft$

→ assume diameter

$D = 22\,ft$

→ tangential stress = 600 lb/ft²

→ specific weight of water tank

tank = 62.4 lb/ft²

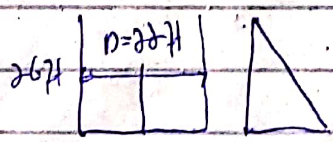
we have to find thickness = ?

Solution:

the pressure develop by water

$P = \gamma h$

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



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

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

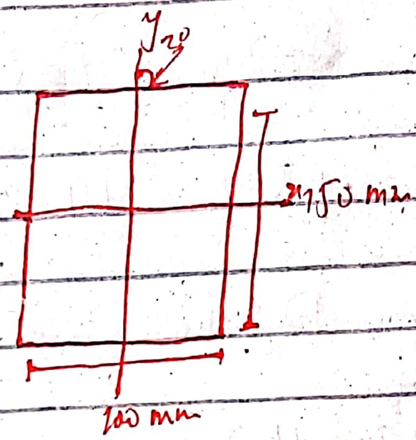
$$2t = \frac{\gamma h l}{\sigma_t}$$

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

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

$$\boxed{t = 0.24''}$$

Q No. 2(a)



Moment of inertia

$$I_z = \frac{bh^3}{12} = \frac{0.1(0.15)^3}{12} = 2.8125 \times 10^{-5}$$

Now

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

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

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

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

Where

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

$$= 12\cos 60^\circ = M_z$$

$Mz = \cancel{1.0851} \; 1.2510$

$M\sin\theta = P\sin\theta = My$

$My = 12\sin b0$

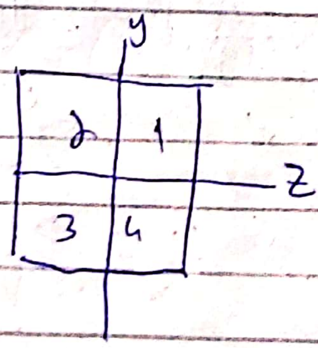
$My = -11.8563$

$$\sigma = \left(\frac{Mz}{Iz}\right) + \left(\frac{My}{Iy}\right)$$

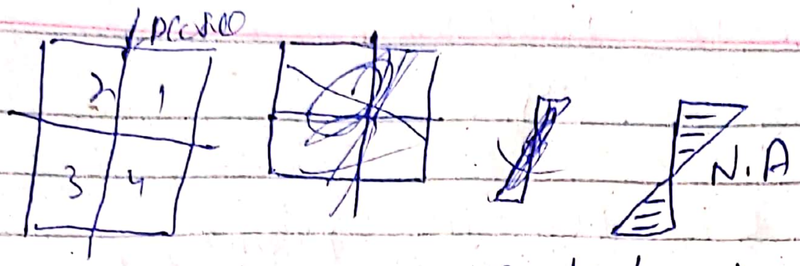
$$\sigma = \frac{1.851}{2.812\times10^{-5}} + \left(\frac{-11.8563}{1.25\times10^{-5}}\right) =$$

$82678 \; N/m^2$

Sign Convention

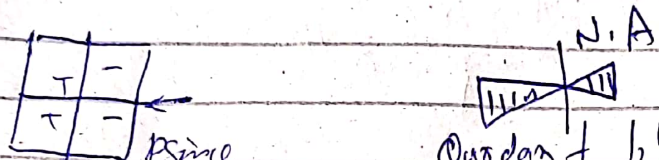


If we compression as negative and tension as possitive and beam in a simply supported



Quadrant 1, 2 -ve

Quadrant 3, 4 +ve



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

Case of Un-symmetrical loading
the neutral axis line of an angle of to the principal axis and the algebraic sum of stress at N.A is zero.

$$\sigma = \frac{M\cos\theta y}{I_z} + \frac{M\sin\theta z}{I_y} \quad \text{--- (1)}$$

in the case N.A passes through 3, 4, 2, 1

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

let consider point "A" on N.A lies quadrant 2,
where Bending stress due to $P\cos\theta$ is compressive
Bending and stress due to $P\sin\theta$ is Tensile
eq (1) $\Rightarrow$ $0 = -\frac{M\cos\theta\, y_A}{I_z} + \frac{M\sin\theta}{I_y} z_A$

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

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

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

$$\frac{y_A}{z_A} = \frac{I_z}{I_y}\,\frac{\sin\theta}{\cos\theta} = \tan\alpha\ \frac{I_z}{I_y}\tan\theta \rightarrow (1c)$$

Now put value of I_z, I_y and θ in eq (1c)

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

$$\tan\alpha = -14.4129$$

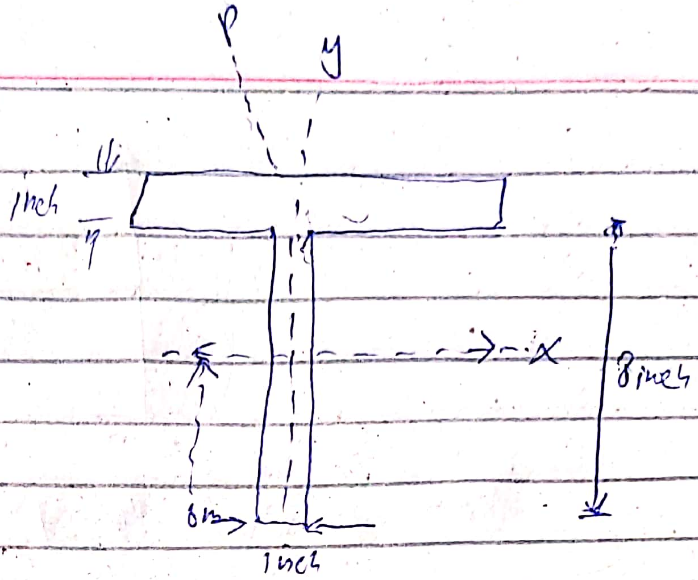
$$\alpha = \tan^{-1}(1-4.4129)$$

$$\alpha = 1.5^\circ$$

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

Q No. 2 (b)

Given data



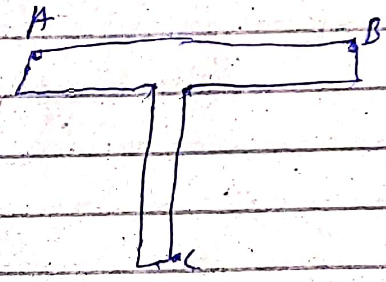
$L = 16\,ft$

$I_x = 112.6\ in^4$

$I_y = 18.7\ in^4$

$\sigma_c = 12000\ psi$

$\sigma_t = 5000\ psi$



Sol

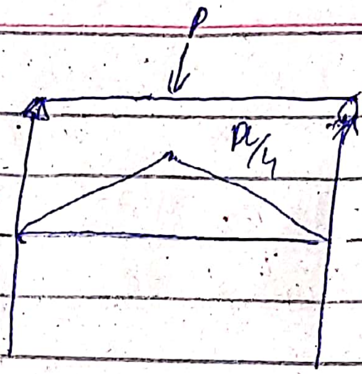
By looking to the fig we can judge that maximum Compression would occur on A and maximum tension at C at B there will be tension as were as Compression which will reduce the effect of each other so we will calculate Stress at A and C

so

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

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

Now M_x and M_y



So

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

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

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

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

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 equation

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

Now

$$\sigma c = \frac{Mxy}{Ix} + \frac{Myx}{Iy}$$

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

Solving the equation

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

So the maximum load P applied should be 1638.6 lb

Q3

Given data

length $l = 10ft$

As both side are hinged

So

$l_e = L$

$E = 10.3 \times 10^6$

Factor of Safety $= 2$

$b = 0.75$ inch

$h = 2$ inch

Required

Determine Safe load $= ?$

Sol:

As

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

As we know that $I = Ar^2$

$$I = Ar^2$$

$$r = \sqrt{I/A}$$

$$r = \sqrt{\frac{hb^3}{12 \cancel{b}h}} = \sqrt{\frac{b^2}{12}}$$

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

$\boxed{r = 0.916 \text{ inch}}$

$$P_{cr} = \frac{\pi^2 E A}{(l_e/r)^2}$$

$$\Rightarrow \frac{(3.14)^2 (10.3\times10^6)(1.5)}{(10/\cancel{0.9376}\ 0.4216)^2}$$

$\boxed{P_{cr} = 853.8343}$

$$\text{Safe load} = \frac{\text{Crippling load}}{\text{Factor of Saftey}}$$

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

$\boxed{\text{Safe load } 426.917}$

For fixed ended Column

$$l_e = L/2 = 10/2$$

$\boxed{l_e = 5ft}$

$$P_{cr} = \frac{\pi E A}{\left(\frac{le}{r}\right)^2}$$

$$= \frac{(3.14) \times (10.3 \times 10^6)(1.5)}{\left(\frac{60}{02.16}\right)^2}$$

$$\boxed{P_{cr} = 1974.2077}$$

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

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

S.L $= \boxed{987.103}$