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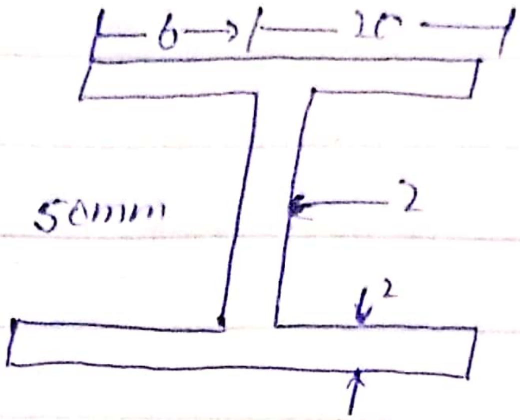
Subject	MOS 2
Date	23 June 2020
Section	A

(1)

Question 1 (A)



Required of location of Shear Center

Solution As we know

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

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

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

$I = 50034.66 + 20833$

$I = 70867.99\ mm^4$

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

So shear center $= e = 11.02mm$

(2)

Question 1 (B)

Data

$H = 26\,ft$

I assume diameter
$D = 22\,ft$
tangential stress $= 600\,lb/ft^2$

Specific weight of water
tank $= 62.4\,lb\,ft^2$
we have to find the
thickness = ?

Solution

The pressure develop by water $= p = \gamma h$

$$ft = \frac{PD}{2t}$$

$$\sigma_t = \frac{PD}{2t} = \frac{\gamma LD}{2t}$$

$$2t \times \sigma_t = \gamma LD$$

$$2t = \frac{\gamma LD}{\sigma_t}$$

$$t = \frac{\gamma LD}{\sigma_t \times 2}$$

$$t = \frac{\dfrac{(62.4) \times 2 (6 \times 12) \times (22 \times 12)}{(12)^3}}{6000 \times 2}$$

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

Question 2 (A) (4)

Moment of inertia

$$I_z = \frac{bh^3}{12} = \frac{0.1\ (0.15)^3}{2} = I_z = 2.8125\times10$$

Now

$$I_y = \frac{hb^3}{12} = 0.15\ (0.1)^2$$

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

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

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

Where

$$M = \cos\theta = p\cos\theta = M_z$$

$$= 18\cos 0^\circ = M_z$$

$$M\sin\theta = p\sin\theta = M_y$$

$$M_y = 12\sin 30$$

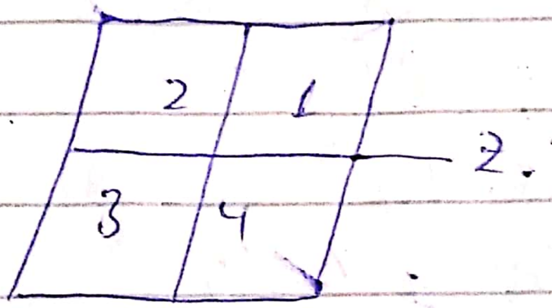
$$M_y = -11.8563$$

$$\sigma = \left(\frac{M_z}{I_z}\right) + \left(\frac{M_y}{I_y}\right)$$

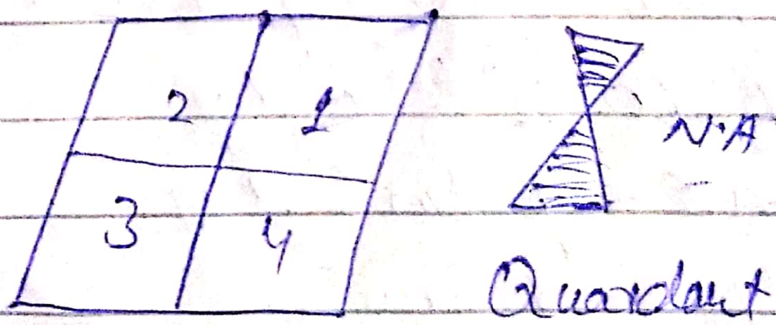
$$\sigma = \frac{1.852}{2.812\times10^{-5}} + \left(\frac{-11.0563}{1.25\times10^{-5}}\right)$$

$= 882678\ Nm^2$

σ convention



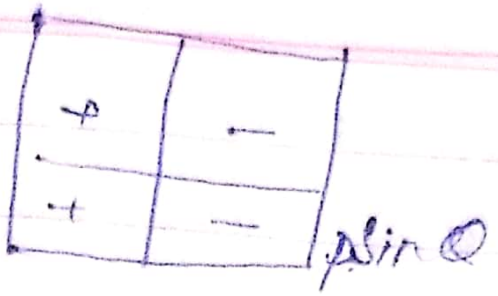
if we take compression as negative and tension as positive and the beam is a simply supported:

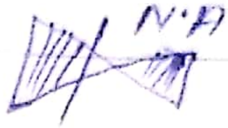


Quadrant 1, 2 -ive

Quadrant 3, 4 +ive

(6)





Quardant 1, 4 -ive
Quardant 2, 3 +ive

In case of unsymatrical loading the neutral axis lies of an angle of α the principle axis and the aljebric sum of stress at N·A is zero.

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

in this case N·A passes through 2, 4

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

Let consider a point A on N·A lies in Quardant 2.

Bending stress due to
pcosθ is compressive
and
Bending stress due to
psinθ is tensile.

equation (i)

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

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

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

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

Now put the value of I_z, I_y and (i) and eq (ii)

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

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

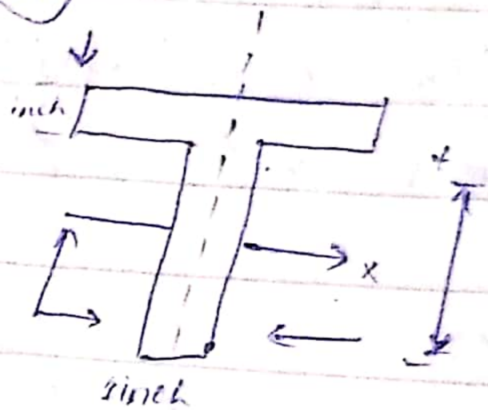
$$\tan\alpha = -14.4129$$

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

$$\alpha = 1.5^\circ$$

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

Question 2
part B
Given Data



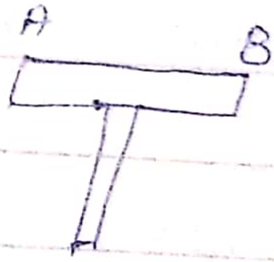
$L = 16 ft$

$I_x = 112.6 inch^4$

$I_y = 18.7 in^4$

$S_c = 12000 psi$

$S_t = 5000 psi$



Solution

By looking figure we can judge that maximum compression would accure on a and maximum tension

C at B. these will tension as well a compression which will reduce that effect of each other. So we will calculate stress at A and C

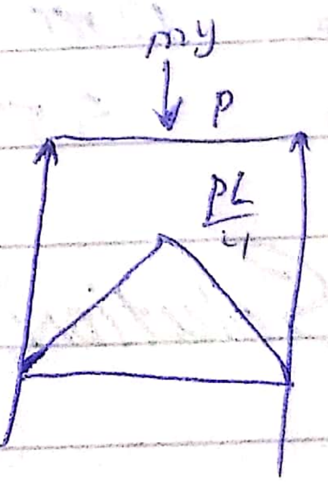
So

$$S_A = \frac{M_x y}{I_x} + \frac{M_y x}{I_y} \text{ comp}$$

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

Now Mx and

So



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

$$M_x = 48 p\cos 60$$

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

$M_y = 48p\sin 60$

Now

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

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

Solving the equation

$$\boxed{p = 1638.6\,lb}$$

Now

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

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

Solving the equation

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$$\boxed{P = 2204.916}$$

(13)

Q No 3

Given data

Lenght "L" = 10 ft

As: both sicks are good

so $Le = L$

$E = 10.3 \times 10^6$

Faster of safety = 2

$b = 0.75$ inch

$h = 2$ inch

Required data

Determine safe load?

Solution

As

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

As we know that = $I = Ar^2$

$I = Ar^2$

$r = \sqrt{I/A}$

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

$$\boxed{r = 0.216 \text{ inch}}$$

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

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

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

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

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

Safe Load $\Rightarrow$ 426.917

For fixed ended column

$Le = L/2 = 10/2$

$Le = 5\,ft$

$P_{cr} = \frac{\pi^2 EA}{(Le/r)^2} \Rightarrow \frac{(3.14)^2 \times 10.3 \times 10^{6} (1.5)}{(60/2.16)^2}$

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

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

$\frac{1974.207}{2} = \boxed{987.103}$