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ID ‡ 7933

Section ‡ B

Dept ‡ Civil

Sub ‡ MOS 2

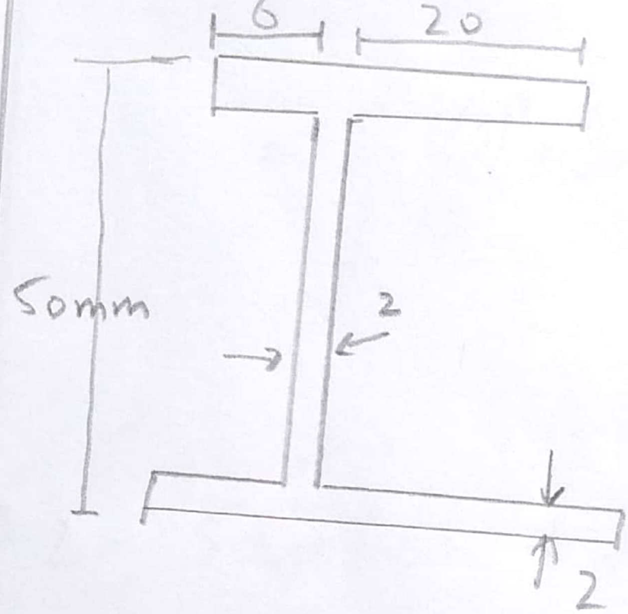
Semister ‡ 4th

Final exam ‡ Paper

(1)

Question No # (1)

Part (a)



Required :-

location of Shear centre

Sol:-

As we know that

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

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(2)

and

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

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

$$I = 50034.66 + 20833$$

$$I = 70867.99\ mm^4$$

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

So Shear centre $\boxed{e = 11.02\ mm}$

(1)

Question No 1
Part (b)

Data:

=> $H = 26$ ft

=> I assume diameter = $D = 22$ ft

=> tangential stress = 600 lb/ft^3

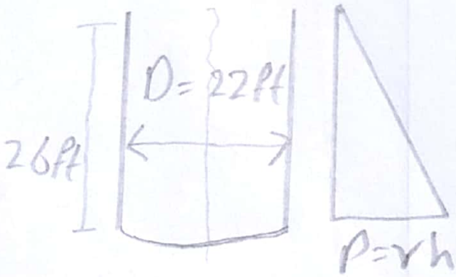
=> Specific weight of water tank = 62.4 lb/ft^3

We have to find the thickness = ?

Solution:

The pressure develope by water $= P = \gamma h$

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



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

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

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

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

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

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

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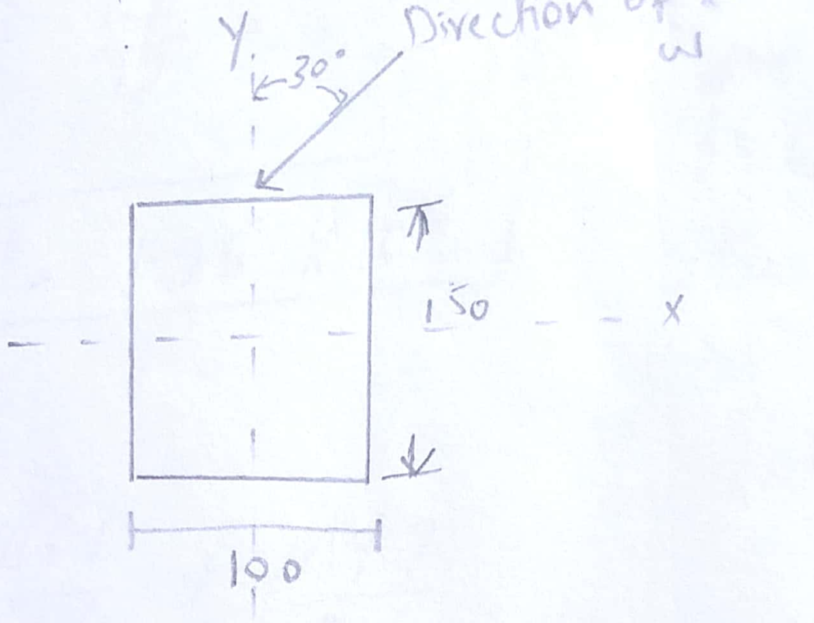
Question No = (2)

Part = (a)

Sol:



Moment of inertia:

$$I_z = \frac{bh^3}{12} =$$

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

$$\boxed{I_z = 2.8125 \times 10^{-5}}$$

(2)

Now

$$I_Y = \frac{hb^3}{12} \Rightarrow \frac{0.15(0.1)^3}{12}$$

$$\boxed{I_Y = 1.25 \times 10^{-5}}$$

$$\sigma = \frac{M_Z Y}{I_Z} + \frac{M_Y \cdot Z}{I_Y}$$

$$\sigma = \frac{M \cos\phi}{I_Z} + \frac{M \sin\theta}{I_Y}$$

Where

$$M = \cos\theta = P\cos\phi = M \cdot Z$$

$$\Rightarrow 12 \cos 30^\circ = M_Z$$

$$\boxed{M_Z = 1.851}$$

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(3)

$$M \sin \phi = P \sin \phi = M_Y$$

$$M_Y = 12 \sin 30$$

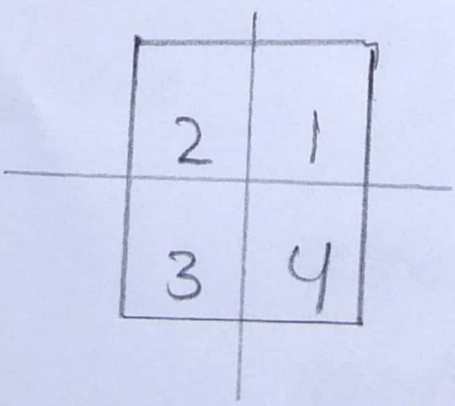
$$\boxed{M_Y = -11.8563}$$

$$\sigma = \left(\frac{M_Z}{I_Z}\right) + \left(\frac{M_Y}{I_Y}\right)$$

$$\sigma = \frac{1.851}{2.812 \times 10^{-5}} + \frac{(-11.8563)}{1.25 \times 10^{-5}}$$

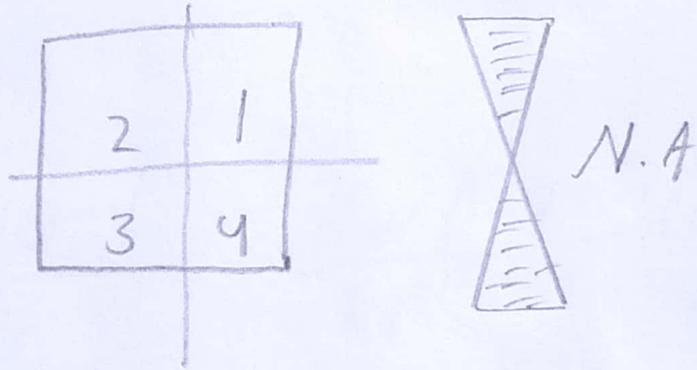
$$\boxed{\sigma = 882628 \ Nm^2}$$

Sign Convention



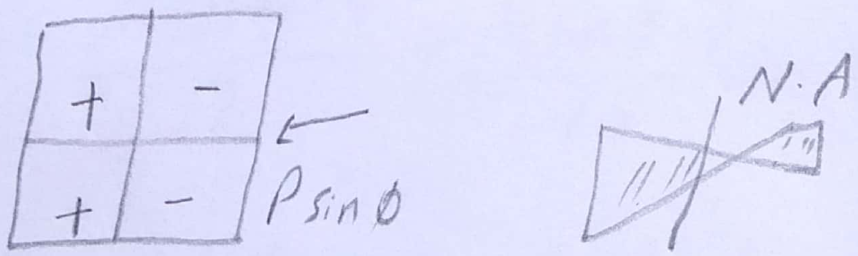
(4)

If we take compression is negative and tension is positive and the beam is a simply supported



quadrant 1, 2 negativ (−)

quadrant 3, 4 positive (+)



qudrant 1, 4 (−)

quadrant 2,3 (+)

(6)

(5)

In case of unsymmetrical loading in N.A lies of an angle of "α" the Principle axis and the algebric Sum of the stress at N.A is Zero

$$6 = \frac{M\cos\phi - Y}{IZ} + \frac{M\sin\phi - Z}{IY} \rightarrow (1)$$

In this case N.A Passes throgh 2, 4

$$6 = \frac{M\cos\phi \cdot Y}{IZ} + \frac{M\sin\phi \cdot Z}{IY}$$

Let consider a Point "A" on N.A lins on quadrant 2, where

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(6)

$\Rightarrow$ Bending stress due $P\cos\phi$ is compressive

$\Rightarrow$ Bending stress due to $P\sin\phi$ is tensile

$$eq\ 1 \Rightarrow 0 = -\frac{M\cos y_A}{I_Z} + \frac{M\sin\phi\ Z_A}{I_Y}$$

$$\Rightarrow \frac{M\cos y_A}{I_Z} + \frac{M\sin\phi}{I_Y} Z_A$$

$$\frac{y_A}{Z_A} = \frac{I_Z \sin\phi}{I_Y \cos\phi}$$

$$\Rightarrow \tan\alpha = \frac{I_Z}{I_Y} \tan\theta \rightarrow 11$$

Now put value of I_Z, I_Y and ϕ in eq 11

(7)

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

$$\Rightarrow \tan\alpha = \frac{2.815\times10^{-5}}{1.25\times10^{-5}}\times(\tan 30^\circ)$$

$$\tan\alpha = -14.4129$$

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

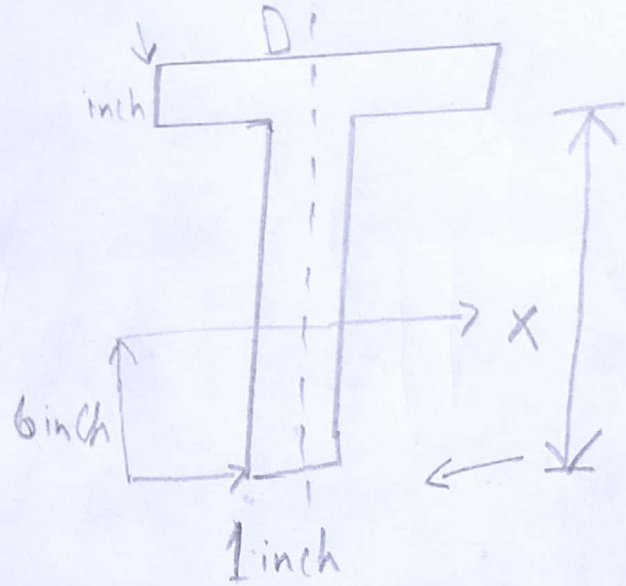
$$\alpha = 1.5^\circ$$

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

(1)

Question No = 2

Part = (b)



Data:

$L = 16\ ft$

$I_x = 112.6\ inch^4$

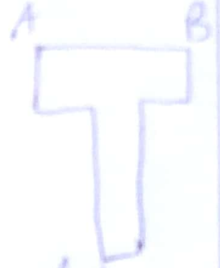
$I_y = 18.7\ in^4$

$S_e = 12000\ Psi$

$S_t = 5000\ Psi$

(2)

By looking fig



We can judge that maximum compression would occur and max tension c at B. These will tension as well as compression which will reduced that effect of each other.

So we will calculate stress at A and C

So =

$$S_A = \frac{M_x Y}{I_x} + \frac{M_y x}{I_y} \text{ Comp}$$

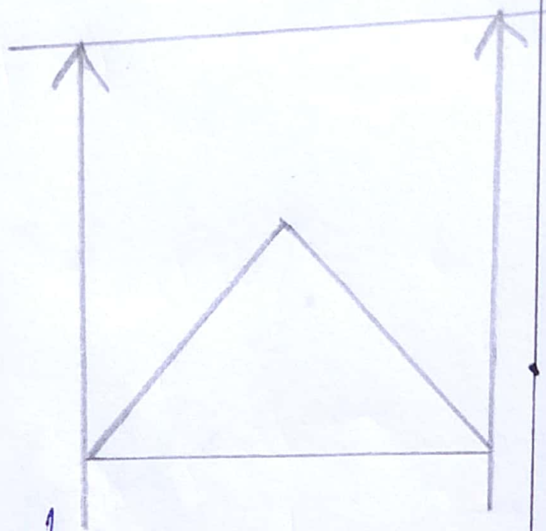
$$S_C = \frac{M_x Y}{I_x} + \frac{M_y x}{I_Y} \text{ (Ten)}$$

(3)

Now M_x and M_y

So

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



$$M_x = 48\,P\cos 60$$

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

$$M_y = 48\,P\,\sin 60$$

Now

$$S.A = \frac{M_x y}{I_x} + \frac{M_y x}{I_y}$$

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(4)

$$12000 = \frac{48P\cos 60^\circ \times 3.07}{112.6} + \frac{48P\sin 60^\circ \times 3}{18.7}$$

Solving the equation

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

Now

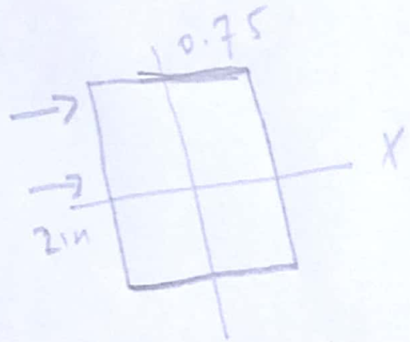
$$S_C = \frac{M_x y}{I_x} + \frac{M_y x}{I_y}$$

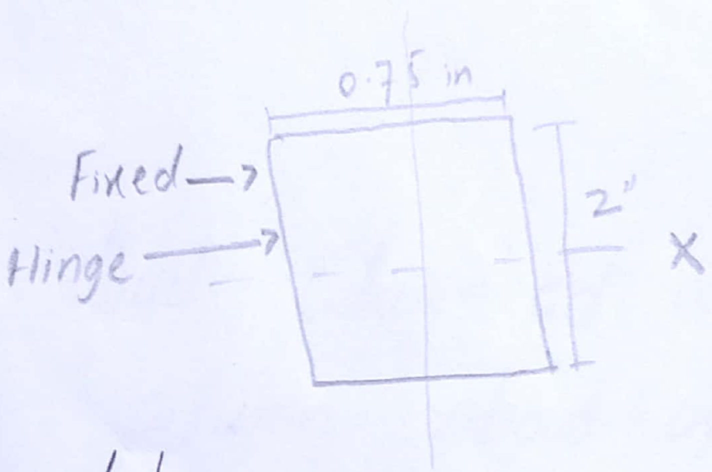
$$5000 = 48P\cos 60 \times 5.93 + \frac{48P\sin 6 \times 0.5}{18.7}$$

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

(1)

Question No # 3





Given data:

Lenth = L = 10 ft

Bredth = b = 0.75"

height = h = 2"

factor of Safety = 2

$E = 10.3 \times 10^6$

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(2) Req data

Safe load = P Safe = ?

Sol:

Case I:

Strut column act as a hinged column about an axis Perpendicular to the 2inch dimension then

$$I = I_X = (3/4)(2)^3 = 0.5 \text{ in}^4$$

$l_e = l$ (for hinged ended column)

(3)

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

$$P_{cr} = \frac{(1)^2 (10.3 \times 10^6)(0.5)(3.14)^2}{(10 \times 12)^2}$$

$$\Rightarrow \boxed{P_{cr} = 3526.17}$$

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

$$P_{safe} = \frac{3526.17}{2}$$

$$\boxed{P_{safe} \doteq 1763.08\ lb}$$

(4)

Case II

Column act as a fixed end about axis Parrallel to 2in i.e Y axis

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

$$I_Y = 0.07 \text{ in}^4$$

Now for fixed ended

$$L_e = L/2$$

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

$$P_{cr} = \frac{(1)^2(10.3 \times 10^6)(0.07)(3.14)^2}{(120/2)^2}$$

(5)

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

For P_{safe}

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

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

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

In both case we take smaller of P_{safe}

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