Name: MUHAMMAD Sulaiman

ID: 7925 Section: A

Subject: MOS II

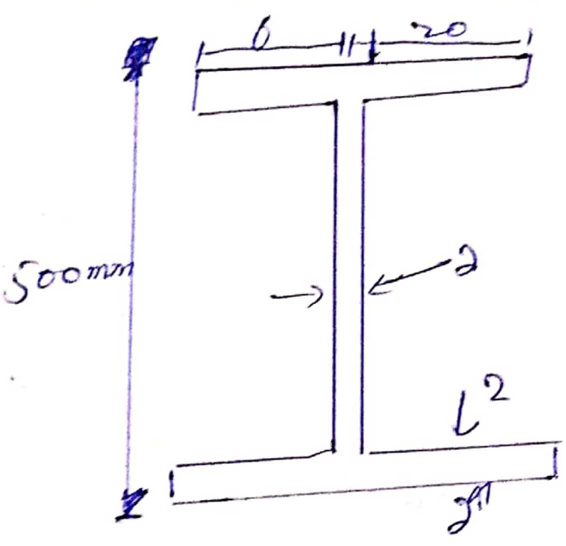
Semester: 4th final Spring ~~Ex~~ paper

Degree: BE Civil

Instructor: Engr. Saqib Shah

Date: 23 June 2020

Q# 1 Part A



Required Location of Shere Center:

Solution:

As we Know that

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

and:

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

① ②

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

$$I = 50034.66 + 20833$$

$$I = 70867.99\ mm^4$$

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

So shear Center $\boxed{e = 11.02mm}$

Question #1 part b

Data

=> $H = 26\ ft$

=> ~~g~~ assume the diameter

$D = 22\ ft$

=> tangential stress $= 600\ lb/ft$

=> specific weight of water tank

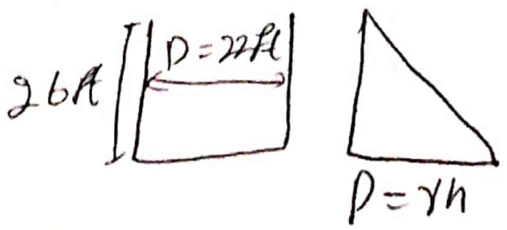
$= 62.4\ lb/ft^3$

we have to find the thickness = ?

Solution::

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

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



$$\sigma t = \frac{PD}{2t} = \frac{\gamma h D}{2t}$$ (4)

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

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

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

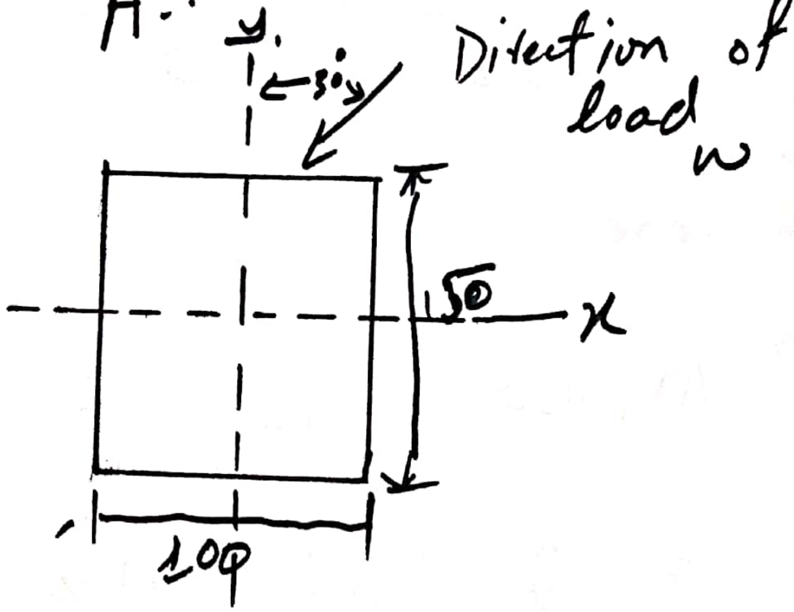
$$t = \frac{\frac{(62.4) \times (26 \times 12)}{(12)^3} \times 22 \times 12}{600 \times 2}$$

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

Scanned with CamScanner

Q# 2 part A::

Solution::



Moment of Inertia

$$I_z = \frac{bh^3}{12} = 0.1\frac{(0.15)^3}{12} = I_z = 2.8125\times10^{-5}$$

Now

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

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

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

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

where

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

$= 12 \cos 30^\circ = M_z$

$M_z = 1.8510$

$M \sin\theta = P \sin\theta^{30} = M_y$

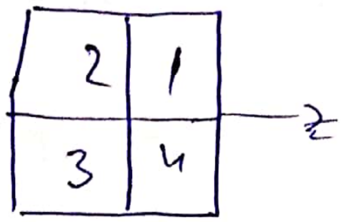
$M_y = 12 \sin$

$M_y = -11.8563$

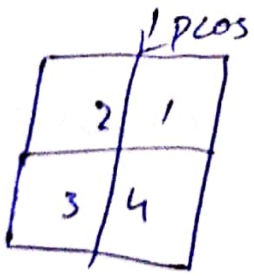
$$\sigma = \left(\frac{M_z}{I_z}\right) + \left(\frac{M_y}{I_y}\right)$$

$$\sigma = \frac{1.881}{2.812 \times 10^{-5}} + \left(\frac{-11.8563}{1.25 \times 10^{-5}}\right) = 882628 \ Nm^{2}$$

Sign converting

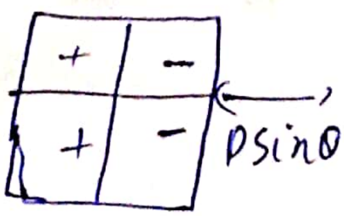


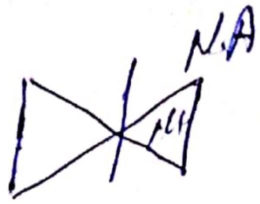
if we take compression as negative and tension as positive and the beam is a simple supported



Quadrant 1,2 – ive

Quadrant 3.4 +ive





8

Quadrant 1,4 -ive

Qudrant 2,3 +ive

In case of an Symetrical loading the Neuttral axis lies of an angle of "α" the principle axis and the algeblic Sum of stress at N.A is zero

$$\sigma = \frac{M\cos\theta}{I_{\cancel{z}}} y + \frac{M\sin\theta}{I_y} z \longrightarrow (1)$$

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 point A on N.A lies in Quadrant where

- Bending stress due to $P\cos\theta$ is compressive

- Bending ~~stress~~ and stress due to $P\sin\theta$ is tensile

eq (1) $\Rightarrow$ $0 = \frac{-M\cos Y_A}{I_Z} + \frac{M\sin\theta}{I_Y} Z_A$

$\Rightarrow 0 = \frac{-M\cos\theta}{I_Z} Y_A + \frac{M\sin\theta}{I_Y} Z_A$

$\Rightarrow \frac{M\cos\theta\, Y_A}{I_Z} + \frac{M\sin\theta}{I_Y} Z_A$

$\frac{Y_A}{Z_A} = \frac{I_Z}{I_Y} \frac{\sin\theta}{\cos\theta} \Rightarrow \tan\alpha = \frac{I_Z}{I_Y}\tan\theta$ (ii)

Now put the value of I_Z, I_Y, and θ in eq (ii)

Scanned with CamScanner

Ou $\tan\alpha = \frac{Iz}{Iy} \tan 30$

$\Rightarrow \tan\alpha = \frac{2.8125 \times 10^{-5}}{1.25 \times 10^{-5}} (\tan 30^\circ)$

$\Rightarrow \tan\alpha = -14.4129$

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

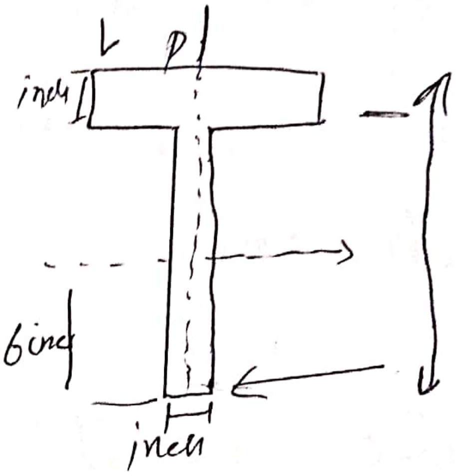
$\alpha = 1.5^\circ$

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

Question # 2

part B

Given



$L = 16 ft$

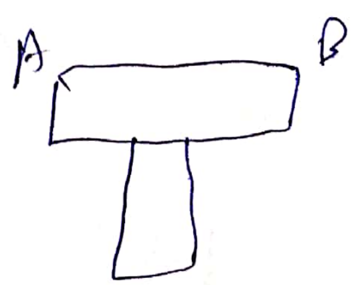
$I_x = 112.6 inch^4$

$I_y = 18.7 in^4$

$\delta_c = 12000 \ psi$

$\delta_t = 5000 \ psi$

Solution :



By Looking figure we

we can Judge that maximum compression would

~~occ~~ occure on a and maximum tension C at B. There will tension as well a compression which ~~effered~~ effect of each other

So we will calculate stress at A and C

So

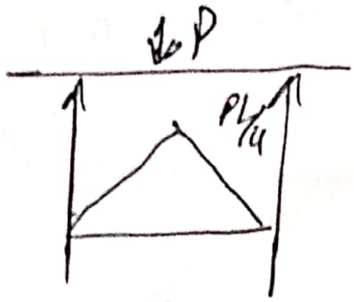
$$\delta A = \frac{M_x y}{I_x} + \frac{M_y x}{I_y} \text{ (compression)}$$

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

Now M_x and M_y

So

$$Mx = \frac{p\cos 60 \times (16 \times 12)}{4}$$



$$\boxed{Mx = 48\, p\cos 60}$$

$$My = \frac{p \sin 60 \,(16 \times 12)}{4}$$

$$\boxed{My = 48\, p \sin 60}$$

Now

$$\delta A = \frac{Mxy}{Ix} + \frac{Myx}{Iy}$$

I_y

1 (4)

$$1200 = \frac{48P \cos 60^\circ \times 3.07}{112.6} + \frac{48P \sin 60 \times 3}{18.7}$$

Solving the equation

$\Rightarrow P = 1638.6$ lb

Now

$$\sigma c = \frac{M x y}{I x} + \frac{M y x}{I y}$$

$$5000 = 48P \cos 60 \times (593) + \frac{48P \sin 60 \times 0.5}{18.7}$$

Solving the equation

$P = 2104.91b$

15

So the maximum load

P applied should 1638.6 lb

a

Q# 03

Answer: Given Data

Length 'L' = 10 ft

As bothsides are hinged

So $L_e = L$

$E = 10.3 \times 10^6$

Factor of safety = 2

b = 0.75 inch

h = 2 inch

②

Required Data

① Determine safe load = ?

② Safe load at fixed = ?

Solution:: As we know that

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

As we know that $I = Ar^2$

$r^2 = I/A$ Now square roots on both side

$I = Ar^2 \Rightarrow$

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

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

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

for hinged column:

$Le = L$

$$I = \frac{1 \times 2(0.75)(2)^3}{12} = 0.5 \, in^4$$

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

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

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

$$= \frac{3526.176}{2} = 1763.089 \, lb$$

P safe load $= 1763.089$ lb

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

$$P_{cr} = \frac{\pi^2 EA}{\left(\frac{Le}{r}\right)^2} \Rightarrow \frac{(3.14)^2 (10-3\times10^6)(1.5)}{\left(\frac{10}{0.216}\right)^2}$$

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

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

$$\Rightarrow \frac{853.834}{2}$$

$$\boxed{\text{Safe Load} = 426.917}$$

(*) for fixed ended columnn

$Le = L/2 = \frac{10}{2} \Rightarrow Le = 5ft$

$Pcr = \frac{\pi^2 EA}{(Le/r)^2} \Rightarrow \frac{(3.14)^2 (10.3 * 10^6)(1.5)}{(60/0.216)^2}$

Le = 5ft
Converted to inch
5×12 = 60 inch

$Pcr = \frac{15233082}{77160.502}$

$\boxed{Pcr = 1974.207218}$

$\boxed{Pcr = 1974.207218}$

$\text{Saf Load} = \frac{Pcr}{\text{factor of Safety}}$

$\text{safe load} = \frac{1974.207218}{2}$

$\text{Safe Load} = \boxed{987.103609}$

Required Answer