ID# 7168

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Mechanics of Solids-II

Day Following Mid Autumn Festival (H.K.) Harvest Moon Festival (Chuseok) (Rep. of Korea)

(10)

Solving the equation

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

Now

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

$$5000 = \frac{48P\cos60\times(5.93)}{112.6} + \frac{48P\sin60\times0.5}{18.7}$$

Solving the equation

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

So the maximum load P applied should be 1638.6 lb

(9)

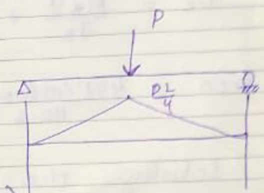
at A & C.

So

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

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

Now M_x & M_y



So

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

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

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

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

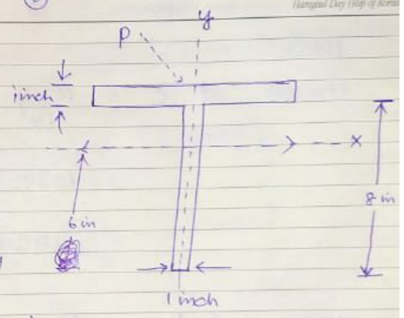
Now

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

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

(8)

(2)
Ans:→ (b)



Given

$L = 16\ ft$

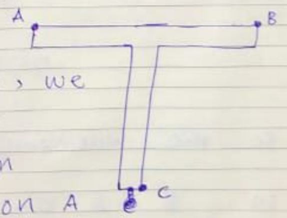
$I_x = 112.6\ in^4$

$I_y = 18.7\ in^4$

$\sigma_c = 12000\ psi$

$\sigma_t = 5000\ psi$

sol:→



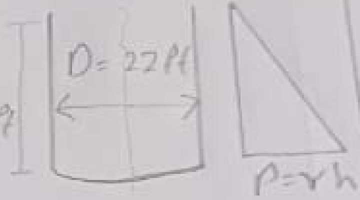
By looking to the figure, we can judge that maxim compression would occur on A & maximum tension at C. at B there will be tension as well as compression, which will reduce the effect of each others so we will calculate stresses

2

Solution:

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

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



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

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

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

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

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

(1)

Question No 1
Part (b)

Data:

$\Rightarrow H = 26\ ft$

$\Rightarrow$ I assume diameter =
$D = 22\ ft$

$\Rightarrow$ tangential Stress = $600\ lb/ft^3$

$\Rightarrow$ Specific weight of water tank = $62.4\ lb/ft^3$

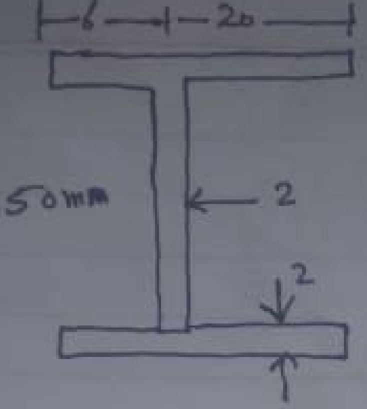
We have to find the

thickness = ?

$P = 1000$ [illegible]

(3)

$\boxed{t = 0.24''}$



Required: location of shear centre.

Sol: As we know

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

and:

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

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

$$I = 50034.66 + 20833$$

$$I = 70867.99\ mm^4$$

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

So shear centre $e = 11.02\ mm$

QNO 3

Ans: 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

Required data.

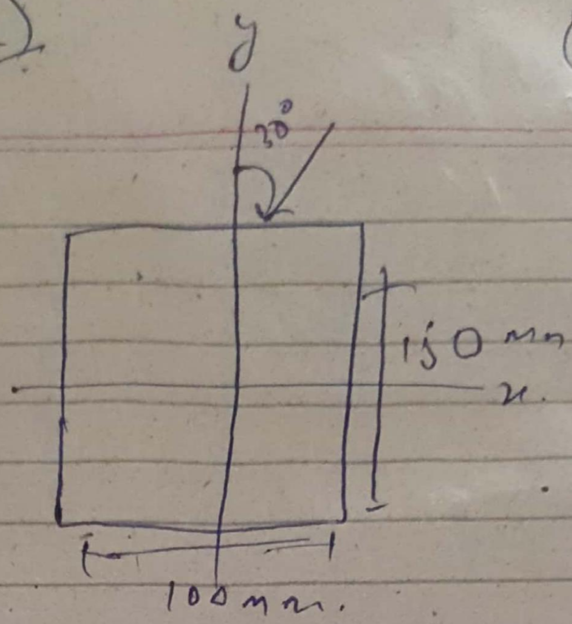
Determine Safe load ?

Solution:- As

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

As we know that $I = Ar^2$

Question #2(a) ①



Moment of inertia

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

Now

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

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

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

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

$$I = Ar^2$$

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

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

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

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

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

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

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

where

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

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

$M_z = 1.8510$

$M\sin\theta = P\sin\theta = M_y$

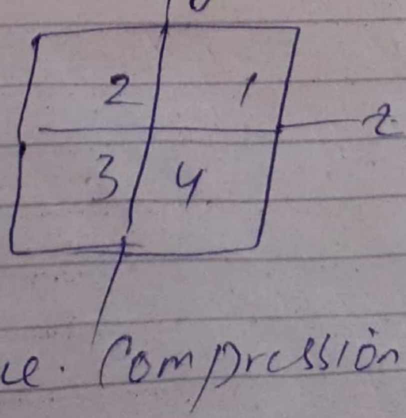
$M_y = 12\sin 30$

$M_y = -11.8563$

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

$\sigma = \frac{1.851}{2.812\times10^{-5}} + \left(\frac{-11.8563}{1.25\times10^{-5}}\right) = 882628$ Nm^2

Sign Convention



If we take compression as negative and tension as positive and the Beam

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

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

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

~~26~~

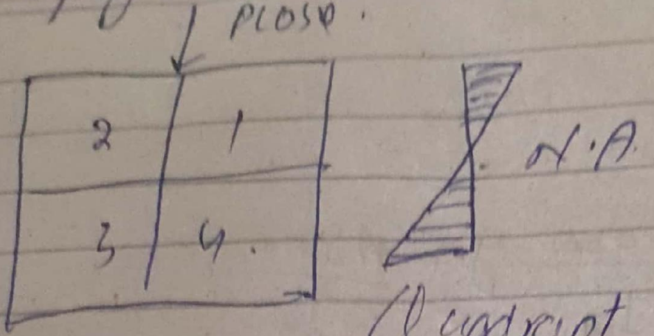
* For fixed ended column

$$Le = L/2 = 10/2$$

$$Le = 5\,ft$$

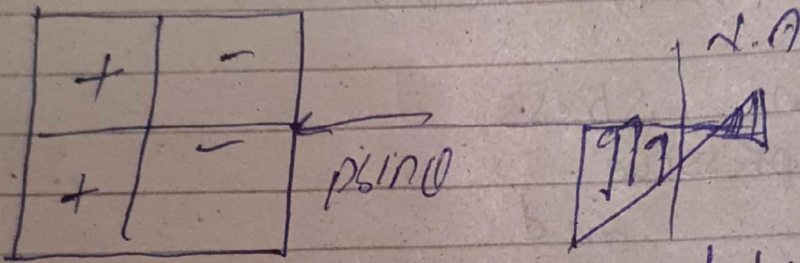
$$P_{cr} = \frac{\pi^2 EA}{(Le/r)^2} \Rightarrow \frac{(3.14)^2 \times (10.3 \times 10^6)(1.5)}{(60/.62.16)^2}$$

is a simply supported.



Quadrant 1, 2 – ve

Quadrant 3, 4 + ve



Quad 1, 4 – ve.

Quad 2, 3 + ve.

Incase of unsymmetrical loading the Neutral axis lies of an angle of "α" The principal axis and the algebric Sum of Stress at N.A is zero

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

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

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

$$\boxed{987.103}$$

Ans.

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

in this case, N.A passes through

z, y , so

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

Let Consider a point 'A' on N.A lies in quadrant 2, where

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

and

- Bending stress due to $P\sin\theta$ is Tensile.

$$eq(1) \Rightarrow 0 = \frac{-M\cos\theta\, y_A}{I_z} + \frac{M\sin\theta}{I_y} z_A$$

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

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

$$\frac{y_A}{z_A} = \frac{I_z}{I_y}\frac{\sin\theta}{\cos\theta} \Rightarrow \tan\alpha = \frac{I_z}{I_y}\tan\theta \longrightarrow (11)$$

Now put values of I_z, I_y and θ in eq (ii)

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

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

$$\tan\alpha = -14.4129$$

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

$$\cancel{\alpha = 01.5}$$

$$\alpha = 1.5^{\circ}$$

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

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