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I.D :- 7889

Section :- A

Subject :- Mechanics of Solid 2

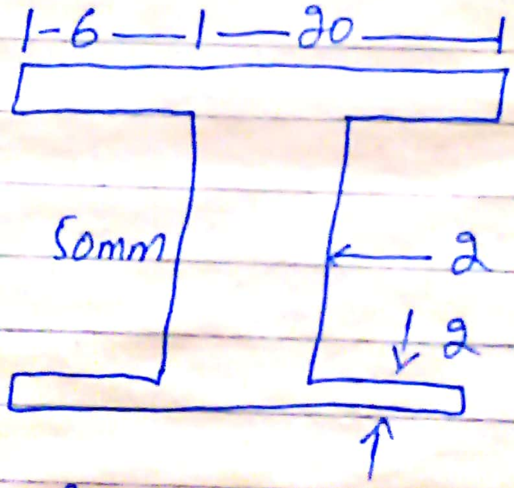
Date :- 23/06/2020.

Question No:- 1

Part (a)

Answer:

Solution:



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)

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

$I = 50034.66 + 20.833$

$I = 70867.99\ mm^4$

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

So Shear Centre $\boxed{e = 11.02mm}$.

(3)

Question: 1

Part (b):

Answer:

Data:

$\Rightarrow H = 26 ft$

$\Rightarrow$ I assume diameter

$D = 22 ft$

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

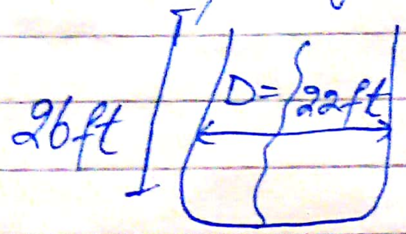
$\Rightarrow$ Specific weight of water tank $= 62.4 lb/ft^3$

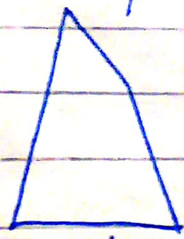
we have to fine the thickness = ?

Solution:

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

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





$P = \gamma h$

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

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

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

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

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

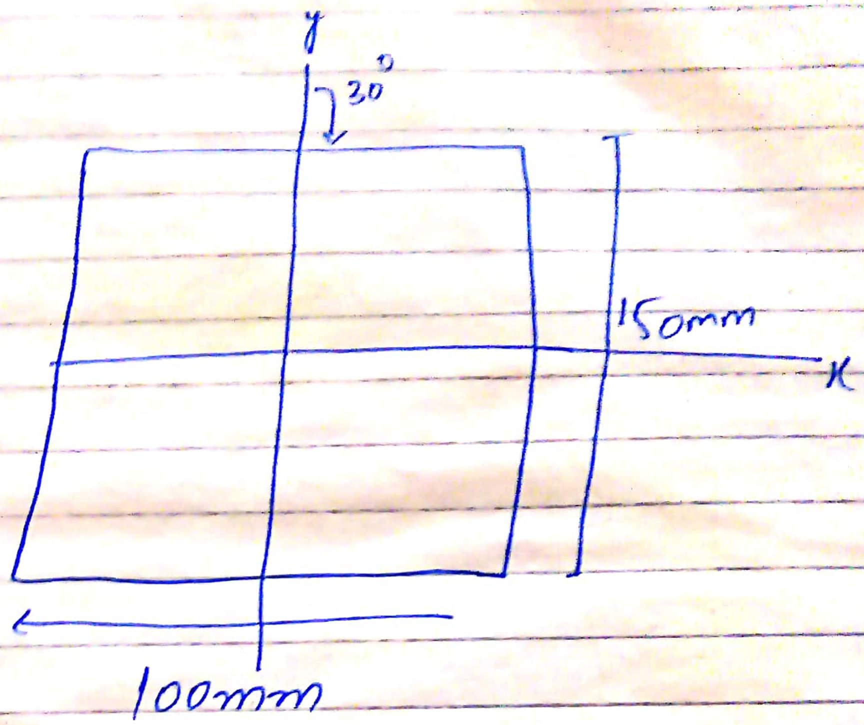
$$\underline{t = 0.24''}.$$

Question:-02:

Part (a)

Answer:

Solution:



moment of inertia

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

Now,

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

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

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

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

where,

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

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

$M_z = 108510$

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

$M_y = 12 \sin 30$

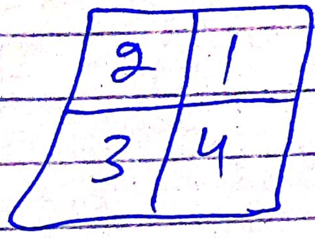
$M_y = -11.8563$

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

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

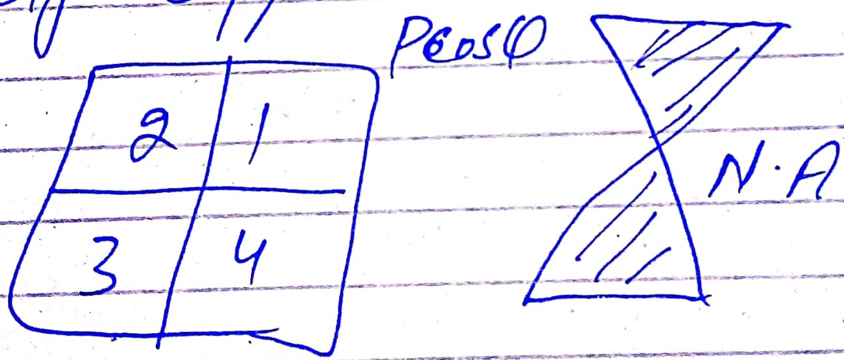
$= 882628 \ Nm^2$

Syn Convention



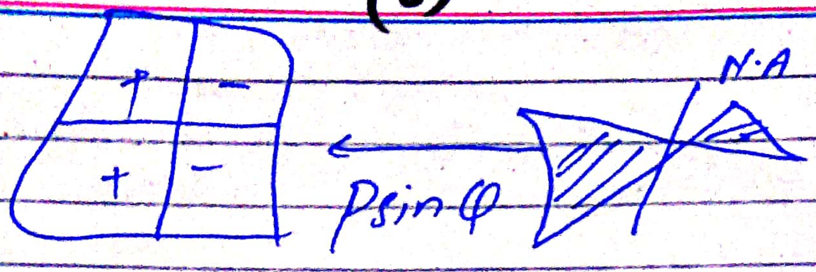
If we take Compression as negative and tension as positive and the beam.

Simply Supported



Quadrant 1,2 -ve

Quadrant 3,4 +ve



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

InCase of unsymetrical loding the neutral axis of on. angle of α. the principal ax(i) & the algebric Sum of Stress at N.A is Zero.

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

In this Case, N.A passes through 2,4 So,

$$\sigma = \frac{m \cos\phi}{I} y + \frac{m \sin\phi}{I_y} z$$

(9)

Let Consider a point "A" on N.A lies in Quadrant 2, where

- Bending Stress due to $P\cos\phi$ is Compressive &
- Bending Stress due to $P\sin\phi$ is tensile.

$$eq(i) \Rightarrow 0 = \frac{-M\cos\phi}{I_Z} y_A + \frac{M\sin\phi}{I_y} Z_A$$

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

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

$$\frac{y_A}{Z_A} = \frac{I_Z}{I_y} \frac{\sin\phi}{\cos\phi} \Rightarrow \tan\phi\alpha = \frac{I_Z}{I_y} \tan\phi \rightarrow (iii)$$

Now put values of I_Z, I_y & θ in eq (ii)

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

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

$$\tan\alpha = -14.4129$$

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

$$\alpha = 1.5^\circ$$

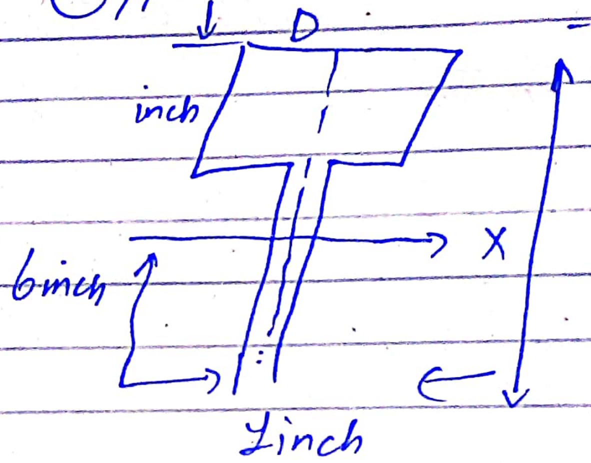
$$\alpha = 1^\circ 30' 5''$$

Question (2)

Part (b)

Answers:-

Solution:: Given:



$L = 16\,ft$

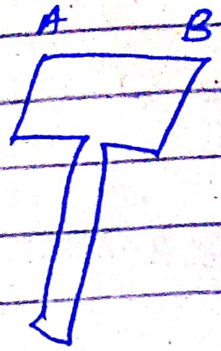
$I_X = 112.6\,inch^4$

$I_y = 18.7\,inch^4$

$\delta e = 12000\,psi$

$\delta t = 500\,psi$

Solution



By looking figer we can judge that maximum compression would accure on A & maximum tension C at B. these will tension as well a compression which will redue that effect of each other, so we will calculatate stresses at A & C.

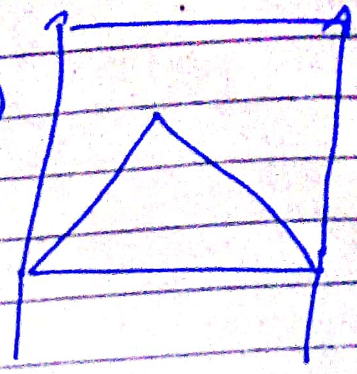
So,

$$\delta A = \frac{M_x y}{I_x} + \frac{M_y x}{I_y} \text{ Comp.}$$

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

Now Mx & My

So,



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

$$M_x = 48P\cos 60$$

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

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

Now,

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

$$\Rightarrow 1200 = \frac{48P\cos 60^\circ \times 3.7}{112.6} + \frac{48\sin 60 \times 3}{18.7}$$

Solving the equation

$$\Rightarrow \boxed{P = 1638.6\,Lb}$$

Now

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

$$5000 = \frac{48 P \cos 60 \times (5.93)}{187} + \frac{48 P \sin 60 \times 0.5}{}$$

Solving the equation

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

So the maximum load P applied should 1638.6 lb

~~Be ended~~

Question No: 3

Answer..

Solution:-

Given data

Length = 10ft
$E = 10.3 \times 10^6$
$b = 0.75$
$h = 2$
Factory of Safety = 2

Required Data:-

(a) Safe Load of haved = ?
(b) Safe Load of at fixed = ?

As we know that

Strut is a Compression member act as a coloumn.

Scanned with CamScanner

Case I:

Strut or Colomn act as a hinged Colom Coloumn about an axis perpendicular to the 8inches

dimension then,

$$I = I_x \frac{(0.75)(2)^3}{12} = 0.5 \text{ inch}^4$$

$Le = L$ = (For hinged ended Coloumn).

$$P_{CB} = \frac{\pi^2 E I \bar{\lambda}^2}{Le^2} = \frac{(1)^2 (10.3\times10^6)(0.5)(\bar{\lambda}^2)}{(10\times12)^2}.$$

P_{CV} = 35.26.176 Lb.

$$P_{safe} = \frac{P_{cr}}{\text{Factor of Safety}} = \frac{3526.176}{2}$$

$P_{safe} = 1763.085\ lb$

Case 2:

Strut or Coloumn act as a fixed ended Coloumn about an axis perpendicular to 0.75 is

Side i.e y-axis

$$I = I_y = \frac{2(0.75)^3}{12} = 0.070\ inch^4.$$

$L_e = L/2$ (For fixed ended Coloumn)

then,

$$P_{cr} = \frac{(n)^2 EI\pi^2}{L_e^2}.$$

$$= \frac{(1)^2 (10.3\times10^6)(0.07)(\pi^2)}{\left(\frac{10}{2}\times12\right)^2}$$

$P_{cr} = 1974.658\ lb$

$$P_{safe} = \frac{P_{cr}}{\text{factory of safty}}$$

$$P_{safe} = \frac{1974.658}{2}$$

$$\boxed{P_{safe} = 987.329\ lb}$$

In both Cases take the smaller value of Psafe.

$P_{safe} = \cancel{918.74}\ 987.32 < 1763$.

By ended thinks You Sir: