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Sec = A

Paper = MOS II

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H-

Question No#1

Part (B)

GIVEN DATA:-

$H = 26\ ft$

Assume diameter $= D = 22\ ft$

Tangential stress $= 600\ lb/ft^3$

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

Now find the thickness $= ?$

Solution:-

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

P.T.O

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

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

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

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

Putting the values

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

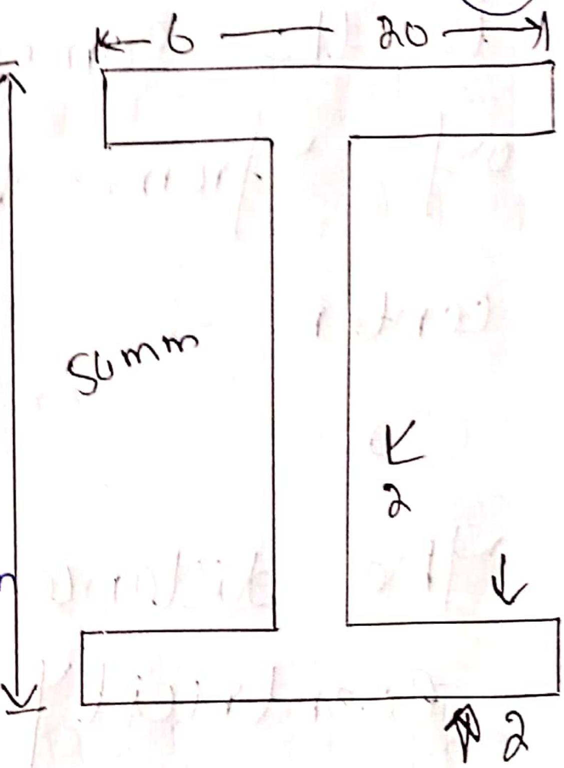
$$t = 0.24''$$

Ans

③

Question No # 1

Part (A)



Given Data:-

height of sec = h = 50mm

Thickness = b = 20+6

⇒ b = 26mm

t_f = 2mm

Required:-

Shear Center = ?

As we know that for the unsymmetrical member of the Shear Center is the same distance away of from the geometrical center.

So,

The distance is called ecentricity which are as given;

Solution:-

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

So,

Here in moment of Inertia and are given as

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

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

$I = 50034.66 + 20833$

$I = 70867.99\ mm^4$

Now eq 1

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

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

$e = 11.0234mm$

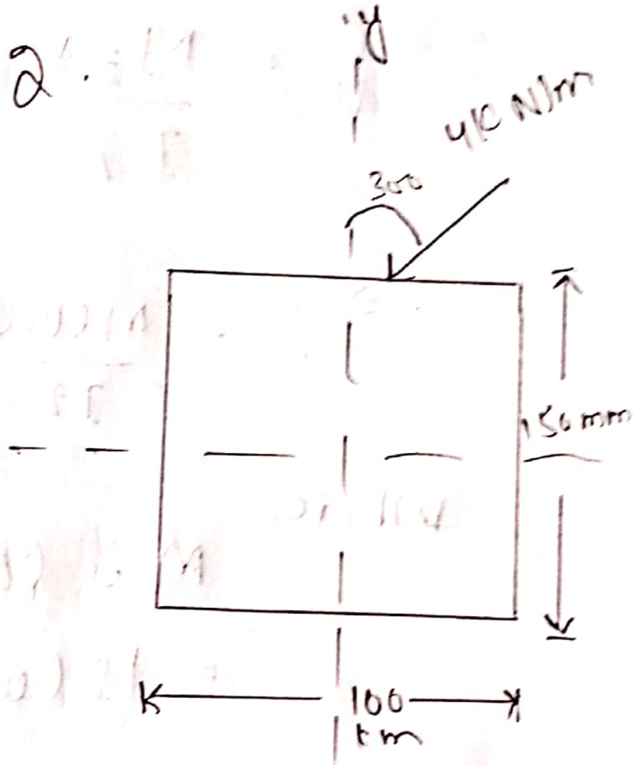
$e = 11.0234\ mm$

Shear center is 11.0234mm away from the geometrical center.

①

QUESTION NO # 2.

Part # (A).



GIVEN DATA:-

$b = 100\,mm$

$h = 150\,mm$

Load $= P = 4\,kN/m$

Length of beam $= 3\,m$.

REQUIRED:-

Bending Stress $= ?$

N.A $= ?$

As we know that

P.T.O

$$\delta = \frac{M_z y}{I_z} + \frac{M_y z}{I_y} \quad \because M_z = M\cos\theta, \; M_y = M\sin\theta$$

$$\Rightarrow \delta = \frac{M\cos\theta}{I_z} + \frac{M\sin\theta}{I_y} \rightarrow (a)$$

Where,

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

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

$$M_z = 1.8510$$

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

$$M_y = 12\sin 30$$

$$M_y = -11.8563$$

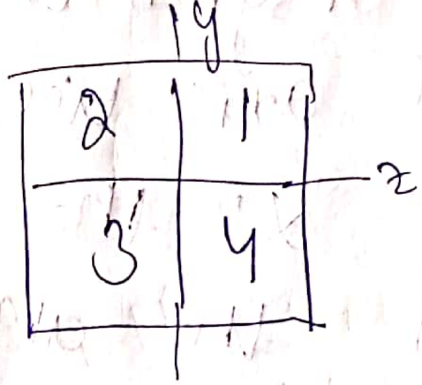
$$\delta = \left(\frac{M_z}{I_z}\right) + \left(\frac{M_y}{I_y}\right)$$

$$\delta = \frac{1.851}{2.812\times10^{5}} + \left(\frac{-11.8563}{1.25\times10^{5}}\right)$$

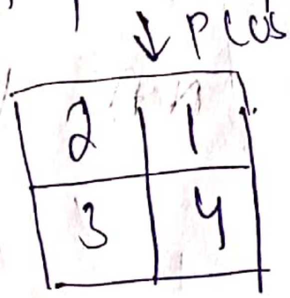
$$= 882678 \; Nm^2$$

p.T.O

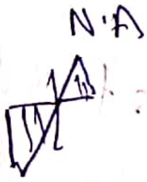
Sign Convention



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



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



Quad 1, 4 -ve
Quad 2, 3 +ve.

In case of unsymmetrical loading the neutral axis lies an angle of "α" the principal axis and the algebric sum of stress at N.A is zero

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

In this case, N.A passes through z, y so

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

let consider a point "A" on N.A lies in quadrant 2, where.

↳ Bending stress due to P cos θ is compressive.

↳ Bending stress due to P sin θ is Tensile

$$eq ① \Rightarrow 0 = -\frac{M\cos\theta\, y_A}{I_Z} + \frac{M\sin\theta\, z_A}{I_Y}$$

$$\Rightarrow 0 = -\frac{M\cos\theta\, y_A}{I_Z} + \frac{M\sin\theta}{I_Y} z_A$$

$$\Rightarrow \frac{M\cos y_A}{I_Z} + \frac{M\sin\theta\, z_A}{I_Y}$$

$$\frac{y_A}{z_A} = \frac{I_Z}{I_Y}\frac{\sin\theta}{\cos\theta}$$

$$\Rightarrow \tan\alpha = \frac{I_Z}{I_Y}\tan\theta \rightarrow (ii)$$

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

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

$$\Rightarrow \tan \alpha = \frac{2.8125 \times 10^{-5} (\tan 30^\circ)}{1.25 \times 10^{-3}}$$

$$\tan' \alpha = -14.4129$$

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

$$\alpha = 1.5^\circ$$

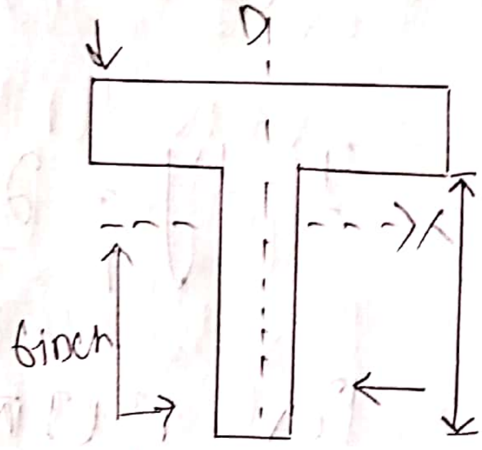
$$\alpha = 1^\circ 30' 5''$$

(P.T.O)

Question # 2

Part # B

Given Data:



$L = 16\ ft$

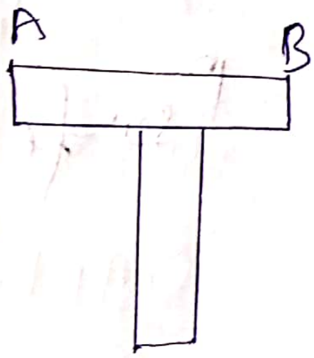
$I_x = 112.6\ inch^4$

$I_y = 18.7\ inch^4$

$\delta_e = 12000\ psi$

$\delta_t = 5000\ psi$

Solution:



By looking figer we can judge that maximum compression would accure on a maximum tension e at B. there will tension as well a

P.T.O

a compression which will reduce that the effect of each other

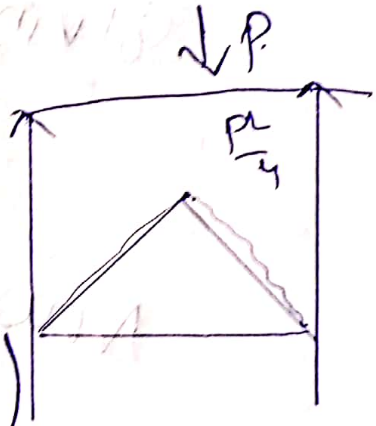
So we will calculate stress at A and C

So,

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

$$\delta_C = \frac{M_x y}{I_x} + \frac{M_y x}{I_y} \text{ tension}$$

Now M_x & M_y.



So

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

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

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

P.T.O

12

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

Now

$$\sigma_A = \frac{Mx\,y}{Ix} + \frac{My\,x}{Iy}$$

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

Solving the equation

$$\boxed{P = 1636.6 \text{ lb}}$$

Now

$$\sigma_C = \frac{Mx\,y}{Ix} + \frac{My\,x}{Iy}$$

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

Solving the equation

$$\boxed{P = 2164.9 \text{ lb}}$$

So the maximum load P applied should be 1638.6 lb

Qestion # 3

Given Data:-

length = 10 ft

E = 10.3×10^6

b = 0.75

h = 2

factor of safety = 2

Required:

(a) safe load at hinged = ?

(b) safe load at fixed = ?

Solution:-

for hinged columns

$L_e = L$

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

P.T.O

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

$$P_{cr} = \frac{50776940}{14400}$$

$$= 3526.176 \text{ lb}$$

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

$$= \frac{3526.176}{2}$$

$$\Rightarrow 1763.088 \text{ lb}$$

(b) Strut act Column:

$L_e = L/2$ (for fixed ended)

$$le = 10/2 = 5\ ft$$

$$I = I_y = \frac{2 \times (0.75)^3}{12} = 0.07\ in^4$$

$$P_{cr} = \frac{n^2 EI \pi^2}{le^2} = \frac{(1)^2 (10.3 \times 10^6)(0.07)(3.14)^2}{(5 \times 12)^2}$$

$$P_{cr} = \frac{7108771.6}{(60)^2}$$

$$P_{cr} = 1974.058\ lb$$

$$P_{safe\ load} = \frac{1974.058}{2}$$

$$= 987.3293\ lb$$

X ——→ A