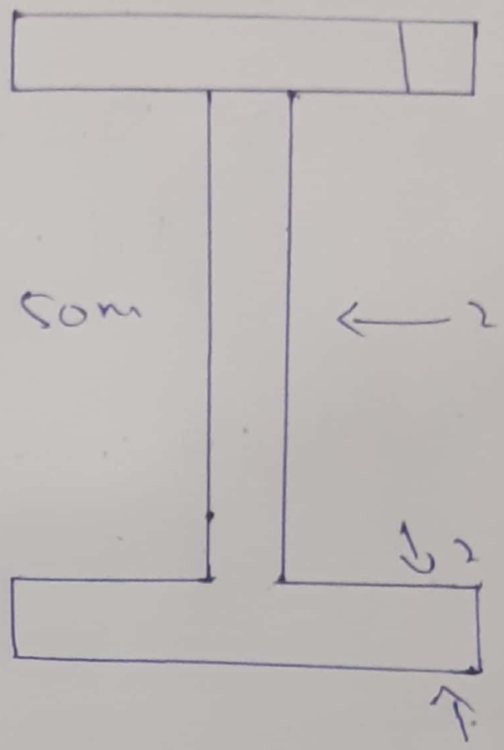
ID 7962

Section B

Paper MoS II

Dep = BE(civil)

Q 1 Part (A)



Required loction of shear stress

Solution

As we know

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

and

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

$$\Rightarrow 2\left(\frac{26(2)^3}{12}\right) +$$

$$\Rightarrow 2\left(\frac{26(3)^3}{12} + (20\times3)(25)^2\right) + \left(\frac{2(50)^3}{12} + 0\right)$$

$I = 50034.66 + 20833$

$I = 70867.99 mm$

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

$= 11.02$ mm

So shear center

$$\boxed{e = 11.02 \text{ mm}}$$

Scanned with CamScanner

Question 1 :

Part = B

Given

$\delta^t = 6000\,psi$

height = 26 ft

$\gamma = 62.41\ lb/ft^3$

Requried

T = ?

Solution

An we know that

$P = \gamma h$

$\delta^t = \frac{PD}{2t}$

$t = \frac{PD}{2\delta^t}$

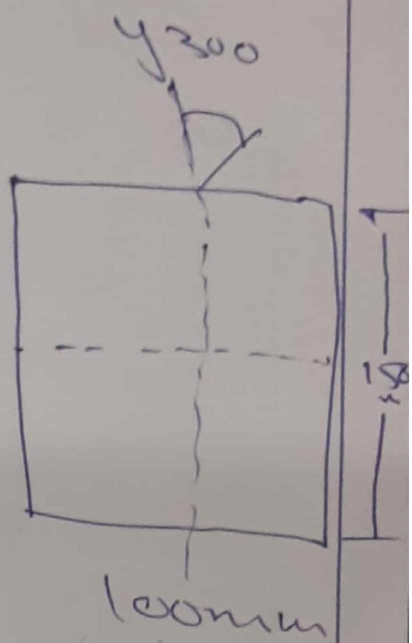
$$t = \frac{62.41 \times 26 \times 22}{2 \times 6000}$$

$$\boxed{t = 2.974} \text{ Ft}$$

Question No 2

Part A

Given Data



$w = 4\ kN/m$

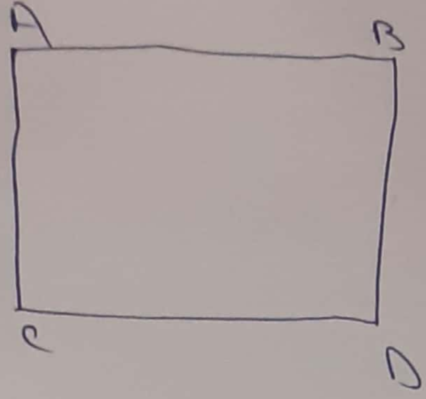
$L = 3m$

Required

maximum bending stress = ?

Solution

As the bending moment is maximum at extremes so we would find stress at A, B, C and D (at)



we know that

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

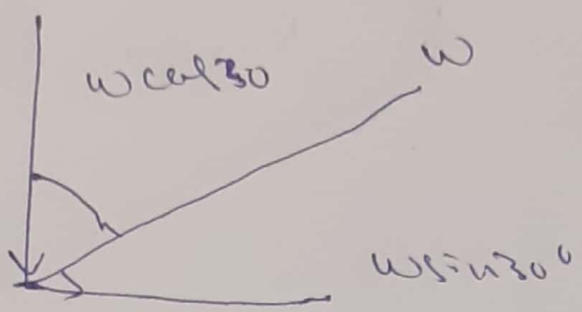
we know to find Mx and My

As per question the max and My should be found at the mid.

As simply supported we have

$$M_{mid} = \frac{wl^2}{8} \rightarrow (1)$$

Now we have to find the components of w in x and y direction



So $$Mx = \frac{(w(\cos 30) \times l^2}{8}$$

$$\Rightarrow Mx = \frac{(4 \times \cos 30) \times 3^2}{8}$$

$$\boxed{Mx = 3.9 \text{ KN-m}}$$

Now

$$My = \frac{(4 \times \sin 30) \times 3^2}{8}$$

$$\boxed{My = 2.25 \text{ KN-m}}$$

Mx is causing compression at A and B and tension at C and D

My is causing compression at B and D tension at A and C

Now

I_x and I_y

$$I_x = \frac{bh^3}{12} = \frac{0.1 \times 0.15^3}{12} = 2.815 \times 10^{-5} m^4$$

$$I_y = \frac{hb^3}{12} = \frac{0.15 \times 0.1^3}{12} = 1.25 \times 10^{-5} m^4$$

Now stresses at extreme fibers

$$\sigma_x = \frac{M \times y}{I_x} = \frac{3.9 \times 0.075}{2.815 \times 10^{-5}}$$

$$\boxed{\sigma_x = 10390.7 \ kN/m^2}$$

$$\sigma_y = \frac{2.25 \times 0.05}{1.25 \times 10^{-5}}$$

$$\boxed{\sigma_y = 9000 \ kN/m^2}$$

Now (Taking tesion +ve)

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

$= 10390.7 + 9000$

$= -1390.7 \, kN/m^2$ (comp)

at B

$\frac{Mxy}{Ix} + \frac{Myx}{Iy}$

$= -10390.7 - 9000$

$\boxed{\sigma \text{ at } B = -19390.7 \, KN/m^2}$

Now

Stresses at C $= \frac{Mxy}{Ix} + \frac{Myx}{Iy}$

$= 10390.7 + 9000$

$= 19390.7 \frac{KN}{m}$ (Tension)

Stresses at D = $\frac{Mx\,y}{Ix} + \frac{My\,x}{Iy}$

$= 10390.7 - 9000$

$= 1390.7 \frac{kN}{m^2}$ (Tension)

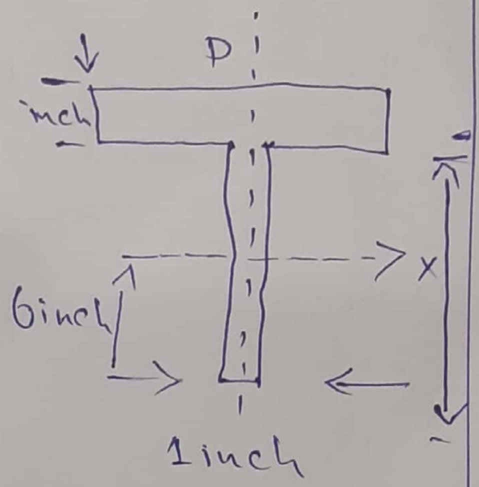
So the maximum stresses are on B and C

B is under compression of 19390.7 KN/m² and C is under tension of the same value.

Question = 2

Part = B

Given



$L = 16 ft$

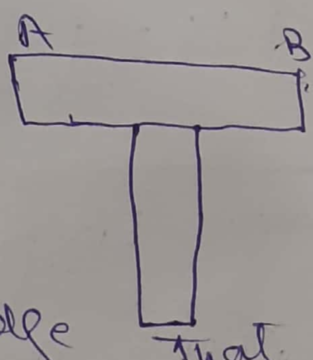
$I_x = 112.6 inch^4$

$I_y = 18.7 in^4$

$\delta_c = 12000$ psi

$\delta_t = 5000$ psi

Solution



By looking

Figer we can Judge that maximum compression would accure on a and maximum tension c at B. There will tension as well a compression which will reduce that effect of each other so we will calculate stress at A and c

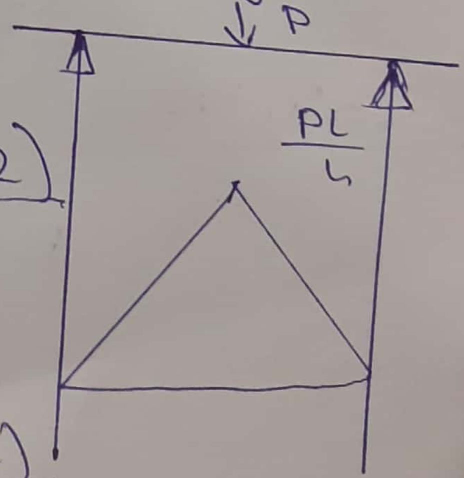
So

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

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

Now Mx and ~~Mp~~ My

So



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

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

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

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

Now

$$SA = \frac{Mxy}{Ix} + \frac{Myx}{Iy}$$

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

Solving the equation

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

Now

$$SC = \frac{Mxy}{Ix} + \frac{Myx}{Iy}$$

$$5000 = \frac{48p \cos 60 \times (5.937)}{} + \frac{48p \sin 60 \times 0.5}{18.7}$$

Solving the equation

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

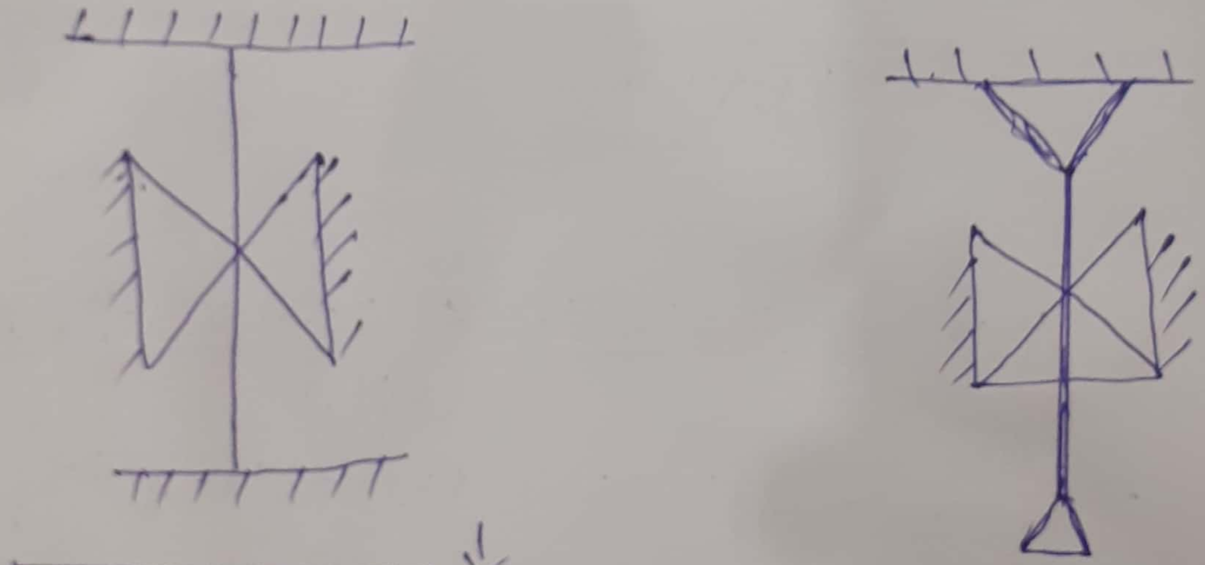
so the maximum load
P applied should 1638.6 lb

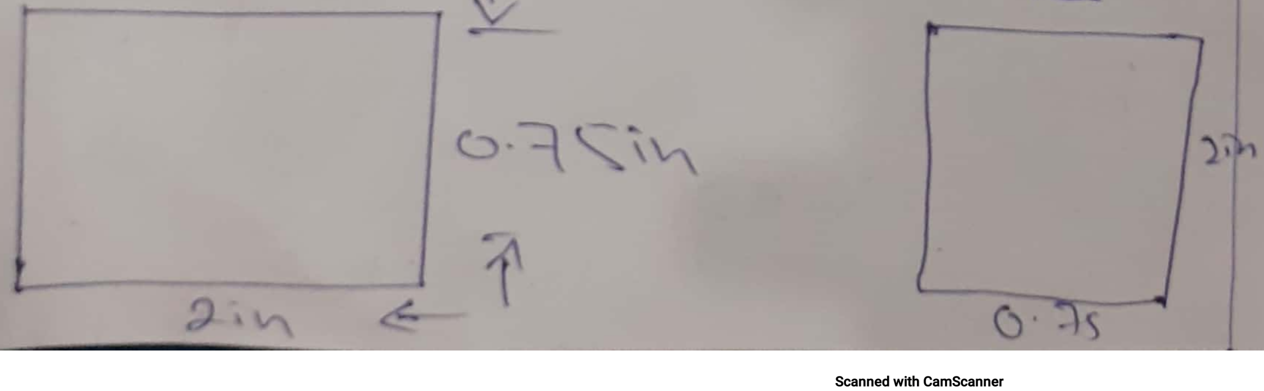
Q No 3

L = 10ft

Solution

According to the given data as condition is not supports it which direction the ~~col~~ column will buckle so we will Analyse both cases.





For

Case 1

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

Here For case 1

$n=2$ $E = 10.3 \times 10^6$ psi

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

$le = 0.5L = 0.5 \times 16 \times 2$

$\Rightarrow \boxed{96 ft}$

$$\Rightarrow P_{cr} = \frac{2 \times 3.14^2 \times 10.3 \times 10^6 \times 0.5}{96^2}$$

$\Rightarrow P_{cr} = 11019.3$ lbs $= 11.61$ kip

For

Case-2

$n=1$ $E = 10.3 \times 10^6$ psi

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$$P_{cr} = \frac{2 \times 3.14^2 \times 10.3 \times 10^6 \times 0.0703}{192^2}$$

$P_{cr} = 387.8 \text{ lbs} = 0.387 \text{ kisps}$

so

factor of safty.

safe load $= \frac{0.387}{2} = 0.2 \text{ kip}$.