ID	7655
Subject	M.O.S 2
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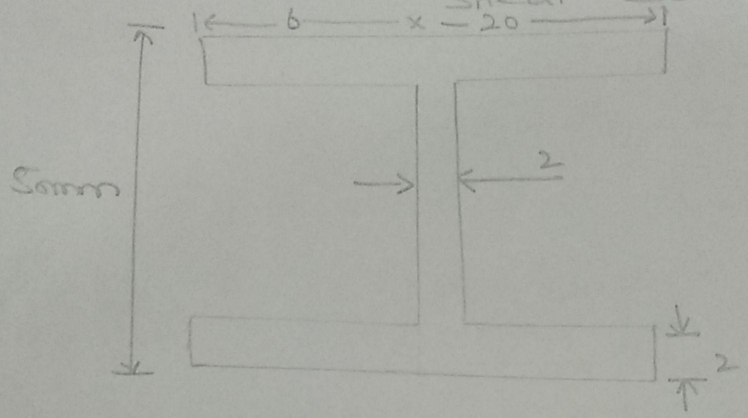
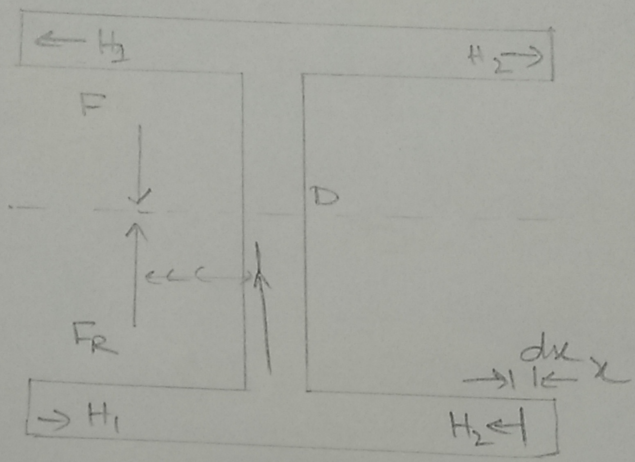
Submitted to	Engineer Saqib
Date	23/7/2020
Semester	10th

Question: No: 1(a)

Shear Centre location





$$H_2 = \int q\,dA = \int \frac{FA\bar{y}}{It}\,dA$$

$$= \frac{F}{I.t}\int A\bar{y}\,dA$$

$$= \frac{F}{I.t}\int_0^{20} 2(20-x)\times(240\times 2)\,dx$$

$$= \frac{F}{I\times 2}\left[19200\right]$$

$$= 9600\,\frac{F}{I}$$

$$H_1 = \frac{F}{2I}\int_0^{6} 2(6-x)\times 240\times 2\,dx$$

$$\Rightarrow H_1 = \frac{F}{2I}\times 1728$$

$H_1 = 864 \frac{F}{I}$

Taking moment about point D

$F_R \times e = 2(H_1 - H_2) \times 240$

$= 2\left(864 \times \frac{F}{I} - 9600 \frac{F}{I}\right) \times 240$

$F_R \times e = \frac{-419328F}{I}$

Here, $I_R = F$

$e = \frac{-49328}{I}$ — (A)

$I = 2\left[\frac{26 \times 2^3}{12} + 52 \times 25^2\right] + \frac{2 \times 46^3}{12}$

$\boxed{I = 86561.33 \text{ mm}^4}$

$\Rightarrow e = \frac{419328}{86561.33}$

$\boxed{e = -4.84 \text{ mm}}$

As the value is negative, it indicates that our assume direction of e is wrong & it is 4.84mm to the right side.

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Question: No: 1 (b)

Given Data:

$h = 26\ ft = 312\ in$

$\delta_f = 6000\ Psi$

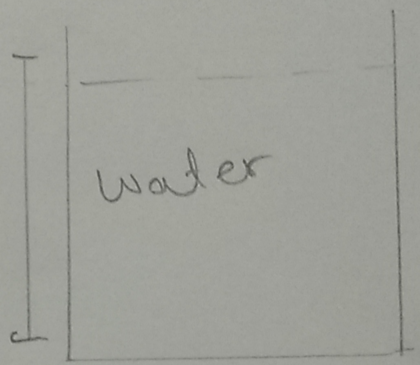
$\gamma_w = 62.4\ lb/ft^3 = 0.036\ lb/in^3$

Required:

thickness $= t = ?$

As we know the

$P = \gamma h$ (for water)



$$\Rightarrow \delta_t = \frac{PD}{2t}$$

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

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

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

$$\boxed{t = 9.38 \times 10^{-4} D} \rightarrow (i)$$

Since D is not given in the question, So t depends on D.

For Diffrent values of D we would have diffrent values of t.

e.g: let take D = 22 ft

$= 22 \times 12$

$= 264$ in

So,

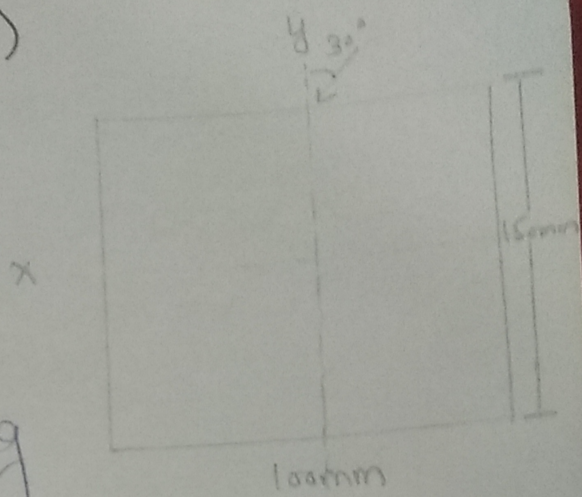
$t = 938 \times 10^{-4} \times 264$

$\boxed{t = 0.248 \text{ inches}}$

Also we can take any value of D & consequently Calculate t.

x — x — x

Question: No: 2(a)



Given Data:

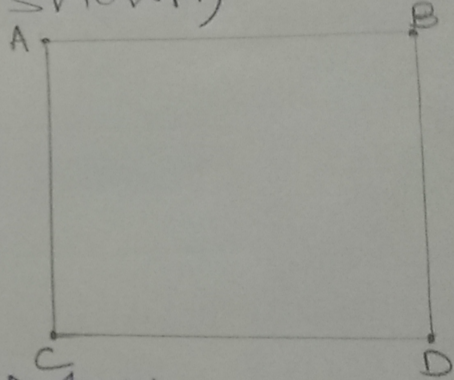
$w = 4 \, KN/m$

$L = 3m$

Required:

Maximum Bending Stress = ?

Solution: As the bending moment is maximum at extremes. So, we would find stresses at, A, B, C & D. (as shown)



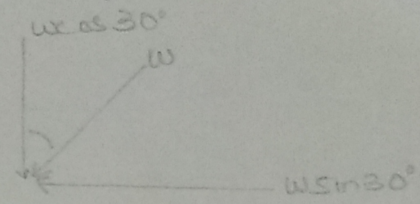
As we know:

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

We have to find M_x & M_y.
As per Question the M_x & M_y should be found at the mid. As for Simply Supported we have:

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

Now we have to find the Components of w in x & y directions.



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

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

$$\boxed{M_x = 3.9 \text{ kN-m}}$$

Now,

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

$$\boxed{M_y = 2.25 \text{ kN-m}}$$

M_x is Causing Compression at A & B & tension at C & D.

M_y is Causing Compression at B & D & tension at A & C.

Now, I_x & I_y

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

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

Now stresses (5) at Extreme fibers.

$$\delta x = \frac{M x y}{I x} = \frac{3.9 \times 0.075}{2.815 \times 10^{-5}}$$

$$\boxed{\delta x = 10390.7 \ KN/m^2}$$

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

$$\boxed{\delta y = 9000 \ KN/m^2}$$

Now, (taking tension +↑)

Stress at A $= \frac{M x y}{I x} + \frac{M y x}{I y}$

$= -10390.7 + 9000$

$= -1390.7 \ KN/m^2$ (Comp)

at B $= \frac{M x y}{I x} + \frac{M y x}{I y}$

$= -10.390.7 - 9000$

$$\boxed{\delta \text{ at } B = -19390.7 \ KN/m^2}$$ (Comp)

Now, stresses at C $= \frac{M x y}{I x} + \frac{M y x}{I y}$

$= 10390.7 + 9000$

$= 19390.7 \ KN/m^2$ (Tension)

Stresses at D $= \frac{M x y}{I x} + \frac{M y x}{I y}$

$= 10390.7 - 9000$

$= 1390.7 \ KN/m^2$ (tension)

So, the maximum stresses are on B & C.
B is under Compression of 19390.7 kN/m^2
& C is under tension of the same value.

Question: No: 2 (b)

Given:

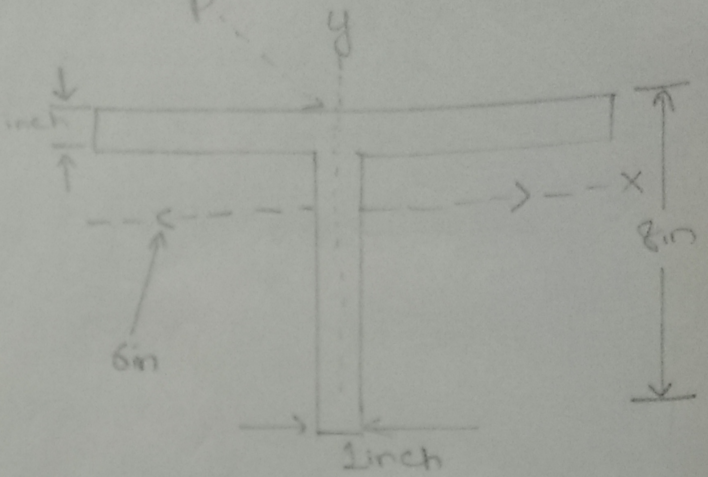
$L = 16 ft$

$I_x = 112.6 \, in^4$

$I_y = 18.7 \, in^4$

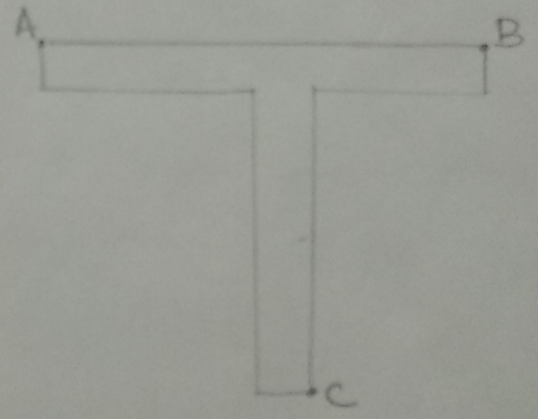
$\delta_c = 12000 \, psi$

$\delta_t = 5000 \, psi$



Solution:

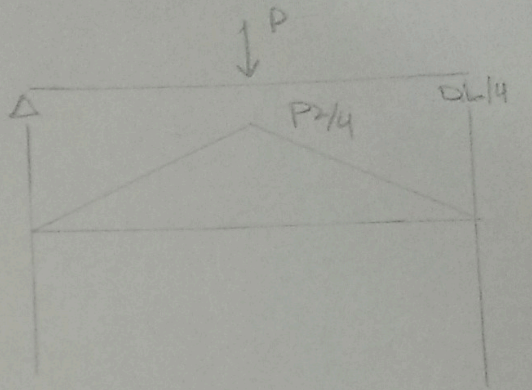
By looking to the figure, we can judge that max in Compression would occur on A & maximum tension at C at B. There will be tension as were as Compression, which will reduce the effects of each other. So we will Calculate stresses at A & C.



So, $\delta_A = \frac{M_x y}{I_x} + \frac{M_y x}{I_y}$ (Comp)

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

Now, M_x & M_y



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

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

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

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

Now, $\delta_A = \frac{M_x y}{I_x} + \frac{M_y x}{I_y}$

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

Solving the equation

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

Now, $\delta_c = \frac{M_x y}{I_x} + \frac{M_y x}{I_y}$

$$5000 = \frac{48P\cos 60 \times (5.93)}{112.6} + \frac{48P\sin 60 \times 0.5}{18.7}$$

Solving the Equation

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

So the maximum load P applied should be 1638.6 lb.

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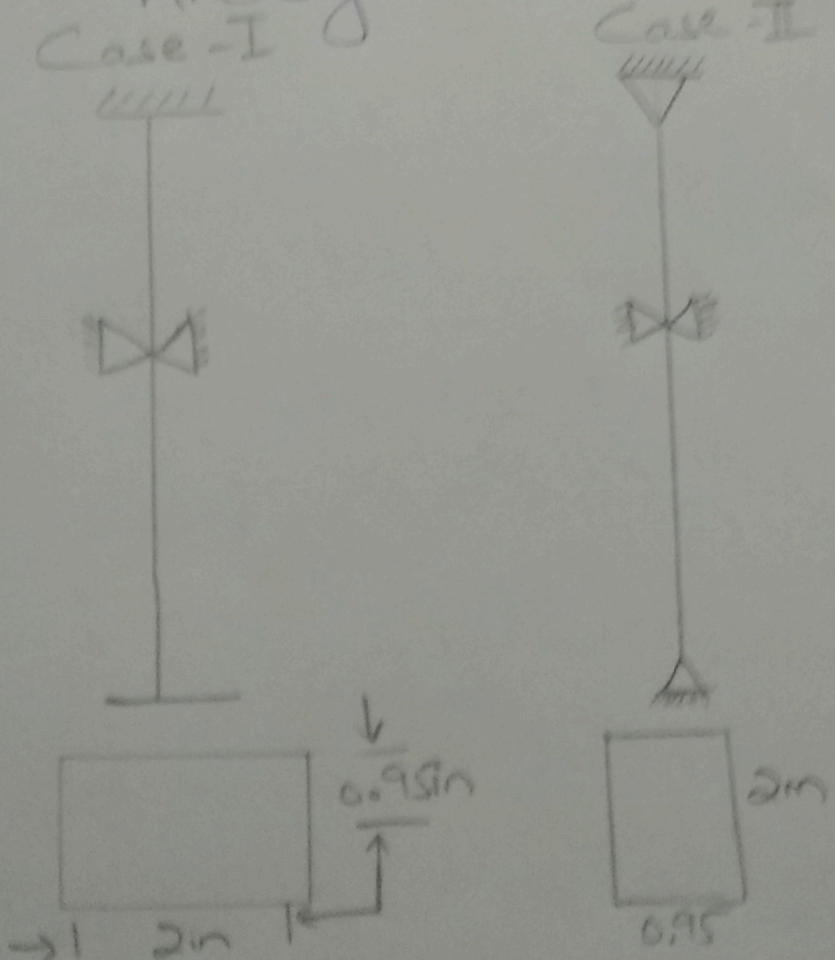
Questions No: 3

L = 10 ft

Solution:

According to the given data of the condition of the supports, it is not clear that in which direction the column will buckle, so we will analyse both cases.



For Case-I

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

Here for Case-I

$n = 2$, $E = 10.3\times10^6$ Psi

$$I = \frac{0.75\times2^3}{12} = 0.5 \text{ in}^4$$

$$L_e = 0.5L = 0.5\times16\times12$$

$$= 96 ft$$

$$\Rightarrow P_{cr} = \frac{2\times3.14^2\times10.3\times10^6\times0.5}{96^2}$$

$$\boxed{P_{cr} = 11019.3 \text{ lbs} = 11.01 \text{ kip}}$$

Now for Case-II

$n = 1$, $E = 10.3\times10^6$ Psi

$$I = \frac{2\times0.75^3}{12} = 0.0703 \text{ in}^4$$

$$L_e = L = 16\times12 = 192$$

$$P_{cr} = \frac{2\times3.14^2\times10.3\times10^6\times0.0703}{192^2}$$

$$\boxed{P_{cr} = 387.8 \text{ lbs} = 0.387 \text{ kips}}$$

So, $\boxed{\text{Safe load} = \frac{0.387}{2} = 0.2 \text{ kip}}$

x — x — x