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I·D NO. 7614

SECTION B

PAPER MOS-II

SUBMITTED TO. ENGR. SAQIB

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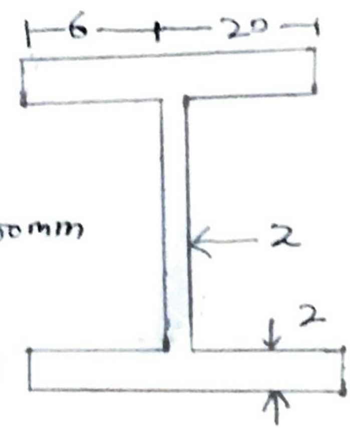
Q No 1:

PART A):

Determine the location of the shear Centre from the beams having cross section dimension shown in Fig 1. All members are to be considered thin wall & calculation should be based on the centre line dimensions.



Ans:

REQUIRED:

To find location of shear centre.

SOLUTION:

As we know that

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

and;

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

Putting the values

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

$$I = 50034.66 + 20833$$

$$I = 70867.99 \text{ mm}^4$$

Now ;

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

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

RESULT:-

Hence shear centre $e = 11.02$ mm.

Question NO 1)

Part (B):

Determine the thickness of the wall of a water tank constructed from steel plates filled to the height of 26 ft, the circumferential stress is limited to 6000 psi, the specific weight of water is 62.4.

Ans: Given DATA:

Height $= H = 26\ ft = 312$ inch

circumferential stress $= \sigma t = 6000$ psi

specific weight $= \gamma w = 62.4\ lb/ft^3$

$= 0.036\ lb/inch^3$.

REQUIRED:-

To find thickness of the tank.

Solution:

As we know that

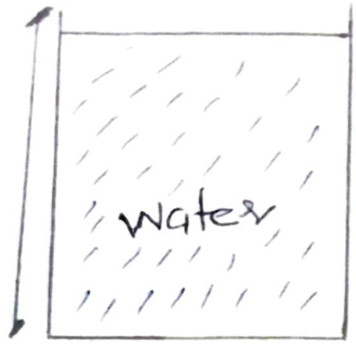
$p = \gamma h$ (For water)

So

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

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

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



putting the values

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

$$t = 9.38 \times 10^{-4} D \longrightarrow \text{eq } 1$$

So, D is not given in the question,

Hence t depends on D.

For different values of D we would have different values of t.

e.g Suppose $D = 22$ ft

$= 22 \times 12$

$= 264$ inch.

Now;

$$t = 9.38 \times 10^{-4} \times 264$$

$$t = 0.247 \text{ inch.}$$

Also we can take any value of D & consequently calculate.

RESULT:

Hence the thickness of the wall of the tank is 0.247 inch.

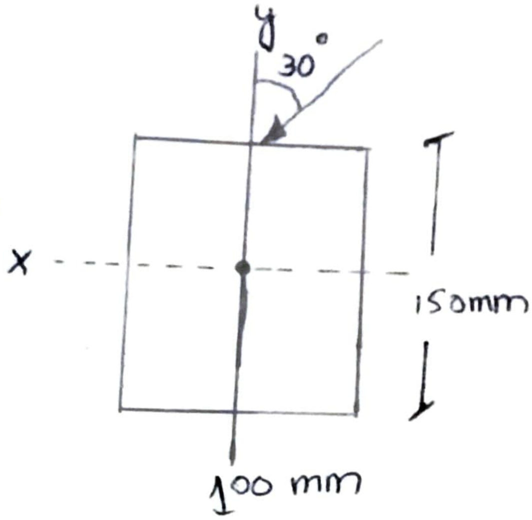
Question no 2):

PART (A): The 100 by 150 mm wooden beam shown in Figure 2, is used to support a uniformly distributed load of 4 KN on a simply span of 3 m. The applied load acts in a plane making an angle of 30 degree with vertical. Calculate the and for the same section locate the neutral axis. Neglect the weight of the beam.

Ans: GIVEN DATA:

weight $= W = 4kN$

span $= L = 3m$

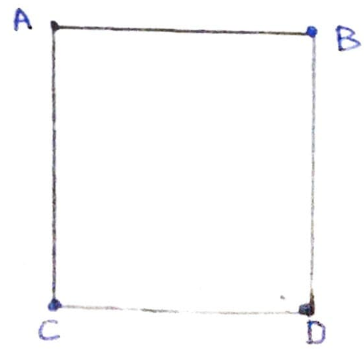


REQUIRED:

To find maximum bending stress.

Solution:

As the bending moment is maximum at extremes. So we would find stresses at A, B, C and D as shown.



As we known that

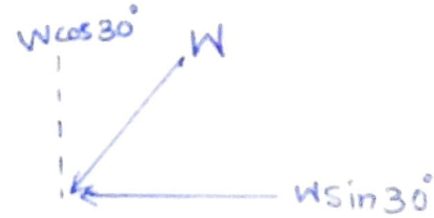
$$\sigma = \frac{M_x y}{I_x} + \frac{M_y x}{I_y}$$

we have to find M_x & M_y should be found at the mid.

so for simply supported we have;

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

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



Now;
$$M_x = \frac{(w\cos 30) \times l^2}{8}$$

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

$$M_x = 3.9 \text{ KN-m.}$$

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

$M_y = 2.25$ kN-m

→ M_x is causing compression at A & B and tension at D & C

→ M_y is causing compression at B and D and tension at A & C.

Now I_x & I_y :

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

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

Now stresses at extreme fibers;

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

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

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

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

Now taking tension +↑

Stress at $A = \dfrac{M_x y}{I_x} + \dfrac{M_y x}{I_y}$

$= -10390.7 + 9000$

compression

$= -1390.7$ KN/m^2 (component)

Stress at $B = \dfrac{M_x y}{I_x} + \dfrac{M_y x}{I_y}$

$= -10{,}390.7 - 9000$

compression

$= -19390.7$ KN/m^2 (component)

Stresses at $C = \dfrac{M_x y}{I_x} + \dfrac{M_y x}{I_y}$

$= 10390.7 + 9000$

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

Stresses at $D = \dfrac{M_x y}{I_x} + \dfrac{M_y x}{I_y}$

$= 10390.7 - 9000$

$= 1390.7$ KN/m^2 (Tension)

B is under Compression of 19390.7 KN/m^2 and C is under tension of the same value.

Question no 2)

Part (B): The T section shown in fig 3 is the cross section of a simply supported beam 16 ft long that carries a central concentrated load inclined 60 degree left to the y axis the centroid is 3.07 in below the top of the section $I_x = 112.6\ in^4$ and $I_y = 18.7\ in^4$. If compression stress is limited to 12000 psi and tensile stress to 5000 psi. what is the maxi. load that will not overstress the beam?

Ans: Given DATA:

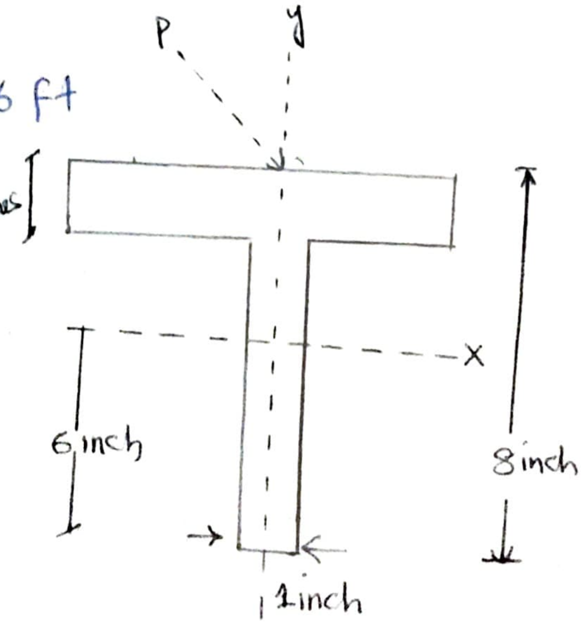
Length = L = 16 ft

$I_x = 112.6\ in^4$

$I_y = 18.7\ in^4$

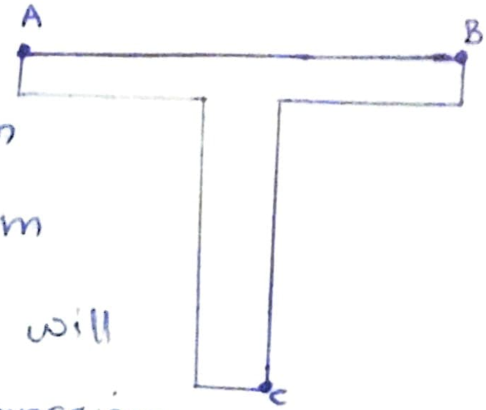
$\delta_c = 12000$ psi

$\delta_t = 5000$ psi



Solution:

From the Fig: we can see that maxi 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 other.



So we will calculate stresses, at A & C.

So

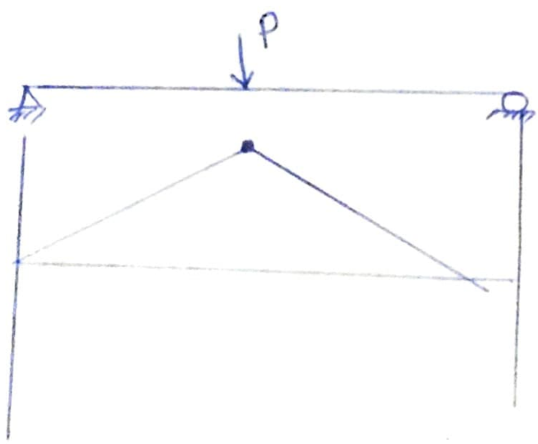
$$\sigma_A = \frac{M_x y}{I_x} + \frac{M_y x}{I_y} \quad (\text{Compression})$$

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

Now M_x & M_y

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

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



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

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

Now

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

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

Solving the equation

$$P = 1638.6 \text{ lbs}$$

Now;

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

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

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

So the maxi load P applied should be 1638.6 lb.

Q NO3 :

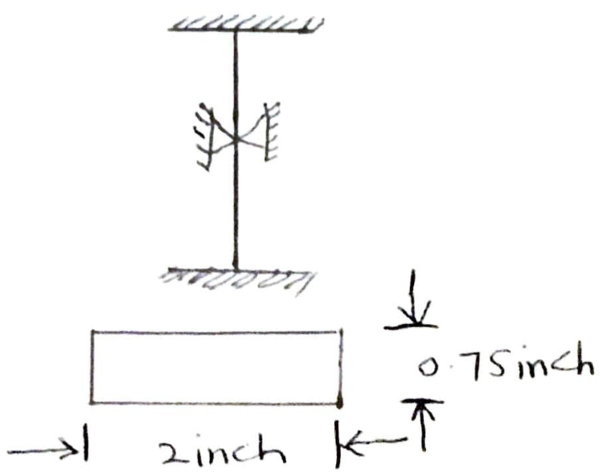
A 10 ft long strut braced in the middle has a rectangular section of 0.75 in by 2 inch. A bolt through each end secures the strut so that it act's on a hinged column about an axis perpendicular to the 2 inch dimension. Determine the safe load P about using a factor of safety of 2 and $E = 10.3 \times 10^6$.

Answer:

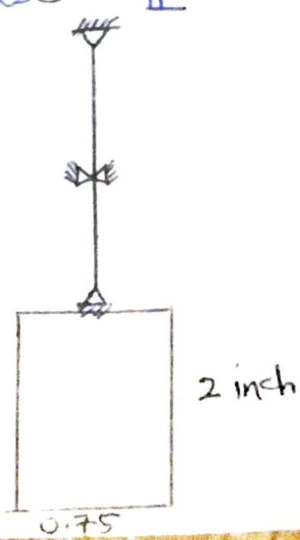
Solution:

According to the given data & conditions of the support, It is not clear that in which direction, the column will bukle buckle so we will analyse both cases;

CASE - I



CASE - II



For case-I

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

Here for case - I

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

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

$Le = 0.5L = 0.5 \times 16 \times 12$

$= 96$ ft

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

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

Now for case - 2

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

$$I = \frac{2 \times 0.75^3}{12} = 0.0703 \text{ in}^4$$

$Le = L = 16 \times 12 = 192$

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

$$\boxed{P_{cr} = 387.8 \text{ lb's} = 0.387 \text{ kip's}}$$

So

$$\text{Safe load} = \frac{0.387}{2}$$

$$\boxed{\text{Safe load} = 0.2 \text{ kip}}.$$