Paper: Final

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Sec : Sec "B"

Subject : MOS II

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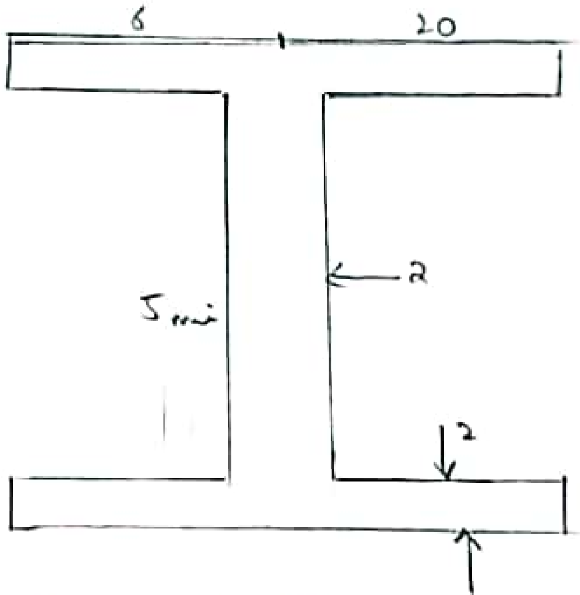
Question : 1

(a) Determine the location of the shear center for the beam having the cross sectional dimmension - - - - - - - - - - - - - - - - center dimension.



Required :- Location of shale center

Solution :-

As we know that

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

and

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

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

$$+ \left[\frac{2(50)^3}{12} + 0\right.$$

$$I = 50034.66 + 20833$$

$$I = 70867.9a \text{ mm}^4$$

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

$\boxed{\text{So shear center } e = 11.02 \text{ mm}}$

Question : b

Determine the thickness of the walls of a water tank constructed from steals plates filled to a height . 26ft - - - -

-- - . —. . . .. – 62.4 lb/ft³

Data:

$\Rightarrow$ H = 26ft

$\Rightarrow$ 9 aume diameter

D = 22ft

$\Rightarrow$ tangential stress = 600lb/ft

$\Rightarrow$ Specific weight of water tank = 62.4 lb/ft³

we have to find the thickness = ?

Solution:-

The pressure develope by water =

$$P = \gamma h$$

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

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

$$2t \times 4 = \gamma h D$$

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

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

$$t = \frac{\left(\frac{62.4}{(12)^3}\right) \times (26 \times 12) \times (22 \times 12)}{6000 \times 2}$$

$$\boxed{t = 0.24''}$$

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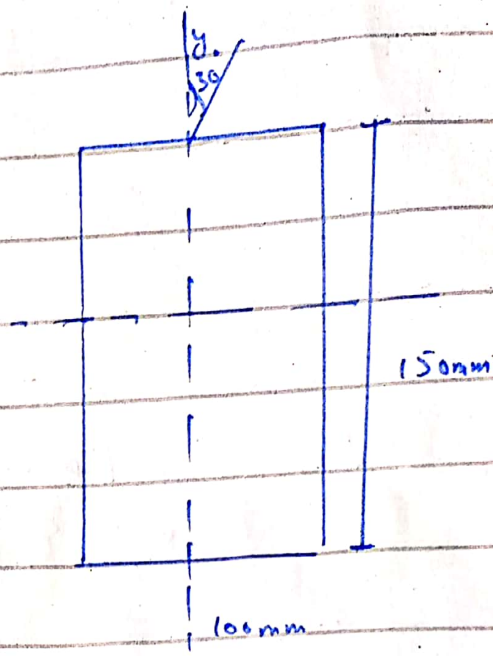


Q NO: 2
Part (a)

Given, Data

w = 4kN/m

L = 3m

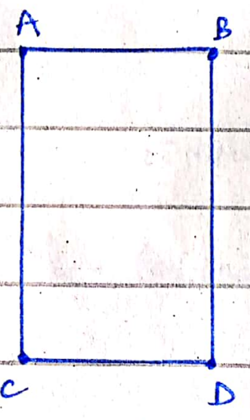
Required

Max Bending

stress = ?

Sol:-

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



As we know that

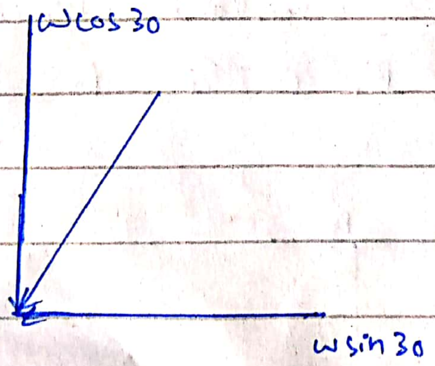
$$\sigma = \frac{M_x y}{I_x} + \frac{M_y x}{I_y}$$

We ~~know~~ have to find M_x & M_y

As For simply supported we have

$$M_{id} = \frac{wl^2}{8} \quad \text{--- (1)}$$

Find the component of w in x and y direction.



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

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

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

Now

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

$$M_y = 2.25\,kN$$

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

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

Now I_x & I_y

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

$$I_y = \frac{hb^3}{12} = \frac{0.15 \times 0.1^3}{12} = 1.25 \times 10^{-8}\,m^4$$

Now stress at External Fiber.

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

$$\sigma_x = 10390.7 \ kN/m^2$$

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

$$\sigma_y = 9000 \ kN/m^2$$

Now

Taking tension $+$ ↑

stress at $A = \frac{M_x y}{I_x} + \frac{M_y x}{I_y}$

$= -10390.7 + 900$

$= \cancel{-10390} -1390.7 \ kN/m^2$ (Comp)

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

$= -10.340.7 - 9000$

σ at $B = -19390.7 \ kN/m^2$ (Comp)

Now

stress at $C = \frac{M_x y}{I_x} + \frac{M_y x}{I_y}$

$= 10390.7 + 9000$

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

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

$= 10390.7 - 9000$

$= 1390.7$ KN/m (Tension)

So the maximum stress are on B and C.

⇒ B is under compression of 19390.7 & C is under tension of the same value.

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Q No: 2
Part (b)

Given Data

$L = 16\,ft$
$I_x = 112.6\,in^4$
$I_y = 18.7\,in^4$

$\sigma_c = 12000\,psi$
$\sigma_T = 5000\,psi$

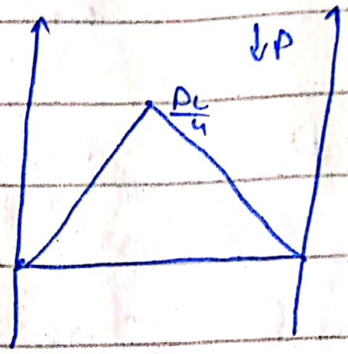
Sol:-
By looking to the figure to we can judge that Max compression would occur on A & Max Max Tension at C & B There will be tension as well as compression which will reduced that effects of each other calculate stress at A & C.

So

$$\sigma A = \frac{M_x y}{I_x} + \frac{M_y x}{I_y} \text{ (Comp)}$$

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

Now M_x & M_y



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

$M_x = 48 P \cos 60$

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

$$M_y = 48 P \sin 60$$

Now

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

$$1200 = \frac{48 P \cos 60^\circ \times 30.07}{112.6}$$

$$= \frac{48 P \sin 60^\circ \times 3}{18.7}$$

Solving the equation.

$$\text{Now} = \frac{M_x y}{I_y} + \frac{M_y x}{I_y}$$

$$5000 = \frac{48 P \cos 60 \times 5.93}{112.6} + \frac{48 P \sin 60 \times 0.05}{18.7}$$

Solving the equation

$P = 2104.9 lb$

So the maximum load "P" applied should be 1638.6 lb.

Q No : 3

Given Data:-

Length , L = 10 ft
Breath , b = 0.75"
height , h = 2"

Factor of Safety = 2

$E = 10.3 \times 10^6$

Required:-

Safe load , P_{safe} = ?

Sol:-

Case 1:-

Strut column act as a hinged column about an axis perpendicular to the 2in dimension then.

$$I = I_r = \left(\frac{3}{4}\right)(2)^3 = 0.5 in^4$$

$l_e = L$ for Hinged ended colu

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

$$P_{cr} = \frac{1^2(10.3\times10^6)(0.5)(3.14)^2}{(10\times12)^2}$$

$$P_{cr} = 3526.17$$

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

$$P_{safe} = \frac{3526.17}{2} = 1763.08$$

$$P_{safe} = 1763.08$$

CASE 2:-

Column act as a fixed end about axis parallel to 2in i.e y-axis

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

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$I_y = 0.07 \, in^4$

Now For fined ended $le = l/2$

$$P_{cr} = \frac{(1)^2 (10.3 \times 10^6)(0.07)(3.14)^2}{120/2}$$

$P_{cr} = 1974.65 \, lb$

For Psafe

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

$$P_{safe} = \frac{1974.65}{2}$$

$P_{safe} = 987.32 \, lb$

In both case we take smaller value of safe.

$P_{safe} = 987.32 < 1763.07$