Paper: Final

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Section: B

Subject: MOS II

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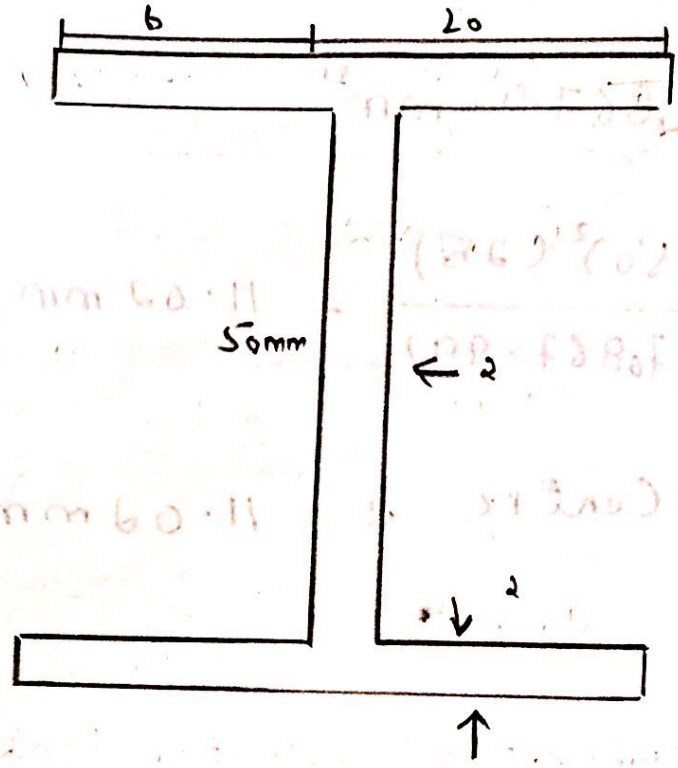
Question:1

(a) Determine the location of the shear centre for the beam having the cross sectional dimmension . . . . Centre dimensions.



Required:- location of shear Centre

Solution:→

As we know that

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

and.

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

$$= 2\left[\frac{26(2)^3}{12} + (40\times 2)(25)^2\right] + \left[\frac{2(50)^3}{12} + 0\right]$$

$$I = 50034.66 + 20833$$

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

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

So Shear Centre $e = 11.02$ mm.

Question: b

Determine the thickness of the wall of a water tank constructed from steel plates filled to a height . 26 ft

. . . . 62.4 lb/ft³

Given, Data:

$H = 26\ ft.$

g = assume diameter as given

$D = 22\ ft.$

Tangential stress $= 6000\ lb/ft^2$, PSI.

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

Required:-*

Thickness = ?

Solution: →

As $p = \gamma h$

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

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

$$2t = \frac{\gamma h D}{6 ft}$$

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

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

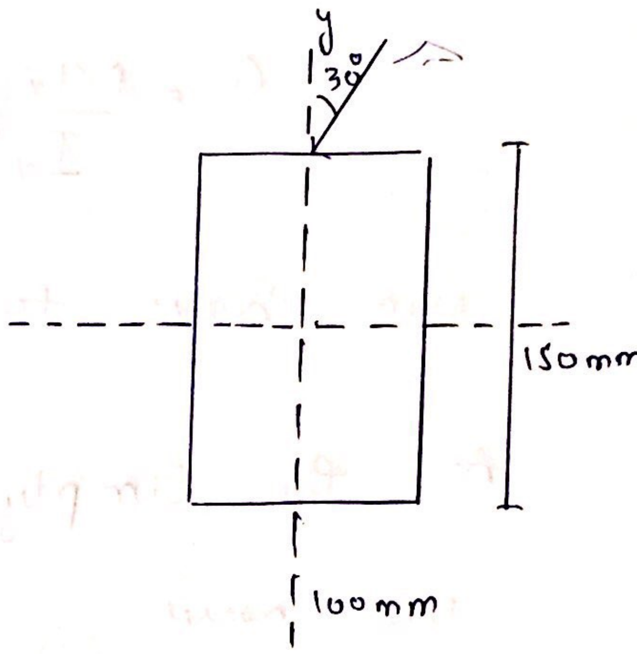
$$t = 0.24''$$

Que:no #2
(a)

Given, Data

$w = 4KN/m$

$L = 3m$

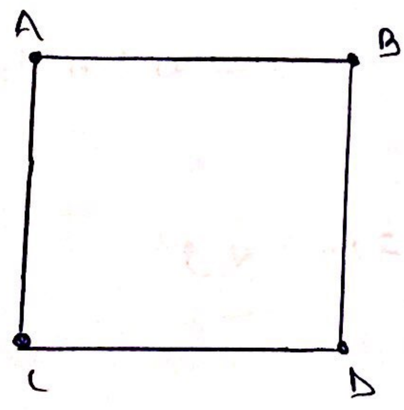


Required:

Max 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 know that

$$6 = \frac{M_x y}{I_x} + \frac{M_y x}{I_y}$$

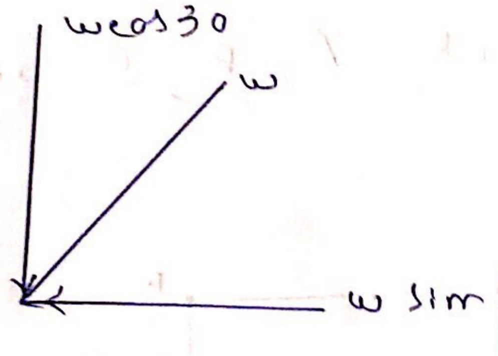
we have to find M_x & M_y

As for simply supported

we have

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

Find the component of w in x and y direction



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

2.015 × 10

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

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

Now

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

$$M_y = 2.25 \text{ kN}$$

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 and 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 Stress at Exterem Fiber.

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

$\sigma_x = 10390.7 \text{ KN/m}^2$

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

$\sigma_y = 9000 \text{ KN/m}^2$

Now: $\longrightarrow$ Taking tension + ↑

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

$= -10390.7 + 9000$

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

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

$= -10390.7 - 9000$

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

Now

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

$= 10390.7 + 9000$

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

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

$= 10390.7 - 9000$

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

So the maximum stress are on B and C

→ B is under Compression of 19390.7 KN/m²

and C is under tension of the same value.

Que: no 2
(B)

Given Data;

$L = 16 ft$

$I_x = 112.6 \ in^4$

$I_y = 18.7 \ in^4$

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

Solution:-

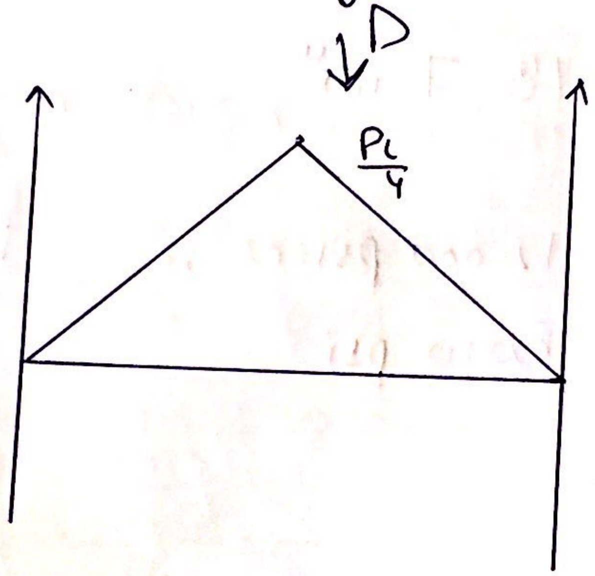
By looking to the figure to we can judge that Max Compression would occur on A & Max Tension at C and B there will be tension as well as compression, which will reduced that effects of each other Calculate stress at A & C

So

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

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

Now M_x & M_y



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

$M_x = 48\, p \cos 60$

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

$M_y = 48\, p \sin 60$

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

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

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

Solving the Equation:-

$l = L$ For Hinged ended column

$P = 2104.9 \, lb$

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

Que: no3

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, $P_{safe} = ?$

Solution: →

Case: 1

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

$$I = I_x = (3/4)(2)^3 = 0.5 in^4$$

$L_e = L$ For Hinged ended column

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

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

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

$$P_{cr} = 3526.17.$$

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

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

$$P_{safe} = 1763.08$$

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

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

$$I_y = 0.07\ in^4.$$

Now For fixed ended $l_e = l/2$

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

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

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

Solving the Equation:-

$P = 2104.9\ lb$

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