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* **Subject:-**

  * MOS-II

* **Submitted to:-**

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"IQRA NATIONAL UNIVERSITY"

Q 1- Part "a"

Given Data:-

upper web = 6mm and 20mm
flange = 2mm
thickness = 2mm

Req. Data:-

location of shear center = ?

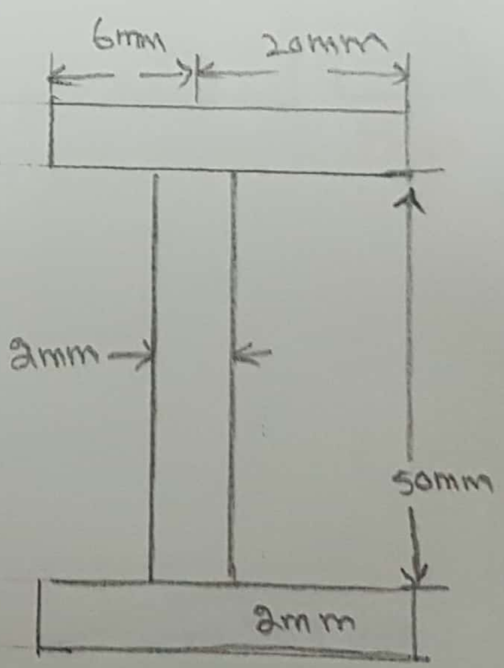
Solution:-

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

$$I = 2\left(\frac{26(2)^3}{12} + (26\times2)(24)^2\right) + \left(\frac{2(46)^3}{12}\right)$$

$$I = 29969.33 + 16222.66$$

$$\boxed{I = 76161.33 \text{ mm}^4}$$



$$e = \frac{2(50)^2(26)^2}{4\times76161.33}$$

$$\boxed{e = 11.099 \text{ mm}}$$

Q:- No.1 – Part "b"

Given Data:-

height upto which tank is filled, $h = 26$ ft

Water tank diameter, $d = 22$ ft

Circumferential stress, $\sigma_t = 6000$ psi

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

Required Data:-

Thickness of wall of water tank, $t = ?$

Solution:-

pressure developed

$$P = \gamma h$$

Circumferential stress,

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

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

So thickness is

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

$$t = \frac{\frac{62.4}{12^3} * 26*12 * 22*12}{2*6000} \text{ in} = \boxed{0.247 \text{ inch}}$$

(P-T-O)

Q **No:2 Part: a**

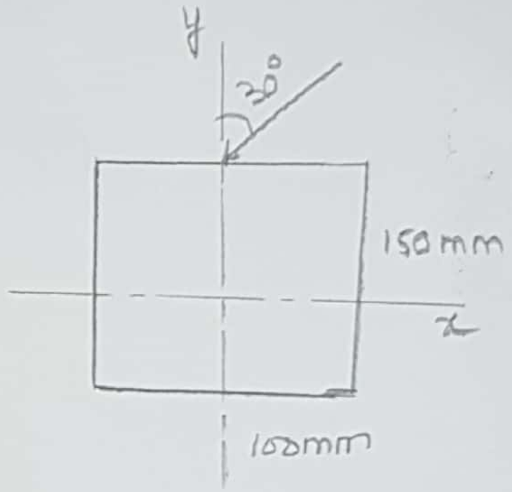
Given Data:-

beam section = 100x150 mm

uniform load = 4KN

span = 3m

angle with vertical = 30°



Req. Data:-

maximum bending stress at mid span and for same section locate neutral axis.

Solution:-

Moment of inertia

$$I_z = \frac{bh^3}{12} = \frac{0.1m\,(0.15)^3}{12} = 2.8125\times10^{-5}\,m^4$$

$$I_y = \frac{bh^3}{12} = \frac{0.15\,(0.1)^3}{12} = 1.25 * 10^{-5}\,m^4$$

$$\sigma = \frac{M_z y}{I_z} + \frac{M_y z}{I_y}$$

$$\sigma = \frac{M \cos\alpha\, y}{I_z} + \frac{M \sin\alpha\, z}{I_y}$$

$M_z = M\cos 30 = 12\times\cos 30°$

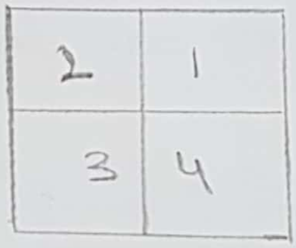
$M_z = 10.39 * 10^3\ N.m = 10392.30\ N.m$

$M_y = M\sin 30° = 12 * \sin 30 = 6000\ N.m$

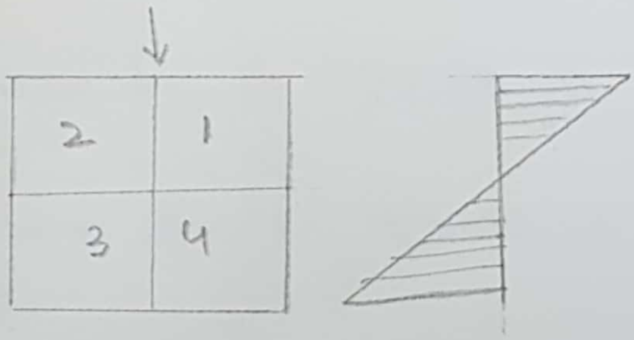
$$\sigma = \frac{10392.3 \times 0.075}{2.8125 \times 10^{-5}} + \frac{6000 \times 0.05}{1.25 \times 10^{-5}}$$

$$\boxed{\sigma = 51712800 \ N/m^2}$$

Sign Convention:-

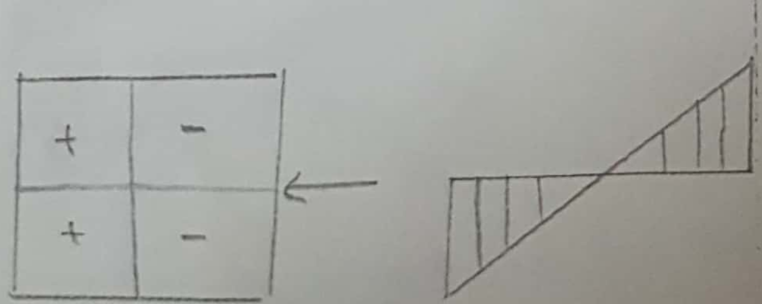


if we take compression as negative and tension as +ve and the



Quadrant 1, 2, -ve

Quadrant 3, 4, +ve



Quadrant 1, 4, -ve
Quadrent 2, 3, +ve

* In case of unsymmetrical loading the neutral axis lies of an angle of "α" the principal axis and the algebric sum of stress at N.A is zero in this case neutral axis pass through 2, 4

$$\sigma = \frac{M\cos\theta\, y}{I_z} + \frac{M\sin\theta\, z}{I_y}$$

* let consider a point "A" on N.A lies in quadrant "2" where

* Bending stress due to $P\cos\theta$ is compressive

* Bending stress due to $P\sin\theta$ is tensile

$$0 = \frac{M\cos\theta\, y}{I_z} + \frac{M\sin\theta\, z}{I_y}$$

$$0 = -\frac{M\cos\theta\, y}{I_z} + \frac{M\sin\theta\, z}{I_y}$$

$$\Rightarrow \frac{M\cos\theta\, y}{I_z} = \frac{M\sin\theta\, z}{I_y}$$

$$\frac{y}{z} = \frac{I_z M\sin\theta}{M\cos\theta\, I_y} = \frac{I_z}{I_y}\tan\theta$$

$$\Rightarrow \tan\alpha = \frac{I_z}{I_y}\tan\theta$$

$$\Rightarrow \tan\alpha = \frac{I_z}{I_y}\tan 30$$

$$\tan\alpha = \frac{2.8125 * 10^{-5}}{1.25 * 10^{-5}}(\tan 30^\circ)$$

$$\tan\alpha = 1.294$$

$$\tan\alpha = 1.294$$

$$\alpha = \tan^{-1}(1.294)$$

$$\boxed{\alpha = 52.2^\circ}$$

Q:2:- Part (b):-

Given Data:-

length = 16 ft

angle of load = 60 degree

$I_x = 112.6 \text{ in}^4$

$I_y = 18.7 \text{ in}^4$

Compressive Stress = 12000 psi

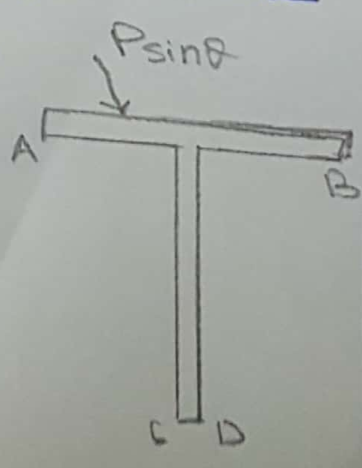
tensile stress = 5000 psi

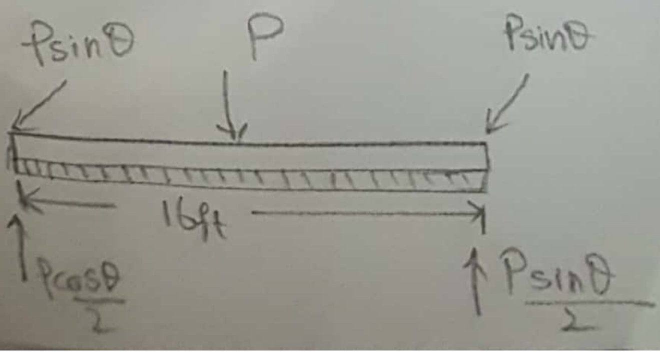
* Required Data:-

what is maximum load. that will not overstress load.

⊙ Solution:-

The maximum bending stress occur at the mid section due to minimum bending moment so the critical section is the mid section. where the compressive and tensile stresses can-exceed the limiting values we also know that at any given section the maximum stress accurate at the extreme fiber for example point A, B, C, D.





for point load max moment at mid section

$$M = \frac{PL}{4}$$

so,

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

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

Stress at A, B, C, D

at "A"

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

$$= -\frac{(48\,P\cos 60)(3.07)}{112.6} + \frac{48(P\sin 60)(3)}{18.7}$$

$$= -0.654P + 6.6P$$

$$= 6.01P \text{ tension}$$

$$\text{tension} \leq 5000 \text{ psi}$$

$$5000 = 6.01P$$

$$P = \frac{5000}{6.01} = 831.94 \text{ lb}$$

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A+B

$$\sigma = -\frac{48 P\cos60(3.07)}{112.6} - \frac{48(P\sin60)(3)}{18.7}$$

$$= -0.654p - 0.6p$$

$$= -7.2p \quad \text{compressive}$$

Compression ≤ 12000 psi

$$12000 = -7.25p$$

$$P = \frac{12000}{7.25} = 1655 \text{ lb}$$

$$1655 \text{ lb} > 831.9$$

controlling value is 831.9 lb

A+C

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

$$= \frac{48P\cos60(5.93)}{122.6} + \frac{48P\sin60(0.5)}{18.7}$$

$$= 1.26p + 1.11p$$

$$\sigma = 2.37p$$

$<$ tension $\leq$ 5000 psi

$$5000 = 2.37 P$$

$$P = \frac{5000}{2.37} = 2109.7 \text{ lb}$$

at D:-

$$f = \frac{48 P \cos 60 (5.93)}{112.6} - \frac{48 P \sin 60 (0.5)}{18.7}$$

$$6 = 1.26 P - 1.11 P$$

$$6 = 0.15 P$$

$$P = \frac{5000}{0.15} = 33333.33 \text{ lb}$$

So controlling value is 2109.70 lb

Q **NO: 3:-**

Given Data:-

Length of strud = 10 ft

rectangular section = 0.75 in X 2 in

factor of safety = 2

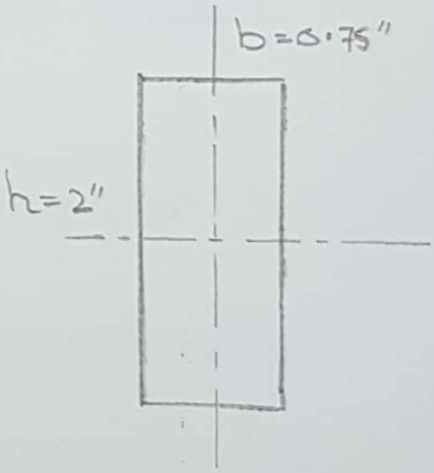
$E = 10.3 \times 10^6$ psi

Required Data:-

Determine safe load, P = ?

Solution:-

* strutt is a compression member and act as a column.



Case: 1

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

$$I = I_x = \frac{(0.75 in)(2 in)^3}{12} = 0.5 in^4$$

$L_e = L$ (for hinged ended column)

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

$$P_{cr} = \frac{(1)^2 (10.3 \times 10^6)(\pi^2)(0.5)}{(6 * 12)^2}$$

$$P_{cr} = 9804.8 \text{ lb}$$

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

$$P_{safe} = \frac{9804.8 \text{ lb}}{2}$$

$$P_{safe} = 4902.43 \text{ lb}$$

* **Case-2**

strut or column act as a fixed Ended column about an axis parallel to on - 2in dimension

$$I = I_y = \frac{2(0.75)^3}{12} = 0.07 \text{ in}^4$$

$$L_e = \frac{L}{2} \text{ (for fixed ended column)}$$

then

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

$$= \frac{(1)^2 (10.3 \times 10^6)(0.07)(\pi^2)}{\left(\frac{6 \times 12}{2}\right)^2}$$

$$P_{cr} = 5490.7 \text{ lb}$$

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

$$P_{safe} = \frac{5490.7}{2} \text{ lb}$$

$$P_{safe} = 2745.36 \text{ lb}$$

* In both cases take smaller value of P_{safe}

$$P_{safe} = 2745.36 < 4902.43 \text{ lb}$$