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SEC :- B

SUBJECT :- MOS - II

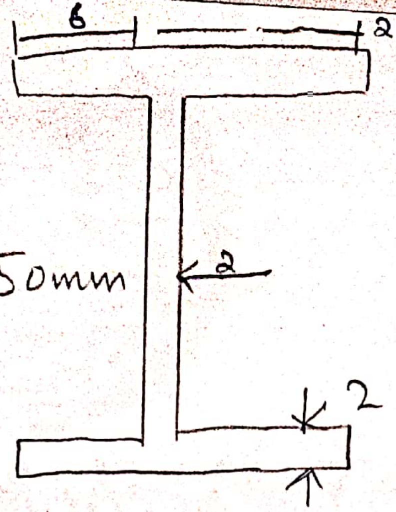
TEACHER :- SIR SAQIB

EXAM :- FINAL

SEM :- 4

DEPT :- CIVIL

Question 1 (a)



Required:- location of shear centre

Sol:- As we know that

$$e = \frac{6_f h^2 b^2}{4I}$$

and

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

$$= 2\left[\frac{26(2)^3}{12} + (20\times2)(25)^2\right] + \left[\frac{2(50)^3}{12} + 0\right]$$

$I = 50034.67 + 20833$

$I = 70867.98 \text{ mm}^4$

$$e = \frac{2(50)^2(25)^2}{4(70867.98)} = 11.03 \text{ mm}$$

So,

Shear centre $e = \boxed{11.03 \text{ mm}}$

Question :- 2 part (b)

Given data:-

$h = 26ft \times 12$

tangential stress $= 6000\ Psi$

specific weight $= 62.4\ lb/ft^3 = 62.4/12^3$

dia $d = 22ft \times 12$

Required:-

thickness , $t = ?$

Solution:

As,

$$\sigma_t = \frac{PD}{2t} \quad -① \qquad \text{where } P \text{ exerted by water} \quad P = \gamma h$$

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

OR

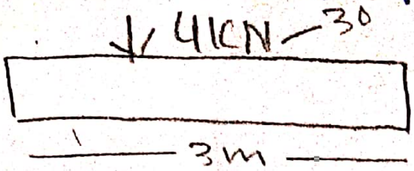
$$t = \frac{\gamma h D}{\sigma_t \times 2}$$

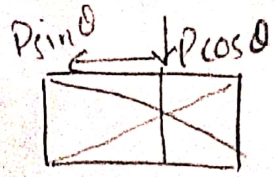
$$t = \frac{(62.4) \times 12\,(26)\times 12\,(22)\times 12)}{(6000) \times 2}$$

$$t = 0.2474$$

$$t = 0.0206\ ft$$

Question: 2 Part (A)



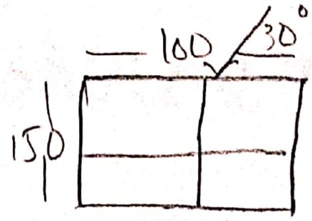


Given:

Load = 4kN

$\theta = 30^\circ$

Length = 3m



Required:

$\sigma_x = \frac{M_x y}{I_x}$ (Bending stress)

$\sigma_y = \frac{M_y x}{I_y}$

Location of neutral axis = ?

$\sigma = \sigma_x + \sigma_y$

Solution:

$M_x = P\cos\theta$

$= (\cos 30^\circ \times 2) \times 150/2$

$= (4 \times 0.866) \times (0.075)$

$= 259.8$ Nm

$M_y = P\sin\theta x$

$\Rightarrow M_y = 4\sin 30^\circ \times 0.05$

$M_y = 100$ NM

Now

$$I_x = \frac{bh^3}{12}$$

$$\Rightarrow I_x = \frac{0.4(0.15)^3}{12}$$

$$I_x = 2.8125 \times 10^{-5} m^4$$

$$I_y = \frac{hb^3}{12}$$

$$= \frac{0.15(0.1)^3}{12}$$

$$\underline{I_y = 1.25 \times 10^{-5} m^4}$$

$$\sigma_x = \frac{M_x}{I_x}$$

$$\Rightarrow \sigma_x = \frac{259.8}{2.8125 \times 10^{-5}}$$

$$\sigma_x = 9.237 MNm^2$$

$$\sigma_y = \frac{M_y}{I_y}$$

$$\sigma_y = \frac{100}{1.25 \times 10^{-5}}$$

$$\sigma_y = 8 MNm^2 \text{ (compression)}$$

Now

Total bending stress, $\sigma = -\sigma_x + \sigma_y$

$$\Rightarrow \sigma = -9.237 + 8$$

$\Rightarrow \sigma = -1.237 \, MN m^2$

Now for neutral axis of unsymmetrical bending

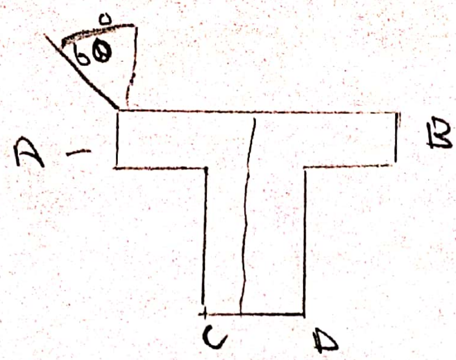
$$\tan\alpha = \frac{I_x}{I_y} \cdot \frac{M_y}{M_x}$$

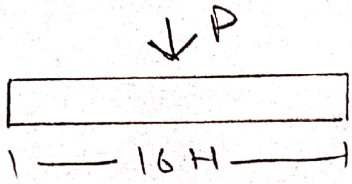
$$= \frac{2.8105 \times 10^{-5}}{12 \times 10^{-5}} \times \frac{100}{259.8}$$

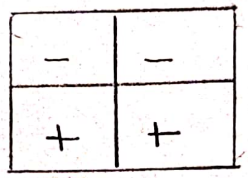
$\tan\alpha = 0.8666$

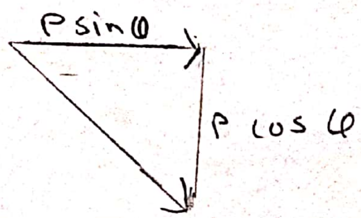
$\alpha = \tan^{-1} 0.8666$

$\alpha = 40.89^\circ$.









the max moment of mid section is

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

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

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

stress of A, B, C, D

A →

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

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

$$= -0.654P - 6.6P$$

$$= -7.2 \text{ Compression}$$

$\sigma_{compression} \le 12000$ psi

$$1200 = -7.25P$$

$$P = 1655.116$$

B →

$$6 = \frac{-40P\cos 60(3.07)}{112.6} + \frac{(48P\sin 60)(3)}{18.7}$$

$$= -0.654P + 6.6P$$

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

$\sigma_{Tension} \le 500$ psi

$$5000 = 6.01P$$

$$P = \frac{5000}{6.01}$$

$$P = 831.94 \text{ lb}$$

$\underrightarrow{C}$

$$6 = \frac{(48 \cos 60)(3.07)}{112.6} + \frac{(48P \sin 60)(3)}{18.7}$$

$$= 0.654P + 6.6P$$

$$= 7.25\ P$$

ξ Tension $\leq$ 5000 psi

$$5000 = 7.25\ P$$

$$P = 689.65\ lb$$

$\underline{D}$

$$= + \frac{(48P \cos 60)(3.0)}{112.6} - \frac{(48P \sin 60)(3)}{18.7}$$

$$= 0.654P - 6.6\ P$$

$$= -5.946\ P$$

ξ compression = 1200 psi

$$12000 = -5.946\ P$$

$$P = 2018.16\ lb$$

Question 1: 03

Given data:-

length $L = 10ft$

As both sides are hinged

so

$le = l$

$E = 10.3 \times 10^6$

factor of safety $= 2$

$b = 0.75 inch$

$h = 2 inch$

Required:-

safe load =?

Solution:

$$P_{cr} = \frac{\pi^2 EI}{le^2} \qquad \because I = Ar^2$$

$I = Ar^2$

$r = \sqrt{I/A}$

$$r = \sqrt{\frac{\frac{hb^3}{12}}{bh}} \Rightarrow \sqrt{\frac{b^2}{12}}$$

$$r = \frac{b}{2\sqrt{3}} \Rightarrow \frac{0.75}{2\sqrt{3}}$$

$r = 0.216 inch$

$$P_{cr} = \frac{\pi^2 EA}{(le/r)^2}$$

$$\Rightarrow \frac{(3.14)^2 (10.3\times10^6)(1.5)}{(10/0.216)^2}$$

$$\boxed{P_{cr} = 853.8434}$$

$$\text{Safe load} = \frac{\text{crippling load}}{\text{factor of safety}}$$

$$\Rightarrow \frac{853.8434}{2}$$

$$\text{Safe load} \Rightarrow \boxed{426.917}$$

* for fixed ended column

$$l_e = l/2 = 10/2$$

$$l_e = 5\,ft$$

$$P_{cr} = \frac{\pi^2 EA}{(l_e/r)^2} = \frac{(3.14)^2 \times (10.3\times10^6)(1.5)}{(60/0.216)}$$

$$P_{cr} = 1974.207$$

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

$$= \frac{1974.207}{2}$$

$$\boxed{987.103}$$