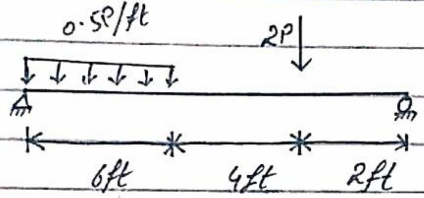
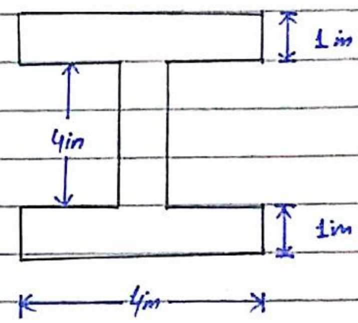
Paper: Mechanics of Solid 2.

ID: 7313 Ahmad Faraz Khan.

Q.No.1: Construct the Mohr's diagram.....
.......... - ...... in pounds.




Given data!

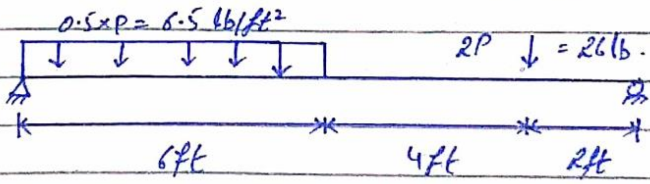
Note: ID = 7313.

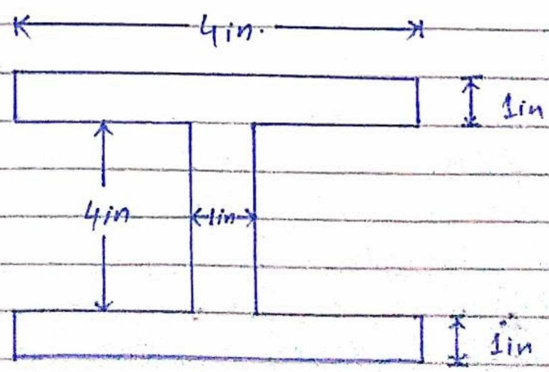
So load = 13 lb.

$P = 13 lb$

$0.5P = 0.5(13) = 6.5 \ lb/ft^2$.

$2P = 2(13) = 26 \ lb$.



## Solution:

Find the force $R_A$ & $R_B$.

$R_A + R_B = 65$ lb.

$\circlearrowleft + \; \Sigma M_A = 0$.

$-6.5 \times 6 \times 3) - (26 \times 10) + 12 R_B = 0$

$-117 - 260 + 12 R_B = 0$.

$R_B \times 12 - 377 = 0$.

$R_B = \frac{377}{12}$

$R_B = 31.41$ lb.

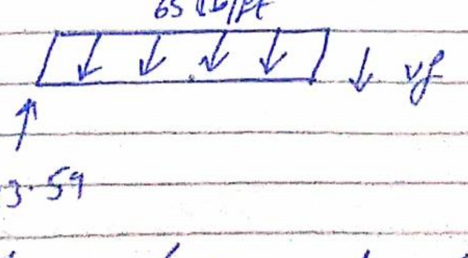
Now we know that.

$R_A + R_B = 65$ lb.

$R_A = 65 - 31.41$

$R_A = 33.59$.

Now shear force at change point of beam



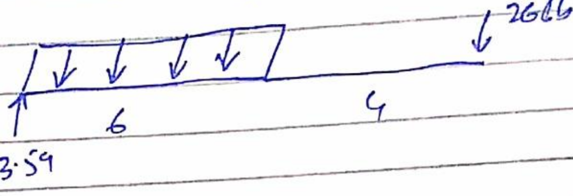

Shear force at 6th ft from left.

$\Sigma f_y = 0 \uparrow +$

$$33.59 - (6.5)\times 6 - Vf_{6'} = 0$$
$$33.59 - 39 = Vf_{6'}$$

$$Vf_6 = -5.41$$

Now shear at 10ft.

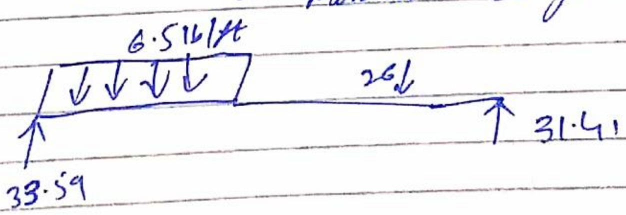


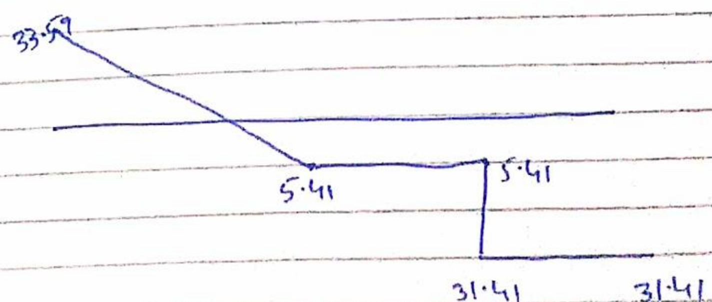

$\Sigma f_y = 0 + \uparrow$

$$33.59 - (6.5)(6) - 26 - Vf_{10} = 0$$

$$Vf_{10ft} = 31 \ (-ve).$$

Shear force ~~diagram~~ and Moment diagram.




By similar triangle.

$$\frac{33.59}{x} = \frac{5.41}{(6-x)}$$

$$201.54 = 33.59x + 5.41x.$$

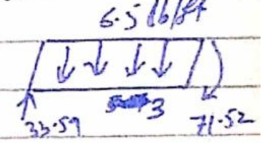
$$x = \frac{201.54}{39}$$

$$x = 5.17.$$

At center of UDL 3ft from left.

(+ $M = -33.59 \times 3 + (6.5)(3) \times (1.5).$

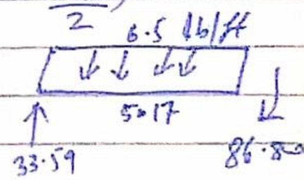
$M = 71.52$ ~~lbft~~ lbft.




at distance 5.17 from left support

(+ . $M = -33.59 \times 5.17 + (6.5 \times 5.17 \times \frac{5.17}{2})$

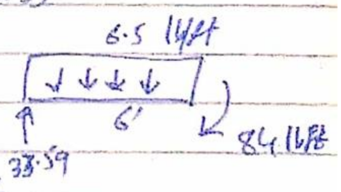
$M = 86.80$ lbft.




At distance 6th from left.

(+ $M = -33.59 \times 6 ) + (6.5 \times 6 \times 3).$

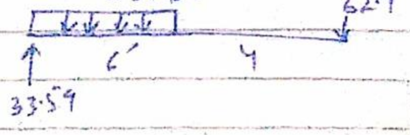
$M = 84$ lbft.

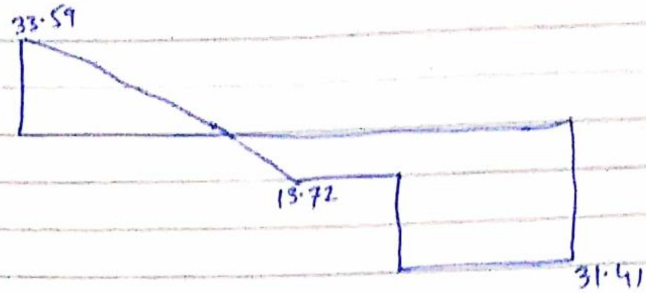


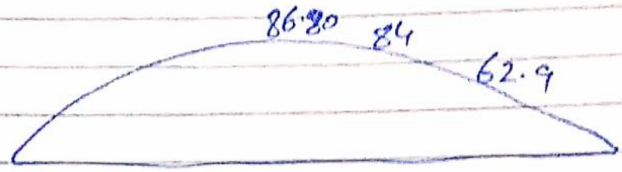

At distance of 10' from left.

(+ $M = -33.59 \times 10) + (6.5 \times 6 \times 7)$

62.9 lbft.






Shear ~~force~~ stress :-

As per the question the maximum shear stress $T = \frac{VQ}{It}$ occurs where the maximum sherforce lies in above diagram max shear force is= 14.09lb

$$+\uparrow \Sigma f_y \Rightarrow 33.59 - 6.5 \times 3 - V = 0$$

$$V = 14.09 lb$$

find Moment of inertia :-

$$I_{xx} = I_{xx_1} + I_{xx_2} + I_{xx_3} \text{ -- from given}$$

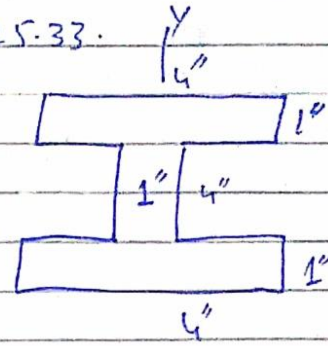
$$I_{x_1} = \frac{1}{12}(4)(1)^3 + 4(2.5)^2 = 25.33$$

$$I_{x_2} = \frac{1}{12}(4^3)(1) + 4(0)^2 = 5.33$$

$$I_{x_3} = \frac{1}{12}(1)^3(4) + (3-5.5)^2 4 = 25.33$$

$$I_{xx} = I_{xx_1} + I_{xx_2} + I_{xx_3}$$

$I_{xx} = 25.33 + 5.33 + 25.33.$




$I_{xx} = 56 \, in^4.$

$I_{yy} = I_{yy1} + I_{yy2} + I_{yy3}.$

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

$= \frac{4^3 \times 1}{12} + \frac{1^3 + 4}{12} + \frac{1 \times 4^3}{12}$

$I_{yy} = 11 \, in^4$

find ~~shear~~ stress at point c.

$T_{xy} - T_{yx} = \frac{VQ}{IB}$

$Q = AY$

$\cancel{A} = Ay.$

$A = 1 \times 4.$

$Q = 4 \, in^2$

$Q = 1 \times 4 \times 2.5$

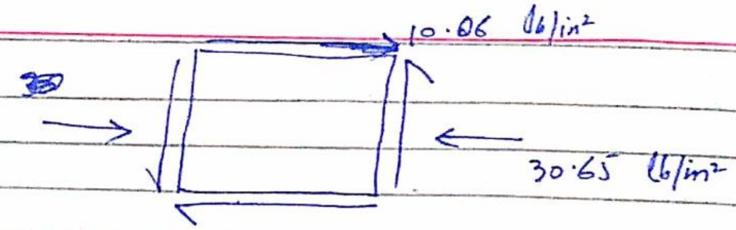
$Q = 10 \, in.$

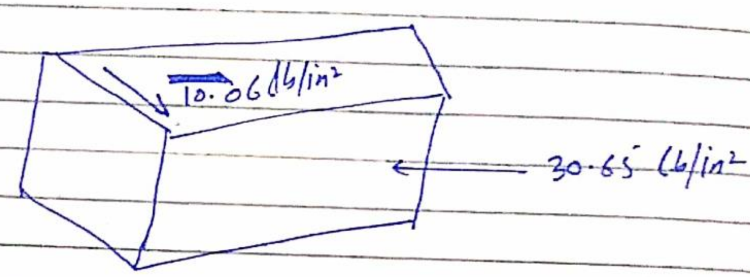
$T_{xy} = T_{yx} = \frac{14.09 \times 10}{56 \times 4} = 10.06 \, lb/in^2.$

$\sigma M = \frac{My}{I} = \frac{12 \times 71.52 \times 0}{56} = 30.56 \, lb/in^2$

Stress at point c.

$\tau = 0.629 \, lb/in^2$




Assume element rotate at 30°

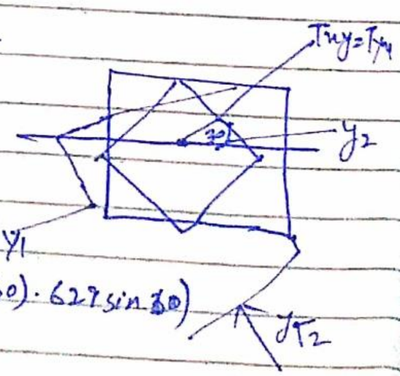
~~Use~~ As we know that

$$\sigma_{x'} = \frac{\sigma_x + \sigma_y}{2} + \frac{(\sigma_x - \sigma_y)}{2}(\cos 60) + \tau_{xy} \sin 60$$

$$= 33.65 + 0 + (-33.65 + 0)(\cos 2 \times 30^\circ) + .629 \sin 60^\circ$$

$$\sigma_x = -22.44 \text{ lb/in}^2$$

for dy.

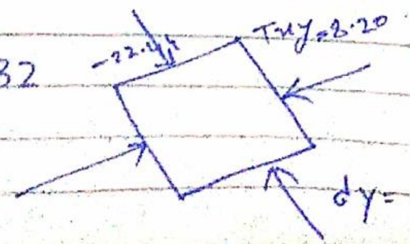



$$\sigma_y = 33.65 + 0 - (-33.65 \div 0)(\cos 60) \cdot .629 \sin 30)$$

$$= -8.20 \text{ lb/in}^2$$

$$\tau_{xy'} = -33.65 - 0 \sin 60 + .629 \cos 60$$

$$= 15.32$$



find Principlal !

$$\sigma_{1,2} = \frac{33.65+0}{2} \pm \sqrt{\left(\frac{33.65-0}{2}\right)^2 + (15.32)^2}$$

$$= -32.30 \pm 32.33.$$

$$= 0.03 \ lb/in^2.$$

$$= -32.30 - 32.33 = -64.63 \ lb/in^2$$

To find $\theta P$.?

$$\tan 2\theta p = \frac{\tau xy}{(\sigma x - \sigma y/2)} = \frac{15.32}{(30.65-0)} = 0.499$$

clockwise.

Put general equation.

$$= 33.65 + 0 + (-33.65 + 0) \cos(2)(-2.70).$$
$$+ 15.32 \sin 2(-2.70).$$

$\sigma x_{max} =$ 111.911.

Max in plane shear stress

$$\tan 2\theta = -\frac{(\sigma x - \sigma y)/2}{\tau xy}$$

$$\tan 2\theta = 23.21$$

$\theta =$ 175.11 Anticlockwise.

Mohrs circle.

$$h, h = \left[\frac{-33.65+0}{2}, 0\right]$$

$$= -15.325, 0.$$

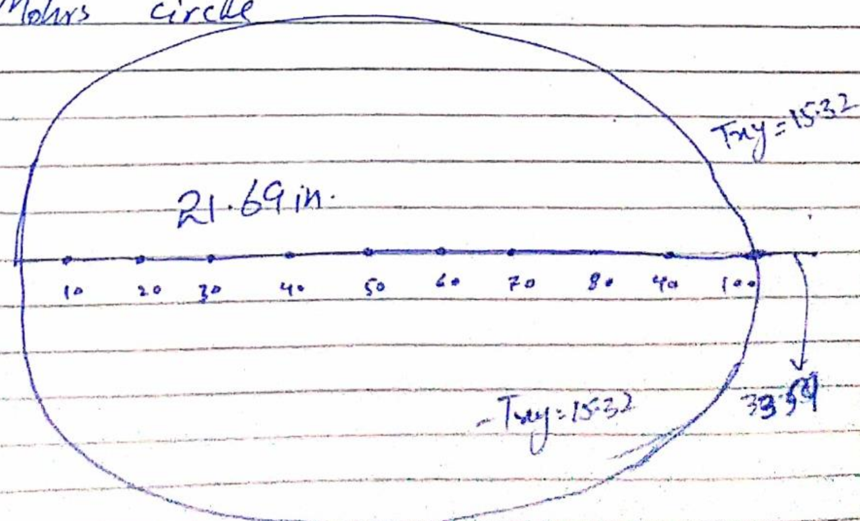
Radius mohr circles is

$$r = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$r = \sqrt{\frac{33.65-0}{2} + (15.32)^2}$$

$$r = 21.69 \text{ in.}$$

Mohrs circle



$\sigma_x = 33.59.$

$\sigma_2 = 0.$

As shown in Mohr circle:-

The value obtain that of principle stress and the maximum shear stress are almost same with value obtained from transformation equation.