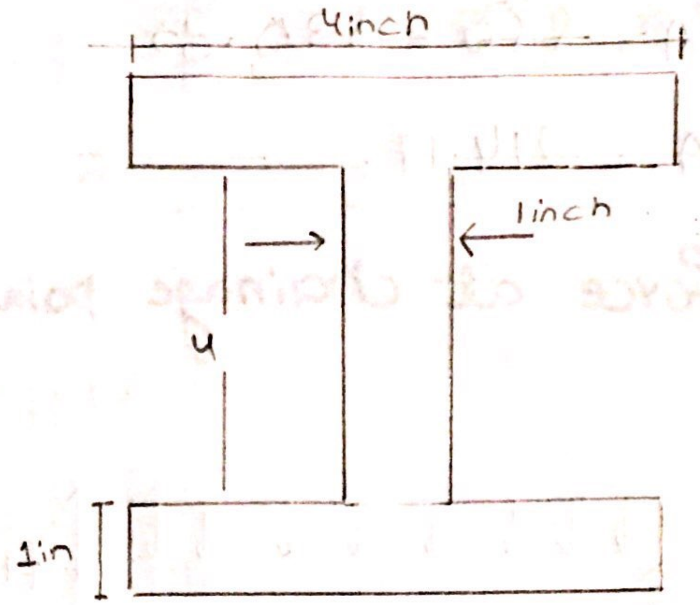
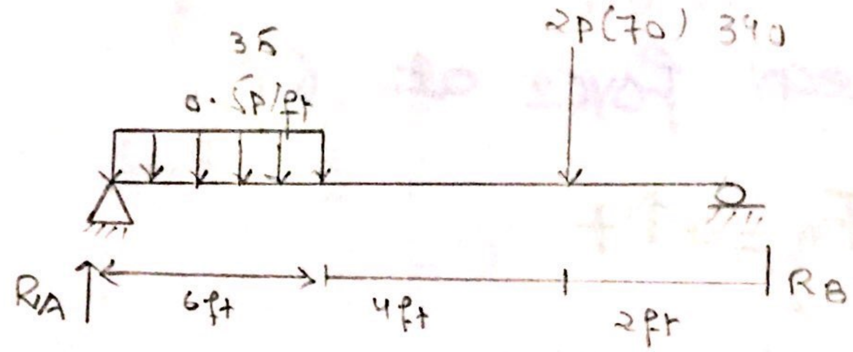
7970, Sec# B






$\Sigma F_y = 0$ ↑ + upward is positive

$$R_A + R_B = 35 \times 6 - 340 = 0$$

$$R_A + R_B = 550.$$

$\Sigma M_A = 0$ ↺ + Anticlockwise is Positive.

$$R_B(12) - 340(10) - 35(6) \times 3 = 0$$

$$R_{B(12)} = 3400 - 630 = 0$$

$$R_B = \frac{4030}{12} = 335.83$$

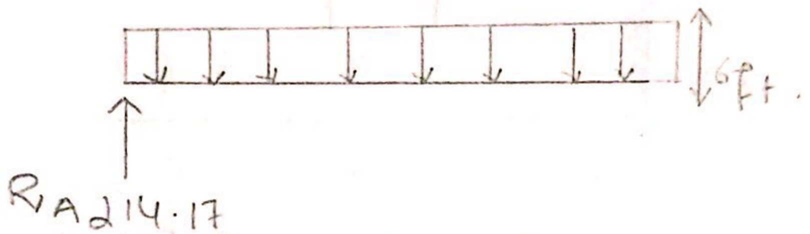
Now:*

$$R_B + R_A = 550$$

$$R_A = 550 - 335.83$$

$$R_A = 214.17.$$

Now shear force at chainage point of Beam:



Shear force at 6 ft.

$$\Sigma F_y = 0 \uparrow +$$

$$-V_{6ft} + 214.17 - 35 \times 6 = 0$$

$$V_{6ft} = 4.17$$

$\Sigma F_y = 0$ Shear force at 10 feet.

$$214.17 - 35 \times 6 - 340 - V_{10ft} = 0$$

$$-335.83 = V_{10ft}.$$

$$V_{10ft} = -335.83.$$

## Moment at Change Points:* #3

Find Zero shear point:

$$\frac{214.17}{x} = \frac{4.17}{6-x}$$

$$214.17(6-x) = 4.17x$$

$$1285.02 - 214.17x = 4.17x$$

$$1285.02 = 4.17x + 214.17x$$

$$128.02 = 218.34x$$

$$x = \frac{128.02}{218.34}$$

$$x = 5.8854$$

→ As we know that moment is max where shear force is zero.

Take section at 5.8854 from left Support. And Find moment.

$$\Sigma M_{5.855} = 0 \circlearrowleft +$$

$$M_{5.855} - 214.17(5.885) + 35 \times 6 \left(\frac{5.885}{3}\right) = 0$$

$$Max = M_{5.885} = 848.440.$$

$\Sigma M_{6ft} =$

$= -214.17 \times 6 + 35(6)\left(\frac{6}{3}\right)$

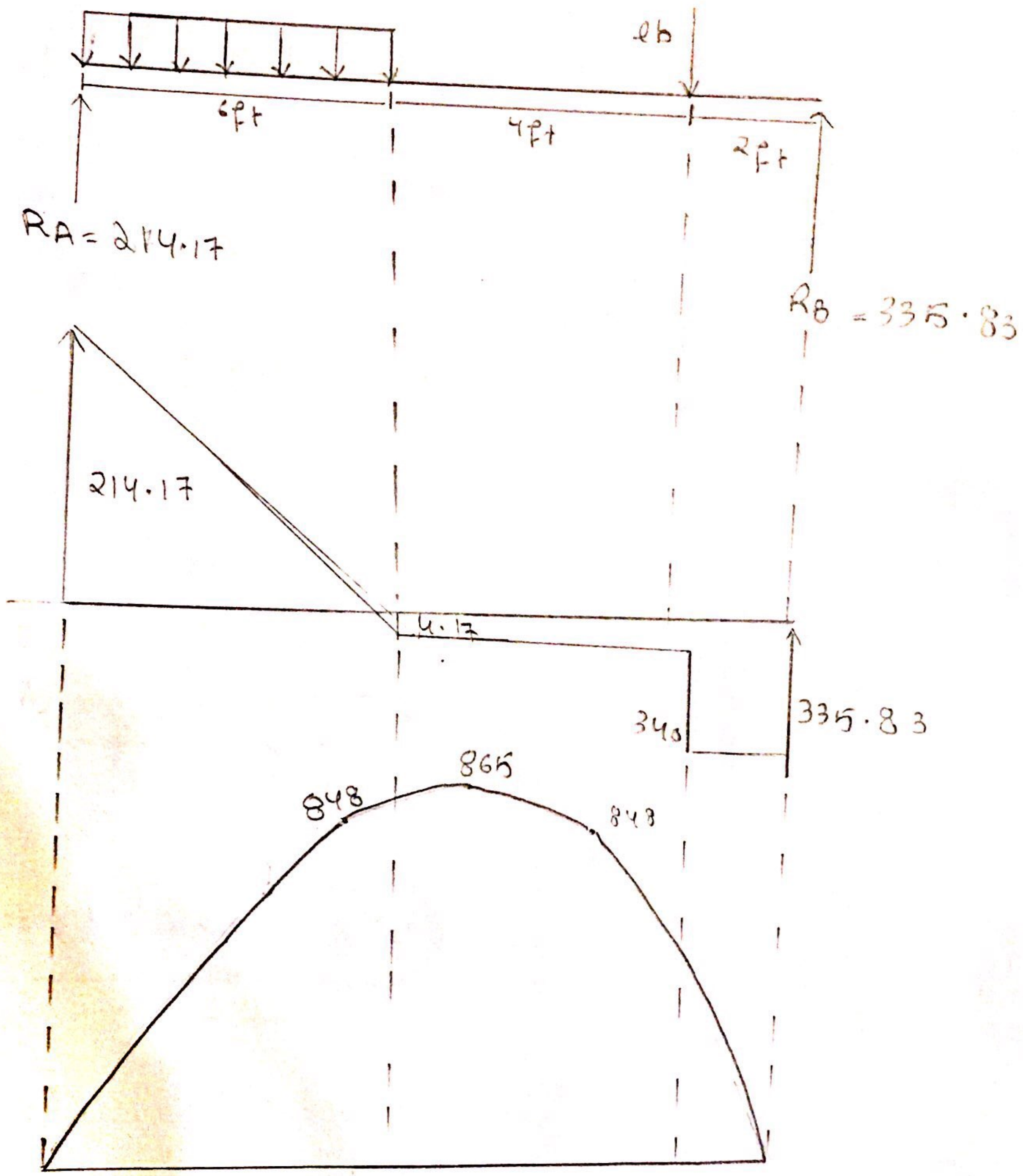
$= 865.02$

$\Sigma M_{3ft} = 0$ (Moment For Centre uniformly distributed load)

$M_3 - 214.17(3) + 35(6)(3) = 0$

$M_3 - 642.51 + 630 = 0$

$M_3 = 12.51$



lb
6ft
4ft
2ft
RA = 214.17
RB = 335.83
214.17
4.17
340
335.83
848
865
848

# Moment of Inertia:- #5

→ $y_1 = 5.5$

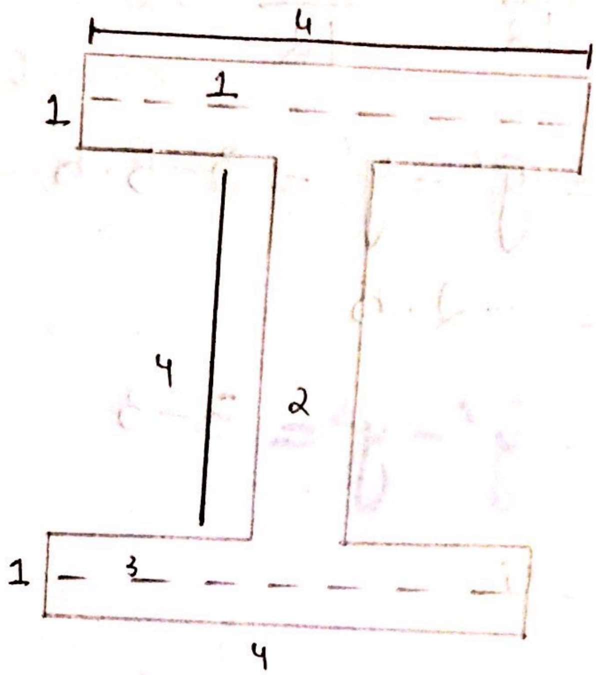
$y_2 = 3$

$y_3 = 0.5$

$A_1 = 4 \, inch^2$

$A_2 = 4$ "

$A_3 = 4$ "




$$\bar{y} = \frac{A_1 \times y_1 + A_2 \times y_2 + A_3 \times y_3}{A_1 + A_2 + A_3}$$

$$\bar{y} = \frac{4 \times 5.5 + 4 \times 3 + 4 \times 0.5}{4 + 4 + 4}$$

$\bar{y} = 3^4$

$I_1 = \frac{bh^3}{12} \Rightarrow \frac{4 \times 1^3}{12}$

$I_1 = 0.33 \text{ inch}^4$

$I_2 = \frac{bh^3}{12} \Rightarrow \frac{1 \times 4^3}{12}$

$I_2 = 5.33 \text{ inch}^4$

#6

$I_3 = \frac{bh^3}{12} = \frac{4 \times 1^3}{12} = 0.33 \text{ inch}^4$

$d_1 = \bar{y}' - y' = 3 - 5.5$

$d_1 = -2.5$

$d_2 = \bar{y}' - y^2 = 3 - 3$

$d_2 = 0$

$d_3 = \bar{y} - y^3 = 2.5$

$\rightarrow I_x$

$I_{1x} = I_1 + A_1 d_1^2$

$I_{1x} = 0.33 + 25$

$I_{1x} = 25.33 \text{ inch}^4$

$I_{2x} = I_2 + A_2 d_2^2$

$I_{2x} = 5.33 + 0 = 5.33 \text{ inch}^4$

$I_{3x} = I_3 + A_3 d_3^2$

$I_{3x} = 0.33 + 25$

$I_{3x} = 25.33$

#8

$I_{xx} = I_{1x} + I_{2x} + I_{3x}$

$I_{xx} = 25.3 + 5.33 + 25.33$

$I_{xx} = ~~1~~55.66 \approx 56 \text{ inch}^4.$

For $V = 335.83$

Case No: 1*

$$\tau_{Top\ Fiber} = \frac{V Q}{I \cdot b}$$

$$= \frac{335.083 \times 0}{56}$$

$$= 0 \text{ psi}$$

Case No 2A: For 1 inch below Topfiber

$$\tau_{1A} = \frac{335.083 \times 10}{56(4)} \qquad \therefore b = 4$$

$$= ~~7.01~~ \text{ psi}. \ 14.95 \text{ psi}$$

Case No 2B:*

$$\tau_{1B} = \frac{335.083 \times 10}{56(1)} \qquad \therefore b = 1$$

$$\tau_{1B} = 59.83 \text{ psi}.$$

$$\sigma = \frac{My}{I}$$

#9.

Moment = 865.02

Moment of Inertia. = I = 56

Case No: 1 (Stress at top fiber)

$$\sigma_{Top} = \frac{My}{I}$$

$$= \frac{865.02 \times 3}{56}$$

$$= 46.340 \text{ psi}$$

Case No: 2 (1 Inch below top fiber)

$$\sigma_1 = \frac{My}{I}$$

$$= \frac{865.02 \times 2}{56}$$

$$= 30.89 \text{ psi}$$

Case No: 3 Stress At Centroidal Axis

$$\tau_{max} = \frac{VQ}{Ib}$$

$$Q = Q_1 + Q_2$$

$$\phi = 10 + 1(2)$$

$$\phi = 12$$

So,

$$\tau_{max} = \frac{335.083 \times 12}{56(1)}$$

$$= 71.8035 \text{ psi}$$

## Case No 4A:- * 1 inch Above Bottom

$$\tau_{2A} = \frac{V\phi}{It} \quad \therefore b = 4$$

$$= \frac{335.083 \times 10}{56 \times 4}$$

$$= 14.95$$

## Case No 4B: *

$$\tau_{2B} = \frac{V\phi}{It} \quad \therefore b = 1$$

$$" = \frac{335.083 \times 10}{56 \times 1}$$

$$" = 59.85$$

## Case No3: (At Geometrical Centroid)

$$\sigma_{centre} = \frac{My}{I} \quad \therefore y = (0)$$

$$'' = 0 \text{ psi}$$

## Case No4:* (1 inch above the bottom fiber)

$$\sigma = \frac{865.02 \times 2}{56}$$

$$\sigma = 30.89 \text{ psi}.$$

## Case No:5* At Bottom fiber.

$$\sigma_{Bottom} = \frac{My}{I}$$

$$\sigma_{Bottom} = \frac{865.502 \times 3}{56}$$

$$= 46.36 \text{ psi}.$$

## Case5:* At Bottom fiber.

$$\tau_B = \frac{VQ}{It}$$

$$\tau_B = \frac{335.083 \times 0}{56(4)}$$

$$\tau_B = 0 \text{ psi.}$$

## Case6:*

Shear force at 6ft from left support.

$$V_{6ft} = 4.17$$

$$Q = 12.$$

$$\tau_{max} = \frac{4.17 \times 12}{56 \times 1}$$

$$\tau_{max} = 0.8935 \text{ psi.}$$

Case No: 7* (At a distance & 1inh Bel

#13.

→ For $b = 4$ $\quad \tau_A = \dfrac{4.17 \times 10}{56(4)}$

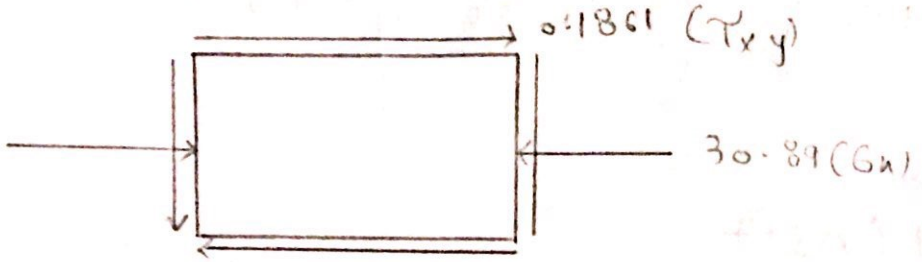
$\quad = 0.1861$ psi

→ For $b = 1$

$\tau_B = \dfrac{4.17 \times 10}{56 \times 1}$

$\quad = 0.7446$ psi.

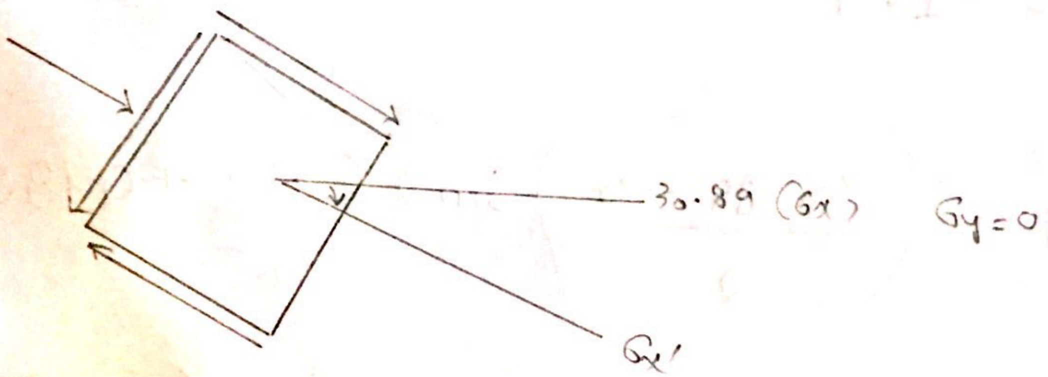
# Shear Stress Transformation: #14




$$\sigma_{av} = \frac{\sigma_x + \sigma_y}{2} = \frac{30.89 + 0}{2}$$

$\sigma_{av} = 15.445$.

Let $\theta$ Assume $= -15°$




$$\sigma_{x'} = -\frac{30.89 + 0}{2} + \left(\frac{-30.89 - 0}{2}\right)\cos 2\theta$$

$$+ 0.1861 \sin 2\theta$$

$$= -15.\cancel{8}445 - 15.445(0.886) + 0.1861(-0.5)$$

$\sigma_x = -29.2$ #15

$$\sigma_y' = \left(\frac{-30.89+0}{2}\right) - \left(\frac{-30.89-0}{2}\right)\cos 2\theta$$

$$-0.1861 \sin 2\theta$$

$$\sigma_y' = -15.445 + 15.445(0.866) - 0.1861 (-0.5)$$

$$\sigma_y' = -1.9$$

$$\tau_{x'y'} = -\left(\frac{-30.89-0}{2}\right)\sin 2(-15) + 0.1861 \cos 2(-15$$

$$'' = 15.445(-0.5) + 0.8161(0.866)$$

$$'' = -7.5.$$

## PRINCIPLE STRESS:*

$$\tan 2\theta_p = \frac{\tau_{xy}}{\sigma_x - \sigma_y / 2}$$

$$\tan 2\theta_p = \frac{0.1861}{15.445}$$

$$\tan 2\theta_p = -0.012$$

$$\theta_p = \tan^{-1}\left(\frac{-0.012}{2}\right)$$

$$\theta_p = \tan^{-1}(-0.06)$$

$$\theta_p = -3.43$$

Now $\longrightarrow$

$$\sigma_x' = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2} \cos 2\theta + \tau_{xy} \sin 2\theta$$

$$\sigma_x' = \frac{-30.89 + 0}{2} + \left(\frac{-30.89}{2}\right) \cos 2(-3.43) + 0.1861 \sin 2(-3.43)$$

#17

$\sigma_x' = -15.445 - 15.445(0.99) + 0.18861(-0.11)$

$\sigma_x' = -30.7$ psI

$\sigma_y' = \frac{\sigma_x + \sigma_y}{2} - \frac{\sigma_x - \sigma_y}{2} \cos 2\theta - \tau_{xy} \sin 2\theta$

$\sigma_y' = \frac{-30.89 + 0}{2} - \left(\frac{-30.89 - 0}{2}\right) \cos 2(-3.43)$

$- 0.1816 \sin 2(-3.43)$

$\sigma_y' = -15.445 + 15.448(0.99) - 0.1861(-0.11)$

$\sigma_y' = -0.13$ psI.

Shear Stress: *

#18

$$\tan 2\theta_B = -\frac{(\sigma_x - \sigma_y)/2}{\tau_{xy}}$$

$$\tan 2\theta_B = -\frac{(-30.89 - 0)/2}{0.1861}$$

$$" = \frac{15.445}{0.1861} \Rightarrow 82.9$$

$$\theta_B = \tan^{-1}\left(\frac{82.9}{2}\right)$$

$$\theta_B = \tan^{-1}(41.45)$$

$$\theta_B = 88.61^\circ$$

Now →

$$\tau_{x'y'} = -\frac{\sigma_x - \sigma_y}{2} \sin 2\theta + \tau_{xy} \cos 2\theta$$

$$" = -\left(\frac{-30.89 - 0}{2}\right) \sin 2(88.61) + 0.1861 \cos 2(88.61)$$

$$" = +15.445\,(0.048) + 0.1861\,(-0.99)$$

$$\tau_{x'y'} = 0.55 \text{ psI}.$$

#19.

# MOHR'S CIRCLE: *

Centre Co-ordinates:

$$(h,k) = \left[\frac{\sigma_x+\sigma_y}{2}, 0\right]$$

$$(h,k) = \left[\frac{-30.89+0}{2}, 0\right]$$

$$'' = [-15.445, 0]$$

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

$$r = \sqrt{(15.445)^2 + 0.1861^2}$$

$r = 15.446$ Radius.

# MOHR's Circle

$\sigma_x = -30.89$ PSI, $\sigma_y = 0$

$\tau_{xy} = 0.1861$ PSI

Scale,

2 psi = 2 cm.

Then,

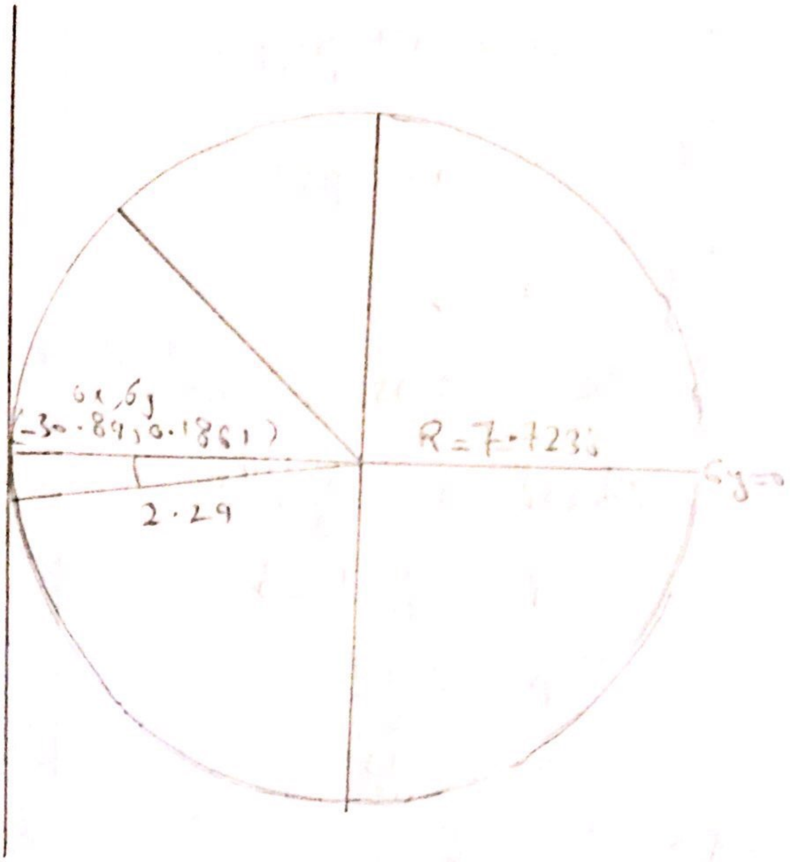
$$\text{Radius} = \frac{x}{2} = \frac{15.446}{2}$$

Radius = 7.723 cm.

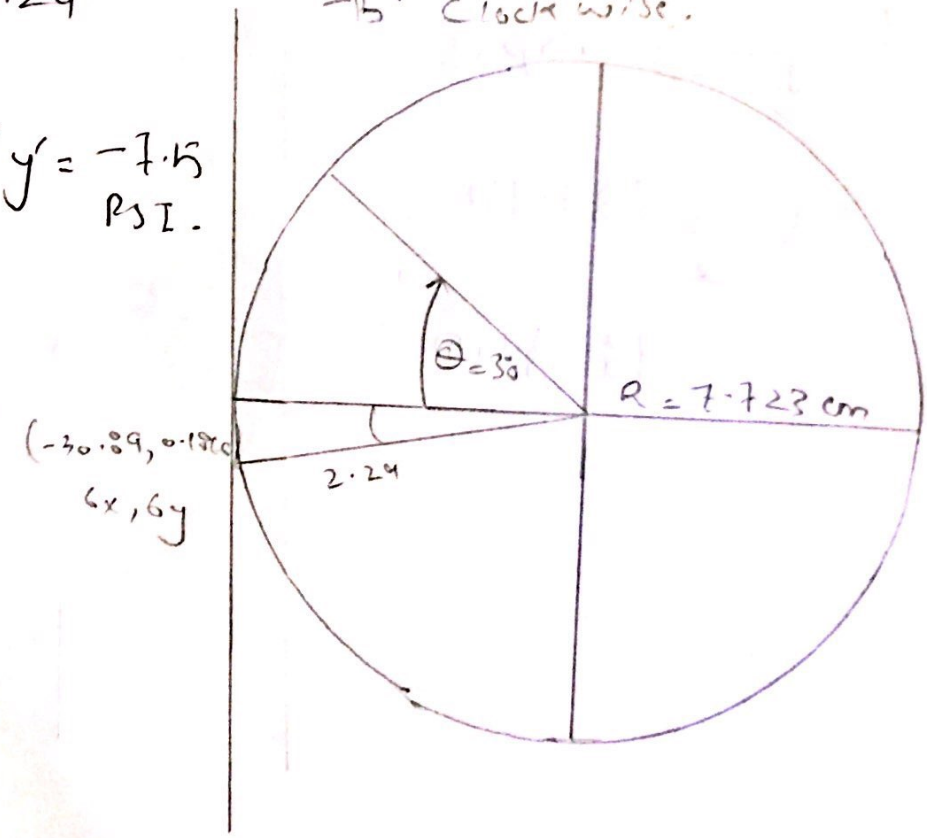
$$\theta = \tan^{-1}\left(\frac{0.1861}{30.89+15}\right)$$

$$\theta = \tan^{-1} 6.94 = 2.29°$$

$\sigma_{x'} = -29.2$ PSI, $\tau_{x'y'} = -7.15$ PSI.




For New Orientation.
-15° Clockwise.



→ For Principal Stress

$\sigma_{x''} = -212.64$ psi

$\sigma_{x'} = -30.7$ psI

$\sigma_{y'} = 0$

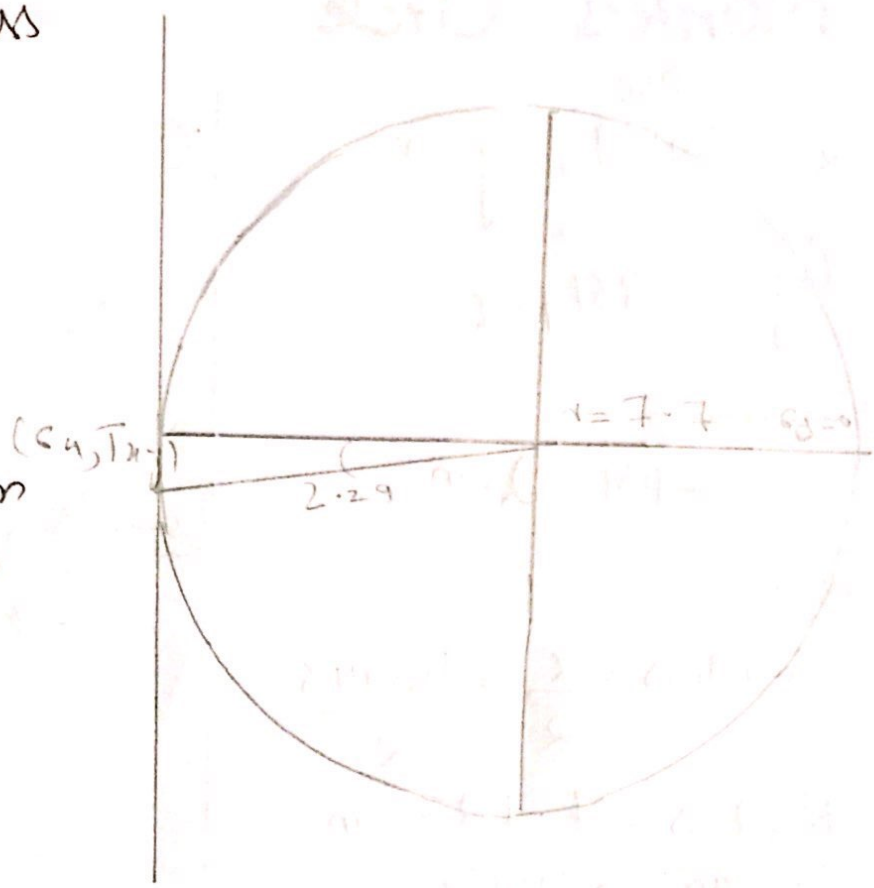
Scale = 1 psI = 2cm

Radius $= \frac{15.446}{2}$

$r = 7.723$

$\theta_p = \frac{2.29}{2}$

$= 1.145$

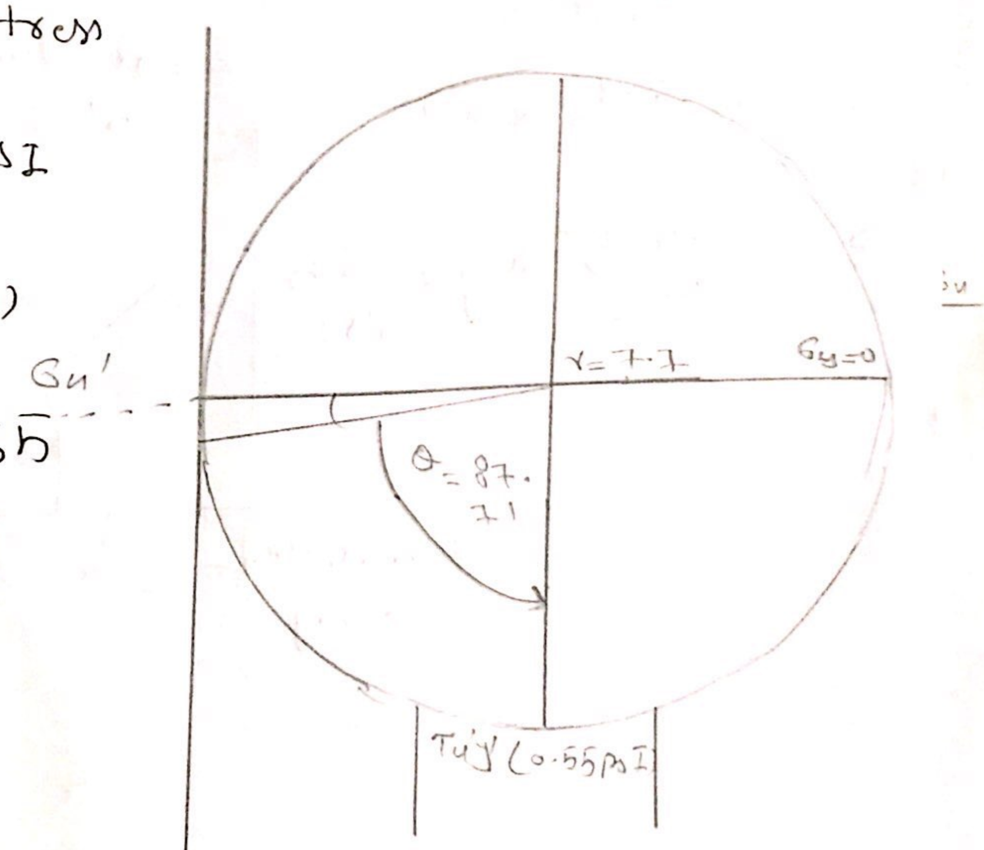



→ For Shear Stress

$\tau_{x'y'} = 0.55$ psI

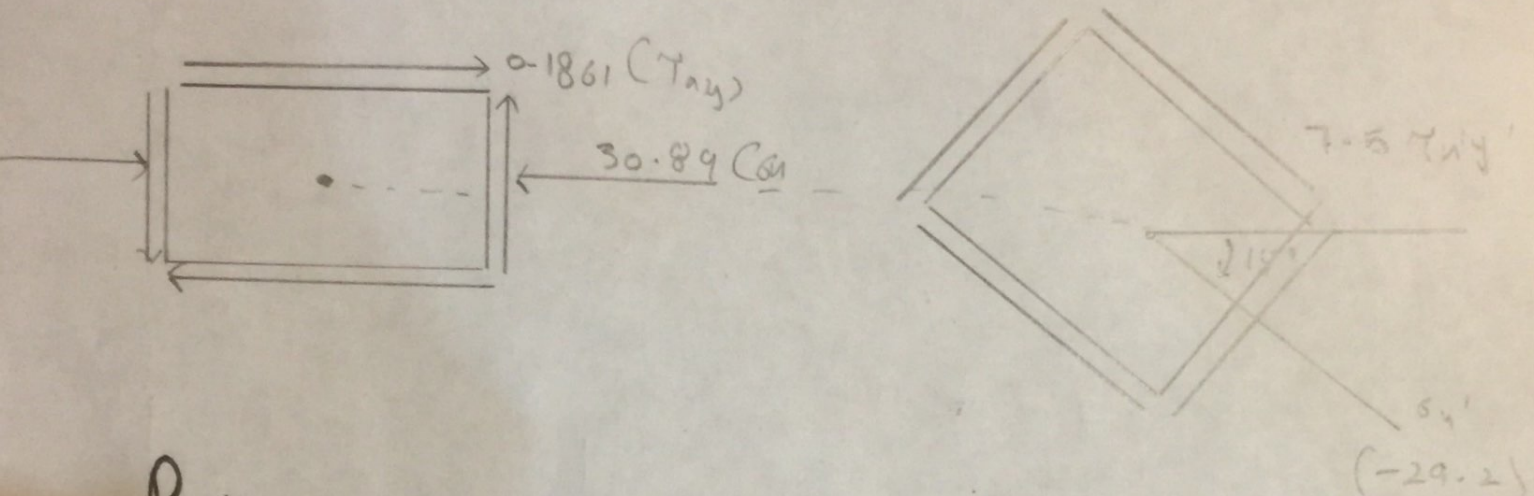
$\theta_s = \frac{1}{2}(87.71)$

$= 43.855$



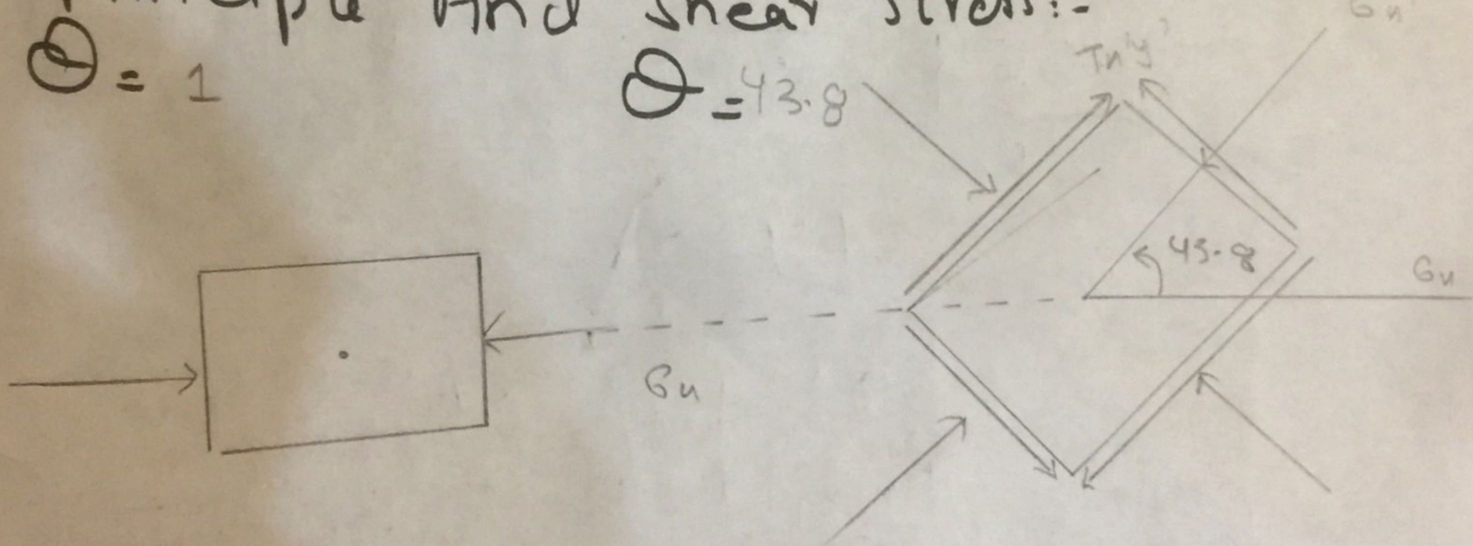
# Result Comparison:

$\theta = 0°$ , $\theta = -15°$ Clock wise




## Principle And Shear Stress:-

$\theta = 1$ $\theta = 43.8$



# SHEAR Force And Bending Stress Diagram:

## Variation :-*