Fic No: _____
(بورڈ کے استعمال کیلئے)

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Subject # Mechanics of Solid (II)

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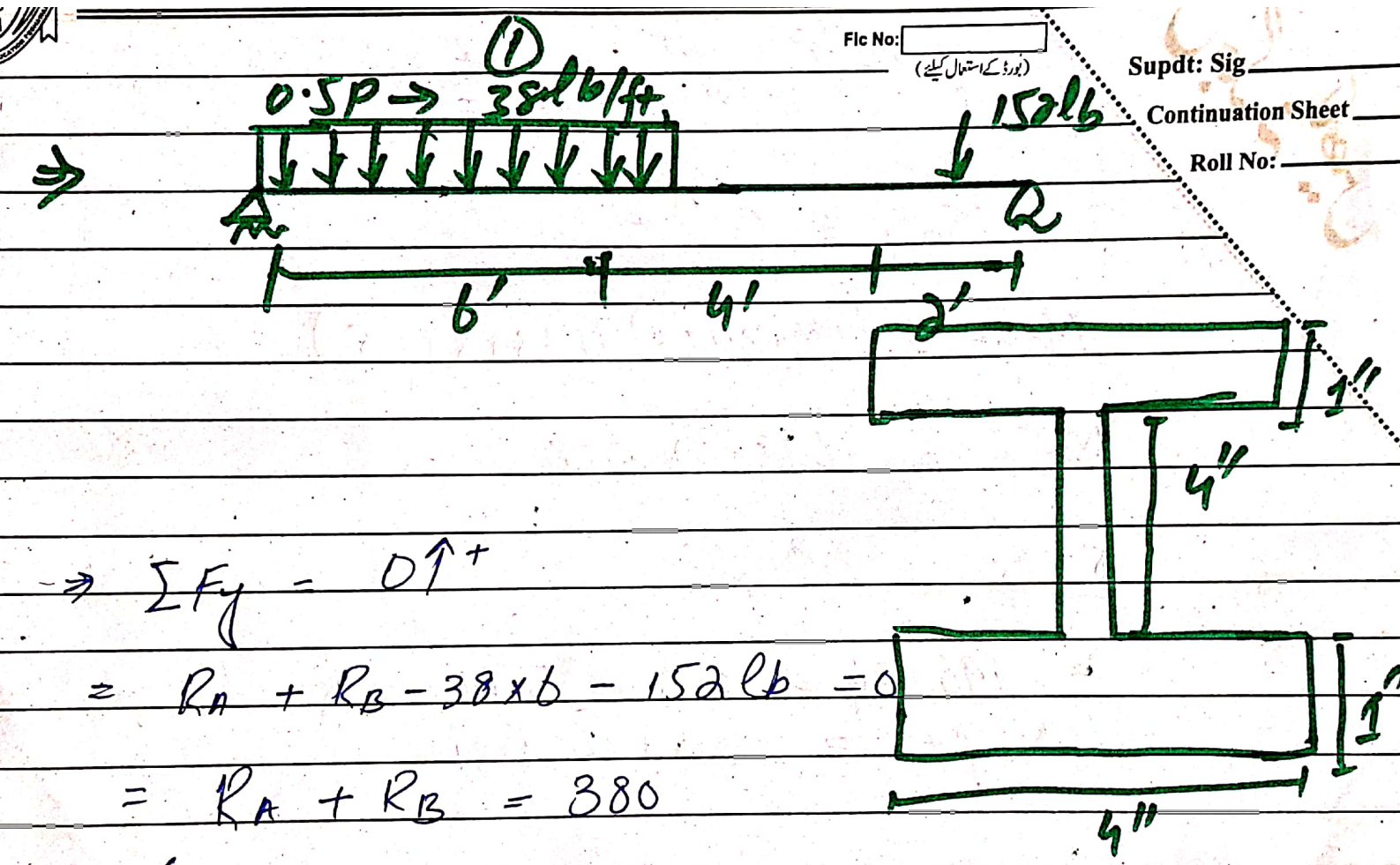


$\Rightarrow \sum F_y = 0 \uparrow +$

$= R_A + R_B - 38 \times 6 - 152\,lb = 0$

$= R_A + R_B = 380$

$\circlearrowleft + \sum M_A = 0$

(a)

$\Rightarrow -(38 \times 6 \times 3) - (152 \times 10) + (R_B \times 12) = 0$

$= 12R_B = 2204$

$= R_B = 183.66 \text{ lb}$

$R_A = R_A + R_B = 380 - R_B$

$R_A = 380 - R_B$

$R_A = 380 - 183.66$

$R_A = 196.34$

(3)

at 6ft

$\Sigma f_y = 0\uparrow +$

$= -V_{6ft} + 196.34 - 38 \times 6 = 0$

$= V_{6ft} = -31.66$

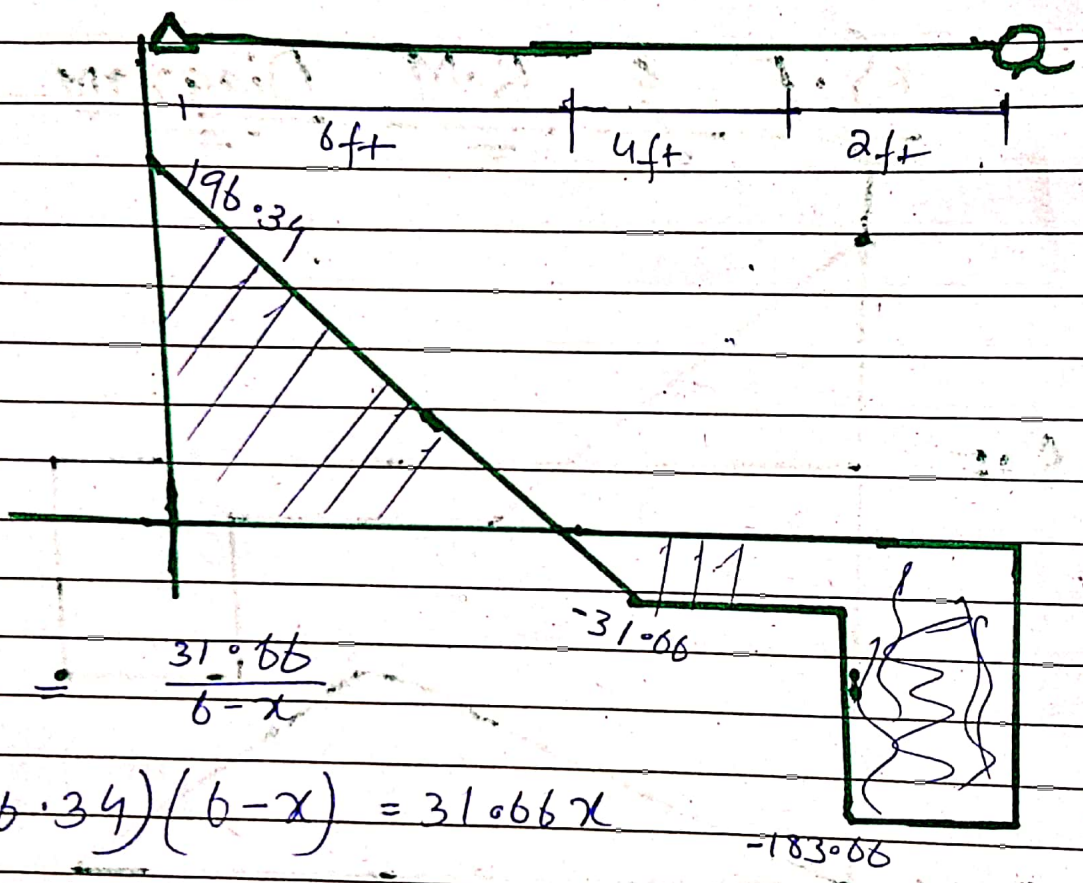
at 10ft

$\Sigma f_y = 0\uparrow +$

$196.34 - 38 \times 6 - 152 - V_{10ft} = 0$

$\boxed{V_{10ft} = -183.66}$

(4)



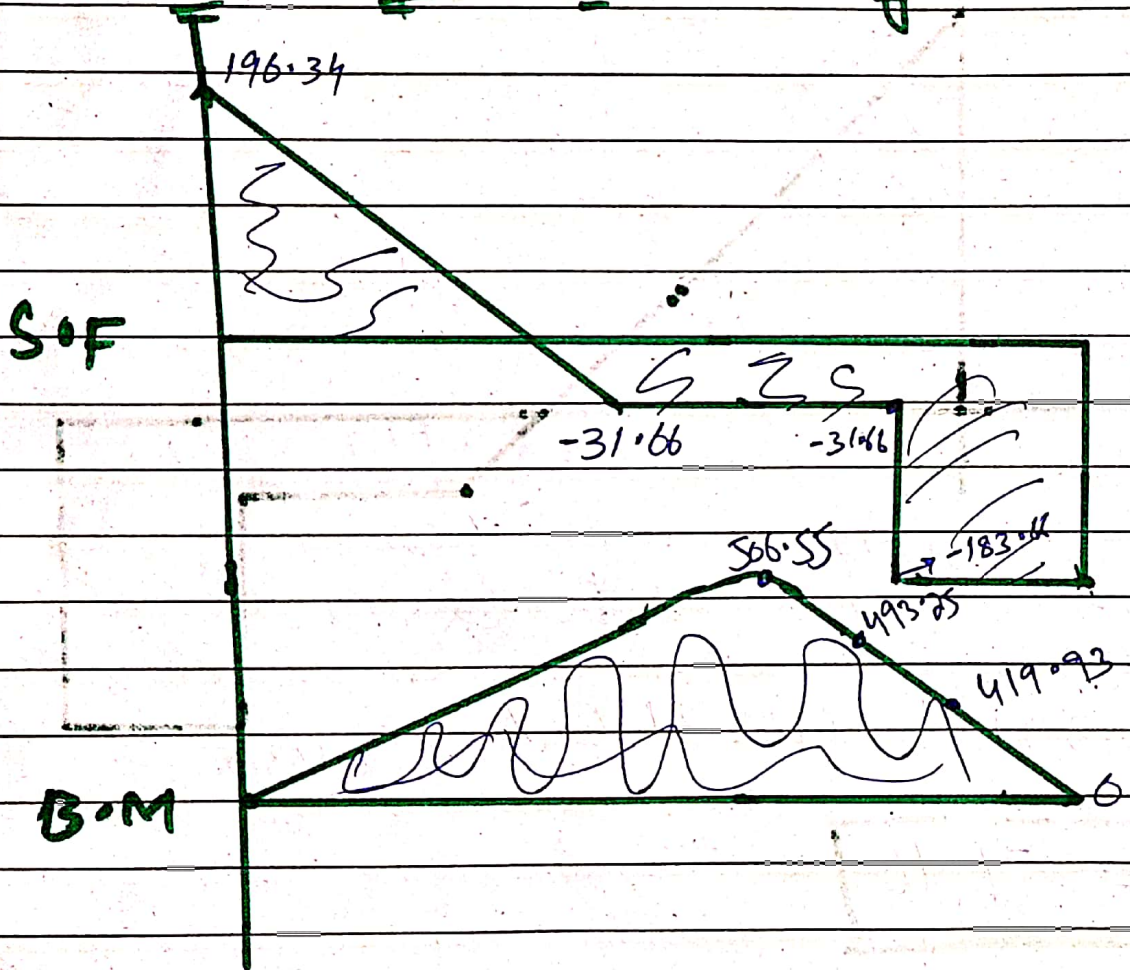
$$= \frac{196.34}{x} = \frac{31.66}{6-x}$$

$$(196.34)(6-x) = 31.66x$$

$$\boxed{x = 7.16}$$

(5)

S.F & B.M Diagram



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Moment at 3ft which is "C" point.

$\sum M_{3ft} = 0 \circlearrowleft +$

$M_{3ft} = (196.34 \times 3) + (38 \times 3 \times 1.5) = 0$

$M_{3ft} = 418.02 \text{ psi}$

$\sum FY = 0 \uparrow +$

$= 196.34 - 38 \times 3 - V_{3ft} = 0$

$V_{3ft} = 82.34 \text{ psi}$

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Shear Stress

To find Shear Stress

$\tau = \frac{V Q}{I b}$ at C point Is is 82.34 psi

Moment of Inertia

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

$I_{xx_1} = \frac{1}{12}(1)^3 + 4(2.5)(2) = 25.33 in^4$

$I_{xx_2} = \frac{1}{12}(4)^3(1) + (4)(0) = 5.33 in^4$

$I_{xx_3} = \frac{1}{12}(1)^3(4) + 4(3 - 5.5)^2 = 25.33 in^2$

(8)

$$I_{xx} = \bar{I}_{xx_1} + \bar{I}_{xx_2} + \bar{I}_{xx_3}$$

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

$$I_{xx} = 56 \text{ in}^4$$

For Shear Stress

$$\tau = \frac{VQ}{Ib}$$

$A = 1 \times 4 = 4 \text{ in}^2$

$Q = 1 \times 4 \times 2.5 = 10 \text{ in}^3$

$$\tau = \frac{82.34 \times 10}{56 \times 4}$$

$$\tau = 3.67 \text{ PSI}$$

(9)

Flexure Stress

The moment at "C" point is 418.02 psi

Flexure Stress $= \sigma = \frac{MY}{I}$

$b_x = \frac{418.02 \times 12 \times 2}{56}$

$b_x = 179.15$ PSI

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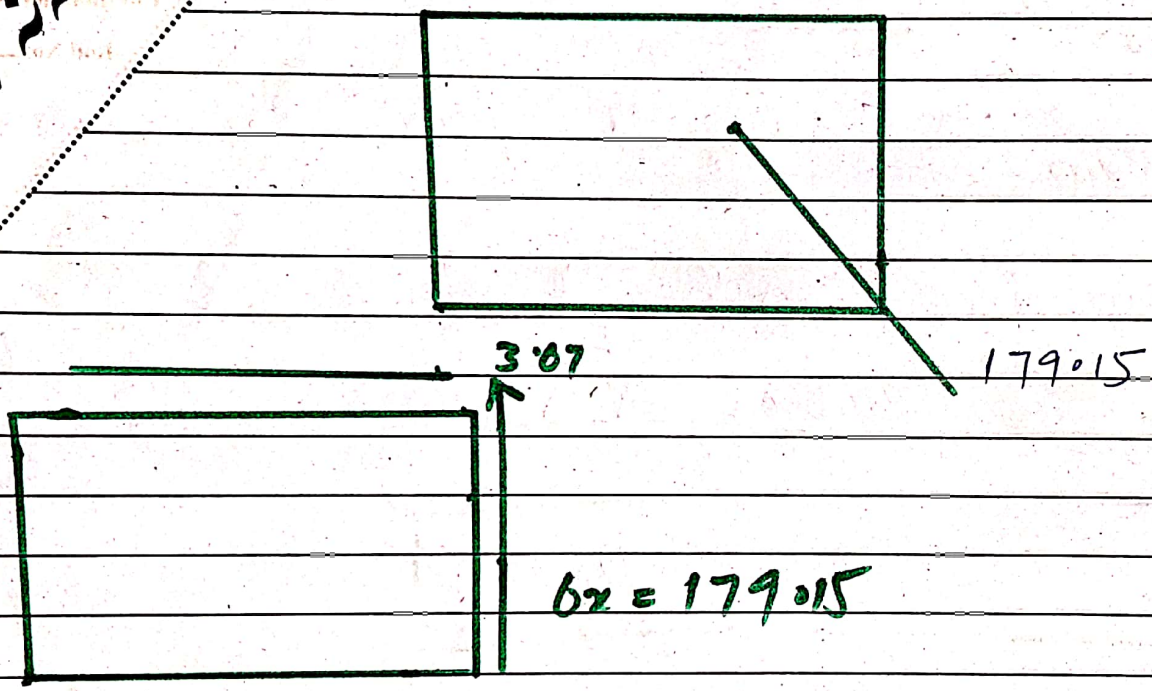
(10)



Stress State condition

Assume angle is 20° clockwise orientation.

$\theta = 20°$

Transformation for σ_{xi}

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

$$\sigma x' = \frac{-179.15 + 0}{2} + \frac{(-179.15 - 0)}{2} \times \cos 2(-20) + 3.67 \sin 2(-20)$$

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$\sigma x' = -160.55$ for $\sigma' y$

$$\frac{\sigma x + \sigma y}{2} - \frac{\sigma x - \sigma y}{2}\cos 2\theta + \tau xy \sin 2\theta$$

$$\sigma y' = \frac{-179.15 + 0}{2} - \frac{(-179.15) - 0}{2}\cos 2(-20) + 3.67 \sin 2(-20)$$

$\sigma y = -23.31$ for $\tau x'y'$

$$\tau x'y' = -\frac{\sigma x - \sigma y}{2}\sin 2\theta + \tau xy \cos 2\theta$$

$$\tau x'y' = \left(\frac{-179.15 - 0}{2}\right)\sin 2(-20) + 3.67 \cos 2(-20)$$

(13)

$$\boxed{\Sigma xy = -54}$$

find it principal stress principal stress equation is

$$\sigma_{1,2} = \sigma_x + \sigma_y \pm \sqrt{\left(\frac{\sigma x - \sigma y}{2}\right)^2 + \tau^2 xy}$$

$$\sigma_{1,2} = \frac{-179.15 + 0}{2} \pm \sqrt{\left(\frac{-179.15 - 0}{2}\right)^2 + (3067)^2}$$

$$\sigma_{1,2} = -89.57 \pm 89.65$$

$$\sigma y = -89.57 + 89.65 = \boxed{0.08 \text{ psi}}$$

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$\sigma_x = \sigma_2 = -89.57 - 89.85 \Rightarrow -179.22 psi$

find $\theta_p = ?$

$\tan 2\theta_p = \frac{\tau_{xy}}{\left(\frac{\sigma_x - \sigma_y}{2}\right)}$

$= \frac{3.67}{\left(\frac{-179.15 - 0}{2}\right)}$

$\theta_p = -2.59$

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put in General equation

$$\sigma'_{max} = \frac{-179.15+0}{2} + \frac{(-179.15-0)}{2}\cos 2(-20.59) + (3.67)\sin 2(-20.59)$$

$$\boxed{\sigma'_{max} = -179.11 \text{ PSI}}$$

Max in plane shear stress

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

$$\tan 2\theta = -\frac{(-179.15-0)/2}{3.67}$$

$$\boxed{\theta_1 = 43.82}$$

Put in general Solution for

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

$$= -\left(\frac{-179.15 - 0}{2}\right)\sin 2(43.82) + 3.67)\cos 2(43.82)$$

$$\boxed{\tau_{x'y'} = 89.57 \text{ psi}}$$

Mohr Circle :- Center Co-ordinate

$$(h, k) = \left(\frac{-179.15 + 0}{2}\right) = (-89.57)$$

Radius of Mohr Circle

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

(17)

$$V = \sqrt{(-179.15 - 0)^2 + (30.67)^2}$$

$$\boxed{V = -89.57 \text{ PSI}}$$