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7983

Section B

MOS 2

4th Semester.

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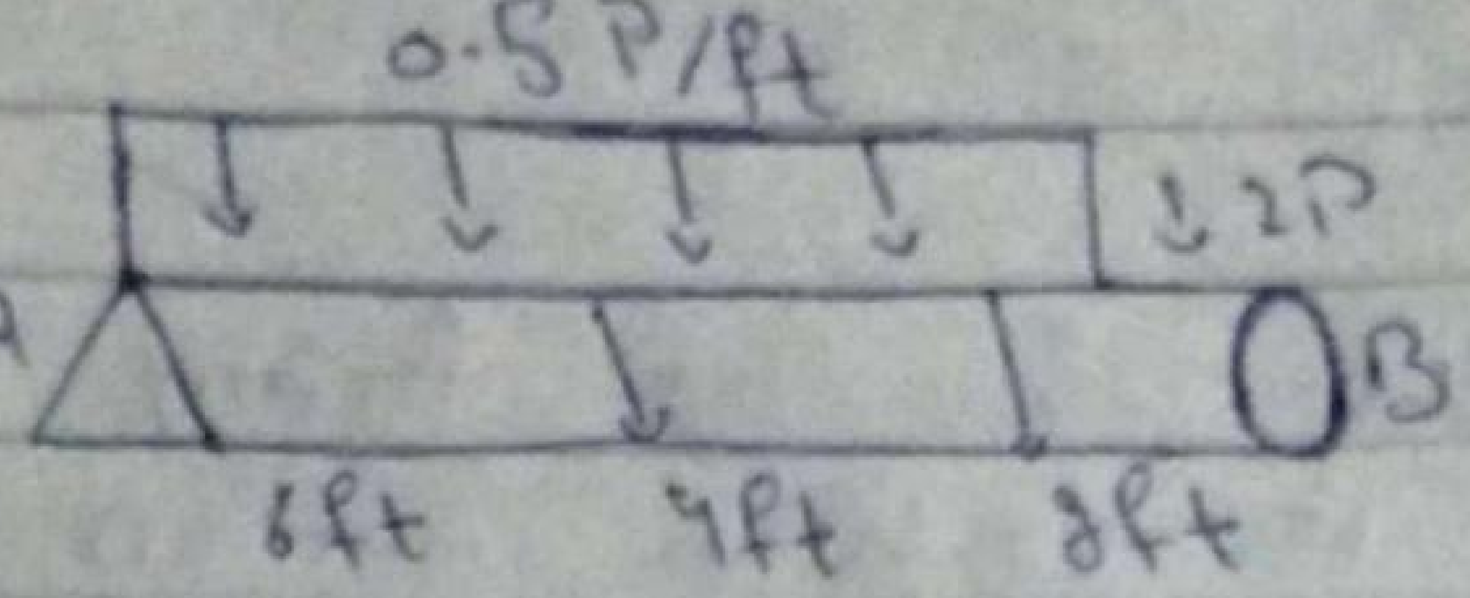

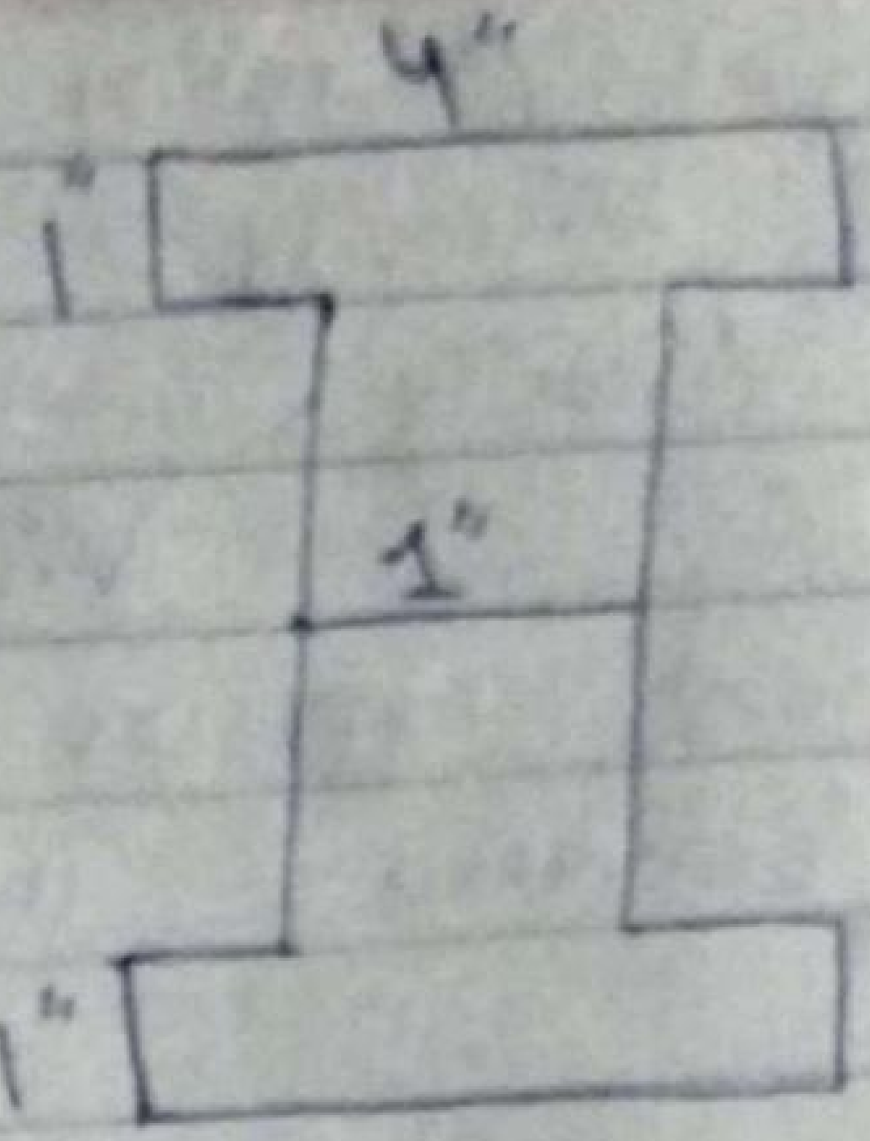

Solution:

$\Sigma f_y = 0$

$RA + RB\ (0.5 \times 83 \times 6) - 2(83) = 0$

$RA + RB = 249 - 166$

$RA + RB = 83$ (equ 1)

Now $\Sigma MA = 0$

$(RA \times 12) - (166 \times 10) - (249 \times 3) = 0$

$RA \times 12 - 1660 - 747 = 0$

$RA \times 12 \quad -913$

$\frac{RA\cancel{12}}{\cancel{12}} = \frac{913}{12}$

$RA = 76.08$

putting RA in equ 1.

$RB + 76.08 = 83$

$RB = -6.92$

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finding:

reactions?

shear force?

Bending moment?

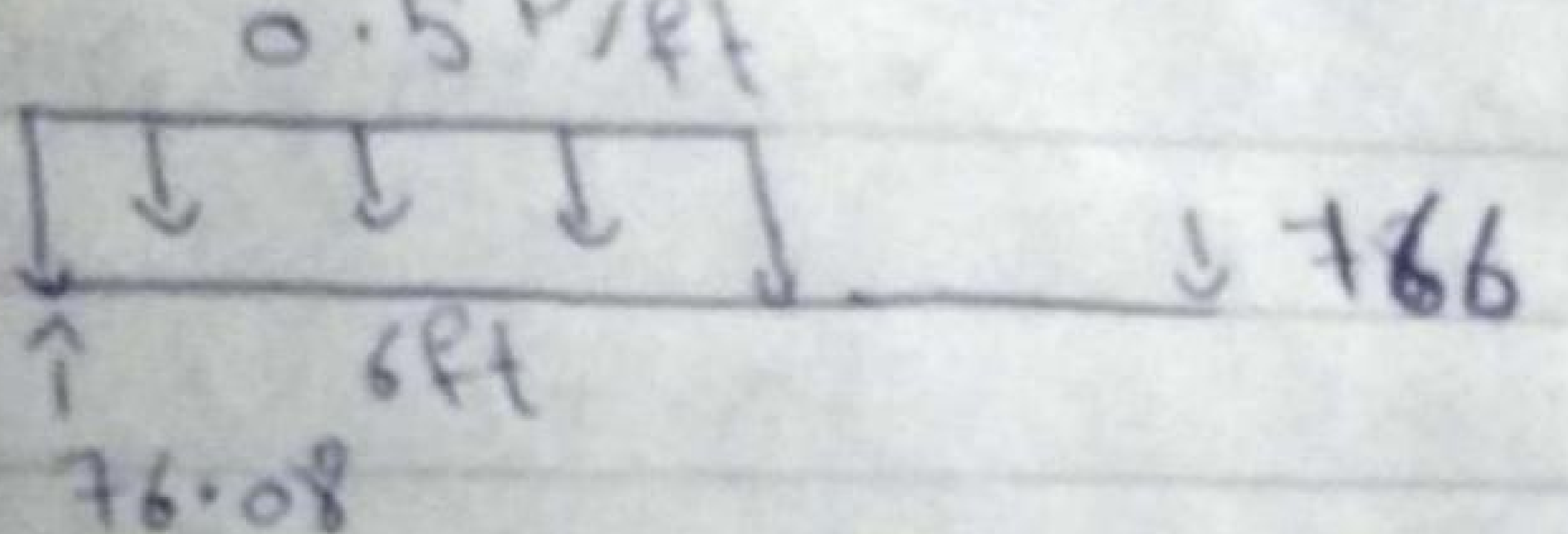
Shear force:

$\Sigma f_y = 0$

$-v_{6ft} + 76.08 - 249 = 0$

$-v_{6ft} = -172.92$

$= 172.92$



$\cancel{(-v_{6ft}}$

$\Sigma f_y = 0$

-6.92

$\cancel{355.95} - 249 - 166 - v_{10ft}$

$-v_{10ft} = \cancel{-359.45} - 421.92$

$v_{10ft} = \cancel{359.945} + 421.92$

Bending moment:

$\Sigma M6ft = (78.06 \times 0.5 \times 6)(83 \times 6)(6/3)$
$M6ft = -234.18 + 996$
$= 761.82$

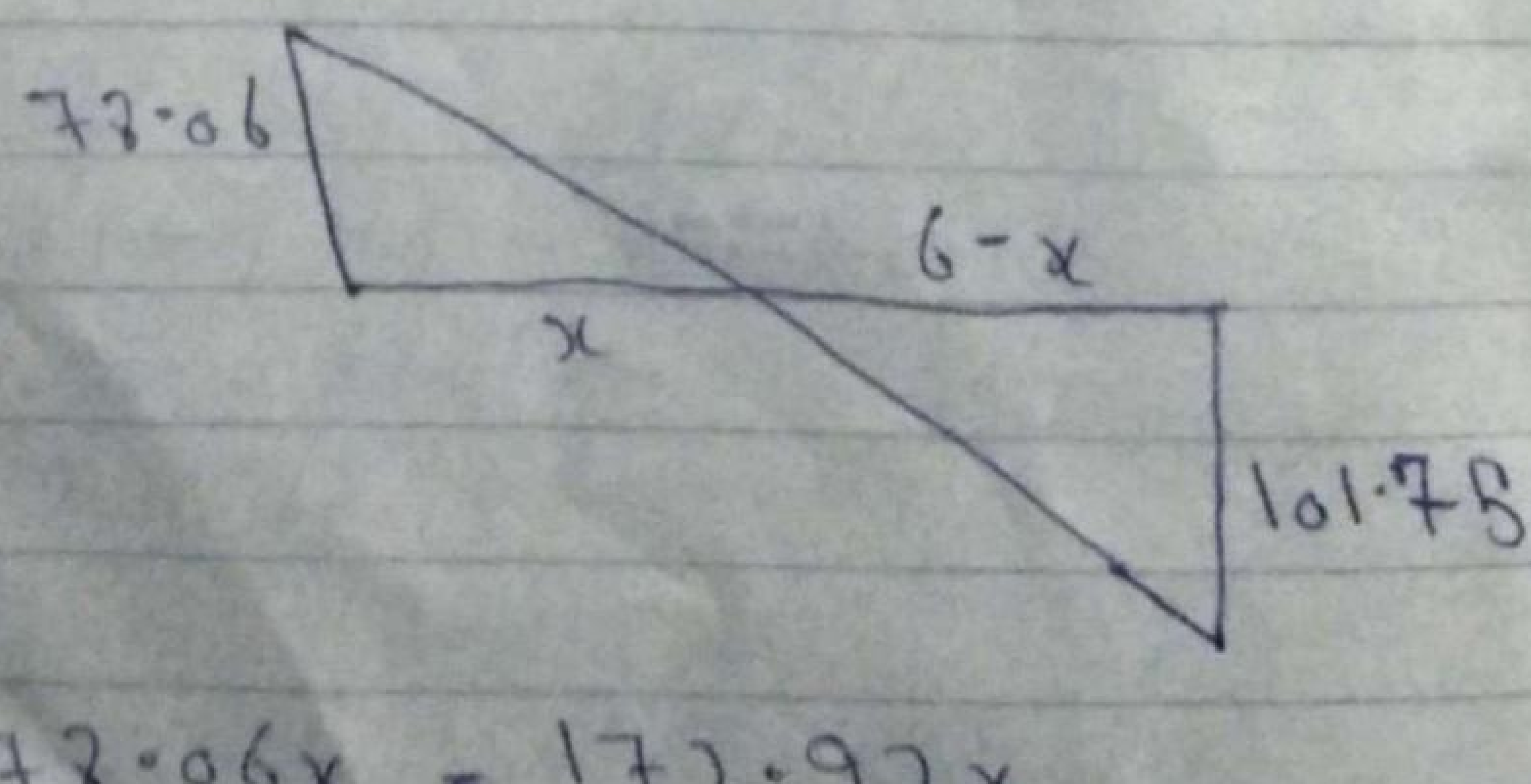
finding moment at 3ft

$\Sigma M_3 ft = -(78.06 \times 3) + (83 \times 6 \times 3)$
$= -(234.18) + (83 \times 6 \times 3)$
$= -(234.18 + 1494)$
$= 1259.82$

(Now at changing point)

$= \frac{78.06}{x} = \frac{172.92}{6-x}$

$= 78.06 \times (6-x) = 172.92x$



$468.36 - 78.06x = 172.92x$

$468.36 = 172.92x + 78.06$
$\frac{468.36}{250.98x} = \frac{250.98x}{250.98x}$

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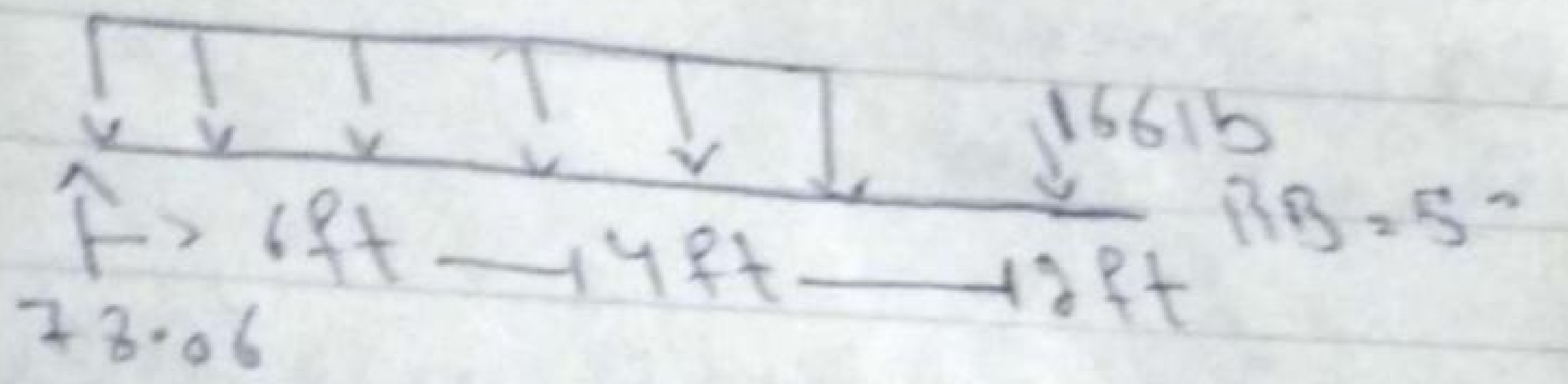
$x = 1.366$

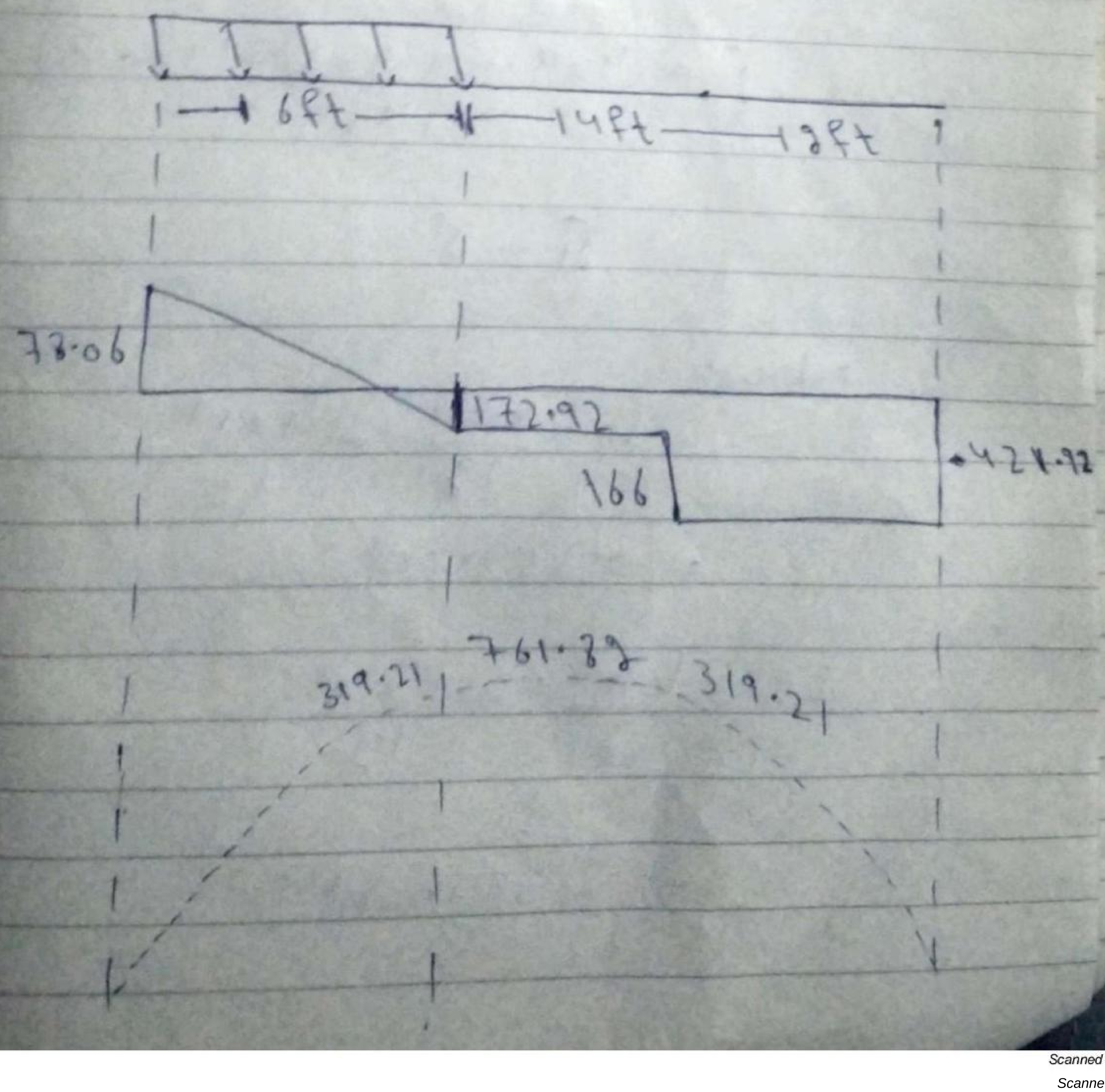
$\Sigma M_{1.366ft} = 0$

$M_{1.366ft} - (73.06 \times 1.366) + (33 \times 6 \times \frac{1.366}{2})$

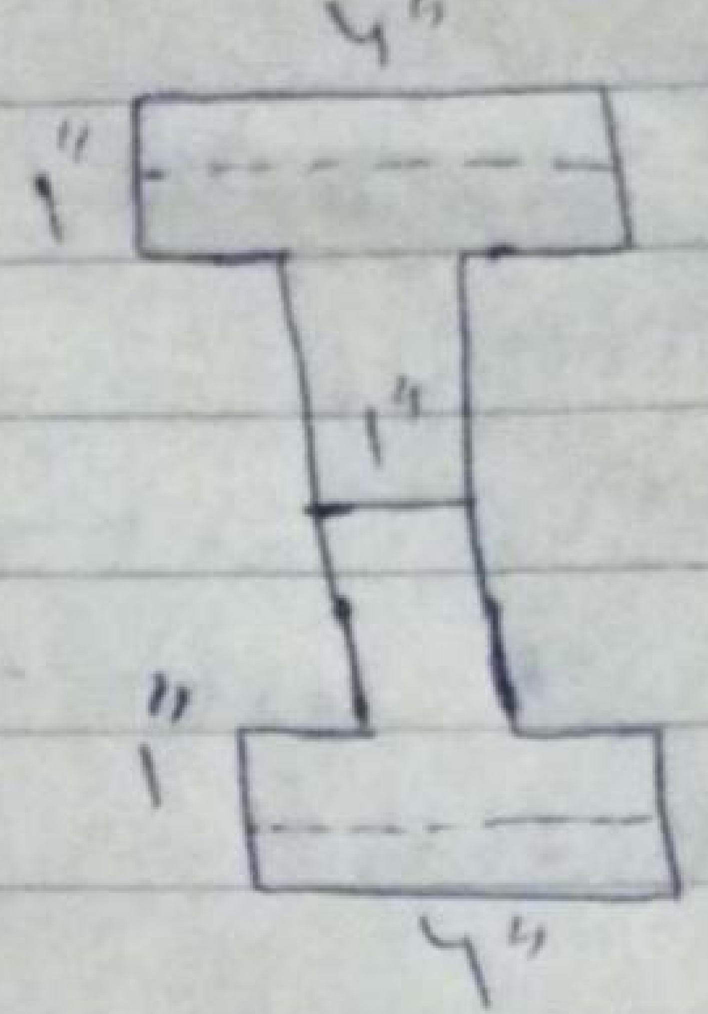
$M_{1.366ft} - (445.42) + (464.63) = 0$

$M_{1.366ft} = 319.21 \text{ lbft}$





Now finding moment of inertia.



$y_1 = 5.5$

$y_2 = 3$

$y_3 = 0.5$

$A_1 = 4 inch^2$

$A_2 = 4 inch^2$

$A_3 = 4 inch^2$

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

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

$$\bar{y} = 3''$$

Now:

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

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

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

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

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$$I_3 = \frac{4 \times 1^3}{12}$$

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

"d"

$d_1 = \bar{y} - y_1$

$d_1 = 3 - 5.5 = -2.5$

$\bar{y} - y_2 \quad d_2 = 3 - 3$

$\cancel{(\bar{y}-y_2)} = d_2 = 0$

$d_3 = \bar{y} - y_3$

$= 2.5$

"Ad^2"

$A_1 d_1^2$

$4 \times (-2.5)^2$

$= 25 \text{ inch}^4$

$A_2 d_2^2$

$4 \times (0)^2 = 0$

$A_3 d_3^3$

$= 25 \text{inch}^4$.

Now:

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

$$I_{1x} = 0.33 + 25$$

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

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

$$I_{2x} = 0 + 5.33$$

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

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

$$= 0.33 + 25$$

$$= 25.33 \text{ inch}^4$$

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$$I_{xx} = I_{1x} + I_{2x} + I_{3x}$$
$$I_{xx} = 25.33 + 5.33 + 25.33$$
$$I_{xx} = 55.99.$$
$$= 56.99 \text{ inch}^4.$$

Part C.

Shear stress:

$$\tau = \frac{VQ}{It} \qquad (A = 0)$$

$$Q = \bar{y}A \qquad , y = 3''$$

$$\tau = \frac{56.99 \times 0}{56 \times 4}$$

$$\tau = 0.$$

Case 2:

$$\frac{(-6.92 \times 10)}{56 \times 4}$$

$$= -4.95 \text{ Psi}$$

$$\tau_B = VQB$$

$$= \frac{(-6.92 \times 1)}{56 \times 1}$$

$$\tau_B = -0.123 \text{ Psi}$$

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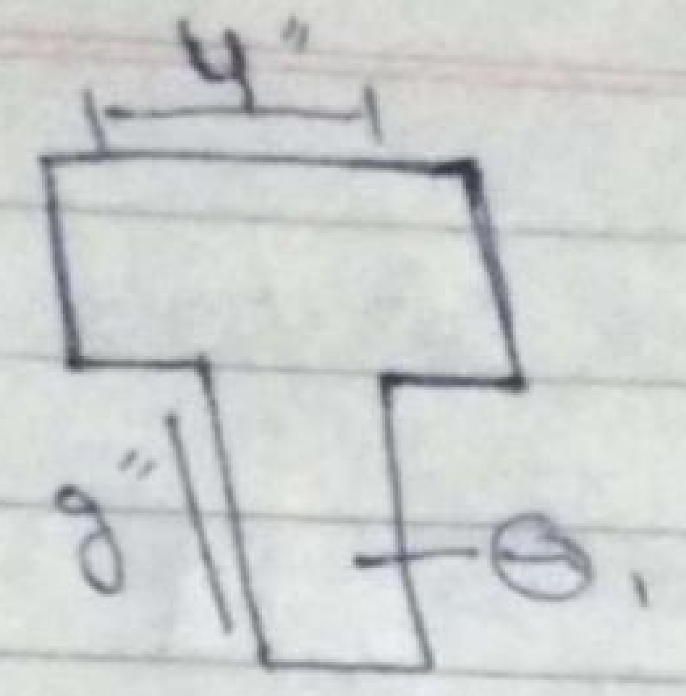
Case 3:



$Q_1 = \bar{y}_1 A_1 = \frac{8}{8}(1\times 2) = 2$

$Q_2 = 2.5\times 4 = 10$

So $Q = 2+10 = 12$

$\tau_{max} = \frac{-6.92\times 12}{56\times 1}$

$= -1.48$ Psi

Case 4:

$\tau_A = \frac{-6.92\times(2.5\times 4)}{56\times 4}$

$\tau_A = 1.235$

$\tau_B = -6.92\times(2.5\times 4)/56\times 4$

$\tau_B = 4.94$

Case 5:

$\bar{y} = 0$, $Q = 4\times 0 = 0$

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

$= \frac{-6.92\times 0}{56\times 1} = 0.12$

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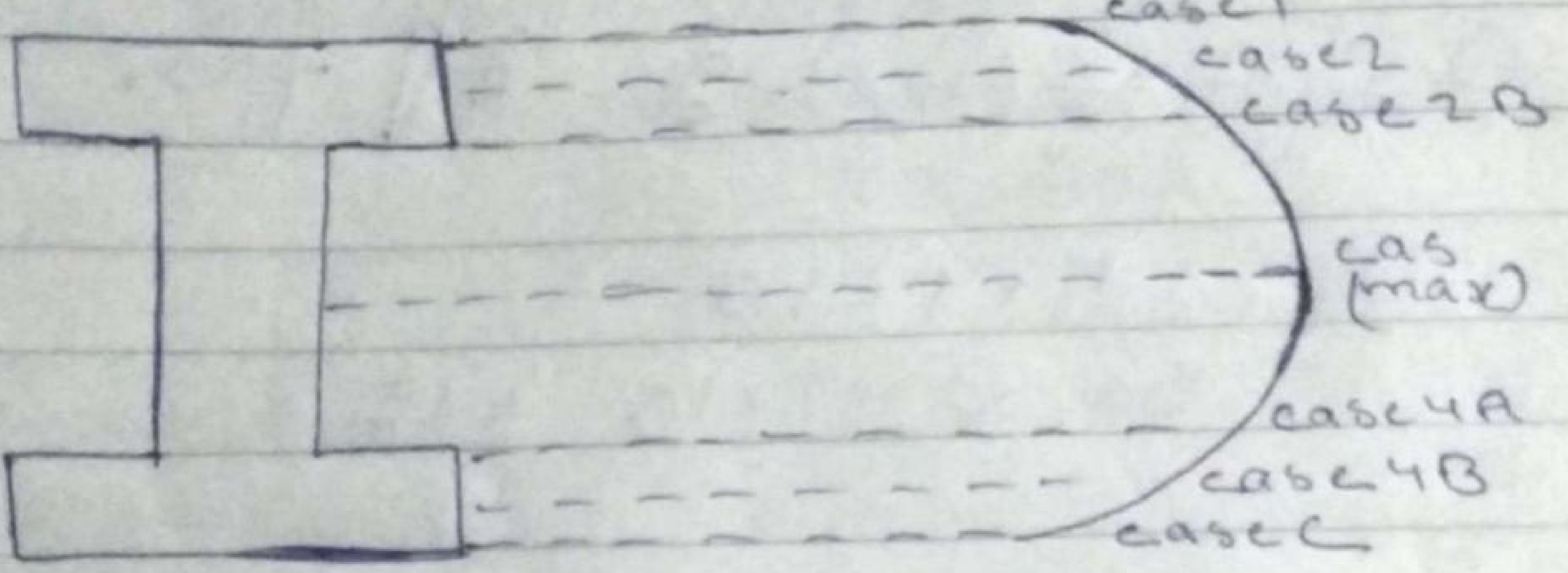
Shear stress variation diagram.



finding maximum shear stress at a distance of 6ft.

$$V = 172.92$$

Case7:

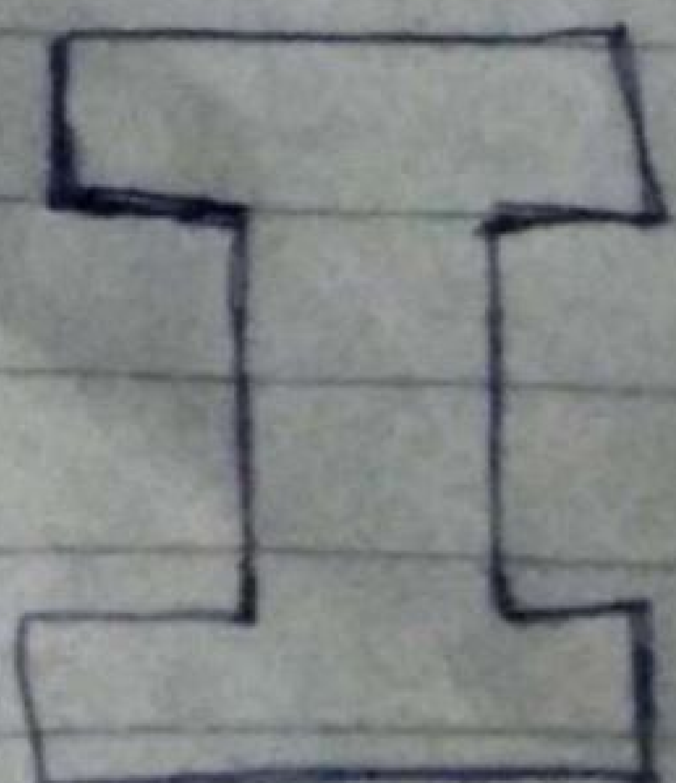
$$\tau = \frac{VQ}{Ib}$$

$$= \frac{172.92}{56 \times 4}$$

$$= 19.35$$

Flexure stress analysis:

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



max bending cap = 185.95 Psi

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Case1:

$$6\bar{c}p = \frac{(185.25)(3)}{56}$$

$$= 9.924 \text{ Psi}$$

Case2:

finding stress at 1inch

$$= \frac{(185.25)(2)}{56}$$

$$= 6.61 \text{ Psi}$$

Case3:

$$6cent = \frac{185.25 \times 0}{56} = 0 \text{ Psi}$$

Case4:

$$6 = \frac{my}{I}$$

$$= \frac{185.25 \times 2}{56} = 6.61 \text{ Psi}$$

Case5:

finding flexure stress at bottom fiber.

$$6_{Bott} = \frac{my}{I} = \frac{185.25 \times 3}{56}$$

$$6_{Bott} = 9.92 \text{ Psi}$$

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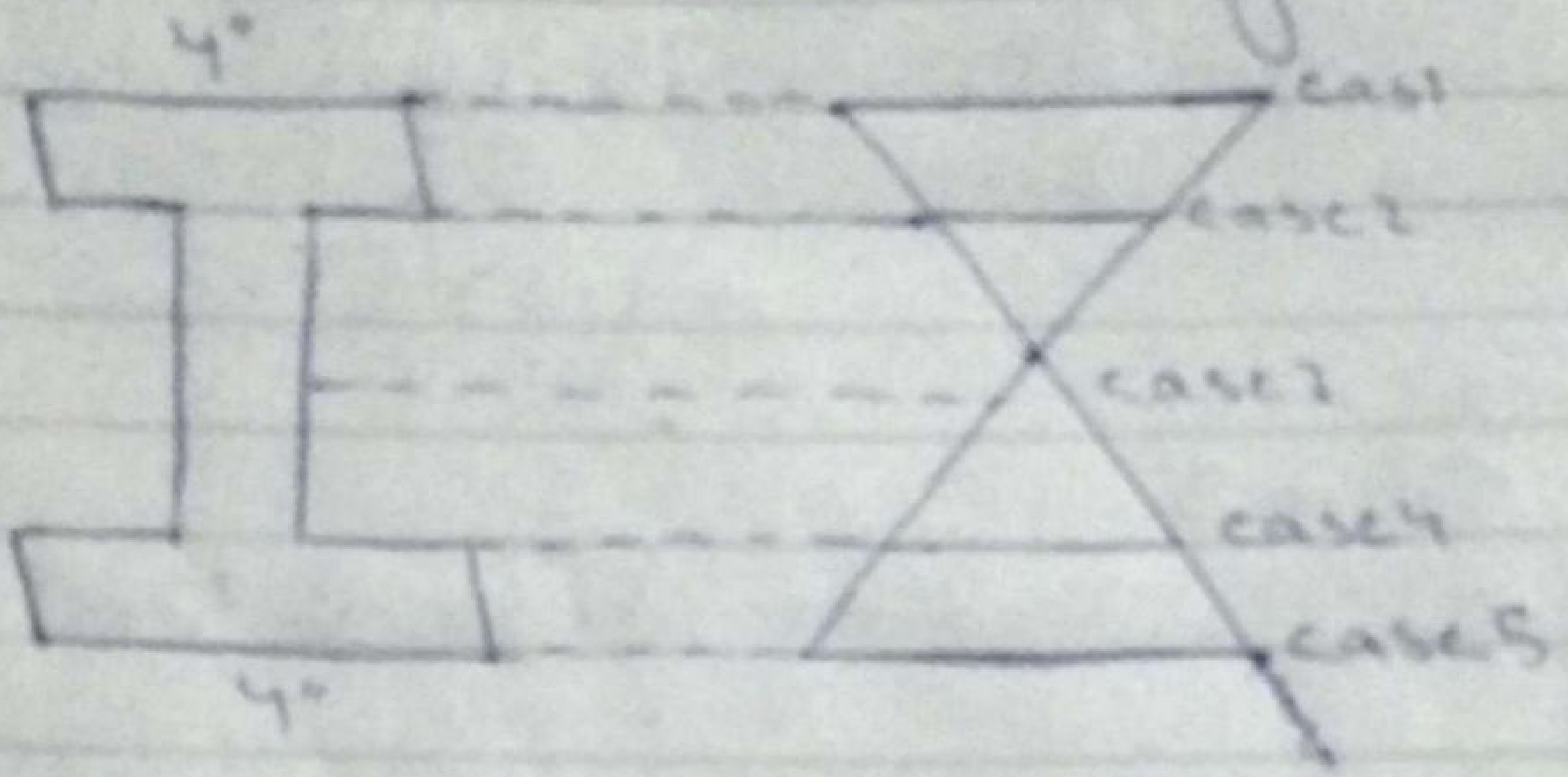
Flexure stress variation Diagram.

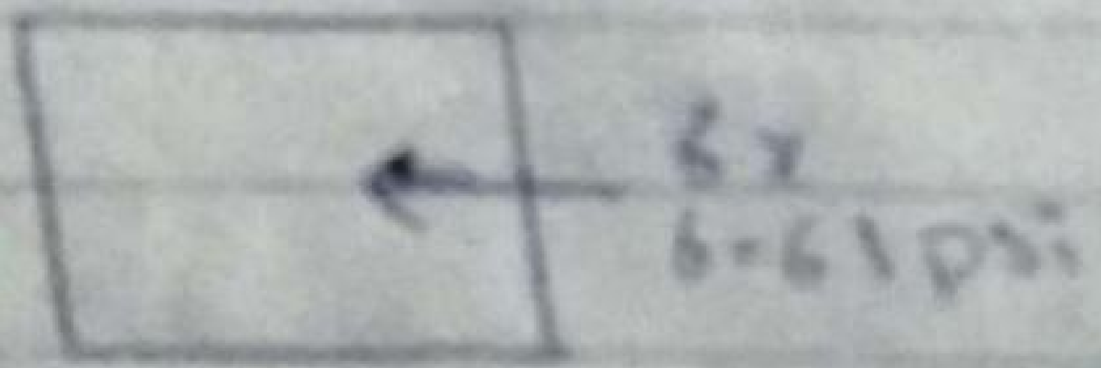


Flexure stress at point C.

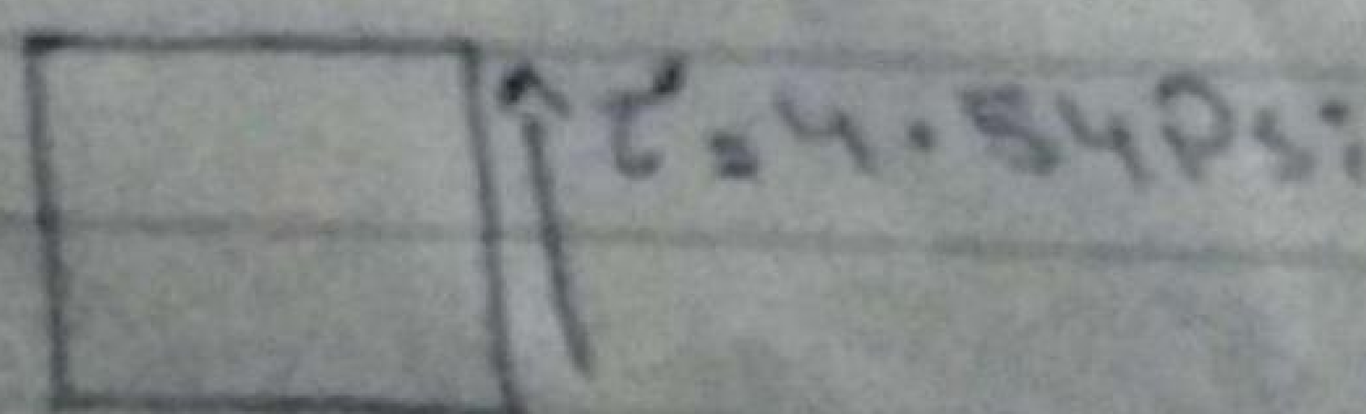
$\sigma = 6.61 Psi$ (case2)

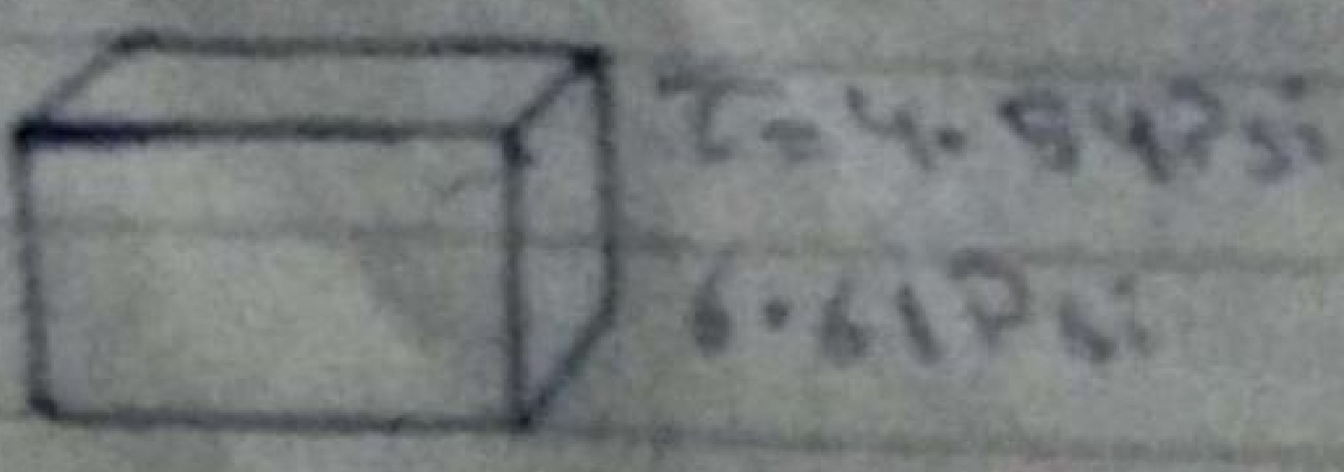
Shear stress at point C.

$\tau = 4.54$ Psi (case7).

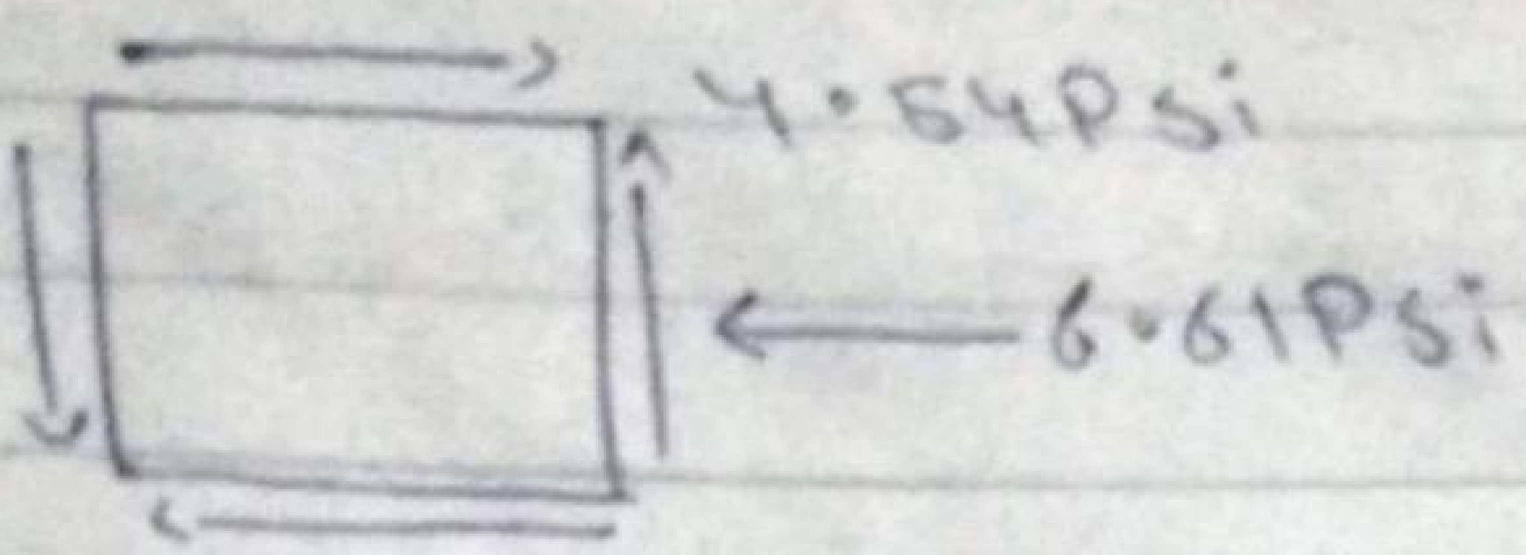


6.61 is σ compressive.
(If point C lies below the centroid then stress would be tensile).





(12).



Part D:

$$\tan 2\theta_P = \frac{\tau}{(\sigma_x - \sigma_y)/2}$$

$$\tan 2\theta_P = \frac{4.54}{(-6.61 - 0)/2}$$

$$\tan 2\theta_P = -1.3736$$

$$2\theta_P = \tan^{-1}(-1.3736)$$

$$\frac{2\theta_P}{2} = \frac{53.54}{2}$$

$$= -26.57$$

Now for σ_x.

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

$$\sigma_x' = -3.30 + 3.305\cos 2(26.97 + (-)4.54 \times \sin 2(26.54)$$

$$\sigma_x' = 12.47 \text{ Psi}$$

(13).

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

$$\sigma y' = \frac{(-6.61 + 0)}{2} - \frac{(-6.61 \times 0)}{2} \cos 2(-4.552)$$

$$- (4.54 \times \sin 2(26.54))$$

$$\sigma y'' = -0.0977 \text{ Psi}$$

Shear plan:

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

$$\tau x'y' = \frac{(-6.61)}{2} \sin 2(40.47) + (4.54 \cos 2) 40.17$$

$$\tau x'y' = 3.34$$

Stress transformation:

Assuming: $\theta = -30^\circ$

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

$$\sigma y' = \frac{(6.61 + 0)}{2} - \frac{(-6.61 - 0)}{2} \cos 2(-30) - 4.54 \sin(-30)$$

$$\sigma x' = -8.268 \text{ Psi}$$

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(14).

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

$$= \frac{-6.61+0}{2} - \frac{(6.61-0)}{2} \cos 2(-30) - 4.54 \sin 2(-30)$$

$$\sigma y' = -4.45 \text{ Psi}$$

$$\tau x'y' = \frac{6.61-0}{2} \sin 2(-30) + 4.54 \cos 2(-30)$$

$$\tau x'y' = -6.9436 \text{ Psi}$$

=> Mohr's circle:

$$(h,k) = \left(\frac{6.61}{2}, 0\right)$$

$$(h,k) = -(3.34, 0)$$

$$(h,k) = (3.34, 0)$$

Radius:

$$r = \sqrt{\left(\frac{\sigma x - \sigma y}{2}\right) + \tau xy^2}$$

$$r = \sqrt{\frac{6.61-0}{2} + (4.54)^2}$$

$$r = 4.79$$

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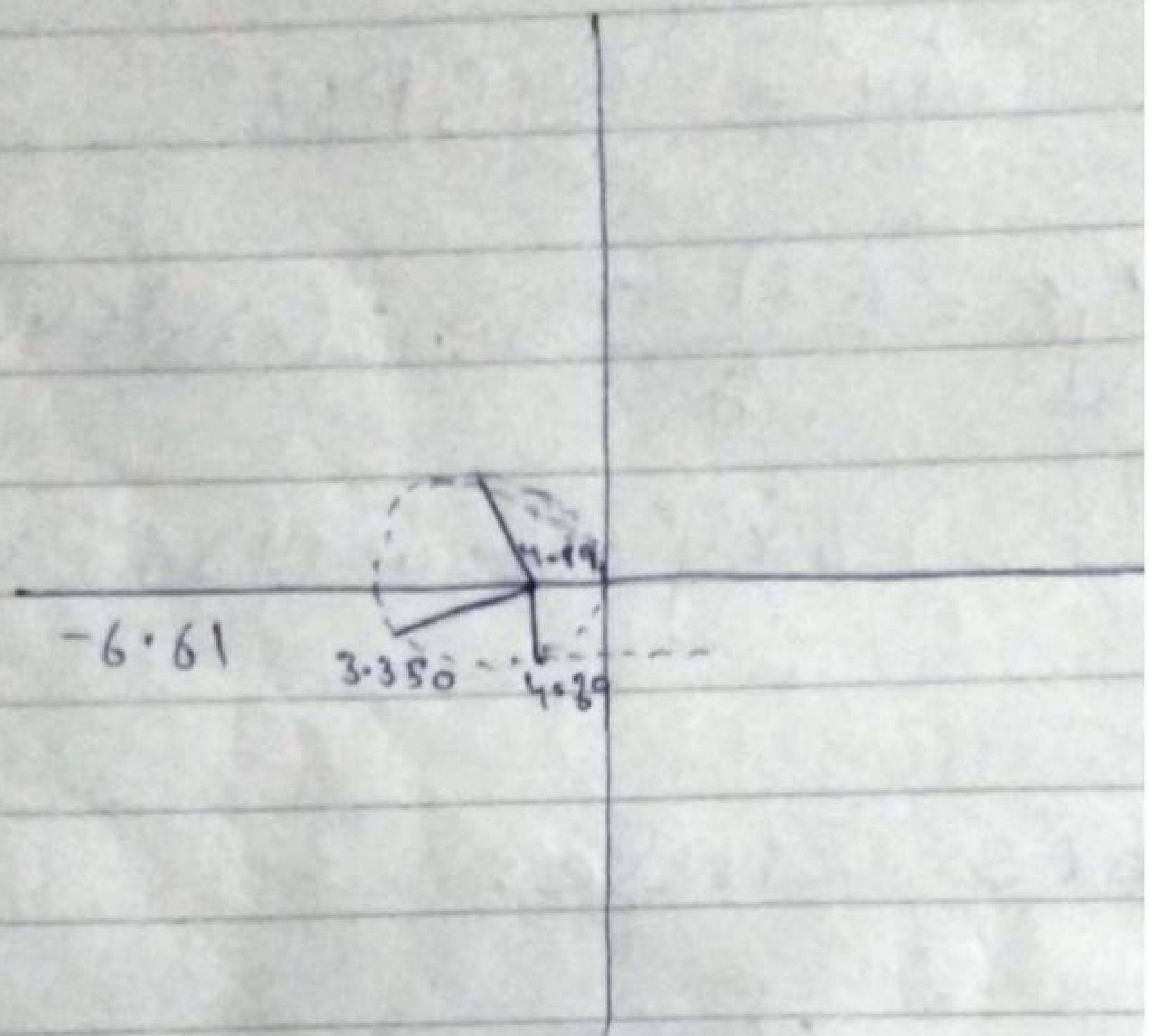
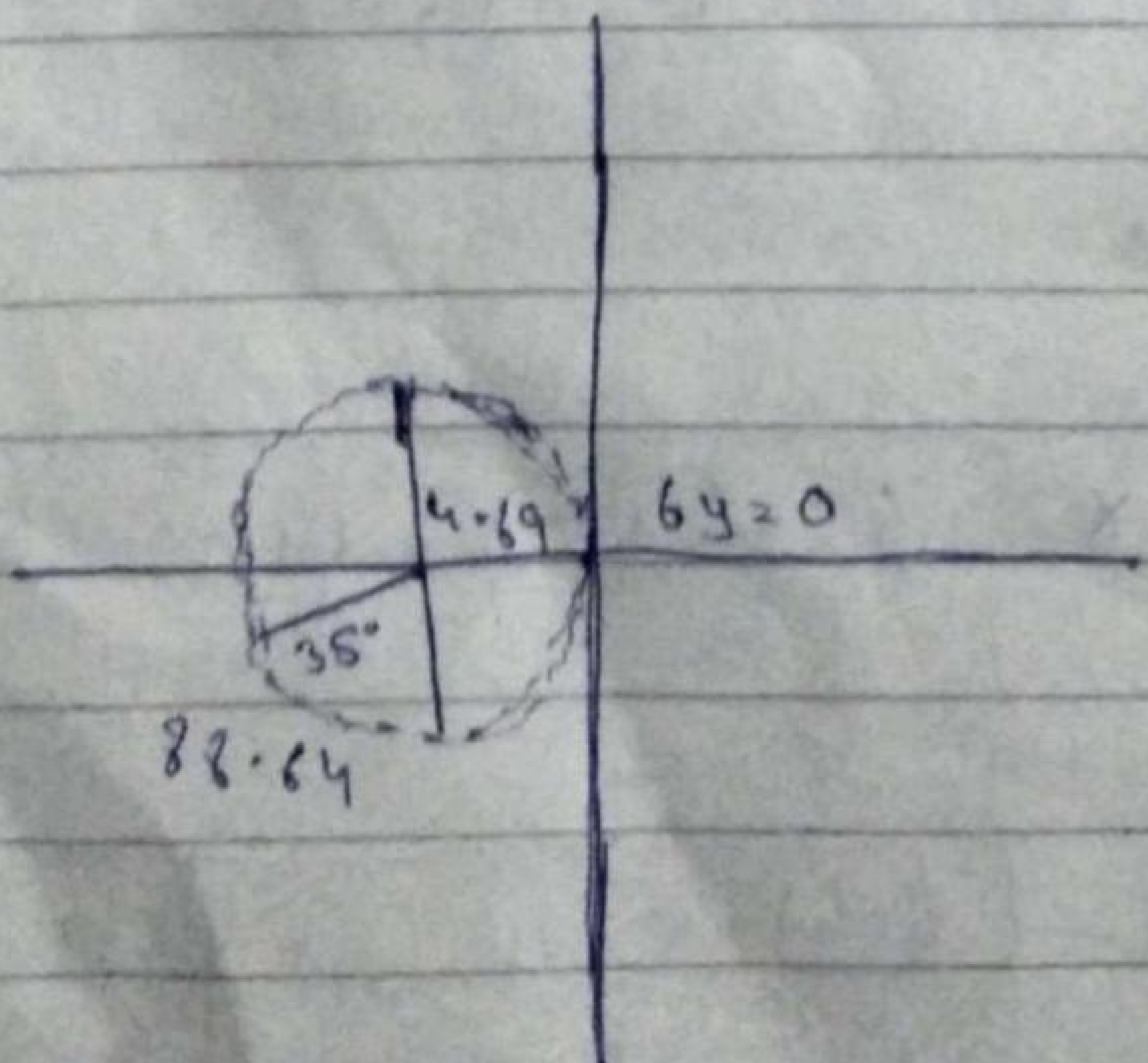
$v = 6.61$ psi



For Principal stress:

$\sigma x = -6.61$

$\sigma y' = 0$



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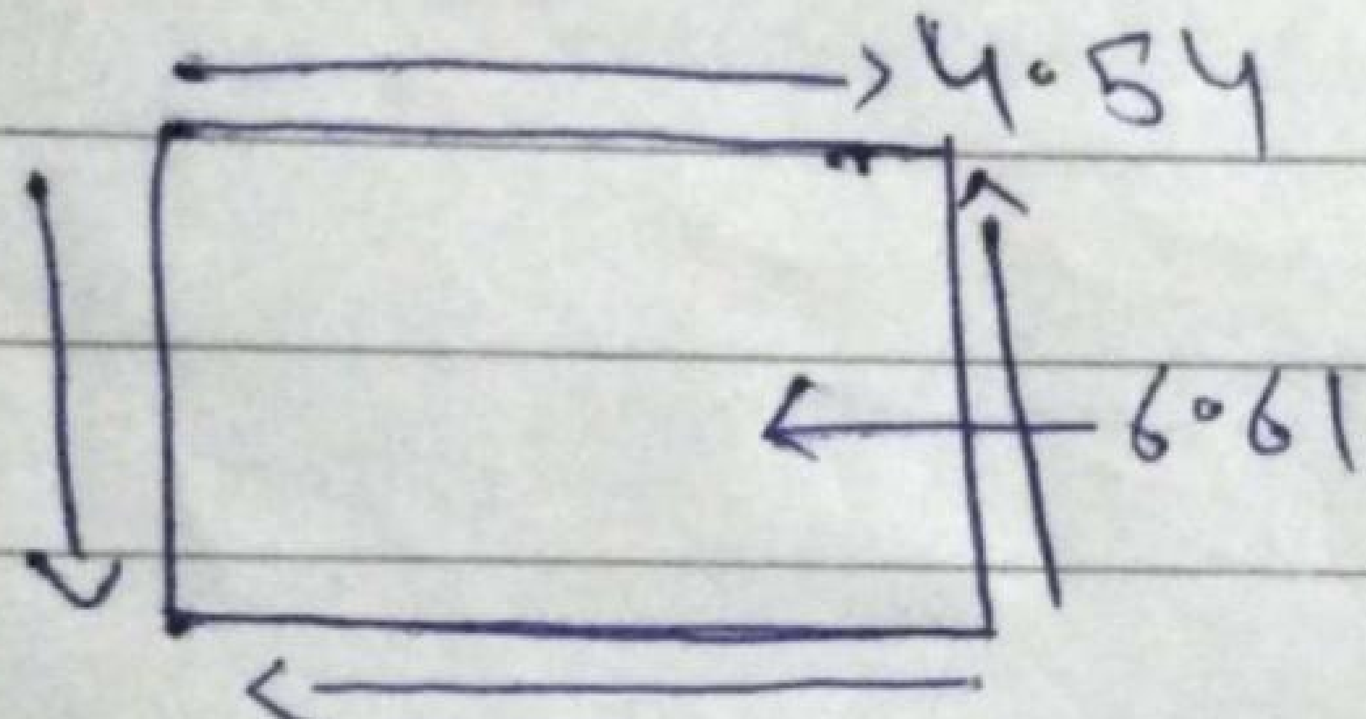
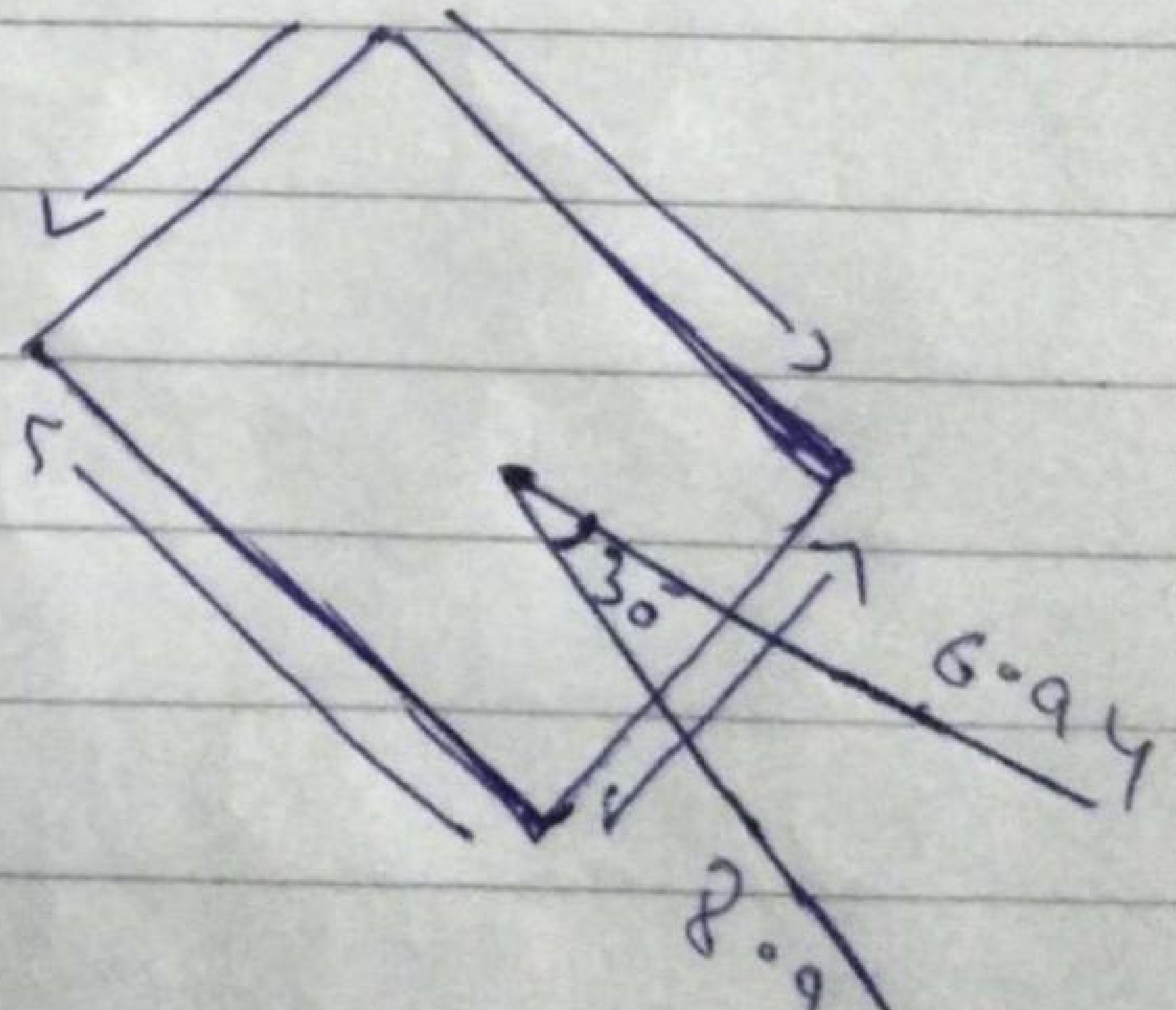
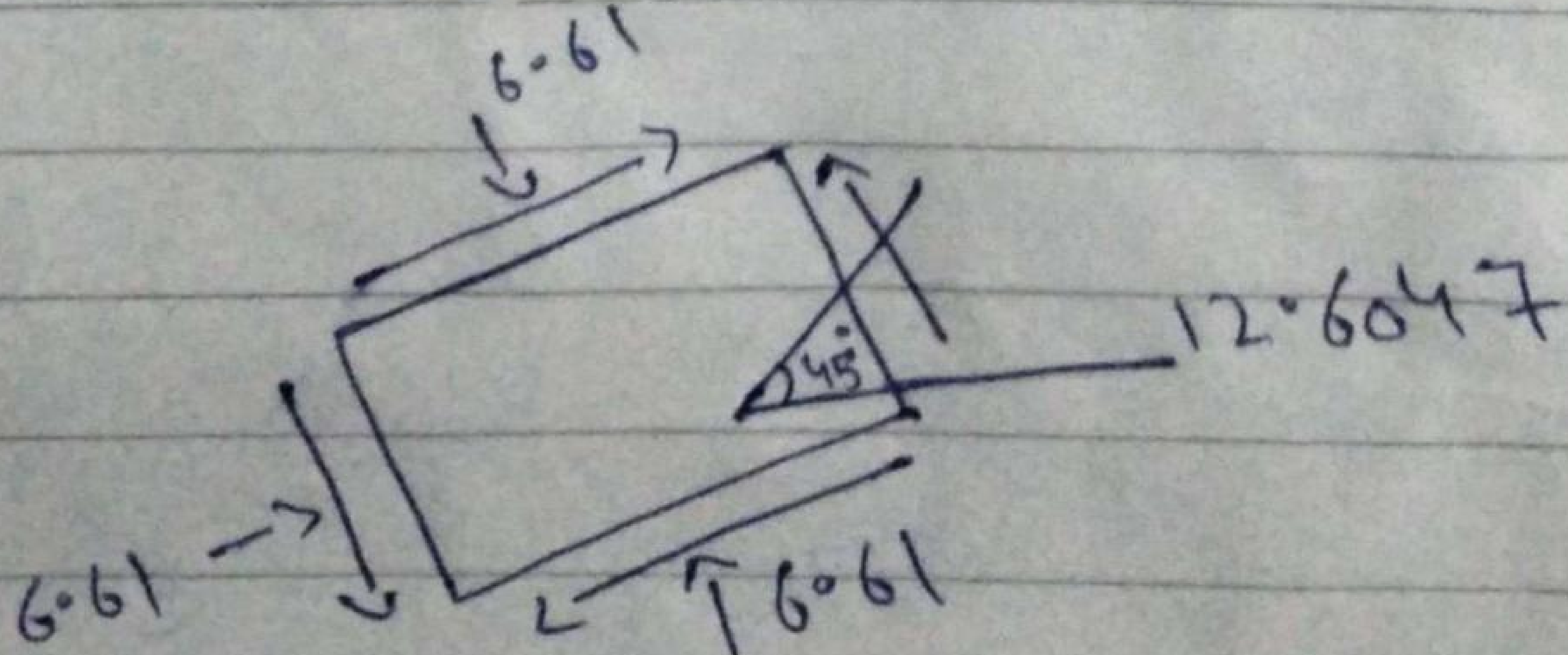
(16).

Comparison of Mohr's circle with shear stress transformation.







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