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Subject:- MOS II

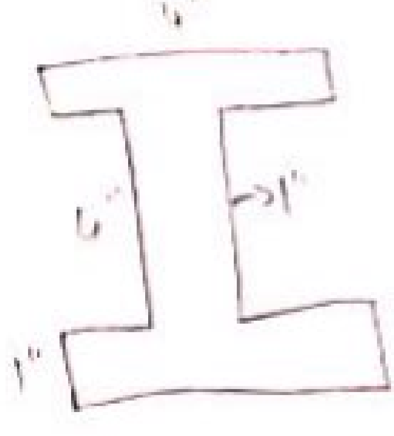
Q Construct the Mohr's Circle diagram and find the principle stress and maximum in plane shear stress for the stress state of a point C located at a centre C dirstributed load and 1" below the top fiber of beam cross-section. Compare result from mohr circle with stress transformation equ.

Sol

ID = 79

0.5x79 = 39.5 lb, take 40 lb/ft²

2P = 80 lb



$+\circlearrowleft \Sigma M_A = 0$

$$\Rightarrow -(40\times6\times3) - (80\times10) + 12R_B = 0$$

$$12R_B = \frac{1520}{12}$$

$$R_B = 126.66 \cong 127^{ks}$$

$+\uparrow F_y = 0$

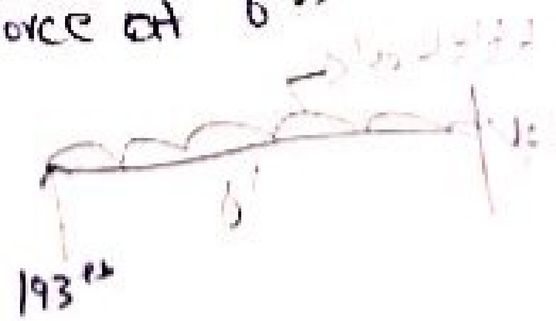
$$R_A + R_B = 320^{ks}$$

$$R_A + 127 = 320$$

$$R_A = 320 - 127$$

$$R_A = 193^{ks}$$

Shear force at 6'..



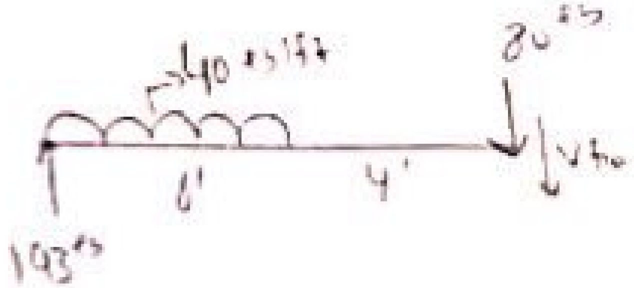
$\uparrow \Sigma F_y = 0$

$$193 - (40\times6) - V_f = 0$$

$$193 - 240 - V_f = 0$$

$$V_f = -47^{ks}$$

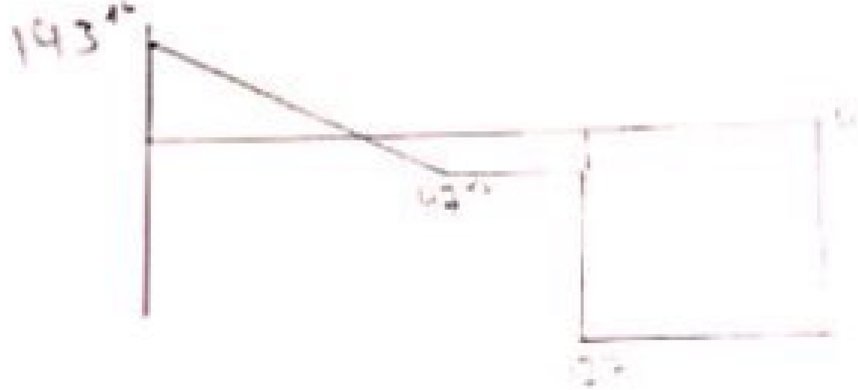
Shear force at 10':-



$\uparrow \Sigma F_y = 0$

$+193 - (40 \times 6) - 80 = 0 + V_{f10}$

$-127 = V_{f10}$



Moment:-

by triangular method:-

$\frac{193}{x} = \frac{47}{6-x}$

$193(6-x) = 47(x)$

$1158 - 193x = 47x$

$1158 = 47x + 193x$

$\frac{1158}{240} = \frac{240x}{240}$

$4.825 = x$

1) Moment at 4.825'

$+\circlearrowleft M = -193(4.825) + 40(4.825 \times 2.4125)$

$M = 466^{lb\text{-}ft}$

at 6'

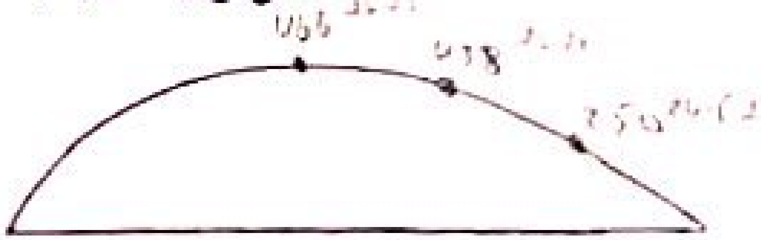
$\rightarrow M = (-193 \times 6) + (40 \times 6 \times 3)$

$M = 438^{lb\text{-}ft}$

at 10'

$M = -(193 \times 10) + (40 \times 6 \times 7)$

$M = 250^{lb\text{-}ft}$



Shear stress:-

$V = 73^{es}$

Moment of Inertia

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

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

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

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

$I_{xx} = 56 in^4$

$I_{yy} = \frac{bh^3}{12}$

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

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

Shear stress at C:-

$Q = A\bar{y}$

$A = 4 in^2$

$Q = 1 \times 4 \times 2.5 = 10''$

$$\tau_{xy} = \tau_{yx} = \frac{VQ}{Ib}$$

$$= \frac{73(10)}{56 \times 4} = 3.25 \text{ lb/in}^2$$

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

$$= \frac{12 \times 399 \times 2}{56}$$

$$\sigma_x = 171 \text{ lb/in}^2$$

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

$$= \frac{(-171) + (0)}{2} + \frac{(-171 + 0)}{2}(\cos 2\,30^\circ) + (3.25 \sin 60^\circ)$$

$$\sigma_x' = -230 \text{ lb/in}^2$$

$$\sigma_y' = -131.06 \text{ lb/in}^2$$

$$\tau_{x'y'} = -\frac{\sigma_x - \sigma_y}{2} \sin 60 + 3.25 \cos 60$$

$$\tau_{x'y'} = 75.67 \text{ lb/in}^2$$

Principle stresses:-

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

$$\sigma_{1,2} = \frac{(-171)+0}{2} \pm \sqrt{\left(\frac{-171-0}{2}\right)^2 + (3.25)^2}$$

$$= -85.5 \pm 85.56$$

$\sigma_1 = 0.06$ lb/in²

$\sigma_{II} = -171$ lb/in²

Mohr's Circle

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

$$r = 85.56$$

Centre Co-ordinate = [85.5, 0]

[+[illegible] -85.56, 0]