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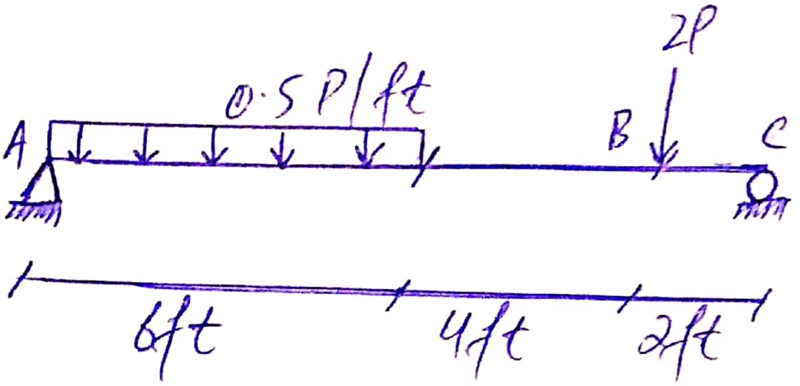
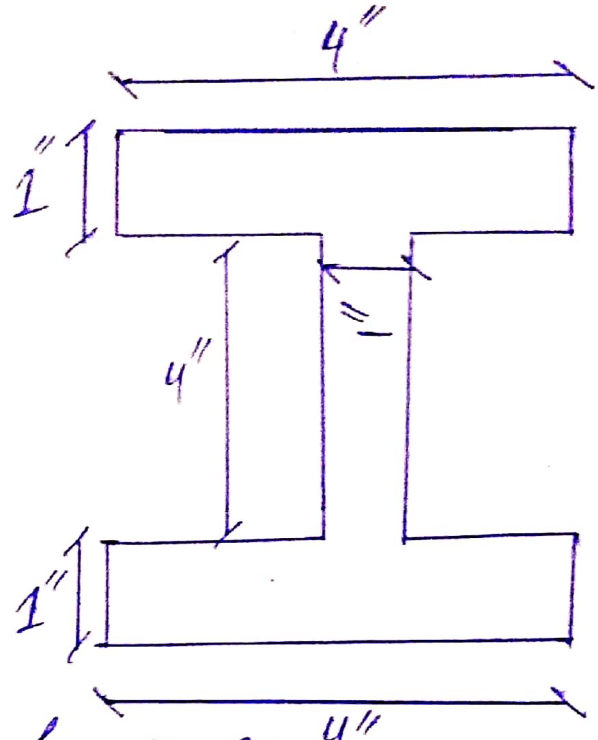
Section A.

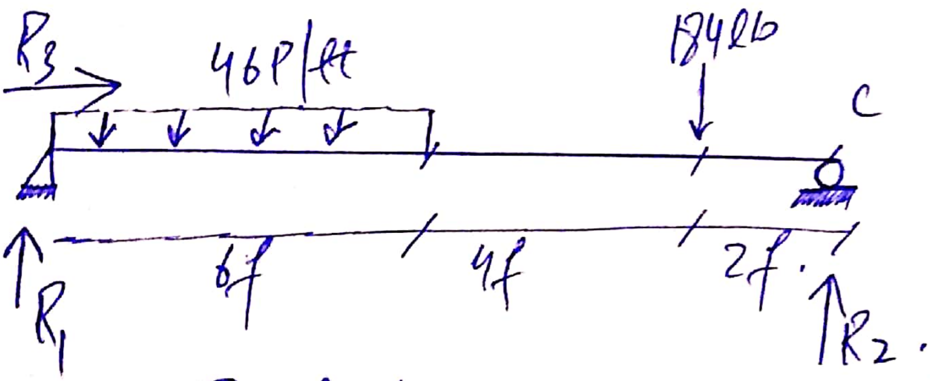
Subject MUS 2

Given Beam :-





Note :- put the value of $P = 92$
So we get.



⇒ To find the unknown Reaction at the Supports.

⇒ Apply equilibrium equation

$\Sigma f_x = 0$ $\quad \overset{+}{\uparrow} \ \overset{-}{\downarrow}$

$\Sigma f_y = 0$

$R_1 + R_2 = (46 \times 6) + 184 \Rightarrow R_1 + R_2 = 460 \rightarrow (1)$

$\Rightarrow \Sigma M_A = 0.$ (−) (+)

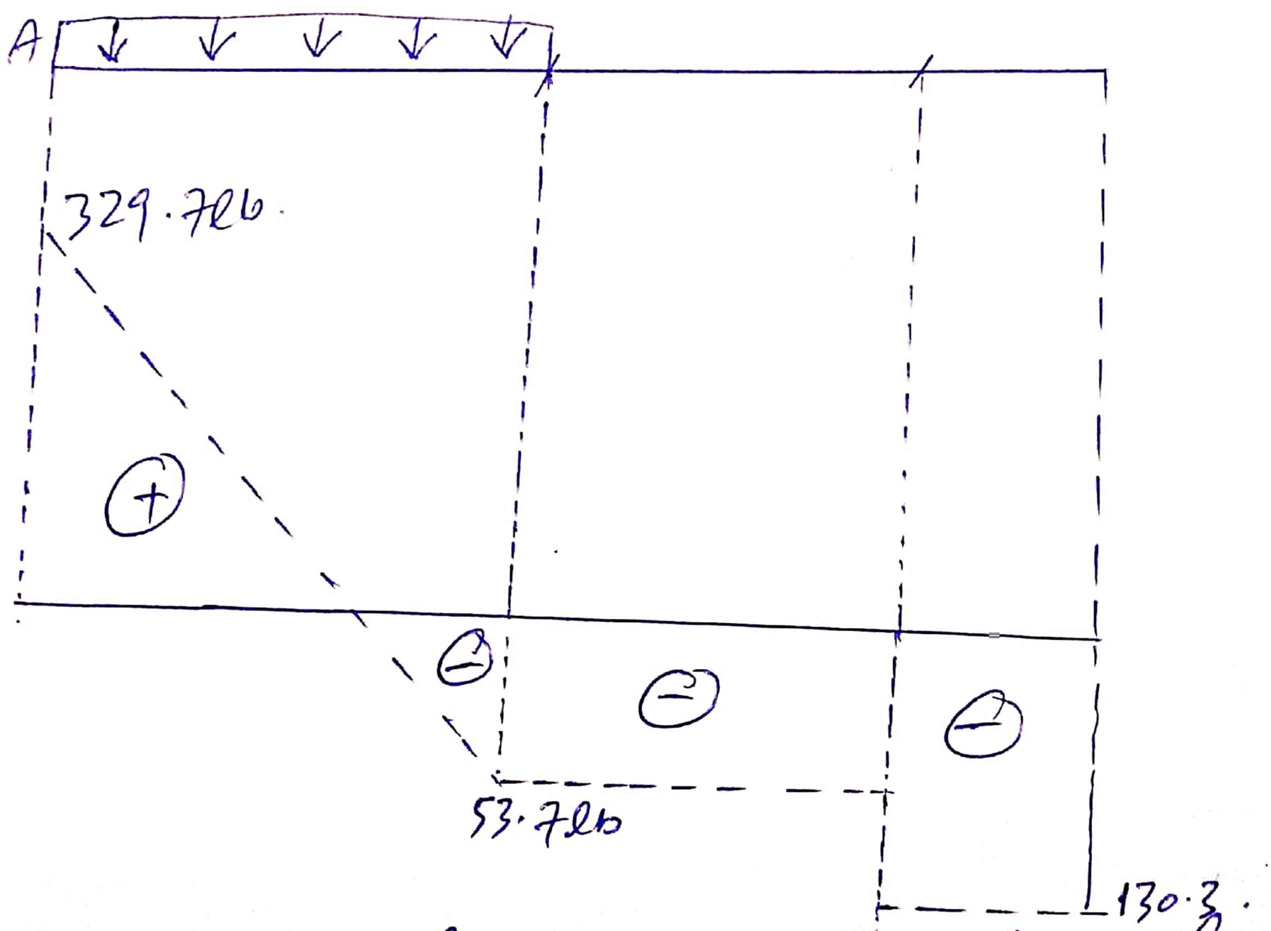
$-R_2 \times 12 + 10 \times 184 - (46 \times 6) = 0.$

⇒ Now put this (2) in eq ①.

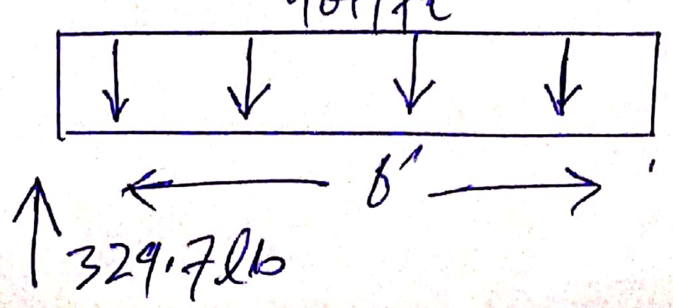
$R_1 + 130.3 = 460$

$R_1 = 329.7\,lb.$

⇒ Now Draw Shear force And Bending Moment Diagram



⇒ Now Shear force at 6ft from left:-

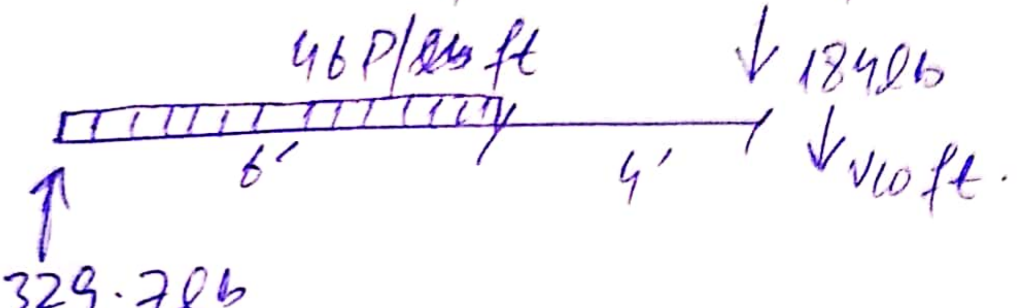


$\Rightarrow \Sigma f_y = 0.$

$$329.7lb - (46 \times 6) - V_{6ft} = 0.$$

$$\boxed{V_{6ft} = -53.7lb.}$$

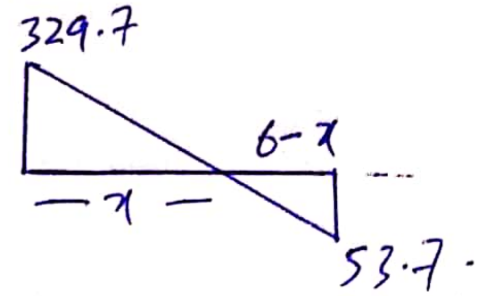
$\Rightarrow$ Now shear force at 10ft.



$$329.7 - 46 \times 6 - 184 - V_{10ft} = 0.$$

$$V_{10ft} = -130.3.$$

$\Rightarrow$ Point of Maximum Bending Moment
As we know that the point where shear force is minimum the Bending Moment is maximum
$\Rightarrow$ from shear force diagram on page ②



we know that

$$\frac{329.7}{x} = \frac{53.7}{x-6} \Rightarrow 329.7x - 1978.2 = 53.7x$$

$$\Rightarrow -1978.2 = -276.7x$$

$$\Rightarrow x = 7.16 \text{ ft}$$

⇒ Now to Determine the value of Moment at 7.16 ft.

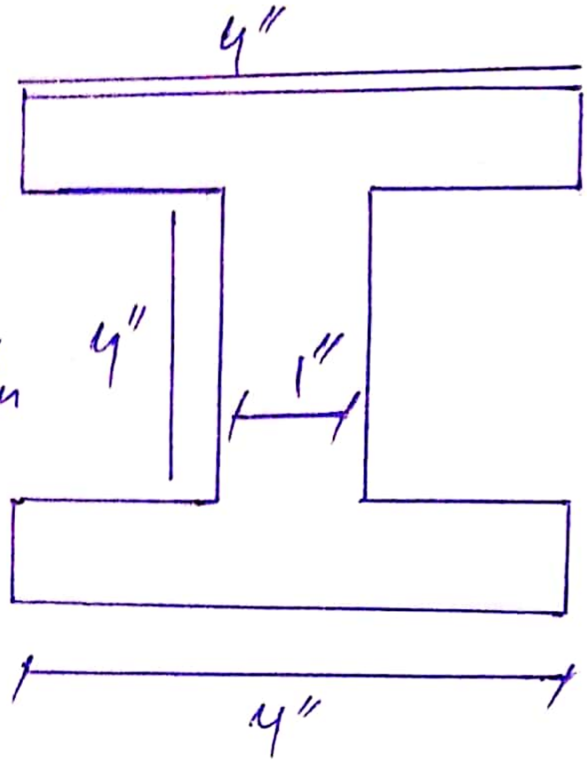
$$M_{7.16} - 329.7 \times 7.16 + (46 \times 7.16) \times \left(\frac{7.16}{2}\right) = 0.$$

$$M_{7.16} - 2360.6 + 329.36 \times 3.58 = 0.$$

$$M_{7.16} - 2030.9 \times 3.58 = 0.$$

$$M_{7.16} = 7270.6 \text{ lb/ft}$$

⇒ for shear stress we have $\tau = \frac{VQ}{Ib}$ So first we have to Determine "I" for the given Section of Beam.



⇒ As the given figure is Symmeterical along Both axis So $\bar{x} = \frac{4}{2} = 2$ in

$\bar{y} = \frac{6}{2} = 3''$

i.e $(\bar{x}, \bar{y}) = (2, 3)$

Area of point ① $= 4 \times 1 = 4\,in^2$

Area of point ② $= 4 \times 1 = 4\,in^2$

Area of point ③ $= 4 \times 1 = 4\,in^2$.

⇒ Moment of inertia about x-axis I_{xy}

⇒ Determing the distances b/w C.G of the whole Section And the Corresponding parts.

let G_1, G_2, G_3 be the Center of gravity of points ① ② ③ and K_1, K_2, K_3 be the Distances B/w $\bar{Y}$ and y_1, y_2, y_3

So

$K_1 = \bar{Y} - Y_1 = 3 - 0.5 = 2.5$ inch.

$K_2 = \bar{Y} - Y_2 = 3 - 3 = 0$ inch.

$K_3 = \bar{Y} - Y_3 = 3 - 0.5 = 2.5$ inch

So $I_{xx} = \frac{b_1 h_1^3}{12} + a_1 k_1^2 + \frac{b_2 h_2^3}{12} + a_2 k_2^2 + \frac{b_3 h_3^3}{12} + a_3 k_3^2$

$\Rightarrow I_{xx} = \frac{(4)(1)^3}{12} + 4(2.5)^2 + \frac{(1)(4)^3}{12} + 4(0) + \frac{4(1)^3}{12} + 4(2.5)^2$

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

Now $I_{yy} = \frac{b_1^3 h_1}{12} + \frac{b_2^3 h_2}{12} + \frac{b_3^3 h_2}{12}$

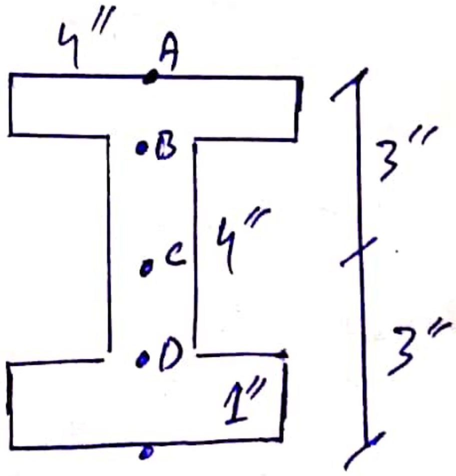
$I_{yy} = \frac{(4)^3(1)}{12} + \frac{(1)^3(4)}{12} + \frac{(4)^3(1)}{12}.$

$I_{yy} = 11 \text{ inch}^4.$

$\Rightarrow$ Next to find the shear stresses at various point we know that.

$\tau = VQ/Ib$

① Shear Stress at point A:-



$\tau = VQ/Ib$

$\because Q = A\bar{Y}$

$V_{max} = 130.3 lb$

$I = 56 \text{ inch}^4$

$\tau = \frac{(130.3)(0)}{56 \times 4}$

$\boxed{\tau = 0.}$

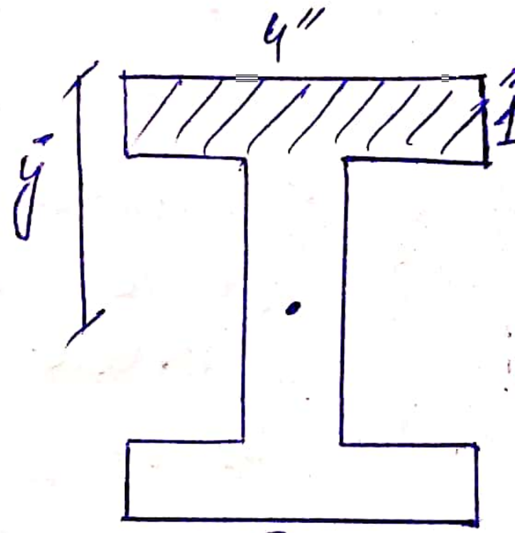
$\because$ Here $A = 0$ Because no area of section exist above point "A"

i.e $Q = A\bar{Y} = 0(\bar{Y}) = 0.$

(ii) Shear Stress at point "B"

$$\tau = VQ/Ib \Rightarrow \frac{(130.3)(4\times1)(3-0.5)}{56\times4}$$

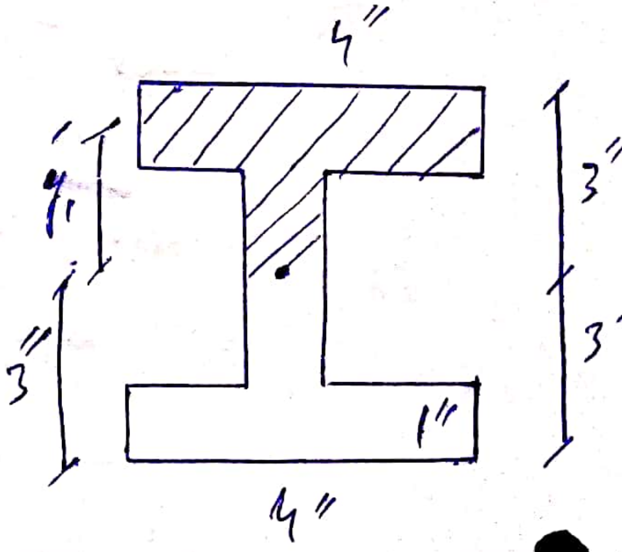
$$\tau = 5.8\ lb/in^2$$



(iii) Shear Stress At point "c" :-

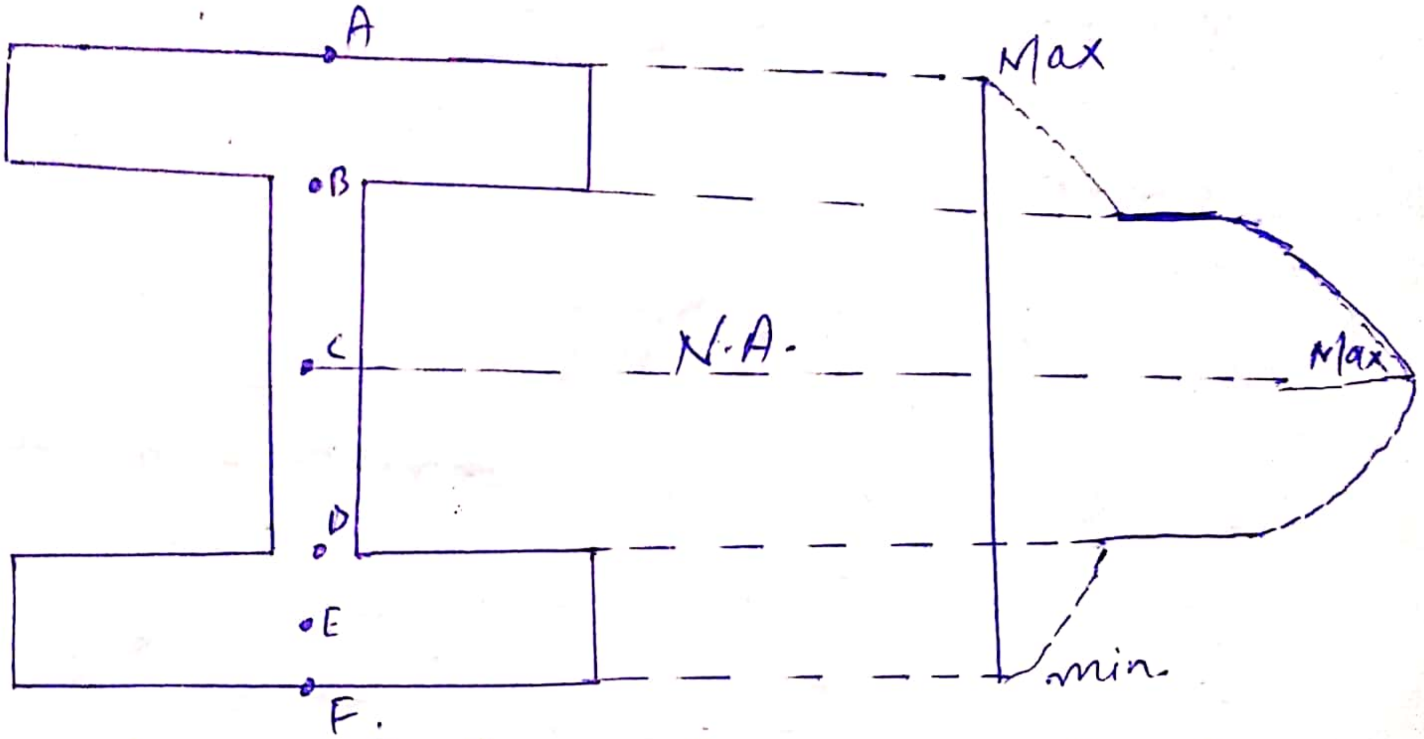
$$\tau = VQ/Ib \Rightarrow \frac{(130.3)[4\times1(3-0.5)+(1\times2)(2-1)]}{56\times1}$$

$$\tau = 27.92\ lb/in^2$$



(iv) Shear Stress at point D and E will be the Same because of the Symetry.

Note:- The maximum Shear Stress value occur at the neutral axis and minimum value at the top of the section



flexural Stress Determination:

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

(i) flexural Stress at point "A"

$$\sigma = \frac{224.89 \times 3}{56} = \boxed{\sigma = 12.047\ lb/in^2}$$

(ii) flexural Stress at point B :-

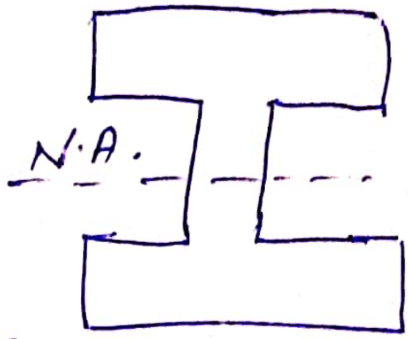
$$\sigma = \frac{MY}{I} \Rightarrow \frac{224.89 \times (3-0.5)}{56} = \boxed{\sigma = 10.39\ lb/in^2}$$

(iv) flexural Stress at point "C"

$$\sigma = \frac{(224.89)(3-1)}{56} \Rightarrow \boxed{\sigma = 8.03\ lb/in^2}$$

(iv) flexural Stress at Neutral Axis (N.A).

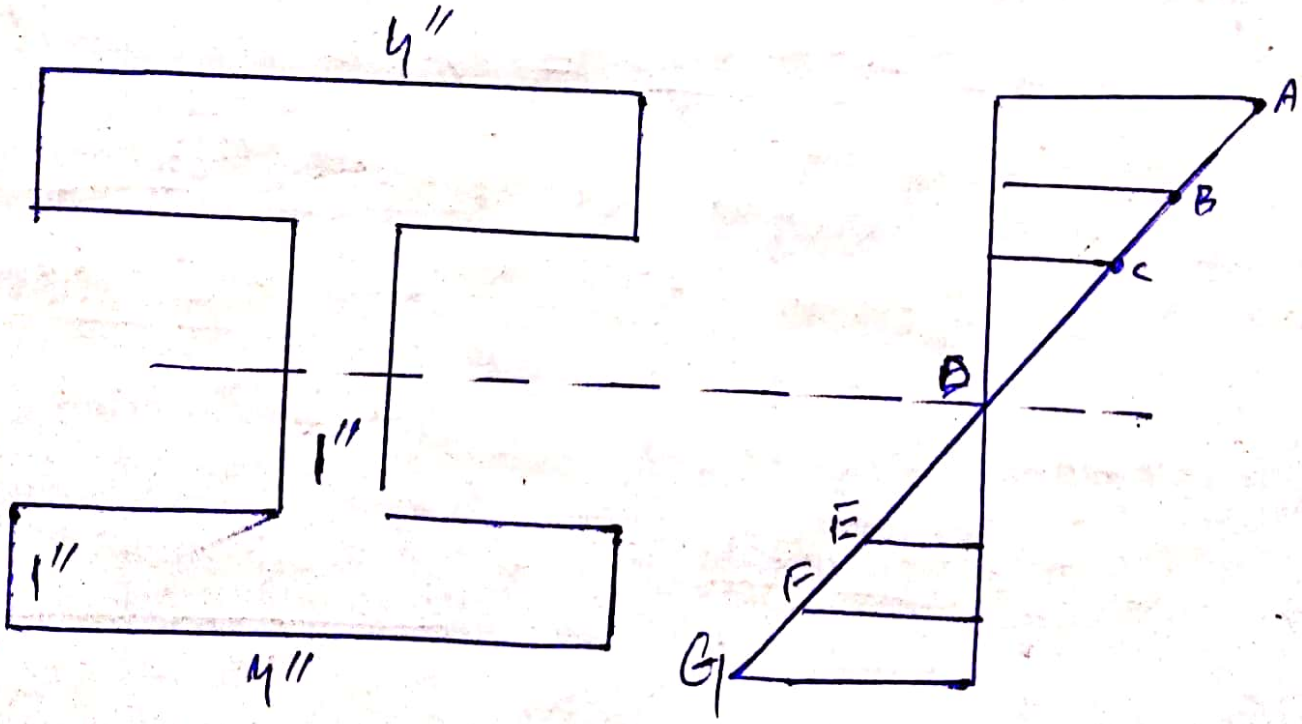
$$f = \frac{224.89 \times 0}{56} = \boxed{f = 0}$$



⇒ flexural stress value at point E, F, and g is same. Because of the same Symmetry. The upper portion above the N.A shows Tension and below the N.A shows Comprision

Note :- The flexural Stress values is maximum at extreame Top and Bottom And zero At zero at N.A.

⇒ flexural Stress Diagram :-



⇒ Now we will Draw Mohr's Circle. for the Given problem

Sol: As we know that to draw the Circle we need the Co-ordinate of Circle as well as radius.

⇒ we find the Co-ordinate of circle by the following Methode

$$\left(\frac{\sigma x+\sigma y}{2}, 0\right)$$

⇒ Center Co-ordinate $(h,k) = \left(-\frac{0.0535}{2}, 0\right)$.

⇒ $(-0.026, 0)$.

Radius of mohr's Circle is

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

$$r = \sqrt{\left(\frac{-0.0535-0}{2}\right)^2 + (0.5543)^2}$$

$$r = 0.5549.$$