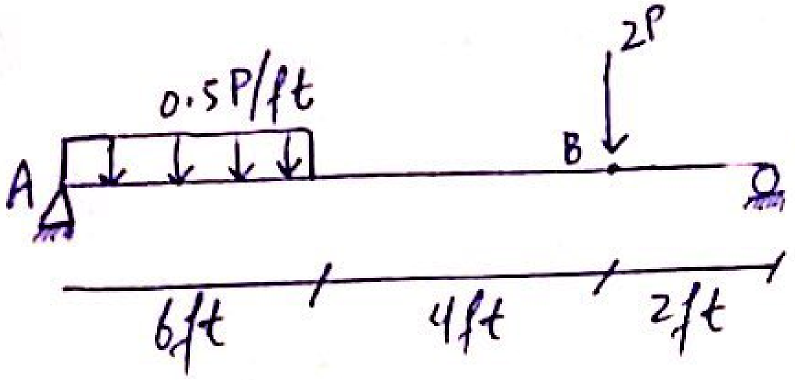
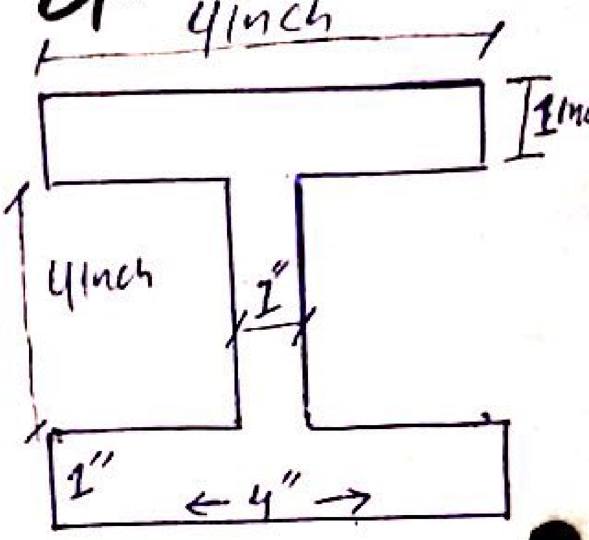
Given Beam:-

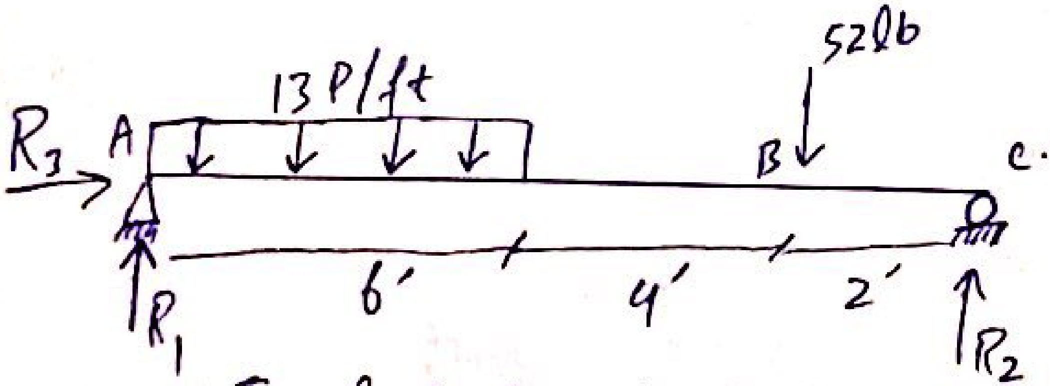


Given section:-



Note:- put the value of P = 26.

So we have.



To find the Unknown Reaction at the Supports Apply equilibrium equation

$\Sigma f_x = 0$ i.e $\boxed{R_3 = 0}$

$\Sigma f_y = 0$ $\overset{+}{\uparrow} \downarrow$

$R_1 + R_2 = (13 \times 6)\,lb + 52\,lb$

$R_1 + R_2 = 130 \rightarrow (1)$

$\Sigma M_A = 0$ (−) (+) ②

$-R_2 \times 12 + 10 \times 52 + (13 \times 6) = 0$

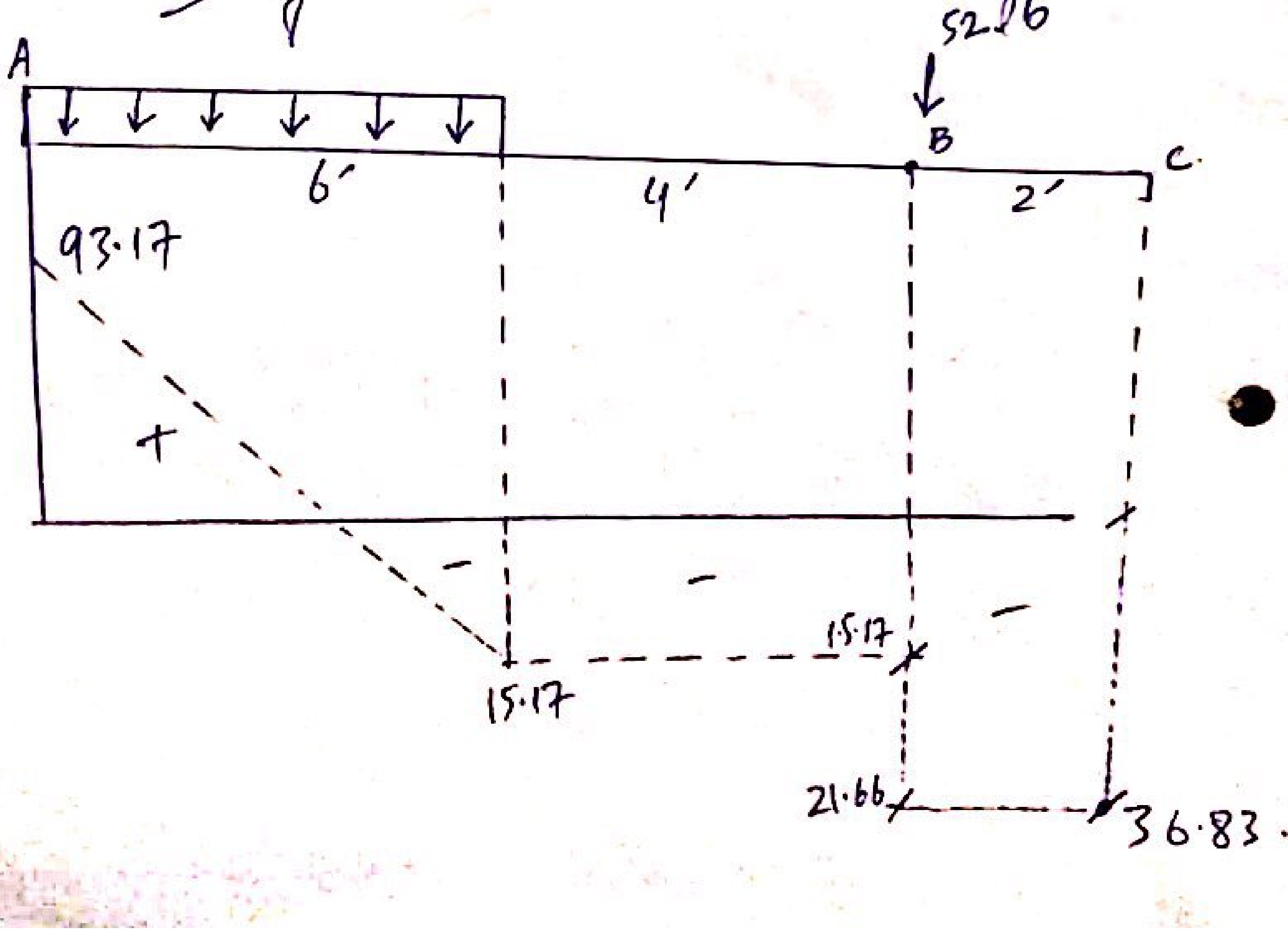
$R_2 = 36.83\ lb.$

Now put this in eq ①.

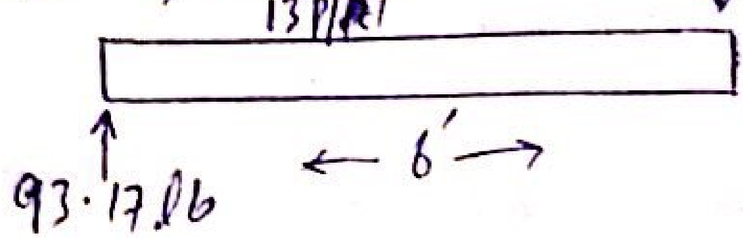
$R_1 + 36.83\ lb = 130$

$R_1 = 93.17\ lb.$

Now Draw Shear Force And Bending Moment Diagram.



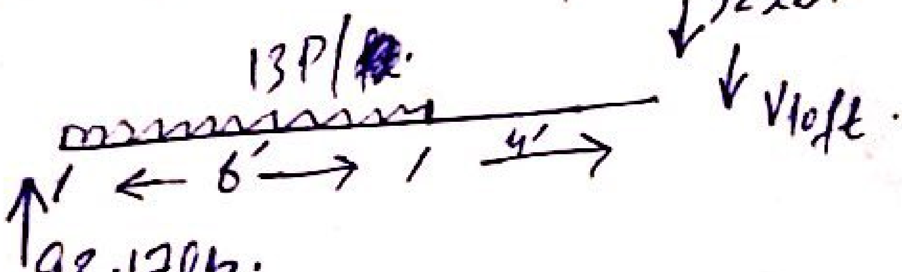
⇒ Now shear force at 6ft from left



$\Sigma f_y = 0 \Rightarrow 93.17 - 13 \times 6 - V_{6ft} = 0$

$\Rightarrow \boxed{V_{6ft} = -15.17\,lb.}$

⇒ Now Shear Stress force at 10ft.

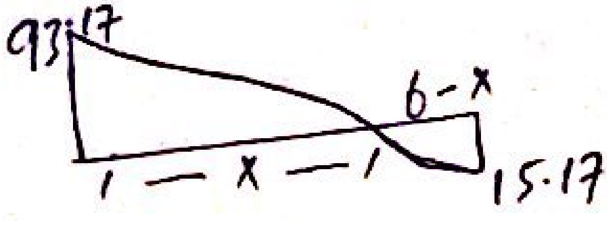


$93.17 - 13 \times 6 - 52 - V_{10ft} = 0.$

$\boxed{V_{10ft} = -36.83\,lb.}$

⇒ Point of Maximum Bending Moment
As we know that the point where Shear force is minimum the Bending Moment is maximum

⇒ from shear force diagram on page (2) we have.



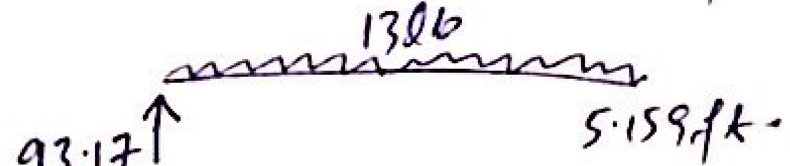
we know that $\frac{93.17}{x} = \frac{15.17}{6-x}$.

$\Rightarrow (6-x)\,93.17 = 15.17x$.

$\Rightarrow 559.02 - 93.17x = 15.17x$.

$\Rightarrow 559.02 = 108.34x$. $\Rightarrow \boxed{x = 5.159\,ft}$

Now Determine the value of Moment at 5.159 ft.

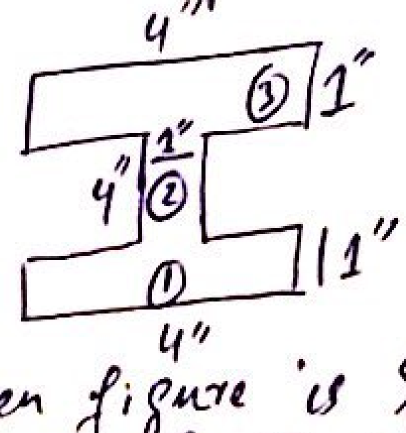


$$M_{5.159} - 93.17 \times 5.159 + (13 \times 5.159) \times \left(\frac{5.159}{2}\right) = 0$$

$$M_{5.159} - 480.664 + 67 \times 5.159/2 = 0.$$

$$M_{5.159} = 307\ lb\cdot ft.$$

$\Rightarrow$ 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 the axis So $\bar{x} = 4/2 = 2in$, $\bar{y} = \frac{6}{2} = 3''$

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

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 Intertia about x-axis I_{xy}

Determine 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 distance B/w $\bar{y}$ and y_1, y_2, y_3 respectively

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 $I_{xx} = \frac{b_1 h_1^3}{12} + a_1 K_1^2 + \frac{b_2 h_2^3}{12} + a_2 K_2^2 + \frac{b_3 h^3}{12} + a_3 K_2^2$

$I_{xx} = \frac{(4)(1)^3}{12} + 4(2.5)^2 + \frac{(1)(4)^3}{12} + a_2(0) + \frac{4(1)^3}{12} + 4(2.$

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

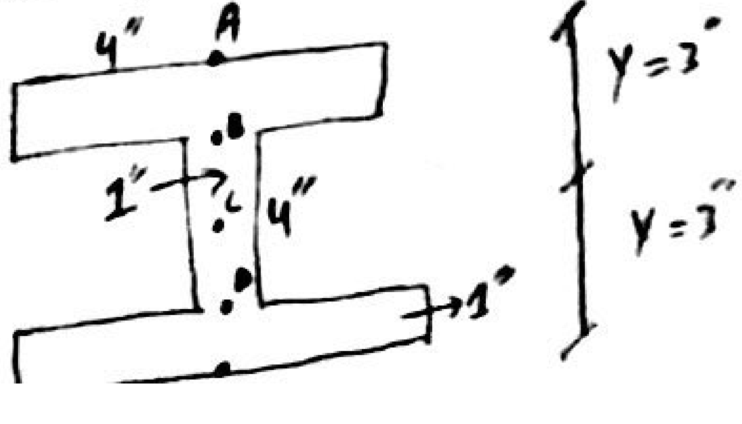
Now $I_{yy} = b_1^3 h_1/12 + \frac{b_2^3 h_2}{12} + \frac{b_3^3 h_3}{12}$

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

$I_{yy} = 64/12 + 4/12 + 64/12$

$$\boxed{I_{yy} = 11 \text{ inc}^4}$$

⇒ Next find the shear stresses at various point we know that $\tau = \frac{VQ}{Ib}$



(b)

① Shear Stress at point "A"

$\tau = VQ/Ib$:- $Q = A\bar{y}$

$V_{max} = 36.83\,lb$

$I = 56\,in^4$

So $\tau = \dfrac{36.83(0)}{(56)(4)}$

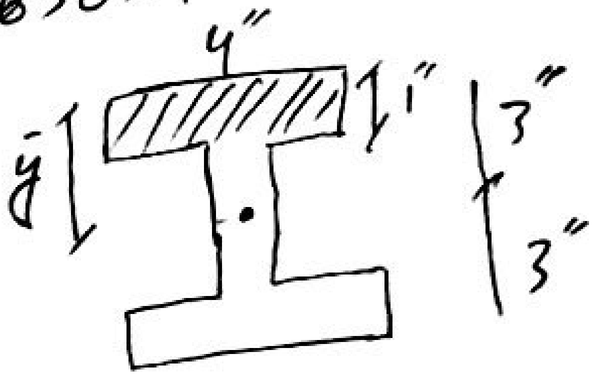
Here $A = 0$ Because no area of section exist above point "A" i.e $Q = A\bar{y} = 0(\bar{y}) = 0$.

So $\tau = 0$.

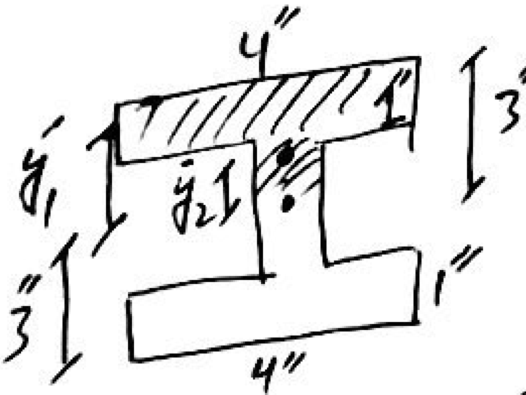
(ii) Shear Stress at point "B"

$\tau = VQ/Ib \Rightarrow \dfrac{36.83 \times (4\times1)(3-0.5)}{56\times4}$

$\tau = 26.30\,lb/in^2$



(iii) Shear Stress at point "C" :-



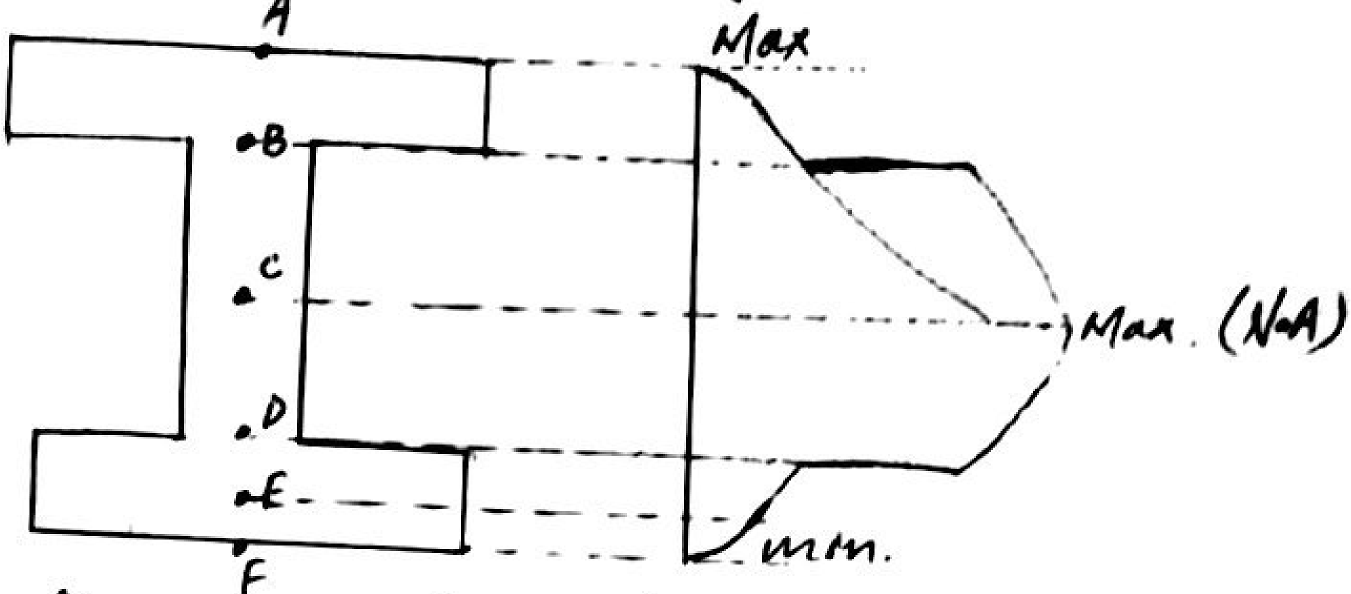
$\tau = VQ/Ib \Rightarrow \dfrac{36.83\times[4\times1\times(3-0.5)+(1\times2)(2-1)]}{52\times1}$

$\tau = 368.33\,lb/in^2$.

(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 Nuetral axis and minimum value at the Top of the Section.

Shear Stress (7) Diagram:-



Flexural Stress Determination:-

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

(i) flexural stress at point A

$$\sigma = \frac{224.89 \times 3}{52}$$

$$\sigma = 12.97 \text{ lb/in}^2$$

(ii) flexural stress at point B

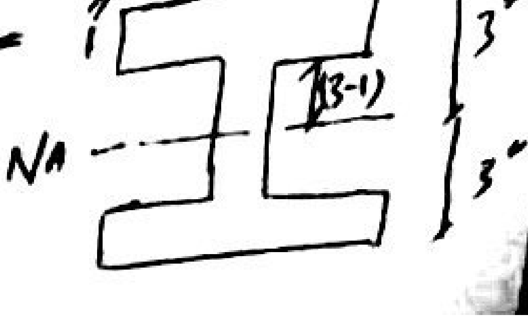
$$\sigma = \frac{MY}{I}$$

$$\Rightarrow \sigma = \frac{224.89 \times (3 - 0.5)}{52}$$

$$\Rightarrow \sigma = 10.81 \text{ lb/in}^2$$

(iii) flexural stress at point "C"

$$\sigma = \frac{224.89 \times (3 - 1)}{52}$$



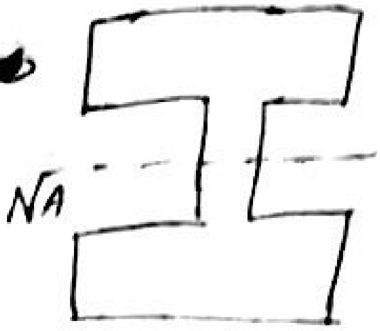
$$\sigma = 8.6 \text{ lb/in}^2$$

(8)

(iv) flexural Stress at Neutral Axis (NA).

$$f = \frac{MY}{I} \Rightarrow \frac{224.89 \times 0}{67}$$

$$f = 0 \ lb/in^2.$$

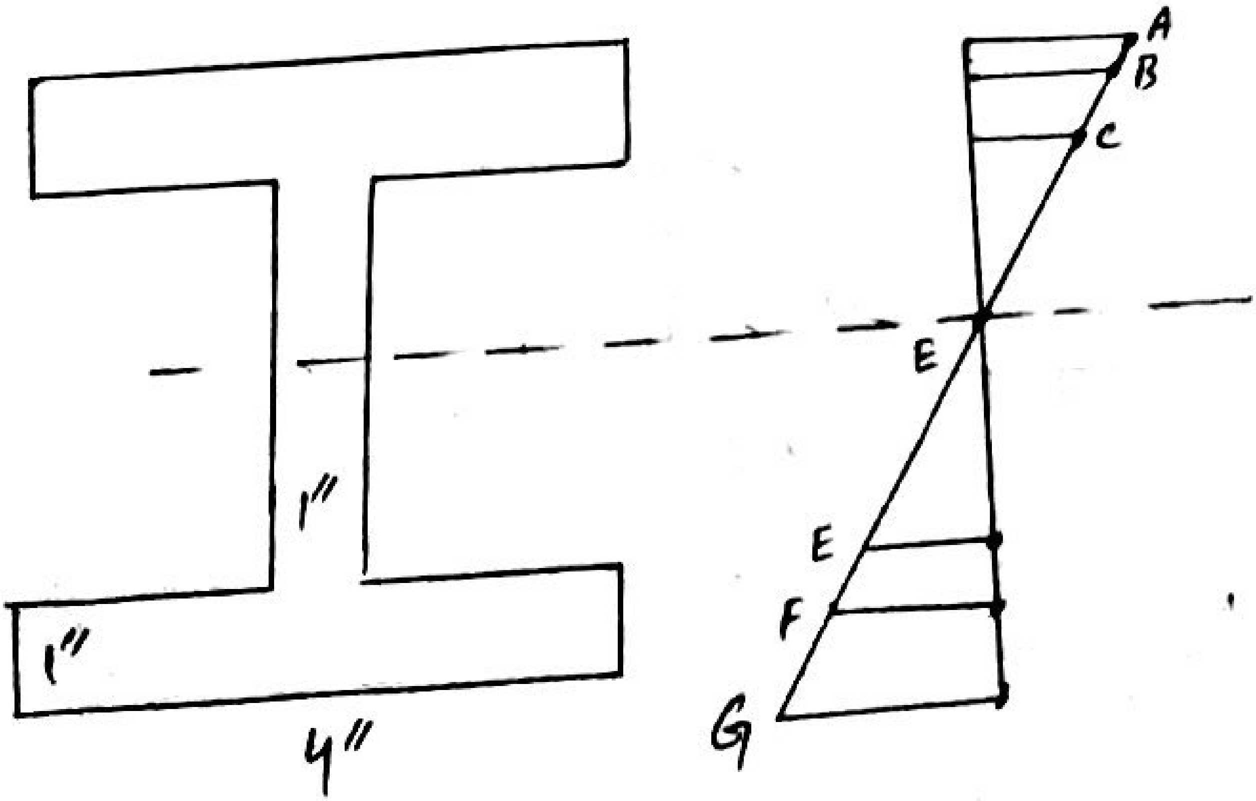


flexural Stress value at point E, F and G

Because of the Same Symmetry.
The upper portion above the NA Shows Tension and below the NA Shows Compression

Note:- The flexural Stress values is maximum at extreame top and Bottom And 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.

$$r = \sqrt{\left(\frac{\sigma x - \sigma y}{2}\right)^2 + 4(\tau xy)^2}$$

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

$$r = 0.5549.$$