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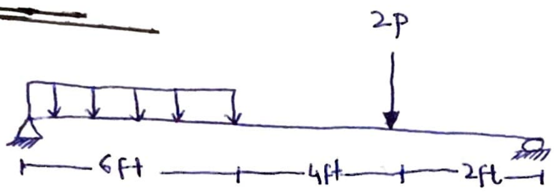
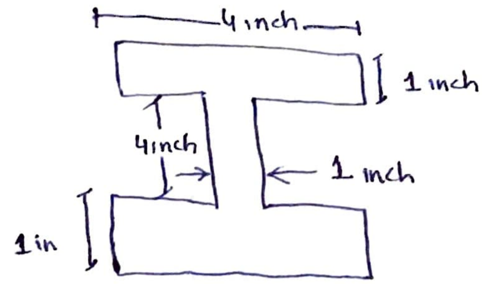
I.D NO	7614
SEMESTER	10th
SECTION	B
PAPER	MOS-II
DATE	17-APRIL-2020

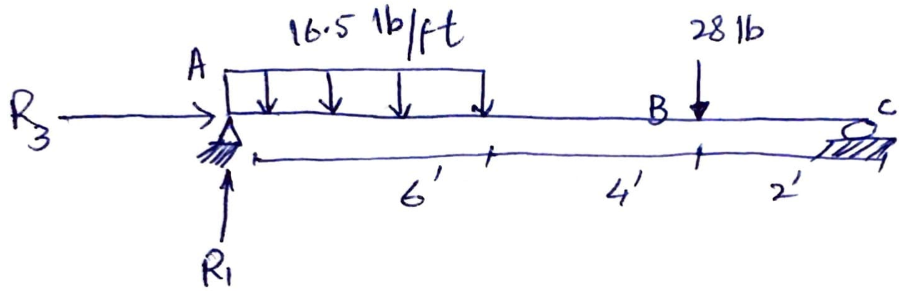
Solution





Put the value of $P = 14$

So we have;



To find the unknown reaction at the support Apply Equillibrium equations;

$\Sigma F_x = 0$ i-e $R_3 = 0$

$\Sigma F_y = 0$ $\oplus\uparrow\downarrow\ominus$

$$R_1 + R_2 = (16.5 \times 6)\ lb + 28\ lb$$

$$R_1 + R_2 = 99 + 28$$

$$R_1 + R_2 = 127 \quad \text{—— eq } 1$$

So;

$$\Sigma M_A = 0 \quad (+ -)$$

$$R_2 \times 12 - 10 \times 28 - (16.5 \times 6) \times 6/2 = 0$$

$$12 R_2 = 280 + 297$$

$$\frac{12 R_2}{12} = \frac{577 \text{ lb-ft}}{12}$$

$$\boxed{R_2 = 48.08 \text{ lb}}$$

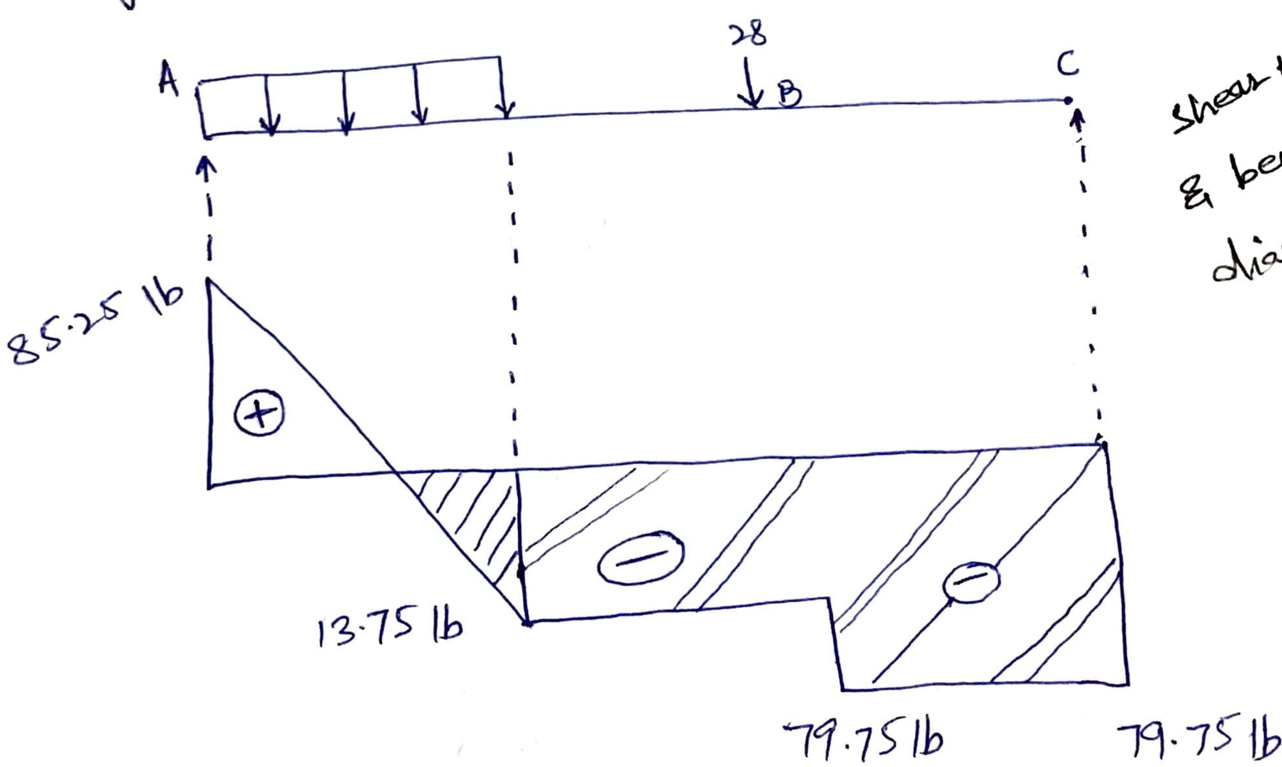
$$R_1 + R_2 = 165$$

$$R_1 = 165 - R_2$$

$$R_1 = 165 - 48.08$$

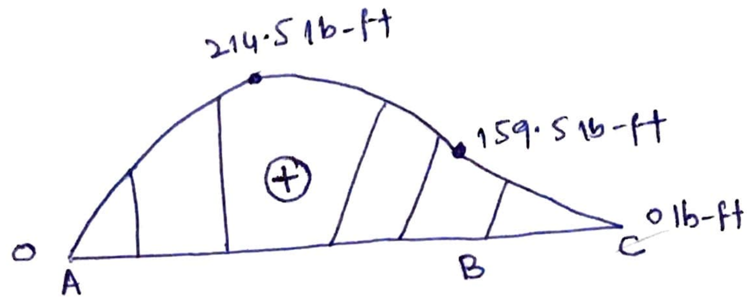
$$\boxed{R_1 = 116.92 \text{ lb}}$$

Now draw shear force & bending moment diagram. we have;

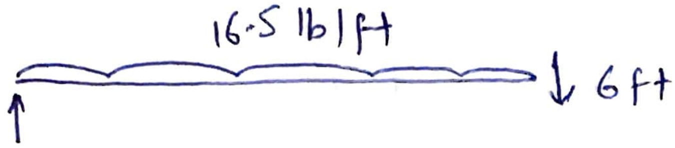


shear force & bending moment diagram.

Bending moment diagram



Now shear force at chainge point of beam



shear force at 6 ft from left support

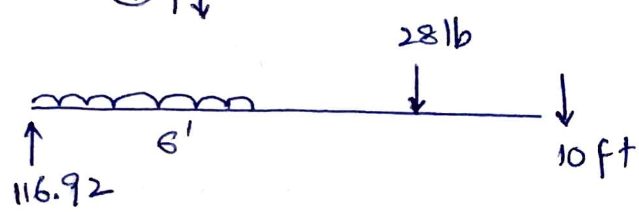
$\Sigma F_y = 0 \quad \oplus \uparrow \downarrow \ominus$

$116.92 - 16.5 \times 6 - V_{6\,ft} = 0$

$\boxed{V_{6\,ft} = -17.92}$

Now shear force at left

$\Sigma F_y = 0 \quad \oplus \uparrow \downarrow \ominus$



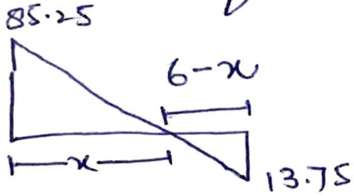
$116.92 - 16.5 \times 6 - 28 - V_{10\,ft} = 0$

$\boxed{V_{10\,ft} = -10.8 \text{ lb}}$

Point of maximum bending moment As we know that the point where shear force is minimum the B.M is maximum so from point of zero shear corresponding point will have maximum bending moment.

From Shear force diagram on page (2)

we have;



we known that

$$\frac{85.25}{x} = \frac{13.75}{6-x}$$

$$(6-x)\,85.25 = 13.75x$$

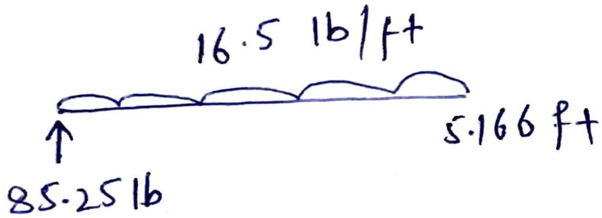
$$511.5 - 85.25x = 13.75x$$

$$511.5 = 13.75 + 85.25x$$

$$99x = 511.5$$

$$\boxed{x = 5.166\ ft}$$

Now determine the value of moment at 5.166 ft



$$M_{5.166} - 85.25 \times 5.166 + (16.5 \times 5.166) \times \frac{5.166}{2} = 0$$

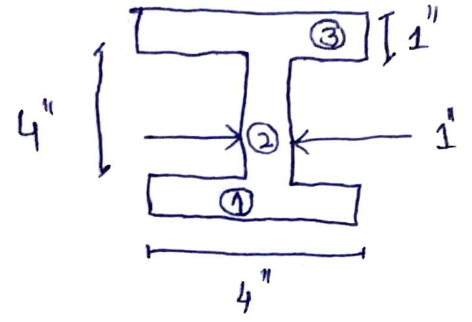
$$M_{5.166} - 440.4015 + 215.50 = 0$$

$$\boxed{M_{5.166\ ft} = 224.899\ lb\text{-}ft}$$

For Shear force we have

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

First we determine moment of Inertia I for the given section of beam.



As the given Fig. is Symmetrical along the both axis so;

$\bar{x} = 4/2 = 2$ inch , $\bar{y} = 6/2 = 3$ inch

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

From extream left & bottom

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 (centroid) I_{xx}.

Determine distance b/w C.G of the whole section & the corresponding parts.

Let G_1, G_2, G_3 be the centre of gravity of point ①, ②, ③ & k_1, k_2, k_3 be the distance b/w $\bar{y}$ & y_1, y_2, y_3 respectively.

so;

$$k_1 = \bar{y} - y_1 = 3 - 0.5 = 2.5 \text{ inch}$$

$$k_2 = \bar{y} - y_2 = 3 - 3 = 0 \text{ inch}$$

$$k_3 = \bar{y} - y_3 = 3 - 0.5 = 2.5 \text{ inch}$$

Now;

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

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

$$I_{xx} = 4/12 + 25 + 64/12 + 4/12 + 25$$

$$I_{xx} = \frac{4 + 12(25) + 64 + 4 + 12(25)}{12}$$

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

Now;

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

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

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

$$I_{yy} = \frac{64 + 4 + 64}{12} = 11 \text{ inch}^4.$$