ASSIGNMENT # 03

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SUBJECT:- MECHAICS OF SOLIDS-II

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SEMESTER:- SENIOR.

SECTION:- B

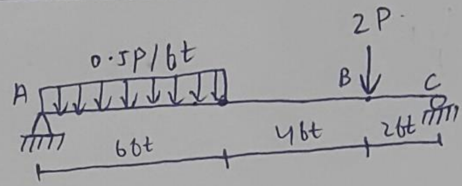
DATE:- 19th APRIL, 2020.

Mechanics of Solid - II

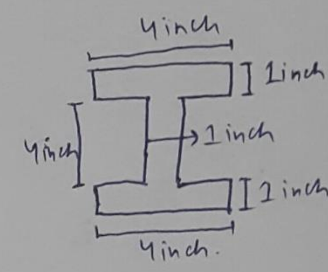
Assignment # 03.

Given Condition:-

$P = 69$.



Given Section:-

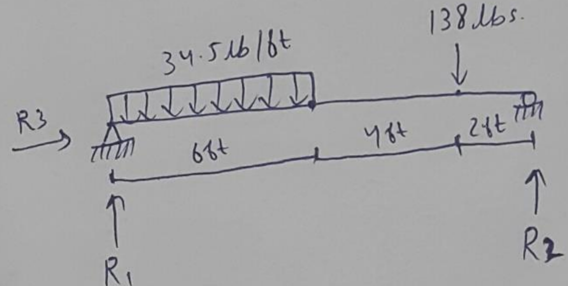


Put the value of $P = 69$.

$0.5 \times 69 = 34.5\ lb/ft$

$2 \times 69 = 138\ lb$

So, we have.



For finding the unknown Reactions at Support we will Apply the Equilibrium Conditions.

i.e $\Sigma F_x = 0 \longrightarrow R_3 = 0$.

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

$R_1 + R_2 = (34.5 \times 6) + 138\ lb$

$R_1 + R_2 = 345\ lbs \longrightarrow$ (i).

$\Sigma M_A = 0$ (↺+ ↻−)

$R_2 \times 12 - (138 \times 10) - (34.5 \times 6) \times 6/2$

$12 R_2 = 1380 + 621$

$\boxed{12 R_2 = 2001 \text{ lbs.}}\text{/ft}$

$R_2 = \frac{2001}{12}$

$\boxed{R_2 = 166.75 \text{ lb}}$

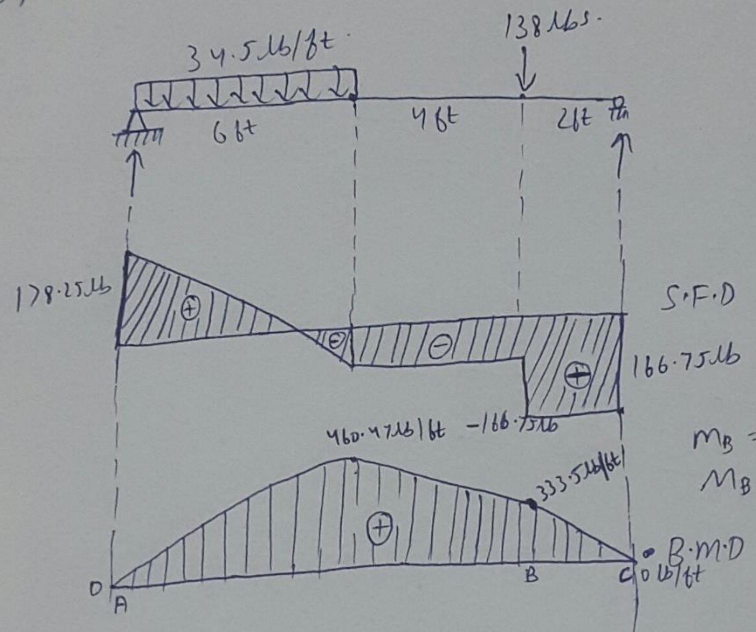
$R_1 + R_2 = 345 \text{ lb.}$

$R_1 = 345 - 166.75$

$\boxed{R_1 = 178.25 \text{ lb}}$

Now the Next step is to draw Shear force and Bending Moment Diagrams.

So,

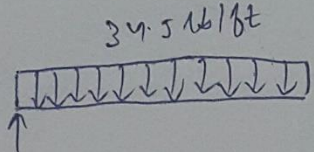


$m_B = 166.75 \times 2$

$M_B = 333.5 \text{ lb/ft}$

Now finding Shear force (V) at 6ft (V_{6ft}):-

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



$V_{6ft} = ?$

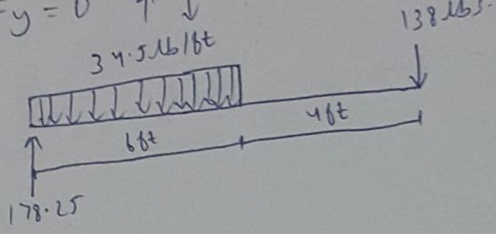
$178.25 - 34.5 \times 6 - V_{6ft} = 0$

$\boxed{V_{6ft} = -28.75 \text{ lb}}$

Now Finding Shear force At 10 ft :-

$V_{10ft} = ?$

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



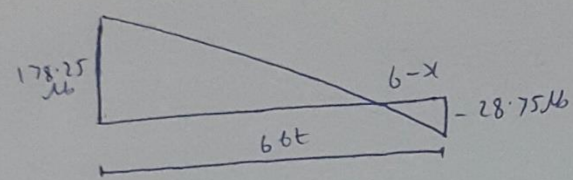
$178.25 - 34.5 \times 6 - 138 - V_{10ft} = 0$

$$\boxed{V_{10ft} = -166.75 \text{ lb}}$$

Point of maximum Bending Moment

As we know that the point where the shear force is minimum then at that the Bending Moment will be maximum. So from the point of zero shear the corresponding point will have maximum Bending Moment.

In shear force diagram we have,



We know that,

$$\frac{178.25}{x} = \frac{28.75}{6-x}$$

By cross multiplication.

$$(6-x)178.25 = 28.75x.$$

$$1069.5 - 178.25x = 28.75x$$

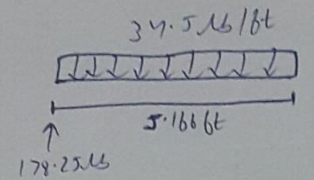
$$1069.5 = 28.75 + 178.25$$

$$1069.5 = 207x$$

$$x = \frac{1069.5}{207}$$

$$\boxed{x = 5.16\ ft}$$

Now find the value of Moment At 5.166ft.

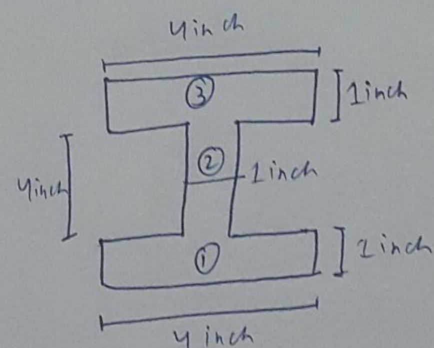


$$M_{5.166} = -178.25 \times 5.166 + (34.5 \times 5.166) \times \left(\frac{5.166}{2}\right) = 0$$

$$\boxed{M_{5.166} = +460.47\ lb/ft}$$

For Shear Stress we have, $\tau = \frac{VQ}{Ib}$.

First find Moment of Inertia for given Section.



As the Given figure Symetrical along the both axis.

so, $\bar{x} = 4/2 = 2$ inch,

$\bar{y} = 6/2 = 3$ inch.

$(\bar{x}, \bar{y}) = (2, 3)$ (Center of Gravity).

From Extreme left and Bottom.

Area of Part ① = $4 \times 1 = 4\,inch^2$

Area of Part ② = $1 \times 4 = 4\,inch^2$

Area of Part ③ = $4 \times 1 = 4\,inch^2$

→ Moment of Inertia about x-axis (Centroidal) I_{xx} ?

Determine distances between C.G of the whole Section and the corresponding parts.

Let,

G_1, G_2, G_3 be the center of gravity of Part (1), (2) and (3) and K_1, K_2 and K_3 be the distance between $\bar{y}$ and $y_1\ y_2$ & y_3 respectively.

So,

$K_1 = \bar{y} - y_1$, $K_2 = \bar{y} - y_2$, $K_3 = \bar{y} - y_3$

$= 3 - 0.5$, $K_2 = 3 - 3$, $K_3 = 3 - 0.5$

$= 2.5\,in$, $K_2 = 0\,inch$, $K_3 = 2.5\,inch$

So,

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

Putting values
we have,

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

$$I_{xx} = 4/12 + 5 + 64/12 + 4/12 + 25$$

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

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

Now,

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

Putting values
we have,

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

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

$$I_{yy} = 64 + 4 + 64 \qquad \boxed{I_{yy} = 11 \text{ in}^4}$$