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Section : A

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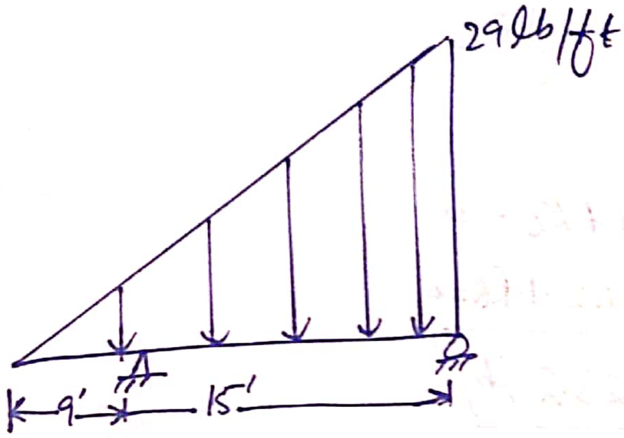
Subject :- Structural Analysis (1)

Exam: Final Term.

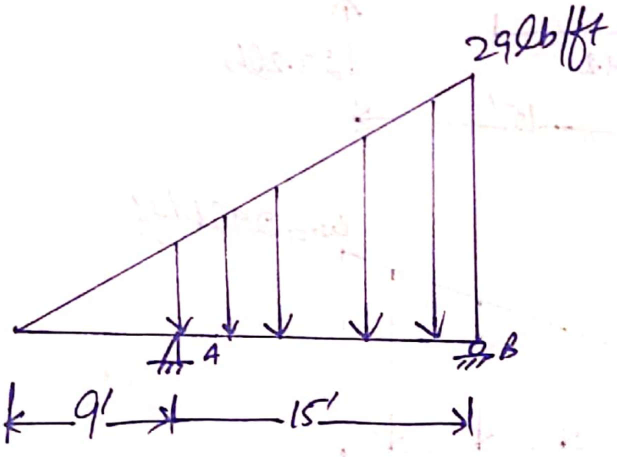
① 7829

Q1:-

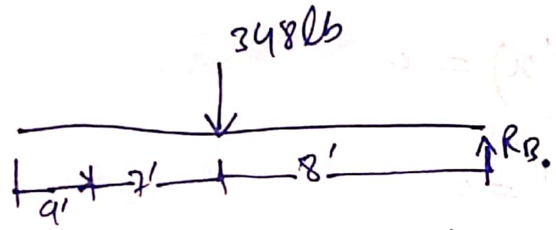


Sol:- To find shear force & Bending moment Diagram

F.B.D



To find at the point load at uniform varing load.



To find out the support reaction

(↺+) $\Sigma M_B = 0$

$$-15R_A + 348(16) = 0$$

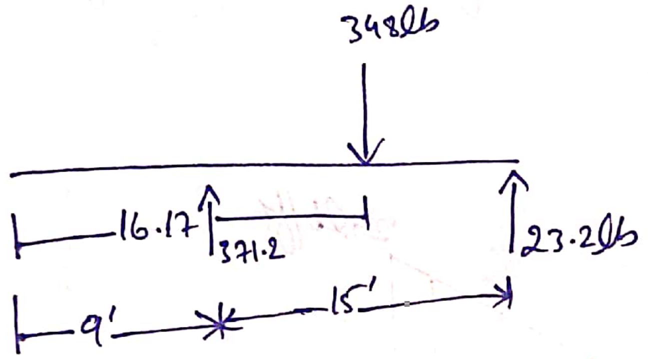
$$R_A = 371.2\ lb$$

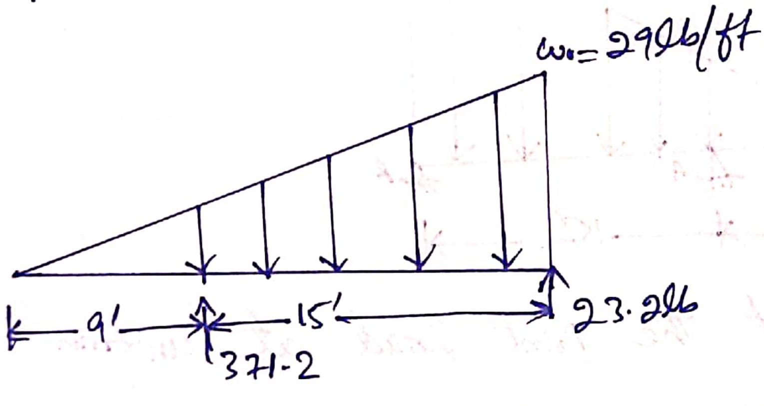
$\Sigma F_y = 0$

$-348 + R_A + R_B = 0$

$-348 + 371.2 + R_B = 0$

$\boxed{R_B = 23.2 \text{ lb}}$





Now the applicable load is to be

$$\frac{w_0 L}{4} - \frac{1}{2}\left(\frac{w_0 x}{l}\right)(x) = 0$$

$$= \frac{(29)(24)}{4} - \frac{1}{2}\left(\frac{29x^2}{l}\right) = 0$$

$$= 174 - \frac{1}{2}\,\frac{29x^2}{l}$$

(14.5)

$$= \frac{14.5}{l}x^2 - 174 = 0$$

$$= 1.625\,x^2 - 174 = 0$$

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$\sqrt{x^2} = \sqrt{107.40}$

$\Rightarrow \boxed{x = 10.36}$

(-ive +ive) $\Sigma M = 0$

$M + \frac{1}{2}\left(\frac{w_o x}{L}\right) x \left(\frac{x}{3}\right) - \frac{w_o l}{4}\left(x - \frac{l}{3}\right) = 0$

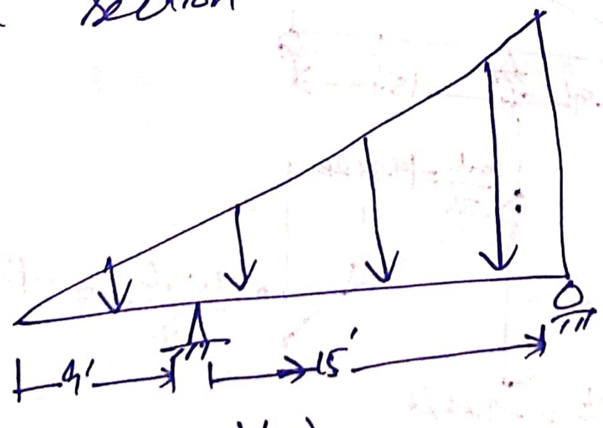
$m = -\frac{1}{2}\left(\frac{29(10.36)}{24}\right)(10.36)\left(\frac{10.36}{3}\right) + \frac{29 \times 24}{4}\left(10.36 - \frac{(\frac{1}{4})}{3}\right) =$

$m = -223.93 + 1802.099$

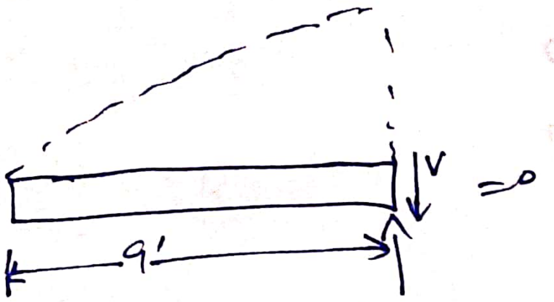
$m = 1578.169$ lb/ft.

The positive sign shown that the moment section is in anti-clockwise direction.

Now a section



$\frac{1}{2}\left(\frac{w_o x}{l}\right)(x)$



$\frac{w_0}{L} x$

$\frac{w_0 l}{4}$

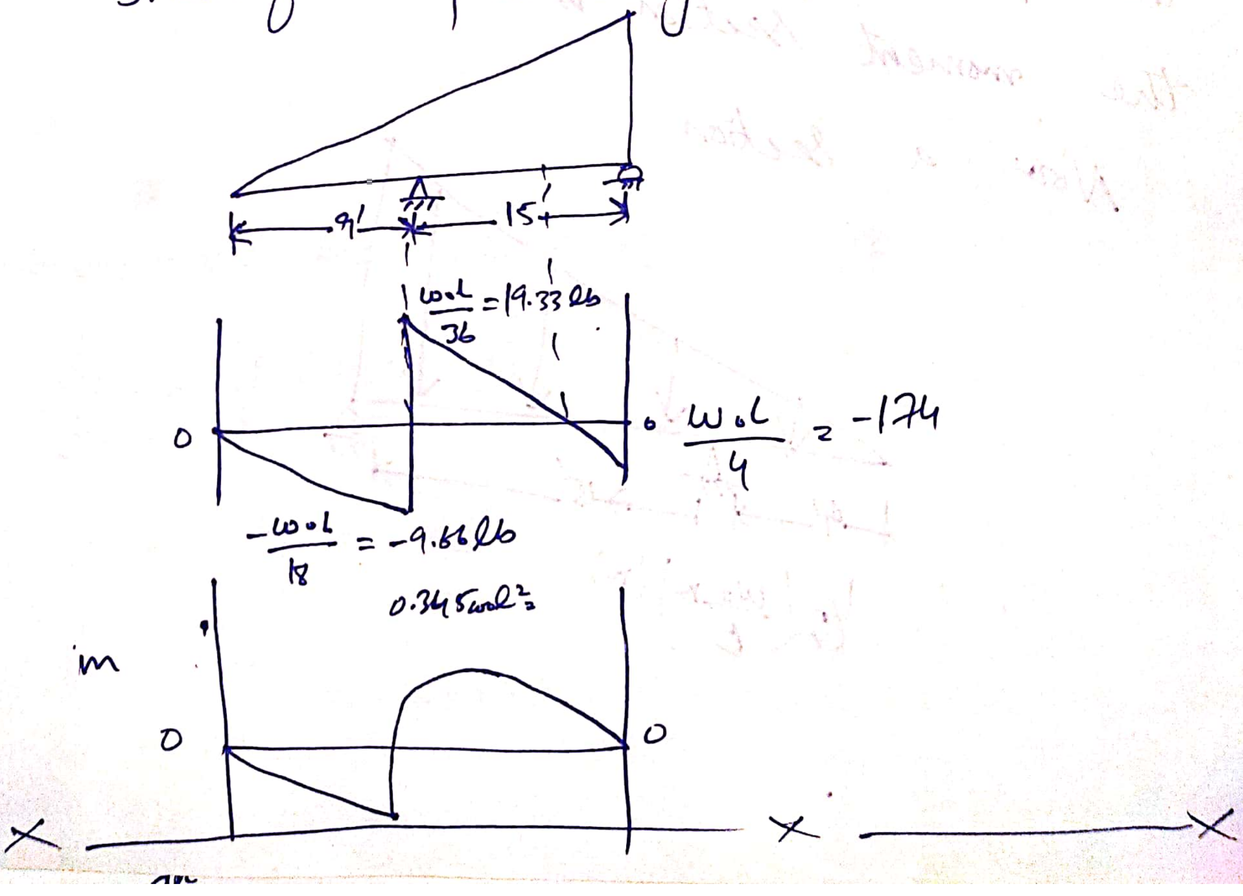
$= \frac{1}{2}\left(\frac{(29)(10.36)}{24}\right)(10.36)$

$= 64.84$ lb/ft

$\frac{w_0}{L} x = \frac{29}{24}(10.36)$

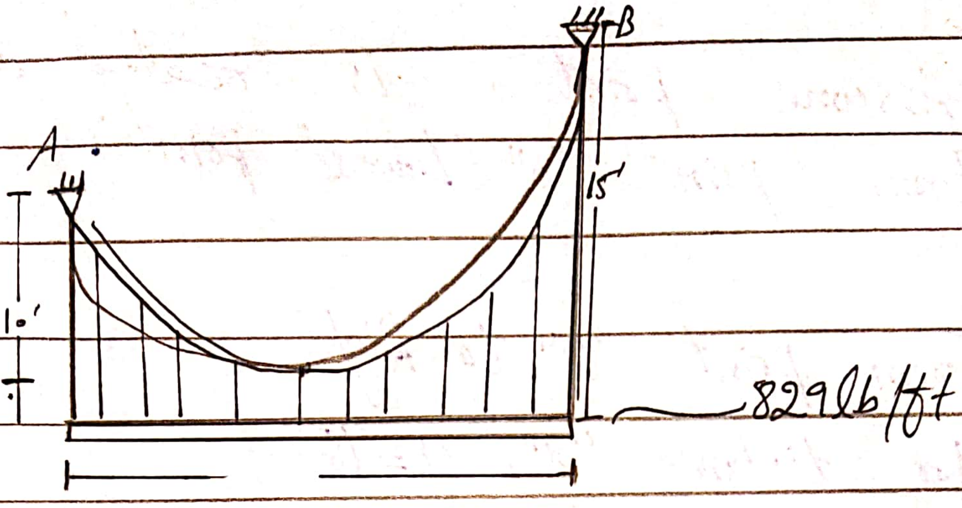
$= 12.51$ lb/ft

Now Shear force & Bending moment.



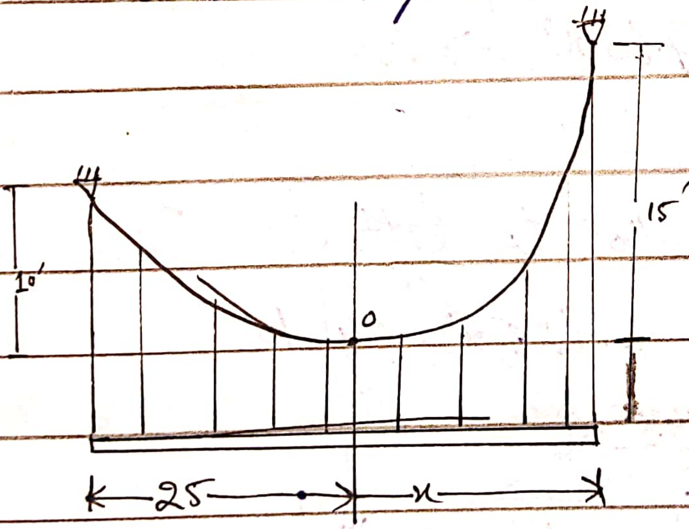
Ⓢ 7829

Q#2



Sol:-

Let suppose we take a point "O" in the Cable which is the lowest point, whose slope is Zero.



Using formula:

$$y = \frac{W_o}{2T_o} \cdot x^2 = \frac{829}{2T_o} x^2$$

$$y = \frac{414.5}{T_o} \cdot x^2$$

(6) 7829

Now,
Assume point c is located at x distance from point "o" (Lowest point)

So,
→ From point "O" to Right
For distance "x", $y = 15'$

$$\Rightarrow y = \frac{414.5}{T_o} x^2$$

$$15 = \frac{414.5}{T_o} x^2 \Rightarrow \boxed{T_o = \frac{414.5\,x^2}{15}} \rightarrow (1)$$

$$\boxed{T_o = 27.63\,x^2} \rightarrow (2)$$

Again
⇒ ~~From point "o" to left~~
~~For distance $-(25-x)$, $y = 10$~~

~~$$\Rightarrow y = \frac{414.5}{T_o} x^2$$~~

~~$$10 = \frac{414.5}{T_o} [-(25-x)]^2 \rightarrow (2)$$~~

Again
⇒ From point "O" to left
For distance $-(25-x)$, $y = 10$

$$\Rightarrow y = \frac{414.5}{T_o} x^2$$

$\Rightarrow 10 = \frac{414.5}{T_0}\left[-(25-x)\right]^2$

$\Rightarrow \boxed{T_0 = \frac{414.5}{10}\left[-(25-x)\right]^2} \rightarrow (3)$

Comparing eq (1) & (3),

$\frac{414.5}{15}x^2 = \frac{414.5}{10}\left[-(25-x)\right]^2$

Interchanging,

$\Rightarrow \frac{414.5}{414.5}x^2 = \frac{15}{10}(625-50x+x^2)$

$\Rightarrow x^2 = 1.5(625-50x+x^2)$

$\Rightarrow x^2 = 937.50 - 75x + 1.5x^2$

$\Rightarrow 937.50 - 75x + 1.5x^2 - x^2 = 0$

$\Rightarrow 0.5x^2 - 75x + 937.50 = 0$

By solving,

Using Quadratic Equation

$a = 0.5, \; b = -75, \; c = 937.50$

$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

Putting Values

$x = \frac{+75 \pm \sqrt{5625-1875}}{1}$

(8) 78291

$x = 75 \pm \sqrt{3750}$

$\boxed{x = 137 ft} \rightarrow (4)$

Now put eq (4) in (2)

$T_o = 27.63 x^2$

$T_o = 27.63 (137)^2$

$\boxed{T_o = 5{,}231.39 \text{ lbs}}$

Now we have to find the Tension at given points:-

By using formula

$y = \frac{w_o}{2T_o} x^2$

$y = \frac{414.5}{T_o} x^2$

Differentiate the above eq w.r.t "x"

$\frac{dy}{dx} = \frac{d}{dx}\left(\frac{414.5}{T_o} . x^2\right)$

$= \frac{414.5}{T_o} . 2x$

$\frac{dy}{dx} = \frac{829}{T_o} x \rightarrow (a)$

Also

$\frac{dy}{dx} = \tan\theta \rightarrow (b)$

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So

$$\tan\theta = \frac{829}{T_o} x$$

At point "A" is −11.24 away from "o"

$$\tan Q_A = \frac{829}{5231.39}(-11.24)$$

$$Q_A = \tan^{-1}(-1.7811)$$

$$\boxed{Q_A = -60.68}$$

Now, Tension at point A is,

$$T_A = \frac{T_o}{\cos Q_A} \qquad \because \left(\cos\theta = \frac{T_o}{T_A}\right)$$

$$= \frac{5231.39}{\cos(-60.68)}$$

$$T_A = 10{,}683.13 \text{ lbs}$$

$$T_A = 10.683 \text{ Kips}$$

→ Now point "B" where $x = 13.76$ ft

$$\tan\theta_B = \frac{829}{T_o}(13.76)$$

$$= \frac{829}{5231.39}(13.76)$$

$$\theta_B = \tan^{-1}(2.180)$$

$$\boxed{Q_B = 65.3^\circ}$$

Now Tension,

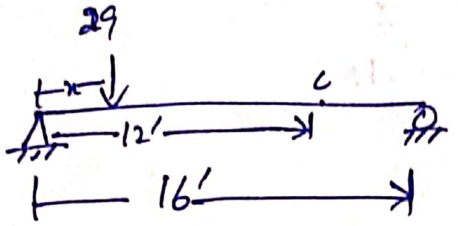
$$T_c = \frac{T_o}{\cos \theta_B}$$

$$T_c = \frac{5231.39}{\cos(85.3)}$$

$T_c = 12,519.26$ lbs

$\therefore T_c = 12.51$ kips

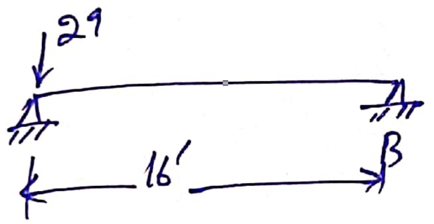
Q. No. 3.



influence at "c" and "A"

P = 29

For $x = 0$ $R_A = ?$

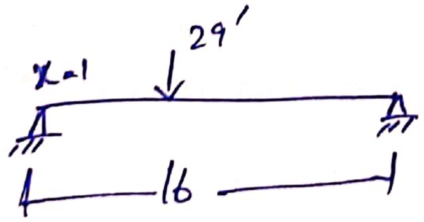


$\Sigma M_B = 0$

$-(29 \times 16) + R_A(16) = 0$

$\boxed{R_A = 29K}$

For $x = 1'$ $R_A = ?$



$\Sigma M_B = 0$

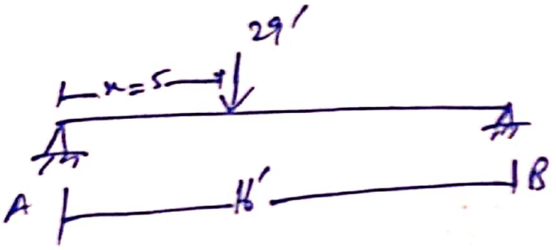
$-(29 \times 15) + R_A(16) = 0$

$R_A = 27.1875$

$x = 5$

For

$x = 5$

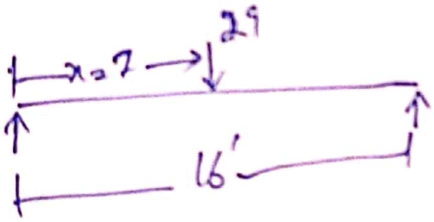


$\sum M_B = 0$ (+ ↺)

$-(29 \times 5) + 16(R_A) = 0$

$R_A = 9.06$

$x = 7 \quad R_A = ?$

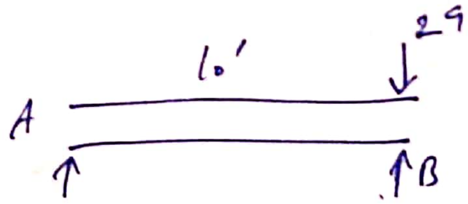


$\sum M_B = 0$ (+ ↺)

$-(29 \times 7) + R_A(16) = 0$

$R_A = 8.31$

$\sum M_B = 0$ (+ ↺)



$+R_A(16) - 62(0) = 0$

$16 R_A = 0$

$R_A = 0$

(13) 7829

$R_{A_1} = 29$

$R_{A_2} = 27.18$

$R_{A_3} = 9.06$

$R_{A_4} = 8.31$

$R_{A_5} = 0$