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Subject Structural Analysis I

Department BE (civil)

Submitted to Engr Saqib Khan

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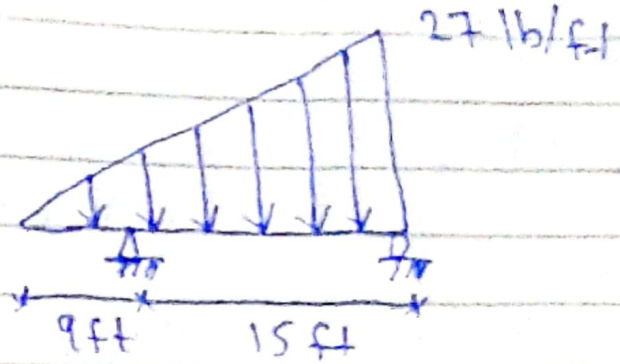
Ans 1,

Shear & Bending Moment



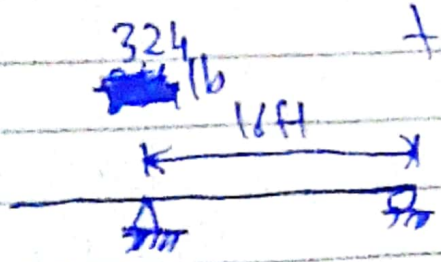
Sol;

Converting UVL to Point Load.

We have,

$$X = \frac{2B}{3} = \frac{2(24)}{3} = \frac{48}{3}$$

X = 16 ft from the largeend of the load triangle.

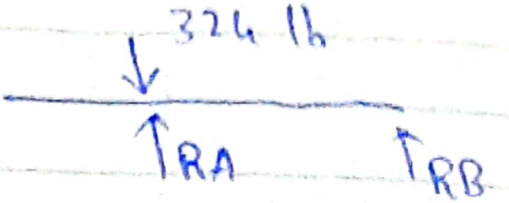


Magnitude of concentrated Point load.

$$= 1/2\ bh = \frac{1}{2}(24)(27)$$

$$= 324\ lb$$

Support Reaction;



$\curvearrowleft^{+} \Sigma M_B = 0$

$-15R_A + 324(16) = 0$

$15R_A = 5184$

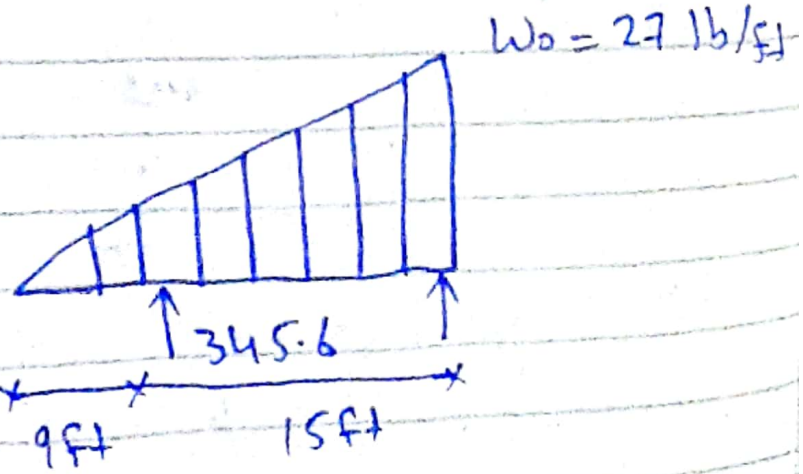
$$\boxed{R_A = 345.6 \text{ lb}}$$

$+\uparrow \Sigma F_Y = 0$

$-324 + R_A + R_B = 0$

$-324 + 345.6 + R_B = 0$

$R_B = 21.6 \text{ lb}$



Now;

$$\frac{W_0 L}{4} = \frac{1}{2}\left(\frac{W_0 x}{L}\right)(x) = 0$$

$$\frac{162}{} = \frac{1}{2}\left(\frac{27x^2}{L}\right) = 0$$

$$0.56x^2 = 162 = 0$$

$$x^2 = 162/0.56 = 289$$

$$\sqrt{x^2} = \sqrt{289}$$

$$x = 17$$

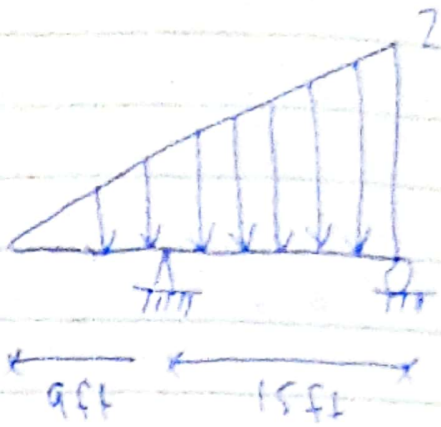
Now;

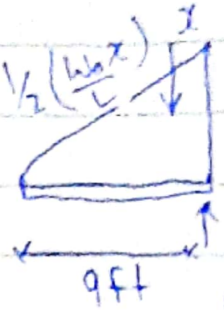
$$\zeta + \Sigma M = 0$$

$$M + 1/2\left(\frac{W_0 x}{L}\right)(x/3) - \left(\frac{W_0 L}{4}\right)(x - 1/3) = 0$$

$$M = -1/2\left(\frac{(27)(17)}{24}\right) \times (17/3) + \frac{27(24)}{4}(7 - 1/3) = 0$$

$$\boxed{M = -959.565 \text{ lb/ft}}$$





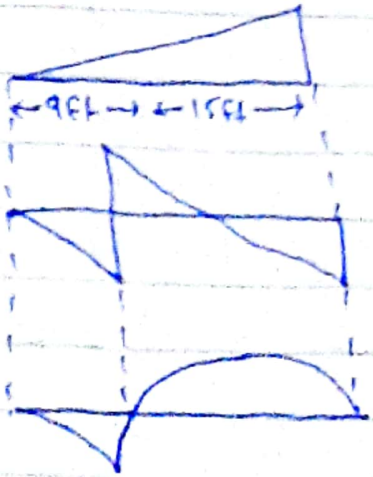
$\frac{W_0 L}{4}$

$$\frac{1}{2}\left(\frac{27(17)}{24}\right)(17) = \boxed{162.562 \text{ lb}}$$

$$\frac{W_0}{L}x = \frac{27}{24}(17) = \boxed{19.125 \text{ lb/ft}}$$

Now,

Shear force & Bending Moment Diagram.



Ans # 02 ;

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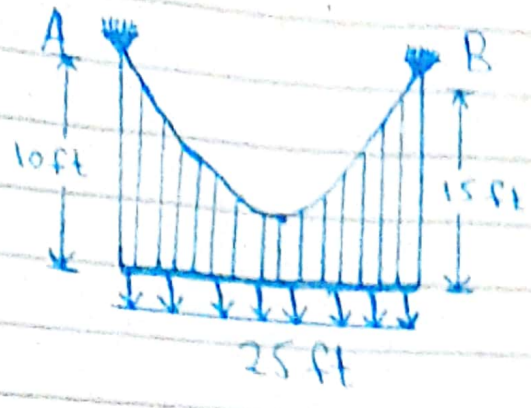
Cable =



- Cable Support Uniform load = 727 lb/ft

Determine the tension in the cable at ;

Support A = ?

Support B = ?

Sol;

$$Y = \frac{W_o}{2FH} x^2$$

By Putting values ;

$$15 = \frac{727}{2FH} x^2 \quad \text{---} \quad (i)$$

$$10 = \frac{727}{2FH} (25-x)^2 \quad \text{---} \quad (ii)$$

By solving both equations,

$$FH = \frac{727}{2(15)} x^2 \quad , \quad FH = \frac{727}{2(10)} (25-x)^2$$

Now,

$$FH = FH$$

$$\frac{727}{2(15)} x^2 = \frac{727}{2(10)} (25-x)^2$$

$$24.23 x^2 = 36.35 (625 - 50x + x^2)$$

$$x^2 = \frac{36.35}{24.23} (625 - 50x + x^2)$$

$$x^2 = 1.494 (625 - 50x + x^2)$$

$$= 1.494 x^2 - 74.7x + 933.75 = 0 \quad \text{--(i)}$$

Now,

Choose root < 25 ft

By solving eq (i)

$x = 13.76$ ft

Now;

$25 - 13.76 = 11.25$ ft

As;

$$FH = \frac{727}{2(15)} x^2 = \frac{727}{2(15)} (13.76)^2 = 4588 \text{ lb} - (A)$$

$$FH = \frac{727}{2(10)} (25-x)^2 = \frac{727}{20} (11.25)^2 = [illegible] (A)$$

$$= 4600.5 \text{ lb} - (B)$$

Support B ;

$$y = \frac{W_o}{2FH} x^2 = \frac{727}{2([illegible])(4588)} (x^2)$$

$$\frac{dy}{dx} = \tan\theta B = 0.0792 (x^2)$$

$$= 0.0792 (13.76)^2$$

$$= [illegible] 14.995$$

We have,

$\tan\theta_B = 14.995$

$\theta_B = \tan^{-1}(14.995)$

$\theta_B = 86.184°$

Tension at B;

$T_B = \frac{FH}{\cos\theta_B} = \frac{4588}{\cos(86.184)} = 68938\ lb$

$= 68.938\ kips.$

Support A;

$y = \frac{w_o}{2FH}x^2 = \frac{727}{2(4588)}(25-x)^2 = \frac{727}{2(4588)}(11.25)^2$

$y = 10.027$

$\frac{dy}{dx} = \tan\theta_B = 10.027$

$\theta_A = \tan^{-1}(10.027) \Rightarrow \theta_A = 84.304°$

Now,

$$T_A = \frac{F_H}{\cos\theta_A} = \frac{4588}{\cos(84.304)} = 46226.56 \text{ lb}$$

$$= 46.226 \text{ kips.}$$

Ans # 03 .

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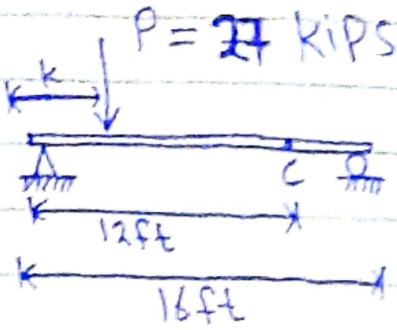
Influence line



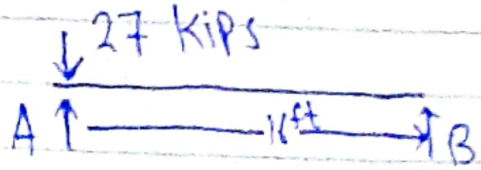
Shear Influence line at Point 'C' = ?

Influence line for reaction 'A' = ?

Sol;

Influence line for reaction 'A';

For, $x = 0$, $R_A = ?$



$$\circlearrowleft + \Sigma M_B = 0$$

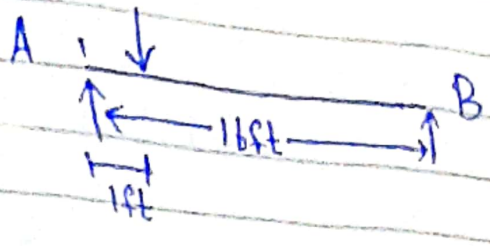
$$(27)(16) - R_A(16) = 0$$

$$16 R_A = 432$$

$$\boxed{R_A = 27}$$

For $x = 1$ ft

$R_A = ?$



$\circlearrowleft + \Sigma M_B = 0$

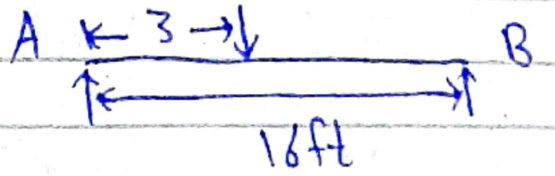
$(27)(15) - R_A(16) = 0$

$405 - 16R_A = 0$

$16R_A = 405$

$R_A = \boxed{25.31 \text{ kips}}$

For $x = 3$ ft



$\circlearrowleft + \Sigma M_B = 0$

$(27)(13) - R_A(16) = 0$

$351 - 16R_A = 0$

$16R_A = 351$

$\boxed{R_A = 21.93 \text{ kips}}$

For $x = 6$ ft, $R_A = ?$

$\curvearrowleft + \Sigma M_B = 0$

$(27)(10) - R_A(16) = 0$

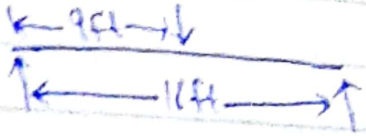
$270 - 16R_A = 0$

$16R_A = 270$

$\boxed{R_A = 16.87 \text{ kips}}$

For $x = 9$ ft, $R_A = ?$

$\curvearrowleft + \Sigma M_B = 0$



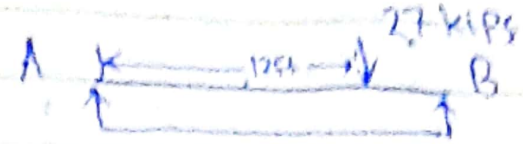
$(27)(7) - R_A(16) = 0$

$189 - 16R_A = 0$

$16R_A = 189$

$\boxed{R_A = 11.81 \text{ kips}}$

For $x = 12$ ft



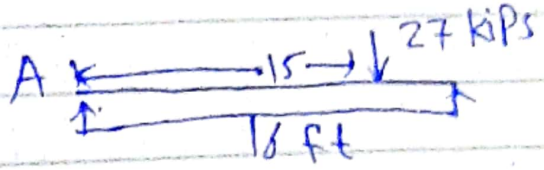
$$(27)(4) - R_A(16) = 0$$

$$108 - R_A(16) = 0$$

$$16 R_A = 108$$

$$\boxed{R_A = 6.75 \text{ kips}}$$

For $x = 15$ ft

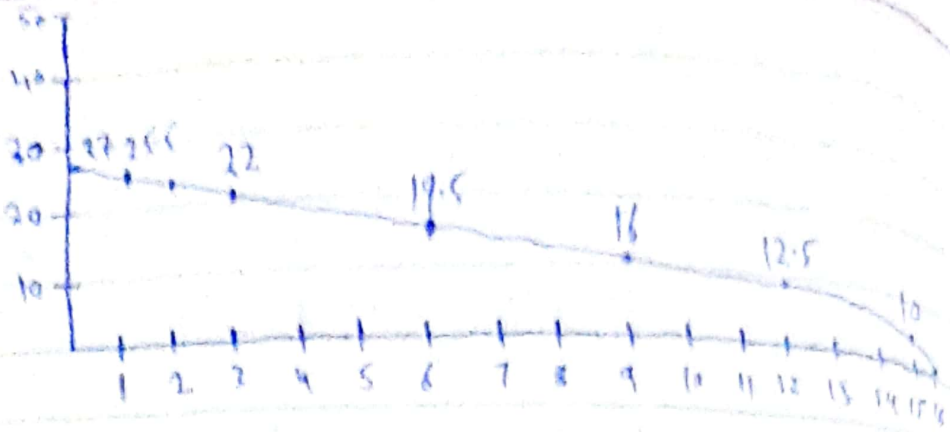


$$(27)(1) - R_A(16) = 0$$

$$27 - 16 R_A = 0$$

$$16 R_A = 27$$

$$\boxed{R_A = 1.687 \text{ kips}}$$

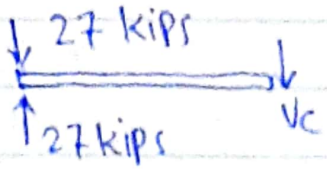


Influence line for RA.

Now;

Shear Influence line at Point 'C';

For $x = 0$, $VC = ?$



$+\uparrow \Sigma FY = 0$

$RA = -27 - VC = 0$

$= 27 - 27 - VC = 0$

$\boxed{VC = 0}$

For $x = 1$ ft , $V_C = ?$

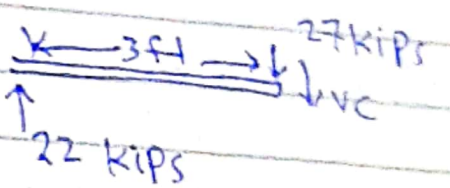
$+\uparrow \Sigma F_Y = 0$

$R_A - P - V_C = 0$

$25.5 - 27 - V_C = 0$

$\boxed{V_C = -1.5}$

For $x = 3$ ft , $V_C = ?$



$+\uparrow \Sigma F_Y = 0$

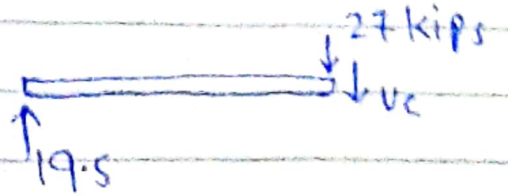
$R_A - P - V_C = 0$

$22 - 27 - V_C = 0$

$\boxed{V_C = -5}$

For $x = 6$ ft , $V_C = ?$

$+\uparrow \Sigma F_Y = 0$

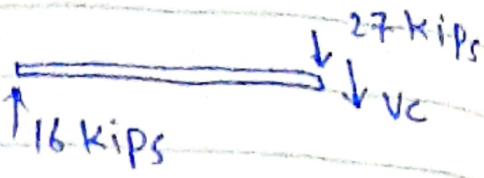


$R_A - P - V_C = 0$

$19.5 - 27 - V_C = 0$

$\boxed{V_C = 7.5}$

For $x = 9$ ft



$+\uparrow \Sigma F_Y = 0$

$R_A - P - V_C = 0$

$16 - 27 - V_C = 0$

$$\boxed{V_C = -11}$$

For $x = 12$ ft, $V_C = 0$

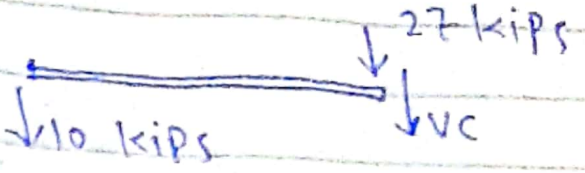
$\uparrow \Sigma F_Y = 0$

$R_A - P - V_C = 0$

$12.5 - 27 - V_C = 0$

$$\boxed{V_C = -14.5}$$

For $x = 15$, $V_C = ?$

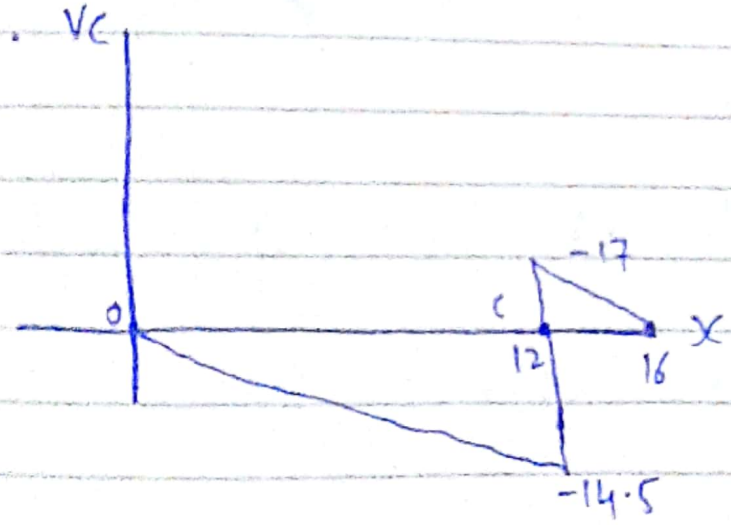


$+\uparrow \Sigma F_Y = 0$

$R_A - P - V_C = 0$

$10 - 27 - V_C = 0$

$\boxed{V_C = -17}$



Shear Influence line at Point 'c'