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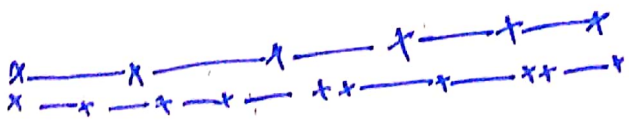
Section :- "C"

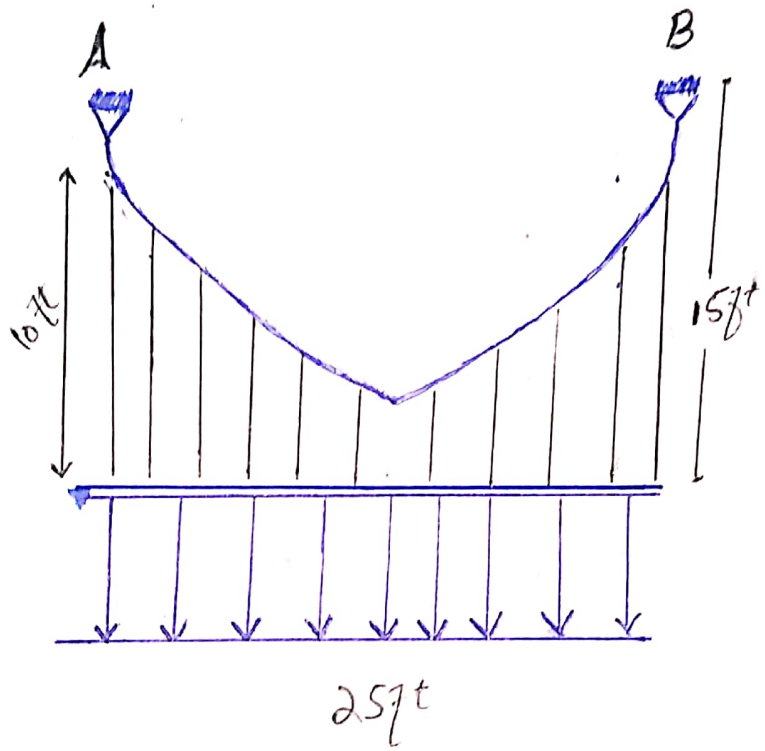
Subject :- Structure analysis I

Teacher :- Sir Saqib Khan



Ans: 02.

"Cable"



⇒ Cable Supports uniform load = 872 lb/ft

Determine the tension in Cable

at Support A = ?

Support B = ?

Soloution:

$$y = \frac{Wl_0}{2F_H} \qquad \left(\text{As } F_H = \frac{WL^2}{2h} \right.$$

By putting values.

$$15 = \frac{871}{2F_H} x^2 \quad \text{——(i)}$$

$$10 = \frac{871}{2F_H} (25-x)^2 \quad \text{——(ii)}$$

By Solving Both equations:

$$F_H = \frac{871}{2(15)} x^2 \;, \quad F_H = \frac{871}{2(10)} (25-x)^2$$

$$F_H = F_H$$

$$\frac{871}{2(15)} x^2 = \frac{871}{2(10)} (25-x)^2$$

$$29.05x^2 = 43.5(625 - 50x + x^2)$$

$$x^2 = \frac{43.60}{29.06}(625 - 50x + x^2)$$

$$x^2 = 1.50(625 - 50x + x^2)$$

$$0.5x^2 - 75x + 937.50 = 0 \quad \text{---(i)}$$

choose root < 25 ft

By Solving eq (i)

$$\boxed{x = 13.76 \text{ ft}}$$

Now

$$25 - 13.76 = (11.2571)$$

As we know

$$F_H = \frac{871}{2(15)} x^2 = \frac{871}{2(15)} (13.76)^2 = 5504.02$$

(A)

$$F_H = \frac{871}{2(10)} (25 - x)^2 = \frac{871}{20} (11.25)^2 = 5518.1221 \text{b}$$

(B)

⇒ Support: B

$$y = \frac{W_o}{2F_H} x^2 = \frac{871}{2(5504.41)} (13.76)^2$$

$$= 14.997$$

Now

$$dy/dx = \tan\theta_B = 14.997$$

$$\theta_B = \tan^{-1}(14.997)$$

$$\boxed{\theta_B = 86.18^\circ}$$

Tension at B:

$$T_B = \frac{F_H}{\cos\theta_B} = \frac{5504.41}{\cos(86.18)} = 82621 \text{ lb}$$

$$\boxed{= 82.621 \text{ kips}}$$

⇒ Support : A

$$y = \frac{w_0}{2F_H} x^2 = \frac{871}{2(5504.41)} (25-x)^2$$

$$= \frac{871}{2(5504.41)} (11.25)^2$$

$$\boxed{y = 10.023}$$

$$dy/dx = \tan\theta_A = 10.023$$

$$\theta_A = \tan^{-1}(10.023)$$

$$\theta_A = 84.301^\circ$$

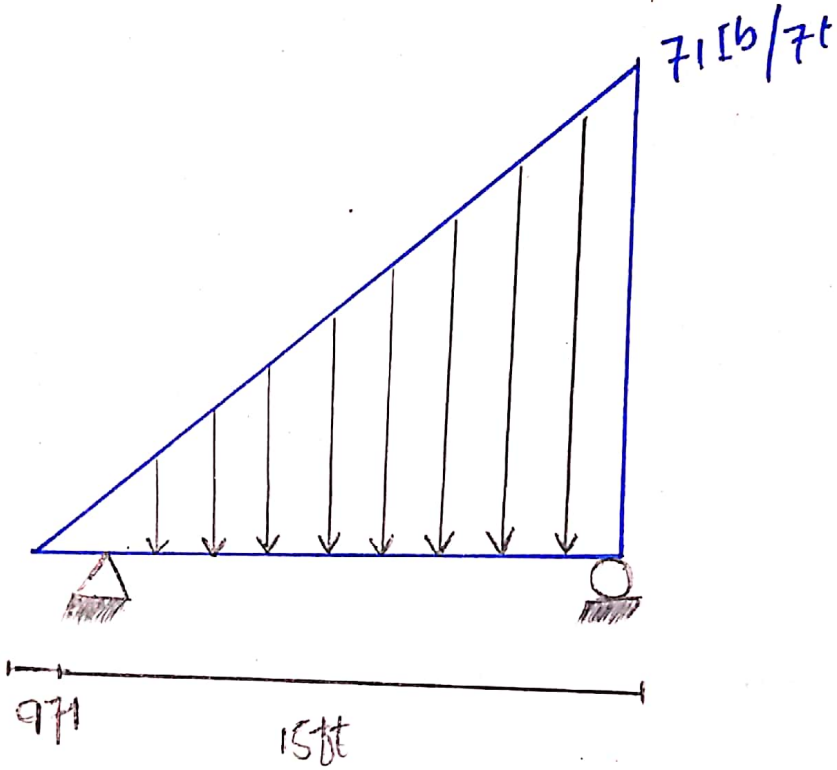
Now

$$T_A = \frac{F_H}{\cos\theta_A} = \frac{5504.41}{\cos(84.302)} = 55440 lb$$

$$\boxed{= 55.440 \text{ kips}}$$

Ans: 02

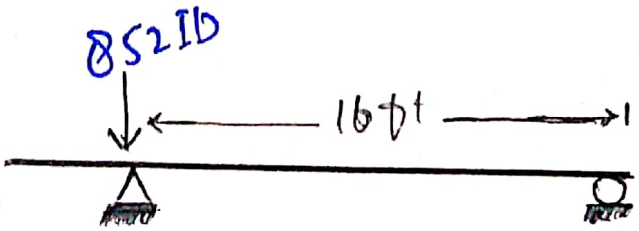
Shear and Bending moment



Sol Converting UVL to point load.

We have $X = 28/3 = 2\frac{(24)}{3} = \frac{48}{3}$

$\boxed{X = 16ft}$ from large end of load triangle



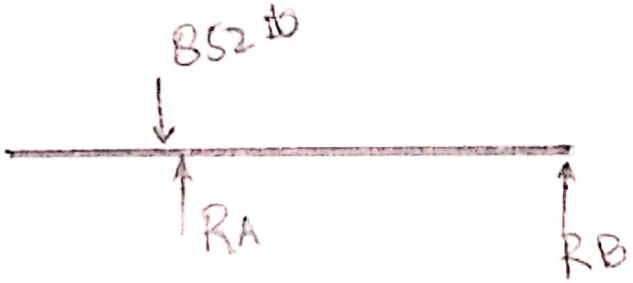
magnitude of Converted point load

$$= \frac{1}{2} bh$$

$$= \frac{1}{2}(24)(71)$$

$$\boxed{= 852 \text{ lb}}$$

※ Support Reaction:



$$(+ \sum MB = 0$$

$$-15RA + 852(16) = 0$$

$$15RA = 13632$$

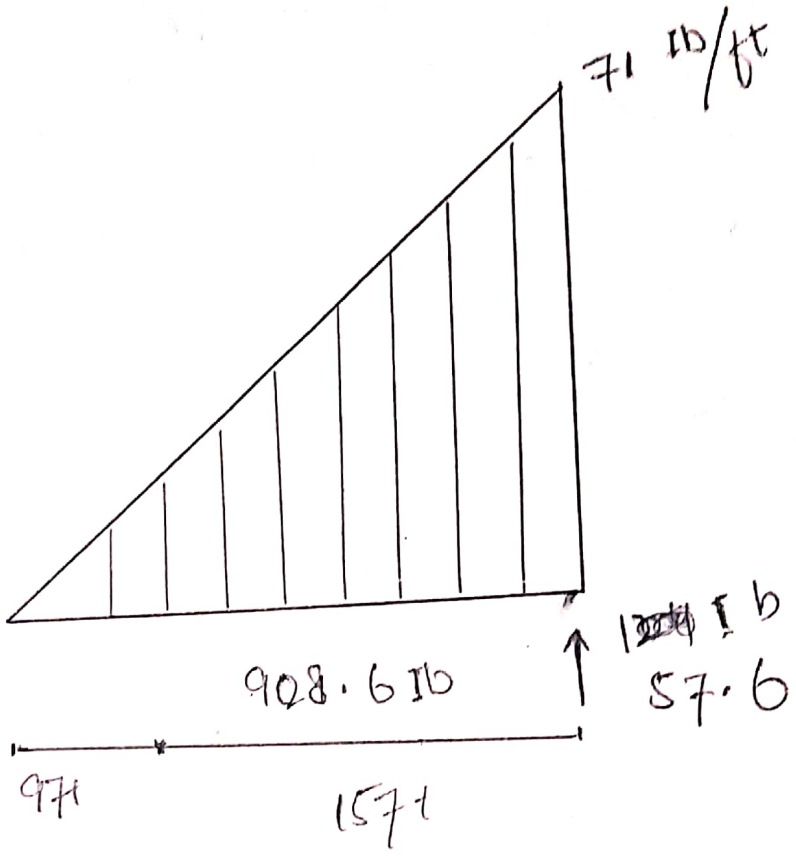
$$\boxed{RA = 908.8 \text{ lb}}$$

$$+\uparrow \sum Fy = 0$$

$$-852 + RA + RB = 0$$

$$-852 + 921.5 + RB = 0$$

$$\boxed{RB = 69.5}$$



We have

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

$$432 \cdot \frac{1}{2}\left(\frac{71 x^2}{L}\right) = 0$$

$$1.5 x^2 - 432 = 0$$

$$x^2 = 432 / 1.5$$

$$\sqrt{x^2} = \sqrt{288}$$

$$\boxed{x = 16.970}$$

Now

$$\left(+\sum M = 0\right)$$

$$M + \tfrac{1}{2}\left(\frac{w_0 x}{L}\right)\left(x/3\right) - \left(\frac{w_0 L}{4}\right)\left(x - 1/3\right) = 0$$

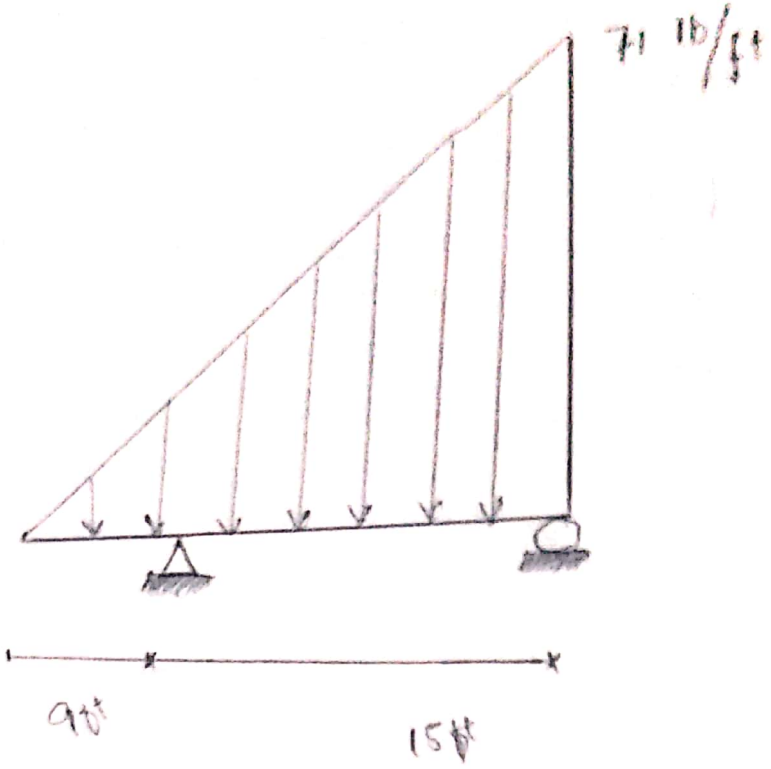
$$M = \tfrac{1}{2}\left(\frac{(71)(16.47)}{24}\right) x \left(16.47/3\right)$$

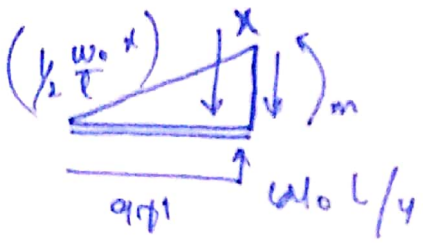
$$+ \frac{71(24)}{4}\left(16.47 - 1/3\right) = 0$$

$$M = -7698.30 + 4025.48$$

$$\boxed{M = -3672.82 \text{ lb·ft}}$$

P.T.O





$$\frac{1}{2}\left(71\frac{(16.97)}{24}\right)(16.97) = \boxed{431.97\ lb}$$

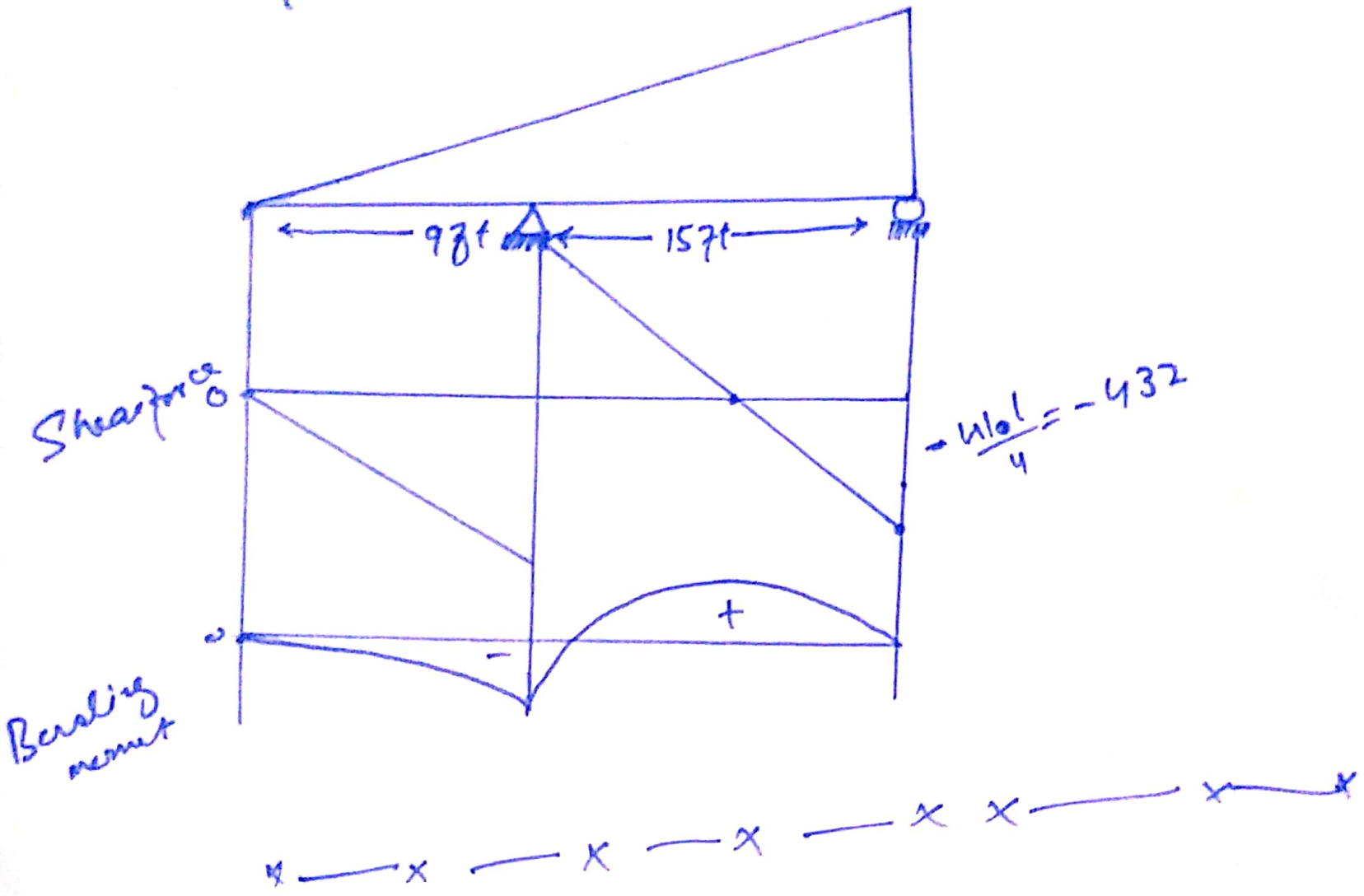
$$\frac{w_0}{\ell}x = \frac{71}{24}(16.47) \boxed{= 50.91}\ lb/ft$$

Now Shearforce and Bending moment diagram

P.T.O

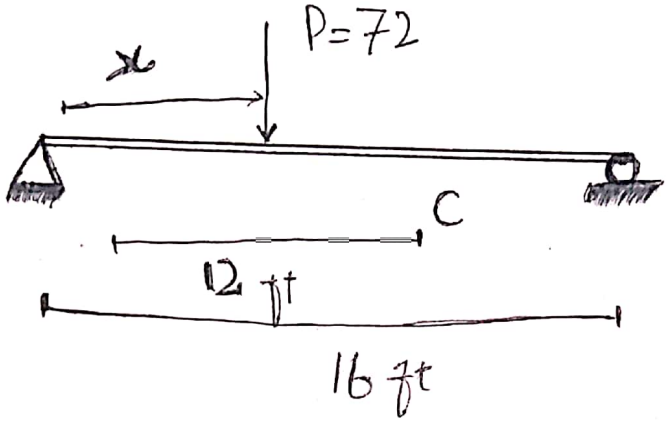
(11)

Shear force and Bending moment diagram



Ans: 03

Influence Line



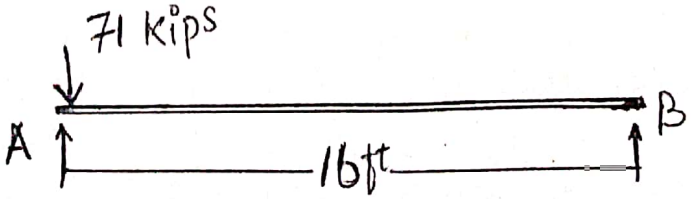
Shear Influence line at point "C" = ?

Influence line for reaction "A" = ?

Sol

Influence line for reaction "A"

for $x = 0$, R_A = ?



$$(+\circlearrowright \sum M_B = 0$$

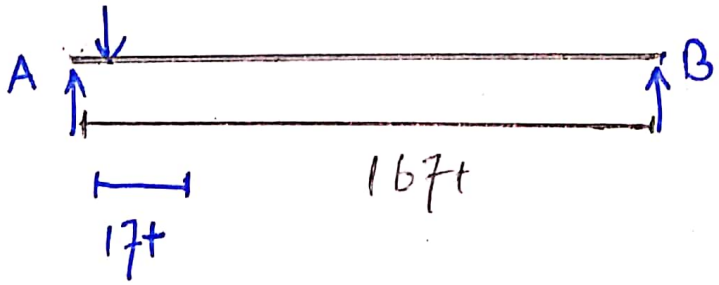
$$(71)(16) - R_A(16) = 0$$

$$16R_A = 1136$$

$$\boxed{R_A = 71 \text{ kips}}$$

$\Rightarrow$ (for $x = 17t$)

$R_A = ?$



$$(+\circlearrowright \sum M_B = 0$$

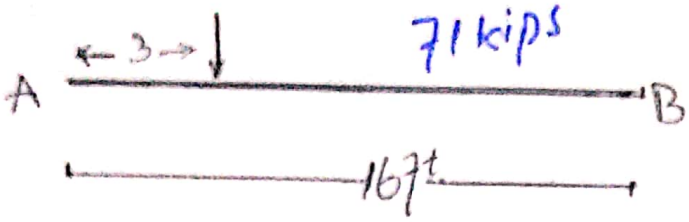
$$(71)(15) - R_A(16) = 0$$

$$1080 - 16R_A$$

$$16R_A = 1080$$

$$R_A = 67.5 \text{ kips}$$

⇒ (for x = 3ft)



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

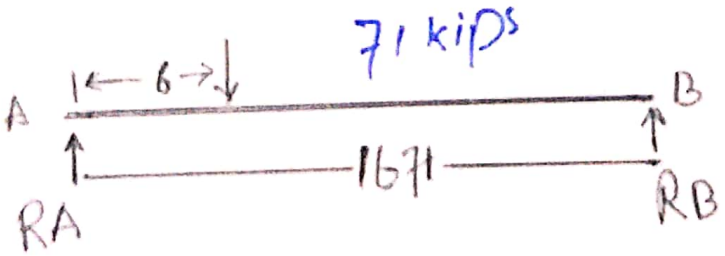
$$(71 \times 13) - RA(16)$$

$$923 - 16RA$$

$$16RA = 923$$

$$RA = 57.68 \text{ kips}$$

⇒ (for x = 6ft)



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

$$(71 \times 10) - RA(16) = 0$$

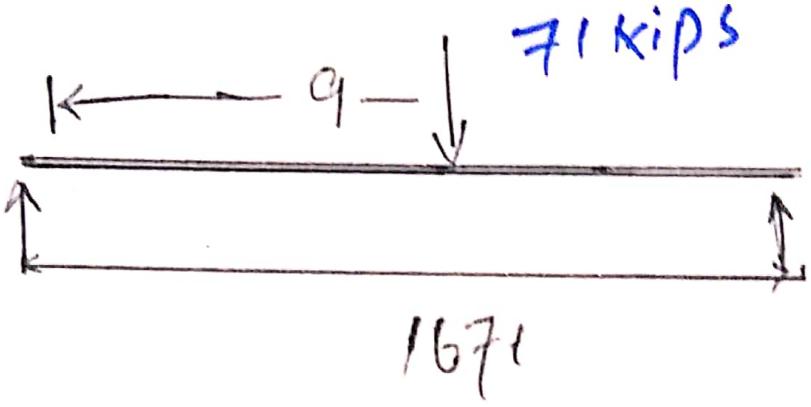
$$710 - RA16$$

$$RA = 44.37$$

$\Rightarrow$ (For $x = 9ft$)

$RA = ?$

$(+ \Sigma M_B = 0$



$(71 \times 7) - RA(16) =$

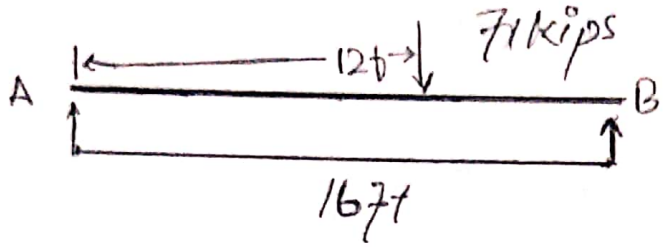
$497 - RA\,16$

$RA = \frac{497}{16}$

$\boxed{RA = 31.5}$

(16)

⇒ (for x = 12ft)



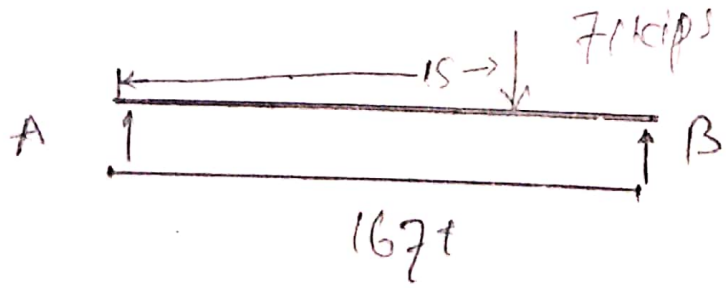
$(71 \times 4) - R_A(16) = 0$

$284 - R_A 16 = 0$

$R_A 16 = 284$

$\boxed{R_A = 17.75}$

⇒ (for x = 15ft)

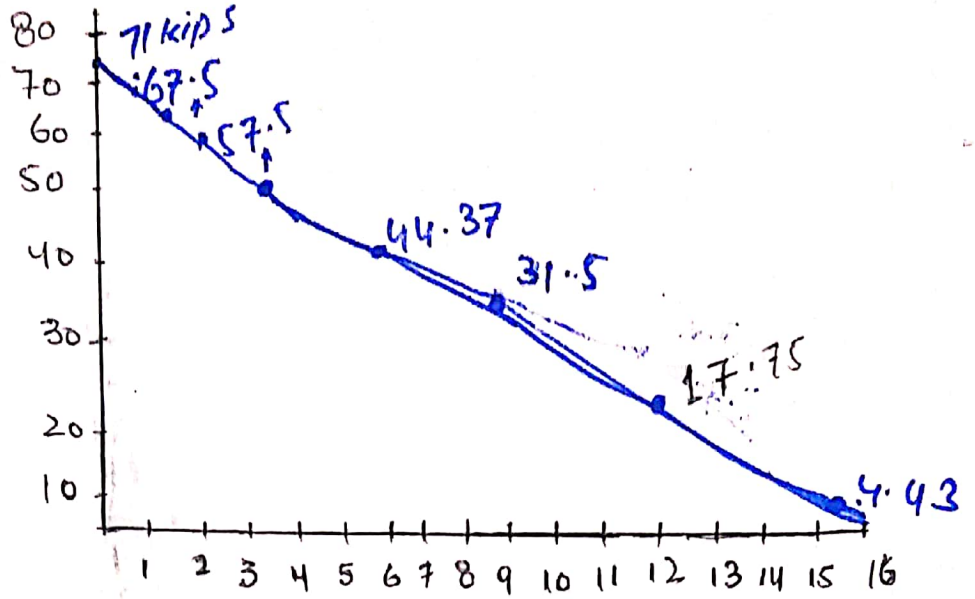


$(71 \times 1) - 16R_A(16)$

$71 - 16R_A$

$16R_A = 71$

$\boxed{R_A = 4.43}$



Influence line of RA:

Now

Shear Influence line at point "C"

for x = 0 Vc = ?

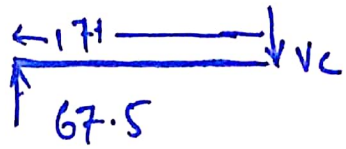
$\Sigma F_y = 0$

$R_A - 72 - V_c = 0$

$71 - 71 - V_c$

$V_c = 0$

for x = 1ft Vc = ?



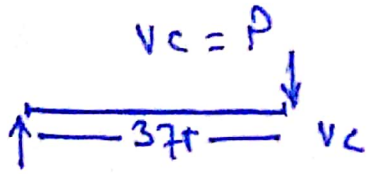
$\Sigma F_y = 0$

$R_A - P - V_c = 0$

$67.5 - 71 - V_c = 0$

$V_c = -4.5$

For ⇒ x = 3ft



58.5 kips

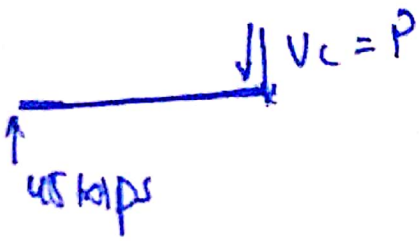
$+\uparrow \Sigma F_y = 0$

$RA - P - Vc = 0$

$58.5 - 71 - Vc = 0$

$\boxed{Vc = -12.5}$

⇒ for x = 6ft



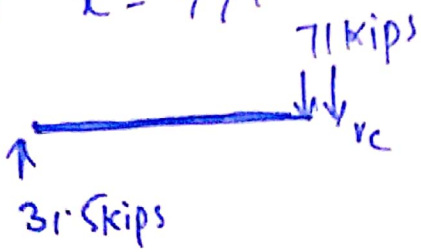
$\uparrow \Sigma F_y = 0$

$RA - P - Vc = 0$

$45 - 71 - Vc =$

$\boxed{Vc = -26}$

⇒ for x = 9ft



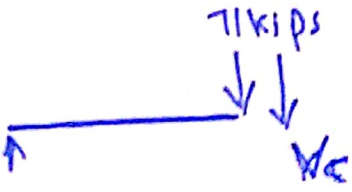
$\uparrow \Sigma F_y = 0$

$RA - P - Vc = 0$

$31.5 - 72 - Vc = 0$

$\boxed{Vc = -39.5}$

⇒ for x = 12ft



$\uparrow \Sigma F_y = 0$

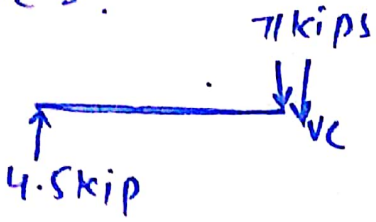
$RA - P - Vc = 0$

$18.25 - 71 - Vc = 0$

$\boxed{Vc = -52.75}$

⇒ For x=15

Vc = ?

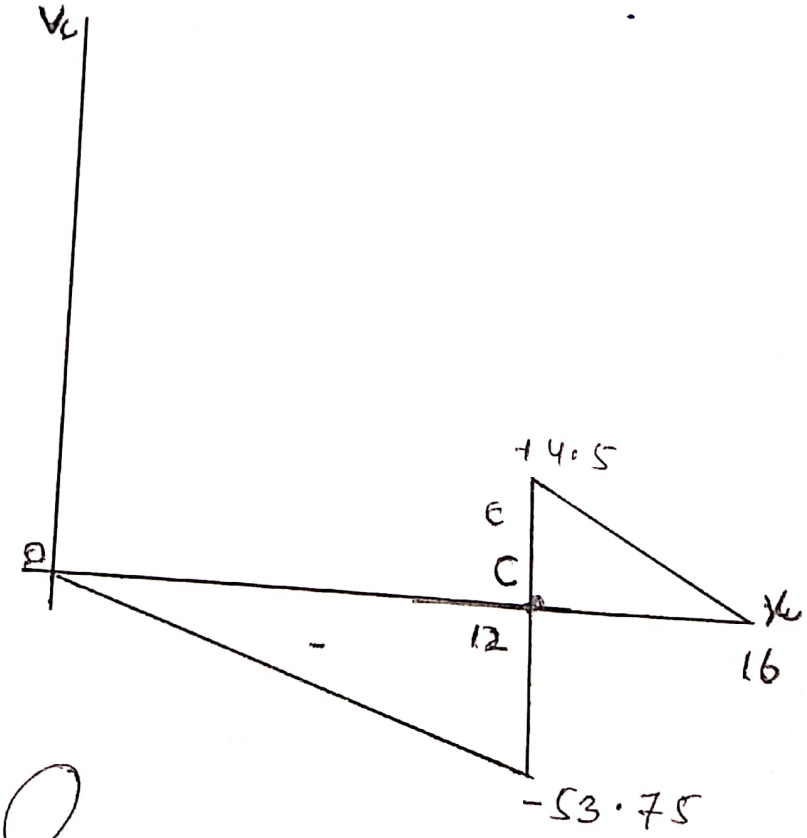


$+\circlearrowleft \sum M_c = 0$ $+\uparrow \sum F_y = 0$

$R_A - V_c = 0$

$4.5 - V_c = 0$

$\boxed{V_c = 4.5}$



Shear Influence line at point "C"