Final paper Summer-20

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Subject — Structure Analysis-I

Submitted To — Engr M. Saqib.

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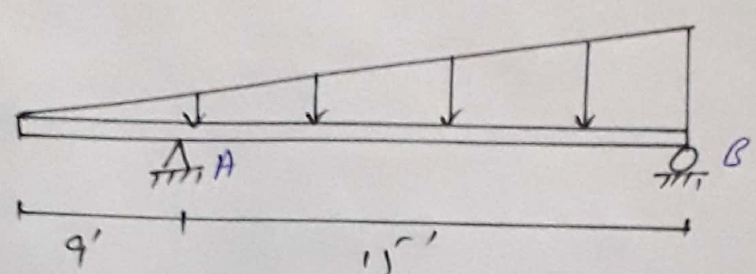
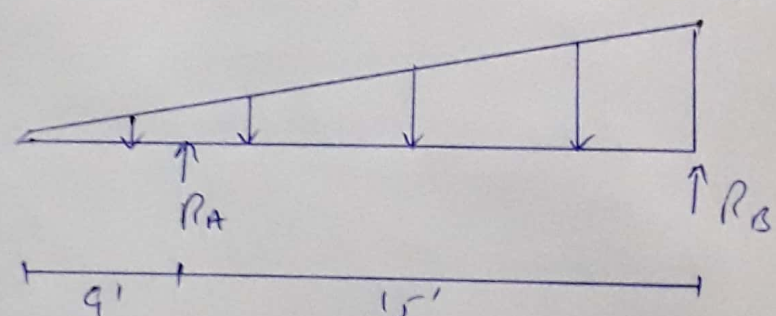
Q:11

P = 07

Solution:



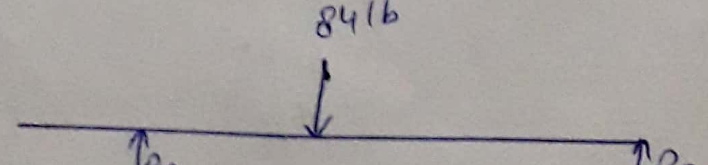


Converting UVL into Point load. = $\frac{1}{2}(7\times24)$

= 84 lb

This point load acts on $\frac{2}{3}$ of beam length =

$\frac{2}{3}\times24 = 16$ ft



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$\Sigma M_A = 0$ ↻+

$-15 R_B + 84 \times 7 = 0$

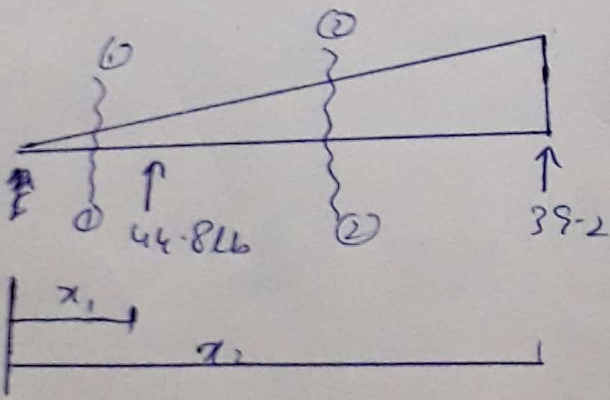
$$R_B = \frac{84 \times 7}{15} = 39.2 \text{ lb}$$

$\Sigma F_y = 0$ ↑+ ↓−

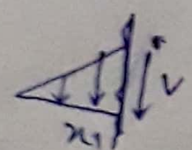
$R_A - 84 + 39.2 = 0$

$$R_A = 44.8 \text{ lb}$$

Finding Shear forces Equations:



Section 1-1 :-



$$V_{1-1} = \frac{1}{2} \times x_1 \times \frac{7}{24} x_1 = \frac{7}{48} x_1^2 \quad \therefore x_1 = 0 \to 9$$

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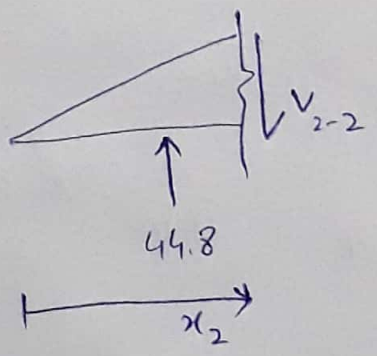
(3)

$$V_{1-1}\Big|_{x=0} = \frac{7}{48}\times(0)^2 = 0$$

$$V_{1-1}\Big|_{x=9} = \frac{7}{48}(9)^2 = 11.81\ lb$$

Section 2-2



$$\Sigma F_y = 0$$

$$-V + 44.8 - \frac{1}{2}\times\frac{7}{24}x_2 \times x_2 = 0$$

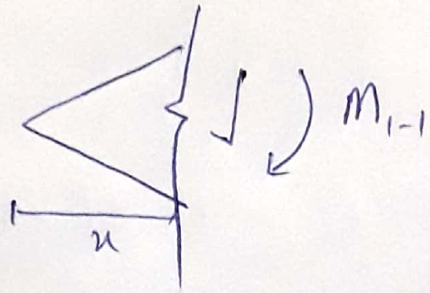
$$V_{2-2} = 44.8 - \frac{7}{48}x_2^2$$

$\therefore x_2 = 9 \rightarrow 24$

$$V_{2-2}\Big|_{x=9} = 44.8 - \frac{7}{48}(9)^2 = 32.99\ lb$$

$$V_{2-2}\Big|_{x=24} = 44.8 - \frac{7}{48}(24)^2 = -39.2$$

Finding Bending moment Equation:-



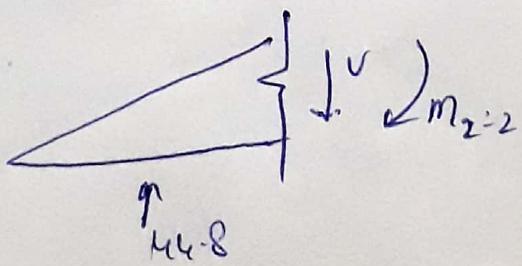
Section 1-1

$$M_{1-1} = \frac{1}{2} \times \frac{7}{24} x_1 \times x \times \frac{1}{3} x_1 = \frac{7}{144} x_1^3 \qquad \therefore x_1 = 0 \rightarrow 9$$

$$M_{1-1}\Big|_{x=0} = \frac{7}{144}(0)^3 = 0 \text{ lb ft}$$

$$M_{1-1}\Big|_{x=9} = \frac{7}{144}(9)^3 = 35.44 \text{ lb-ft}$$

Section 2-2



$$M_{2-2} = \left(\frac{1}{2} \times \frac{7x_2}{24} \times x_2\right)\left(\frac{1}{3} x_2\right) + 44.8 \times \frac{1}{3} x_2 = 0$$

$$\therefore x = 9 \rightarrow 24$$

$$M_{2-2} = \frac{44.8 x_2}{3} - \frac{7 x_2^3}{144}$$

$$M_{2-2}\Big|_{x=9} = 98.96 \text{ lb.ft}$$

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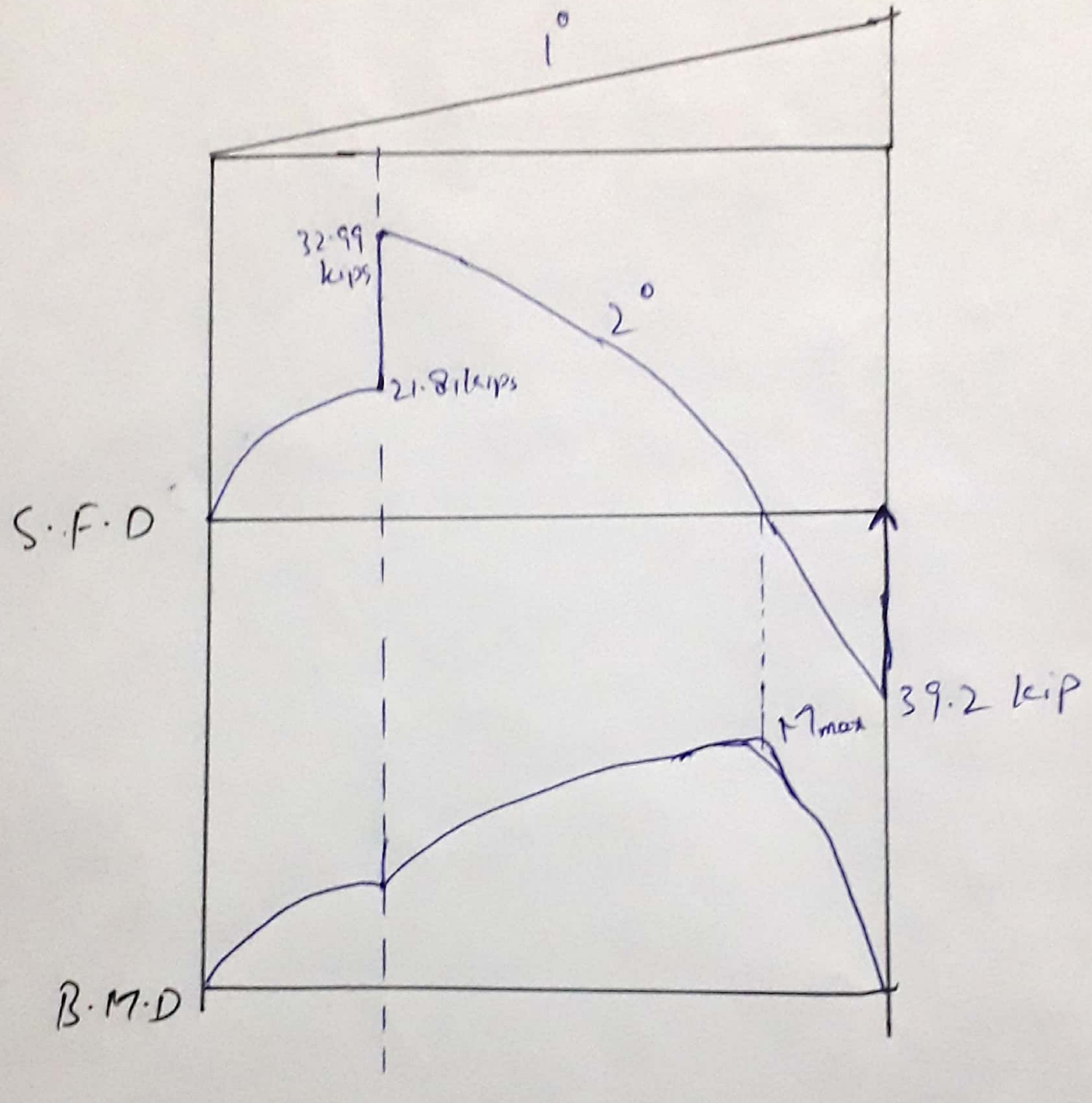

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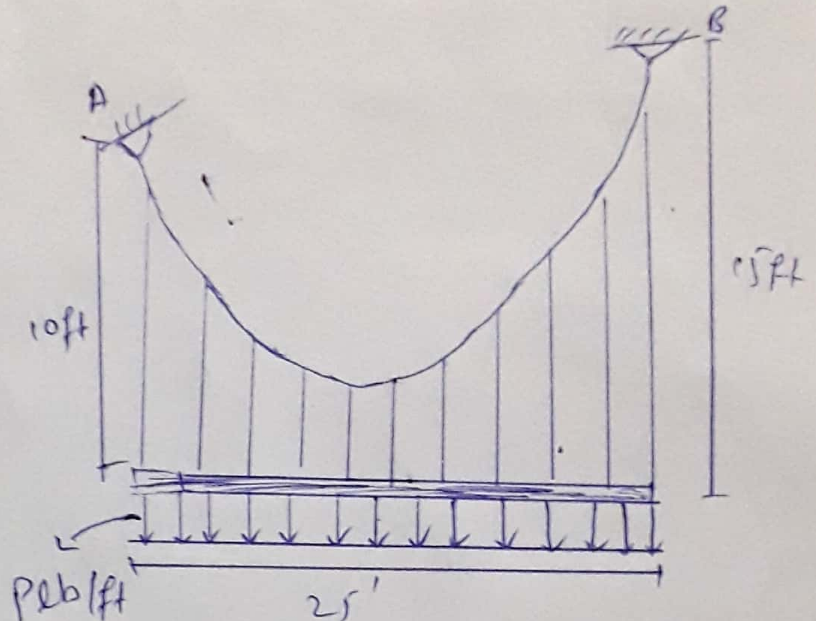
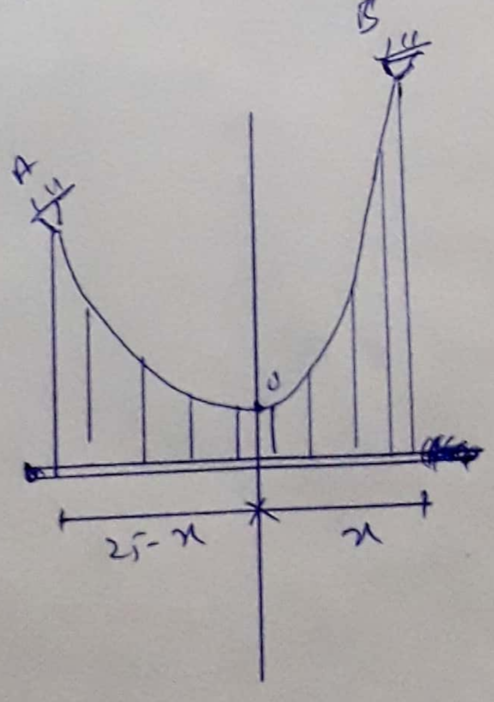
Q: 21 Cable

P = 807 lb/ft



Let Suppose we take a point "O" in the cable which is the lowest point, where Slope is zero.



using formula.

$$y = \frac{w_0}{2T_0} \cdot x^2$$

$$y = \frac{807}{2\,T_0} x^2.$$

$$\boxed{y = \frac{403.5}{T_0} x^2}$$

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now Assume Point C is located at x distance from point "O" (lowest point)

So

⇒ From Point "O" to Right

For distance "x", $y = 15'$

$$\Rightarrow \quad y = \frac{403.5}{T_o} \cdot x^2$$

$$15 = \frac{403.5}{T_o} x^2$$

$$\Rightarrow \boxed{T_o = \frac{403.5}{15} x^2} \quad \text{—} (1)$$

$$\boxed{T_o = 26.9 x^2} \quad \text{—} (2)$$

Again

⇒ From point "O" to left

For distance $-(25-x)$, $y = 10$

$$\Rightarrow \quad y = \frac{403.5}{T_o} (-(25-x))^2$$

$$10 = \frac{403.5}{T_o} \left[-(25-x)\right]^2$$

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$$T_0 = \frac{403.5}{10}\left[-(25-x)\right]^2 \quad \text{--- (3)}$$

Comparing (1) & (3)

$$\frac{403.5}{15}x^2 = \frac{403.5}{10}\left[-(25-x)\right]^2$$

interchanging

$$\frac{403.5}{403.5}x^2 = \frac{15}{10}\left(625 - 50x + x^2\right)$$

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

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

$$\Rightarrow \quad 935.50 - 75x + 1.5x^2 - x^2 = 0$$

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

By using Quadratic Equation.

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

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(9)

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

$$= \frac{-(-75) \pm \sqrt{5625 - 1875}}{1}$$

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

$$\boxed{x = 13.76 \text{ ft}} \quad -(4)$$

Now put (4) in (2)

$$T_0 = 26.43\, x^2$$

$$= 26.43\,(13.76)^2$$

$$\boxed{T_0 = 5004.19 \text{ Lbs}}$$

Now we have to find the tension at given points:

By formula

$$y = \frac{w_o}{2T_0} x^2 = \frac{403.5}{T_0} \cdot x^2$$

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

$$\frac{dy}{dx} = \frac{d}{dx}\left(\frac{403.5}{T_o}x^2\right)$$

$$= \frac{403.5}{T_o} \cdot 2x$$

$$= \frac{807}{T_o}x$$

$$\frac{dy}{dx} = \frac{807}{T_o}x \quad \text{——— (a)}$$

Also

$$\frac{dy}{dx} = \tan\theta \quad \text{—— (b)}$$

So

$$\boxed{\tan\theta = \frac{807}{T_o}x}$$

As point "O" is −11.24 away from "O"

So

$$\tan\theta_A = \frac{807}{5004.19}(-11.24)$$

$$\theta_A = \tan^{-1}(-1.181)$$

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$\boxed{\theta_A = -49.74^\circ}$

along tension at point A is

$$T_A = \frac{T_o}{\cos\theta_A} \qquad \therefore \cos\theta = \frac{T_o}{T_A}$$

$$= \frac{5004.19}{\cos(-49.74)^\circ} = 7743 \text{ lbs}$$

$$= 7.743 \text{ kips}$$

⇒ Now point "B" where $x = 13.76$ ft

$$\tan\theta_B = \frac{807}{T_o}(13.76)$$

$$= \frac{807}{5004.19}(13.76)$$

$$\theta_B = \tan^{-1}(2.21)$$

$$\boxed{\theta_B = 65.65^\circ}$$

Now tension

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

$$T_C = \frac{5004.19}{\cos 65.65)} = 12136.97$$

$$\boxed{= 12.13 \text{ kips}}$$

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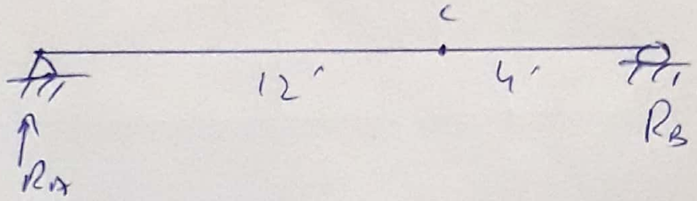
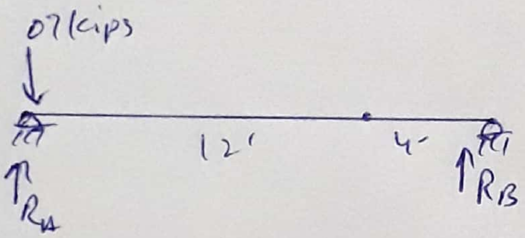
Q:- 3/ Shear force Influence line at Point C.



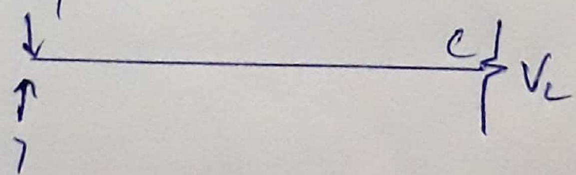
i) when $x = 0$



$\Sigma M_B = 0$ ↻+

$16 R_B = 7 \times 16$

$R_A = 7$ kips

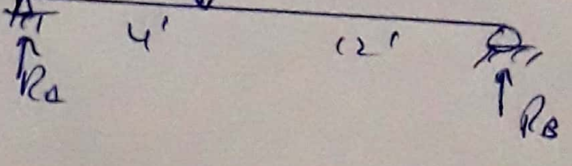


$\Sigma F_y = 0$ ↑+

$-7 + 7 + V_c = 0$

$V_c = 0$

ii) When $x = 4$ ft



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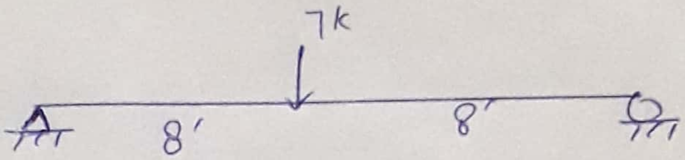
iii) when $x = 8$ ft

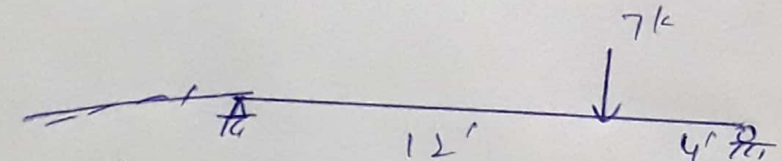
$\Sigma M_B = 0$ ↻+



$16 R_A - 7 \times 8 = 0$

$$R_A = \frac{56}{16} = 3.5 \text{ kips}$$

iv) when $x = 12$ ft



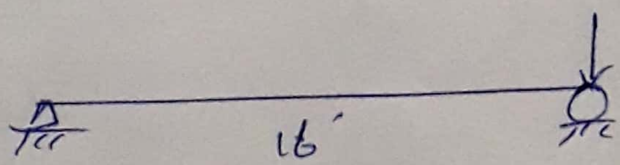
$\Sigma M_B = 0$ ↻+

$16 R_A - 7 \times 4 = 0$

$$R_A = \frac{28}{16} = 1.75 \text{ kips}$$

v) when $x = 16$ ft

$\Sigma M_B = 0$



$16 R_A - 0 = 0$

$$R_A = 0$$

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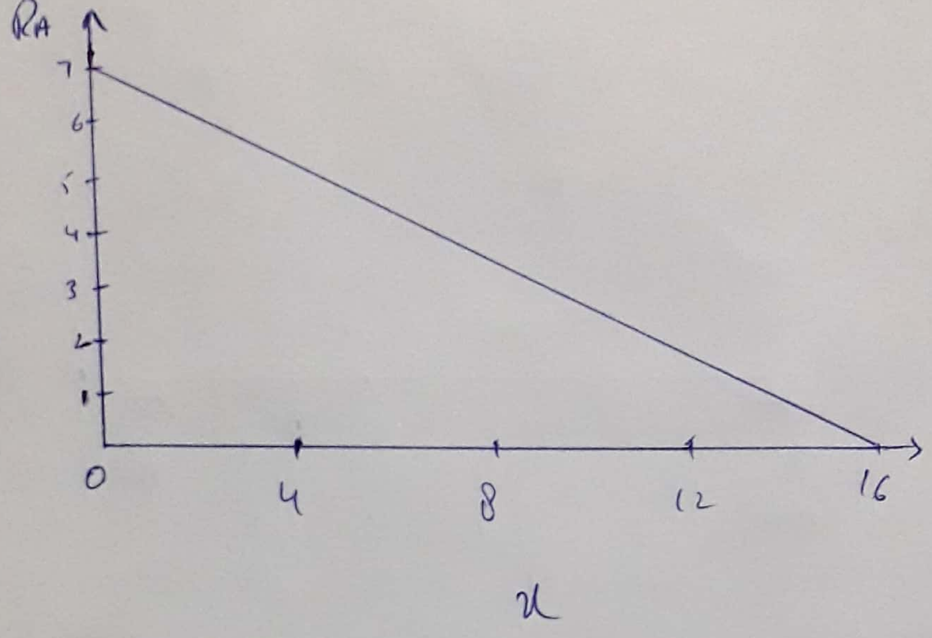

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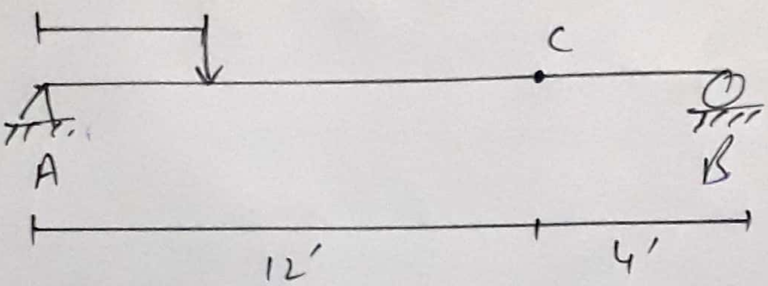
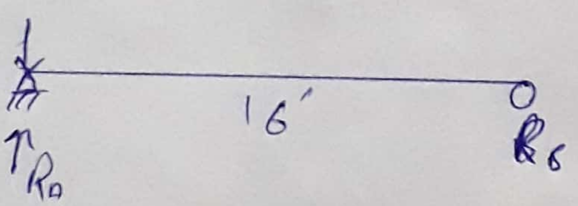
Influence line for Reaction "A"



i) when $x = 0$

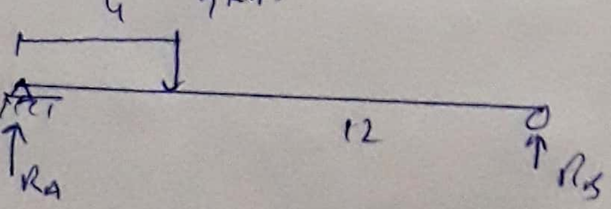


$\Sigma M_B = 0$ ↻+

$16R_A - 7\times16 = 0$

$\Rightarrow$ $R_A = 7$ kips

ii) when $x = 4$ ft



$\Sigma M_B = 0$ ↻+

$16R_A - 7\times12 = 0$

$R_A = \frac{84}{16} = 5.25$ K

$R_A = 5.25$ kip

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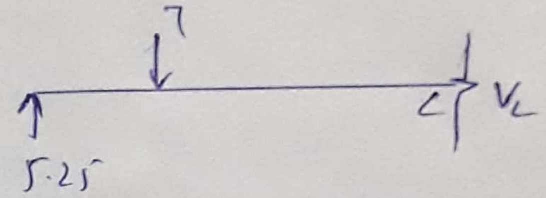
General Equation for $R_A = \frac{7\times(16-x)}{16}$

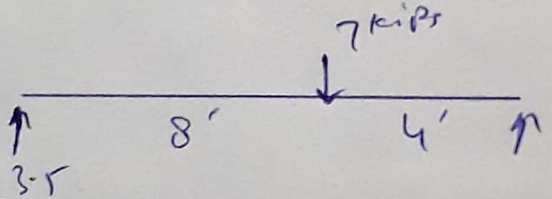
$\rightarrow R_A \big|_{x=4} = \frac{7\times 12}{16} = 5.25$ kips



&.

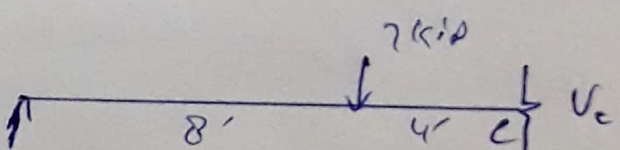
$V_c = 7 - 5.25 = 1.75$ kips

iii) when $x = 8$



$R_A = 7\left(\frac{16-x}{16}\right)$

$R_A = 7\times\frac{8}{16} = 3.5$ kips



$V_c = 7 - 3.5 = 3.5$ kips

4

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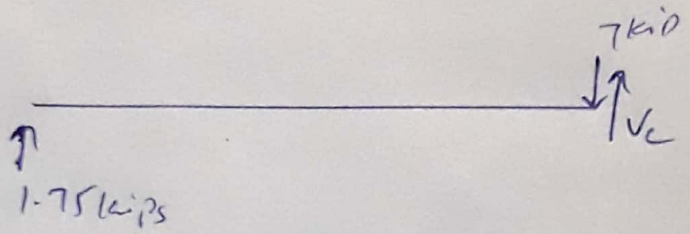
(8)

iv) When $x = 12$ Just to left of C

$$R_A = \frac{7(16-x)}{16} = \frac{7(16-12)}{16} = 1.75 \text{ kips}$$



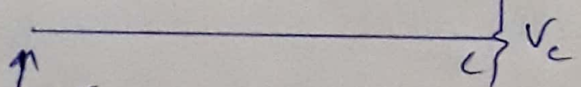
$$V_c - 1.75 = 7$$

$$\boxed{V_c = 5.25 \text{ kips}}$$

v) when $x = 12$: Just to Right of C.

$$R_A = 1.75 \text{ kips}$$

$V_c = -1.75$ kips

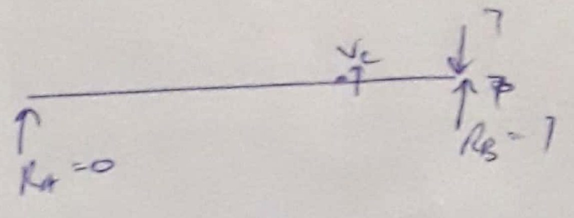


vi) when $x = 16$:

$$R_A = \frac{7(16-x)}{16} = \frac{7(16-16)}{16} = 0$$

$$\Rightarrow V_c = 0$$

10-7807



x	V_c
0	0
4	1.75
8	3.5
12^-	5.25
12^+	-1.75
16	0