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Section A

Subject Structure Analysis I

Submitted to Sir Saqib

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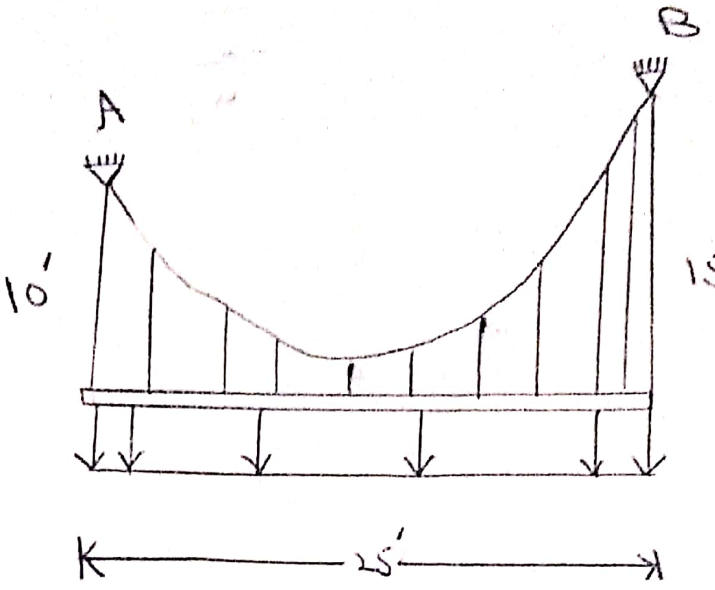
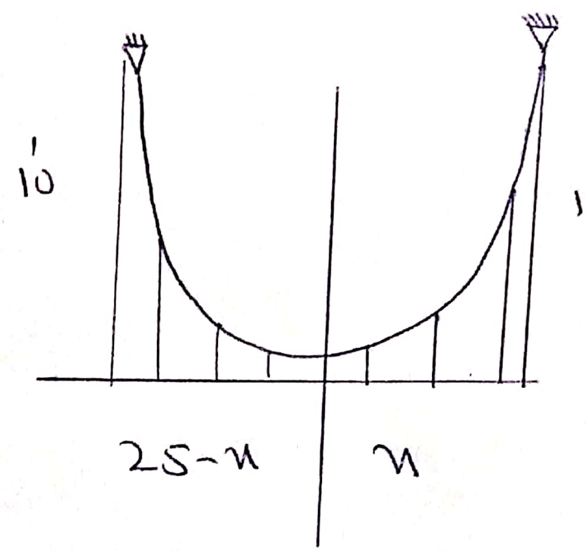
Subject

Ay (2)



<u>Sol</u>

Let Suppose we take a point "O" in the Cable which is the lowest point where Slop is Zero



Using formula

$$y = \frac{w_0}{2T_0} x^2 = \frac{793}{2T_0} x^2$$

$$y = \frac{396.5}{T_0} x^2$$

Now assume point C is located at x distance from point O (lowest point)

So,

From point O to Right

For distance $y = 15'$

$$\Rightarrow \quad y = \frac{396.5}{T_0} x^2$$

$$15 = \frac{396.5}{T_0} x^2$$

$$T_0 = \frac{396.5}{15} x^2 \quad \text{— (1)}$$

$$T_0 = 26.43 x^2 \quad \text{— (2)}$$

Again

From point "O" to left

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

$\Rightarrow \quad y = \dfrac{396.5}{T_0} x^2$

$10 = \dfrac{396.5}{T_0} - (25 - x)^2$

$10 = \dfrac{396.5}{T_0} \left[-(25-x) \right]^2$

~~10~~

Again

From point o to left

For distance $-(25-x)$ $\quad y = 10$

$y = \dfrac{396.5}{T_0} \left(-(25-x) \right)^2$ —

$T_0 = \dfrac{396.5}{10} \left[-25-x \right]^2$ — ③

Comparing ① and ③

$$\frac{396.5}{15}x^2 = \frac{396.5}{10}\left[-(25-x)\right]^2$$

Interchanging

$$\frac{396.5}{396.5}x^2 = \frac{15}{10}(625-50x+x^2)$$

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

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

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

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

By solving

Using Quadratic equation

$a = 0.5$ $\quad b = -75$ $\quad c = 937.50$

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

putting values

$P = 5$

$$x = \frac{-(-75) \pm \sqrt{(-75)^2 - 4(0.5)(937.50)}}{2(0.5)}$$

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

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

we got

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

Now put eq (4) in (2)

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

$$26.43\,(13.76)$$

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

Now we have to find the tension at given point By using formula

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

$$y = \frac{396.5}{T_0} \cdot x^2$$

Differentiate the above eq w.r.t x

$$\frac{dy}{dx} = \frac{d}{dx}\left(\frac{396.5}{T_0} \cdot x^2\right)$$

$$= \frac{396.5}{T_0} 2x$$

$$\frac{dy}{dx} = \tan\theta \quad \text{— (b)} \qquad \frac{dy}{dx} = \frac{793}{T_0} x \quad \text{— (a)}$$

So $$\boxed{\tan\theta = \frac{793}{T_0} x}$$

As point O is -11.24 away from "O"

so

$$\tan\theta_A = \frac{793}{5004.19}(-11.24)$$

$\theta_A = \tan^{-1}(-1.78)$

$$\boxed{\theta_A = -60.67^\circ}$$

Now tension at point A is

$$T_A = \frac{T_o}{\cos\theta_A} \quad \because \cos\theta = \frac{T_o}{T_A}$$

$$= \frac{5004.19}{\cos(-60.67)} = 10215 \text{ lbs}$$

10.2 kips

⇒ Now point B where $x = 13.76$ ft

$$\tan\theta_B = \frac{793}{T_o}(13.76)$$

$$= \frac{793}{5004.19}(13.76)$$

$$\theta_B = \tan^{-1}(2.18)$$

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

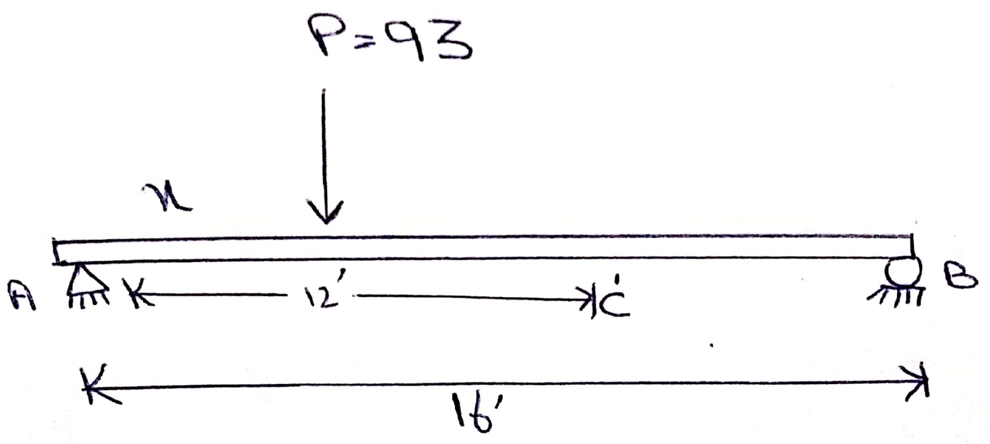
Now Tension

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

$$T_c = \frac{5004.19}{\cos(65.3)} = 11975 \text{ lbs}$$

$$\boxed{T_c = 11.9 \text{ kips}}$$

P = 9



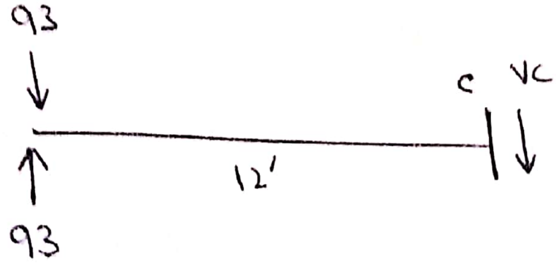
Influence

P = 10

(a) Shear force Influence for the beam

X (ft)	Vc (K)
0	0
4	-20.5K
6	-32.38
8	-44.5
10	-56.62
12	-68.75
14	12.125
16	0

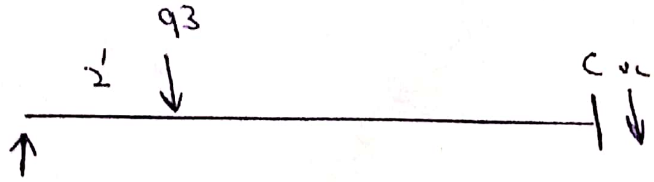
at $x = 0$



$-93 + R_A - V_c = 0$

$V_c = 0$

at $x = 2$

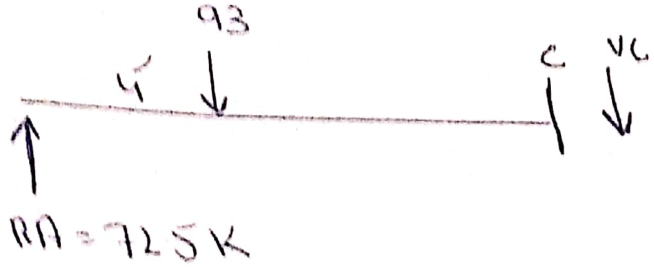


$R_A = 84.87K$

$\Rightarrow -93 + 84.87 - V_c = 0$

$V_c = -8.12K$

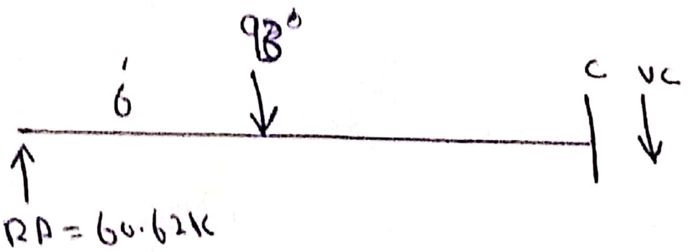
at $x = 4$



$-93 + 72.5 - V_C = 0$

$V_C = -20.5\,K$

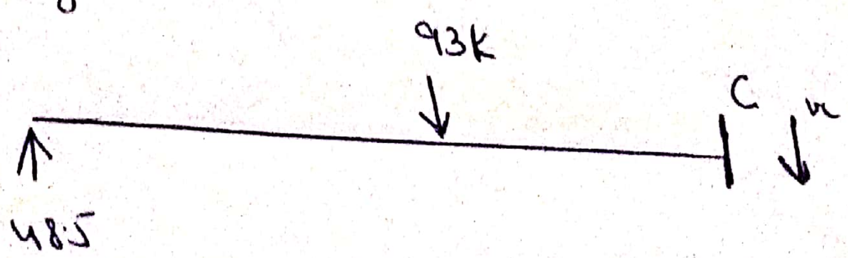
at $x = 6'$



$-93 + 60.62 - V_C = 0$

$V_C = -32.38\,K$

at $x = 8'$

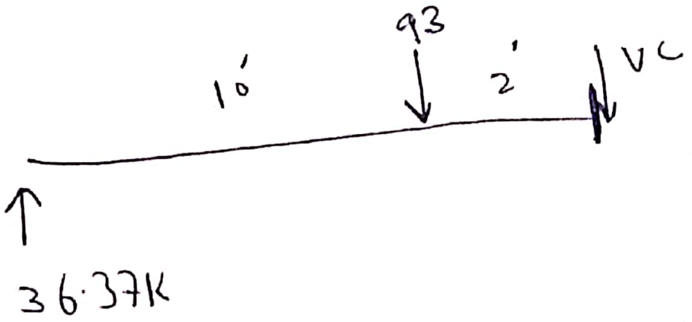


P=12

$-93 + 48.5 - V_C = 0$

$$\boxed{V_C = -44.5K}$$

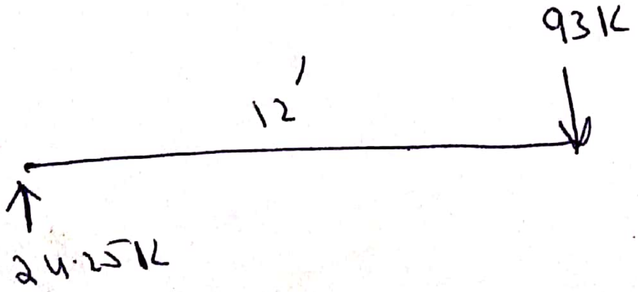
at $x = 10'$



$-93 + 36.375 - V_C = 0$

$$\boxed{V_C = -56.62K}$$

at $x = 12'$ (just to the left)

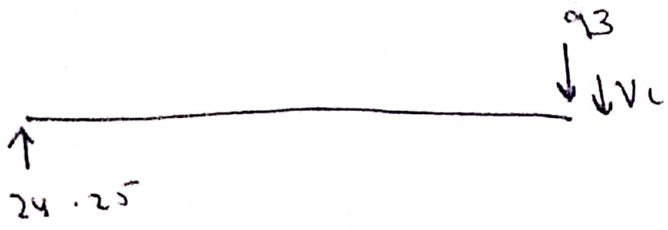


$-93 + 24.25 - V_C = 0$

$V_c = -68.75K$

⇒ ~~Vc~~

at $x = 12$ just to the Right



$+24.25 - V_c = 0$

$V_c = 24.25$

at $x = 14'$

$R_A = 12.25$ $R_B = 84.87$

$V_c = 12.125$

at $x = 16$

$V_C = 0$

eq^n A $x = 0$

$$R_A = \frac{93(16-0)}{16}$$

$R_A = 93K$

at $x = 2$

$R_A = 84.87K$

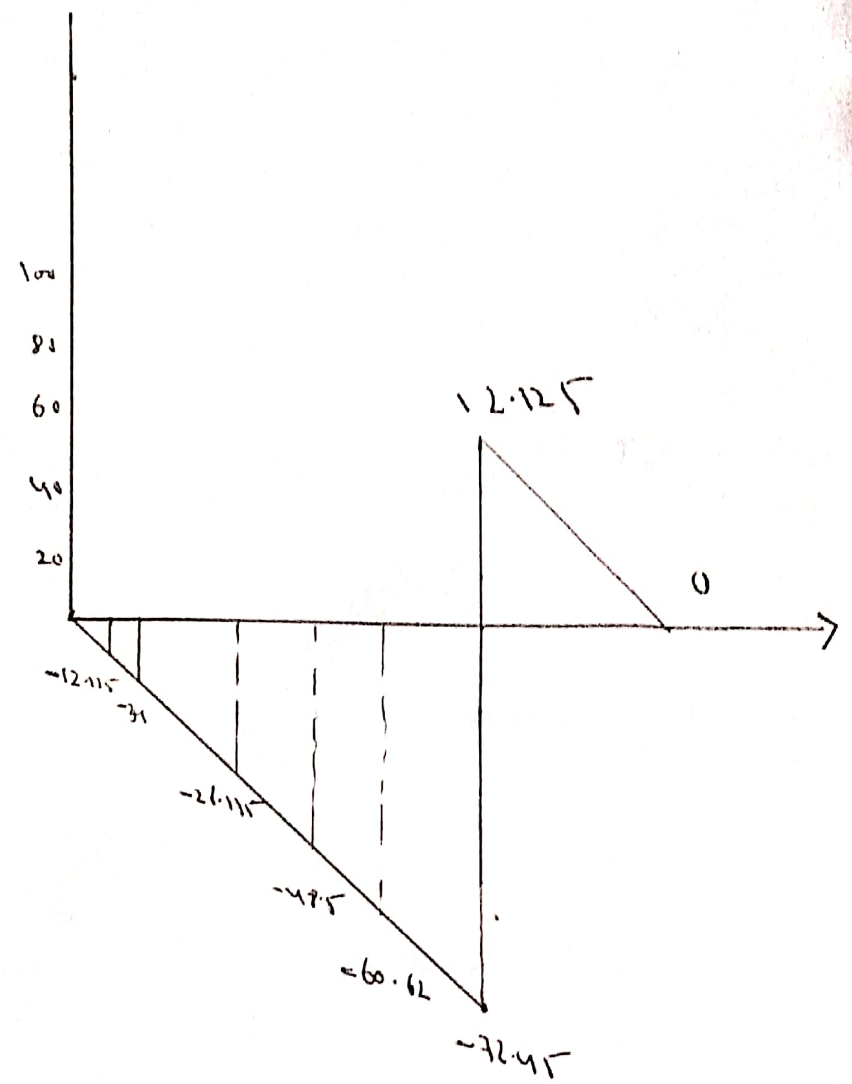
at $x = 4$

$R_A = 72.5K$

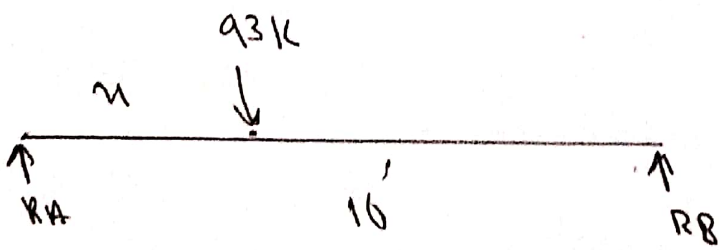
at $x = 6$

$R_A = 60.62K$

P = 14.A



Now Influence line for Reaction at A

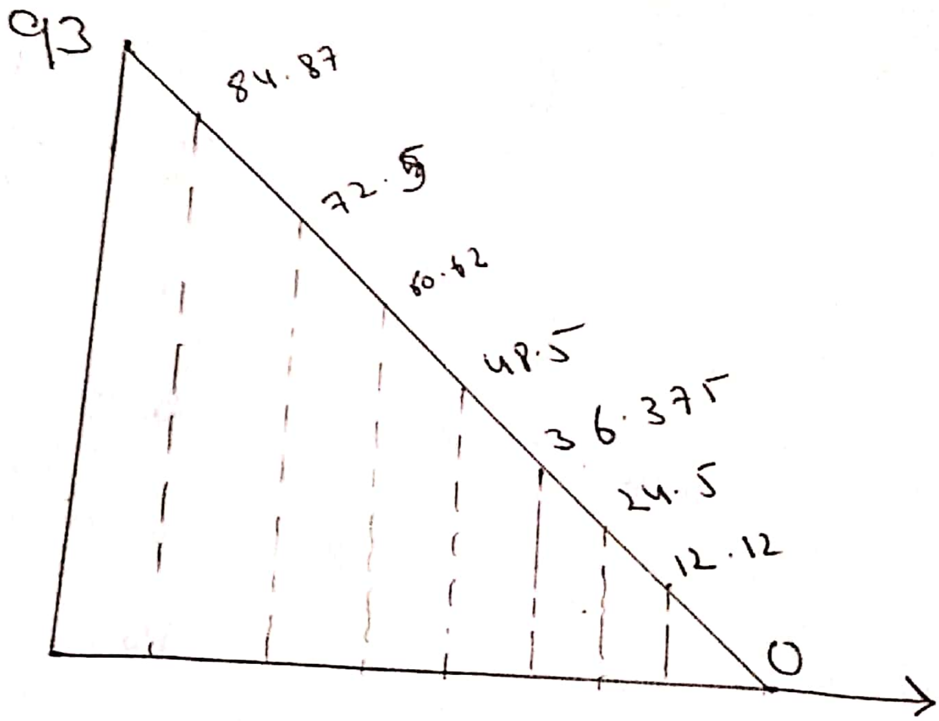


$$RA \times 16 - \frac{93(16-x)}{16} = 0$$

P=15 G

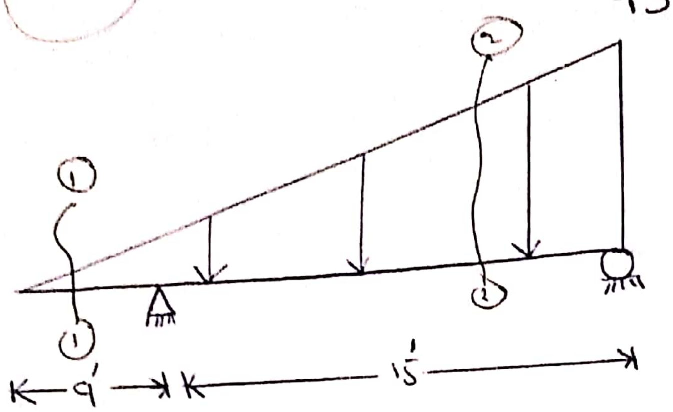
x	RA
0	93
2	84.875
4	72.5
6	60.62
8	48.5
10	36.375
12	12.125
14	12.125
16	0

P=16



P=17

1.



$\Sigma M_B = 0$ ↻+

$\frac{1}{2} \times 93 \times 24 \times \frac{1}{3} \times 24 = RA \times 15$

$1116 \times 8 = RA \times 15$

$RA = 595.2$ lbs

$\Sigma F_y = 0$ ↑+

$RA + RB = \frac{1}{2} \times 93 \times 24$

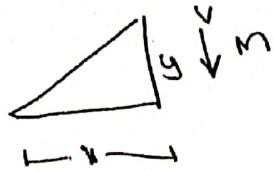
$RA + RB = 1116$

$RB = 1116 - RA$

$RB = 1116 - 595.2$

$RB = 520.8$ lbs

Now section ①-①



for y

$$\frac{y}{x} = \frac{93}{24}$$

$$y = \left(\frac{93}{24}\right)x$$

So

$$\Sigma F_y = 0 \uparrow +$$

$$-\frac{1}{2}x \times \left(\frac{93}{24}\right)x - V_c = 0$$

$$V_c = \frac{-93x^2}{48}$$

at $x = 0$

$V_c = 0$

& at $x = 9$

$$V_c = -156.9$$

$\Rightarrow m = \frac{1}{2} \times x \times \left(\frac{93x}{24}\right) \times \frac{1}{3}x$

$m = \frac{93x^3}{144}$

at $x = 0$

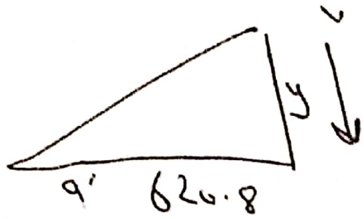
$m = 0$

at $x = 9$

$M = -470.06$ lb-ft

Now for section (2)-(2)

for y



$\frac{y}{(x+9)} = \frac{93}{24}(x+9)$

so

$\Sigma F_y = 0 \uparrow$

$620.8 - \frac{1}{2} \times (x+9)\left(\frac{97}{24}\right)(x+9) - V_c = 0$

$$V_c = 620.8 - \frac{97 \times (x+9)^2}{48}$$

at $x = 0$

$V_c = 463.1$

at $x = 15$

$$\boxed{V_c = -184}$$

$$M + \frac{1}{2} \times (x+9)\left(\frac{93}{24}(x+9)\right) \times \frac{1}{3} \times (x+9) - 620$$

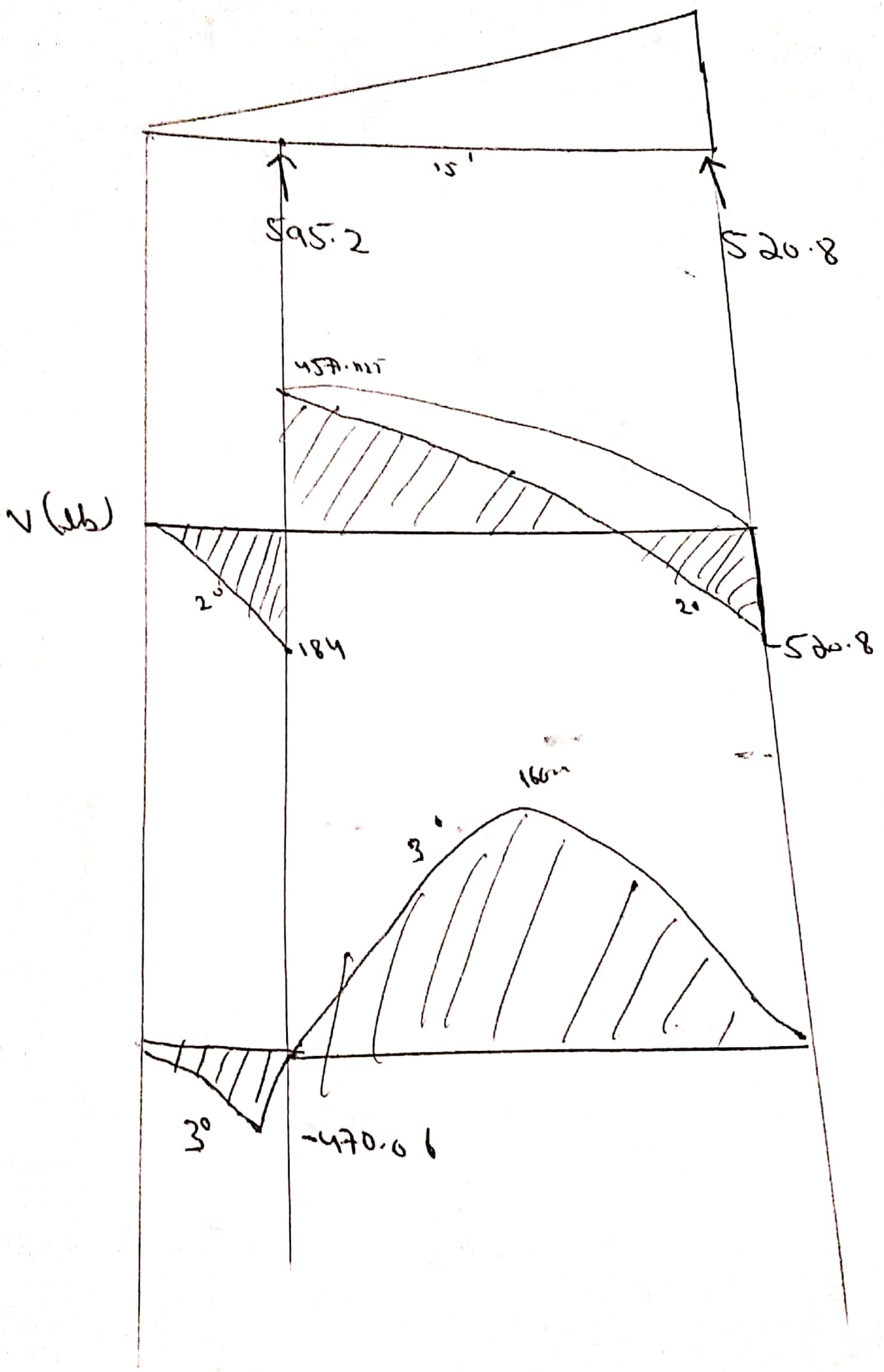
$$M = 620.8x - \frac{93(x+9)^3}{144}$$

at $x = 0$

$M = 491$

at $x = 15$

$$\boxed{M = 0}$$


15'
595.2
520.8
V (lb)
184
520.8
3°
-470.06