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SUBJECT: STRUCTURE ANALYSIS.

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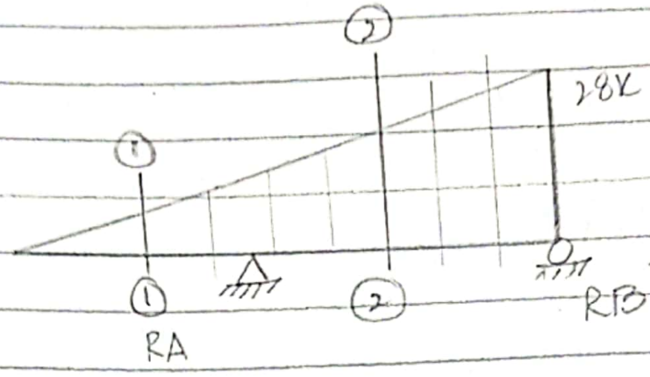
DATE: 26-SEPTEMBER-2020.

QS #01

→ Solution:



$$\Sigma M_B = 0 \circlearrowright +$$

$$\frac{1}{2} \times 28 + \cancel{\times} 24 + \frac{1}{3} \times 24 = RA + 15$$

$$RA = 179.2 lb$$

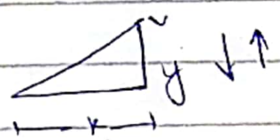
$$\Sigma F_y = 0 \uparrow$$

$$RA + RB = \frac{1}{2} \times 28 \times 24$$

$$RB = 336 - 179.2$$

$$RB = 156.8 lbs.$$

Now section 1 — 1



→ For y:

$$\frac{y}{x} = \frac{28}{24}$$

$$y = \left(\frac{28}{24}\right) x$$

So $\Rightarrow \Sigma F_y = 0 \uparrow$

$$= -\frac{1}{2} + x \left(\frac{28}{24}\right) x - VC = 0$$

$$Vc = 179.2 - \frac{28 \times (x+9)^2}{48}$$

at $x = 0$

$Vc = 131.95$

at $x = 15$

$Vc = -156.8k$

$$M + \frac{1}{2}(x+9)\left(\frac{28}{24}(x+9) \times \frac{1}{3} \times (x+9)\right) - 179.2 = 0$$

$$M = 179.2 - \frac{28(x+9)^3}{144}$$

at $x = 0$

$M = 37.45$ lb ft.

at $x = 15$

$M = 2508.8$

$$Vc = \frac{28}{48} \times x^2$$

at $x = 0$

$Vc = 0$

at $x = 9$

$Vc = -47.25$ lb

$$M = \frac{1}{2} + x\left(\frac{28}{24}x\right) + \frac{1}{3}x$$

$$M = \frac{-28x^3}{144}$$

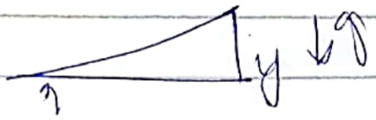
$x = 0$

$M = 0$

at $x = 9$

$M = -141.75\ lb$

Now for section ② - ②



For y:

$$\frac{y}{(x+9)} = \frac{28}{24}$$

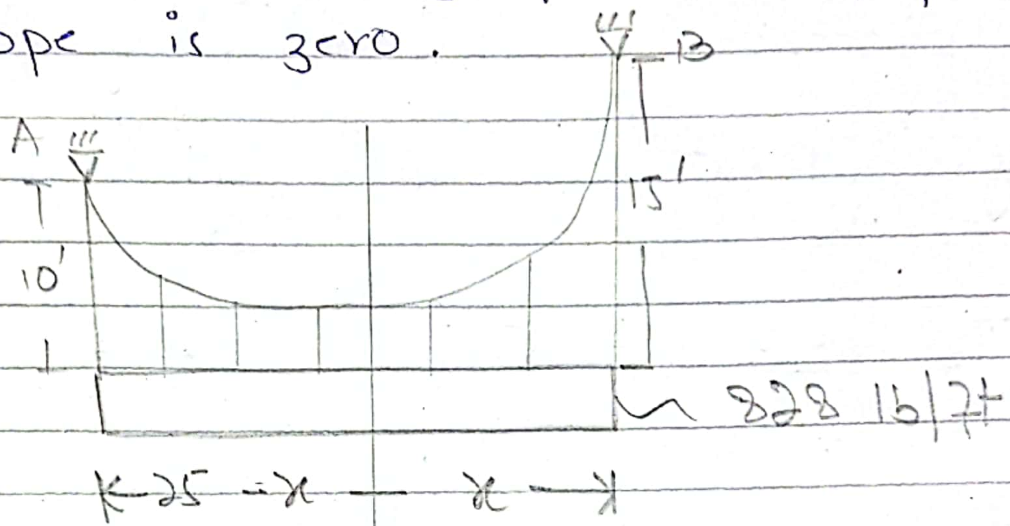
$$y = \frac{28}{24}(x+9)$$

$$\Sigma F_y = 0 \uparrow$$

$$179.2 - \frac{1}{2}(x+9)\left(\frac{28}{24}(x+9)\right) - V_c = 0.$$

Q#02

→ Sol:- let suppose we take a point "O" in the cable which is the lowest point, where slope is zero.



→ Using formula $y = \frac{W_0 \cdot x^2}{2T_0} = \frac{828 \cdot x}{2T_0}$

$$y = \frac{414 \cdot x^2}{T_0}$$

→ Assume point "C" is located at x from "O"
→ From point "O" to right
For distance x $y = 15'$

$$y = \frac{414 \cdot x^2}{T_0} \quad 15 = \frac{414 \cdot x^2}{T_0}$$

$$T_0 = \frac{414 \cdot x^2}{15} \quad — ①$$

$$T_0 = 27.6\ x^2 \quad — ②$$

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

$$y = \frac{414}{T_0} \cdot x^2 , \qquad 10 = \frac{414}{T_0}\left[-(25-x)\right]^2$$

$$T_0 = \frac{414}{10}\left[-(25-x)\right]^2 \quad — ③$$

→ Comparing eq ① and ③

$$\frac{414}{15} \cdot x^2 = \frac{414}{10}\left[-(25-x)\right]^2$$

→ Interchanging.

$$\frac{\cancel{414}}{\cancel{414}} x^2 = \frac{15}{10}(625 - 50x + x^2)$$

$$x^2 = 1.5(625 - 50x + x^2)$$
$$x^2 = 937.50 - 75x + 1.5x^2$$

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

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

→ Solve using quadratic equation.

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

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

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

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

$$x = 75 \pm \sqrt{3750} = 13.76 \text{ ft} \quad -④$$

→ Put eq ④ in ②

$T_o = 27.6 \; (13.76)^2$
$= 5225.71 \text{ lbs}$

→ Find Tension

$$y = \frac{414}{T_o} x^2$$

Differentiate wrt x

$$\frac{dy}{dx} = \frac{d}{dx}\left(\frac{414}{T_0} \cdot x^2\right)$$

$$= \frac{414}{T_0} 2x = \frac{828}{T_0} \cdot x \quad - ⓐ$$

Since $dy/dx = \tan\theta$ — ⓑ

$$\tan\theta = \frac{828}{T_0} \cdot x$$

Point Ⓐ is -11.24 away from "O"

$$\tan\theta_A = \frac{828}{5225.71}(-11.24)$$

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

$$\theta_A = -60.67$$

→ Now Tension At A is :-

$$T_A = \frac{T_0}{\cos\theta_A} = \frac{5225.71}{\cos(-60.67)} = \frac{5225.71}{0.4898}$$

$$= 10669.06 \text{ lbs}$$

$$= 10.6 \text{ kips}$$

Q#03

a) Shear force influence for the beam at $x = 0$

$-28 + RA - Vc = 0$
$Vc = 0$

x	$Vc(k)$
0	0
2	-3.6
4	-5.5
6	-7.5
8	-9.5
10	-11.5
12	-13.5
14	3.5
16	0

→ at $x = 2$

$-(28 \times 14) + RA\,16 = 0$
$-392 - RA\,16 = 0$
$RA = \frac{392}{16} = \boxed{24.5}$

$-28 + 24.4 - Vc = 0$
$Vc = -3.6$

→ at $x = 4$

$-28 + 22.5 - Vc = 0$
$Vc = -5.5$

→ at $x = 6$
$-28 + 20.5 - Vc = 0$
$Vc = -7.5$

Scanned with CamScanner

→ at $x = 8$

$-22 + 12.5 - V_c = 0$
$V_c = -9.5$

→ at $x = 10$

$-22 + 16.5 - V_c = 0$
$V_c = -11.5$

→ at $x = 12$ (Just to the left)

$-22 + 14.5 - V_c = 0$
$V_c = -13.5$

$x = 12$ (Just to the right)

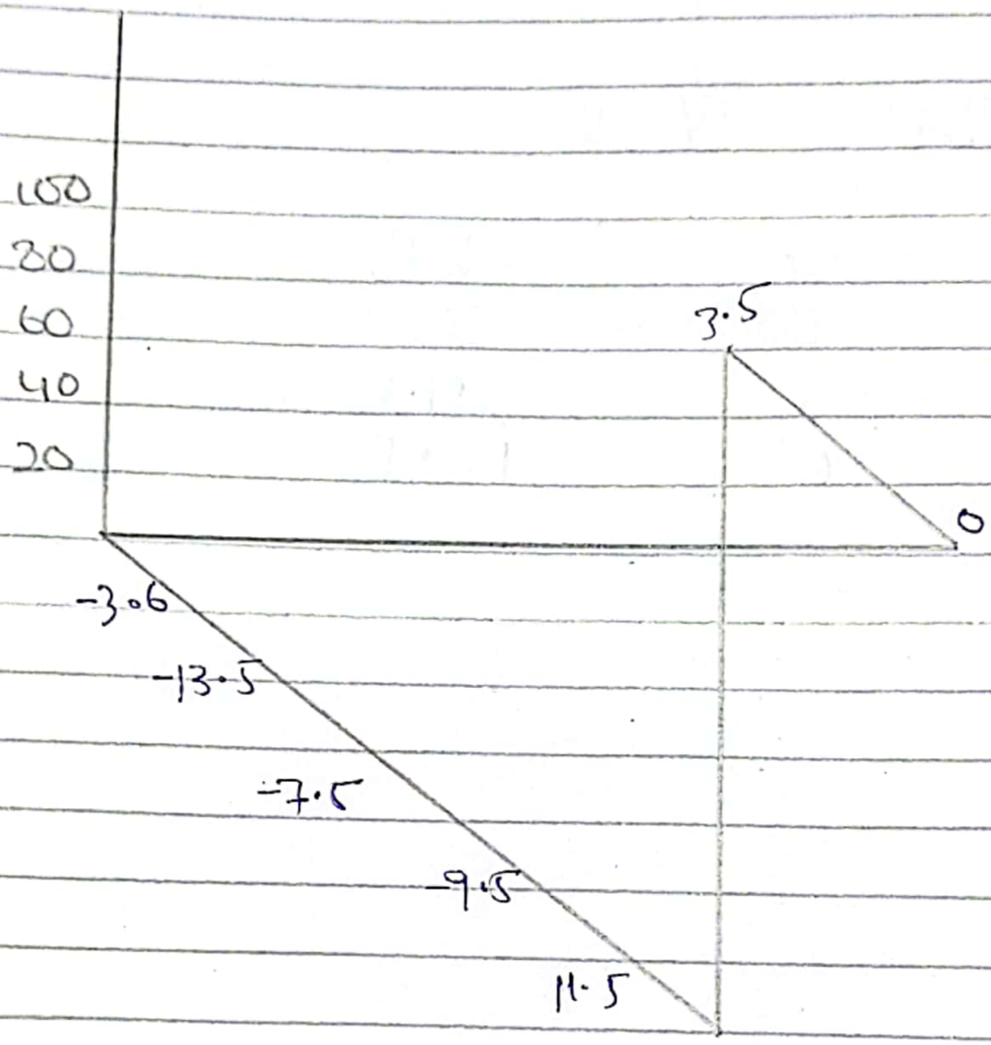
→ $13.5 - V_c = 0$

$V_c = 13.5$

→ at $x = 14$ $R.A = 3.5$

$V_c\ 3.5$

at $x = 16$
$V_c = 0$



5) Now influence line

$\Sigma M_B = 0$

$R_A \times 16 - 28(16-x) = 0$

$R_A = \frac{28(16-x)}{16}$ — (A)

$= 28\ k$

at $x = 2$ $\quad R_A = \frac{28(16-2)}{16} = 24.5$

at $x = 6$

$RA = 17.5$

x	RA
0	28
2	24.5
6	17.5