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Section A.

Subject Structure Analysis.

⇒ Question No 1) :-

⇒ Given Data :-

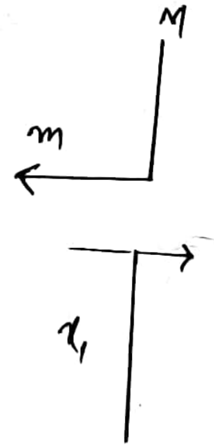
⇒ Uniform load = 4k/ft

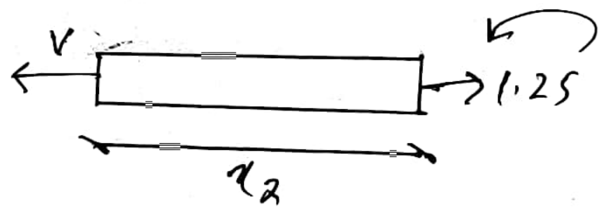
⇒ $E = 29 \times 10^3$ ksi

⇒ $I = 600\ in^4$

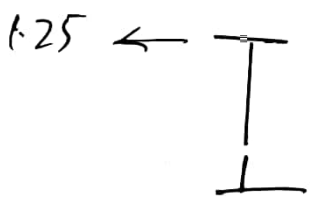
⇒ Required :- Vertical Displacement.

⇒ Solution :- Now Vertical moment.

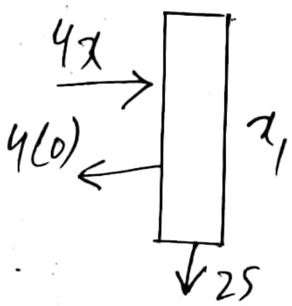




$m_2 = 1.25x.$



Real moment.



$m_2 = 2.5x_2$

$$m'' = \frac{40x_1 - \frac{1}{2}x_1(x_2)}{40x_1 - 2x_1^2}$$

Now By virtual work equation

$$\Delta L = \int_0^L \frac{mM\,dx}{\varepsilon}$$

$$\Delta L = \int_0^{10} \frac{(1x_1)(40x_2 - 2x^2)\,dx}{\varepsilon} +$$

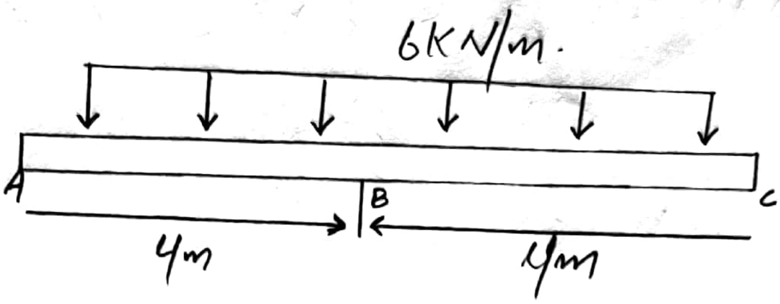
$$\int_0^8 \frac{(1.25x_2)\,(2.5x_2)\,dx}{E.I}$$

$$\Delta L = \frac{1}{E.I} \left| \frac{40x^3}{3} - \frac{2x^3}{4} \right|_0^{10} + \frac{31.25x_2^3}{3} \Big|_0^8$$

$$\boxed{\Delta L = 10649.60184}$$

⇒ Question No 2) :-

⇒ Given Data :-



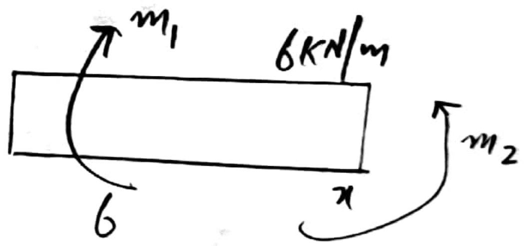
⇒ $E = 200$ GPa

⇒ $I = 60 \times 10^6 \, mm^4$

⇒ Required :-

⇒ Slope And Displacement = ?

⇒ Solution :-



⇒ $m' - m_2 = \frac{1}{2}(x_2)(6 + x_1)$

⇒ $m_2^{\circ} = -m' + \frac{6x_2 + x_1^2}{2}$

⇒ $m = -m' + 3x_2 + x_1^2/2$

taking partial derivative with respect to 'm':

$$\frac{\partial m_2}{\partial P} = -x.$$

(4)

$$\Delta B = \int_0^2 \frac{m(2m)}{2P} \frac{du}{E}$$

$$= \int_0^6 \frac{-3x^2 - x\, dx}{EI} + \int_0^4 \frac{-3x^2(-x)\, dx}{EI}$$

$$\Delta B = \frac{-3x^2}{4EI} \Big|_0^6 + \frac{-3x^4}{4EI} \Big|_0^4$$

puih the value of "EI" and "I"

$$\Rightarrow \frac{-3x^2}{2(200 \times 60 \times 10^6)} \Big|_0^6 + \frac{-3x^4}{4(200)(60 \times 10^6)} \Big|_0^4$$

$$\Rightarrow \frac{-216\ KN ft^3}{4.8 \times 10^6} + \left(\frac{-614.4\ KN ft^3}{4.8 \times 10^6}\right)$$

$$= -4.5 \times 10^{-9} + (-1.28 \times 10^{-8})$$

$$\boxed{\Delta B = 5.76 \times 10^{-10}\ \text{Inch.}}$$ Displacement.

⇒ **Slope:**

$$M + \frac{1}{2} x (6x_1) = 0$$

$$m = -\frac{1}{2} x (6x) = -3x^2$$

So $\frac{\partial m_1}{\partial m_1'} = 0$

$\Rightarrow m_1' - m_2 - \frac{1}{2}(x_2)(6 + x_2)$

$\Rightarrow m = -m' + 6x_2 + x_2^2$

$m = -m' + 3x^2 + x_2^2/2$

$$\frac{\partial m_2}{\partial m_1} = 1$$

$$= \int_0^6 \frac{-3x^2\,dx}{E \cdot I} + \int_0^{10} \left(-2 + 6x^2 + \frac{x^2}{2}\right) dx$$

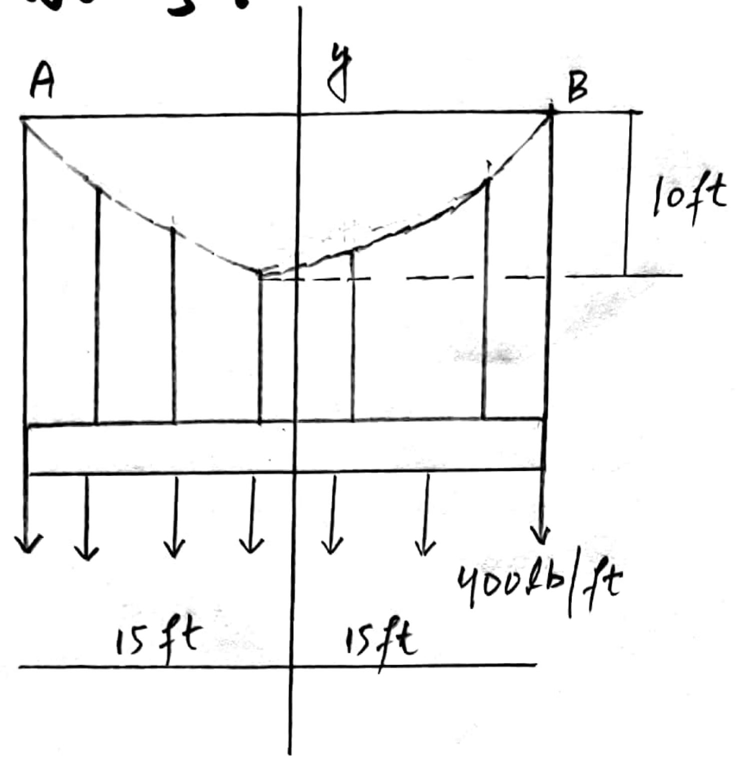
$$= 0 + \left(-x + \frac{6x^3}{3} + \frac{x^3}{6}\right)\Big|_0^{10} \left(\frac{1}{E \cdot I}\right)$$

$$= \frac{1}{200 \times (60 \times 10^6)} \left(-x + \frac{6x^3}{3} + \frac{x^3}{6}\right)\Big|_0^{10}$$

$\Rightarrow$ Slope $= \theta = 4.125 \times 10^{-7}$ Inch

⑥

⇒ Question No 3 :-



⇒ Given Data :-

⇒ Uniform load = w_0 = 400lb/ft.

$h = 10ft.$

$L = 15ft.$

⇒ Required :-

⇒ equation of curve and force in cable = ?

⇒ Solution :-

we know that

$$y = \frac{h}{L^2} x^2$$

Putting values

$$y = \frac{10}{(15)^2} x^2 \Rightarrow \boxed{y = 0.044x^2}$$

Now

$$T_0 = F_H = \frac{w_o L^2}{2h} \Rightarrow \frac{400 \times (15)^2}{2 \times 10}$$

$$\boxed{T_0 = 4500\,lb = 4.5\,klb}$$

And

$$T_B = T_{max} = \sqrt{(F_H)^2 + (w_o L)^2}$$

$$= \sqrt{(4500)^2 + (400 \times 15)^2}$$

$$\boxed{T_{max} = 7500\,lb = 7.5\,klb}$$

Now we find Tmax By Another equation

$$T_B = T_{max} = w_o L \sqrt{1 + \left(\frac{L}{2h}\right)^2}$$

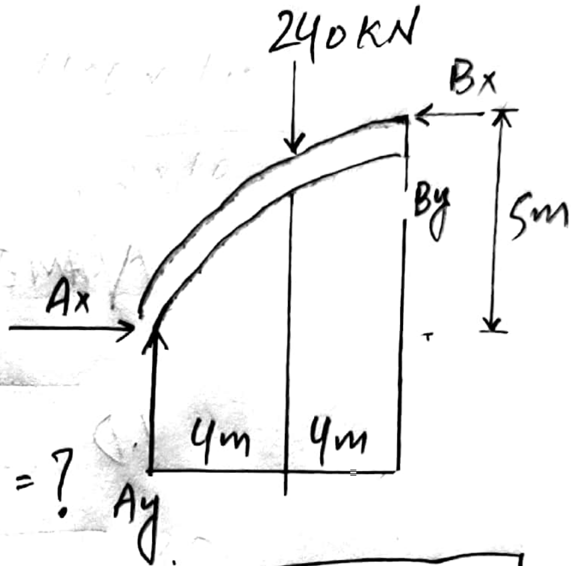
$$= 400 \times 15 \sqrt{1 + \left(\frac{15}{2 \times 10}\right)^2}$$

$$\boxed{T_{max} = 7500\,lb = 7.5\,klb}$$

⇒ QNo4) :-   (8)

⇒ Given Data :-

Uniform load = 30 kN/m

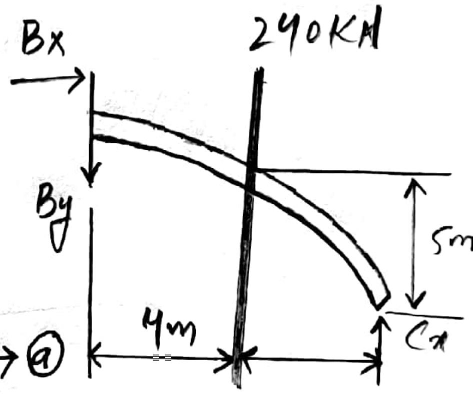


⇒ Required :-

Internal Moment at D = ?

⇒ Solution :-

Divind the whole Arch into two members "AB" and "BC"



AB :-

$\circlearrowright + \sum M_A = 0$

$B_x(5) + B_y(8) - 240(4) = 0 \rightarrow$ ⓐ

BC :-

$+ \sum M_C = 0$

$-B_x(5) + B_y(8) + 240(4) = 0 \rightarrow$ ⓑ

Adding eq ⓐ and ⓑ

$B_x(5) + B_y(8) - 240(4) = 0.$

$-B_x(5) + B_y(8) + 240(4) = 0.$

$2B_y(8) = 0$

(9)

$2By(8) = 0 \Rightarrow \boxed{By = 0\,kN.}$

putting the value of "By" in eq (b)

eq (b) $\Rightarrow$ $-Bx(5) + 0(8) + 960 = 0$

$Bx(5) = 960$

$\boxed{Bx = 192\,kN}$

$\Rightarrow$ Now at Segment DB"

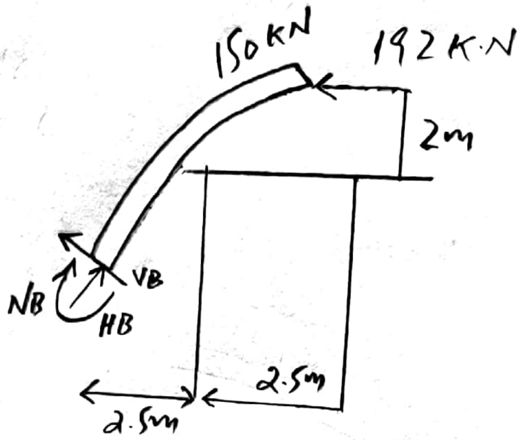
$\curvearrowright + \quad \Sigma M_D = 0$

$192(2) - 150(2.5) - M_D = 0$

$384 - 375 - M_D = 0$

$9 - M_D = 0$

$\Rightarrow \boxed{M_D = 9\,kN.m}$



Member DB