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Subject Structural Analysis I

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Q1
No

Given data:

uniform load = 4K/ft

$E = 29 \times 10^3$ KSi

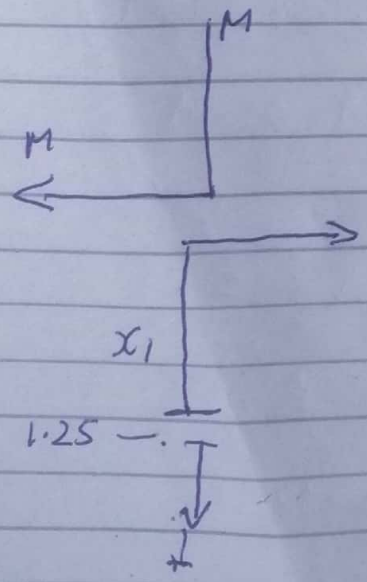
$I = 600$ in^4

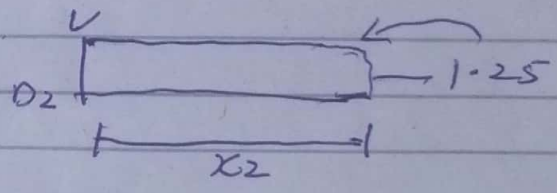
Req:

Vertical Displacement

Sol:

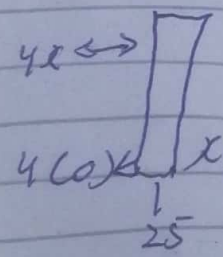
Now Virtical Moment

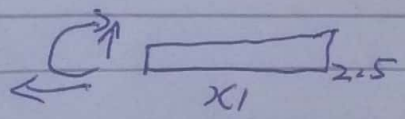




$M_2 = 1.25x$

real Moment





$M_2 = 25 - x_2$

$$M^4 = \frac{40x_1 - \frac{1}{2}x_1(x_2)}{40x_1 - 2x_1^2}$$

Now by virtual work equation

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

$$\Delta L = \int_0^{10} (1x_1)\left\{\frac{40x_2}{E} - 2x^2\right\} dx + \int_0^8 \frac{0.25x_2(25x_2)\,dx}{EI}$$

$$D = \frac{1}{EI}\left|\frac{4x^3}{3} - \frac{2x^3}{4}\right|_0^{10} + \left|\frac{31.25x_2^3}{3}\right|_0^8$$

$$\frac{1}{EI}\left(\frac{4x^2}{3}\,\frac{2x^3}{4}\right|_0^{10} + \left|31.25\,x_2^3\right|_0^8$$

$$\frac{1}{EI}\left[\left|\frac{4x^2}{3}\right|_0^{10} - \frac{2x^3}{4}\right|_0^{10}\Bigg]$$

$$\frac{1}{E}I\left[\int_0^{10}\frac{4x^3}{3} - \int_0^{10}\frac{2x^3}{4}\right]$$

$$\frac{1}{E}I\left[\frac{4}{3}(10)^3 - (0)^3 - \frac{2}{4}\int_0^{10}(10)^3\right]$$

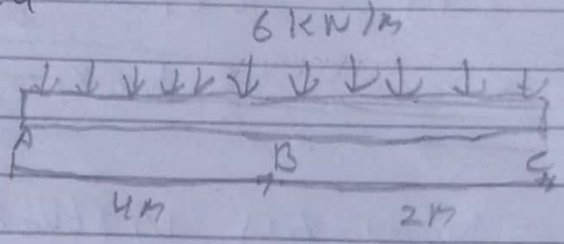
$$\frac{1}{E}I\left[1333.34 - 500\right]$$

$$= \boxed{\frac{833.34}{EI}}$$

Q4

No

Soli: Given data

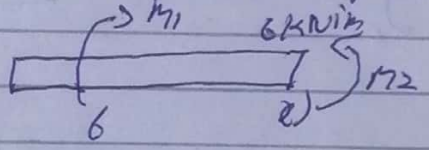


$E = 200\ GPa$

$I = 60 \times 10^6\ mm^4$

Req:

Slope and displacement=



$$M' - M_2 = \frac{1}{2}(x_2)(6 + x_1)$$

$$M' = M - \frac{6x_2 + x_1^2}{2}$$

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

taking Paitial derivitive with respect to M

$$\frac{2M_2}{2P} = -x$$

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

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

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

Put the value of EI and I

$$= \frac{-3x^2}{2(200\times60\times10^6)}\Big|_0^6 + \frac{-3x^4}{4000)(60\times10^9)}\Big|_0^4$$

$$= \frac{-216\ KN\ ft^3}{4.8\times10^{10}} + \frac{-614.4\ KN\ ft^3}{4.8\times10^{10}}$$

$$= -4.5\times10^{-9} + (-1.28\times10^{-8})$$

$$\boxed{\Delta B = 5.76\times10^{-10}\ inch}\ \text{Displacement}$$

Slope:

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

$$M = \frac{-1}{2}\times(6x_2) = 3x^2$$

So, $\frac{2M_1}{2M_1} = 0$

$$M_1 - M_2 - \frac{1}{2}(x_2)(6 + x_2)$$

$$M = -M' + 6x_2 + x_2^2$$

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

$$\frac{2M_2}{2M_1} = -1$$

$$= \int_0^8 \frac{-3x^2(4x + \quad}{EI} + \int_0^{10} (-2 + 6x^2 + \frac{x^2}{2})\,dx$$

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

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

$$\Rightarrow \boxed{\Delta = 4.125 \times 10^{-7} \text{ inch}}$$

Q3

Given dada :-

w = uniform load = 400 lb/ft

$h = 10$ ft

$L = 15$ ft

Required :-

equation of curve and force in cable = ?

Solution :-

We know that

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

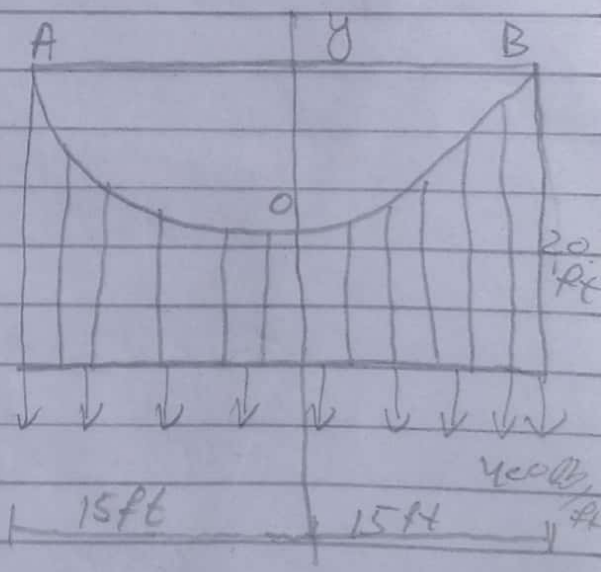
Putting the values

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

$$T_O = F_H = \frac{w_O L^2}{2h}$$

$$= \frac{400 \times (15^2)}{2 \times 10}$$

$$T_O = 4500 \text{ lb} = 4.5 \text{ K}$$



$$T_B = T_{Max} = \sqrt{(FH)^2 + (LbL)^2}$$

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

$$T_{Max} = 7500 \text{ lb} = 7.5 \text{ k}$$

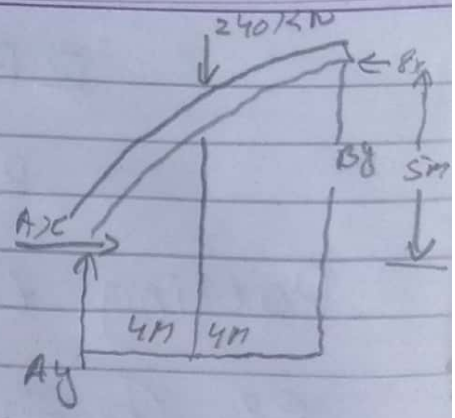
Now T_{Max} Ry and other equation

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

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

$$\boxed{T_{Max} = 7500 \text{ lb} = 7.5 \text{ k}}$$

Q.No 4



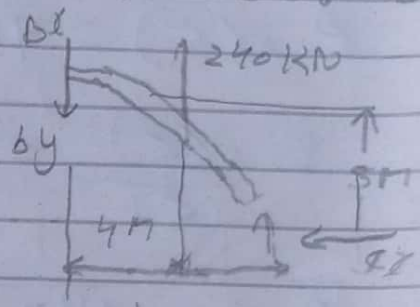
Given data

Uniform load = 30 KN/M

Req:

Internal Moment at D = ?

Member AB



Member BC

Solution:

Dividing into two members.

AB and BC

AB

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

BC

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

Adding eq (a) and (b)

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

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

$0 + 2B_y(8) + 0 = 0$

$$\Sigma B_y(8) = 0$$

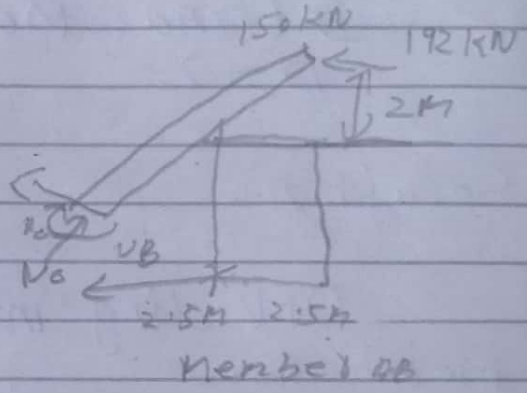
$$\Rightarrow B_y = 0\ KN$$

Putting the value of B_y in eq (b) $\Rightarrow -B_x(5) + 0(8) + 960 = 0$

$$B_x(5) = 960$$

$$\frac{B_x(5)}{(5)} = \frac{960}{5}$$

$$\boxed{B_x = 192\ KN}$$



Now at segment DB

$$\circlearrowleft + \Sigma M_D = 0$$

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

$$389 - 375 - M_D = 0$$

$$9 - M_D = 0$$

$$\Rightarrow M_D = 9\ KN.M.$$