final term

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Sec-A

Semester 4th

BE(C)

Subject:- Structural Analysis

Instructor:- Sir Amjad Islam

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Question No 01

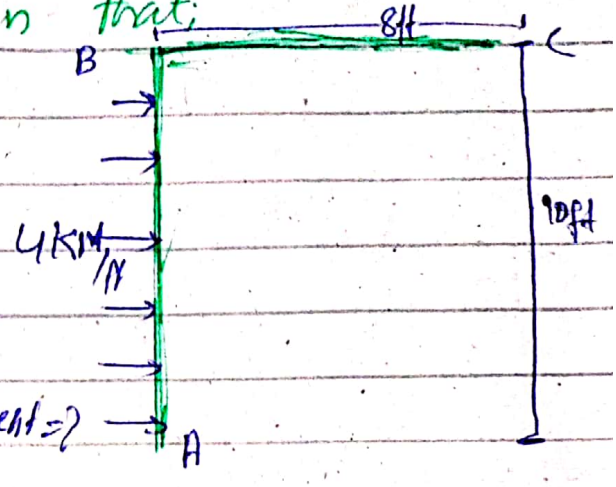
Ans:-

Sol:-

Given that:

$E = 29 \times 10^3 \text{ ksi}$

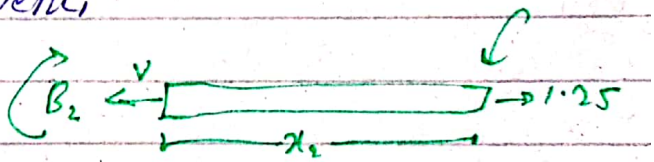
$I = 600 \text{ in}^4$

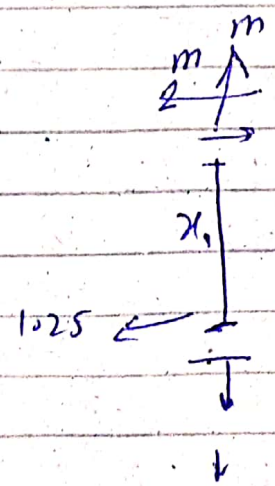


Required:-

Vertical displacement =?

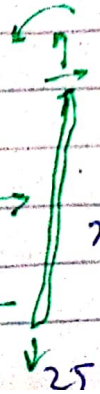
Vertical moment:

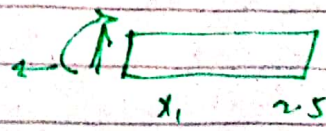




$m_2 = 1.25x$

Real moment:-





$m_2 = 25x_2$

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

Now using virtual work equation

$$1 \cdot \Delta_C = \int_0^2 m \frac{M}{E} dx$$

$$= \int_0^{10} 1x_1 \left(\frac{40x_2 - 2x^2}{E}\right) dx + \int_0^8 \frac{(1.25x_1)(25x_2)}{EI} dx_2$$

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

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

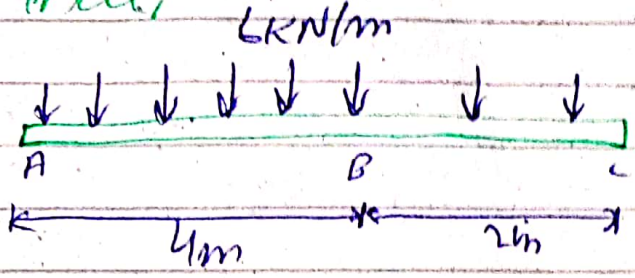
Question No. 02.

Sol:-

Given that:

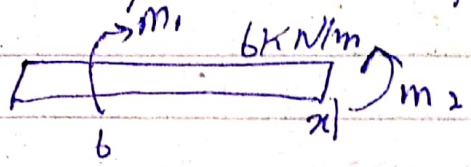
$E = 200\ GPa$

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



Required:

Slope and displacement = ?



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

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

$$m = -m' + 3x^2 + x_1^2/2$$

taking partial derivative with respect to m.

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

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

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

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

Put the value of E, I and I.

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

$$= \frac{-216\ KN\,ft^3}{4.8\times 10^6} + \frac{-614.4\ KN\,ft^3}{4.8\times 10^6}$$

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

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

Slope:-

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

$$m = -\frac{1}{2} \times (6x_1) = -3x^2$$

So;

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

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

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

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

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

$$= \int_0^6 \frac{-3x^2(4)}{E \cdot I} dx + \int_0^{10} \left(-2 + 6x^2 + \frac{x^2}{2}\right) dx$$

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

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

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

Ans.

Question No. (03)

Solution:-

Given that:

w_o = uniform load = 400 lb/ft

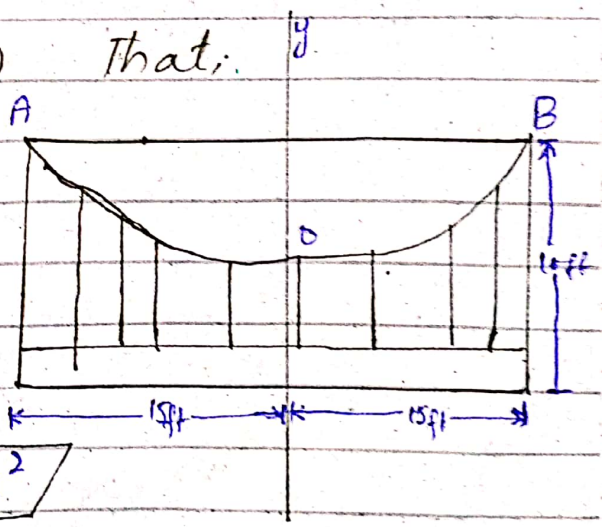
h = height = 10 ft.

L = length = 15 ft.

Required:-

Equation of Curve and forces in cable = ?

As we know that:



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

Putting values

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

$$T_o = H = \frac{w_o L^2}{2h} = \frac{400 \times (15)^2}{2(10)}$$

$$\boxed{T_o = 4500 \text{ lb} = 4.5 \text{ K.lb}}$$

→

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

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

$$T_{max} = 7500 \text{ lb} = 7.5 \text{ k-lb}$$

"T_{max}" By another equation.

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

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

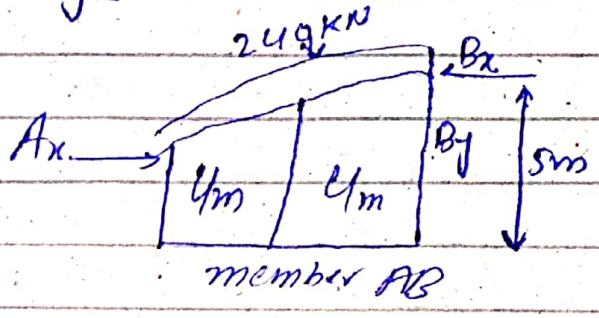
$$\Rightarrow \boxed{T_{max} = 7500 \text{ lb} = 7.5 \text{ k}}$$

X.

Question No. 04

Sol:- Given data:-

Uniform loading = . . = 30kN/m



Required data:-

Internal moment at D = ?

Divide into two members AB and BC.

AB :-

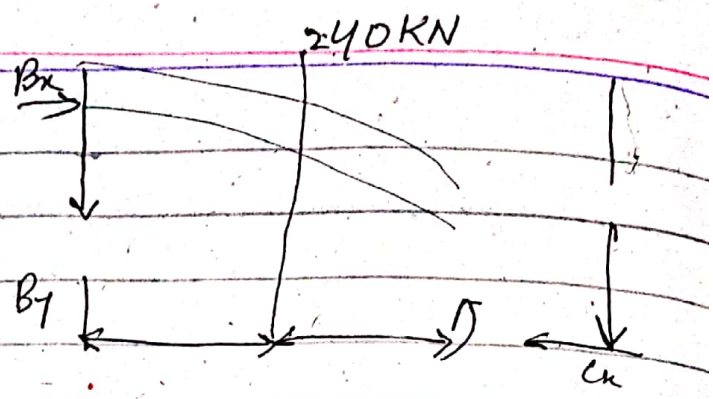
$$\circlearrowright + \sum M_A = 0$$

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

BC :-

$$\circlearrowright + \sum M_C = 0$$

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



member BC

Adding eq (a) and (b)

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

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

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

$$\Rightarrow$$

$$\Rightarrow 2B_y(8) = 0$$

$$\Rightarrow \boxed{B_y = 0 \text{ KN}}$$

put this value of B_y in eq(b). To get value of B_x.

$$-B_x(5) + 0(8) + 960 = 0$$

$$\Rightarrow B_x(5) = 960$$

$$\rightarrow$$

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

Now at "B"

$\curvearrowright^{+} M_D = 0$

$\Rightarrow (9)(27) + 150(2.5) - M_D = 0$

$\Rightarrow 384 - 375 - M_D = 0$

$9 - M_D = 0$

$\Rightarrow \boxed{M_D = 9 \text{ KN.m}}$

THE END.