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Section : A

Semester : 12 (Batch-14)

Paper : Structual Analysis-1

Submitted To: Engr. Ajmad Islam

Q 1 :-

Given Data :-

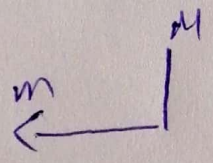
uniform load = 4K/ft

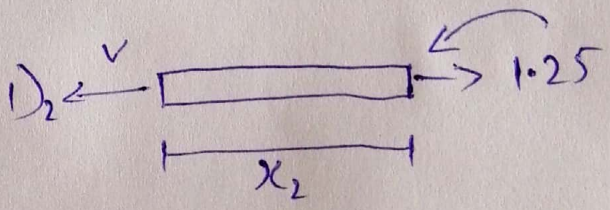
$E = 29 \times 10^3$ KSi

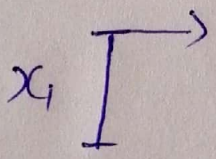
$I = 600 in^4$

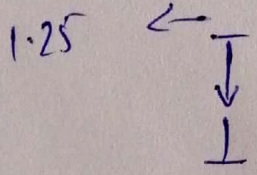
Required :- vertical Displacement

Sol :- Now vertical Moment.



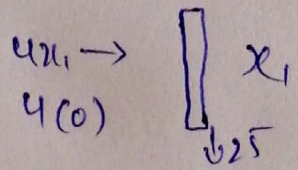


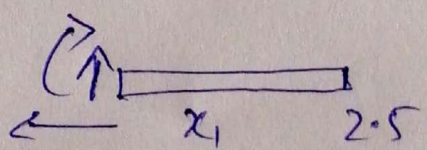




$m_2 = 1.25x$

real moment





$m_2 = 25x_2$

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

Now By virtual work equation.

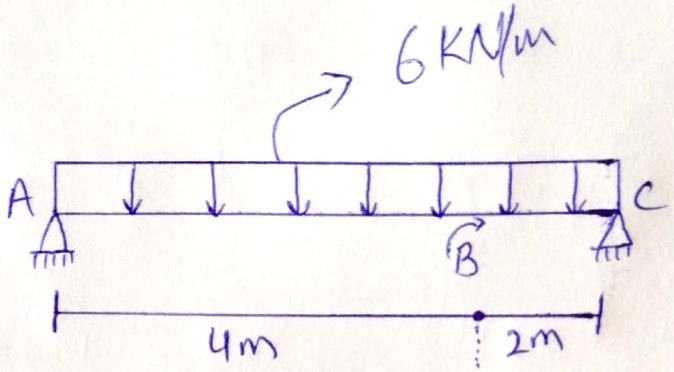
$$\Delta_c = \int_0^c \frac{mM dx}{\mathcal{E}}$$

$$\Delta_c = \int_0^{10} \frac{(1x_1)(40x_2 - 2x^2)dx}{\mathcal{E}} + \int_0^3 \frac{(1.25x_2)(25x_1)dx}{EI}$$

$$\Delta_c = \frac{1}{EI}\left| \frac{40x^3}{3} - \frac{2x^3}{4} \right|_0^{10} + \left| \frac{31.25x_2^3}{3} \right|_0^3$$

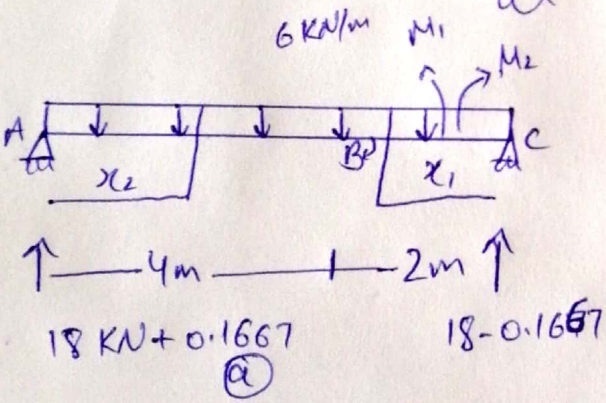
$$\boxed{\Delta_c = 10.64\,mm}$$

Q 2:-



Sol:- Given Data:

Required:- slope & Displacement at Point 'B'.



(a)

$R_1 + R_2 = 0 \rightarrow (1)$

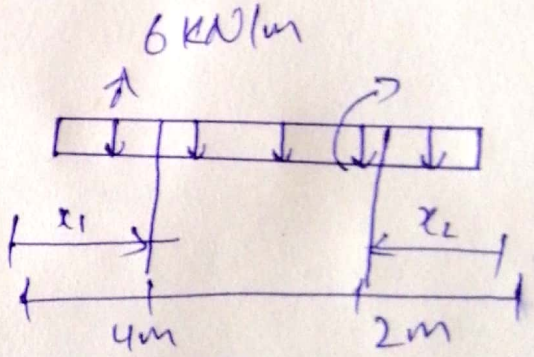
$\Sigma M_A = 0 \circlearrowright +$

$1 + R_2(6) = 0$

$\Rightarrow 0.16667$ Put in (1)

$R_1 + (-0.16667) = 0$

$R_1 = 0.16667\ KN$



(b)

$R_1 + R_2 = 1$

$\circlearrowright + \Sigma M_A = 0$

$-(1)(4) + R_2(6) = 0$

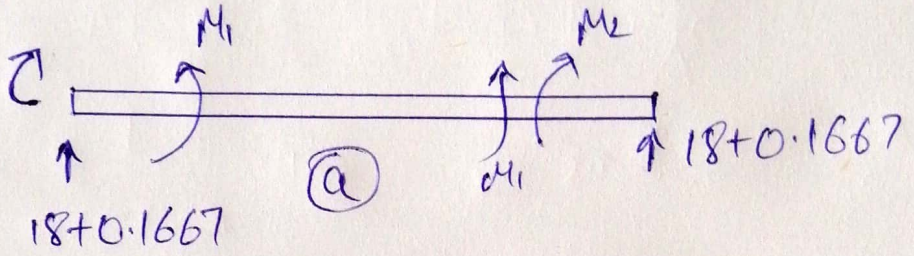
$R_1 = 0.6617\ KN$

$R_2 = 1 - 0.6667\ KN$

$R_2 = 0.333\ KN$

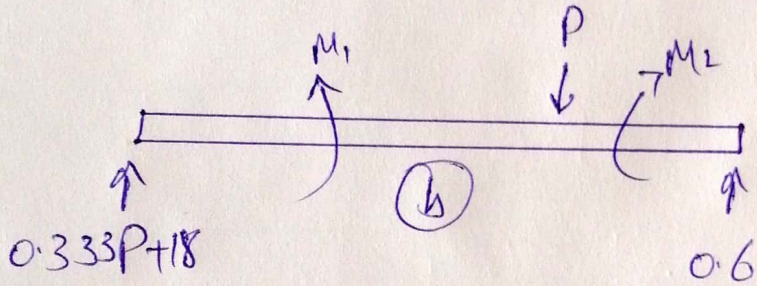
$$M_1 = (18 + 0.1667M')x_1 - 2x_1^2$$

$$M_2 = (18 - 0.1667M')x_2 - 2x_2^2$$



$$M_1 = (0.333P + 18)x_1 - 2x_1^2$$

$$M_2 = (0.667P + 18)x_2 - 2x_2^2$$



The displacement functions shown in the figure "a" above.

Then

$$\frac{\partial M_1}{\partial M_2} = 0.1667x_2 \text{ and } \frac{\partial M_2}{\partial M} = 0.1667x, \text{ set } M=0$$

$$M_1 = (18 + 0.1667(0))x_1 - 2x_1^2$$

$$\rightarrow M_1 = (18x_1 - 2x_1^2)$$

$$\rightarrow M_2 = (18x_2 - 2x_2^2)$$

$$B = \int_0^2 M\left(\frac{\partial M}{\partial M_1}\right)\frac{dx}{E_1} \int_0^9 \frac{(18x_1 - 2x_1^2)(0.1667x_1)dx_1}{E_1}$$

$$\int_0^2 \frac{(18x_2 - 2x_2^2)(0.1667x_2)dx_2}{EI}$$

$$\theta_B = \frac{42.65}{EI} + \frac{6.66}{EI}$$

$$= \frac{49.31}{EI}$$

$$= \frac{49.31}{(200 \times 10^6\ kPa)(0.00006)}$$

$$\boxed{\theta_B = 0.441\ rad}$$

$\Rightarrow$ For displacement function are shown in figure "b"

$\frac{\partial M_1}{\partial M_P} = 0.333x_1$ & $\frac{\partial M_2}{\partial M_P} = 0.6667x_2$ also

Then $M_1 = (18x_1 - 2x_1^2)\ KN-m$

$M_2 = (18x_2 - 2x_2^2)\ KN-m$

$$\Delta_B = \int_0^2 M \left(\frac{\partial M}{\partial P}\right) \frac{dx}{EI}$$

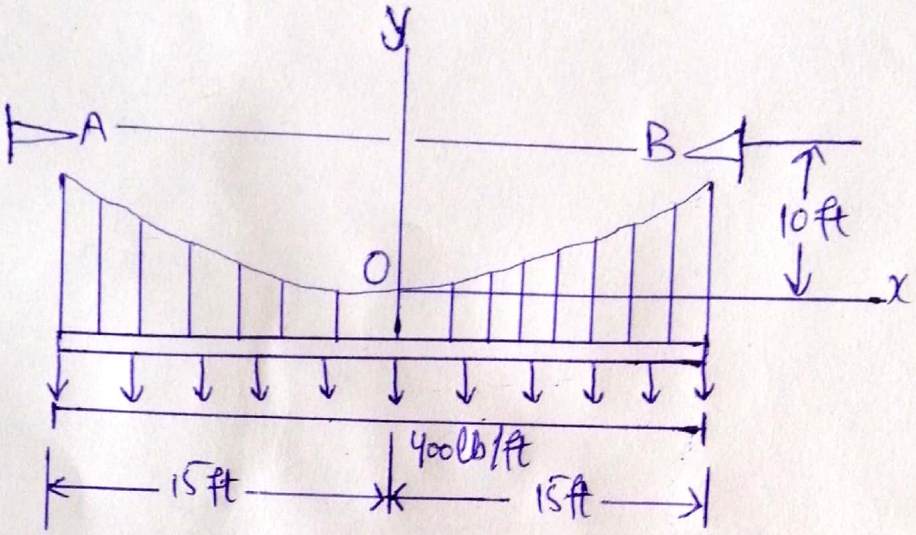
$$\Delta_B = \int_0^4 \frac{(30x\, x_1 - 2x_1^2)(0.333x_1)\,dx}{EI} + \int_0^2 \frac{(80x_2 - 2x_2^2)(0.6667x_2)\,dx}{EI}$$

$$\Delta_B = \frac{218.5}{EI} \Rightarrow \frac{218.5}{(200\times10^6)(0.00006)}$$

$$\Rightarrow 0.018m$$

$$\Rightarrow \boxed{18mm}$$

Q3:-



Sol:- Given Data:-

W_o = Uniform load = 400 lb/ft

h = 10 ft

L = 15 ft

Required:- Equation of Curve and force in cable = ?

Sol:- we know That.

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

Putting The value.

$$y = \frac{10}{(15)^2} x^2 = 0.44 x^2$$

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

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

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

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

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

Now "Tmax" By another equation.

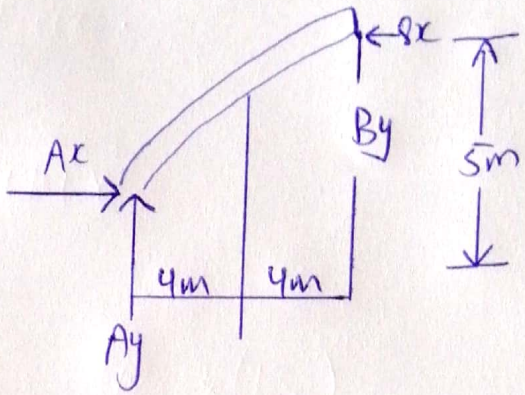
$$T_B = T_{max} = w_o L \sqrt{1 + \left(\frac{L}{2h}\right)^2} = 4500 \times 15 \sqrt{1 + \left(\frac{15}{2 \times 10}\right)^2}$$

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

Q 4:-

Given Data:

Uniform load = 30 KN/m



Required:

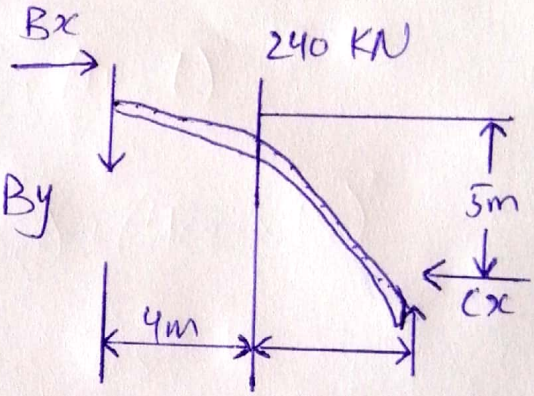
Internal moment at D = ?

Sol:-

"Dividing into two members"

AB & BC.

member AB



member BC

AB:

$$\circlearrowright + \Sigma M_A = 0 \qquad Bx(5) + By(5) + By(8) - 240(4) = 0 \rightarrow (a)$$

BC:

$$\circlearrowright + \Sigma M_C = 0 \qquad -Bx(5) + By(8) + 240(4) = 0 \rightarrow (b)$$

Adding eq ⓐ and ⓑ.

$$Bx(5) + By(8) - 240(4) = 0$$
$$-Bx(5) + By(8) + 240(4) = 0$$

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

$$2By(8) = 0$$

$$\Rightarrow By = 0\ KN$$

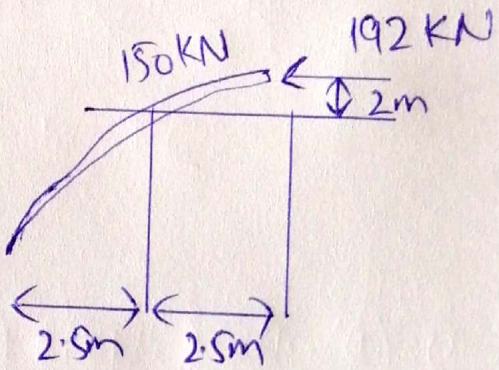
Putting The value of "By" in eq ⓑ

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

$$Bx(5) = 960$$

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

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



member DB.

"Now at segment DB"

$$\circlearrowright + \sum M_D = 0$$

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

$$384 - 375 - M_D = 0$$

$$9 - M_D = 0$$

$$\Rightarrow M_D = 9\,kN.m$$