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Section : A

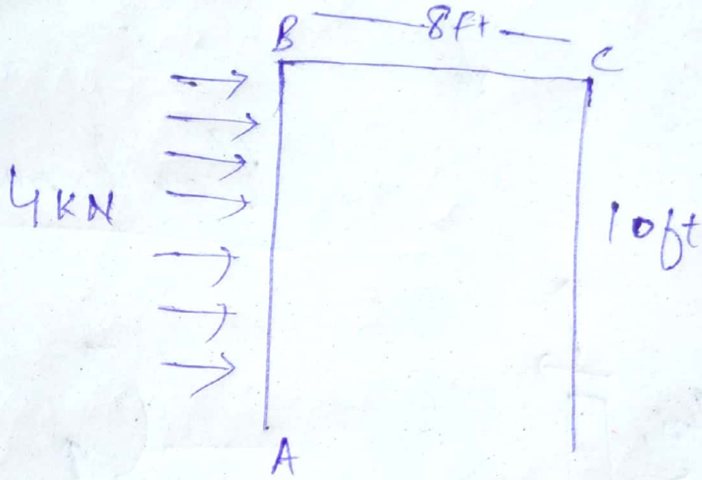
Date : 26/6/020

Subject : Strucher Analysis

Q No 1

Given Data

Ans :-



$E = 29 \times 10^3$ KSI

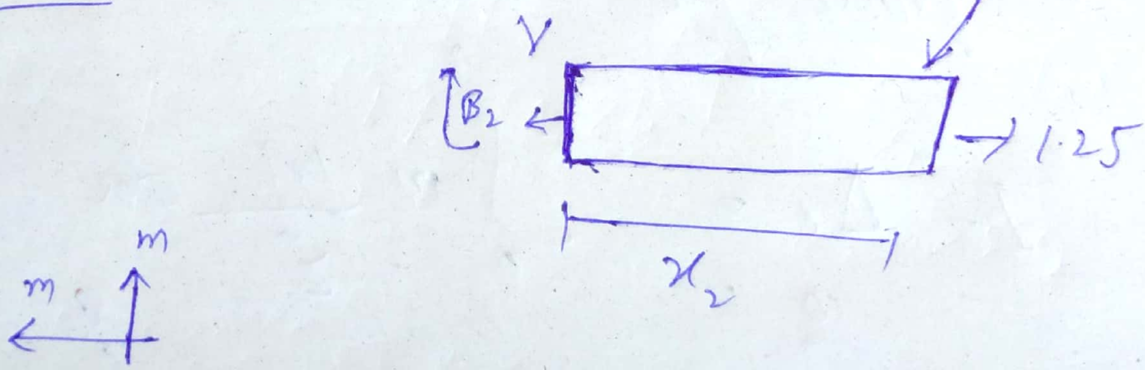
$I = 600\ In^4$

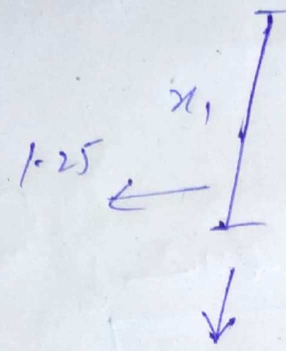
Required data -

Vertical displacement = ?

Vertical moment = ?

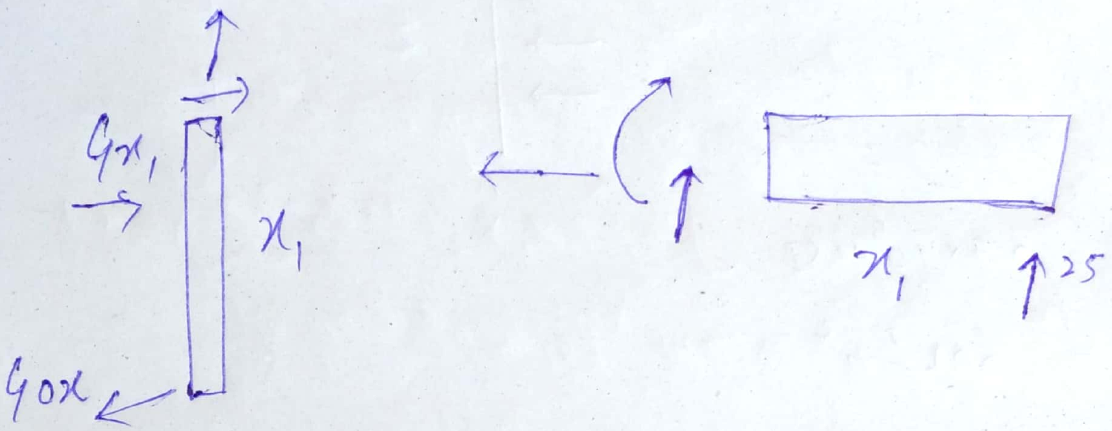
Solution =





$m_2 = 1.25x$

Real moment



$m_2 = 25x_2$

$M = 40x_1 - 2x\frac{1}{2}(x_1)$

$= 40x_1 - 2x_3^2$

Now put virtual work

$$I \cdot \Delta_c = \int_0^2 m\frac{M}{E}dx$$

$$= \int_0^{10} 1x_1\left(\frac{4x_2 - 2x^2}{E}\right)dx + \int_0^8 \frac{(1.25x_1)(25x_2)}{EI}dx$$

(3)

$$\Delta I = \frac{1}{EI}\left(\frac{40x^3}{3} - \frac{2x^4}{4}\right)\Bigg|_0^{10} +$$

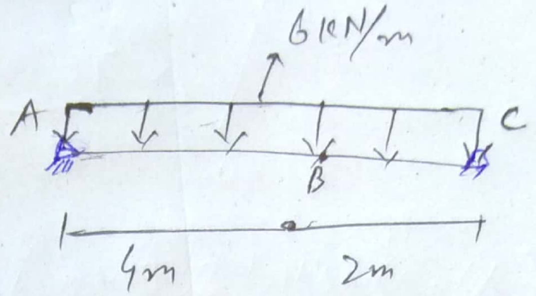
$$\left(\frac{31.25}{3} x_2^3\right)\Bigg|_0^{8}$$

$$\Delta I = \frac{1}{EI}\left(2.333 + 18666.66\right)$$

$$\Delta I = \frac{33999.88}{(200)(60 \times 10^6)}$$

$$\boxed{\Delta I = 2.8833 \times 10^{-6}\ in}$$

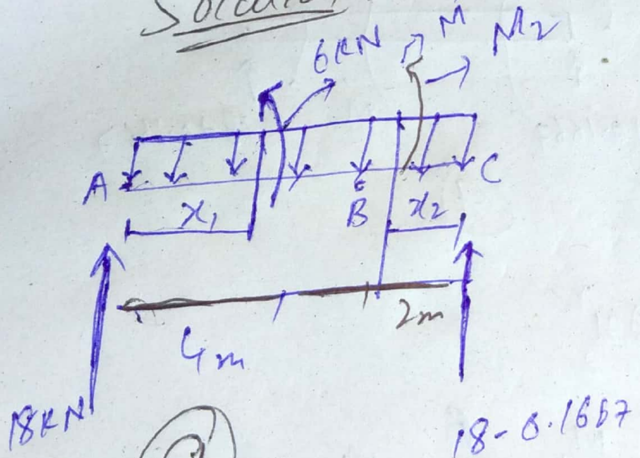
(A) No 2



Required-

Slop and displacment at point B.

Solution =



(a)

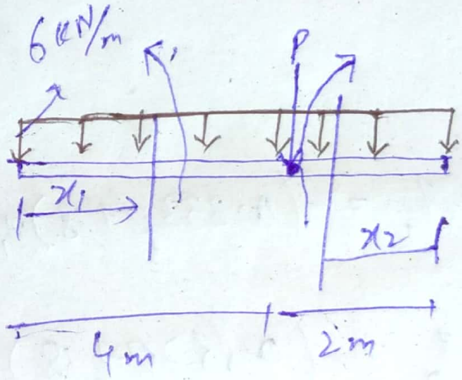
18 - 0.1667

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

$\sum M_A = 0$ ↻+

$1 + R_2(6) = 0$

$\Rightarrow -0.16667$ put in (1)



(b)

$R_1 + R_2 = 1$

↻+ $\sum M_A = 0$

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

$R_1 = 0.6667$ kN

P.T.O

$R_1 + (-0.1667) = 0$

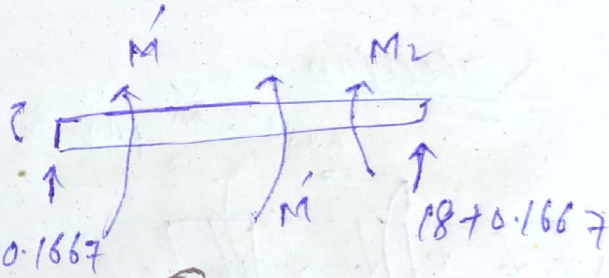
$R_1 = 0.16667\ kN$

$R_2 = 1 - 0.6667\ kN$

$R_2 = 0.333\ kN$

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

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

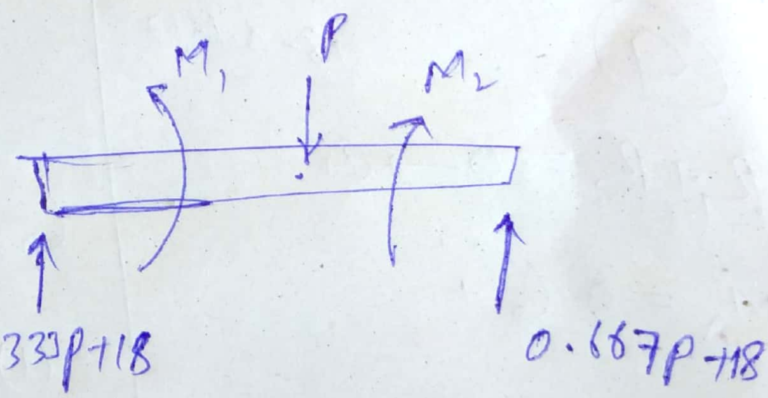


(a)

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

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

(b)



The displacement function shown in the figure "a" above

$$\frac{\partial M_1}{\partial M'} = 0.1667x_1 \text{ and } \frac{\partial M_2}{\partial M'} = 0.1667x_2$$

Set $M' = 0$ then $M_1 = (18 + 0.1667(0)x_1 - 2x_1^2$

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

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

$$Q_B = \int_0^2 M\left(\frac{\partial M}{\partial M_1}\right)\frac{dx}{EI} = \int_0^4 \frac{(18x_1 - 2x_1^2)(0.1667x_1)}{EI} dx_1$$

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

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

Scanned with CamScanner

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

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

$$\boxed{\theta_B = 0.4411 \text{ rad}}$$

→ For the displacement function are shown in figure "b"

$$\frac{\partial M_1}{\partial M_P} = 0.333x_1 \quad \text{and} \quad \frac{\partial M_2}{\partial P} = 0.667x_2$$

also set $P = 0$ then

$$M_1 = (18x_1 - 2x_1^2) \text{ k.N.m}$$

$$M_2 = (18x_2 - 2x_2^2) \text{ kN.m}$$

thus

$$\Delta B = \int_0^{L} \frac{(30 x x_1 - 2x_1^2)(0.333x_1)\,dx}{EI} +$$

$$\int_0^{2} \frac{(30x_2 - 2x_2^2)(0.6667x_2)\,dx}{EI}$$

$$\Delta B = \frac{218.5}{EI} \Rightarrow \frac{218.5}{(200\times 10^6)(0.0006)} =$$

0.018m or 18 mm

X

Q NO 3

Given data :- W_0 = Uniform load = 400 lb/ft

$h = 10\,ft$, $L = 15\,ft$

Required :- Equation of curve and force in Cable = ?

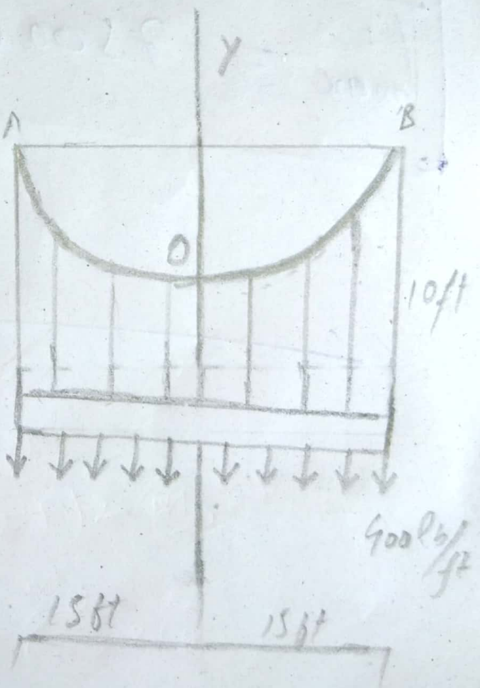
Solution: We know that

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

putting the value

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

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



$T_0 = F_H = \frac{W_0 L^2}{2h} = \frac{400 \times (15)^2}{2 \times 10}$

$T_0 = 4500\,lb = 4.5\,K$

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

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

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

Now "T_{max}" by another Equation

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

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

$$T'_{max} = 7500\ lb = 7.5k$$

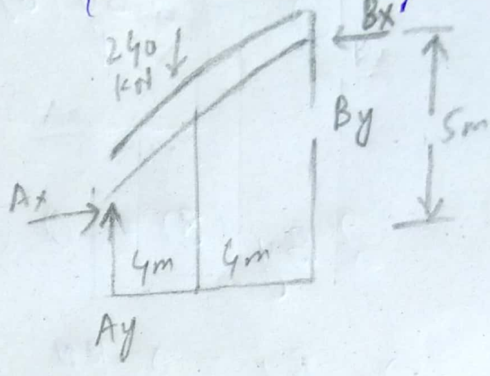
---x---x---

11

Q NO4

Given data:

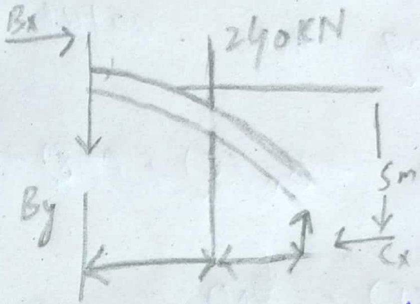
Uniform load = 30KN/m



Required data:

internal moment at D = ?

Member AB



Member BC

Solution:

Dividing into two members AB and BC.

AB:

$\circlearrowleft + \sum M_A = 0$

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

BC:

$\circlearrowleft + \sum M_C = 0$

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

(12)

Adding eq (a) and (b)

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

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

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

$2B_y(8) = 0$

$\Rightarrow B_y = 0 \text{ kN}$

Putting the value of "B_y" in eq (b)

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

$B_x(5) = 960$

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

$B_x = 192 \text{ kN}$

"Now at Segment "DB"

$\circlearrowright^{+} \sum M_D = 0$

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

$384 - 375 - M_D = 0$

$9 - M_D = 0$

$\Rightarrow M_D = 9 \text{ kNm}$