NAME SOHAIL AHMED

ID 7907.

SECTION A.

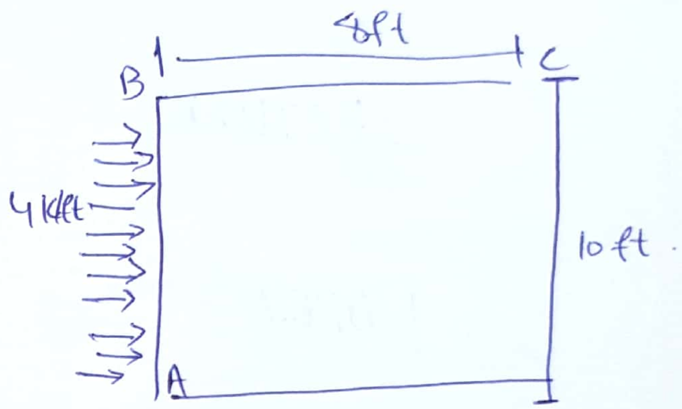
PAPER STRUCTURE ANALYSIS.

DATE 26-06-2020.

ANSWER TO QUESTION NO 1 :

→ Determine the verticle displacement of free end point to the frame in figure. Take 29(10³) ksi & I = 600 in⁴ for both member. use methode of virtual work.

GIVEN DATA :-



$E = 29(10^3)$ ksi

$I = 600$ in^4

REQUIRED ?

Vertical Displacement = ?

SOLUTION:

Now verticle moment

→ For reaction.

$\Sigma M_A = 0$.

$-4(10)(5) + Cy(8) = 0$

$Cy = 25$ kips.

$\Sigma Fy = 0 \uparrow +$

$25 + A_y = 0$

$A_y = -25$ kip

$\Sigma F_x = 0 \rightarrow +$

$40 - A_x = 0$

$A_x = +40$

Real moment;

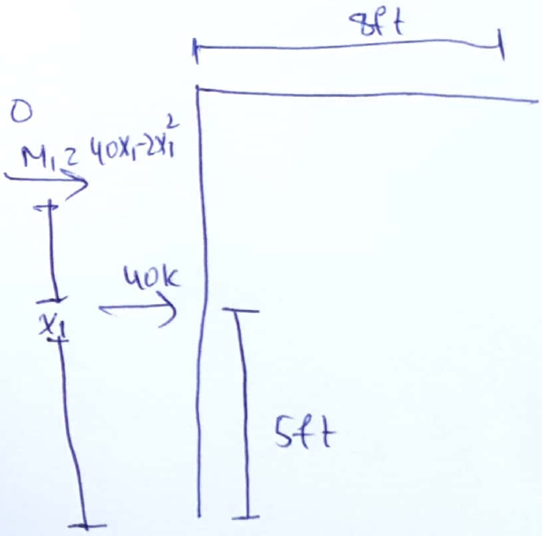
$\Sigma M_1 = 0$

$-40(x_1) + 4x_1\left(\frac{x_1}{2}\right) + M_1 = 0$

$M_1 = 40x_1 - 2x_1^2$

$-25x_2 + M_2 = 0$

$M_2 = 25x_2$



$\rightarrow$ Virtual moments:

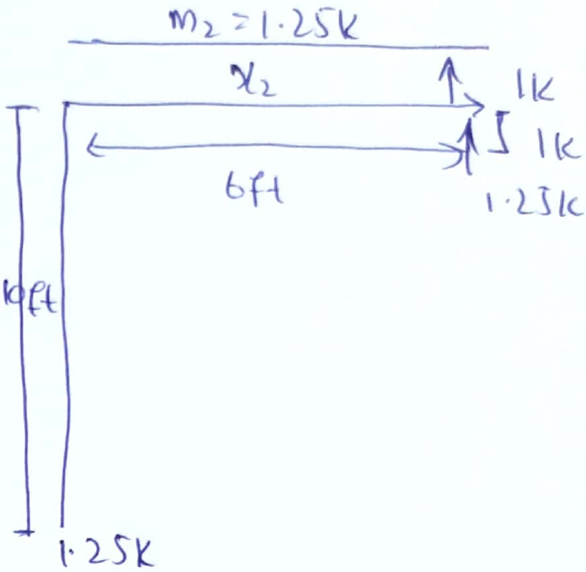
$\Sigma M_1 = 0$

$-1(x_1) + M_1 = 0$

$m_1 = 1x_1$

$-m_2 + 1.25x_2 = 0$

$m_2 = 1.25x_2$



Now from virtual work eq-

$$1k \cdot \Delta c = \int_0^x m \frac{M\,dx}{EI}$$

$$1k \cdot \Delta C = \int_0^{18} \frac{(40x_1 - 2x_1^2)(1x_1)\,dx}{EI}$$

$$\Delta ch = \frac{8333.3}{EI} + \frac{5333.3}{EI}$$

$$\Delta ch = \frac{13666.7}{EI} \; k^3 ft^3$$

$$\Delta ch = \frac{13666.7\,k^2 ft\,(12^3 \cdot 1^3)/1ft^3)}{[29 \times 10^3 k/in^2](600)}$$

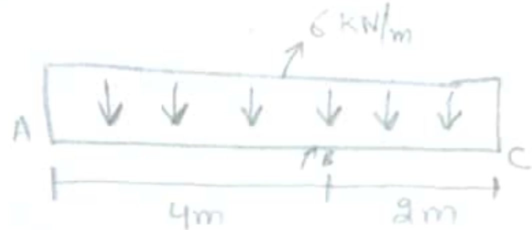
$$\Rightarrow \boxed{\Delta ch = 1.357\,in}$$

Ans.

Scanned with CamScanner

Q#2:-

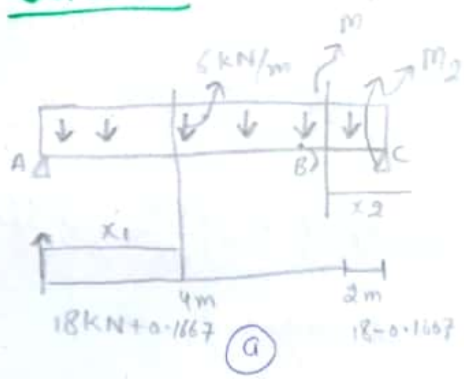
Given Data:



Required:-

Slope and displacement at Point B-

Solution:-



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

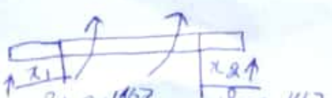
$\Sigma M_A = 0$ ↻+

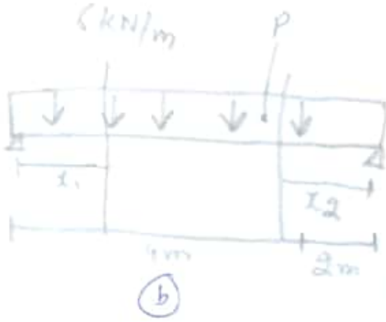
$1 + R_2(6) = 0$

$\Rightarrow -0.1667$ Put in (1)

$R_1 + (-0.1667) = 0$

$R_1 = 0.16667\ kN$





$R_1 + R_2 = 1$

↻+ $\Sigma M_A = 0$

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

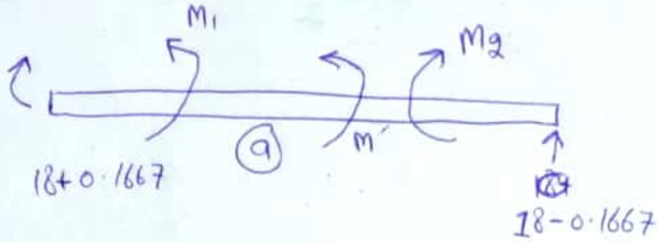
$R_1 = 0.6667\ kN$

$R_2 = 1 - 0.6667\ kN$

$R_2 = 0.333\ kN$

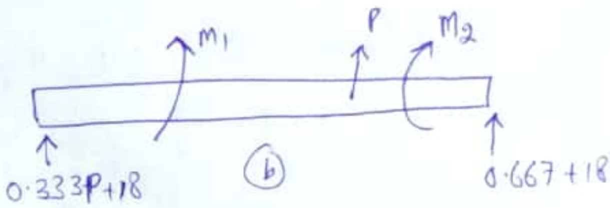
$$M_1 = (18 + 0.1667\, m')\, x_1 - 2x_1^2$$

$$M_2 = (18 - 0.1667\, m')\, x_2 - 2x_2^2$$



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

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



The displacement function shown in the figure "a" above

$$\frac{\partial M_1}{\partial M'} = 0.1667x_1 \text{ and } \frac{\partial M_2}{\partial M_1} = 0.1667x^2,$$

Set $m' = 0$ then

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

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

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

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

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

$$\theta B = \frac{42.65}{Ei} + \frac{6.66}{Ei}$$

$$\theta B = \frac{49.31}{Ei}$$

$$\theta_B = \frac{49.31}{(200\times10^6\ kPa)(0.0006)}$$

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

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

$$\frac{\partial m_1}{\partial M_P} = 0.333x_1 \text{ and } \frac{\partial m_2}{\partial P} = 0.6667x_2 \text{ also}$$

Set $P=0$

then $M_1 = (18x_1 - 2x_1^2)\ kN\cdot m$

$m_2 = (18x_2 - 2x_2^2)\ kN\cdot m$

thus

$$\Delta B = \int_0^L m\left(\frac{\partial m}{\partial P}\right)\frac{dx}{Ei}$$

$$AB = \int_0^4 \frac{(30x_1 - 0x_1^2)(0.333x_1)\,dx}{Ei} + \int_0^2 \frac{(30x_2 - 2x_2^3)(0.6667x_2)\,dx}{Ei}$$

$$AB = \frac{218.5}{Ei} \Rightarrow \frac{218.5}{(200\times10^6)(0.0006)} = \boxed{0.018m \text{ or } 18mm}$$

ANSWER TO QESTION NO 3 :-

GIVEN DATA

$W_o =$ uniform load $= 400$ lb/ft.

$h = 10$ ft

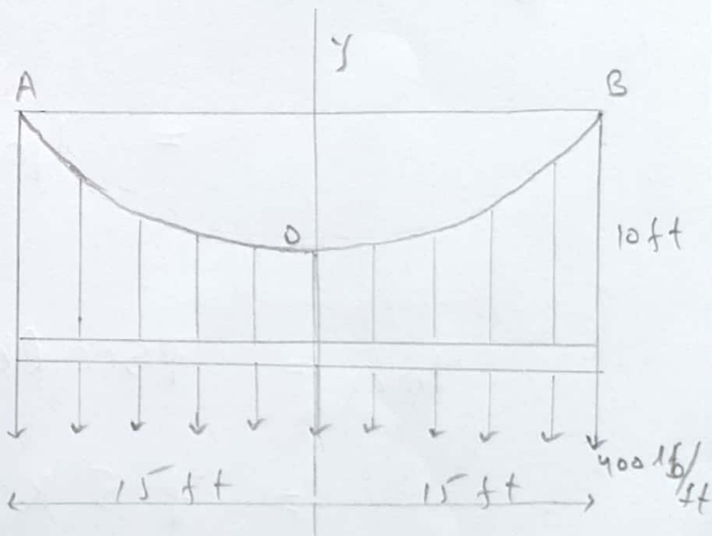
$L = 15$ ft.

REQUIRED :-

Equation of Curve and force in cable = ?

we know that

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



Putting the values,

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

$$= 0.044x^2.$$

$$\rightarrow T_o = F_H = \frac{W_o L^2}{2h}$$

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

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

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

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

$$T_{max} = 7500 \text{ lb}$$

$$= 7.5 \text{ k}$$

Now "T_{max}" By another equation.

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

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

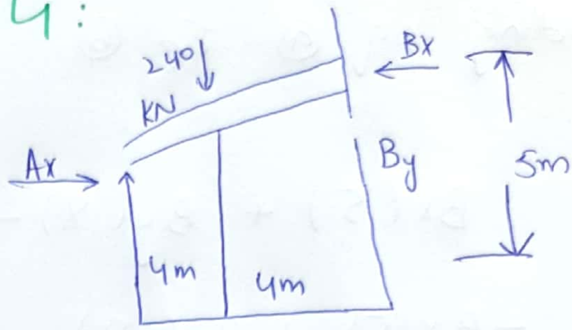
$$T_{max} = 7500 \text{ lb}$$

$$= 7.5 \text{ k}$$

x———————x———————x.

ANSWER TO QUESTION 4:

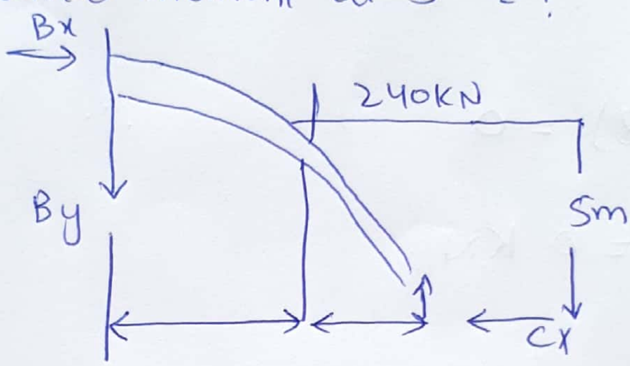
GIVEN DATA :



Membe AB

Required data:

internal moment at D = ?



member BC

SOLUTION :

Dividing into two member AB & BC.

AB

$$\circlearrowright + \Sigma M_A = 0$$

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

BC

$$\circlearrowright + \Sigma M_L = 0$$

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

$$\rightarrow (b)$$

Adding eq (a) & eq (b)

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

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

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

$$2By(8) = 0 \quad \therefore \quad \frac{2By(8)}{2} = \frac{0}{2}$$

$$\Rightarrow \quad By = 0 \text{ KN.}$$

Putting the values of 'By' in eq (b)

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

$$Bx(5) = 960$$

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

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

Now at Segment "DB"

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

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

$$384 - 375 - M_D = 0$$

$$9 - M_D = 0.$$

$$\Rightarrow \boxed{M_D = 9 \text{ KNm}}$$

Ans.