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ID # 7909

Section :- "A"

Subject :- Structural Analysis

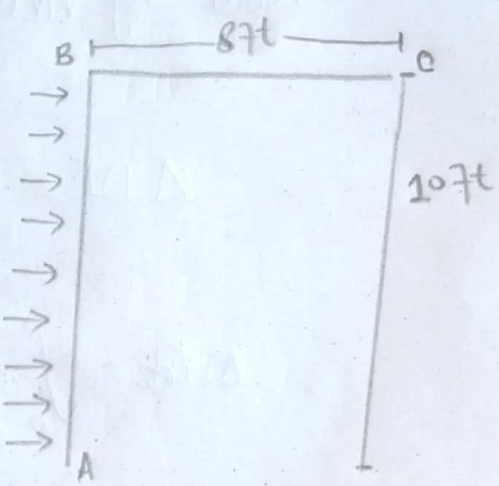
Q# 1:-

Given Data:-

Uniform Load = 4k/ft

$E = 29 \times 10^3$ KSi

$I = 600\ in^4$

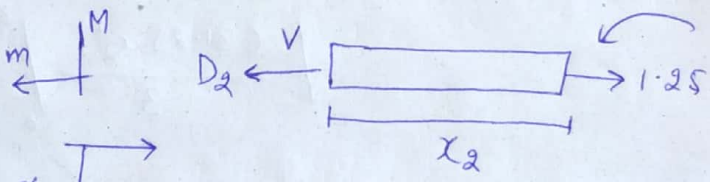


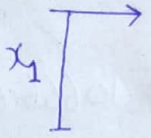
Required:-

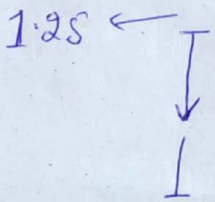
Vertical Displacement

Solution:-

Now virtual moment

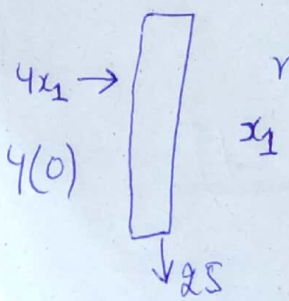


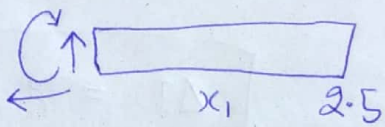




$m_2 = 1.25x$

real moment





$m_2 = 25x_2$

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

Now By Virtual work equation

$$\Delta \cdot DI = \int_0^{@L} \frac{m\,M dx}{\mathcal{E}}$$

$$\Delta I = \int_0^{10} (1x_1)\frac{(40x_2 - 2x^2)}{\mathcal{E}}dx + \int_0^{8} \frac{(1.25v2)(25x_2)\,dx}{\mathcal{E}I}$$

$$\Delta I = \frac{1}{\mathcal{E}I}\left| \frac{40x^3}{3} - \frac{2x^3}{4}\right|_0^{10} + \left| \frac{(31.25\,x_2^3)}{3}\right|_0^{8}$$

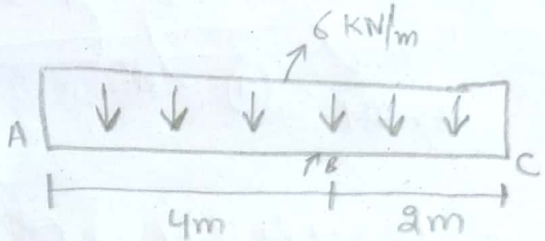
$$\Delta I = \frac{1}{\mathcal{E}I}(2.3333 + 10666.66)$$

$$\Delta I = \frac{33999.99}{(200)(60\times 10^6)}$$

$$\boxed{\Delta I = 2.8338 \times 10^{-6}\ in}$$

Q#2:-

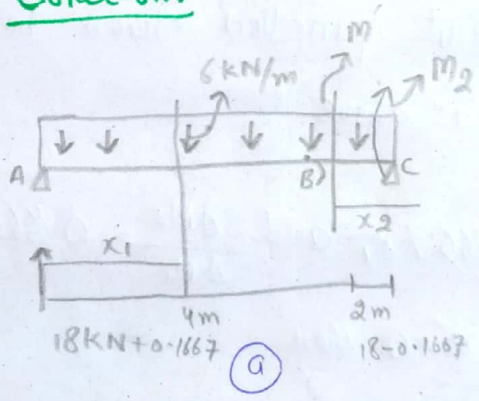
Given Data:-



Required:-

Slope and displacement at Point B-

Solution:-



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

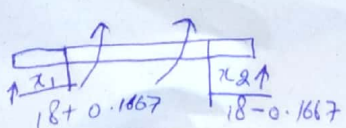
$\Sigma M_A = 0 \quad \circlearrowleft +$

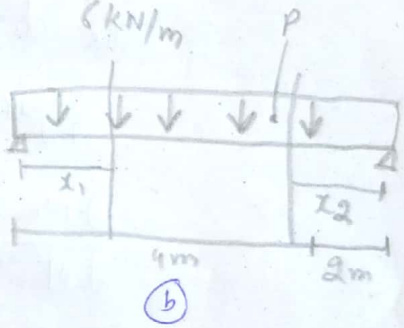
$1 + R_2(6) = 0$

$\Rightarrow -0.1667$ Put m (1)

$R_1 + (-0.1667) = 0$

$R_1 = 0.16667\ KN$





$R_1 + R_2 = 1$

$\circlearrowleft + \Sigma M_A = 0$

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

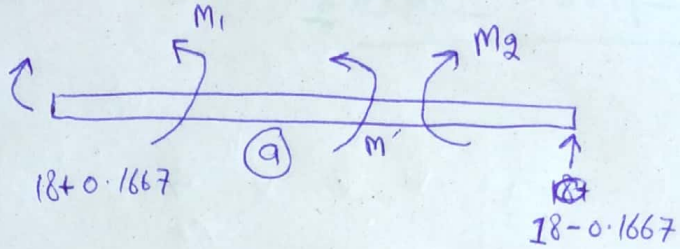
$R_1 = 0.6667\ KN$

$R_2 = 1 - 0.6667\ KN$

$R_2 = 0.0333\ KN$

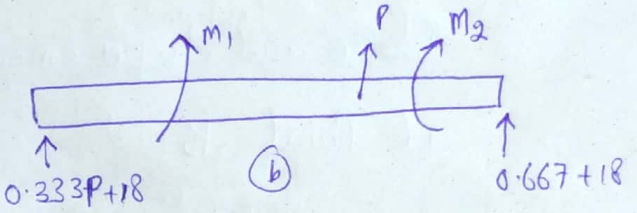
$$M_1 = (18 + 0.1667\,M')\,x_1 - 2x_1^2$$

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



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

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



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

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

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

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

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

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

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

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

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

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

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

$\frac{\partial M_1}{\partial M_P} = 0.333x_1$ and $\frac{\partial M_2}{\partial P} = 0.6667x_2$ 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

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

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

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

Q#3:-

Given Data:-

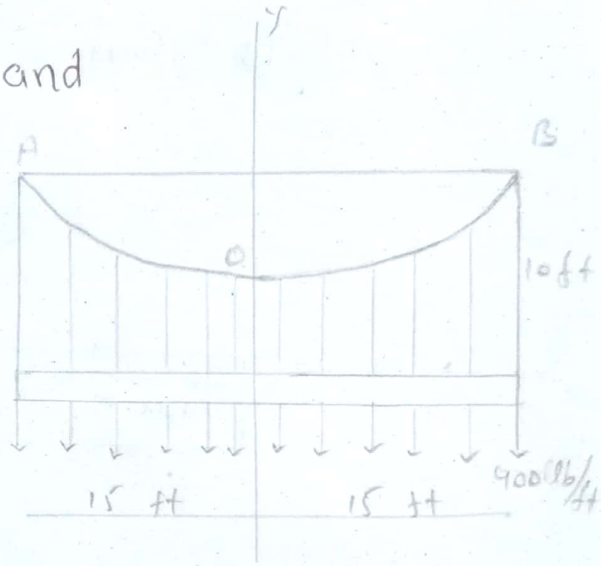
Uniform load = $W_o = 400\ lb/ft$

$h = 10\ ft$

$L = 15\ ft$

Required:-

Equation of Curve and force in Cable = ?



Sol:-

We know that

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

Putting the values

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

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

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

$$\boxed{T_o = 4500lb = 4.5k}$$

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

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

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

Now "T_{max}" By another equation

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

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

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

Q#04 :-

Given data:-

Uniform Load = 30 KN/m

Required:-

Internal Moment at D=?

Sol:-

Dividing into two members

AB and BC

AB :-

$$\curvearrowright + \Sigma M_A = 0$$

$$B_x(5) + B_y(8) - 240(4) = 0 \rightarrow ①$$

BC :-

$$\curvearrowleft + \Sigma M_C = 0$$

$$-B_x(5) + B_y(8) + 240(4) = 0 \rightarrow ②$$

Adding equ (a) and (b)

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

$$2By(8) = 0$$

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

$$\frac{By(8)}{8} = \frac{0}{8}$$

$$\boxed{By = 0 \text{ K·N}}$$

Putting the value of "By" in eq (a)

eq (a)

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

$$-Bx(5) + 960 = 0$$

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

$$\boxed{Bx = 192 \text{ k·N}}$$

Now at Segment DB

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

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

$$384 - 375 - M_D = 0$$

$$9 - M_D = 0$$

$$\boxed{M_D = 9\ kN\cdot m}$$

The End