Name # Muhammad Sulaiman

ID # 7925

Section # A

Subject # Structural Analysis

Semester # 4th spring Final

Instructor # Amjad Islam

Date = 26 June 2020

Q# => 01

Given data :-

Uniform load = 4k/~~ft~~ft

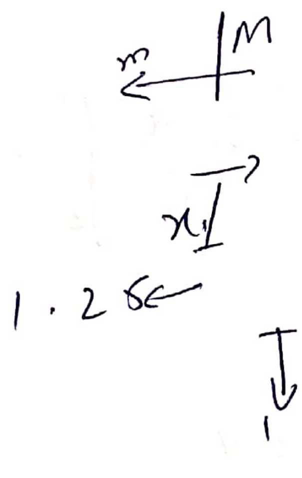
$E = 29 \times 10^3$ ksi

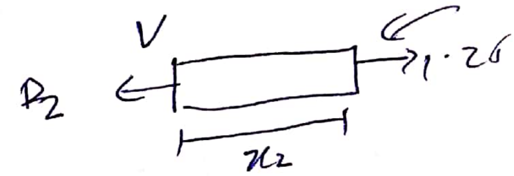
$I = 600\ in^4$

Required Data :

Vertical displacement

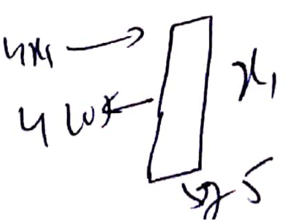
Solution :- No virtual moment

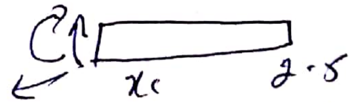




$m_2 = 1.25x$

real Moment





$M_2 = 2.5x_2$

$$M = \frac{40x_1 - \frac{1}{2}x_1(x_2)}{40x_1 - -x_1 2}$$

Now by virtual work equation

$$\Delta DC = \int_0^L \frac{mM\,dx}{E}$$

$$\Delta L = \int_0^{10} (1x_1)\left(\frac{40x_2 - 2x^2}{E}\right)dx + \frac{(1.25x_2)(2.5x_2)\,dx}{EI}$$

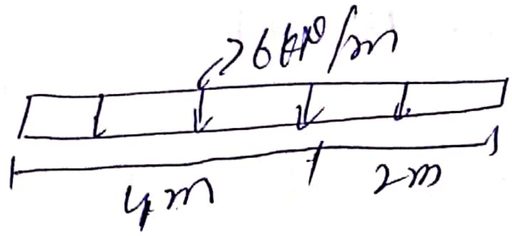
$$\Delta L = \frac{1}{EI}\left|\frac{42x^3}{3} - \frac{2x^3}{4}\right|_0^{10} + \left|\frac{(31.25)x_2^3}{3}\right|_0^{8}$$

$$\boxed{DL = 10649.60180}$$

P-3

Q#2

Given data

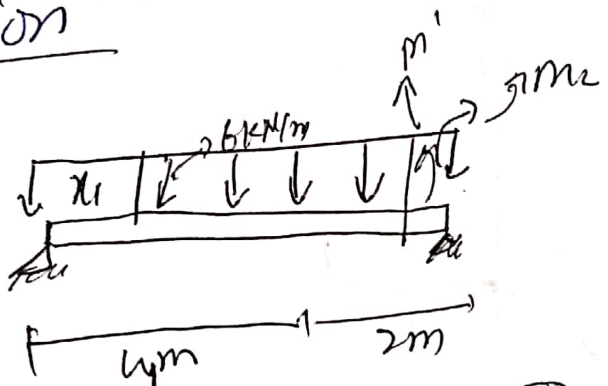


Required

slope and displacement at

point

Solution



18KN + 0.1667 → (a)

18 − 0.1667

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

$\Sigma M_A = 0$ (+)

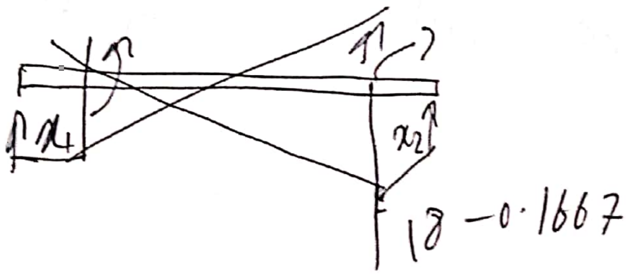
$1 + R_2(6) = 0$

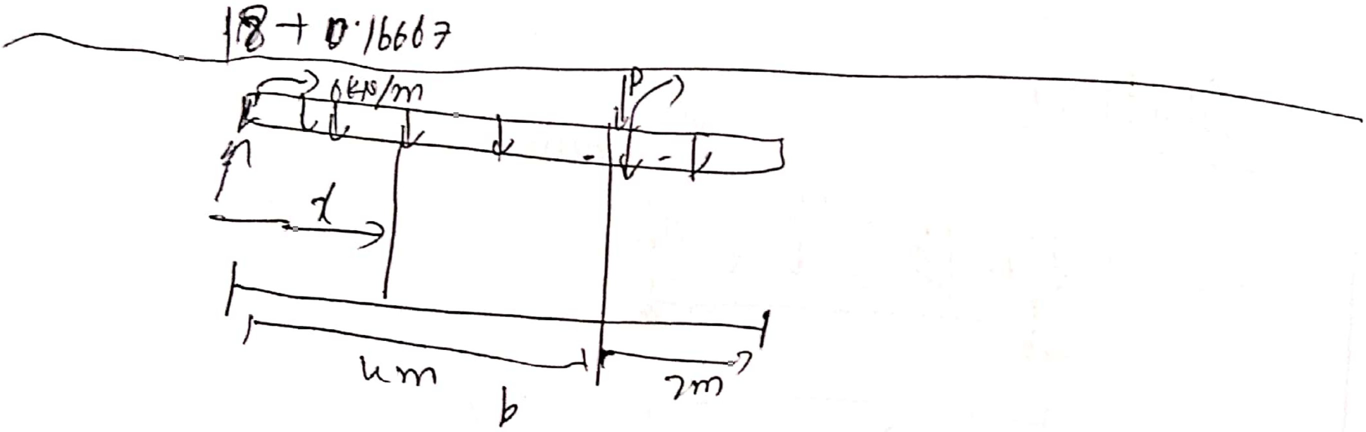
$\Rightarrow -0.16667$ put in eq (i)

$P = 4$

$R_1 + (-0.16667) = 0$

$R_1 = 0.16667\ KN$





$R_1 + R_2 = 1$

$\circlearrowleft^{+} \Sigma M_A = 0$

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

$R_1 = 0.6667\ KN$

$R_2 = 1 - 0.6667\ KN$

$R_2 = 0.333\ KN$

P-5

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

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

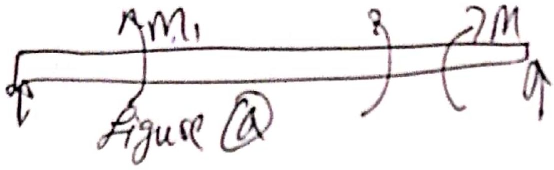


Figure (a)

$18 + 0.1666$

$17 + 0.16667$

$M_1 - (0.333\, P + 8)\, x_1 - 2x_1^2$

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

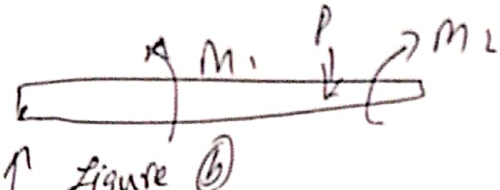


Figure (b)

$0.6667P + 18$

$0.333\,P + 18$

The displacement function shown in a figure "a" above

$\frac{dm_1}{dm_2} = 0.16667x_1$ and $\frac{dm_2}{\partial m'} = 0.1667x_2$, set $m' = 0$

$m_1 = 18 + 0.1667(0)\,]\,x_1 - 2x_1^2$

$\to \quad M_1 = (18x_1 - 2x_1^2)$

$\Rightarrow \quad M_2 = (18x_2 - 2x_2^2)$

$$\phi B = \int_0^L m \left(\frac{dm}{dm_1}\right) \frac{dx}{EI} = \int_0^4 \frac{(18x_1 - 2x_1^2(0.1667x_1)\, dx}{EI}$$

$$= \int_0^8 \frac{(18x_2 - 2x_2^2)(0.1667x_2)\, dx_2}{EI}$$

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

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

$$\phi B = \frac{49.31}{(200 \times 10^{10} \cdot \text{kpa})(0.0006)} = 0$$

$\phi B = 0.4411$ rad

For the displacement are shown in figure (B)

$$\frac{\partial m_1}{\partial m_p} = 0.333\, x_1 \quad \text{and} \quad \frac{\partial m_2}{\partial p} = 0.6667\, x_2$$

also

then

$$m_1 = (18x_1 - 2x_1^2)\ \text{KN-m}$$

$$m_2 = 18x_2 - 2x_2^2)\ \text{kn}\cdot\text{m}$$

thus

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

$$\Delta B = \int_0^{4} \frac{(30x\, x_1 - 2x_1^3)(0.333x_1)\,dx}{Ei} + \int_0^{2} \frac{(30x_2 - 2x^2{}_2\,(0.6667x_2)\,dx}{EP}$$

$$\Delta B = \frac{218.5}{Ei} \Rightarrow \frac{218.5}{(200\times10^6)(0.0006)} = \sout{0.019m}$$

$$\Rightarrow \boxed{0.018m = 18mm}$$

P-7

Q# 3 (Part)

Given Data:

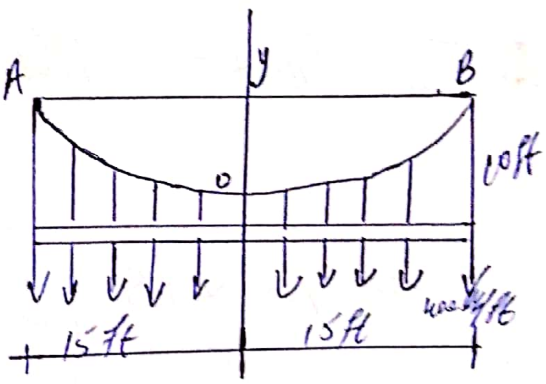
W_0 = Uniform load = 400lb/ft

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 values

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

P-8

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

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

$$T_B = T_{max} = \sqrt{(F_H)^2 + (W_o L)^2} = \sqrt{(4500)^2 + (400 \times 15)^2}$$

$$T_{max} = 7500 = 7.5K$$

Now "T_{max}" By another equation

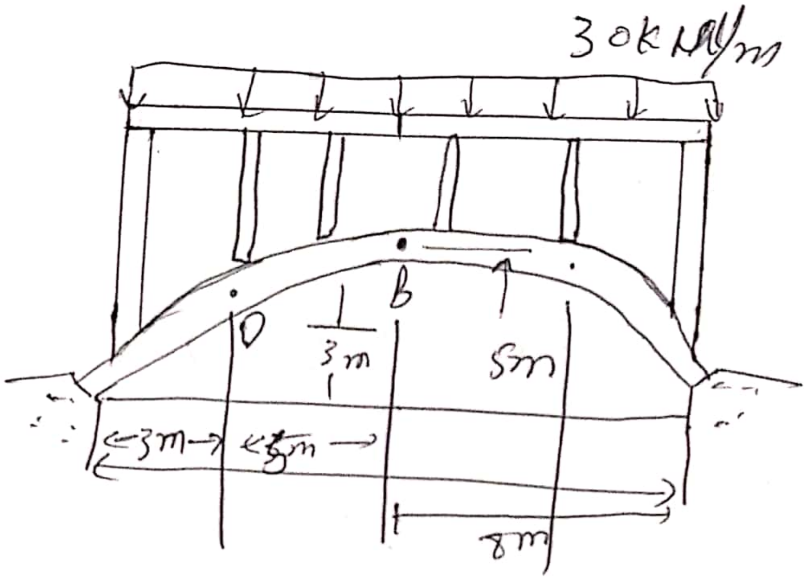
$$T_B = T_{max} = W_o L \sqrt{1 + \left(\frac{L}{2h}\right)^2}$$

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

$$\Rightarrow T_{max} = 7500 \text{ lb} = 75K$$

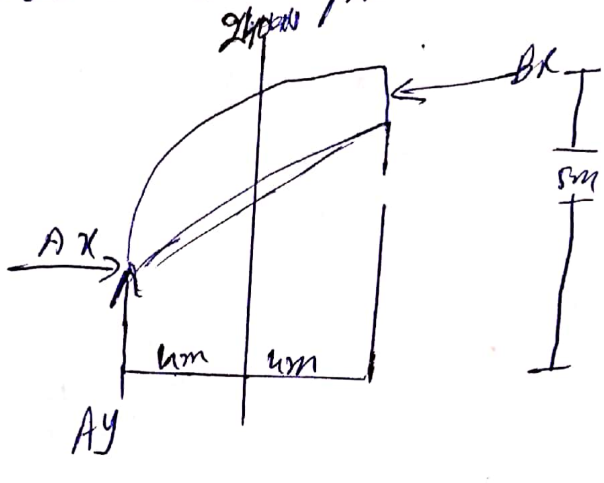
The ⟵ End ⟶ of Q #3

Q# 04)



Q#4:: P-10

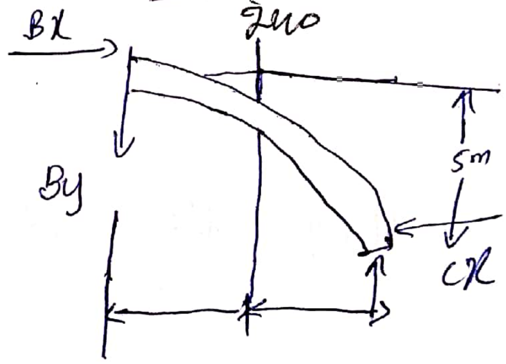
Given Data: Uniform Load = 30KN/m



Required:

Internal Moment At P = ?

Solution:: Dividing into two member AB and BC



AB :-

$\curvearrowright^{+} \sum M_A = 0$ $\quad B_x(5) + B_y(8) - 240(4) = 0 \rightarrow (a)$

BC :

$\curvearrowleft^{+} \sum M_C = 0$ $\quad -B_x(5) + B_y(8) + 240(4) = 0 \rightarrow (b)$

Adding eq (a) and (b)

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

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

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

$$2By(8) = 0$$

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

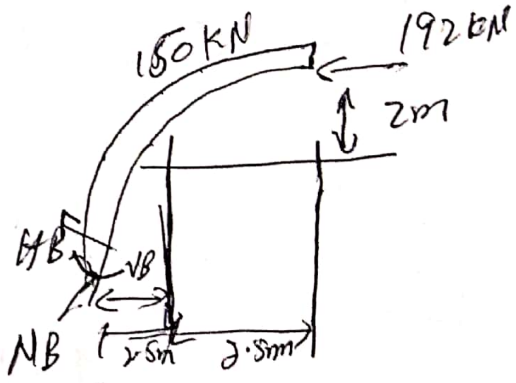
Putting the value of "By" in eq (b)

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

$$Bx(5) = 960$$

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

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



Member AB

Now at Segment DB

$\hookrightarrow \sum M_D = 0$

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

$384 - 375 - M_D = 0$

$9 - M_D = 0$

$\Rightarrow M_D = 9 \text{ KN}\cdot\text{m}$