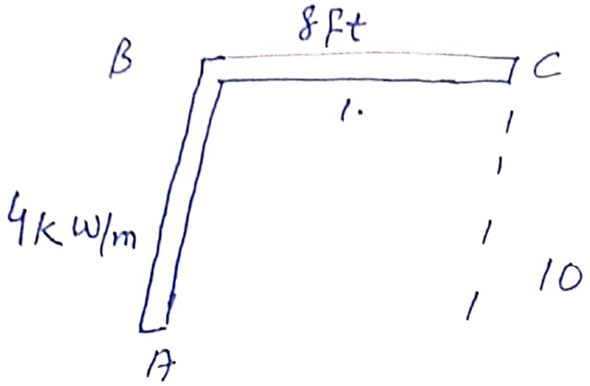
Name = Umair Niaz

ID # 7910

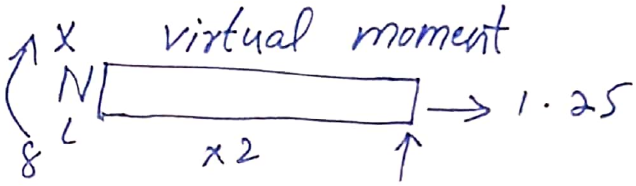
Subject = Structural Analysis - I

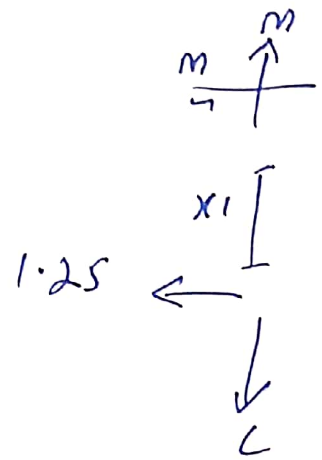
Submitted to = Sir Amjad Islam.

Question No #1 ①



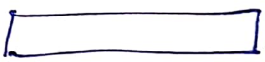
virtual moment



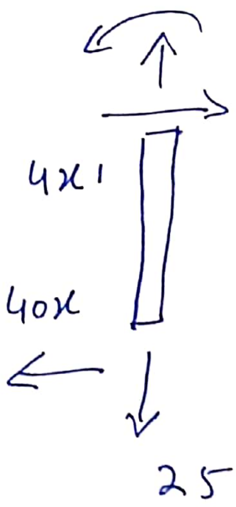


$m_1 = x\,2$

$m_2 = 1.25x$



real moment



$m1 \uparrow 25$

$m_2 = 25x\,2$

$$m^4 = 40x_1 \frac{1}{2x}(x_1)(x_1)$$

$$= 40x\,3 - 2x_1^2$$

Now put virtual work equation

1. $\Delta L = \int_0^l \frac{m M}{E} dx$ ②

$$\Delta L = \int_0^{10} 1x_1 \frac{(40x_2 - 2x^2)}{E} dx$$

$$+ \int_0^8 \frac{(1.25x_2)(25x_2)}{EI} dx$$

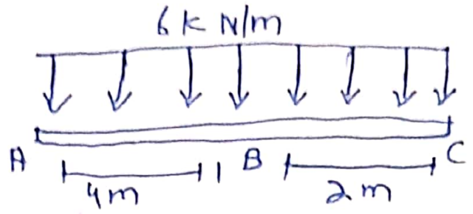
$$\Delta l = \frac{1}{E}\left(\frac{40x^3}{3} - \frac{2x^3}{4}\right)\Big|_0^{16}$$

$$+ \left(\frac{31.25x_2^3}{3}\Big|_0^8\right)\frac{1}{EI}$$

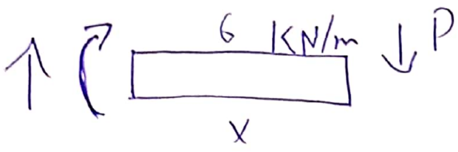
$$\Delta L = 10649.60184$$

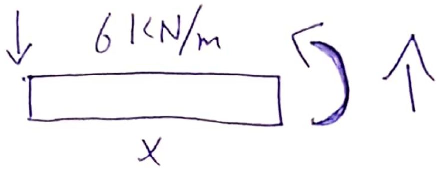
③

Question No #2.



Displacement





$-m - \frac{1}{2}(x)(6x) - Px = 0$ $\quad$ $m + \frac{1}{2}(x)(6x) + Px = 0$

$m = -3x^2 - Px$ $\quad$ $m = -3x - Px$

Partial deiivation

$\frac{\partial m}{\partial P} = -x$ $\quad$ $\frac{\partial m}{\partial P} = -x$

$$\Delta B = \int_0^l m \frac{(\partial m)}{\partial P} \frac{dx}{E}$$

$$= \int_0^6 -3x^2(-x)\frac{dx}{EI} + \int_0^4 -3x^2(-x)\frac{dx}{EI}$$

4

$$\frac{-3x^2}{4EI}\Big|_0^6 + \frac{-3x^4}{4EI}\Big|_0^4$$

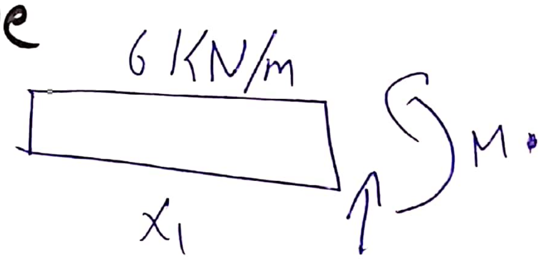
Put value of E.I and displacement.

$$\frac{-3x^2}{4(200)(60000000)}\Big|_0^6 + \frac{-3x^4}{4(200)(60000000)}\Big|_0^4$$

$$= \frac{-216 KN \cdot ft^3}{4.8\times10^{10}} + \frac{-614.4\ KNft^2}{4.8\times10^{10}}$$

$$\Delta P = 5.76\times10^{-10}\ IN.$$

Slope



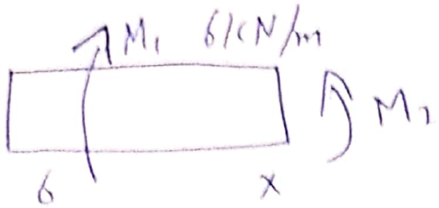
$$M + \frac{1}{2}\times(6x_1) = 0$$

$$M = -\frac{1}{2}\times(6x_1) = -3x^2$$

Now we take partial derivative w.r.t "M"

$$\frac{\partial m_1}{\partial m_1} = 0$$

(5)



$$m_1 - m_2 = -\frac{1}{2}(x_2)(6+x_2)$$

$$m = m' + \frac{6x_2 + x_2^2}{2}$$

$$m = -m' + 3x^3 + x_2^2/2$$

Now we take partial derivative w.r.t "M1"

$$\frac{\partial m_2}{\partial m_1} = -1$$

$$\int_0^l \frac{-3x^2(0)}{EI}\,dx + \int_0^{10} \left(-1 + 6x^2 + \frac{x^3}{2}\right) dx$$

$$0 + \left(-x + \frac{6x^3}{3} + \frac{x^3}{6}\right) \Big|_0^{10} \frac{1}{EI}$$

$$\theta = 4.125 \times 10^{-7} \text{ in}$$

END.

Question No # 3

Given Data:-

W_o = Uniform Load = 400 lb/ft

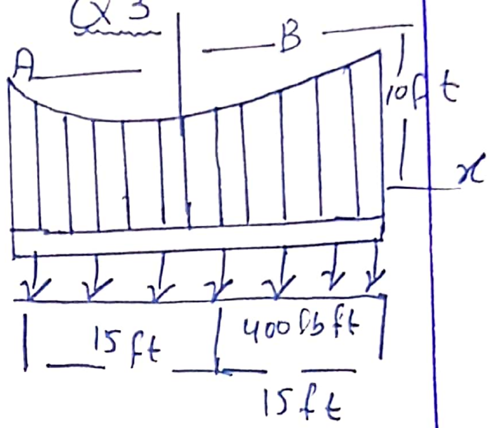
h = 10 ft

L = 15 ft

Required:-

equation of curve and force in cable = ?

SoL:-



We know that

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

putting values in equation

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

$$y = 0.044 x^2$$

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

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

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

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

7

Now "T_{max}" By another equation

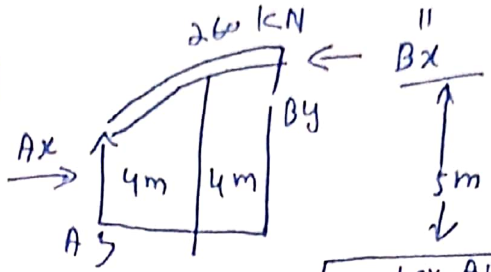
$$T_B = T_{max} = W_0 L \sqrt{1+\left(\frac{L}{2h}\right)^2} = 400 \times 15 \sqrt{1+\left(\frac{15}{2\times 10}\right)^2}$$

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

END

Question No # 4

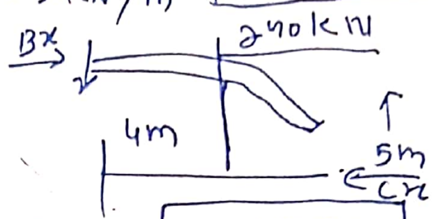
Given Data:-



Uniform load = 30 kN/m

= 30kN/m

member AB



member BC

Required:-

Internal moment at D = ?

at D = ?

8

Sol:-

Dividing into two numbers

AB & BC

AB :-

$$\circlearrowleft + \sum M_A = 0 \qquad B_x(5) + B_y(8) - 240(4) = 0 \quad \text{— (a)}$$

BC :-

$$\circlearrowleft + \sum M_C = 0 \qquad -B_x(5) + B_y(8) + 240(4) = 0 \quad \text{— (b)}$$

Adding eq (a) & (b)

$$\cancel{B_x(5)} + B_y(8) - \cancel{240(4)} = 0$$

$$-\cancel{B_x(5)} + B_y(8) + \cancel{240(4)} = 0$$

$$2B_y(8) = 0$$

$$B_y = 0$$

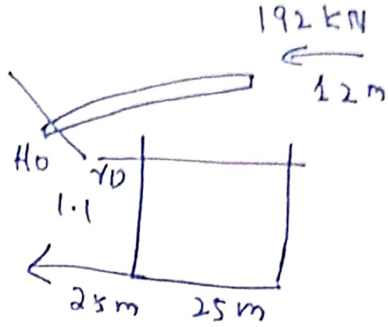
9

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

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

$$Bx(5) = 960$$

$$Bx = \underline{192\,kN}$$



"Now at Segment DB"

$\boxed{\text{Member DB}}$

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

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

$$384 - 375 - M_D = 0$$

$$9 - M_D = 0$$

$$M_D = 9\ kN\cdot m$$

END