SHAH HASSAN.

ID- 7978

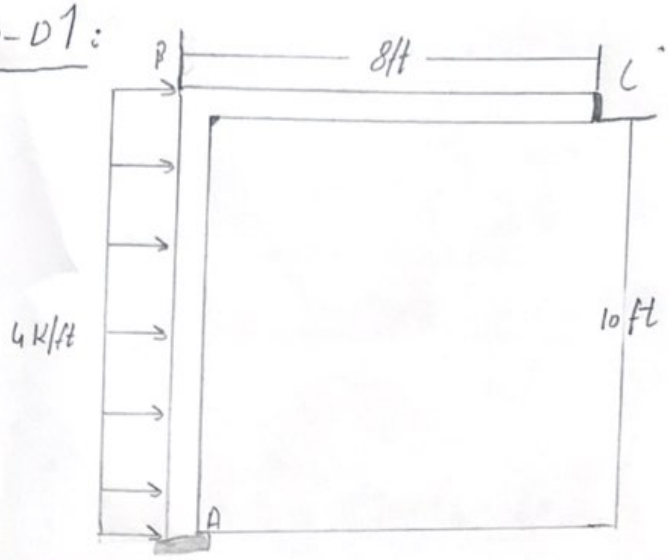
SEC- B

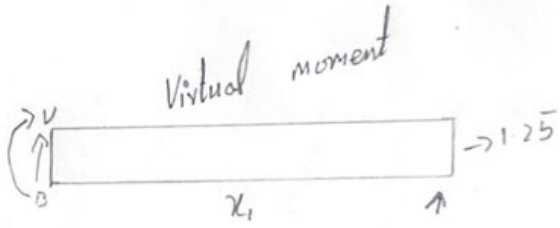
Subject – Structural Analysis-I

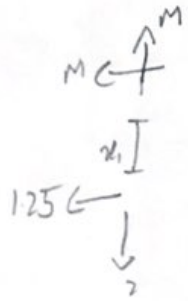
To,

ENGR. Amjad Islam.

Q-No-01:

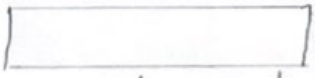




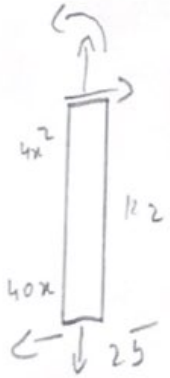


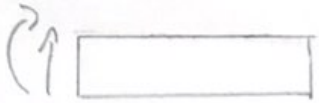
$m_2 = x_2$

$m_2 = 1.25x$



Real moment





$M_1 \curvearrowright 25$

$M_2 = 25 \times 2$

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

Now put virtual work equation

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

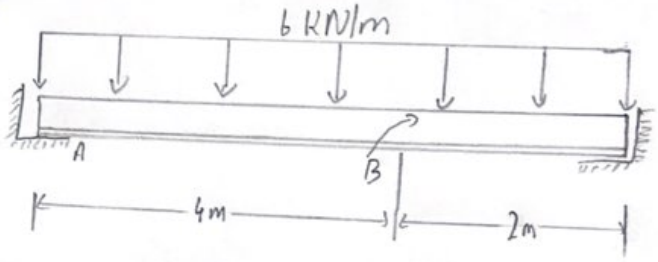
$$\Delta L = \int_0^{10} \frac{(1x_1)(40x_2 - 2x^2)}{\mathcal{E}}\,dx + \int_0^3 \frac{(1.25x_2)(25x_2)\,dx}{EI}$$

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

$$\boxed{\Delta L = 10669.601}$$

Q-No-02

Given



$E = 200\ GPa$

$I = 60 \times 10^6\ mm^4$

Required:

Slope for displacement = ?

Solution:

$$m' - m_2 = \frac{1}{2}(x_2)(6 + x_1)$$

$$m_2' = \frac{-m' + 6x_2 + x_2^2}{2}$$

$$m = -m' + 3x^2 + \frac{x_2^2}{2}$$

taking partial divivative which repeat to m.

$$\frac{2m_2}{2P} = -x$$

$$DB = \int_0^2 m\frac{(2m)}{2P}\frac{dx}{E}$$

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

$$DB = \frac{-3x^2}{4E\bar{I}}\Big|_0^6 + \frac{-3x^4}{4EI}\Big|_0^4$$

Put values of EI & $\bar{I}$

$$= \frac{-3x^2}{2(200)(60\times 10^4)}\Big|_0^6 + \frac{-3x^4}{400(60\times 10^4)}\Big|_0^4$$

$$= \frac{-216\ KNH^3}{4.8NV^6} + \frac{-614.4KN\cdot ft^3}{4.8\times 10^{10}}$$

$$= -4.5\times 10^{-9} + (-1.28\times 10^{-8})$$

$\boxed{DB = 5.76 \times 10^{-10} \text{ inch}}$ displacement

Slope

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

$$m = -\frac{1}{2}(6x_2) = -3x^2$$

So,

$$\frac{2m_1}{2m_1'} = 0$$

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

$$m = -m' + 6x_2 + x_2^2$$

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

$$\frac{2m_2}{2m_1} = -1$$

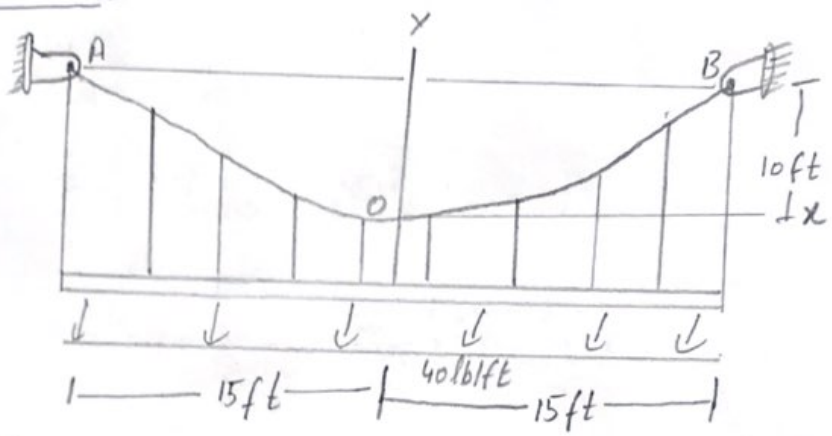
$$= \int_0^6 \frac{-3x^2 \cdot 6 dx}{E \cdot I} + \int_0^{10} (-2 + 6x^2 + \frac{x^2}{2}) dx$$

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

$$= \frac{1}{200(66 \times 10^6)} (-x + \frac{6x^3}{3} + \frac{x^3}{6}) \Big|_0^{10}$$

$$\Rightarrow \boxed{\theta = 4.125 \times 10^{-7} \text{ inch}}$$

Q No-03:



Solution:

We know that

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

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

$$y = 0.0444 x^2$$

from eq of

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

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

$$\boxed{F_H = 4500}$$

From eq of

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

$$T_{max} = \sqrt{[4500]^2 + [100 \times 15]^2}$$

Also from eq

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

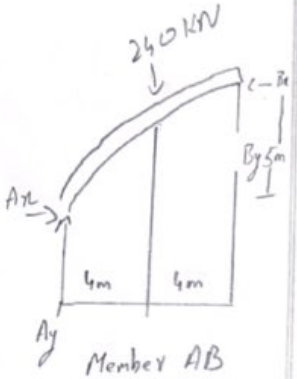
$$T_{max} = \sqrt{400(15)\ 1 + \left(\frac{15}{2(10)}\right)^2}$$

$$\boxed{T_{max} = 7500 lb = 75 K}$$

Q-No-04

Given data:

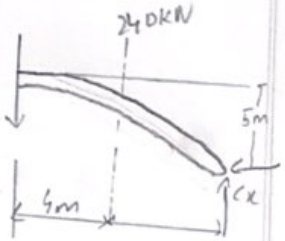
Uniform load = 30KN/m



Member AB

Required:

Internal movement at D = ?



Member BC

Solution:

Dividing into two members

AB & BC

AB

$\circlearrowleft + \Sigma M_A = 0 \quad B_x(5) + B_y(8) - 240(4) = 0 \quad - (a)$

BC

$\circlearrowleft + \Sigma M_C = 0 \quad -B_x(5) + B_y(8) + 240(4) = 0 \quad - (b)$

adding eq (a) & (b)

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

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

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

$$\Rightarrow 2B_y(8) = 0$$

$$B_y = 0 \text{ KN}$$

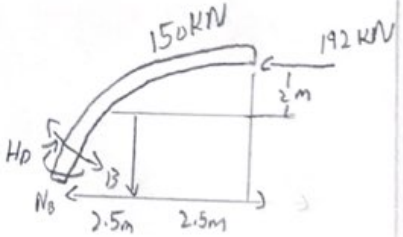
Putting the values of B_y in eq (b)

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

$$B_x(5) = 960$$

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

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



Member DB

Now at segment DB

$$\zeta + \Sigma M_D = 0$$

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

$$384 - 375 - M_D = 0$$

$$9 - M_D = 0$$

$$\boxed{M_D = 9\,kN.m}$$