NAME: ASFANDYAR KHAN
ROLL#: 7399
PAPER: Structure Analysis 1

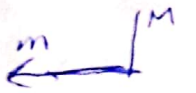
QNO1 :-

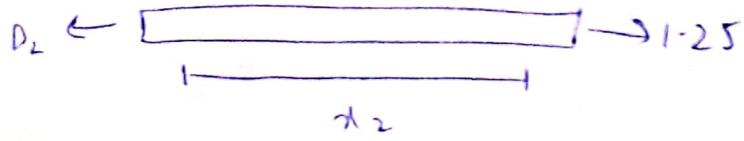
GIVEN DATA :-

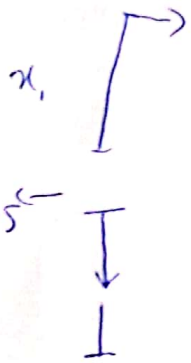
Uniform load = 4k/ft
$E = 29 \times 10^3$ ksi
$I = 600 in^4$

REQUIRED :-
Vertical displacement

SOLUTION :-
Now virtual moment

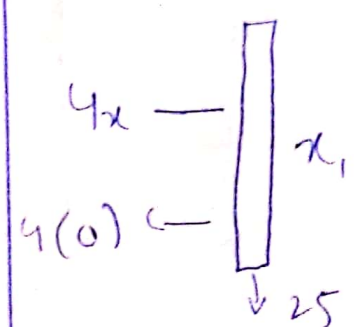


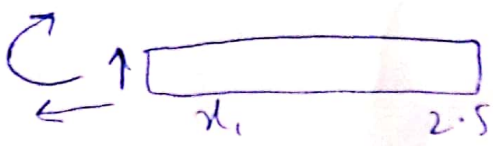




$m_2 = 1.25x$

real moment





$m_2 = 25 x_1$

$$m'' = \frac{40x_1 - \frac{1}{2} Y_1(x_2)}{40x_1 - 2x_1^2}$$

Now by virtual work equation

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

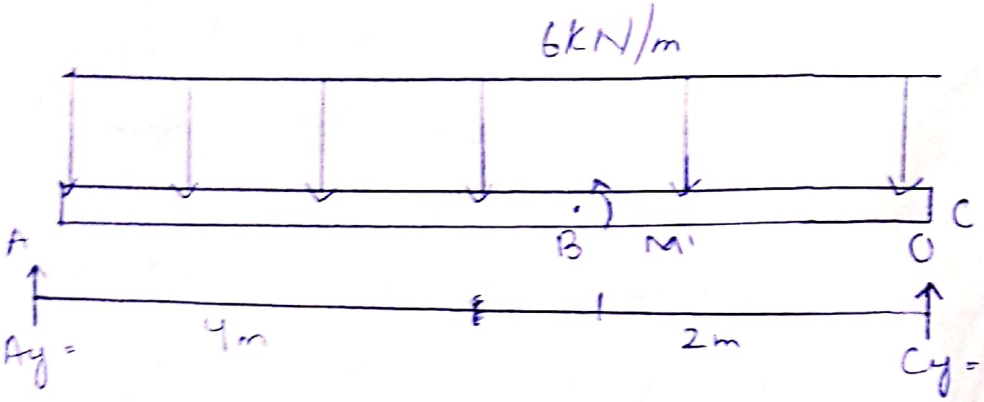
$$\Delta C = \int_0^{10} (1x_1)\left(\frac{40x_2 - 2x^2}{E}\right) dx + \int_0^{7} \frac{(1.25x_2)(25x_2)}{EI} dx$$

$$\Delta C = \frac{1}{EI} \Big/ \frac{42X3}{3} - \frac{2x^3}{4} \int_0^{10} \frac{31.25X x^2}{3} \Big/_0^3$$

$$\Delta C = 10.55\ mm.$$

Q No 2:-

First we find reaction and moment at Section by apply unit moment at point B



First we find reactions using equilibrium method;

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

$$(36 \times 3) - M' - Cy \times 6 = 0$$

$$Cy = \frac{(36 \times 3) - M'}{6}$$

$$Cy = 18 - 0.1667M'$$

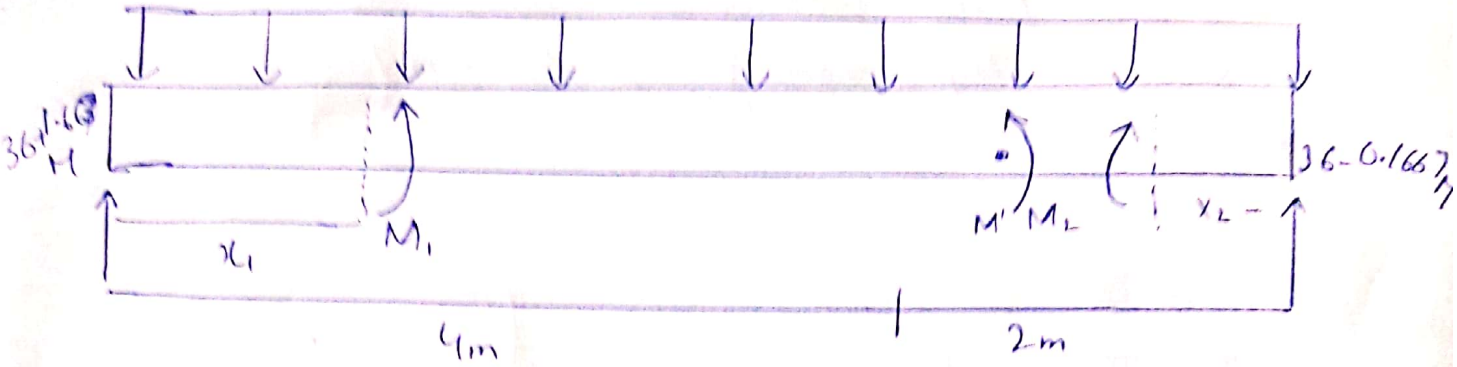
$$\Sigma fy(\uparrow +) = 0$$

$$Ay - 36 + 18 + 18 - 0.1667M' = 0$$

$$Ay = 36 + 0.1667M'$$

PTO →

(4)

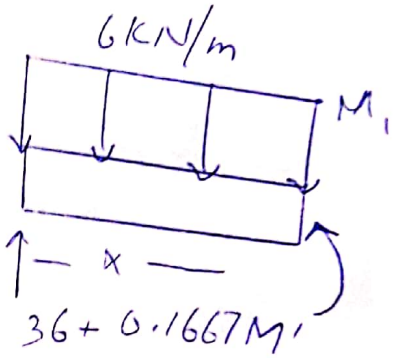


Now we take sections and find moment at that section as:

SECTION 1 : (x_1)

$\Sigma M = 0$ ↻

$-M_1 = (36 + 0.1667M')x_1 - (6x_1)(x_1/2) = 0$



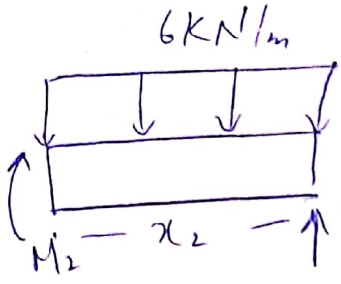
$M_1 = (36 + 0.1667M')x_1 - 3x_1^2$

SECTION 2 : (x_2)

$\Sigma M = 0$ ↻

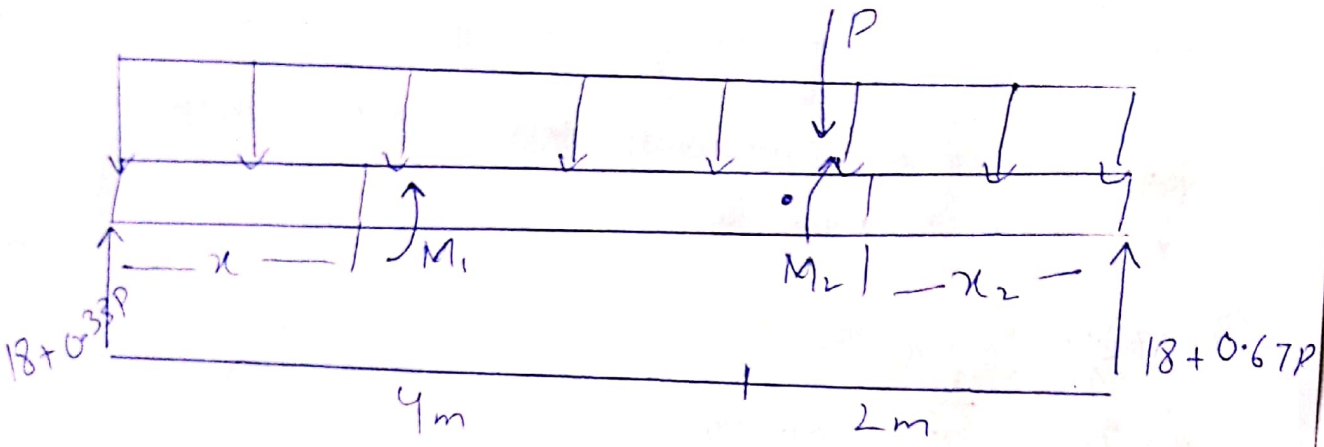
$M_2 + 3x_2 - (36 - 0.1667M')x_2 = 0$

$M_2 = (36 - 0.1667M')x_2 - 3x_2$



PTO →

Now we find reactions and moment at section by apply unit load (P) at point B



REACTIONS:-

$$Ay = 36\left(\frac{7}{6}\right) + \left(P\left(\frac{2}{6}\right)\right)$$

$$Ay = 18 + 0.33P$$

$$Cy = 36\left(\frac{7}{6}\right) + P\left(\frac{4}{6}\right)$$

$$Cy = 18 + 0.67P$$

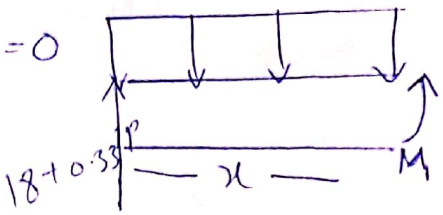
Now we find moment of sections as;

SECTION 1(x_1):-

$\Sigma M = 0$ +↙

$$(18 + 0.33P)\,x_1 - M_1 - (6x_1)(x_1/2) = 0$$

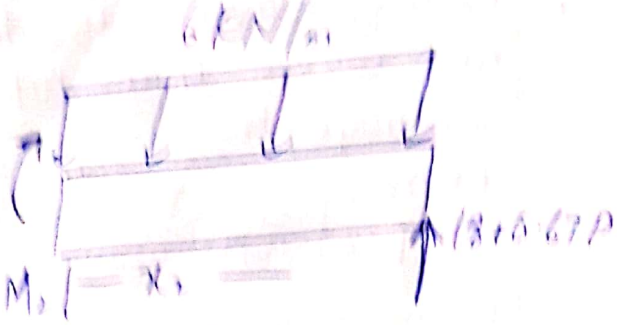
$$M_1 = (18 + 0.33P)x_1 - 3x_1^2$$



SECTION 2(x_2) :-

$\Sigma M = 0 \; +\circlearrowleft$

$M_2 = (18 + 0.67P)\, x_2 - 3x_2^2$



FOR SLOPE :

$\frac{2M_1}{2M'} = 0.1667 x_1$

$\frac{2M_2}{2M'} = 0.1667 x_2$

By taking derivative of eq (1) and (2) w.r.t M' we get

Also put $M' = 0$ in eq (1) and (2)

$M_1 = (36x_1 - 3x_1^2)$ kN·m

$M_2 = (36x_2 - 3x_2^2)$ kN·m

$$\theta_B = \int_0 M \left(\frac{2M}{2M'}\right) \frac{dx}{EI}$$

$$= \int_0^4 \frac{(36x_1 - 3x_1^2)(0.1667x_1)}{EI}\, dx_1 + \int_0^2 \frac{(36x_2 - 3x_2^2)(0.1667x_2)}{EI}\, dx_2$$

= Put in calculator directly.

For DISPLACEMENT:-

Taking derivative of eqn (3) and (4) w.r.t P.

$$\frac{\partial M_1}{\partial P} = 0.33x_1$$

$$\frac{\partial M_2}{\partial P} = 0.67x_2$$

Also put $P = 0$ in eqn (3) and (4)

$$M_1 = (18x_1 - 3x_1^2)$$

$$M_2 = (18x_2 - 3x_2^2).$$

Q 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 = ?

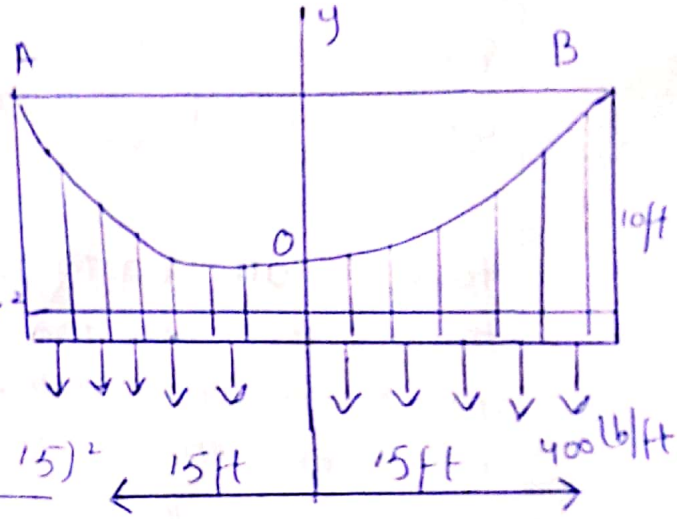
SOLUTION:-

We know that

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

Putting the values

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



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

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

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

$$T_{max} = 7500 \text{ Lb} = 7.5 \text{ K}$$

Now T_{max} by another equation

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

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

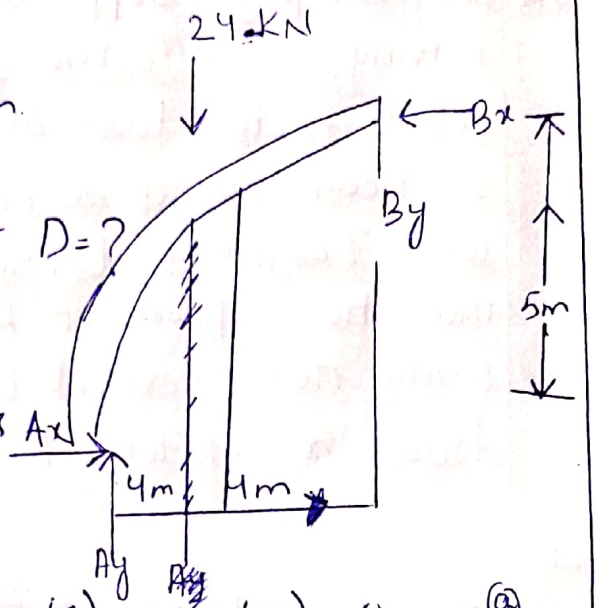
QNo 4:-

GIVEN DATA :-

Uniform load = 30 KN/m

REQUIRED :-

Internal moment at D = ?



SOLUTION :-

Dividing into members AB and BC

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

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

Adding eq (a) and (b)

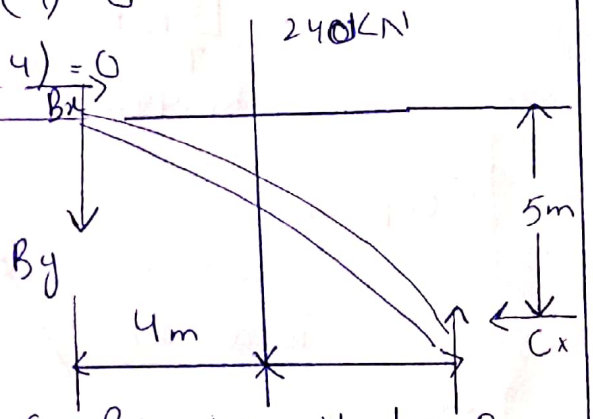
$B_x(5) + B_y(8) - 240(4) = 0$

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

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

$2B_y(5) = 0$

$\Rightarrow B_y = 0$ KN



Putting the value of By in Member BC

eq (b).

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

eq b $\Rightarrow -B_x(5) = 960$

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

$B_x = 192$ KN

Now at segment DB

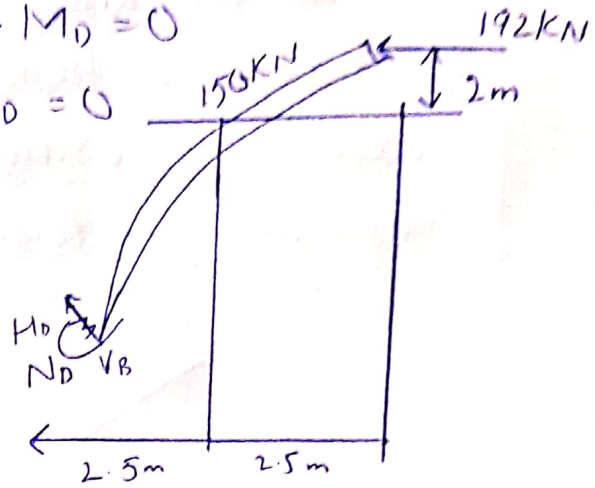
$\circlearrowleft + \Sigma M_D = 0$

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

$384 - 375 - M_D = 0$

$9 - M_D = 0$

$\Rightarrow M_D = 9\,KN\,m$



Member DB.