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subject # Structural Analysis

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Q n.o 3

$$Y = \frac{h}{L^2} x^2 = \frac{8}{(15)^2} x^2$$

$$Y = 0.0356x^2 \quad \text{Ans}$$

Now we know that

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

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

$$= 4500 \, lb = 4.500k \quad \text{Ans}$$

Now

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

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

$$= 7500 lb = 7.50k \quad \text{Ans}$$

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

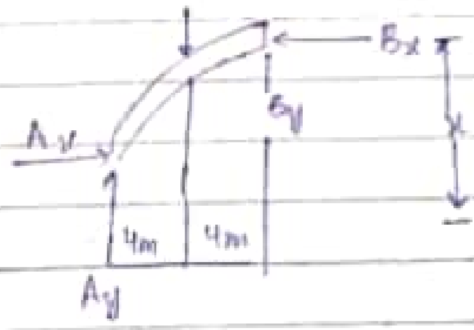
$= (400)(15)\sqrt{1+\left(\frac{15}{2(10)}\right)^2}$

$= 7500 lb = 7.500 k$ Ans

Q:4

Given data

uniform load = 30 kN/m

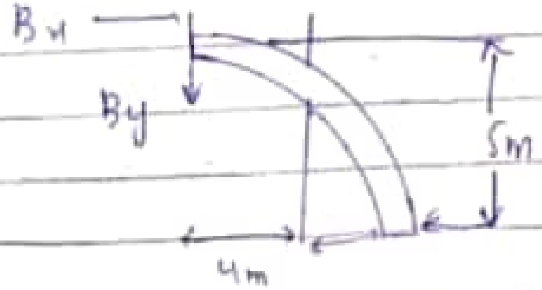


Req :-

Internal moment at D = ?

Sol :-

Dividing into AB and BC members



member BC

AB

$\circlearrowleft + \sum M_A = 0$

$-B_x(5) + B_y(8) + 240(4) = 0$ — (a)

<u>BC</u>

$\curvearrowright + \Sigma M_c = 0$

$-B_x(5) + B_y(8) + 240(4) = 0$ — (b)

adding (a) & (b)

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

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

$0 + 2B_y(8) = 0$

$\boxed{B_y = 0}$

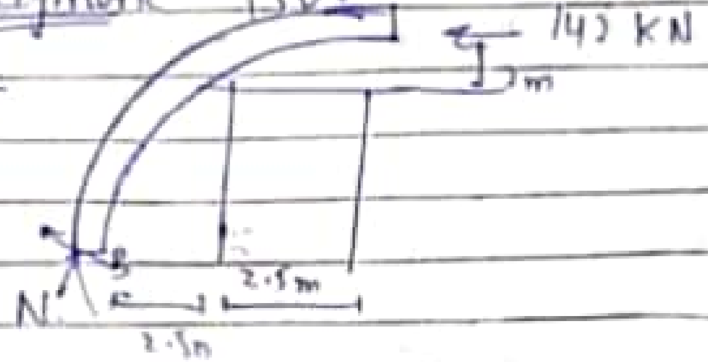
Putting the value of By in eq "b"

eq "b" $-B_x(5) + 0(8) + 960 = 0$

$B_x(5) = 960$

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

<u>Now segment</u> <u>DB</u>



Member DB

$\Sigma M_D = 0$

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

$384 - 375 - M_D = 0$

$9 - M_D = 0$

$M_D = 9 \, kN \cdot m$

Qno 2:-

Given data:

uniform load = 4 k/ft

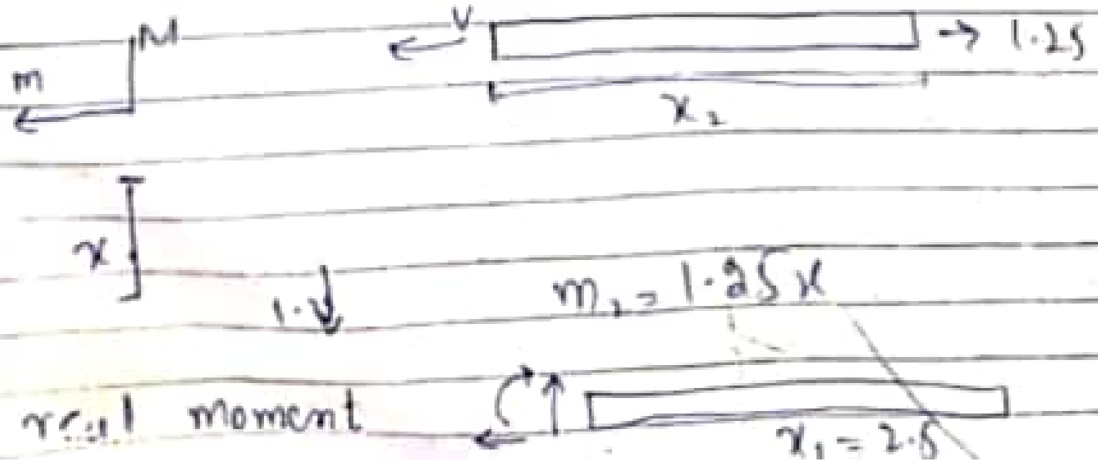
$E = 29.29 \times 10^3$ ksi

$I = 600 \, in^4$

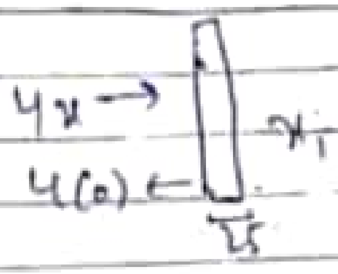
Required

virtual displacement = ?

Sol:- Now virtual movement



$m_2 = 25 x_1$



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

$40x_1 - 2x_1^2$

Now by virtual work equation

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

$$\Delta L = \int_0^{10} 1(x_1)\left(\frac{40x_1 - 2x^2}{\varepsilon}\right) dx + \int_0^8 (1.2502)(2.5x_1) d$$

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

$\boxed{\Delta L = 10.6496018 4}$

Q : 02

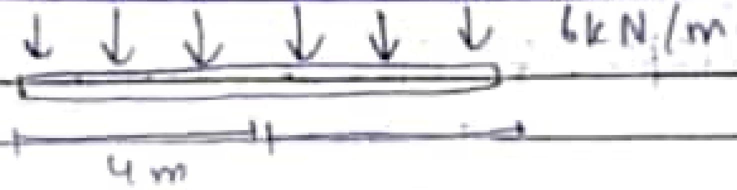
Given that

$E = 200 \text{ GPa}$

$I = 60 \times 10^6 \text{ mm}^4$

Scanned with CamScanner

(6)



Req:-

Slope and displacement = ?

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

$m' = -m' + \frac{6x_1 + x^2}{2}$

$m = -m' + 3x^2 + \frac{x_1^2}{2}$

taking partial derivative w.r.t m

$\frac{\partial m_1}{\partial p} = -x$

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

$\int_0^6 \frac{-3x^2(-x)\,dx}{EI} + \int_6^4 \frac{-3x^2(-x)\,dx}{EI}$

$DB = \left\{ \frac{-3x^2}{4EI} \Big|_0^6 + \frac{-3x^4}{4EI} \Big|_0^4 \right.$

Putting value of EI & I

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

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

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

Slope :-

$$m + \frac{1}{2} x (6x_1) = 0$$

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

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

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

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

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

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

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

$$= 0 + \left(-x + \frac{6x^2}{3} + \frac{x^3}{6}\right)\Big|_0^{10} \left(\frac{1}{EI}\right)$$

$$= \frac{1}{(200)(60 \times 10^6)} \left| -x + \frac{6x^3}{3} + \frac{x^3}{6} \right|_0^{10}$$

Slope = 4.125×10^{-7} Inch