PAPER:
STRUCTURAL ANALYSIS I.

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ID:
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SECTION:
B.

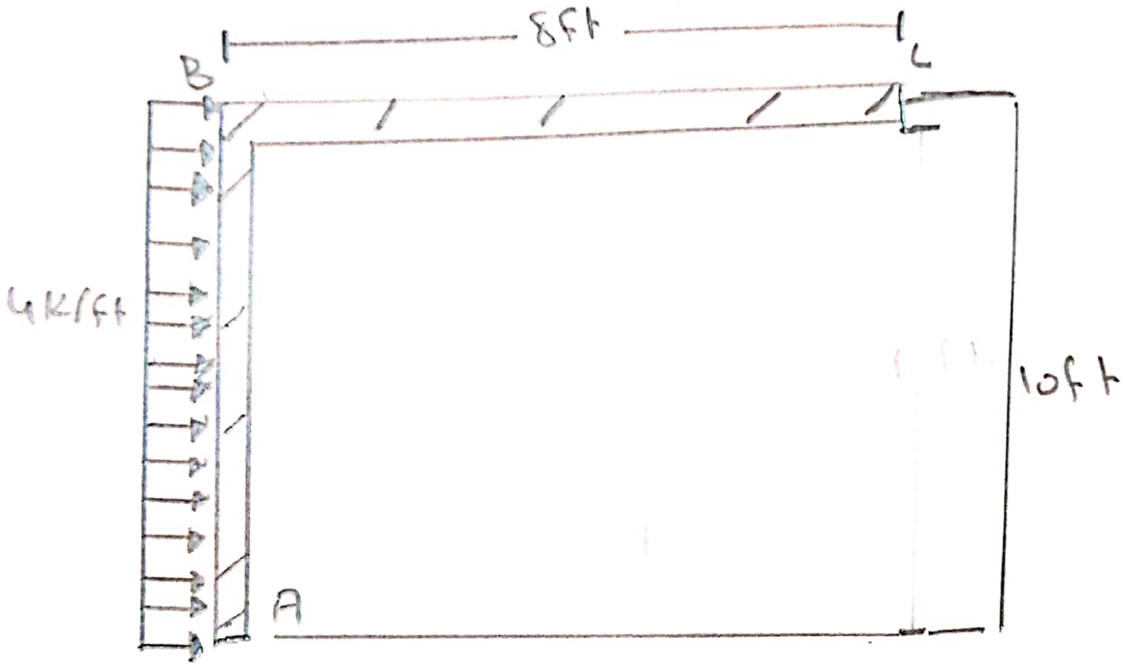
DATE:
26-06-2020.

SUBMITTED TO:
SIR AMJAD ISLAM.

Q NO 1:

Ans Of Q No 1:

GIVEN:



$I = 600\ in^4$

$E = 29(10^3)$

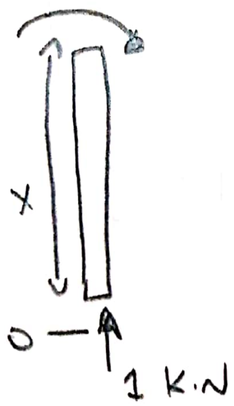
SOLUTION:

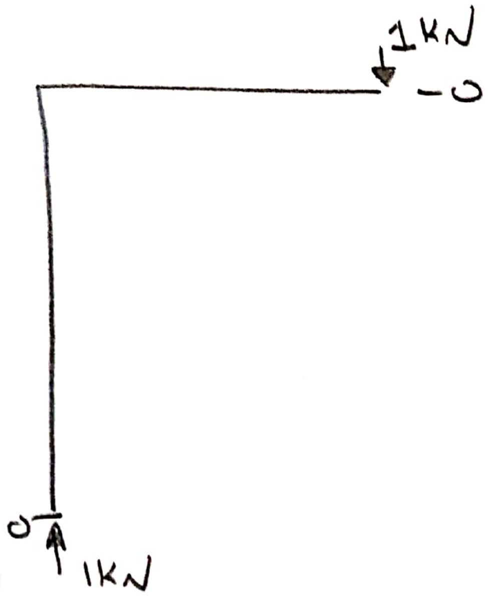
VIRTUAL MOMENTS:

For convinience the coordinates the x_1 and x_2 will be used. A horizantal unit load is applied at C.

$m_2 = x_2$

$m_1 = 0$

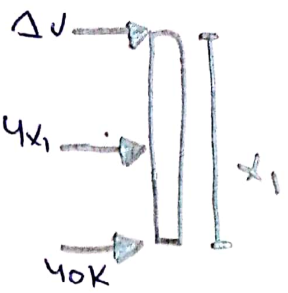


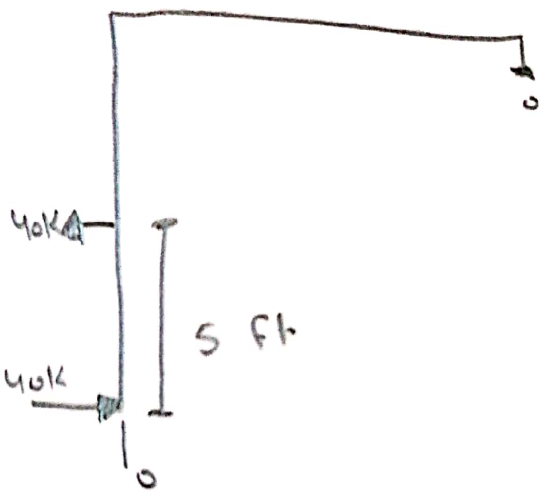


REAL MOMENTS:

$m_2 = 0 \times X_2 = 0$

$M_1 = 40X_1 - 2X_1 2$





Now using virtual work equation.

$$\Delta_c = \int_0^2 \frac{m M}{EI} \, dx$$

$$\Delta_c = \int_0^{10} \frac{m_1 M_1}{EI} \, dx_1 + \int_0^{8} \frac{m_2 M_2}{EI} \, dx_2$$

$$\Delta_c = \int_0^{10} \frac{(0x) + 40x_1 - 2x_1^2)}{EI} \, dx_1$$

$$+ \int_0^{8} \frac{1 X_2 \times (0)}{EI} \, dx^2$$

$$\Delta c = 0 + 0$$

$$\Delta c = 0$$

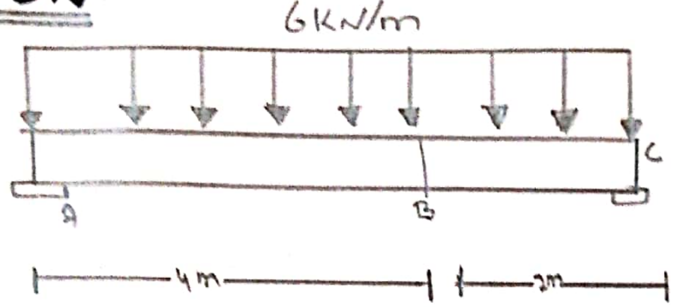
RESULT:

$$\Delta c = 0$$

Q no 2 :

Ans Of Q no 2 :

GIVEN:



E = 200 GPa

I = $60(10)^6 mm^4$

To FIND:

θ = ?

Δ = ? at Point B

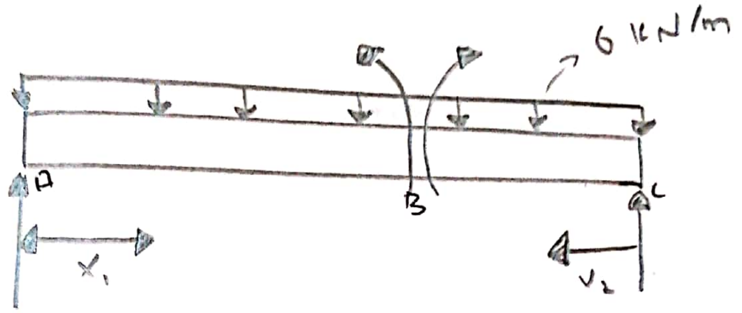
SOLUTION:

EXTERNAL COUPLE MOMENT M':

Since the slope at "B" is to be determined, an external couple M is Placed on the Beam

I at this Point.

INTERNAL MOMENT:



$V_A = 18 + 0.1667M'$ $\qquad$ $V_c = 18 - 0.1667M'$

As $\curvearrowright + M_c = 0$

so $V_A \times 6 (6 \times 6) \times 3 - M' = 0$

$$V_A = \frac{108 + M'}{6}$$

$$V_A = 18 + 0.1667M'$$

Similarly.

$$V_B = 18 - 0.1667M'$$

For X_1:

$$M_1 = (18 + 0.1667M')x_1 - 3x_1^2$$

$$\frac{dM_1}{dM'} = 0.1667x_1$$

For X_2:

$$\Sigma M = 0$$

$$M_2 = (18 - 0.1667M')x_2 - 3x_2^2$$

$$\frac{dM_2}{dM'} = -0.1667x_2$$

For Slope:

$$\theta_B = \int_0^2 M \frac{\partial M}{\partial M'} \frac{dx}{EI}$$

$$\theta_B = \int_0^4 \frac{(18 - 3x_1^2) \times 0.1667x_1}{EI}$$

$$+ \int_0^2 \frac{(18 - 3x_2^2) \times 0.1667x_2}{EI} dx$$

$$\theta_B = \int_0^4 \frac{(3x^2 - 0.5x^3)}{EI} dx$$

$$+ \int_0^2 \frac{(-3x^2 + 0.5x^3)}{EI} dx$$

$$\theta_B = \left(\frac{3x^3}{3} - \frac{0.5x^4}{4} \right|_0^4 + \left| -\frac{3x^3}{3} + \frac{0.5x^4}{4} \right|_4^2$$

$$\theta_B = \frac{32 - 6}{EI}$$

$$\theta_B = \frac{26 \text{ KN/m}^2}{EI}$$

$$\theta_B = \frac{26}{200\times10^6 \times \frac{60\times10^6}{1000^4}}$$

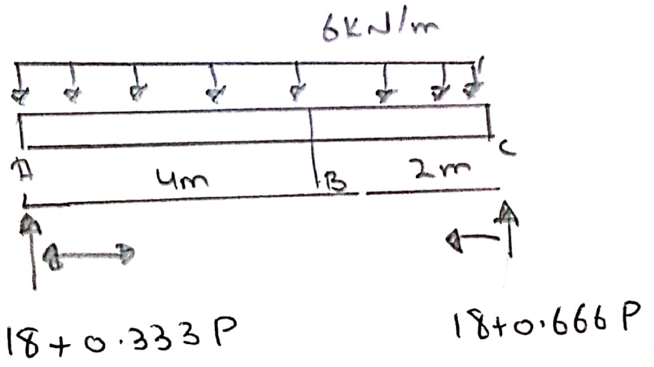
$\theta_B = 0.00216$ rad

For displacement:

External Force:

A vertical force P is placed on the Beam at "B"

Internal Moments:



For X_1:

$$\Sigma M_1 = 0$$

$$M_1 = (18 + 0.333P) \times X_1 - 3X_1^2$$

$$\frac{dM_1}{dP} = 0.33X_1$$

For X_2 :

$$\Sigma M = 0$$

$$M = (18 + 0.6667P)\,x_2 - 3x_2^2$$

$$\frac{dM_2}{dP} = 0.6667x_2$$

set $P = 0$

$$M_1 = 18 - 3x_1^2 \qquad kN\text{-}m^2$$

$$M_2 = 18x_2 - 3x_2^2 \quad kN\text{-}m^2$$

Now For displacement:

$$\Delta_B = \int_0^2 M\left(\frac{dM}{dP}\right)\frac{dx}{EI}$$

$$\Delta_B = \int_0^4 \frac{(18 - 3x_1^2) \times 0.33x_1}{EI}\,dx + \int_0^2 \frac{(18 - 3x_2^2) \times 0.66x_2}{EI}$$

$$\Delta_B = \int_0^4 \frac{5.94x_1^2 - x^3}{EI}\,dx + \int_0^2 \frac{12x_2^2 - 2x_2^3}{EI}\,dx$$

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$$\Delta_B = \left(\frac{5.94x^3}{3} - \frac{x^4}{4} \right|_0^4$$

$$+ \left(\frac{12x^3}{3} - \frac{2x^4}{4} \right|_0^2$$

$$\Delta_B = \frac{62.72 + 24}{EI}$$

$$\Delta_B = \frac{86.72}{EI} \text{ KN.m}^2$$

$$\Delta_B = \frac{86.72}{200\times10^6 \times \frac{60\times10^6}{10^{12}}}$$

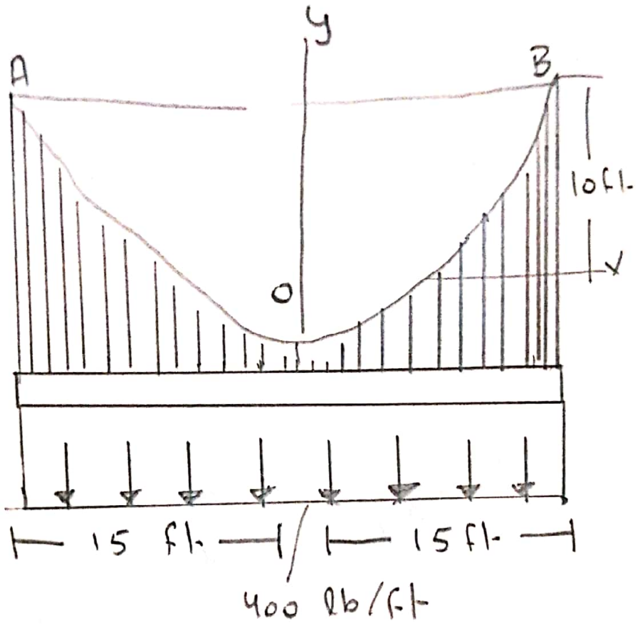
$$\Delta_B = 0.00722 \text{ m}$$

$$\Delta_B = 0.000722 \text{ m}$$

Qno 3:

Ans Of Qno 3:

GIVEN:



SOLUTION:

As we know

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

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

$$y = 0.0444 x^2$$

$$T_o = F_y = \frac{w_o L^2}{2h}$$

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

$T_o = 4500$ lb

$\div$ ing by 1000

$T_o = 4.5$ K

$T_o = 4.5$ K

From eq 5-10 :

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

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

$$'' = \sqrt{2025000 + (400 \times 15)^2}$$

$T_B = T_{max} = 7.5$ K

From eq 5-11 we have.

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

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$$T_B = T_{max} = 400(15)\sqrt{1+\left(\frac{15}{20}\right)^2}$$

$$\text{"} = 6000\sqrt{1+\frac{2\times5}{100}}$$

$$\text{"} = 6000(1.25)$$

$T_B = T_{max} = 7500\,lb$ ÷ing by 1000

$T_B = T_{max} = 7.5K.$

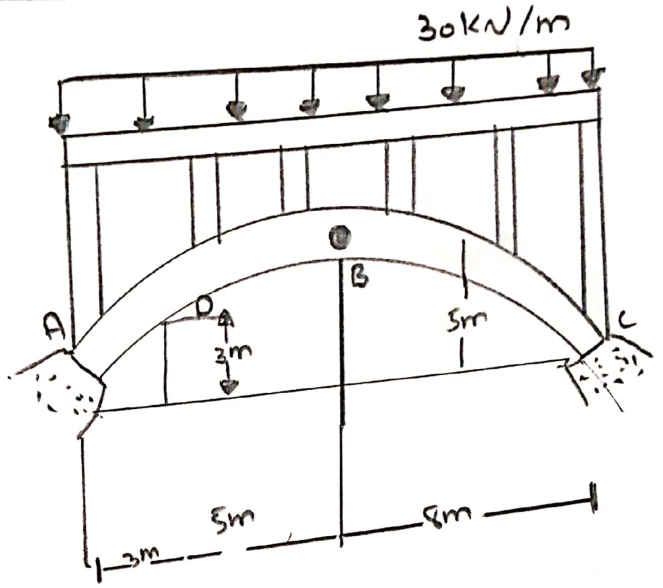
RESULT:

$T_B = T_{max} = 7.5K.$

QNo4 :

Ans Of QNo 4:

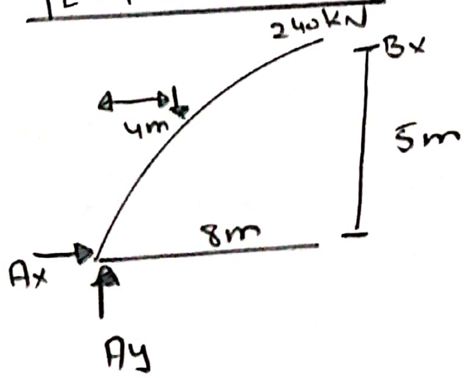
GIVEN:



Uniform load = 30kN/m.

SOLUTION:

MEMBER AB:

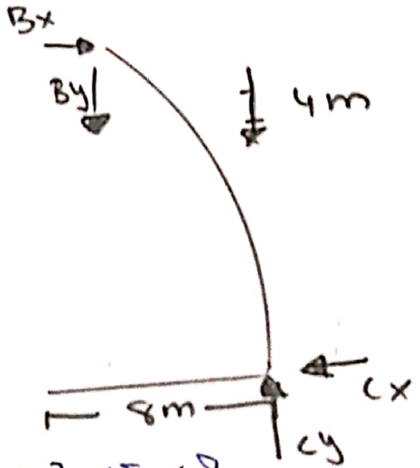


$\circlearrowright^{+} M_A = 0$

$B_x \times 5 + B_y \times 8 - (30 \times 8 \times \frac{8}{2})$

$5B_x + 8B_y = 960 \rightarrow (1)$

MEMBER BC :



$\circlearrowright^{+} \Sigma M_c = 0$

$B_x \times 5 + B_y \times 8 + 3 \times 8 \times \frac{8}{2} = 0$

$-5B_x + 8B_y = -960 \rightarrow (2)$

$-5B_x + 8B_y = -960 \rightarrow (2)$

Subtracting eq (2) from (1)

$5B_x + 8\cancel{B_y} = 960$

$\underset{+}{-} 5B_x \underset{-}{+} 8\cancel{B}y = \mp 960$

$10B_x = 1920$

÷ b.s by 10

$$\frac{10\,Bx}{10} = \frac{1920}{10}$$

$Bx = 192$ kN

$Bx = 192$ kN

From eq 1

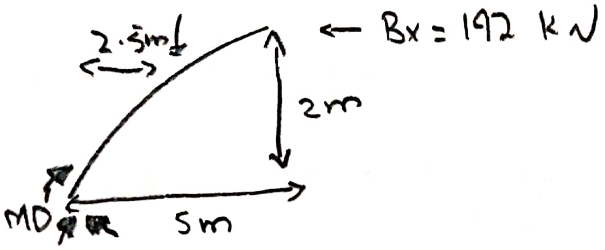
$5(192) + 8By = 960$

$8By = 960 - 960$

$By = 0$ kN

$By = 0$ kN

SEGMENT DB:



$+ M_D = 0$

$-MD + 192 \times 2 - (30 \times 5) \times 2.5$

$MD = +9$ kN-m