ALI HASNAIN TARIQ

SECTION-B (7968)

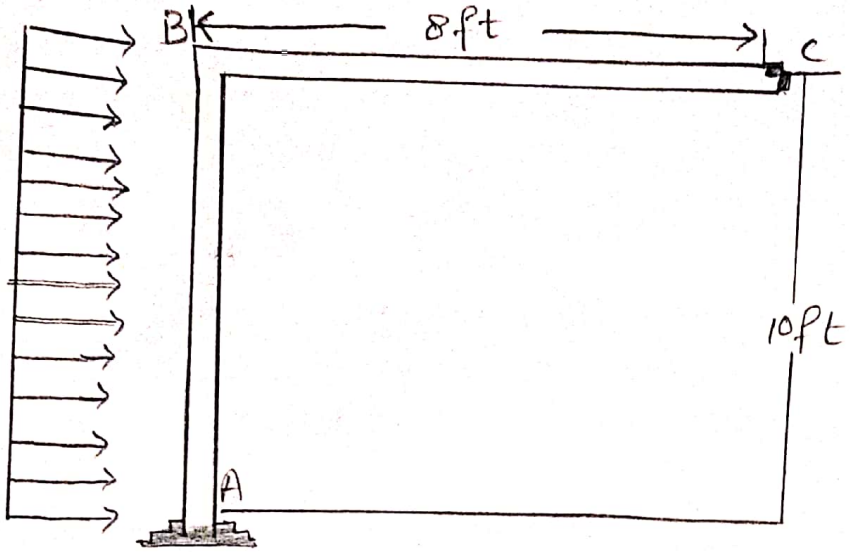
SIR AMJAD ISLAM

FINAL EXAM

CIVIL 4TH SEM

Question:- 01

Answer:



Given data:

$E = 29(10)^3$ ksi

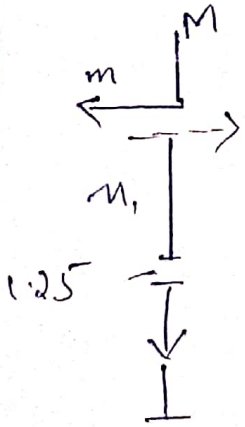
$I = 600^4$.

Required:

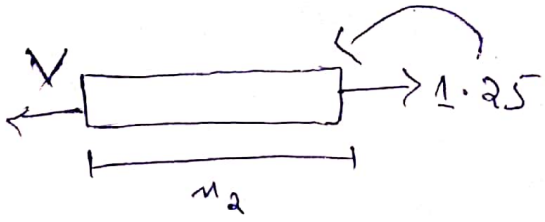
Vertical displacement.

Use virtual work.

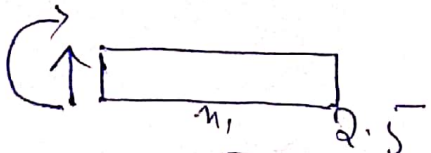
Solution:-



real moment



$m_2 = 1.25x$



$m_2 = 25x_2$

Find reaction

$\circlearrowleft + \Sigma M_A = 0$

$-4(10)(5) + C_y(8) = 0$

$C_y = 25 \text{ kip}$

$\Sigma F_y = 0 \uparrow +$

$25 + A_y = 0$

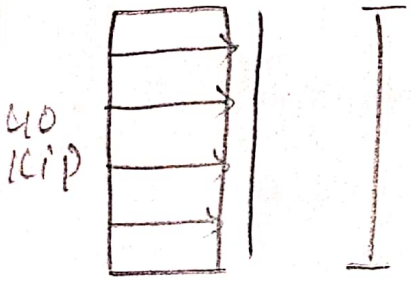
$A_y = -25 \text{ kips}$

$\Sigma F_x = 0 \longrightarrow +$

$40 - A_x = 0$

$\Rightarrow A_x = 40 \text{ k}$

Taking section



Real moment

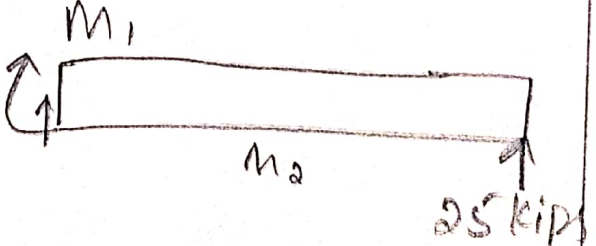
$\circlearrowleft + \Sigma M_1 = 0$

$-40(x_1) + 40x_1\left(\frac{x_2}{2}\right) + C x_1 = 0$

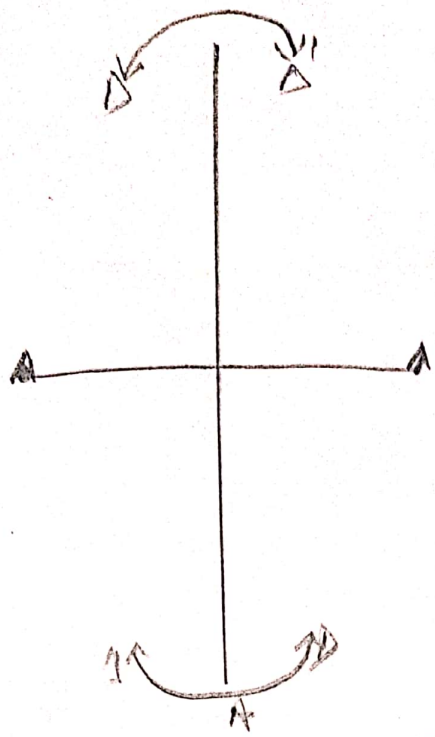
$M_1 = 40x_1 - 20x_1$

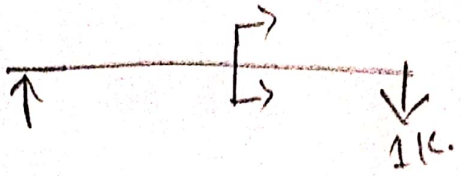
$-25(x_2) + M_2 = 0$

$M_2 = 25x_2 \text{ kips}$



Now





Mem	BA	CB
origin	B	C
Limit	0-10	0-8
M	$2x^2$	0
$\bar{M}$	$\frac{x}{8}$	$\bar{M}_1$

By virtual method:

$$1.D_1 = \int_0^{10} \frac{2x_2(8)\,dx}{EI} + \int_0^8 \frac{(0)(x_2)}{EI}$$

$$= \frac{16x^3}{3}\Big|_0^{10} + 0$$

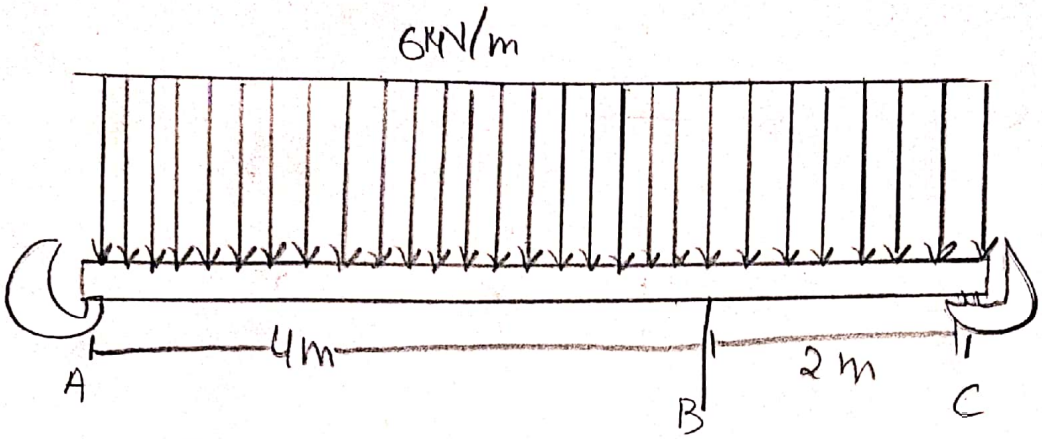
$$= \frac{16\times 1000}{3}\Big|\frac{}{EI}$$

$$= \frac{6333.33}{EI} = \frac{5333.33}{29\times 10^3 \times 600}$$

$$1.D_1 = 3.06\times 10^{-4}\ in$$

Question:- 02

Answer:



Given data:-

$E = 200 GPa$

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

Required:

Slope and displacement at point B

Use Castigliano's theorem.

Solution:-

$R_1 + R_2 = 0$ —①

$\Sigma M_A = 0$ L>t

$-1 + R_2(6) = 0$

-0.16667 put in ①

$R_1 + (-0.1667) = 0$

$R_1 = 0.1667$

$\Rightarrow R_1 + R_2 = 1.$

↳ $+\circlearrowleft \sum M_A = 0$

$-(1)(4) + R_2(6) = 0$

$R_1 = 0.6667\,KN$

$R_2 = 1 - 0.6667\,KN$

$R_2 = 0.3331\,KN$

$\Rightarrow M_1 = (18 + 0.16667M')x_1 - 2x_1^2$

$M_2 = (18 - 0.16667M')x_2 - 2x_2^2$

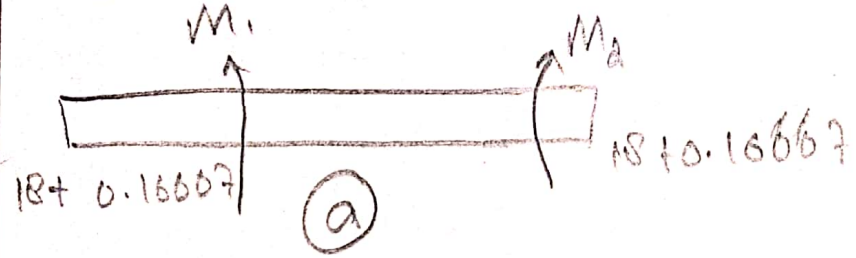
$M_1 = (0.3331P + 18)x_1 - 2x_1^2$

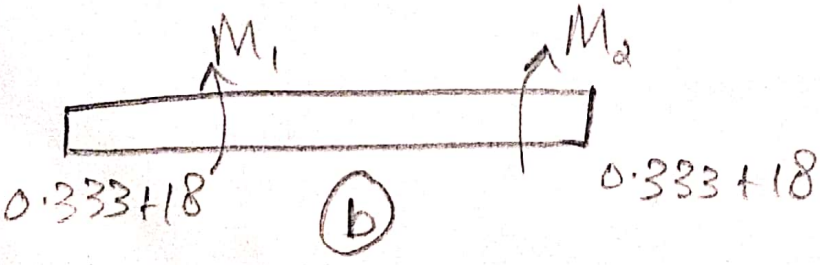
$M_2 = (0.6667P + 18)(x_2 - 2x_1^2)$

The displacement function is show in the figure (a) and (b)

$\frac{\partial M_1}{\partial M_1'} = 0.1667x_1$ & $\frac{\partial M_2}{\partial M'} = 0.1667x_2$

Set $M' = 0$ than





$M_1 = (18 + 0.1667(0))x_1 - 2x_1^2$

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

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

$$\theta B = \int_0^2 m\left(\frac{\partial M}{\partial M_1}\right)\frac{dx}{EI} = \int_0^4 \frac{(18x_1 - 2x_1^2)(0.1667)}{EI}$$

$$+ \int_0^2 \frac{(18x_2 - 2x_2^2)(0.1667x_2)dx_2}{EI}$$

$$\theta B = \frac{42.65}{EI} + \frac{6.66}{EI}$$

$$\theta B = \frac{49.31}{EI}$$

$$\theta B = \frac{49.31}{(200\times10^6\ kpa)(0.00006)}$$

⇒ for the displacement.

$$\frac{\partial M_1}{\partial M_p} = 0.333x_1 \quad \& \quad \frac{\partial M_2}{\partial P} = 0.6007x_2$$

also set $p = 0$

Then $M_1 = (18x_1 - 2x_1)\ kN/m$

$M_2 = (18x_2 - 2x_2^2)\ kN/m$

Thus

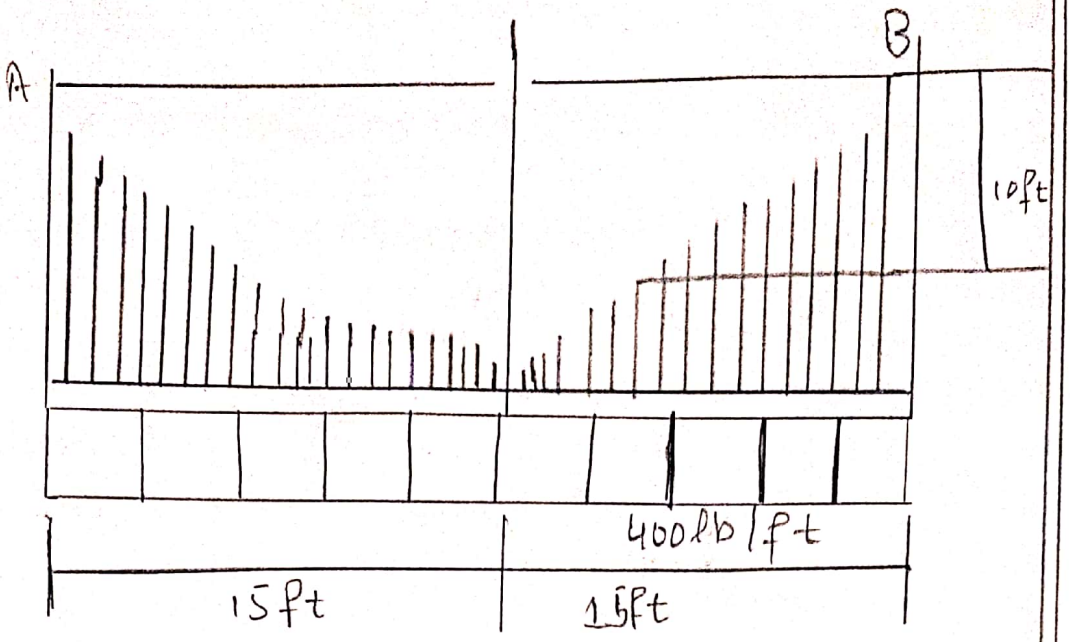
$$\Delta B = \int_0^2 m\left(\frac{\partial M}{\partial P}\right)\frac{dx}{EI}$$

$$\Delta B = \int_0^4 \frac{(30\times x_1 - 2x_1^2)(0.333x_1)dx}{EI}$$

$$\Delta B = \frac{218.5}{EI} \Rightarrow \frac{218.5}{(200\times10^6)(0.00006} \Rightarrow 18mm$$

Ans.

Question no: 03



Solution:

As we know from equation.

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

$$y = \frac{10}{(15)^2} x^2 = 0.0444x^2$$

From eq.

$$T_0 = F_u = \frac{w_0 L^2}{2h}$$

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

$T_0 = 4500\,lb$

÷ing by 1000

$T_0 = 4.5K$

From eq:

$$T_B = T_{max} = \sqrt{F_v^2 + (W_0 L)^2}$$

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

$$= \sqrt{20250000 + (400 \times 15)^2}$$

$$= 7500 \text{ lb.}$$

÷ing by 1000

$$T_B = T_{max} = \frac{7500}{1000} = 7.5 \text{ K.}$$

Also from eq 5.11

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

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

$$= 6000\sqrt{1 + \frac{225}{400}}$$

$$= 6000(1.25)$$

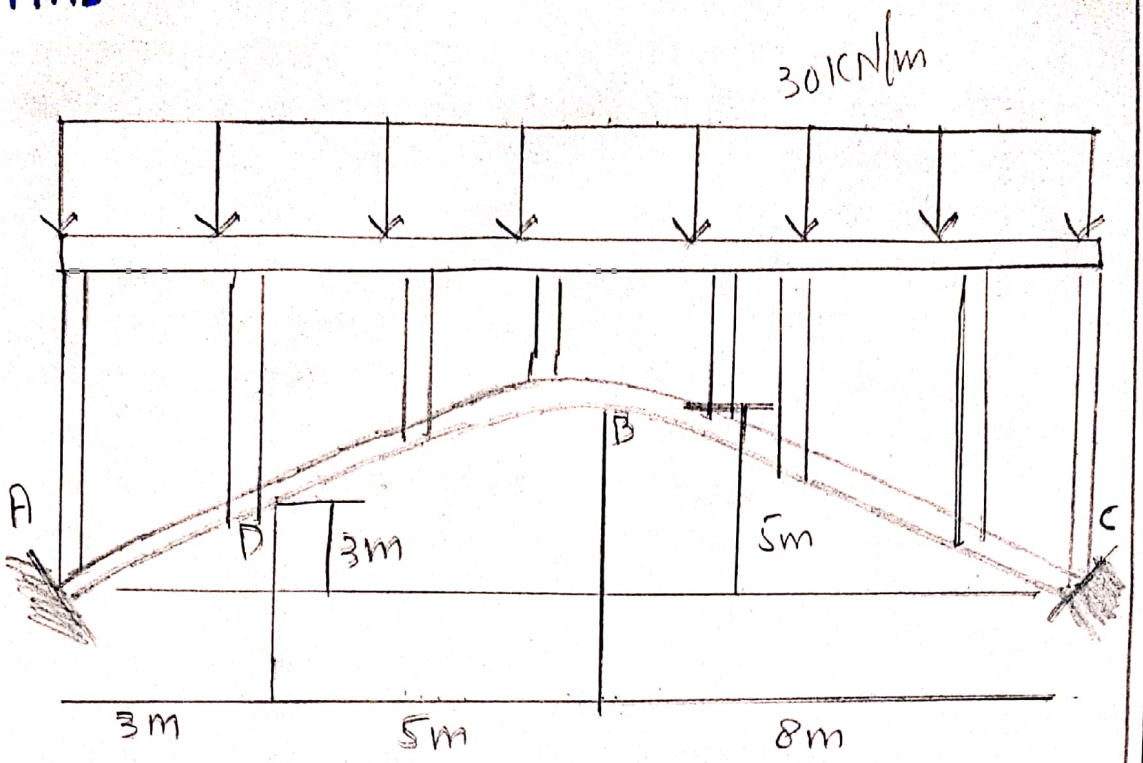
$$= 7500 \text{ lb}$$

÷ing by 1000

$$T_B = T_{max} = \frac{7500}{1000} = 7.5 \text{ kg}$$

Question :- 04

Answer:



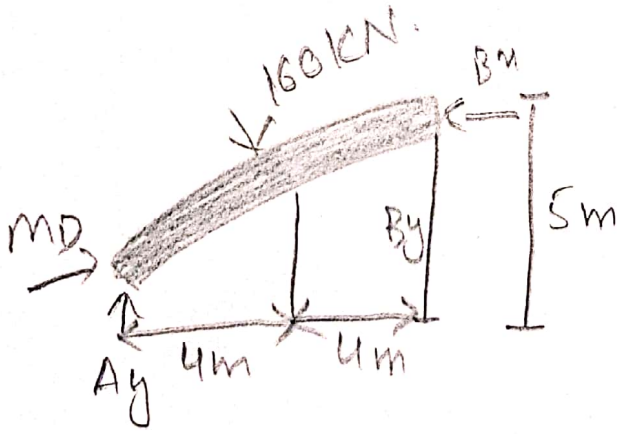
Solution:-

Member AB :-

$\circlearrowright + \Sigma M_A = 0$

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

$5B_x + 8B_y = 960$



Member BC:-

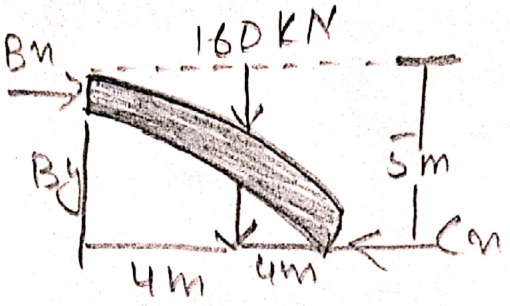
↳ $+M_C = 0$

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

$\Rightarrow -5B_x + 0 + 960$

$\Rightarrow 5B_x = 960$

$B_x = 192$



Member BD:-

↳ $M_D = 0$

$\Rightarrow B_x(2) - (120 \times 25) - M_D = 0$

$\Rightarrow (192 \times 2) - (300) - M_D = 0$

$\Rightarrow 84 - M_D = 0$

$\Rightarrow M_D = 84 KN.m$

Result:-

Hence $M_D = 84 KNm$