HARIS IQBAL
7426 (A)

## => Question # 1

## => Given DATA:

Uniform load = 4k/ft

$E = 29\times10^3$ ksi

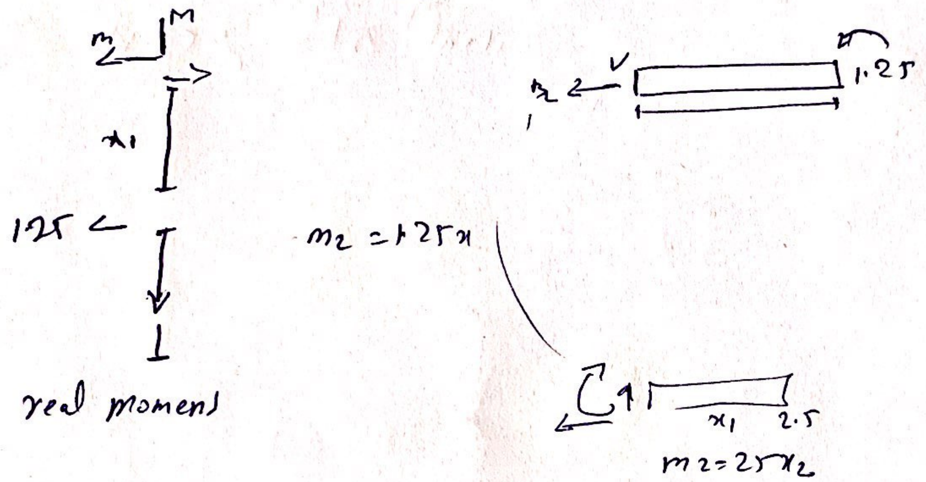
$I = 600 in^4$

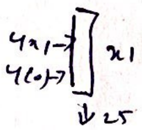
## => Required:

Vertical Displacement.

## => Solution:

Now vertical moment




$$m = 40x_1 - \tfrac{1}{2}x_1(x_2)$$
$$40x_1 - 2x_1^2$$

## => By virtual equations

$$\Delta DC = \int_0^L \frac{m\,M\,dx}{E}$$

$$\Delta L = \int_0^{10} (1x_1)\left(\frac{40x_2 - 2x^2}{E}\right)dx + \int_0^8 \frac{(1.25x_2)(25x_2)\,dx}{EI}$$

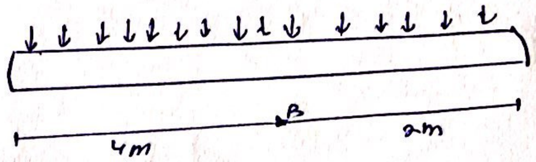
$$\Delta L = \frac{1}{EI}\left|\frac{40x^3}{3} - \frac{2x^3}{4}\right|_0^{10} + \left|\frac{(31.25x^3)}{3}\right|_0^8$$

$$\Delta L = 10649.60184$$

## Question-2

## Solution:

## Given Data:-

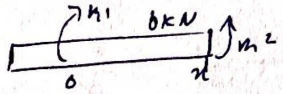



$E = 200\ GPa$

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

## Required:

Slope and displacement = ?




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

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

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

Taking partial derivation with respect to m.

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

$$\Delta B = \int_0^2 m \frac{(\partial m)}{\partial P} \frac{dy}{E}$$

$$= \int_0^6 \frac{-3x^2(-x)\,dx}{E2} + \int_0^4 \frac{-3x^2(-x)\,dx}{EI}$$

$$\Delta B = \frac{-3x^2}{4EI}\Big|_0^6 + \frac{-3x^4}{4EI}\Big|_0^4$$

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⇒ Put the value of EI and I.

$$= \frac{-3x^2}{2(200)(60\times10^6)} \Big|_0^6 + \frac{-3x^4}{400)(60\times10^6)} \Big|_0^7$$

$$= \frac{-216 kN ft^3}{4.8\times10^6} + \frac{-614 kN ft^3}{4.8\times10^{10}}$$

$$= -4.5\times10^{-9} + (-1.28\times10^{-8})$$

$$\boxed{\Delta B = 5.76\times10^{-10} \text{ inch}}$$ Displacment.

⇒ Slope:-

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

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

So $$\frac{\partial m_1}{\partial m_1} = 1$$

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

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

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

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

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

$$= 0 + \left(-x+\frac{6x^3}{3}+\frac{x^3}{6}\right) \int_0^{10} \left(\frac{1}{EI}\right)$$

$$= \frac{1}{200 \times (60\times10^6)} \left(-x+\frac{6x^3}{3}+\frac{x^3}{8}\right) \Big|_0^{10}$$

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

# QUESTION :- 3

## Given DATA:

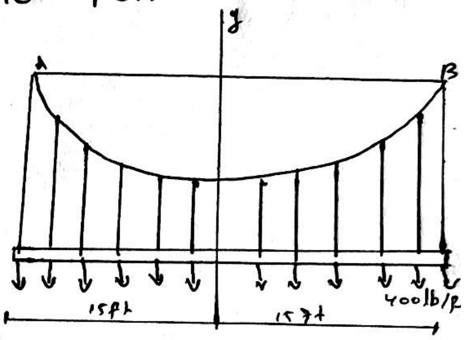
$W_o$ = Uniform load = 400 lb/ft

$h$ = 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 values:

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

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

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

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

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

∴ $T_{max}$ by another equation.

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

$$\boxed{T_{max} = 7500 \text{ lb} = 7.5 k}$$

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## Question# 4

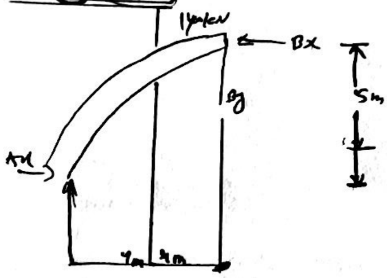
### Given Data

Uniform load $= 30\,kN/m$

### Required

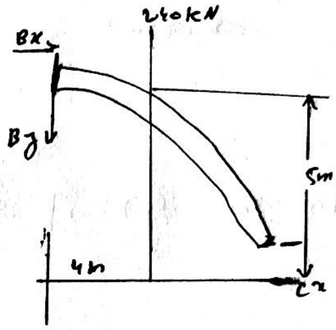
Internal moment at $D = ?$

Fig #1




member AB

Fig #2




### Solution

Dividing into two member

AB and BC

**AB**:

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

**BC**:

$\circlearrowright + \Sigma M_c = 0 \quad - B_x(5) + B_y(8) + 240(4) = 0 \rightarrow$ ⓑ

Adding eq ⓐ and b.

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

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

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

$2B_y(8) = 0$

$\Rightarrow B_y = 0\,kN$

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=> Putting values of "By" in eq (b)

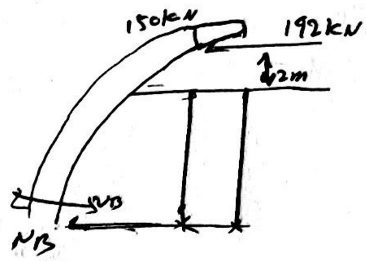
eq (b) => $-Bx(5) + 0(8) + 960 = 0$

$Bx(5) = 960$

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

$Bx = 192KN$

Fig#3




Member DB

=> Segment DB:

$\circlearrowright^{+} \sum M_0 = 0$

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

$384 - 375 - MD = 0$

$9 - MD = 0$

$\Rightarrow MD = 9 KN \cdot M$