STRUCTURAL ANALYSIS FINAL TERM

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SECTION: "A"

SEMESTER: 4th

SUBMITED TO: AMJAD ISLAM

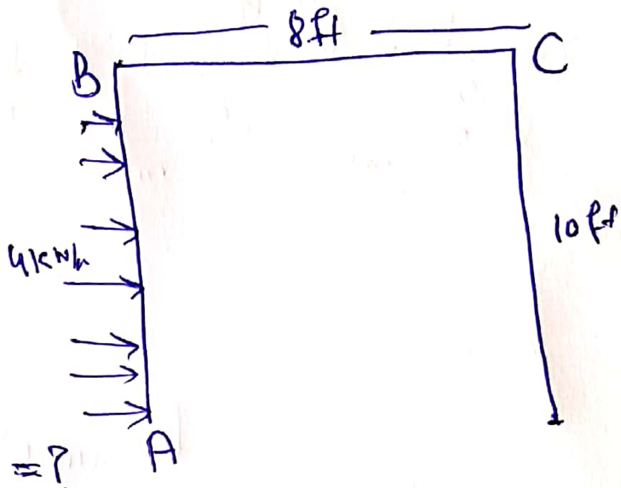
DATE: 26-June-2020

QUESTION #1

GIVEN DATA:

$E = 29 \times 10^3$ Ksi

$I = 600 \ In^4$

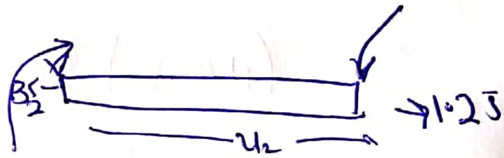


REQUIRED:

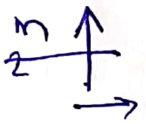
Vertical displacement = ?

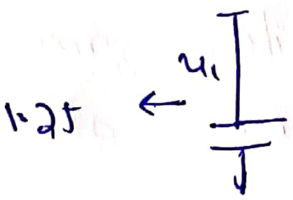
~~Vertual moment~~

SOLUTION:



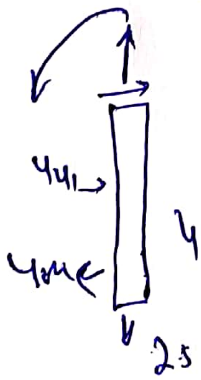
Vertual moment

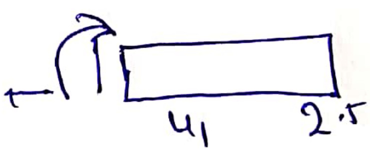




$m_2 = 1.25 u_1$

Real moment:





$m_2 = 2.5 u_2$

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$$m' = \frac{40u_1 - \frac{1}{2} u_1 (u_2)}{40u_1 - 2u_1^2}$$

Now using virtual work

$$1 \cdot \Delta C = \int_0^L m \frac{M}{E} du$$

$$= \int_0^{10} 1u_1 \frac{(40u_2 - 2u^2)}{E} du + \int_0^8 \frac{[1.25u_1 (25u_2)]}{EI} du_2$$

$$\Delta L = \frac{1}{EI} \left(\frac{40u^3}{3} - \frac{2u^3}{4} \right) \Big|_0^{10} + \left(\frac{31.25u_2^3}{3} \right) \Big|_0^8$$

$$\boxed{\Delta L = 10649.6018}$$

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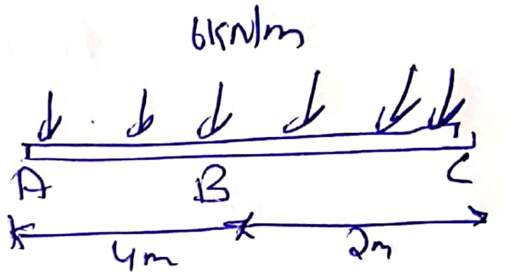
QUESTION #2

GIVEN DATA:

$E = 200 GPa$

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



REQUIRED:

Slope and displacement = ?

SOLUTION:-

Displacement:

$m' - m_2 = \frac{1}{2}(u_2)(6+u_1)$

$m' = -m' + \frac{6u_2 + u_1^2}{2}$

$m = -m' + 3u^2 + u_1^2/2$

Taking partial derivative with respect to m

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

$\Delta B \int_0^2 m \left(\frac{\partial m}{\partial P}\right) \frac{du}{E}$

$= \int_0^6 \frac{-3u^2(-u)\,du}{EI} + \int_0^4 \frac{-3u^2(-u)\,du}{EI}$

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

Put the value of EI and I

$$= \frac{-3u^2}{2(200)(60\times10^6)}\Big|_0^6 + \frac{-3u^4}{(4000)(60\times10^6)}\Big|_0^4$$

$$= \frac{-216\ kN\ ft^3}{4.8\times10^{6}} + \frac{-614.4\ kN\ ft^3}{4.8\times10^{16}}$$

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

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

Slope:

$$m + \frac{1}{2}\times(6u_1) = 0$$

$$m = -\frac{1}{2}x(6u_2) = 3u^2$$

So

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

$$m'_1 - m_2 = \frac{1}{2}(u_2)(6+u_2)$$

$$m = -m' + 6u_2 + u_2^2$$

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

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

$$= \int_0^6 \frac{-3u^2 / 6u}{6 \cdot I} + \int_0^{10} \left(-2 + 6u^2 + \frac{u^2}{2}\right) du$$

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

$$= \frac{1}{(200)(66 \times 10^6)} \left(-u + \frac{6u^3}{3} + \frac{u^3}{6}\right)\Big|_0^{10}$$

$$\boxed{\Delta = 4.125 \times 10^{-7} \text{ inch}}$$

Scanned with CamScanner

QUESTION #3

GIVEN DATA:

w_o = uniform load = 400 lb/ft

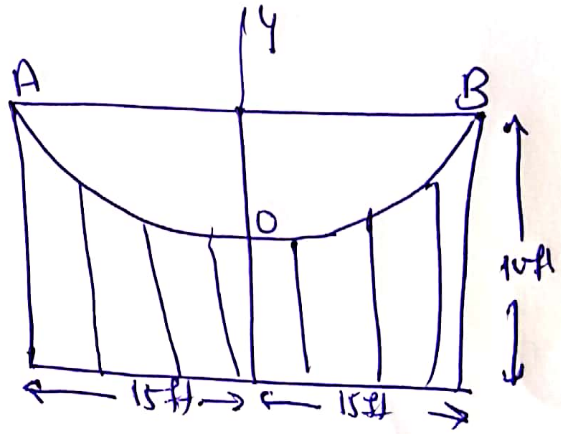
h = height = 10 ft

L = length = 15 ft

REQUIRED:

Equation of curve and forces in cable = ?

SOLUTION:



We know that

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

Putting values

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

$$\boxed{y = 0.044 x^2}$$

$$T_0 = F_H = \frac{wL^2}{2h}$$

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

$$\boxed{T_0 = 4500 \text{ lb} = 4.5 \text{ Klb}}$$

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$$T_B = T_{max} = \sqrt{(H)^2 + (w_0 L)^2}$$

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

$T_{max} = 7500\ lb = 7.5\ klb$

T_{max} by another equation

$$T_B = T_{max} = w_0 L \sqrt{1 + \left(\frac{L}{2h}\right)^2}$$

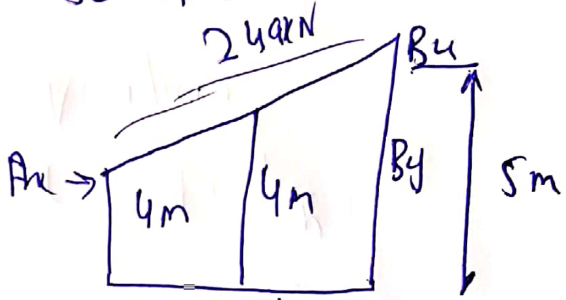
$$= 400 \times 15 \sqrt{1 + \left(\frac{15}{2 \times 10}\right)^2}$$

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

QUESTION #4

GIVEN DATA:

Uniform loading = 30kN/m



REQUIRED:

Internal moment at D=? member AD

SOLUTION:

Divide into two members AB and BC

AB:

$$\circlearrowright + \sum M_A = 0$$

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

BC

$$\circlearrowright + \sum M_C = 0$$

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

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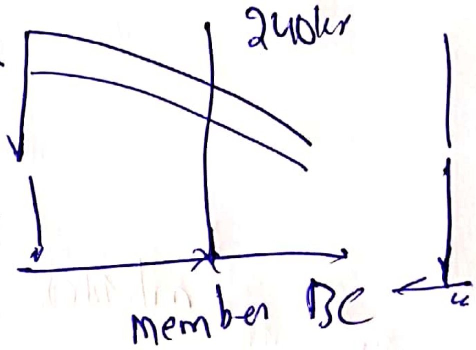
Adding eq a & b



$$Bu(5) + By(8) - 240(4) = 0$$
$$-Bu(5) + By(8) + 240(4) = 0$$

$$+ \quad + 2By(8) + 0 = 0$$

$$2By(8) = 0$$

$$\boxed{By = 0kN}$$

Put this value of By in eq (b).

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

$$Bu(5) = 960$$

$$\boxed{Bu = 192kN}$$

Now at "B"

$$+M_D = 0$$

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

$$384 - 375 - MD = 0$$

$$9 - M_D$$

$$\boxed{M_D = 9kNm}$$

THE END