DTY Tutoring, inc.
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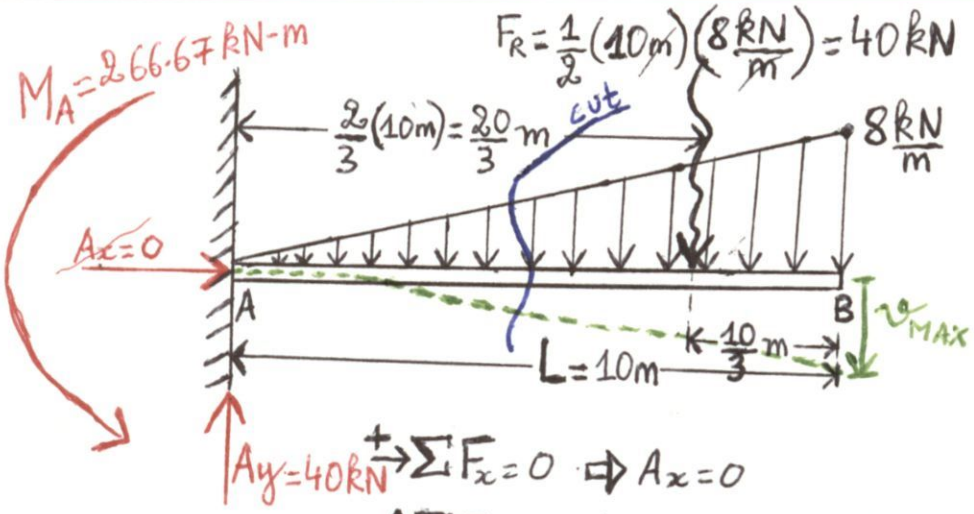
Date: 17th May 2019



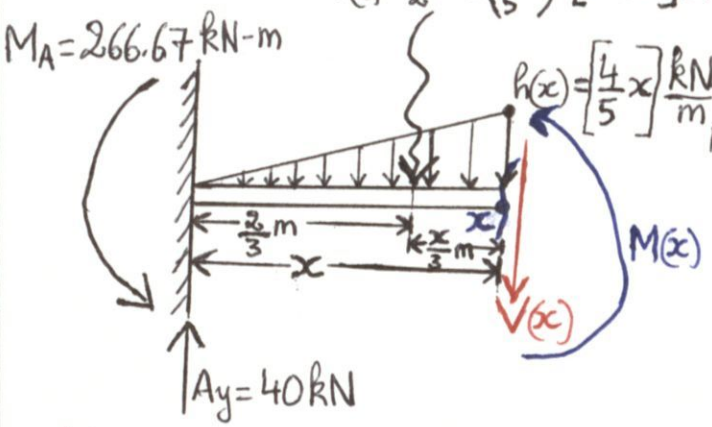
$$\overset{+}{\rightarrow}\sum F_x = 0 \Rightarrow A_x = 0$$

$$+\uparrow \sum F_y = 0 \Rightarrow A_y = F_R = 40kN$$

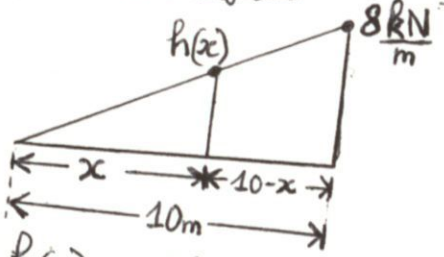
$$+\circlearrowleft \sum M_A = 0 \Rightarrow (-F_R)\left(\frac{20}{3}m\right) + M_A = 0 \Rightarrow M_A = (F_R)\left(\frac{20}{3}m\right) = (40kN)\left(\frac{20}{3}m\right) = \frac{800}{3}kN\text{-}m = 266.67kN\text{-}m$$

FBD Cut

$$F_{R(x)} = \frac{1}{2}(x)\left(\frac{4}{5}x\right) = \left[0.4x^2\right]kN$$



Using Similar triangles



$$\frac{h(x)}{x} = \frac{8\,kN/m}{10m}$$

$$h(x) = \frac{8}{10}x = \left[\frac{4}{5}x\right]\frac{kN}{m}$$

$$+\uparrow \sum F_y = 0 \Rightarrow A_y - F_{R(x)} - V(x) = 0$$

$$V(x) = A_y - F_{R(x)} = \left[40 - \frac{4}{5}x\right]kN$$

$$+\circlearrowleft \sum M_x = 0 \Rightarrow (F_{R(x)})\left(\frac{x}{3}\right) + (-A_y)(x) + M_A + M(x) = 0$$

$$M(x) = (A_y)(x) - (F_{R(x)})\left(\frac{x}{3}\right) - M_A$$

$$= \left[(40)(x) - (0.4x^2)\left(\frac{x}{3}\right) - 266.67\right]kN\text{-}m$$

$$M(x) = \left[40x - \left(\frac{2}{15}\right)x^3 - 266.67\right]kN\text{-}m$$

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Boundary Conditions (BCs)

$v(0) = 0$

$v'(0) = 0$

Solve deflection equation by double integration

$$EI\,v''(x) = M(x) \Rightarrow v''(x) = \frac{M(x)}{EI}$$

$$v''(x) = \frac{\left[40x - \left(\frac{2}{15}\right)x^3 - 266.67\right]}{EI}$$

$$EI\,v'(x) = \int M(x)\,dx = \frac{40}{2}x^2 - \left(\frac{2}{15}\right)\left(\frac{x^4}{4}\right) - (266.67)x + C_1$$

$$= 20x^2 - \frac{x^4}{30} - 266.67x + C_1 \Rightarrow v'(0) = 0 \Rightarrow C_1 = 0$$

Slope Equation ⇒

$$v'(x) = \frac{\left[20x^2 - \frac{x^4}{30} - 266.67x\right]}{EI} = \left[\frac{600x^2 - x^4 - 8{,}000.1x}{30EI}\right]$$

$$EI\,v(x) = \int v'(x)\,dx = \frac{1}{30EI}\int (600x^2 - x^4 - 8{,}000.1x)\,dx$$

$$= \frac{1}{30EI}\left[\frac{600}{3}x^3 - \frac{x^5}{5} - (8{,}000.1)\frac{x^2}{2} + C_2\right] \Rightarrow v(0) = 0 \Rightarrow C_2 = 0$$

$$= \frac{20}{3EI}x^3 - \frac{1}{150EI}x^5 - \frac{133.335}{EI}x^2$$

$$v(x) = \frac{1{,}000x^3 - x^5 - 20{,}000.25x^2}{150EI}$$ ⇒ Deflection Equation

$$v_{MAX} = v(L) = v(10m) = \frac{1{,}000(10)^3 - (10)^5 - 20{,}000.25(10)^2}{150EI} = -\frac{7{,}333.5}{EI}\,m$$ ⇒ Maximum Deflection