DTY TUTORING, inc.
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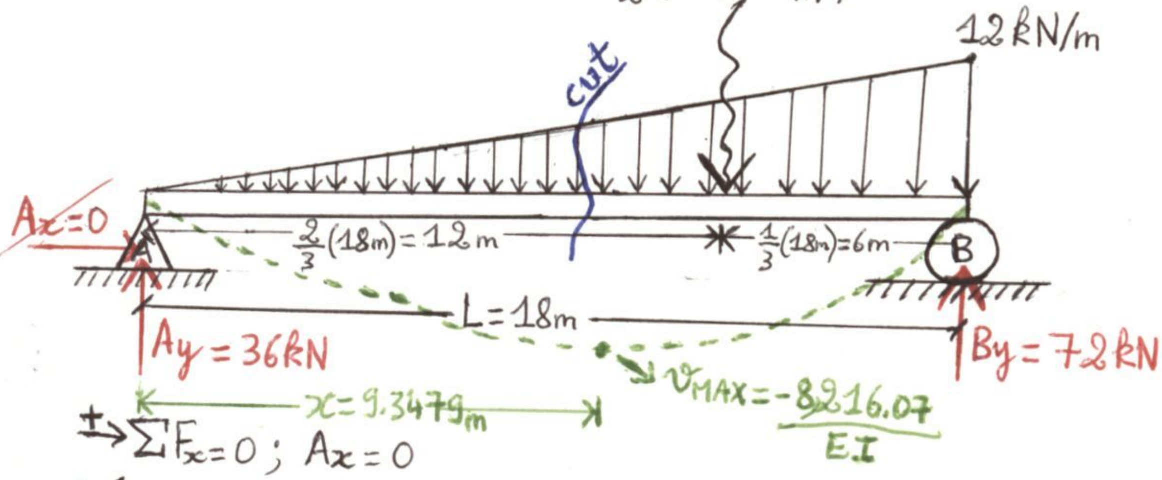
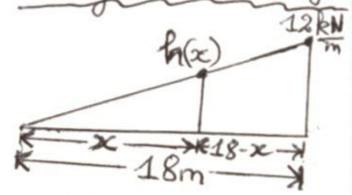
Date: 26th June 2019

$F_R = \frac{1}{2}(18m)\left(12\frac{kN}{m}\right) = 108\,kN$



Using similar triangles



$$\frac{12\frac{kN}{m}}{18m} = \frac{h(x)}{x}$$

$$h(x) = \frac{2}{3}x$$

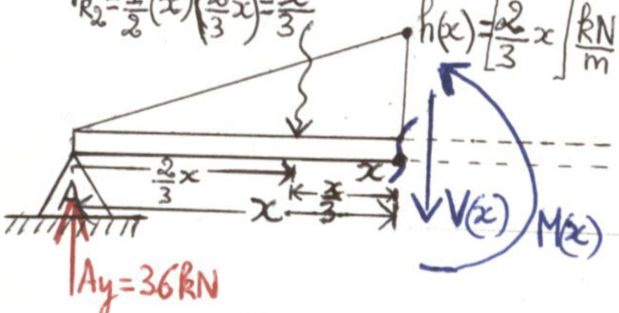
$\xrightarrow{+} \sum F_x = 0;\ A_x = 0$

$+\circlearrowleft \sum M_A = 0;\ (B_y)(18m) - (108kN)(12m) = 0 \Rightarrow B_y = 72\,kN$

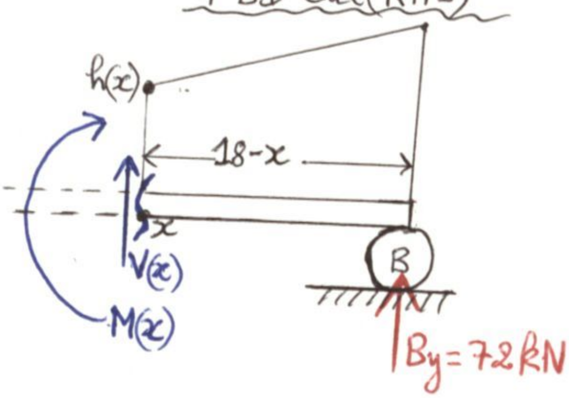
$+\uparrow \sum F_y = 0;\ A_y + B_y = 108\,kN \Rightarrow A_y = (108kN) - (72kN) = 36\,kN$

FBD Cut (LHS)

$F_{R_2} = \frac{1}{2}(x)\left(\frac{2}{3}x\right) = \frac{x^2}{3}$



FBD Cut (RHS)



$\Downarrow$

$+\uparrow \sum F_y = 0;\ (36kN) - V(x) - \frac{x^2}{3} = 0 \Rightarrow V(x) = \left[36 - \frac{x^2}{3}\right] kN$

$+\circlearrowleft \sum M_x = 0;\ \left(\frac{x^2}{3}\right)\left(\frac{x}{3}\right) + (-36kN)(x) + M(x) = 0$

$$M(x) = \left[36x - \frac{x^3}{9}\right] kN\text{-}m$$

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Boundary Conditions (BCs)

$v(0) = 0$

$v(L) = v(18m) = 0$

Solve deflection and slope equations using double integration

$$EI\,v''(x) = M(x) = 36x - \frac{x^3}{9}$$

$$EI\,v'(x) = \int M(x)dx = \int\left(36x - \frac{x^3}{9}\right)dx = 36\left(\frac{x^2}{2}\right) - \left(\frac{1}{9}\right)\left(\frac{x^4}{4}\right) + C_1 = 18x^2 - \frac{x^4}{36} + C_1$$

$$EI\,v(x) = \int v'(x)dx = \int\left(18x^2 - \frac{x^4}{36} + C_1\right)dx = 18\left(\frac{x^3}{3}\right) - \frac{x^5}{36(5)} + C_1x + C_2$$

$$EI\,v(x) = 6x^3 - \frac{x^5}{180} + C_1x + C_2$$

$$v(0) = 0 \Rightarrow EI(0) = 6(0)^3 - \frac{(0)^5}{180} + C_1(0) + C_2 \Rightarrow C_2 = 0$$

$$v(18m) = 0 \Rightarrow EI(0) = 6(18m)^3 - \frac{(18m)^5}{180} + C_1(18m) = 0 \Rightarrow C_1 = -1{,}360.8$$

(a)

$$\boxed{\theta(x) = v'(x) = \frac{648x^2 - x^4 - 48{,}988.8}{36EI}}$$ → Slope Equation

$$\boxed{v(x) = \frac{1{,}080x^3 - x^5 - 244{,}944x}{180EI}}$$ → Deflection Equation

(b)

$$v'(x) = 0 \Rightarrow 36EI(0) = 648x^2 - x^4 - 48{,}988.8 \Rightarrow x = 9.347933202m$$

Location where max deflection occurs

$$v_{MAX} = [v(9.3479m)] = \frac{1{,}080(9.3479m)^3 - (9.3479m)^5 - 244{,}944(9.3479m)}{180EI}$$

$$\boxed{v_{MAX} = -\frac{8{,}216.073742}{EI}}$$ → Maximum Deflection