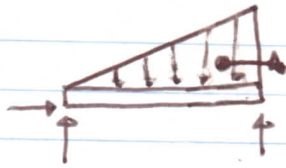
Nov. 7 /16



- From a distributed load, the Force is applied through the centroid. (For triangle, 2/3 From short end)

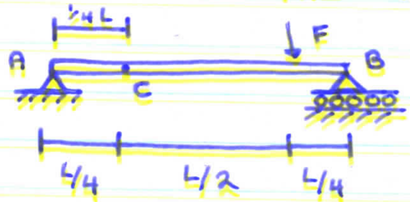
2 - Internal Forces and Moments in Beams

a/ Determine the external forces and moments.

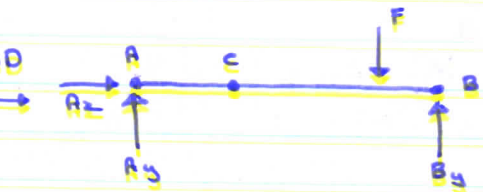
b/ Draw the FBD of part of the beam.

c/ Apply the equilibrium equations.

- Determine the internal forces and moment at C



FBD



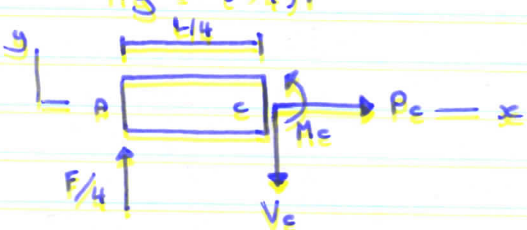
$\Sigma F_x = A_x = 0$

$\Sigma F_y = (3/4)F + A_y - F = 0$

$A_y = (1/4)F$

$\Sigma M_A = LB_y - F(3/4)L = 0$

$B_y = (3/4)F$



(because $A_x = 0$)

$\Sigma F_x = 0 \Rightarrow P_c = 0$

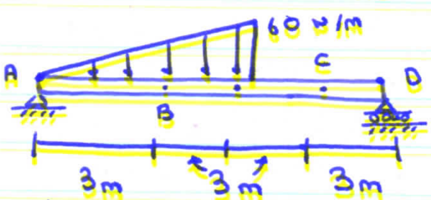
$\Sigma F_y = \frac{1}{4}F - V_c = 0$

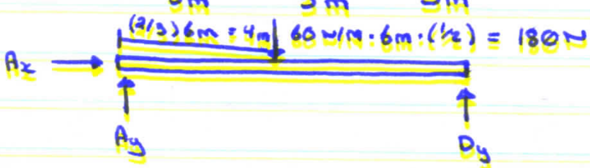
$\therefore V_c = \frac{1}{4}F$

$\Sigma M_c = M_c - (\frac{1}{4})(\frac{F}{4}) = 0$

$M_c = \frac{1}{16}FL$

Determine the internal Forces and moments (a) at a and (b) at C





$\Sigma F_x = A_x = 0$

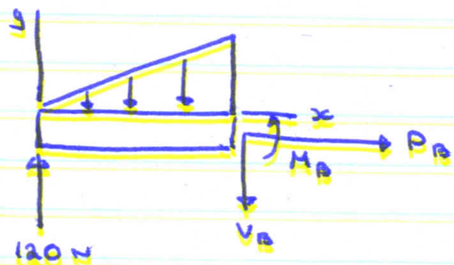
$\Sigma F_y = 0 \Rightarrow A_y + D_y + 180$

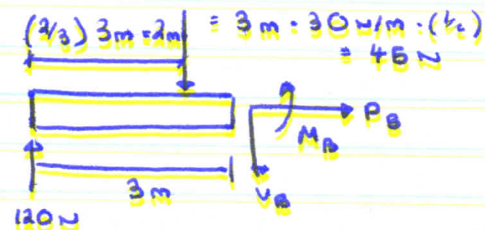
$\Sigma M_A = 0 \Rightarrow 12 D_y - 4(180)$

$A_x = 0$

$A_y = 120N$

$D_y = 60N$

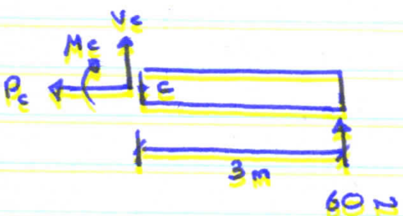




$\Sigma F_x = 0 \Rightarrow P_B = 0$ $\qquad$ $P_B = 0$

$\Sigma F_y = 120\,N - 45\,N - V_B$ $\qquad$ $V_B =$

$\Sigma M_B = M_B + 1 \cdot 45\,N - 3 \cdot 120\,N$ $\qquad$ $M_B =$



$\Sigma F_x = -P_c = 0$

$\Sigma F_y = V_c + 60 = 0$

$\Sigma M_c = -M_c + 3(60) = 0$

$P_c = 0 \qquad V_c = -60\,N \qquad M_c = 180\,N \cdot m$

3 - Shear Force and Bending Moment Diagrams

The shear force and bending moment diagrams are simply the graphs of V and M, respectively, as functions of x. They show the changes in the shear force and bending moment that occur along the beam's length as well as the maximum and minimum value.

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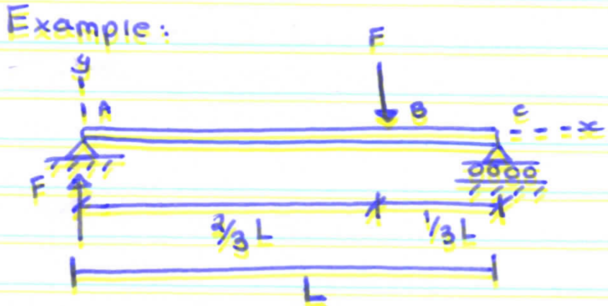
Example:



$+\circlearrowleft \Sigma M_C = 0$

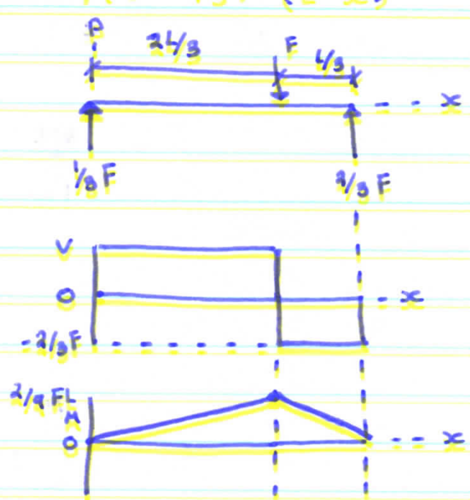
$\frac{1}{3}F = A_y$

$A_y = \frac{1}{3}F \uparrow$

$\therefore C_y = \frac{2}{3}F \uparrow$

$$\left.\begin{aligned} P &= 0 \\ V &= \tfrac{1}{3}F \\ M &= \tfrac{1}{3}Fx \end{aligned}\right\} \quad 0 < x < \tfrac{2}{3}L$$

$$\left.\begin{aligned} P &= 0 \\ V &= -\tfrac{2}{3}F \\ M &= \tfrac{2}{3}F(L-x) \end{aligned}\right\} \quad \tfrac{2}{3}L < x < L$$

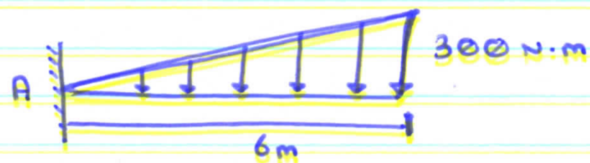


1 - Relations Between Distributed Load, Shear Force, and Bending Moment

$dv/dx = -\omega$

$dM/dx = V$

Determine the shear force and bending moment diagrams for the beam



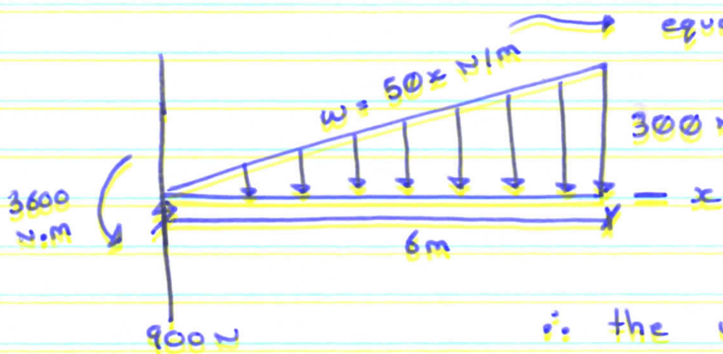
We must first determine the reactions at A

$\Sigma F_y = A_y = \left(\frac{6 \cdot 300 \, N \cdot m}{2}\right)$

$A_y = 900 \, N$

$\Sigma M = M_A = 2/3 \cdot 6\,m \cdot \left(\frac{6\,m \cdot 300 \, N \cdot m}{2}\right)$

$M_A = 3600 \, N \cdot m$ (check)??



equation of line, where $y = mx + b$

$\left(\omega = \frac{300}{6} x + 0\right)$

$(\therefore \omega = 50x)$

$\therefore$ the upward force at A causes a positive of V of 900 N

$$\int_{V_A}^{V} dv = \int_0^x -\omega \, dx = \int_0^x -50x \, dx$$

$V = V_A - 25x^2 = 900 - 25x^2$

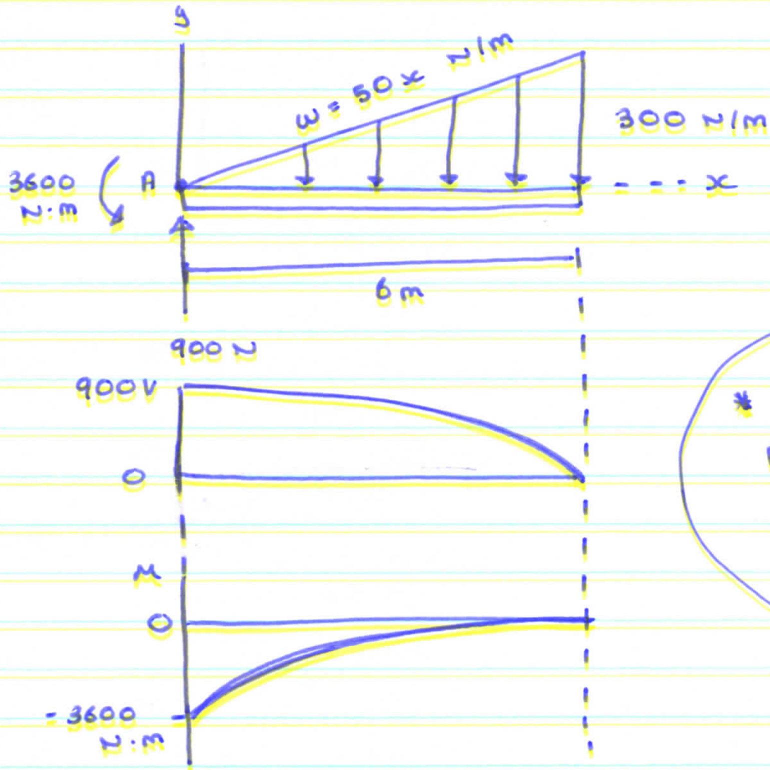
The counterclockwise couple at A causes a negative value of 3600 N:m

$$\int_{M_A}^{M} dM = \int_0^x v \, dx = \int_0^x (900 - 25x^2) \, dx$$

$$\int_{M_A}^{M} dM = \int_0^x V\,dx = \int_0^x (900 - 25x^2)\,dx$$

$$M = M_A + 900x - \frac{25}{3}x^3$$

$$M = -3600 + 900x - \frac{25}{3}x^3$$



* Draw shear + bending moment diagram very likely to be on Final exam. For whatever reason.

Distributed Loads on Cables

1- Loads distributed uniformly along a horizontal line.
The main cable of a suspension bridge is the classic example of a cable subjected to a load uniformly distributed along a horizontal line. The load transmitted to the main cable by the large number of vertical cables can be modeled as a distributed load.