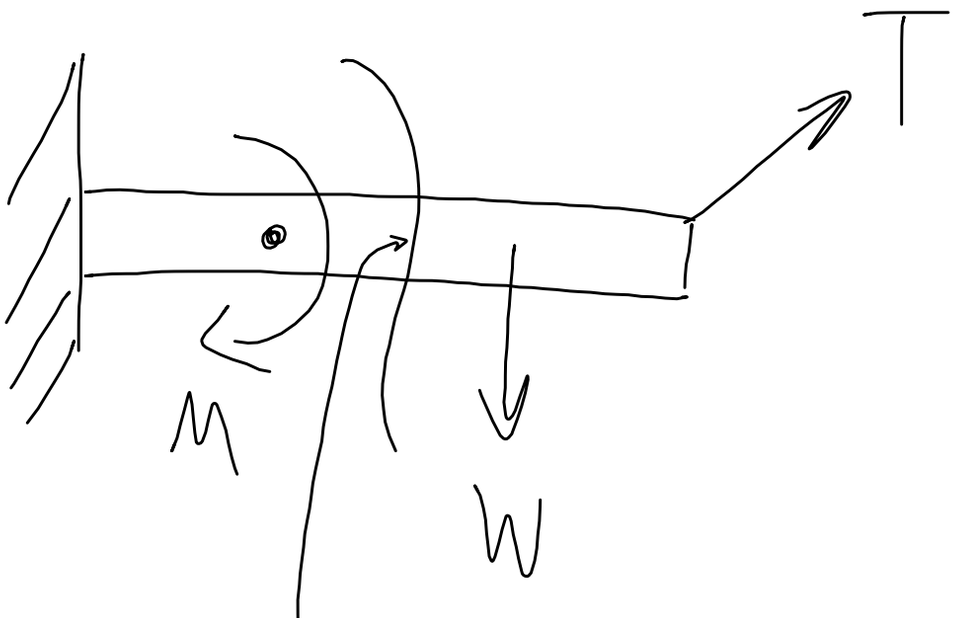
Internal Forces & Moments

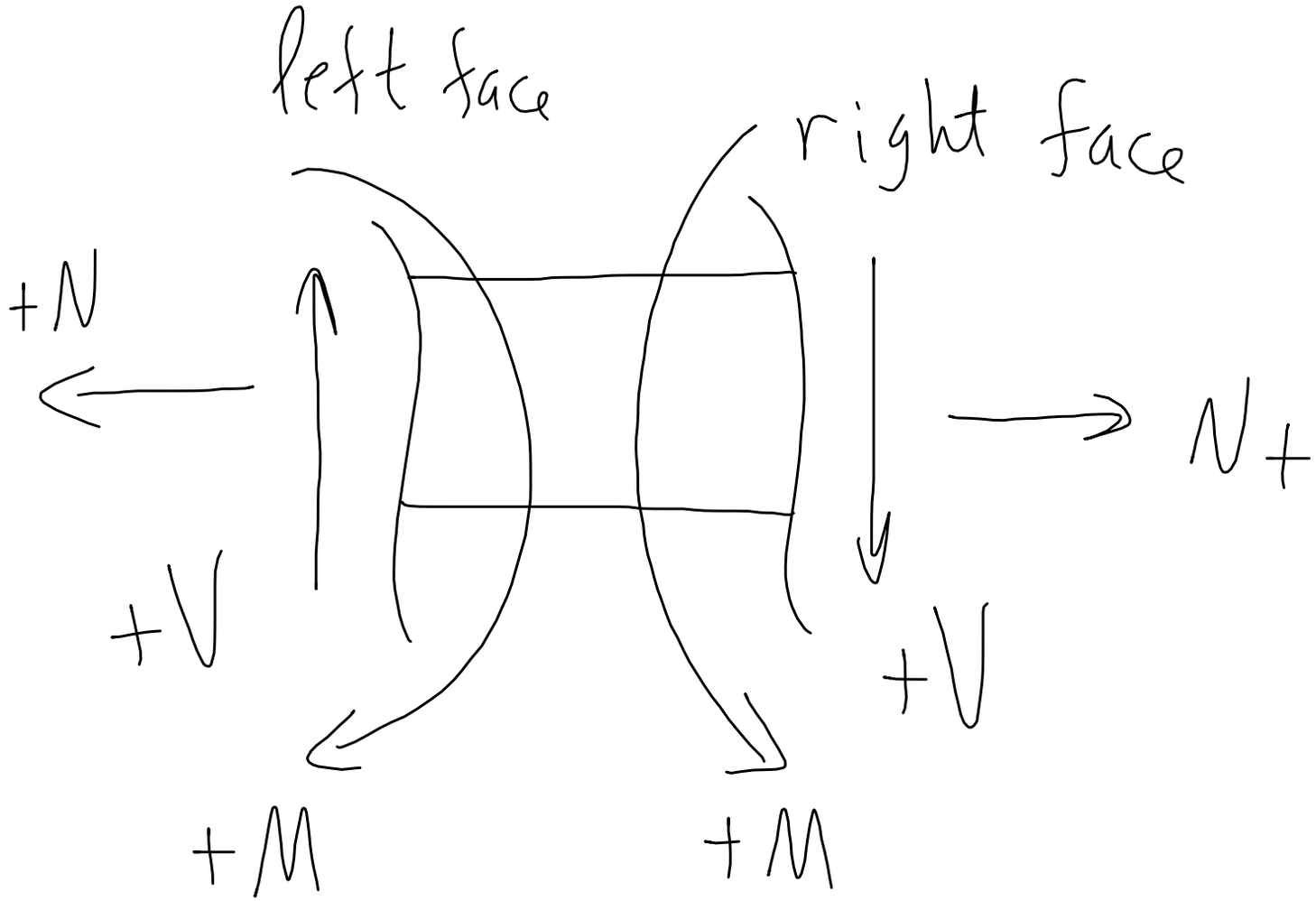


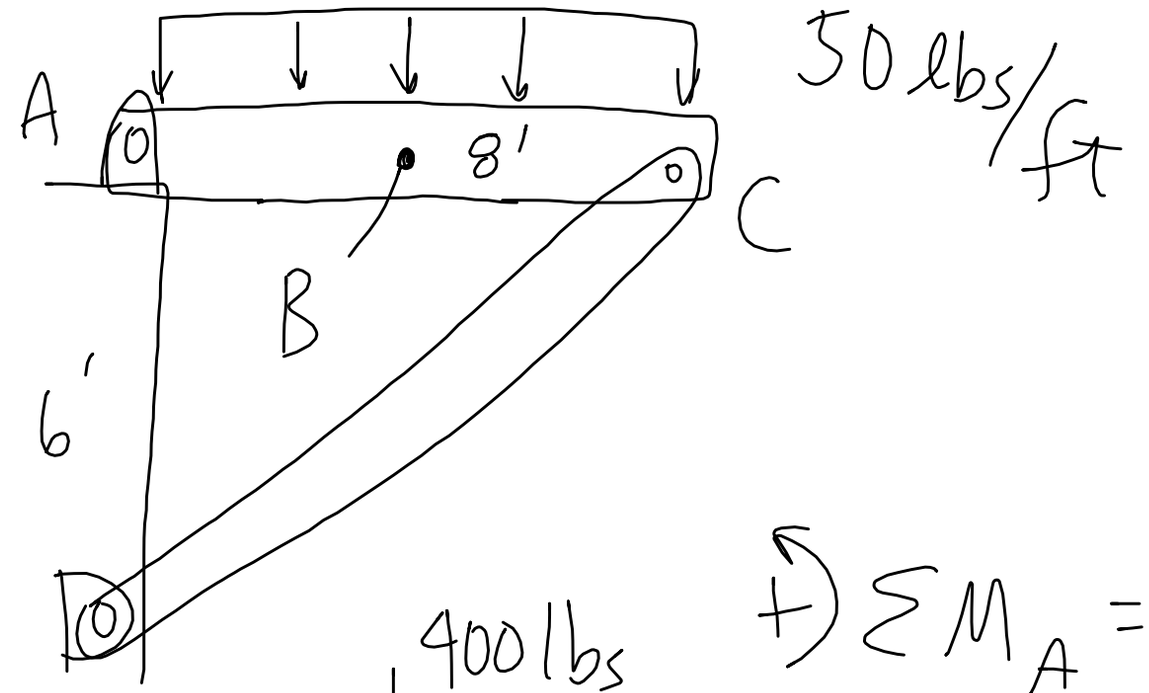
What are forces & moments?

$V \Rightarrow$ shear force

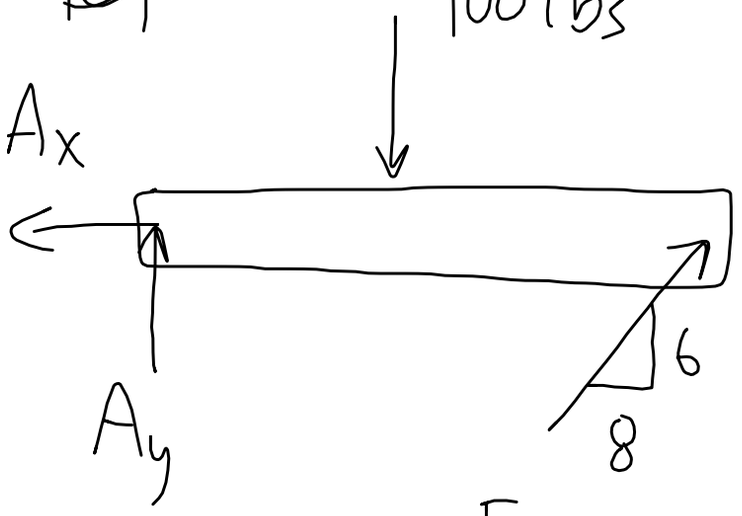
$N \Rightarrow$ axial force

$M \Rightarrow$ bending moment


left face
right face
+N
N+
+V
+V
+M
+M



What are V, N, M @ B?



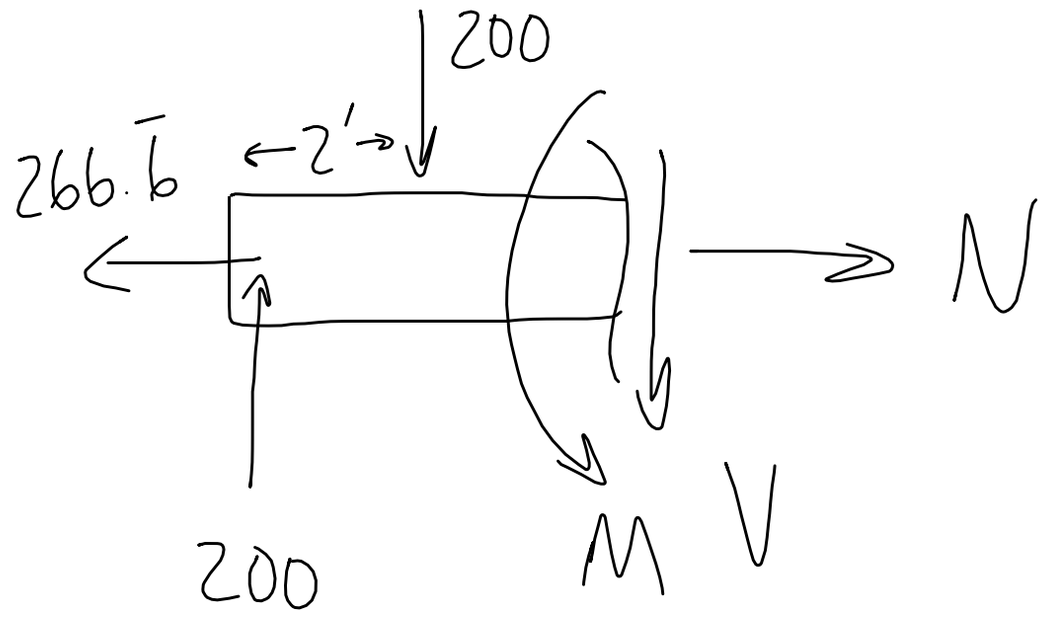
$$+\circlearrowleft \sum M_A = F_c\left(\frac{6}{10}\right)8 - 400(4) = 0$$

$$F_c = 333.\overline{3}\ \text{lbs}$$

$$A_x = 333.\overline{3}\left(\frac{8}{10}\right) = 266.\overline{6}\ \text{lbs}$$

$$+\uparrow \sum F_y = A_y - 400 + 333.\overline{3}\left(\frac{6}{10}\right) = 0$$

$$A_y = 200\ \text{lbs}$$



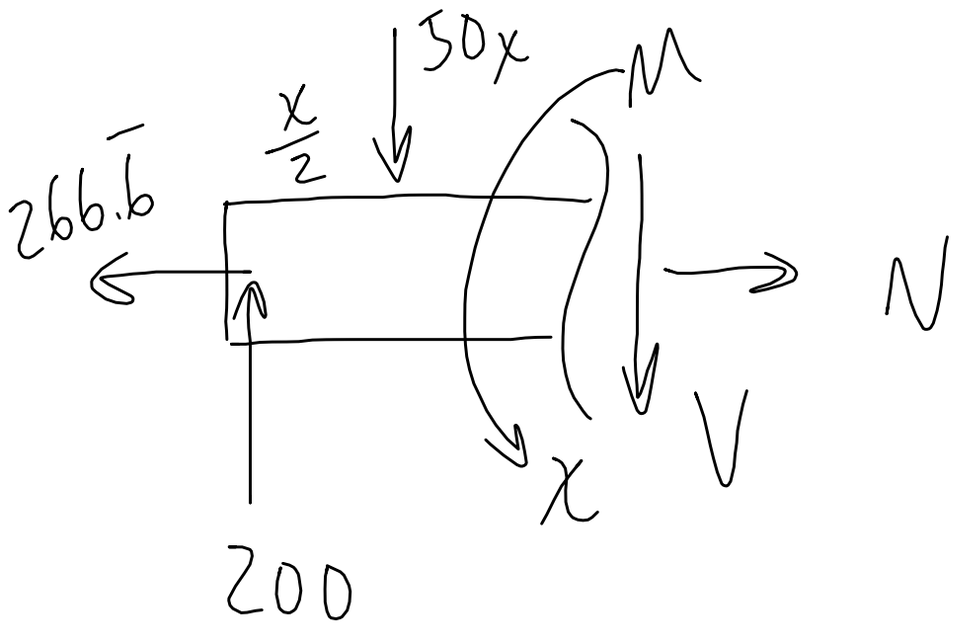
By inspection of $\sum F_x$

$N = 266.6̄ \text{ lbs}$

$+\downarrow \sum F_y = V + 200 - 200 = 0 \quad V = 0$

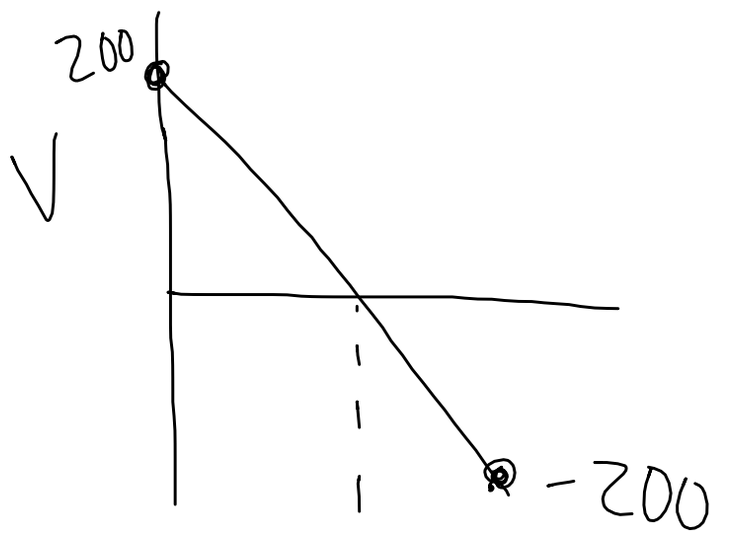
$+\circlearrowleft \sum M_{cut} = M + 200(2) - 200(4) = 0$

$M = 400 \text{ lb ft}$



$N = 266.\bar{6}$ lbs

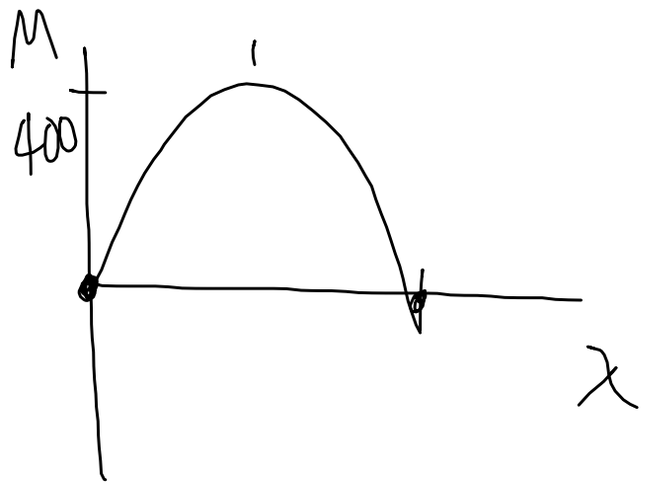
$$+\downarrow \sum F_y = V + 50x - 200 = 0$$



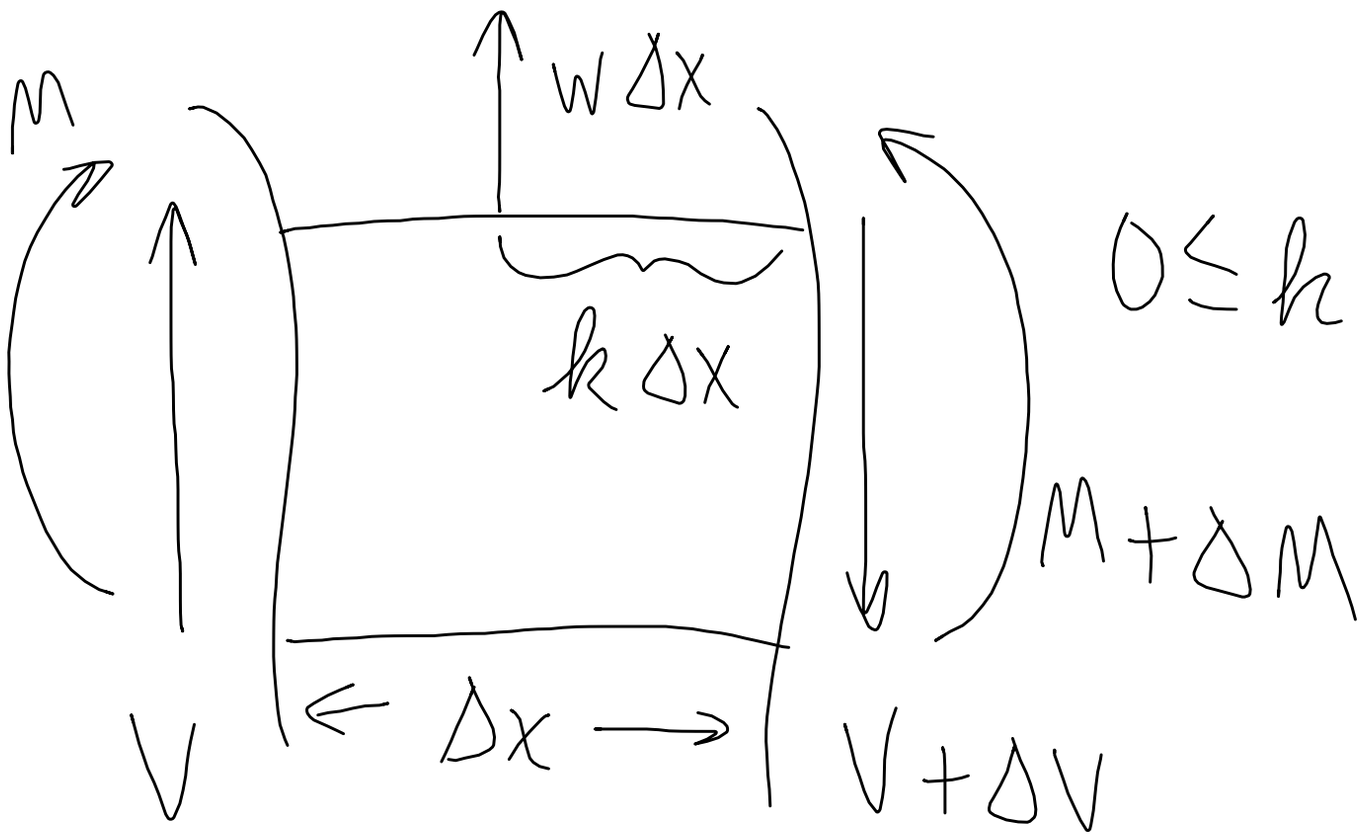
$$V(x) = -50x + 200$$

$$\left(+\circlearrowleft\right) \sum M_{cut} = M + 50x\left(\frac{x}{2}\right) - 200x = 0$$

$$M(x) = -25x^2 + 200x$$



Another sign convention $\Rightarrow$ $w(x)$ is + ↑



$+\uparrow \Sigma F_y = V - (V + \Delta V) + w\Delta x = 0$

$w\Delta x = \Delta V$ or $w = \frac{\Delta V}{\Delta x} \Rightarrow w(x) = \frac{dV(x)}{dx}$

$$+\circlearrowleft \sum M_{\substack{rt \\ face}} = M + \Delta M - M - V\Delta x$$

$$- \underbrace{w\Delta x \; k\Delta x}_{\text{ignore}} = 0$$

$$V = \frac{\Delta M}{\Delta x} \quad \text{or} \quad V(x) = \frac{dM(x)}{dx}$$

So $w = \frac{dV}{dx}$ $\int_a^b w\,dx = \Delta V \Big|_a^b$

$V = \frac{dM}{dx}$ $\int_a^b V\,dx = \Delta M \Big|_a^b$