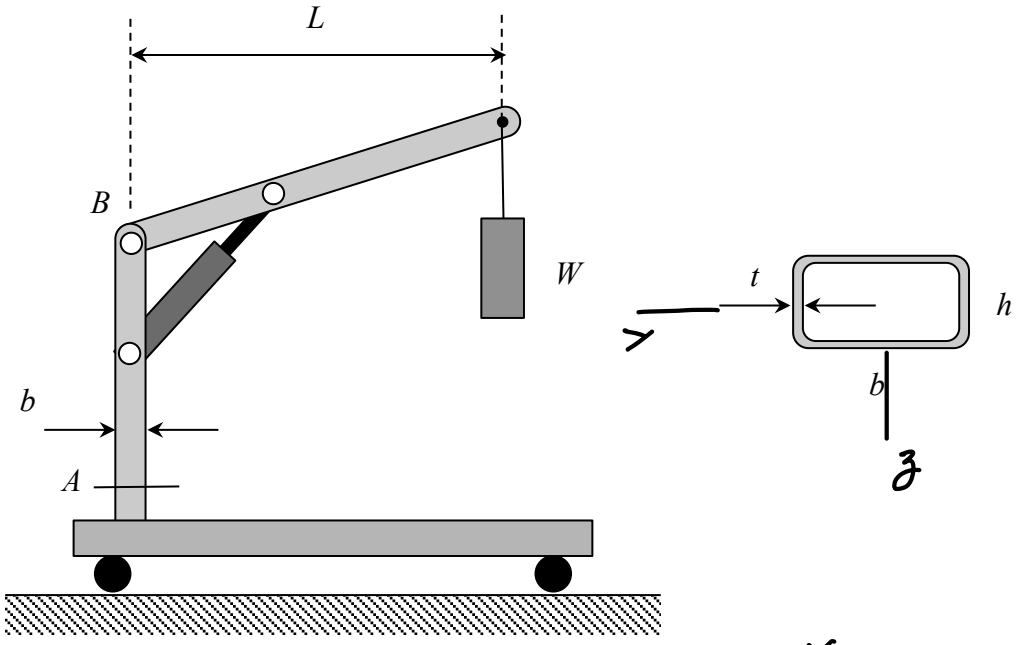
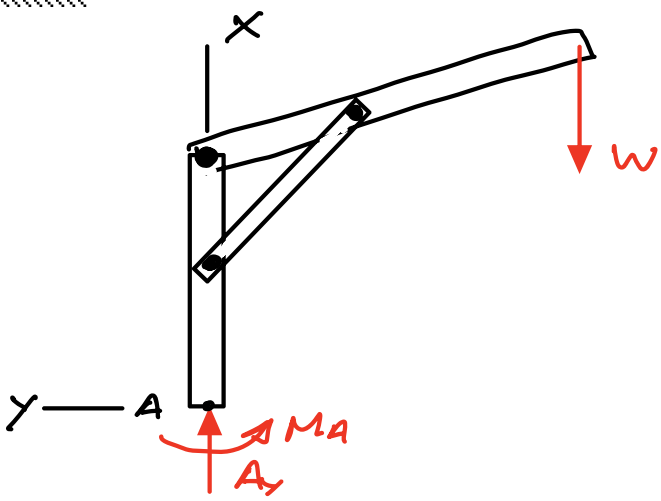
A crane is made up of a vertical column AB with a boom pinned to the column at B. The columnn has a tubular cross section of thickness t, as shown below. The boom supports a block with a weight of W. Determine the maximum tensile stress and maximum compressive stress near the base cross section at A when the boom is in the position shown.



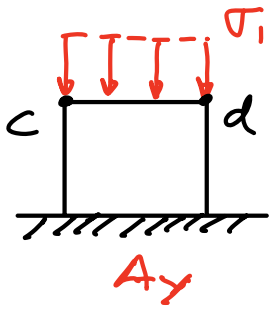

## Equilibrium and internal resultants

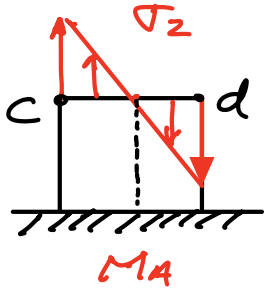
$\Sigma M_A = -WL + M_A = 0 \Rightarrow M_A = WL$

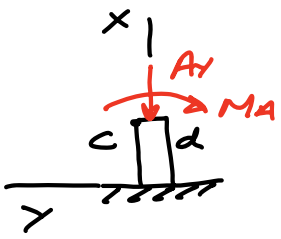
$\Sigma F_x = A_y - W = 0 \Rightarrow A_y = W$




## Stress distributions



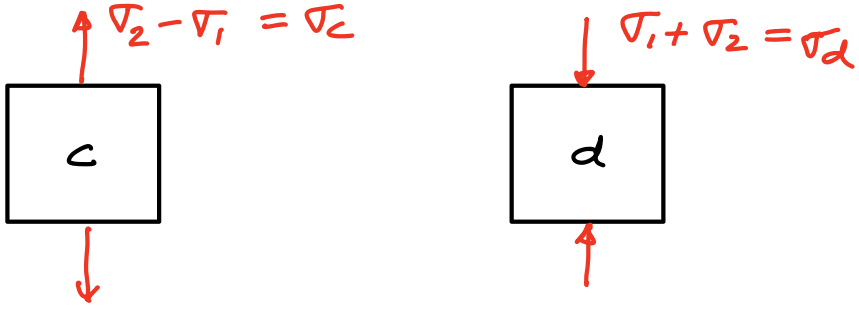
## Stress components

$A$ = cross-sectional area $= bh - (b-2t)(h-2t)$

$I_z$ = 2nd area moment about z-axis

$= \frac{1}{12} h b^3 - \frac{1}{12} (h-2t)(b-2t)^3$

| | @ "c" | @ "d" |
|---|---|---|
| $A_y$ | $\sigma_1 = \frac{A_y}{A} = \frac{W}{A}$ | $\sigma_1 = \frac{A_y}{A} = \frac{W}{A}$ |
| $M_A$ | $\sigma_2 = \frac{M_A h/2}{I} = \frac{WLh}{2I}$ | $\sigma_2 = \frac{M_A h/2}{I} = \frac{WLh}{2I}$ |




Note:
- If $\sigma_2 > \sigma_1$, $\sigma_c$ = tensile
- If $\sigma_2 < \sigma_1$, $\sigma_c$ = compressive, but less than $\sigma_d$
- $\sigma_d$ is ALWAYS compressive