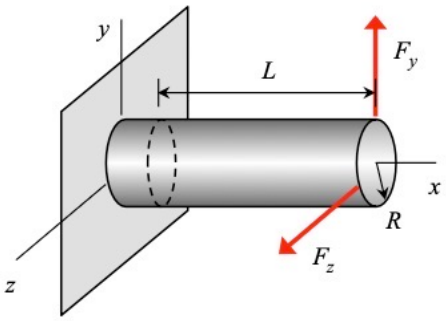
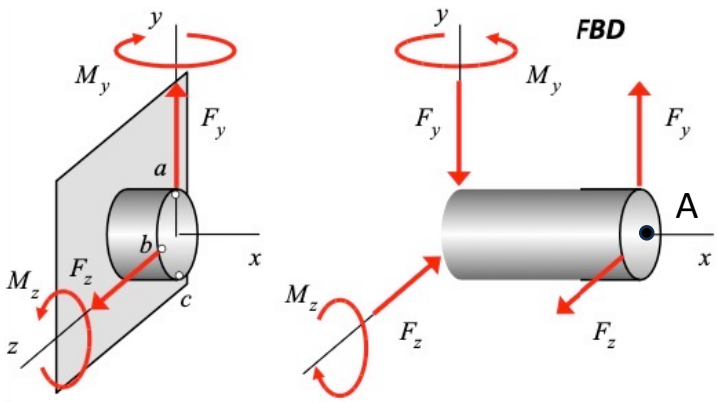
Combined states of stress: Method and example

1. Draw FBD of section of structure cut at the location where stresses are desired. Solve for the *internal resultants* (forces and couples) from equilibrium. Draw the internal resultants on the positive x-face of the cut. These resultants should be drawn in the correct directions, without signs. DO NOT USE SIGNS in your work from this point on.
2. Show the *stress distributions* originating from these resultants on the positive x-face.
3. Create a table of *stress component equations* resulting from these stress distributions at the selected points on the cross-section. Include no signs in these equations.
4. Draw the *stress elements* for the selected points on the cross-section. The direction of these stress components should jive with the stress directions shown in your stress distribution sketches in 3. above. Focus first on drawing the stress components on the positive *x*-face. Once that is done, complete the drawing showing the non-zero components on the remaining faces.



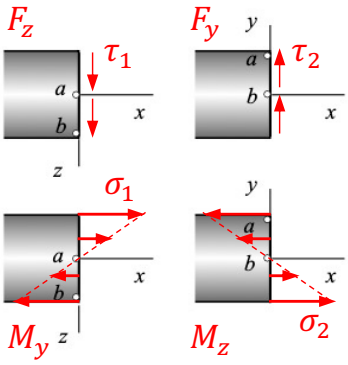
1. Internal resultants



$$\sum M_{Ay} = M_y - F_z L = 0 \Rightarrow M_y = F_z L$$

$$\sum M_{Az} = -M_z + F_y L = 0 \Rightarrow M_z = F_y L$$

2. Stress distribution



3. Stress component equations

loading	*stress comp. @ "a"*	*stress comp. @ "b"*
F_y	0	$\tau_2 = \frac{4}{3}\frac{F_y}{A}$
F_z	$\tau_1 = \frac{4}{3}\frac{F_z}{A}$	0
M_y	0	$\sigma_1 = \frac{M_y R}{I}$
M_z	$\sigma_2 = \frac{M_z R}{I}$	0

4. Stress Elements