- Critério de Tresca:

$$\begin{aligned} |\sigma_1 - \sigma_3| &\leq \bar{\sigma}_e \\ \sqrt{(\sigma_{xx} - \sigma_{yy})^2 + 4\tau_{xy}^2} &\leq \bar{\sigma}_e \\ \sqrt{\sigma^2 + 4\tau^2} \leq \bar{\sigma}_e &\leq \bar{\sigma}_e \end{aligned}$$

- Critério de von-Mises:

$$\begin{aligned} \frac{\sqrt{2}}{2}\sqrt{(\sigma_1 - \sigma_2)^2 + (\sigma_1 - \sigma_3)^2 + (\sigma_2 - \sigma_3)^2} &\leq \bar{\sigma}_e \\ \sqrt{\sigma_{xx}^2 + \sigma_{yy}^2 - \sigma_{xx}\sigma_{yy} + 3\tau_{xy}^2} &\leq \bar{\sigma}_e \\ \sqrt{\sigma^2 + 3\tau^2} \leq \bar{\sigma}_e & \end{aligned}$$

$$\sigma_x = \frac{N}{A} + \frac{M_z y}{I_z} - \frac{M_y z}{I_y} \qquad \tau = \frac{QM_s}{tI} \qquad \tau = \frac{T\rho}{J}$$

$$\tau_{max} = \frac{M_t}{\alpha a b^2}, \qquad \tau_B = \eta \tau_{max}$$

a/b	1.00	2.00	3.00	6.00
α	0.208	0.246	0.267	0.299
η	1.000	0.795	0.753	0.743

$$P_{cr} = \frac{\pi^2 EI}{l_{fl}^2}, \qquad \rho^2 = \frac{I}{A}$$

$$y_{max} = e\left[\sec\left(\sqrt{\frac{P}{EI}}\frac{l_{fl}}{2}\right) - 1\right]$$

$$M_{max} = P \times (e + y_{max})$$

$$\sigma_{max} = \frac{P}{A} + \frac{M_{max} y}{I}$$

$$\sigma_{max} = \frac{P}{A}\left[1 + \frac{ec}{\rho^2}\sec\left(\frac{l_{fl}}{2\rho}\sqrt{\frac{P}{EA}}\right)\right]$$

Condição dos apoios	l_{fl}
rótula/rótula	l
engaste/ rótula	$0.7l$
engaste/ engaste	$0.5l$
engaste/ livre	$2l$