Problema 1.

$$\sigma_{rr}(r) = -\frac{\left(\frac{a^2}{r^2}-\frac{a^2}{b^2}\right)}{\left(1-\frac{a^2}{b^2}\right)}p_i + \frac{\left(\frac{a^2}{b^2}-\frac{a^2}{r^2}\right)}{\left(1-\frac{a^2}{b^2}\right)}p_o \qquad \left.\begin{matrix} b\to\infty \\ p_i = p \\ p_o = 0\end{matrix}\right\} \Rightarrow \sigma_{rr}(r) = -\frac{(D/2)^2}{r^2}p$$

$$\sigma_{\theta\theta}(r) = \frac{\left(\frac{a^2}{r^2}+\frac{a^2}{b^2}\right)}{\left(1-\frac{a^2}{b^2}\right)}p_i - \frac{\left(1+\frac{a^2}{r^2}\right)}{\left(1-\frac{a^2}{b^2}\right)}p_o \qquad \left.\begin{matrix} b\to\infty \\ p_i = p \\ p_o = 0\end{matrix}\right\} \Rightarrow \sigma_{\theta\theta}(r) = \frac{(D/2)^2}{r^2}p$$

$$u_r(r) = \frac{1-\nu}{E}\frac{\left(p_i\frac{a^2}{b^2}-p_o\right)}{\left(1-\frac{a^2}{b^2}\right)}r + \frac{1+\nu}{E}\frac{(p_i-p_o)}{\left(1-\frac{a^2}{b^2}\right)}\frac{a^2}{r} \qquad \left.\begin{matrix} b\to\infty \\ p_i = p \\ p_o = 0\end{matrix}\right\} \Rightarrow \Delta D = 2u_r(D/2) = \frac{1+\nu_f}{E_f}pD$$

Problema 2.

Variação no diâmetro do revestimento (tubo de paredes finas)

$$\Delta D_R = (p_i - p_o)D^2/2E_t t$$

Variação no diâmetro do poço (ver Problema 1)

$$\Delta D_f = (1+\nu_f)p_o D/E_f$$

Compatibilidade de deslocamentos:

$$\Delta D_R = \Delta D_f \;\Rightarrow \boxed{p_o = p_i\left[1+2(1+\nu_f)(tE_t/DE_f)\right]^{-1}}$$

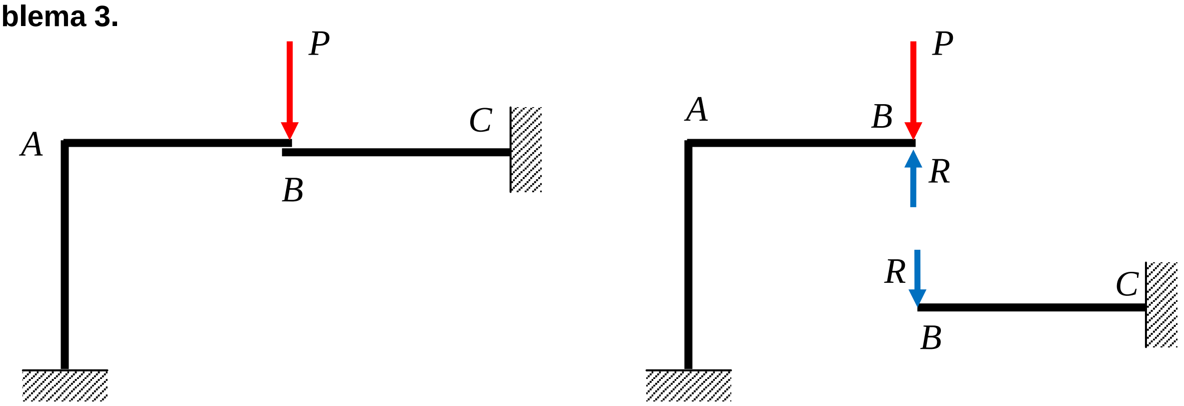
Tensões principais em $r = D/2$

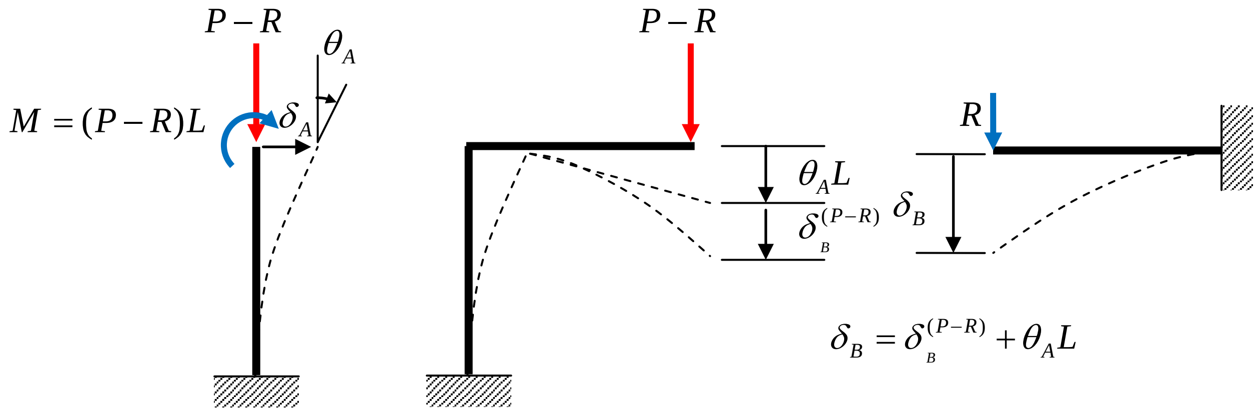
$$\sigma_1 = \sigma_{\theta\theta}(D/2) = p_o,\ \sigma_2 = 0,\ \text{e}\ \sigma_3 = \sigma_{rr}\left(\frac{D}{2}\right) = -p_o$$

Tensão cisalhante máxima em $r = D/2$

$$\boxed{\tau_{\max} = (\sigma_1 - \sigma_3)/2 = p_o = p_i\left[1+2(1+\nu_f)(tE_t/DE_f)\right]^{-1}}$$

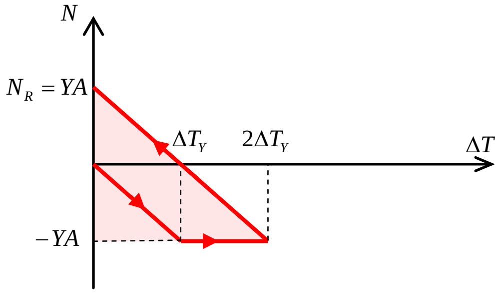
Problema 3.





$$\left.\begin{array}{l} \delta_B = \dfrac{RL^3}{3EI} \\ \delta_B^{(P-R)} = \dfrac{(P-R)L^3}{3EI} \\ \theta_A = \dfrac{(P-R)L^2}{EI} \end{array}\right\} \rightarrow \delta_B = \delta_B^{(P-R)} + \theta_A L \Rightarrow R = \frac{4P}{5} \Rightarrow \boxed{\delta_B = \frac{4PL^3}{15EI}}$$

Problema 4.



(i) $\Delta T < \Delta T_y$ (regime elástico)

$$\varepsilon = \frac{N}{EA} + \alpha\Delta T = 0 \Rightarrow N = -\alpha EA\Delta T$$

$$\Delta T = \Delta T_y \Rightarrow N = -YA \Rightarrow \boxed{\Delta T_y = Y/\alpha E}$$

(ii) $\Delta T = 0 \rightarrow 2\Delta T_y \rightarrow 0$

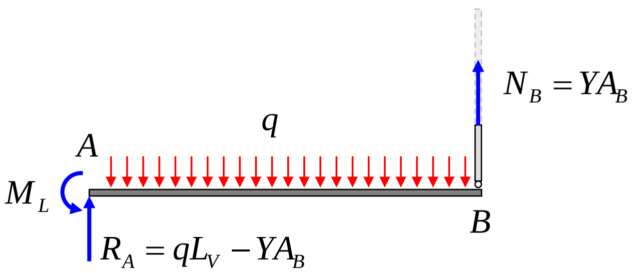
$$N_R - (-YA) = \alpha EA(2\Delta T_y) \Rightarrow N_R = \alpha EA(2Y/\alpha E) - YA = YA$$

$$\sigma_R = N_R/A = Y$$

Problema 5.

Assumindo que as deformações plásticas têm início na barra, o colapso ocorre quando tanto a barra quanto a seção do engaste da viga estiverem completamente plastificadas. Neste caso, o momento fletor em A é igual ao momento limite M_L.

Fazendo o balanço de momentos:



$$YA_B L_V - qL_V^2/2 + M_L = 0$$

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$$q_L = 2M_L/L_V^2 + 2YA_B/L_V$$