

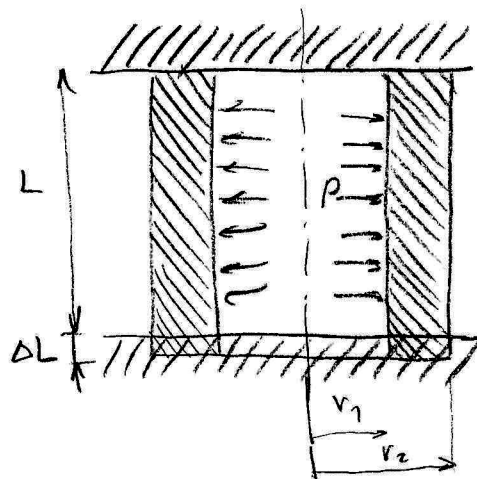
$p = 50 \text{ MPa}$, $r_1 = 20 \text{ mm}$, $r_2 = 50 \text{ mm}$, $\Delta L = -0.07 \text{ mm}$, $E = 2.1 \cdot 10^5 \text{ MPa}$, $\mu = 0.3$, $\sigma_{\text{ek}} = 300 \text{ MPa}$
 $L = 300 \text{ mm}$

1. Okružné podmienky

$$\sigma_r = -p \text{ pri } r = r_1$$

$$\sigma_r = 0 \text{ pri } r = r_2$$

$$w = \Delta L$$



2. Stanovení A, B

$$A' - \frac{B}{r_1^2} = -p$$

$$A' - \frac{B}{r_2^2} = 0$$

$$-\frac{B}{r_1^2} + \frac{B}{r_2^2} = -p \Rightarrow B = \frac{-p}{-\frac{1}{r_1^2} + \frac{1}{r_2^2}} = \frac{-p \cdot r_1^2 r_2^2}{-r_2^2 + r_1^2} = \frac{-50 \cdot 20^2 \cdot 50^2}{-50^2 + 20^2} = 23810 \text{ MPa}$$

$$A' = \frac{B}{r_2^2} = \frac{23810}{50^2} = 10 \text{ MPa} \cdot \text{mm}^{-2}$$

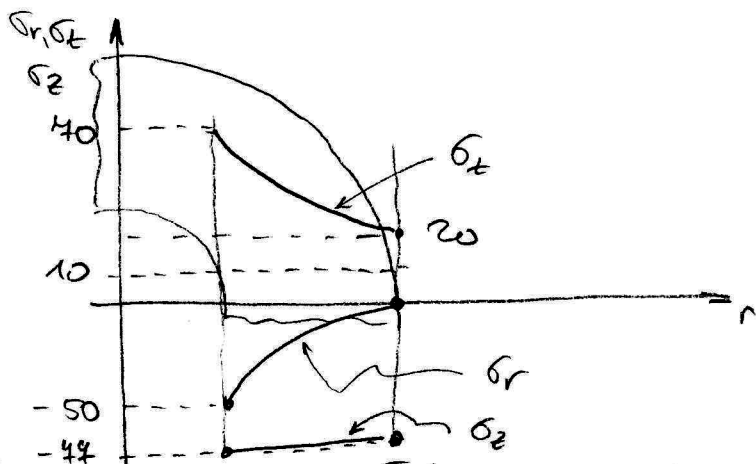
3. Řešení

(i) bezpečnost k MS pružnosti

$$\sigma_r = A' - \frac{B}{r^2} = 10 - \frac{23810}{r^2}$$

$$\sigma_t = A' + \frac{B}{r^2} = 10 + \frac{23810}{r^2}$$

$$\sigma_z = 2 \cdot \mu A' + \frac{E(1-\mu+2\mu^2)}{(1+\mu)(1-2\mu)} \frac{\Delta L}{L} = 2 \cdot 0.3 \cdot 10 - \frac{2.1 \cdot 10^5 (1-0.3+2 \cdot 0.3^2)}{(1+0.3)(1-2 \cdot 0.3)} \cdot \frac{0.07}{300} = -44 \text{ MPa}$$



$$\sigma_{\text{ekd}} = |\sigma_t - \sigma_z|_{r=r_1} = |40 - (-44)| = 144 \text{ MPa}$$

$$k = \frac{\sigma_{\text{ek}}}{\sigma_{\text{ekd}}} = \frac{300}{144} = 2.04$$

(ii) posumiť $u(r=r_1, r_2)$

$$u = \left[\frac{(1+\mu)(1-2\mu)}{E} A' - \mu \frac{\Delta L}{L} \right] r + \frac{1+\mu}{E} \cdot \frac{B}{r} = \left[\frac{(1+0.3)(1-2 \cdot 0.3)}{2.1 \cdot 10^5} \cdot 10 + 0.3 \cdot \frac{0.04}{300} \right] \cdot r + \frac{1+0.3}{2.1 \cdot 10^5} \cdot \frac{23810}{r} = 9.48 \cdot 10^{-5} r + \frac{0.15}{r}$$

$$u(r=20) = 9.40 \cdot 10^{-5} \text{ mm}$$

$$u(r=50) = 4.74 \cdot 10^{-3} \text{ mm}$$