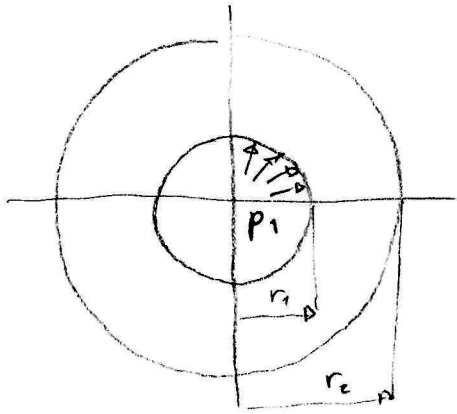


Pr: Určete bezpečnost k MS pružnosti a rozšíření vnějšího pláště trubky podle obr.



mat.: E, ν, σ_k

okr. podmínky: $\sigma_r|_{r=r_1} = -p_1$

$$\sigma_r|_{r=r_2} = 0$$

$$\varepsilon_z = 0 \quad (\text{rovinová deformace})$$

$$\sigma_r = A - \frac{B}{r^2} \Rightarrow A - \frac{B}{r_1^2} = -p_1, A - \frac{B}{r_2^2} = 0 \Rightarrow$$

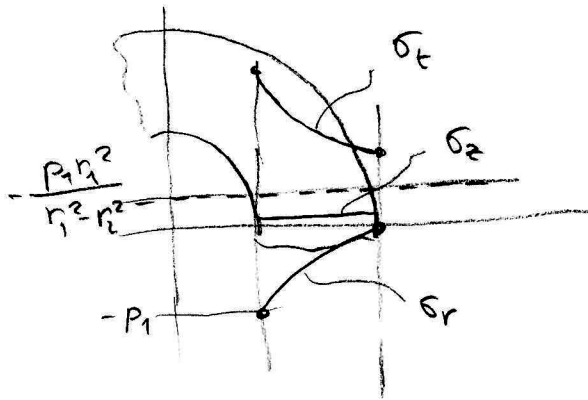
$$\Rightarrow B \left(-\frac{1}{r_1^2} + \frac{1}{r_2^2} \right) = -p_1 \Rightarrow B = - \frac{p_1}{-\frac{1}{r_1^2} + \frac{1}{r_2^2}} = - \frac{p_1 r_1^2 r_2^2}{r_1^2 - r_2^2} \Rightarrow$$

$$\Rightarrow A = \frac{B}{r_2^2} = - \frac{p_1 r_1^2}{r_1^2 - r_2^2}$$

$$\sigma_r = - \frac{p_1 r_1^2}{r_1^2 - r_2^2} \left(1 - \frac{r_2^2}{r^2} \right)$$

$$\sigma_t = - \frac{p_1 r_1^2}{r_1^2 - r_2^2} \left(1 + \frac{r_2^2}{r^2} \right)$$

$$\sigma_z = 2\nu A = -2\nu \frac{p_1 r_1^2}{r_1^2 - r_2^2}$$



$$\sigma_{\text{red}}^{\text{max}} = |\sigma_r - \sigma_t| \Big|_{r=r_1} = - \frac{p_1 r_1^2}{r_1^2 - r_2^2} \cdot \frac{r_2^2}{r_1^2} \Rightarrow k = \frac{\sigma_k}{\sigma_{\text{red}}^{\text{max}}}$$

$$u = \frac{(1+\nu)(1-2\nu)}{E} \cdot \left(- \frac{p_1 r_1^2}{r_1^2 - r_2^2} \right) \cdot r + \frac{1+\nu}{E} \cdot \frac{- \frac{p_1 r_1^2 r_2^2}{r_1^2 - r_2^2}}{r} \Rightarrow u(r=r_2) = - \frac{p_1 r_1^2}{r_1^2 - r_2^2} \cdot$$

$$\cdot \left[\frac{(1+\nu)(1-2\nu)}{E} \cdot r_2 + \frac{1+\nu}{E} \cdot \frac{r_2^2}{r_2} \right] = - \frac{p_1 r_1^2 r_2}{r_1^2 - r_2^2} \cdot \frac{(1+\nu)(1-2\nu) + (1+\nu)}{E}$$