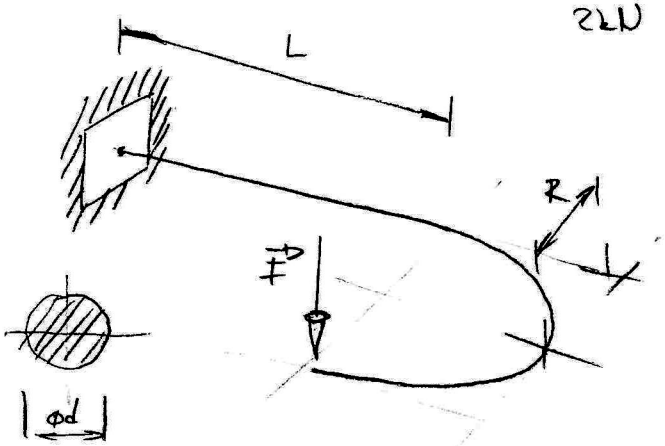
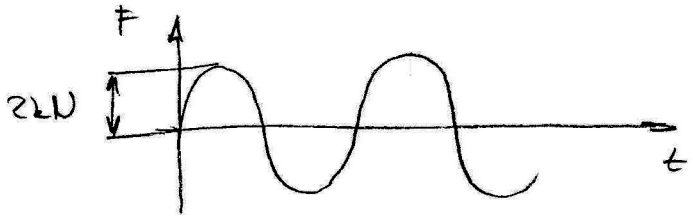
PŘ: Určete bezpečnost vzhledem k MS neomezené životnosti u součásti podle obrázku.





materiál ocel; povrch leštěn, kaleno

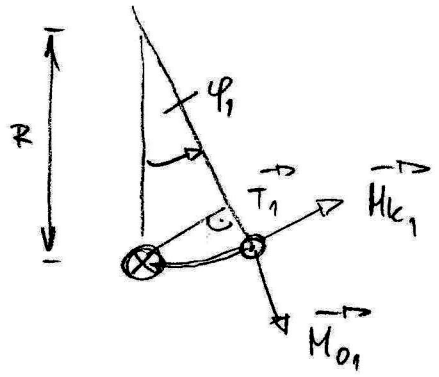
$\sigma_{pt} = 650\ MPa$ $\quad h_1 = 10\ mm$

$\sigma_c = 215\ MPa$ $\quad d = 50\ mm$

$\sigma_{co} = 140\ MPa$ $\quad R = 300\ mm$

$\tau_c = 40\ MPa$ $\quad L = 600\ mm$

1. VVÚ

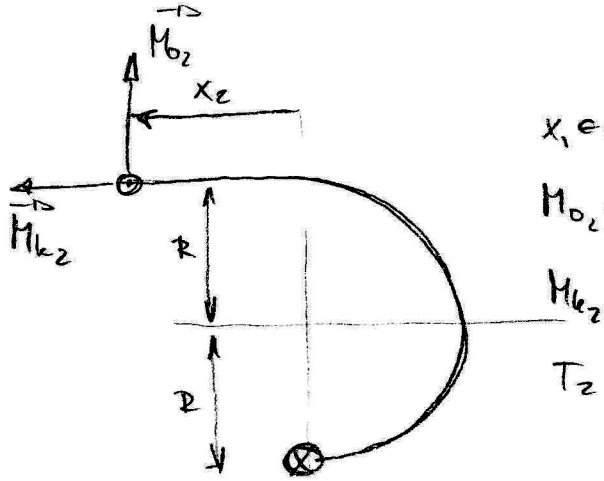


$\varphi_1 \in (0, \pi)$

$M_{O_1} = -F \cdot R \cdot \sin\varphi_1$

$M_{k_1} = F \cdot R\,(1 - \cos\varphi_1)$

$T_1 = F$



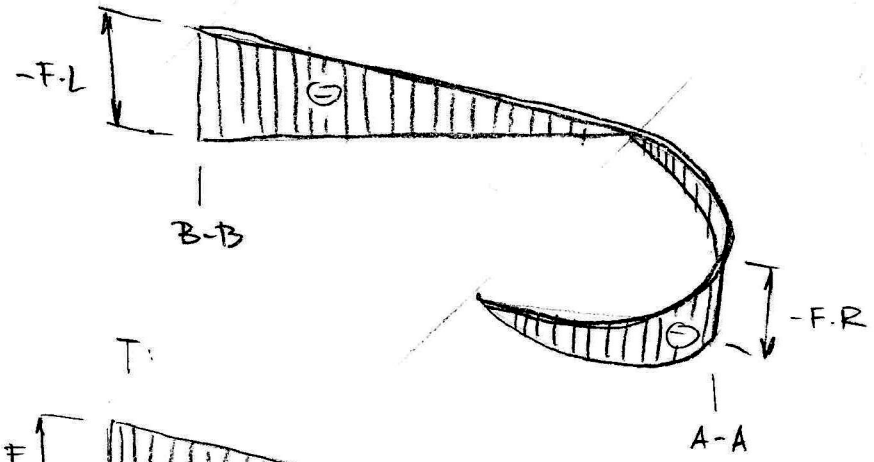
$x_1 \in (0, L)$

$M_{O_2} = -F\,x_2$

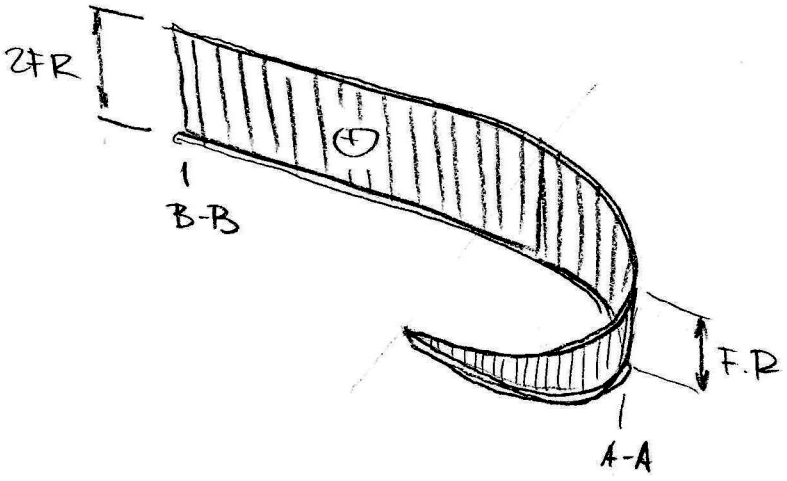
$M_{k_2} = 2F \cdot R$

$T_2 = F$

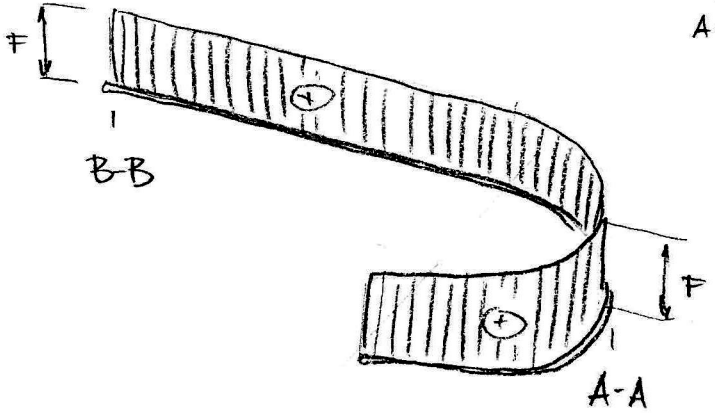
M_o:



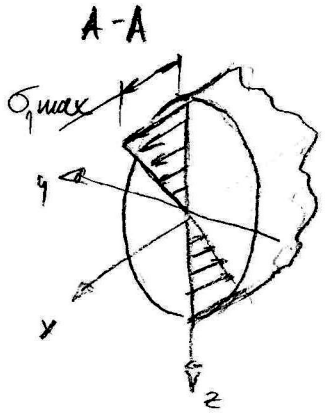
M_k:

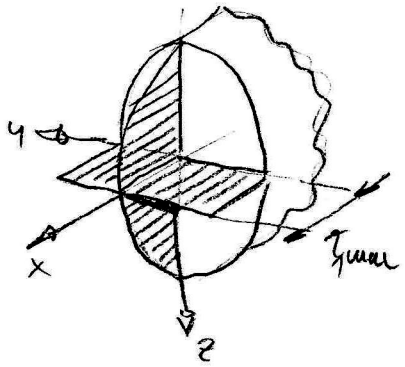


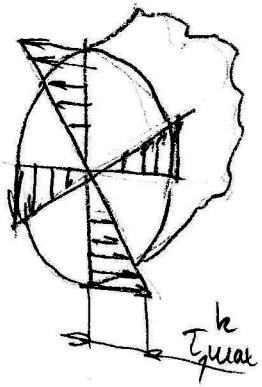
T:

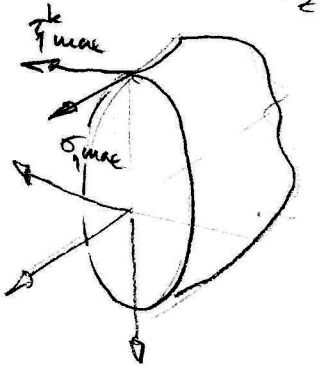


2. Řešení









$$\sigma_{1max} = \frac{F \cdot R}{W_o} = \frac{2000 \cdot 300}{\frac{\pi \cdot 50^3}{32}} = 49\ MPa$$

$$\tau_{1max} = \frac{4}{3} \cdot \frac{F}{S} = \frac{4}{3} \frac{2000}{\frac{\pi \cdot 50^2}{4}} = 1\ MPa$$

$$\tau^k_{1max} = \frac{F \cdot R}{W_k} = \frac{2000 \cdot 300}{\frac{\pi \cdot 50^3}{16}} = 24\ MPa$$

$$k'_\sigma = \frac{\sigma_c^*}{\sigma_{1max}} = \frac{267}{49} = 5.44$$

$$k'_\tau = \frac{\tau_c^*}{\tau^k_{1max}} = \frac{254}{24} = 10.71$$

$$\Rightarrow k_1 = \frac{k'_\sigma \cdot k'_\tau}{\sqrt{k'^2_\sigma + k'^2_\tau}} = \frac{5.44 \cdot 10.71}{\sqrt{5.44^2 + 10.71^2}} = 4.85$$

$$\sigma_c^* = \frac{\vartheta_\sigma \eta_\sigma}{\beta_\sigma}\sigma_c \quad , \tau_c^* = \frac{\vartheta_\tau \eta_\tau}{\beta_\tau}\sigma_c \Rightarrow \sigma_c^* = \frac{0.8 \cdot 1.55}{1} \cdot 215 = 264 \quad , \tau_c^* = \frac{0.62 \cdot 1.55}{1} \cdot 264 = 257 \text{ MPa}$$

součinitel velikosti

$$\vartheta_\sigma = \vartheta_1 \vartheta_{2\sigma} = 0.88 \cdot 0.91 = 0.8$$

$$\vartheta_\tau = \vartheta_1 \vartheta_{2\tau} = 0.88 \cdot 0.40 = 0.62$$

$$\vartheta_1 = 1 - \sqrt{k \cdot \log \frac{h}{h_1}} = 1 - \sqrt{2 \cdot 10^{-2} \cdot \log \frac{50}{10}} = 0.88$$

$$\vartheta_{2\sigma} = 1 + \left(\frac{\sigma_{cou}}{\sigma_c} - 1\right)\sqrt{\frac{h_1}{h}} = 1 + \left(\frac{140}{215} - 1\right)\sqrt{\frac{10}{50}} = 0.91$$

$$\vartheta_{2\tau} = 1 + \left(\frac{\tau_c}{\sigma_c} - 1\right)\sqrt{\frac{h_1}{h}} = 1 + \left(\frac{40}{215} - 1\right)\sqrt{\frac{10}{50}} = 0.40$$

součinitel vrubu

$$\beta_\sigma = \beta_\tau = 1$$

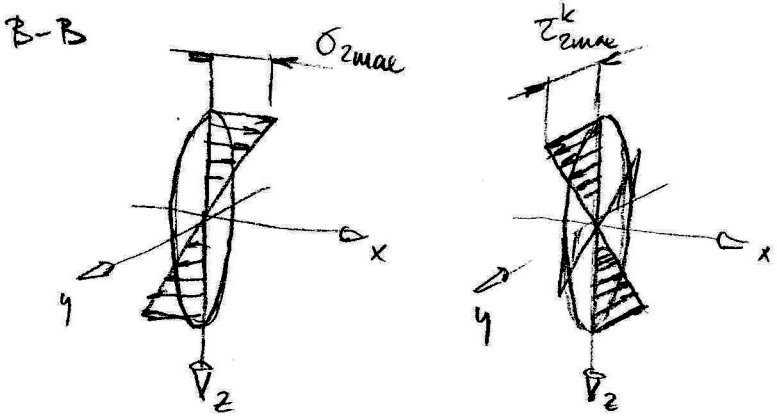
součinitel povrchu

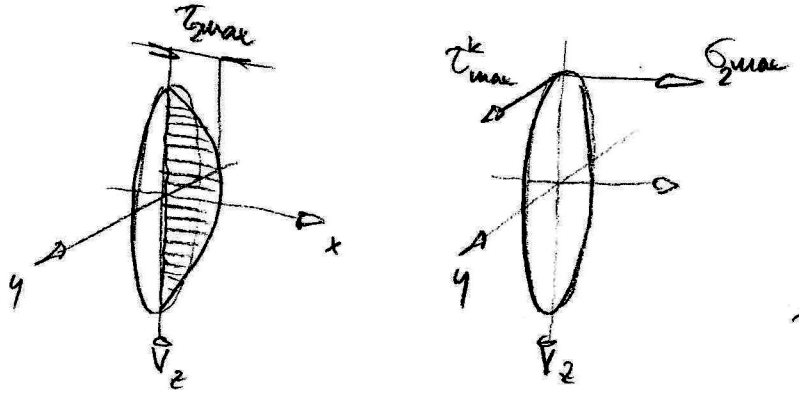
$$\eta_\sigma = \eta_1 \cdot \eta_2 = 0.97 \cdot 1.6 = 1.55$$

$$\eta_1 = 0.97$$

$$\eta_2 = 1.6$$

B-B





$$\sigma_{2max} = \frac{F \cdot L}{W_o} = \frac{2000 \cdot 600}{\frac{\pi \cdot 50^3}{32}} = 98 \text{ MPa}$$

$$\tau_{2max} = \frac{4}{3}\frac{F}{S} = \frac{4}{3}\frac{2000}{\frac{\pi \cdot 50^2}{4}} = 1 \text{ MPa}$$

$$\tau^k_{2max} = \frac{2T \cdot R}{W_k} = \frac{2 \cdot 2000 \cdot 300}{\frac{\pi \cdot 50^3}{16}} = 49 \text{ MPa}$$

$$k_\sigma^2 = \frac{\sigma_c^*}{\sigma_{2max}} = \frac{264}{98} = 2.42$$

$$k_\tau^2 = \frac{\tau_c^*}{\tau^k_{max}} = \frac{257}{49} = 5.24$$

$$\Rightarrow k_2 = \frac{k_\sigma^2 k_\tau^2}{\sqrt{k_\sigma^{2^2} + k_\tau^{2^2}}} = \frac{2.42 \cdot 5.24}{\sqrt{2.42^2 + 5.24^2}} = 2.41$$

$$k = \min\{k_1, k_2\} = 2.41$$