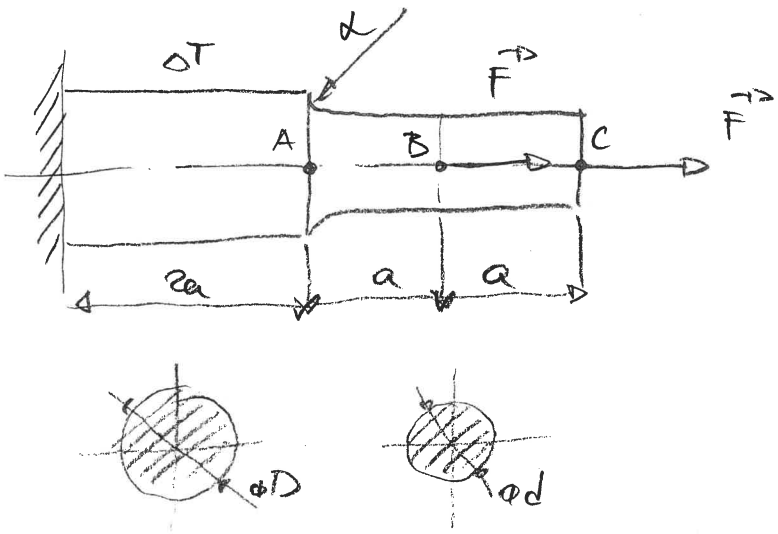
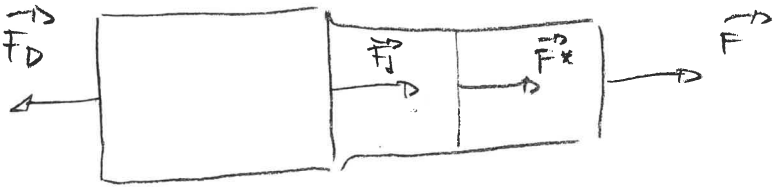
Př: Stanovte bezpečnost k MS pevnosti a posuvů příčezů A, B, C.



$F = 12\,kN$
$a = 500\,mm$
$d = 20\,mm$
$D = 30\,mm$
$E = 2.1 \cdot 10^5\,MPa$
$\alpha_T = 12.5 \cdot 10^{-6}\,K^{-1}$
$\Delta T = 50\,°C$
$\alpha = 1.3$
$\sigma_k = 300\,MPa$

1. Úplné uvolnění

$|\vec{F}_d| = 0 \quad |\vec{F}^*| = F$



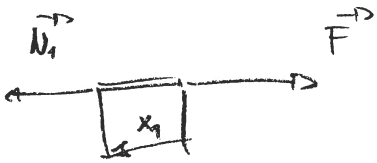
2. Stat. vazbor

$NP = \{F_D\}$

$\mu = 1$, $v = 1$ $\Rightarrow$ $s = \mu - v = 0$ ← úloha stat. určitá

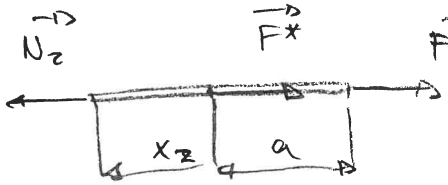
3. VVÚ

$x_1 \in (0, a)$

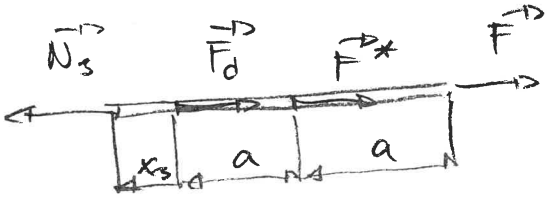


$N_1 = F$

$x_2 \in (0, a)$



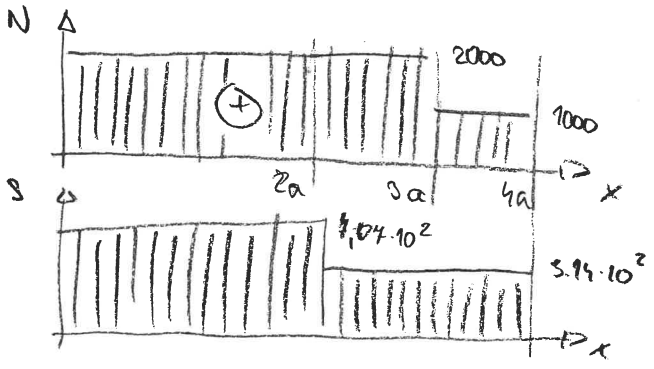
$N_2 = F + F^*$

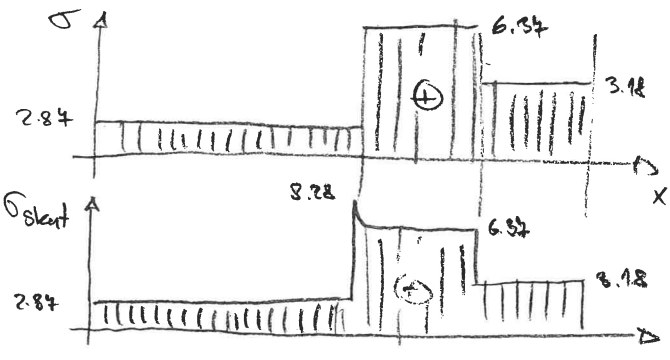


$x_3 \in (0, 2a)$

$N_3 = F + F^* + F_d$

4. Řešení





$$\sigma_{skut} = \alpha \cdot \frac{N_2}{S_1} = 1.3 \cdot \frac{2000}{\frac{\pi \cdot 20^2}{4}} = 8.28\ MPa$$

$$k = \frac{\sigma_k}{\sigma_{skut}} = \frac{300}{8.28} = \underline{36.2}$$

$$u_A = \frac{\partial W}{\partial F_d} = \int_0^a \frac{N_1}{ES_1}\frac{\partial N_1}{\partial F_d}dx_1 + \int_0^a \frac{N_2}{ES_1}\frac{\partial N_2}{\partial F_d}dx_2 + \int_0^{2a} \frac{N_3}{ES_2}\frac{\partial N_3}{\partial F_d}dx_3 + \Delta T \alpha_T \cdot 2a =$$

$$= \frac{N_1 \cdot a}{ES_1}\frac{\partial N_1}{\partial F_d} + \frac{N_2 a}{ES_1}\frac{\partial N_2}{\partial F_d} + \frac{N_3 \cdot 2a}{ES_2}\frac{\partial N_3}{\partial F_d} + \Delta T \alpha_T \cdot 2a = \frac{F \cdot a}{ES_1} \cdot 0 + \frac{2Fa}{ES_1} \cdot 0 +$$

$$+ \frac{2F \cdot 2a}{ES_2} \cdot 1 + \Delta T \alpha_T \cdot 2a = \frac{4F \cdot a}{ES_2} + \Delta T \alpha_T \cdot 2a$$

$$u_B = \frac{\partial W}{\partial F^*} = \frac{N_1 a}{ES_1}\frac{\partial N_1}{\partial F^*} + \frac{N_2 \cdot a}{ES_1}\frac{\partial N_2}{\partial F^*} + \frac{N_3 \cdot 2a}{ES_2}\frac{\partial N_3}{\partial F^*} + \Delta T \alpha_T \cdot 2a = \frac{F \cdot a}{ES_1} \cdot 0 +$$

$$+ \frac{2F \cdot a}{ES_1} \cdot 1 + \frac{2F \cdot 2a}{ES_2} \cdot 1 + \Delta T \alpha_T \cdot 2a = \frac{2F \cdot a}{E}\left(\frac{1}{S_1} + \frac{2}{S_2}\right) + \Delta T \alpha_T \cdot 2a$$

$$u_C = \frac{\partial W}{\partial F} = \frac{N_1 \cdot a}{ES_1}\frac{\partial N_1}{\partial F} + \frac{N_2 \cdot a}{ES_1}\frac{\partial N_2}{\partial F} + \frac{N_3 \cdot 2a}{ES_2}\frac{\partial N_3}{\partial F} + \Delta T \alpha_T \cdot 2a = \frac{F \cdot a}{ES_1} \cdot 1 + \frac{2F \cdot a}{ES_1} \cdot 1 +$$

$$+ \frac{2F \cdot 2a}{ES_2} \cdot 1 + \Delta T \alpha_T \cdot 2a = \frac{F \cdot a}{E}\left(\frac{1}{S_1} + \frac{2}{S_1} + \frac{4}{S_2}\right) + \Delta T \alpha_T \cdot 2a$$

$$S_1 = 314\ mm^2, \quad S_2 = 404\ mm^2$$

$$u_A = \frac{4 \cdot 1000 \cdot 500}{2.1 \cdot 10^5 \cdot 404} + 50 \cdot 12.5 \cdot 10^{-6} \cdot 1000 = \underline{6.38 \cdot 10^{-1}}\ mm$$

$$u_B = \frac{2 \cdot 1000 \cdot 500}{2.1 \cdot 10^5}\left(\frac{1}{314} + \frac{2}{404}\right) + 50 \cdot 12.5 \cdot 10^{-6} \cdot 1000 = \underline{6.54 \cdot 10^{-1}}\ mm$$

$$u_C = \frac{1000 \cdot 500}{2.1 \cdot 10^5}\left(\frac{1}{314} + \frac{2}{314} + \frac{4}{404}\right) + 50 \cdot 12.5 \cdot 10^{-6} 1000 = \underline{6.61 \cdot 10^{-1}}\ mm$$