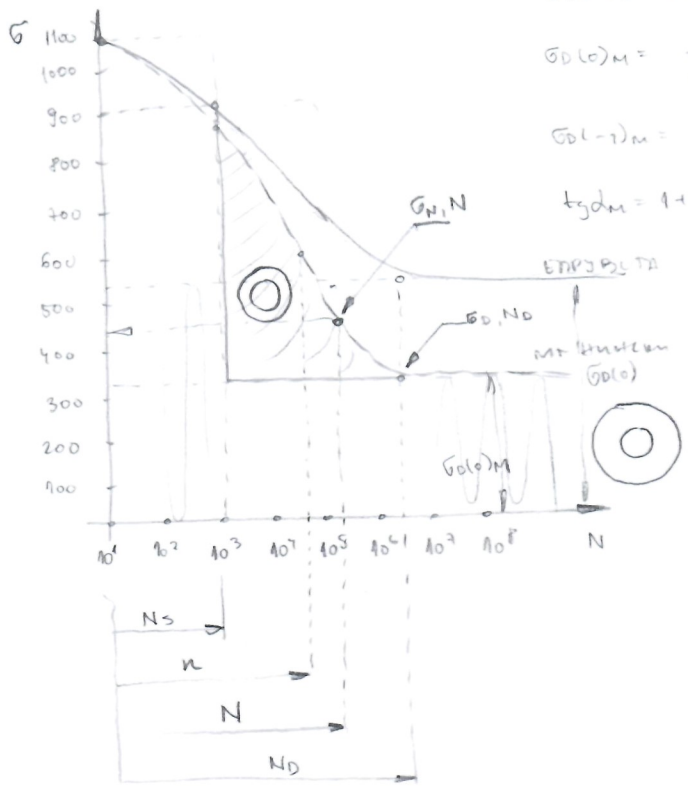
3.1

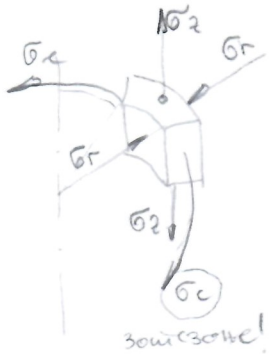
42CrMo4: $R_e = 900$, $R_m = 1100$, $\sigma_{D(0)} = 550$, $\sigma_{D(-1)} = 320$

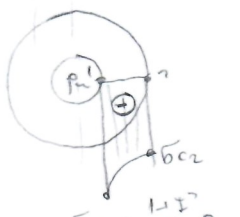



$$\sigma_{D(0)M} = \frac{\sigma_{D(-1)M}}{1 - 0{,}5\,tg\alpha_M} = 334{,}4 \frac{N}{mm^2}$$

$$\sigma_{D(-1)M} = \frac{\sigma_{D(-1)}}{K_D} = \frac{320}{1{,}75} = 182{,}85 \frac{N}{mm^2}$$

$$tg\alpha_M = 1 + \left(1 - \frac{2 \cdot \sigma_{D(-1)}}{\sigma_{D(0)}}\right)\frac{1}{K_D} = 0{,}90\,6494$$




$$\sigma_{c_1} = \frac{1+\gamma^2}{1-\gamma^2} p_w$$

$n = 8 \cdot 10^4$

$N = 1{,}2 \cdot 10^5$

a) $\sigma < \sigma_{do2}$

$$\sigma_c < \frac{[\sigma]}{S} = \frac{\sigma_{D(0)M}}{S} = \frac{334{,}4}{1{,}5} = 222{,}9$$

$$\frac{1+\gamma^2}{1-\gamma^2} p_w < 222{,}9$$

$$\frac{1+\gamma^2}{1-\gamma^2} < \frac{222{,}9}{p_{wg}} = \frac{222{,}9}{60} = 3{,}715$$

$$1+\gamma^2 < (1-\gamma^2)\,3{,}715$$

$$1+\gamma^2 < 3{,}715 - 3{,}715\gamma^2$$

$$4{,}715\gamma^2 < 2{,}715$$

$$\gamma^2 < \frac{2{,}715}{4{,}715} = 0{,}5758$$

$$\gamma = \sqrt{0{,}5758} = 0{,}7588 < 0{,}9 \checkmark$$

$$\gamma = \frac{d_w}{d_1} \Rightarrow d_1 = \frac{d_w}{\gamma} = \frac{72}{0{,}7588} = 94{,}88\,mm$$


$$B_1 = (d_1^2 - d_w^2)\frac{\pi}{4}$$

$$= (95^2 - 72^2)\frac{\pi}{4}$$

$$B_1 = 3016{,}71\,mm^2$$

b) $S_N = \frac{N}{n} \Rightarrow N = S_N \cdot n = 1{,}5 \cdot 80\,000 = 120\,000$

$$\sigma_N^m \cdot N = \sigma_D^m \cdot N_D$$

$$\sigma_N = \left(\frac{N_D}{N}\right)^{\frac{1}{m}} \cdot \sigma_D = \left(\frac{3{,}6 \cdot 10^6}{1{,}2 \cdot 10^5}\right)^{\frac{1}{8}} \cdot 334{,}4 = 511{,}5$$

$\sigma_c < \sigma_N$

$$\frac{1+\gamma^2}{1-\gamma^2} p_w < 511{,}5$$

$$\frac{1+\gamma^2}{1-\gamma^2} < \frac{511{,}5}{p_{wg}} = \frac{511{,}5}{60} = 8{,}525$$

$$1+\gamma^2 = (1-\gamma^2)\,8{,}525$$

$$1+\gamma^2 = 8{,}525 - 8{,}525\gamma^2$$

$$9{,}525\gamma^2 = 7{,}525$$

$$\gamma^2 = \frac{7{,}525}{9{,}525} = 0{,}79$$

$$\gamma = \sqrt{0{,}79} = 0{,}88 < 0{,}9 \checkmark$$

$d_1 = 81\,mm$


$$B_2 = (81^2 - 72^2)\frac{\pi}{4}$$

$$B_2 = 1081{,}49\,mm^2$$

c) $m = \rho \cdot V = \rho \cdot B \cdot h$

$m_1 = \rho B_1 h$, $m_2 = \rho B_2 h$

$$\frac{m_1}{m_2} = \frac{\rho B_1 h}{\rho B_2 h} = \frac{B_1}{B_2} = \frac{3016{,}71}{1081{,}49} = 2{,}79!$$