



$$01) \quad p_{\max} = 0,4 \sin 90^\circ = 0,4 \text{ MPa}$$

$$\theta_1 = 25^\circ$$

$$\theta_2 = 125^\circ$$

$$d_6 = 200 \text{ mm}$$

$$d_7 = \frac{100}{\cos 25^\circ} = 110,34 \text{ mm}$$

$$r = 150 \text{ mm}$$

6x0,5

$$T_T = 2 \frac{\mu \cdot p_{\max} \cdot b \cdot r^2}{\sin \theta_{\max}} (\cos \theta_1 - \cos \theta_2)$$

$$T_T = 2 \frac{0,4 \cdot 0,4 \cdot 10^6 \cdot 35 \cdot 10^{-3} \cdot 0,15^2}{(1)} (\cos 25^\circ - \cos 125^\circ) = 372,93 \text{ Nm} \checkmark$$

$$M_N = \frac{d_7 \cdot b \cdot r \cdot p_{\max}}{4 \sin \theta_{\max}} \left[ 2(\theta_2 - \theta_1) \frac{\pi}{180^\circ} - \sin 2\theta_2 + \sin 2\theta_1 \right]$$

$$M_N = \frac{110,34 \cdot 35 \cdot 0,15 \cdot 0,4}{4} \left[ 2(100) \frac{\pi}{180^\circ} - \sin 250^\circ + \sin 50^\circ \right]$$

$$M_N = 301,02 \text{ Nm} \checkmark$$

$$M_F = \frac{\mu \cdot b \cdot r \cdot p_{\max}}{\sin \theta_{\max}} \left[ -r(\cos \theta_2 - \cos \theta_1) + \frac{d_7}{4} (\cos 2\theta_2 - \cos 2\theta_1) \right]$$

$$M_F = \frac{0,4 \cdot 35 \cdot 150 \cdot 0,4}{(1)} \left[ -0,15(\cos 125^\circ - \cos 25^\circ) + \frac{110,34 \cdot 10^{-3}}{4} (\cos 250^\circ - \cos 50^\circ) \right]$$

$$M_F = 163,64 \text{ Nm} \checkmark$$

$$F_1 = \frac{M_N - M_F}{d_6} = \frac{301,02 - 163,64}{0,2} = 686,9 \text{ N} \checkmark$$

$$F_2 = \frac{M_N + M_F}{d_6} = \frac{301,02 + 163,64}{2} = 2323,3 \text{ N} \checkmark$$

$$02) y_1 = y_2$$

$$\frac{8 \cdot D^3 \cdot N_0 \cdot F_1}{8 \cdot d^4} = \frac{8 \cdot D^3 \cdot N_0 \cdot F_2}{8 \cdot d^4}$$

$$\frac{(25 \cdot 10^{-3})^3 \cdot 10 \cdot F_1}{(5 \cdot 10^{-3})^4} = \frac{(45 \cdot 10^{-3})^3 \cdot 5 \cdot F_2}{(8 \cdot 10^{-3})^4}$$

$$F_1 = 0,44 F_2$$

$$F_1 + F_2 = 4200$$

$$\text{logo: } 1,44 F_2 = 4200$$

$$F_2 = 2916,67 \text{ N} \checkmark$$

$$F_1 = 1283,33 \text{ N} \checkmark$$

$$n_1 = \frac{1664,92}{1283,33} \approx 1,3 \checkmark$$

$$n_2 = \frac{3620,6}{2916,67} \approx 1,24 \checkmark$$

$$y = \frac{8 \cdot (5)^3 \cdot 10 \cdot 1283,33}{78,6 \cdot 10^9 \cdot (5 \cdot 10^{-3})^3}$$

$$y_{\text{conj}} \approx 32,65 \text{ mm} \checkmark$$

① INTERNA

$$C = \frac{D}{d} = \frac{25}{5} = 5$$

$$K_N = \frac{20-1}{20-4} + \frac{0,615}{5}$$

$$K_{N1} = 1,31$$

② EXTERNA

$$C = \frac{D}{d} = \frac{45}{8} = 5,625$$

$$K_N = \frac{22,5-1}{22,5-4} + \frac{0,615}{5,625}$$

$$K_{N2} = 1,27$$

$$\sigma = 0,67 \frac{A}{d^m}$$

$$\sigma_1 = 0,67 \frac{2153,5}{5^{0,1625}} = 1110,8 \text{ MPa}$$

$$\sigma_2 = 0,67 \frac{2153,5}{8^{0,1625}} = 1029,12 \text{ MPa}$$

$$\sigma_{\text{max}1} = 1,31 \frac{8 \cdot F_1 \cdot 5}{\pi \cdot (5 \cdot 10^{-3})^2} = 1110,8 \cdot 10^6$$

$$F_{1\text{MAX}} = 1664,92 \text{ N} \checkmark$$

$$\sigma_{\text{max}2} = 1,27 \frac{8 F_2 \cdot 5,625}{\pi \cdot (8 \cdot 10^{-3})^2} = 1029,12 \cdot 10^6$$

$$F_{2\text{MAX}} = 3620,6 \text{ N} \checkmark$$

7x0,5

$$03) F' = \frac{F}{n} = \frac{45000}{9} = 5000 \text{ N}$$

$$M = F \cdot \text{dist} = 45000 \cdot 500 = 22,5 \cdot 10^6 \text{ N} \cdot \text{mm}$$

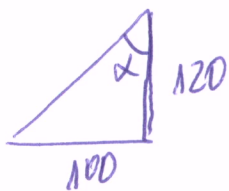
$$r = \sqrt{100^2 + 120^2} = 156,2 \text{ mm}$$

$$\sum r_i^2 = 4(156,2)^2 + 2(100)^2 + 2(120)^2 + 0$$

$$\sum r_i^2 = 1,4639 \cdot 10^5 \text{ mm}^2$$

$$F'' = \frac{M \cdot r}{\sum r_i^2} = \frac{22,5 \cdot 10^6 \cdot 156,2}{1,4639 \cdot 10^5}$$

$$F'' = 24007,79 \text{ N} \checkmark$$



$$\text{tg } \alpha = \frac{100}{120}$$

$$\alpha = 39,8^\circ$$

$7 \times 10^5$

$$R_x = 24007,79 \cdot \cos \alpha = 18444,79 \text{ N} \checkmark$$

$$R_y = 24007,79 \cdot \sin \alpha + 5000 = 20367,62 \text{ N} \checkmark$$

$$R = \sqrt{R_x^2 + R_y^2} = 27478,18 \text{ N} \checkmark$$

$$\sigma_{\text{psc}} = 340 \text{ MPa} \Rightarrow \bar{\sigma} = \frac{0,67 \cdot 340}{1,2} = 189,83 \text{ MPa} \checkmark$$

$$\bar{\sigma} \leq \bar{\sigma}_R$$

$$189,83 = \frac{27478,18}{\frac{\pi d^2}{4}} \Rightarrow d = 13,57 \text{ mm} \checkmark$$

M 14  $\checkmark$