Problema (7.1)

E_1: 40 dentes $\quad \phi_1 = 30$ mm

E_2: 30 dentes $\quad \phi_2 = 25$ mm

$P = 745{,}7 \cdot 25 = 18642{,}5\ W$

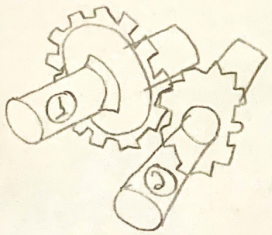
$\omega = 150\ rpm \cdot \left[\frac{2\pi}{60}\right] = 5\pi\ \frac{rad}{s}$

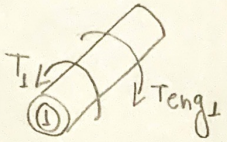
Eixo 1:

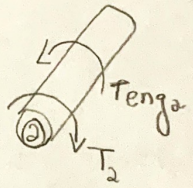
$T_1 = \frac{P}{\omega} = \frac{18642{,}5}{5\pi} = 1186{,}82\ N.m$

$J_{P_1} = \frac{\pi r_1^4}{2} = 2{,}53\pi \times 10^{-8}\ m^4$

$\tau_{x\theta} = \frac{T_1 \cdot r_1}{J_{P_1}} = \frac{1186{,}82 \cdot 15 \times 10^{-3}}{2{,}53 \cdot \pi \times 10^{-8}} = 223{,}87\ MPa$







$\Sigma T_1 : T_1 = T_{eng1}$

$\omega_1 R_1 = \omega_2 R_2 \quad \frac{rad}{s}$

$\omega_2 = 5\pi \cdot \frac{40}{30} = \frac{20\pi}{3}$

$T_{eng2} = \frac{18642{,}5}{\frac{20\pi}{3}} = 890{,}11\ N.m$

$J_{P_2} = \frac{\pi r_2^4}{2} = 1{,}22\pi \times 10^{-8}$

$\tau_{x\theta} = \frac{890{,}11 \cdot 12{,}5 \times 10^{-3}}{1{,}22\pi \times 10^{-8}} = 290{,}3\ MPa$

Maior tensão de cisalhamento

(7.2) Dois eixos

$\omega_1 = 300\ rpm = 10\pi\ rad/s$

$\downarrow$

$\omega_2 = 100\ rpm = \frac{10\pi}{3}\ rad/s$

$\tau_{x\theta_M} = 80\ MPa$

$\theta_{MAX} = 5° = 0{,}087\ rad$

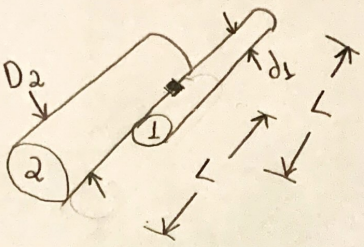
$P = 30\ kW$

$L = 100\ mm = 0{,}1\ m$

$G = 78\ GPa$

Sabe-se:

$R_2 > R_1 ; T_2 > T_1$



$J_{P_1} = \frac{\pi r_1^4}{2}$

Para 1:

$$T_1 = \frac{P}{\omega_1} = \frac{30 \times 10^3}{10\pi} = 954{,}93\ N.m \Rightarrow \tau_{x\theta} = \frac{T_1 . r_1}{J_{P_1}} = \frac{2T_1}{\pi . r_1^3} \quad (1)$$

Para 2:

$$T_2 = \frac{P}{\omega_2} = \frac{30 \times 10^3}{10\pi} . 3 = 2864{,}79\ N.m \Rightarrow \tau_{x\theta} = \frac{T_2 . r_2}{J_{P_2}} = \frac{2T_2}{\pi . r_2^3} \quad (2)$$

Para 1:

$$\varphi = \frac{T . L}{G . J_P} = \frac{T_1 . L . 2}{G . \pi . r_1^4} \quad (3)$$

Para 2:

$$\varphi = \frac{T . L}{G . J_P} = \frac{T_2 . L . 2}{G . \pi . r_2^4} \quad (4)$$

Em (1) e (3):

$$80\ MPa \geq \frac{2 . 954930}{\pi . r_1^3} \Rightarrow r_1 \geq \sqrt[3]{\frac{2 . 954930}{80 . \pi}} \rightarrow r_1 \geq 19{,}66\ mm$$

$$\therefore d_1 \geq 39{,}32\ mm$$

$$0{,}087 \geq \frac{954930 . 100 . 2}{78000 . \pi . r_1^4} \Rightarrow r_1 \geq \sqrt[4]{\frac{200 . 954930}{78000 . \pi . 0{,}087}} \rightarrow r_1 \geq 9{,}73\ mm$$

$$r_2 \geq \sqrt[3]{\frac{2 . 2864790}{80\pi}}$$

$$r_2 \geq 28{,}35\ mm$$

$$r_2 \geq \sqrt[4]{\frac{200 . 2864790}{78000 . \pi . 0{,}087}}$$

$$r_2 \geq 12{,}8\ mm$$

$\therefore$

$$D_2 \geq 56{,}7\ mm$$

(7.3) Pela questão 7.2, tem-se que: $\theta_{MÁX} = 1° = 0,017$ rad

Para $T_x\theta_{MAX}$ $\begin{cases} r_1 \geq 19,66 \text{ mm} \\ r_2 \geq 28,35 \text{ mm} \end{cases}$ $\therefore d_1 \geq 39,32$ mm

$D_2 \geq 56,7$ mm

Para 1:

$$\varphi = \frac{T_1 \cdot L \cdot 2}{G \cdot \pi \cdot r_1^4} \Rightarrow 0,017 \geq \frac{954930 \cdot 100 \cdot 2}{78000 \cdot \pi \cdot r_1^4} \rightarrow r_1 \geq \sqrt[4]{\frac{190986000}{1326\pi}} \rightarrow r_1 \geq 14,63 \text{ mm}$$

Para 2:

$$0,017 \geq \frac{2 \cdot 100 \cdot 2864790}{78000 \cdot \pi \cdot r_2^4} \rightarrow r_2 \geq \sqrt[4]{\frac{200 \cdot 2864790}{78000 \cdot 0,017\pi}} \rightarrow r_2 \geq 19,26 \text{ mm}$$

(7.4) Pela questão 7.2 tem-se que: $\theta_{MAX} = 4° = 0,0698$ rad

Para $T_x\theta_{MAX}$ $\begin{cases} r_1 \geq 19,66 \text{ mm} \\ r_2 \geq 28,35 \text{ mm} \end{cases}$ $\therefore$ $d_1 = 39,32$ mm

$D_1 = 56,7$ mm

Para 1:

$$r_1 \geq \sqrt[4]{\frac{190986000}{78000 \cdot \pi \cdot 0,0698}} \rightarrow r_1 \geq 10,28 \text{ mm}$$

$$r_2 \geq \sqrt[4]{\frac{200 \cdot 2864790}{78000 \cdot \pi \cdot 0,0698}} \rightarrow r_2 \geq 13,53 \text{ mm}$$