

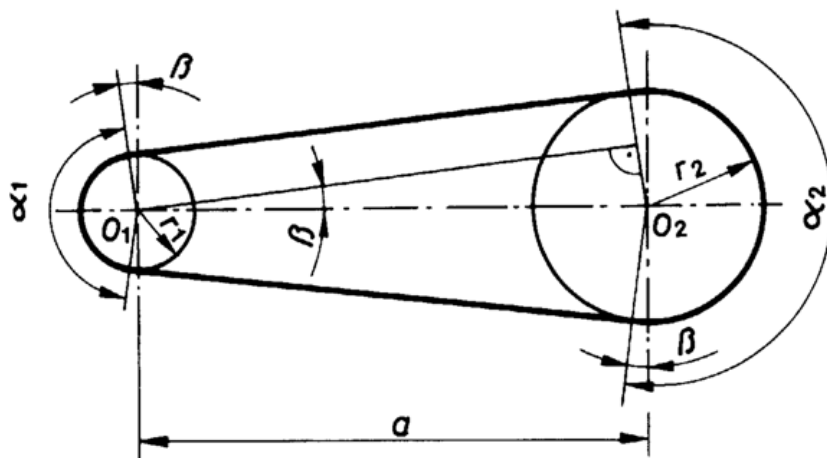


MAŠINSKI ELEMENTI - TREĆA GODINA

Proračun klinastog remenog para - Grupa A

Za prikazani klinasti remeni par, na osnovu poznatih parametara, potrebno je:

1. izračunati podeoni prečnik pogonske remenice
2. izračunati podeoni prečnik gonjene remenice
3. odrediti odvojni ugao pogonske i gonjene remenice
4. izvršiti izbor standardne dužine remena
5. sracunati stvarno osno rastojanje i stvarne odvojne uglove
6. odrediti obimnu silu na pogonskoj remenici
7. odrediti koeficijent trenja između remena i remenice
8. izračunati silu u vucnom i slobodnom ogranku remena
9. odrediti silu zatezanja remena
10. odrediti broj potrebnih klinastih remena za prenos date snage
11. odrediti mere klinastih remena
12. sracunati napon zatezanja u vucnom ogranku, napon usled centrifugalne sile i napon savijanja
13. odrediti maksimalni napon u remenu
14. izračunati broj promena napona savijanja do razaranja remena
15. proceniti radni vek remena



Polazni podaci

snaga pogonske masine	$P = 40 \cdot \text{kW}$
broj obrtaja pogonske masine	$n_1 = 1200 \cdot \text{min}^{-1}$
prenosni odnos remenog para	$i = 2$
tip remena	D
polozaj remenog para	vertikalan
preopterećenje	do 20%

Resenjepodeoni prečnik pogonske remenice

$$d_1 = 500 \cdot \text{mm} \quad \text{Tab. 4.15 str. 161}$$

podeoni prečnik gonjene remenice

$$d_2 = d_1 \cdot i \cdot \xi_k$$

$$\xi_k = 0.985$$

$$d_2 = d_1 \cdot i \cdot \xi_k \quad d_2 = 985 \text{ mm}$$

usvajam

$$d_2 = 1000 \cdot \text{mm}$$

odvojni ugao pogonske i gonjene remenice

$$\alpha_1 = 180 \text{ deg} - 2 \cdot \beta$$

$$\alpha_2 = 180 \text{ deg} + 2 \cdot \beta$$

$$\sin(\beta) = \frac{d_2 - d_1}{2 \cdot a}$$

$$a = (1.2 + 2)(d_1 + d_2)$$

usvajam

$$a = 1.6 \cdot (d_1 + d_2)$$

$$a = 2.4 \text{ m}$$

$$\beta = \arcsin\left(\frac{d_2 - d_1}{2 \cdot a}\right)$$

$$\beta = 5.979 \text{ deg}$$

$$\alpha_1 = 180 \cdot \text{deg} - 2 \cdot \beta$$

$$\alpha_1 = 168.042 \text{ deg}$$

$$\alpha_2 = 180 \cdot \text{deg} + 2 \cdot \beta$$

$$\alpha_2 = 191.958 \text{ deg}$$

izbor standardne duzine remena

$$L_p = (d_1 + d_2) \cdot \frac{\pi}{2} + 2 \cdot a \cdot \cos(\beta) + (d_2 - d_1) \cdot \frac{\pi}{2} \cdot \frac{\beta}{90 \cdot \text{deg}}$$

$$L_p = 7.182 \text{ m}$$

usvajam

$$L_p = 7100 \cdot \text{mm}$$

str. 160

stvarno osno rastojanje

$$a = \frac{1.01 \cdot L_p - (d_1 + d_2) \cdot \frac{\pi}{2} - (d_2 - d_1) \cdot \frac{\pi}{2} \cdot \frac{\beta}{90 \cdot \text{deg}}}{2 \cos(\beta)}$$

$$a = 2.394 \text{ m}$$

stvarni odvojni ugao pogonske i gonjene remenice

$$\beta = \arcsin\left(\frac{d_2 - d_1}{2 \cdot a}\right)$$

$$\beta = 5.993 \text{ deg}$$

$$\alpha_1 = 180 \cdot \text{deg} - 2 \cdot \beta$$

$$\alpha_1 = 168.013 \text{ deg}$$

$$\alpha_2 = 180 \cdot \text{deg} + 2 \cdot \beta$$

$$\alpha_2 = 191.987 \text{ deg}$$

obimna sila na pogoskoj remenici $F_t = \frac{2 \cdot T}{d_1}$

$$T = \frac{P}{\omega_1}$$

$$\omega_1 = 2 \cdot \pi \cdot n_1 \quad \omega_1 = 125.664 \text{ s}^{-1}$$

$$T = \frac{P}{\omega_1} \quad T = 318.31 \text{ N}\cdot\text{m}$$

$$F_t = \frac{2 \cdot T}{d_1} \quad F_t = 1.273 \times 10^3 \text{ N}$$

koeficijent trenja izmedju remena i remenice

$$\mu = 0.3 \quad \text{str. 163}$$

sila u vucnom i slobodnom ogranku remena

$$F_1 = F_t \cdot \frac{e^{\mu \cdot \alpha_1}}{e^{\mu \cdot \alpha_1} - 1} \quad F_1 = 2.176 \times 10^3 \text{ N}$$

$$F_2 = F_t \cdot \frac{1}{e^{\mu \cdot \alpha_1} - 1} \quad F_2 = 902.87 \text{ N}$$

sila zatezanja remena (opterećenje vratila)

$$F_R = (1.5 + 3) \cdot F_t \cdot \sin\left(\frac{\alpha_1}{2}\right)$$

$$F_R = 2.2 \cdot F_t \cdot \sin\left(\frac{\alpha_1}{2}\right) \quad F_R = 2.786 \times 10^3 \text{ N}$$

broj potrebnih remena $z = \frac{P}{P_1} \cdot K_A$

$$P_1 = P_{n1} \cdot \xi_\alpha \cdot \xi_\delta \cdot \xi_d$$

$$P_{n1} = 9.6 \text{ kW}$$

Tab. 4.24 str. 169

$$v = d_1 \cdot \pi \cdot n_1$$

$$v = 31.416 \frac{\text{m}}{\text{s}}$$

$$\xi_\alpha = 0.98$$

Tab. 4.20 str. 168

$$\alpha_1 = 168.013 \text{ deg}$$

$$\xi_\delta = 0.8$$

Tab. 4.22 str. 169

za vertikalni remeni par

$$\xi_d = 1$$

str. 170

$$d_1 \geq d_{\min}$$

$$P_1 = P_{n1} \cdot \xi_\alpha \cdot \xi_\delta \cdot \xi_d$$

$$P_1 = 7.526 \text{ kW}$$

$$K_A = 1.1$$

Tab. 4.18 str. 167

$$z = \frac{P}{P_1} \cdot K_A$$

$$z = 5.846$$

usvajam

$$z = 6$$

mere klinastih remena

$$b = 32 \text{ mm}$$

$$h = 19 \text{ mm}$$

$$l_p = 27 \text{ mm}$$

$$\alpha = 40 \text{ deg}$$

napon zatezanja u vucnom ogranku

$$\sigma_1 = \frac{F_1}{z \cdot A}$$

$$A = h \cdot \left(b - h \cdot \tan\left(\frac{\alpha}{2}\right) \right)$$

$$A = 476.607 \text{ mm}^2$$

$$\sigma_1 = \frac{F_1}{z \cdot A}$$

$$\sigma_1 = 0.761 \frac{\text{N}}{\text{mm}^2}$$

napon od centrifugalne sile

$$\sigma_c = \rho \cdot v^2$$

$$\rho = 1250 \cdot \frac{\text{kg}}{\text{m}^3}$$

str. 165

$$\sigma_c = \rho \cdot v^2$$

$$\sigma_c = 1.234 \frac{\text{N}}{\text{mm}^2}$$

napon savijanja $\sigma_s = \frac{h}{d_1} \cdot E_s$

$E_s = 40 \div 50 \cdot \frac{N}{\text{mm}^2}$ str. 165

usvajam $E_s = 45 \cdot \frac{N}{\text{mm}^2}$

$\sigma_s = \frac{h}{d_1} \cdot E_s$ $\sigma_s = 1.71 \frac{N}{\text{mm}^2}$

maksimalni napon u remenu

$\sigma_{\max} = \sigma_1 + \sigma_c + \sigma_s$ $\sigma_{\max} = 3.705 \frac{N}{\text{mm}^2}$

broj promena napona savijanja do razaranja remena $N = N_0 \cdot \left(\frac{\sigma_{N0}}{\sigma_{\max}} \right)^m \cdot \frac{\xi_i}{K_A}$

$\sigma_N^m \cdot N = \sigma_{N0}^m \cdot N_0 = \text{const}$

$\sigma_{N0} = 7.5 \cdot \frac{N}{\text{mm}^2}$ Tab. 4.16 str. 167

$N_0 = 10^7$ Tab. 4.16 str. 167

$m = 8$ Tab. 4.16 str. 167

$\xi_i = 1.8$ Tab. 4.17 str. 167 $i = 2$

$N = N_0 \cdot \left(\frac{\sigma_{N0}}{\sigma_{\max}} \right)^m \cdot \frac{\xi_i}{K_A}$

radni vek remena $t = \frac{N}{f_s}$

$f_s = \frac{2 \cdot v}{L_p}$ $f_s = 8.85 \text{ s}^{-1}$

$t = \frac{N}{f_s}$ $t = 1.449 \times 10^5 \text{ hr}$