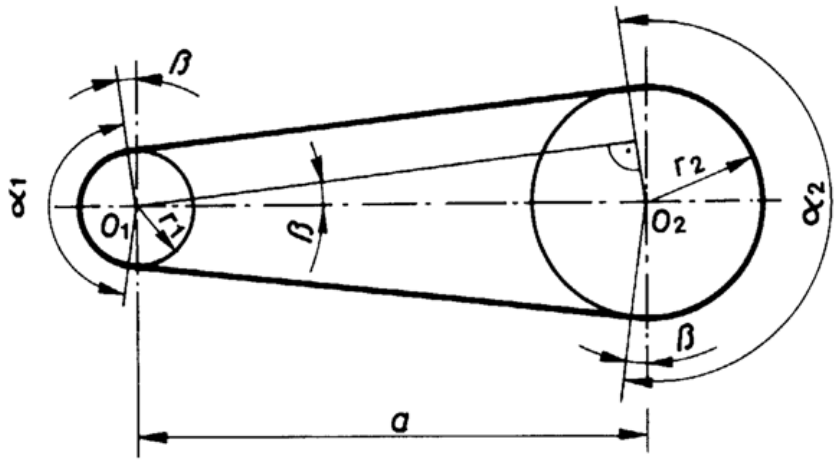
Pro\Machine

MAŠINSKI ELEMENTI - TRECA GODINA

Proracun pljosnatog remenog para - Grupa B

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

1. izracunati podeoni precnik pogonske remenice
2. izracunati podeoni precnik gonjene remenice
3. odrediti odvojni ugao pogonske i gonjene remenice
4. izvrsiti izbor standardne duzine remena
5. sracunati stvarno osno rastojanje i stvarne odvojne uglove
6. odrediti obimnu silu na pogonskoj remenici
7. odrediti koeficijent trenja izmedju remena i remenice
8. izracunati silu u vucnom i slobodnom ogranku remena
9. odrediti silu zatezanja remena
10. usvojiti standardnu sirinu remena
11. sracunati napon zatezanja u vucnom ogranku, napon usled centrifugalne sile i napon savijanja
12. odrediti maksimalni napon u remenu
13. izracunati broj promena napona savijanja do razaranja remena
14. proceniti radni vek remena



Polazni podaci

snaga pogonske masine	$P = 6 \cdot kW$
broj obrtaja pogonske masine	$n_1 = 900 \cdot min^{-1}$
prenosni odnos remenog para	$i = 2.5$
materijal remena	viseslojni remen sa vucnom trakom od poliamida
debljina remena	$h = 3 \cdot mm$
polozaj remenog para	pod uglom od 45 stepeni
preopterecenje	do 20%

Resenje

podeoni precnik pogonske remenice

$\frac{d}{h} = 90$ Tab. 4.14 str. 158

$d = 90 \cdot h$ $d = 270\,mm$ usvajam $d_1 = 270 \cdot mm$

podeoni precnik gonjene remenice $d_2 = d_1 \cdot i \cdot \xi_k$

$\xi_k = 0.985$

$d_2 = d_1 \cdot i \cdot \xi_k$ $d_2 = 664.875\,mm$ usvajam $d_2 = 665 \cdot mm$

odvojni ugao pogonske i gonjene remenice $\alpha_1 = 180deg - 2 \cdot \beta$ $\alpha_2 = 180deg + 2 \cdot \beta$

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

$a = (0.6 \div 2)(d_1 + d_2)$ usvajam $a = 1.3 \cdot (d_1 + d_2)$ $a = 1.216\,m$

$$\beta = \operatorname{asin}\left(\frac{d_2 - d_1}{2 \cdot a}\right) \qquad \beta = 9.351\,deg$$

$\alpha_1 = 180 \cdot deg - 2 \cdot \beta$ $\alpha_1 = 161.298\,deg$

$\alpha_2 = 180 \cdot deg + 2 \cdot \beta$ $\alpha_2 = 198.702\,deg$

izbor standardne duzine remena

$$L_p = (d_1 + d_2) \cdot \frac{\pi}{2} + 2 \cdot a \cdot \cos(\beta) + (d_2 - d_1) \cdot \frac{\pi}{2} \cdot \frac{\beta}{90 \cdot deg} \qquad L_p = 3.932\,m$$

usvajam $L_p = 4000 \cdot mm$ str. 160

stvarno osno rastojanje

$$a = \frac{1.01 \cdot L_p - (d_1 + d_2) \cdot \frac{\pi}{2} - (d_2 - d_1) \cdot \frac{\pi}{2} \cdot \frac{\beta}{90 \cdot deg}}{2\cos(\beta)} \qquad a = 1.27\,m$$

odvojni ugao pogonske i gonjene remenice

$$\beta = \operatorname{asin}\left(\frac{d_2 - d_1}{2 \cdot a}\right) \qquad \beta = 8.944\,deg$$

$\alpha_1 = 180 \cdot deg - 2 \cdot \beta$ $\alpha_1 = 162.111\,deg$

$\alpha_2 = 180 \cdot deg + 2 \cdot \beta$ $\alpha_2 = 197.889\,deg$

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

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

$\omega_1 = 2 \cdot \pi \cdot n_1$ $\omega_1 = 94.248\,s^{-1}$

$T = \frac{P}{\omega_1}$ $T = 63.662\,N \cdot m$

$F_t = \frac{2 \cdot T}{d_1}$ $F_t = 471.57\,N$

koeficijent trenja izmedju remena i remenice

$\mu = 0.6$ Tab. 4.14 str. 158

sila u vucnom i slobodnom ogranku remena

$F_1 = F_t \cdot \frac{e^{\mu \cdot \alpha_1}}{e^{\mu \cdot \alpha_1} - 1}$ $F_1 = 577.281\,N$

$F_2 = F_t \cdot \frac{1}{e^{\mu \cdot \alpha_1} - 1}$ $F_2 = 105.71\,N$

sila zatezanja remena (opterecenje vratila)

$$F_R = (2.5 \div 3.5) \cdot F_t \cdot \sin\left(\frac{\alpha_1}{2}\right)$$

$F_R = 3 \cdot F_t \cdot \sin\left(\frac{\alpha_1}{2}\right)$ $F_R = 1.398 \times 10^3\,N$

sirina remena

$\sigma_k = \frac{F_t}{A} \cdot K_A \le \sigma_{kd}$ $A = b \cdot h$

$$b = \frac{F_t \cdot K_A}{h \cdot \sigma_{kd}}$$

$\sigma_{kd} = \sigma_{kd0} \cdot \xi_\alpha \cdot \xi_v \cdot \xi_\delta$

$\sigma_{kd0} = 7 \cdot \frac{N}{mm^2}$ Tab. 4.19 str. 168

$\xi_\alpha = 0.94$ Tab. 4.20 str. 168 $\alpha_1 = 162.111\ deg$

$\xi_v = 0.98$ Tab. 4.21 str. 168 $v = d_1 \cdot \pi \cdot n_1$ $v = 12.723 \frac{m}{s}$

$\xi_\delta = 0.9$ Tab. 4.22 str. 169 za remeni par pod uglom od 45 stepeni

$\sigma_{kd} = \sigma_{kd0} \cdot \xi_\alpha \cdot \xi_v \cdot \xi_\delta$ $\sigma_{kd} = 5.804 \frac{N}{mm^2}$

$K_A = 1.1$ Tab. 4.18 str. 167

$b = \frac{F_t \cdot K_A}{h \cdot \sigma_{kd}}$ $b = 29.794\,mm$ usvajam $b = 32 \cdot mm$ Tab. 4.23 str. 169

napon zatezanja u vucnom ogranku $\sigma_1 = \frac{F_1}{A}$

$A = b \cdot h$ $A = 96\,mm^2$

$\sigma_1 = \frac{F_1}{A}$ $\sigma_1 = 6.013 \frac{N}{mm^2}$

napon od centrifugalne sile $\sigma_c = \rho \cdot v^2$

$\rho = 1150 \cdot \frac{kg}{m^3}$ Tab. 4.14 str. 158

$\sigma_c = \rho \cdot v^2$ $\sigma_c = 0.186 \frac{N}{mm^2}$

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

$E_s = 750 \cdot \frac{N}{mm^2}$ Tab. 4.14 str. 158

$\sigma_s = \frac{h}{d_1} \cdot E_s$ $\sigma_s = 8.333 \frac{N}{mm^2}$

maksimalni napon u remenu

$$\sigma_{max} = \sigma_1 + \sigma_c + \sigma_s \qquad \sigma_{max} = 14.533 \frac{N}{mm^2}$$

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

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

$\sigma_{N0} = 80 \cdot \frac{N}{mm^2}$ Tab. 4.16 str. 167

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

$m = 13$ Tab. 4.16 str. 167

$\xi_i = 1.75$ Tab. 4.17 str. 167 $i = 2.5$

$$N = N_0 \cdot \left(\frac{\sigma_{N0}}{\sigma_{max}} \right)^m \cdot \frac{\xi_i}{K_A} \qquad N = 6.78 \times 10^{16}$$

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

$$f_s = \frac{2 \cdot v}{L_p} \qquad f_s = 6.362\, s^{-1}$$

$$t = \frac{N}{f_s} \qquad t = 2.961 \times 10^{12}\, hr$$