Machine Elements Report

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F_t tangential force, N
v conveyor belt speed, m/s
D pulley diameter, mm
L service life, $year$
T working torque, $N \cdot mm$
t working time, s
δ_u error of speed ratio, %

Chapter 1

Shaft Design

1.1 Choose material

We choose material based on the following formula:

$$v_s = 4.5 \times 10^{-5} n \sqrt[3]{T}$$

With $n_{sh1} = 2930$ (rpm), $T_{sh1} \approx 37570.93$ (N $\cdot$ mm) $\Rightarrow v_{s1} \approx 4.42$ (m/s)
With $n_{sh2} = 586$ (rpm), $T_{sh2} \approx 178537.08$ (N $\cdot$ mm) $\Rightarrow v_{s2} \approx 1.48$ (m/s)
Therefore, for shaft 1, we choose worm wheel material бра жн 10-4-4, which yields $\sigma_{b1} = 600$ (MPa), $\sigma_{ch1} = 200$ (MPa) according to table 7.1. Using interpolation and table 7.2, the choice of shaft material is quenched and tempered 45 steel (specifications in table 6.1), which yields $[\sigma_{H1}] \approx 191.3259$ (MPa).
For shaft 2, we choose worm wheel material сч 15-32, which yields $\sigma_{b2} = 150$ (MPa), $\sigma_{ch2} = 320$ (MPa) according to table 7.1. Also using interpolation and table 7.2, the choice of shaft material is 20X steel (specifications in table 6.1), which yields $[\sigma_{H2}] \approx 141.7534$ (MPa).

1.2 Determine permissible stress

1.2.1 Find $[\sigma_H]$

Since $v_{s1} \approx 4.42\ (\mathrm{m/s}) < 5\ (\mathrm{m/s})$ and $v_{s2} \approx 1.48\ (\mathrm{m/s}) < 2\ (\mathrm{m/s})$, table 7.2 is used to find $[\sigma_H]$. From the results above, we choose:

$[\sigma_{H1}] \approx 191.3259$ (MPa)

$[\sigma_{H2}] \approx 141.7534$ (MPa)

1.2.2 Find $[\sigma_F]$

For shaft 1, we use the formula:

$$[\sigma_{F1}] = [\sigma_{FO1}] K_{FL1}$$