MA3001 CA2 Belt Pulley Selection July 2023

Machine Element Design (Nanyang Technological University)

MA3001 CA2
Individual Assignment
Belt Pulley Selection

Objective: to familiarise students with using catalogue to select pulleys and to present dimensioned drawings (scaled drawings are not required).

Task: You are to select the appropriate pulleys for the belt drive in Example 1 of the Lecture Notes on Belt Drives. To determine the shaft diameters, it is assumed that all other forces are negligible except for the torque acting on the shafts. The allowable shear stress in the shafts carrying the pulleys is assumed to be 40 MPa. In reality, a shaft can be subjected to a combination of torques, bending moments, lateral forces and axial forces. The accompanying course pulley catalogue allows for selection of taper lock bushes for the shaft.

You are to:

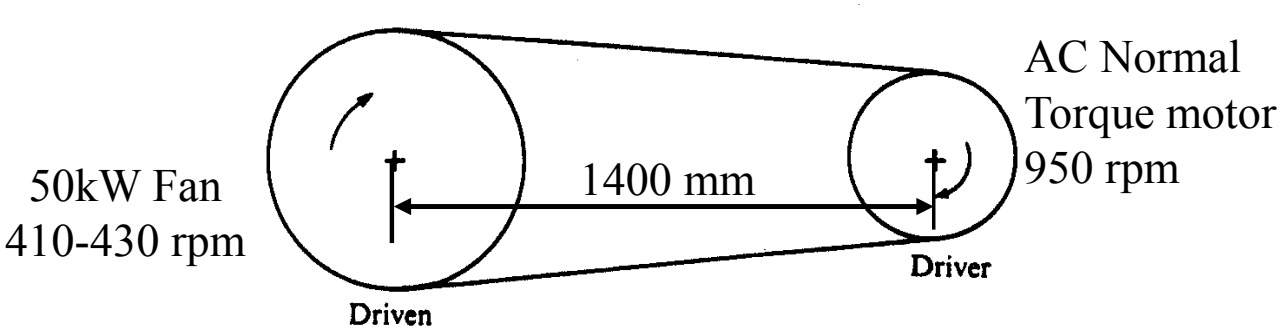
1. show the full analysis and the selection of the taper lock pulleys and taper lock bushes using the course catalogue (taper lock pulleys).
2. make a dimensioned sketch (not necessary to scale) of the two sheaves with the assembled bushes.

Note: in reality and for the design project, you can also select pulleys from other commercial catalogues that do not use detachable bushes or pre-manufactured bores and keyways. You can specify your customized bore diameters and keyways.

Requirements: Individual submission at the end of the session.

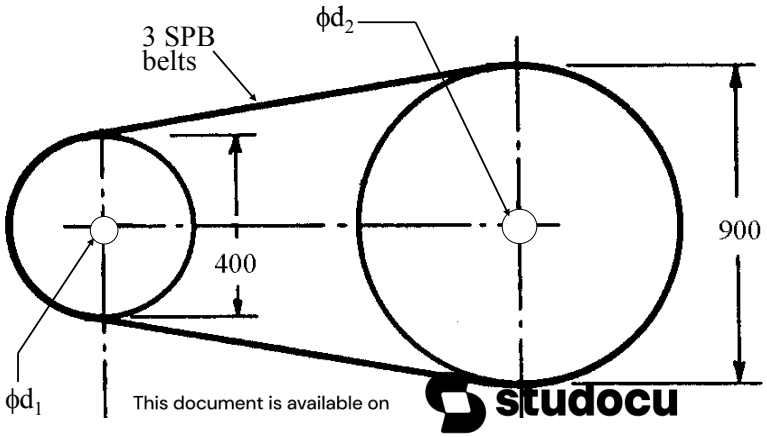
EXAMPLE 1 (covered in lecture)

Design a V-belt drive to transmit 50 kW. Driver sheave speed is 950 rpm and driven sheave speed is 410-430 rpm. Power will be supplied by an AC normal torque motor; the driven unit is a fan which will be operated about 12 hours per day. The centre distance is approximately 1400 mm.



Solution: 3 SPB belt, L = 5000 mm, D_1 = 400 mm, D_2 = 900 mm

d_1 & d_2 are bore diameters (same diameters as shafts)



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1. Torque experienced by each shaft

$P = T\omega$

$\omega_1 = \frac{950 \times 2\pi}{60} = 99.48 \text{ rad/s} \Rightarrow T_1 = \frac{P}{\omega_1} = \frac{50\,000}{99.48} = 502.61 \text{ Nm}$

$\omega_2 = \frac{410 \times 2\pi}{60} = 42.93 \text{ rad/s}$

$\Rightarrow T_2 = \frac{50\,000}{42.93} = 1164.68 \text{ Nm}$

or $\frac{430 \times 2\pi}{60} = 45.03 \text{ rad/s}$

or $\frac{50\,000}{45.03} = 1110.37 \text{ Nm}$

2. Given allowable shear stress = 40 MPa

$\tau = \frac{Tr}{J}, \quad J = \frac{\pi r^4}{2}$

$\Rightarrow \tau = \frac{2Tr}{\pi r^4} = \frac{2T}{\pi r^3}$

$r = \sqrt[3]{\frac{2T}{\tau\pi}}$

$r_1 = \sqrt[3]{\frac{2(502.61)}{40 \times 10^6 \times \pi}}$

$= 0.0199 \text{ m}$

$\approx 0.02 \text{ m} = 20\text{mm}$

$\Rightarrow d_1 = 2r_1 = 40\text{mm}$

$r_2 = \sqrt[3]{\frac{2(1164.68)}{40 \times 10^6 \times \pi}}$

$= 0.026 \text{ m} = 26\text{mm}$

$\Rightarrow d_2 = 2r_2 = 52\text{mm}$

3. From Catalogue SPB, $d_1 = 40\text{mm}$, $D_m = 400\text{mm}$

for 3 belts, $\Rightarrow$ Bush no. = 3535 / using Figure.7

↳ From bushes appendix, for 40 mm

↳ Keyway width = 12 mm, depth = 3.3mm

From Catalogue SPB, $d_2 = 52\text{mm}$, $D_m = 900\text{mm}$

for 3 belts, $\Rightarrow$ Bush no. = 3535 / using Figure.7

↳ From bushes appendix, for 55 mm

↳ Keyway width = 16 mm, depth = 4.3mm