MECHANICAL ENGINEERING SCIENCE

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NUMERICALS

A shaft runs at 80 rpm and drives another shaft at 150 rpm through belt drive. The diameter of the driving pulley is 600 mm. Determine the diameter of the driven pulley in the following cases:
   (i) Neglecting belt thickness
   (ii) Taking belt thickness as 5 mm
   (iii) Assuming for case (ii) a total slip of 4%

NUMERICALS

Solution:

$$N_1 = 80 \text{ rpm} \qquad D_1 = 600 \text{ mm}$$
$$N_2 = 150 \text{ rpm}$$

(i) $\dfrac{N_2}{N_1} = \dfrac{D_1}{D_2}$ or $\dfrac{150}{80} = \dfrac{600}{D_2}$

or $D_2 = \underline{320 \text{ mm}}$

(ii) $\dfrac{N_2}{N_1} = \dfrac{D_1 + t}{D_2 + t}$ or $\dfrac{150}{80} = \dfrac{600 + 5}{D_2 + 5}$

$$D_2 = 317.7 \text{ mm}$$

NUMERICALS

Solution:

(iii) $\dfrac{N_2}{N_1} = \dfrac{D_1 + t}{D_2 + t}\left(\dfrac{100 - S}{100}\right)$

or $\dfrac{150}{80} = \left(\dfrac{600 + 5}{D_2 + 5}\right)\left(\dfrac{100 - 4}{100}\right)$

$D_2 = 304.8 \text{ mm}$

NUMERICALS

Two parallel shafts, connected by a crossed belt, are provided with pulleys 480 mm and 640 mm in diameters. The distance between the centre lines of the shafts is 3 m. Determine by how much the length of the belt should be changed if it is desired to alter the direction of rotation of the driven shaft.

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Solution:

Given: $d_1 = 2\,r_1 = 640\ mm$, $d_2 = 2\,r_2 = 480\ mm$, $x = 3000\ mm$

$\therefore\ r_1 = 320\ mm,\ r_2 = 240\ mm$

Find: $(L_c - L_o) = ?$

For crossed belt

$$L_c = \pi\,(r_1 + r_2) + 2\,x + \frac{(r_1 + r_2)^2}{x}$$

$$L_c = \pi\,(320 + 240) + 2\,(3000) + \frac{(320 + 240)^2}{3000}$$

$$L_c = 7863.83\ mm$$

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Solution:

For open belt

$$L_0 = \pi \, (r_1 + r_2) + 2 \, x + \frac{(r_1 - r_2)^2}{x}$$

$$L_0 = \pi \, (320 + 240) + 2 \, (3000) + \frac{(320 - 240)^2}{3000}$$

$$L_0 = 7761.43 \, mm$$

$\therefore$ Change in length of the belt $= (L_c - L_o) = (7863.83 - 7761.43) = \mathbf{102.4 \, mm}$

$\therefore$ For open belt **shorten the belt by 102.4 mm**

1. Two pulleys of diameters 400 mm and 200 mm are mounted on parallel shafts 1.2 meters apart. A flat open belt connects them.

2. The speed of a driving shaft is 80 rpm and the speed of driven shaft is 120 rpm. Diameter of the driving pulley is given as 600 mm. Find the diameter of driven pulley in the following cases:
(a) If belt thickness is negligible
(b) If belt thickness is 5 mm
(c) If total slip is 10% (considering thickness of belt)
(d) If a slip of 2% on each pulley (considering thickness of belt)

THANK YOU

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