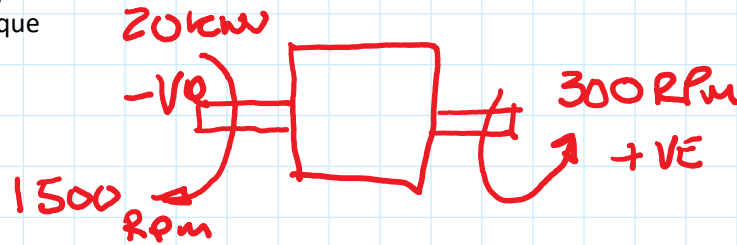


Worked Example 1

24 February 2020 10:20

A simple gearbox the input shaft rotates at 1500 RPM in a clockwise direction and the output shaft at 300 RPM in an anticlockwise direction. If the input power is 20 KW and the gearbox is 70% efficient determine the following:

1. The gear ratio of the gearbox.
2. The input torque
3. The output power
4. The output torque
5. The holding torque



1) GEAR RATIO

$$GR = \frac{\text{INPUT SPEED}}{\text{OUTPUT SPEED}} = \frac{1500}{300} = 5:1 \text{ RATIO}$$

2) INPUT TORQUE (T_1)

$$P = T\omega \rightarrow \text{Power} = \frac{2\pi N T}{60}$$

$$T = \frac{P_1 \times 60}{2\pi N} = \frac{20000 \times 60}{2 \times \pi \times 1500}$$

$$= 127.32 \text{ Nm} \\ \text{Clockwise (-ve)}$$

3) output Power (P_2)

$$\text{Efficiency } \eta = \frac{\text{POWER OUT}}{\text{POWER IN}} \times 100$$

Power In

$$\text{Efficiency} = 70\% = \frac{700}{1000} = 0.7$$

$$0.7 = \frac{P_2}{20000}$$

$$P_2 = 0.7 \times 20000 = \underline{\underline{14000 \text{ W}}}$$

14 kW

4) Output Torque

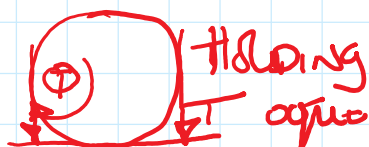
$$\text{Power out} = \frac{2\pi N_2 \times T_2}{60}$$

$$T_2 = \frac{P_2 \times 60}{2\pi N_2} = \frac{14000 \times 60}{2\pi \times 300}$$

$$= 455.63 \text{ Nm}$$

Anti-clockwise +ve

5) Holding Torque (T_3)



For Equilibrium $T_1 + T_2 + T_3 = 0$

$$-127.32 + 455.63 + T_3 = 0$$

$$T_3 = 127.32 - 455.63$$

$$T_3 = -328.31 \text{ Nm}$$

"Clockwise"