SNS COLLEGE OF TECHNOLOGY

COIMBATORE-35

DEPARTMENT OF MECHANICAL ENGINEERING

UNIT -1

Design of Flat Belts and Pulleys

1. Design Parameters to Consider

- **Power to be Transmitted (P)**: The required power in kW or HP.
- **Speed of Driver and Driven Shafts (N1, N2)**: Determines the velocity ratio.
- **Pulley Diameters (D1, D2)**: Affects speed and belt contact area.
- **Center Distance (C)**: Distance between driver and driven pulley shafts.
- **Belt Material and Type**: Affects tensile strength, friction, and flexibility.
- **Load Type**: Steady or variable load conditions.
- **Operating Conditions**: Environmental factors such as temperature and humidity.

2. Steps in Designing Flat Belts and Pulleys

a. Selection of Belt Material

- **Common Materials**: Leather, rubber, fabric, synthetic materials.
- **Factors to Consider**:
  - Coefficient of friction.
  - Tensile strength.
  - Durability under environmental conditions.

b. Determination of Pulley Diameters

- Select diameters D_1 (driver pulley) and D_2 (driven pulley) based on the desired velocity ratio:

$$\text{Velocity Ratio (VR)} = \frac{N_1}{N_2} = \frac{D_2}{D_1}$$

- Larger diameters reduce belt stress and wear.

c. Calculation of Belt Length (L)

- The total belt length is calculated using:

$$L = 2C + \pi \frac{(D_1 + D_2)}{2} + \frac{(D_2 - D_1)^2}{4C}$$

Where:

- C: Center distance.
- D_1: Diameter of the driver pulley.
- D_2: Diameter of the driven pulley.

d. Speed of the Belt (V)

- The linear speed of the belt is given by:

$$V = \frac{\pi D_1 N_1}{60}$$

Where:

- V: Belt speed in m/s.
- D_1: Diameter of the driver pulley in meters.
- N_1: Speed of the driver pulley in RPM.

e. Power Transmission Capacity

- The power transmitted by the belt is determined by:

$$P = (T_1 - T_2) \cdot V$$

Where:

- T_1: Tension on the tight side of the belt.
- T_2: Tension on the slack side.
- V: Belt speed.

f. Tension Ratio

- The ratio of tensions is given by the belt friction equation:

$$\frac{T_1}{T_2} = e^{\mu\theta}$$

Where:

- μ: Coefficient of friction between the belt and pulley.
- θ: Angle of contact (in radians) between the belt and pulley.

g. Determination of Initial Tension (T0)

- The initial tension in the belt ensures effective operation and grip.

$$T_0 = \frac{T_1 + T_2}{2}$$

h. Selection of Pulley Material

- **Common Materials**: Cast iron, steel, wood, or plastic.
- **Factors**: Load capacity, durability, and operating conditions.

i. Groove Design (Optional)

- Flat pulleys may include grooves to improve grip in specific applications.
- Grooves are more common in specialized flat belt drives.

3. Advantages of Flat Belt Drives

- Simple construction and easy maintenance.
- Can transmit power over long distances.
- Operates smoothly with minimal noise.
- Capable of handling moderate loads and speeds.

4. Limitations of Flat Belt Drives

- Slippage reduces efficiency.
- Requires high tension, which can lead to shaft or bearing wear.
- Not suitable for very high power transmission.

5. Applications of Flat Belt Drives

- Textile machinery.
- Agricultural equipment.
- Conveyor systems.
- Early automotive and industrial machinery.