UNIT-II

DESIGN OF SHAFTS AND COUPLINGS

Shaft is a rotating machine element, which transmits Power, shafts are subjected to tensile, bending (or) torsional ~~moment~~ stresses (or) to a combination of these stresses.

Types of Shafts:-

1) For prime movers.
   a) Engine shafts. b) Generator shafts c) Turbine shafts
2) Machine shafts → Intergral part of machine itself
   → or Crank shaft.
3) For Power Transmission.
   a) Line shafts. b) Counter shafts, All factory shafts.

Shaft

→ The shaft may be designed on the basis of
1) strength
2) Rigidity and stiffness
3) Critical speed.

1. Solid shaft
2. Hollow shaft

Design of shaft

on the basis of strength [Data book pg.no 7.21]

1) Twisting moment only.
2) Bending moment only.
3) Combined Twisting and Bending.
4) Combined shock and fatigue factor.

1) Shafts subjected to twisting moment only.

$$\frac{T}{J} = \frac{\tau}{r}.$$

$$J = \pi/32\, d^4.$$

$$J = \pi/32\left[d_o^4 - d_i^4\right].$$

$$T = \pi/16 \times \tau (d_o)^3 (1 - k^4)$$

$$k = d_i/d_o.$$

↑ Ratio of inside diameter to outside diameter

2) For hollow shafts,

$$T = \pi/16 \times \tau \left[\frac{d_o^4 - d_i^4}{d_o}\right]$$

$$T = \pi/16 \times \tau \times d^3.$$

$$\frac{d_o^4 - d_i^4}{d_o} = d^3 \text{ (or)}$$

$$d_o^3 (1 - k^4) = d^3$$

2) $P = \frac{2\pi NT}{60}$ (or) $T = \frac{P \times 60}{2\pi N}$.

3) In case of belt drives, the twisting moment (T) is given by,

$$T = (T_1 - T_2) R.$$

T_1, T_2 = Tensions in the tight side and slack side.

R = Radius of pulley.