EX-1 **A hollow shaft of 200mm inside dia and 300mm outside dia is transmitting 2500KW at 200RPM. Calculate shear stress induced in the shaft.**

SOLUTION:-

- D= 300 mm
- d = 200 mm
- P = 2500KW
- N = 200RPM
- τ = ????

1. Find Twisting moment

$$M_t = \frac{KW \times 10^6 \times 60}{2\pi N} \ (N.mm)$$

$= 2500 \times 10^6 \times 60/(2 \times \pi \times 200)$

$= 119.36 \times 10^6$ N -mm

2.Find shear stess

$$M_t = \frac{\pi}{16}\left[\frac{D^4 - d^4}{D}\right] \times [\tau]$$

$\tau = 16 \times 300 \times 119.36 \times 10^6/(\pi \times (300^4 - 200^4))$

$\tau = 28.06 \ N/mm^2$

EX-2 **A hollow shaft of 240mm inside dia and 320mm outside dia is transmitting 2240KW at 120RPM. Calculate shear stress induced in the shaft.**

SOLUTION:-

- D= 320 mm
- d = 240 mm
- P = 2240 KW
- N = 120 RPM
- τ = ????

1. Find Twisting moment

$$M_t = \frac{KW \times 10^6 \times 60}{2\pi N} \ (N.mm)$$

= 2240 x 10^6 x 60/(2 x π x 120)

= 178.28*10^6 N*mm

2. Find shear stess

$$M_t = \frac{\pi}{16}\left[\frac{D^4 - d^4}{D}\right] \times [\tau]$$

τ = 16 x D x M_t/(π x (D^4-d^4))

τ = 16 x 320 x 178.28 x 10^6/(π x (320^4-240^4))

τ = 40.53 N/mm^2

EX-3. A solid shaft is transmitting 1MW power at 240 RPM. Determine diameter of shaft if maximum torque transmitted exceeds mean torque is 20%. Assume maximum allowable shear stress is 60 Mpa.

SOLUTION:-

- P = 1 MW = 1000 KW
- N = 240 RPM
- τ = 60 Mpa = 60 N/mm^2
- d = ???

1. Find Torque

$$M_t = \frac{KW \times 10^6 \times 60}{2\pi N} \ (N.mm)$$

$T = 1000 \times 10^6 \times 60/(2 \times \pi \times 240)$

$T = 39.78 \times 10^6$ N-mm

2. Maximum torque

$T_{max} = T + (20\% \text{ of } T)$

$= T + (0.2 \times T)$

$= 1.2 \times T$

$= 1.2 \times 39.78 \times 10^6$

T_{max} = 47.73 x 10^6 N-mm

3. Dia of solid shaft

$$M_t = \frac{\pi}{16} d^3 \times [\tau]$$

T_{max} = (π /16) x d^3 x τ

d^3 = 16 x T_{max} /(π x τ)

d^3 = 16 x 47.73 x 10^6/(π x 60)

d = 159.41 mm

EX-4 A hollow shaft is transmitting 20 KW at 300 RPM. If diameter ratio is 0.8 and allowable shear stress for the shaft material is 55 MPa, find thickness of shaft.

SOLUTION:-

- P = 20 KW
- N = 300 RPM
- d/D = 0.8 , d = 0.8*D
- τ = 55 MPa = 55 N/mm^2
- t = ?????

1. Find Torque

$$M_t = \frac{KW \times 10^6 \times 60}{2\pi N} \ (N.mm)$$

= 20 x 10^6 x 60/(2π x 300)

$= 636.61 \times 10^3$ N-mm

2. Find diameter

$$M_t = \frac{\pi}{16}\left[\frac{D^4 - d^4}{D}\right]\times[\tau]$$

$= (\pi \times (D^4 - 0.8^4 D^4) \times 55)/(16 \times D)$ $(1-0.8^4) = 0.59$

$M_t = (\pi \times D^3 \times 0.59 \times 55)/16$

$D^3 = 16 \times M_t/(\pi \times 0.59 \times 55)$

$= 16 \times 636.61 \times 10^3/(\pi \times 0.59 \times 55)$

$= 99.91 \times 10^3$

D = 46.40 mm = 48 mm

Inside dia d = 0.8 x D

d = 0.8 x 48

= 38.40 mm

= 40 mm

3. Thickness of Shaft

t = (D-d)/2

= (48 -40)/2

t = 4 mm