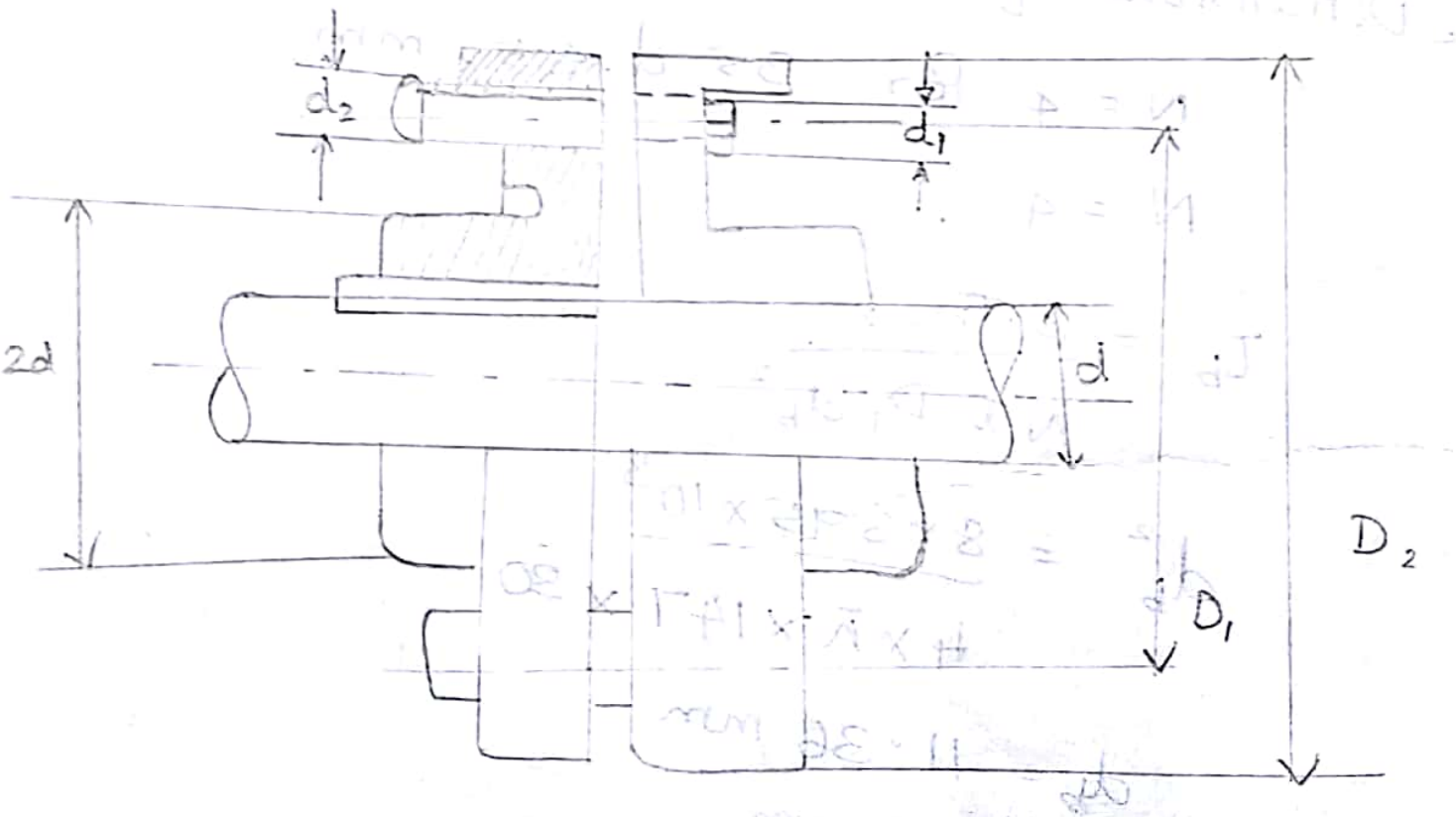
1. Design Bushed pin type flexible flange Coupling transmit 30 kW power at 900 rpm from electical motors to pumps. The maximum torque transmitted is 25% greater than mean torque. Allowable shear stress of shaft & key is 40 MPas. Allowable shear stress of CI flange is 14 MPas. Bearing pressure of push is 6 MPas.



Given :-

$P = 30\ kW$

$N = 900\ rpm$

$\sigma_{SK} = 80\ MPas$

$\tau_{SK} = 40\ MPas.$

$\tau_{CI} = 14\ MPa.$

Diameter of shaft :-

$$T_{max} = \frac{16\, T_{max}}{\pi d^3}.$$

$$T_{mean} = \frac{60 \times P}{2\pi N}$$

$$= \frac{60 \times 30 \times 10^3}{2\pi \times 900.}$$

$$= 318.3 \times 10^3\ N \cdot mm$$

$$T_{max} = 1.25 \times T_{mean}.$$

$$= 397.8 \times 10^3\ N \cdot mm.$$

$$40 = \frac{16 \times 397.8 \times 10^3}{\pi d^3.}$$

$$d^3 = \frac{16 \times 397.8 \times 10^3}{\pi \times 40.}$$

$$d = 37\ mm.$$

Key dimensions.

Width of the key $= d/4$

$= 9.25\ mm.$

$$h = \left(\frac{2}{3}\right) w = 6.16\ mm.$$

iii) Length of key:

$$l = 1.5d$$
$$= 1.5 \times 37$$
$$= 55.5 \text{ mm}$$

$$\tau_d = \frac{2T}{dwl}$$

$$40 = \frac{2 \times 397.8 \times 10^3}{37 \times 9.25 \times l}$$

$$l = \frac{2 \times 397.8 \times 10^3}{37 \times 9.25 \times 40}$$

$$l = 58 \text{ mm}.$$

$$\sigma_c = \frac{4T_{max}}{dlh}$$

$$80 = \frac{4 \times 397.8 \times 10^3}{37 \times 6.16 \times l}$$

$$l = \frac{4 \times 397.8 \times 10^3}{37 \times 6.16 \times 80}$$

$$= 87.26 \text{ mm}$$

$$l = 87 \text{ mm}.$$

iv) Dimension of hub.

i) Length of hub $L = l = 87$ mm.

Outside diameter $D = 2d$

$= 2 \times 37$.

$= 74$ mm.

$$k = d/D = \frac{37}{74}$$

$$= 0.5$$

$$\tau_h = \frac{16T}{\pi D^3 (1-k^4)}$$

$$= \frac{16 \times 397.8 \times 10^3}{\pi \times 74^3 (1-0.5^4)}$$

$$= \frac{6364800}{1193483.19}$$

$$= 5.331 < 14 \text{ MPa}$$

Design is safe.

Dimensions of flange.

$$t_f = 0.5d$$
$$= 0.5 \times 37$$
$$= 18.5 \text{ mm}$$

$$t_p = 0.25d$$
$$= 9.25 \text{ mm}$$

$$\tau_f = \frac{2T}{\pi D^2 t_f}$$

$$= \frac{2 \times 397.8 \times 10^3}{\pi \times 74^2 \times 18.5}$$

$$= 2.49 \text{ N/mm}^2 < 14 \text{ MPa}.$$

Design is safe.

5. Dimension of pin.

i) Number of pins.

$N = 4$

ii) Nominal diameter of pin.

$$d_b = \frac{0.5d}{\sqrt{N}}$$

$$= \frac{0.5 \times 37}{\sqrt{4}}$$

$$= 9.25 \text{ mm}.$$

$$d_1 = d_b + 4$$

$$= 13.25 \text{ mm}.$$

$$d_2 = d_1 + 16 \text{ mm}$$

$$= 13.25 + 16$$

$$= 29.25 \text{ mm}.$$

Diameter of bolt circle

$$D_1 = D + d_2 + 16$$

$$= 74 + 29.25 + 16.$$

$$= 119.25 \text{ mm}.$$

Length of bush in flange.

$$P_b = \frac{2T}{N D_1 d_2 l_b}.$$

$$l_b = \frac{2T}{N D_1 d_2 P_b}.$$

$$= \frac{2 \times 397.8 \times 10^3}{4 \times 119.25 \times 29.25 \times 6}.$$

$l_b = 9.5\ mm$.