A LECTURE NOTE
ON
TH.1 THEORY OF MACHINE
SEMESTER -4

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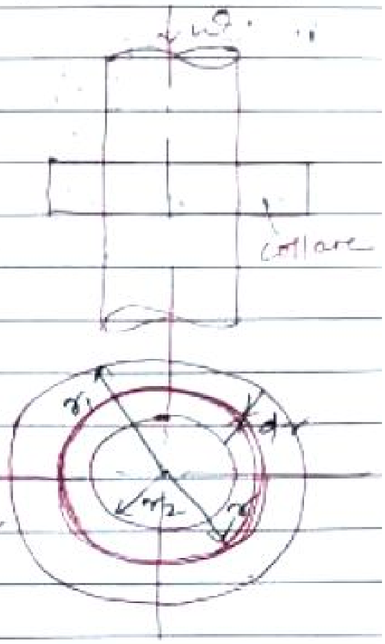
Flat collar Bearing :-



Collar bearing are also known as thrust bearing.

Let r_1 = external radius of collar

r_2 = Internal radius of collar

Area of bearing surface = $\pi(r_1^2 - r_2^2)$ ——— ⟨1⟩

⟨1⟩ Considering uniform press. condition

load on the bearing $W = P \times A$

$$P = \frac{W}{A}$$

$$P = \frac{W}{\pi(R_1^2 - R_2^2)}$$

load on the ring $(dw) = P\,2\pi r\,dr$

frictional force on ring $(dF) = \mu \times dw$

$$dF = \mu p\,2\pi r\,dr$$

frictional torque on ring $(dT) = r \times dF$

$$dT = \mu p\,2\pi r^2\,dr$$

Total torque on bearing $\int_0^T dT = \mu p\,2\pi \int_{r_2}^{r_1} r^2\,dr$

$$T = \mu p\,2\pi\,\frac{R_1^3 - R_2^3}{3}$$

$$T = \mu \times \frac{W}{\pi(R_1^2 - R_2^2)} \times \frac{2\pi(R_1^3 - R_2^3)}{3}$$

$$\boxed{T = \frac{2}{3}\mu W\left(\frac{r_1^3 - r_2^3}{r_1^2 - r_2^2}\right)}$$

(ii) Considering uniform wear condition :—

$P \times r = C$

$P = C/r$ ——— (1)

Load on the ring $(dW) = 2\pi r\,dr\,p$

bearing $\int_0^W dW = 2\pi p \int_{r_2}^{r_1} r\,dr$

$$W = \frac{C}{r} \times 2\pi r \int_{r_2}^{r_1} dr$$

$$W = C\,2\pi (r_1 - r_2)$$

$$C = \frac{W}{2\pi (r_1 - r_2)} \quad \text{——— (2)}$$

Frictional force on ring $(dF) = \mu \times dW$

$$dF = \mu \times p \times 2\pi r\,dr$$

Frictional torque on ring $(dT) = r \times dF$

$$dT = \mu p \times 2\pi r^2 dr$$

$$= \mu \times \frac{C}{r} \times 2\pi r^2 dr$$

$$\int_0^T dT = \mu C\,2\pi \int_{r_2}^{r_1} r\,dr$$

$$T = \mu C\,2\pi \cdot \frac{(r_1^2 - r_2^2)}{2}$$

$$T = \mu \times \frac{W}{2\pi (r_1 - r_2)} \times \pi (r_1^2 - r_2^2)$$

$$T = \frac{\mu \times W}{2} \times (r_1 + r_2) \frac{(r_1 - r_2)}{(r_1 - r_2)}$$

$$\boxed{T = \frac{1}{2} \mu W (r_1 + r_2)}$$

* In order to increase rubbing surface and to reduce intensity of pressure, it is better to use two or more collars, rather than one large collar.

1) In multi-collar bearing, say (n) collars, the intensity of uniform pressure.

$$p = \frac{W}{n \times \text{Bearing area of 1 collar}}$$

$$p = \frac{W}{n\pi(r_1^2 - r_2^2)}$$

2) Total torque in multi-collar shaft remains constant

$$T = \frac{2}{3}\mu n W\left(\frac{r_1^3 - r_2^3}{r_1^2 - r_2^2}\right)$$