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

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Sr. Lecture Mechanical Engineering

Mechanical Engineering

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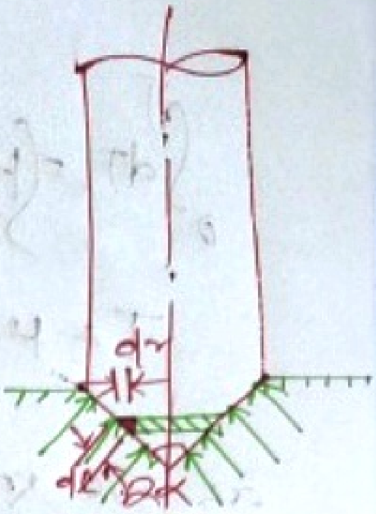
Conical Pivot Bearing



p = pressure intensity

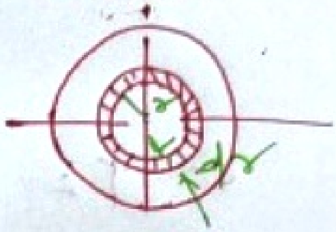
α = semi angle of cone

μ = co-efficient of friction

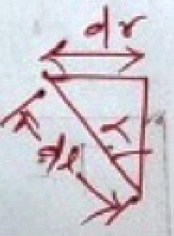
R = radius of shaft

Uniform Pressure Condition

Consider a ring of radius (r) and thickness (dr). Let (dl) be length of ring along the cone



So $\boxed{dl = \operatorname{cosec}\alpha \cdot dr}$



$$\sin\alpha = \frac{dr}{dl}$$

$$dl = \frac{dr}{\sin\alpha}$$

$$dl = \operatorname{cosec}\alpha \cdot dr$$

area of ring $(dA) = 2\pi r \cdot dl$

$$dA = 2\pi r \cdot \operatorname{cosec}\alpha \cdot dr \quad \text{——} \langle 1 \rangle$$

load on ring $(dw) = p \times 2\pi r \cdot \operatorname{cosec}\alpha \cdot dr$ —— $\langle 2 \rangle$

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

$$dF = \mu \times p \times 2\pi r \operatorname{cosec}\alpha \cdot dr \quad \text{——} \langle 3 \rangle$$

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

$$= \mu \times p \times 2\pi r^2 \operatorname{cosec}\alpha \cdot dr \quad \text{——} \langle 4 \rangle$$

Total torque on the bearing surface

$$\int_0^T dT = \mu \times p \times 2\pi \times \operatorname{cosec}\alpha \int_0^R r^2 dr$$

$T = \mu \times p \times 2\pi \times \frac{R^3}{3} \times \operatorname{cosec}\alpha$

as we know $p = \frac{W}{\pi R^2}$

so, $T = \mu \times \frac{W}{\pi R^2} \times \frac{2\pi \times R^3}{3} \operatorname{cosec}\alpha$

$$T = \frac{2}{3}\mu W R \operatorname{cosec}\alpha$$

$\text{Power}(P) = \frac{2\pi N T}{60}$

Uniform wear condition

$p \times r = C$

$p = C/r$

Load transmitted to the ring

$dW = p\, 2\pi r\, dr$

$\int_0^W dW = \int_0^R \frac{C}{r} 2\pi r\, dr$

$W = C\, 2\pi R$

$C = \frac{W}{2\pi R}$ —— ⟨1⟩

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

$dF = \mu p\, 2\pi r\, dr \operatorname{cosec}\alpha$

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

$dT = \mu p\, 2\pi r^2 dr \operatorname{cosec}\alpha$

$$\int_0^T dT = \int \mu \frac{c}{r} 2\pi r \, dr \, \text{cosec}\,\alpha$$

$$T = \mu c \, 2\pi \, \text{cosec}\,\alpha \, \frac{R^2}{2}$$

as we know $c = \dfrac{W}{2\pi R}$

so $T = \mu \times \dfrac{W}{2\pi R} \times \pi \, \text{cosec}\,\alpha \times R^2$

$$\boxed{T = \frac{1}{2} \mu W R \, \text{cosec}\,\alpha}$$

$$\boxed{P = \frac{2\pi N T}{60}}$$