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

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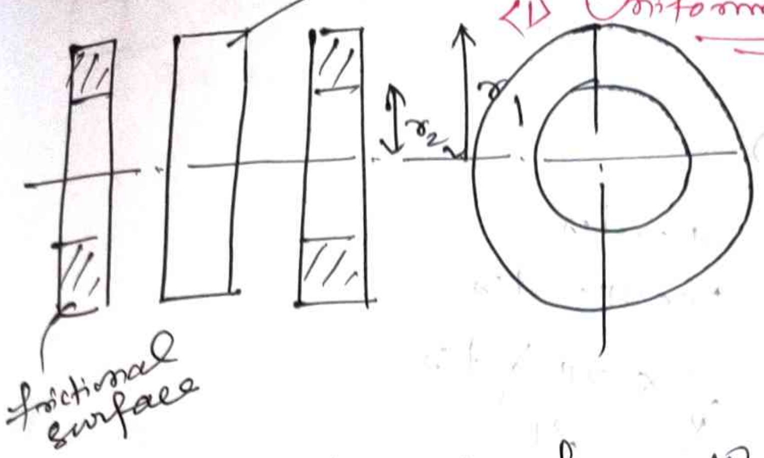
# Frictional Clutch

## (1) Uniform pressure Condition




pressure $p = \frac{Load}{Area} = \frac{w}{\pi(r_1^2 - r_2^2)}$ —— (1)

area on ring $(dA) = 2\pi r\,dr$
load on ring $(dw) = p \times area$
$= p \times 2\pi r\,dr$

Frictional force on ring $(dF) = \mu \times dw$
$= \mu \times p \times 2\pi r\,dr$

Frictional torque on ring $(dT) = \mu \times p \times 2\pi r^2 dr$

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

$$T = \mu p \frac{2}{3}\pi \cdot (r_1^3 - r_2^3)$$

$$T = \frac{2}{3}\mu w \pi \frac{(r_1^3 - r_2^3)}{\pi(r_1^2 - r_2^2)}$$

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

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

## (II) Uniform wear Theory.

(I) $p \times r = C$

$p = C/r$ ——— (1)

area on ring $(dA) = 2\pi r\,dr$

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

$$dW = \frac{C}{r} \times 2\pi r\,dr$$

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

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

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

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

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

Frictional torque on ring $(dT) = \mu\,2\pi r^2\,dr \cdot p$

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

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

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

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

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

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

$$T = n \times \mu W R$$

$n$ = no. of pairs of friction/contact surface

$R = \frac{2}{3}\left(\frac{r_1^3 - r_2^3}{r_1^2 - r_2^2}\right)$ :: Uniform press cond$^n$

$R = \frac{1}{2}(r_1 + r_2)$ :: Uniform wear cond$^n$.

* for single disc/plate clutch normally both side effective. for single plate clutch has two pairs of surface in contact i.e $n = 2$.

* Since intensity of press is max. at inner radius ($r_2$) of the friction/contact surface

$$P_{max} \times r_2 = C$$

$$P_{max} = C/r_2$$

* Since intensity of press is minimum at outer radius ($r_1$). of the friction surface.

$$P_{min} \times r_1 = C$$

$$P_{min} = C/r_1$$

* Average pressure

$$P_{avg} = \frac{W}{\pi(r_1^2 - r_2^2)}$$