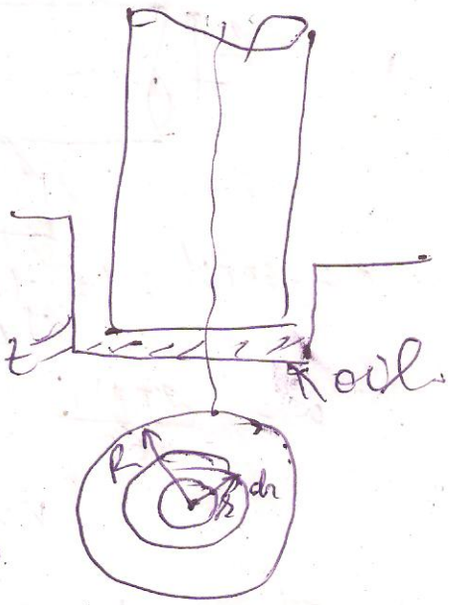
## * Power absorbed in footstep bearing :-

$v = \omega \times r$

$= \frac{2\pi N}{60} \times r$.

Area of ring $= 2\pi r dr$.




$\tau = \mu \frac{du}{dy}$, $\frac{du}{dy} = \frac{v}{t}$.

$\tau = \mu \times \frac{2\pi N}{60} \times \frac{r}{t}$.

shear force

$dF = \tau \times$ Area of ring.

$= \frac{\mu 2\pi N}{60} \times \frac{r}{t} \times 2\pi r dr$.

$= \frac{\mu}{15t} \pi^2 N r^2 dr$,

torque req$^n$ $= dF \times r$

$dT = \frac{\mu}{15t} \pi^2 N r^3 dr$.

Total torque Re$^n$

$T = \int_0^R \frac{\mu}{15t} \pi^2 N r^3 dr = \int_0^R \frac{\mu}{15t} \pi^2 N \frac{R^4}{4}$

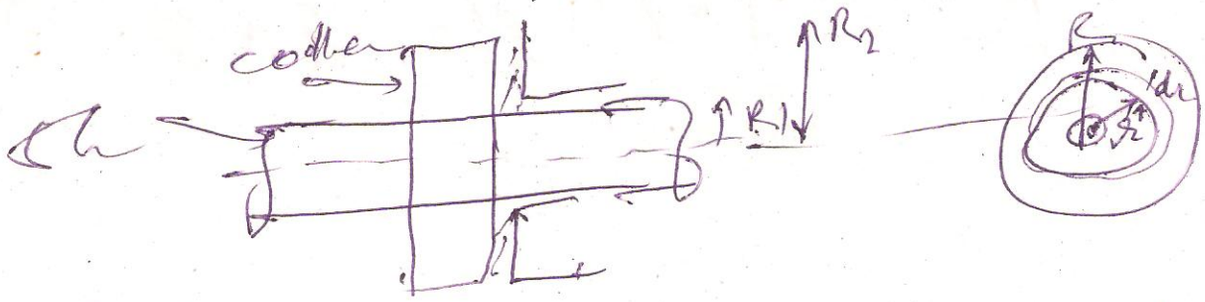
$= \frac{\mu \pi^2 N R^4}{60t}$.

$P = \frac{2\pi NT}{60} = \frac{2\mu\pi^3 N^2 R^4}{60 \times 60t} = \frac{\mu \pi^3 N^2 R^4}{600t}$ Ans.

## * Power absorbed in collar bearing :-

till $dT$ same as footstep bearing

Now




Total torque $T = \int_{R_1}^{R_2} \frac{\mu}{10t} \pi^2 N r^3 dr = \frac{\mu \pi^2 N}{10t \times 4} [R_2^4 - R_1^4]$

$= \frac{\mu \pi^2 N}{60t} [R_2^4 - R_1^4]$

$P = \frac{2\pi NT}{60} = \frac{2\pi N}{60} \times \frac{\mu \pi^2 N [R_2^4 - R_1^4]}{30 \times 60t}$

$$P = \frac{\mu \pi^3 N^2 [R_2^4 - R_1^4]}{60 \times 30 t}$$