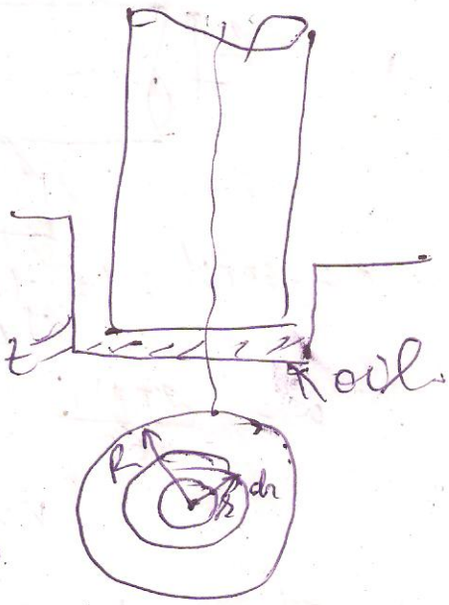
* Power absorbed in footstep bearing :-

$v = \omega \times r$

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

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