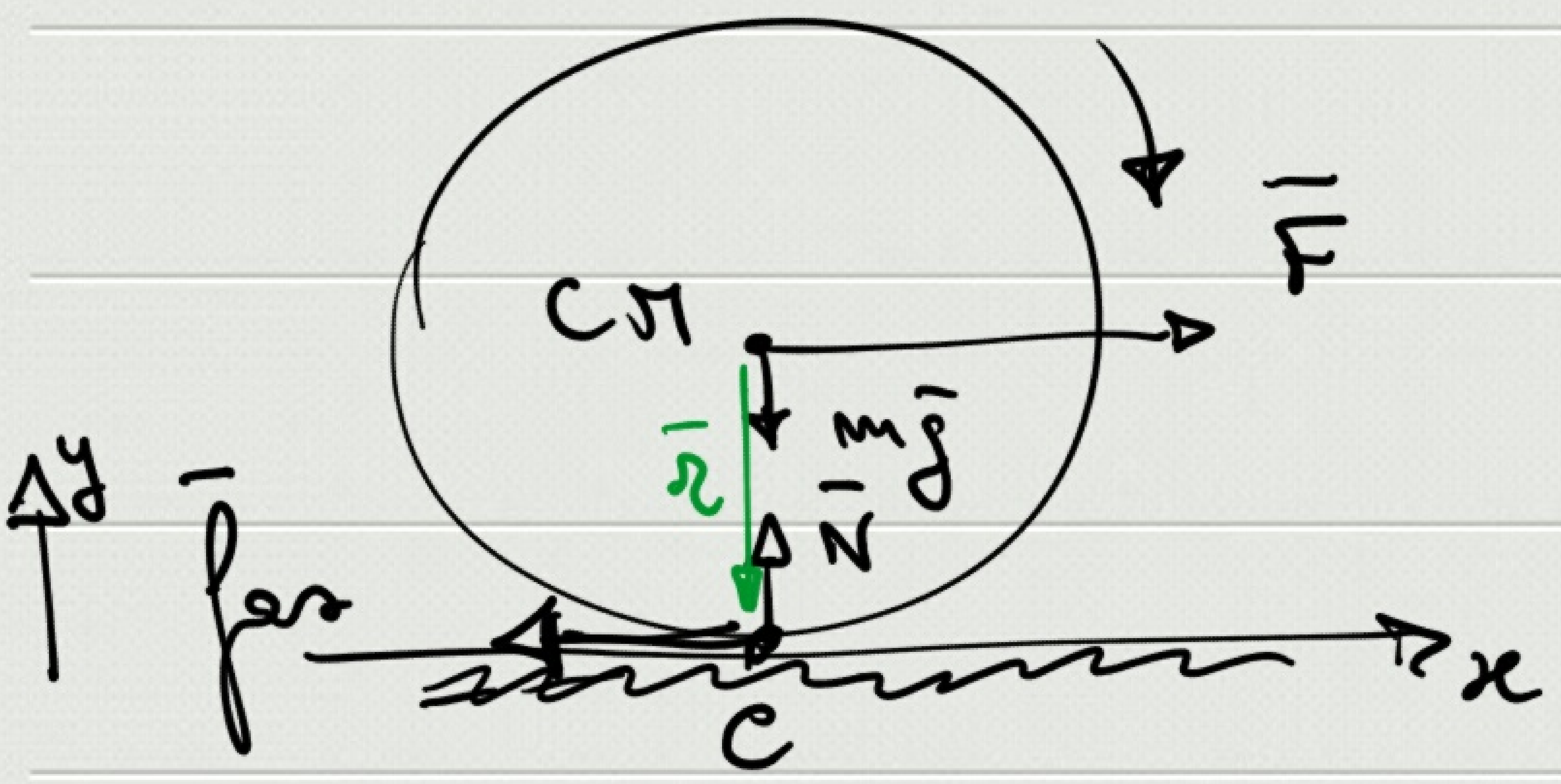


$$\bar R^E = m\,\bar a_{CM}$$

$$\bar M^E_{polo} = I_{asse}\,\bar\alpha$$

$$\bar M_O = \bar r \times \bar F$$

$$\bar F + m\bar g + \bar N + \bar f_{as} = m\,\bar a_{CM}$$

$$\text{polo} \equiv CM \Rightarrow \underset{\otimes}{\bar R \times \bar f_{as}} = I_{CM}\,\bar\alpha$$

$$\Rightarrow \begin{cases} F - f_{as} = m\,a_{CM} \\ N - mg = 0 \qquad \Rightarrow N = mg \\ R\,f_{as} = I_{CM}\,\alpha \\ a_{CM} = \alpha R \end{cases}$$

$$\Rightarrow R\,f_{as} = I_{CM}\,\alpha = I_{CM}\frac{a_{CM}}{R} \Rightarrow f_{as} = \frac{I_{CM}}{R^2}\,a_{CM}$$

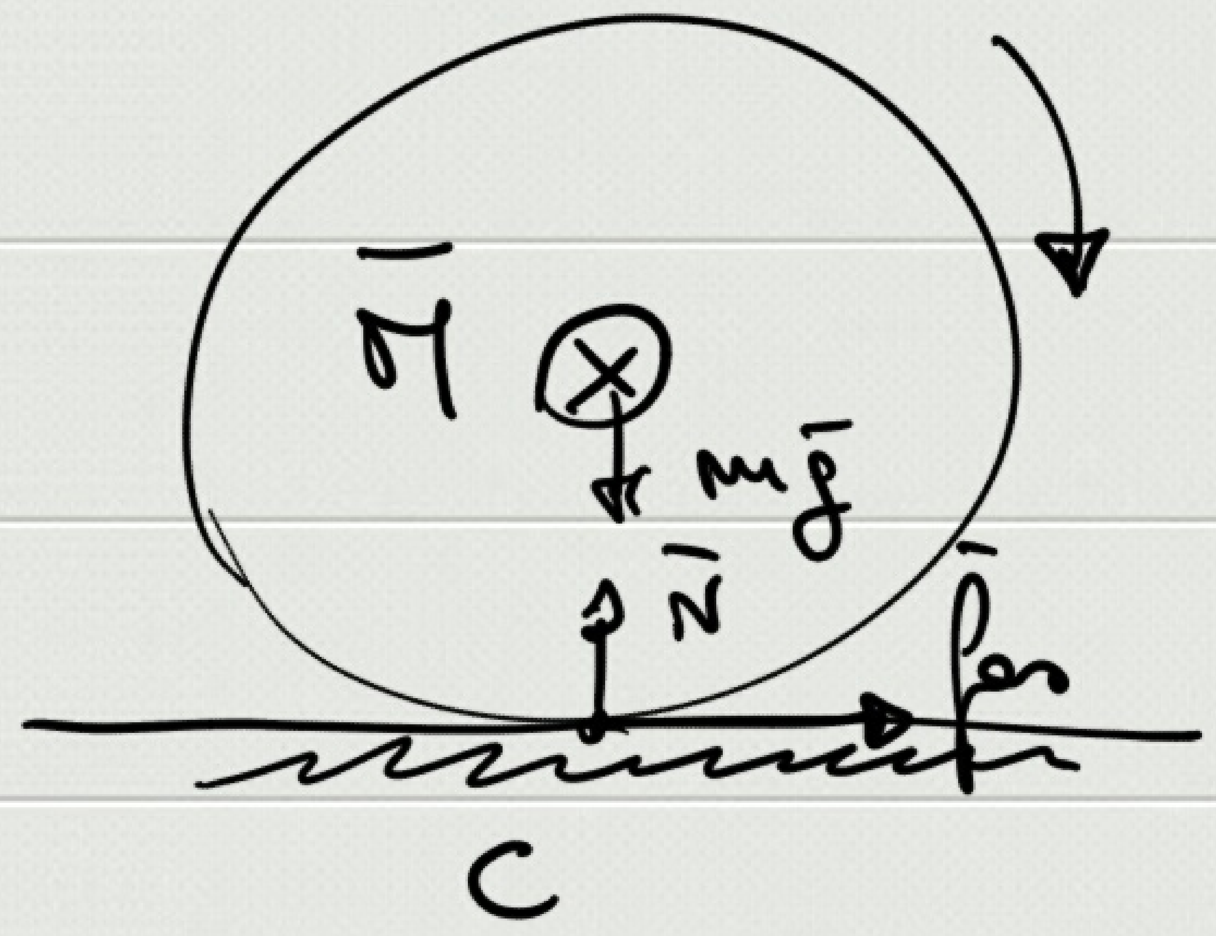
$$\Rightarrow F - \frac{I_{CM}}{R^2}\,a_{CM} = m\,a_{CM} \Rightarrow \boxed{a_{CM} = \frac{F/m}{1 + \frac{I_{CM}}{mR^2}}}$$

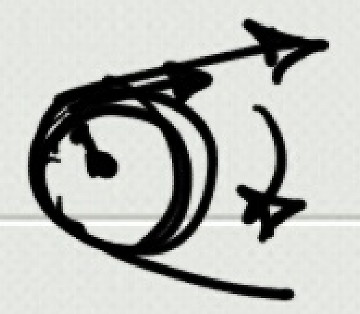
$$\underbrace{f_{as} = \frac{I_{cm}}{R^2}\,\frac{F/m}{1+\frac{I_{cm}}{mR^2}} = \frac{F}{1+\frac{mR^2}{I_{cm}}}}$$

$$f_{as} \leq f_{as,max} = \mu_s N$$

$$\Rightarrow f_{as} = \frac{F}{1+\frac{mR^2}{I_{cm}}} \leq \mu_s m g \Rightarrow$$

$$\Rightarrow \boxed{F \leq F_{max} = \mu_s m g \left(1+\frac{mR^2}{I_{cm}}\right)}$$





$$\begin{cases} m\bar{g} + \bar{N} + \bar{f}_{es} = m\,\bar{a}_{cm} \\ \bar{r} \times \bar{f}_{es} + \bar{M} = I_{cm}\,\bar{\alpha} \end{cases}$$

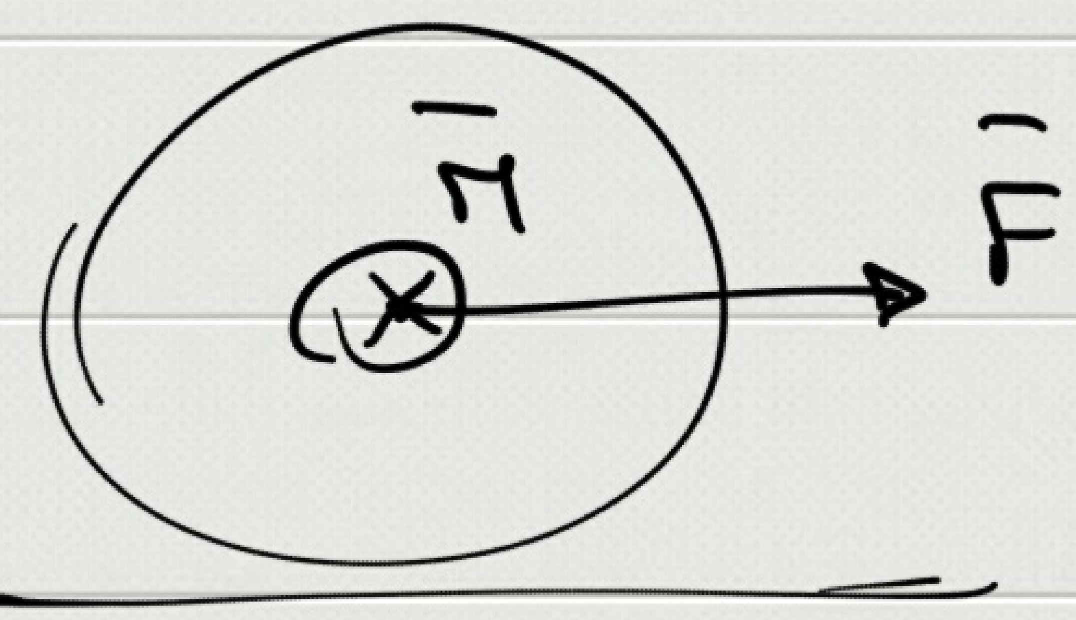
$$\Rightarrow \begin{cases} f_{es} = m\,a_{cm} \qquad\qquad N = mg \\ -R f_{es} + M = I_{cm}\,\alpha = I_{cm}\,\dfrac{a_{cm}}{R} \end{cases}$$

$$\Rightarrow M - mR\,a_{cm} = I_{cm}\,\frac{a_{cm}}{R}$$

$$\Rightarrow \boxed{a_{cm} = \frac{M/mR}{1 + \frac{I_{cm}}{mR^2}}}$$

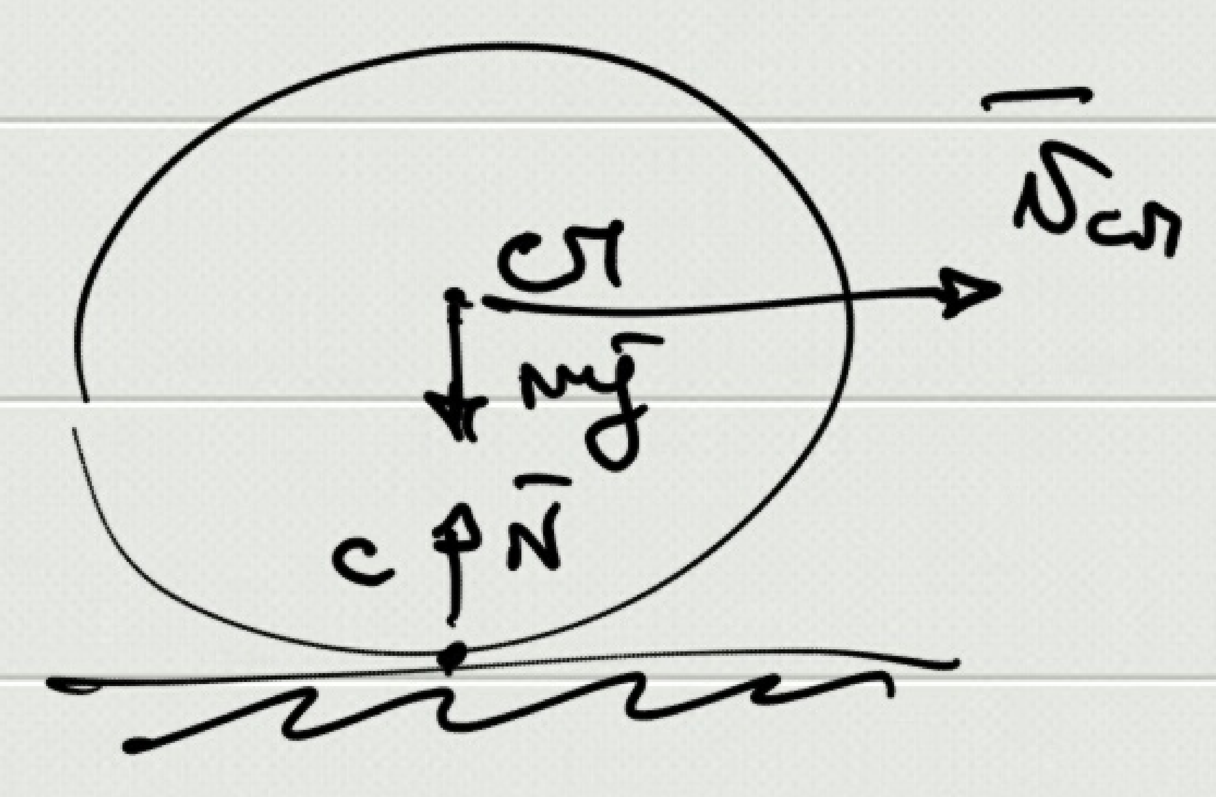
$$\Rightarrow \boxed{f_{es} = \frac{M/R}{1 + \frac{I_{cm}}{mR^2}}} \leq f_{es,max} = \mu_s mg$$

$$\Rightarrow \quad M \leq \mu_s m g R \left(1 + \frac{I_{cm}}{mR^2}\right)$$



$$a_{cm} = \frac{1}{m} \frac{M/R + F}{1 + \frac{I_{cm}}{mR^2}} \qquad f_{as} = \frac{M/R - \frac{I_{cm}}{mR^2} F}{1 + \frac{I_{cm}}{mR^2}}$$

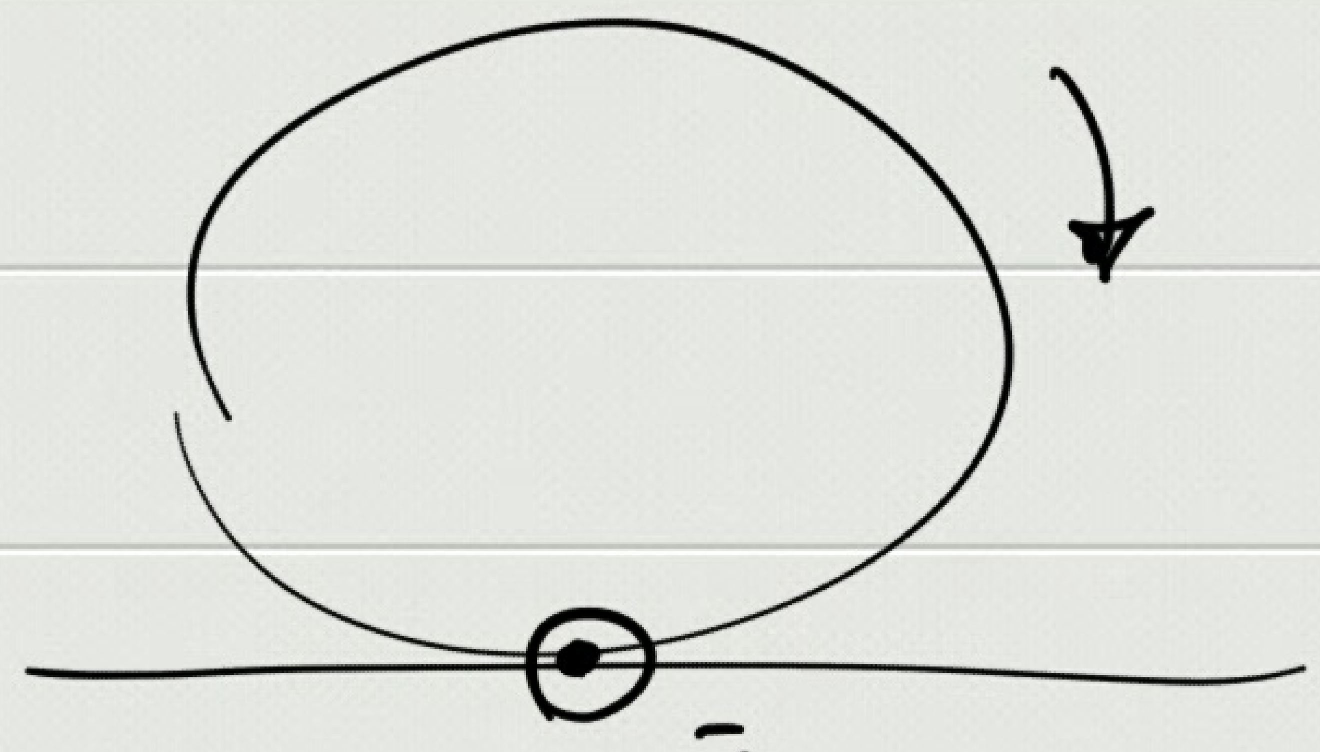
$$W_{TOT} = \Delta E_K$$



$$W = \int \bar{F} d\bar{s}$$

$$\Rightarrow \quad W_{f_{as}} = \int \bar{f}_{as} d\bar{s} = 0$$

Attrito volvente



$\bar{M}_v$

$$\bar{M}_v = -h N \bar{u}_\omega$$

h: coeff. di attrito volvente

generalmente è trascurabile