Circolazione in curva

- Stabilità in curva (verifica a sbandamento):

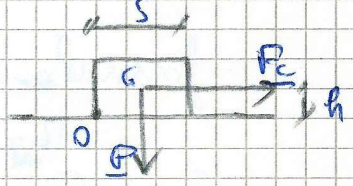
$$a_c = \frac{v^2}{R} \Rightarrow F_c = m a_c = \frac{P}{g} \cdot \frac{v^2}{R}$$

Due casi:

- senza sopraelevazione:

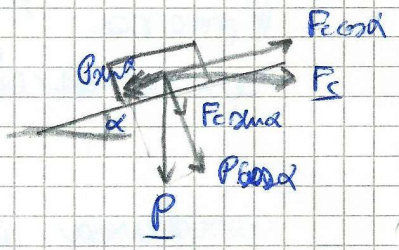
$$F_c \le P f_a$$

$$\Rightarrow \frac{P}{g}\frac{v^2}{R} \le P f_a \Rightarrow v \le \sqrt{g R f_a}$$



- con sopraelevazione

$$F_c \le P f_a$$



$F_{cn} = F_c\cos\alpha \quad P_\perp = P\cos\alpha$

$F_{c\perp} = F_c\sin\alpha \quad P_{//} = P\sin\alpha$

$$\Rightarrow F_c\cos\alpha - P\sin\alpha \le f_a (P\cos\alpha + F_c\sin\alpha)$$

$$\Rightarrow \frac{P v^2}{gR}\cos\alpha - P\sin\alpha \le f_a\left(P\cos\alpha + \frac{P v^2}{gR}\sin\alpha\right) \Big/ \frac{1}{\cos\alpha}$$

$$\Rightarrow \frac{v^2}{gR} - \operatorname{tg}\alpha \le f_a\left(1 + \frac{v^2}{gR}\operatorname{tg}\alpha\right)$$

$$\Rightarrow \frac{v^2}{gR}(1 - f_a\operatorname{tg}\alpha) \le f_a + \operatorname{tg}\alpha \qquad f_a\operatorname{tg}\alpha \simeq 0$$

$$\Rightarrow v \le \sqrt{gR(f_a + \operatorname{tg}\alpha)}$$

- verifica a ribaltamento:

$$M_R = F_c \cdot h = m\frac{v^2}{R}h$$

$$M_S = P\frac{S}{2} = \frac{1}{2}mgS$$

$$\Rightarrow M_R \le M_S \Rightarrow \cancel{m}\frac{v^2}{R}h \le \frac{1}{2}\cancel{m}gS$$

$$\Rightarrow v^2 \le \frac{1}{2}RhS \Rightarrow v \le \sqrt{\frac{1}{2}RhS}$$

- allargamento curva:

$$e = \frac{K}{R}$$

K vale 30 o 45

- clotoide di equazione $\rho S = A^2$ con A dato da:

- cambio di $\varepsilon = \frac{da_c}{dt} = \frac{d(v^2)}{R} = d\left(\frac{v^2}{A^2}S\right) = \frac{d}{dt}\left(\frac{v^3 t}{A}\right) = \frac{v^3}{A} = \frac{50{,}4}{v} = \varepsilon_{max}$

$$\Rightarrow A^2_{min} = v^3 \cdot \frac{v}{50{,}4} = \frac{v^4}{50{,}4} \Rightarrow A_{min} = \frac{v^2}{\sqrt{50{,}4}}$$

- sopraelevazione oppure: $A_{min} = \sqrt{\frac{R}{\Delta i}B(q_i + q_f)}$, B larghezza carreggiata e Δi pendenza long

- precisione ottica: $\frac{R}{3} \le A \le R$