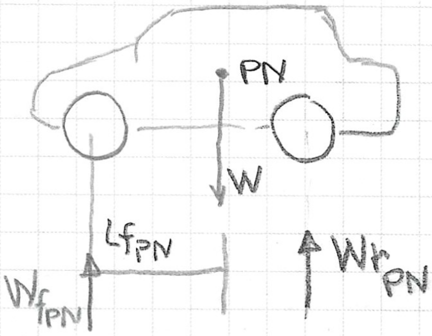
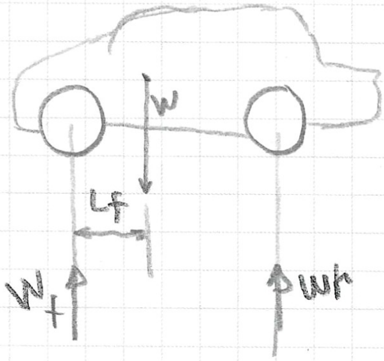
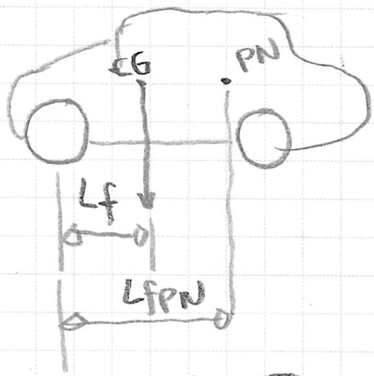
Se, $K=0$. Este ponto recebe o nome de "ponto neutro de manobra". Sua posição será determinada tendo o eixo dianteiro como referência:



Com o centro de gravidade do veículo em outra posição tem-se:



A margem de estabilidade direcional estática é definida como:



$$\boxed{SM = \frac{Lf_{PN} - Lf}{L} \times 100} \quad (26)$$

Da equação (25),

$$K = \left(\frac{Wr_{PN}}{C\alpha r} - \frac{Wf_{PN}}{C\alpha f} \right) = 0 \quad (27)$$

→ definição de ponto neutro de manobra.

⇒

$$\frac{W_{fPN}}{-C_{\alpha f}} + \frac{W_{rPN}}{C_{\alpha r}} = 0 \quad (28)$$

sendo $Y_\delta = -C_{\alpha f}$ e

$$Y_\beta = C_{\alpha f} + C_{\alpha r} \Rightarrow C_{\alpha r} = Y_\beta - C_{\alpha f} \Rightarrow$$

$$C_{\alpha r} = Y_\beta + Y_\delta \quad (29)$$

De (28) e (29) tem-se:

$$\frac{W_{fPN}}{Y_\delta} + \frac{W_{rPN}}{Y_\delta + Y_\beta} = 0 \quad (30)$$, sendo $W_{f_{PN}} = \frac{W}{L} \cdot L_{rPN}$ e $W_{r_{PN}} = \frac{W}{L} L_{fPN}$ >

$$\Rightarrow \frac{W}{L}\left(\frac{L_{rPN}}{Y_\delta} + \frac{L_{fPN}}{Y_\delta + Y_\beta}\right) = 0 \Rightarrow$$

$$\frac{L_{fPN}}{Y_\delta + Y_\beta} + \frac{L - L_{fPN}}{Y_\delta} = 0 \Rightarrow$$

$$\Rightarrow \frac{L_{fPN}}{Y_\delta + Y_\beta} + \frac{L}{Y_\delta} - \frac{L_{fPN}}{Y_\delta} = 0 \Rightarrow$$

$$\Rightarrow L_{f_{PN}}\left(\frac{1}{Y_\delta + Y_\beta} - \frac{1}{Y_\delta}\right) + \frac{L}{Y_\delta} = 0$$

$$L_{f_{PN}}\left(\frac{Y_\delta - (Y_\delta + Y_\beta)}{Y_\delta (Y_\delta + Y_\beta)}\right) + \frac{L}{Y_\delta} = 0 \Rightarrow$$

$$\Rightarrow L_{f_{PN}}\left(\frac{-Y_\beta}{Y_\delta (Y_\delta + Y_\beta)}\right) = -\frac{L}{Y_\delta} \Rightarrow$$

$$L_{f_{PN}} = \left(-\frac{L}{\cancel{Y_\delta}}\right) \frac{\cancel{Y_\delta}(Y_\delta + Y_\beta)}{(-Y_\beta)} = \boxed{L_{f_{PN}} = L \times \left(\frac{Y_\delta + Y_\beta}{Y_\beta}\right)} \quad (31) \quad * \Rightarrow$$

$$\Rightarrow SM = \frac{-L_f + L_{fPN}}{L} \times 100 \Rightarrow \boxed{SM = \frac{-L_f + L\left(\frac{Y_\delta + Y_\beta}{Y_\beta}\right)}{L} \times 100} \quad (32) \Rightarrow$$

*

$$SM = \frac{1}{L}\left(-L_f + L\left(\frac{y_\delta + y_\beta}{y_\beta}\right)\right) \times 100$$

$$Sm = \frac{1}{L}\left(\frac{-y_\beta \cdot L_f + L y_\delta + L y_\beta}{y_\beta}\right) \times 100 \Rightarrow$$

$$\Rightarrow SM = \frac{1}{L}\left(\frac{\cancel{-y_\beta \cdot L_f} + \cancel{L_f y_\beta} + L_r y_\beta + L y_\delta}{y_\beta}\right) \times 100 \Rightarrow$$

$$\Rightarrow SM = \frac{1}{L}\left(\frac{L_r y_\beta + L y_\delta}{y_\beta}\right) \times 100 \Rightarrow$$

$$\Rightarrow SM = \frac{1}{L}\left(\frac{L_r y_\beta + L_f y_\delta + L_r y_\delta}{y_\beta}\right) \times 100 \Rightarrow$$

$$\Rightarrow SM = \frac{1}{L}\left(\frac{L_r(y_\beta + y_\delta) + L_f \cdot y_\delta}{y_\beta}\right) \times 100 \Rightarrow$$

$$\Rightarrow \boxed{Sm = \frac{1}{L}\left(\frac{L_f \cdot y_\delta + L_r(y_\beta + y_\delta)}{y_\beta}\right) \times 100} \rightarrow \text{testado no simulador}$$

Resumindo:

$$K = \left(\frac{W_r}{C_{\alpha r}} + \frac{W_f}{y_\delta}\right)$$

$$C_{\alpha r} = y_\beta - C_{\alpha f} = y_\beta + y_\delta$$

$$\Rightarrow K = \frac{W_r}{y_\beta + y_\delta} + \frac{W_f}{y_\delta} \quad e$$

$$Sm = \frac{1}{L}\left(\frac{L_f y_\delta + L_r(y_\beta + y_\delta)}{y_\beta}\right) \times 100$$

se $SM = 0 \Rightarrow L_f \cdot y_\delta + L_r(y_\beta + y_\delta) = 0$

$$y_\beta + y_\delta = \frac{-L_f \cdot y_\delta}{L_r} \Rightarrow K = \frac{1}{L}\left(\frac{\cancel{L_f \cdot y_\delta + L_r \cdot \frac{L_f \cdot y_\delta}{L_r}}}{y_\beta}\right) = 0$$