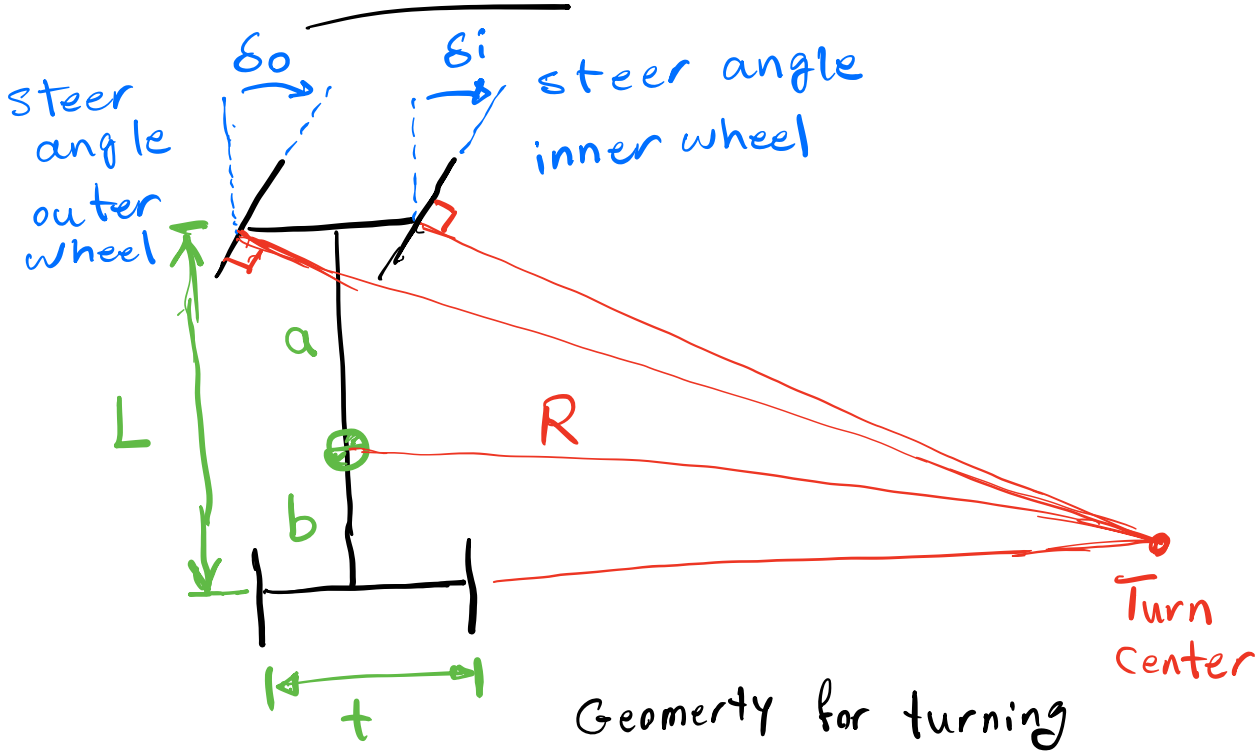
Module 5 - Low speed steady state turning

- At low speed all states of the vehicle are in equilibrium.
- The tire slip is minimal and vehicle cornering is largely based on Kinematic constraints.
- The radii of curvature are usualy much larger than the vehicle dimension and small angle approximation applies.



Geomerty for turning

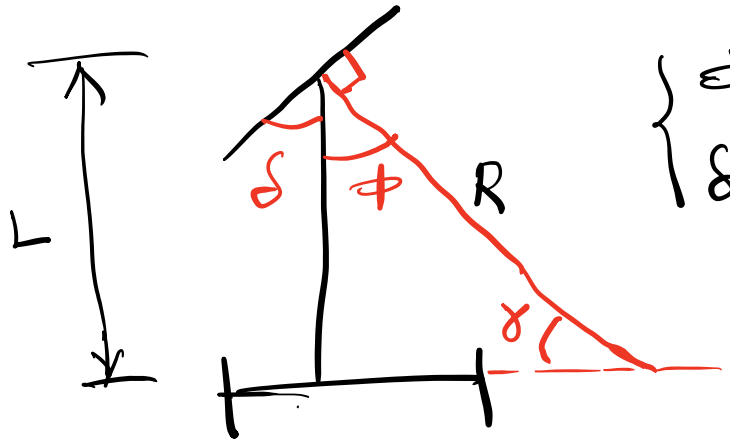
For the front wheels not to slip, they must have perpendiculars that pass through the turn center.

IF rear wheels have no slip angle the center of turn must lie on the projection of the rear axle.

steer angles:

$$\delta_o = \frac{L}{R + \frac{t}{2}} \qquad \delta_i = \frac{L}{R - \frac{t}{2}}$$

The average angle of the front wheels (for small angles) is defined as the Ackerman Angle: $\delta = \frac{L}{R}$



$$\begin{cases} \Phi + \gamma = 90^\circ \\ \delta + \Phi = 90^\circ \end{cases}$$

$$\delta - \gamma = 0$$

or

$$\delta = \gamma$$

For small angle: $\gamma = \sin\gamma = \frac{L}{R}$

steer angle $\frac{L}{R}$

convert to degrees (57.3)

As L increases (e.g. long truck), a sharper steer angle is required compared to smaller L values.

If we take into account the width of the car:

$$\delta_i = \frac{L}{R - t/2} \qquad \delta_o = \frac{L}{R + t/2}$$

inside wheel — outside wheel

Therefore for no slip condition, the inner wheel should turn more than the outer wheel.