Driving a vehicle around a curve

The cornering considerations are limited to the simplest case when the vehicle is traveling at a steady speed. It is assumed that neither the driving force nor the braking force and the corresponding driving resistances associated with these forces act on the vehicle. We can neglect inertia resistance, rolling resistance, air resistance, including tire flexibility. For suspension, we assume that perfect stabilizers do not allow the body to tilt relative to the axles.

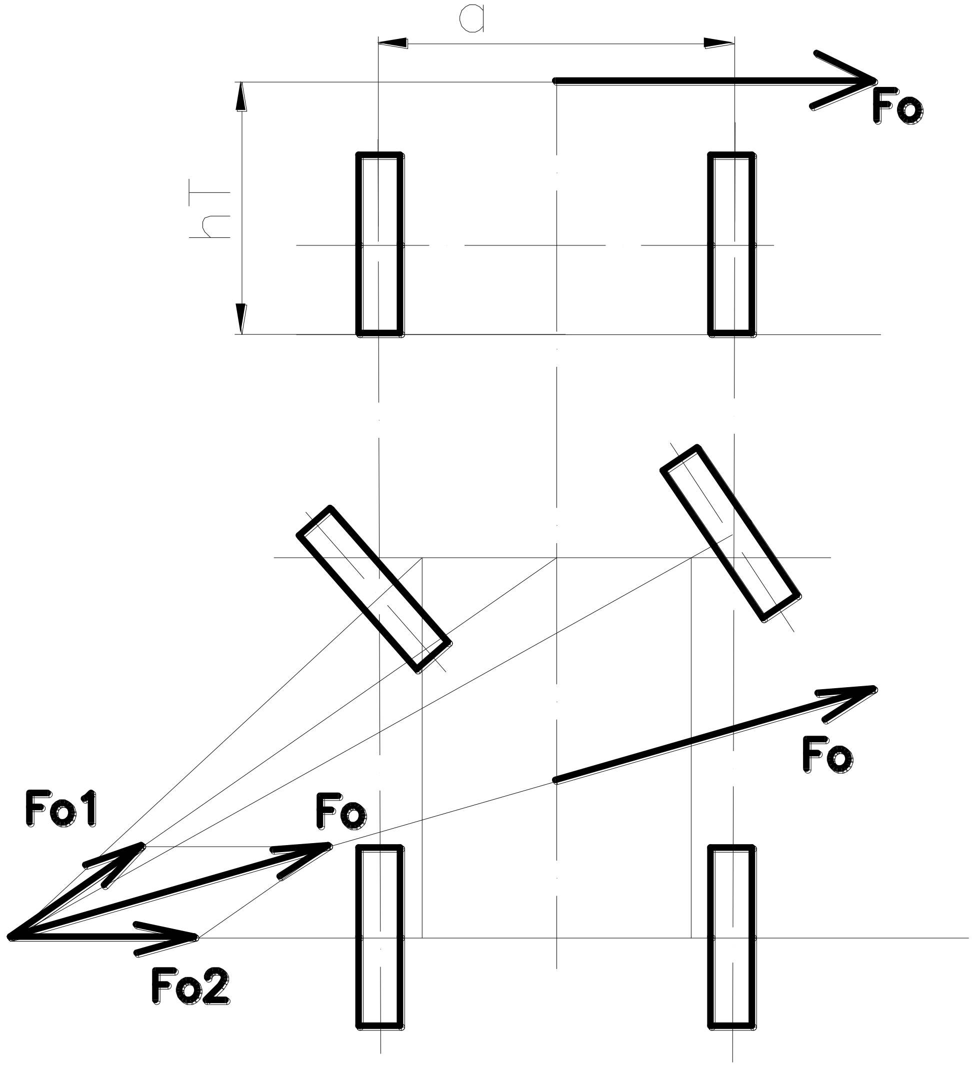

Fig. Driving the vehicle around a bend on a horizontal surface

The following condition must apply when driving around a curve to prevent it from skidding:

$$F_0 \leq G.\varphi$$

$$F_0 = \frac{G.v^2}{g.r} \leq G.\varphi$$

$$\varphi \geq \frac{v^2}{g.r}$$

when:
v- Vehicle speed [m/s],
r – Curve radius [m].

From the last equation, the maximum permitted speed can be calculated with the known coefficient of friction and curve radius. At the same time, however, the condition that the vehicle does not tip over must be met. This condition is determined as follows:

$$F_0.h_F \leq G.\frac{a}{2}$$

$$\frac{G.v^2}{g.r} \leq G.\frac{a}{2}$$

$$\frac{a}{2.h_F} \geq \frac{v^2}{g.r}$$

when:
a – track width [m].
by comparing the conditions of passing the vehicle through the curve, we get the shape:

$$\frac{a}{2.h_F} \geq \varphi \geq \frac{v^2}{g.r}$$

If the proportion of the first fraction is less than the coefficient of friction, then we must proceed to calculate the maximum cornering speed with anti-tipping conditions. The above equations must also apply to individual axles, but from Fig. it follows that the centrifugal force is not distributed to the axles. When calculating the passage of the vehicle through the curve which is tilted fig. two basic considerations are offered. We have to think about a stationary vehicle and a passing vehicle.

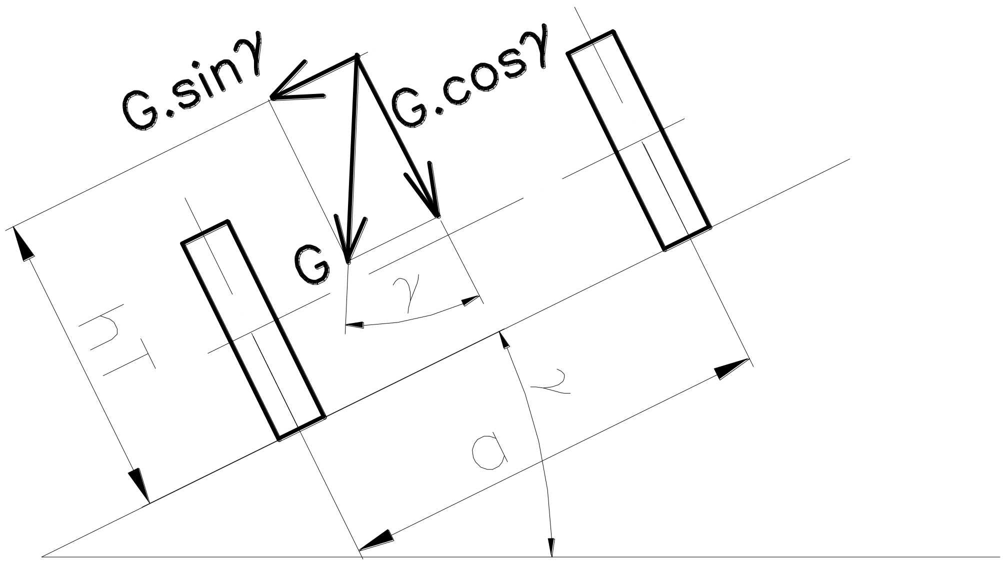

Fig. Passing a vehicle with a tilted curve

The stationary vehicle must meet a condition that prevents the vehicle from slipping and tipping over.

A condition that prevents the vehicle from slipping

$$G.cos\gamma.\varphi \geq G.sin\gamma$$

$$\varphi = tg\gamma$$

A condition that prevents the vehicle from tipping over:

$$G.cos\gamma.\varphi.\frac{a}{2} \geq G.sin\gamma.h_T$$

$$\frac{a}{2.h_T} \geq tg\gamma$$

The following follows from both conditions:

$$\frac{a}{2.h_T} \geq \varphi \geq tg\gamma$$

The condition for correct cornering requires that the resultant weight of the vehicle G and the centrifugal force F_0 be perpendicular to the road.

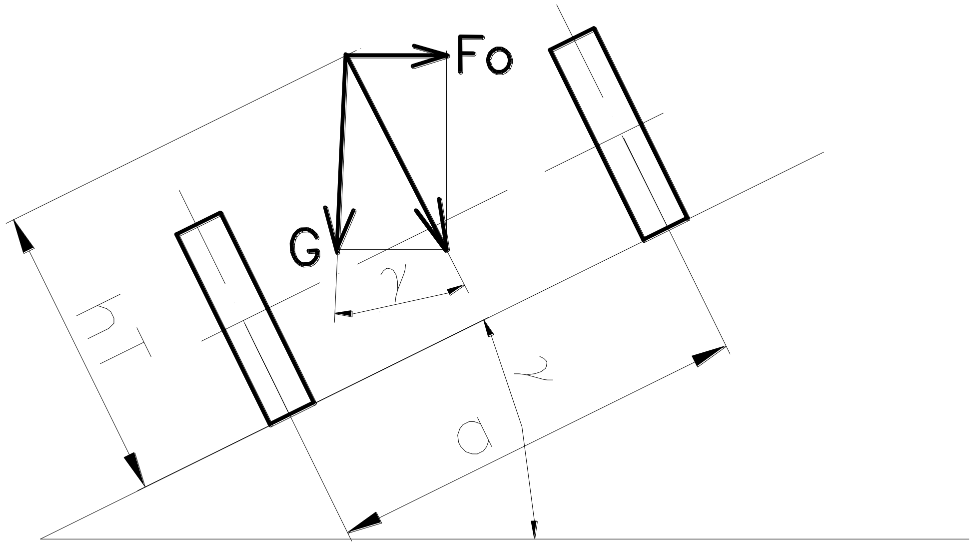

Fig. Condition of correct passage with a curve

$$tg\gamma = \frac{F_0}{G} = \frac{G.v^2}{G.g.r} = \frac{v^2}{g.r}$$

When cornering at maximum speed, conditions must be met to prevent the vehicle from slipping and tipping over.

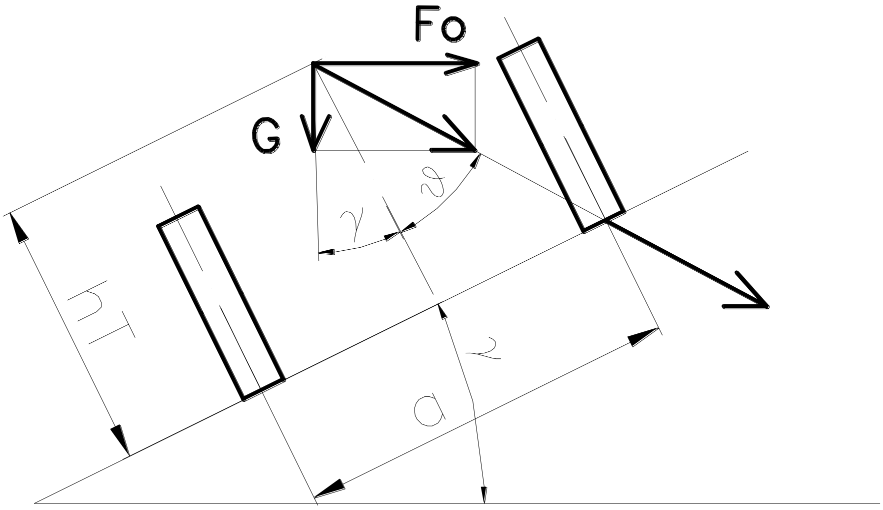

Fig. Condition for passing the curve at the highest speed

A condition that prevents the vehicle from slipping laterally:

$$\sqrt{G^2 + {F_0}^2}.cos\vartheta.\varphi \geq \sqrt{G^2 + {F_0}^2}.sin\vartheta$$

$$\varphi \geq tg\vartheta$$

The resulting shape of the condition for the vehicle to pass through the curve at the maximum speed has a shape:

$$\frac{a}{2.h_T} \geq \varphi \geq tg\vartheta$$