Steady-State Yaw Rate and Lateral Acceleration Gain

Steady-state yaw rate and lateral acceleration of a car per unit steer angle by the bicycle model, from wheelbase, understeer gradient, speed and steering ratio.

Method: Linear bicycle model

Input parameters

Unit system: SI

Parameter	Value	Unit
Wheelbase	2.7000	m
Understeer gradient (per g)	2.5000	°
Speed	100.00	km/h
Steering wheel angle	30.000	°
Steering ratio	15.000	

Calculated results

Parameter	Value	Unit
Road wheel angle	2.0000	°
Yaw rate gain	4.5291	1/s
Yaw rate	9.0583	°/s
Lateral acceleration	4.3916	m/s²
Path radius	175.70	m

Notes for this case

• r/δ = (v/L)/(1 + Kv²/(gL)); a_y = rv. An understeering car's yaw gain peaks at the characteristic speed and then falls; a neutral car's rises linearly with speed. Linear only at small lateral accelerations (below about 0.4 g).

Formula and method

$$\frac{r}{\delta} = \frac{v/L}{1 + \frac{Kv^2}{gL}}, \quad a_y = rv, \quad R = \frac{v}{r}$$

Variables

L	Wheelbase	m
K	Understeer gradient (per g)	rad
v	Speed	m/s
δ_{sw}	Steering wheel angle	rad
i_s	Steering ratio	-
δ	Road wheel angle	rad
r/δ	Yaw rate gain	1/s
r	Yaw rate	rad/s
a_y	Lateral acceleration	m/s²
R	Path radius	m

Method and standards

Yaw gain.

Assumptions and limits

- Linear tyres; constant speed; small angles.

References

Linear bicycle model

Report details

Report reference	FCC-XPAJ-W9BS (the same inputs always give the same reference)
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Calculator	Steady-State Yaw Rate and Lateral Acceleration Gain
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/automotive/vehicle-dynamics/yaw-rate-gain-bicycle

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.