Tyre Cornering Force from Slip Angle (Fiala Brush Model)

Lateral tyre force at a slip angle by the Fiala brush model from load, cornering stiffness and friction, the linear-range force and the slip angle of full sliding.

Method: Fiala brush model

Input parameters

Unit system: SI

Parameter	Value	Unit
Vertical load	4,000.0	N
Cornering stiffness (N/rad)	60,000	
Friction coefficient	1.0000	
Slip angle	4.0000	°

Calculated results

Parameter	Value	Unit
Lateral force (brush model)	2,899.6	N
Linear-range force C_α·α	4,188.8	N
Slip angle of full sliding	11.310	°
Grip used	72.491	%

Notes for this case

• Fiala: θ = C_α·tanα/(3μF_z); F_y = μF_z(3θ − 3θ² + θ³) up to θ = 1, then μF_z (full sliding). Small angles give F_y ≈ C_αα. The brush model has no peak-and-fall; measured tyres peak and drop slightly, which the Magic Formula captures with fitted coefficients.

Formula and method

$$\theta = \frac{C_\alpha \tan\alpha}{3\mu F_z}, \quad F_y = \mu F_z(3\theta - 3\theta^2 + \theta^3)\ (\theta < 1), \quad \alpha_{sl} = \tan^{-1}\frac{3\mu F_z}{C_\alpha}$$

Variables

F_z	Vertical load	N
C_α	Cornering stiffness (N/rad)	-
μ	Friction coefficient	-
α	Slip angle	rad
F_y	Lateral force (brush model)	N
$F_{y,lin}$	Linear-range force C_α·α	N
α_{sl}	Slip angle of full sliding	rad
$F_y/\mu F_z$	Grip used	-

Method and standards

Brush model.

Assumptions and limits

- Steady state; pure cornering; parabolic pressure distribution.

References

Fiala brush model

Report details

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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/tyres-wheels/tyre-cornering-force-brush

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Reopens the calculator with the inputs of this report.