Ackermann Steering Angles and Turning Circle

Ideal Ackermann inner and outer wheel angles, the turning radius at full inner lock and the kerb-to-kerb turning circle of the outer front wheel.

Method: Ackermann steering geometry

Input parameters

Unit system: SI

Parameter	Value	Unit
Wheelbase	2.7000	m
Kingpin track	1.4500	m
Maximum inner wheel lock	38.000	°
Tyre width	205.00	mm

Calculated results

Parameter	Value	Unit
Turning radius to rear axle centre	4.1808	m
Ackermann outer wheel angle	28.827	°
Kerb-to-kerb turning diameter	11.380	m
Mean (bicycle) steer angle	32.854	°

Notes for this case

• Ackermann condition: cot δ_o − cot δ_i = w/L, all wheels turning about one point on the rear axle line. With inner lock δ_i, R = L/tan δ_i + w/2; the outer front tyre's outer edge sweeps the kerb-to-kerb circle. Real linkages deviate from Ackermann at full lock, and tyre slip makes high-speed turns differ.

Formula and method

$$\cot\delta_o - \cot\delta_i = \frac{w}{L}, \quad R = \frac{L}{\tan\delta_i} + \frac{w}{2}, \quad D_{kerb} = 2\sqrt{\left(R + \frac{w}{2} + \frac{b_t}{2}\right)^2 + L^2}$$

Variables

L	Wheelbase	m
w	Kingpin track	m
$\delta_{i,max}$	Maximum inner wheel lock	rad
b_t	Tyre width	m
R	Turning radius to rear axle centre	m
δ_o	Ackermann outer wheel angle	rad
D_{kerb}	Kerb-to-kerb turning diameter	m
δ_{mean}	Mean (bicycle) steer angle	rad

Method and standards

Ackermann geometry.

Assumptions and limits

- Low speed, no tyre slip; ideal Ackermann linkage.

References

Ackermann steering geometry

Report details

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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/ackermann-turning-circle

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Reopens the calculator with the inputs of this report.