Superelevation and Side Friction on a Horizontal Curve

Superelevation and side friction needed on a horizontal road curve for a design speed and radius (e + f = v²/gR), the minimum radius and the safe speed.

Method: Point-mass equilibrium on a banked curve; e + f = v²/(gR) (AASHTO and IRC basic relation)

Input parameters

Unit system: SI

Parameter	Value	Unit
Design speed	80.000	km/h
Curve radius	300.00	m
Maximum superelevation allowed From your road standard.	7.0000	%
Side friction factor allowed From your road standard for the speed.	0.15000	

Calculated results

Parameter	Value	Unit
Total needed v²/(gR)	0.16785	
Superelevation needed if friction takes its full share	1.7855	%
Minimum radius for e_max and f	228.89	m
Safe speed on this radius	91.587	km/h

Notes for this case

- Road standards add rules on how superelevation and friction share the load; follow yours for design.

Formula and method

$$e + f = \frac{v^2}{gR}, \quad R_{min} = \frac{v^2}{g(e_{max} + f)}$$

Variables

v	Design speed	m/s
R	Curve radius	m
e_{max}	Maximum superelevation allowed	-
f	Side friction factor allowed	-
$e + f$	Total needed v²/(gR)	-
e_n	Superelevation needed if friction takes its full share	-
R_{min}	Minimum radius for e_max and f	m
v_{safe}	Safe speed on this radius	m/s

Method and standards

Equilibrium on a banked curve.

Assumptions and limits

- Point mass, small angles.
- When e_n exceeds e_max (radius below R_min) the page warns: the curve cannot carry the design speed within the allowed superelevation and friction.

References

- Point-mass equilibrium on a banked curve
- e + f = v²/(gR) (AASHTO and IRC basic relation)

Report details

Report reference	FCC-J8DP-C7SJ (the same inputs always give the same reference)
Generated	17 November 2026, 19:36 UTC
Calculator	Superelevation and Side Friction on a Horizontal Curve
Method last reviewed	12 November 2026
Software release	FireCAD Calc, release of 17 November 2026
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/civil/roads/superelevation-curve

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.