Crest and Sag Vertical Curve Length for Sight Distance

Minimum length of a crest vertical curve for a sight distance and eye and object heights, or a sag curve for headlight sight distance, from the grade change.

Method: Sight-distance lengths of parabolic vertical curves

Input parameters

Unit system: SI

Parameter	Value	Unit
Curve type	Crest (sight over the hump)	
Approach grade (rising positive)	3.0000	%
Departure grade	-2.0000	%
Sight distance required	130.00	m
Driver eye height (crest)	1.0800	m
Object height (crest)	0.60000	m
Headlight height (sag)	0.60000	m
Upward headlight beam spread (sag)	1.0000	°

Calculated results

Parameter	Value	Unit
Algebraic grade difference $\|g_1 - g_2\|$	5.0000	%
Minimum curve length	128.40	m
Governing case (1: S < L, 0: S > L)	0	
Rate of vertical curvature L/A (m per %)	25.680	m
Middle ordinate AL/8	0.80251	m

Notes for this case

• Parabolic vertical curve: S < L gives L = AS²/[2(√h₁ + √h₂)²] (crest) or AS²/[2(h_L + S tan β)] (sag); S > L gives L = 2S − (same denominator)/A. Grades as fractions.

Formula and method

$$\text{crest},\ S<L: L=\frac{AS^2}{2(\sqrt{h_1}+\sqrt{h_2})^2},\quad S>L: L=2S-\frac{2(\sqrt{h_1}+\sqrt{h_2})^2}{A}$$

$$\text{sag},\ S<L: L=\frac{AS^2}{2(h_L+S\tan\beta)},\quad S>L: L=2S-\frac{2(h_L+S\tan\beta)}{A}$$

Variables

curve	Curve type	-
g_1	Approach grade (rising positive)	-
g_2	Departure grade	-
S	Sight distance required	m
h_1	Driver eye height (crest)	m
h_2	Object height (crest)	m
h_L	Headlight height (sag)	m
β	Upward headlight beam spread (sag)	rad

A	Algebraic grade difference	$g_1 - g_2$
L_{min}	Minimum curve length	m
$S \lessgtr L$	Governing case (1: S < L, 0: S > L)	-
K	Rate of vertical curvature L/A (m per %)	m
y_m	Middle ordinate AL/8	m

Method and standards

Vertical curve sight-distance geometry.

Assumptions and limits

- Symmetrical parabolic curve, flat road surface profile.

References

Sight-distance lengths of parabolic vertical curves

Report details

Report reference	FCC-VCRZ-YSPC (the same inputs always give the same reference)
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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/civil/roads/crest-vertical-curve-length

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Reopens the calculator with the inputs of this report.