Vertical Curve: Offsets, Elevations and High or Low Point

Elevation of a parabolic vertical curve at a distance from its start from the two grades and length, with the offset from the tangent and the high or low point.

Method: Equal-tangent parabolic vertical curve

Input parameters

Unit system: SI

Parameter	Value	Unit
Incoming grade	3.0000	%
Outgoing grade	-2.0000	%
Curve length (horizontal)	200.00	m
Elevation at the start of the curve	100.00	m
Distance from the start	80.000	m

Calculated results

Parameter	Value	Unit
Algebraic grade difference $g_2 - g_1$	-5.0000	%
Offset from the incoming tangent $(g_2 - g_1)\,x^2/(2L)$	-0.80000	m
Curve elevation at x	101.60	m
Distance to the high or low point	120.00	m
Elevation of the high or low point	101.80	m

Formula and method

$$z(x) = z_{BVC} + g_1 x + \frac{(g_2 - g_1)x^2}{2L}, \quad x_t = -\frac{g_1 L}{g_2 - g_1}$$

Variables

g_1	Incoming grade	-
g_2	Outgoing grade	-
L	Curve length (horizontal)	m
z_{BVC}	Elevation at the start of the curve	m
x	Distance from the start	m
A	Algebraic grade difference $g_2 - g_1$	-
y	Offset from the incoming tangent $(g_2 - g_1)\,x^2/(2L)$	m
$z(x)$	Curve elevation at x	m
x_t	Distance to the high or low point	m
z_t	Elevation of the high or low point	m

Method and standards

Equal-tangent parabola.

Assumptions and limits

- When both grades have the same sign there is no high or low point inside the curve; x_t and z_t are then left out (the extreme elevations are at the ends).
- Horizontal distances, symmetric curve.

References

- Equal-tangent parabolic vertical curve

Report details

Report reference	FCC-1FFZ-6NE5 (the same inputs always give the same reference)
Generated	17 November 2026, 19:48 UTC
Calculator	Vertical Curve: Offsets, Elevations and High or Low Point
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/vertical-curve-offsets

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.