Unequal-Tangent Vertical Curve

BVC, CVC and EVC elevations, the common grade and the elevation at any station of a vertical curve with unequal tangents, with its high or low point.

Method: Unequal-tangent vertical parabolic curve

Input parameters

Unit system: SI

Parameter	Value	Unit
Station of the PVI	1,500.0	m
Elevation of the PVI	120.00	m
Incoming grade	3.0000	%
Outgoing grade	-2.0000	%
Length before the PVI	120.00	m
Length after the PVI	200.00	m
Station to evaluate	1,460.0	m

Calculated results

Parameter	Value	Unit
BVC elevation	116.40	m
EVC elevation	116.00	m
Grade at the CVC	-0.12500	%
CVC elevation (under the PVI)	118.12	m
Curve elevation at the station	117.97	m
Station of the high or low point	1,495.2	m

Notes for this case

• An unequal-tangent curve is two equal-tangent parabolas meeting at the CVC under the PVI with a common grade $g_3 = (g_1L_1 + g_2L_2)/(L_1 + L_2)$. Each part has its own rate of change $r_1 = (g_3 - g_1)/L_1$, $r_2 = (g_2 - g_3)/L_2$; elevations follow $y = E + gx + rx^2/2$. The high or low point is where the grade is zero (station 0 if the grade does not change sign within the curve). Used where a vertical curve must fit between fixed features.

Formula and method

$$g_3 = \frac{g_1 L_1 + g_2 L_2}{L_1 + L_2}, \quad E_{CVC} = E_{BVC} + \frac{g_1 + g_3}{2} L_1, \quad y = E + gx + \frac{r}{2}x^2$$

Variables

Sta_{PVI}	Station of the PVI	m
E_{PVI}	Elevation of the PVI	m
g_1	Incoming grade	-
g_2	Outgoing grade	-
L_1	Length before the PVI	m
L_2	Length after the PVI	m
Sta_x	Station to evaluate	m
E_{BVC}	BVC elevation	m
E_{EVC}	EVC elevation	m
g_3	Grade at the CVC	-

E_{CVC}	CVC elevation (under the PVI)	m
E_x	Curve elevation at the station	m
Sta_{hl}	Station of the high or low point	m

Method and standards

Unequal vertical curve.

Assumptions and limits

- Parabolic curves; stations in metres.

References

Unequal-tangent vertical parabolic curve

Report details

Report reference	FCC-E88Z-K5M4 (the same inputs always give the same reference)
Generated	23 November 2026, 18:09 UTC
Calculator	Unequal-Tangent Vertical Curve
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 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/surveying/unequal-tangent-vertical-curve

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.