Equal-Tangent Vertical Curve Through a Fixed Point

Length of an equal-tangent vertical curve that passes through a given elevation at a given station (a clearance point), with its BVC and EVC elevations.

Method: Equal-tangent vertical curve through a fixed point

Input parameters

Unit system: SI

Parameter	Value	Unit
Station of the PVI	2,000.0	m
Elevation of the PVI	85.000	m
Incoming grade	-4.0000	%
Outgoing grade	3.0000	%
Station of the fixed point	2,030.0	m
Required elevation at the fixed point	86.200	m

Calculated results

Parameter	Value	Unit
Curve length	125.63	m
BVC station	1,937.2	m
BVC elevation	87.513	m
EVC elevation	86.884	m
Rate of change of grade (per 100 m)	5.5719	%

Notes for this case

• On an equal-tangent curve the elevation at a point a distance d from the PVI (negative before it) is E_PVI + g_1d + (g_2 − g_1)(d + L/2)²/2L. Setting it equal to the required elevation gives a quadratic in L: L²/4 + (d − 2Q)L + d² = 0 with Q = (E_P − E_PVI − g_1d)/(g_2 − g_1); the longer root keeps the point within the curve. Used to clear a culvert, match a crossroad or give clearance under a bridge.

Formula and method

$$E_P = E_{PVI} + g_1 d + \frac{(g_2 - g_1)(d + L/2)^2}{2L} \;\Rightarrow\; \frac{L^2}{4} + (d - 2Q)L + d^2 = 0$$

Variables

Sta_{PVI}	Station of the PVI	m
E_{PVI}	Elevation of the PVI	m
g_1	Incoming grade	-
g_2	Outgoing grade	-
Sta_P	Station of the fixed point	m
E_P	Required elevation at the fixed point	m
L	Curve length	m
Sta_{BVC}	BVC station	m
E_{BVC}	BVC elevation	m
E_{EVC}	EVC elevation	m
r	Rate of change of grade (per 100 m)	-

Method and standards

Curve through a point.

Assumptions and limits

- Equal tangents; parabolic curve.

References

Equal-tangent vertical curve through a fixed point

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/civil/surveying/vertical-curve-fixed-point

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Reopens the calculator with the inputs of this report.