Bridge Design Details 2E June 2025

Horizontal Curve Equations

BC = Beginning of Curve

EC = End of Curve

PC = Point of Curvature

PT = Point of Tangency

d = Deflection Angle for point on curve

Δ = Delta or Central Angle

ℓ = Length along Curve (BC to POC)

L = Length of Curve = $\dfrac{2\pi R}{360^\circ}\Delta$

LC = Long Chord = $2R\left(1 - \sin\dfrac{\Delta}{2}\right)$

M = Middle Ordinate = $R\left(1 - \cos\dfrac{\Delta}{2}\right)$

PI = Point of Intersection

POC = Point on Curve

R = Radius

T = Tangent Distance = $R\tan\dfrac{\Delta}{2}$

Ex = External = $\left(\dfrac{R}{\cos\dfrac{\Delta}{2}} - R\right)$

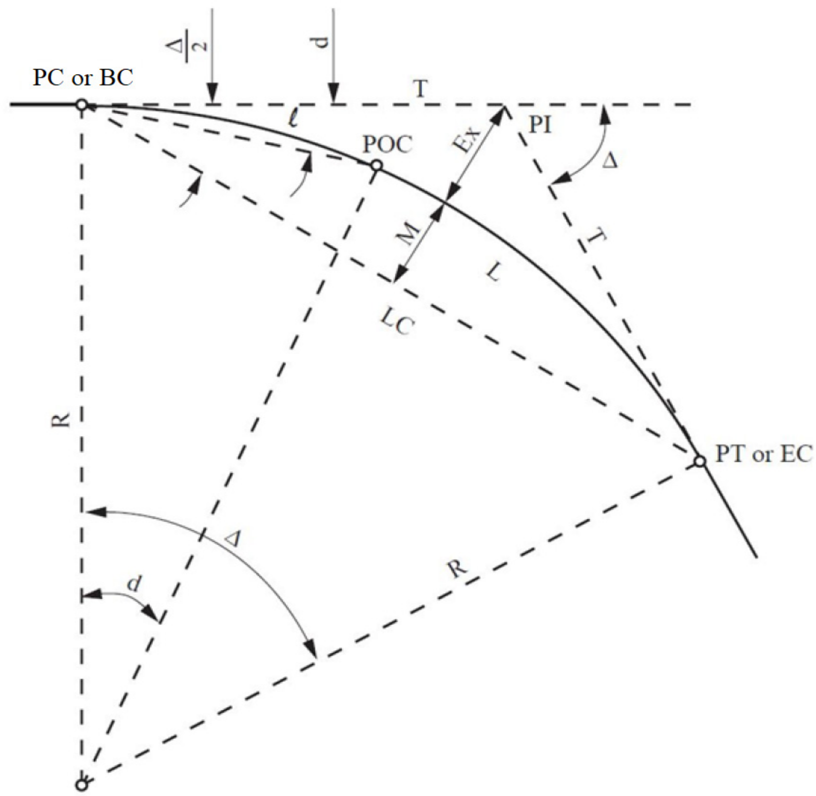

Figure 2A.E.1 Horizontal Curve Functions

All Curve Data may be obtained with two of the following curve parameters:

- Delta (Δ)
- Radius
- Tangent
- Length
- External

Example:

Given Length and Radius, solve for Delta Δ.

$$T = R\ \tan\frac{\Delta}{2} \qquad L=\frac{2\pi R}{360^\circ}\Delta$$

$$\tan\frac{\Delta}{2} = \frac{T}{R} \Rightarrow \Delta = 2\tan^{-1}\left(\frac{T}{R}\right),\ \Delta \text{ in degrees}$$

$$\Delta \text{ in degrees} = \frac{L \text{ x } 57.2958}{R}$$

Example:

Given Radius and Delta Δ, solve for L.

$$L = \frac{2\pi R\Delta}{360^\circ} \text{ or } L = R\ \text{func}\,\Delta \Rightarrow \frac{L}{2\pi R} = \frac{\Delta}{360^\circ} \Rightarrow L = \frac{2\pi R}{360^\circ}\Delta \quad \text{where } \Delta \text{ is in degrees}$$

$$d = \frac{\Delta d}{2} \text{ where } \frac{\Delta d}{360} = \frac{\ell}{2\pi R} \Rightarrow d = \frac{180\ell}{2\pi R} \quad \text{(in degrees)}$$

$$Ex = \frac{R}{\cos\frac{\Delta}{2}} - R \Rightarrow R\left(\frac{1}{\cos\frac{\Delta}{2}} - 1\right)$$

$$M = R - R\ \cos\frac{\Delta}{2} \Rightarrow R\left(1 - \cos\frac{\Delta}{2}\right)$$