Horizontal Curves

Chapter 24

Types of Circular Curves

Simple Curve

Compound Curves

Broken-Back Curves

Reverse Curves

Broken-Back Curves should be avoided if possible. It is better to replace the Curves with a larger radius circular curve.

A tangent should be placed between reverse Curves.
Typical Configurations of Curves

Spirals are typically placed between tangents and circular curves to provide a transition from a normal crown section to a superelevated one.

Spirals are typically used at intersections to increase the room for large trucks to make turning movements.

Arc Definition

The equation for the arc definition is given by:

\[
\frac{D}{360} = \frac{100}{2\pi R}
\]

or

\[
R = \frac{5729.58}{D}
\]
Circular Curve Elements

Equations for Computing Properties of Horizontal Curves
Equations for Computing Properties of Horizontal Curves

\[
\begin{align*}
L &= 100 \frac{I^2}{D^2} \text{ (ft)} \\
L &= \frac{I^2}{D^2} \text{ (sta)} \\
L &= R (l \text{ in radians}) \\
R &= \frac{5729.58}{D} \text{ (ft)} \\
T &= R \tan \frac{I}{2} \\
L.C &= 2R \sin \frac{l}{2} \\
E &= R \left[ \frac{1}{\cos(I/2)} - 1 \right] \\
M &= E \cos \frac{l}{2} \\
E &= T \tan \frac{l}{4} \\
M &= R \left( 1 - \cos \frac{l}{2} \right)
\end{align*}
\]

Example Problem

A tangent with a bearing of N 56° 48' 20" E meets another tangent with a bearing of N 40° 10' 20" E at PI STA 6 + 26.57. A horizontal curve with radius = 1000 feet will be used to connect the two tangents. Compute the degree of curvature, tangent distance, length of curve, chord distance, middle ordinate, external distance, PC and PT Stations.

Solution:

\[
\begin{align*}
I &= 56° 48' 20" - 40° 10' 20" = 16° 38' 00"
\end{align*}
\]

\[
\begin{align*}
D &= 5729.58/R = 5729.58/1000 = 5° 43' 46"
\end{align*}
\]

\[
\begin{align*}
L &= 100 (I/D) = 100 (16.633333/5.72944444) = 290.31'
\end{align*}
\]

\[
\begin{align*}
T &= R \tan \frac{I}{2} = 1000 \tan (16.63333/2) = 146.18'
\end{align*}
\]

\[
\begin{align*}
L.C &= 2R \sin \frac{l}{2} = 2(1000) \sin (16.63333/2) = 289.29'
\end{align*}
\]

\[
\begin{align*}
E &= R \left[ \frac{1}{\cos(I/2)} - 1 \right] = 1000 \left[ \frac{1}{\cos (16.63333)} - 1 \right] = 10.63'
\end{align*}
\]

\[
\begin{align*}
M &= R \left( 1 - \cos \frac{l}{2} \right) = 1000 \left( 1 - \cos (16.63333/2) \right) = 10.52'
\end{align*}
\]
Example Problem (continued)

A tangent with a bearing of N 56° 48’ 20” E meets another tangent with a bearing of N 40° 10’ 20” E at PI STA 6 + 26.57. A horizontal curve with radius = 1000 feet will be used to connect the two tangents. Compute the degree of curvature, tangent distance, length of curve, chord distance, middle ordinate, external distance, PC and PT Stations.

Solution:

PC STA = PI STA – T = 626.57 – 146.18 = PC STA 4 + 80.39
PT STA = PC STA + L = 480.39 + 290.31 = PT STA 7 + 70.70

Final thoughts:

Given the coordinates of the PI can you compute the coordinates of the PC?

How about the PT?

Can you compute the coordinates of the center of the circle?

Curve Layout by Deflection Angles
Subchords and Subdeflections