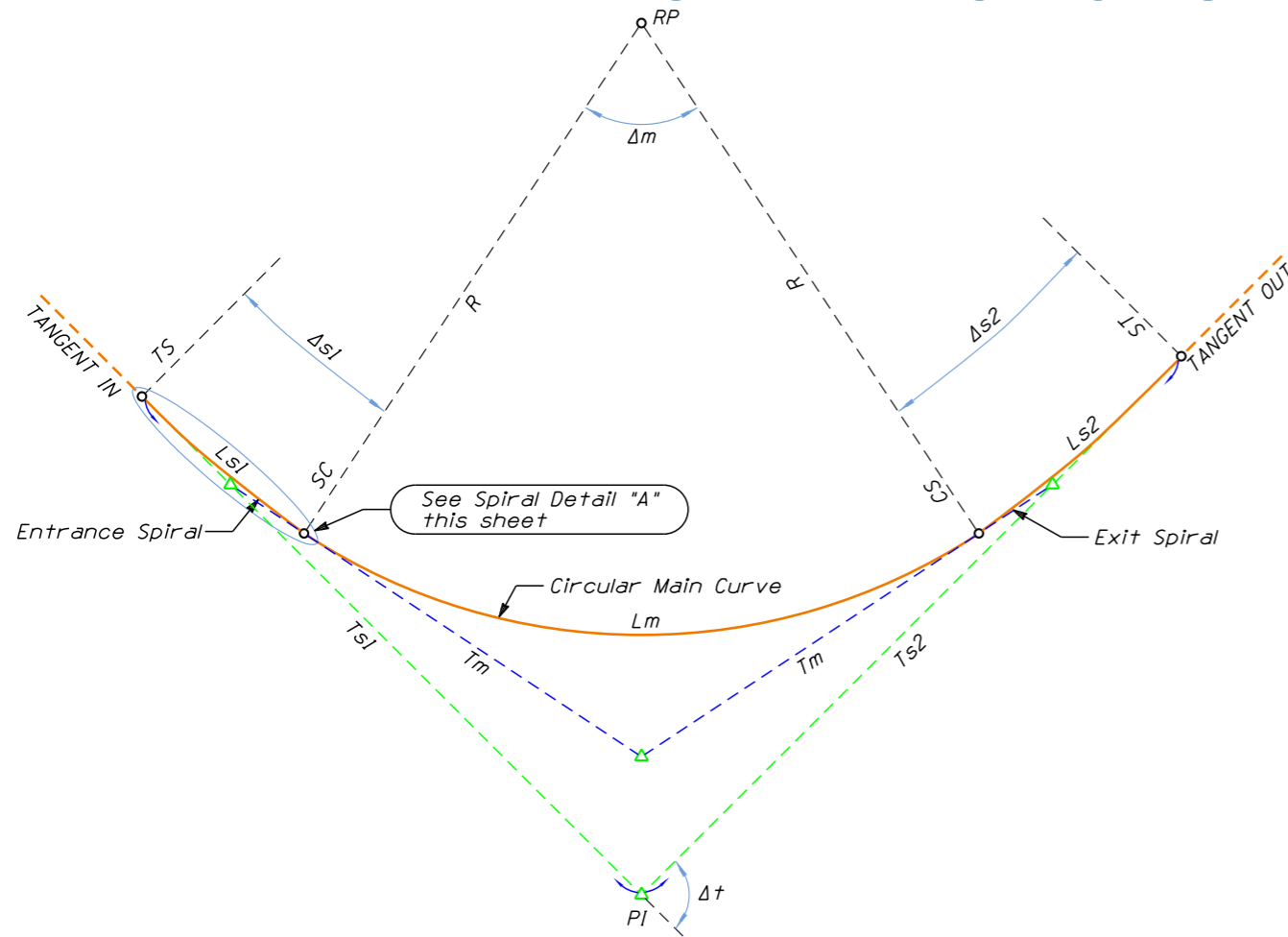
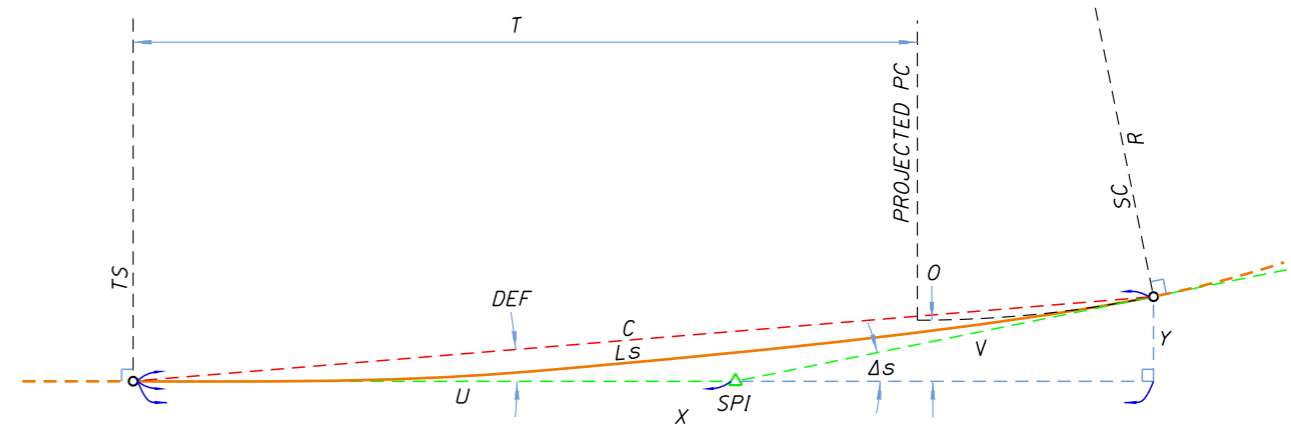


FULL TRANSITION UNEQUAL SPIRAL CURVES



TYPICAL HIGHWAY SPIRAL-MAIN-SPIRAL CURVE
Not to scale



SPIRAL DETAIL "A"
Not to scale

Highway Spiral Curve where $\Delta s < 16^\circ$

FORMULAS

See SC-1 for spiral formulas

$$\begin{aligned} \Delta m &= \Delta t - \Delta s1 - \Delta s2 \\ Xa &= \text{Cos}(\Delta s1) * (V1 + Tm) \\ Ya &= \text{Sin}(\Delta s1) * (V1 + Tm) \\ Xb &= \text{Cos}(\Delta m + \Delta s1) * (V2 + Tm) \\ Yb &= \text{Sin}(\Delta m + \Delta s1) * (V2 + Tm) \\ Xc &= (Ya + Yb) / \text{Tan}(\Delta t) \\ Ts1 &= Xa + Xb - Xc + U1 \\ Ts2 &= \sqrt{Xc^2 + (Ya + Yb)^2} + U2 \end{aligned}$$

EXAMPLE

Given: $\Delta t = 36^\circ 29' 16''$; $D = 2^\circ 00' 00''$; $Ls1 = 200'$; $Ls2 = 300'$; $TS(S+a) = 2180+84.70$

Entrance Spiral (Ls1)

$$\begin{aligned} a &= (2.0000^\circ * 100) / 200 = 1.00 \\ O &= 0.0727 * 1 * ((200 / 100)^3) = 0.58160 \\ T &= (200 / 2) - (0.000127 * 1^2 * (200 / 100)^5) = 99.99594 \\ C &= 200 - (0.00034 * 1^2 * (200 / 100)^5) = 199.98912 \\ DEF &= (1 * 200^2) / 60000 = 0.666667^\circ \text{ or } 0^\circ 40' 00'' \\ \Delta s &= 0.005 * 2.0000^\circ * 200 = 2.0000^\circ \text{ or } 2^\circ 00' 00'' \\ U &= 199.98912 * \text{Sin}(2.0000^\circ * 2 / 3) / \text{Sin}(2.0000^\circ) = 133.34112 \\ V &= 199.98912 * \text{Sin}(2.0000^\circ * 1 / 3) / \text{Sin}(2.0000^\circ) = 66.67508 \\ X &= 199.98912 * \text{Cos}(0.666667^\circ) = 199.97558 \\ Y &= 199.98912 * \text{Sin}(0.666667^\circ) = 2.32693 \end{aligned}$$

Main Curve

$$\begin{aligned} R &= 5729.57795 / 2.0000^\circ = 2864.78898 \\ \Delta m &= 36^\circ 29' 16'' - 2^\circ 00' 00'' - 3^\circ 00' 00'' = 31^\circ 29' 16'' \text{ or } 31.48778^\circ \\ Lm &= (31.48778^\circ * 2864.78898 * 3.141592654) / 180 = 1574.38900 \\ Tm &= 2864.78898 * \text{Tan}(31.48778 / 2) = 807.62426 \end{aligned}$$

$$\begin{aligned} SC(S+a) &= 2180+84.70 + 200 = 2182+84.70 \\ CS(S+a) &= 2182+84.70 + 1574.39 = 2198+59.09 \\ ST(S+a) &= 2198+59.09 + 300 = 2201+59.09 \\ PI(S+a) &= 2180+84.70 + 1045.74 = 2191+30.44 \end{aligned}$$

Exit Spiral (Ls2)

$$\begin{aligned} a &= (2.0000^\circ * 100) / 300 = 0.66667 \\ O &= 0.0727 * 0.66667 * ((300 / 100)^3) = 1.30860 \\ T &= (300 / 2) - (0.000127 * 0.66667^2 * (300 / 100)^5) = 149.98628 \\ C &= 300 - (0.00034 * 0.66667^2 * (300 / 100)^5) = 299.96328 \\ DEF &= (0.66667 * 300^2) / 60000 = 1.000^\circ \text{ or } 01^\circ 00' 00'' \\ \Delta s &= 0.005 * 2.0000^\circ * 300 = 3.000^\circ \text{ or } 3^\circ 00' 00'' \\ U &= 299.96328 * \text{Sin}(3.000^\circ * 2 / 3) / \text{Sin}(3.000^\circ) = 200.02630 \\ V &= 299.96328 * \text{Sin}(3.000^\circ * 1 / 3) / \text{Sin}(3.000^\circ) = 100.02838 \\ X &= 299.96328 * \text{Cos}(1.000^\circ) = 299.91759 \\ Y &= 299.96328 * \text{Sin}(1.000^\circ) = 5.23508 \end{aligned}$$

Tangents

$$\begin{aligned} Xa &= \text{Cos}(2.000) * (66.67508 + 807.62426) = 873.76674 \\ Ya &= \text{Sin}(2.000) * (66.67508 + 807.62426) = 30.51261 \\ Xb &= \text{Cos}(31.48778 + 2.000) * (100.02838 + 807.62426) = 756.98550 \\ Yb &= \text{Sin}(31.48778 + 2.000) * (100.02838 + 807.62426) = 500.80562 \\ Xc &= (30.51261 + 500.80562) / \text{Tan}(36.48778) = 718.35575 \\ Ts1 &= 873.76674 + 756.98550 - 718.35575 + 133.34112 = 1045.73711 \\ Ts2 &= \sqrt{718.35575^2 + (30.51261 + 500.80562)^2} + 200.02630 = 1093.52171 \end{aligned}$$