
Spiral Transitions

Current guidance states that the use of spiral transitions reduce crash probability and are beneficial for operational and aesthetic performance. Since this guidance will result in increased spiral transition usage and spiral transitions are not currently widely used within our department, this document is intended to provide an introduction for drafting in Microstation V8i to assist our designers.

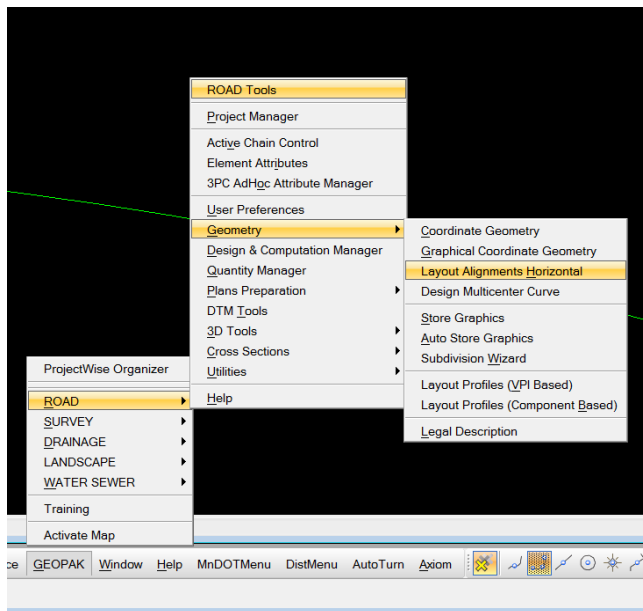
Short Discussion on Choosing Spiral Length

Spiral transitions typically vary in length from 200-ft. to 400-ft., either set to the length of superelevation runoff or in even 100-ft. increments. Loop style ramps drive well and have exhibited improved safety performance using 300-ft. entry spirals. 200-ft. lengths are sufficient when transitioning between compound curves in the same direction or in other situations with minimal superelevation transition length, as well as in constrained situations. 400-foot lengths are less common but can be beneficial where particular safety concerns or extraordinary superelevation runoff lengths are in play.

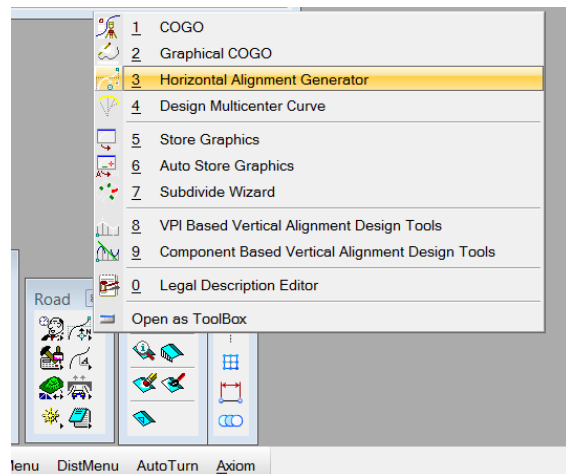
Demonstrations of three different tools (easiest last) with basic instructions on their use included below. Alternate methods provided because different tools may be better suited to different situations. Also note that the upcoming version of our CADD system may eliminate or change some of these tools.

Location of Spiral Drafting Tools

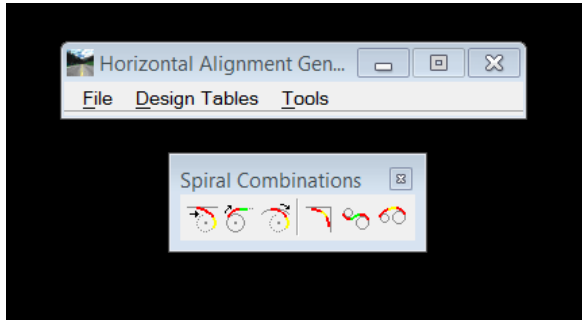
GEOPAK>ROAD>Geometry>Layout Alignments Horizontal (COGO opens with these tools)



Or access **Horizontal Alignment Generator** from the COGO menu bar



Select Tools>Spiral Combinations



Spiral Combination Tools



Place SC Tangent To Line

This tool enables the user to store a spiral / curve combination tangent to a line.



Place ST Tangent To Curve

This tool enables the user to store a spiral / tangent combination tangent to a curve.



Place SC Tangent To Curve

This tool enables the user to store a compound spiral / curve combination tangent to a curve.



Place SCS (Intersecting Elements)

This tool enables the user to store a spiral / curve combination tangent to a line. The Design Table enables the user to select the desired Design Speed / Lanes and Degree based on the data from files stored in the User Preferences.



Place STS (Disjoint Curves)

This tool enables the user to store a spiral tangent spiral combination tangent between two elements.

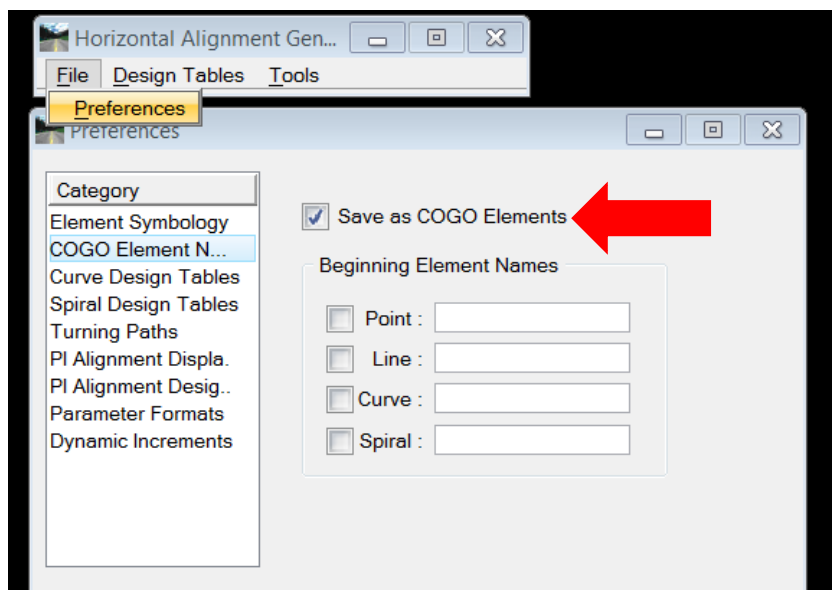


Place SCS (Disjoint Curves)

This tool stores a spiral curve spiral combination between two curves. Note the tool also works with overlapping curves. The Design Table enables the user to select the desired Design Speed / Lanes and Degree or Radius based on the data from files stored in the User Preferences.

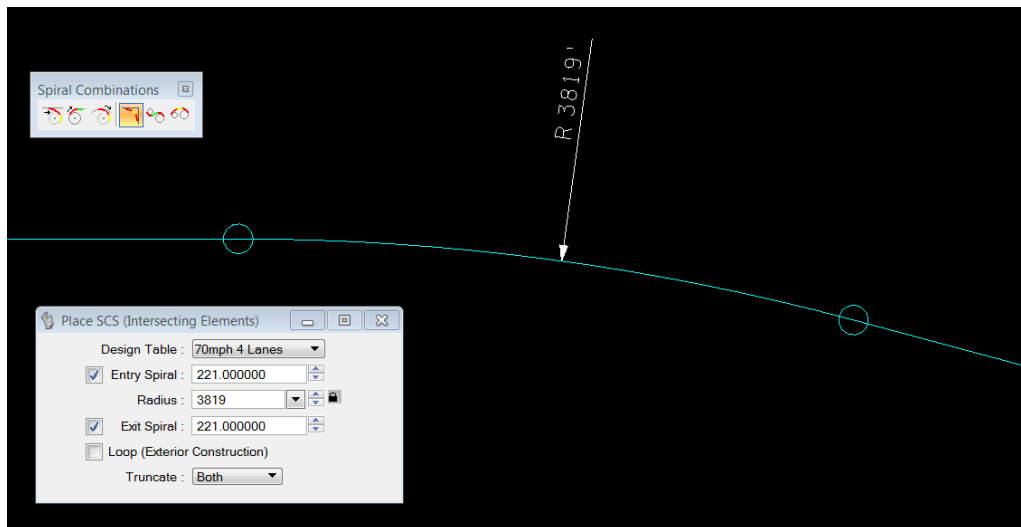
Automatic Save Feature

The alignment tools shown in this document exist within Geopak and have the save feature defaulted to on. If multiple iterations of the design are likely it may be preferable to disable this automatic save option. The elements can be saved after an acceptable design is found, or the save feature can be turned on so the tool can be used to save with the preferred settings.



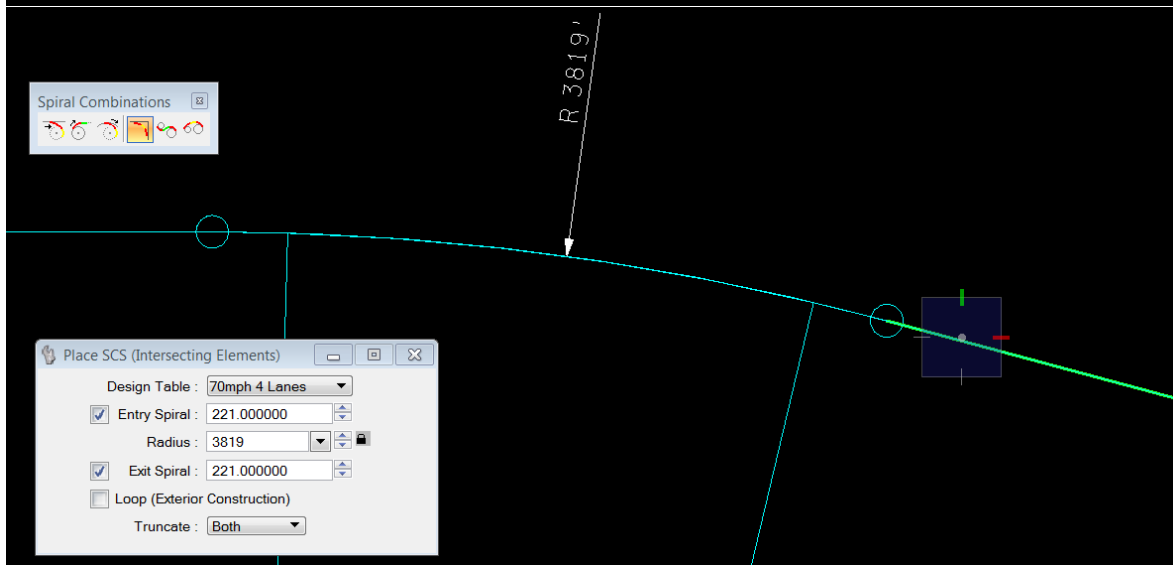
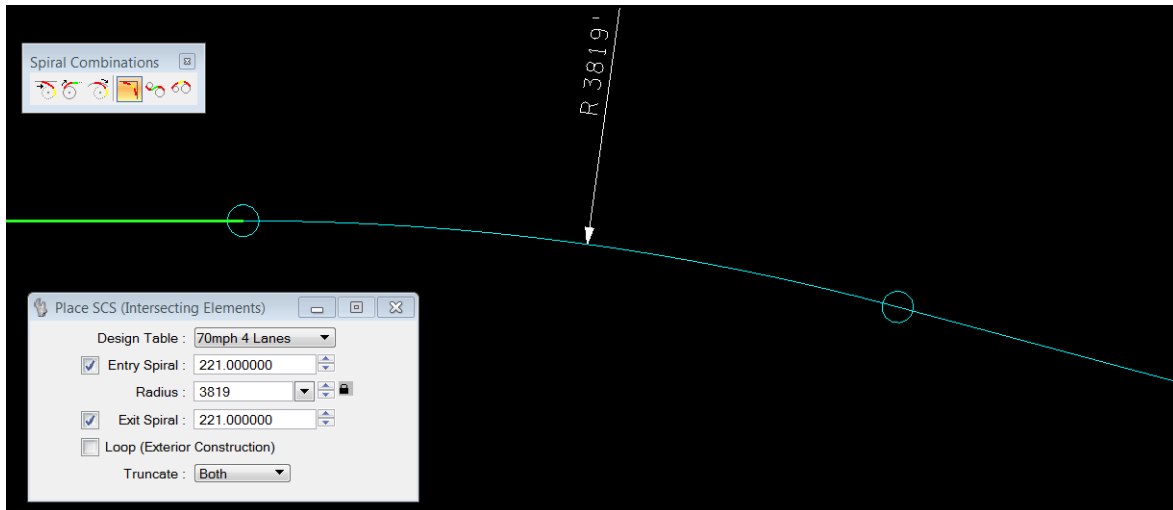
Place Spiral Into And Out Of A Circular Curve

Choose **Place SCS (Intersecting Elements)**

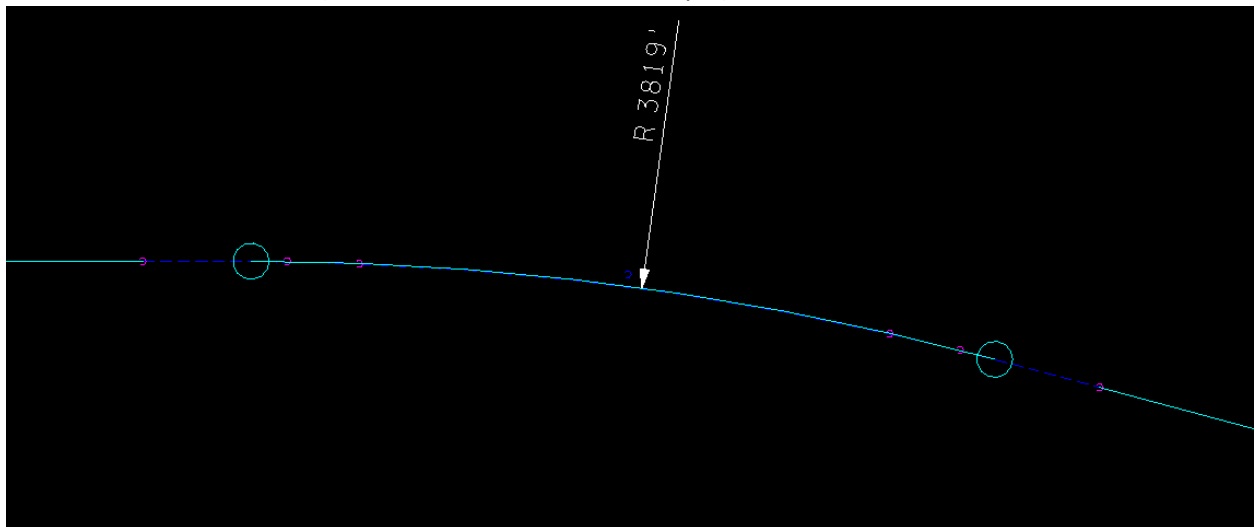


Choosing a **Design Table** consistent with your Design Speed and roadway section will pre-select entry and exit spiral lengths. Adjust to chosen spiral length, commonly the length of Superelevation Runoff.

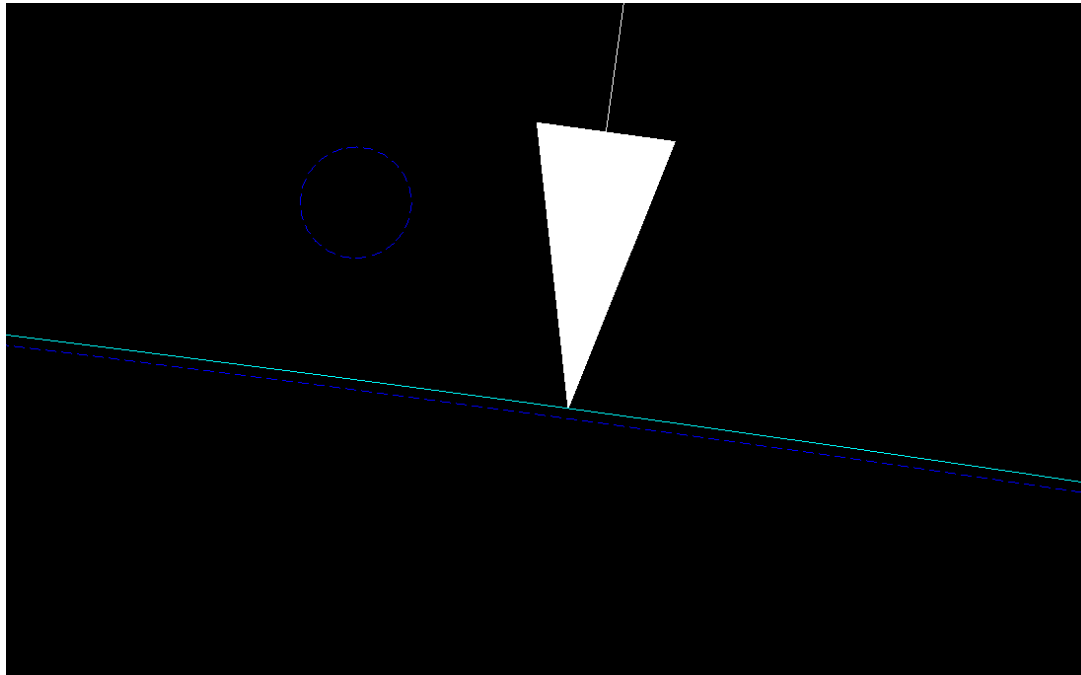
Follow instructions on the status bar `Place SCS (Intersecting Elements) > Identify first element` to select and accept the tangent on either side of the curve you want to add spirals to.



Hold cursor so that the tentative curve is shown on the correct side before final left click to accept. The new SCS is now visualized (dashed blue lines in this example).



The zoomed in shot below shows the offset between the original (cyan) and new (dashed blue) curves. The offset is ~1-ft. in this example, but will vary by radius and deflection angle. Radius adjustments could be used to reduce offset if necessary or desired.



The spiral was saved in the gpk (check the automatic save feature if not saving).

Coordinate Geometry Job: 000 Operator: jl

File Edit Element View Tools

99.1234 9°9'9.12" << < > >>

COGO Key-in: STORE SPIRAL C2A CS X 450341.68350402 Y 265789.33939755 DB 42.375029257496 LS -221.0000000000 RADIUS 3819.0000000000

```

<+ 15 STORE SPIRAL C2A CS X 450341.68350402 Y 265789.33939755 DB 42.375029257496 LS -221.0000000000 RADIUS 3819.-
0000000000
Spiral C2A          Type 2      Spiral Element
Angle      1° 39' 28.12" (RT) P      0.5329   BK 42° 22' 30.11"
LS         221.0000      K          110.4969   AH 44° 01' 58.23"
R          3,819.0000   LT          147.3398   CB 43° 28' 48.87"
YS         2.1314      ST           73.6725   Defl 0° 33' 09.36"
XS         220.9815   LC          220.9918   Deg  1° 30' 01.02"
    
```

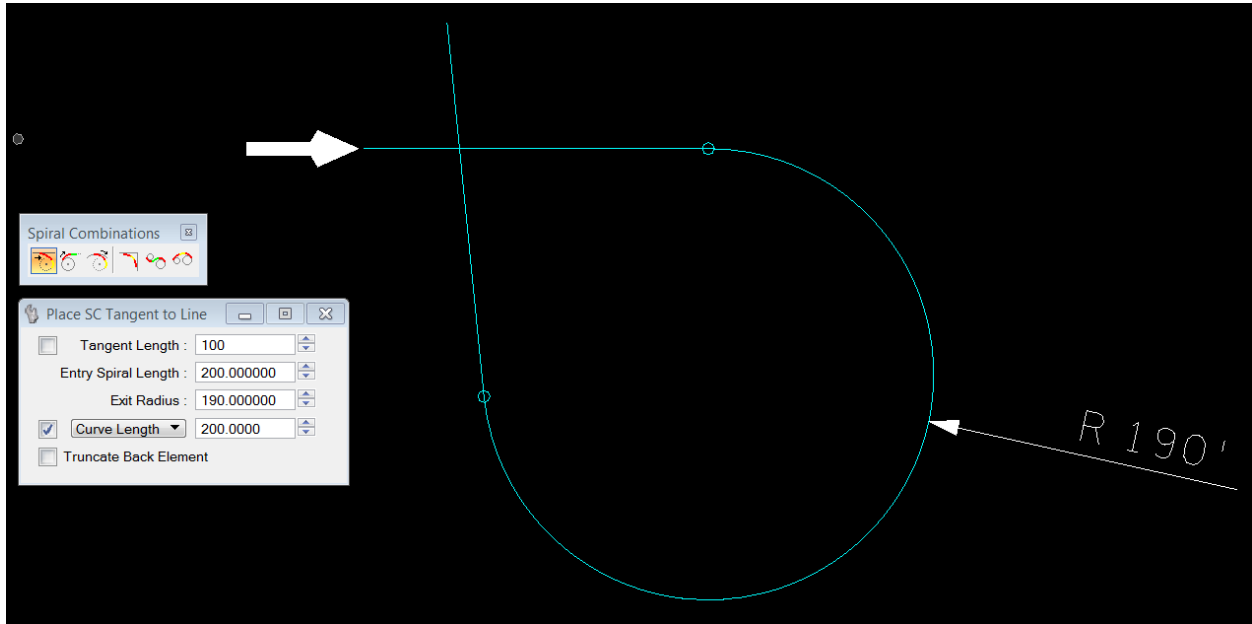
Spiral Coordinates

Point	X	Y	Station
CS	450,341.6835	265,789.3394	0+00.00
PI	450,391.3374	265,843.7649	0+73.67
ST	450,493.7489	265,949.6936	2+21.00
CC	453,162.9665	263,215.4079	

Spiral C2A stored

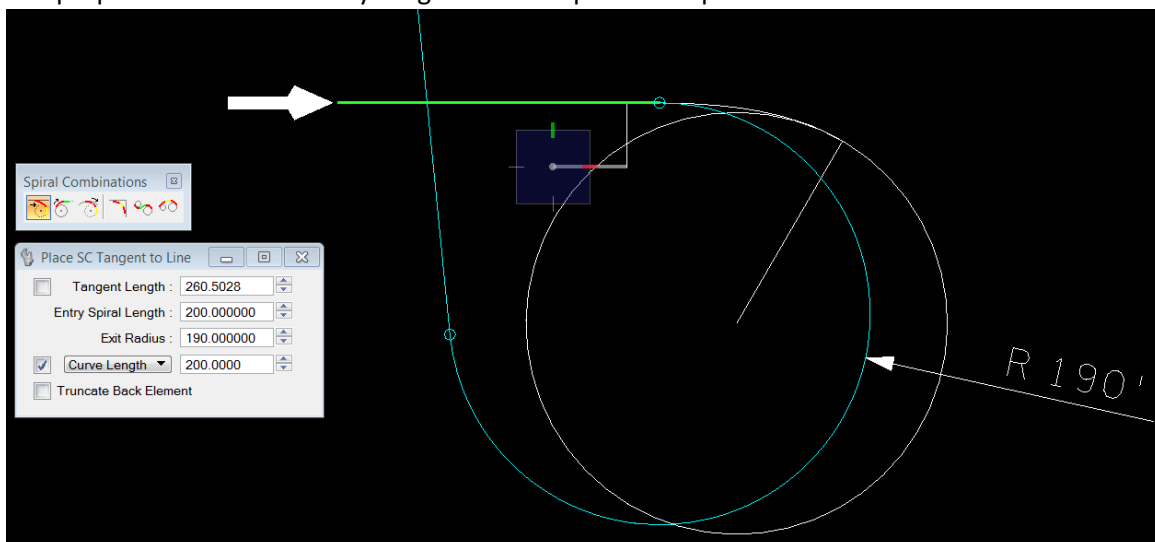
Place Loop With Spirals And A Compound Curve

Aligning a loop with a spiral on either side can probably be accomplished in many ways. One will be shown here and will be updated later if a simpler solution is suggested to us.

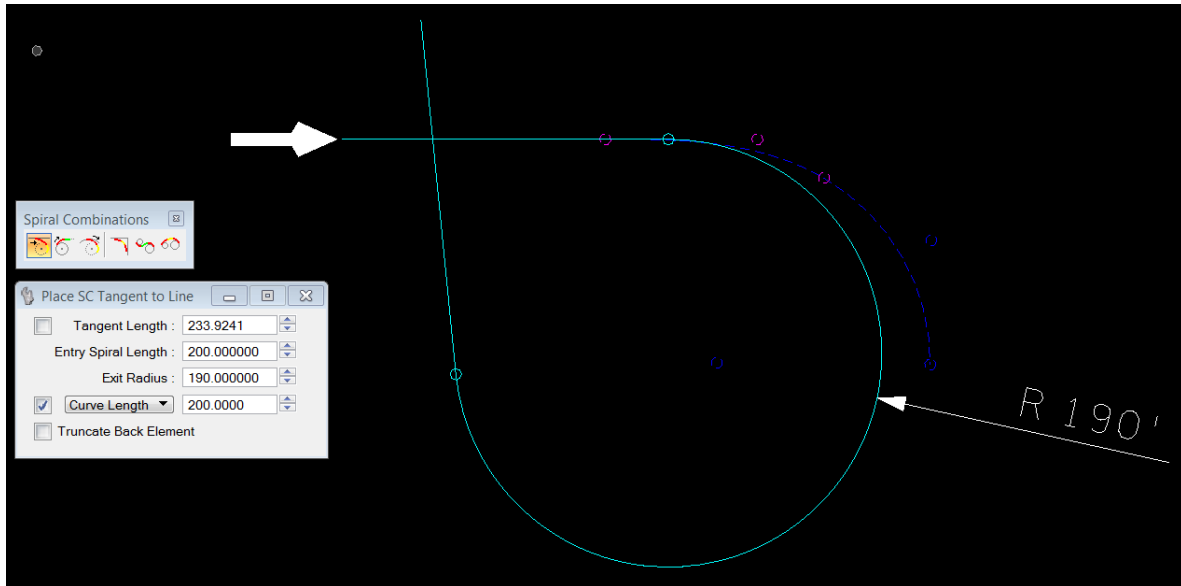


Use the **Place SC Tangent to Line** tool to create a spiral from a line to a curve radius. Entry Spiral Length is where the chosen spiral length is set, 200-ft. used in this example, although 300-ft. is preferred for loops. Tangent length and curve length cause the tool to draw these elements instead of just the spiral alone. Include some curve length because we will use it to help locate the spiral later.

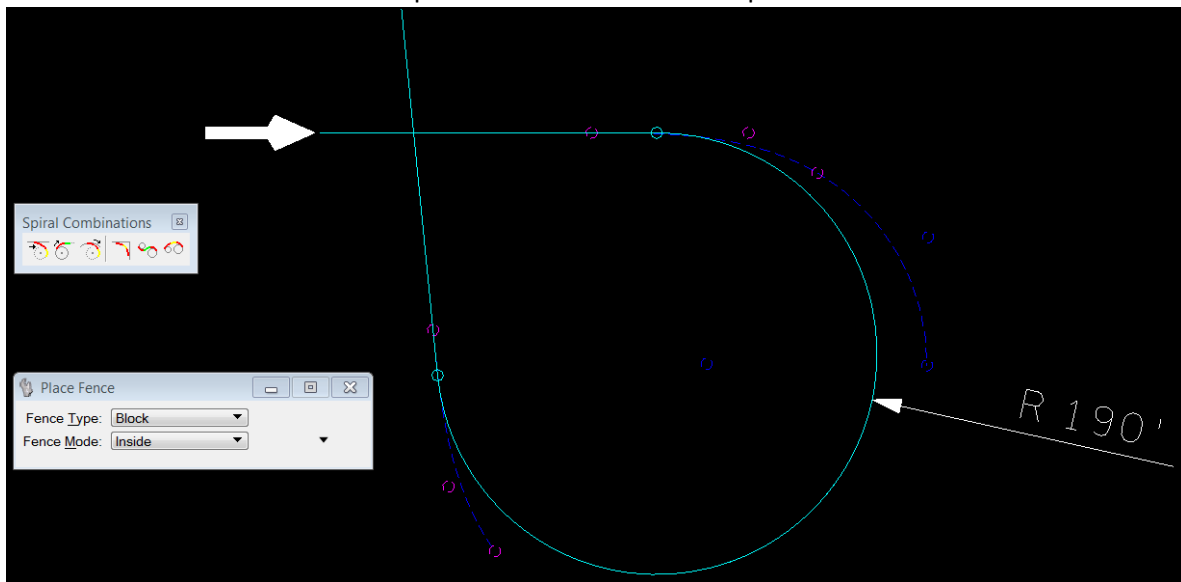
Follow the status bar prompt and select the right side of the tangent that the spiral will begin from (choosing the other side of the line will orient the spiral in the opposite direction). *Note the handle line perpendicular to the entry tangent used to place the spiral.



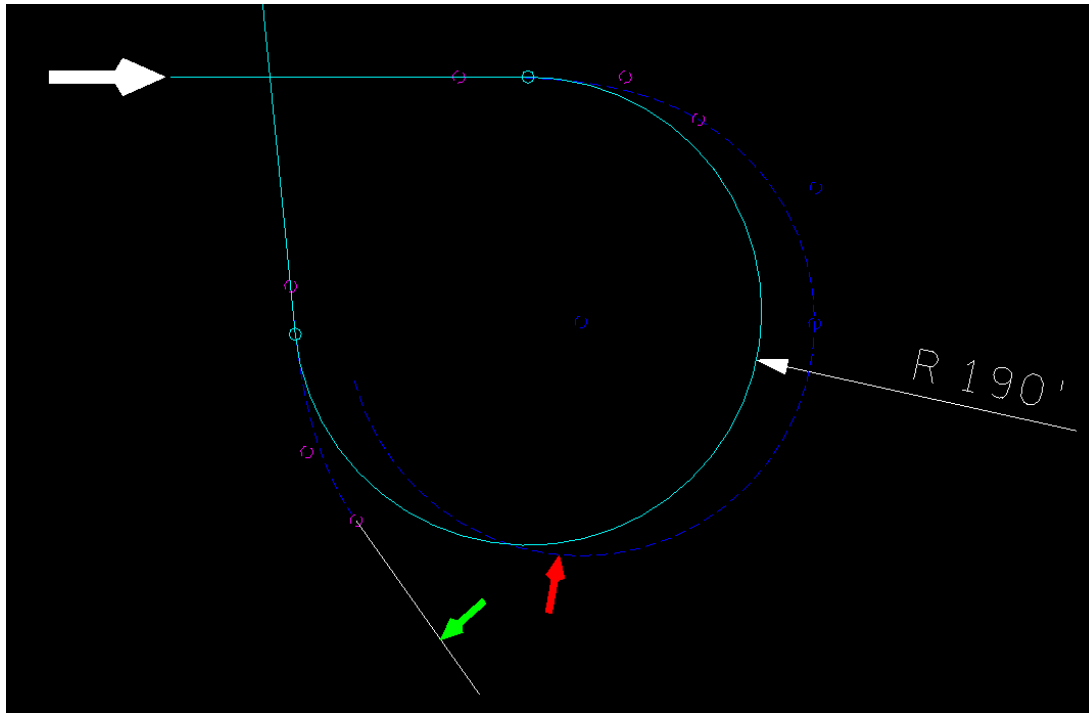
Left click to accept, locating the spiral and curve somewhere near the original (new spiral visualization shown as blue dashed lines).



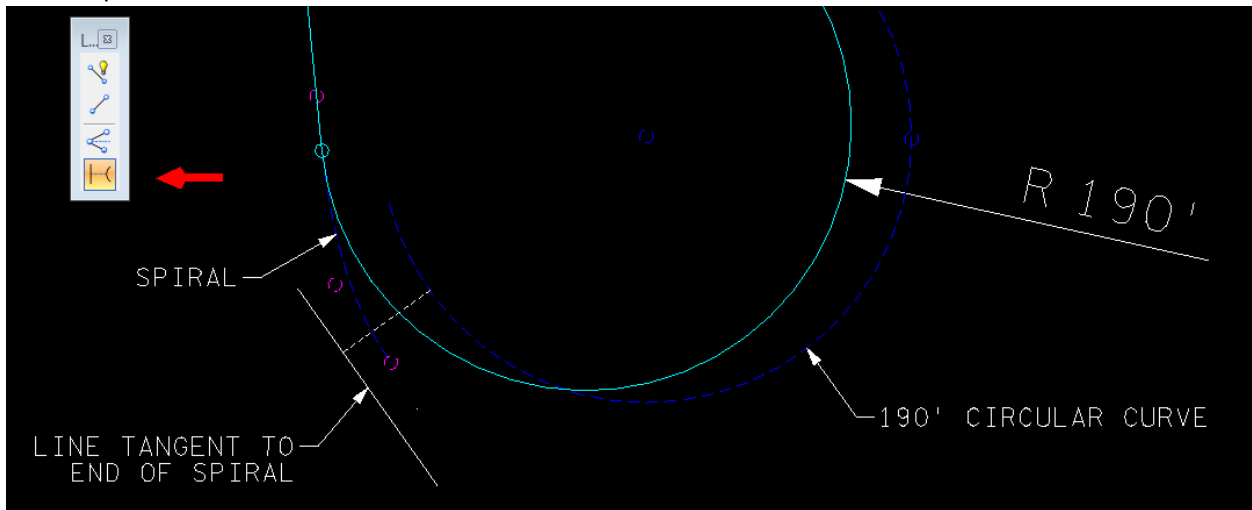
Repeat this process to create a spiral curve combination on the alignment at the other end of the loop. Delete the circular curve that was produced with this second spiral.



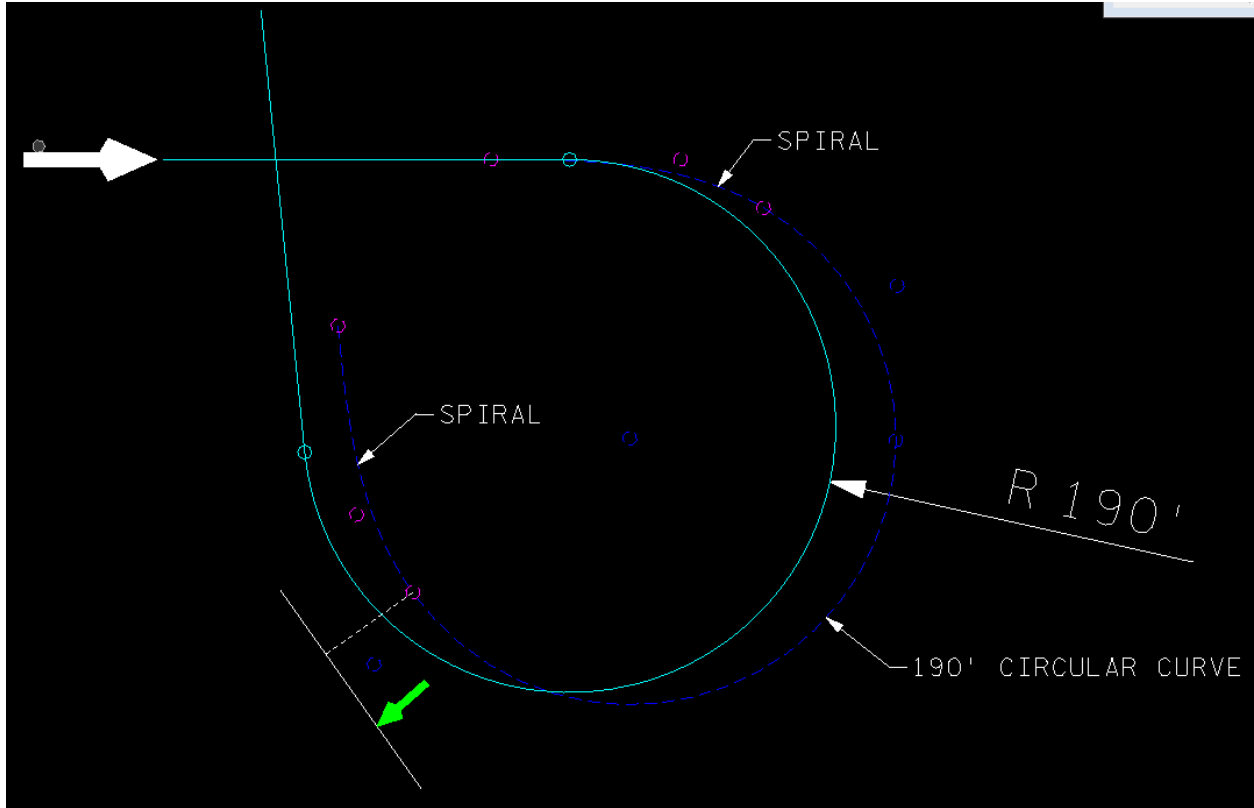
Extend the circular curve around as shown below (marked with red arrow) and create a line tangent to the end of the spiral (marked with green arrow).



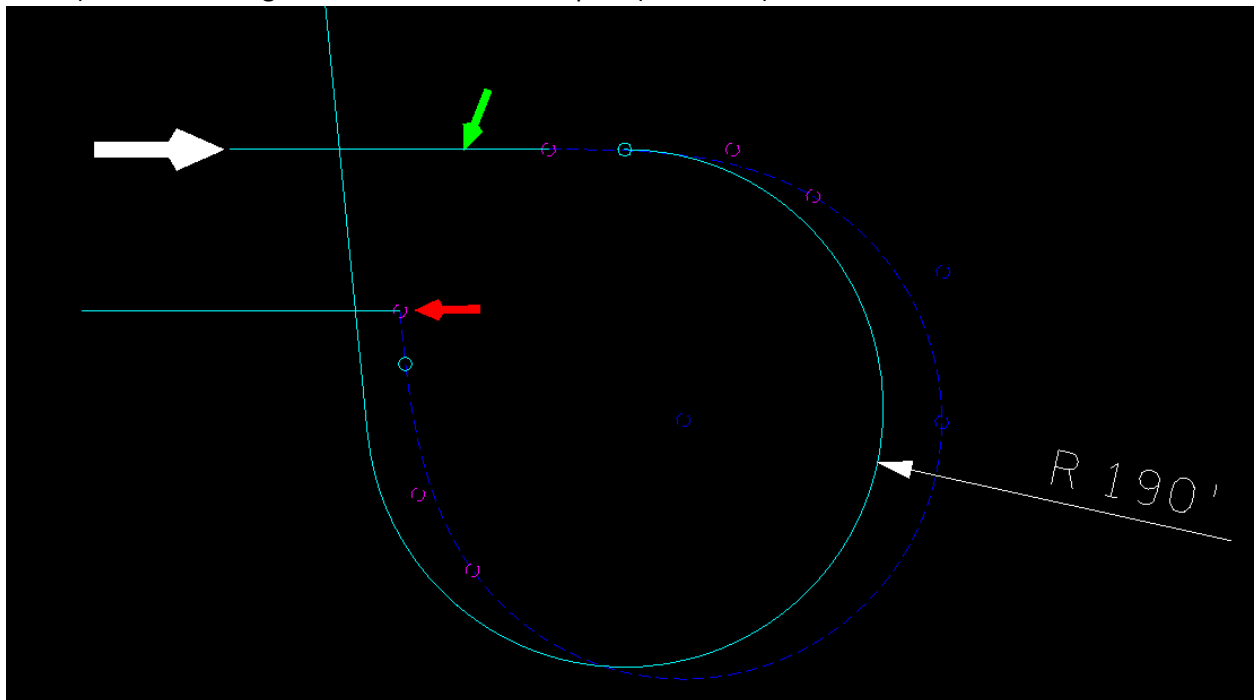
Use **Construct Minimum Distance Line** tool (red arrow) can be used to draw a line (dashed white) to the nearest point of the circular curve.



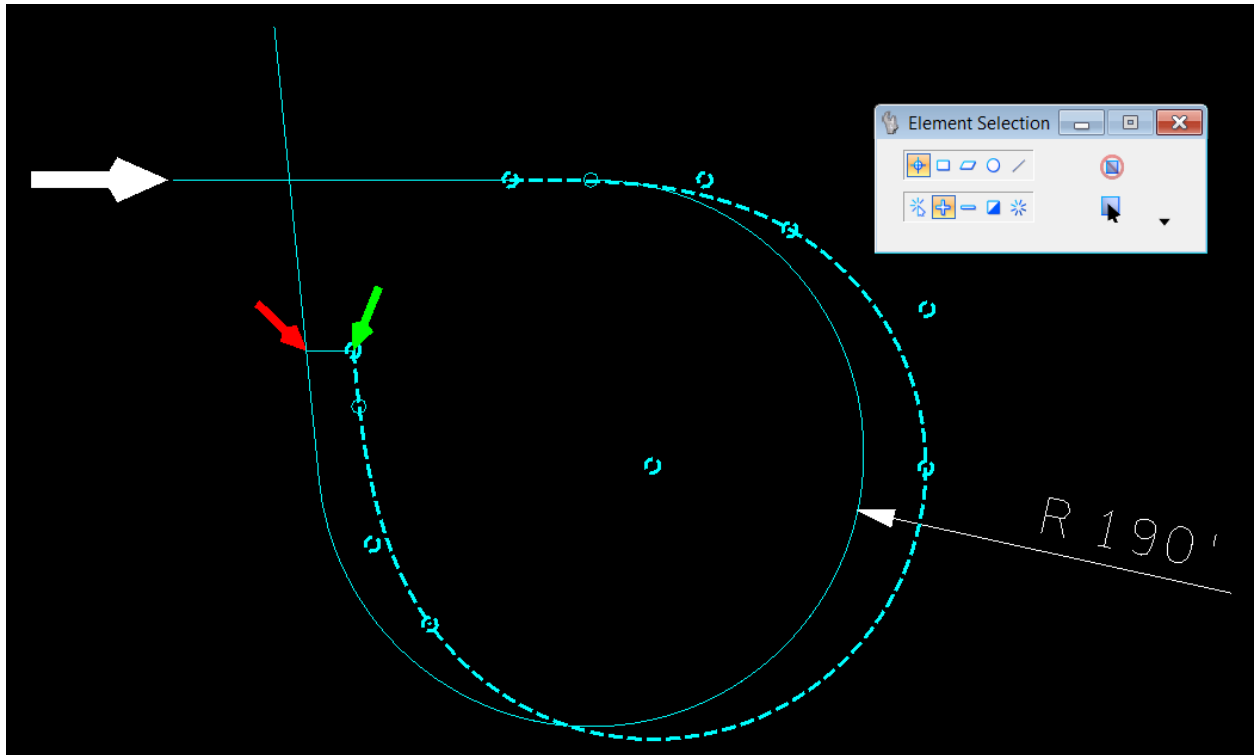
Trim the circular curve at the dashed white line. This leaves the end of the circular curve tangent to the spiral (green arrow). Move the spiral and connect it to the circular curve as shown below.



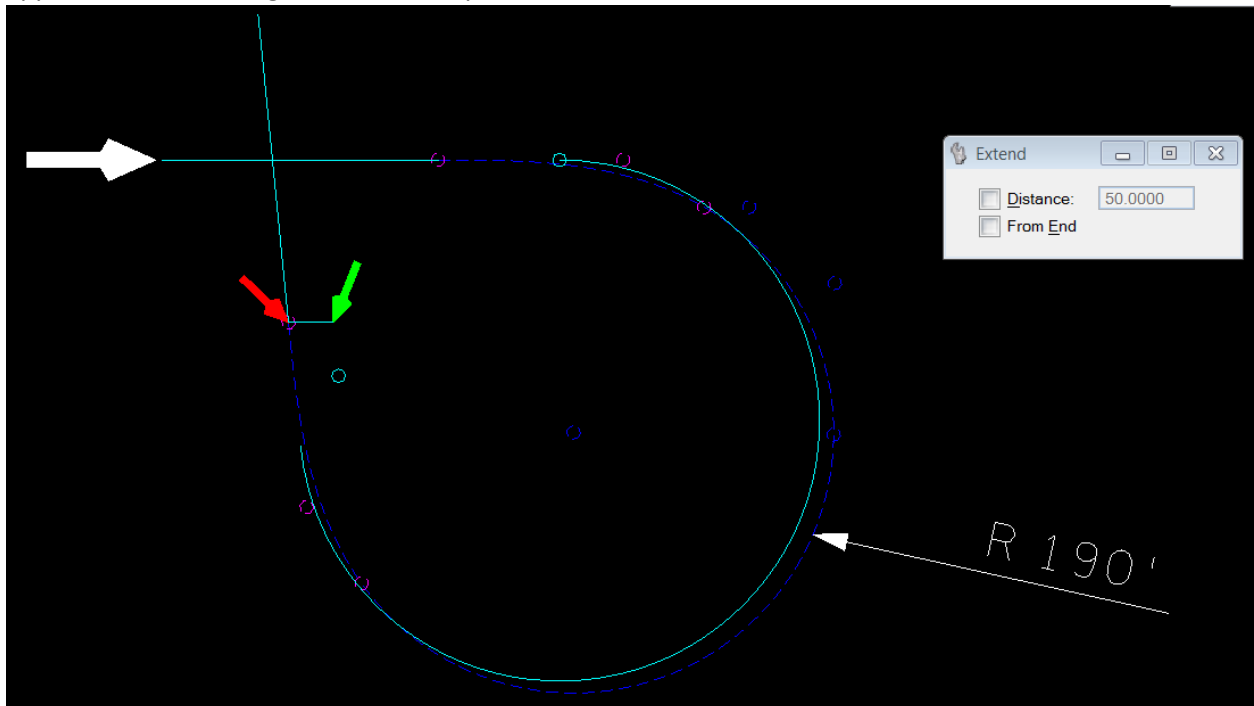
Next the SCS loop we have created needs to be shifted so that end spirals meet the exit tangent while keeping the entry spiral on the entry tangent. Accomplish this by copying the entry tangent (green arrow) and connecting it to the end of the exit spiral (red arrow).



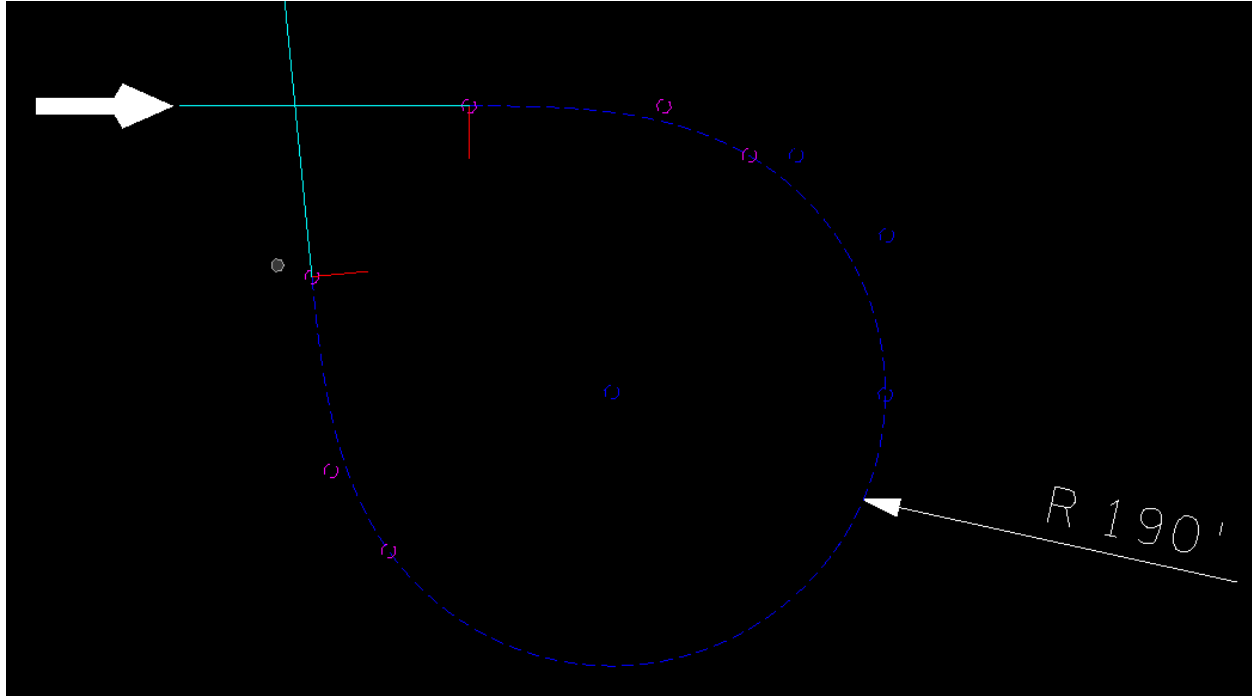
Trim this new line where it meets the exit tangent (red arrow) and then make a selection set of the new SCS loop.



Move the SCS loop along the line that was just trimmed (from green arrow to red arrow). Trim approach and exit tangents to end of spirals.



These graphical elements no longer match the spirals and curve stored in the gpk. **Caution:** These items can be removed from the gpk, but may result in deletion of the visualization elements we have been using. Creating spirals in the new location can easily be accomplished by placing lines perpendicular to the entry and exit tapers (shown in red) to match the spiral placement handles pointed out earlier in this section.



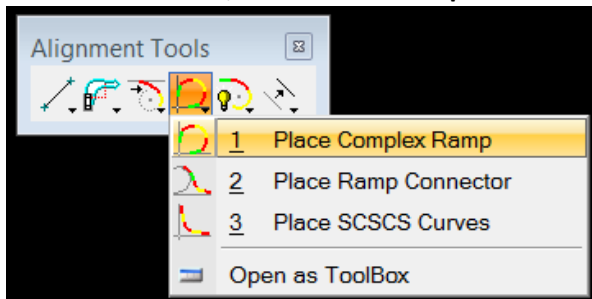
Place Complex Ramp

This example shows a simpler tool to create a loop ramp with a spiral entry and exit.

GEOPAK>ROAD>Geometry>Layout Alignments Horizontal, or open from the Geopak Road toolbar:

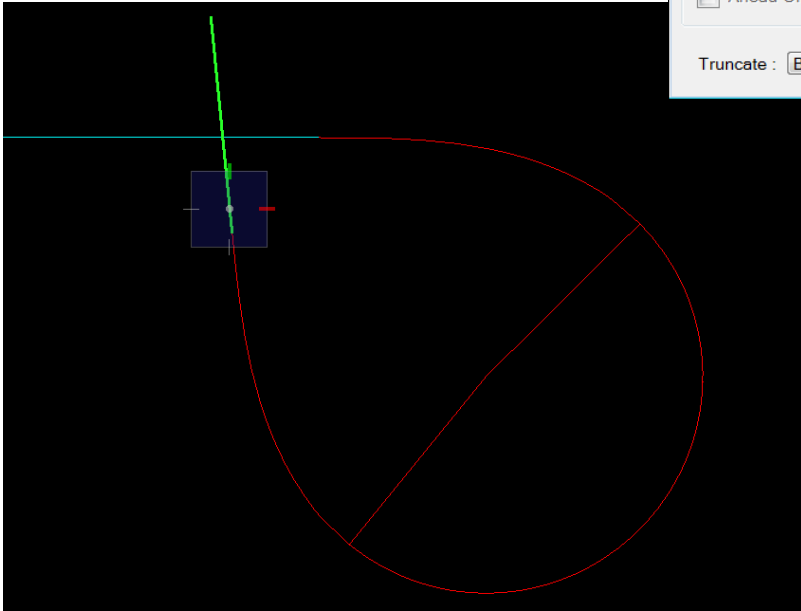
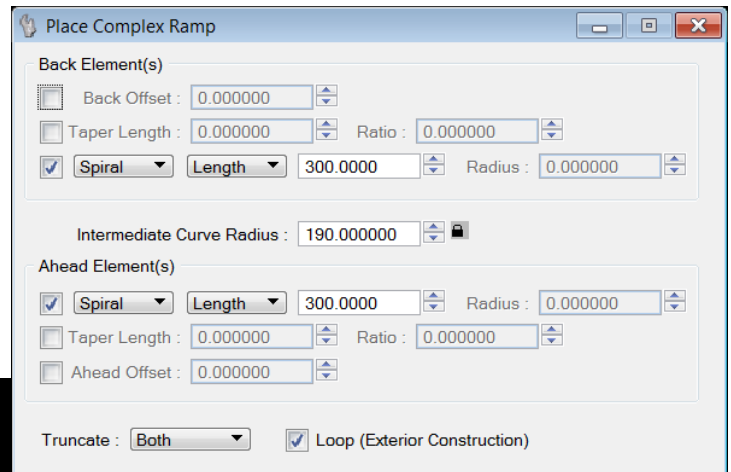


Select **Tools>Main**, then choose **Complex Transitions>Place Complex Ramp**



Choose drop down options as shown here:

Set chosen values for entry and exit spiral lengths, and for the Intermediate Curve Radius. Also, set Truncate: Both and check Loop (Exterior Construction).



Follow status bar prompts to choose and accept the first element. Select, but **wait** to accept the second element. Move the cursor until the visualized loop ramp appears in the appropriate quadrant, and then click to accept.

After acceptance the new loop ramp will be visualized on screen and stored in Geopak if the automatic save setting is still enabled.

