Module 7

Plan Geometry

April 11, 2023

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About this Practice Workbook...

- This PDF file includes bookmarks providing an overview of the document. Click on the bookmark to quickly jump to any section in the file. You may have to turn on the bookmark function in your PDF viewer, such as Adobe Reader.

- The dataset used throughout this module uses English units and US Survey Feet.

- Each module in this series is self-contained. You can jump to any module and begin the exercises.

- This training module uses the DOT-US North Carolina WorkSpace and the R-2635C (Training) Workset installed. It is very important that you select the correct WorkSpace, Workset and Desktop Icon/Discipline/future Role **NCDOT_Roadway** when working the exercises in this course.

- The tool tips and help were copied from the Bentley Online Help. See this link for the complete list of tools and common usage.

  OpenRoads Designer CONNECT Edition Help (bentley.com)

- This workbook was written with the release of OpenRoads Designer 10.09.00.91 (2020 Release 3 Update 9).

- This workbook has been updated for OpenRoads Designer 10.10.XX.XX (2021 Release 1 Update 10).

Table of Contents

Overview

Plan geometry is a very different concept in ORD when compared to MicroStation SS2.

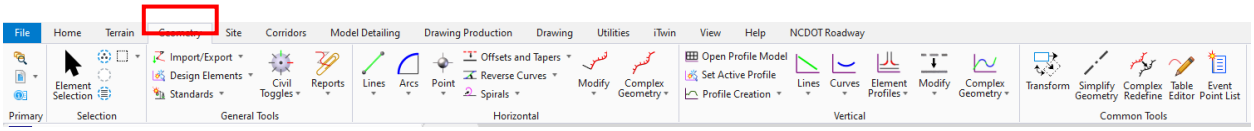
Plan Geometry refers to everything that is not a Horizontal or Vertical Alignment. This includes EOT, Paved Shoulder, Walls, Barriers, Guardrail, Bridges, Approach Slabs, Right-Of-Way, Curbs, Sidewalks, Islands etc. When using MicroStation SS2 these elements were just lines and arcs in space with no intelligence or design intent. When using ORD these elements can be created with a relationship to other elements that can preserve design intent and build smarter plans. The user can construct turn lanes and barriers that can adjust automatically with revisions to the reference elements. This is the same concept that was demonstrated in the Horizontal and Vertical Alignment training modules.

As demonstrated in module 5 – Initial Corridor Modeling many of the plan view graphics can be generated by the template in the CMD file, saving the user time, effort, and duplicate data. When using the standard NCDOT templates and workflows most of the plan graphics will be generated from the model.

When placing the Plan Geometry that affects the model; EOT, Paved Shoulder, Sidewalks, etc. the elements can be placed in the CMD file or in the DSN file. The elements can also be placed with construction class feature definitions that the template can target, these are generally placed in the CMD file. Or, the elements can be placed with primary class feature definitions that are not targeted by the template, generally placed in the DSN file, these will require other methods to incorporate the model, point controls, parametric constraints etc. Which file contains the elements, CMD or DSN, and what type of feature definitions is used, primary or construction class, will largely be up to the user and will depend on things like, personal preference, project complexity, project size.

For this module, the tools and methods will be demonstrated in the DSN file using the primary class Feature Definitions. For more information on when and how to use the construction class feature definitions within the CMD file see the modules that specifically deal with Corridor Modeling.

Geometry Ribbon Tab

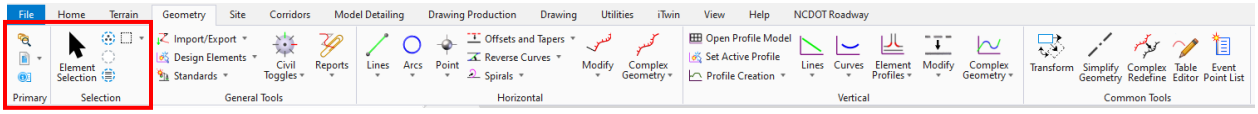


The *Geometry* Ribbon contains tools that the designer will use to create Horizontal and Vertical Geometry and plan elements that are based on Civil Geometry. The Ribbon is broken into 6 sections.

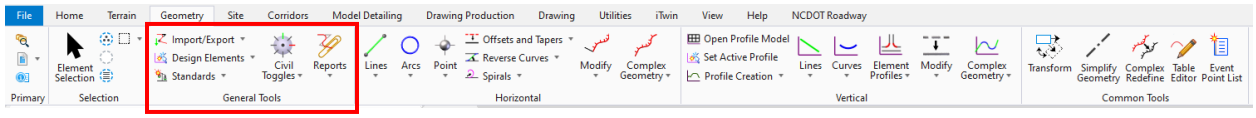
This section of the training Module will only focus on the tools used to create Vertical alignments. These tools will include Lines and Curves and will function very similar to the tools used for Horizontal Alignments

Primary & Selection Tool Group

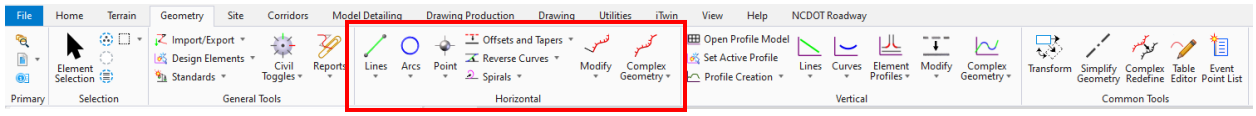
These two (2) groups are common throughout the ribbons. To see all the tools in these sections, use the Home ribbon. The other ribbons include a partial group of the tools included in these two sections



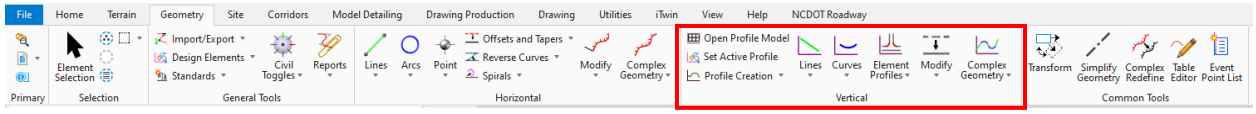
General Tool Group



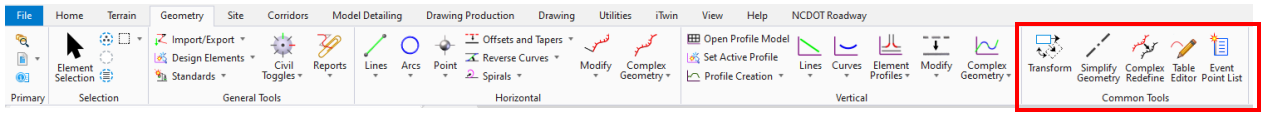
Horizontal Tool Group



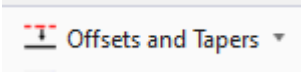
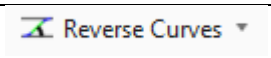
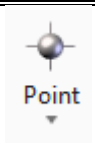
Vertical Tool Group



Common Tool Group



(Table 2-1) Important Tools Used in Vertical Alignments

 Offsets and Tapers	Offset a reference element and create ruled geometry through various methods, parallel offset of the entire or partial element or tapered offsets
 Reverse Curves	Create reverse curves between previously drawn elements
 Point	Draw individual points, useful for setting Right of Way and Easements

Feature Definition Toolbar

Feature Definitions are included in the NCDOT workspace. They are used to control symbology, and various other properties that are applied to the geometric elements. In the same way that using the correct feature definition for the horizontal alignment is an important part of the design process it is important to use the correct feature definition for the vertical alignment design process.

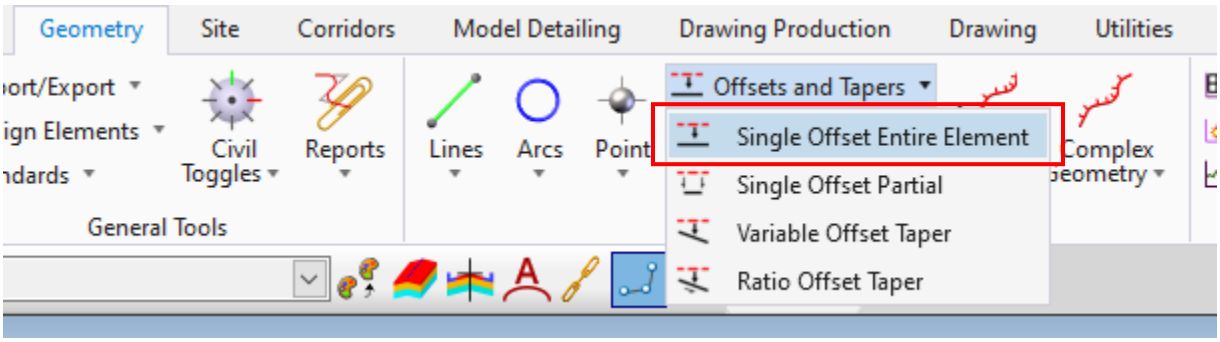
When designing elements that fall under the Plan Geometry umbrella the feature definition is critical. For some elements, guardrail for example, the feature definition will control the display of the element in the plan view, the 3D model view and the cross sections view and the display in each view will be different. The feature definition will be used by the templates as a targeting line, if the wrong feature definition is used the model will produce incorrect results.

It is important to use the correct feature definition when placing each element in the DSN file.

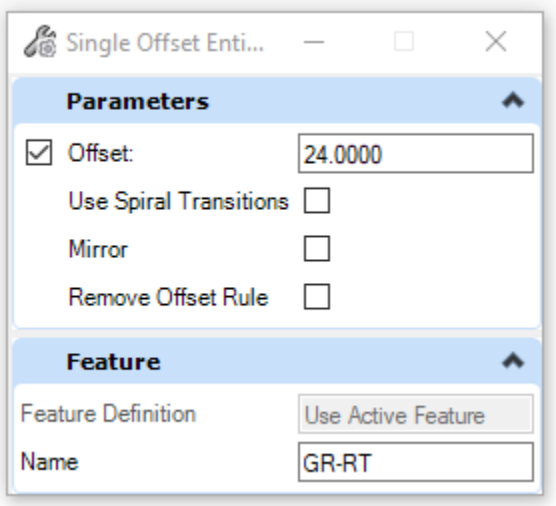
Plan Geometry – Offset and Tapers Tools Overview

The **Offsets and Tapers** tool group contains tool that will be commonly used to design elements like edge of travel, paved shoulders, and guardrail. The **Offsets and Tapers** tool group is in the *Horizontal* section of the *Geometry* ribbon. The **Offset and Tapers** tool group, along with the horizontal **Line** and **Arc** tools will be the most common tools used for the creation of other Plan Geometry.

1. **Single Offset Entire Element**
   A. The **Single Offset Entire Element** will offset an entire complex element and create ruled geometry.

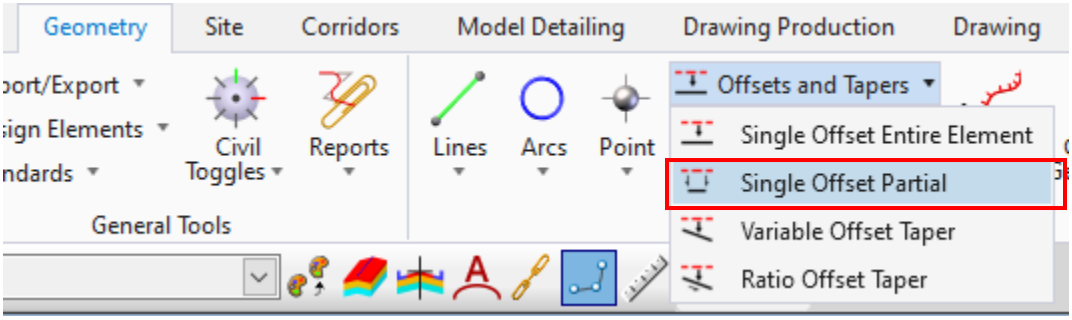


   B. The dialog allows for incorporating Spiral Geometry, creating a Mirrored Element at the same time and Removing the Rules.

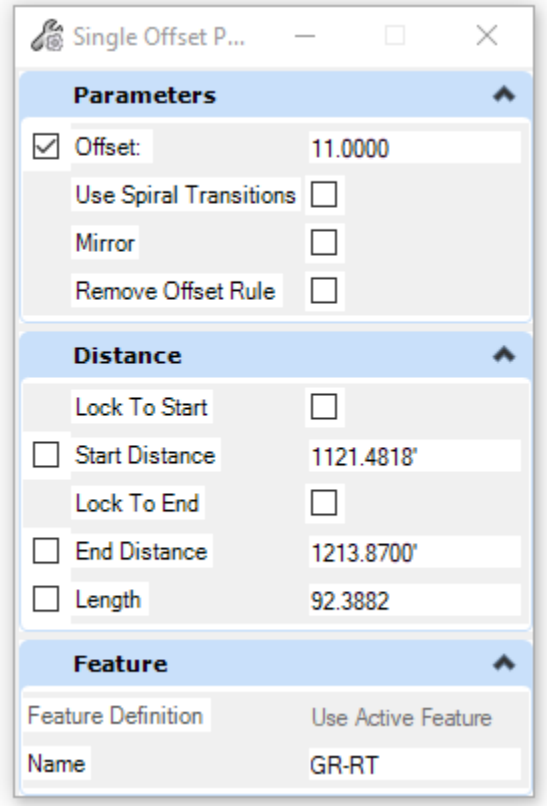


2. Single Offset Partial

A. The **Single Offset Partial** tool functions the same as the **Single Offset Entire Element** tool but allows the user to specify a range of the base element to offset. Note that the range can start and stop anywhere along the base element it does not have to be at the beginning or end of a component.

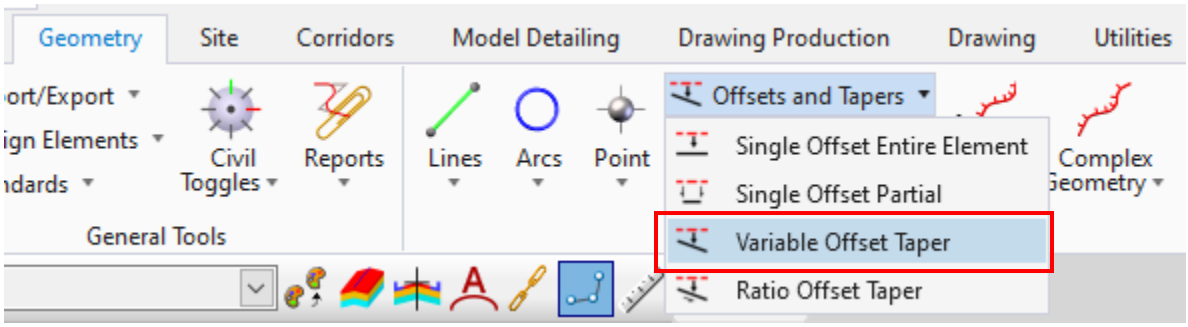


B. The prompt is very similar to the **Single Offset Entire Element** prompt but additionally will allow the user to specify a length for the offset element.

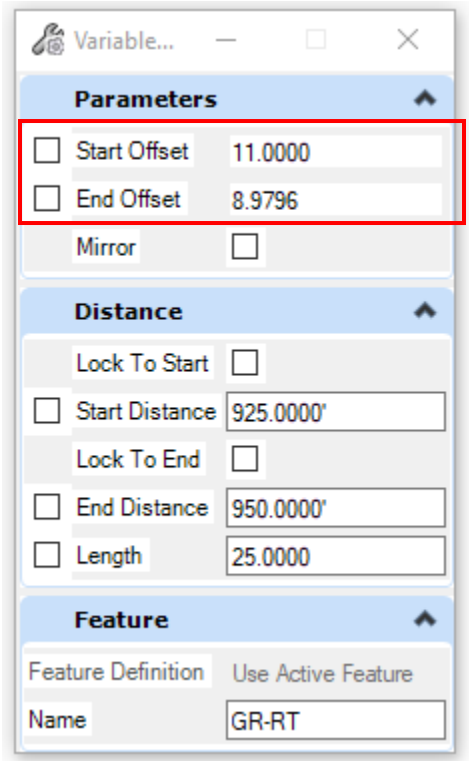


3. Variable Offset Taper

A. The **Variable Offset Taper** tool draws allows the user to specify a beginning and ending offset distance from the base element. The offset element does not have to be parallel.

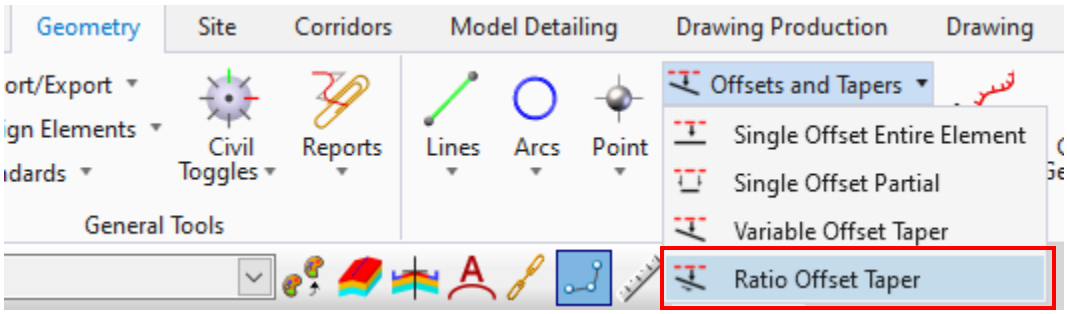


B. The dialog allows for the user to input the Begin and End offset or the offset can be graphically selected.

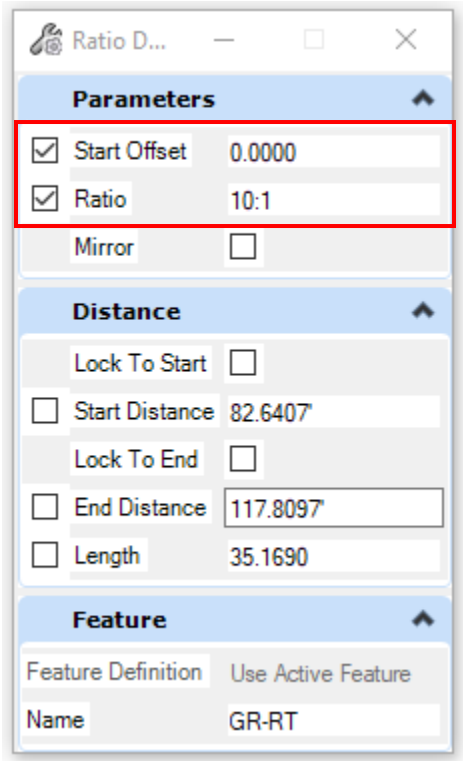


4. Ratio Offset Taper

A. The **Ratio Offset Taper** tool functions like the **Variable Offset Taper** tool but uses a defined ratio relative to the base element to create the offset element.



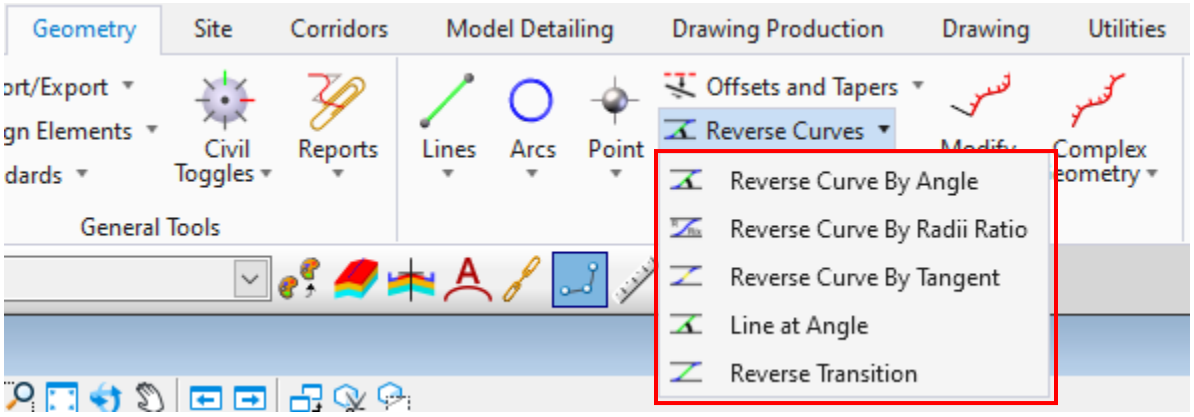
B. The dialog allows for the user to input the Begin offset and the ratio to the base element.



Plan Geometry – Reverse Curves

The reverse curve tool group will not be used as commonly as the Offsets and tapers tool group, but it does contain very useful tools that the user should understand. This group of tools can create various Reverse Curve combinations between reference elements that will be useful for edge of pavement transitions. This tool group could also be used in conjunction with the Horizontal Line and Arc tools to create alignments, particularly on-site detour alignments.

1. Reverse Curves

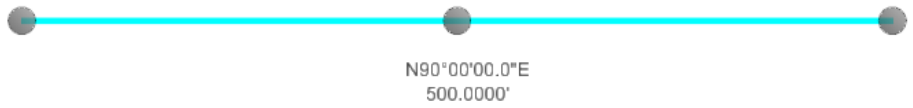


Plan Geometry - Intervals

1. Understanding Intervals

A. Intervals are a concept that was introduced in the Horizontal Alignment training module. As part of creating Plan Geometry elements understanding intervals is important for the designer.

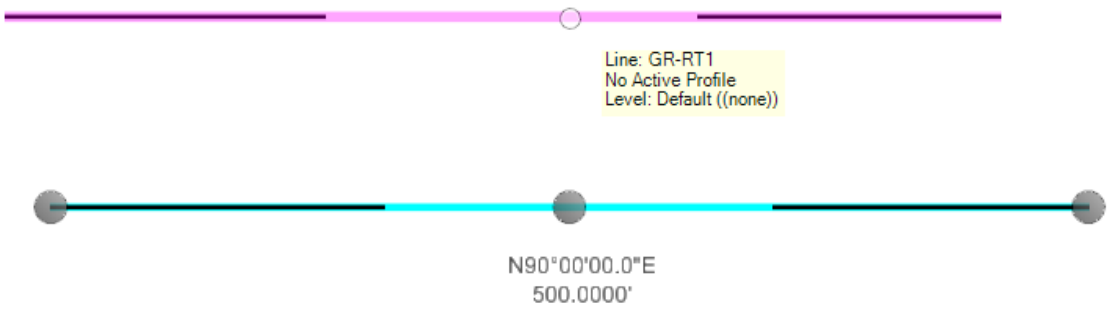
B. When an element is placed into a dgn file there are geometry rules created, in the case of this line it is ruled by the bearing and offset.



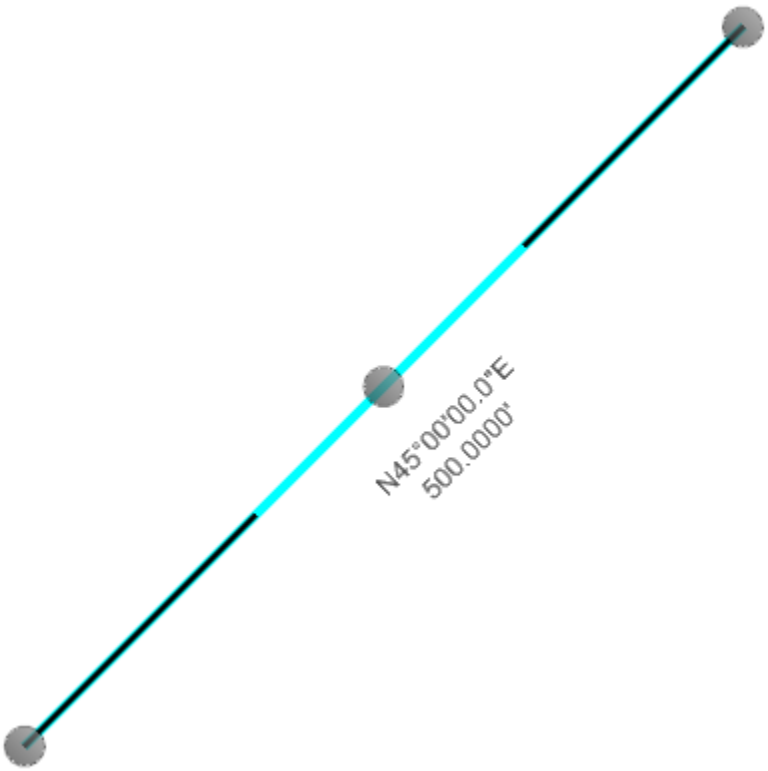
C. By using the MicroStation Break Element command, this line can be broken in the middle. For example, if this was and EOT line at a proposed intersection.

D. The two portions of the line remaining are called intervals and the original line is now a base element. The intervals are dependent on and ruled to the based element. If an interval is selected the text manipulators are red indicating that they cannot be edited.

E. The base element is still in the drawing and can be viewed by selecting the center section, the base element is still there but is not visible. The text manipulators will be displayed in gray indicating that they can be edited.



F. Any edit to the text manipulators for the base element will be reflected in the intervals.



G. The reason the concept of base elements and intervals is important is that as a rule it is better to create less intervals. Less intervals make the base elements easier to work with and result in a more efficient design process.
H. When placing Plan Geometry elements this concept will influence which tool the designer selects to place the element.
I. When creating the Edge of Travel for an Urban project with a significant number of Y Line intersections, the designer may choose the **Single Offset Partial Element** tool to create offset element between each intersection. This will create more base elements, but each base element will have fewer intervals.
J. When creating the median on a divided controlled access facility that will have very few, if any, breaks the design may use the **Single Offset Entire Element** tool creating a single base element, but because there will be very few breaks there will be very few intervals created.
K. Different tools can be used to generate the same solution but often one tool will produce a better workflow and efficiency compared to another tool and creating fewer intervals for each base element is part of that process.

Plan Geometry – DSN Drafting Edge of Pavement

Throughout the rest of this training module, we will focus on creating elements in the DSN file. As noted in the introduction not all the elements need to be placed in the DSN file. Based on user preference most if not all these elements could be placed in the CMD file using the Construction Class Elements to control the corridor.

The purpose of this module is not to define a specific method for organizing and creating a project but to show the methods and tools used to create plan view elements and to demonstrate how those elements interact with the 3D model. Other methods of accomplishing the same result will be demonstrated in other training modules.

In this portion we will create the L line typical sections pavement lines and some of the tapers and transitions.

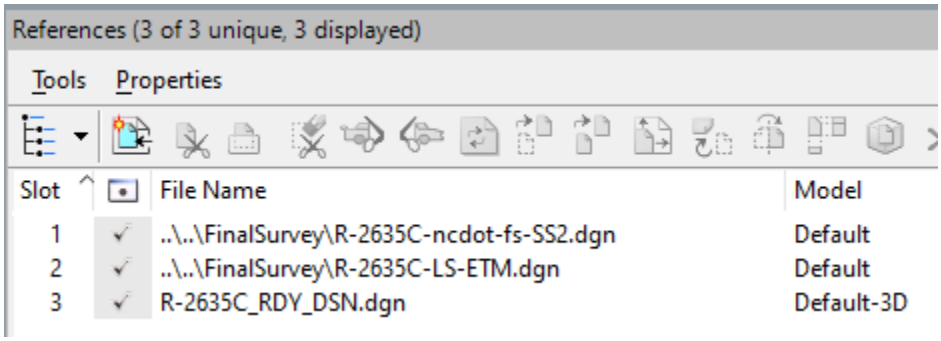
1. Create the DSN File

A. Create a new design file using the 2D seed file: ***R-2635C_RDY_DSN.dgn***
   - This file should be created in the Alignments folder of the training directory *…\Module 7 Plan Geometry\R-2635C\Roadway\Design*

B. Attach the Final Survey file ***R-2635C_NCDOT_FS.dgn*** located in the FinalSurvey folder.

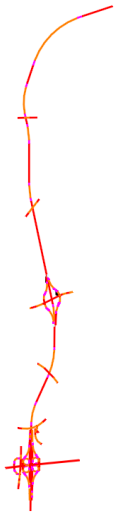
C. Attach the Existing Terrain Model ***R-2635C_NCDOT_FS.dgn*** located in the FinalSurvey folder.

D. Set the Terrain Active, this will create the 3D Model view.



E. Attach the Master Alignment file ***R-2635C_RDY_ALG.dgn*** from the Alignment folder. Set the nesting option to Live Nesting and the Depth to 1. This will show all the individual alignments.

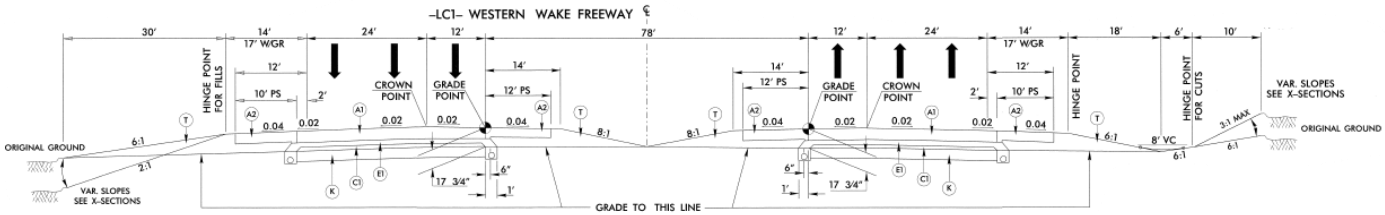
F. Turn off the FS file and the ETM file and the 2d View should look like the picture Below.



2. Pavement Lines – Inside Edge of Travel L

In this section we will use the **Offsets and Tapers** tools and **Reverse Curve** tools to create Edge of Travel and Paved shoulder lines for various alignments. As demonstrated in the Initial Corridor Modeling training module most if not all these lines can be generated through the Modeling Process and displayed in the CMD file. Using the model to generate plan view linework is the preferred workflow. This module and this section are meant to familiarize the user with the tools. These same tools and methods can be used in the CMD file with the Construction Class feature definitions to control the model.

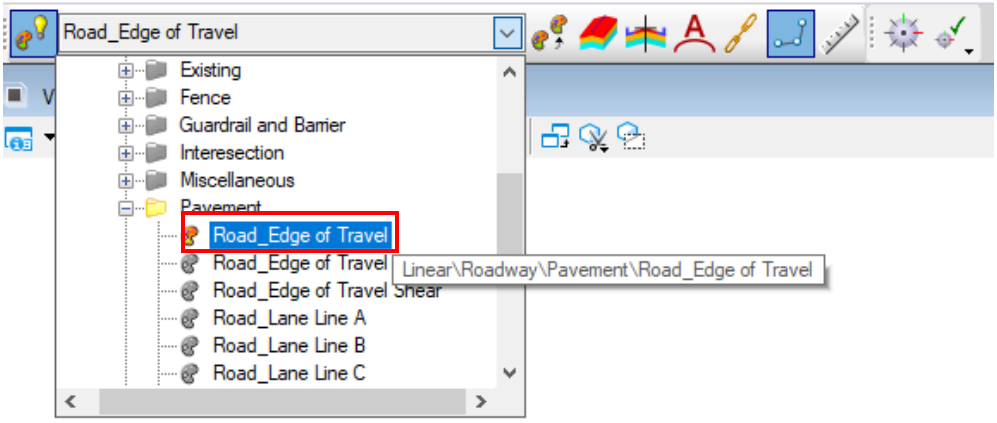
A. This is a divided facility with 3 lanes in each direction.



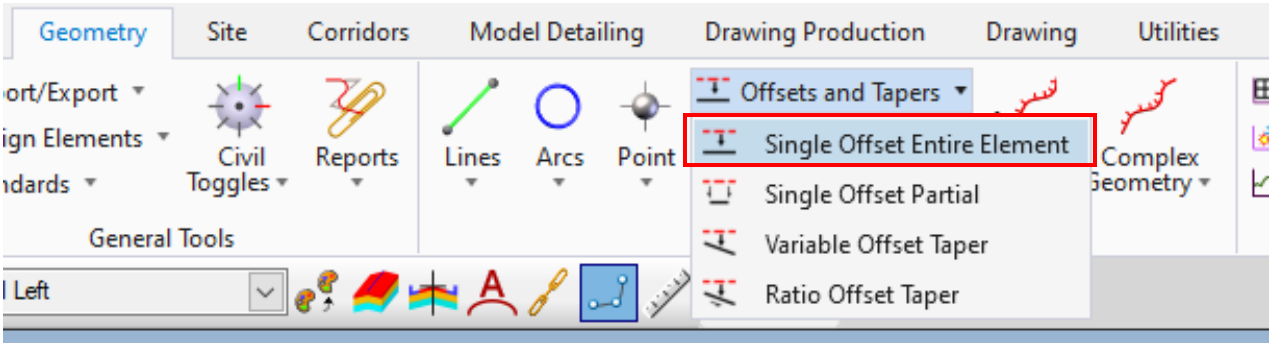
TYPICAL SECTION NO. 1

- 78’ Median Width
  1. This will transition to 60’ Median at the end of the project
- 36’ Typical Travel Lane Width
- 12’ Paved Median Shoulders
- 12’ Paved Outside Shoulders

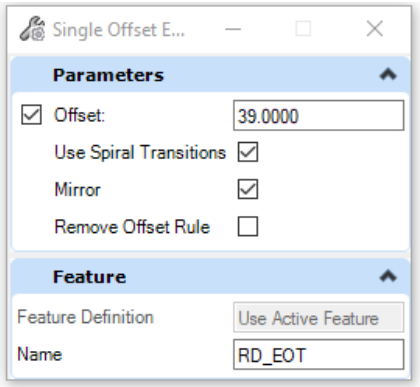
B. Set the Feature Definition to Road-Edge of Travel. This is under Linear\Roadway\Pavement.



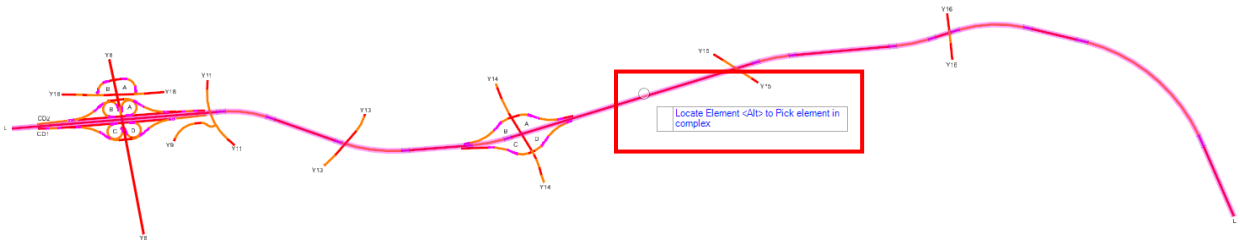
C. Select the **Single Offset Entire Element** tool. Use this tool because there will be very few breaks in the median pavement lines, only at bridges and overpasses.



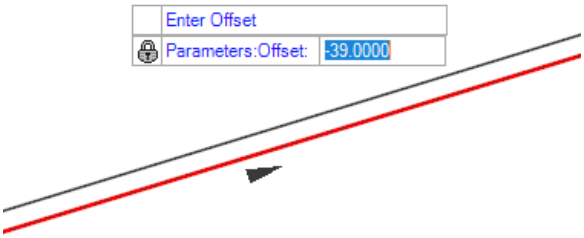
D. In the dialog box set
   - Offset = 39’ – Half of the median width
   - Use Spiral Transitions – Checked
     1. This will match the spiral transitions in the centerline alignment.
   - Mirror – Checked
     1. This will mirror the offset and create both side of the median at the same time.
   - The name will automatically be filled in based on the Feature Definition.



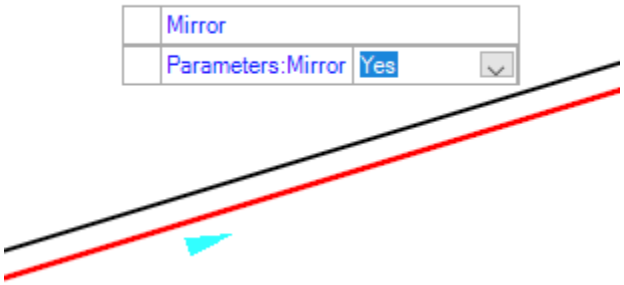
E. Left click to locate the L centerline.



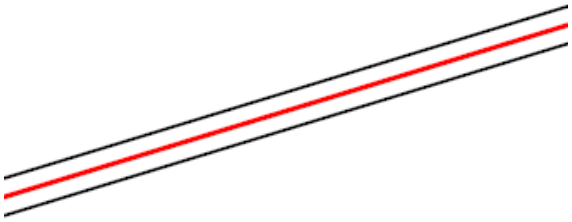
F. Left click to accept the offset of 39.00’. The sign (+) or (-) is not important for this task.



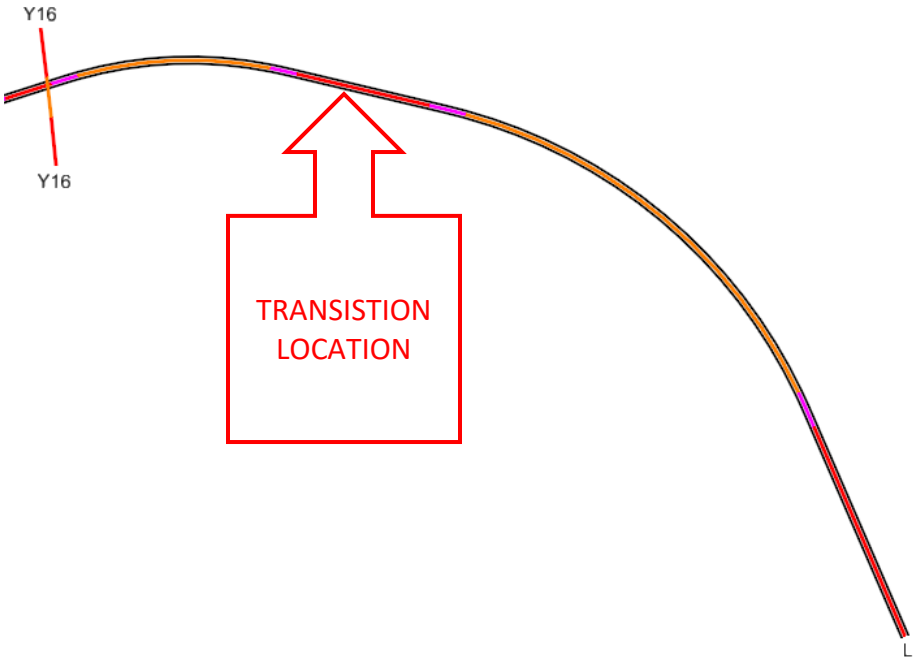
G. Left click to accept the option to Mirror the element.



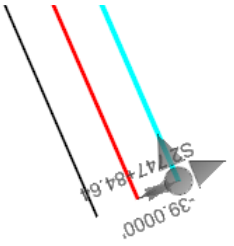
H. That will complete the tool, placing to inside edge of travel lines at an offset of 39’ on each side of the centerline.



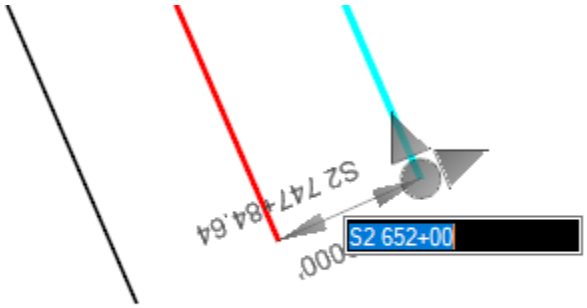
I. Now we want to add a transition from a 78’ median to a 60’ median just before the last curve on the L Line.



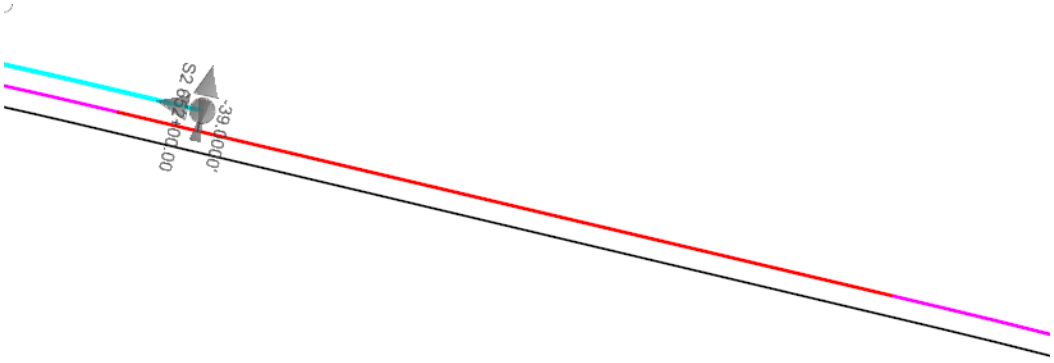
J. Use the **Element Selection** tool to highlight the left edge of travel line and activate the grab handles and text manipulators.



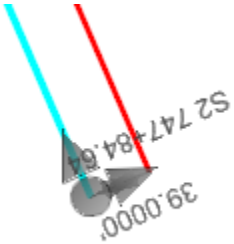
K. Change the Station Value to 652+00.00



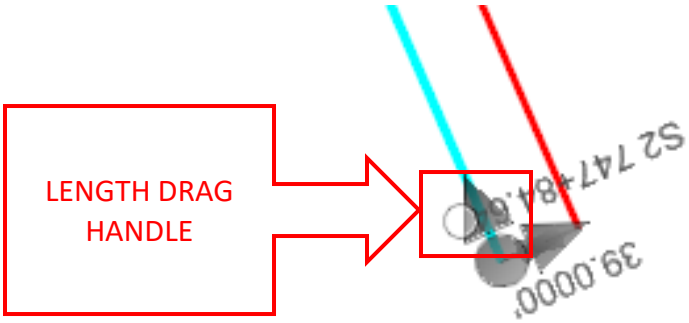
L. This will end the left edge of travel line at station 652+00.



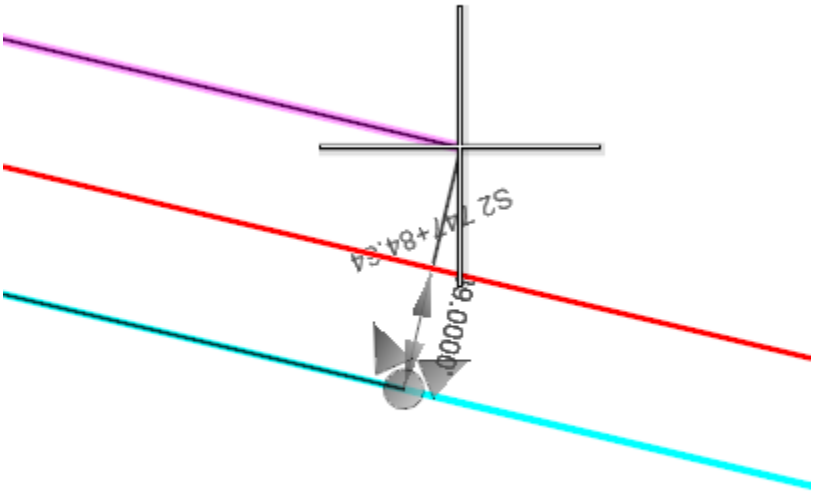
M. Use the **Element Selection** tool to select the right edge of pavement and highlight the drag handles and text manipulators.



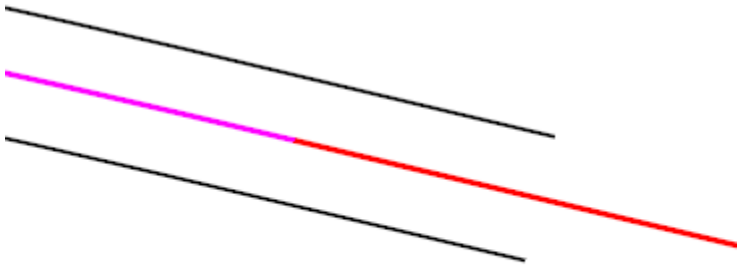
N. Use the cursor to pick the arrow that is parallel to the edge of travel line, and left click to activate the drag handle.



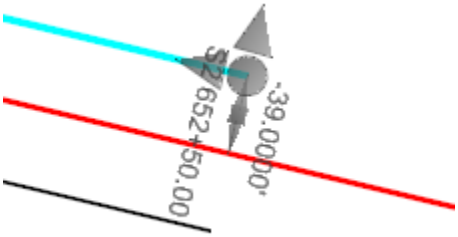
O. Drag the line back to the end of the left edge of travel line. Snap to the left edge of travel line to set the end of the right edge of travel line. This will also create a snap constraint.



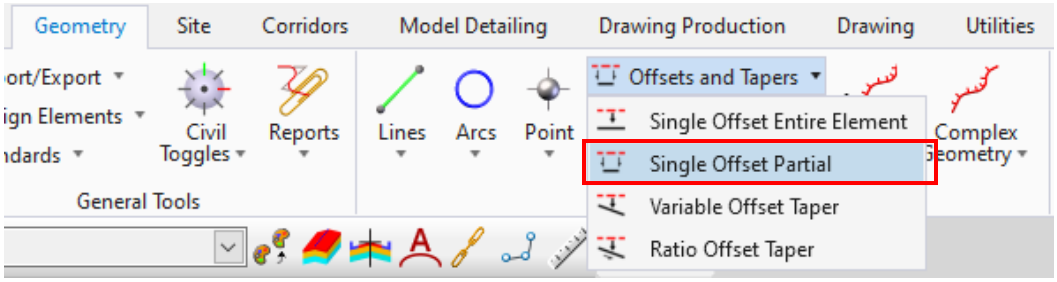
P. The two lines will now end at the same location.



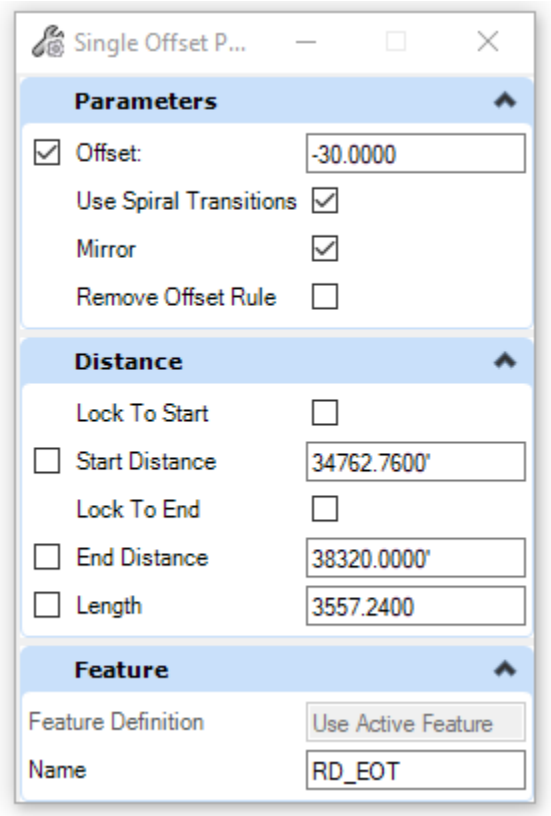
Q. Use the **Element Selection** too to pick the left edge of travel and activate the drag handles and text manipulators. Change the station to 652+50. Note that the right edge of travel lines automatically adjusts to the same station. This is because of the snap rule created in the previous operation.



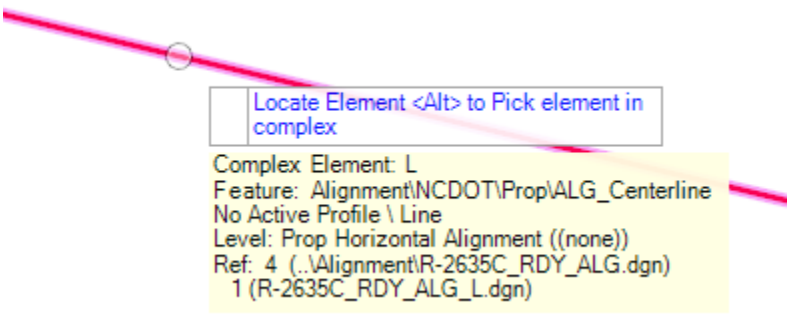
R. To construct the remaining portion of the edge of travel line that will be for the section with the 60' median select the **Single Offset Partial** tool. In this situation we can use the tool because we only want to offset a small portion of the L centerline, even though there will be no intervals.



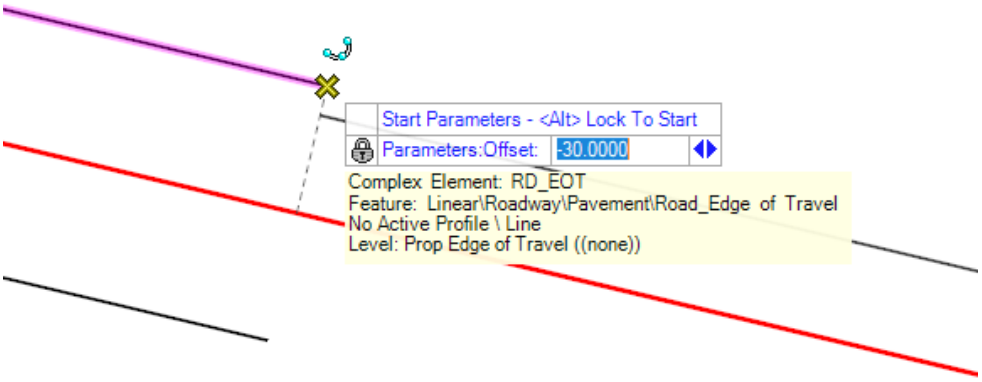
S. In the dialog box set
- Offset = 30’
- Use spiral transitions – Checked
- Mirror – Checked
- There are some additional settings to preset begin and end station or length, we will do this graphically when placing the offset element.



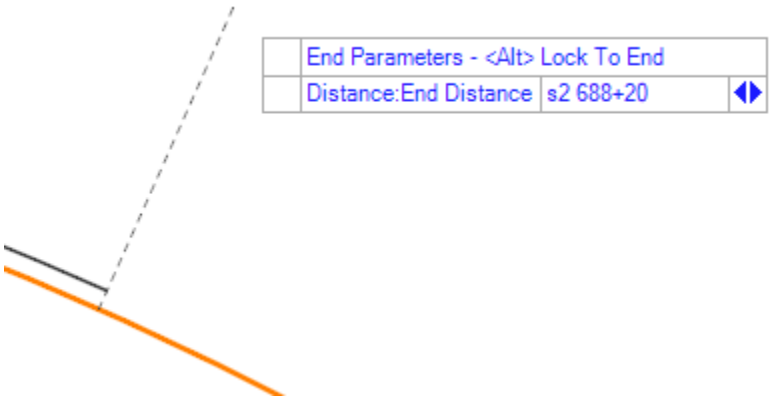
T. Left click to pick the L centerline



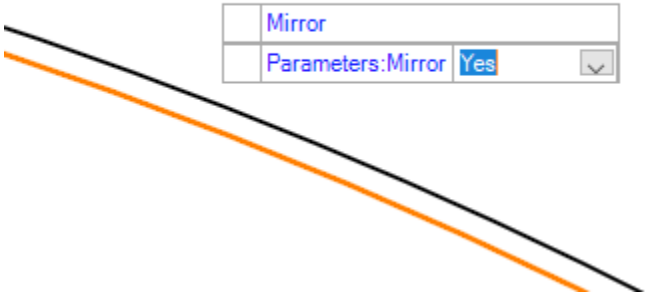
U. Snap to the start of the left edge of travel line to set the start location.



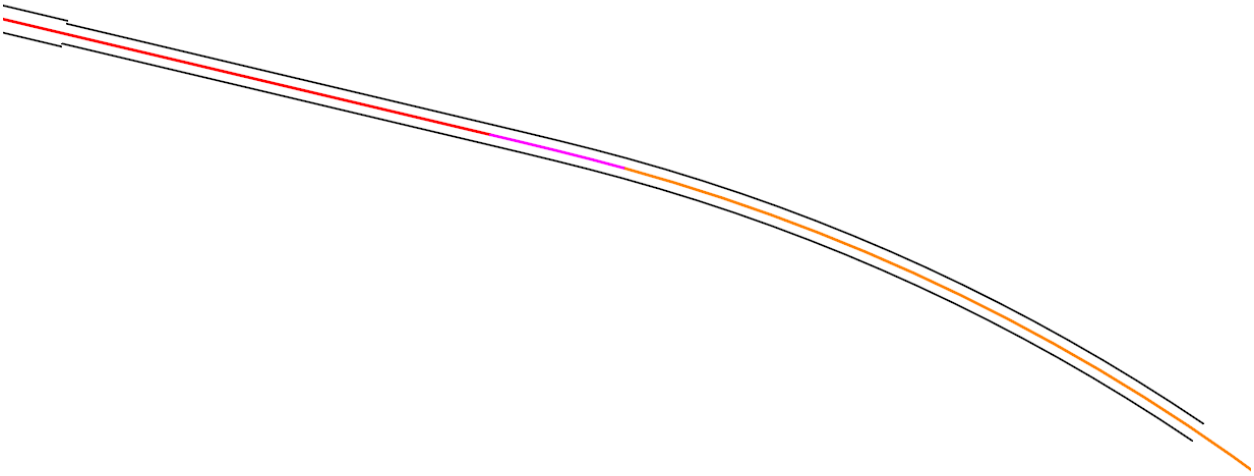
V. At the heads-up display enter S2 688+20 for the end station and left click to accept.



W. Left click to mirror.

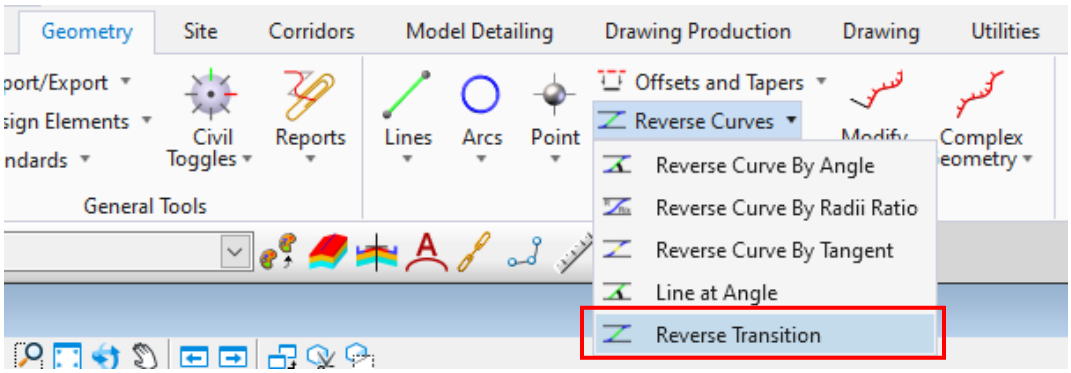


X. This will complete the tool and there should be two edge of travel lines set at a 30’ offset from the L centerline on each side.



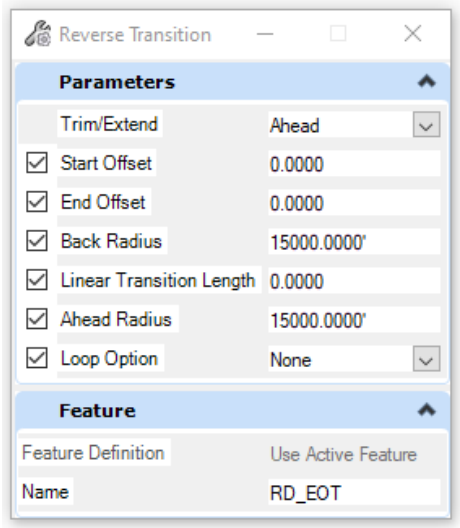
3. Pavement Lines – Reverse Curve Transitions

A. The last step is to create the transition from the 78’ median to the 60’ median using reversing curves. Start the **Reverse Transition** tool.

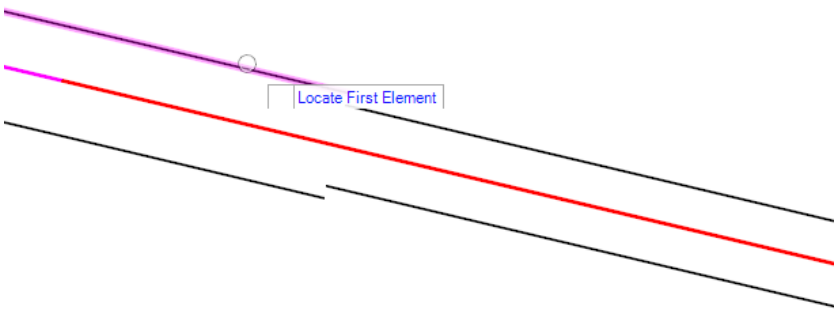


B. In the dialog box set

- Trim/Extend = Ahead
- Start Offset = 0.00’
- End Offset = 0.00’
- Back Radius = 15,000.00’
- Linear Transition Length = 0.00’
  1. This is the tangent length between the reversing curves
- Ahead Radius = 15,000.00’
- Loop Option = None

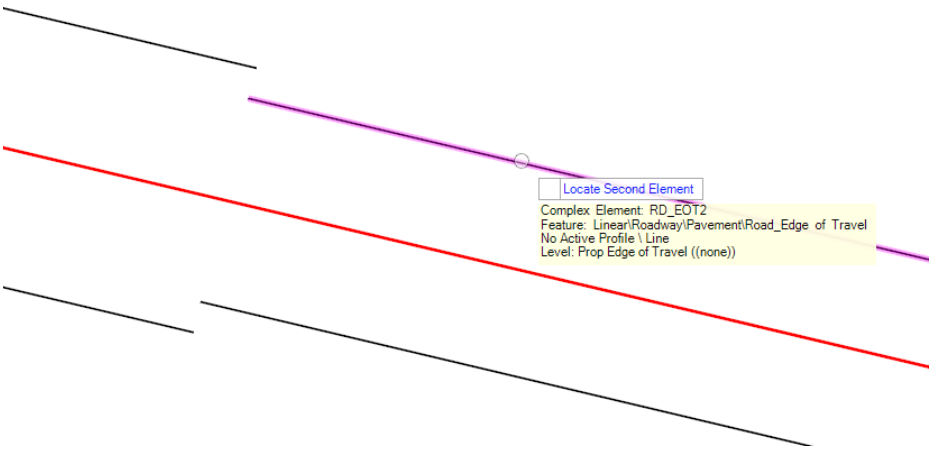


C. Left click on the left edge of pavement in the 78’ median section to locate the first element.

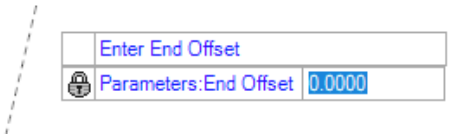


D. Left click to accept the initial offset = 0.00’

E. Left click on the left edge of pavement in the 60’ median section to locate the second element.

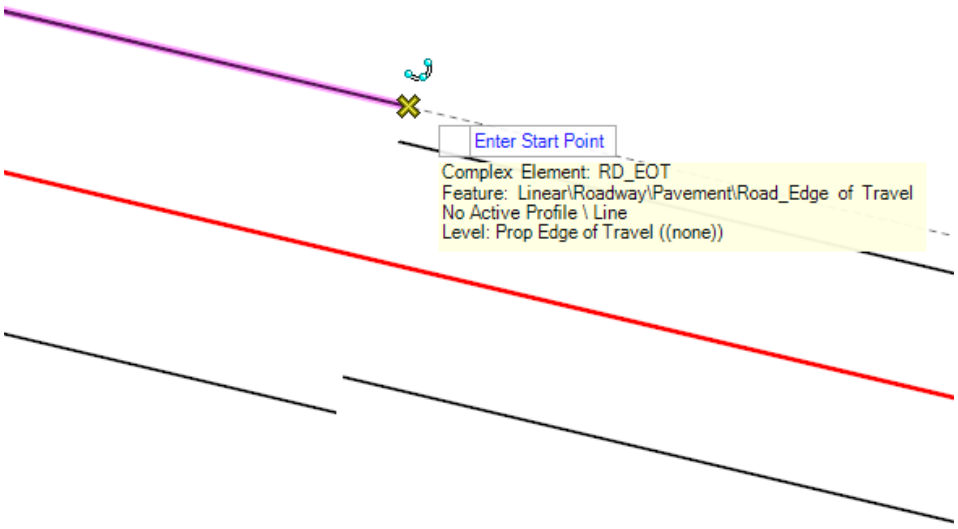


F. Left click to accept the end offset 0.00’.



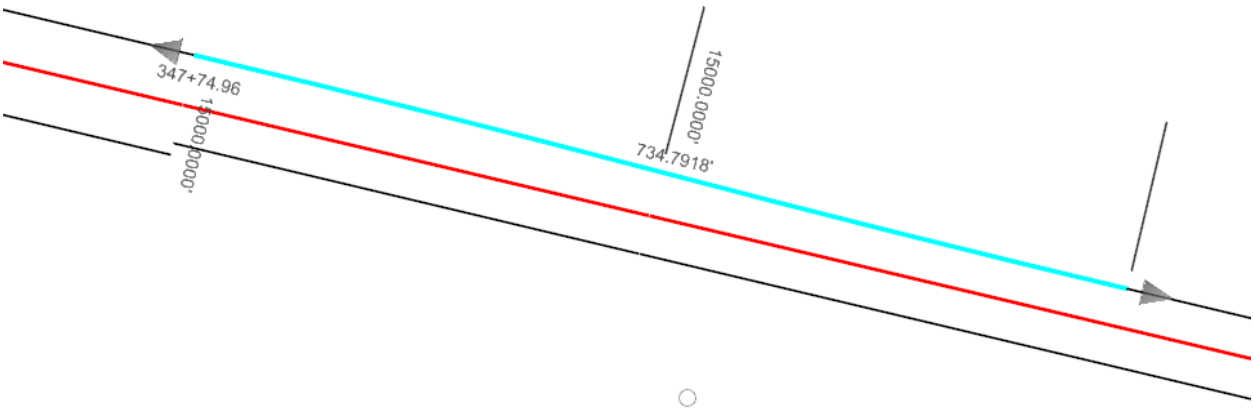
G. Left click to accept the Linear Transition Length = 0.00’

H. Snap to the end of the edge of travel in the 78’ section to set the start point.

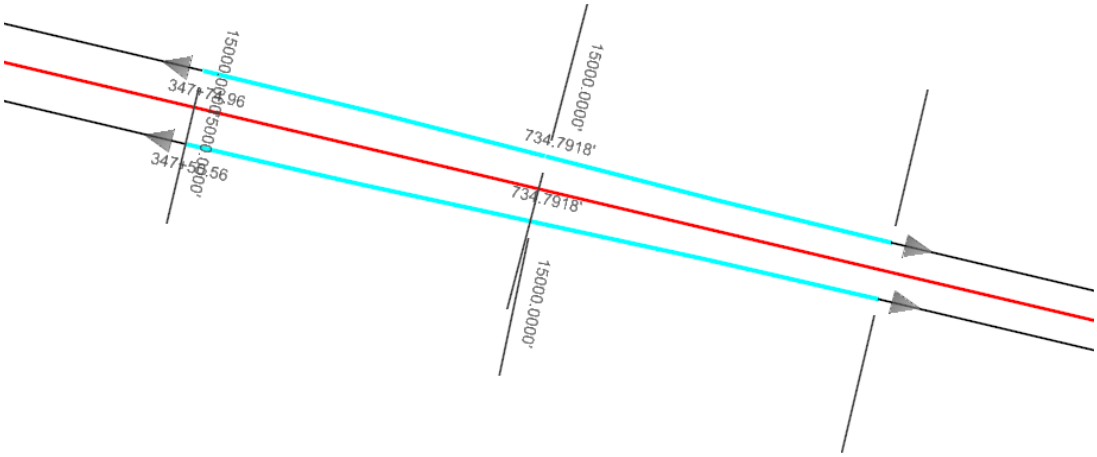


I. Left click to accept Trim option of Ahead.

J. This will complete the tool and draw the transition.



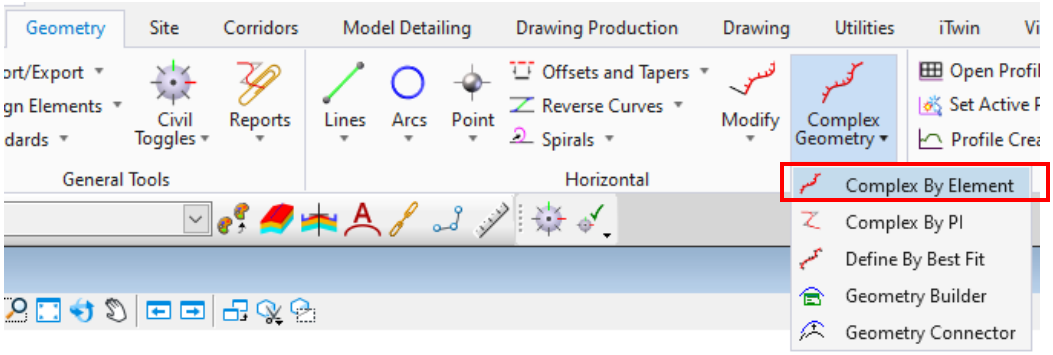
K. Repeat this process for the right side edge of travel lines.



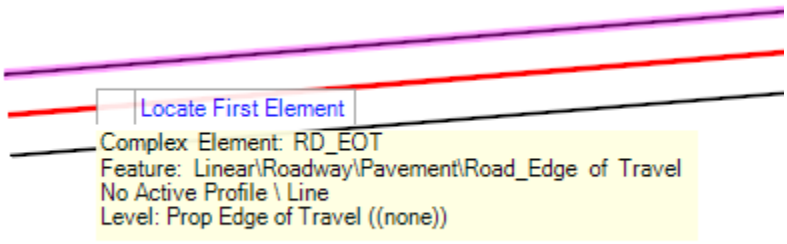
4. Pavement Lines – Inside Shoulder

A. The inside edge of travel is complete and is 3 separate elements, the 78' median section, the transition section, and the 60' median section. Because the median will have very few breaks, and therefore very few intervals it is possible to use the **Complex By Element** tool to join these three sections together into a single complex element. This will make creation of the inside shoulder and some of the outside edge of travel geometry more efficient. This is the same process used to create Complex Geometry for horizontal alignments.

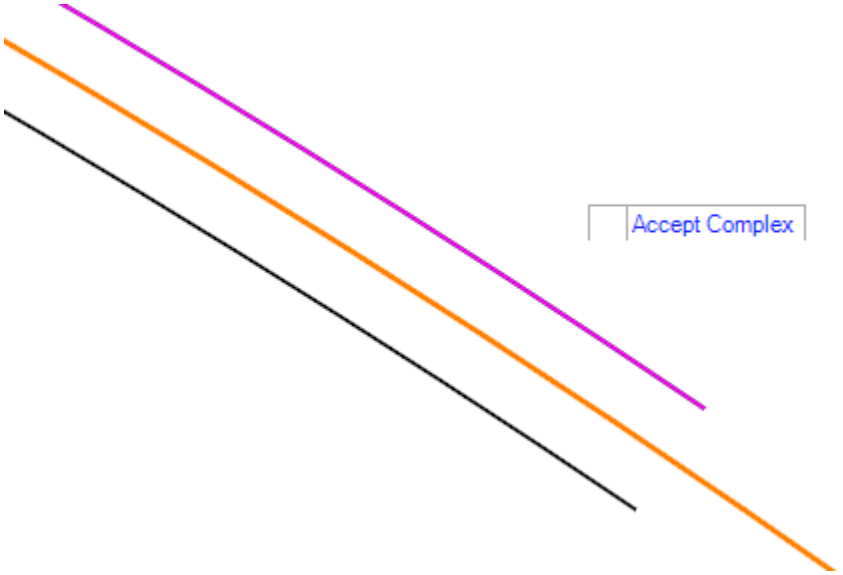
B. Start the **Complex By Element** tool.



C. Left click on the left inside edge of travel at the beginning of the L alignment.



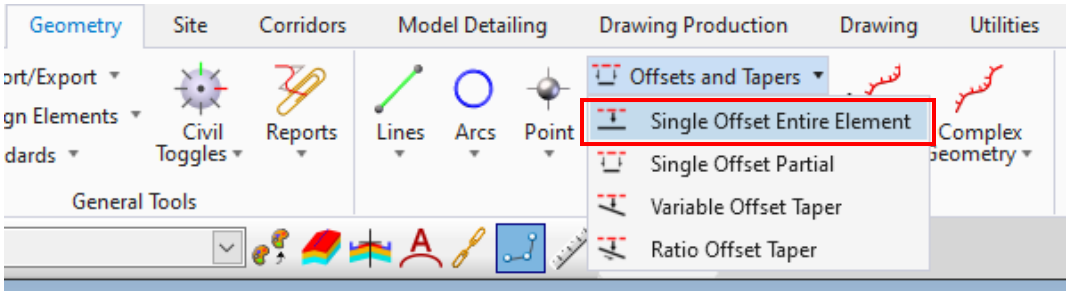
D. This will select the entire left edge of travel. Left click to accept the complex element.



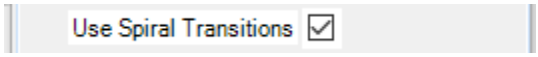
E. Repeat the process for the right side edge of travel line.

F. Change the Active Feature Definition to Road_Paved Shoulder

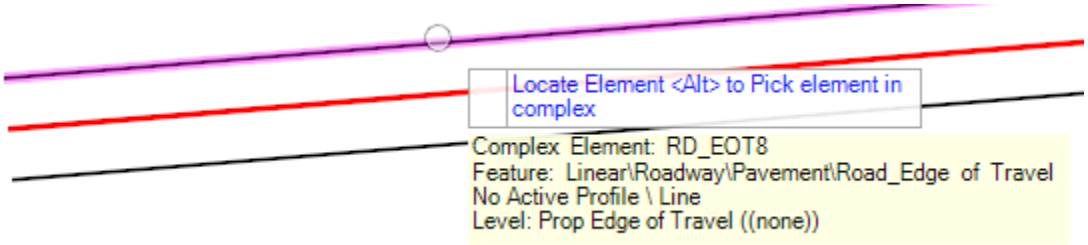
G. Start the **Single Offset Entire Element** tool.



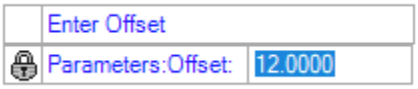
H. Make sure the Use Spiral Transitions option is Checked in the dialog box.



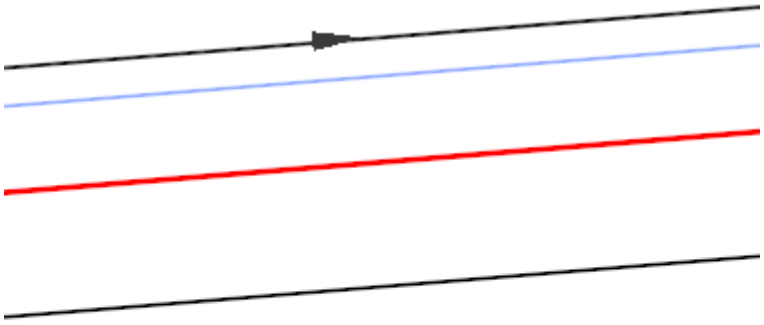
I. Left click on the left inside edge of travel.

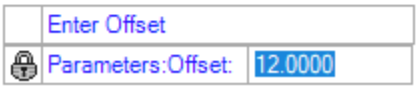


J. At the heads-up prompt type 12 and <ENTER> to lock.



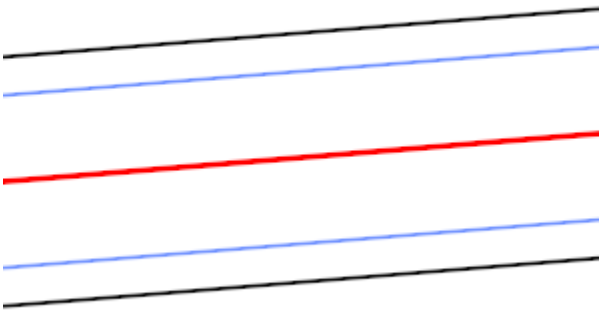
K. Move the cursor so the paved shoulder line is offset to the inside towards the centerline and left click to accept.





L. Use the Down Arrow key to set the Mirror Option to NO.

M. This will complete the tool. Repeat the same steps for the right side. The inside paved shoulders will now be complete.

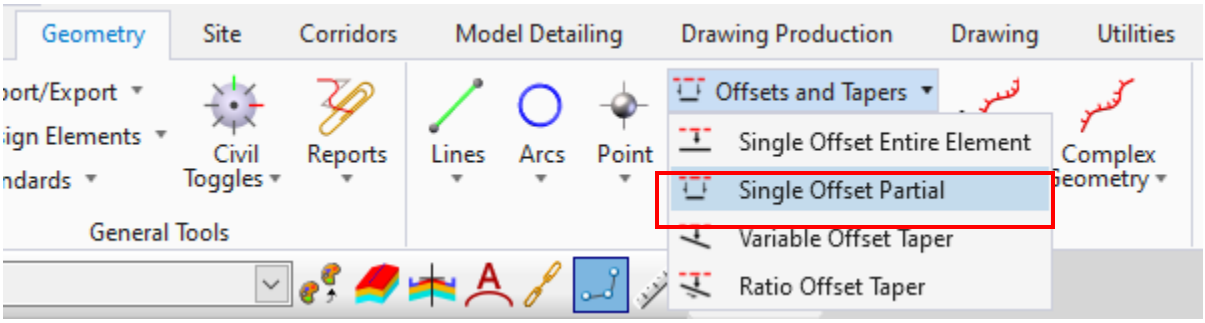


5. Pavement Lines – Ramps

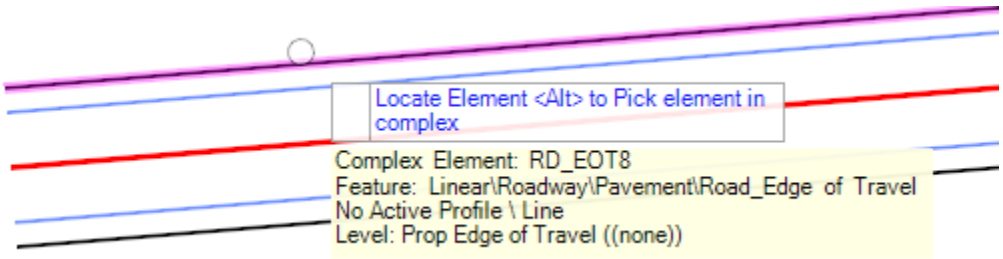
A. To create the outside edge of pavement lines, use the **Single Offset Partial** tool to create pavement lines that start and stop at the ramps at the interchanges. This will eliminate the intervals that would otherwise be created by the Ramp Gore areas.

B. Set the Active Feature Definition to Road_Edge of Travel

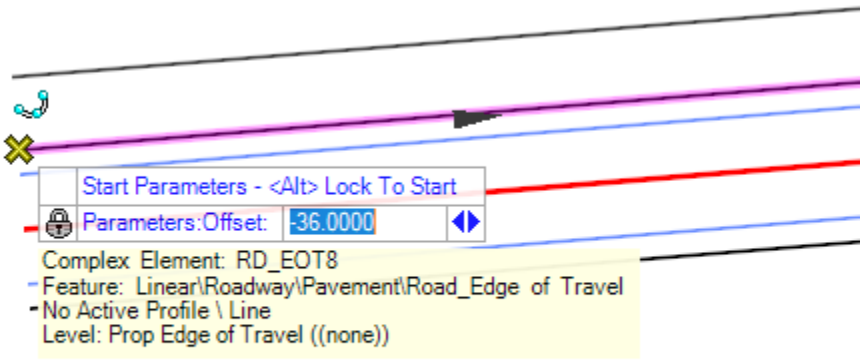
C. Start the Single Offset Partial tool.



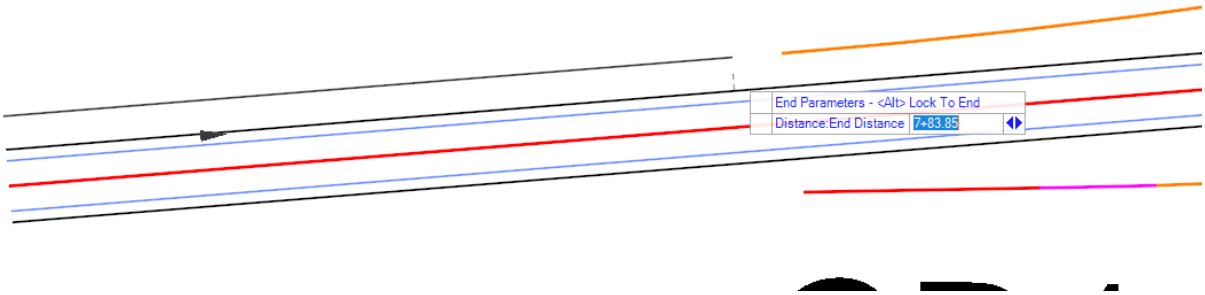
D. Left click to locate the reference element, use the left inside edge of travel. We will pick the inside edge of travel as the reference so that the rules are based on that element. If the inside edge of travel shifts for any reason the outside edge of travel will automatically adjust to maintain the 36’ pavement width.



E. Enter 36’ for the offset and snap to the start of the inside edge of travel to set the start location.

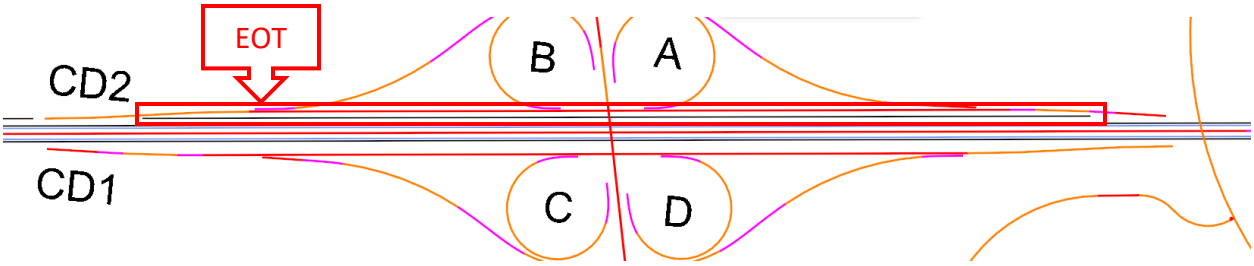


F. Left click to end the element before the beginning of the CD2 alignment. When the acceleration lane is added the outside edge of travel will be revised. The exact end point is not critical.



G. Left click to accept the mirror option of No.

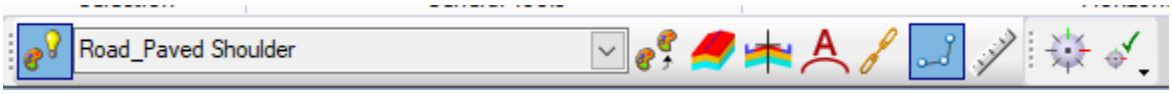
H. Use the same process create a new outside edge of travel lane that starts just after the CD2 alignment and ends just before the other end of the CD2 alignment.



I. Draw a line in between the Ramp A alignment at Y8 and the Ramp B Alignment at Y14.
J. Draw a line between the ramp gore areas of Ramp B and Ramp A at the Y14 interchange.
K. Draw and edge of travel from the end of ramp A to the end of the project. Note that the median transition is reflected in the new offset element.

L. Create the outside edge of pavement on the right side using the same process with the **Single Offset Partial** tool.

M. Change the Active Feature Definition to Road_Paved Shoulder



N. Using the **Single Offset Entire Element** tool offset the newly created outside edge of pavement lines 12’ to create the outside paved shoulder lines.

Adding Auxiliary Lanes

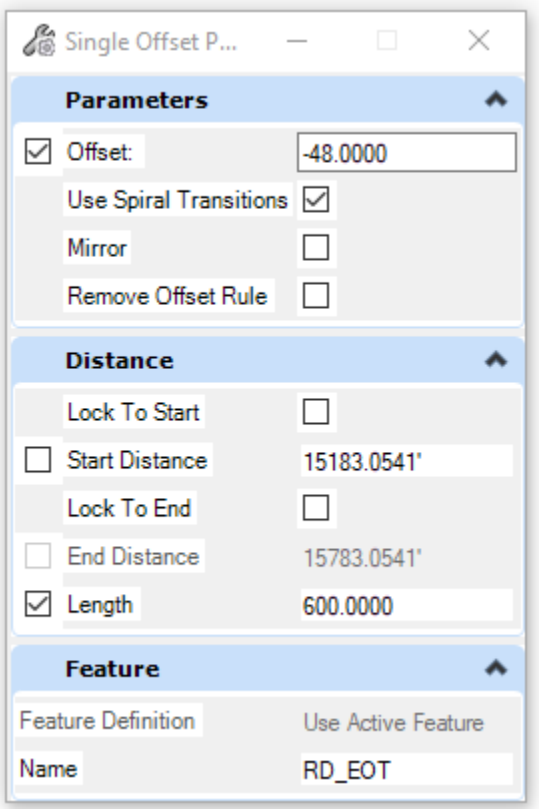
1. Auxillary Lanes

A. In this exercise we will add an acceleration lane for Ramp B at the Y14 Interchange. This acceleration lane will be 600’ long and then have a 300’ Taper back to the typical lane configuration.

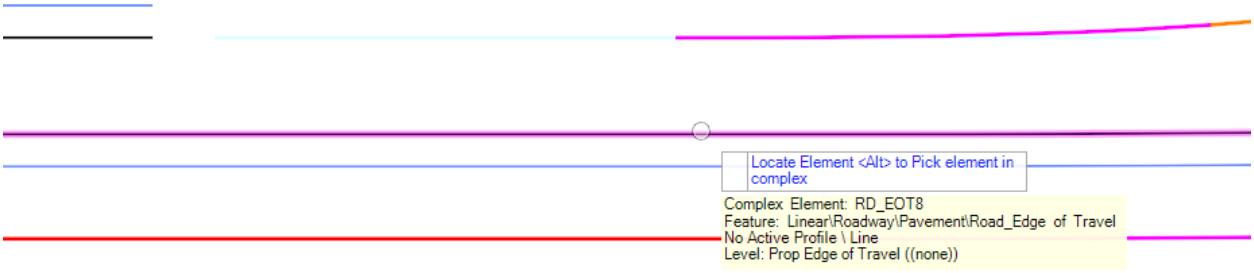
B. Ste the Active Feature Definition to Road_Edge of Travel

C. Start the **Single Offset Partial** tool and set the dialog

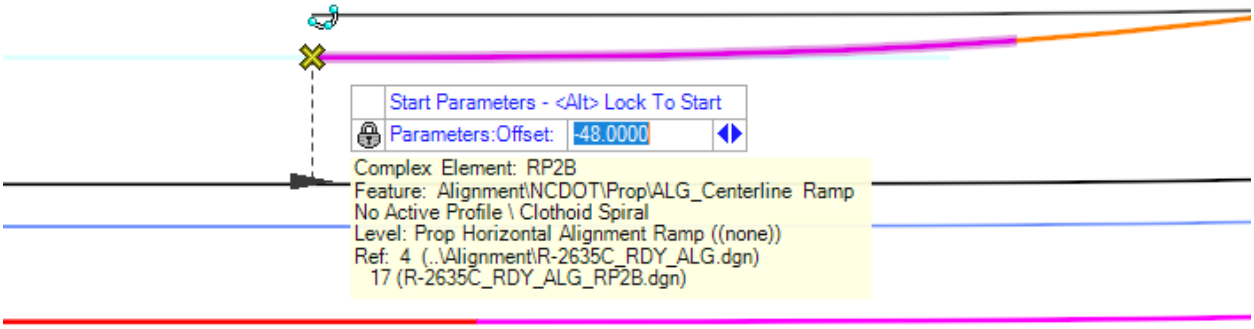
- Offset = 48.00’
- Length = 600.00’



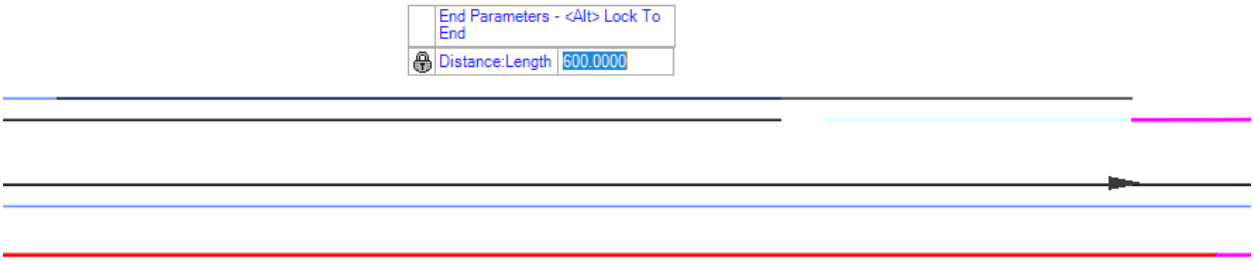
D. Left click to locate the inside edge of travel as the reference element.



E. Snap to the beginning of the ramp alignment to set the offset at 48.00’ and to pick the beginning of the offset element.

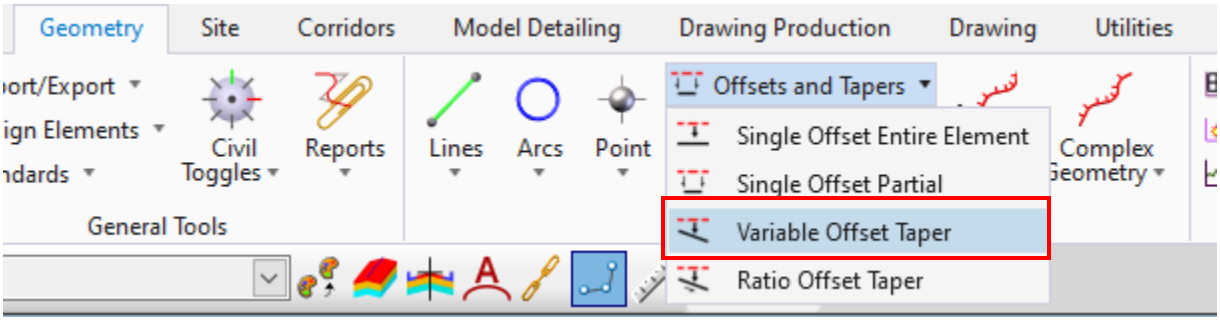


F. Move the cursor to the left of the start point to set the direction of the offset element and left click to accept the length of 600’

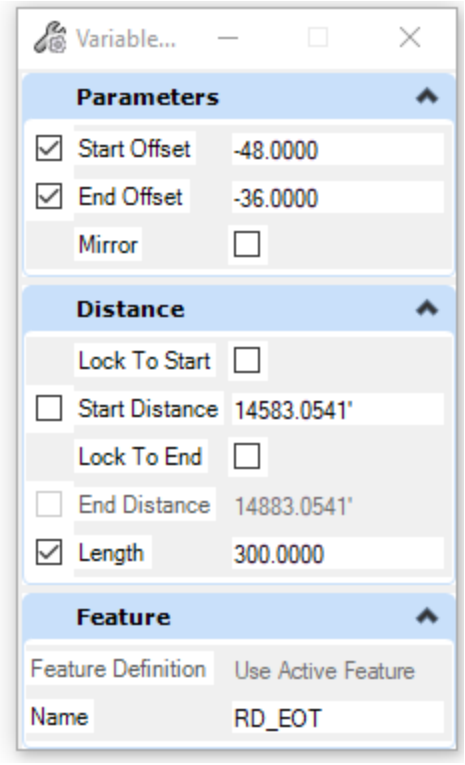


G. Left click to set the mirror option as No.

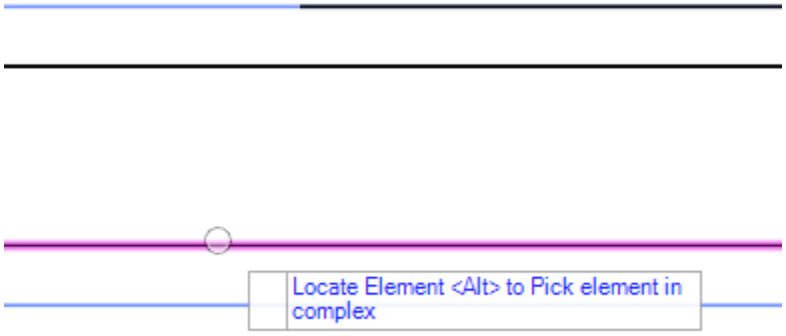
H. To draw the taper portion of the acceleration lane, select the **Variable Offset Taper** tool.



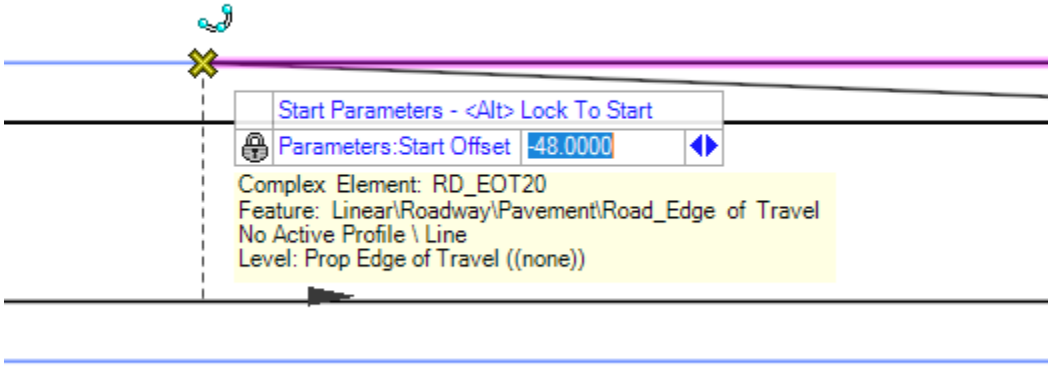
I. In the dialog box set
   - Start Offset = -48.00’
   - End Offset = -36.00’
     1. Note that generally it is preferable to use the same element as a reference when building other elements. For example, to set the outside of the auxiliary lane we used the inside edge of travel, so it is preferable to use the inside edge of travel to set the taper offsets. This will also help avoid the problem of circular references.
   - Set the length to 300.00’
     1. This is the length of the taper measured along the reference element.



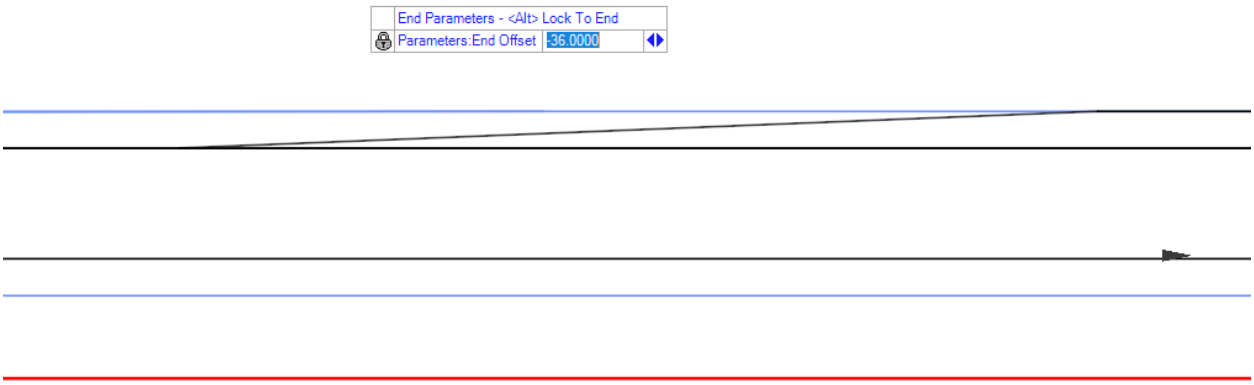
J. Left click the inside edge of travel to locate the reference element.



K. Snap to the end of the auxiliary lane to set the start point and accept the offset of 48.00’ from the reference element.



L. Move the cursor to the left to set the taper in the correct location and left click to accept the length of 300.00’ and the end offset of 36.00’ from the reference element.

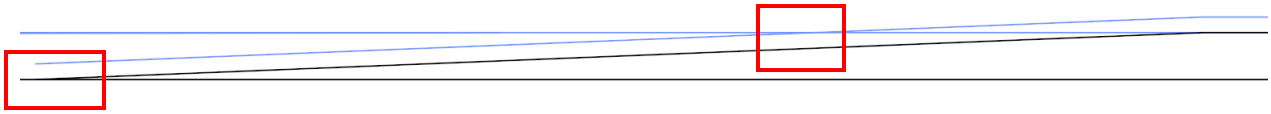


M. Left click to set the Mirror option to No.

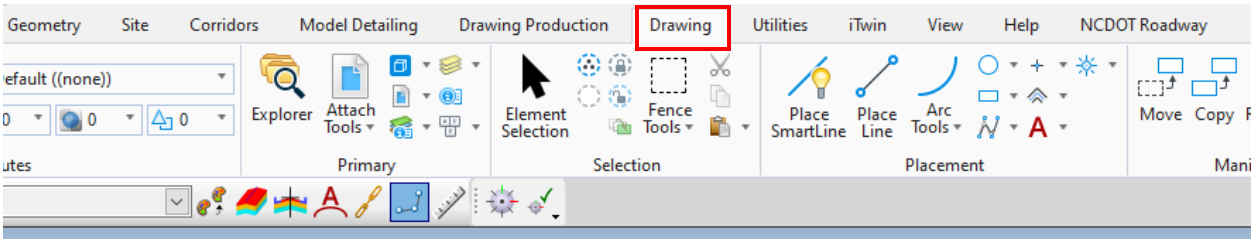
N. Set the Active Feature Definition to Road_Paved Shoulder

O. Use the **Single Offset Entire Element** tool to offset the auxiliary lane edge of travel 4.00’ to create the paved shoulder line.

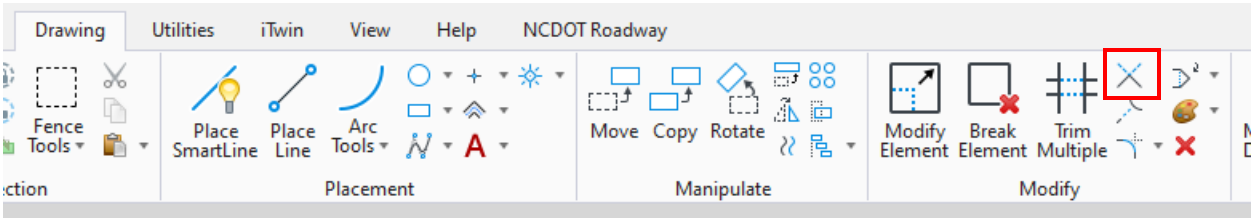
P. At this point we can use regular MicroStation CADD commands to intersect the paved shoulder and edge of travel lines.



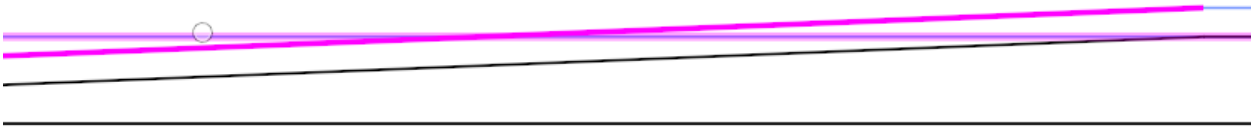
Q. Switch to the *Drawing* ribbon.



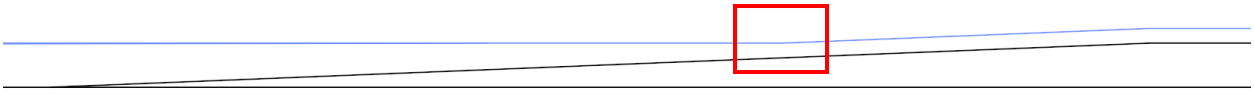
R. Locate the **Trim to Intersection** tool in the *Modify* section of the *Drawing* ribbon.



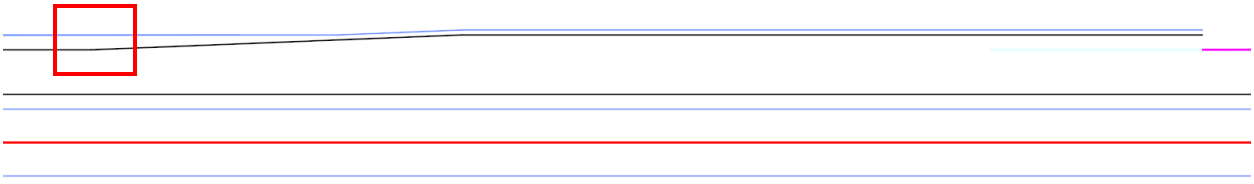
S. Use the Trim to Intersection tool to trim the lines to meet. This tool works the same in CONNECT as it did in SS2.



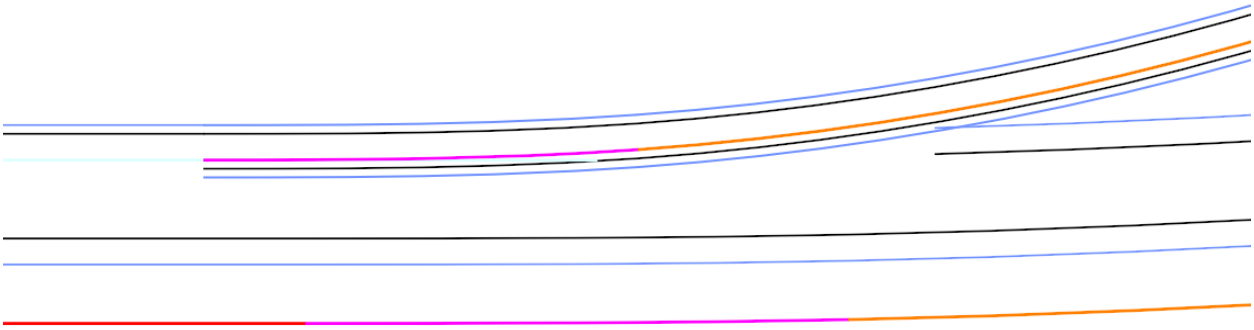
T. This will intersect the paved shoulder lines.



U. Repeat for the edge of travel line.



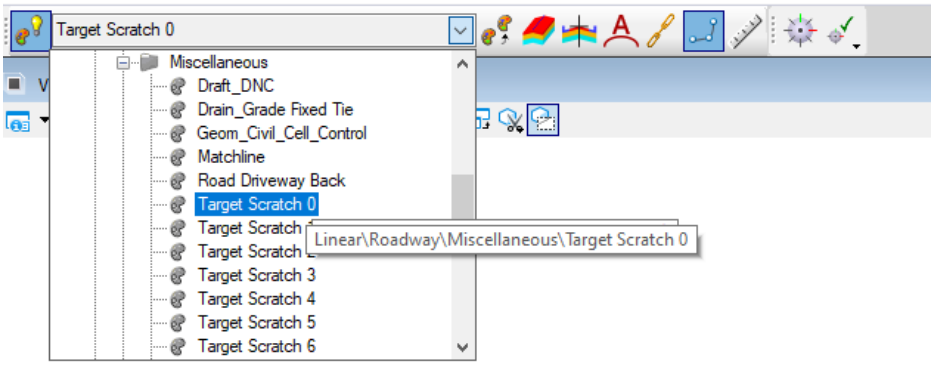
V. Switch back to the *Geometry* ribbon and using the **Single Offset Entire Element** tool complete the pavement line drafting for Ramp B.
   - 16’ Lane width 12’ to the outside and 4’ to the inside
   - 4’ Paved shoulder inside and outside
   - Use the correct Feature Definition



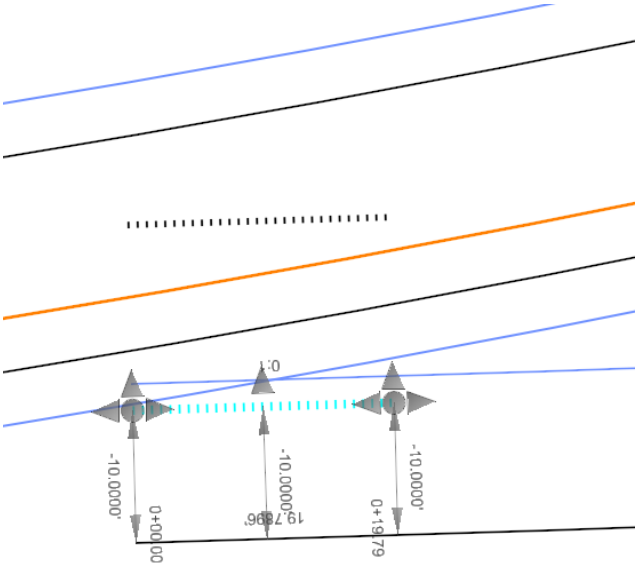
Gore Areas

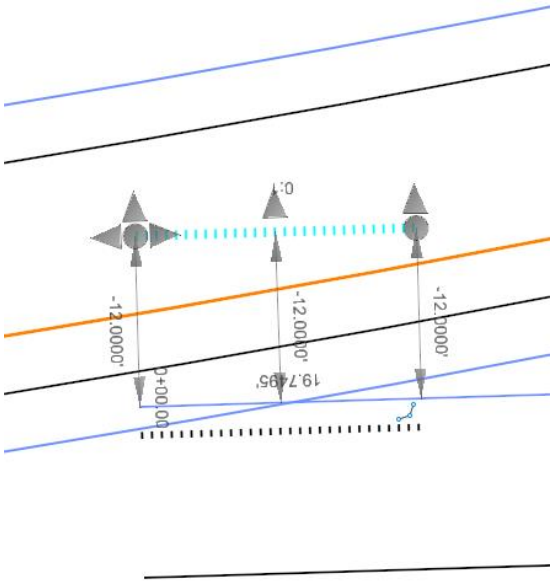
1. Gore Area Drafting

A. To draft the gore area pavement lines, we will need some construction class elements. Change the Feature Definition to Target Scratch 0 under Linear\Roadway\Miscellaneous\

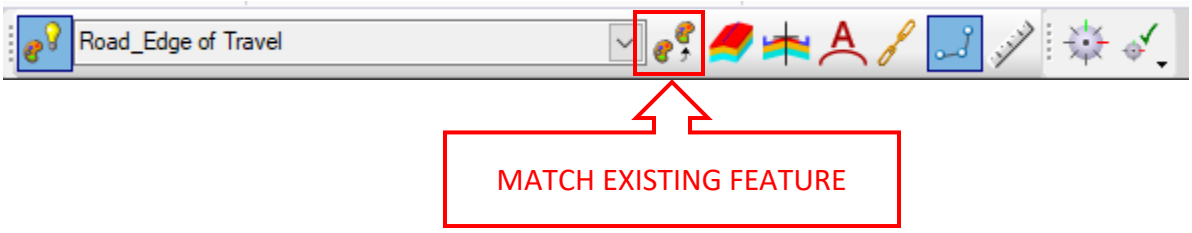


B. Use the **Single Offset Partial** tool to create two short line segments. One that is 10’ offset from the edge of travel and one that is 12’ offset from the paved shoulder.

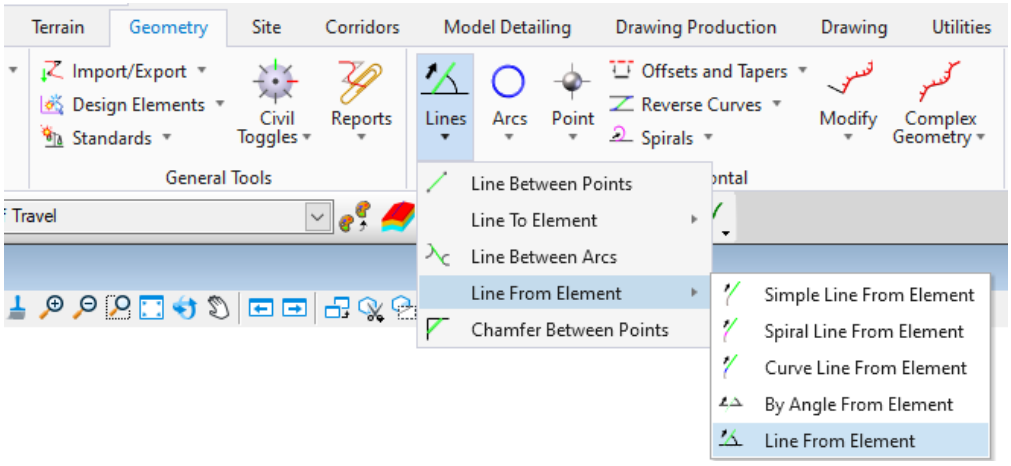




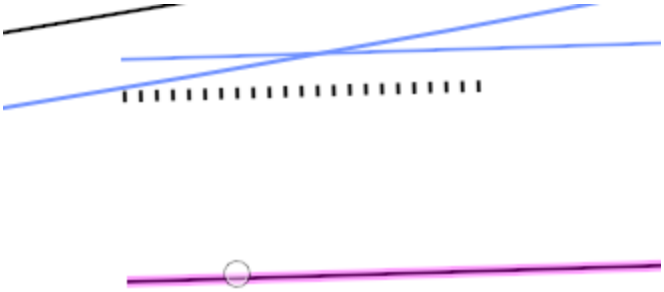
C. Change the active Feature Definition back to Road_Edge of Travel. This can be done easily by using the match icon and selecting one of the previously placed edge of travel lines.



D. Use the line from element tool to draw a line perpendicular from the L edge of travel to the intersection of the 10’ offset line and the ramp edge of travel.

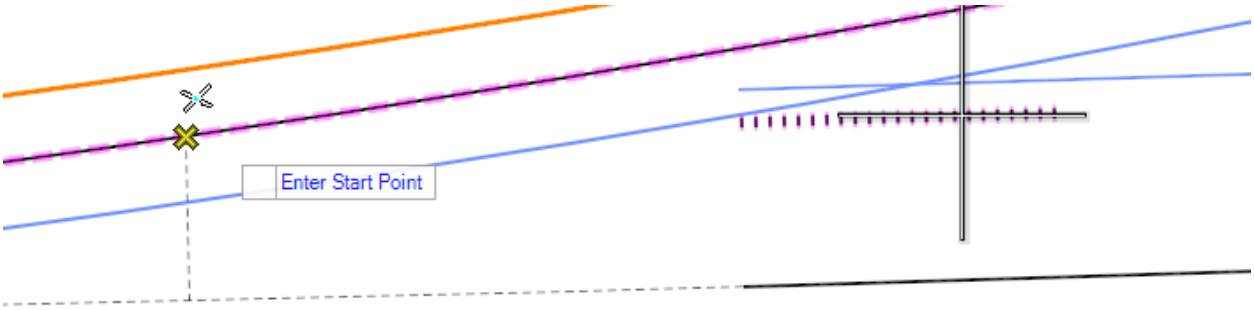


E. Left click to pick the L edge of travel

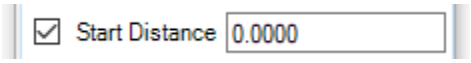


F. Left click to accept offset of 0.00’

G. Snap to the intersection of the 10’ offset line and the ramp edge of travel to set the start point.

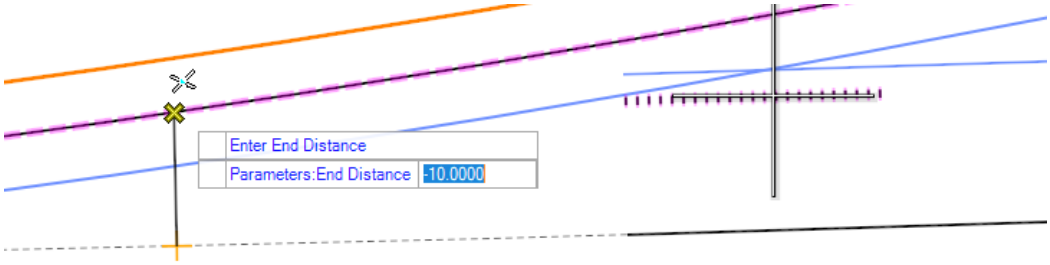


H. Set start distance in dialog to 0.00’



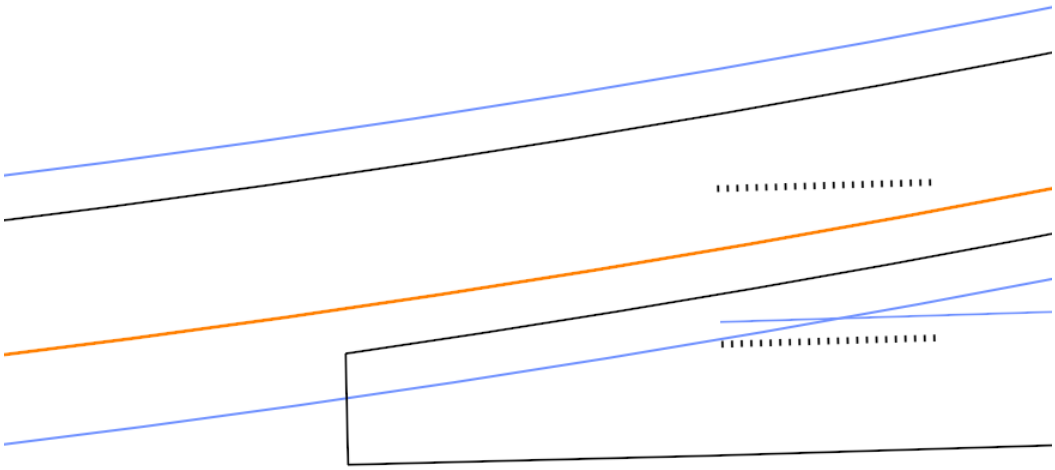
I. Left click to accept Skew angle of 90°

J. Snap to intersection of 10’ Offset line and Ramp edge of travel to set end point, end distance should show 10.00’

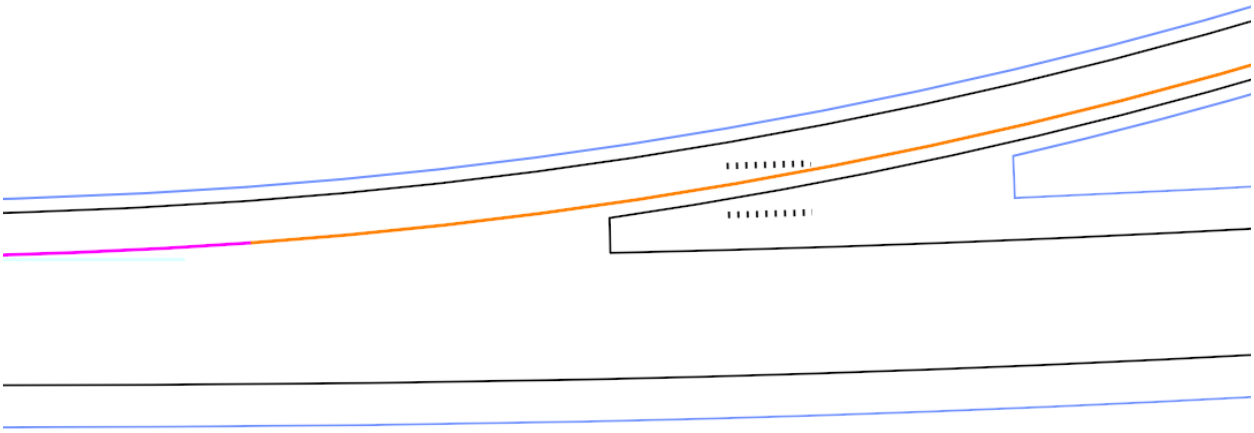


K. Set the trim extend option to None

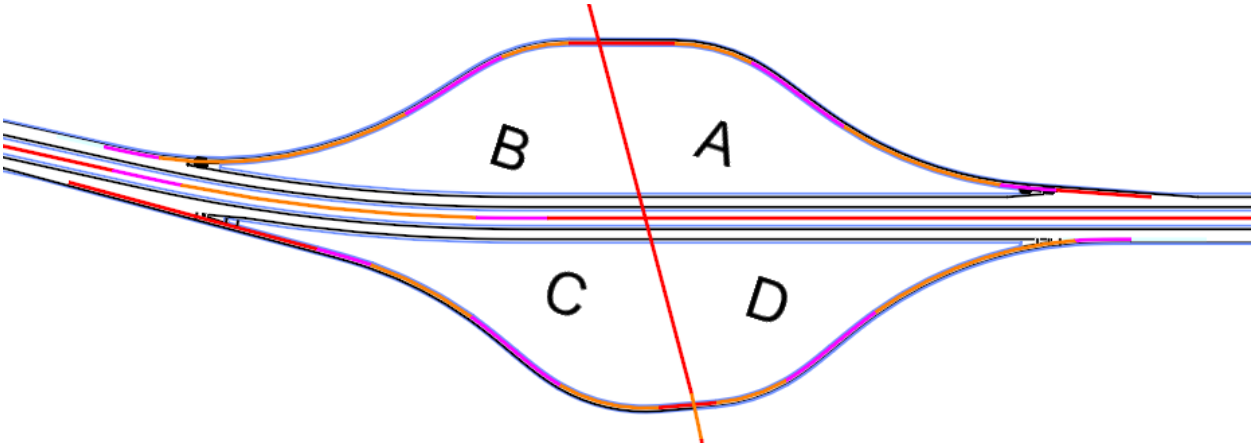
L. Use the **Trim to Intersection** tool from the *Modify* section of the *Drawing* ribbon to trim the pavement lines in the gore area.



M. Change the active Feature Definition to Paved Shoulder and repeat the process for the paved shoulder line.



N. Practice using the **Offset and Taper** tools by completing the remaining ramp gore sections



O. It is important to understand that many of these elements will be generated by the model and can be referenced from the CMD file as shown in the Modeling training modules. It will not be required to draft a lot of the Edge of Pavement lines in the DSN file in order to have them show up on the plan sheets.

These exercises are only to practice and become familiar with the various tools and the methods in which they can be used to place elements in the design, whether the elements are in the CMD file or whether the elements are in the DSN file.

Plan Geometry – DSN Drafting – Bridge

In this section we will focus on drafting required for Y14 over L, including the bridge and approach slab, edge of pavement tapers and transitions, ramp terminals, lane lines and concrete islands.

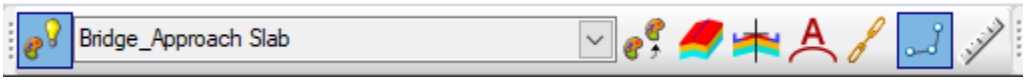
As previously noted most if not all these elements could be placed in the CMD file using the Construction Class Elements to control the corridor.

The purpose of this module is not to define a specific method for organizing and creating a project but to show the methods and tools used to create plan view elements and to demonstrate how those elements interact with the 3D model. Other methods of accomplishing the same result will be demonstrated in other training modules.

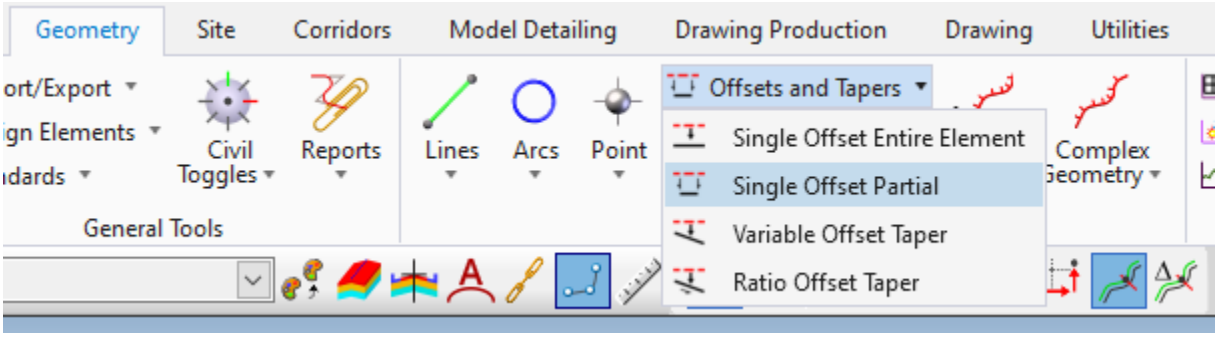
1. Y Line Over – Bridge on Y14 Over L

A. The bridge on Y14 over L is a 5-lane section, the thru lanes are 12’ wide and the center turn lane is 16’ wide, the shoulders are 6’ wide for a total width between the barrier rails of 76.00’. The begin and end of the bridge are located at an offset of 101.76’ from the L centerline.

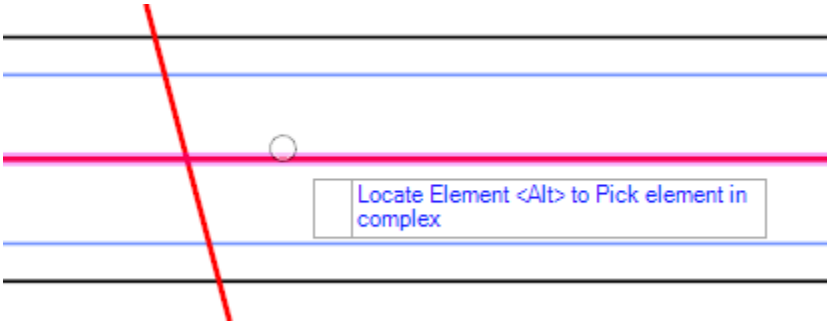
B. Set the Active Feature Definition to Bridge_Approach Slab



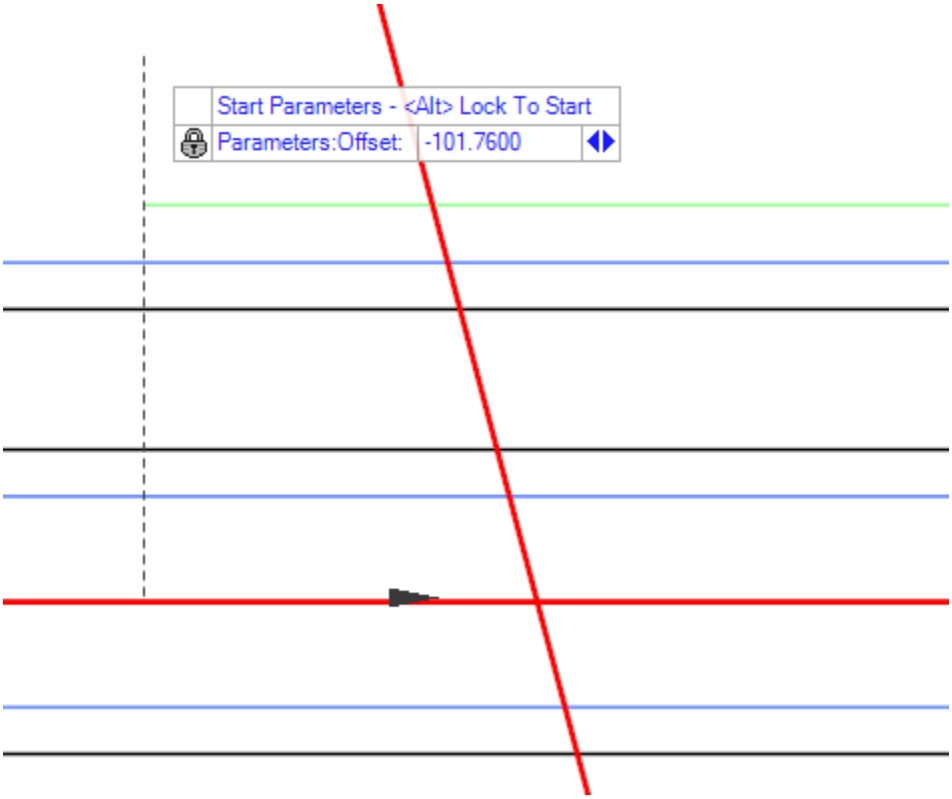
C. Select the **Single Offset Partial** tool.



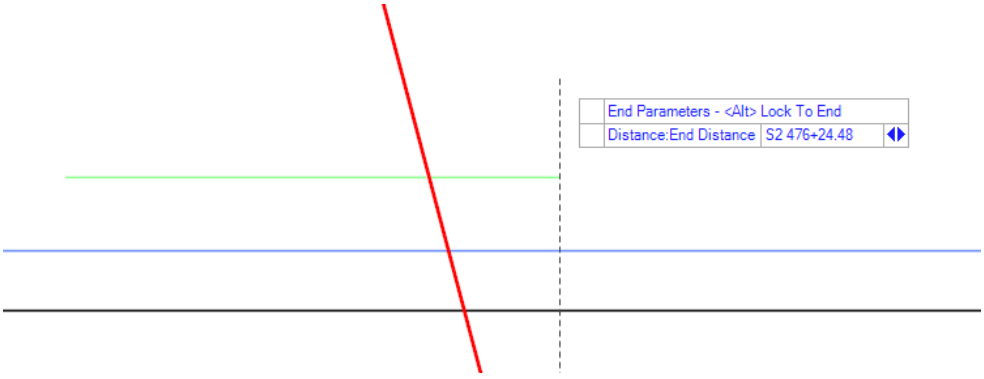
D. Left click to pick the L centerline.



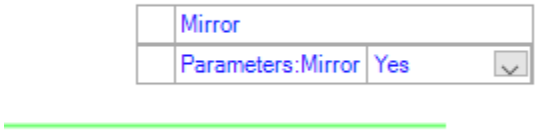
E. Enter 101.76’ for the offset and press <ENTER> to lock.



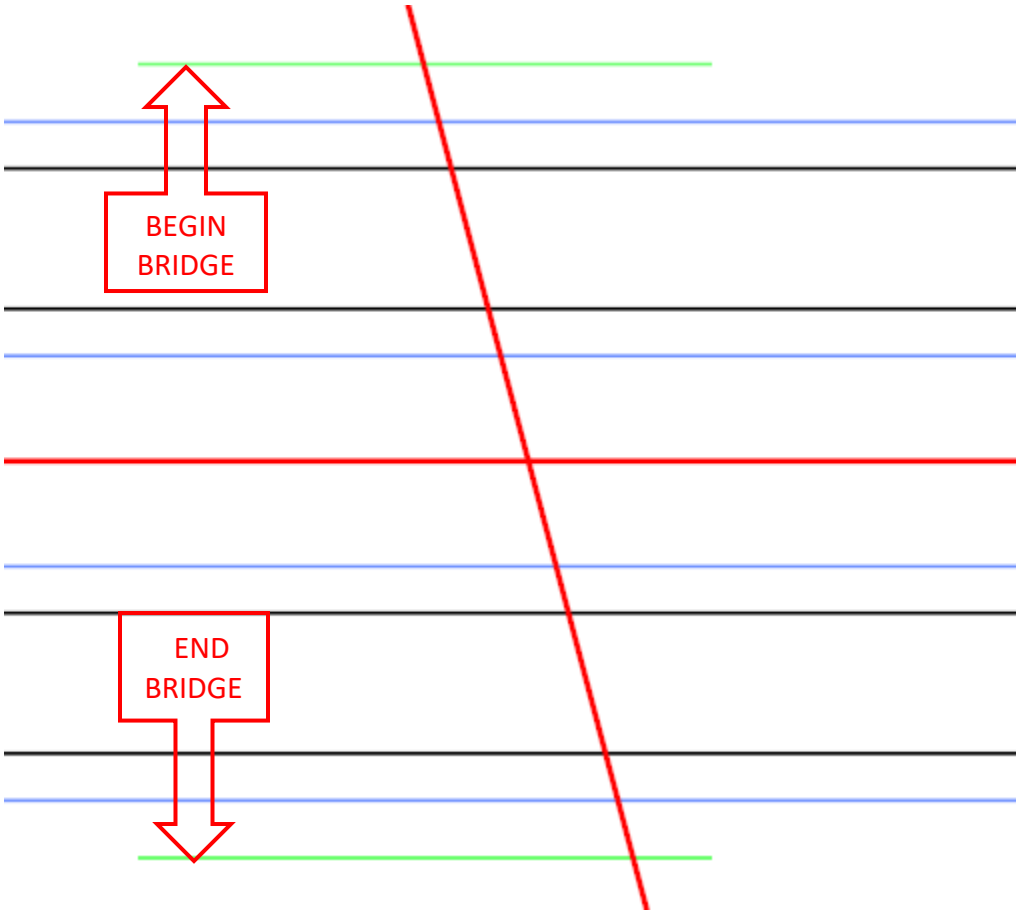
F. Left click to set a start point. The start point is not critical, we will use the modify tools later to complete the bridge, after offsetting for the bridge rail.



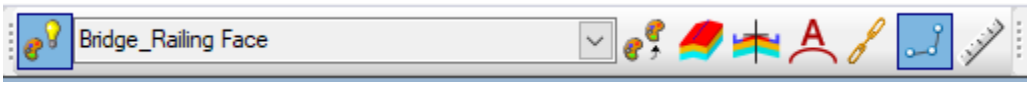
G. Left click to set the end point, again this location is not critical. Left click to accept the mirror option of YES.



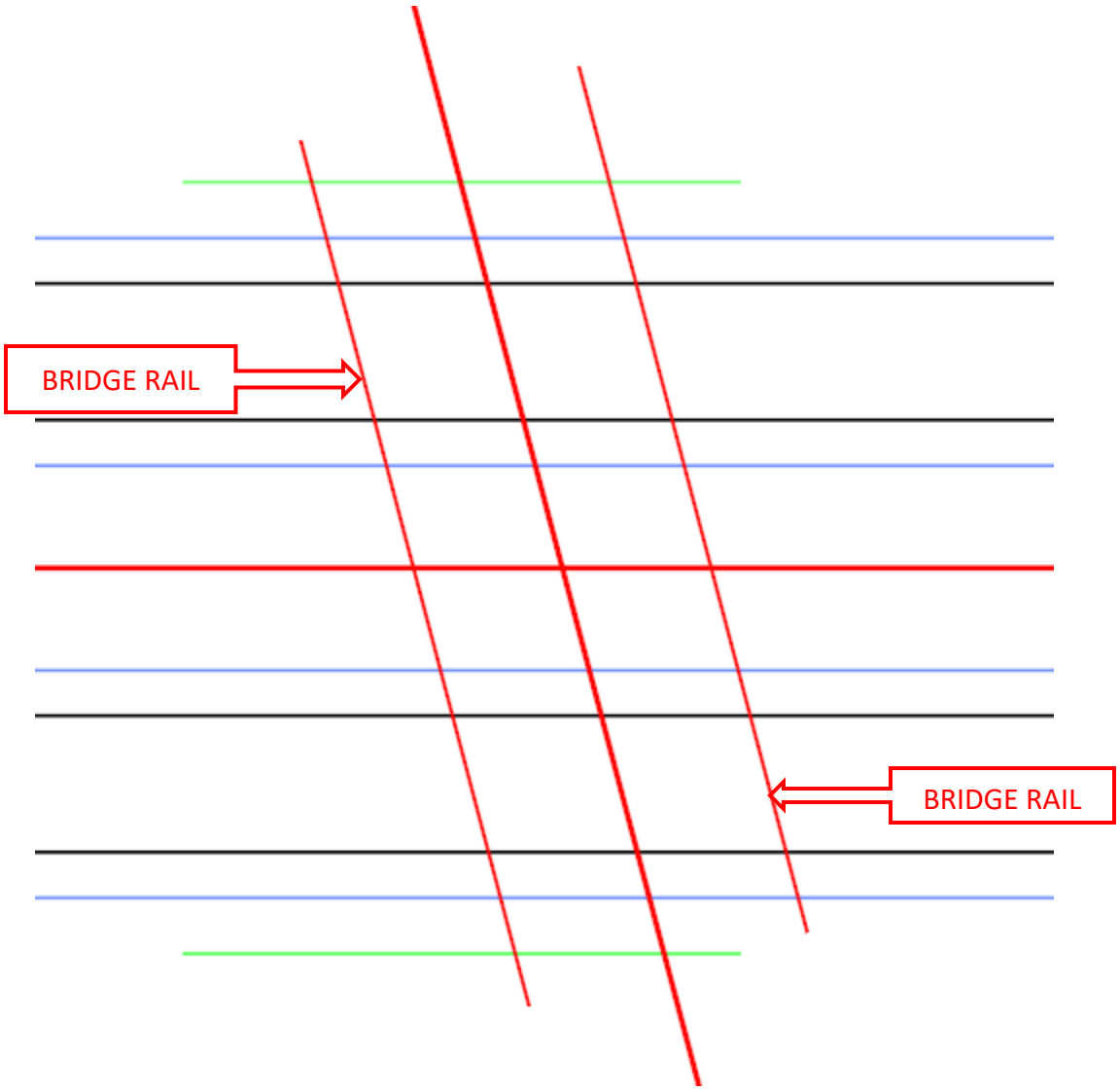
H. This will complete the tool and place bot the begin and end bridge line at an offset of 101.76’ from the L centerline.



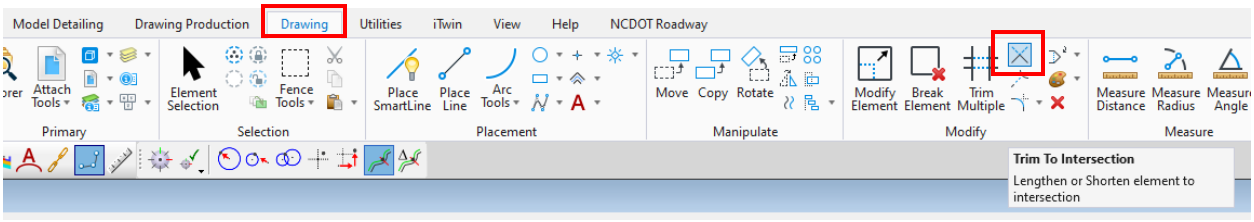
I. Change the Active Feature Definition to Bridge_Railing Face



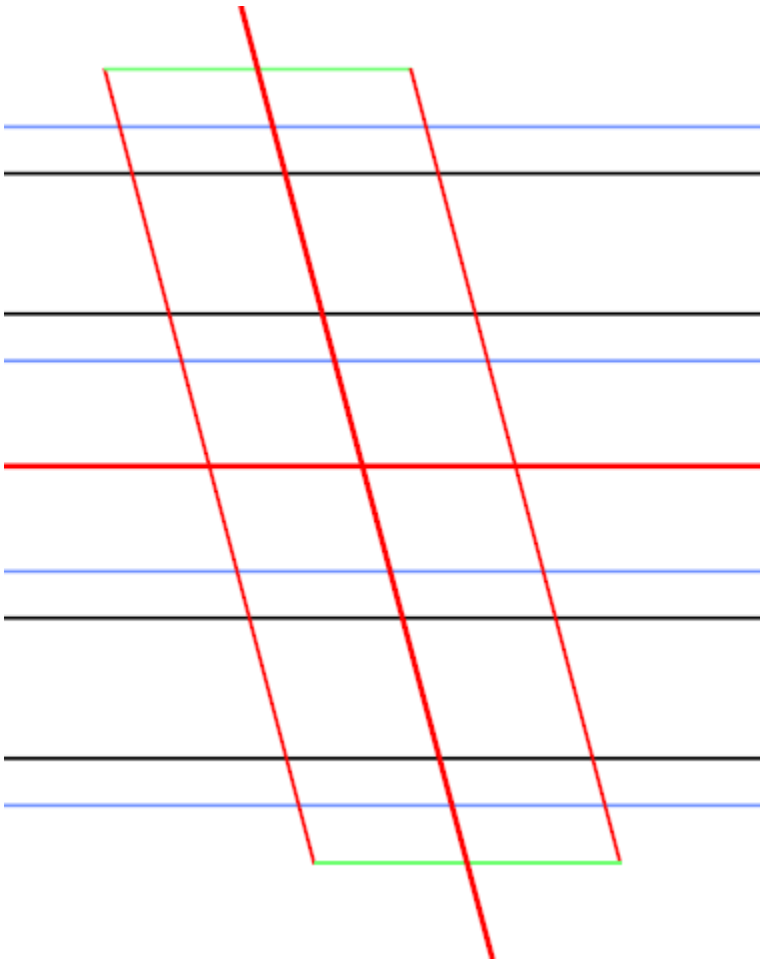
J. Using the **Single Offset Partial** tool and the same process used to create the begin and end bridge lines, create the inside of the bridge rail at a 38.00’ offset from the Y14 centerline.



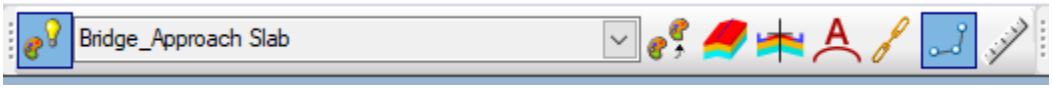
K. Switch to the *Drawing* ribbon and select the **Trim to Intersection** tool from the *Modify* section.



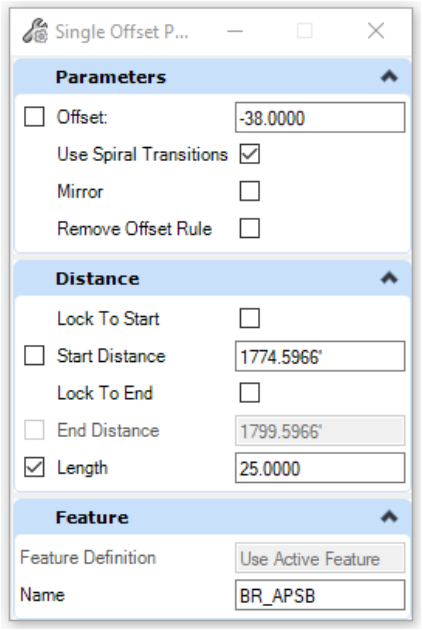
L. Use the tool to intersect the bridge rail lines with the begin and end bridge line to complete the bridge shape.



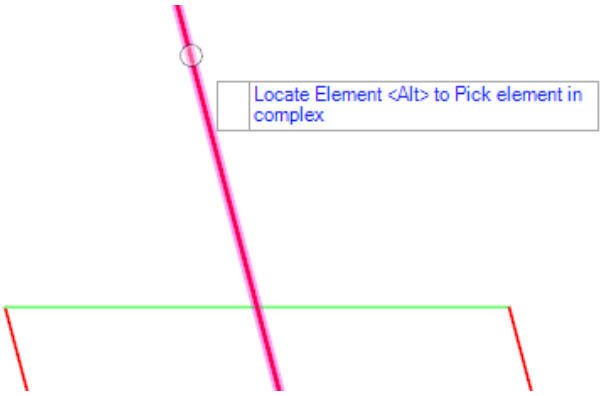
M. Change the Active Feature Definition back to Bridge_Approach Slab.



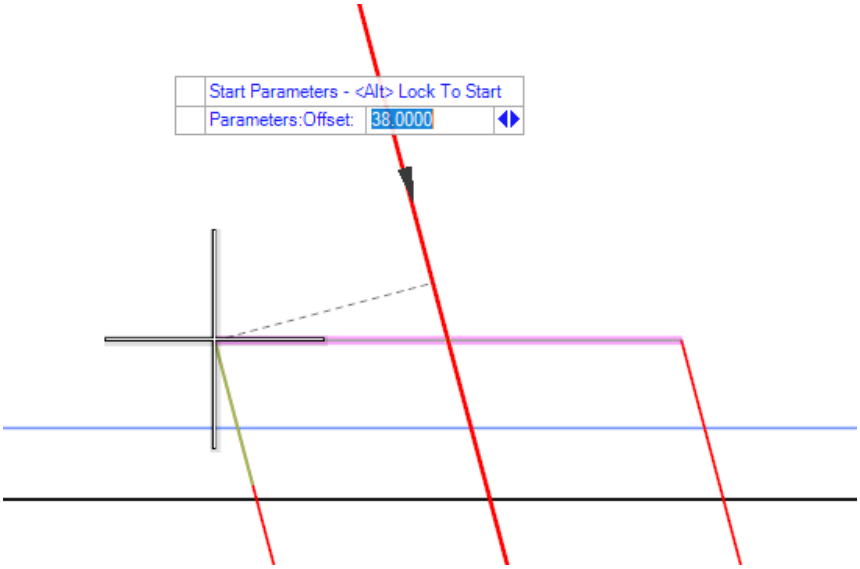
N. Start the **Single Offset Partial** tool. In the dialog box enter 25.00’ for the length of the offset element. This is the length of the approach slab measured along the workline, the Y14 centerline.



O. Left click to select the Y14 centerline.



P. Snap to one corner of the bridge to set the start point.

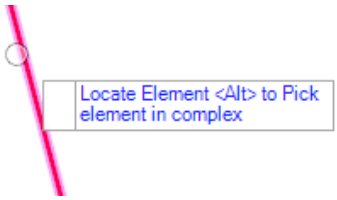


Q. Move the cursor so that the line is placed in the correct direction and left click to accept.

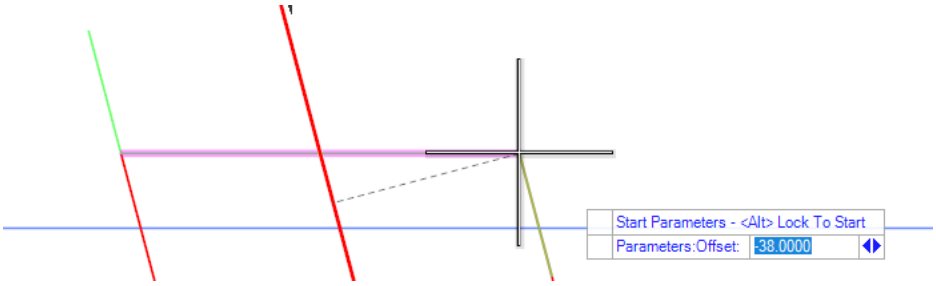
R. Left click to accept the mirror option of NO.

S. Repeat the process for the other side of the approach slab.

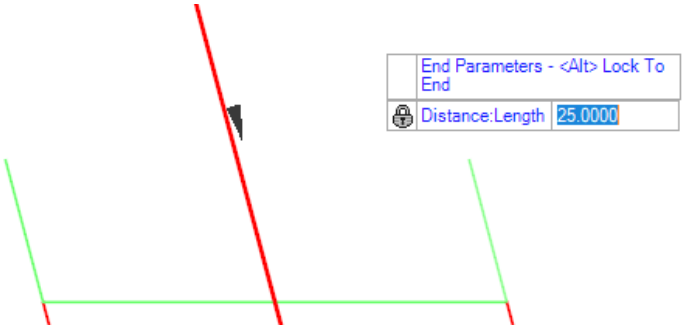
- Step 1



- Step 2

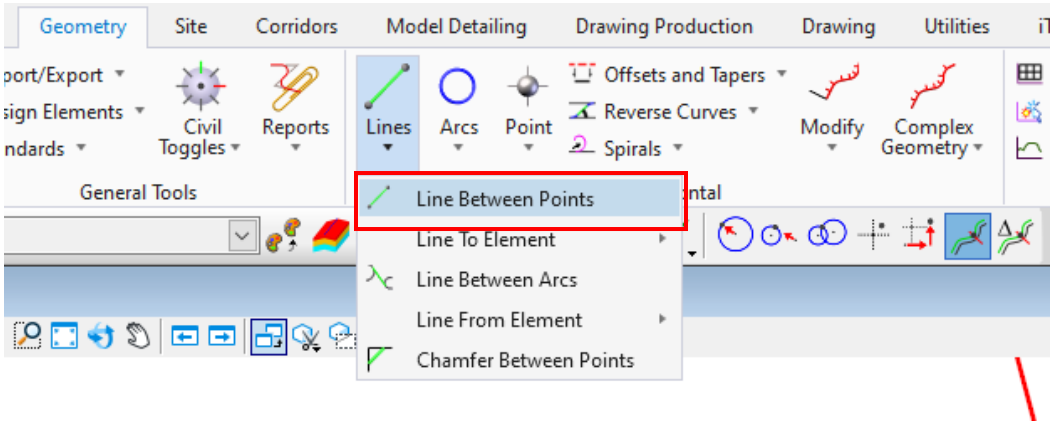


- Step 3

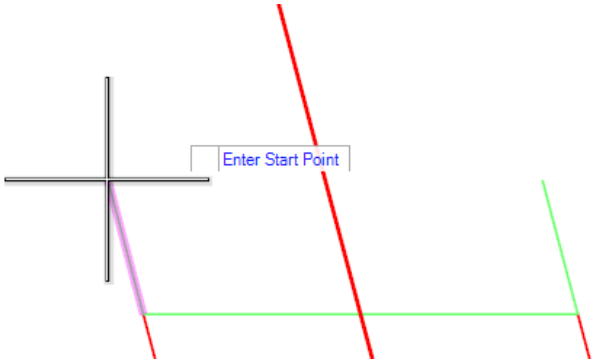


- Step 4

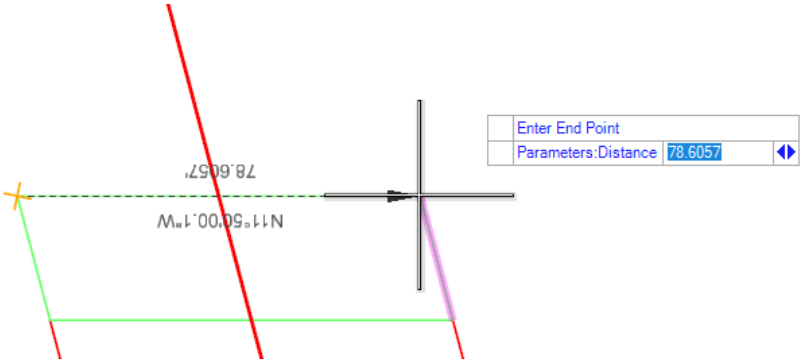
T. Select the **Line Between Points** tool.



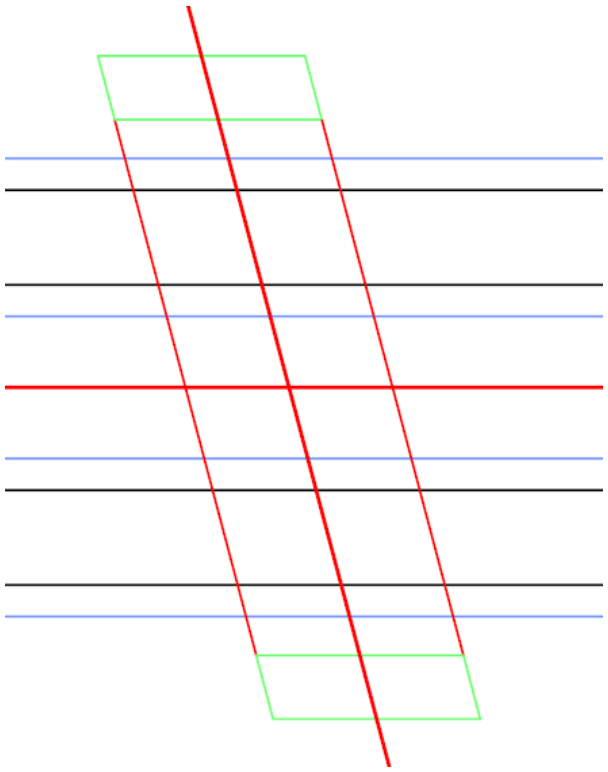
U. Draw a line connecting the sides of the approach slab.



V. Snap to teach point to create a snap constraint. By doing that if the bridge length changes the approach slab will automatically adjust to maintain the design intent, which is a 25.00’ long approach slab.



W. Repeat the process to complete the other approach sab and finish the bridge drafting.



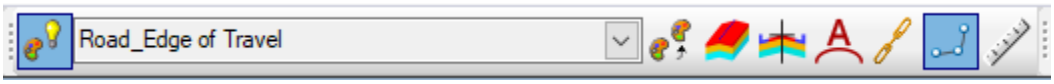
X. Again, it is important to understand that a lot of this linework may come from a bridge model. The purpose of this exercise is to show one possible method to use the tools to draft a bridge and approach slabs.

DSN Drafting – Interchange Pavement Lines

1. Y Line Over – Y14 Pavement Lines

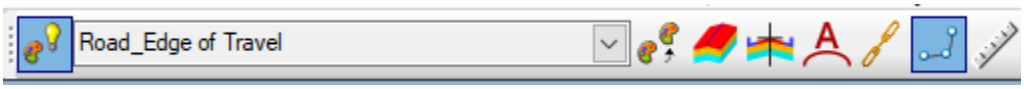
A. The Y14 Typical Section is a 5-lane shoulder section, the thru lanes are 12’ wide and the center turn lane is 16’ wide. There are 6’ paved shoulders. To minimize the number of intervals created we are going to draw the pavement lines in 4 sections.
- The Begin Paving Station 14+00 to the Ramp A/B terminals
- Ramp A/B terminals to the Bridge
- The Bridge to the Ramp C/D terminals
- Ramp C/D terminals to the End Paving Station 48+50.00

B. Set the Active Feature Definition to Road-Edge of Travel

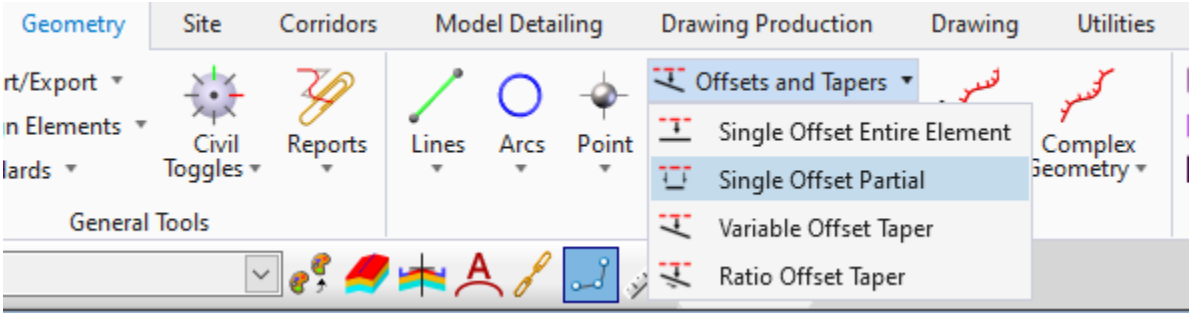


C. The first edge of pavement section we will create are the sections inside the interchange. These pavement sections will be the full pavement width of 32’ on each side. After completing these sections, we will draw the Intersection return radius and after the radius are completed, we can draw the pavement edges that taper back to the existing pavement width.

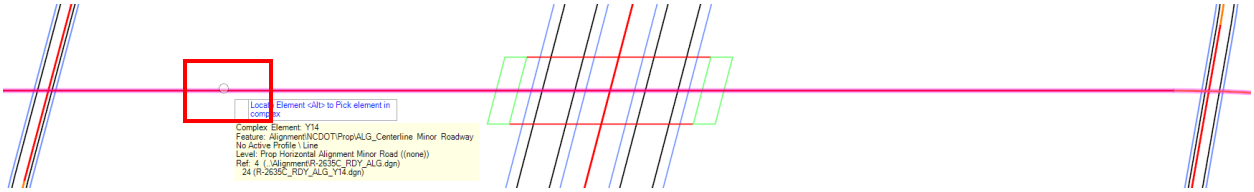
D. Start by setting the Active Feature Definition to Road_Edge of Travel.



E. Start the **Single Offset Partial** tool to create the edge of travel line. It is in the **Offsets and Taper** tool group in the *Horizontal* section of the *Geometry* ribbon.

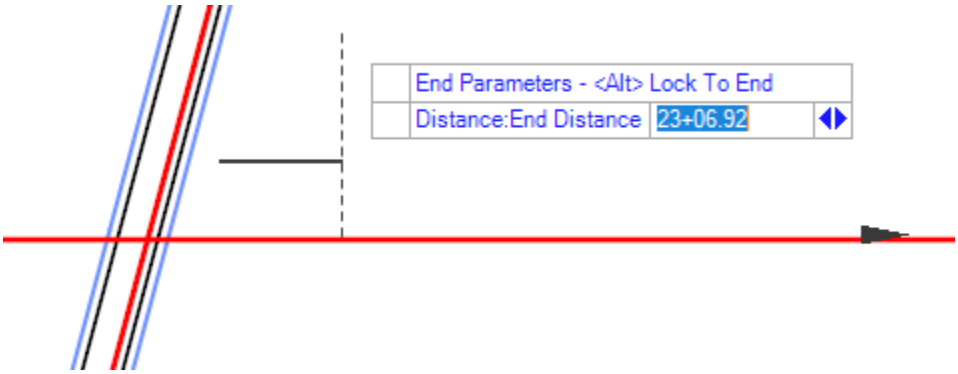


F. Left click to locate the Y14 centerline.

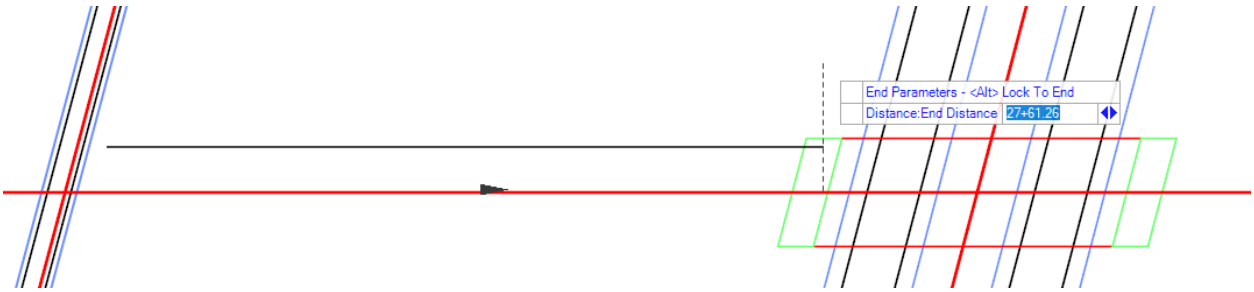


G. At the heads-up prompt enter -32.00’ for the offset.

H. Left click near the Ramp A/B terminal to accept the offset and select the start point. The location of the start point is not critical we will fill this area in with the intersection radius.

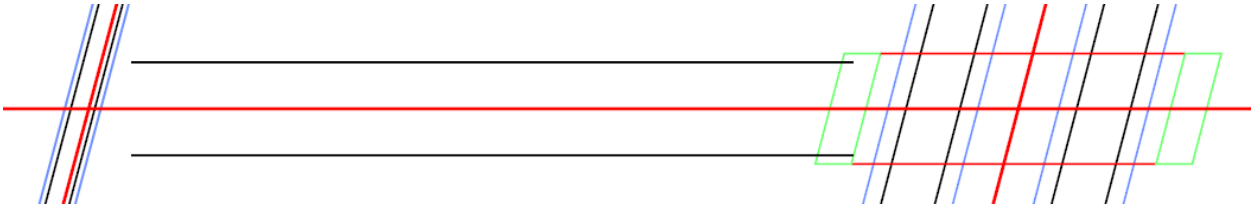


I. Left click near the bridge approach slab to set the end point. This location is not critical either, we will use the extend element tool to set the end point of the line.

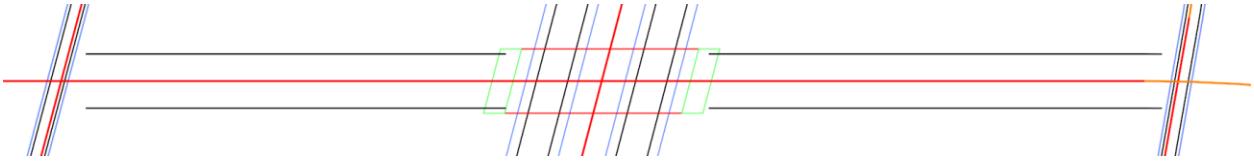


J. Set the mirror option to YES and left click to accept.

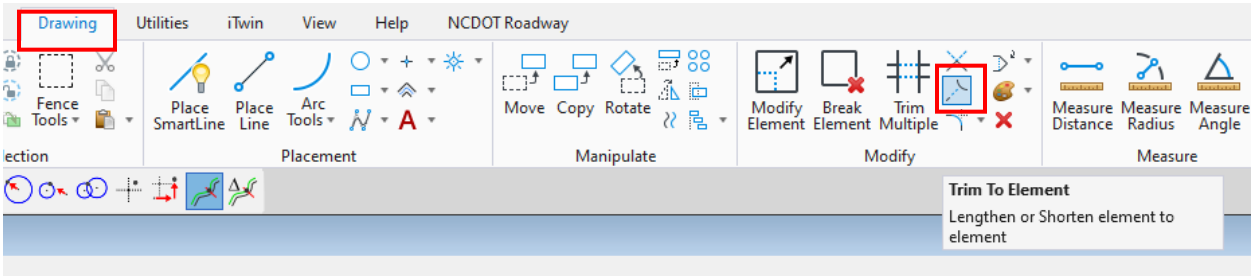
K. This will draw and edge of pavement line on the left and right side of Y14 in between the ramp A/B terminals and the bridge approach slab.



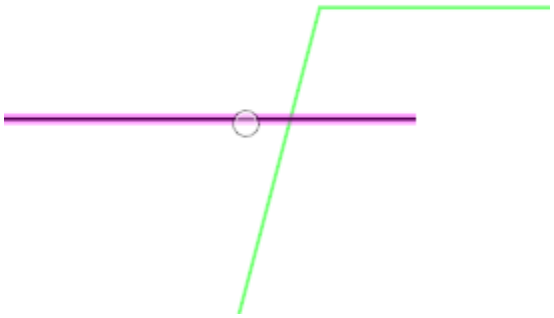
L. Repeat the process for the portion of Y14 in between the end of the bridge and the Ramp C/D ramp terminals, use the same 32.00’ offset.



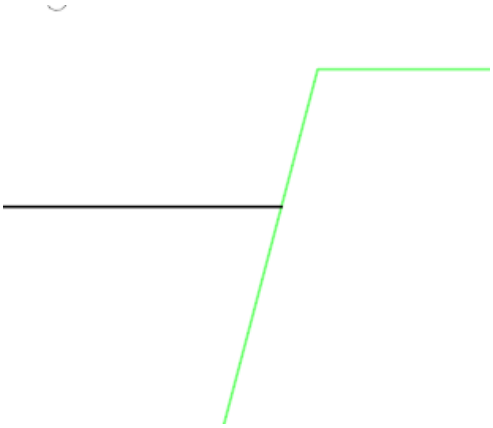
M. Use the **Trim to Element** tool from the *Modify* section of the *Drawing* ribbon to Trim the edge of pavement lines to the previously place Approach Slab lines.



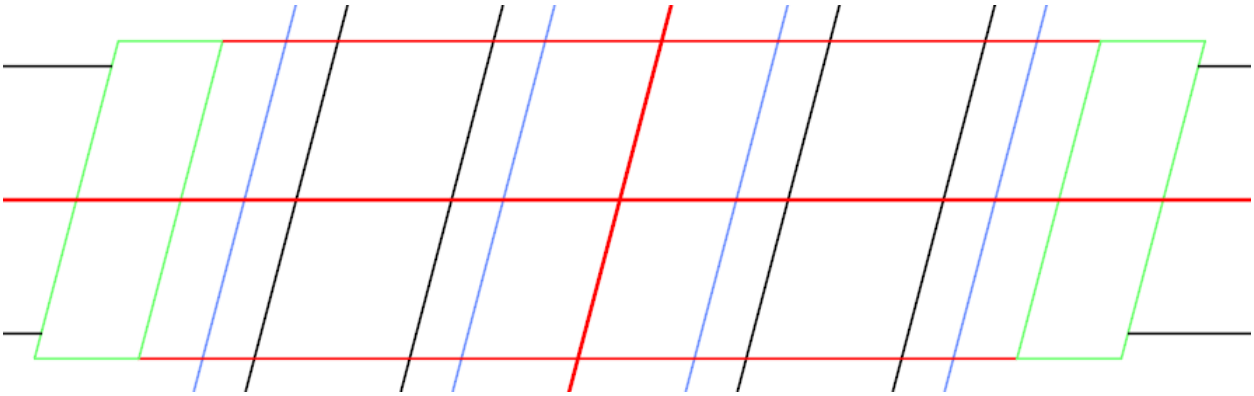
N. Before trimming the edge of pavement line.



O. After trimming.



P. All the edge of pavement lines should now meet the approach slab.

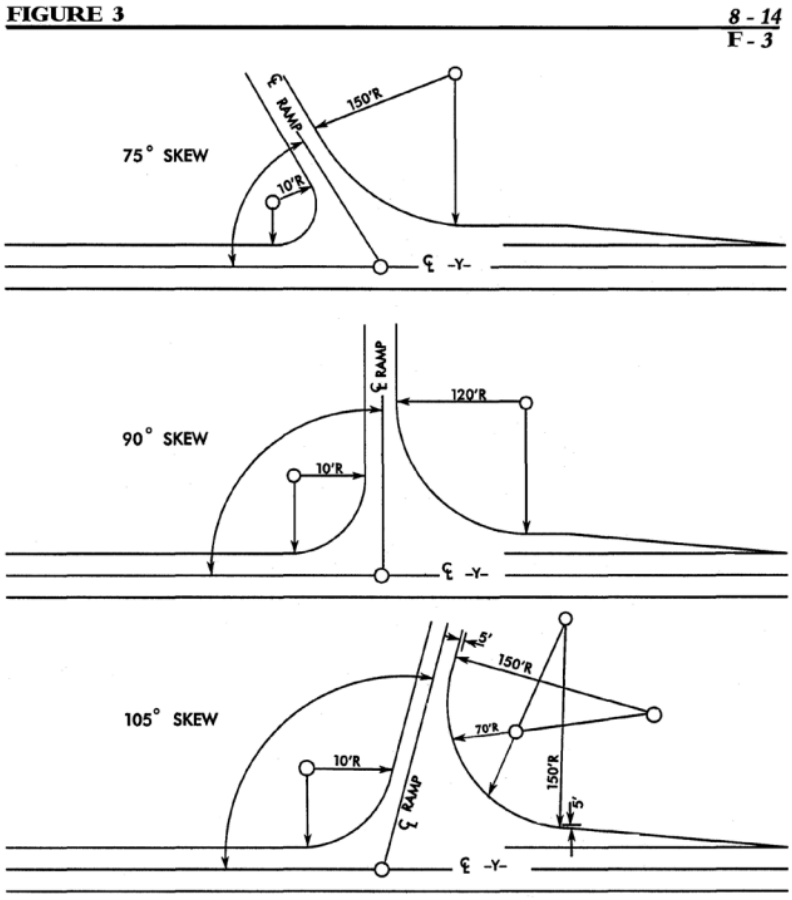


Q. This completes the placement of the edge of pavement lines on the inside of the interchange.

DSN Drafting – Ramp Terminals

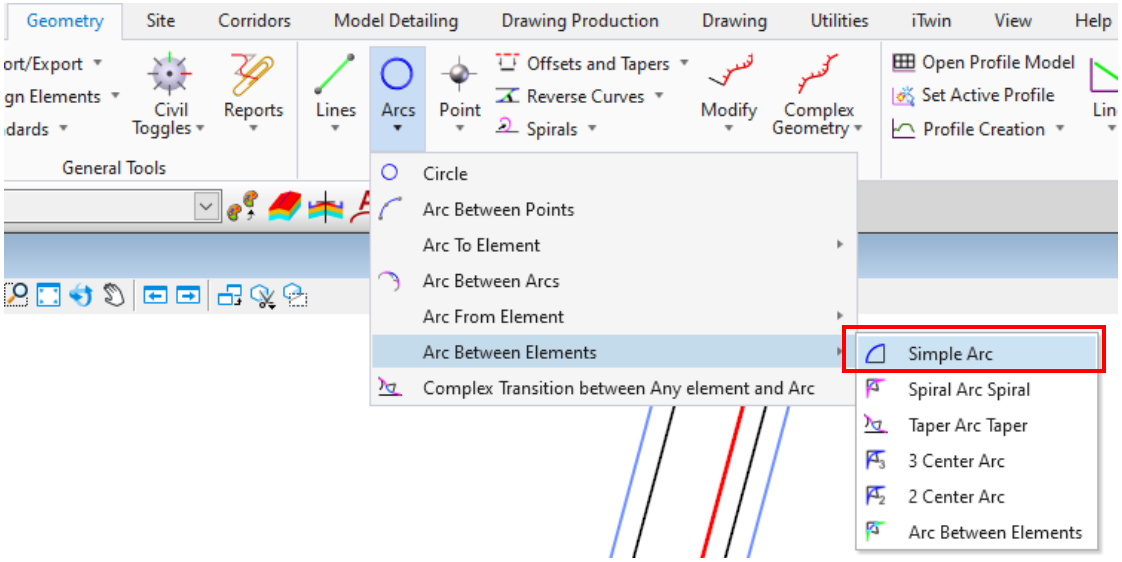
1. Y Line Over – Y14 Ramp Intersection Radius

A. In this section we will create the intersection edge of pavement radius for the ramp terminals. The ramp terminal configuration will be based on Figure 3 in section 8/14 of the NCDOT roadway design manual.

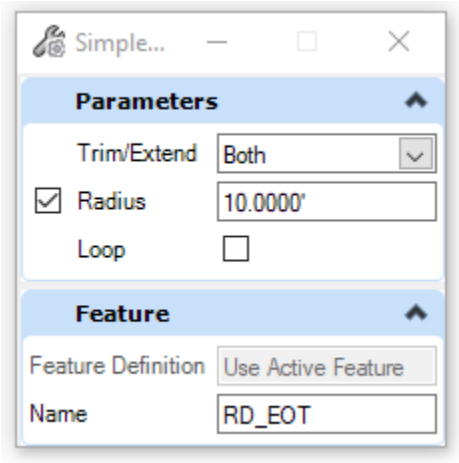


SUGGESTED RAMP TERMINAL RADII

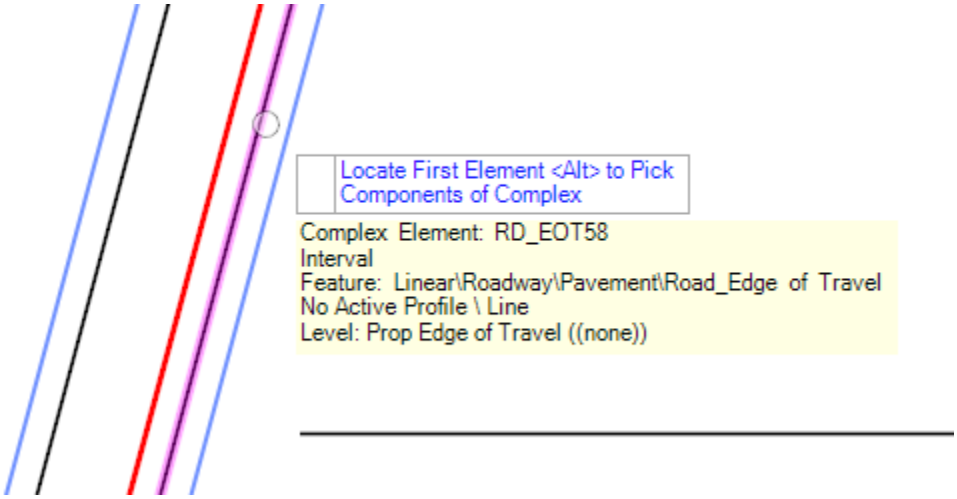
B. Start by creating the edge of pavement radii on the side of the ramp that is closes to the bridge, these radii are the simplest to create and are all 10'. Start with Ramp A and start the **Simple Arc** tool from the **Arc Between Elements** tool group in the *Horizontal* section of the *Geometry* ribbon.



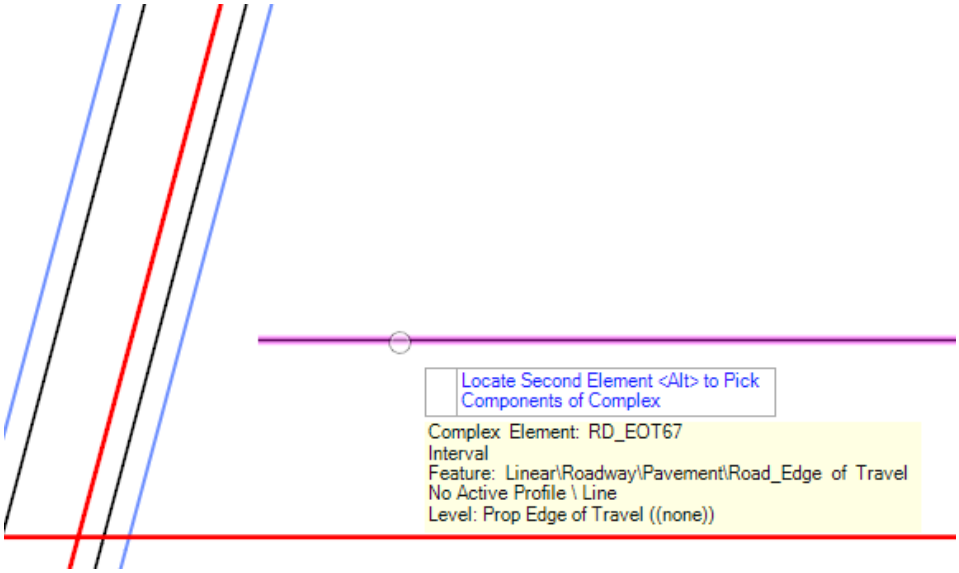
C. In the dialog box set the
- Trim/Extend option = Both
- Radius = 10.00'
- The Feature name is not important for plan geometry elements, the program will automatically select a name prefix based on the feature definition used and will automatically increment the named elements as required.



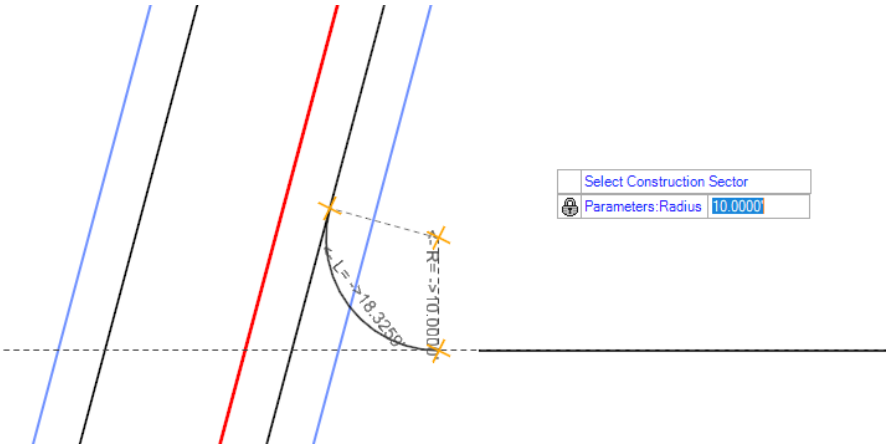
D. Left click to locate the ramp edge of travel.



E. Left click to locate the Y14 edge of travel line.

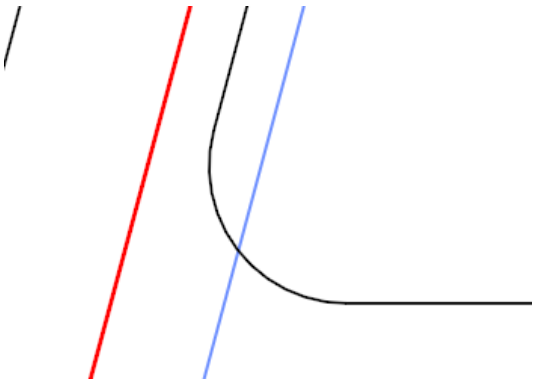


F. Place the cursor on the side of the curve to select the correct solution and left click to accept.

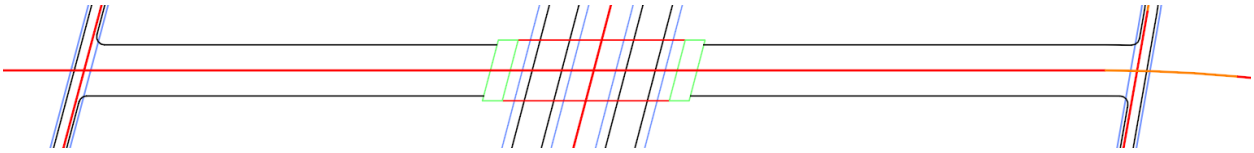


G. Left click to accept the trim option of BOTH.

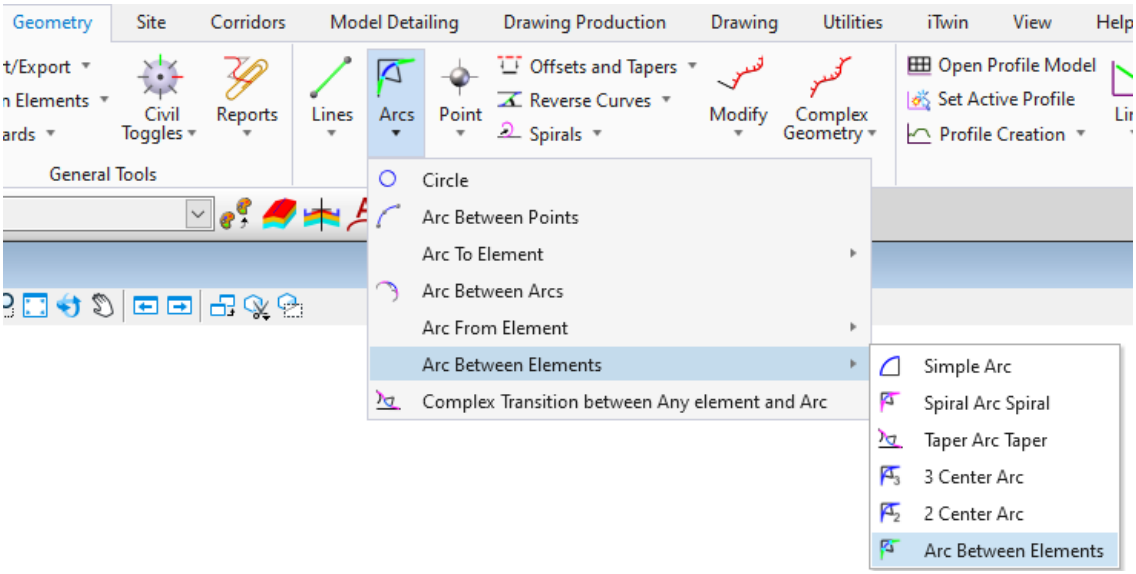
H. This will place the arc and Trim or Extend the edge of pavement lines to meet.



I. Repeat this process for the three remaining intersections at the other ramps. Because the tool is still active, and the settings are the same the user only needs to left click through each setting to accept and then place the curves at each location

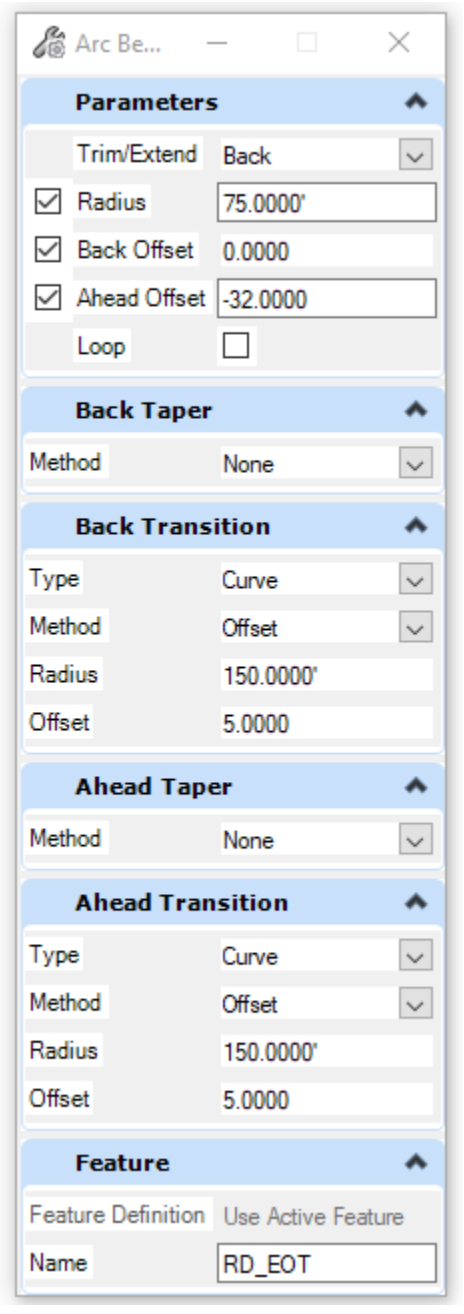


J. Now place the curve for the right turn movement from Ramp A to Y14. The skew at this location is 105°. Based on the standard place a 3 centered curve Radii = 150'-75'-150' with a 5' offset. This curve will tie to a 32' offset from the Y14 Centerline. Start the **Arc Between Elements** tool from the **Arc Between Elements** tool group located in the *Horizontal* section of the *Geometry* ribbon.

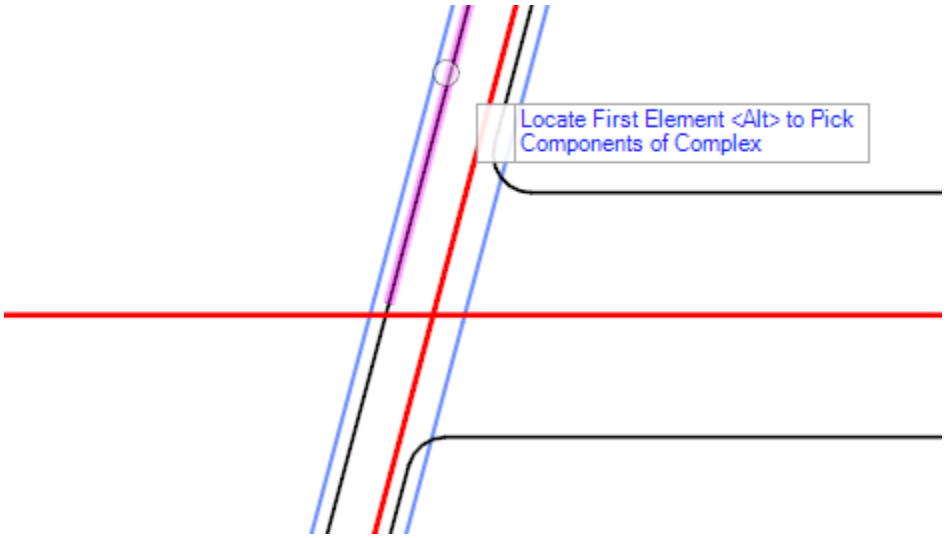


K. We selected this tool instead of the **3 Center Arc** tool because it will allow for the arc to tie at an offset to the reference element.

L. Set the dialog to match the desired 3 center arc design parameters
- Trim/Extend = Both
  1. Because we will be tying to an offset of the Y14 centerline alignment there will only be one element to Trim. the back element, the Ramp A edge of travel.
- Radius = 75.00’
  1. This is the radius of the central curve
- Back Offset = 0.00’
  1. This is the offset from the back reference element, we will use the Ramp A edge of travel so the offset should be 0.00’
- Ahead Offset = -32.00’
  1. This is the offset from the Y14 centerline reference element.
- Back Taper = none
- Back Transition = Curve
- Method = Offset
- Radius = 150.00’
- Offset = 5.00’
  1. This is the offset where the back curve is tangent to the central curve
- Ahead Taper = None
- Ahead Transition = Curve
- Method = Offset
- Radius = 150.00’
- Offset = 5.00’

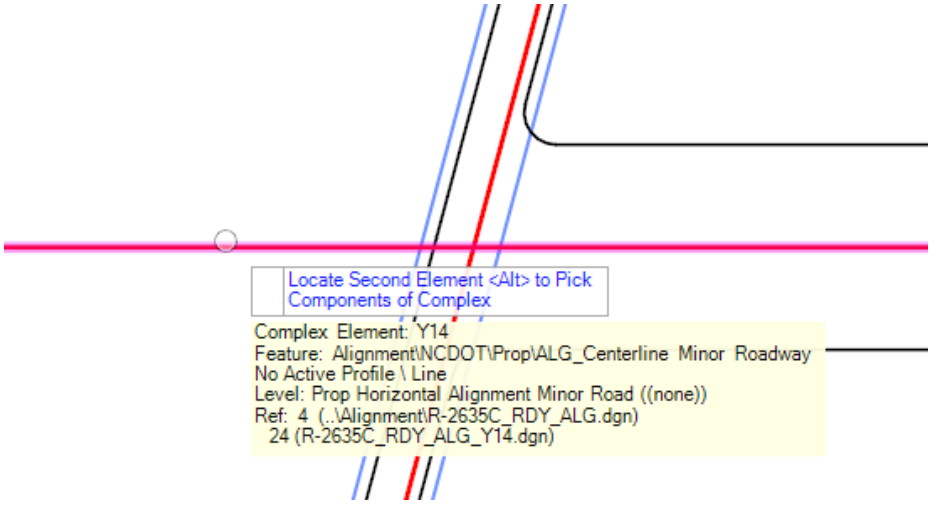


M. Left click on the Ramp A edge of travel to locate the first element. Because of the way the dialog is set to have the Back Offset be 0.00’ it is important that the Ramp A edge of travel is selected first as the Back Element.

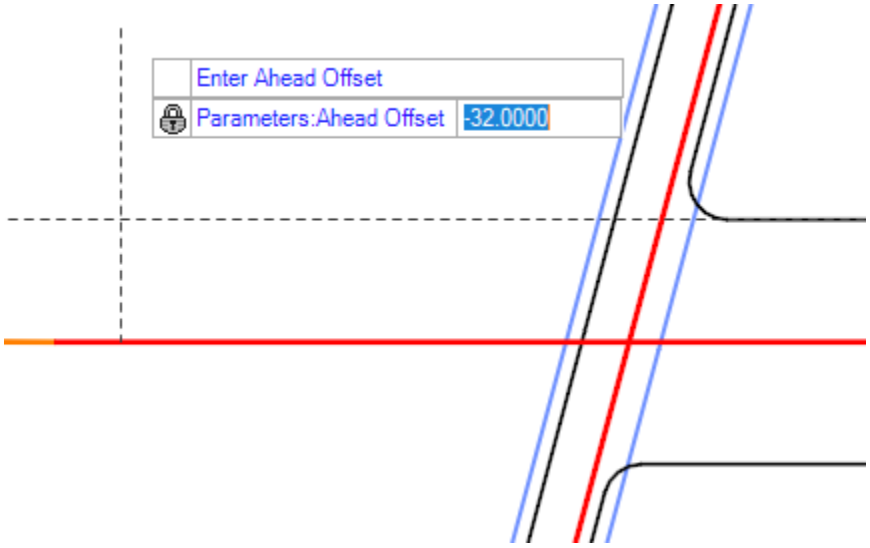


N. Left click to accept the 0.00’ offset.

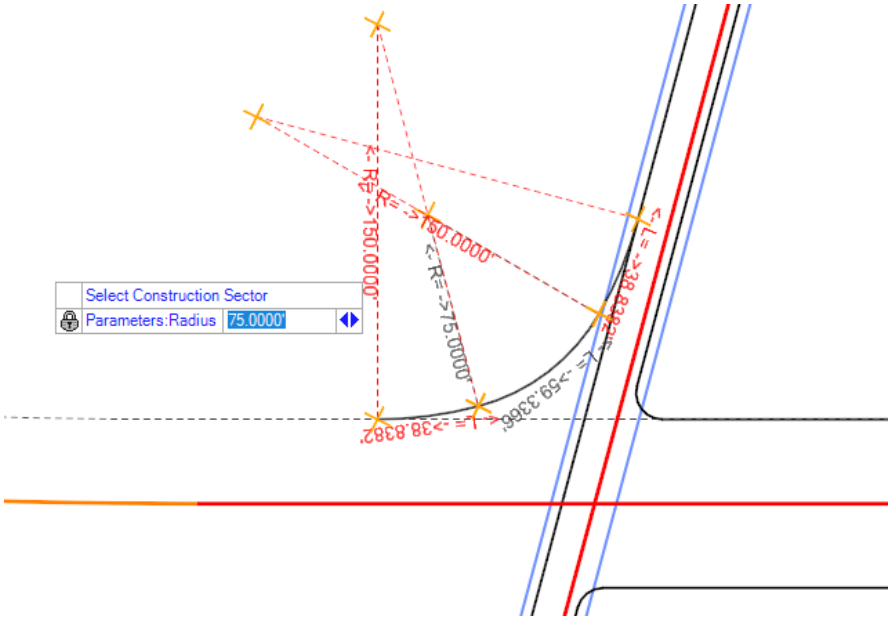
O. Left click on the Y14 centerline to select the second element, this is the ahead element.



P. Left click to accept the Offset as -32.00', make sure to place the cursor on the left side of Y14, if not the sign of the offset will change, and the curve construction will be incorrect.

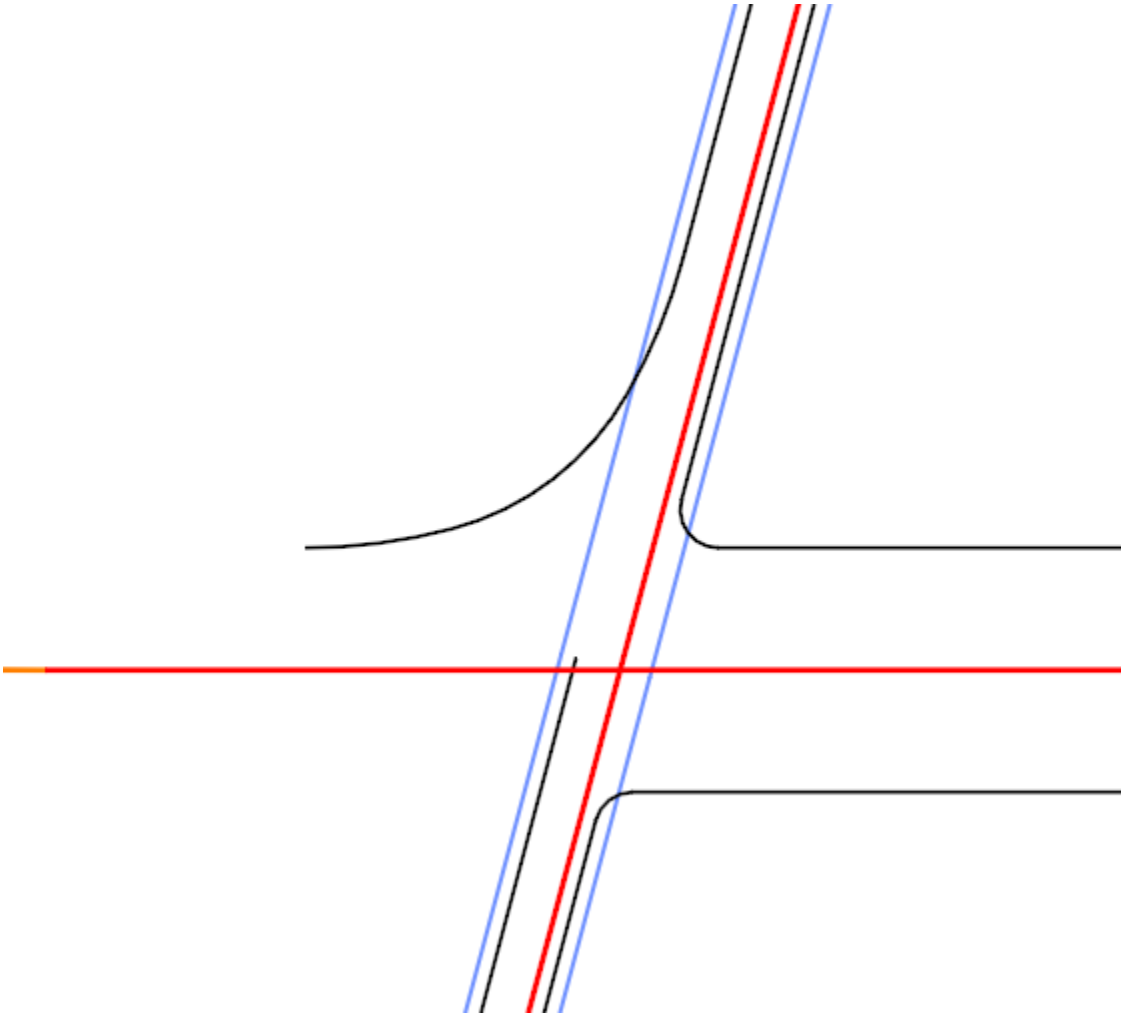


Q. Place the cursor in the outside quadrant to produce the correct result and left click to accept.

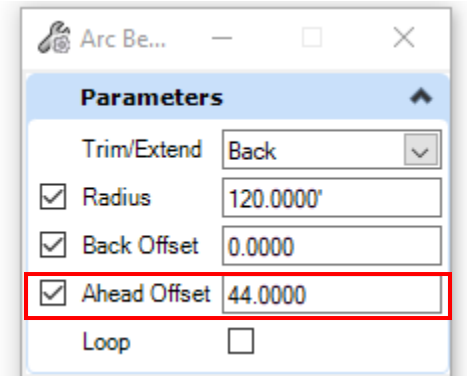


R. Left click to accept the Trim Option of BACK.

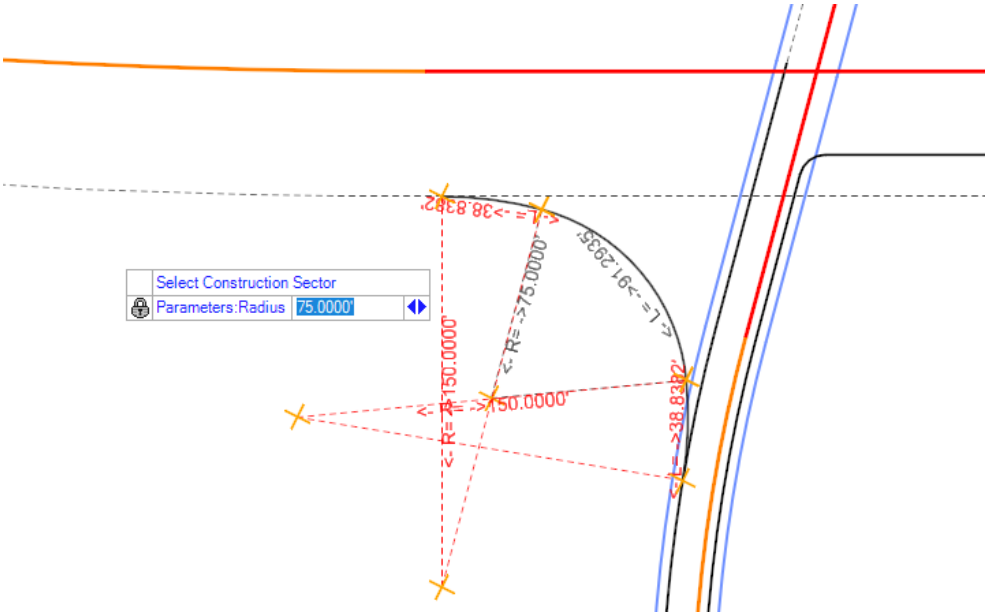
S. This will place the curve and trim the Ramp A edge of travel line.



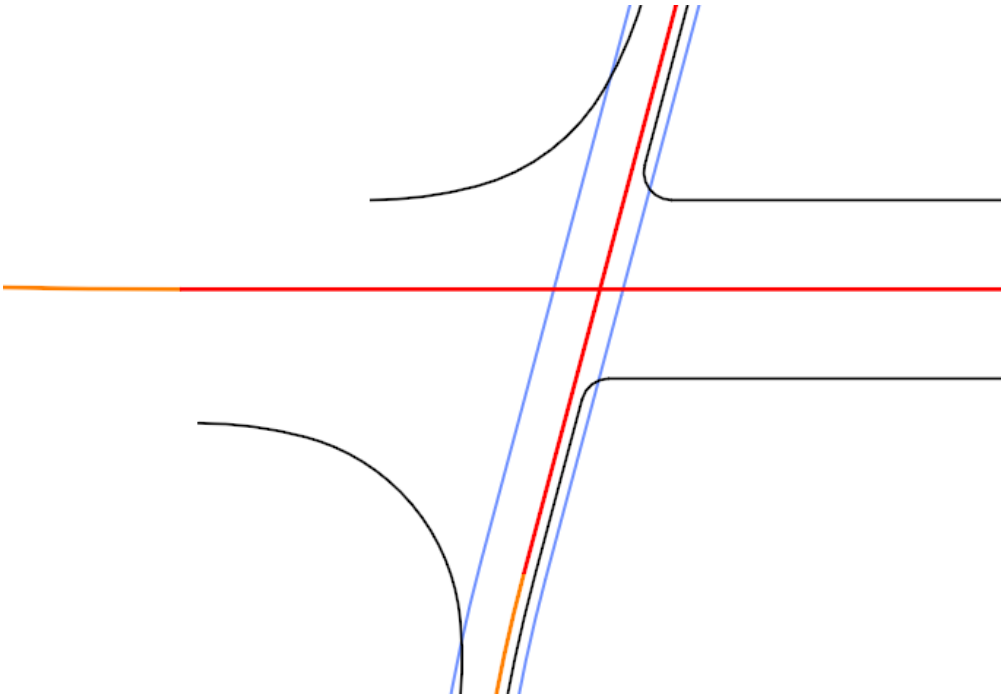
T. The Ramp B intersection curve requires the same design except for the Ahead Offset which will be 44', this will allow for a right turn lane in addition to the 2 thru lanes. Modify the dialog box entry for an Ahead offset of 48.00'



U. Repeat the process used for the Ramp A intersection curve, select the Ramp B edge of travel line as the first element, this will set it as the back element and apply the 0.00' offset. The Y14 centerline will be the second element and will use the Ahead Offset of 48.00'.

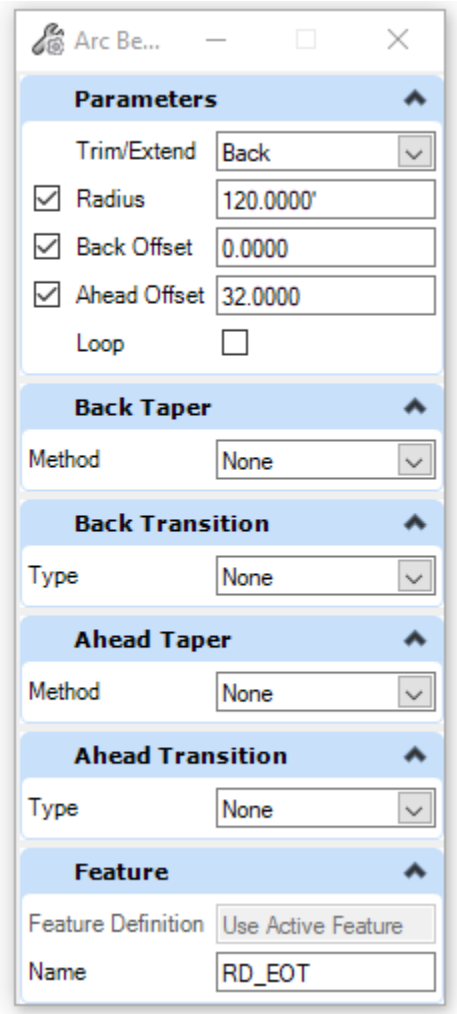


V. This will complete the intersection curves at the Ramp A/B terminals. The paved shoulder lines will be completed later.

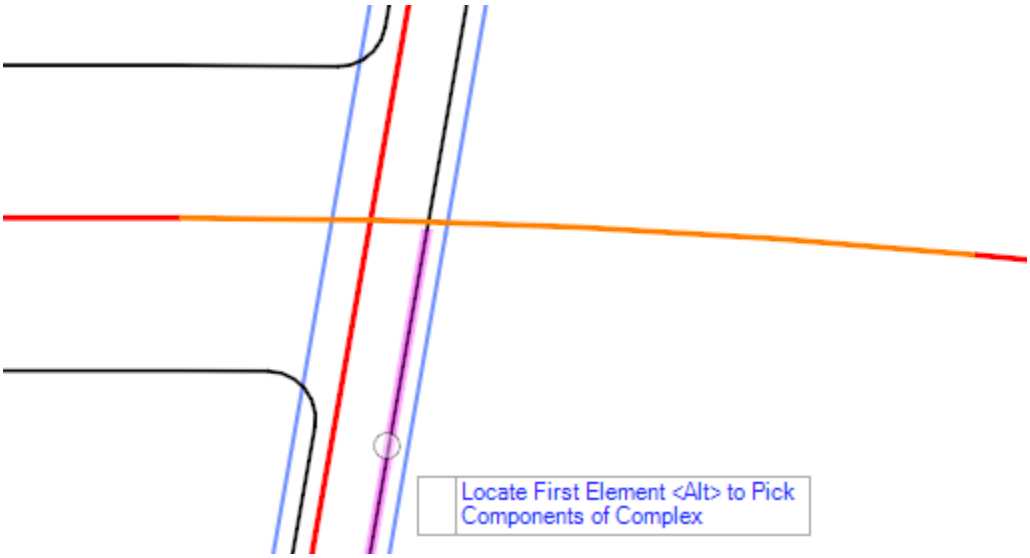


W. The Ramp C/D terminals are close enough to 90° that only a simple curve is required with a radius of 120'. The best tool to use is still the **Arc Between Elements** tool that was used for the 3 Centered Curves, this will allow for the offset to be specified and we can use the Y14 baseline as the reference element.

X. To create the intersection radius at the Ramp C terminal
- Change the Radius to 120’
- Set the Ahead Offset to 32.00’
- Change the Back and Ahead Transition to None.

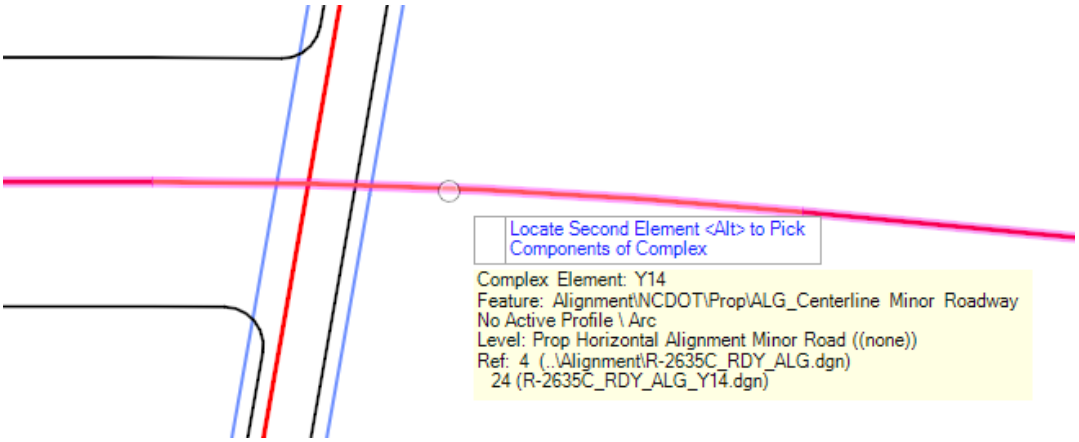


Y. Left click to select the first element as the Ramp C edge of travel.

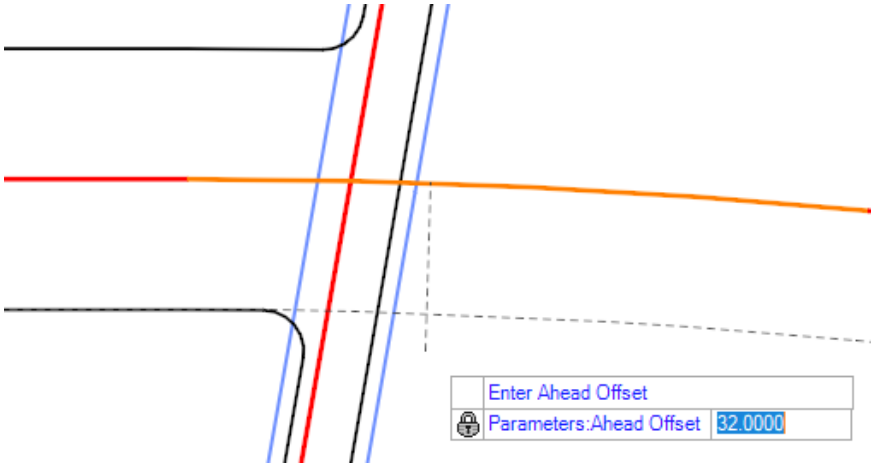


Z. Left click to accept the offset of 0.00’

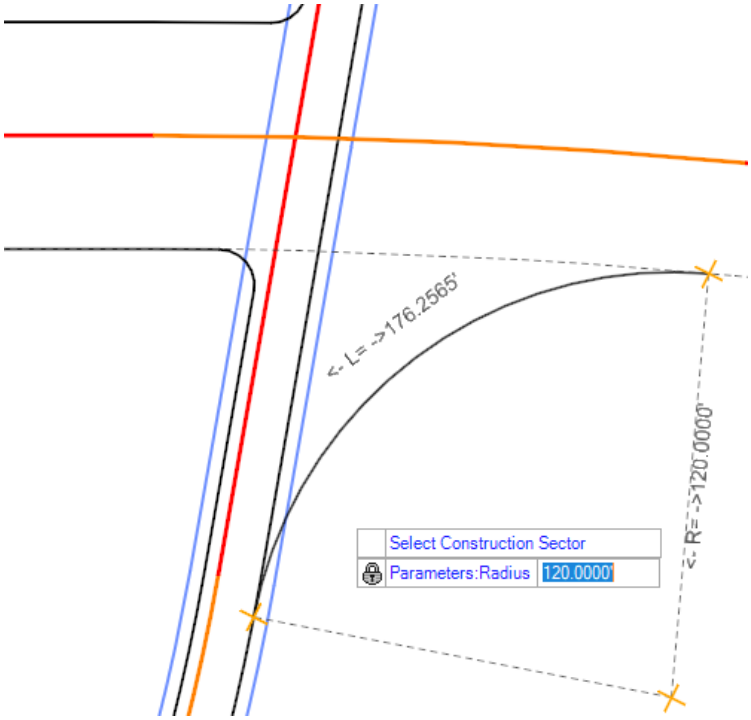
AA. Left click to select the Y14 centerline as the second element.



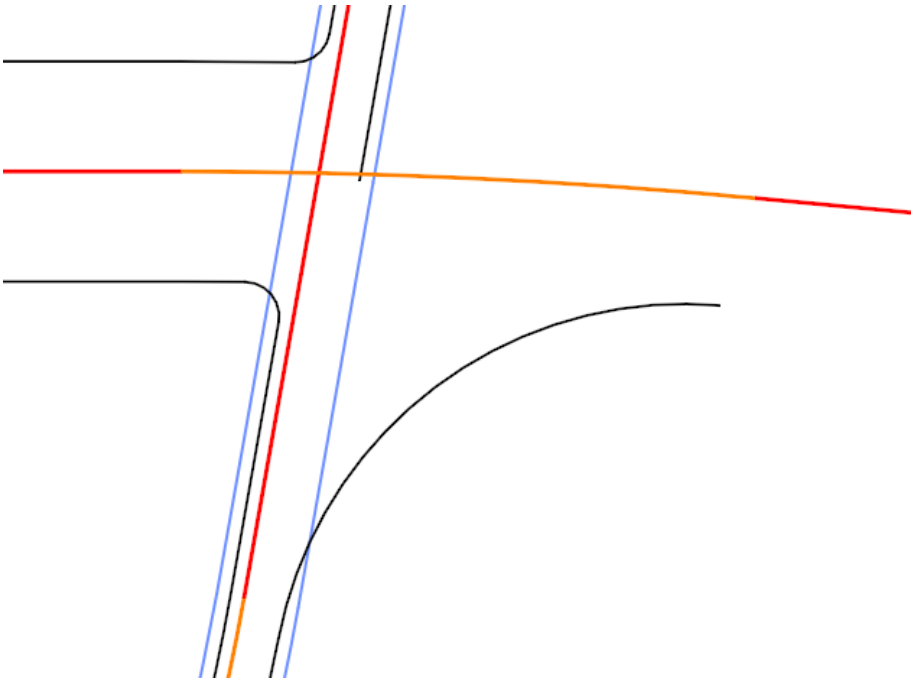
BB. Left click to accept the offset of 32.00’.



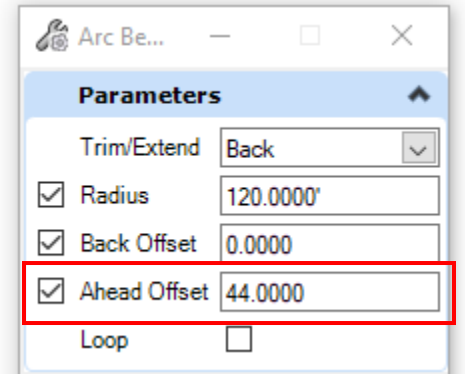
CC. Left click to accept the radius of 120.00’ and place the curve.



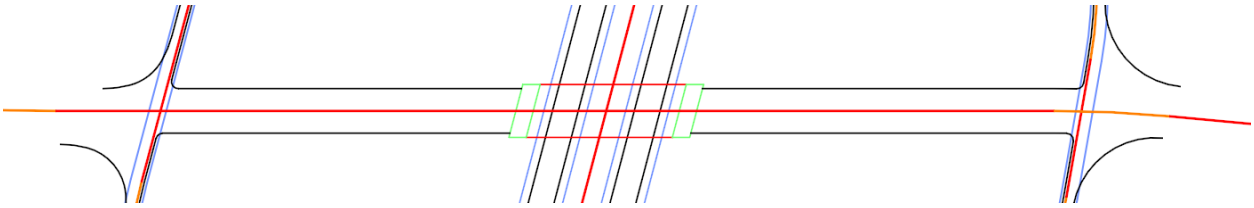
DD. Left click to accept the Trim option of Back, this will finish the curve and trim the ramp edge of pavement to match.



EE. Repeat the process with the same setting for the Ramp D terminal except for the offset, which should be changed to 44’ to allow for a right turn lane.



FF. This completes the design of the ramp terminal intersection radii.

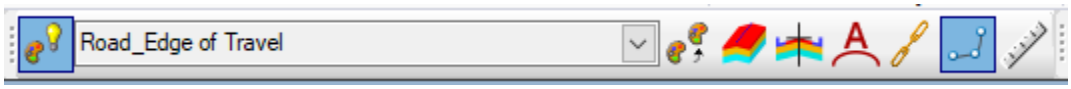


DSN Drafting – Turn Lanes and Transistions

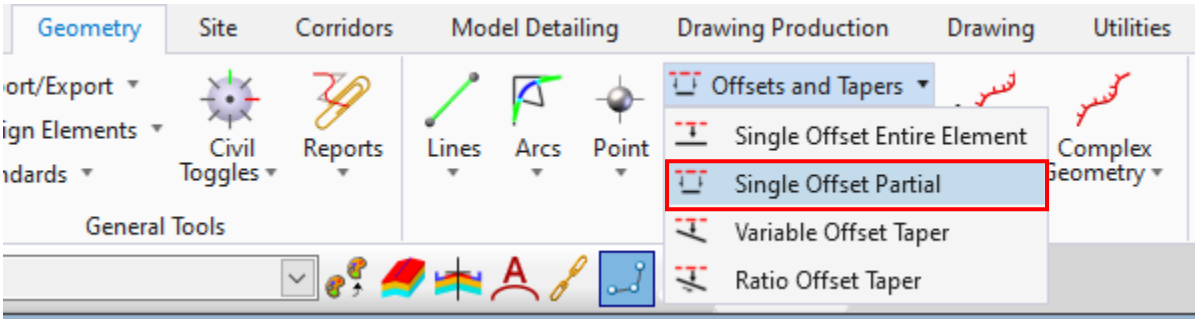
1. Y Line Over – Pavement Transitions – Beginning Section Right Side

A. In this exercise we will construct the edge of pavement tapers and transitions from the beginning of the project to the Ramp A/B terminals. Because we know the transition and storage lengths and have already set the intersection curves at the terminal, we will work from the ramp terminal back to find the beginning of the construction on Y14.

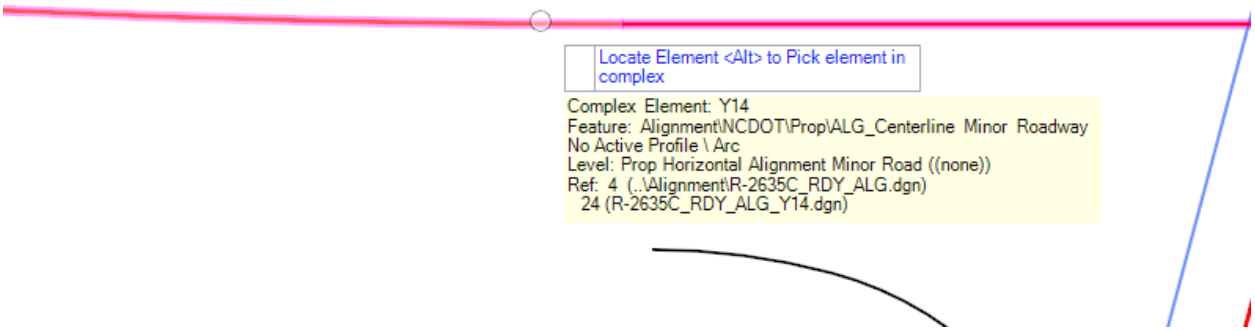
B. Starting on the right side we will construct a 250’ right turn lane onto Ramp B with a 150’ long bay taper. Set the Active Feature Definition to Road_Edge of Travel.,



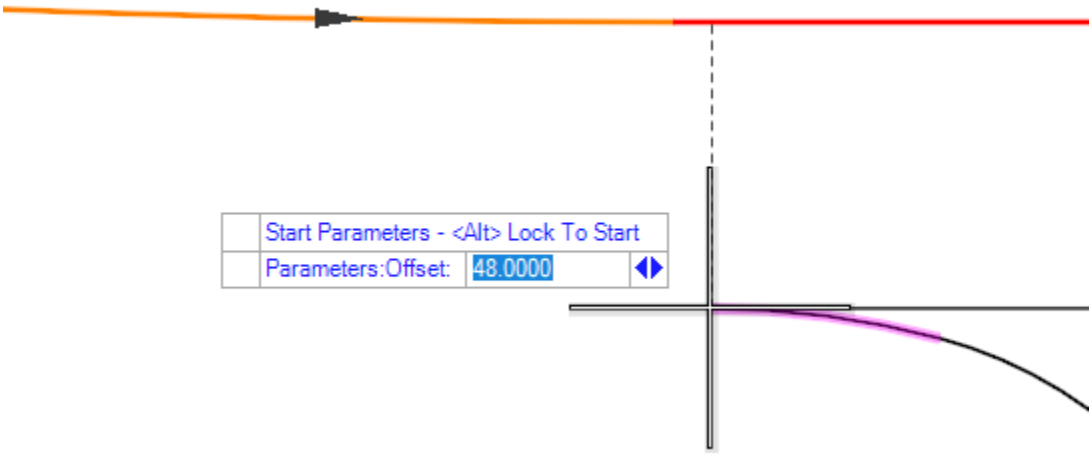
C. Start the **Single Offset Partial** tool.



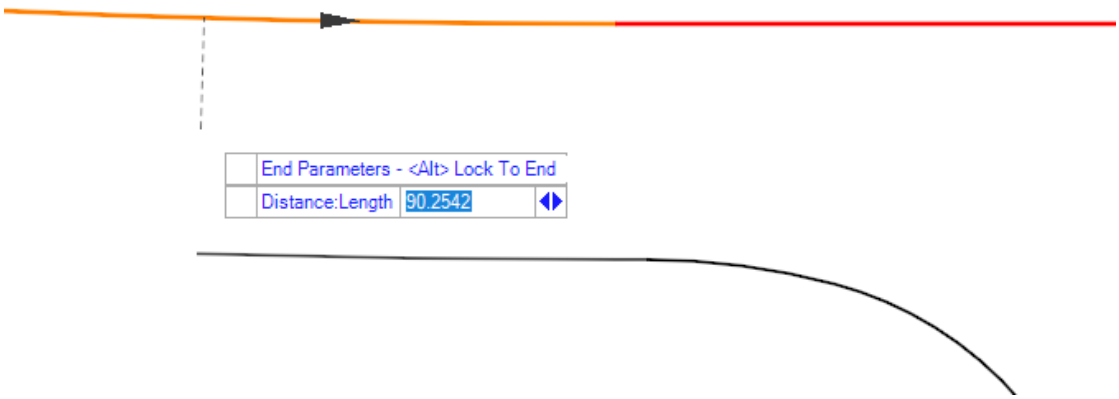
D. Uncheck all dialog boxes and left click to locate the Y14 Alignment.



E. Snap to the end of the Ramp B intersection radius to set the start point and the offset.

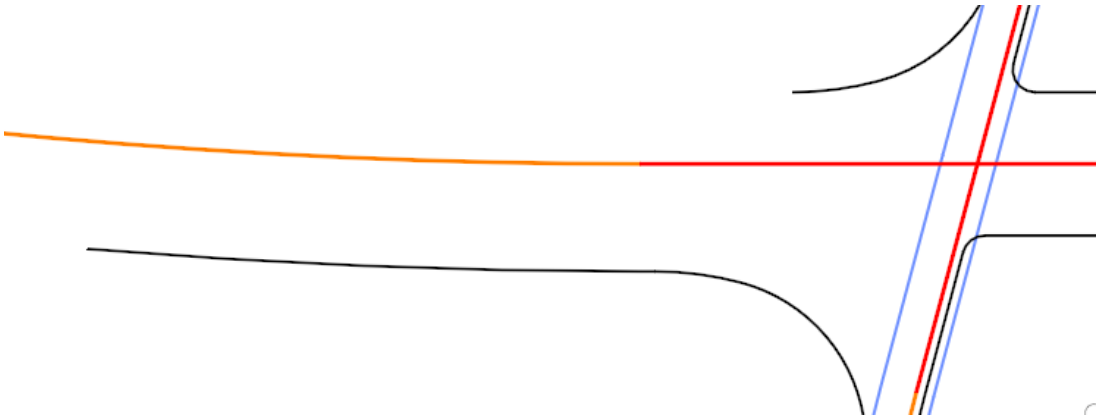


F. Use the left arrow key to toggle the heads up display to the Distance Length option.

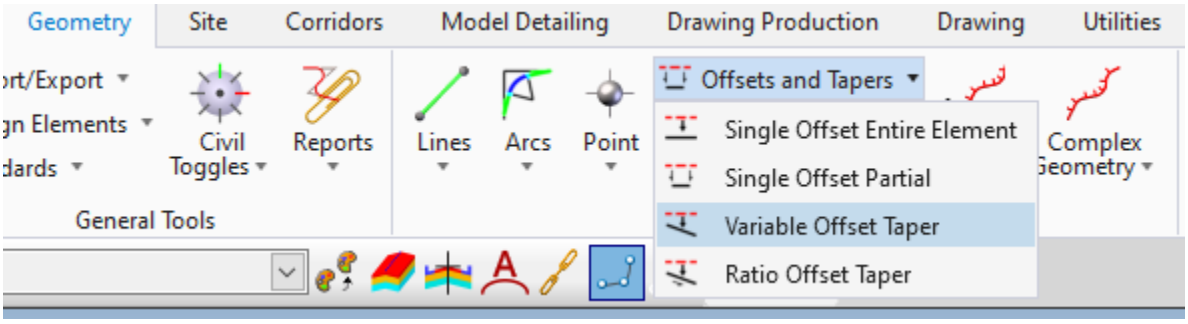


G. Type in 250.00’ and <ENTER> to lock.

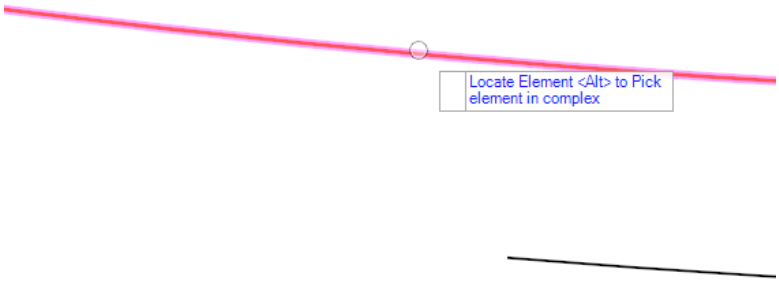
H. Left click to accept. Set the mirror option to NO and left click to finish placing the edge of travel line, representing the 250’ right turn lane.



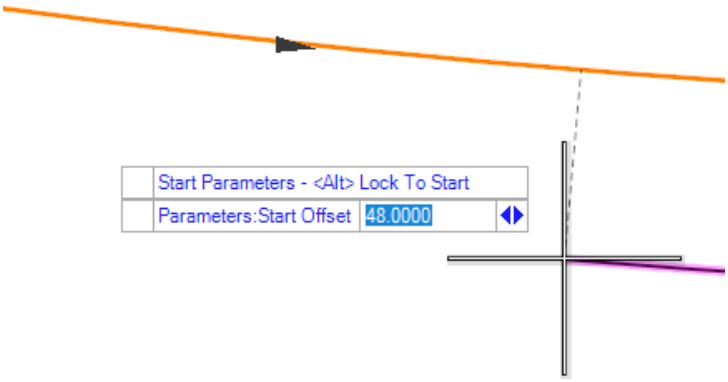
I. To create the taper, start the **Variable Offset Taper** tool.



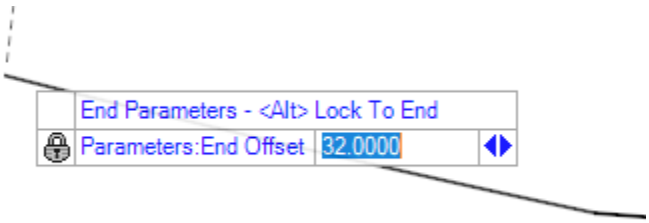
J. Uncheck all the dialog boxes and left click on the Y14 centerline to select the reference element.



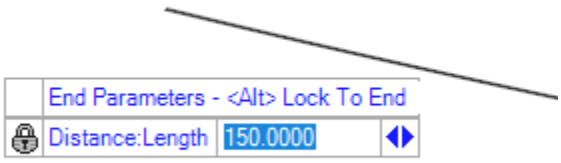
K. Left click to the end of the turn lane to set the start point and the offset.



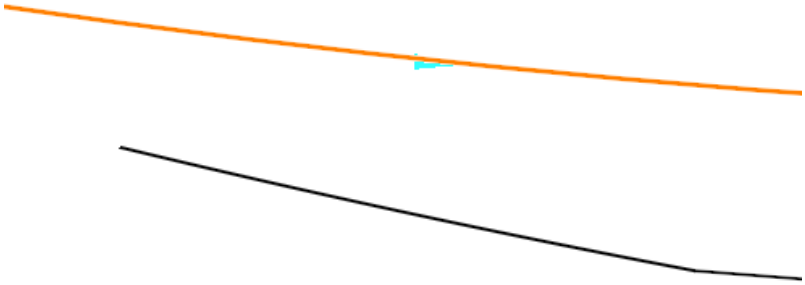
L. At the heads-up prompt type in 32.00’ for the End Offset and <ENTER> to lock. Do not left click.



M. Use the arrow keys to toggle to the Distance Length entry and type 150.00’ and <ENTER> to lock.

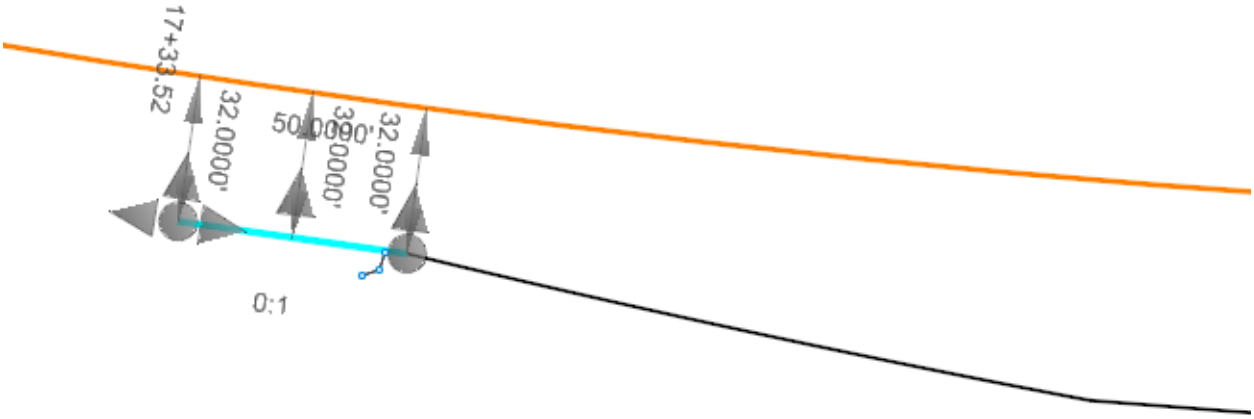


N. Move the cursor to display the correct location for the taper and left click to accept.

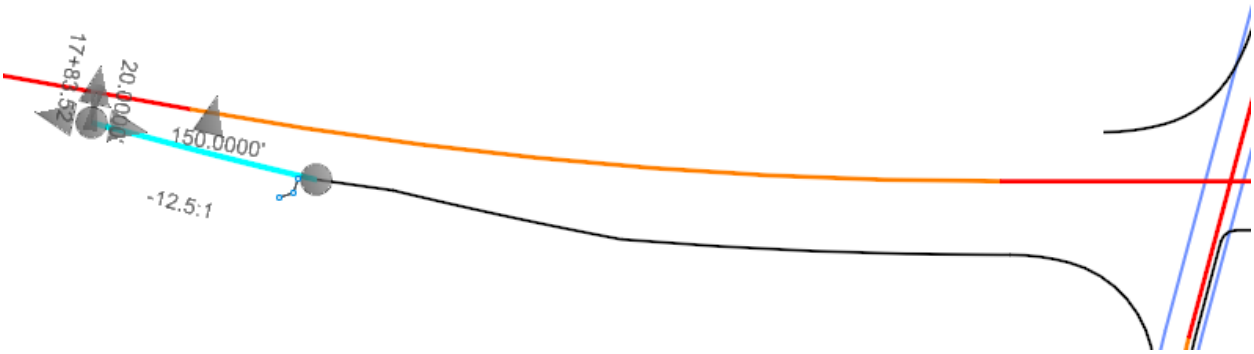


O. Set the mirror option to NO and left click to finish placing the Taper.

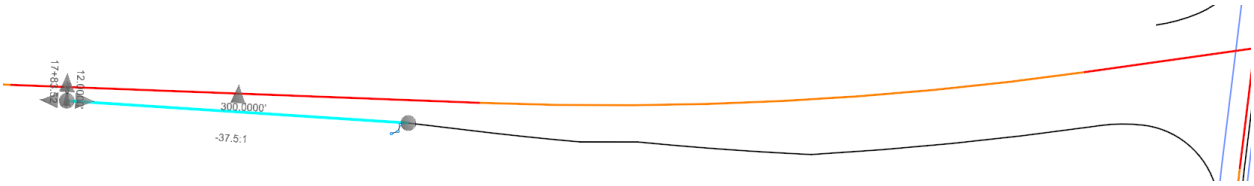
P. Now we need a section parallel to Y14 at a 32.00’ offset for 50.00’ Use the **Single Offset Partial** tool the same way as creating the turn lane.
- Snap to the taper to set the start point and offset
- Use arrow key to get to Length setting and input 50.00’
- Left click to accept
- Set mirror to NO and left click to finish.



Q. Using the same steps to create the Turn Lane taper create a 150’ taper to change the pavement width from 32.00’ to 20.00’. Start the **Variable Offset Taper** tool.
- Left click to select Y14 centerline as the reference element.
- Snap to the end of the previously placed line to set the start point and offset and left click to accept
- Enter 20.00’ for the offset and <ENTER> to lock, do not left click
- Use the arrow key to toggle to the length input and type 150.00’ and <ENTER> to lock
- Position the cursor to provide the correct solution and left click to accept.
- Set mirror option to NO and left click to finish placing the taper.



R. Using the same steps from above create a 300’ taper to change the pavement width from 20’ to 12’.

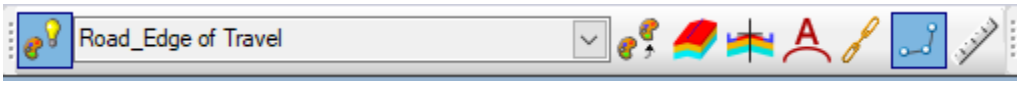


S. This is the end of the right side tapers and transitions. We will create the end of pavement taper on the left and right side at the same time at the end of the exercise.

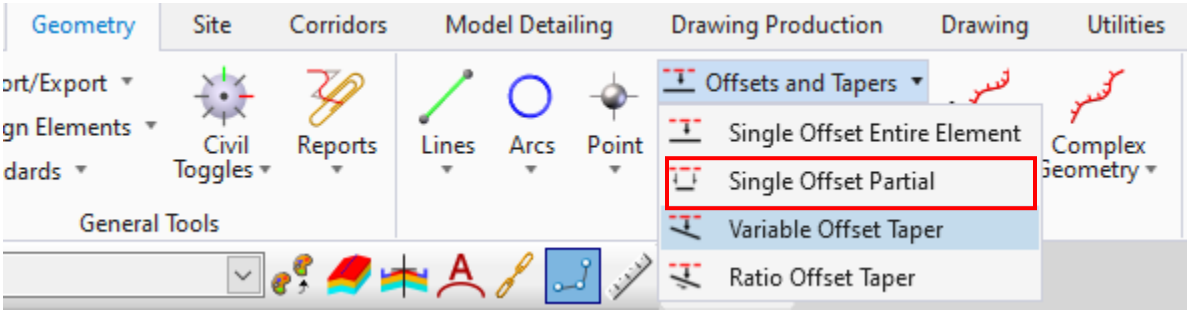
2. Y Line Over – Pavement Transitions -Beginning Section Left Side

A. For the left side tapers, we will match the 300’ median taper at the beginning, then we will add a 300’ lane drop taper and then tie the proposed edge of travel to the intersection radius that has been established at Ramp A. This will be a similar process to laying out the right side edge of travel but instead of starting at the Ramp terminal we will begin where the right side edge of travel begin and work towards the ramp terminal.

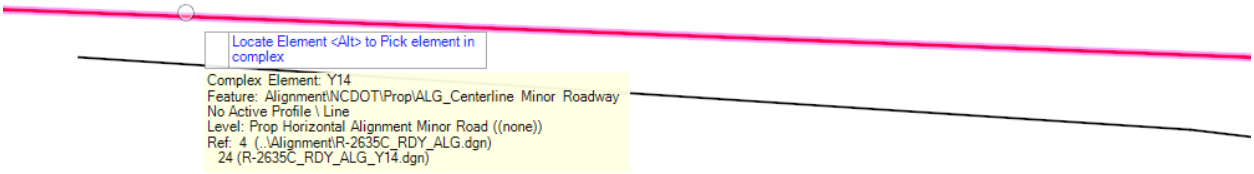
B. Make sure the Active Feature Definition is set to Road_Edge of Travel



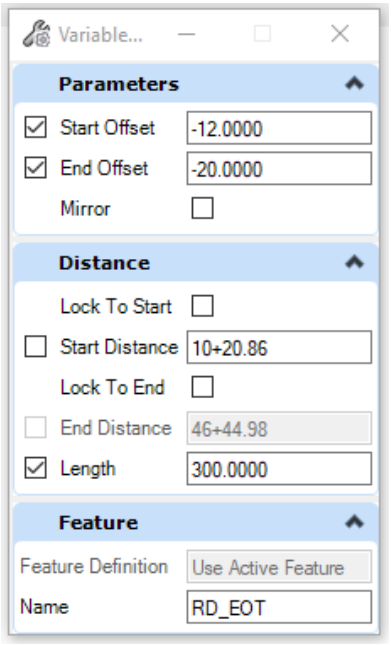
C. The first task is to create a 300’ median taper that start where the right side taper starts, for this use the **Variable Offset Taper** tool.



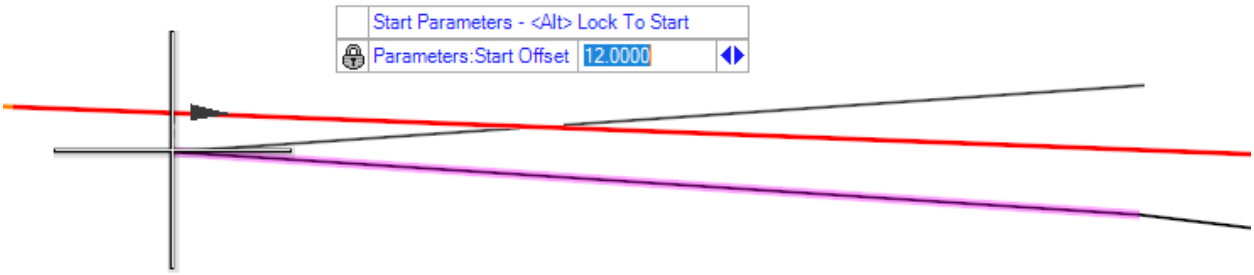
D. Left click to locate the Y14 centerline.



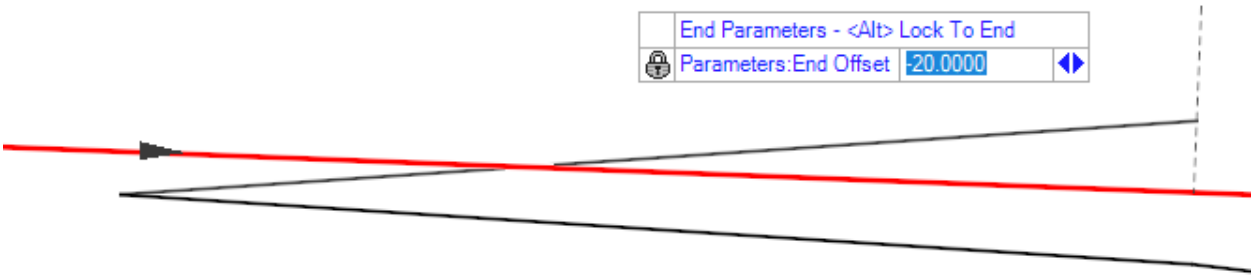
E. In the dialog box set the
   - Start offset = -12.00’
   - End Offset = -20.00’
   - Length = 300.00’



F. To set the beginning point snap to the beginning of the median taper on the right side, note that this will change the offset to a +12.00’, we will revise this after placing the element.

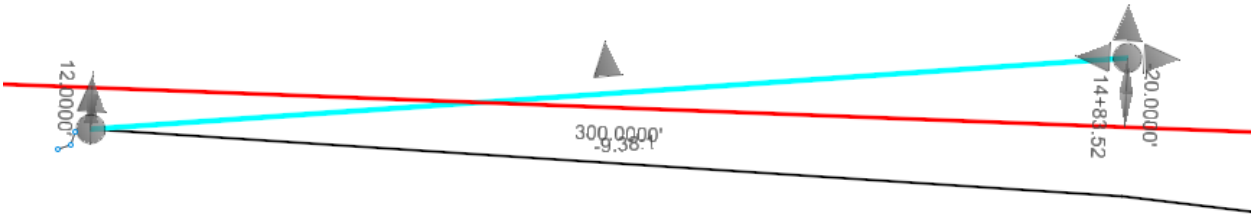


G. Left click to accept the end offset = -20.00’

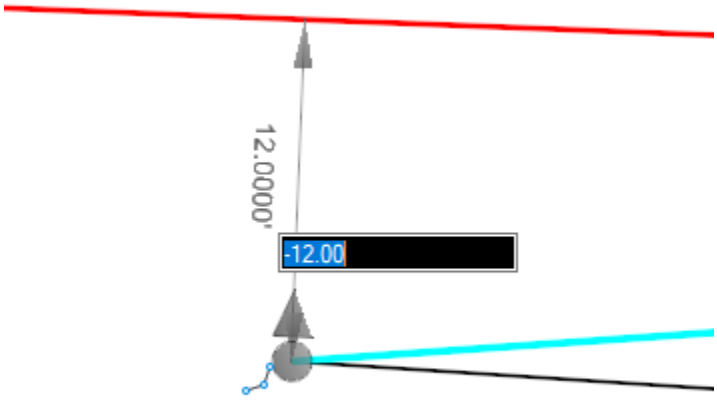


H. Left click to accept the mirror option NO.

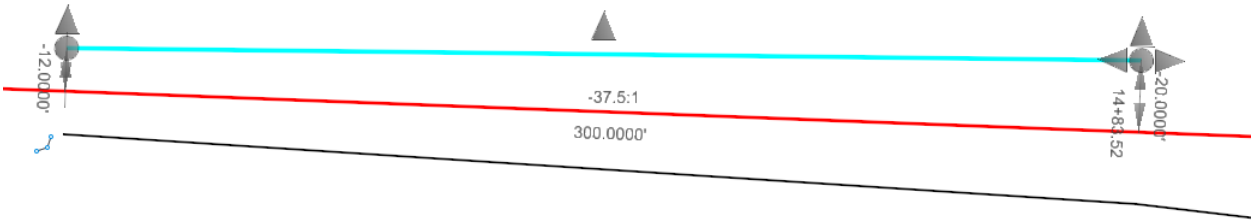
I. To fix the beginning offset use the **Element Selection** tool to highlight the taper and activate the text manipulators.



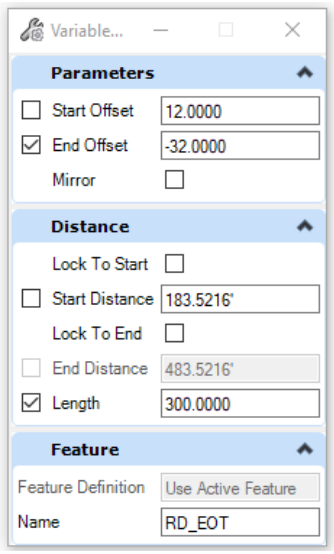
J. Highlight the 12.00’ text at the beginning of the taper and change the sign to a negative (-)



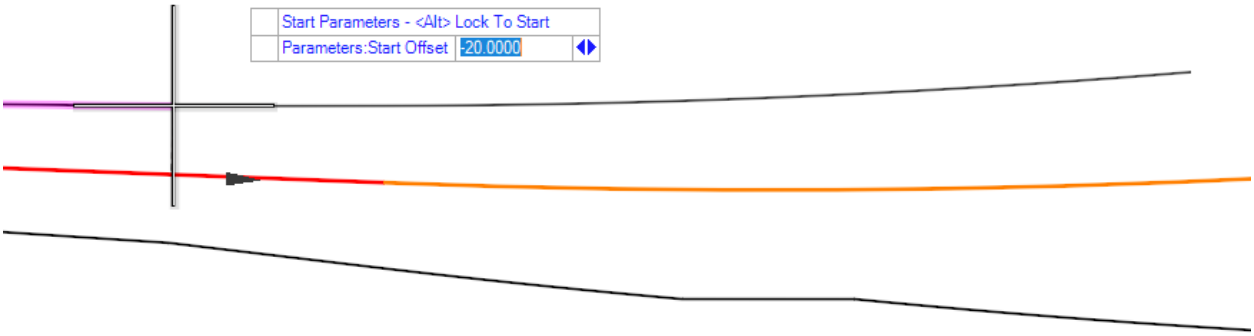
K. This will correct the offset and create a taper that matches the taper on the right side.



L. The next step is to create a 300’ Lane drop taper. Use the **Variable Offset Taper** tool again to create the lane drop. In the dialog box
- Start Offset = Unchecked
- End offset = -32.00’
- Length = 300.00’



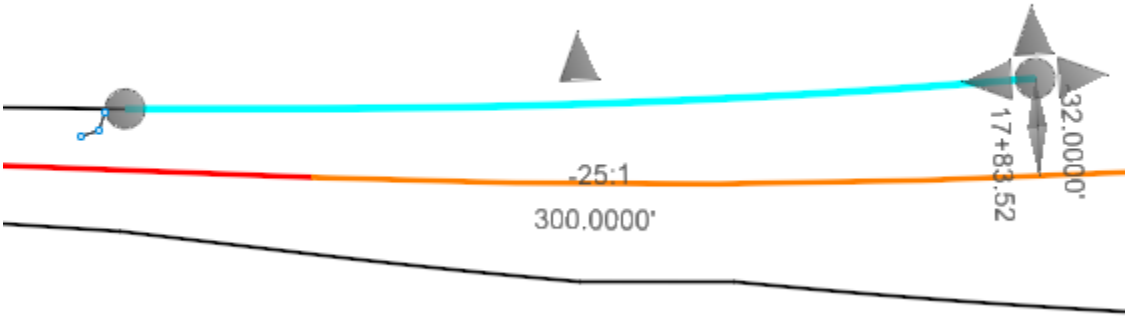
M. Select the Y14 centerline to start the tool. Snap to the end of the median taper, this will set the start station and offset for the lane drop taper.



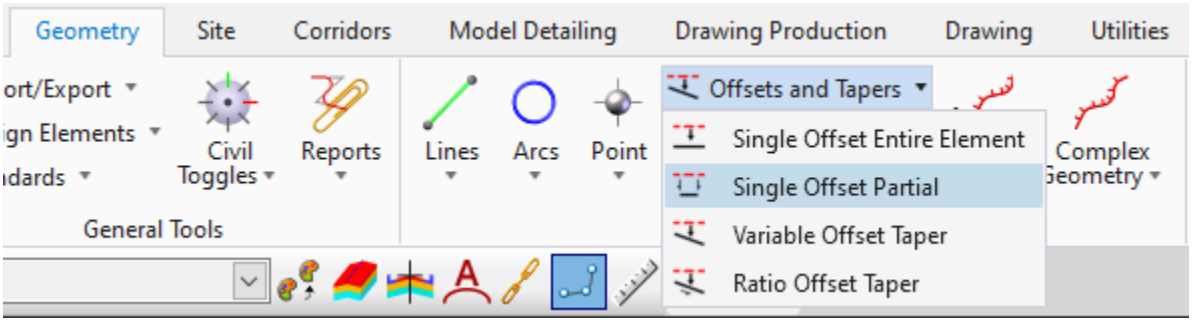
N. Left click to accept the end taper offset of -32.00’ and the length of 300.00’

O. Left click to accept the mirror option of NO.

P. This will complete the lane drop taper. Note the offset is not show at the beginning because the taper is ruled to the end of the median taper with a snap constraint.

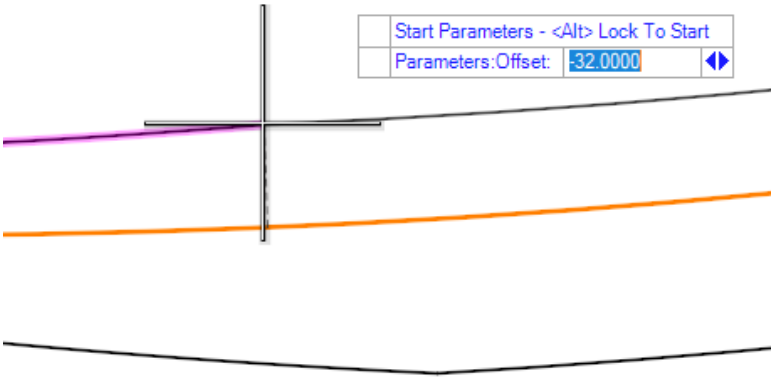


Q. The last step is to connect the edge of pavement taper line to the intersection radius at Ramp A. Using the **Single Offset Partial** tool, we will construct an element at a 32.00’ offset.

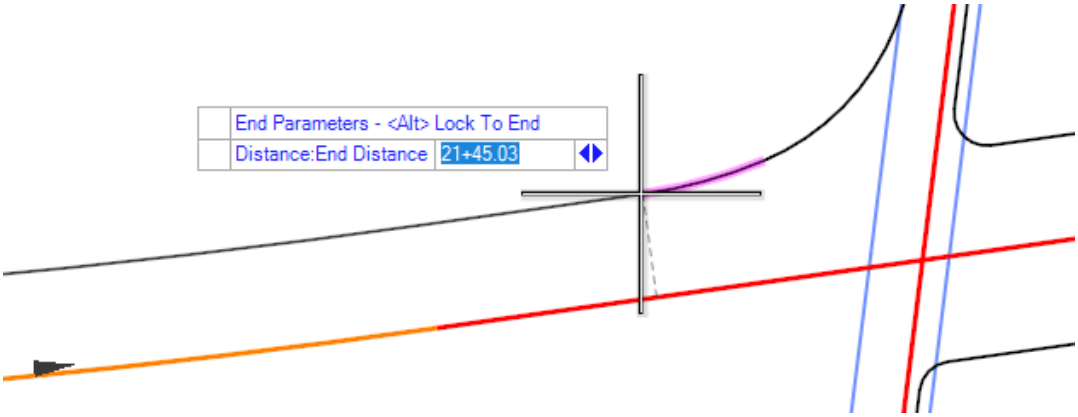


R. All boxes should be unchecked in the dialog box. Left click on the Y14 centerline to start the tool.

S. Snap to the end of the lane drop taper to set the start station and offset.

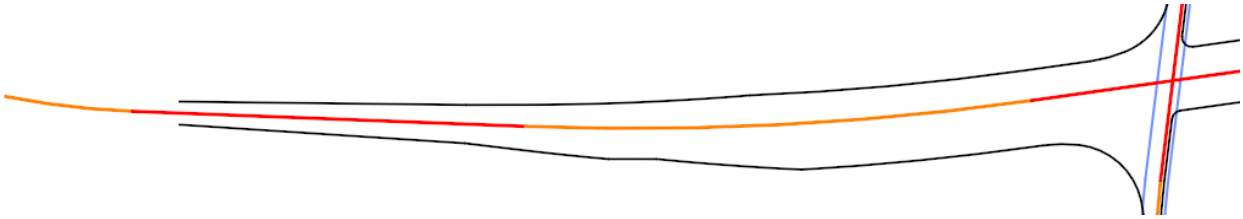


T. Snap to the intersection curve to set the end station.



U. Left click to accept the Mirror Option of No.

V. This completes the left side edge of pavement lane tapers.



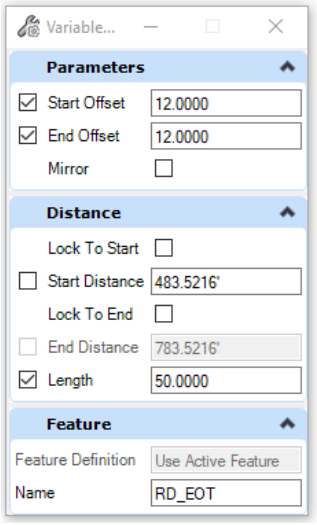
3. Y Line Over – Transition Existing Pavement to Proposed – Beginning Section

A. The final step is to transition from the proposed lane width of 12.00’ to the existing lane width on each side at the beginning of the Y14 pavement widening. The Taper will be 50’ in length.

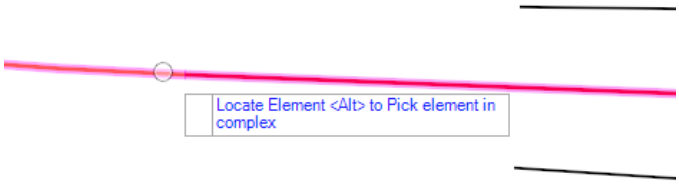
B. To construct the taper, we will use the **Variable Offset Taper** tool to initially create a 50’ long element at a constant offset of 12’ on each side, then using the drag handles we will reset the beginning of the element to tie to the existing edge of pavement.

C. Start the **Variable Offset Taper** tool and set the dialog box for

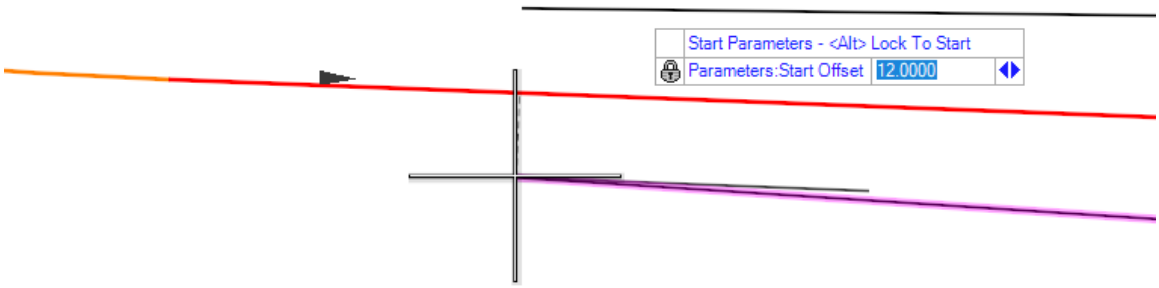
- Start offset = 12.00’
- End Offset = 12.00’
- Length = 50.00’



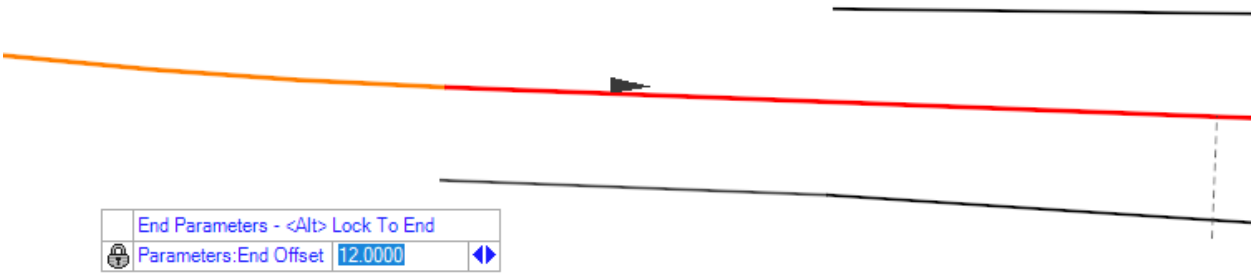
D. Left click on the Y14 centerline to start the tool.



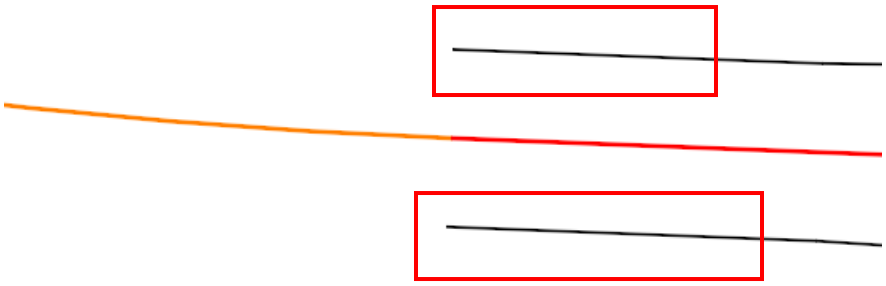
E. Snap to the beginning of the 300’ median taper line constructed earlier to set the start point.



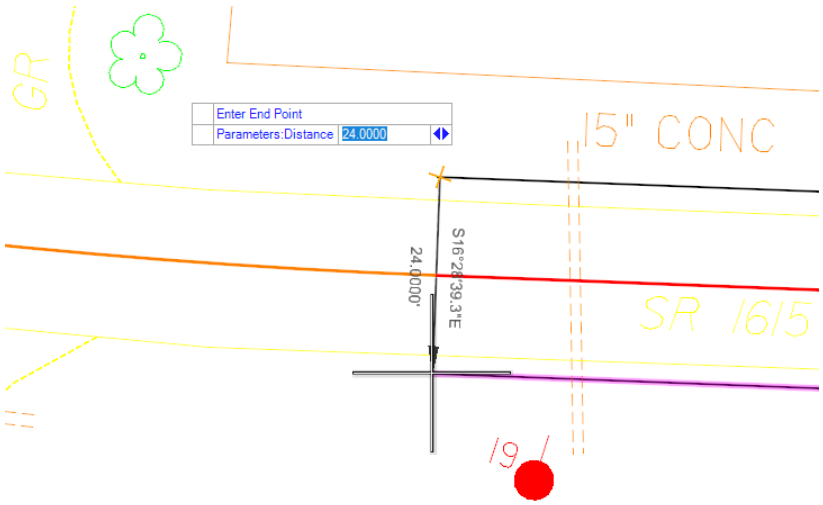
F. Move the cursor so the element moves towards the beginning of the alignment and left click to accept the offset of 12.00’



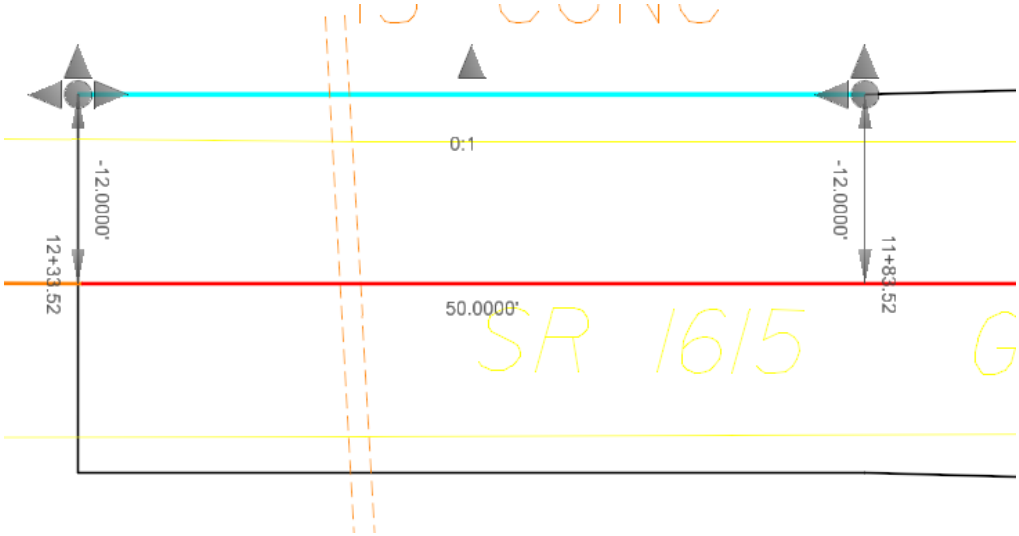
G. Use the <DOWN> arrow key to toggle the Mirror Option to YES and left click to accept. This will create a 50’ element at a 12.00’ offset on each side of the centerline.



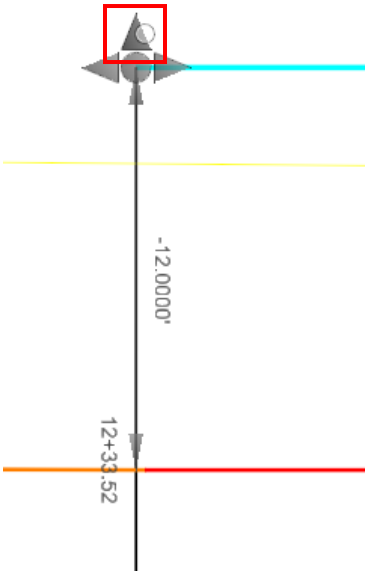
H. Turn on the FS reference file to display the existing edge of pavement. Using the **Line Between Points** tool draw a line from the end point of one element to the end point of the other. This is the begin pavement line.



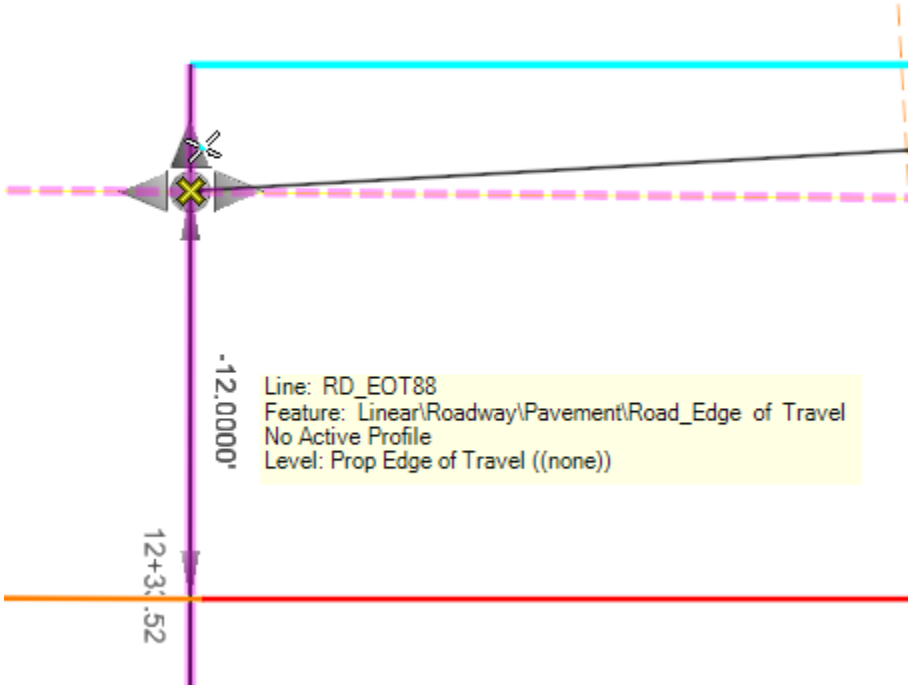
I. Use the **Element Selection** tool to highlight the left edge of pavement line.



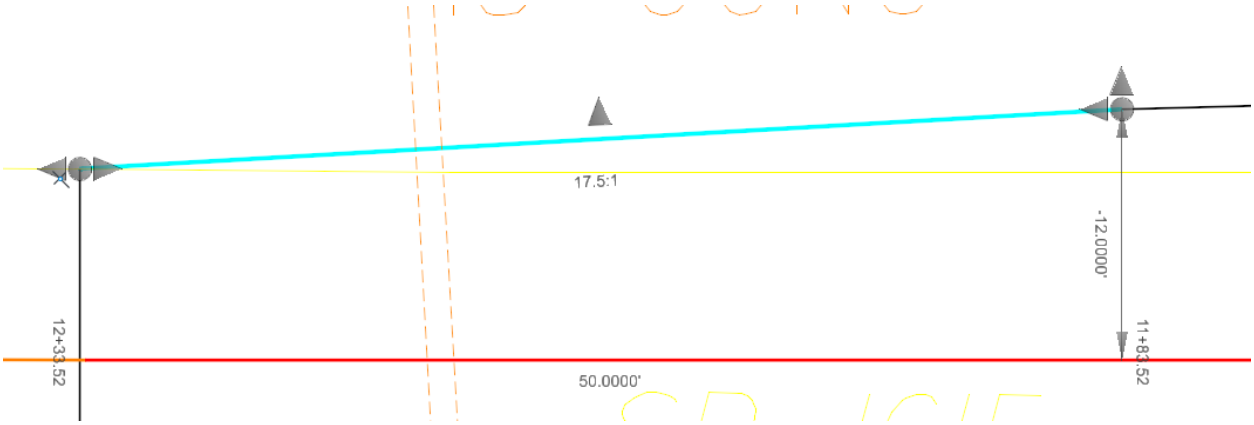
J. Select the drag handle arrow that is perpendicular to the centerline.



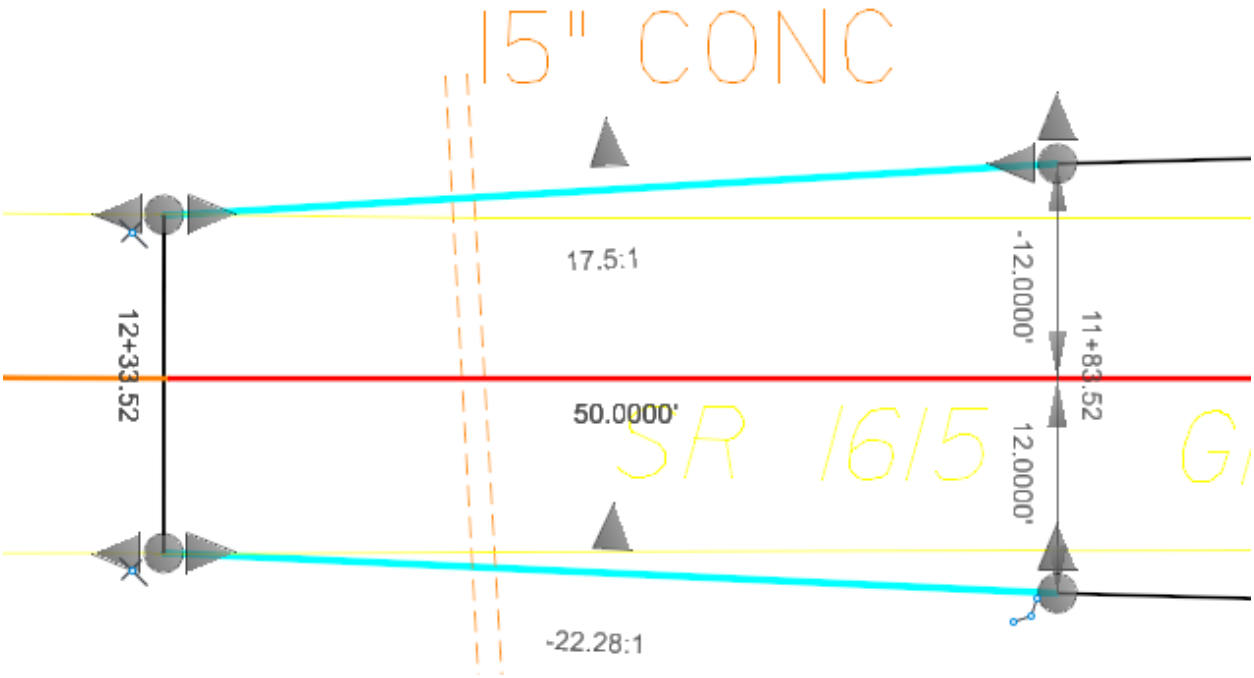
K. Drag the end point of the line and snap the intersection of the begin pavement line and the existing edge of pavement line.



L. This will set the edge of pavement taper for the left side.



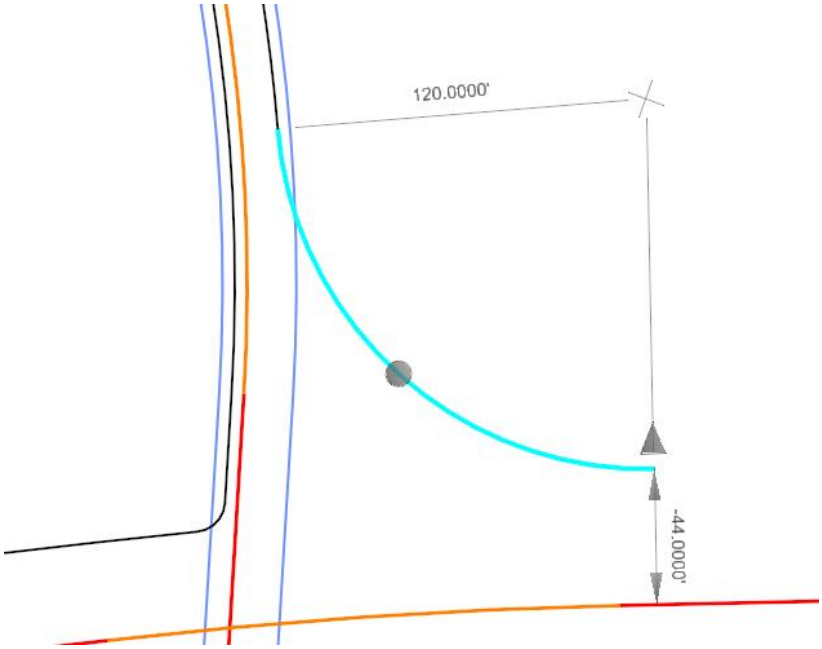
M. Repeat this process for the right side. This will complete the beginning taper from the existing pavement width to the proposed pavement width.



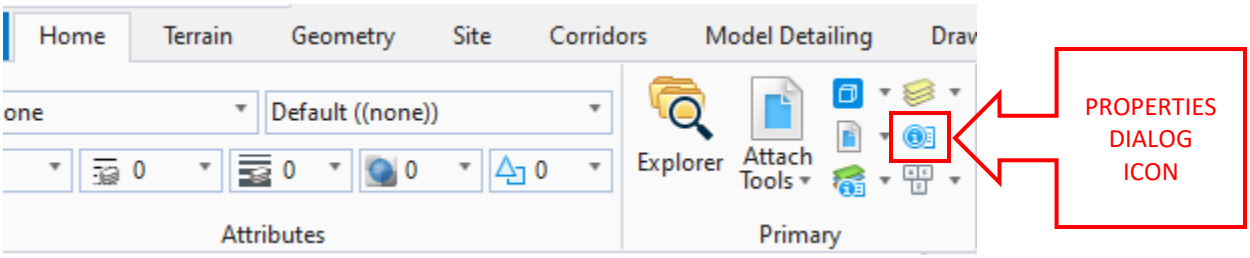
4. Y Line Over – Pavement Transitions – Ending Section - Left Side

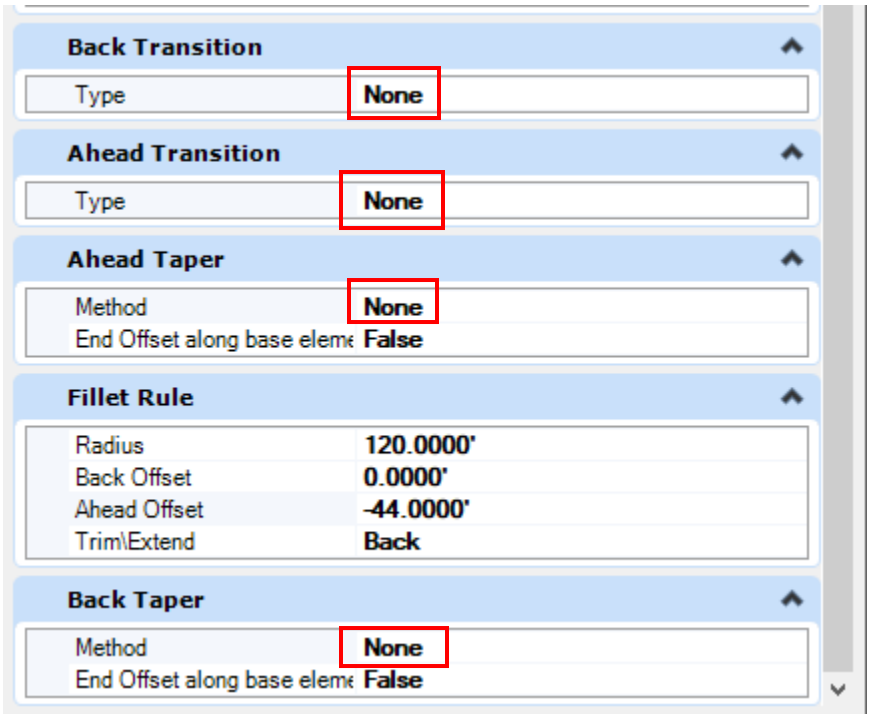
A. Using a similar method as described above we will complete the end section pavement transitions. This section will provide the design data and tool to use to complete each element, for detailed instructions and step by step guidance see the above sections.

B. Beginning with the left create a right turn taper, this will be taper from the typical section width of 32.00’ to 44.00’ that ties to the intersection curve radius at Ramp D. There will not be any right turn storage length. There are several ways to accomplish this, but one way is to edit the previously placed intersection curve to include the taper. Use the **Element Selection** tool to highlight the curve.



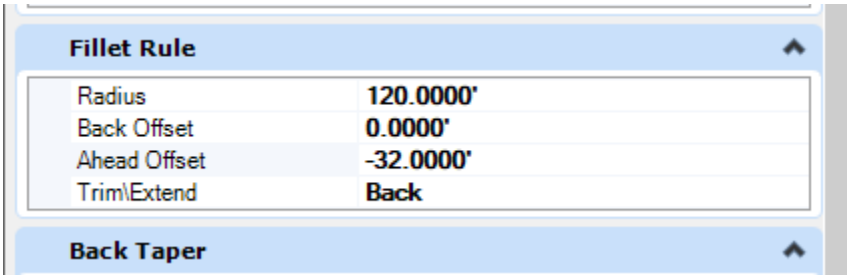
C. Locate the properties dialog and scroll to the bottom to find the curve design data. If the properties dialog is not open activate it by selection the icon from the Primary section of the *Home* ribbon

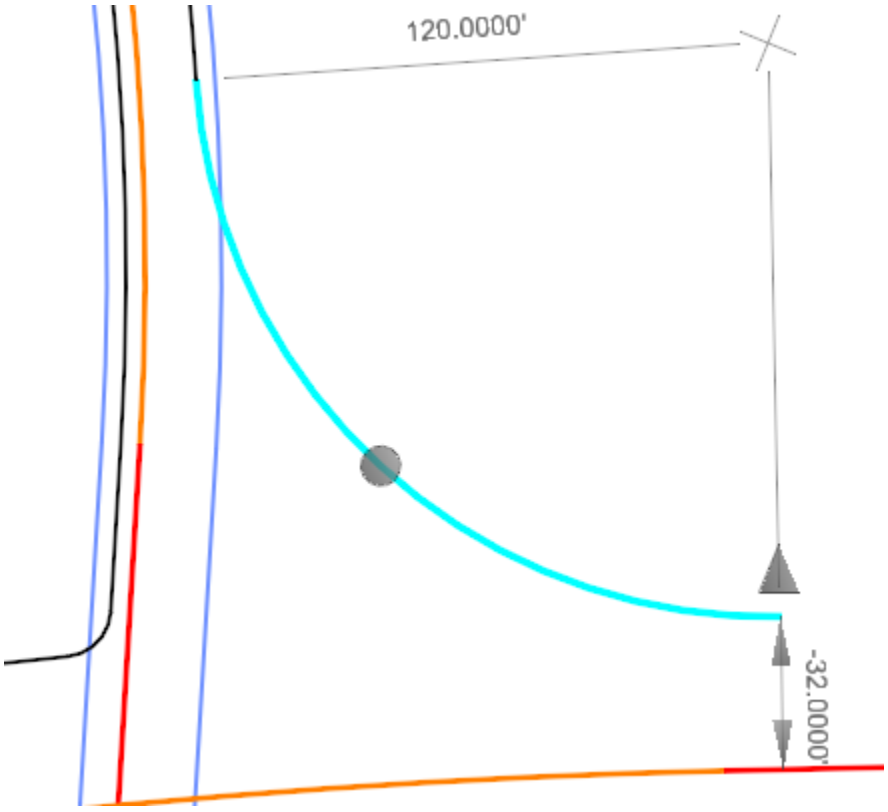




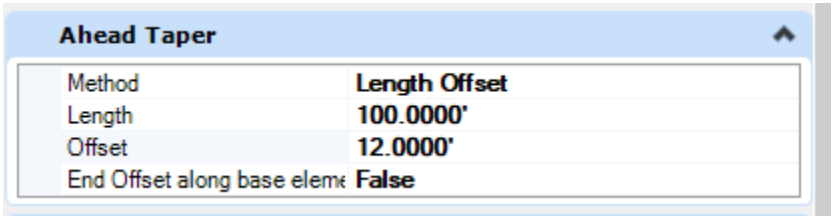
D. Note that this is a simple curve, and the Transition and Taper options are all set to None. We will use the properties dialog to revise the curve to include the 100’ taper.

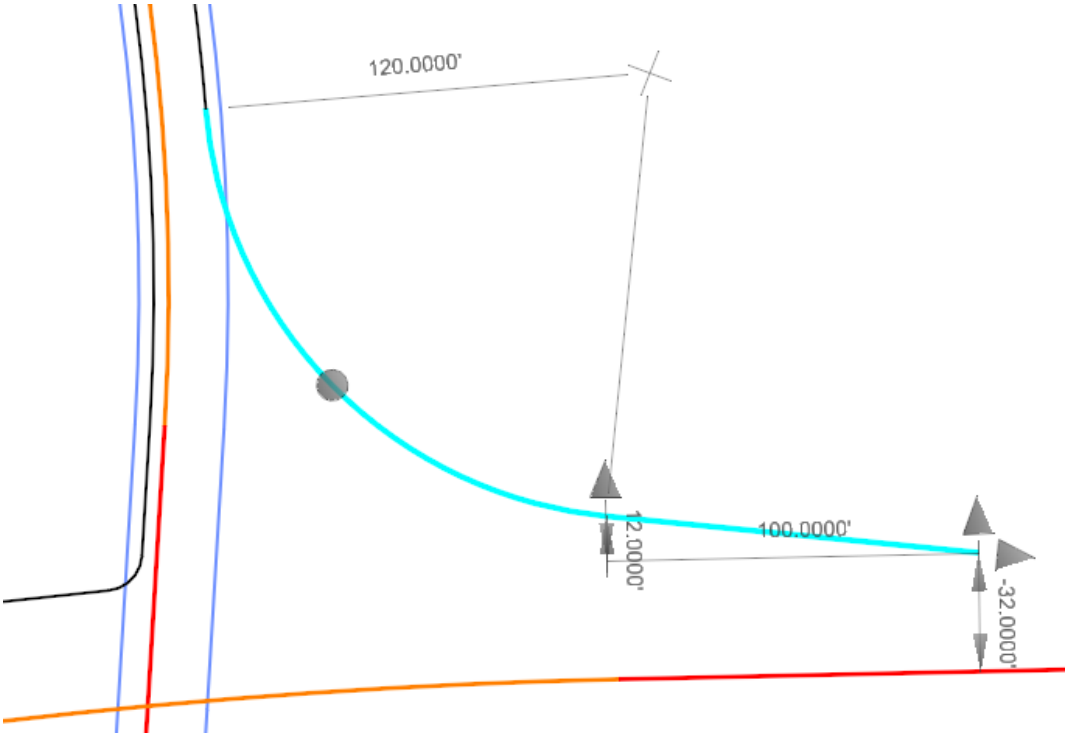
E. First change the ahead offset to 32.00’. Remember this is the offset for the entire curve including tapers and transitions.





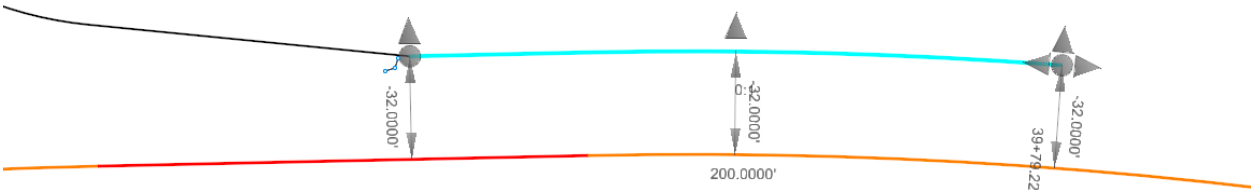
F. Next set the Ahead Taper to
- Method = Length Offset
  1. We want to construct a 100’ taper that will be offset 12’
- Length = 100’
  1. Overall Length of the linear taper
- Offset = 12.00’
  1. This is the offset in addition to the curve offset of 32.00’. This offset will create the 12’ right lane taper width at the tangent point of the curve.



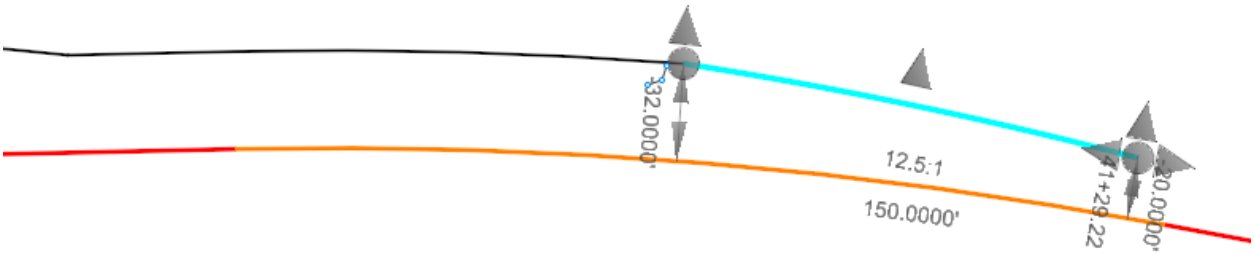


G. Now we have a right lane taper that ends tangent to the simple curve at a 12’ offset.

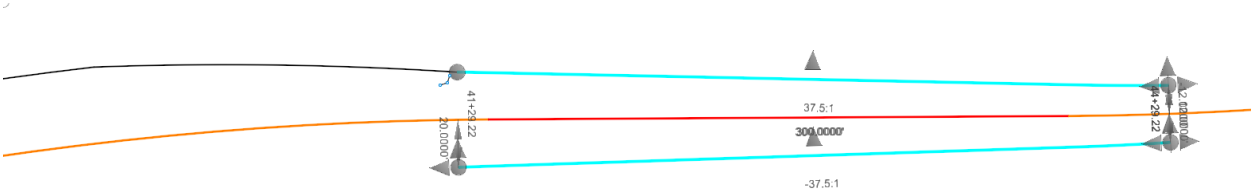
H. The next step is to create a 200.00’ long with an offset of 32.00’ using the **Single Offset Partial** tool starting from the end of the intersection curve/taper element.



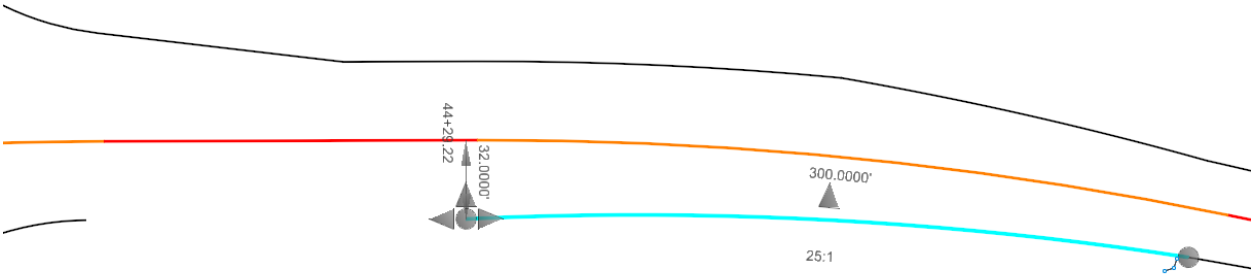
I. Next use the **Variable Offset Taper** tool to create a 150’ lane taper from on offset of 32.00’ to an offset of 20.00’.



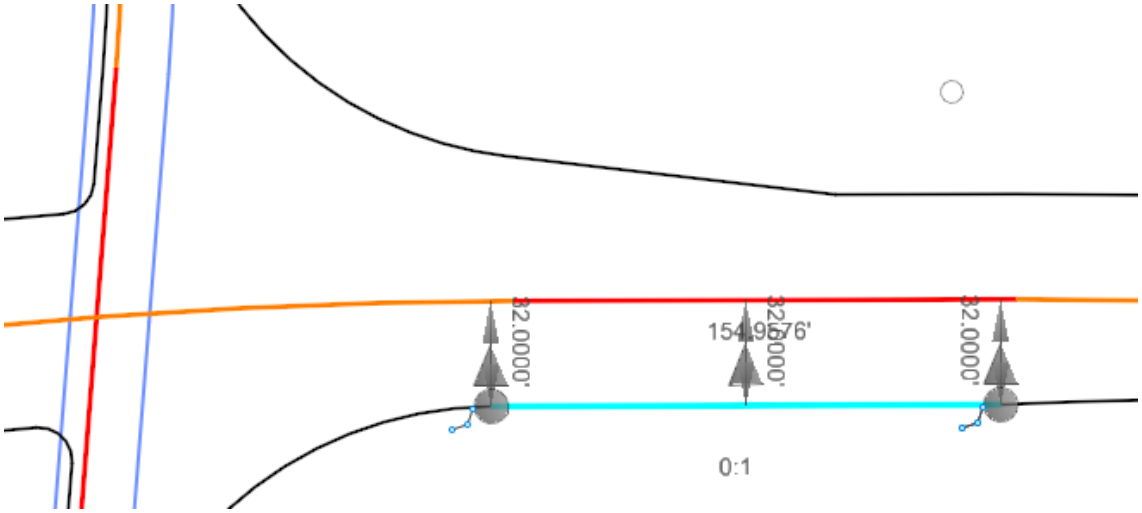
J. Use the **Variable Offset Taper** tool again to create a 300.00’ median taper from an offset of 20.00’ to an offset of 12.00’. We know we want this taper to match on the left and right side so set the mirror option to YES and create the right side automatically.



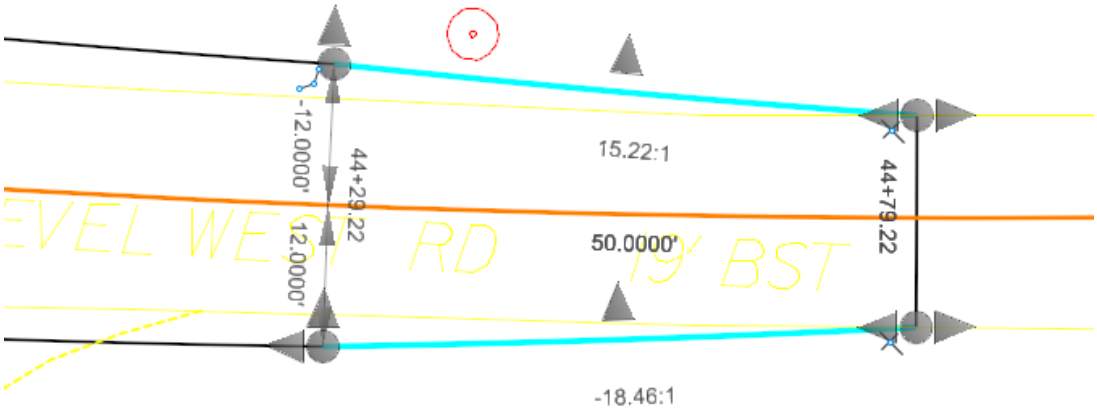
K. For the remaining right side edge of pavement starts at the beginning of the 300.00’ median taper on the right and using the **Variable Offset Taper** tool draw a 300.00’ lane drop taper that extends back towards the ramp from a beginning offset of 20.00’ and an ending offset of 32.00’.



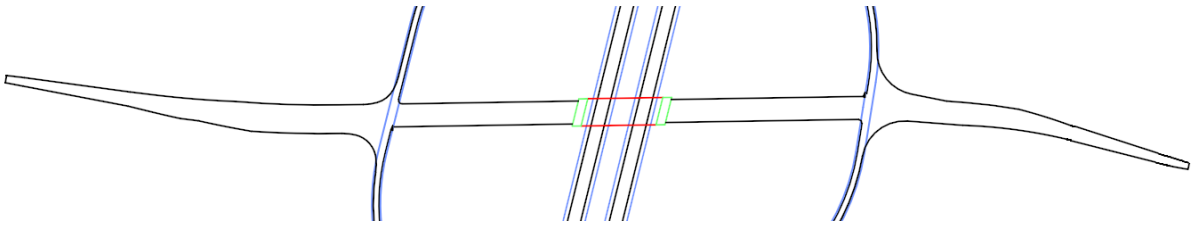
L. Using the **Single Offset Partial** tool now connect the lane drop taper to the intersection radius at Ramp C.



M. The last step is to create the 50’ edge of pavement taper from the proposed 12’ pavement width at the end of the median taper back to the existing pavement width. Follow the same steps shown above to create this taper.



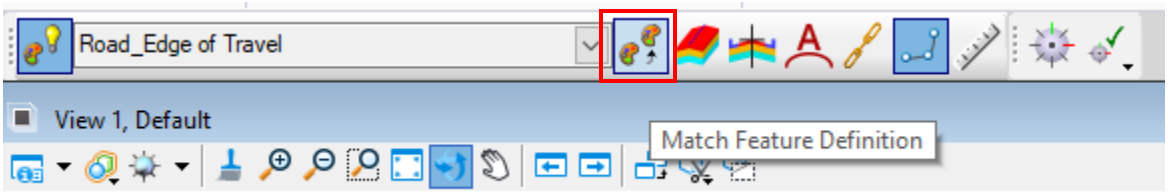
N. This completes the proposed edge of pavement lines.



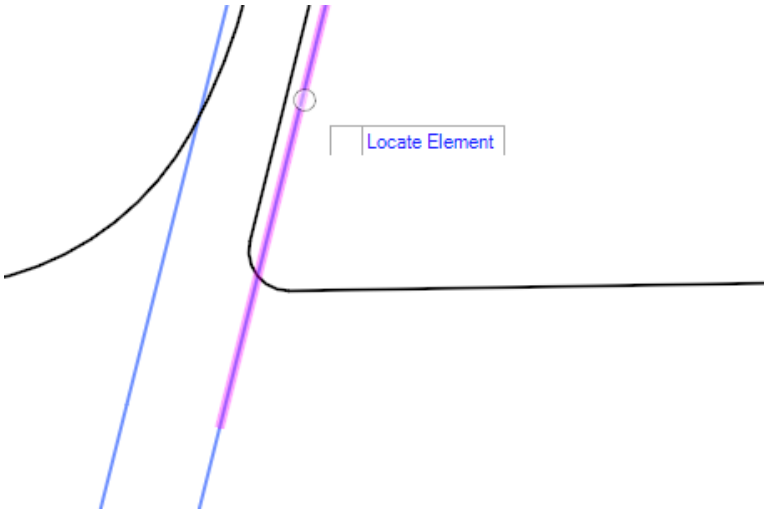
5. Y Line Over - Paved Shoulder Lines

A. Using the **Single Offset Entire Element** tool offset the proposed edge of pavement lines to create a 6’ wide paved shoulder.

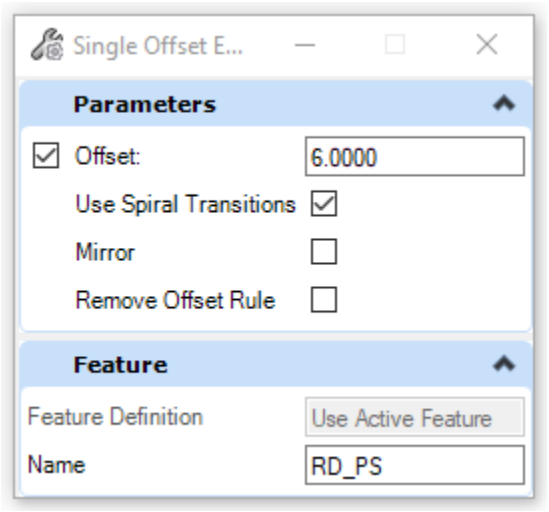
B. To set the Active Feature Definition to Road_Paved Shoulder select the Match Feature Definition icon on the feature definition toolbar.

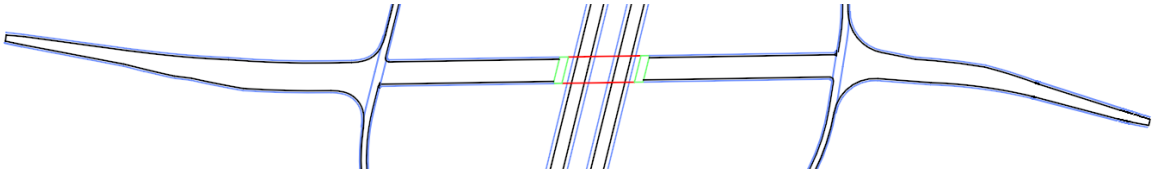


C. Left click on a previously placed paved shoulder line to match the feature definition.

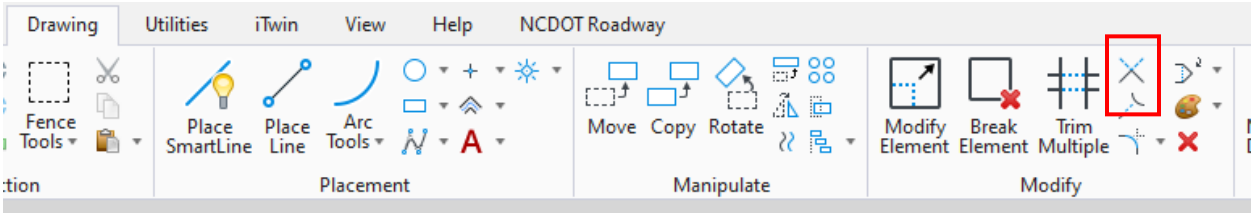


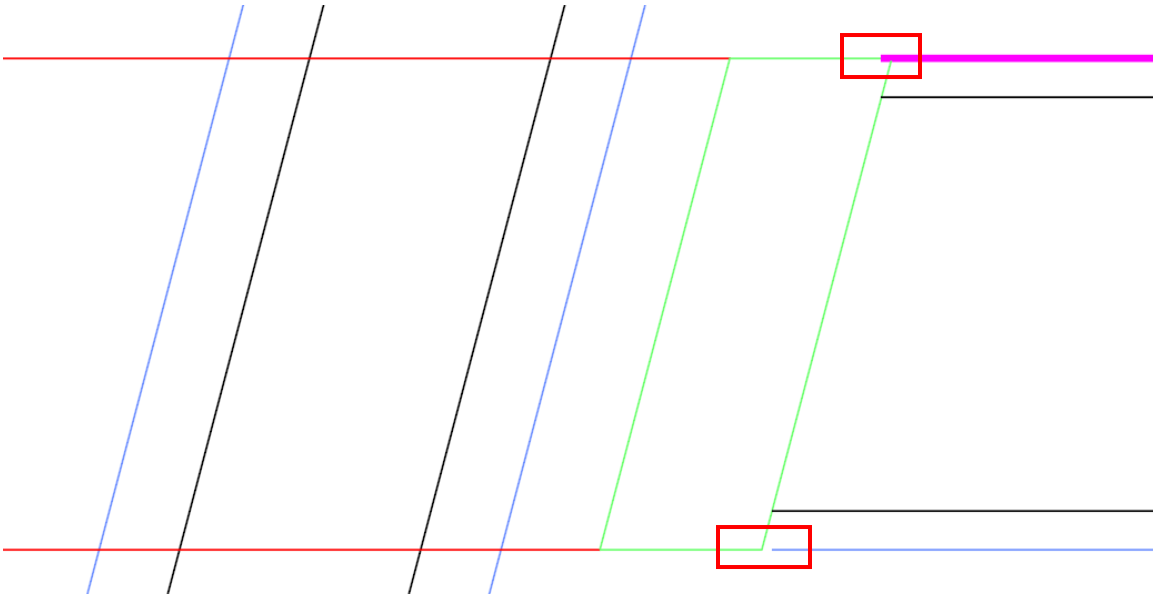
D. Use the **Single Offset Entire Element** tool to create a 6’ paved shoulder line along Y14

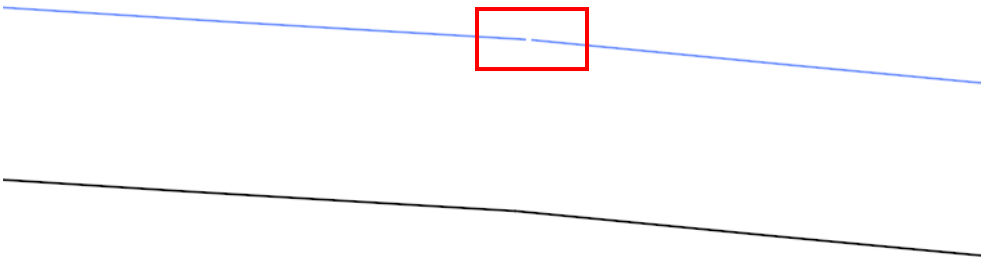




E. Switch to the *Drawing* ribbon and use the **Trim to Element** or **Trim to Intersection** tool to trim or extend the paved shoulder line to meet in areas of tapers and the bridge approach slab. Do not adjust the shoulder are the intersection curves of the ramp terminals with this method.

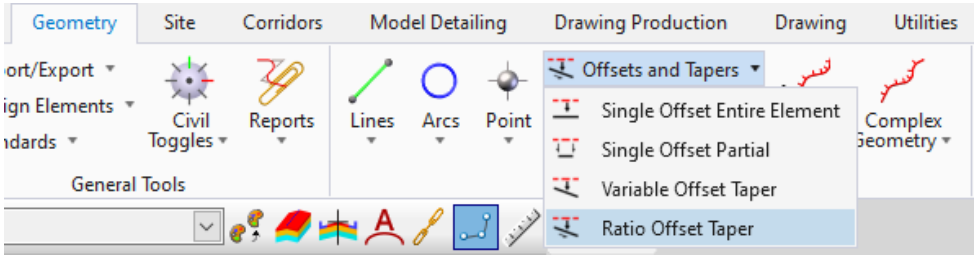






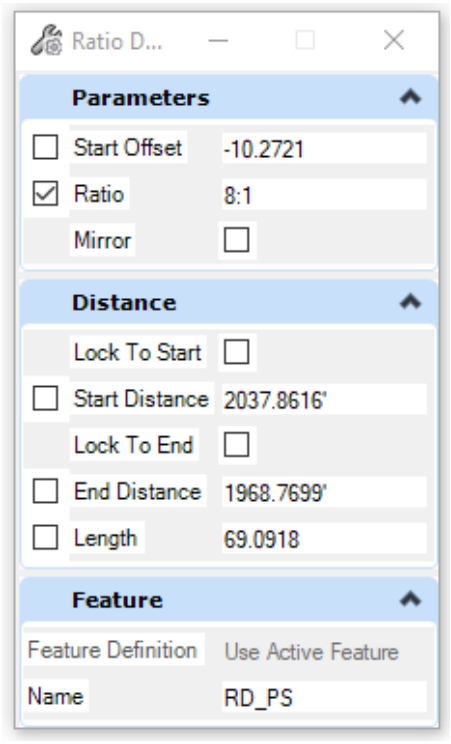
F. To tie the paved shoulder lines together tat the ramp terminals we will use an 8:1 taper.

G. Start the **Ratio Offset Taper** tool, this works very similar to the **Variable Offset Taper** tool but instead of specifying a Begin and End offset this tool uses a Begin Offset and a Ratio to the reference element. The reference element can be anything it does not have to be a centerline.

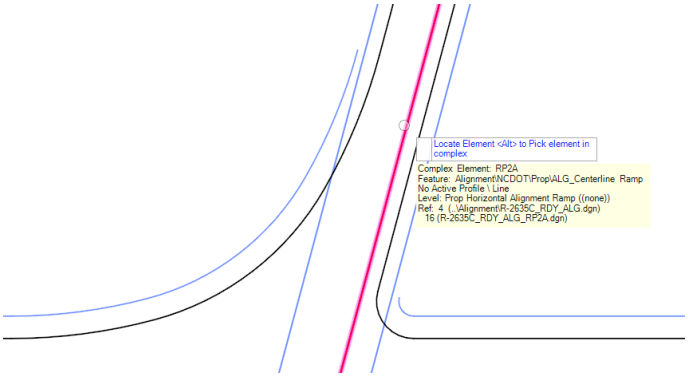


H. Set the dialog for a ratio of 8:1

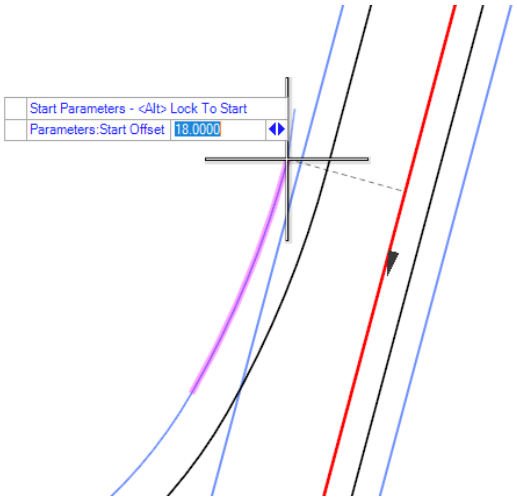
- The sign on the ratio is dependent on the direction of the reference element and the start point of the taper. If the taper is not placed with the correct direction change the symbol in front of the taper to a negative → -8:1



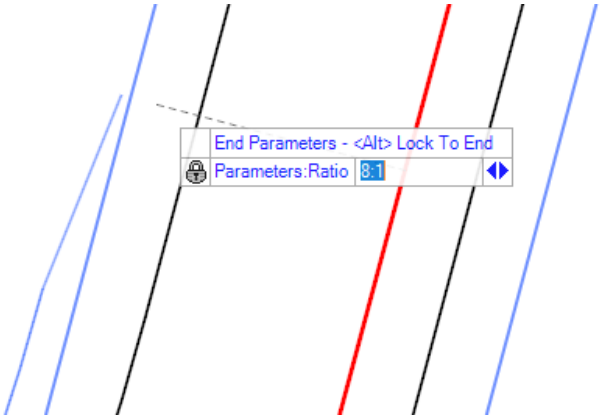
I. Left click to locate the reference element. In this case we want to use the Ramp Centerline. By using the Ramp Centerline, we will be able to use the **Trim to Intersection** tool later to trim the paved shoulder lines. If we used the paved shoulder line as the reference element, we would not be able to use the **Trim to Intersection** tool because this would create a circular reference. Because the taper would be based on the shoulder line, we could not intersect those two elements because one is dependent on the other. This concept is very prevalent when modeling but also comes into play with the new rule based geometry.



J. Snap to the end of the intersection radius to set the start point.

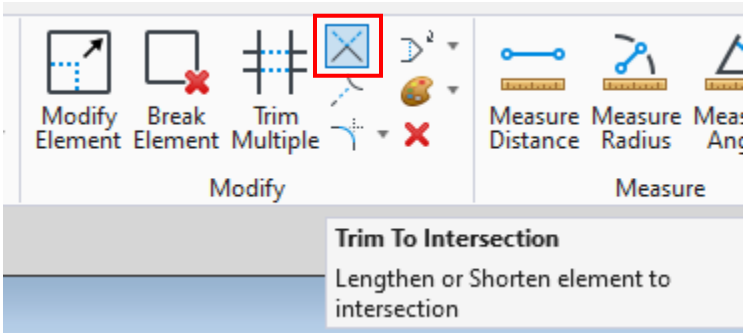


K. Move the cursor to set the taper length and direction. The length is not critical we will use the **Trim to Intersection** tool to set the final length. Left click to accept.

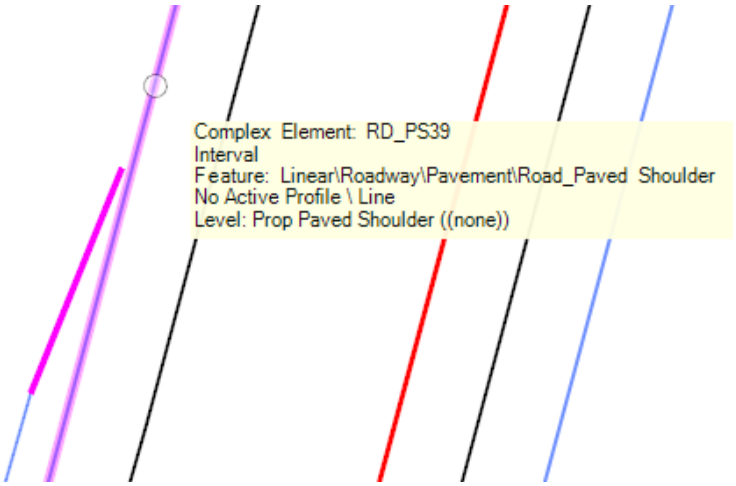


L. Left click to accept the Mirror option of NO.

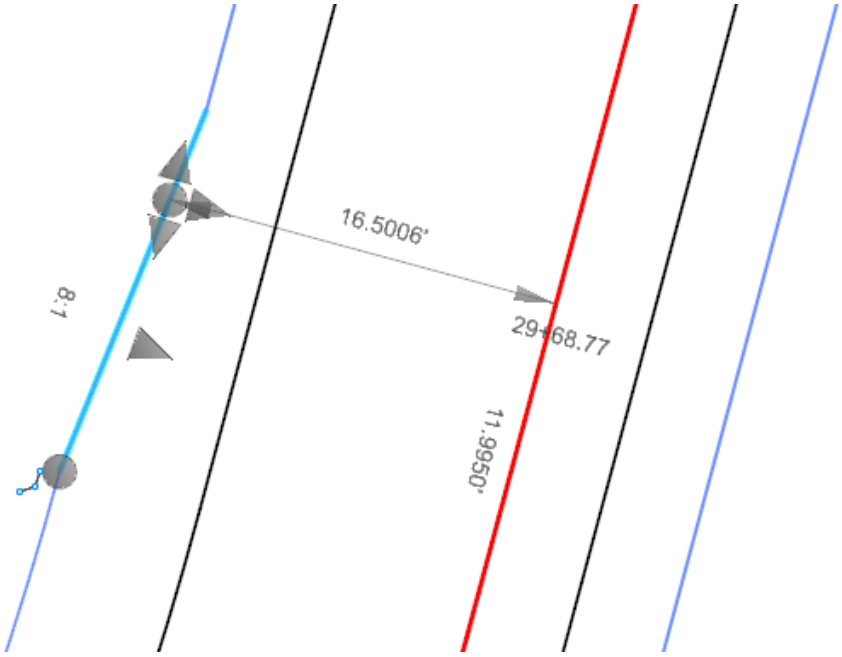
M. Switch to the *Drawing* Ribbon and select the **Trim to Intersection** tool from the *Modify* Section.



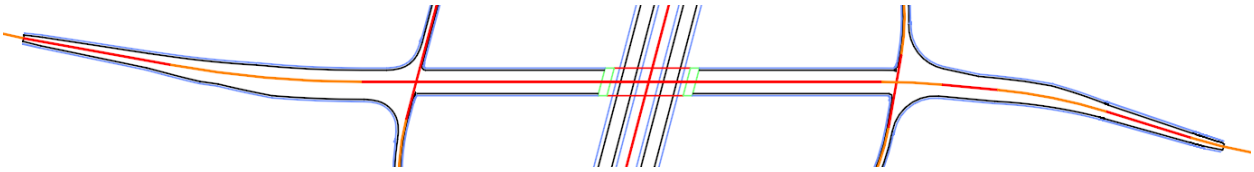
N. Use the tool to intersection the taper and the ramp paved shoulder.



O. This will complete the paved shoulder transition from 6’ on Y14 to 4’ on Ramp A.



P. Repeat this process at all the remaining intersection curves at the ramp terminals.



Q. This completes the edged of pavement and paved shoulder lines.

DSN Drafting - Lane Lines

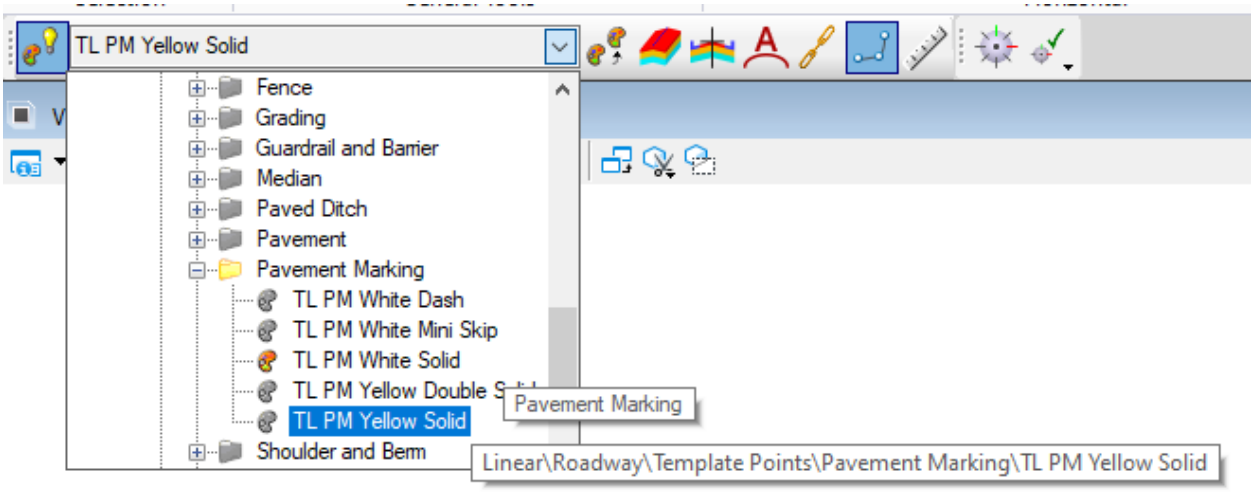
In this section we will build on the interchange layout by adding the lane lines

As shown in the modeling modules many of the lane lines will be generated by the templates and shown in the CMD file. There will be areas in the tapers and transitions where the designer may have to add lanes lines

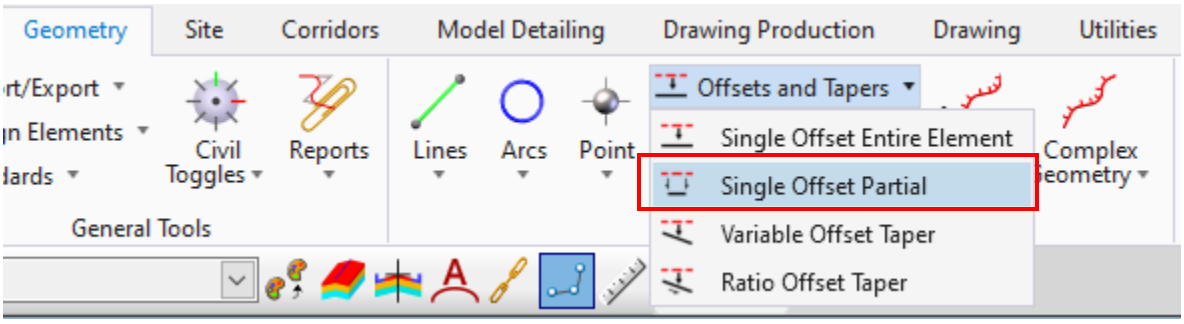
1. Y Line Over – Lane Lines

A. In this exercise we will complete the lanes lines and the monolithic island. The full typical section consists of 5 lanes, 4-12' thru lane and a 16' center turn lane. The first step will be creating the center turn lane.

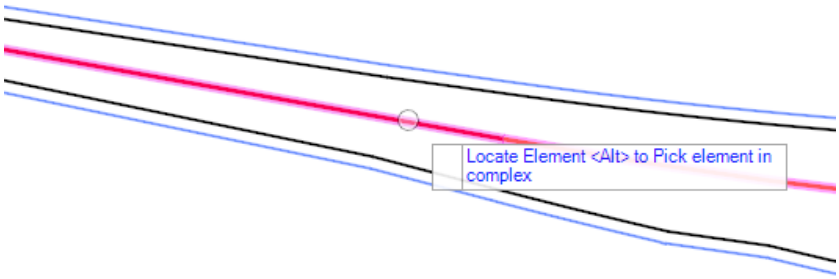
B. Set the Active Feature Definition to TL PM Yellow Solid. This can be found under Linear\Roadway\Template Points\Pavement Marking\TL PM Yellow Solid



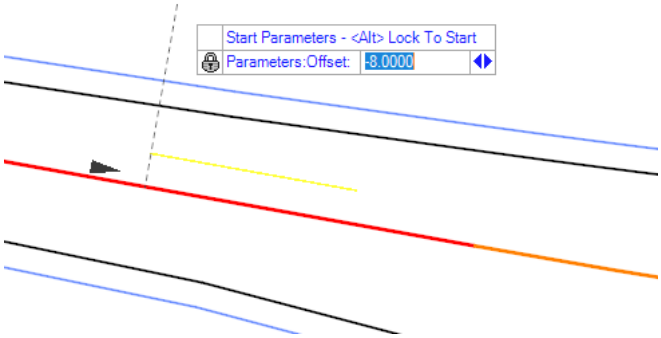
C. Use the **Single Offset Partial** tool to offset the Y14 centerline 8.00' on each side to create the center turn lane taper. The turn lane should extend from one median taper to the other.



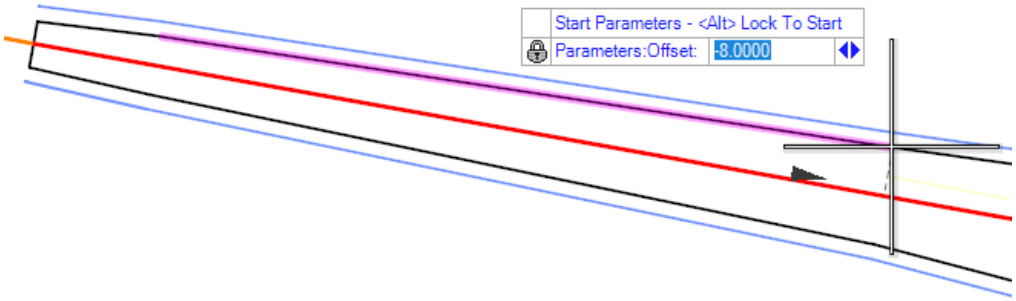
D. Left click to locate the Y14 centerline.



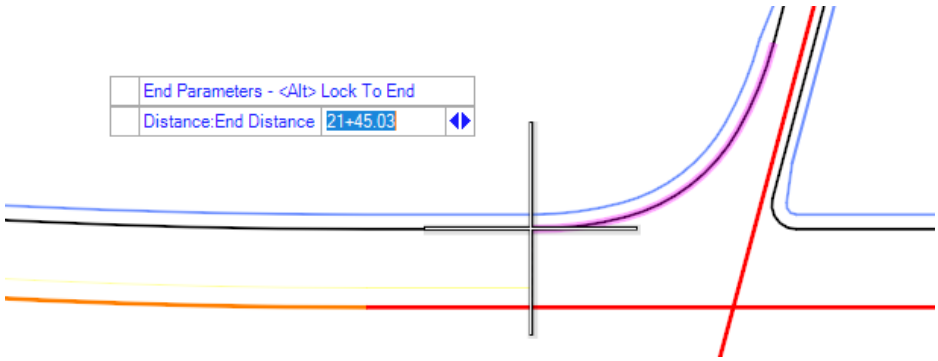
E. At the heads up prompt enter -8.00’ for the offset.



F. Snap to the end of the median taper at the beginning of the project to set the start point.

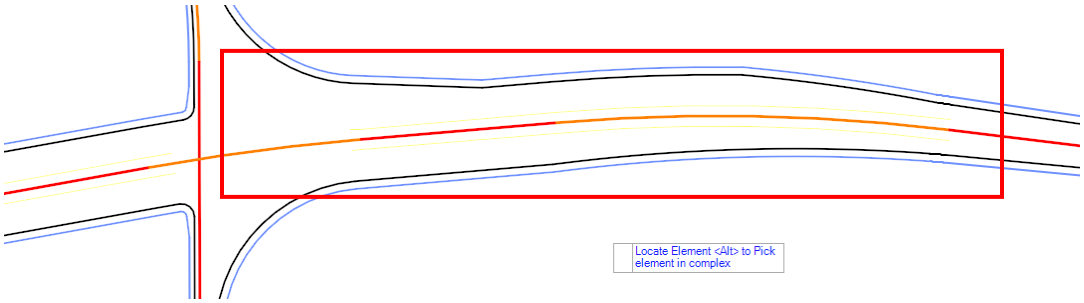


G. Snap to the end of the intersection curve at the Ramp A terminal to set the end point.

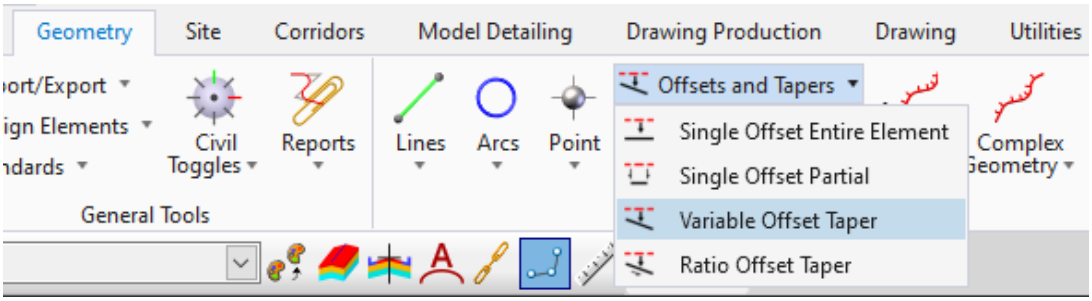


H. Set the mirror option to YES and left click to accept.

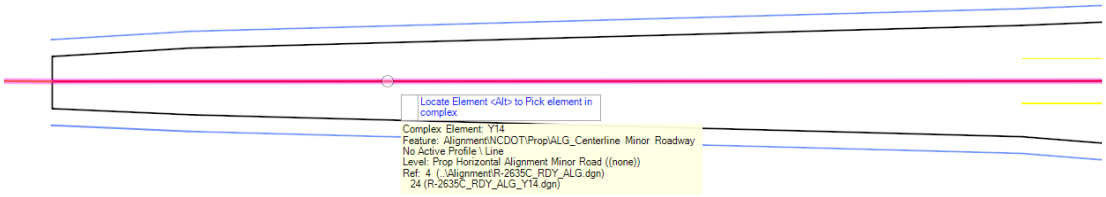
I. To Finish the turn lane, repeat again from the end of the Ramp C intersection radius to the beginning of the median taper at the end of the alignment.



J. To finish the center, turn lane taper line we need to draw the taper from the 16.00’ wide center turn lane back to the proposed centerline. Use the **Variable Offset Taper** tool to create a taper from 0’ to 8’ that matches the location of the median taper edge of pavement line.

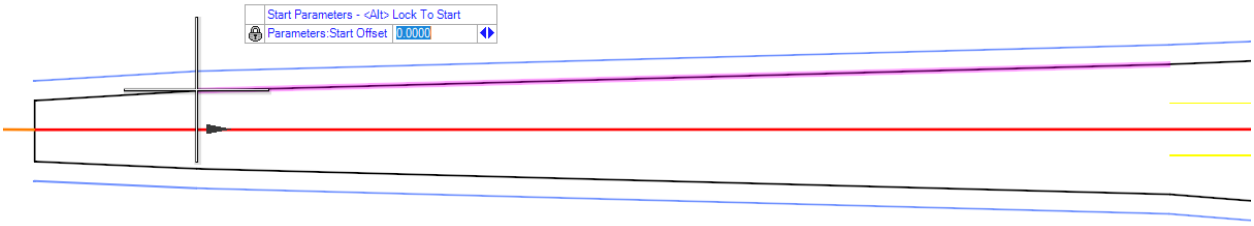


K. We will construct the taper at the beginning of the alignment first. Left click to locate the Y14 centerline.



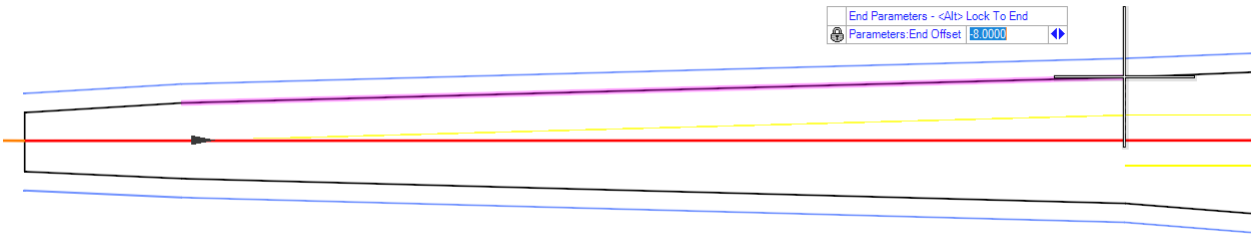
L. At the heads up prompt enter an offset of 0.00’

M. Snap to the beginning of the median taper edge of travel line to set the start point.



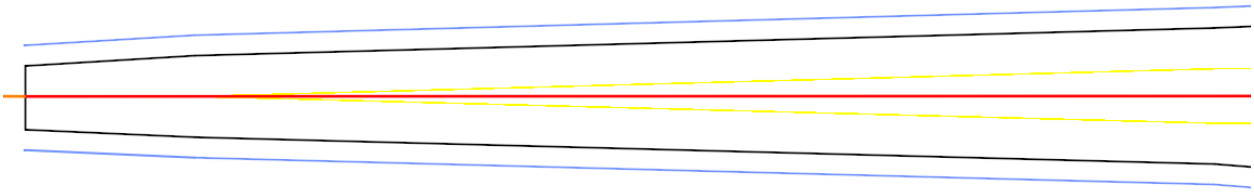
N. At the heads up prompt enter -8.00’ for the end offset.

O. Snap to the end of the median taper edge of pavement line to set the end point.

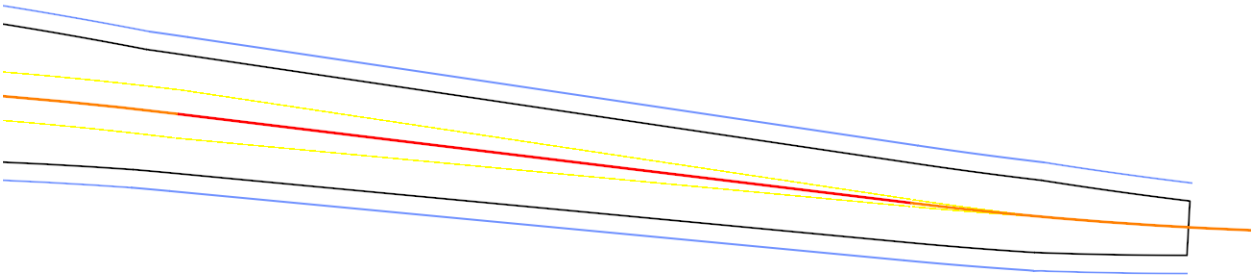


P. Using the <DOWN> arrow key set the Mirror option to YES and left click to accept.

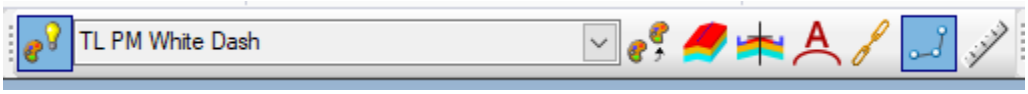
Q. This will finish the median taper lane line.



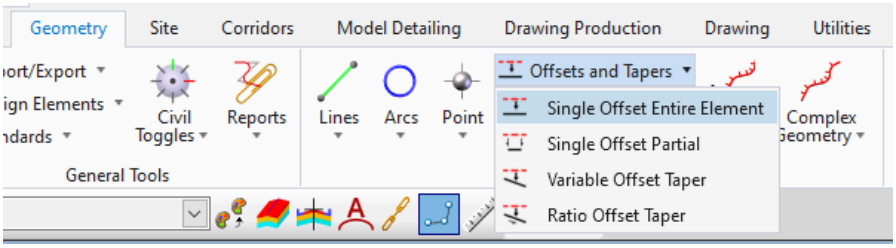
R. Repeat this process at the end of the alignment.



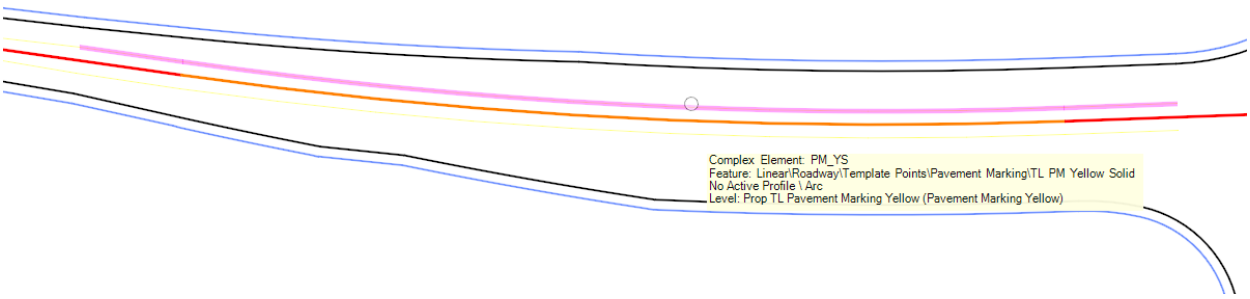
S. To create the skip lines for the thru lane, change the Active Feature Definition to TL PM White Dash



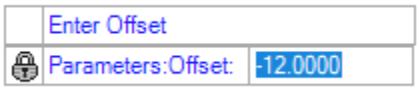
T. Select the **Single Offset Entire Element** tool.



U. Starting at the beginning end of Y14 eft click to locate the yellow turn lane line on the left side of the centerline.

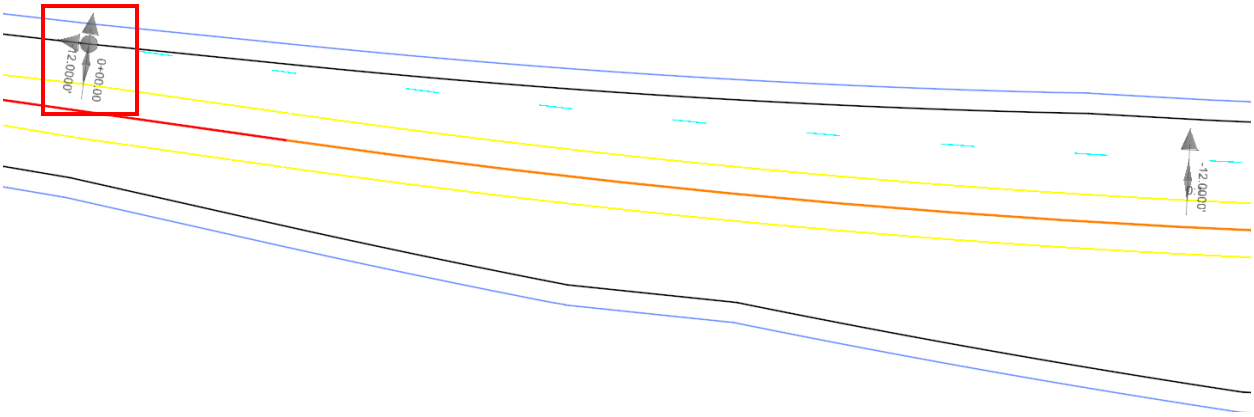


V. Set the offset to -12.00’

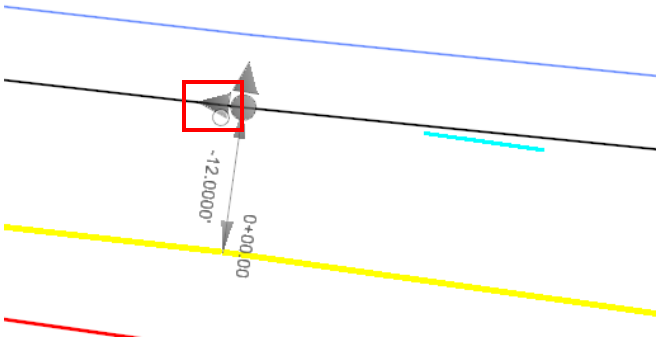


W. Set the mirror option to NO.

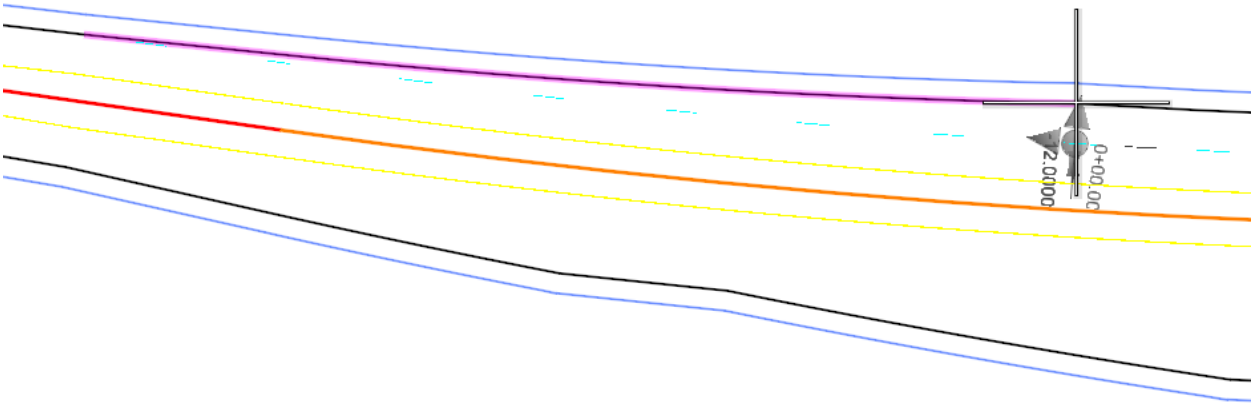
X. To finish the line, we need to modify the start location to line up with the lane drop taper. Use the **Element Selection** tool to high light the lane line and activate the drag handles.



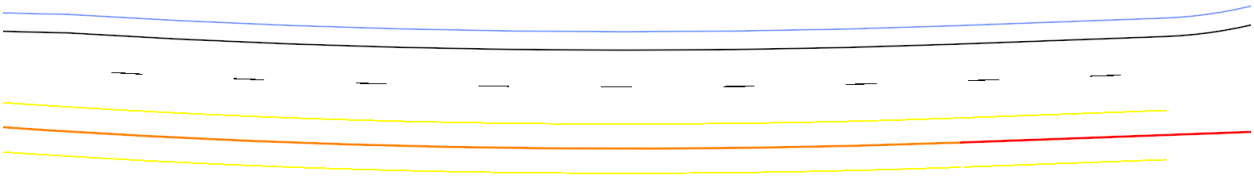
Y. Use the cursor to grab the arrow that is parallel to the alignment.



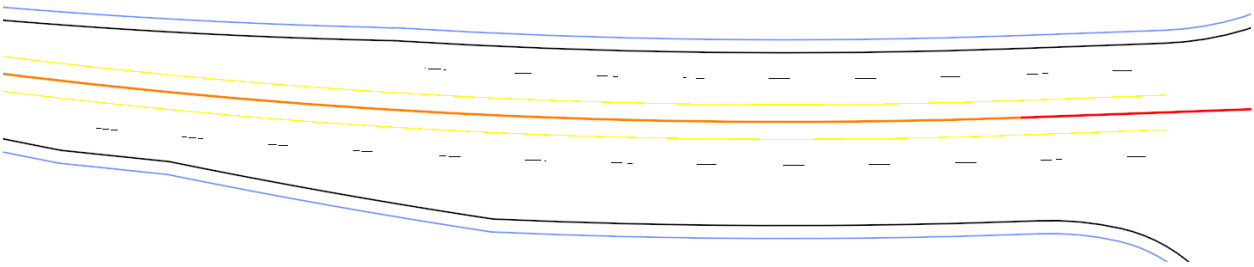
Z. Pull the arrow back and snap to the beginning of the lane drop taper.



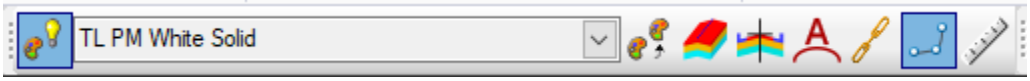
AA. This will place the lane line on the left side of the alignment.



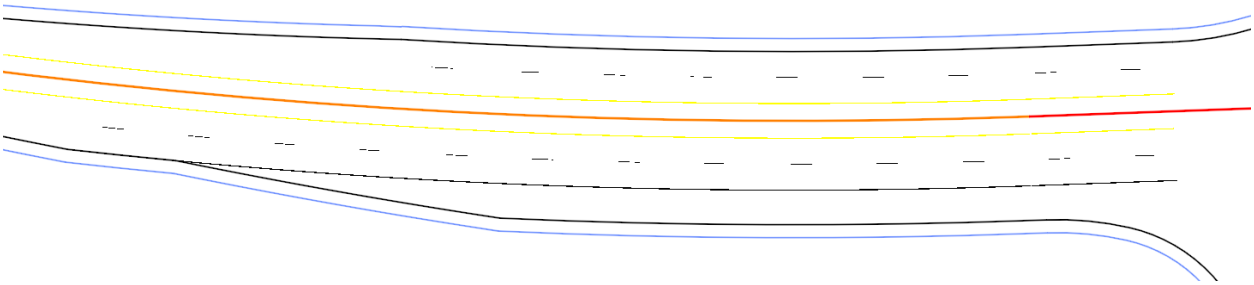
BB. Repeat this process on the right side. The lane line should line up with the end of the first lane taper.



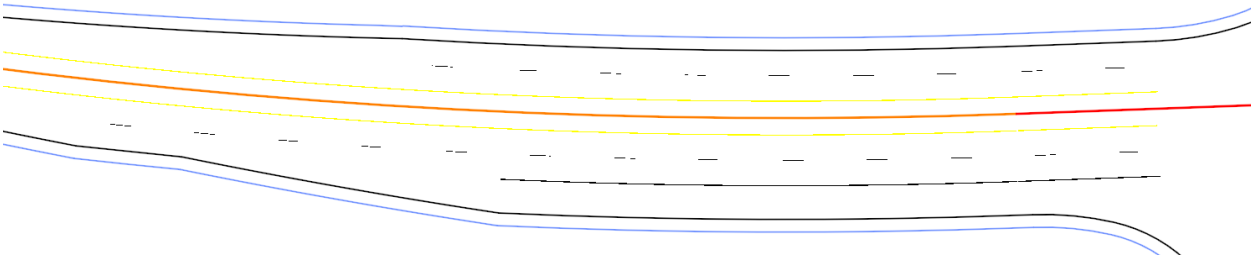
CC. To create the right turn lane line, change the Active Feature Definition to TL PM White Solid.



DD. Use the Single Offset Entire Element to offset the right side dashed lane line 12.00’

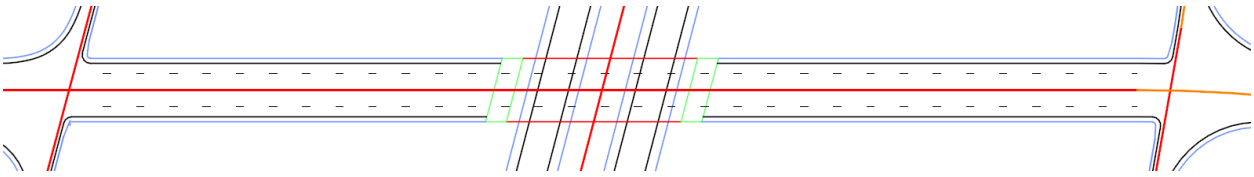


EE. Use the drag handles to adjust the start of the solid lane line to line up with the right lane bay taper.

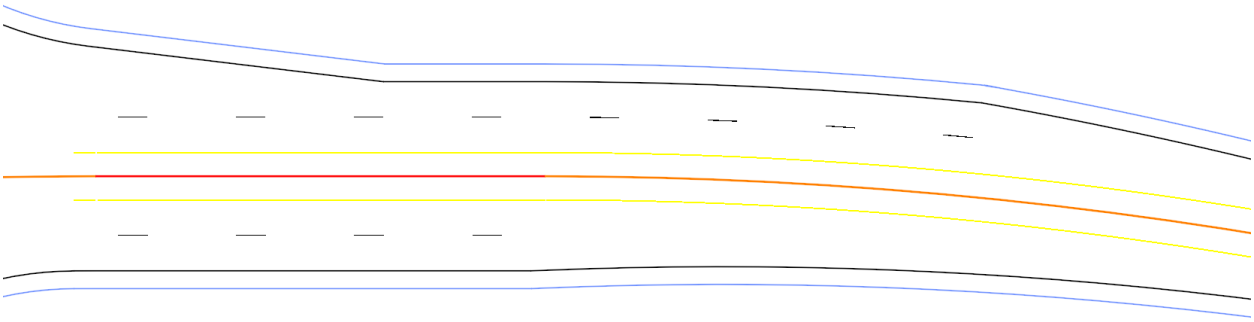


FF. Create the lane lines in the middle of the interchange

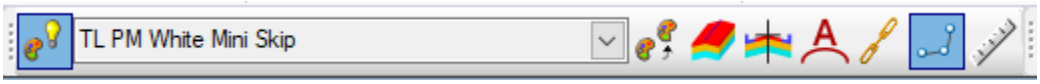
- Switch the Active Feature Definition to TL PM White Dash
- Use the **Single Offset Entire Element** tool
- Offset the yellow center turn lane 20.00’ to create the dashed lane line



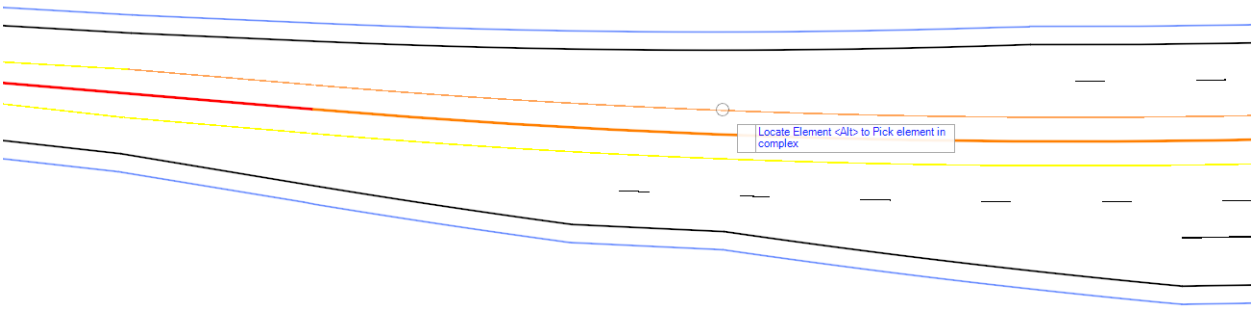
GG. Using the same process create the lane lines at the end of the project. Use the TL PM White Dash feature definition and the **Single Offset Entire Element** tool.



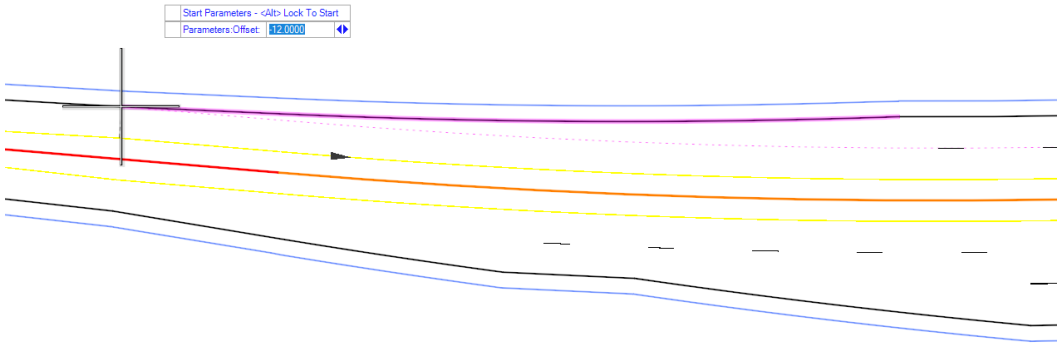
HH. The last step to complete the lane lines is to add the mini skip lines in the taper area. Change the Active Feature Definition to TL PM White Mini Skip.



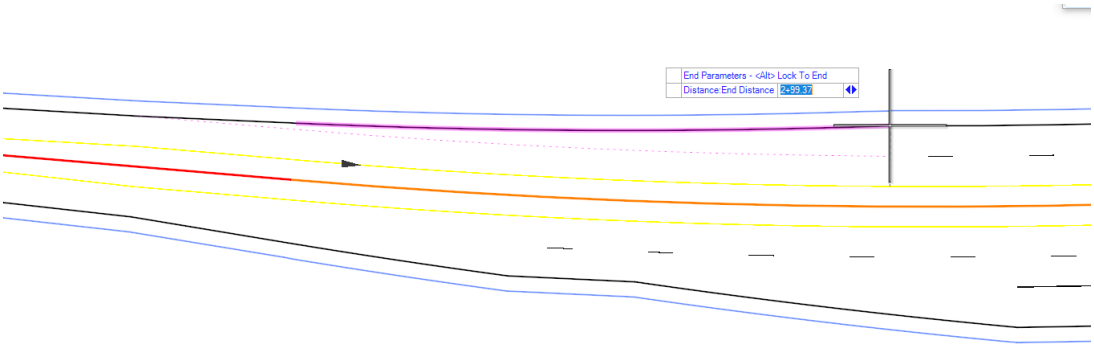
II. Starting with the lane drop taper on the left side at the beginning of the alignment use the **Single Offset Partial** tool and left click to accept the center turn lane line.



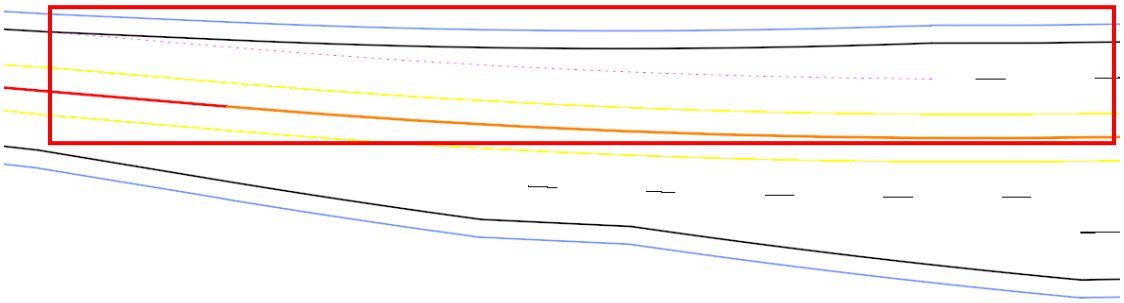
JJ. Make sure all boxes are unchecked in the dialog. Snap to the beginning of the median taper to set the start station and offset for the mini skip line.



KK. Snap to the end of the median taper to set the end station.



LL. This will create a mini skip line.



MM. Repeat this process at the other taper locations.

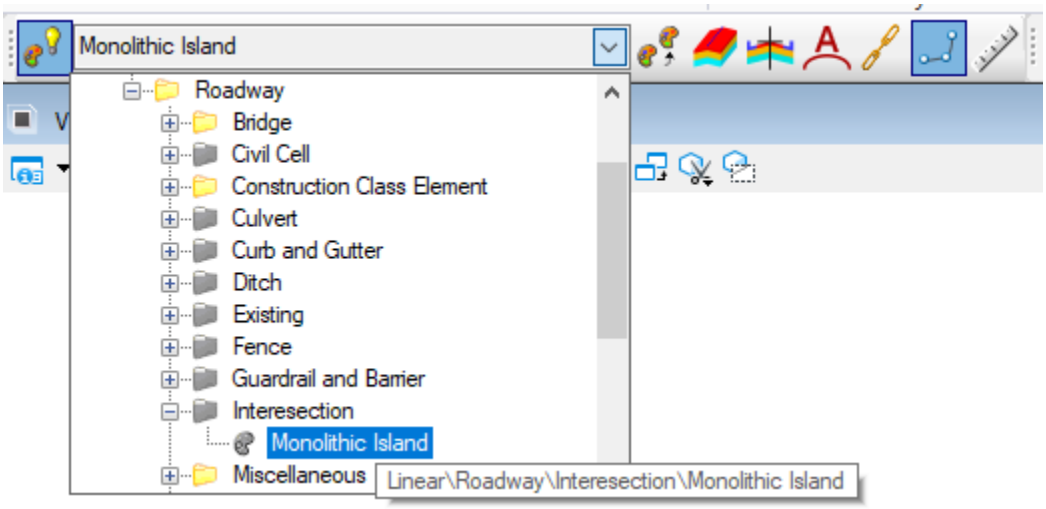
DSN Drafting - Monolithic Island

In this section we will add a monolithic concrete island to the design.

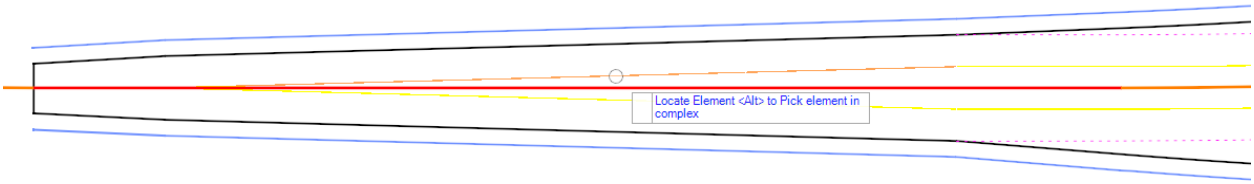
In most cases the designer will construct a monolithic island with the horizontal geometry tools, and then using the vertical and modeling tools add that island to the 3D model.

1. Monolithic Island

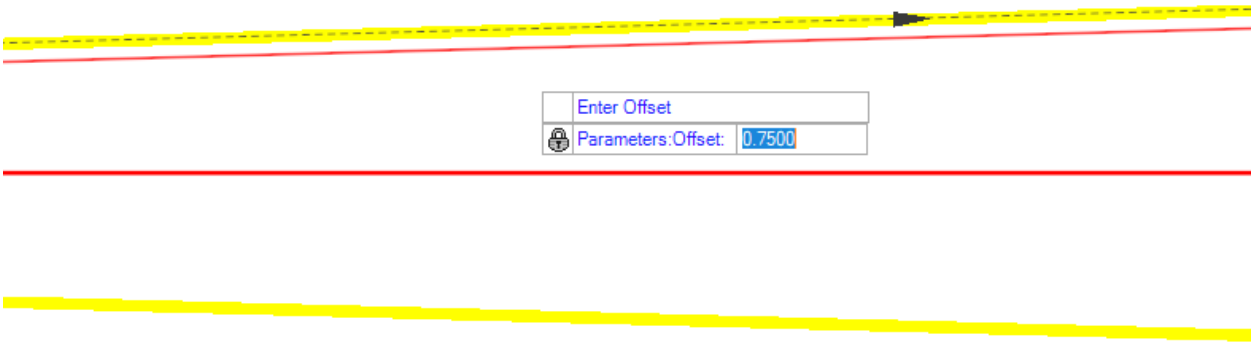
A. Set the Active Feature Definition to Monolithic Island, this is in Linear\Roadway\Intersection\Monolithic Island



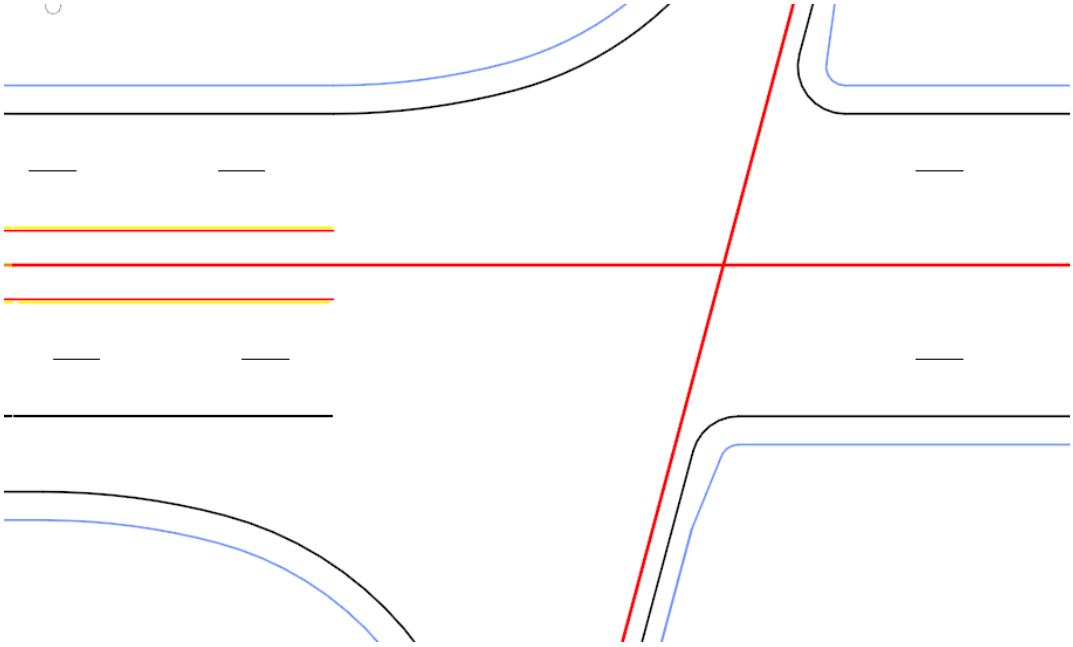
B. Starting at the beginning of the Y14 alignment use the **Single Offset Entire Element** tool to offset the center lane line 0.75’ to create the edge of the monolithic island. Locate the center turn lane line on the left side at the median transition.



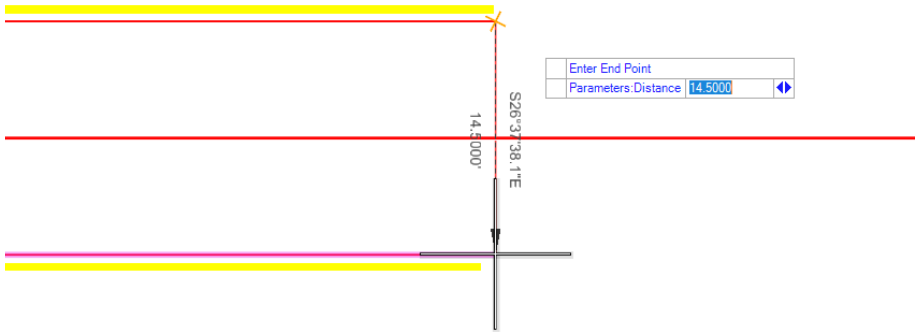
C. Offset the lane line 0.75’ towards the centerline to create the edge of the monolithic island.



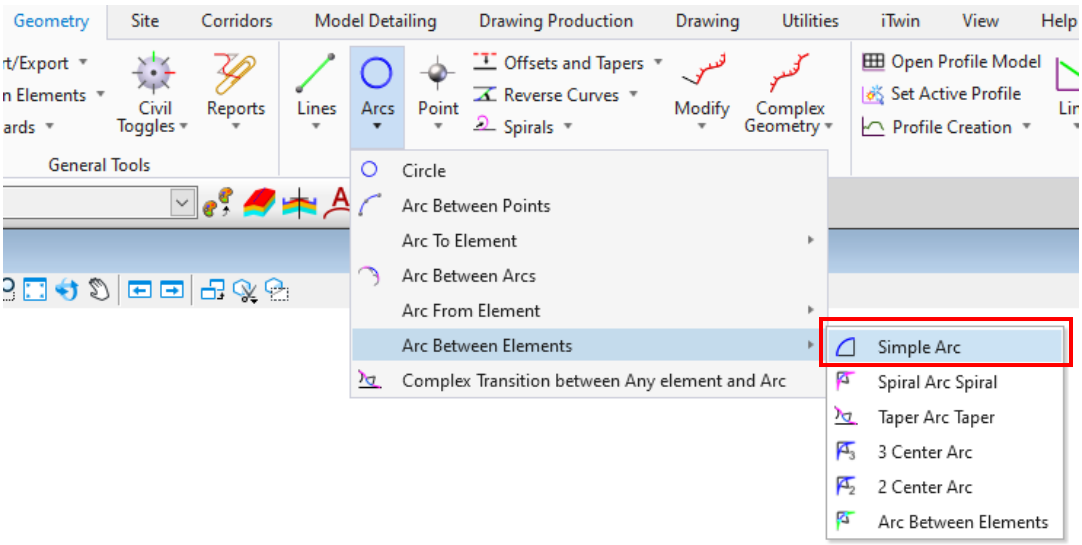
D. Do this for each element from the beginning up to the Ramp A/B terminals.



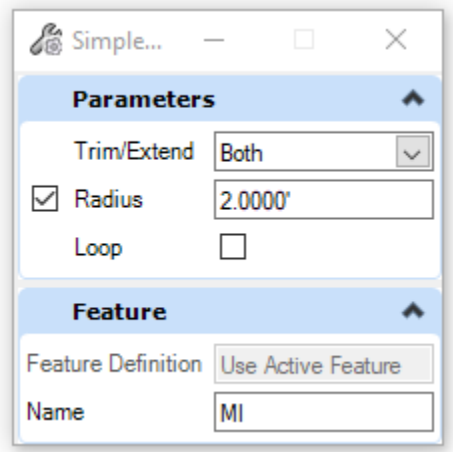
E. At the end of the island at the ramp terminals, use the **Line Between Points** tool to connect the left and right side of the monolithic island.



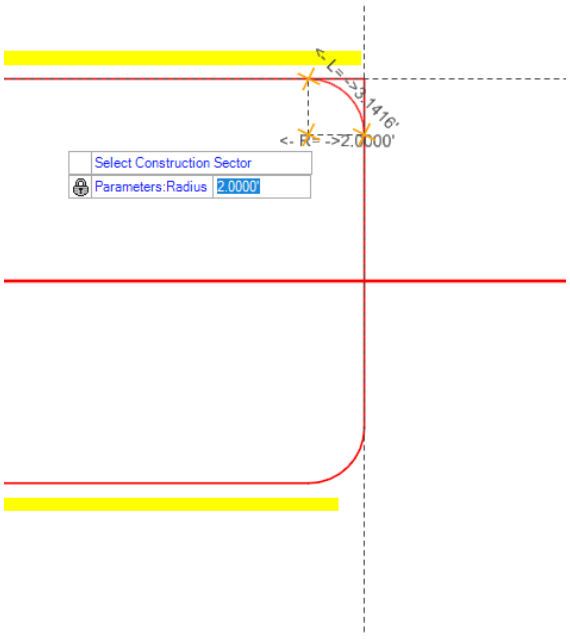
F. To add the corner radius on the island, select the **Simple Arc** tool from the **Arc Between Elements** tool group.



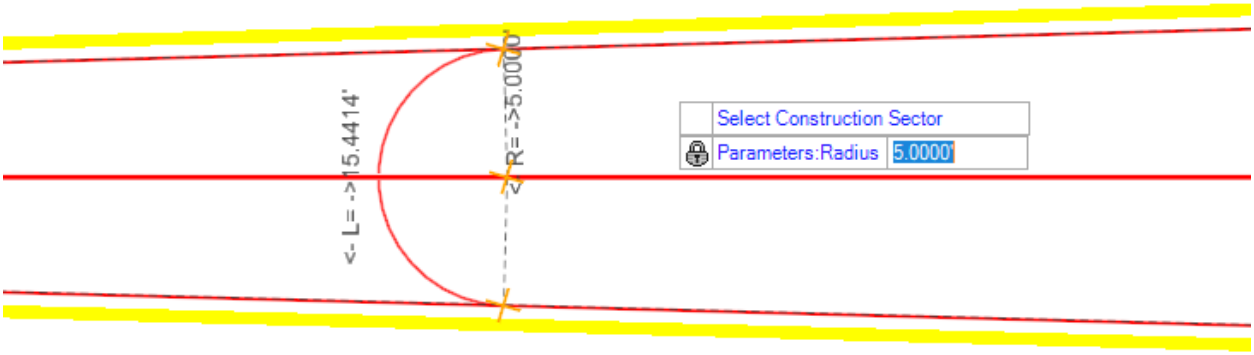
G. Set the radius to 2.00’ and the Trim/Extend option to Both.



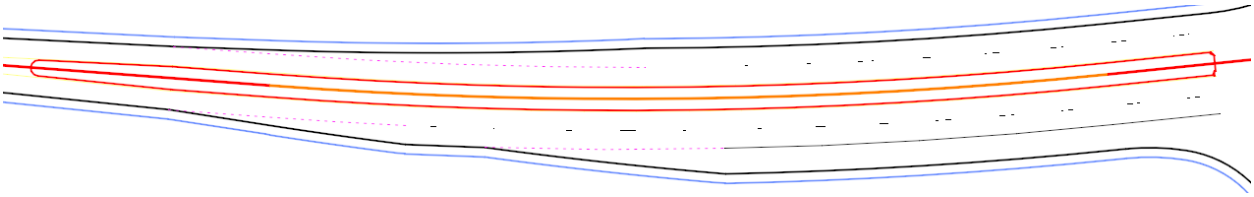
H. Create a simple arc at each corner.



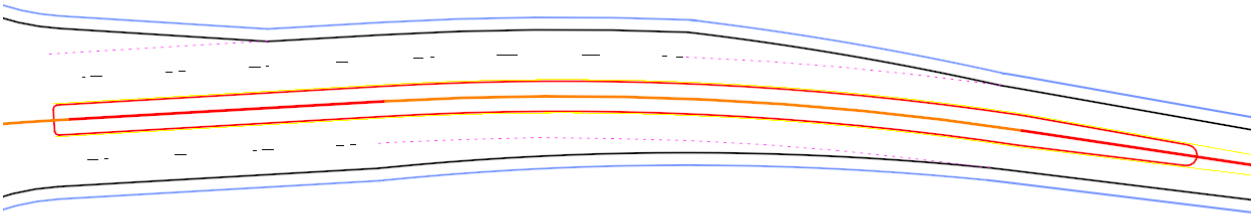
I. At the beginning of the island change the radius to 5.00’ and create a radius at the beginning of the alignment.



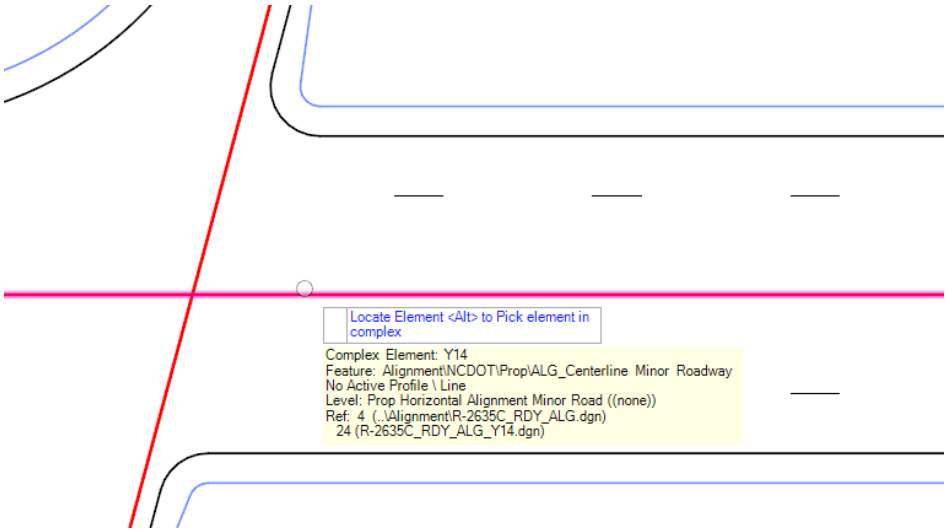
J. This will complete the concrete monolithic island at the beginning of the alignment.



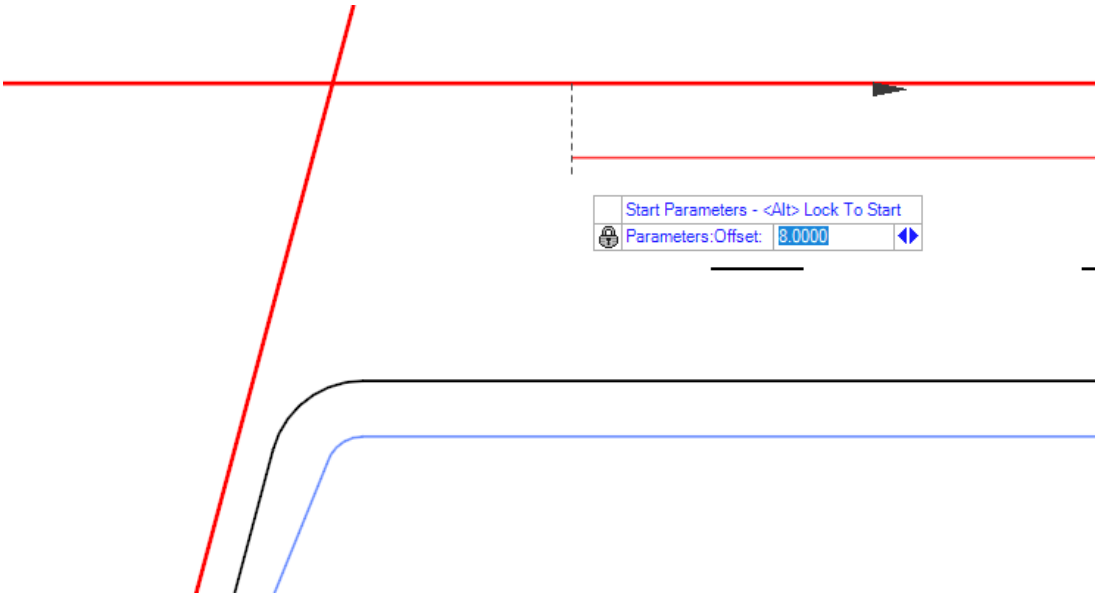
K. Repeat this process at the end of the alignment to create a similar island.



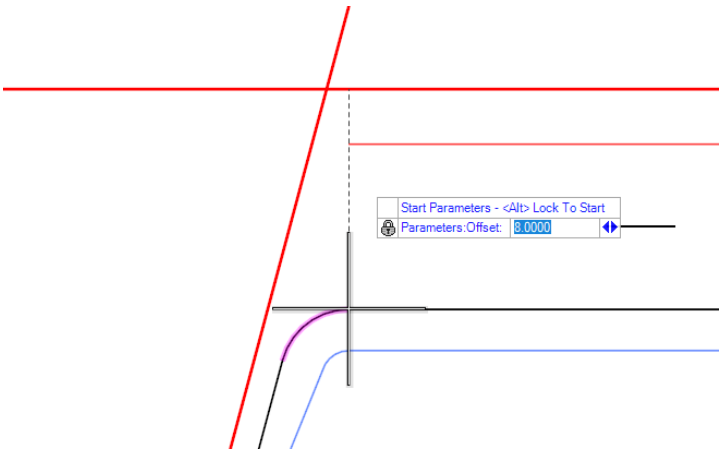
L. The final concrete island will be in the middle of the interchange. This will be a 4.00' wide island that tapers to create two left turn lanes. Use the **Single Offset Partial** tool create the left turn lane at the Ramp B terminal. Left click on the Y14 centerline to select the reference element.



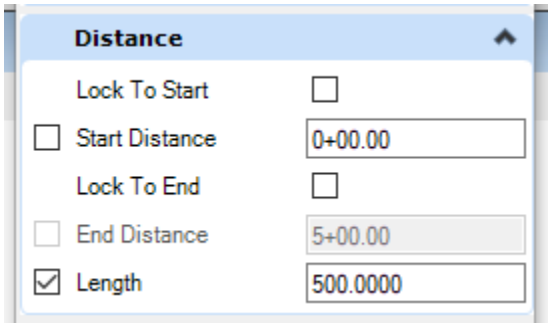
M. Set the offset to 8.00'



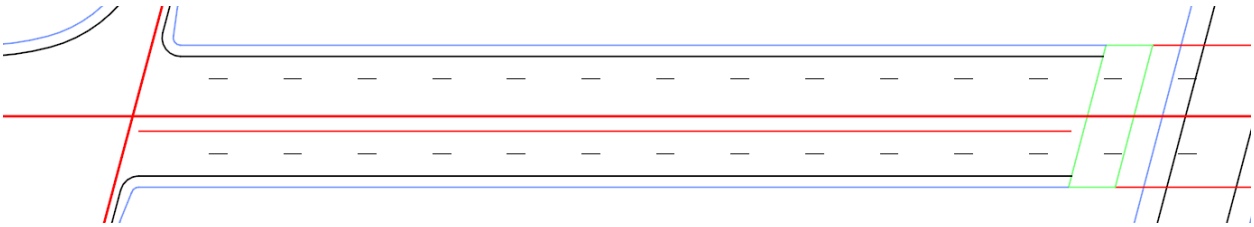
N. Snap to the end of the intersection radius at Ramp B to set the start point.



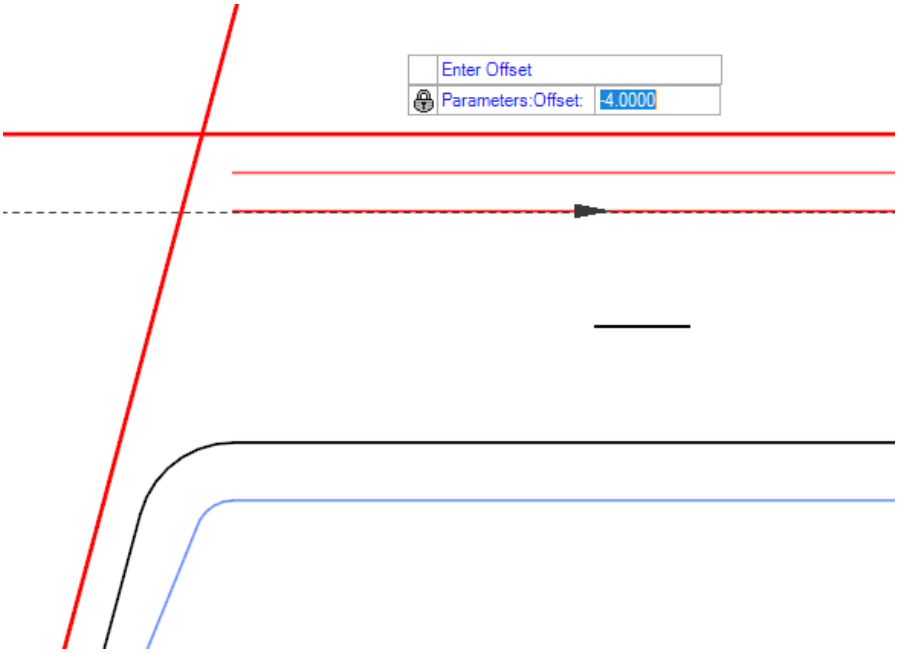
O. In the dialog box set the length to 500’.



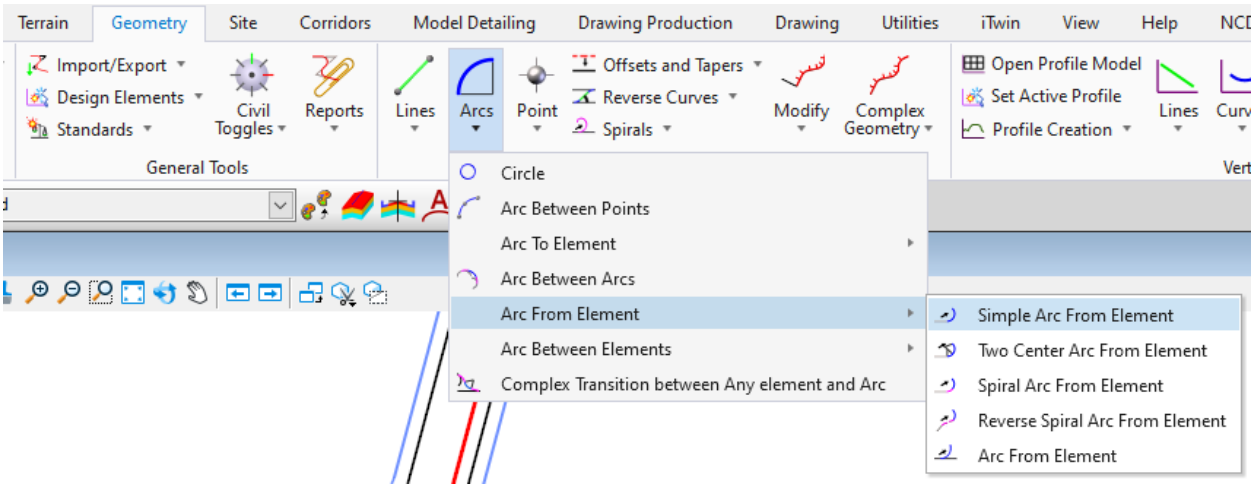
P. Left click to accept the end point, use mirror option of NO.



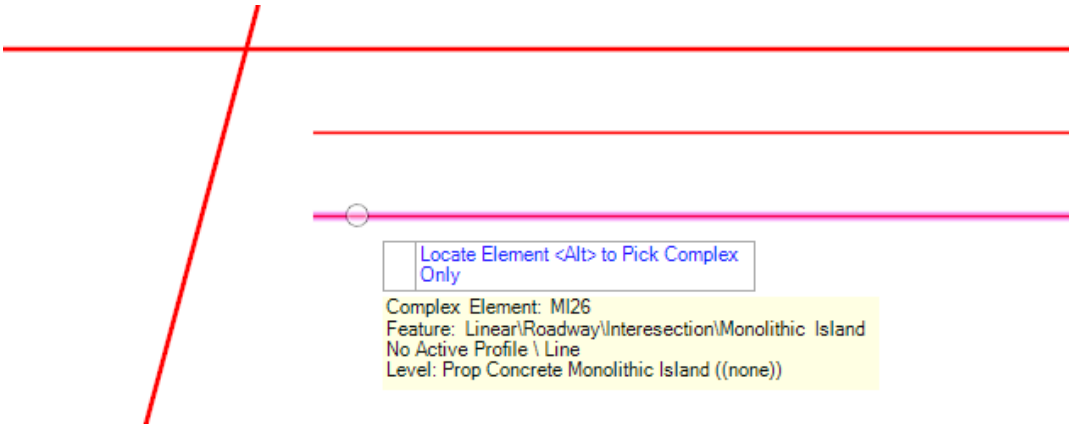
Q. Use the Single Offset Entire Element to offset the monolithic island line 4.00’.



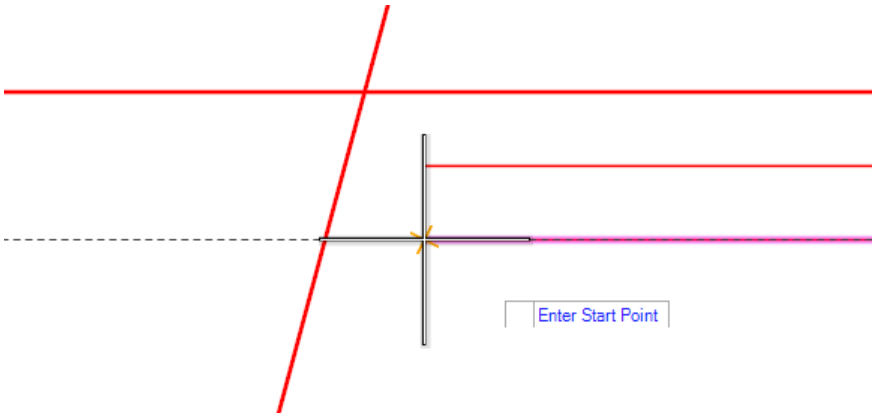
R. To create the noes of the island, use the **Simple Arc From Element** tool.



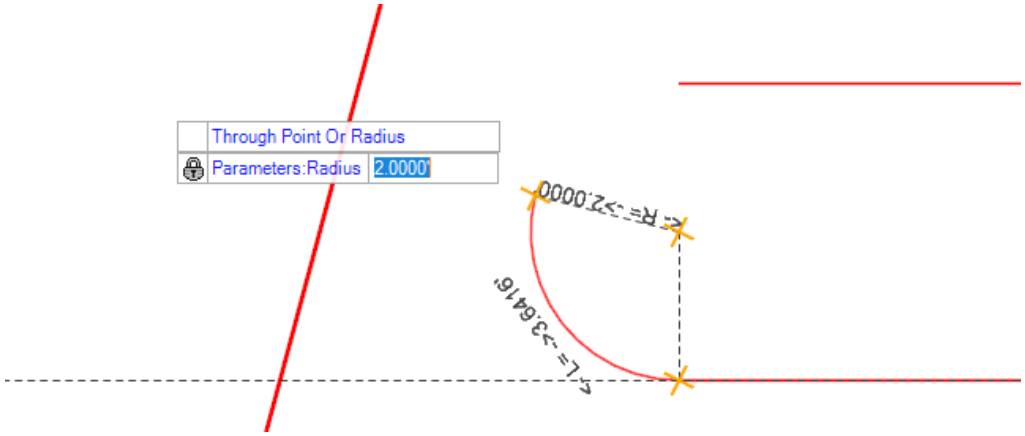
S. Left click to select the edge of the monolithic island.



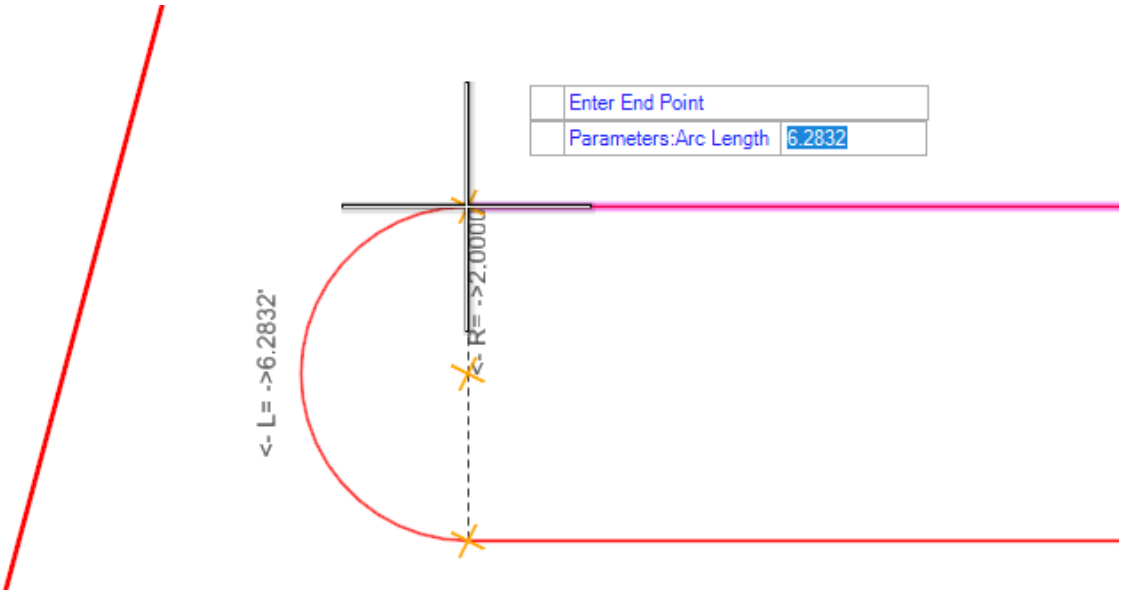
T. Snap to the end of the island let to set the start point.



U. Set the radius to 2.00’ and left click to accept.

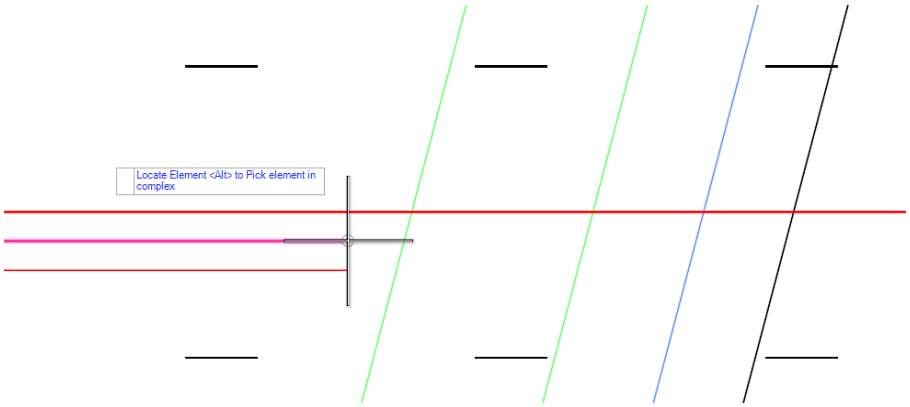


V. Snap to the end of the inside line to set the end point.

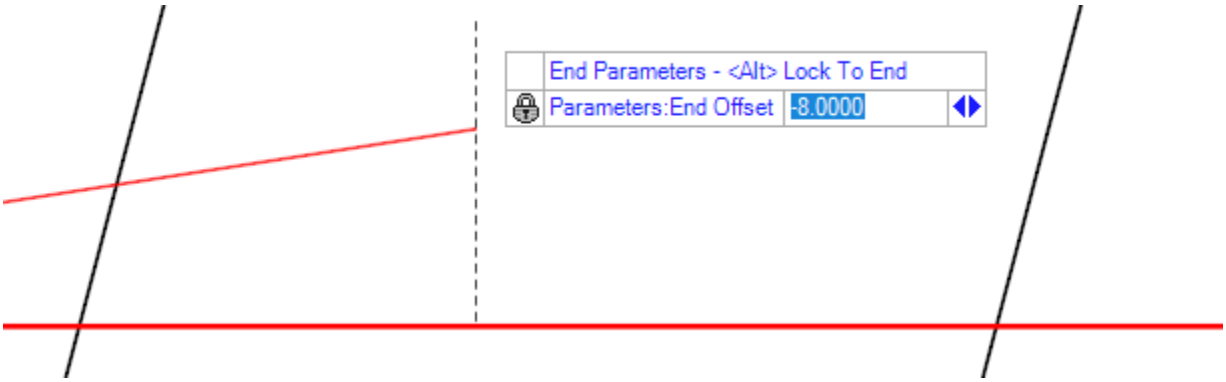


W. Set the trim option to NONE.

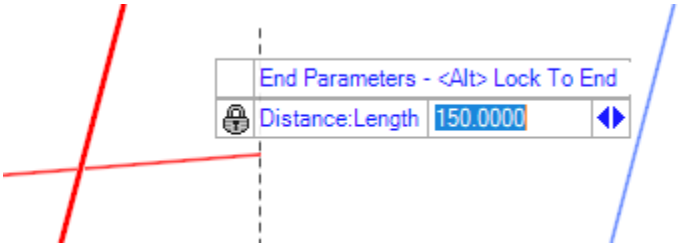
X. Create the turn lane taper by using the **Variable Offset Taper** tool. Start the taper at the inside edge of the previously placed island components. All boxes in the dialog should be unchecked, by snapping to the end of the line the start offset and start station will automatically be set.



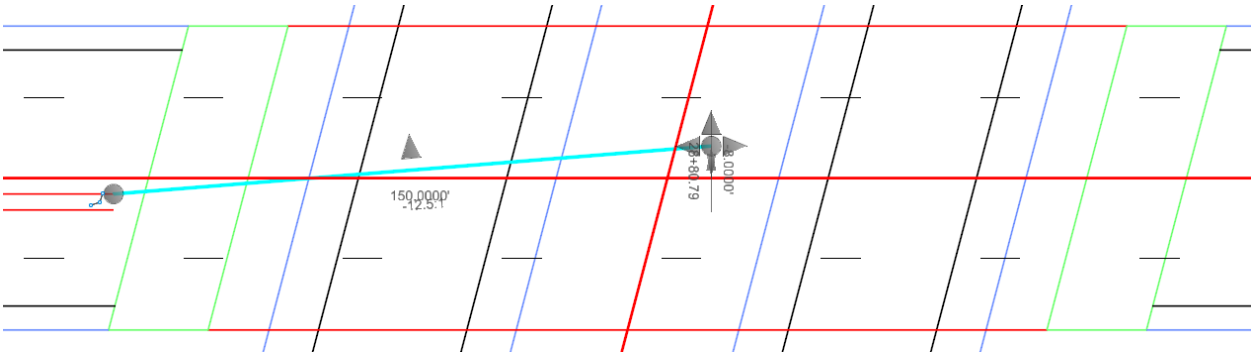
Y. At the heads up prompt set the end offset to -8.00.



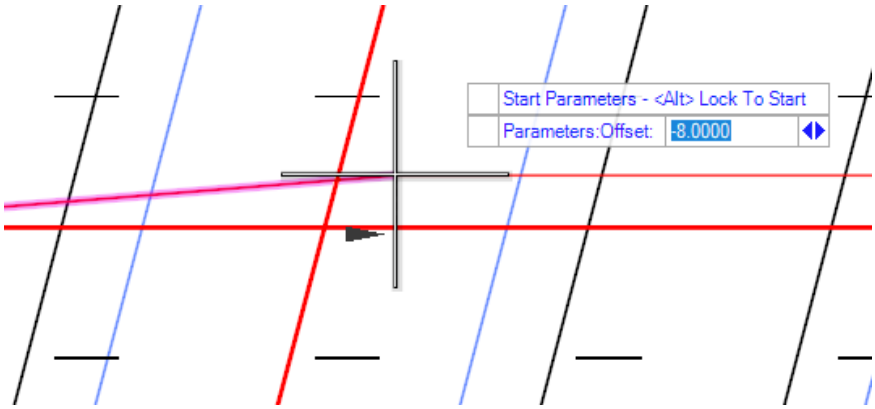
Z. Use the left arrow key to toggle to the length input and enter 150.00’



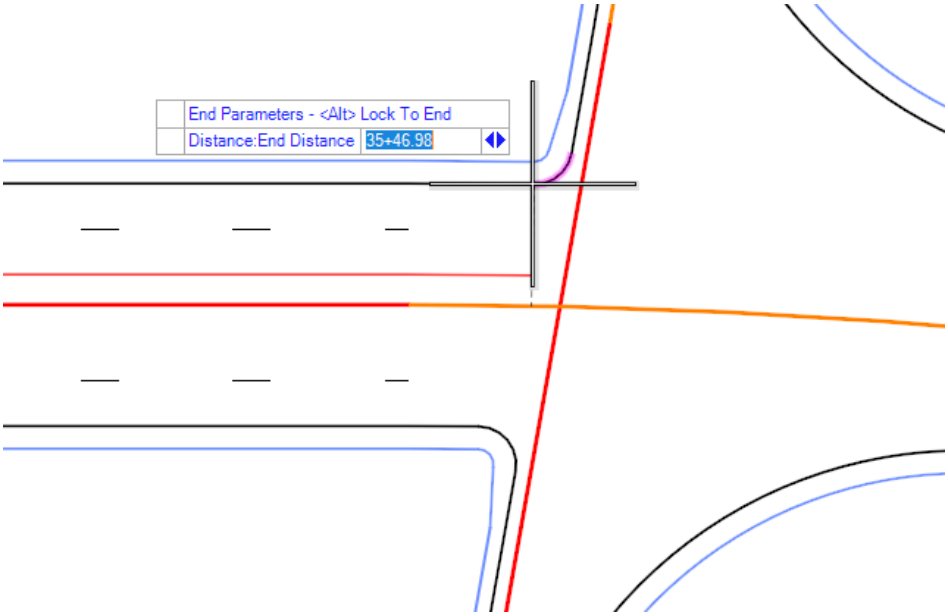
AA. Set the mirror option to NO and left click to accept and place the taper.



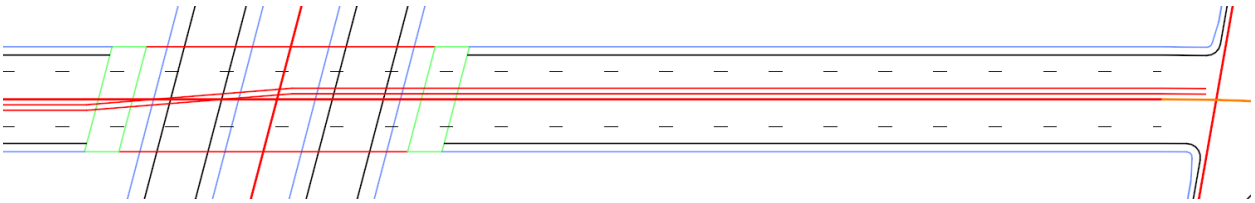
BB. Use the **Single Offset Partial** tool to draw the outside edge of the remaining part of the monolithic island, creating the left turn lane onto Ramp D. Start the tool and uncheck all the dialog boxes. Snap to the end of the taper to set the start station and start offset.



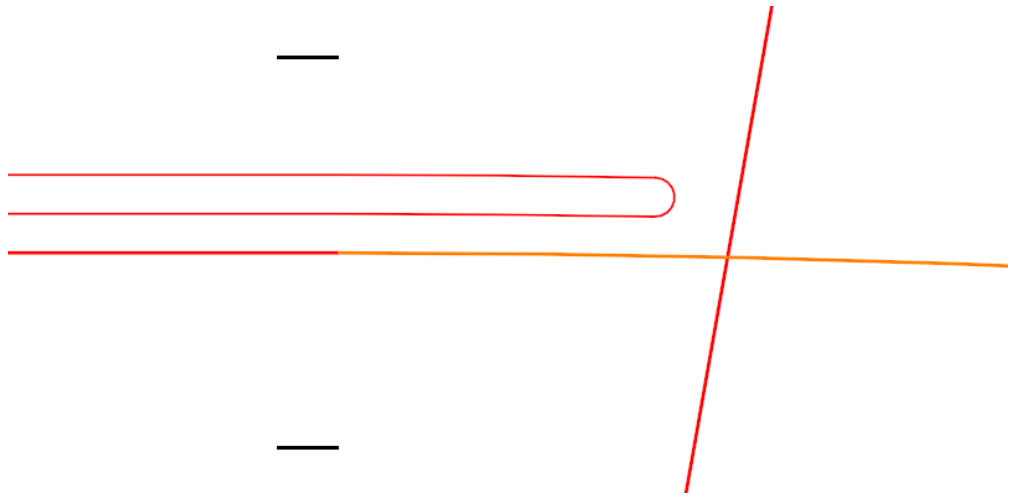
CC. To set the end station snap to the end of the radius at the Ramp D intersection.



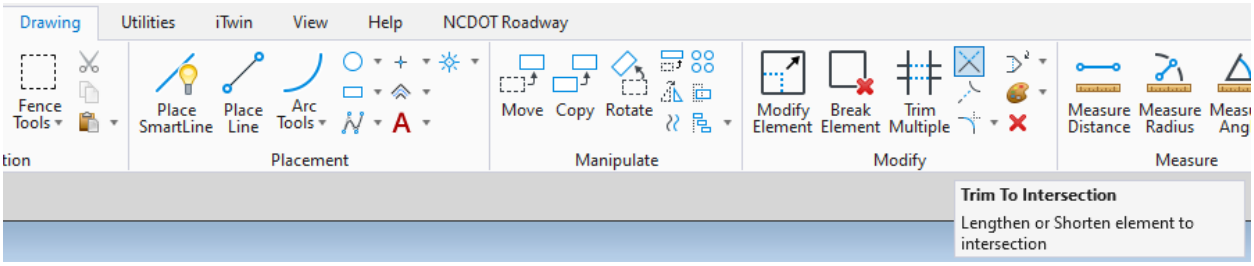
DD. Use the **Single Offset Entire Element** to offset the taper and the outside of the island 4.00’.



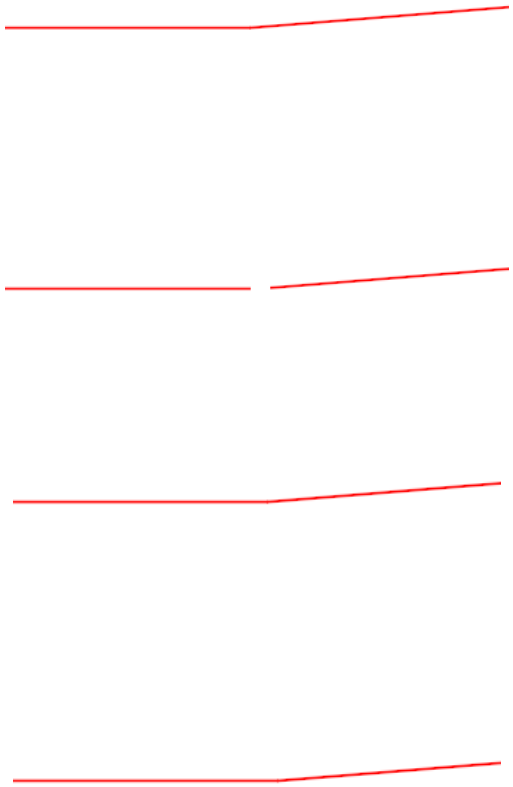
EE. Use the same process to create the nose at the end of the island.



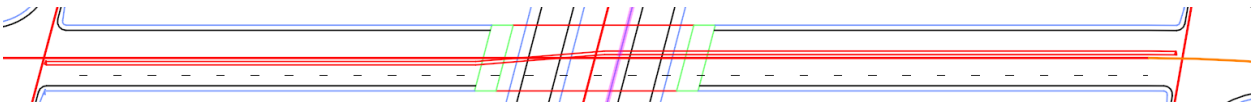
FF. Switch to the *Drawing* ribbon and select the **Trim to Intersection** tool from the *Modify* section.



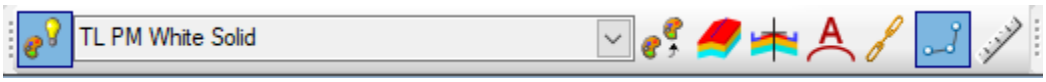
GG. Intersect the corners of the island and the taper where the lines do not meet.



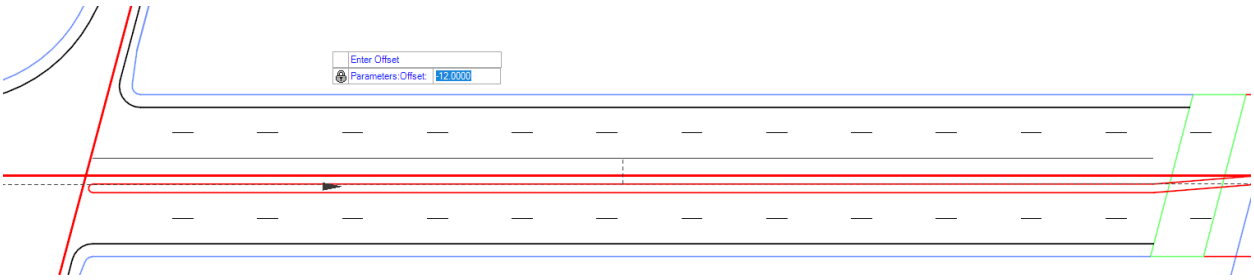
HH. This completes the monolithic concrete island.



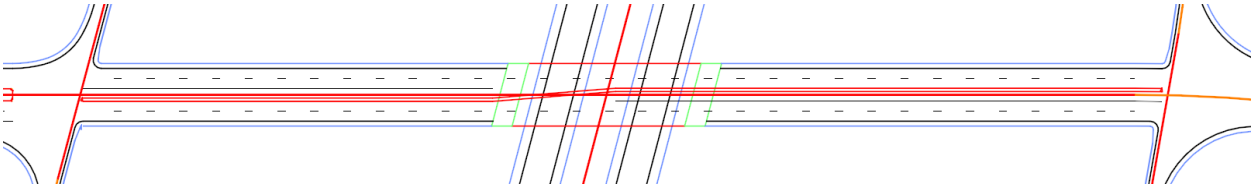
II. The last step is to create the left turn lane line. Change the Active Feature Definition to TL PM White Solid



JJ. Use the Single Offset Entire Element to offset the inside of the turn lane 12.00'.



KK. Repeat this for the turn lane at Ramp D.



LL. This will complete the interchange layout.

DSN Drafting - Guardrail

In this exercise we will place guardrail in the DSN file. When using Geopak SS2 the templates showed locations where the guardrail was required for a fill slope warrant and placed it in the model and on the cross sections. The designer then reviewed these locations and added guardrail to the DSN file as a 2D line string. The model was then updated with any new guardrail locations and reprocessed.

This method has several limitations. In some cases, because a fill warrant is detected it does not always mean that guardrail will be placed in that location, maybe there is a drive or an intersection or some other reason that guardrail cannot be used. In other situations, guardrail may be warranted where no fill warrant was detected. In the case of shop curved guardrail, it may not be parallel to the edge of travel. Combining the automatically placed guardrail and the designer placed guardrail was always a challenge.

The method developed for ORD tries address some of the issues created by allowing the designer more flexibility when designing guardrail. ORD has the capability of utilizing a 3D line style to represent the guardrail. This line style will display as 2D DSN file, as 3D in the Default 3D model and place a cell in the Cross Sections. All of this is accomplished by placing a 2D element in the DSN file. (Note that this can also be done in the CMD file)

Using the new workflow, the model will flag locations where the guardrail is warranted, the designer will then review those locations, along with any fixed object warrants and design the guardrail in the 2D model. The designer will then design the shoulder around the guardrail, allow an accurate model reflective of the standards and design constraints.

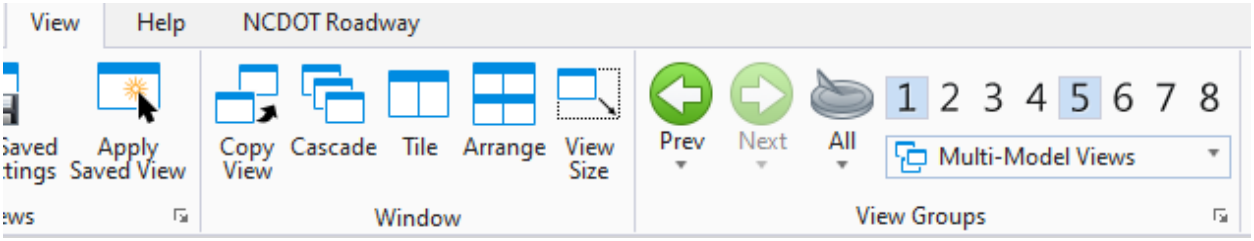
In this exercise we will focus on placing the guardrail element in the DSN file and reviewing how it is displayed in the default 3D model and the dynamic sections. For more information on how to design the shoulder point to accommodate the guardrail line see the training modules on Modeling.

This section needs review, if the templates are adjusted to add the shoulder widening in by targeting the guardrail is placed then this section may need some updating. The guardrail also needs some additional work on feature definitions, structure units are needed and left ahead, left back, right ahead, right back line style is needed to facilitate drafting. This section will need to be revisited and updated when the guardrail workflow and process is fully developed. For now this is a general reference for how the guardrail is added.

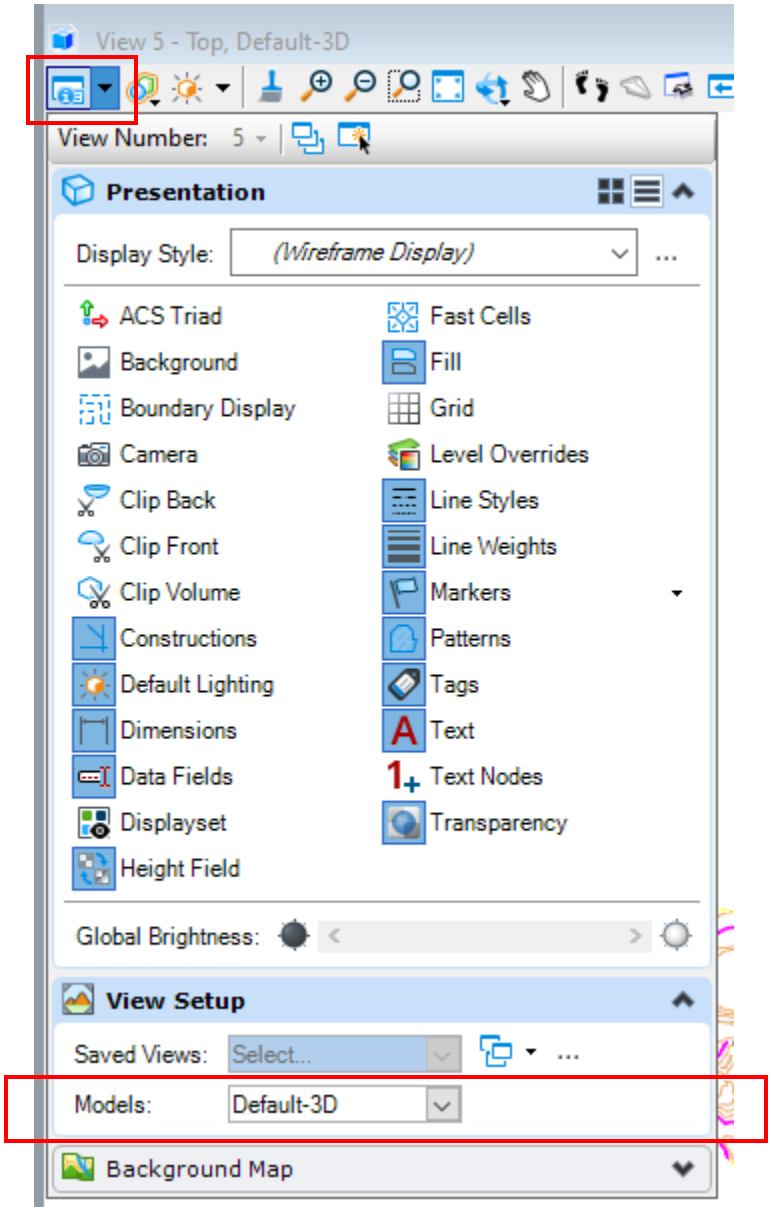
1. Place Guardrail in 2D DSN

A. Attach the ***R-2635C_RDY_CMD_Y11.dgn*** and the ***R-2635C_RDY_CMD_BRIDGE.dgn*** files from the design directory (these were created during the initial corridor modeling training module)
C:\NCDOT Training\Roadway\Module 7 Plan Geometry\R-2635C\Roadway\Design

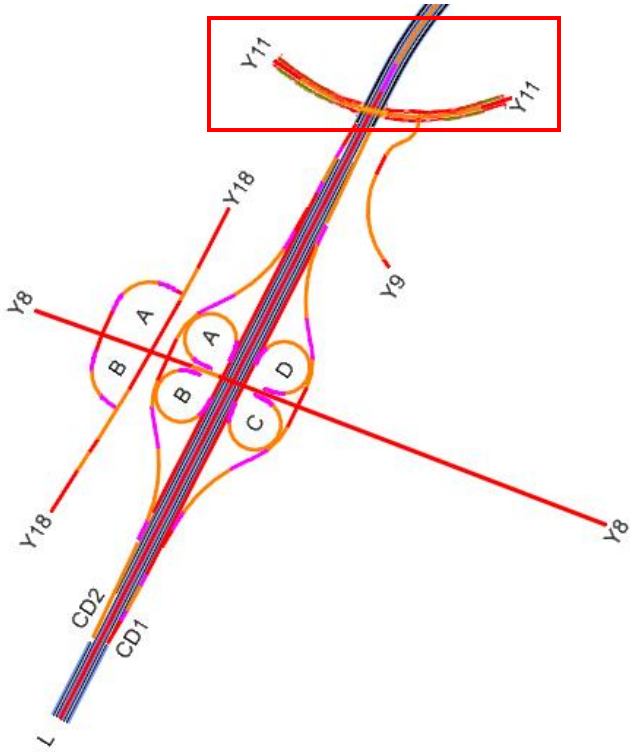
B. Switch to the *View* ribbon and open view 5. (This can be any view window)



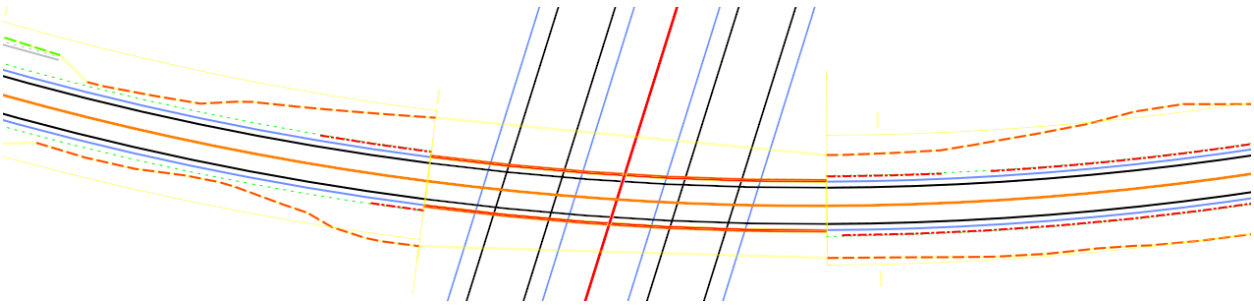
C. Go to the view attributes of View 5 and switch to the Default 3D model view.



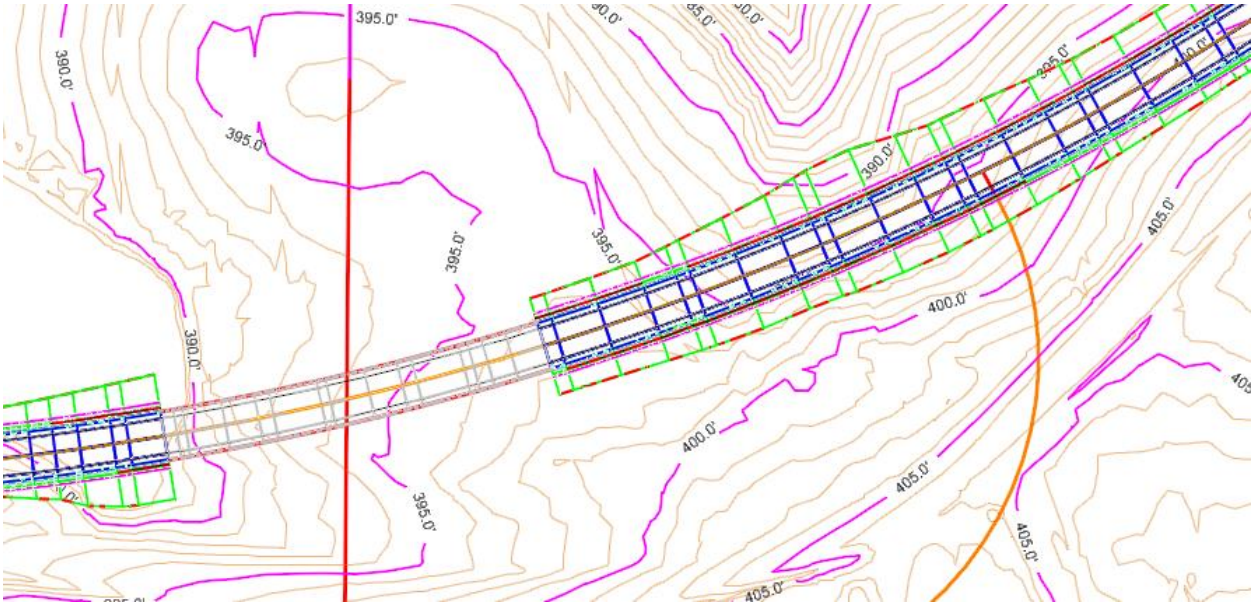
D. Find Y11 going over L. This is just after the first interchange.



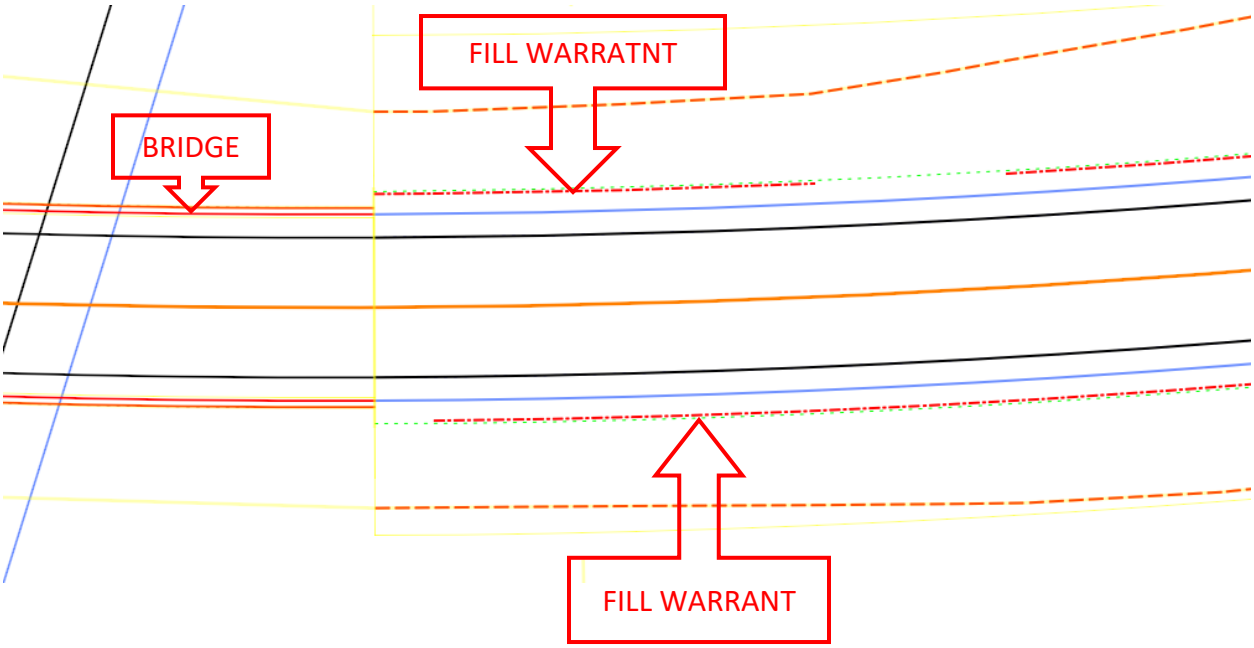
E. The 2D view in the DSN should show the slope stakes, pavement lines, corridor limits and bridge.



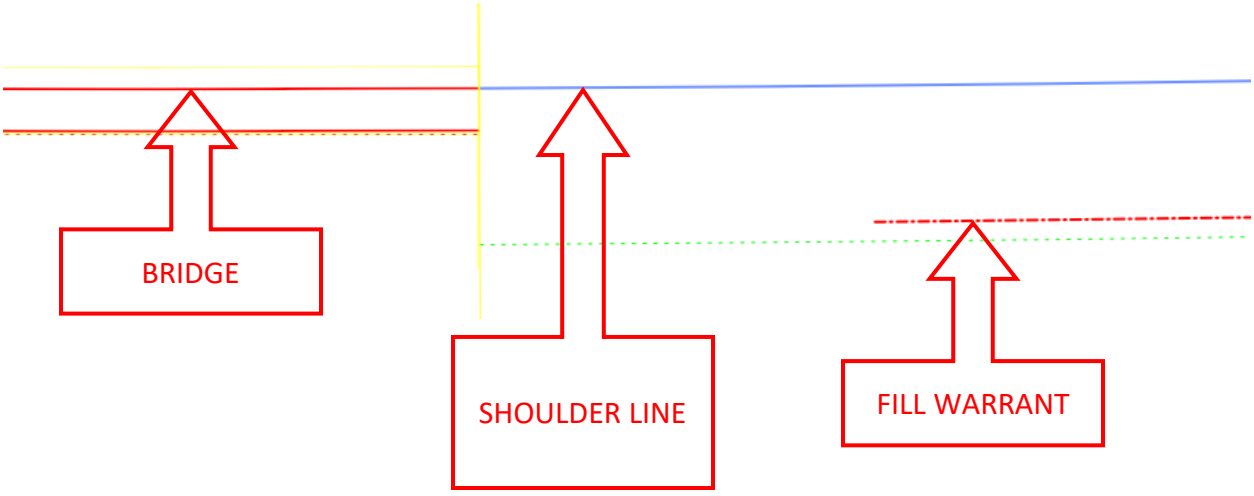
F. The Defaul-3D in View 5 will show the 3D elements and the ETM should be visible.



G. During the initial corridor modeling phase, the template flagged locations where there is a fill warrant. In the cross-section view this is shown as a red flag. In plan view this is shown as a red line with dash-dot symbology.



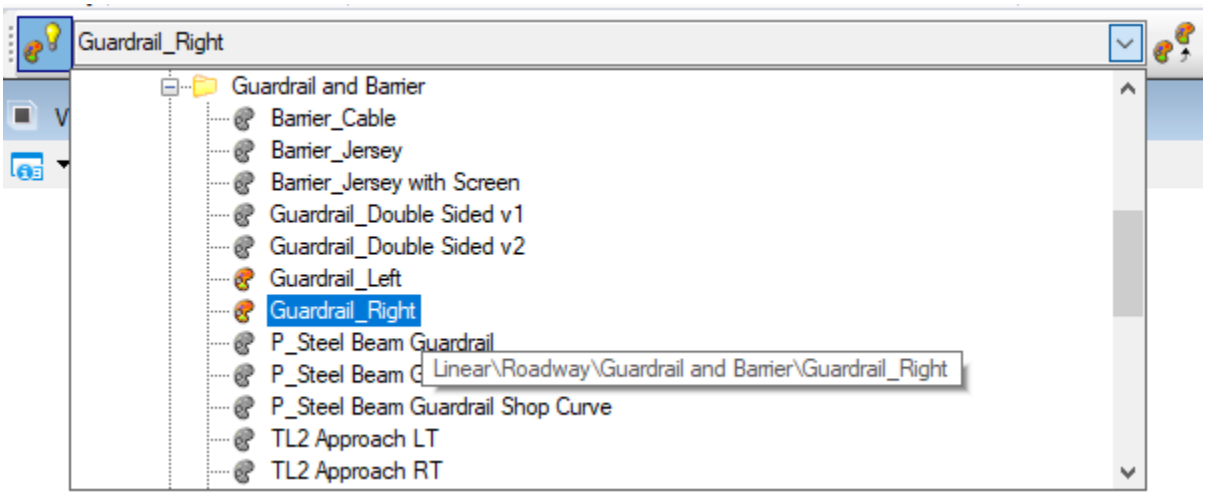
H. Zoomed in view



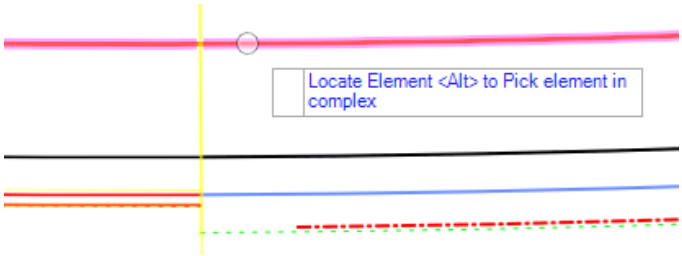
I. The first section of guardrail will be from the end of the bridge on the right side going line ahead.
   - Add the guardrail to the 2D DSN file.
   - Profile the guardrail based on the Y11 design corridor
   - Review the guardrail in the Default 3D Model
   - Review the guardrail in the Dynamic Cross Sections

   (Note: at the time of development of the training materials some of the guardrail feature definitions were in development, these include structure anchor units and line styles to use when drafting guardrail going line back)

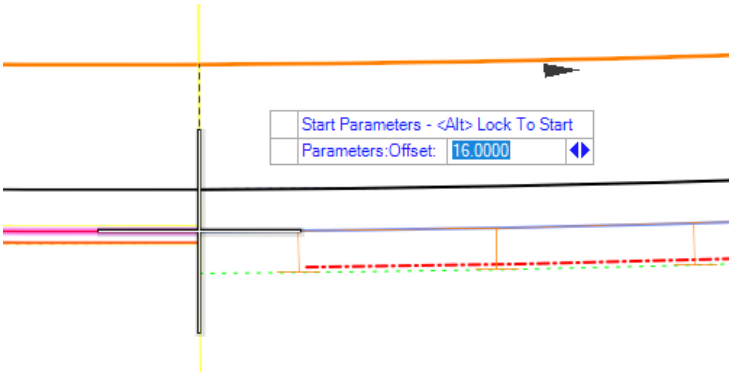
J. Set the Active Feature definitions to Guardrail_Right



K. Using the **Single Offset Partial** tool create a guardrail element parallel to the Y11 centerline that starts at the end of the bridge rail and is 22.875’ long. This represents the B-77 Structure Anchor Unit. Left click to select the Y11 centerline.

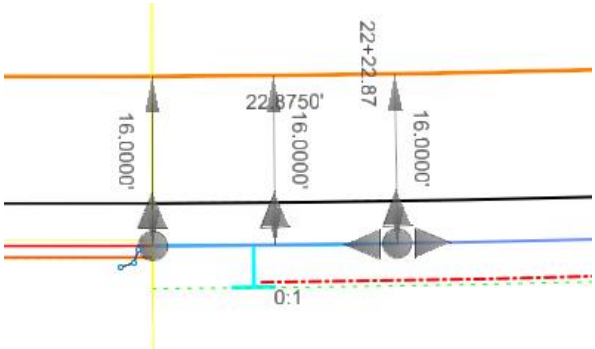


L. Left click to the end of the bridge rail to set the start offset and start station.

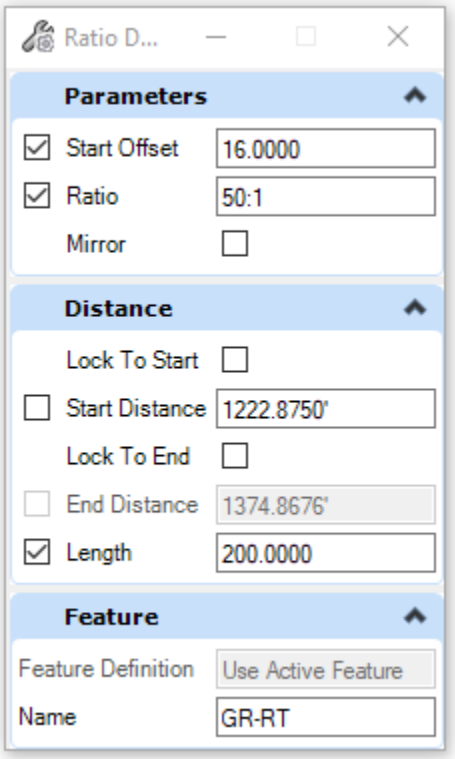


M. Use the <LEFT> arrow key to toggle to the length input and enter 22.875’. <ENTER> to lock and left click to accept.

N. Set the mirror option to NO and left click to accept, this will create the structure anchor unit parallel to the centerline.

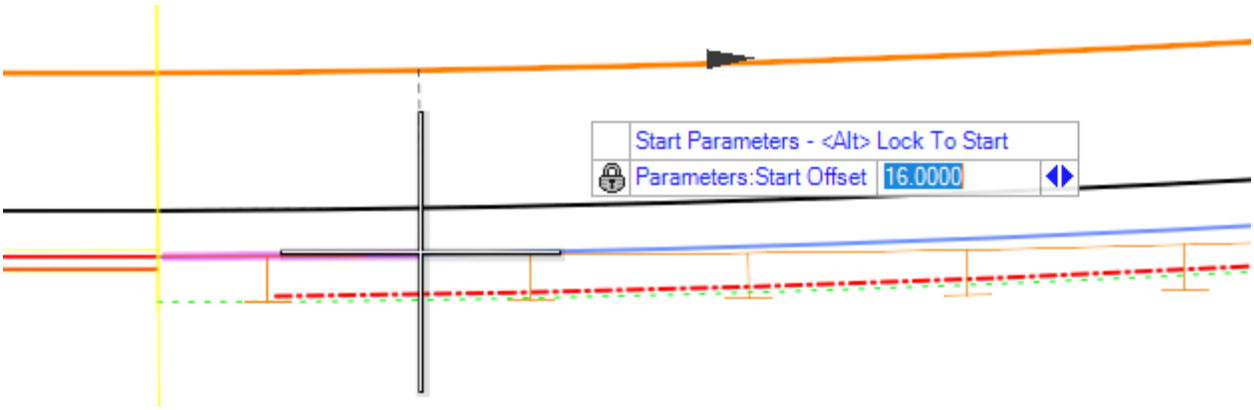


O. Next use the **Ratio Offset Taper** tool to create a guardrail element that tapers from 16.00’ offset to a 20.00’ offset on a 50:1 ratio.

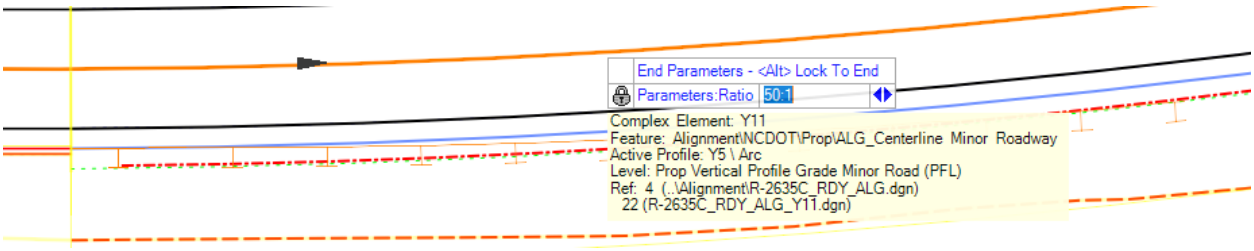


P. Left click to accept the Y11 centerline as the reference.

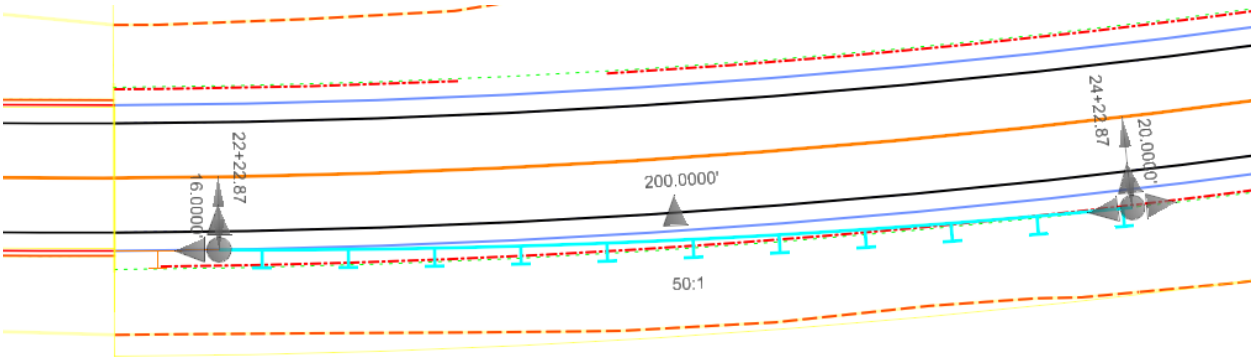
Q. Snap to the end of the preciously placed guardrail element to set the start point and left click to accept the 16.00’ beginning offset.



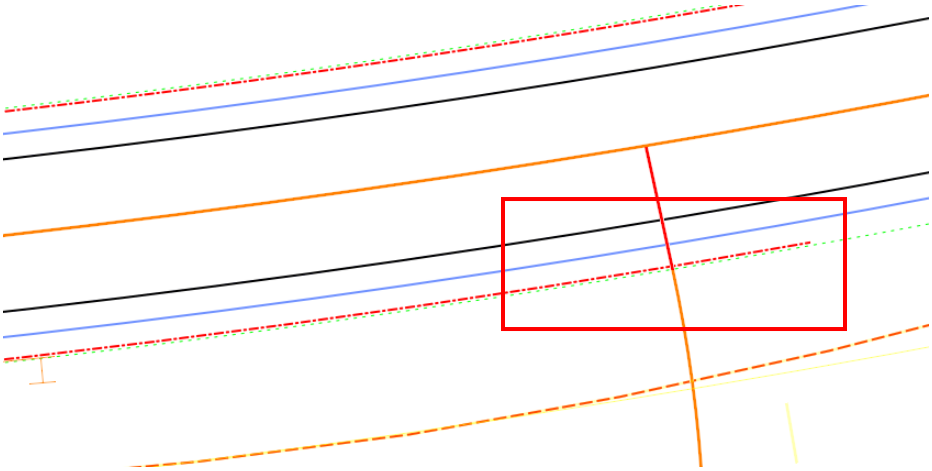
R. Place the cursor so the solution is line ahead and left click to accept the 50:1 taper.



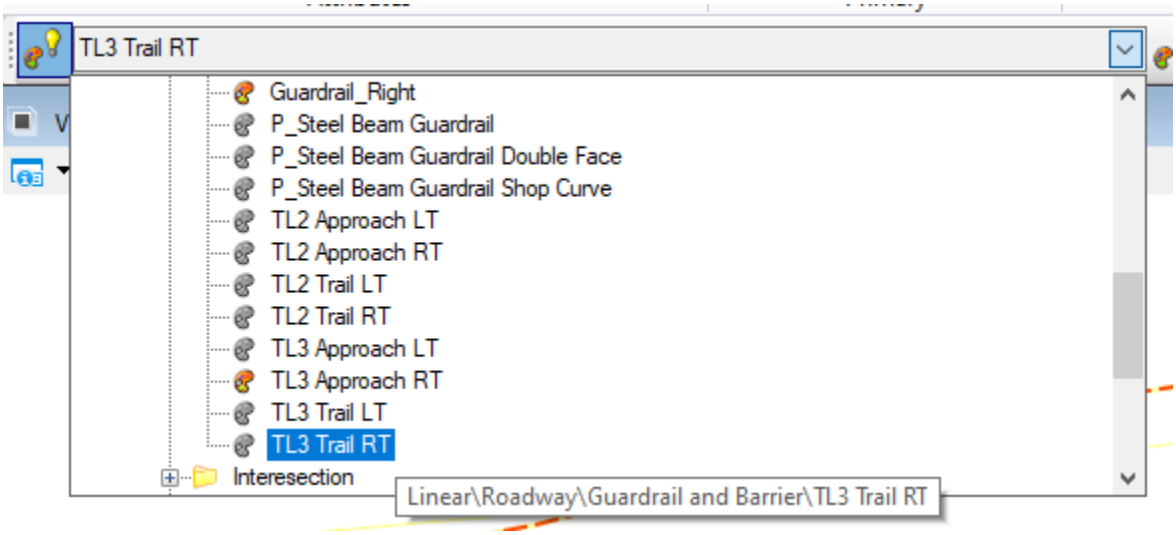
S. Left click to accept the mirror option as no. This will place the guardrail element.



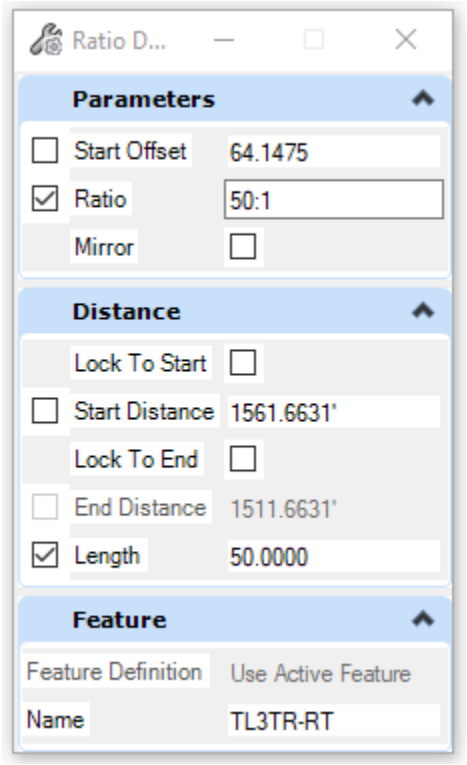
T. Because the guardrail fill warrant goes through the intersection with Y9, as shown by the red flag line.



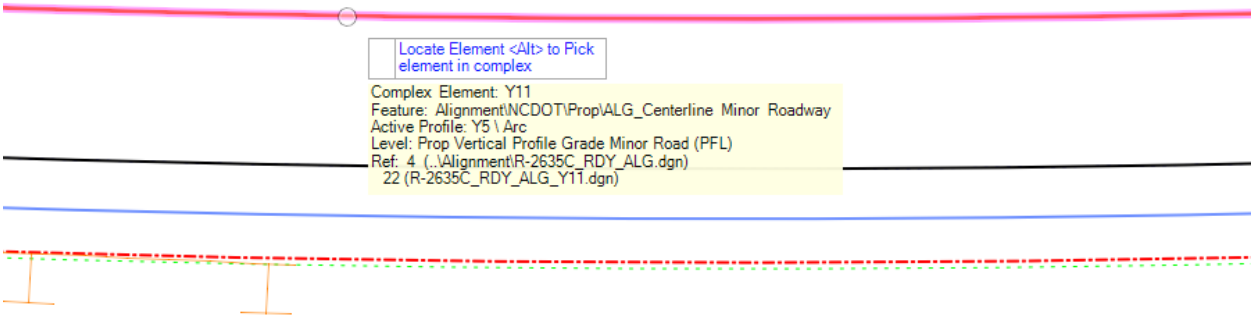
U. Add a Type TL-3 Anchor unit to the end of the previously placed guardrail and terminate the guardrail prior to the Y9 intersection. The Anchor Units are also line styles, but they will have the appearance of a cell. Set the Active Feature definition to TL3 Trail RT. It is important to use the correct feature definitions, the line styles used with ruled geometry and that have 3D components cannot be "flipped" around as easily as they could in SS2.



V. Select the **Ratio Offset Taper** tool. Set the dialog for 50:1 Taper and 50.00’ Length.

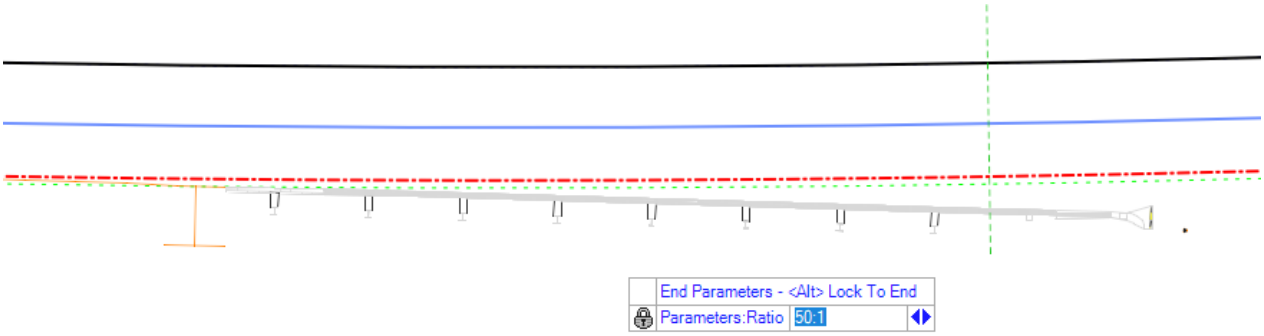


W. Left click on the Y11 centerline to select the reference element.



X. Snap to the end of the guardrail to set the offset and start station. Because this feature definition functions more like a cell than a line style the guardrail end unit is visible.

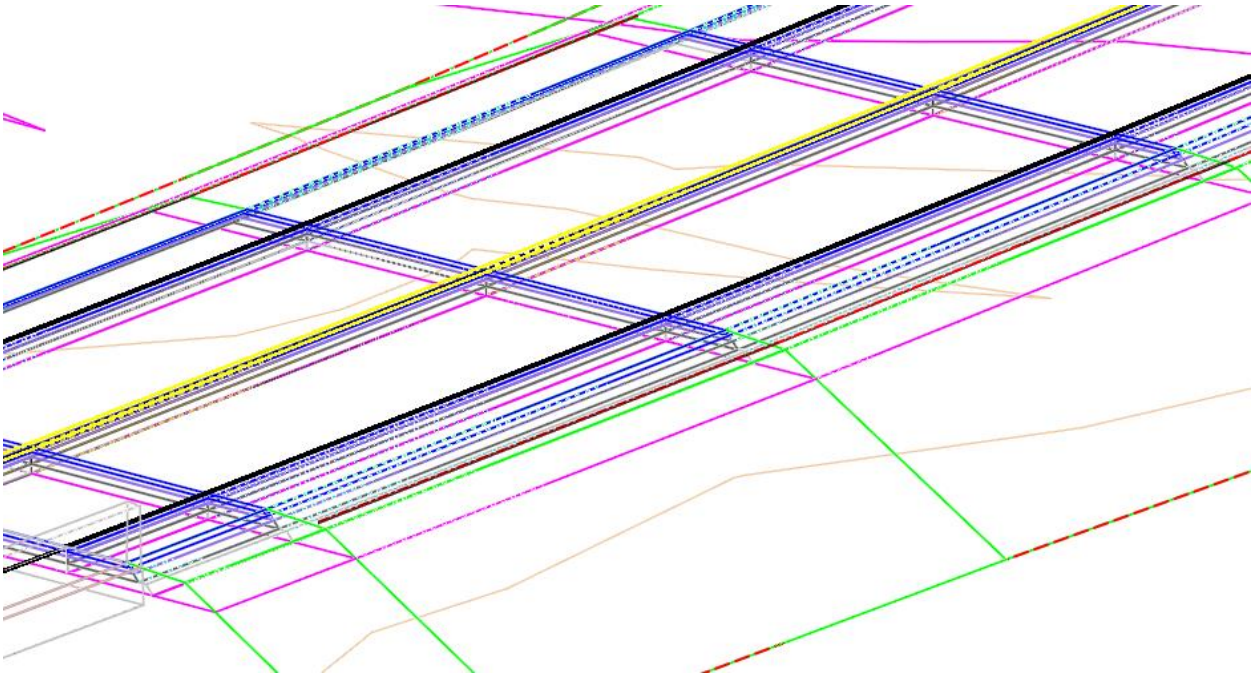
Y. Position the cursor so the end unit faces the correct direction and left click to accept the taper ratio of 50:1



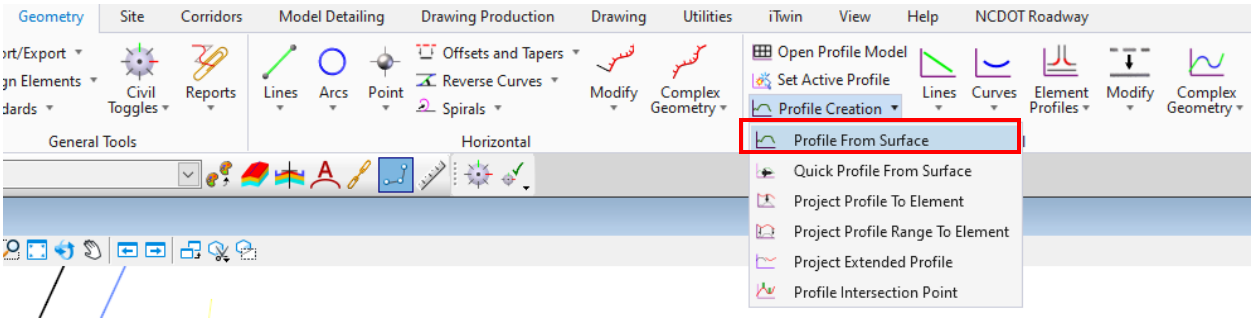
Z. Left click to accept the mirror option of NO and finish the end unit placement.

2. Profile Guardrail Elements

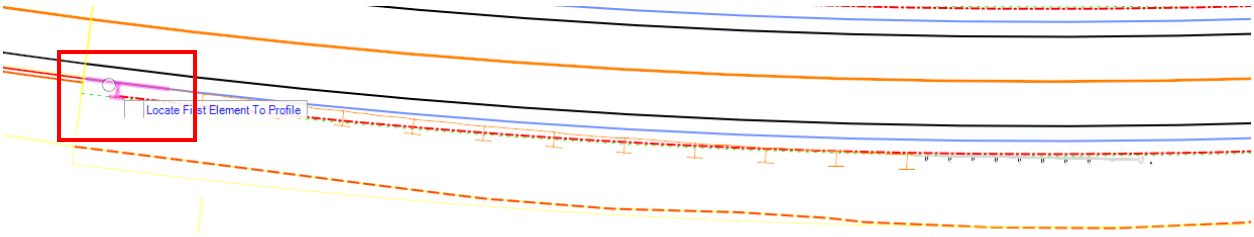
A. The guardrail elements are now placed in the 2D DSN file. At this point they will not display in the Default 3D model because they do not have any vertical components.



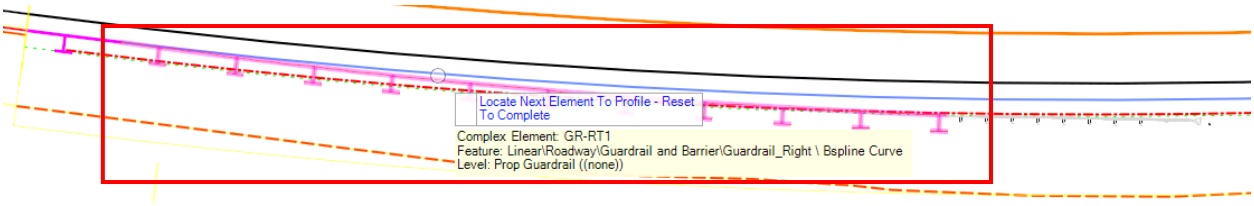
B. To add a vertical component to the guardrail elements we will get the elevations from the Y11 corridor. Start the **Profile From Surface** tool located in the *Vertical* section of the *Geometry* ribbon. This tool can add profile to multiple elements at the same time based on one or more surfaces, existing or proposed.



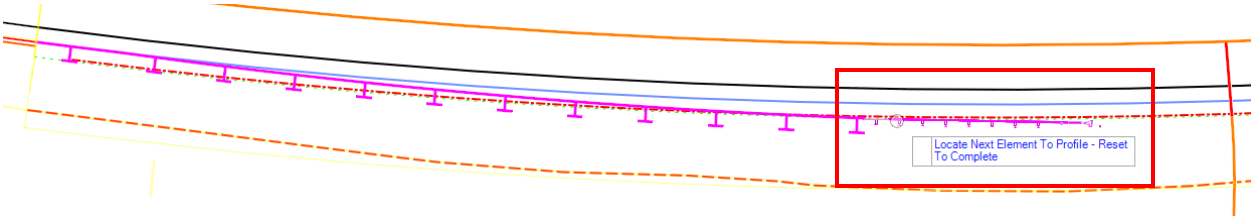
C. At the heads-up prompt left click on the first guardrail section to locate the element to profile.



D. Left click on the middle section to locate the second element

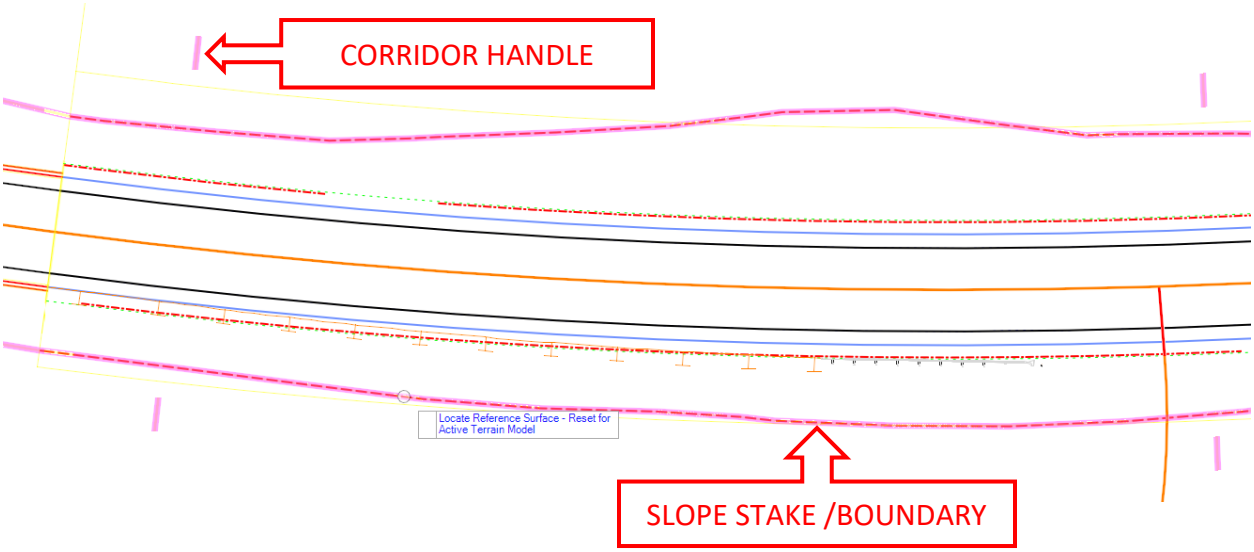


E. Left click to accept the end unit.



F. Right click to “Reset” and finish the selection process.

G. Left click to locate the surface which will be used to profile the selected elements. In this case use the proposed Y11 corridor. This can be selected by left clicking on the slope stake line, which is the boundary of the corridor, or the corridor handles.



H. For point Selection use the <DOWN> arrow key to toggle to ends and left click to select. This will base the profile on a straight line grade between the end points of each individual element. The elevation at each end point is based on the elevation of the proposed surface.

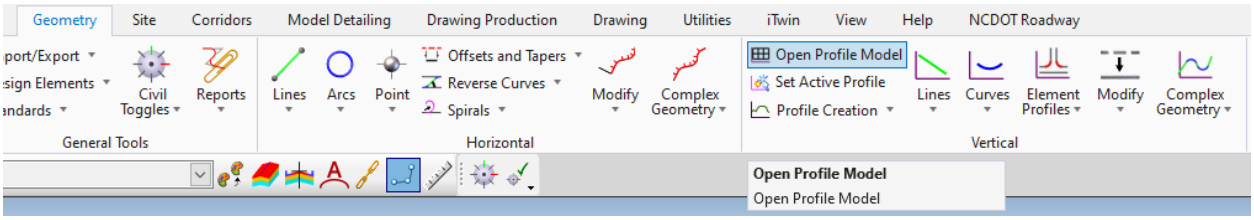
I. The other profile options are
   - Centroid
     1. Will set a flat profile based on the elevation at the centroid of the element
   - All
     1. Will set a profile that utilizes the entire element, depending on the element and the relationship to the proposed surface and template drops this option is not always the most appropriate but can produce the most accurate profile when used in the correct situation.
   - Vertices
     1. This will set a profile at all the vertices and would be used for a complex element. For simple elements this will produce the same result as the ENDS option.

J. Left click to accept profile adjustment as None. The other options are Minimum and Maximum. These options will set a flat grade profile at the Minimum or Maximum elevation of the reference surface based on the method chosen in the previous step.

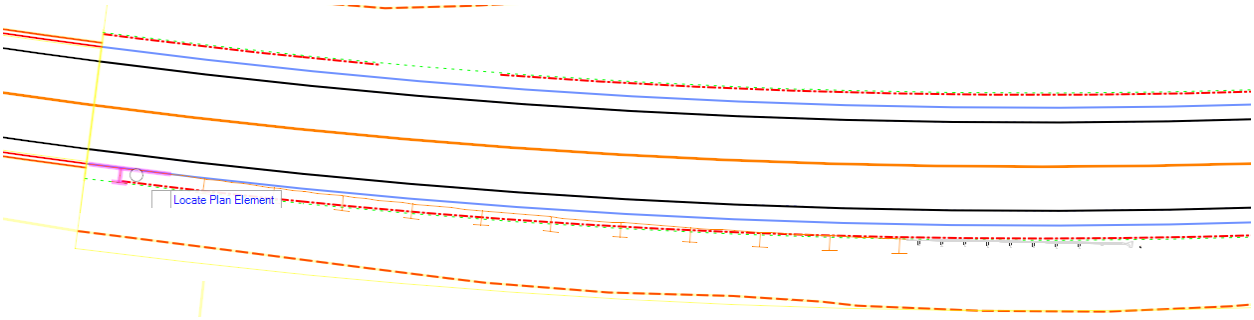
K. Left click to accept Horizontal Offset of 0.00’

L. Left click to accept vertical offset of 0.00’

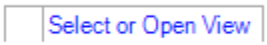
M. That completes the profile process. The last step is to set the profiles active. Remember that a single horizontal element can have many associated profiles but only one profile can be active at any time and the user must select which profile to use. Select the **Open Profile Model** tool.



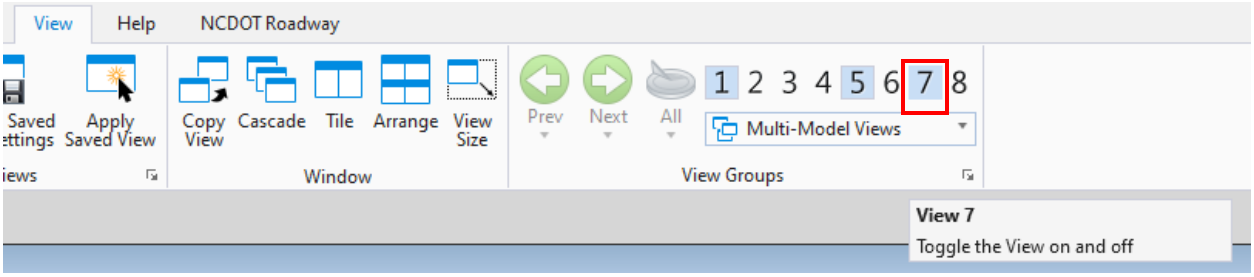
N. At the prompt left click to locate the first guardrail section.



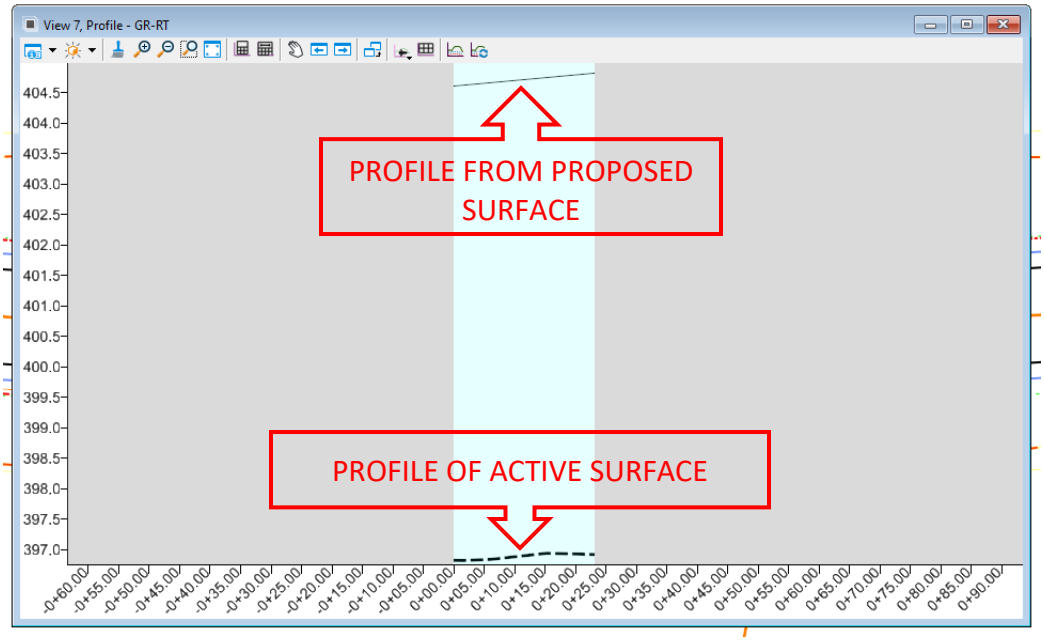
O. When prompted to Select or Open View



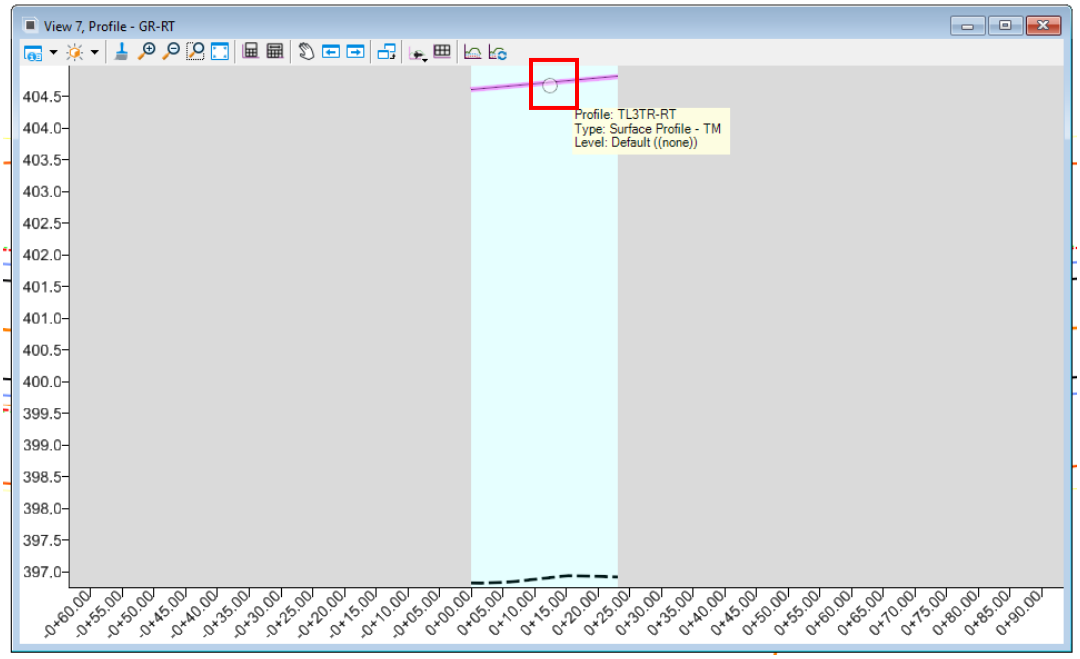
P. Switch to the *View* ribbon and open any of the unused views from the *View Groups* section.



Q. Left click in the view to open the profile model.

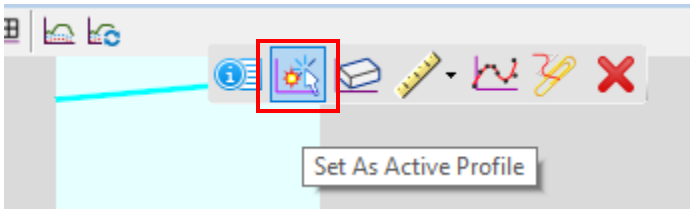


R. Use the **Element Selection** tool to highlight the profile from the proposed surface.

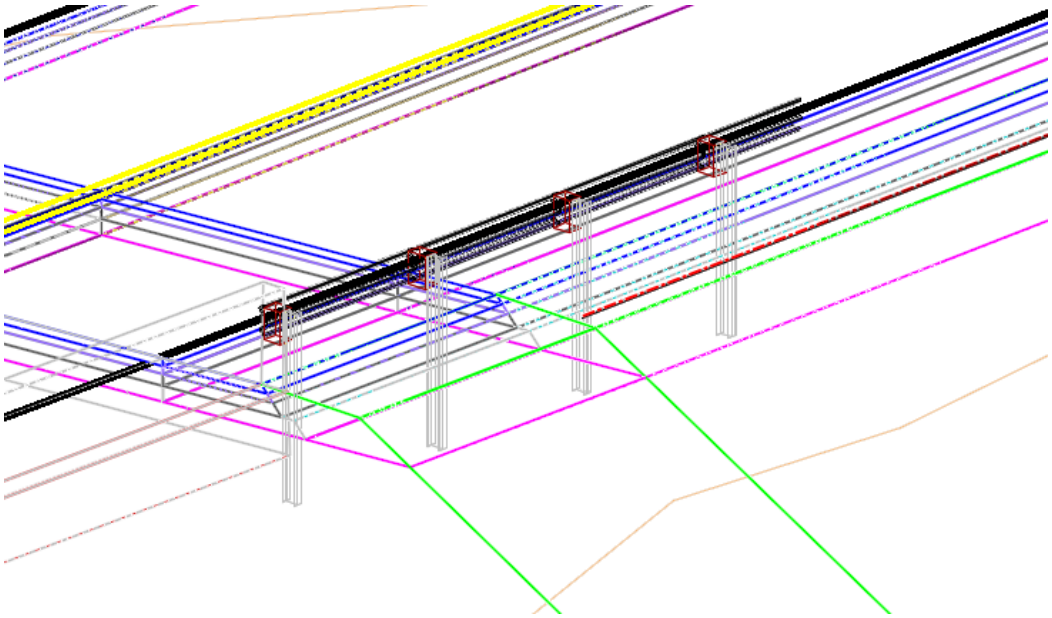


S. Move the cursor off the profile and then back on to activate the pop-up context menu bar.

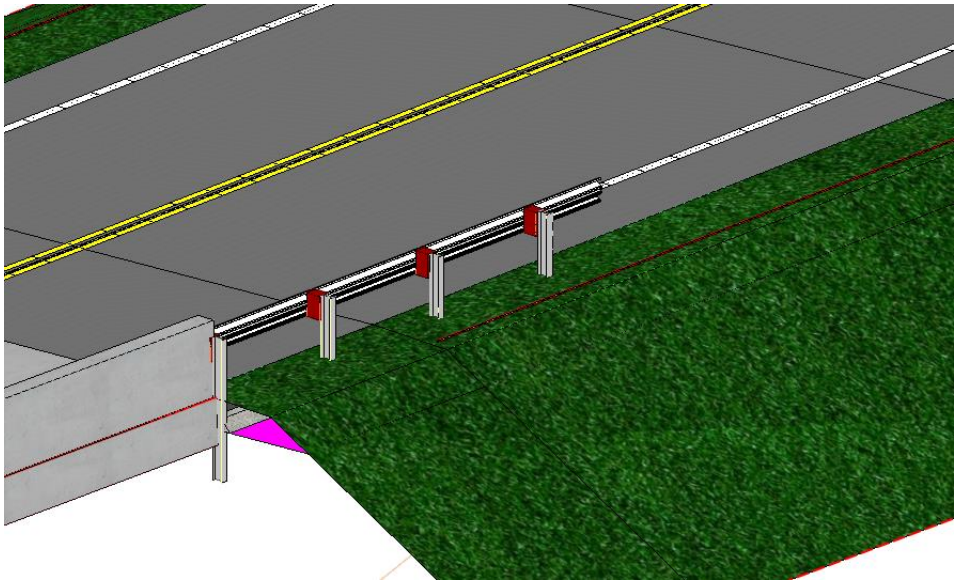
T. Select the Set as Active Profile icon



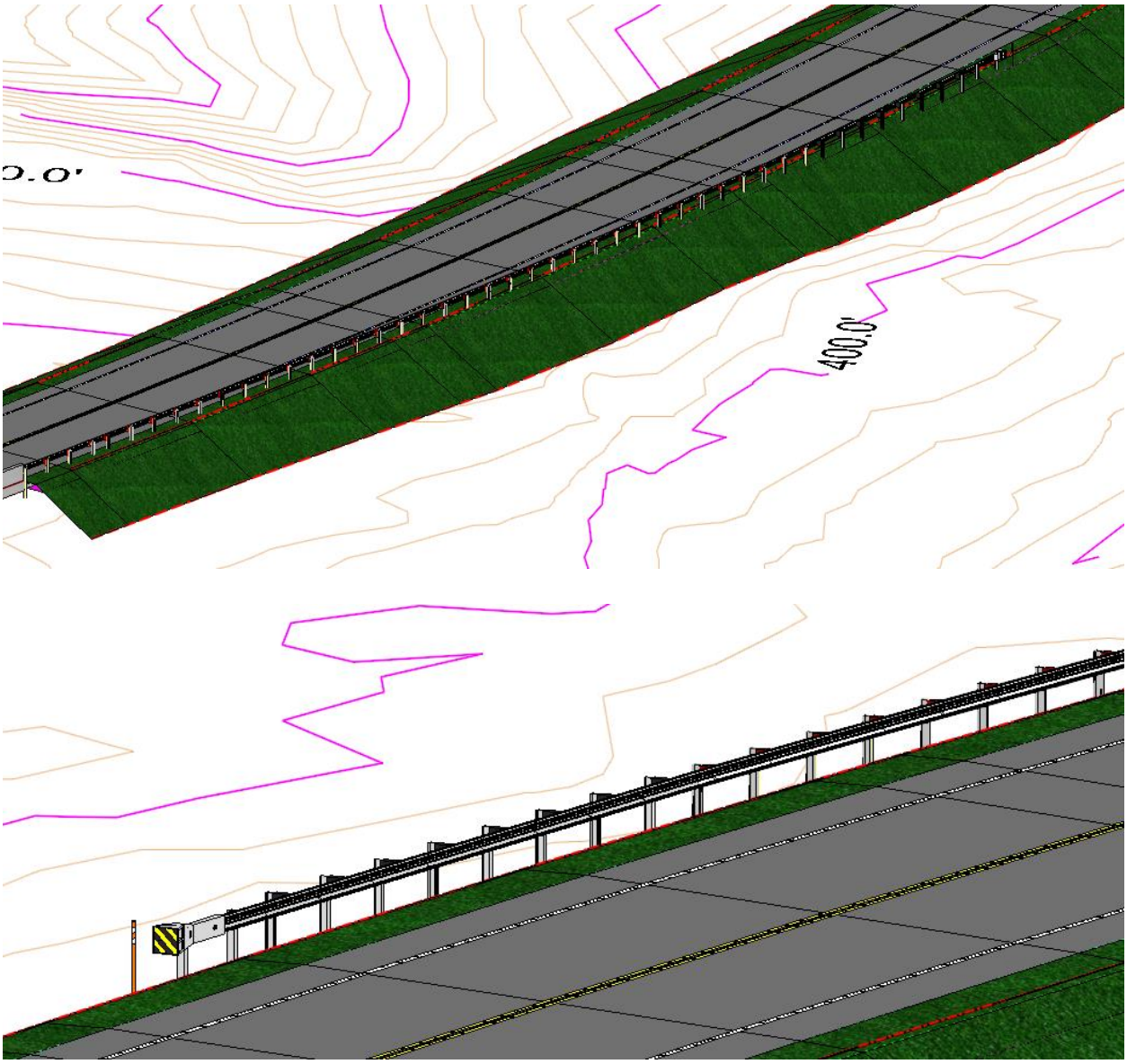
U. Note in the Default 3D model that the Guardrail Element is now visible at the correct elevation. In the standard wireframe view.



Or in the Illustration Ignore Lighting View

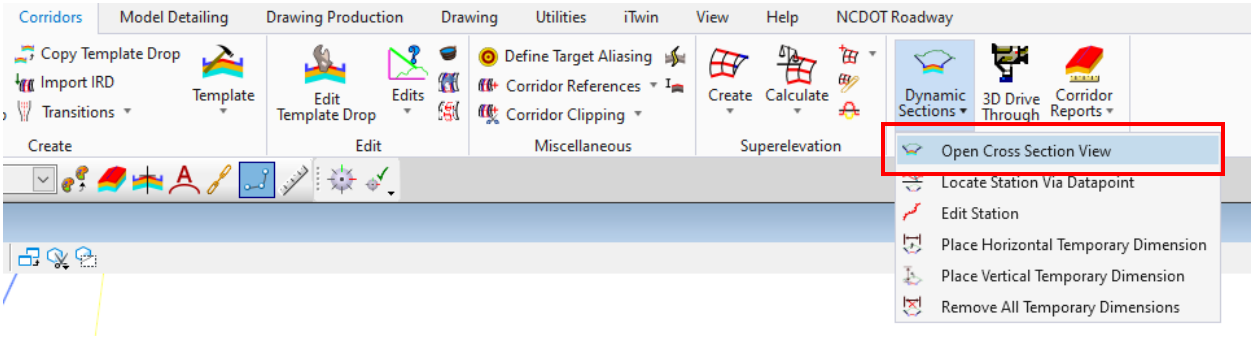


V. Repeat the process of setting the active profile for the last two guardrail elements. Note that it may be necessary to use the **Element Selection** tool to clear the selection of the previous element before opening the next profile model. Each new profile model can be opened in the same window. After setting the active profile for each element all the guardrail should be visible in the Default 3D model.

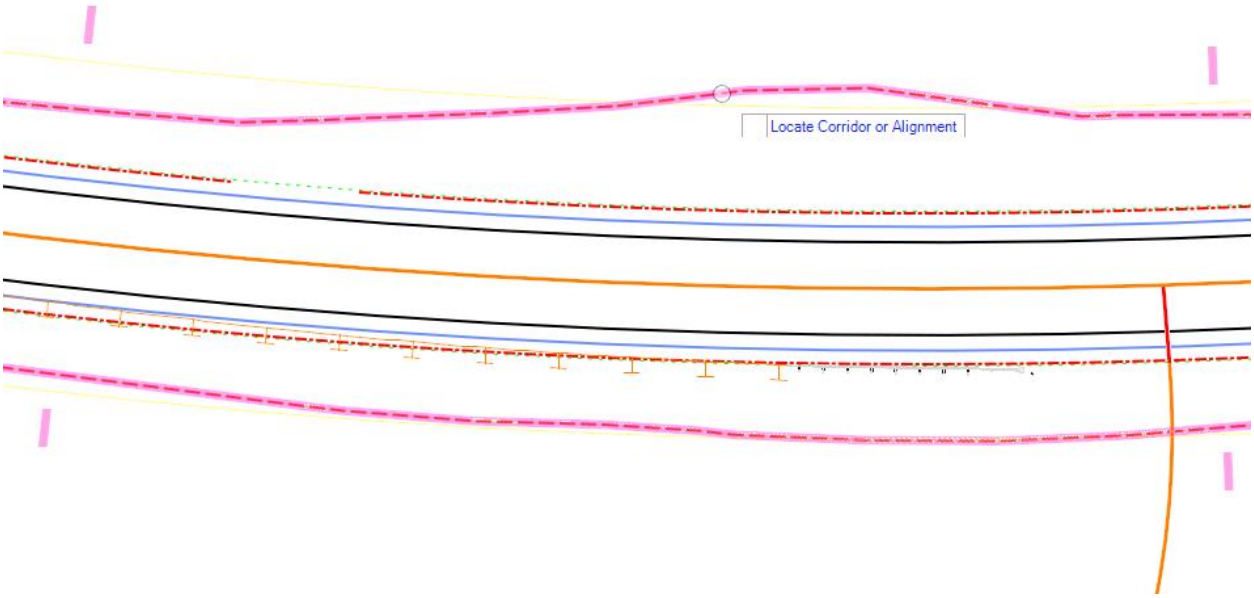


3. Guardrail in Dynamic Sections

A. To see the guardrail in the sections, select the **Open Cross Section View** tool in the Dynamic **Sections** tool group located in the *Review* section of the *Corridors* ribbon.

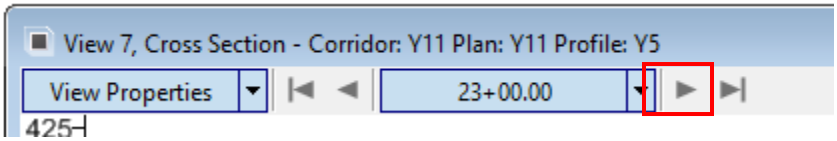


B. At the prompt locate the corridor by left clicking on the corridor. Note that the guardrail will only be visible in the dynamic section by selection the Corridor. If the centerline option is selected the guardrail and the guardrail flags will not be visible.



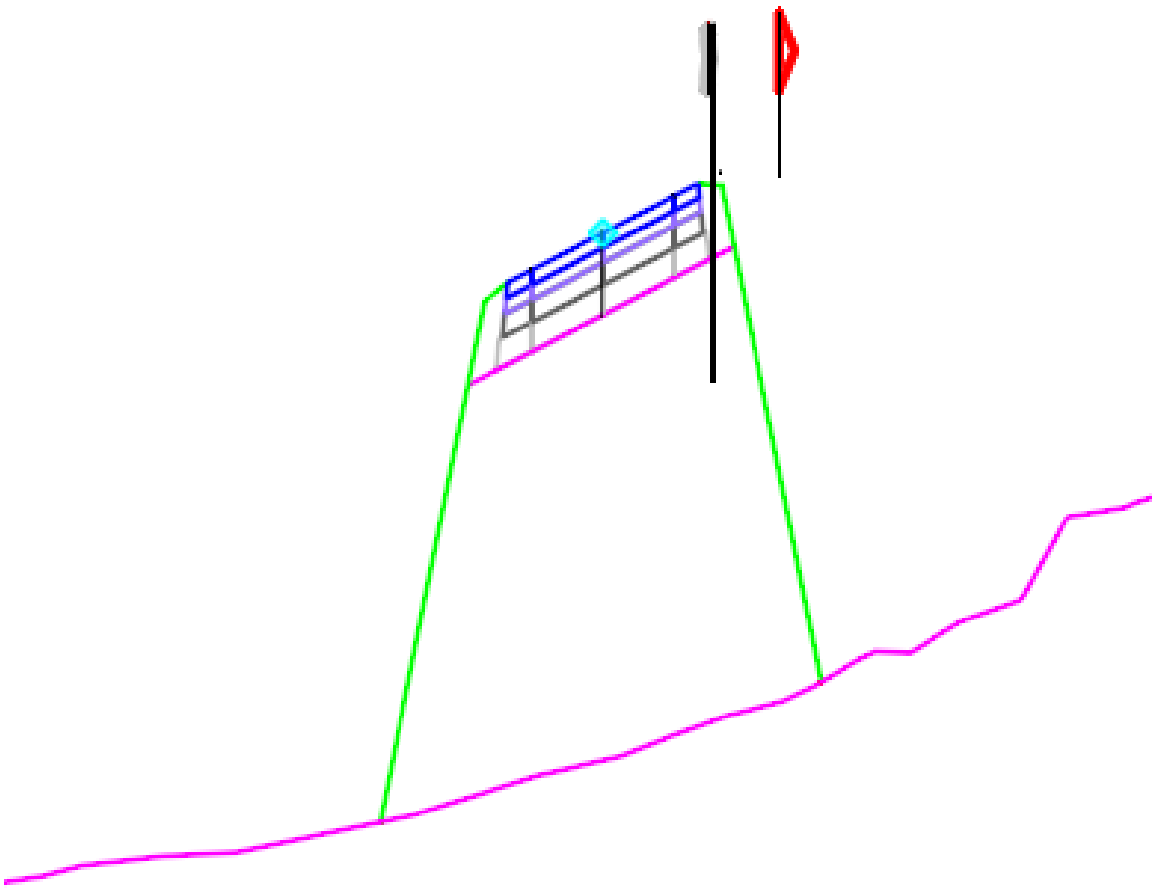
C. Select or Open a new view. This is the same process as opening a profile model view. Either click in the open profile model to change it to a cross section model or open a new view and left click in the view to activate the cross-section model.

D. Use the arrow key at the top to step through to station 23+00.



E. Note that currently there is no option for a pull down list to navigate directly to station 23+00.00 like the navigator in SS2. Also note that because the dynamic cross section view is based on the corridor the bridge sections will be skipped, if the centerline had been chosen as the reference the bridge sections would be visible, but the guardrail would not.

F. Below note the guardrail, this is not actually the 3D line string but instead the program reads the 3D line string and places a cell at that location, so the guardrail will always show a post even if the section is in between the post spacing. Also note the Red flag that indicates a fill warrant location.



G. The final step would be to modify the shoulder point to match the standards. This process is covered in the training modules dealing with modeling.

DSN Drafting – Superstreet

In this section we will focus on some of the possible tools and methods that could be used to create typical superstreet geometry. This will include turn lanes and tapers, U Turn Bulbs.

All the concepts can be applied to the Construction Class elements used in the CMD to control the model.

1. Superstreet Layout – Edge of Travel and Raised Median

A. In this exercise we will work through the layout of a superstreet intersection, including the median cross over and the bulb turnarounds.

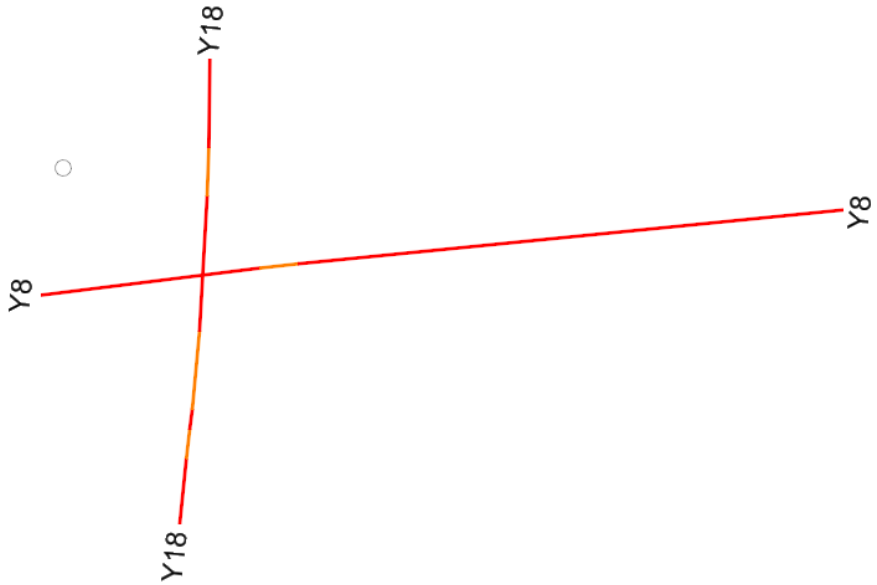
B. Path to the superstreet training directory in the Module 7 Plan Geometry data set.
C:\NCDOT Training\Roadway\Module 7 Plan Geometry\Superstreet

C. Create a new DSN file – ***R-2635C_RDY_DSN.dgn*** using the 2D seed file.

D. Attach the ETM file and FS file from the FinalSurvey Folder and the ALG file set to a nesting depth of 1 from the Alignments folder. Set the ETM Active to create the Default-3D model view.

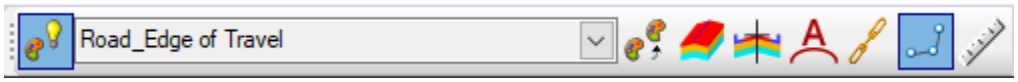
Slot	File Name	Model
1	..\..\FinalSurvey\R-2635C-LS-ETM.dgn	Default
2	..\..\FinalSurvey\R-2635C-ncdot-fs-SS2.dgn	Default
3	..\Alignment\R-2635C_RDY_ALG.dgn	Default
4	R-2635C_RDY_DSN.dgn	Default-3D

E. Turn off the ETM and the FS references.

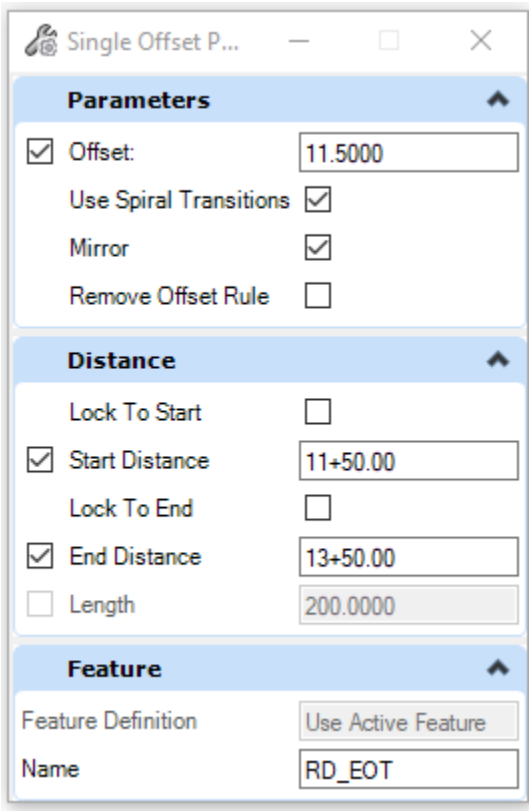


F. For this exercise, the superstreet will be along Y8 and Y18 will be the intersecting roadway. Both roads will be 2'-6" curb and gutter typical sections.
   - Y8 will be based on a 23' raised median with 1'-6" curb and gutter median and 2 lanes in each direction.
   - The Y8 drafting will begin at station 11+50 and end at station 35+00
   - Y18 will be 24' wide with one lane in each direction
   - The Y18 drafting will begin at station 18+50 and end at station 36+00
   - The superstreet layout will be based on the dimension in the NCDOT Roadway Design Manual section 9-4 Fig 1.

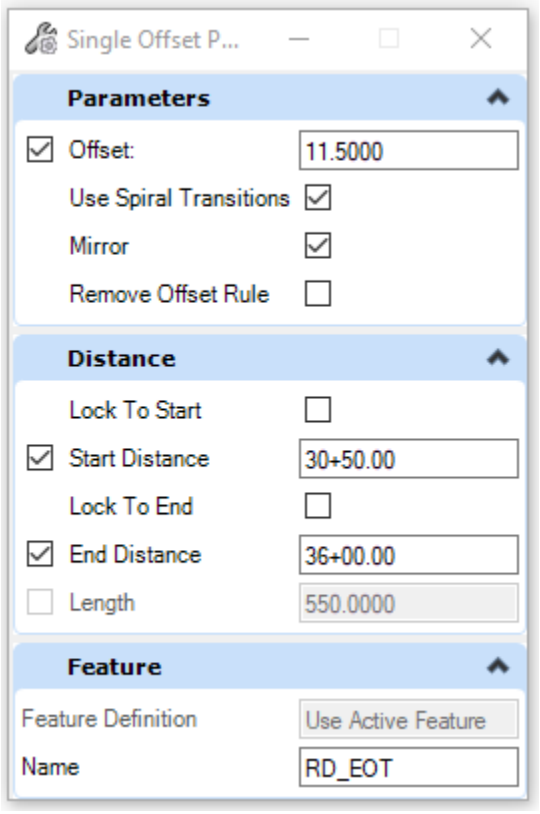
G. Start by creating the Edge of Travel lines for both roadways. Set the Active Feature Definition to Road_Edge of Travel.



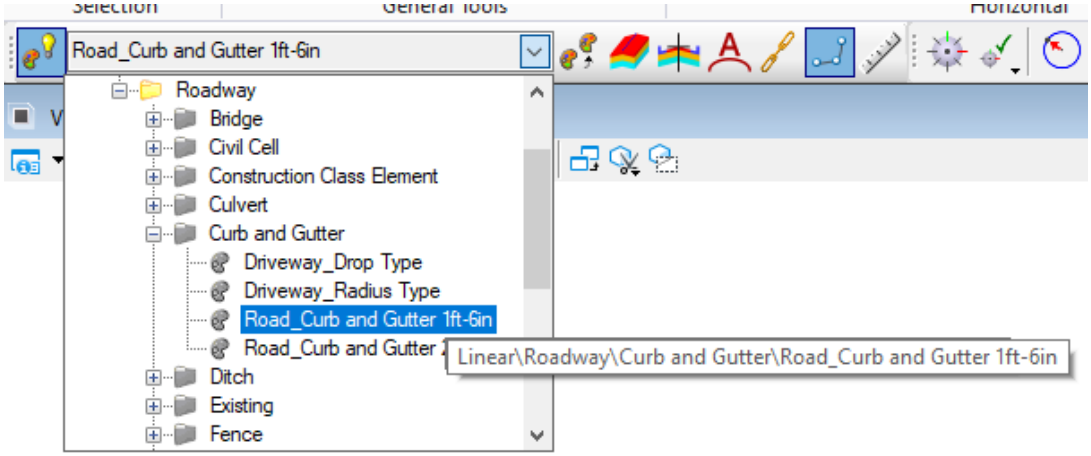
H. Use the **Single Offset Partial** tool to create median Edge of Pavement lines along Y8 at an Offset of 11.50' on both sides. Start the lines at station 11+50 and end at 13+50. This dialog box should be set to match this.



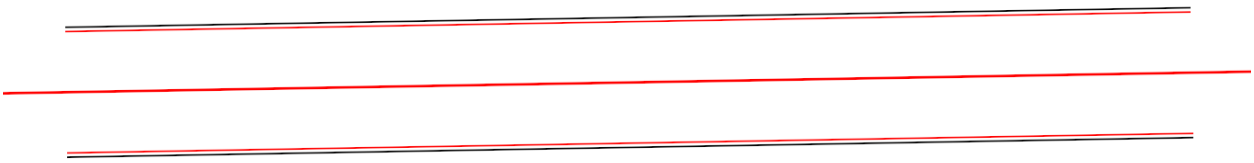
I. Using the same tool create the remaining median Edge of Travel Lines along Y8 from 30+50 to 36+00.



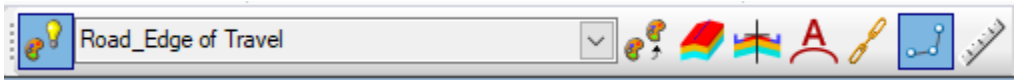
J. Change the Active Feature Definition to Road_Curb and Gutter 1ft-6in



K. Use the **Single Offset Entire Element** tool to offset the median edge of travel line 0.75’.



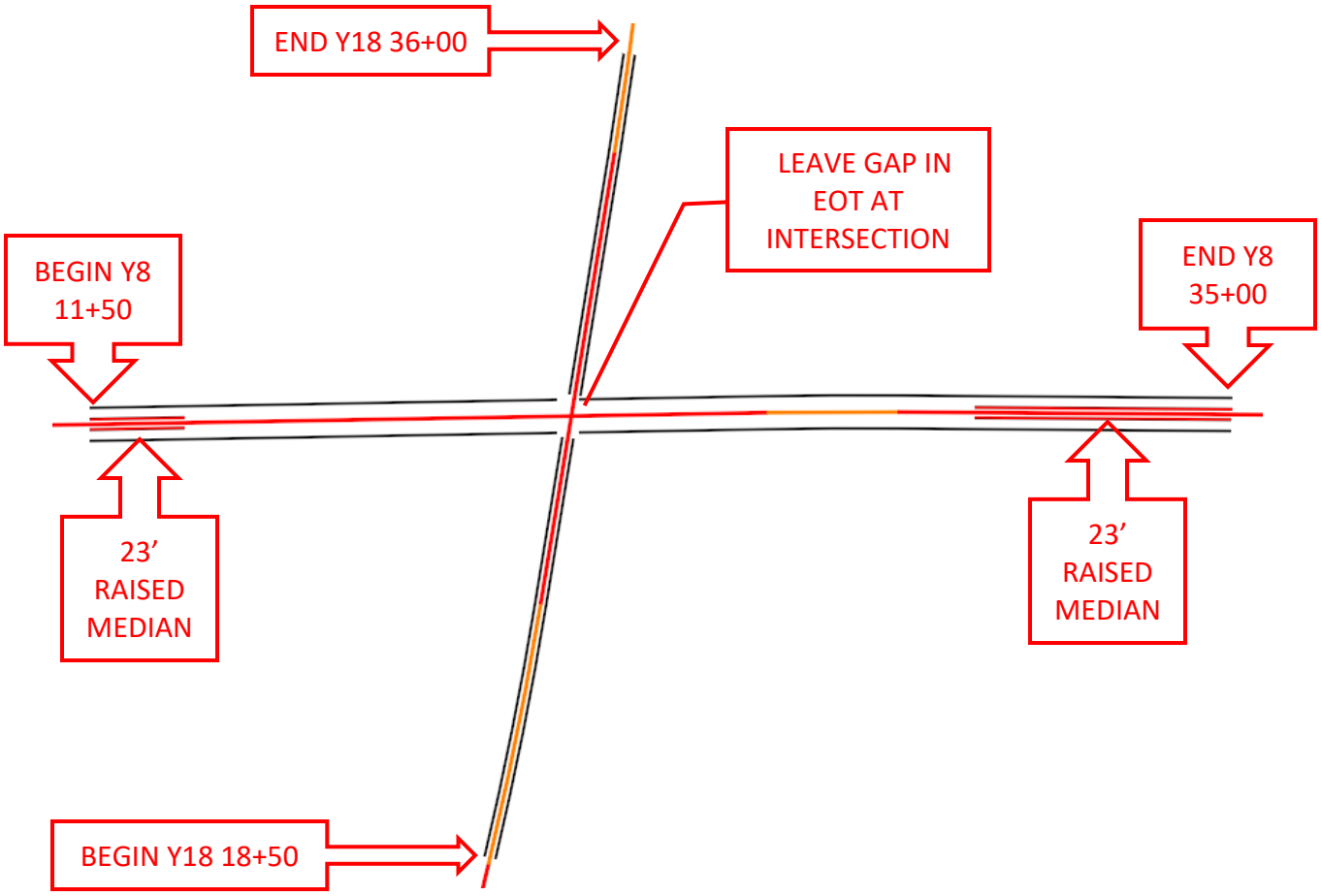
L. Change the Active Feature Definition to Road_Edge of Travel



M. Use the **Single Offset Partial** tool to create the Left and Right outside edge of travel for Y8.
   - The offset to the edge of travel is 35.50’.
   - Create the elements in two sections, this will eliminate an interval at the intersection with Y18
     1. Station 11+50 to 21+50
     2. Station 22+00 to 35+00
     3. These stations can be set in the dialog box
   - Do not create the 2’-6” Curb and Gutter line yet, we will do that after the design is completed.

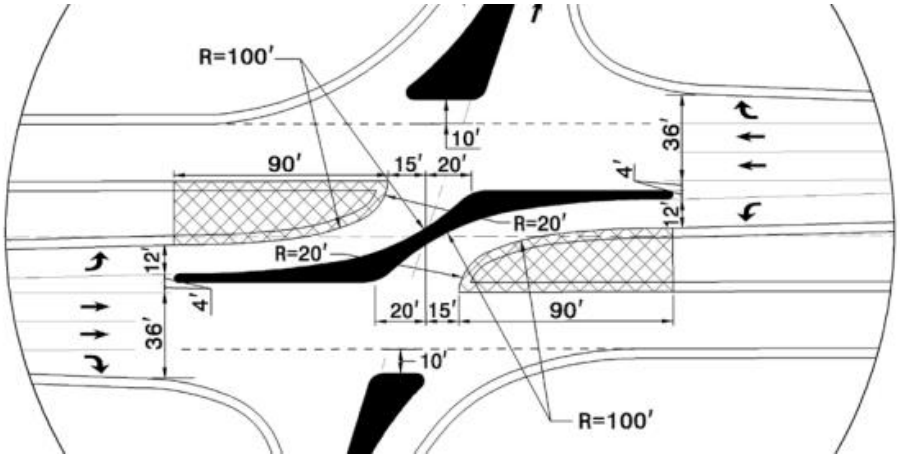
N. Use the Single offset Partial toll to create the Left and Right edge of travel for Y18.
   - The offset to the edge of travel is 12’
   - Like Y8 create the elements in two sections, do not offset the element through the intersection. The stopping and starting station near the intersection is not important, just pick a point close to the intersection we will fill it in later with Arcs.
   - The Start station on Y18 is 18+50
   - The End Station on Y18 is 36+00

O. This completes the basic edge of travel and median setup.

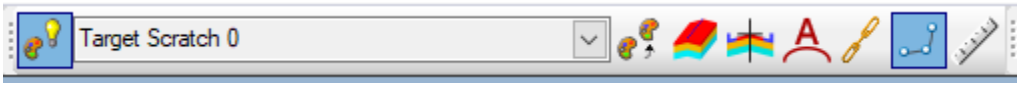


2. Superstreet Layout – Center Crossover Island

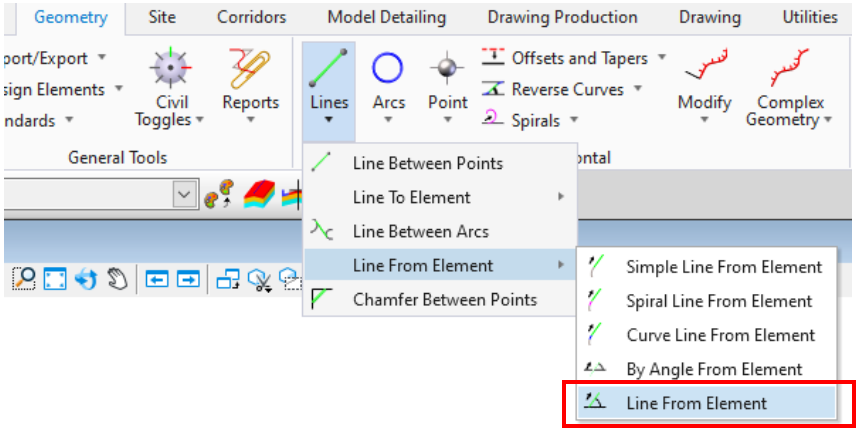
A. In this exercise we will layout the central crossover island.



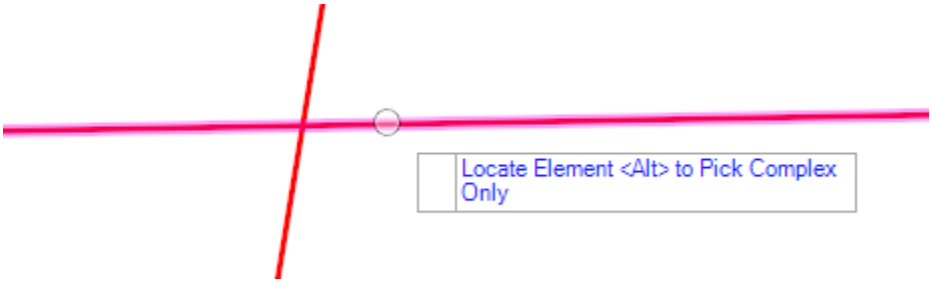
B. To start the process of laying out the island we will need a reference line to base all the offsets and measurements from. This line will be perpendicular to Y8 and located at the intersection of Y8 and Y18. This is the center point of the crossover median. Set the Active Feature Definition to Target Scratch 0



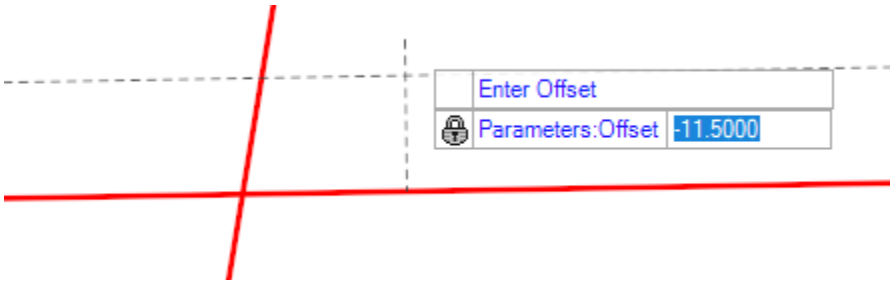
C. Start the **Line From Element** tool.



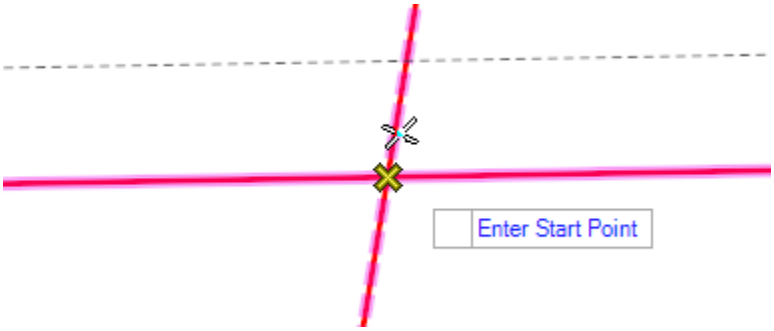
D. Left click to locate the Y8 centerline as the reference element.



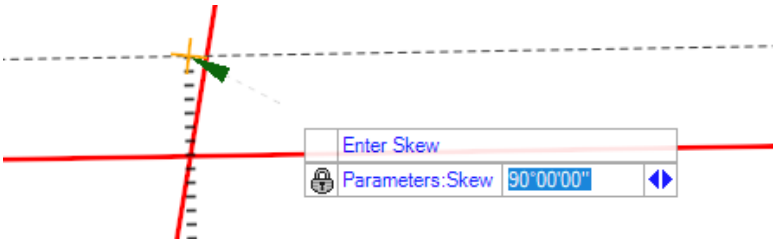
E. Enter a starting offset of -11.50’ and left click to accept. This distance is critical it could be anything.



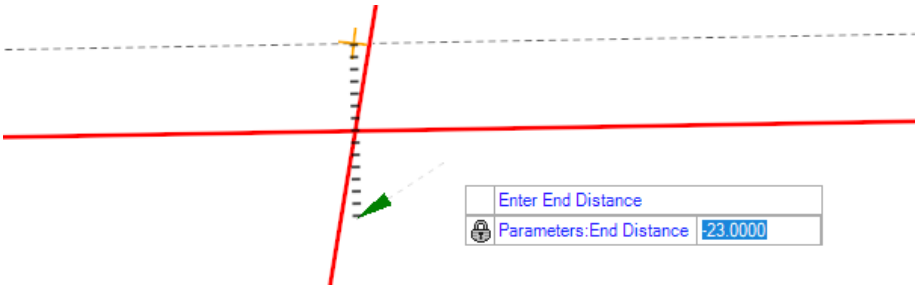
F. Snap to the intersection of Y8 and Y18 to set the start point.



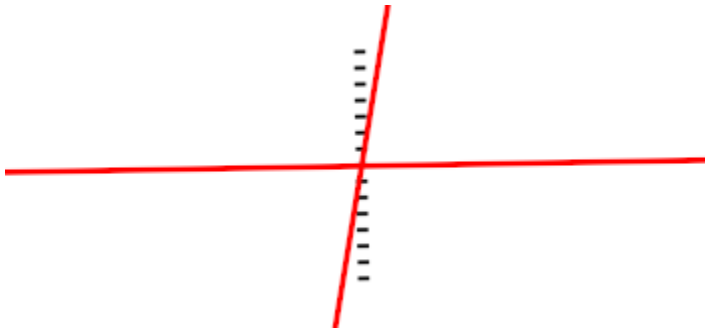
G. Enter 90°00’00” for the skew and left click to accept.



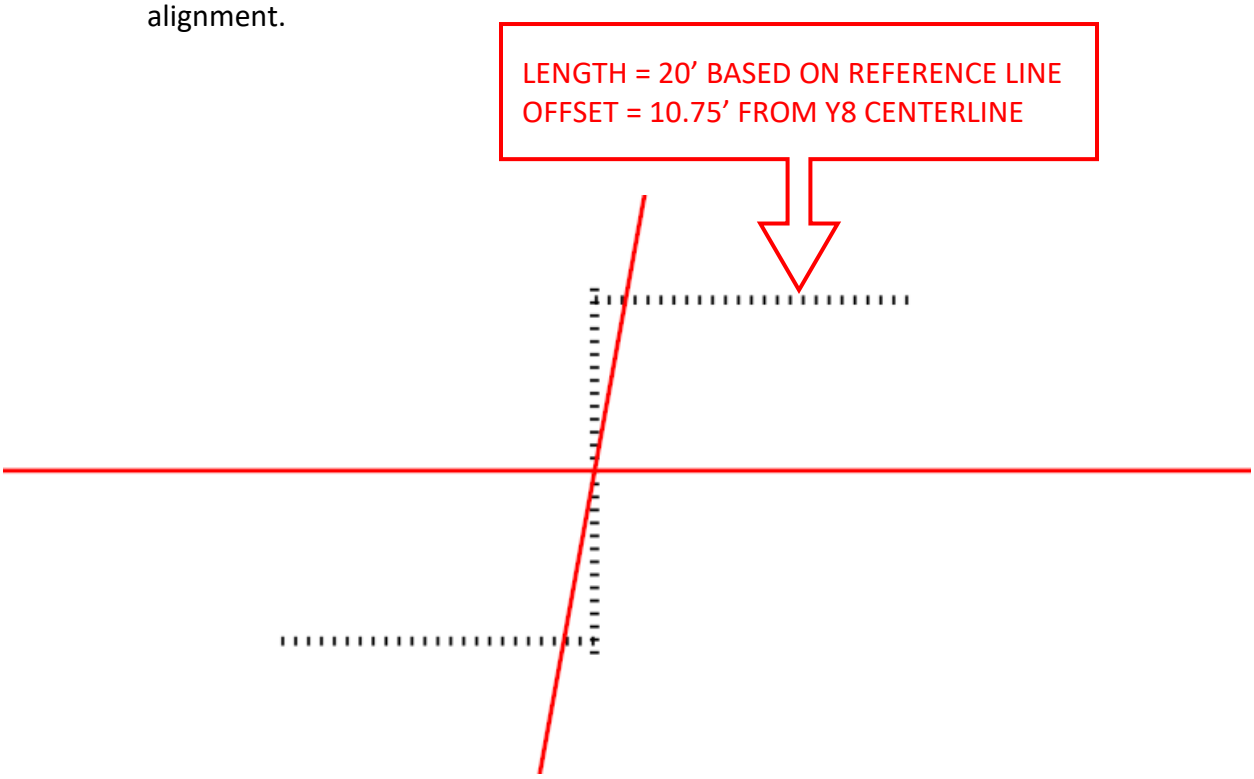
H. Enter -23.00’ for the end distance and left click to accept.



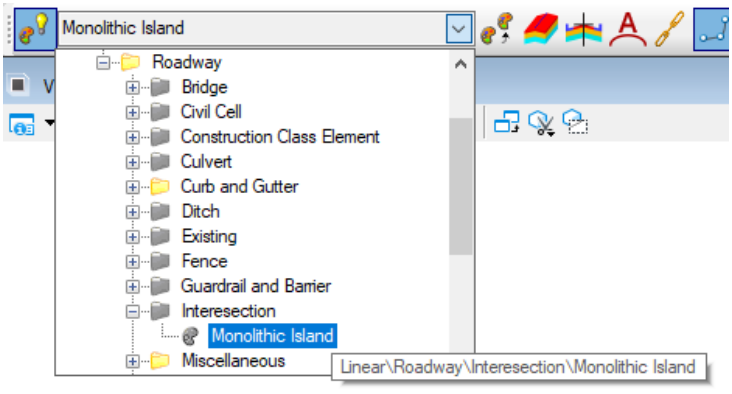
I. This will create the reference line perpendicular to Y8 located at the intersection of Y8 and Y18.



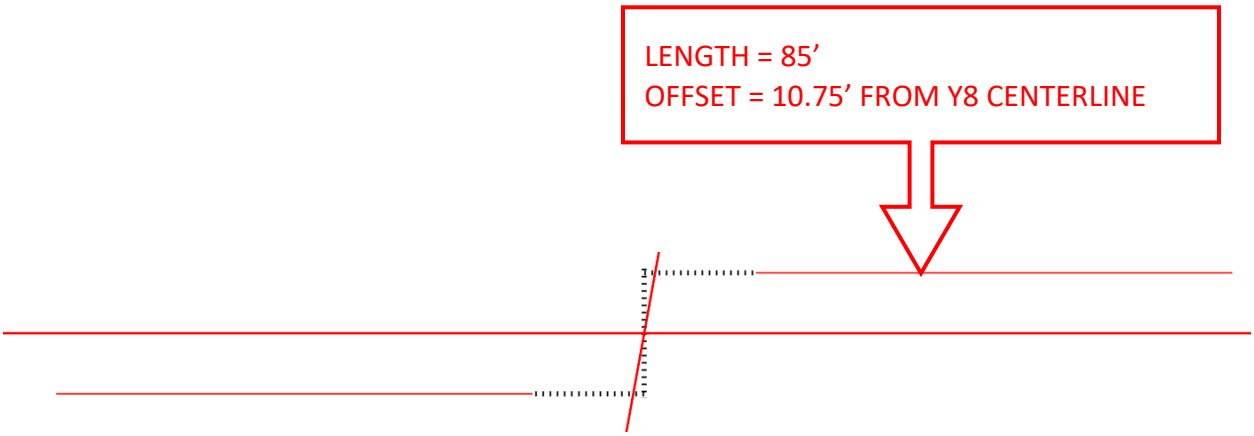
J. Based on the standard the end of the median island is105’ from the reference line in each direction and the intersection of the cross over portion is 20’ from the reference line. For a 23’ wide median the offset to the outside edge of the island is 10.75’. This first step will be to mark the intersection location of the crossover portion of the island. To create this portion of the island, use the **Single Offset Partial Element** tool to create a line based on the Y8 alignment at an offset of 10.75’ that starts at the reference line location and is 20’ long. Do this on each side of the alignment.



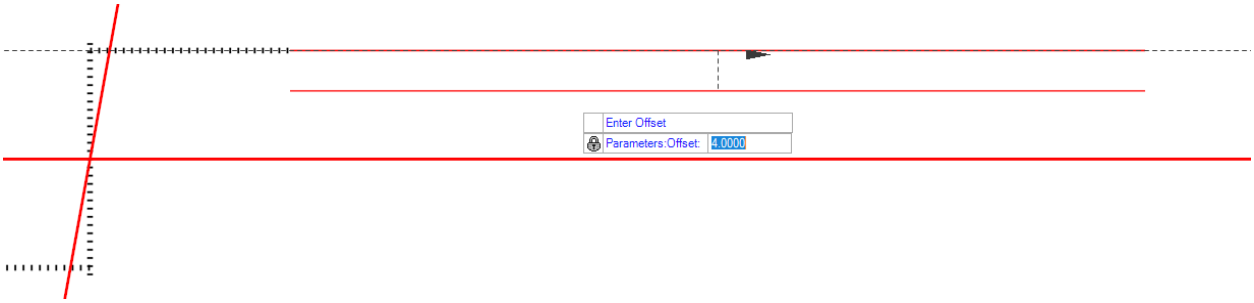
K. Change the Active Feature Definition to Monolithic Island



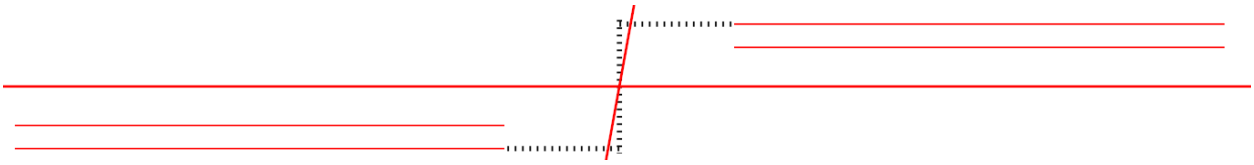
L. Use the **Single Offset Partial Element** tool to create a line based on the Y8 alignment at an offset of 10.75’ that starts at the end of the previous line and is 85’ long. Do this on each side of the alignment.



M. To create the inside of the island, use the **Single Offset Entire Element** tool and offset the outside island line 4’.

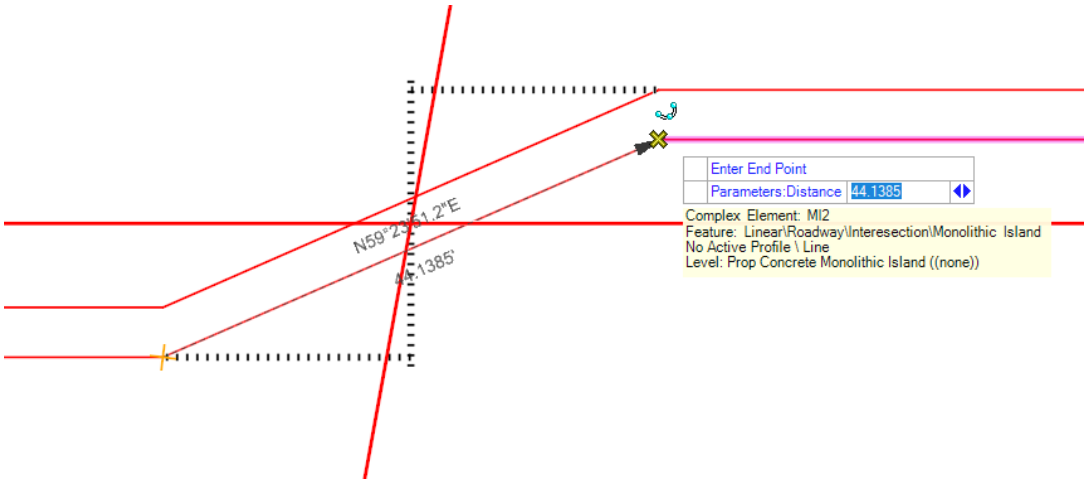


N. Do this for both sides.

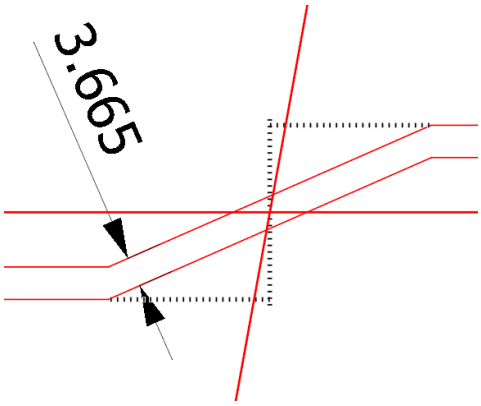


O. It is important to understand that the correct tools to use to create the island are the **Offsets and Tapers** tool and that the Y8 centerline should be used as the reference element. By doing it this way the island geometry will match the centerline geometry. Any arcs in the centerline geometry will be reflected in the island geometry.

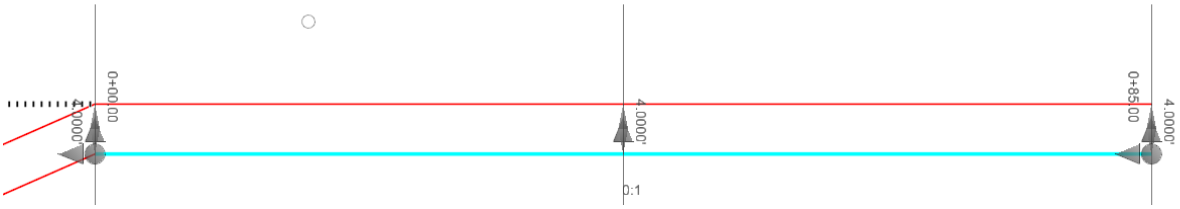
P. Use the **Line Between Points** tool to connect the island components and complete the crossover.



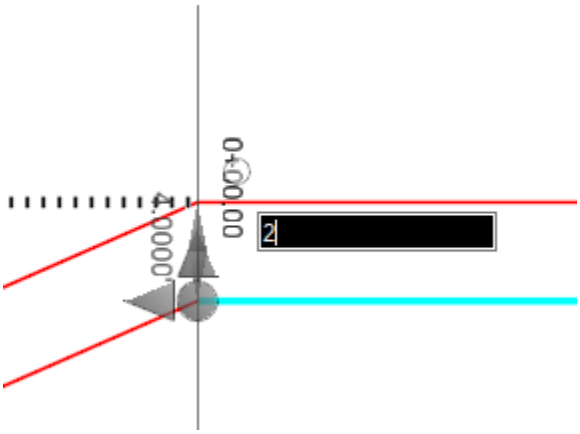
Q. The outside intersection point is known, it is based on the standard, and it has been marked using the reference elements. The inside intersection point will vary slightly based on the median width. This picture shows that the median width for the crossover portion is too narrow, it should be 4.0' minimum.



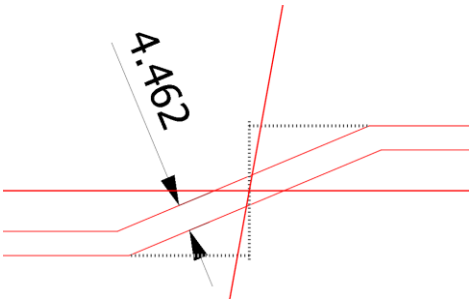
R. To make the island wider we will shift the intersection point back 2.0'. Use the **Element Selection** tool to highlight the inside island line and show the text manipulators and drag handles.



S. Note that the stations shown on the element are 0+00 and 85+00. This is because this element was created as an offset of the outside element, so the stationing shown is based on the outside element, which automatically started at 0+00, and not the centerline. Change the station at 0+00 to 0+02. This will move the intersection point by 2'.

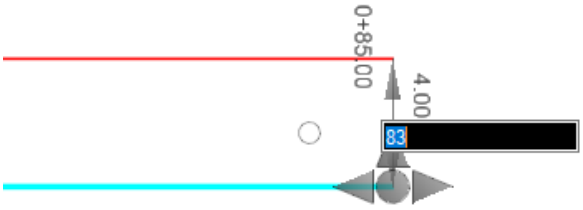


T. Repeat the process for the other side. The crossover portion will automatically update because of the snap rules that were created when placing the element using the **Line Between Points** tool.

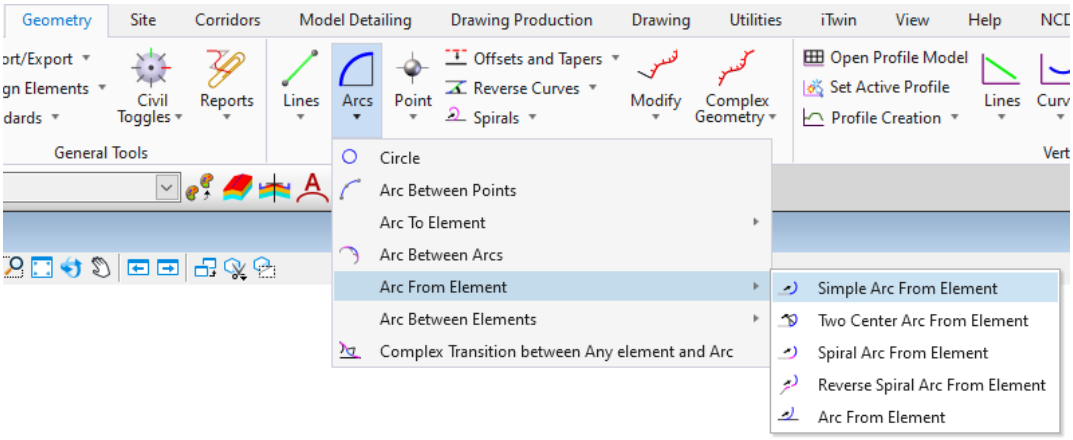


U. To create the nose at the end of the island we need to place an arc with a 2’ radius. The end of the nose should be at the 105’ offset limit. To create the nose, use the same method from above to shorten the inside line by 2’. Use the **Element Selection** tool to highlight the inside of the island.

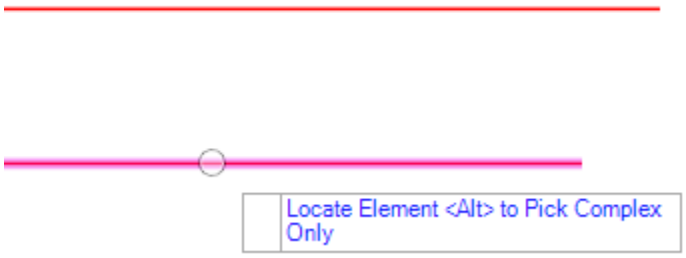
V. Change the 0+85 station text manipulator to 0+83.



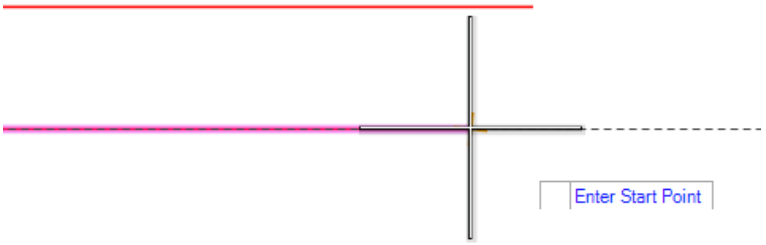
W. Start the **Simple Arc From Element** tool.



X. Left click to locate the inside island line as the from element.

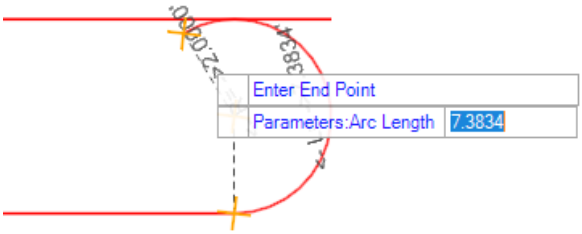


Y. Snap to the end of the line to set the start point.

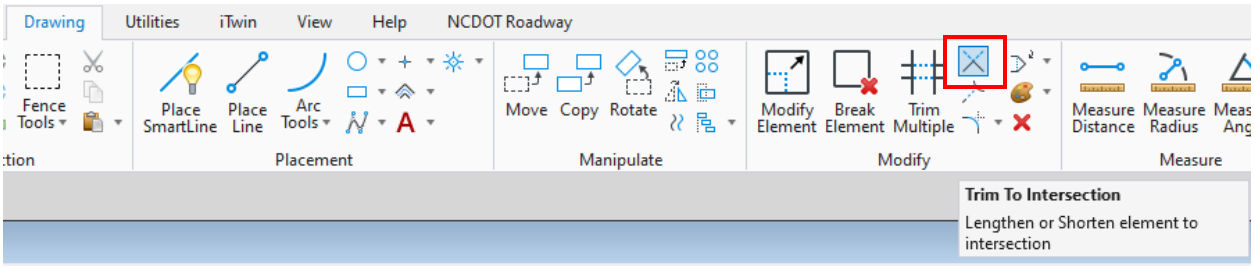


Z. Enter the radius of 2.00’

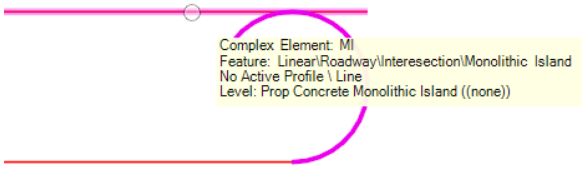
AA. Left click to set the end point. Set the Trim option to None.

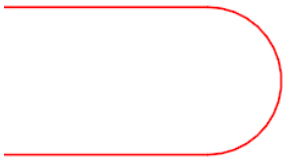


BB. Switch to the *Drawing* ribbon and select the **Trim to Intersection** tool from the *Modify* section.

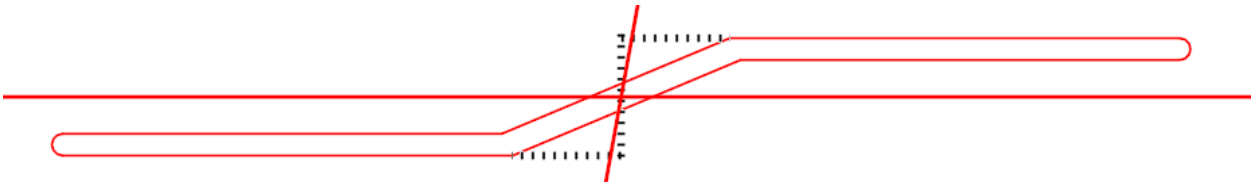


CC. Intersect the arc and the line to complete the nose of the island.

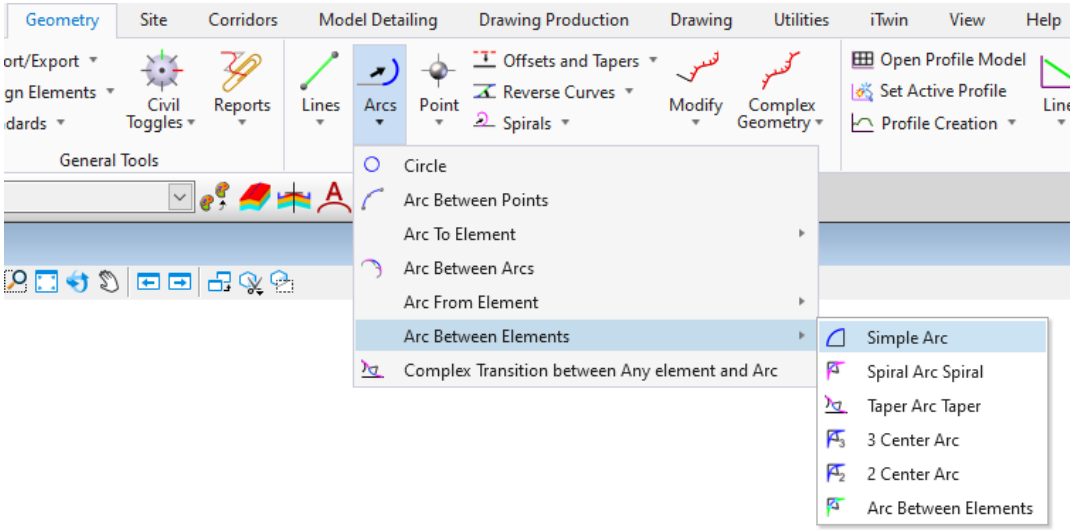




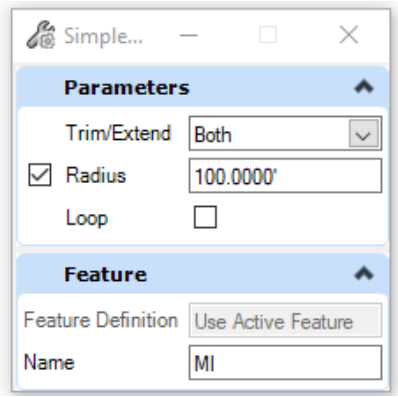
DD. Repeat this process for the other nose section.



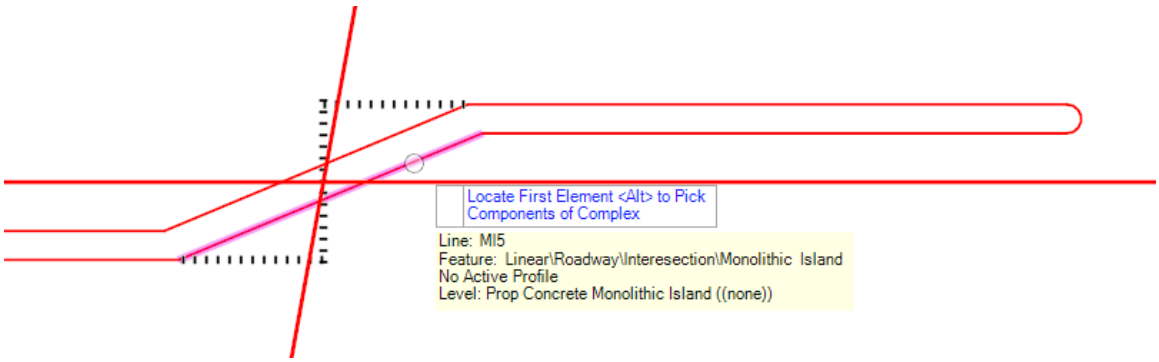
EE. The final step for the crossover island is to create the curves in the middle section. There is a large curve at the inside corner with a radius of 100’ and a small curve at the outside corner with a radius of 20’. Start the **Simple Arc** tool from the **Arc Between Elements** tool group.



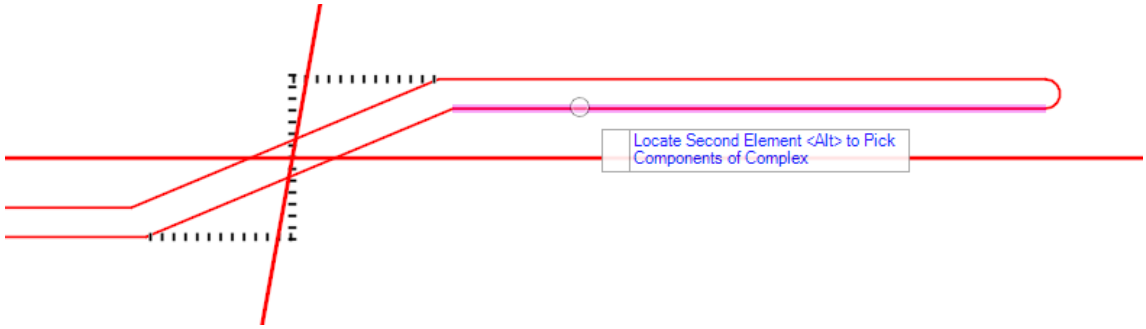
FF. Set the radius to 100’ and the Trim Option to Both.



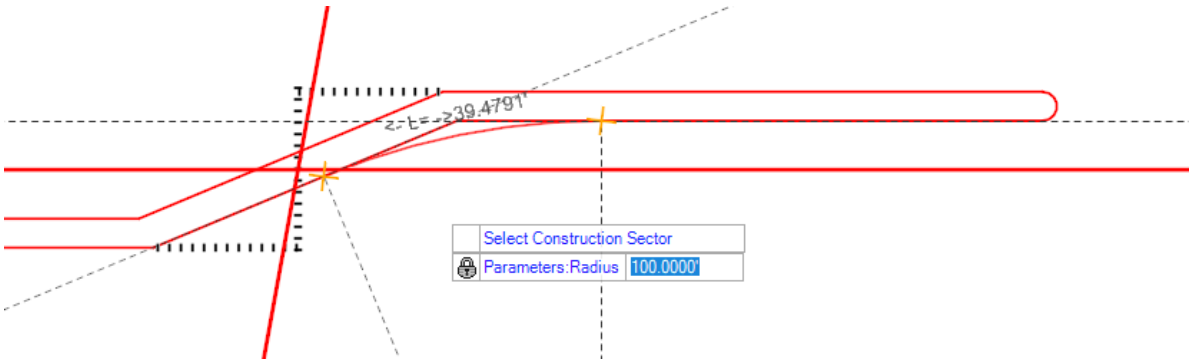
GG. Left click on the inside edge of the crossover portion of the island to select the first element.



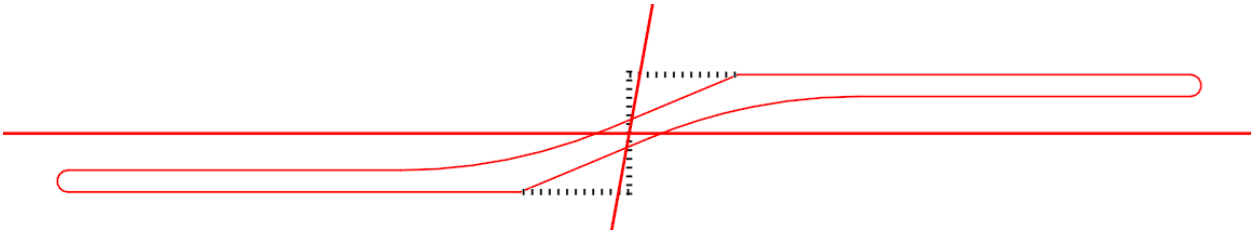
HH. Left click on the inside edge of the leg portion of the island to select the second element.



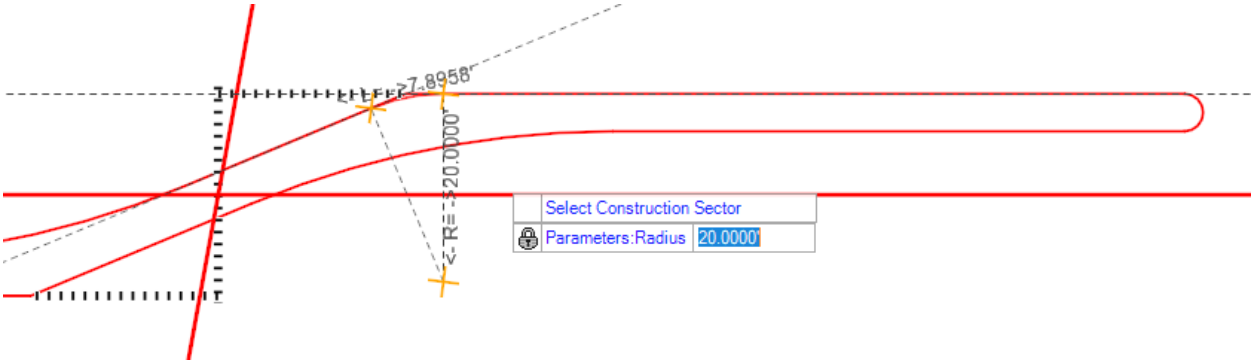
II. Move the cursor so the curves are on the inside of the island and left click to accept the radius and the Trim option.



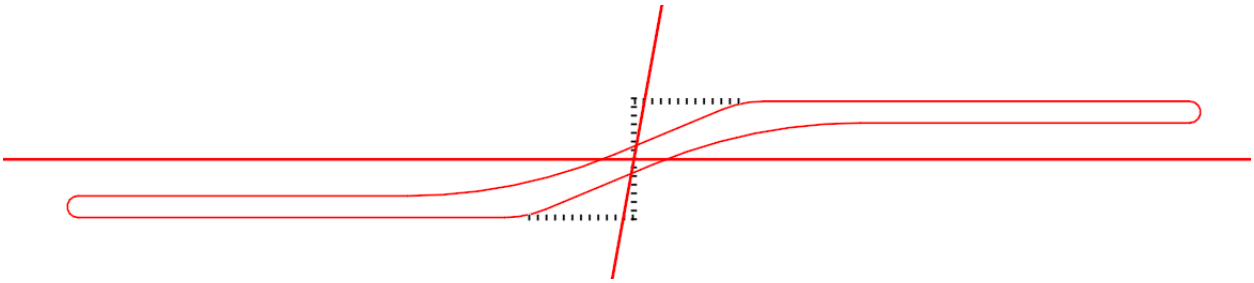
JJ. Repeat this process for the other side of the island.



KK. To create the curve on the outside corner, change the radius in the dialog box to 20' and repeat the process at the outside corners.



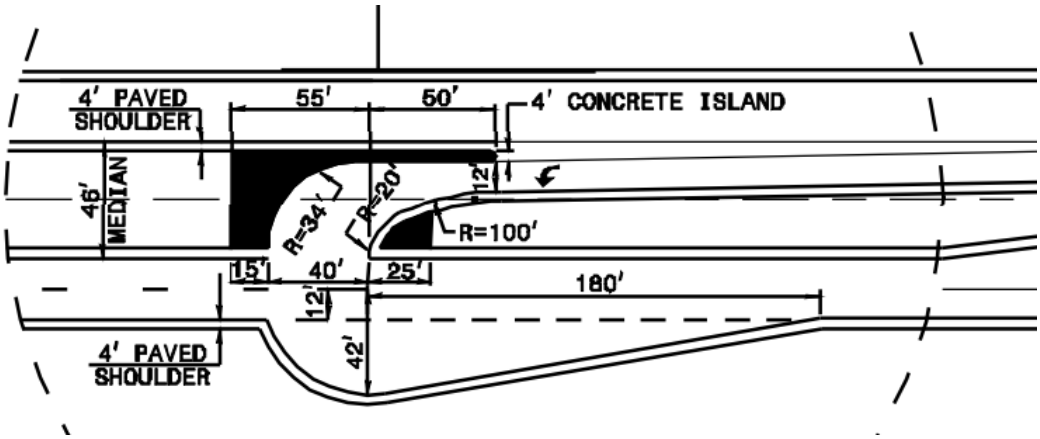
LL. This will complete the central crossover island.



3. Superstreet Layout – U Turn Bulb

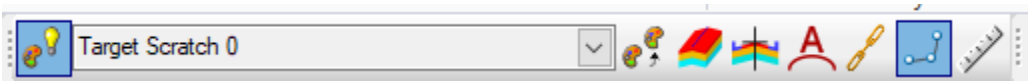
A. In this exercise we will see one way to draft the U Turn bulb The design will be based on this standard but because the median is 23’ wide we will use a 60’ Radius for the U Turn Bulb centered on the outside edge of travel.

B. In this design the center of the U Turn Bulb will be 800’ from the Intersection. We will also use a 180’ Taper which puts the beginning of the taper at 620’ from the

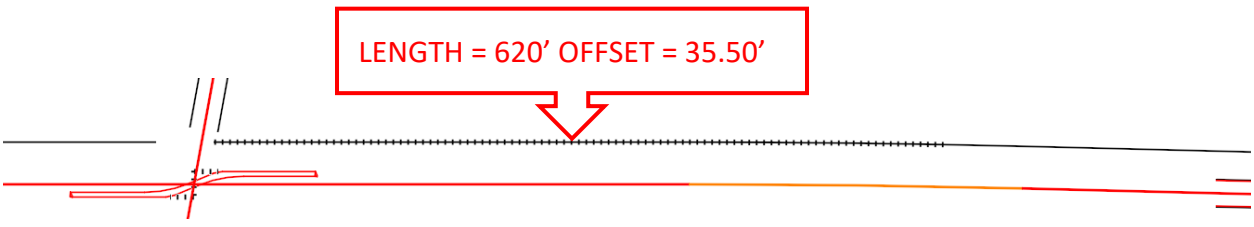


intersection. To locate these two points, we will create some targeting graphics using the Target Scratch 0 Feature definition. These graphics are totally optional, the only real reason is to provide an alternate way to edit the bulb location, but they are not required.

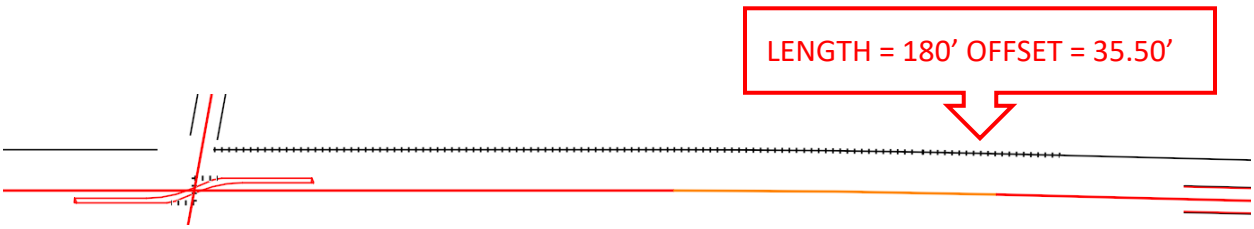
C. Set the Active Feature Definition to Target Scratch 0



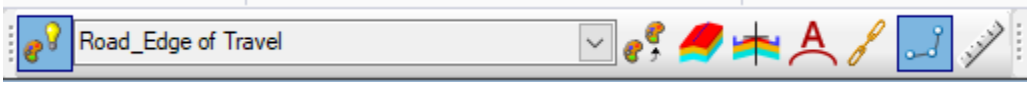
D. Starting with the bulb on the left side of the roadway, use the Single Offset Partial too to offset the Y8 centerline -35.50’ the line should start at the intersection reference line and have a length of 620’.



E. Repeat the process to draw a line 180’ long that starts at the end of the previous line, this will locate the center of the U Turn Bulb 800’ from the intersection.

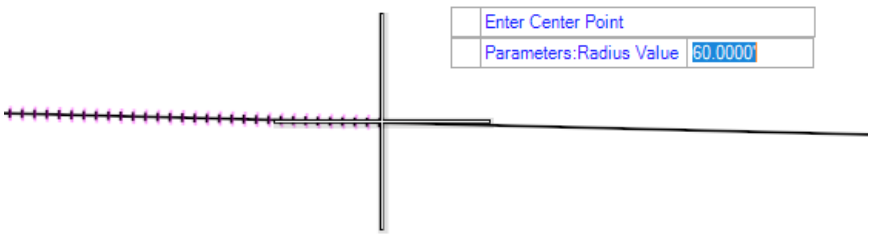


F. Set the Active Feature Definition to Road_Edge of Travel

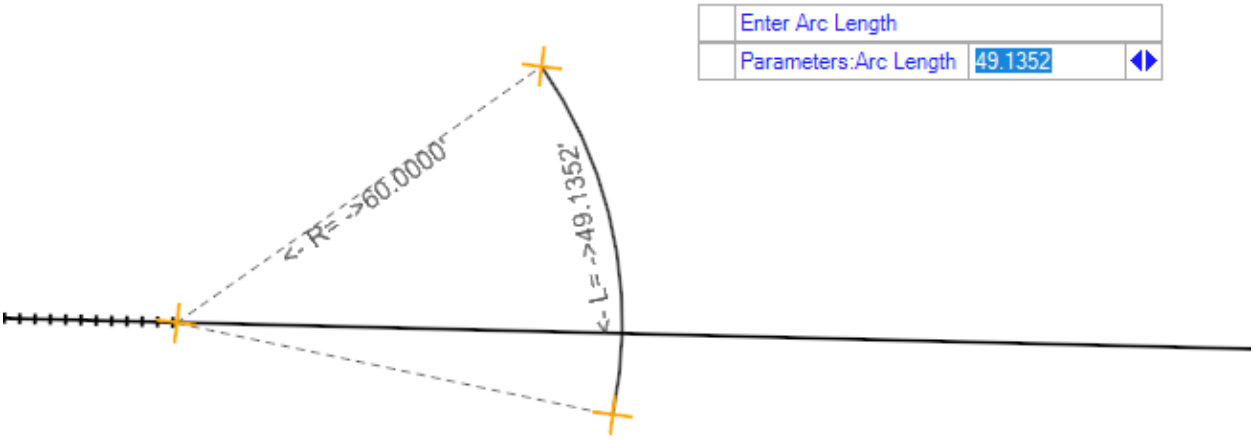


G. Start the **Arc Between Points** tool. Use the <UP> arrow key to move to the Center/Radius option.

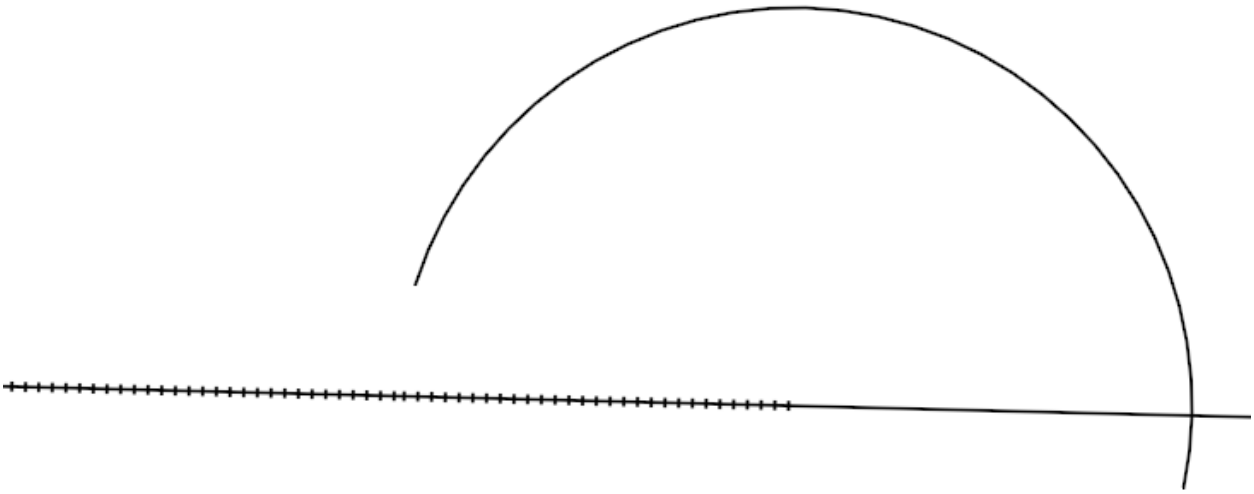
H. Snap to the end of the Scratch Target line to set the center point.



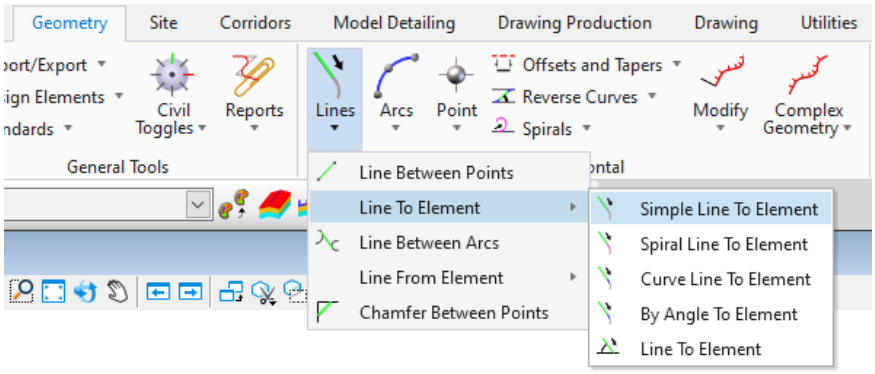
I. Enter 60.00’ for the radius and left click to accept. This will also set the start point.



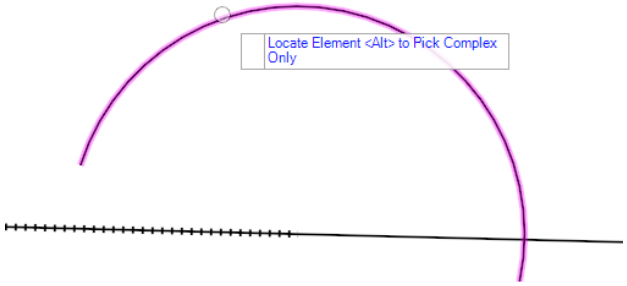
J. Left click again to set the end point of the curve.



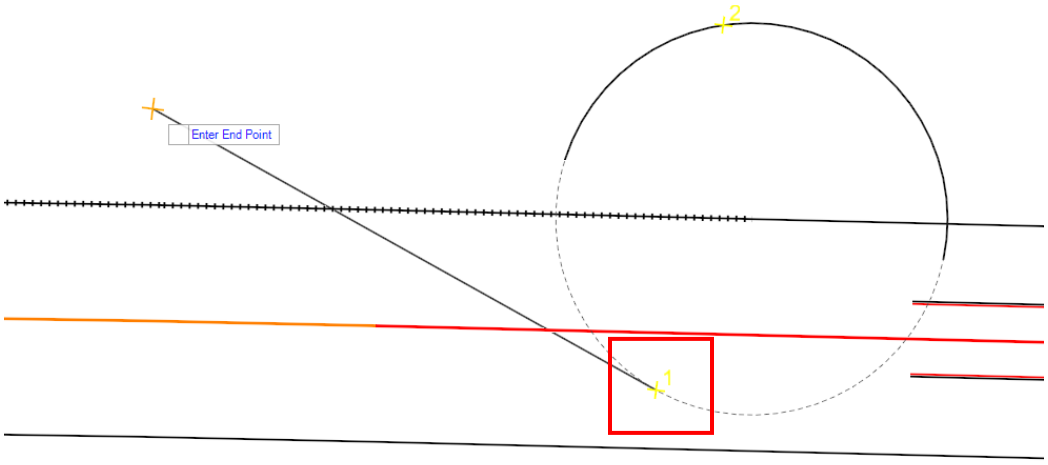
K. To draw the taper, start the **Simple Line To Element** tool.



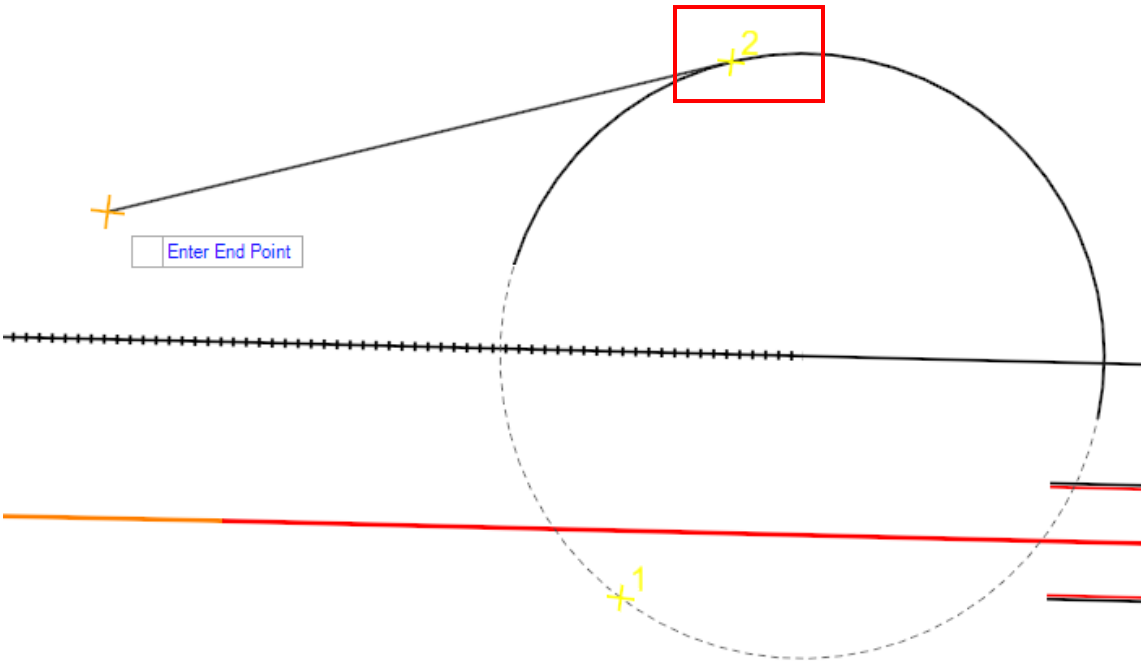
L. Left click the arc to select the To element.



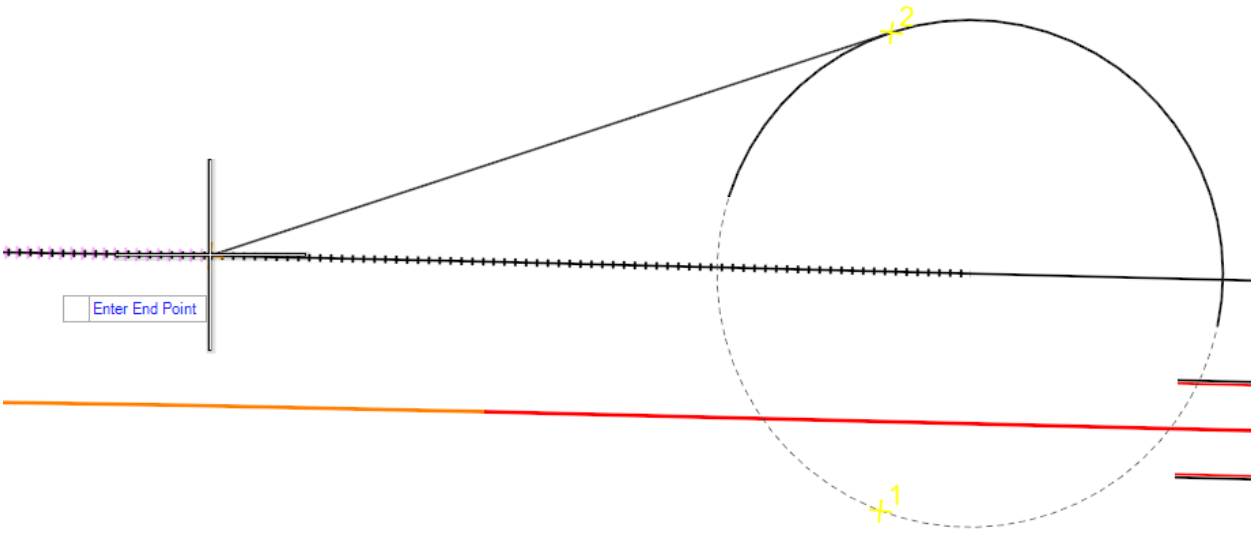
M. If the incorrect solution appears



N. Use the <ALT> key to select the correct solution.

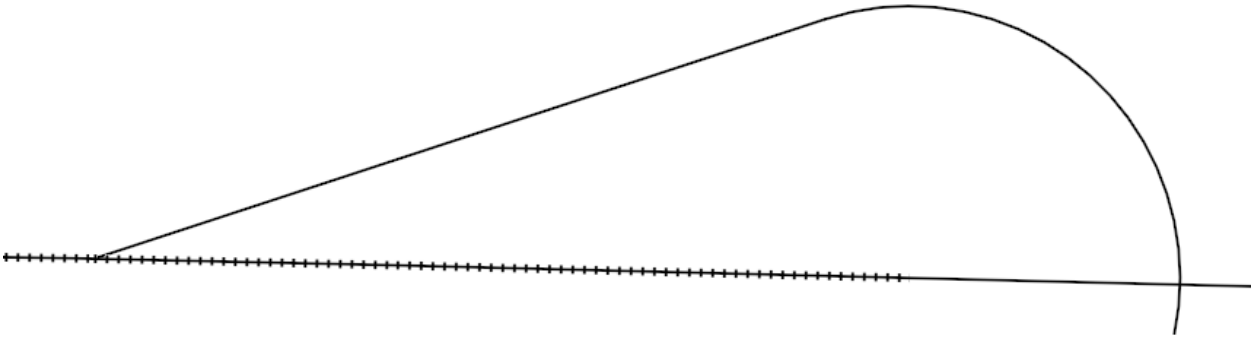


O. Snap to the end of the line that represents the end of the target line that represents the end of the taper.

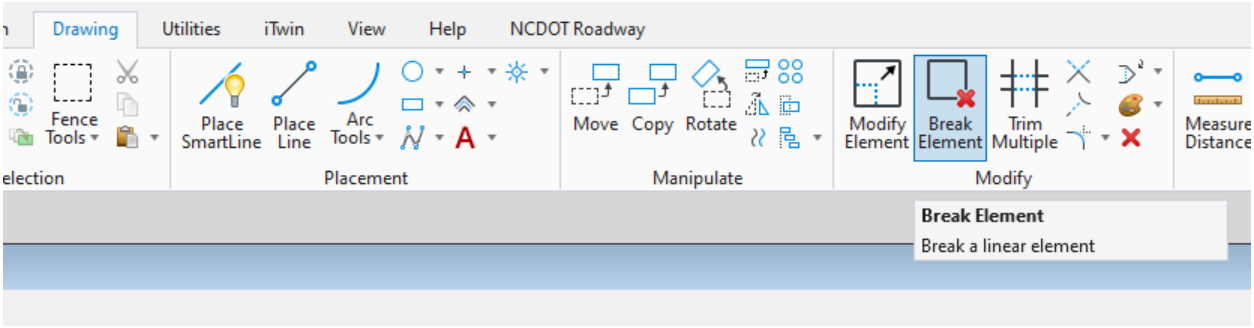


P. Set the trim option to Back and left click to accept.

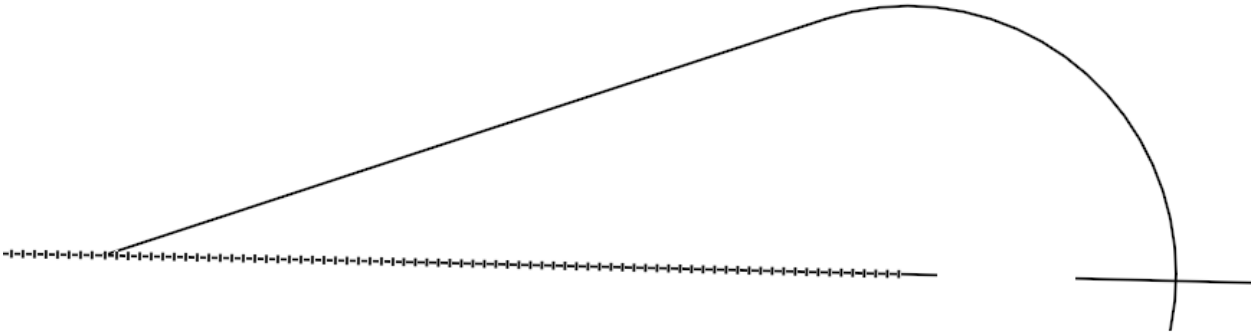
Q. This should complete the taper and trim the arc to meet the line.



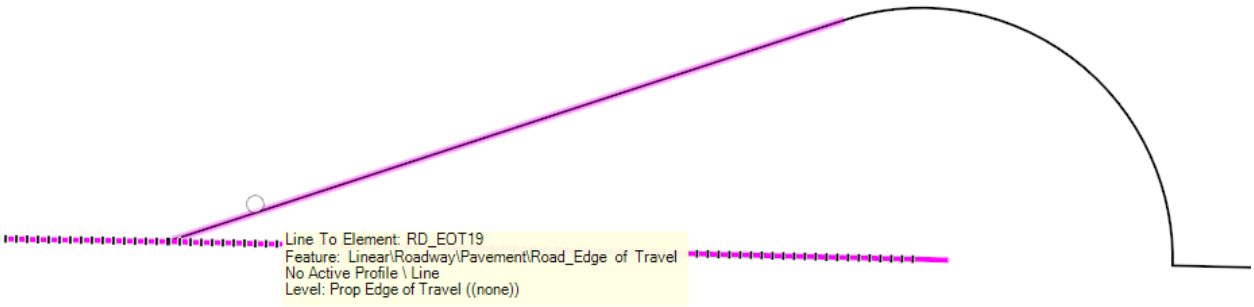
R. Switch to the *Drawing* ribbon and select the **Break Element** tool from the *Modify* section.



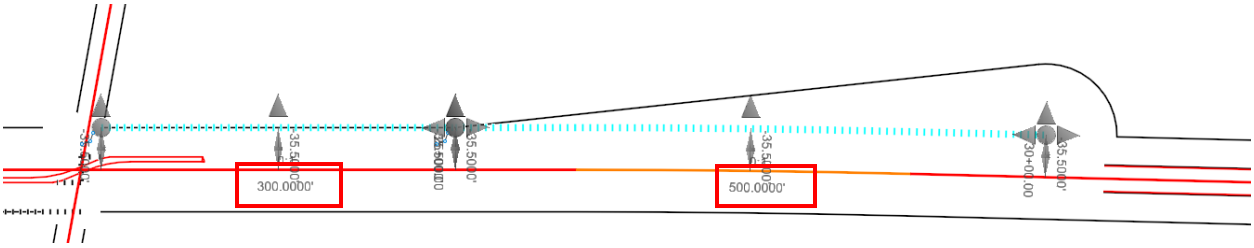
S. Select the outside edge of travel line and break the line, this will create an interval, a gap in the line.



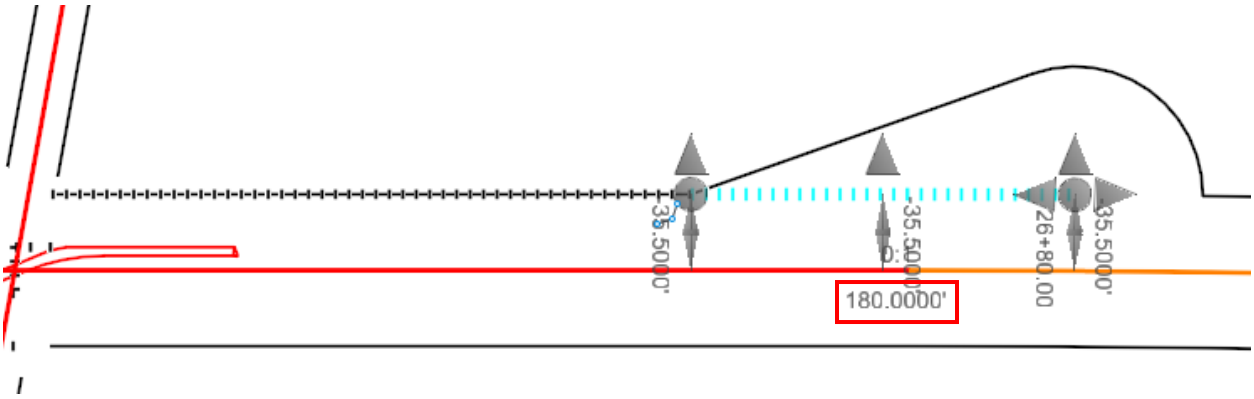
T. Use the **Trim to Intersection** tool from the same Modify group to extend the outside edge of travel line with the U Turn bulb at both ends. Select the edge of travel line not the Target Scratch 0 line.



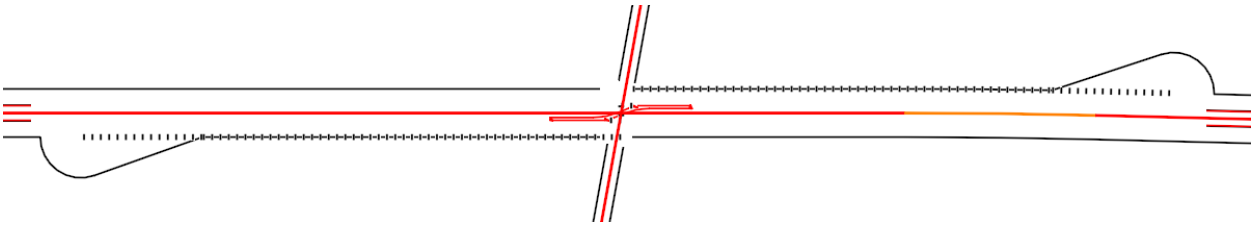
U. This will complete the U Turn Bulb. The location of the bulb and the length of the taper can be changed by changing the length of the Target Scratch Line using the text manipulators. In this example the locator line lengths were changed to 300.00’ and 500’ for the taper.



V. Note that the arc portion of the bulb stayed in the same place because the overall length is still 800’. The taper lengthened because there was a snap constrain created at the end of the Target Scratch line. The taper did maintain tangency to the arc because we used the **Line to Element** tool and the Trim Back option. By changing the Target Scratch Line length back to 180’ the taper will update, and the arc will shift because of the snap constraint created when placing the arc.

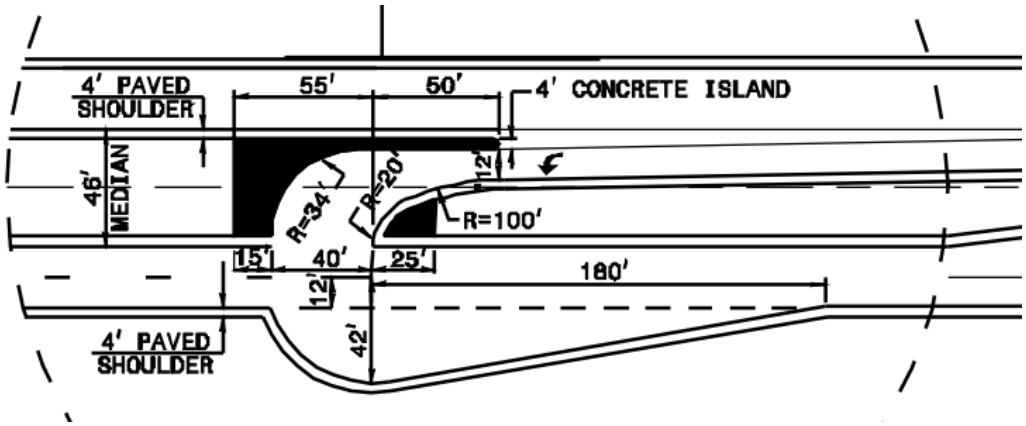


W. Set the target line length back to 620’ and 180’.
X. Repeat the process to create the bulb on the other side of the roadway.

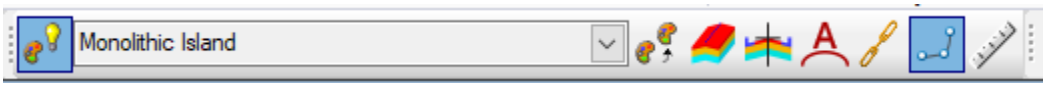


4. Superstreet – Protected Left Turn Island at U Turn

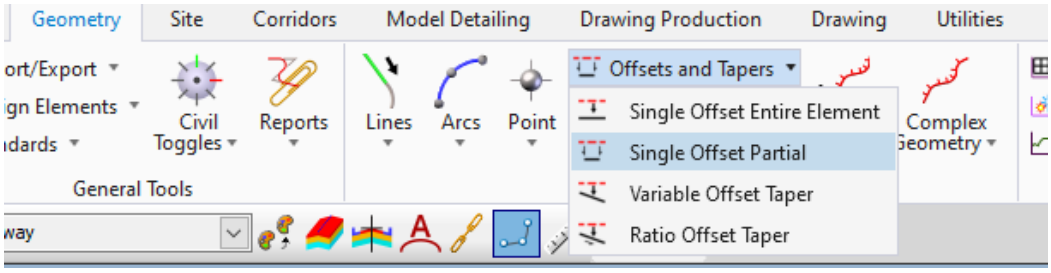
A. In this exercise we will create the monolithic island that separates the left turn and the thru lanes at the U Turn Bulb. This is based on the same standard that was used during the previous exercise. These steps will cover the bulb location on the left side of the roadway.



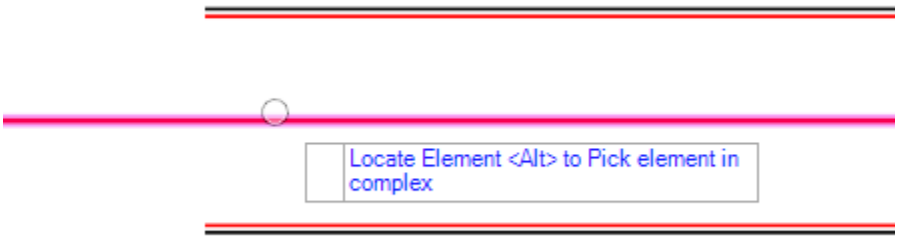
B. Change the Active Feature Definition to Monolithic Island



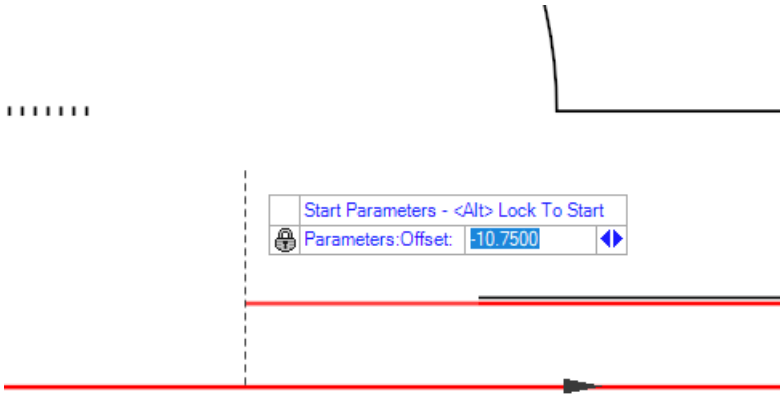
C. Based on the Standard Drawing the island should extend 15' past the location where the U Turn bulb arc intersects the outside edge of pavement. Start the **Single Offset Partial** tool.



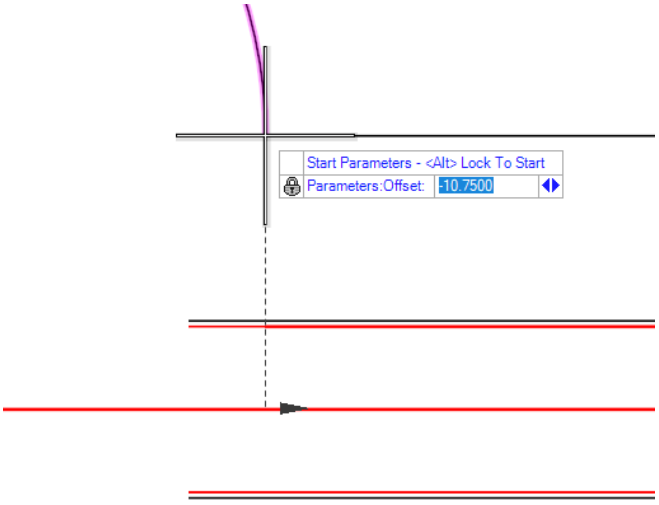
D. Select the Y8 centerline.



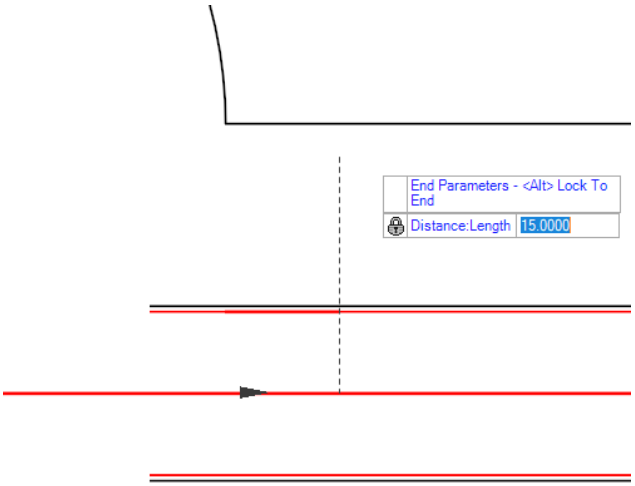
E. Set the offset to -10.75



F. Left click to the end of the Arc portion of the U Turn bulb to set the start point.

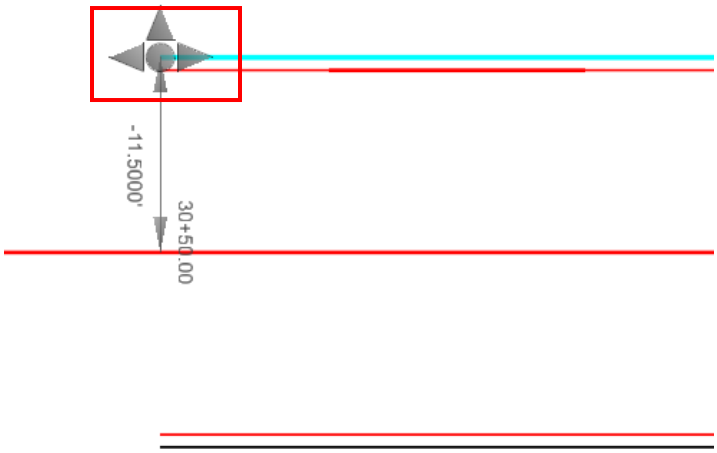


G. Set the length to 15.00’ and move the cursor to draw the line away from the bulb.

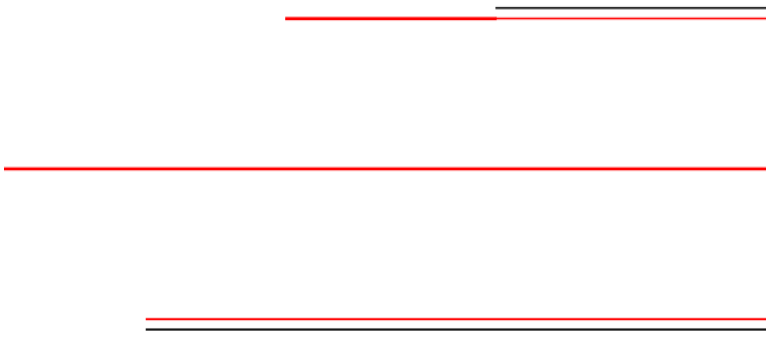


H. Set the mirror option to NO and left click to accept.

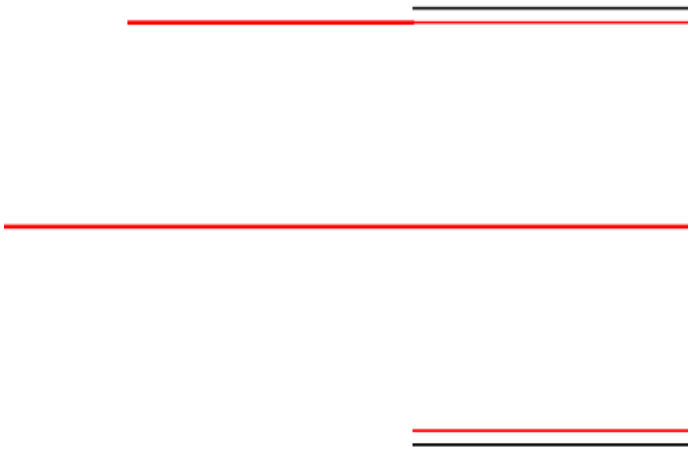
I. To adjust the median pavement and curb line to meet the monolithic concrete island line use the **Element Selection** tool to highlight the pavement line and activate the drag handles.



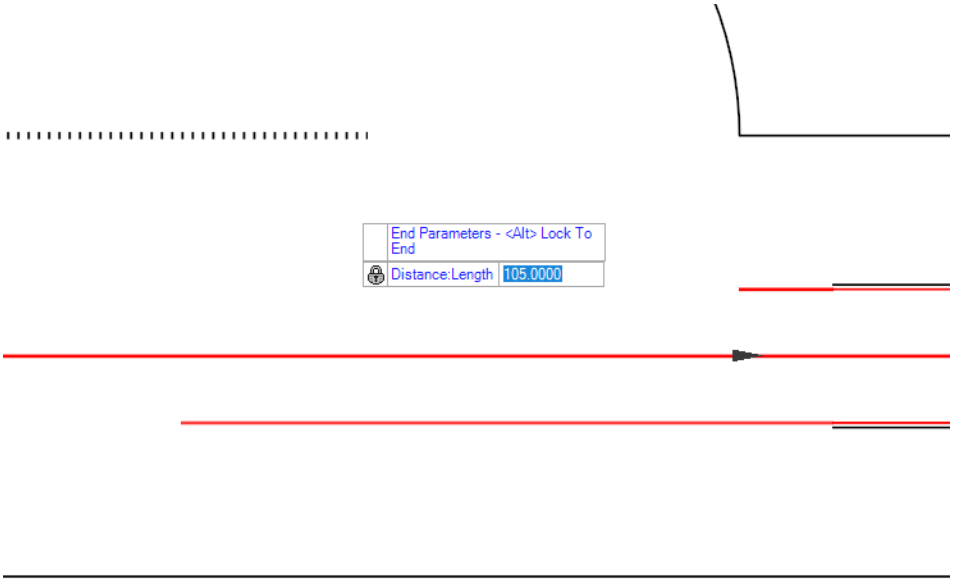
J. Pick the arrow that is parallel to the Y8 centerline and “drag” the line back to the end point of the newly placed concrete island line. By selecting this arrow, the offset of the pavement line will not change.



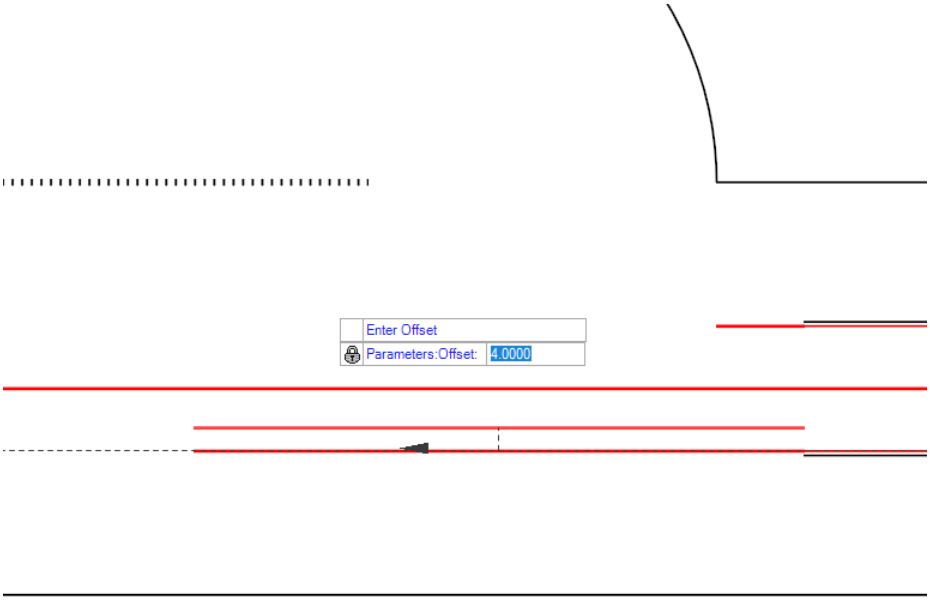
K. Note that the curb line also updated, this is because the curb line was created using the **Single Offset Entire Element** tool which rules it to the base element, which is the pavement line, and any change to the base element will automatically be reflected in the ruled element. Repeat the process for the pavement line on the right side of Y8.



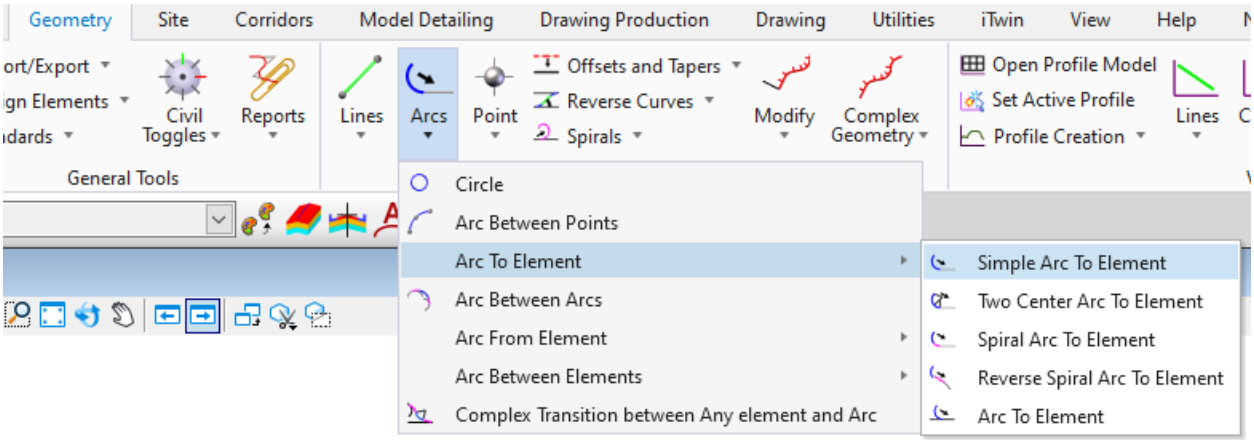
L. Based on the standard the line on the other side is 105’ long. Using the **Single Offset Partial** tool create the outside edge of the concrete island.



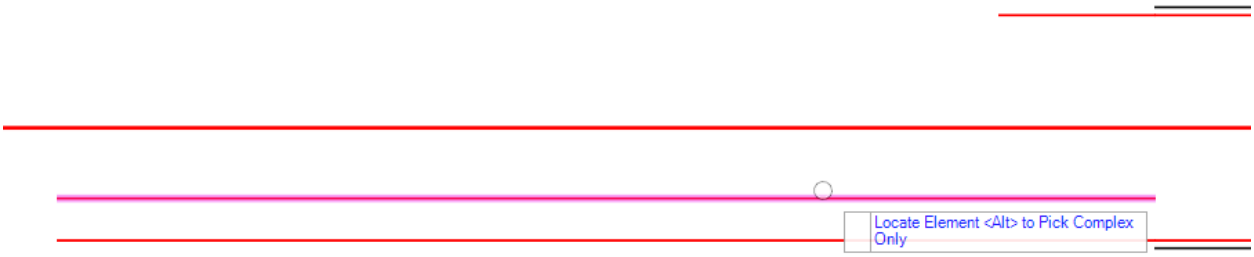
M. Use the **Single Offset Entire Element** tool to offset this line 4’ to create the inside edge of the island.



N. To construct the inside radius, use the **Simple Arc to Element** tool.

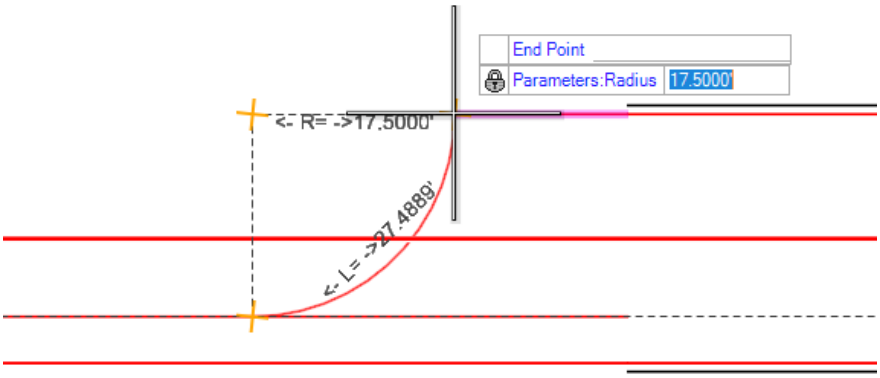


O. Left click to pick the inside edge of the island as the To Element.



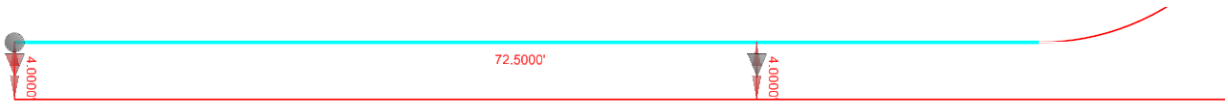
P. Set the radius to 17.50’ and left click to accept. This is the distance from the inside edge of the island to the outside edge on the left side of the roadway.

Q. Snap to the end of the left side of the island to complete the arc.

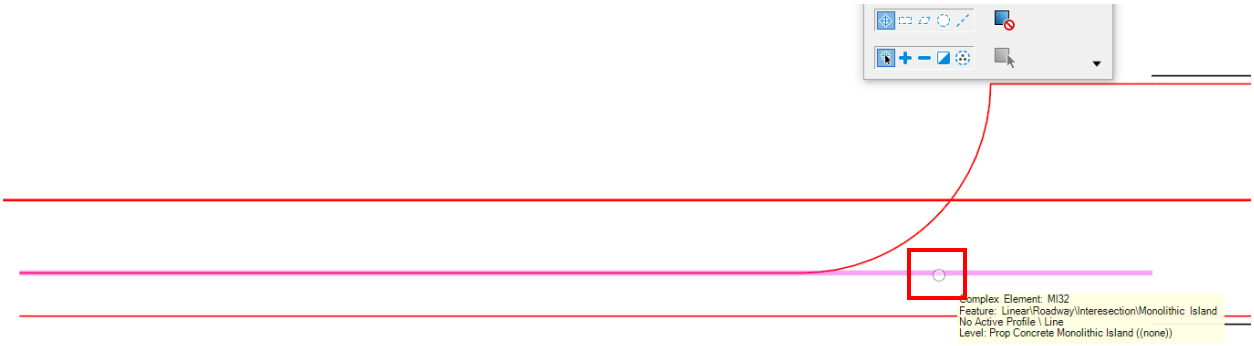


R. Set the Trim mode to Back and left click to accept.

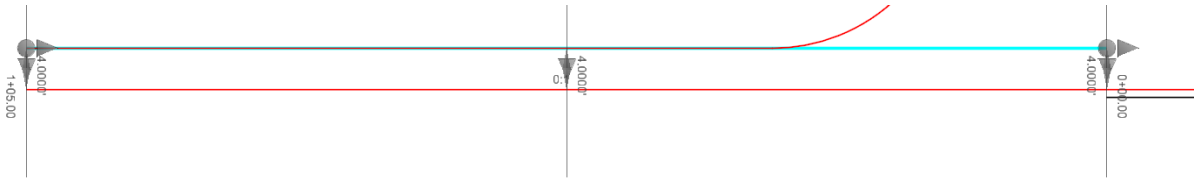
S. Complete the nose of the island the same way we did the nose of the crossover island. Highlight the inside edge of the island with the **Element Selection** tool. Note that is you pick the line the text manipulators and drag handles are red, indicating they cannot be modified. This is because this line is the interval that was created when the inside arc was constructed, and filet command was applied.



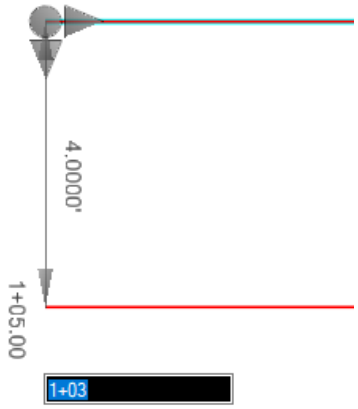
T. Select the underlying geometry by moving the cursor to the area where the original line was located before the trim command was applied.



U. This will select the underlying geometry making the text manipulators editable. Indicated by the gray color.



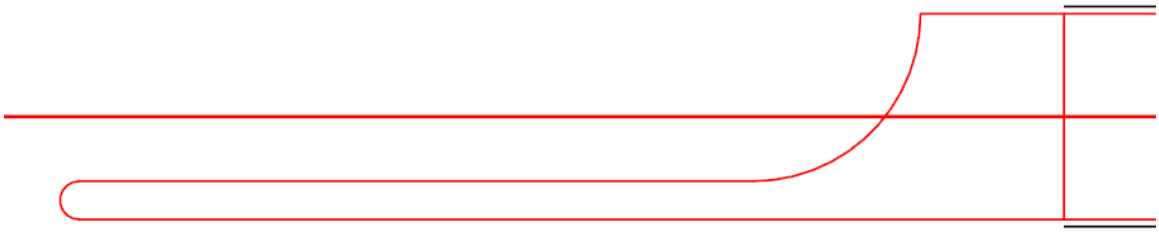
V. Modify the end station from 1+05 to 1+03. Remember because this line was created with the **Single Offset Entire Element** tool the offset is based on the original element not necessarily the centerline stationing.



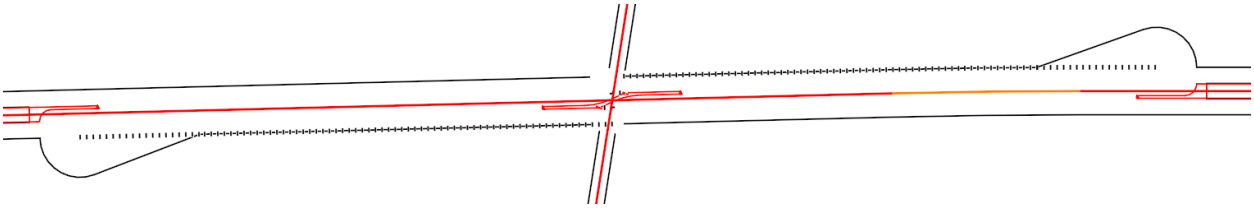
W. Use the **Simple Arc From Element** tool to create an arc with a 2’ radius.
- Left click to select the inside edge of the island
- Snap to the end of the line to set the start point.
- Enter a radius of 2.00’ and left click to accept
- Left click to set the end point
- Set the Trim mode to None

X. Switch to the *Drawing* ribbon and use the **Trim to Intersection** tool from the *Modify* group to trim the end of the curve to the outside line.

Y. To complete the island, go to the *Geometry* ribbon and select the **Line Between Points** tool. Connect the Left side of the island to the Right side where it meets the curb line.

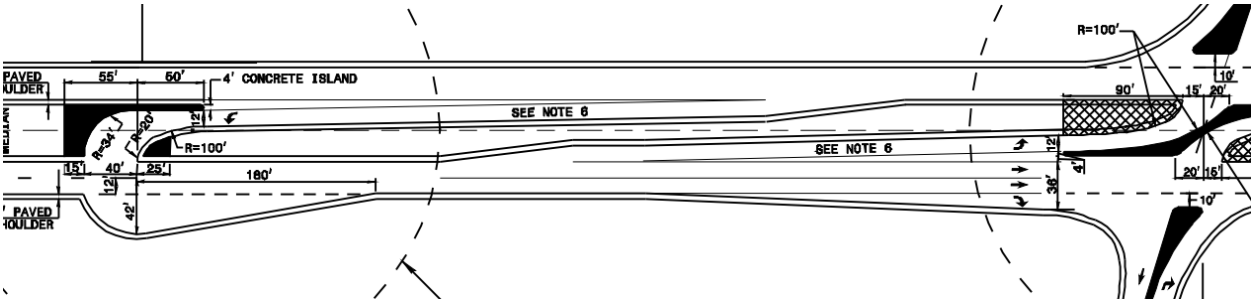


Z. This completes the island, repeat the same process at the other bulb location.

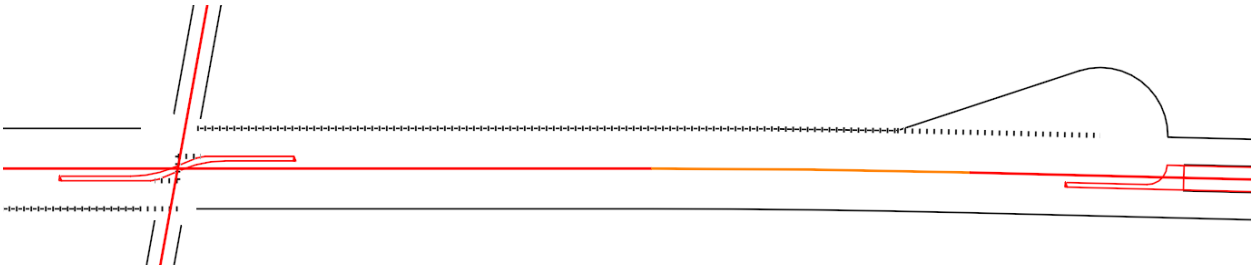


5. Superstreet – Center Turn Lane Island

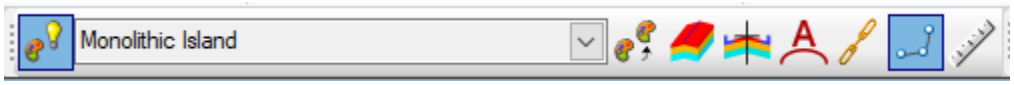
A. In this exercise we will construct the center left turn lane monolithic island. This island will be based on the dimensions in the Design Manual, modified slightly to accommodate a 23’ raised median.



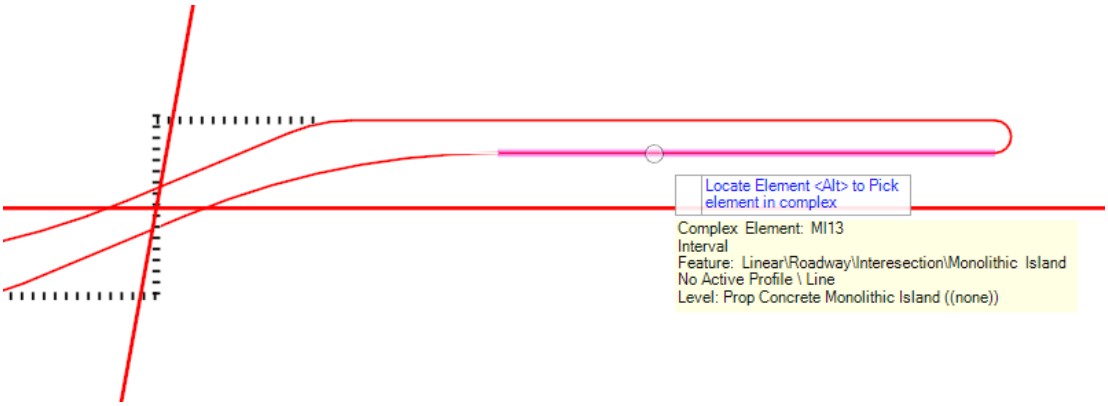
B. We will be adding the center turn lane island to the portion of the superstreet where the bulb is located on the left side of Y8.



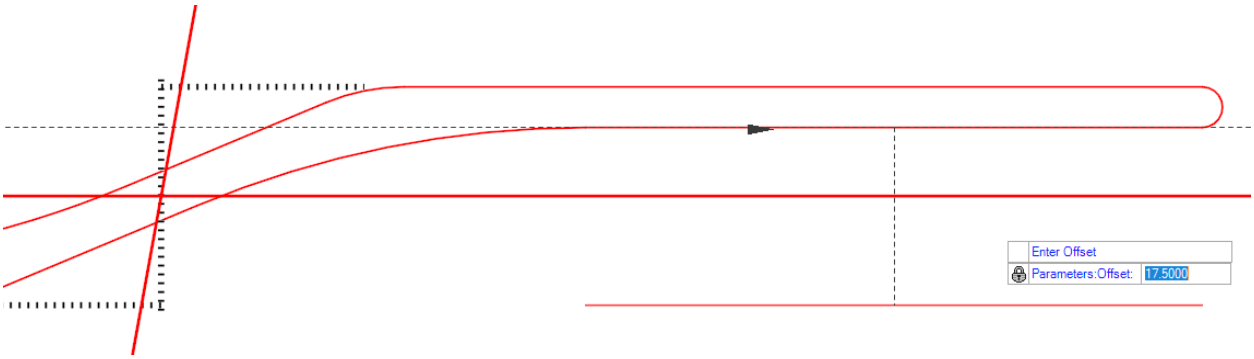
C. Set the Active Feature Definition to Monolithic Island.



D. Starting at the intersection create the portion of the island adjacent to the cross over island. Use the **Single Offset Entire Element** tool to offset the inside of the median crossover island.

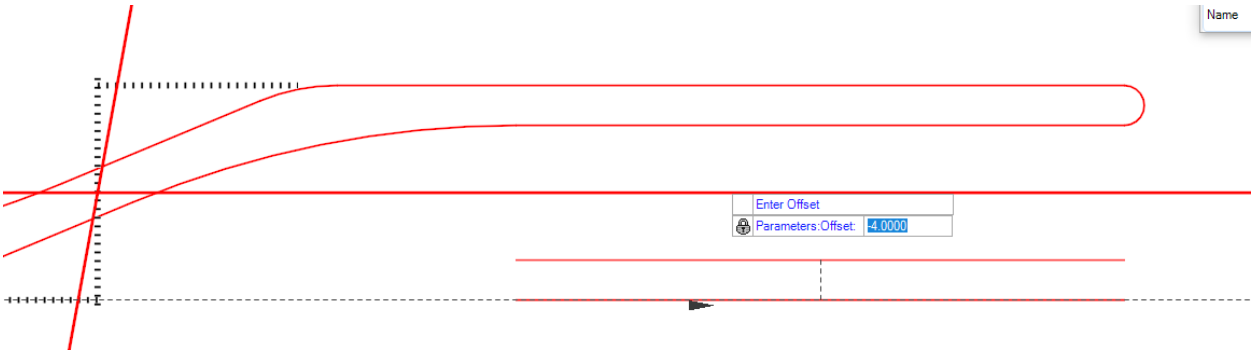


E. Offset this 17.50’ to line up with the right outside of the crossover island. By using the **Offset Entire Element** tool, the end of the nose will automatically begin where the inside radius on the island starts. For different median widths and configurations, a different tool may be more appropriate.

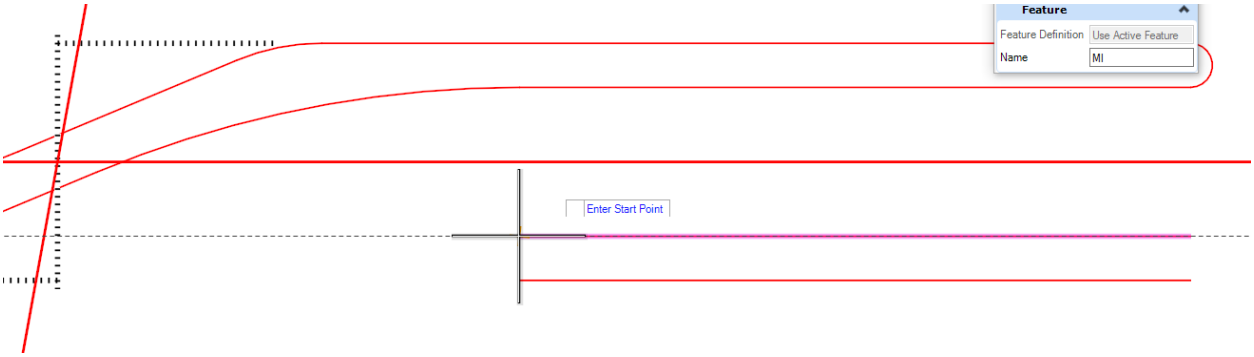


F. Set the mirror option to NO

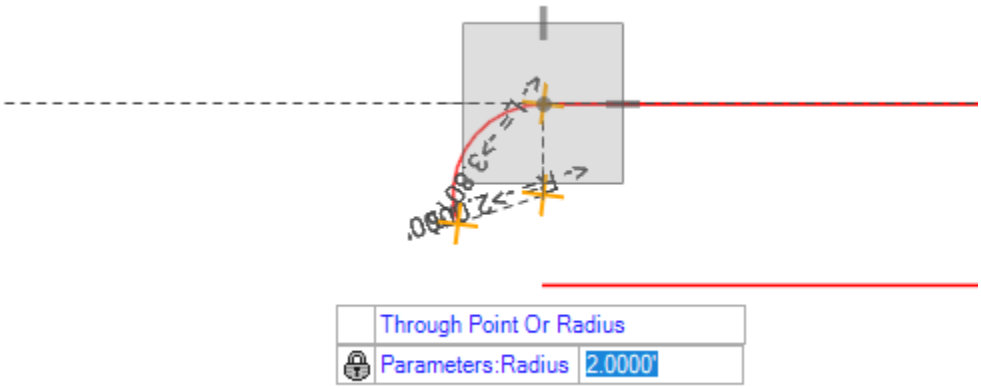
G. Use the **Single Offset Entire Element** tool to offset the outside concrete island line to the inside 4.00’.



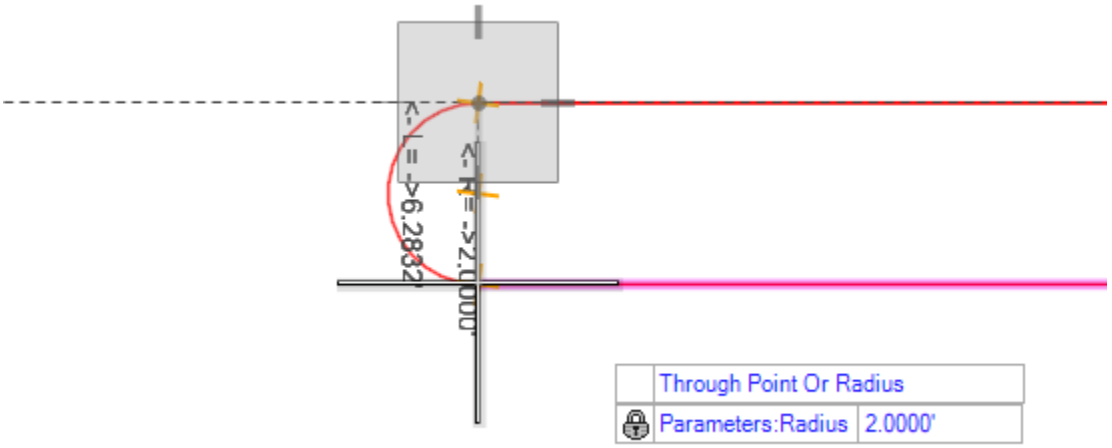
H. To create the nose of the island, use the **Simple Arc From Element** tool to create an arc with a 2’ radius. Set the start point at the end of the inside island line.



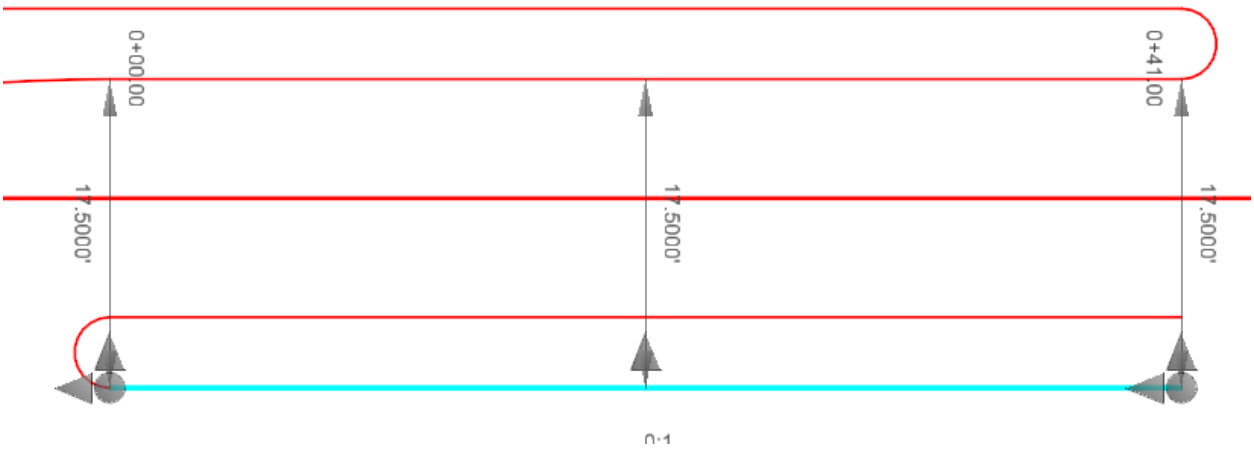
I. Enter 2.00’ for the radius and left click to accept.



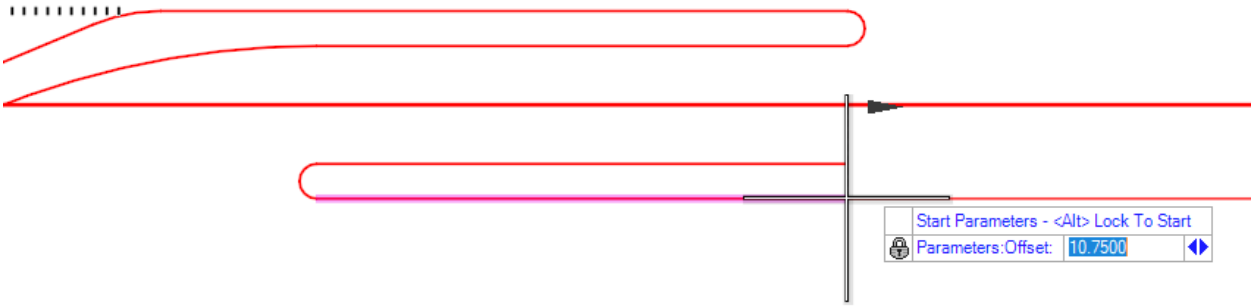
J. Snap to the outside concrete island line and left click to accept and finish the nose of the island.



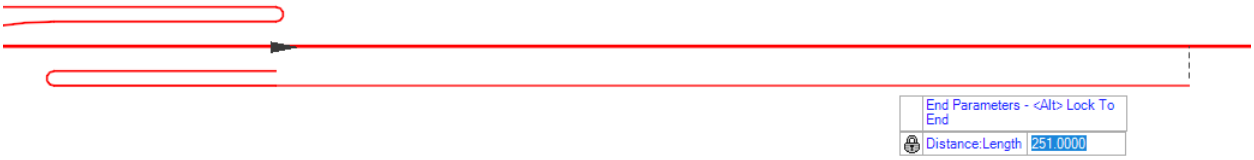
K. This left turn lane, from Y8 onto Y18 should be 300’ long. The portion of the island that has already been constructed is 41.00’ long. We can determine that by directly measuring the length or using the **Element Selection** tool to active the text manipulators, the element station should indicate the length.



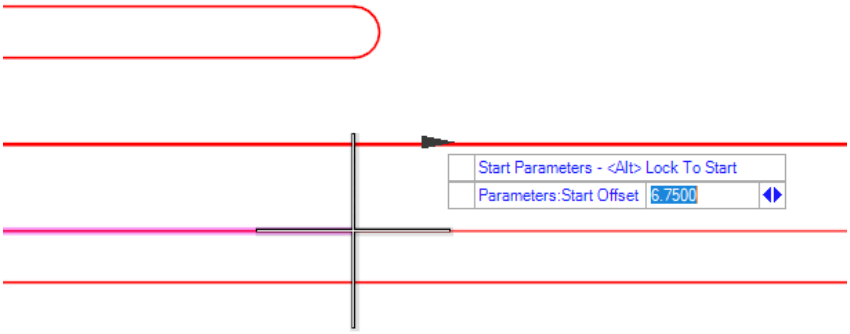
L. To finish the turn lane, we need to construct a 259’ long lane taper. Using the **Single Offset Partial** tool create an offset element from the Y8 centerline. The offset should be 10.75’.



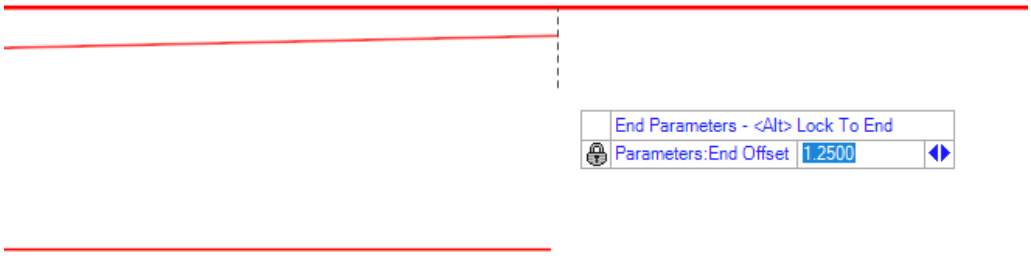
M. The length should be 259.00’, set the mirror option to NO.



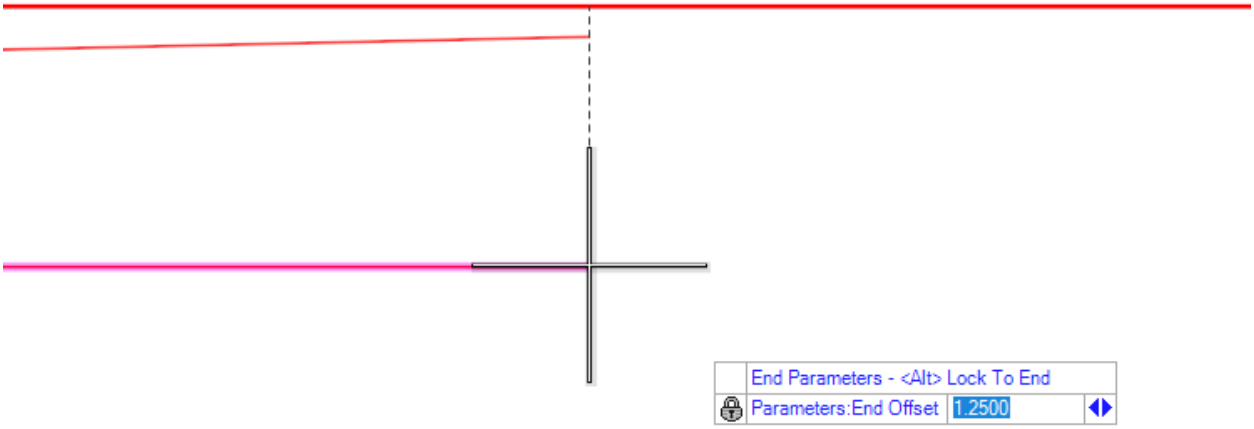
N. Using the **Variable Offset Taper** tool create the lane taper, Set the start point by snapping to the end of the inside concrete island line.



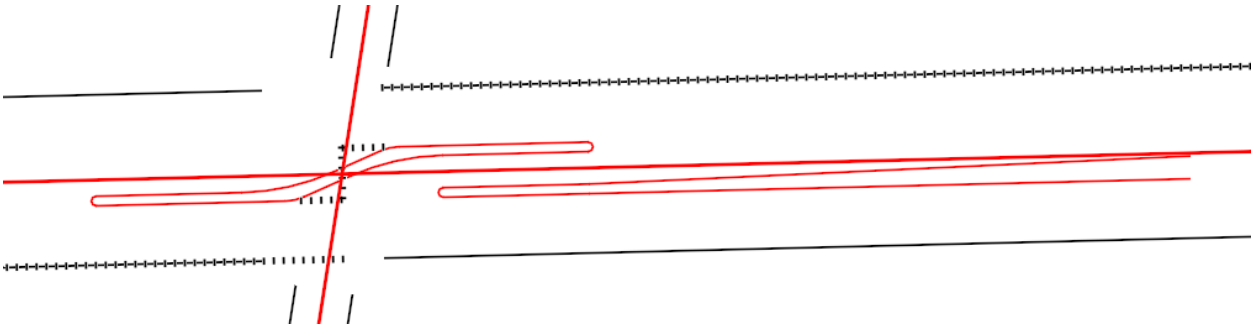
O. To set the opposite end type in 1.25’ for the offset and <ENTER> to lock.



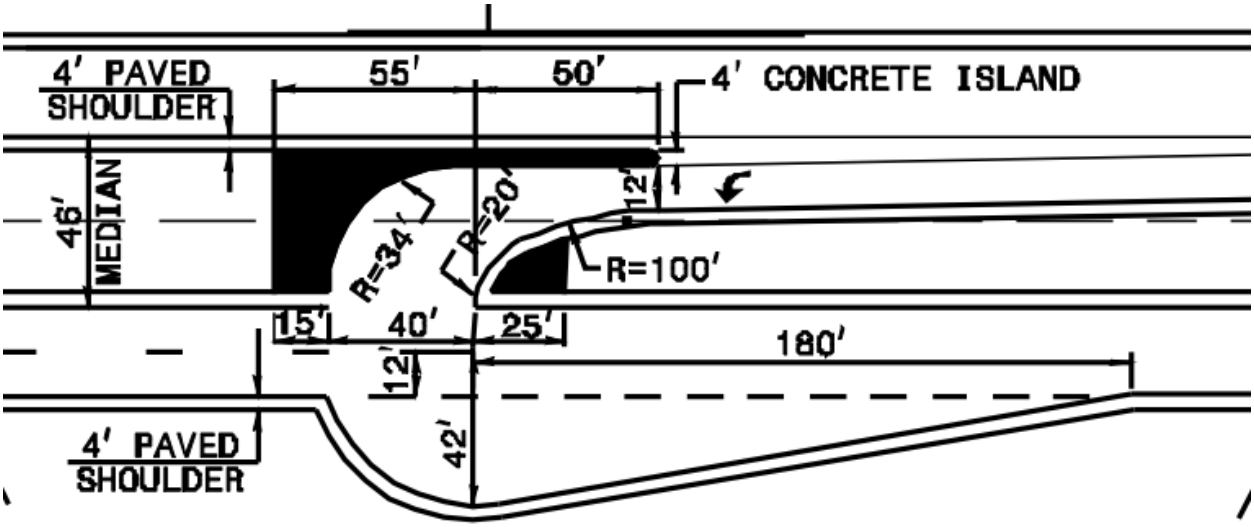
P. To set the end point location snap to the end of the previously constructed line. Because the offset is locked to 1.25’ the offset will be maintained, but by snapping to the end of the previous line a rule will be created and any change to the length of the reference line will be reflected in the length, but not the offset, of the taper line.



Q. This will complete the left turn lane taper.

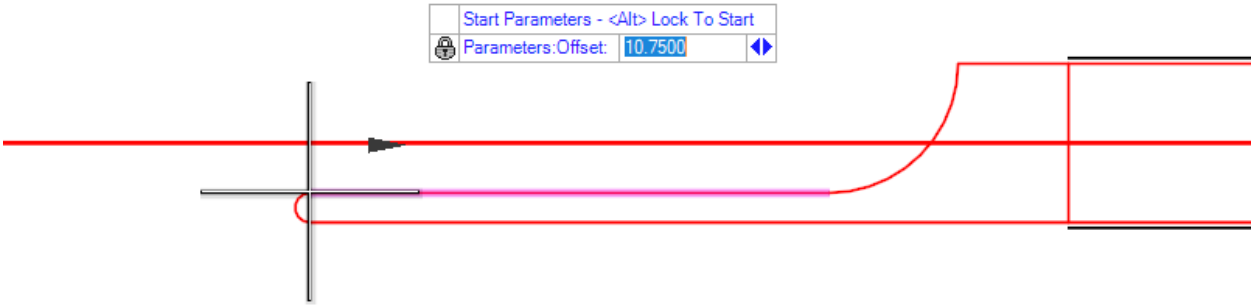


R. To create the center island at the U Turn Bulb we need to create a 40’ opening at the U Turn Bulb.

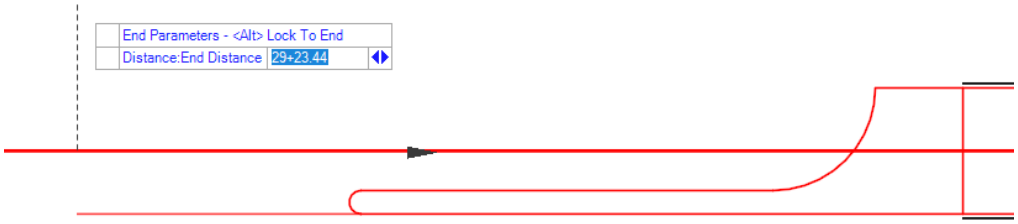


S. To start this, use the **Single Offset Partial** tool to create an element base on the Y8 the offset should be 10.75’

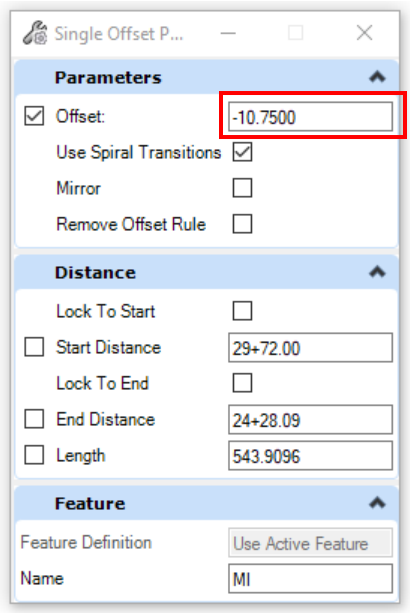
T. Snap to the end of the concrete island to set the start point and left click to accept.



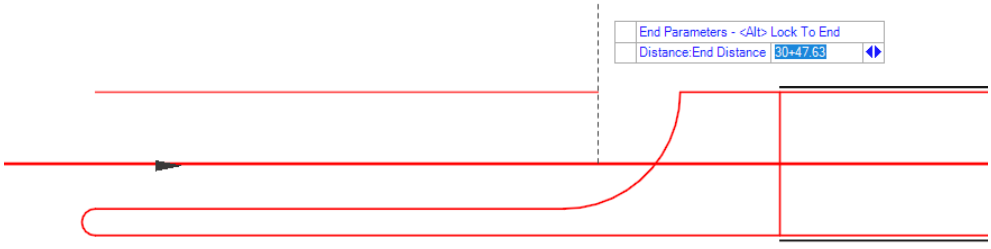
U. Note that this changed the offset value to a positive and the line is now on the wrong side of the Y8 centerline.



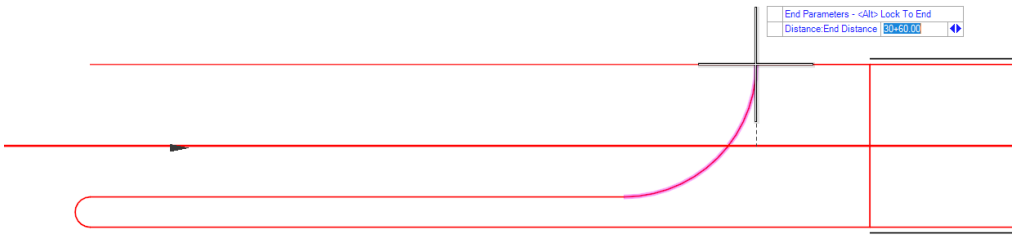
V. Find the dialog box and change the value back to -10.75’



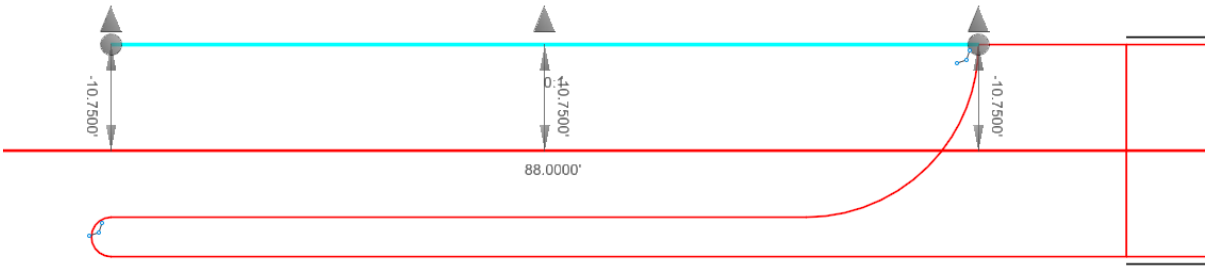
W. This will shift the line to the left side of the Y8 centerline.



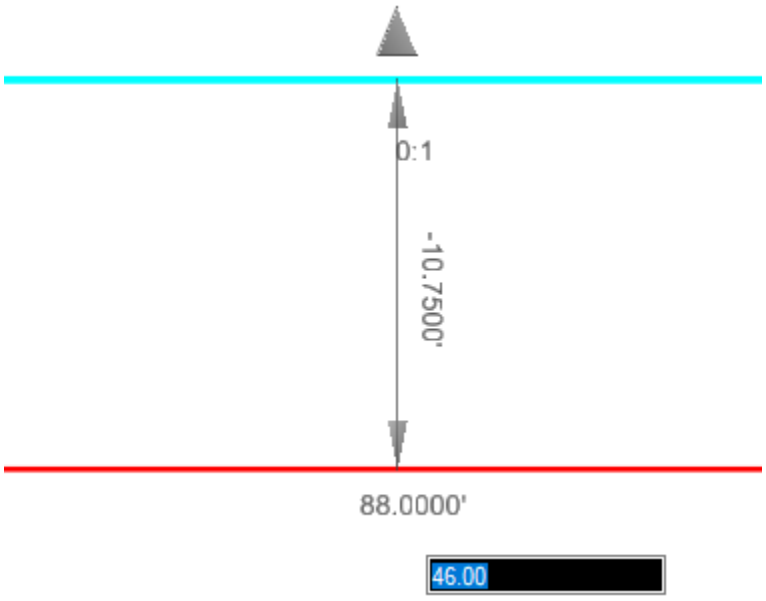
X. Snap to the end point of the concrete island to set the end point of the element. Set the mirror option to NO.



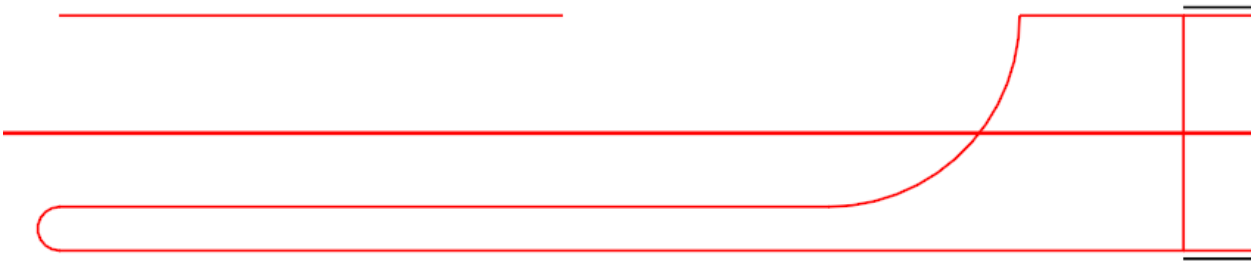
Y. We now need to create a 40’ opening based on the standard. To do this we will shorten the line by 42’, this will allow a nose with a 2’ radius to be added while still maintaining the 40’ opening. Start by using the **Element Selection** tool to highlight the element and activate the text manipulators.



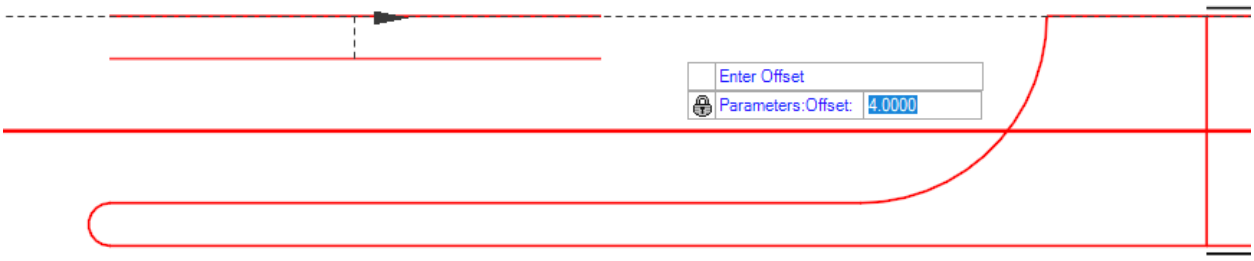
Z. Change the length of the line from 88.00’ to 46.00’.



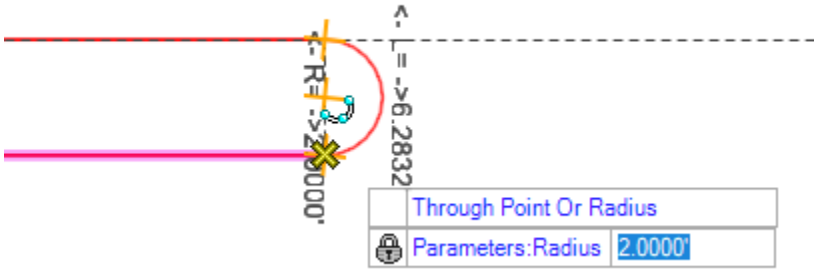
AA. This will shorten the line creating the desired gap. Note that using the text manipulator to change length the beginning of the line will remain in the same place and the length will change from the end. Because this line was place from right to left, the left end was the end that changed. This should be considered when placing the original offset element.



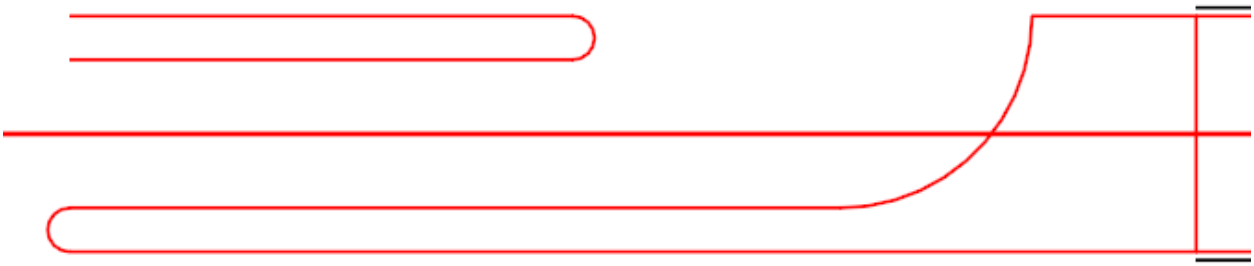
BB. Now use the **Single Offset Entire Element** tool to offset the element 4.00’ towards the centerline.



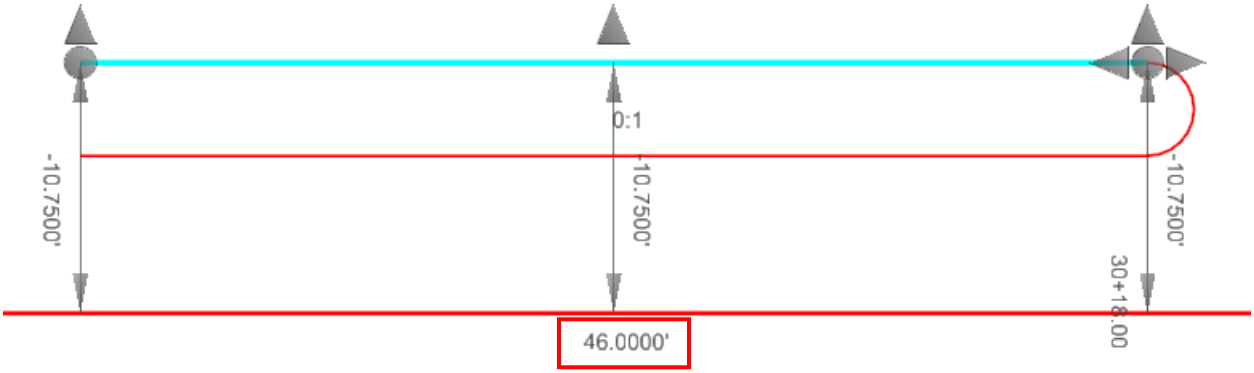
CC. To create the nose, use the **Simple Arc From Element** tool to create the island nose, this is the same process used previously, the radius is 2.00’.



DD.This will complete this portion of the island.

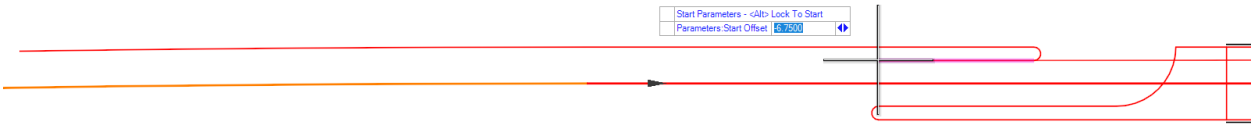


EE. To create the turn lane taper we will use the same process used for the previous turn bay. Use the **Single Offset Partial** tool to create the parallel portion of the turn bay, the length of the bay that has already been created is 46.00’.



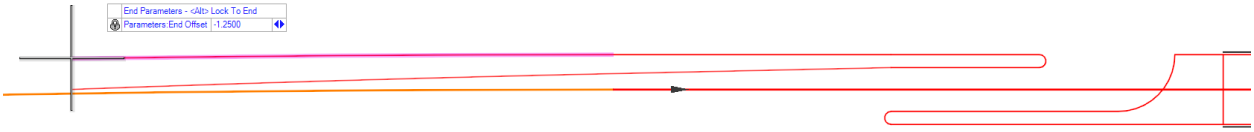
FF. Use the **Single Offset Partial** tool to create an element that is 10.75’ offset and 254.00’ long.

GG. Create the lane taper using the **Variable Offset Taper** tool, the taper should start at the end of the inside concrete island line, set this point by napping to the end of the line.



HH.Set the offset to -1.25’ and <ENTER> to lock.

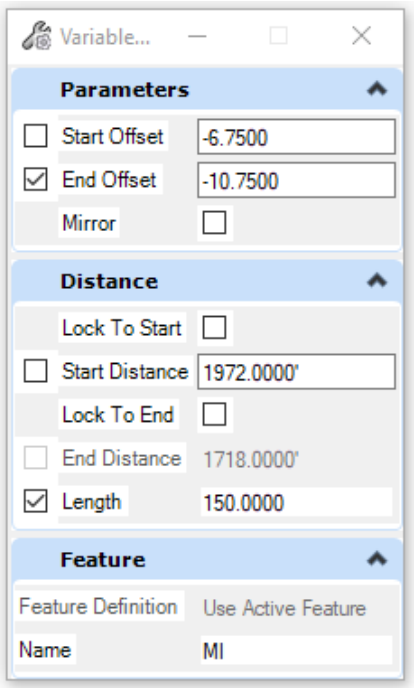
II. Snap to the end of the previous line to set the location of the end point.



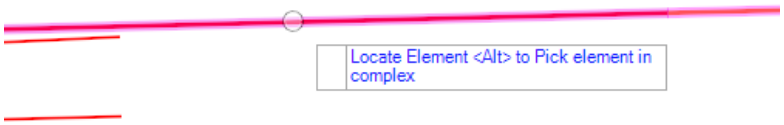
JJ. This will complete the turn lane taper.

KK. The last step is to create the bay tapers that connect each lane taper. The bay tapers are 150.00’ each. Start the **Variable Offset Taper** tool. Set the dialog box for

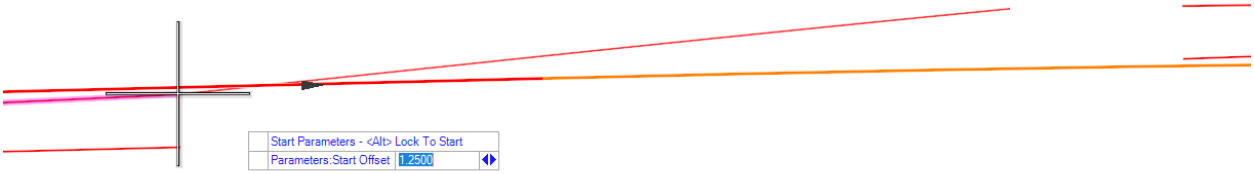
- End Offset = -10.75
- Length = 150.00’



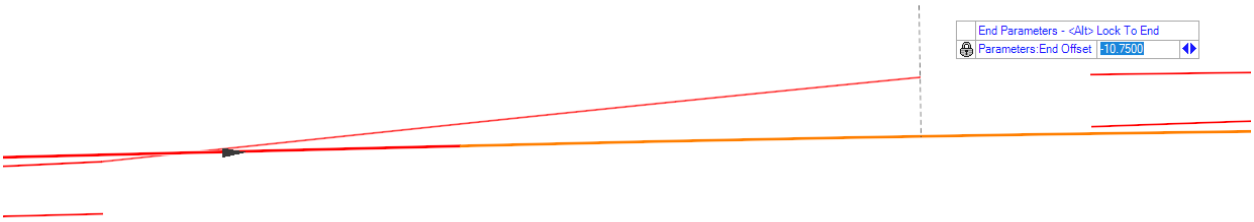
LL. Left click on the Y8 centerline to select the reference element.



MM. Snap to the end of the lane taper to set the start point and the offset.



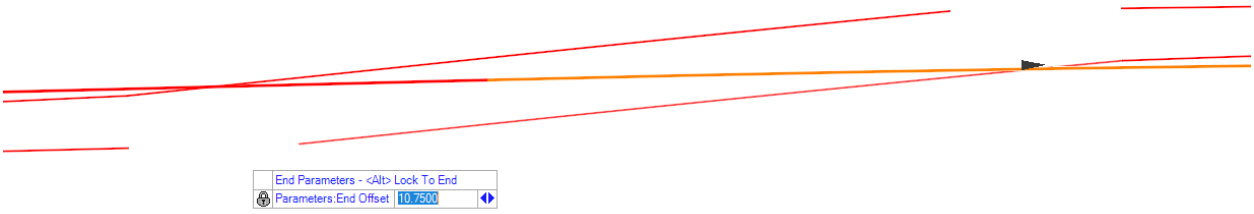
NN. Left click to accept the end offset of 10.75’ and the length of 150.00’.



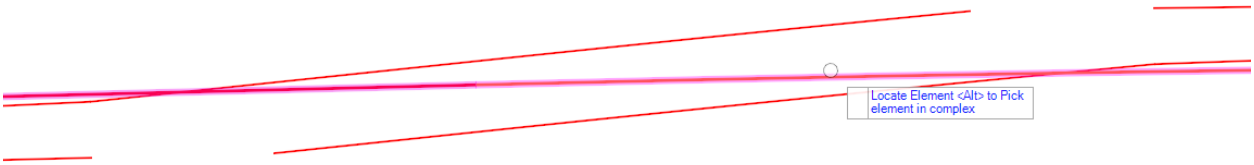
OO. Set the mirror option to NO.

PP. Repeat the process for the other Bay Taper

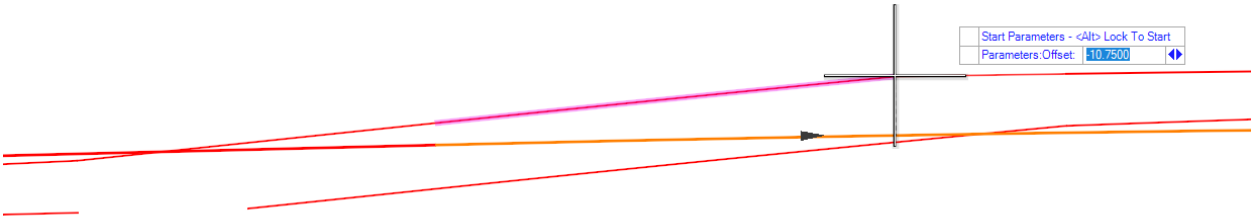
- Select the Y8 Centerline
- Snap to the end of the lane taper
- Left click to accept ending offset and length
- Left click to accept mirror option of NO



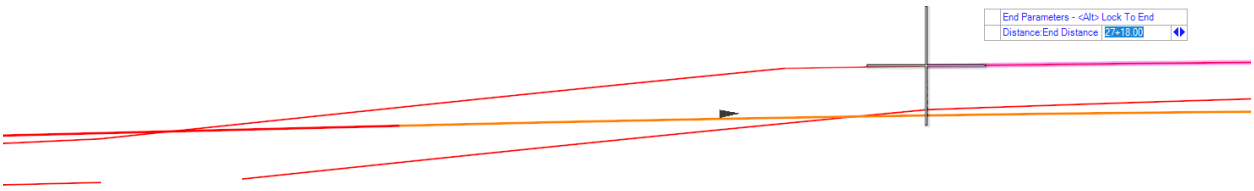
QQ. The last step is to connect the bay taper line to the concrete island line. For this task we will use the **Single Offset Partial** tool to make the connection. Select the Y8 centerline.



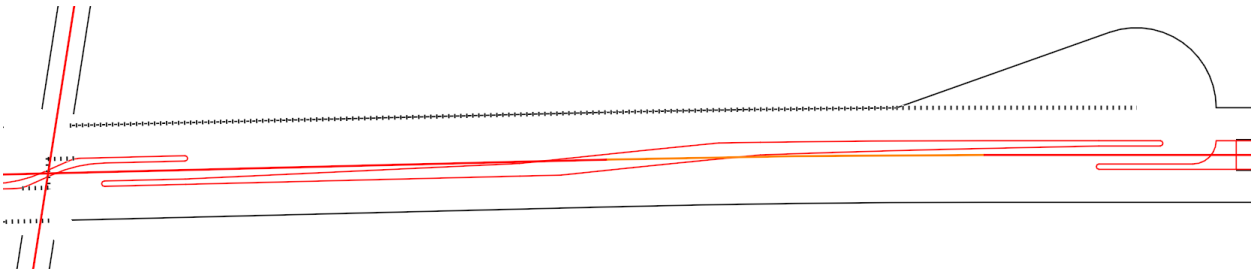
RR. Snap to the end of the bay taper line to set the start point and start offset.



SS. Make sure the length value is checked off and snap to the end of concrete island to set the end point. Set the mirror option to NO.



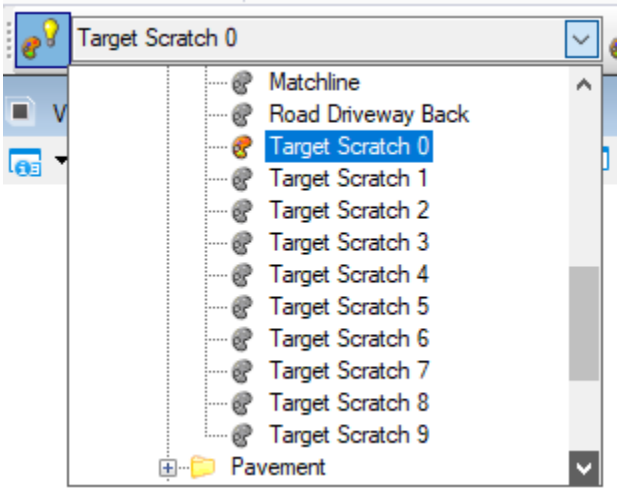
TT. Repeat this process for the other gap in the island.



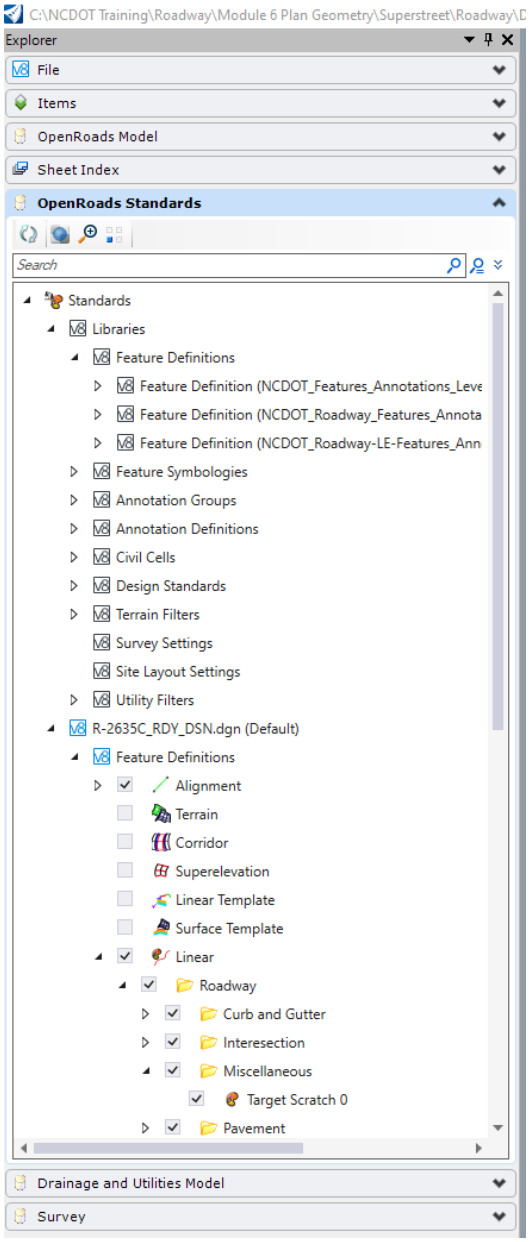
UU. While it would be possible to use the **Trim To Intersection** tool to extend the lines to meet this would break some of the previously established rules. With some use and practice it will become evident what tools to use and when to use them. There were many instances during this exercise where a different tool or method could have been used.

VV. Repeat this process for the other left turn island.

WW. In ORD multiple feature definitions can all share a single level. For example, there are 9 separate feature definitions for Target Scratch. All these different feature definitions share the same level Draft_Construction_Class_Element. By turning off the level all the elements on that level would turn off.

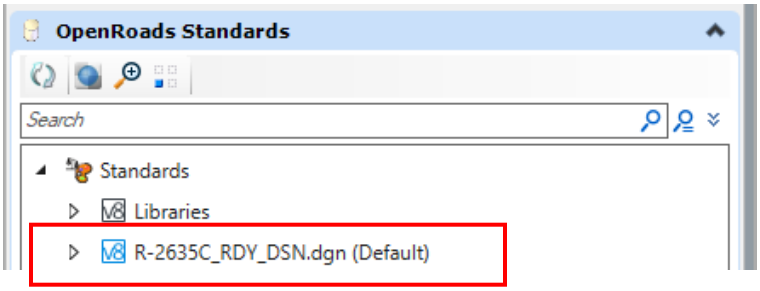


XX. If the user only wanted to turn off the Target Scratch 0 but leave Target Scratch 1 visible, the way to accomplish that is to go to the Explorer Window.

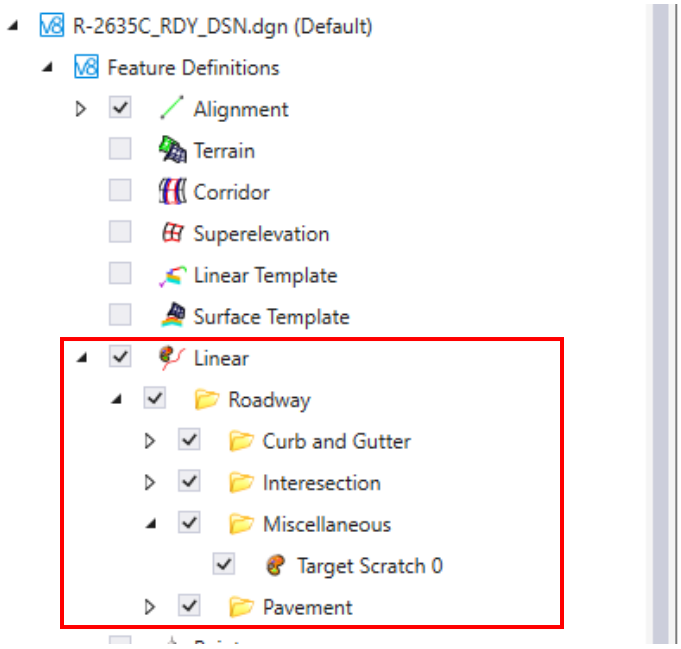


YY. Go to the Open Roads Standards Tab

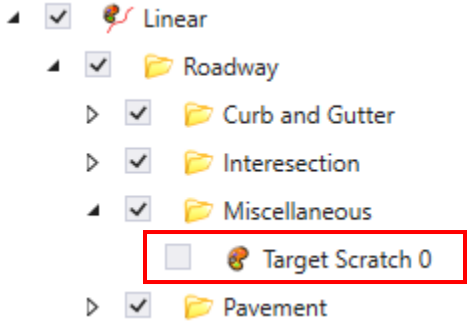
ZZ. Go to the Active File Section of the tab.



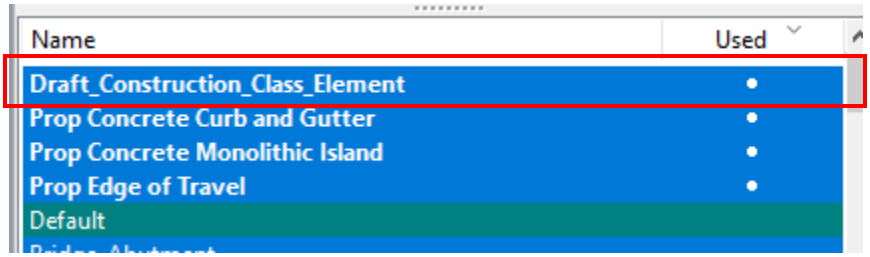
AAA. Expand this section to the Linear Feature Definition list. This will show all the Feature Definitions that have been placed in the current file.



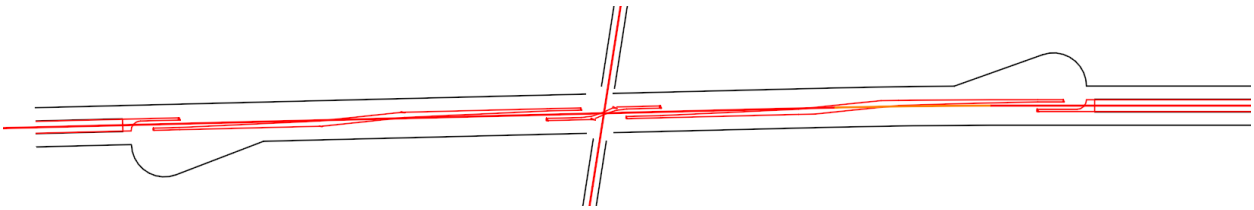
BBB. Find the Target Scratch 0 Feature Definition and uncheck the box.



CCC. This will turn off the Feature Definition even though the level is still ON.

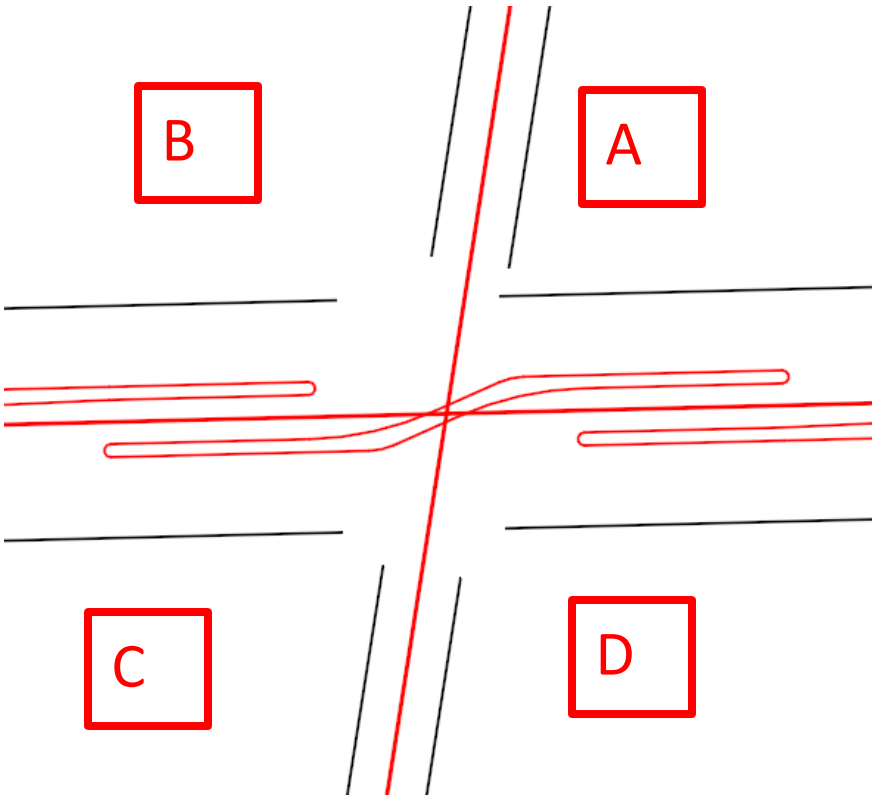


DDD. This will show the partially completed superstreet design with the Monolithic Islands on Y8 and the U Turn Bulbs. The elements created as reference points should not be displayed.

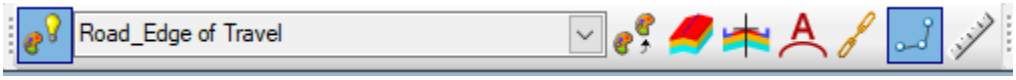


6. Superstreet – Edge of Pavement Intersection Radius

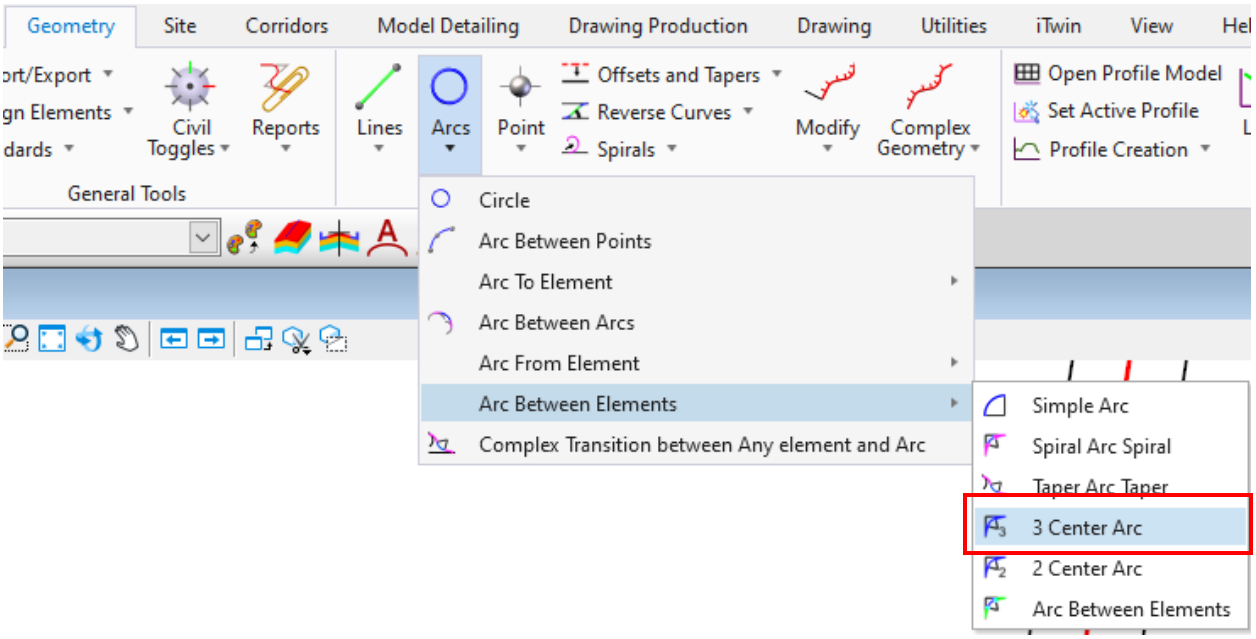
A. In this exercise we will construct the edge of pavement for the Y8 and Y18 intersection. For the radius at the right turn from Y18 onto Y8 in quadrant B and D we will construct offset curves with a linear taper. For the radius at the right turn from Y8 onto Y18 in quadrant A and C we will construct 3 centered curves.



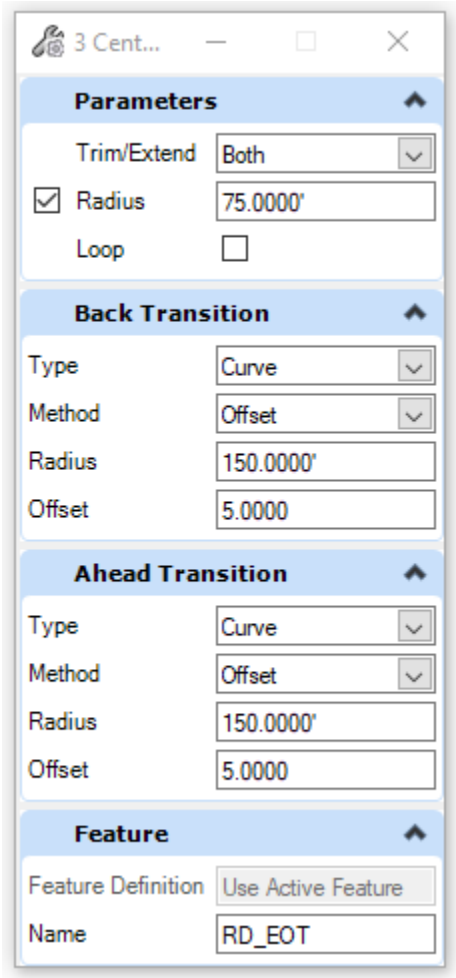
B. In quadrant A we will construct a 3 Centered Curve with radius of 150-75-150 and a 5.0’ offset. Set the Active Feature Definition to Road_Edge of Travel



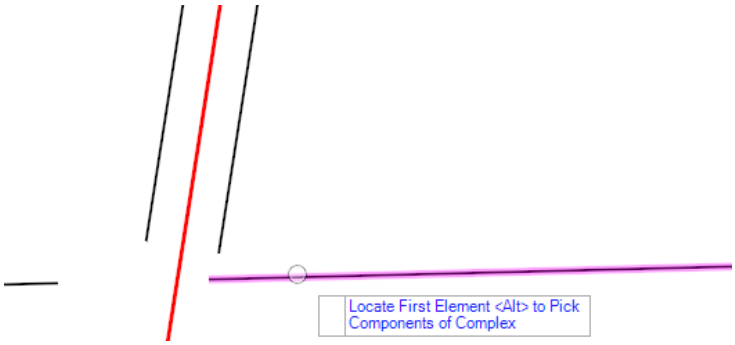
C. From the Horizontal section of the *Geometry* ribbon select the **3 Center Arc** tool.



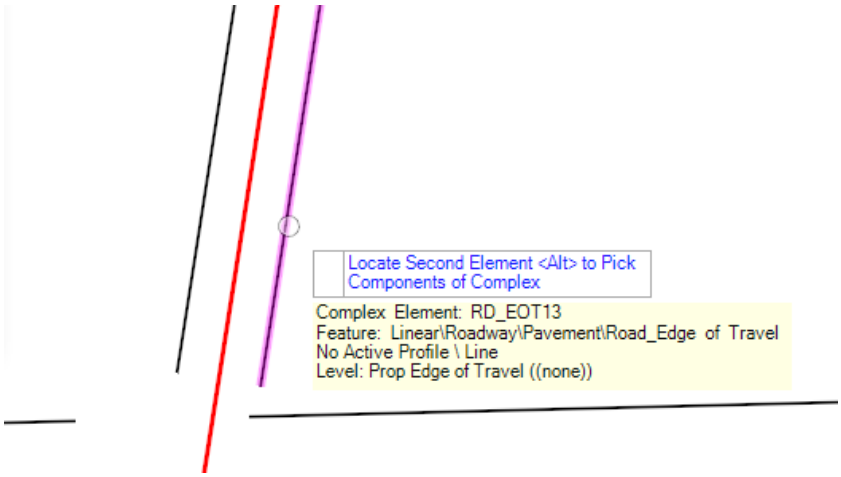
D. Set the dialog for a 3 Centered Curve with the appropriate design information.



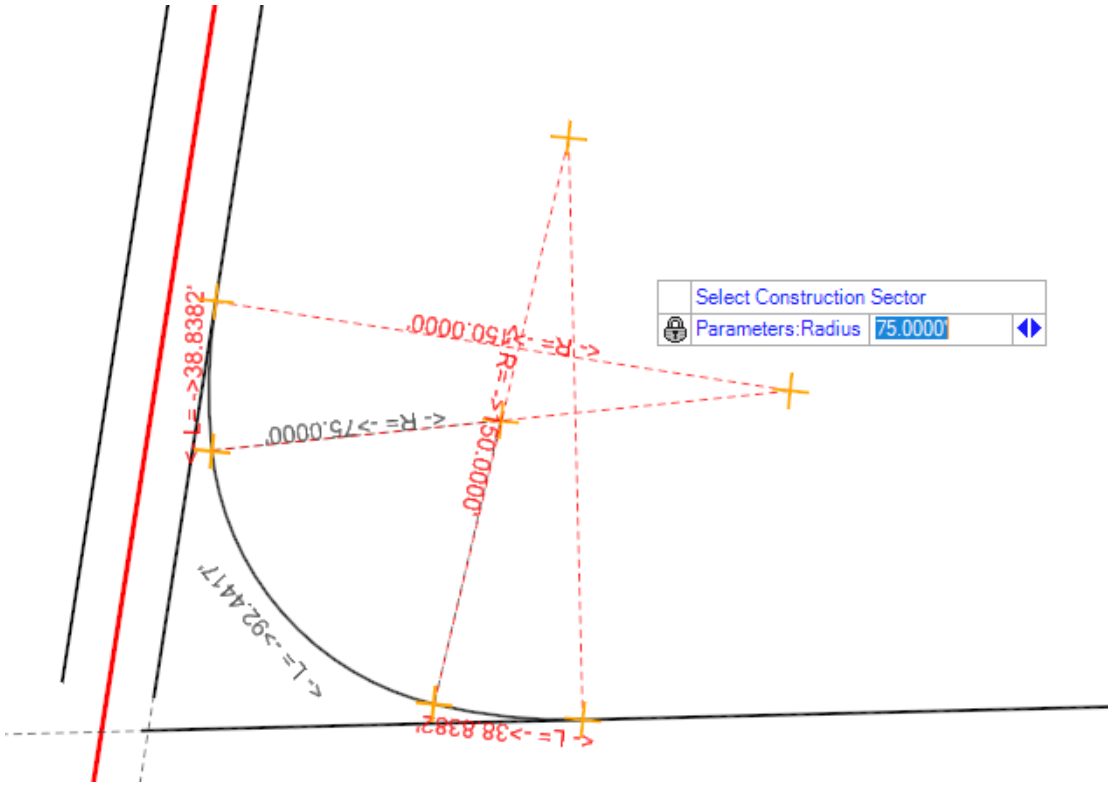
E. Left click on the Y8 edge of pavement to select the first element.



F. Left click on the Y18 edge of pavement to select the second element.

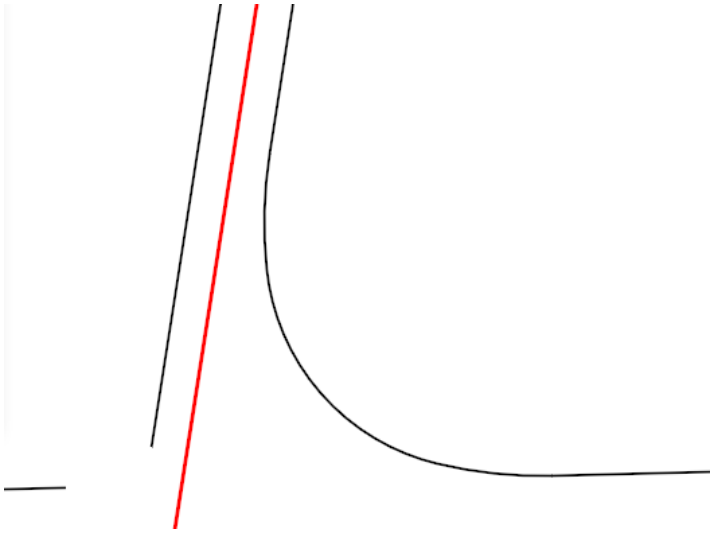


G. Move the cursor into quadrant A to select the correct solution, and left click to accept.

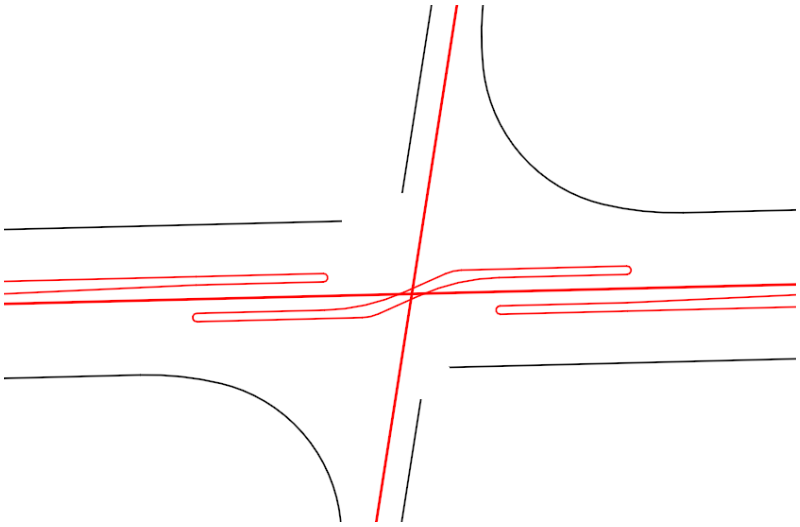


H. Left click to accept the trim option for BOTH.

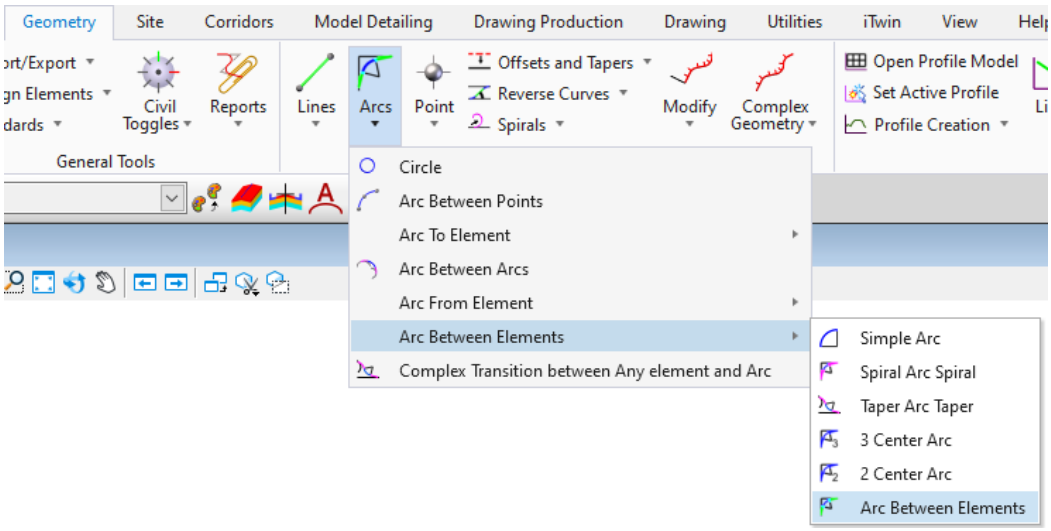
I. This will complete the 3 Centered Curve placement.



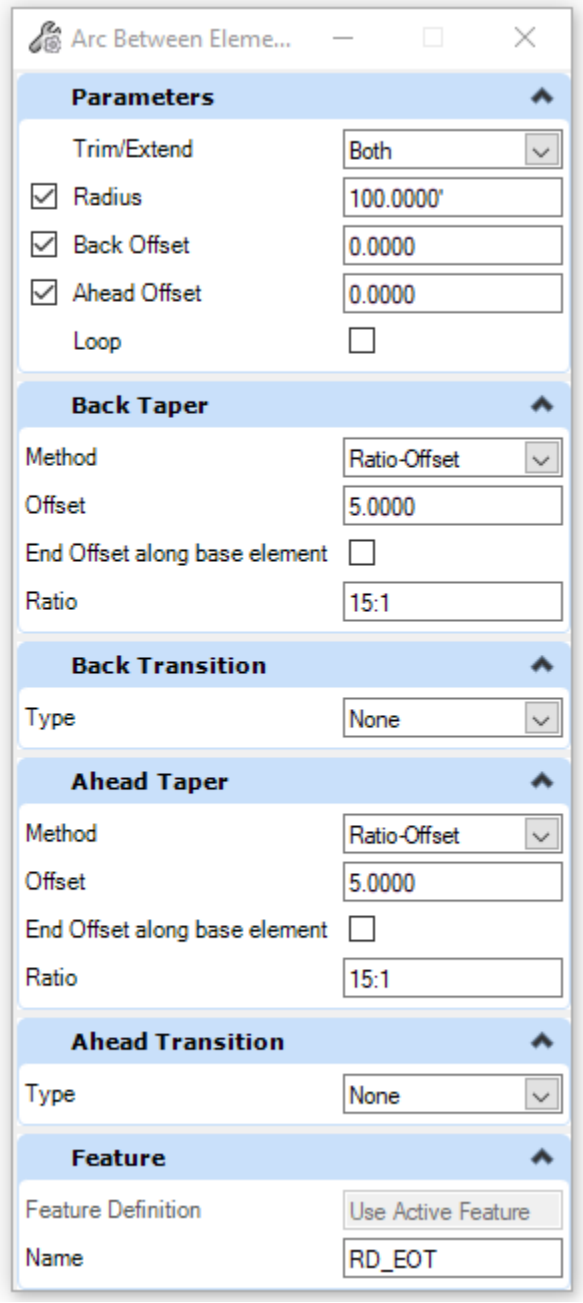
J. The 3 Centered tool will remain active, just repeat the steps, left clicking to accept the previously entered data to complete the 3 Centered Curve in quadrant C.



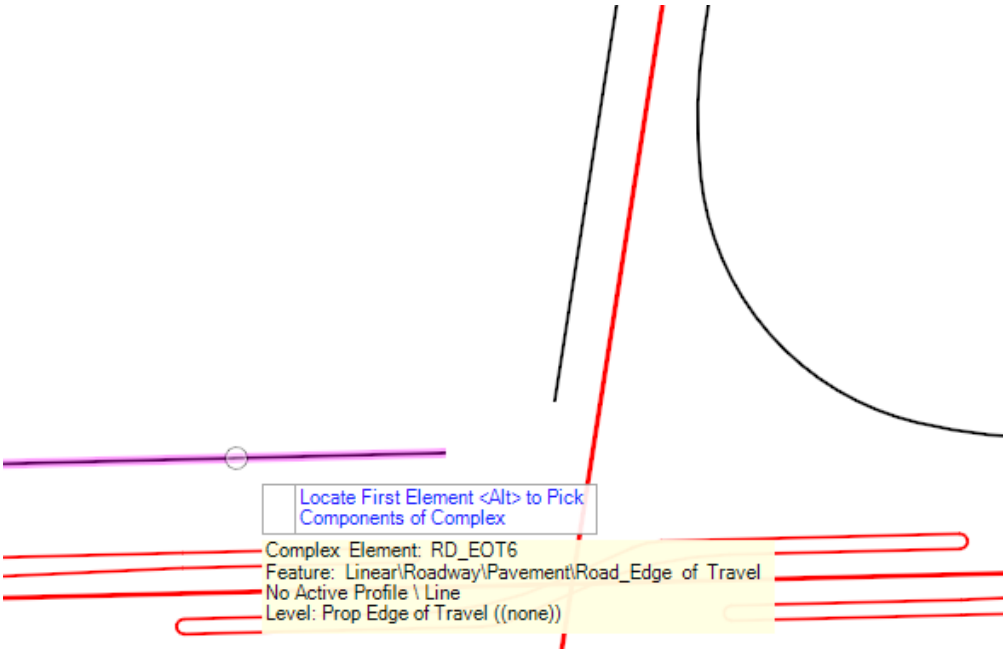
K. In quadrant B and D, we will place an intersection curve with a radius of 100’ an offset of 5’ and a linear taper with a ratio of 15:1. Start the **Arc Between Elements** tool.



L. Set the dialog for the appropriate design information.

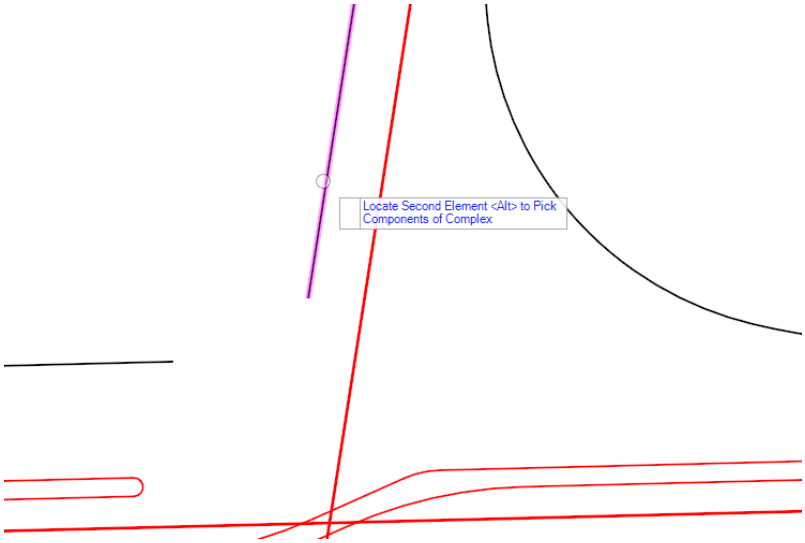


M. Left click to accept the first element.



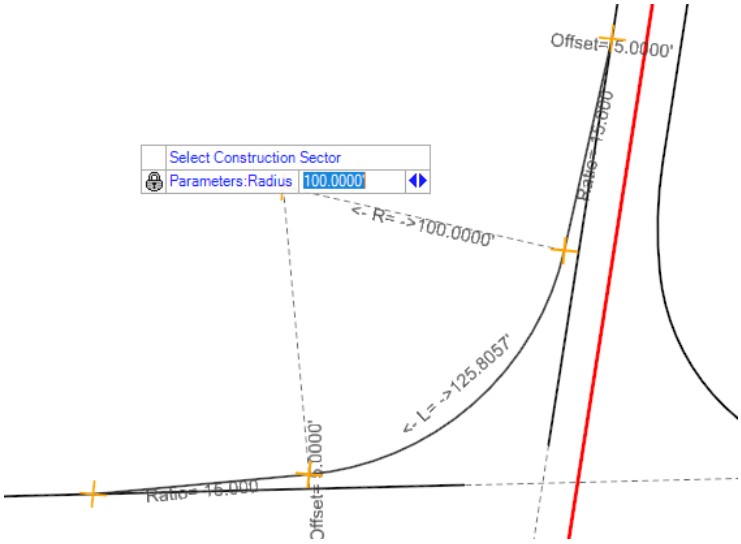
N. Left click to accept Back Offset of 0'. Remember from the Horizontal tool training this is not the offset of the central curve but the offset of the tangent point from the reference element. The offset of the curve is handled by the specified taper offset.

O. Left click to locate the second element.



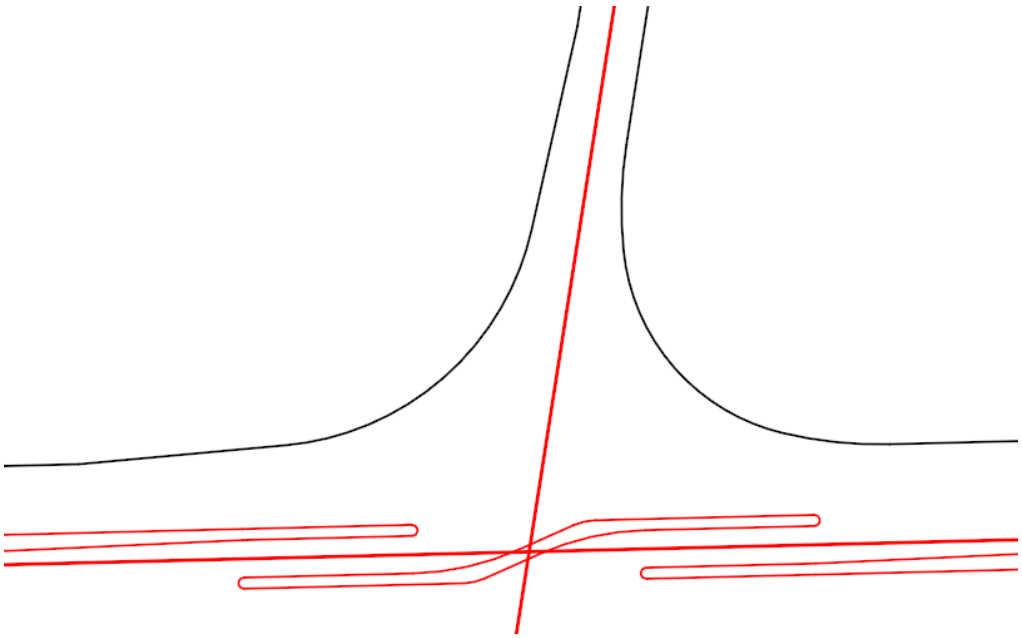
P. Left click to accept the ahead offset of 0'.

Q. Place the cursor in the B quadrant to select the correct solution and left click to accept.

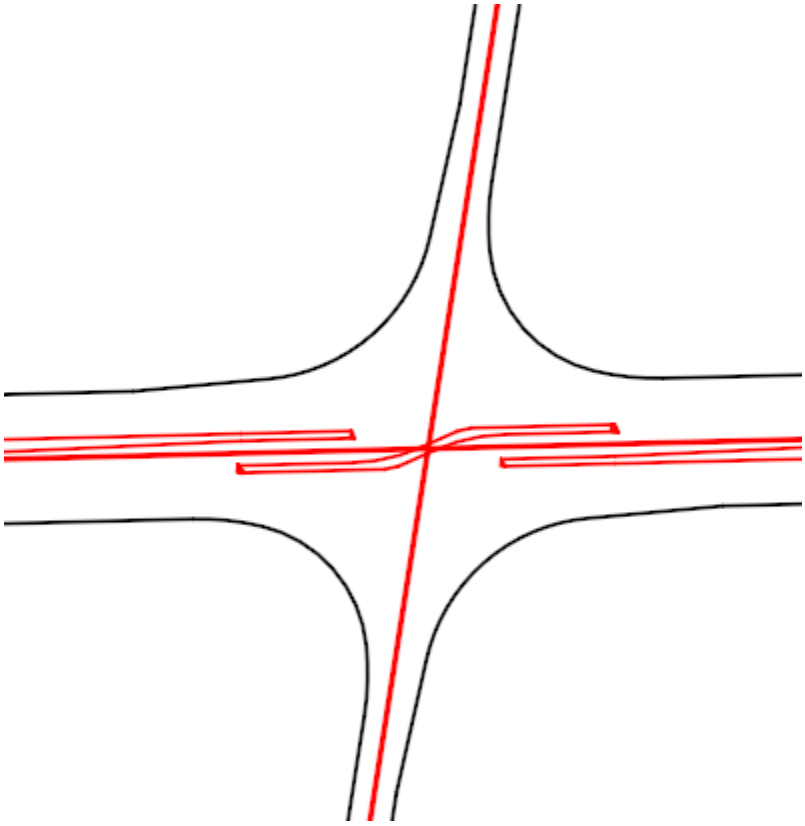


R. Left click to accept the trim option of BOTH.

S. This will place the curve and trim the edge of pavement lines to match.

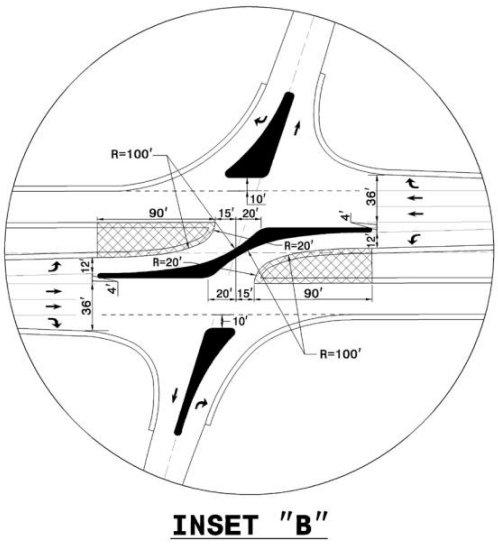


T. Repeat the same process in the D quadrant. Because the curve design is the same and the tool is still active the user only needs to left click to select reference elements and accept design inputs. This will complete the intersection edge of pavement design.



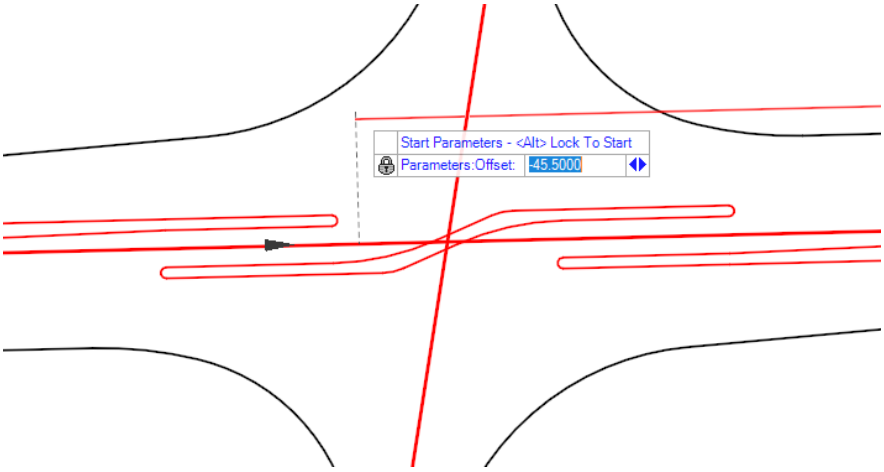
7. Superstreet – Intersection Islands

A. In this exercise we will construct the monolithic islands located in the intersection along Y18. This is the final step required to finish the super street design.

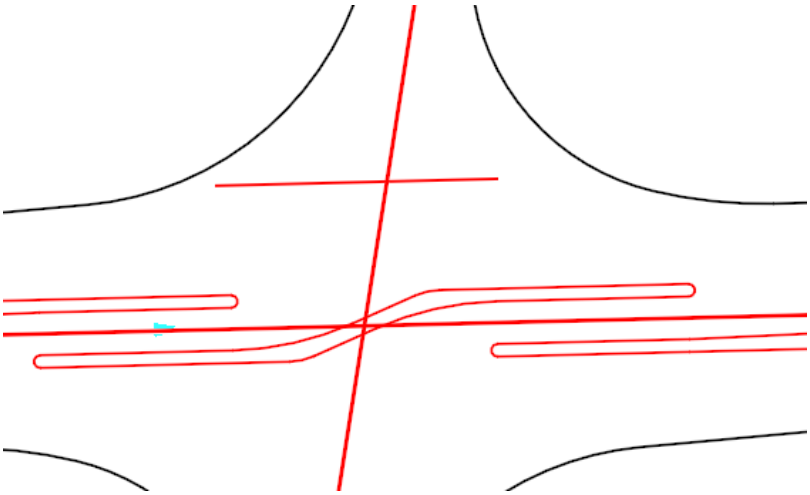


INSET "B"

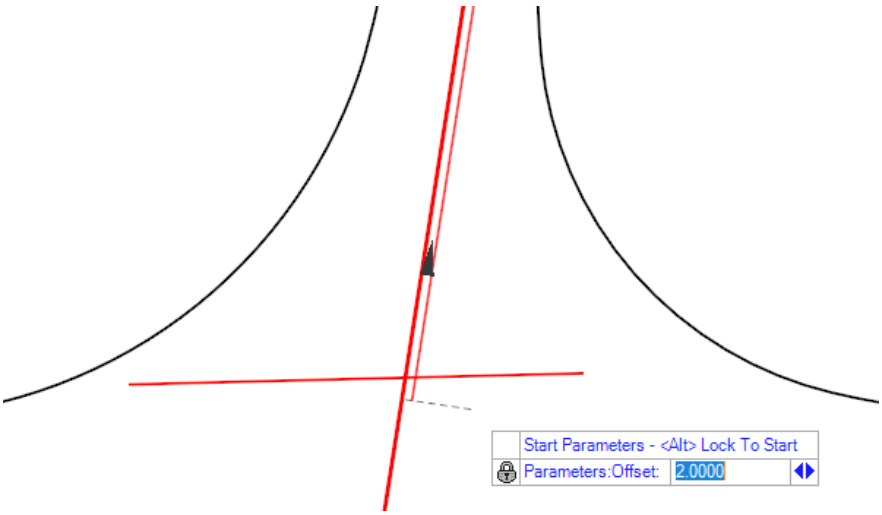
B. Begin with the island at the intersection on the left side of the road. Select the **Single Offset Partial** tool. Set the offset distance to 45.50' and offset the Y8 centerline to establish the edge of the island adjacent to the Y8 travel lanes.



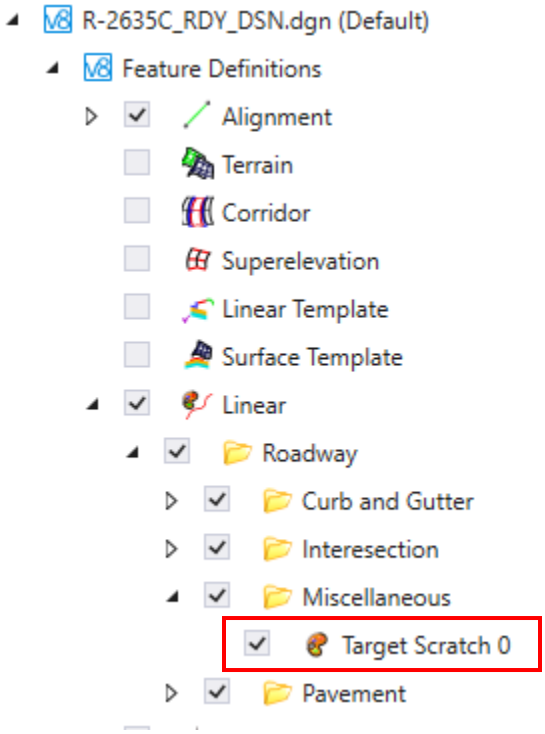
C. This will establish the 10’ offset shown in the standard.



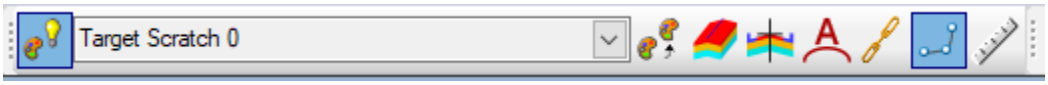
D. To construct the right side of the island, use the **Single Offset Partial** tool and construct an element offset 2’ from the Y18 centerline.



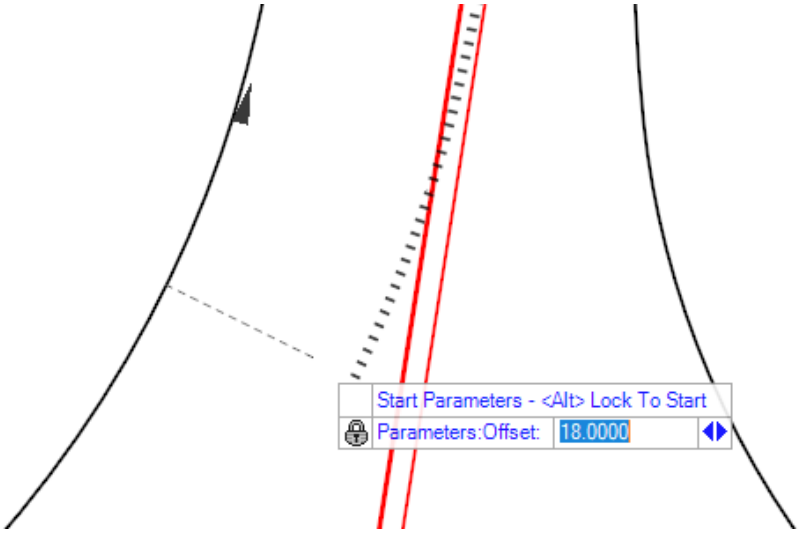
E. For the edge of the island adjacent to the right turn movement from Y18 onto Y8 we will set the lane width to vary from 18’ minimum to 14’ minimum. Turn the Target Scratch 0 feature definition back on in the Explorer



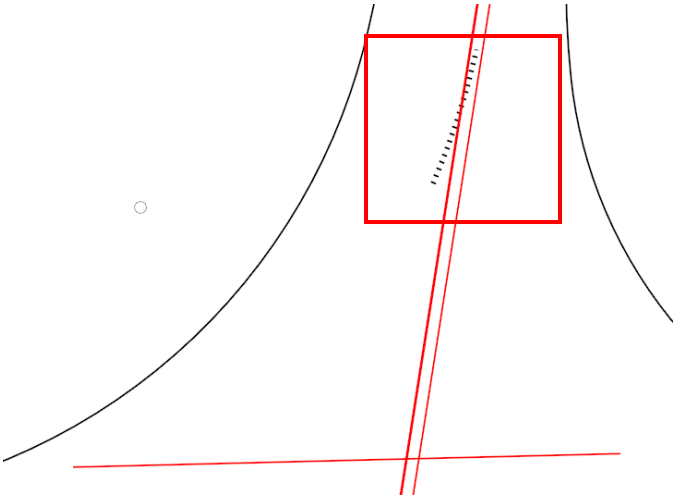
F. And set it as the Active Feature Definition.



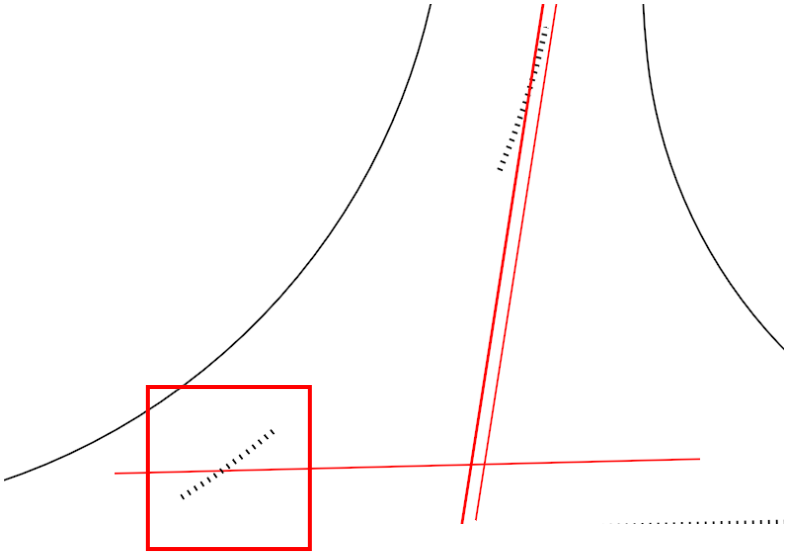
G. Use the **Single Offset Partial** tool and offset the intersection edge of pavement 18.00'.



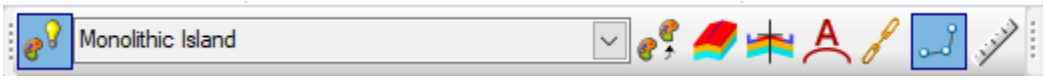
H. This only needs to be done in a short segment close to where it intersects with the Y18 centerline.



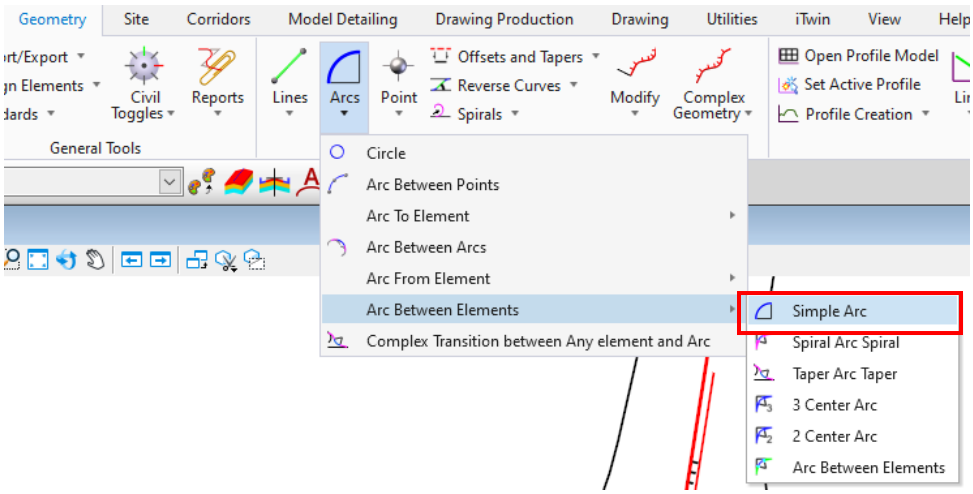
I. Use the same **Single Offset Partial** tool to offset the same edge of pavement line 14.00'. This only needs to be a short segment close to the 10' offset line created earlier.



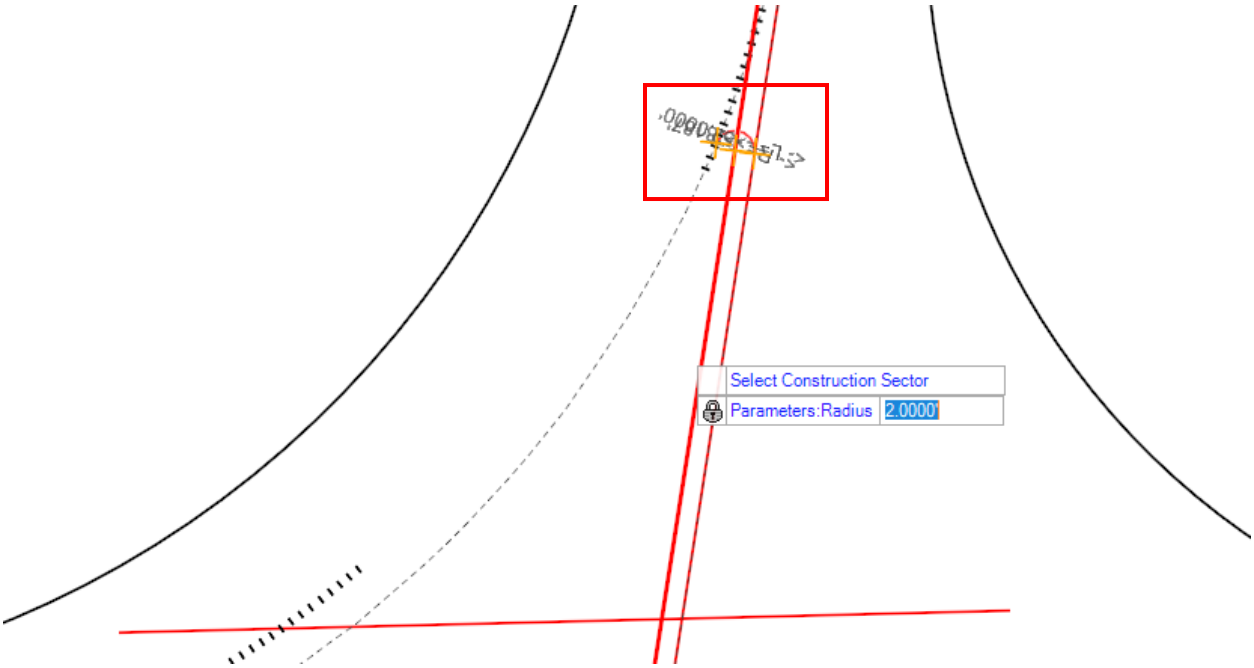
J. Change the Active Feature Definition back to Monolithic Island.



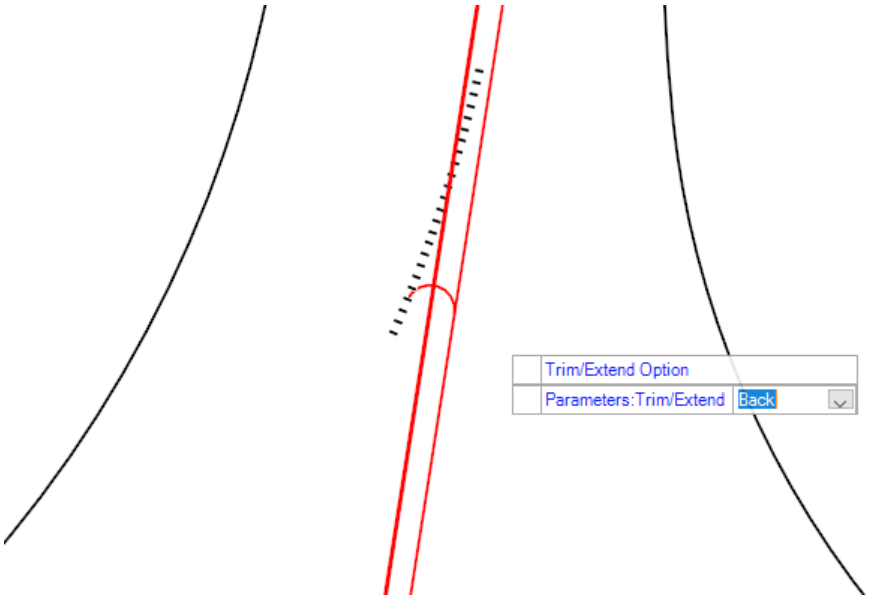
K. Select the **Simple Arc** tool from the **Arc Between Elements** tool group.



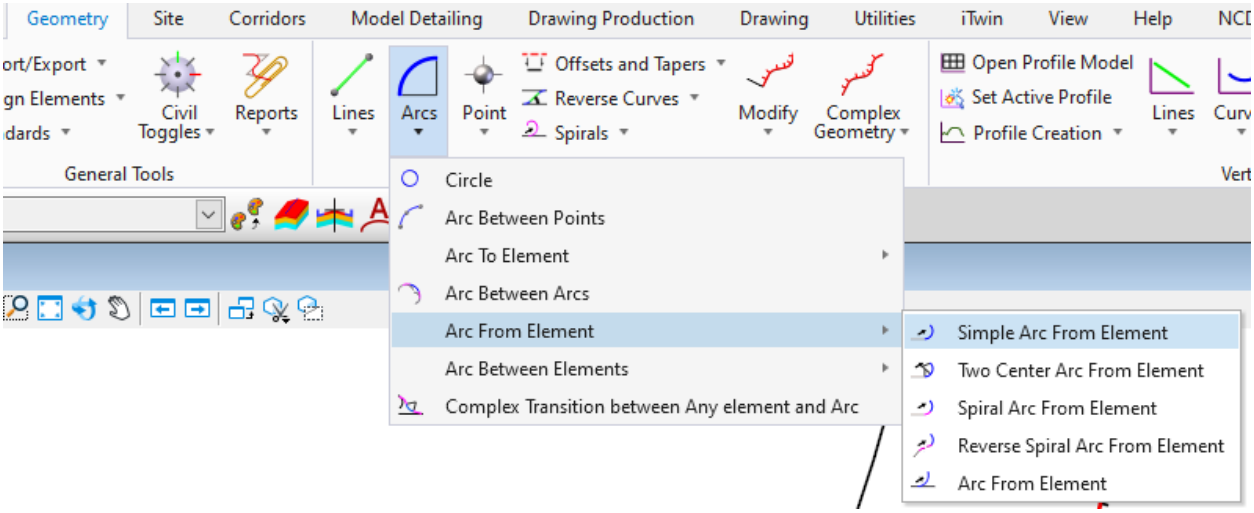
L. Construct a curve with a 2’ radius between the edge of the monolithic island and the 18’ offset construction line.



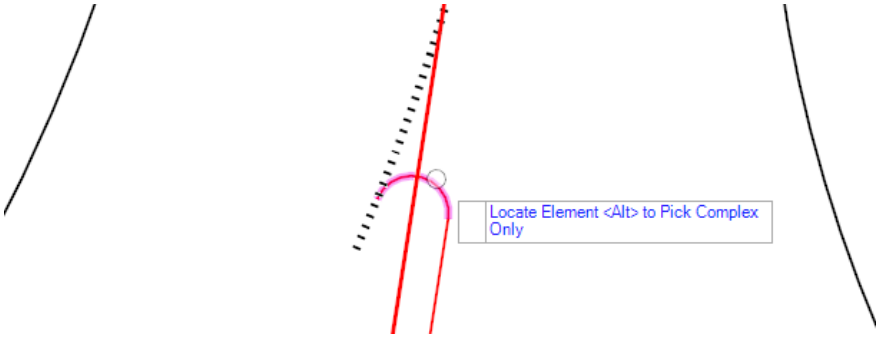
M. Set the Trim Option to BACK.



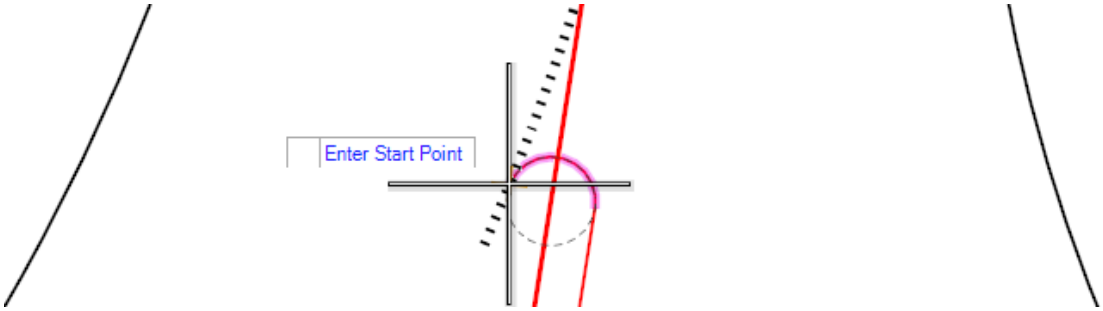
N. Start the **Simple Arc From Element** tool.



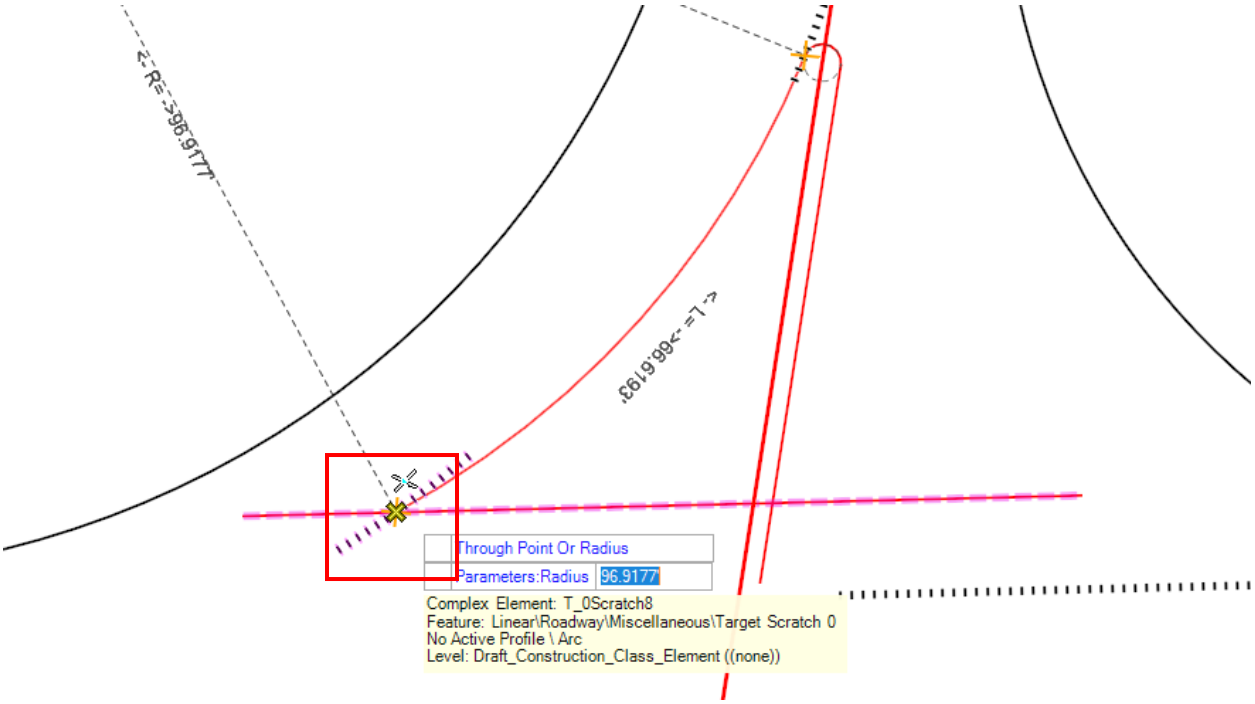
O. Left click to select the previously placed arc with 2’ radius.



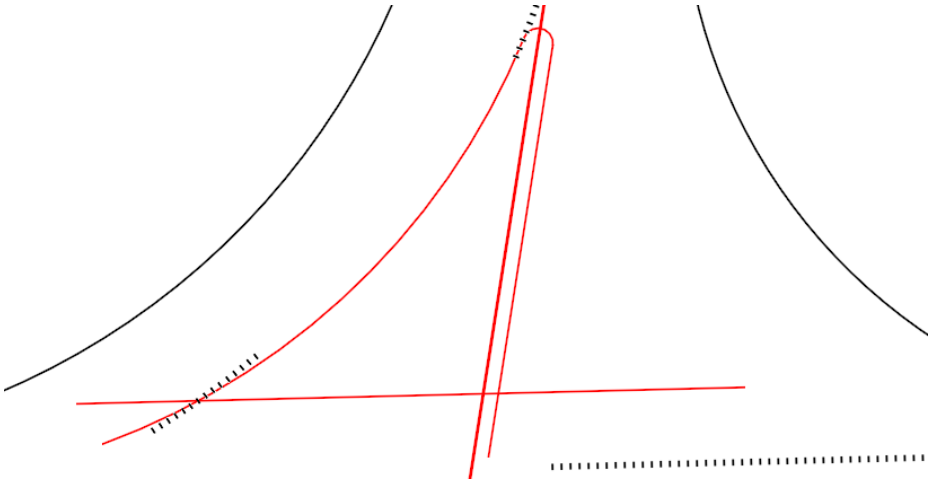
P. Snap to the end point of the arc to locate the start point.



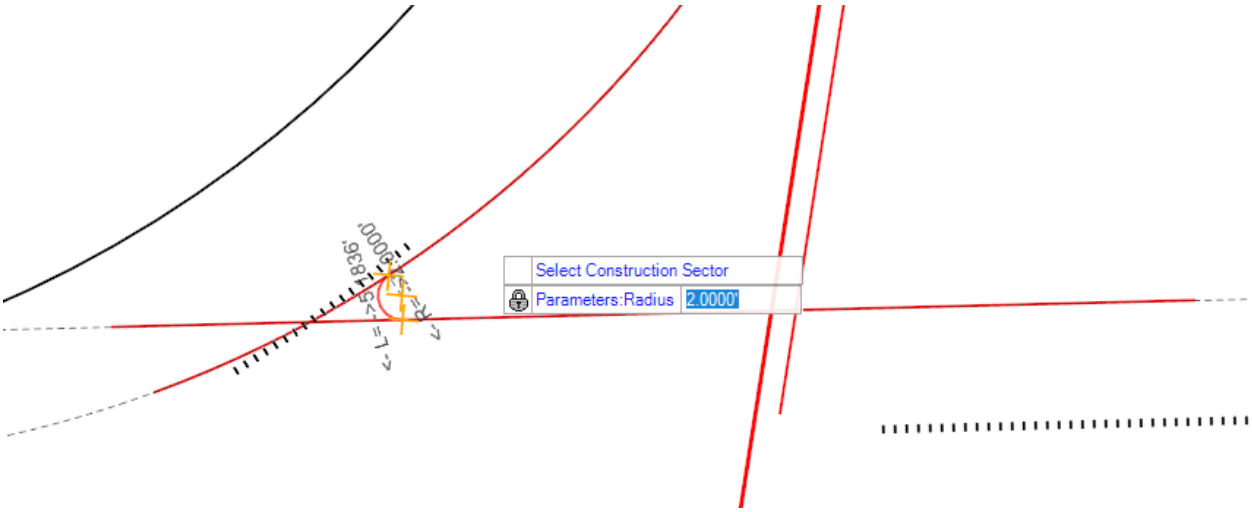
Q. Snap to the intersection of the 10’ offset line from the Y8 edge of travel and the 14’ offset construction line.



R. Left click to set the arc end point, this is not a critical location. Set Trim extend to NONE.

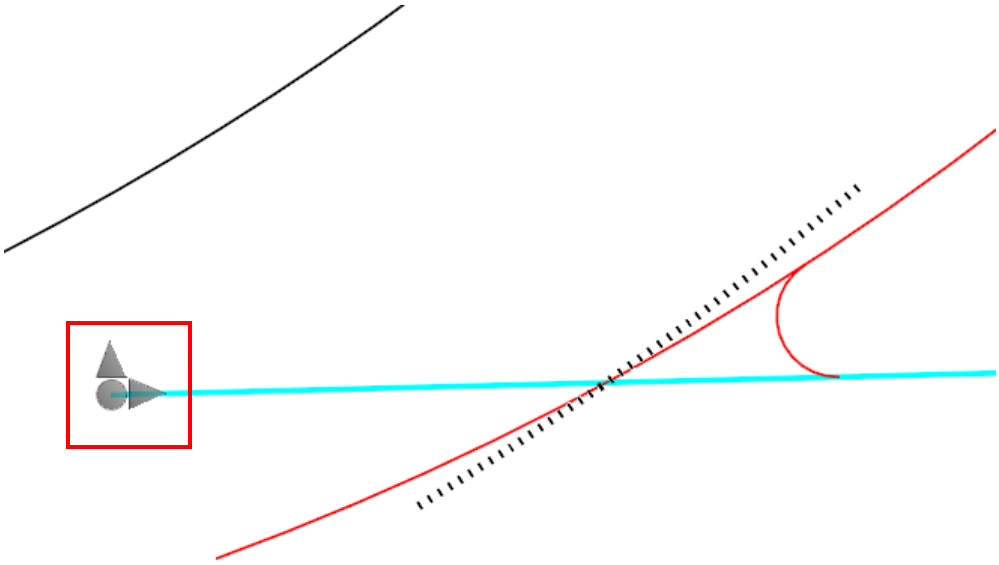


S. Select the **Simple Arc** tool from the **Arc Between Elements** tool group and create a 2’ radius arc between the previously placed line and the 10’ offset line.

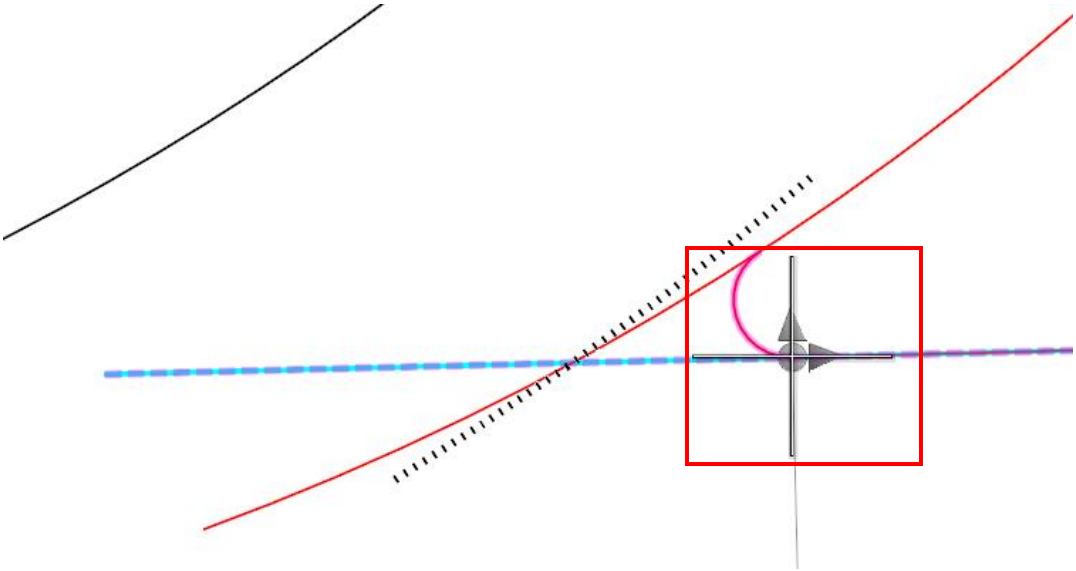


T. Set the trim option to BOTH.

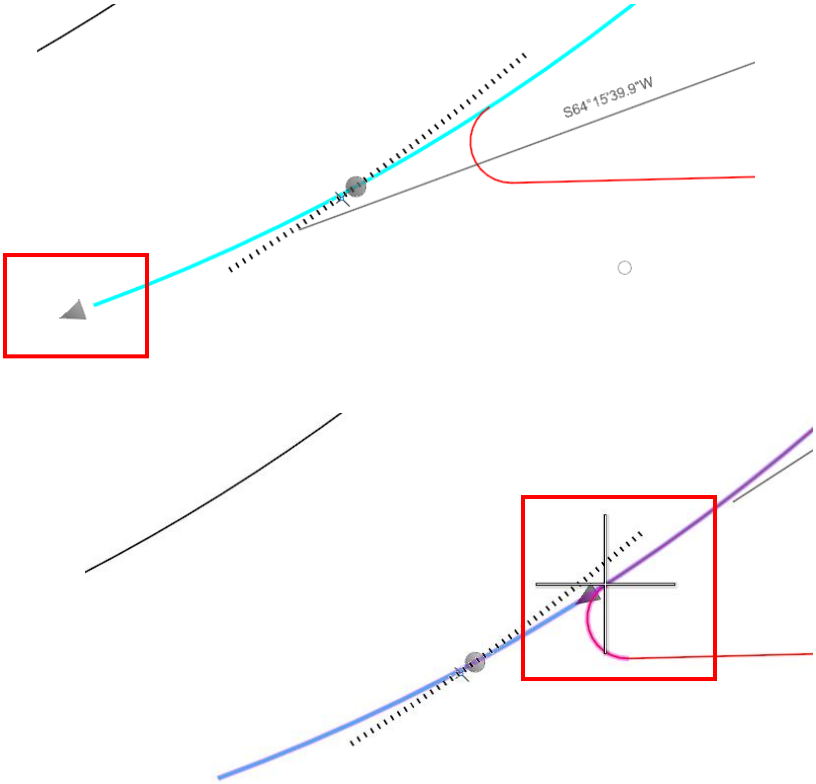
U. In this case the reference elements did not trim, in some circumstances for one reason or another the Trim option may not work correctly. In that case use the **Element Selection** tool to highlight the reference elements and activate the drag handles.



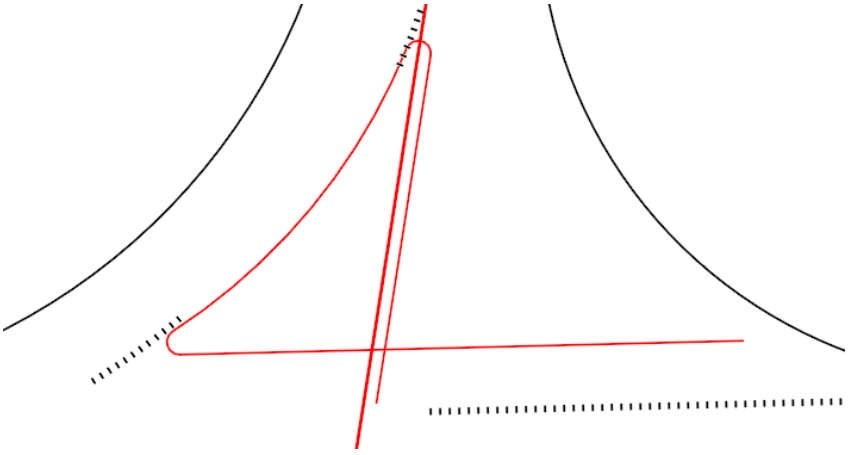
V. Use the drag handles to adjust the end of the reference elements to meet the 2' radius corner arc.



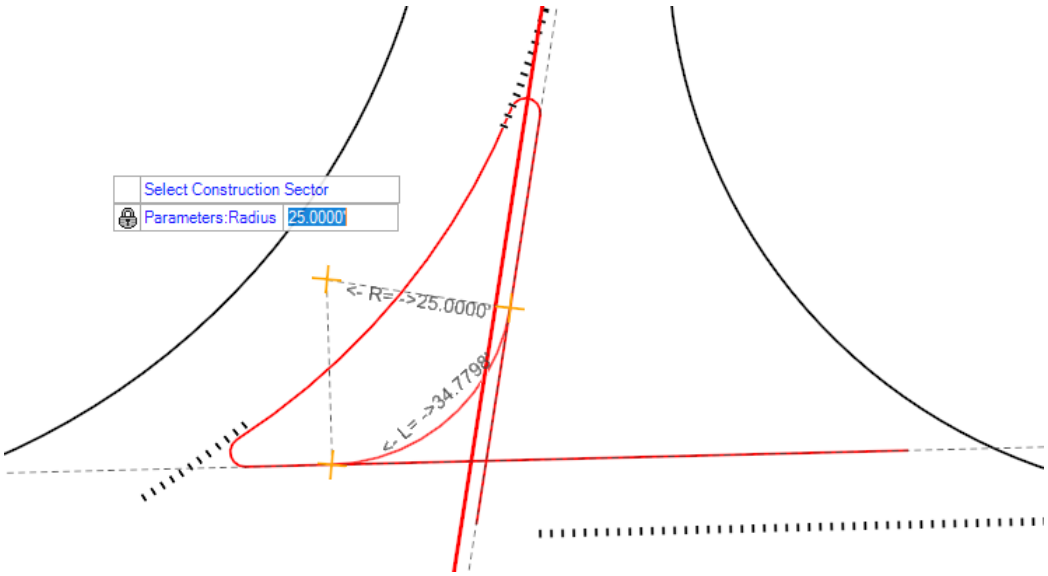
W. Repeat for the other concrete island edge.



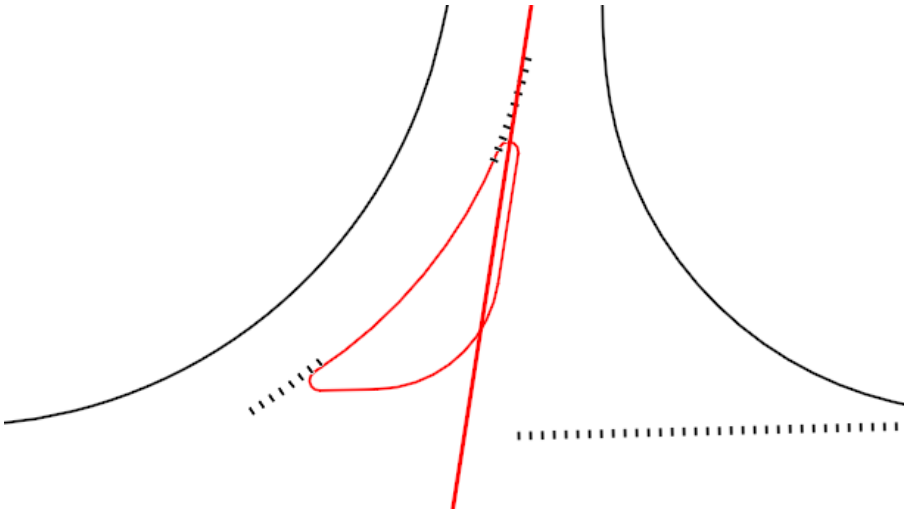
X. This will complete the edge of the concrete island.



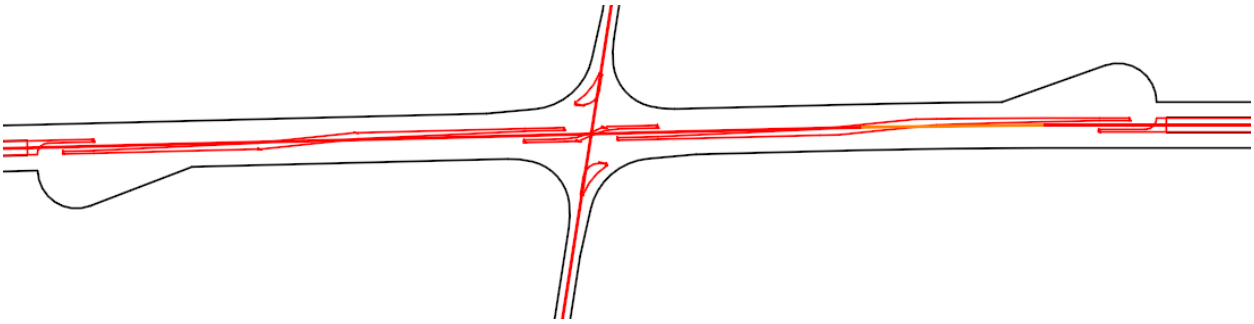
Y. For the final corner of the island select the **Simple Arc** tool from the **Arc Between Elements** tool group and place an arc with a 25’ radius and a Trim option of BOTH.



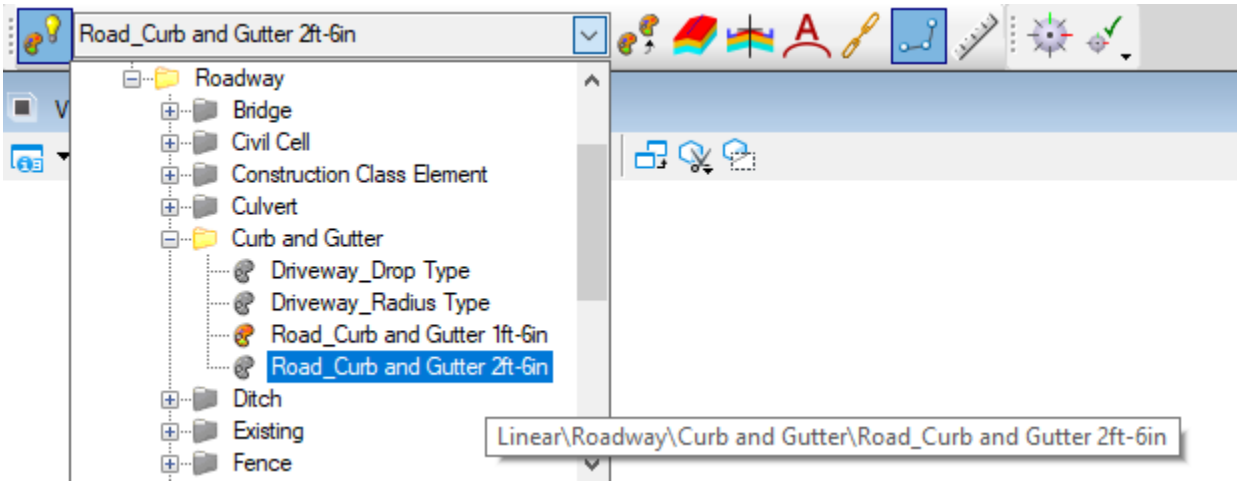
Z. This will complete the island placement.



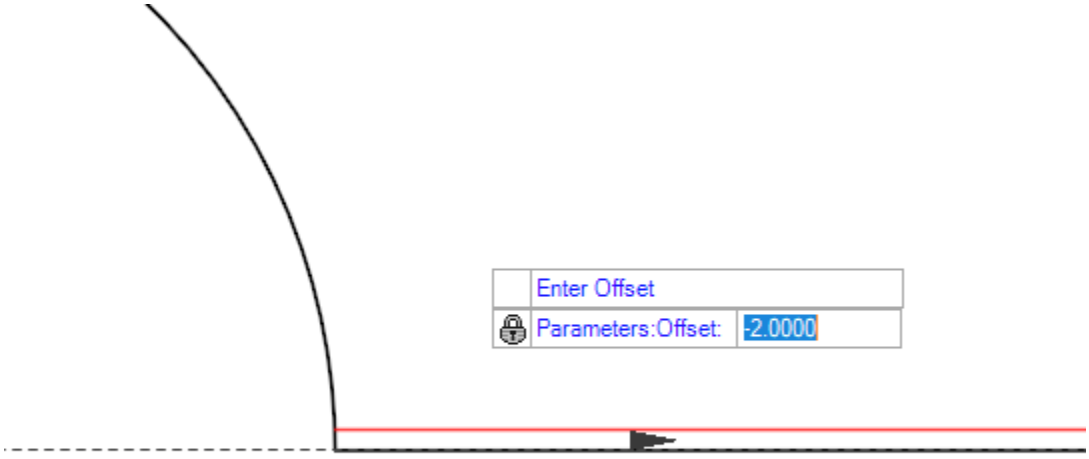
AA. Repeat this process for the other intersection and turn the Target Scratch 0 Feature definition OFF. This will complete the plan geometry layout of the Superstreet Intersection.



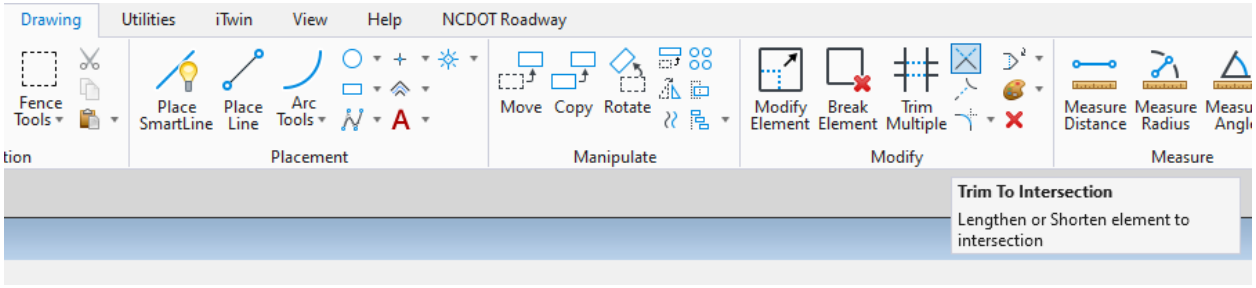
BB. To finish the design, create the outside 2'-6" curb and gutter line. Set the Active Feature Definition to Road_Curb and Gutter 2ft-6in.

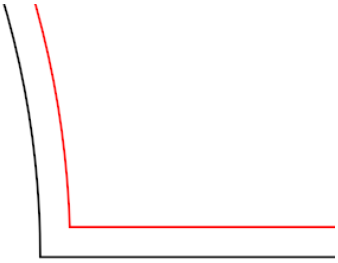


CC. Use the **Single Offset Entire Element** tool to offset the outside pavement lines 2.00' to create the face of curb line. Make sure to select the intervals and not the base underlying geometry.



DD. At the areas around the Bulb where the curb line overlaps use the **Trim to Intersection** tool from the *Modify* section of the *Drawing* ribbon to trim the elements.





EE. Note that this exercise was intended to demonstrate the tools and concepts for one way to lay out a superstreet intersection. There are various ways to achieve the same results. Additionally all dimensions would need to be verified to meet design vehicle criteria for the specific geometry of each intersection.

Plan Geometry – Proposed Right of Way

In this section we will review placing RW lines and Markers, this section will only focus on the placement of the markers and the lines, see additional CONNECT training guidelines for information on placing labels

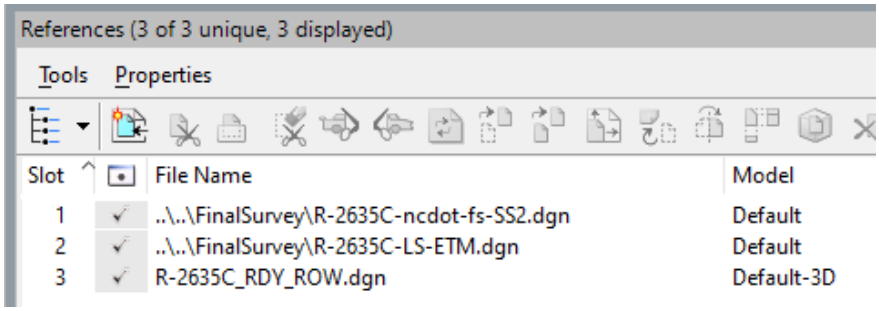
1. Create RW File

A. Create a new design file using the 2D seed file: ***R-2635C_RDY_ROW.dgn***
   - This file should be created in the Alignments folder of the training directory *…\Module 7 Plan Geometry\R-2635C\Roadway\Design*

B. Attach the Final Survey file ***R-2635C_NCDOT_FS.dgn*** located in the FinalSurvey folder.

C. Attach the Existing Terrain Model ***R-2635C_NCDOT_FS.dgn*** located in the FinalSurvey folder.

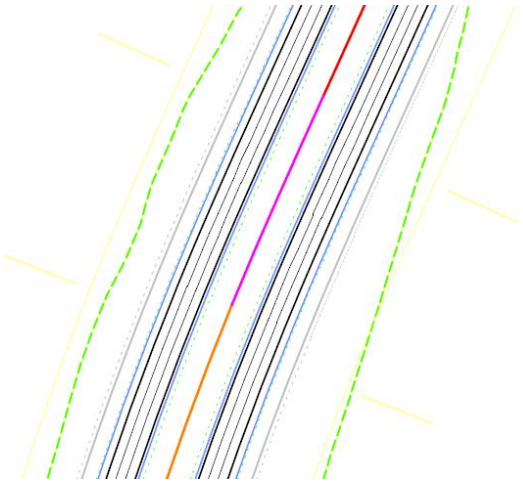
D. Set the Terrain Active, this will create the 3D Model view.



E. Attach the Master Alignment file ***R-2635C_RDY_ALG.dgn*** from the Alignment folder. Set the nesting option to Live Nesting and the Depth to 1. This will show all the individual alignments.

F. Attach the ***R-2635C_CMD_L.dgn*** files from the design folder. The CMD file is the file that will contain the construction limits generated by the model.

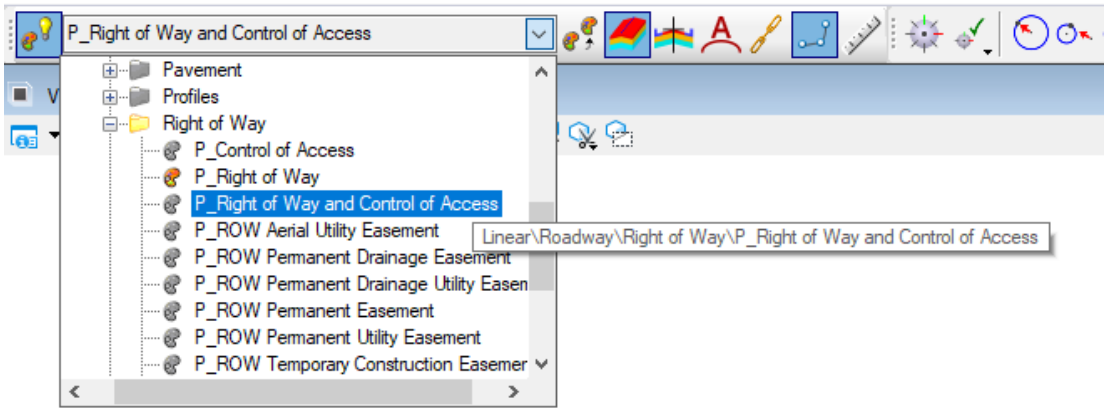
G. Turn off the FS file and the ETM file and the 2d View should look like the picture Below.



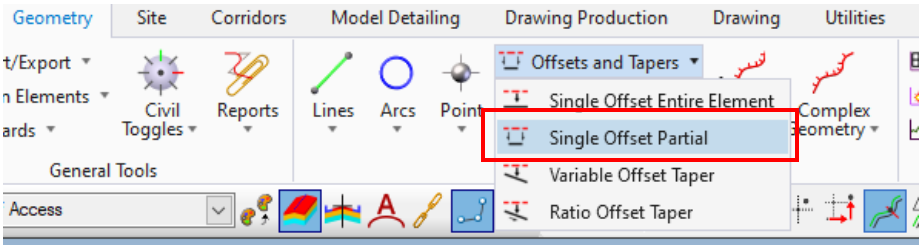
2. Placing RW Lines and Markers Constant Offset

A. In this exercise we will review placing the RW lines and Markers at a constant offset from the reference centerline. We will be placing the RW along the section of the L line from Y16 to the end. This section will be 350’ wide.

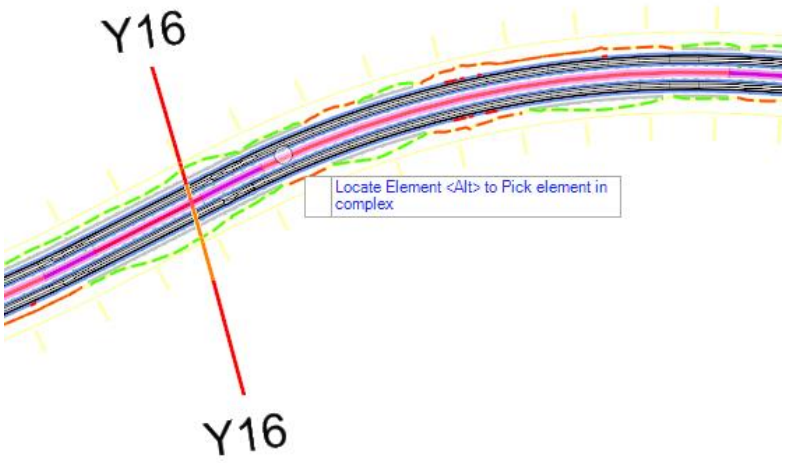
B. Set the Active Feature Definition to P_Right of Way and Control of Access



C. Select the **Single Offset Partial** tool.

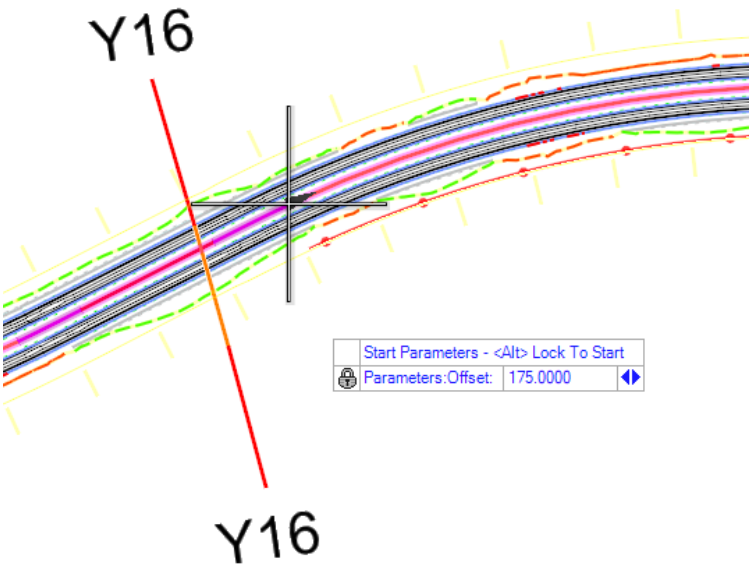


D. Left click to locate the L centerline just past the Y16 alignment.

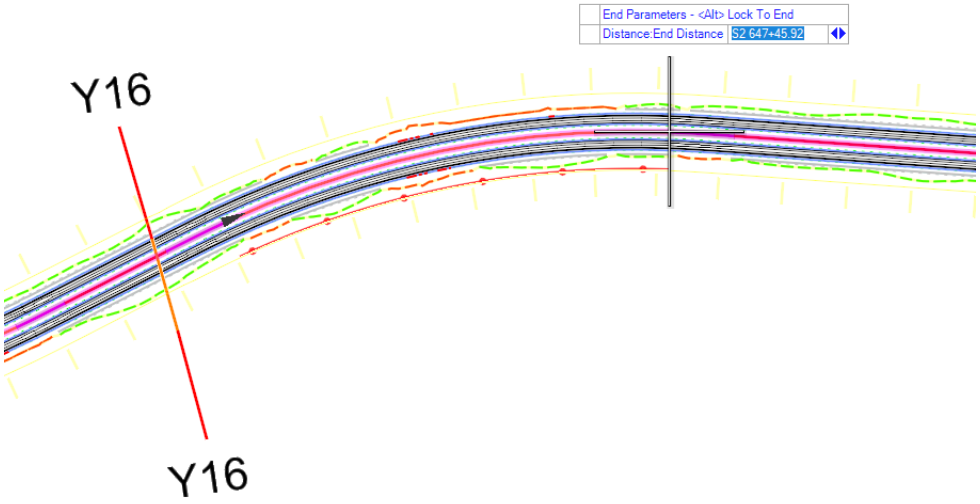


E. Type in 175.00’ for the offset and <ENTER> to lock.

F. Snap to the beginning of the first curve past Y16 to set the start station.

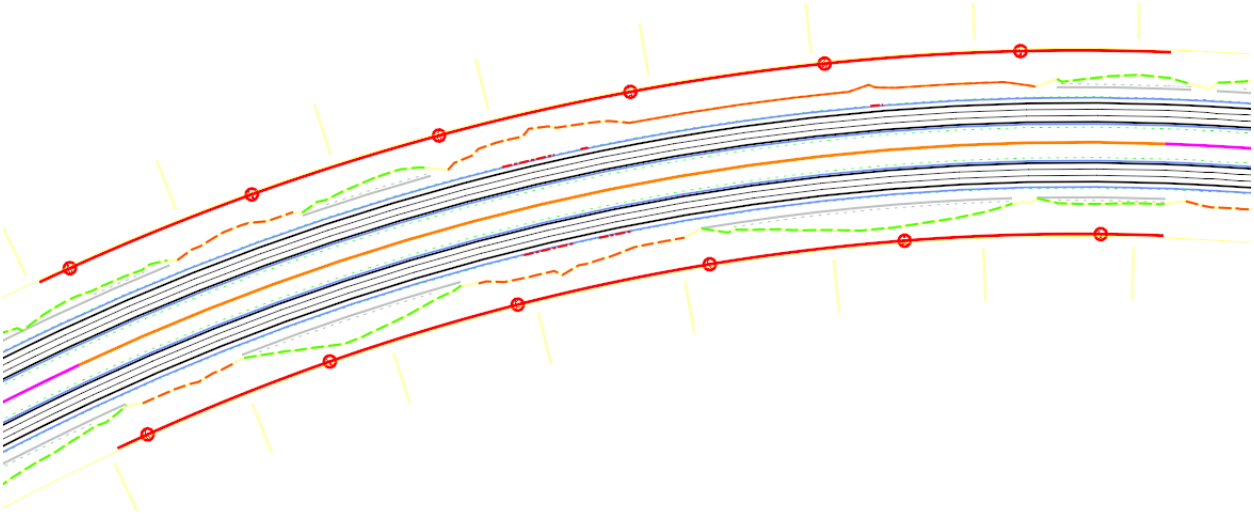


G. Snap to the end of the curve to set the send station.

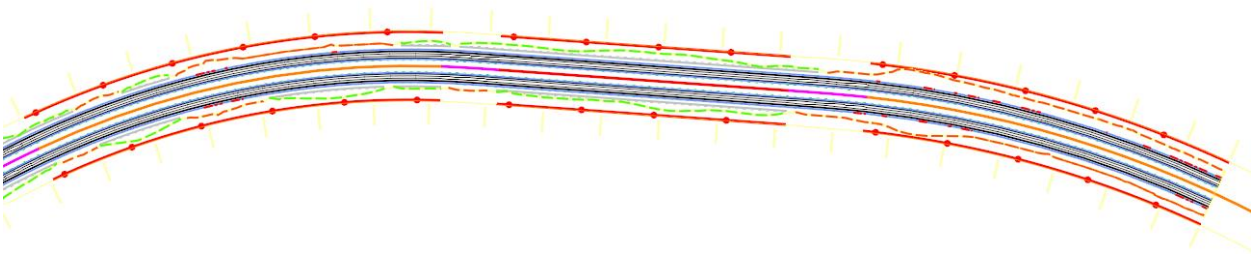


H. Set the Mirror option to YES and left click to accept.

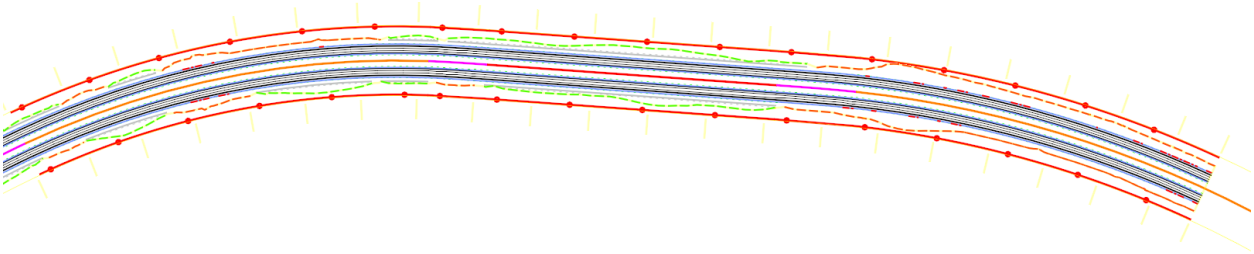
I. This will place a RW/CA element on the left and right side of the L alignment at a 175’ offset from the centerline.



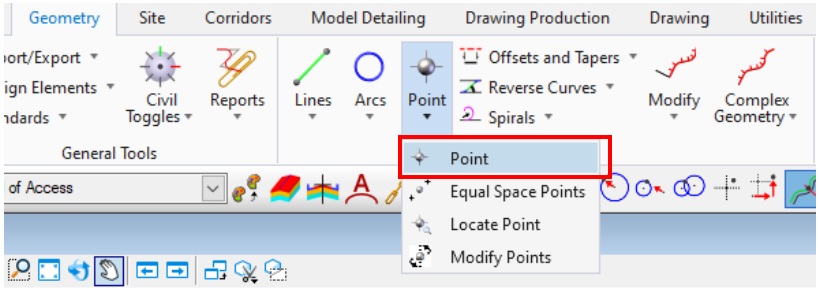
J. Repeat this process for the tangent portion of the alignment and the final arc. Stop the RW/CA at the end of the pavement.



K. It is important to note that because the elements were created with the horizontal geometry tools in the modeling workflow that they must be drawn in the direction of the alignment, or the symbology will be reversed. The change curve direction tool will not work on elements created with the Horizontal Geometry tools.
L. Connect the Arc sections of the RW/CA line to the Tangent section using the **Line Between Points** tool. This completes the RW lines in this section.

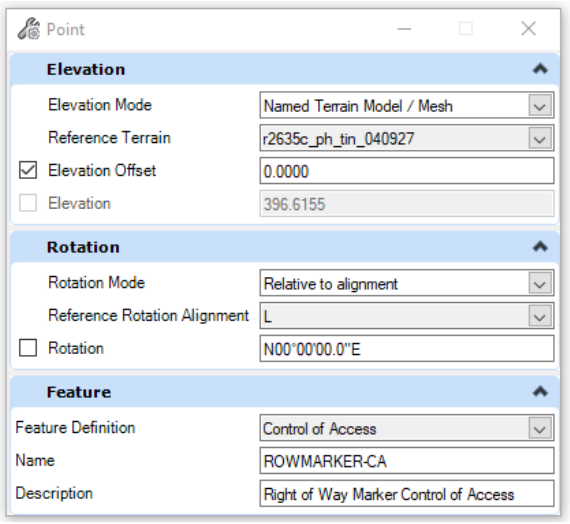


M. To place the CA Markers, select the **Point** tool from the *Horizontal* section of the *Geometry* ribbon.



N. Set the dialog to

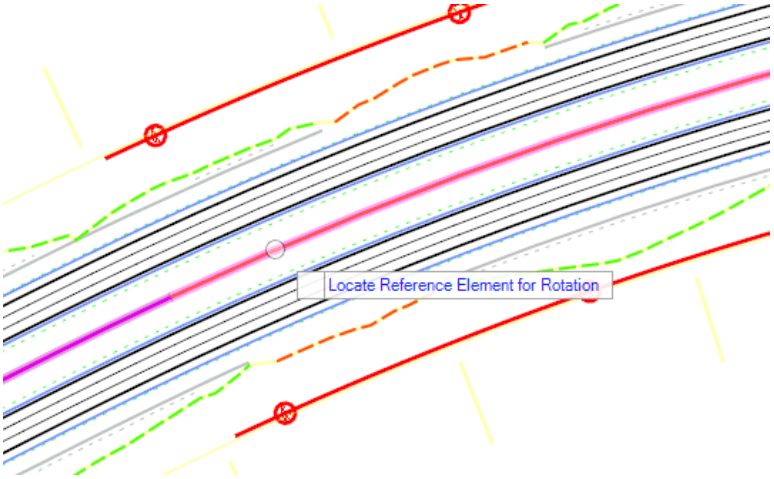
- Elevation Mode= Named Terrain Model / Mesh
  1. This will place the marker at the elevation of the selected terrain model or mesh. The markers in the NCDOT workspace will display as 3D cells in the Default 3D model
  2. This can be selected dynamically during the placement if desired
- Reference Terrain = r2635c_ph_tin_040927
- Elevation Offset = 0.00’
- Rotation Mode = Relative to Alignment
- Reference Alignment = Leave blank, this can be selected dynamically
- Rotation = Leave unchecked
- Feature Definition = Control of Access
  1. This is the type of marker being placed



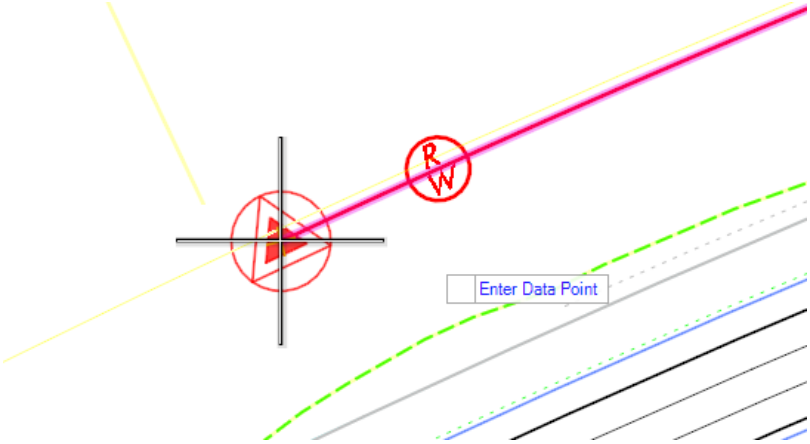
- Name = Will be completed based on the selected Feature Definition
- Description = Will be completed based on the selected Feature Definition

O. Left click to accept the Elevation Offset = 0.00’

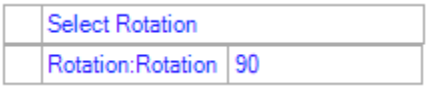
P. Left click on the L alignment to locate the Reference Element for Rotation.



Q. Snap to the end of the RW/CA line and left click to enter the first data point

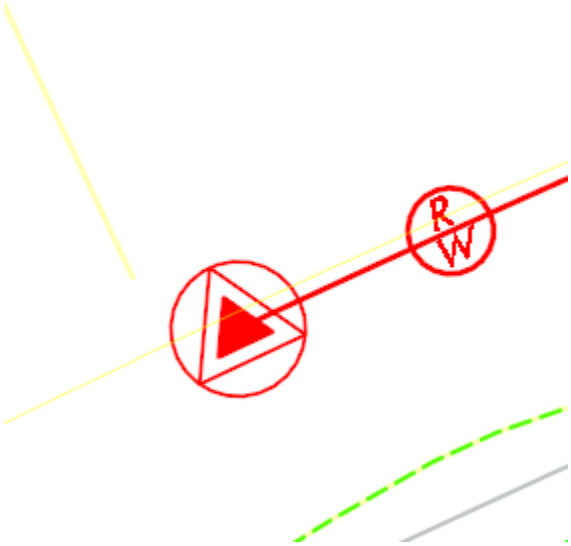


R. For the rotation angle type 90 and enter.

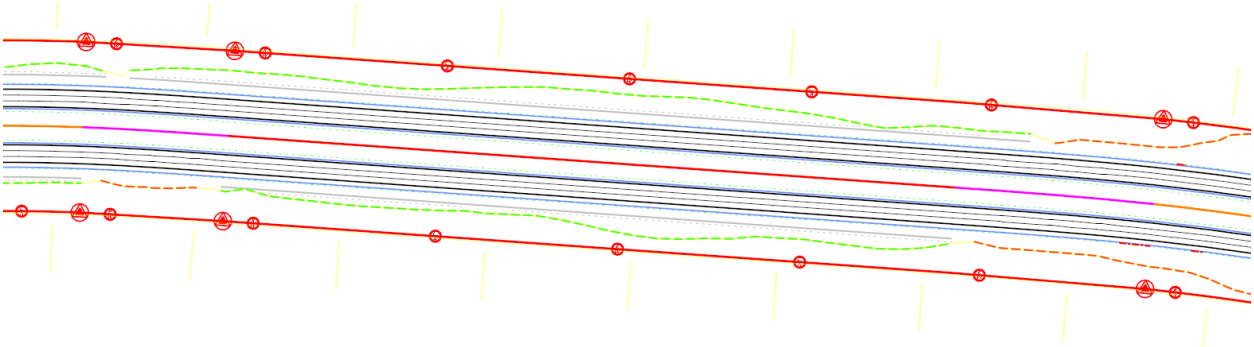


S. Note that the dialog will change to show a bearing, this will be adjusted at each point to maintain the 90° rotation to the centerline.

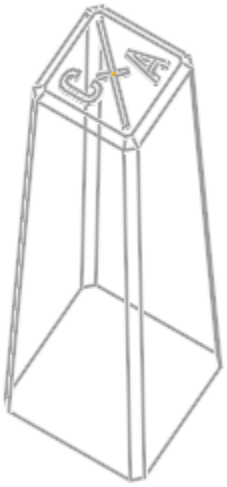
T. Left click to accept the placement of the CA marker.



U. To place the remaining markers is a simple process, the tool will maintain all the previous setting and the users only needs to:
   - Snap to locate the end point of the RW/CA elements
   - Left click to accept the location
   - Left click to accept the previously set rotation
   - Repeat for remaining markers.
   - Right click to exist the tool



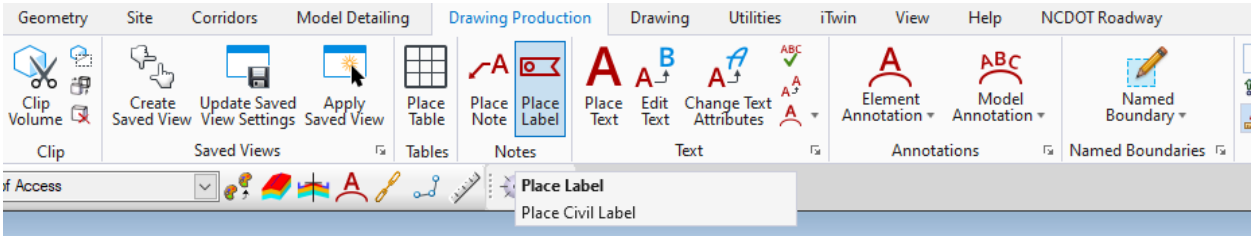
V. This completes the process of placing the RW lines and markers at a constant offset. The Default 3D model will show the 3D view of the marker placed at the correct elevation. These cells are the actual size of the marker and will appear small compared to some of the other elements.



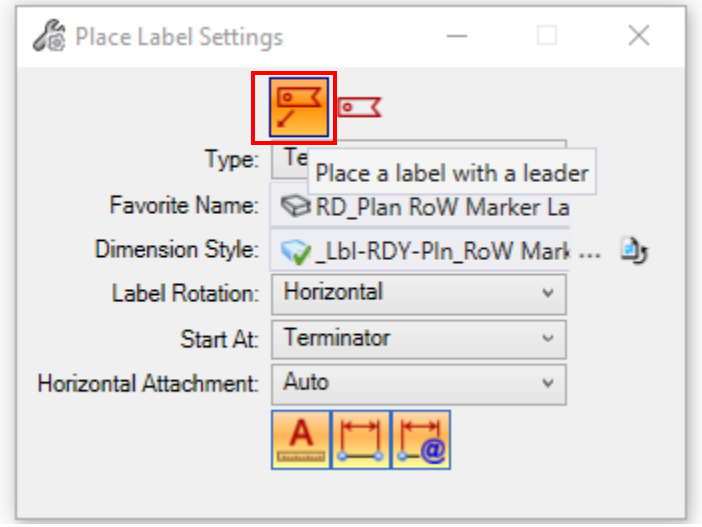
3. Marker Station and Offset Labels

A. The final step is to place the Station and Offset labels. The annotation tools contained within the program are currently under development and the current process may differ from the steps presented below.

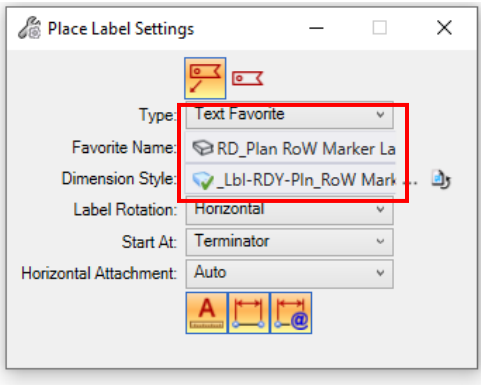
B. Select the **Place Label** tool from the *Notes* section of the *Drawing Production* ribbon.



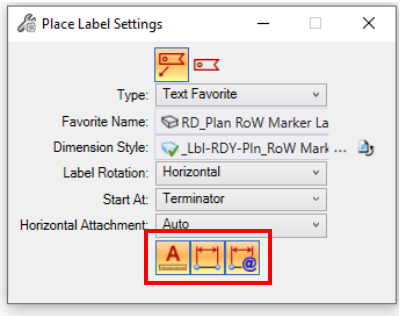
C. Set the Dialog for Place a label with a leader



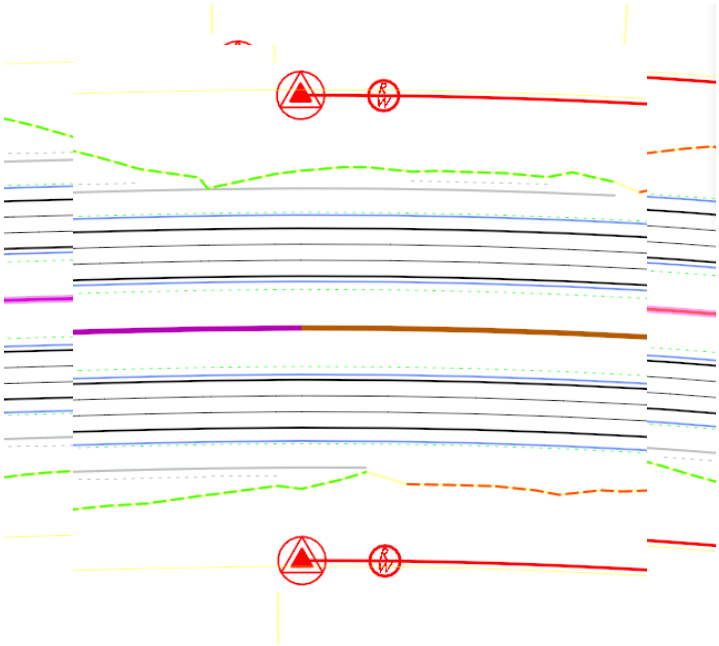
D. Set the Type to Text Favorite
   - This will use a preset text favorite contained within the workspace to set the text settings
E. Set the Favorite name to RD_Plan RoW Marker Label
   - This is the favorite that will control the text setting
F. Set the dimension style to _Lbl-RDY-Pln_RoW Marker Label
   - This controls the dimension style for the leader portion of the label



G. Set the Label Rotation to Horizontal
H. Set Start At to Terminator
I. Set Horizontal Attachment to Auto
J. Check on all three boxes at the bottom of the dialog
   - The first box is Annotation Lock, this will set the text based on the scale of the drawing and will update the text size if a different scale is used
   - The second box is Create Associations, this will create an association between the point that is labeled and the label, is the point is moved the label will automatically update
   - The last is Create Relative Association, this will create an association between the point and the position of the label so if the points move the entire label will also move.

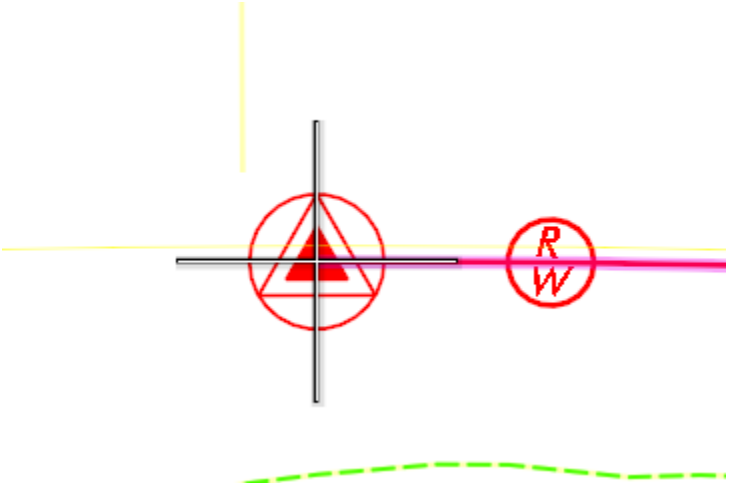


K. The first step is to identify the reference element. This is the element that the station and offset is based on. Left click on the L centerline. This step requires a snap so if Accusnap is toggled off snap on the L alignment and left click to accept.

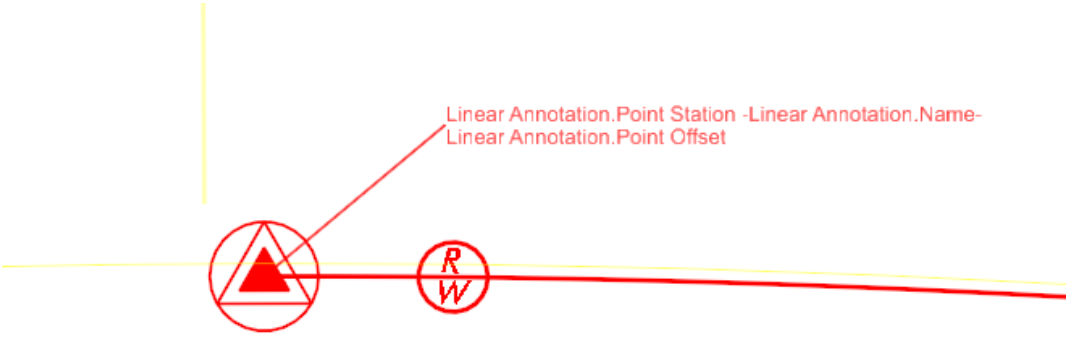


L. The reference element will highlight after it has been correctly selected.

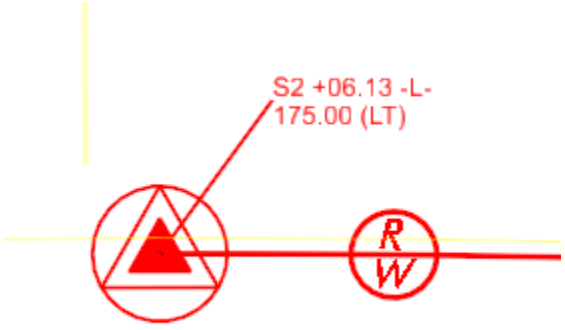
M. Snap to the point to label, in this case the CA Marker.



N. Left click to accept the point. At this point the label will display with the default text shown.



O. Left click to place the label and the text will update to indicate the station and offset.

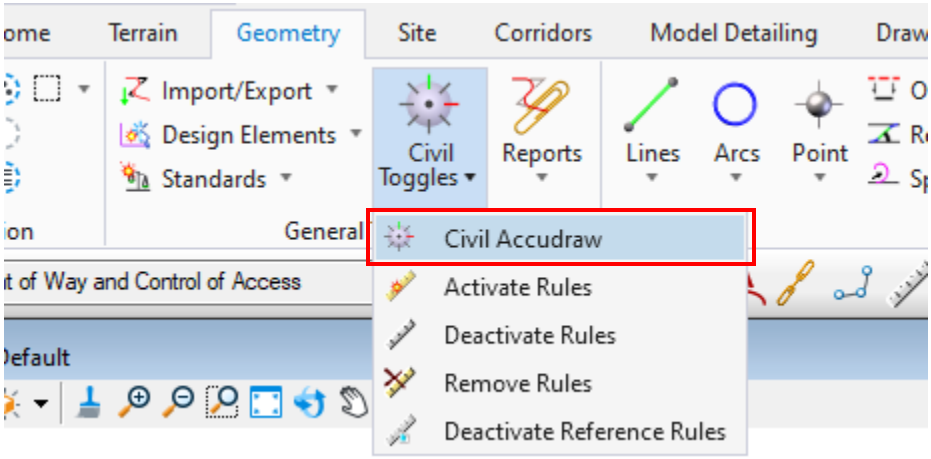


P. To place additional labels with the same setting simply snap to the desired location and then left click to place the label. Repeat this process for the remaining CA markers.

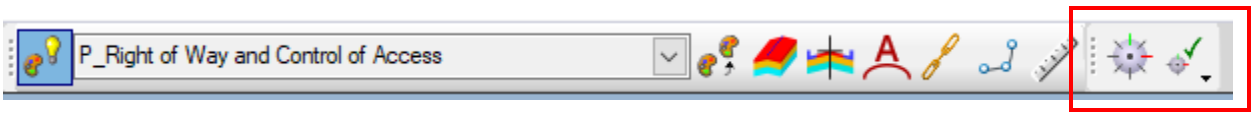
4. Place RW Line with Civil Accudraw

A. In this exercise we will see how to use Civil Accudraw to place a RW Marker at a Precise Station and Offset. See additional training materials for more detailed information regarding the use of civil accudraw.

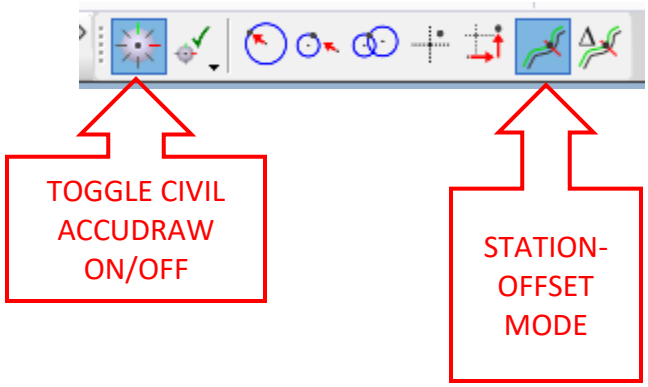
B. If the Civil Accudraw Tool bar is not visible go to the *General* section of the *Geometry* ribbon and select the **Civil Accudraw** tool from the Civil Toggles tool group.



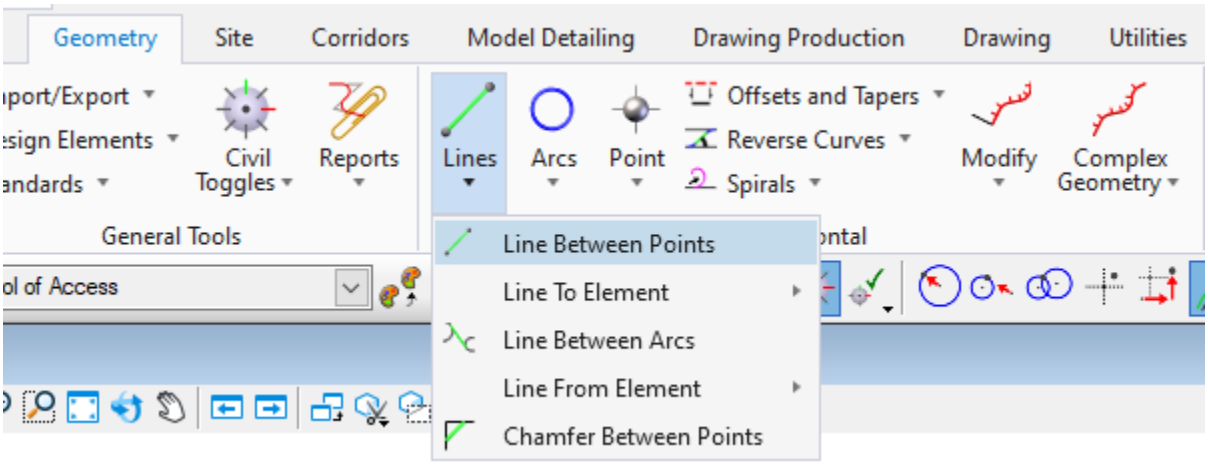
C. This will open the Civil Accudraw tool bar which can be docked by the Feature Definition toolbar.



D. Toggle On Civil Accudraw and Select the Station Offset mode.

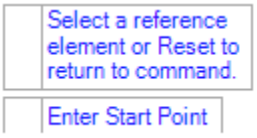


E. Civil Accudraw is not a tool by itself but works with other civil tools to allow for precision input based on various modes. Start the **Line Between Points** tool.

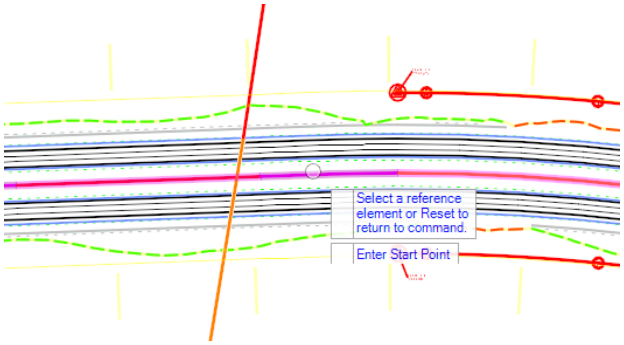


F. Note that the heads up display now has inputs for station and offset.

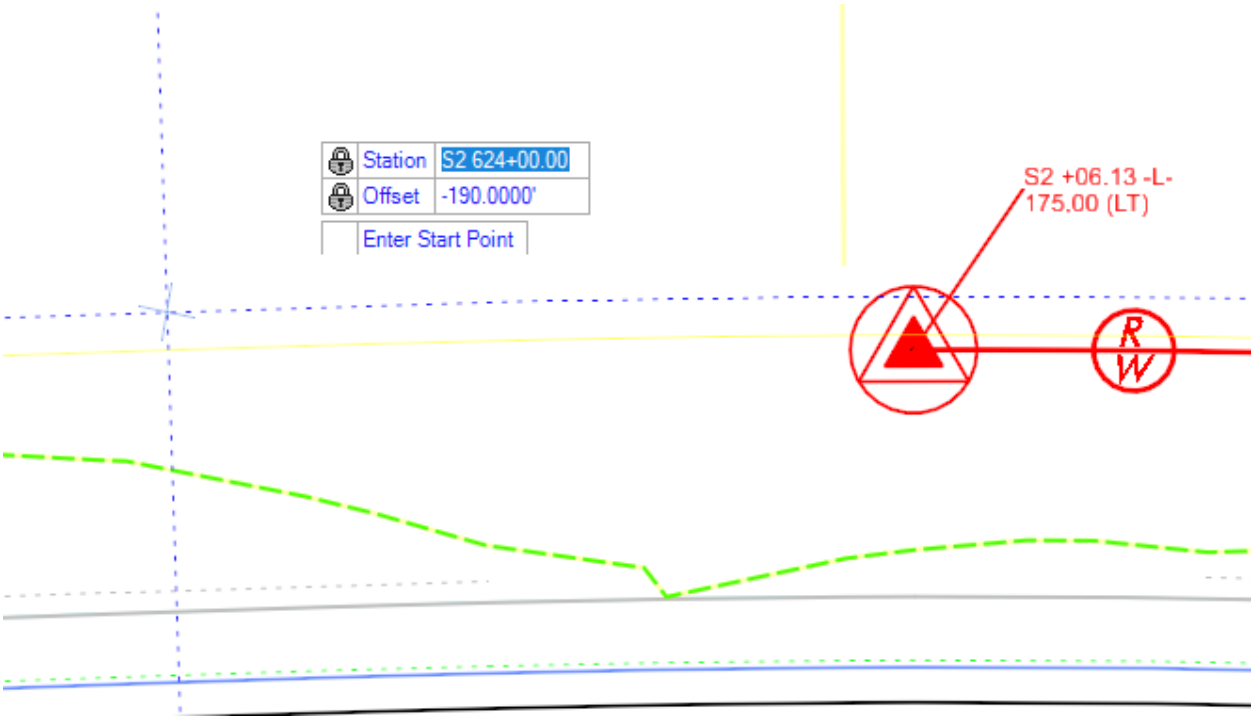
G. To set the reference alignment type the letter ‘O’ in the station block



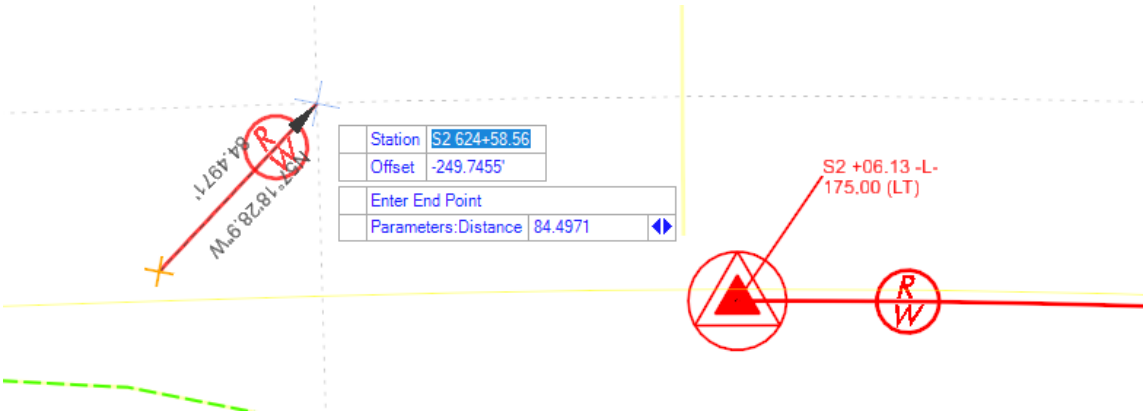
H. Left click on the L alignment to set the reference station.



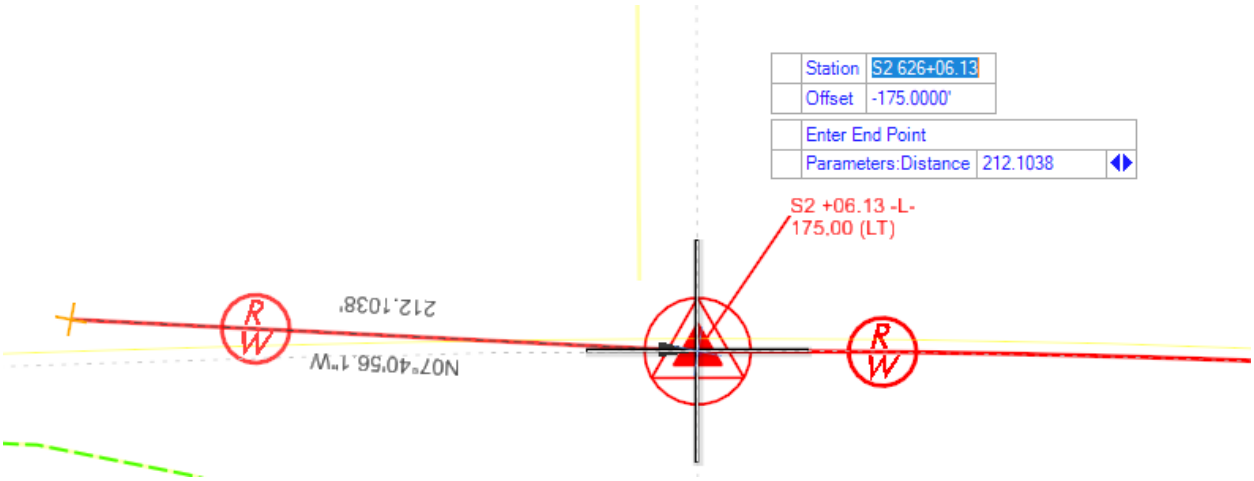
I. In the station block enter S2 624+00 (the S2 indicates section 2, the L alignment has a station equation in it) and in the offset block enter -190.00’



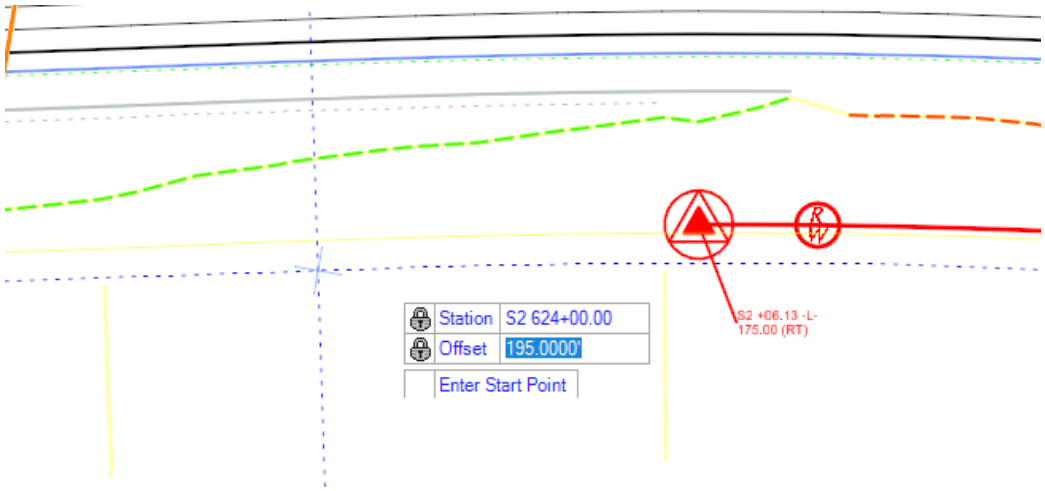
J. Left click to accept the station offset location as the start point>



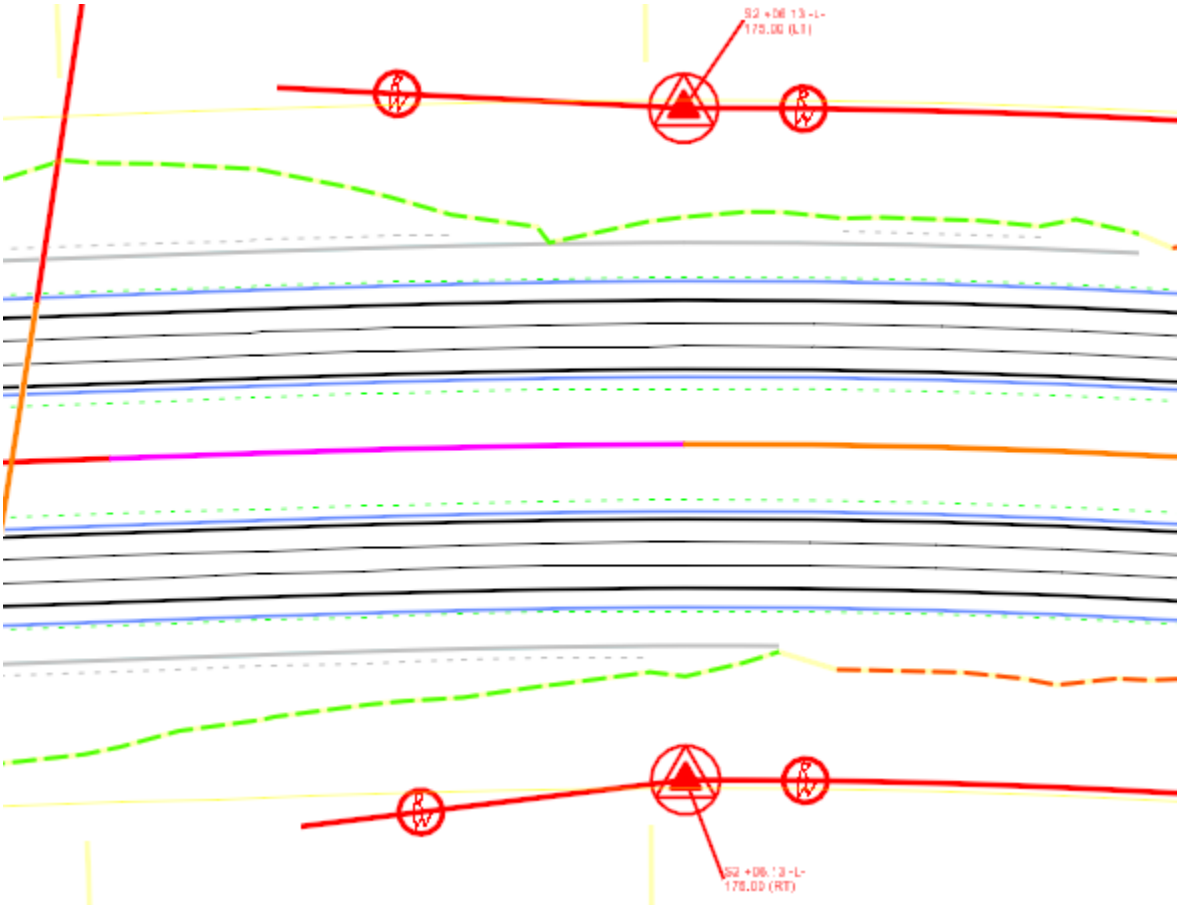
K. Snap to the beginning of the adjacent RW line. Note that the station and offset shown in the heads-up display is dynamically updating and matches the label placed earlier.



L. To place a RW line on the right side type in S2 624+00 and offset of 195.00’ and <ENTER> to lock the station and offset.



M. Left click to accept the start point and snap to the beginning of the adjacent RW line on the right side. This will complete the RW lines.

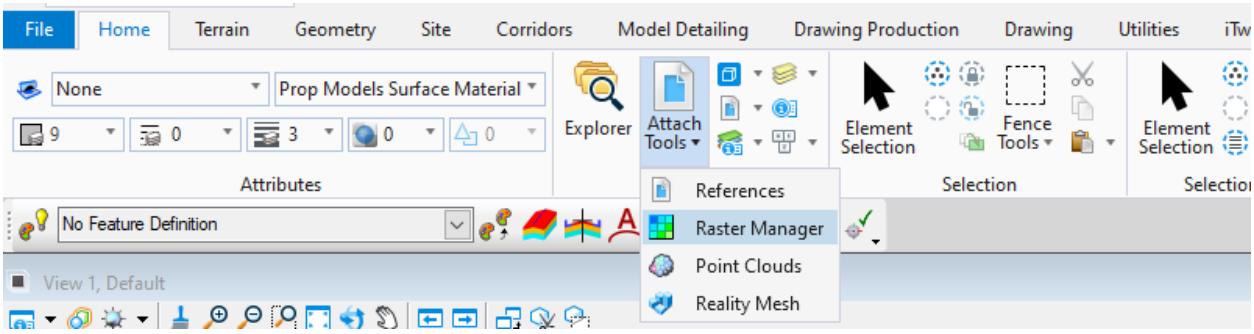


N. Markers and labels can be added using the steps outlined in the previous sections.

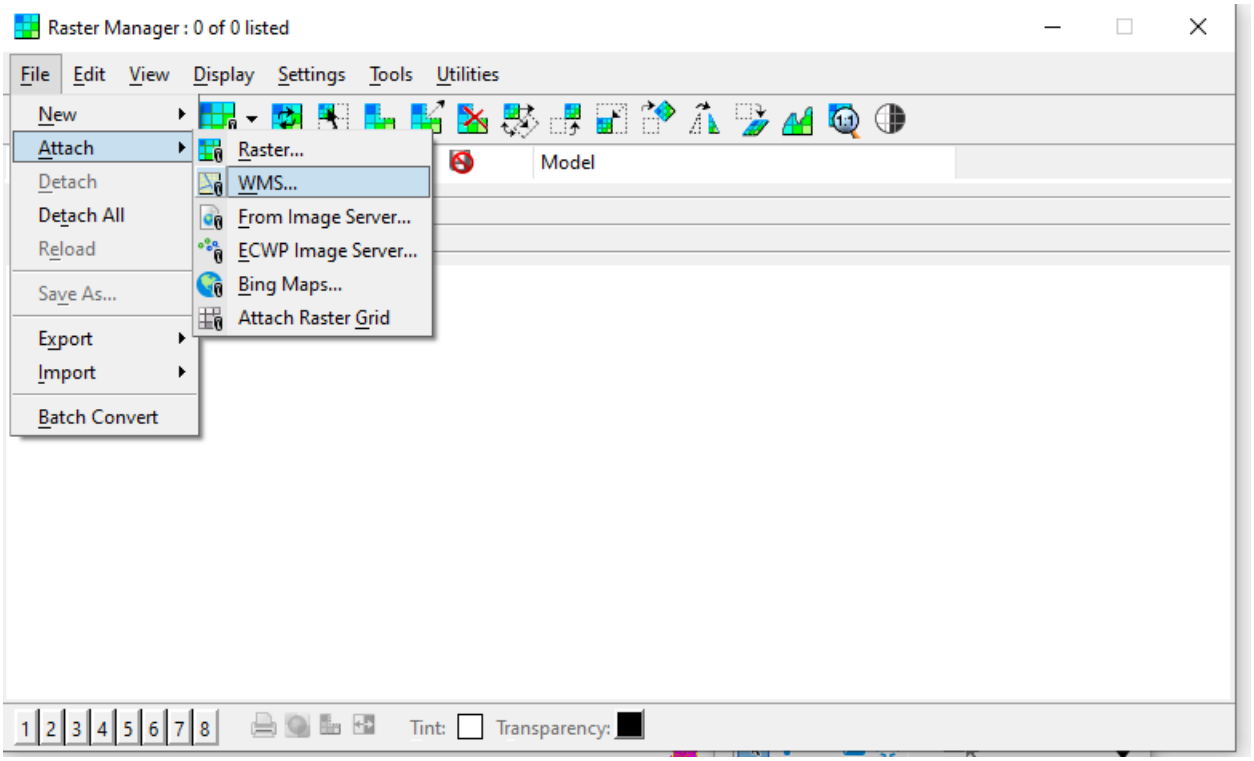
Plan Geometry – NC One Map

1. Attach NC One Map Aerial Imagery

A. Open the raster manager.



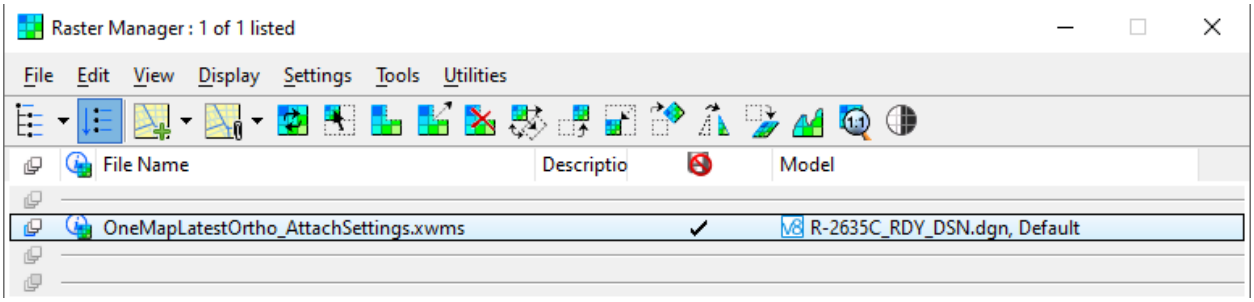
B. Select attach WMS



C. Path to the workspace location

…MICROSTATION_CONNECT_WORKSPACE\Configuration\Organization-Civil\NCDOT\Image

D. Attach the ***OneMapLatestOrtho_AttachSettings.xwms*** file.



E. This will display the NC One Map Aerial Imagery.