

# *Road 1*



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## Chapter 1

# Introduction to the Terrain Model

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## 1.1 Objectives

- Understand what is a Civil Terrain Model
- Download LiDAR information for a Project Location
- Learn how to display an Existing Civil Terrain Model
- Learn how to export an Existing Civil Terrain Model

## 1.2 Definitions

A **Terrain Model** is a set of three-dimensional triangles mathematically computed from point data collected on the surface being modeled. Models are used to define highly irregular surfaces, particularly the surface of the earth, but can be generated for proposed surfaces, subsurface geotechnical layers, and etcetera. Terrain models are also referred to as digital terrain models (DTMs), triangulated irregular networks (TINs), or triangulated surfaces.

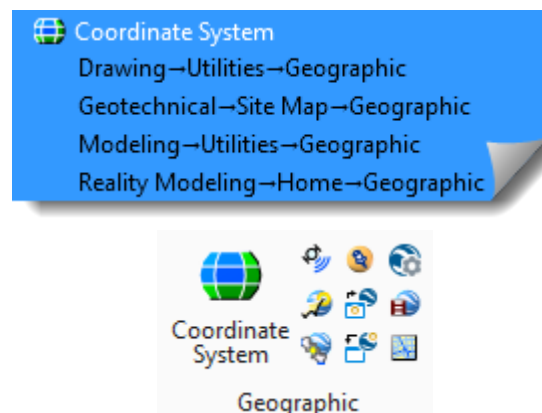
The MicroStation Terrain Model tools support importing and labeling terrain contours and spots on terrain models. You can import a terrain model into a DGN to use its data. Terrain models imported from the LandXML file format are supported within MicroStation. However, any manipulation or importing from Civil products must be done within Bentley Civil. Importing in MoDOT should not be necessary, as the Survey department provides all existing terrain information into a separate DGN file.

## 1.3 Geographic Coordinate Systems

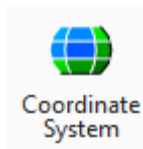
Geographic Coordinate Systems are important to set when importing Terrain files or creating geometry in OPENROADS DESIGNER. This helps in referencing in Bing Maps and getting Google Map images and creating KML files. The use of GCS ensures that the project is in the right location for different types of projection.

### Geographic Toolbar

May be found in the following locations:



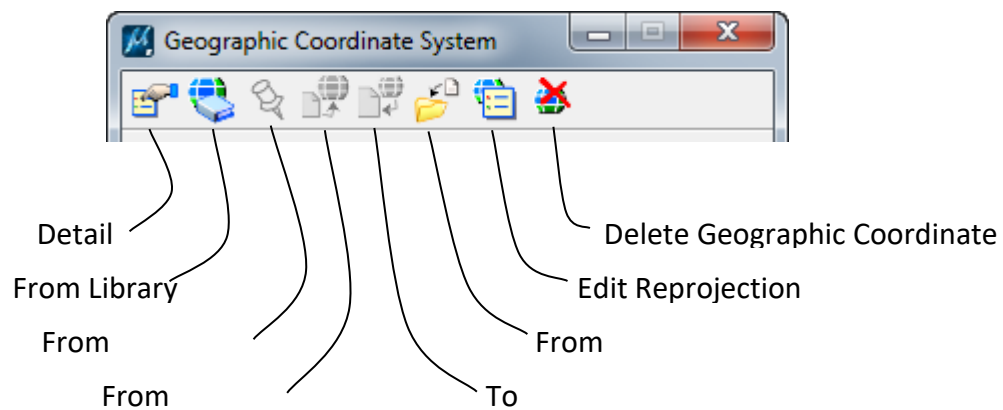
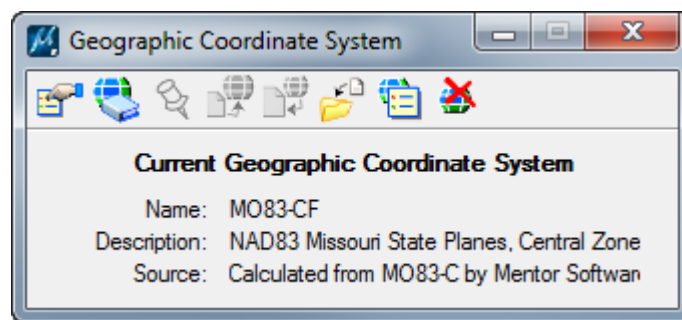
The **Geographic Tab** contains tools for interacting with a Global Positioning System (GPS) or Google Earth. In this chapter we will only be discussing the Coordinate System tool for selecting the correct GCS for the project.



Select Coordinate System

### Select Geographic Coordinate System

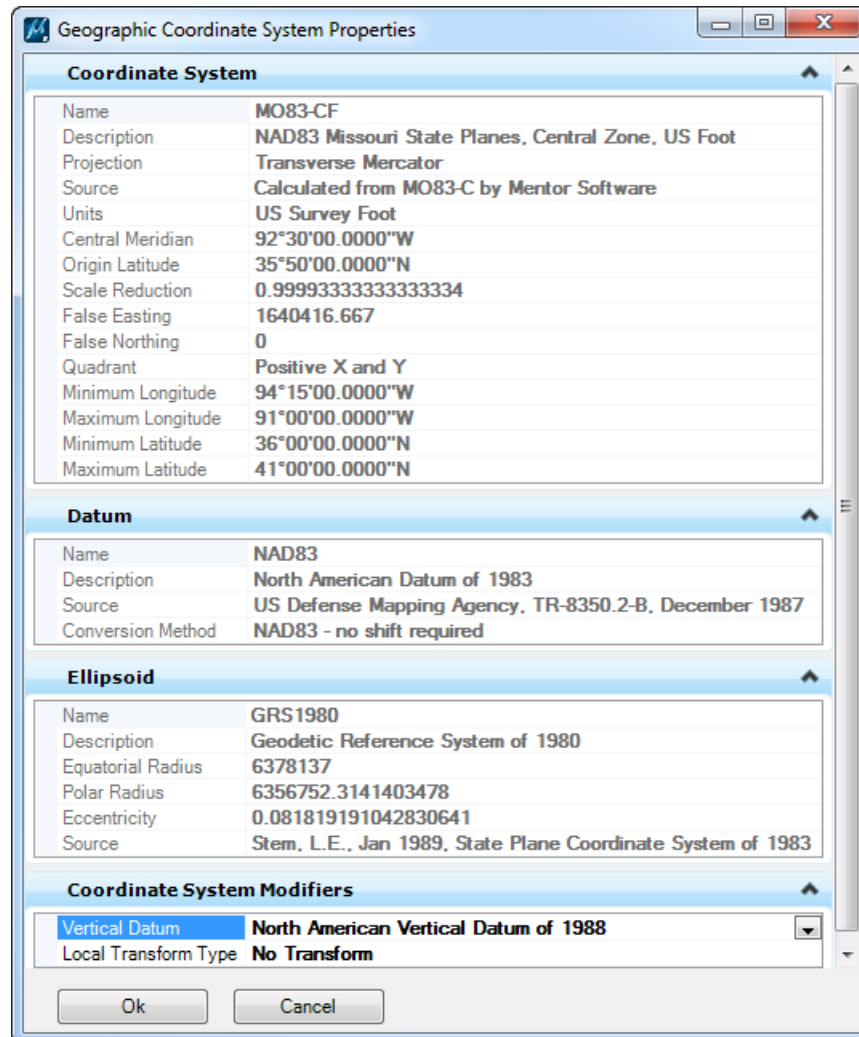
This tool is used to open the Geographic Coordinate System dialog, which is used to select a geographic coordinate system (GCS) from a library of predefined geographic coordinate systems.





## Details

This tool opens the Geographic Coordinate System Properties dialog box. It is used to display the properties of a geographic coordinate system (GCS) that is attached to the MicroStation file.



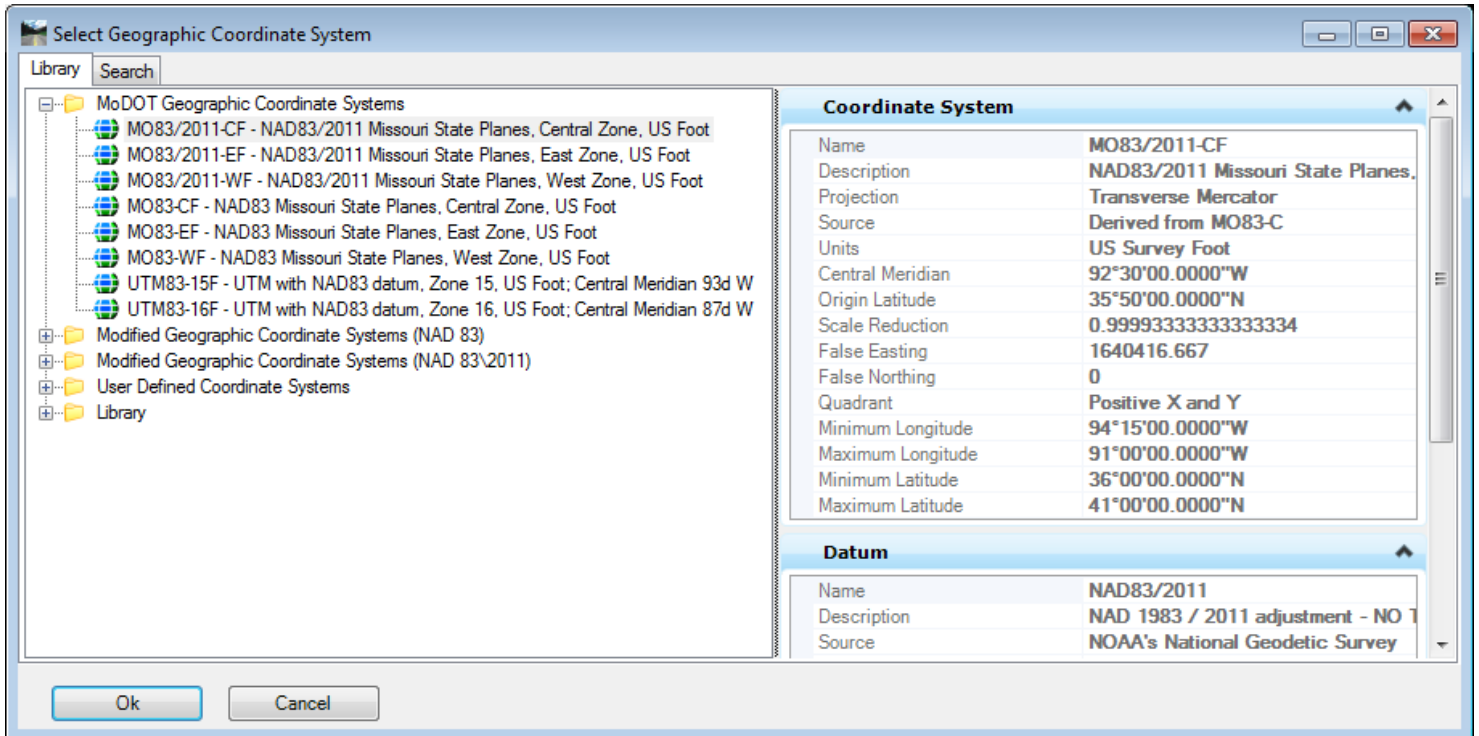
## From Library

This tool is used to select a geographic coordinate system (GCS) from MicroStation's library of predefined geographic coordinate systems.

This is useful when:

- Existing data was drawn in a geographic coordinate system (for example a state plane or country grid coordinate system) and you want to make MicroStation aware of that GCS.
- Data is correctly drawn in one specified GCS, but you want to reproject that data to a different GCS.
- You want to designate the GCS for a new design file.

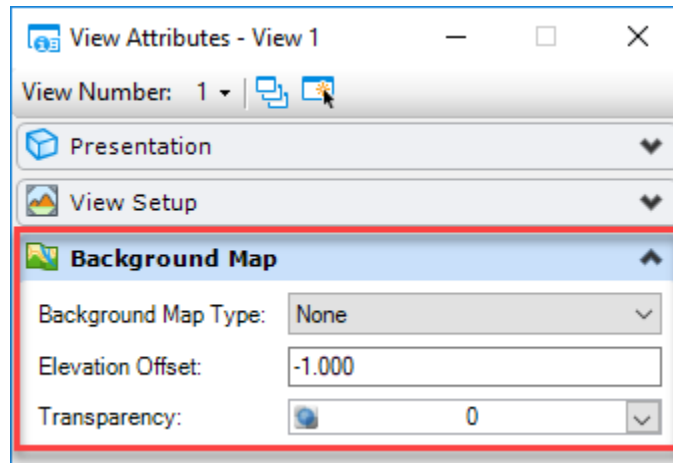
CADD Support has provided groups called **MoDOT Geographic Coordinate Systems**, **Modified Geographic Coordinate Systems (NAD 83)**, and **Modified Geographic Coordinate Systems (NAD 83\2011)** which contain the most commonly used coordinate systems for MoDOT projects, depending on the district boundaries.



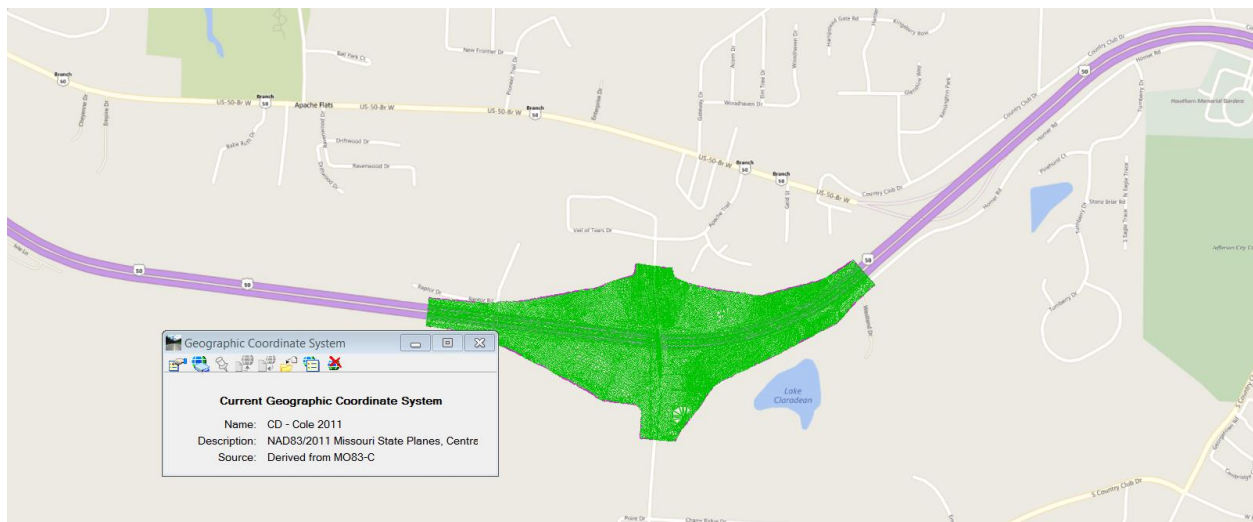
For projects that use a “modified” coordinate system instead of the standard coordinate system or “county wide” coordinate system, you will need to copy and modified the standard coordinate system to match the applied projection factor (grid to ground factor) for the project. These “modified” geographic coordinate systems will be saved to the **User Defined Coordinate Systems** folder for future use.

## 1.4 Bing Maps Display

Bing Maps can be used to display a live streaming map of the project location, if the Geographic Coordinate System has been applied to the MicroStation file.



Once Geographic Coordinate System has been applied to the drawing, the **Background Map Type** option will now be available in the View Attributes dialog. If the User switches the **Background Map Type** to anything other than **None** the background will change to show roadways and other information in the area. This can be very helpful in laying out a project by showing existing features in the project corridor.




The above example shows the Big Horn corridor with the correct Geographic Coordinate System applied and a terrain model imported at the correct coordinates.

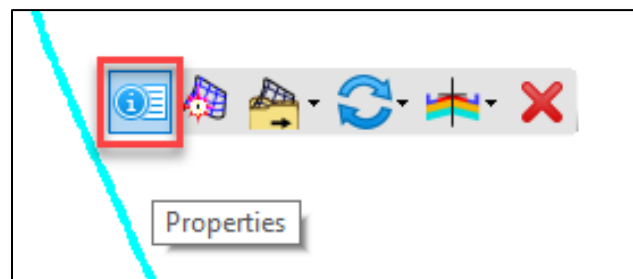
## 1.5 Terrain Models and Feature Definition

The display of terrain model properties can be controlled by using a feature definition. You can apply it to any terrain model.

Name		Terrain Model: J5P3181 E	
Number of Points	83,159		
Number of Point Featu	9		
Number of Islands	0		
Number of Voids	37		
Number of Features	46		
Number of Contours	0		
Number of Breaklines	0		
Number of Triangles	165,116		
Edge Method	Max Edge Length		
Length	1000.0000'		
Major Contours	Off		
Minor Contours	Off		
Triangles	Off		
Spots	Off		
Flow Arrows	Off		
Low Points	Off		
High Points	Off		
Breaklines	Off		
Boundary	On		
Imported Contours	Off		
Islands	Off		
Holes	Off		
Voids	Off		
Feature Spots	Off		
Feature Name	J5P3181 Existing Ground		
Feature Definition	Existing Boundary		

### 1.5.1 Applying a Feature Definition to a Terrain Model

1. Open the MicroStation file where the terrain model resides.
2. Use the Element Selection  tool to select the terrain model.
3. In the *Heads-up display* toolbox, select **Properties**.



The properties dialog box allows for the modifications of display, terrain Feature Definition name and the type of Edge Method being applied to the terrain model.

## 1.6 Referencing Terrain Models

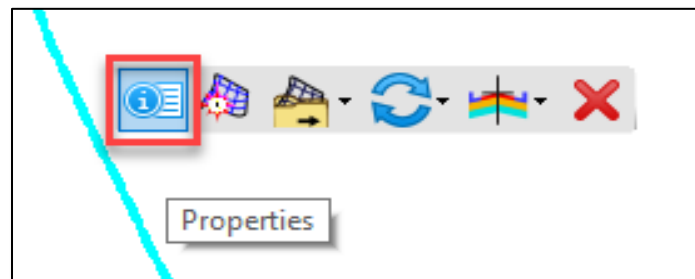
People in different job roles may want to see terrains displayed differently. For example, a designer of surfaces may need to see triangles, while a designer of drainage features may need to see contours. Rather than duplicating the terrain model in various places, the best workflow is to maintain a single terrain model and reference it into other DGN files.

When a DGN file containing a terrain model is referenced into another DGN file, you can allow the terrain model to be displayed differently in the other file. This allows the presentation to vary for different purposes, without changing the terrain model display in the original DGN file.

### To Override the Symbology of a referenced Terrain Model

If a Terrain Model is attached as a reference, to override the terrain symbology do the following:

1. Select the terrain model and from the pop-up tools select **Properties**





2. Within the Terrain Model Properties switch the Override Symbology option from “No” to “Yes”.

Name	Terrain Model: J5P3181 E
Number of Points	83,159
Number of Point Features	9
Number of Islands	0
Number of Voids	37
Number of Features	46
Number of Contours	0
Number of Breaklines	0
Number of Triangles	165,116
Edge Method	Max Edge Length
Length	1000.0000'
Major Contours	Off
Minor Contours	Off
Triangles	Off
Spots	Off
Flow Arrows	Off
Low Points	Off
High Points	Off
Breaklines	Off
Boundary	On
Imported Contours	Off
Islands	Off
Holes	Off
Voids	Off
Feature Spots	Off
Feature Name	J5P3181 Existing Ground
Feature Definition	Existing Boundary
Override Symbology	No
	No
	Yes

3. Change other display properties as needed.

The display of the terrain model changes in your DGN file according to these settings, but not in the original DGN file.

## 1.7 Overview of Civil Terrain Model

Terrains Models (TM) play a key role in Infrastructure and Mapping workflows. The data collection methods underlying these models are ever increasing in detail and coverage. Therefore, resulting terrains need to be accessible across a variety of Infrastructure and Mapping workflows.

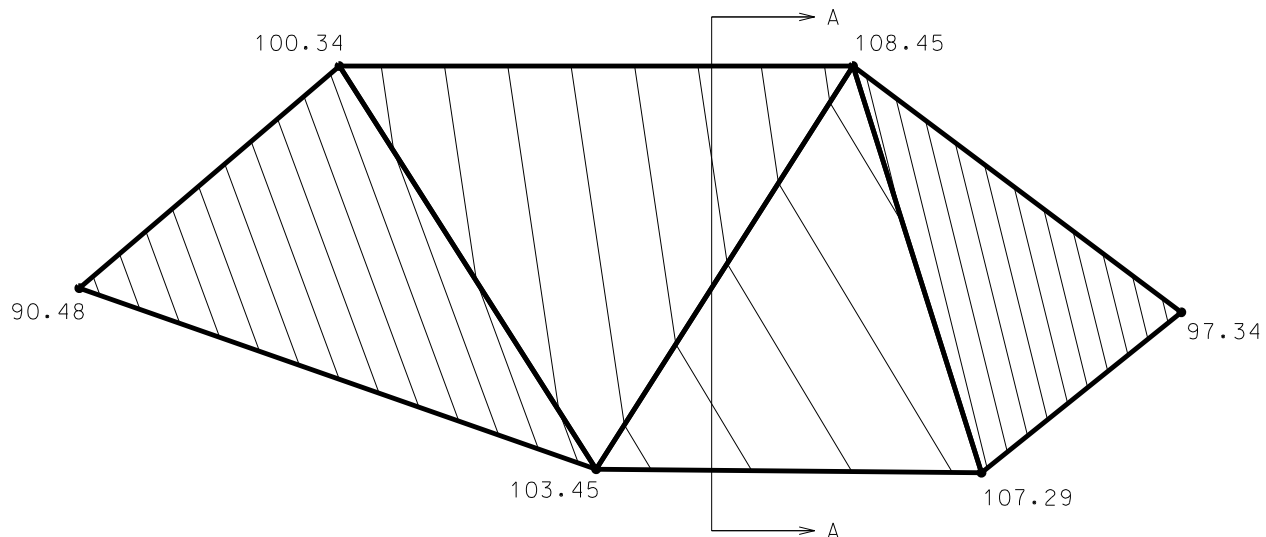
Data in a variety of formats including raw graphical elements 2D and 3D can be provided for consumption into the terrain model. The existing ground terrain model can also be used as the starting point for the creation of a proposed design terrain model using the Corridor Modeling tools.

## 1.8 Terrain Model Features

The concept of feature types is used throughout the Terrain Model tools. The available feature types are defined below.

### 1.8.1 Spot or Spot Elevation

Points (with X, Y, Z data) that have no functional relationship to any other point. Random survey shots in open terrain would be an example of random spots. Point elements such as cells, circles, and text strings are typical MicroStation elements used to graphically define spot elevations, lines,



line strings, and other longitudinal elements are equally valid. The software creates a spot elevation for each vertex of each longitudinal element.

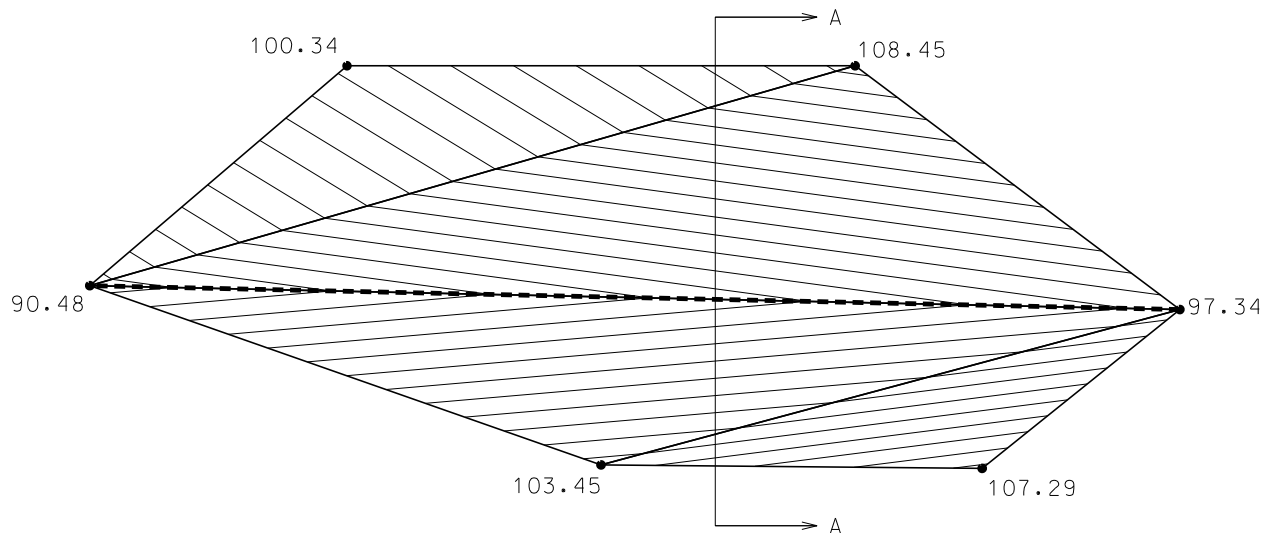
If a section is cut through this digital terrain model at the location A-A, where the elevation of the triangle leg as linearly interpolated between the triangle vertices is plotted along the distance of the section, the section would look as shown in the picture below.



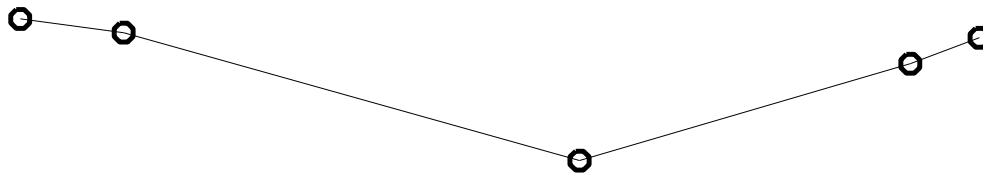
### 1.8.2 Break Line

Breaks are used to designate linear features such as edges of pavement, ditch bottoms, ridges, etcetera where an abrupt change of slope occurs. Any longitudinal element may be defined as a break line. Triangles will not cross a break line in the terrain model.

Adding a break line to the same set of points (used in the above illustration) will produce the terrain model as shown below.



Cutting a section at the same location will produce very different results as shown in the section below.

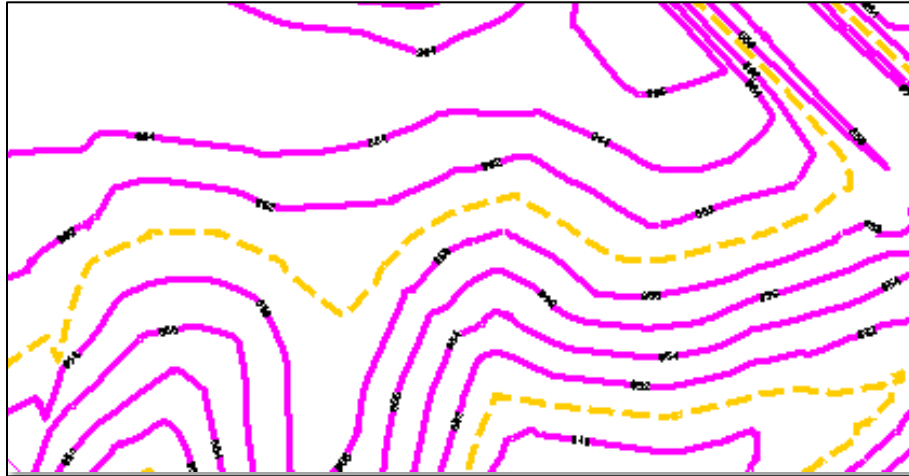


### 1.8.3 Soft Break Line

A soft break line is a break line; however, if it crosses a break line, it will not affect the triangulation and is ignored. This feature type is not frequently used. It can be used during survey collection to identify a feature that is a breakline, but is known to cross another break line, resulting in crossing breaklines.

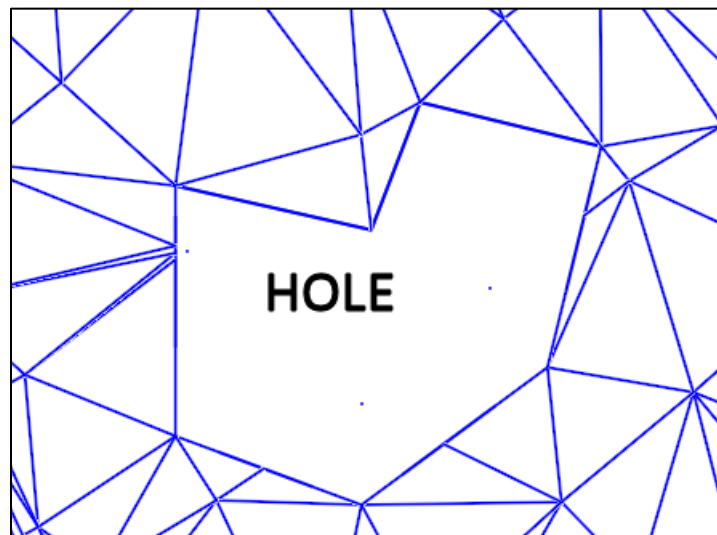
### 1.8.4 Contour

A contour is an element or set of elements of the same elevation. Contours may be used as source data to generate a terrain model, or may be computed (drawn based on terrain model). For example, you may want to create a terrain model from digitized contours from an old plan.



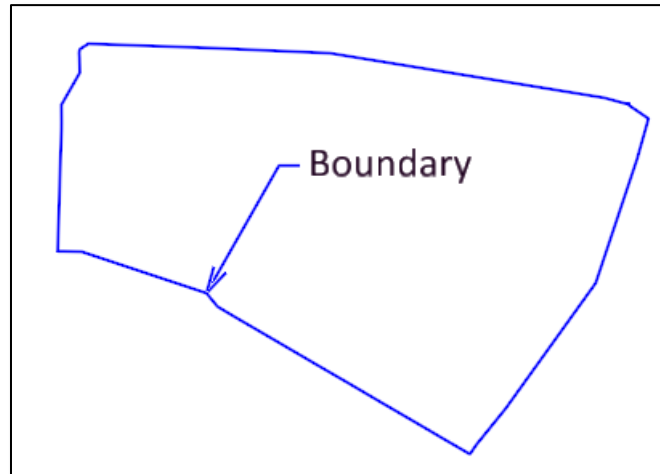
### 1.8.5 Hole

An area defined by a closed shape that demarcates a region where the current terrain is ignored and the underlying terrain is utilized. For example, holes can be used for marking areas where you would not want to disturb during a design.



### 1.8.6 Boundary

A boundary is the maximum external limits a terrain model can extend. No triangles will be created outside of this boundary. For example, a boundary can be changed on a terrain model by deleting triangles or changing the *Edge Method*. A new boundary can be added to an existing terrain model using the *Add Features* command.

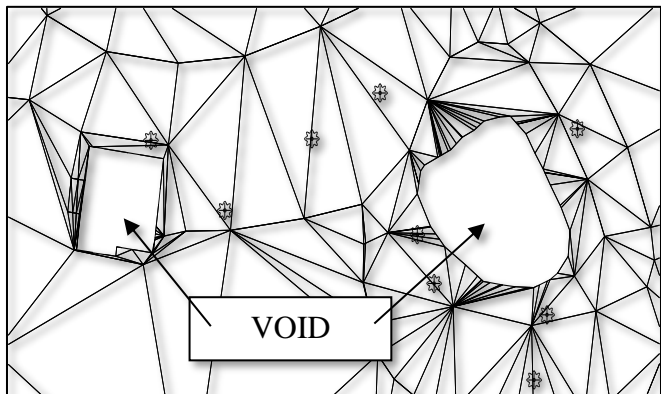


### 1.8.7 Drape Boundary

A drape boundary is a surface boundary that determines its elevations by draping on the underlying surface. For example, you may use a drape boundary to limit the extent of the triangles by drawing the boundary as an element, using the *Add Features* command to add the boundary to the terrain model. The new boundary would use the elevations of the underlying surface as the boundary elevations.

### 1.8.8 Voids

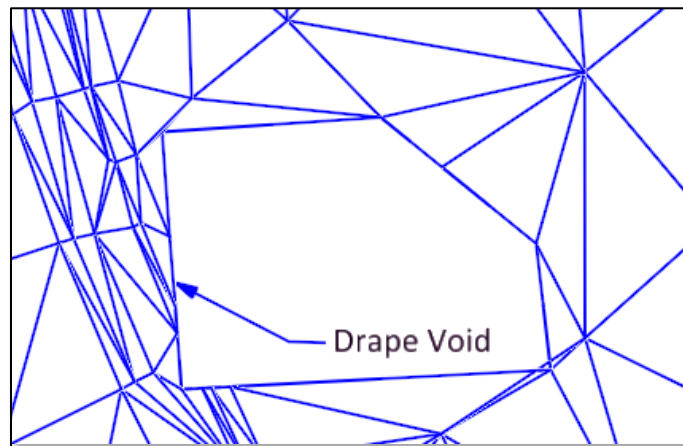
An area defined by a closed shape that demarcates a region of missing data or obscure areas. No point or break data located within the void area is utilized and no triangles are created inside the void areas. The Void coordinates are included in the triangulation and void lines between successive void coordinates are inserted as drape lines on the surface. Therefore, they do not change the slope or elevations of the surface.





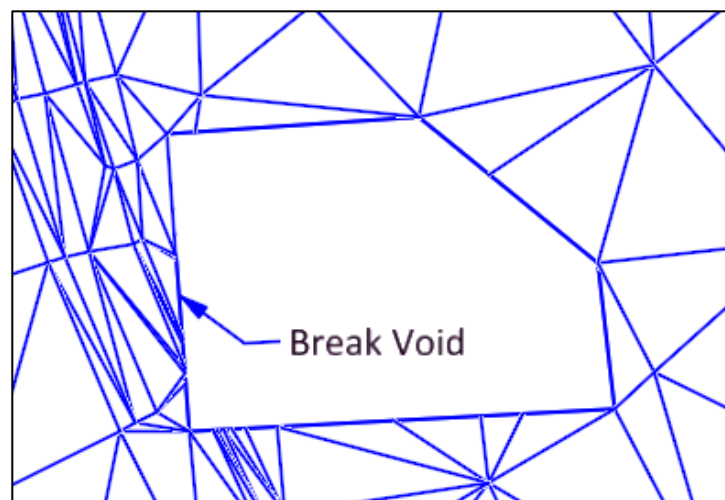
### 1.8.9 Drape Void

An area defined by a closed shape that demarcates a region of missing data or obscure areas. No point or break data located within the void area is utilized and no triangles are created inside the void areas. In the drape void, the void coordinates are not included in the triangulation. Voids are inserted post triangulation. The void coordinates and lines are draped on the terrain model surface. Even though a user must provide an elevation for Drape Void vertices, the user elevations are changed to the elevation of the terrain model surface at the XY Drape Void coordinate position. For example, if you don't have accurate survey data for the void area, you may want to use the drape void.



### 1.8.10 Break Void

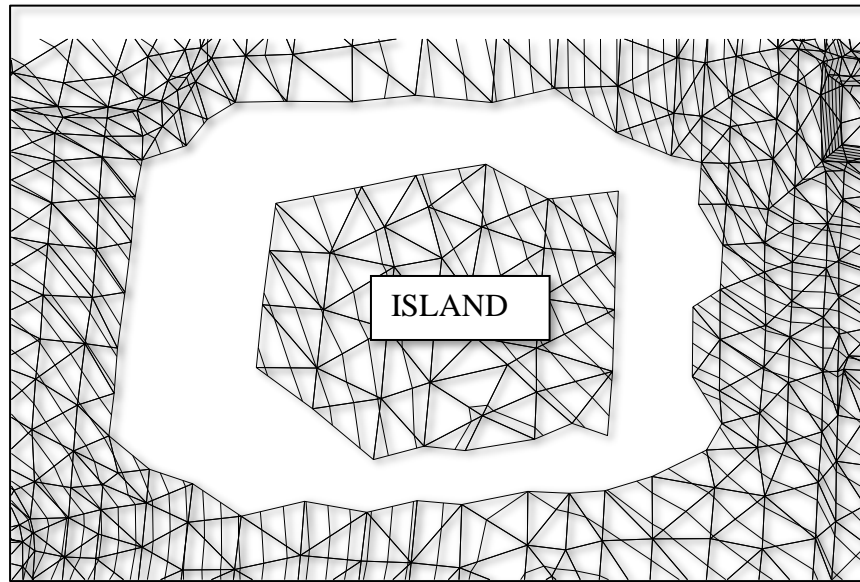
An area defined by a closed shape that demarcates a region of missing data or obscure areas. No point or break data located within the void area is utilized and no triangles are created inside the void areas. It differs from Voids and Drape Voids in that it utilizes the vertex elevations of the graphical element, while the void lines between successive void coordinates are inserted as break lines. Therefore, break voids change the slope and elevations of the surface. For example, if you have accurate survey data for the void area, you may want to use a break void. These could be used for surveyed building footprints or ponds where the points have been accurately surveyed.



### 1.8.11 Islands

An area defined by a closed shape that demarcates a region of data wholly within a void.

Example, islands in the middle of rivers, lakes, etcetera.



## 1.9 Triangulation Options - Edge Method

Several of the terrain model tools utilize the triangulation options section where the Edge Method is specified.

Many of the external edge triangles are thin and narrow and not representative of the surface. This is particularly evident where the edge of the data set is concave in nature. One approach to eliminate these triangles is the use of the Edge Method.

The Edge Method defines which triangles around the edge of a Terrain Model get created.

There are two options to control the edge triangles. The terrain model is updated dynamically when the Edge Method changes so if the results are not acceptable, change the value until the results are acceptable. Only triangles along the edge of a terrain model are affected by this parameter. Interior triangles are never removed.

There are three settings for the Edge Method option: None, Remove Slivers, and Max Triangle Length.

**None** - No external triangles are deleted. Note the Maximum Triangle Side Length is ignored. There are no user defined parameters

**Slivers** - Long, thin triangles are dissolved based on a formula hard coded within the software. Note the Maximum Triangle Side Length is ignored. There are no user defined parameters.

**Max Triangle Length** - External triangles whose external edge is longer in length than the user specified distance are deleted. Note the maximum length does not apply to internal triangles, only those on the edge of the model. Specify the Maximum Triangle Length in master units.

## 1.10 Terrain Models in Properties (Element Information)

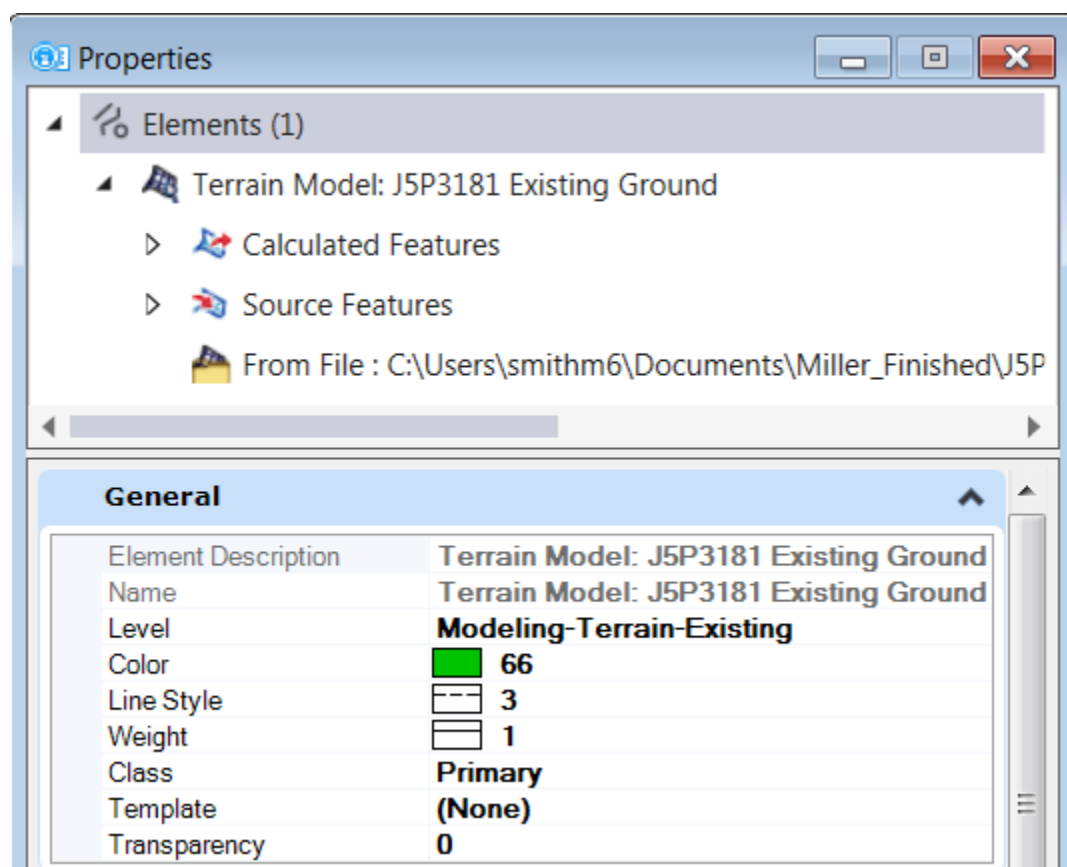
As a terrain model is a MicroStation element, a wealth of information can be found in the Properties (Element Information) dialog. One important option is display on/off of terrain model features. For example, you can turn on and off the display of the contours, triangles, and voids.

The element information can be accessed by selecting *Properties icon* off of the OpenRoads Modeling menu or by selecting the properties option from the context sensitive toolbar that pops up when the mouse hovers over an element when the *Properties* tool is active.

Some of the items in the Element Information dialog are informational and cannot be changed. Some of the items can only be changed if you are in the MicroStation file that contains the Terrain Model. Following are descriptions of the functionality of each tab in the Properties dialog.

### 1.10.1 General

This displays the terrain model *Description* and *Name*. It also identifies the display symbology of the terrain model. The symbology is only used if the Feature Definition was not defined during the creation of the terrain model. You can also select a *Feature Definition* in order to change the display of the terrain model within the General tab.



### 1.10.2 Extended

Allows you to set the terrain to *Snappable* or *Not Snappable*, *Lock* or *Unlock* the terrain, and view the model it is in, its creation date, and the modification state of the terrain.

Extended	
Model	Default
Last Modified	9/14/2018 1:33:19 PM
Snappable	Snappable
Modified	Modified
New	New
Locked	Unlocked

### 1.10.3 Feature

Element Information will list the feature name and feature definition of the selected terrain model.

Feature	
Feature Definition	Existing Boundary
Feature Name	J5P3181 Existing Ground

### 1.10.4 Information

Lists the X, Y, Z range of the selected terrain model. In addition, it has the number of each type of source features, i.e., the number of points, voids, or break lines.

Information	
Number of Points	75,223
Number of Point Features	8
Number of Islands	0
Number of Voids	37
Number of Features	45
Number of Contours	0
Number of Breaklines	0
Number of Triangles	149,855



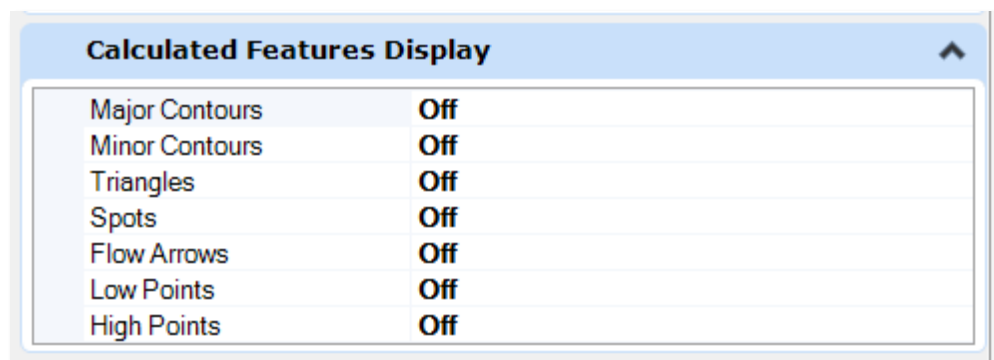
### 1.10.5 Edge Method

This displays the *Edge Method* used when creating the terrain model.



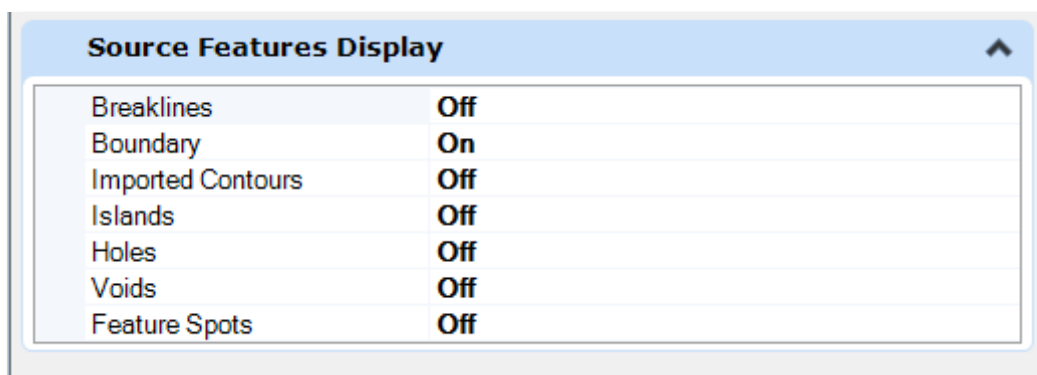
### 1.10.6 Calculated Features

Turns the display off or on for any data in the terrain model that is not source data. Example, triangles, high points, low points, and flow arrows. The change is immediately visible on the screen, it is not necessary to exit the file and re-enter.



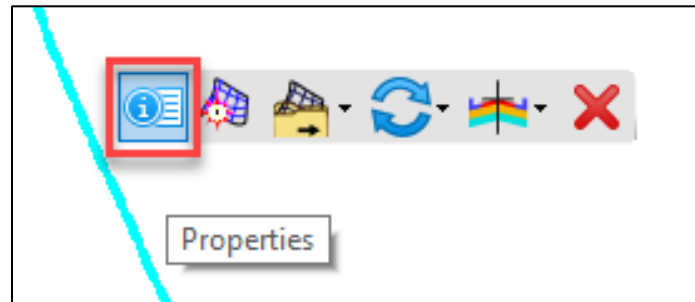
### 1.10.7 Source Features Display

Turns the display off or on for any data that was used to create the terrain model. The change is immediately visible on the screen, it is not necessary to exit the file and re-enter.



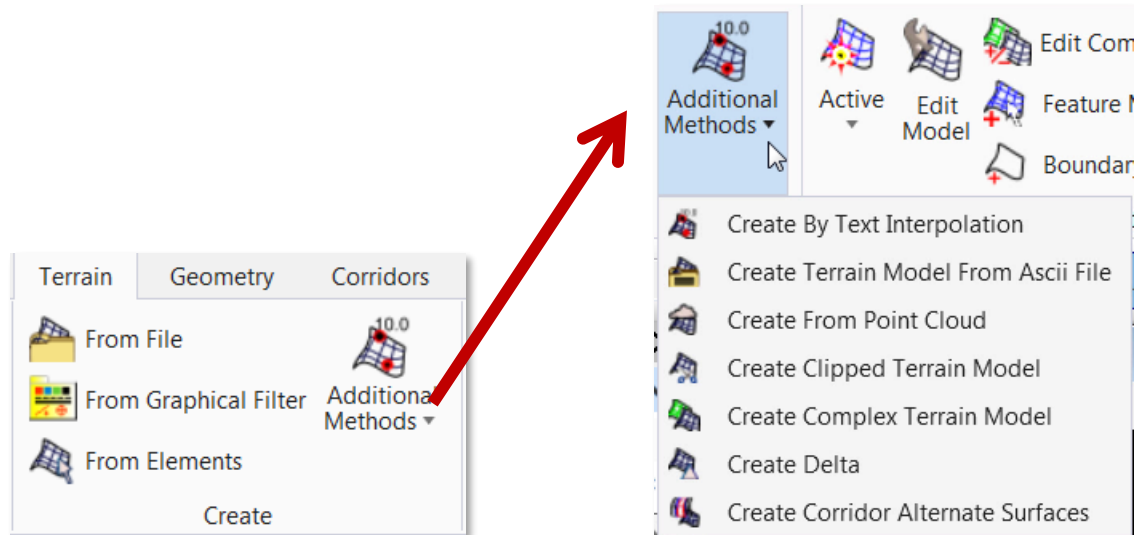
## Quick Properties of Terrain Models

Selecting the terrain model using the Element Selection tool and clicking on Properties opens the terrain model Properties pop-up where you can set the maximum triangle length, turn on/off various graphical features and change the feature name and definition.

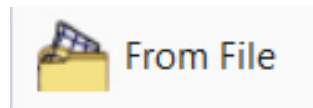


Name	Terrain Model: J5P3181 E
Number of Points	83,159
Number of Point Features	9
Number of Islands	0
Number of Voids	37
Number of Features	46
Number of Contours	0
Number of Breaklines	0
Number of Triangles	165,116
Edge Method	Max Edge Length
Length	1000.0000'
Major Contours	Off
Minor Contours	Off
Triangles	Off
Spots	Off
Flow Arrows	Off
Low Points	Off
High Points	Off
Breaklines	Off
Boundary	On
Imported Contours	Off
Islands	Off
Holes	Off
Voids	Off
Feature Spots	Off
Feature Name	J5P3181 Existing Ground
Feature Definition	Existing Boundary

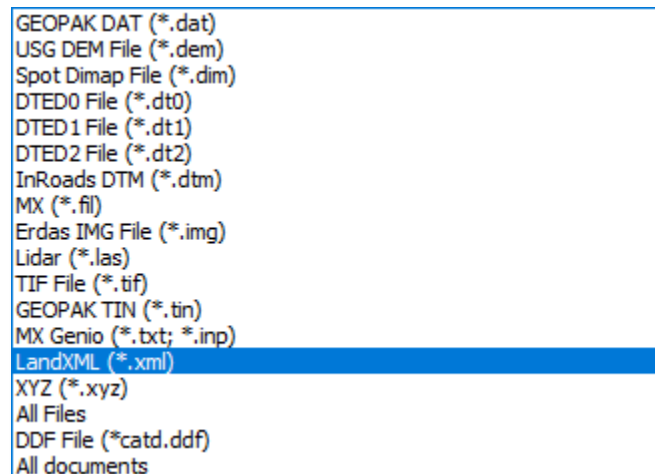
## 1.11 Terrain > Create Ribbon Menu



**Terrain Model Create** - Contains tools to create a terrain model from graphical elements, ASCII files, point clouds, LandXML, and import existing surface files. Tools are also available to merge two or more models together and/or to clip models.



**Create From File** creates a Terrain Model by importing an existing digital terrain model file. Import options include *Import Terrain Only*, *Import Features Only* and *Import Both*. Importing features only writes the features to the design file as MicroStation graphics not tied to the Terrain Model.

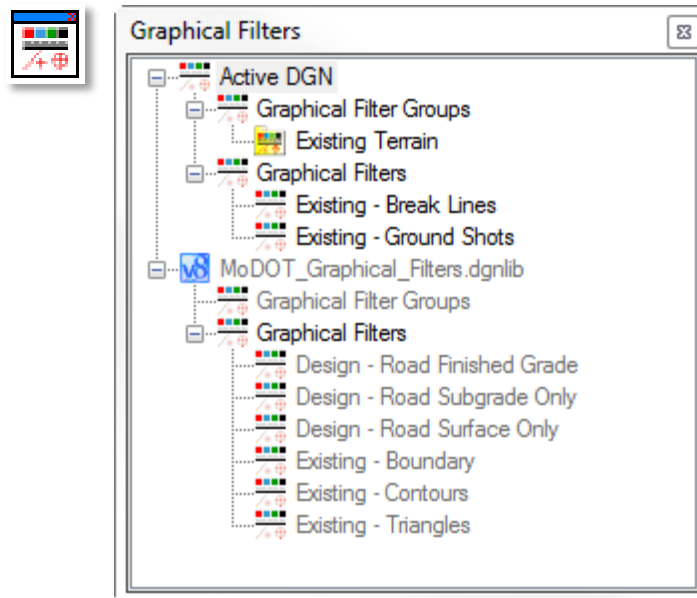




**Create Terrain Model from ASCII File** creates a terrain model by importing from an ASCII file type using customized user file formats.



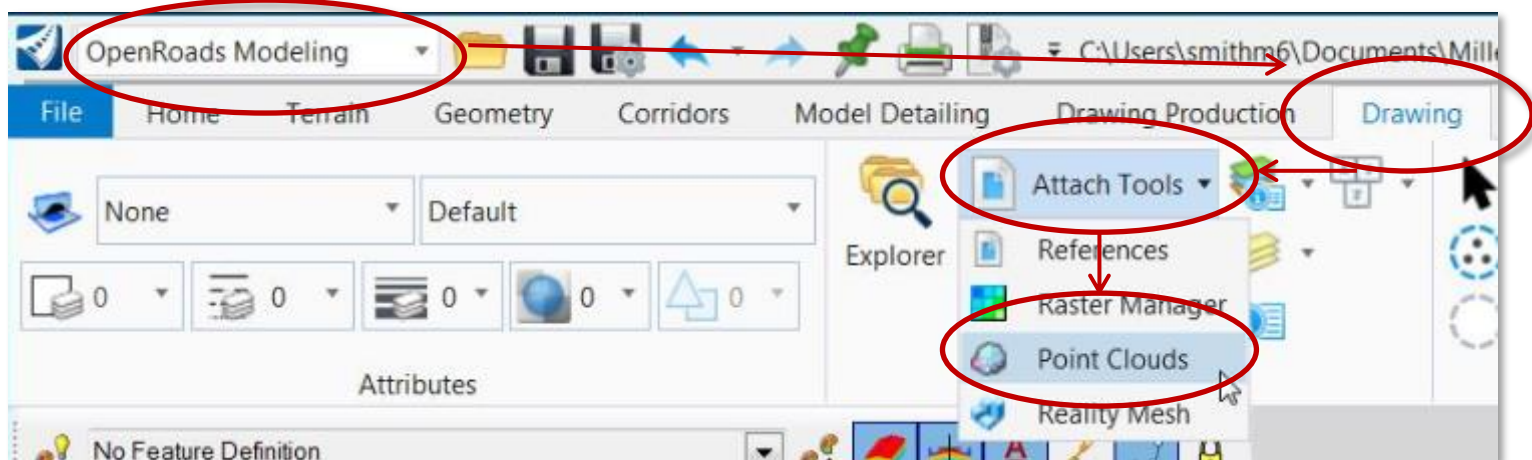
**Create Terrain Model by Graphical Filter** is an automated way of storing search settings for graphic elements to automate Create Terrain Model by Filter Elements. Uses the settings stored by Graphical Filter Manager to create the terrain. The Graphic Filter Manager icon is located in the Terrain > Miscellaneous Ribbon.



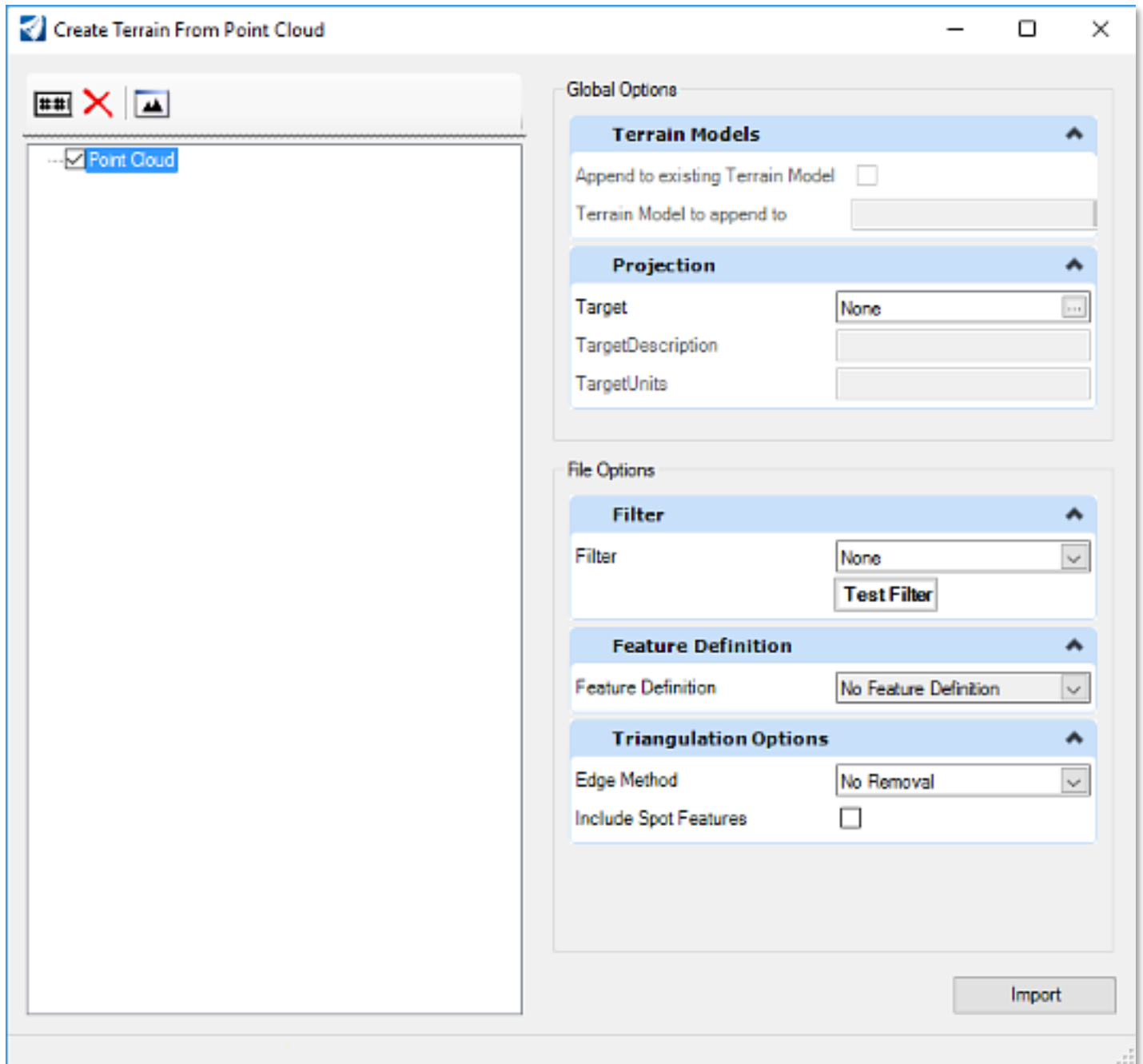
**Create from Point Cloud** creates a terrain model from MicroStation Point Cloud data. The Point Cloud has to be attached to the dgn prior to being able to create a Terrain Model.

1. Select **OpenRoads Modeling > Drawing > Primary > Point Clouds**.

2. In the Point Clouds dialog, choose Attach





After manipulating or editing the Point Cloud (as needed), the next step is creation of the terrain model. The entire Point Cloud can be used, or the Point Cloud Presentation can be used to limit the import to certain classifications, or a fence may be placed in the area of interest. The fence should be placed prior to starting the tool.





Two tools are supported in the upper left corner of the dialog:

Settings	Description
 Rename Terrain Model	renames the specified Terrain Model.
 Remove Terrain Model	removes the specified Terrain Model from the list.

The following options are supported in the right pane of the dialog:

- Terrain Models -options if there is already a terrain model in the active \*.dgn file and how to combine with the data to be imported.
- Filter - Filtering may be a useful option for large datasets.
- Feature Definition - feature definition to be used for imported terrain. If none is selected, the terrain model is drawn using the active symbology.
- Geographical Coordinate Systems (GCS) - If the software can determine the geographical coordinate system of the file to be imported, the fields are populated. If set to Unknown, the software uses the MicroStation design units. This section is used if the resultant terrain model needs to be in a different GCS.

### Filter by Tile TIN

This tool supports two filtering algorithms. One is **Tile** based and the other **Tin** or triangulation based. From empirical studies, the tiling algorithm is faster and typically produces a 30% to 50% reduction in file size. **The TIN algorithm typically produces a 70% to 90% reduction.**

The tiling algorithm is a recursive divide and conquer algorithm that divides the LIDAR data set into tiles. A best fit plane is calculated for each tile and LIDAR points are removed if they fall within the user set Z tolerance to the plane.

The TIN algorithm filters LIDAR points if they fall within the user set Z tolerance of the triangle planes. The TIN algorithm first tiles the LIDAR points into tiles with a maximum of 2 million points and then repetitively triangulates each tile filtering out points. This algorithm running on a 1.67 GHz machine with 1 GB of memory will typically take about 12 minutes to filter 30 million LIDAR points.

Settings	Description
File Option	Tile or TIN filter
Z Tolerance	Z Tolerance is common to both algorithms and is basically the variation in the Z coordinate that the surface is allowed to move during the filtering process. Typically for the first invocation of the filtering function, the Z tolerance should be set from <b>0.5 to 1.0 for imperial data</b> sets and from <b>0.25 to 0.5 for metric data</b> sets. Depending on the outcome and desired result, the Z tolerance can be varied up or down. MoDOT aerial LiDAR flown in 2019 had a vertical tolerance of 0.3ft
Min. Tile Points (Tile)	A tile will not be subdivided if it has less than this number of points. Typically set this to five.
Max Tile Divisions (Tile)	Allowable level of recursion allowed and is the number of times the initial tiling set can be subdivided. Typically set this to five.
Start Tile Length (Tile)	The LIDAR data set is initially divided into tiles of this size, prior to recursion to the minimum tile points. The setting of this parameter requires some knowledge of the distance between the LIDAR points, which requires an inspection of the LIDAR points in MicroStation to determine. Typically set this to 10 times the distance between the LIDAR points.
Coarse Filters (TIN)	Filters more points with some blurring of ridges and valleys.
Fine Filter (TIN)	Filters fewer points with less blurring of ridges and valleys.
Reinsert Points (TIN)	Reinsert points adds points back if the iterative filtering on the terrain removes points which are within the tolerance. For example, this process could remove points at the top of a hill and the second iteration could remove points around the high point making the point out of the thinning tolerance. The iterative process can happen a maximum of five times.

**Workflow:**

1. Open or reference the DGN file containing point cloud.
2. Set the view attributes of the cloud to display all points which are desired in the terrain model
3. **Optionally** make a fence around points to extract.
4. Start the Terrain from Point Cloud command.
5. Filter, if desired.
6. Set the feature Definition and Triangulation Option.
7. Datapoint to accept and build the terrain model, named Point Cloud Surface\_1 by default.
8. Rename the terrain model, if desired.



**Create from Elements** creates a terrain model from 3D graphical elements. The elements can be in a reference file.



**Create Complex Terrain Model** creates a new Complex terrain model by merging/append multiple terrain models.



**Create Clipped Terrain Model** creates a terrain model by clipping an existing terrain model and providing an optional horizontal or vertical offset.



**Create Delta Terrain Model** creates a new terrain model using the difference between 2 terrain models or a terrain model and a plane (elevation). Vertical offsets can be assigned to the Terrain Models in the Terrain Model to Terrain Model method.



**Create Terrain by Text Interpolation** creates a terrain model from 2D graphics which also contain an elevation label.

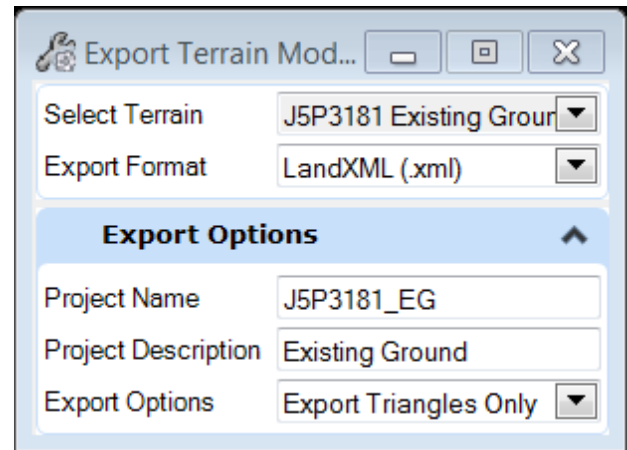
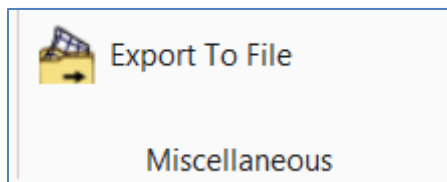


**Create Corridor Alternate Surfaces** is used to manage alternate surfaces in the template. This command is useful for the generation of surfaces to be exported to Automated Machine Control LandXML files.

## 1.12 Export to XML for Electronic Deliverables

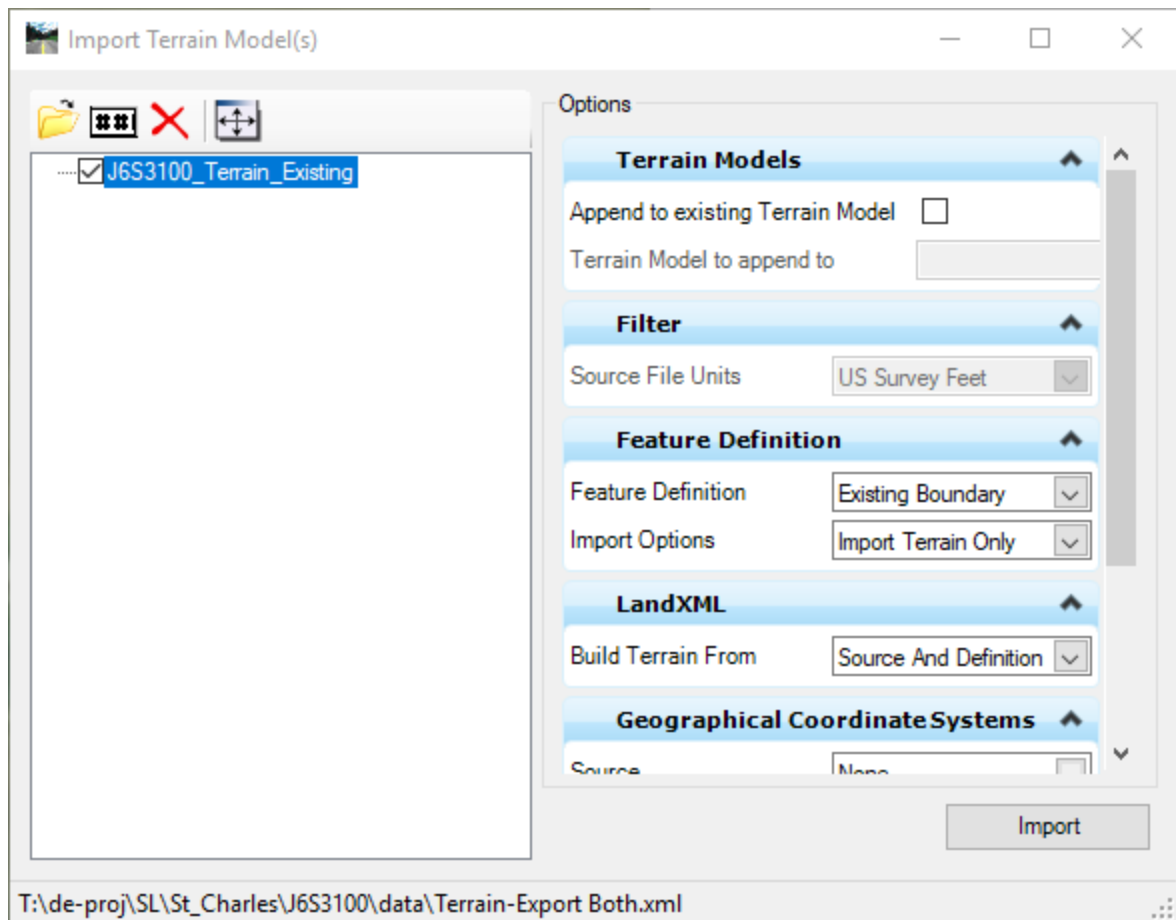
The Electronic Deliverables require the Existing Terrain in an XML format. This is achieved by Opening the 3D Existing Terrain DGN supplied by the Surveyor and using the Export to File tool in ORD.

1. Set the Workflow to **OpenRoads Modeling**
2. Select the **Terrain** Ribbon group
3. Locate the **Miscellaneous** task group
4. Select **Export to File**



5. Select the Terrain Model from the drawing
6. Save the XML

## 1.13 Import from XML



Creates a TM by importing from an external file type. The following formats are supported for import:

The import process supports multiple files of the same type to be imported at once. The import settings that are defined are generic to all files selected for import.

### Import Terrain Model dialog

The Import Terrain Model dialog is modal form and does not allow interaction with the graphics environment once open.

---

**Four** tools are supported in the upper left corner of the dialog:

Select Files to Import	Displays the Select Files to Import dialog.
Rename Terrain Model	Renames the specified Terrain Model.
Remove Terrain Model	Removes the specified Terrain Model from the listing. Note it does not delete the terrain model.
Fit View	Places the entire specified Terrain Model within the active view.

Several options are supported in the right pane of the dialog:

- Terrain Models - options if there is already a terrain model in the active \*.dgn file and how to combine with the data to be imported.
- Filter - Filtering may be a useful option for large datasets.
- Feature Definition - feature definition to be used for imported terrain. If none is selected, the terrain model is drawn using the active symbology.
- Triangle options - specifies how to address the external triangles of the created Terrain Model
- Geographical Coordinate Systems (GCS) - If the software can determine the geographical coordinate system of the file to be imported, the fields are populated. If set to Unknown, the software uses the MicroStation design units. This section is used if the resultant terrain model needs to be in a different GCS.

**Terrain Models**

Tool Setting	Description
Append to existing Terrain Model	<p>When toggled on, appends to the selected Terrain Model in the *.dgn.</p> <p>When toggled off, a new terrain model is created, ignoring any other Terrain Models in the active file or referenced.</p>
Terrain Model to append to	<p>Type the Terrain Model name or Select from the list of available Terrain Models.</p> <p>Available when Append to existing Terrain Model is selected.</p>

**Filter**

Note the settings in this section vary depending on the file type of the source data.

Select to reduce the number of data points imported to the TM then enter the Maximum Number of points value in the field provided.

Tool Setting	Description
Source File Units	<p>If the software can determine the units from the data file, this field is populated. If it cannot determine the units, Unknown is displayed. The user can specify Unknown, Millimeters, Centimeters, Meters, Kilometers, Inches, Feet, US Survey Feet, Miles. If Unknown, then the design file units are used.</p>

For details on filtering, see Filtering.

**Feature Definition**

Tool Setting	Description
Feature Definition	No Feature Definition is default. Select from drop down menu the feature definition.
Import Options	<p>Creates design file elements according to the styles defined in the source file. The DGN is scanned and the first 15,000 elements found are added to the rule that is attached to the terrain model that gets created. Changing one of these elements affects the terrain model. All other elements found in the DGN are added into the terrain model but not added to the rule. Changing one of these elements does not affect the terrain model. A warning displays in the Civil Message Center if the limit is reached.</p> <p>Import Both - Creates terrain with features.</p>

**Triangulation Options**

Setting	Description
Edge Method	<p>No removal - No external triangles are removed.</p> <p>Sliver - Long, thin triangles are dissolved based on a formula hard coded within the software.</p> <p>Side - External triangles whose external edge is longer in length than a user specified distance are removed. The side option does not apply to internal triangles, only those on the edge of the model.</p>

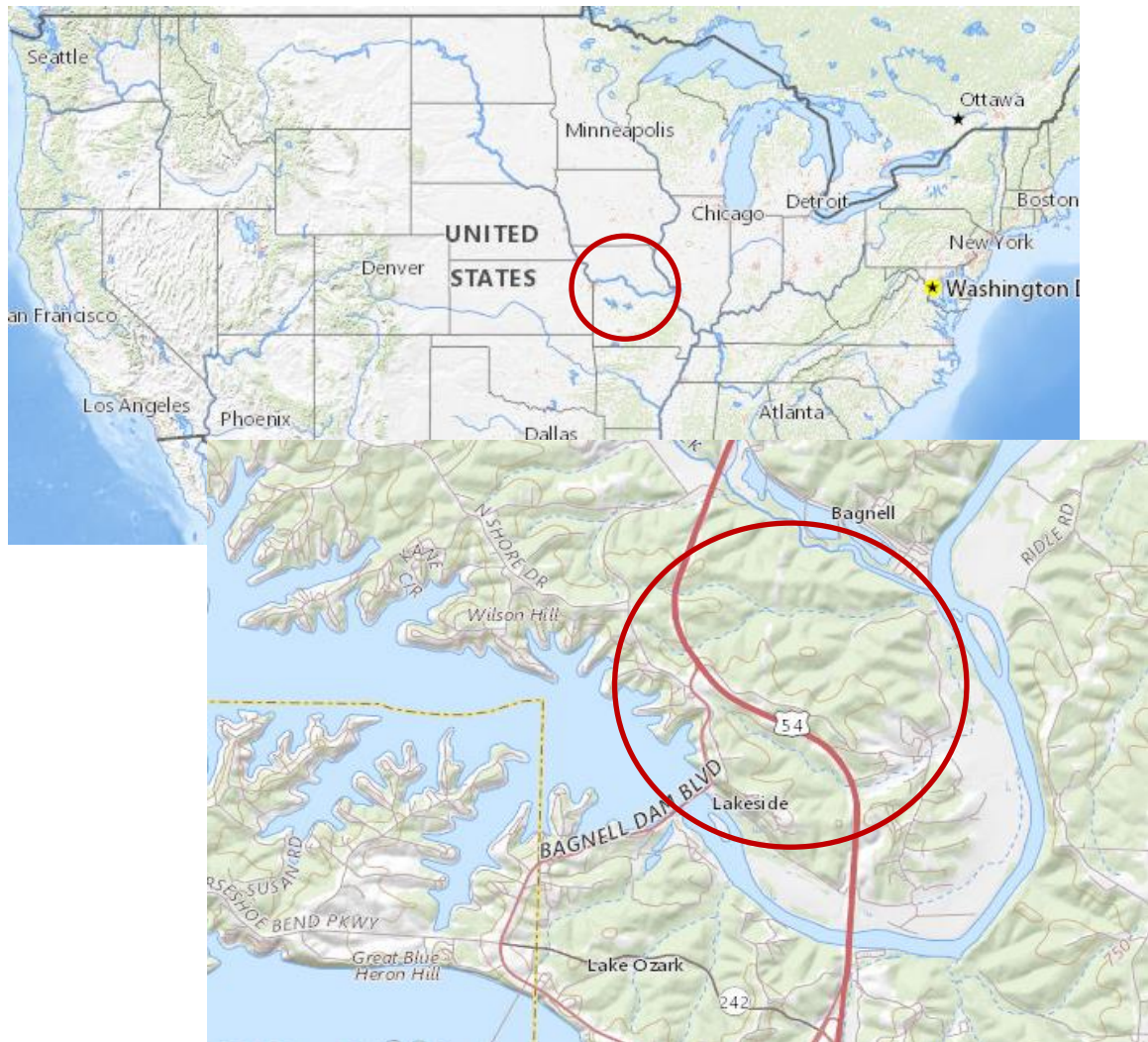
**Note:** Selecting Import Features Only or Import Both limits the amount of editing that can be done in a terrain model. Triangle edges cannot be switched along features, nor can vertices be deleted. Importing features only writes the graphics to the design file without creating a terrain. Importing both, as implied, imports both the terrain model and its features. The graphics are not tied to the terrain model. MDT Best Practice is to import the terrain only.



## 1.14 Group Exercise: Preliminary Surface from The USGS National Map LiDAR

For preliminary surface data, MSDIS has certain areas of Missouri covered for LiDAR (Point Cloud) data as does the USGS site. This data may be downloaded and manipulated to produce a terrain model that can be used to give the designer a starting point in the design process. Later, aerial or survey data should replace the preliminary terrain for more accurate solutions. In this exercise we will visit the National Map (USGS) website and learn how to download the LiDAR data, look at the metadata and develop an existing ground surface. MSDIS (Missouri Spatial Data Information Service) is also another location for LiDAR data but is limited to certain areas of the state and can be found at the following link: <http://msdis.missouri.edu/>

1. Within **Roadway/data-1** folder select the following USGS link:  
<https://viewer.nationalmap.gov/basic/>
2. In the right National Map window, zoom and then double-click into Missouri at an area close to the project.



3. In the Left pane, place a check mark in **Elevation Source Data (3DEP) – Lidar, IfSAR**

USGS  
science for a changing world

TNM Download (v2.0) Help Custom Views ▾ Share Link Contact Us **New: topoBuilder**

Datasets Products Cart

Select products below and then hit "Search Products"

Area of Interest: Map Extent/Geometry ▾ Extent Polygon Point Enter Coords Clear Geometry

Advanced Search

Search Products Reset Map Upload shapefile

Map

☐ US Topo

☐ Historical Topographic Maps

Data

☐ Boundaries - National Boundary Dataset

☐ Elevation Products (3DEP)

☒ Elevation Source Data (3DEP) - Lidar, IfSAR

☐ Hydrography (NHDPlus HR, NHD, WBD)

☐ Imagery - NAIP Plus (1 meter to 1 foot)

☐ Map Indices

☐ Names - Geographic Names Information System (GNIS)

☐ Small-scale Datasets

☐ Structures - National Structures Dataset

☐ Topo Map Data and Topo Stylesheet

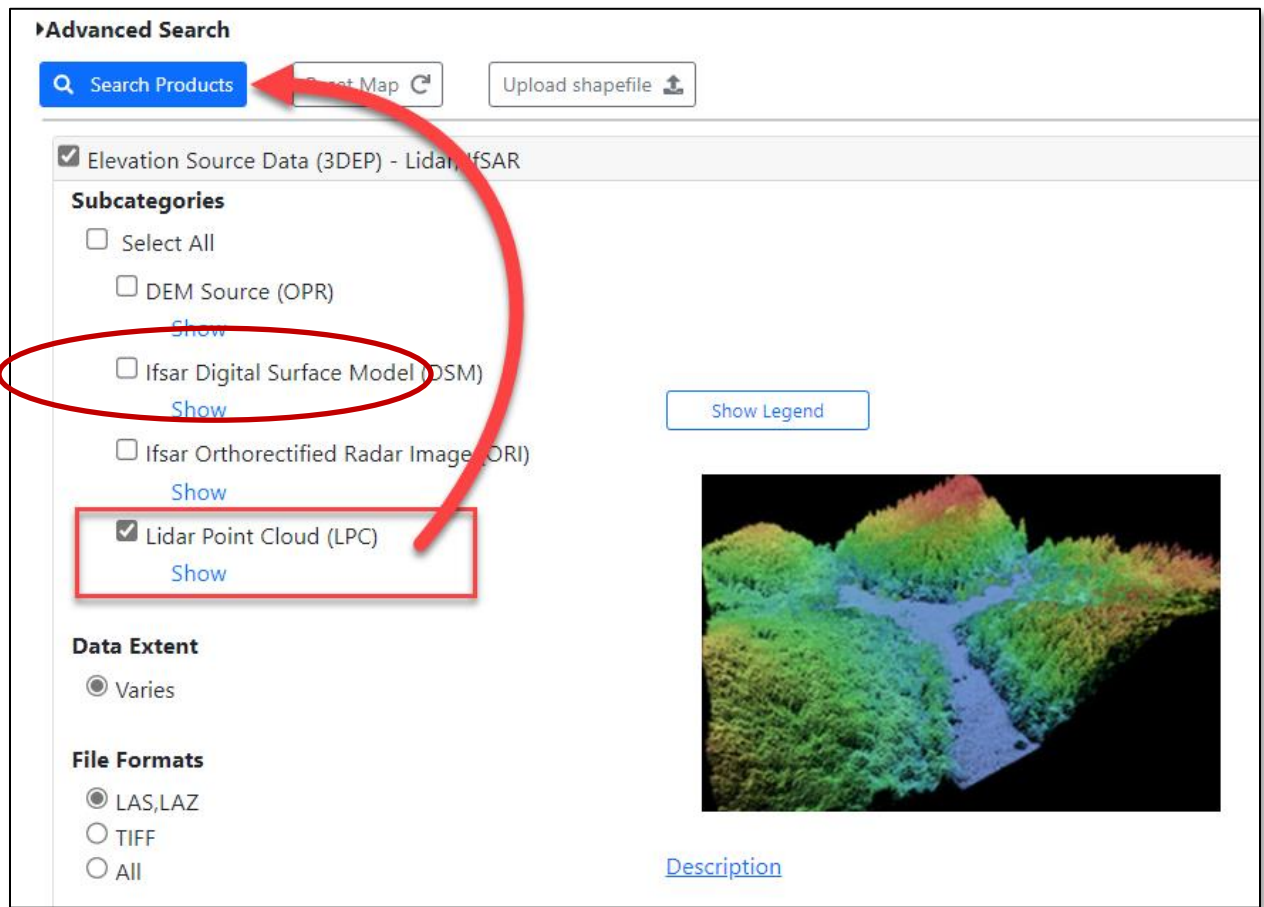
☐ Topobathy - Elevation

☐ Transportation

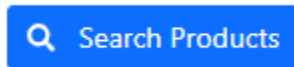
☐ Woodland Tint

[National Land Cover Database \(NLCD\)](#) data can be downloaded at the MRLC website.

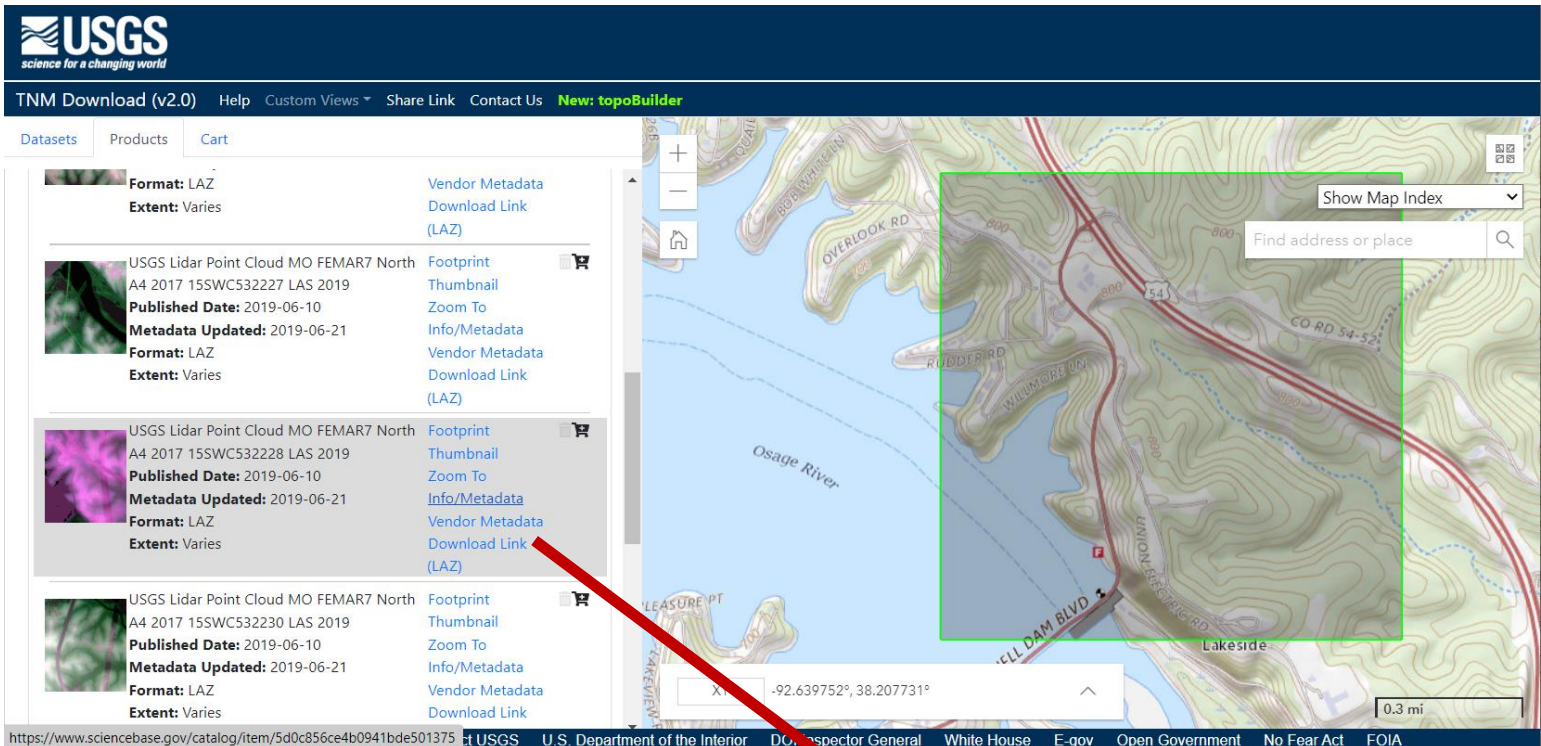
4. Verify a check mark is next to **Lidar Point Cloud (LPC)**



5. In the Left pane, click **Search Products**
6. Wait a few seconds and the Left pane will populate with LiDAR data the is available in the windowed area.



- Click on the **Thumbnail** option to see what area is available.



- When the desired product is found, click on **Download LAZ**

**Note:** LAZ is the same as LAS but compressed. LAS file is an industry-standard binary format for storing airborne lidar data

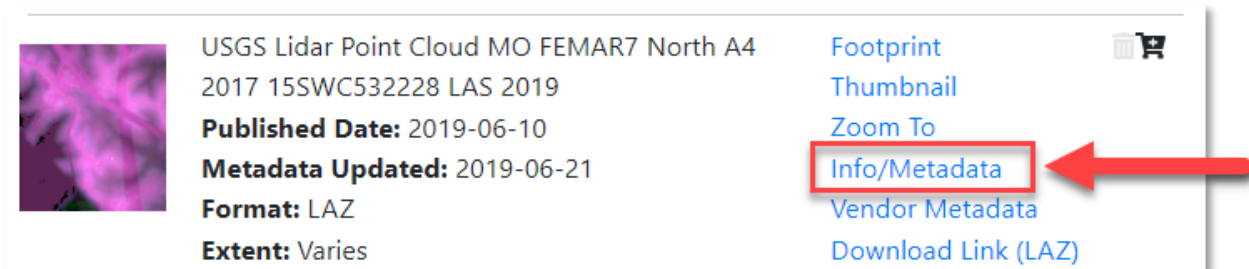
- Click **YES** to the security warning if it pops up
- You may also have to allow Pop-ups for this site – Click on **Options for the Site**, choose **Always Allow**

**Note:** You may need to click **Start Over** and begin the process again after allowing popups if the window freezes.

- Save As... save the LAZ file to the Desktop, and then drag the file into PW.

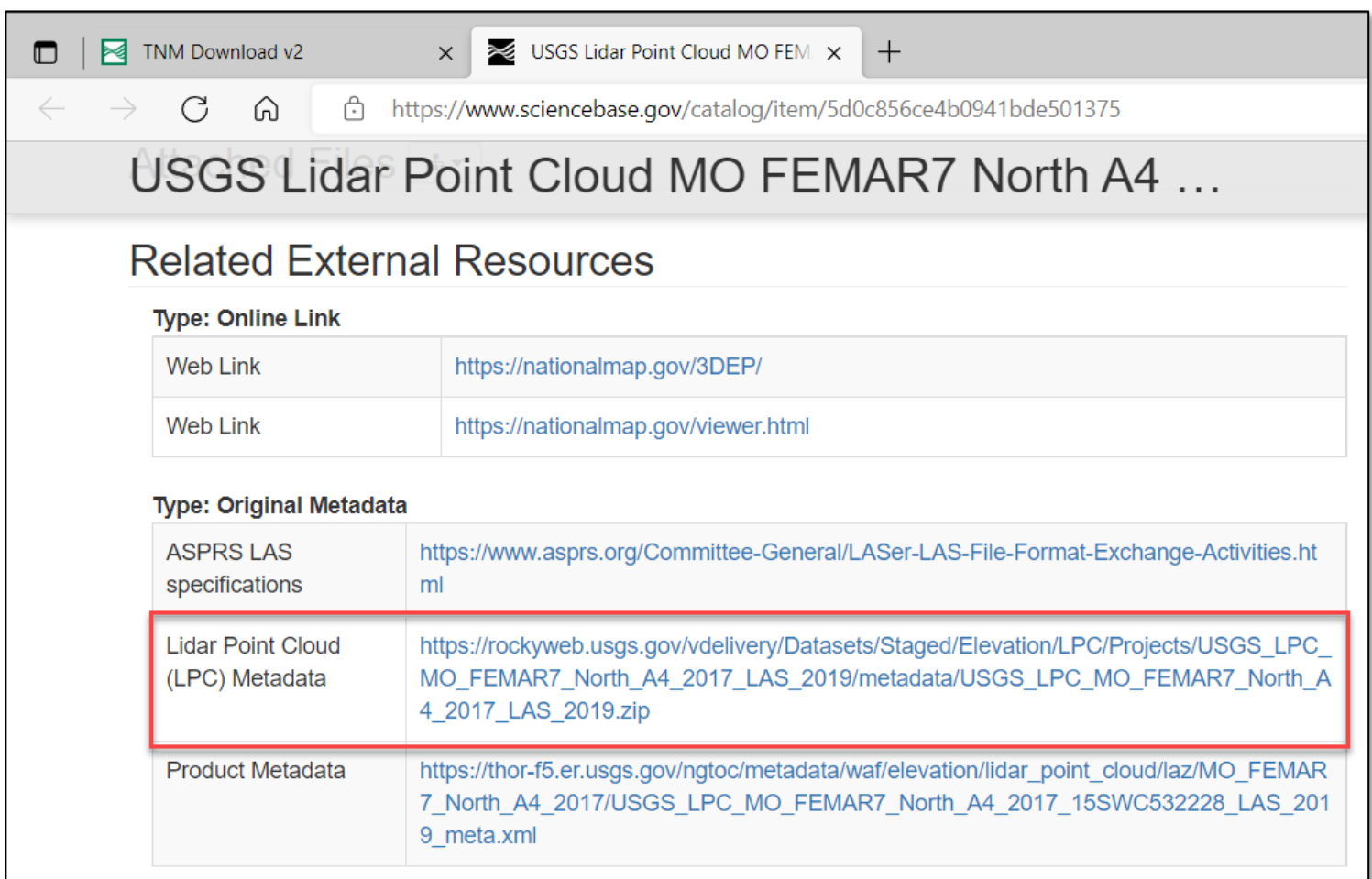


**Note:** When downloading data from USGS or MSDIS, the User will have to determine what the projection/datum the data is based on. To do this the User will need to download the Info/Metadata and search for this information.



USGS Lidar Point Cloud MO FEMAR7 North A4  
2017 15SWC532228 LAS 2019  
**Published Date:** 2019-06-10  
**Metadata Updated:** 2019-06-21  
**Format:** LAZ  
**Extent:** Varies

Footprint  
Thumbnail  
Zoom To  
**Info/Metadata**  
Vendor Metadata  
Download Link (LAZ)



USGS Lidar Point Cloud MO FEMAR7 North A4 ...

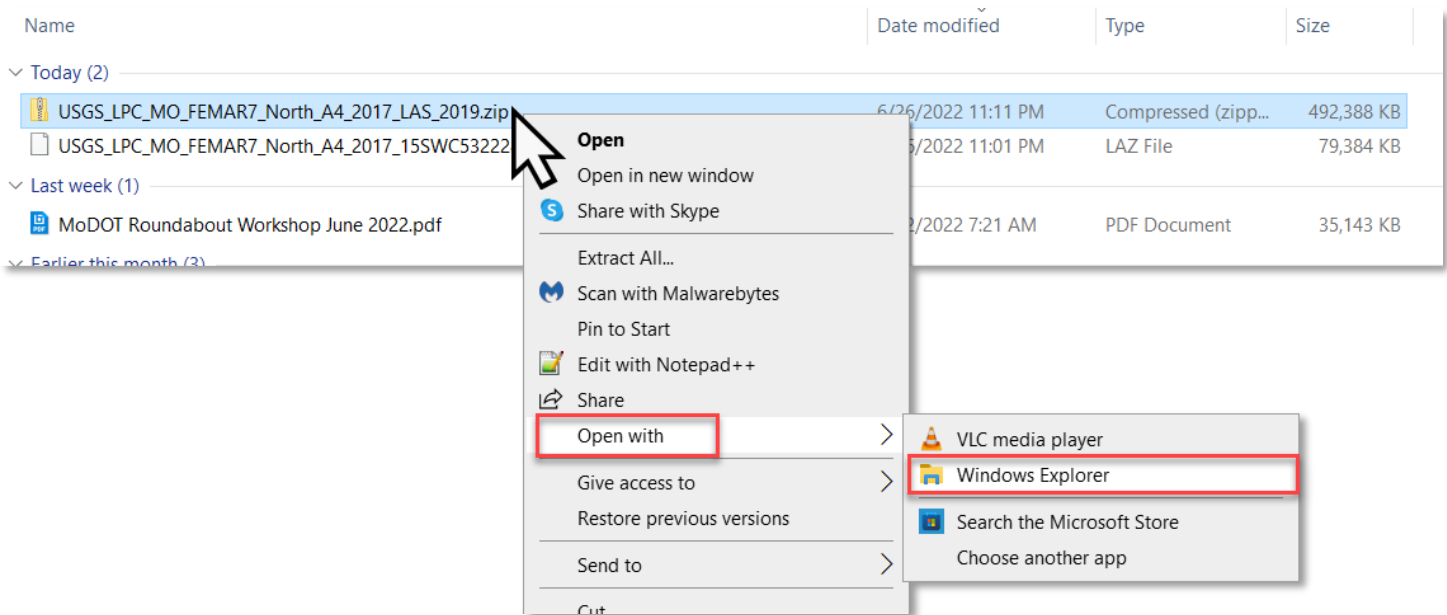
### Related External Resources

**Type: Online Link**

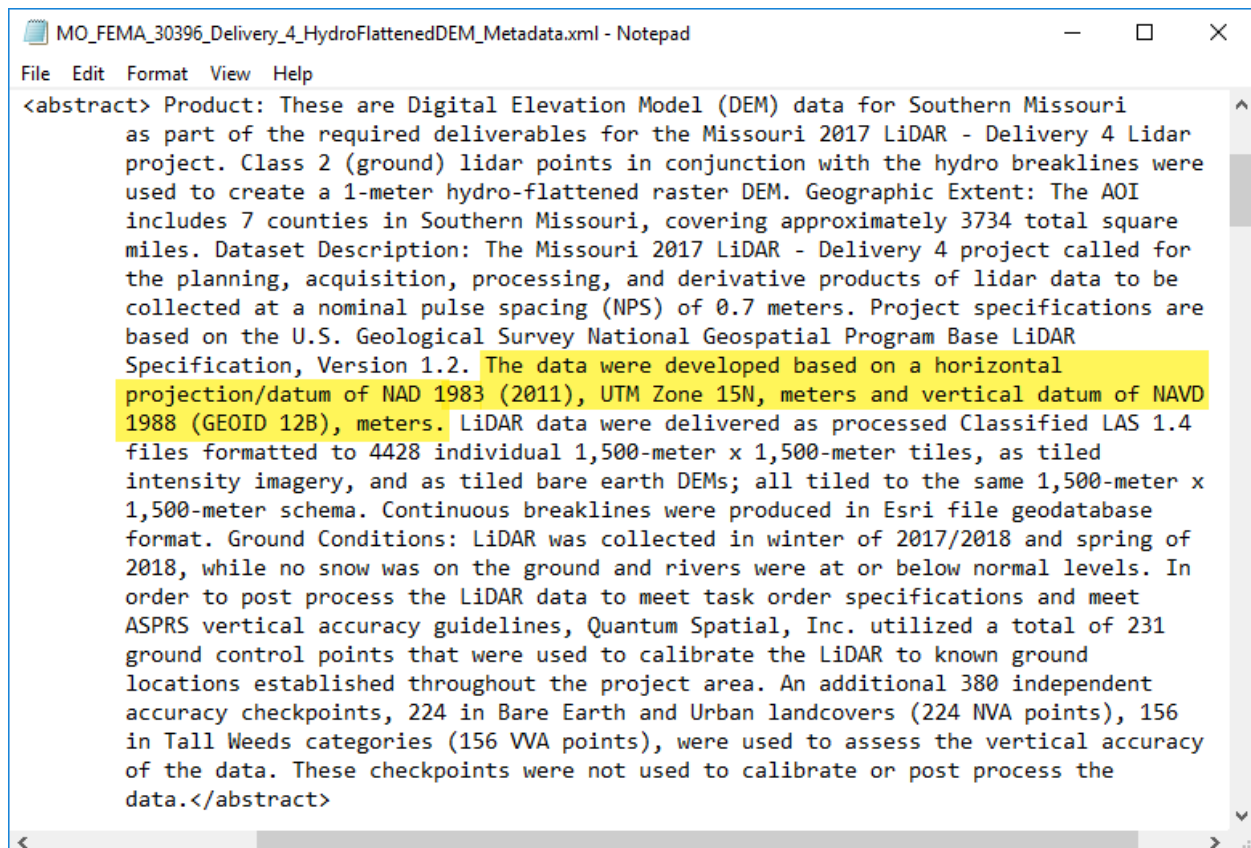
Web Link	<a href="https://nationalmap.gov/3DEP/">https://nationalmap.gov/3DEP/</a>
Web Link	<a href="https://nationalmap.gov/viewer.html">https://nationalmap.gov/viewer.html</a>

**Type: Original Metadata**

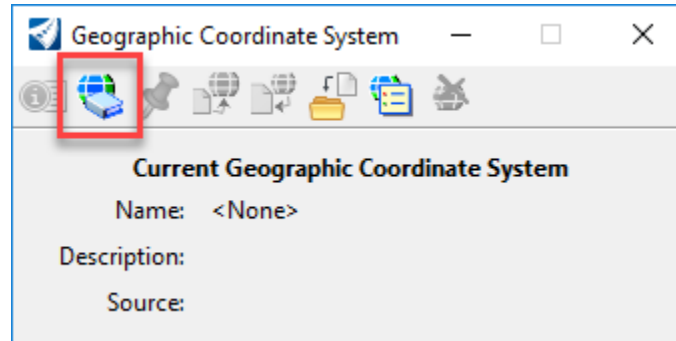
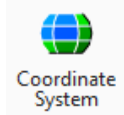
ASPRS LAS specifications	<a href="https://www.asprs.org/Committee-General/LASer-LAS-File-Format-Exchange-Activities.html">https://www.asprs.org/Committee-General/LASer-LAS-File-Format-Exchange-Activities.html</a>
Lidar Point Cloud (LPC) Metadata	<a href="https://rockyweb.usgs.gov/vdelivery/Datasets/Staged/Elevation/LPC/Projects/USGS_LPC_MO_FEMAR7_North_A4_2017_LAS_2019/metadata/USGS_LPC_MO_FEMAR7_North_A4_2017_LAS_2019.zip">https://rockyweb.usgs.gov/vdelivery/Datasets/Staged/Elevation/LPC/Projects/USGS_LPC_MO_FEMAR7_North_A4_2017_LAS_2019/metadata/USGS_LPC_MO_FEMAR7_North_A4_2017_LAS_2019.zip</a>
Product Metadata	<a href="https://thor-f5.er.usgs.gov/ngtoc/metadata/waf/elevation/lidar_point_cloud/laz/MO_FEMAR7_North_A4_2017/USGS_LPC_MO_FEMAR7_North_A4_2017_15SWC532228_LAS_2019_meta.xml">https://thor-f5.er.usgs.gov/ngtoc/metadata/waf/elevation/lidar_point_cloud/laz/MO_FEMAR7_North_A4_2017/USGS_LPC_MO_FEMAR7_North_A4_2017_15SWC532228_LAS_2019_meta.xml</a>



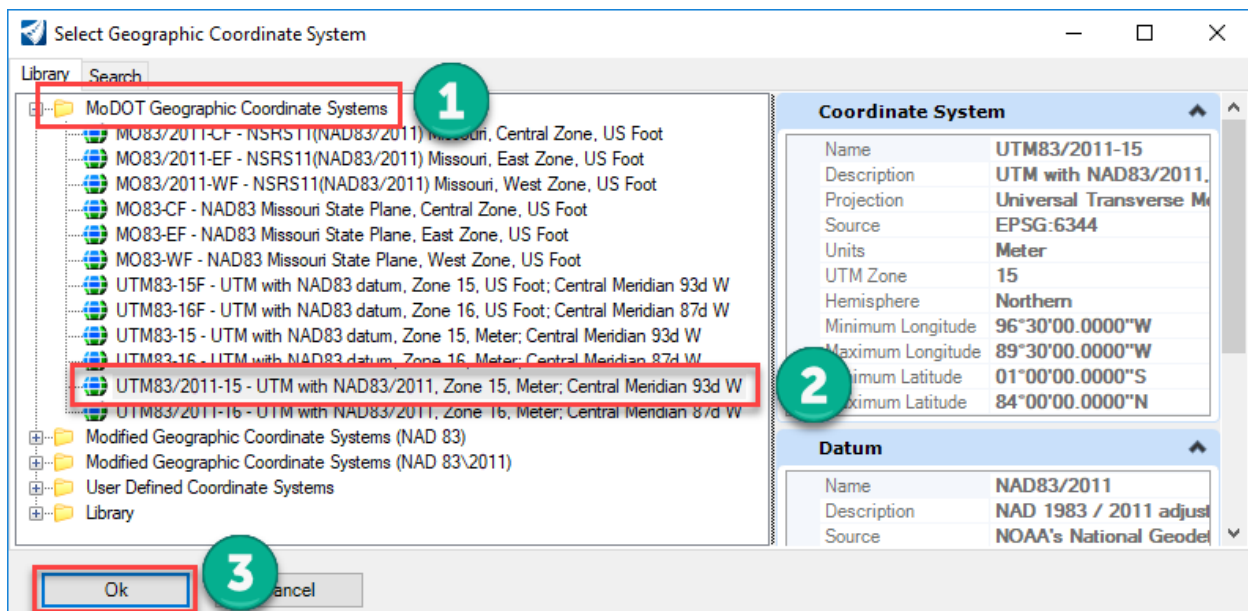
**Note:** Within several of the metadata files, you can see the datum/projection for the LiDAR data. We will use this datum/projection when creating a dgn file so that when the User imports the LiDAR information it lands geospatially correct. Once the LiDAR information has been imported, the User can then create the preliminary surface terrain model from that data.



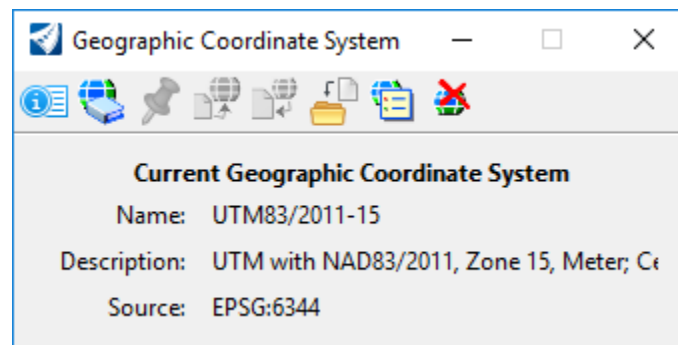
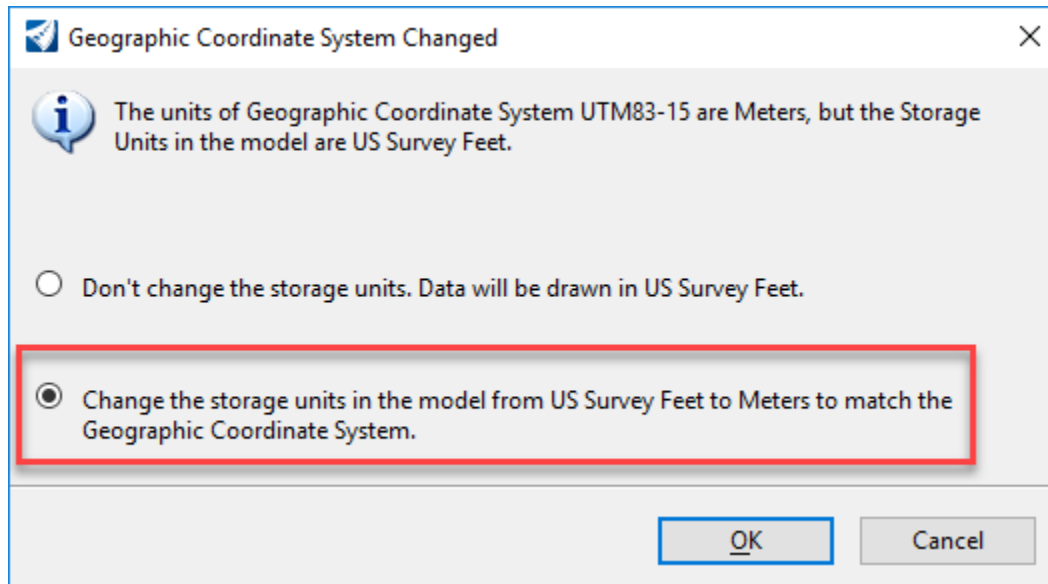
13. Create a new file named **J5P3181\_Point\_Cloud.dgn** (Use a 3D Seed file for terrain models). In this file we will store the projects preliminary LiDAR data.
14. Open the **Coordinate System** tool by selecting the **OpenRoads Modeling Workflow → Utilities Tab → Geographic Section**.
15. Select “**From Library**” icon.



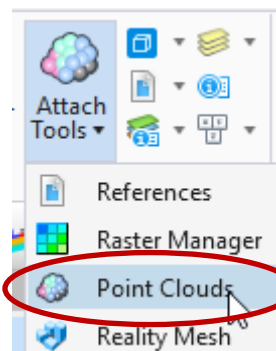
16. From the folder **MoDOT Geographic Coordinate Systems**, select:  
**UTM83-15 – UTM with NAD83/2011, Zone 15, Meter; Central Meridian 93d W**



17. Select the option below switching the Storage Units from English to Metric.



18. In Open Roads Designer (ORD) select **OpenRoads Modeling > Home > Primary** tools click the down arrow for **Attach Tools** and click **Point Clouds**



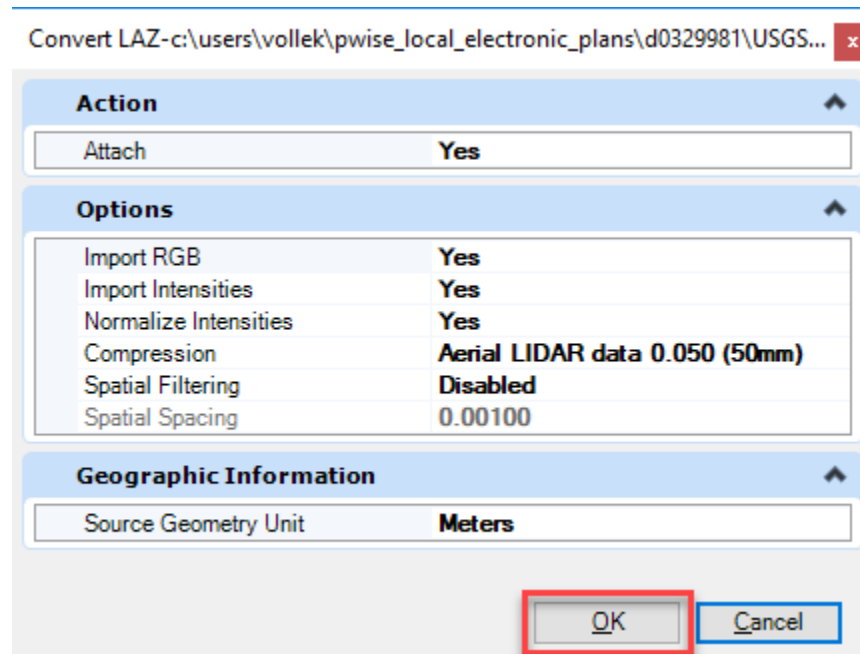
19. Click **File > Attach** from the pull-down menu of the Point Clouds dialog

20. Change the File name filter to “laz”.

21. Select the downloaded LAZ file and click **Open**



22. This will open the Convert dialog in order to convert the LAZ file to a POD (Point Database) file that will be recognized by ORD. Click the **OK** button.

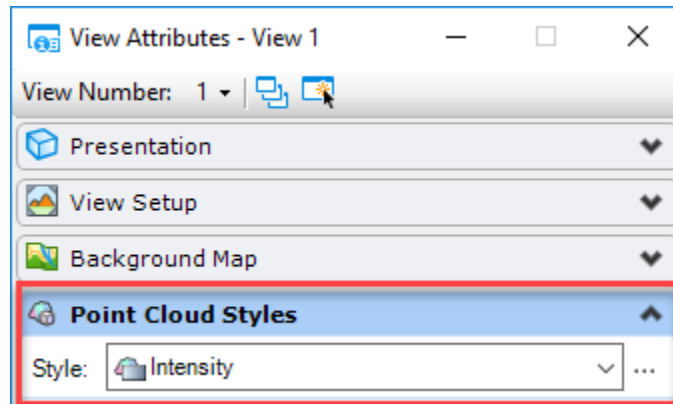


23. **No Wizard**, if asked by ProjectWise. Click **OK**
24. Select the project's **data-1** folder to save the POD file in
25. Click **Save** to create the POD file
26. **Fit the View**

This will attach the POD file to the DGN.

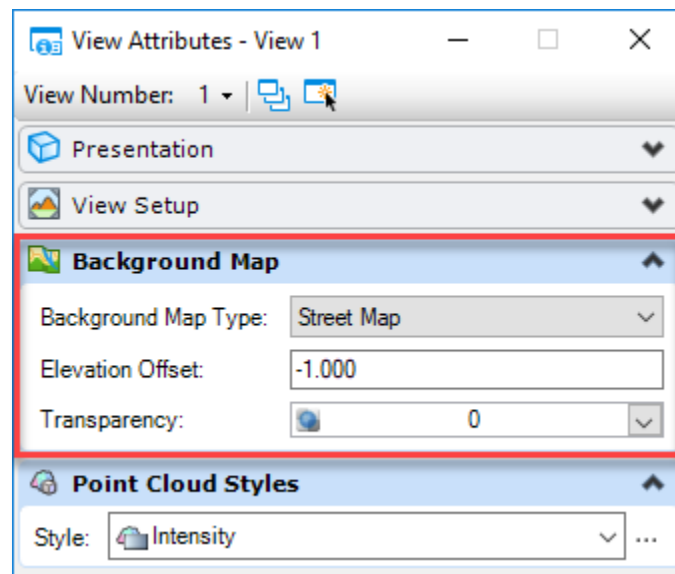
**Note:** If the POD file comes in Red, simply export the POD file from ProjectWise to your local machine and attach it to the drawing.

27. From the View Attributes drop down, change the **Point Cloud Style** to **Intensity**



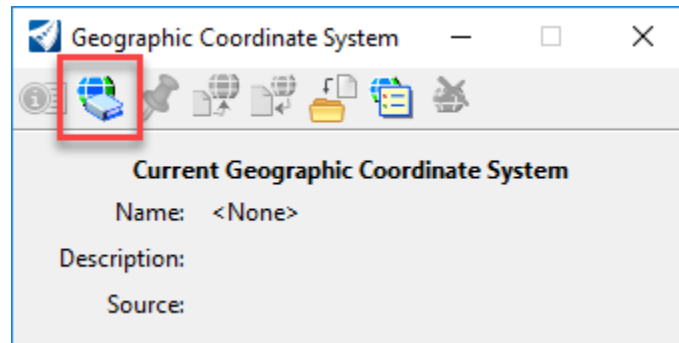
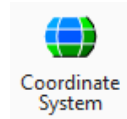
### Add in Mapping with Bing Maps

28. Because Geographic Coordinate System has been applied to the drawing, you can access Bing Maps by opening the **View Attributes** dialog and within the **Background Map** section select **Background Map Type** ➔ **Street Map**



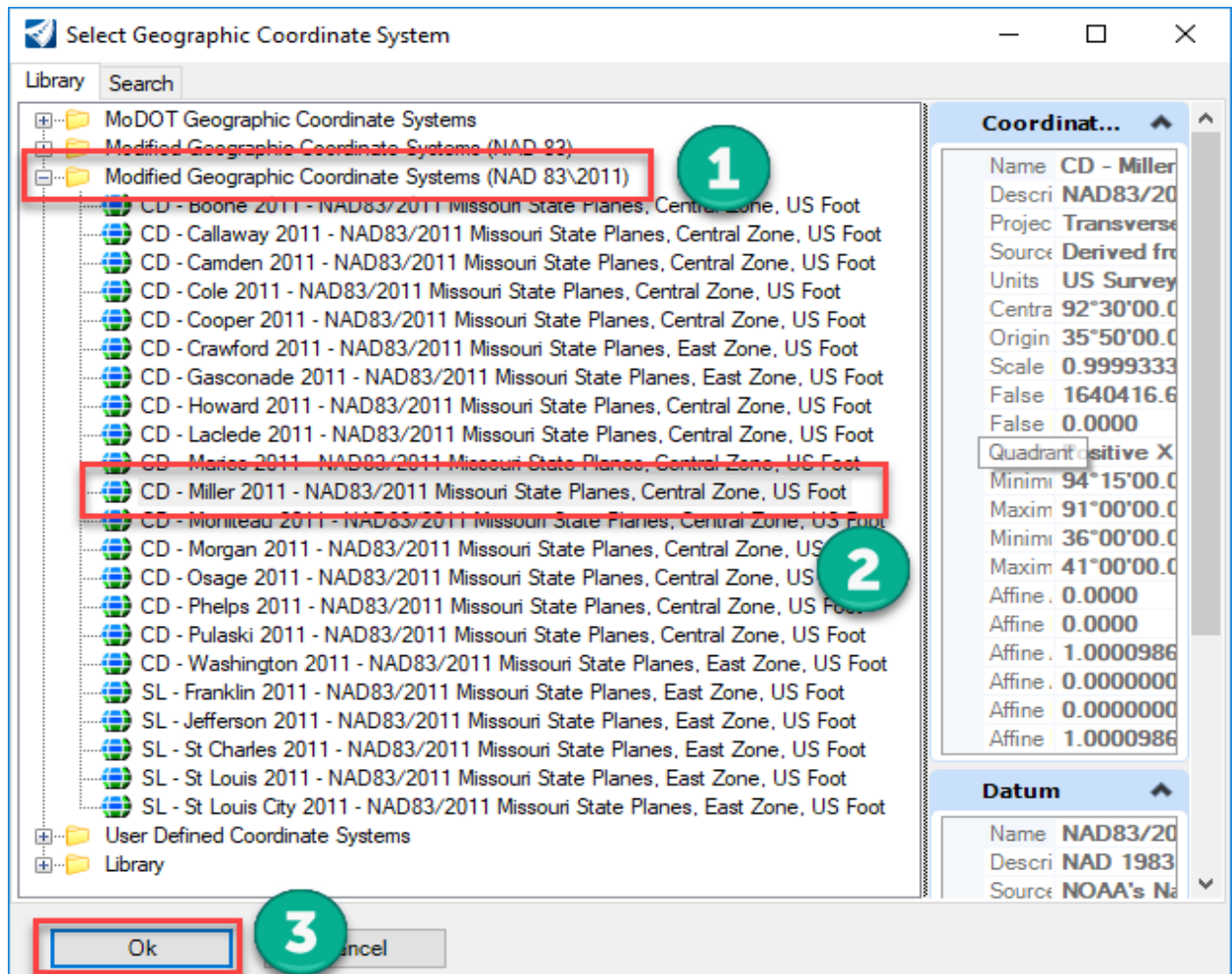
Creating the Terrain Model from the Point Cloud

29. Create a new file named **J5P3181\_Terrain\_Existing\_Preliminary.dgn** (Use a 3D Seed file for terrain models). In this file we will generate a Terrain model from LiDAR data.
30. Open the **Coordinate System** tool by selecting the **OpenRoads Modeling Workflow → Utilities Tab → Geographic Section**.
31. Select “**From Library**” icon.

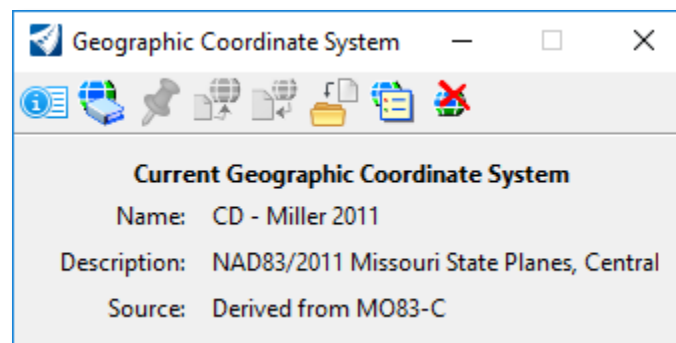


32. From the folder **Modified Geographic Coordinate Systems (NAD 83\2011)**, select:

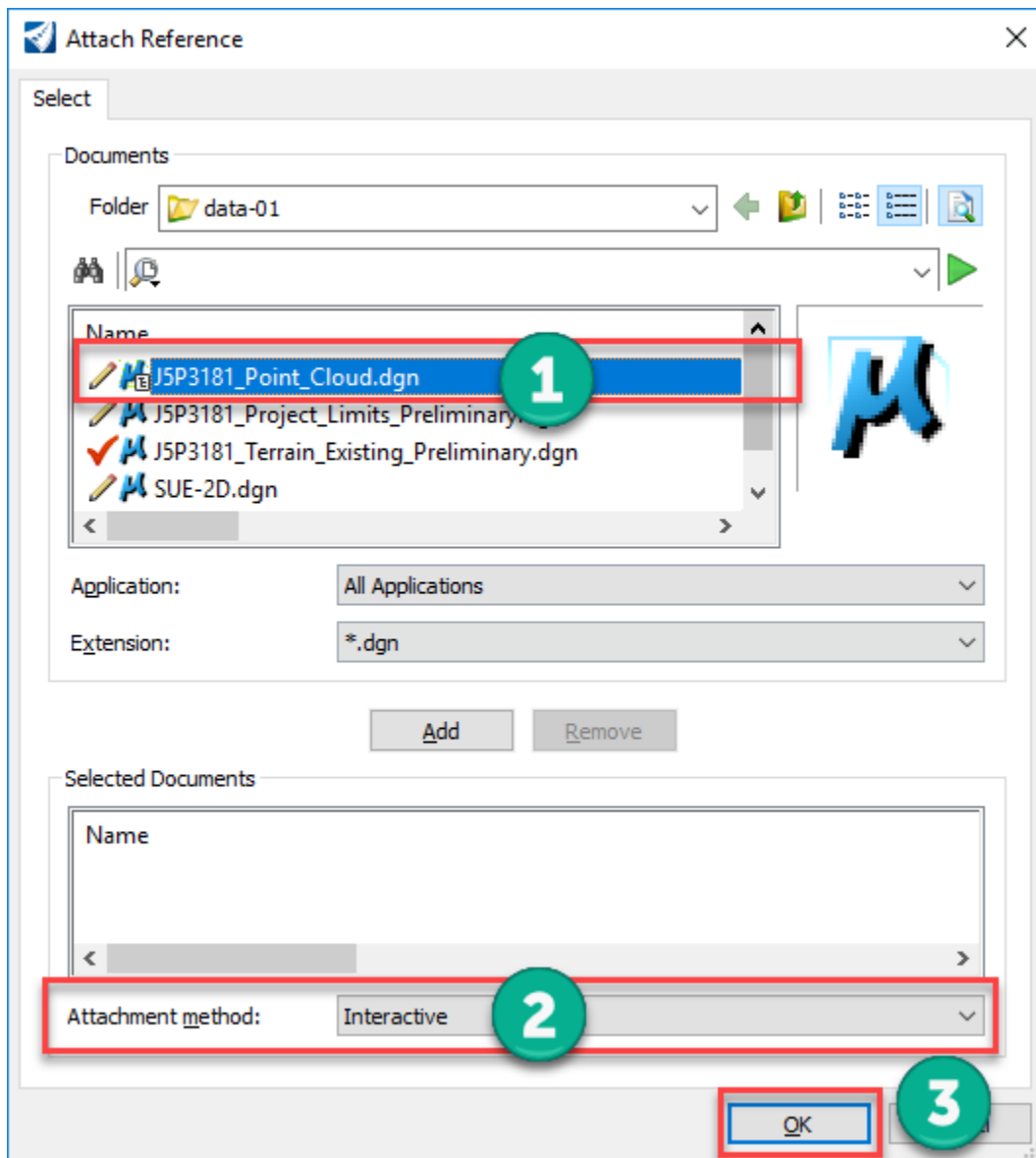
**CD - Miller 2011 - NAD83/2011 Missouri State Planes, Central Zone, US Foot**



33. After verifying the Current Geographical Coordinate System, close the dialog.



34. Attach the **J5P3181\_Point\_Cloud.dgn** file. Because the active and the referenced file have different Geographical Systems, when attaching use the **Attachment Method** of **Interactive**.



35. Continue: Then select **Geographic – Reprojected** for the Orientation.

Reference Attachment Properties for ...\\J5P3181\_Point\_Cloud.dgn

File Name: PW\_WORKDIR:d0329981\\J5P3181\_Point\_Cloud.dgn  
Full Path: ...\\d0329981\\J5P3181\_Point\_Cloud.dgn  
Model: Default  
Logical Name:   
Description: Master Model

Orientation:

View	Description
Coincident	Aligned with Master File
Coincident - World	Global Origin aligned with Master File
Geographic - AEC Transform	Calculated Transform, max error 0.004840
Geographic - Reprojected	Reproject reference data to Master GCS
Standard views	
Saved Views (none)	
Named Boundaries (none)	

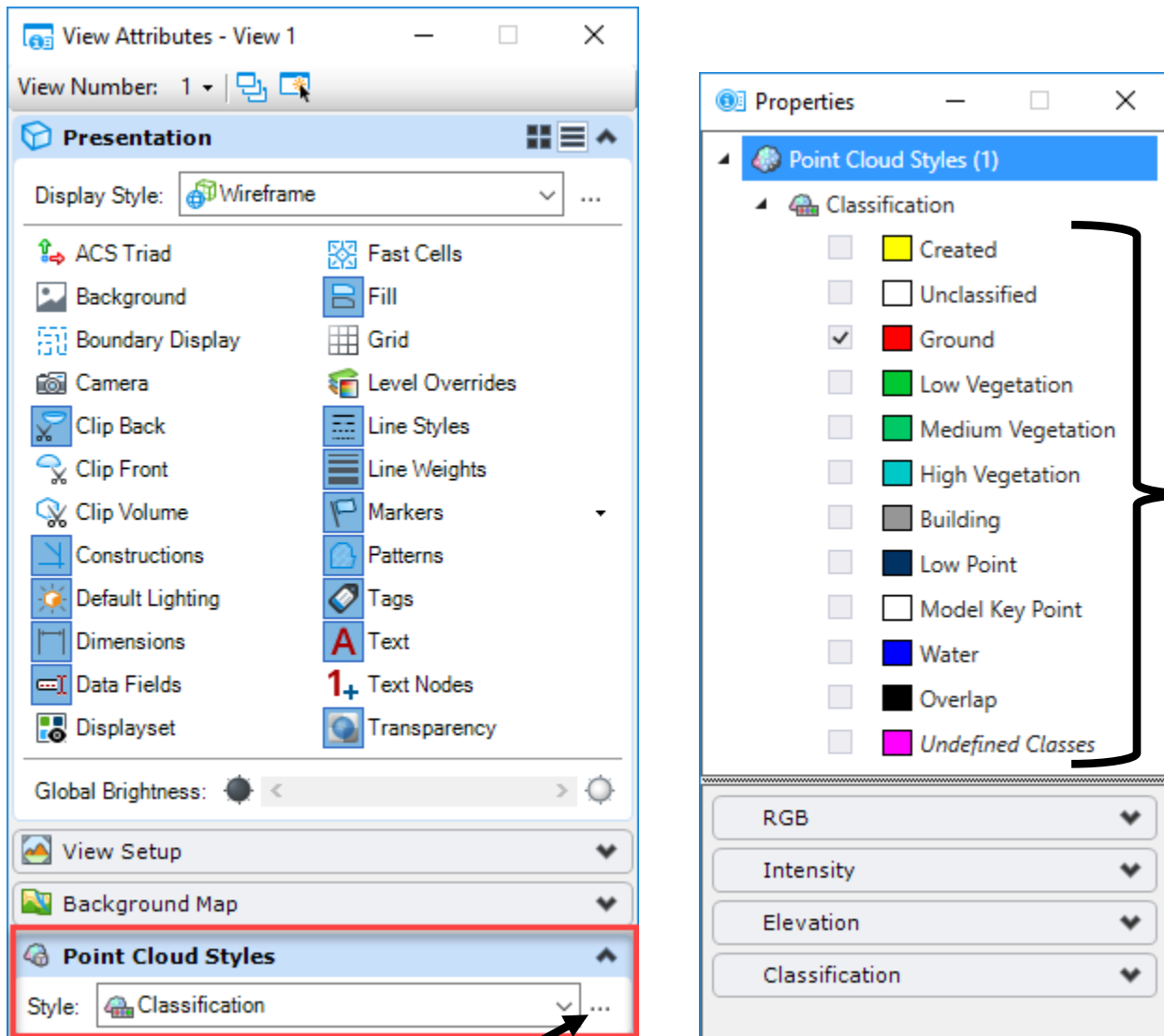
Detail Scale: 1"=50'  
Scale (Master:Ref): 1.000000000 : 1.000000000  
Named Group:   
Revision:   
Level:   
Nested Attachments: Live Nesting Nesting Depth: 0  
Display Overrides: Allow  
New Level Display: Use MS\_REF\_NEWLEVELDISPLAY Cor  
Global LineStyle Scale: Master  
Synchronize View: Volume Only

Toggles

OK Cancel

Once attached select **Fit View**

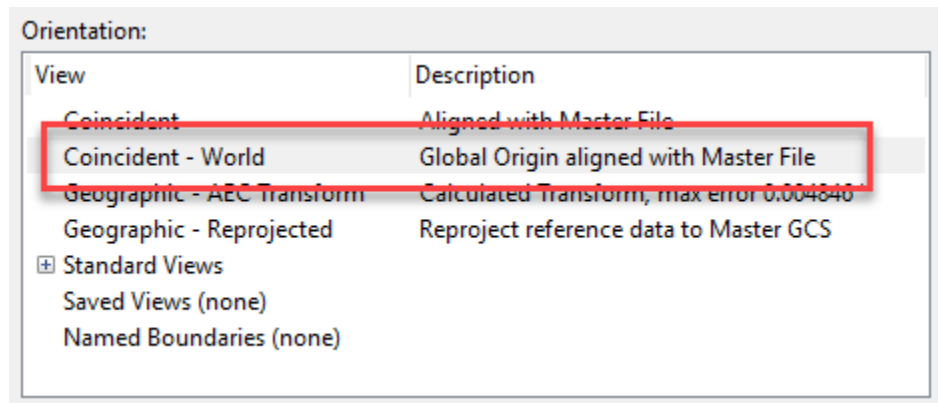
36. Within the **View Attributes** ➔ **Point Cloud Styles**, switch the Style to **Classification**.



37. Selecting the **Styles Properties** button **turn off** all Classifications except for “**Ground**”

38. In the next step we are going to place a fence around the area of our project. We will use this fence to define the limit of our preliminary terrain model.

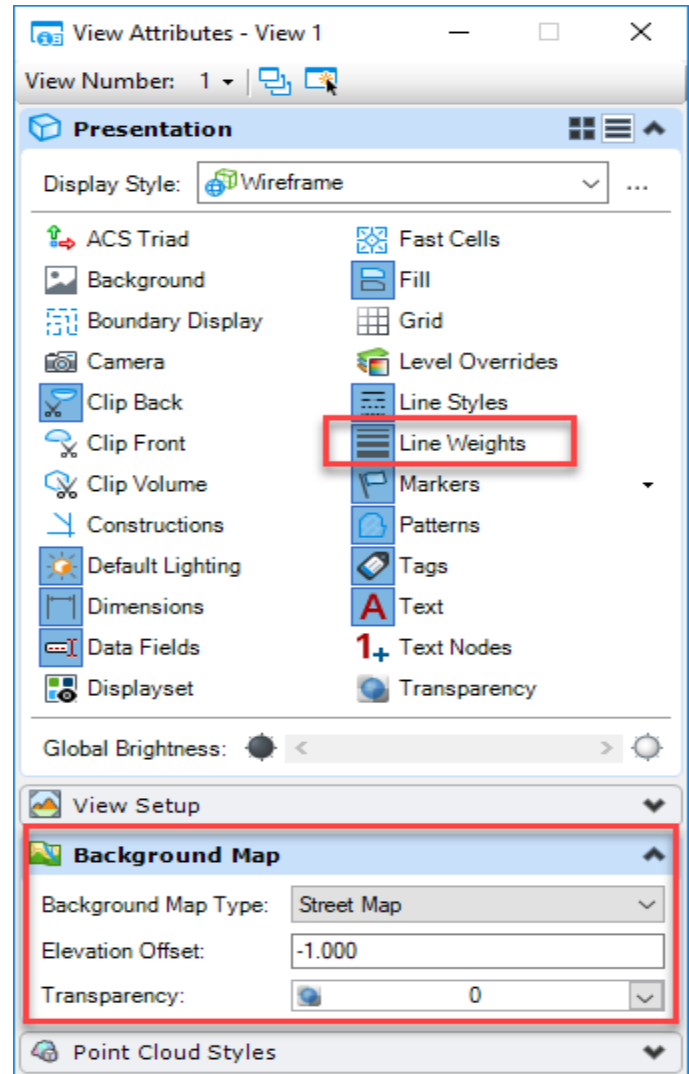
Attach the **J5P3181 Preliminary Project Limits.dgn** file, this file already has our Preliminary Project Limits defined. Because the active and the referenced file have same Geographical Systems, when attaching use the **Attachment Method of Interactive**. Then select **Coincident - World**.





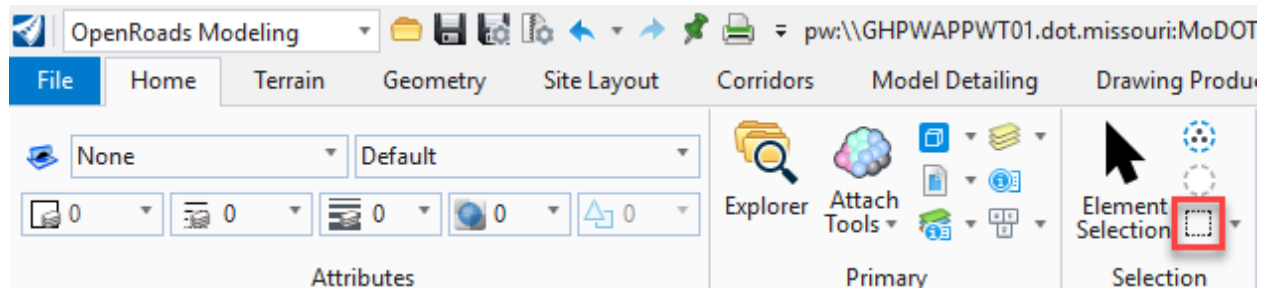
- 39) In the **View Attributes** dialog toggle on **Line Weights** and switch the **Background Map type** to **Street Map**

Review that all files are lining up.

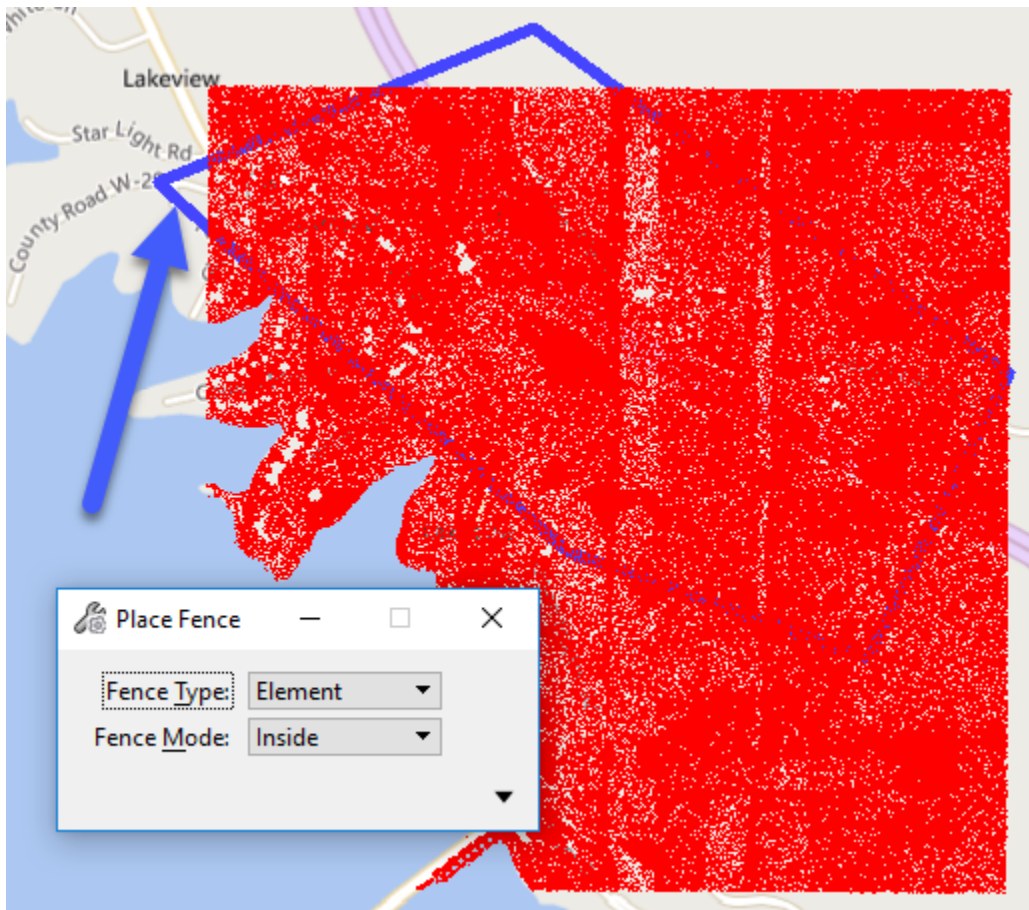


39. After verifying the data is lining up, go into **View Attributes** dialog and within the **Background Map** section select **Background Map Type → None**

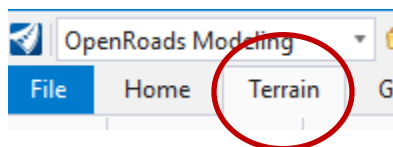
40. From **OpenRoads Modeling > Home Tab > Selection**, select the **Fence** tool.



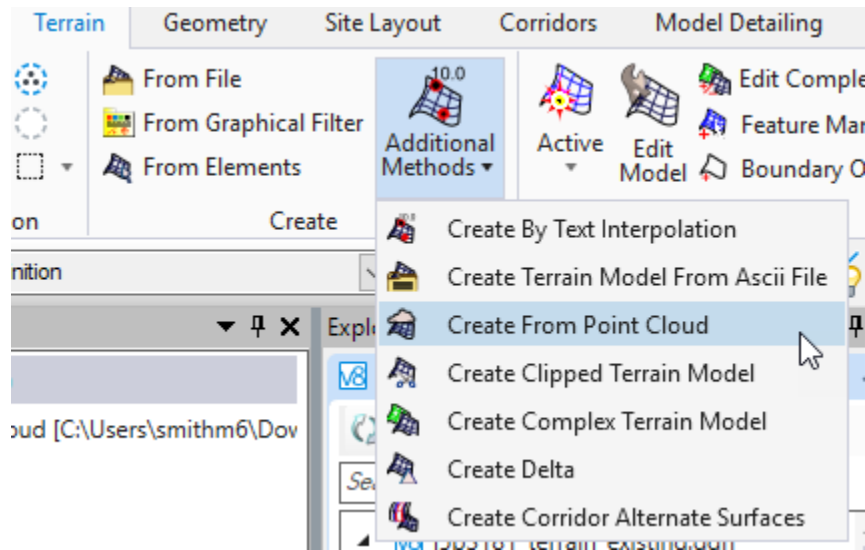
41. For the **Fence Type**, use **Element** (Currently a BUG in the Software, use **Shape** Option) and then select the blue shape.



42. From the **OpenRoads Modeling** workflow, select the **Terrain** Tab



43. From the Create section, choose **Additional Methods** pull-down, and select **Create from Point Cloud**



**Note:** The **Create from Point Cloud** tool will only utilize the visible elements of the Point Cloud to create the Terrain Model.

- 44) Fill out the **Create from Point Cloud** dialog as follows:

Global Options

**Terrain Models**

Append to existing Terrain Model ☐

Terrain Model to append to

**Projection**

Target

TargetDescription

TargetUnits

File Options

**Feature Definition**

Feature Definition

**Filter**

Filter

Z Tolerance

Granularity

Reinsert Points ☒

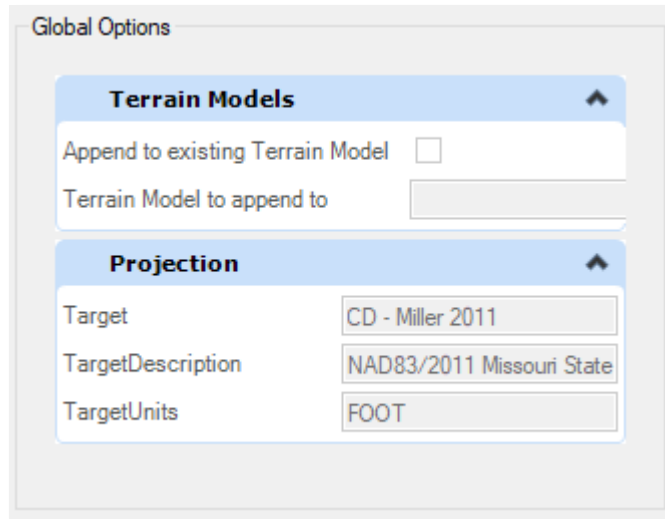
**Triangulation Options**

Edge Method

Include Spot Features ☒

**Create from Point Cloud** dialog option explained below:

**Global Options:** Go with **default** settings below.

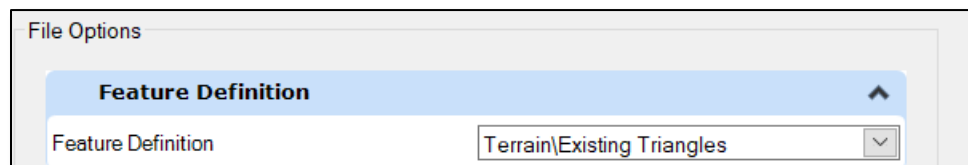


The Global Options dialog box is shown with two sections: Terrain Models and Projection. The Terrain Models section has a checkbox for 'Append to existing Terrain Model' which is unchecked, and a text field for 'Terrain Model to append to' which is empty. The Projection section has three fields: 'Target' set to 'CD - Miller 2011', 'TargetDescription' set to 'NAD83/2011 Missouri State', and 'TargetUnits' set to 'FOOT'.

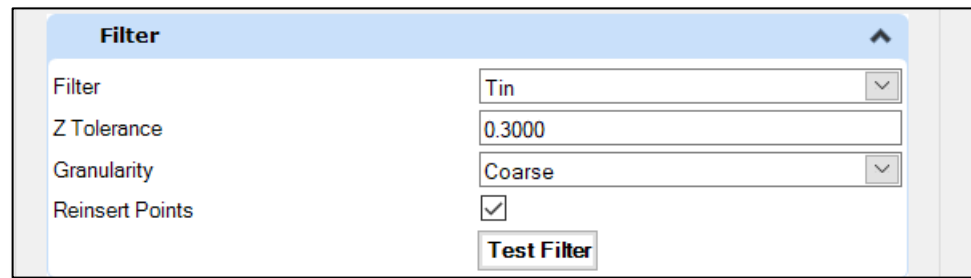
- a) Terrain Models -options if there is already a terrain model in the active \*.dgn file and how to combine with the data to be imported.
- b) Geographical Coordinate Systems (GCS) - If the software can determine the geographical coordinate system of the file to be imported, the fields are populated. If set to Unknown, the software uses the MicroStation design units. This section is used if the resultant terrain model needs to be in a different GCS.

**File Options:**

- a) **Feature Definition:** Existing Triangles



The File Options dialog box is shown with a section titled Feature Definition. It contains a text field for 'Feature Definition' which is set to 'Terrain\Existing Triangles'.

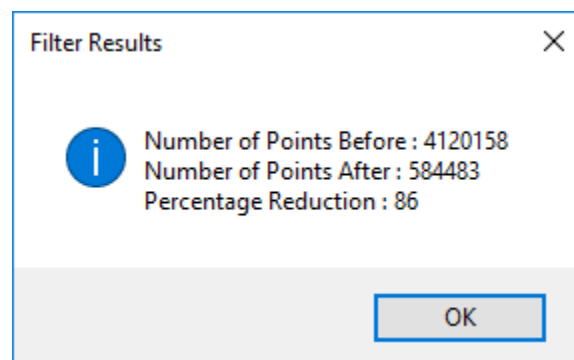
**File Options (Continued):**


Filter	
Filter	Tin
Z Tolerance	0.3000
Granularity	Coarse
Reinsert Points	<input checked="" type="checkbox"/>
<b>Test Filter</b>	

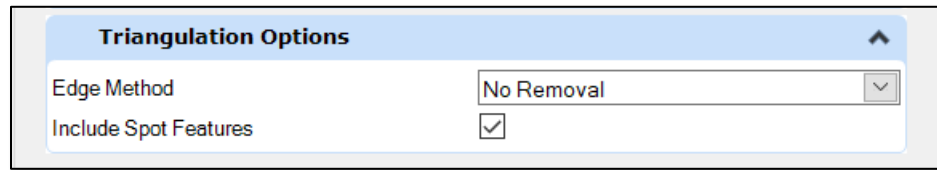
- b) **Filter:** Always use **TIN** Filter option - Much slower than Tile option but gives 90% + reduction rates while maintaining TIN accuracy within desired values.
- c) **Z Tolerance:** Z Tolerance is common to both algorithms and is basically the variation in the Z coordinate that the surface is allowed to move during the filtering process. Typically for the first invocation of the filtering function, the Z tolerance should be set from 0.5 to 1.0 for imperial data sets and from 0.25 to 0.5 for metric data sets. Depending on the outcome and desired result, the Z tolerance can be varied up or down. MoDOT aerial LiDAR flown in 2019 had a vertical tolerance of 0.3ft, for this metric data use **0.3 feet**
- d) **Granularity:** Use **Coarse** which will filter more points with some blurring of ridges and valleys
- e) **Reinsert Points:** Always use Re-Insert Points option - After all the points are filtered out, a 'final' TIN is built from the remaining points. At this point in the process, all the discarded points are draped on this 'final' TIN ... any discarded points that fall outside of the vertical tolerance are added back in and the TIN is rebuilt. This is a safety measure, allowing the re-inserting of points that may have been mistakenly removed.
- f) **Test Filter:** Filter results will vary depending on the size of the fence shape.

Click the **Test Filter** to see how much the number of points will be reduced.

*Filter results will vary depending on the fence shape you drew to create the POD file.*



Filter Results	
	Number of Points Before : 4120158 Number of Points After : 584483 Percentage Reduction : 86
<b>OK</b>	

**Triangular Option:**c) Edge Method: **No Removal**

- 1) We are using the No Removal option because the shape we are using has no external angles less than 180 degrees, thus no unwanted triangles will be created.

d) **Include Spot Features**

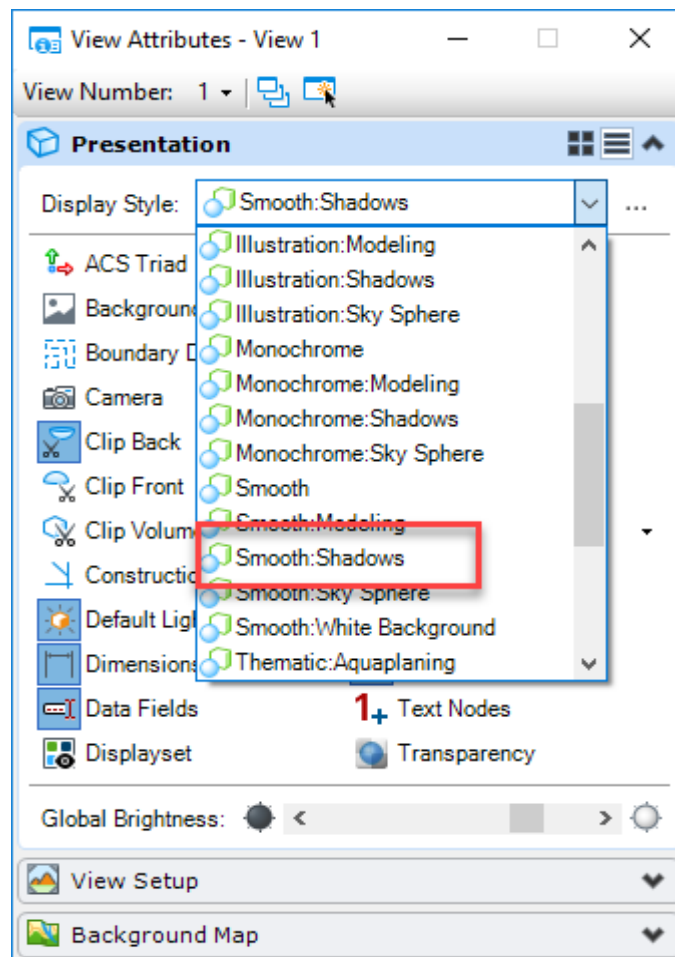
45) Click Import.

46. Detach the **J5P3181\_Point\_Cloud.dgn** and **5P3181\_Preliminary\_Project\_Limits.dgn**

47. If needed, turn off **Line Weights** in **View Attributes** for easier viewing.

48. Review the resulting triangles.

49. Go into **View Attributes** dialog and within the **Display Style** and select **Smooth: Shadows**



52. Rotate the view around using Rotate View and AccuSnap
53. Once finished reviewing the 3D surface, rotate the view to the Top View
54. Go into **View Attributes** dialog and within the **Display Style** and select **Wireframe**
55. Data point on the boundary of the Terrain Model and wait for the context sensitive menu to appear.



Select *Properties*.

56. Set the *Feature Definition* to **Feature Definition > Existing Boundary**
57. Select **File > Update Server Copy**

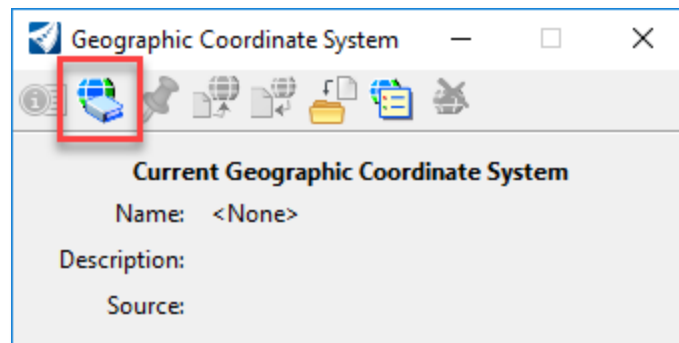
## 1.15 Exercise: Preliminary Surface from the “Topo Import” tool

For preliminary surface data, Bentley has introduced a new tool in Open Roads Designer 2020 Release 2 called Topo Import. Users can simply identify an area in which their project is located and download terrain data from three different sources

- ESRI - Geographic information system company (Best)
- USGS - United States Geological Survey (Better)
- SRTM - Shuttle Radar Topography Mission (Good)

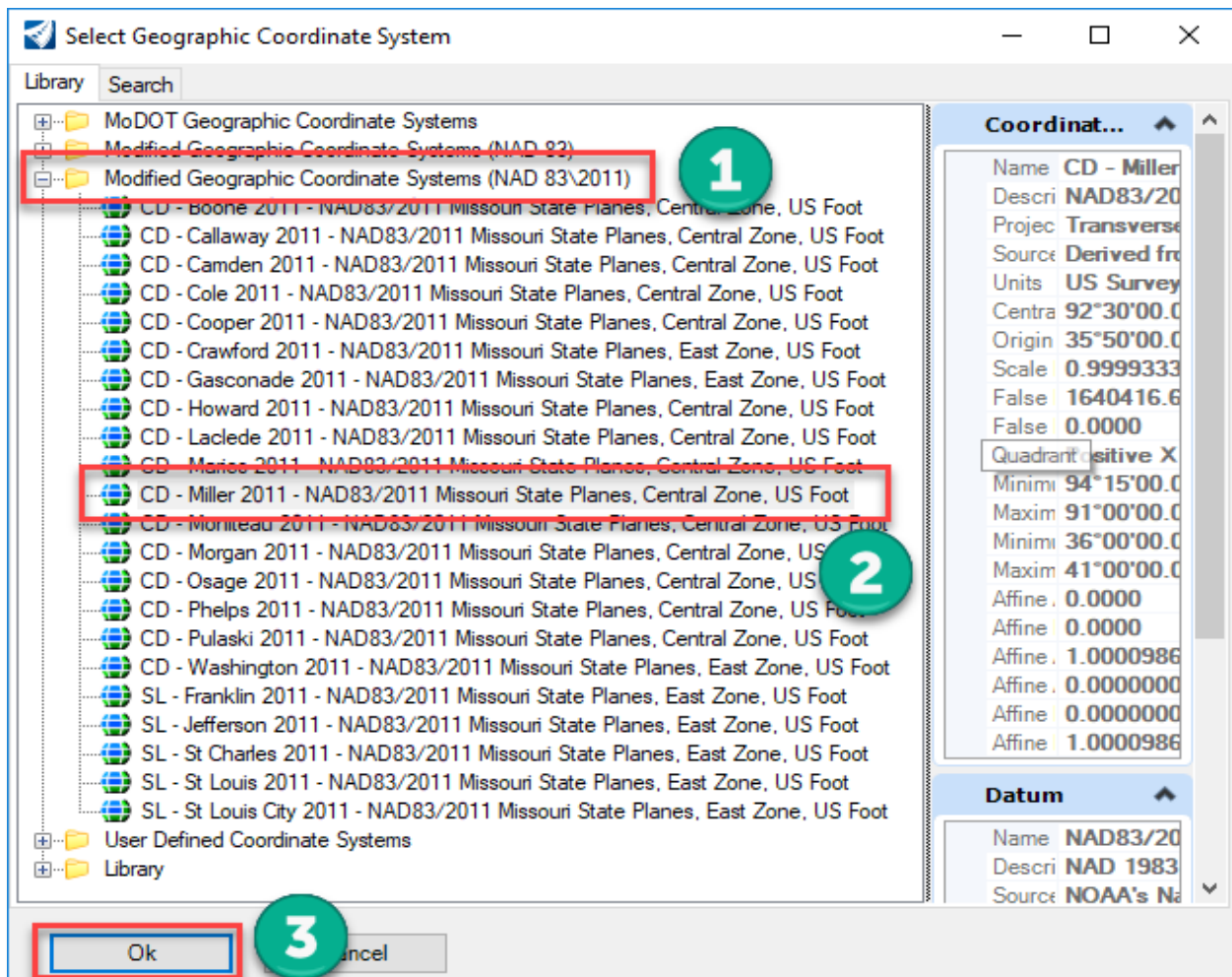
This data will create a terrain surface ready for Users to start designing. Of course, **this not meant to replace field collected data** but when a designer needs a quick start just to help a User understand if this a good location for their project,

1. Create a new file named **J5P3181 Terrain from Topo Import.dgn** (Use a 3D Seed file for terrain models). In this file we will store the projects preliminary LiDAR data.
2. Open the **Coordinate System** tool by selecting the **OpenRoads Modeling Workflow → Utilities Tab → Geographic Section**.
3. Select “**From Library**” icon.

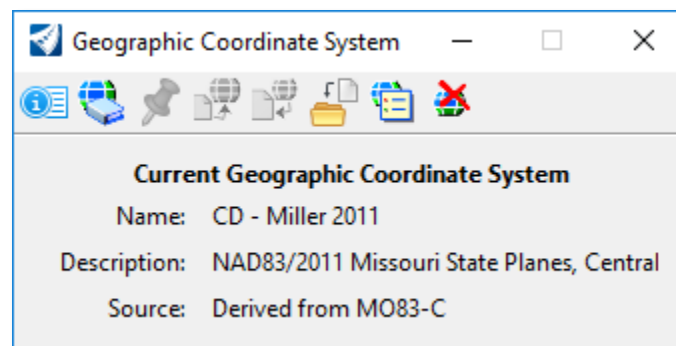




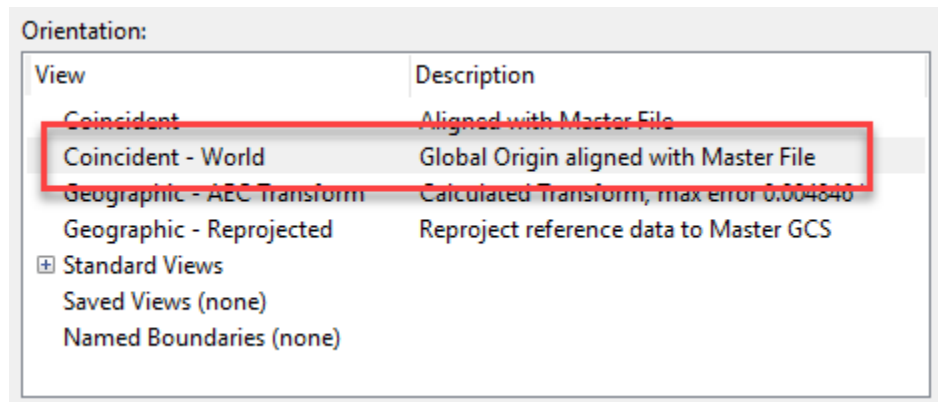
4. From the folder **Modified Geographic Coordinate Systems (NAD 83\2011)**, select:  
**CD - Miller 2011 - NAD83/2011 Missouri State Planes, Central Zone, US Foot**



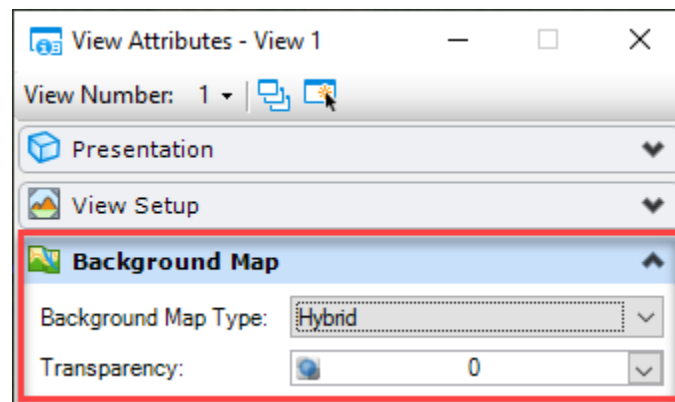
5. After verifying the Current Geographical Coordinate System, close the dialog.



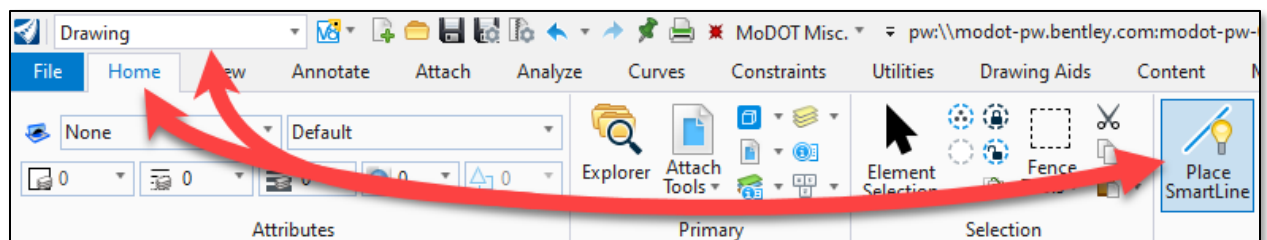
6. Attach the **J5P3181 Preliminary Project Limits.dgn** file, this file already has our Preliminary Project Limits defined. Because the active and the referenced file have same Geographical Systems, when attaching use the **Attachment Method of Interactive**. Then select **Coincident - World**.



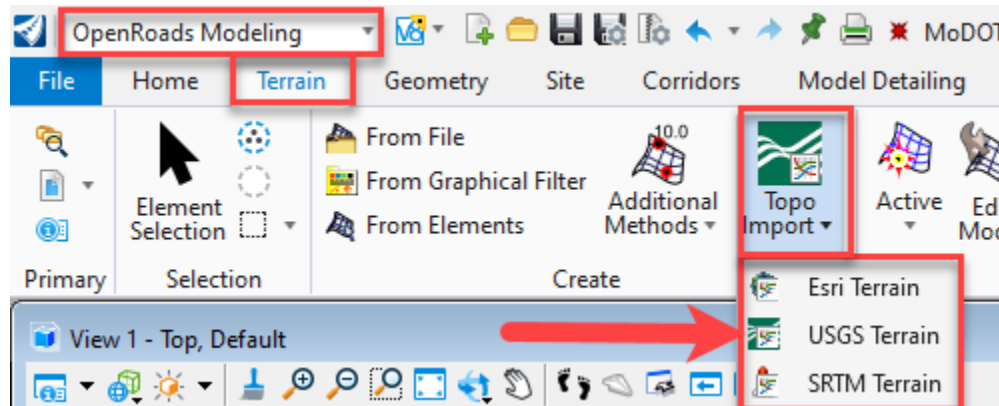
7. Turn on the Background Map to view location of project. Because Geographic Coordinate System has been applied to the drawing, you can access Bing Maps by opening the **View Attributes** dialog and within the **Background Map** section select **Background Map Type → Hybrid**



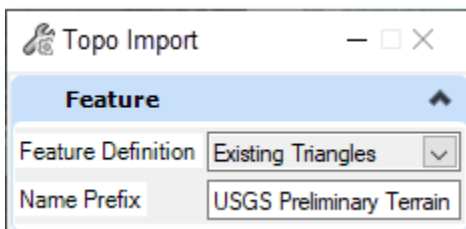
8. Using the **Place Smart-line** tool trace the entire circumference around the Project Limits



9. Next we are going to create a Preliminary Terrain using the **Topo Import** tool located under **Open Road Modeling** workflow → **Terrain** → **Topo Import** → **USGS Terrain**



10. After selecting the **Topo Import** tool, define the following:



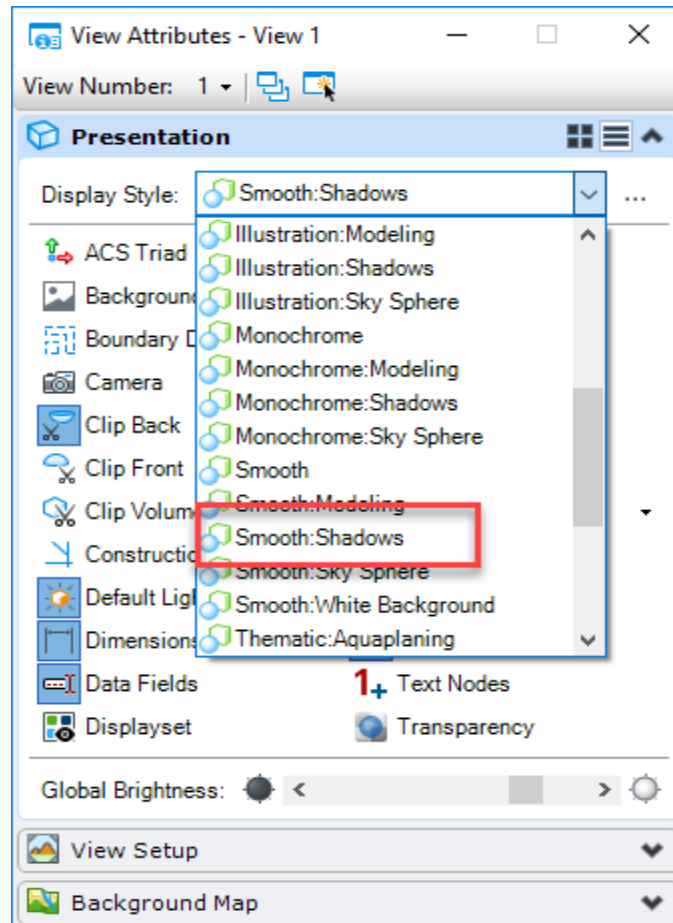
Feature Definition: **Existing Triangles**  
Name Prefix: **USGS Preliminary Terrain**

11. Next, follow the heads up prompts and “**Locate the Element**” and left-click to accept:



12. Turn off the display to the reference file and delete the Project Limits Smart-line.

13. Review the resulting triangles.
14. Go into **View Attributes** dialog and within the **Display Style** and select **Smooth: Shadows**



15. Rotate the view around using Rotate View and AccuSnap.
16. Once finished reviewing the 3D surface, rotate the view to the Top View
17. Go into **View Attributes** dialog and within the **Display Style** and select **Wireframe**
18. Data point on the boundary of the Terrain Model and wait for the context sensitive menu to appear.



Select *Properties*.

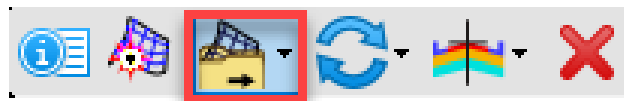
19. Set the *Feature Definition* to **Feature Definition > Existing Boundary**
20. Select **File > Update Server Copy**

## 1.16 Exercise: Export Terrain to LandXML file.

At the end of your project the User will need to export all surfaces (Proposed and Existing) to a LandXML file. These files will be part of the **CADD/BIM Deliverables** provided to Construction.

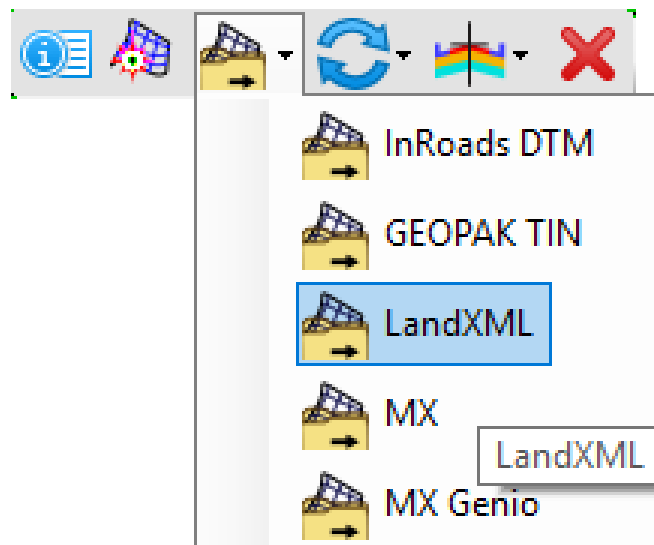
What Is **BIM**?

- A Digital collaboration that transfers and builds on information from design through construction. The goal is to enhance decision making and improve the owner's ability to manage their assets more efficiently and effectively throughout their lifecycle.
  - In short it's a digital information sharing and asset management process.
1. Data point on the boundary of the Terrain Model and wait for the context sensitive menu to appear. Select the **Export Terrain Model** Pull-down.



Export Terrain Model

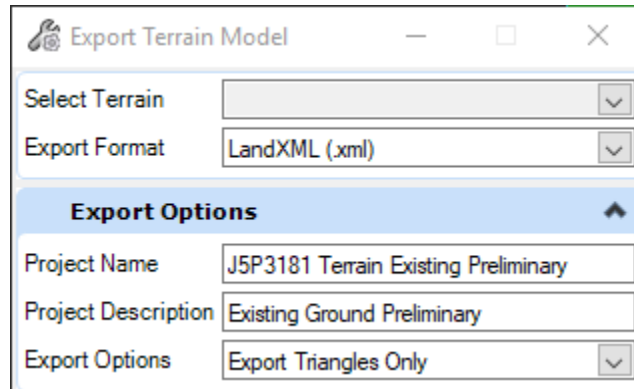
2. In the **Export Terrain Model** Pull-down select **LandXML**



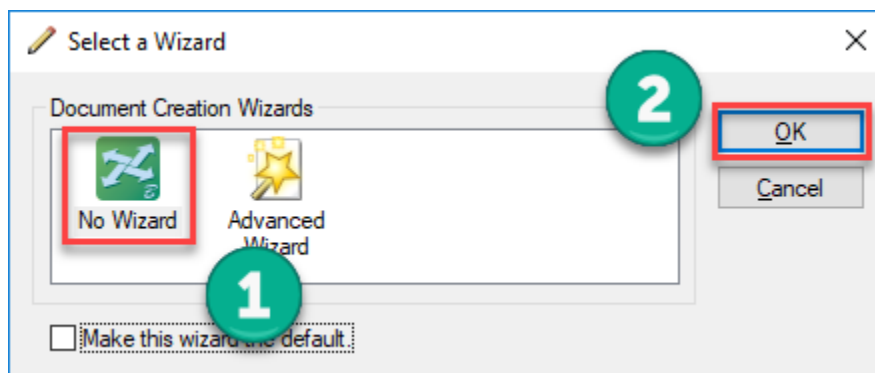
3. Project Name: **J5P3181 Terrain Existing Preliminary**

Project Description: **Existing Ground**

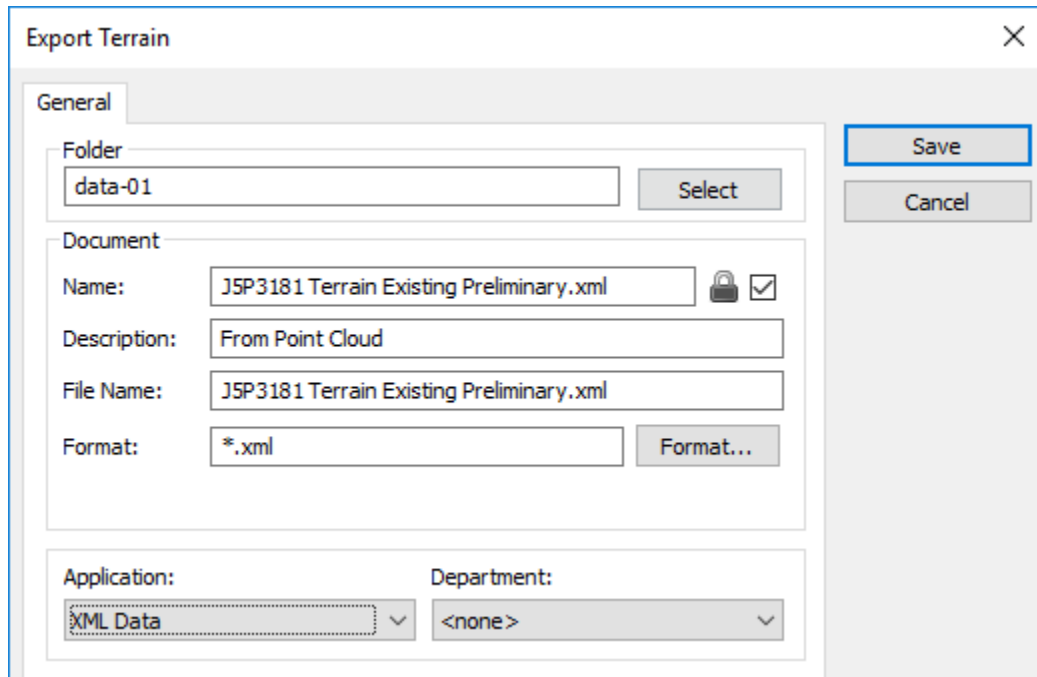
Export Options: **Export Triangles Only**



4. Accept all of the prompts from the dialog by left-clicking on the screen.
5. When saving the file if you get the following dialog select **No Wizard** and then select **OK**.



6. Fill out Export Terrain Dialog as follows:



The image shows the 'Export Terrain' dialog box in OpenRoads Designer. The dialog has a title bar with a close button (X). It contains a 'General' tab. Inside the tab, there are several sections: 'Folder' with a text field containing 'data-01' and a 'Select' button; 'Document' with fields for 'Name' (J5P3181 Terrain Existing Preliminary.xml), 'Description' (From Point Cloud), 'File Name' (J5P3181 Terrain Existing Preliminary.xml), and 'Format' (\*.xml), along with a 'Format...' button; and a section at the bottom with 'Application' (XML Data) and 'Department' (<none>) dropdown menus. On the right side of the dialog, there are 'Save' and 'Cancel' buttons. The 'Save' button is highlighted with a blue border.

Export Terrain

General

Folder: data-01 [Select]

Document

Name: J5P3181 Terrain Existing Preliminary.xml [Lock] [Checkmark]

Description: From Point Cloud

File Name: J5P3181 Terrain Existing Preliminary.xml

Format: \*.xml [Format...]

Application: XML Data [v] Department: <none> [v]

Save [Cancel]

7. Select **File > Update Server Copy**.

---

## Chapter 2

# Horizontal Geometry

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## 2.1 Objectives

- Understand and use Feature Definitions
- Create PI based horizontal geometry using the Complex by PI tool
- Use the OpenRoads Technology heads-up display and element manipulators
- Associate Design Standards with alignment geometry and review feedback when design standards are violated
- Import geometry from native geometry database
- Discuss using manipulators and handlers

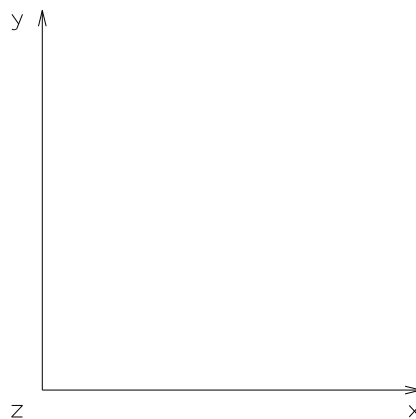
## 2.2 Definitions

Civil Geometry is a dynamic, interactive, rules-based approach to geometry that provides an unprecedented level of associativity by preserving design intent, snaps and Civil AccuDraw input. The results of the tools are intelligent MicroStation graphic elements which can be dynamically edited and associations between elements are automatically updated.

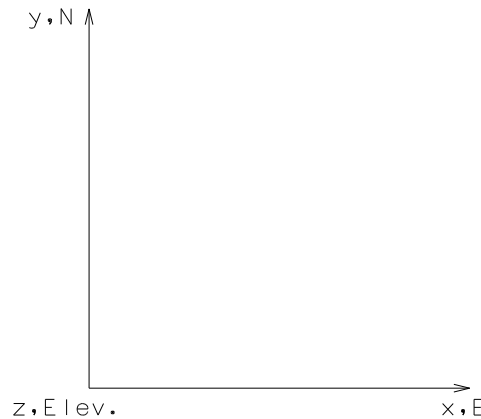
In addition, the result of using the Civil Geometry tools are graphical geometry elements that are stored as MicroStation elements. No external geometry file is required. The MicroStation elements serve as the geometry elements with additional intelligence applied to store the rules and associations.

### 2.2.1 Coordinate System

The Coordinate system is defined with **XYZ** Coordinates. The **X** and **Y** Coordinates define a horizontal plane, while the **Z** Civil defines the vertical dimension. All points in a civil geometry element are defined by at least an **X** coordinate and a **Y** Coordinate. If an elevation is to be stored, the **Z** Coordinate will also be defined.



The **XYZ** Coordinates can also be referred to in **Northing (N)**, **Easting (E)**, and **Elevation (Z)** Coordinates. The **Northing** Civil refers to the **Y** value, the **Easting** Civil refers to the **X** value, and the **Elevation** refers to the **Z** value.

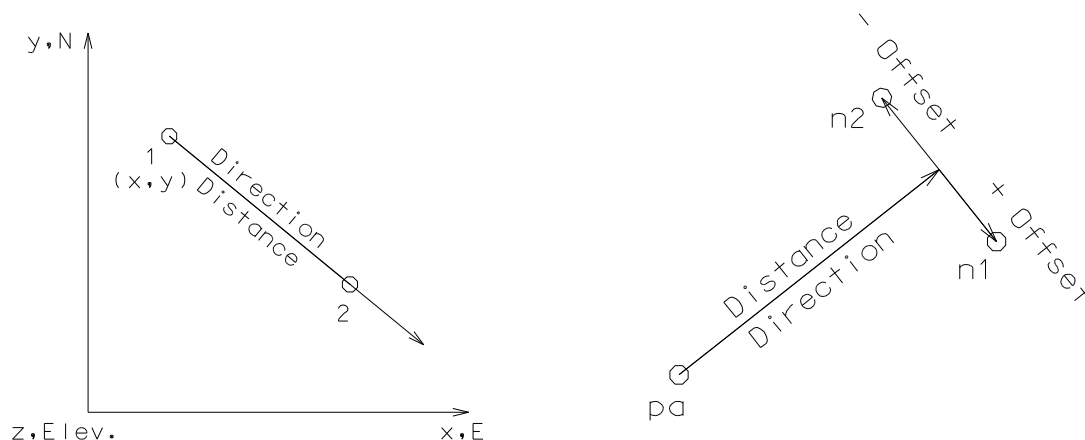


The user must be aware of the Coordinate system the data is in, and the Coordinate system that GEOPAK is using. When referring to the **XYZ** coordinate system, the Coordinates are listed as **(X, Y, Z)**. When referring to the **Northing, Easting, Elevation** coordinate system, the Coordinates are listed as **(N, E, Elev.)**. When translating this to the **XYZ** coordinate system, the Coordinates would be **(Y, X, Z)**.

### 2.2.2 Points

**Points** are defined by a single set of Coordinates. Each **point** will have an X and a Y Coordinate. The point may also have a Z coordinate if an elevation is defined.

**Points** can be stored from a set of Coordinates, or located from other elements. To define a point from another point, a distance and direction need to be defined.



Modifiers can be added to the direction and distance. An offset can be applied. This will locate the point at the specified distance and direction from the starting point, then perpendicular to the specified direction for the specified offset distance. A positive offset will go to the right of the specified direction, and a negative offset will go to the left of the specified direction.

### 2.2.3 Lines and Linear Elements

**Lines** are defined by a location point and a direction, and are infinite in length.

**Civil Geometry Linear Elements** are a portion of a line that is defined by a beginning and an ending point.

### 2.2.4 Curves

**Curves** are a segment of a circular arc. **Curves** can be defined by either the **arc method** (central angle that produces a 100' arc) or **chord definition** (central angle that produces a 100' chord). MoDOT uses the arc definition for all new alignments; however the chord definition has been used in the past, and may still be shown on old plans. This is configured in design file settings > Civil Formatting.

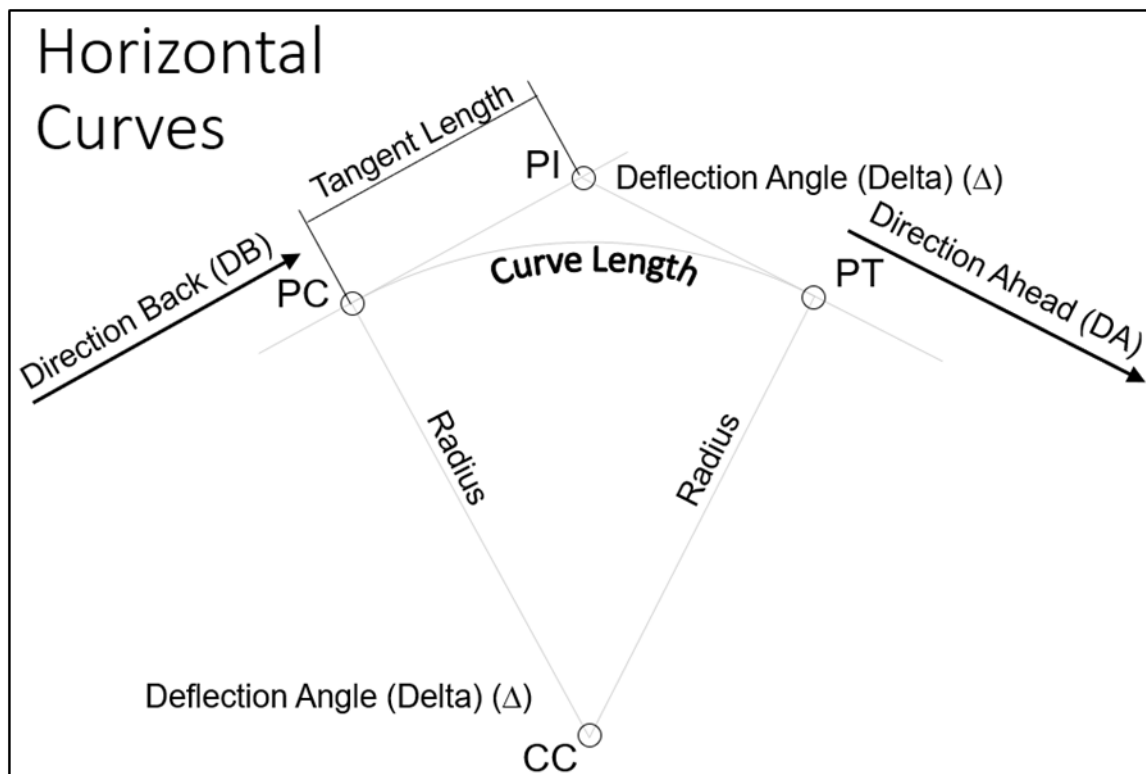
A **curve** has several points associated with it. These points help to define the **curve**, and are stored automatically when the **curve** is stored.

**PC** – Point of Curvature; Beginning of the curve.

**PT** – Point of Tangency; End of the curve.

**PI** – Point of Intersection; Point where the two tangents meet.

**CC** – Circle Center; Point at the center of the circle from which the curve is segmented.



### 2.2.5 Spirals

**Spirals** are a transitional curve. Typically a **spiral** will transition from a tangent (infinite radius) to a specified radius defined by a curve. **Spirals** can also transition between 2 specified radii as defined by 2 curves.

Several points are also stored with a **spiral**. They are as follows:

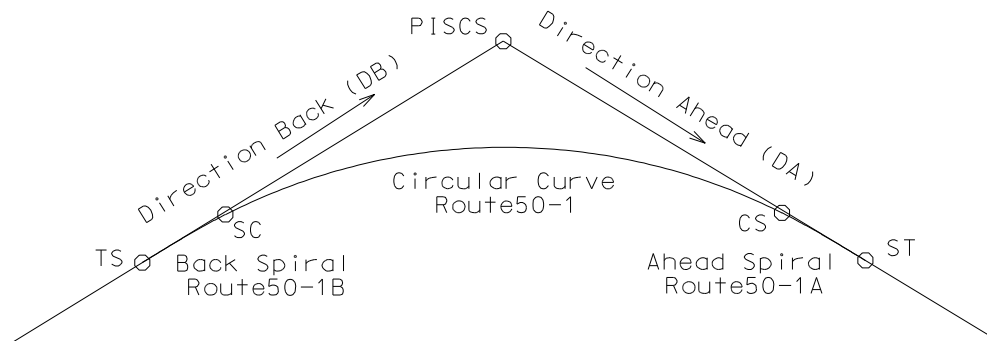
**TS** – Tangent to Spiral Point

**SC** – Spiral to Curve Point

**CS** – Curve to Spiral Point

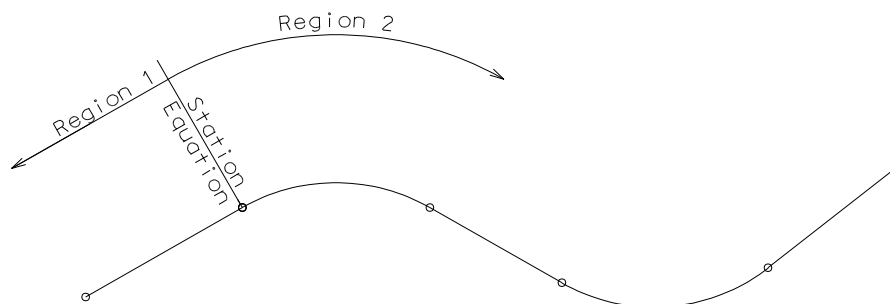
**ST** – Spiral to Tangent Point

**PISCS** – Overall Point of Intersection for the spiral-curve-spiral combination.



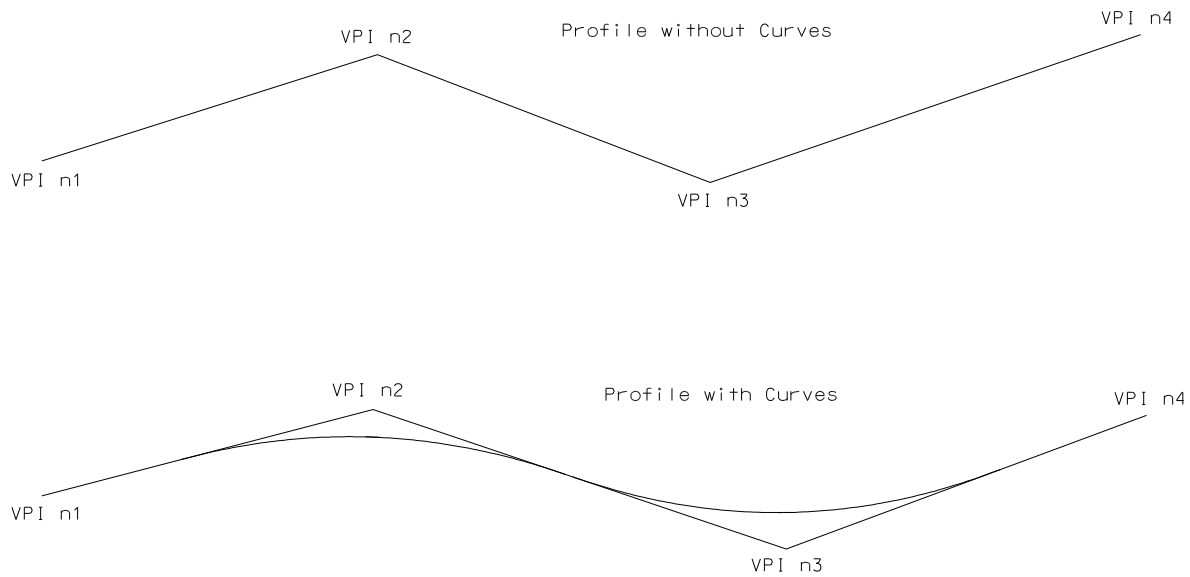
### 2.2.6 Complex Elements

**Complex Elements** are a combination of other elements. They can consist of linear elements, curves, spirals, or other Complex Element. Complex Elements can represent horizontal alignments, or the horizontal location of some element. Complex Elements have *stationing* associated with them. Locations along the Complex Elements can be determined by the stationing. If the stationing is adjusted along the Complex Elements a *station equation* is used. The *stations from the beginning of the Complex Elements to the first station equation* are referred to as **Region 1**. The *stations from the first station equation to the second station equation or the end of the Complex Elements* are referred to as **Region 2**.



### 2.2.7 Profiles

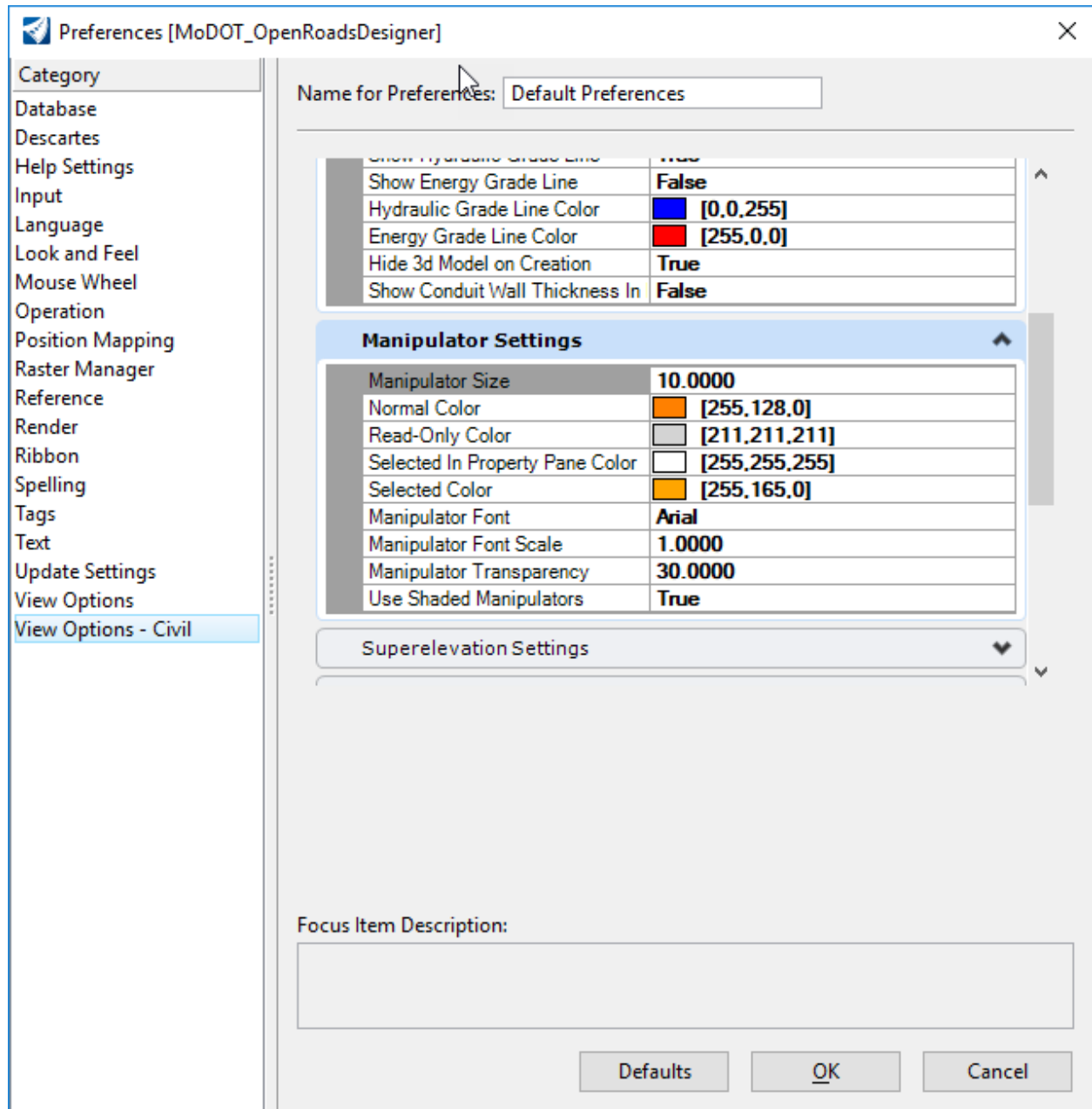
**Profiles** are vertical alignments defined by stations and elevations. They are associated with some horizontal plan element. Profiles can be stored with or without vertical curves. Profiles without curves generally represent the existing ground profile, or a ditch profile. Profiles with vertical curves are generally used as proposed corridor.



## 2.3 Open Roads Preferences

The seed files delivered in the workspace have MoDOT design file preferences configured.

### 2.3.1 Preferences (ORD Updated)



This dialog provides settings for the cursor prompt, manipulators, and various operational toggles. Enable this dialog from the *File > Settings – User > Preferences* menu and selecting the **View Options-Civil** category.

**Manipulator Settings**

These settings allow the user to control the settings and symbology of the civil geometry manipulators and any associated text.

**Superelevation Settings**

When the super elevation components are drawn into the design file, these two options allow the user to specify whether they are to be drawn as Color Shaded Fill or Boundary Only.

**Survey Locator**

This setting is used by the Survey tools to control the display and symbology of the locator.

**Survey Maximum Error Ellipse**

This setting allows the user to specify a major error ellipse value with regard to the standard deviation resulting from a Least Squares Adjustment. Any standard deviation exceeding this limit results in a graphical flag based on this symbology.

**Survey Medium Error Ellipse**

This setting allows the user to specify a medium error ellipse value with regard to the standard deviation resulting from a Least Squares Adjustment. Any standard deviation exceeding this limit results in a graphical flag based on this symbology.

**Survey Minimum Error Ellipse**

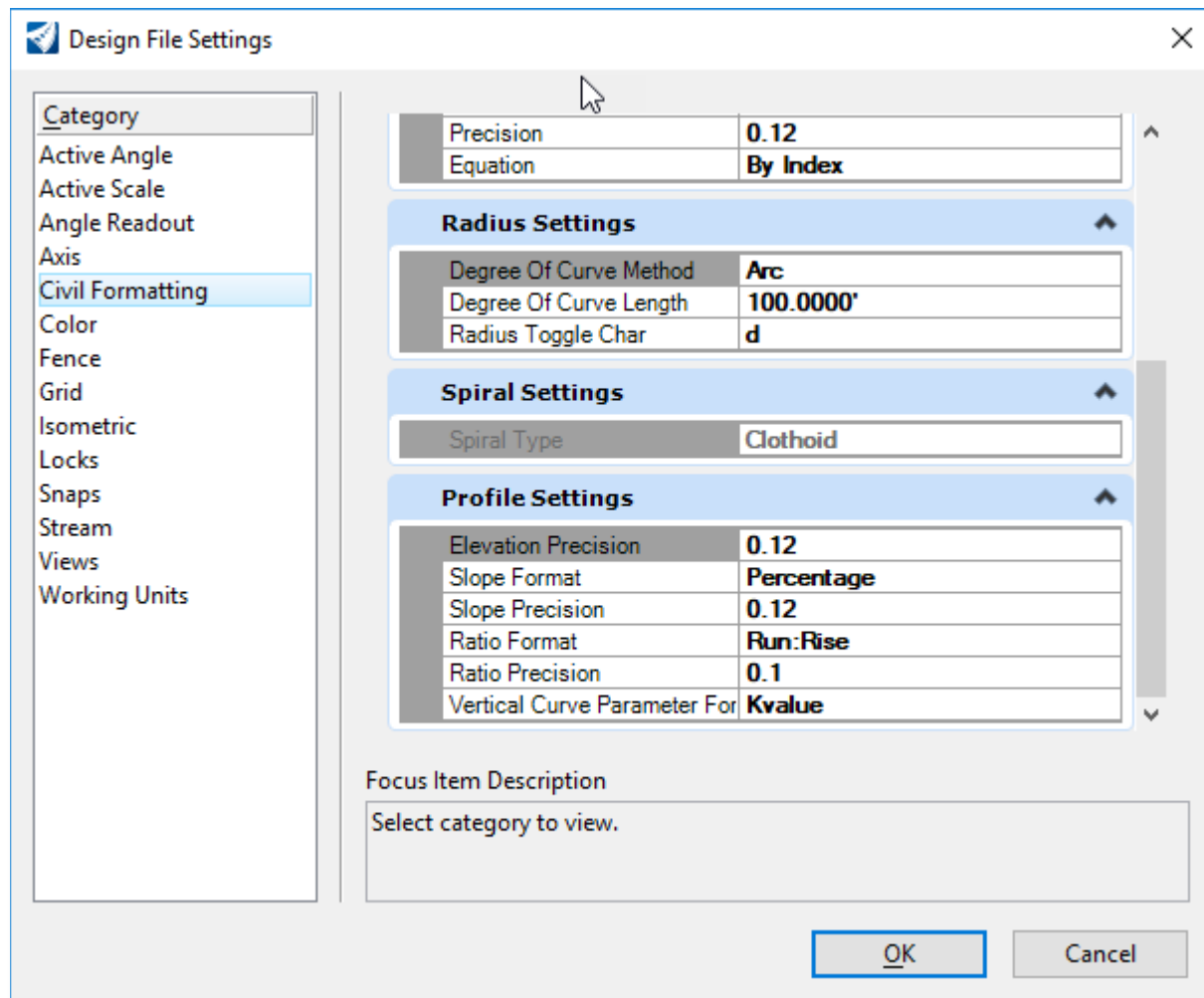
This setting allows the user to specify a minimum error ellipse value with regard to the standard deviation resulting from a Least Squares Adjustment. Any standard deviation exceeding this limit results in a graphical flag based on this symbology.

**Aquaplaning Settings**

This setting allows the user to specify a low risk upper limit up to a high risk upper limit.



## 2.4 Design File Settings



**Design File Settings** dialog provides options for civil settings that control civil annotation within the design file. Enable this dialog from the *File > Settings – File > Design File Settings* menu and selecting the **Civil Formatting** category.

- **Coordinate Settings**

Controls the display and precision of their coordinates within any of the civil dialogs. In addition, this setting also controls how any inputted coordinates are interpreted. For example, if set to “X, Y” then all coordinates are interpreted and displayed as being in the “X, Y” format. If set to “Nothing, Easting” then the same applies.

- **Ratio Settings (Distance: Offset)**

Controls the display and precision of ratios within any of the civil dialogs. In addition, this setting also controls how any inputted ratios are interpreted. For example, if set to “1:D” then all ratios are interpreted and displayed in this format (1:100, 1:50, etcetera). If set to “D:1” then the ratios are similarly displayed and interpreted (5:1, 10:1, etcetera).

- **Station Settings**

Controls the format, delimiter and precision of the station values to be used and displayed in the civil dialogs. **Equation** can be set to:

**By Name** - This is the standard InRoads presentation (A100+00, B105+00, etcetera).

**By Index** - This is the standard GEOPAK presentation (100+00 R 1, 105+00 R 2, etcetera).

- **Radius Settings**

**Degrees of Curve Method** - Two options are available, *Arc* and *Chord*.

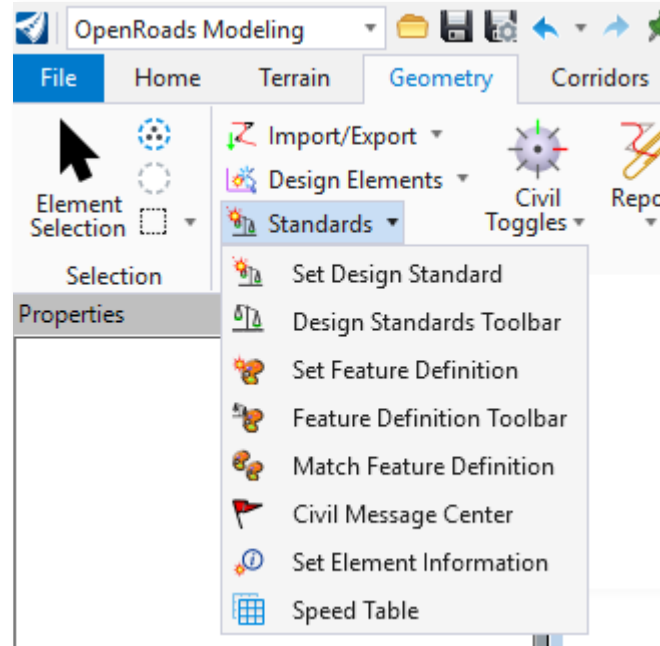
**Degree of Curve Length** - This sets the standard definition of a 1 degree of curve.

**Radius Toggle Char** - This allows the user to specify which character will be used within the civil dialogs to 'toggle' between a radius definition and a degree of curve definition. The letter **d** is the default setting.

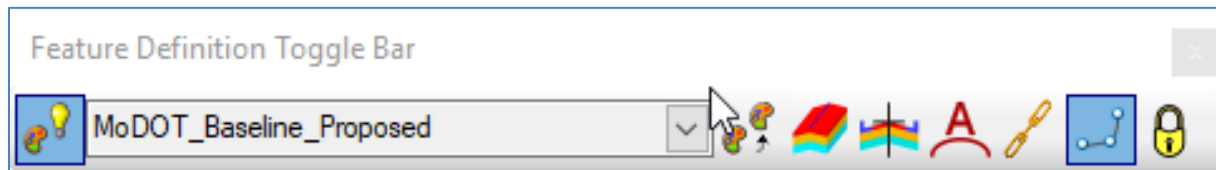
- **Profile Settings** - Controls the precision and display or input formats of slopes and ratios within a profile context. In addition, sets the default Vertical Curve Parameter Format (Radius, K Value or M Value).

## 2.5 Features and Feature Definitions

Access the **Feature Definitions Toggle Bar** from the *Geometry Ribbon in the OpenRoads Modeling Workspace*.



Having the *Definitions Toggle Bar* open and available is very useful for expediting the association of a feature definition to a new geometry feature.

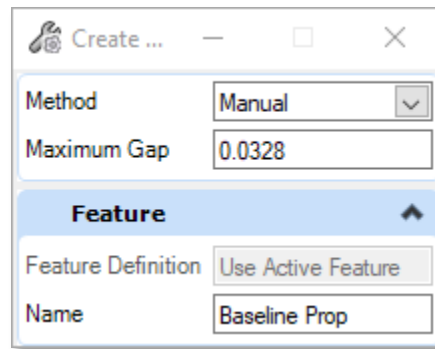


Feature definitions are used to define options when creating features. These are the items which are created in advance, usually used across multiple projects, and define symbology, annotation and quantities. The feature definition is assigned (usually) in the plan model, and optionally in profile and 3D feature definitions.

A Feature is anything that can be seen or located and is a physical part of your design representing a real-world entity. Examples include curb and gutter, pavement, power lines, trees, etc.

A feature's definition is one of its properties. At any given time in the design process, the feature will have horizontal geometry, vertical geometry, 3D geometry or a combination to define its location. Generally, the feature's definition is assigned at time of creation, but can be assigned after-the-fact.

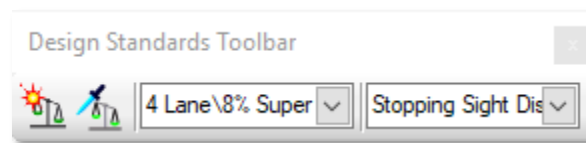
Most Civil tools have entry fields for *Feature Definition* in their dialog as illustrated below.



The rules applied to Feature Definitions are:

- If no Feature Definition is selected, the active MicroStation symbology is used and no feature is defined, but you can define a Name Prefix.
- If a Feature Definition is assigned, a Name Prefix is applied, and the symbology, attributes, and annotation defined in the feature definition are applied to the element.

## 2.6 Design Standards

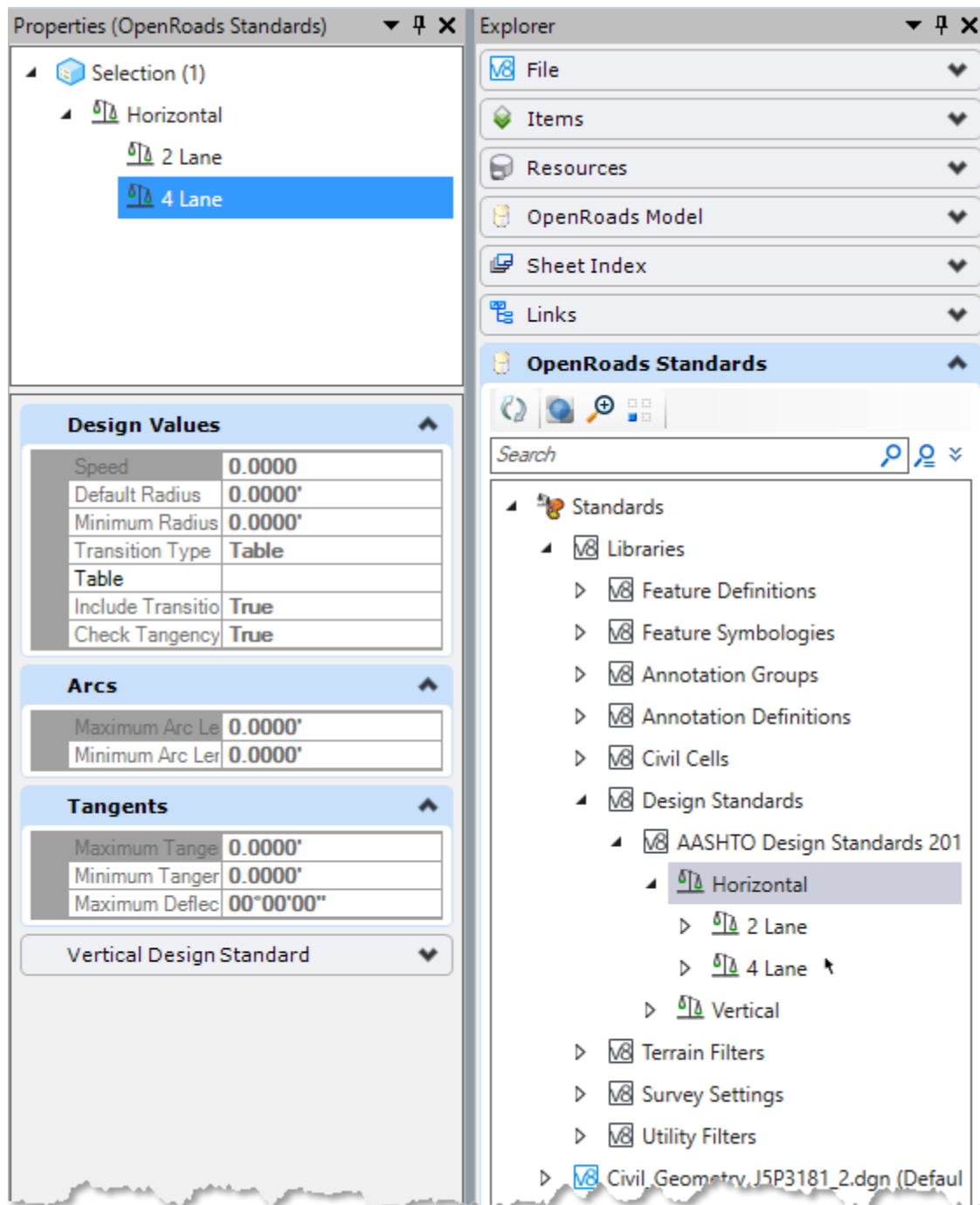


Design standards are used to monitor required curvature and other alignment checks on horizontal Civil Geometry elements and slopes and K values on vertical geometry elements. The standards are stored in a design library (DGNLIB) which can be read-only and stored in a central location for use by all users and referenced by the configuration variable MS\_DGNLIBLIST. A DGNLIB is an empty file (does not contain any MicroStation elements) similar to a seed file where you can set up various MicroStation and Civil resources. An organization can utilize numerous DGNLIBs to facilitate management of their standards. For example, horizontal and vertical standards could be stored in one DGNLIB while other standards would be defined in other DGNLIBs. If utilizing both Metric and English units, you may want a separate DGNLIB for each.

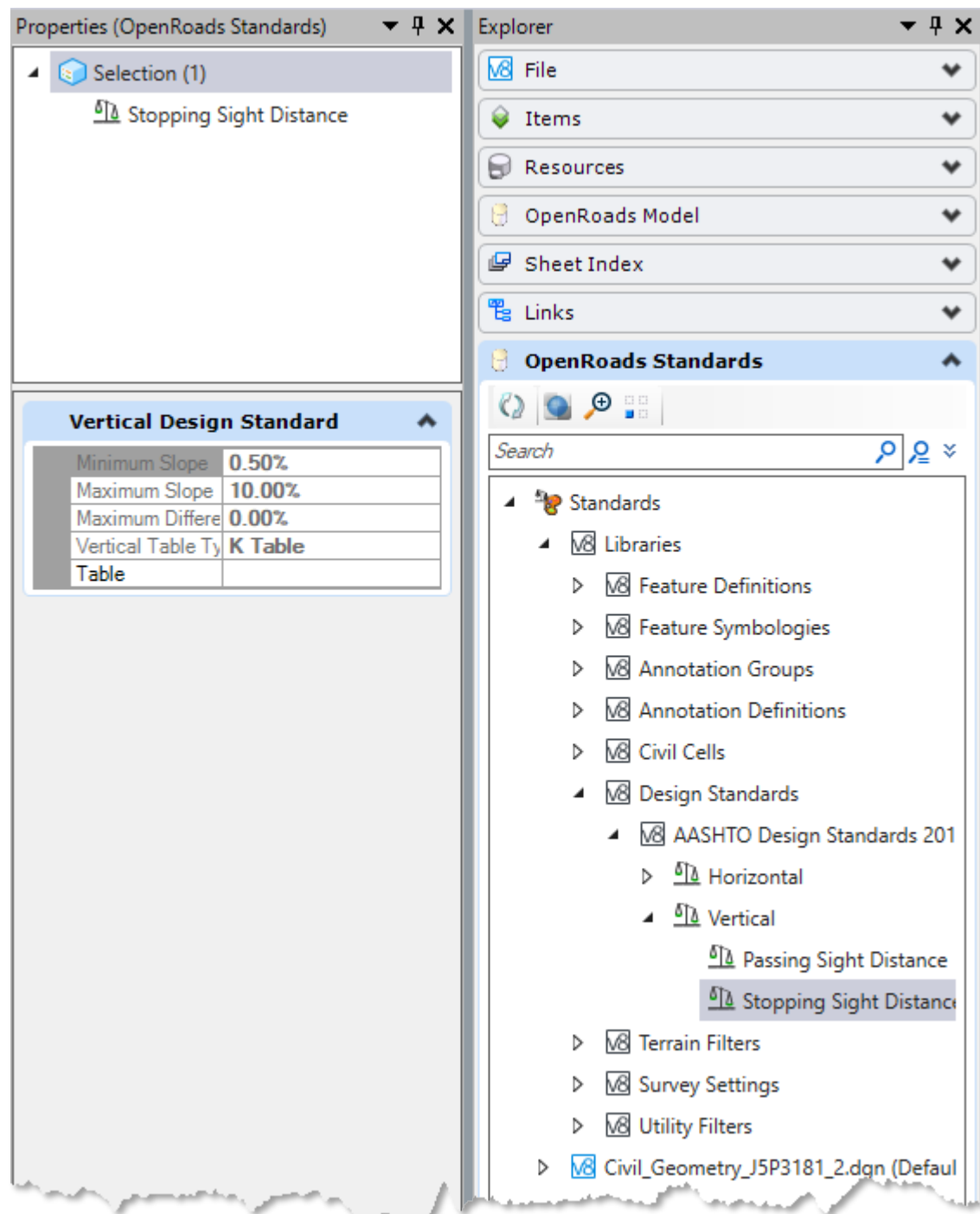
The standards are set up within the Explorer. Note the hierarchy from the Explorer is mirrored in the Design Standards Tool Bar pick lists. The hierarchy is customizable to conform to your organization's standards. As most organizations utilize AASHTO standards, the default libraries included in the installation package are based on the 2001 and 2004 versions of "A Policy on Geometric Design of Highways and Streets."

The Explorer is accessed by selecting The *Drawing Ribbon > Explorer icon*. It is more efficient to complete the vertical standards first, as they are referenced when building the horizontal standards.

Right-click on the individual entry and select Properties from the pop-up menu to review the settings



*Horizontal Design Standards Properties 4 Lane example*



*Vertical Design Standards Properties*

## 2.7 Viewing and Accessing Horizontal and Vertical Standards

The Design Standards branch lists the design standards that are available within the active design model or a DGN library. The Design standards defines Design standards that are used to assist the designer in maintaining required curvature and other checks when performing geometric layouts and are normally based on accepted standards for a geographic area or authority, these standards are stored in DGN libraries.

The properties for each Horizontal standard are:

- **Design Values**

**Speed** - this is the design speed for the standard.

**Default Radius** - this is the radius used to populate commands when initiated.

**Minimum Radius** - this is the minimum radius for the corresponding design speed. Utilizing values lower than this radius will cause a warning to be displayed.

**Transition Type** - can be by Table or Equation.

**Table** - If transition type is table then this is used to populate the table.

**Include Transitions**

**Check Tangency**

- **Arcs**

**Maximum Arc Length**

**Minimum Arc Length**

- **Tangents**

**Maximum Tangent Length**

**Minimum Tangent Length**

**Maximum Deflection** - the maximum angle between the lines where two tangents join without a curve.

The properties for each Vertical standard are:

- **Vertical Design Standards**

**Minimum slope**

**Maximum slope**

**Maximum difference in grade**

**Vertical Table Type**

**Table**

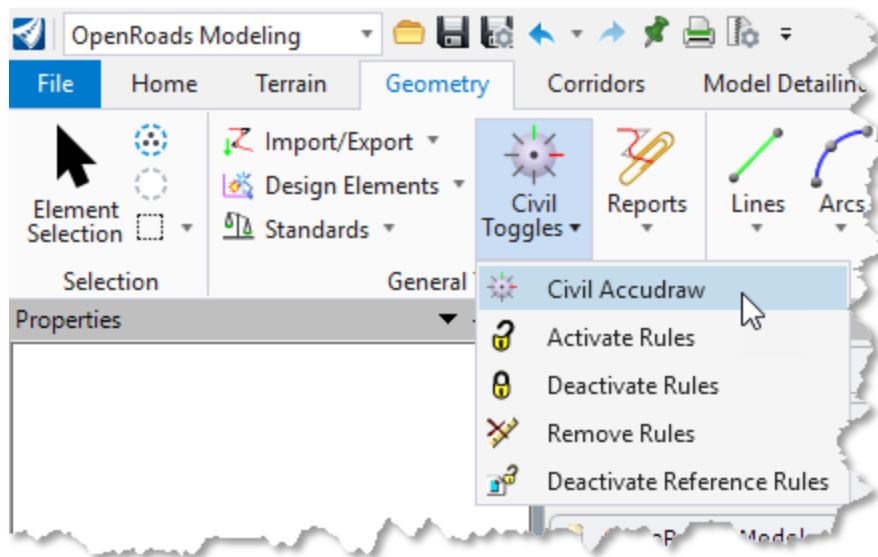
## 2.8 Civil AccuDraw

**Civil AccuDraw** performs many of the same functions as *MicroStation AccuDraw* but has greatly expanded capabilities for the civil designer. It allows the user to define a point location at any stage of any placement tool (MicroStation or Open Roads) and accept input that results in more sophisticated point locations.



### Accessing Civil AccuDraw

Civil AccuDraw can be accessed from **Geometry Ribbon> Civil Toggle pull down > Civil AccuDraw**



### Benefits

There are many benefits in using Civil AccuDraw.

1. It extends the drafting power of MicroStation by providing Civil point location methodologies in all the MicroStation and Civil commands. For example, a user will be able to place a cell at an offset using the normal place cell but invoking Civil AccuDraw to enter the station and offset.
2. It will eliminate the need to create temporary construction geometries just to perform more complex point locations. For example, to place a line at a given distance from 2 points a user would need to draw 2 circles at each point with the desired offset as the radius of each station and then place a line tangent to these circles, and finally delete the unwanted circles. Civil AccuDraw provides a Distance from Point snap where the point can be identified, the offset entered, and the data point applied to the construction.



3. When used in conjunction with the Civil Geometry commands the resultant elements are constrained by rules set by the selection of the Civil AccuDraw ordinates.
4. The Civil Geometry heads up display options are enhanced when Civil AccuDraw is active and the options available are determined by the method selected.

#### Use Tips with the Geometry commands

1. Selecting the Tab key while in an entry field will change focus.
2. Selecting Enter will set the value in the field and lock it
3. Selecting the End key will unlock the field
4. Selecting the left or right arrow key will move through the favorite options.
5. Selecting the down key will bring up the associated command entry dialog in addition to the heads up display.

### 2.8.2 Civil AccuDraw Overview



Toggle Civil AccuDraw on/off.

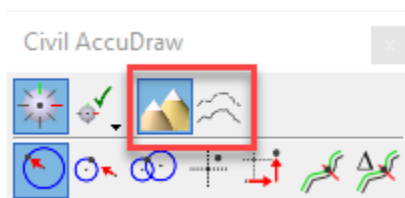


Drop down list of various tools including Civil AccuDraw settings and common shortcuts. This drop-down is also available by pressing space bar when any Civil AccuDraw field has focus.

These are the ordinate systems delivered in a default installation.

- Distance – Direction
- Distance – Direction Unlinked with two origin points
- Distance – Distance
- X – Y
- Dx – Dy
- Station – Offset
- DeltaStation-Offset

In a three-dimensional design file there are two additional icons



Sets the elevation ordinate



ProfileOffset

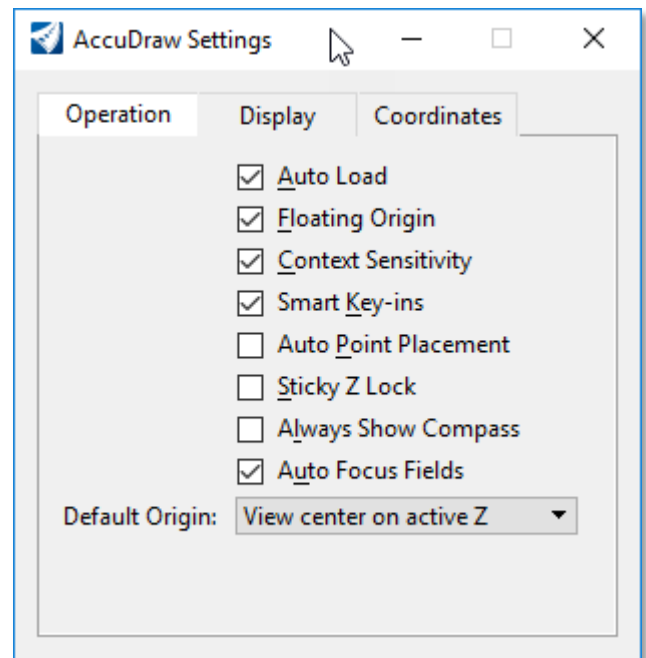
**Some differences between the MicroStation AccuDraw tool and the Civil AccuDraw tool:**

- Civil AccuDraw compass will always point north regardless of view rotation.
- Civil AccuDraw uses a heads-up on-screen prompt at the cursor to allow precise key-in of distance and direction. A fixed dialog box becomes available when the down arrow is selected.
- The Civil AccuDraw compass will always be circular. MicroStation AccuDraw changes the compass to rectangular for Cartesian ordinate systems.

**Civil AccuDraw Settings**

The **Operation** tab is like that of MicroStation AccuDraw.

- Operations of the same name have the same function in both AccuDraws.
- Selection or de-selection in one AccuDraw does not affect the selection in the other AccuDraw.
- Selecting the Show AccuDraw Dialog will result in the dialog and the heads up display both being available to the user during element placement.

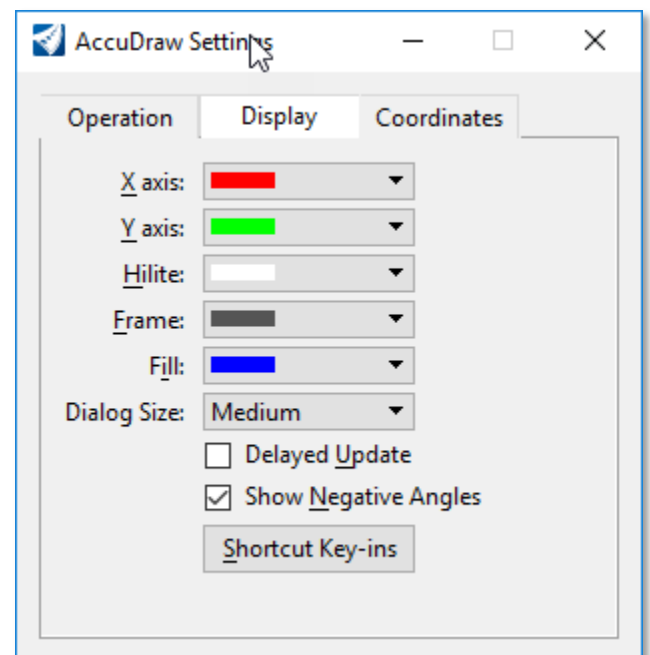


The **Display** tab contains settings for:

- Color of compass axis
- Points** configures the number of points in the compass circle
- Color of the constraint lines
- Whether you want to see the constraint lines and color of the constraint lines

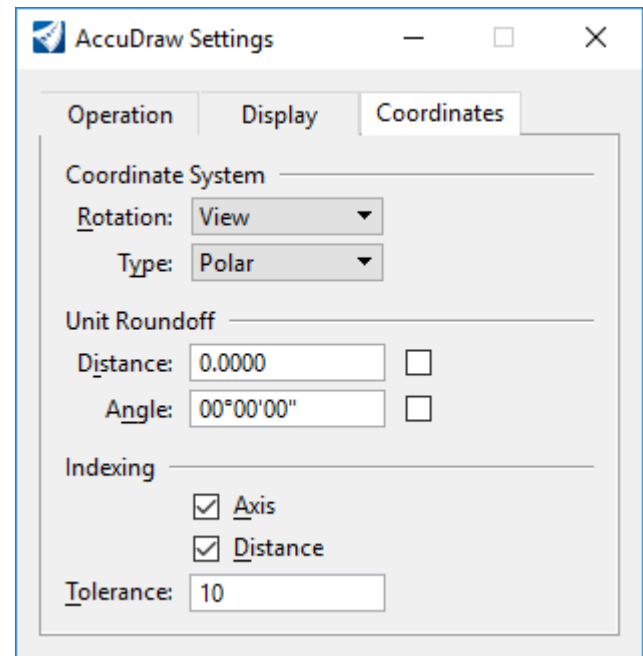
The shortcut button brings up the same shortcut list as used by MicroStation AccuDraw.

Both MicroStation AccuDraw and Civil AccuDraw access the same shortcut.txt file.

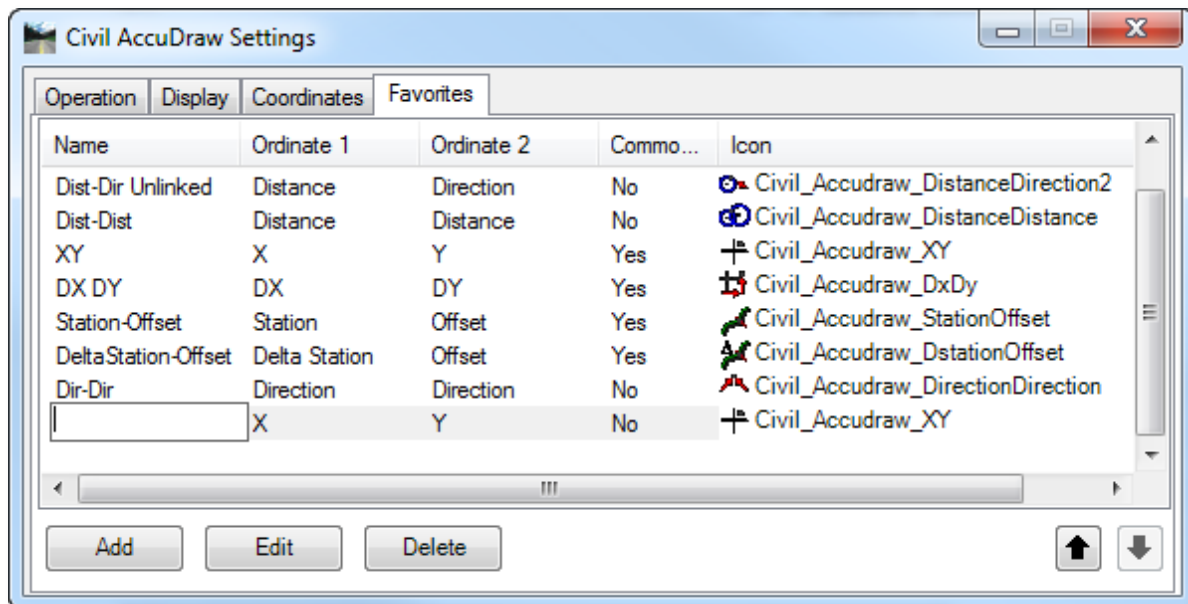


The **Coordinates** tab contains the same round off and indexing settings as MicroStation AccuDraw and function the same way.

- Civil AccuDraw has additional settings that are provided to allow the round-off of **station** and **offset** values.
- The numbers must be changed to values other than zero to be accepted.



The **Favorites** tab allows for the configuration of the most commonly used ordinate systems. It is one of the primary differentiators between Civil AccuDraw from MicroStation AccuDraw. The favorite selected determines what input fields are available during the placement of an element.



**Ordinate 1 and Ordinate 2** are the measurement methods used in determination of the coordinates.

**Common Origin** has a *Yes/No* option.

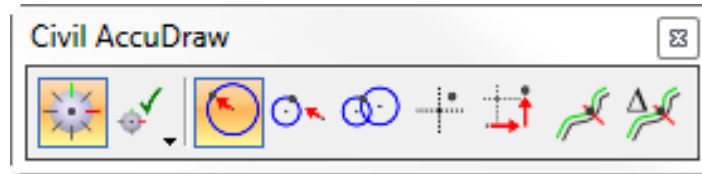
- **Yes** indicates that both ordinate measurements come from the same origin location.
- **No** indicates each ordinate has a different location.

To add a new favorite:

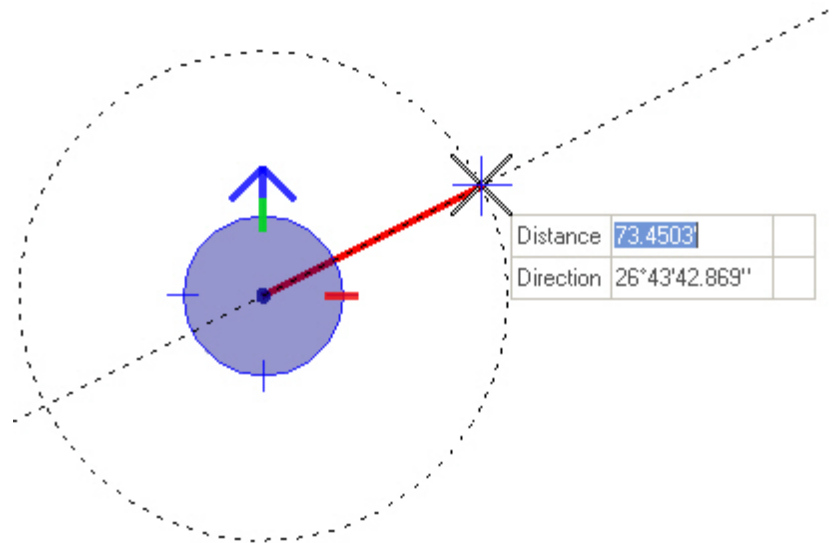
1. Select Add
2. Key in the Name
3. Select the Ordinates.
4. Select whether the ordinates share a common origin.


### 2.8.3 Simple Linked Favorite Civil AccuDraw Workflow

A **Linked** favorite has two ordinates or measurement methods that share the **same Point of Beginning (POB) or Origin**.



1. Ensure *Civil AccuDraw* is active. If it is active then the first icon in the toolbox will have an orange background.
2. Set the active symbology or active feature. If no feature is assigned, the element will use *Default*.
3. Start the tool of interest and place the first point. This can be by XY= key-in or a data point. If the Civil AccuDraw XY favorite is active the X and Y fields will be available in the heads up display.

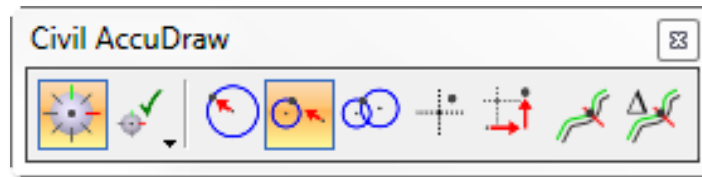



4.  Select the **Dist-Dir** favorite. Entries in the distance and direction fields present a dynamic circle and line feedback for the constraints.
5. Key in a distance and then press the **Enter** key to lock the distance.
6. As the cursor moves over one of the compass points (north, south, east or west) there is a color change feedback indicating a compass direction locks.
7. To unlock a value use the **End** key.

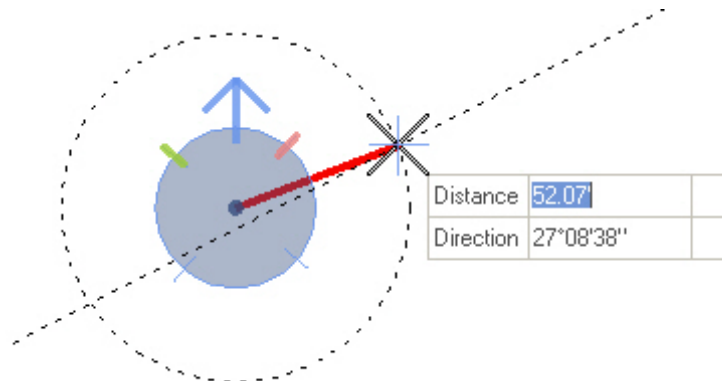
8. **Data Point** to accept the value.

### 2.8.4 Simple Un-Linked Favorite Civil AccuDraw Workflow

An **Un-Linked** favorite has two ordinates or measurement methods each with a **unique Point of Beginning (POB) or Origin**.

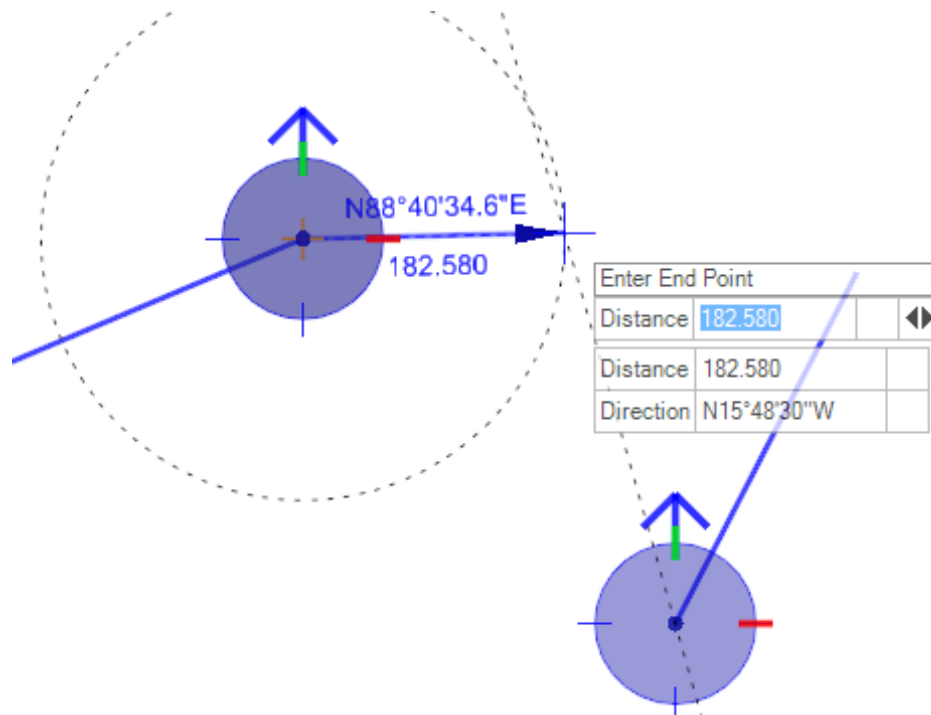


1. Ensure Civil AccuDraw is active. If it is active then the first icon in the toolbox will have an orange background.
2. Select an element placement command.
3. Set the active symbology or active feature.
4. Start the tool of interest for example *Distance-Direction*. 
5. Place the first point. This can be by XY= key-in or a data point. If the Civil AccuDraw XY favorite is active the X and Y fields will be available on the Heads Up Display.
6. With the focus in the distance field press the letter **(O)** on keyboard. Then left click on the position to set the origin for measuring distance. This could be a graphical element, a terrain Model element, a Civil Geometry Element or a data point.



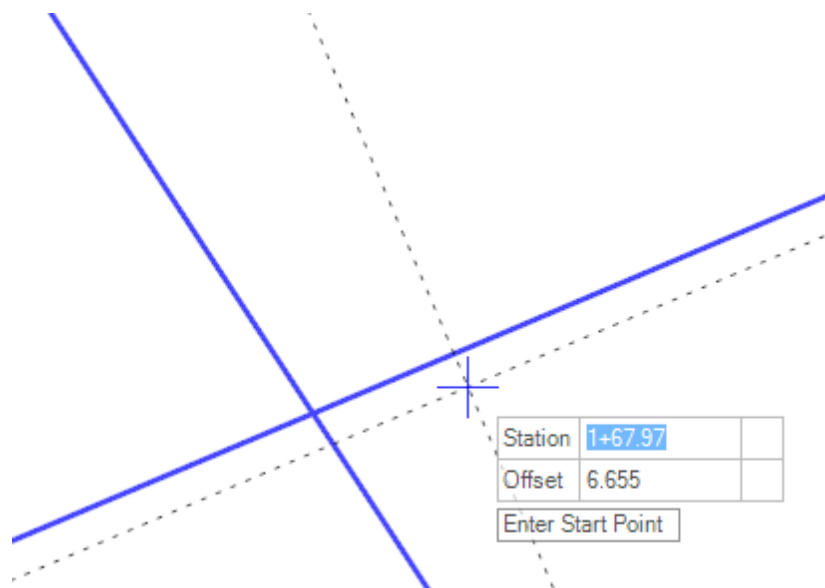
7. The origin shortcut **(O)** in Civil AccuDraw waits for a data point before setting the origin. This is to provide capability for the (O) shortcut to also choose the baseline for station offset ordinates.

8. Select the **Tab** key to move focus to the direction field, press **(O)** again, identify the location for the second ordinate point of beginning, and click a second data point to set the direction origin. This results in two independent compasses to measure the distance and direction. Both distance and direction can be locked as needed.



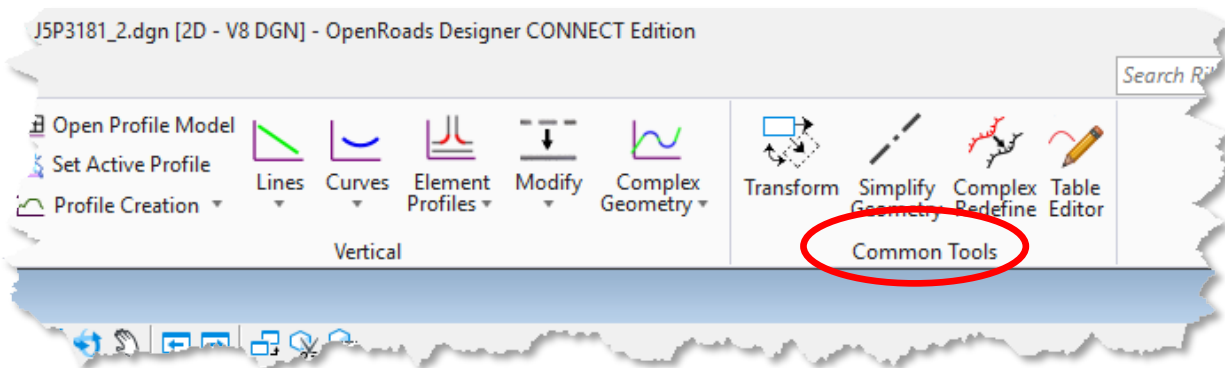
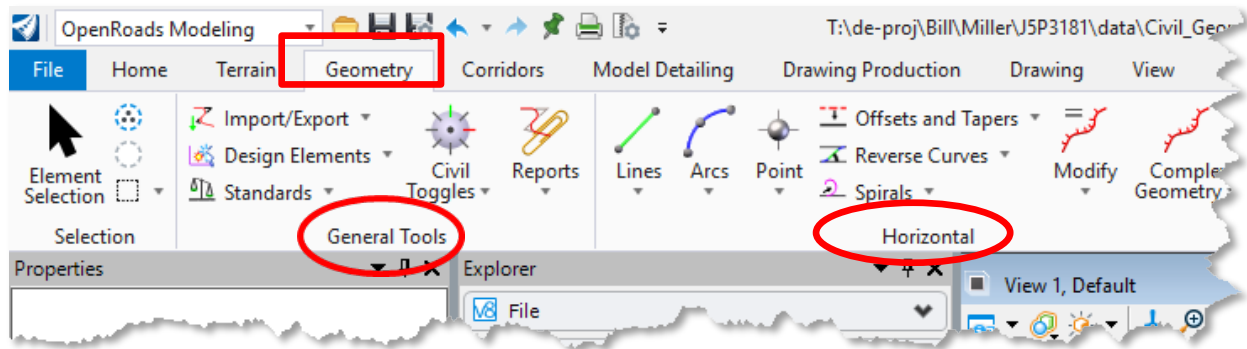
### 2.8.5 Station-Offset Linked Favorite

The **Station and Offset** linked favorite pulls the station and offset from the element identified after the origin shortcut (O) is entered. Selecting Tab will lock the value.



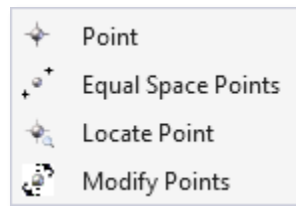
## 2.9 Civil Horizontal Geometry Commands





Civil Horizontal Geometry tools can be accessed by selecting the **Geometry Ribbon** from the *OpenRoads Modeling* workspace



### 2.9.1 Point Geometry

There are four point options; *Place Point*, *Equal Space Points*, *Locate Point*, and *Modify Point*.



 Point	Constructs a civil point element.
 Equal Space Points	Inserts a specified number of points, points at a defined interval, or a combination of both into the View
 Locate Point	Store a new point based off three existing points using one of the three methods, Angle Resection, Points of Intersection, and Points on Curve.
 Modify Point	Modify the elevation and/or Rotation of an existing Point



## Locate Point (Methods)

**Locate Point**

Method: Points Of Intersection

Point 1:

Point 2:

Point 3:

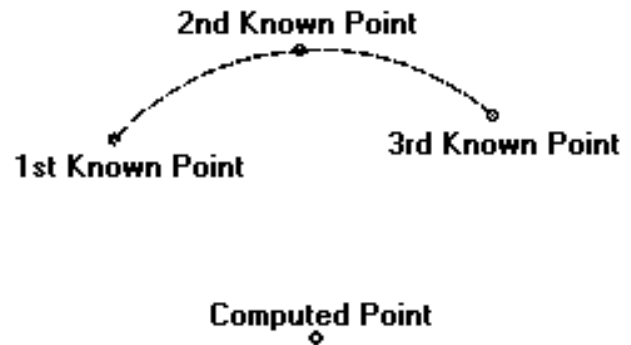
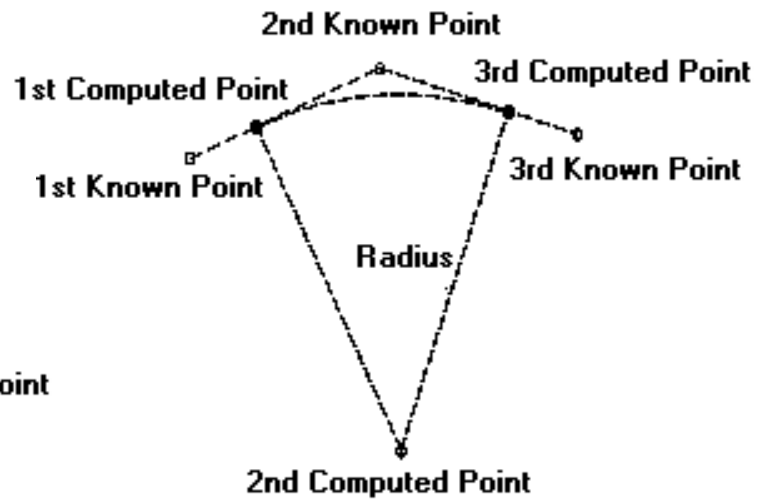
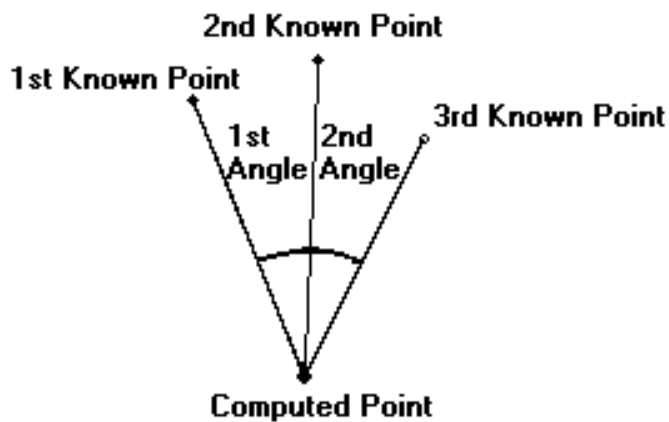
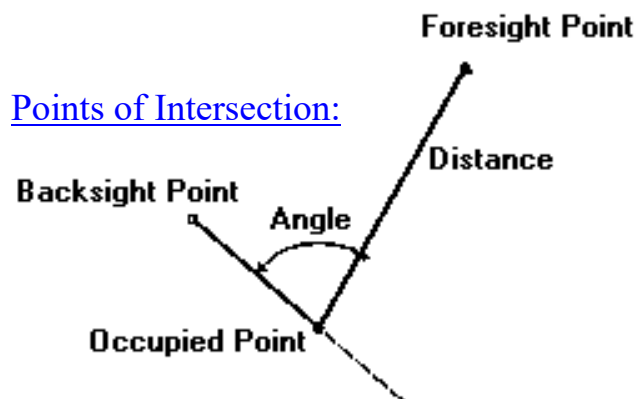
☒ Radius: 50.0000'

**Feature**

Feature Definition: COGO Point

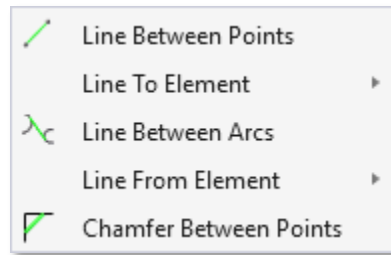
Name: COGO Point







Description:

Points on Curve:Points of Intersection:Angle Resection:Points of Intersection:






### 2.9.2 Line Geometry

There are various line placement tools (By points, To elements, From elements, Between Arcs, and Chamfers).








 Line Between Points	Creates a line between two user defined points.
 Line to Element	Constructs a line at a skew to a reference element.
 Line Between Arcs	Constructs a line between two previously placed arcs.
 Line From Element	Constructs a line at a skew to a reference element.
 Line from Element	Constructs a line at a skew from a base element. See below for extended tool options
 Chamfer Between Points	Planes a corner, example, it alters an existing intersection by inserting a line between the elements.

**Line to Element Tools**

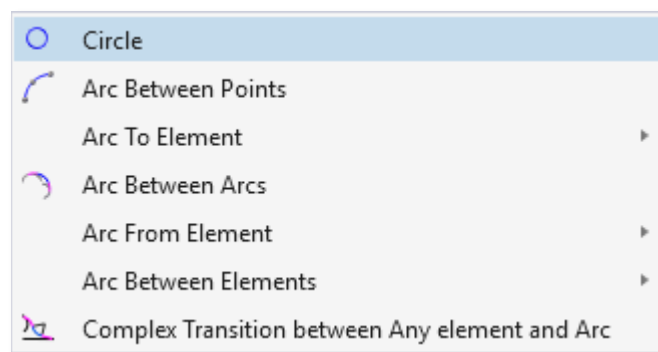
 <p>Simple Line to Element</p>	Creates a line without any transition to another element at zero degrees skew angle, applicable only when the To element is a curve, Offset locked at zero.
 <p>Spiral-Line to Element</p>	Creates a line with a spiral transition to another element at zero degrees skew angle, applicable only when the To element is a curve, Offset locked at zero.
 <p>Curve-Line to Element</p>	Creates a line with an arc transition to another element at zero degrees skew angle, applicable only when the To element is a curve, Offset locked at zero.
 <p>By Angle Line to Element</p>	Creates a line without any transition at user defined skew angle, Offset locked at zero.
 <p>Line to Element</p>	Constructs a line at a skew to a reference element.








### Line from Element Tools

 <p>Simple Line from Element</p>	Creates a line without any transition from another element at zero degrees skew angle, Applicable only when the From element is a curve, Offset locked at zero.
 <p>Spiral-Line from Element</p>	Creates a line with a spiral transition from another element at zero degrees skew angle, applicable only when the From element is a curve, Offset locked at zero.
 <p>Curve-Line from Element</p>	Creates a line with an arc transition from another element at zero degrees skew angle, applicable only when the From element is a curve, Offset locked at zero.
 <p>By Angle Line from Element</p>	Creates a line without any transition from another element at a skew angle you define, Offset locked at zero.
 <p>Line from Element</p>	Constructs a line at a skew from a base element.






### 2.9.3 Arc Geometry

Various arc placement tools (By points, To elements, From elements, Between Arcs, 2 Center and 3 Center and Complex Transitions).








 <a href="#">Circle</a>	Draws a circle.
 <a href="#">Arc Between Points</a>	Creates an arc between points.
 <a href="#">Arc to Element</a>	Constructs an arc based on a selected base element which controls tangency at one end.
 <a href="#">Arc Between Arcs</a>	Constructs an arc between two previously placed arcs. This tool has the ability to optionally apply both a back and/or forward transition between the base arcs and the constructed arc.
 <a href="#">Arc From Element</a>	Constructs an arc based on a selected base element that controls tangency at one end. The construct may also include an optional spiral transition or arc transition (2 center curve).
 <a href="#">Arc Between Elements</a>	Constructs an arc between two previously placed elements. This tool has the ability to optionally apply a back and/or forward transition and/or taper between the elements and the constructed arc.
 <a href="#">Complex Transition Between Any Element and Arc</a>	Constructs an arc between two previously placed elements. This tool has the ability to optionally apply a Back Spiral and/or Ahead Transition between the elements and the constructed arc.

**Arc to Element Tools**






 <p>Simple Arc to Element</p>	Creates a simple radius arc without any transition to another element, Offset locked at zero.
 <p>2 Center Arc to Element</p>	Creates an arc with an arc transition to another element, Offset locked at zero.
 <p>Spiral Arc To Element</p>	Creates an arc with a spiral transition to another element, Offset locked at zero.
 <p>Reverse Spiral Arc To Element</p>	Creates an arc with a reverse spiral transition to another element, applicable only when the To element is a curve of opposite hand, Offset locked at zero.
 <p><a href="#">Arc To Element</a></p>	Constructs an arc based on a selected base element which controls tangency at one end.


**Arc from Element Tools**

 <p>Simple Arc From Element</p>	Creates a simple radius arc without any transition to another element, Offset locked at zero.
 <p>2 Center Arc From Element</p>	Creates an arc with an arc transition from another element, Offset locked at zero.

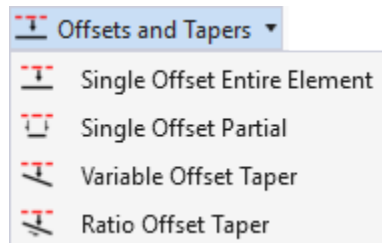
 <p>Spiral Arc From Element</p>	Creates an arc with a spiral transition from another element, Offset locked at zero.
 <p>Reverse Spiral Arc From Element</p>	Creates an arc with a reverse spiral transition to another element, applicable only when the From element is a curve of opposite hand, Offset locked at zero.
 <p><a href="#">Arc From Element</a></p>	Constructs an arc based on a selected base element that controls tangency at one end.





### Arc Between Elements Tools

 <p>Simple Arc</p>	Creates a radius arc without spirals or tapers at both ends, Offsets locked at zero.
 <p>Spiral Arc Spiral</p>	Creates a radius arc with spiral transitions but no tapers at both ends, Offsets locked at zero.
 <p>Taper Arc Taper</p>	Creates a radius arc with tapers but no transitions at both ends, Offsets locked at zero.
 <p>3 Center Arc</p>	Creates a radius arc with radius transitions at both ends, result is a three centered curve, Offsets locked at zero.
 <p>2 Center Arc</p>	Creates a radius arc with radius transitions at one end, result is a two centered curve, Offsets locked at zero.

 <p>Arc Between Elements</p>	Constructs an arc between two previously placed elements.
---	---

### 2.9.4 Offsets and Tapers

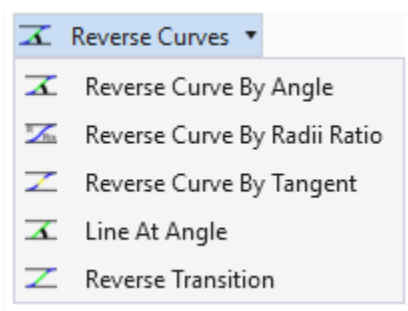







 <p>Single Offset Entire Element</p>	Offsets the selected element by a constant value along the entire length
 <p>Single Offset Partial</p>	Offsets the selected element by a constant value along a user selected station range
 <p>Variable Offset Taper</p>	Offsets the selected element by a variable amount along a user selected station range
 <p>Ratio Defined Taper</p>	Offsets the selected element by a ratio along a user selected station range



### 2.9.5 Reverse Curves

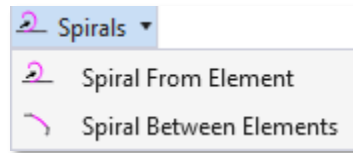
Tools to assist in the layout of a horizontal alignment in which a curve to the left or right is followed immediately by a curve in the opposite direction.





Select in the Toolbox	Description
 Reverse Curve by Angle	Constructs reverse curves between previously drawn elements.
 Reverse Curve by Radii Ratio	Creates a reverse curve where the second curve radius is a ratio of the first curve radius. Offsets locked at zero.
 Reverse Curve by Tangent	Creates a reverse curve where the two radii are equal and you may specify a tangent length between the curves, Offsets locked at zero.
 Line at Angle	Creates a simple linear element at a deflection angle measured from the first picked element, Offsets locked at zero.
 Reverse Transition	Constructs reverse curves between previously drawn elements with an optional tangent length between the two curves.

### 2.9.6 Horizontal Geometry Spiral

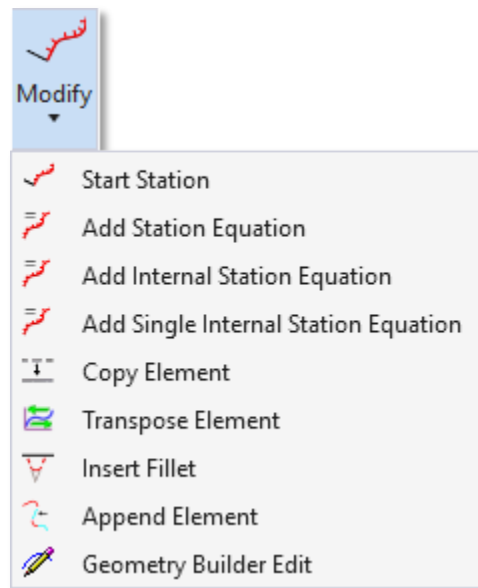
Various spiral placement tools. (From elements, Between Elements)












Select in the Toolbox	Description
 Spiral From Element	Constructs a spiral from a previously placed element, using this base element to determine tangency at one end.
 Spiral Between Elements	Constructs a spiral (or spirals) between two base elements that determine tangency.

### 2.9.7 Horizontal Geometry Modify

Stationing, Station Equations, working with Civil rules and copying civil elements.

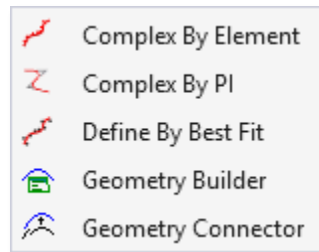







 <a href="#">Start Station</a>	Assigns stationing to an element.
 <a href="#">Add Station Equation</a>	Defines a station equation at a designated location on an element.
 <a href="#">Add Internal Station Equation</a>	Add station equation(s) to an offset alignment in order to keep its stationing matching the primary alignment.
 <a href="#">Add Single Internal Station Equation</a>	Add a single station equation to an offset alignment in order to keep its stationing matching the primary alignment.

 <a href="#">Copy Element</a>	The Copy Element tool creates a new instance of visible geometry only.
 <a href="#">Transpose Element</a>	Reverses the direction of the element.
 <a href="#">Horizontal Insert Fillet</a>	Constructs a complex element by appending additional elements in a previously established complex element.
 <a href="#">Append Element</a>	Constructs an element that best fits a course defined by a selected linear object.
 <a href="#">Geometry Builder Edit</a>	Edit Geometry in a Spreadsheet type dialog called Geometry Builder.

## 2.9.8 Creating Complex Geometry

Creating and redefining Complex alignments, Best Fit, Offset tools (copy parallel) reverse curves, and Create Geometry by Template.



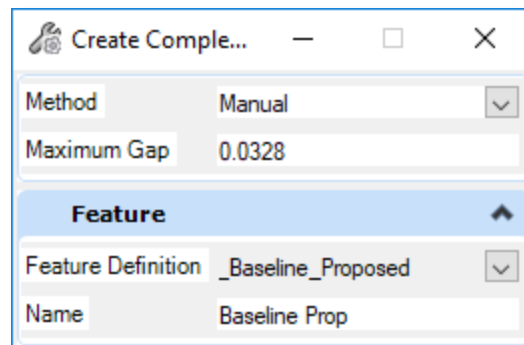
 <a href="#">Complex by Element</a>	Constructs a complex element of previously placed elements by joining them in sequence.
 <a href="#">Complex by PI</a>	Creates a linear element with curves based on user input of PI (point of intersection) locations. The curves can include transitions or set the radius to zero for no curves at the PI.
 <a href="#">Define by Best Fit</a>	Constructs an element that best fits a course defined by a selected linear object.
 <a href="#">Geometry Builder</a>	Create an alignment in a spreadsheet type dialog.
 <a href="#">Geometry Connector</a>	No information is available for this tool.



**Complex By Elements** - Constructs a complex element of previously placed elements by joining them in sequence.

- Ribbon: Geometry > Horizontal > Complex Geometry split button

Complex By Elements constructs a complex element of previously placed elements by joining them in sequence.



### Workflow

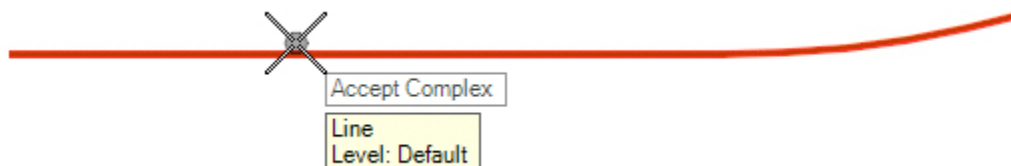
1. Click Complex By Elements. The Complex Element dialog displays.

There are two methods of operation: Manual and Automatic.

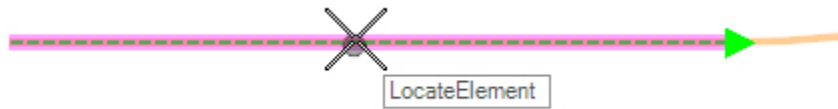
2. Using the Automatic method, hover over the beginning element until the directional arrow points to the desired direction. Left mouse-click to accept the chosen element.



3. At this point, the complex path will be highlighted. Left-click again to accept the complex creation or right-click to cancel.

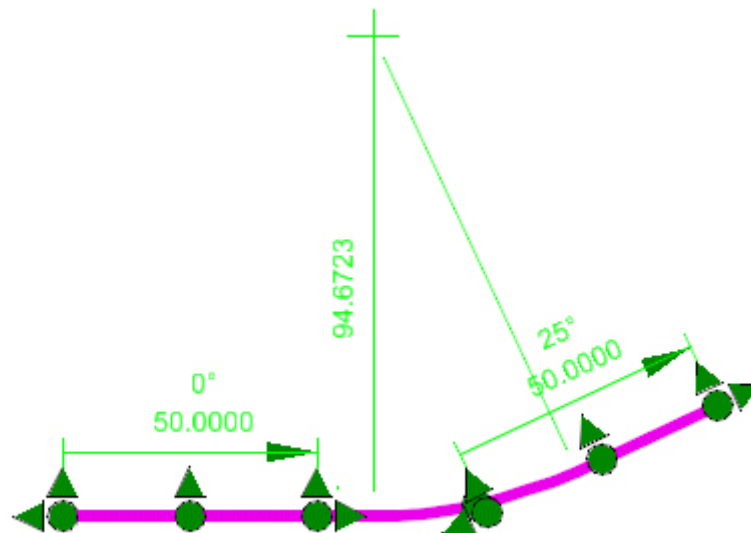


- Alternatively, using the Manual method, select each element individually using the left-click.



Once all items are selected, data point, example, left-click in the drawing area off of the elements to accept the complex element creation.

### Manipulators



When the elements are migrated to a complex element, the individual element manipulators remain intact.

### Properties

The rule data is also accessible in the properties of the individual elements making up the complex element. Select the individual element to edit the properties. Most data in the property pane can be edited to change any of the element's definitions.



**Complex By PI** - Creates a linear element with curves based on user input of PI (point of intersection) locations. The curves can include transitions or set the transitions to none.

- Ribbon: **Geometry** ➔ **Horizontal** ➔ **Complex Geometry** split button

Complex By PI creates a linear element with curves based on user input of PI (point of intersection) locations. The curves can include transitions or set the radius to zero for no curves at the PI.

The transitions on the curves can be arc transitions or clothoid spirals using the following methods. See [Spiral from Element](#) for a description of the various spiral parameters.

- Spiral - Length
- Spiral - A-Value
- Spiral - Deflection
- Spiral - Delta R
- Spiral - RL
- Curve - Length
- Curve - Deflection
- Curve - Delta R
- Curve - Ratio

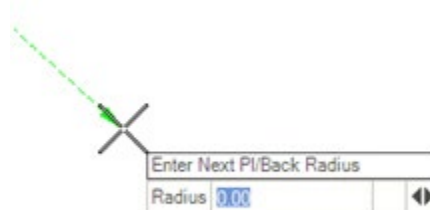
### Workflow

- Click Complex By PI. The Complex Element By PI dialog displays.
- Data point to set the beginning of the element.



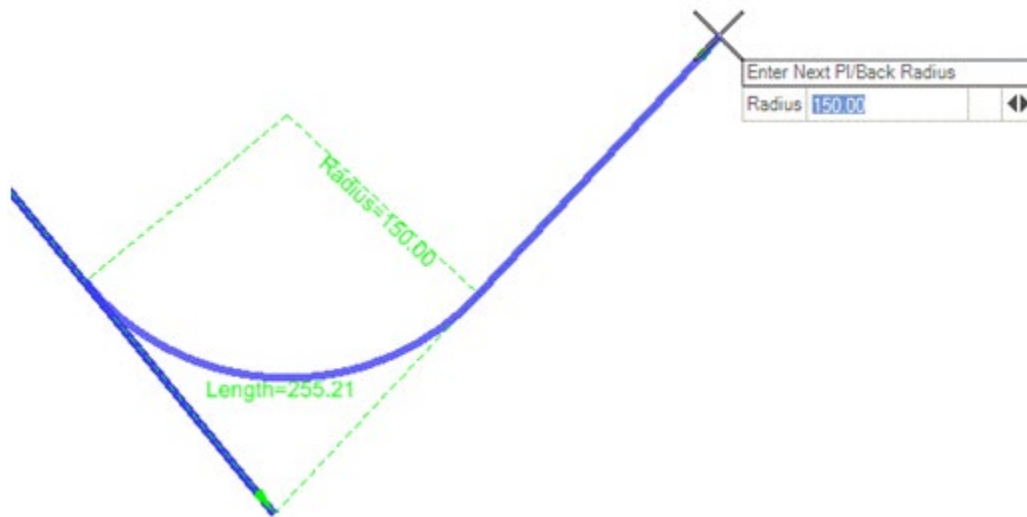
Complex Element By PI	
<input checked="" type="checkbox"/> Radius	500.0000'
<b>Back Transition</b>	
Type	Spiral
Method	Length
Length	200.0000
<b>Ahead Transition</b>	
Type	Spiral
Method	Length
Length	200.0000
<b>Feature</b>	
Feature Definition	MoDOT_Baseline_Proposed
Name	Baseline Prop

- Data point to set the second PI.



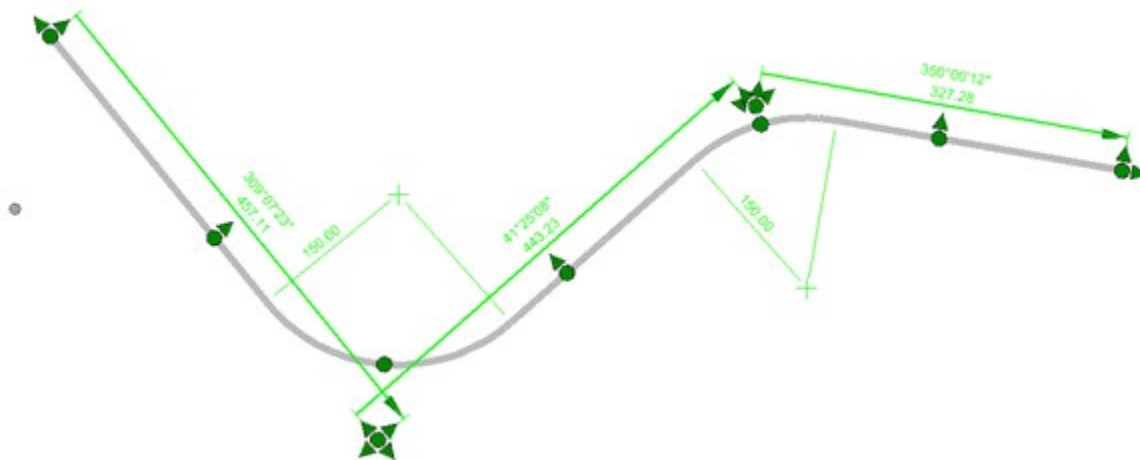


4. Data point to set the third PI. Radius always applies to the PI prior to the one where the data point is currently being set. You can edit the radius by keying in a new value in the prompt. This is a triple toggle input. Toggle with left-right arrow keys to set back and ahead transition parameters.



5. Continue to data point to add more PI points. Click the Reset button to stop adding PI points.

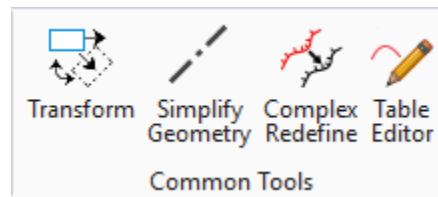
#### Manipulators







Manipulators are available for:

- Distance and direction on each line segment
- Radius and transition parameter on each curve
- Drag handles at PI points

### 2.9.1 Geometry Common Tools



 Transform	<p>This single tool is capable of Translating, Rotating, and Scaling an element. Civil elements are not valid for the three above separate power platform tools so this tool can do all three modifications on regular or civil elements at once, if desired.</p> <p>If civil elements are transformed, they become simplified elements, meaning if the element is a target of a rule then that rule is removed. A warning box appears if civil elements are about to be transformed.</p>
 Simplify Geometry	<p>Simplify Geometry is a tool used for removal of intervals and external referencing rules for horizontal and vertical geometries.</p>
 Complex by PI	<p>Used to preserve the original Alignment name, allowing all rules built off the original geometry to update in line with the new geometry.</p>
 Table Editor	<p>Used to modify geometry in a spreadsheet type dialog where values can be locked.</p>

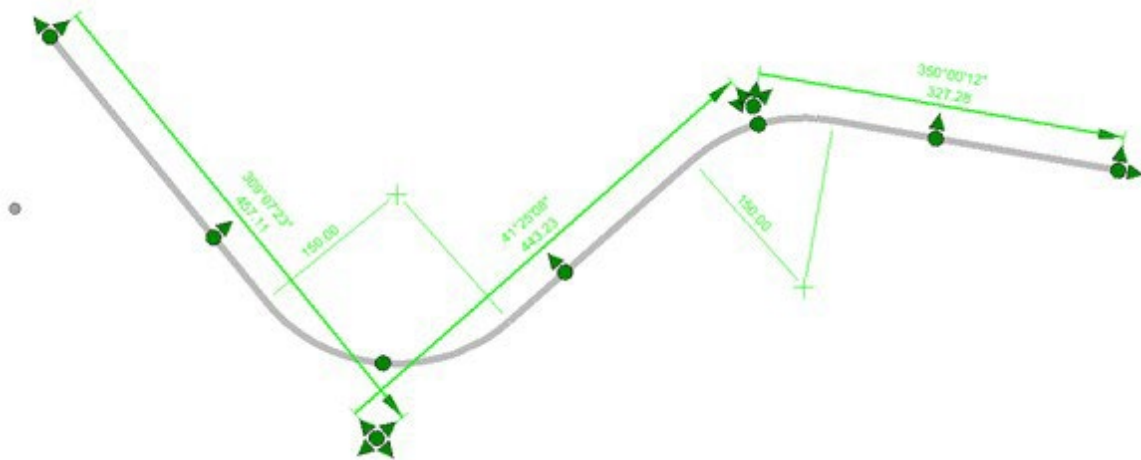
## 2.10 Editing Horizontal Geometry

Once a Civil Geometry Element is placed, selection of that element will display the appropriate manipulators, defining the element.

### Manipulators

Manipulators are available for:

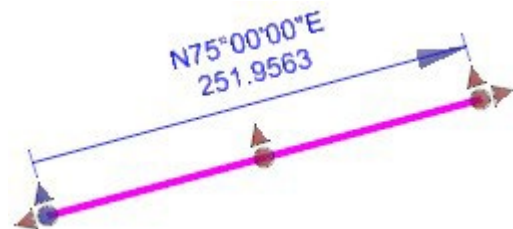
- Distance and direction on each line segment
- Radius and transition parameter on each curve
- Drag handles at PI points



### Normal Line Manipulators

When the line is placed without any snaps and without any Civil AccuDraw constraints, you will see the onscreen manipulators as shown right. These manipulators can be used to edit the line as follows:

- The distance and direction text manipulators can be clicked to allow editing of the value
- The arrows parallel to the line can be used to extend or trim the line (i.e., change the distance)
- The end point arrows perpendicular to the line can be used to rotate the line (i.e., hold the distance and change the direction)
- The perpendicular arrow at midpoint can be used to move the line parallel
- The dot at the end points can be used to move the point without constraining the distance or direction
- The dot at the midpoint can be used to move the line in its entirety



## Snap Manipulator

When a line end point has been snapped, the normal manipulators are replaced by a snap manipulator. The end on the left was snapped by key point, so you see a single dot and an icon indicating the snap type.

You can move the snapped end in space by clicking the dot and dragging. This breaks the snap and creates a new endpoint location that might be a data point, a different snap or a Civil AccuDraw input.



If you hover over the snapped end point dot, the normal manipulators will appear to allow extend/trim or rotate of the line. This also breaks the snap. Similarly, when a line endpoint is created by Civil AccuDraw, the normal manipulators are replaced by a single dot and the AccuDraw manipulators. The AccuDraw Manipulators are text labels that can be clicked and edited.

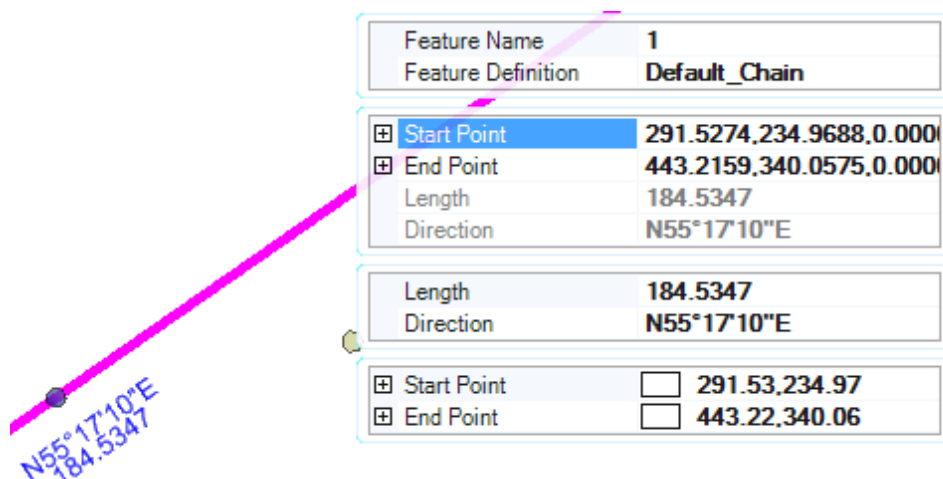
Hover over the dot to show the normal manipulators for rotate and trim/extend functions. This replaces the AccuDraw input with the new input values.

## 2.11 Horizontal Geometry Properties

The rule data is also accessible in the properties of the line. Select the line and click *Properties* from the heads-up menu. Most data in the property pane can be edited to change the line definition. You can also select the geometry using the Element Selection tool and use the Element Information dialog to make changes



**Note:** When you review geometry the Element Information dialog displays the terrain models that the geometry belongs to, if any.



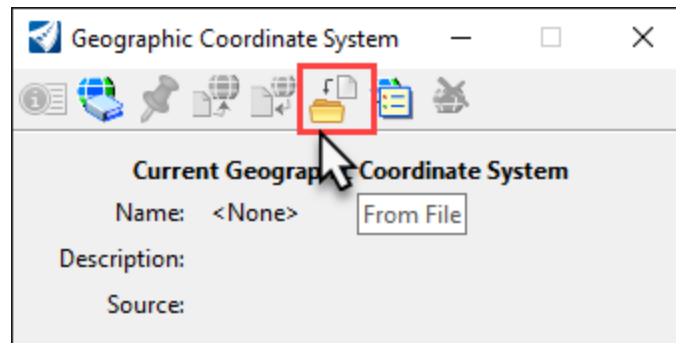
## 2.12 Exercise #1 (Group): Ramp 4 Alignment

1. Within the **Roadway\data-2** folder, open the file: **Terrain\_J5P3181.dgn**
2. Create a new file named **Civil\_Geometry\_J5P3181.dgn** using the following the 2D seed file:

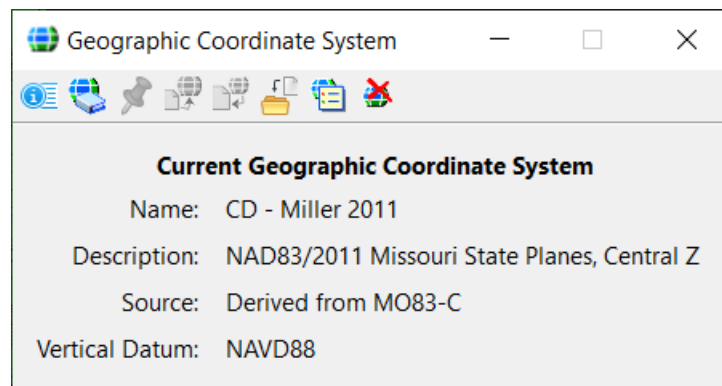
*pw:\CADD\_Standards\Seed Files\Design - English\MoDOT\_Design\_Seed\_2D.dgn.*

This new file will hold Horizontal and Vertical Alignments for the project.

3. Open the **Coordinate System** tool by selecting the **OpenRoads Modeling Workflow** → **Utilities Tab** → **Geographic** Section.
4. Select “**From File**” icon.



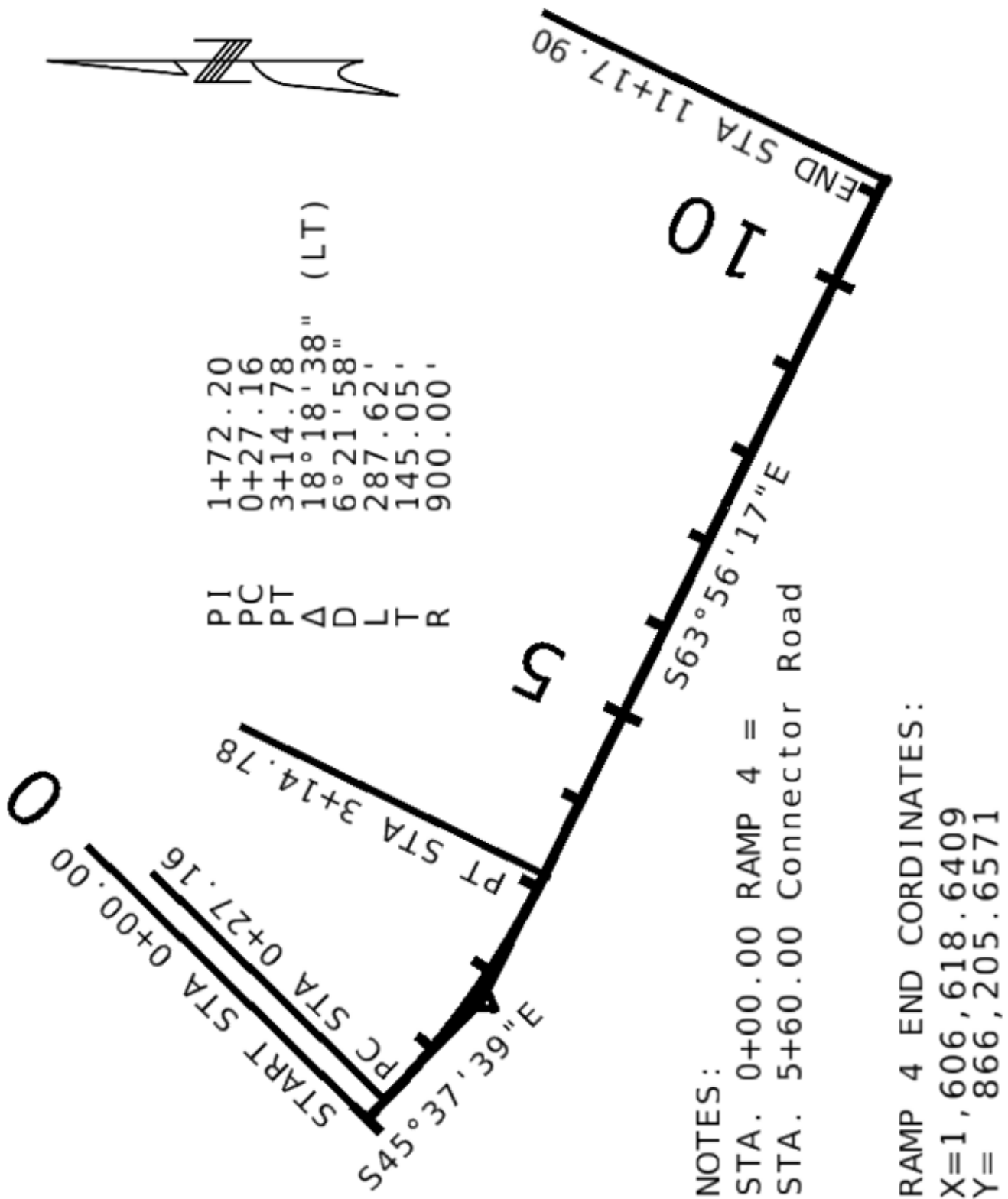
5. Select the **Terrain\_J5P3181.dgn** file in the **data-2** folder.
6. Verify the settings.



7. Reference in the following file:

**Terrain\_J5P3181.dgn.**

8. Create the alignment as shown below and per the steps outlined on the following pages.



## Ramp 4

Beginning Point: **Station 5+60.0000 Connector Road = Station 0+00.00 Ramp 4**  
Ending Point: **X = 1,606,618.6409 Y = 866,205.6571**

Beginning station of **Ramp 4** is **0+00.00**

### Curve #1 Information

Direction Back = **S 45° 37' 39" E**  
Radius = **900.00'**  
Direction Ahead = **S 63° 56' 17" E**

**Note:** Before you start this exercise understand it is best to use the most accurate information you are given. Information like Coordinates out to 4 decimal places, and Line Direction bearings out to the “seconds” place, are all very accurate to use. Things to avoid are Coordinates, Stations, and Distances only reported to two decimal places. Referred

9. We first need to import the **Connector Road** Alignment.
  - a. Select the “**Import Geometry**” tool (by selecting the **OpenRoads Modeling Workflow**, then **Geometry** → **General Tools** → **Import/Export** → **Import Geometry**)
  - b. Select the **Connector Road.xml** within your **data-2** folder.
  - c. Set the following settings in the **Import Geometry** dialog and then select **Import**:

Import Geometry

☒ LandXML

- ☒ Alignment
  - ☒ Alignment\MoDOT\_Baseline\_Proposed
    - ☒ Connector Road

☐ Assign Feature Definitions from Table

Feature Definitions Table:

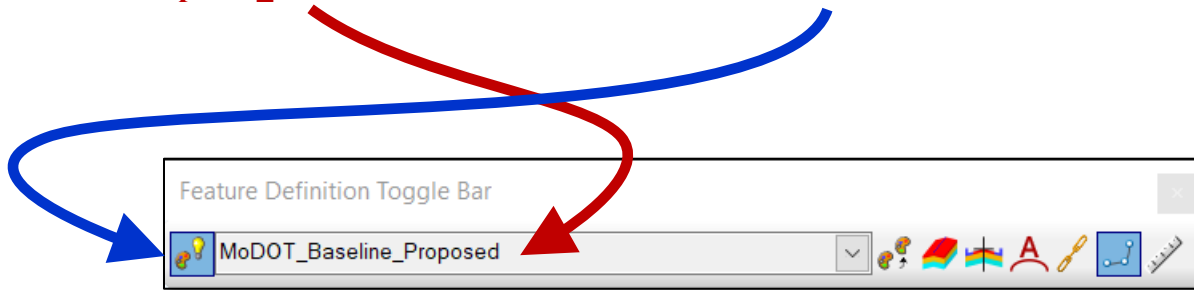
☒ Assign Feature Definition

Linear Features:

Point Features:

☒ Create Civil Rules

10. Add the **Connector Road** Alignment Annotation by selecting the **OpenRoads Modeling Workflow** → **Drawing Production Tab** → **Annotation Section** → **Annotate Element**
11. Within the Feature Definition Toggle Bar set the active feature to **Alignment > MoDOT Proposed\_Baseline** and then Enable the **Use Active Feature Definition** icon.



12. Select the **Line Between Points** tool from the **OpenRoads Modeling Workflow** → **Geometry Tab** → **Horizontal Section**.
13. In this step use the “**Line Between Points**” tool and **Civil AccuDraw** to place lines that represent the two tangent sections of the **Ramp 4** alignment. Make sure these two lines are long enough so that they overlap each other. By overlapping the two tangent lines we are locating the PI location of the Curve using the intersection point of the two Civil Geometry Lines.
  - a. First select the “**Line Between Points**” tool located in the **OpenRoads Modeling Workflow** → **Geometry Tab** → **Horizontal Section** → **Lines Tools** → **Line Between Points**.
  - b. Next, select the **Civil AccuDraw** tool and its **Station Offset** mode and key in the values **STA = 5+60.0000 (Connector Road)**, **Offset = 0.00**
  - c. Once the start of the alignment has been defined, continue to place the line using **Civil AccuDraw** and its **Distance-Direction** mode at a bearing of **S 45° 37’ 39” E** at a length that would extend past the PI location of the Curve (a length of at least 200 feet will work). When typing in a bearing use a colon “:” in-between the **Degrees:Minutes** and **Minutes:Seconds**. For this step you would type **S45:37:39E**

Note: If “**Angle**” is display instead of “**Bearing**” in the Civil AccuDraw heads-up display select the keyboard keys “**R**” and then “**T**”. This is a Civil AccuDraw shortcut to **Rotate** the compass to the **Top** view.

  - d. Select the “**Line Between Points**” tool, and using **Civil AccuDraw** and its **XY** function, key in the coordinates **X = 1,606,618.6409**    **Y = 866,205.6571**
  - e. Once the end of the alignment has been defined, continue to place the line using **Civil AccuDraw** and its **Distance-Direction** option at a bearing of **N 63° 56’ 17” W** at a length that would extend past the Overall PI location of the Spiral-Curve-Spiral (a length of at least 1,000 feet will work). When typing in a bearing use a colon “:” in-between the **Degrees:Minutes** and **Minutes:Seconds**. For this step you would type **N63:56:17W**



Note: If “**Angle**” is display instead of “**Bearing**” in the Civil AccuDraw heads-up display select the keyboard keys “**R**” and then “**T**”. This is a Civil AccuDraw shortcut to **Rotate** the compass to the **Top** view.

14. Deactivate **Civil AccuDraw**.

15. Next store the **Curve** by selecting the **OpenRoads Modeling** Workflow, then **Geometry** Tab ➔ **Horizontal** Section ➔ **Arcs** Tools ➔ **Arc Between Elements** ➔ **Simple Arc** tool, and defining the tool with the following parameters:

**Radius of Curve = 900’**

Notes:

- If you need to switch from **Radius** to **Degree of Curve** type in a “**d**” in the Radius field and then the degree of curve value.
- When typing in a Degree of Curve use a colon “**:**” and place in-between the **Degrees:Minutes** and **Minutes:Seconds**. For example, **3° 30’ 00”** you would type **d3:30:00** or **d3:30** for short.
- Spirals requirements come from the **MoDOT Superelevation Standard Plans** which is based on **AASHTO 2018 Green Book**.

Once the tool is defined with the correct parameters select each tangent and place the Curve trimming both tangents back.

16. Select **Create Complex Element** and to turn the individual element into one complex element.

- a. Name the complex element “**Ramp 4**”.
- b. Make sure the stationing will be flowing (getting larger) in a southerly direction

17. Add the **Ramp 4** Alignment Annotation by selecting the **OpenRoads Modeling** Workflow ➔ **Drawing Production** Tab ➔ **Annotation** Section ➔ **Annotate Element**

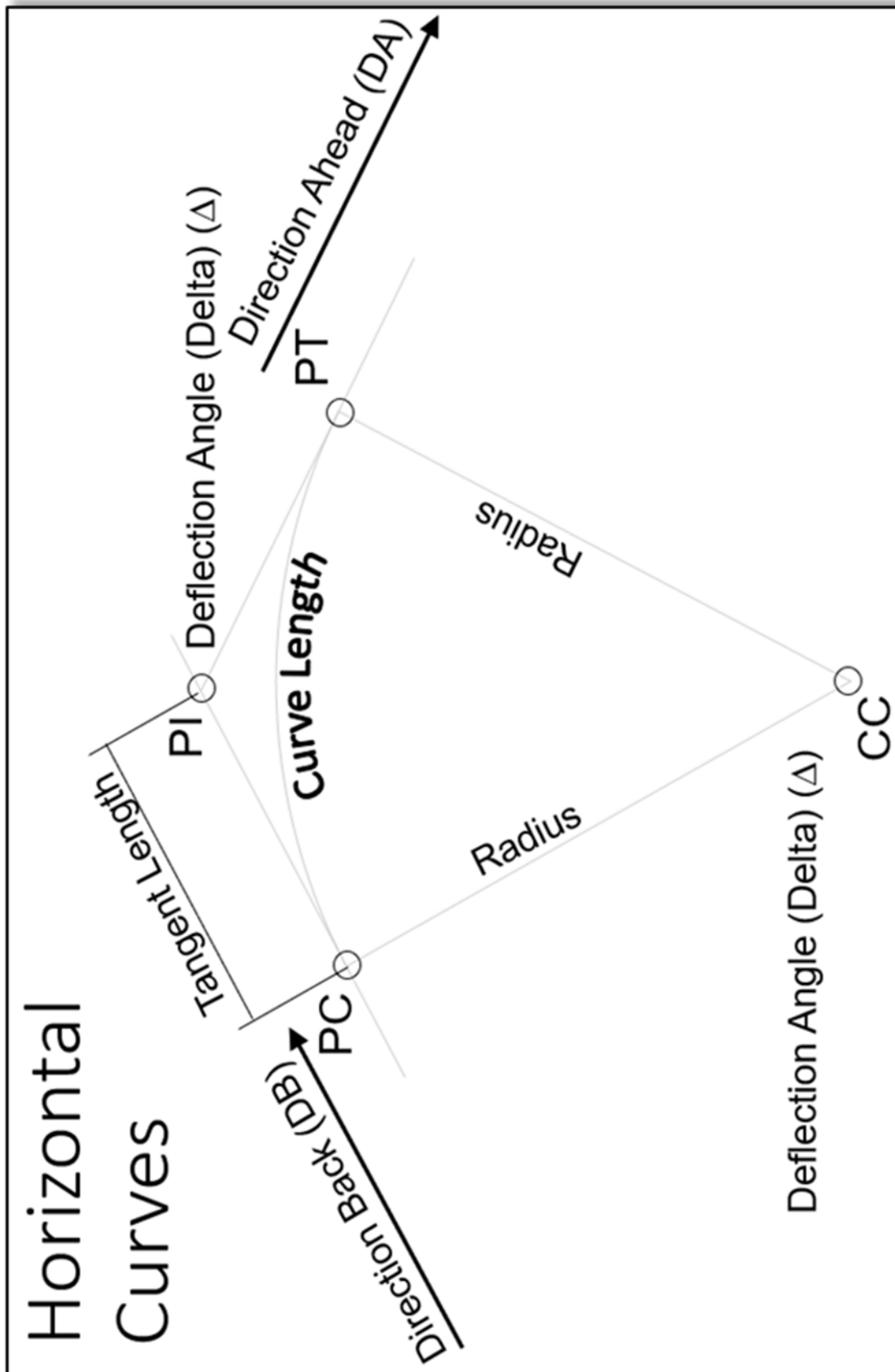
18. Using the “**Start Station**” tool set the *Beginning Station* to **0+00.00**.

19. Set the Drawing Scale is set to **1”=50’**.

20. Generate a **Horizontal Geometry Report** by “left clicking” on the alignment and selecting from the heads-up menu the **Horizontal Geometry Report** Tool.

- a. Using the report verify your alignment matches the Alignment diagram at the beginning of this exercise.

21. Select **File > Update Server Copy**.



## Horizontal Alignment Review Report

Report Created: Tuesday, November 29, 2022

Time: 10:22:43 PM

**Project:** Default

**Description:**

**File Name:** c:\temp\dms23209\Civil\_Geometry\_J5P3181.dgn

**Last Revised:** 11/29/2022 21:39:36

**Note:** All units in this report are in feet unless specified otherwise.

**Alignment Name:** Ramp 4

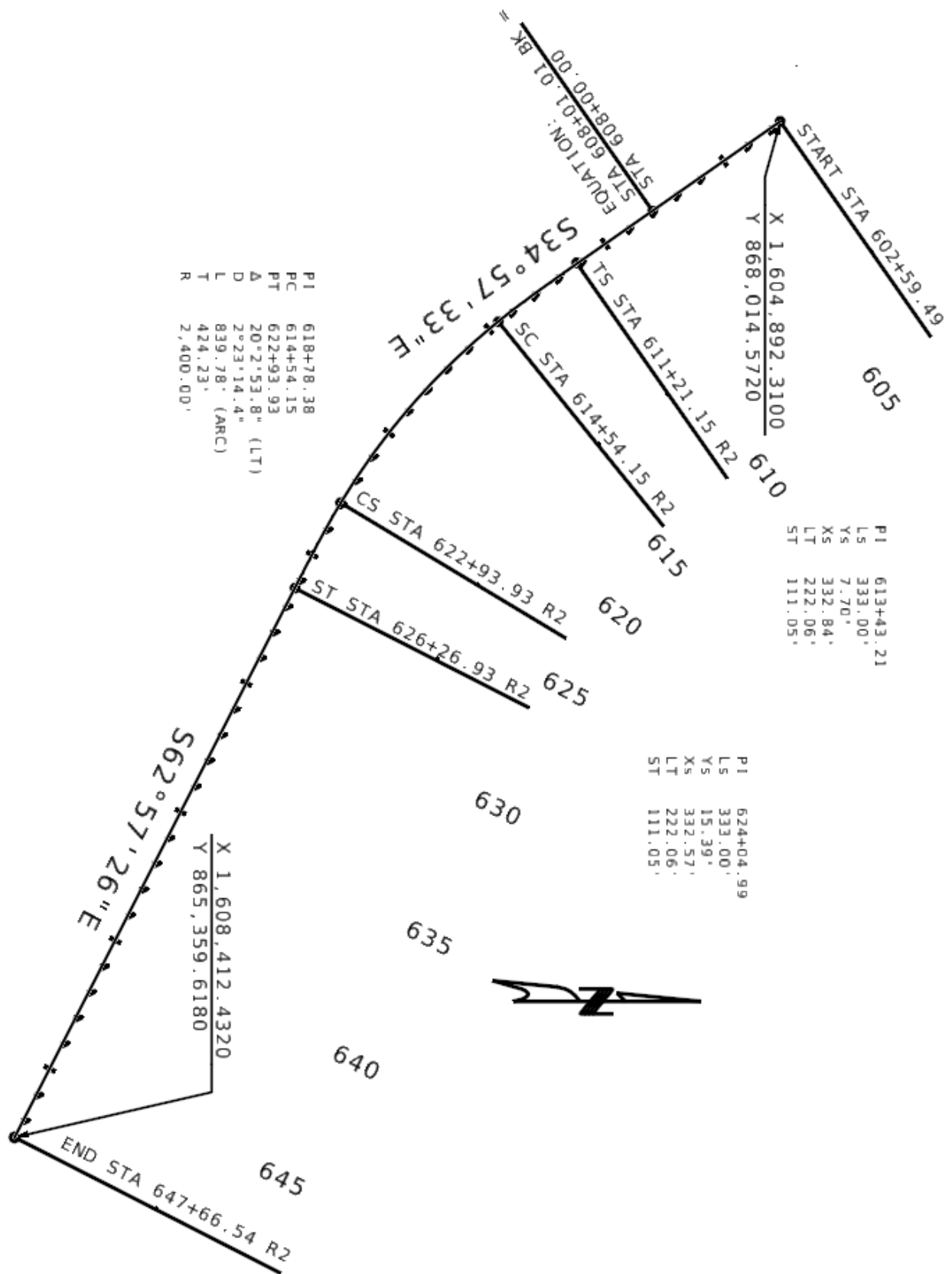
**Alignment Description:**

**Alignment Style:** Alignment\MoDOT\_Baseline\_Proposed

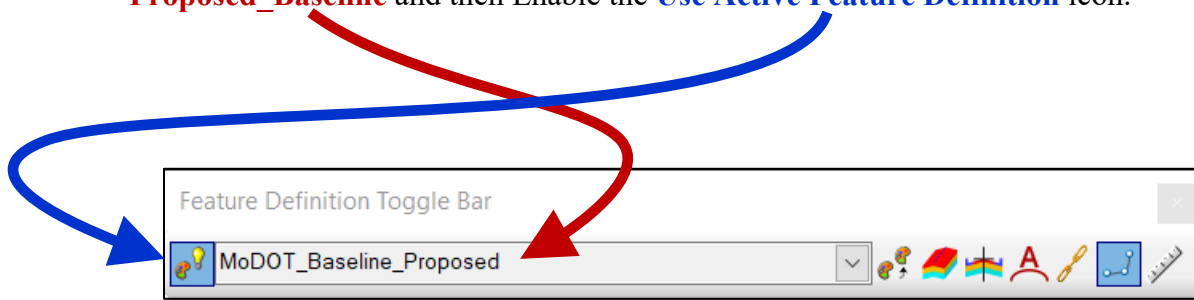
		<b>Station</b>	<b>Northing</b>	<b>Easting</b>
Element: Linear				
START	( )	0+00.00 R1	866742.6534	1605643.7897
PC	( )	0+27.16 R1	866723.6627	1605663.2010
Tangential Direction:		S45°37'39"E		
Tangential Length:		27.16		
Element: Circular				
PC	( )	0+27.16 R1	866723.6627	1605663.2010
HPI	( )	1+72.20 R1	866622.2282	1605766.8820
CC	( )		867366.9903	1606292.5893
PT	( )	3+14.78 R1	866558.5027	1605897.1809
Radius:		900.00		
Delta:		18° Left		
Degree of Curvature (Arc):		6°		
Length:		287.62		
Tangent:		145.05		
Chord:		286.40		
Middle Ordinate:		11.47		
External:		11.61		
Back Tangent Direction:		S45°37'39"E		
Back Radial Direction:		S44°22'21"W		
Chord Direction:		S54°46'58"E		
Ahead Radial Direction:		S26°03'43"W		
Ahead Tangent Direction:		S63°56'17"E		
Element: Linear				
PT	( )	3+14.78 R1	866558.5027	1605897.1809
END	( )	11+17.90 R1	866205.6571	1606618.6409
Tangential Direction:		S63°56'17"E		
Tangential Length:		803.12		

## 2.13 Exercise #2 (Individual): Route 54 Alignment

1. Create the alignment as shown below and per the steps outlined on the following pages.



2. Within the Feature Definition Toggle Bar set the active feature to **Alignment > MoDOT Proposed\_Baseline** and then Enable the **Use Active Feature Definition** icon.



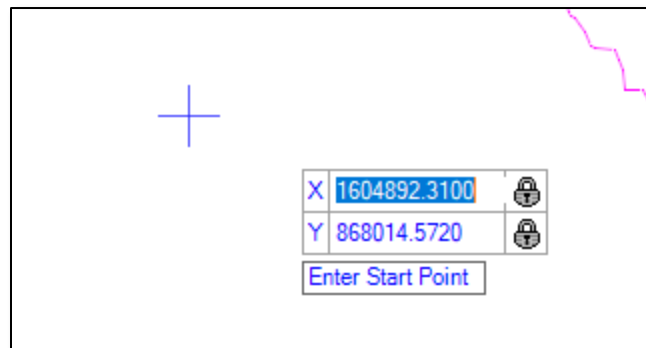
3. Select the **Line Between Points** tool from the **OpenRoads Modeling Workflow** → **Geometry Tab** → **Horizontal Section**.
4. Activate Civil AccuDraw and then select the **XY** mode.



5. Using the heads-up display, key in the coordinates of the first PI:

**X = 1,604,892.3100**

**Y = 868,014.5720**



**Hint:** After locking in each value move the mouse to ensure the value is set.

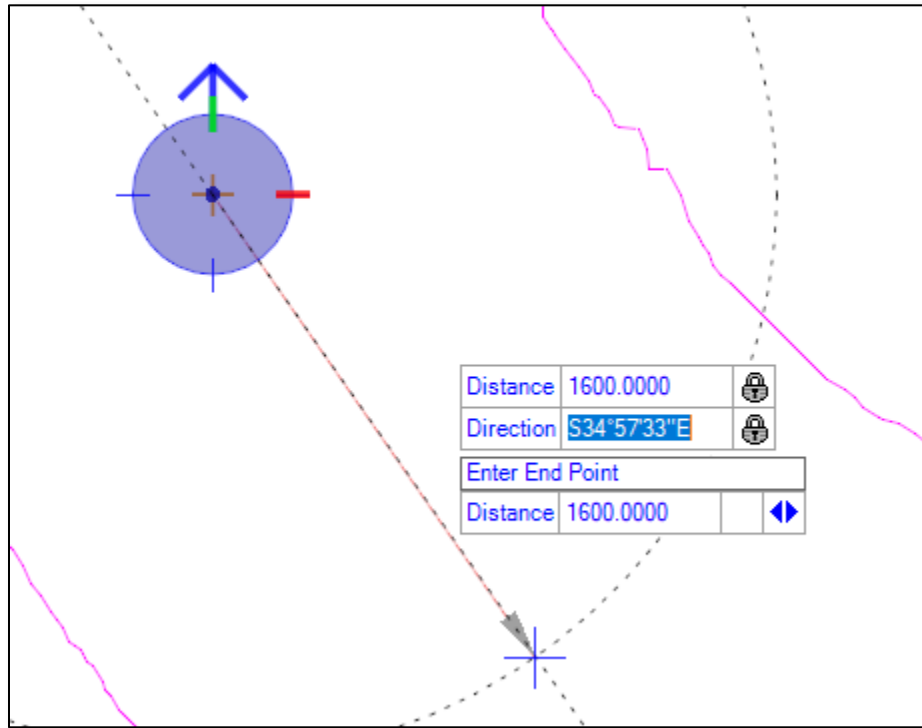
6. Data point to accept the placement of the first point.
7. When prompted to **Enter End Point**, make the **Distance-Direction** mode active in Civil AccuDraw. This will change the heads display.



8. Locate the second point with a **Distance = 1,600 ft** and the **Direction = S 34:57:33 E**

**Hint:** Directions or angles should be entered in this format **DD:MM:SS. S34:57:33E**

If **Bearing** is the MicroStation Definition, then the **Alpha** indicators (N, S, E, and W) should be entered with no spaces before the **DD** and after the **SS**.

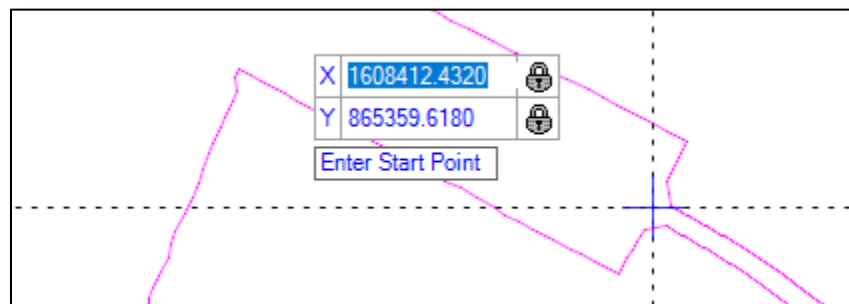


9. Data point to accept.

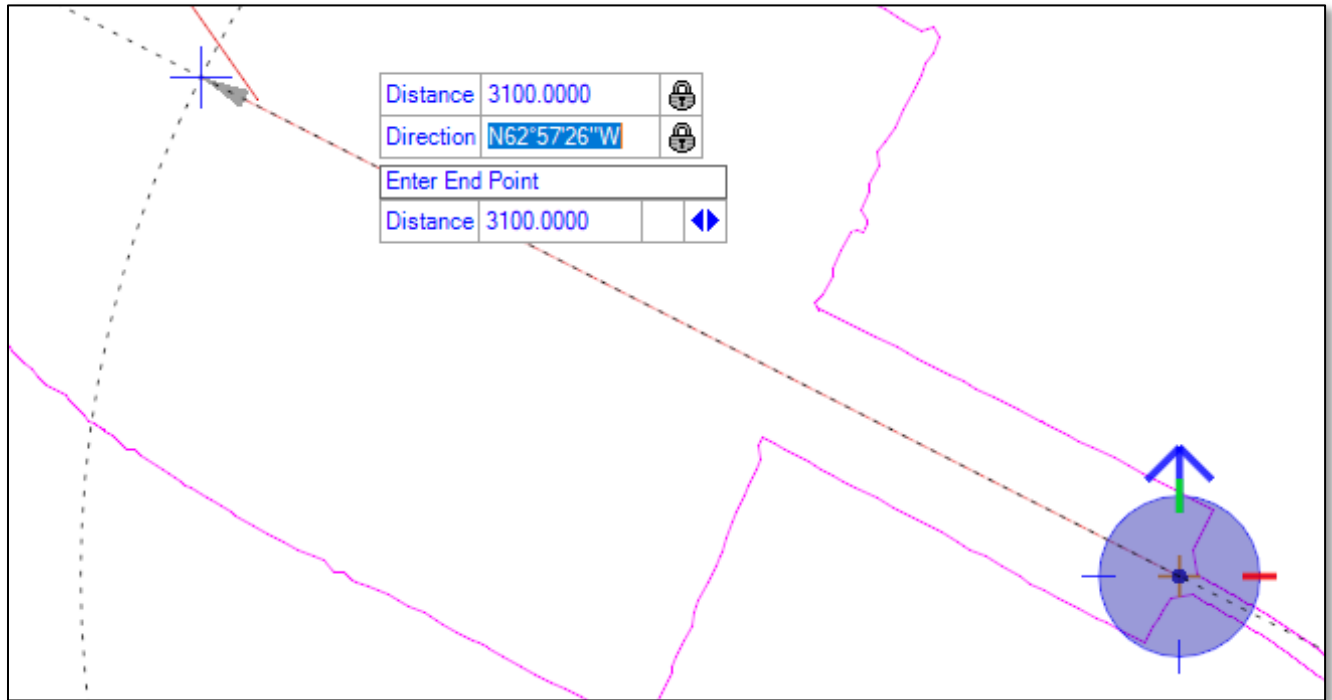
10. Select the **XY** favorite from the **Civil AccuDraw** toolbar.



11. Place another line with a Start point at **X = 1,608,412.4320** and **Y = 865,359.6180**



12. Define the End point as *Distance* = **3,100 ft** and the *Direction* = **N62:57:26W**.



13. Data point to accept.

14. Deactivate **Civil AccuDraw**.

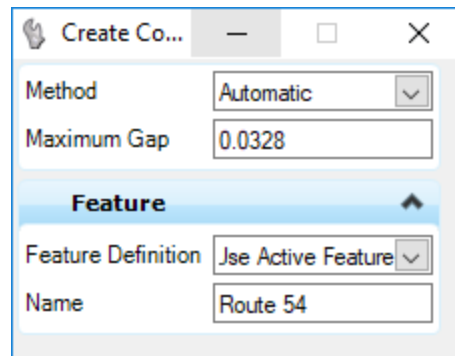
15. Next store the Spiral-Curve-Spiral by selecting the **Spiral Arc Spiral** tool located the **OpenRoads Modeling Workflow** → **Geometry Tab** → **Horizontal Section** → **Arc Between Elements** Tools.

Define the tool with the following parameters:

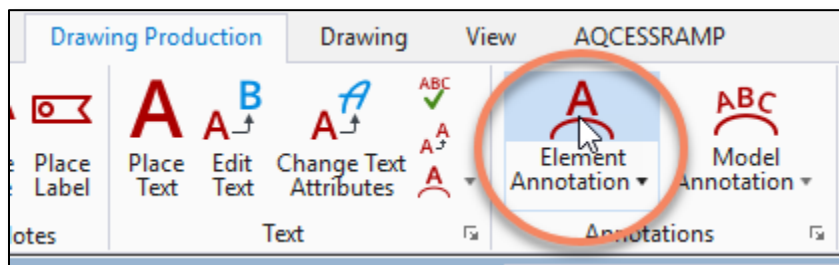
Radius = **2,400 ft**  
Spirals = **333 ft**

Once the tool is defined with the correct parameters select each tangent and place the Spiral Curve-Spiral **trimming both tangents back**.

16. Select **Create Complex Element** and to turn the individual element into one complex element. Name the complex element “**Route 54**”. Start the complex element selecting the northern most end of the north line to ensure that stationing will be flowing (getting larger) in a southerly direction.

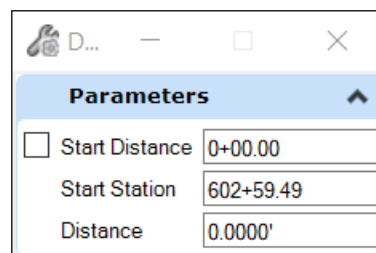


17. Add **Stationing** and **Tic** marks to the Alignment using the **Element Annotation** tool located under the **OpenRoads Modeling Workflow** → **Drawing Production Tab** → **Annotation Section**.



- Select the **Alignment**
  - Reset** to complete
18. Using the **Start Station** tool to apply a beginning Station to our Route 54 alignment of **602+59.49**.

The **Start Station** tool located under the **OpenRoads Modeling Workflow** → **Geometry Tab** → **Horizontal Section** → **Modify Tools**.



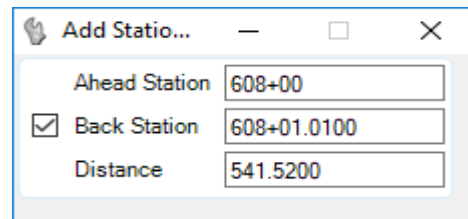


19. Next apply a **Station Equation** at **608+01.01** to even out the stationing going forward in this alignment. Use the **Station Equation** tool located under the **OpenRoads Modeling Workflow** → **Geometry** Tab → **Horizontal** Section → **Modify** Tools.

Enter the following parameters:

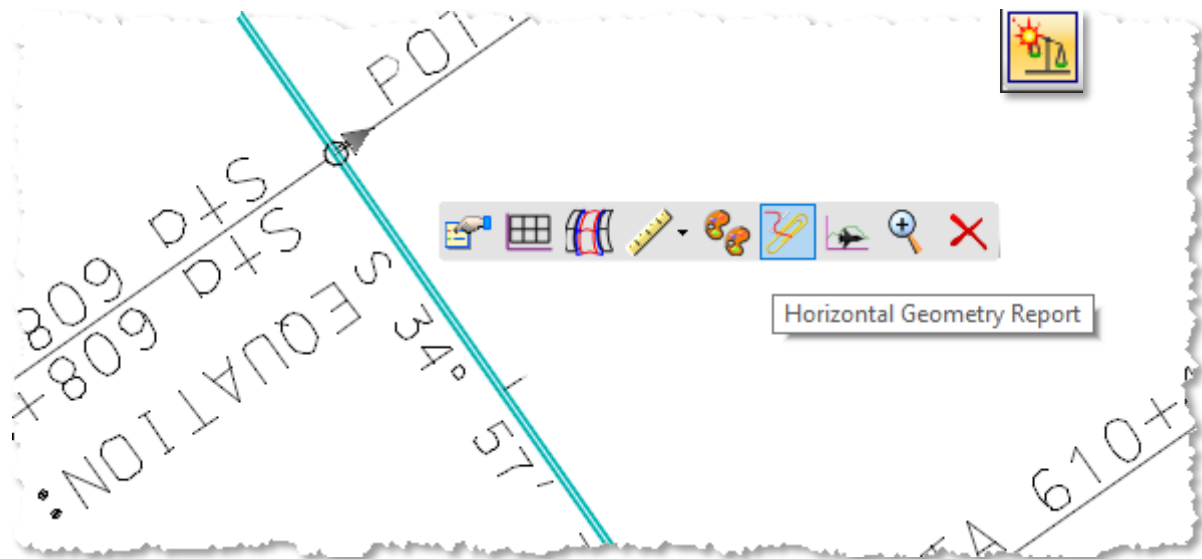
**Back Station = 608+01.01**

**Ahead Station = 608+00**



Add Station...	
Ahead Station	608+00
<input checked="" type="checkbox"/> Back Station	608+01.0100
Distance	541.5200

20. Select the **Horizontal Reports** tool using the heads-up display of the RTE54 alignment.



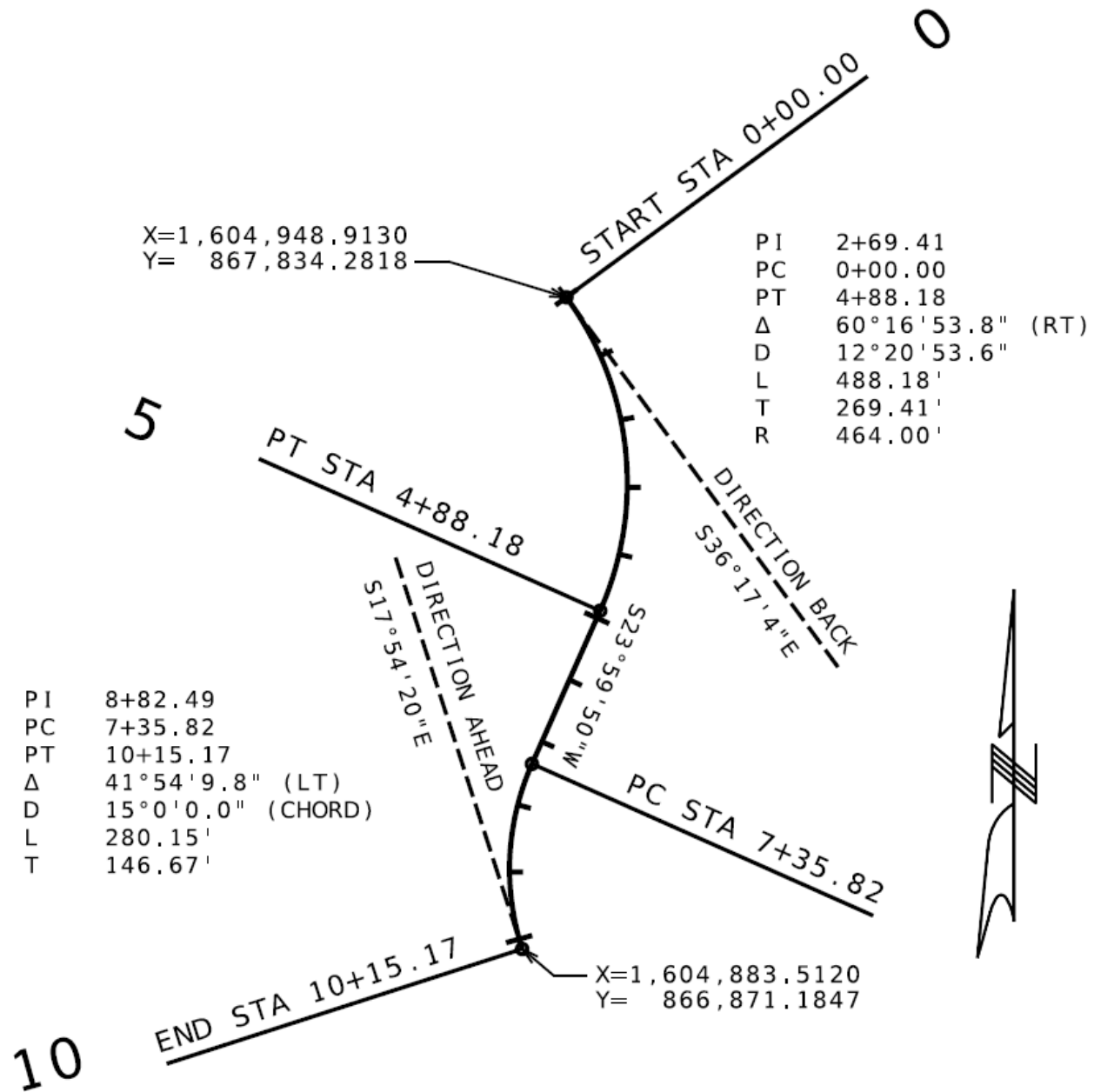
21. Select the XSL report named **HorizontalAlignmentReviewReport.XSL** and compare your results with the one below.

Horizontal Alignment Review Report				
Report Created: Wednesday, December 7, 2022				
Time: 10:10:34 AM				
Project: Default				
Description:				
File Name: c:\temp\dms24340\Route-54.dgn				
Last Revised: 12/7/2022 10:07:46				
Note: All units in this report are in feet unless specified otherwise.				
Alignment Name: Route 54				
Alignment Description:				
Alignment Style: Linear\Design\Roadway\EOP_New				
		Station	Northing	Easting
Element: Linear				
START	( )	602+59.49 R1	868014.5720	1604892.3100
	EQNBK	608+01.01 R1	867570.7635	1605202.5969
	EQNAHD	608+00.00 R2	867570.7635	1605202.5969
TS	( )	611+21.15 R2	867307.5580	1605386.6160
Tangential Direction:		S34°57'33"E		
Tangential Length:		862.67		
Element: Clothoid				
TS	( )	611+21.15 R2	867307.5580	1605386.6160
SPI	( )	613+43.21 R2	867125.5697	1605513.8524
SC	( )	614+54.15 R2	867039.1866	1605583.6396
Entrance Radius:		0.00		
Exit Radius:		2400.00		
Length:		333.00		
Angle:		03°58'30" Left		
Constant:		893.98		
Long Tangent:		222.06		
Short Tangent:		111.05		
Long Chord:		332.93		
Xs:		332.84		
Ys:		7.70		
P:		1.92		
K:		166.47		
Tangent Direction:		S34°57'33"E		
Radial Direction:		S55°02'27"W		
Chord Direction:		S36°17'03"E		
Radial Direction:		S51°03'57"W		
Tangent Direction:		S38°56'03"E		

Element: Circular				
SC	( )	614+54.15 R2	867039.1866	1605583.6396
HPI	( )	618+78.38 R2	866709.1931	1605850.2348
CC	( )		868547.4080	1607450.5269
CS	( )	622+93.93 R2	866490.5878	1606213.8010
Radius:		2400.00		
Delta:		20°02'54" Left		
Degree of Curvature (Arc):		02°23'14"		
Length:		839.78		
Tangent:		424.23		
Chord:		835.50		
Middle Ordinate:		36.64		
External:		37.21		
Back Tangent Direction:		S38°56'03"E		
Back Radial Direction:		S51°03'57"W		
Chord Direction:		S48°57'29"E		
Ahead Radial Direction:		S31°01'04"W		
Ahead Tangent Direction:		S58°58'56"E		
Element: Clothoid				
CS	( )	622+93.93 R2	866490.5878	1606213.8010
SPI	( )	624+04.99 R2	866433.3630	1606308.9726
ST	( )	626+26.93 R2	866332.4040	1606506.7506
Entrance Radius:		2400.00		
Exit Radius:		0.00		
Length:		333.00		
Angle:		03°58'30" Left		
Constant:		893.98		
Long Tangent:		222.06		
Short Tangent:		111.05		
Long Chord:		332.93		
Xs:		332.84		
Ys:		7.70		
P:		1.92		
K:		166.47		
Tangent Direction:		S58°58'56"E		
Radial Direction:		S31°01'04"W		
Chord Direction:		S61°37'56"E		
Radial Direction:		S27°02'34"W		
Tangent Direction:		S62°57'26"E		
Element: Linear				
ST	( )	626+26.93 R2	866332.4040	1606506.7506
END	( )	647+66.54 R2	865359.6180	1608412.4320
Tangential Direction:		S62°57'26"E		
Tangential Length:		2139.61		

### 2.14 Exercise #3 (Individual): Ramp 2 Alignment

1. Continue in the Civil\_Geometry\_J5P3181.dgn



## Ramp 2

Beginning Point:      **X = 1,604,948.9130      Y = 867,834.2818**  
 Ending Point:        **X = 1,604,883.5120      Y = 866,871.1847**

Beginning station of **Ramp 2** is **0+00.00**

### Curve #1 Information

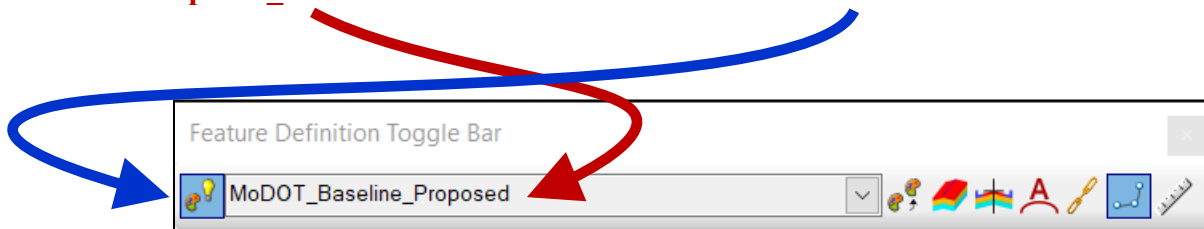
Direction Back                      = **S 36° 17' 04" E**  
 Radius                                = **464.00'**  
 Direction Ahead                    = **S 23° 59' 50" W**

### Curve #2 Information

Direction Back                      = **S 23° 59' 50" W**  
 Degree of Curvature                = **15° 00' 00" (Chord)**  
 Direction Ahead                    = **S 17° 54' 20" E**

**Note:** Before you start this exercise understand it is best to use the most accurate information you are given. Information like Coordinates out to 4 decimal places, and Line Direction bearings out to the “seconds” place, are all very accurate to use. Things to avoid are Coordinates, Stations, and Distances only reported to two decimal places.

2. Within the Feature Definition Toggle Bar set the active feature to **Alignment > MoDOT Proposed\_Baseline** and then Enable the **Use Active Feature Definition** icon.



3. Store alignment.

**Hint:** To switch between **Arc** and **Chord** Defined Curves you need to select the following:

**File** (takes you to the Backstage) → **Settings** → **File** → **Design File Settings** → **Civil Formatting** → **Radius Settings** → **Degree of Curve Method**

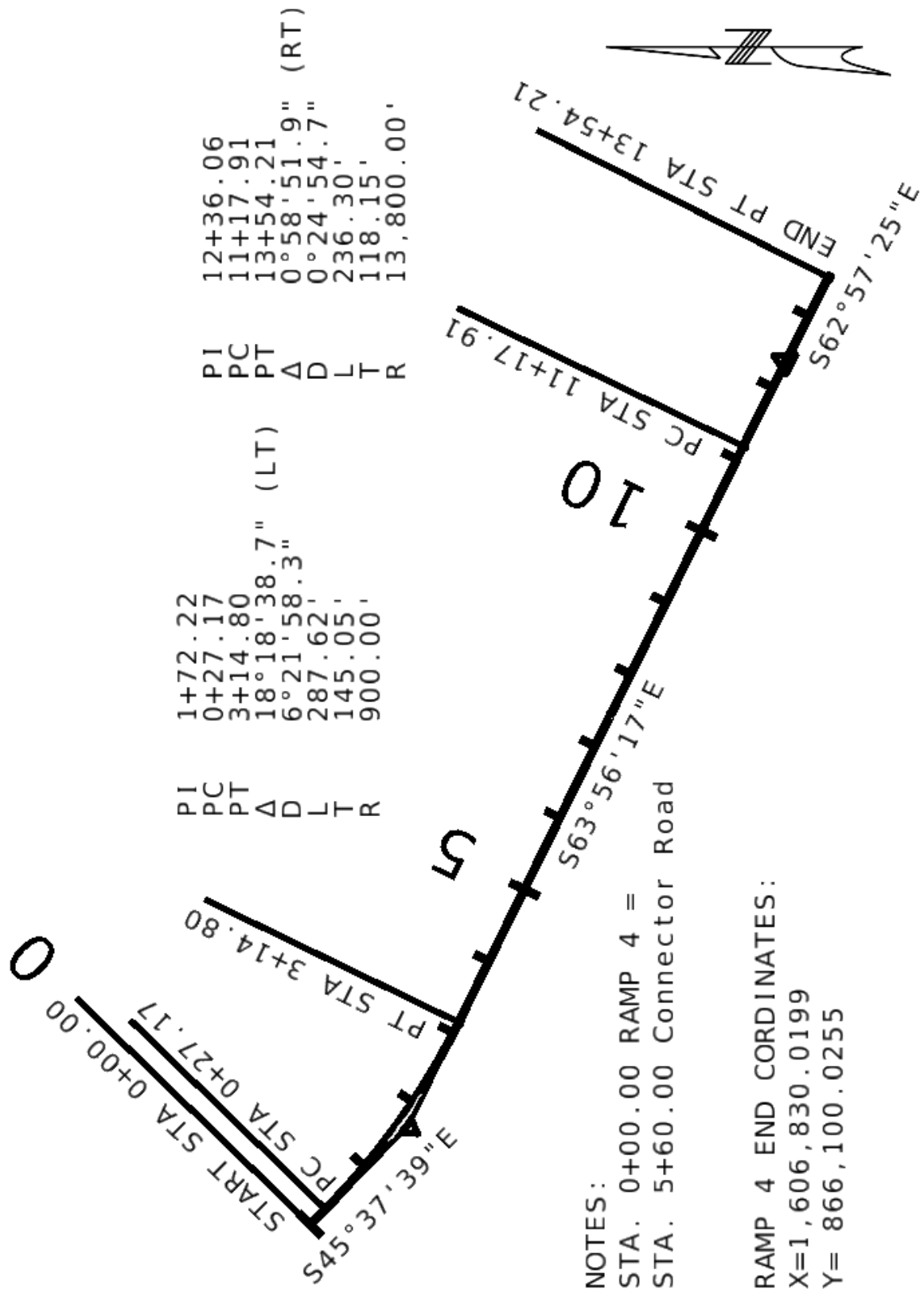
4. Annotate Alignment (Stationing and Tic Marks)
5. Generate a **Horizontal Geometry Report** by “left clicking” on the alignment and selecting from the heads-up menu the **Horizontal Geometry Report Tool**.
6. Using the report verify your alignment matches the Alignment diagram at the beginning of this exercise.

7. Select **File > Update Server Copy**.

Horizontal Alignment Review Report				
Note: All units in this report are in feet unless specified otherwise.				
Alignment Name: Ramp 2				
Alignment Description:				
Alignment Style: Alignment\MoDOT_Baseline_Proposed				
		Station	Northing	Easting
Element: Circular				
PC	( )	0+00.00	867834.2818	1604948.9130
HPI	( )	2+69.41	867617.1109	1605108.3501
CC	( )		867559.6892	1604574.8877
PT	( )	4+88.18	867370.9844	1604998.7821
Radius:		464.00		
Delta:		60°16'54" Right		
Degree of Curvature (Arc):		12°20'54"		
Length:		488.18		
Tangent:		269.41		
Chord:		465.97		
Middle Ordinate:		62.74		
External:		72.54		
Back Tangent Direction:		S36°17'04"E		
Back Radial Direction:		S53°42'56"W		
Chord Direction:		S06°08'37"E		
Ahead Radial Direction:		N66°00'10"W		
Ahead Tangent Direction:		S23°59'50"W		
Element: Linear				
PT	( )	4+88.18	867370.9844	1604998.7821
PC	( )	7+35.82	867144.7468	1604898.0681
Tangential Direction:		S23°59'50"W		
Tangential Length:		247.64		
Element: Circular				
PC	( )	7+35.82	867144.7468	1604898.0681
HPI	( )	8+82.49	867010.7524	1604838.4179
CC	( )		866988.9576	1605248.0230
PT	( )	10+15.17	866871.1847	1604883.5120
Radius:		383.06		
Delta:		41°54'10" Left		
Degree of Curvature (Chord):		15°00'00"		
Length:		280.15		
Chord Length:		279.35		
Tangent:		146.67		
Chord:		273.95		
Middle Ordinate:		25.33		
External:		27.12		
Back Tangent Direction:		S23°59'50"W		
Back Radial Direction:		N66°00'10"W		
Chord Direction:		S03°02'45"W		
Ahead Radial Direction:		S72°05'40"W		
Ahead Tangent Direction:		S17°54'20"E		

## 2.15 Exercise #4 (Individual): Ramp 4 Alignment “Advanced”

1. Continue in the Civil\_Geometry\_J5P3181.dgn





## Ramp 4 (Advanced)

Beginning Point:      **Station 5+60.0000 Connector Road = Station 0+00.00 Ramp 4**

Ending Point:          **X = 1,606,830.0199      Y = 866,100.0255**

Beginning station of **Ramp 4** is **0+00.00**

### Curve #1 Information

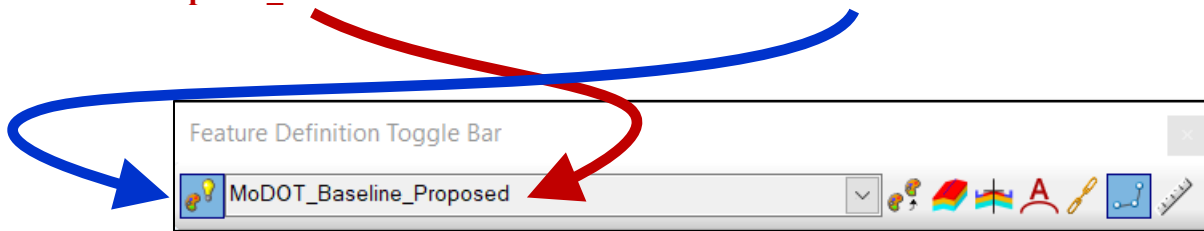
Direction Back	= S 45° 37' 39" E
Radius	= 900.00'
Direction Ahead	= S 63° 56' 17" E

### Curve #2 Information

Direction Back	= S 63° 56' 17" E
Radius	= 13,800'
Direction Ahead	= S 62° 57' 25" E

**Note:** Before you start this exercise understand it is best to use the most accurate information you are given. Information like Coordinates out to 4 decimal places, and Line Direction bearings out to the “seconds” place, are all very accurate to use. Things to avoid are Coordinates, Stations, and Distances only reported to two decimal places.

2. Continue in the **J5P3181\_Civil\_Geometry.dgn** file and delete the previously stored **Ramp 4** alignment.
3. When laying out this alignment **do not** use the ending alignment Coordinates from the **Exercise #1** as the coordinates of the **PC** Location of this example's **second** curve.
4. Within the Feature Definition Toggle Bar set the active feature to **Alignment > MoDOT Proposed\_Baseline** and then Enable the **Use Active Feature Definition** icon.



5. Store alignment.
6. Annotate Alignment (Stationing and Tic Marks)



7. Generate a **Horizontal Geometry Report** by “left clicking” on the alignment and selecting from the heads-up menu the **Horizontal Geometry Report Tool**.
  - a. Using the report verify your alignment matches the Alignment diagram at the beginning of this exercise.
8. Select **File > Update Server Copy**.

Horizontal Alignment Review Report				
Report Created: Wednesday, December 7, 2022				
Time: 10:49:34 AM				
Project: Default				
Description:				
File Name: c:\temp\dms24340\Civil_Geometry_J5P3181.dgn				
Last Revised: 12/7/2022 10:44:59				
Note: All units in this report are in feet unless specified otherwise.				
Alignment Name: Ramp 4				
Alignment Description:				
Alignment Style: Alignment\MoDOT_Baseline_Proposed				
		Station	Northing	Easting
Element: Linear				
START	( )	0+00.00	866742.6553	1605643.7878
PC	( )	0+27.16	866723.6628	1605663.2009
Tangential Direction:		S45°37'39"E		
Tangential Length:		27.16		
Element: Circular				
PC	( )	0+27.16	866723.6628	1605663.2009
HPI	( )	1+72.21	866622.2282	1605766.8820
CC	( )		867366.9904	1606292.5892
PT	( )	3+14.78	866558.5027	1605897.1809
Radius:		900.00		
Delta:		18°18'38" Left		
Degree of Curvature (Arc):		06°21'58"		
Length:		287.62		
Tangent:		145.05		
Chord:		286.40		
Middle Ordinate:		11.47		
External:		11.61		
Back Tangent Direction:		S45°37'39"E		
Back Radial Direction:		S44°22'21"W		
Chord Direction:		S54°46'58"E		
Ahead Radial Direction:		S26°03'43"W		
Ahead Tangent Direction:		S63°56'17"E		

Element: Linear				
PT	( )	3+14.78	866558.5027	1605897.1809
PC	( )	11+17.90	866205.6571	1606618.6409
Tangential Direction:		S63°56'17"E		
Tangential Length:		803.12		
Element: Circular				
PC	( )	11+17.90	866205.6571	1606618.6409
HPI	( )	12+36.06	866153.7462	1606724.7826
CC	( )		853808.8469	1600555.7129
PT	( )	13+54.21	866100.0255	1606830.0199
Radius:		13800.00		
Delta:		00°58'52" Right		
Degree of Curvature (Arc):		00°24'55"		
Length:		236.31		
Tangent:		118.16		
Chord:		236.30		
Middle Ordinate:		0.51		
External:		0.51		
Back Tangent Direction:		S63°56'17"E		
Back Radial Direction:		S26°03'43"W		
Chord Direction:		S63°26'51"E		
Ahead Radial Direction:		S27°02'35"W		
Ahead Tangent Direction:		S62°57'25"E		

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## Chapter 3

# Vertical Geometry

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### 3.1 Objectives

- Create and store vertical alignments using **Vertical Geometry** tools
- Review the Vertical Geometry Settings
- View Vertical Geometry Standards and Reports
- Modifying Vertical Geometry information
- Using the Table Editor

### 3.2 Definitions

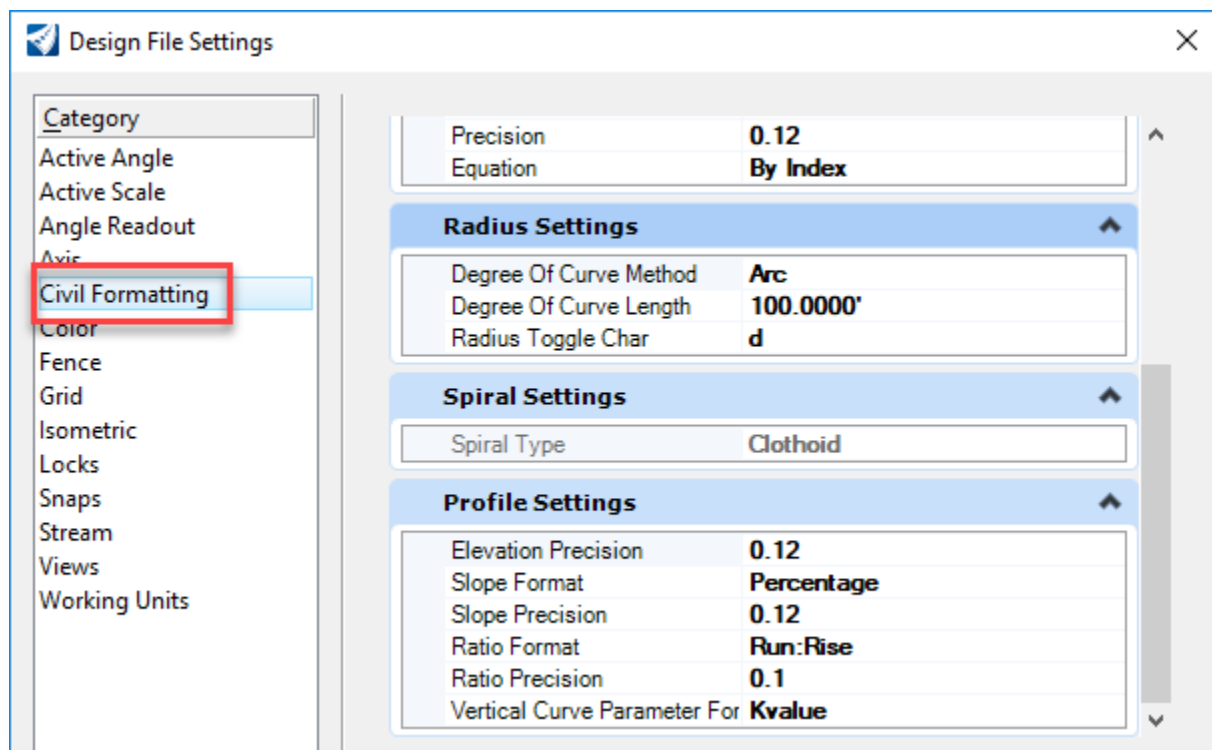
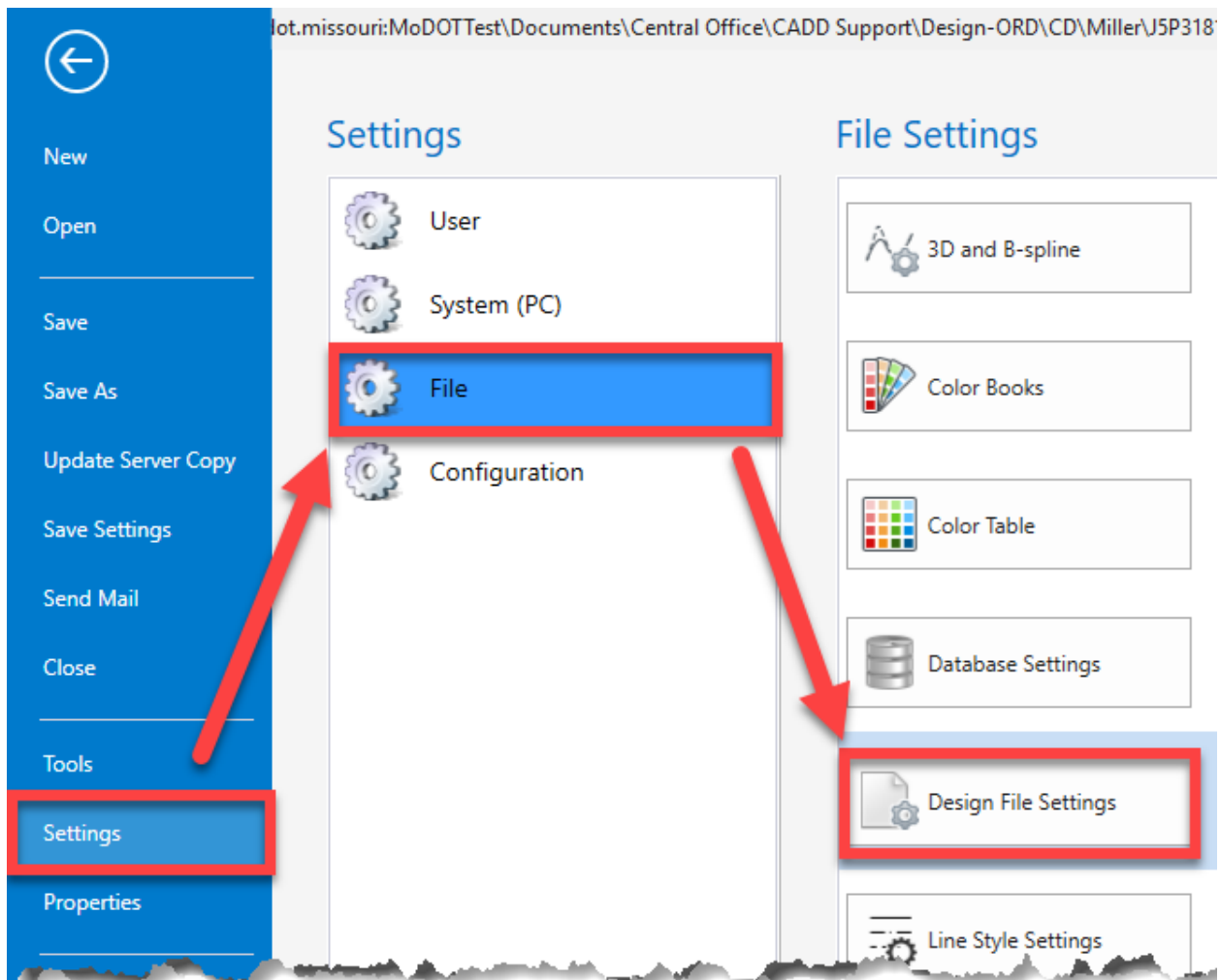
The **Vertical Geometry** ribbon group in the *OpenRoads Modeling workspace > Geometry tab* is a collection of Open Roads tools that are used to graphically create and modify proposed design profiles or modify an existing ground profile. These operations may be accomplished through a dialog box and/or by dynamic manipulation of graphic elements.

### 3.3 Vertical Geometry Settings

Profiles have overall settings that may be modified to display information the user may wish to see. Examples include Elevation and Slope precision, Slope format and ratio settings.

1. From the drawing click **File** from the pull-down menu
2. Click **Settings** from the side panel options
3. Click on **File** under the Settings pane
4. Click on **Design File Settings**
5. Choose **Civil Formatting**
6. Make the desired changes and click **OK**

**Note:** See next page for Vertical Geometry Settings dialog.



## 3.4 Vertical Geometry Tools



### Open Profile Model

Use the Open Profile Model command to generate a profile view for the chosen feature and gain access to the Vertical Geometry tools.

1. Ribbon: Geometry > Vertical > **Open Profile Model**, click the Open Profile Model icon.
2. Move the cursor into a view and note the command prompt to *Locate Plan Element*.
3. Select the plan element with which you wish to work in profile.
4. The cursor is now equipped with the prompt *Select or Open View*.
  - a. If another View is already open, data point in it to present the selected element in profile. (if the 3D model has been opened using the F6 tool, do not use this view. It is set up with different viewing displays and will cause confusion when working with the profile)
  - b. If another view is not open, select a view from the *View Groups* toolbar that is not being used for other models, then data point in the new View.
5. Use the Vertical Geometry tools to create or edit your vertical alignment.

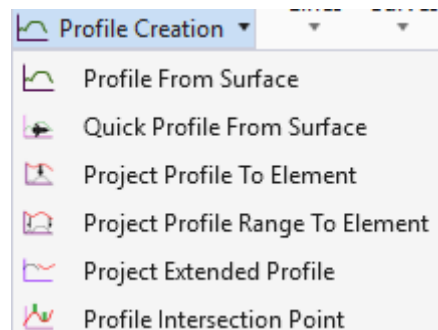


### Set Active Profile

Use the *Set Active Profile* command to designate which of profile elements will drive the 3D model. The result is the creation of a 3D spline in the 3D model representing the combination of the Horizontal alignment plus the Design profile.

### 3.4.2 Profile Creation Tools

The **Profile Creation** drop down in the **Vertical Geometry** ribbon group in the *OpenRoads Modeling workspace > Geometry tab* is a collection of Open Roads tools that assist in the creation of a proposed profile. Surface profiles can also be utilized to create offsets of existing ground or other terrain models accessible to the design file.



**Profile from Surface**

Use the *Profiles from Surface* command to generate a profile whose elevations are determined by draping onto a surface. The surface may be a terrain model, a mesh, or mesh solid.

**Quick Profile from Surface**

*Quick Profile from Surface* is a companion command that provides the same result but simplifies the input by assuming that the entire element is draped and that the offsets are zero.

**Project Profile To Element**

*Project Profile To Element* is used to show one element's profile into the profile view of another element.

**Project Profile Range To Element**

*Project Profile Range To Element* performs the same function as the Project Profile tool except a station range can be used instead of the entire element. Use the Project Profile Range to Element tool to show a portion of one element's profile in the profile space of another element.

**Project Extended Profile**

Use the *Project Extended Profile* tool to show, in an element's profile view, the profiles of adjacent elements. For example, the edges of pavement adjacent to an intersection turning radius are important in the design of the radius profile.

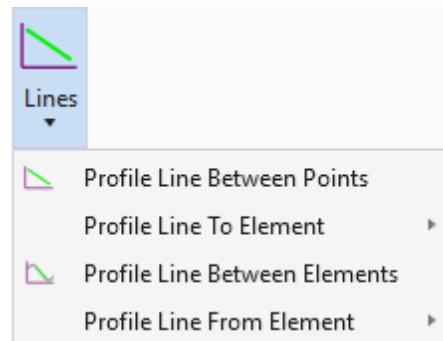
**Place Profile Intersection Point**

Use the *Place Profile Intersection Point* command to indicate in a Profile View where one element crosses another. The point is placed at the station and elevation of the intersected element. The intersected element must have a designated active profile.



### 3.4.3 Vertical Geometry - Line tools

The **Line tool** drop down in the *OpenRoads Modeling workspace > Geometry tab* is a collection of Open Roads tools that assist in the creation of a proposed profile using single line elements.



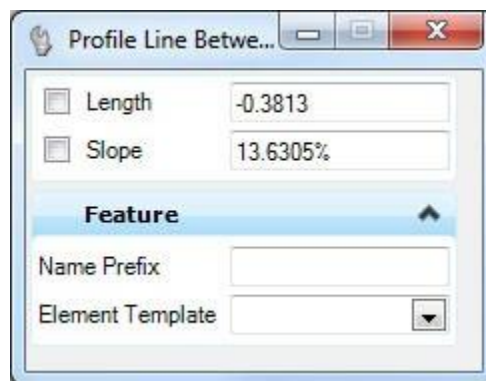
#### Profile Line between Points

Use the Profile Line between Points command to construct a profile line between two designated points.

1. Open the **Lines** drop down in the **Vertical Geometry** ribbon group in the *OpenRoads Modeling workspace > Geometry tab* then click the *Profile Line Between Points* tool.

**Note:** If your View isn't in Profile mode, an error message will indicate that you need to open a Profile Model

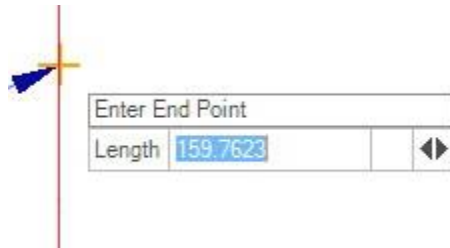
- The *Profile Line Between Points* dialog opens.



- Checking the box next to any field locks the associated value.
2. When you move the cursor into the Profile View, it is equipped with a prompt. Enter the Start Point in the View by data pointing (*i.e.*, left-clicking) at the desired location.



3. When prompted to *Enter End Point*, data point the location for the end of the profile line. Or you can use one of the following methods to establish the Slope or Length (choose between the two by striking the left or aright arrow keys to toggle between them):
  - Move the cursor slightly, key in the value, then data point.
  - As you move the cursor, a value is displayed on the prompt. Data point.



- **Note:** If the data entry field is locked on the Place Plan Profile between Points dialog, you cannot set a new value.



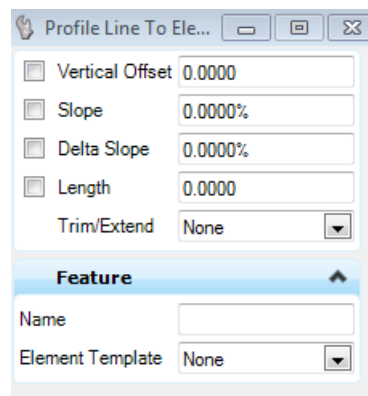
### Profile Line to Element

Use the **Profile Line To Element** command to construct a profile line, at a delta slope, from a designated location to a reference element.

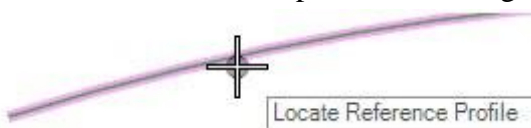
1. In the **Vertical Geometry** ribbon group in the *OpenRoads Modeling workspace > Geometry tab* click the *Profile Line to Element* tool.

**Note:** If your View isn't in Profile mode, an error message will indicate that you need to open a Profile Model.

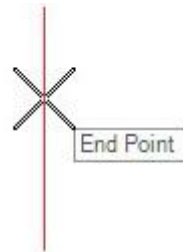
- The *Profile Line to Element* dialog opens.



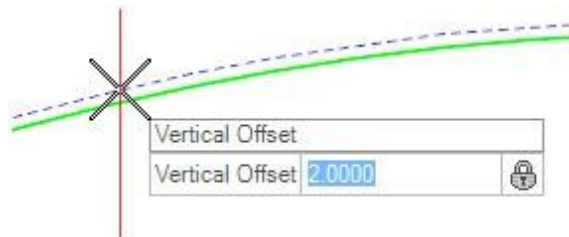
- Checking the box next to any field locks the associated value.
2. When you move the cursor into the Profile View, it is equipped with a prompt. When prompted to *Locate Reference Profile*, move the cursor to the element to which you wish to draw a line then data point on the target element.



3. Establish the *End Point* in the View by data pointing (i.e., left-clicking) at the desired location.



4. Establish the *Vertical Offset* with one of the following methods:
  - Key in the desired distance and press the Enter key to lock then data point to accept.
  - Move the cursor to a station displayed on the prompt. Data point at the desired station.



5. Use one of the following methods to establish the *Delta Slope* or *Length*; choose between the two by using the left or right arrow keys to toggle between them.
  - Key in the desired distance and strike the Enter key to lock then data point to accept.
  - As you move the cursor, a value is displayed on the prompt. Data point at the desired distance.



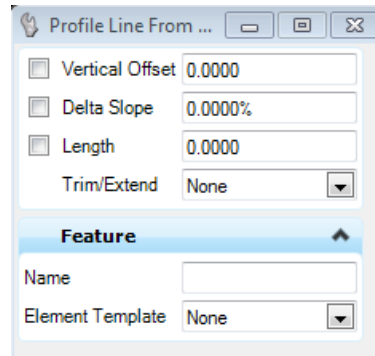
### Profile Line from Element

Use the *Profile Line From Element* command to construct a profile line, at a delta slope, from a reference element to a designated location.

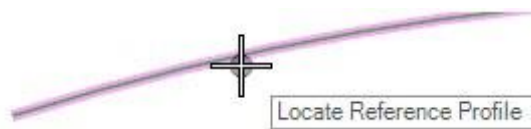
1.  the *Profile Line From Element* tool.

**Note:** If your View isn't in Profile mode, an error message will indicate that you need to open a Profile Model.

- The *Profile Line from Element* dialog opens.



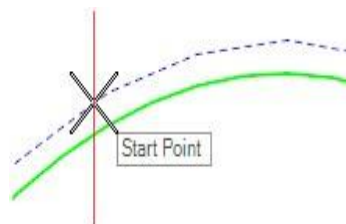
- Checking the box next to any fields locks the associated value.
2. When you move the cursor into the Profile View, it is equipped with a command prompt requesting that you *Locate Reference Profile*, so move the cursor to the element from which you wish to draw a line then data point (i.e., left-click) on it.



3. Establish the *Vertical Offset* with one of the following methods:
  - Key in the distance and strike the Enter key to lock then data point to accept.
  - As you move the cursor, a distance is displayed on the prompt. Data point at the desired distance.

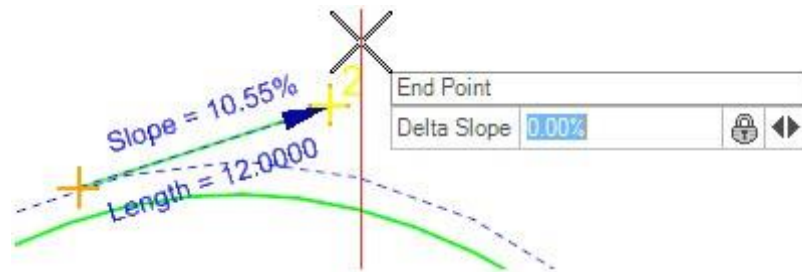


4. Identify the *Start Point* along the offset line at the location where the profile line should cross. Data point at the location.

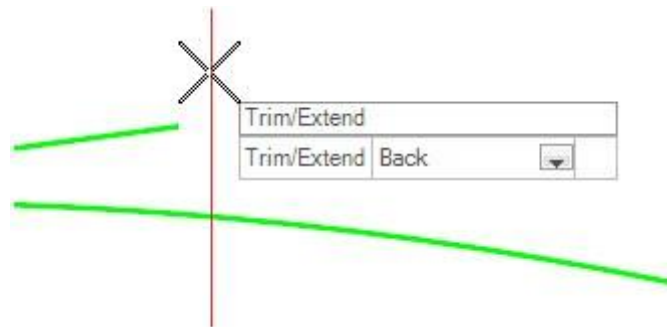


5. To establish the *Delta Slope* or *Length*, select the left or right arrow keys to toggle between them then perform one of the following:
  - Key in the value then data point.

- The value is displayed on the prompt and updated as it moves. Data point at the value.

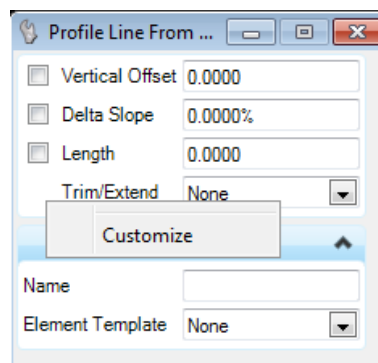


6. To trim the element at the intersection with the Profile line or to extend the element to intersect with the Profile line, strike the up or down arrow keys to choose a Trim/Extend option.

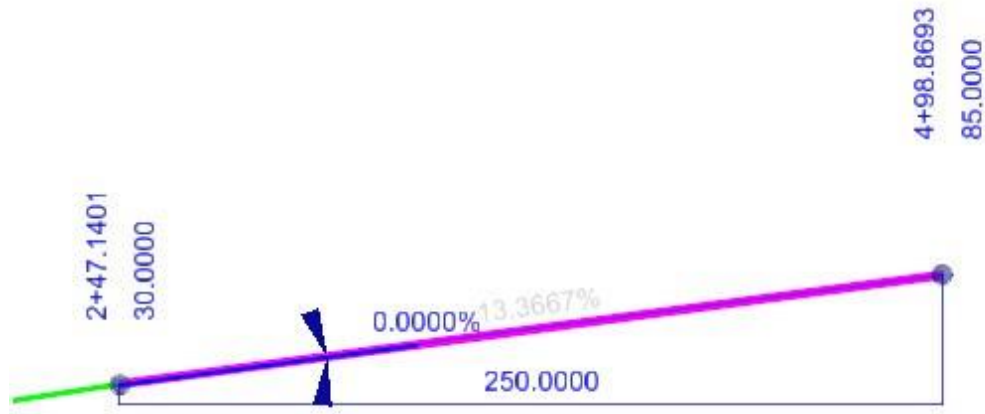


## Dialog Customization

Right-click on the *Profile Line From Element* dialog to customize it for specific tasks or to personal preference.



## Manipulators



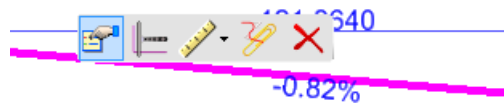
Manipulators are available for:

- Offset from base element (not shown here)
- Delta Slope
- Length
- Drag a grip to dynamically adjust start and end distance

## Properties

To View the new element's properties, equip the Element Selection tool.

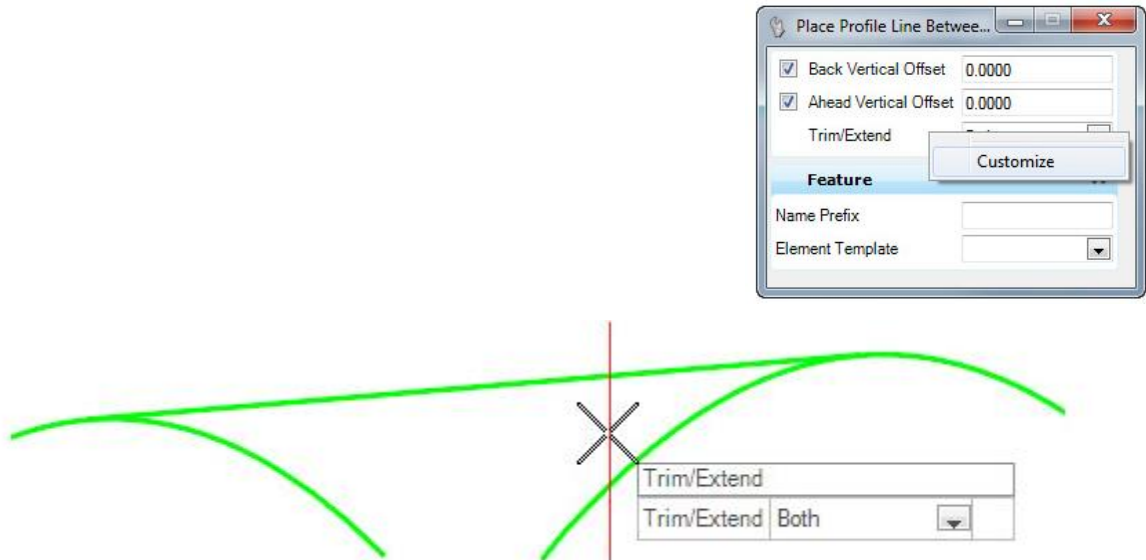
Select the element in the View then let the cursor hover over the selected element. Click the Properties icon to access rule data for the chosen element.



**Tangent Profile Line from Element** - Creates a profile line from another element at zero deflection, applicable only when the From element is a profile curve, Offset locked at zero

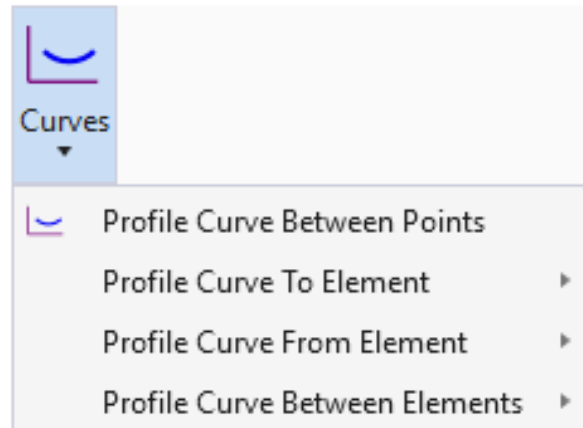
**Profile Complex by VPI**

Use the *Profile Line between Elements* command to construct a profile line between two previously placed profile curves.



### 3.4.4 Curves tools

The **Curve tool** drop down in the *OpenRoads Modeling workspace > Geometry tab* is a collection of Open Roads tools that assist in the creation of a proposed profile single element curves. The lines and curves created can be combined to form one complete profile.



#### Profile Curve Between Points

Use the *Profile Curve between Points* tool to construct a vertical curve between designated points.

1. Select the Profile Curve between Points icon.
  - The Place Profile Curve between Points dialog opens.

A screenshot of the 'Profile Curve Between Points' dialog box. The dialog has a title bar with a gear icon and the text 'Profile Curve Between Po...'. It contains several fields and checkboxes. The 'Placement Method' is set to 'Start\End\Pass-through'. There are checkboxes for 'Length', 'Start Grade', 'End Grade', 'Vertical Curve Parameter', and 'Vertical Curve Type'. The 'Length' field is set to '0.0000', 'Start Grade' to '0.00%', 'End Grade' to '0.00%', 'Vertical Curve Parameter' to '0.000', and 'Vertical Curve Type' to 'Parabola'. Below these is a 'Feature' section with a 'Feature Definition' set to 'No Feature Definition' and a 'Name' field.

- Checking the box next to any of the fields locks in the associated value.



- When you move the cursor into the Profile View, it is equipped with a command prompt that invites you to choose a Placement Method. Navigate the options by striking the up and down arrow keys.

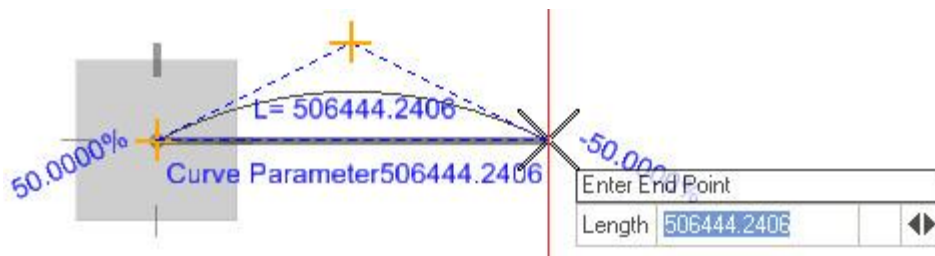


### Start\End\VPI

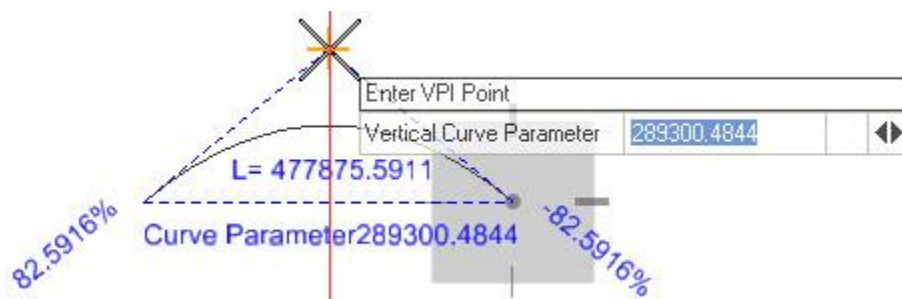
- To create a symmetrical, vertical curve defined by a Start Point, an End Point, and the Vertical Point of Intersection, choose Start\End\VPI by striking the down arrow key on the Placement Method prompt. Strike the Enter key to initiate the Start\End\VPI method.
- When prompted to "Enter Start Point", so move the cursor to the point at which you wish the curve to originate then data point.



- When prompted to "Enter End Point"; use one of the following methods to establish the end of the curve:



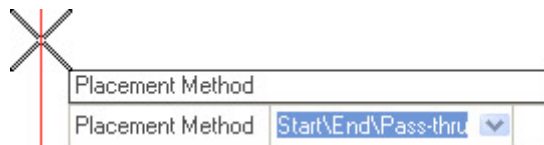
- Move the cursor to the desired location and data point.
  - Strike the left and right arrow keys to choose the Length option on the prompt, key in a value, and then strike the Enter key.
- Use one of the following methods to set the VPI (navigate the options by striking the left or right arrow keys):



- As you move the cursor, a value is displayed on the prompt. Data point at the desired value.
- Enter a value for Start Grade and strike the Enter key then data point.
- Enter a value for End Grade and strike the Enter key then data point.
- Enter a value for Vertical Curve Parameter and strike the Enter key then data point.

### Start\End\Pass-thru

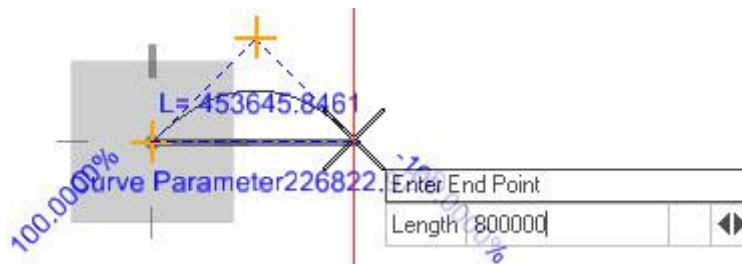
1. To create a symmetrical, vertical curve defined by a Start Point, an End Point, and a point through which the curve must pass, choose Start\End\Pass-thru by striking the down arrow key on the Placement Method prompt. Strike the Enter key to initiate the Start\End\Pass-thru method.



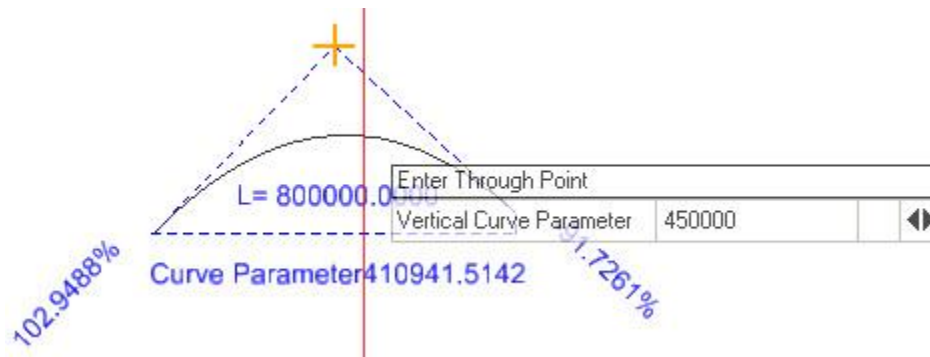
2. When prompted to "Enter Start Point", so move the cursor to the point at which you wish the curve to originate then data point.



3. When prompted to "Enter End Point"; use one of the following methods to establish the end of the curve:



- Move the cursor to the desired location and data point.
  - Strike the left and right arrow keys to choose the Length option on the prompt, key in a value, and strike the Enter key then data point.
4. Use one of the following methods to designate a point through which the curve must pass (navigate the options by striking the left or right arrow keys):



- As you move the cursor, a value is displayed on the prompt. Data point at the desired value.
- Enter a value for Start Grade and strike the Enter key then data point.
- Enter a value for End Grade and strike the Enter key then data point.
- Enter a value for Vertical Curve Parameter and strike the Enter key then data point.

### High\Low\End

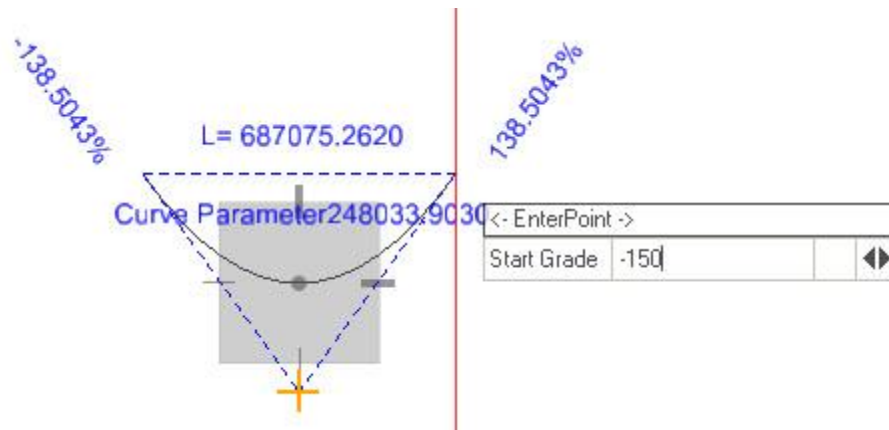
1. To create a symmetrical, vertical curve defined by a the High or Low Point and an End Point, choose igh\Low\End by striking the down arrow key on the Placement Method prompt. Strike the Enter key to initiate the High\Low\End method.



2. When prompted to "Enter HighLow Point", so move the cursor to the curve's highest or lowest point then data pointX.



3. Use one of the following methods to the set the end of the curve (navigate the options by striking the left or right arrow keys):

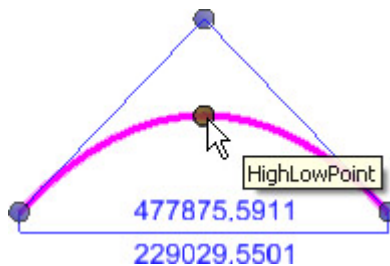


- As you move the cursor, a value is displayed on the prompt. Data point at the desired value.
- Enter a value for Start Grade and strike the Enter key then data point.
- Enter a value for End Grade and strike the Enter key then data point.
- Enter a value for Vertical Curve Parameter and strike the Enter key then data point.

### Vertical Curve Type

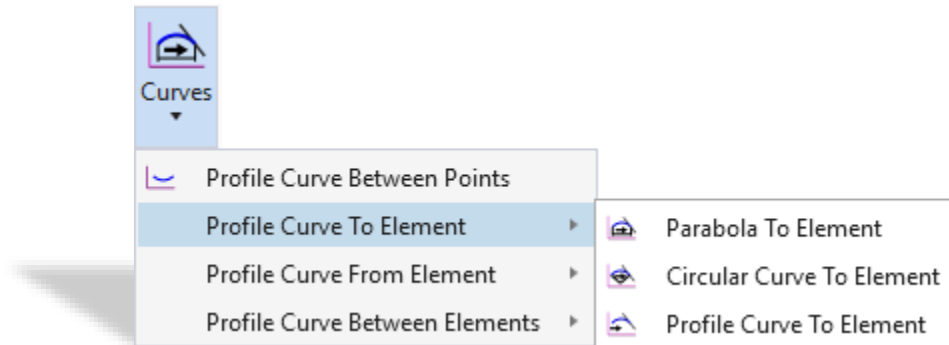
The option for curve type can be changed in the dialog or by pressing Shift key on keyboard. Supported curve types are:

- Parabola Symmetric Parabolic Curve
- Asymmetric Asymmetric Parabolic Curve
- Circular A simple curve defined by radius

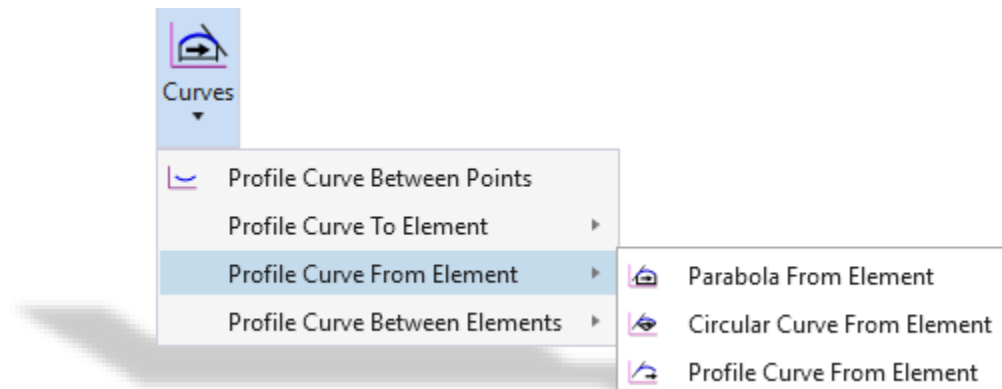


**Profile Curve To Element**

Use the Profile Curve to Element tool to construct a vertical curve from a designated point to an element.

**Profile Curve From Element**

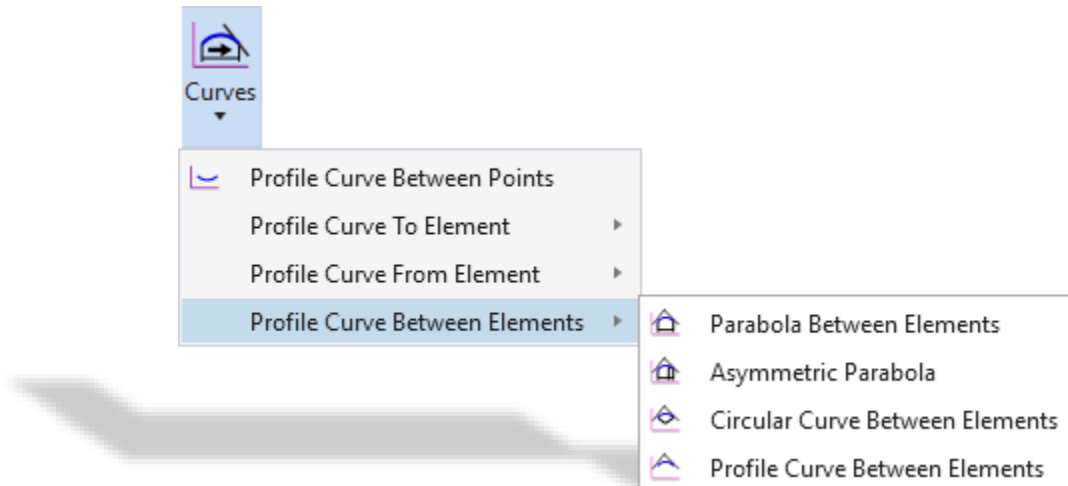
Used to construct a vertical curve between an existing element and a point you will designate.





### Profile Curve between Elements

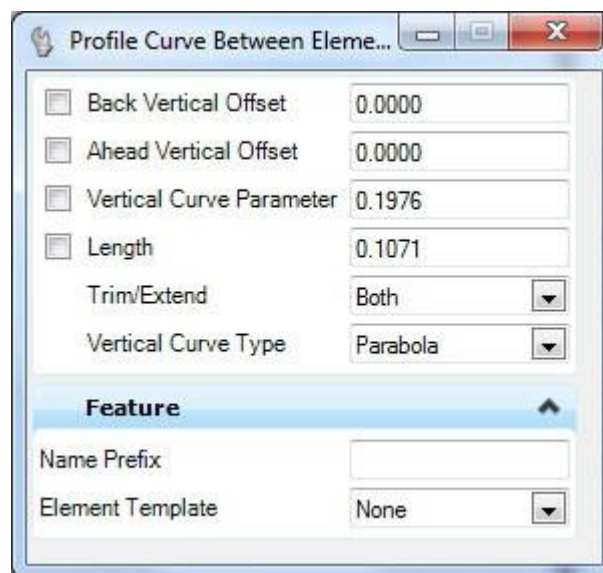
Use the *Profile Curve Between Elements* command to constructs a vertical curve between two designated elements.



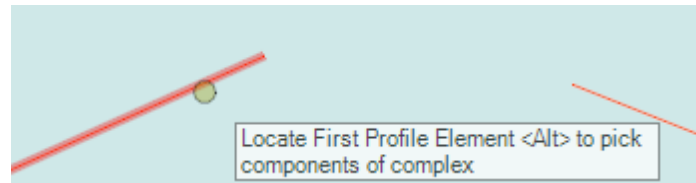
1. In the **Vertical Geometry** ribbon group in the *OpenRoads Modeling workspace* > **Geometry tab** click the *Profile Curve Between Elements* icon.

**Note:** If your View isn't in Profile mode, an error message will indicate that you need to open a Profile Model.

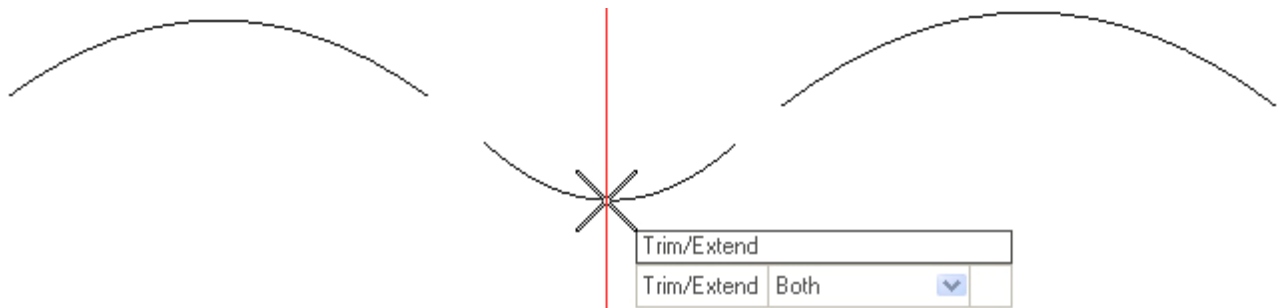
- The *Profile Curve Between Elements* dialog opens.



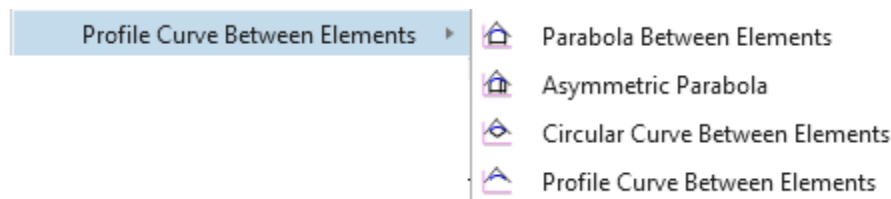
- The back and ahead elements can be lines or curves and can be attached or not. If attached the elements will be clipped based on the curve parameters selected.



- Checking the box next to any of the fields locks-in the associated value.
2. Once the cursor is in the Profile View, a command prompt requesting *Locate First Profile Element* is presented. Data point on the element that will come into the curve.
  3. Set the *Back Vertical Offset* either by keying in a value or locating a distance graphically by moving the cursor.
  4. When prompted to *Locate Second Profile Element*, move the cursor to the element to which the curve must extend then data point.
  5. Enter the Ahead Vertical Offset.
  6. Use one of the following methods to designate a point through which the curve must pass. Navigate the options by selecting the left or right arrow keys.
    - As you move the cursor, a value is displayed on the prompt. Data point at the desired value.
    - Enter a value for *Length* and select the Enter key then data point.
    - Enter a value for *Vertical Curve Parameter* and select the Enter key then data point.
  7. To trim the element at the intersection of the curves or to extend the new curve to intersect with the old, your Offset value must be zero. Strike the down arrow key to choose the Both option then strike the Enter key.



Other tools under Profile Curve Between Elements drop down menu include other types of curves. Typically we only utilize Parabola for MoDOT vertical curves.



**Parabola between Elements** - Creates a parabola between two elements, Offsets are locked at zero



**Asymmetric Parabola** - Creates an asymmetric parabola between two elements, Offsets are locked at zero



**Circular Curve between Elements** - Creates a simple profile radius between two elements, Offsets are locked at zero

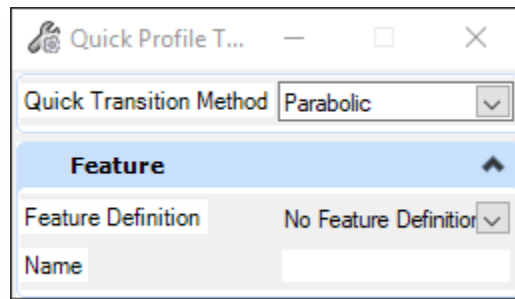


### 3.4.5 Element Profiles tools



#### Quick Profile Transition

Use the *Quick Profile Transition* tool to define the profile of an element by matching the slope and elevation of adjoining elements. Depending on the configuration of adjacent elements, either a single crest/sag curve is created or a reverse transition. Perfect for Radius Return Profiles at intersections.

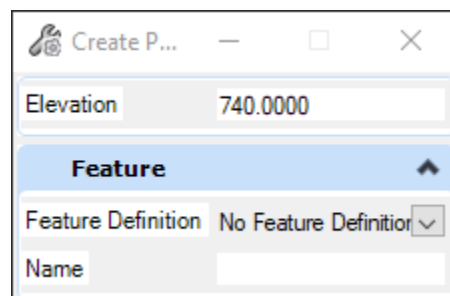


**Note:** The adjoining elements must have a design profile.



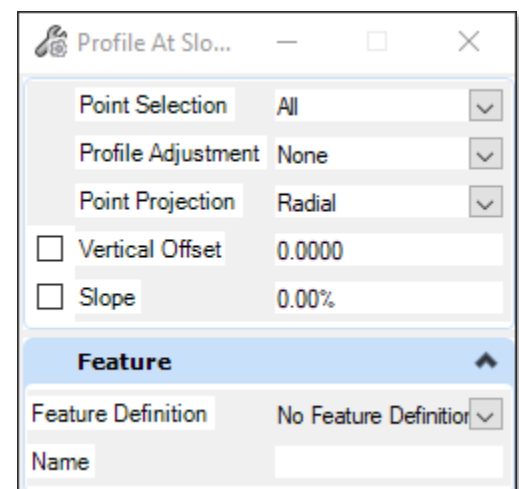
#### Profile By Constant Elevation

Use the *Profile By Constant Elevation* tool to define a flat profile at a given elevation for the entire element.



#### Define Profile by Slope from Point

Use the *Define Profile by Slope from Point* tool to define a profile of an element by computing a slope from a 3D point. A 3D Point is created when placing a point with an Elevation.





### Profile by Slope From Element

Use the *Profile by Slope From Element* tool to define an elements profile by projecting a fixed slope from another element with a design profile.

1. Select the Define Profile by Slope from Element icon.
  - o The Define Profile by Slope from Element dialog opens.

Profile At Slope

Slope Style: Constant

☐ Slope: 0.00%

☐ Vertical Offset: 0.0000

**Range**

☐ Lock To Start

☐ Start Distance: 0.0000'

☐ Lock To End

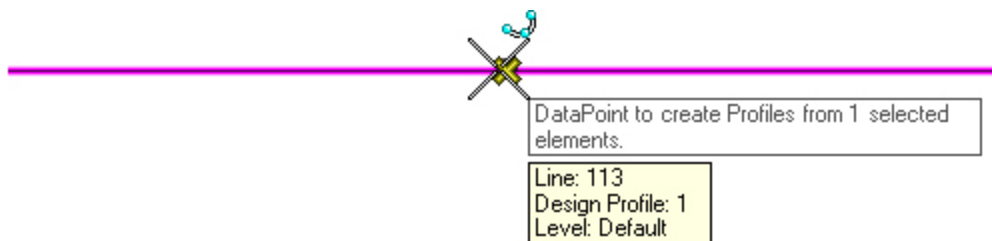
☐ End Distance: 0.0000'

**Feature**

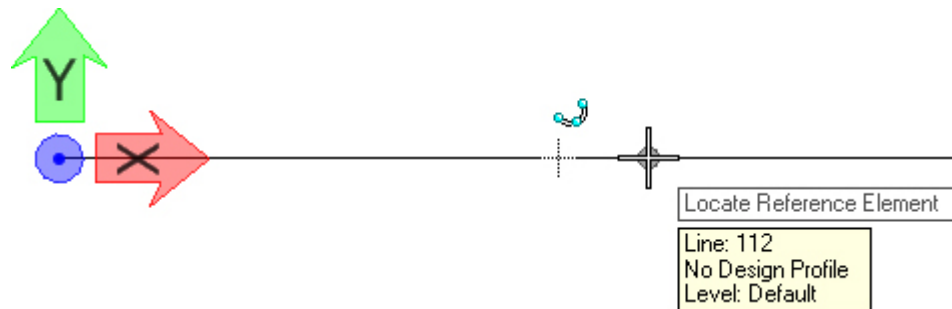
Feature Definition: No Feature Definition

Name:

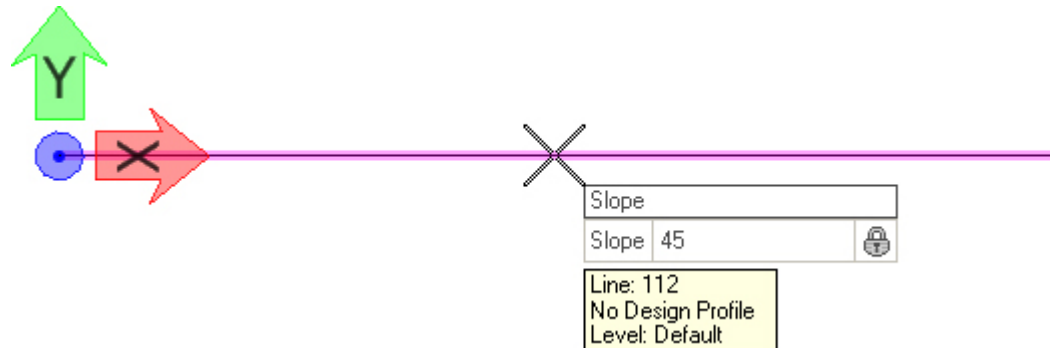
- o Checking the box next to any of the fields locks in the associated value.
2. When you move the cursor into the View, it is equipped with a command prompt. Select the element that you wish to define the profile.



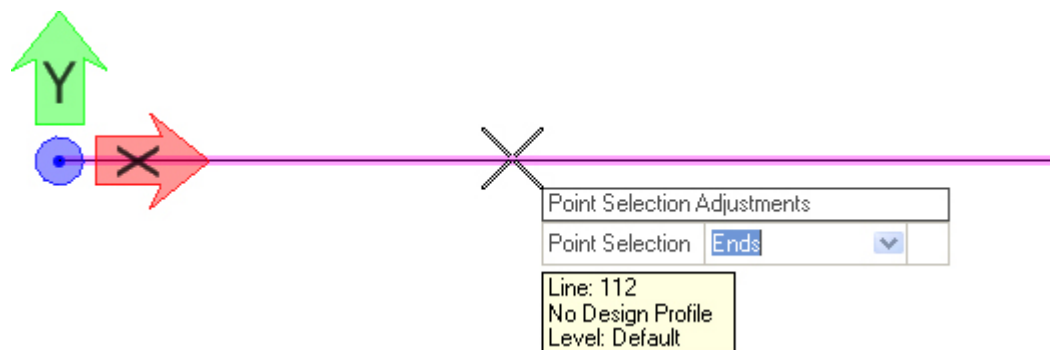
3. When prompted to "Locate Reference Element", move the cursor to the element that will serve as a reference for the profile then data point, example, left-click.



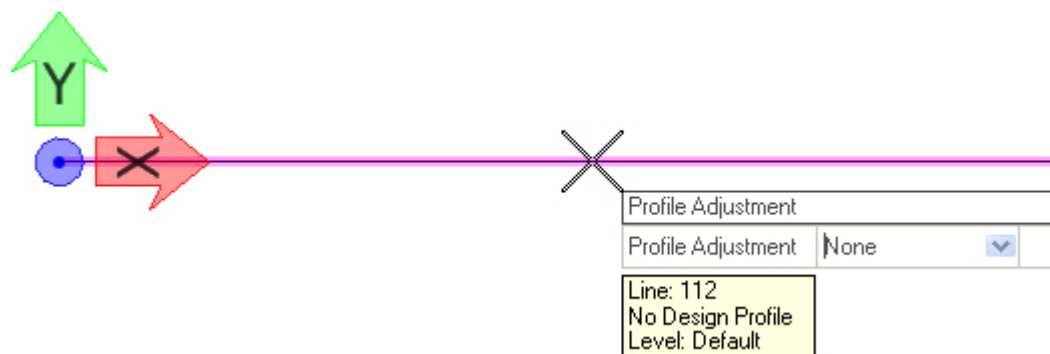
4. When prompted to provide the desired Slope, enter the value then strike the Enter key.



5. When prompted to choose a Point Selection Adjustment, navigate the options by striking the up or down arrow key then strike the Enter key.



6. When prompted to choose a Profile Adjustment, navigate the options by striking the up or down arrow key then strike the Enter key. Options are:



- None - no adjustment is performed

- Minimum - of the points used in previous step, select the minimum elevation and use this value for the entire profile
  - Maximum - of the points used in previous step, select the maximum elevation and use this value for the entire profile
7. The vertical offset is an additional adjustment to the profile after all the above slope computations are complete.



### **Profile By Variable Slope From Element**

Use the *Profile By Variable Slope From Element* tool to define an elements profile by projecting a variable slope from another element with a design profile. This tool differs from the Profile by Slope tool only in the fact that you have additional options. Specifically, you can define a range instead of the entire element, and there are multiple methods of slope rather than fixed slope alone.

Options for slope style are:

- *Constant* uses a constant fixed slope
- *Linear* slope transitions between a start and end value using a linear method
- *Reverse Biquadratic* slope transitions between a start and end value using a reverse biquadratic transition method
- *Reverse Cubic* slope transitions between a start and end value using a reverse cubic transition method



### **Profile By Vertical Offset From Element**

Use the *Profile By Vertical Offset From Element* tool to define the profile of an element based on a vertical offset. The results are similar to Profile by Variable Slope tool, except that, instead of transitioning two slopes, two vertical offsets are used.



### **Profile By 3D Element**

Use the *Profile By 3D Element* tool to produce a profile (in profile space) from a 3D element in the drawing. Must have a 3D element referenced in to the 2D Default model.

### 3.4.6 Modify tools

The **Modify** drop down in the *OpenRoads Modeling workspace* > **Geometry tab** is a collection of Open Roads tools to assist in copying, inserting curves or appending elements to a complex profile.



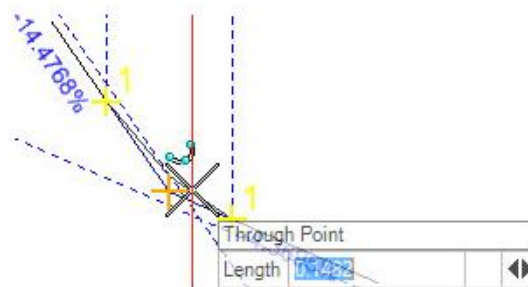
#### Copy Vertical

*Copy Vertical* tool is used to replicate geometry in the same horizontal element with the same or different feature definition. The profiles can also be copied to another piece of horizontal or vertical geometry.



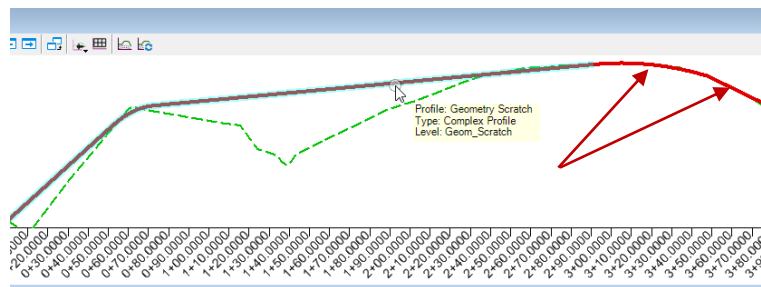
#### Profile Insert Curve

Use the *Profile Insert Curve* tool to insert a vertical curve into a profile element. The tool will allow the user to insert a defined parabolic curve.



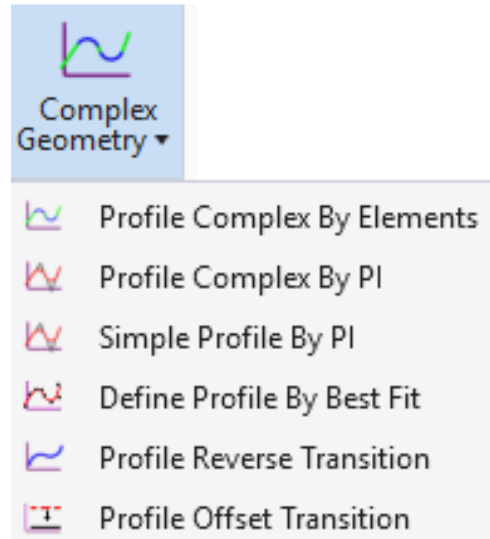
#### Append Profile Element

Use the *Append Profile Element* tool to append additional elements to a previously established complex element. First element must be a complex element, additional elements may be curves, lines or complex elements.



### 3.4.7 Complex Geometry tools

The **Complex Geometry** drop down in the *OpenRoads Modeling workspace > Geometry tab* is a collection of Open Roads tools that assist in the creation of a proposed profile alignments or complex chains. These tools create or combine elements to create a complex profile with tangents and parabolic curves.



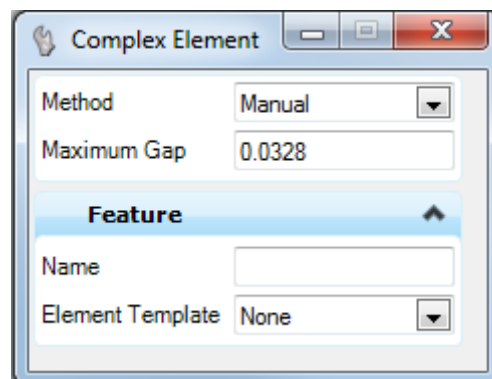
#### Profile Complex by Elements

Use the *Profile Complex by Elements* command to construct a complex profile element from previously placed elements.

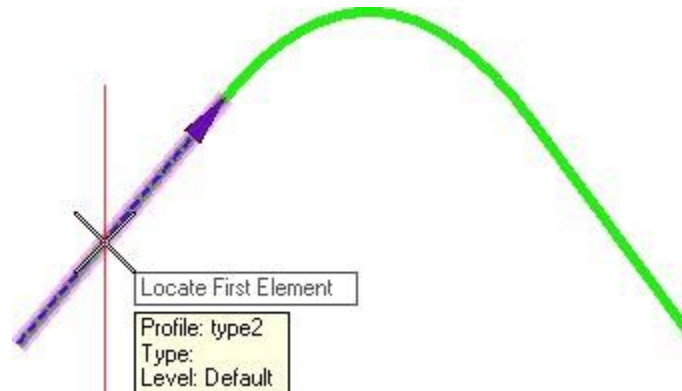
1. Open the *OpenRoads Modeling workspace > Geometry tab* go to the Vertical Geometry section then click the **Complex Geometry** tool and choose the *Profile Complex by Elements* tool.

**Note:** If your View isn't in Profile mode, an error message will indicate that you need to open a Profile Model.

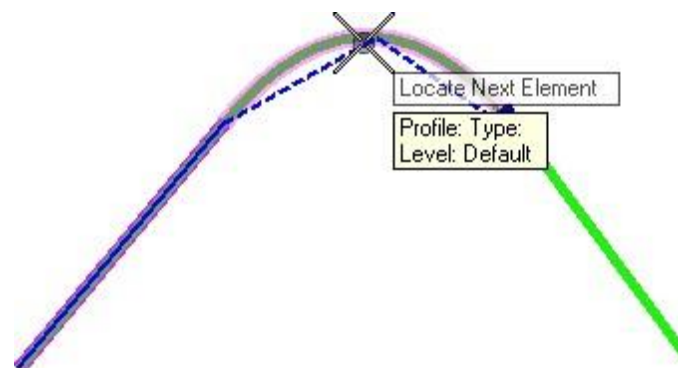
- The *Complex Elements* dialog opens.
- Checking the box next to any of the fields locks-in the associated value.



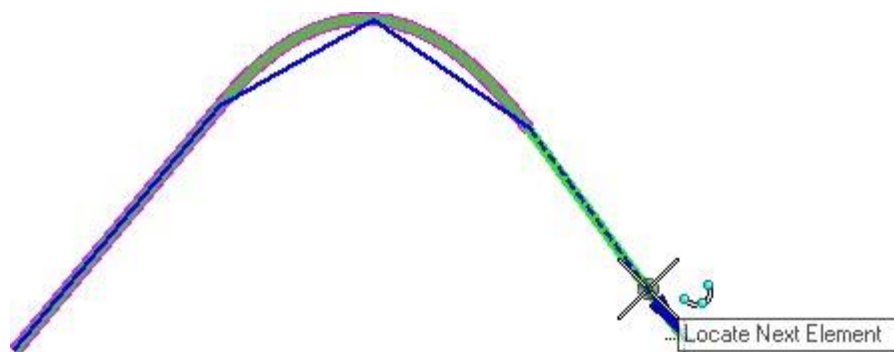
2. On the *Complex Element* dialog, expand the *Method* drop-down and choose the **Manual Option**.
  - **Manual** allows the identification of the elements to include and the direction of the elements.
  - **Automatic** will select the elements based on juxtaposition.
3. When you move the cursor into the Profile View, it is equipped with a command prompt requesting that you *Locate First Element*, move the cursor to one of the elements that you wish to include in the complex element and click on it.



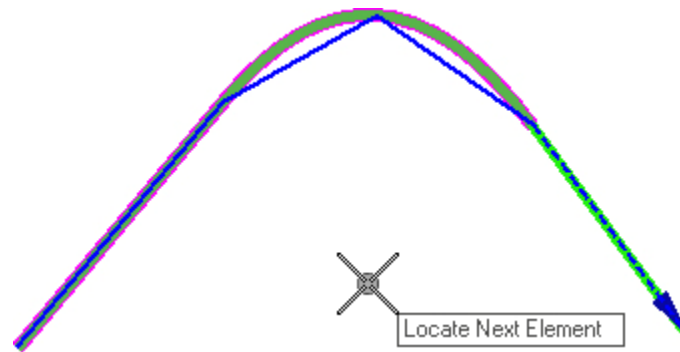
4. When prompted to *Locate Next Element*, move the cursor to another element that you wish to include in the complex element and data point.



5. When prompted to *Locate Next Element*, move the cursor to another element that you wish to include in the complex element and data point.



- When a line appears to link the elements, data point to create the new complex element.



**Note:** The line that appears between the elements vanishes upon confirmation. It is simply a visual aid to identify the component elements.



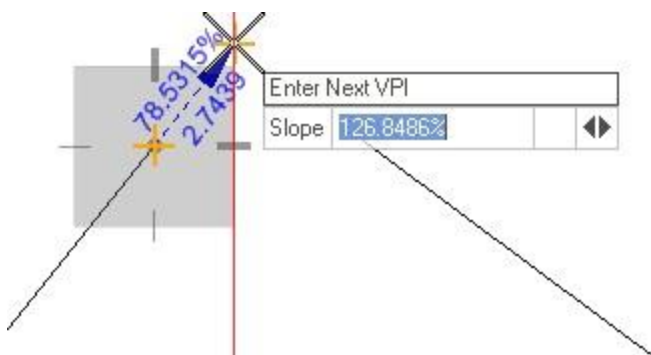
### Profile Complex by PI

Use the *Profile Complex by VPI* command to construct a profile complex defined by vertical points of intersection (VPI).

- In the **Vertical Geometry** ribbon group in the *OpenRoads Modeling workspace* > **Geometry tab** click the *Profile Complex by VPI* tool.
 

**Note:** If your View isn't in Profile mode, an error message will indicate that you need to open a Profile Model.

  - The *Complex Element by VPI* dialog opens.
  - Checking the box next to any of the fields locks-in the associated value.
- When the cursor moves into the Profile View, it is equipped with a command prompt requesting that you *Enter First PI*. Place the cursor over the initial point of intersection by data pointing at the location.
- When prompted to *Enter Next VPI*, use one of the following methods to designate a point through which the curve must pass (navigate the options by striking the left or right arrow keys on the keyboard):



Complex Element By VPI

☐ Vertical Curve Parameter 0.0000  
☒ Curve Length 0.0000  
☐ Slope -61.82%  
Vertical Curve Type Circular

**Feature**

Name  
Element Template None



- As the cursor moves, the value is updated in the prompt. Data point at the required value.
- Enter a value for the *Curve Length* then strike the Enter key to lock in the value. Data point to accept.
- Enter a value for the *Vertical Curve Parameter* then strike the Enter key to lock in the value. Data point to accept.
- Enter a value for the *Slope* then strike the Enter key to lock in the value. The slope can always be locked independently of the length or curve parameter. Data point to accept.

**Note:** The VPI can be positioned dynamically or with the aid of **Civil AccuDraw**. The heads up prompt can also be used to lock desired slope value from the previous VPI to the current VPI.

4. On the 3rd and subsequent VPIs, the Length and/or Curve Parameter can be used to control the curve placed at the previous VPI. For example, the length entered at the 3rd VPI prompt is used to define the curve at VPI 2 and 1.

### Vertical Curve Type

The option for curve type can be changed in the dialog or by pressing Shift key on keyboard. Supported curve types are:

- **Parabola** - Symmetric Parabolic Curve
- **Asymmetric** - Asymmetric Parabolic Curve
- **Circular** - A simple curve defined by radius



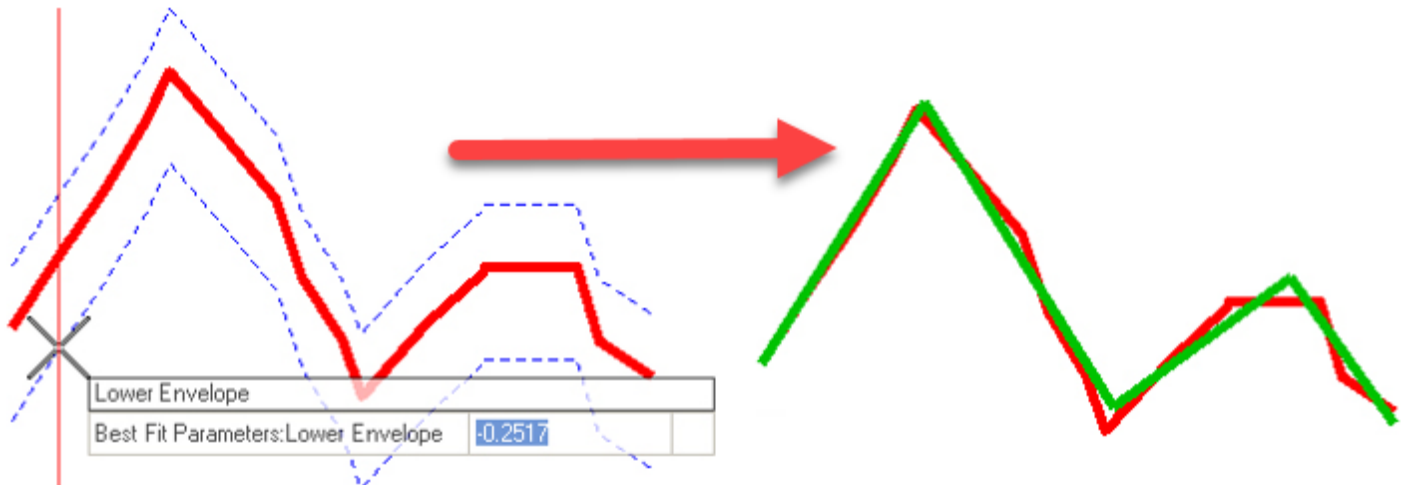
### Simple Profile by PI

Use the *Simple Profile by PI* command to construct a complex profile element by simply clicking locations of VPI's in a profile view. User may input a Vertical Curve Parameter only.



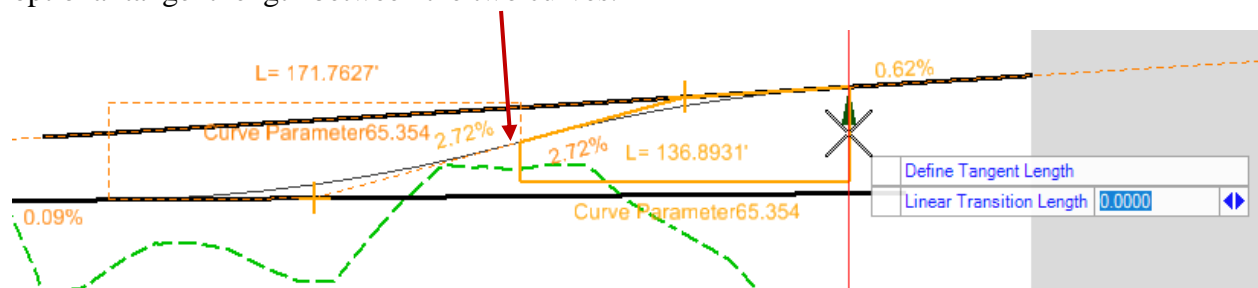
### Define Profile By Best Fit

Use the *Define Profiles by Best Fit* tool to construct a profile complex defined by best fitting through a selected profile. For example, pick an existing ground profile and best fit a profile to match the ground. The program will determine the profile based on an upper and lower envelope and desired and minimum curve information.



### Profile Reverse Transition

*Profile Reverse Transition* constructs reverse curves between previously drawn elements with an optional tangent length between the two curves.



### Profile Offset Transition

*Profile Offset Transition* constructs profile elements at an offset from a base element. The base element may be a line, arc, spiral, or complex.



## 3.5 ORD Common Tools - Profiles

### 3.5.1 Table Editor



Within the **Geometry** tab of OpenRoads Modeling, locate the **Common Tools** group. **Table Editor** tool can be used on horizontal or vertical geometry. Table Editor displays K values, back slope, back tangent length, and allows either parabolic and/or arc defined geometry for vertical geometry. Edit any of the geometry that is available for edit and select Apply.

Profile Table Editor: Geometry Scratch

	Back Tangent Length	Back Slope	Station	Elevation	Curve Length	K Value	Ahead Slope	Ahead Tangent Length
▶		<input type="checkbox"/>	<input type="checkbox"/> 0+00.0000	<input type="checkbox"/> 783.9228			<input type="checkbox"/> 27.60%	52.0280
	52.0280	<input type="checkbox"/> 27.60%	<input type="checkbox"/> 0+62.0280	<input type="checkbox"/> 801.0422	20.0000	0.8082	<input type="checkbox"/> 2.85%	219.0378
	219.0378	<input type="checkbox"/> 2.85%	<input type="checkbox"/> 2+91.0659	<input type="checkbox"/> 807.5781			<input type="checkbox"/>	

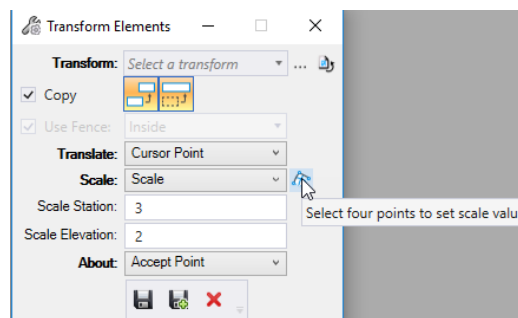
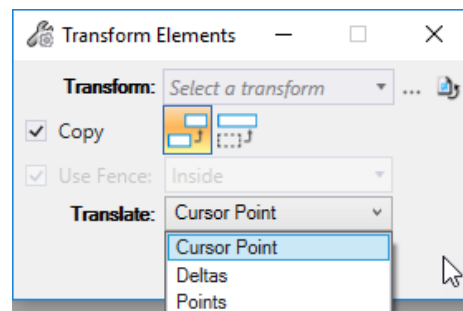
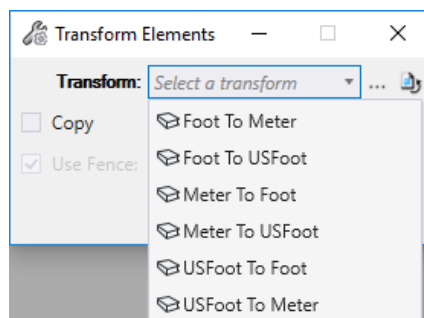
Report Apply

### 3.5.2 Transform Tool









Within the **Geometry** tab of OpenRoads Modeling, locate the **Common Tools** group.



**Transform** tool can be used on horizontal or vertical geometry. Options for this tool depend on the active model when the tool is invoked. With the profile model active, Copy and Scale options are available. Options are also available to transform from English to Metric units as well.



Transforms can be saved for future use.

Setting	Description
Transform	Select a transform. Choose Foot to Meter, Foot to USFoot, Meter to Foot, Meter to USFoot, USFoot to Foot, or USFoot to Meter.
 Browse Transforms	
 Reset All Transforms	
 Enable to translate elements.	Choose one or more Enable to rotate elements, Enable to scale elements, or Apply transforms to Z or elevation values.
 Scale	Choose Scale or Active Scale.  Select 4 points to set scale value.
Translate Select translate option.	Choose Cursor Point, Deltas, or Points. Active if Enable to translate elements is enabled.
Copy	Enable to make a copy.
 Save Transform	
 Duplicate Transform	
 Delete Transform	

### 3.5.3 Simplify Geometry

Within the *Geometry* tab of OpenRoads Modeling, locate the **Common Tools** group.



**Simplify Geometry** The tool reduces the rules to the defining geometry. In other words, it removes rules and relationships from other elements, which includes snap rules, offset rules, and

intervals from other elements that constructed the geometry. After running the tool, the geometry reflects the ruling of geometry that is imported in from ALG, GPK, FIL, and LANDXML.

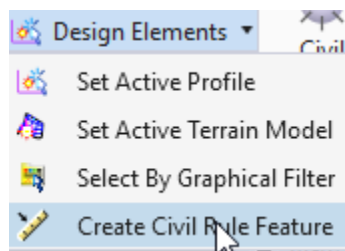
This tool should be used with caution, since the referencing rules that constructed the geometry are removed. This means the original design intent no longer exists and the geometry will no longer update since it no longer monitors these elements for changes.

## 3.6 Profile Rules

Several tools exist in various locations in the Geometry tab of the OpenRoads Modeling ribbon. These tools create rules and remove rules on profile geometry. The tools shown here can be useful when working with the Vertical Geometry line work.

### 3.6.1 Create Civil Ruled Feature

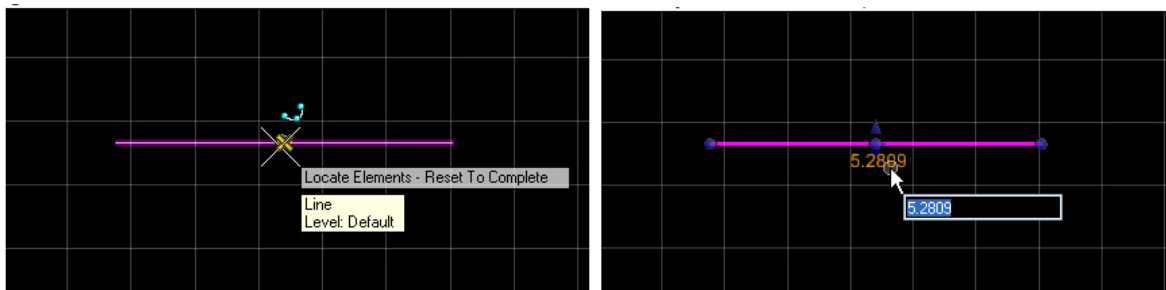
Within the **Geometry** tab of **OpenRoads Modeling**, locate the **Design Elements** drop down and select the down arrow.



Use the *Create Civil Rule Feature* tool to assign Civil Geometry rules to elements created by tools other than civil geometry tools. For example, MicroStation smart lines can become Civil Geometry ruled elements complete with manipulators and all the editing capabilities that derive therefrom.

In profiles, base elements with active profiles that are then complexed in horizontal, automatically pass the base elements forward (requires active profiles). Where this is true vertical geometry it is not editable in the complex profile because it is controlled at the element profile level. A copy can be made that is a vertical element snapshot that is editable using the **Copy Vertical** tool discussed earlier.

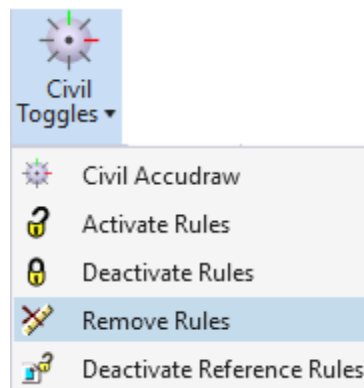
Example: Smartline to Civil Profile Element



### 3.6.2 Remove Rules



Within the **Geometry** tab of **OpenRoads Modeling**, locate the **Civil Toggles** drop down and select the down arrow. Use the **Remove Rules** command to remove rules on selected elements. When rules are removed, the manipulators are unavailable for editing and the elements will not update. This will basically turn the element into a standard MicroStation element with no civil rules.

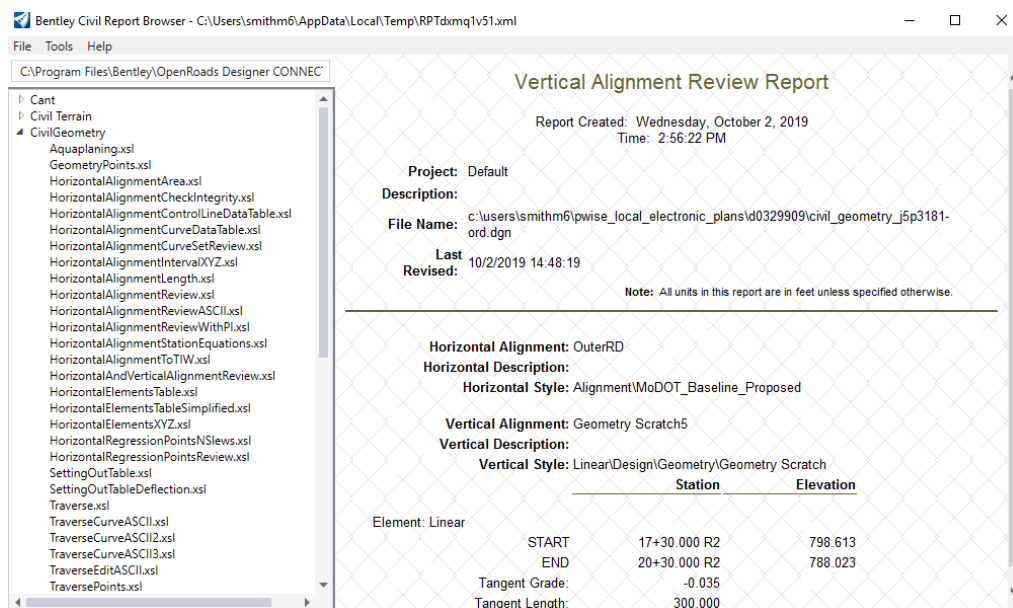


### 3.6.3 Profile Reports

Within the **Geometry** tab of **OpenRoads Modeling**, locate the **General Tools** group in the

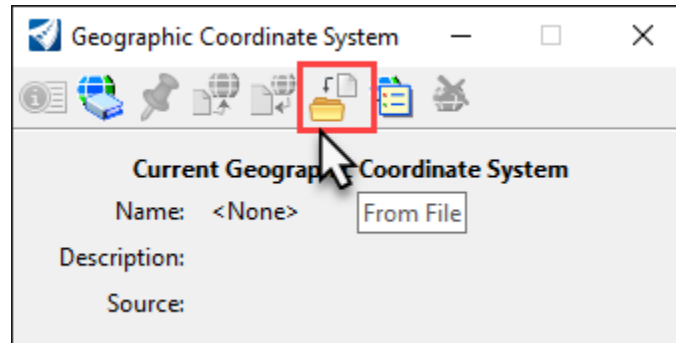
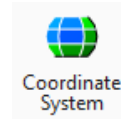


ribbon and select **Reports** down arrow. Choose **Profile Reports**. Left click on a profile line, curve or complex element. Reset to complete. When finished, the report will generate with the default style sheet. You may click on other vertical reports and using the Tools > Options pull down to modify the way the report displays the information.

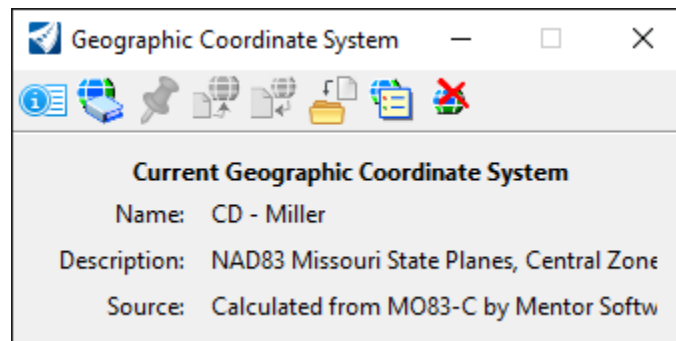


### 3.7 Exercise 1 (Group): Create Route 54 Profile - Part 1

1. Within the **Roadway/data-3** folder, open the file: **Civil\_Geometry\_J5P3181.dgn**
2. Open the **Coordinate System** tool by selecting the **OpenRoads Modeling Workflow → Utilities Tab → Geographic Section**.
3. **If not already set**, Choose the “**From File**” icon.



4. Select the **Terrain\_J5P3181.dgn** file in the **data-3** folder.
5. Verify the settings.



6. If not already set change the **Annotation Scale** to **1”=50’**
7. Set **J5P3181** as the active Terrain Model.
8. After Left Clicking on the **Route 54** Alignment select **Open Profile Model** from the heads-up display.
9. When prompted to **Select or Open View**, select **View 8** from *View Groups* and **data point** in the view.
10. Use **Zoom** (the roller button on the mouse) and the **Pan** (hold the roller button down) to navigate around the profile model.

11. Use the **Profile Complex By VPI** tool and create a “**rough draft**” proposed profile that has 3 VPIs. Adjustments to rough draft profile will be made in next steps. **Do not** Snap or AccuSnap to any location in the profile window.

The **Profile Complex By VPI** tool is located under the **OpenRoads Modeling** Workflow → **Geometry** Tab → **Vertical Section** → **Complex Geometry** Tools.

In the dialog set the following items:

Complex Element By V...

**Parameters**

☐ Vertical Curve Parameter 0.000

☒ Curve Length 100.0000

☐ Slope 0.00%

Vertical Curve Type Parabola

**Feature**

Feature Definition MoDOT\_Baseline\_Propos

Name Route 54 Proposed

Note: **AASHTO 2018** page **3-165** states “For simplicity, a **Parabolic Curve** with an equivalent vertical axis centered on the Vertical Point of Intersection (VPI) is **usually used in roadway profile design.**”

VPI	Station	Elevation	Back Grade	Curve Length
VPI # 1	602+59.49	774.1		
			1.40%	
VPI # 2	627+03.06 R2	808.32		1000
			-3.55%	
VPI # 3	647+66.54 R2	735.07		

12. After the “Rough Draft” profile has been placed use the chart above adjust the **VPI’s Station** values.
13. Next, using the chart above adjust the **Grade Values** for profile.
14. Lastly, using the chart above adjust the **Curve Length** for the Vertical Curve defined in the profile.
15. Select the new **Profile** using the Heads Up display and select **Set As Active Profile**.
16. Select the new **Profile** using the Heads Up display and select **Profile Report**. Verify your Profile data matches data on the next page.
17. Select **File** → **Update Server Copy**.



Vertical Alignment Review Report				
<b>Horizontal Alignment:</b> Route 54				
<b>Horizontal Description:</b>				
<b>Horizontal Style:</b> Alignment\MoDOT_Baseline_Proposed				
<b>Vertical Alignment:</b> Route 54 Proposed				
<b>Vertical Description:</b>				
<b>Vertical Style:</b> Alignment\MoDOT_Baseline_Proposed				
		Station		Elevation
Element: Linear				
	START	602+59.49		774.10
	EQNBK	608+01.01		
	EQNAHD	608+00.00	R2	
	VPC	622+03.06	R2	801.32
	Tangent Grade:	1.40%		
	Tangent Length:	1944.58		
Element: Symmetrical Parabola				
	VPC	622+03.06	R2	801.32
	VPI	627+03.06	R2	808.32
	VPT	632+03.06	R2	790.57
	VHP	624+85.89	R2	803.30
	Length:	1000.00		
	Entrance Grade:	1.40%		
	Exit Grade:	-3.55%		
	$r = (g2 - g1) / L$ :	-0.49		
	$K = 1 / (g2 - g1)$ :	202.02		
	Middle Ordinate:	-6.19		
Element: Linear				
	VPT	632+03.06	R2	790.57
	END	647+66.54	R2	735.07
	Tangent Grade:	-3.55%		
	Tangent Length:	1563.48		

### 3.8 Exercise 1 (Group): Create Route 54 Profile - Part 2

- Next we are going to create the profile a second way using **Civil AccuDraw** to place the Vertical Curve information. First we need to **delete** the previously store profile by selecting the **Route 54 Propose Profile** and using the heads up display and selecting **Delete**.

Select the **Profile Complex By VPI** tool.

The **Profile Complex By VPI** tool is located under the **OpenRoads Modeling Workflow** → **Geometry Tab** → **Vertical Section** → **Complex Geometry Tools**.

In the dialog set the following items:

Complex Element By V...

**Parameters**

☐ Vertical Curve Parameter 0.000

☒ Curve Length 1000.0000

☐ Slope 0.00%

Vertical Curve Type Parabola

**Feature**

Feature Definition MoDOT\_Baseline\_Propos

Name Route 54 Proposed

- Activate the **Civil AccuDraw** tool.
- Snap** or **AccuSnap** to the beginning point of the existing ground.
- This time using Civil AccuDraw and its “**Z**” and “**Slope**” mode, create the same Route 54 Proposed profile using the following criteria:

VPI	Station	Elevation	Back Grade	Curve Length
VPI # 1	Snap to Existing Profile			
			1.40%	
VPI # 2	627+03.06 R2			1000
			-3.55%	
VPI # 3	647+66.54 R2			

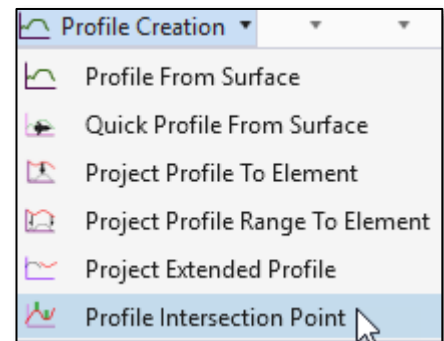
- Select the new **Profile** using the Heads Up display and select **Set As Active Profile**.
- Select the new **Profile** using the Heads Up display and select **Profile Report**. Verify your Profile data matches data on the previous page.
- Select **File** → **Update Server Copy**.

### 3.9 Exercise 2 (Individual): Create Ramp 4 Profile

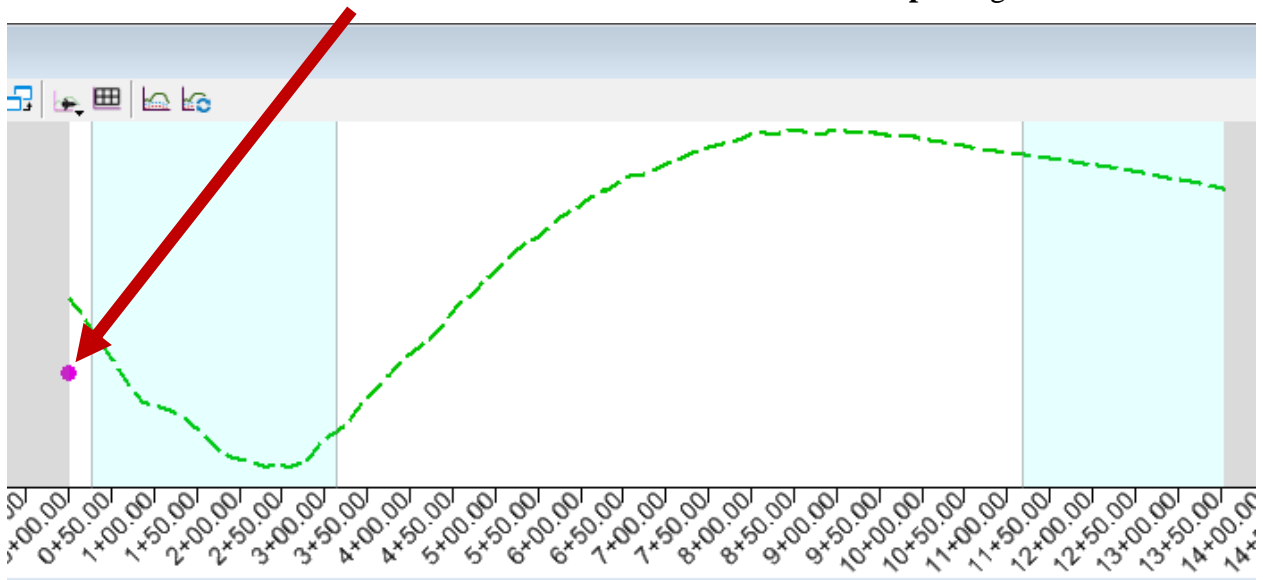
1. Continue working in the **Civil\_Geometry\_J5P3181.dgn**
2. After Left Clicking on the **Ramp 4** Alignment select **Open Profile Model** from the heads-up display.
3. When prompted to *Select or Open View*, select **View 8** from *View Groups* and **data point** in the view.
4. Use **Zoom** (the roller button on the mouse) and the **Pan** (hold the roller button down) to navigate around the profile model.

**Connector Road** crosses over our new **Ramp 4**. There is an active profile for the Connector Road. Place a point in the profile window at the elevation of the intersection.

5. In the **OpenRoads Modeling** workflow, locate the **Vertical** group in the ribbon. Click the arrow by **Profile Creation** and select **Profile Intersection Point**.
  - a. For the “*Locate Element to show Intersection*”, select the Ramp 4 alignment
  - b. For the “*Locate Element which Intersects*”, select Connector Road.



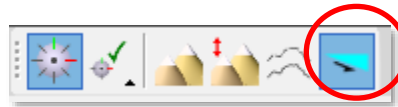
Elevation of **Connector Road** Profile as it crosses the **Ramp 4** alignment



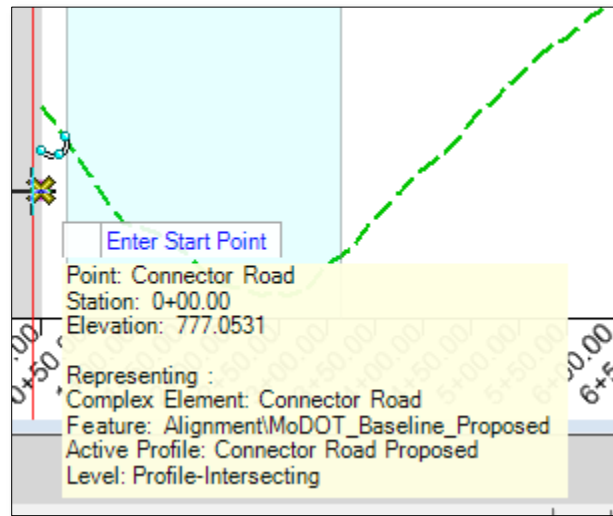
Note: The User might need to turn the Line Weights on in the Profile View to better see the Intersecting Point.

VPI	Station	Elevation	Back Grade	Curve Length
VPI #1	Snap to the Magenta Point representing Connector Rd			
			-4%	
VPI #2	2+50			340
			5.50%	
VPI #3	9+00			300
			(-0.94%)	
VPI #4	Snap to End of Alignment Existing Ground			

6. Turn on Civil Accudraw. Select the **Slope** mode.

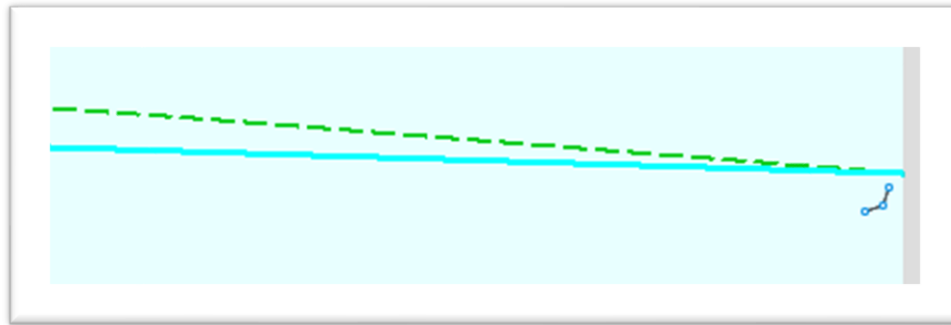


7. Select the  **Profile Line Between Points** tool and snap to the magenta point that represents the **Connector Road**



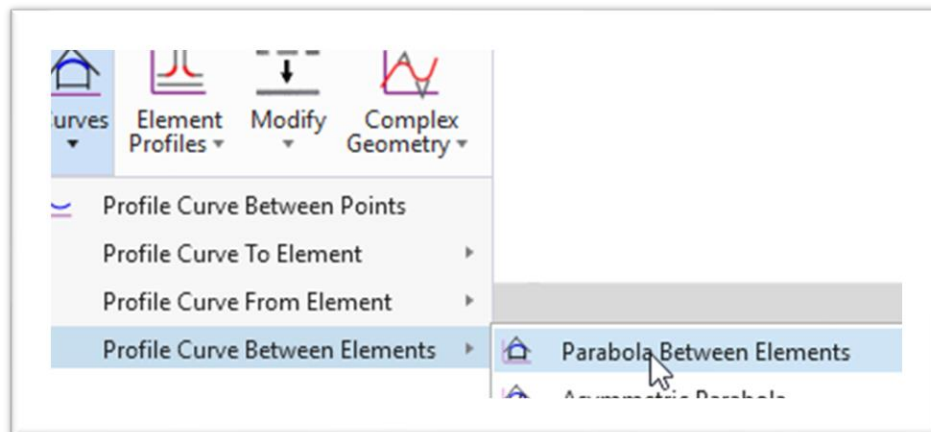
8. Key in Station **2+50** and hit **Enter**
9. Key in Slope of **-4.00%** and hit **Enter**
10. Accept the location with a **Left Click**
11. Using **Profile Line Between Points** tool, snap to the end of the previous line at 2+50
12. In Civil Accudraw, key in station **9+00** and hit **Enter**
13. For slope, key in **5.50%** and hit **Enter**

14. Using **Profile Line Between Points** tool, snap to the end of the previous line at 9+00
15. Next, snap the end point to the Existing Ground at the end of the Alignment



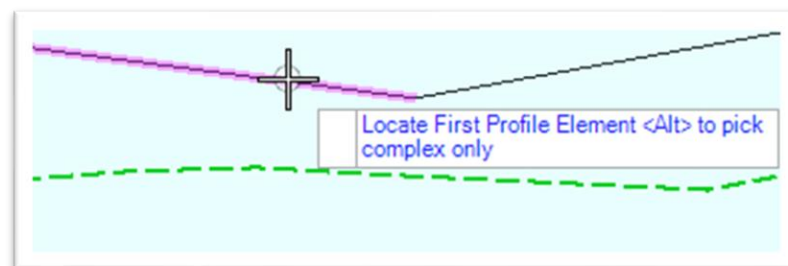
Next we need to have a curve that goes through the PI points created.

16. Use the **Profile Curve Between Elements** tool to create a curve between the lines that have been drawn. **Choose Parabola Between Elements**

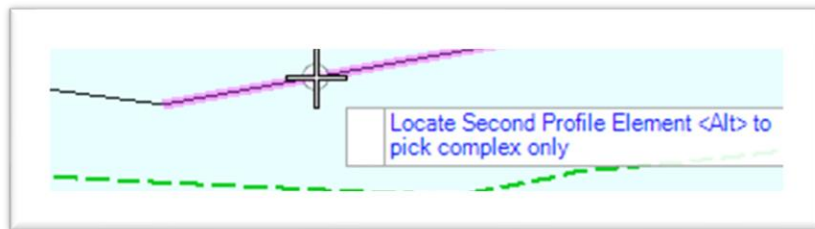


Note: **AASHTO 2018** page **3-165** states “For simplicity, a **parabolic curve** with an equivalent vertical axis centered on the Vertical Point of Intersection (VPI) is **usually used in roadway profile design.**”

17. Fill in the Length of **340'**
18. Select the **First Element**

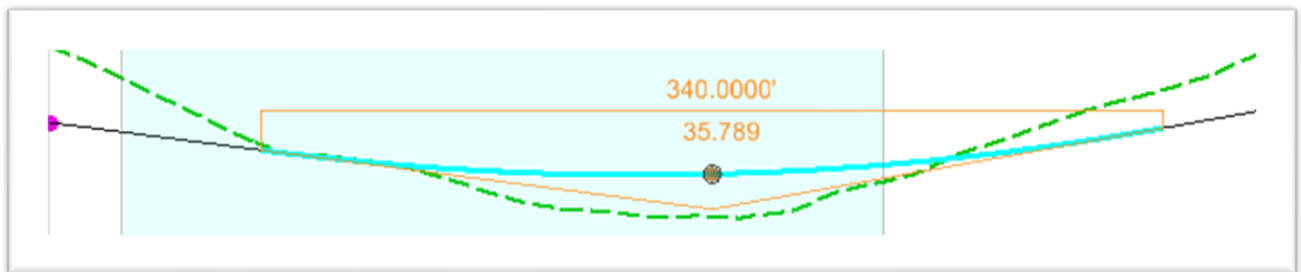


19. Select the **Second Element**



20. Accept the **340'** Length

21. Trim **Both** and Accept



22. Use the **Profile Curve Between Elements** tool to create a curve between the next lines that have been drawn. **Choose Parabola Between Elements**

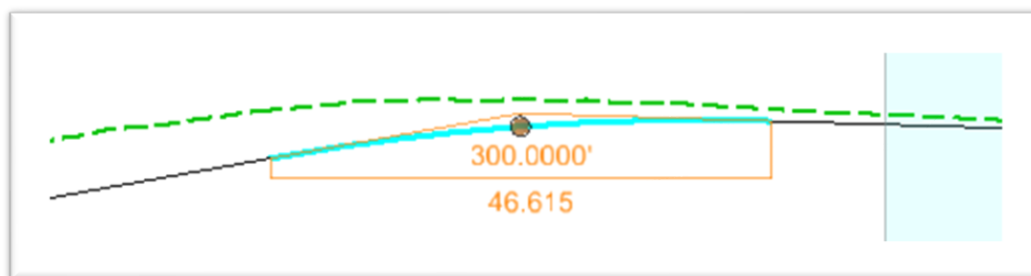
23. Fill in the Length of **300'**

24. Select the **first element**, choose the tangent line from 9+00.

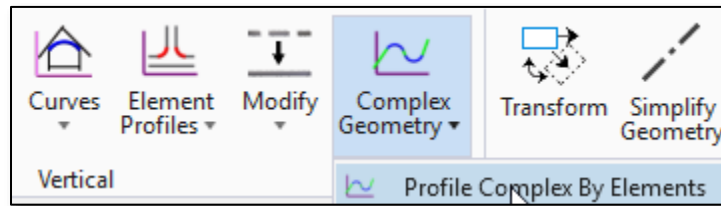
25. Select the **second element**, which is the last tangent line

26. Accept the **300'** length above the profile

27. Accept Trim/Extend **Both**



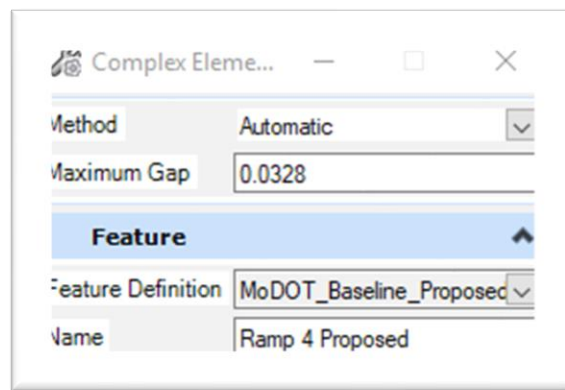
28. Select the **Profile Complex by Element** tool under the Vertical ribbon Complex Geometry



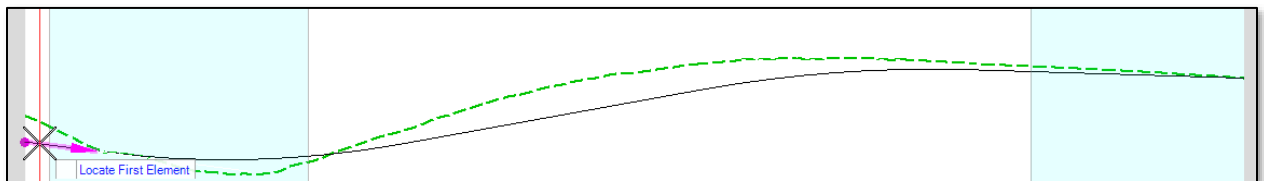
Name the Profile **Ramp 4 Proposed**

Set Method to **Automatic**

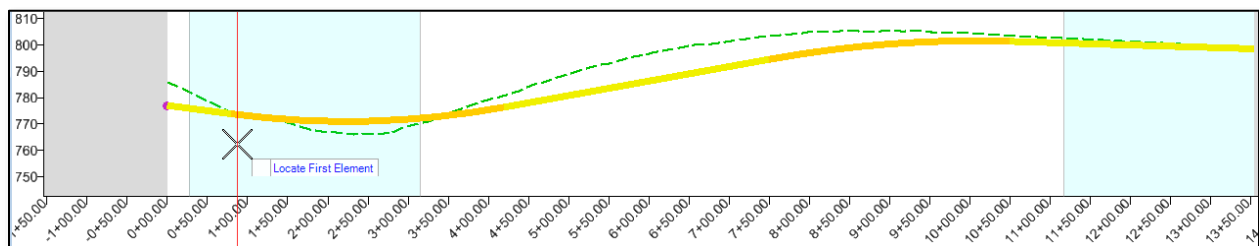
Set Feature Definition to Alignment > **MoDOT\_Baseline\_Proposed**



**Highlight** the first tangent towards the beginning of that line so that the arrow points right



29. **Select** the first line and accept the entire element to create one element.



30. Select **File > Update Server Copy**.

31. Create the Profile Report. Verify your Profile data matches data on the next page.

Vertical Alignment Review Report			
Report Created: Wednesday, July 13, 2022 Time: 4:23:02 PM			
<b>Project:</b> Default			
<b>Description:</b>			
<b>File Name:</b> c:\users\vollek\pwise_local_ord_04\dms17607\Civil_Geometry_J5P3181.dgn			
<b>Last Revised:</b> 7/13/2022 16:00:25			
<b>Note:</b> All units in this report are in feet unless specified otherwise.			
<b>Horizontal Alignment:</b> Ramp 4			
<b>Horizontal Description:</b>			
<b>Horizontal Style:</b> Alignment\MoDOT_Baseline_Proposed			
<b>Vertical Alignment:</b> Ramp 4 Proposed			
<b>Vertical Description:</b>			
<b>Vertical Style:</b> Alignment\MoDOT_Baseline_Proposed			
		Station	Elevation
Element: Linear			
	START	0+00.00	777.05
	VPC	0+80.00	773.85
	Tangent Grade:	-0.04	
	Tangent Length:	80.00	
Element: Symmetrical Parabola			
	VPC	0+80.00	773.85
	VPI	2+50.00	767.05
	VPT	4+20.00	776.40
	VLP	2+23.16	770.99
	Length:	340.00	
	Entrance Grade:	-0.04	
	Exit Grade:	0.06	
	$r = 100 * (g2 - g1) / L$ :	2.79	
	$K = L / (g2 - g1)$ :	35.79	
	Middle Ordinate:	4.04	
Element: Linear			
	VPT	4+20.00	776.40
	VPC	7+50.00	794.55
	Tangent Grade:	0.06	
	Tangent Length:	330.00	
Element: Symmetrical Parabola			
	VPC	7+50.00	794.55
	VPI	9+00.00	802.80
	VPT	10+50.00	801.40
	VHP	10+06.38	801.60
	Length:	300.00	
	Entrance Grade:	0.06	
	Exit Grade:	-0.01	
	$r = 100 * (g2 - g1) / L$ :	-2.15	
	$K = L / (g2 - g1)$ :	46.61	
	Middle Ordinate:	-2.41	
Element: Linear			
	VPT	10+50.00	801.40
	END	13+54.21	798.55
	Tangent Grade:	-0.01	
	Tangent Length:	304.21	



### 3.10 Exercise 3 (Bonus - Individual): Create Ramp 2 Profile

- 1) Continue working in the **Civil\_Geometry\_J5P3181.dgn**
- 2) Using what you have learned from this chapter, create the following profile for **Ramp 2**.
- 3) Name the profile **Ramp 2 Proposed**

VPI ▼	Station ▼	Elevation ▼	Back Grade ▼	Curve Length ▼
VPI #1	0+00	779.58		
			-0.5%	
VPI #2	3+70			500
			(5.95%)	
VPI #3	7+95	803.00		250
			(3.69%)	
VPI #4	Snap to End of Alignment Existing Ground			

1. Select the new **Profile** using the Heads Up display and select **Set As Active Profile**.
2. Select the new **Profile** using the Heads Up display and select **Profile Report**. Verify your Profile data matches data on the next page.
3. Select **File ➔ Update Server Copy**.

## Vertical Alignment Review Report

Report Created: Tuesday, January 10, 2023  
Time: 6:07:56 PM

**Project:** Default  
**Description:**  
**File Name:** c:\temp\dms25402\Civil\_Geometry\_J5P3181.dgn  
**Last Revised:** 1/10/2023 18:03:22

**Note:** All units in this report are in feet unless specified otherwise.

**Horizontal Alignment:** Ramp 2  
**Horizontal Description:**  
**Horizontal Style:** Alignment\MoDOT\_Baseline\_Proposed

**Vertical Alignment:** Baseline Prop  
**Vertical Description:**  
**Vertical Style:** Alignment\MoDOT\_Baseline\_Proposed

	Station	Elevation
Element: Linear		
START	0+00.00	779.58
VPC	1+20.00	778.98
Tangent Grade:	-0.50%	
Tangent Length:	120.000	
Element: Symmetrical Parabola		
VPC	1+20.00	778.98
VPI	3+70.00	777.73
VPT	6+20.00	792.59
VLP	1+58.79	778.88
Length:	500.000	
Entrance Grade:	-0.50%	
Exit Grade:	5.95%	
$r = 100 * (g2 - g1) / L$ :	1.289	
$K = L / (g2 - g1)$ :	77.579	
Middle Ordinate:	4.028	
Element: Linear		
VPT	6+20.00	792.59
VPC	6+70.06	795.57
Tangent Grade:	5.95%	
Tangent Length:	50.059	
Element: Symmetrical Parabola		
VPC	6+70.06	795.57
VPI	7+95.06	803.00
VPT	9+20.06	807.61
Length:	250.000	
Entrance Grade:	5.95%	
Exit Grade:	3.69%	
$r = 100 * (g2 - g1) / L$ :	-0.901	
$K = L / (g2 - g1)$ :	110.948	
Middle Ordinate:	-0.704	
Element: Linear		
VPT	9+20.06	807.61
END	10+15.17	811.13
Tangent Grade:	3.69%	
Tangent Length:	95.115	

---

## Chapter 4

# Creating Templates

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## 4.1 Objectives

- Learn the MoDOT Template Library
- Work with Components, End Conditions and Templates
- Understanding Template Points

## 4.2 Definitions

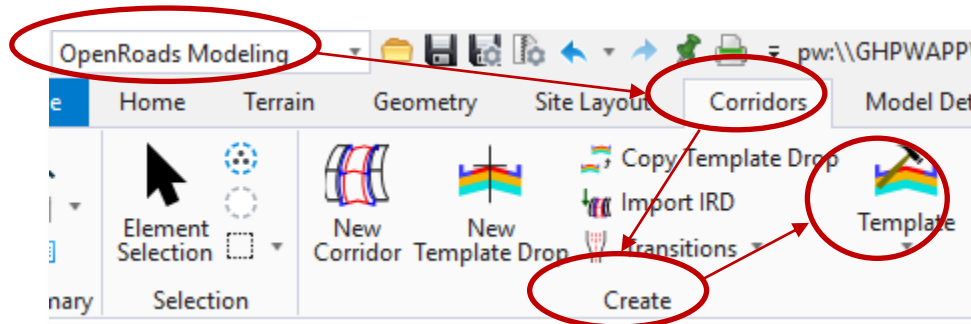
The **Create** ribbon group in the *OpenRoads Modeling workspace > Corridors* is a collection of Open Roads tools that are used to create and modify corridors. One aspect of this group is the Template icon. This icon can be used to open an ITL, which is an OpenRoad Template Library. CADD Support has created a default template library. This library contains most used components and end conditions at MoDOT. A limited number of templates are available through this template library. The intent is for the user to assemble his/her own templates giving the districts more flexibility in their design; therefore, the default MoDOT library needs to be copied to the user's working directory when creating new projects.

## 4.3 Template Creation Tools

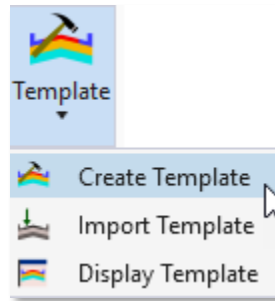
The first step to creating a 3D model is to create templates for the roadway design. Templates are dynamic typical sections used in Corridor Modeling that use transverse geometry to create 3D models. Each template contains a series of points and components that represent breaklines, which are used to create the roadway surfaces. All these points, components, and templates are stored in the template library (itl).



To access the Create Template Dialog, select the icon through the *OpenRoads Modeling* workflow, locate the *Corridors* Tab in the ribbon. The tool is in the *Create* group of this ribbon.

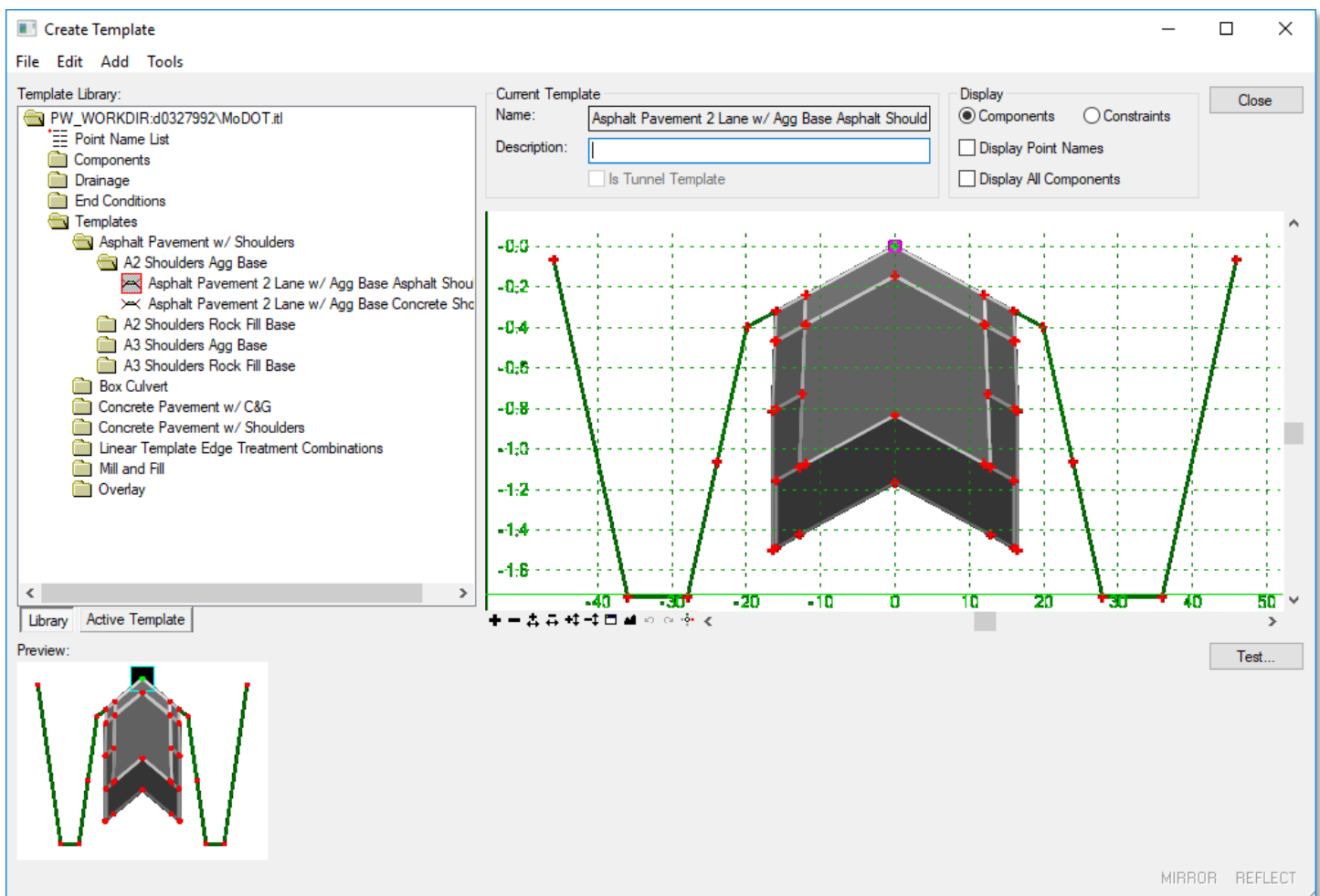


There are three options under the template drop down



### 4.3.1 Create Template

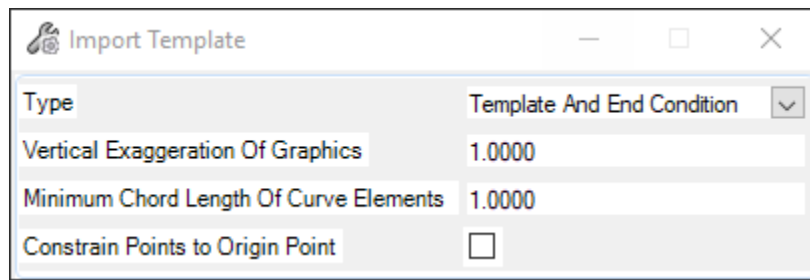
The Create Template tool will open the current ITL. If this is the first-time opening ORD, it will open the Standard MoDOT.itl. You can save the ITL into your current project. The ITL contains all the Templates, components, end conditions, etc. that will make up your typical section. This dialog will be discussed further in this chapter.



### 4.3.2 Import Template



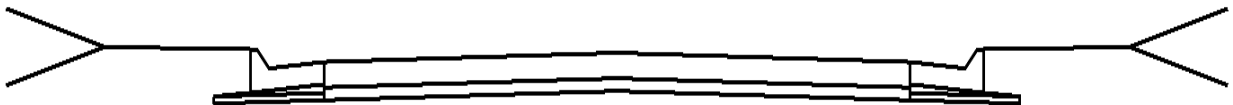
Import Template allows you to import a template from graphics previously identified in a selection set. MicroStation Elements drawn together can be selected to create a custom template that will be placed in the current ITL. Choose what type of elements you are trying to create, determine the vertical exaggeration and chord lengths. Choose elements from the origin point out. Define the origin point and hinge points and a generic template will be created.



### 4.3.3 Display Template

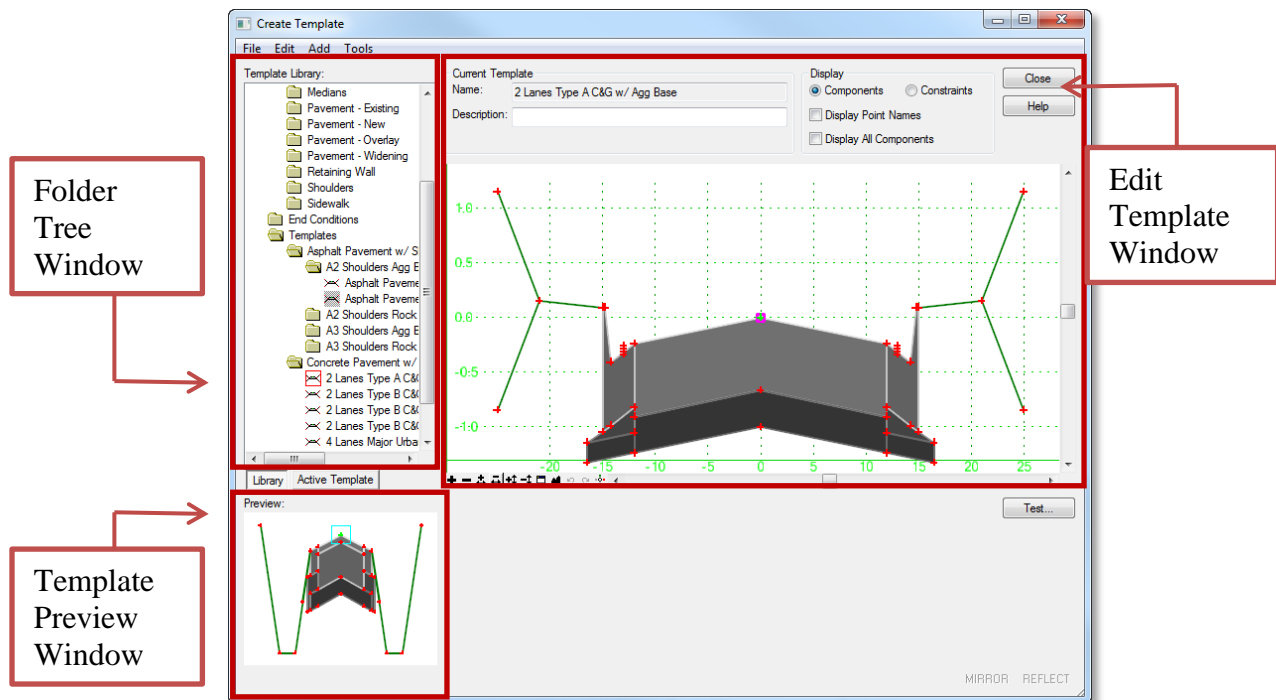


Display Template is used to draw MicroStation elements into the DGN from the Template Library. This may be modified with MicroStation tools and imported back into the Template Library. All MoDOT specific information is lost and may not function as expected if used on a MoDOT project.



## 4.4 Create Template Dialog

The Create Template Dialog is composed of three major areas: Folder Tree Window, Current Template Window, and the Template Preview Window, which are shown below.



### Folder Tree Window

This view allows the user to navigate through the template library selected. The folder tree structure begins with the template library. Underneath, the user will find the following categories: Point Name List, Components Folder, End Conditions Folder, CADD Support Templates, and District User Templates. This window is completely user definable, and it has all windows capabilities like right click functions, copy, paste, drag and drop.

### Point Name List

This list contains previously created names to be utilized in the creation of new points for creating components for templates. Each point on a template must be unique, so no point can have the same name. CADD Support has created a point name list for standardization.

### Components

A component is a set of points defining an open or closed shape that represent different portions of the template. For example, pavement structure, curbs, gutters, shoulders, medians, retaining walls, etc. MoDOT default library has many components from which to choose to create templates. These components are organized in categories according to functionality. These components do not include side slope conditions.



## End Conditions

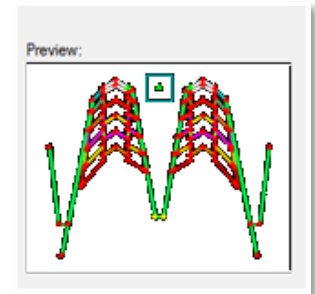
End conditions are simply side slope condition components that tie to existing ground. These include fill slope, cut slopes, ditches and/or combination thereof.

## CADD support templates

The MoDOT standard template library will contain a limited number of templates. Only these templates will be housed in this folder.

## District user templates

The user will save the template library in his/her working directory and will be able to modify the library by adding new templates or components. Any templates created by a district user should be stored in this folder.

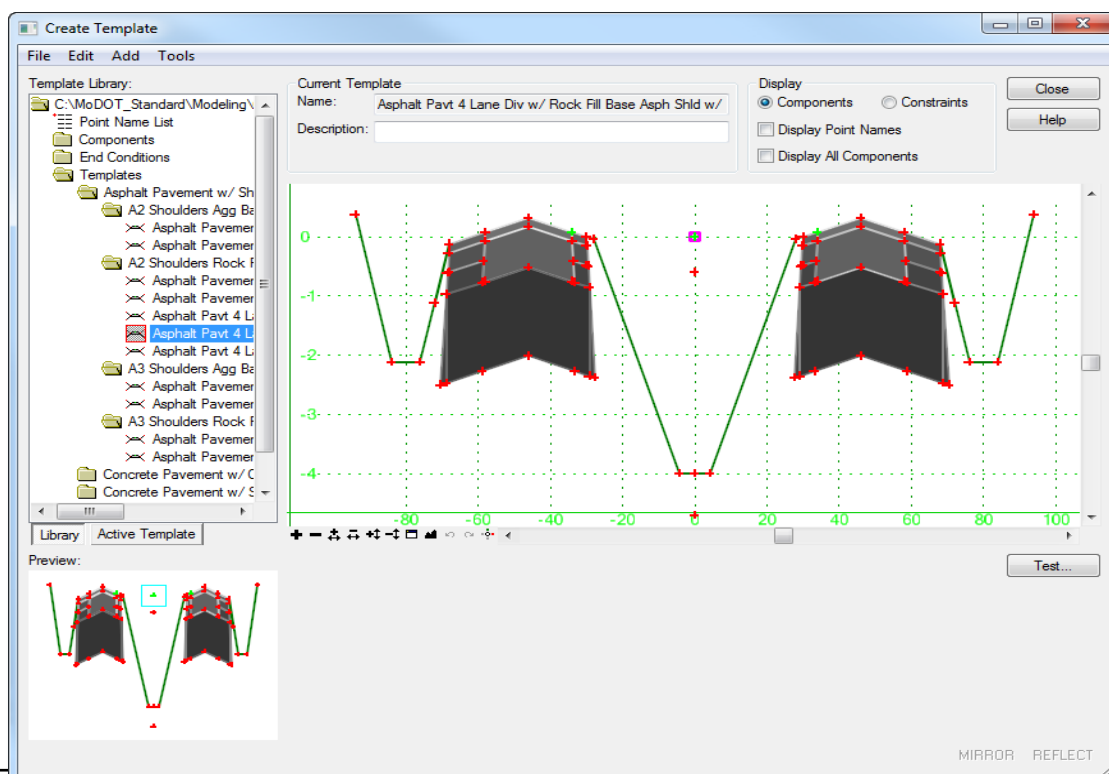


## Preview Template Window

The template preview window shows the template that is highlighted in the folder tree view. A Cyan color box denotes the placement location for that template. Usually this is at the origin of the template, but the user can click on any point to move the placement point location. The user can drag and drop from the preview area to the current template window.

## Current Template Window

This is the large window on the right hand side of the Create Template Dialog where templates are assembled and edited. The current template window shows the user the name, description and design of the template currently being edited, reviewed or assembled.



#### 4.4.1.1 DISPLAY OPTIONS

The two radio buttons allow the user to choose what to display in the center window. The **Components** option shows the typical section component/template picture. The **Constraints** option show how each point in the component/template is constrained to each other. Constraints will be covered in another section.

There are two check boxes the user can select for displaying various portions of the template. When the **Display Point Names** option is checked on, all the point names in the current template are displayed. Point names are long and when displayed the window can be too cluttered. Sometimes templates have hidden components controlled by certain design situations. This concept will be discussed in a later chapter. When the **Display All Components** option is selected, these hidden components are displayed.

### Center Window

The center window is the main graph for creating/modifying templates. This window has its own graphics engine and so it is not a MicroStation window. The scale of the graph is dynamic and changes as you zoom in and out.

The center point of the window is marked by the dynamic origin, which is a magenta-colored box. The dynamic origin is used as a reference point and can be moved to any location in the graph.

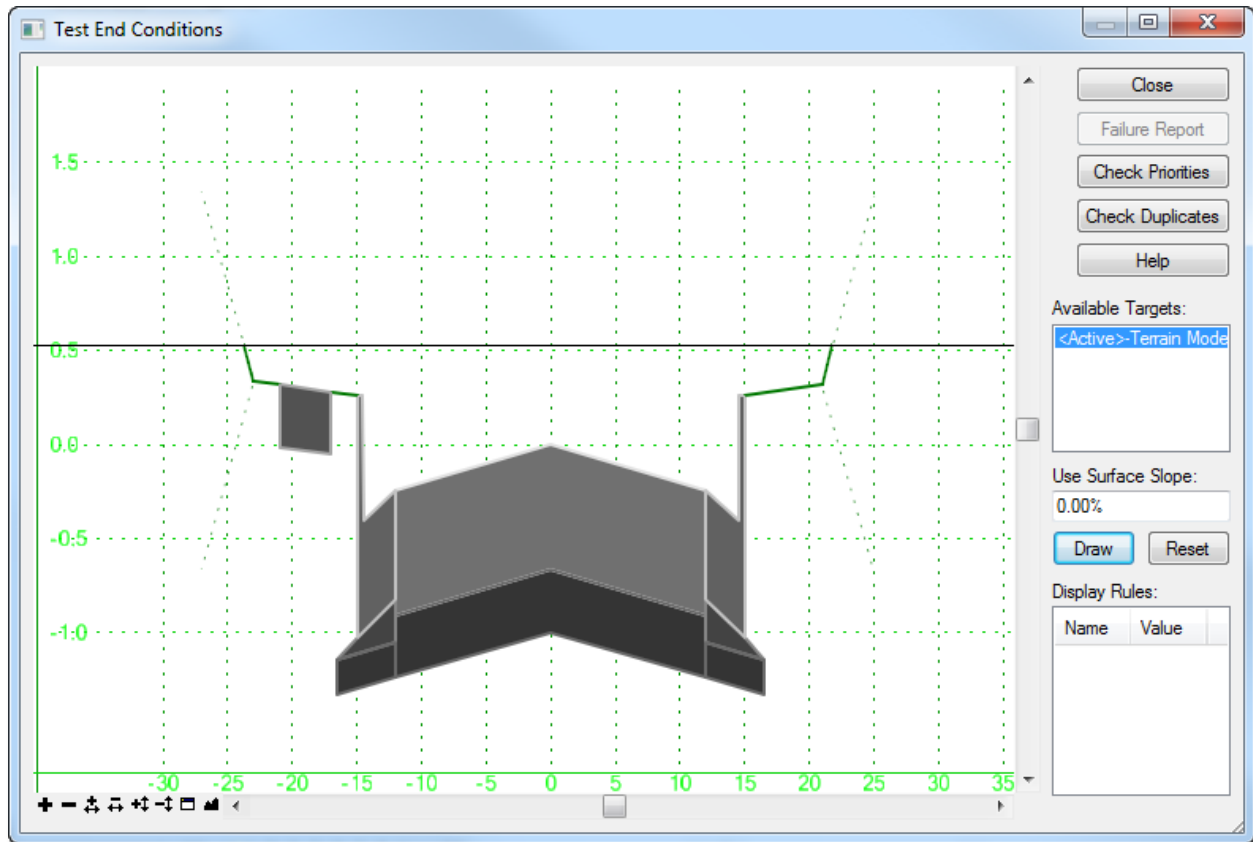
### View Commands



These commands are similar to the MicroStation view commands. They allow the user to perform the standard zoom in/out, zoom in/out in the X direction, zoom in/out in the Y direction; window in an area, and fit the view, undo, redo, and set dynamic settings.

## Testing End Conditions

**Test** – Opens the Test End Conditions dialog box. This tool allows the user to test the end condition solutions.



This tool displays the current template; the non-solved end conditions and their child components are displayed in dashed lines. The normal components and solved end conditions are displayed as solid lines.

The **Available Targets** area lists all of the targets available whether they are surfaces or specific Feature Definitions. The user simply selects the desired target, sets the **Surface Slope**, and then clicks on **Draw** to test. The Surface Slope is the slope of the surface that is being placed. The **Reset** button clears all the drawn targets.

**Display Rules** - list the display rules for the current template. Left-click over a value to toggle between True and False. Press the Reset button to restore the original Display Rules values.

**Failure Report** – activates the Results dialog. When a template fails to get a solution on one or both sides, the results show which components failed and which end condition start points were not solved.

**Check Priorities** – tests the template for priority conflicts. Each end conditions starting at the same point has a priority assigned, and must be unique. When a conflict exists, a message is displayed indicating there are end conditions starting at the same point having the same priority assigned. If there are no conflicts, a message box indicating no conflicts is displayed.

**Check Duplicates** – checks for duplicate feature and component names for the given solution. If duplicate feature or component names are found, the Duplicate Feature Name List dialog is displayed. If no duplicates are found, a message to this effect is displayed.

**Close** – dismisses the dialog.


**Help** – displays the help for this dialog.

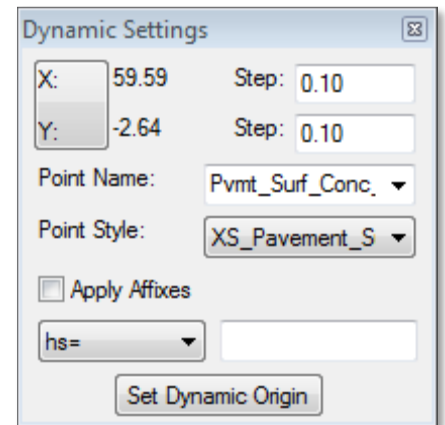
## Dynamic Settings

Similarly to the MicroStation AccuDraw tool, the **Dynamic Settings** are used for precision input of the template components and to assign point names and Feature Definitions when creating components.

It also serves as a compass for the cursor location with respect to the dynamic origin. The dynamic origin can be modified by using the “**Set Dynamic Origin**” at the bottom of the dialog box.

## Accessing the Dynamic Settings

The Dynamic Settings can be accessed by selecting **Tools>Dynamic Settings** or by using the view control icon . The dynamic setting **Step** should be set to x = 0.1, y = 0.1 before creating templates to allow for easy dynamic positioning.



## Precision Key-In Commands

XY = Key-in absolute coordinates (x, y)

DL = Key-in delta coordinates from last point placed (defaults to the dynamic origin if it is the first point of a component)

HS = Key-in horizontal delta distance and slope from last point placed

VS = Key-in vertical delta distance and slope from last point placed

OL = Key-in delta coordinates from dynamic origin

## Creating Templates from Components

Templates can be assembled by dragging and dropping components and end conditions into the Current Template window one at a time.

Each point on a component has a unique point name. These point names are created without being specific to “left” or “right” side of the roadway. The user assigns a prefix or suffix to determine “left” or “right” when creating the template via the Dynamic Settings.

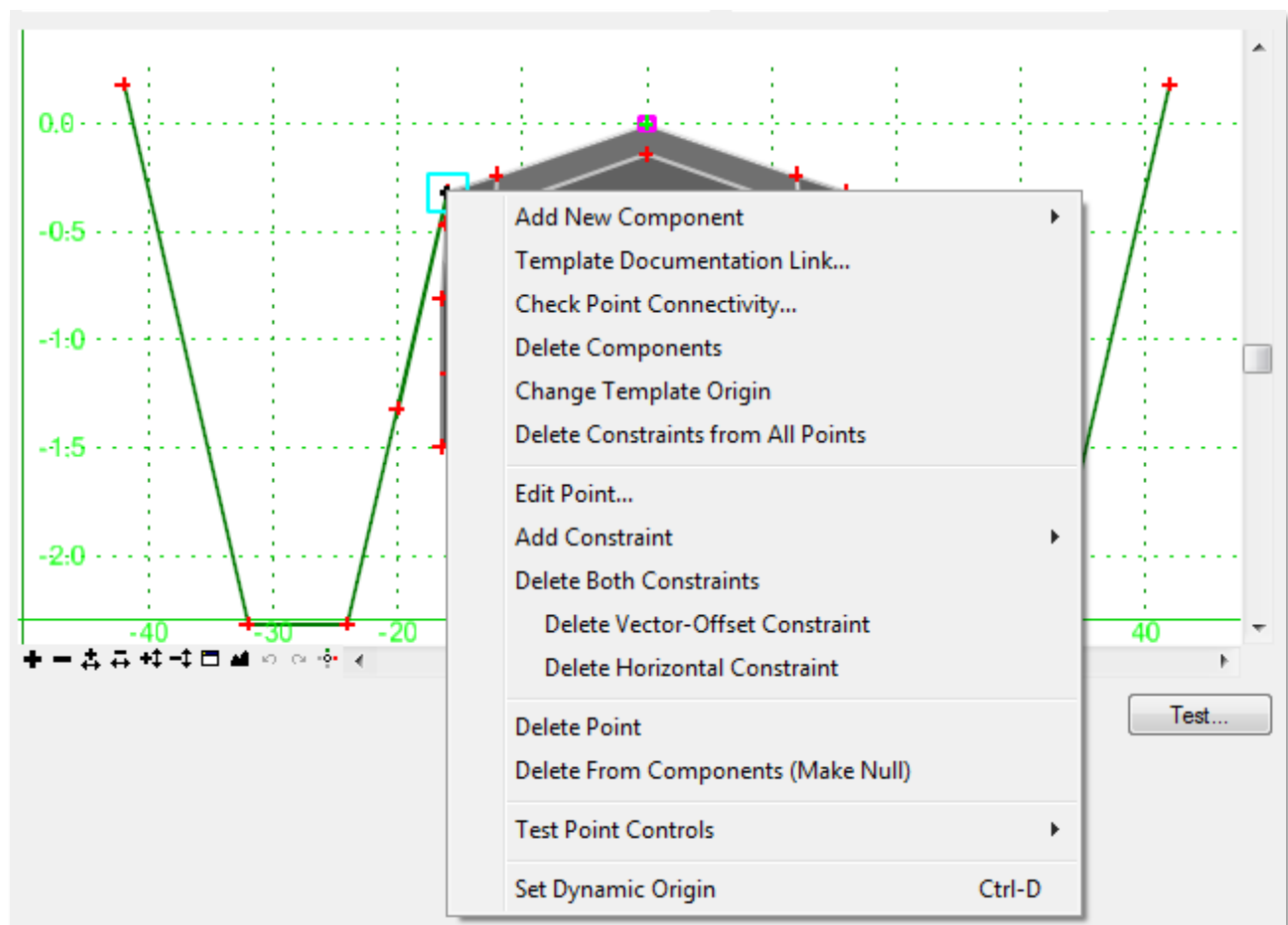
Creating components will be covered in a later chapter.

## Dragging and Dropping Components

When two points coincide, a heavy white plus sign will appear. When connecting two components together, the existing connection point name will override the dropped point name. Dynamic Settings should be set before starting to drag and drop components to create a template.

Once a component is created, it can be modified by editing any property, inserting new points, or creating display rules. Once two or more components have been combined, they can also be merged.

To edit components, simply right-click between the components to access the editing commands.



**Basic Template Creation Workflow**

1. Open Template Library
2. From the folder tree view, right-click and select **Create > New Template**
3. “Drag and drop” template components
4. Merge Components
5. Verify Point Names
6. Save the Template Library

**Pull Down Menus**

**File** – allows the user to create a new template library, new folder, or new template; open another library, save the current library, or import a template from another library.

**Edit** – has the common Windows commands undo, redo, cut, copy, paste, clear, delete, and rename.

**Add** – has all the options for developing new components. Components are covered in a later chapter.

The Tools menu offers several tools to manage the template library, but the only two tools pertaining to the MoDOT template library are the Dynamic Settings covered in section 2.6 and the **Template Library Organizer**, which allows the user to copy components and templates from one library to another.

**Point Constraints**

Templates and components are defined by the points making their shapes. Thus point constraints are used to manage the behavior of all template points. The purpose of point constraints is to create relationships between the points in a template so that if one point moves, the other points follow in a predictable manner.

Each template point has a maximum of two constraints on it. A template point with two constraints is considered “fully constrained” and is represented graphically by a red plus sign on the template display. A template point with only one constraint is considered “partially constrained” and is represented graphically by a yellow plus sign. A point with no constraints is considered “unconstrained” and is shown as a green plus sign.

**Types of Constraints**

There is a total of 11 different types of constraints:

**Horizontal** - Allows the placement of a new point (or child point) a specified horizontal distance from a reference point (or parent point).

**Vertical** - Allows the placement of a new point (or child point) a specified vertical distance from a reference point (or parent point).

**Slope** - Allows the placement of a new point (or child point) using a specified slope from the reference point (or parent point). Slope constraints are absolute. Slopes going from lower-left to upper right are positive regardless of whether the child point is to the left or right of the parent.

**Horizontal Maximum** - The child point has two parent points and remains at the specified horizontal distance from the parent point that is farthest to the right (has a maximum horizontal or X value).

**Horizontal Minimum** - The child point has two parent points and remains at the specified horizontal distance from the parent point that is the farthest to the left.

**Vertical Maximum** - The child point has two parent points and remains at the specified vertical distance from the parent point that is the highest (has a maximum vertical or Y value).

**Vertical Minimum** - The child point has two parent points and remains at the specified vertical distance from the parent point that is lowest (has the minimum vertical or Y value).

**Vector-Offset** - The child point is projected onto the vector defined by two parent points. If the offset is not zero, then the child point will maintain a perpendicular offset from the parent vector at the specified offset value. Negative values indicate an offset to the left of the vector defined by the parent points. Positive values indicate an offset to the right. If the offset is zero, the child point is located on the parent vector.

**Project to Surface (to Existing Ground)** - This constraint must be used in conjunction with one of the previously defined constraints. The other constraint will define the projection direction. The child point will then be projected to the surface with the specified name. If the surface does not exist, or no solution is found, the point will remain where it is placed in the template.

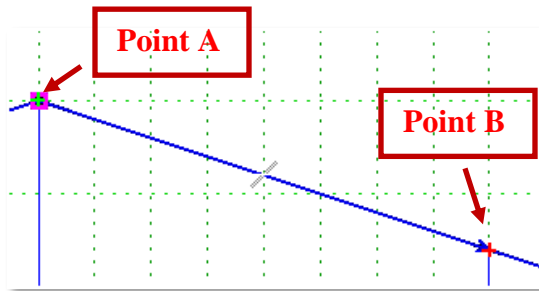
**Project to Design** - This constraint is similar to Project to Surface, except that the point is projected to the design surface of the template. A projection value is given to indicate whether the projection is to be to the left or to the right. Again, the point must also be constrained by one of the previous constraints, excluding the Project to Surface constraint, so that a direction for the projection may be determined. If no solution is found, then the point will remain where it is placed in the template.

**Angle distance** - This command is used to fully constrain a point in the template. This constraint requires two parent points, a distance, and an angle. The point is constrained to the location defined by the distance from the first parent, and the angle from the first parent relative to the vector defined by the two parent points. This constraint creates a rigid-body rotation. When selected, no other constraint types are available.

## Parent-Child Point Relationship

When a template point is constrained by either one or two other points, it is considered the “child” of those reference points. The reference points are then known as the “parent” point(s).

If the parent point moves, the child also moves based on the constraints established.



Example:

Point B is a child of point A. Point A is unconstrained and shown as a green plus sign on the screen. Point B is fully constrained. Point B has a horizontal and a slope constraint, and is shown as a red plus sign. In addition, the parent point (Point A) has a blue arrow pointing to the child point (Point B).

### Visual Indicators for Vertical, Horizontal and Slope Constraints



Child is vertically constrained to parent. When the parent point moves, the child point follows at a constant vertical distance to that point.



Child is horizontally constrained to parent. When the parent point moves, the child point follows at a constant horizontal distance to that point.



Child is constrained to parent by a slope. When the parent point moves, the child point follows a constant slope with respect to the parent point.

### Modifying Constraints

Once a point has been created with or without constraints in a template, it can still be modified. Modifications include: adding or deleting constraints, or changing the type of constrained originally set for a point.



## 4.5 Template Components

Templates are a grouping of several components, and each component is a set of points that defined an open or closed shape. Each component represents a material for the typical section at a particular location. Each component is given a name and assigned a Feature Definition. A Feature Definition is simply the MicroStation symbology used to draw the component both in cross section view as well as plan view.

There are six types of components: *Simple*, *Constrained*, *Unconstrained*, *Null Point*, *Overlay*, and *End Condition*.

Once created, components can be modified as desired. There is no limit to the number of points or components in a template. When templates are paired with horizontal and vertical alignments and superelevation, they define the surface of a corridor. Templates are flexible design components that allow you to model simple highway design items such as ditches and sidewalks to the more complex multi-lane highways with superelevated curves and variable side slopes.

### 4.5.1 Simple Component

A simple component is a closed parallelogram (4 constrained points) that is defined by the slope and thickness (for example, a pavement layer). In this case, if any point is moved, the entire shape moves keeping the same relationships determined by the original slope and thickness, making this a rigid shape.

### 4.5.2 Constrained

A constrained component consists of points that are all restricted to the movement of the first point. A constrained point is typically used to manage the behavior of other points in the template. When a point (parent) is moved, any constrained point (child) also moves. This restriction only affects the offset and elevation (x, y) of the restrained point and, the relationship is unidirectional (movement of child point does *not* move the parent point).

### 4.5.3 Unconstrained

An unconstrained component is open or closed-shaped with no movement restrictions. This type of component is only used for very specific purposes, such as “tracing” a previously placed component.

### 4.5.4 Null Point

A null point is a template point that is purposely not related to any particular component. It’s most often used as a reference for controlling other points. A null point is considered a “check or test point”. For example, a null point is used to check if there is an entrance to the right or left of the alignment.

### 4.5.5 Overlay

This is a special type of component that allows the user to add overlay/stripping properties in order to calculate milling, and/or leveling (overlay) quantities.

### 4.5.6 End Conditions

An end condition is a special open-shaped component that targets a surface, a surface Feature Definition, an elevation, or an alignment. In other words, the end condition components are simply the fill/cut/ditch slopes or benching which tie back to ground. The integrity of end conditions can now be routinely tested while the roadway template is being created.

## 4.6 Creating Basic Components

### 4.6.1 Point Name List and Feature Definition

Each point used for creating a component must be given a name and a Feature Definition associated with such. CADD Support has created a point name list from which to select. Point naming convention is extremely important in the creation of templates, so especial attention must be paid while creating individual components.

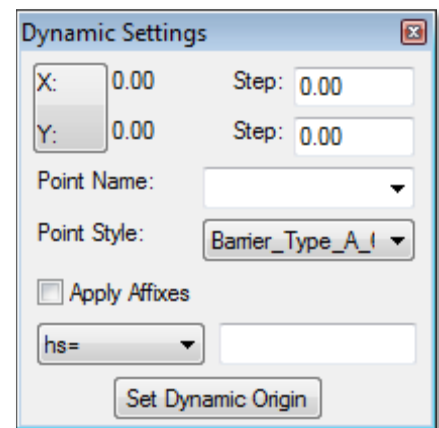
### 4.6.2 Setting Display Options

The dynamic settings need to be set prior to creating a component, end condition or template.

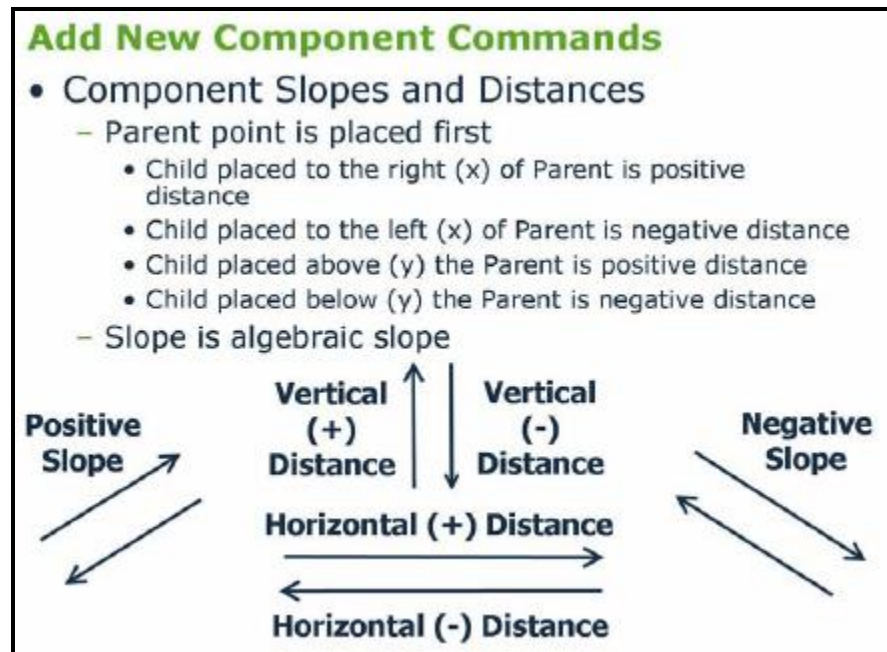
#### Key-In

Specifies the type of key in to be performed.

- XY= key in absolute coordinates
- DL= key in delta coordinates from last point placed (defaults to the dynamic origin if it is the first point of a component).
- HS= key in horizontal delta distance and slope from last point placed.
- VS= key in vertical delta distance and slope from last point placed.
- OL= key in delta coordinates from dynamic origin.
- OS= key in horizontal delta distance and slope from dynamic origin.



## 4.7 The Sign of the Distance and Slope

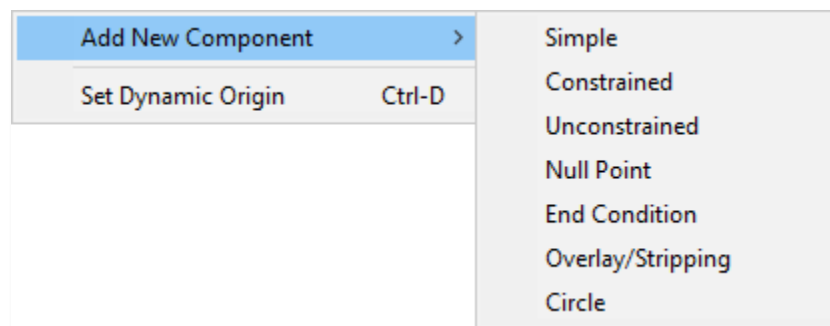


When defining components with precision input, the sign of the distance is dependent on the parent-child relationship. The parent is always the first point placed when creating template components. The distance is positive if the parent has a lower X or Y value than the child. The distance is negative if the parent has a higher X or Y value than the child. The sign of the component slope is based on the mathematical slope.

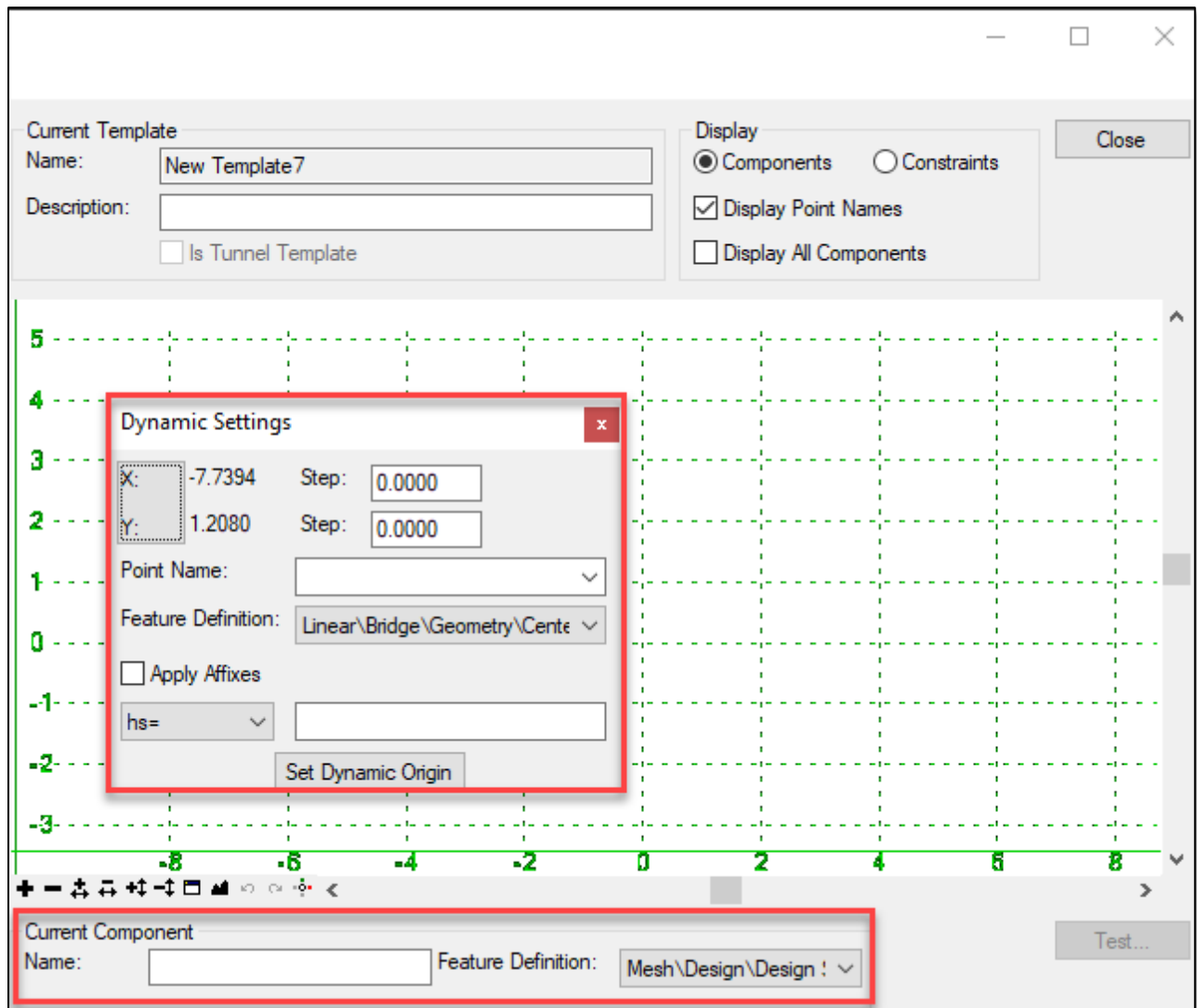
### 4.7.1 Adding Components

Adding components is a simple process guided by dialog boxes, but point name and placement must be carefully thought of before starting the process. The steps are as follow:

1. Create the component structure in the library folder tree to the left.
2. Activate and set and activate the setting display options.
3. Right click on the current template window and select **Add New Component**.

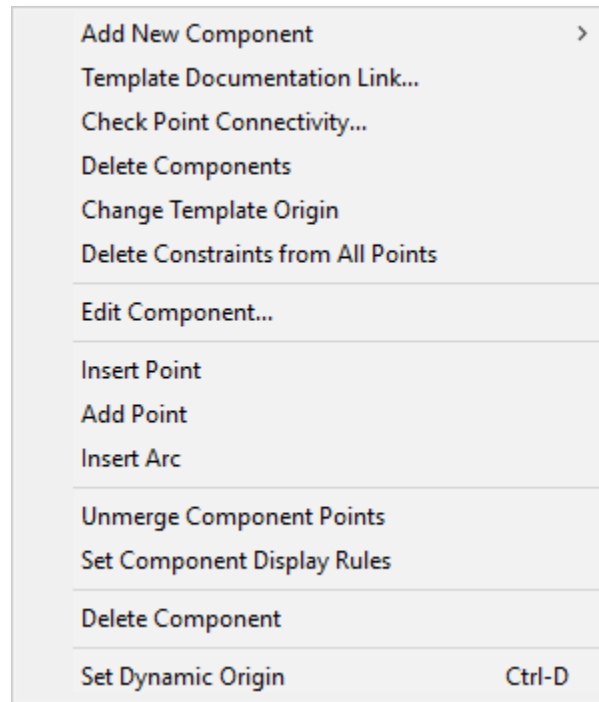


4. Select the type of component desired.
5. Populate the display setting options and current component dialog.



6. Data point to the origin to start placing the component or type 0, 0 using the x, y key-in.
7. Add points by using the precession key-in commands in the dynamic settings to finish the desired shape. For unconstrained and constrained components, once the shape has been drawn, right click and select **Finish** to complete.

Once a component has been created, it can be modified visually by adding, deleting points or taking away/adding constraints.



Also, the component can be modified through the point properties dialog box.

**Note:** In order to modify a component, the user must modify the points making up the component.

### 4.7.2 Point Properties Dialog

To access the *Point Properties* dialog box, right click on the point to modify and select **Edit Point**.

The screenshot shows the 'Point Properties' dialog box with the following settings:

- Name:** LT\_Dtch\_Bkslp\_1\_T
- ☒ **Use Feature Name Override:** LT\_LOC\_Cut
- Feature Definition:** Linear\Design\Template Point Fea
- ☐ **Superelevation Flag**
- Alternate Surface:** Proposed Finished Grade
- End Condition Properties:**
  - ☒ Check for Interception
  - ☒ Place Point at Interception
  - ☒ End Condition is Infinite
  - ☐ Do Not Construct
- Member of:** LT\_Cut Slope
- Constraints:**

Constraint 1		Constraint 2	
Type:	Slope	Type:	Horizontal
Parent 1:	LT_Berm	Parent 1:	LT_Berm
Parent 2:	<input type="checkbox"/> Rollover Values...	Parent 2:	<input type="checkbox"/> Rollover Values...
Value:	-25.00%	Value:	-4.0000
Label:	-Dtch_Bkslp_1_Slope	Label:	-Dtch_Bkslp_1_Width
<input type="checkbox"/> Horizontal Feature Constraint		<input type="checkbox"/> Horizontal Feature Constraint	
Range:		0.0000	

### 4.7.3 Basic Component Creation Workflow

1. Open a template library
2. Navigate to folder where component will be placed
3. Right click on folder, and select **Create Template**
4. Select and set dynamic settings
5. Create components by using the point names in the point list
6. Edit any points if necessary
7. Save template library

## 4.8 Creating an Overlay/Stripping Component

Creating an overlay/stripping component is similar to creating a basic component. The only difference is that overlay/stripping components are a single line “closed” components and they have additional attributes to determine overlay/milling quantities. Detail creation of an overlay/stripping component will be covered in the *Overlay Tools* chapter.

## 4.9 Creation of Basic End Conditions

End conditions are components of the template used to create cut and fill treatments. These end condition components have a specific target such as, terrain models, elevations, horizontal and vertical alignments.

### 4.9.1 Target Types

Target types are defined only for end condition components, and are a property of that component. An end condition solution can intercept multiple targets and target types. For example when designing a special ditch, the sideslope condition “targets” the special ditch profile elevation, and then intercepts the original ground terrain model to form the ditch bottom and backslope.

### 4.9.2 End Condition Settings

End conditions will draw based on the targets and settings set. These settings are considered specifically end condition properties and are enabled/disabled through the point property dialog box. The end condition settings are described below.

**Check for Intersection** – when set, the line segment will search for the specified target. If not set, the line segment will be created at its full width regardless of whether it intersects the target, provided that one of the segments connected to this segment successfully intersects the target.

**Place Point at Intersection** – when set, a point will be placed at the location of the intersection. If not set, the line segment will be created at its full width, provided that one of the segments connected to this segment successfully intersects the target.

**End Condition is Infinite** – when set, the line segment will automatically be extended to intercept the target. If not set, the line segment will only extend to its maximum constraint to meet its target. This applies only to the last line segment in an end condition.

The screenshot shows the 'Point Properties' dialog box. The 'Name' field is 'LT\_Dtch\_Bkslp\_1\_T'. The 'Use Feature Name Override' checkbox is checked, with the value 'LT\_LOC\_Cut' in the adjacent field. The 'Feature Definition' is 'Linear\Design\Template Point Fea'. The 'Superelevation Flag' is unchecked. The 'Alternate Surface' is 'Proposed Finished Grade'. The 'End Condition Properties' section is highlighted with a red box and contains four checked options: 'Check for Intersection', 'Place Point at Intersection', 'End Condition is Infinite', and 'Do Not Construct' (unchecked). The 'Member of' field is 'LT\_Cut Slope'. Buttons for 'Apply', 'Close', '< Previous', and 'Next >' are on the right.

**Do Not Construct** - If set, the end point of the line segment will be used as a reference point to find a subsequent point. The point will be solved like any other end condition point, but that point will be skipped when drawing the final component segments. This is normally not set and is used only for more complex condition testing.

### 4.9.3 Testing End Conditions

Testing end conditions gives the user the ability to verify the solutions and priorities as well as testing multiple targets without using the Create Corridor tool.

When creating end conditions, the user should test to see if desired results are generated. This can be done before, during or after creation of the end condition.

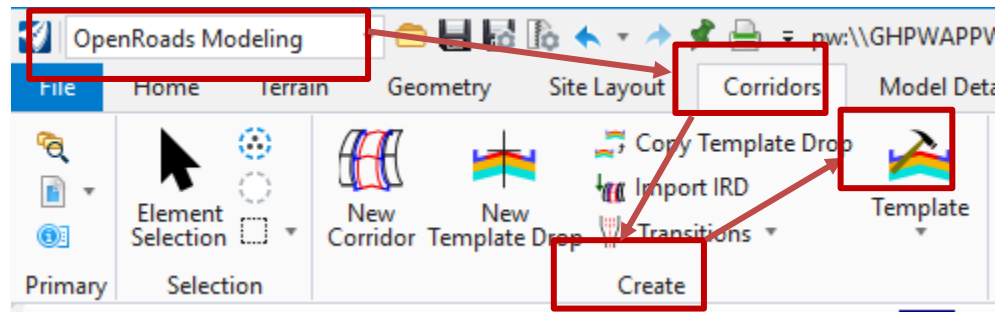
### 4.9.4 Basic End Conditions Creation Workflow

1. Open a template library
2. Navigate to the folder where templates will be stored
3. Select create template
4. Create a new template
5. Create end condition components
6. Test end conditions
7. Save the template library



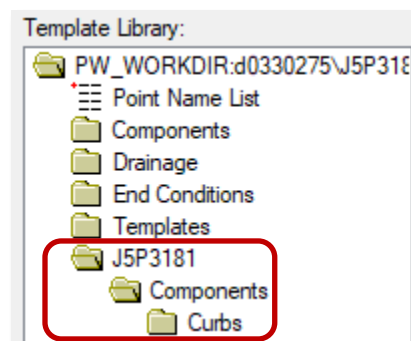
## 4.10 Group Exercise 4-1: Creating a Constrained Component - Curb

1. Within the **Roadway\data-4** folder, open the file: **Civil\_Geometry\_J5P3181.dgn**
2. From the **OpenRoads Modeling** Workflow, open the **Corridors** Tab, select the **Create Template** icon.

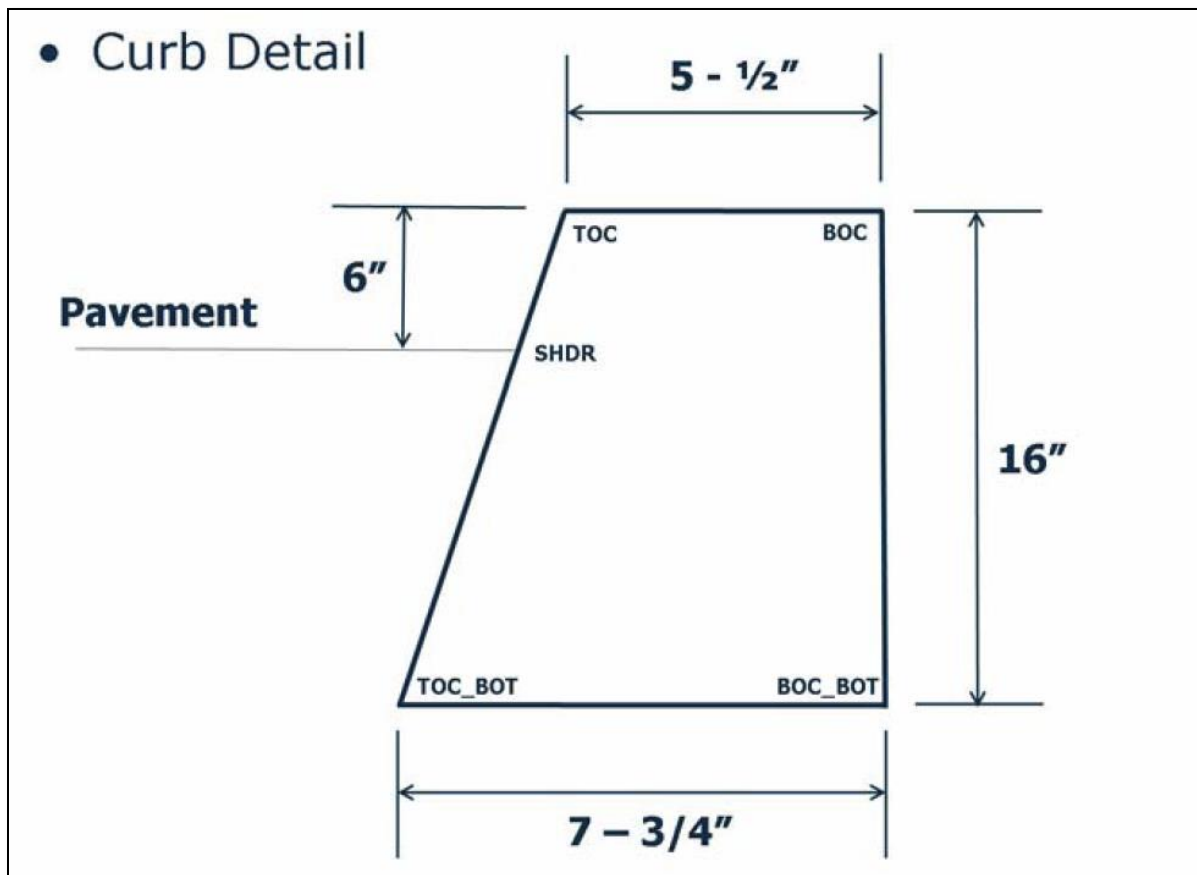


3. Select **File > Save As** from the **Create Template** dialog menus. Save the MoDOT Workspace template library as **J5P3181.itl** in the **Roadway\data-4** folder.
4. **Right click** on the file path at the top of the dialog and create the following folder structure:

**J5P3181 → Components → Curbs**

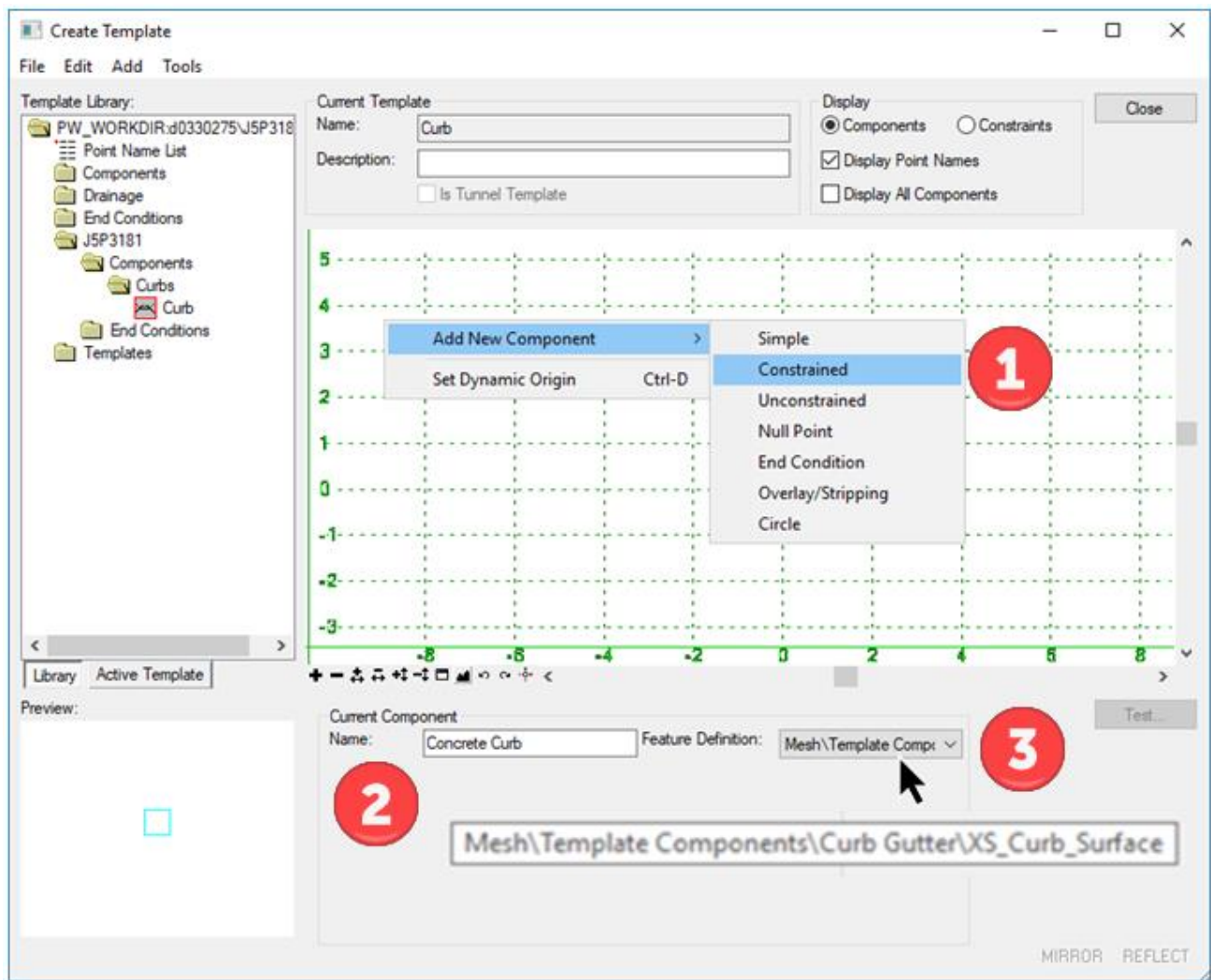


5. Within the **Curbs** folder, create a new template named **Curb**.
6. If the **Dynamic Settings** dialog is not displayed, select **Tools → Dynamic Settings**. Set the step increment to **0.10**.
7. If not set, toggle **ON** the *Display Point Names* check box in *Create Template* dialog.
8. Right-click on the **Current Template** window and select **Add New Component → Constrained**.



9. Setup the Current Component portion of the *Create Template* dialog as follows:
- *Component Name:* **CONCRETE CURB**
  - *Feature Definition:* Mesh\Template Components\Curb Gutter\XS\_Curb\_Surface

**Note:** See next page for dialog:



10. Setup the **Dynamic Settings** dialog as follows:

- *Point Name:* **SHDR** (key in)
- *Feature Definition:* *Linear\Design\Template Point Features\Curb Gutter\XS\_Curb\_Surface*
- *Apply Affixes:* **Disabled**
- *Precision Input:* **x, y = 0, 0**
- Press the **Enter** key

**Notes:**

- **Do NOT** click the Set Dynamic Origin button. This will change the template origin to the location in the dialog box.
- The default units for precision input are feet. You can enter other units with the proper specification, such as 6" instead of 0.5.
- Watch the prompts in the lower left corner of the Create Template dialog.
- When creating a component using precision key-in, an ESC allows you to go back.

11. Setup the **Dynamic Settings** dialog as follows:

- *Point Name:* **TOC** (key in)
- *Feature Definition:* *Linear\Design\Template Point Features\Curb Gutter \XS\_Curb\_Surface*
- *Apply Affixes:* **Disabled**
- *Precision Input:* **xy = 0.07,0.5** (from similar triangles)
- Press the **Enter** key

12. Setup the **Dynamic Settings** dialog as follows:

- *Point Name:* **BOC** (key in)
- *Feature Definition:* *Linear\Design\Template Point Features\Curb Gutter \XS\_Curb\_Surface*
- *Apply Affixes:* **Disabled**
- *Precision Input:* **hs = 5.5",0.0**
- Press the **Enter** key

13. Setup the **Dynamic Settings** dialog as follows:

- *Point Name:* **BOC\_BOT** (key in)
- *Feature Definition:* *Linear\Design\Template Point Features\Curb Gutter \XS\_Curb\_Surface*
- *Apply Affixes:* **Disabled**
- *Precision Input:* **dl = 0.0,-16"**
- Press the **Enter** key

14. Setup the **Dynamic Settings** dialog as follows:

- *Point Name:* **TOC\_BOT** (key in)
- *Feature Definition:* *Linear\Design\Template Point Features\Curb Gutter \XS\_Curb\_Surface*
- *Apply Affixes:* **Disabled**
- *Precision Input:* **dl = -7.75",0**
- Press the **Enter** key

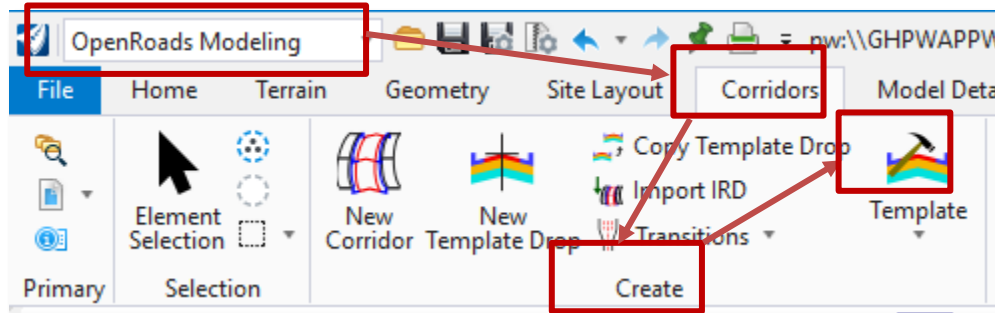
15. Right-click on the *Current Template* window and select **Finish**.
16. Enable the **Display Point Names** option.

## 4.11 Group Exercise 4-2: Creating an End Condition

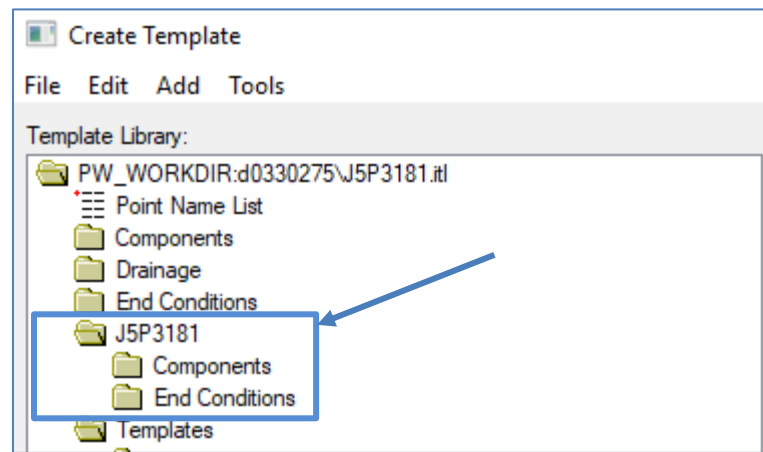
Create a **Fill and Ditch End Condition** in the same End Condition Template by right-clicking on the Template Window and select **Add New Component > End Condition**.

In this exercise the design criteria calls for a **6:1 Fill and 6:1 Ditch slopes**.

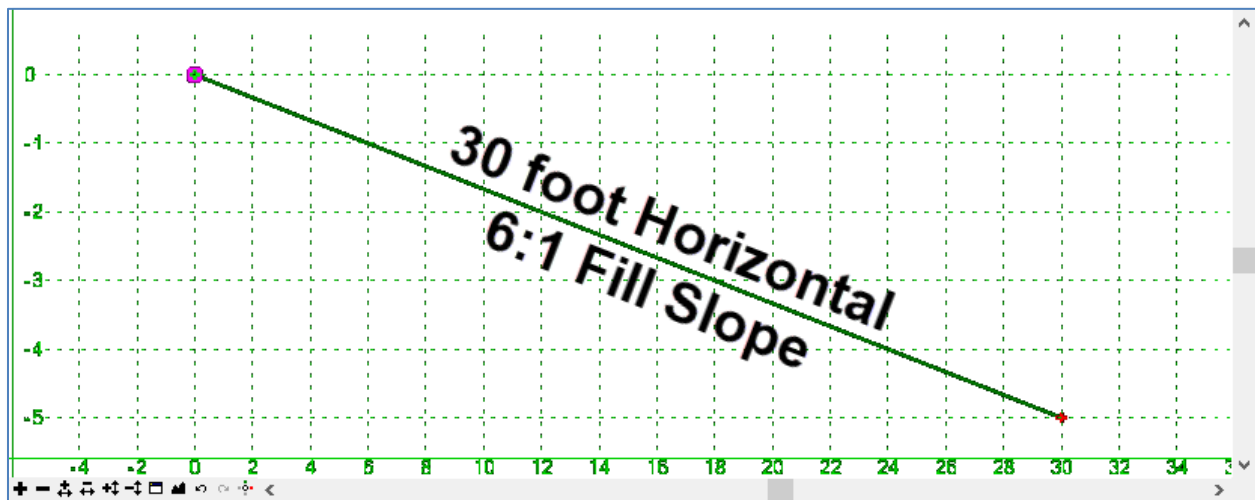
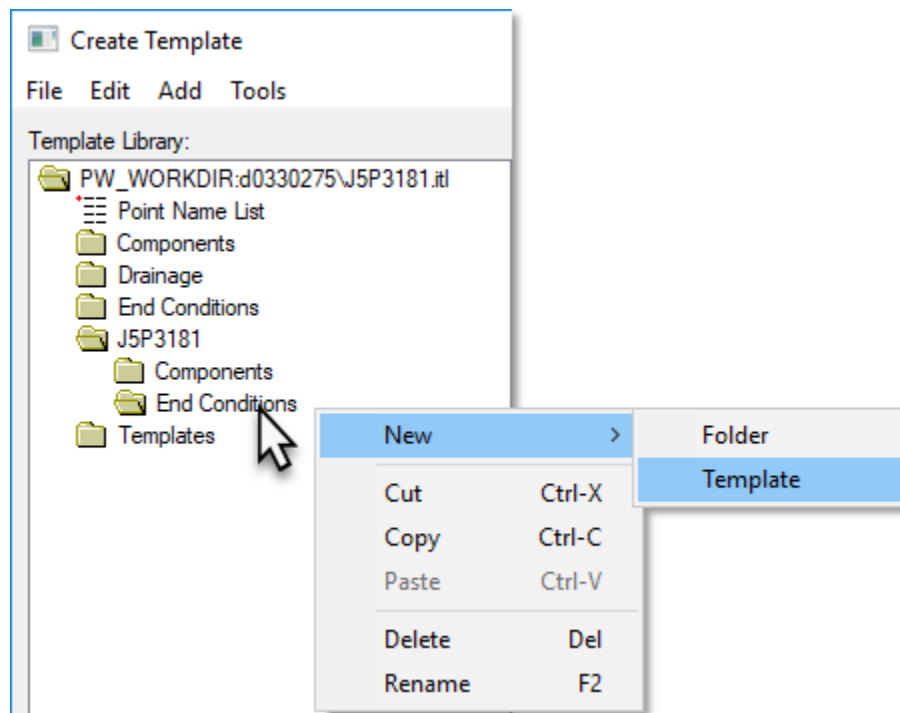
1. From the *OpenRoads Modeling* workflow, open the *Corridors* tab, select the **Create Template** icon.



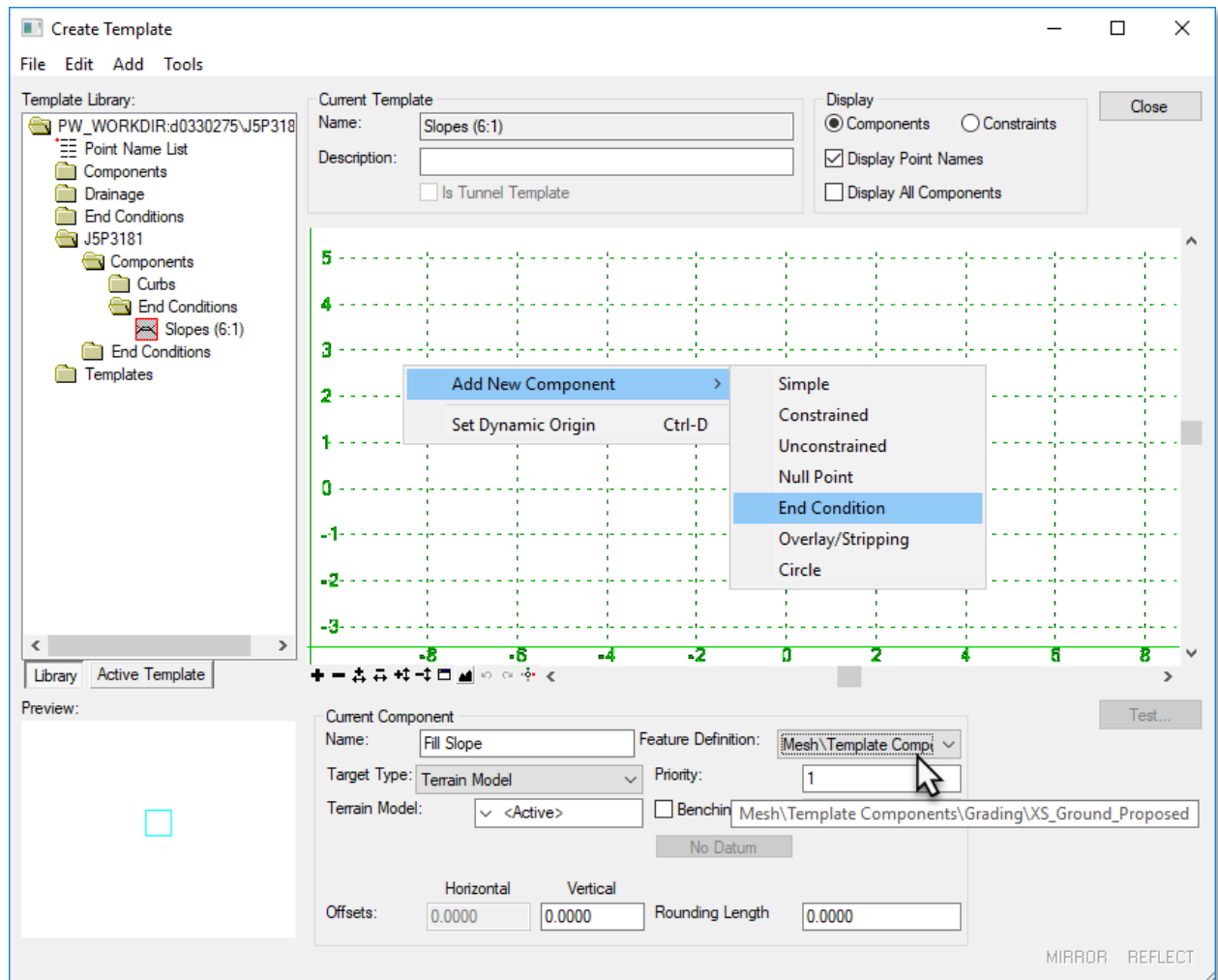
2. Select **File > Open** from the *Create Template* dialog menus. Open template library named **J5P3181.itl** from the **J5P3181/Data04** folder.
3. Navigate to the **J5P3181** folder and create a new folder called **End Conditions**.



4. Within the **End Conditions** folder create a new template called **Slopes (6:1)**.



5. To create the new slope component, right-click on the *Edit Template* Window and select **Add New Component > End Condition**.



6. Setup the *Current Component* portion of the *Create Template* dialog as follows:

<i>Name:</i>	<b>Fill Slope</b>
<i>Feature Definition:</i>	<b>Mesh\Template Components\Grading\XS_Ground_Proposed</b>
<i>Target Type:</i>	<b>Terrain Model</b>
<i>Priority:</i>	<b>1</b>
<i>Terrain Model:</i>	<b>&lt;Active&gt;</b>



7. For the first point setup the **Dynamic Settings** dialog as follows:

*Name:* **Fill\_Slope\_T** (select from list)

*Feature Definition:* Linear\Design\Template Point Features\Grading\XS\_Ground\_Proposed

*Apply Affixes:* **Disabled**

*Precision Input:* **xy = 0,0**

8. With your cursor in the **xy=0,0** field, press the **Enter** key on your keyboard.

9. For the second point setup the *Dynamic Settings* dialog as follows:

*Check for Interception:* **Enable**

*Place Point at interception:* **Enable**

*End Condition is Infinite:* **Enable**

*Do Not Construct:* **Disabled**

*Point Name:* **Fill\_Slope\_B** (pull-down)

*Feature Definition:* **XS Ground Proposed**

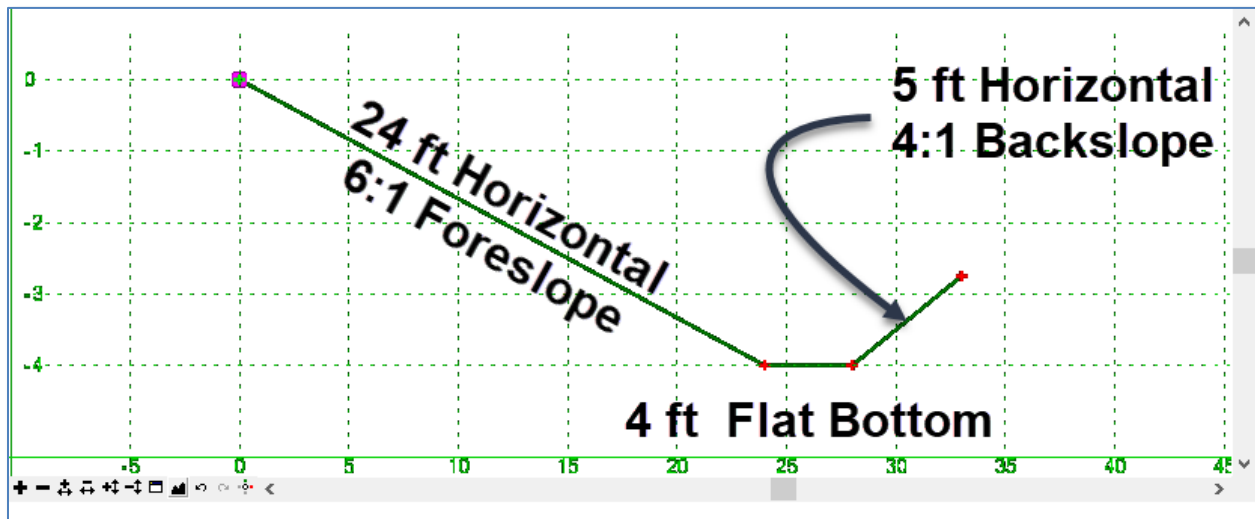
*Apply Affixes:* **Disabled**

*Precision Input:* **hs = 30,-1:6**

With your cursor in the **hs = 30 -1:6** field, press the **Enter** key on your keyboard.

10. Right-click on the *Edit Template* window and select **Finish**.

The next few steps describe the steps need to build a **Ditch End Condition**



11. Create Ditch End Components by right-clicking in the *Current Template* window and select **Add New Component > End Condition**.

12. Setup the Current Component portion of the Create Template dialog as follows:

**Name:** Ditch  
**Feature Definition:** XS Ground Proposed  
**Target Type:** Terrain Model  
**Priority:** 1  
**Terrain Model:** <Active>

Current Component			
Name:	<input type="text" value="Ditch"/>	Feature Definition:	<input type="text" value="XS Ground Proposed"/>
Target Type:	<input type="text" value="Terrain Model"/>	Priority:	<input type="text" value="1"/>
Terrain Model:	<input type="text" value="&lt;Active&gt;"/>	<input type="checkbox"/> Benching Count:	<input type="text" value="0"/>
<input type="button" value="No Datum"/>			
Offsets:	Horizontal <input type="text" value="0.0000"/>	Vertical <input type="text" value="0.0000"/>	Rounding Length <input type="text" value="0.0000"/>

13. For the first point setup the *Dynamic Settings* dialog as follows:

*Point Name:* **Ditch\_Frslp\_1\_T** (select from list)

*Point Feature Definition:* **XS\_Ground\_Proposed**

*Apply Affixes:* **Disabled**

*Precision Input:* **xy = 0,0**

Dynamic Settings

X: 12.9000 Step: 0.1000

Y: 0.0000 Step: 0.1000

Point Name: Ditch\_Frslp\_1\_T

Feature Definition: Features\Grading\XS\_Ground\_Proposed

☐ Apply Affixes

xy= 0,0

Set Dynamic Origin

With your cursor in the **xy=0,0** field, press the **Enter** key on your keyboard.

14. To place the **Fore-Slope bottom** point, set the *Dynamic Settings* dialog as follows:

*Point Name:*

**Dtch\_Frslp\_1\_B** (select from list)

*Check for Interception:*

**Disabled** (this forces this line segment to be placed)

*Place Point at Interception:*

**Disable**

*End Condition is Infinite:*

**Disabled**

*Do Not Construct:*

**Disabled**

*Apply Affixes:*

**Disabled**

*Precision Input:*

**hs = 24,-1:6**

Dynamic Settings

X: 16.8000 Step: 0.1000

Y: 1.3000 Step: 0.1000

☐ Check for Interception

☐ Place Point at Interception

☐ End Condition is Infinite

☐ Do Not Construct

Point Name: Dtch\_Frslp\_1\_B

Feature Definition: Features\Grading\XS\_Ground\_Proposed

☐ Apply Affixes

hs= 24,-1:6

Set Dynamic Origin

With your cursor in the **hs = 24,-1:6** field,  
Press the **Enter** key

15. To place the **Back of Ditch bottom** point, set the **Dynamic Settings** dialog as follows:

<i>Point Name:</i>	<b>Dtch_Bkslp_1_B</b> (select from list)
<i>Check for Interception:</i>	<b>Disabled</b> (This forces this line segment to be placed)
<i>Place Point at Interception:</i>	<b>Disable</b>
<i>End Condition is Infinite:</i>	<b>Disabled</b>
<i>Do Not Construct:</i>	<b>Disabled</b>
<i>Apply Affixes:</i>	<b>Disabled</b>
<i>Precision Input:</i>	<b>hs = 4,0</b>

With your cursor in the **hs = 4,0** field,  
Press the **Enter** key.

16. To place **Slope-Stake point**, set up the **Dynamic Settings** dialog as follows:

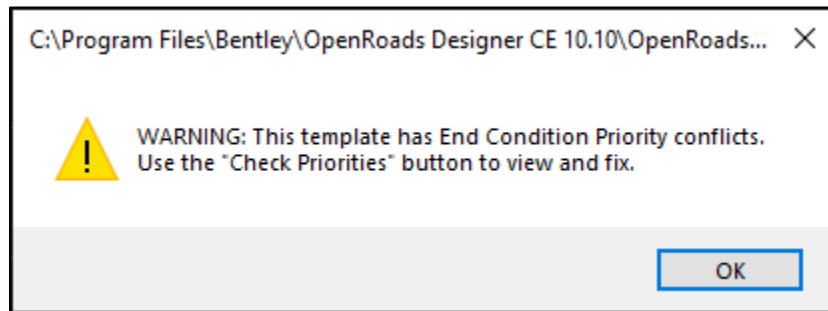
<i>Point Name:</i>	<b>Dtch_Bkslp_1_T</b> (select from list)
<i>Check for Interception:</i>	<b>Enable</b>
<i>Place Point at Interception:</i>	<b>Enable</b>
<i>End Condition is Infinite:</i>	<b>Enable</b>
<i>Do Not Construct:</i>	<b>Disabled</b>
<i>Apply Affixes:</i>	<b>Disabled</b>
<i>Precision Input:</i>	<b>hs = 5,25%</b>

Toggle on **End Condition is Infinite**

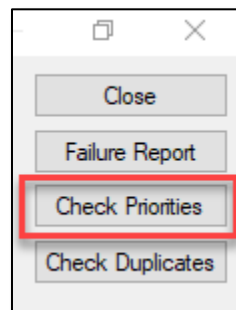
With your cursor in the **hs = 5,25.0%**,  
press the **Enter** key.

17. **Right-click** on the *Edit Template* window and select **Finish**.

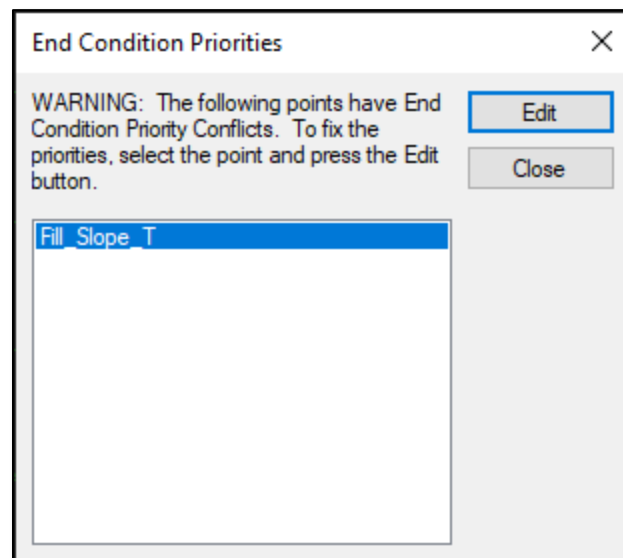
18. Test the End Conditions by selecting the *Test* button located under the *Current Template* window. A warning will be given about the template having end condition priority conflicts.



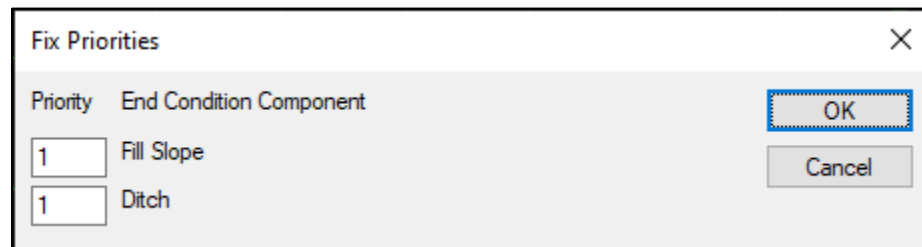
19. Select **Check Priorities** on the right side of the *Test End Conditions* window.



Notice the **Fill\_Slope\_T** point is the point that has the priority conflicts.

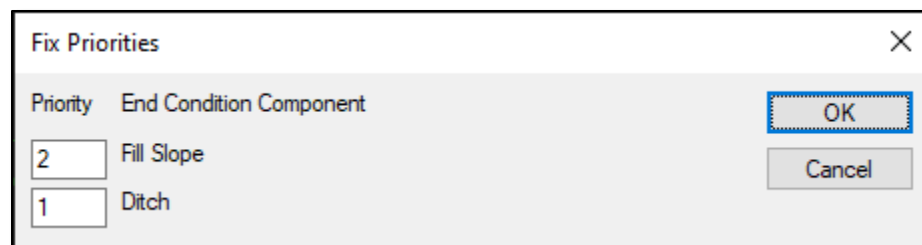


20. In the **End Condition Priorities** dialog select **Edit**. Notice that all the end conditions have the same priority number.



Put your cursor in each of the fields and notice the segments highlighting.

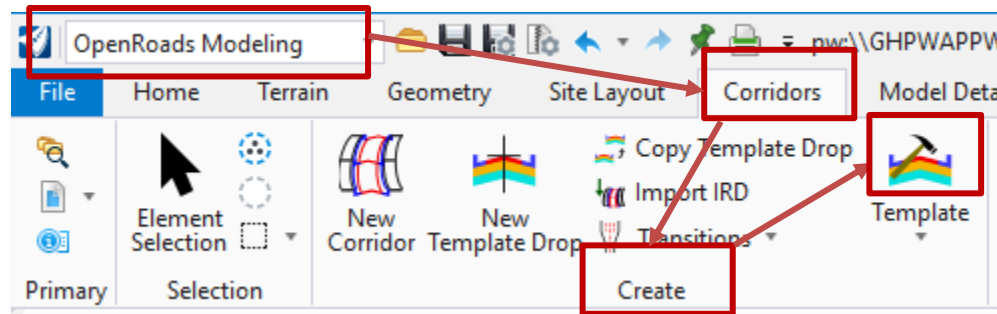
Assume that Ditch is the most desirable condition and change the Priority of the **Fill Slope** priority to “2”.



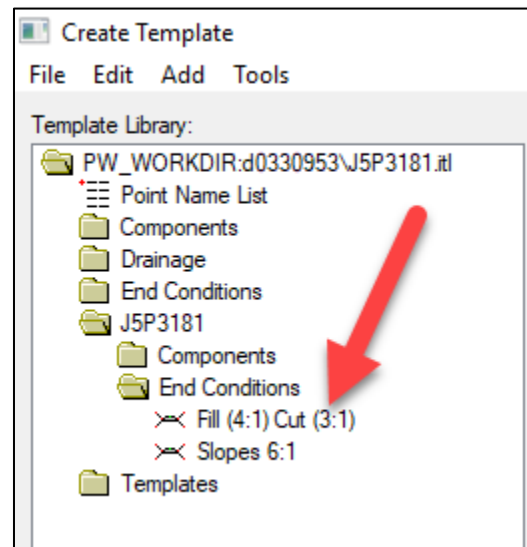
21. Click **OK**, and then **Close**.
22. Click **Draw** on the right side of the **Test End Conditions** window. Move your cursor over the end conditions.
23. Close the *Test End Conditions* dialog.

## 4.12 Individual Exercise 4-3: Creating an End Condition

1. From the *OpenRoads Modeling* workflow, open the *Corridors* tab, select the **Create Template** icon.



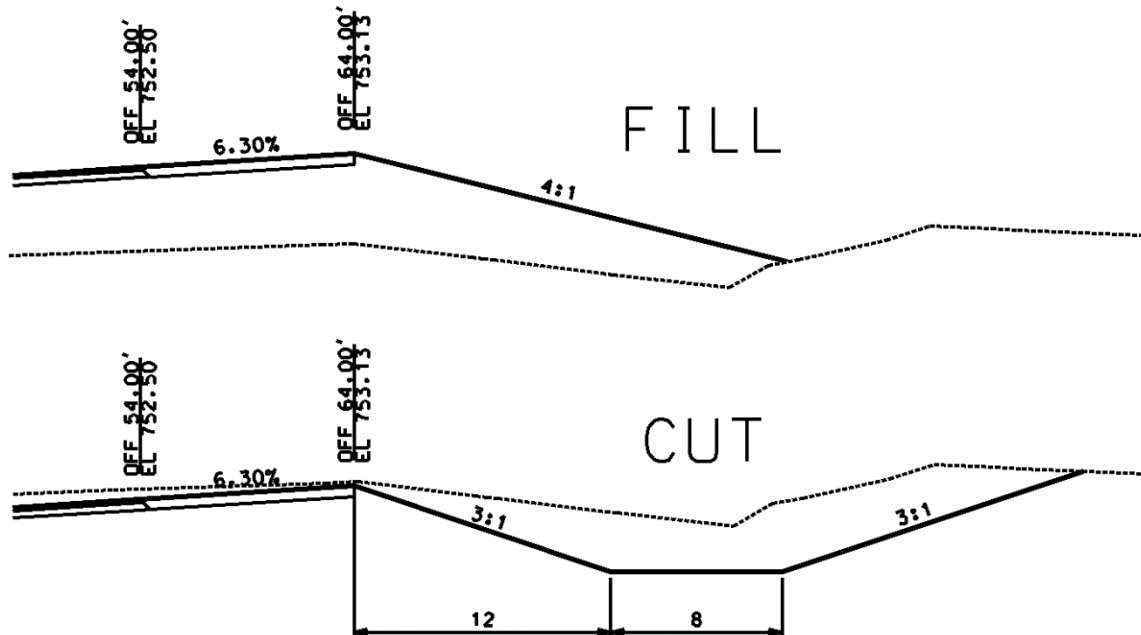
2. Select **File > Open** from the *Create Template* dialog menus. Open template library named **J5P3181.itl** from the **J5P3181/data-4** folder.
3. Navigate to the **J5P3181** folder and **End Conditions**, create a new template called **Fill (4:1) Cut (3:1)**



4. Create a **Fill and Ditch End Condition** in the same End Condition Template by right-clicking on the Template Window and select **Add New Component > End Condition**.

In this exercise the design criteria call for a **4:1 Fill** and **3:1 Ditch slope**.

Using the previous exercise create the following two end conditions. Also test end conditions to make sure there are no conflicts.

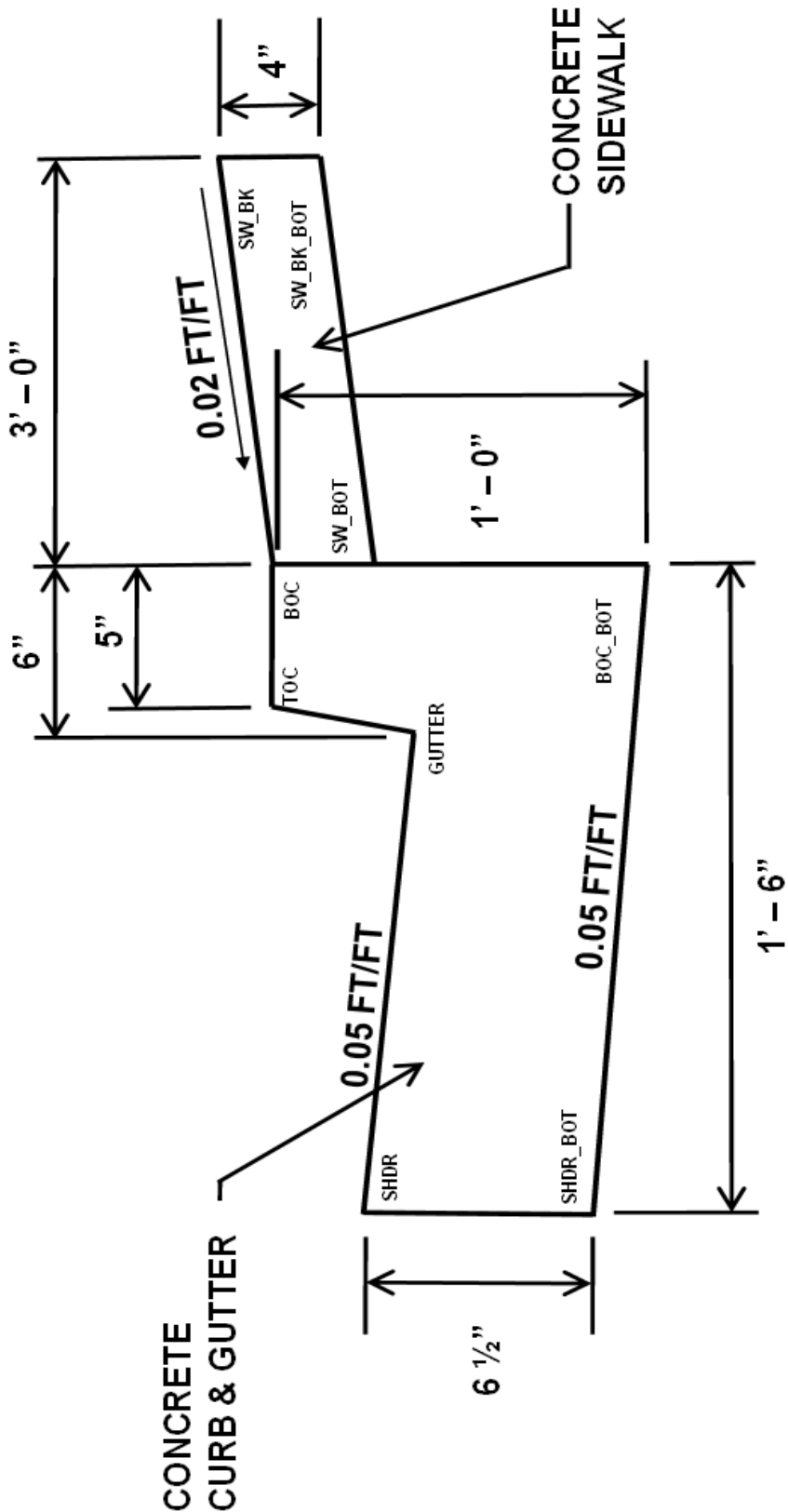


**Note:** In this exercise the User only needs to create the End Conditions shown above. The User does not have to create any of the main components of the Roadbed (shoulder, pavement, etc.).



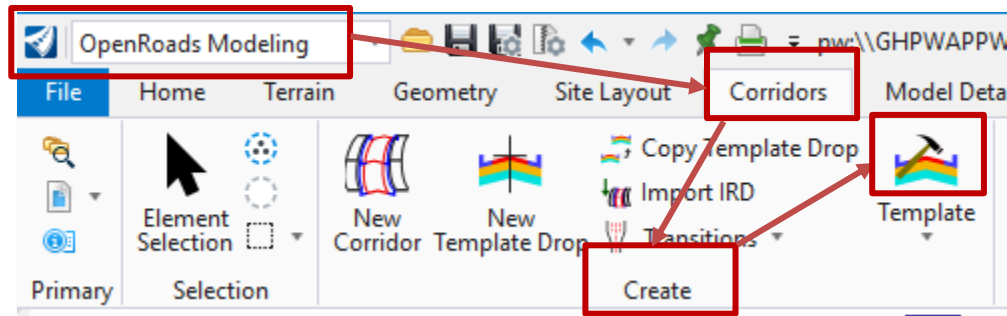
### 4.13 Bonus Individual Exercise: Creating a Curb and Gutter w/Sidewalk

## Practice #2 - Adding a Constrained Component Curb & Gutter Detail

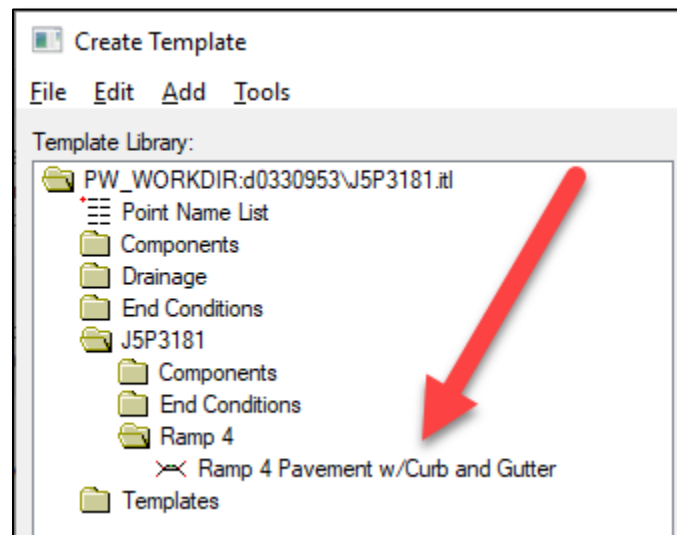


#### 4.14 Group Exercise 4-4: Creating a Template (Pavement w/Curb & Gutter)

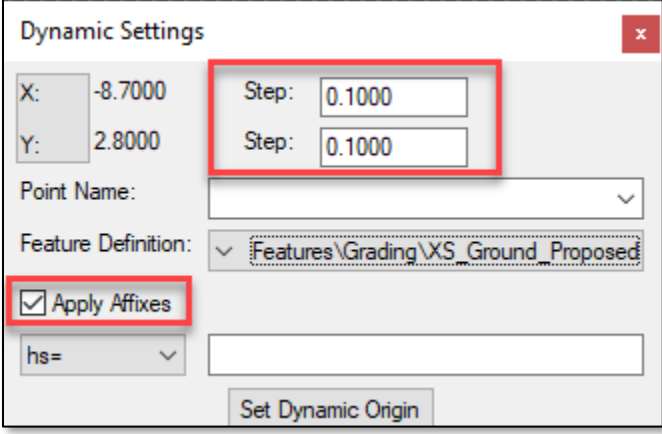
1. From the *OpenRoads Modeling* workflow, open the *Corridors* tab, select the **Create Template** icon.



2. Select **File > Open** from the *Create Template* dialog menus. Open template library named **J5P3181.itl** from the **J5P3181/data-4** folder.
3. Navigate to the **J5P3181** folder and **create** a new folder named **Ramp 4**.
4. Within the **Ramp 4** folder, create a new template called **Ramp 4 Pavement with Curb and Gutter** by right clicking on the **Ramp 4** folder and selecting **New > Template**.



5. Set the following *Dynamic Settings*:

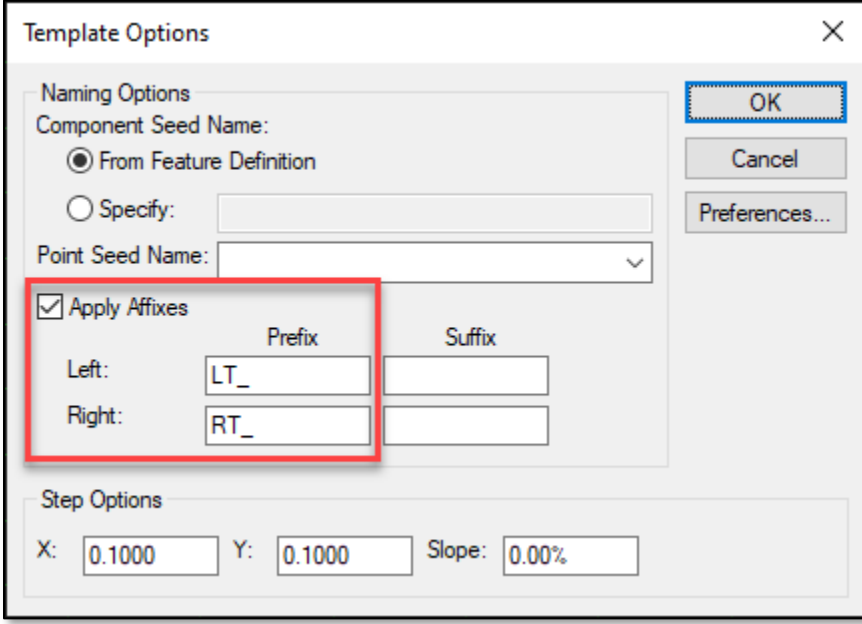


The **Dynamic Settings** dialog box is shown. It contains the following fields and controls:

- X:** -8.7000
- Y:** 2.8000
- Step:** 0.1000 (two instances)
- Point Name:** (empty dropdown)
- Feature Definition:** Features\Grading\XS\_Ground\_Proposed
- ☒ **Apply Affixes**
- hs=** (empty dropdown)
- Set Dynamic Origin** button

Red boxes highlight the **Step** fields and the **Apply Affixes** checkbox.

6. In *Create Template* go to **Tools > Options** and confirm the following Affixes are set:



The **Template Options** dialog box is shown. It contains the following fields and controls:

- Naming Options**
  - Component Seed Name:**
    - ☒ From Feature Definition
    - ☐ Specify: (empty text box)
  - Point Seed Name:** (empty dropdown)
- ☒ **Apply Affixes**
  - Prefix**
    - Left:** LT\_
    - Right:** RT\_
  - Suffix**
    - (empty text box)
    - (empty text box)
- Step Options**
  - X:** 0.1000
  - Y:** 0.1000
  - Slope:** 0.00%

Red boxes highlight the **Apply Affixes** checkbox and the **Prefix** fields.

7. Use the following Components and End Conditions to create the **Ramp 4 Pavement with Curb and Gutter** template:

**Setup Requirements:**

- Make the concrete thickness **9-3/4" (-0.8125')** before adding **Curb and Gutter Type B w/ Agg Base**. If you already place the Curb and Gutter, select "Undo".
- Modify pavement width to 18 feet
- Have the pavement slope downward to the right at 2%
- After adding each Curb and Gutter move the **CL Merge Point** to opposite edge of pavement and merge points. When asked which point to delete select **CL Merge Point**
- When bringing in the Cut Wall, merge the **LT\_Ret\_Wall\_Lower\_Ground\_Tie** point to the **LT\_Curb\_Surf\_Back** point. Utilize the preview window to do this.
- Remove the **LT\_RetainingWallUpperGround** End Condition from the Cut Wall.
- Place the Type A Gutter **6 inches** down from the outside of the Cut Wall.
- Adjust the Sidewalk Outer Buffer to slope down away from Sidewalk at a -2% slope.
- At this time, do not worry about the unconstrained point within Cut Wall.
- Save Template Library

**Components:**

**Left Side**

Concrete Pavement w/ Agg Base  
Curb and Gutter Type B w/ Agg Base  
Cut Wall Case 5- use existing ground no profiles exist  
Gutter Type A

**Right Side**

Curb and Gutter Type B w/ Agg Base  
Sidewalk w/ Outer Buffer

**End Conditions:**

**Left Side**

Ditch Back Slope 1 (4:1)

**Right Side**

Ditch  
Fill Slope 1 (4:1)

**Concrete Pavement w/ Agg Base** is in the following location:

**Components → Pavement New → Pavement Only → Concrete**

**Curb and Gutter Type B w/ Agg Base** is in the following location:

**Components → Curb and/or Gutter**

**Cut Wall Case 5 - use existing ground no profiles exist** is in the following location:

**Components → Retaining Wall → Cut Wall**

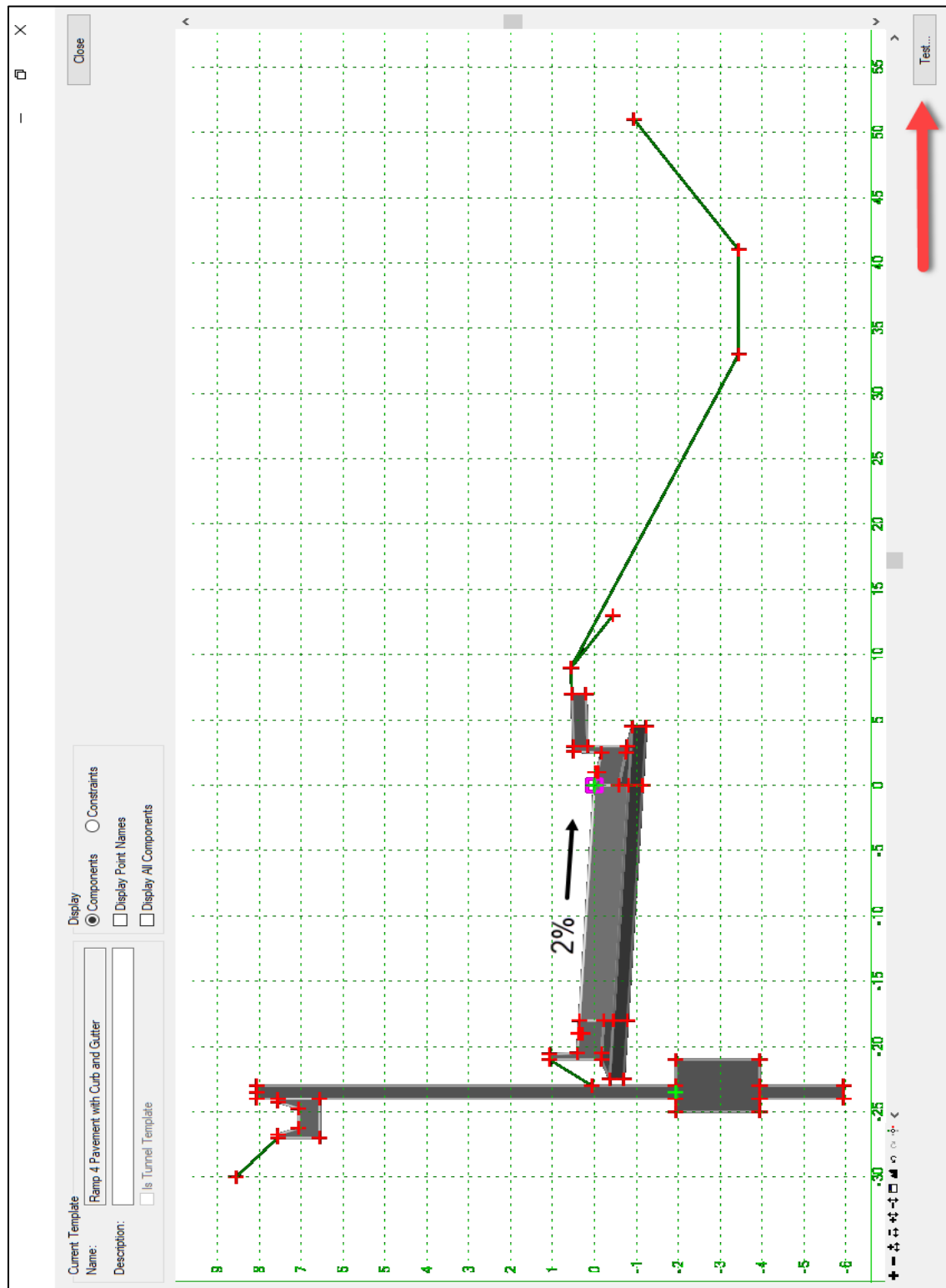
**Sidewalk w/ Outer Buffer** is in the following location:

**Components → Sidewalk**

**Gutter Type A** is in the following location:

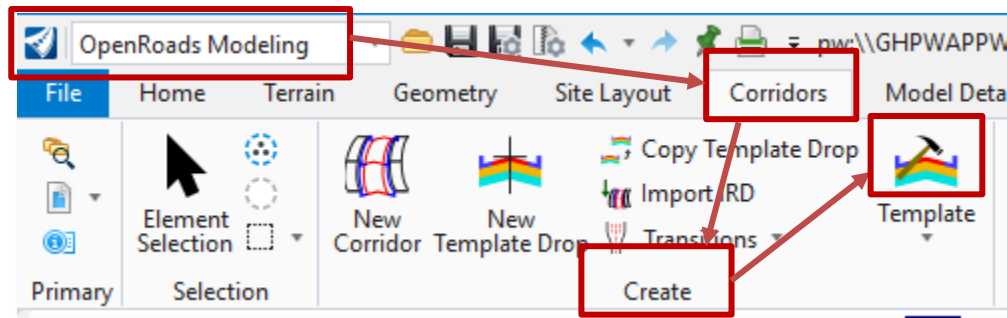
**Components → Curb and/or Gutter**

8. In **Create Template** select the **Test** button to check the End Condition Priorities.

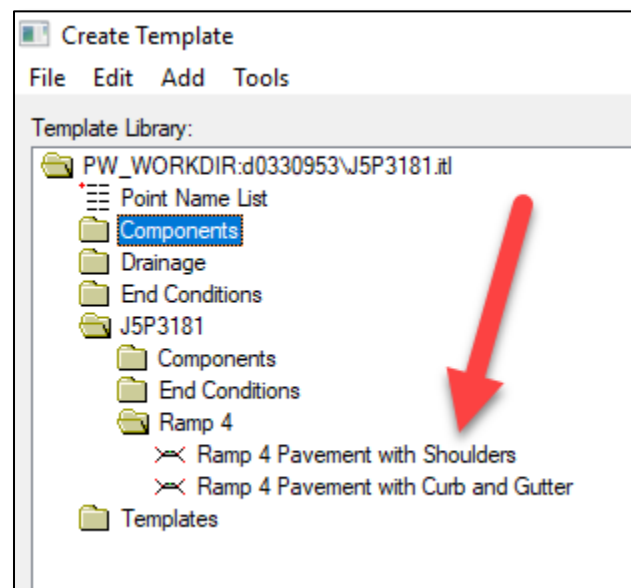


### 4.15 Individual Exercise 5-5: Creating a Template (Pavement w/Shoulder)

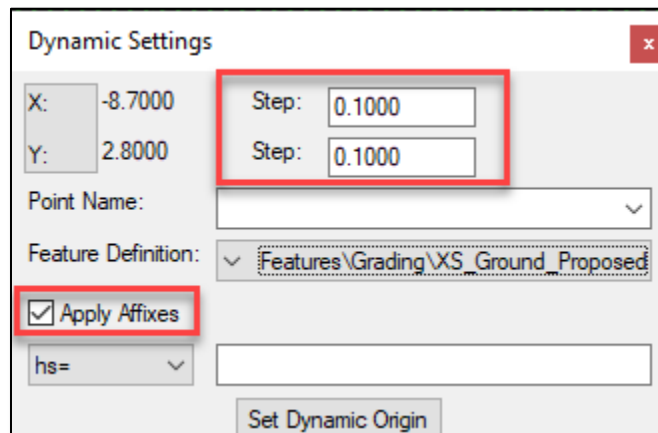
1. From the *OpenRoads Modeling* workflow, open the *Corridors* tab, select the **Create Template** icon.



2. Select **File > Open** from the *Create Template* dialog menus. Open template library named **J5P3181.itl** from the **J5P3181/data-4** folder.
3. Navigate to the **J5P3181** folder.
4. Within the **Ramp 4** folder, create a new template called **Ramp 4 Pavement with Shoulders** by right clicking on the **Ramp 4** folder and selecting **New > Template**.



5. Verify the following *Dynamic Settings*:

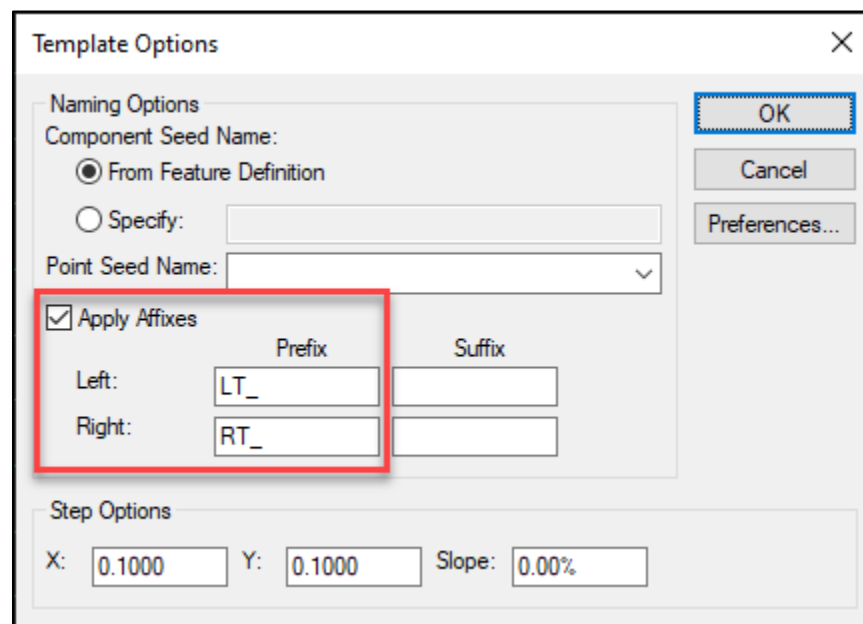


The **Dynamic Settings** dialog box is shown. It contains the following fields and settings:

- X: -8.7000
- Y: 2.8000
- Step: 0.1000 (for both X and Y)
- Point Name: (empty dropdown)
- Feature Definition: Features\Grading\XS\_Ground\_Proposed
- ☒ Apply Affixes
- hs= (empty dropdown)
- Set Dynamic Origin button

Red boxes highlight the Step fields and the Apply Affixes checkbox.

6. In *Create Template* go to **Tools > Options** and confirm the following Affixes are set:



The **Template Options** dialog box is shown. It contains the following sections and settings:

- Naming Options**
  - Component Seed Name:
    - ☒ From Feature Definition
    - ☐ Specify: (empty text field)
  - Point Seed Name: (empty dropdown)
  - ☒ Apply Affixes
    - Prefix
      - Left: LT\_
      - Right: RT\_
    - Suffix
      - (empty text field)
      - (empty text field)
- Step Options**
  - X: 0.1000
  - Y: 0.1000
  - Slope: 0.00%

Red boxes highlight the Apply Affixes checkbox and the Affix fields.

7. Use the following components to create the **Ramp 4 Pavement with Shoulders** template:

**Setup Requirements:**

- Modify pavement width to 18 feet.
- Verify **Pavement** is sloping downward to the right at **2%**
- Have the **Left and Right Shoulder Slopes** follow the pavement slope using a **Vector Offset** constraint.
- When bringing in the Cut Wall, select the **LT\_Ret\_Wall\_Lower\_Ground\_Tie** point in the preview window and place it on top of the **LT\_Conc\_T\_O\_EOS** shoulder point.
- Remove the **LT\_RetainingWallUpperGround** End Condition from the Cut Wall.
- Place the **Type A Gutter 6 inches** down from the outside of the Cut Wall.
- Adjust the **all** surface slopes of the **Sidewalk w/ Inner and Outer Buffer** to be **-2%** sloping downward to the right
- At this time, do not worry about the unconstrained point within Cut Wall.
- Save Template Library.

**Components:**

**Left Side**

Concrete Pavement w/ Agg Base  
A2 Shoulder Concrete Option 1 w/ Agg Base  
Cut Wall Case 5- use existing ground no profiles exist  
Gutter Type A

**Right Side**

A2 Shoulder Concrete Option 1 w/ Agg Base  
Sidewalk w/ Inner and Outer Buffer

**End Conditions:**

**Left Side**

Ditch Back Slope 1 (4:1)

**Right Side**

Ditch  
Fill Slope 1 (4:1)

**Concrete Pavement w/ Agg Base** is in the following location:

**Components → Pavement New → Pavement Only → Concrete**

**A2 Shoulder Concrete Option 1 w/ Agg Base** is in the following location:

**Components → Shoulders → Concrete w/o Curb**

**Cut Wall Case 5 - use existing ground no profiles exist** is in the following location:

**Components → Retaining Wall → Cut Wall**

**Sidewalk w/ Inner and Outer Buffer** is in the following location:

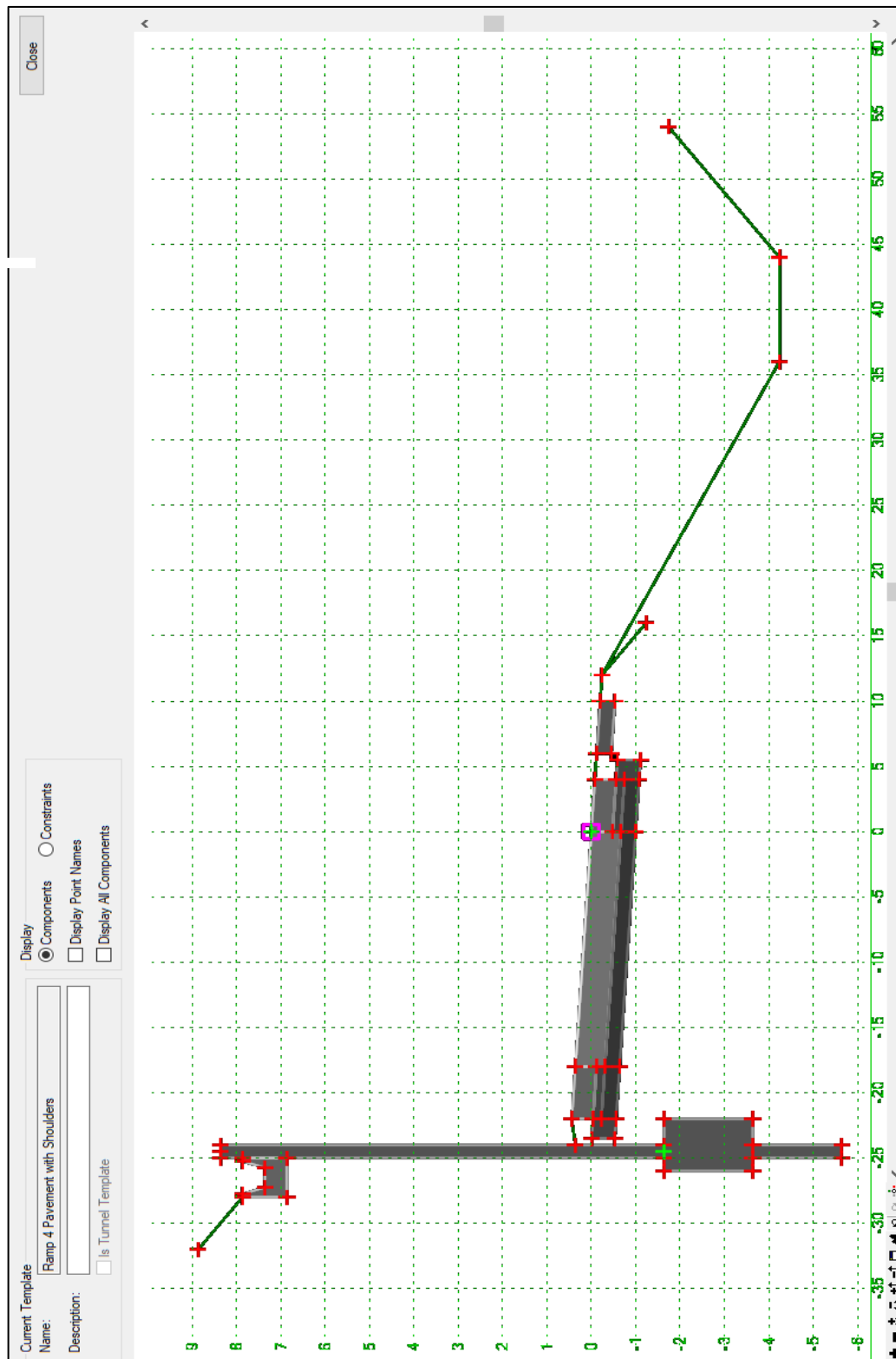
**Components → Sidewalk**

**Gutter Type A** is in the following location:

**Components → Curb and/or Gutter**



8. In **Create Template** select the **Test** button to check the **End Condition Priorities**.



9. Close the Template Library and select **“Save”** to save the *Template Library*.

---

## Chapter 5

# Corridor Modeling

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## 5.1 Objectives

- Create Corridor
- Assign Multiple templates to one corridor
- Create new templates from existing templates

## 5.2 Corridor Modeling Overview

The Corridor Modeling toolset is a group of highly interactive commands to create new design surfaces that represent a new roadway or other type of surface. Tools for creation, modification, management, and report functions are supported.

Corridor Modeling tools aggregates a variety of civil data. The geometry is created with the Horizontal and Vertical Geometry tools, while the existing ground is defined by a MicroStation mesh or Civil Terrain Model. Plan view elements, such as edges of pavement, shoulders, curbs, etc. can be 2D or 3D. Superelevation information is defined within a design file using standards or imported data. Templates are utilized from one or more template libraries.

Reference files can be used extensively with Corridor Modeling. On a simple project, the data may be all in one file; larger projects may have geometry in one file, plan view graphics in a second, terrain in another, superelevation in a fourth and the actual model in a fifth. All files can reference the others, to present a complete picture of the project.

When working with Corridor Modeling, you can draw in 2D or 3D. When using 2D (such as for plan-view graphics), a 3D view is automatically created and maintained. For example, when a vertical geometry element is initially defined for a horizontal geometry element, the Default-3D model is created, if there isn't one already. The 3D baseline (combination of horizontal and vertical element) is drawn into the 3D model. As template drops are added, and progressed, they are added to the 3D model automatically.

When starting to create a corridor, basic information can be used. A single template can be used, along with preliminary geometry and a high level terrain model. As the design progresses, more detail can be added. Instead of a single template drop, perhaps more templates better define the roadway. Transitions can be added to smoothly move from one template to another. There may be multiple roadways all interconnected using the target aliasing tools. All the while, as changes are made, the corridor model is updating, so you see up-to-the minute results. Simple projects may not require all the tools, and a basic corridor model may be sufficient. But all the tools are available to handle basic to complex, small-scale to large-scale projects.

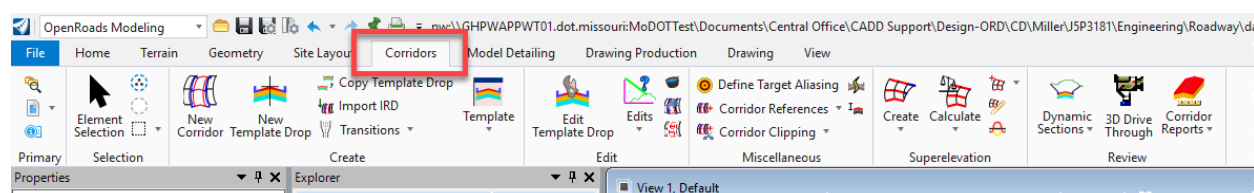
## 5.3 Prerequisites

The following are minimum requirements to use Corridor Modeling.

- One Civil horizontal element and one Civil vertical element, generally the centerline and profile of the design roadway
- One template stored in a template library

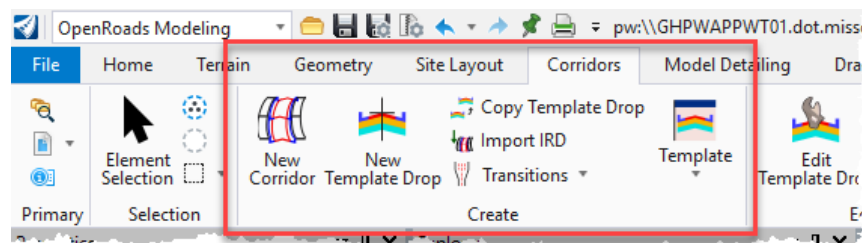
A terrain model is not required for corridor modeling. If the template includes end conditions and no terrain model is defined, the software generates as much of the model as possible, but will not complete the end condition that ties to ground and no error message is given.

## 5.4 Corridor Modeling Tools

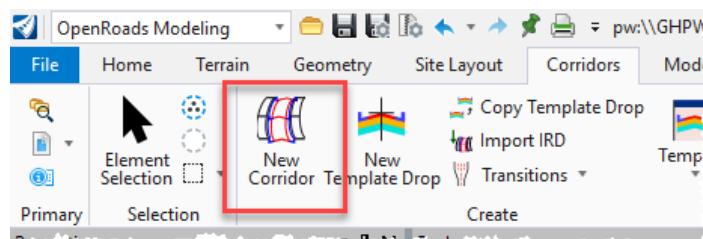


### 5.4.1 Corridor Creation Tools

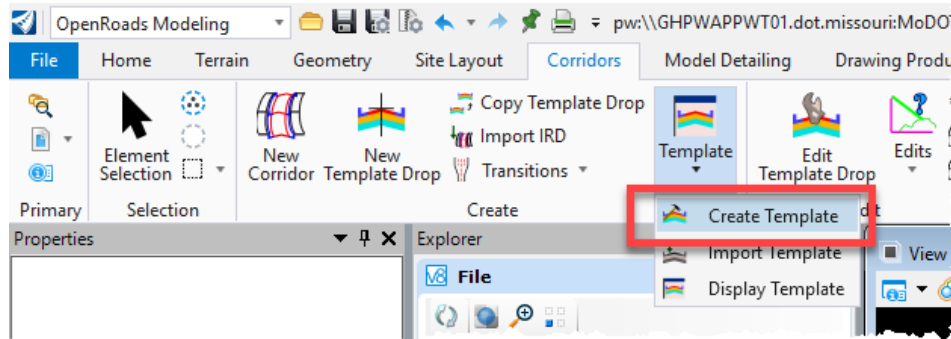
The first toolbox is used when beginning design on a corridor and includes tools for creating corridors, template drops, and transitions; along with various tools for working with the template library.



**New Corridor** - The New Corridor tool is the initial step in corridor design; names the corridor and identifies the geometry. No processing of templates is done within this tool; rather it's a set-up step prior to template work.



After the corridor is created/drawn, the software automatically advances to the Create Template Drop tool.



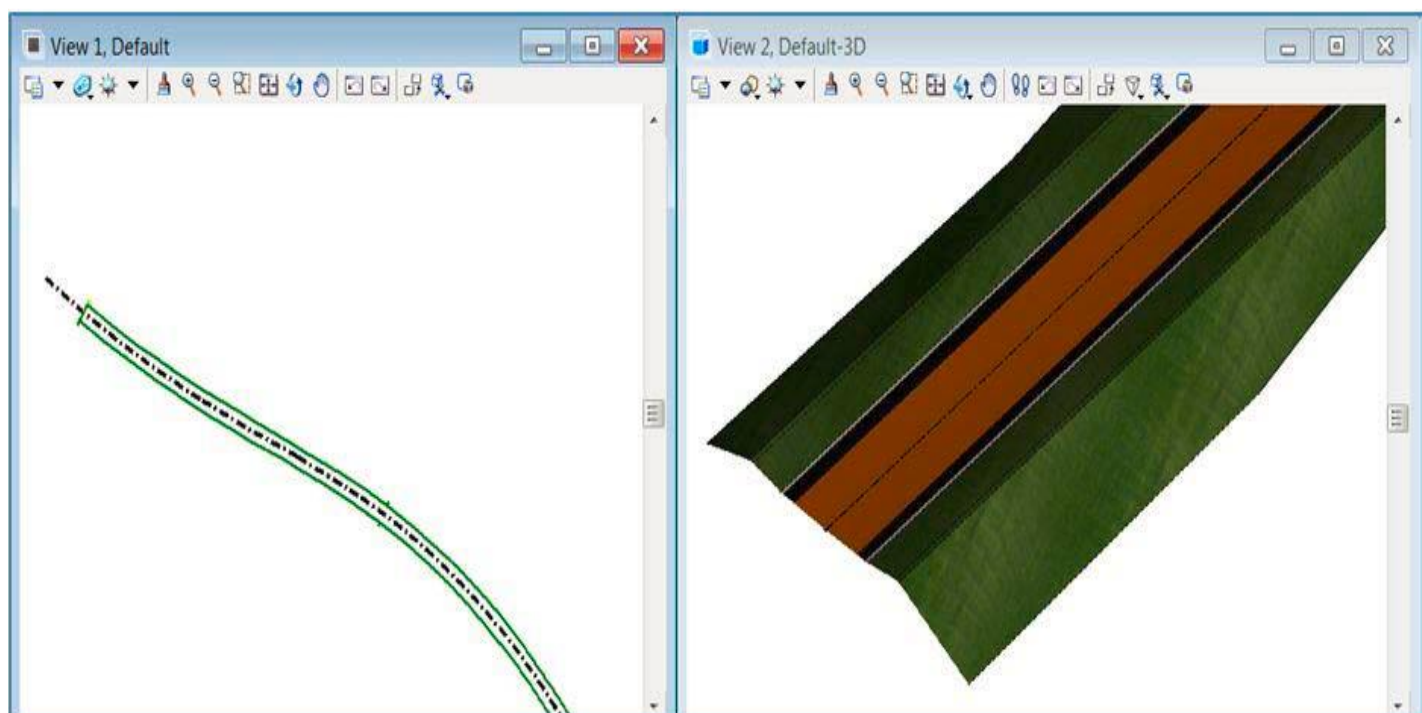
**Create Template Drop** - defines what the cross sections of the roadway look like for that portion of the road based on user-defined station range. A project may comprise of a single template drop or multiple template drops. Often, transitions are used between two template drops, rather than an abrupt change from one template to another.

Careful consideration should be given for the Drop Interval used for a corridor, although it can be changed at any time. It specifies the distance between each processing of the template (in master units). Generally, this value is equal to or less than (but still a multiple) of the desired interval for the final cross sections, since cross section stations should be coincident with processing stations. It is not necessary to set the interval so small that it encompasses all desired cross section stations, as stations with particular project interest can be added to the model with the use of the Key Station tool. If the model is to be used in construction, the smaller the interval, the more detailed the model, but will require more processing time.

**Note** Drop Intervals are impacted by the Design Stages.

- Minimum Transition Before Drop and Minimum Transition After Drop are inputs in the Create Template Drop tool. If they are non-zero, then a transition drop is created at the beginning/end of the template drop with a length greater than or equal to the value entered. The actual length is determined by how far it is between the new drop and the drop before/after the new drop. If there isn't enough space to meet the minimum, then the previous/next drop is shortened to accommodate the transition. If there is no previous/next drop, then no transition drop is created.

After completing the prompts, the corridor is automatically processed and can be viewed in both 2D and 3D views. The corridor can be rendered, if desired.



The symbology is based on the feature definitions within the template. The Project Explorer is also updated with the corridor information, including template drops, components and features.

## Create Template Drop Workflow

Select the **Create Template Drop** tool. This tool is automatically invoked at the end of the Create Corridor tool, but you can use it independently of the Create Corridor tool.

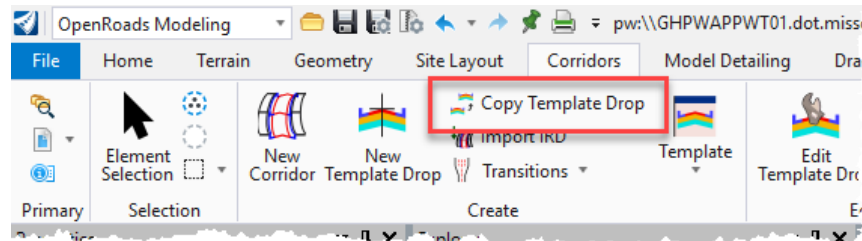
Select the Corridor wherein the template drop will be added.

1. **Select Template** - Select the template from the pull-down list of recently used templates, or select <Alt> <Down> on the keyboard to open the active template library and select the template. Data point to accept the template and move to the next prompt.
2. **Start Station** - Graphically define the start station or enter the value in the edit field. Data point to accept and move to the next prompt. The Start station can be locked by <Enter> after keying in the station or selecting <Alt>. Selecting <Alt> again unlocks the field.
3. **End Station** - Graphically define the end station or enter the value in the edit field. Data point to accept and move to the next prompt. The End station can be locked by <Enter> after keying in the station or selecting <Alt>. The template is copied to the new station range. Selecting <Alt> again unlocks the field.
4. **Drop Interval** - specifies the distance between each processing of the template (in master units). Generally, this value is equal to or less than (but still a multiple) of the desired

interval for the final cross sections, since cross section stations should be coincident with processing stations. Note that this is impacted by the Design Stages.

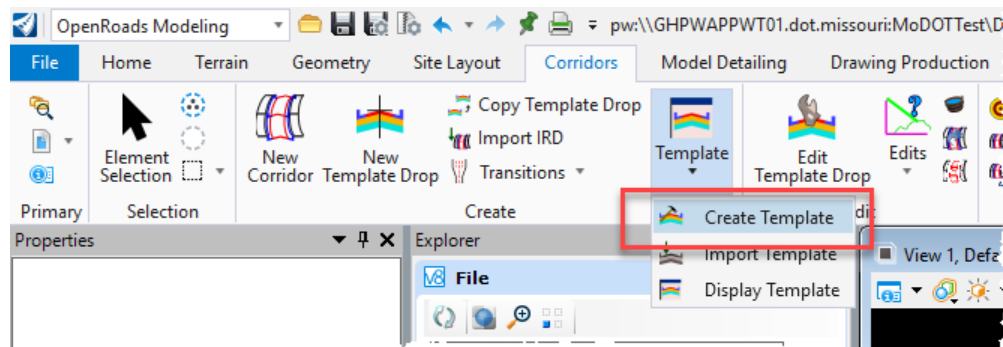
**Copy Template Drop** - As an alternate to creating and modifying a template drop, this tool copies an existing template drop to a newly defined station range along the same baseline reference.

The Copy Template Drop tool can be used as an alternate to creating and modifying a template drop, as the tool copies an existing template drop to a newly defined station range along the same baseline reference within the same corridor.



## Copy Template Workflow

1. Select the **Copy Template Drop** tool.
2. **Locate Template Drop** - Select the previously created template that you want to copy to a different location.
3. **Start Station** - Graphically define the start station or enter the value in the edit field. Data point to accept and move to the next prompt. The Start station can be locked by **<Enter>** after keying in the station or selecting **<Alt>**. Selecting **<Alt>** again unlocks the field.
4. **End Station** - Graphically define the end station or enter the value in the edit field. Data point to accept and move to the next prompt. The End station can be locked by **<Enter>** after keying in the station or selecting **<Alt>**. The template is copied to the new station range. Selecting **<Alt>** again unlocks the field.

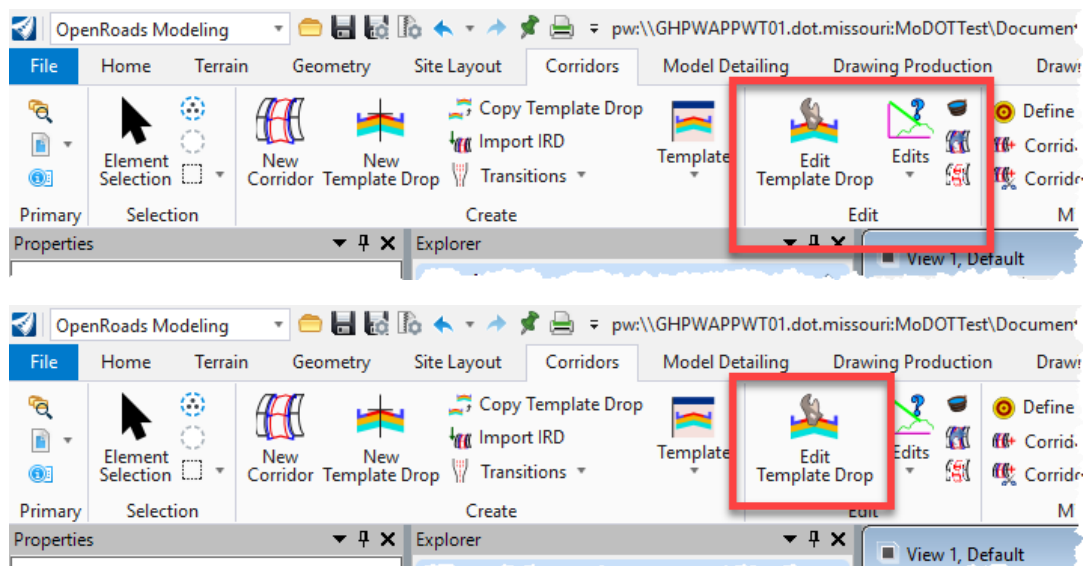


**Create Template** - Opens the current template library to add a new template, delete or modify an existing template.



## 5.4.2 Corridor Edit Tools

This ribbon contains tools for editing of a previously created corridor and associated template drops. These tools enable you to refine the model by adding more detailed information to respond to project-specific requirements and constraints.



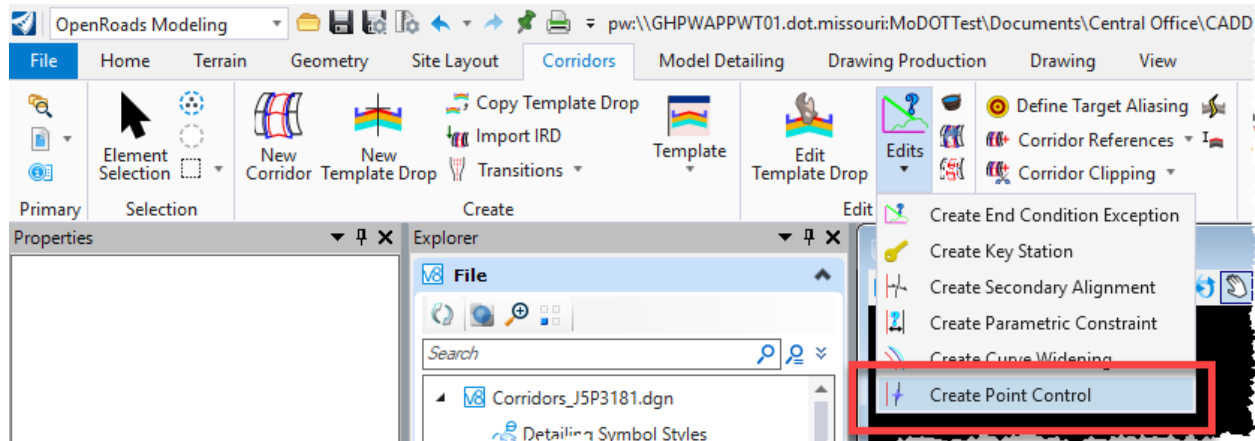
**Edit Template Drop** - Opens the current template library and displays the template with the selected template drop. While the dialog is the template library interface, keep in mind that the editing is only being done to the template within the template drop, not the actual template library. Therefore, if any changes are made, the template associated with the template drop is no longer in sync with the template library. For project specific circumstances, this may be required. The tools and options within the edit template drop function identically to those in the template library, except the File tools are not available.

If the changes are needed in the template library, use the Create Template tool.

To update the template associated with the template drop to match the template in the template library, use the Synchronize with Library tool. When this tool is used, the template from the template library overwrites the template associated with the template drop, so all changes are lost with no warning given.

### Edit Template Drop Workflow

1. Select the **Edit Template Drop** tool.
2. **Locate the Template Drop.** Select the template drop whose template needs editing. The Editing Roadway Design Template Drop dialog (whose interface is identical to the Template Library dialog) opens with the current template.
3. Edit as needed. Click **OK** to close the dialog. You do not have to File > Save to save your edits (most File functions are ghosted out).



**Create Point Control** These are used to override the normal locations of one or more points and or components in a cross section. Examples of this include lane widening, staying within the right-of-way, maintaining a particular slope for a ditch, and superelevation.

An example would be a ramp is merging into the main road. The ramps left edge is vertically controlled by the main road right edge of pavement. The ramps left edge is horizontally controlled by the main road right edge from 0+00 to 1+00, and then it is controlled by a horizontal alignment named rampLeft.

**Station Limits (Start/Stop)** - specifies the start and stop stations for the control.

**Control Description** - allows you to enter a description of the control.

**Point** - allows you to select the point to be controlled. Select from the list or identify the point in the cross-section using the locate button. The selected point is highlighted in plan/cross section and profile or superelevation views as applicable.

**Mode** - allows you to select the control mode: Horizontal, Vertical, or Both.

**Control Type** - specifies the type of control.

If the Mode is **Horizontal** or **Both**, valid control types are Linear Geometry, Feature Definition, or Corridor Feature.

If the Mode is **Vertical**, valid control types are Linear Geometry, Feature Definition, Corridor Feature, Superelevation, Elevation Difference, Elevation and Grade.

The selection combo boxes and/or field displayed depends on the selected Mode and Control Type.

**Type - Linear Geometry** If the type is Linear Geometry, a Horizontal Offsets combo box is displayed. If the mode is Both, a Vertical Offsets combo box is also displayed.

**Type - Feature Definition** If the type is Feature Definition, a Feature Definition and Range text field is displayed.

**Type - Corridor Point** For all modes, Corridor and Reference Feature combo boxes are displayed. These options allow you to set up the control of one corridor's points(s) from another corridor's point(s).

Targeting another corridor's point cannot be done simultaneously with Target Aliasing of that same corridor. If Target Aliasing has been defined, the Corridor Point is not available for selection within the Point Control dialog. This produces a recursive situation, making the corridor point control unavailable for selection until that Target Aliasing is removed.

**Type – Superelevation** This option displays a Superelevation control line combo box, and a Reference Point combo box. Superelevation control lines are stored in the roadway design, not on the alignment. The reference point is the pivot point (feature) about which the point will rotate.

**Type - Elevation Difference** This option displays Horizontal and Vertical alignment combo boxes. The vertical alignment represents a vertical difference value to be applied to the points' current elevation.

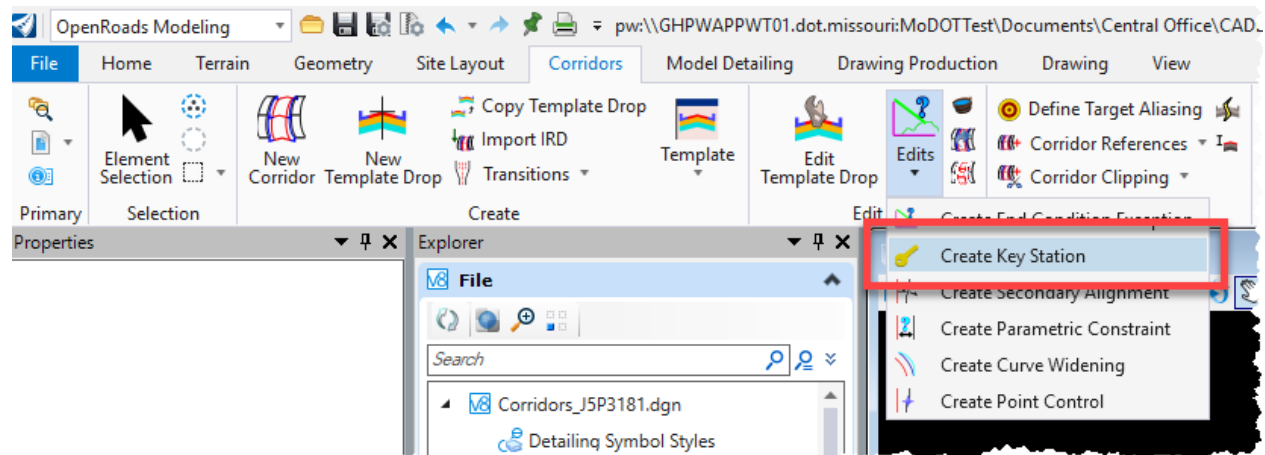
**Type - Elevation and Grade** This option displays an Elevation field, and a Grade field. The control sets elevation of the point at the start station to the elevation specified. The slope of the point's line is then at the grade specified until the end station is reached.

**Priority** - determines the order of controls on a point. This value applies only when there are conflicting controls on a point. Where there is a conflict, the control with the lower priority is applied (that is, lower numbers are applied first).

**Use as Secondary Alignment** - specifies that horizontal point controls are also used as secondary alignments. This option is available only when working with a 2D entity. If you are using a 3D object, the software skips the secondary alignment option.

**Horizontal Offsets (Start/Stop)** - specifies the start and stop horizontal offset controls for the corridor. If the values are different, then the value applied at a given station is calculated using a linear algorithm.

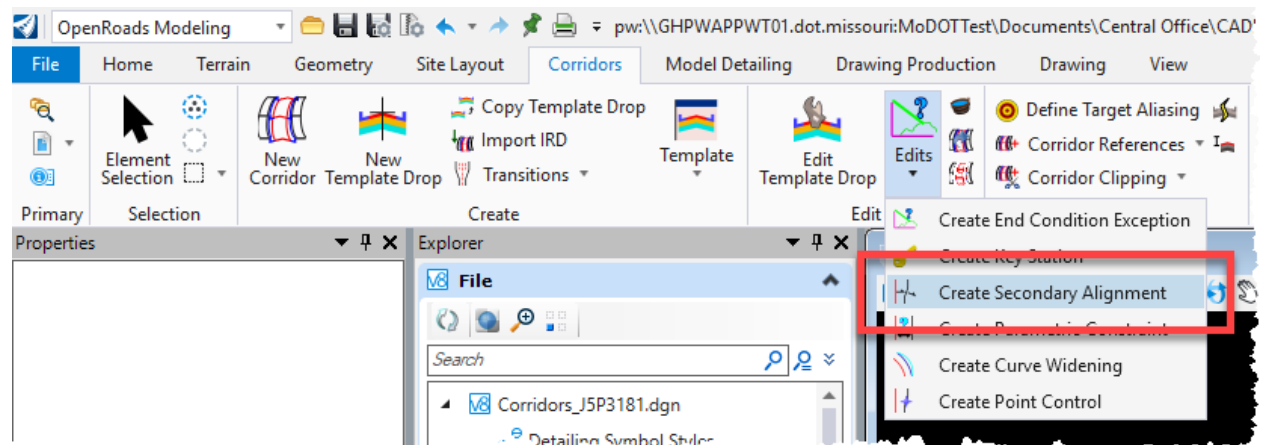
**Vertical Offsets (Start/Stop)** - specifies the start and stop vertical offset controls for the corridor.



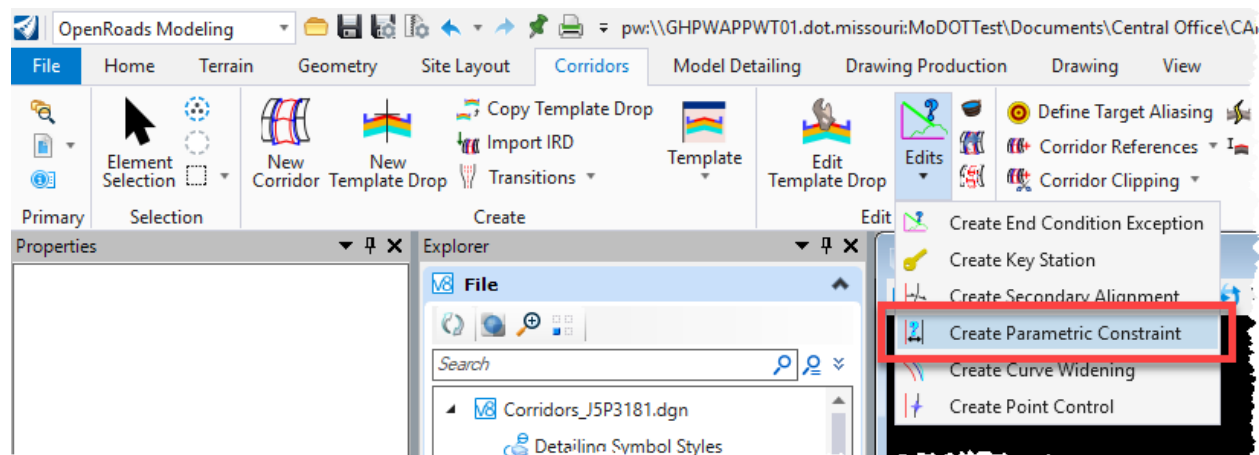
**Create Key Station** - The Create Key Station tool is useful to add stations that are not coincident with the template interval, when a special circumstance of the project occurs and it's desirable to include the station in processing.

### Create Key Station Workflow

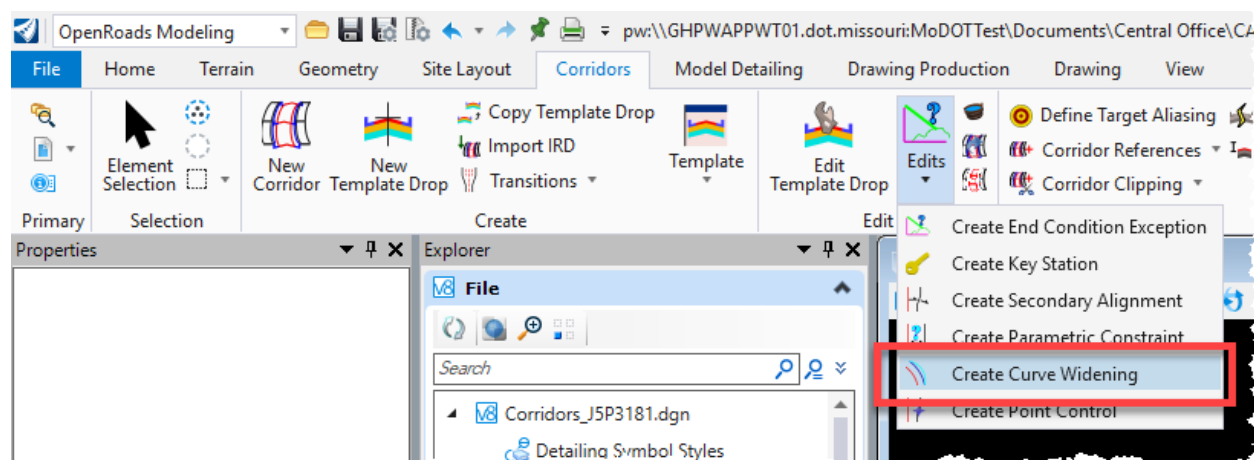
1. Select the **Create Key Station** tool.
2. **Locate Corridor** - Select the corridor for station addition. A display line dynamically running perpendicular to the baseline reference is visible.
3. **Station** - Define the key station by dynamically moving the display to the desired location (and data point) or by keying in the station, <Enter> and **data point** to accept. The key station is added to the Key Station list, and the corridor is automatically reprocessed to include the new station.



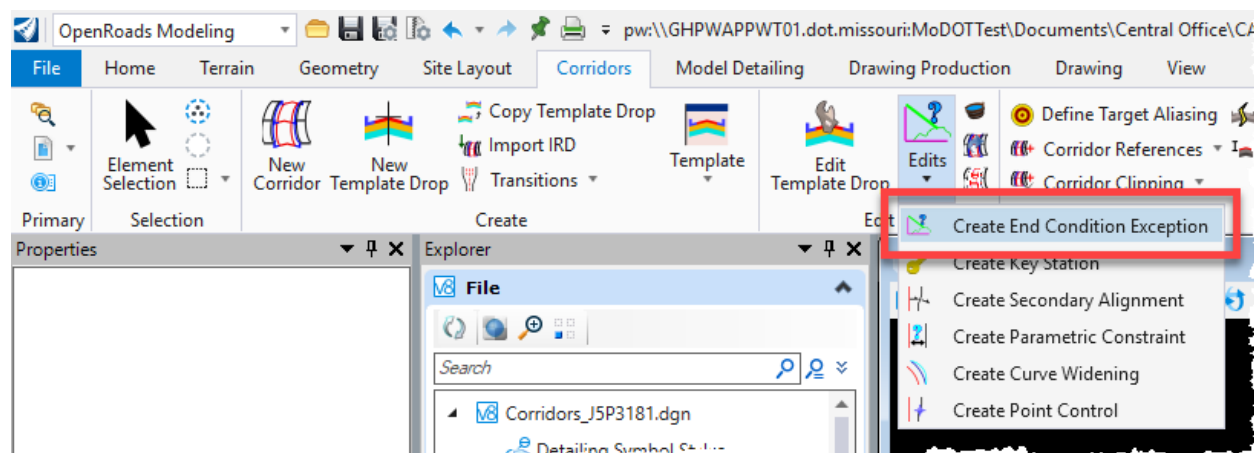
**Create Secondary Alignment** - Sets parameters for secondary alignments, which are used to modify the direction of cross section processing. Requirements include corridor selection, secondary alignment definition, beginning and ending station (in cases where only part of the alignment element is to be used) and beginning and ending offsets.



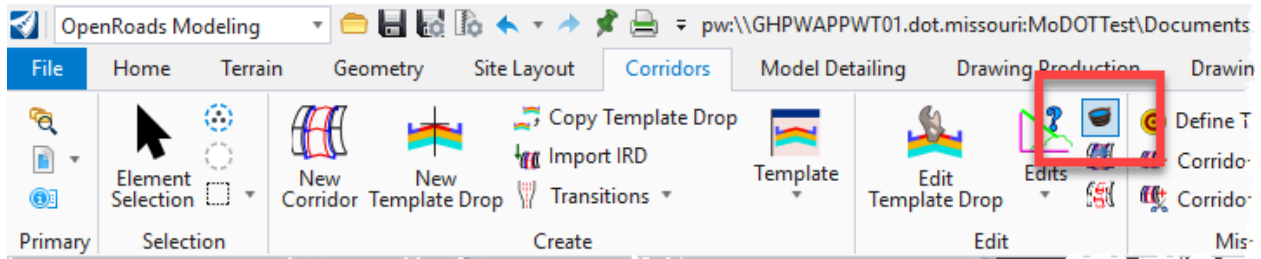
**Create Parametric Constraints** - Sets up constraint value overrides for specified station ranges.



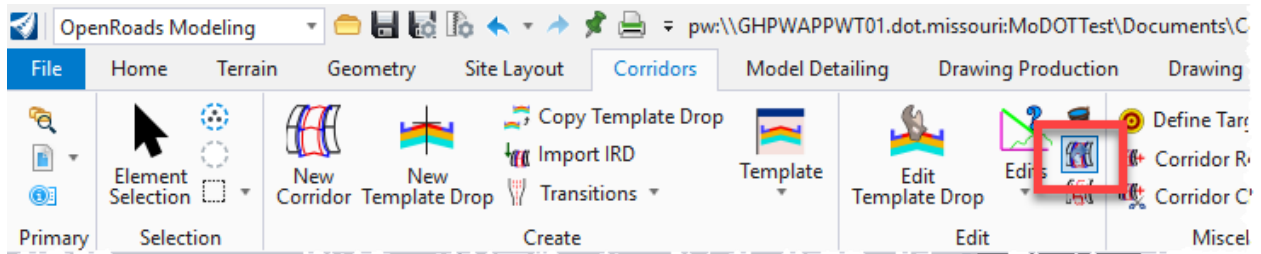
**Create Curve Widening** - Applies horizontal controls to points to move them farther from the centerline at each curve of the controlling alignment.



**Create End Condition Exception** - Defines end condition exceptions, which are used to modify the behavior of an end condition solution without requiring the use of additional template drops.



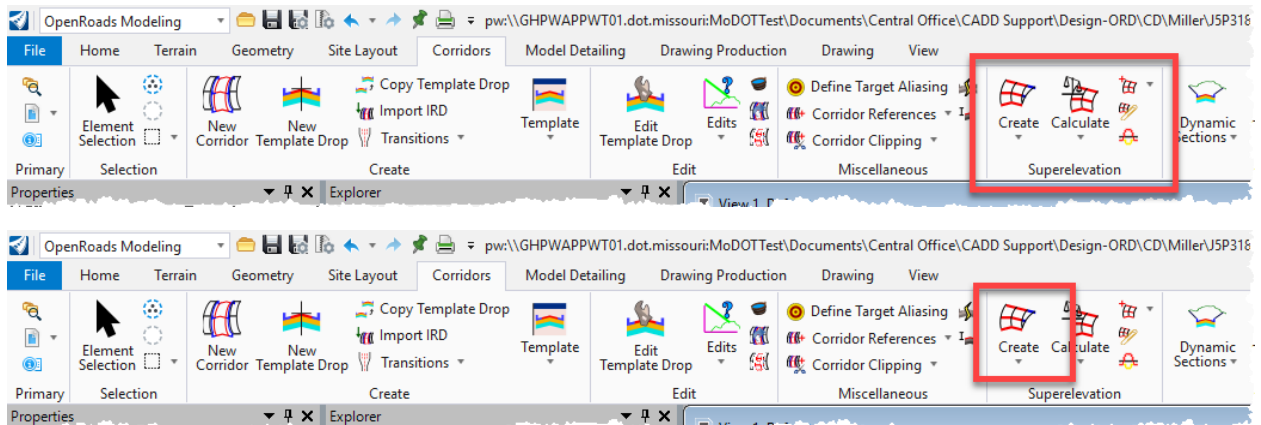
**Corridor Objects** - One-stop viewing of data relating to corridor objects. Excellent for managing your corridor data, as it encompasses template drops, key stations, parametric constraints, point controls, various references and end condition exceptions all within one dialog.



**Process Corridor** - Processes the corridor to ensure that it is up to date.

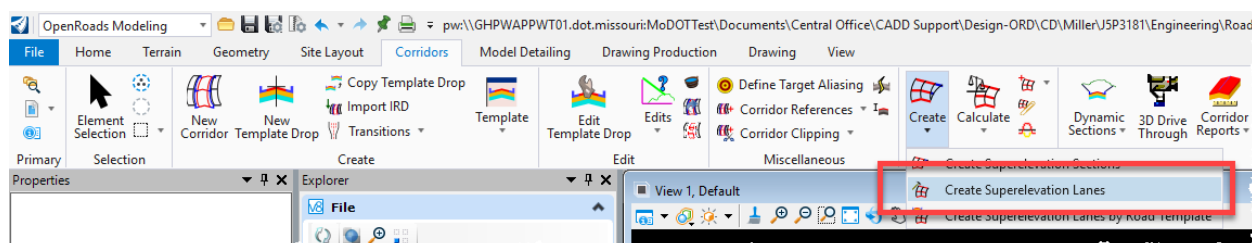
### 5.4.3 Superelevation Tools

This toolbox contains tools for creating, calculating, and editing superelevation lanes. Tools are also supported for importing excel (CSV) data and reporting.

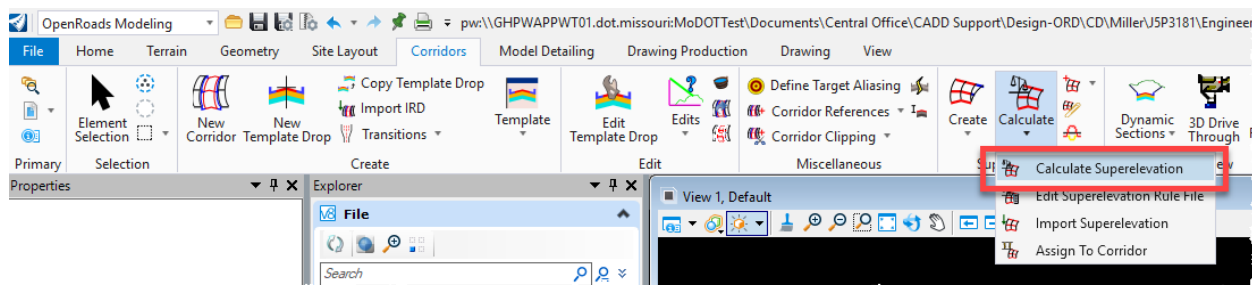


**Create Superelevation Sections** - Adds a superelevation sections (generally one per curve set) for the specified station range on the baseline reference.

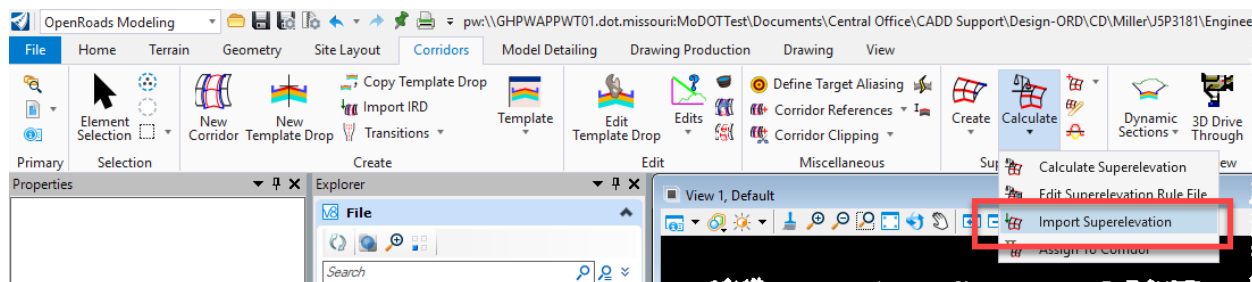




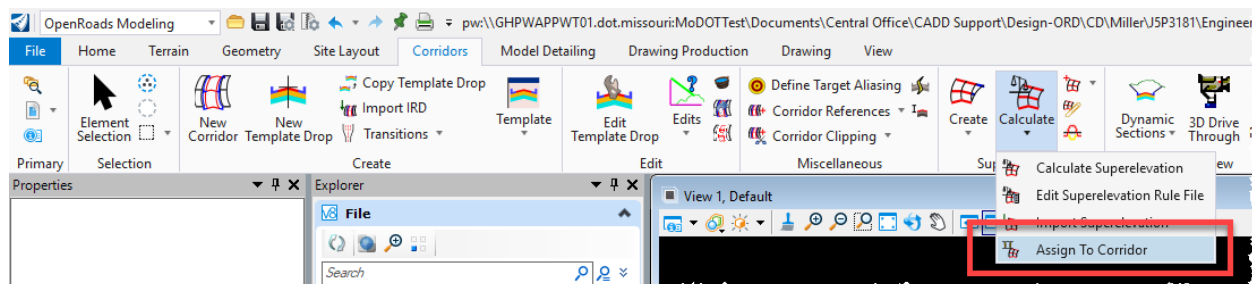
**Create Superelevation Lanes** - Creates color-filled lanes based on width and offsets from the baseline reference, as a precursor to superelevation calculations.



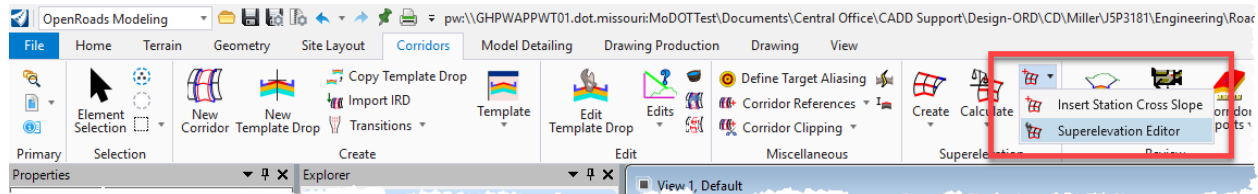
**Calculate Superelevation** - Calculates station and superelevation transitions rates based on a preferences or rules file (\*.sep,\*.srl). The values are augmented to the superelevation lanes, edit manipulators are created, and the color fill is recolored based on the cross slopes.



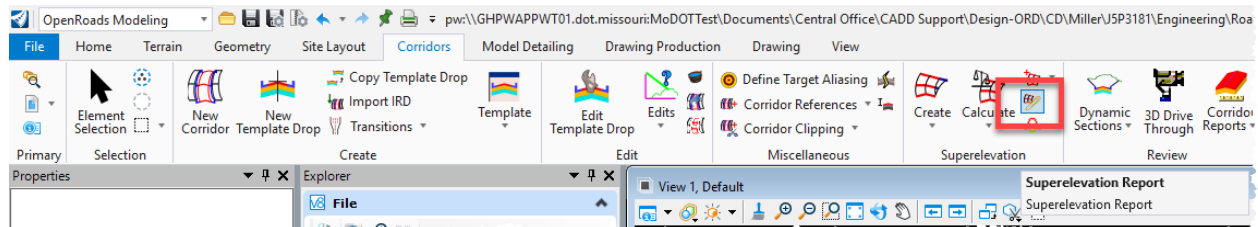
**Import Superelevation** - Optionally, imports data from a CSV file.



**Assign Superelevation to Corridor** - Associates superelevation with a corridor, so the pavement reflects the superelevation stations / cross slopes, rather than the pavement cross slope defaults in the template.

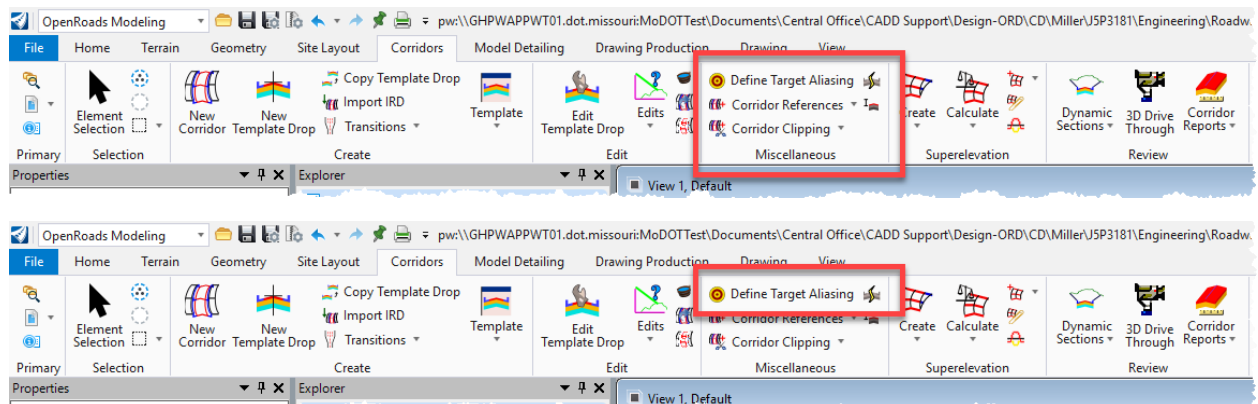


**Superelevation Editor** - Opens the superelevation editor allowing the user to edit the calculated superelevation in a tabular format.



**Superelevation Report** - Creates a superelevation XML report and opens the Bentley Civil Report Browser.

#### 5.4.4 Corridor Miscellaneous Tools



**Define Target Aliasing** - Aliasing allows you to target other corridor surfaces or features or to set up a prioritized target list for end condition solutions on surfaces, features and alignments. This means that on a large job where the existing surface may have been broken up into more than one surface, you don't need to be concerned about where those breaks occur, and you don't need to create a different template for each existing surface. Use target aliasing to find the proper solution.

In any situation where the active surface is the target, the software looks for the mainline corridor surface and uses whichever is closer because you have turned on that option. If the **Use Closest** option is not set, then it would search for the surfaces in the order they are displayed, and it would stop as soon as a solution was found.

Target Aliasing cannot be defined with a corridor that targets that particular corridor with a Corridor Point Control. This produces a recursive situation, making the corridor unavailable for Target Aliasing until that corridor point control is removed.

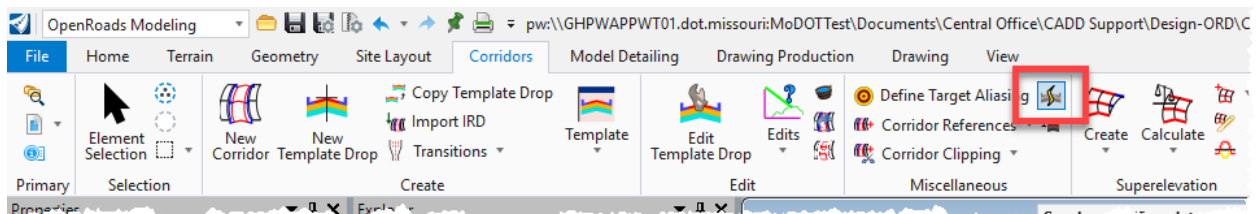


<b>Target</b>	lists end-condition targets for the current corridor.  does not list feature definition targets.
<b>Surface or Corridor</b>	lists all the available aliases for the current target. If the target is a surface, it displays a list of alternate surfaces and corridors. If the target is a feature, then the list displays available surface features and corridor points. If the target is an alignment, it displays a list of available alignments.
<b>Aliases</b>	lists the aliases for the current target. The order of the list indicates the priority of the target aliases.
<b>Add, Remove, Move Up, Move Down</b>	activates as items are selected. The left and right buttons allow you to move items between lists. More than one item can be selected and moved. The up and down buttons allow you to change the priority of a single item in the alias list by moving up or down in the list.
<b>Use Closest</b>	Ignores the order of the aliases, when checked on. The solution seeks the closest alias that satisfies the solution (end condition).

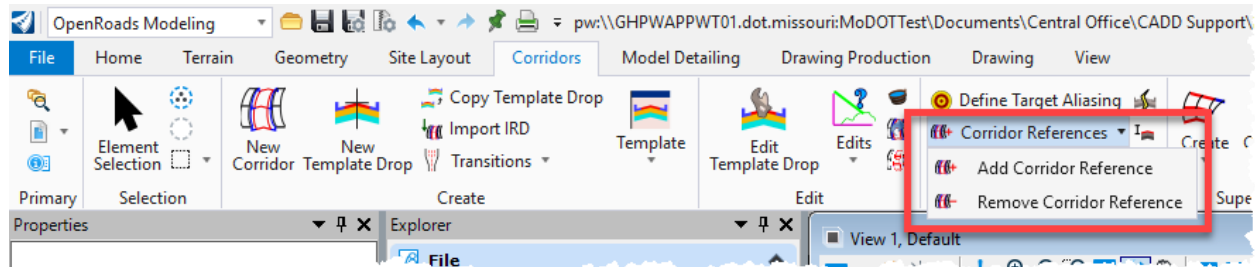
### Define Target Aliasing Target Workflow

1. Select the **Define Target Aliasing** tool.
2. Select the corridor. This opens the Target Aliasing dialog.
3. Use the Add, Remove, Move Up, Move Down, and Use Closest to set the Target Aliasing.

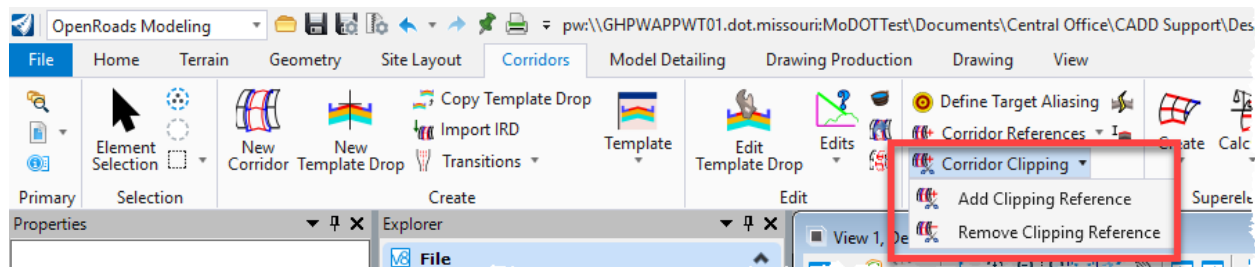
**Synchronize Template** - Updates a template within a template drop with the template of the same name from the current template library. Any changes previously made to the template in the template drop are overwritten with no warning.



**Add Corridor Reference** - The Add Corridor Reference tool adds graphical elements to the corridor processing. This must be done even if the feature is targeted in the template, otherwise the elements will not process. It enables only those elements associated with a particular corridor to be processed, rather than all elements of a particular feature definition. This speeds up processing, and eliminates processing of unwanted elements of the same feature definition. The elements can be selected within the tool, or a selection set can be created prior to commencing the tool.



**Remove Corridor Reference** - The Remove Corridor Reference tool removes graphical elements from the corridor processing, but does not delete the element. The elements can be selected within the tool, or a selection set can be created prior to commencing the tool.



**Add Clipping Reference** - allows you to remove areas of overlap when working with multiple corridors in a single surface. For example, in a corridor intersected by a crossing roadway, clipping would be used to remove all overlapped features within the intersection.

### Add Clipping Reference Workflow

1. Select the **Add Clipping Reference** tool.
2. Select the corridor to be clipped.
3. Locate Clipping Reference - select elements until all are defined, then reset to complete. The corridor is processed and the clipping reference is added.

**Remove Clipping Reference** - Removes the clipping reference, reprocesses the corridor, restoring the clipping area to its previous state prior to clipping.

### Remove Clipping Reference Workflow

1. Select the **Add Clipping Reference** tool.
2. Select the Corridor where the clipping is to be removed.
3. Locate Clipping Reference - select elements until all are defined, then reset to complete. The corridor is processed and the clipping reference is removed.

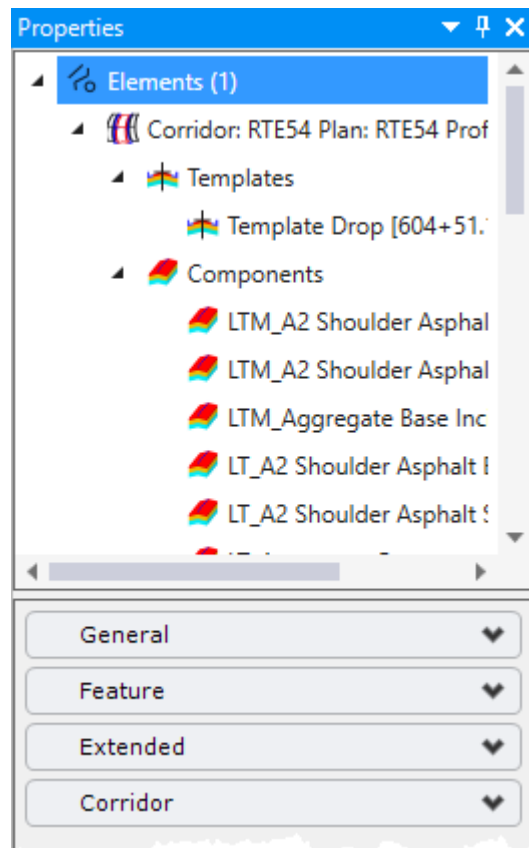
### Managing Corridor Data

Several tools can be used to help manage the corridor model data. Depending on the tool selected, the data may be read-only or may be manipulated. These include:

- Properties
- Corridor Objects - view and manage all the input objects in the corridor in one location
- Project Explorer - see all corridor information in one place

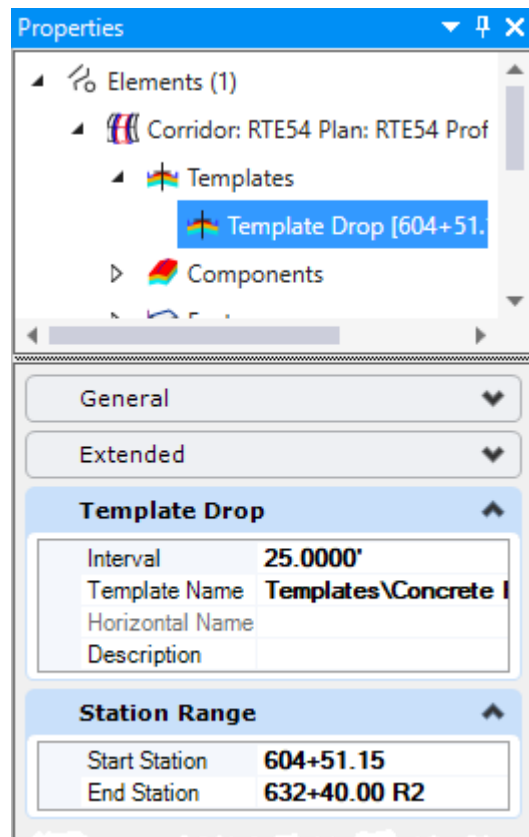
## Properties

Clicking on the corridor border opens the Element Information with most of the same information found in the Project Explorer Corridor. It includes the corridor tree, symbology, Corridor Info (Name, Alignment Name, Profile Name, and Design Stage).



The dialog changes as the tree is navigated, based on the current highlighted item in the tree. Much of the information can be edited, which is automatically reflected in the corridor model.

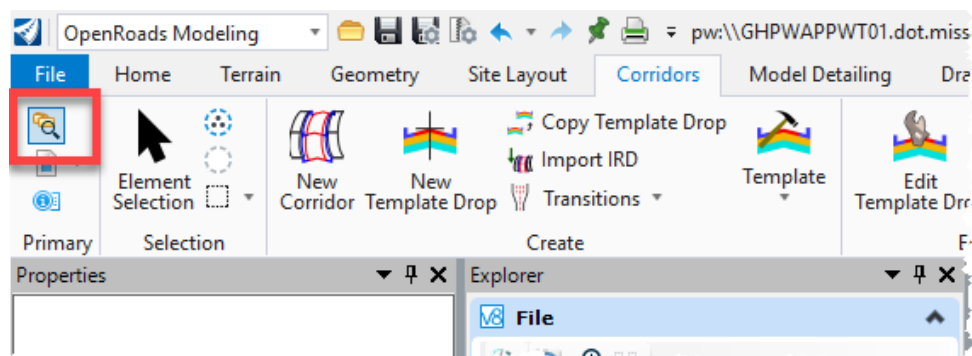
If a Template Drop is selected, the Element Information dialog reflects the template drop information, which can be edited.



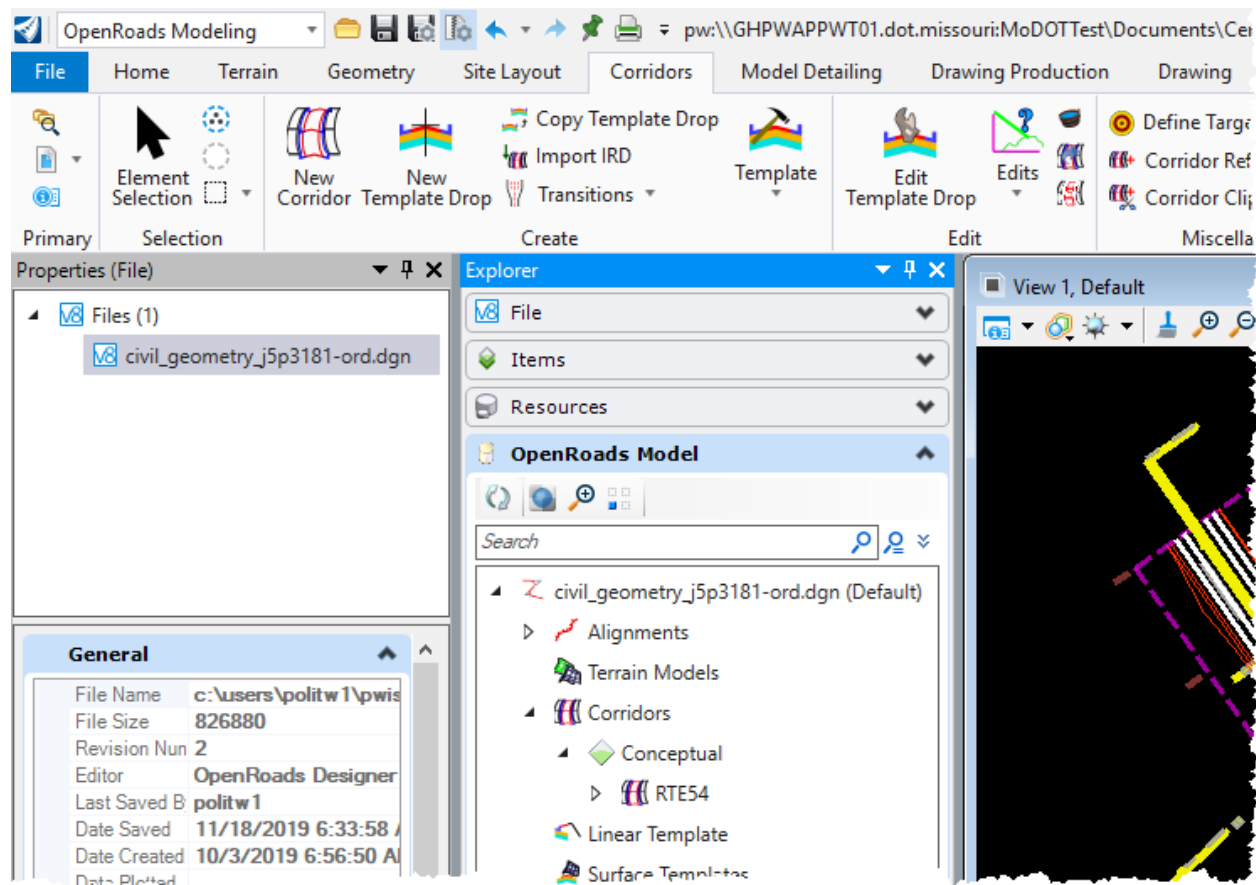
**Corridor Objects** - Allows you to view and manage all the input objects in the corridor in one location.

### Explorer

The Explorer is located in OpenRoads Modeling workflow > Corridors ribbon > Primary tool set. As the design progresses, the information is continually created / updated automatically.



Each corridor (and associated data) is listed separately. As the tree is navigated, additional data is exposed. In addition, right-click context sensitive menus are available for common tasks and information.



## Template Management

SS4 Design Stage has been replaced with Feature Definition. You can access the Design Features within the Properties from the heads-up display tools.

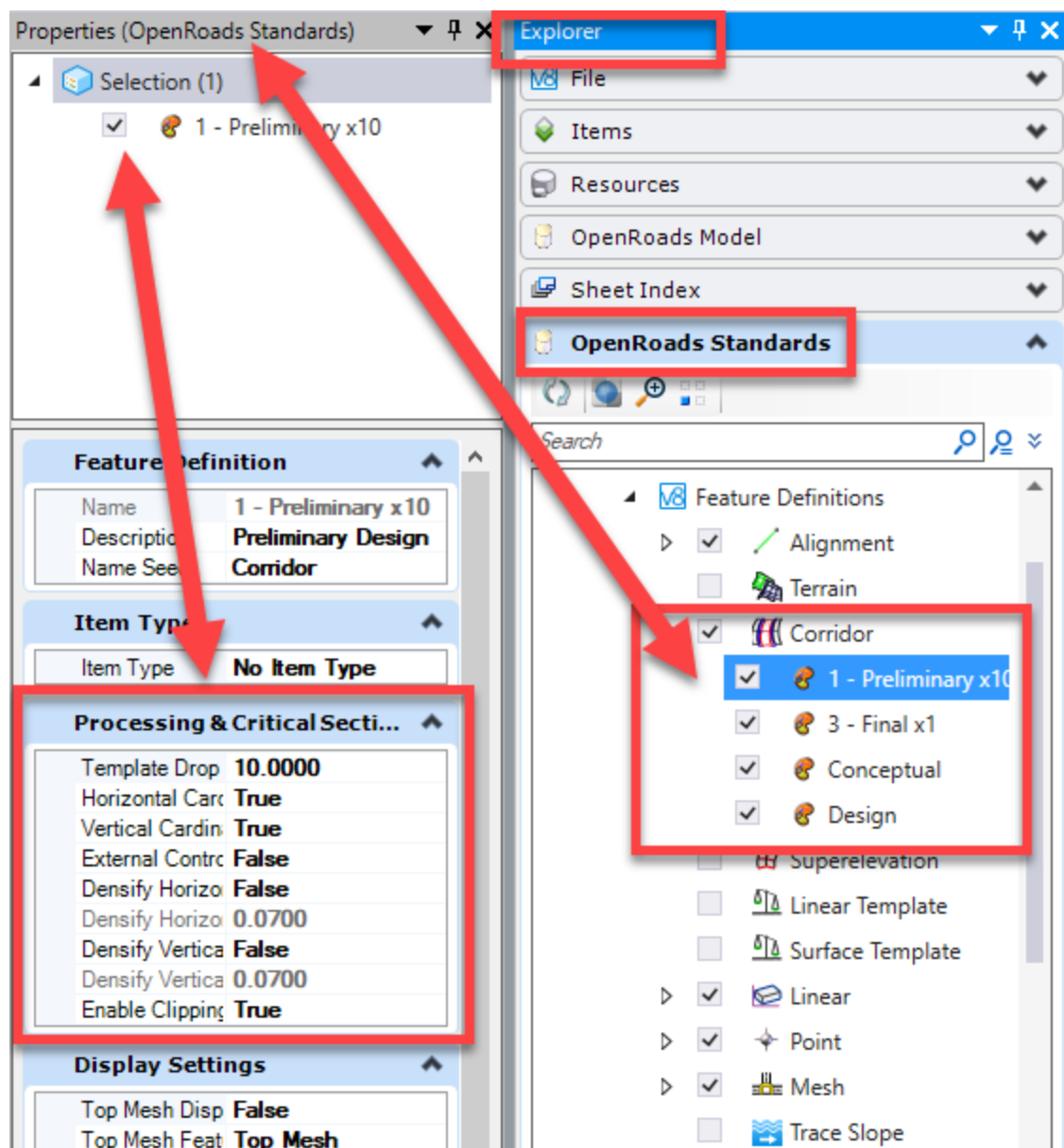
The Template Drop Interval Multiplier is used in conjunction with the Interval Drop specified when the template drop was created. Its purpose is to enable designers to use larger intervals for preliminary work and easily shorten the interval as the design is refined. To determine the interval used for processing, the Interval Drop is multiplied by the Template Drop Interval Multiplier and the result is used.

MoDOT uses the following Design Stages:

Stage	Multiplier	Description
Preliminary x 10	10	Used for general design work, until high level of accuracy is required towards the end of the project. Faster processing time on larger Corridors.
Final x 1	1	Used for cross section sheets with 25, 50 or 100 feet between sections. Best and more accurate Design stage for final cross sections
Final x 1 w/Meshes	1	Used for creating Mesh surface
Final x 1 Top Mesh	1	Used for creating Top Mesh surface
Final x 1 Bottom Mesh	1	Used for creating Bottom Mesh surface
Final x 1 Linear Features	1	Used for creating surfaces
Final x 1 Components Only	1	

## Processing & Critical Sections

This information is also located in the Properties tool when the Corridor Design Stage is selected from the OpenRoads Standards of **Explorer**.

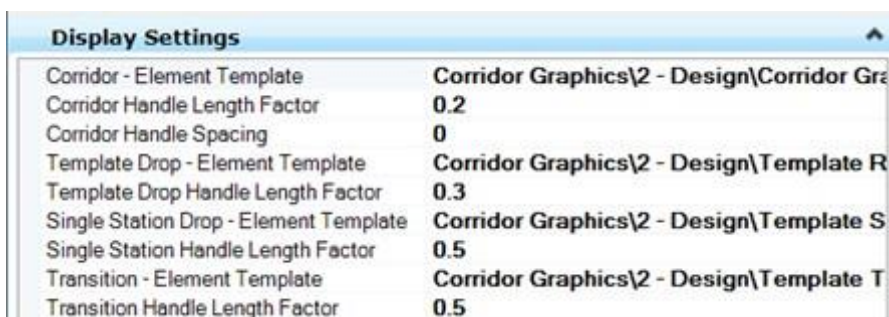


Option	Description
Template Drop Interval Multiplier	The Interval multiplier times the template drop interval is the distance between template drops depending on the chosen stage.
Horizontal Cardinal Points	When set to True, the location of cardinal points of the active horizontal alignment (PC, PT, CS, etc.) are used to compute a point or template drop interval location.
Vertical Cardinal	Points When set to True, the location of cardinal points of the active vertical alignment (VPC, VPT, VPI, etc.) are used to compute a point or template drop interval location.
External Control Points	When set to True, the location of horizontal and/or vertical point controls are used compute a point or template drop interval location.
Densify Horizontal Curves	When set to true, the processing along horizontal curves is at a closer interval. This option utilizes the CIVIL_DEFAULT_CURVE_STROKING configuration variable value, with extra points being computed based on the chord offset from the horizontal curve. The value defines the chord height used to calculate the extra points. If configuration variable is not set or Densify Horizontal Curves is set to False, the value defaults to 0.01.



## Display Settings

This information is also located in the Element Information tool when the Corridor Design Stage is selected in the Project Settings of **Project Explorer**.

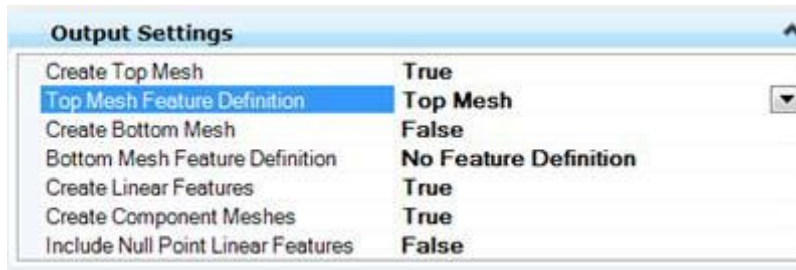


Display Settings	
Corridor - Element Template	Corridor Graphics\2 - Design\Corridor Gra
Corridor Handle Length Factor	0.2
Corridor Handle Spacing	0
Template Drop - Element Template	Corridor Graphics\2 - Design\Template R
Template Drop Handle Length Factor	0.3
Single Station Drop - Element Template	Corridor Graphics\2 - Design\Template S
Single Station Handle Length Factor	0.5
Transition - Element Template	Corridor Graphics\2 - Design\Template T
Transition Handle Length Factor	0.5


Option	Description
Corridor - Element Template	Element template utilized to draw the corridor boundary in the Create Corridor tool. As a best practice, place the graphics for the boundaries in a construction class to allow for easily turning them off / on as needed.
Corridor Handle Length Factor Template Drop Handle Length Factor Single Station Handle	The Length Factors are a ratio of the handle length to the width of the corridor. So 1.0 would make the handle as long as the width of the corridor at that point.
Corridor Handle Spacing	The handle spacing either is set to a physical distance as shown or set to zero. If you set to zero you will get 11 handles per corridor regardless of its length. Any non-zero value is used as a distance between handles measured in master units along the horizontal alignment.
Template Drop Element Template	Element template utilized to draw the template drop boundary in the Create Template Drop tool. As a best practice, place the graphics for the boundaries in a construction class to allow for easily turning them off / on as needed.
Transition Element Template	Element template utilized to draw the transition boundary in the Create Transition tool. As a best practice, place the graphics for the boundaries in a construction class to allow for easily turning them off / on as needed.

## Output Settings

This information is also located in the Element Information tool when the Corridor Design Stage is selected in the Project Settings of **Project Explorer**.



For all options, when set to False, no elements, features, or meshes are drawn.

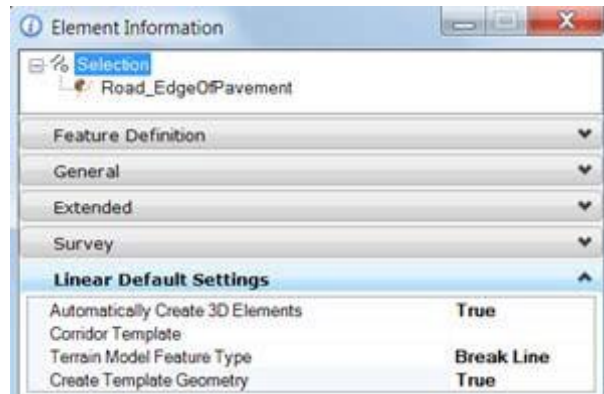
Option	Description
Create Top Mesh Top Mesh Feature Definition	<p>When set to True, a mesh is created for each component in the corridor (based on its template) which has Exclude From Top / Bottom Mesh toggled OFF. The mesh is drawn using the specified Feature Definition.</p>  <p>If Create Top Mesh is set to False, no Top Mesh Feature Definition</p>
Create Bottom Mesh Bottom Mesh Feature Definition	<p>When set to True, a mesh is created for each component in the corridor (based on its template) which has Exclude From Top / Bottom Mesh toggled OFF. The mesh is drawn using the specified Feature Definition. If Create Bottom Mesh is set to False, no Bottom Mesh Feature Definition can be selected.</p>

## Create Linear Features

When set to True, 3D linear features are drawn based on Feature Definitions. First, review the Point Properties within the template:

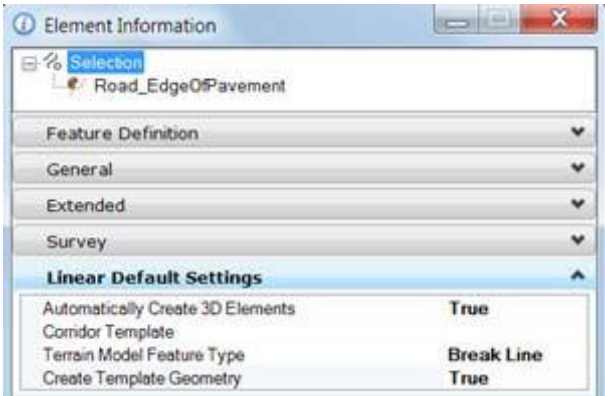

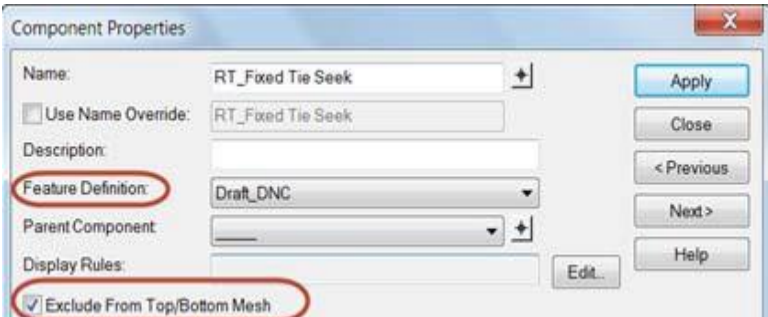


Then review the corresponding Feature Definition.



If the Create Template Geometry setting is set to True, then the linear feature is drawn, based on the 3D settings.



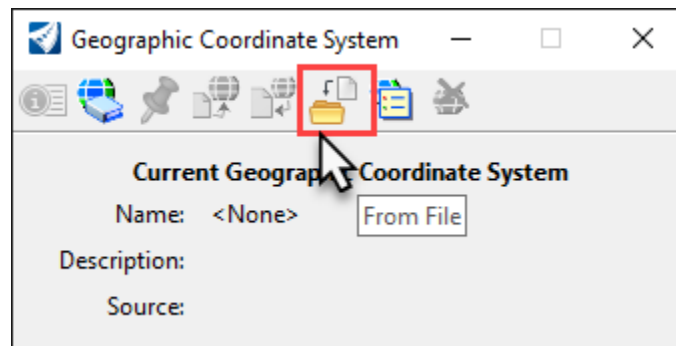
Create Linear Features Continued	<div></div> <p>If the Create Template Geometry setting is set to True, then the linear feature is drawn, based on the 3D settings.</p> <div></div>
Create Component Meshes	<p>When set to True, a mesh is created for each component in the corridor (based on its template) which has Exclude From Top / Bottom Mesh toggled On. The mesh is drawn using the specified Feature Definition in the Component Properties.</p> <div></div>
Include Null Point Linear Features	<p>When set to True, linear features for null points are drawn, basis on the same criteria as Create Linear Features.</p>

## 5.5 Group Exercise: Creating a Corridor – Ramp 4

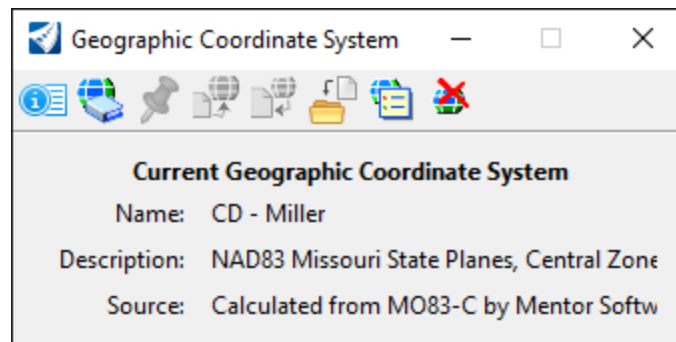
1. Within the **J5P3181\data-5** folder, open the file: **Civil\_Geometry\_J5P3181.dgn**
2. Create a new file named **Corridors\_Ramp-4\_J5P3181.dgn** using the  
**MoDOT\_Roadway\_Seed\_2D.dgn** seed file.

This new file will hold the proposed corridor for **Ramp 4**

3. Open the **Coordinate System** tool by selecting the **OpenRoads Modeling Workflow** → **Utilities** Tab → **Geographic** Section.
4. Select “**From File**” icon.



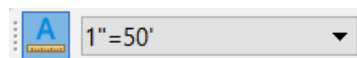
5. Select the **Terrain\_J5P3181.dgn** file in the **data-5** folder.
6. Verify the settings.



7. Reference in the following files:

**Terrain\_J5P3181.dgn**  
**Civil\_Geometry\_J5P3181.dgn.**

8. Set the **Annotation Scale** to **1”=50’**

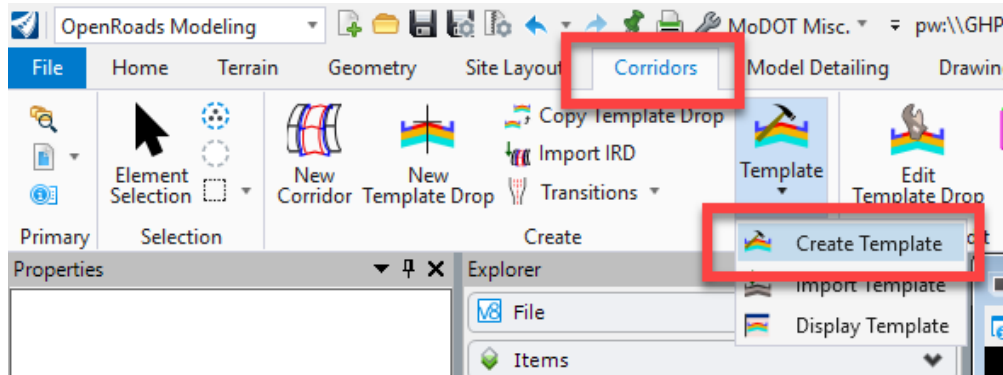


9. Select the Terrain Model and select the **Set As Active Terrain Model** icon from the pop up menu.



## Setting Project Template Active

From **Corridors** tab of the **OpenRoads Modeling Workflow**, select **Create Template**.



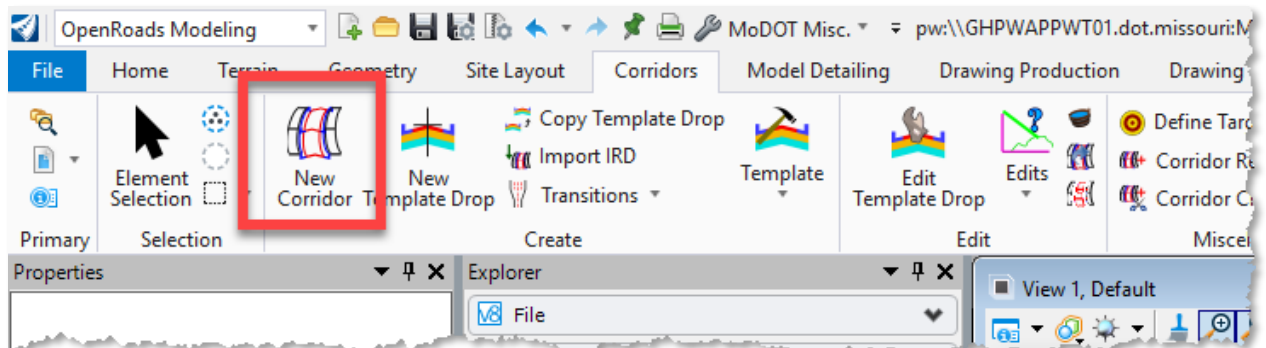
10. To set the **J5P3181.itl** as the **Active Template Library** select **File > Open** from the **Create Template** dialog menu.

**Roadway → data-5 → J5P3181.itl**

11. Close the **J5P3181.itl** Template Library.

## Setting up the Corridor

12. From **Corridors** tab of the **OpenRoads Modeling Workflow**, select **New Corridor**.



**Create Corridor** command is also available from the context sensitive pop-up menu presented when hovering over a selected horizontal civil geometry element.

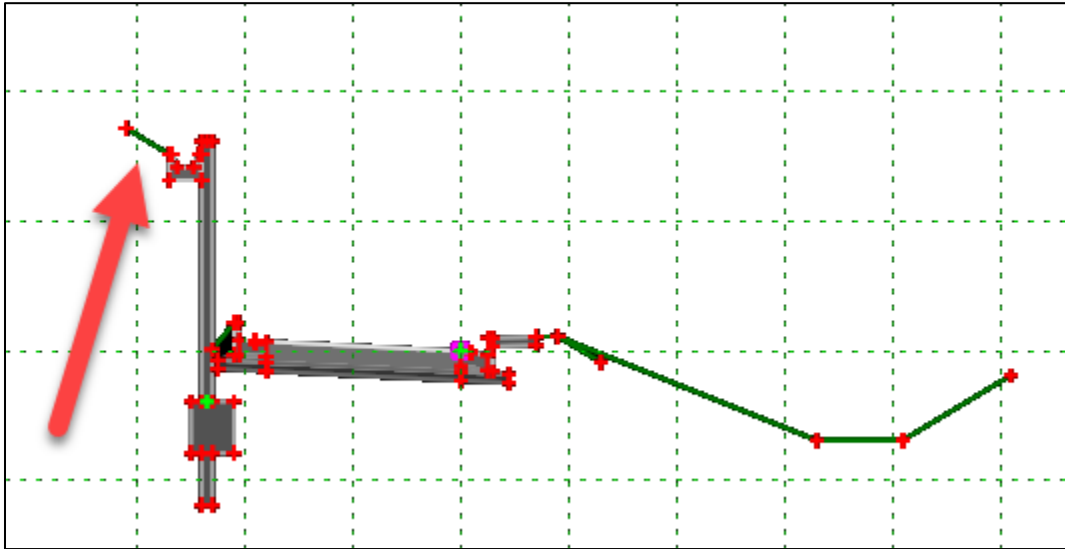


13. When prompted to **Locate Corridor Baseline**, data point on **Ramp 4**.
  - a. Right-click to reset to select the active profile.
  - b. Name the Corridor **Ramp 4**.
  - c. **Data point** to accept.
  - d. Select <Alt> + **Down** to pick a template or use the **Create Template Drop** dialog box.
  - e. Expand the project folder **J5P3181** and **Ramp 4** folders. Select the **Ramp 4 Pavement with Curb and Gutter** template. Click **OK** to dismiss the dialog and **data point** in the view to accept the choice of template.
  - f. When prompted to enter the **Start Station**, select the <Alt> key to lock the Start Station to the start and **data point** in the view to accept it.
  - g. When prompted to enter the **End Station**, key in **2+50** and **Enter** to lock the value. **Data point** in the view to accept the end station.
  - h. When prompted for the Interval, key in **5** and **Enter** to lock the value and **data point** to accept the value.
14. Select <Alt> + **Down** to pick another template or use the **Create Template Drop** dialog box.
  - a. Expand the folder **J5P3181** and the **Ramp 4** folder and select **Ramp 4 Pavement with Shoulders** template. Click **OK** to dismiss the dialog and **data point** in the view to accept the choice of template.
  - b. When prompted to enter the Start Station, key in **2+50** and **Enter** to lock the value. **Data point** in the view to accept the start station.
  - c. When prompted to enter the End Station, key in **5+00** and **Enter** to lock the End Station and data point to accept it.
  - d. When prompted for the Interval, key in **5** and **Enter** to lock the value and **data point** to accept the value.
15. Select <F4> to close the **Create Template Drop** tool down.
16. Press <F6> key to setup the 3D view.

**Note:** If you don't see end conditions then the original ground terrain model was not active.
17. The Cut Wall Ditch Backslope is set to 4:1. For this project we want the **Ditch End Slopes to be 1:1 (100%)** so edit the two template drops (**Ramp 4 Pavement with Shoulders** and **Ramp 4 Pavement with Curb and Gutter**) in the Template Library to adjust the Left Cut Wall Ditch Slopes.

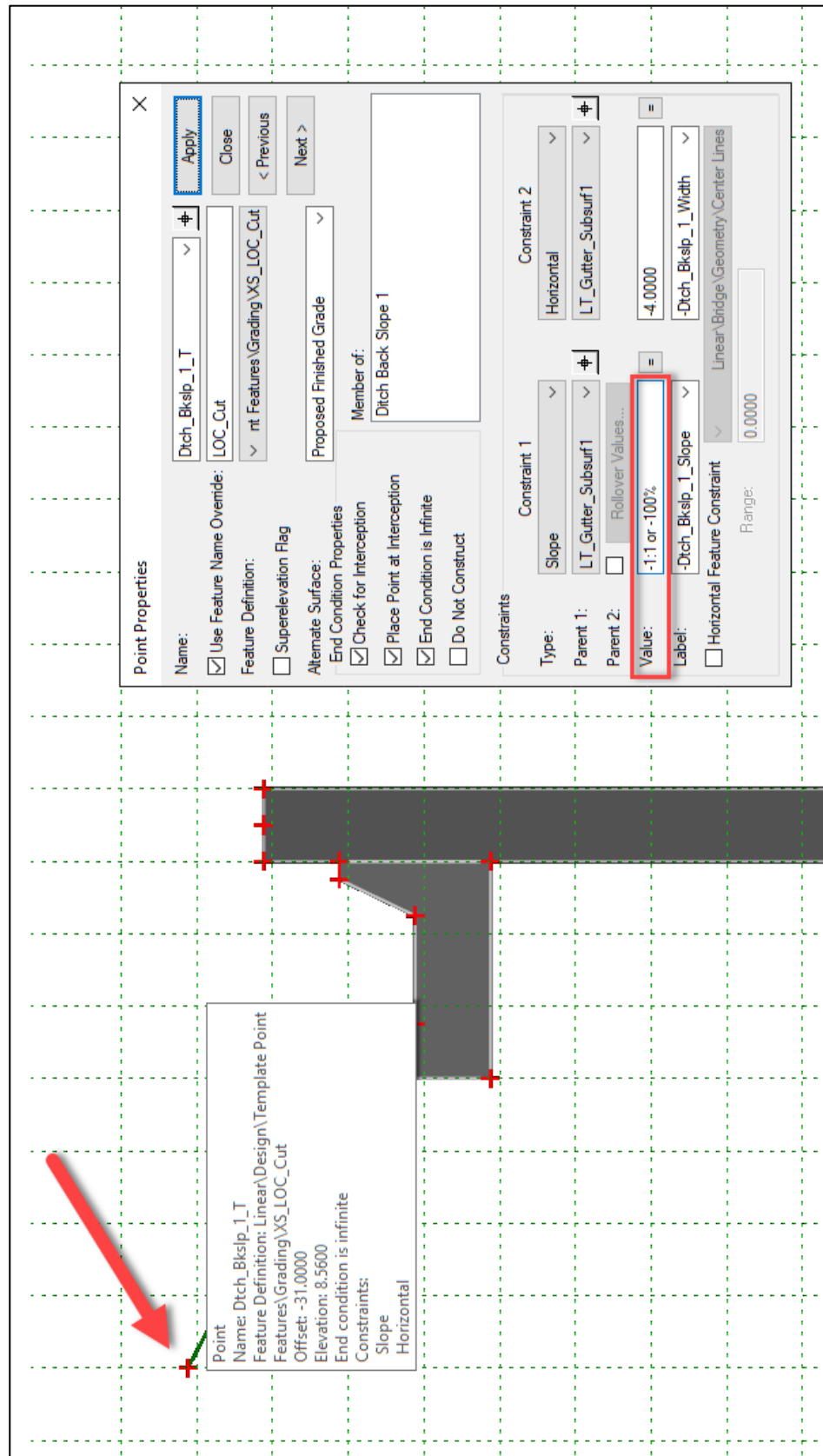
18. To edit the template drop, open the template library by selecting the **OpenRoads Modeling Workflow → Corridors Tab → Create Section → Create Template**

Verify the **Roadway/Data-5/J5P3181.itl** is the active template library.

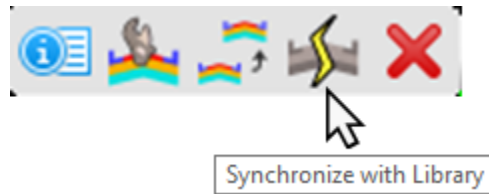




19. Double click on the **LT\_Ditch\_Bkslp\_1\_T** point.

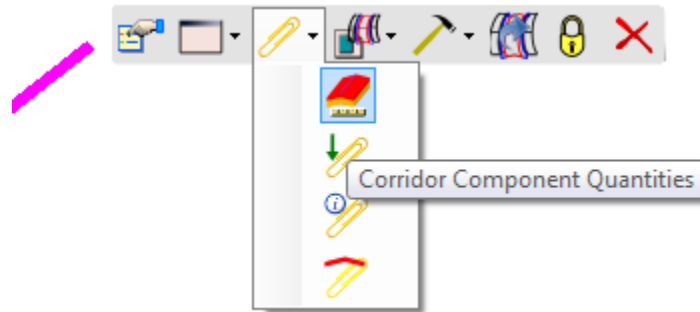


20. After changes have been made synchronized the Template Library with the **two** Ramp 4 Templates in the **Corridors\_J5P3181.dgn** file. To do this select the heads up prompts/tools by selecting **both** **Template Drops** grips and then **Synchronize with Library**.



### **Review the Model and the effect of adjusting the Corridor Feature Definition**

21. Select the corridor by picking one of the handles.
22. Select the Corridor Component Quantities option from the Corridor Reports pop-up.



23. Key in some unit cost values.
24. Select **Report**.
25. Review the reports available. Close the Report Browser.
26. Display the pop-up menu again and select **Properties**.

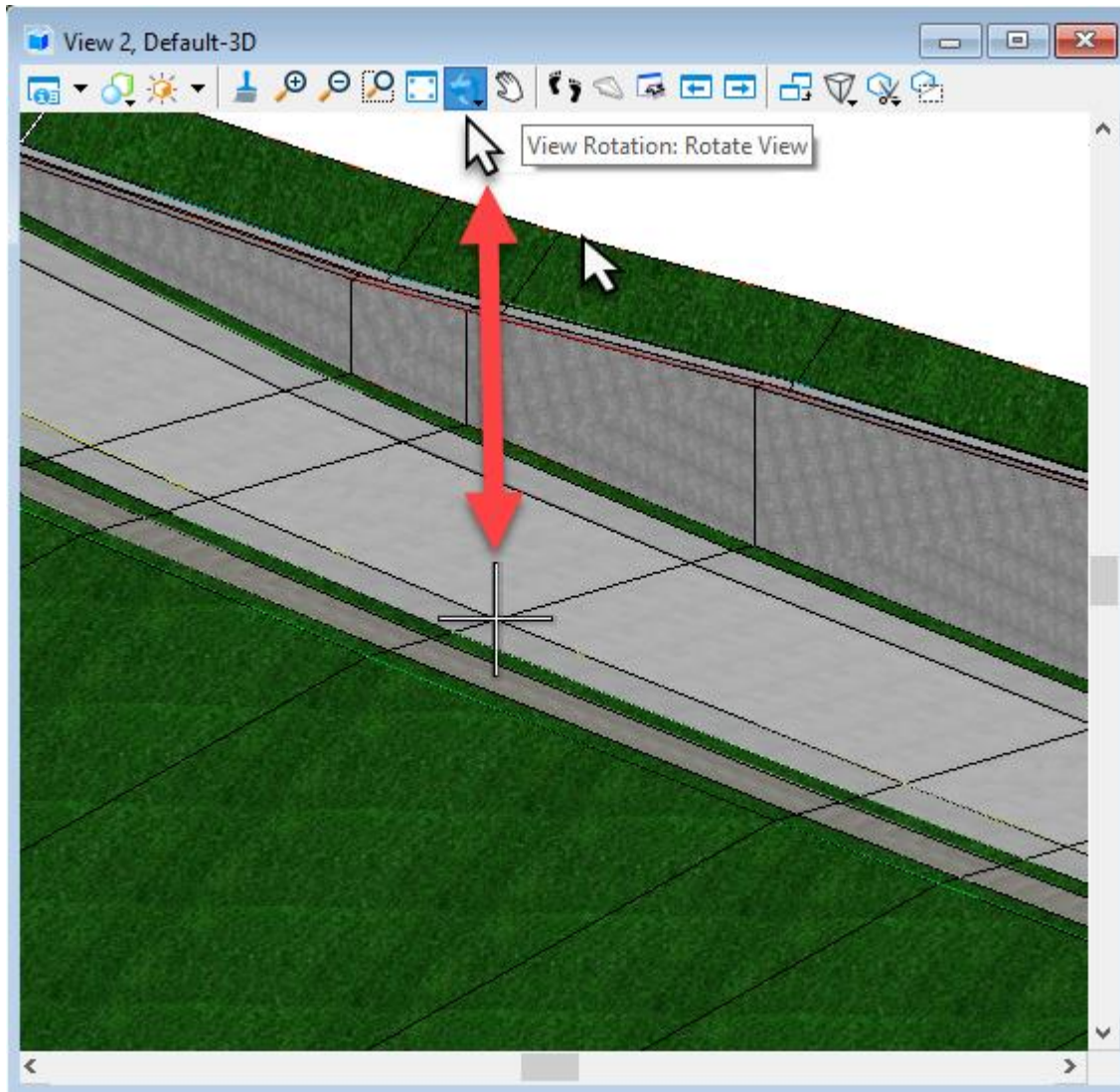


27. Select and explore the options for Feature definition.

Feature Definition	0-Preliminary x5
Feature Name	Ramp 4
Name	Ramp 4
Horizontal Name	Ramp 4
Use Active Profile	True
Profile Name	Ramp 4 Proposed

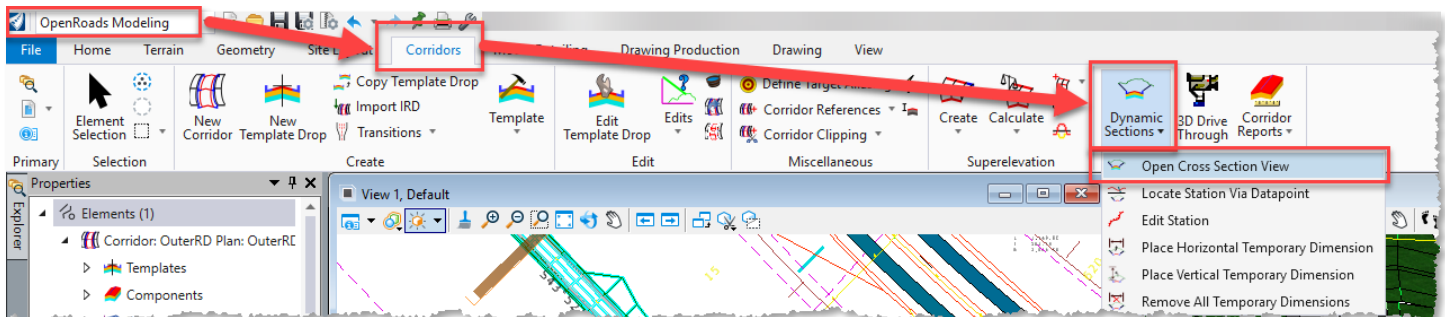
28. In View 2, the Default-3D window use the **View Rotation** tool to rotate the view to see 3D effects on the **Ramp 4** corridor.

Note: Left click and drag the cross hair to a snap location on the surface to gain a rotation point about. Then left click and hold in the window while moving the mouse to rotate effectively.

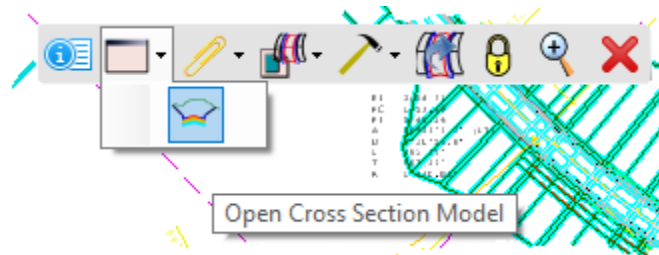


## Open Cross Section Model

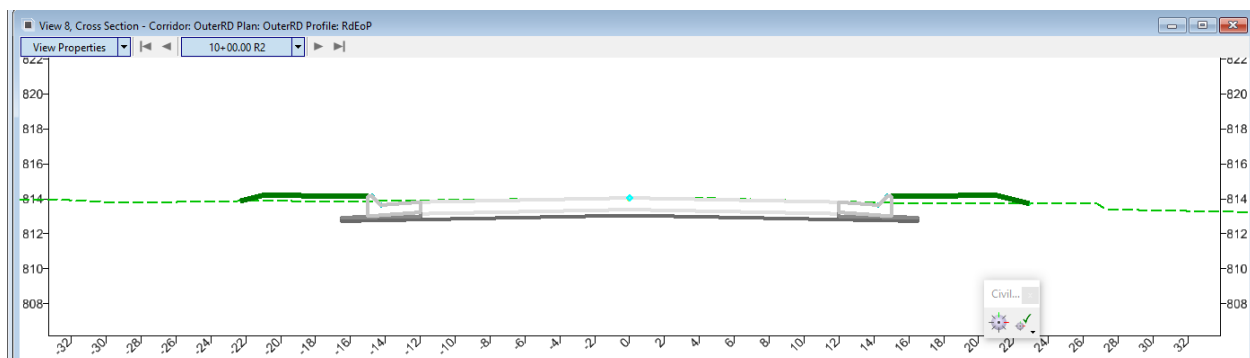
29. From Corridor ribbon, select pull down Dynamic Sections, Select **Open Cross Section View**. 



Open Cross Section View command is also available from the context sensitive pop-up menu presented when hovering over a corridor handle.



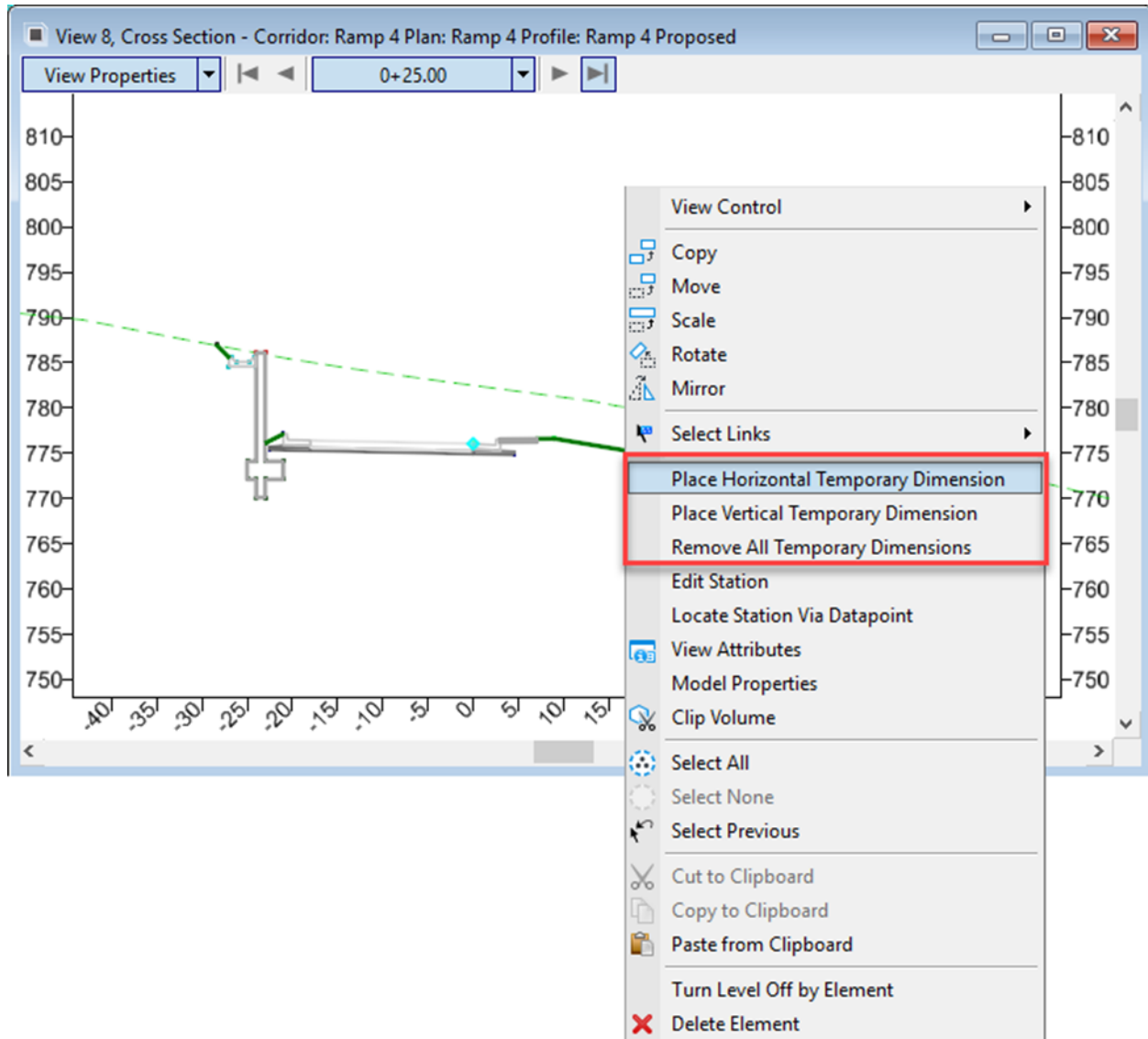
30. When prompted to **Locate Corridor or Alignment**, identify the corridor by selecting a grab handle on the corridor.
31. When prompted to **Select or open View**, open window 8 and **data point** in the view. This will present the first Cross Section of the corridor. To Navigate up and down the corridor use the arrow indicators at the top of the view. To navigate within in the view, use the mouse wheel; rolling the wheel forward zooms in, rolling back zooms out. Depressing the wheel and moving the mouse pans the view.



NOTE: Since superelevation will be changing the slopes, having feedback to the slope at each station is useful, the next steps describe how to place a dimension line from the edge of pavement to the center line on each side of the road.

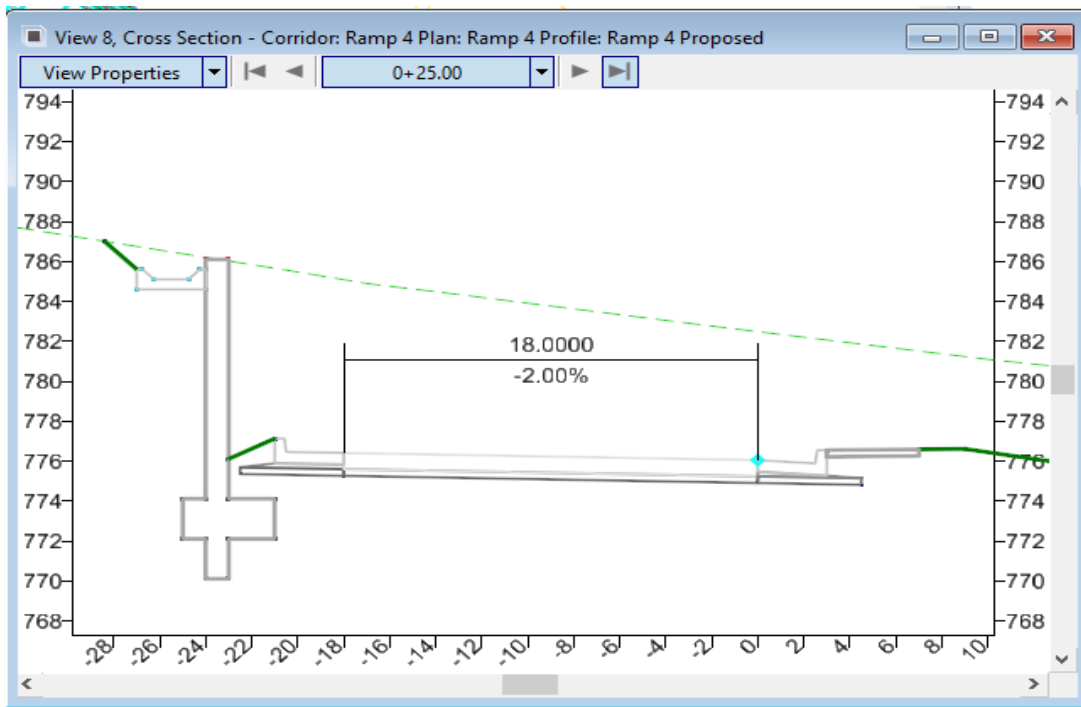
## Place Temporary Dimensions

32. Right click and hold for 1 second in the **Cross Section Model**. This will bring up a menu with Temporary Dimension options.



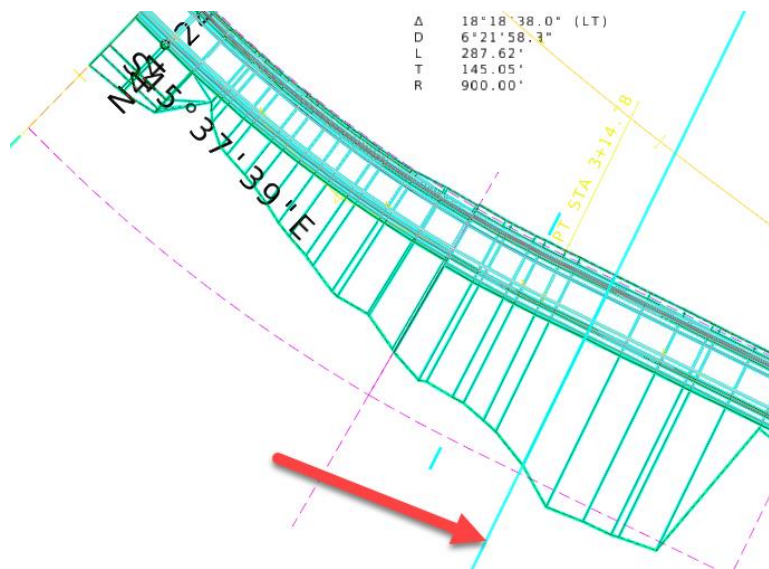
33. Select **Place Horizontal Temporary Dimension**.
34. At the Start Point prompt, identify the center of the roadway, **data point** to accept.
35. At the End Point prompt, identify the right EOP point, **data point** to accept.

36. Place the dimension height above or below the component in a location that will be easy to read, **data point** to accept the location.



**Note:** This places the same dimension on all cross sections.

**Note:** The blue line on the alignment represents the location of the cross-section.



37. **Save Settings** on the design file. The corridor is stored as MicroStation data; no .ird file is created.
38. Select **File > Update Server Copy**.

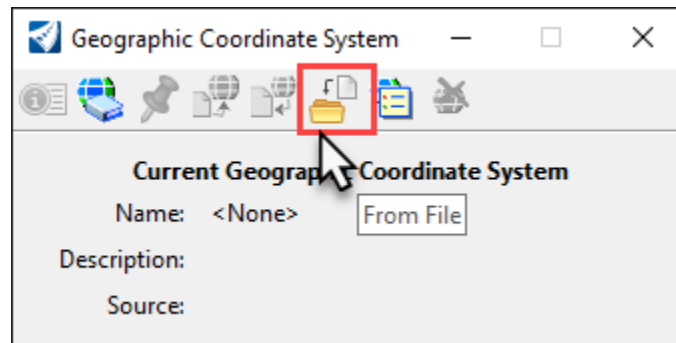


## 5.6 Individual Exercise: Creating a Corridor for Route 54

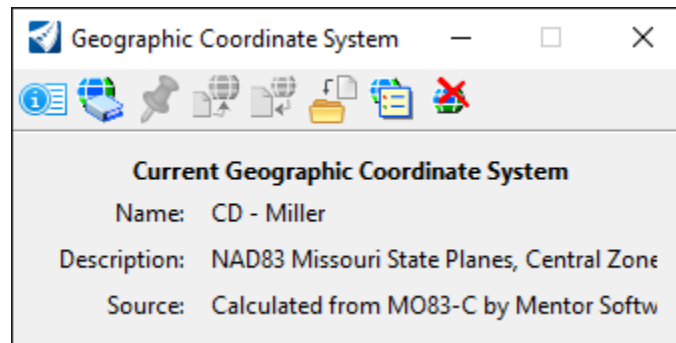
1. Create a new file named **Corridors\_Route-54\_J5P3181.dgn** using the **MoDOT\_Roadway\_Seed\_2D.dgn** seed file.

This new file will hold the proposed corridor for **Route 54**.

2. Open the **Coordinate System** tool by selecting the **OpenRoads Modeling Workflow** → **Utilities** Tab → **Geographic** Section.
3. Select “**From File**” icon.



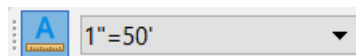
4. Select the **Terrain\_J5P3181.dgn** file in the **data-5** folder.
5. Verify the settings.



6. Reference in the following files:

**Terrain\_J5P3181.dgn**  
**Civil\_Geometry\_J5P3181.dgn.**  
**Corridors\_Ramp-4\_J5P3181.dgn.**

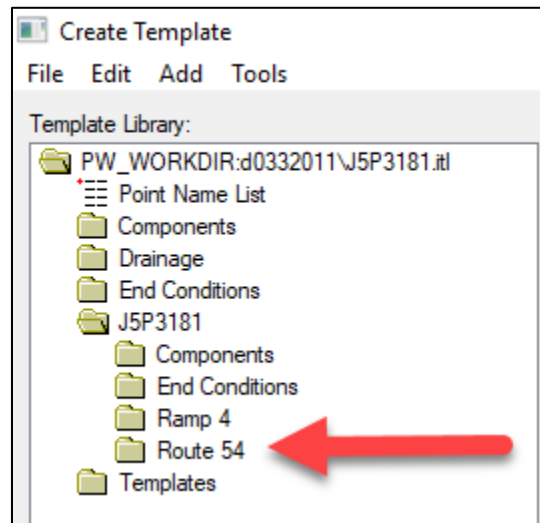
7. Set the **Annotation Scale** to **1"=50'**



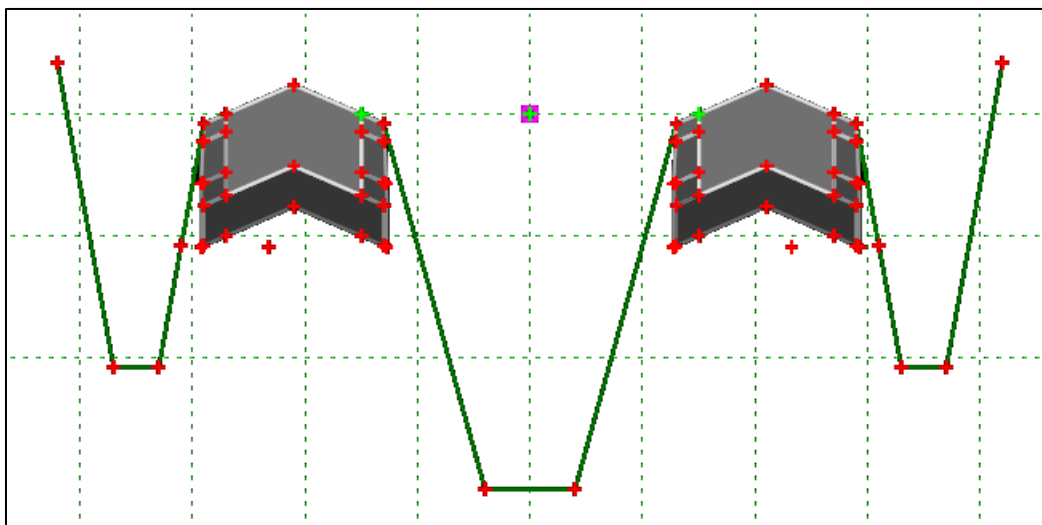
8. Select the Terrain Model and select the **Set As Active Terrain Model** icon from the pop up menu.



9. From Corridors tab of the OpenRoads Modeling Workflow, select **Create Template**.
10. Select file open and navigate to the the project diretory and open the project template library: **J5P3181.itl**.
11. In **Create Template** dialog right-click on the **J5P3181**, select **New > Folder** and create a folder called **Route 54**.



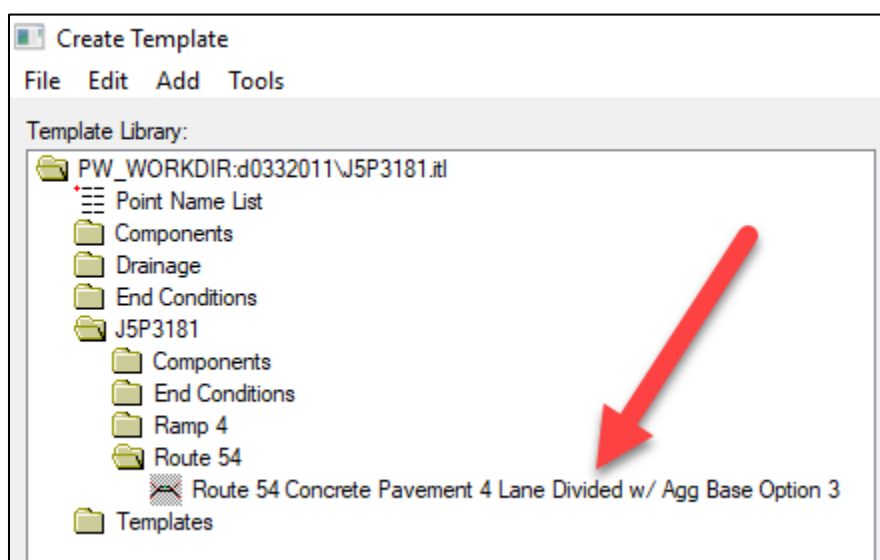
12. Select the **Templates** → **Concrete Pavement w/ Shoulders** → **A2 Shoulders Agg Base** folder.
13. Right click on the **Concrete Pavement 4 Lane Divided w/ Agg Base Option 3** template and select **Copy**.



14. Right click on the **Route 54** folder and select **Paste**.



15. **Rename the template** adding **Route 54** to the beginning of the name.



16. Test the template by clicking **Test**.
17. **Save** your changes to the **J5P3181.itl** and then close the Create Template dialog.
18. From **Corridors tab** of the OpenRoads Modeling Workflow, select **New Corridor**.
19. When prompted to Locate Corridor Baseline, data point on **Route 54**.
20. Right-click to reset to select the Active Profile.
21. Name the corridor **Route 54**.

Corridor Name	
Feature:Name	Route 54

22. **Data point** to accept.
23. Select <Alt> + **Down** to pick a template or use the **Create Template Drop** dialog box.
24. Expand the folder J5P3181 and the **Route 54** folder.
25. Select the **Route 54 Concrete Pavement 4 Lane w/ Agg Base Option 3** template. Click **OK** to dismiss the dialog
26. **Data point** in the view to accept the choice of template
27. When prompted to enter the Start Station, select the Alt key to lock to the beginning station, and **Data point** in the view to accept.
28. When prompted to enter the End Station, select the <Alt> key to lock the End Station to the end and **data point** in the view to accept it.
29. When prompted for the Interval, key in **25** and **Tab** to lock the value.

30. **Left Click** to **Accept** the placement of the **Template Drop**.
31. Select <**F4**> to close the Create Template Drop tool.
32. Select the Corridor and from the Properties pop-up menu, select and explore different design stages.
33. If the 3D View is not open select <**F6**> key to open a 3D view of the corridors.
34. In the View 2, Default-3D window use the View Rotation tool to rotate the view to see 3D effects on the **Route 54** corridor.

### Set up Dynamic Cross sections



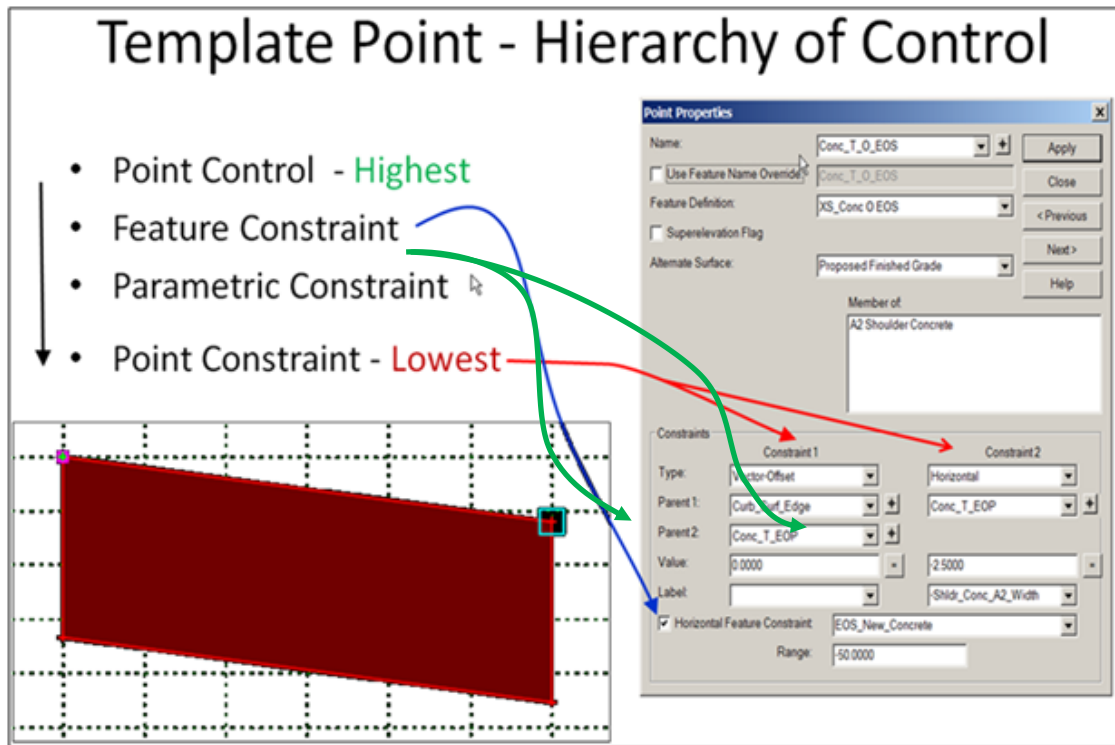
35. From context sensitive pop-up menu presented when hovering over a corridor handle, select the pull-down next to the **Dynamic Sections** icon, then select **Open Cross Section View**.
  - a. When prompted to Locate Corridor or Alignment, identify the **Route 54** corridor by selecting a grab handle on the corridor.
  - b. When prompted to Select or Open View, select a view not in use, (View 8) and **data point** in the view. This will present the first Cross Section of the corridor. To navigate up and down the corridor, use the arrow indicators at the top of the view.

Since superelevation will be changing the slopes, having feedback to the slope at each station is useful, the next steps describe how to place a dimension line from the edge of pavement to the center line on each side of the road.

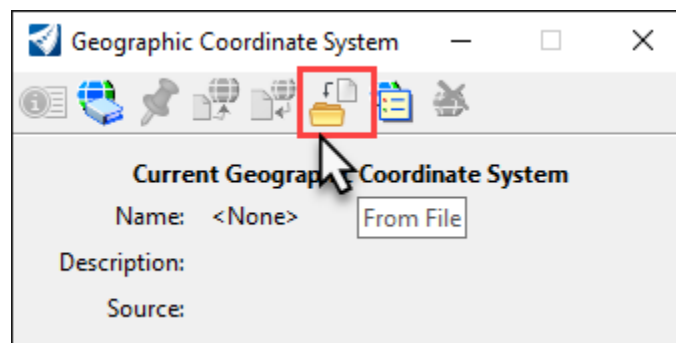
36. **Right click and hold for 1 second** in the **Cross Section Model**. This will bring up a menu with Temporary Dimension options.
37. Select the Cross Section view.
38. Select **Place Horizontal Temporary Dimension**.
39. At the Start Point prompt, identify the center of the roadway, **data point** to accept.
40. At the End Point prompt, identify the right EOP point, **data point** to accept.
41. Place the dimension height above or below the component in a location that will be easy to read, **data point** to accept the location.
42. Do this for both the North bound and the South bound lanes of **Route 54**.
43. **Close** View 8.
44. Select **File > Update Server Copy**.

## 5.7 Group Exercise: Horizontal Feature Control

In this Exercise we are going to add a plan graphic and have the corridor draw to that graphic. This process is called adding a **Horizontal Feature Constraint**.

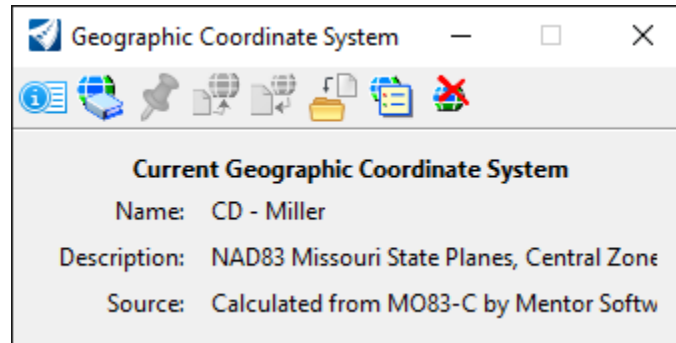


1. Create a new file named **Plan\_J5P3181.dgn** using the **MoDOT\_Roadway\_Seed\_2D.dgn** seed file.
2. Open the **Coordinate System** tool by selecting the **OpenRoads Modeling Workflow** → **Utilities Tab** → **Geographic Section**.
3. Select “**From File**” icon.



4. Select the **Terrain\_J5P3181.dgn** file in the **data-5** folder.

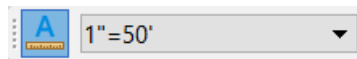
5. Verify the settings.



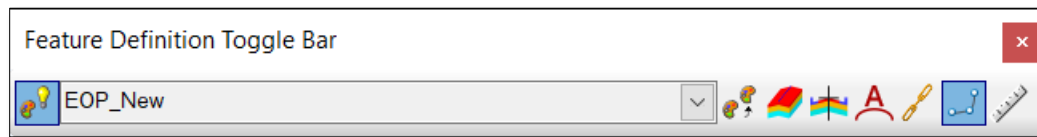
6. Reference in the following files:

**Civil\_Geometry\_J5P3181.dgn**  
**Terrain\_J5P3181.dgn**

7. Set the **Annotation Scale** to **1"=50'**

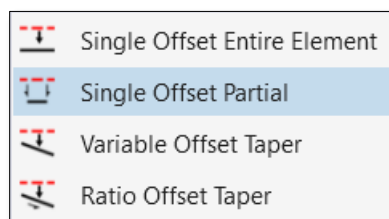


8. Using the **Feature Definition Toggle Bar** set the Feature Definition to **EOP\_New** (Edge of Pavement New). Also toggle on **Use Active Feature Definition**.

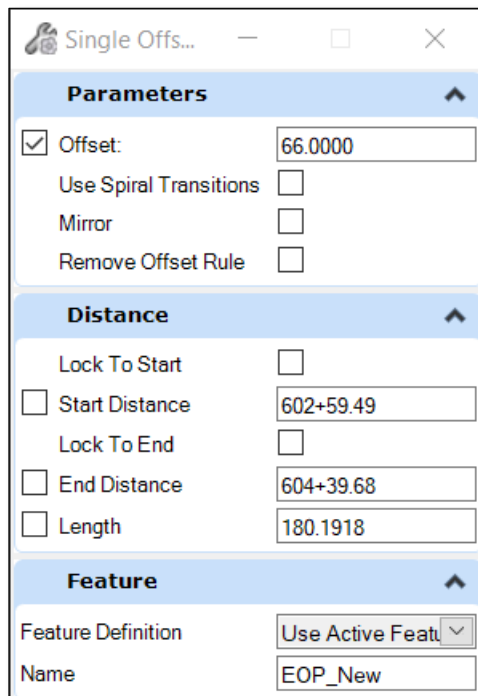


**EOP\_New** is located following place: **Linear → Design → Roadway**

9. Open the **Single Offset Partial** tool by selecting the **OpenRoads Modeling Workflow → Geometry Tab → Horizontal Section**.



10. Within the **Single Offset Partial** tool use the following parameters:



The screenshot shows the 'Single Offs...' dialog box with three sections: Parameters, Distance, and Feature. In the Parameters section, 'Offset' is checked and set to 66.0000, while 'Use Spiral Transitions', 'Mirror', and 'Remove Offset Rule' are unchecked. In the Distance section, 'Lock To Start' is unchecked, 'Start Distance' is set to 602+59.49, 'Lock To End' is unchecked, 'End Distance' is set to 604+39.68, and 'Length' is set to 180.1918. In the Feature section, 'Feature Definition' is set to 'Use Active Feat...' and 'Name' is set to 'EOP\_New'.

Parameters	
<input checked="" type="checkbox"/> Offset:	66.0000
Use Spiral Transitions	<input type="checkbox"/>
Mirror	<input type="checkbox"/>
Remove Offset Rule	<input type="checkbox"/>

Distance	
Lock To Start	<input type="checkbox"/>
<input type="checkbox"/> Start Distance	602+59.49
Lock To End	<input type="checkbox"/>
<input type="checkbox"/> End Distance	604+39.68
<input type="checkbox"/> Length	180.1918

Feature	
Feature Definition	Use Active Feat...
Name	EOP_New

Locate Element:	Route 54 Alignment
Offset:	66.00 ft
Start:	Start of Route 54 Alignment
Stop:	Beginning of Ramp 2 Alignment

11. Open the file: **Corridors\_Route-54\_J5P3181.dgn**

12. Reference in the **Plan\_J5P3181.dgn** into the default 2D view.

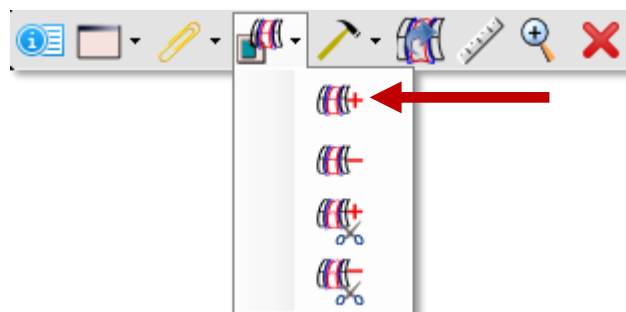
13. Sometimes it is helpful to turn off the 3D Corridor View to make the 2D Corridor View less cluttered. Within the active 2D View open the Reference Dialog and turn off the Display of the **3D Corridors\_Route-54\_J5P3181.dgn** file.

14. Edit the **Route 54 Template Drop** and open the Point Properties Dialog for the **RT\_Conc\_T\_EOP1** point. Set the **Horizontal Feature Constraint** to seek the following Feature Definition:

**Linear/Design/Roadway/EOP\_New**

The screenshot shows the 'Point Properties' dialog box for the point 'RT\_Conc\_T\_EOP1'. The 'Name' field is set to 'RT\_Conc\_T\_EOP1'. The 'Feature Definition' is set to 'nt Features\Pavement\XS\_Conc EOP'. The 'Alternate Surface' is set to 'Proposed Finished Grade'. The 'Superelevation Flag' is checked. The 'Member of' list includes 'RT\_A2 Shoulder Asphalt Surface' and 'RT\_Concrete Pavement'. The 'Constraints' section shows two constraints: 'Constraint 1' with Type 'Slope', Parent 1 'RT\_Conc\_T\_CL', and Value '-2.00%'; and 'Constraint 2' with Type 'Horizontal', Parent 1 'RT\_Conc\_T\_CL', and Value '12.0000'. The 'Horizontal Feature Constraint' is checked, and the 'Feature Definition' is set to 'Linear\Design\Roadway\EOP\_New'. The 'Range' is set to '50.0000'.

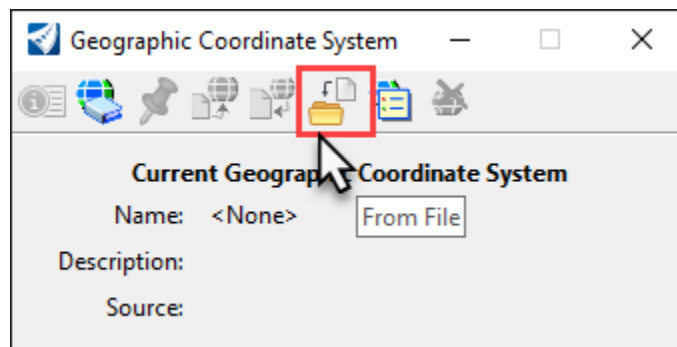
15. Add the newly place EOP\_New line as a **Corridor Reference** to the **Route 54 Corridor**



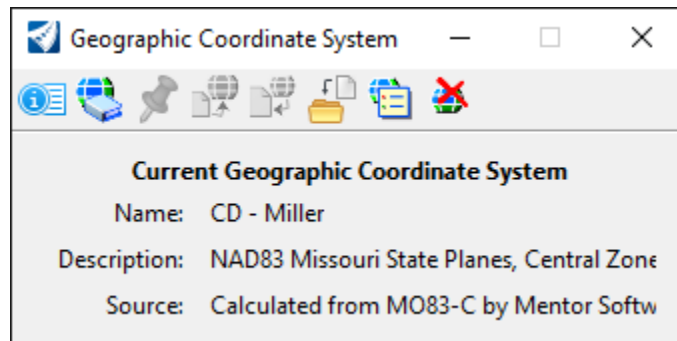
## 5.8 Group Exercise: Adding Right of Way to Route 54

### Create a New Land Boundary Design File:

1. Within the **Roadway\data-5** folder, open the file: **Corridors\_Route-54\_J5P3181.dgn**
2. Create a new file named **Land\_Boundary\_J5P3181.dgn** using the  
**MoDOT\_Roadway\_Seed\_2D.dgn** seed file.
3. Open the **Coordinate System** tool by selecting the **OpenRoads Modeling Workflow** → **Utilities Tab** → **Geographic Section**.
4. Select “**From File**” icon.



5. Select the **Terrain\_J5P3181.dgn** file in the **data-5** folder.
6. Verify the settings.

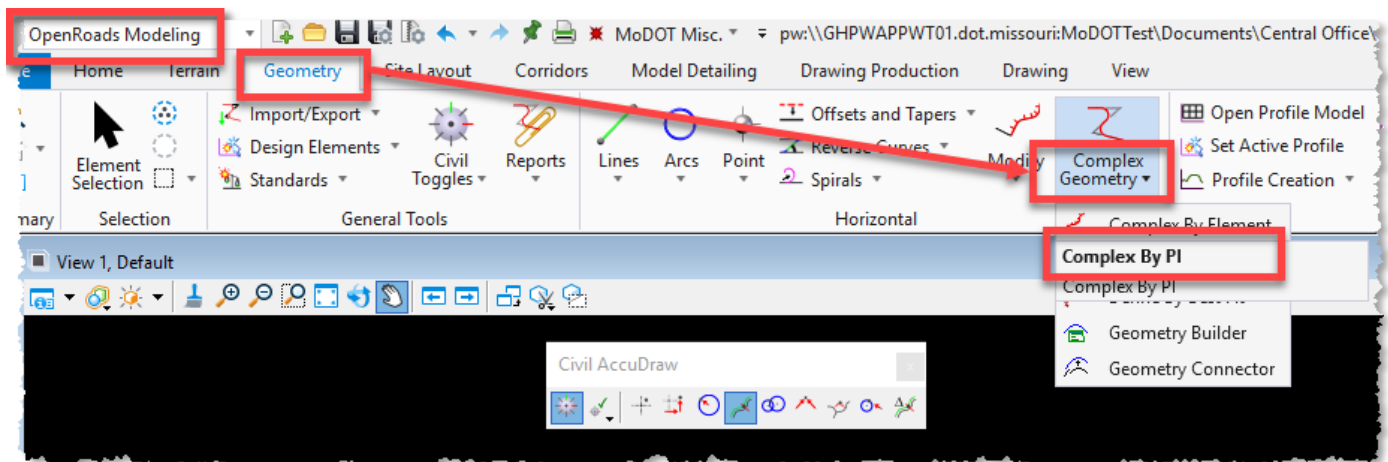


7. Reference in the following file:
  - a. **Civil\_Geometry\_J5P3181.dgn**
  - b. **Terrain\_J5P3181.dgn**
8. Change the **Annotation Scale** to **1"=50'**
9. **Activate** the Terrain Model **J5P3181**.

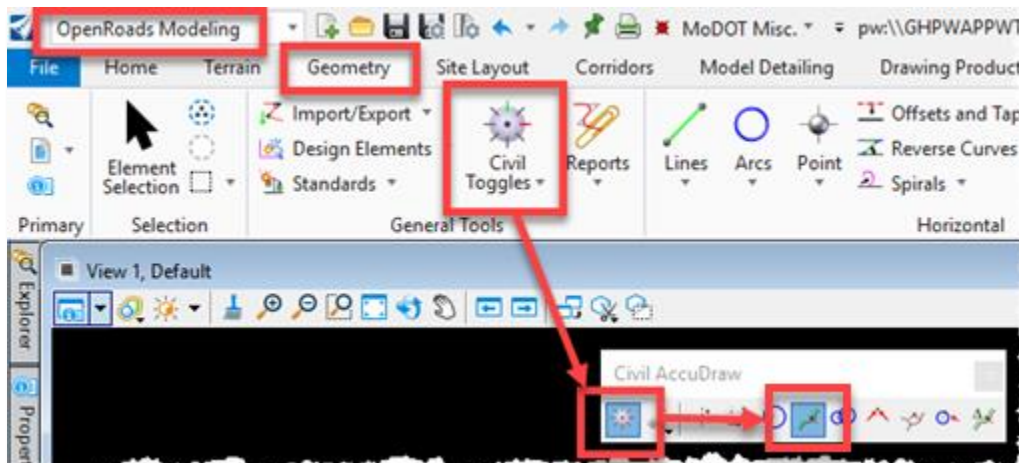
## Creating the 3 individual Right of Way Lines as Complex Elements:

Use **Civil AccuDraw** with a zero **Curve Radius** and zero **Spiral Transition Length** along with the **Route 54 alignment** to place line accurately along the **Route 54 Alignment** using the **Station-Offset** mode

10. In the **Feature Definition Toggle Bar** set the Feature Definition to **RW\_Controlled\_Access\_Proposed**. Also toggle on **Use Active Feature Definition**.
11. Using the OpenRoads Modeling Workflow select the **Geometry** tab
12. Open the **Complex By PI** tool from the pull down

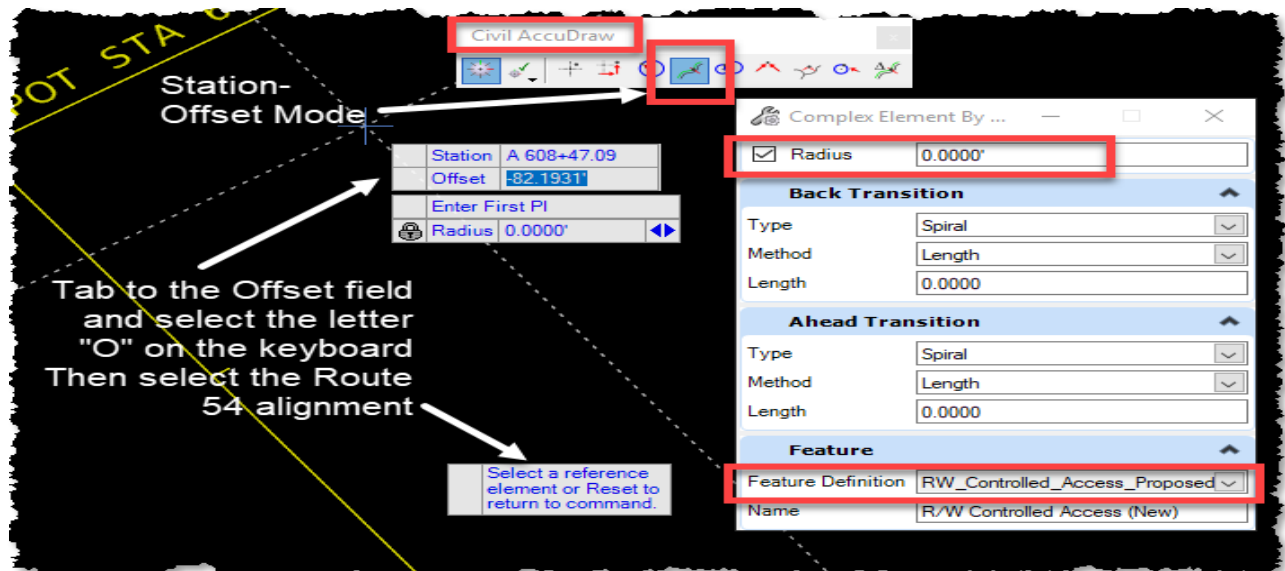


13. Open the **Civil AccuDraw** tool and set the mode to **Station/Offset**





14. Use the Horizontal Geometry Tool **Complex By PI** to place a line with a Feature Definition of **Linear** → **Design** → **Right of Way** → **RW\_Controlled\_Access\_Proposed** at the following locations:



Left Side

Station (6 entries)	Left Offset
602+60 R1	-300
613+44 R2	-374
614+78 R2	-604
620+13 R2	-574
622+18 R2	-200
635+00 R2	-200

Right Side

Station (2 entries)	Right Offset
602+60 R1	305
607+00 R1	305

Station (8 entries)	Right Offset
609+24 R2	175
615+00 R2	175
616+31 R2	315
618+20 R2	328
623+49 R2	198
627+00 R2	260
630+00 R2	200
635+00 R2	200

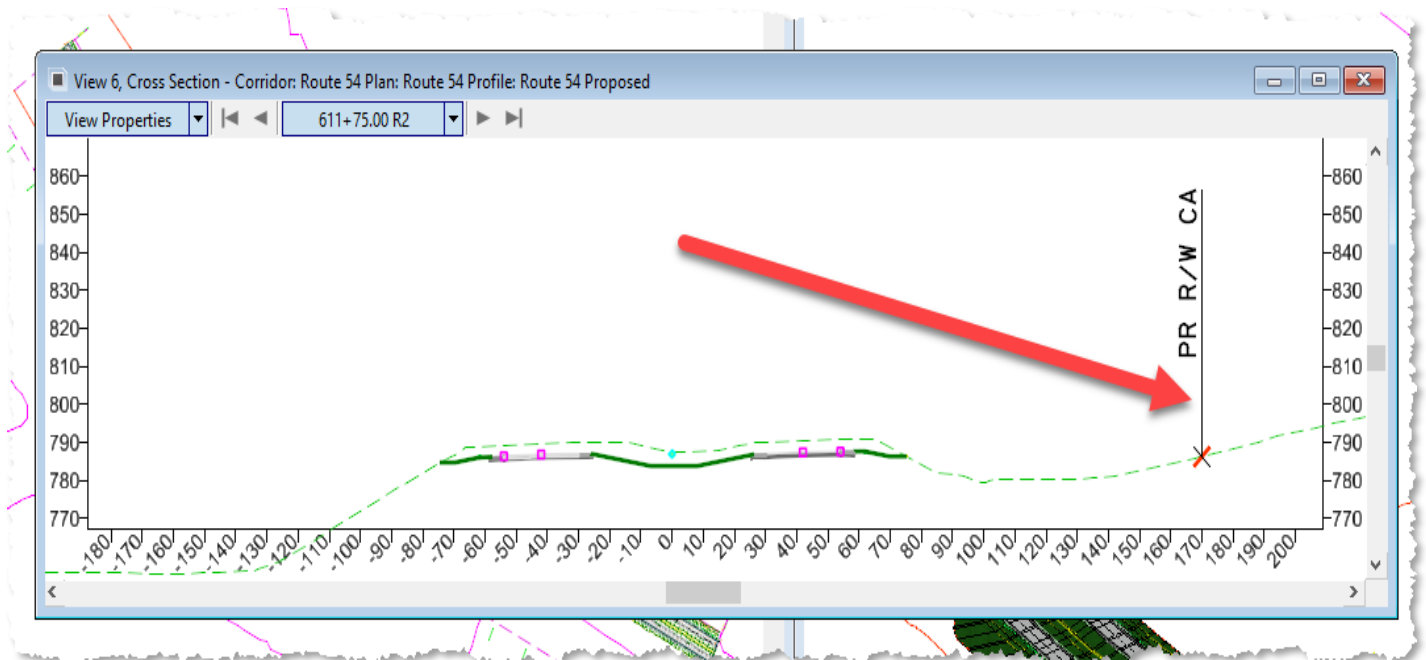
15. If not already done, select the Terrain Model **J5P3181** and set it **Active**.
16. Open the Profile View of each just placed **RW\_Controlled\_Access\_Proposed** element.
17. Set the existing ground as the **Active Profile**.

**Note:** by setting active the Right of Way line profile, future cross section will now show a label of the locations of said Right of Way line in the Dynamic Cross-Section window and Named Boundary created cross section sheets and models.

18. Select File > **Update Server Copy**.

### Updating the Corridors file:

19. Within the **Roadway\data-5** folder, open the file: **Corridors\_Route-54\_J5P3181.dgn**
20. **Reference** in the newly created **Land\_Boundary\_J5P3181.dgn** into the 2d View
21. Verify the dynamic cross-section view shows the **R/W lines**



**End of Exercise**

---

## Chapter 6

# Superelevation

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## 6.1 Objectives

- Create a superelevation section and lane
- Calculate superelevation using an XML file, or import data from CSV file
- Review / edit the data utilizing the table editor and SE Model
- Assign the superelevation information to a corridor

## 6.2 Overview

Superelevation tools calculate how much banking to apply to curves and spirals in the horizontal alignment to help offset centrifugal force. These commands also compute how the road will make the transition from normal crown to a fully banked curve and back again.

Superelevation can be calculated in two ways:

**Rules-based** – using a set of preferences (**XML** file) the station and associated cross slopes of the transitions are based on design speed, curvature, and other design parameters. As the design progresses and parameters change (i.e., design speed exceptions) superelevation can be reprocessed to the revised parameter(s).

**Import** – using a comma separate values (**CSV**) file to import the station and associated cross slope of each transition. In this option, the rules are not utilized; the data is simply applied to the superelevation lanes.

The result of superelevation is a DGN file of graphic superelevation lanes with cross slope attributes. This file can be referenced to a corridor model and associated, so the superelevation transitions are incorporated into the corridor model. The superelevation data can be in its own DGN file, or can be drawn into any of the other project DGN files with geometry, corridor, etc.

## 6.3 Prerequisites

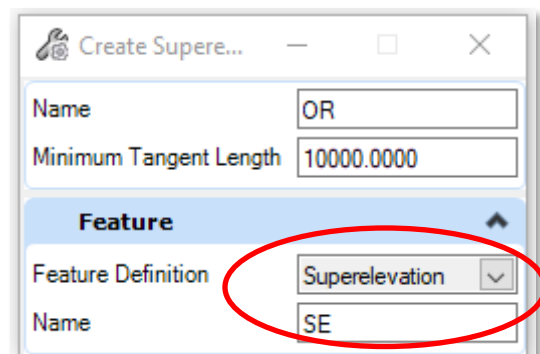
In order to create superelevation, the following are minimum requirements:

- One Civil horizontal geometry element
- Superelevation preferences (an **XML** file)

In order to add the superelevation data to a corridor, you will need:

- Superelevation lanes
- Corridor whose template has superelevation flags for control points (for association step)

Superelevation data is drawn using a Feature Definition for Superelevation. Therefore, turning off the levels with superelevation data removes it from the active view.



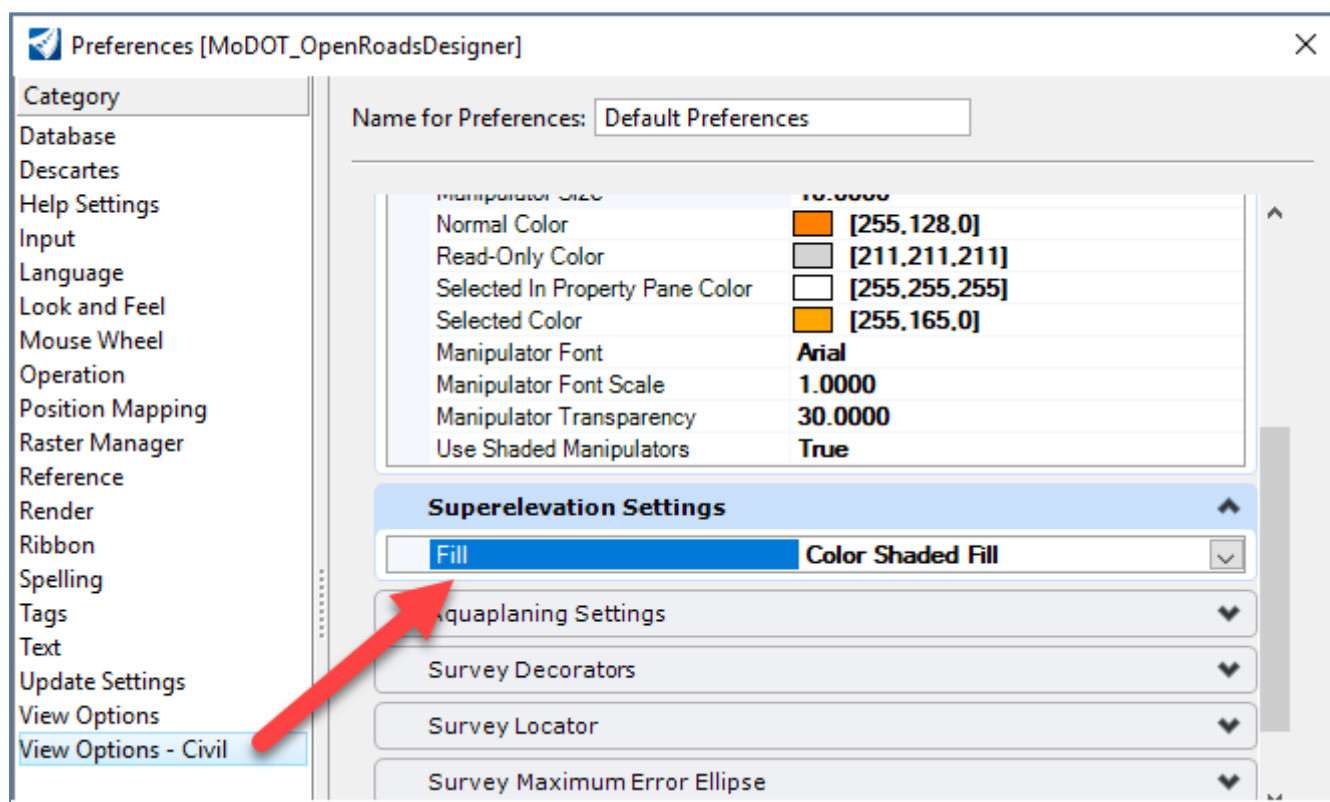
## 6.4 Settings

The following two sets of settings are utilized within the superelevation tools. It is prudent to set them prior to drawing lanes. There are no required values; these are user preference.

- fill settings for superelevation lanes
- decimal place settings for element handlers

## 6.5 Fill Settings

Located under **File > Settings > User** from the main Backstage menu, the **View Options - Civil** listing provides options for the superelevation fill.



Option	Description
<b>Color Shaded Fill</b>	<p>Color Shaded Fill Color fills superelevation lanes AFTER calculations are complete. The coloring is hard-coded based on the cross slope:</p> <p>slope &lt; -10% =blue</p> <p>-10% &lt;= slope &lt;= -0.5% = Calculated color between green and blue</p> <p>-0.5% &lt; slope &lt; 0.5% = white</p> <p>0.5% &lt;= slope &lt;= 10% = Calculated color between red and yellow slope &gt; 10% = dark red</p> <p>Based on the side of road, the colors flip. In addition to setting this option, the</p>
<b>Boundaries Only</b>	<p>In this option, only the outside boundary of each lane is displayed and can be selected.</p>
<b>None</b>	<p>No superelevation lanes / edit handlers are displayed; however, they are still in the file. To display them, set to one of the other two options.</p>

## 6.6 Stationing and Decimal Place Settings

Located under *File > Settings > File > Design File Settings* from the main Backstage menu, the Civil Formatting category listing has options for controlling display of element handlers. These settings are not unique to superelevation; the same settings are used throughout the Civil products.

Option	Description
<b>Station</b>	Used for section and lane edit handlers.
Format	Controls the number of places after the delimiter.
Format	Controls the delimiter, generally the plus (+) sign.
Precision	Defines the number of decimal places for stationing.
<b>Profile</b>	Used for lane edit handlers.
Slope Format	Used for cross slope edit handlers. Generally, set to percentage for
Slope Precision	Defines number of decimal places in cross slope edit handlers.

### Superelevation General Workflow

The general workflow for superelevation is described in the following steps. Steps 4-6 can be done in a different order and not all steps are required.

1. Create the super section(s).
2. Define the lanes with *Create Superelevation Lanes (by Road Template or manual)*.
3. Calculate superelevation transitions and cross slopes.
4. Review and edit as needed.
5. Add auxiliary lanes.
6. Associate to a corridor.

## 6.7 Create the Super Section(s)

In this first step, the Civil horizontal geometry element is identified, and station limits of the superelevation are defined. Station limits are useful if the horizontal geometry element is substantially longer than the project limits.

In a basic project where the through lane pavement configuration is consistent (i.e., all 2 lane rural with a few turn lanes), a single section may be used. However, if there are significant changes to the road, i.e., changing from 2 lane rural to 4 lane divided, separate sections should be created.

The general rule is to create a new section if you are using rule-based calculations and the through lane configuration or pivot method changes. The changes should be based on the through lanes, as auxiliary lanes such as turn lanes, ramp entrances and exits and truck climbing lanes are handled independently. If you are importing superelevation, one section can be used for an entire alignment.



### 6.7.1 Create Superelevation Lanes

Once the section is defined, define the lanes. Focus on the through lanes, as the turn lanes and intermittent lanes can be added at any time. Lanes are defined by selection of the horizontal geometry and offsets. Default cross slope, used for subsequent calculations, is also defined. The result of this step is that graphic lanes (filled with green and yellow, no choice of colors) are drawn.

### 6.7.2 Create Superelevation Lanes by Road Template

OpenRoads Designer allows for the ability to select the template that has been used on your project to define the superelevation lanes. Users would want to make sure their templates used in the DGN match the current ITL template. The program will utilize the points with the superelevation flag option and determine lane widths automatically.



### 6.7.3 Calculate Superelevation Transitions and Cross Slopes

In this step, there are two options: **rule-based** and **imported** data. Generally, one method would be selected, however, you can use rule-based for part of the project and import other parts (although this would be confusing).

The rules-based tool uses a preferences file (XML file) to compute the station and cross slopes of transitions, while the import superelevation method uses a comma separate values (CSV) file containing the station and cross slopes, which were calculated by an exterior program (or manually). The inputs vary depending on the method used and the preferences within the XML file.

The result of this step is the augmentation of station/cross slopes of transitions to the lanes created in the previous step. It is easy to see the results if the fill is toggled on as the lanes change from solid yellow and green to a gradient coloring, based on cross slopes.

### 6.7.4 Review and Edit as Needed

There are several ways to review the superelevation data and edit if desired. Highlighting a section displays station and cross slope values for review and editing. Stationing can be changed dynamically by selecting the gray wedge and dragging to the desired station. Each lane can be manipulated independently of the adjacent lanes. The station can all be keyed into the edit field. Slopes can be changed by keying the slope into the edit field.

The superelevation editor is another way to edit the data, in a tabular format. Any changes made in the editor are automatically synced with the graphic lanes and vice versa. The fields in the editor can be customized so unused or unwanted fields can be hidden. Any data in gray cannot be edited, due to constraints used during calculations with the XML method.

OpenRoads Designer also has the option to edit the Superelevation graphics through a Model.



The Open Superelevation View will take the graphics displayed in the Edit Table dialog and open it up in a MicroStation Model for editing.

### **6.7.5 Add Auxiliary Lanes**

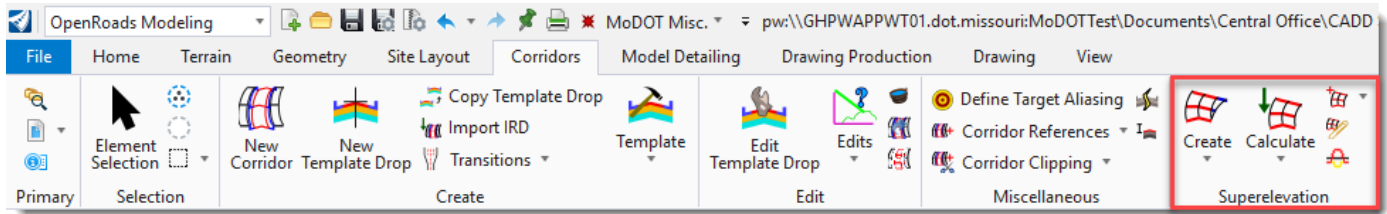
At any time during the process, additional lanes can be added in any section. Primary lanes (those lanes that are rule based) or auxiliary lanes (those with user-specified cross slopes) can be added. The result of this step is graphic superelevated primary or auxiliary lanes.

### **6.7.6 Associate to a Corridor**

At any time during the process, the superelevated lanes can be associated with a corridor. If the superelevated lanes are in a different file than the corridor, you must be in the corridor file with the super lanes attached as a reference. They can both be in the same file.

The result of this step is the superelevated pavement is reflected in the corridor model.

## 6.8 Accessing Superelevation Tools



### Create Superelevation Sections



In this tool the Civil horizontal geometry element is identified and station limits of the superelevation are defined. Station limits are useful if the horizontal geometry element is substantially longer than the project limits.

#### Determination of Sections

If you are importing superelevation, one section can be used for an entire alignment. The advantage of curve sets for each curve versus one large section is the ability to reprocess rules for a single curve set or two. Since rules are not used in an imported project, separate curve sets serve no useful purpose aside from shorter, piecemeal reports and more granularities in the editor.

In a basic rules-based project where the through lane pavement configuration is consistent (i.e., all 2 lane rural with a few turn lanes), a single section may be used. However, if there are significant changes to the road, i.e., changing from 2 lane rural to 4 lane divided, separate sections should be created.

The general rule is to create a new section if you are using rule-based calculations and the through lane configuration or pivot/rotation method changes. The changes should be based on the through lanes, as auxiliary lanes such as turn lanes, ramp entrances and exits and truck climbing lanes are handled independently. However, the auxiliary lanes must be drawn within a single section.

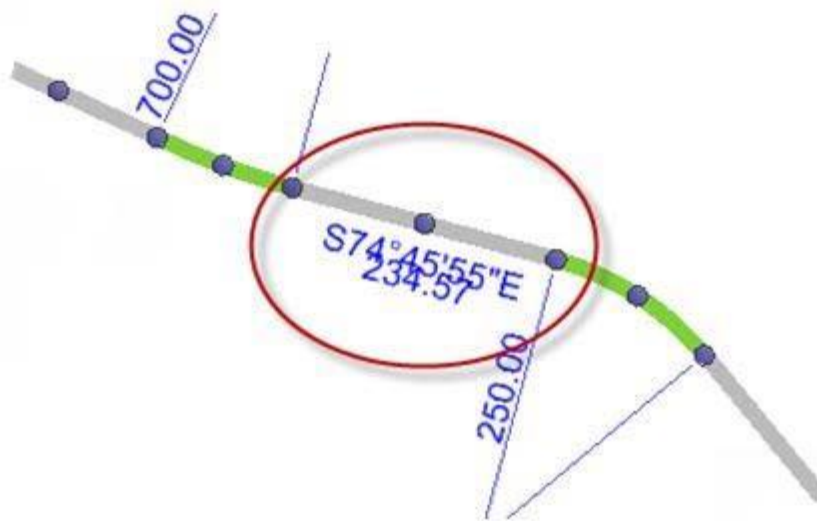
#### Workflow

1. Select **Create Superelevation Section**.
2. Set the Feature Definition to *Superelevation*
3. Follow the heads-up prompts.

Prompt	User Action
<b>Name</b>	Name each section, suggestions include alignment name which can be appended -1, 2, etc. for projects with multiple sections.
<b>Locate Reference Element</b>	Select the Civil horizontal element to be used as a basis for superelevation lanes and calculations.
<b>Start Station</b>	Graphically define (based on the dashed line perpendicular to the reference element) the beginning of the section. The station can also be keyed in and locked
<b>End Station</b>	Graphically define (based on the dashed line perpendicular to the reference element) the ending of the section. The station can also be keyed in and locked
<b>Minimum Tangent Length</b>	Enter a value (in master units). If the tangent distance between two adjacent curves is less the specified value, the two curves and adjacent tangent are drawn into one curve set. If the tangent distance between two adjacent curves is greater the specified value, each curve and half of the adjacent tangent are drawn into each curve set. At the completion of this prompt, the sections are drawn and the software automatically advances to the Create Superelevation Lanes tool

### Minimum Tangent Length

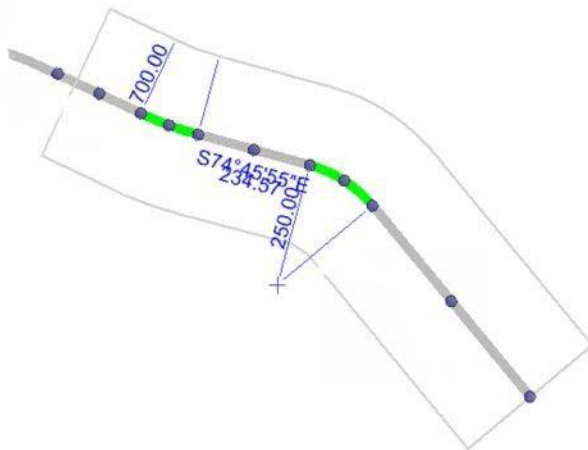
This variable defines the minimum tangent between curves and is the determining factor on how curve sets are defined. When using rule-based calculations, there are times when you need to reprocess part of the superelevation calculations, perhaps due to a horizontal geometry change or design speed revision. If your project is one big section, then reprocessing is performed on the entire section, and overwrites any manual editing. For flexibility, curve sets enable the processing of one curve or multiple curves, while leaving manually manipulated sets intact. In the following example, the distance between curves is 234.57 master units.



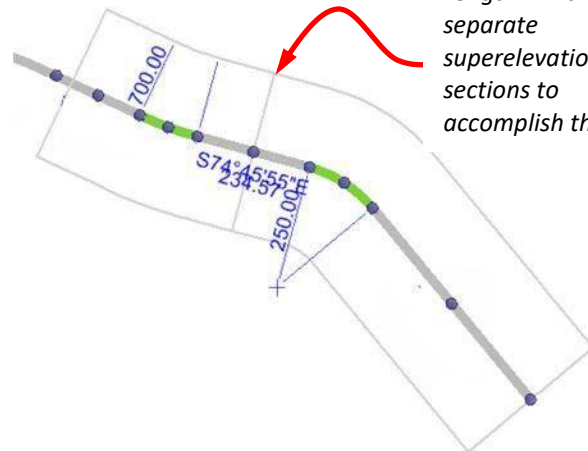
*This line separates the two superelevation sections.*

*Example: first section may have a speed limit of 30 mph and the second section may have a speed limit of 25 mph. Using the Minimum Tangent Length will allow for separate superelevation sections to accomplish the task.*

The following results illustrate the impact of the **Minimum Tangent Length**.



One curve set created (Min. Tangent Distance = 235)



Two curve sets created (Min. Tangent Distance = 225)

**Create Superelevation Lanes**

At any time during the process, additional lanes can be added in any section. Primary lanes (those lanes that are rule based) or auxiliary lanes (those with user-specified cross slopes) can be added. The result of this step is graphic superelevated primary or auxiliary lanes.

**Workflow for Through Lanes**

1. Select the **Create Superelevation Lanes** tool.
2. Follow the heads-up prompts.

Prompt	User Action
<b>Locate First Superelevation Section</b>	Select the first section. In lieu of selecting each section individually, drag your cursor diagonally across all desired sections. Your diagonal defines a square wherein the entire section must be encompassed in order to be included.
<b>Locate Next Superelevation Section or Reset to Complete</b>	Continue selecting sections until all are highlighted, then reset to move to the next prompt.
<b>Enter Lane Name</b>	Name each lane, suggestions include RT or LT which can be appended - 1, 2, etc. for projects with multiple lanes.
<b>Select Side of Centerline</b>	Select the first section. In lieu of selecting each section individually, drag your cursor diagonally across all desired sections. Your diagonal defines a square wherein the entire section must be encompassed in order to be included.
<b>Inside Edge Offset</b>	Enter the offset (in master units) from the baseline reference. If the lane edge is the baseline reference, enter 0.
<b>Width</b>	Enter the width of the lane (in master units).
<b>Normal Cross Slope</b>	Enter the default cross slope to be used for calculations (in percent format). It not necessary to add the percent sign.
<b>Name</b>	The prompts are looping again, so you can define multiple lines with a single selection of the tool. You may need to move the cursor slightly for the prompt to appear. When you have no additional lanes to define, reset to exit the tool.



*Two lanes defined, yellow and green; one each side of baseline reference (red)*

## Create Superelevation Lanes by Road Template



In lieu of manual entry of primary lane widths, a template representing the roadway may be selected. This is an alternate way to create superelevation lanes by using the widths and cross slopes of a specified template along with parameters specified in the Superelevation Rules File. Instead of having to enter the lane widths and slopes, they can be garnered from a road template if that template has superelevation points flagged. The resulting superelevation lanes are drawn as graphics in a DGN file.

### Adding Lanes

At any time during the process, additional lanes can be added in any section. Primary lanes (those lanes that are rule based) or auxiliary lanes (those with user-specified cross slopes) can be added using the Create Superelevation tool, but within a single section. When a single section is selected, the prompts change to reflect adding an individual lane. The result of this step is graphic superelevated primary or auxiliary lane. The lane needs to be associated to the corridor, similar to the through lanes.

### Workflow for Individual Lane

1. Select the Create Superelevation Lanes tool.
2. Follow the heads-up prompts:

Prompt	User Action
<b>Locate First Superelevation Section</b>	Select the first section.
<b>Locate Next Superelevation Section or Reset to Complete</b>	Reset to move to the next prompt.
<b>Type</b>	Options include: Primary (calculations based on rules) or Auxiliary (based on user- defined). After the selection, the dialog/heads-up prompts change to reflect the selection.
<b>Application Type (Aux. lane only)</b>	How to define cross-slope: <b>None</b> - no cross slopes are assigned. <b>Constant</b> - Fixed slope of specified value. If lane is transition, use this option, and then modify one end in the editor or graphically after creation. <b>Follow Adjacent</b> - Projects cross slopes from adjacent lane to this lane.
<b>Select Side of Centerline</b>	Right or left
<b>Inside Edge Offset</b>	Enter the offset (in master units) from the baseline reference. If the lane edge is the baseline reference, enter 0.

<b>Width</b>	Enter the width of the lane (in master units). If the lane is of varying widths, you can use the widest width, or narrower than the width. In both cases, the template can control the width by parametric constraints or graphical features.
<b>Start Station</b>	Graphically define (based on the dashed line perpendicular to the reference element) the beginning of the lane. Station can be keyed in and locked.
<b>End Station</b>	Graphically define (based on the dashed line perpendicular to the reference element) the end of the lane. Station can be keyed in and locked.
<b>Normal Cross Slope</b>	Enter the default cross slope to be used for calculations (in percent format). It is not necessary to add the percent sign.

**Calculate Superelevation**

The rules-based tool uses a preferences file (XML) to compute the station and cross slopes of transitions.

**Workflow**

1. Select **Calculate Superelevation**.
2. Follow the heads-up prompts for XML file.

Prompt	User Action
<b>Locate First Superelevation Section</b>	Select the first section. In lieu of selecting each section individually, drag your cursor diagonally across all desired sections. Your diagonal defines a square wherein the entire section must be encompassed in order to be included.
<b>Locate Next Superelevation Section; or Reset to Complete</b>	Continue selecting sections until all are highlighted, then reset to move to the next prompt.
<b>Standards File Name</b>	Select the XML containing the superelevation standards/parameters. Use <ALT> <DOWN> to open the File Manager to select directory/file. Data prompt to accept and move to the next prompt.
Note: The prompts below and their options may vary based on the options within the XML file.	
<b>e Selection L Selection</b>	The available e and length Selection fields are filled in according to the XML file. Those combo boxes determine which table within the .XML file will be used for computation.
<b>Design Speed</b>	Design Speed is to be used either in the tables or equations for e and length computations.
<b>Pivot Method</b>	Valid values here are: Crown, Inside Edge, Outside Edge, Left Edge, Right Edge, Divided Inside, and Centerline. If Divided Inside is used on an undivided roadway, it will be the same as using Crown. If an invalid value is entered, Crown will be the default. Centerline always uses the base alignment radius to calculate eRate. All other methods use the radius +/- the offset of the pivot to calculate eRate.
<b>Open Editor</b>	When calculations are complete and lanes updated, the superelevation editor is opened and populated with the new calculated lanes.



### **Edit Superelevation Rule File**



The superelevation calculator uses an XML-formatted rules file to calculate various aspects of superelevation. This file is used to calculate Max E rate for each curve of an alignment and the transition lengths needed to rotate the road bed from normal crown cross slopes to full superelevation cross slope (Max E).

MoDOT will not typically edit the XML file for calculating superelevation.



### **Import Superelevation**

In lieu of using rule-based superelevation transitions, the data may be imported from a CSV file, where calculations are done outside of the Civil products and just the results are imported. In this case, rules do not apply, so no XML is needed or specified.

Entire projects can be imported, in which case, only one superelevation section is needed. However, you can also import just a turn lane or two, or part of your project. Keep in mind the superelevation section and lanes must be created prior to importing, and lane names associated with the graphics must match the names in the import file.

The Windows delimiter value is used, which is generally set to comma; however, if you are experiencing difficulties, you may want to verify this on your workstation or laptop.

If a file is imported twice, duplicate lanes are not created; rather the values of the import file overwrite any values (including manual edits) of lanes.

The file format of the comma separated values file is:

<b>Data</b>	<b>Description</b>
<b>Superelevation Lane</b>	Links the data to an existing superelevation lane.
<b>Station</b>	Units should match design file. Station equations supported based on the sections reference alignment.
<b>Cross Slope</b>	Formatted as a double value : $\pm 0.0$ (i.e. -2% == -0.02)
<b>Pivot About</b>	Enumerated list: {LS,RS} LS = left side RS = right side

The following details the optional information:

<b>Data</b>	<b>Description</b>
<b>Point Type</b>	<p>Enumerated list: {NC,NCIN,NCOUT,LC,LCIN,LCOUT,RC,RCIN,RCOUT,FS,FSIN,FSOUT,U}</p> <p>NC = Normal Crown, LC = Level Crown, RC = Reverse Crown, FS = Full Super, U = Undefined</p>
<b>Transition Type</b>	<p>Enumerated list : {L,PC,PRC,BRC,CRC,SRC}</p> <p>L = Linear, PC = Parabolic Curve, PRC = Parabolic Reverse Curve, BRC = Biquadratic Reverse Curve, CRC = Cubic Reverse Curve, SRC = Symmetrical Reverse Curve</p>
<b>Non-Linear Curve Length</b>	<p>Default Value = 0.0</p> <p>Only pertinent for transition type: parabolic curve or symmetrical reverse curve.</p>

### Workflow

1. Create the **CSV** file, based on file format.
2. Create superelevation section and lanes, ensuring the lane names match those used in the CSV file.
3. Select the **Import Superelevation** tool.
4. Follow the heads-up prompts:

<b>Prompt</b>	<b>User Action</b>
<b>Locate First Superelevation Section</b>	Select the first section. In lieu of selecting each section individually, drag your cursor diagonally across all desired sections. Your diagonal defines a square wherein the entire section must be encompassed in order to be included.
<b>Locate Next Superelevation Section or Reset to Complete</b>	Continue selecting sections until all are highlighted, then reset to move to the next prompt.
<b>Import File Name</b>	Use <ALT> <DOWN> to open the File Manager to select directory / CSV file.

The results look identical to those of the calculated superelevation lanes. All functionality (i.e., editor, graphic manipulation, etc.) supported for calculation lanes is also supported for imported lanes, aside from reprocessing.

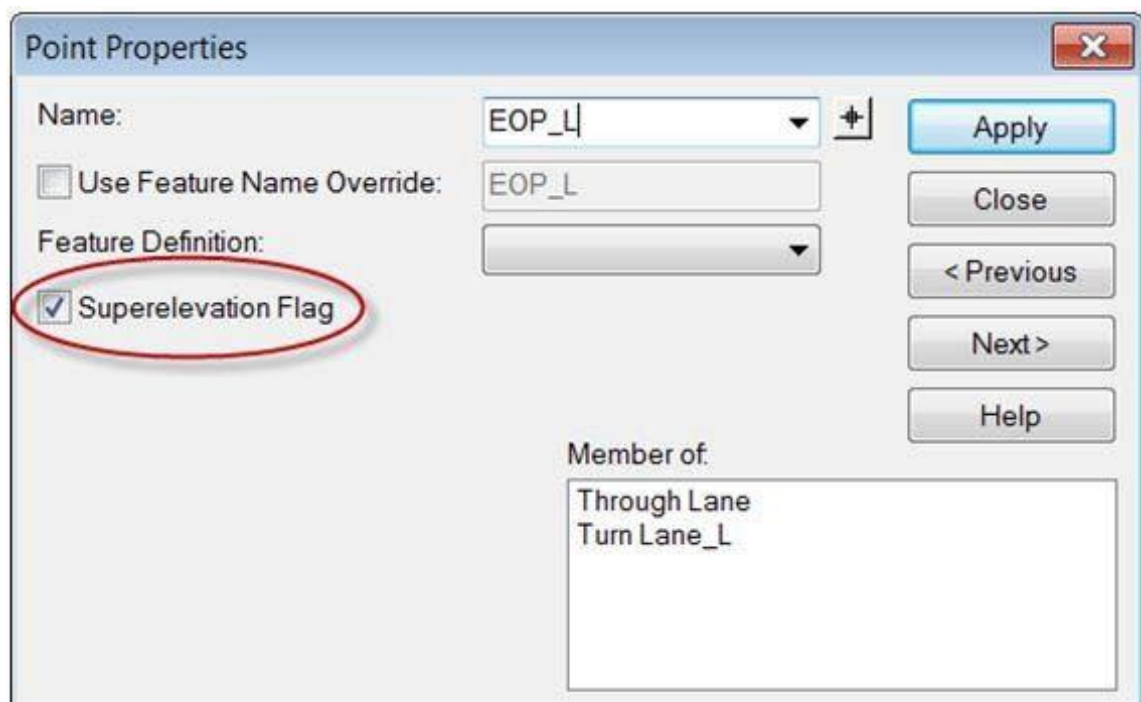
**Assign Superelevation to Corridor**

At any time during the process, the superelevated lanes can be associated with a corridor. If the superelevated lanes are in a different file than the corridor, you must be in the corridor file with the super lanes attached as a reference. They can both be in the same file.

The result of this step is the superelevated pavement is reflected in the corridor model.

**Workflow**

1. Verify that the template has the *Superelevation Flag* set for all pavement points used as candidate superelevation points. This flag is used for automatically setting the point controls. To discover if the Flag has been applied to the template, Open the Edit Template Drop and select the Template Drop handle. Once inside the Editor, double click on the EOP point.



2. From within the DGN containing the corridor model, select the **Assign Superelevation to Corridor** tool.
3. Follow the heads-up prompts.

Select the first section. In lieu of selecting each section individually, drag your cursor diagonally across all desired sections. Your diagonal defines a square wherein the entire section must be encompassed in order to be included.

Prompt	User Action
<b>Locate First Superelevation Section</b>	Select the first section. In lieu of selecting each section individually, drag your cursor diagonally across all desired sections. Your diagonal defines a square wherein the entire section must be encompassed in order to be included.
<b>Locate Next Superelevation Section or Reset to Complete</b>	Continue selecting sections until all are highlighted, then reset to move to the next prompt.
<b>Locate Corridor</b>	Select the corridor wherein the superelevation transitions are to be applied.

The *Associate Superelevation* dialog is displayed.

	Superelevation Object	Superelevation Point	Pivot Point	Start Station	Stop Station	Priority
▶	LT-2 ▼	EOTL_L ▼	EOP_L ▼	10+00.00 R1	42+36.42...	1
	LT-1 ▼	EOP_L ▼	CL ▼	10+00.00 R1	42+36.42...	1
	RT-1 ▼	EOP_R ▼	CL ▼	10+00.00 R1	42+36.42...	1
	RT-2 ▼	EOTL_R ▼	EOP_R ▼	10+00.00 R1	42+36.42...	1
*	▼	▼	▼			

OK Cancel

1. If the information is correct, click **OK**. If not, click **Cancel** and review the template. Superelevation has been incorporated into the corridor model.
2. Generate a dynamic cross section view to see the superelevation.

**Insert Station Cross Slope**

There may be times when an additional station and cross slope transition need to be added to an existing superelevation lane. Rather than deleting the lane and recreating it, *the Insert Superelevation Station/Cross-slope* tool can be used.

**Insert Superelevation Station/Cro...**

**Distance Constraint**

Distance Constraint Type: None

**Slope Constraint**

Slope Constraint Type: None

Pivot About: Left Edge

Transition Type: Linear

☐ Station: 0.0000'

Cross Slope: 0.00%

Point Type: Undefined Type

**Workflow**

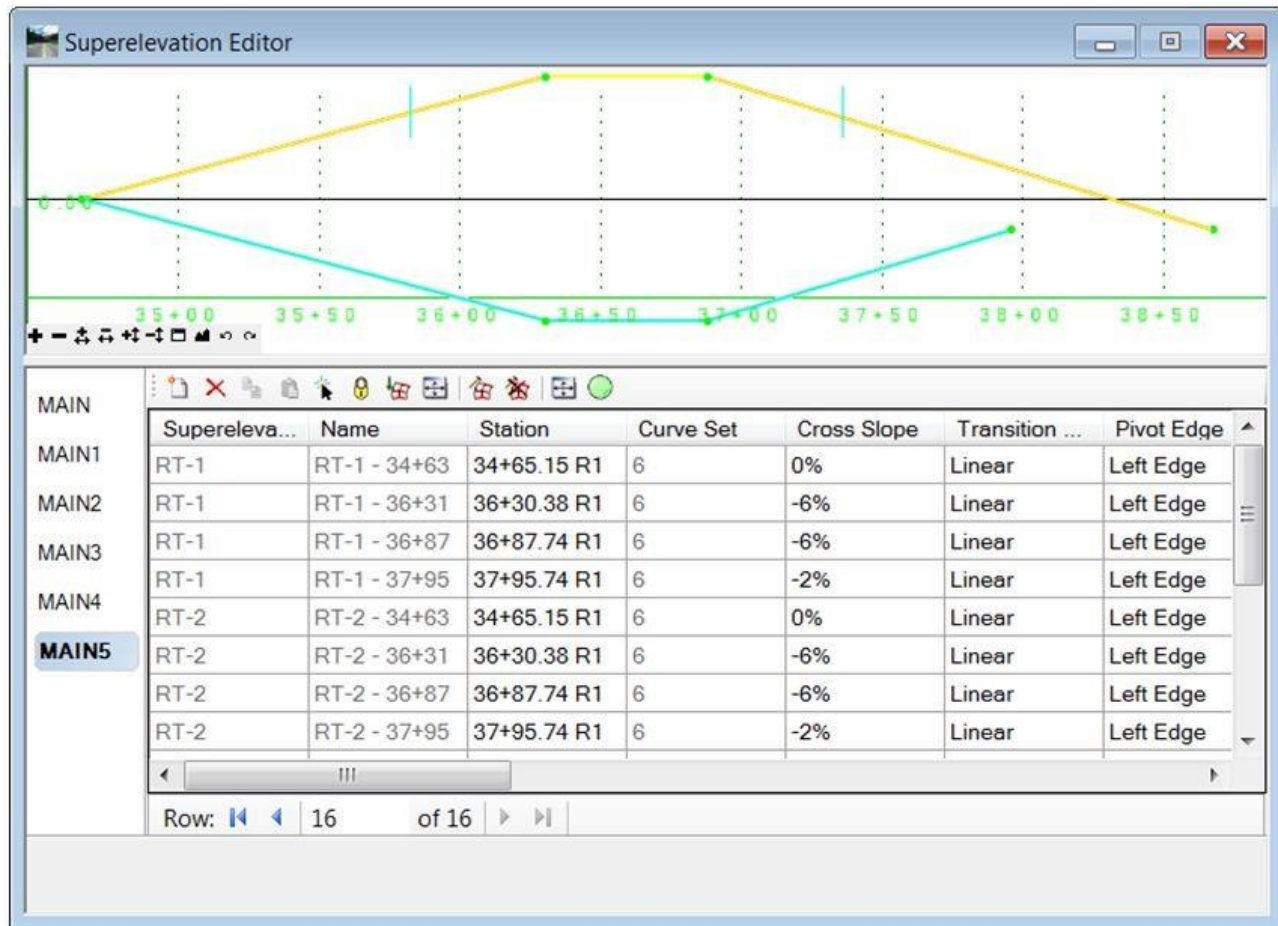
1. Select **Superelevation Station/Cross-slope**.
2. Follow the heads-up prompts.

Prompt	User Action
Locate Superelevation	Select a previously created superelevation lane that has superelevation calculations already assigned.
Distance Constraint Type	None = Distance Offset = Vector Slope =
Slope Constraint Type	None = Cross Slope = Mirror Cross Slope = Match Cross Slope = Vector Slope =
Pivot About	Identifies which edge to pivot about.

Transition Type	<p>Optional - Type of superelevation transition at this station and cross slope. Possible values include:</p> <p>L = Linear  PC = Parabolic Curve  PRC = Parabolic Reverse Curve  BRC = Biquadratic Reverse Curve  CRC = Cubic Reverse Curve  SRC = Symmetrical Reverse Curve</p>
Station	<p>Required - Station where cross slope is defined.</p> <p>Station equations supported based on the section's reference alignment and the Design File Settings &gt; Civil Formatting &gt; Station Settings &gt; Equation setting.</p>
Cross Slope	<p>Required – Cross slope at the specified station formatted as a double value (-2% = -0.02).</p>
Point Type	<p>Optional – Type of superelevation point at this station and cross slope. Possible values include:</p> <p>NC = Normal Crown  NCIN = Normal Crown Inside  NCOUT = Normal Crown Outside  LC = Level Crown  LCIN = Level Crown Inside  LCOUT = Level Crown Outside  RC = Reverse Crown  RCIN = Reverse Crown Inside  RCOUT = Reverse Crown Outside  FS = Full Super  FSIN = Full Super Inside  FSOUT = Full Super Outside  U = Undefined</p>
Locate Reference Element	<p>Select the Civil horizontal element to be used as a basis for superelevation lanes and calculations.</p>
Start Station	<p>Graphically define (based on the dashed line perpendicular to the reference element) the beginning of the section. The station can be keyed in and locked.</p>

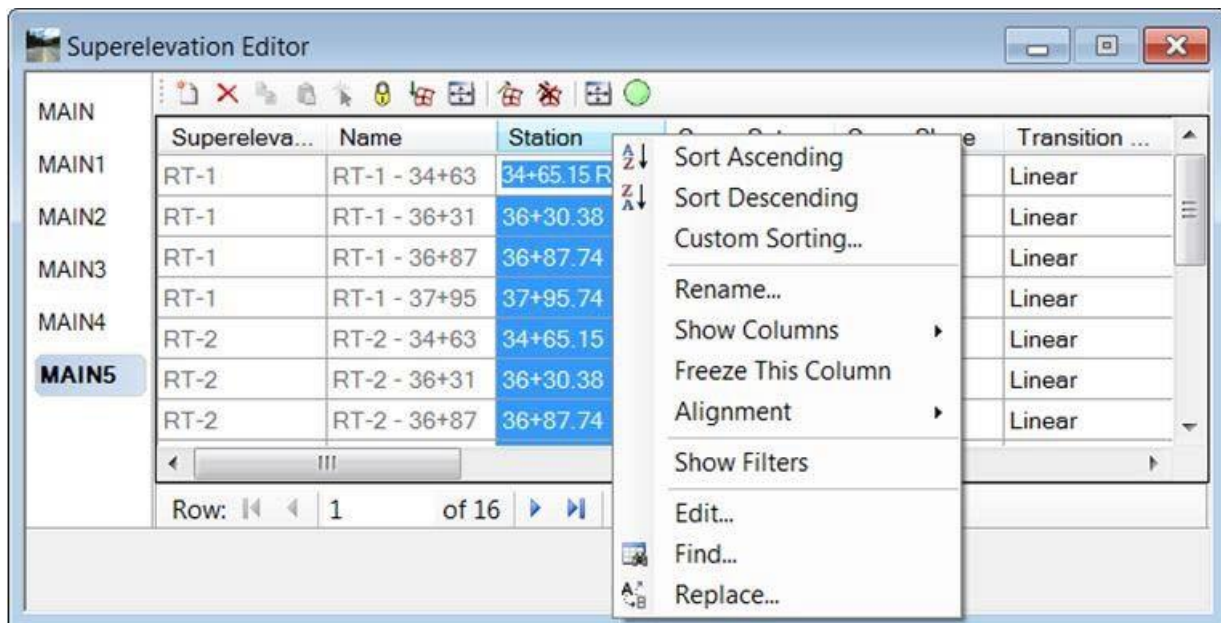
**Superelevation Editor**

The superelevation editor is another way to edit the data, in a tabular format. Any changes made in the editor are automatically synced with the graphic lanes and vice versa. Any data in gray cannot be edited, due to constraints used during calculations with the XML method.



The editor is opened by selecting the tool, then selecting the superelevation section(s). The curve sets are listed along the left side. Highlighting any curve set populates the table. Colored points indicate:

- **Red** - fully constrained
- **Yellow** - partially constrained
- **Green** - not constrained



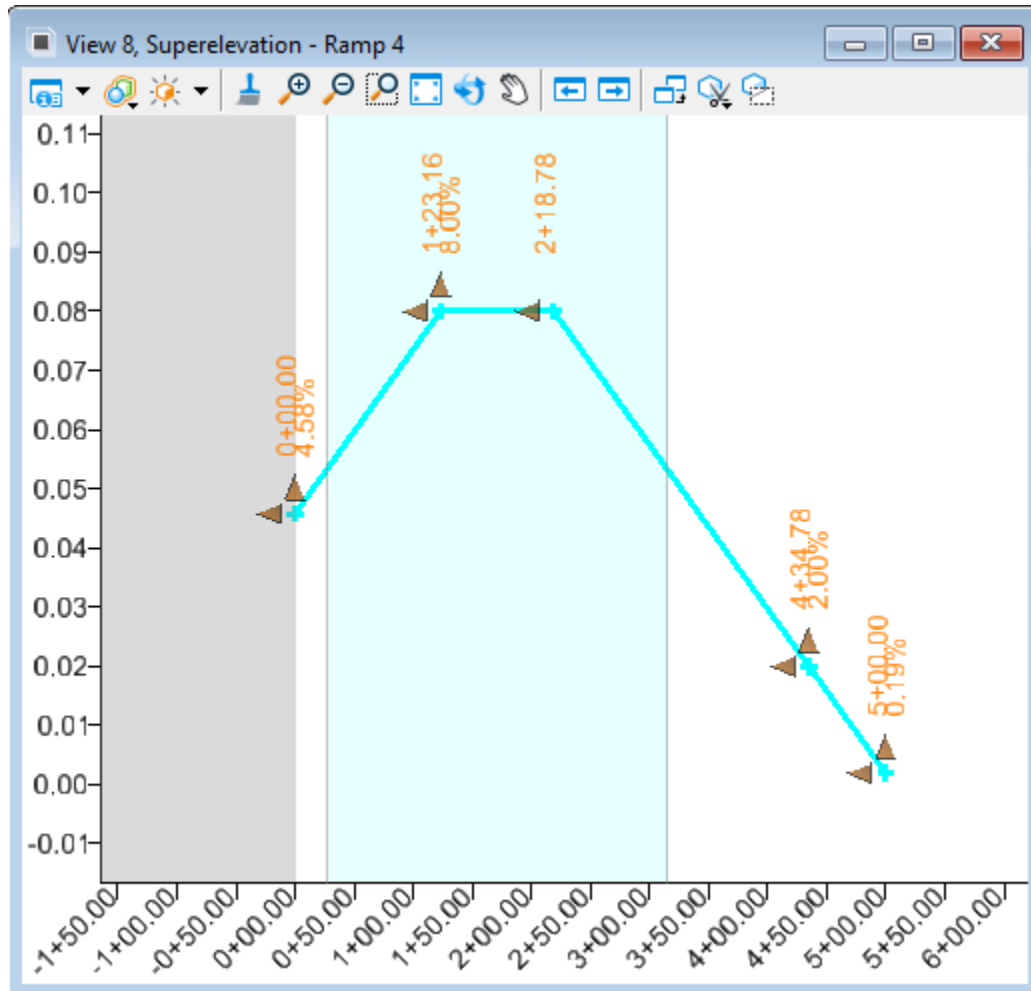
Between the diagram and the table are numerous short-cut icons to the superelevation tools. The superelevation diagram at the top is display only. Right click on the superelevation diagram to display the Superelevation Display List dialog.

The fields in the editor can be customized so unused or unwanted fields can be hidden. This is accomplished by right-clicking on any Header in the tabular data area to open the pop-up menu.



**Open Superelevation View**

Opens the editable superelevation diagram directly in a MicroStation view or Model. Certain points in the view may be edited directly in this Superelevation Model.



**Superelevation Report**

Superelevation reports can be generated for a single or multiple sections. Reports are displayed in the Civil Report browser.

**Workflow**

1. Select **Superelevation Report**.
2. Follow the heads-up prompts.

Prompt	User Action
<b>Name</b>	Name each section, suggestions include alignment name which can be appended -1, 2, etc. for projects with multiple sections.
<b>Locate Reference Element</b>	Select the Civil horizontal element to be used as a basis for superelevation lanes and calculations.
<b>Start Station</b>	Graphically define (based on the dashed line perpendicular to the reference element) the beginning of the section. The Station can also be keyed in and locked.

Superelevation Cross Slope Report

Report Created: Thursday, April 2, 2020  
Time: 3:36:07 PM

File Name:

Input Grid Factor:

Note: All units in this report are in feet unless specified

Section Name:

Ramp 4-1

Base Horizontal Name:

Ramp 4

Standards Filename:

c:\users\vollek\pwise\_local\_electronic\_plans\d0327990\MoDOT.xml

Design Speed:

50

Pivot Method:

Inside Edge

E Selection:

8%

L Selection:

MoDOT - AASHTO 2011 Eq. 3-23 and Table 3-16

Superelevation: Ramp 4

Station	Width	Drop/Rise	Cross Slope
0+00.00	18.0000	0.8242	0.046
1+23.16	18.0000	1.4400	0.080
2+18.78	18.0000	1.4400	0.080
4+34.78	18.0000	0.3600	0.020
5+06.78	18.0000	0.0000	0.000
5+78.78	18.0000	-0.3600	-0.020
11+17.90	18.0000	-0.3600	-0.020
13+54.21	18.0000	-0.3600	-0.020

## Superelevation by Corridor

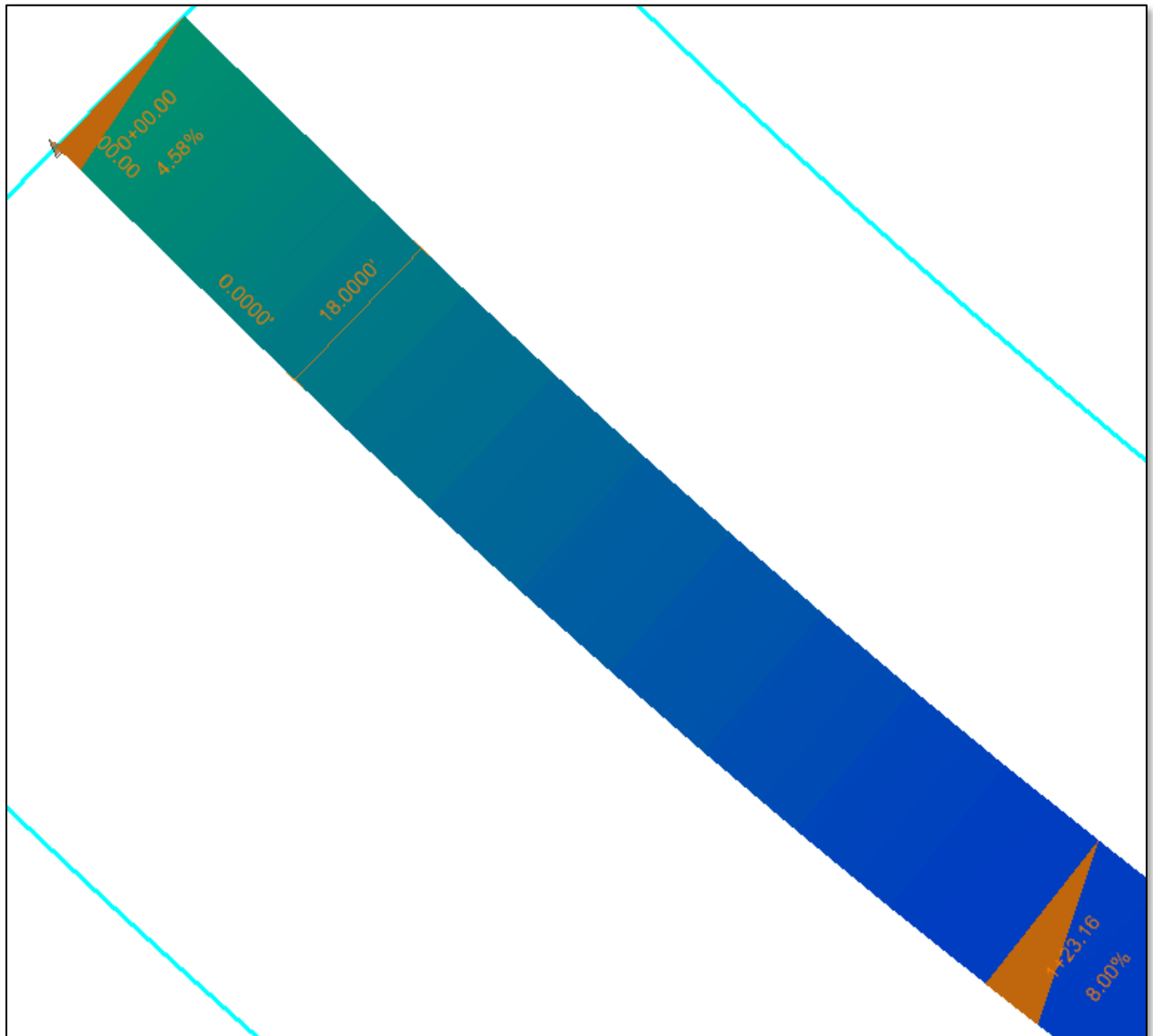


In OpenRoads Designer, the ability to choose the corridor instead of an alignment. This will use the template(s) used in the corridor to create sections, create lanes, calculate superelevation and assign those calculations to the corridor. This is by far the easiest way to create superelevation. The steps require the superelevation be placed in the same DGN file as the corridor.

2. Under *Corridors > Superelevation > Create* choose **Create Superelevation Sections**
  - a) Name the Superelevation
  - b) Locate the Corridor – select the corridor
3. Choose the Rules File (XML) **MoDOT\_Superelevation\_Rules\_File.xml**
4. Key-in the Minimum Tangent Length
  - a. For MoDOT projects this is typically a a large value so that only on Section is created for the entire alignment.
  - b. When you have only one section, the User will apply a Design Speed for the entire alignment/section.
  - c. If the User needs to have different Design Speeds throughout an alignment, the User will need to create a sperate Superelevation Section for each area with a different Design Speed.
5. Left-click to allow the tool to run. This will create and apply superelevation to the corridor

**Editing Lanes**

There are several ways to review the superelevation data and edit if desired. Highlighting a section displays station and cross slope values for review and editing. Stationing can be changed dynamically by selecting the gray wedge and dragging to the desired station. Each lane can be manipulated independently of the adjacent lanes. The station can all be keyed into the edit field. Slopes can be changed by keying the slope into the edit field.

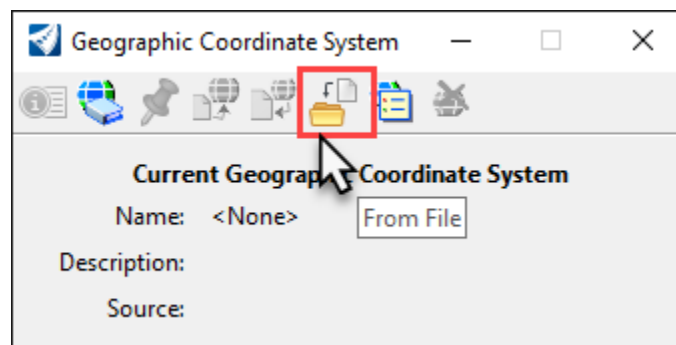


## 6.9 Group Exercise – Ramp 4 Superelevation

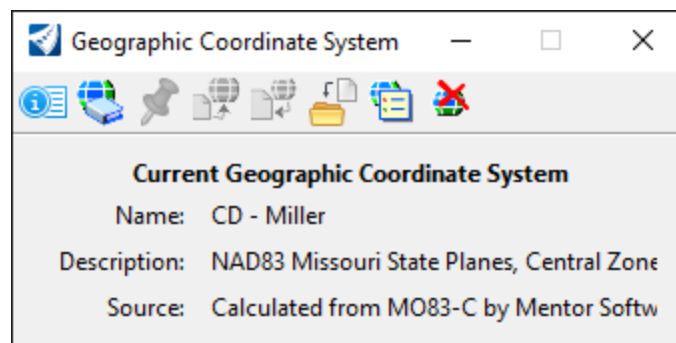
1. Within the **Roadway\data-6** folder, open the file: **Corridors\_Ramp-4\_J5P3181.dgn**
2. Create a new file named **Superelevation\_J5P3181.dgn** using the **MoDOT\_Roadway\_Seed\_2D.dgn** seed file.

This new file will hold all of the Superelevation sections.

3. Open the **Coordinate System** tool by selecting the **OpenRoads Modeling Workflow → Utilities Tab → Geographic Section**.
4. Select “**From File**” icon.



5. Select the **Terrain\_J5P3181.dgn** file in the **data-6** folder.
6. Verify the settings.



7. Reference in the following file:  
**Civil\_Geometry\_J5P3181.dgn.**
8. Change the **Annotation Scale** to **1”=50’**

**Create Superelevation Sections**

9. To Start creating the Superelevation for **Ramp 4** select the following:

**Open Roads Modeling Workflow → Corridors Tab → Superelevation Section → Create Tools → Create Superelevation Sections**

- a. Set the Feature Definition to **Superelevation**
- b. When prompted for the **Name** key in **Ramp 4** and **data point** or **tab** to accept.
- c. When prompted to **Locate Reference Element** data point on the **Ramp 4** horizontal geometry.
- d. When prompted to enter the **Start Station** either select the beginning of Road or press the **Alt** key to lock to the beginning station. **Data point** to accept.
- e. When prompted to enter the **End Station** either select the end of Road or press **Alt** to lock to the ending station. **Data point** to accept.
- f. There are two horizontal curves in the Ramp 4 alignment. Since MoDOT uses the same Design Speed for the entire alignment, the User will enter a value longer than the distance between the two curves for the **Minimum Tangent Length** (for example: 10000 ft) so that the tool just creates a single superelevation section. **Data point** to accept.

**Note:** If the geometry had multiple curves with different design speeds, then the User would use a smaller Transition Length to create multiple Superelevation Sections.

Parameters	
Name	Ramp 4
Lock To Start	<input type="checkbox"/>
<input type="checkbox"/> Start Station	0+00.00
Lock To End	<input type="checkbox"/>
<input type="checkbox"/> End Station	13+54.21
Minimum Tangent Length	1000.0000
Lane Creation Method	Manual

Feature	
Feature Definition	Superelevation
Name	Ramp 4

**Create Superelevation Lane(s)**

10. After creating the Superelevation Section, the Superelevation tool will now prompt you to create the Superelevation Lane(s)
  - a. Enter the Lane name: **0 to 6FT**
  - b. Enter Lane Type: **Primary**
  - c. Side of Centerline: **Left**
  - d. Inside Edge Offset: **0'**
  - e. Width: **6'** (The template width of Ramp 4 is 18ft, 18ft - 12ft = 6ft )
  - f. Normal Cross Slope: **2%** (sloping UP from the baseline)
  - g. Enter the Lane name: **6 to 18FT**
  - h. Enter Lane Type: **Primary**
  - i. Side of Centerline: **Left**
  - j. Inside Edge Offset: **6'**
  - k. Width: **12'** (typically AASHTO defines the width of one lane of pavement as 12')
  - l. Normal Cross Slope: **2%** (sloping UP from the baseline)
  - m. **Right Click** to exit from the Lane Creation.

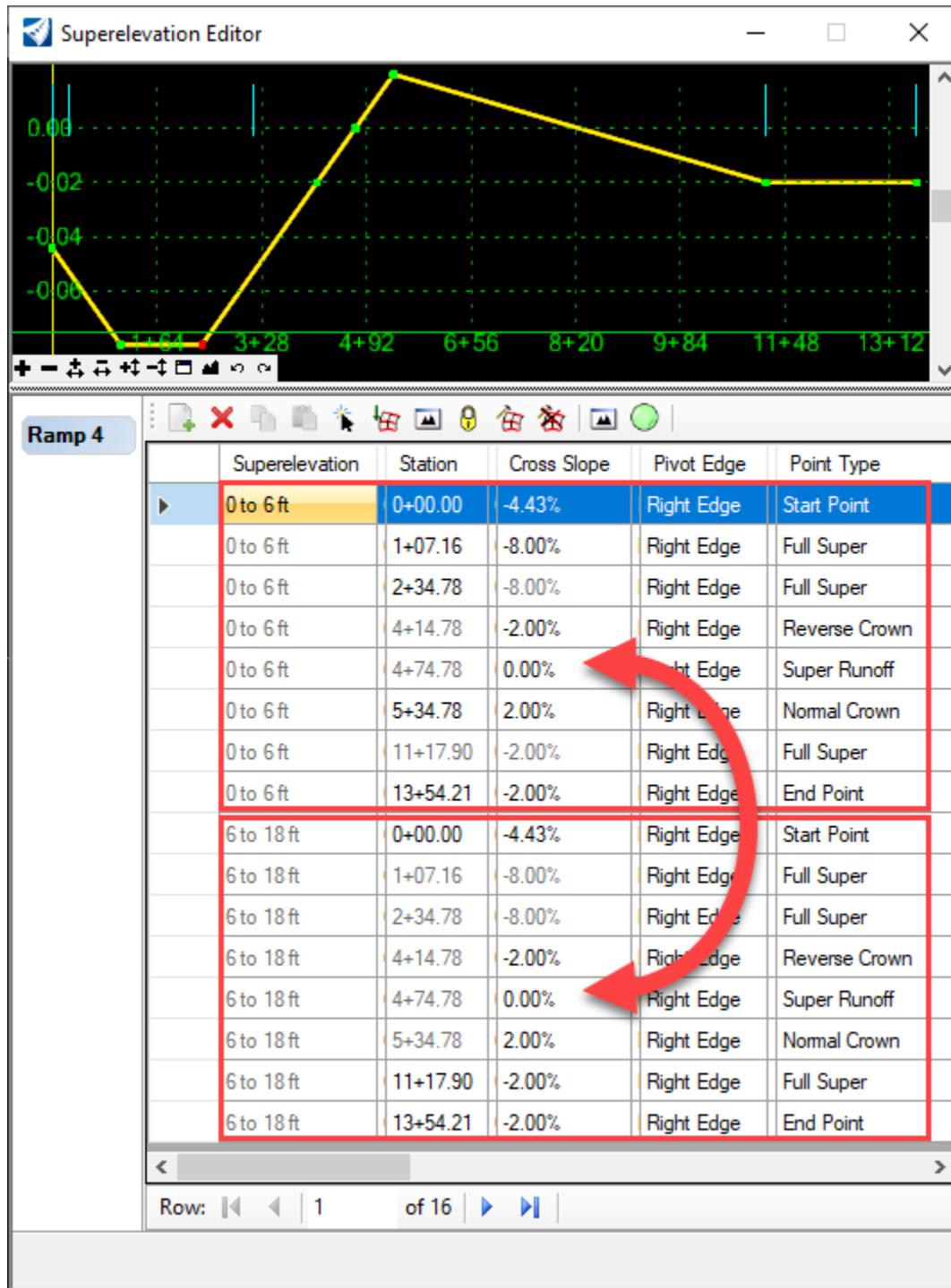
- Notes:**
- There is a Superelevation concept called “**Number of Lanes Rotated**”, which will adjust the Runoff distance **UP** if the **Number of Lanes Rotated** is greater than one. See AASHTO 2018 Table 3-16a.
  - AASHTO typically consider a “**Full-Lane**” being **12ft wide**.
    - MoDOT uses a hard coded Nominal Lane Width = 12 ft in its Superelevation Rules File. If MoDOT did not hard code the Nominal Lane Width, OpenRoads Designer would use the width of the outermost lane as the lane width in its Superelevation calculations.
    - Lane widths greater than **0ft** and up to **6ft**, will be considered a “**Half-Lane**”, as defined in the MoDOT’s Superelevation Rules File.
    - Lane widths is greater than **6ft**, will be considered a “**Full-Lane**”, as defined in the MoDOT’s Superelevation Rules File.
  - The program looks at the lanes to determine the number of lanes rotated. The lanes also assist the “Assign to Corridor” to match the super control lines with the points in the template that they should control.
  - There are two types of superelevation lanes. **Primary lanes** extend the entire length of a section. They begin and end stations are defined by the section. Primary lanes are generally the through lanes that extend throughout the project. **Auxiliary lanes** are lanes that are added and dropped along the alignment such as turn lanes.

**Calculate Superelevation**

11. After Right Clicking the Superelevation tool will now prompt the User for the settings to calculate the Superelevation for this alignment.
- a. Select Rules File: **MoDOT\_Superelevation\_Rules\_File.xml**
  - b. e Selection: **8%** (since this is a rural project MoDOT uses 8% for and e Max)
  - c. L Selection: **MoDOT - AASHTO 2018 Eq. 3-23 and Table 3-16**
  - d. Design Speed: **50mph**
  - e. Pivot: **Right Edge** The Superelevation tool will utilize the lane width and the pivot method to determine the adjusted radius distance to calculate the Runoff distance.
  - f. Open Editor: **Yes**



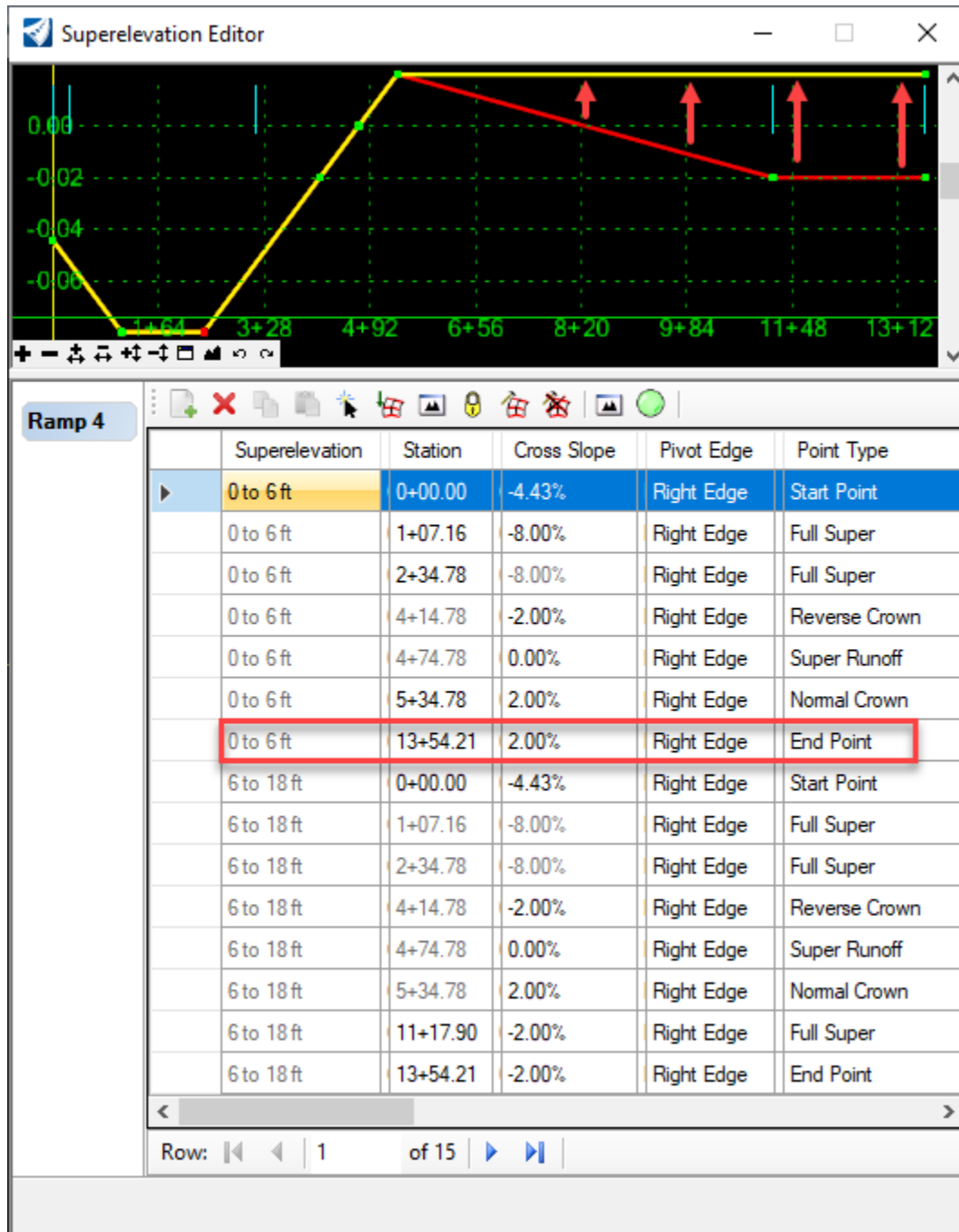
12. Below is what the User will get when the **Editor** option is selected:



- a. The User might notice that the two superelevation lanes have the same values. There are two lines in the diagram representing each lane, but since they have the same values they are directly on top of each other.

13. To demonstrate that the Superelevation “Profile” can be modified using the **Superelevation Editor** adjust following two items of only the **0 to 6 ft Superelevation “Profile” Line**.

- Delete the entire row with the Station **11+17.90** in the lane **0 to 6 ft**
- Adjust Station **13+54.21** to have a positive **2.00%** slope



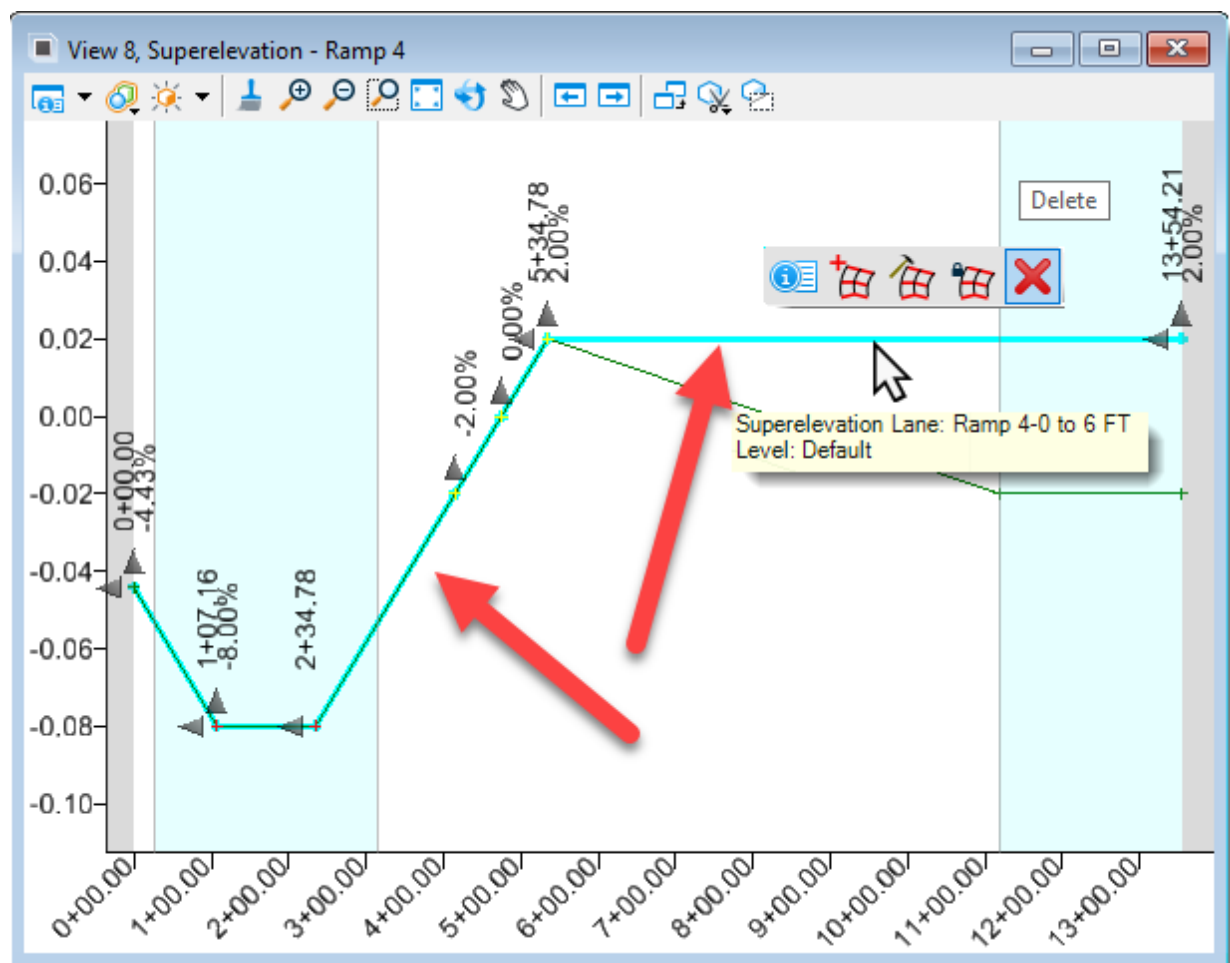
- Close the Superelevation Editor.

**Open Superelevation View**

14. Open the superelevation view for **Ramp 4** by select the following:

**Open Roads Modeling Workflow → Corridors Tab → Superelevation Tools → Open Superelevation View**

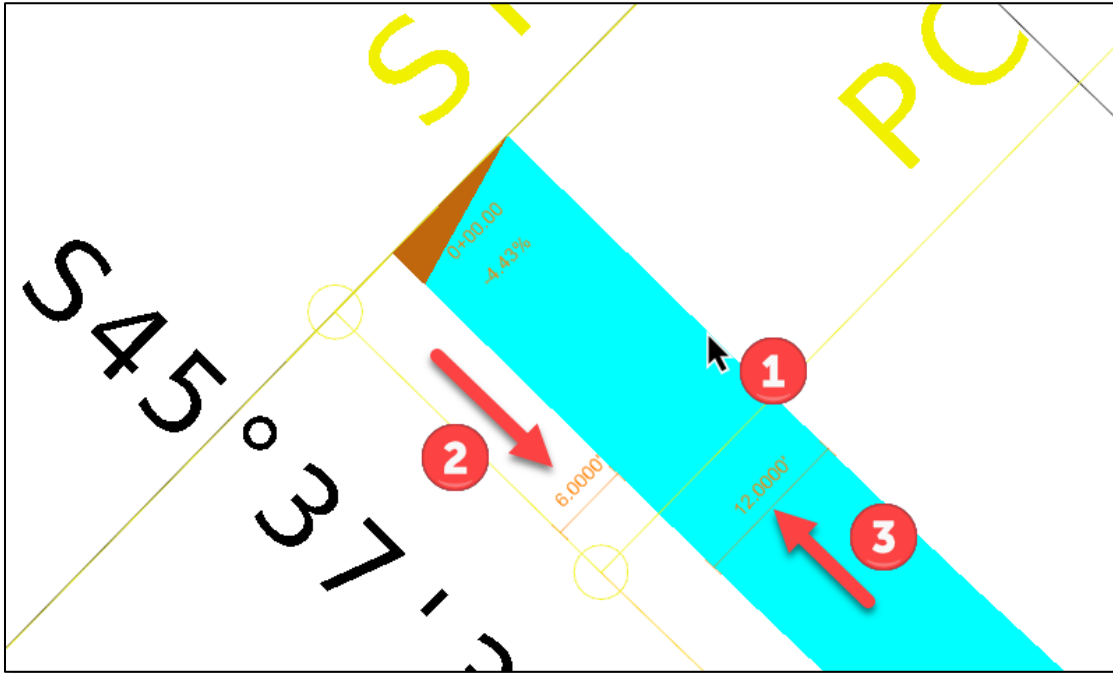
- After enabling the **Open Superelevation View** tool and choosing the **Ramp 4** Superelevation Section, select **View 8** to display the Superelevation “Profile”.
- Select the **F8** key to change your background from black to white.



15. To demonstrate that the Superelevation “Profile” can be modified within the **Superelevation View**, delete the **0 to 6 ft Superelevation “Profile” Line** by left clicking and using the heads-up tools select **Delete**.

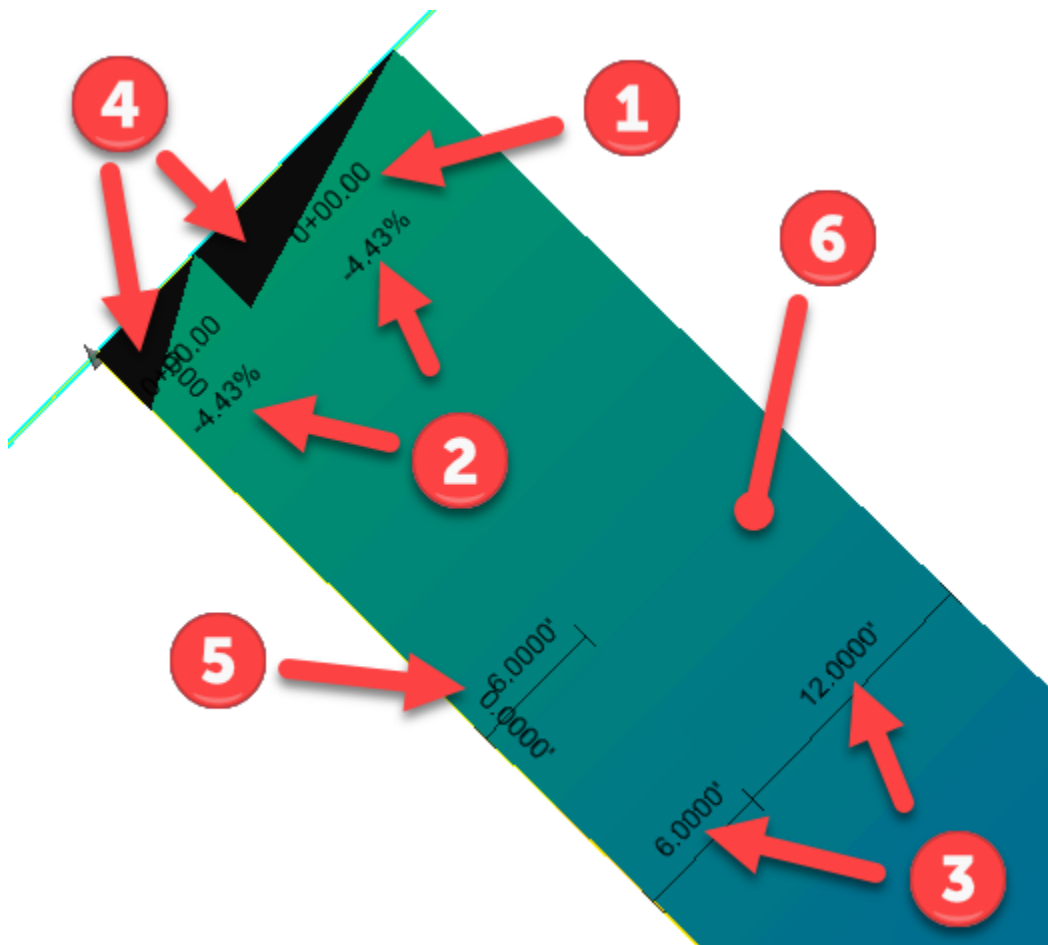
**Close** the Superelevation View.

16. Select the **F8** key to change your background from White to Black.
17. Next, in the **6 to 18FT Lane** adjust the Inside Edge Offset from **6 ft to 0 ft (Zero)**, then adjust the **Lane Width** to **18 ft**. To do this left click on the Lane Shape itself and bring up the heads-up values (see below).

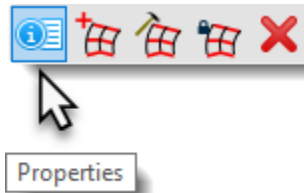


18. The User should note that the Superelevation Shape in the dgn has adjusted to every change made in the last few steps. All the changes could have been made by clicking on the Superelevation Section and modifying the heads-up Superelevation Shape settings.

- 1 The station value of the slope can be adjusted by selecting these values.
- 2 Slope values can be adjusted selecting these values.
- 3 Lanes width can be adjusted by selecting these values.
- 4 These arrows indicate the direction of superelevation slope.
- 5 These values show the inside edge offsets to the lanes.
- 6 By left clicking on the shape you can bring the heads-up tools



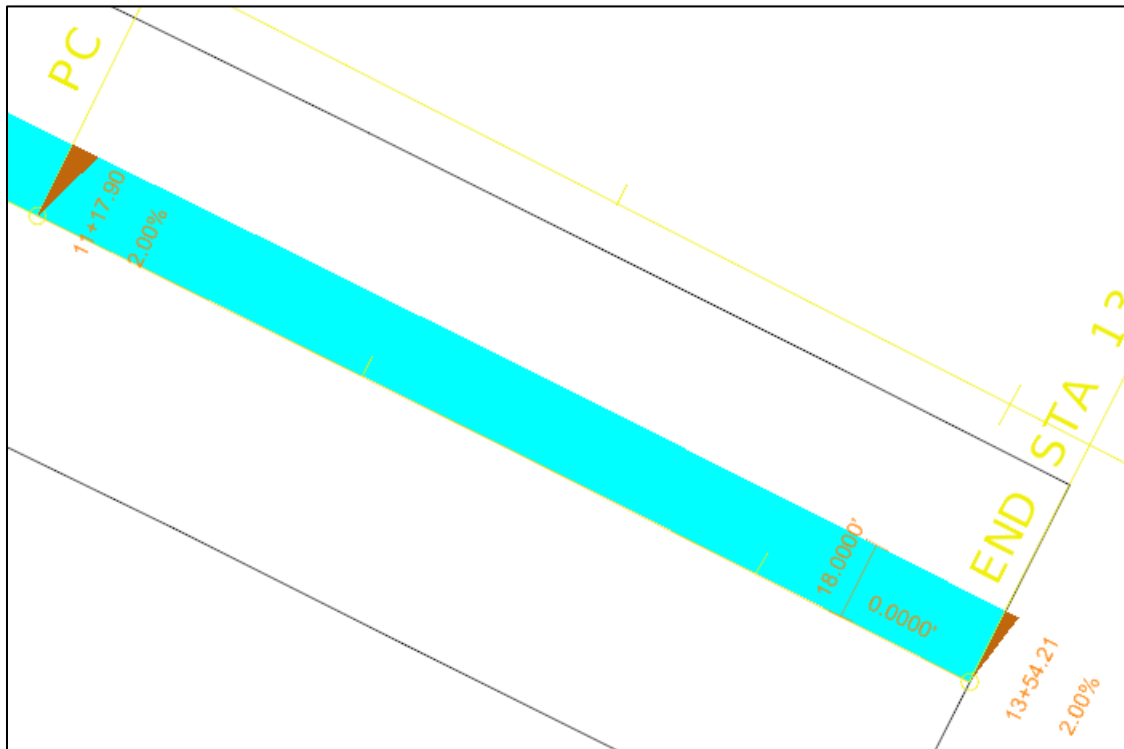
19. Select the Superelevation Shape and using the heads-up tools adjust the Shapes Name to “0to 18ft”.



Name	0 to 18 ft
Side Of Centerline	Left
Inside Edge Offset	0.0000'
Width	18.0000'
Normal Cross Slope	2.00%
Type	Primary

20. To match the slope of the Route 54 pavement at the end of the Ramp 4, select the Superelevation Shape and verify the slopes of the shape at the following two stations.

<u>Station</u>	<u>Slope</u>
11+17.90	2.00% (Sloping toward the Ramp4 baseline)
13+54.21	2.00% (Sloping toward the Ramp4 baseline)



**Assign Superelevation to Corridor**

21. Next, we need to apply the Superelevation to the **Ramp 4** Corridor. Open the **Corridors\_Ramp-4\_J5P3181.dgn** file. Check in the **Superelevation\_J5P3181.dgn** file when prompted.
22. Reference in the **Superelevation\_J5P3181.dgn** file.
23. To apply the Superelevation, select the following:

**Open Roads Modeling Workflow → Corridors Tab → Superelevation Tools → Calculate Tools → Assign to Corridor**

24. When prompted to **Locate First Superelevation Section** left click on the **Ramp 4** Superelevation Section.
  - a. Since there is only one section for **Ramp 4**, when prompted, **Reset** to Complete.
25. When prompted to **Locate Corridor**, identify one of the **Ramp 4** corridor handles. These extend from the outside edge of the corridor.
26. A dialog with a list of the Superelevation objects will display. Review to verify. If changes to Stations, priorities, or points are required, they can be made here. If correct click **OK**.

**Associate Superelevation**

	Superelevation Lane	Superelevation Point	Pivot Point	Start Station	Stop Station	Priority
▶	0 to 18 ft ▼	LT_Conc_T_EOP ▼	Conc_T_CL ▼	0+00.00	13+54.21	1
*	▼	▼	▼			

OK Cancel

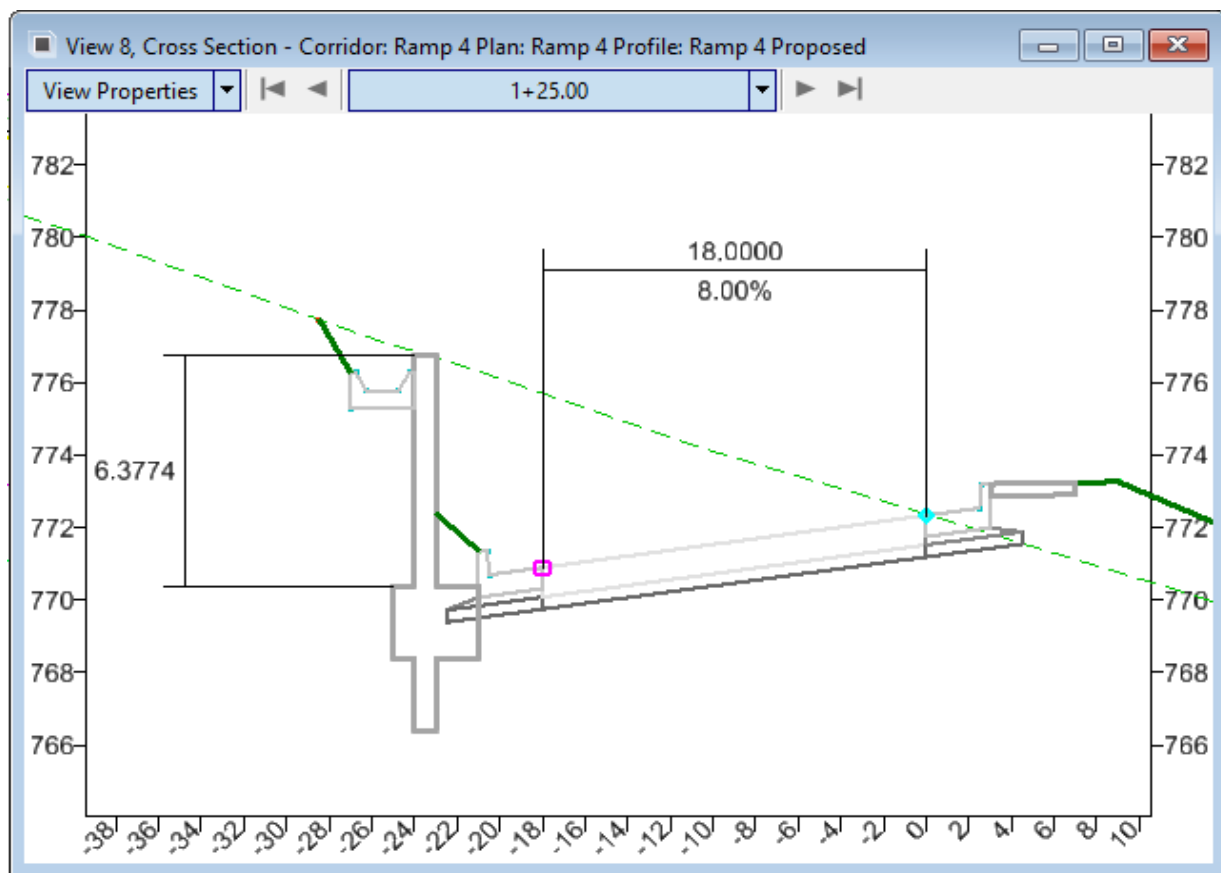
- a. Select **“F4”** to exit the tool.
27. Next in the Reference Dialog turn off the display of the **Superelevation\_J5P3181.dgn** for **View 1**.

**Open Cross Section View**

28. Open the dynamic **Cross Section Dynamic** View for **Ramp 4** by select the following:

**Open Roads Modeling Workflow → Corridors → Review Tab → Dynamic Sections → Open Cross Section View**

- (a) After enabling the **Open Cross Section View** tool and choosing the **Ramp 4** corridor, select **View 8** to display the Dynamic Cross Sections.
- (b) While navigating from section to section
- (c) Right-Click and hold in a blank area to bring up the heads-up tools.
  1. Place a **Horizontal** Temporary Dimension Line
  2. Place a **Vertical** Temporary Dimension Line.
- (d) Use the Locate Station Via Datapoint
- (e) **Remove All** Temporary Dimension Lines



29. Close **View 8**

30. Select **File > Update Server Copy**



## 6.10 Individual Exercise – Route 54 Superelevation

1. Within the **Roadway\data-6** folder, open the file: **Superelevation\_J5P3181.dgn**

Verify that the active template library is the project's **J5p3181.itl**. If needed use the Create Template tool to activate template library.

### Create Superelevation Sections



2. To Start creating the Superelevation for **Route 54** select the following:

**OpenRoads Modeling Workflow → Corridors Tab → Superelevation Section → Create Tools → Create Superelevation Sections**

- a. Set the Feature Definition to **Superelevation**
- b. When prompted for the **Name** key in **Route 54** and **data point** or **tab** to accept.
- c. When prompted to **Locate Reference Element** data point on the **Route 54** horizontal geometry.
- d. When prompted to enter the **Start Station** either select the beginning of Road or press the **Alt** key to lock to the beginning station. **Data point** to accept.
- e. When prompted to enter the **End Station** either select the end of Road or press **Alt** to lock to the ending station. **Data point** to accept.
- f. When prompted to enter the **Transition Length** enter **1000 ft**
- g. When prompted to enter the **Lane Creation Method** enter **Template**

**Note:** Since **Route 54** only has one curve in the alignment, no matter what you type in for a transition length only one Superelevation section will be created.

**Create Superelevation**

**Parameters**

Name: Route 54

Minimum Tangent Length: 1000.0000

Lane Creation Method: Template

**Feature**

Feature Definition: Superelevation

Name: SE - Route 54

3. Select **"F4"** or **right click** to get out of the tool.

**Create Superelevation**

**Parameters**

Name: Route 54

Lock To Start: ☐

☐ Start Station: 602+59.49

Lock To End: ☐

☐ End Station: A 647+66.54

Minimum Tangent Length: 1000.0000

Lane Creation Method: Template

**Feature**

Feature Definition: Superelevation

Name: SE-Route 54

### Create Superelevation Lane(s) by Road Template



4. Create the Superelevation lanes for **Route 54** using the following tool:

Open Roads Modeling Workflow → Corridors Tab → Superelevation Tools → Create Tools → **Create Superelevation Lanes by Road Template**

5. After activating the tool do the following:
- Select the **Route 54** Superelevation Section, this is the only section for the alignment.
  - Select the following template:

**Route 54\Route 54 Concrete Pavement 4 Lane Divided w/ Agg Base Option 3**

### Calculate Superelevation



6. Calculate the **Route 54** superelevation using the following tool:

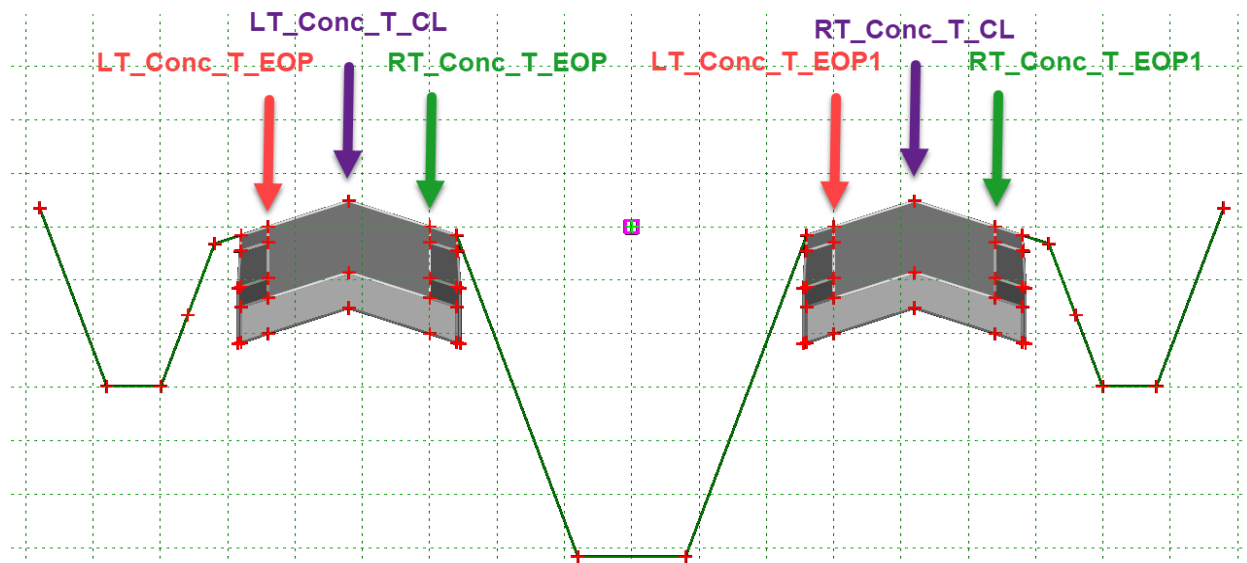
Open Roads Modeling Workflow → Corridors Tab → Superelevation Tools → Calculate Tools → **Calculate Superelevation**

7. After activating the tool select the following:
- Select Rules File: **MoDOT\_Superelevation\_Rules\_File.xml**
  - e Selection: **8%** (since this is a rural project MoDOT uses 8% for and e Max)
  - L Selection: **MoDOT - AASHTO 2018 Eq. 3-23 and Table 3-16**
  - Design Speed: **70mph** (to get 70mph to show up in the pull-down list you might have to switch the e Selection from 8% to 4% and then back to 8%).
  - Pivot: **Divided Inside** - The Superelevation tool will utilize the lane width and the pivot method to determine the adjusted radius distance to calculate the Runoff Lengths.
  - Open Editor: **Yes**

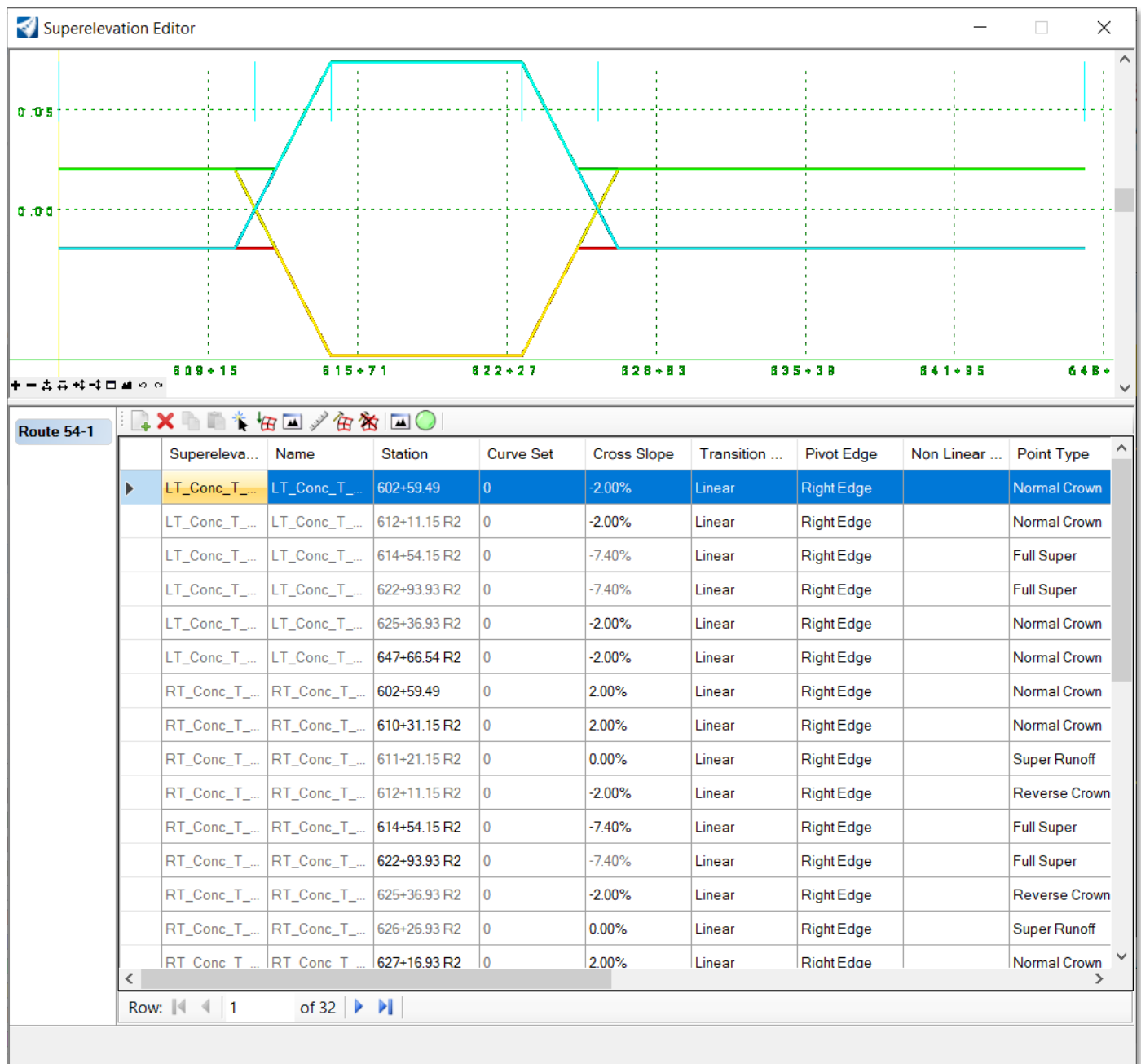
The screenshot shows the 'Calculate Superelevation' dialog box with the following parameters:

Parameters	
Rules File Name	c:\Spaces\MoDOT\Standards\Superelevation\MoDOT_Superelevation_Rules_File.xml
e Selection	8%
L Selection	MoDOT - AASHTO 2018 Eq. 3-23 and Table 3-16a
Design Speed	70
Pivot Method	Divided Inside
Open Editor	<input checked="" type="checkbox"/>

- There is a Superelevation concept called “**Number of Lanes Rotated**”, which will adjust the Runoff distance **UP** if the **Number of Lanes Rotated** is greater than one. See AASHTO 2018 Table 3-16a.
- AASHTO typically consider a “**Full-Lane**” being **12ft wide**.
  - MoDOT uses a hard coded Nominal Lane Width = 12 ft in its Superelevation Rules File. If MoDOT did not hard code the Nominal Lane Width, OpenRoads Designer would use the width of the outermost lane as the lane width in its Superelevation calculations.
  - Lane widths greater than **0ft** and up to **6ft**, will be considered a “**Half-Lane**”, as defined in the MoDOT’s Superelevation Rules File.
  - Lane width is greater than **6ft**, and up to **12ft** will be considered a “**Full-Lane**”, as defined in the MoDOT’s Superelevation Rules File.
- The program looks at the lanes to determine the number of lanes rotated. The lanes also assist the “Assign to Corridor” to match the super control lines with the points in the template that they should control.
- There are two types of superelevation lanes. **Primary lanes** extend the entire length of a section. They begin and end stations are defined by the section. Primary lanes are generally the through lanes that extend throughout the project. **Auxiliary lanes** are lanes that are added and dropped along the alignment such as turn lanes.
- The User needs to understand that certain constraints of points in the template will be overridden with a **Point Control** when Superelevation is applied to the template. The reason points are available to be overridden is because within their **Template Point Properties** the **Superelevation Flag** option is enabled. Please review the template points below that are available to the Superelevation tool:



8. Below is what the User will get when the **Editor** option is selected:

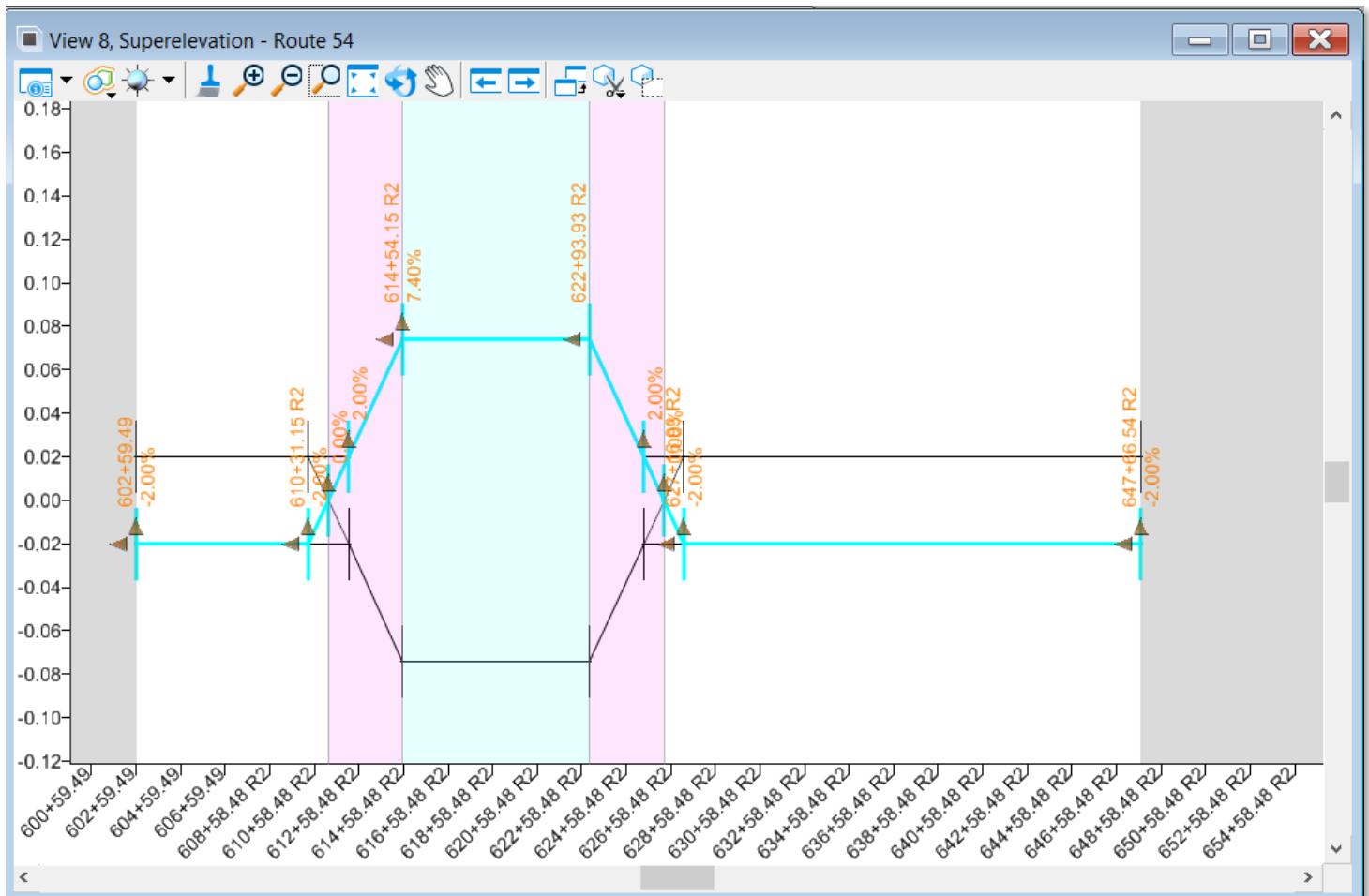


a. **Close** the Superelevation Editor.

**Open Superelevation View**

9. Open the superelevation view for **Route 54** by select the following:

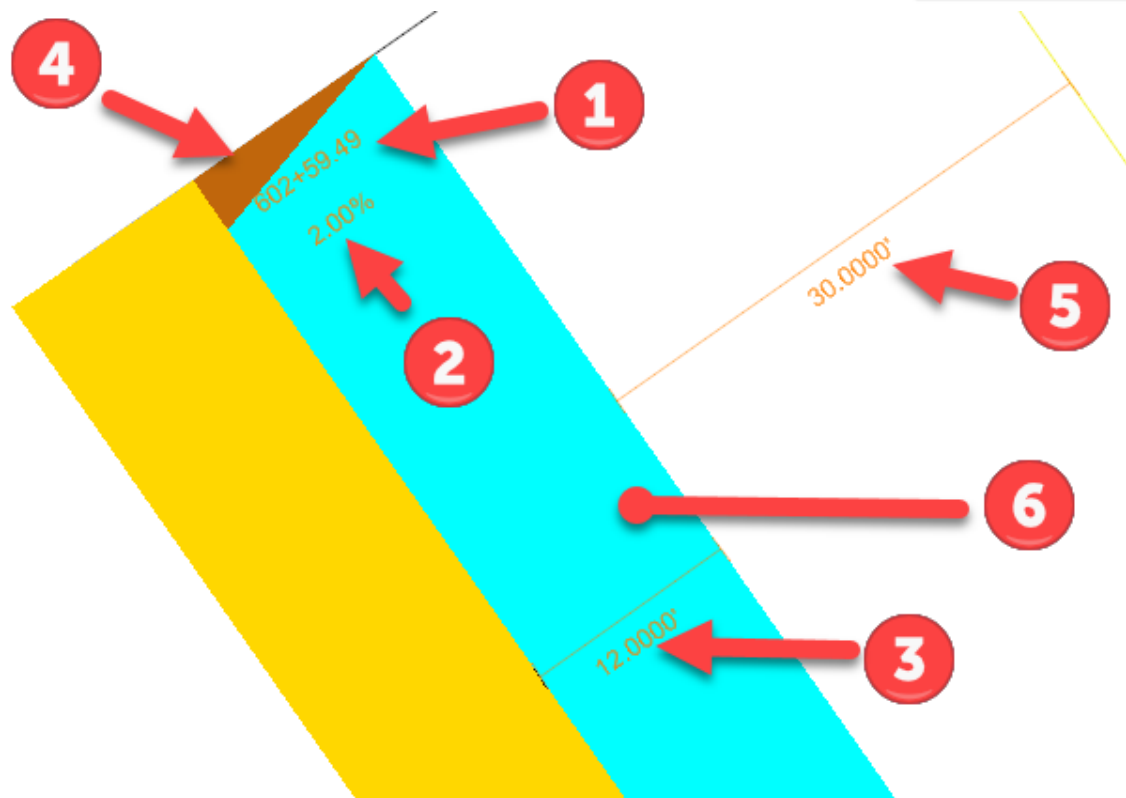
**Open Roads Modeling Workflow → Corridors Tab → Superelevation Section →  
Open Superelevation View**



- a. **Review** the Superelevation View, then close view.

10. The User should note that changes to the Superelevation can be made by clicking on the Superelevation Section and modifying the heads-up Superelevation Shape settings.

- 1 The station value of the slope can be adjusted by selecting these values.
- 2 Slope values can be adjusted selecting these values.
- 3 Lane width can be adjusted by selecting these values.
- 4 These arrows indicate the direction of superelevation slope.
- 5 These values show the inside edge offsets to the lanes.
- 6 By left clicking on the shape you can bring the heads-up tools



11. Select the Superelevation Section and verify the slopes at the following locations.

<u>Alignment Location</u>	<u>Station</u>	<u>Slope Section</u>
Tangent to Spiral (TS)	611+21 R2	B-B Section ( <b>Level Crown</b> )
Spiral to Curve (SC)	614+54 R2	D-D Section ( <b>Full Super</b> )
Curve to Spiral (CS)	622+93 R2	D-D Section ( <b>Full Super</b> )
Spiral to Tangent (ST)	626+26 R2	B-B Section ( <b>Level Crown</b> )

**Assign Superelevation to Corridor**

12. Next, we need to apply the Superelevation to the **Route 54** Corridor. Open the **Corridors\_Route-54\_J5P3181.dgn** file. Check in the **Superelevation\_J5P3181.dgn** file when prompted.
13. Reference in the **Superelevation\_J5P3181.dgn** file into the **2-D** View.
14. To apply the Superelevation, select the following:  
**Open Roads Modeling Workflow → Corridors Tab → Superelevation Section → Calculate Tools → Assign to Corridor**
15. When prompted to **Locate First Superelevation Section** left click on the **Route 54** Superelevation Section. **The Section Line is hidden under the Superelevation shape**. The easiest place to select this section line is at the beginning or ending of the alignment.
  - a. Since there is only one section for **Route 54**, when prompted, **Reset** to Complete.
16. When prompted to **Locate Corridor**, identify one of the **Route 54** corridor handles. These extend from the outside edge of the corridor.
17. A dialog with a list of the Superelevation objects will display. Review to verify. If changes to Stations, priorities, or points are required, they can be made here. If correct click **OK**.

Associate Superelevation

	Superelevation Lane	Superelevation Point	Pivot Point	Start Station	Stop Station	Priority
▶	LT_Conc_T_CL - LT_Conc_T_EOP	LT_Conc_T_EOP	LT_Conc_T_CL	602+59.49	647+66.54 R2	1
	RT_Conc_T_EOP - LT_Conc_T_CL	LT_Conc_T_CL	RT_Conc_T_EOP	602+59.49	647+66.54 R2	1
	LT_Conc_T_EOP1 - RT_Conc_T_CL	RT_Conc_T_CL	LT_Conc_T_EOP1	602+59.49	647+66.54 R2	1
	RT_Conc_T_CL - RT_Conc_T_EOP1	RT_Conc_T_EOP1	RT_Conc_T_CL	602+59.49	647+66.54 R2	1
*						

OK Cancel

18. Next in the **Reference Dialog** turn off the display of the **Superelevation\_J5P3181.dgn** for **View 1**.

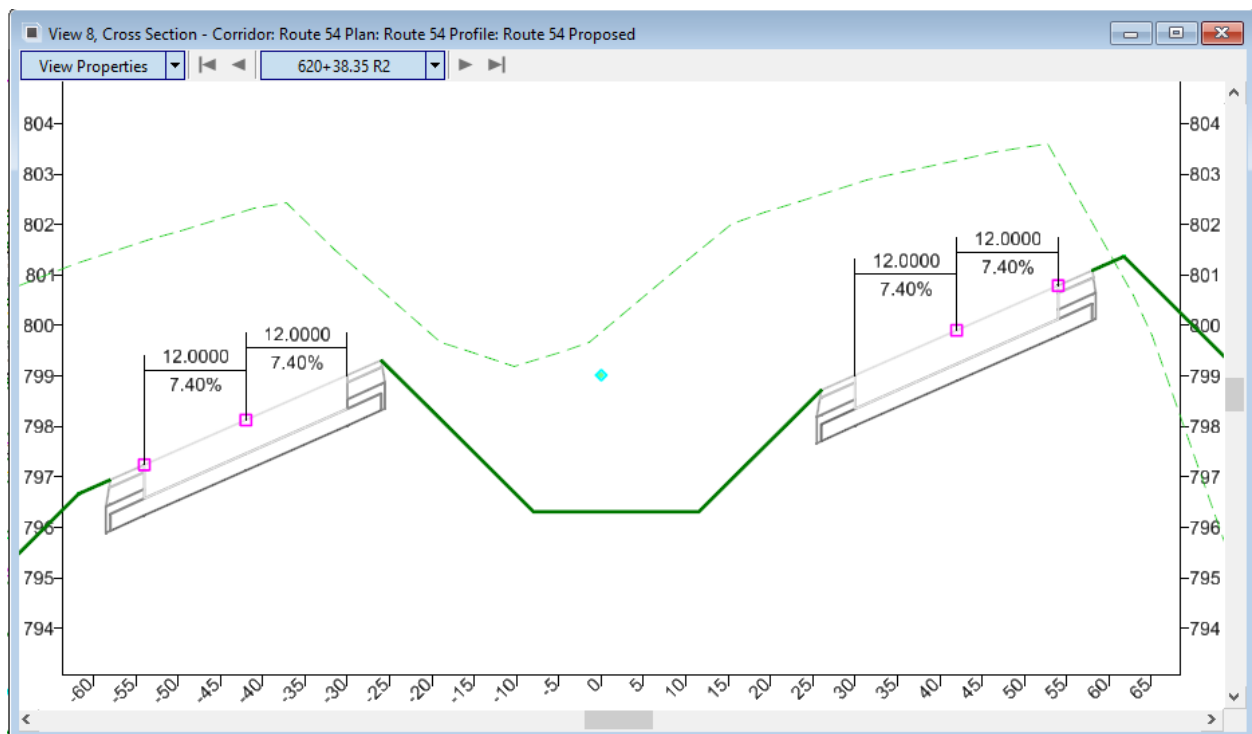
### Open Cross Section View



19. Open the dynamic **Cross Section Dynamic** View for **Route 54** by select the following:

**Open Roads Modeling Workflow → Corridors → Review Tab → Dynamic Sections → Open Cross Section View**

- After enabling the **Open Cross Section View** tool and choosing the **Route 54** corridor, select **View 8** to display the Dynamic Cross Sections.
- While navigating from section to section
- Right-Click and hold in a blank area to bring up the heads-up tools.
  - Place a **Horizontal** Temporary Dimension Line
  - Place a **Vertical** Temporary Dimension Line.
- Use the Locate Station Via Datapoint
- Remove All** Temporary Dimension Lines



20. Close **View 8**

21. Select **File → Update Server Copy**



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## Chapter 7

# Advanced Corridor Modeling

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## 7.1 Objectives

The purpose of this chapter is to show the user how to use the multiple tools available in Corridor Modeling task group to achieve desired results for the design of the corridor.

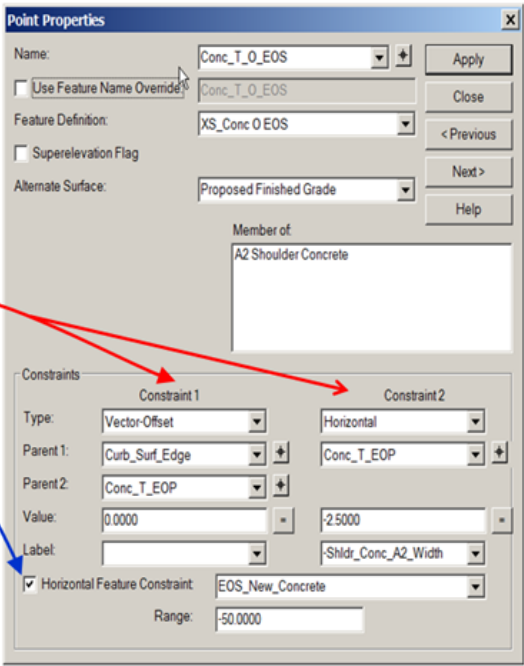
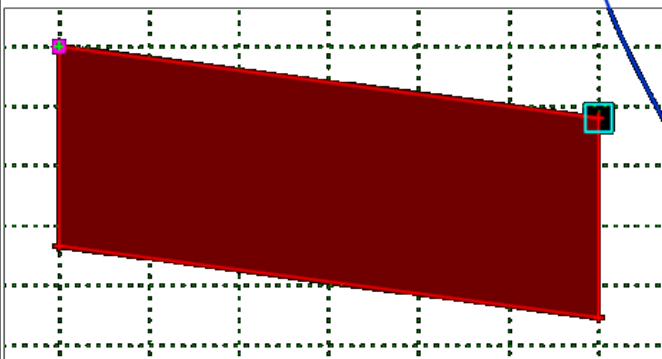
- Template Drop Editing
- Point Controls
- Parametric Constraints
- Corridor References (Feature Constraints)
- Transitioning (components and end conditions)
- Target Aliasing
- Corridor Clipping

Learn about the Hierarchy of control for points in templates

## 7.2 Template Point – Hierarchy of Control

### Template Point - Hierarchy of Control

- Point Control - **Highest**
- Feature Constraint
- Parametric Constraint
- Point Constraint - **Lowest**



The diagram illustrates the hierarchy of control for a template point. A red trapezoidal area is shown on a grid, with a point control icon at the top right corner. The Point Properties dialog box is shown, detailing the point's name, feature definition, alternate surface, and constraints. The constraints section shows two constraints: Constraint 1 (Vector-Offset) and Constraint 2 (Horizontal). The Horizontal Feature Constraint is checked, indicating the lowest level of control.

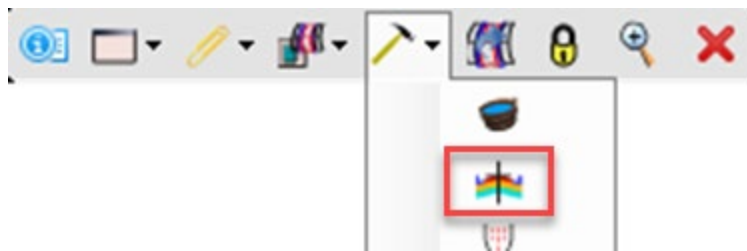
## 7.3 Template Drop Editing

### Create Template Drop



Using the Create Template Drop tool defines what the cross sections of the roadway look like for that portion of the road based on user-defined station range. A project may comprise a single template drop, or multiple template drops.

The tool can be used for either adding on more template drops or completely replacing a station range with a different template.

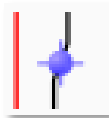


### Template Editor

In order to use tools such as Parametric Constraints, Corridor References, or having end conditions seek something other than the active surface, certain requirements need to be met in the template.

Points in a template need to meet certain requirements for Parametric Constraints and Corridor References

## 7.4 Template Point Controls



Point controls are used to override the established horizontal and vertical locations of points from the original point location on the template. Point controls are the equivalent of the criteria adhoc placed on plan graphics with D&C Manager to control widths, ditch slopes, etc. Point controls then are used to control horizontal and vertical locations for EOP, EOS, sidewalks, retaining walls, barriers, special ditch profiles and ditch widths, etc.

The Create Point Control icon can be accessed thru the Corridor Modeling tasks group.

**Point Controls** are used to override the normal locations of one or more points and or components in a cross section. Examples of this include lane widening, staying within the right-of-way, maintaining a particular slope for a ditch, and superelevation.

An example would be a ramp is merging into the main road. The ramps left edge is vertically controlled by the main road right edge of pavement. The ramps left edge is horizontally controlled by the main road right edge from 0+00 to 1+00, and then it can be controlled by a horizontal alignment, for example of a name to use would be **“Ramp Left EOP”**.

The following are the prompts for the **Create Point Control** command:

**Locate Corridor** Selects the corridor where the point controls are applied.

**Station Limits (Start/Stop)** Specifies the start and stop stations for the control.

**Control Description** Allows you to enter a description of the control.

**Point** Allows you to select the point to be controlled. Select from the list or identify the point in the cross-section using the locate button. The selected point is highlighted in plan/cross section and profile or superelevation views as applicable.

**Mode** Allows you to select the control mode: Horizontal, Vertical, or Both.

**Control Type** Specifies the type of control.

If the mode is **Horizontal** or **Both**, valid control types are Linear Geometry, Feature Definition, or Corridor Feature.

If the mode is **Vertical**, valid control types are Linear Geometry, Feature Definition, Corridor Feature, Superelevation, Elevation Difference, Elevation and Grade.

The selection combo boxes and/or field displayed depends on the selected Mode and Control Type.

**Type - Linear Geometry** If the type is Linear Geometry, a Horizontal Offsets combo box is displayed. If the mode is Both, a Vertical Offsets combo box is also displayed.

**Type - Feature Definition** If the type is Feature Definition, a Feature Definition and Range text field is displayed.

**Type - Corridor Point** For all modes, Corridor and Reference Feature combo boxes are displayed. These options allow you to set up the control of one corridor's points(s) from another corridor's point(s).

Targeting another corridor's point cannot be done simultaneously with Target Aliasing of that same corridor. If Target Aliasing has been defined, the Corridor Point is not available for selection within the Point Control dialog. This produces a recursive situation, making the corridor point control unavailable for selection until that Target Aliasing is removed.

**Type – Superelevation** This option displays a Superelevation control line combo box, and a Reference Point combo box. Superelevation control lines are stored in the roadway design, not on the alignment. The reference point is the pivot point (feature) about which the point will rotate.

**Type - Elevation Difference** This option displays Horizontal and Vertical alignment combo boxes. The vertical alignment represents a vertical difference value to be applied to the points' current elevation.

**Type - Elevation and Grade** This option displays an Elevation field, and a Grade field. The control sets elevation of the point at the start station to the elevation specified. The slope of the point's line is then at the grade specified until the end station is reached.

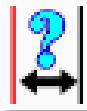
**Priority** Determines the order of controls on a point. This value applies only when there are conflicting controls on a point. Where there is a conflict, the control with the lower priority is applied (that is, lower numbers are applied first).

**Use as Secondary Alignment** Specifies that horizontal point controls are also used as secondary alignments. This option is available only when working with a 2D entity. If you are using a 3D object, the software skips the secondary alignment option.

**Horizontal Offsets (Start/Stop)** Specifies the start and stop horizontal offset controls for the corridor. If the values are different, then the value applied at a given station is calculated using a linear algorithm.

**Vertical Offsets (Start/Stop)** Specifies the start and stop vertical offset controls for the corridor.

## 7.5 Parametric Constraints



Parametric constraints are used to override the original constraint values established in the template from the library being used. The **Create Parametric Constraint** icon can be accessed from the Corridor Modeling tasks group.

The parametric constraints are the equivalent of a re-definable variable. So, the names of the parametric constraints established in MoDOT Template Library mirrors the criteria names as much as possible.

Parametric Constraints are setup in the template and applied to the corridor using the **Create Parametric Constraint** command.

The prompts for the **Create Parametric Constraint** command are as follows:

**Locate Corridor** – select the corridor where you want the Parametric Constraints applied.

**Start/End Station** - Specify the start/end station for the override.

**Constraint Label** - Lists all labeled constraints in the design. The selected label receives the override.

**Start/Stop Value** - Specifies the constraint value and can be transitioning from the first parametric value at the start and stop values.

## 7.6 Corridor References



The Add Corridor Reference tool adds graphical elements to the corridor processing. This must be done even if the feature is targeted in the template, otherwise the elements will not process. It enables only those elements associated with a particular corridor to be processed, rather than all elements of a particular feature definition. This speeds up processing, and eliminates processing of unwanted elements of the same feature definition. The elements can be selected within the tool, or a selection set can be created prior to commencing the tool.

### Workflow

1. Select the Add Corridor Reference tool.
2. Select the Corridor.
3. Select the First Reference Element - select the graphical element to be added as a reference.
4. Continue selecting until all elements are referenced, then reset to exit tool.

The Remove Corridor References tool removes graphical elements from the corridor processing, but does not delete the element. The elements can be selected within the tool, or a selection set can be created prior to commencing the tool.

### Workflow

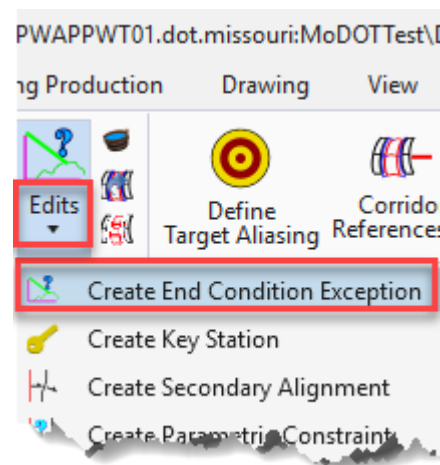
1. Select the Remove Corridor Reference tool.
2. Select the Corridor.
3. Select the First Reference Element - select the graphical element to be removed as a reference.
4. Continue selecting until all elements are referenced, then reset to exit tool.

## 7.7 End Condition Exceptions



Used to modify the behavior of an end condition solution without requiring the use of additional template drops.

You can access this tool from the following:



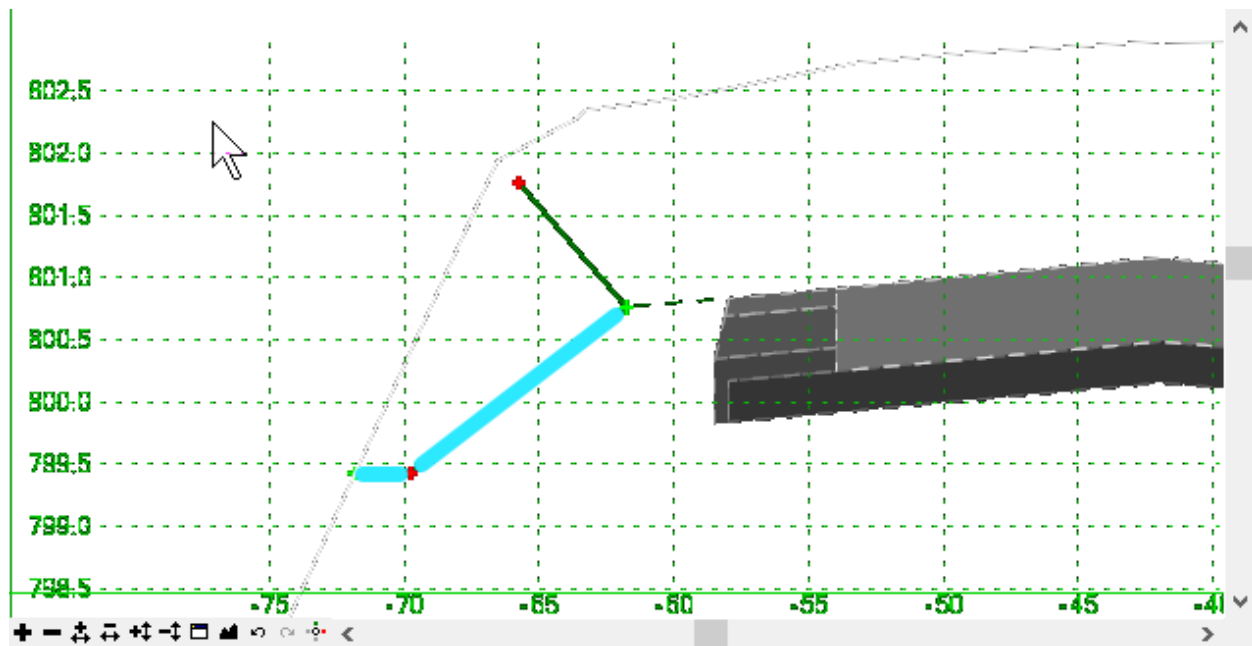
### Open Roads Modeling → Corridors → Edit → Edits → End Condition Exception

In many cases, it is desirable to keep the backbone of the road the same but change what is happening where the new design is intersecting the surface. One way to do this is to create a new template with the same backbone components and new or different end condition components; then, drop this new template at the appropriate station. The problem with this approach is that 1) it creates template transitions that must be resolved, 2) the conditions on the left and right sides of the design are likely to change at different locations, possibly requiring extensive collection of slightly varying templates to meet all the possible combinations (also numerous template drops). The solution to this situation is End Condition Exceptions. End Condition Exceptions are used to modify the behavior of an end condition solution without requiring the use of additional template drops. When an end condition exception is added, it must be edited to change its behavior. End condition exceptions come in two classes:

- Overrides
- Transitions

### Overrides

Overrides allow you to replace or override the template drop end conditions on the left or right of the backbone. When you choose this option, you must edit the override to set up the new end condition. When the override exception is edited, the Create Template dialog is displayed allowing you to edit the end-condition. You may also drag and drop a standard end condition from the library and make edits.



### Transitions

End condition transitions are used where the end condition may change suddenly due to changes in the existing surface or other reason, and you want the transition to be smooth over a specified station range rather than a sudden change over a short length. One common instance of this is where the end condition criteria may cause a slope to be changed from 1:6 to 1:2 over a 5 foot processing length. In this case, a smooth transition from 1:6 to 1:2 over 100 feet would be ideal. A transition could be created that starts 100 feet back from the 2:1 slope station and ended at the 2:1 slope station. Another instance would be going from an end condition with no shoulder to one with a shoulder. Here, you could model the shoulder as gradually appearing rather than going from no shoulder to full shoulder in a 5 foot interval.

As with the override exception, the transition exception needs to be edited after placement. The following graphic is an example of editing a transition from no shoulder to having a shoulder. Notice that the shoulder point was selected first so that the transition line uses that feature style.

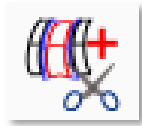


**Backbone Only**

Backbone Only (Left) - indicates that no end condition will be applied over the station range on the left side.

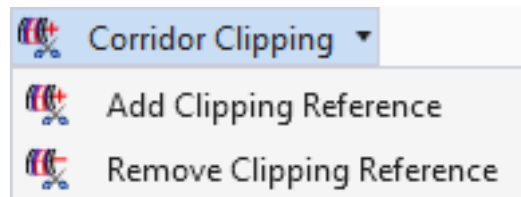
Backbone Only (Right) - indicates that no end condition will be applied over the station range on the right side.

## 7.8 Corridor Clipping

**Adding a Clipping Reference**

The "clipping" feature allows you to remove areas of overlap when working with MicroStation elements or multiple corridors. In the following illustration, the rectangle (MicroStation element) is defined as the clipping reference for the corridor. Therefore, all elements of the corridor within the rectangle are "clipped" or deleted, leaving only the horizontal geometry element. When working with multiple corridors where a corridor intersects a crossing roadway (defined by a second corridor), clipping would be used to remove all overlapped features within the intersection.

You can access this tool from the following:



**Open Roads Modeling ➔ Corridors ➔ Miscellaneous ➔ Corridor Clipping ➔ Add Corridor Reference**

The "clipping" feature allows you to remove areas of overlap when working with multiple corridors in a single surface. For example, in a corridor intersected by a crossing roadway, clipping would be used to remove all overlapped features within the intersection.

Workflow:

5. Select the Add Clipping Reference tool.
6. Select the corridor to be clipped.
7. Locate Clipping Reference - select elements until all are defined, then reset to complete. The corridor is processed, and the clipping reference is added.

### Removing a Clipping Reference



Removing a Clipping Reference removes a clipping reference and reprocesses the corridor model without the reference. It does not delete the actual clipping reference element. However, you will want to always remove a clipping reference in a corridor before deleting the element being used as the clipping reference.

You can access this tool from the following:

**Open Roads Modeling → Corridors → Miscellaneous → Corridor Clipping → Remove Clipping Reference**

The Remove Clipping Reference tool removes the clipping reference, reprocesses the corridor, restoring the clipping area to its previous state prior to clipping.

Workflow:

1. Select the Add Clipping Reference tool. Select the Corridor where the clipping is to be removed. Locate Clipping Reference - select elements until all are defined, then reset to complete. The corridor is processed and the clipping reference is removed.

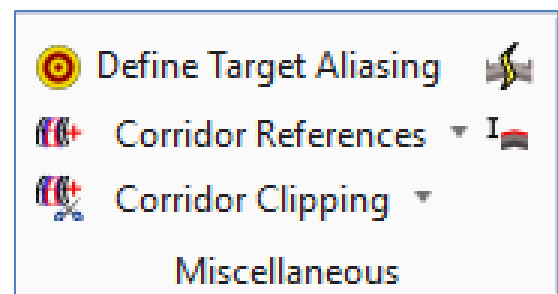
## 7.9 Target Aliasing

Target aliasing allows you to target other corridor surfaces or features or to set up a prioritized target list for end condition solutions on surfaces, features and alignments. This means that on a large job where the existing surface may have been broken up into more than one surface, you don't need to be concerned about where those breaks occur, and you don't need to create a different template for each existing surface. Use target aliasing to find the proper solution.

In any situation where the active surface is the target, the software looks for the mainline corridor surface and uses whichever is closer because you have turned on that option. If the Use Closest option is not set, then it would search for the surfaces in the order they are displayed, and it would stop as soon as a solution was found.

Target Aliasing cannot be defined with a corridor that targets that corridor with a Corridor Point Control. This produces a recursive situation, making the corridor unavailable for Target Aliasing until that corridor point control is removed.

You can access this tool from the following:



## 7.10 Design Changes

The lifecycle of a roadway project is long, and complex. Changes must be done to accommodate for unforeseen situations or to stay within budget. The Corridor Modeling tools offers the flexibility to allow these design changes.

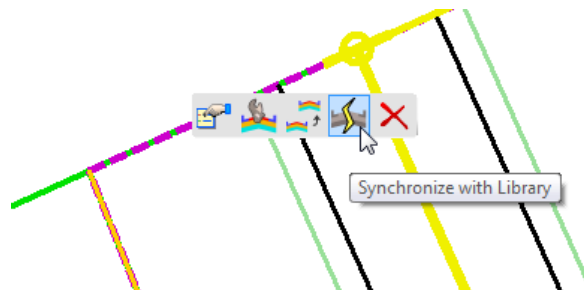
### 7.10.1 Geometry Changes

Once the horizontal and vertical geometry are created and used by a corridor, the user can go back and change the geometry. Any changes will be reflected in the corridor design.

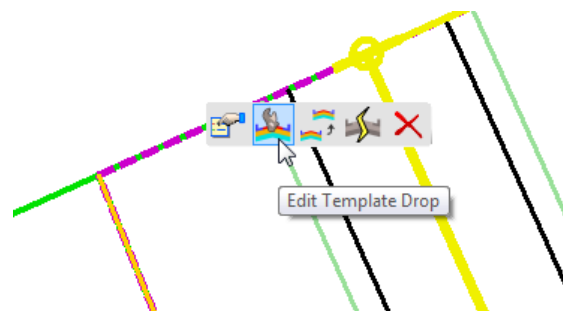
### 7.10.2 Template Library Synchronization

Changes to the template can be made either in the Corridor or in the Template Library. Where a user makes the changes for his/her template depends on the circumstances and needs to be reviewed on a case by case basis.

Any changes made in the template library can be obtained by synchronizing the template drops with the library. This is accomplished by selecting the template drop on the corridor in the plan view and selecting **Synchronize with Library** icon from the heads-up menus.

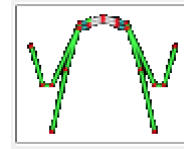


Changes can be made to a template used in a corridor by using the **Edit Template** command. The **Edit Template** command can either be accessed by selecting the template drop on the corridor in the plan view and selecting **Edit Template** icon from the heads-up menus or from the Corridor Modeling tasks group.



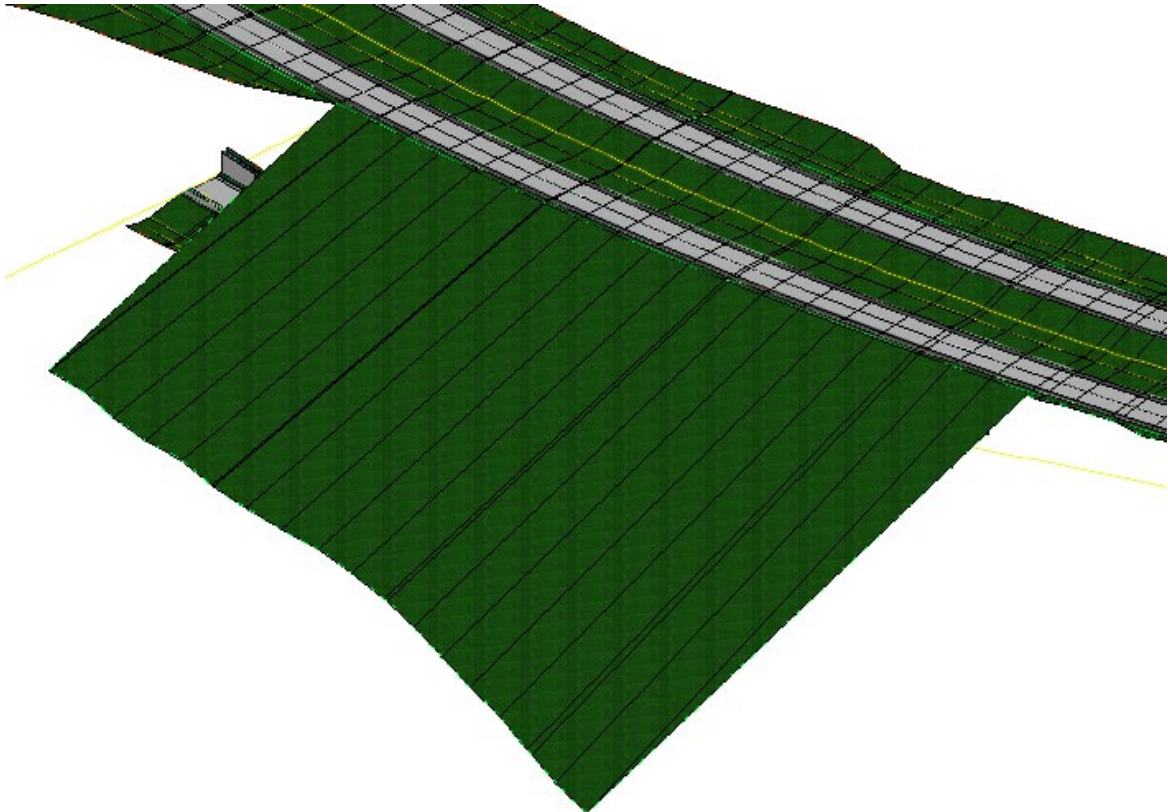
### 7.11 Basic Design Workflow with Corridor Modeling Tools

5. Set up a corridor
6. Insert template drops as needed
7. Create any template point controls
8. Design superelevation
9. Set parametric constraints as needed
10. Review design
11. Make revisions as needed and re-review

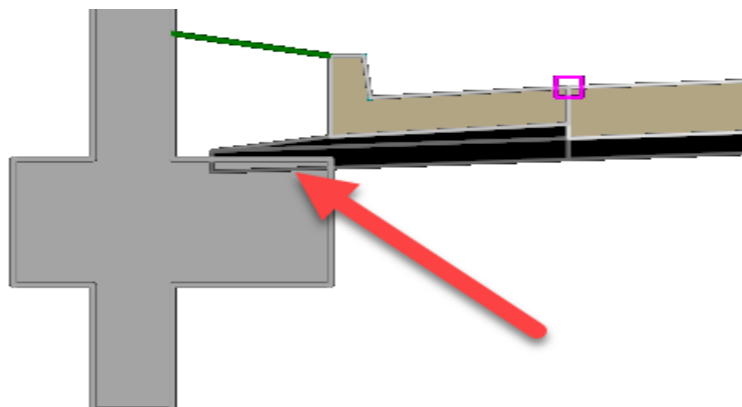


## 7.12 Group Exercise: Corridor Modifications - Ramp 4

1. Within the **Roadway\data-7** folder, open the file: **Corridors\_Ramp-4\_J5P3181.dgn**
2. When superelevation was applied to the **Route 54 Corridor** in the last chapter, the end slopes of **Route 54** now overlap the **Ramp 4 Corridor** (See Below). To help visualize the **Ramp-4** Corridor turn off the **Reference Display** of the **Route 54 Corridor** in both the **2D** and **3D** View.



3. Set the active **Template Library** to the following:  
**Roadway/data-7/J5P3181.itl**
4. Due to the Superelevation being applied the Retaining Wall footing is now hitting the Curb and Gutter and Shoulder.

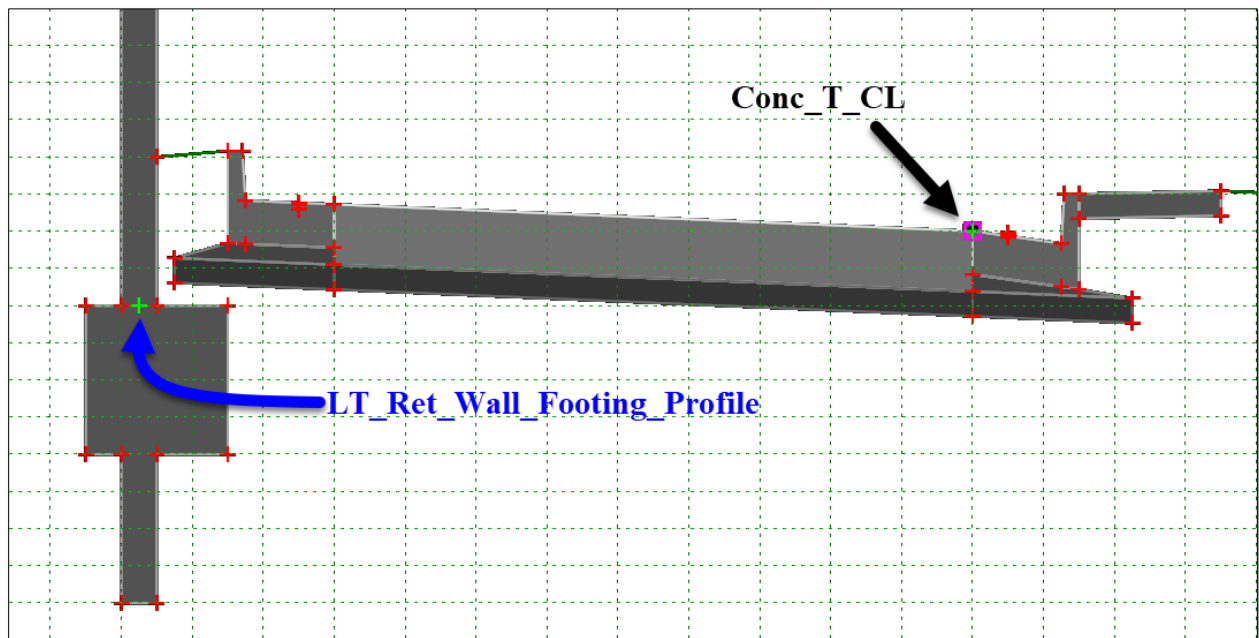


5. In both **Ramp 4** template drops adjust the **LT\_Ret\_Wall\_Footing\_Profile** point so that it has the following constraints:

<b>Template Drop #1</b>	Parent 1:	<b>Conc_T_CL</b>	
	Constraint 1	<b>Horizontal</b>	Value: -23.5000
	Constraint 2	<b>Vertical</b>	Value: -3

<b>Template Drop #2</b>	Parent 1:	<b>Conc_T_CL</b>	
	Constraint 1	<b>Horizontal</b>	Value: -24.5000
	Constraint 2	<b>Vertical</b>	Value: -3

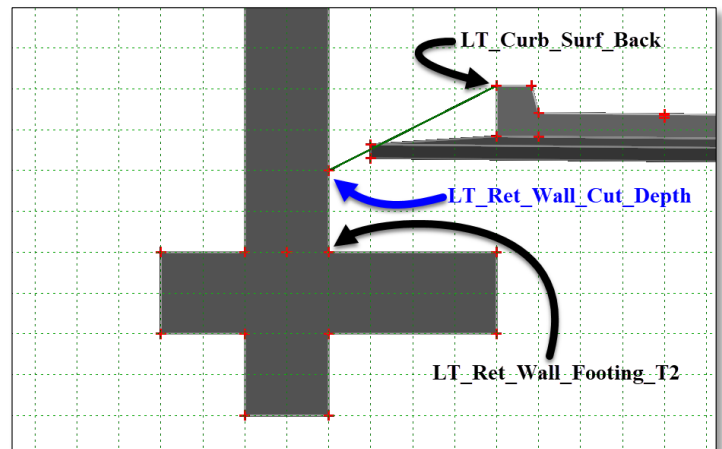
Also add in a **Parametric Label** for the **Horizontal Constraint** called **Retaining Wall Offset**.



6. Place a **2%** grass slope from the Retaining Wall to the back of Curb and Gutter and Shoulder (sloping downward toward the right). In both **Ramp 4** template drops adjust the **LT\_Ret\_Wall\_Cut\_Depth** point so that it has the following constraints.

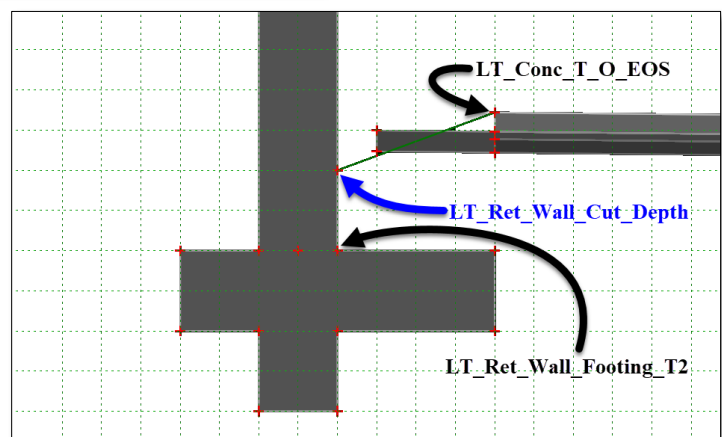
### Template Drop #1

Constraints	
Type:	Constraint 1: Slope
Parent 1:	LT_Curb_Surf_Back
Parent 2:	<input type="checkbox"/> Rollover Values...
Value:	-2.00%
Label:	



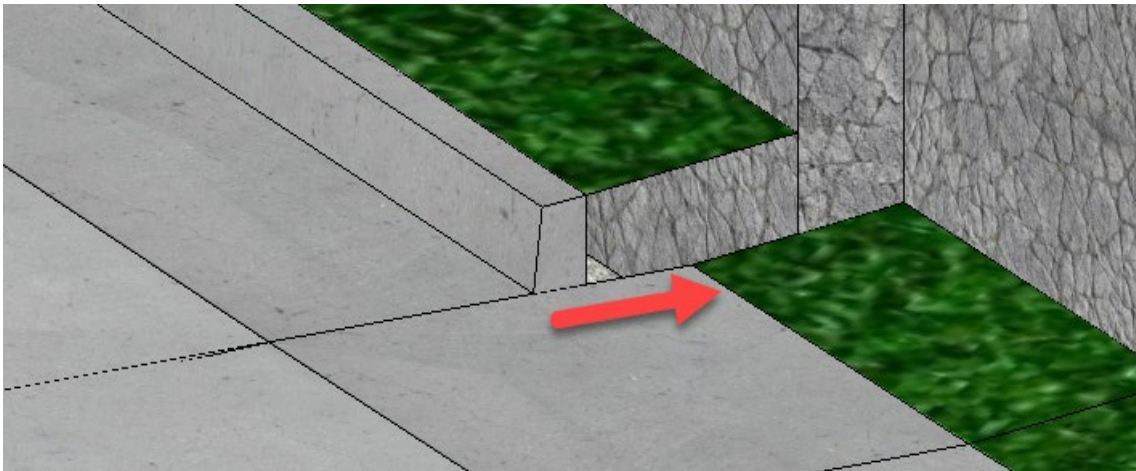
### Template Drop #2

Constraints	
Type:	Constraint 1: Slope
Parent 1:	LT_Conc_T_O_EOS
Parent 2:	<input type="checkbox"/> Rollover Values...
Value:	-2.00%
Label:	

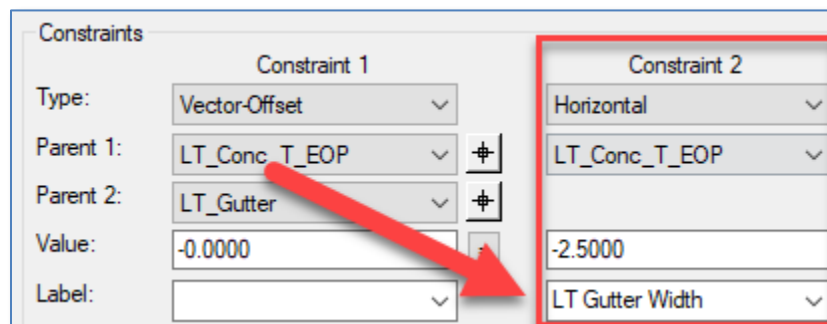


In the next few steps, we are going to try and transition the **Ramp 4 Curb and Gutter Template** to a **Shoulder template**.

7. In this step we are going to setup a Parametric Label to help transition the **Curb Width** out (over a distance) to match the Shoulder Width.

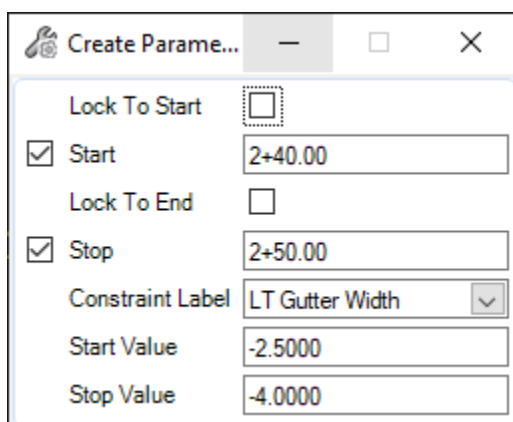


In the first **Ramp 4** template drop adjust the **LT\_Curb\_Surf\_Flowline** point so that it has the following Parametric Label.



8. Select the **Ramp 4** Corridor Grips and bring up the heads-up tools. In those tools select the **Corridor Creation Tools** and then select the **Parametric Constraint** tool.

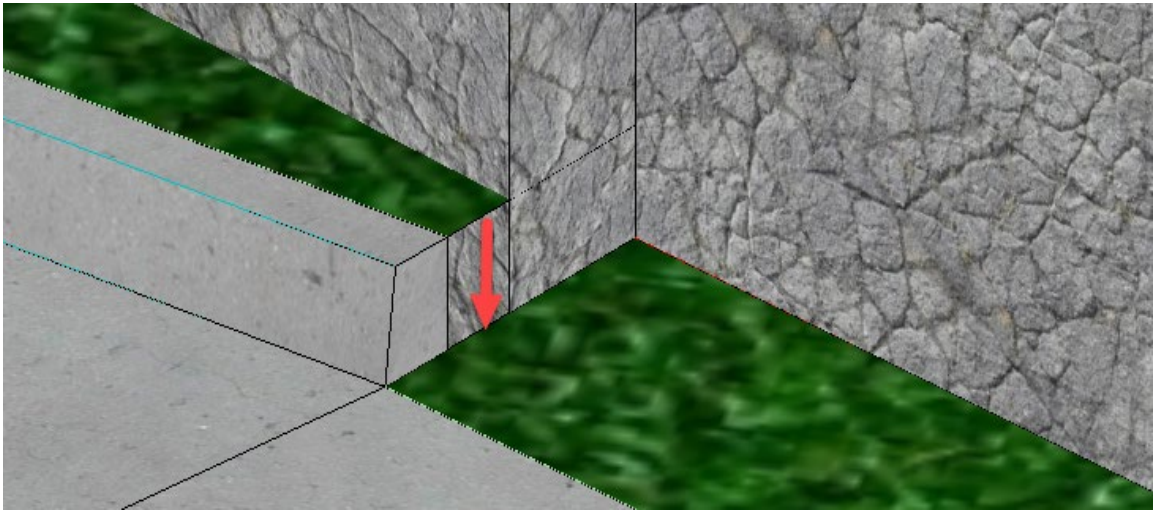
In the **Parametric Constraint** dialog, define the values as listed below, once the values are defined accept values by left clicking to create the Parametric Constraint.



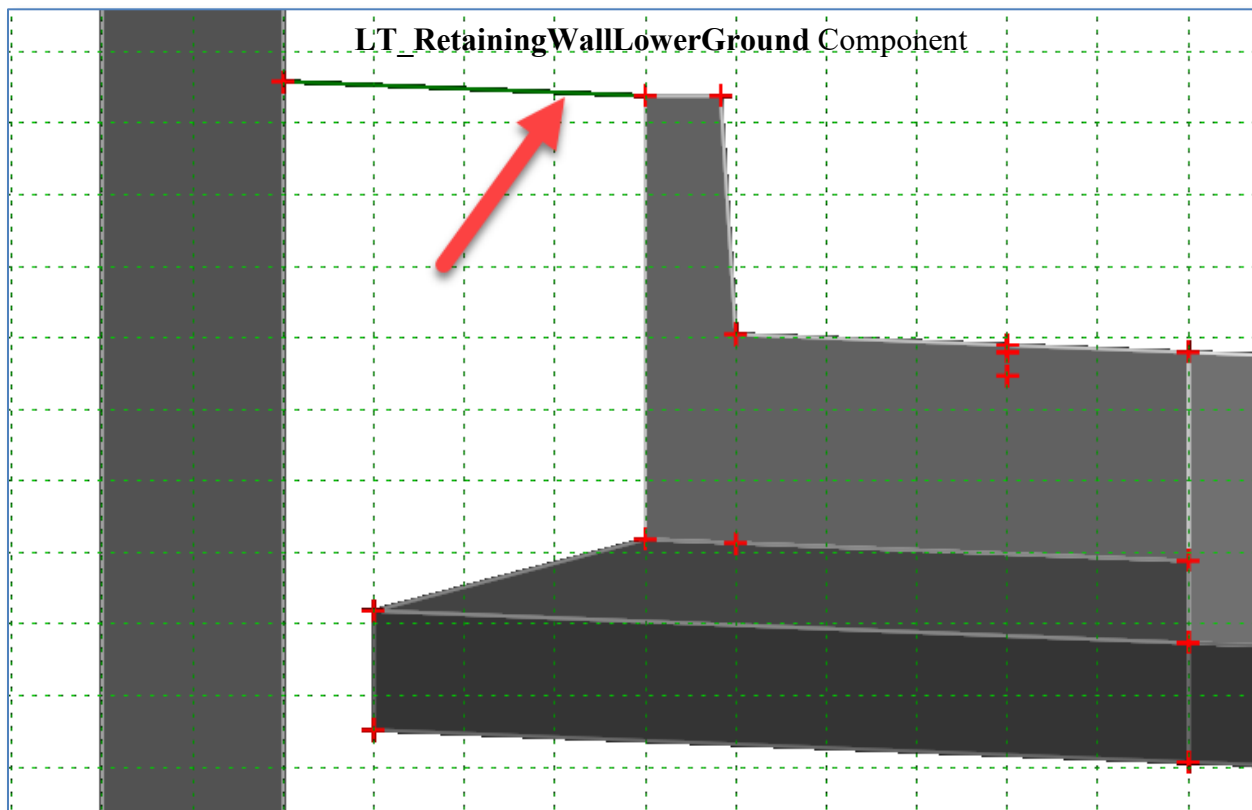
Start:	2+40
Stop:	2+50
Constraint Label:	LT Gutter Width
Start Value:	-2.5000
Stop Value:	-4.0000



9. In the next few steps, we are going to adjust the first template drop so the Ground Line between the Retaining Wall and the Back of Curb will transition down to the elevation at the Edge of Shoulder.



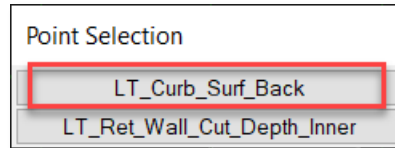
**Right Click** on the **LT\_RetainingWallLowerGround** Component and **Insert a Point** on top of the **LT\_Curb\_Surf\_Back** point



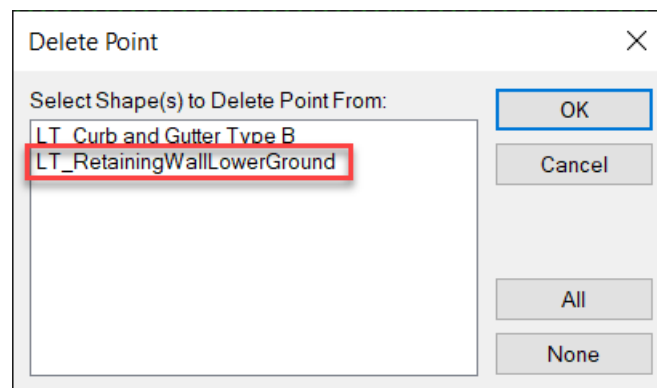
10. Double click on newly place point and open the Point Properties dialog. Rename the point to **LT\_Ret\_Wall\_Cut\_Depth\_Inner**

11. In the next step we are going to delete a point, but in reality, we are only **removing** the **LT\_Curb\_Surface\_Back** point from the **LT\_RetainingWallLowerGround** component.

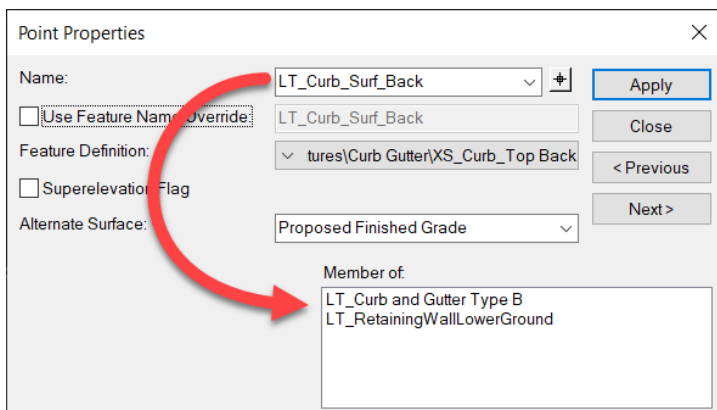
Right click on newly place point and select **Delete Point**. Delete the **LT\_Curb\_Surface\_Back** point:



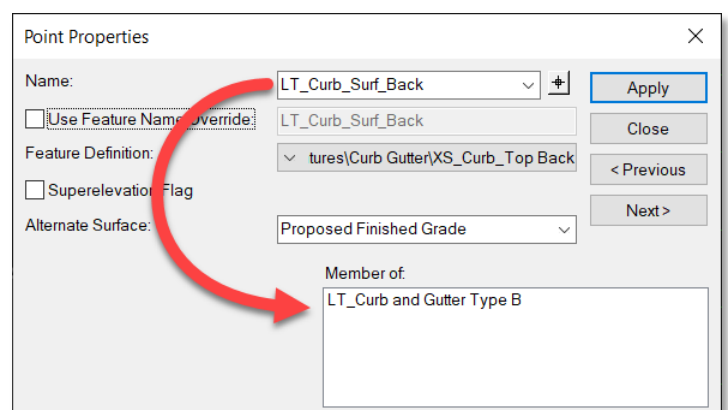
12. Delete the **LT\_RetainingWallLowerGround** (Component) from the Point.



### Before deleting Point



### After deleting Point



13. Right click on the point **LT\_Ret\_Wall\_Cut\_Depth\_Inner** and add the following Constraints.

Also add in a **Parametric Label** called

The screenshot shows the 'Constraints' dialog box with two columns for 'Constraint 1' and 'Constraint 2'.  
Constraint 1:  
Type: Vector-Offset  
Parent 1: LT\_Conc\_T\_EOP  
Parent 2: Conc\_T\_CL  
Value: -0.6566  
Label: LT Ground Height  
Constraint 2:  
Type: Horizontal  
Parent 1: LT\_Curb\_Subsurf\_Back  
Value: 0.0000

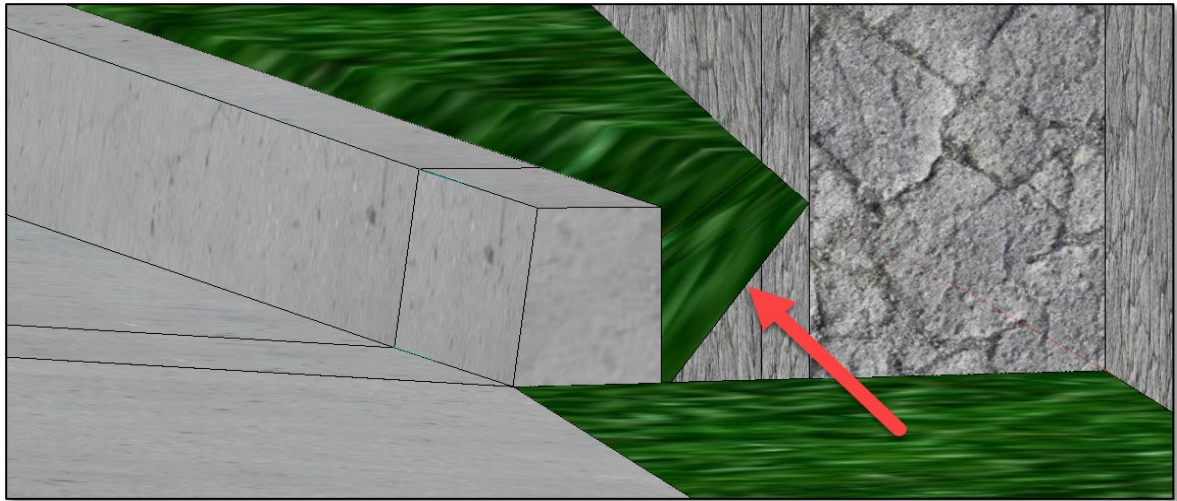
**Note:** After applying the **Vector-Offset**, you might notice the grass line is not exactly at the top of the Curb. Vector-Offset are applied/evaluated at the **Point Constraint** level, before any **Parametric Constraints**, **Horizontal Feature Constraints**, or **Point Controls** are applied.

14. Select the **Ramp 4** Corridor Grips and bring up the heads-up tools. In those tools select the **Corridor Creation Tools** and then select the **Parametric Constraint** tool.
15. In the **Parametric Constraint** dialog, define the values as listed below once the values are defined accept values by left clicking to create the Parametric Constraint.

The screenshot shows the 'Create Parametric Constraint' dialog box with the following settings:  
Parameters:  
Lock To Start: ☐  
Start: ☒ 2+40.00  
Lock To End: ☐  
Stop: ☒ 2+50.00  
Constraint Label: LT Ground Height  
Start Value: -0.6566  
Stop Value: -0.0461

Start:	2+40
Stop:	2+50
Constraint Label:	LT Ground Height
Start Value:	-0.6566
Stop Value:	-0.0461

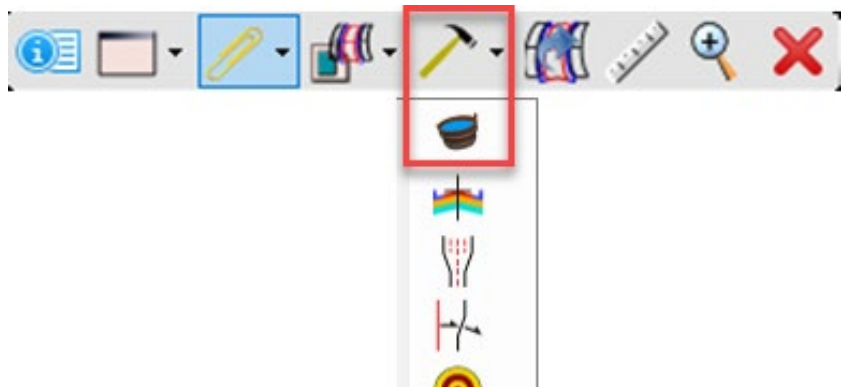
16. In this step we are going to modify the Parent Point of the **LT\_Ret\_Wall\_Cut\_Depth** point. It is currently pointing to the **LT\_Curb\_Surface\_Back** point, which is causing our Ground Slope not to draw at a 2.00% Slope.



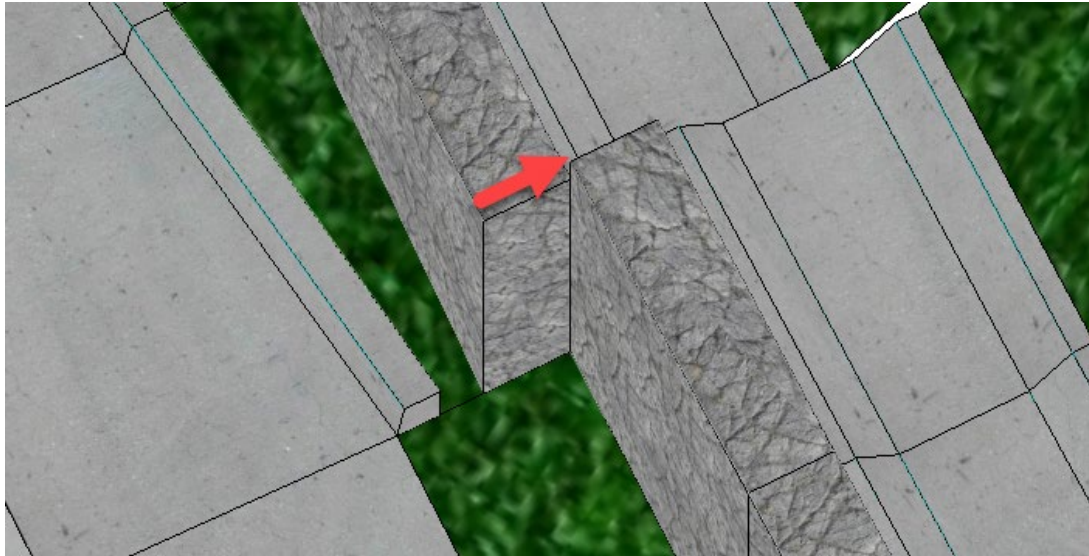
Adjust the Parent Point of the Slope Constraints to point to the **LT\_Ret\_Wall\_Cut\_Depth\_Inner** point:

Constraints	
Type:	Horizontal
Parent 1:	LT_Ret_Wall_Footing_Prof
Value:	0.5000
Label:	
<input type="checkbox"/> Horizontal Feature Constraint	
Range:	0.0000
Type:	Slope
Parent 1:	LT_Ret_Wall_Cut_Depth_Ir
<input type="checkbox"/> Rollover Values...	
Value:	-2.00%
Label:	
Linear\Design\DNC\DNC	

- Optional Step) If the Ground Line behind the Curb did not match up with the Ground line behind the Shoulder, use the **Corridor Creation Tools** → **Corridor Objects Bucket** → **Parametric Constraints** to modify the Parametric Value so that the ground line matches up more closely.



17. In this step we are going to transition the **Retaining Wall** over to match the offset off the shoulder.



In the first **Ramp 4** template drop adjust the **LT\_Ret\_Wall\_Footing\_Profile** point so that it has the following Parametric Label.

Constraints	
Type:	Horizontal
Parent 1:	Conc_T_CL
Value:	-23.5000
Label:	Retaining Wall Offset

Select the **Ramp 4** Corridor Grips and bring up the heads-up tools. In those tools select the **Corridor Creation Tools** and then select the **Parametric Constraint** tool.

In the **Parametric Constraint** dialog, define the values as listed below, once the values are defined accept values by left clicking to create the **Parametric Constraint**.

Create Parametric Constraint	
Lock To Start	<input type="checkbox"/>
<input checked="" type="checkbox"/> Start	2+40.00
Lock To End	<input type="checkbox"/>
<input checked="" type="checkbox"/> Stop	2+50.00
Constraint Label	Retaining Wall Offset
Start Value	-23.5000
Stop Value	-24.5000

Start:	2+40.00
Stop:	2+50.00
Constraint Label:	Retaining Wall Offset
Start Value:	-23.5000
Stop Value:	-24.5000

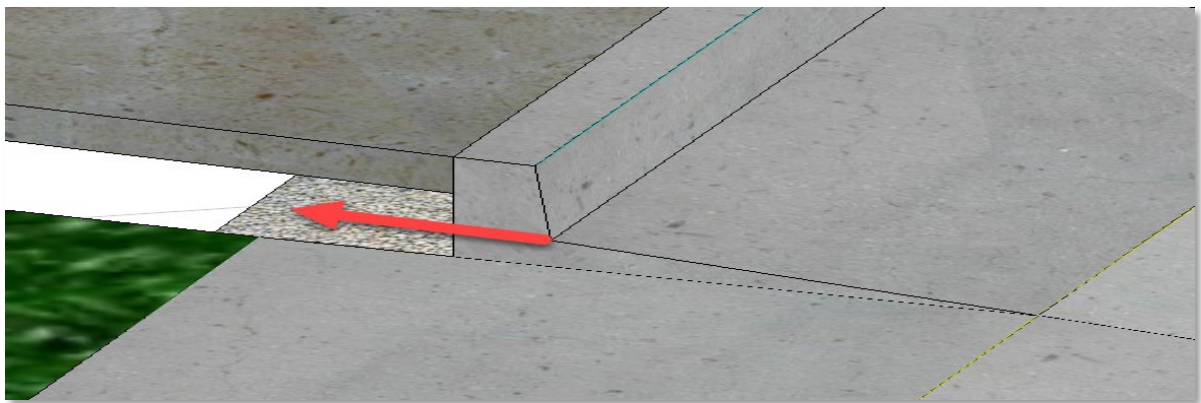


### 7.13 Individual Exercise: Corridor Modifications - Ramp 4

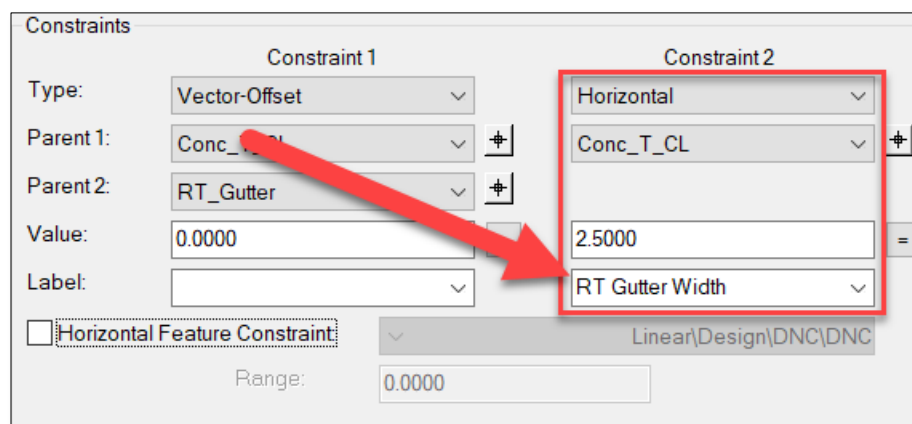
1. If not already open, do the following:
  - a. Open the **Roadway/data-7/Corridors\_Ramp-4\_J5P3181.dgn**.
  - b. Set the active **Template Library** to the **Roadway/data-7/J5P3181.itl**

In the next few steps, we are going to transition the **Ramp 4 Curb and Gutter Template** to a Template with a **Shoulder, Grass Buffer and Sidewalk**.

2. In this step we are going to setup a Parametric Label to transition the **Curb Width** out (over a distance) to match the Shoulder Width.

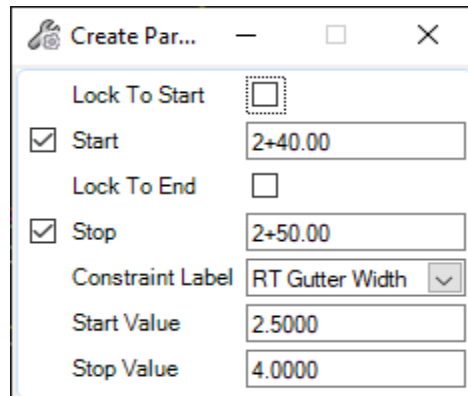


In the first **Ramp 4** template drop adjust the **RT\_Curb\_Surf\_Flowline** point so that it has the following Parametric Label.



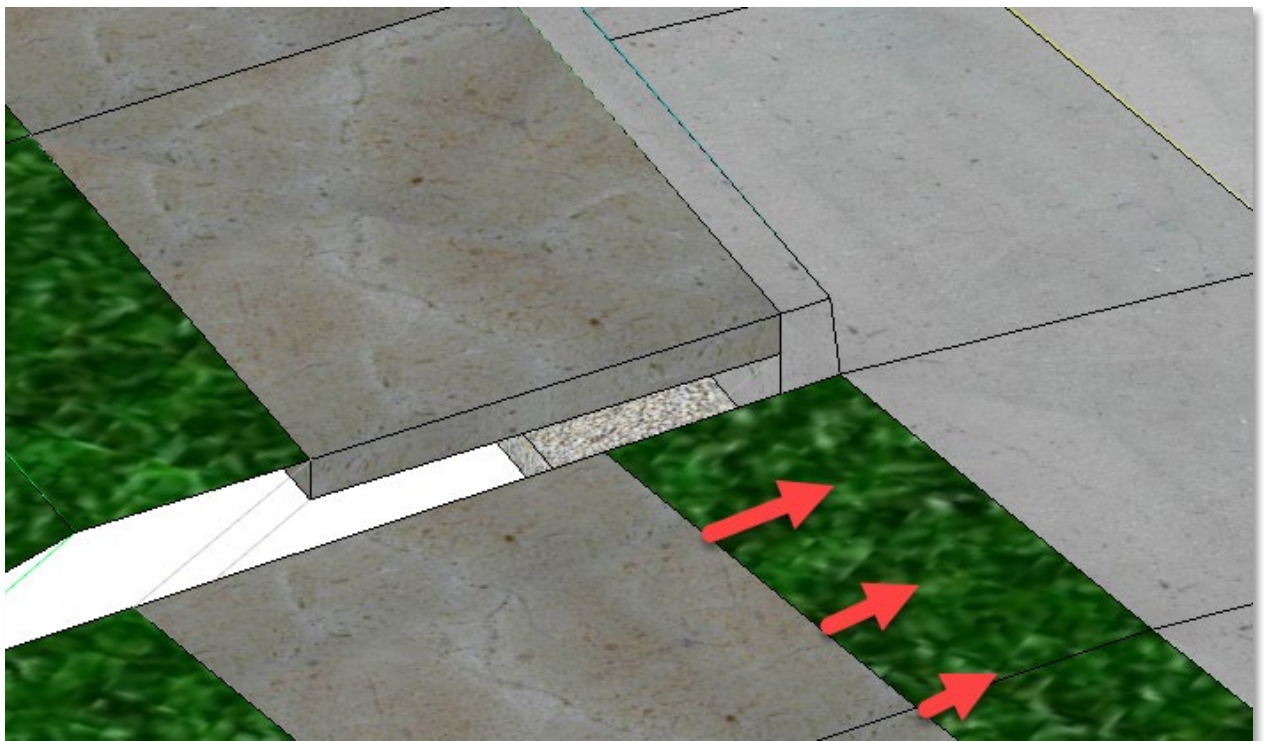
4. Select the **Ramp 4** Corridor Grips and bring up the heads-up tools. In those tools select the **Corridor Creation Tools** and then select the **Parametric Constraint** tool.

5. In the **Parametric Constraint** dialog, define the values as listed below, once the values are defined accept values by left clicking to create the Parametric Constraint.



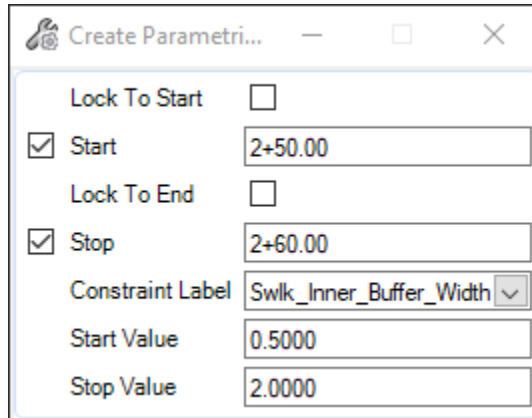
Start:	2+40
Stop:	2+50
Constraint Label:	RT Gutter Width
Start Value:	2.5000
Stop Value:	4.0000

6. In this step we are going to transition the **Sidewalk Offset** in to match the Sidewalk behind the Curb and Gutter.



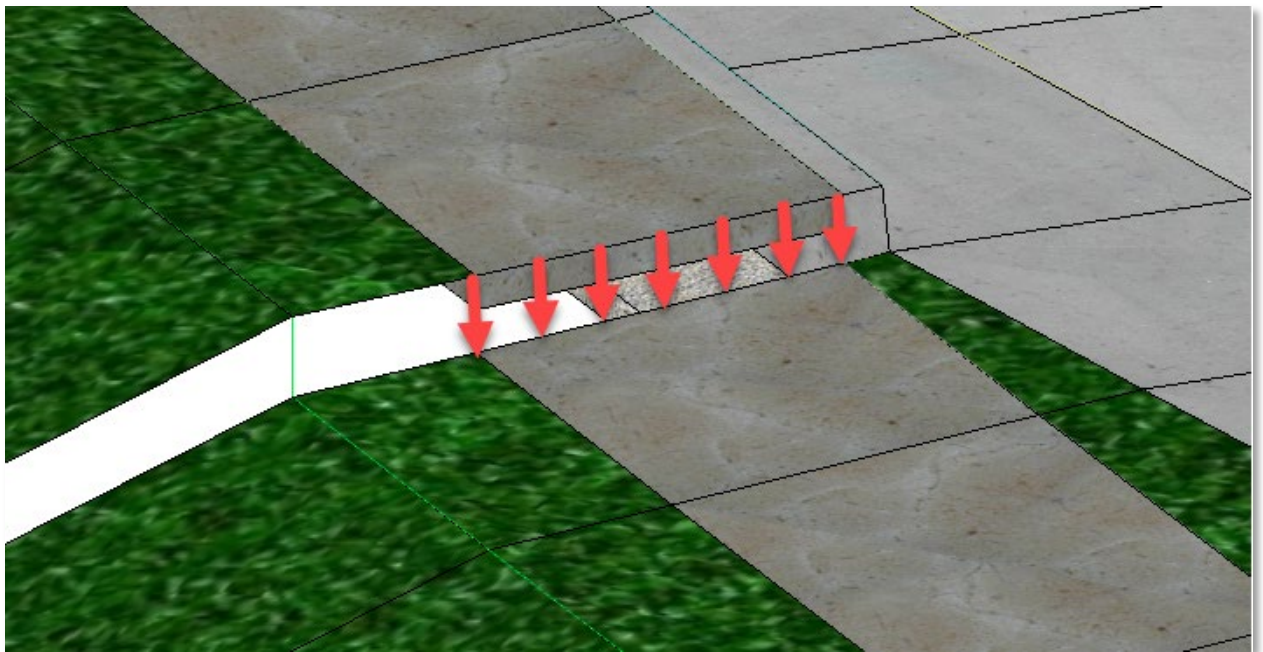
Select the **Ramp 4** Corridor Grips and bring up the heads-up tools. In those tools select the **Corridor Creation Tools** and then select the **Parametric Constraint** tool.

In the **Parametric Constraint** dialog, define the values as listed below, once the values are defined accept values by left clicking to create the Parametric Constraint.



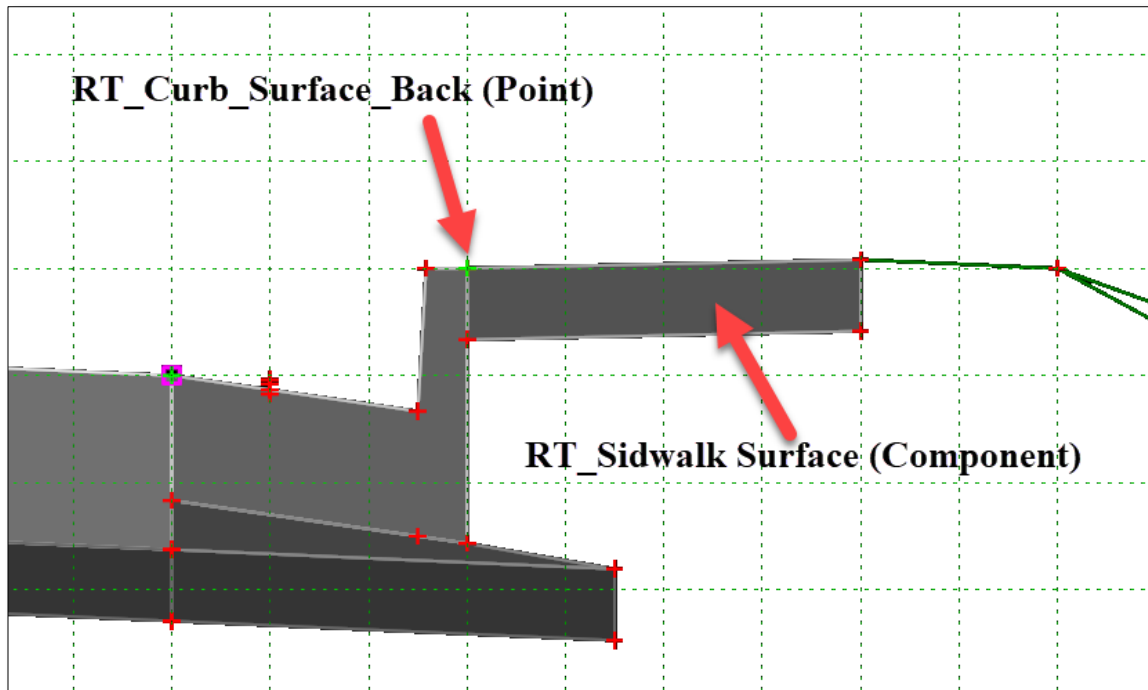
Start:	2+50.00
Stop:	2+60.00
Constraint Label:	Swlk_Inner_Buffer_Width
Start Value:	0.5000
Stop Value:	2.0000

7. In this step we are going to transition the **Curb and Gutter Sidewalk** down to match the **Sidewalk** behind the **Shoulder and Grass Buffer**.



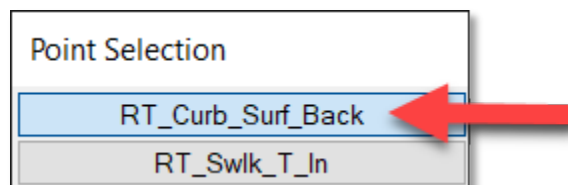


In the **first** **Ramp 4** template drop, right click on the top of the **RT\_Sidewalk Surface** Component and **Insert a Point** on top of the **RT\_Curb\_Surf\_Back** point.

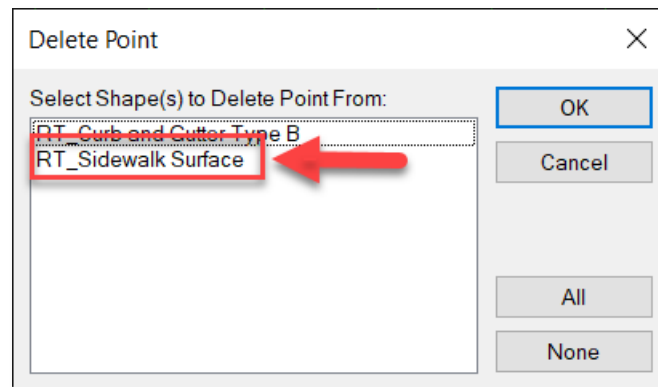


8. Double click on newly place point and open the Point Properties dialog. Rename the point to **RT\_Swlk\_T\_In**.
9. In the next step we are going to delete a point, but in reality, we are only **removing** the **RT\_Curb\_Surface\_Back** point from the **RT\_Sidewalk Surface** component.

Right click on newly place point and select **Delete Point**. Delete the **RT\_Curb\_Surface\_Back** point:

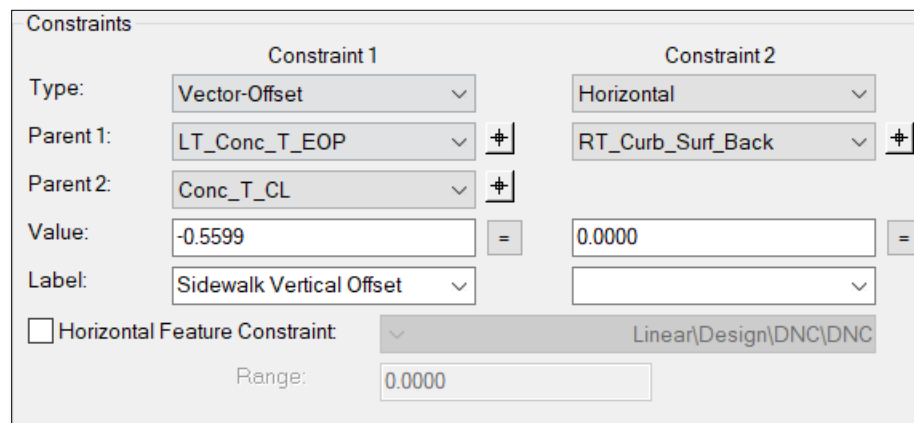


10. Delete the **RT\_Sidwalk Surface** (Component) from the Point.



**Note:** The **RT\_Curb\_Surface\_Back** point was included in both the **Sidewalk** and **Curb** components before the deletion.

11. Right click on the point **RT\_Swlk\_T\_In** and add the following Horizontal and Vertical Constraints.



Also add in a Parametric Label called **Sidewalk Vertical Offset** to the Vector Offset Constraint.

12. Modify the Parent Point of the **RT\_Swlk\_T\_Out** point. It is currently pointing to the **RT\_Curb\_Surface\_Back** point, which would cause our Sidewalk Slope not to draw at a 1.00% Slope.

Adjust the Parent Point of the Slope and Horizontal Constraints as follows:

Constraints

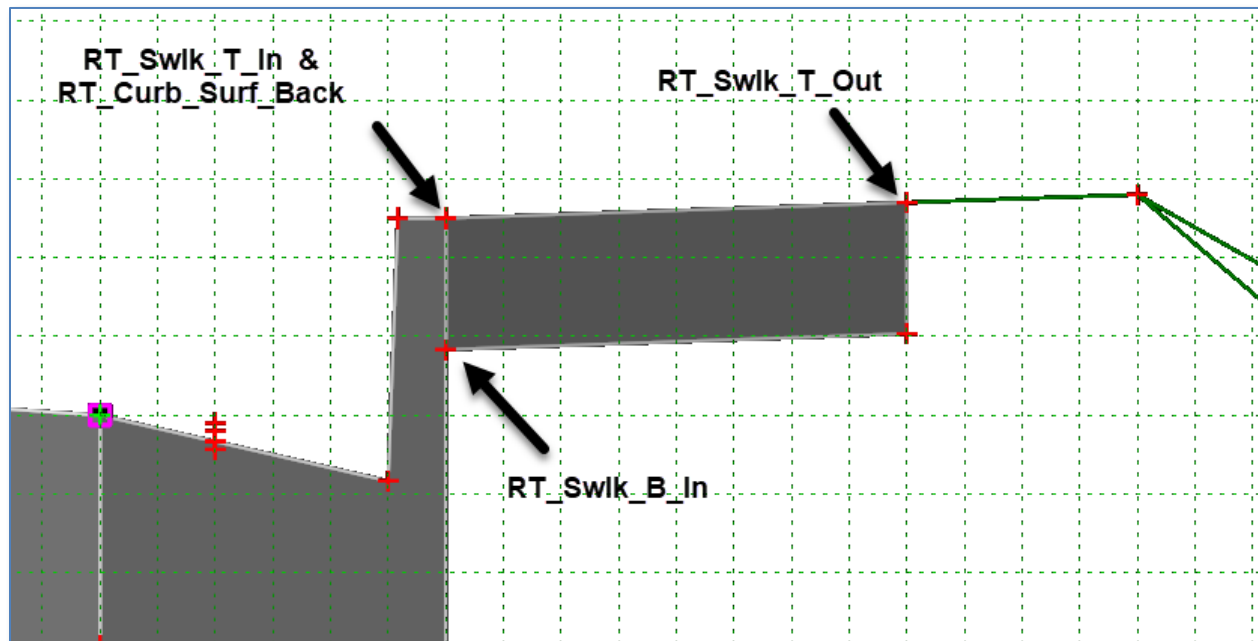
	Constraint 1	Constraint 2
Type:	Slope	Horizontal
Parent 1:	RT_Swlk_T_In	RT_Swlk_T_In
Parent 2:	<input type="checkbox"/> Rollover Values...	
Value:	1.00%	4.0000

13. Modify the Parent Point of the **RT\_Swlk\_B\_In** point. It is currently pointing to the **RT\_Curb\_Surface\_Back** point, which is causing our Sidewalk not to draw correctly.

Adjust the Parent Point of the Slope and Horizontal Constraints as follows:

Constraints

	Constraint 1	Constraint 2
Type:	Vertical	Horizontal
Parent 1:	RT_Swlk_T_In	RT_Swlk_T_In
Value:	-0.3333	0.0000

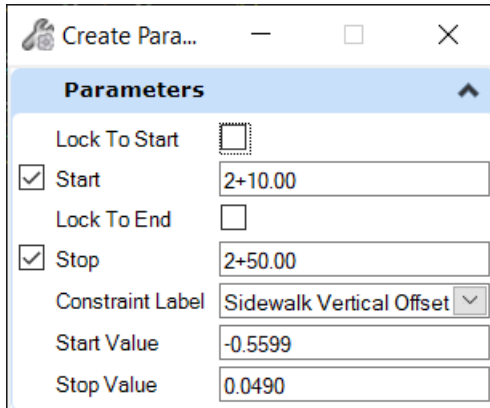


14. When done making the changes to the Points close the **Editing Roadway Designer Template Drop** dialog to Save changes.

**Note:** After applying the template changes, you might notice the top of sidewalk is not exactly at the top of the Curb. Remember that Vector-Offsets are applied/evaluated at the Point Constraint level, before **Parametric Constraints**, **Horizontal Feature Constraints**, or **Point Controls** are applied.

15. Select the **Ramp 4** Corridor Grips and bring up the heads-up tools. In those tools select the **Corridor Creation Tools** and then select the **Parametric Constraint** tool.

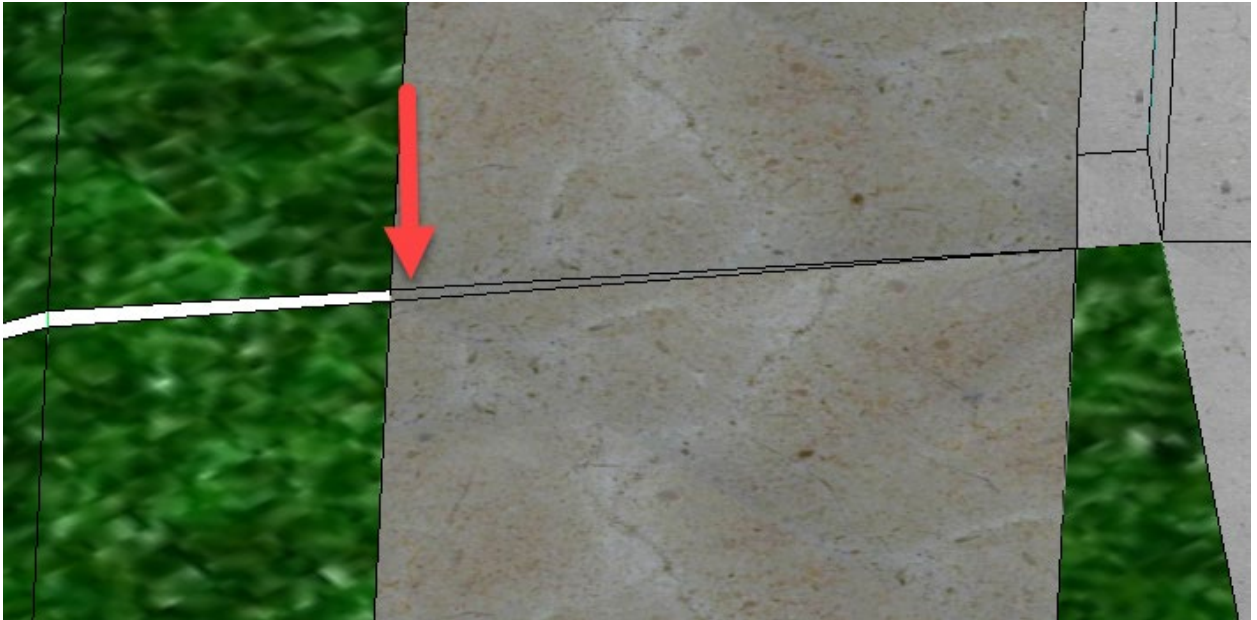
In the Parametric Constraint dialog, define the values as listed below, once the values are defined accept values by left clicking to create the Parametric Constraint.



Parameters	
Lock To Start	<input type="checkbox"/>
<input checked="" type="checkbox"/> Start	2+10.00
Lock To End	<input type="checkbox"/>
<input checked="" type="checkbox"/> Stop	2+50.00
Constraint Label	Sidewalk Vertical Offset
Start Value	-0.5599
Stop Value	0.0490

Start:	2+10
Stop:	2+50
Constraint Label:	Sidewalk Vertical Offset
Start Value:	-0.5599
Stop Value:	0.0490

16. In this step we are going to transition down the **Sidewalk Slope** behind the **Curb and Gutter** to match the **Sidewalk Slope** next to the **Shoulder**.



Select the **Ramp 4** Corridor Grips and bring up the heads-up tools. In those tools select the **Corridor Creation Tools** and then select the **Parametric Constraint** tool.

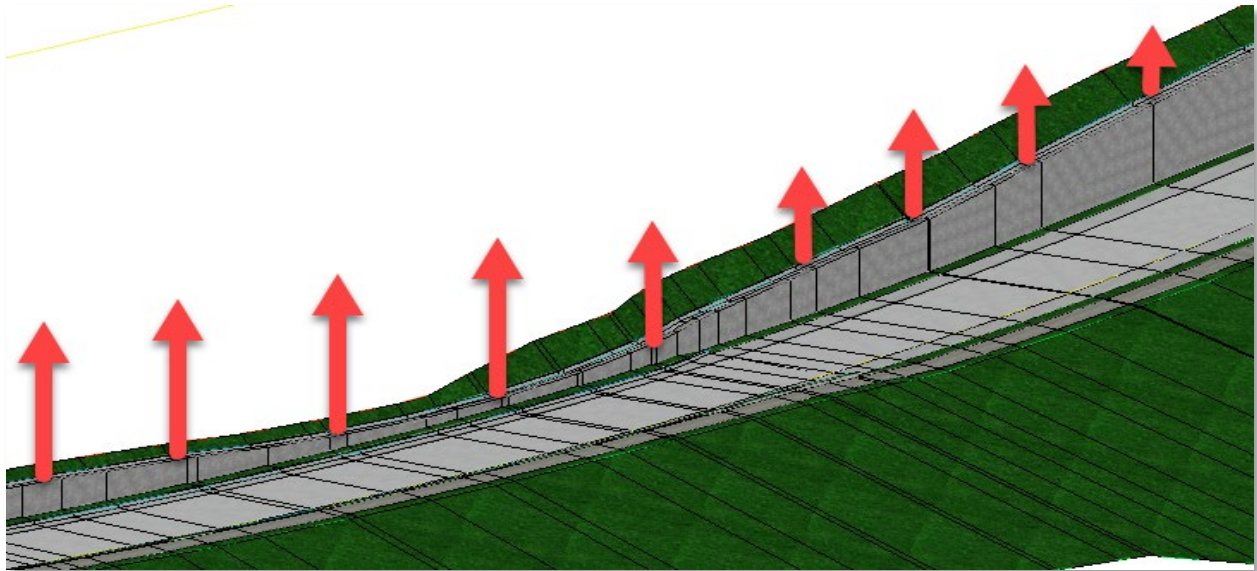
In the Parametric Constraint dialog, define the values as listed below once the values are defined accept values by left clicking to create the Parametric Constraint.

Create Para...	
Parameters	
Lock To Start	<input type="checkbox"/>
<input checked="" type="checkbox"/> Start	2+40.00
Lock To End	<input type="checkbox"/>
<input checked="" type="checkbox"/> Stop	2+50.00
Constraint Label	Swlk_Surf_Slope
Start Value	1.00%
Stop Value	-2.00%

Start:	2+40.00
Stop:	2+50.00
Constraint Label:	Swlk_Surf_Slope
Start Value:	1.00%
Stop Value:	-2.00%

## 7.14 Group Exercise: Corridor Modifications - Ramp 4 & Route 54

1. If not already open, do the following:
  - a. Open the **Roadway/data-7/Corridors\_Ramp-4\_J5P3181.dgn**.
  - b. Set the active **Template Library** to the **Roadway/data-7/J5P3181.itl**
2. To help with the steep slope between the **Ramp 4** and **Route 54** corridors, we are going to raise the retaining wall height.



3. Select the **Ramp 4** Corridor Grips and bring up the heads-up tools. In those tools select the **Corridor Creation Tools** and then select the **Create Point Control** tool.

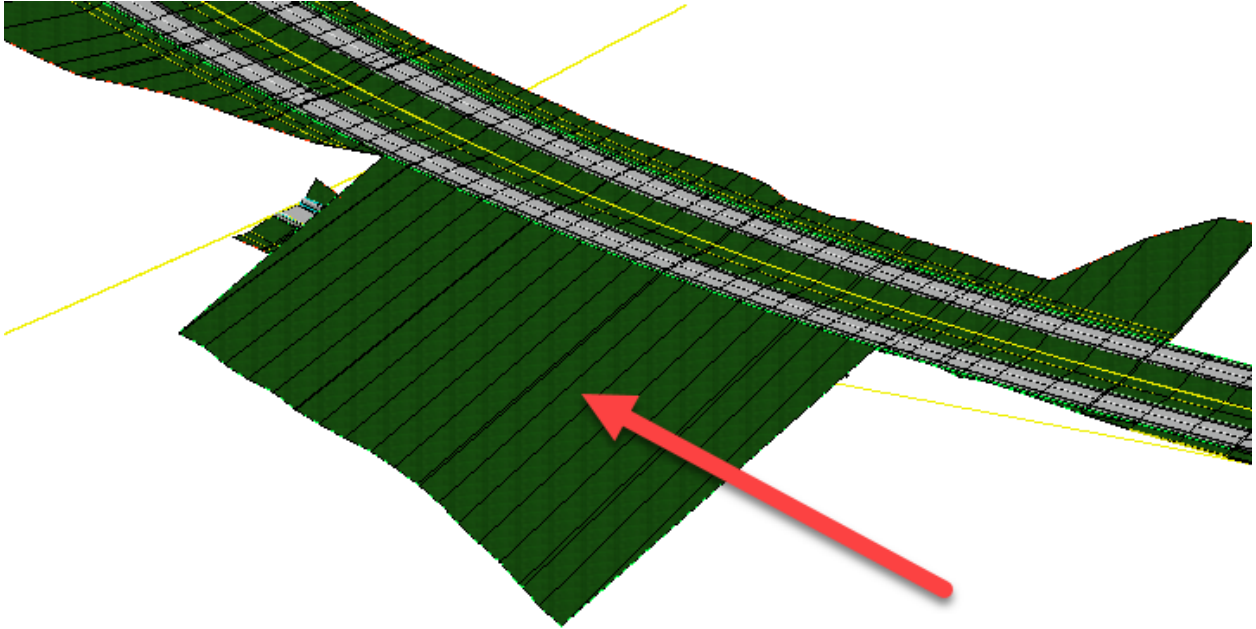
In the **Point Control** dialog, define the values as listed below, once the values are defined accept values by left clicking to create the **Point Control**.

Create Point Control	
Lock To Start	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Start	0+00.00
Lock To End	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Stop	13+54.21
Control Description	Raise Wall
Point	LT_Ret_Wall_Top_Profile
Mode	Vertical
Control Type	Elevation and Grade
Elevation	779.0000
Grade	4.50%
Priority	1

Start:	Lock to Start
Stop:	Lock to End
Control Description:	Raise Wall
Point:	LT_Ret_Wall_Top_Profile
Mode:	Vertical
Control Type:	Elevation and Grade
Elevation:	779.00
Grade:	4.50%
Priority:	1

4. Within the **Roadway\data-7** folder, open the file: **Corridors\_Route-54\_J5P3181.dgn**

In the next few steps, we are going to modify the Right Route 54 Fill Slope in the area of the Ramp 4 corridor using an **End Condition “Override” Exception**.



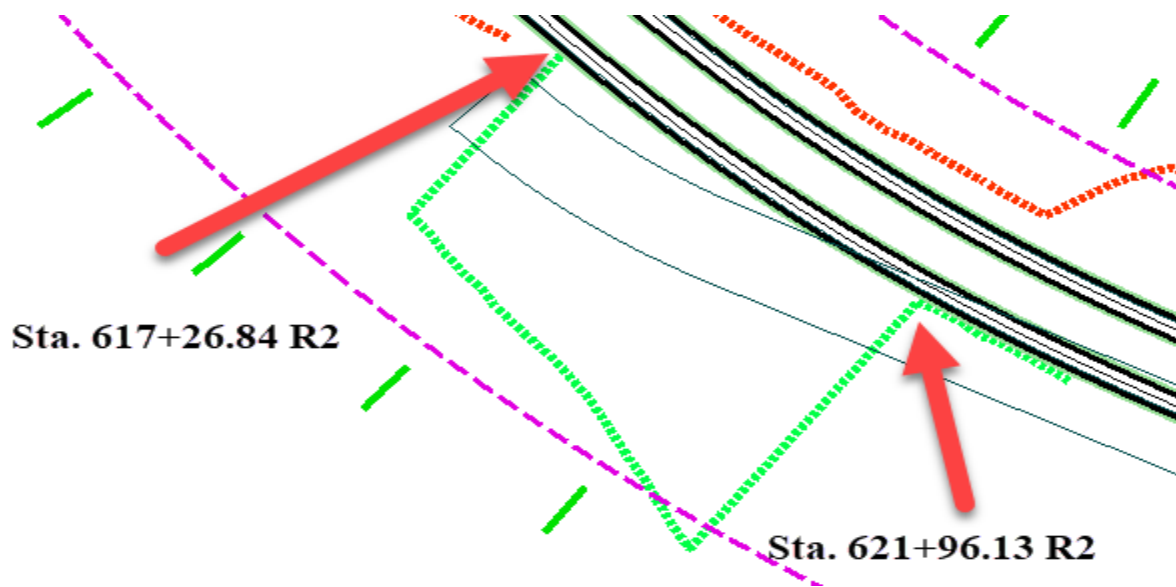
5. Select the **Route 54** Corridor Grips and bring up the heads-up tools. In those tools select the **Corridor Creation Tools** and then select the **Create End Condition Exception** tool.

In the **Create End Condition Exception tool**, first define the Name and then the Type of Exception.

End Condition Name:	<b>Override at Ramp 4</b>
Apply to End Condition Exception To (ECE):	<b>Right Override</b>



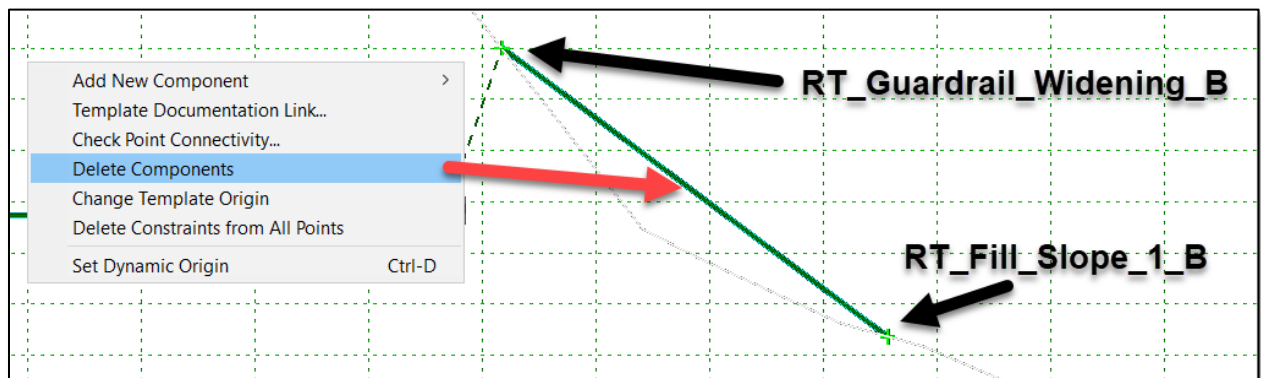
6. Next define the **Start** and **Stop Station** values.



Parameters	
Name	Override at Ramp 4
Apply ECE To	Right Override
<input checked="" type="checkbox"/> Start	617+26.84 R2
<input checked="" type="checkbox"/> Stop	621+96.13 R2

<b>End Condition Name:</b>	Override at Ramp 4
<b>Apply ECE To (Type):</b>	Right Override
<b>Start Station:</b>	617+26.84 R2
<b>End Station</b>	621+96.13 R2

7. **Do not** AccuSnap or Snap to any location on **Route 54** corridor, User will typically get a message saying “**Circular Dependency Detected - Reference Entity Depending on Corridor Result**”
8. Next, we need to first delete the current End Condition that is in the model.





9. In the Template Library select **Tools** ➔ **Options** and define the **Apply Affixes** ➔ **Prefixes** and **Step Options** as follows:

Template Options

Naming Options

Component Seed Name:

☒ From Feature Definition

☐ Specify:

Point Seed Name:

☒ Apply Affixes

Prefix Suffix

Left:

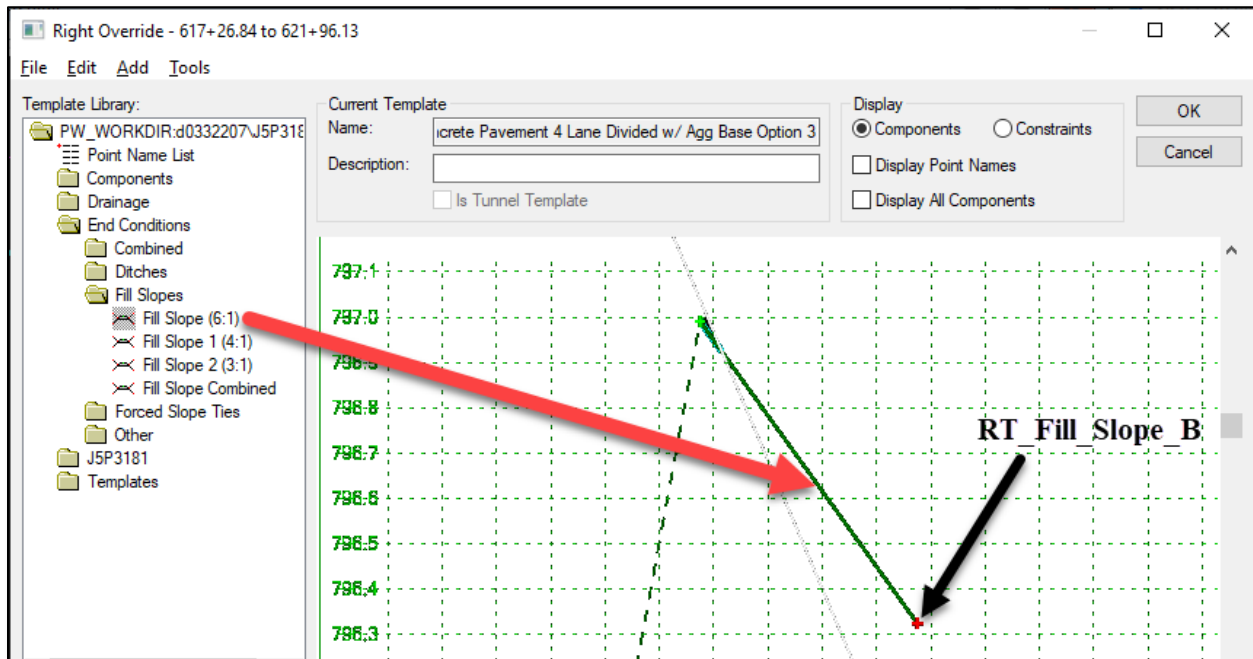
Right:

Step Options

X:  Y:  Slope:

OK Cancel Preferences...

10. Add the **Fill Slope (6:1) End Condition** to the template to define the Slope on the Right side.



11. Select the **RT\_Fill\_Slope\_B** point and modify the follows settings:

**Point Properties**

Name: RT\_Fill\_Slope\_B

☒ Use Feature Name Override: RT\_LOC\_Fill

Feature Definition: sint Features\Grading\XS\_LOC\_Fill

☐ Superelevation Flag

Alternate Surface: Proposed Finished Grade

**End Condition Properties**

☐ Check for Interception

☐ Place Point at Interception

☐ End Condition is Infinite

☐ Do Not Construct

Member of: RT\_Fill Slope

**Constraints**

Constraint 1

Type: Slope

Parent 1: RT\_Guardrail\_Widening\_

Parent 2: ☐ Rollover Values...

Value: -16.67%

Label: Fill\_Slope\_X\_Slope

☒ Horizontal Feature Constraint

Range: 100.0000

Constraint 2

Type: Horizontal

Parent 1: RT\_Guardrail\_Widening\_

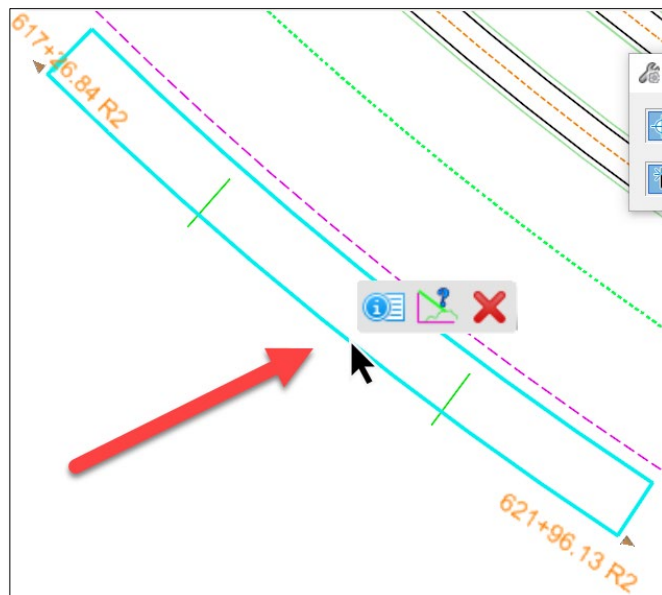
Value: 60.0000

Label: Fill\_Slope\_X\_Width

Linear\Bridge\Geometry\Center Lines

When done making the changes to the Point select **Apply** → **Close** → **OK**

12. In your **2D Corridor View** you should now have **End Condition Exception “Shape”**. If you **single left click** on the Shape you will get the **Station Values, Properties, Edit, and Delete** options for the Exception.

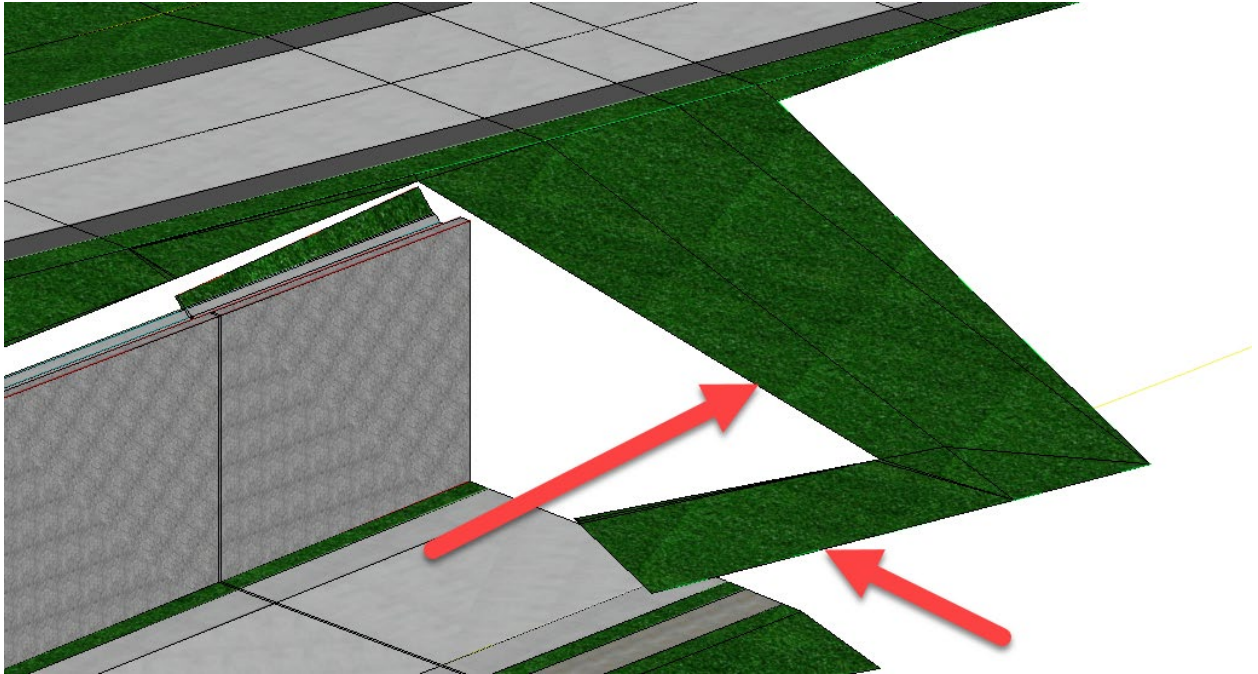


13. Next, we are going to **Clip-Out** the **Ramp-4 Corridor** so that there is no overlap between the two Corridors.

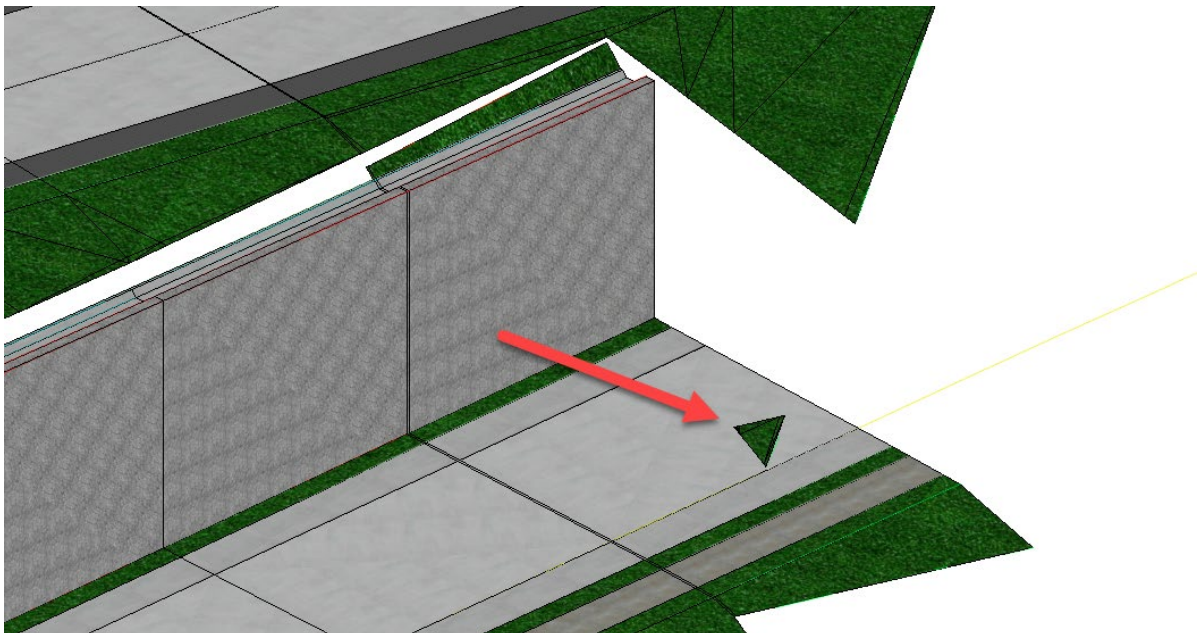
Select the **Route 54** Corridor Grips and bring up the heads-up tools. In those tools select the **Corridor Reference** ➔ **Add Clipping Reference**.

Next select the **Ramp-4 Corridor** and **Left-Click** to accept.

14. You will notice an area at the end of our **Ramp 4 Corridor** that is still protruding out from the **Route 54 Corridor**.

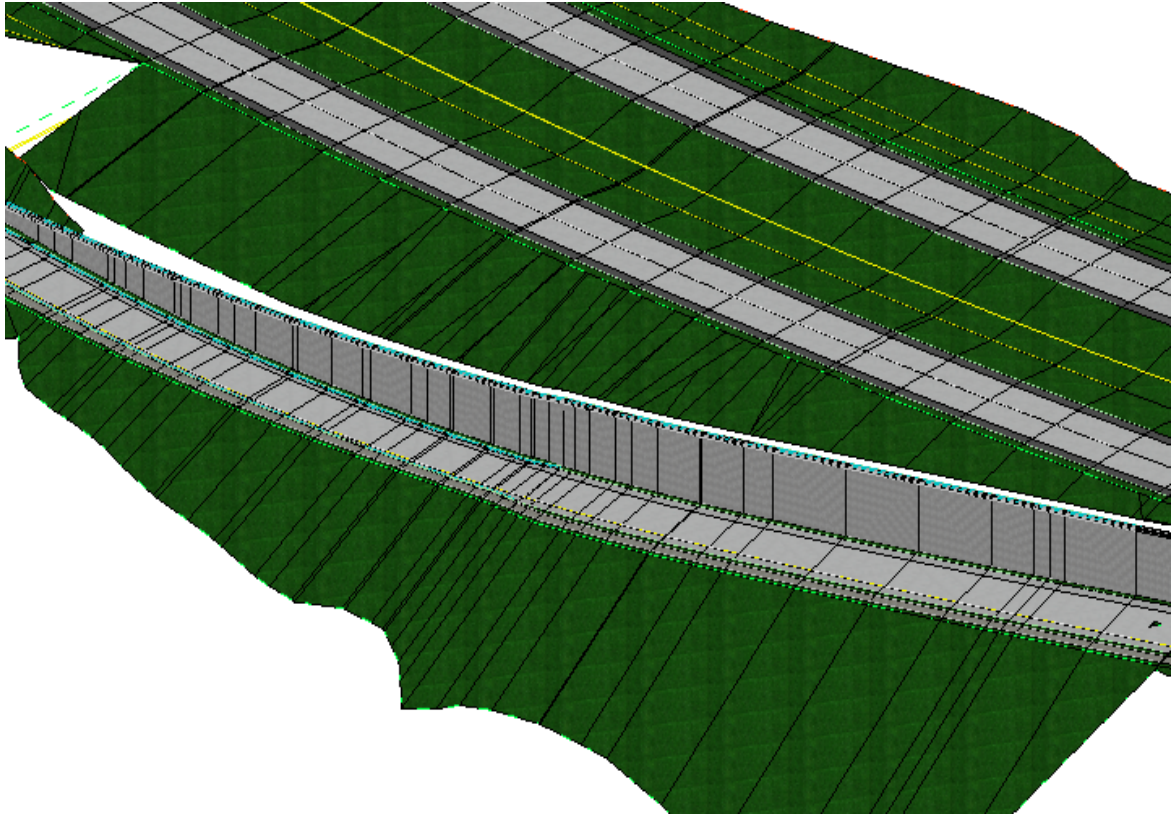


Adjust the end station of the End Condition Exception in your **2D Corridor View** to minimize this issue. Use a Station Value of **621+48 R2**. You will still have a little piece of the **Route 54 Corridor** hanging out in mid-air (See Below).



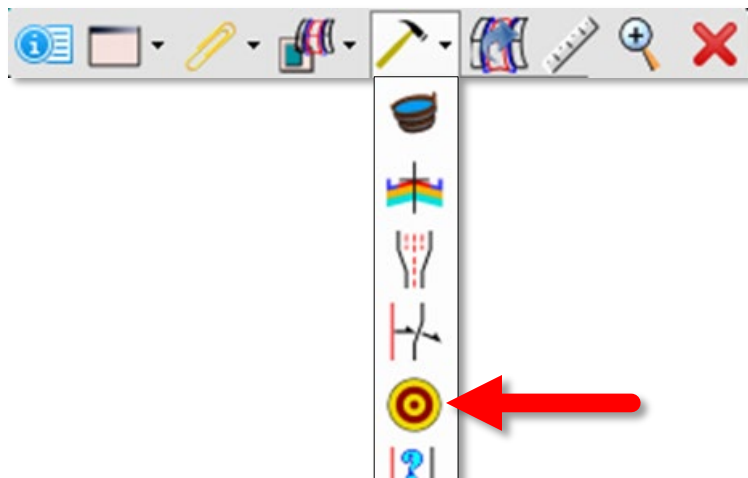


15. Within the **Roadway\data-7** folder, open the file: **Corridors\_Ramp-4\_J5P3181.dgn**
16. In the **Reference Dialog** turn on the Display of the **Route 54 Corridor** in both the **2D** and **3D** views.

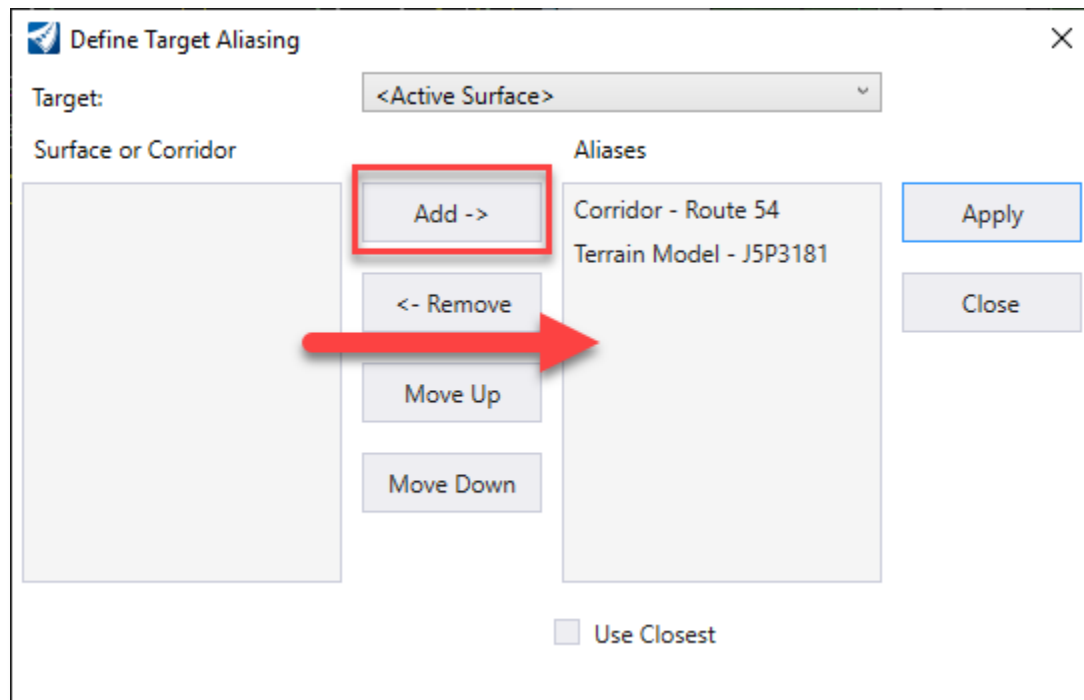


17. From the **Ramp 4 Corridor** we are going to adjust what our **End Conditions** are targeting. Currently the **End Condition** are targeting the **Active Surface** which is the **Existing Ground** surface/terrain.

Using the **Target Aliasing** tool, we are going to instruct our **End Conditions** to target the **Route 54** corridor **first**, and if the End Condition does not see the **Route 54** corridor, then target the **Active Surface** (Existing Ground Terrain).



18. Select the **Ramp 4** Corridor Grips and bring up the heads-up tools. In those tools select the **Corridor Creation Tools** → **Define Target Aliasing**.

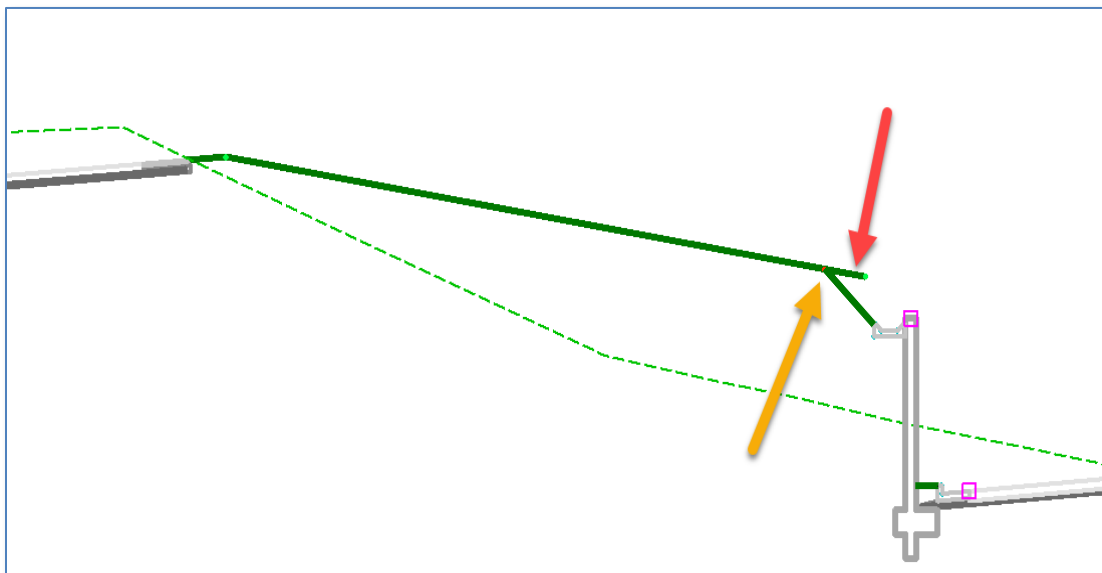


Add the **Route 54 corridor first** and then the **Terrain Model – J5P3181**.

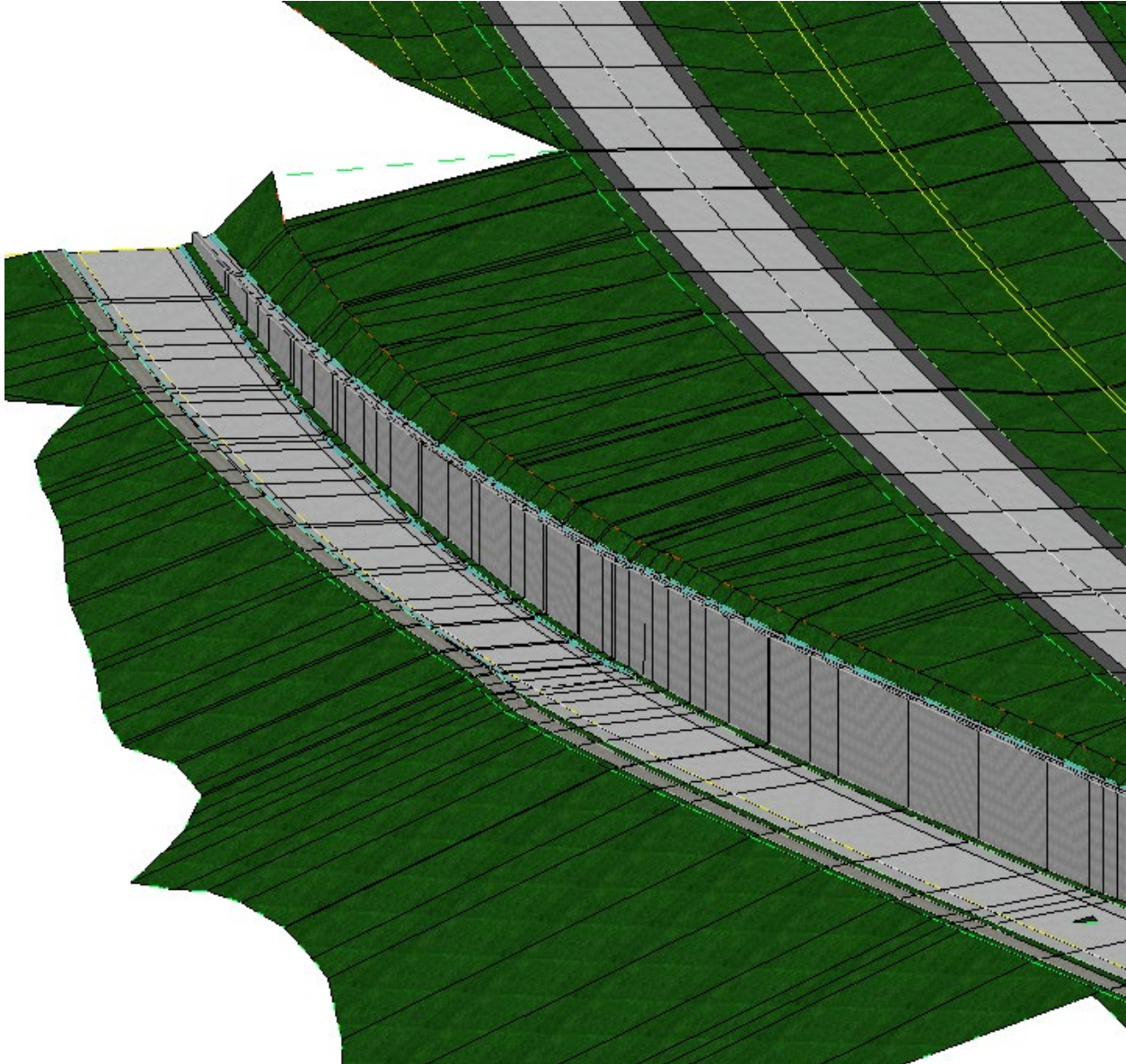
**Note:** Order does matter in this dialog, item at the top will be targeted first.

19. Select the **Ramp 4** Corridor Grips and bring up the heads-up tools. In those tools select the **Corridor Views** → **Open Cross Section Model**.

You will notice an overhang in the **Route-54** model. You will need to open the **Corridors\_Route-54\_J5P3181.dgn** file and let the corridor process the changes to the **Ramp 4 Corridor**. Remember the **Route 54 Corridor** was Clipping out the **Ramp 4 Corridor**.



20. Within the **Roadway\data-7** folder, open the file: **Corridors\_Route-54\_J5P3181.dgn**
21. If needed, select the **Route 54** Corridor Grips and bring up the heads-up tools. In those tools select the **Process Corridor** to update the corridor.



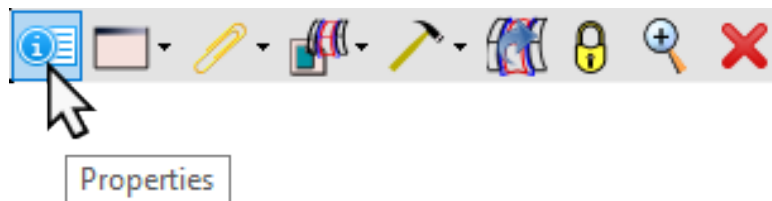


## 7.15 Group Exercise: Adjusting the Feature Definition (Corridor Design Stage)

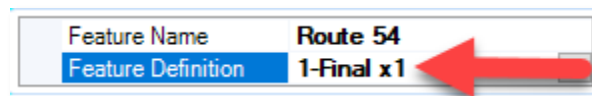
In the next chapter we are going to create Cross Sections, before doing so the User will switch and adjust the **Feature Definition** (Corridor Design Stage) to **1-Final x 1**.

Within the **Roadway\data-7** folder, *open both Corridor Files* and adjust the **Feature Definition** (Corridor Design Stage) to **1-Final x 1**

Select the Corridor Grips and bring up the heads-up tools. In those tools select the **Properties** icon.

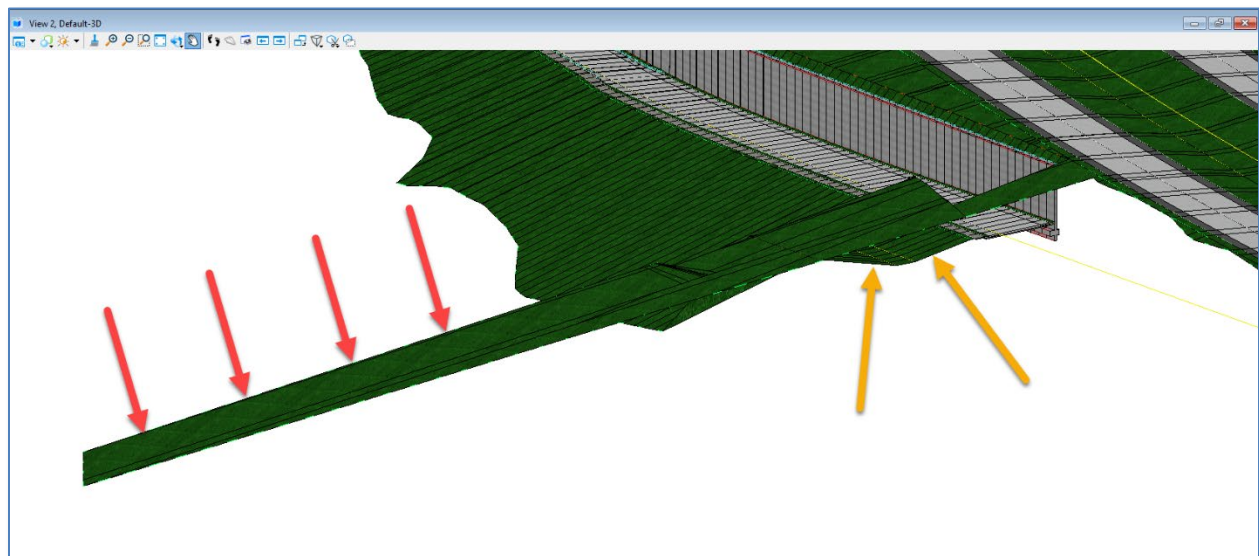


1. Set the **Feature Definition** (Corridor Design Stage) to **1-Final x 1**



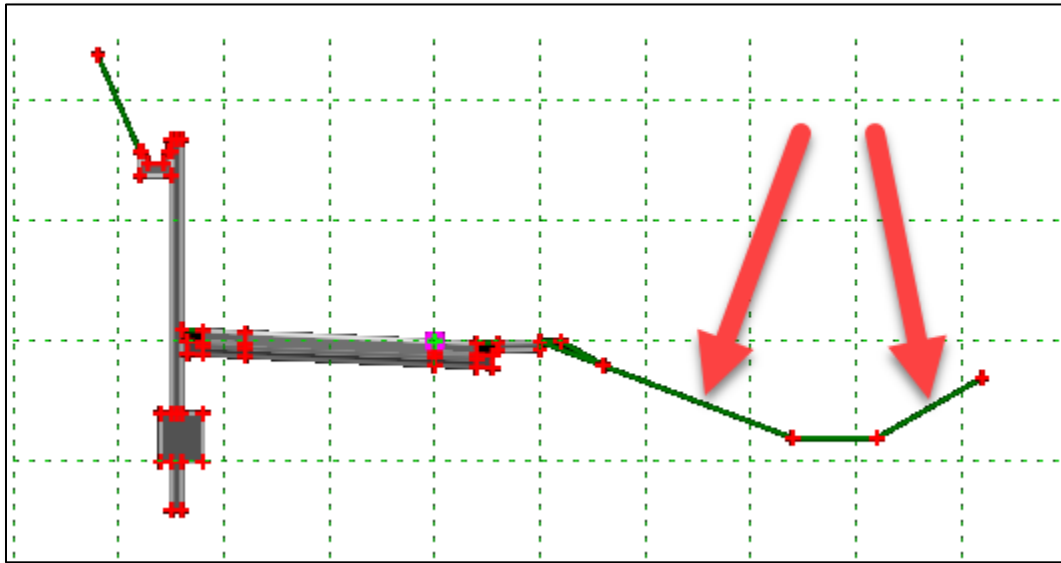
2. When the **Corridor Feature Definition** (Corridor Design Stage) is set to **1-Final x 1**, the change causes the following two things to happen to the model.

- **Red Arrow** → The **Route 54** side slope becomes more pronounced at the end of **Ramp 4**.
- **Yellow Arrow** → A ditch is drawn at the end of the **Ramp 4**

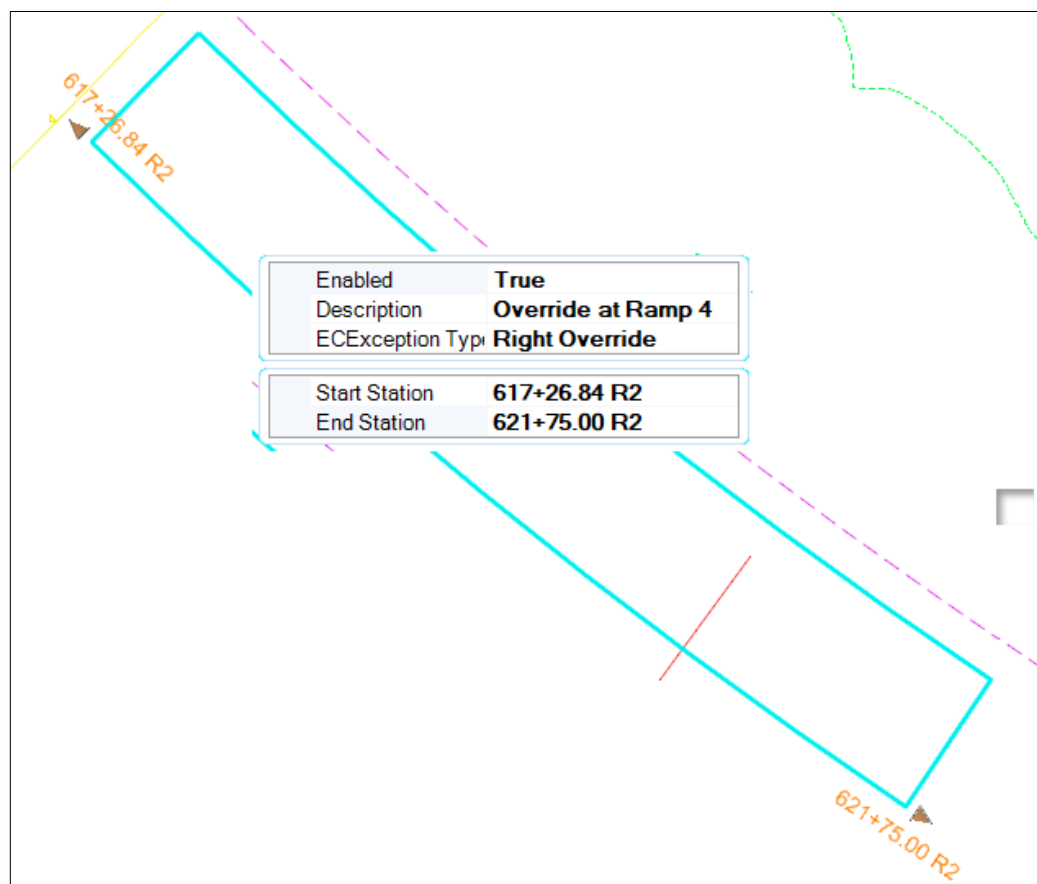


3. To remove those two effects first open the file: **Corridors\_Ramp-4\_J5P3181.dgn**, within the **Roadway\data-7** folder.

Within Ramp 4's **second template drop**, remove/delete the **Ditch End Condition**.



4. Open the file: **Corridors\_Route\_54\_J5P3181.dgn**, within the **Roadway\data-7** folder.
5. To help remove some of the long **Fill Slopes** coming off **Route 54**, select the **End Condition Override** shape, modify by extending the End Station to **621+75.00 R2**





6. To help further remove the remaining long Fill Slopes coming off Route 54, use the following Parametric Constraint instructions:

Within the **End condition Override** identify the **Parametric Label** for the **Horizontal Constraint** *RT\_Fill\_Slope\_B*.

The screenshot shows the 'Constraints' dialog box with two constraints defined:

Constraint 1	Constraint 2
Type: Slope	Type: Horizontal
Parent 1: RT_Guardrail_Widening_	Parent 1: RT_Guardrail_Widening_
Parent 2: <input type="checkbox"/> Rollover Values...	Parent 2: <input type="checkbox"/> Rollover Values...
Value: -16.67%	Value: 60.0000
Label: Fill_Slope_X_Slope	Label: Fill_Slope_X_Width
<input checked="" type="checkbox"/> Horizontal Feature Constraint	<input checked="" type="checkbox"/> Horizontal Feature Constraint
Range: 100.0000	Range: 100.0000

Select the **Route 54** Corridor Grips and bring up the heads-up tools. In those tools select the **Corridor Creation Tools** and then select the **Parametric Constraint** tool.

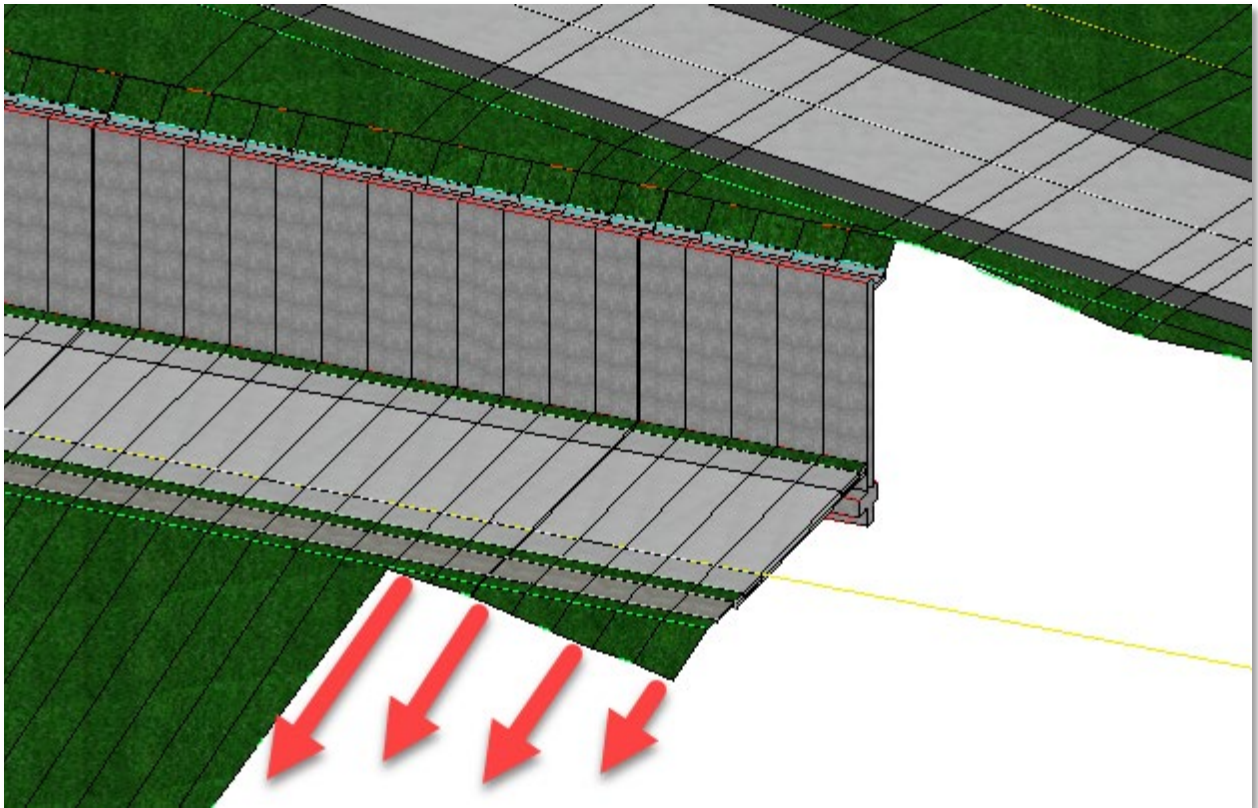
In the Parametric Constraint dialog, define the values as listed below, once the values are defined accept values by left clicking to create the Parametric Constraint.

The 'Create Parametric Constraint' dialog box contains the following settings:

Lock To Start	<input type="checkbox"/>
<input checked="" type="checkbox"/> Start	621+40.00 R2
Lock To End	<input type="checkbox"/>
<input checked="" type="checkbox"/> Stop	621+75.00 R2
Constraint Label	Fill_Slope_X_Width
Start Value	5.0000
Stop Value	0.0000

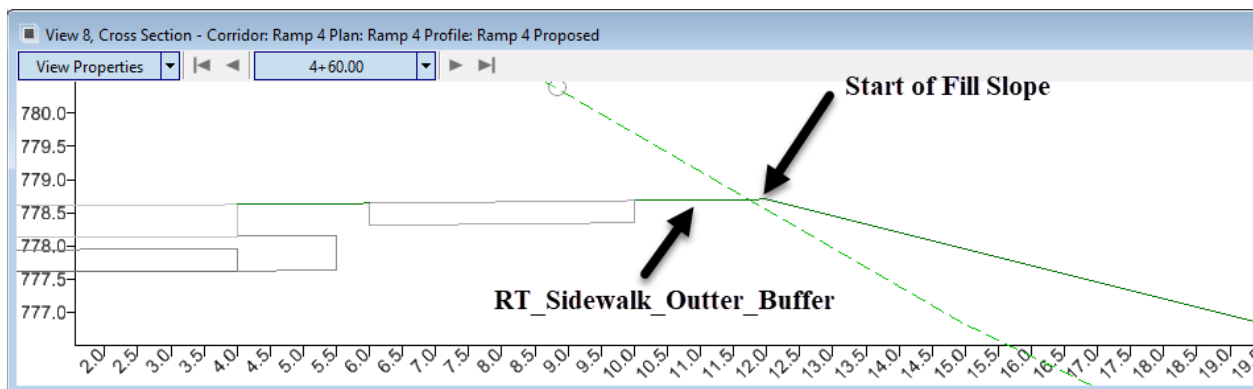
Start:	621+40.00 R2
Stop:	621+75.00 R2
Constraint Label:	Fill_Slope_X_Width
Start Value:	5.0000
Stop Value:	0.0000

7. Lastly let us extend the Fill Slope downward so that they look similar to the Fill Slopes within the Ramp 4 Corridor.

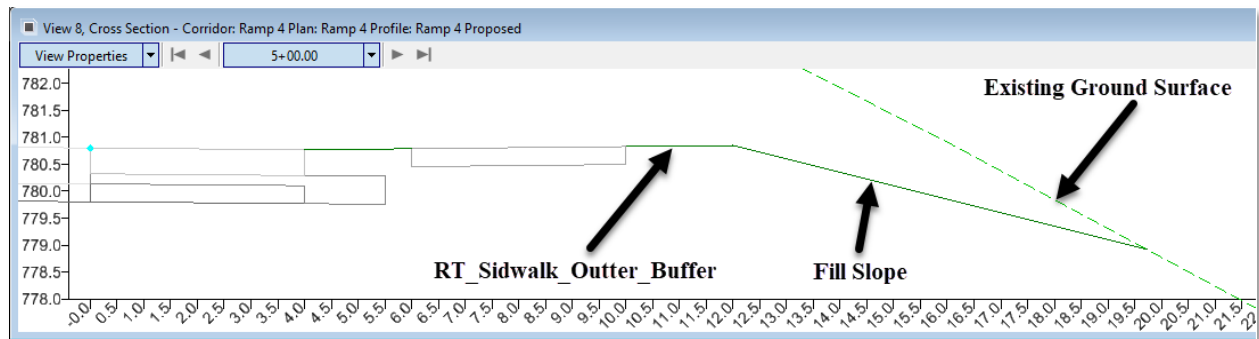


8. Open the file: **Corridors\_Ramp\_4\_J5P3181.dgn**, within the **Roadway\data-7** folder.

The reason the Fill slopes are so long mostly throughout the **Ramp 4 Corridor** is because the ground line goes through the **RT\_Sidewalk\_Outter\_Buffer**, which is not part of the End Condition. The Fill Slope eventually does find its target, but it must go a long way reach the Existing Ground Surface.

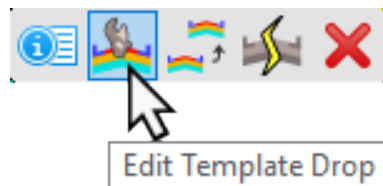


The reason the Fill slopes are so short at the End of the **Ramp 4 Corridor** is because the ground line goes through the **Fill Slope**, which is part of the End Condition, and thus hits its target.

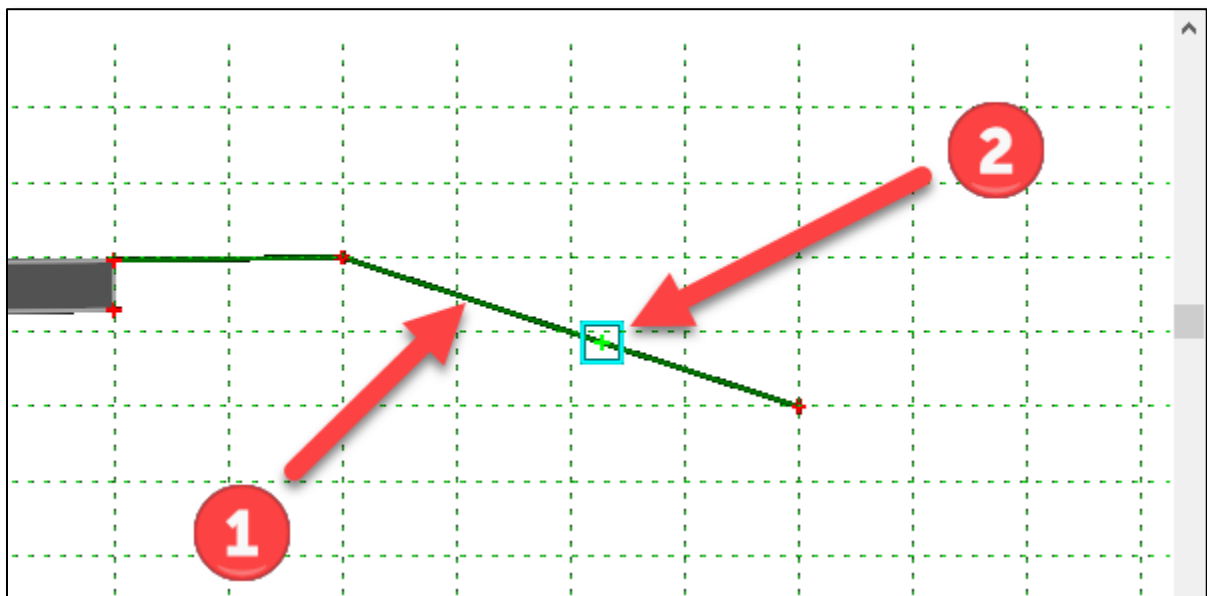


9. To make the **Right End Slopes** at the end of the alignment look like the rest of the corridor we are going to adjust the End Condition in the Template. To do this we will adjust the Template Drop within the Corridor/dgn file.

Select the Second **Ramp 4** Template Drop and bring up the heads-up tools. In those tools select the **Edit Template Drop** tool.



Within the template Drop, first **Select the Right Fill Slope** and then select **Insert Point**. Place the point somewhere between the two existing points.



10. Double-Click on new “Inserted” point and define the point as follows:

**Point Properties**

Name: **RT\_Fill\_Slope\_1\_Mid** [Apply]

☐ Use Feature Name Override: [Close]

Feature Definition: [No Feature Definition] [< Previous]

☐ Superelevation Flag [Next >]

Alternate Surface: [ ]

**End Condition Properties**

☐ Check for Interception

☒ Place Point at Interception

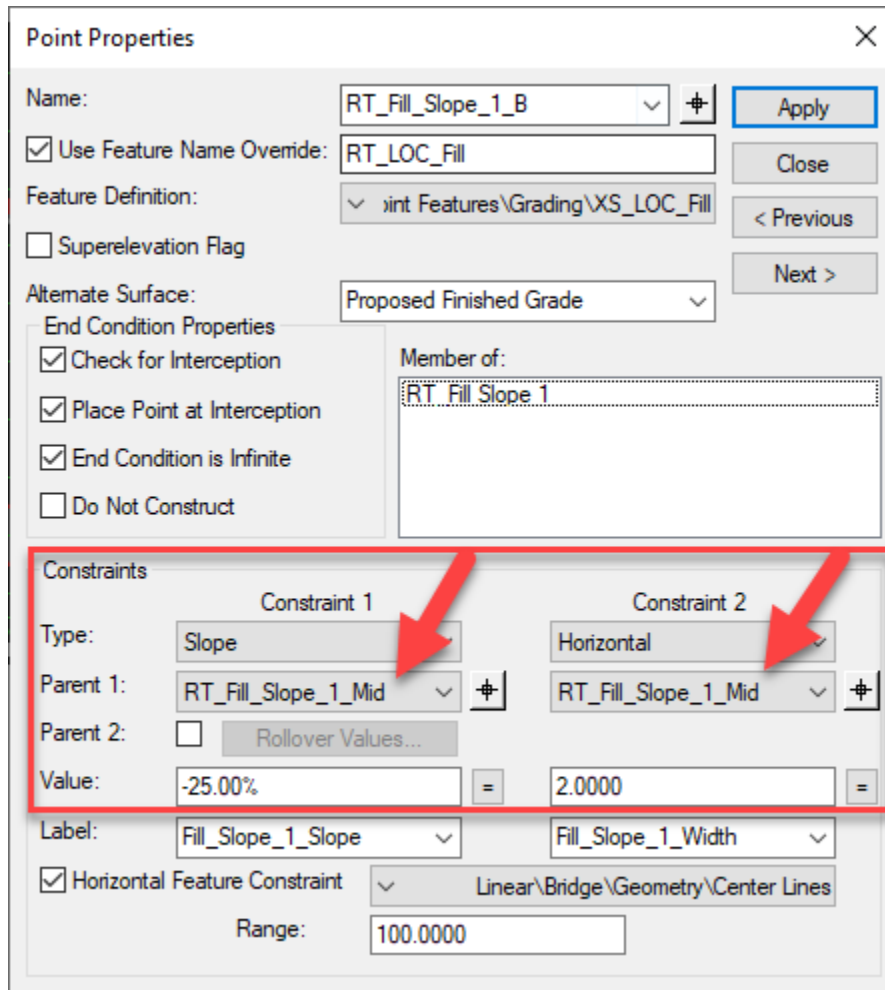
☐ Do Not Construct

Member of: RT\_Fill Slope 1

**Constraints**

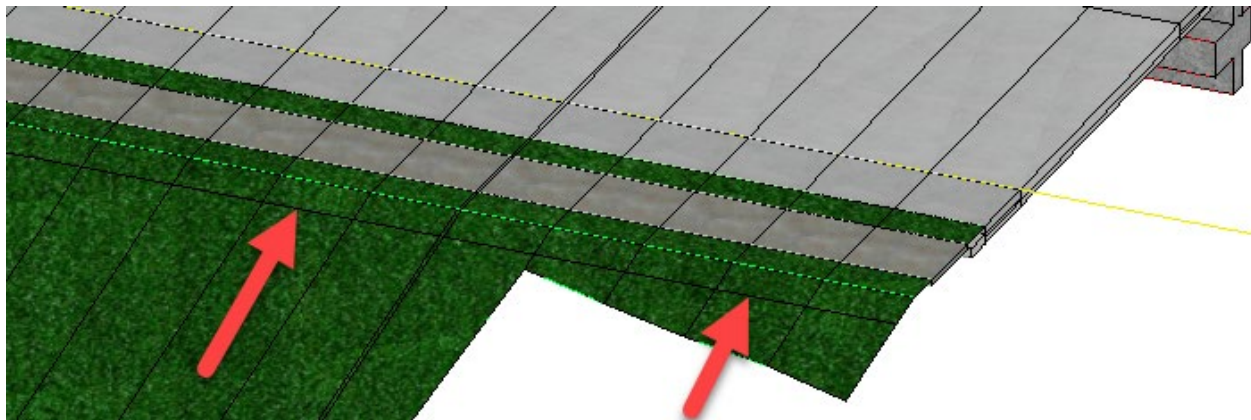
	Constraint 1	Constraint 2
Type:	Horizontal	Slope
Parent 1:	RT_Swlk_Outer_Buffer	RT_Swlk_Outer_Buffer
Value:	2.0000	-25.00%
Label:		
<input type="checkbox"/> Horizontal Feature Constraint	Linear\Bridge\Geometry\Center Lines	
Range:	0.0000	

11. Double-Click on the last point of the Fill Slope (**RT\_Fill\_Slope\_1\_B**) and redefine the Parent points to **RT\_Fill\_Slope\_1\_Mid**:

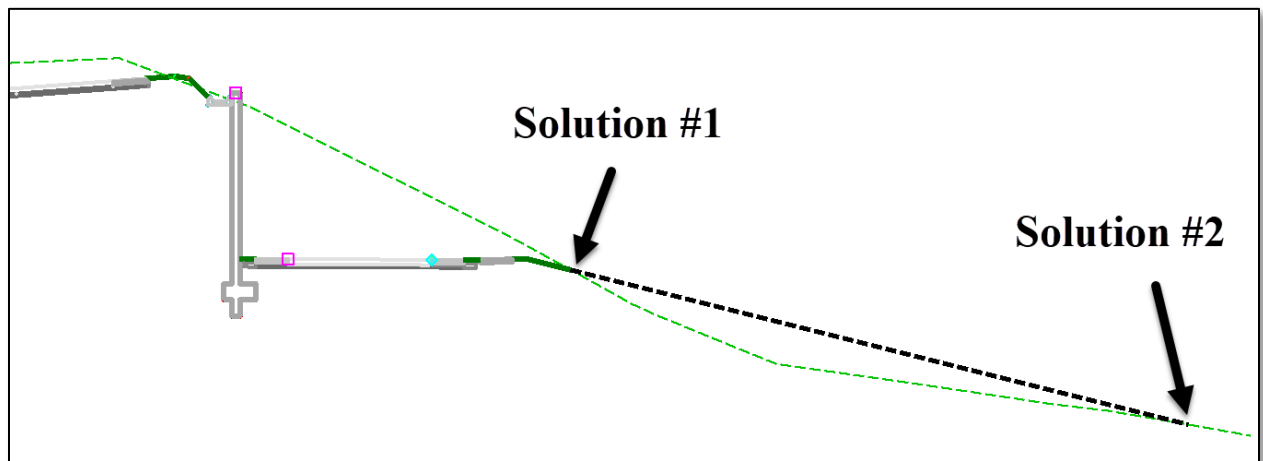


The screenshot shows the 'Point Properties' dialog box for the point **RT\_Fill\_Slope\_1\_B**. The 'Name' field is set to **RT\_Fill\_Slope\_1\_B**. The 'Use Feature Name Override' checkbox is checked, and the 'Feature Definition' is set to **int Features\Grading\XS\_LOC\_Fill**. The 'Alternate Surface' is set to **Proposed Finished Grade**. The 'End Condition Properties' section includes checkboxes for 'Check for Interception' (checked), 'Place Point at Interception' (checked), 'End Condition is Infinite' (checked), and 'Do Not Construct' (unchecked). The 'Member of' list contains **RT\_Fill\_Slope\_1**. The 'Constraints' section is highlighted with a red box and red arrows pointing to the 'Parent 1' and 'Parent 2' fields, which are both set to **RT\_Fill\_Slope\_1\_Mid**. The 'Value' field is set to **-25.00%**. The 'Label' field is set to **Fill\_Slope\_1\_Slope**. The 'Horizontal Feature Constraint' checkbox is checked, and the 'Range' is set to **100.0000**.

12. You will notice that the Model did change slightly because End Condition is still hitting its target (Existing Ground Surface) at the first Solution. If the User moves the **RT\_Fill\_Slope\_1\_Mid** point out further the End Condition will not solve until it hits the Existing Ground Surface further out, the second solution (see image below).



In the cross-sections at the end of **Ramp 4** the End Condition has two solutions



13. Double-Click on new “Inserted” point named **RT\_Fill\_Slope\_1\_Mid** and adjust the **Horizontal Constraint** to **10.000 Feet**:

Point Properties

Name: RT\_Fill\_Slope\_1\_Mid [Apply]

☐ Use Feature Name Override: RT\_Fill\_Slope\_1\_Mid [Close]

Feature Definition: [No Feature Definition] [< Previous] [Next >]

☐ Superelevation Flag

Alternate Surface: [ ]

End Condition Properties

☐ Check for Interception

☒ Place Point at Interception

☐ Do Not Construct

Member of: RT\_Fill Slope 1

Constraints

Constraint 1

Type: Horizontal

Parent 1: RT\_Swlk\_Outer\_Buffer

Value: 10.0000

Label: [ ]

☐ Horizontal Feature Constraint

Range: 0.0000

Constraint 2

Slope

Parent 2: RT\_Swlk\_Outer\_Buffer

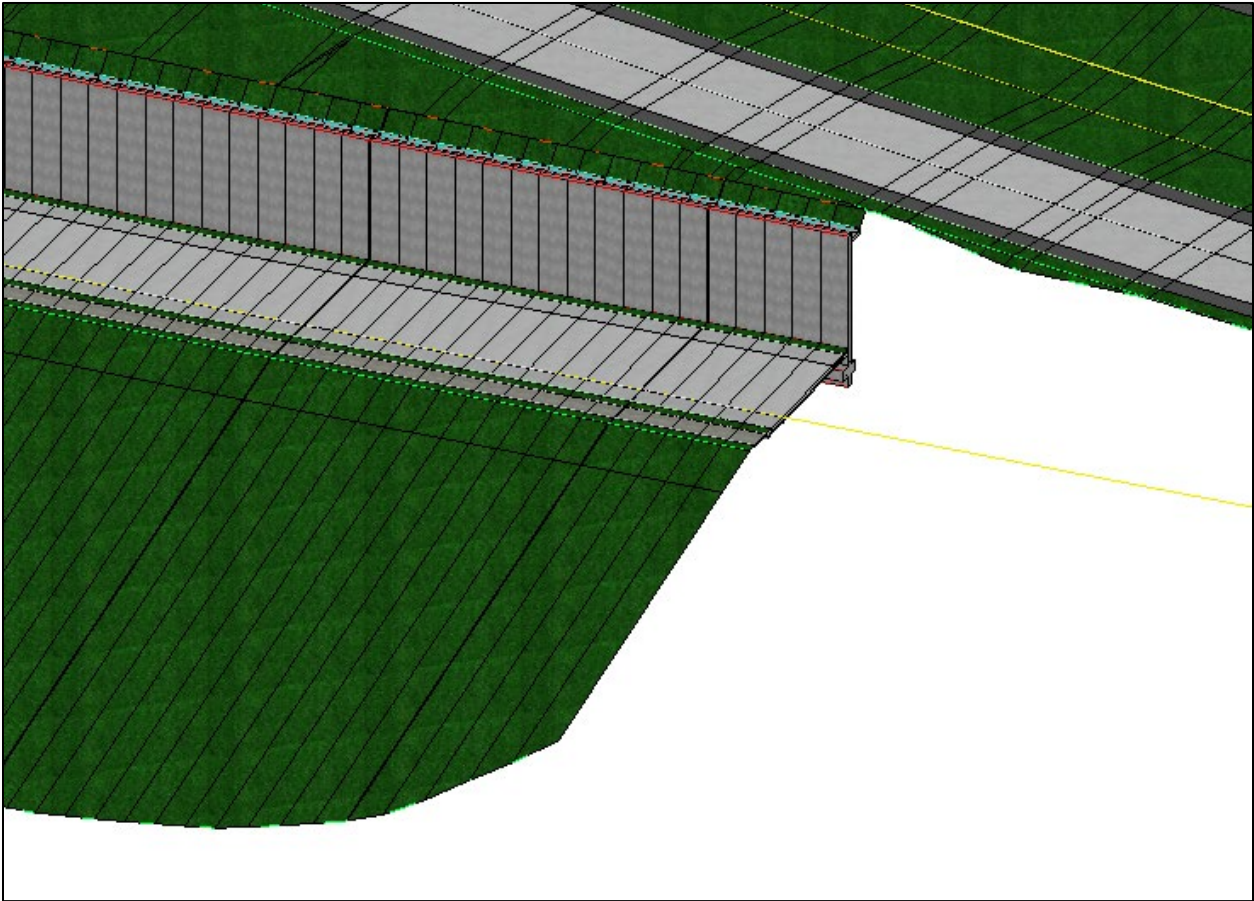
☐ Rollover Values...

Value: -25.00%

Linear\Bridge\Geometry\Center Lines



14. After Selecting “**Apply**”, and “**Save**” to the template changes, the model should update and look like the following:



---

## Chapter 8

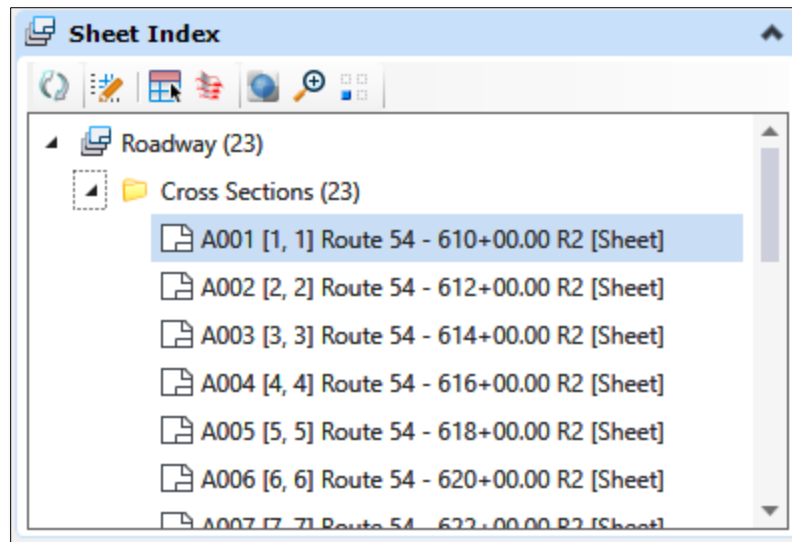
# Named Boundaries: Cross Sections, Annotation, Sheet Index, and End Area Volumes




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## Explorer Dialog Sheet Index Tab

A sheet index is an organized and named collection of sheet models from one or more design files. You may link any sheet model from any design file into a sheet index. You can then manage the properties of all the sheet models within the sheet index collectively. Sheet indexes may also be added to print organizer print sets for printing.

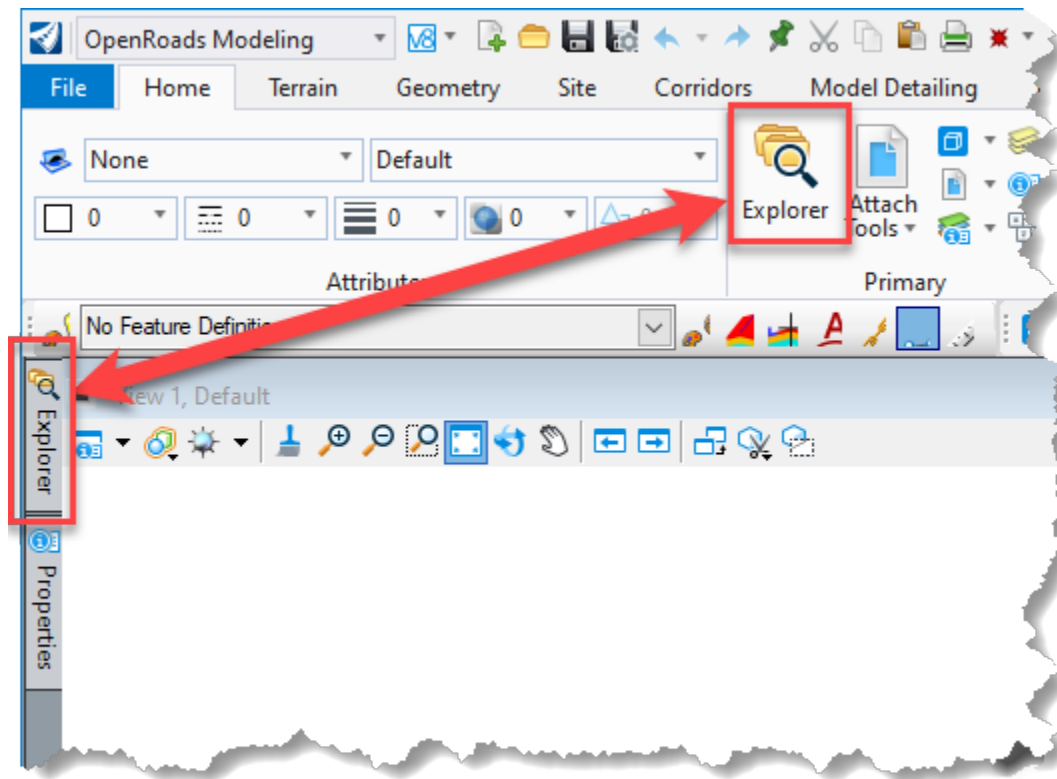


Setting	Description
<b>Refresh</b>	 <p>Refreshes the content of the sheet index. Though the sheet index automatically refreshes when you make any changes, in some cases, you may need to refresh it manually by clicking this icon.</p>
<b>Open Sheet Index for Edit</b>	 <p>Allows you to make changes to the sheet index. When you click this icon, other users cannot make changes to the sheet index.</p>
<b>Make Sheet Index Read Only</b>	 <p>Turns off editing options on the sheet index. When you click this icon, the changes made to the sheet index are saved and other users can make changes to the sheet index.</p>

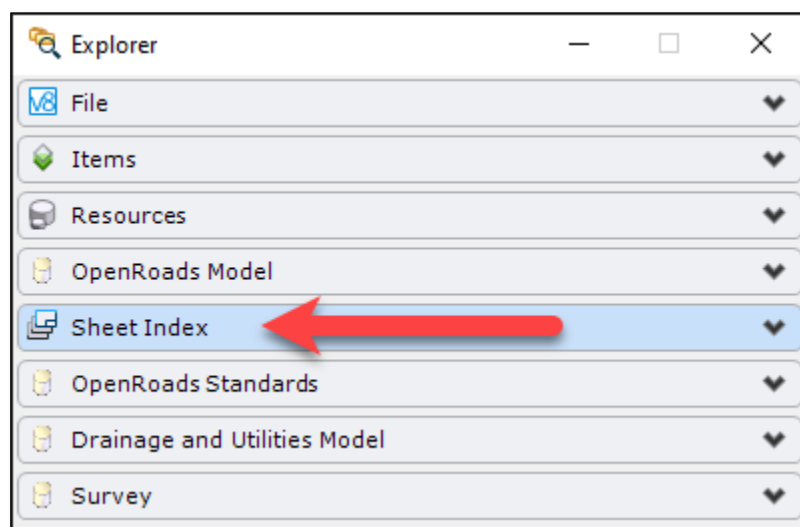
Setting	Description
<b>Manage Sheet Index</b>	 <p>Opens the <b>Manage Sheet Index dialog</b> in which you can manage the sheet index and its properties.</p>
<b>Create Folder</b>	 <p>Creates a new folder in the sheet index.</p>
<b>Add Sheet</b>	 <p>Opens the <b>Add Sheet</b> dialog from where you can select the file from which you want to <b>add sheet links</b>.</p>
<b>Delete</b>	 <p>Deletes the selected folder or sheet link from the sheet index. If the folder contains links or other folders, they are deleted as well.</p>
<b>Place as Table</b>	 <p>Starts the <b>Place Table tool</b> to place the index sheet. An index sheet contains properties of all the sheets in the sheet index that is placed as a table. Once placed, a report definition of the index sheet is also created in the Reports dialog.</p>
<b>Open Print Organizer</b>	 <p>Opens the Select Print Style dialog. Selecting the desired print style in the Select Print Style dialog and clicking OK opens the Print Organizer. The Sheet Index displays in the Print Organizer. You can compose a new print set file using the sheet index.</p>

## 8.1 Group Exercise: Creating a Sheet Index

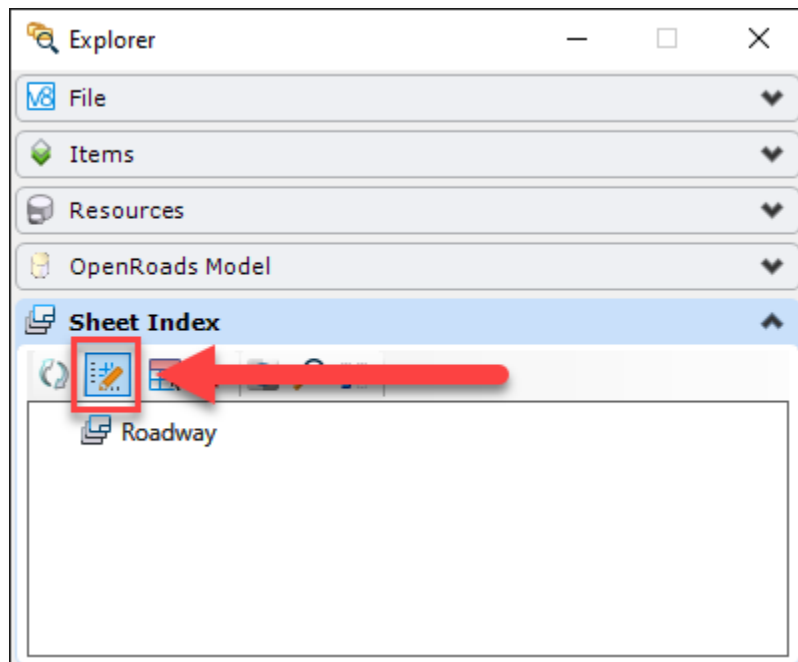
1. Within the **Roadway\data-8** folder, open the file: **Corridors\_Route-54\_J5P3181.dgn**
2. Open the **Explorer** tool by selecting the **OpenRoads Modeling Workflow** → **Home Tab** → **Primary Section**.



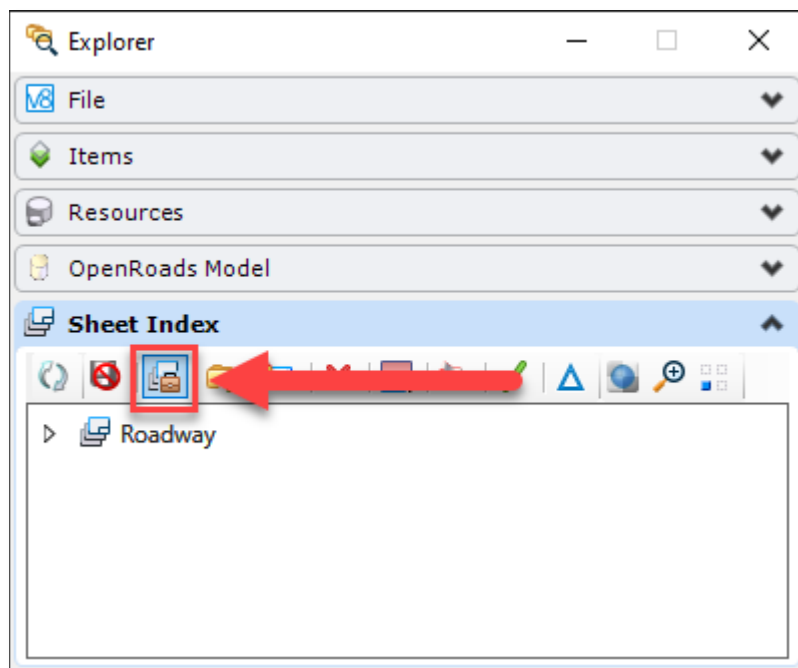
3. Navigate to the **Sheet Index** section.



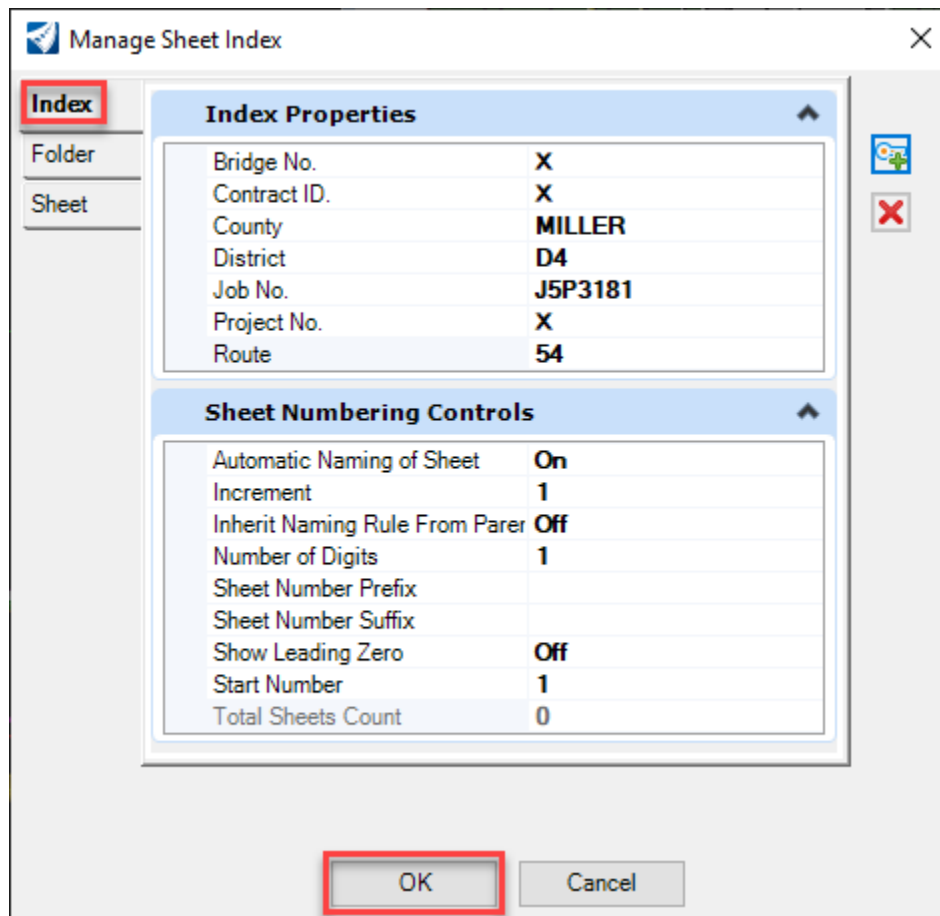
4. Select the **Open Sheet Index for Edit** tool.



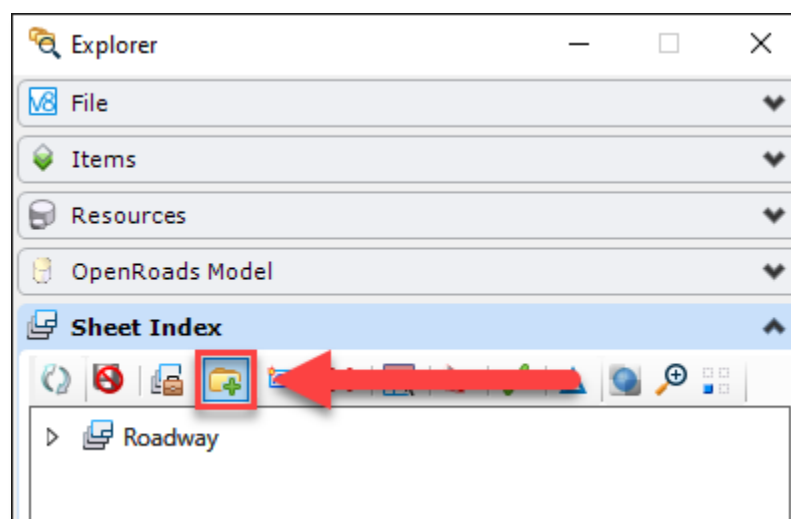
5. Select the **Manage Sheet Index** tool.



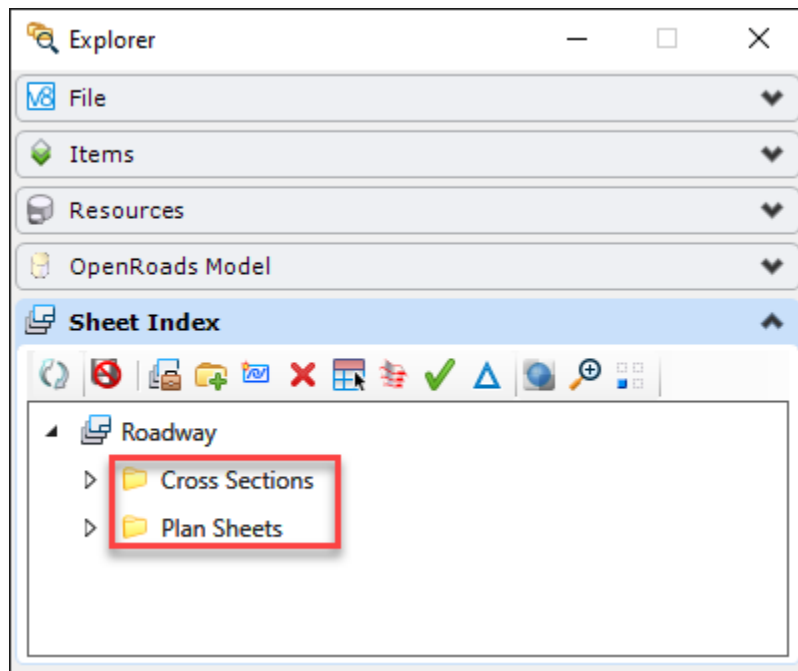
6. Edit the **Index** properties and then select “OK”



7. Select the **Create Folder** tool.



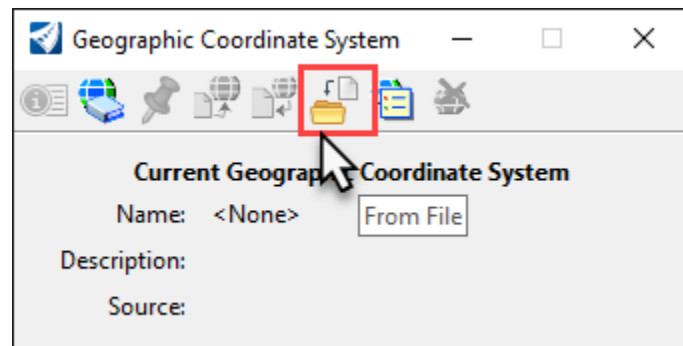
8. Create a folder named **Cross Sections** and then another folder named **Plan Sheets**.



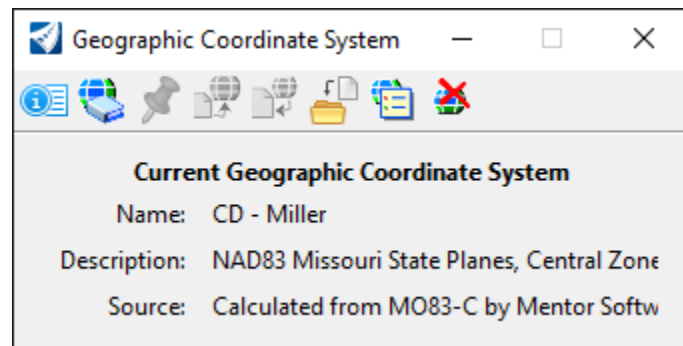
## 8.2 Group Exercise: Creating Route 54 Cross Sections

### Create a New Cross-Section Design File:

1. If not open already, within the **Roadway\data-8** folder, open the file: **Corridors\_Route-54\_J5P3181.dgn**
2. Create a new file named **Named\_Boundary\_Route-54\_XS\_J5P3181.dgn** using the **MoDOT\_Roadway\_Seed\_2D.dgn** seed file.
3. Open the **Coordinate System** tool by selecting the **OpenRoads Modeling Workflow** → **Utilities Tab** → **Geographic Section**.
4. Select “**From File**” icon.



5. Select the **Terrain\_J5P3181.dgn** file in the **data-8** folder.
6. Verify the settings.



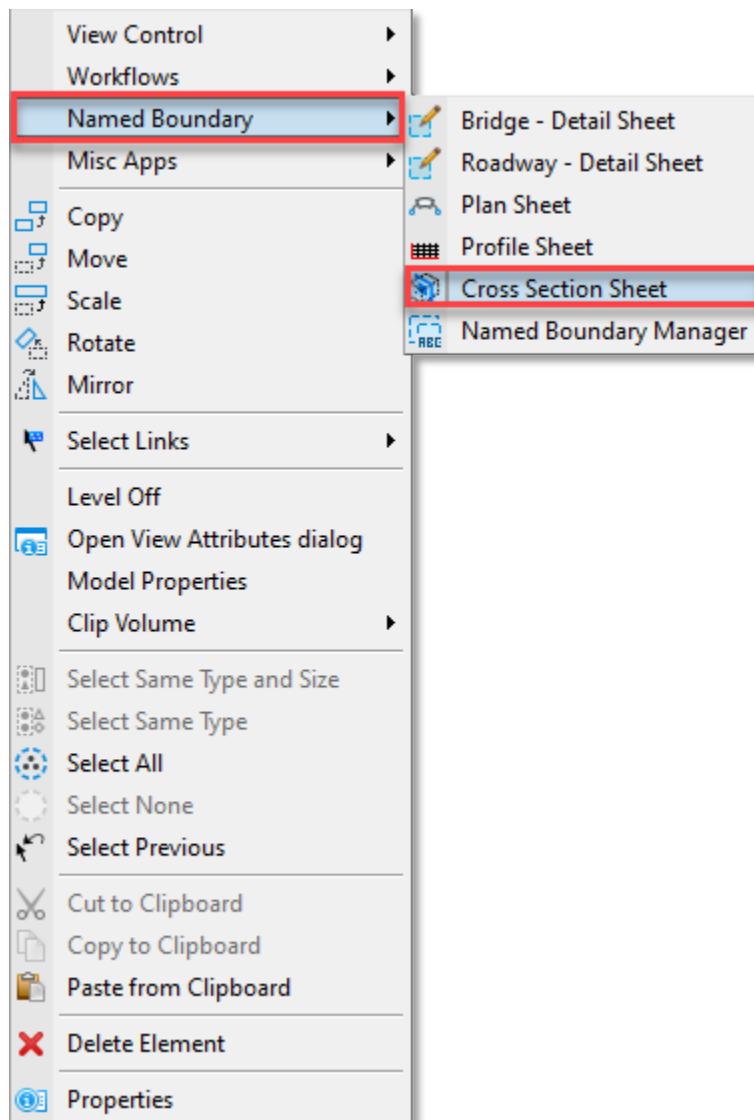
7. Reference in the following file:
  - a. **Civil\_Geometry\_J5P3181.dgn**
  - b. **Corridors\_Route-54\_J5P3181.dgn**
  - c. **Land\_Boundary\_J5P3181.dgn**
  - d. **Terrain\_J5P3181.dgn**
8. Change the **Annotation Scale** to **1”=50’**
9. MicroStation **Fit View** to the project location.
10. Activate the **Terrain**

11. Zoom in to the **Route 54** Corridor.

## Creating the Named Boundary

12. **IMPORTANT:** Enable both the **2D** and a **3D** view by selecting the **F6** key (or the tool will create the Named Boundaries and **NOT** the sheet and drawing models. The sheets may be created at a different time using the Named Boundaries Manager)
13. In this next step we are going to be placing Named Boundarys to indicate where we want to cut cross sections. We are going to show you two ways to open the Named Boundary Tool.

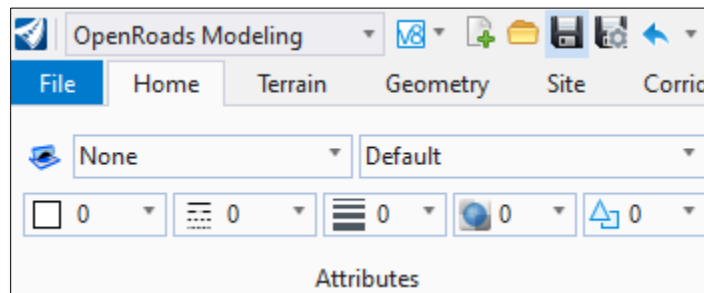
The first way to open the **Named Boundary** tool is to **Right-Click** in a blank area in the Default 2D window (typically **View #1**)



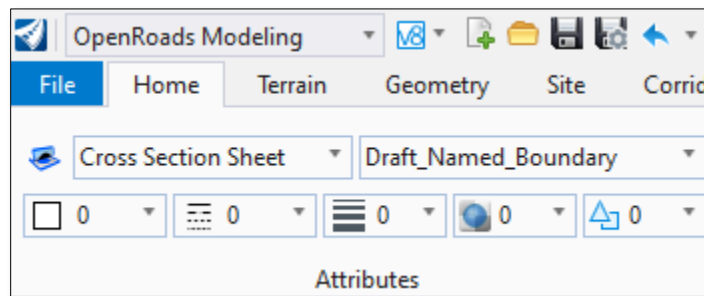


The benefit of using the right click option is that ORD will automatically set up the Attributes for the **Named Boundary**.

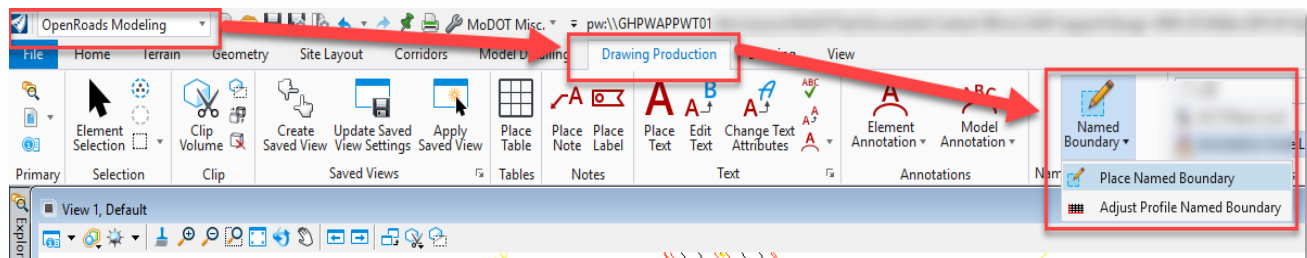
Before



After

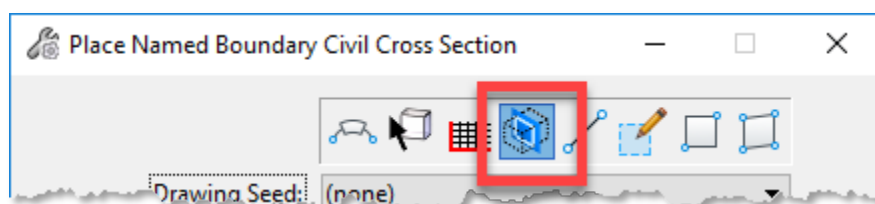


The second way to access the Named Boundary tool is to select the **OpenRoads Modeling Workflow → Drawing Production** tab → **Named Boundary** tool.



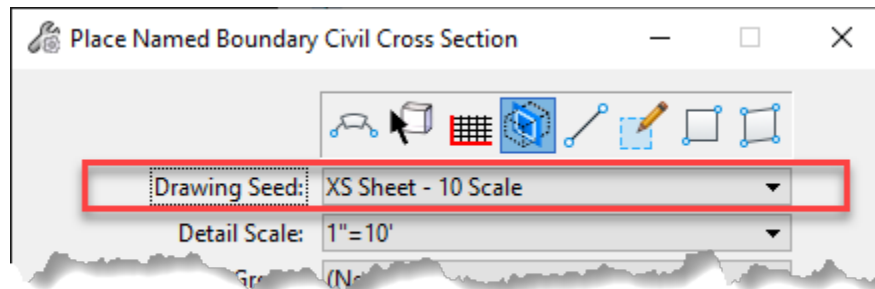
This method unfortunately does not set up the **Named Boundary** Attributes.

14. After the Place Named Boundary dialog opens, select the **Civil Cross Section** icon



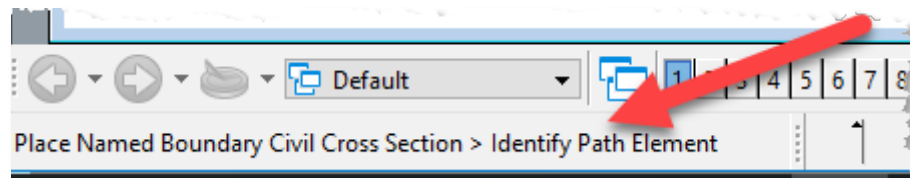
15. **Choose** the Drawing Seed from the drop-down menu

**XS Sheet – 10 Scale option**



**NOTE:** Once the Drawing Seed is selected the default preference (the offsets, interval and the clearances) will be added to the dialog box.

16. In the Lower Left Corner OpenRoads should be prompting you to **Identify Path Element**.



17. **Data Point** on the centerline of **Route 54**.

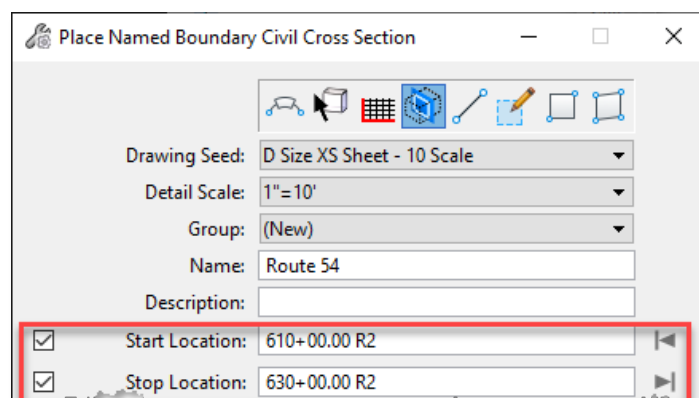
**Note:** The tool will progress to picking a **Start Station** dynamically or by key-in. You can move your cursor beyond the start of the alignment and data point in a blank area which will apply the first station as the start station. To **manually key-in a station** it must be done in the Place Named Boundary Civil Cross Section dialog after the start station has been accepted by a data point in a blank area of the screen.

18. For this exercise we will use **610+00 R2** as the start station for this exercise.

**Note:** The “R” represents that the alignment has a **station equation** applied to it and the following number represents the region

**Accept the 610+00 R2 start station** by data point in a blank area.

19. The stop station will be **630+00 R2**. Input the data in the dialog and **accept**.



20. The **Left Offset** = **-110** and the **Right Offset** = **170** for this exercise

**NOTE:** Viewing the 2D model makes it clear that there is more room needed on the right side of the alignment for the slope limits of construction.

21. The **Interval** = **100** for this exercise.

Left Offset: -110.000000  
Right Offset: 170.000000  
Interval: 100.000000  
Vertical Exaggeration: 1.000000  
☒ Top Clearance: 20.000000  
☒ Bottom Clearance: 10.000000  
Elevation Datum Spacing: 5.000000  
Event Point List: (None)

22. **Include Control Points** - Adds cross sections at horizontal control points such as PC and PT (Optional)

**Backward Facing** – Will create boundaries with a backward facing view

**Create Drawing** - When enabled, the process to create the cross-section sheets is automatically started after the named boundaries are created. When disabled, the named boundaries are created but the sheets are not created.

**Show Dialog** – when enabled, a dialog with additional parameters set by the Drawing Seed is shown

☐ Include Event Points Only  
☐ Include Control Points  
☐ Backward Facing  
☒ Create Drawing  
☒ Show Dialog

23. **Review** Place Named Boundary Civil Cross Section Dialog:

**Place Named Boundary Civil Cross Section**

Drawing Seed: XS Sheet - 10 Scale

Detail Scale: 1" = 10'

Group: (New)

Name: Route 54

Description:

☒ Start Location: 610+00.00 R2

☒ Stop Location: 630+00.00 R2

Left Offset: -110.000000

Right Offset: 170.000000

Interval: 100.000000

Vertical Exaggeration: 1.000000

☒ Top Clearance: 20.000000

☒ Bottom Clearance: 10.000000

Elevation Datum Spacing: 5.000000

Event Point List: (None)

☐ Include Event Points Only

☐ Include Control Points

☐ Backward Facing

☒ Create Drawing

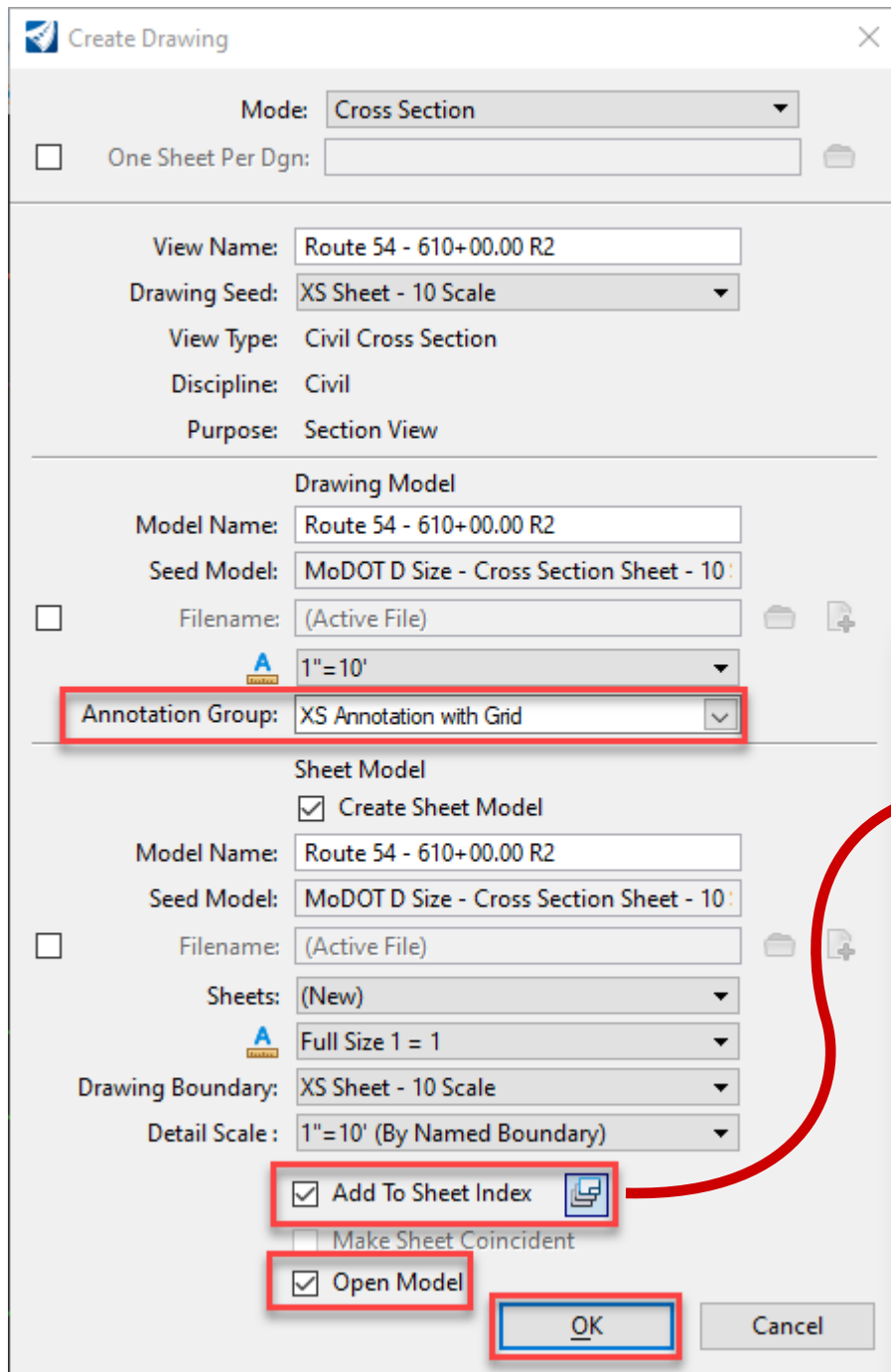
☒ Show Dialog

24. Once the dialog has been filled out then Accept/Reject to either place the named boundary or end the tool.

Place Named Boundary Civil Cross Section > Accept/Reject. Data point in Plan View to place boundary

25. When you **Accept** the dialog input with the **Show Dialog** checked on there will be another dialog that opens (see next page).

26. Change the Annotation Group to the **XS Annotation with Grid** option.



**Create Drawing**

Mode: **Cross Section**

☐ One Sheet Per Dgn: [ ]

View Name: **Route 54 - 610+00.00 R2**

Drawing Seed: **XS Sheet - 10 Scale**

View Type: **Civil Cross Section**

Discipline: **Civil**

Purpose: **Section View**

---

**Drawing Model**

Model Name: **Route 54 - 610+00.00 R2**

Seed Model: **MoDOT D Size - Cross Section Sheet - 10**

☐ Filename: **(Active File)**

**1"=10'**

**Annotation Group: XS Annotation with Grid**

---

**Sheet Model**

☒ Create Sheet Model

Model Name: **Route 54 - 610+00.00 R2**

Seed Model: **MoDOT D Size - Cross Section Sheet - 10**

☐ Filename: **(Active File)**

Sheets: **(New)**

**Full Size 1 = 1**

Drawing Boundary: **XS Sheet - 10 Scale**

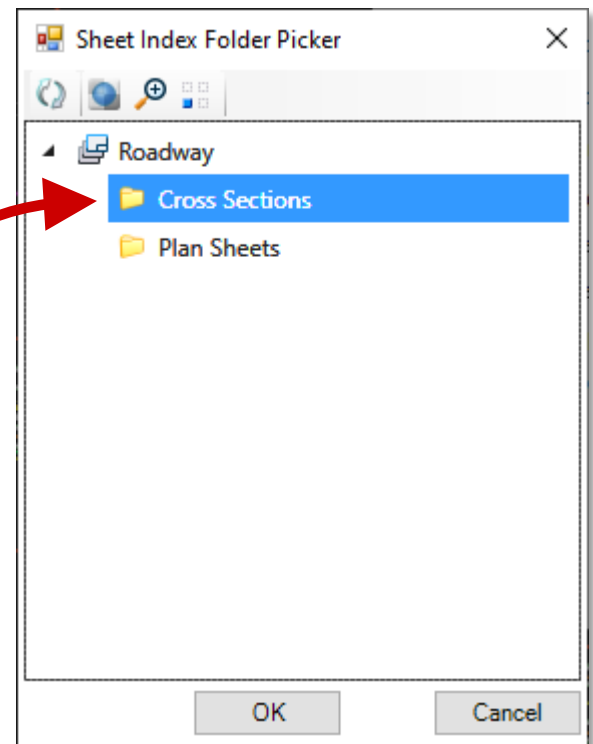
Detail Scale: **1"=10' (By Named Boundary)**

☒ **Add To Sheet Index** [Icon]

☐ Make Sheet Coincident

☒ **Open Model**

**OK** Cancel



**Sheet Index Folder Picker**

Roadway

- Cross Sections**
- Plan Sheets

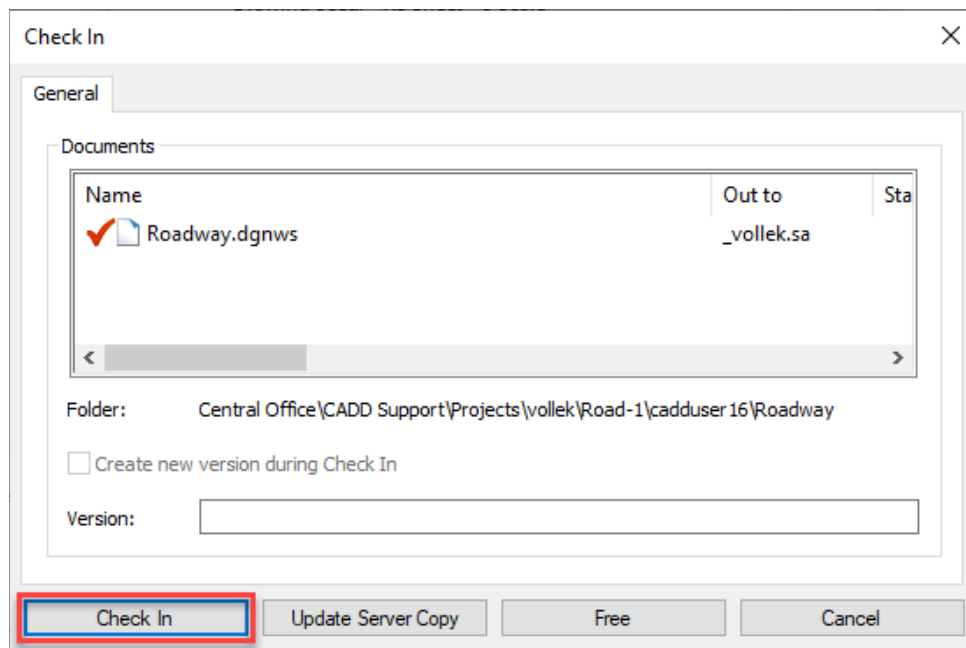
OK Cancel

27. Check On the **Add To Sheet Index** option

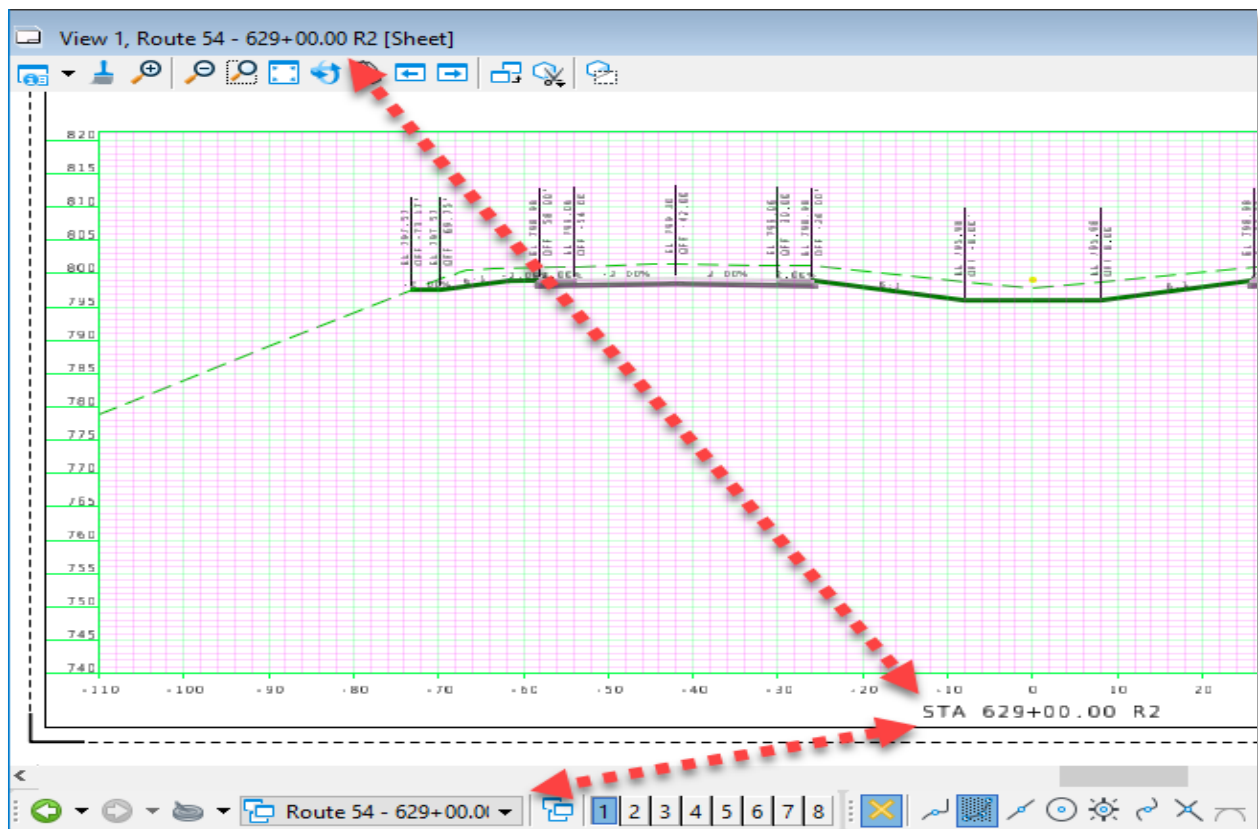
- Select the **pathing folder icon** to the right of the Add To Sheet Index
- Open the *Roadway* folder and select the **Cross Section** folder. This will add all the Sheet Models created to the Sheet Index tool

28. Verify the check is on for the **Open Model** option then select **OK** to process.

29. Check in dgws.

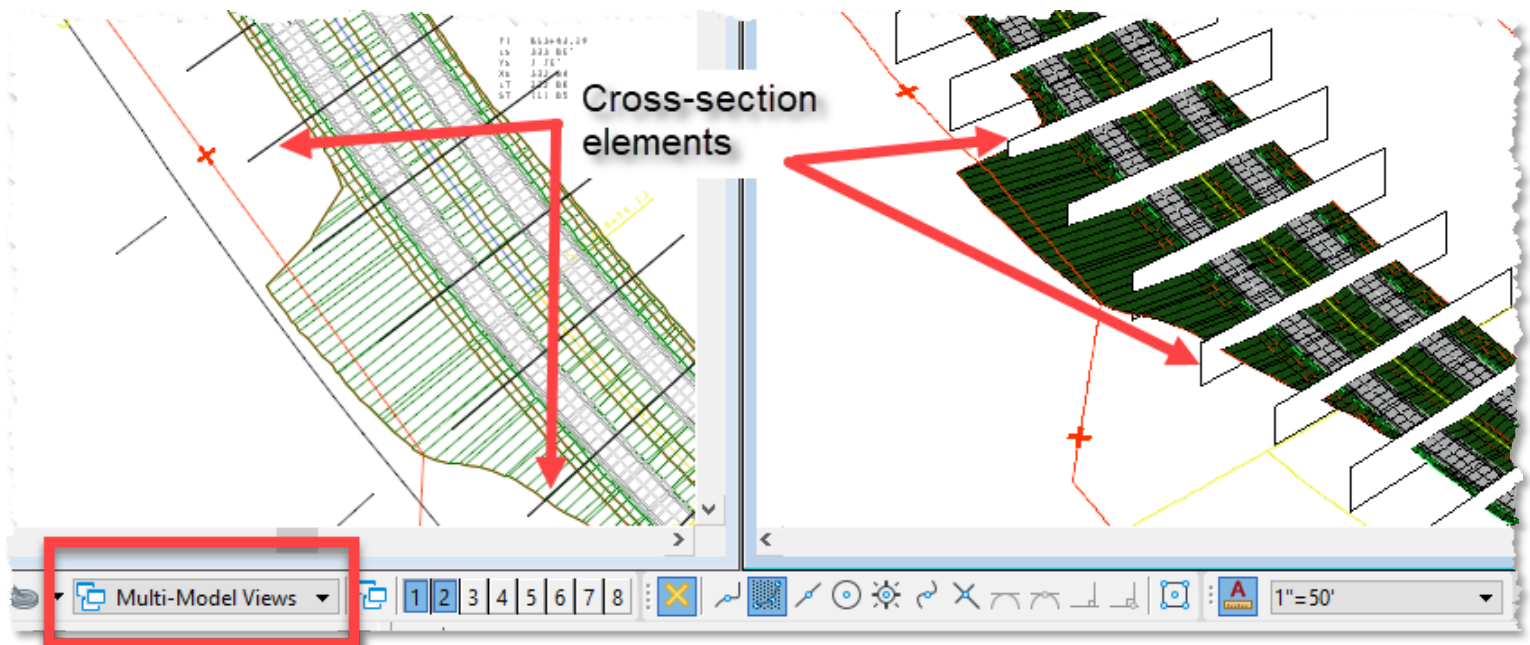


30. The **Open Model** option from the previous dialog when checked on will open a Cross-Section drawing or sheet model after the processing.

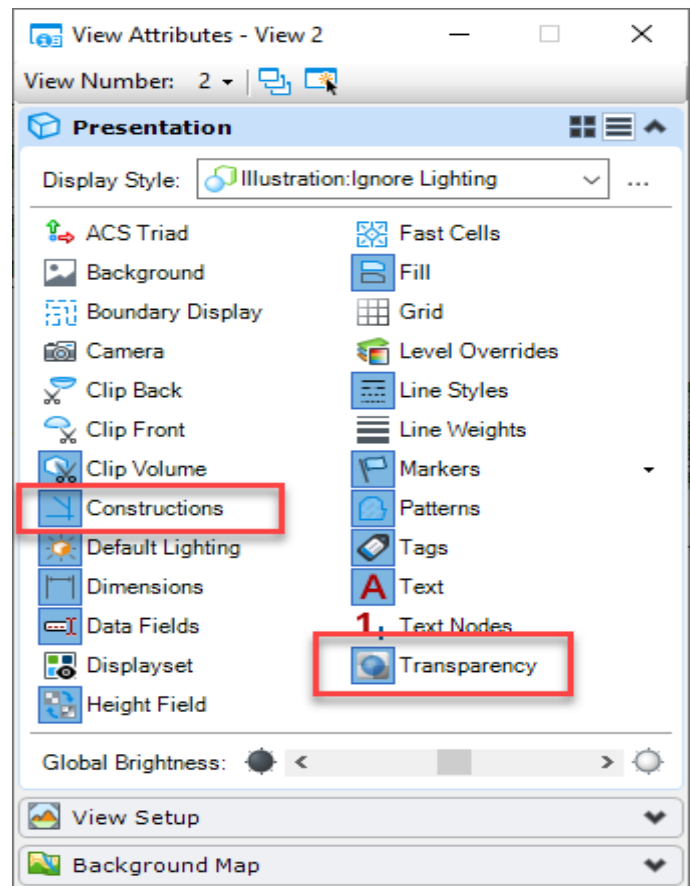


**NOTE:** In this example the tool opened the sheet model for the last cross-section.

31. When the **Multi Model View** is opened after processing the cross-section models there will be elements in the 2D view and shapes in the 3D view that represent the drawing and sheet model locations of the cross-sections.



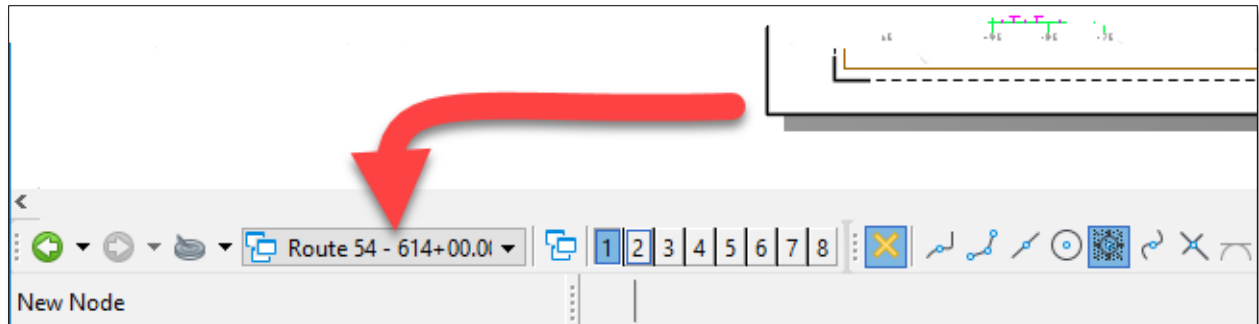
**NOTE:** If the shapes do not show up, verify that the **View Attribute > Constructions** is turned on for each model view of the 2D and 3D models. Also, if the transparency to the shapes do not show, verify that the option **View Attribute > Transparency**



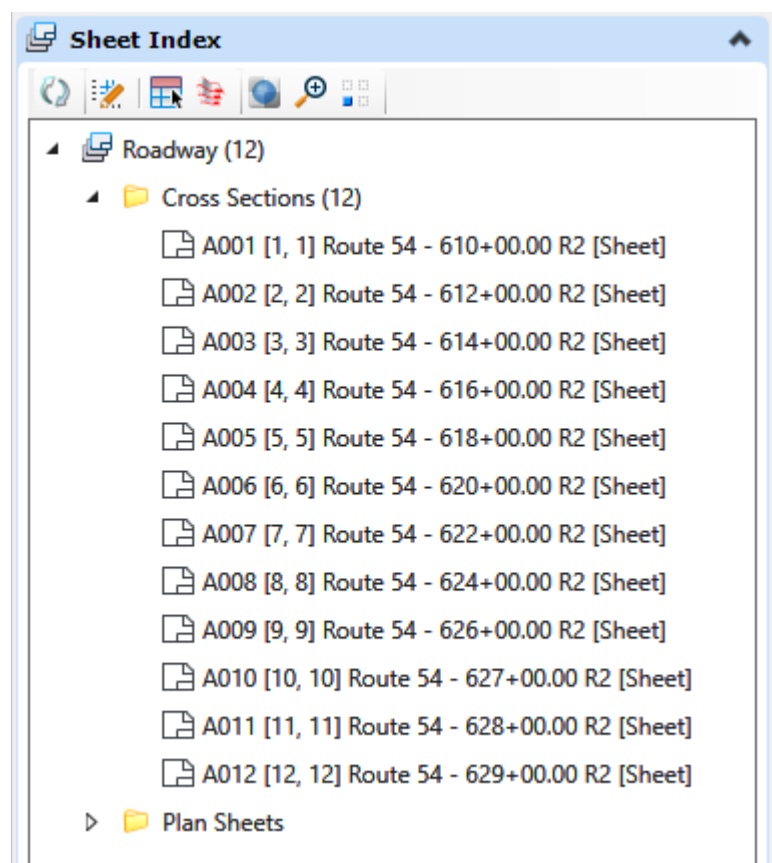
**Viewing the Cross Section Drawing Models and the Sheet Models**

Cross-Sections are now created in individual MicroStation and sheet models. There are various ways to view and open these models but, in this exercise, we will use the **Active View Groups** tool that is located at the bottom left of the default MoDOT interface.

32. Select the **Set the Active View Group** pull-down and navigate to **614+00 R2 (Sheet View)**.



33. **Open the Sheet Index** and verify that the Cross Section Models were added.

**End of Exercise**



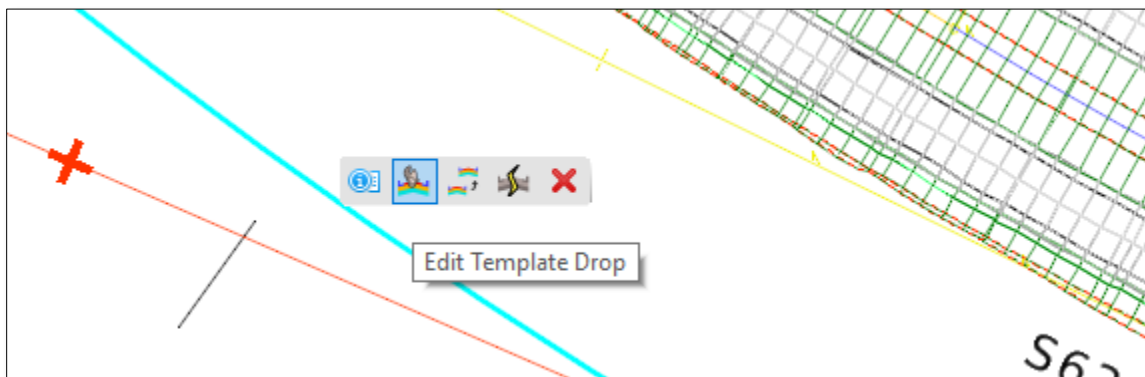
### 8.3 Adding and Removing Annotation of the XS Route 54

Annotation of Cross-Sections are automatic when first processing but if changes happen to the Corridor or Profile the annotation does not update. The following steps will demonstrate how to remove and apply annotation if changes occur to the corridor or profile after cross-sections have been created.

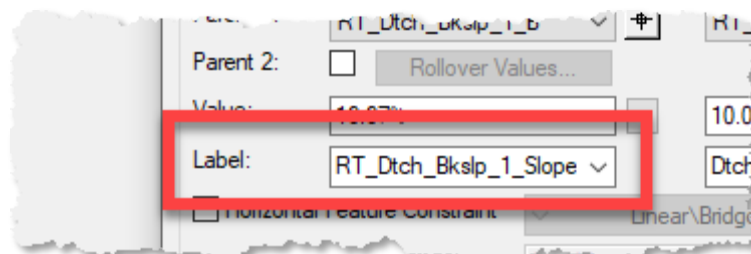
In this example there is an area where the ditch backslope exceeds the right of way. We will use a parametric constraint to bring the slope back within the right of way limits.

#### Adding Parametric Constraints:

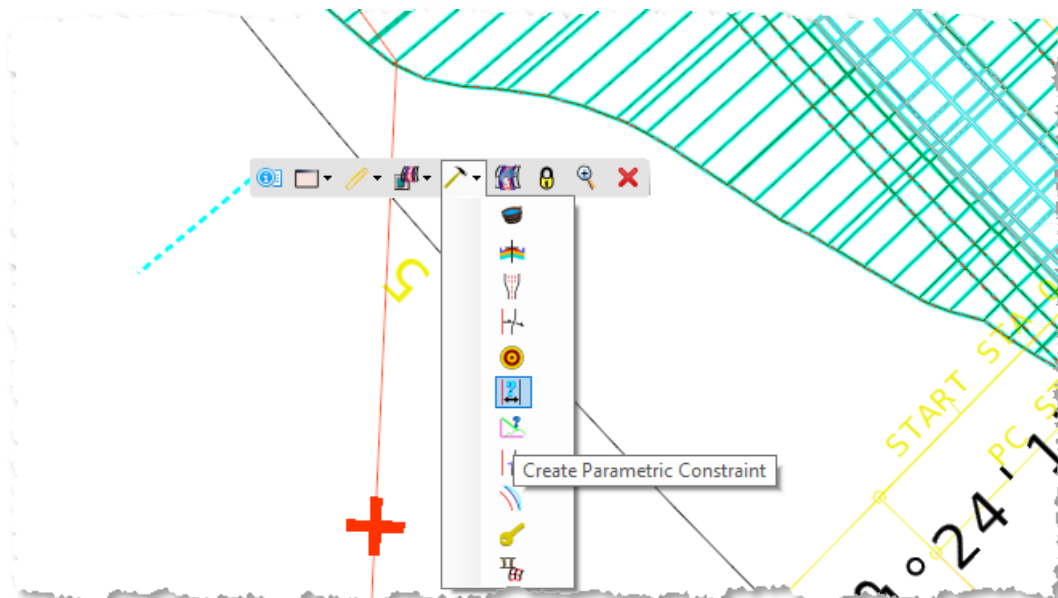
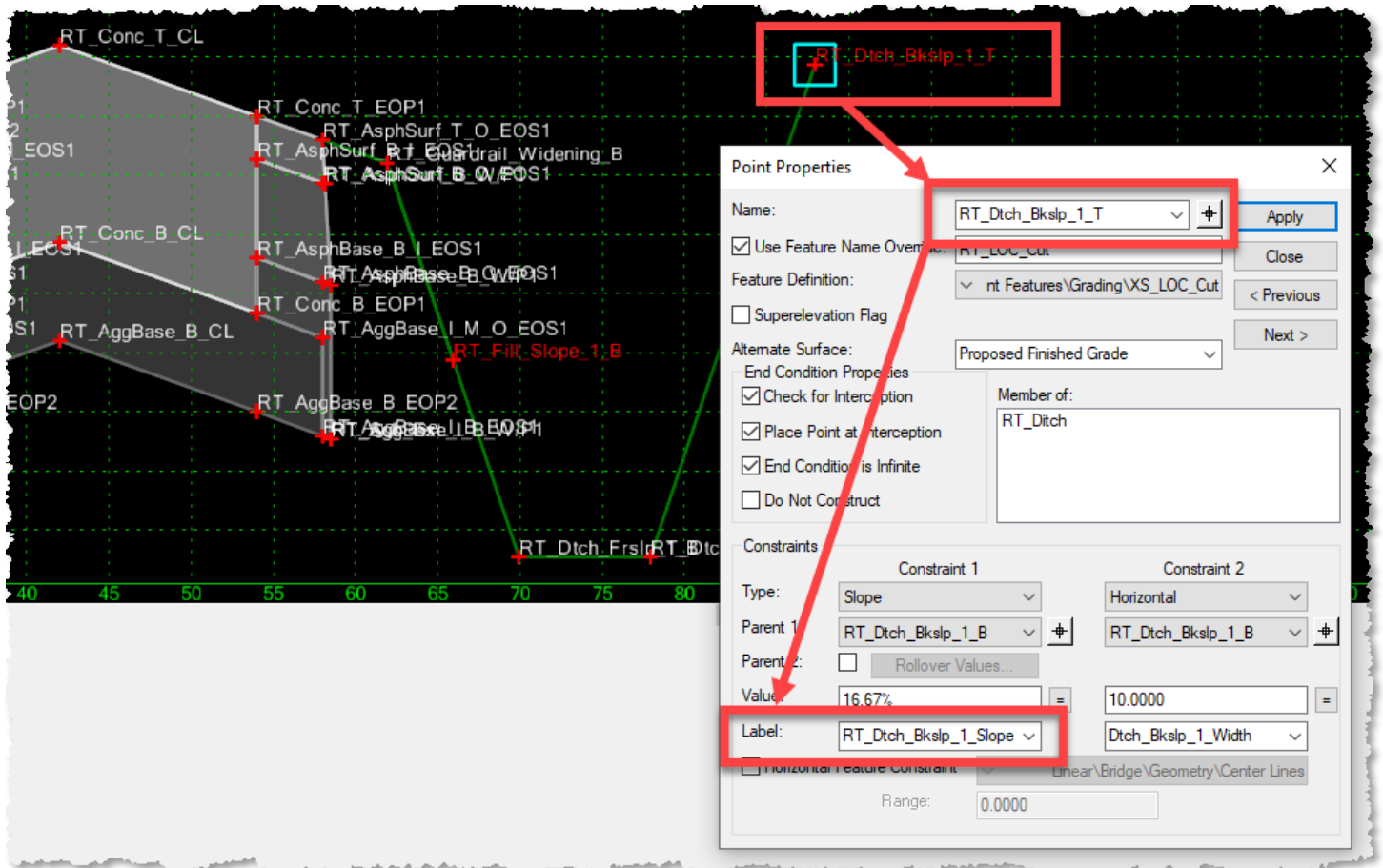
1. Open the **Roadway\data-8\Corridors\_Route-54\_J5P3181.dgn** file.
2. Open the **template drop** for **Route 54** using the heads-up display tool.



3. In the **RT\_Ditch** Component, open the Point Properties of the **RT\_Dtch\_Bkslp\_1\_T**
4. Edit the (Parametric) Label to add the prefix **RT\_** to the **Dtch\_Bkslp\_1\_Slope** label.



5. Add 3 **parametric constraints** to the **Route 54** corridor as shown below to adjust the backslopes:



## Parametric Constraint Settings for the RT\_Ditch\_Bkslp\_1\_Slope

Create Paramet... — □ ×

Lock To Start ☐

☒ Start 612+50.00 R2

Lock To End ☐

☒ Stop 612+80.00 R2

Constraint Label RT\_Dtch\_Bkslp\_1\_Slop ▾

Start Value 16.67%

Stop Value 25.00%

Start: 612+50.00 R2  
Stop: 612+80.00 R2  
Constraint Label: RT\_Ditch\_Bkslp\_1\_Slope  
Start Value: 16.67%  
Stop Value: 25.00%

Create Paramet... — □ ×

Lock To Start ☐

☒ Start 612+80.00 R2

Lock To End ☐

☒ Stop 615+26.00 R2

Constraint Label RT\_Dtch\_Bkslp\_1\_Slop ▾

Start Value 25.00%

Stop Value 25.00%

Start: 612+80.00 R2  
Stop: 615+26.00 R2  
Constraint Label: RT\_Ditch\_Bkslp\_1\_Slope  
Start Value: 25.00%  
Stop Value: 25.00%

Create Paramet... — □ ×

Lock To Start ☐

☒ Start 615+26.00 R2

Lock To End ☐

☒ Stop 616+00.00 R2

Constraint Label RT\_Dtch\_Bkslp\_1\_Slop ▾

Start Value 25.00%

Stop Value 16.67%

Start: 615+26.00 R2  
Stop: 616+00.00 R2  
Constraint Label: RT\_Ditch\_Bkslp\_1\_Slope  
Start Value: 25.00%  
Stop Value: 16.67%

**NOTE:** 2D and 3D views after the parametric constraints have been applied you will see the limits of construction are now within the right of way limits:



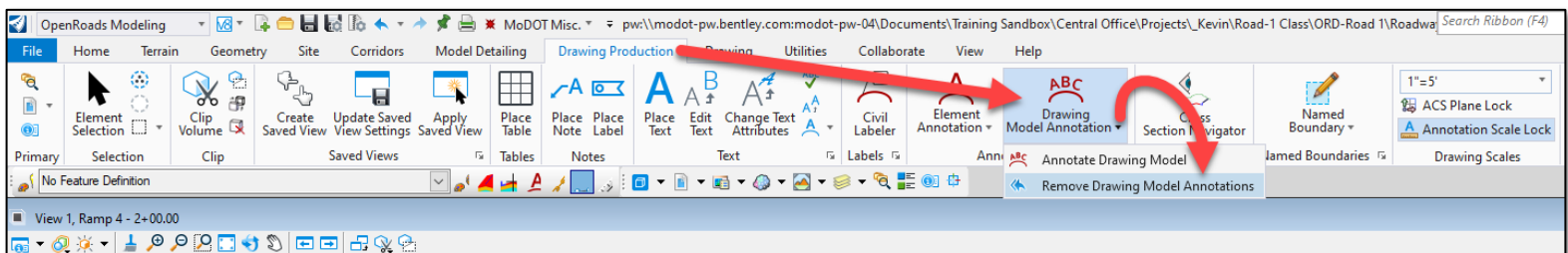
6. Open **Named\_Boundary\_Route-54\_J5P3181.dgn** checking in the corridors file saving the changes

7. **Navigate** to the **615+00 R2** Drawing Model

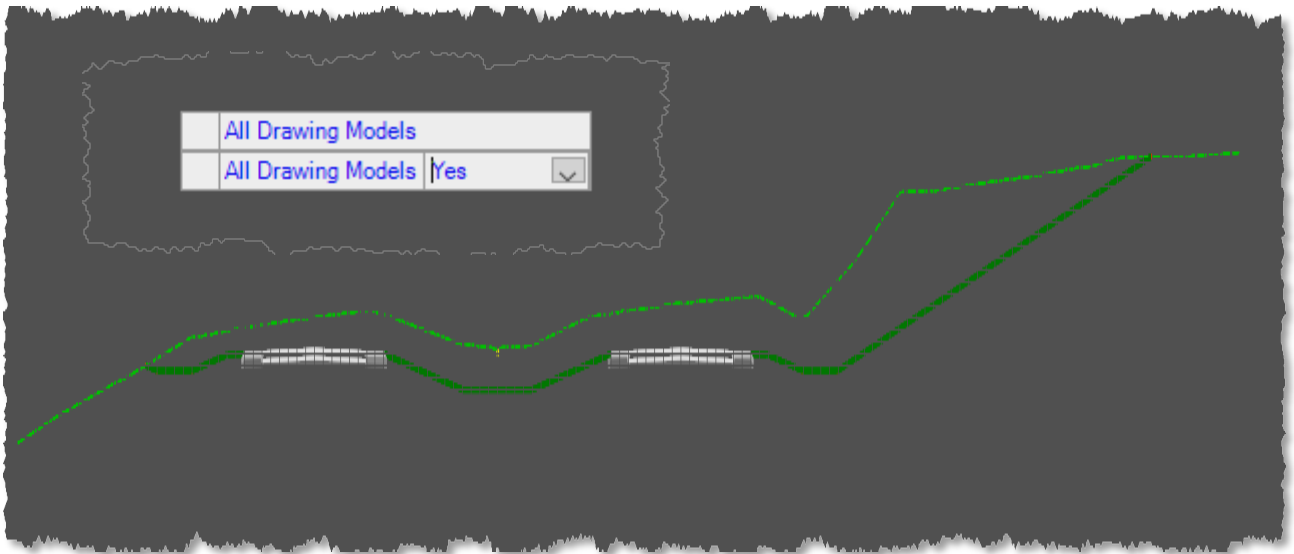
**Notice** that the slopes have changed according to the parametric constraint that was added but the annotation has not updated. The annotation wasn't showing before since the point on the slope wasn't within the view but now the slope is solving in the view, but the annotation is missing and did not update automatically.

8. Select the **Remove Drawing Model Annotations** option from the Model Annotation pull down.

**Note:** You have to be in one of the **Drawing Models** to remove or add annotation.

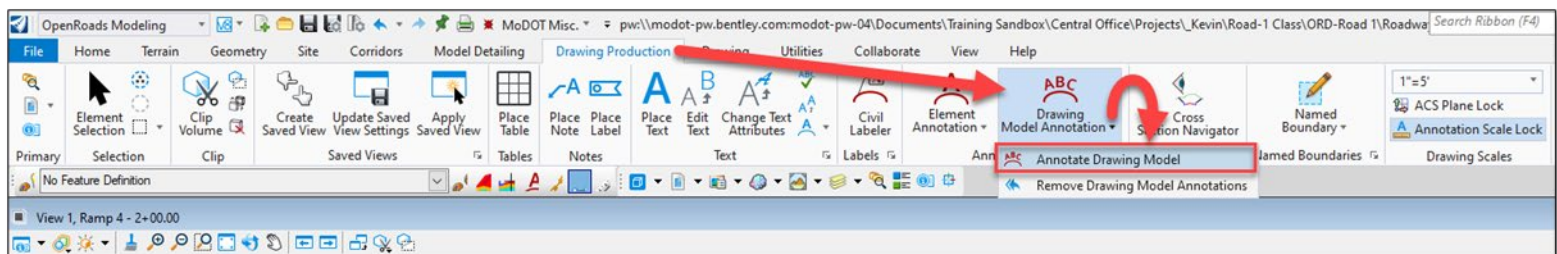


9. The heads-up tool will show an option to either effect All Drawing Models by choosing Yes or No. We will select **Yes** and Accept in a blank area of the screen.

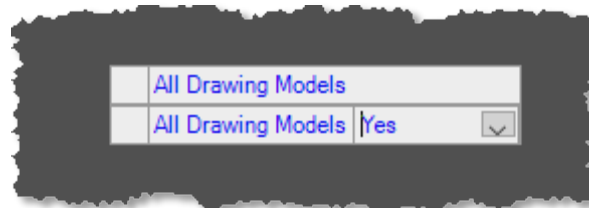


The annotation along with all grid lines will be removed from all the Drawing/Sheet Models.

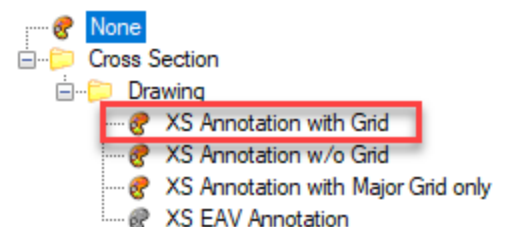
10. Select the **Annotate Drawing Model** option from the Drawing Model Annotation pull down.



11. The heads-up tool will show an option to either effect All Drawing Models by choosing Yes or No. We will select **Yes** and Accept in a blank area of the screen.

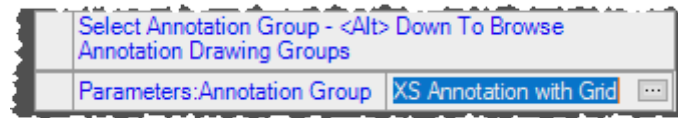


12. This will open a heads-up display where selecting the **<Alt>Down** will allow browsing for an annotation group which will give a couple options for annotations.

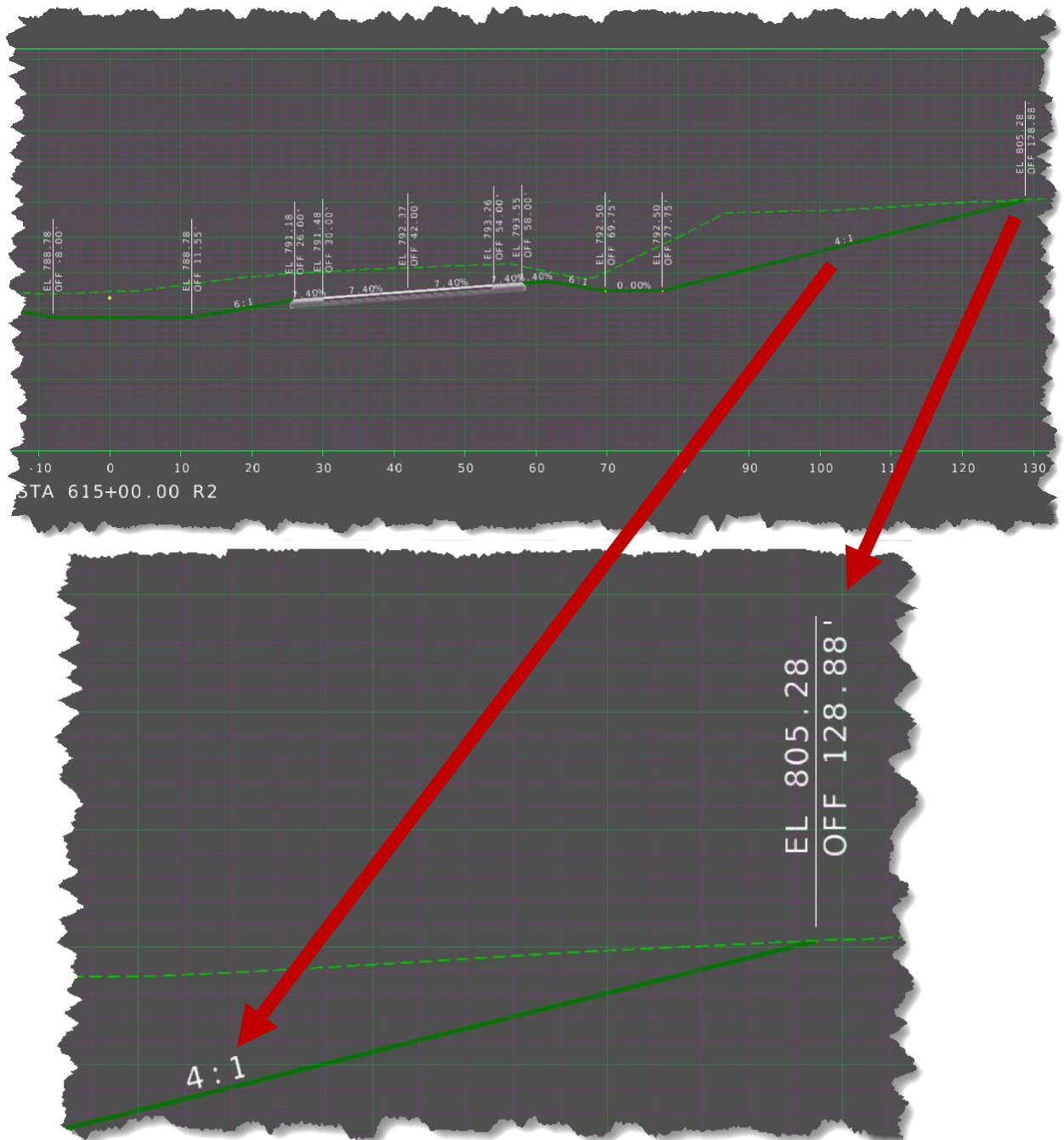




13. The default will be the **XS Annotation with Grid** and should be accepted in a blank area to annotate all the models.



Note: Pictured below is the re-applied annotations with the slope changes annotated.



**End of Exercise**

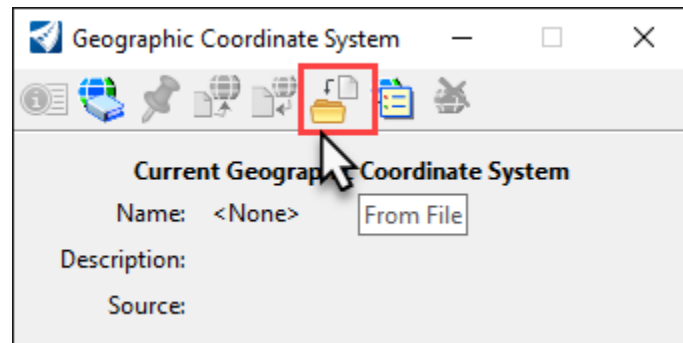
## 8.4 Individual Exercise: Creating Ramp 4 Cross Sections

### Create a New Cross-Section Design File:

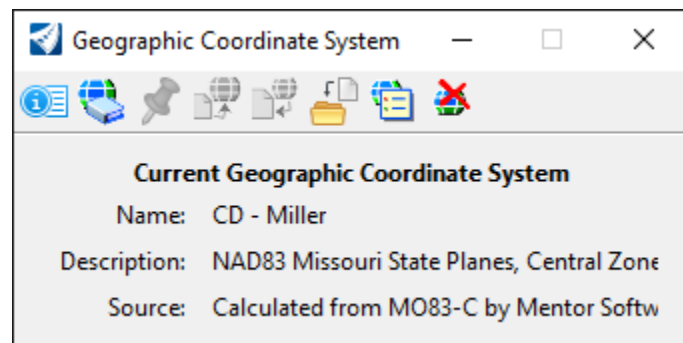
1. Within the **Roadway\data-8** folder, create a new file named **Named\_Boundary\_Ramp-4\_XS\_J5P3181.dgn** using the following seed file:

**MoDOT\_Roadway\_Seed\_2D.dgn** seed file.

2. Open the **Coordinate System** tool by selecting the **OpenRoads Modeling Workflow** → **Utilities Tab** → **Geographic Section**.
3. Select “**From File**” icon.



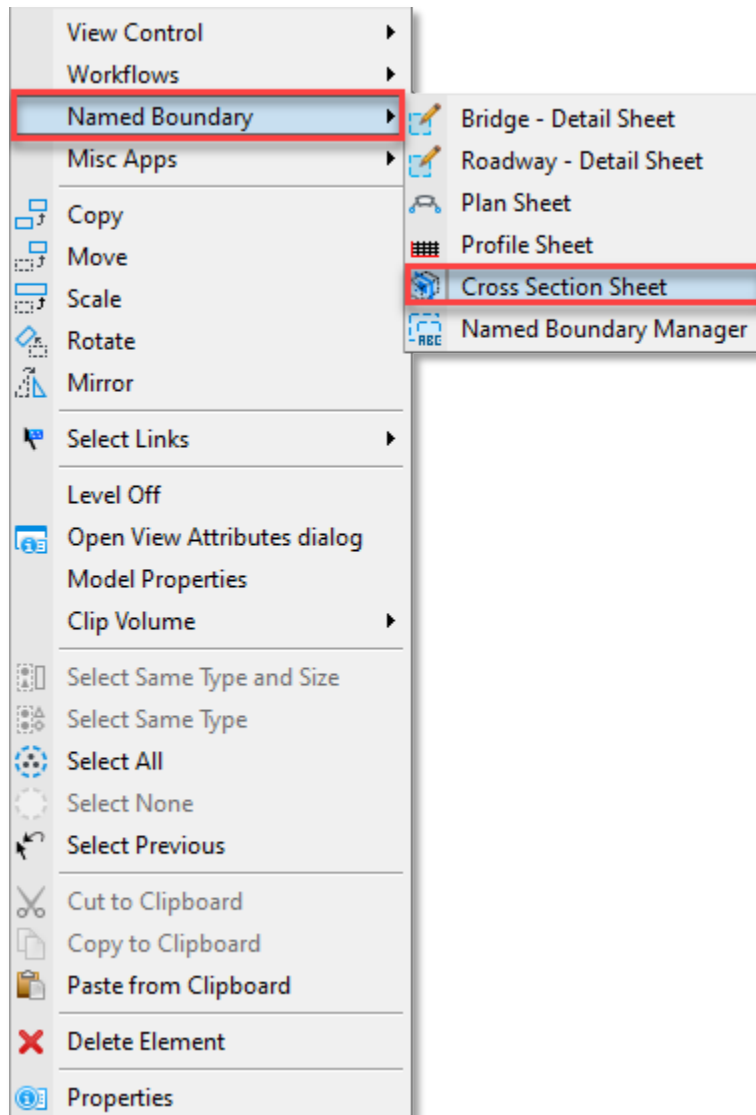
4. Select the **Terrain\_J5P3181.dgn** file in the **data-8** folder.
5. Verify the settings.



6. Reference in the following file:
  - a. **Civil\_Geometry\_J5P3181.dgn**
  - b. **Corridors\_Ramp-4\_J5P3181.dgn**
  - c. **Land\_Boundary\_J5P3181.dgn**
  - d. **Terrain\_J5P3181.dgn**
7. Change the **Annotation Scale** to **1"=50'**
8. MicroStation **Fit View** to the project location.
9. Activate the **Terrain**
10. Zoom in to the **Ramp-4** Corridor.

**Creating the Named Boundary:**

11. Enable both the **2D** and a **3D** view by the **F6** key
12. Open the **Named Boundary** tool by **Right-Clicking** and **holding** in a blank area of the Default 2D window (typically **View #1**)

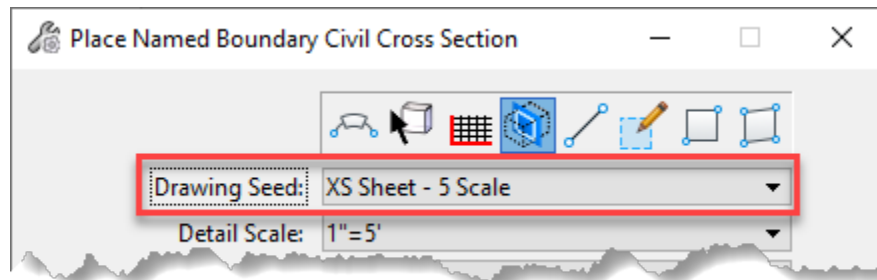


13. Select the Place Named Boundary **Civil Cross Section** icon



14. **Choose** the Drawing Seed from the drop-down menu

**XS Sheet – 5 Scale option**



15. When prompted to Identify Path Element, **data point** on the centerline of **Ramp 4**.

16. For this exercise we will use **0+00** as the **start station** for this exercise.

17. We will use **5+00** as the **stop station**.

18. The **Left Offset** = **-40** and the **Right Offset** = **100** for this exercise

**NOTE:** Viewing the 2D model makes it clear that there is less room needed with the retaining wall and more room needed on the right side of the alignment for the slope.

19. We will use an **Interval of 50** for this exercise

20. **Create Drawing:** When enabled, the process to create the cross-section sheets is automatically started after the named boundaries are created. When disabled, the named boundaries are created but the sheets are not created.

**Optional:** Show Dialog – when enabled, a dialog with additional parameters set by the Drawing Seed is shown.

21. Data Point in a blank area once the Named Boundaries dialog has been filled out as shown in the picture below

**Place Named Boundary Civil Cross Section**

**Drawing Seed:** XS Sheet - 5 Scale

**Detail Scale:** 1"=5'

**Group:** (New)

**Name:** Ramp 4

**Description:**

☒ **Start Location:** 0+00.00

☒ **Stop Location:** 5+00.00

**Left Offset:** -40.000000

**Right Offset:** 100.000000

**Interval:** 50.000000

**Vertical Exaggeration:** 1.000000

☒ **Top Clearance:** 10.000000

☒ **Bottom Clearance:** 5.000000

**Elevation Datum Spacing:** 5.000000

**Event Point List:** (None)

☐ Include Event Points Only

☐ Include Control Points

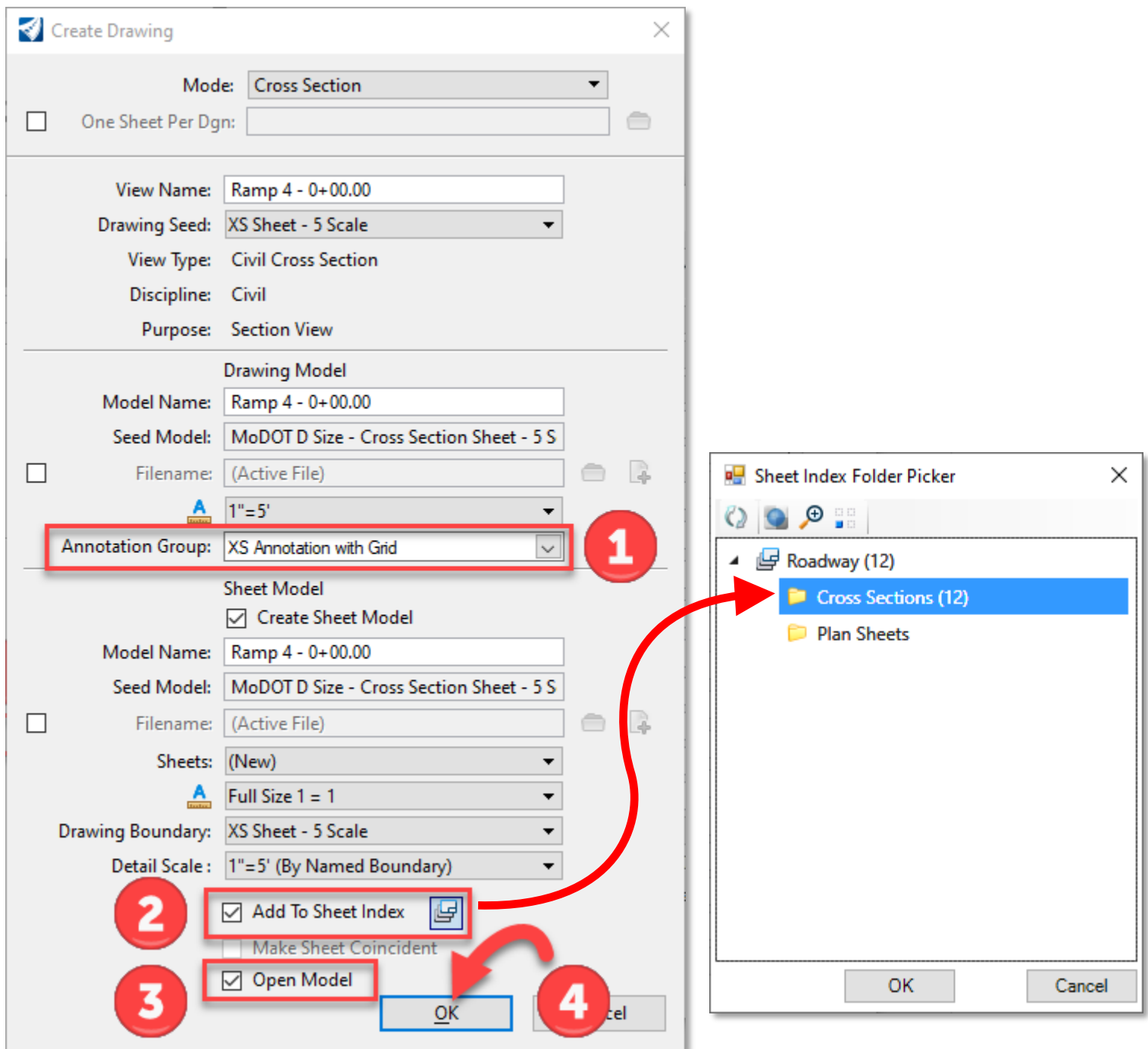
☐ Backward Facing

☒ Create Drawing

☒ Show Dialog

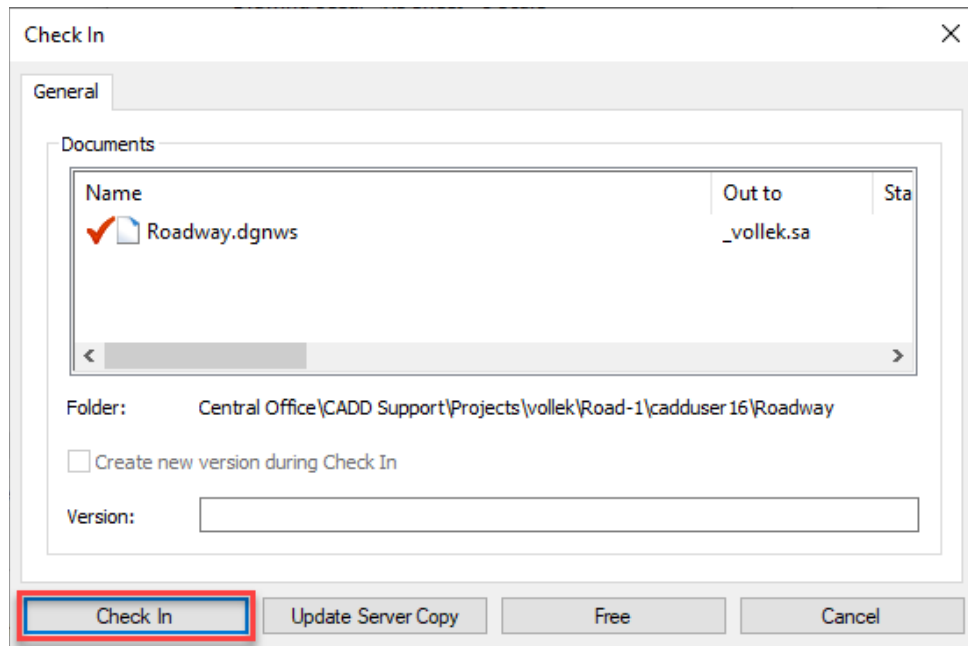
22. Data point to progress to the next dialog.

23. In the **Create Dialog** set the **Annotation Group**, **Add Sheets to the Cross Section Sheet Index**, and select **Open Model**.

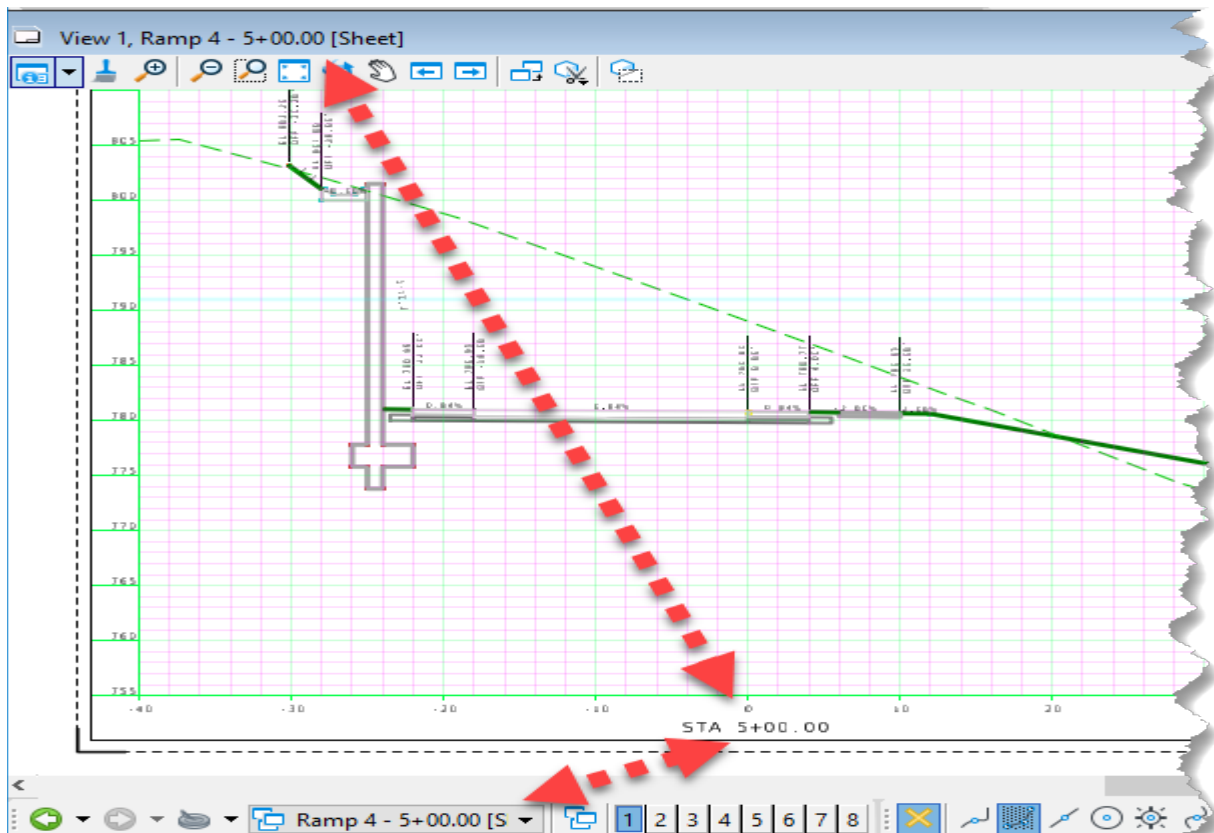


22. Verify the the dialog is set up as above with the Sheet Index pointing to the Cross Section folder and then select **OK** to process.

23. Check in dgws.

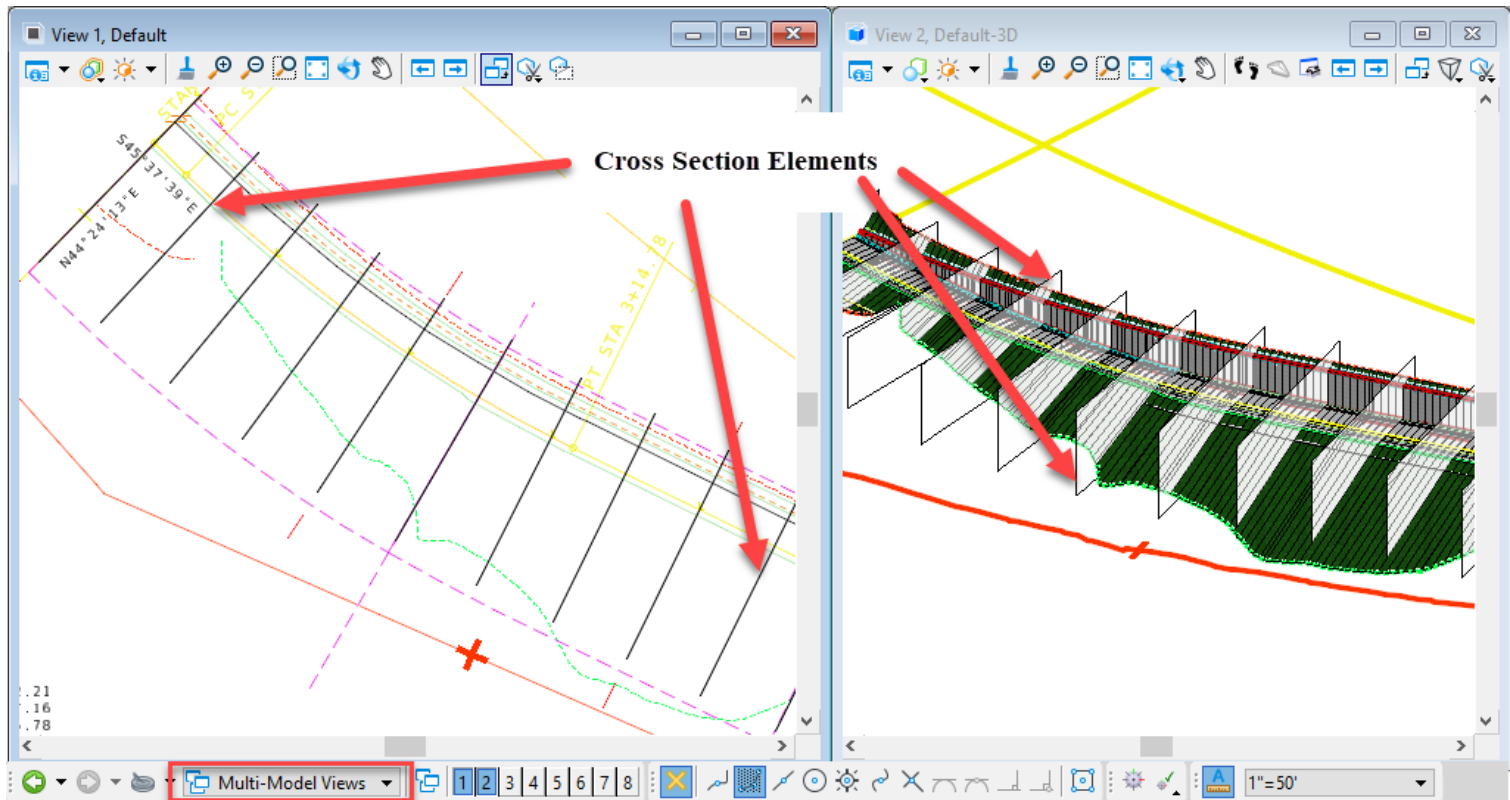


24. The **Open Model** option from the previous dialog when checked on will open a Cross-Section drawing or Sheet Model after the processing.

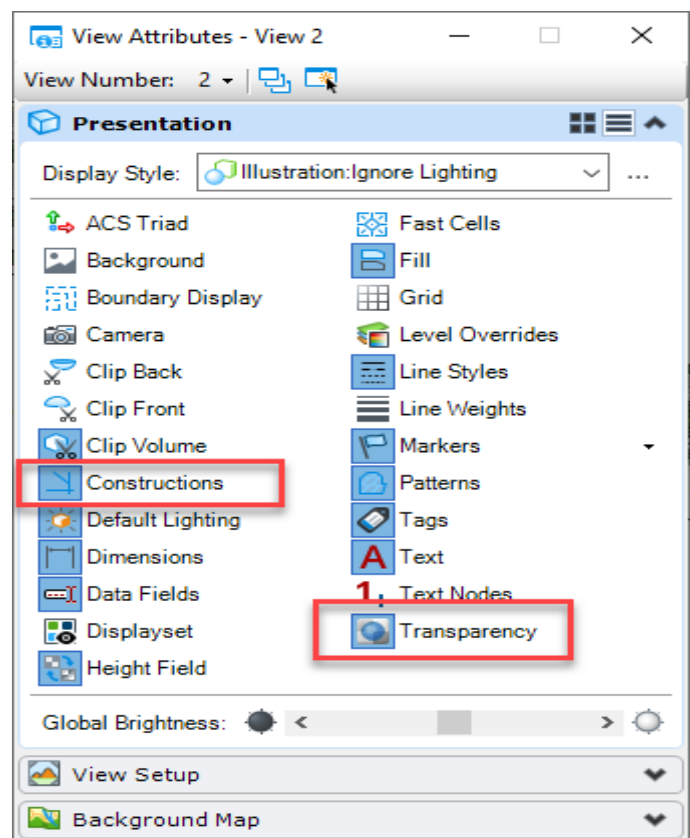


**NOTE:** In this example the tool opened the sheet model for the last cross-section.

25. When the **Multi Model View** is opened after processing the cross-section models there will be elements in the 2D view and shapes in the 3D view that represent the drawing and sheet model locations of the cross-sections.



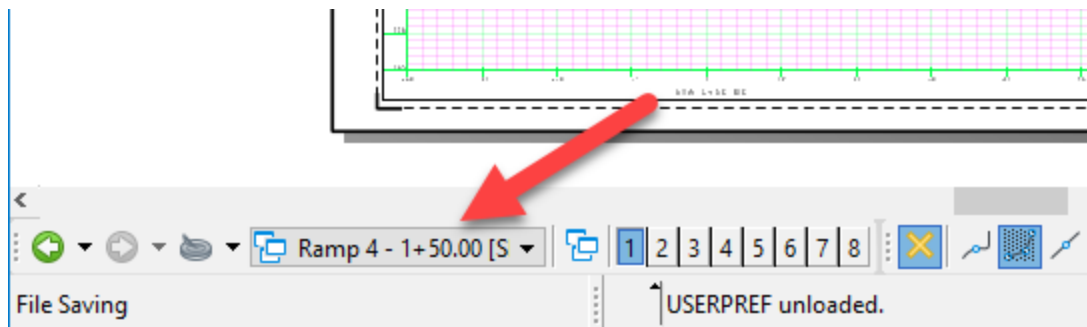
**NOTE:** If the shapes do not show up, verify that the **View Attribute > Constructions** is turned on for each model view of the 2D and 3D models. Also, if the transparency to the shapes do not show, verify that the option **View Attribute > Transparency**



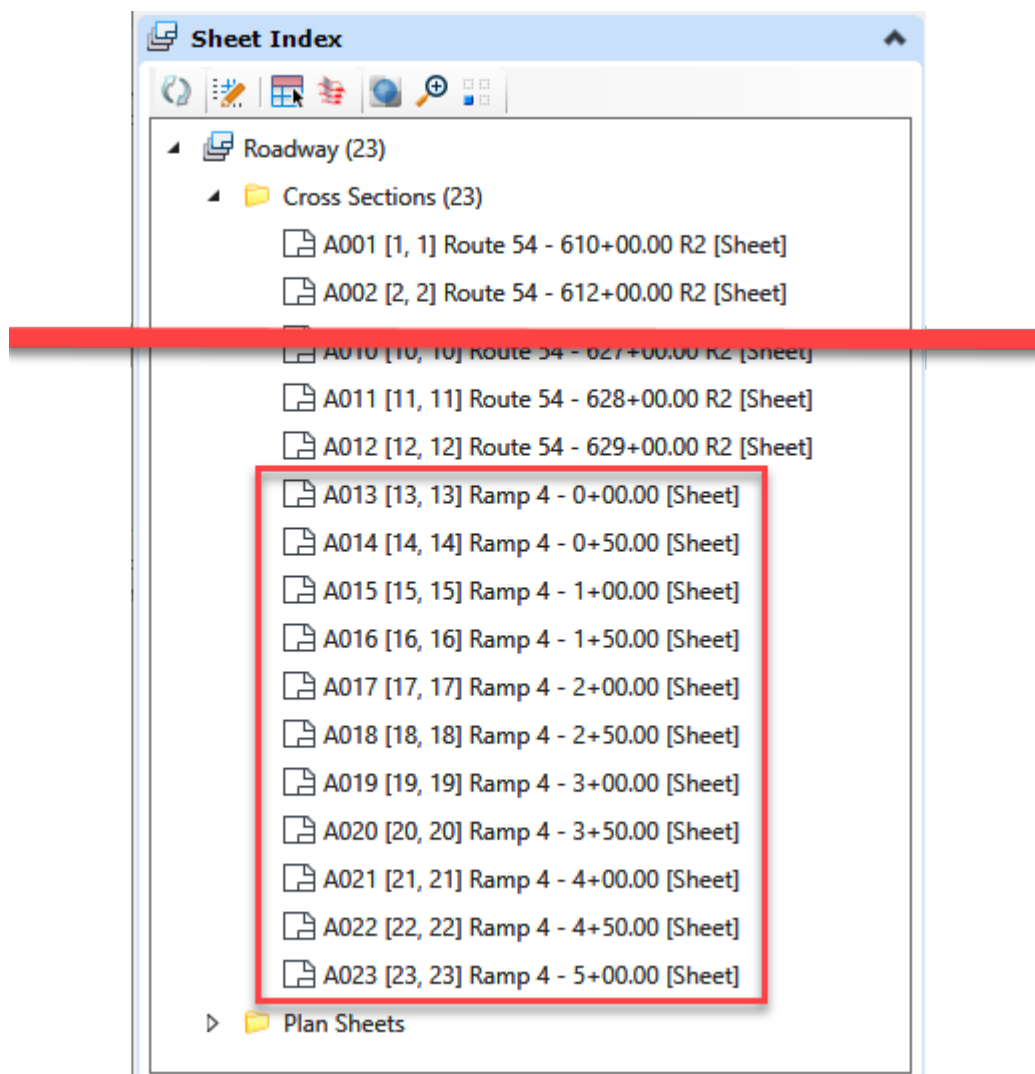
**Viewing the Cross Section Drawing Models and the Sheet Models**

Cross-Sections are now created in individual MicroStation and sheet models. There are various ways to view and open these models but, in this exercise, we will use the **Active View Groups** tool that is located at the bottom left of the default MoDOT interface.

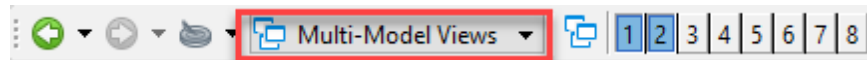
26. Select the **Set the Active View Group** pull-down and navigate to **1+50 (Sheet View)**.



27. **Open the Sheet Index** and verify that the Cross Section Models were added.



28. Open the Multi-Model view.



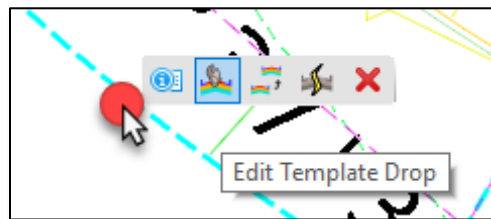
**Note:** If there is no **Multi-Model View** select the **Default 2D View** and then select the **F6 Key**.

### Changing the Fill Slope:

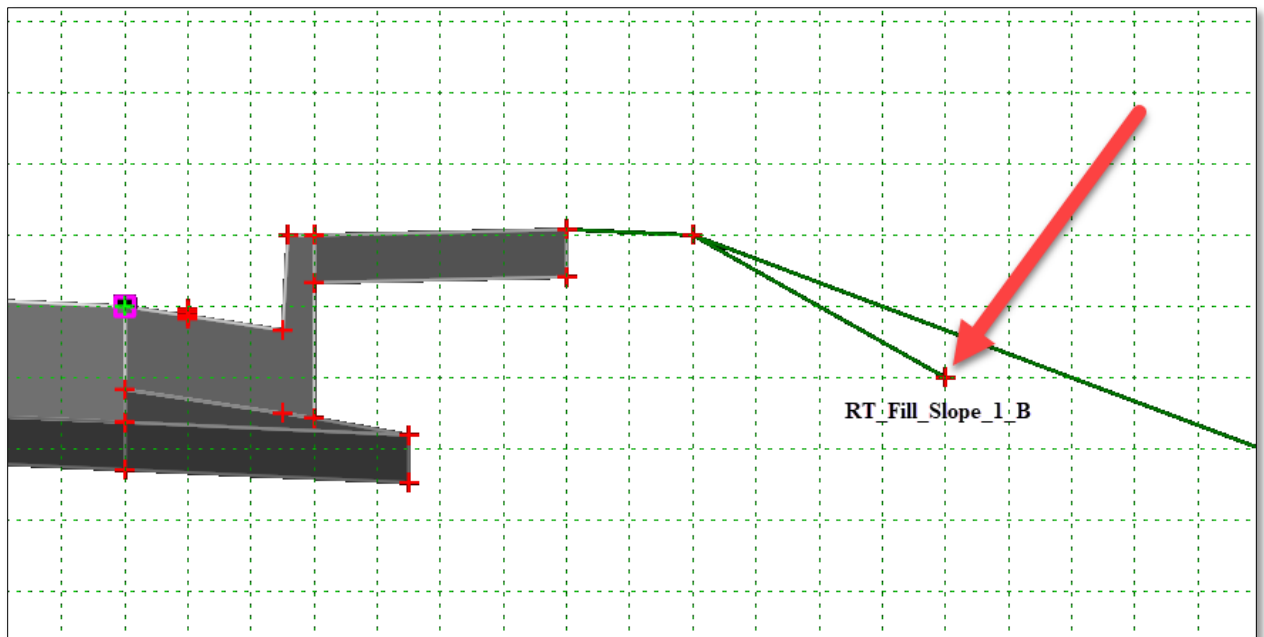
**NOTE:** The object of this part of the exercise is to change the fill slope on the 2 template drops within the Ramp 4 corridor located in the **Corridors\_Ramp-4\_J5P3181.dgn** file.

29. Open the **Roadway\data-8\Corridors\_Ramp-4\_J5P3181.dgn** file.

30. Select the **Ramp 4 Pavement with Curb and Gutter** template drop for the Ramp 4 corridor, hover over the template drop and select **Edit Template Drop** from the heads-up tool.



31. Open the Point Properties on point **RT\_Fill\_Slope\_1\_B**



32. Change the Slope Constraint value from -25% to **-33.333% or -1:3**

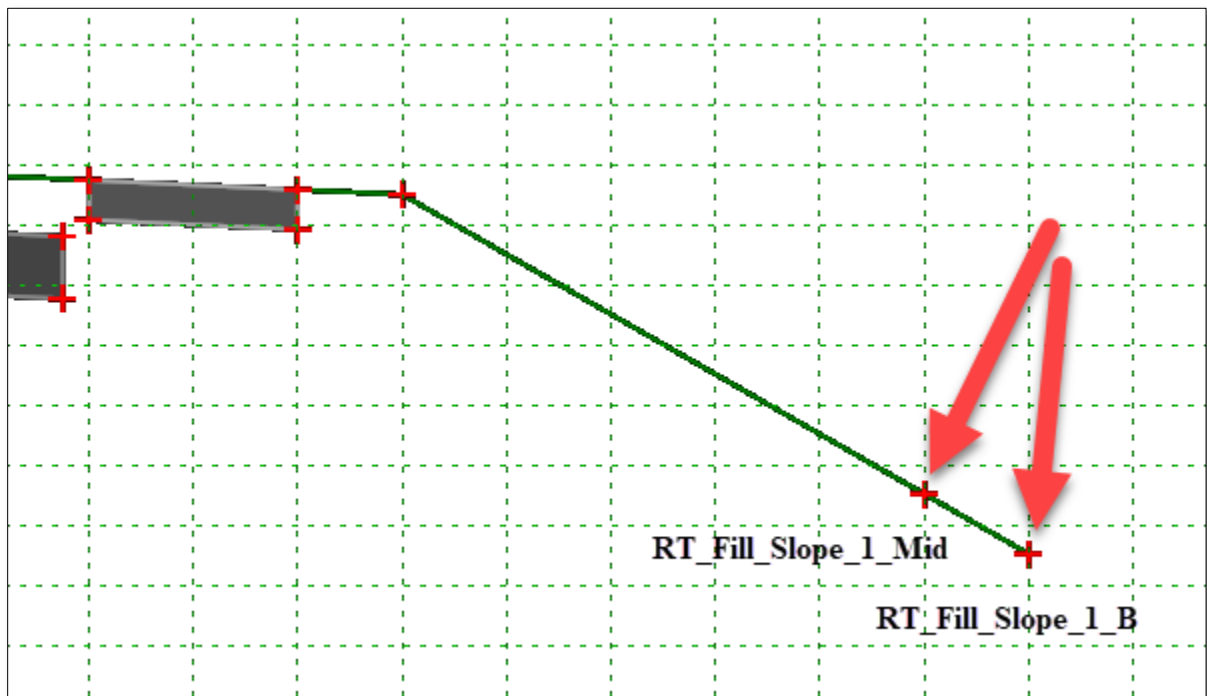
The screenshot shows the 'Constraints' dialog box with two tabs: 'Constraint 1' and 'Constraint 2'. Under 'Constraint 1', the 'Type' is 'Slope', 'Parent 1' is 'RT\_Swlk\_Outer\_Buffer', and the 'Value' is '-33.33%'. The 'Value' field is highlighted with a red rectangle. Under 'Constraint 2', the 'Type' is 'Horizontal', 'Parent 1' is 'RT\_Swlk\_Outer\_Buffer', and the 'Value' is '4.0000'. The 'Label' for Constraint 1 is 'Fill\_Slope\_1\_Slope' and for Constraint 2 is 'Fill\_Slope\_1\_Width'. The 'Horizontal Feature Constraint' checkbox is checked, and the 'Range' is '100.0000'.

33. **Apply** the change and close the Point Properties dialog.

34. Close the Edit Template Drop dialog by selecting the **Okay** button

35. **Select the Ramp 4 Pavement with Shoulders template drop** for the Ramp 4 corridor, hover over the template drop and select Edit Template Drop from the heads-up tool.

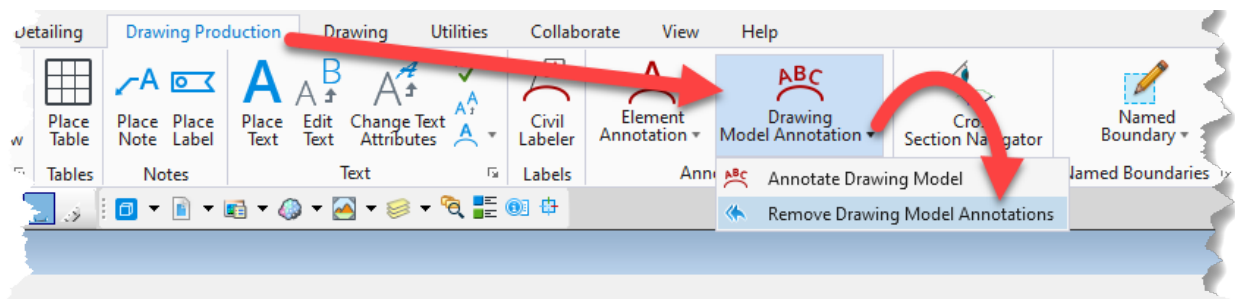
36. Open the Point Properties on the following points **RT\_Fill\_Slope\_1\_Mid**, and **RT\_Fill\_Slope\_1\_B**



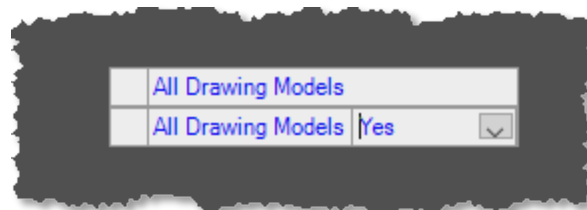


37. Change the Slope Constraint value from -25% to **-33.33% or -1:3**
38. **Apply** the change and close the Point Properties dialog.
39. Close the Edit Template Drop dialog by selecting the **Okay** button
40. **Reopen** the **Named\_Boundary\_Ramp-4\_XS\_J5P3181.dgn** saving and checking in the **Corridors\_J5P3181.dgn** file when prompted.
41. Open the **1+50 Drawing Model**. You will notice the slope does not have labels on it.
  - a. Select the **Remove Drawing Model Annotations** option from the Model Annotation pull down.

**Note:** You have to be in one of the **Drawing Models** to remove or add annotation.

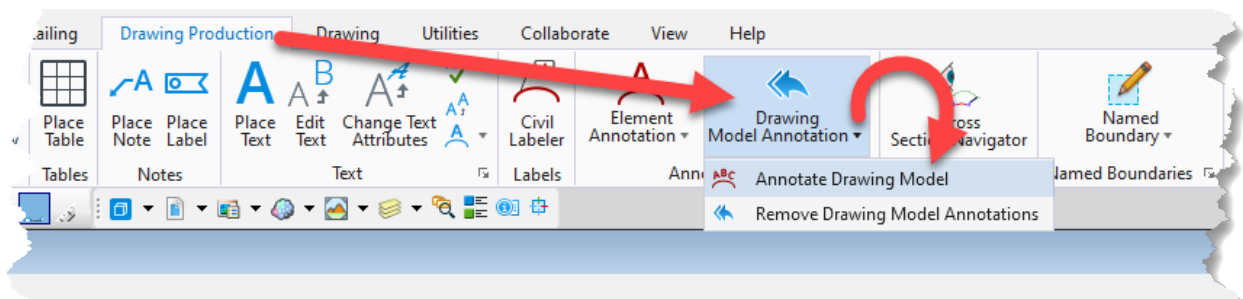


- b. We will select **Yes** to All Drawing Models and **Accept** in a blank area of the screen.

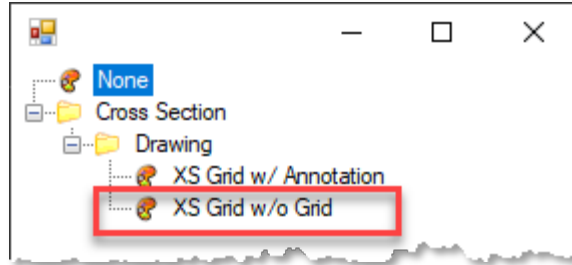


The annotation along with all grid lines will be removed from all the Drawing and Sheet Models.

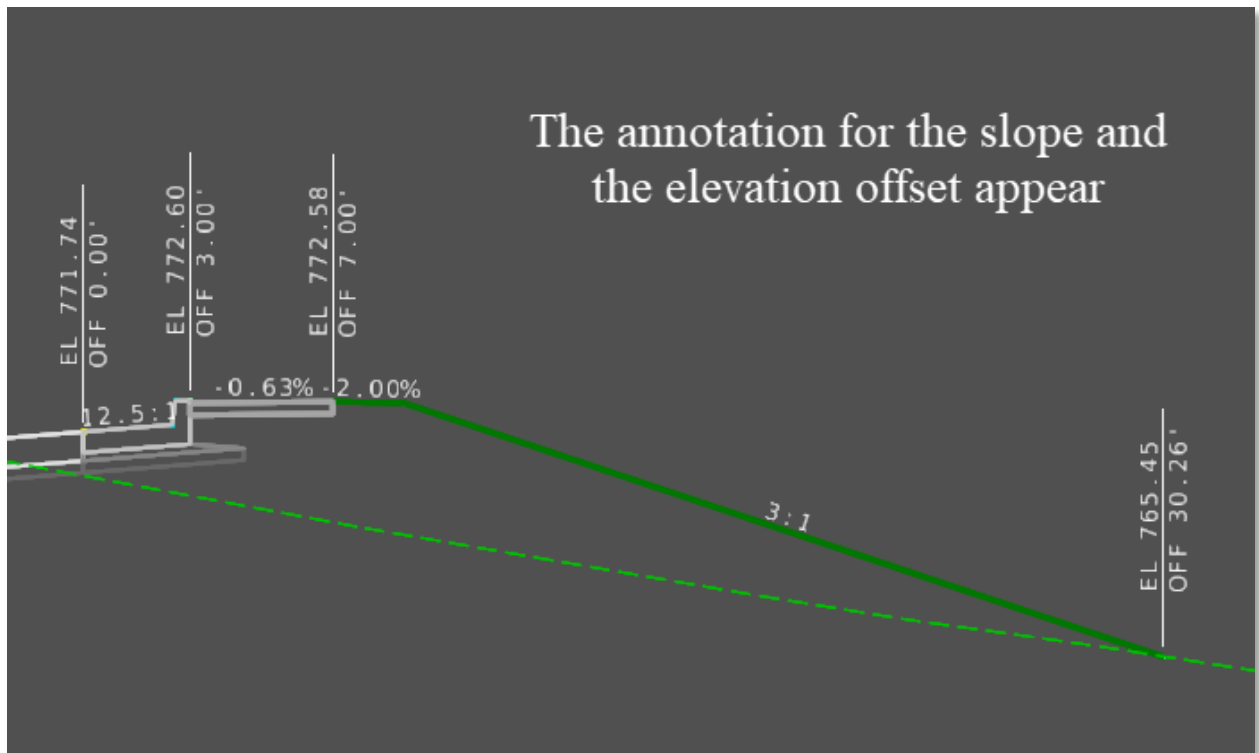
38. Select the **Annotate Drawing Model** option from the Drawing Model Annotation pull down.



39. We will select **Yes** and **Accept** in a blank area of the screen to re-apply annotations to all the drawing and sheet models.
40. This will open a heads-up display where we will navigate to the **XS Grid w/o Grid** in this example.



41. Datapoint in a blank area to **Accept** the re-annotation on the model.



**End of Exercise**

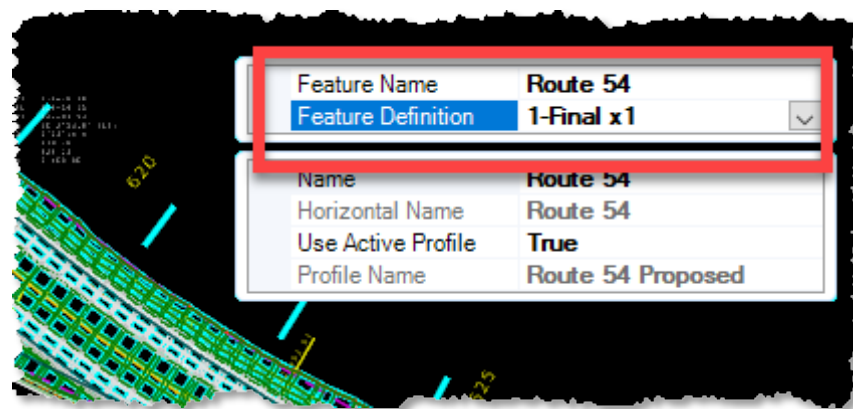
## 8.5 Group Exercise: Create Cut Fill Volumes Route 54

The objective of this exercise is to show how to create a mesh surface for the cut and fill volumes and to calculate end area volume reports. We will also learn how to create cross section models and label them with the end area volume quantities.

The process of calculating for a single corridor or multiple corridors requires its own design file or the tool will calculate ALL corridors in the design file.

### Final Feature Definition (Design Stage in SS10)

1. Open the **Corrdiors\_Route-54\_J5P3181.dgn** and verify that the Feature Definition is set to **1-Final x 1**. This will ensure the most accurate earthwork quantities.



### Create an Earthwork File:

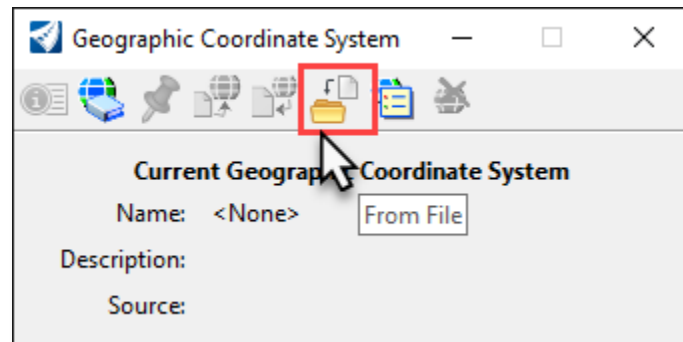
**Note:** In this step we are going to create a separate **Route 54 Named Boundary File for Earthwork**. Typically the **Designer** would only calculate **Earthwork** in the **Cross Section Named Boundary** file. We are not doing this because we feel it is easier to show how the tool works if we create a separate **Named Boundary file for Cross Sections** and then another for **Earthwork**.

2. Within the **Roadway\data-8** folder, create a new file named **Named\_Boundary\_Route-54\_EAV\_J5P3181.dgn** using the following seed file:

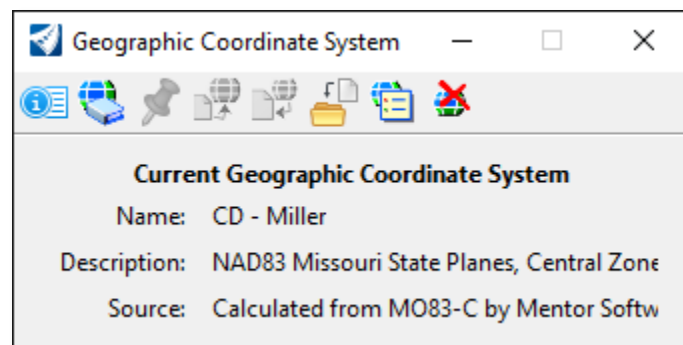
**MoDOT\_Roadway\_Seed\_2D.dgn** seed file.

**Attach the Coordinate System:**

3. Open the **Coordinate System** tool by selecting the **OpenRoads Modeling Workflow** → **Utilities Tab** → **Geographic Section**.
4. Select “**From File**” icon.



5. Select the **Terrain\_J5P3181.dgn** file in the **data-8** folder.
6. Verify the settings.

**Attach the Reference Files:**

7. **Attach** the following files as reference files”
  - **Civil\_Geometry\_J5P3181.dgn**
  - **Corridors\_Route-54\_J5P3181.dgn**
  - **Terrain\_J5P3181.dgn**
8. Change the **Annotation Scale** to **1”=50’**
8. Make the **Terrain\_J5P3181.dgn** the **active surface**
9. In the **Default** model, select the **F6 key** to open the 3D model view

**Create Named Boundaries:**

To run an **Earthwork End Area Volume Calculation** the User will need to have Cross Section Named Boundaries in place.

9. Open the **Named Boundary** tool by **Right-Clicking** and **holding** in a blank area of the Default 2D window (typically **View #1**)
10. Select the **Named Boundary** ➔ **Cross Section Sheet**
11. For the Drawing Seeds select the **XS Sheet – 20 Scale** option (utilizing the widest XS section setting).
12. Identify the Route-54 alignment
  - **Start Location** = **Start of Alignment Route-54**
  - **Stop Location** = **End of Alignment Route-54**
  - **Left Offset** = **-280**
  - **Right Offset** = **280**
  - **The Interval** = **100**
13. Check the **Create Drawing** and **Show Dialog** box, then left click in the 2D plan view to accept the settings.

**Place Named Boundary Civil Cross Section**

Drawing Seed: XS Sheet - 20 Scale  
Detail Scale: 1"=20'  
Group: (New)  
Name: Route 54  
Description:  
☒ Start Location: 602+59.49  
☒ Stop Location: 647+66.54 R2  
Left Offset: -280.000000  
Right Offset: 280.000000  
Interval: 100.000000  
Vertical Exaggeration: 1.000000  
☒ Top Clearance: 40.000000  
☒ Bottom Clearance: 20.000000  
Elevation Datum Spacing: 5.000000  
Event Point List: (None)  
☐ Include Event Points Only  
☐ Include Control Points  
☐ Backward Facing  
☒ Create Drawing  
☒ Show Dialog

14. When the **Create Drawing** dialog opens set the following settings:
- Change the Annotation Group to **XS Annotation w/o Grid**
  - Uncheck** Open Model
  - Select the **OK** button to start the processing of cross-section models

**Note:** This will create all the sheet models and drawing models but leave you in the Multi-model mode (both 2D and 3D windows opened) **if** the **Open Model** box was checked, then the tool will take you to the last sheet model created and will need to navigate to the Multi-model view to continue the process.

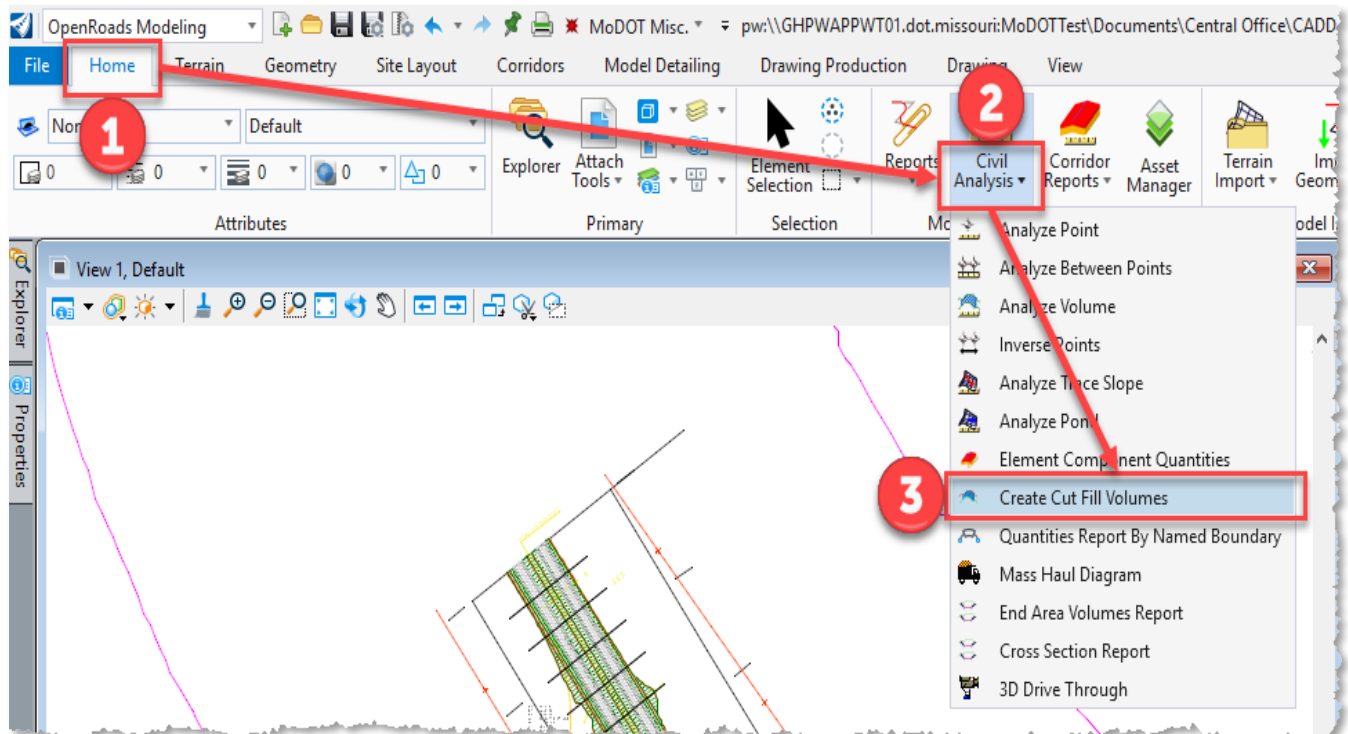
The screenshot shows the 'Create Drawing' dialog box with the following settings:

- Mode:** Cross Section
- ☐ One Sheet Per Dgn:
- View Name:** Route 54 - 602+59.49
- Drawing Seed:** XS Sheet - 20 Scale
- View Type:** Civil Cross Section
- Discipline:** Civil
- Purpose:** Section View
- Drawing Model**
  - Model Name:** Route 54 - 602+59.49
  - Seed Model:** MoDOT D Size - Cross Section Sheet - 20
  - ☐ **Filename:** (Active File)
  - Scale:** 1"=20'
  - Annotation Group:** XS Annotation w/o Grid (highlighted with red circle 1)
- Sheet Model**
  - ☒ **Create Sheet Model**
  - Model Name:** Route 54 - 602+59.49
  - Seed Model:** MoDOT D Size - Cross Section Sheet - 20
  - ☐ **Filename:** (Active File)
  - Sheets:** (New)
  - Full Size 1 = 1**
  - Drawing Boundary:** D Size XS Sheet - 20 Scale
  - Detail Scale:** 1"=20' (By Named Boundary)
  - ☐ **Add To Sheet Index**
  - ☐ **Make Sheet Coincident**
  - ☐ **Open Model** (highlighted with red circle 2)
- Buttons:** OK (highlighted with red circle 3) and Cancel

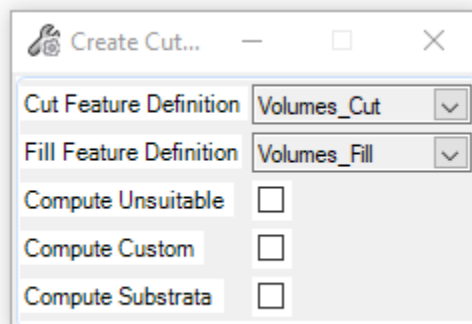
## Create Cut and Fill Volumes:

This process will create a mesh surface for each of the cut and fill material for extracting of quantities.

15. Within the OpenRoads Modeling Workflow select the **Home Tab → Model Analysis and Reporting Section → Civil Analysis Tools → Create Cut Fill Volumes**



16. The dialog will open and will allow the user to specify a **Cut** and **Fill** Feature Definition, the MoDOT default values should be already be set.



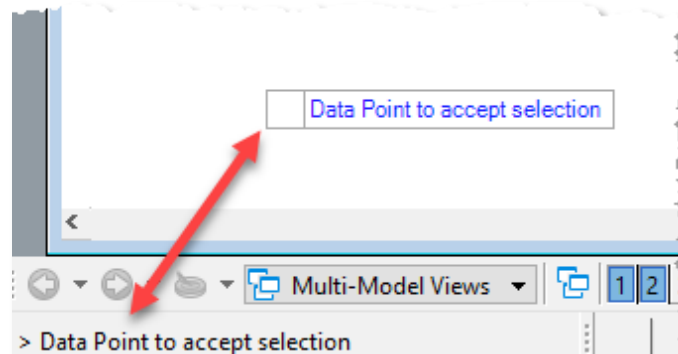
Cut Feature Definition	
Cut Feature Definition	Volumes_Cut

**NOTE:** Compute **Unsuitable**, **Custom** and **Substrata** use feature definitions assigned to the component in a template and will be discussed more in depth in **MoDOT's Road 2 Class**.

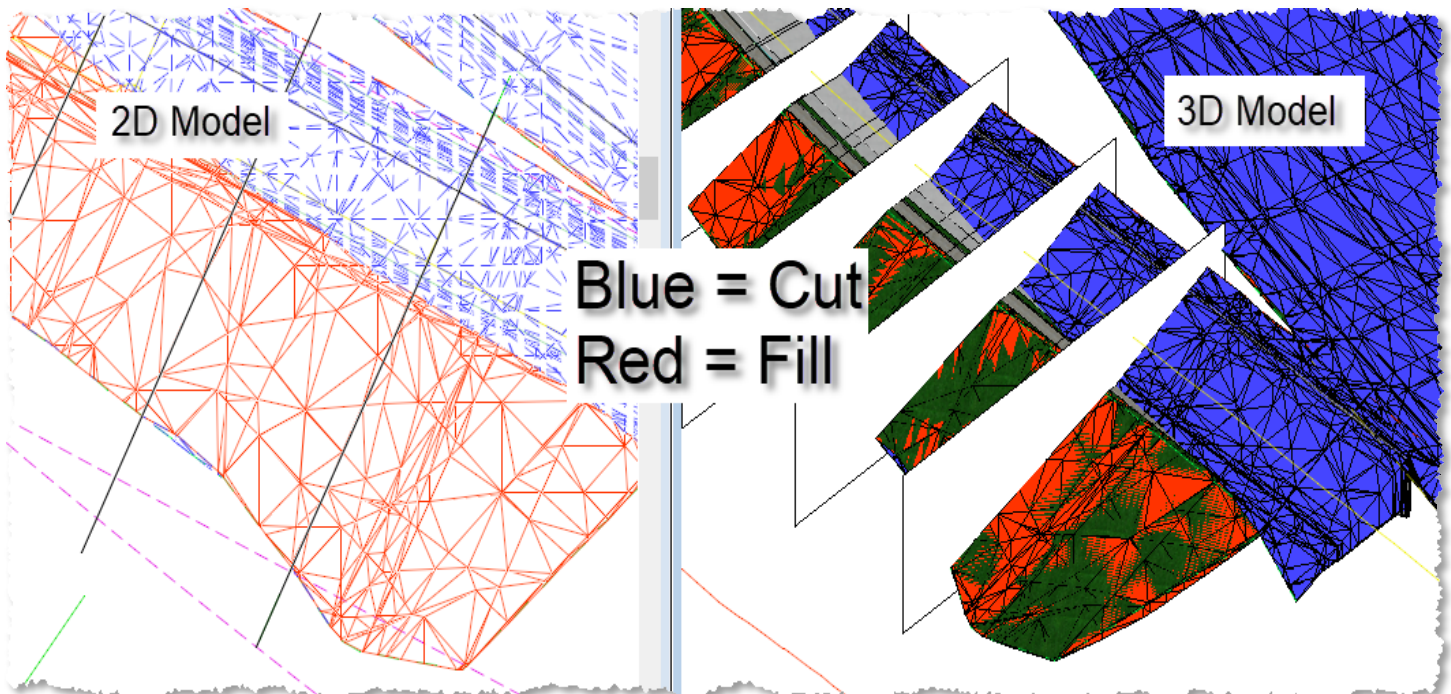


17. **Accept** (left mouse clicks) in a blank area through each of the default options.

And **accept** one last time to accept the selection.



**NOTE:** After processing, a blue colored mesh will represent cut and a red colored mesh will represent fill.



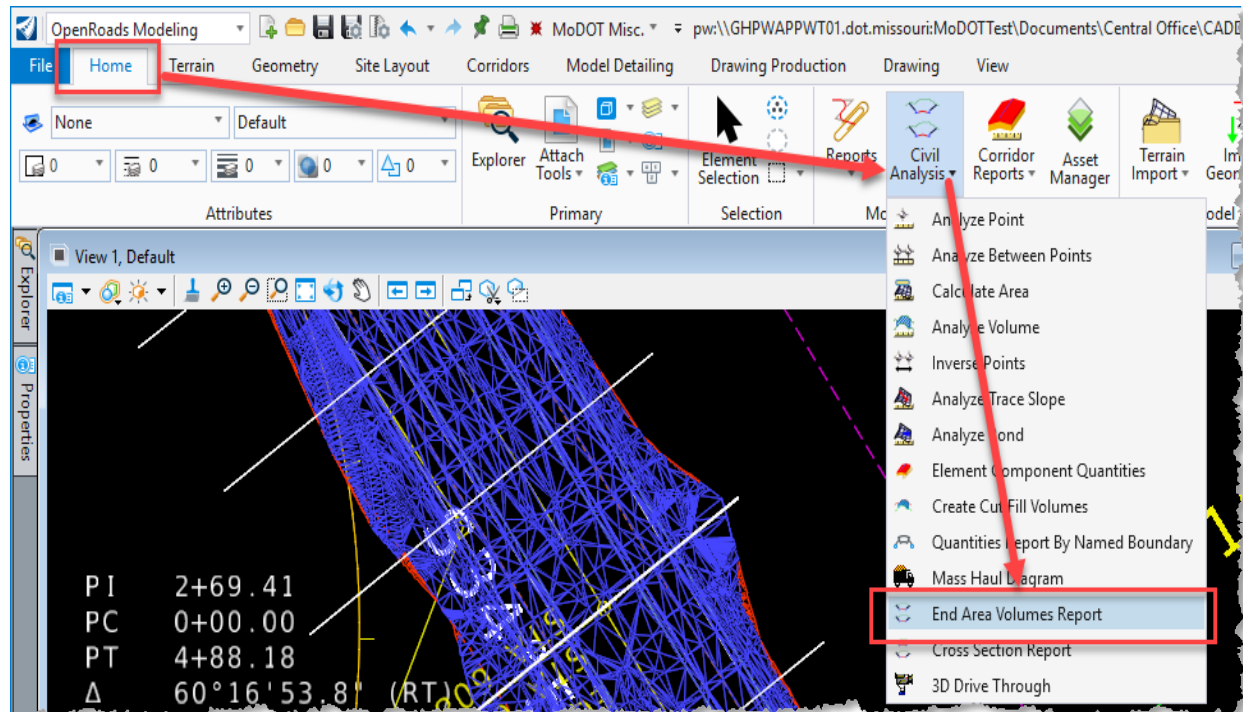
**Notes:** - The process of Creating Cut Fill Volumes will run throughout the existing ground and proposed corridors entirely. Meaning that all corridors will be calculated in this process. Therefore, one single corridor per design file is recommended at this time.

- Meshes **are not dynamic**. If something changes in the design, then the old meshes need to be replaced with new meshes using the Create Cut Fill Volume tool.

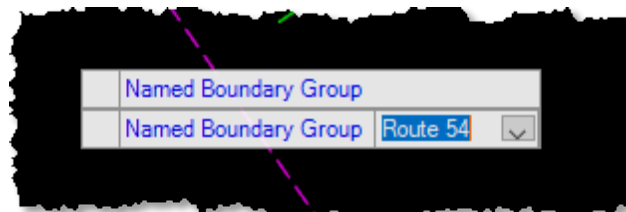


**End Area Volume reporting:**

18. Within the OpenRoads Modeling Workflow select the **Home Tab** → **Model Analysis and Reporting Section** → **Civil Analysis Tools** → **End Area Volume Report** tool.



19. Choose the **Route-54** for the Named Boundary Group.



20. In the next prompt, the tool will ask the User to define a **Volume Exception** by selecting the start and stop cross section named boundaries. Once the **Volume Exception** is defined or if there is no **Volume Exception**, the User can just **Reset** (Right-Click) to complete and create the **End Area Volume** report.

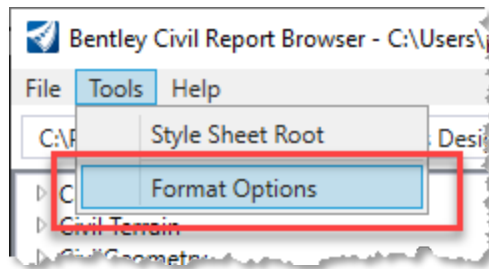
Select the start cross section named boundary for volume exception. Reset to complete.

Select the end cross section named boundary for volume exception. Reset to complete.

**Note:** This will bring up a report that has many other volume reports that are created. The importance of this report is that it creates an XML that is attached to each of the cross-section shapes that will allow for annotation.

**Changing the Format Options of the Report:**

21. Select the **Tools** option in the top left corner of the report and then select **Format Options**



22. In the Format Options dialog change the following:

- Station **ss+ss.ss**
- Cubic Units **Check the Convert to Cubic Yards box**

**NOTE:** Then close the dialog. In SS4 this dialog was dynamic meaning that if you changed a setting it would immediately change the report but in ORD it is not so closing the dialog enables the changes made.

A screenshot of the "Format Options" dialog box. The dialog has a title bar with the Bentley logo and the text "Format Options", and a close button (X) in the top right corner. The main area contains several settings organized into columns: "Mode", "Precision", and "Format".

	Mode	Precision	Format
Northing/Easting/Elevation:		0.12	
Angular:	Degrees	0	ddd^mm'ss
Slope:		0.12	0.5
Use Alternate Slope if Slope Exceeds:		0.00%	
Alternate Slope:		0.12	0.5
Linear:		0.12	
Station:		0.12	ss+ss.ss
Acres/Hectares:		0.12	
Area Units:		0.12	
Cubic Units:		0.12	<input checked="" type="checkbox"/> Convert to Cubic Yard
Direction:	Bearings	0	ddd^mm'ss
Face:	Right Face		
Vertical Observation:	Zenith		

On the right side of the dialog, there is a checkbox labeled "Include Angular Suffix" which is currently unchecked, and a "Delimiter:" field containing a "+" sign. A "Close" button is located in the top right corner of the dialog area. Two red rectangles are drawn on the dialog: one around the "Station" row and another around the "Cubic Units" row.

## End Area Volume Report

Report Created: Thursday, March 9, 2023  
Time: 4:36:16 PM

Cross Section Set Name: Route 54

Alignment Name: Route 54

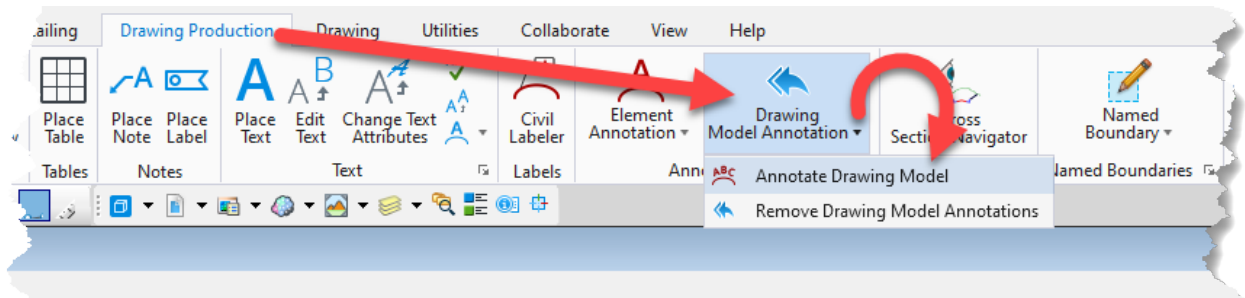
Input Grid Factor: Note: All units in this report are in feet, square feet and cubic yards unless specified otherwise.

----- Station Quantities -----									
Baseline Station	----- Cut -----				----- Fill -----				Mass Ordinate
	Factor	Area	Volume	Adjusted	Factor	Area	Volume	Adjusted	
602+59.49 R1	1.00	535.37	0.00	0.00	1.00	0.00	0.00	0.00	0.00
603+00.00 R1	1.00	544.74	810.28	810.28	1.00	0.00	0.00	0.00	810.28
604+00.00 R1	1.00	551.23	2029.58	2029.58	1.00	0.00	0.00	0.00	2839.86
605+00.00 R1	1.00	553.04	2044.94	2044.94	1.00	0.00	0.00	0.00	4884.80
606+00.00 R1	1.00	606.29	2146.91	2146.91	1.00	0.00	0.00	0.00	7031.71
607+00.00 R1	1.00	596.14	2226.72	2226.72	1.00	0.00	0.00	0.00	9258.43
608+00.00 R1	1.00	779.99	2548.38	2548.38	1.00	0.05	0.09	0.09	11806.73
608+00.00 R2	1.00	780.17	29.18	29.18	1.00	0.06	0.00	0.00	11835.90
609+00.00 R2	1.00	533.43	2432.61	2432.61	1.00	0.00	0.10	0.10	14268.41
610+00.00 R2	1.00	531.56	1972.21	1972.21	1.00	0.03	0.06	0.06	16240.56
611+00.00 R2	1.00	525.37	1957.27	1957.27	1.00	0.09	0.24	0.24	18197.59
612+00.00 R2	1.00	538.96	1970.97	1970.97	1.00	0.02	0.21	0.21	20168.35
613+00.00 R2	1.00	635.34	2174.62	2174.62	1.00	0.00	0.04	0.04	22342.93
614+00.00 R2	1.00	907.75	2857.56	2857.56	1.00	0.00	0.00	0.00	25200.49
615+00.00 R2	1.00	880.03	3310.71	3310.71	1.00	0.00	0.00	0.00	28511.20
616+00.00 R2	1.00	724.75	2971.82	2971.82	1.00	0.00	0.00	0.00	31483.02
617+00.00 R2	1.00	599.58	2452.47	2452.47	1.00	0.02	0.03	0.03	33935.46
618+00.00 R2	1.00	586.35	2196.18	2196.18	1.00	385.23	713.42	713.42	35418.21
619+00.00 R2	1.00	603.69	2203.78	2203.78	1.00	429.53	1508.83	1508.83	36113.17
620+00.00 R2	1.00	598.77	2226.78	2226.78	1.00	163.40	1098.04	1098.04	37241.91
621+00.00 R2	1.00	589.60	2200.70	2200.70	1.00	27.74	353.97	353.97	39088.63
622+00.00 R2	1.00	545.74	2102.48	2102.48	1.00	0.00	51.37	51.37	41139.75
623+00.00 R2	1.00	816.95	2523.50	2523.50	1.00	0.00	0.00	0.00	43663.25
624+00.00 R2	1.00	951.16	3274.28	3274.28	1.00	0.00	0.00	0.00	46937.53
625+00.00 R2	1.00	464.73	2622.01	2622.01	1.00	0.00	0.00	0.00	49559.53
626+00.00 R2	1.00	345.15	1499.77	1499.77	1.00	0.29	0.54	0.54	51058.76
627+00.00 R2	1.00	332.43	1254.78	1254.78	1.00	0.59	1.63	1.63	52311.91
628+00.00 R2	1.00	301.10	1173.20	1173.20	1.00	0.41	1.85	1.85	53483.27
629+00.00 R2	1.00	369.72	1242.26	1242.26	1.00	0.22	1.16	1.16	54724.37
630+00.00 R2	1.00	419.13	1460.84	1460.84	1.00	0.00	0.41	0.41	56184.80
631+00.00 R2	1.00	472.26	1650.71	1650.71	1.00	0.00	0.00	0.00	57835.52
632+00.00 R2	1.00	591.94	1970.74	1970.74	1.00	0.00	0.00	0.00	59806.26
633+00.00 R2	1.00	918.01	2796.21	2796.21	1.00	0.00	0.00	0.00	62602.47
634+00.00 R2	1.00	2062.34	5519.18	5519.18	1.00	0.00	0.00	0.00	68121.65
635+00.00 R2	1.00	3618.67	10520.40	10520.40	1.00	0.00	0.00	0.00	78642.04
636+00.00 R2	1.00	507.53	7641.11	7641.11	1.00	0.00	0.00	0.00	86283.16
637+00.00 R2	1.00	504.13	1873.45	1873.45	1.00	0.00	0.00	0.00	88156.60
638+00.00 R2	1.00	517.25	1891.44	1891.44	1.00	0.00	0.00	0.00	90048.04
639+00.00 R2	1.00	570.65	2014.62	2014.62	1.00	0.00	0.00	0.00	92062.66
640+00.00 R2	1.00	561.54	2096.65	2096.65	1.00	0.00	0.00	0.00	94159.31
641+00.00 R2	1.00	572.87	2100.77	2100.77	1.00	0.00	0.00	0.00	96260.08
642+00.00 R2	1.00	546.60	2073.09	2073.09	1.00	0.00	0.00	0.00	98333.17
643+00.00 R2	1.00	543.05	2017.86	2017.86	1.00	0.00	0.00	0.00	100351.03
644+00.00 R2	1.00	538.04	2002.01	2002.01	1.00	0.00	0.00	0.00	102353.04
645+00.00 R2	1.00	539.35	1995.17	1995.17	1.00	0.00	0.00	0.00	104348.21
646+00.00 R2	1.00	561.76	2039.11	2039.11	1.00	0.00	0.00	0.00	106387.32
647+00.00 R2	1.00	506.76	1978.75	1978.75	1.00	0.00	0.00	0.00	108366.07
647+66.54 R2	1.00	476.83	1212.09	1212.09	1.00	0.00	0.00	0.00	109578.15
Grand Total:			113310.15	113310.15			3731.99	3731.99	

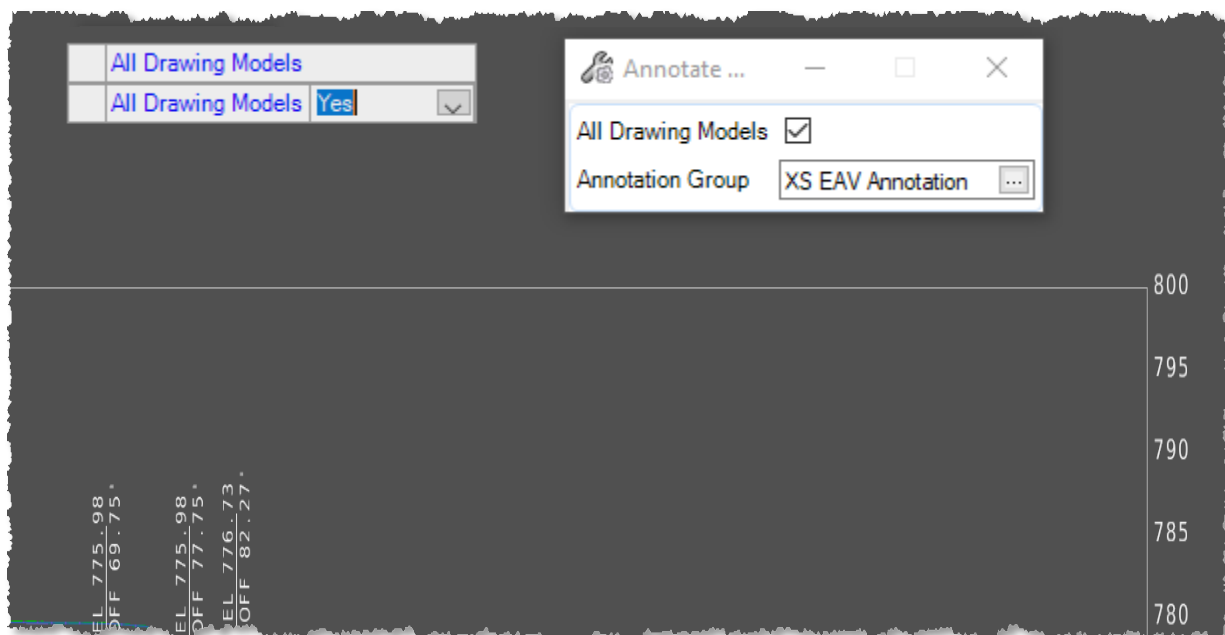
**Adding End Area Volume annotation to cross-sections:**

23. Open a Drawing Model. We will open **615+00 R2** for this example.

24. Apply **End Area Volume Annotation** by opening the **Annotate Drawing Model** tool.



25. The Annotate dialog will open and again we will choose **Yes** to annotate **All Drawing Models** by either the up/down arrows or checking the box in the dialog



26. Next, choose the triple dot box to open the **Annotation Group** pick list.

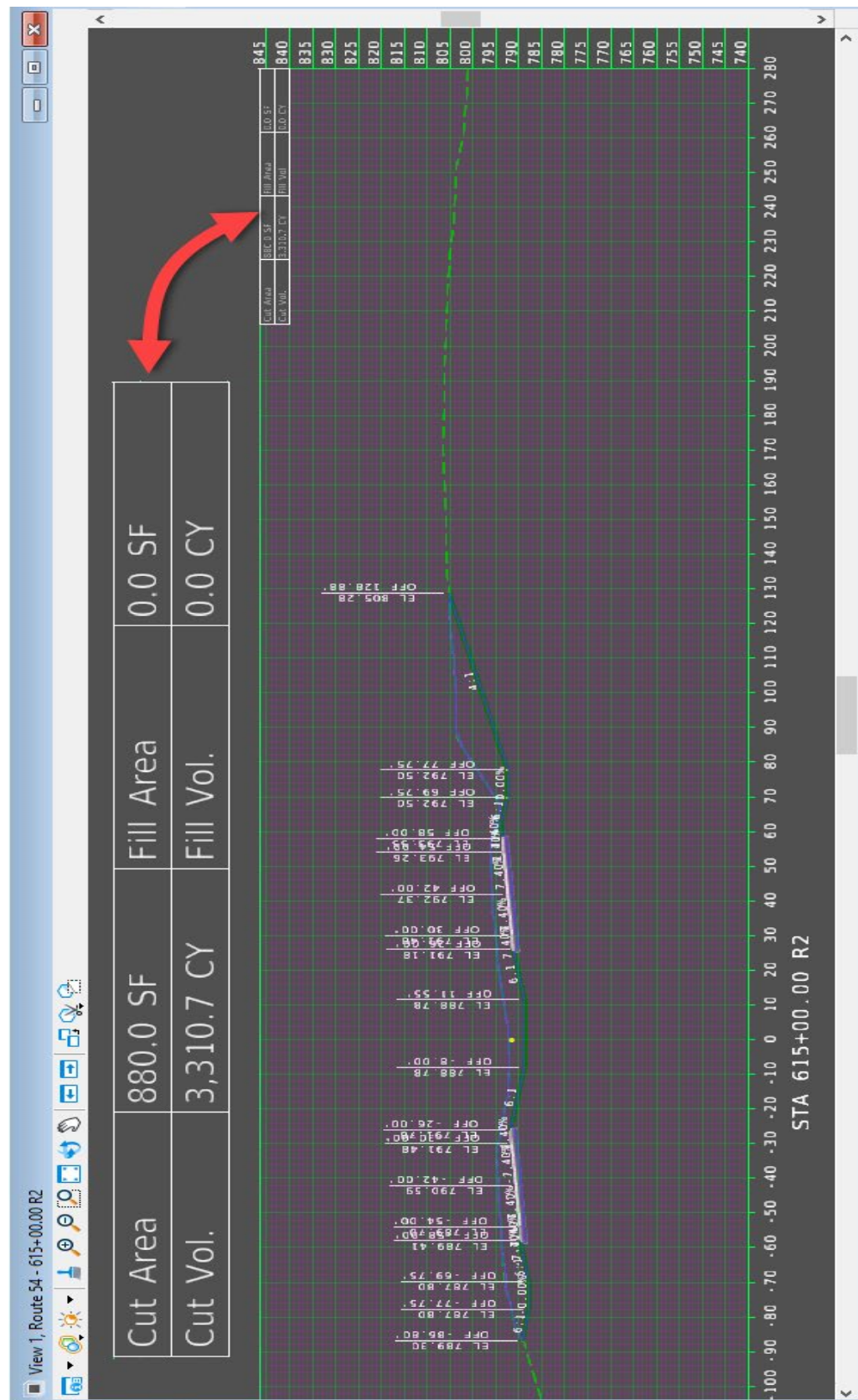
27. Navigate by opening the **Cross-Section** folder.

28. Open the **Drawing** folder to see the options for annotation

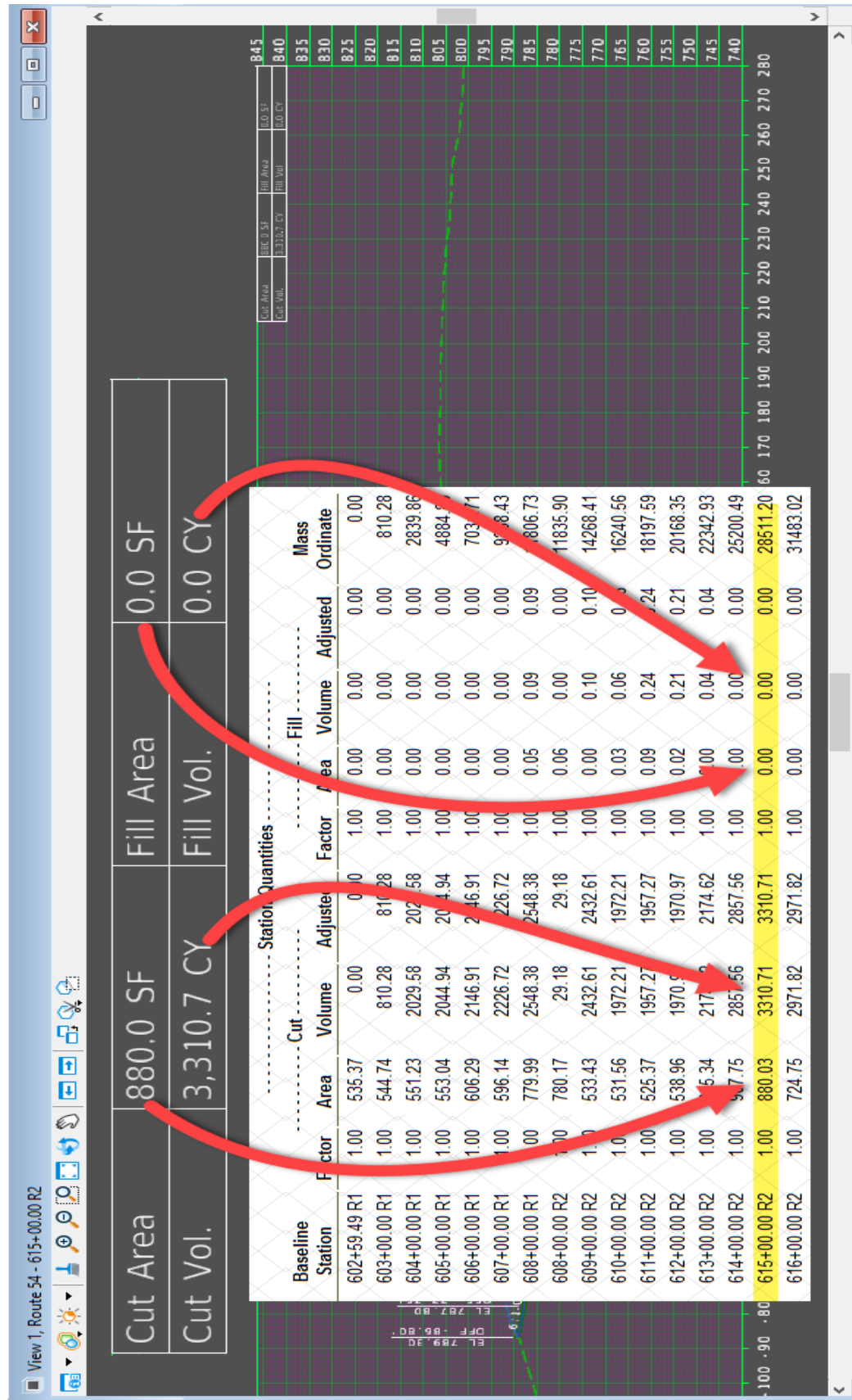
29. First use the annotation group **XS Annotation with Grid** and then **XS EAV Annotation**.



30. Accept through the heads-up prompts to get the End Area Volume cell to be placed in the top right corner of the drawing model



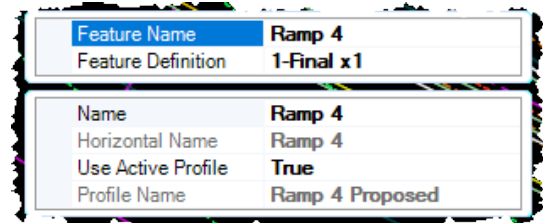
31. Compare the report to the information in the earthwork cell



## 8.6 Individual Exercise: Create Cut Fill Volumes Ramp 4

### Final Feature definition (Design Stage SS4)

1. Open the **Corridors\_Ramp-4\_J5P3181.dgn** and verify that the Feature Definition is set to **1-Final x 1**. This will ensure the most accurate earthwork quantities.



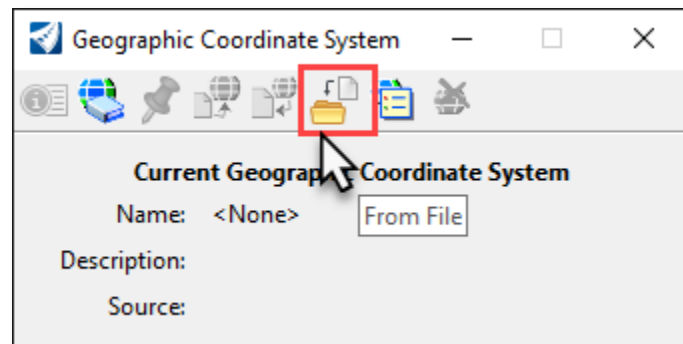
### Create an Earthwork File:

2. Within the **Roadway\data-8** folder, create a new file named **Named\_Boundary\_Ramp-4\_EAV\_J5P3181.dgn** using the following seed file:

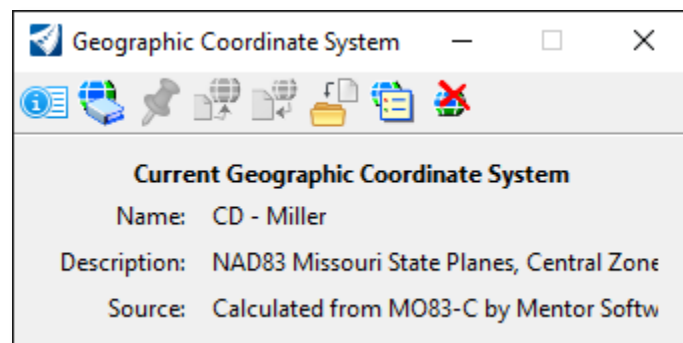
**MoDOT\_Roadway\_Seed\_2D.dgn** seed file.

### Attach the Coordinate System:

3. Open the **Coordinate System** tool by selecting the **OpenRoads Modeling Workflow** → **Utilities Tab** → **Geographic Section**.
4. Select “**From File**” icon.



5. Select the **Terrain\_J5P3181.dgn** file in the **data-8** folder.
6. Verify the settings.



**Attach the Reference Files:**

7. **Attach** the following files as reference files”
  - **Civil\_Geometry\_J5P3181.dgn**
  - **Corridors\_Ramp-4\_J5P3181.dgn**
  - **Terrain\_J5P3181.dgn**
8. Change the **Annotation Scale** to **1”=50’**
9. Make the **Terrain\_J5P3181.dgn** the active surface
10. In the **Default** model, select the **F6 button** to open the 3D model view

**Create Named Boundaries:**

11. From the **Drawing Production** tab select the **Place Named Boundary** tool
12. Select the **Civil Cross Section** icon
13. Select the **D Size XS Sheet – 5 Scale** option
14. Identify the Ramp-4 alignment.

- Start Location = beginning of alignment Ramp-4
- Stop Location = 5+00
- Left Offset = -40
- Right Offset = 100
- The Interval = 50
- Create Drawing = Check
- Show Dialog = Check

**Place Named Boundary Civil Cross Section**

Drawing Seed: D Size XS Sheet - 5 Scale

Detail Scale: 1"=5'

Group: (New)

Name: Ramp 4

Description:

☒ Start Location: 0+00.00

☒ Stop Location: 5+00.00

Left Offset: -40.000000

Right Offset: 100.000000

Interval: 50.000000

Vertical Exaggeration: 1.000000

☒ Top Clearance: 10.000000

☒ Bottom Clearance: 5.000000

Elevation Datum Spacing: 5.000000

Event Point List: (None)

☐ Include Event Points Only

☐ Include Control Points

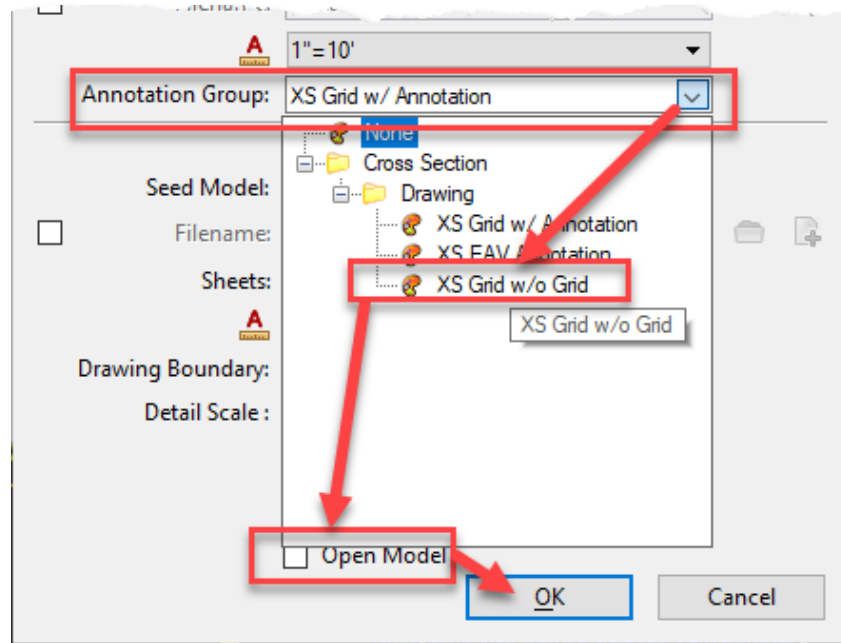
☐ Backward Facing

☒ Create Drawing

☒ Show Dialog



15. Create Drawing dialog opens:
  - a. Change the Annotation Group to **XS Annotation w/o Grid**
  - b. **Uncheck** Open Model
  - c. Select the **OK** button to start the processing of cross-section models



### Create Cut and Fill Volumes:

This process will create a mesh surface for each of the cut and fill material for extracting of quantities.

16. Select the **Home** tab
17. Select the **Civil Analysis** pull down
18. Select **Create Cut Fill Volumes**
19. The dialog will open and will allow the user to specify a **Cut** and **Fill** Feature definition, the MoDOT default values should be already be set.
20. **Accept** (left mouse clicks) in a blank area through each of the default options

### End Area Volume reporting:

21. **Open** the End Area Volume Report tool:

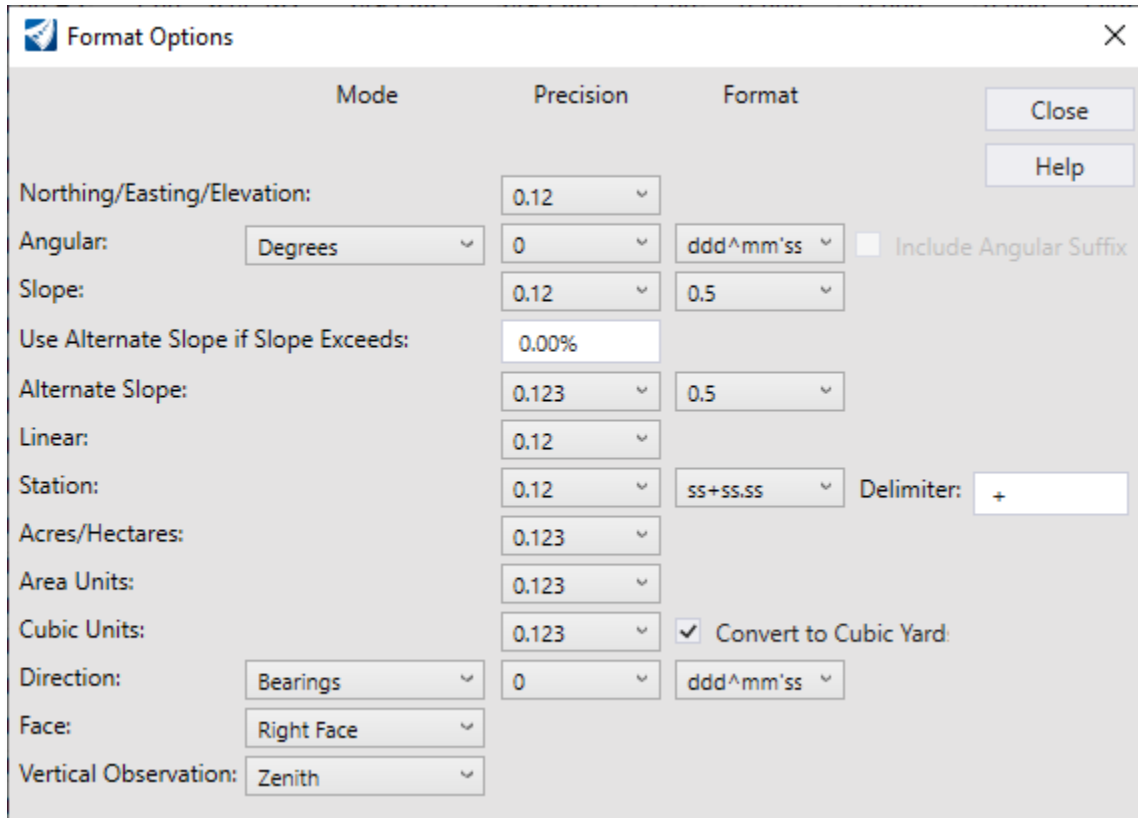
**Home Tab → Civil Analysis → End Area Volume Report**
22. **Choose** the **Ramp-4** Named Boundary option.

**Changing the Format Options of the Report:**

23. Select the **Tools** option in the top left corner of the report and then select **Format Options**

24. In the Format Options dialog change the following:

- a. Angular      **ddd^mm'ss**
- b. Station      **ss+ss.ss**
- c. Cubic Units      **Check the Convert to Cubic Yards box**
- d. Direction      **ddd^mm'ss**



The image shows a screenshot of the 'Format Options' dialog box. The dialog has a title bar with a close button (X) and a 'Format Options' label. It contains several sections for configuring report formats. The 'Angular' section has a 'Mode' dropdown set to 'Degrees', a 'Precision' dropdown set to '0', and a 'Format' dropdown set to 'ddd^mm'ss'. There is an unchecked checkbox for 'Include Angular Suffix'. The 'Slope' section has a 'Precision' dropdown set to '0.12' and a 'Format' dropdown set to '0.5'. The 'Use Alternate Slope if Slope Exceeds:' section has a text input field set to '0.00%'. The 'Alternate Slope:' section has a 'Precision' dropdown set to '0.123' and a 'Format' dropdown set to '0.5'. The 'Linear' section has a 'Precision' dropdown set to '0.12'. The 'Station' section has a 'Precision' dropdown set to '0.12', a 'Format' dropdown set to 'ss+ss.ss', and a 'Delimiter' dropdown set to '+'. The 'Acres/Hectares' section has a 'Precision' dropdown set to '0.123'. The 'Area Units' section has a 'Precision' dropdown set to '0.123'. The 'Cubic Units' section has a 'Precision' dropdown set to '0.123' and a checked checkbox for 'Convert to Cubic Yard:'. The 'Direction' section has a 'Mode' dropdown set to 'Bearings', a 'Precision' dropdown set to '0', and a 'Format' dropdown set to 'ddd^mm'ss'. The 'Face' section has a 'Mode' dropdown set to 'Right Face'. The 'Vertical Observation' section has a 'Mode' dropdown set to 'Zenith'. There are 'Close' and 'Help' buttons in the top right corner.

	Mode	Precision	Format	
Northing/Easting/Elevation:		0.12		
Angular:	Degrees	0	ddd^mm'ss	<input type="checkbox"/> Include Angular Suffix
Slope:		0.12	0.5	
Use Alternate Slope if Slope Exceeds:		0.00%		
Alternate Slope:		0.123	0.5	
Linear:		0.12		
Station:		0.12	ss+ss.ss	Delimiter: +
Acres/Hectares:		0.123		
Area Units:		0.123		
Cubic Units:		0.123	<input checked="" type="checkbox"/> Convert to Cubic Yard:	
Direction:	Bearings	0	ddd^mm'ss	
Face:	Right Face			
Vertical Observation:	Zenith			

## End Area Volume Report

Report Created: Tuesday, August 16, 2022  
Time: 11:54:43 AM

Cross Section Set Name: Ramp 4

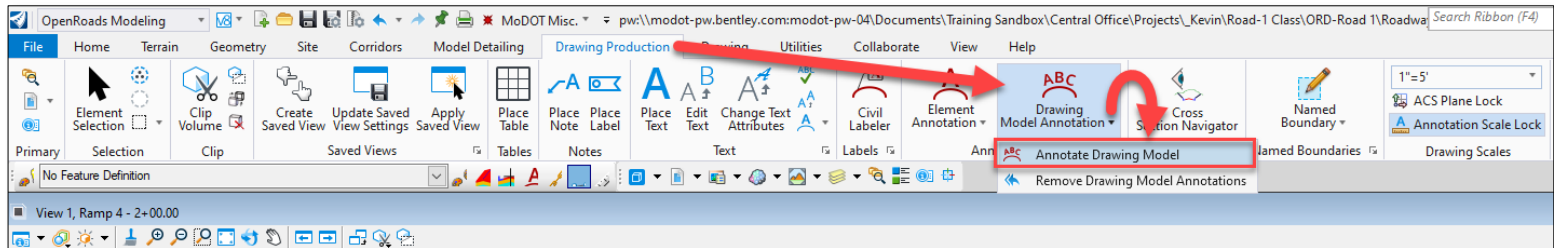
Alignment Name: Ramp 4

Input Grid Factor:      **Note:** All units in this report are in feet, square feet and cubic yards unless specified otherwise.

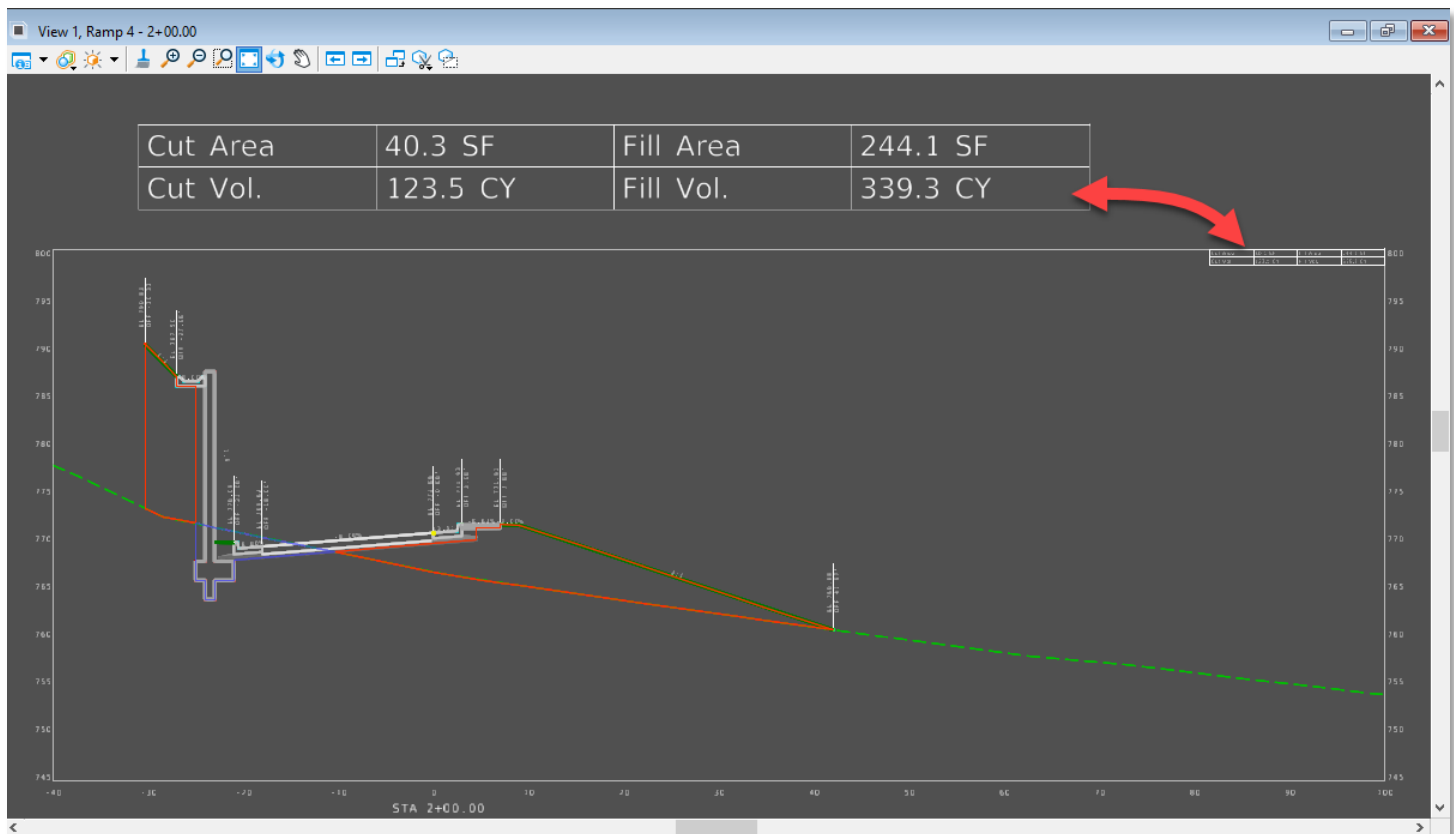
----- Station Quantities -----									
Baseline Station	Factor	----- Cut -----			----- Fill -----			Adjusted	Mass Ordinate
		Area	Volume	Adjusted	Factor	Area	Volume		
0+00.00	1.00	717.899	0.000	0.000	1.00	0.000	0.000	0.000	0.000
0+50.00	1.00	295.236	938.087	938.087	1.00	8.395	7.773	7.773	930.314
1+00.00	1.00	128.015	391.899	391.899	1.00	68.133	70.860	70.860	1251.353
1+50.00	1.00	93.121	204.756	204.756	1.00	122.315	176.341	176.341	1279.768
2+00.00	1.00	40.263	123.504	123.504	1.00	244.100	339.273	339.273	1063.998
2+50.00	1.00	68.037	100.278	100.278	1.00	297.126	501.135	501.135	663.141
3+00.00	1.00	132.663	185.833	185.833	1.00	311.104	563.176	563.176	285.798
3+50.00	1.00	244.109	348.863	348.863	1.00	255.914	525.017	525.017	109.644
4+00.00	1.00	337.301	538.342	538.342	1.00	251.217	469.567	469.567	178.420
4+50.00	1.00	416.791	698.233	698.233	1.00	243.021	457.628	457.628	419.025
5+00.00	1.00	508.250	856.519	856.519	1.00	0.102	225.114	225.114	1050.429
Grand Total:			4386.313	4386.313			3335.884	3335.884	

**Adding End Area Volume annotation to cross-sections:**

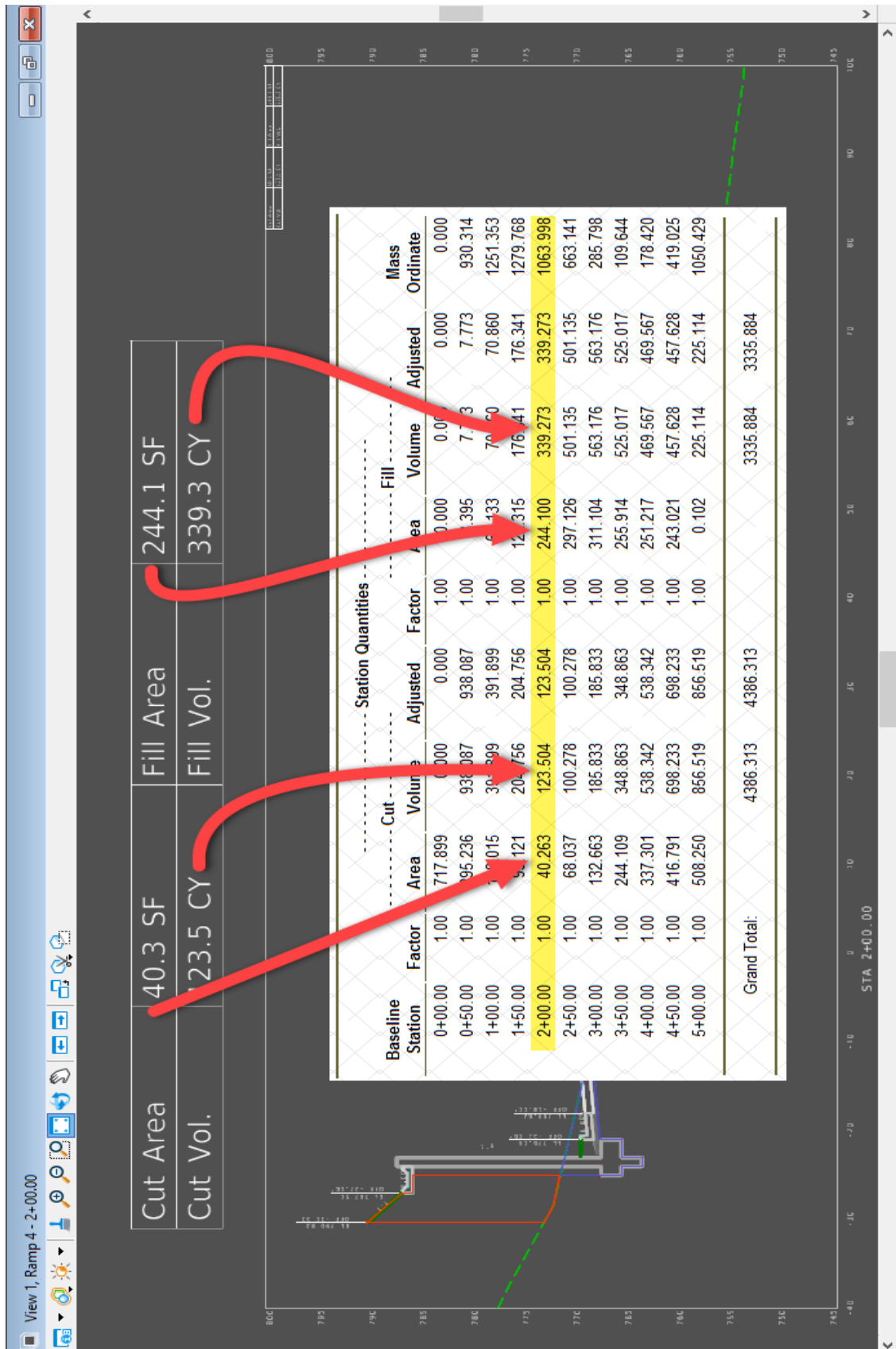
25. Open a drawing model. We will open **2+00** for this example.
26. Apply an annotation by opening the **Annotate Drawing Model** tool.



27. The Annotate dialog will open and we will choose “**Yes**” to annotate “**All Drawing Models**” by either the up/down arrows or checking the box in the dialog
28. Next, choose the **triple dot box** to open the **Annotation Group pick list**
29. Navigate by opening the **Cross-Section ➔ Drawing** folder.
30. Select **XS EAV Annotation**
31. Accept through the heads-up prompts to get the End Area Volume cell to be placed in the top right corner of the drawing model.



32. Compare the report to the information in the earthwork cell



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## Chapter 9

# Plan Sheet Production

9.1	Exercise #1 (Group) Full Plan Sheets.....	1
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### PLAN SHEET CREATION HELP DOCUMENTATION:

<https://docs.bentley.com/LiveContent/web/OpenRoads%20Designer%20CONNECT-v8/en/GUID-F093B73D-E20A-4E4E-B458-7B244AEEA21A.html>

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## 9.1 Exercise #1 (Group) Full Plan Sheets

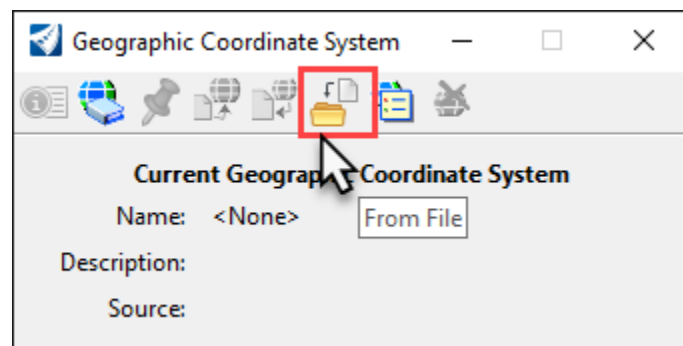
1. Create a new folder within **data-9** called **Plan\_Sheets**
2. Within the **data-9** folder open the **Civil\_Geometry\_J5P3181.dgn**
3. Create a new file named:

**Named\_Boundary\_Full-Plan\_Route-54\_J5P3181.dgn**

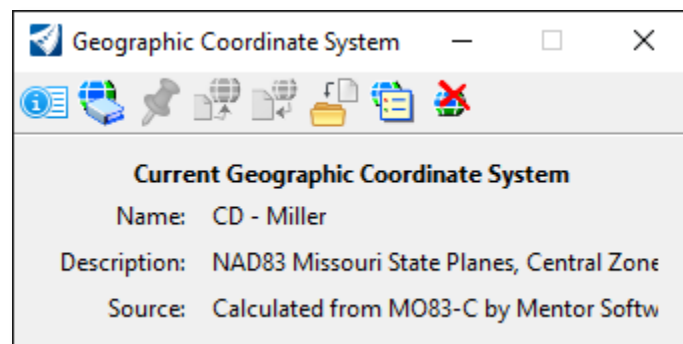
using the:

**MoDOT\_Roadway\_Seed\_2D.dgn** seed file.

4. Open the **Coordinate System** tool by selecting the **OpenRoads Modeling Workflow** → **Utilities** Tab → **Geographic** Section.
5. Select “**From File**” icon.



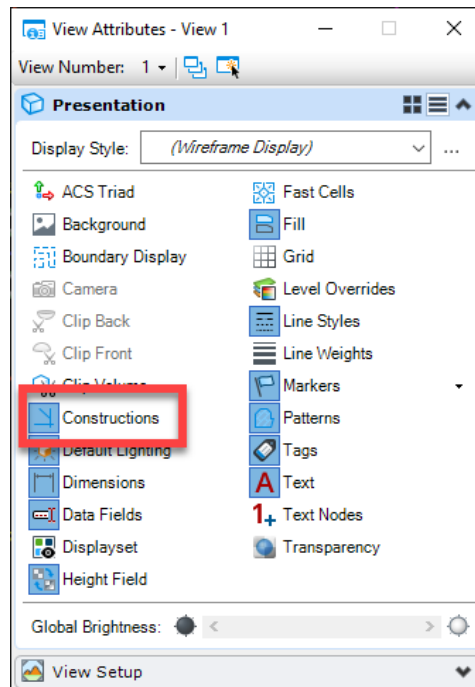
6. Select the **Terrain\_J5P3181.dgn** file in the **data-9** folder.
7. Verify the settings.



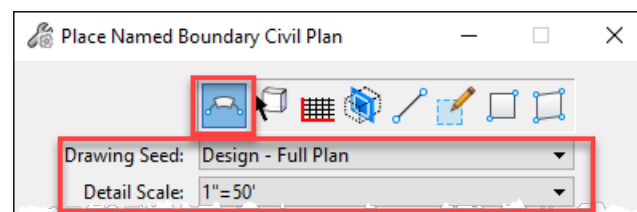
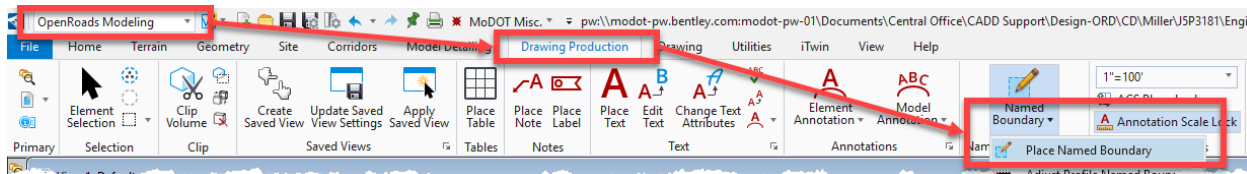
8. Reference in the following file:
  - **Civil\_Geometry\_J5P3181.dgn**
  - **Corridors\_Route-54\_J5P3181.dgn**
  - **Corridors\_Ramp-4\_J5P3181.dgn**
  - **Land\_Boundary\_J5P3181.dgn**
9. Change the **Annotation Scale** to **1" = 50'**
10. MicroStation **Fit View** to the project location.



11. **Turn on/off levels** as desired before processing the plan sheets.
12. In **View Attributes**, verify that the toggle is **ON** for **Constructions**.



13. From **OpenRoads Modeling** workflow, select the **Drawing Production** tab and then select the **Named Boundary** tool.



14. Select the **Civil Plan** method
15. Select a **Drawing Seed** file
16. Select a **Detail Scale**
17. **Select the alignment or baseline**

18. In the **Place Named Boundary** dialog, change the options as desired to produce the clipping shapes for the plan sheets.

- For class purposes, fill out as shown below.

Place Named Boundary Civil Plan

Drawing Seed: Design - Full Plan

Detail Scale: 1" = 50'

Name: Plan 1

Description:

Group: (New)

Name: Route 54

Description:

☒ Start Location: 602+59.49

☐ Stop Location: 575+59.49

Length: 1350.000000

Left Offset: -477.820000

Right Offset: 477.820000


Overlap: 0.000000

Boundary Chords: 1

☒ Create Drawing

☒ Show Dialog

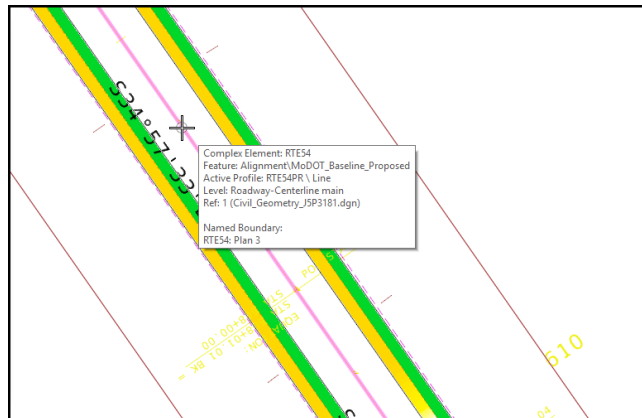
Predefined values that fit within the border

- Clipping shape options** - set to **Civil Plan**. 
- Drawing Seed** - select **Design - D Size Full Plan**
- Detail Scale** – **50'**
- Name** – defined by picking the alignment or user defined
- Start Location & Stop Location** - can be typed in or dynamically placed in the dgn file
- Overlap** – adds additional overlap area to Named Boundaries = **0**
- Boundary Chords** - set to **1**
- Create Drawing** - toggle **ON** (Off will mandate the use of the Named Boundary Manager to process sheets)
- Show Dialog** – toggle **ON** (Off will require going through the Create Drawing tool again as there are important settings that need to be utilized)

**Note:** *Length, Left Offset and Right Offset options should not be adjusted after selecting the desired scale. Adjusting these will produce undesirable results on the final cut plan sheet.*

19. Once the **Named Boundary** dialog is filled out, you can now start the process to create the clipping shapes for the full plan sheets.

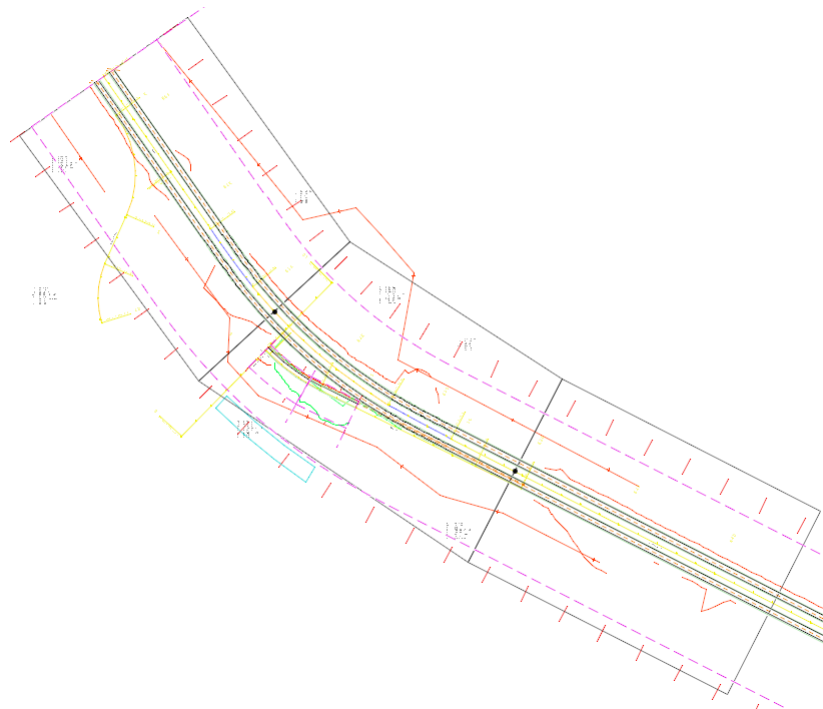
**(Optional)** Select the **alignment** to place the clipping shapes along.



20. **Select the start location.**

Move along the alignment and **left click** once you have the desired number of clipping shapes created.

**Left click** again in a blank area to accept the clipping shapes.



**Note:** The Start Location and Stop Location can also be typed in the Place Boundary dialog if desired.

21. (Optional) **Move the shapes as needed** to get the correct area for the clipping shape.

**Note:** Currently, the clipping shapes will not dynamically follow along the alignment. Also not supported is the ability to move the preceding and following clipping shapes when moving a clipping shape.

22. Now that the clipping shapes are created, you can now start the process to create the plan sheet files by **left clicking** one last time to bring up the **Create Drawing** dialog box.

23. In the **Create Drawing** dialog, change the options as desired to produce the plan sheets.

- For class purposes, fill out the dialog exactly like the dialog below.

The screenshot shows the 'Create Drawing' dialog box with the following settings and annotations:

- Mode:** Plan
- One Sheet Per Dgn:** ☒ (Annotated with a red box)
- Path:** Roadway\data-9\Plan Sheets\ (Annotated with a red box and a folder icon)
- View Name:** Route-54\_J5P3181\_Plan\_01 (Annotated with a green box)
- Drawing Seed:** Design - Full Plan (Annotated with a green box)
- View Type:** Civil Plan
- Discipline:** Civil
- Purpose:** Plan View
- Drawing Model:**
  - Model Name:** Route-54\_J5P3181\_Plan\_01 (Annotated with a green box)
  - Seed Model:** MoDOT D Size - Design Full Plan Sheet.dwg
- Filename:** (Active File)
- Annotation Group:** Plan Annotation (Annotated with a red box)
- Scale:** 1"=50' (Annotated with a red box)
- Sheet Model:**
  - Model Name:** Route-54\_J5P3181\_Plan\_01 (Annotated with a green box)
  - Seed Model:** MoDOT D Size - Design Full Plan Sheet.dwg
- Filename:** (Active File)
- Sheets:** (New)
- Full Size 1 = 1**
- Drawing Boundary:** Design - Full Plan
- Detail Scale:** 1"=50' (By Named Boundary) (Annotated with a red box)
- Options:**
  - ☐ Add To Sheet Index
  - ☐ Make Sheet Coincident
  - ☒ Open Model

Annotations in the image:

- Green text: "All 3 naming fields can be renamed to something more towards the naming convention before processing" (pointing to View Name, Drawing Seed, and Model Name fields).
- Red text: "Plan Annotation allows for a match line and a north arrow to be created when processing" (pointing to the Annotation Group field).

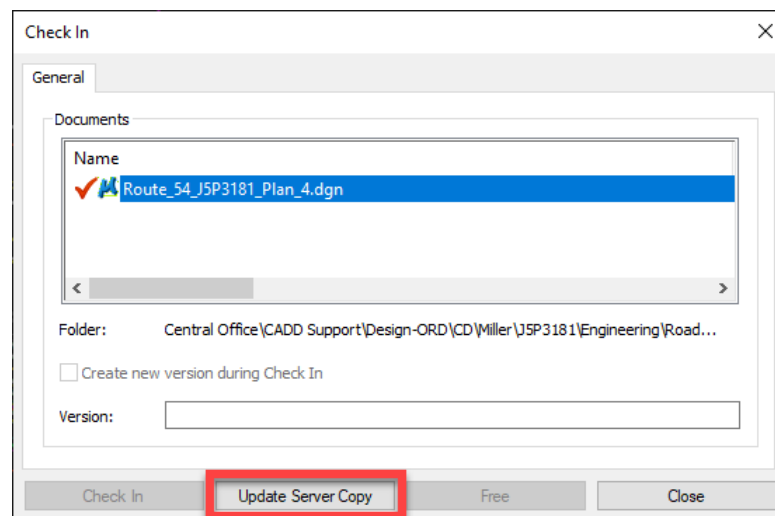
a) Name – **Route-54\_J5P3181\_Plan\_01**

- Sheets will need to be named to conform to the “file naming convention” for contract plans

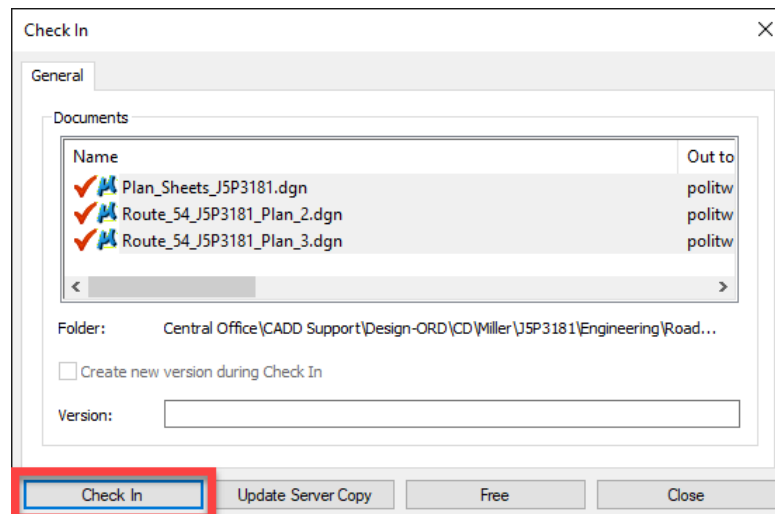
b) **One Sheet Per Dgn** - toggle **ON** and set locationc) **Folder** – Allows the user to navigate to the **Plan\_Sheets** folder to store the created plan sheetsd) **Annotation Scale** (*Drawing Model*) - select the same scale as from the *Place Named Boundary* dialog **50**e) **Annotation Group** - Allows the placement of match lines & a north arrowf) **Detail Scale** - same scale the Drawing Model annotation scale **50**

24. Select **OK** to create the sheet. This will create separate sheet files in the location that you selected in the dialog box.

25. After the sheets are created, select **Update Server Copy** on the “Check In” dialog box.

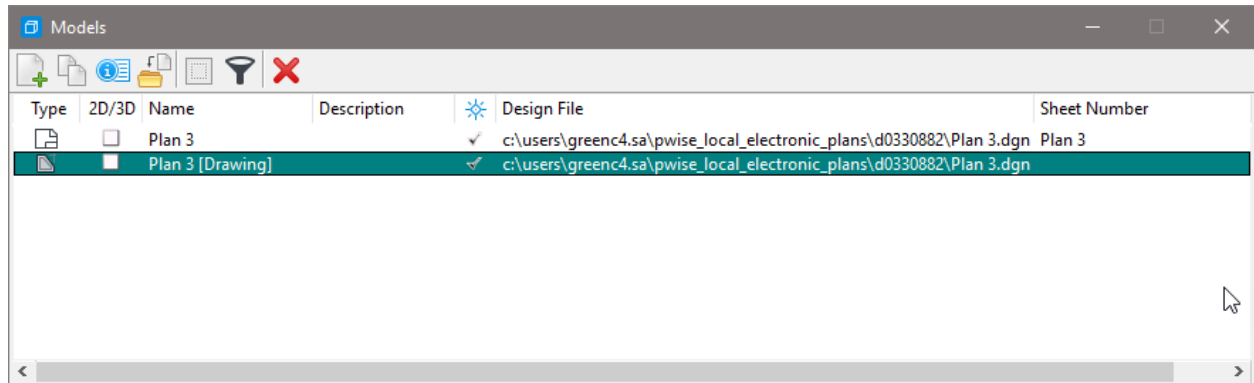


26. In the next “Check In” dialog box, select the **Check In** option.

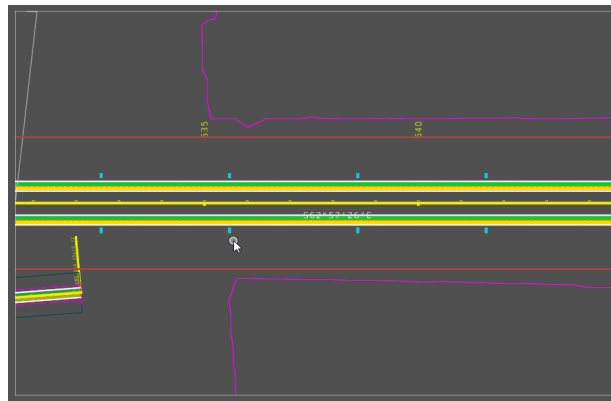


27. Open the sheet files and review.

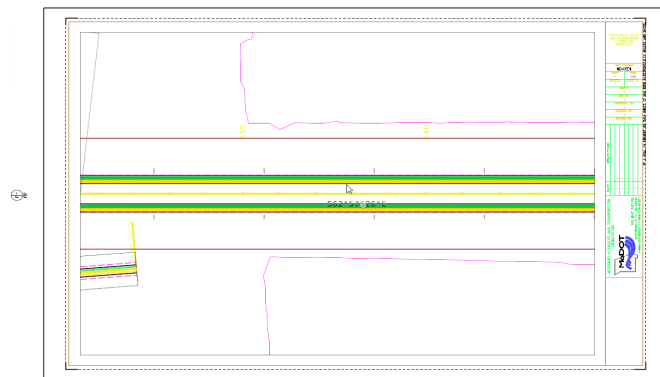
In the **Models** tool, you will see that it creates a drawing model and a sheet model.



The **Drawing model** is designed to add geometry like text, notes, dimensions, extra reference files, etc. to the file. The drawing model is still a 1:1 scale, so everything is the same scale as from the file that you cut the sheets from.



The **Sheet model** takes what is in the Drawing model and scales it down to fit the border that is in the Sheet Model. Adding geometry (except for the text that is needed for the border information) to the sheet model is **not recommended or supported** by CADD Support.

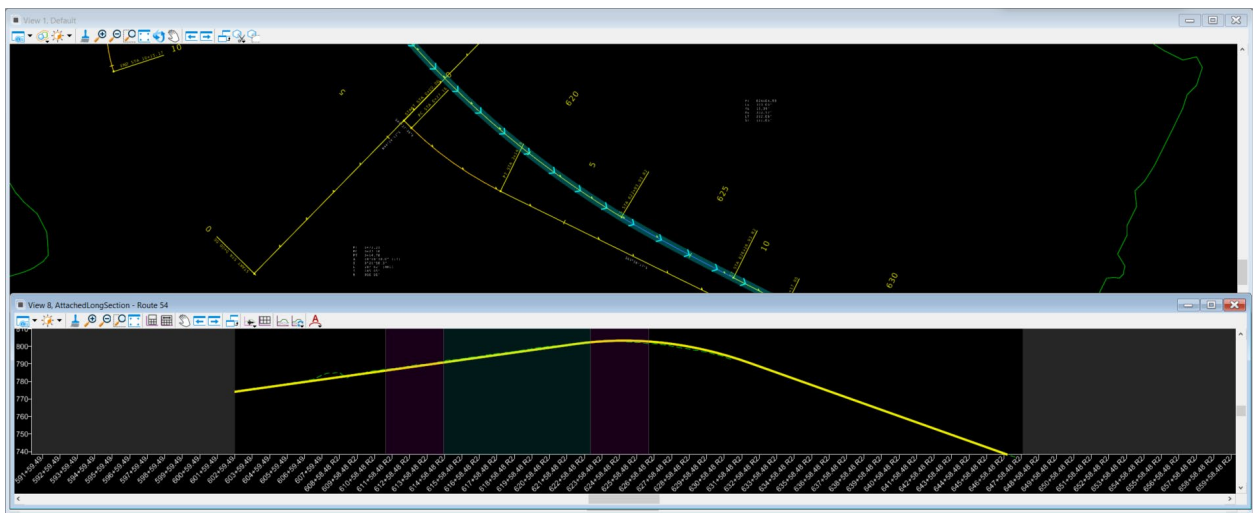


## End of Exercise

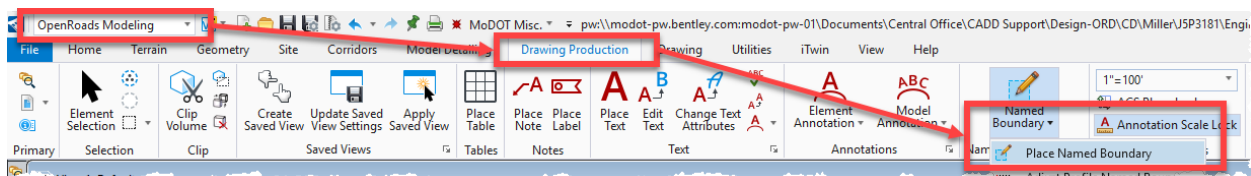
## 9.2 Exercise #2 (Group): Full Profile Sheets (Route 54)

1. Create a new 2D file named **Named\_Boundary\_Full\_Profile\_Route-54\_J5P3181.dgn** from the **Civil\_Geometry\_J5P3181.dgn** file located in the **data-9** folder.
2. From the **OpenRoads Modeling** workflow, Utilities tab, select the **Coordinate System** tool. Set the GCS to: NAD83 Missouri State Planes, Central Zone, US Foot using the **From File** or **From Library** option.
3. Reference in the **Civil\_Geometry\_J5P3181.dgn** and **Terrain\_J5P3181**.
4. Turn on/off levels as desired before processing the plan sheets. (This will keep you from needing to open each created plan sheet to turn off unwanted levels.)
5. In **View Attributes**, verify that the toggle is **ON** for **Constructions**.
6. We will need to open a view/window (View 8) to place the profile into to create the Profile sheets.
7. In the plan view (**View 1**), select the desired alignment (**Route 54**) that has a profile assigned to it. From the **heads-up tools**, select the **Open Profile Model** option.

Select the bottom view (**View 8**) to apply the profile model in that view.



8. From **OpenRoads Modeling** workflow, select the **Drawing Production** tab and then select the **Named Boundary** tool.



9. In the **Place Named Boundary** dialog, change the options as desired to produce the clipping shapes for the full profile sheets.
  - For class purposes, fill out the dialog exactly like the dialog below.

The screenshot shows the 'Place Named Boundary Civil Profile' dialog box. Red arrows point to the following settings:

- Clipping shape options** (represented by a grid icon in the top toolbar)
- Drawing Seed:** Design - D Size Full Profile
- Detail Scale:** 1"=50'
- Name:** Profile 1
- Method:** Station Limits
- Group:** (New)
- Name:** Route 54 Proposed
- Start Location:** 602+59.49 (with a red box around the left arrow icon)
- Stop Location:** 602+59.49
- Length:** 1400.000000
- Vertical Exaggeration:** 5.000000
- Available Profile Height:** 191.128000
- Top Clearance:** 0.500000
- Bottom Clearance:** 2.000000
- Elevation Datum Spacing:** 5.000000
- Station Datum Spacing:** 100.000000
- Profile Shifts:** Datum Stations
- Use Terrains:** ☐
- Use Active Vertical:** ☒
- Whole Conduits Only:** ☐
- Create Drawing:** ☒
- Show Dialog:** ☒

a) **Clipping shape options** - set to **Civil Profile**. 

b) **Drawing Seed** - select **Design - D Size Full Profile**

c) **Detail Scale** – 1" = 50 scale for the clipping shapes

d) **Name** – **Route 54 Proposed** or user defined

e) **Method** - set option as **Station**

- *Station Limits* - option will allow you to dynamically place the clipping shapes along the proposed profile. This will also use the Start Location & Stop Location if they are locked.

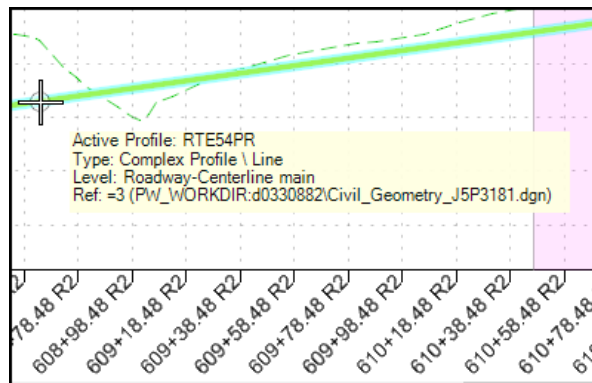


- *From Plan Group* - option will place the profile clipping shapes at the exact same location as the plan clipping shapes.
- f) **Start Location & Stop Location** – Beginning station or can be typed in and locked to get exact station limits for the profile sheets
- g) **Vertical Exaggeration** - set to appropriate scale
- **2** – 20 Scale
  - **5** – 50 scale (for this exercise)
  - **10** – 100 scale
  - **20** – 200 scale
- h) **Create Drawing** - toggle **ON**
- i) **Show Dialog** – toggle **ON**

**Note:** Length through Profile Shifts options **should not be adjusted** after selecting the desired scale. Adjusting these will produce undesirable results on the final cut profile sheets.

10. Once the **Named Boundary** dialog is completely filled out, you can now start the process to create the clipping shapes for the full profile sheets.

**Select the profile** to place the clipping shapes along.

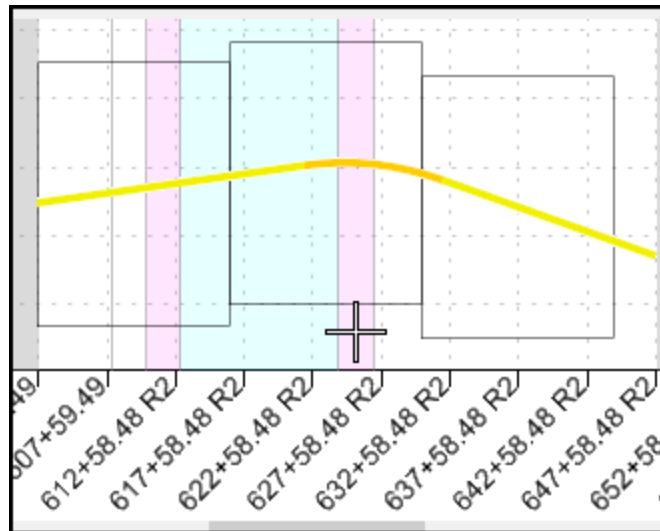


11. **Select the start location** by moving the mouse left or right along the profile.

- Optional – Start Location and Stop Location can be typed in and locked to lock in the exact station limits for the profile clipping shapes

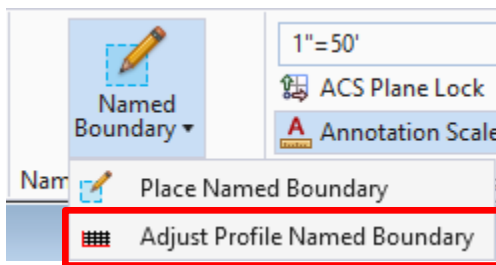
Move along the alignment and **left click** once you have the desired number of clipping shapes created.

**Left click** again in a blank area to accept the clipping shapes.



12. **(Optional)** Move the shapes as needed to get the correct area for the clipping shape.

The **Adjust Profile Name Boundary** tool will allow you to adjust the clipping shape **VERTICALLY** while keeping clipping shape locked in horizontally.



**Note:** Currently, the clipping shapes will **not** dynamically follow along the alignment **and** there is **no option** to move the preceding and following clipping shapes along with the clipping shape being moved.

When placing the profile clipping shapes using the *From Plan Group* method, there is **no option** to lock the profile clipping shapes with the plan clipping shapes. So, if you move the plan clipping shape, the profile shape will **not** follow along with it.

13. Now that the profile clipping shapes are created, you can now start the process of creating the full profile sheet files by **left clicking** one final time to advance to the **Create Drawing** dialog box.
14. In the **Create Drawing** dialog, change the options as desired to produce the full profile sheets.
  - For class purposes, fill out the dialog exactly like the dialog below.

**Create Drawing**

Mode: Profile

☒ One Sheet Per Dgn: \\Roadway\\data-9\\Plan\_Sheets\\

View Name: Route-54\_J5P3181\_Profile\_01

Drawing Seed: Design - Full Profile

View Type: Civil Profile

Discipline: Civil

Purpose: Profile View

**Drawing Model**

Model Name: Route-54\_J5P3181\_Profile\_01

Seed Model: MoDOT D Size - Design Full Profile Sheet.d

Filename: (Active File)

Annotation Group: 1"=50' Profile Grid - 50 Scale

**Sheet Model**

Model Name: Route-54\_J5P3181\_Profile\_01

Seed Model: MoDOT D Size - Design Full Profile Sheet.d

Filename: (Active File)

Sheets: (New)

Full Size 1 = 1

Drawing Boundary: Design - Full Profile

Detail Scale: 1"=50' (By Named Boundary)

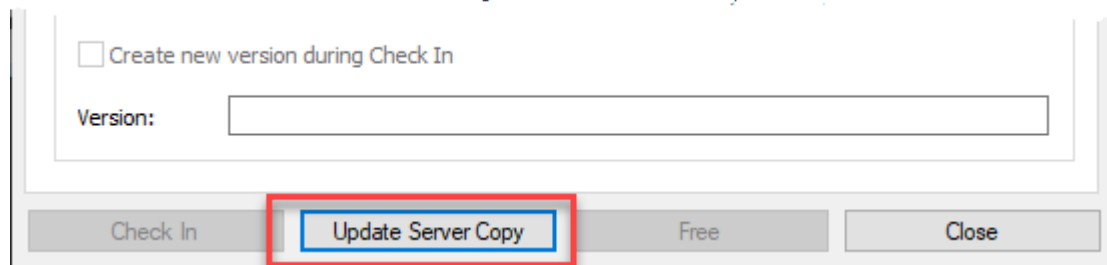
☐ Add To Sheet Index

☐ Make Sheet Coincident

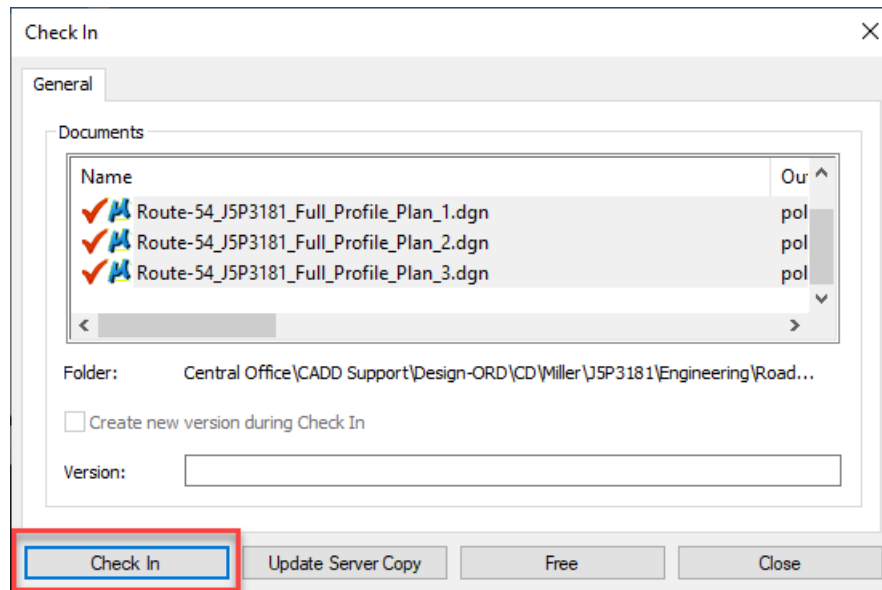
☒ Open Model

OK Cancel

- a) **Name – Route-54\_J5P3181\_Profile\_01**
    - Sheets will need to be renamed to conform to the “file naming convention” for contract plans
  - b) **One Sheet Per Dgn** - toggle **ON** and set location
  - c) **Annotation Scale** (*Drawing Model*) – 1 “ = **50’** select the same scale as from the *Place Named Boundary* dialog
  - d) **Annotation Group - Profile Grid – 50 Scale** set to same scale the Drawing Model annotation scale
  - e) **Detail Scale – 1” = 50’ (By Named Boundary)** same scale the Drawing Model annotation scale
15. Select **OK** to create the sheets. This will create separate sheet files in the location that you selected in the dialog box.
16. After the sheets are created, select **Update Server Copy** on the “Check In” dialog box.

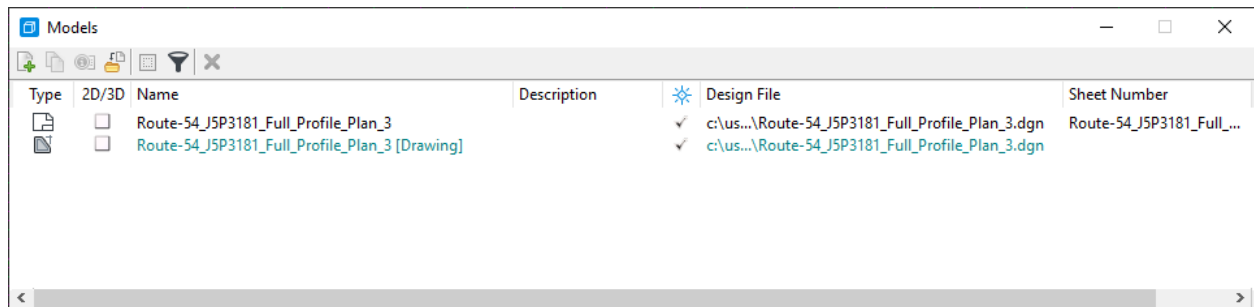


17. In the next “Check In” dialog box, select the **Check In** option.

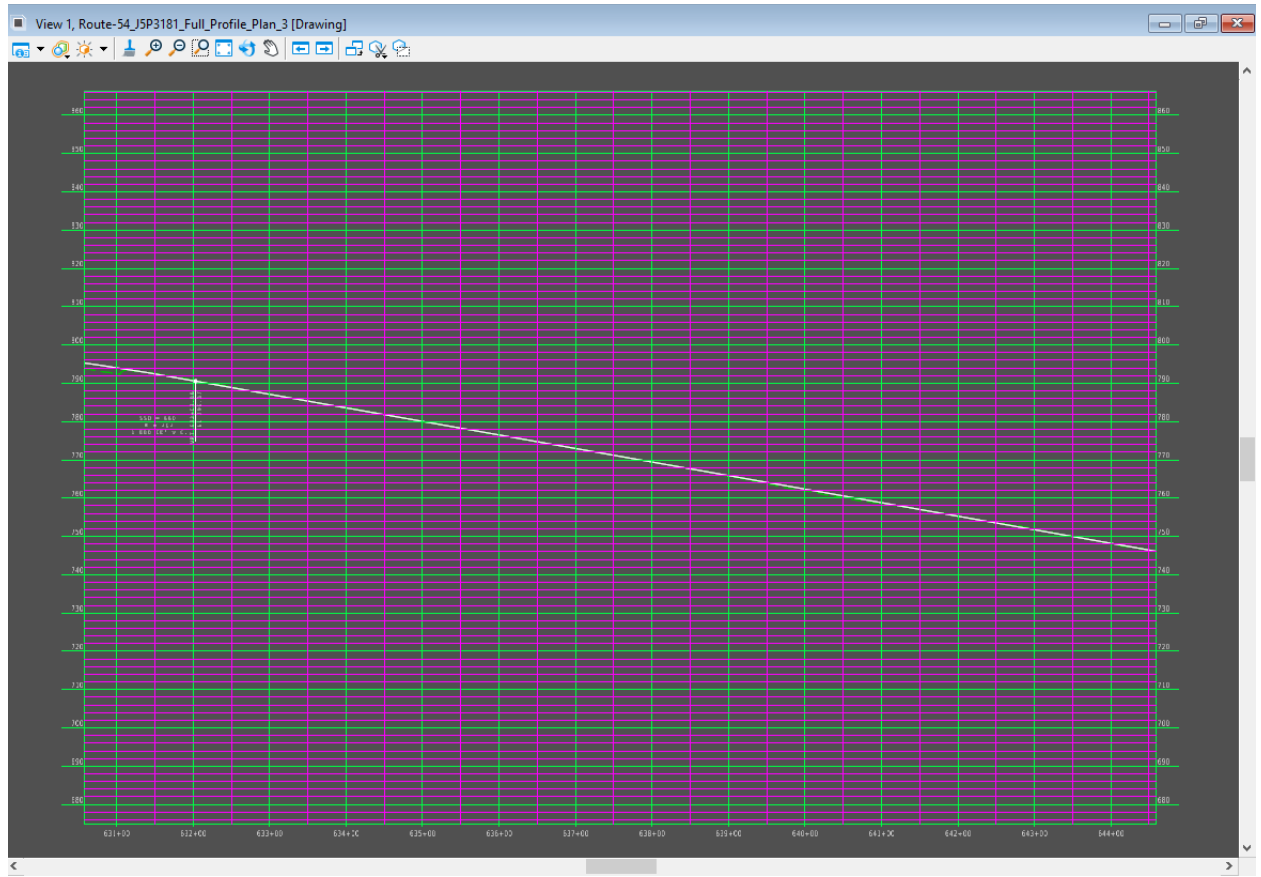


18. Open the sheet files and review.

In the **Models** tool, you will see that it creates a drawing model and a sheet model.

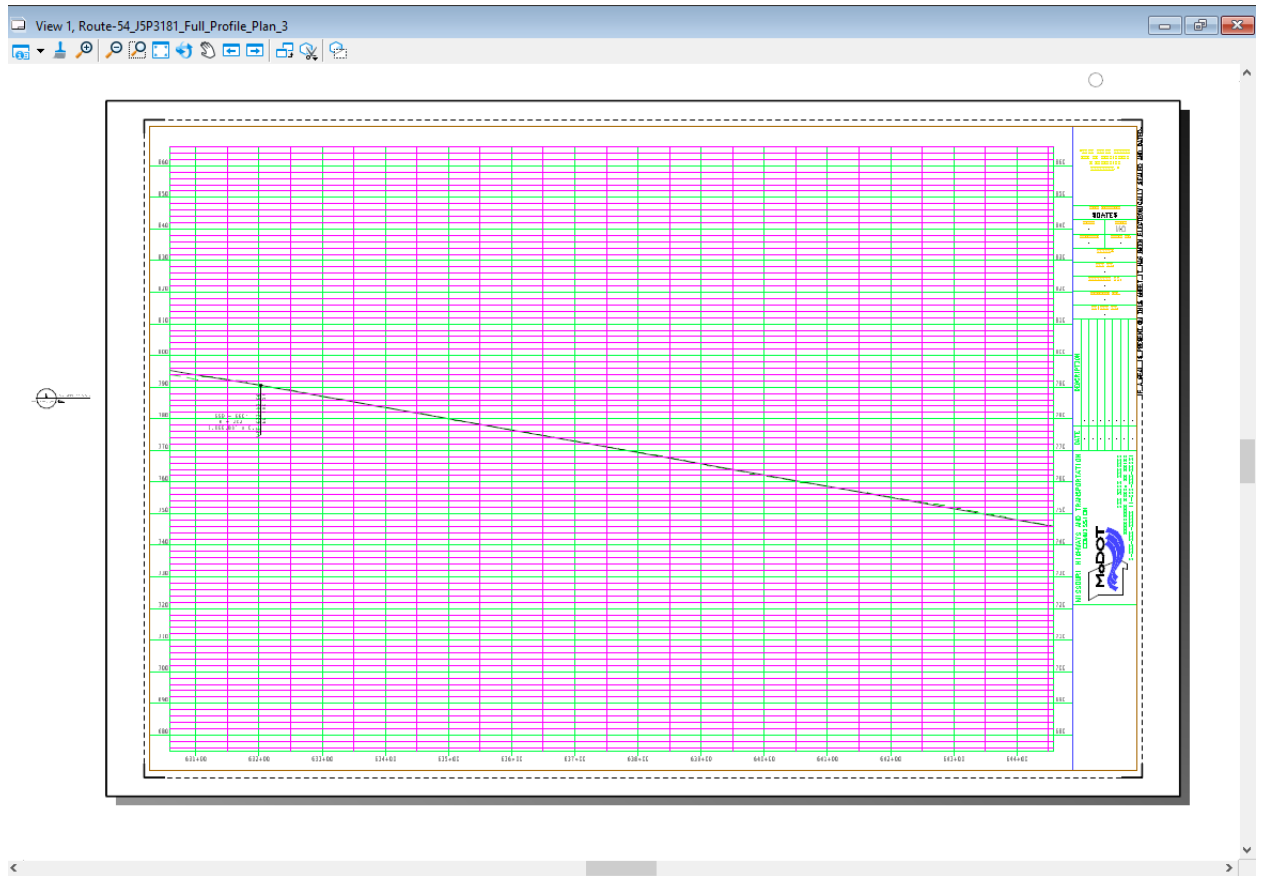


The **Drawing model** is designed to add geometry like text, notes, dimensions, extra reference files, etc. to the file. The drawing model is still a 1:1 scale, so everything is the same scale as from the file that you cut the sheets from.



The **Sheet model** basically takes what is in the Drawing model and scales it down to fit the border that is in the Sheet Model.

**NOTE:** *Adding geometry (except for the text that is needed for the border information) to the sheet model is **not recommended or supported** by CADD Support.*

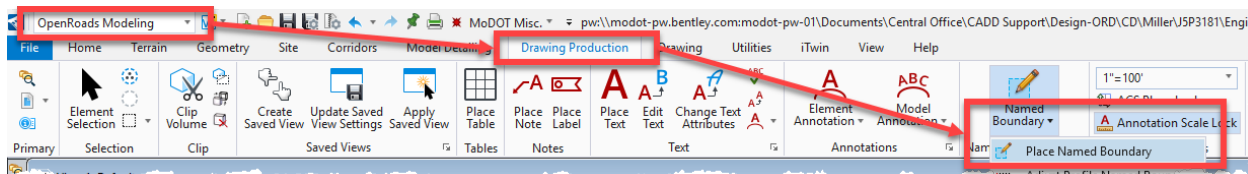


## End of Exercise

### 9.3 Exercise #3 (Group): Plan-Profile Sheets (Route 54)

1. Create a new 2D file named **Named\_Boundary\_Plan-Profile\_Route-54\_J5P3181.dgn** from the **Civil\_Geometry\_J5P3181.dgn** file located in the **data-9** folder.
2. From the **OpenRoads Modeling** workflow, Utilities tab, select the **Coordinate System** tool. **Set the GCS** to: NAD83 Missouri State Planes, Central Zone, US Foot using the **From File** or **From Library** option.
3. **Reference** in the following files:
  - **Civil\_Geometry\_J5P3181.dgn**
  - **Corridors\_Route-54\_J5P3181.dgn**
  - **Corridors\_Ramp-4\_J5P3181.dgn**
  - **Land\_Boundary\_J5P3181.dgn**
  - **Terrain\_J5P3181.dgn** (make active)
4. **Turn on/off levels** as desired before processing the plan sheets. (This will keep you from needing to open each created plan sheet to turn off unwanted levels.)

#### Creating the Plan portion of the Plan/Profile Sheets



5. In the **Place Named Boundary** dialog, change the options as desired to produce the clipping shapes for the plan view of the plan-profile sheets.
  - For class purposes, fill out the dialog exactly like the dialog below.



Place Named Boundary Civil Plan

Drawing Seed: Design - Plan-Profile - Plan

Detail Scale: 1" = 50'

Name: Plan 1

Description:

Group: (New)

Name: Route 54

Description:

☒ Start Location: 602+59.49

☐ Stop Location: 645+60.83 R2

Length: 1350.000000

Left Offset: -237.042500

Right Offset: 237.042500

Overlap: 0.000000


Boundary Chords: 1

☐ Create Drawing

☒ Show Dialog

Uncheck

Predefined values that are set up to fit within the border

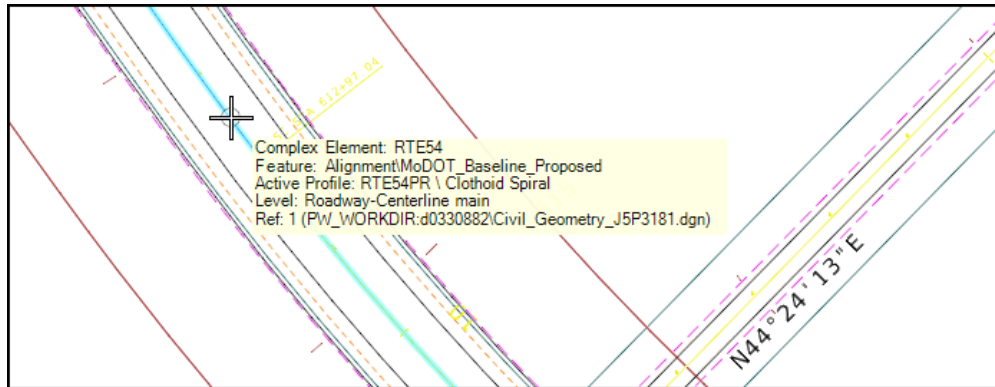
- Clipping shape options - set to Civil Plan. 
- Drawing Seed - select Design – Plan-Profile – Plan
- Detail Scale – 1" = 50'
- Name - user defined
- Start Location & Stop Location - can be typed in or dynamically placed in the dgn file
- Overlap - adjust as needed to get additional area 0
- Boundary Chords - set to 1
- Create Drawing - toggle OFF

i) **Show Dialog** – toggle **Ghosted out**

**Note:** Length, Left Offset and Right Offset options **should not be adjusted** after selecting the desired scale. Adjusting these will produce undesirable results on the final cut plan sheet.

6. Once the **Named Boundary** dialog is completely filled out, you can now start the process to create the plan view clipping shapes for the plan-profile sheets.

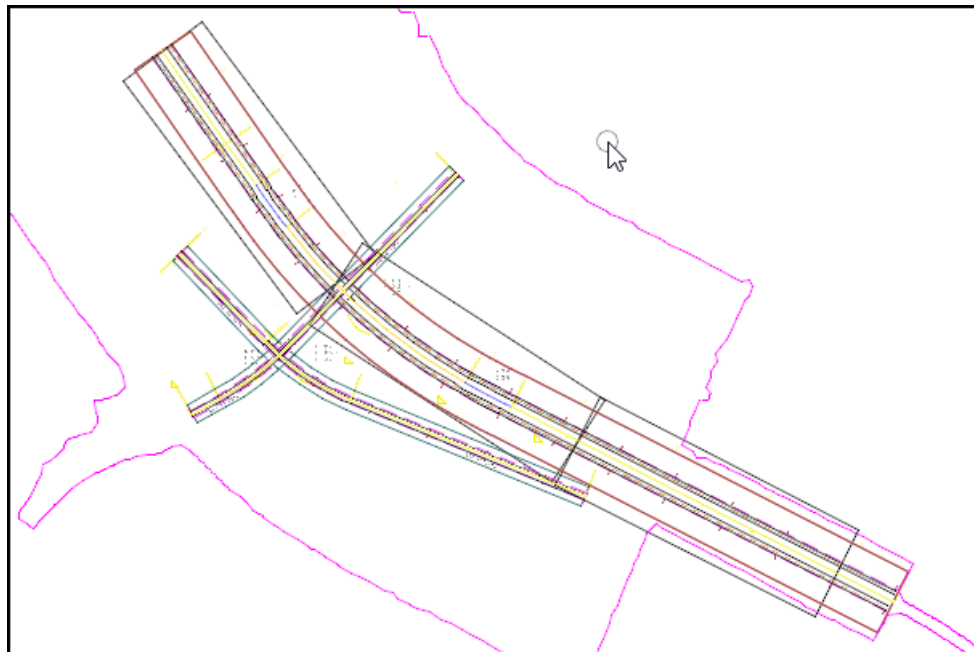
**Select the alignment** to place the clipping shapes along.



7. **Select the start location.**

Move along the alignment and **left click** once you have the desired number of clipping shapes created.

**Left click** again in a blank area to accept the clipping shapes.

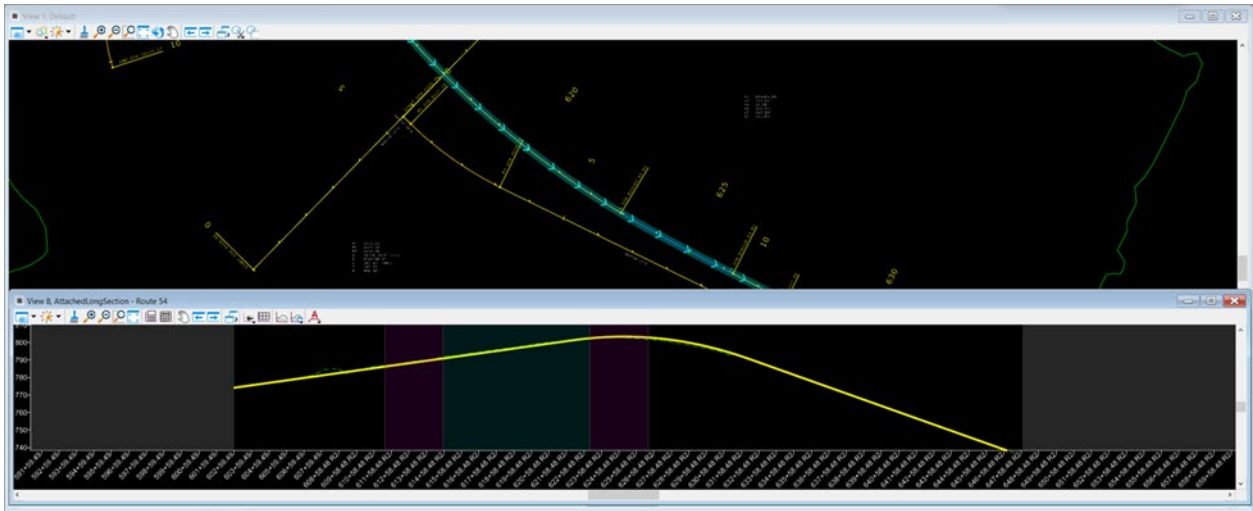


**Note:** The Start Location and Stop Location can also be typed in the Place Boundary dialog if desired.

**Note:** Currently, the clipping shapes will not dynamically follow along the alignment. Also not supported is the ability to move the preceding and following clipping shapes when moving a clipping shape.

### Creating the Profile portion of the Plan/Profile Sheets

8. In the plan view (**View 1**), select the desired alignment (Route 54) that has a profile assigned to it. From the **heads-up tools**, select the **Open Profile Model** option.
9. Then select the view (View 8) to apply the profile model in that view.



10. Now create the Profile view clipping shapes.

In the **Place Named Boundary** dialog, change the options as desired to produce the clipping shapes for the full profile sheets.

- For class purposes, fill out the dialog exactly like the dialog below.

Place Named Boundary Civil Profile

Clipping shape options:

Drawing Seed: Design - D Size PlanProfile - Profile View

Detail Scale: 1"=50'

Name: Profile

Description:

Method: From Plan Group

Plan Group: Route 54

Group: (New)

Name: Route 54 Proposed

Description: From Plan Group: Route 54

Vertical Exaggeration: 5.000000

Available Profile Height: 90.000000

Top Clearance: ☐

Bottom Clearance: ☐

Elevation Datum Spacing:

Station Datum Spacing:

Profile Shifts: Datum Stations

Use Terrains: ☐

Use Active Vertical: ☒

Whole Conduits On: ☐

Create Drawing: ☐

Show Dialog: ☒

**DO NOT MODIFY SHADED AREA**

**DO NOT Check Create Drawing**

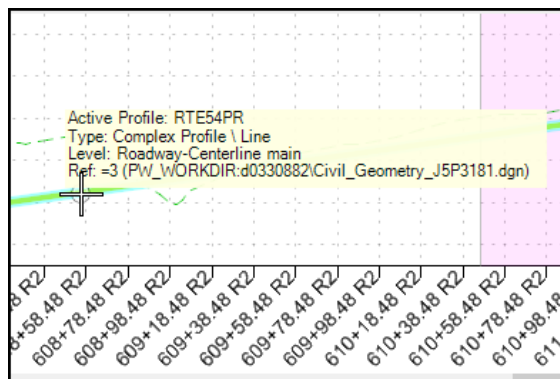
- Clipping shape options** - set to **Civil Profile**.
- Drawing Seed** - select **Design - D Size PlanProfile – Profile View**
- Detail Scale** - select the same scale from the plan clipping shapes = **1" = 50'**
- Name** - user defined
- Method** - set option as desired = **From Plan Group**
  - Station Limits* - option will allow you to dynamically place the clipping shapes along the proposed profile. This will also use the Start Location & Stop Location if they are locked.
  - From Plan Group* - option will place the profile clipping shapes at the exact same location as the plan clipping shapes.

- f) **Start Location & Stop Location** - can be typed in and locked to get exact station limits for the profile sheets
- g) **Vertical Exaggeration** - set to appropriate scale
  - 2 – 20 Scale
  - 5 – 50 scale
  - 10 – 100 scale
  - 20 – 200 scale
- h) **Create Drawing** - toggle **OFF**
- i) **Show Dialog** – toggle **Ghosted out**

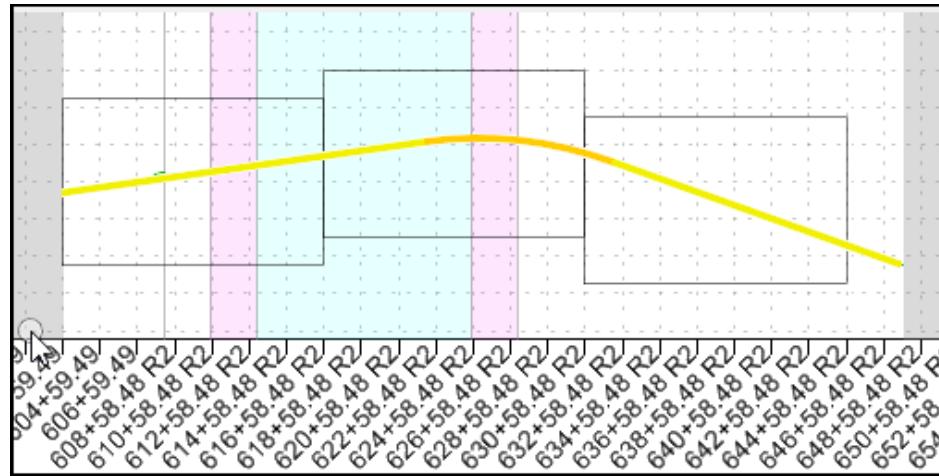
**Note:** Length through Profile Shifts options should not be adjusted after selecting the desired scale. Adjusting these will produce undesirable results on the final cut profile sheets.

11. Once the **Named Boundary** dialog is completely filled out, you can now start the process to create the profile view clipping shapes for the plan-profile sheets.

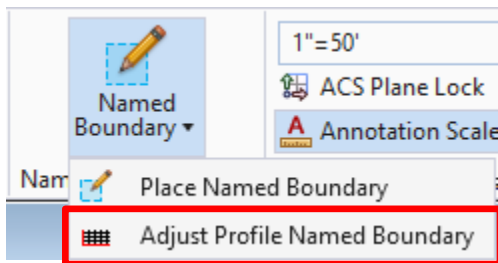
**Select the profile** to place the clipping shapes along.



**Left click** again in a blank area to accept the clipping shapes.



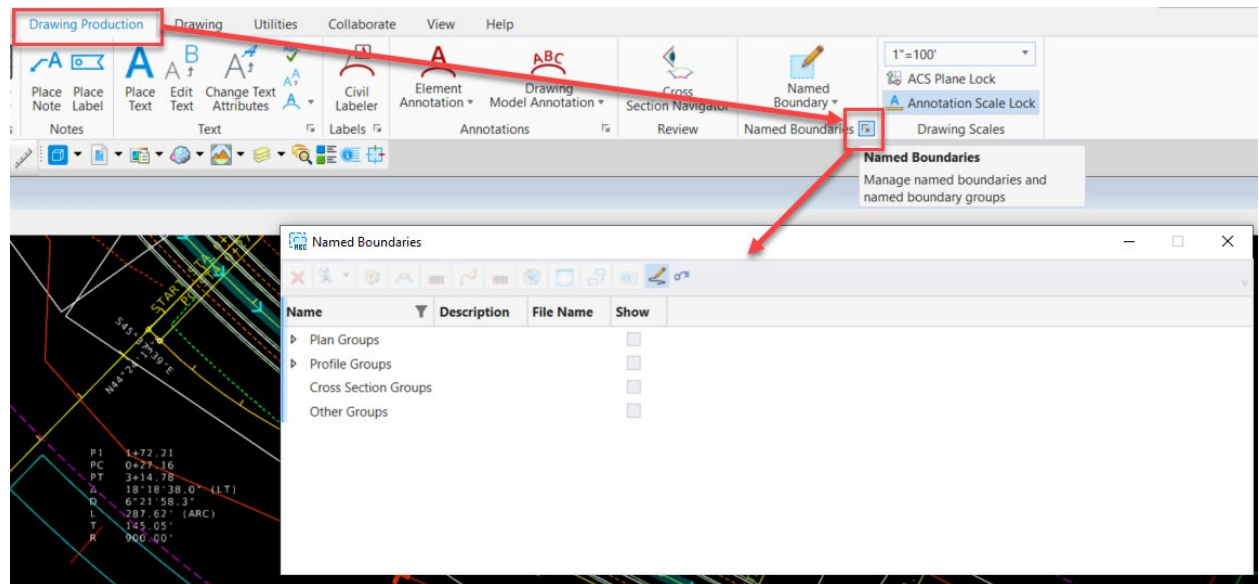
12. (Optional) Use the **Adjust Profile Name Boundary** tool to vertically move the profile clipping shapes as needed while keeping clipping shape locked in horizontally.



**Note:** Currently, the clipping shapes will **not** dynamically follow along the alignment **and** there is **no option** to move the preceding and following clipping shapes along with the clipping shape being moved.

When placing the profile clipping shapes using the *From Plan Group* method, there is **no option** to lock the profile clipping shapes with the plan clipping shapes. So if you move the plan clipping shape, the profile shape will **not** follow along with it.

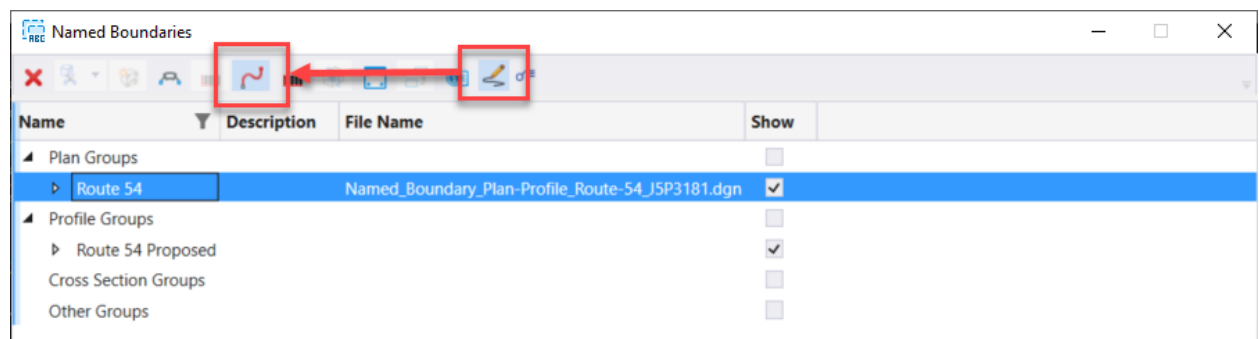
13. Open the Named Boundary Manager to process the Plan/Profile sheets.



14. Open and select either the **Plan Group** or the **Profile group** for Route 54.

15. Check on **Show the Create Drawing Dialog**

16. Select the **Create Plan/Profile Drawing**.



17. In the **Create Drawing** dialog, change the options as desired to produce the plan-profile sheets.

- For class purposes, fill out the dialog exactly like the dialog below.
- Left side options are for the Plan view clipping shape (top section of the sheet)
- Right side options are for the Profile view clipping shape (bottom section of the sheet)



**Create Drawing**

Mode: Plan and Profile

☒ One Sheet Per Dgn: .Roadway\data-9\Plan Sheets\

**Left Pane (Route-54\_PlanProfile\_J5P3181\_01):**

- View Name: Route-54\_PlanProfile\_J5P3181\_01
- Drawing Seed: Design - Plan-Profile - Plan
- Drawing Model:
  - Model Name: Route-54\_PlanProfile\_J5P3181\_01
  - Seed Model: MoDOT D Size - Design Plan-Profile.dgnli
  - Filename: (Active File)
  - Annotation Group: Plan Annotation
- Sheet Model:
  - Model Name: Route-54\_PlanProfile\_J5P3181\_01
  - Seed Model: MoDOT D Size - Design Plan-Profile.dgnli
  - Filename: (Active File)
  - Sheets: (New)
  - Full Size 1 = 1
  - Drawing Boundary: (New)
  - Detail Scale: 1"=50' (By Named Boundary)
- ☐ Add To Sheet Index
- ☐ Make Sheet Coincident
- ☒ Open Model

**Right Pane (Route 54 Proposed - Profile 1):**

- View Name: Route 54 Proposed - Profile 1
- Drawing Seed: Design - Plan-Profile - Profile
- View Type: Civil Profile
- Discipline: Civil
- Purpose: Profile View
- Drawing Model:
  - Model Name: Route 54 Proposed - Profile 1-1
  - Seed Model: MoDOT D Size - Design Plan-Profile.dgnli
  - Filename: (Active File)
  - Annotation Group: Profile Grid - 50 Scale
- Sheet Model:
  - Model Name: Route 54 Proposed - Profile 1-1
  - Seed Model: MoDOT D Size - Design Plan-Profile.dgnli
  - Filename: (Active File)
  - Sheets: (New)
  - Full Size 1 = 1
  - Drawing Boundary: Design - Plan-Profile - Profile
  - Detail Scale: 1"=50' (By Named Boundary)

**Callout:** View Name, Drawing & Sheet Model Names being named the same will be reflected in the new file name

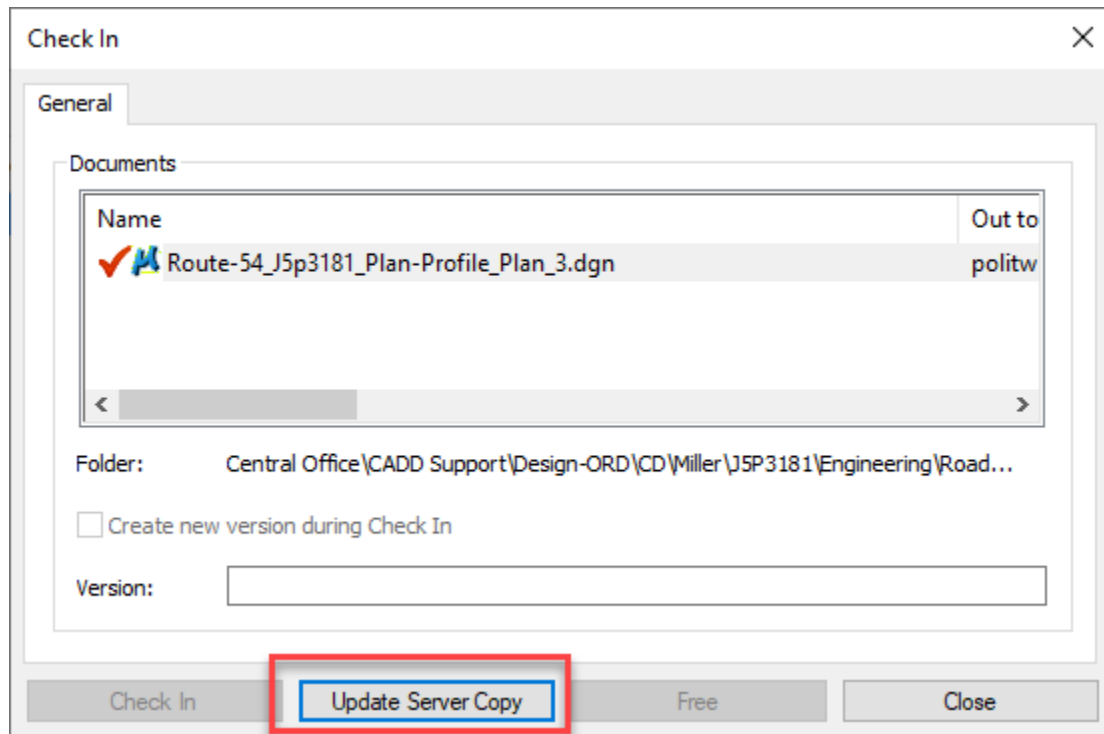
**Buttons:** OK, Cancel

- Mode** - set to **Plan and Profile**
- Name** - **Route-54\_PlanProfile\_J5p3181\_01**
  - Sheets will need to be named to conform to the “file naming convention” for contract plans
- One Sheet Per Dgn** - toggle **ON**
- Folder** – Path to the **data\_9 > Plan\_Sheets** folder
- Annotation Scale (Drawing Model) (Both Sides)** - select the same scale as from the *Place Named Boundary* dialog = **50**
- Annotation Group (Lt. Side only)** - set to **Plan Annotation**
- Annotation Group (Rt. Side only)** - set to same scale as Drawing Model annotation scale = **Profile Grid – 50 Scale**
- Detail Scale (Both sides)** - same scale the Drawing Model annotation scale (By Named Boundary)

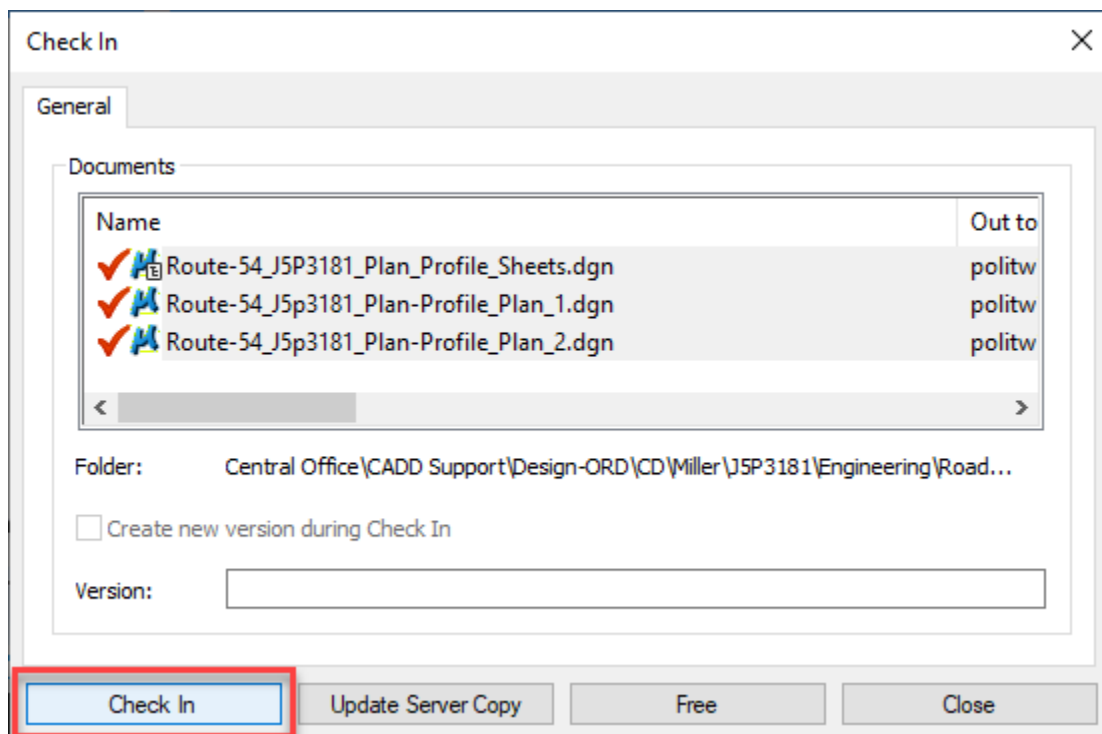
18. Select **OK** to create the sheet. This will create separate sheet files in the location that you selected in the dialog box.

19. After the sheets are created, select **Update Server Copy** on the “Check In” dialog box.



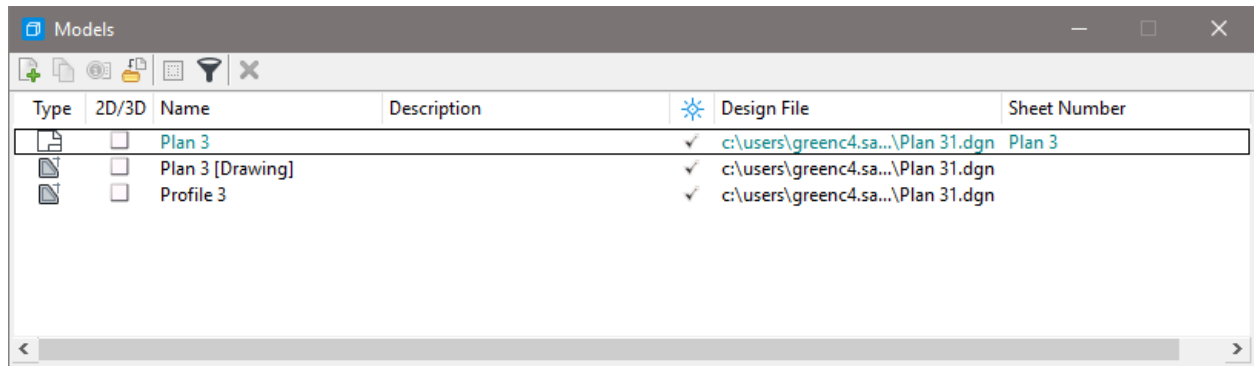


20. In the next “Check In” dialog box, select the **Check In** option.

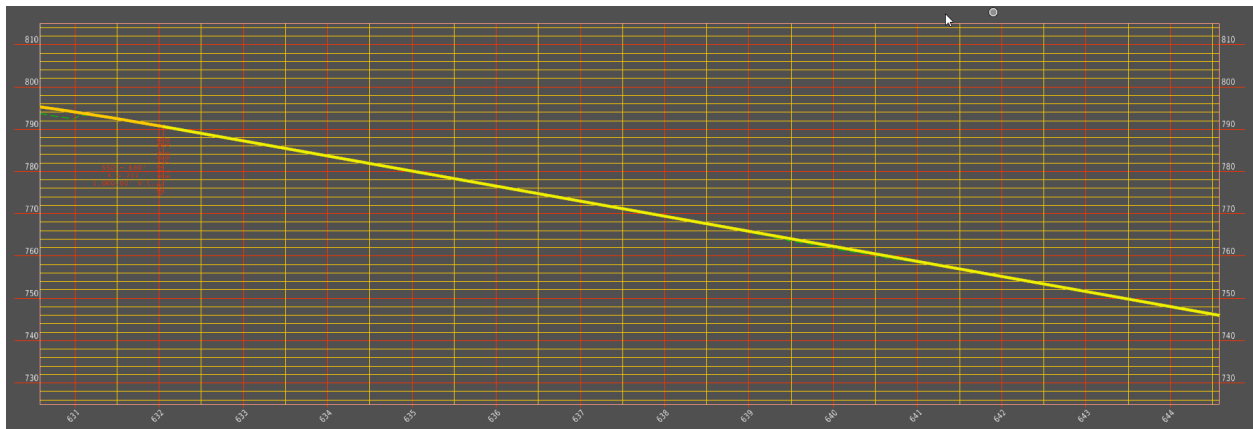
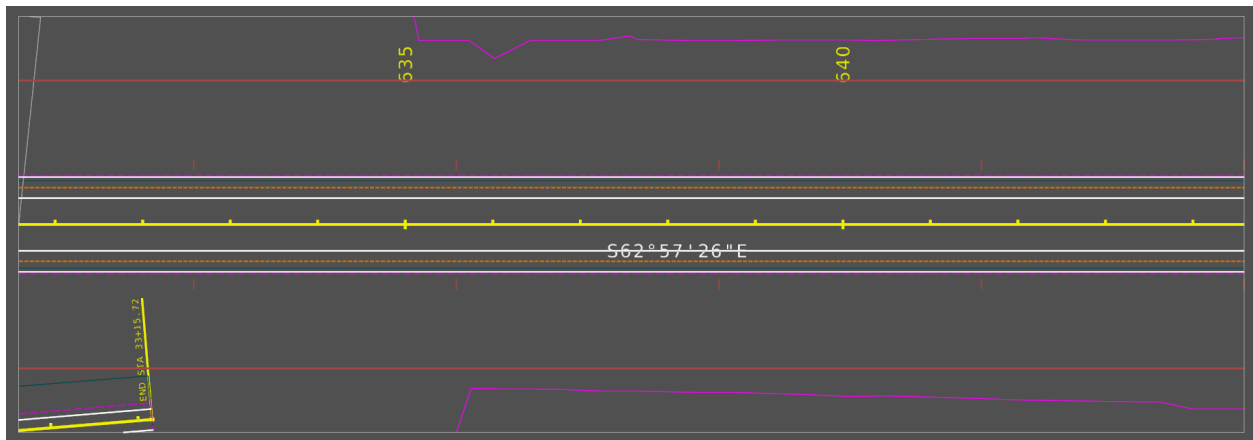


This will open the last sheet file created.

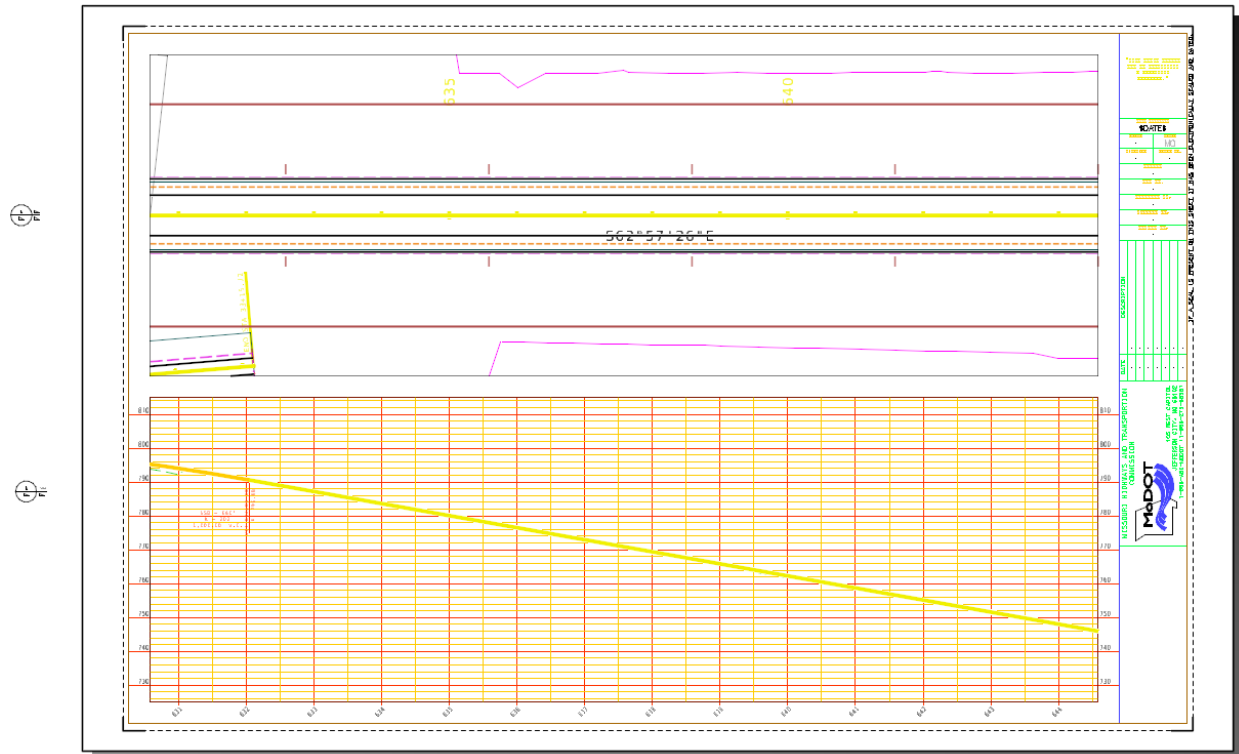
In the **Models** tool, you will see that it creates a plan drawing model, profile drawing model and a sheet model.



The **Drawing model** is designed to add geometry like text, notes, dimensions, extra reference files, etc. to the file. The drawing model is still a 1:1 scale, so everything is the same scale as from the file that you cut the sheets from.



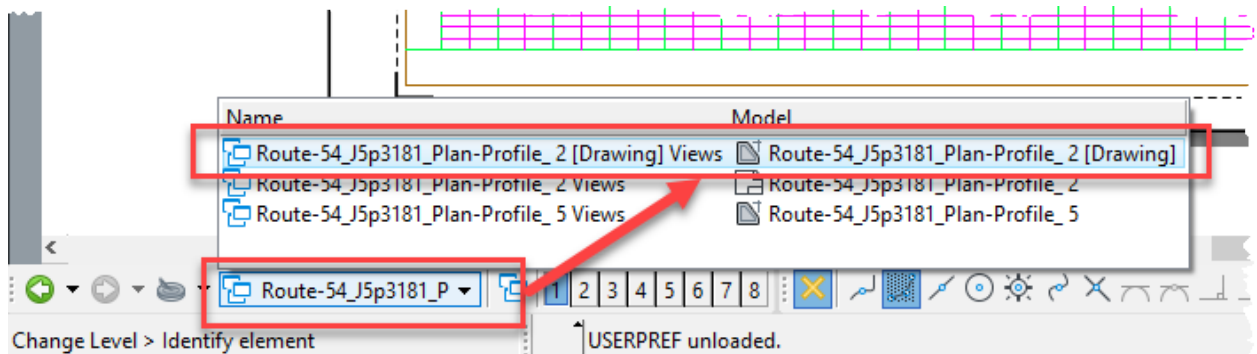
The **Sheet model** basically takes what is in the Drawing models and scales it down to fit the border that is in the Sheet Model. Adding geometry (except for the text that is needed for the border information) to the sheet model is **not recommended or supported** by CADD Support.



**End of Exercise**

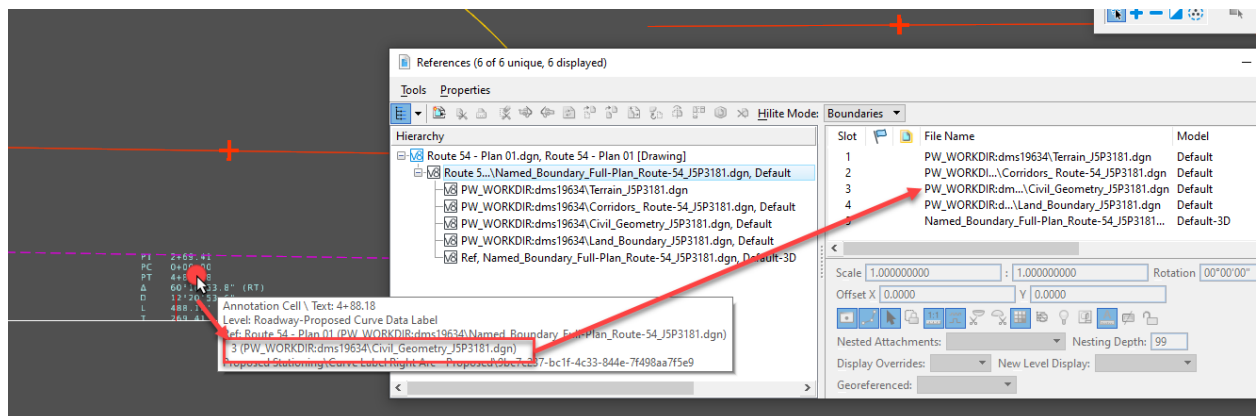
## 9.4 Exercise #5 (Group): Editing Plan-Profile Sheets (Route 54)

1. Open the **Route-54\_Plan-Profile\_J5p3181\_02.dgn** file from the data-09/Plan\_Sheets folder
2. Open the **Drawing Model** (the drawing model is where the plan sheets should be edited)

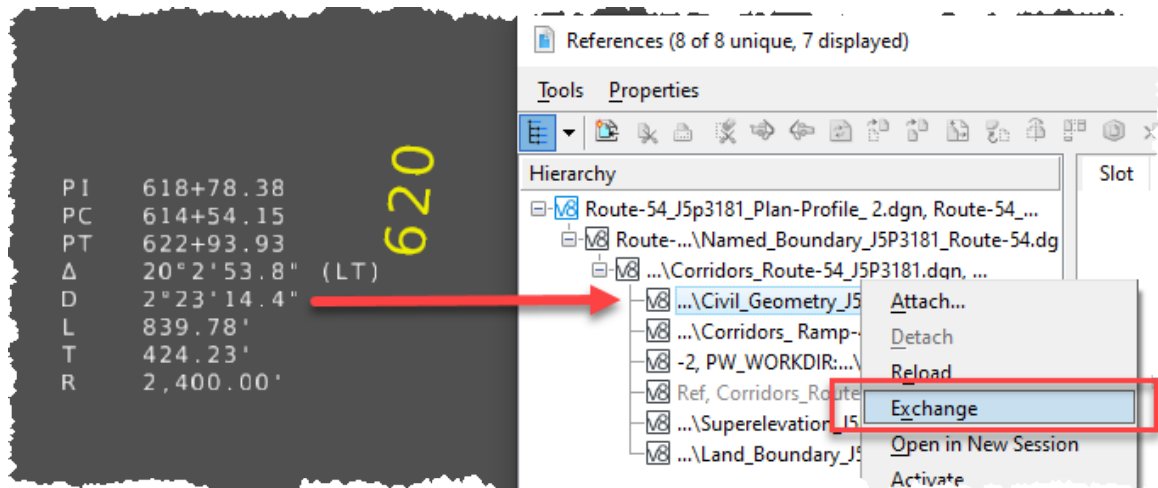


Moving text in reference files:

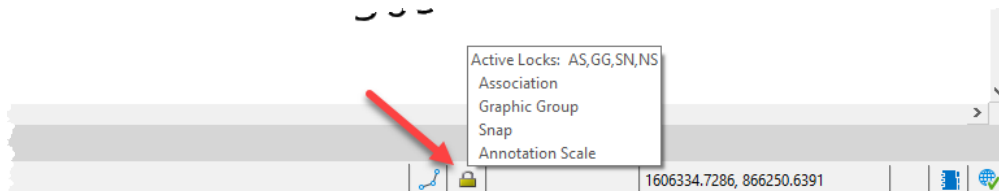
3. Open the Reference Dialog, Identify the reference of the text/geometry



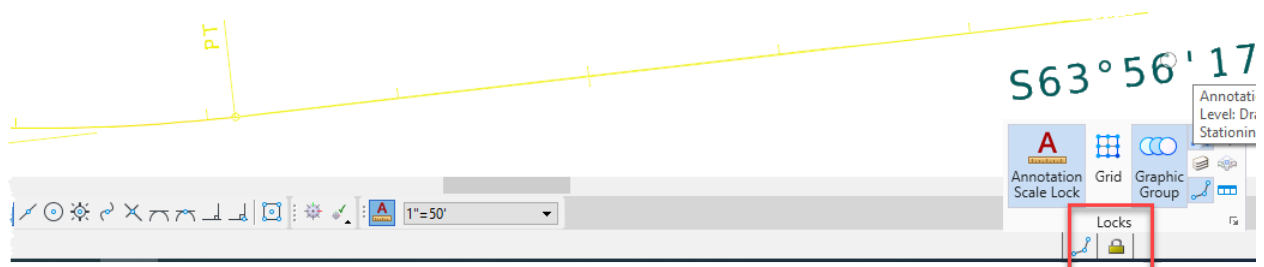
4. In the Reference Dialog, Select the Civil Geometry file, right click and choose the option to **Exchange**. This will open the Civil Geometry file up at the location that you are zoomed to. (Check in the previous file after you select Exchange)



- Verify that the Graphic Group Lock is toggled on so when we grab the text the whole text cell moves as on. Hover over the icon (located at the bottom right of the MicroStation Window) and it will show all the locks that are currently being utilized.



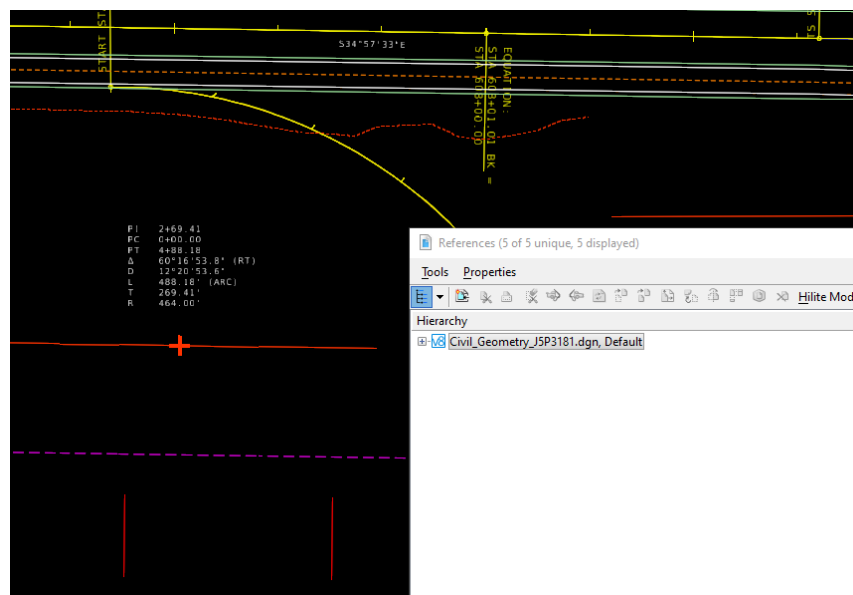
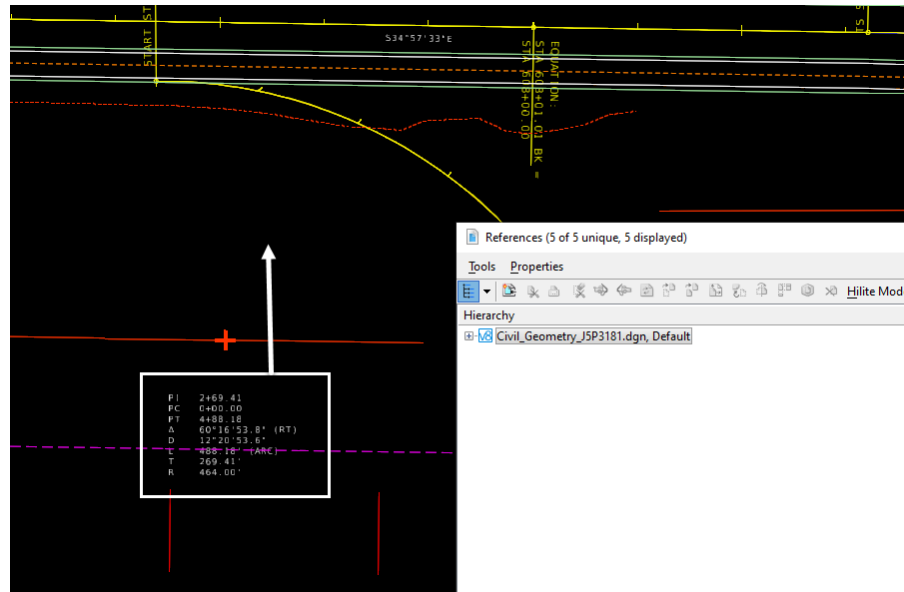
(Optional) If the Graphic Group is not on, select the pad lock icon and then select the Graphic Group icon



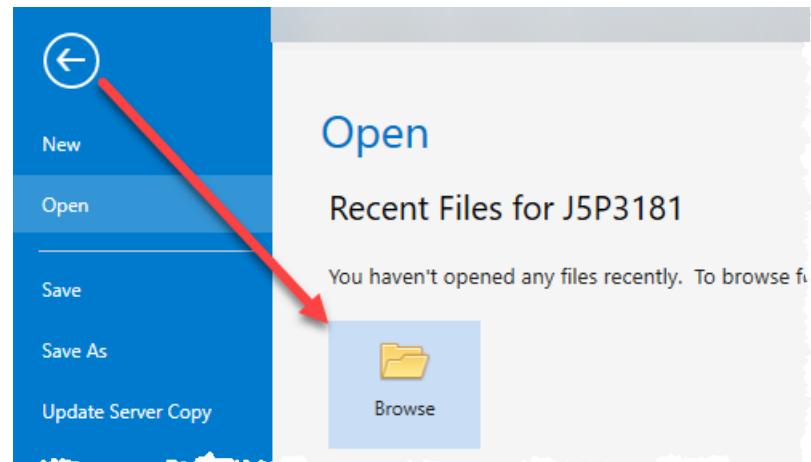
- Reference** in the Corridors files for Route 54 and Ramp 4 for reference locations of geometry and text.

7. **Moving** the Text cell:

- Select the Text cell (In this case the curve data)
- Left click and hold the button down to drag the cell to a location where it won't interfere with other geometry or text.

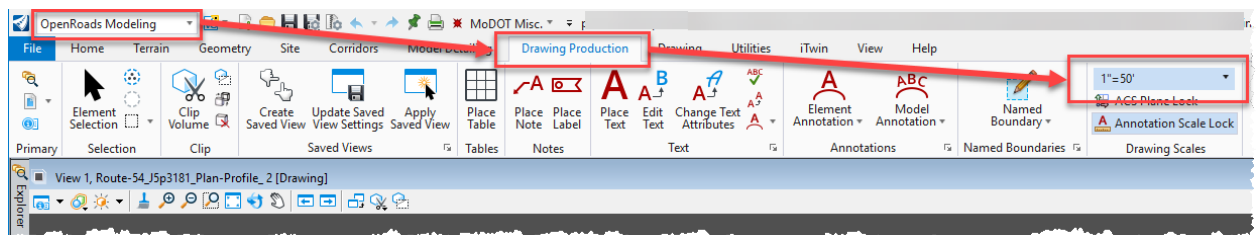


8. Open the **Route-54\_Plan-Profile\_J5p3181\_02.dgn** file from the data-09/Plan\_Sheets folder. Once opened you will see that the text cell has been moved.

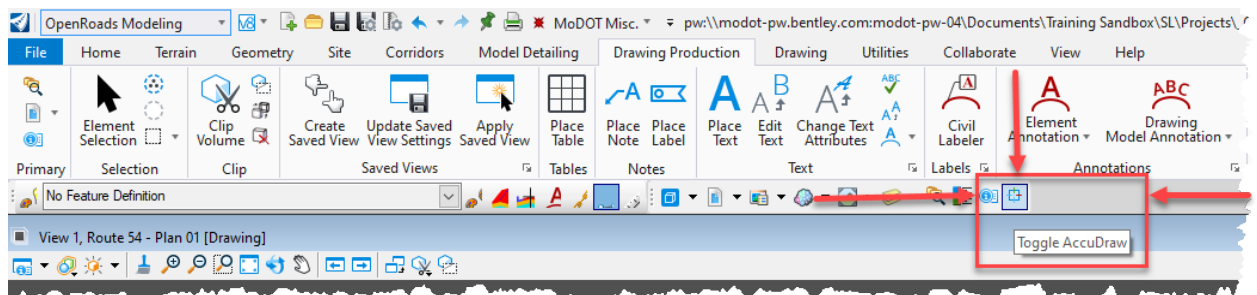


### Adding a North Arrow using the MicroStation AccuDraw Tool

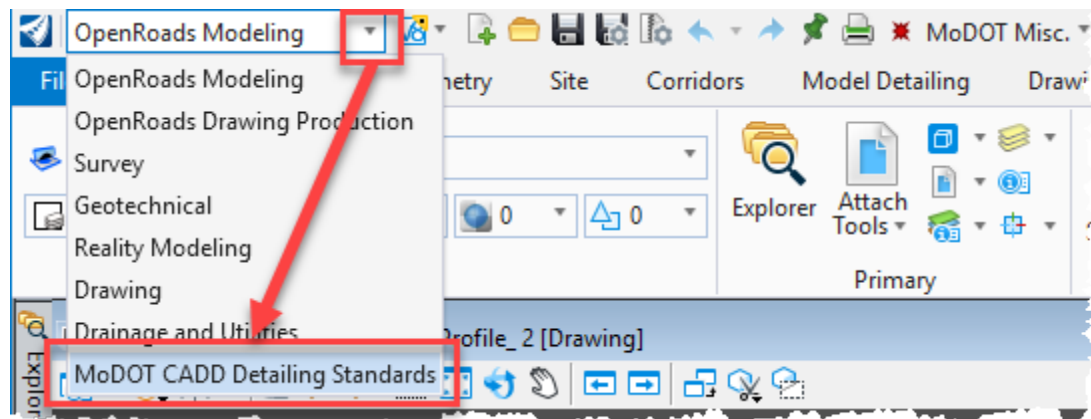
9. Verify that the Drawing scale is set to **1" = 50'**



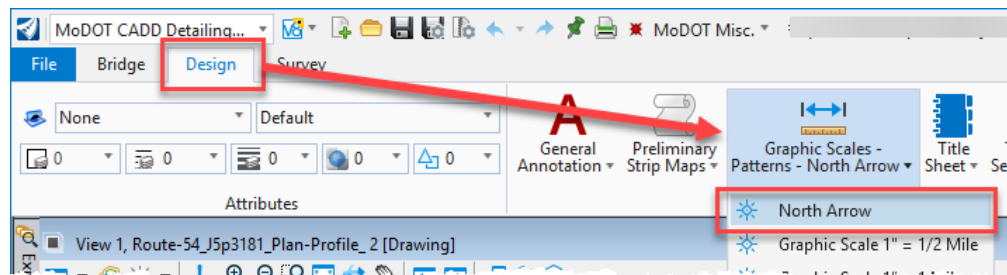
10. Activate the **MicroStation AccuDraw** tool by selecting it from the Quick Menu or through any of the other ways you may prefer.



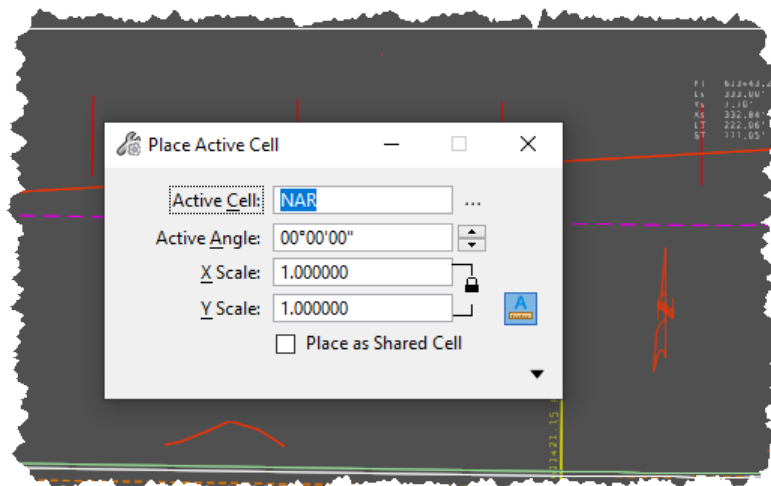
11. Navigate to the North Arrow cell by changing the Workflow to **MoDOT CADD Detailing Standards**



12. Select the **Design** tab. Select the **Graphic Scales** button to open the pull down **Select the North Arrow**.



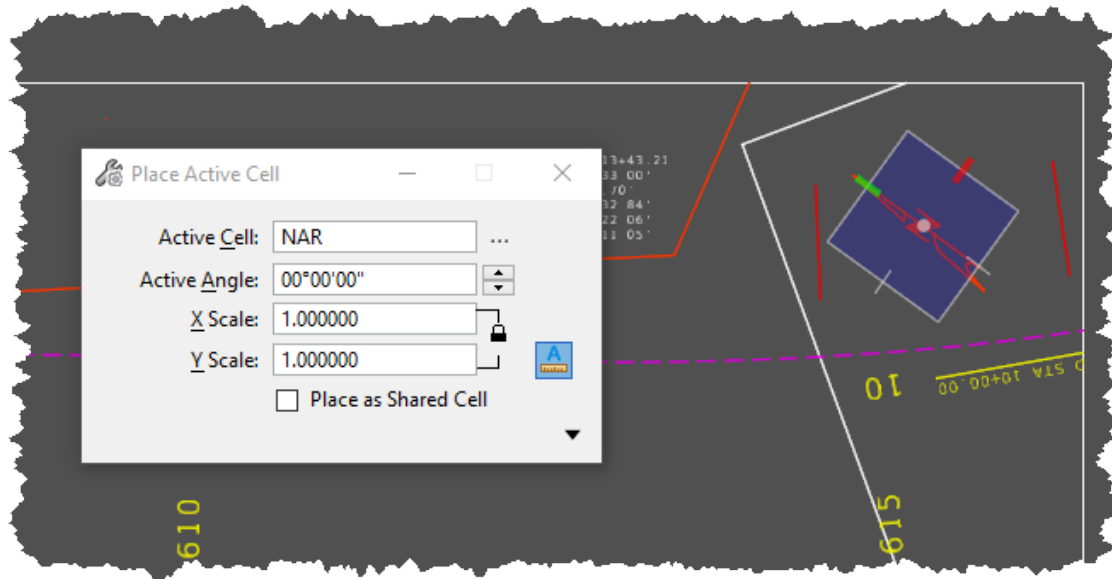
13. Once the North Arrow has been selected it may be displaying straight up and not as “true north” of the project



14. Select the AccuDraw banner of the dialog. **Type the letter T** to change the direction of the North Arrow to the project's True North. **Type the letter V** to change the direction to the view's North.



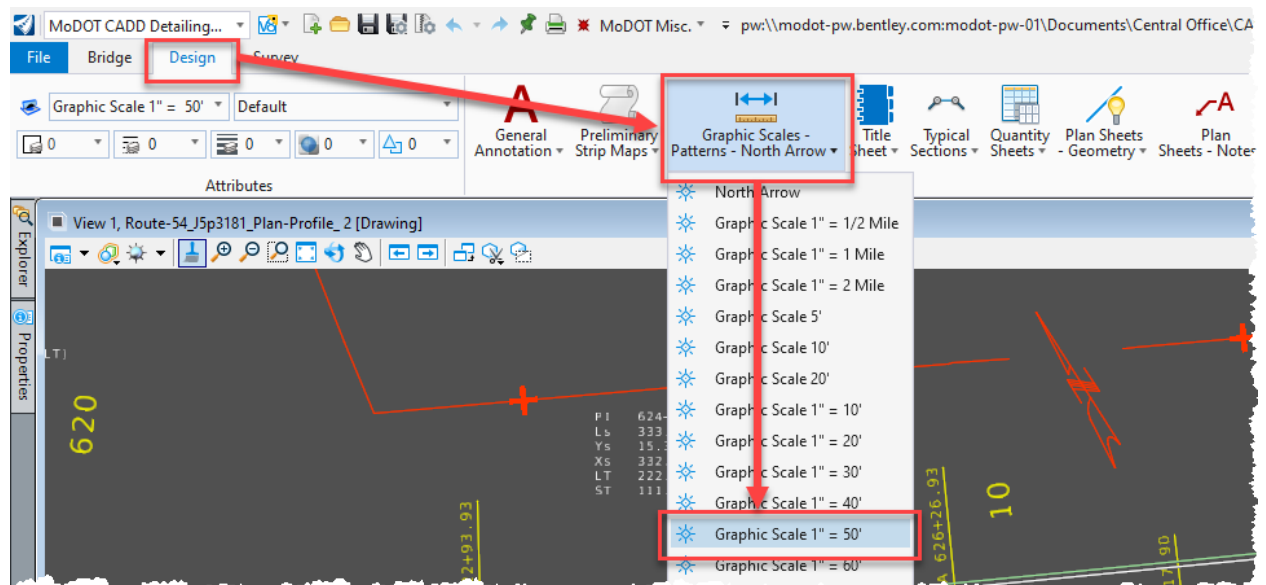
**Place the North Arrow** by data pointing (left mouse click) in a clean unused area within the white border of the Drawing Model shape.



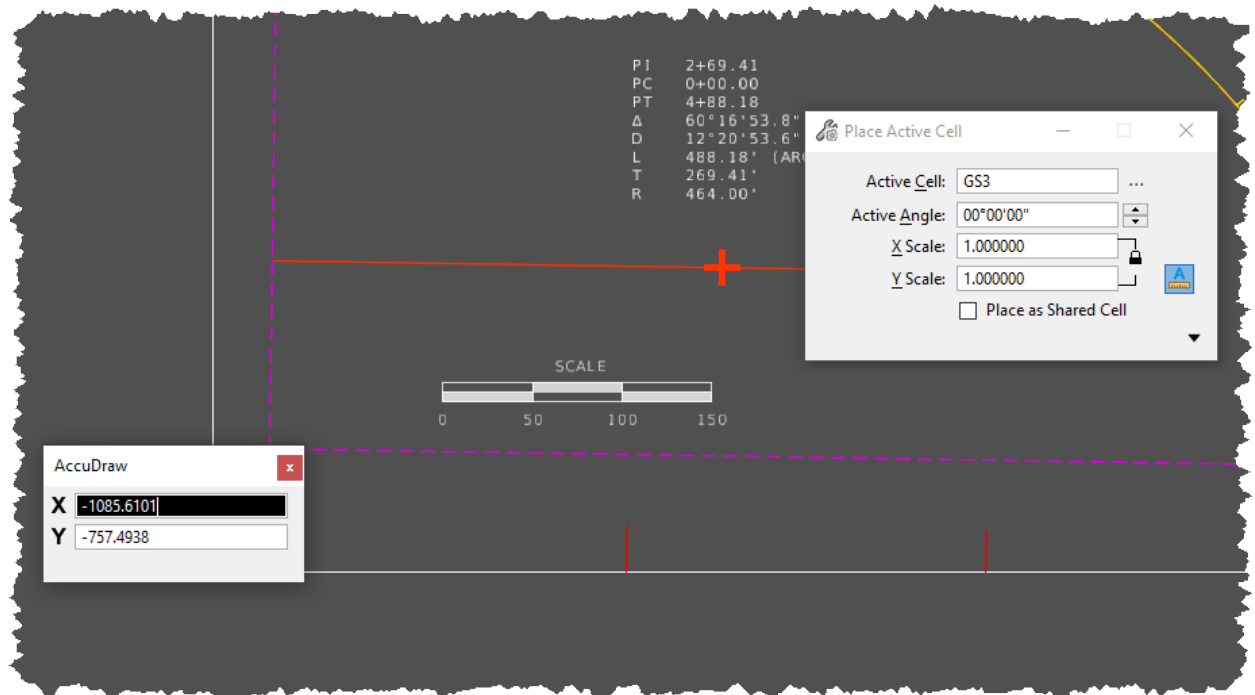
**NOTE:** Clean and organized plan sheets are the desired look so avoid placing elements, cells, and text over other each other when at all possible.

15. Adding a Graphic Scale to your plan sheet:

- From the **MoDOT CADD Detailing Workflow**, select the **Design** tab,
- Select **Graphic Scales – Patterns – North Arrow** button on the ribbon,
- Select the Graphic Scale **1" = 50'**



- Data point** the desired location to place the Graphic scale cell,

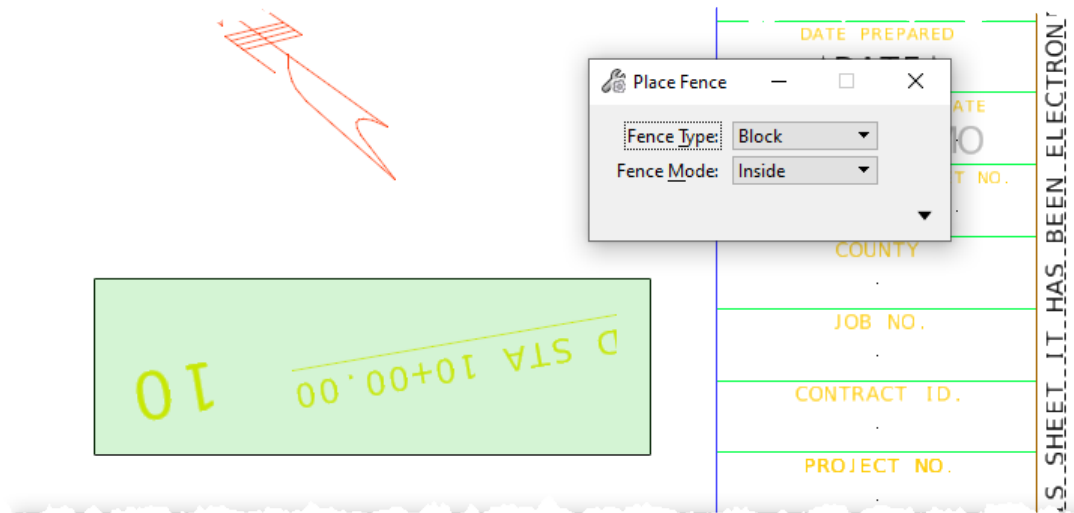


e) Right click to reset the tool

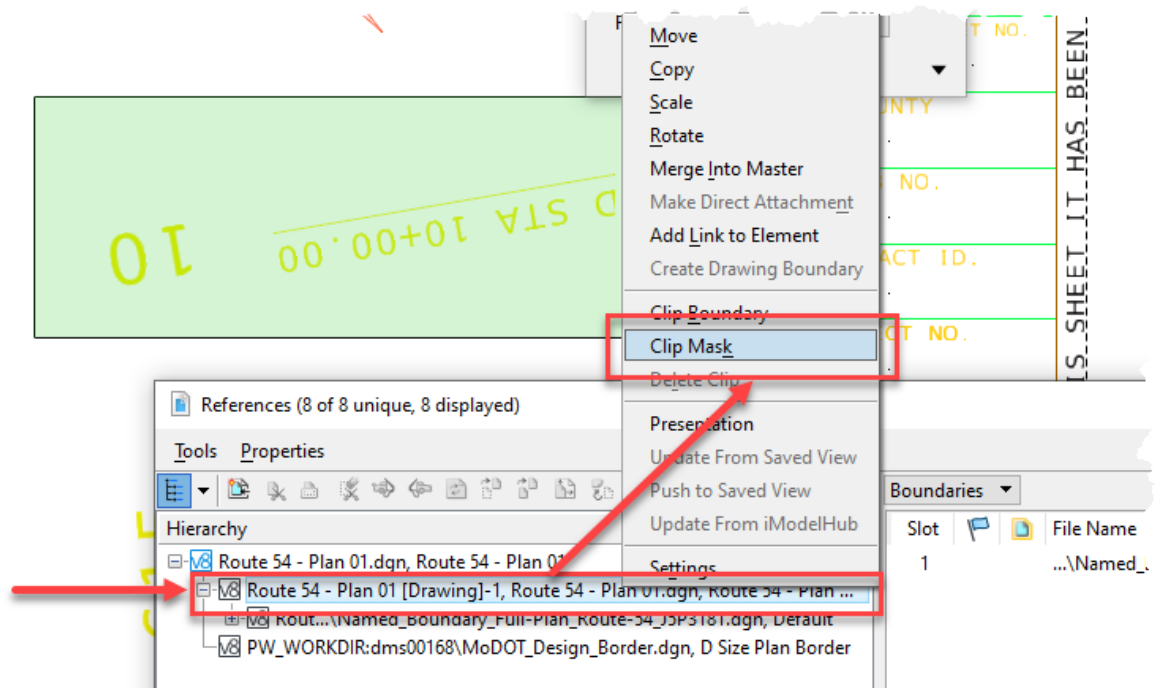
### Masking items from the plan sheet

16. To **remove/mask items from a reference file** as in any elements follow the next few steps:

- Open the **Sheet Model**
- Change the Workflow back to **OpenRoads Modeling**
- Select the **Drawing** tab
- Select the **Fence** tools
- Change Fence Type to **Block or Shape**
- Create a block or shape** around the stationing to be masked

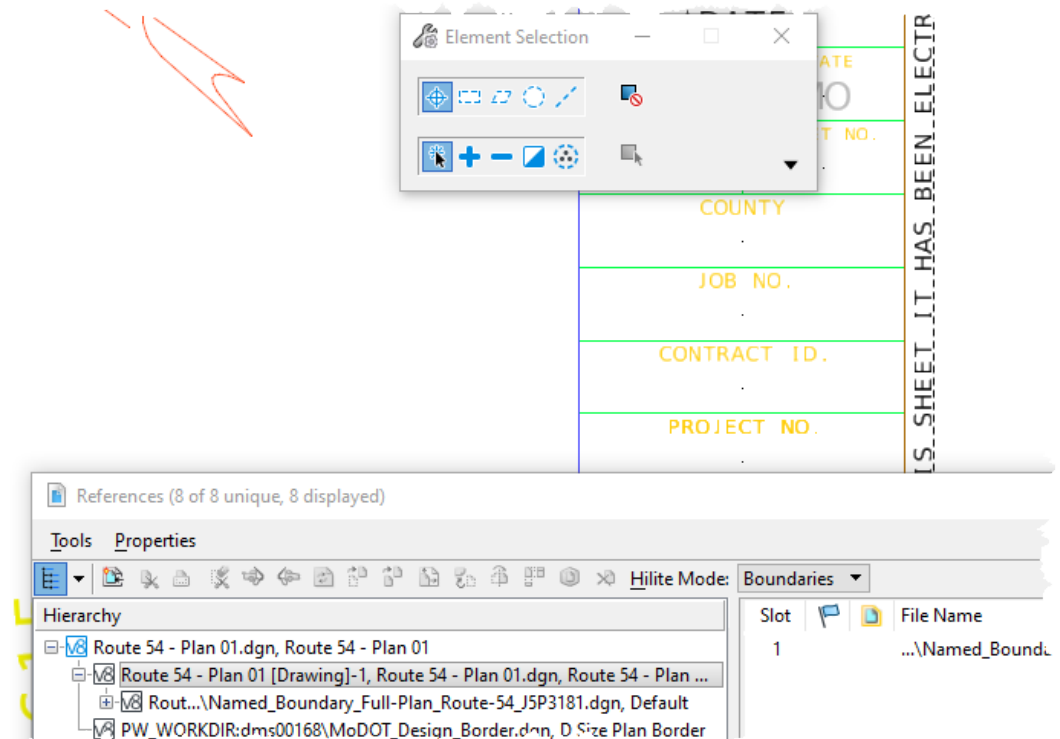


- g) Open the **Reference** dialog
- h) Open the **Hierarchy Tree**
- i) Select the + (plus sign) to open the **Drawing Model** reference
- j) Right click on the **Drawing Model** reference
- k) Select the **Clip Mask** option



- l) **Accept** (Left click in a blank area)
- m) **Accept** in a blank area again to drop the fence (or hit F 4 on the keyboard)

- n) This process will mask out the unwanted station from another alignment that is not needed to be shown in this set of plan sheets.



**NOTE:** the goal is to produce clean plan sheets using the MoDOT standards. Avoid placing notes, leaders, cells, linear elements over any other items to achieve clean and readable plan sheets.

## End of Exercise

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## Chapter 10

# Pavement Markings

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## 10.1 Objectives

The purpose of this chapter is to show the user how to use the multiple tools to place pavement markings including symbols, stop bars, centerlines, edge lines and more.

- Point Tools to Place Symbols such as Left Turn, Stop Lines, etc.
- Linear Pavement Marking through Standard Templates
- Linear Pavement Markings through custom Template points
- Linear Pavement Marking through Horizontal and Vertical Geometry Tools
- Reports for Pavement Marking (Points and Linear)

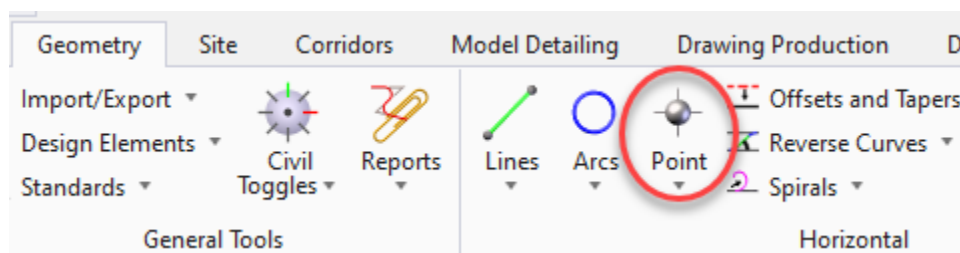
## 10.2 Point Symbols – Typical Pavement Markings

Pavement Marking symbols are MicroStation Cells that can be placed on Civil Points and given elevation. The elevation will create the Cell and place it in the 3D model. This is possible in ORD with new elevation options which will be described in this section.

### 10.2.1 Placing Pavement Markings

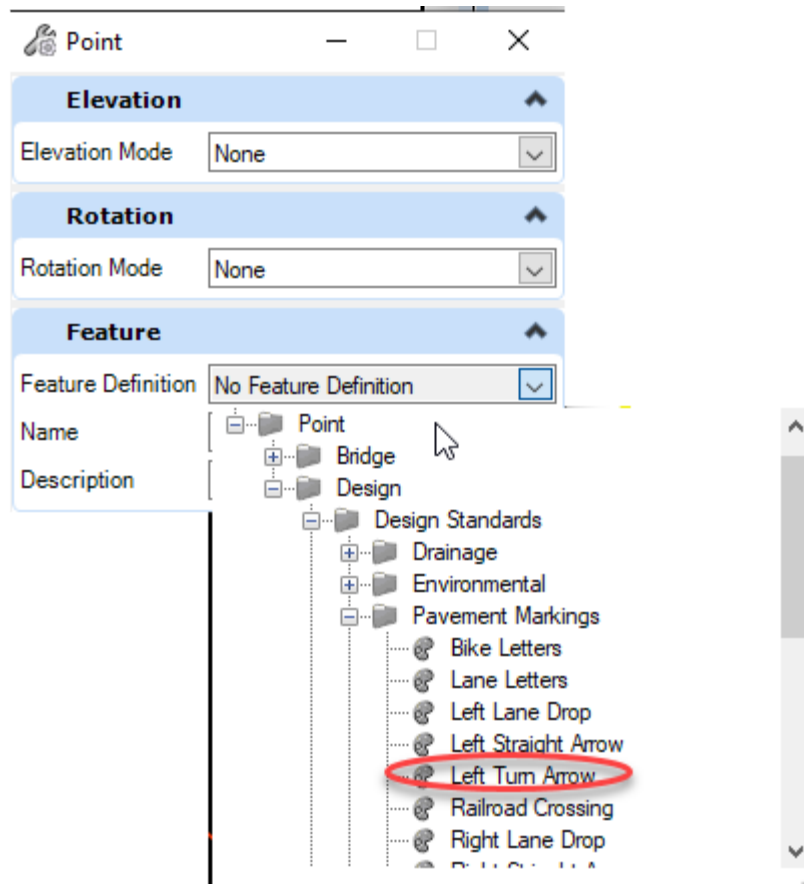
To place a standard MoDOT Pavement Marking, utilizing the Civil Geometry Point tool:

1. Open the Tab **Geometry** from the Ribbon
2. Select the **Point** tool

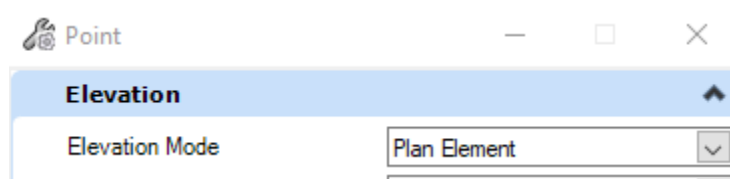


3. The Point dialog box opens. The Feature Definition area allows for the selection of a pavement marking. Click the down arrow next to **Feature Definition**.
4. The Pavement Marking cells are located under:
  - Point
    - Design
      - Design Standards
        - Pavement Markings

Select a Pavement Marking (Ex. **Left Turn Arrow**)

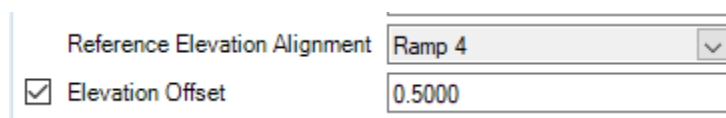


5. Once Selected, Choose the **Elevation Mode**. To allow for a Pavement Marking to show on the corridor's 3D surface, select **Plan Element**.



6. Choose a **Plan element** such as the Baseline or Centerline. Place a positive number in the Elevation Offset to make sure the Pavement Marking is above the corridor surface. For example, **Ramp 4** alignment elevation and 6" above that elevation.

*(if known, you can enter the Value of the Elevation by choosing Value for your Elevation Mode and keying in the elevation.)*





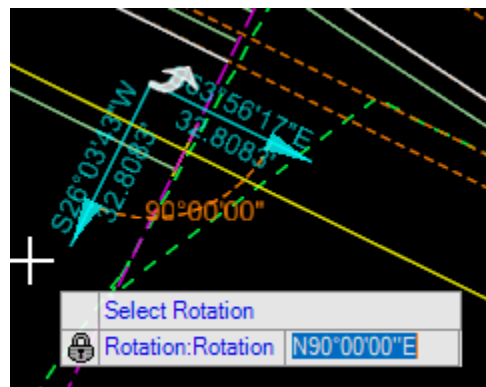
7. Next, select a Rotation for the cell. None, Absolute Value, or Relative to alignment. If **Relative to Alignment** is chosen, then select a Reference Rotation Alignment. For example, **Ramp 4**.

Rotation	
Rotation Mode	Relative to alignment
Reference Rotation Alignment	Ramp 4

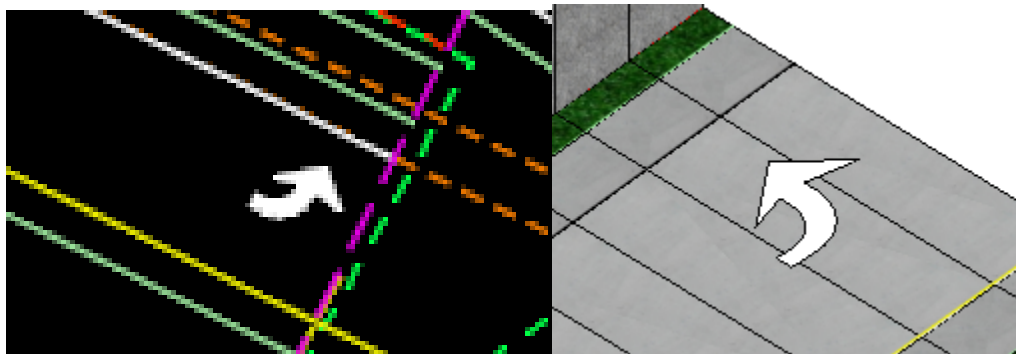
8. Move out on to the drawing screen. The prompt will read *Enter Offset*. This will be the vertical offset from the alignment elevation. If you have keyed in the elevation offset in the dialog, you can accept that value with a **Left Click**. If you did not fill it out in the dialog, this is where you can key in the value (example: 0.5) and Enter.

Enter Offset	
Elevation: Elevation Offset	0.5000

9. Next *Enter Data Point*. At this prompt you can place your cell in the drawing. This can be placed using Civil Accudraw with station and offset, or just by Left Clicking a location. **Left Click** to place. (Cell can be moved later as well).
10. After the location is given, the prompt will move to *Select Rotation*. This can be a dynamic rotation by moving the mouse, or Key In a specific rotation. Since this example is based on Ramp 4 centerline, the cell can be placed perpendicular to the alignment by keying in **N90E** and hitting **Enter**.



11. Accept the value with a **Left Click**.




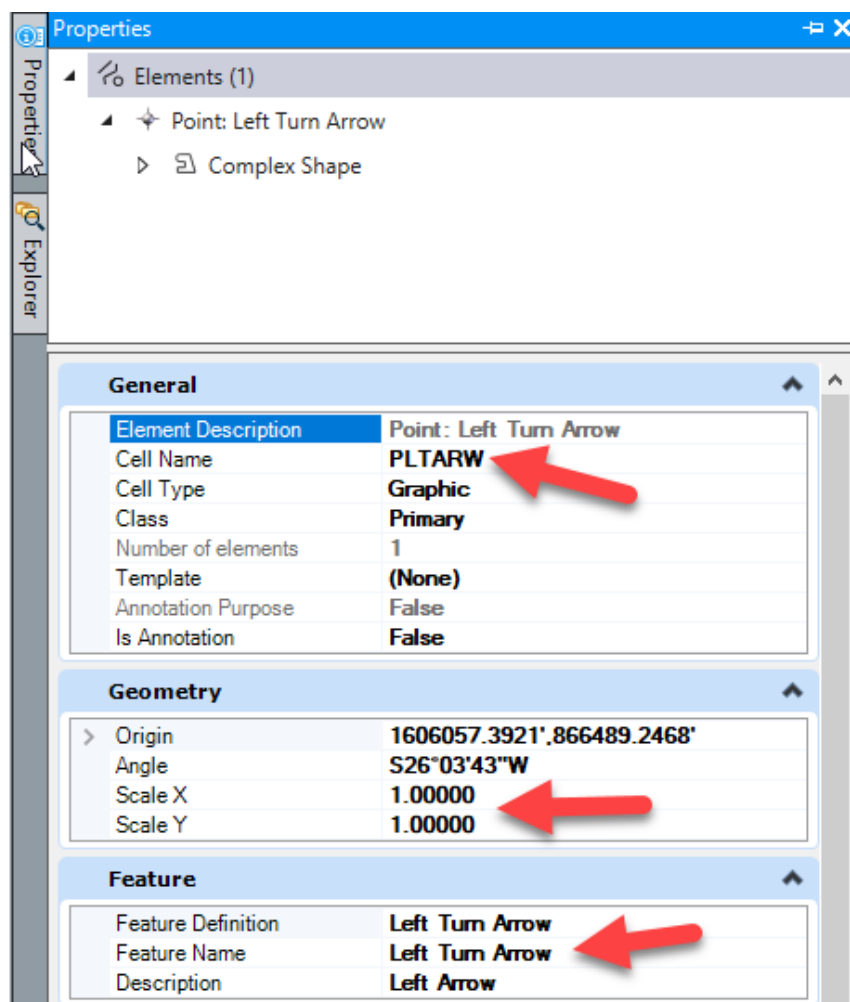
### 10.2.2 Modifying Pavement Marking Points

There are several methods for modifying a point after it has been placed.

- Using the Element Section to select the point and move to a new location.
- Select the point and open the Properties Dialog and make any changes.
- Use the Modify Points tool in the Geometry > Horizontal > Points tools.

By the Element Properties dialog

1. Locate the point to be modified.
2. Select the point (Pavement Marking) with the Element Selection tool.
3. Open the Properties dialog. (it may already be docked on the left of the screen) 
4. In the Properties dialog, modify any field to the desired result. For example, change the cell being used, the scale, the feature name or feature definition or rotation and elevation.

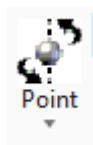


Geometry Points	
X	1606057.3921'
Y	866489.2468'
Elevation	780.7052'
Rotation	S26°03'43"W
Rotation Offset	N90°00'00"E
Rotation Reference	Ramp 4
Absolute Angle	False

Point Constraints	
Delta Elevation	0.5000'
Reference Alignment	Ramp 4

The ORD tool Modify Point is under the **Geometry Tab > Horizontal > Points > Modify Point**. This tool is used to change elevation and rotation of a point.



1. Open the **Modify Point** tool
2. Choose options to change in the dialog

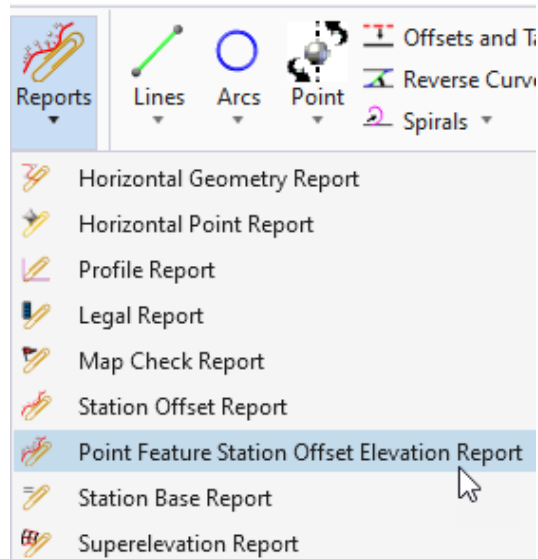
3. Accept the dialog settings with a series **Left Clicks** on the screen
4. Select the Pavement Marking to modify



5. Reset (**Right Click**) to finish.

### 10.2.3 Pavement Marking Symbols Report

There are a number of reports that may be used for gathering information from pavement marking symbols that have been placed with the Civil Points method described in this chapter. Perhaps the most common report is the Point Feature Station Offset Elevation Report for those that are looking for location based on alignment. The Horizontal Point Report works as well and gives an X,Y,Z format.



1. From the Geometry Tab > Reports choose **Point Feature Station Offset Elevation Report**
2. Using this report requires a baseline. At the *Locate Baseline Element*, choose the alignment to base the information on. For example, **Ramp 4**.
3. Then at the *Locate Offset Element*, select each of the Pavement Markings you wish to have displayed in the report. They will all show station and offset from that alignment.
4. Reset (**Right Click**) when finished.

The Report will load with the information. This can be saved off in PDF or Execl.

Station Offset Elevation Feature Report					
Report Created: Thursday, October 7, 2021 Time: 9:09:38 AM					
Project: Default					
Description:					
Baseline (Active) Alignment: Ramp 4					
File Name: c:\users\smithm6\pwise_local_development\ld0334820\Corridors_Route-54_J5P3181.dgn					
Last Revised: 10/7/2021 08:00:18					
Input Grid Factor:					
Note: All units in this report are in feet unless specified otherwise.					
Point	Description	Station	Offset	Elevation	Feature
Left Turn Arrow3	Left Arrow	0+59.270	-9.539	775.182	Point\Design\Design Standards\Pavement Markings\Left Turn Arrow
Left Turn Arrow2	Left Arrow	1+94.538	-9.045	771.604	Point\Design\Design Standards\Pavement Markings\Left Turn Arrow
Left Turn Arrow1	Left Arrow	3+75.807	-9.473	774.745	Point\Design\Design Standards\Pavement Markings\Left Turn Arrow
Left Turn Arrow	Left Arrow	4+89.128	-8.174	780.705	Point\Design\Design Standards\Pavement Markings\Left Turn Arrow

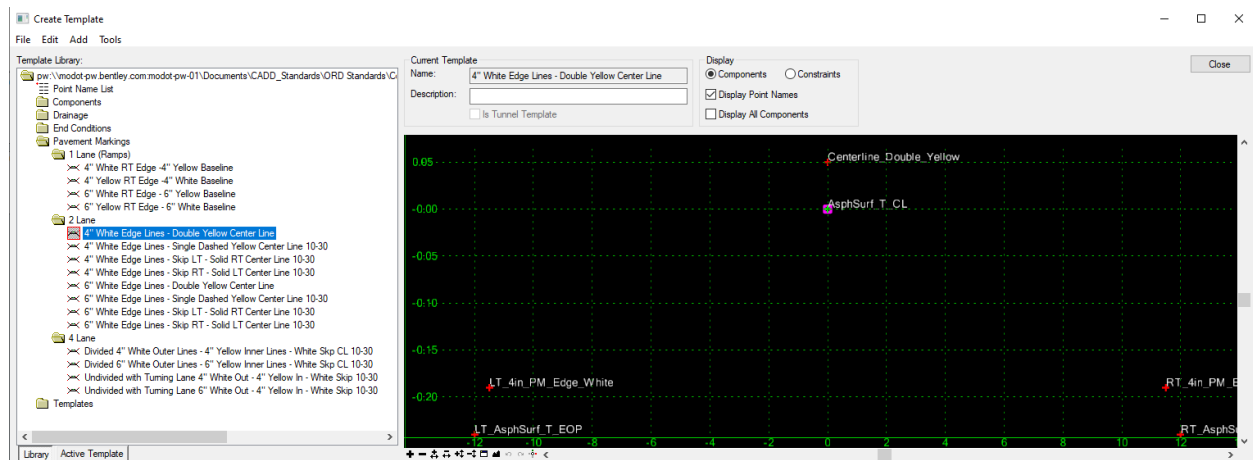
## 10.3 Linear Pavement Marking through Standard Templates

ORD offers a component that will draw EOP, CL and other Linear Pavement Markings, by adding the component to the roadway section template. By adding the component to the template and applying the correct Feature Definition, linear Pavement Markings will draw automatically. These Feature Definitions can be changed at any time to accommodate changes in striping for a given area. This section explains the Pavement Marking templates that are supplied in the MODOT.ITL for use with MODOT Standard Templates.

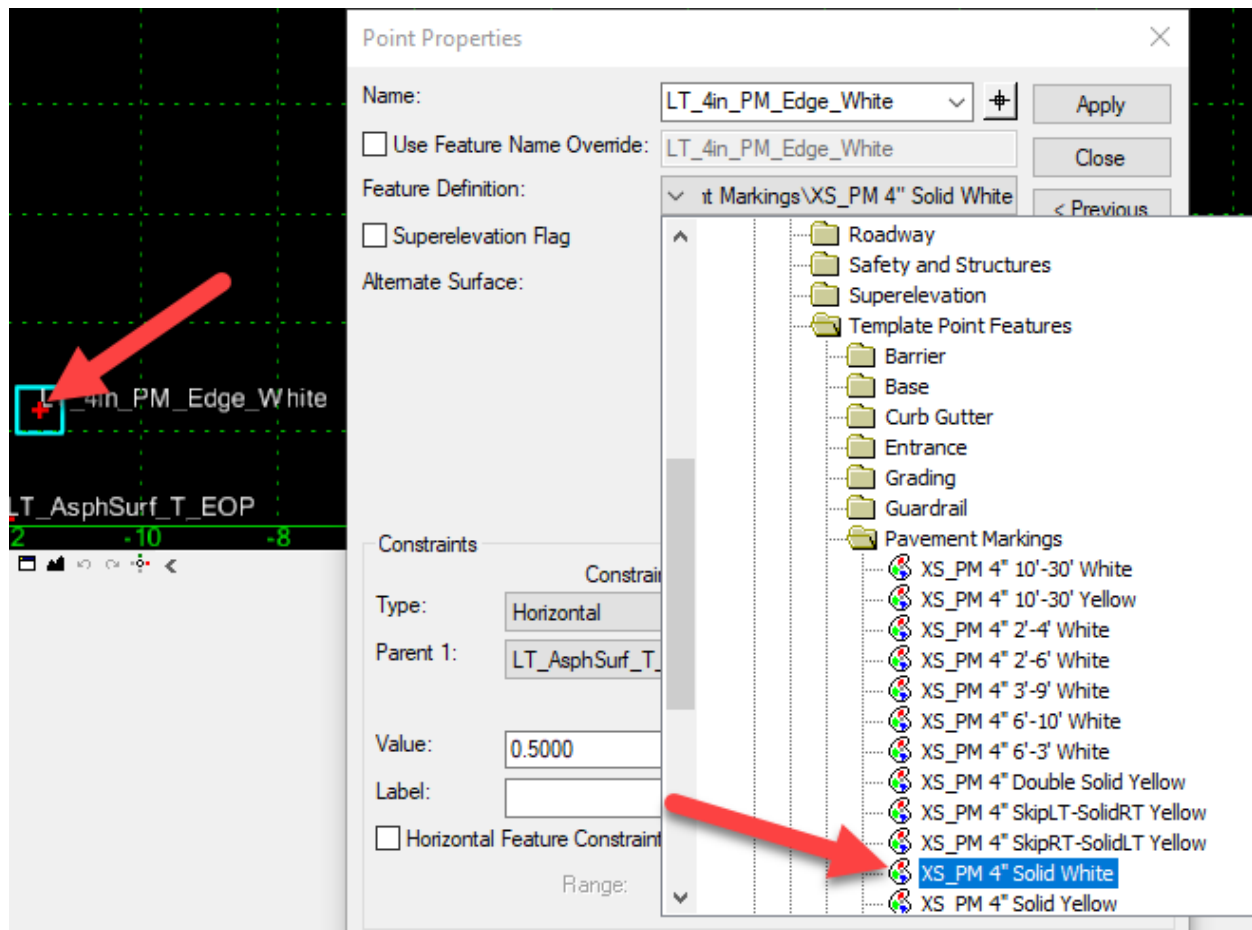
### 10.3.1 Pavement Marking Templates

Templates have been set up with MODOT Pavement Marking Features to match the points in a Standard MODOT Template for 1, 2 and 4 lane pavements. These work with asphalt or concrete pavements.

In the MODOT.ITL Locate the Pavement Markings folder.



Each component in the Template is assigned an XS\_PM feature that is tied to a 2D and 3D Linear element. They are set to draw in the plan view. Each point is tied to an EOP or CL point that is defined in the other MODOT Standard Templates. The next section will discuss how to use these Templates.

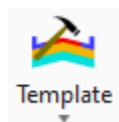


These Templates can be Drag and Dropped onto the CL point of existing Templates. Then EOP points can be merged. When the EOP points are merged, the Pavement Marking components automatically change the parent points to the existing EOP points that remain after the merge.

### 10.3.2 Assigning Pavement Markings to Corridor Templates

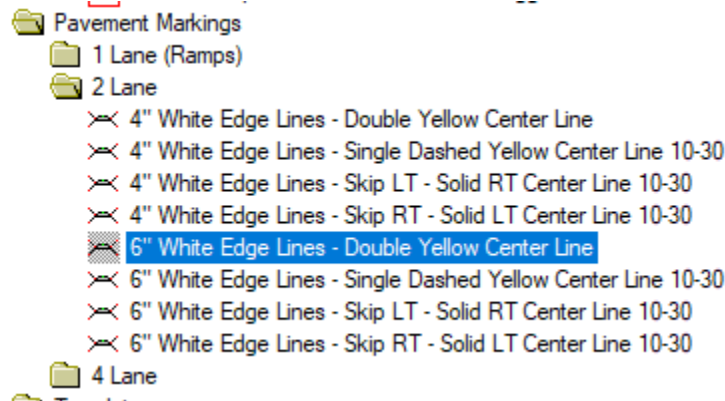
Pavement Marking Templates are meant to be placed on an existing Corridor Template. They can be placed on your Template Library Project Templates or in the DGN Templates in-use by the corridor. The Pavement Markings are drawn in the Plan view on specific levels for Pavement Markings, so they can appear in sheets that you need them to show. This example will show how to add Pavement Markings to the Templates already in use in the DGN.

1. Open the Template that is to receive Pavement Markings, either from the DGN or in the Template Library. For this example, we will do this in the **Template Library**.



2. In the Template Library, locate the Template to be updated and open it in the Template Editor window on the right. For this example: “J5P3181 Asphalt Pavement 2 Lane w/ Agg Base Concrete Shoulder”

3. Locate and expand the **Pavement Markings** folder in the Library List.
4. Open the folder **2 Lane**
5. Select (One Left Click) on **6" White Edge Lines – Double Yellow Center Line**



6. This will place it in the Preview Window. Notice the Green Point in the Preview Window. This is the point that will match up to the Green Point in the open template.
7. Drag the **6" White Edge Lines – Double Yellow Center Line** to the Green Point (AsphSurf\_T\_CL) and let go.
8. On a Standard MoDOT Template the EOP points may automatically merge, causing the RT and LT Pavement Markings to be based on the EOP points in the existing Template.

Note: You may have to Merge the EOP points, removing the ones that come from the PM Template. This can happen when points do not have the same name as the PM template. If lanes are greater or less than the standard 12', it may be necessary to remove the constraints from the newly placed EOP's, Move the points to the EOP's in the current Template, then Merge.



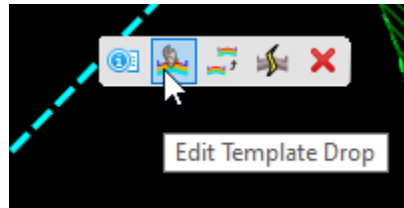
## 10.4 Custom Pavement Marking Templates

Using ORD Template Components, you can make your own Linear Pavement Markings through the Corridor Templates. This section will discuss how to set up the component to have the template place 2D and 3D Pavement Markings in a modified or non-standard Corridor Template.

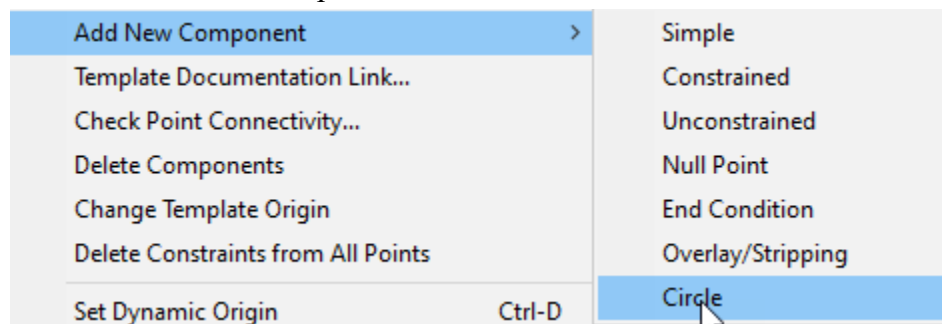
### 10.4.1 Adding the Pavement Markings to a Corridor Template

These are the steps to add Pavement Markings to a Template in the Template Library for use in a new corridor or when synchronizing a template that resides in the DGN or directly modifying a Template in-use in the DGN.

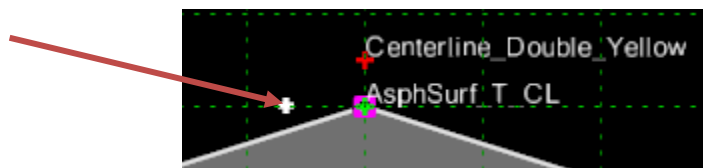
1. Modifying a Template using the **Edit Template Drop**



2. In the Template Editor, **Right-Click** and Select **Add New Component**
3. Choose **Circle** from the list of options

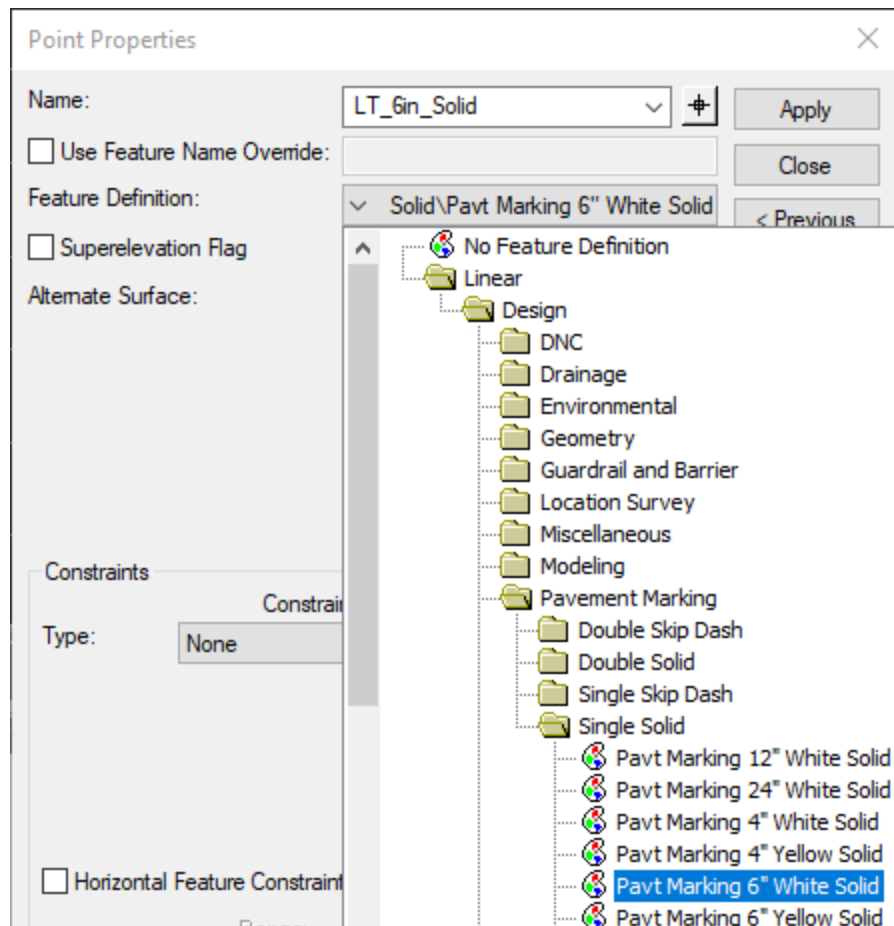


4. **Left-Click** a Center of Circle Location
5. **Left-Click** on the same location for a 0 Radius Circle

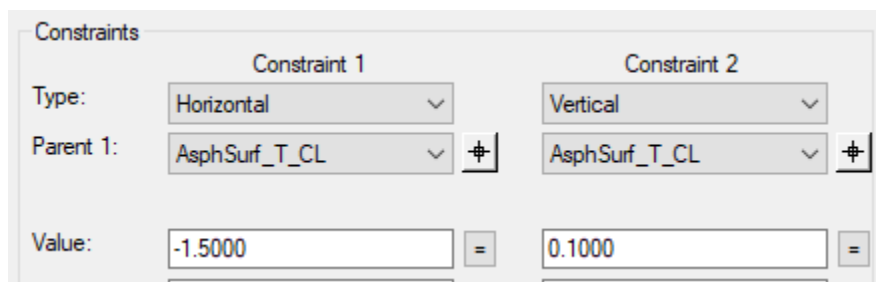


6. Double Left-click on the new point to open the point dialog properties
7. Name this the Pavement Marking Type, for this Example – **LT\_6in\_Solid**

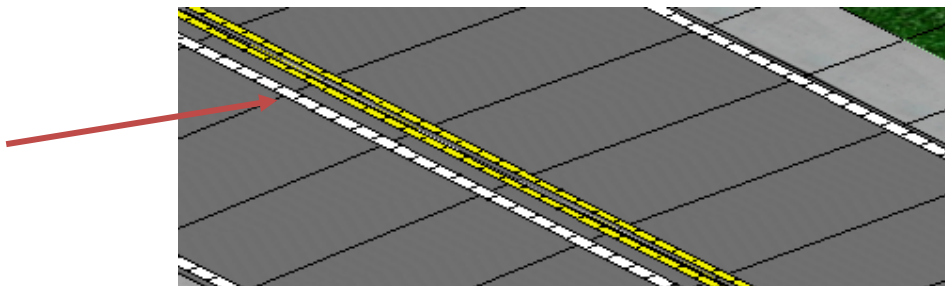




8. Add constraints to the new point. Example, a Horizontal from the CL of -1.5 and a Vertical of 0.1 from the CL.



9. Apply and Close  
10. Click OK to the Template Drop Editor  
11. Notice the new Pavement Marking on the Corridor for the added point



## 10.5 Civil Geometry Pavement Markings

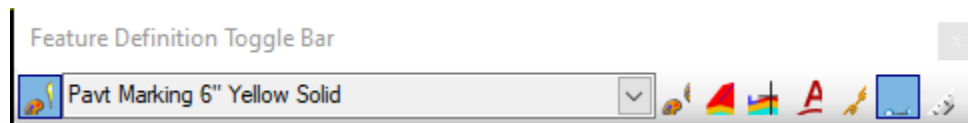
Pavement Markings may be drawn using the various Civil Geometry tools, such as, Complex Element and Line Between Points. Civil Offset tools may be used to offset the EOS inside 1 foot to show a 6" White Pavement Edge for example.

To create Pavement Markings with this method, simply set the active Feature Definition to a Pavement Marking of your choice and draw the line work. Stations may be given to the lines as well for reporting purposes.

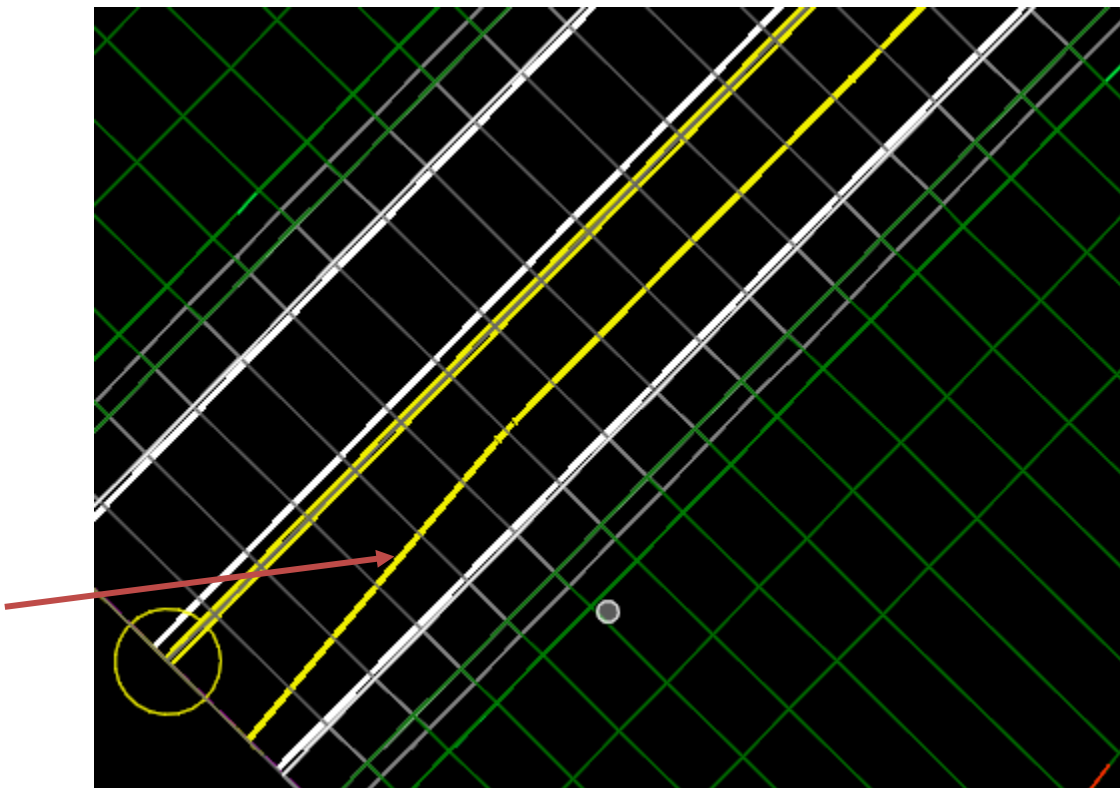
### 10.5.1 Adding the Pavement Markings By Civil Geometry

These are the steps to add Pavement Markings to a Corridor by Civil Geometry.

1. Set the Feature Definition to the desired Pavement Marking. For example **Linear > Design > Pavement Marking > Single Solid > Pavt Marking 6" Yellow Solid**
2. Set it **Active**

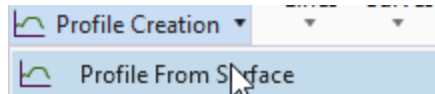


3. With the Feature Definition active, you can choose any Horizontal Geometry Tool to create the Pavement Marking. For example, choose Geometry > Horizontal > **Complex by PI**
4. Create a **Horizontal Element**

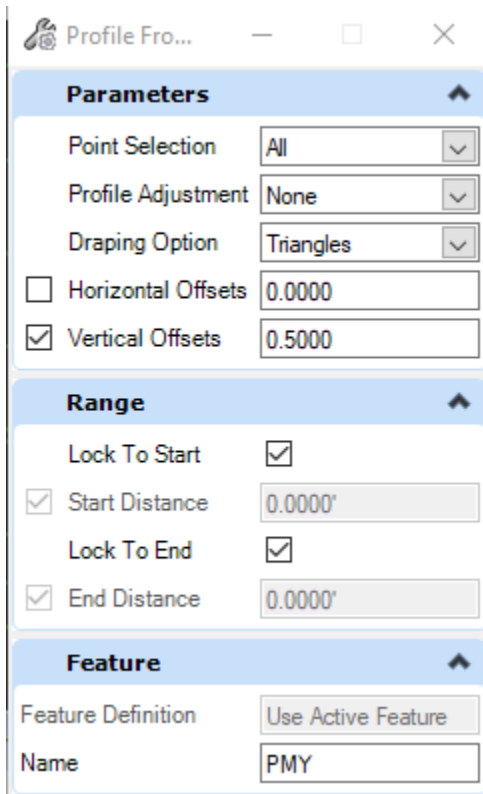


5. This will show in the 2D view for Pavement Markings. If you wish for it to also appear in the 3D view on the Corridor, you may apply a profile based on the corridor surface Plus a .5 Elevation Difference.

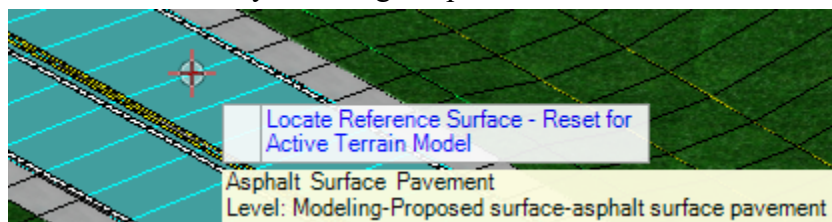
- a. Open the Profile Model in View 8 for the Pavement Marking
- b. Make sure the 3D model of the corridor can be viewed. Either **F6**, or have the 3D model on in the 2D view. For this example, we will use the 3D Model Default-3D.
- c. From the Geometry > Vertical ribbon, choose the Profile Creation > **Profile From Surface**



- d. Set the dialog up to profile the entire element with a Vertical Offset of 0.5 as shown in the image. You may also give it a name for the profile.

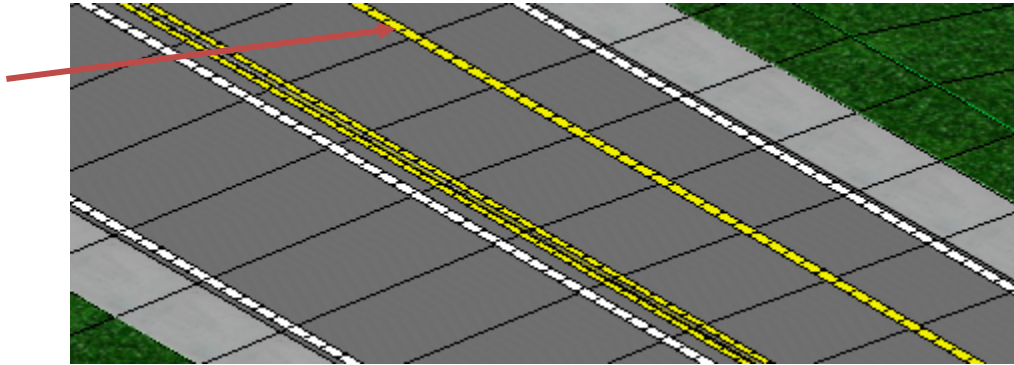


- e. Locate First Element to Profile: **Select the Horizontal Pavement Marking**
- f. **Right-Click** in a blank area to reset
- g. Locate Reference Surface by choosing the pavement from the 3D model.



- h. **Right-Click** in a blank area to reset
- i. Lock to start and end as shown in the dialog and accept the remaining prompts by **Left-Clicking** on the screen.

- j. Horizontal Offset of **0** when prompted and **Enter** (you could also lock this at 0 in the dialog)
- k. Take a look at the 3D model and the Pavement Marking should now appear over the Corridor.



### 10.5.2 Adding Start Station to Pavement Markings

If the stationing needs to be something other than 0+00 for the start of a pavement marking, you can use the Start Station tool to set the stationing.

1. From Geometry > Horizontal > Modify choose **Start Station**
2. Select the Pavement Marking to station
3. Move the mouse to the desired location to add the stationing and **Left-Click**
4. Key in the new station
5. Reporting will now use the new stationing for the Pavement Marking.

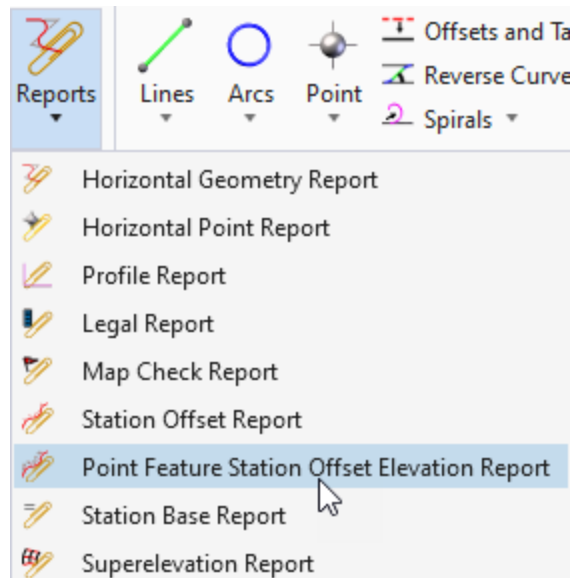
## 10.6 Pavement Marking Reports

Pavement Markings may be Linear or Point markings for the various reports to work. There are reports for each type. Some are MoDOT created reports, others can use the built in Bentley reports.

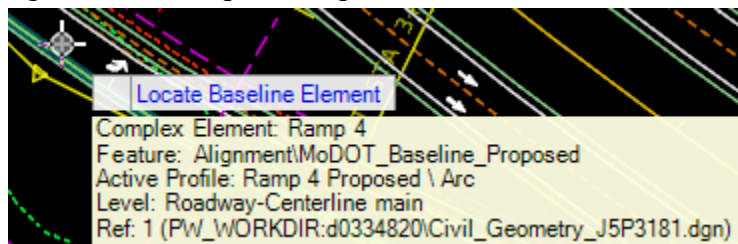
### 10.6.1 Point Pavement Marking Reports

Point Markings are pavement markings such as turn arrows, lane drops, straight arrows, etc. they are placed using the Civil Point Placement tools. The Feature Definitions of these points allows them to be reported on using the Civil Reports.

1. From the Geometry > General Tools ribbon, expand Reports and select **Point Feature Station Offset Elevation Report**



2. Locate Baseline Element: This is what the report will use for station and offset of the pavement marking. In this example, Ramp 4.



3. Next, Locate Offset Element, will be each of the Pavement Marking Points to be included in the report. Select each Pavement Marking Point.



4. When finished selecting items, Right-Click in a blank area.
5. The report will display with the standard Bentley Report.

- MoDOT
- Cant
- Civil Terrain
- Civil Geometry
- Civil Survey
- Corridor Modeling
- Evaluation
- Legal Description
- Map Check
- Milling
- Stakeout
- Station Offset
  - CivilToolsStationOffset.xml
  - CivilToolsStationOffsetExtended.xml
  - ProfileExistingProposedElevation.xml
  - ProfileExistingProposedElevationExtended.xml
  - ProfileStationElevation.xml
  - ProfileStationElevationASCII.xml
  - ProfileStationOffsetElevationASCII.xml
  - StationBaseCompare.xml
  - StationBaseCoordinates.xml
  - StationBaseCrossSlope.xml
  - StationBaseSimplifiedCrossSlope.xml
  - StationBaseSingle.xml
  - StationBaseVerticalClearance.xml
  - StationBaseWGrades.xml
  - StationOffset.xml
  - StationOffsetAlongSingleAlignment.xml
  - StationOffsetAlongSingleAlignmentExistGround.xml
  - StationOffsetAlongSingleAlignmentWRadius.xml
  - StationOffsetElevationFeature.xml**
  - StationOffsetNorthingFactoring.xml

### Station Offset Elevation Feature Report

Report Created: Thursday, October 21, 2021  
Time: 11:10:35 AM

Project: Default

Description:

Baseline (Active) Alignment: Ramp 4

File Name: c:\users\smithm6\pwise\_local\_development\d0334820  
\Corridors\_Route-54\_J5P3181.dgn

Last Revised: 10/21/2021 10:52:15

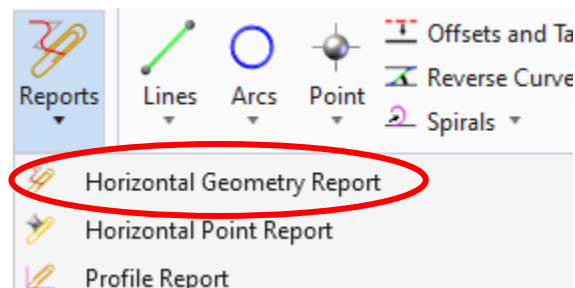
Input Grid Factor:      Note: All units in this report are in feet unless specified otherwise.

Point	Description	Station	Offset	Elevation	Feature
Left Turn Arrow3	Left Arrow	0+59.270	-9.539	775.182	Point\Design\Design Standards\Pavement Markings\Left Turn Arrow
Left Turn Arrow2	Left Arrow	1+94.538	-9.045	771.604	Point\Design\Design Standards\Pavement Markings\Left Turn Arrow
Left Turn Arrow1	Left Arrow	3+75.807	-9.473	774.745	Point\Design\Design Standards\Pavement Markings\Left Turn Arrow
Left Turn Arrow	Left Arrow	4+89.128	-8.174	780.705	Point\Design\Design Standards\Pavement Markings\Left Turn Arrow

## 10.6.2 Linear Pavement Marking Reports

Linear Markings are pavement markings such as Edge of Pavement, dashed or solid centerlines, double centerlines etc. These lines can be reported on as well. There is a MoDOT created report that simplifies the reporting and puts it in a format that's easily used.

1. From the Geometry > General Tools ribbon, expand Reports and select **Horizontal Geometry Report**



2. Locate First Element: Select each of the lines that you wish to report on
3. Right-Click when Finished
4. **Left-Click** to accept **None** for the Event Points option
5. **Left-Click** to accept the **None** for Profile
6. The Report will be generated. In the left pane, expand **MoDOT**
7. Click on the **MoDOT\_Pavement\_Markings** style sheet to display the Pavement Marking report.

MoDOT  
 MoDOT\_Horizontal\_and\_Vertical\_Alignment\_Review  
 MoDOT\_ORD\_Vertical\_Channel\_Definition\_Station\_Elements  
 MoDOT\_Pavement\_Markings.xml

Cant  
 Civil Terrain

CivilGeometry  
 Aquaplaning.xml  
 GeometryPoints.xml  
 GeometryPointsASCII\_CommaDelimited.xml  
 GeometryPoints\_FeatureNoPath.xml  
 HorizontalAlignmentArea.xml  
 HorizontalAlignmentCheckIntegrity.xml  
 HorizontalAlignmentControlLineDataTable.xml  
 HorizontalAlignmentCurveDataTable.xml  
 HorizontalAlignmentCurveSetElementReview.xml  
 HorizontalAlignmentCurveSetReview.xml  
 HorizontalAlignmentEventPointList.xml  
 HorizontalAlignmentIntervalXYZ.xml  
 HorizontalAlignmentLength.xml  
 HorizontalAlignmentReview.xml  
 HorizontalAlignmentReviewASCII.xml  
 HorizontalAlignmentReviewWithPI.xml  
 HorizontalAlignmentStationEquations.xml  
 HorizontalAlignmentToTIW.xml  
 HorizontalAndVerticalAlignmentReview.xml  
 HorizontalElementsTable.xml  
 HorizontalElementsTableSimplified.xml  
 HorizontalElementsXYZ.xml  
 HorizontalRegressionPointsNSlews.xml  
 HorizontalRegressionPointsReview.xml  
 SettingOutTable.xml  
 SettingOutTableDeflection.xml  
 Traverse.xml  
 TraverseCurveASCII.xml

## Pavement Markings Report

Report Created: Thursday, October 21, 2021  
 Time: 12:12:09 PM

Project: Default

File Name: c:\users\smithm6\pwise\_local\_development\d0334820\Connector\_Rd\_Corridor.dgn

Last Revised: 10/21/2021 12:06:21

Note: All units in this report are in feet unless specified otherwise.

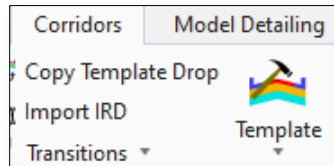
Pavement Marking Type	Length
RT_6in_PM_Edge_White	1000.000
Start Station (START) 0+00.000 R1	
Pavement Marking Type	Length
LT_6in_Solid	1000.000
Start Station (START) 0+00.000	
Pavement Marking Type	Length
Centerline_Double_Yellow	1000.000
Start Station (START) 0+00.000	
Pavement Marking Type	Length
6" Yellow Solid	95.032
Start Station (START) 0+00.000	
Pavement Marking Type	Length
LT_6in_PM_Edge_White	1000.000
Start Station (START) 0+00.000	



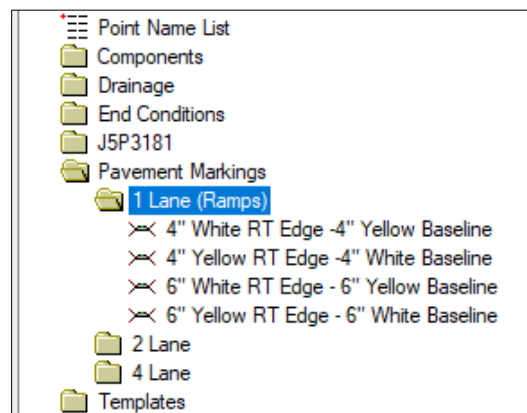
## 10.7 Group Exercise – Ramp 4 Linear Markings

In this exercise, we will work together in the class to place baseline and edge of pavement markings on **Ramp 4**.

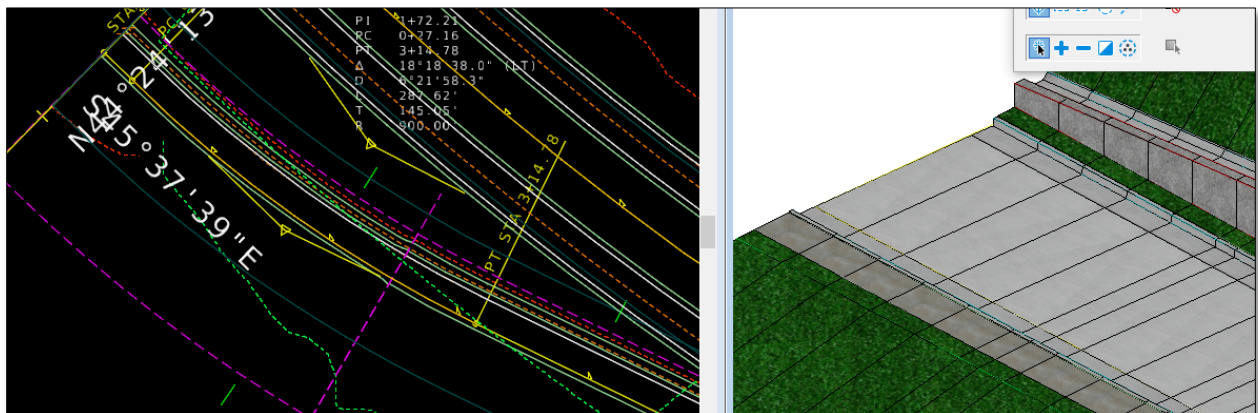
1. Open the file **Corridors\_Ramp-4\_J5P3181.dgn** from the **data-10** folder.
2. Hit **F6** to show both 2D and 3D views (if not already displaying)
3. Open the **J5P3181.itl** in the **data-10** folder from the **Corridors** Tab → **Template Tools** → **Create Template**.



4. Check to make sure the **Pavement Markings** folder is in the list of folders. This will also set the current ITL, so that we may choose the pavement marking templates.

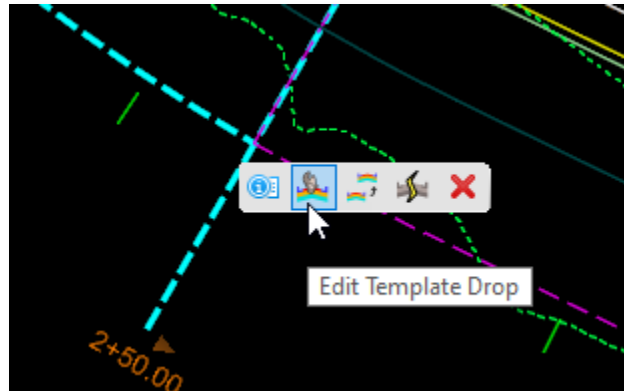


5. Review the current 2D and corridor view

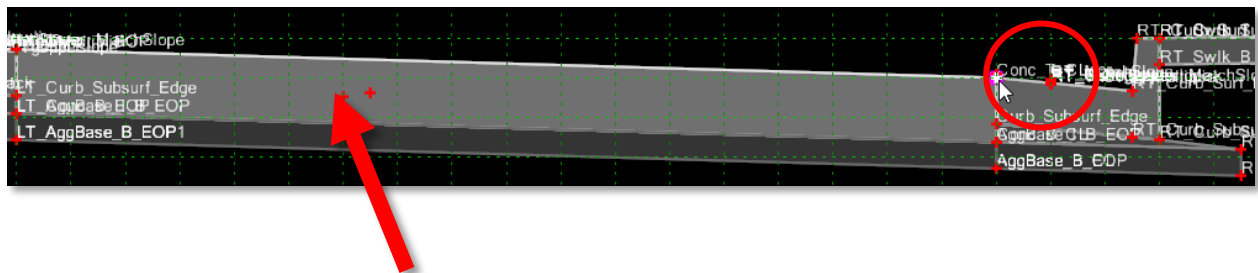




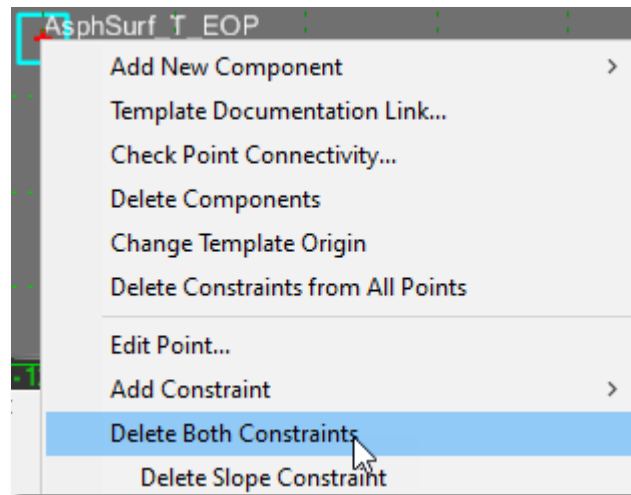
6. Locate the first template drop (purple dashed line shown in step 3). From the heads-up display choose the **Edit Template Drop** tool.



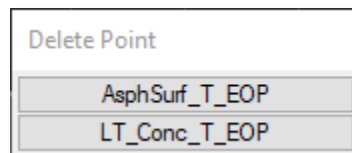
7. Once the Template Drop appears in the editor, locate the **Pavement Markings** folder on the left panel and expand it out.
8. Expand **1 Lane (Ramps)**
9. For this exercise, we will place a 4" Yellow Baseline and a 4" White EOP. Select the **4" White RT Edge - 4" Yellow Baseline** to show it in the Preview Pane.
10. Drag this template to the editor window and **Right-Click** while dragging. Select **Reflect**.
11. Drop the pavement marking template off on top of the **Conc\_CL** point (It will turn white)



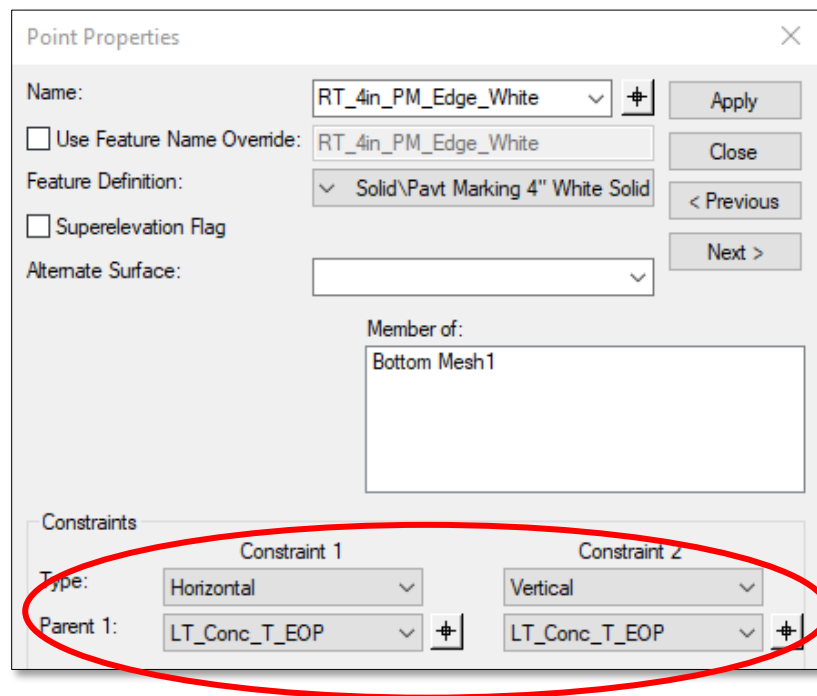
12. The Pavement Marking point and the EOP point are placed in the middle of the roadway. We need to move the EOP point to be on top of the EOP point in the Ramp 4 template. **Right-Click** on the new point **AsphSurf\_T\_EOP** and select **Delete Both Constraints**.



13. The **AsphSurf\_T\_EOP** point will turn **Green**. This indicates all constraints have been removed.
14. Right-Click over the **AsphSurf\_T\_EOP** point and select Move Point.
15. Move the point over the top of **LT\_Conc\_T\_EOP**
16. Right-Click again over the **AsphSurf\_T\_EOP** and click Merge Points
17. Select the **AsphSurf\_T\_EOP** to delete

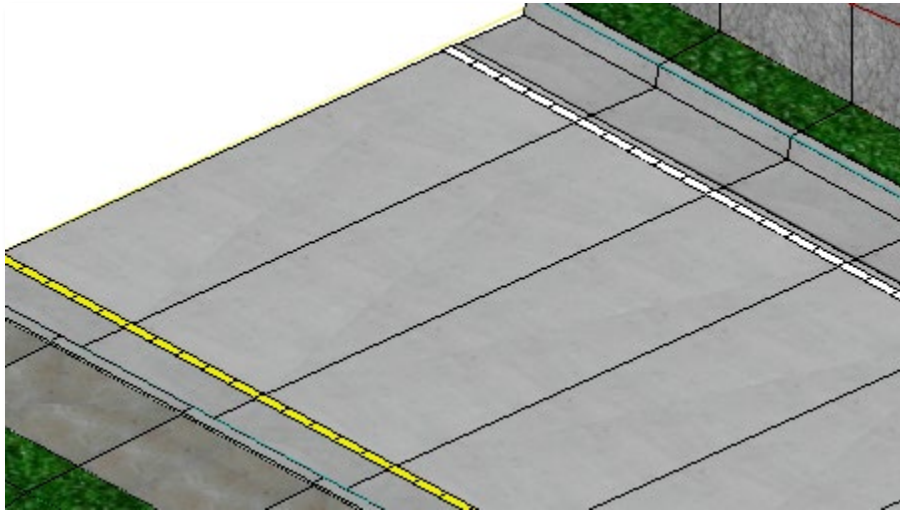


18. Since the point has been merged, now the **RT\_4in\_PM\_Edge\_White** point will change it's parent point to the **LT\_Conc\_T\_EOP**. You can double click on the **RT\_4in\_PM\_Edge\_White** point and review the point properties to see the change.

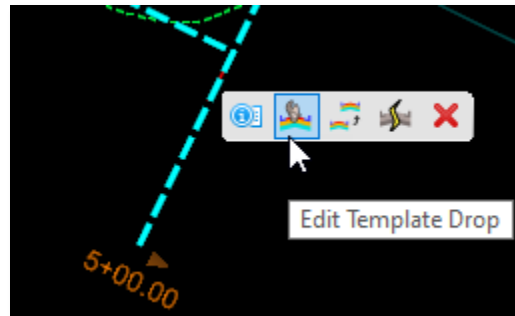


The screenshot shows the 'Point Properties' dialog box. The 'Name' field is 'RT\_4in\_PM\_Edge\_White'. The 'Feature Definition' is 'Solid\Pavt Marking 4" White Solid'. The 'Member of' field is 'Bottom Mesh1'. The 'Constraints' section is circled in red, showing 'Constraint 1' with 'Type: Horizontal' and 'Parent 1: LT\_Conc\_T\_EOP', and 'Constraint 2' with 'Type: Vertical' and 'Parent 1: LT\_Conc\_T\_EOP'.

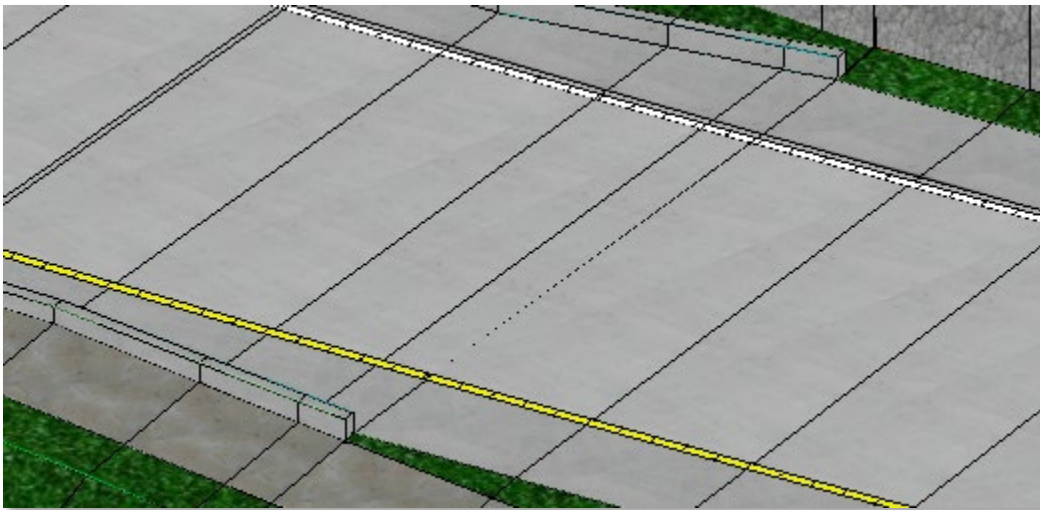
19. Close the Point Properties dialog
20. Click **OK** to the Editor box
21. View the **3D** model to see the pavement markings appear on the pavement.



22. Since there are 2 templates in this corridor, we must make the change to the second template as well. Locate the **2<sup>nd</sup> template's** purple dashed handle and open the Template Editor for that template.



23. Repeat steps 7 – 20 for the **2<sup>nd</sup> template** to add the pavement markings to the remaining Ramp 4.



**Note:** The points in **Template 1** and **Template 2** are named the same and will report back as one element for the full length of the corridor. If for some reason you want the pavement marking to be separated for quantities, simply rename the point for the pavement marking by adding a number to the end. For example: Change the point name on Template 2 from **Centerline\_Solid\_Yellow** to **Centerline\_Solid\_Yellow2**. This will separate them out. You would then need to add a Start Station value to the 2<sup>nd</sup> set of pavement markings. For this example, you would change the Start Station to **2+50**.

24. Run the report for the Linear Markings. **Geometry Tab → General Tools Section → Reports Tools → Horizontal Geometry Report.**

25. Select the **White EOP Pavement Marking** line and the **Yellow Baseline** for Ramp 4.



26. **Right-Click** to end the selection process
27. **Left-Click** to accept None for Event Points
28. **Left-Click** to accept None for Profiles to include
29. The report will display. **Review** the report.

MoDOT

- MoDOT\_Horizontal\_and\_Vertical\_Alignment\_Review
- MoDOT\_ORD\_Vertical\_Channel\_Definition\_Station\_Element
- MoDOT\_Pavement\_Markings.xml
- Cant
- Civil Terrain
- Civil Geometry
  - Aquaplaning.xml
  - GeometryPoints.xml
  - GeometryPointsASCII\_CommaDelimited.xml
  - GeometryPoints\_FeatureNoPath.xml
  - HorizontalAlignmentArea.xml
  - HorizontalAlignmentCheckIntegrity.xml
  - HorizontalAlignmentControlLineDataTable.xml
  - HorizontalAlignmentCurveDataTable.xml
  - HorizontalAlignmentCurveSetElementReview.xml
  - HorizontalAlignmentCurveSetReview.xml
  - HorizontalAlignmentEventPointList.xml
  - HorizontalAlignmentIntervalXYZ.xml
  - HorizontalAlignmentLength.xml
  - HorizontalAlignmentReview.xml
  - HorizontalAlignmentReviewASCII.xml

### Pavement Markings Report

Report Created: Friday, October 22, 2021  
Time: 8:36:08 AM

**Project:** Default

**File Name:** c:\users\smithm6\pwise\_local\_development\d0332773\Corridors\_Ramp-4\_J5P3181.dgn

**Last Revised:** 10/22/2021 08:27:33

Note: All units in this report are in feet unless specified otherwise.

Pavement Marking Type	Length
RT_4in_PM_Edge_White	494.407
Start Station (START) 0+00.000	
Pavement Marking Type	Length
Centerline_Solid_Yellow	500.000
Start Station (START) 0+00.000	

30. **Close** the Report

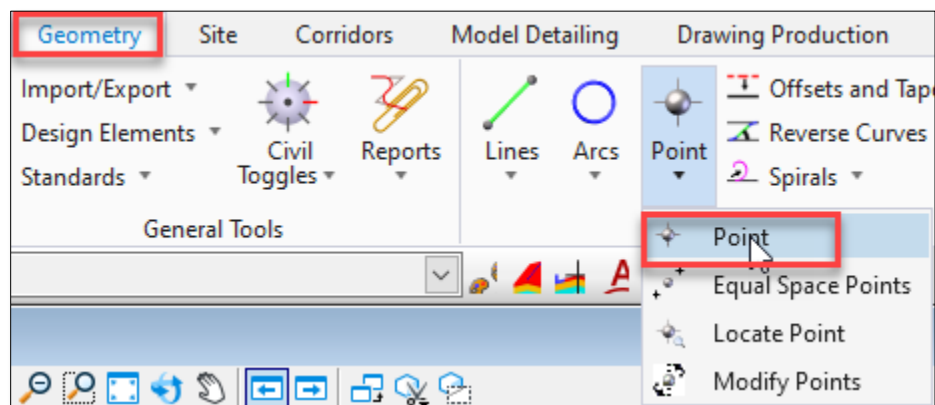
## 10.8 Group Exercise – Ramp 4 Point Markings

In this exercise, we will work together in the class to place Point Markings. We will use Civil Accudraw to accurately place each point marking and base elevation off Ramp 4 baseline profile elevations.

1. Continue (or open if necessary) in the **data-10/ Corridors\_Ramp-4\_J5P3181.dgn**
2. Hit **F6** to show both 2D and 3D views (if not already displaying)
3. Zoom in to the area of **Ramp 4**
4. Start **Civil Accudraw** with **Station/Offset** option selected



5. From **Geometry Tab** → **Horizontal Section** → **Point Tools** → **Point**



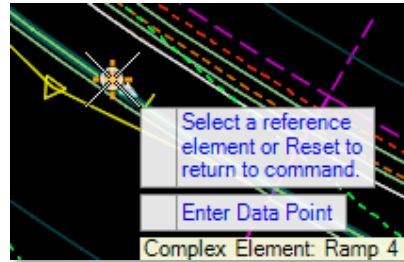
6. In the Point dialog, set the following:
  - a. Elevation Mode: **Plan Element**
  - b. Elevation Offset: **0.5**
  - c. Rotation Mode: **Relative to alignment**
  - d. Rotation: **N00d00'00'E**
  - e. Feature Definition: **Straight Arrow**
  - f. Name: **Straight Arrow**
  - g. Description: **Straight Arrow**
7. At the prompt **Locate Elevation Plan Element** select **Ramp 4** Baseline



8. Accept the Elevation Offset of 0.5000 that has been entered into the dialog.
9. At the prompt *Locate Reference Element for Rotation* select **Ramp 4** Baseline



10. Set the Civil Accudraw to be based off the Ramp 4 Baseline. **Tab** down to the **Offset** Field in Civil Accudraw and hit the letter **O**.

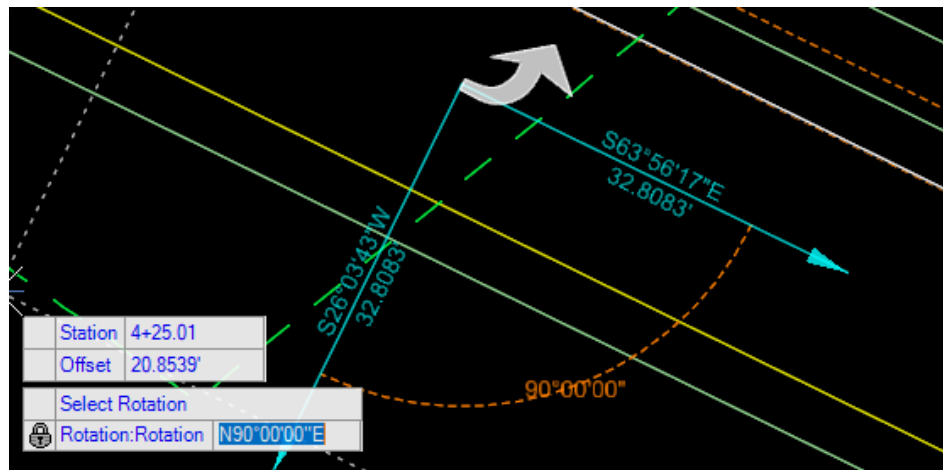


11. At the prompt *Select a reference element...* select **Ramp 4** Baseline
12. In Civil Accudraw Key in **0+50** for the Station and hit **Enter** to lock it in
13. In the Offset field key in **-9** and hit **Enter** to lock it in
14. **Left click** in a blank area to accept the key ins
15. **Left click** to accept the rotation of **N00d00°00"E** based on Ramp 4 direction

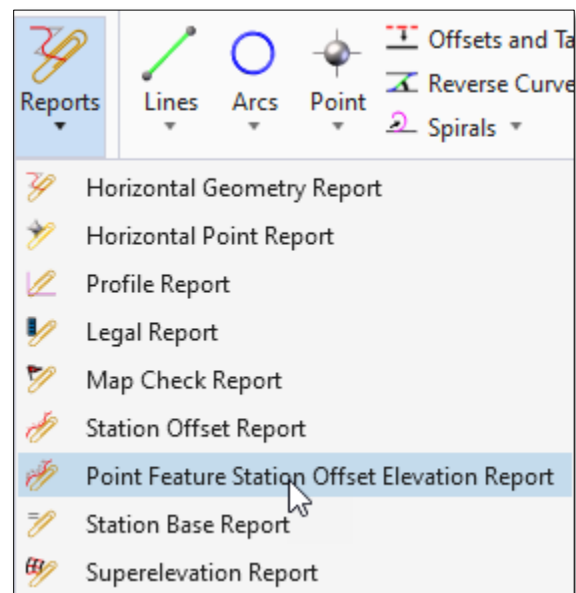


16. Repeat the necessary steps to place Straight Arrows at the following locations:
  - a. Station **2+50** Offset **-9.00'**
  - b. Station **4+00** Offset **-9.00'**

17. Place a **Left Turn Arrow** at Station **4+50** with an Offset of **-9.00'** Rotation **N90E**



18. From the **Geometry Tab** → **General Tools Section** → **Reports Tools** → **Point Feature Station Offset Elevation Report**



19. At the prompt **Locate Baseline Element** select **Ramp 4 Baseline**

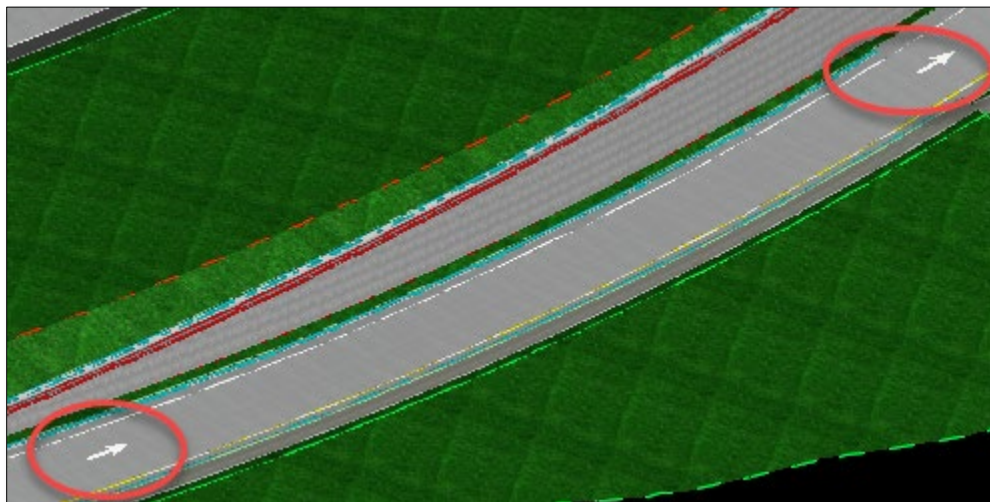
20. At the prompt **Locate First Offset Element** select the **3 Straight Arrows** and the **Left Turn Arrow**.



21. **Right Click** to reset and automatically open the report

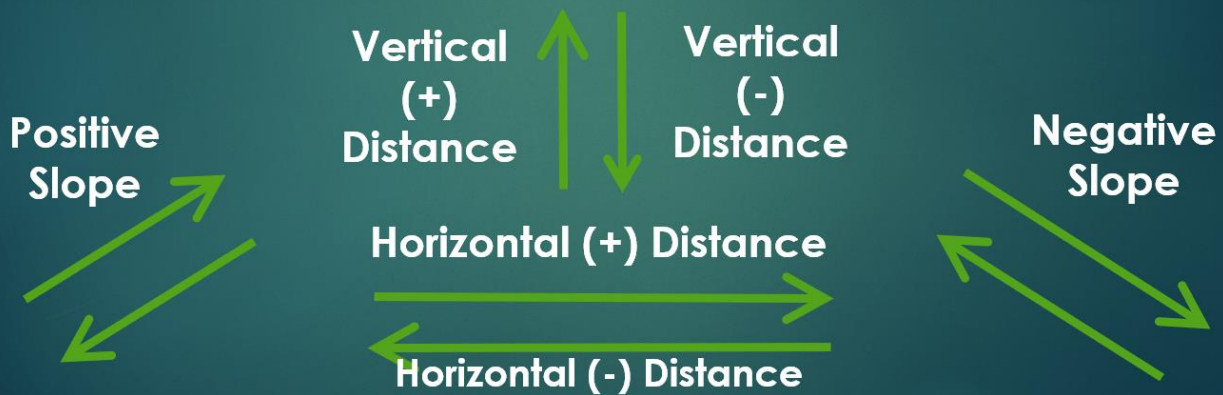
Station Offset Elevation Feature Report					
Report Created: Wednesday, November 3, 2021 Time: 8:39:18 AM					
Project: Default					
Description:					
Baseline (Active) Alignment: Ramp 4					
File Name: c:\users\smithm6\pwise_local_development\d0334820\Corridors_Ramp-4_J5P3181.dgn					
Last Revised: 11/3/2021 08:35:16					
Input Grid Factor:			Note: All units in this report are in feet unless specified otherwise.		
Point	Description	Station	Offset	Elevation	Feature
Straight Arrow	Straight Arrow	0+50.000	-9.000	775.553	Point\Design\Design Standards\Pavement Markings\Straight Arrow
Straight Arrow1	Straight Arrow	2+50.000	-9.000	771.591	Point\Design\Design Standards\Pavement Markings\Straight Arrow
Straight Arrow2	Straight Arrow	4+00.000	-9.000	775.859	Point\Design\Design Standards\Pavement Markings\Straight Arrow
Left Turn Arrow	Left Arrow	4+50.000	-9.000	778.553	Point\Design\Design Standards\Pavement Markings\Left Turn Arrow

22. Zoom around the **3D Model** to view the Pavement Markings on the corridor



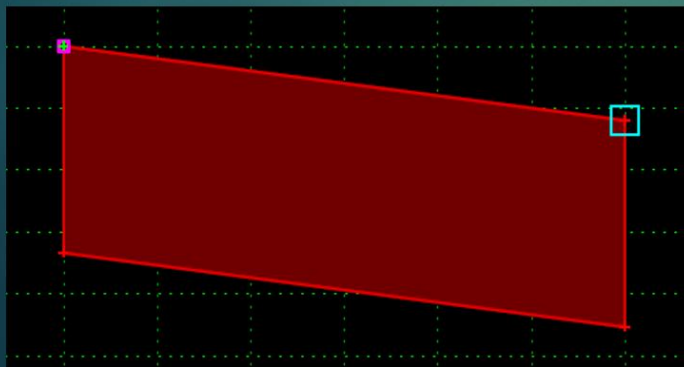
# Component Slopes and Distances

- ▶ Parent point is placed first
  - ▶ Child placed to the right of Parent is positive distance
  - ▶ Child placed to the left of Parent is negative distance
  - ▶ Child placed above the Parent is positive distance
  - ▶ Child placed below the Parent is negative distance
- ▶ Slope is algebraic slope



## Template Point - Hierarchy of Control

- ▶ Point Control - Highest
- ▶ Horizontal Feature Constraint
- ▶ Parametric Constraint
- ▶ Point Constraint - Lowest



The screenshot shows the 'Point Properties' dialog box. The 'Name' field is 'RT\_AsphSurf\_T\_EOP'. The 'Feature Definition' is '.\_res\Pavement\XS\_AsphSurf EOP'. The 'Alternate Surface' is 'Proposed Finished Grade'. The 'Member of' list includes 'Asphalt Surface Pavement' and 'RT\_A2 Shoulder Asphalt Surface'. The 'Constraints' section shows two constraints: 'Constraint 1' with 'Type: Slope', 'Parent 1: AsphSurf\_T\_CL', 'Parent 2: Rollover Values...', 'Value: -2.00%', 'Label: RT\_Pvmt\_Surf\_Asph\_Slo', and 'Horizontal Feature Constraint' checked; and 'Constraint 2' with 'Type: Horizontal', 'Parent 1: AsphSurf\_T\_CL', 'Parent 2: Rollover Values...', 'Value: 12.0000', 'Label: RT\_Pvmt\_Surf\_Asph\_Wi', and 'Horizontal Feature Constraint' checked. The 'Range' is '50.0000'.