FDOTConnect for OpenRoads Designer

Roadway Design 3-D Modeling

COURSE GUIDE

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State of Florida

Department of Transportation

FDOTConnect

for

OpenRoads Designer

Roadway Design

3-D Modeling

Course Guide

2024

PRODUCTION SUPPORT / CADD OFFICE

TALLAHASSEE, FLORIDA

http://www.fdot.gov/cadd

FDOTConnect

for

OpenRoads Designer

Roadway Design 3-D Modeling

Description

This is a 2-day training course to include fundamentals of 3D Modeling. Participants will continue to learn the Bentley OpenRoads Designer Connect Edition tools for design and modeling within the FDOTCONNECT WorkSpace. Several advanced concepts and technologies will be introduced including:

- Rule Based Superelevation Design Parameters
- Associating Template Points to Superelevation Lanes
- Constructing 3D Elements
- Building Intersection Terrains from 3D Elements
- Appling a Surface Depth to Terrain Elements
- Placing 3D Civil Cells
- Configuring Advanced 2D and 3D Civil Cells
- Corridor and Terrain Model Clipping
- Applying Linear Templates to 3D Elements
- Building DTM, XML Files for Construction Deliverables

Objectives

- Create a Superelevation Shape Model.
- Create Superelevation Sections and Lanes.
- Calculate and Assign Superelevation to a Corridor.
- Create an Intersection Terrain Model from 3D Elements.
- Create a Traffic Separator Nose Model on the Corridor Model.
- Create an Island Model on an Intersection.
- Apply Linear Corridors along 3D Elements.
- Create 3D Driveway on a Corridor Model.
- Create 3D Sidewalk Ramps on Intersection Model.
- Prepare the Files Necessary for Construction Deliverables.

Audience

- ***FDOT Roadway Designers and Engineers***

Prerequisites

Participants need to have a basic understanding of Computer Aided Drafting and Design (CADD) using MicroStation, a basic understanding of OpenRoads Designer Connect Edition concepts and a solid understanding of the engineering necessary to design a Roadway.

In addition to the above, the participant is required to complete:

FDOT Roadway Design and 2-D Baiscs.

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INTRODUCTION

This course was developed to introduce OpenRoads Designer CONNECT Edition - OpenRoads Technology tools for design and modeling on Florida Department of Transportation (FDOT) projects. The curriculum was developed within the FDOTCONNECT WorkSpace to provide sample exercises for most of the new Civil Tools on a sample project data set.

This training guide was developed with FDOTConnect10.12. Any reference to FDOTConnect within this document should indicate either FDOTConnect10.12 or the currently supported FDOTConnect version.

COURSE OBJECTIVES

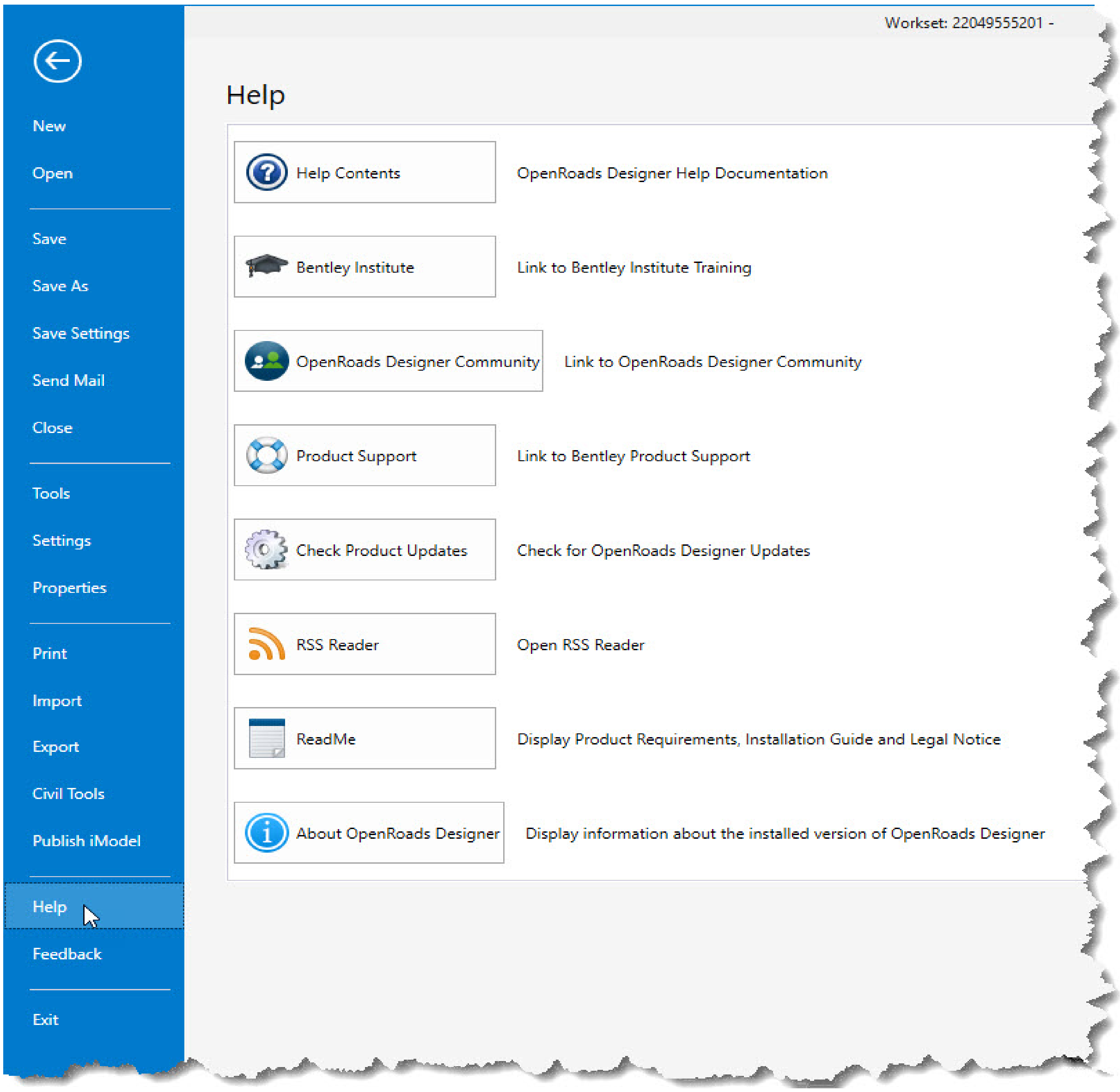
Participants of this course will be introduced to the newest OpenRoads Technology and a Workflow for designing two dimensional (2D) Plans, Profiles, Cross Sections and three dimensional (3D) Models for Construction Deliverables. At successful completion they will have learned how to:

- Create a Terrain Element from the existing surface to be used as a reference for the project.
- Develop Existing Feature Terrain Surfaces to be shown on cross sections and used in earthwork calculations.
- Use Civil Geometry Elements in the design file to calculate and define a proposed centerline of construction and while using the built in Design Standards Criteria checking.
- Use Civil Geometry Elements in the design file to define the roadway features of the proposed design.
- Apply Civil Cells delivered within the FDOTCONNECT Civil Cell DGN library.
- Use Civil Geometry Elements in the design file to define the vertical profiles of a proposed centerline.
- Use the Standard Components and Templates within the FDOTCONNECT Template library.
- Create a 3D Model of the existing and proposed Roadways.
- Reference 2D Civil Geometry Elements to a Corridor Model by adding the elements for use as design model control lines.
- Apply varying Typical Section conditions along the project, including: variable medians, special ditches, handrail checks, gravity wall placement, slope conditions, left and right turns, etc.
- Define the Superelevation Standards along a corridor.
- View Dynamic Cross Sections for review, updates, and design checks along the project before cross sections are created for printing.
- Create and display 3D Models for better designing and visualization.
- Use the Milling Overbuild and Overlay Components on a project corridor.
- Apply Corridor Modeling Techniques used for developing driveways and intersection, etc.

EXPECTATIONS – WHAT THIS COURSE PROVIDES

This course provides a standard workflow for designing a project with Bentley Systems OpenRoads Designer CONNECT Edition - OpenRoads Technology within the FDOTCONNECT WorkSpace. Although the majority of tools are used throughout, this course does not provide a description of every Bentley Systems OpenRoads Designer CONNECT Edition - OpenRoads Technology Civil Tool. Integrated help for each of the tools can be found by selecting FILE then going to the backstage and selecting Help to bring up Bentley's ONLINE HELP or from the Ribbon pick the HELP icon.

FILE>HELP



DOCUMENT STYLE

Style conventions used throughout the course guide are shown in the following table.

Item	Convention	Example
Menu names, Commands, and Ribbon Navigation	Bold (Names separated with > symbol)	• General form is **Workflow > Tab > Group > Tool** • **File > Open** • **File > Settings > User > Preferences** • **OpenBridge Modeler > FDOT > Actions > Create File**
Dialog actions	Bold	• Click the **Apply** button. • Click the **Graphic Select** button to the right of the *Horizontal Alignment Include* box.
Dialog field names	Italic	• Key in **Hemfield Road** in the *Alignment Name* field. • Click the **Graphic Select** button to the right of the *Horizontal Alignment Include* field.
Key-ins	Bold	• Key in **Hemfield Road** in the *Alignment Name* field.
File names	Italic	• Open the file *Working Graphics.dgn* in the C:\Bentley Training\GEOPAK 101\Project Setup\Practice\ folder.
File paths	Not Italic or Bold	• Open the file *Working Graphics.dgn* in the C:\Bentley Training\GEOPAK 101\Project Setup\Practice\ folder.

FILE TYPES

The Bentley Systems OpenRoads Technology road design process uses a single source file type, the *DGN* file. All pertinent design data is stored in the design file. This information can be viewed through the Project Explorer and reported on in the Civil Report Browser.

Below is a brief description of some file types which can be imported or exported **(i/o)** with OpenRoads Technology.

File Type Description:

- ***Surface.tin (i/o)*** - A binary file, also known as a GEOPAK digital terrain model (DTM),that stores features made up of random points, break lines, and boundary data along with triangulated surface model. The features and the triangles together represent an existing ground surface.
- ***Surface.xml (i/o)*** – A text based file, LandXML format, which stores civil data such as surfaces, breaklines, or horizontal and vertical alignments
- ***Surface.dat (i)*** - A binary (or ASCII) file containing string and point information that is used for digital terrain model construction.
- ***Surface.dtm (i/o)*** – A binary file, also known as a Roadway Designer digital terrain model that stores features made up of components, break lines, and boundary data along with triangulated surface model. The features and the triangles together represent either existing ground surface or the proposed roadway corridor model.
- ***Template Library.itl (i)*** - Stores templates and template components. Different components can be assembled to build templates, which define the typical sections of a roadway. Only one Template Library file may be open for editing at a given time.

LEARNING RESOURCES

There are several resources available for learning about the various Bentley Systems OpenRoads Designer CONNECT Edition OpenRoads Technology tools. Among them are:

Bentley Communities:

https://communities.bentley.com/products/road___site_design/w/road_and_site_design__wiki/33435/openroads-designer

http://communities.bentley.com/products/road___site_design/w/road_and_site_design__wiki/7021.openroads-support-clips-technotes-faqs.aspx

Bentley Learn:

Bentley Institute site is for registered user and may require a Select Server site license to participate: https://learn.bentley.com

Bentley Product OpenRoads:

Videos are available on a variety of topics: https://www.Bentley.com

YouTube:

Bentley OpenRoads Videos are available on a variety of topics: http://www.youtube.com/user/BentleyCivil

YouTube Search - Google:

Bentley OpenRoads returns several sites with videos for learning how to apply the technology on project specific situations.

Production Support Office | CADD (CADD) Website: http://www.fdot.gov/cadd/

Webinar training recordings are available on many of the subjects covered in this manual:

http://www.fdot.gov/cadd/main/FDOTCaddTraining.shtm

http://www.fdot.gov/cadd/downloads/webinars/Posted.shtm#loadSection

https://www.youtube.com/channel/UCqbY8kqZuXp1pyYV6IlQw_A

COURSE SUPPORTING FILES

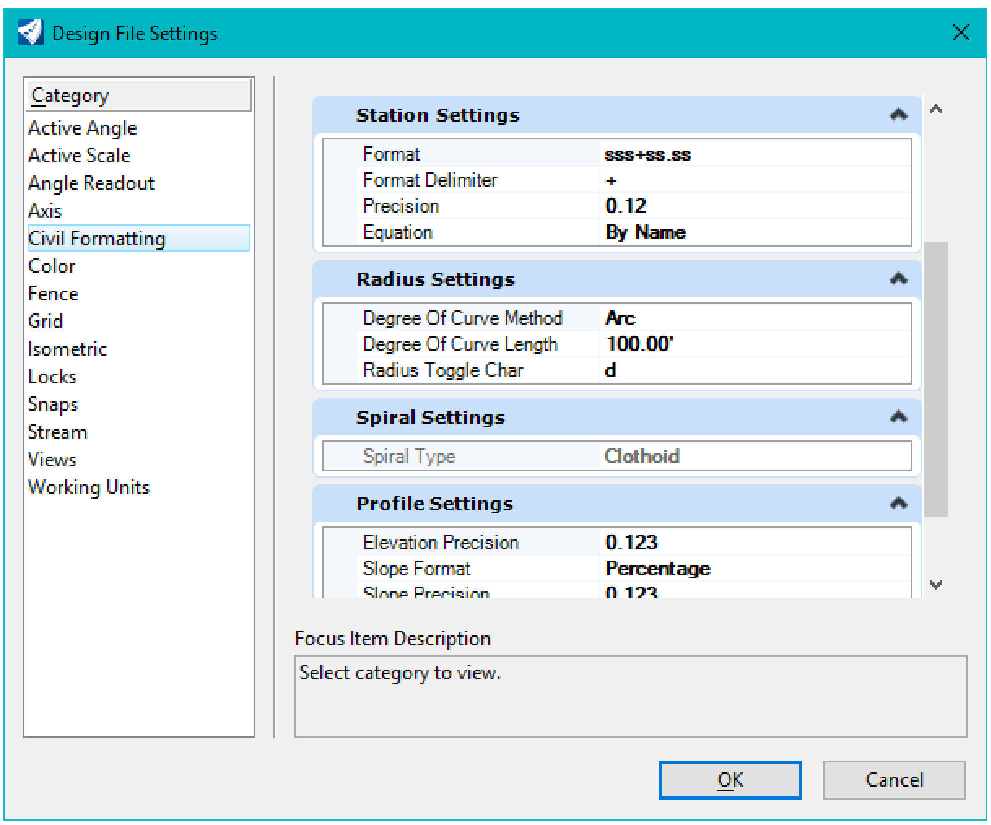
The exercises for each chapter are independent of one another and can be used without having to complete the exercises in previous modules. A Training_Files folder is provided in each of the discipline folders of the dataset which contain completed files for each chapter. All files used in this course are located also at this link:

https://www.fdot.gov/cadd/downloads/documentation/fdotconnecttraining/fdotord/fdotconnect-roadway-design-3d-modeling

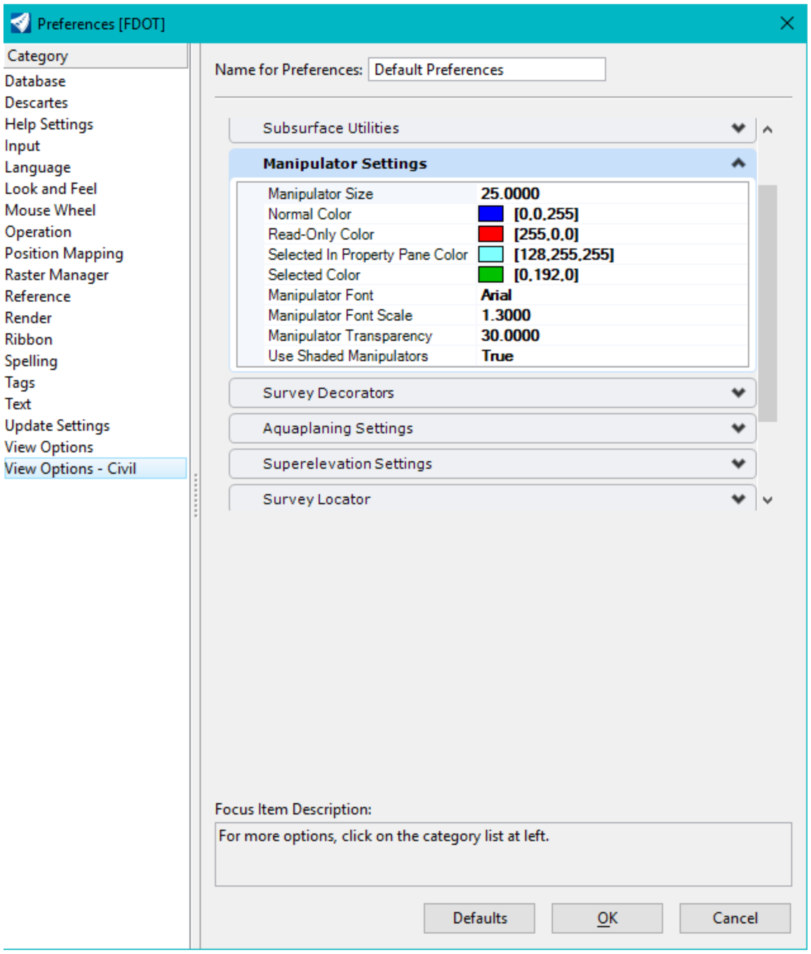
INTRODUCING A NEW WORKSPACE

FDOTCONNECT PREDEFINED SETTINGS

DESIGN FILE SETTINGS:

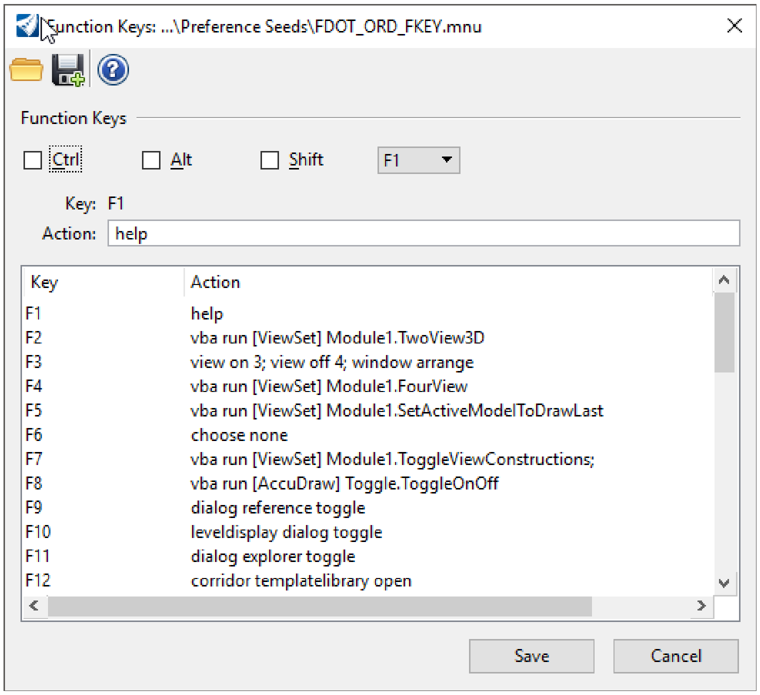


FDOTCONNECT WORKSPACE PREFERENCES:

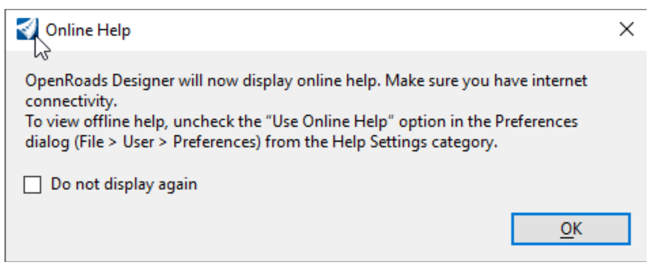


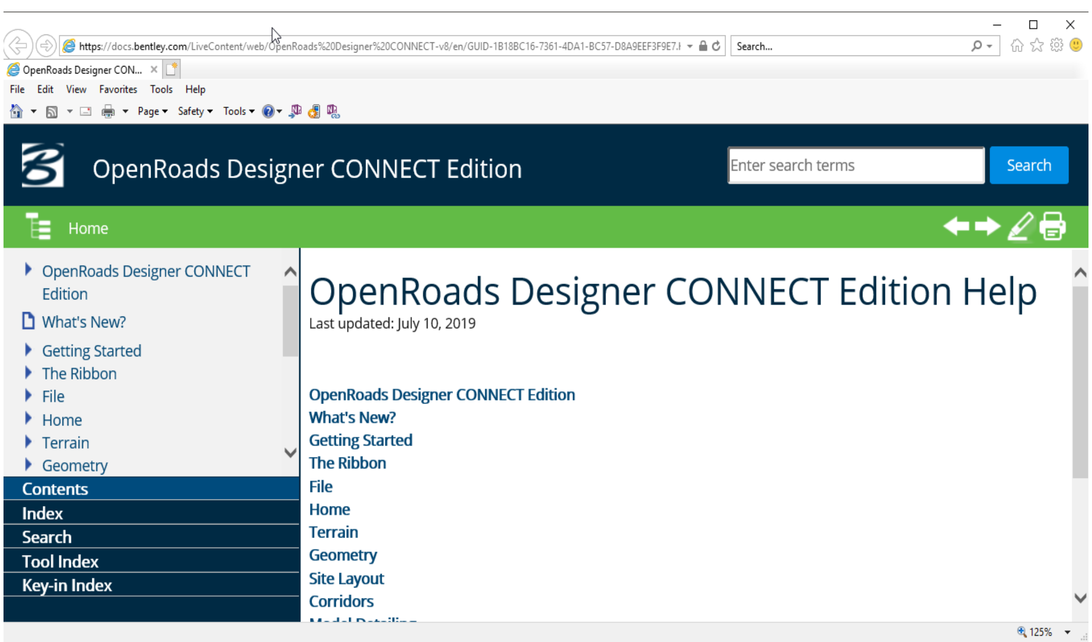
FDOTCONNECT FUNCTION KEYS

FDOTCONNECT Function Key Assignments	
F1	Opens the OpenRoads Designer OnLine Help. Ctrl+F1 Closes all Views except View 1
F2	Open View 1 (2D Plan) and View 2 (3D Isometric) and fits both views.
F3	Opens View 3 (2D Plan), closes all View 4, and arranges all Views.
F4	Open View 1 (2D Plan) , View 2 (3D Isometric), View 1 (2D Plan), View 1 (2D Plan) & Fits All views
F5	Toggles Dim References ON/OFF
F6	Resets out of any ongoing commands.
F7	Toggles the Construction view attribute ON/OFF.
F8	Toggles between MicroStation AccuDraw and Civil AccuDraw.
F9	Toggles (opens or closes) the Reference dialog.
F10	Toggles (opens or closes) the Level Display dialog.
F11	Toggles (opens or closes) the Project Explorer dialog.
F12	Opens the Create Template dialog.

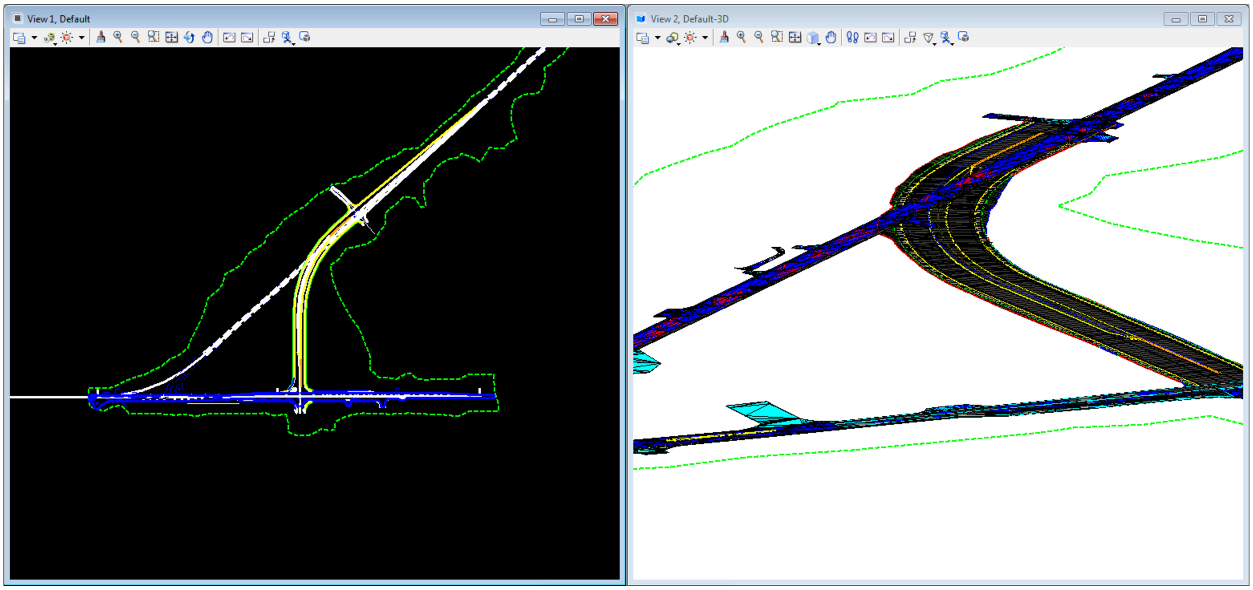


Function Key F1 – Civil Help

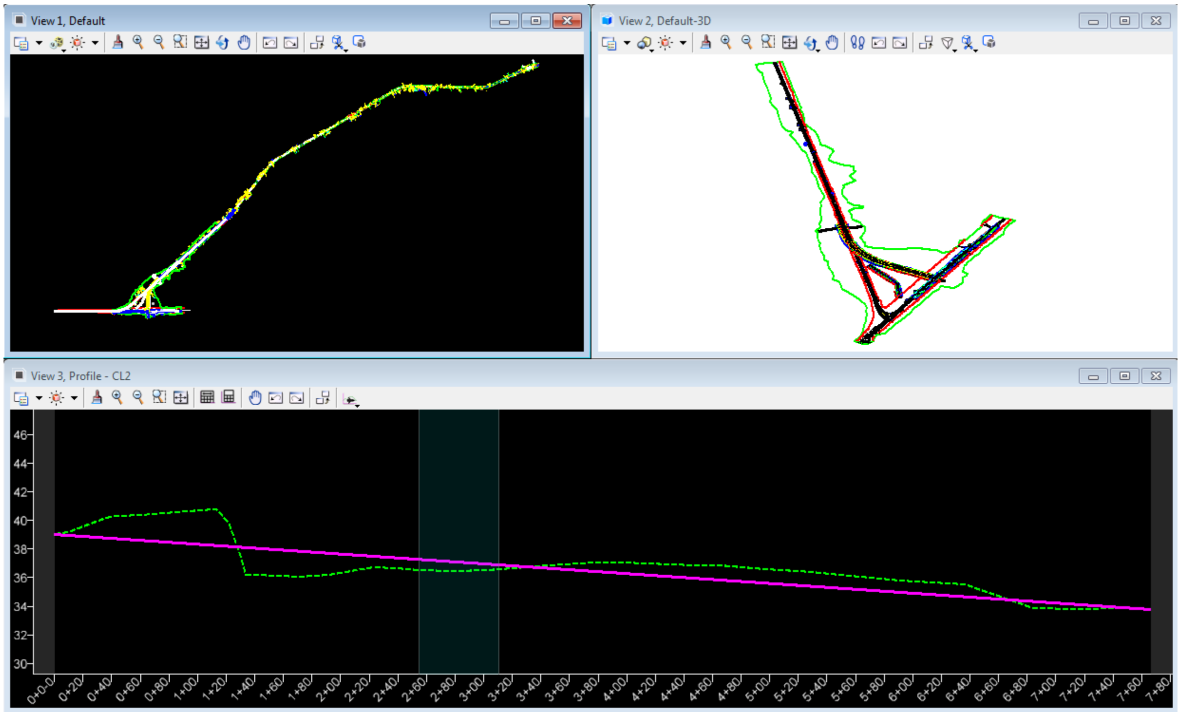




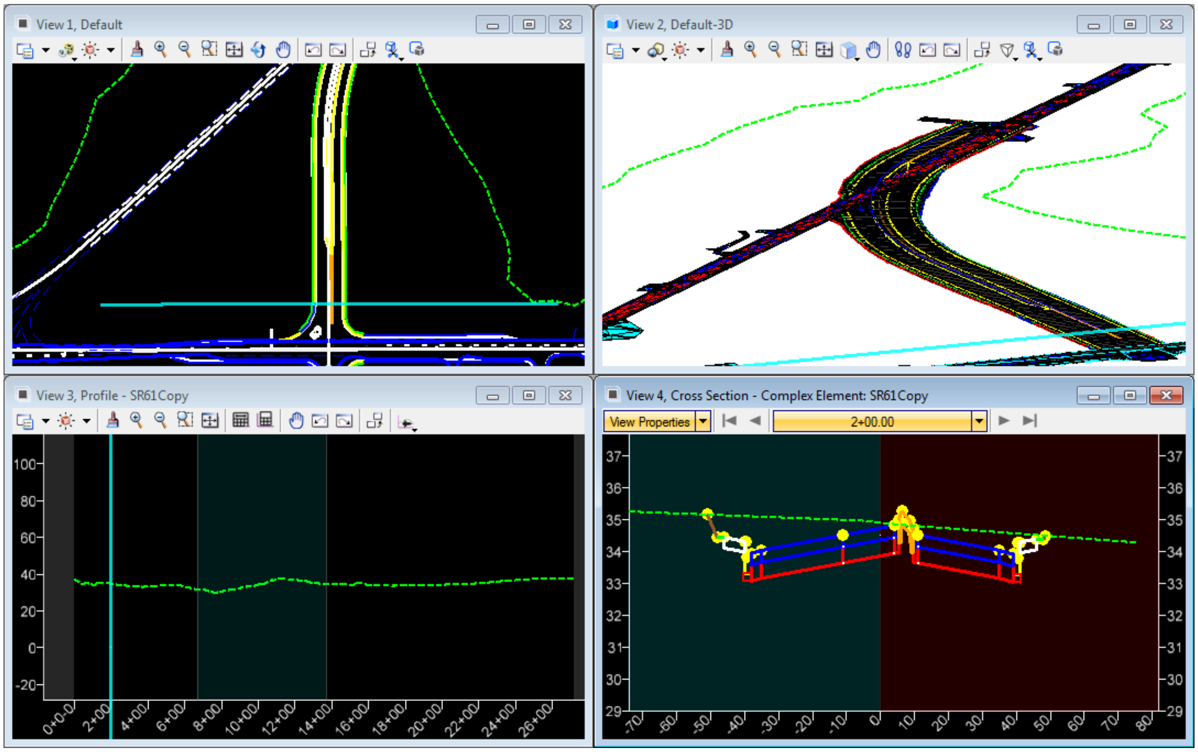
Function Key F2 – Open and Fits Two Views Setup; View 1- 2D Plan, View 2-Isometric.



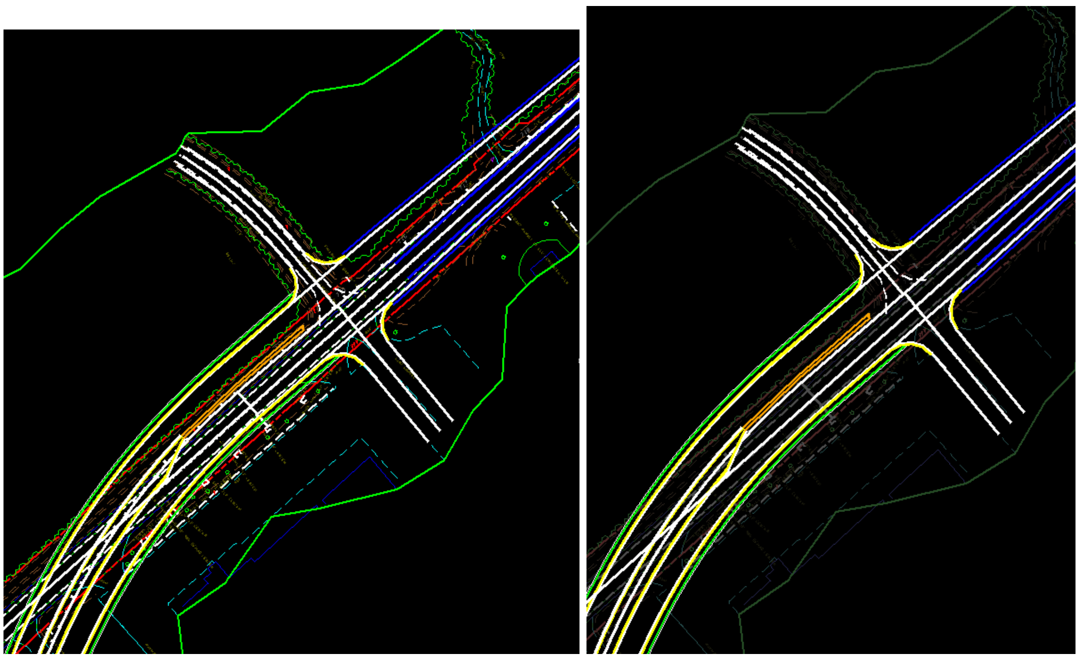
Function Key F3 – Opens View 3; Closes View 4 and Arranges Views.



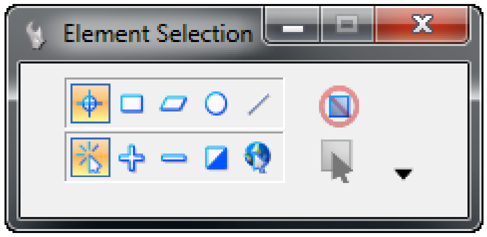
Function Key F4 – Opens and fits Four View Setup; View 1- 2D Plan, View 2-Isometric, View 3,4 - custom.



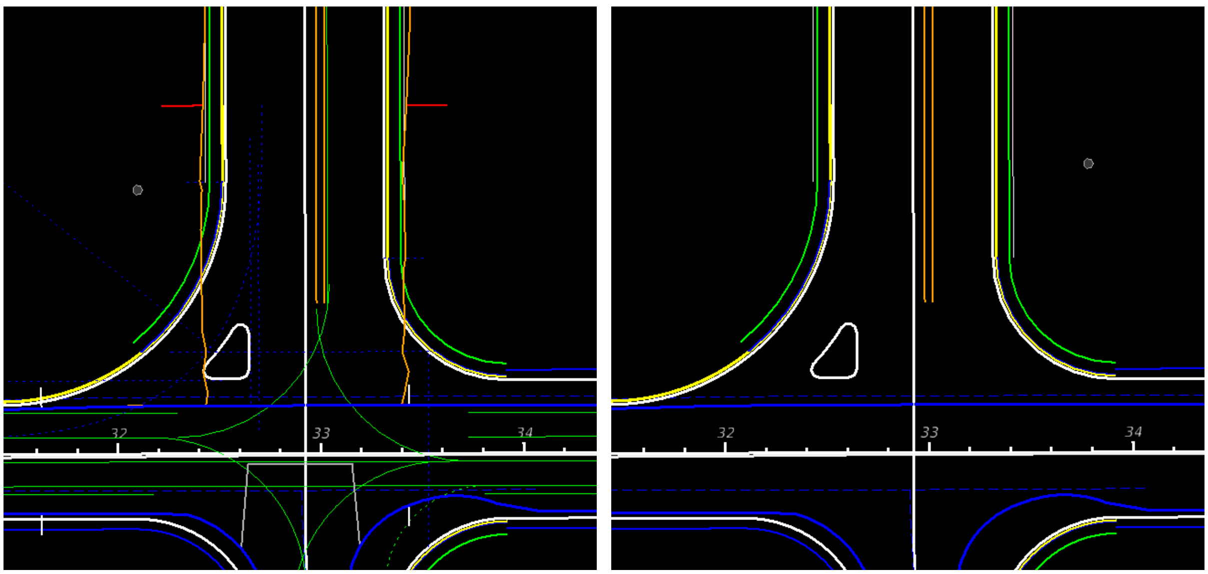
Function Key F5 – Toggle Dim References.



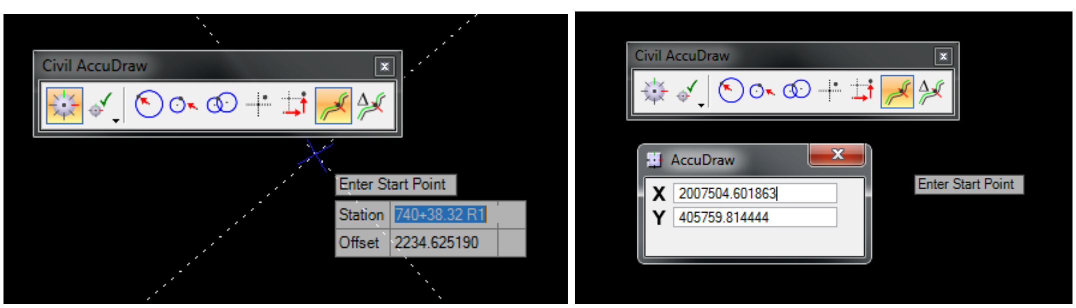
Function Key F6 – Resets Out of Any Ongoing Commands.



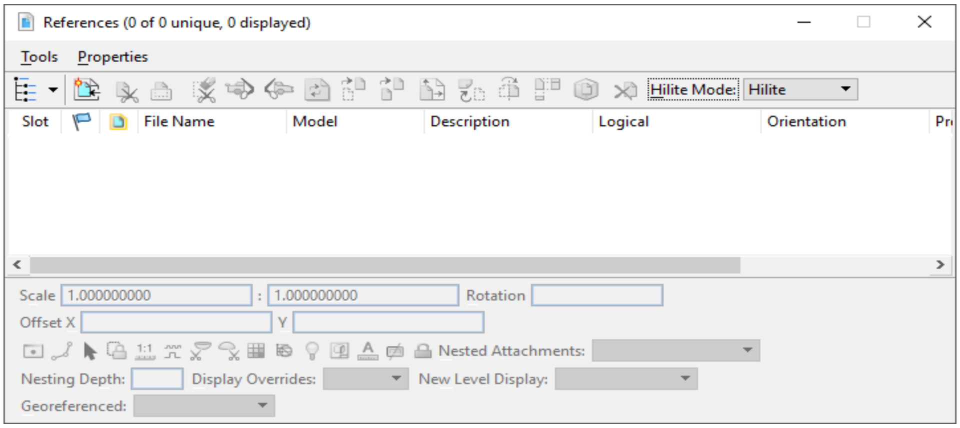
Function Key F7 – Toggles On/Off Construction View Attributes.



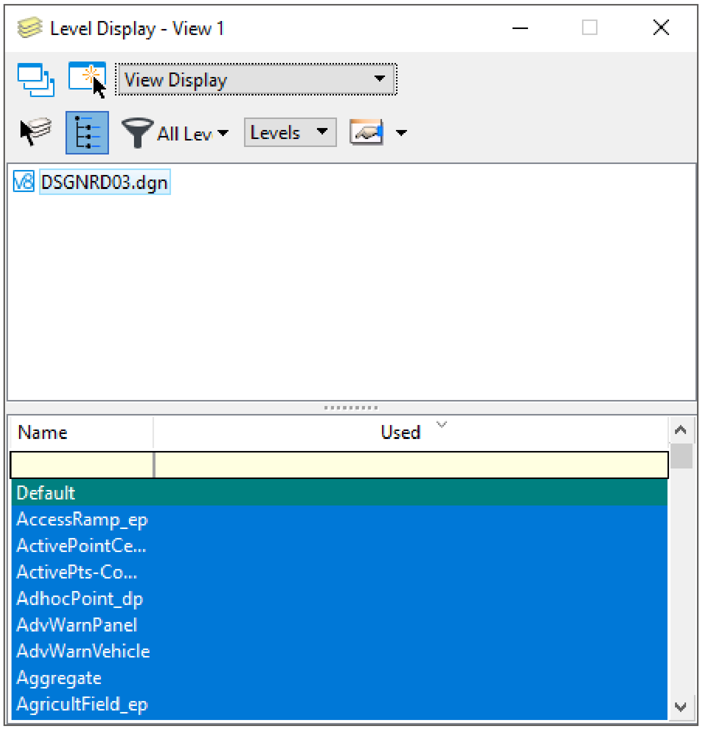
Function Key F8 – Toggles Between MicroStation AccuDraw and Civil AccuDraw.



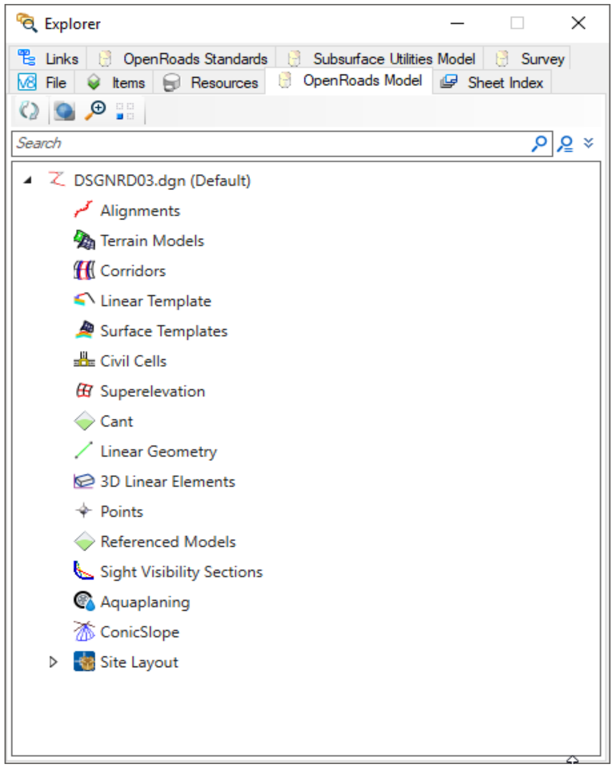
Function Key F9 – Toggles *References* Dialog Open\Close.



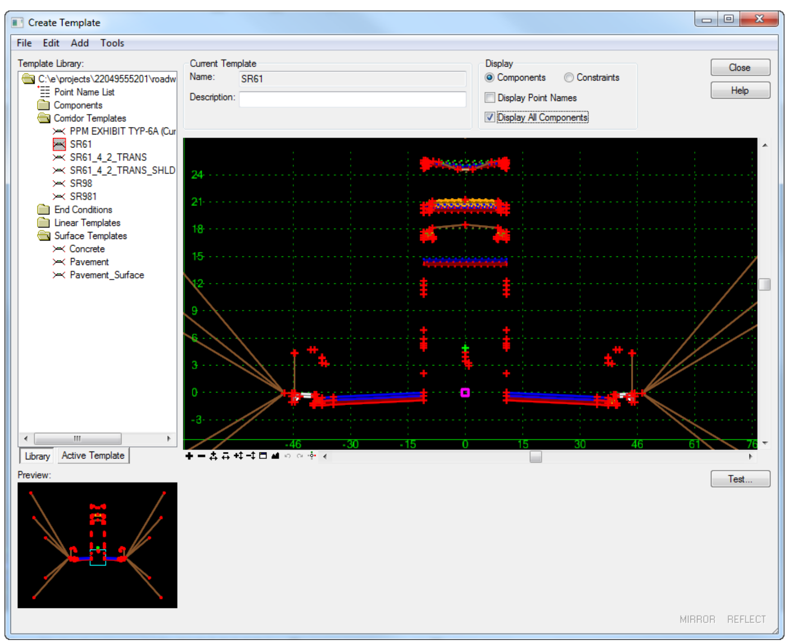
Function Key F10 – Toggles *Level Display* Dialog Open\Close.



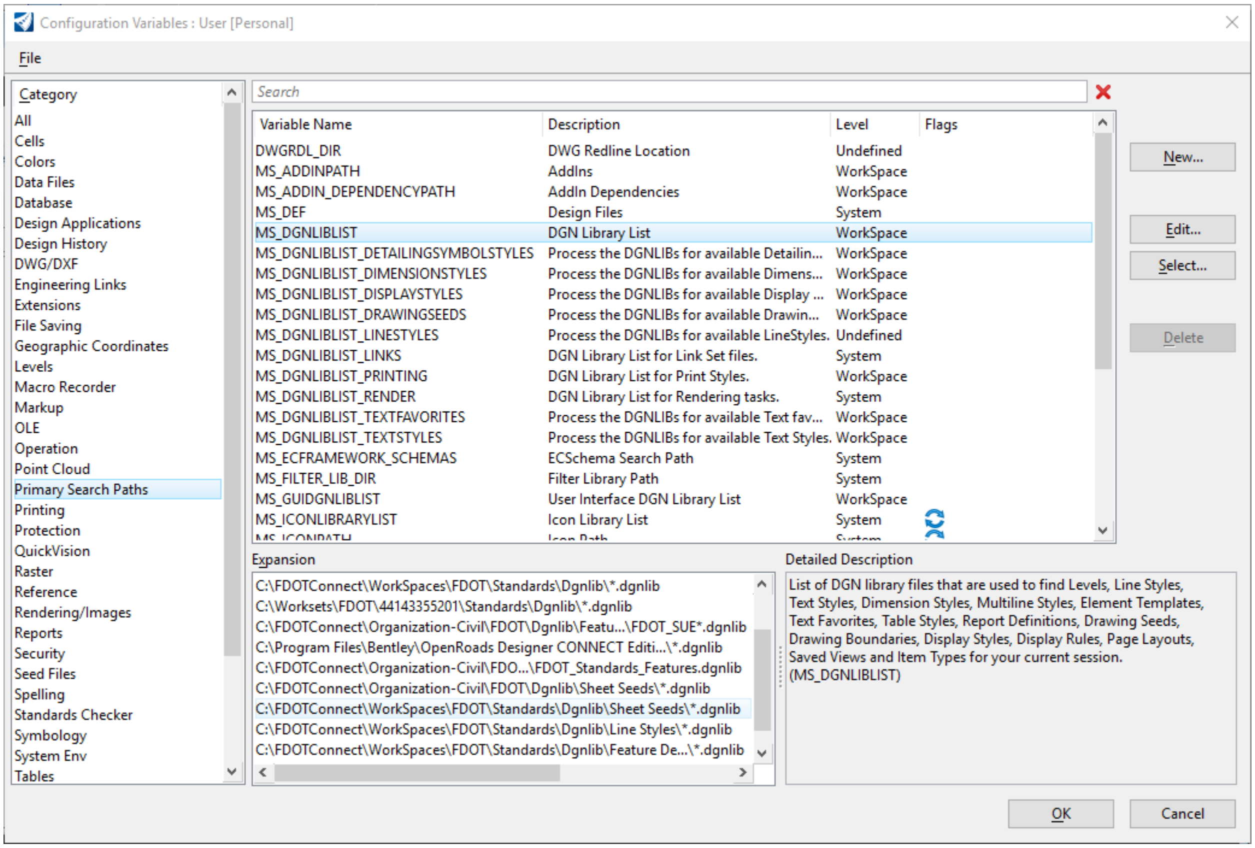
Function Key F11- Toggles *Explorer* Dialog Open/Close.



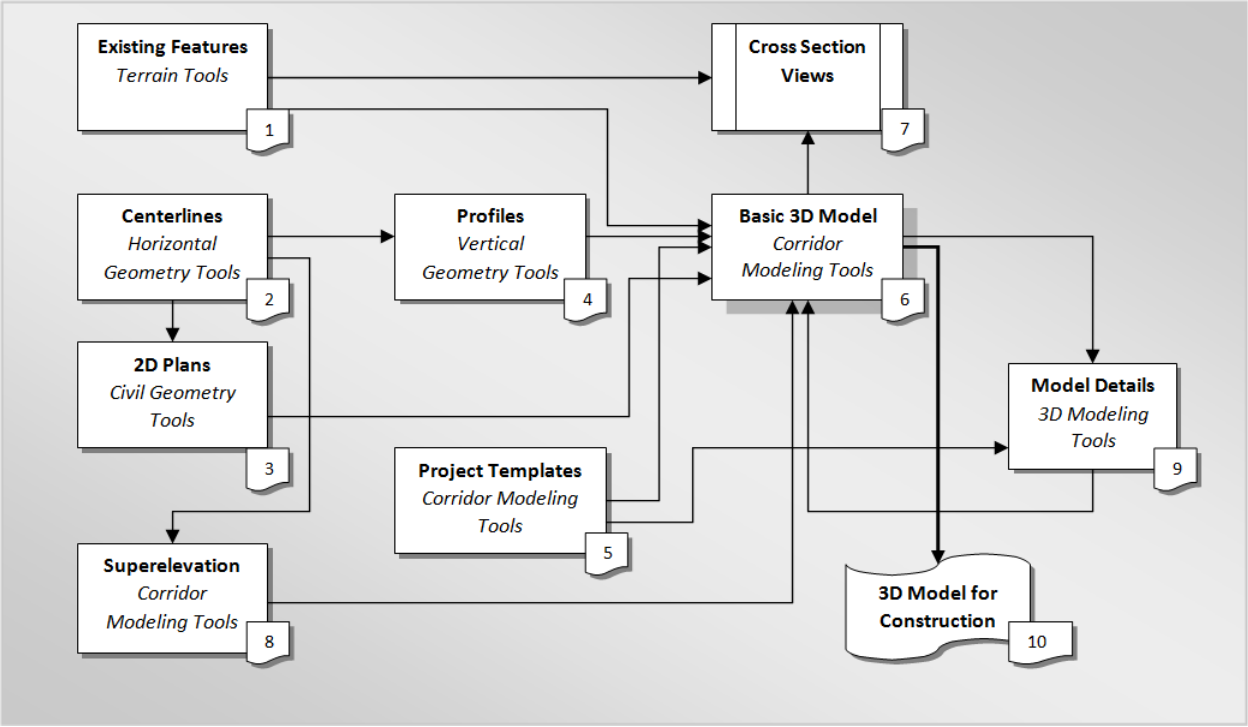
Function Key F12- Corridor Modeling, Opens *Create Template* Dialog.



FDOTCONNECT USER CONFIGURATION VARIABLES



FDOTCONNECT DESIGN AND 3D MODELING OVERVIEW



GENERAL WORKFLOW AND CHAPTER OUTLINE

1. Existing Terrain and Existing Features
2. Design Centerlines Alignments
3. Prepare 2D Plan Layout
4. Design Profiles
5. Define Project Templates
6. Create 3D Design Model and add 2D References
7. Create Cross Section View
8. Define Superelevation and Assign to the Corridor Model
9. Detail Modeling for Intersections, Median Traffic Separator Nose, Side Roads, Driveways, Curbs Ramps, etc.
10. Prepare Construction Deliverables

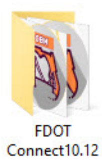
RECOMMENDED MICROSTATION SETTINGS

Various tools and settings will be used throughout the workshop. Therefore, for quick accessibility, several of the dialogs are better docked on the sides the MicroStation view.

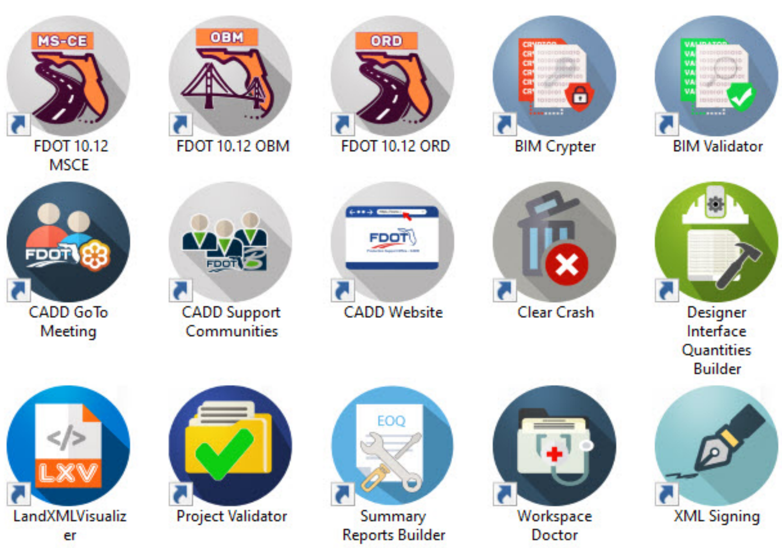
LAUNCHING FDOTCONNECT FOR OPENROADS DESIGNER

FDOTConnect can be launched from the icons located in the FDOTConnect folder on your desktop. The first time it is launched, it is important to select the Custom Configuration and the FDOT WorkSpace from the WorkSpace dropdown.

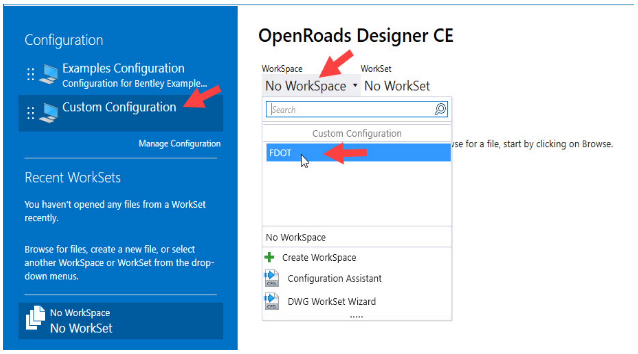
1. Find the FDOTConnect launch icons on your desktop or locate the FDOTConnect folder on your desktop.



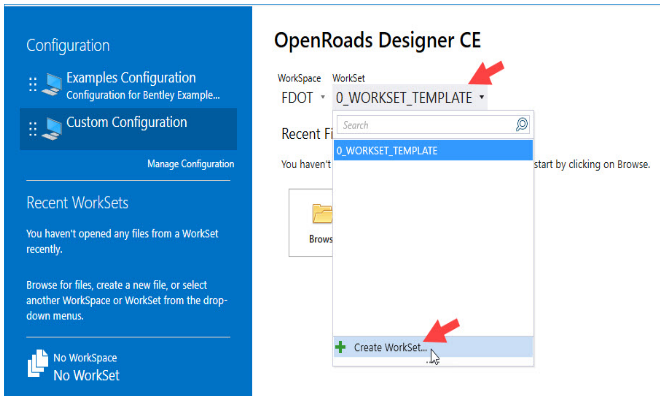
2. Launch FDOTConnect for OpenRoads Designer by double-clicking one of the FDOT icons. Note that your FDOTConnect launch icons will vary depending on which Bentley Connect Edition platforms you have installed. FDOTConnect will create an icon for OpenRoads Designer, an icon for Microstation Connect Edition (MSCE), and an icon for OpenBridge Modeler (OBM) depending on which of these applications is present on your machine during installation of the Workstation or Client.



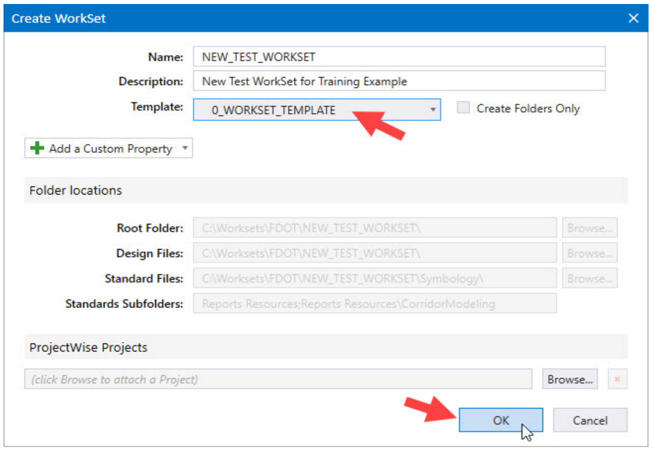
3. In the Configuration section, select *Custom Configuration*, then in the *WorkSpace* drop down menu, select *FDOT*.



4. From here, you can now create a new WorkSet, this is done by selecting the *WorkSet* drop down menu, and select **Create WorkSet.**

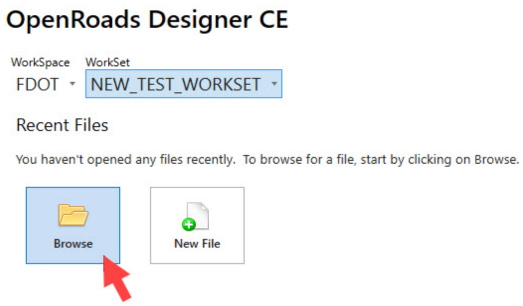


5. Give the new *WorkSet* a *Name* and *Description* and be sure to select the **0_WORKSET_TEMPLATE** as the WorkSet Template. Click "**OK**" after filling in the *Create Workset* dialog.

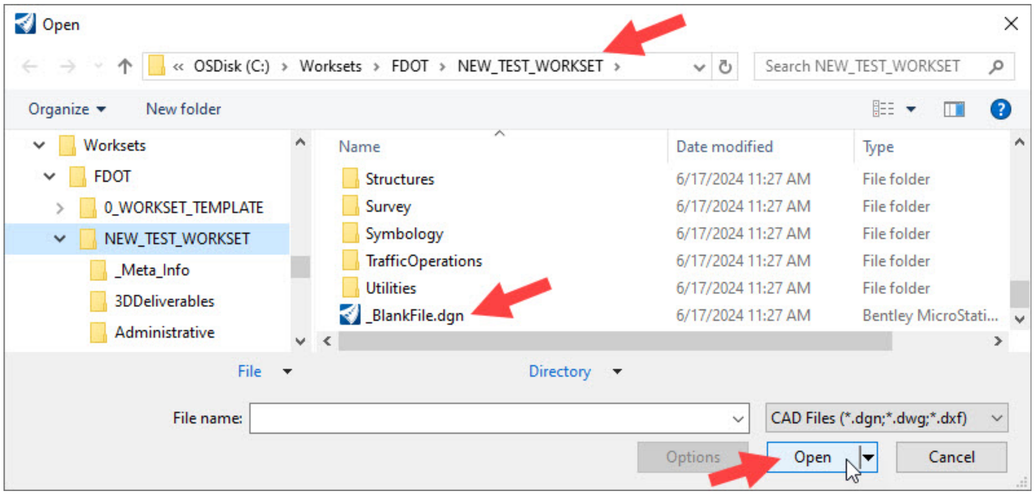


6. After creating a new project using the FDOT Workset Template, you can create new files using the **FDOT Create File** tool. This tool is launched from within the FDOTConnect WorkSpace, so you must first open a file. The FDOT WorkSet template includes a blank starting file from which to launch the **FDOT Create File** tool.

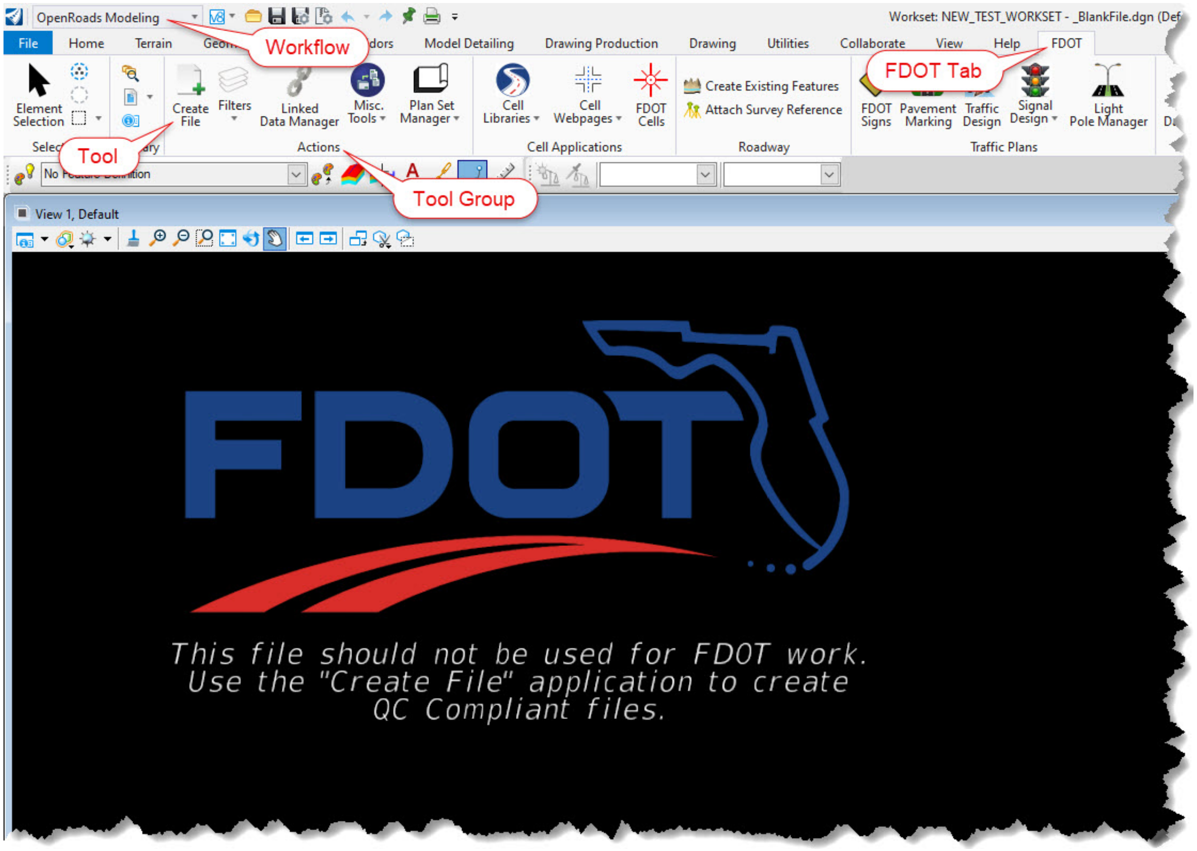
7. From the OpenRoads Designer file *Open* dialog, select **Browse** to browse the contents of your new WorkSet.



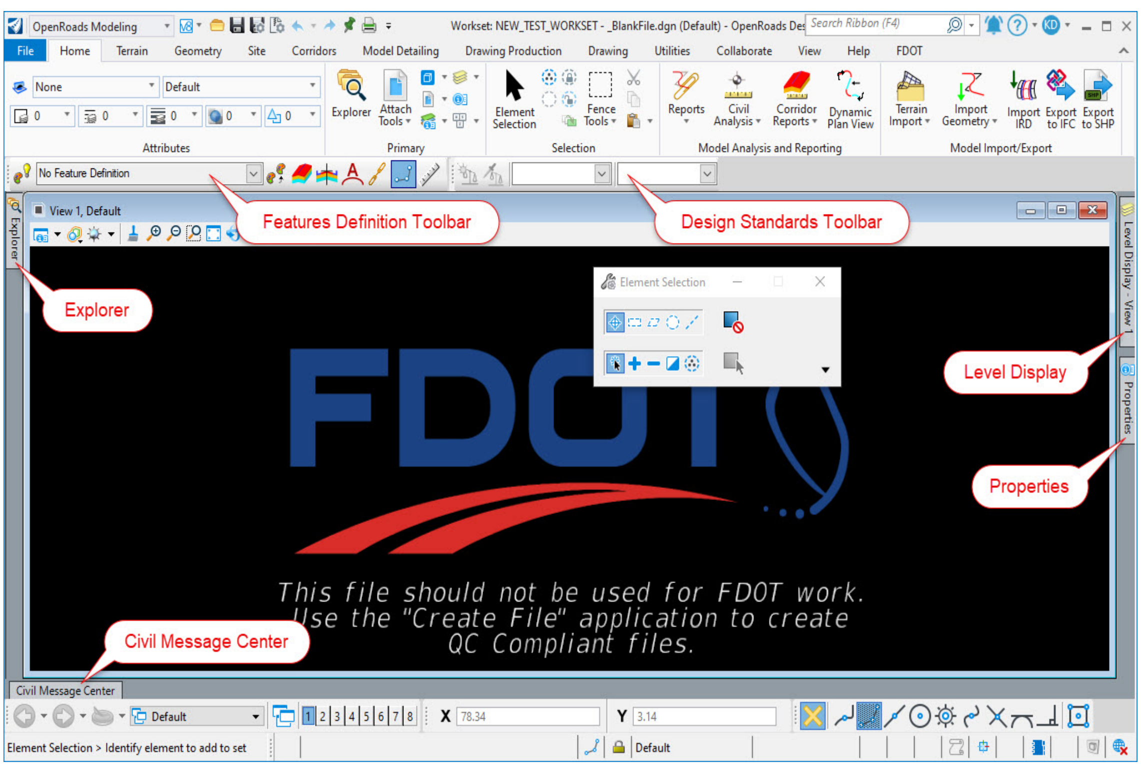
8. Locate *_Blankfile.dgn* at the root of your WorkSet folder structure. Select this file and then select **OPEN** to open it.



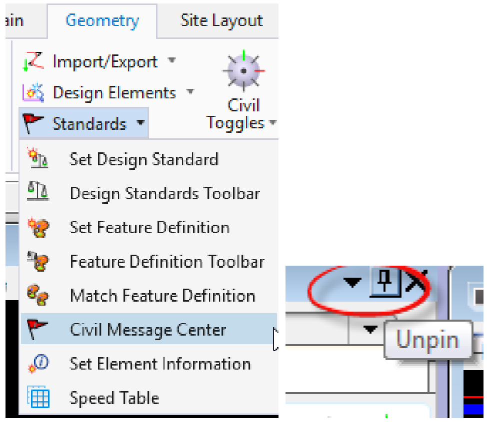
9. When the file opens, you can locate the FDOT ribbon by selecting the *OpenRoads Modeling* workflow from the drop-down menu at the top left of the screen. The **FDOT** tab is located at the far right of tab row. Select **Create File** to launch the **Create File** tool from the *Actions* tool group for creating FDOT project files.



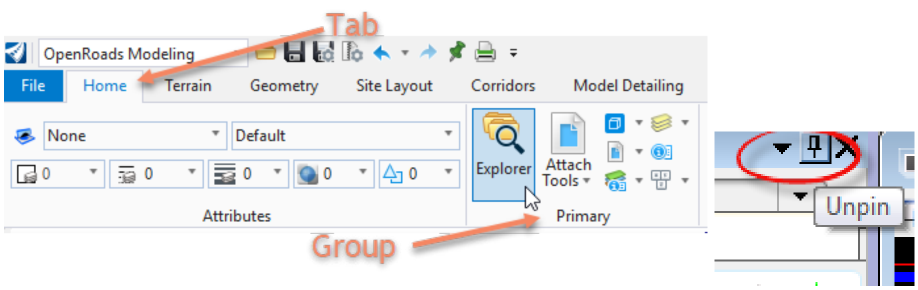
MENU DOCKING



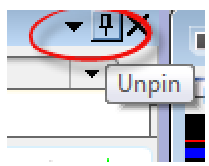
1. Verify that the *Civil Message Center* tool is already docked on the bottom; if not, select it from the *General Geometry Task* group, dock and unpin.



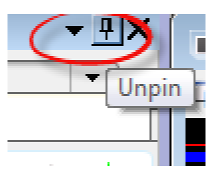
2. Verify that the *Explorer* is docked on the left side; if not, from the Ribbon select the *Home* tab then in the group named *Primary* click on the **Explorer** icon…Or use the F11 function key to toggle ON/OFF the dialog.



3. Verify that the *Level Display* is docked on the right side; if not, from the FDOT-Function Keys press F10, dock and unpin.



4. Verify that the *Properties* is docked on the right side; if not, this can be brought up by selecting Ctrl+I , dock and unpin.



5. Many of the dialog settings are stored in user preferences defined in xml data files located in the users data folders i.e. C:\Users\rd964vd\AppData\Local\Bentley\OpenRoadsDesigner\10.0.0\prefs.

1 TEMPLATE DESIGN

OVERVIEW

The Create Template command generates the transverse geometry that is central to roadway design. A template comprises a series of points and components that represent break line features that are processed using Corridor Modeling commands. Roadway features that have been processed are saved to the design surface. Templates are stored in a template library (**.itl)*.

TEMPLATE BASICS

- The FDOTCONNECT WorkSpace provides an extensive Template Library.
- FDOTCONNECT Templates closely follow CADD Manual, FDM and FDOT Design Standards and should be used to start a project.
- FDOTCONNECT Templates are designed from the FDM typical sections of the proposed roadway.
- FDOTCONNECT Templates are stored in the *CIVIL FDOT ORD.itl*.
- The CIVIL FDOT ORD*.itl* Templates have Features, Point Names, Component Names, Parametric Constraints and Display Rules which follow a standard naming convention.
- A project specific Template Library is created and CIVIL FDOT ORD.itl file templates are copied to that library and are modified to meet the specific needs of the project.
- New and modified templates should adhere to the template standards of the CIVIL FDOT ORD*.itl* file.
- When applied to a Corridor, templates are written to the design file and can be edited within the file.
- Once templates are in a design file, they can be copied to another Project Template Library or design file.

APPLYING TEMPLATES

- Templates create a model of the proposed roadway.
- Template points generate longitudinal break line features in the model.
- Templates are used to create a proposed model of the roadway.
- Templates are assigned to specific stations along an alignment at a specific interval, which are called template drops.
- When a corridor is processed, the points of the template drops are connected to form a model of the roadway.
- The connected template points also form longitudinal break line of the surface model.
- The model can be exported into a traditional surface Terrain model.

CREATE TEMPLATE DIALOG

The *Create Template* dialog is accessed from the **Corridor Modeling > Create Template** tool. To create or edit a Template Library, click the **Open Create Template** icon on the *Corridor Modeling* dialog. This displays the *Create Template* dialog.

The *Create Template* dialog is the primary place where templates are created and edited. This is also where templates are copied from a standard Template Library to a project Template Library using **Tools > Template Library Organizer**.

- User Definable Folder Structure
- Create Templates, Components and End Conditions
- Right-click Functions
- Copy and Paste, and Drag and Drop
- Red-colored Box Indicates Current Template
- Drag and Drop Components to Current Template Window

On the left side of the dialog, you will find the Template Library area, which contains a Windows-like folder structure. The root folder is the name and location of the Template Library that is currently open. Only one Template Library may be open at a time.

To navigate the folder structure, double-click the folders you want to open or close. Inside any folder you can create and organize your templates and subfolders. The organization of the folder structure is user definable. The folder structure also supports common Windows functions, such as drag and drop, cut and paste, etc.

Most commonly used commands can be accessed by right clicking on the folders and templates. If you double click a template, it becomes the Current Template and is signified by a red box around the Template icon. The Current Template is also identified in the Current Template area next to the Template Library area. To assemble or edit a template, it must be the Current Template.

CURRENT TEMPLATE WINDOW

- Templates Assembled and Edited
- Right-click To Create Components
- Double-click To Edit Points and Components
- View Commands Bottom of Window

In the center of the Create Template dialog is the main graph for creating templates. The graph is called the Current Template window. The Current Template window uses its own graphics engine and is not a MicroStation View. The scale of the graph is dynamic and changes as you zoom in and out.

The center point of the Current Template 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.

At the bottom of the graph there are numerous view commands, which are similar to MicroStation View commands. There are two buttons that look like the MicroStation View Previous and View Next commands, however, they are used to undo and redo template creation operations.

If your mouse has a scroll wheel, it can be used to pan and zoom. The CTRL-Z keyboard hot key will undo your last edit or creation. In the graph area you can right-click to access commands and you can double-click elements in the graph for editing purposes.

TEMPLATE PREVIEW WINDOW

- Previews Templates and Components
- Works on Non-current Templates
- Placement Point Location Denoted by a Cyan-colored Box
- Click Point to Move Placement Point Location
- Drag and Drop from Preview Area to Current Template Window

Under the Template Library area is the Preview area. When you highlight (single click) a template, the template is displayed in the Preview area.

You can use the Preview to assemble templates from their parts or components. This is accomplished using drag and drop functions. The cyan-colored box in the Preview represents the insertion point for any drag and drop operation. You can change the insertion point location by clicking the desired insertion point on the preview.

DYNAMIC SETTINGS

- Tools > Dynamic Settings Command
- Precision Input Template Points
- XY = Absolute Coordinates
- HS = Horizontal Delta Distance and Slope from Last Point Placed
- DL = Enter Delta Coordinates from Last Point Placed

The *Dynamic Settings* dialog is used for precision input of the template components and to assign point names and styles when creating components. It also serves as a compass for the location of your cursor with respect to the dynamic origin. The dynamic origin can be moved using **Set Dynamic Origin**, located at the bottom of the *Dynamic Settings* dialog.

The *Dynamic Settings* dialog is accessed by selecting the menu option **Tools > Dynamic Settings** or using the **View Control** icons located below the Current Template window.

The Key-in pull-down 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

COMPONENTS

- Components are Parts of the Template
- Curb and Gutter, Median Barrier, Pavement Layers, Cut and Fill, etc.
- Simply Drag and Drop Components Together to Create a Complete Template
- When Two Points Coincide, Heavy White Plus Sign Appears
- Existing Connection Point Name Override Dropped Point Name

Components are logical parts of a template. Portions of the template that are separated into components are normally based on tabulation considerations. Examples of components include curb and gutter, median barrier, pavement layers, cut and fill slopes, and ditches.

Components are normally kept in a separate folder in the Template Library and are used to assemble complete templates. Drag and drop the components to the Current Template window to create a complete template. When connecting two components, the connecting point will change to a white colored plus sign prior to placing the component. This is the indication that the points coincide. When the components are connected together, using drag and drop from the Template Library folders, any coincident component points will use the point names of the previously placed component. Template point names can be edited anytime during the creation process.

Components are normally created with point names that are not specific to being on the left or right side of the roadway. When they are used to create completed templates, prefixes and suffixes to the template points can be automatically added during component placement. Prefixes and suffixes are controlled using **Tools > Options** in the *Create Template* dialog and can be set and cleared in the *Dynamic Settings* dialog during placement using the *Apply Affixes* check box.

MERGING COMPONENTS

- Right-click Between the Components to Merge
- Select the Merge Components Command

When combining two components of a pavement section together, two separate components are produced with a vertical segment dividing them. To remove the vertical segment, position the cursor over the vertical segment and right-click. Then select Merge Components.

EXERCISE OVERVIEW

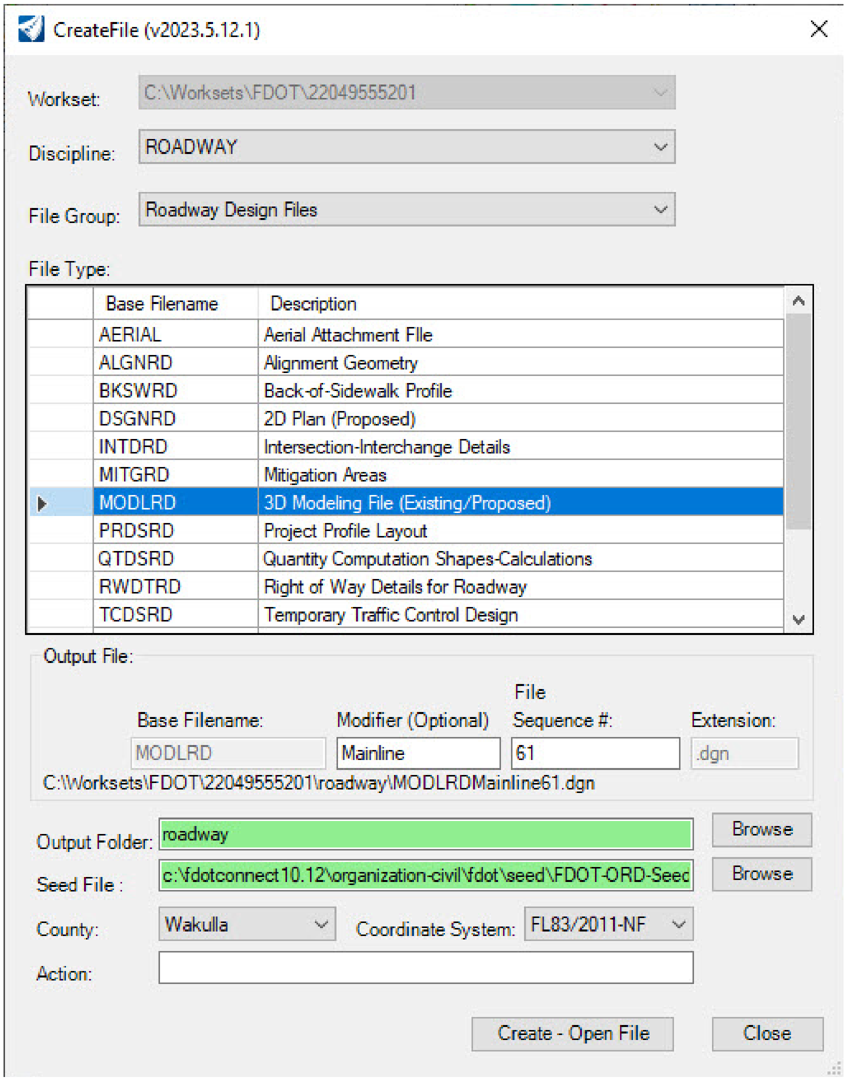
EXERCISE 1.1 *Create Template*

This exercise opens the proposed roadway 3D Model file, *MODLRDMainline61.dgn*, with Open Roads Technology and using the FDOTConnect WorkSpace and WorkSet configuration. The *Create Template* dialog displays and a new Template Library file created for the WorkSet in the WorkSet Roadway folder. This new project Template Library is the container for all the components and templates used to develop the design model for the project design.

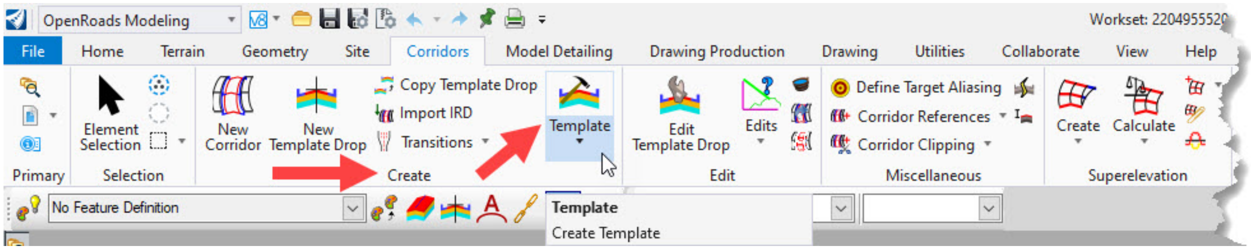
1. Open the *_BlankFile.dgn* file of the C:\Worksets\FDOT\22049555201 folder of the WorkSet.

2. Go to the FDOT ribbon and choose **Create File**.

3. Create a new *MODLRDMainline61.dgn* file. Select **Wakulla** County. Choose **Create/Open File.** If the file already exists, select **OK** to overwrite the existing file. *(See following page.)*



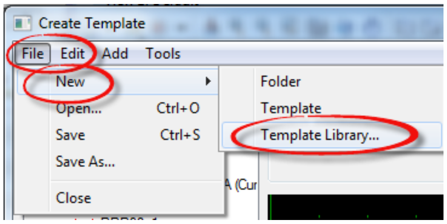
4. Navigate to the *Corridors* Tab of the Ribbon (in the *OpenRoads Modeling* workflow), then using the *Create* tool group select the **Create Template** icon to launch the **Create Templat**e tool.



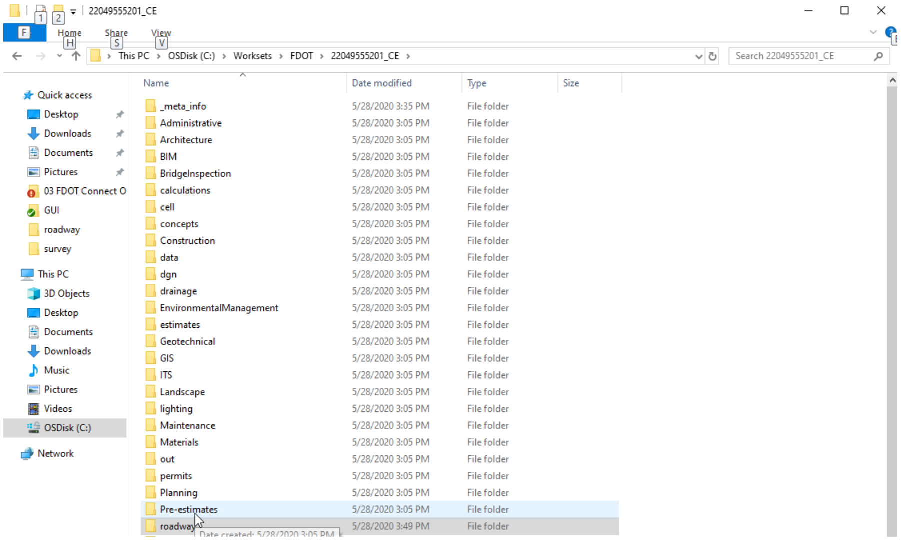
Hint: ***Use the F12 function key to access the Create Template Dialog***.

EXERCISE 1.2 *Creating a Blank Template Library (optional)*

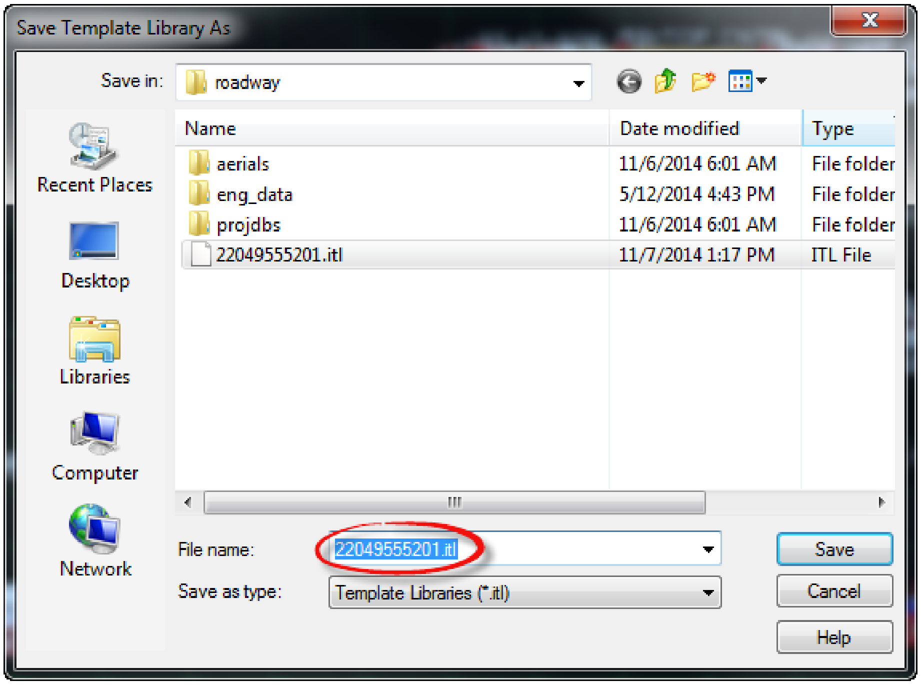
1. From the *Create Template* dialog select **File > New > Template Library**.



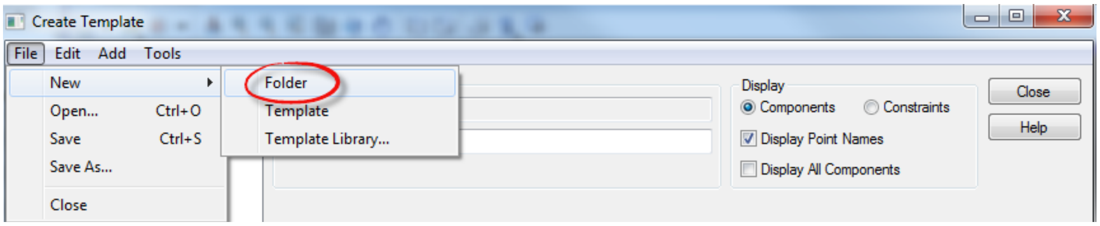
2. Navigate to the WorkSet Roadway folder, C:\Worksets\FDOT\22049555201\Roadway.



3. Enter the new *Template Library File Name*, **22049555201**. and click **Save**.

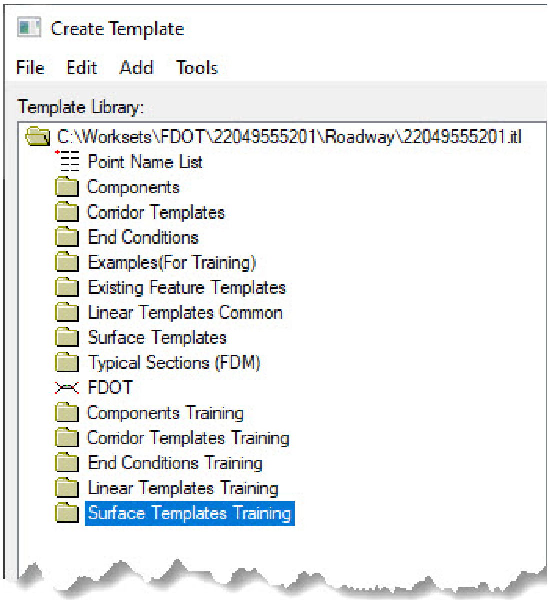


4. Create new folders in the Project Template Library.



5. Create and re-name five folders. Select the root folder and repeat steps to include all the following folders:

    - Components Training
    - Corridor Templates Training
    - End Conditions Training
    - Linear Templates Training
    - Surface Templates Training



6. Select **File > Save** to save the project Template Library .itl file.

EXERCISE 1.3 *Create Default Template Library*

- Components
- Corridor Templates
- End Conditions
- Linear Templates
- Surface Templates

The Components, End Condition, Linear Templates, Surface Templates folders contain parts of the full Templates and is obtained from the FDOTConnect Template Library.

The Corridor Templates folder contains the constructed templates for the corridor. The Project Templates in the exercises to follow are named and saved in stages or phases in order to track the progress of the design. This method is also recommended to provide a backup and/or history for potential trouble shooting along the way.

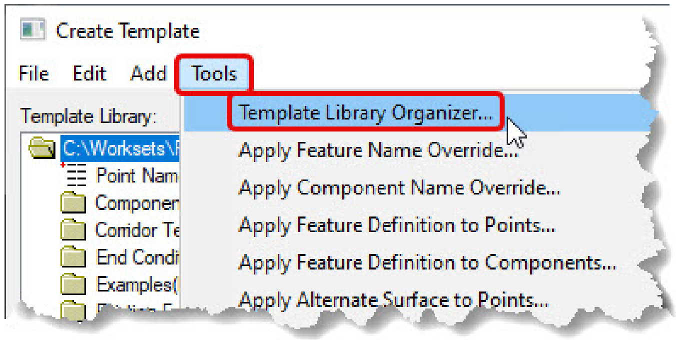
1. From the *Create Template* dialog, select **File > Open** and navigate to the FDOTConnect WorkSpace folder C:\FDOTConnect10.12\Organization-Civil\FDOT\Template Library directory and choose the *EmptyProject.itl* Template Library.

2. From the *Create Template* dialog, select **File > Save As.** If Exercise 1.2 was performed, overwrite the blank *22049555201.itl* Template Library created earlier.

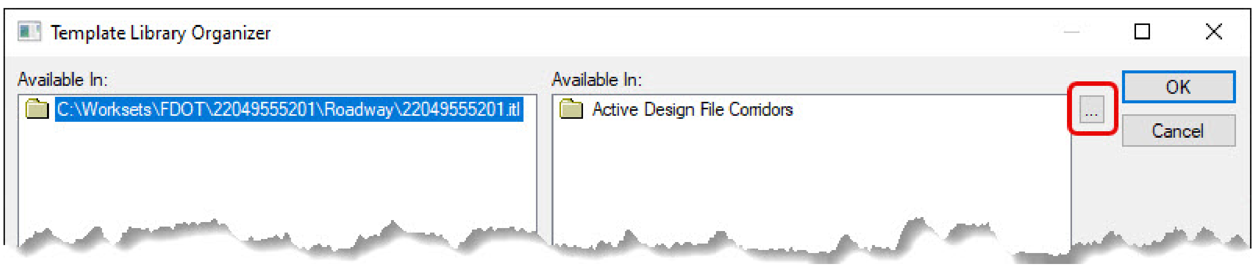
EXERCISE 1.4 *Using the Template Library Organizer*

This exercise uses the *Create Template* dialog to open the Template Library Organizer from the *Tools* menu option. Various components and templates from other Template Libraries and Roadway Designer files are obtained from using the Template Library Organizer. For the Chapter exercises to follow, the CIVIL FDOT ORD Template Library contains a basic Typical Section and all of the components used for the project design.

1. Use **Create Template** and select **Tools > Template Library Organizer**.

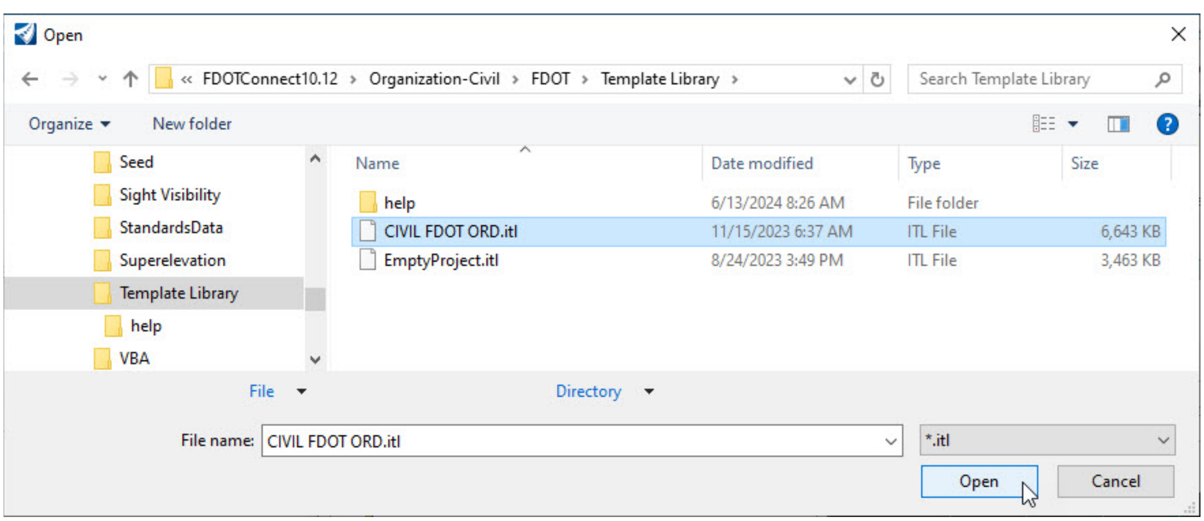


2. From the *Template Library Organizer* dialog, click the **Ellipsis** icon next to the **OK** button. The *Open Template Library* window displays.

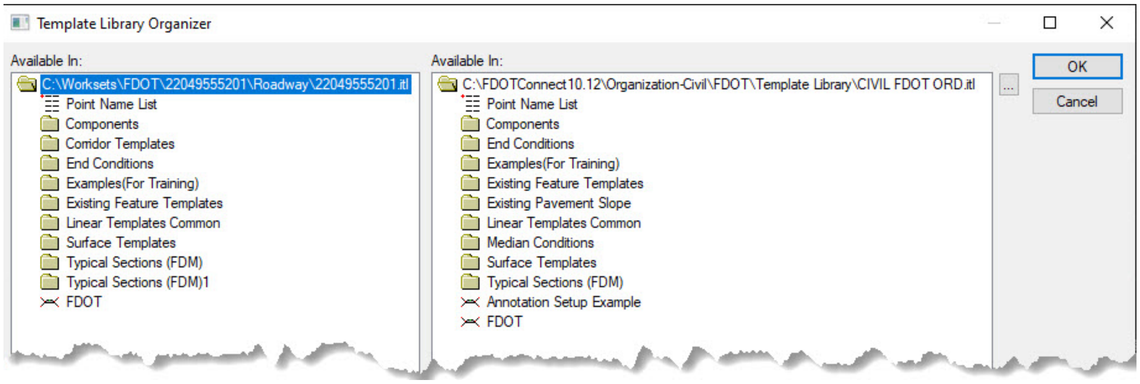


3. From Open Template Library, navigate to the *CIVIL FDOT ORD.itl*

   This is located in the FDOTConnect WorkSpace in the following folder location C:\FDOTConnect10.12\Organization-Civil\FDOT\Template Library folder *CIVIL FDOT ORD.itl*. Click **Open**.

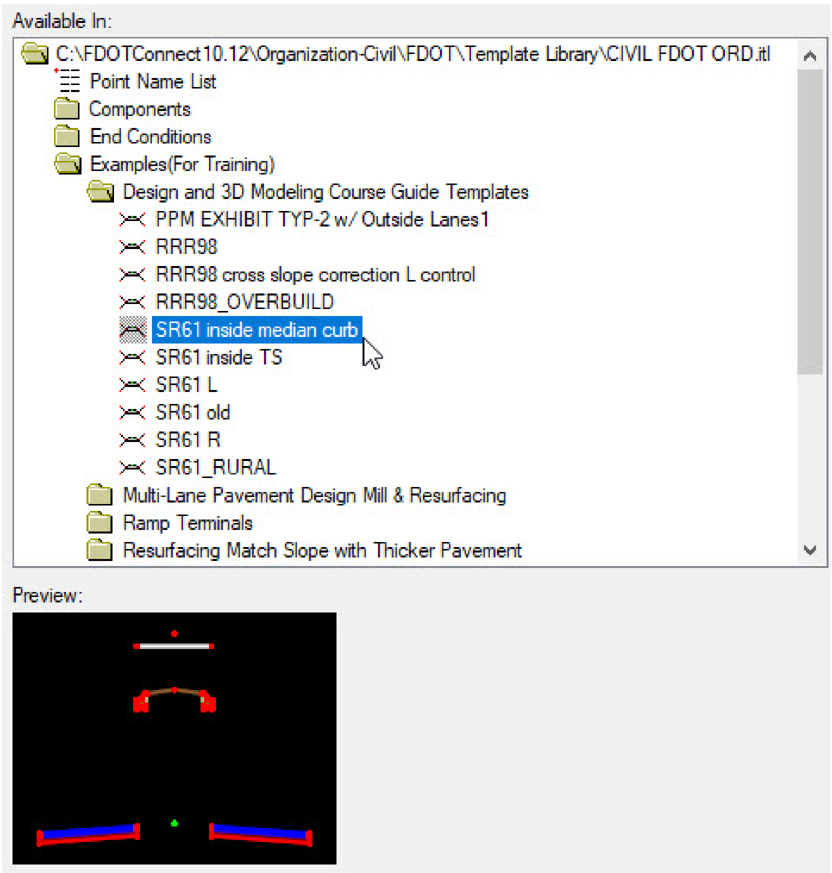


4. The Template Library Organizer dialog displays with the *.itl* file listed in the right *Available In:* window pane.

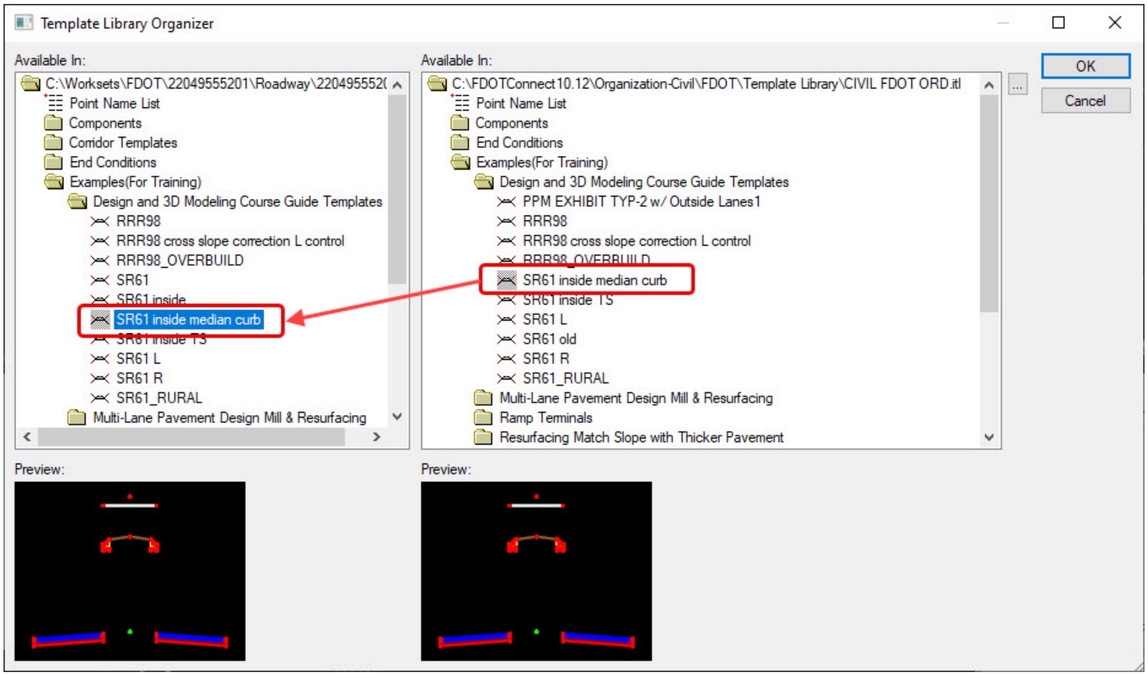


5. From the *Template Library Organizer*, navigate to the Examples (For Training) folder. Open the folder by double clicking on it, select the **SR61 inside median curb** template.

6. By selecting the template a preview will show in the *Preview* window below the directory view.



7. Drag the **Template** from the right side to the left side onto the **Examples(For Training) > Design and 3D Modeling Course Guide Templates** folder for the project.



8. Collect the following items from the CIVIL FDOT ORD *Template Library* and drag them to the *Project Folders Locations* as shown below.

CIVIL FDOT ORD Template Location	Project Folder Location
Examples (For Training)/ Design and 3D Modeling Course Guide Templates	Entire folder to Examples (For Training)/Design and 3D Modeling Course Guide Templates
End Conditions/Parts	Entire ***Parts*** folder to End Conditions
Component/Pavement/Resurfacing (Milling, Overbuild and Overlay)	Entire ***Resurfacing (Milling, Overbuild and Overlay)*** folder to Components
Component/Curb & Gutter	***Curb Type E Inside*** to Linear Templates Common
Linear Templates Common	Outside Lane w/ Paved Shoulder to Linear Templates Common
Linear Templates Common	Outside Lane w/ Type F Curb to Linear Templates Common
Surface Templates	Pavement Asphalt to Surface Templates

If template exists still add it and see that it will increment the template that you are adding (the program will add a 1 to the end of the template added.)

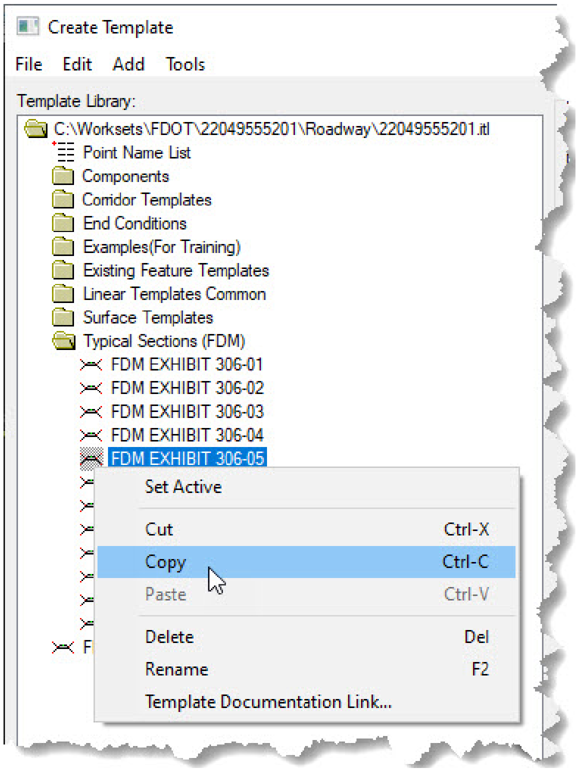
9. Click **OK** to return to the *Create Template* dialog and click **Yes** in the *Save data to file* dialog. The FDOT Standard Items are now saved in the Project Template Library.

EXERCISE 1.5 Naming Project Templates

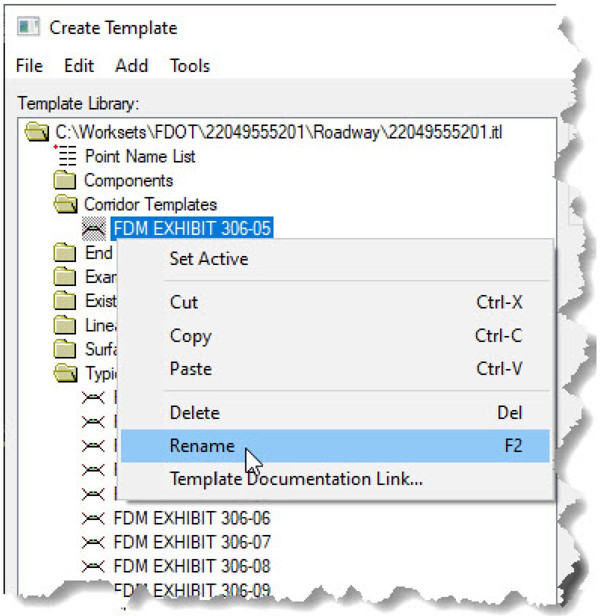
This exercise copies and renames the Typical Section obtained from the *CIVIL FDOT ORD.itl* Template Library in the project Template Library template folder using the *Create Template* dialog. The *Create Template* dialog has functionality similar to Window Explorer to help manage templates for each project.

NOTE ***A consistent project template naming convention is valuable as the design progresses. As more are added to the template design, create a backup copy and add a suffix to the name "_1, _2, _3, etc.***

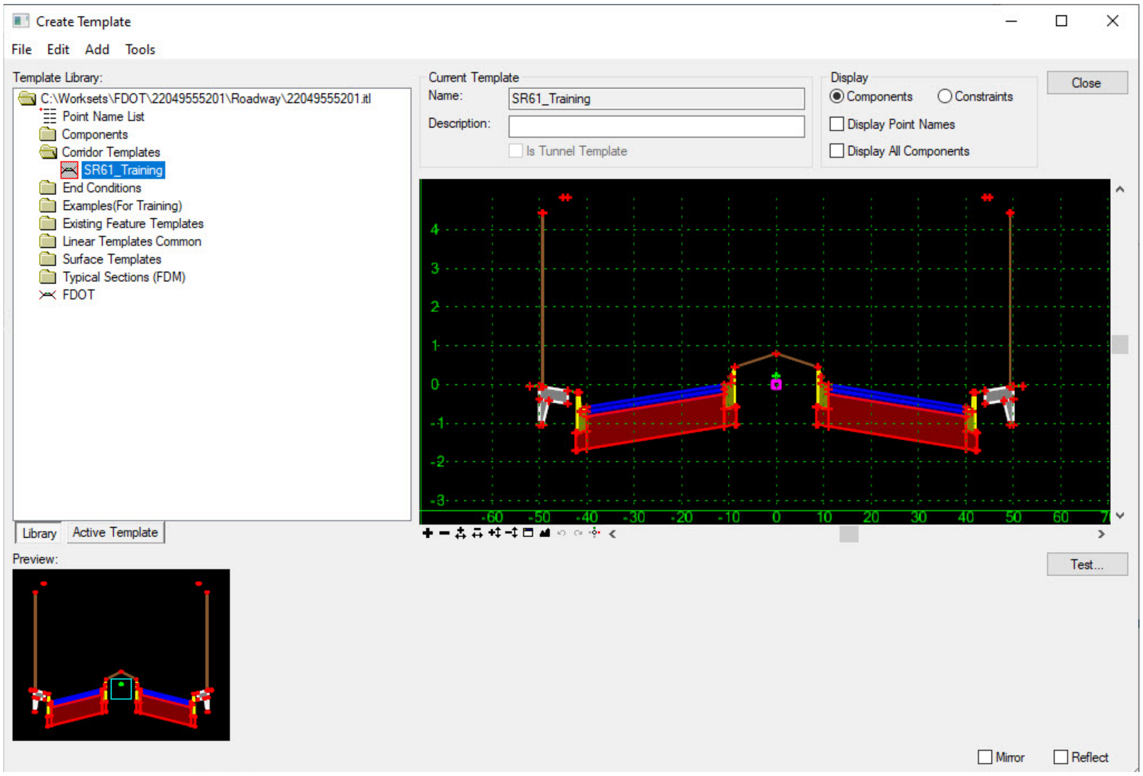
1. In the Typical Sections (FDM) folder, right click on the **FDM EXHIBIT 306-05** template and select **Copy**.



2. Right click on the *Corridor Templates* folder and select **Paste**. Right click on the copied **FDM EXHIBIT 306-5** Template and select **Rename**.



3. Change the *Name* of the Template to **SR61_Training**. Right click on the **SR61_Training** Template and select **Set Active**. A small red box will indicate the Active Template.

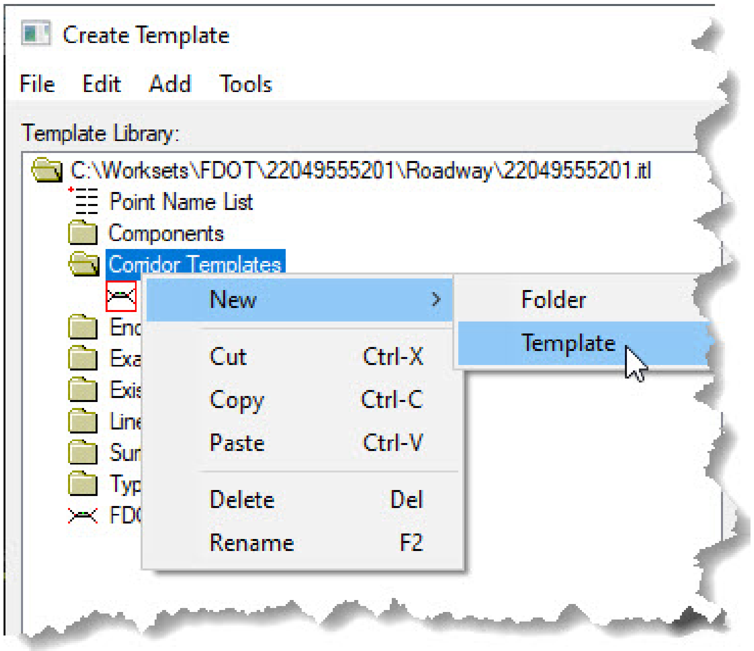


4. Select **File > Save** to save the Project Template Library.

EXERCISE 1.6 *Creating a Resurfacing Template*

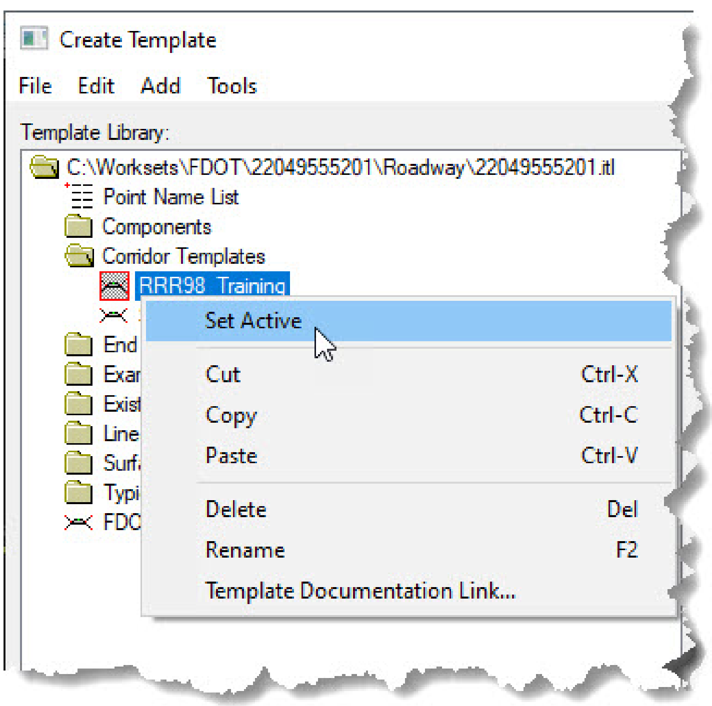
This exercise creates a Resurfacing Template within the project Template Library. This exercise helps provide a basic understanding of the basic template creation methods from the CIVIL FDOT ORD Template library components types, connection points, constraints, targets, etc

1. Right click on the *Corridor Templates* folder and select **New > Template**.



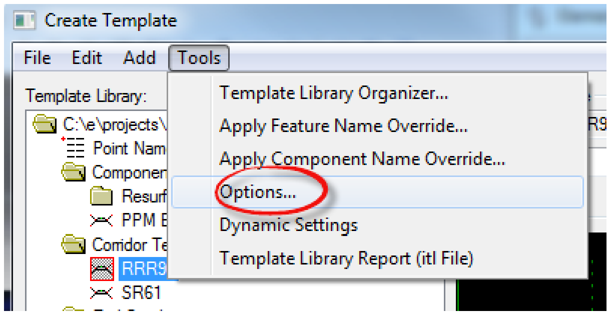
2. Right click on the New Template1 and select **Rename**. Change the Name to RRR98_Training and Select **Enter** to store the name.

3. Right click again on the RRR98_Training and select **Set Active.**

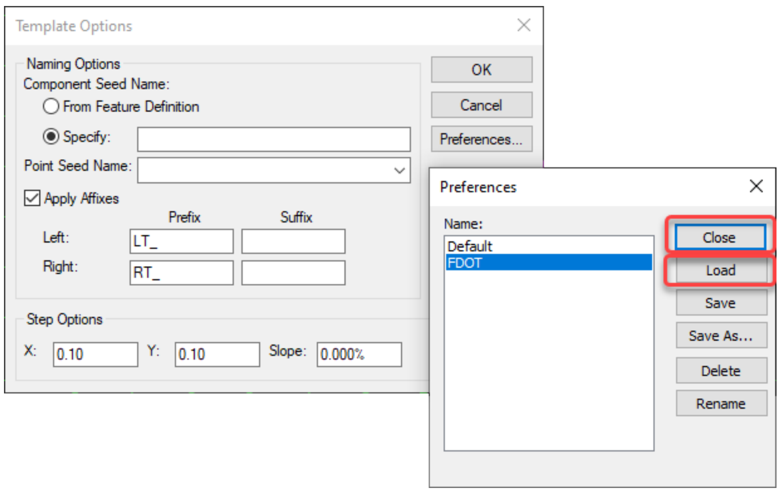


▶ ***Before Adding Components, Open Preference File to Add a Prefix to the Point Names.***

1. Select the **Tools > Options** from the *Create Template* dialog to launch the *Template Options* dialog.



2. Click the **Preferences** button and then select the **FDOT** list item. Click **Load** and then **Close** the Preferences dialog. Click **OK** to close the Template Options dialog.

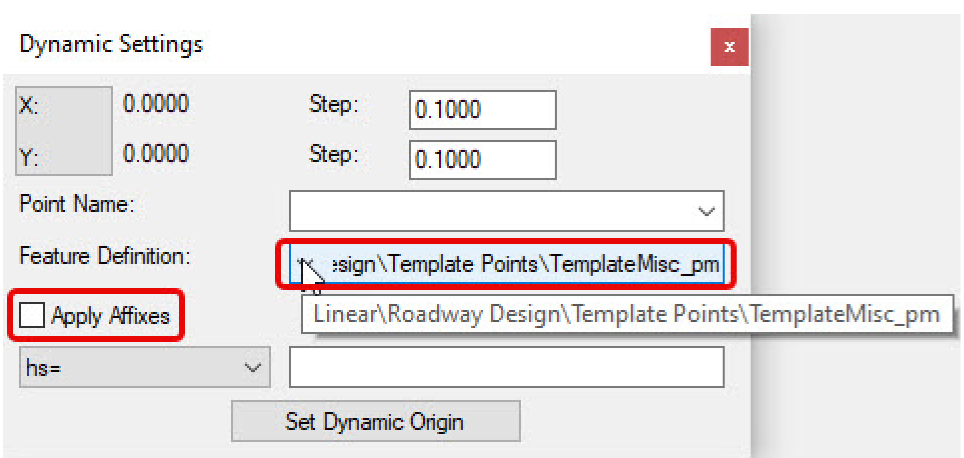


3. Select the **Tools > Dynamic Settings** from the *Create Template* dialog. This provides a toolbox like dialog for placing components.

NOTE ***The X and Y Step value 0.1000 functions similar to a grid lock in MicroStation when placing the components.***

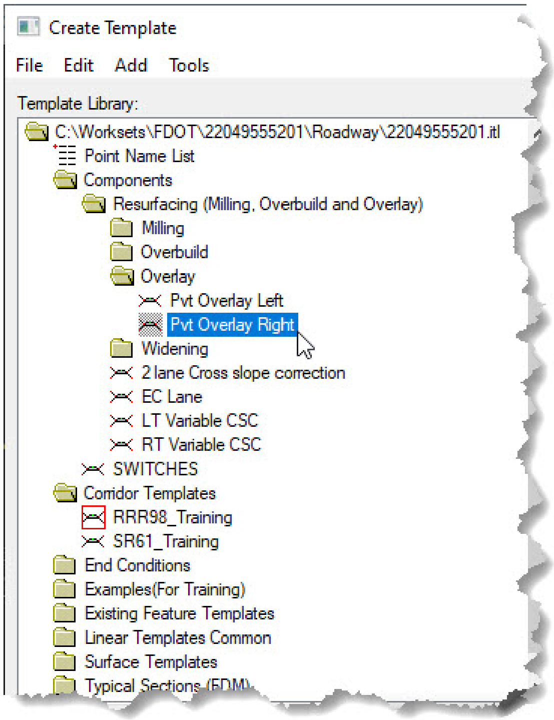
   a. Change the *Feature Definition* to **Linear > Roadway Design > Template Points > TemplateMisc_pm.**

   b. Uncheck *Apply Affixes*.

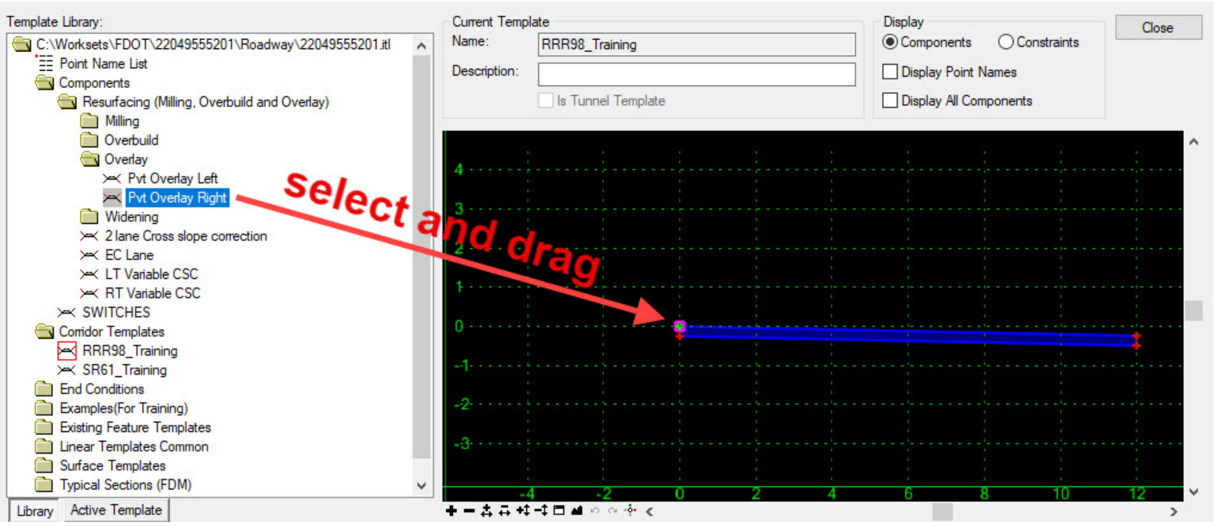


▶ *Add Components*

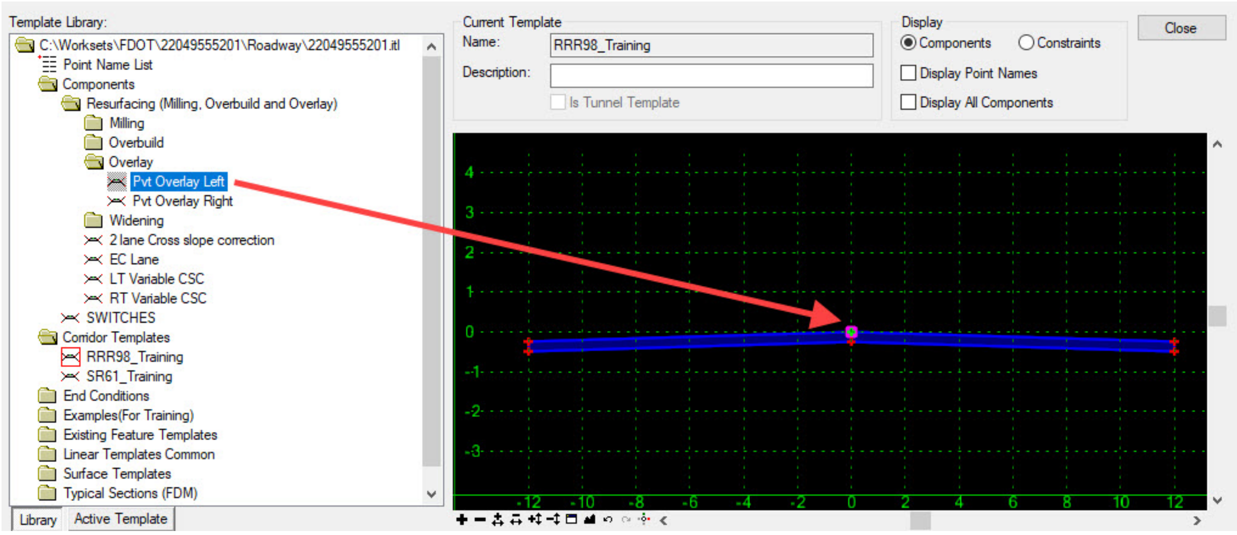
1. Navigate to **Components > Resurfacing (Milling, Overbuild and Overlay) > Overlay** and select the **Pvt Overlay Right** *Component*.



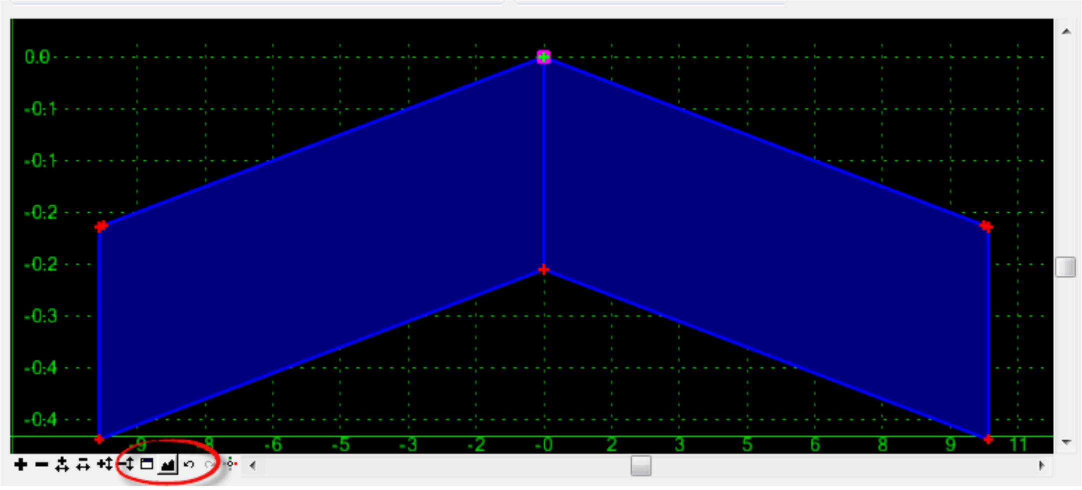
2. Using the Preview window drag the *Component* to the small magenta square in large view.



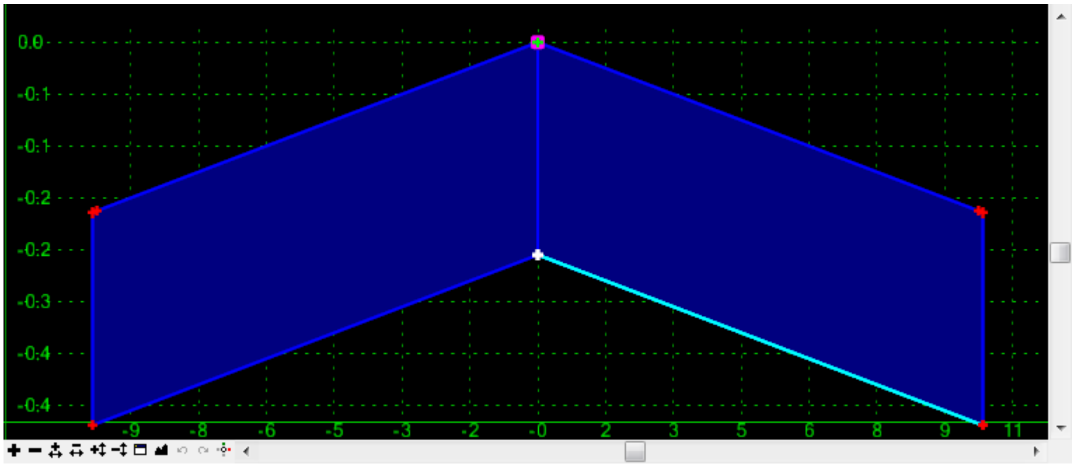
3. Repeat this step to place the **Pvt Overlay Left** *Component* on the small magenta square.



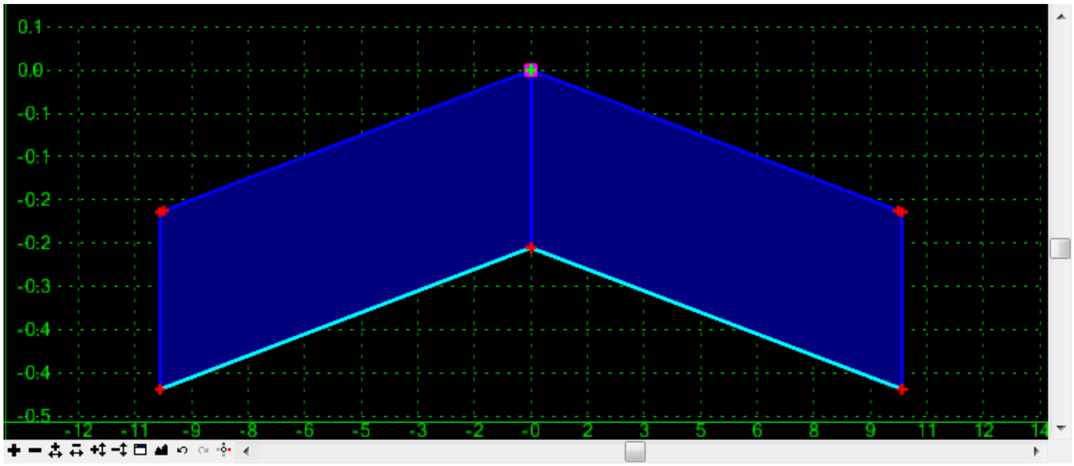
4. Fit View by selecting the **Fit** icon below the *Active Template* window.



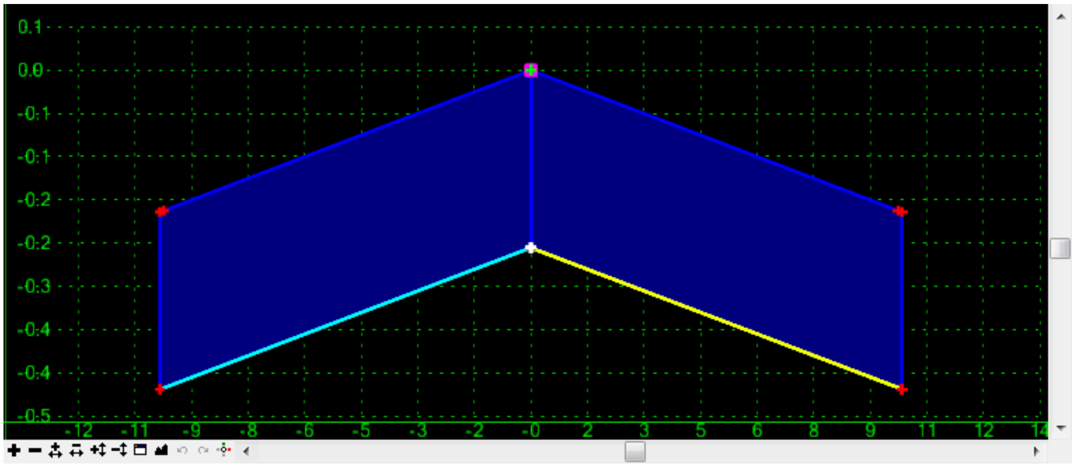
5. Drag and drop the **Components > Resurfacing (Milling, Overbuild and Overlay) > Milling > Pvt Milling Right** *Component* and connect it to the bottom side of the overlay component in the template. The cursor will turn white when it is locked on the location.



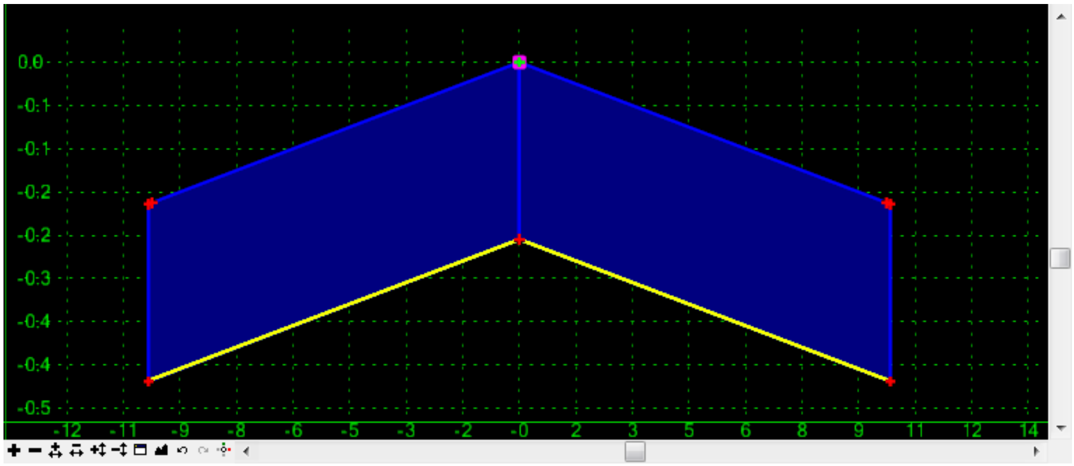
6. Repeat this step for the **Left Milling** *Component*.



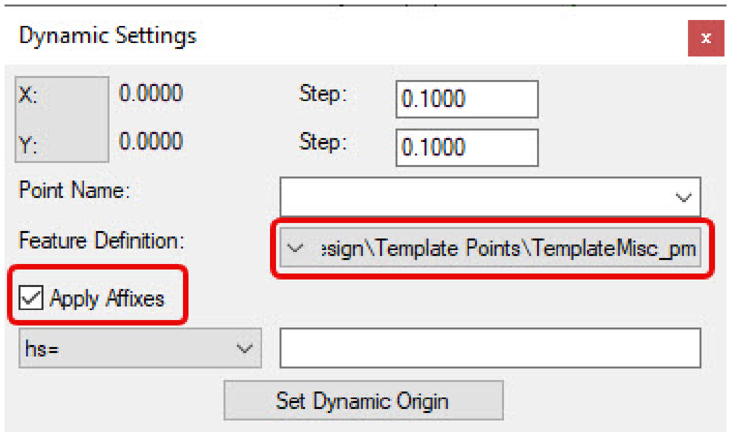
7. Drag and drop the **Components > Resurfacing (Milling, Overbuild and Overlay) > Overbuild > Pvt Overbuild Right** *Component* and connect it to the bottom side of the **Overlay** *Component* in the template. The cursor will turn white when it is locked on the location.



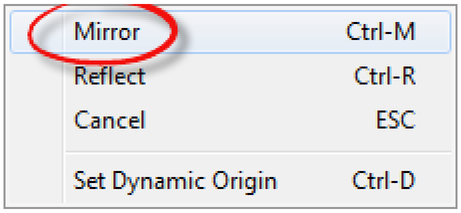
8. Repeat this step for the **Left Overbuild** *Component*.

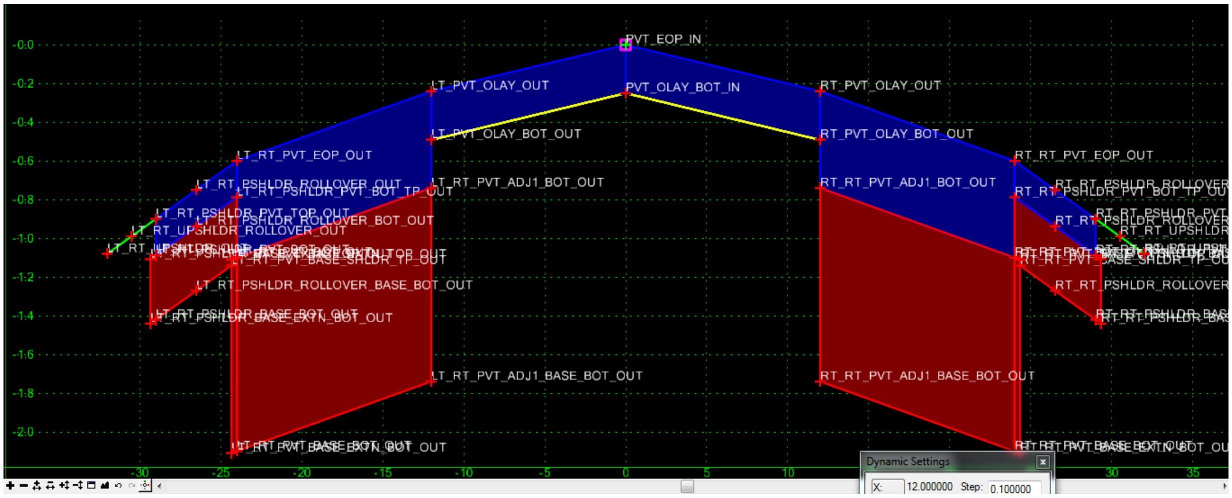


9. Check *Apply Affixes* on the *Dynamic Settings* dialog.



10. Drag and drop the **Linear Templates Common > Outside Lane w/ Paved Shoulder** component and connect it to the top side of the milling template. While dragging, right click and turn **On** *Mirror.*

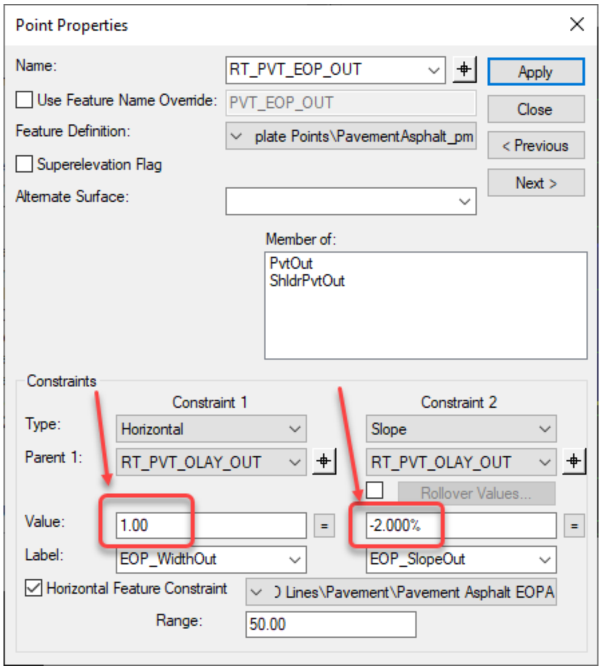




11. Modify the widening lane *Width* and *Slope*,

    a. Edit the *Point* **RT_PVT_EOP_OUT**, double click on the *Point* to open the *Point Properties* dialog.

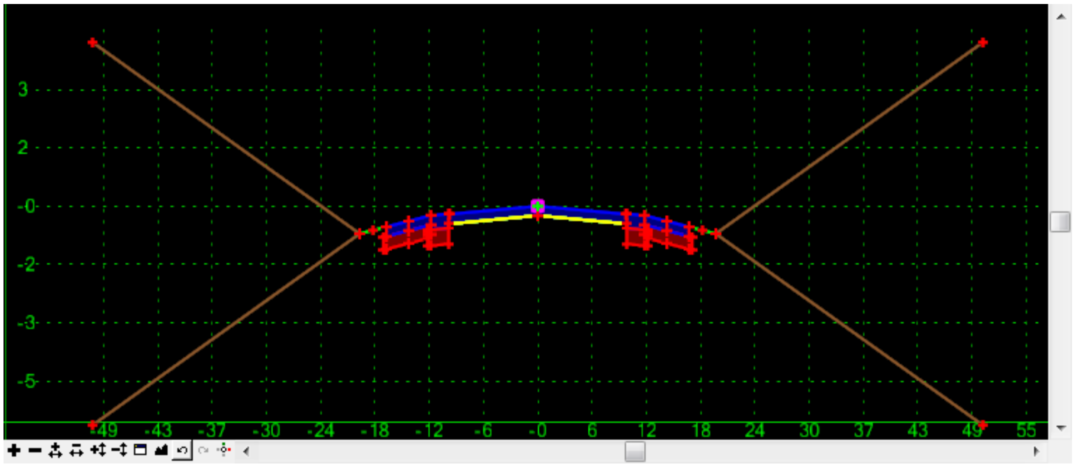
    b. Change the *Constraint 1 Horizontal Value* to 1.00 and *Constraint 2 Slope Value* to -2.000%.



12. Repeat for the left side widening pavement, **LT_PVT_EOP_OUT**, use *Constraint 1 Horizontal Value* to -1.00 and *Constraint 2 Slope Value* to 2.000%.

▶ *Add End Conditions to the SR61 and RRR98 templates*

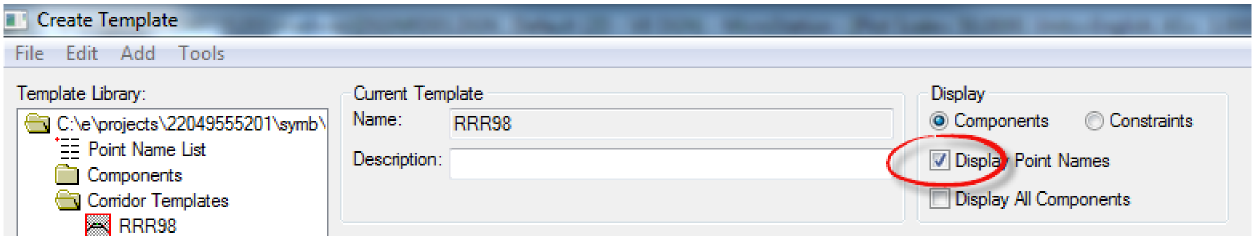
1. Drag and drop the **End Conditions > Parts > 6:1 Cut** and **6:1 FILL TO 5'** *Components* to both sides.
2. Select **File > Save** to save the Template changes.



NOTE ***The undo icon is also at the bottom of the view.***

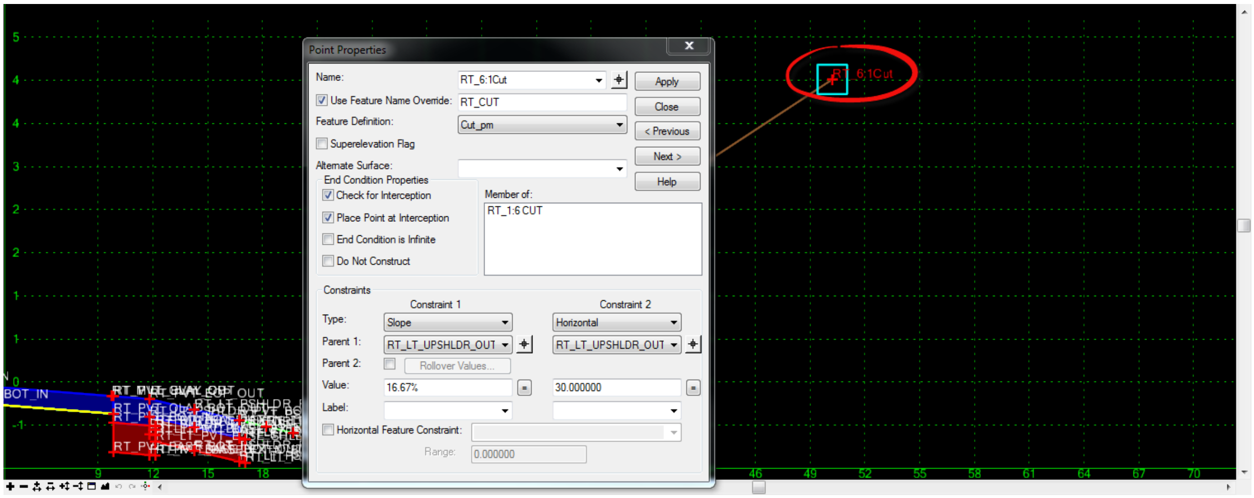
EXERCISE 1.7 *Editing Templates*

1. On the *Create Template* dialog, check **On** the *Display Point Names* option.

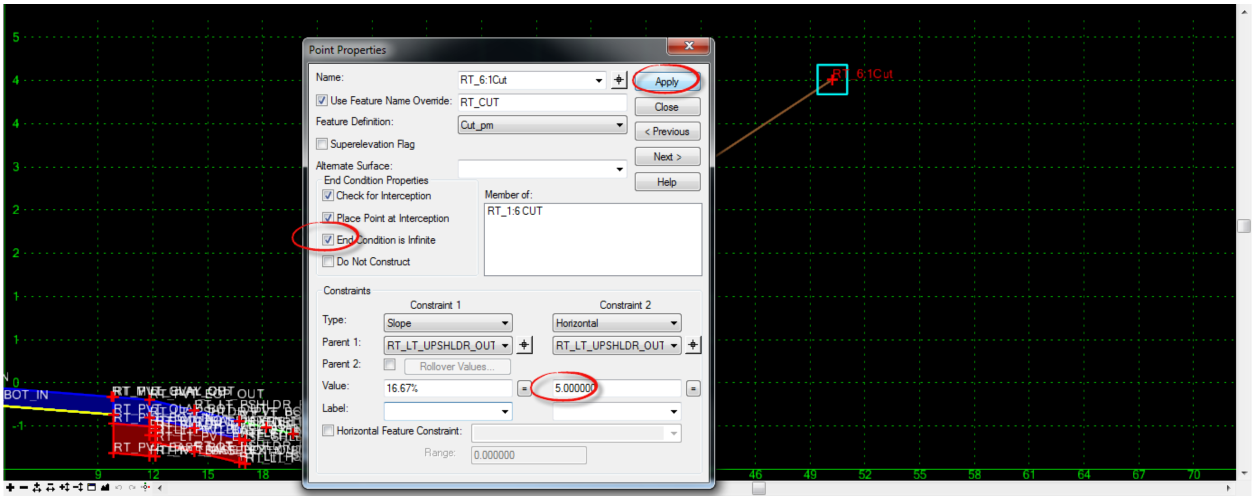


▶ *Change End Condition Point Properties*

1. Double click on the **RT 6:1 Cut** P*oint* to launch the *Point Properties* dialog.

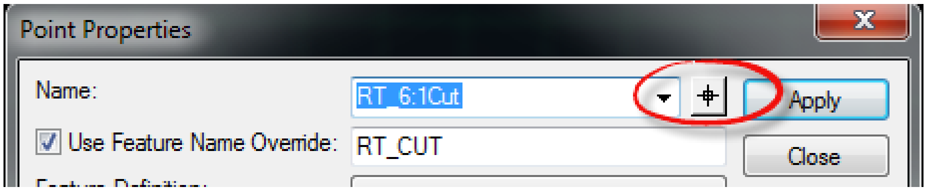


2. Check the *End Condition is Infinite* box and change *Constraint 2, Horizontal Value*, from **30** to **5 feet**. Click **Apply** and then **Close**.

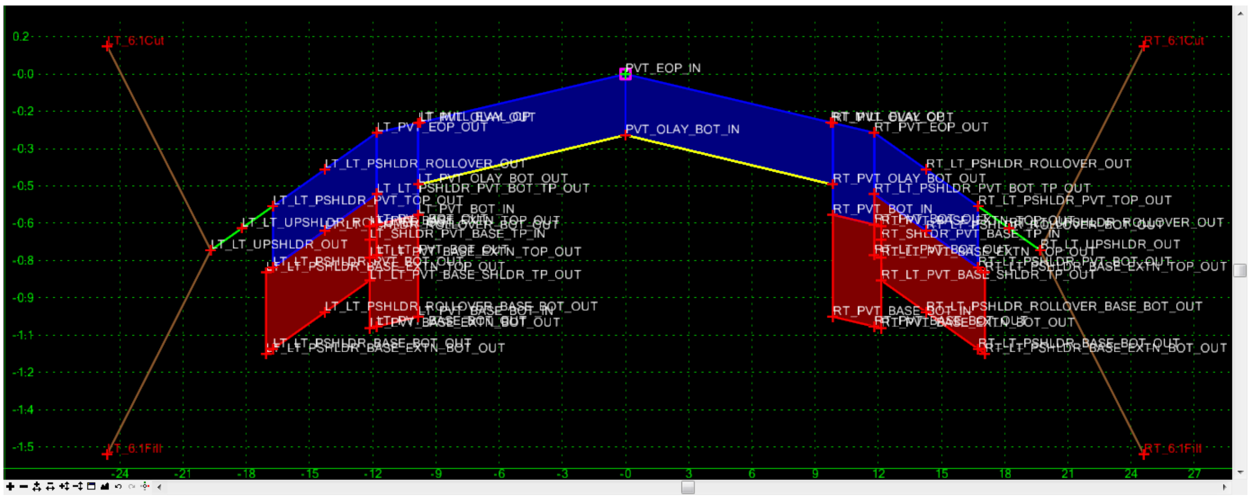


3. Repeat these changes for the remaining *End Conditions*; **RT 6:1Fill, LT 6:1Cut, RT 6:1Fill.**

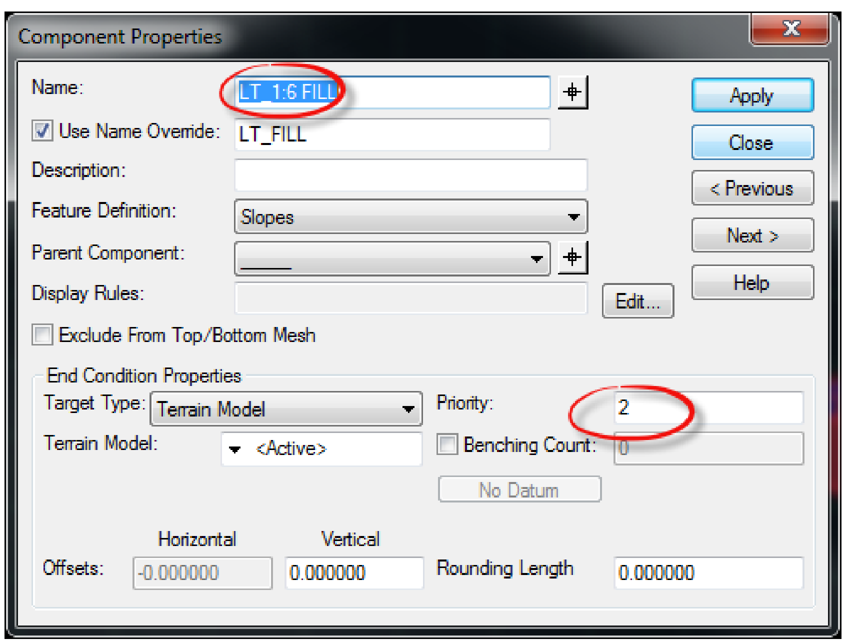
NOTE ***Use -5 for left side points. To edit consecutive points, click the pick icon next to the point name and select the next point.***



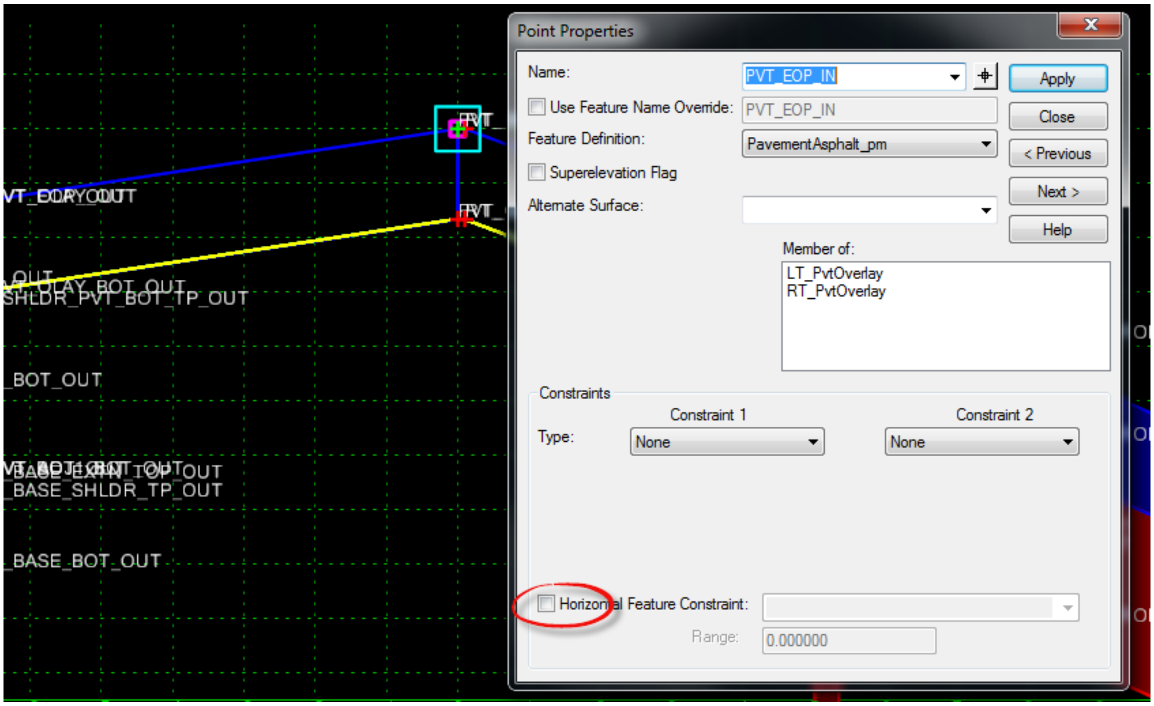
4. Select **Fit View** to zoom to the entire active template and review the changes.



5. Right click on the each Fill components and choose *Edit Component*. Change the *Priority* value to 2.



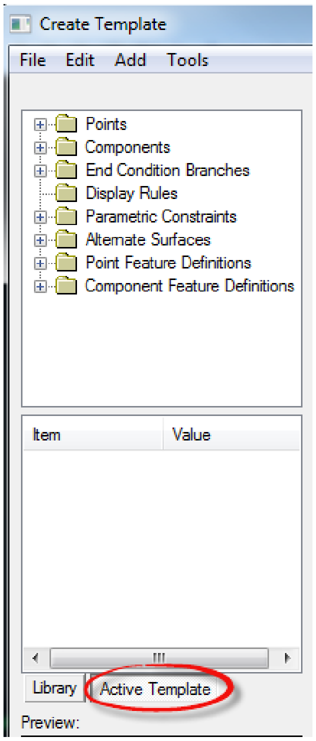
6. Turn **OFF** the *Horizontal Feature Constraint* on the middle point, **PVT _EOP_IN Point.**



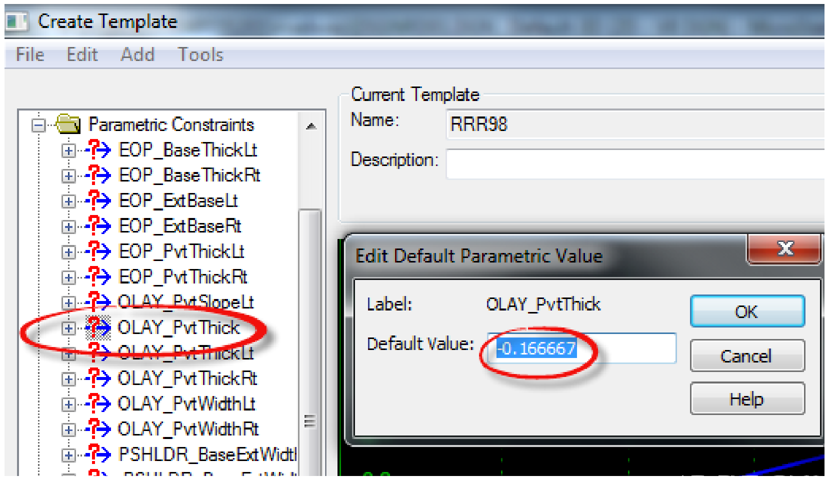
7. Select **File > Save** to save the Template changes.

▶ *Change the Overlay Depth Properties*

1. Change the bottom tab on the left side of the *Create Template* dialog to **Active Template.**



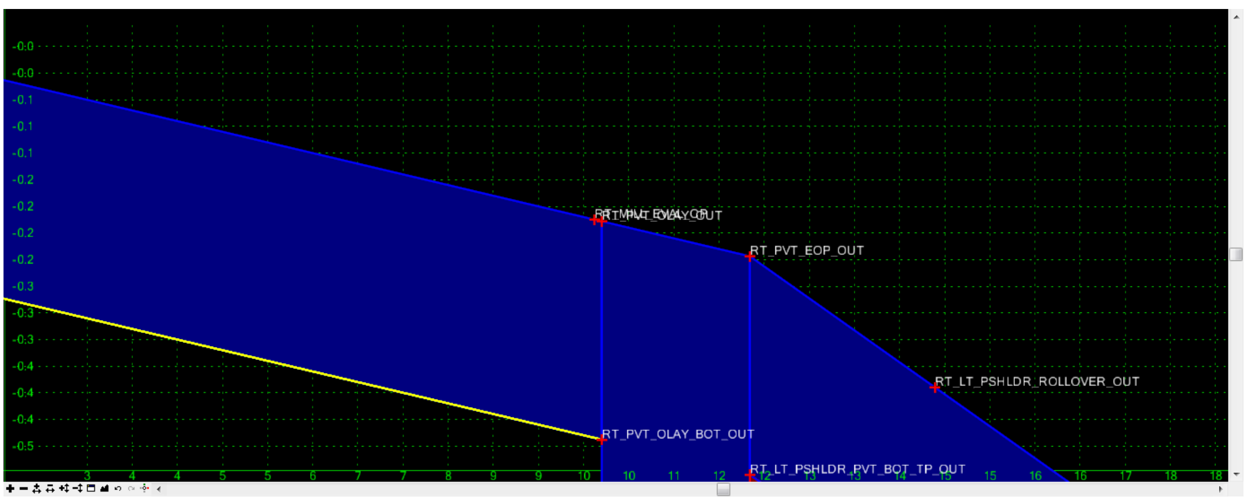
2. Open the *Parametric Constraints* folder, double click on the **OLAY_PvtThick** *Label* and change the *Default Value* from **-.25** to **-2/12**. Click **OK**.



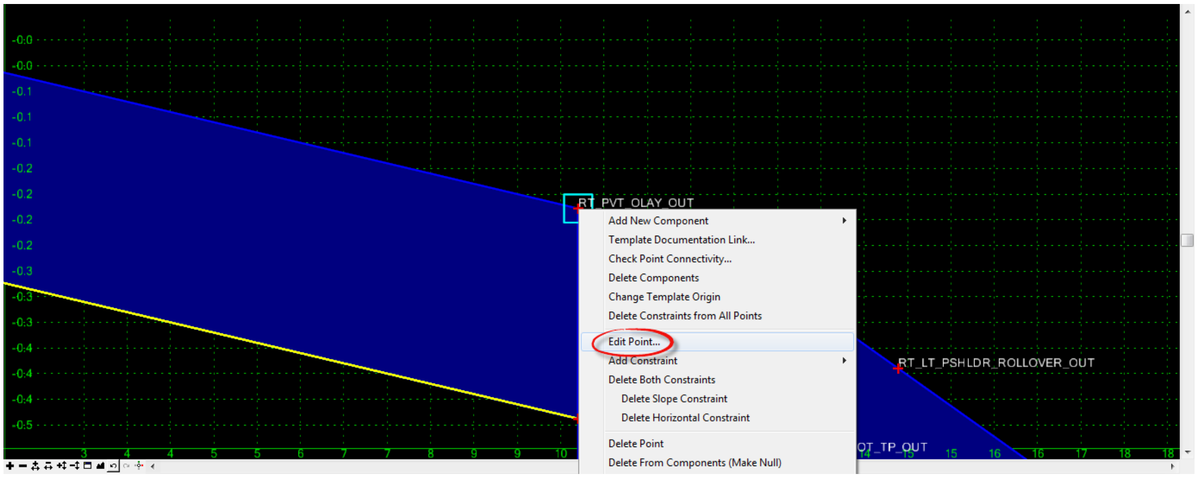
3. Repeat these steps for the **OLAY_PvtThickLt** and **OLAY_PvtThickRt** *Labels*.

▶ ***Change the Milling Point Properties***

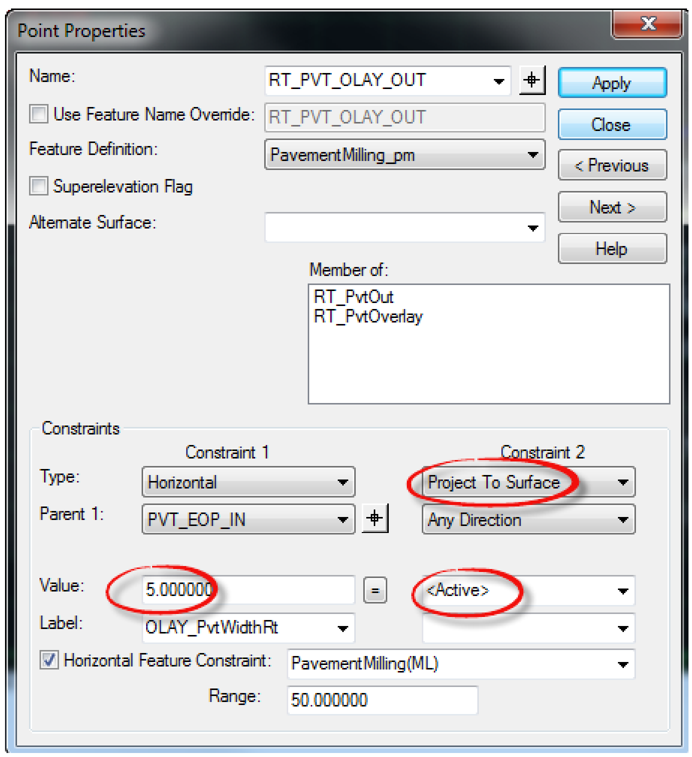
1. Zoom in the Active Template View to the Right Widening side.



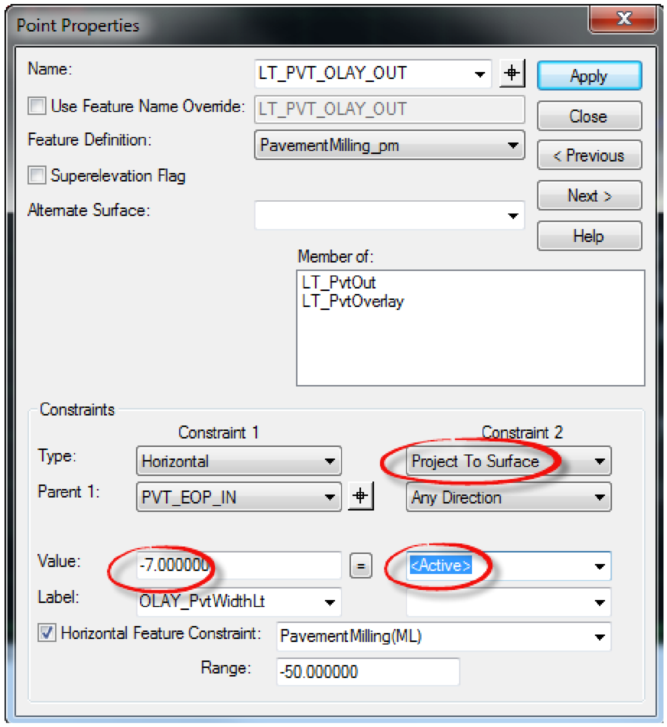
2. Right click on the **RT_PVT_OLAY_OUT** and select **Edit Point**.



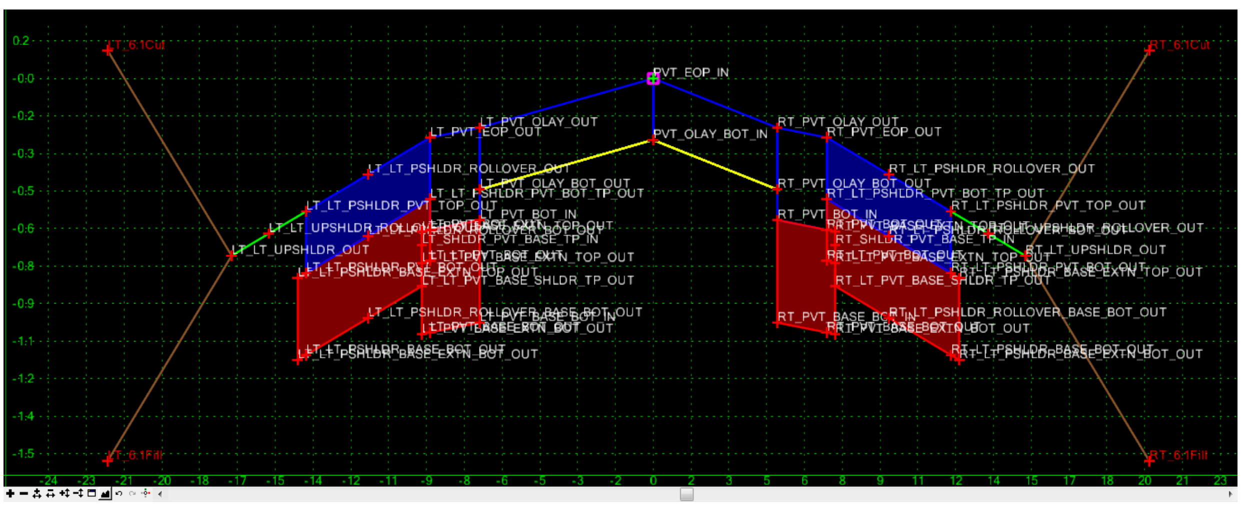
a. Change the *Constraint 1, Horizontal Value* from 12 to 5 feet.
b. Change *Constraint 2*, from *Slope* to *Project to Surface*.
c. Set the *Constraint 2 Value* to *Active*.
d. Click **Apply** and then **Close**.



e. Repeat these steps for the **LT_PVT_OLAY_OUT**, change the *Horizontal Value* from **-12** to **-7** and *Slope* to *Project to Surface.*



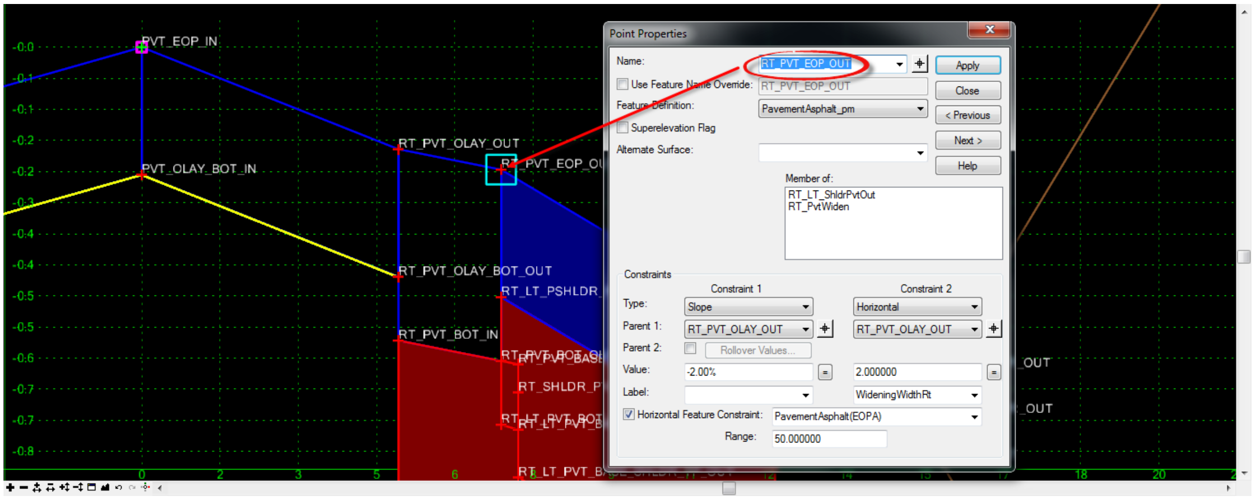
3. Zoom out of the Active Template to view the results.



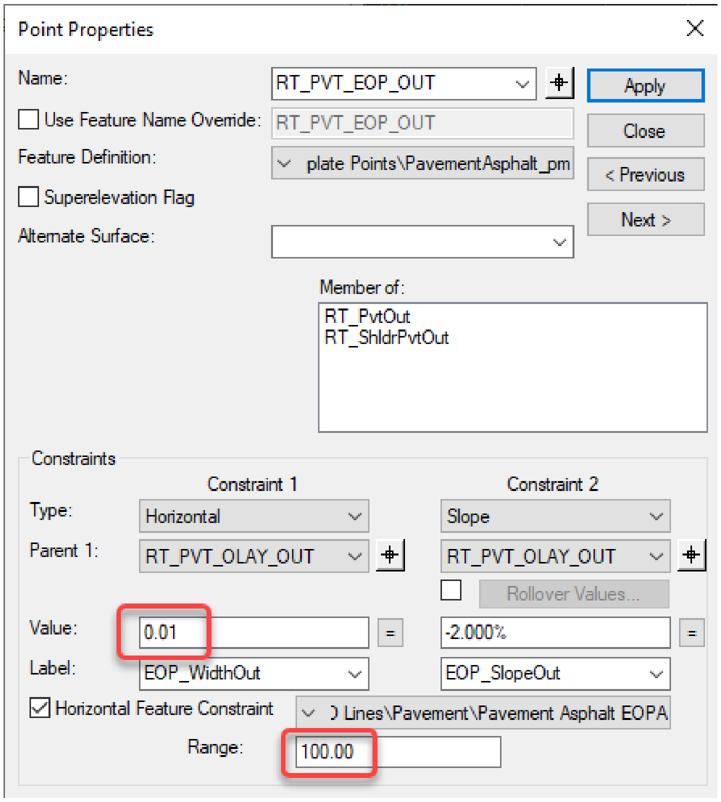
4. Select **File > Save** to save the Template changes.

▶ ***Change the Widening Point Properties***

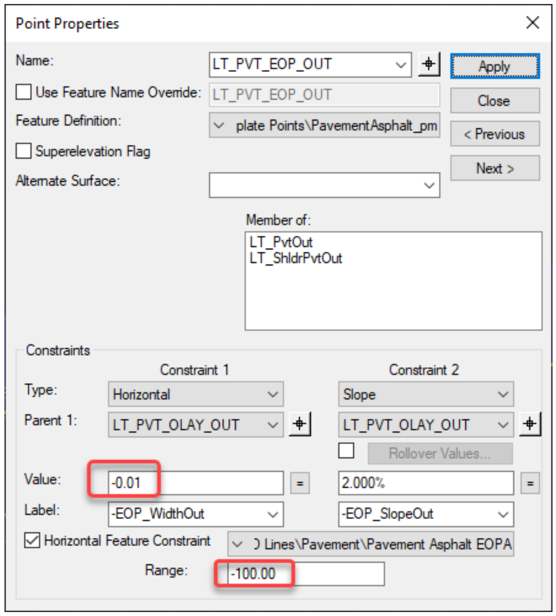
1. Double click on the **RT_PVT_EOP_OUT** to edit the *Point Properties*.



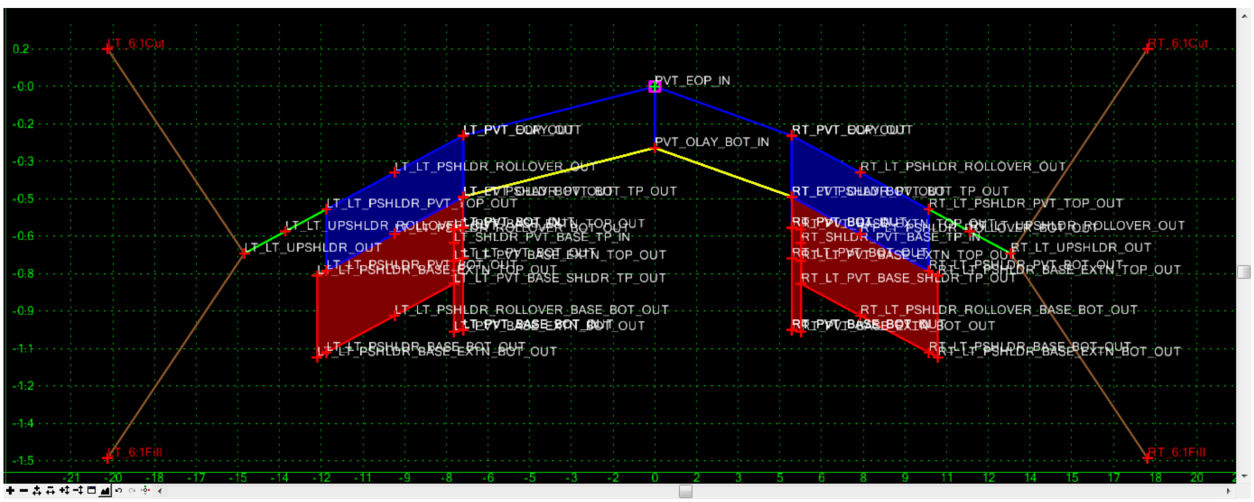
2. Change the *Constraint 1, Horizontal Value* from **1** to**.01 feet** and *Horizontal Feature Constraint Range* from **50** to **100 feet**. Click **Apply** and then **Close**.



3. Repeat these steps for the **LT_PVT_EOP_OUT**, change the *Horizontal Value* from **-1** to **-.01** and *Horizontal Feature Constraint Range* from **-50** to **-100 feet**. Click **Apply** and then **Close**.



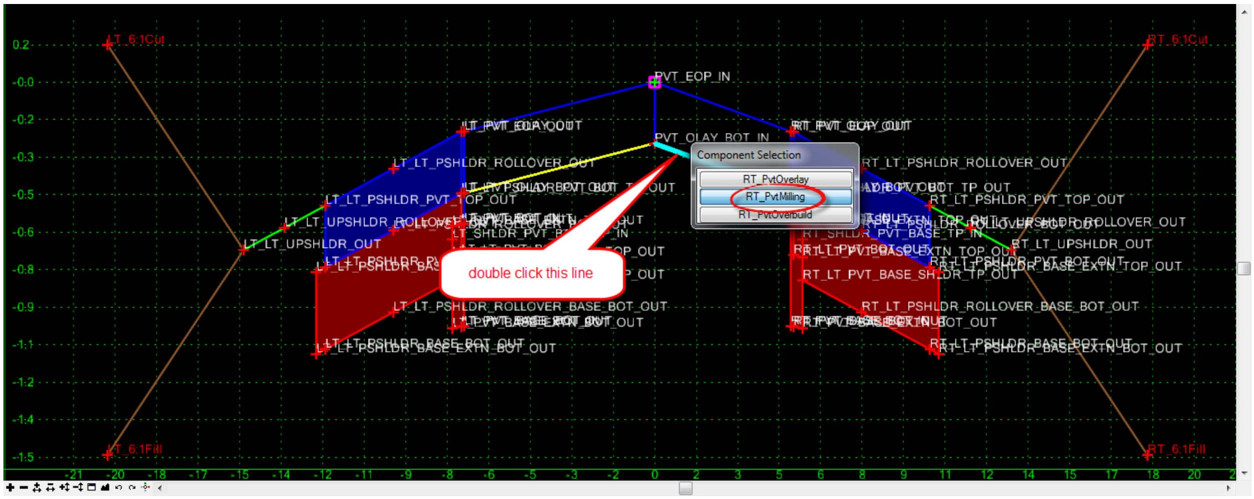
4. **Fit View** the Active Template to view the results.



5. Select **File > Save** to save the Template changes.

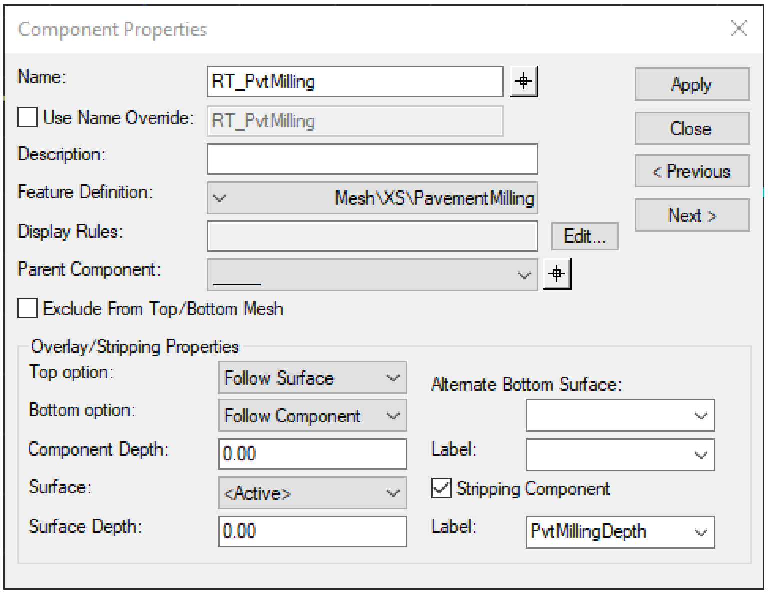
▶ *Check the Milling Component Properties*

1. Double click on the bottom line of the **RT_PvtOverlay** to open the *Component Selection* dialog and select the **RT_PvtMilling** option to edit the *Component Properties*.

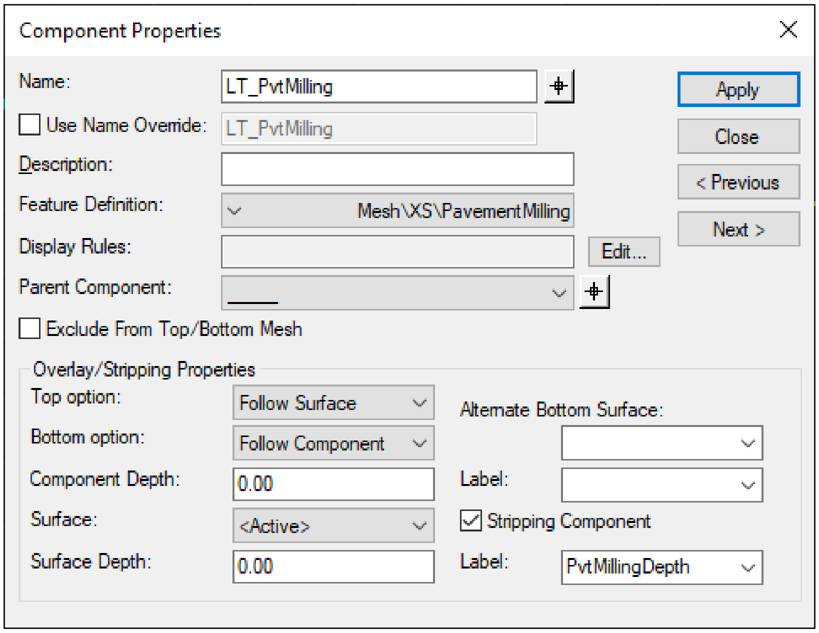


2. Change the *Overlay/Stripping Properties / Bottom* option from **Follow Surface** to **Follow Component**. Click **Apply** and then **Close**.

NOTE ***This is the appropriate setting for constant depth milling to match existing pavement slope between two points.***



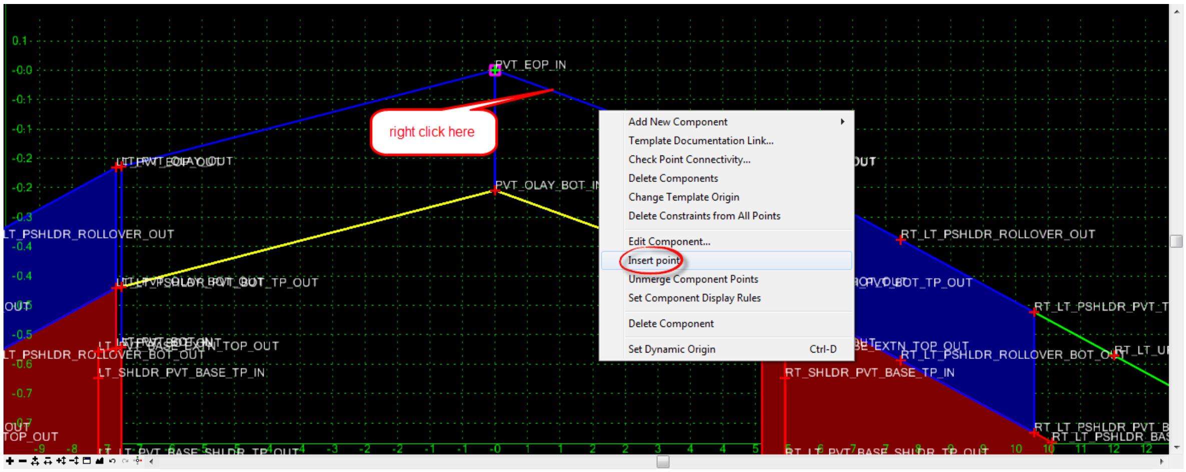
3. Repeat these steps for the **LT_PvtMilling** *Component*, change the *Overlay/Stripping Properties / Bottom* option from **Follow Surface** to **Follow Component**. Click **Apply** and then **Close**.



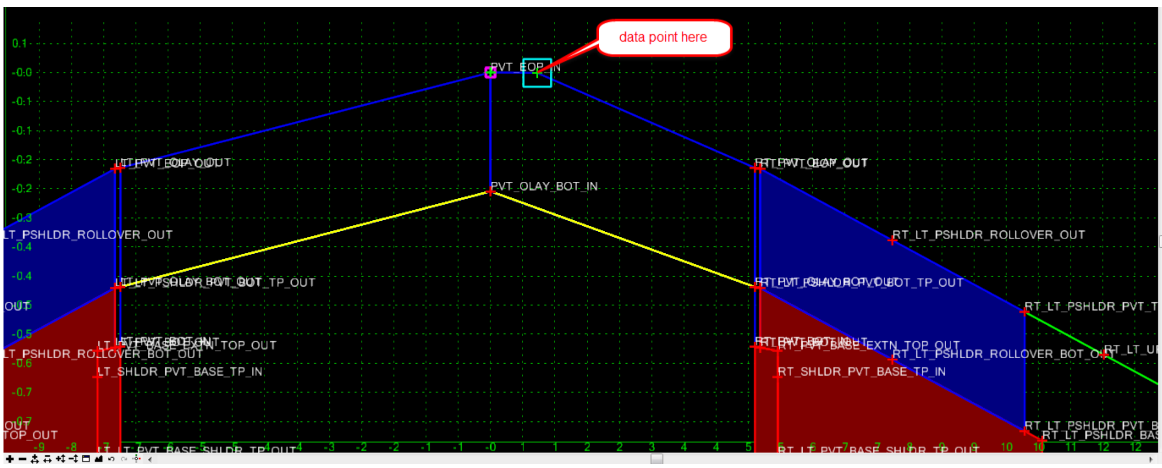
4. Select **File Save** to save the Template changes.

▶ *Insert a Milling Slope Break Template Point*

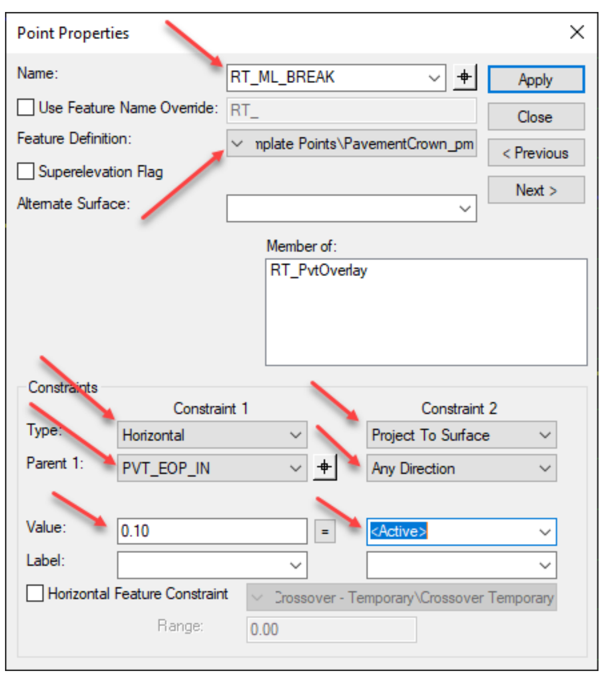
1. Right click on the **RT_PvtOverlay** *Component* and select **Insert Point**.



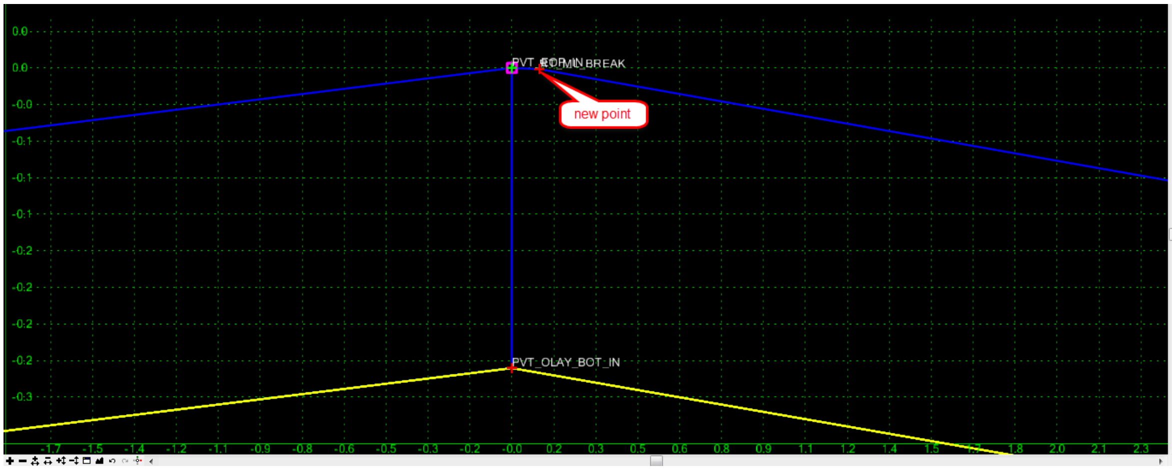
2. Data point in the Active Template View to store a point. Right click and select **Finish.**



3. Double click on the new *Point* to edit the **Point Properties**. Change the **Point Constraints** as shown.

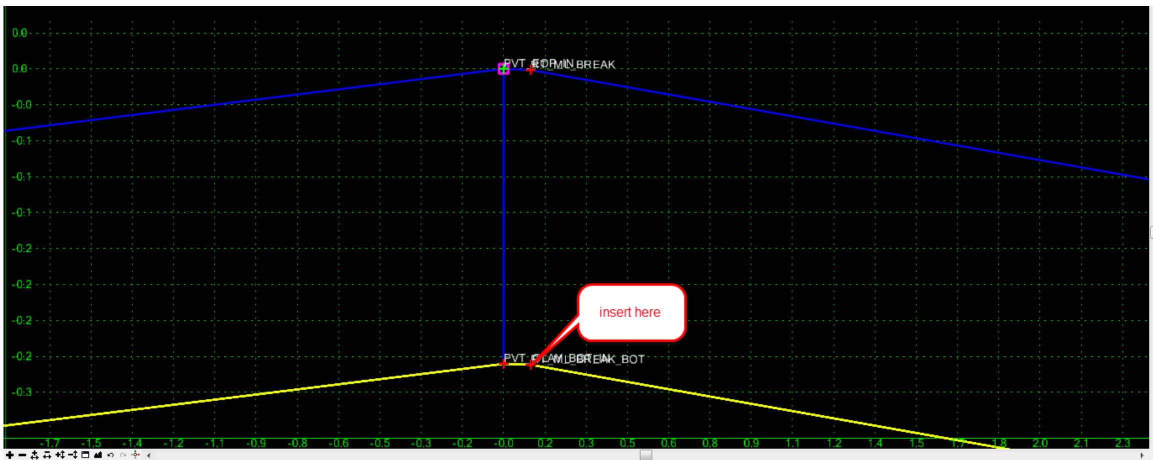


4. Click **Apply** and then **Close**.

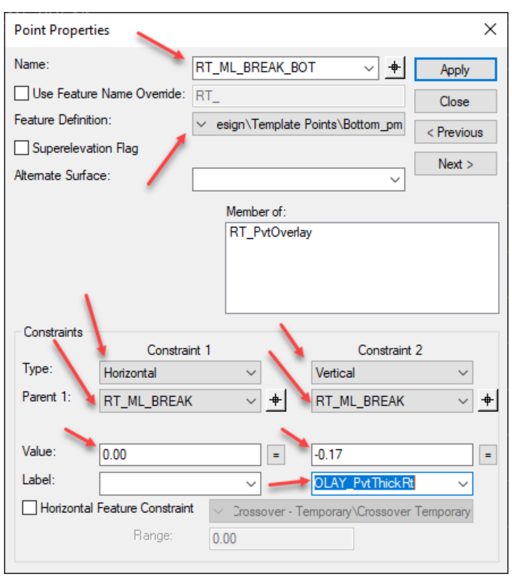


5. Repeat the steps above to insert *Points* on the bottom of the **PvtOverlay, PvtMilling,** and **PvtOverbuild** *Components*.

NOTE ***If insert point option is not available for the last component, use add point.***

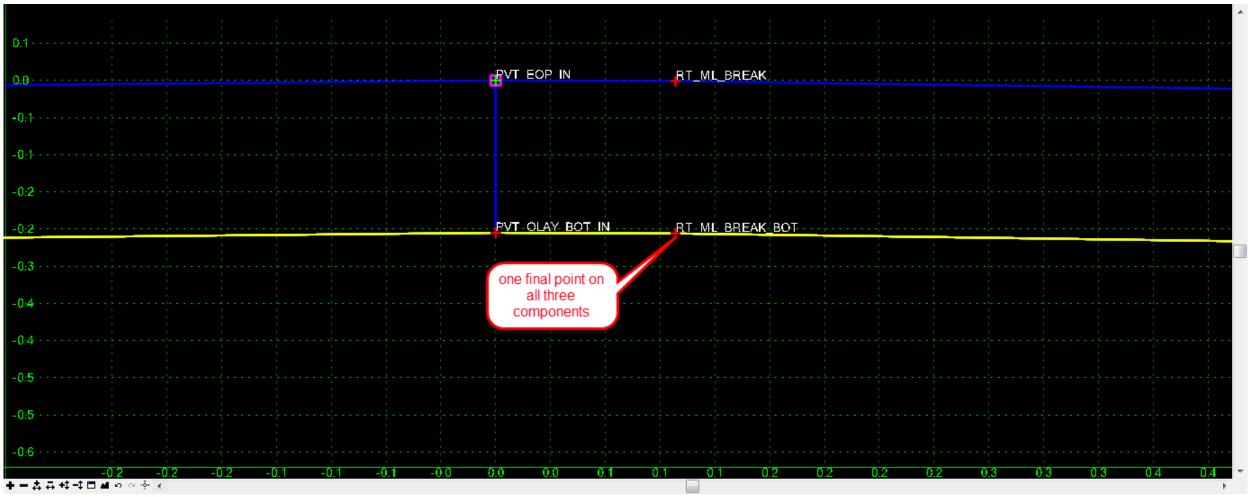


6. Set the *Point Properties* as shown.



NOTE ***When inserting the point on the PvtMilling and PvtOverbuild components, data point on the RT_ML_BREAK_BOT point to save from setting any other Point Properties edit steps.***

7. Merge the three points into one final point.

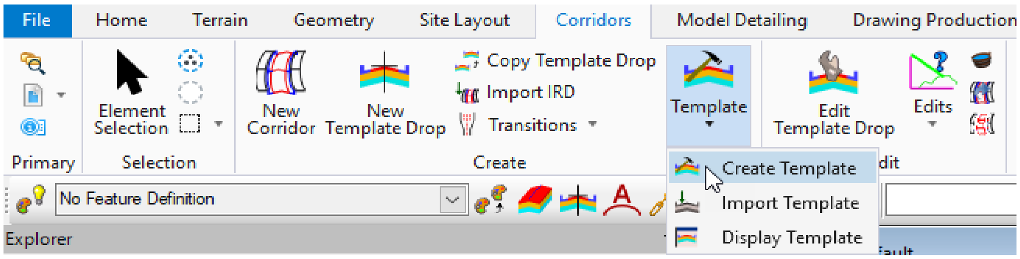


8. Select **File > Save** to save the Template changes and then close the *Create Template* dialog.

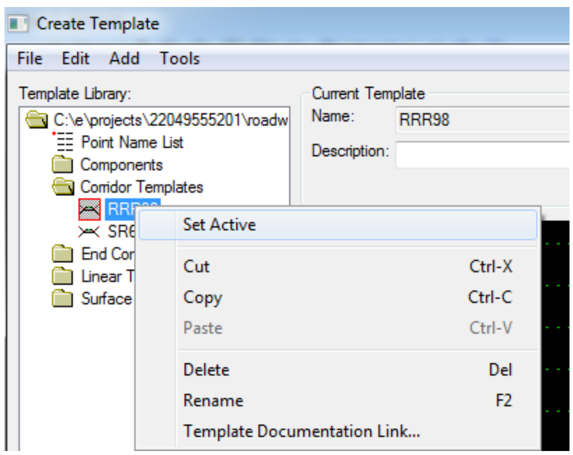
Exercise 1.8 *Add a Component Switch to the RRR98 Template (optional)*

This exercise adds a Component Switch to the RRR98 template to be used across the limits of the intersection. This switch is implemented using a Parametric Constraint on the BL98 corridor to turn off all the outside components for the corridor through the intersection, in Chapter 4.

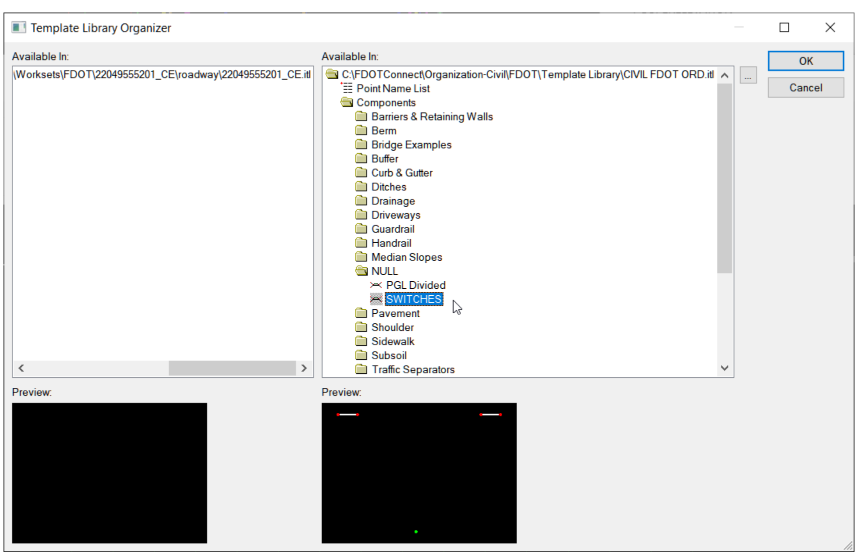
1. Use the **Corridors > Create > Template > Create Template** tool.



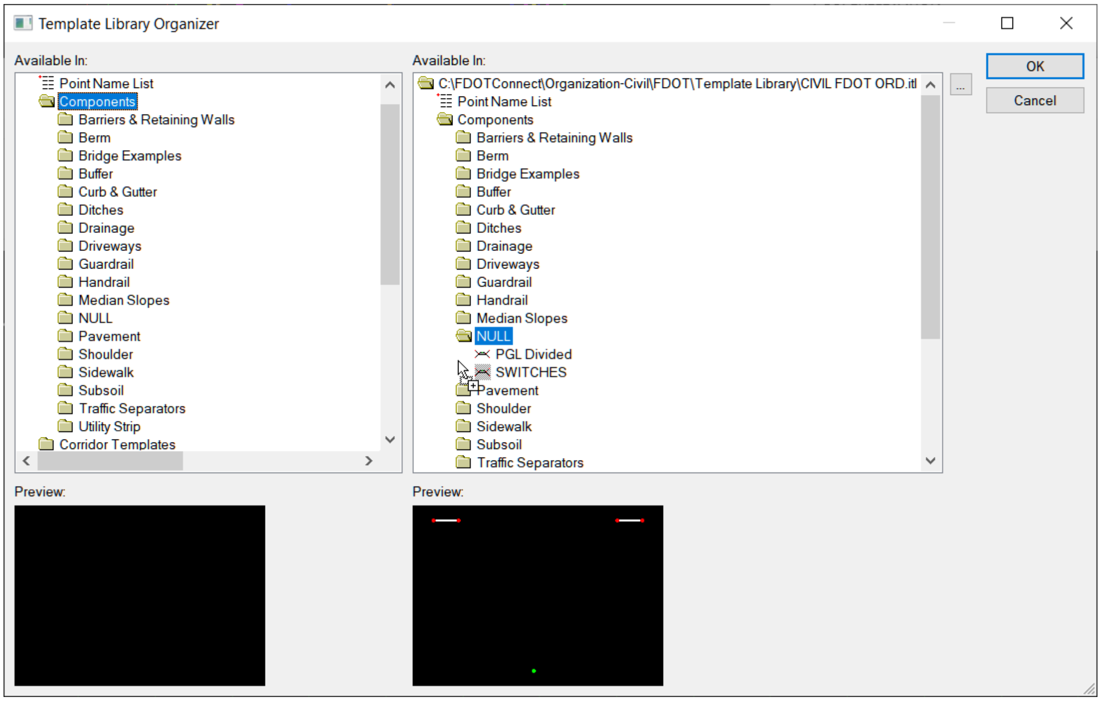
2. Right click on the *RRR98* Template and select **Set Active**.



3. Using the *Template Library Organizer,* locate the **SWITCHES** template in the *Civil FDOT ORD.itl* file.

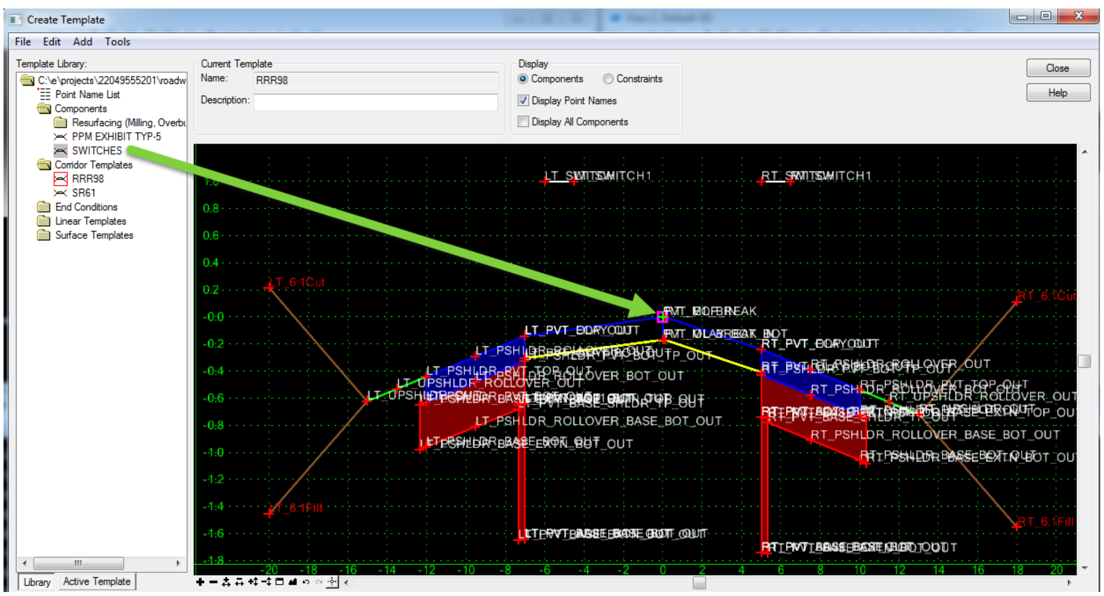


4. Drag the **SWITCHES** template to the project **Components** folder.



5. Choose **OK** and choose **Yes** to Save the data to the project template library, *22049555201.itl*.

6. With the *RRR98* template active, drag the **SWITCHES** template onto the center of the *RRR98* template.



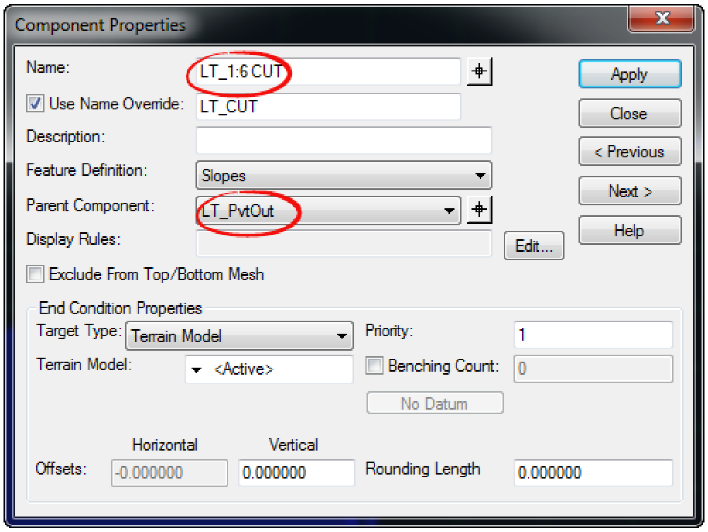
NOTE ***The switch template consists of two simple components left and right of the centerline. A label has been assigned to the horizontal constraint value. Also, display rules have been created for when the value is 1,2,3,4, or 5. By assigning one of the rules to a component, the display of that component and all related components can be controlled based on the value of the switch.***

▶ ***Create a Parent /Child relationship of all the Left side components.***

1. Open the *Component Properties* dialog for the **Left Cut Component**.

   a. Set the *Parent Component* by using the pick icon , select the **LT_PvtOut**.

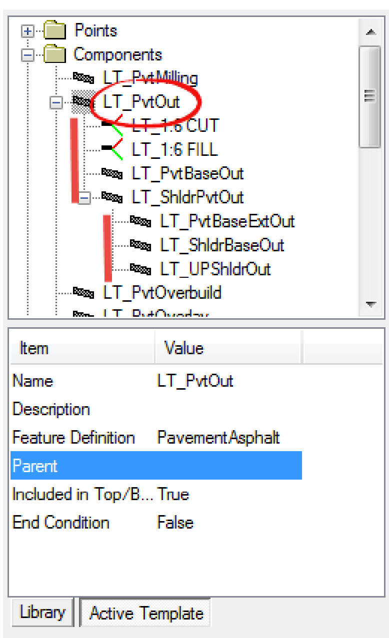
NOTE ***Use the wheel to zoom into the Left Widening LT_PvtOut component or select it from the list.***



   b. Choose **Apply** and **Close** the *Component Properties* dialog.

   c. Repeat this procedure for the **Left Fill**, and **Left Shoulder** components. The **Unpaved Shoulder** and **Base** components should already have a parent relationship which can be used.

2. Use the **Active Template** Tab to view the Component Relationships to the **LT_PvtOut.**

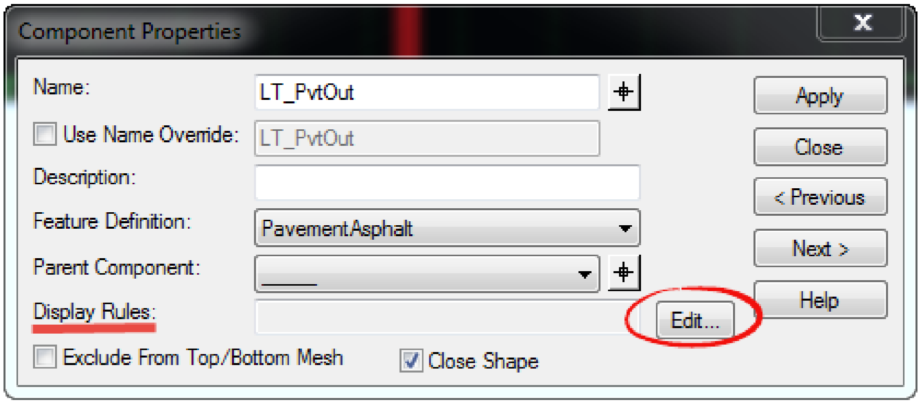


3. In the *Active Template* Component List, right click on the **LT_PvtOut** Component and uncheck the **Display** option,

4. All of the left side components should turn off, right click on the **LT_PvtOut** Component and toggle the **Display** back on.

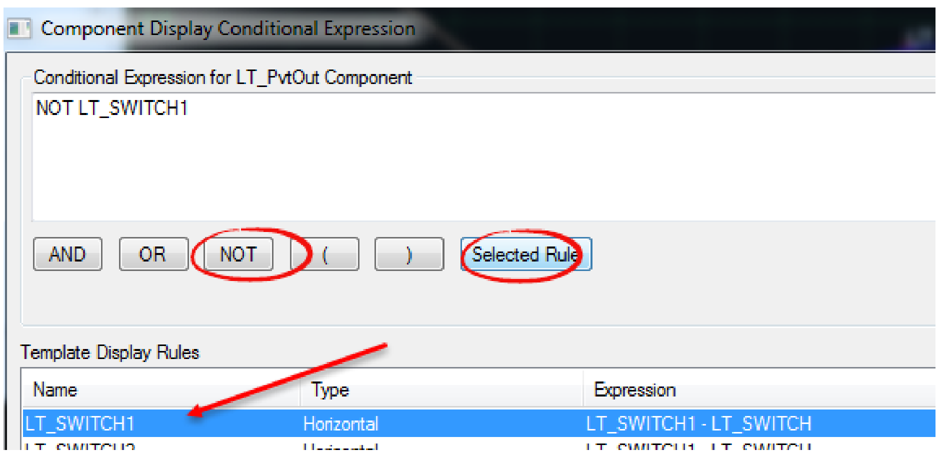
5. In the *Active Template* Component List, right click on the **LT_PvtOut** Component and choose **Edit**.

6. From the *Component Properties* dialog, Select **Edit** on the *Display Rules*: field



a. Select the *Template Display Rule* **LT_SWITCH1** rule from the list.

b. Build the *Conditional Expression* **NOT LT_SWITCH1** by clicking the **NOT** button and then **Selected Rule** button.



c. Choose **OK**, then **Apply**, then **Close** to save the display rule to the component.

NOTE ***Adding the rule NOT SWITCH1 is telling the template left side "Not To Display If The Horizontal Distance Of The Switch Is The Value 1"***

7. Choose **Close** and **Yes** to save change to exit the *Create Template* dialog.

2 BASIC CORRIDORS MODELS

CORRIDOR MODELING OVERVIEW

As defined in the Bentley Civil Help:

> *"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."*

The following are minimum requirements to use Corridor Modeling.

- Civil horizontal element
- Civil vertical element
- 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.

Corridor models are built at an interval, which determines the level of detail of the model. OpenRoads essentially takes the typical section stored in the template and places it every 25' (or whatever the interval is set to) along the alignment in order to build the 3D model. The FDOT CADD manual section 8.4.7 sets forth the maximum required intervals for a corridor, depending on the Context Classification of the roadway. Corridors can certainly be built at a more frequent interval, but this is at the expense of more computing power (RAM, disk space, and CPU). To optimize the model, the interval spacing should only be made tighter than the maximum when needed.

For this project, the Context Classification is C3C. An excerpt from the table in the CADD manual is shown below, showing the corridor interval requirement for C3C. The interval can be set to the tangent requirement as long as the design stage used decreases the interval spacing on curves.

Maximum Corridor Frequency Interval Spacing (Feet)			
Context Classification	**Tangent**	**Curve**	**Intersection**
C3C	20	10	5

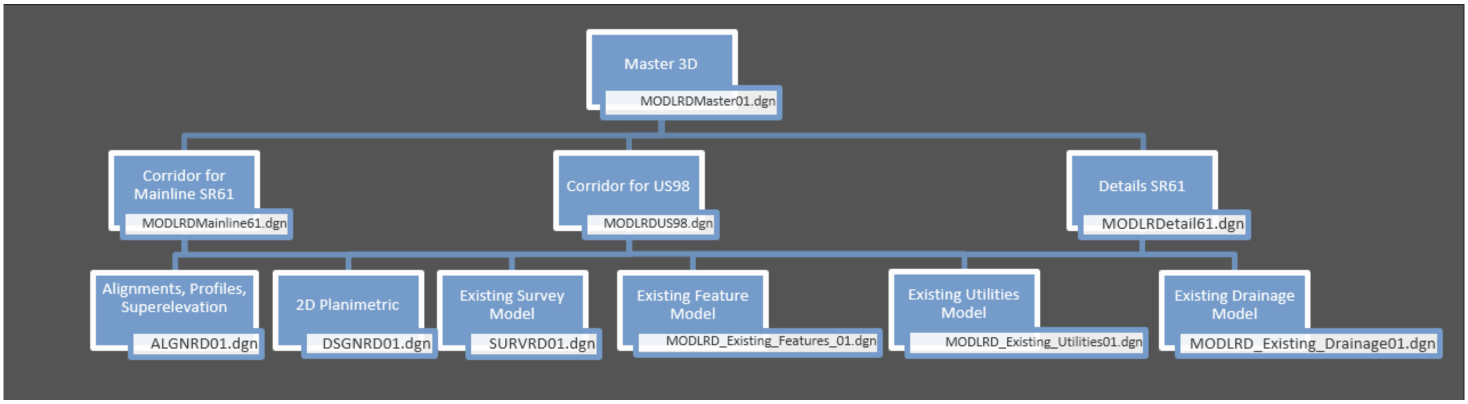
CORRIDOR MODELING PLANNING

It is recommended to plan out the 3D modeling approach on a project. Some have referred to this a Model Management Plan. This plan will attempt to outline the following:

- Determine how to break up the project into logical independent corridors.
- Determine which sections of the project are needed for detail modeling and surface modeling.
- Determine the files and filenames to be used for corridors and details.

NOTE ***The project 3D Model may be in separate files or all combined into one file.: The FDOT file defined to be used for Corridor and Detail Models is MODLRD(xx)## with an optional descriptor in the parentheses.***

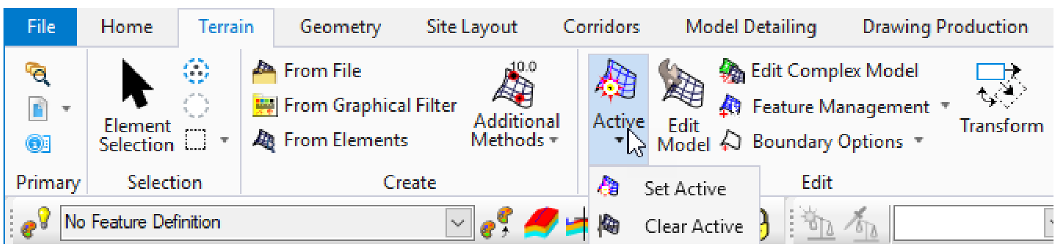
Below is the Model Management Plan for this project dataset. In this chapter we will be creating the three proposed model files.



Exercise Overview – Basic Corridor Modeling

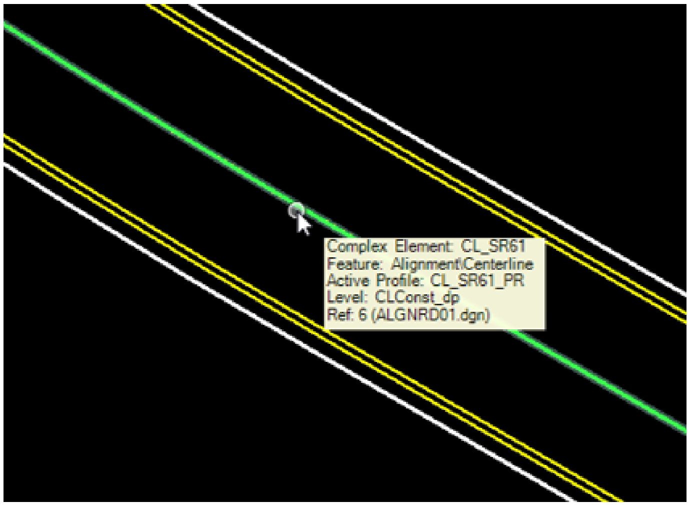
Exercise 2.1 Prepare to Create Corridor Model for SR61

1. Open the *MODLRDMainline61.dgn* file of the C:\Worksets\FDOT\22049555201\Roadway folder of the WorkSet.
2. Reference the *GDTMRD01, ALGNRD01 and DSGNRD01* files.
3. Use the **Terrain > Edit > Active > Set Active** tool.

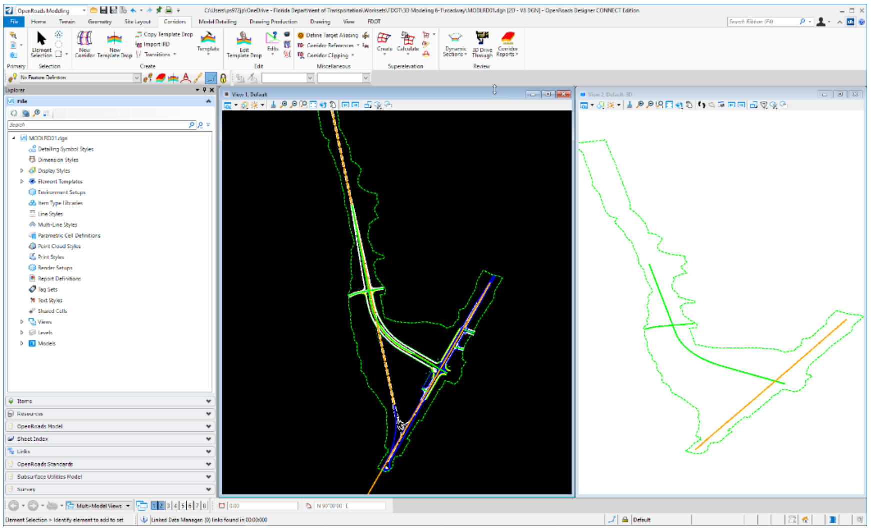


4. At the cursor prompt, select the **Terrain Boundary** green dashed line from the attached *SURVRD01* reference file. This will set the terrain model as active.

5. Move the cursor over the SR61 Centerline Feature and verify an Active Profile is set..



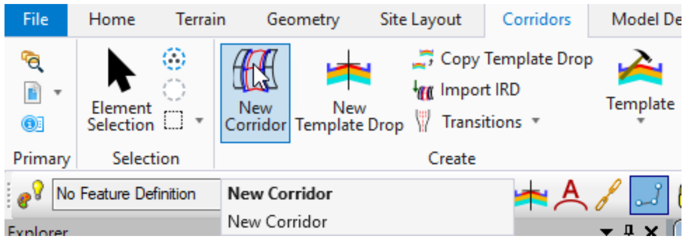
6. To set up the Views for viewing the 2D Plan and 3D Model simultaneously in the FDOTCONNECT WorkSpace, Select the F2 Function Key on the keyboard. This will open an Isometric View of the project.



7. Save Settings.

Exercise 2.2 *Create Corridor*

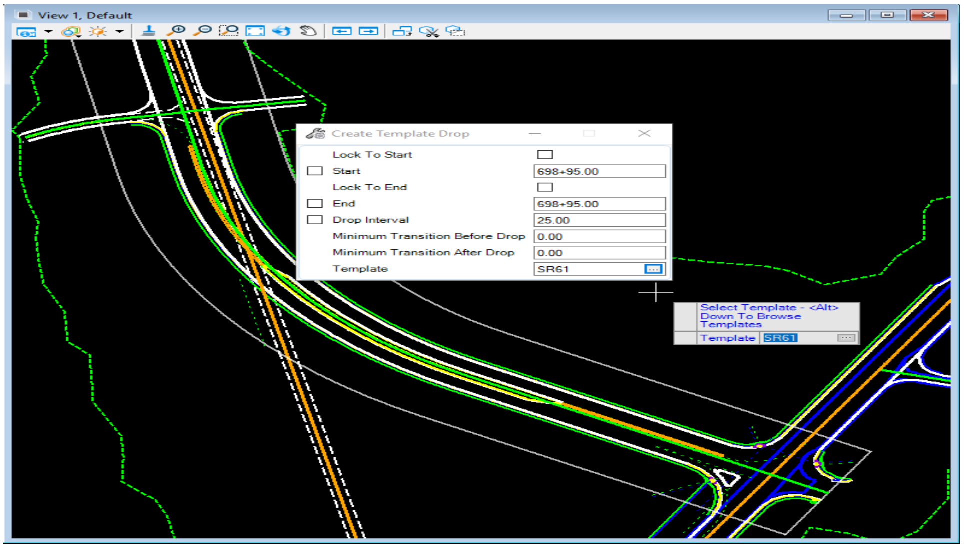
1. Use the **Corridors > Create > New Corridor** tool.



2. Select the SR61 Centerline in the Plan View when the "Locate Corridor Baseline" prompt comes up.
3. Reset to accept the **Active Profile**. This profile resides with the *SR61 Civil Feature Centerline*.
4. Enter the *Feature Name*, **SR61**, in the *Create Corridor* dialog.
5. Data point to accept the Name of the Corridor, **SR61**. The corridor is created AND the integrated *Create Template Drop* diaog launches.

NOTE *Once a Corridor is created, a shape boundary is placed in the Plan View representing its outline. This shape is initially placed on the CorrHndlStg1_dp level. It has several properties which can be seen by clicking on the shape and choosing first icon. One of the properties is the Feature Definition (Design Stage).*

6. Once the *Create Template Drop* dialog is opened, first select the corridor *Template* to be placed on the corridor. Either use the **Ellipsis** icon on the dialog <OR> select **ALT down arrow** to pick a Template.



7. Find the **SR61 inside TS** template in the *Corridor Templates* folder of the active Project Template Library. Select it and click **OK**.

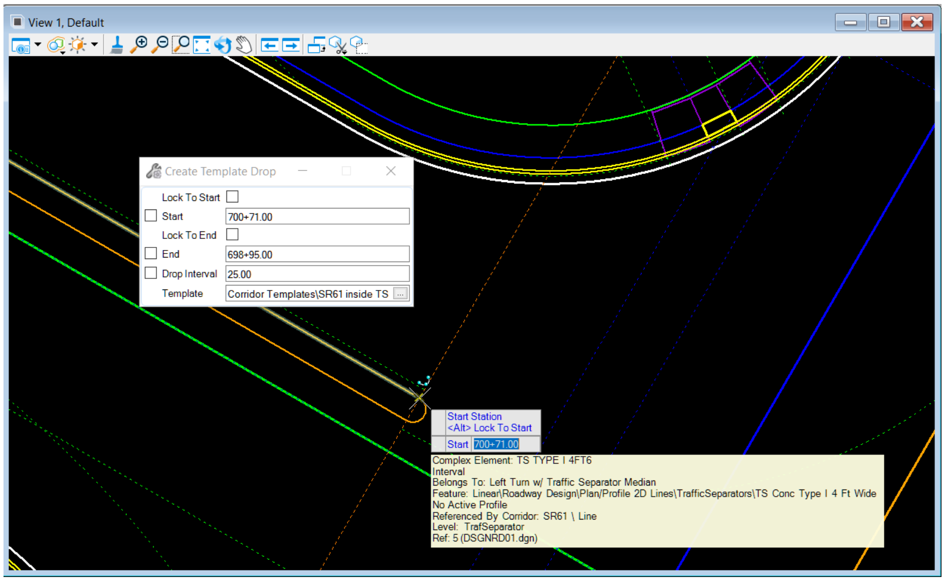
NOTE ***OpenRoads appears to have an issue applying superelevation properly when a template has multiple end condition search functions, so we have split the corridor into three template drops, one for the two traffic separator sections and one for the median section.***

NOTE ***Verify that the correct .itl Template Library is loaded at the top left of the Pick Template dialog. If it is not, the correct template can be loaded by opening the Create Template dialog and opening a different .itl file prior to using the tool. Refer to the previous chapter.***

8. Data point to accept the *Template* and move to the next setting.

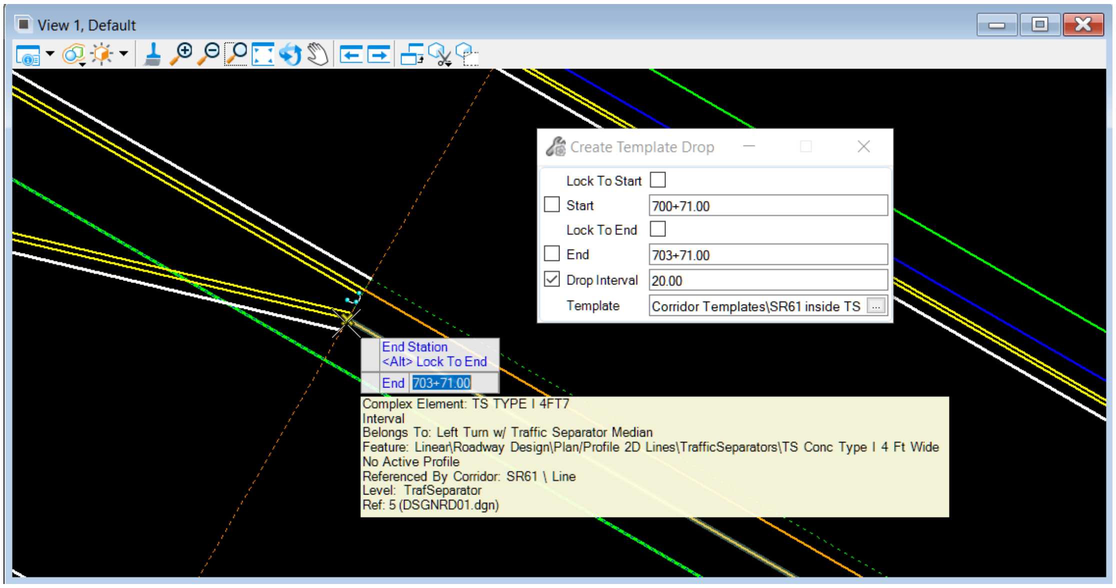
9. Continue to define the *Create Template Drop* dialog information entering and accepting the following for the SR61 Corridor:

    a. *Start* – Use keypoint or intersect snap click to the traffic separator nose near the intersection with US 98, *Station* **700+71.00** as shown below.



b. *End* – snap to the end of the traffic separator at *Station* **703+71.00** as shown below.

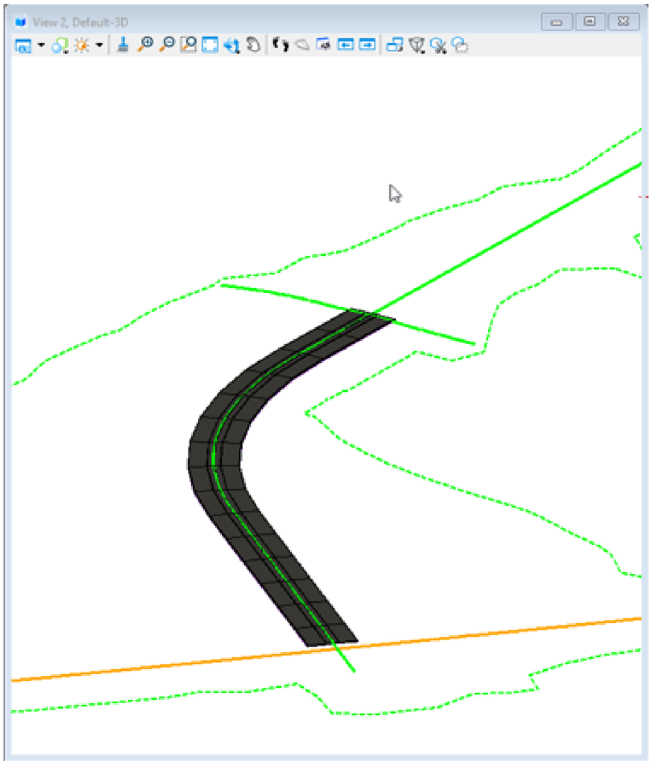
c. Set the *Drop Interval* to **20**.

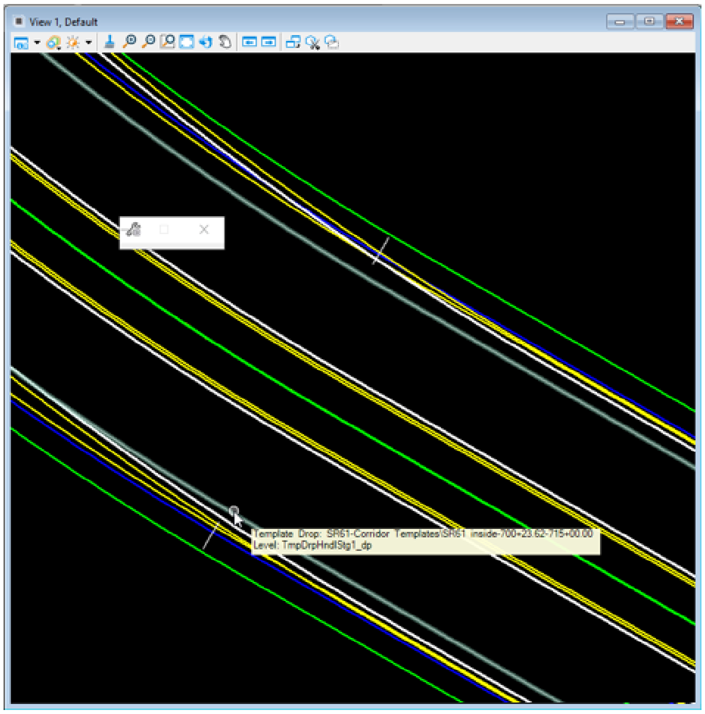


10. Repeat Steps 6-8, selecting the **SR61 inside median curb** in the *Pick Template* dialog.
    a. Snap the **start station** to the end of the previously inserted template at the beginning of the curbed median section, Sta. **703+71.00**.
    b. Snap the **end station** to the end of the curbed median section, Sta. **711+88.90**.
    c. Ensure the **drop interval** is set the same as above.

11. Repeat Steps 6-8 to insert another template drop for the next traffic separator section.
    a. Snap the **start station** to the end of the previously inserted template at the end of the curbed median section, Sta. **711+88.90**.
    b. Snap the **end station** to the beginning of the radius return for the side street shortly after the end of the traffic separator, Sta. **714+23.96**.
    c. Ensure the **drop interval** is set the same as above.

12. Upon completion of the *Corridor Processing* bar in the lower right hand side of the OpenRoads status bar, the 3D model will be displayed in View 2.



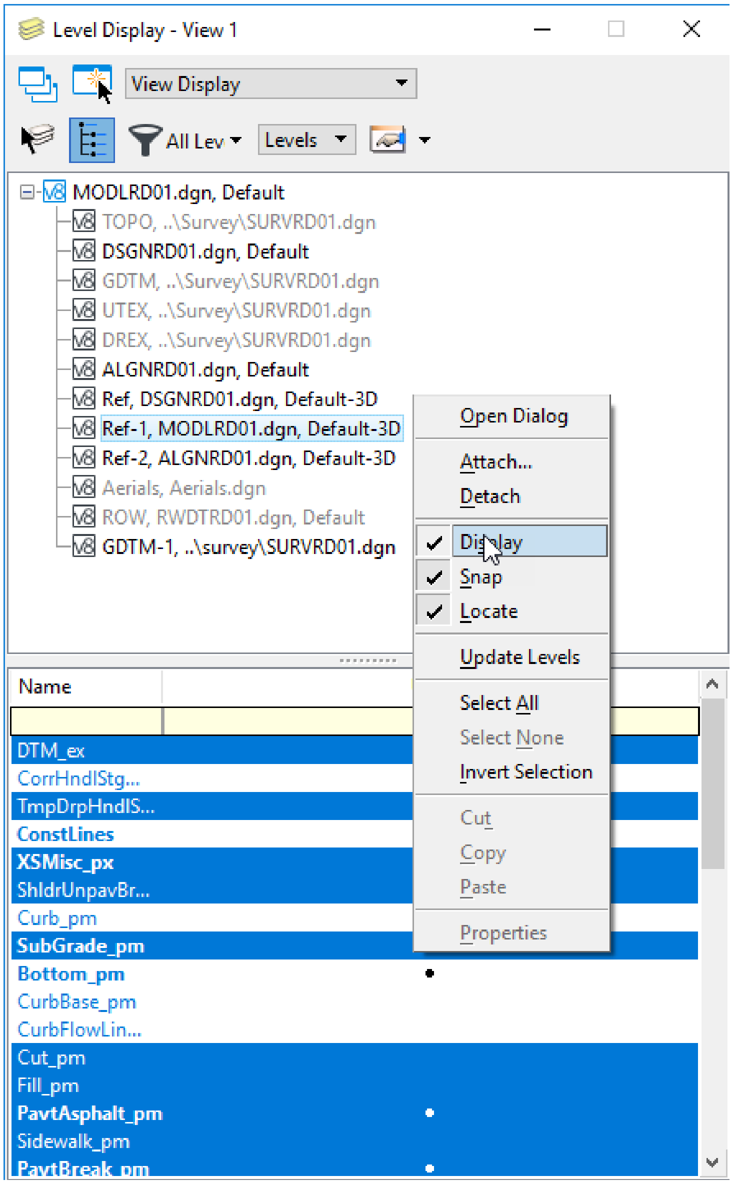


NOTE ***Once a Template Drop is created, a shape boundary is placed in the Plan View represent its outline. This shape is initially placed on the TmpDrpHndlStg1_dp level. It has several properties which can be seen by clicking on the shape and choosing first icon. Properties include the Template Drop Interval and the Template Name.***

▶ *Turn 3D Reference File Display Off in the Plan View*

At times the line work in the Plan View can become confusing with 3D lines over top of the 2D lines. This View can be simplified by turning the 3D Model Reference file display Off.

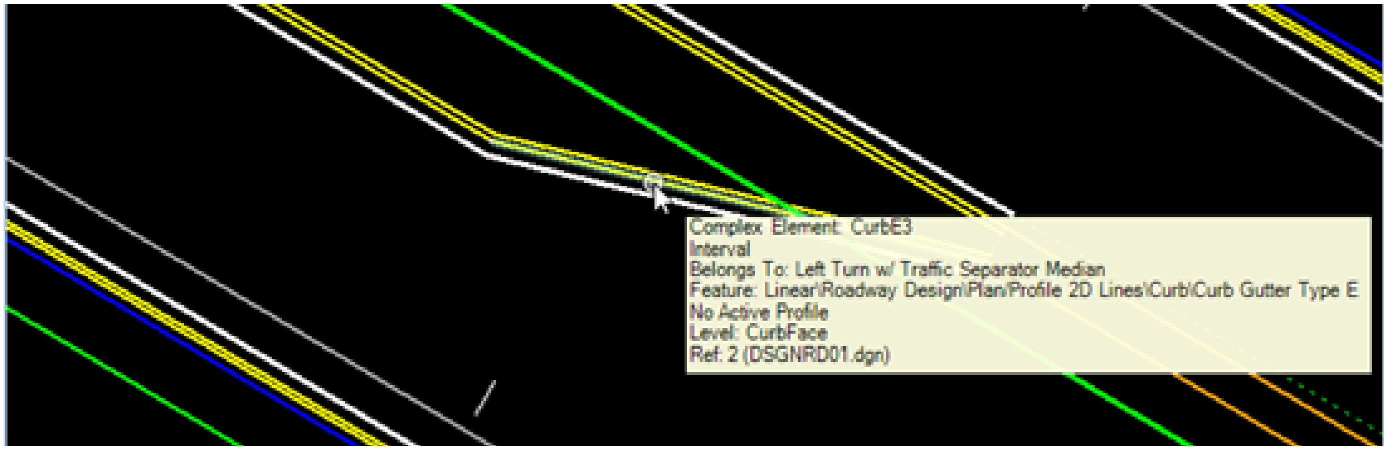
1. Data Point somewhere in View 1 to make it active.
2. On the OpenRoads **Level Display** dialog, navigate to the *Ref. MODLRDMainline61.dgn, Default-3D* file.
3. Right click on the file name and un-check the **Display** option.



Exercise 2.3 *Add Corridor References, SR61*

Corridor References are related to the template points having a Horizontal Feature Constraint to control the location of the point on the corridor. They are 2D graphical Civil Features that need to be added to a corridor. For the SR61 corridor a selection of median Civil Features are used for template external references.

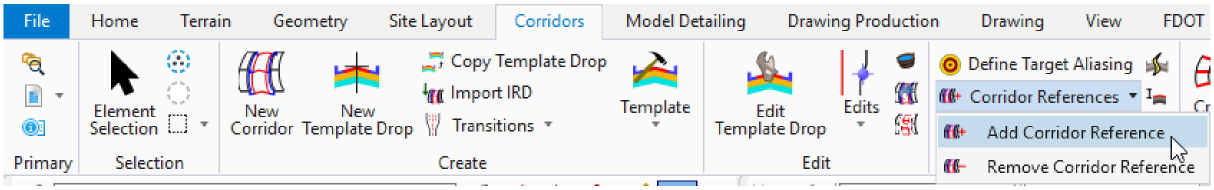
1. The SR61 template is designed to target Curb Gutter Type E lines in the median. Hover the cursor over one of the median lines to verify that it has the Feature Definition of Curb Gutter Type E.



2. Create a selection set of the following 12 features in the plan view:
   - 2 – Pavement Asphalt EOPA lines in the median
   - 4 – Pavement Asphalt EOPA taper lines in the median
   - 4 – Pavement Asphalt EOPA lines on the outside edge of pavement
   - 2 – Curb Gutter Type E lines in the median
   - 2 – Curb Gutter Type E taper lines in the median
   - 4 – TS Conc Type I 4 ft Wide lines in the median

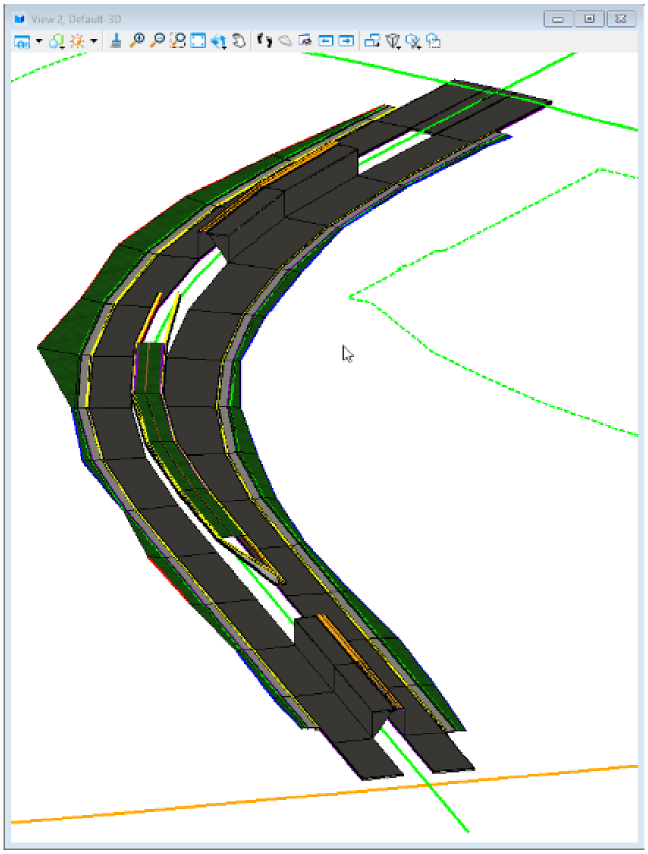
- Modeling the TrafSeparator level, do not add the Nose Radius Element to the Selection Set. This will be modeled in Chapter 9 with a 3D Civil Cell.

3. Use the **Corridors > Miscellaneous > Corridor References > Add Corridor Reference** tool.



4. At the *Locate Corridor* prompt, select the corridor handle and then data point to add the selected lines as listed above to the corridor.

5. Once the Reference Lines have been added, the Corridor will automatically process to include the new Horizontal Feature Constraints. The median features will come in several feet above the pavement, as intended on the template. This will be resolved in the next exercise.



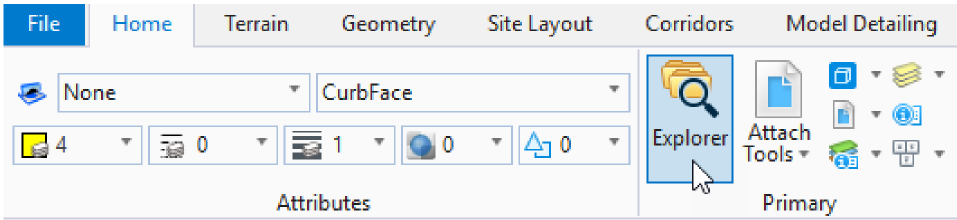
Exercise 2.4 *Change Corridor Feature Definition, SR61*

The FDOTConnect WorkSpace includes several Corridor Feature Definitions to help with various tasks for Design and 3D Modeling. Depending on the active Feature Definition, processing the Corridor will take longer.

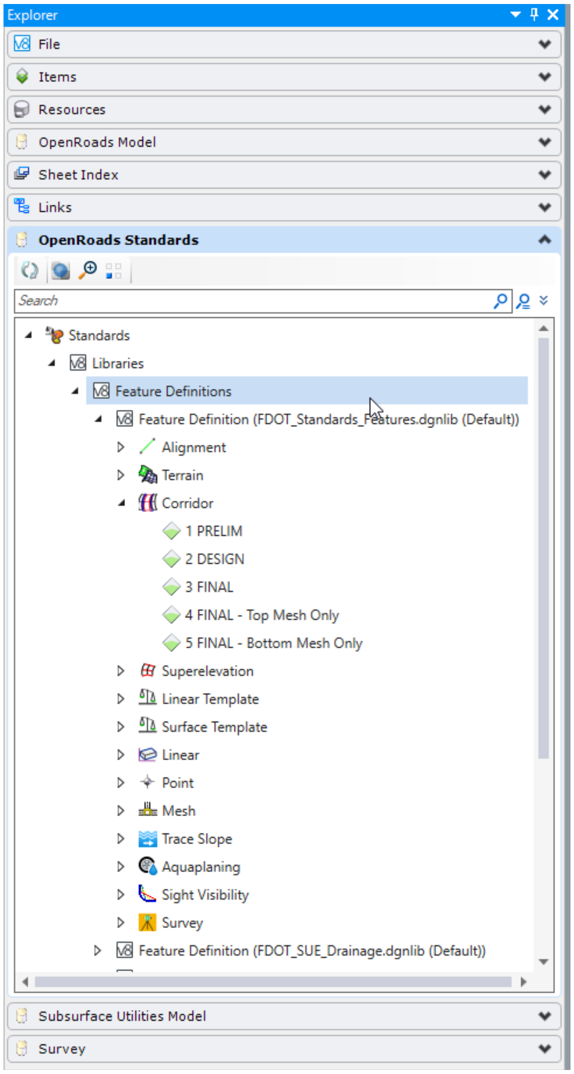
To optimize model performance, it is recommended that designers wait to change the Feature Definition until later in the design process, as each definition is set up with multipliers that decrease the corridor interval spacing.

For example, the Design stage might be utilized for a 60% submittal, while the Final stage might be utilized for the 90% and final submittals.

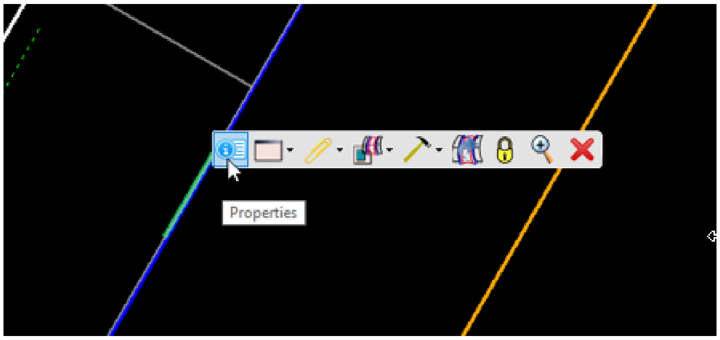
1. Open the *Explorer* pane from the *Home* tab or with the **F11** *Function Key.*



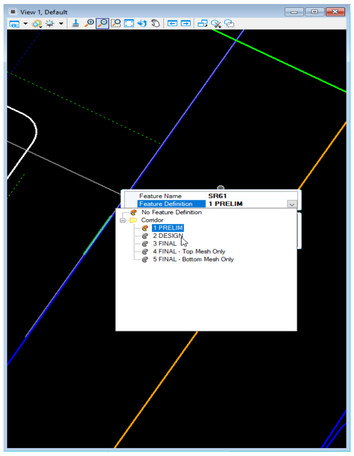
2. Select to expand the **OpenRoads Standards** section and expand the **Standards** option list.
3. Expand **Corridor** under **Libraries > Feature Definitions > Feature Definition** *(FDOT_Stanrdards_ Features.dgnlib (Default))*. These Feature Definitions are set up for various Design Stages.



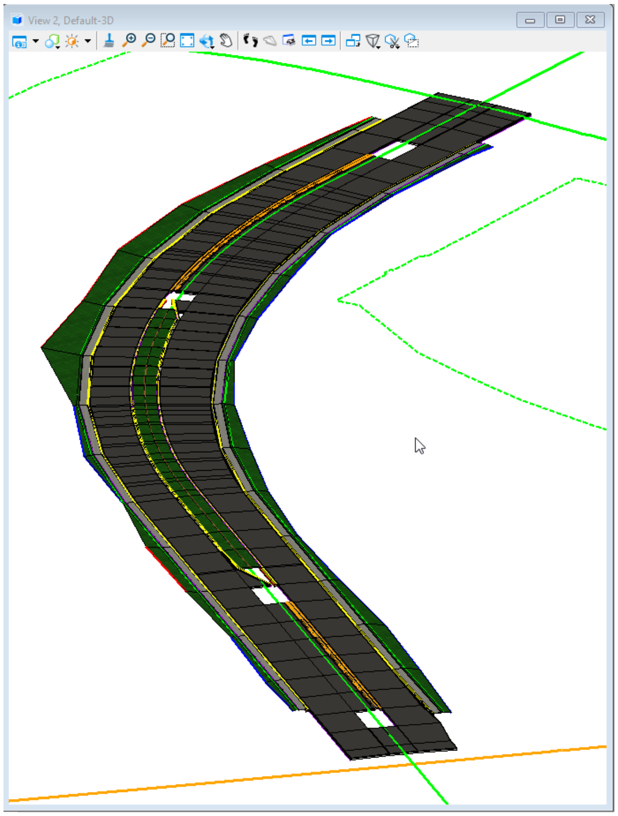
4. Select the **Handle** of the **SR 61** Corridor and locate the **Properties** icon when the menu displays.



5. Select the **Properties** icon and change the *Feature Defintion* from **1 PRELIM** to **3 FINAL.**



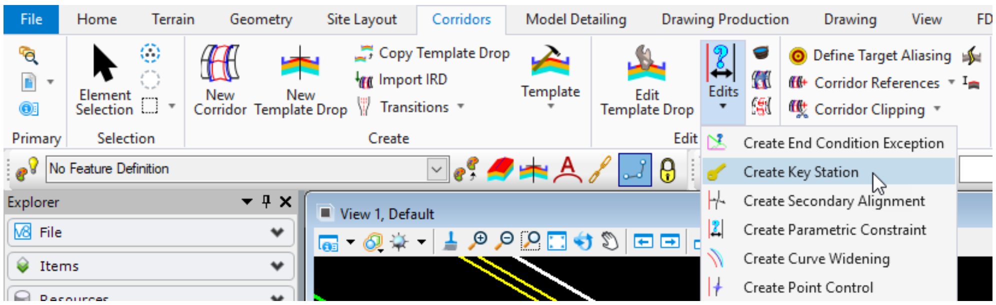
6. The Corridor will re-process and the 3D Model will re-draw with a tighter interval. Notice that the outside corridors remain unchanged.



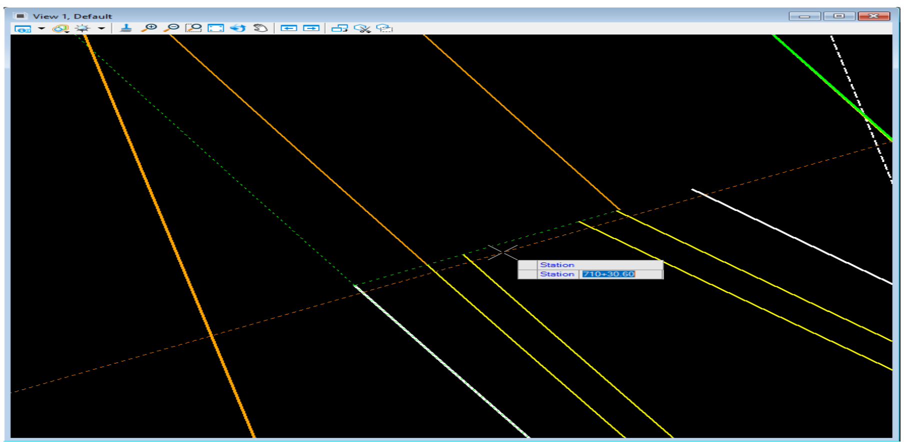
Exercise 2.5 *Add Key Stations, SR61*

Create Key Station tool is useful to add stations that are not coincident with the template interval. When the median conditions change abruptly, it is desirable to include the station for processing. Otherwise the model may have holes or overlaps, which is not desirable when it is used to generate 3D Deliverables for Automated Machine Guidance.

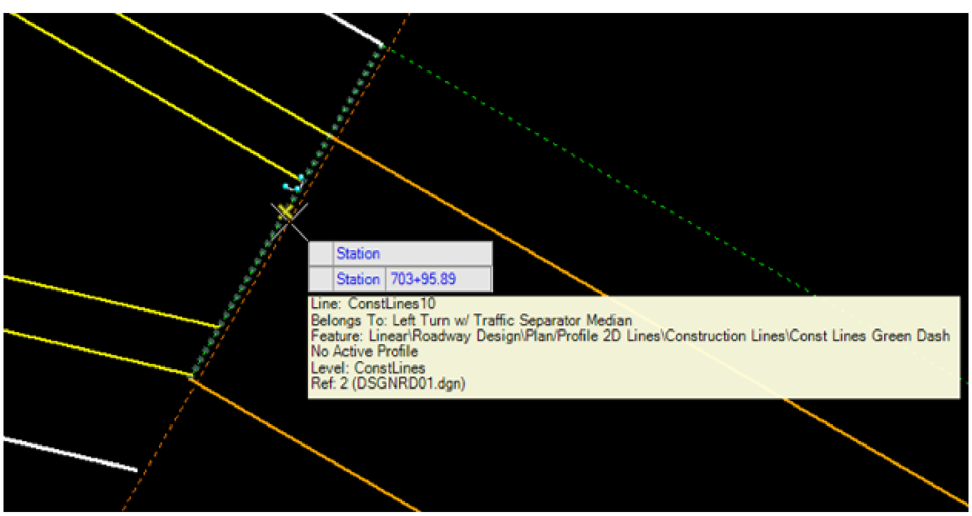
1. Use the **Bold Corridors > Edits > Create Key Station** tool.



2. Identify the **Corridor Boundary** *handle* of the **SR61** Corridor.
3. Use **AccuSnap** to locate the Plan View **CurbMedian / Traffic Separator** *division line.* Snap to a point on this line.

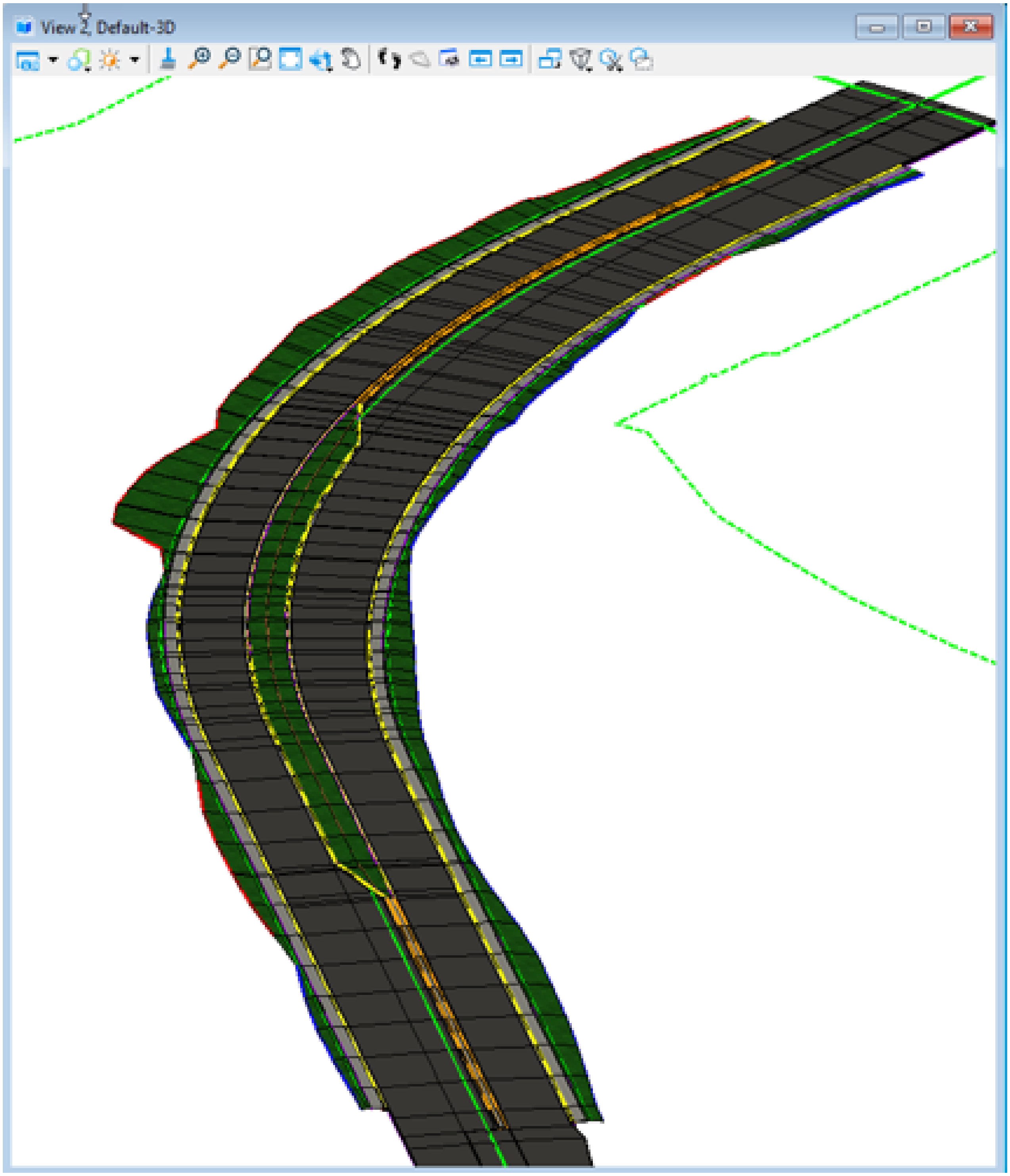


4. Repeat these steps for both **Traffic Separator** locations in the *Plan View.*



5. Add Key Stations at other transition areas, including where the left turn lane transition begins. If snapping directly on the transition point does not work, sometimes a key station is needed immediately before and/or after the transition point in order to minimize the size of the hole.

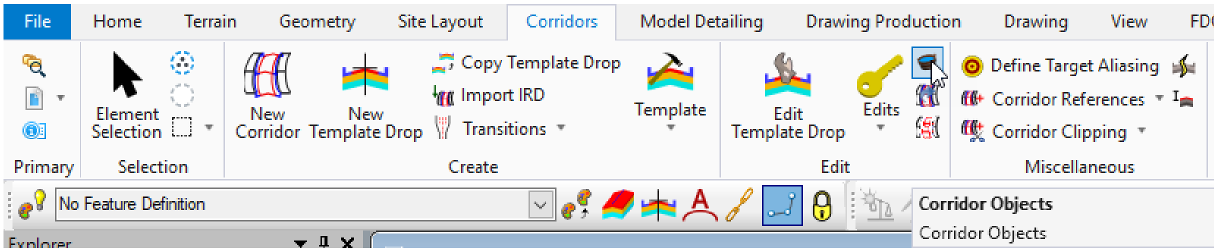
6. (Optional) Rotate the 3D View to a Top-down orientation, as it is sometimes easier to see where to snap to in the 3D view.



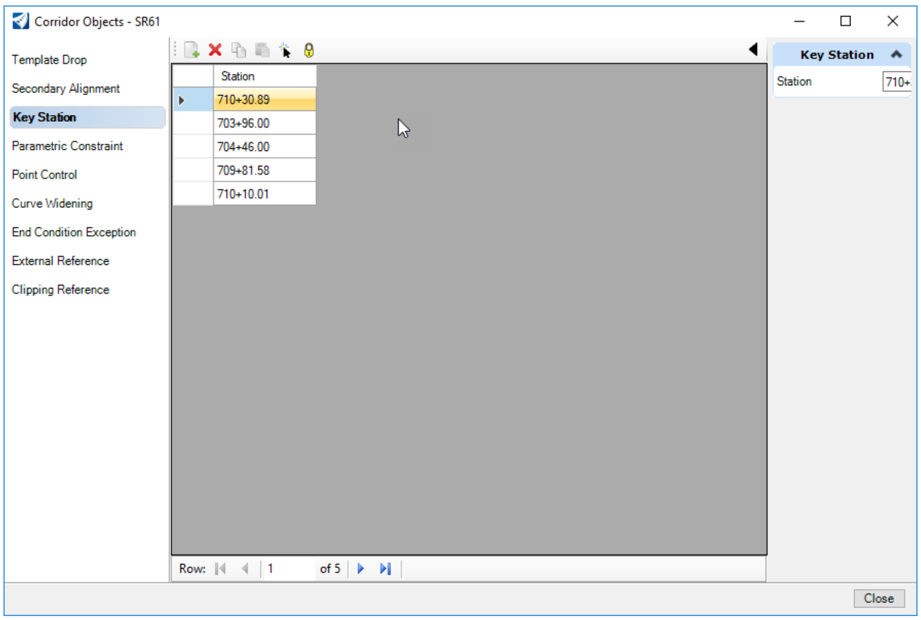
Exercise 2.6 *Review Corridor Objects, SR61*

The *Corridor Objects* dialog is a summary of all Corridor Modeling objects and provides an excellent method of managing data.

1. Use the **Bold Corridors > Corridor Objects** tool.



2. Identify the **Corridor Boundary** *handle* to open the *Corridor Objects* dialog.



3. Review the various objects on the corridor. If too many key stations were added in the previous step, they can be deleted or modified in this dialog.

Exercise 2.7 *Parametric Constraints, SR61*

The *FDOTConnect.itl* file contains some FPM Exhibit Templates which are delivered with variable medians included. The median can vary with the following conditions or component sets:

- Curb Median with or without Left Turns
- Crossovers at Intersections
- Traffic Separators with Left Turns

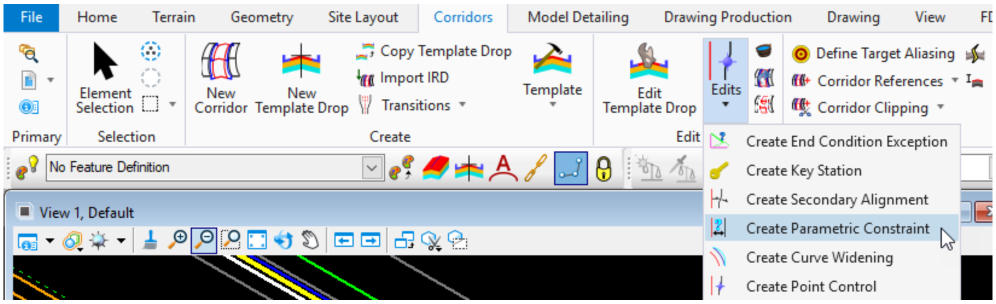
To properly operate the median condition templates, consider the following:

- The various median component sets have a parent end condition search lines that targets plan features; e.g. Curb Gutter Type E, Pavement Asphalt EOPA.
- Each of the median components sets are displayed ONLY if the target is found. This is by the Parent/Child relationship of the Template components.
- The LT and RT PGL Handles, or the LT and RT PGL in points, control the overall width of the median and can be modified to fit any project.
- Many of the median components have Horizontal Feature Constraints (HFC) defined to locate the 2D civil features and the horizontal range will need to be modified to fit the project.

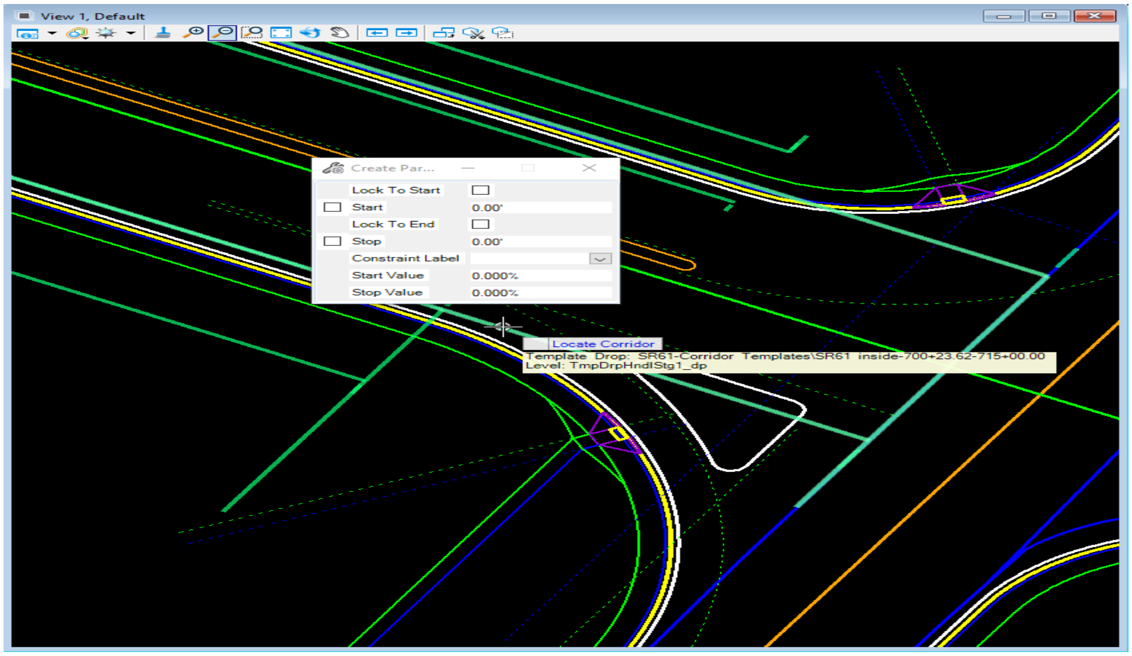
▶ *Add Parametric Constraint for Variable Median, SR61 Template*

The templates used have variable median conditions built within that needs to be set in place for the corridor.

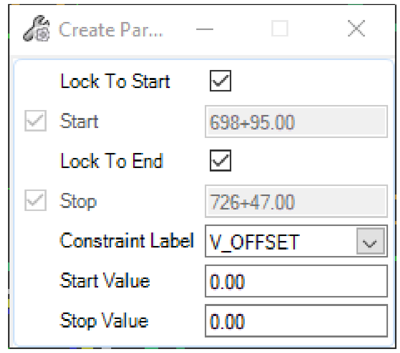
1. Use the **Corridors > Edit > Edits > Create Parametric Constraint > Create Parametric Constraint** tool.



2. Identify the **Corridor Boundary** *handle*. Continue to define the **Create Parametric Constraint** dialog information.



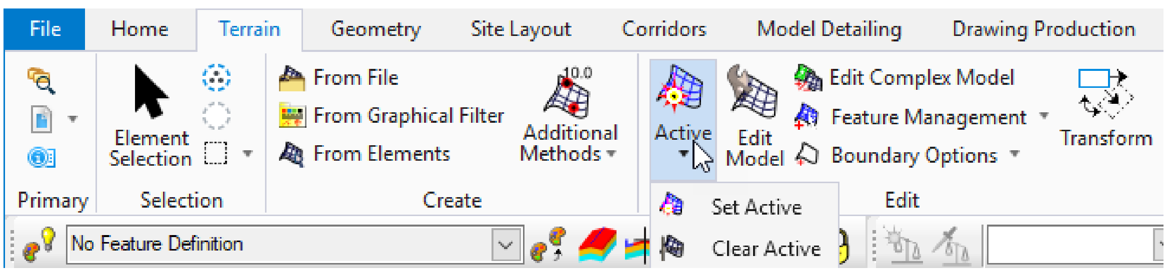
3. Enter and accept the following for the **SR61 Corridor**:
    - *Start Station* **Alt for Begin**
    - *Stop Station* **Alt for End**
    - *Constraint Label* **V_Offset**
    - *Start Value* **0.0**
    - *Stop Value* **0.0**



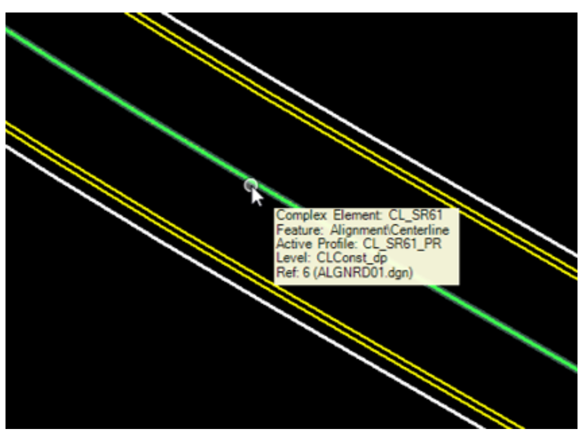
4. The variable median conditions are placed at the correct location vertically. This will ensure the median is at the correct elevation for the next exercise.

Exercise 2.8 *Prepare to create Corridor Model, SR61 End Conditions*

1. Go to the *FDOT ribbon* and Choose **Create File**.
2. Create a new *MODLRDDetail61.dgn* file. Select *Wakulla County*. Choose **Create/Open File**. If the file already exists, select **OK** to overwrite the existing file.
3. Reference the *MODLRDMainline61* file. Set Live Nesting Depth to 1.
4. Use the **Terrain > Active > Set Active** tool.



5. At the cursor prompt, select the **Terrain Boundary** green dashed line from the attached *SURVRD01* reference file. This will set the *terrain model* as **Active**.
6. Move the cursor over the **SR61** *Centerline Feature* and verify an **Active Profile**.

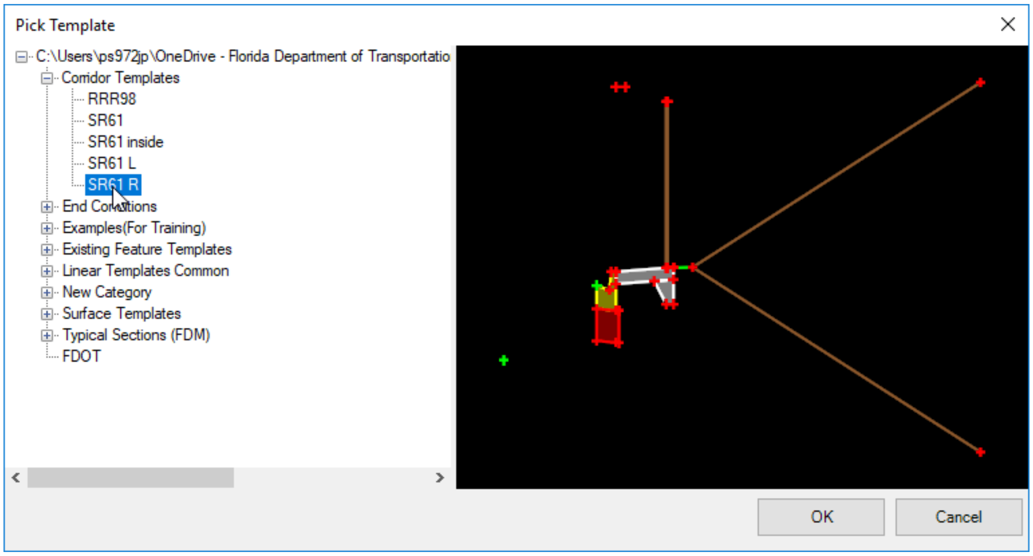


7. To set up the *Views* for viewing the **2D Plan** and 3D Model simultaneously in the FDOTConnect WorkSpace, Select the **F2** *Function Key* on the keyboard. This will open an *Isometric View* of the project.
8. **Save Settings**.

Exercise 2.9 Create Corridor, SR 61 End Conditions

Splitting the template allows more flexibility when adding driveways and side streets, as the end condition (outside) template can change at those locations without affecting the mainline. The template for the previous exercise only extended to the edge of pavement and did not include curb. In this exercise we will add the curb and the end conditions.

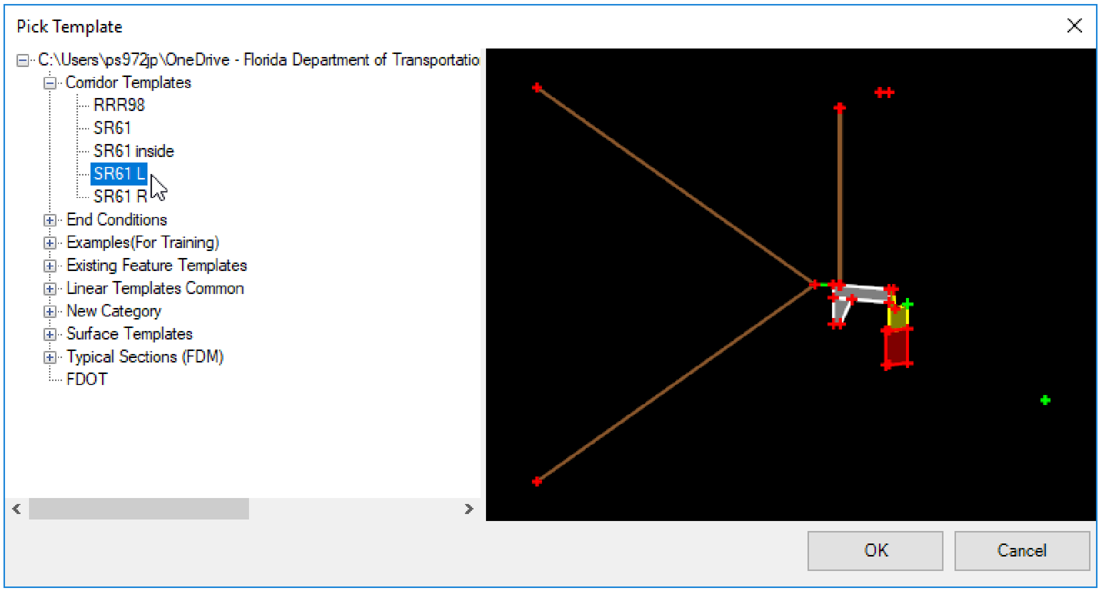
1. Use the **Corridors > New Corridor** tool.
2. Select the **SR61 Centerline** in the Plan View when the "Locate Corridor Baseline" prompt comes up.
3. Reset to accept the **Active Profile**. This profile resides with the *SR61 Civil Feature Centerline*.
4. Enter the *Corridor Name***, SR61 R**, in the *Create Corridor* dialog.
5. OpenRoads will continue on to the **Create Template Drop** command. Either use the **icon** on the dialog <OR> select **ALT down arrow** to pick a template.



6. Pick the **SR61 R** *template* in the *Corridor Templates* folder of the active Project Template Library.
7. Continue to define the *Create Template Drop* dialog information entering and accepting the following for the **SR61** *Corridor*:
   a. *Start* – Snap to the beginning of the curb radius return on the right side of SR 61 at the T intersection, *Station* **700+40.00**.
   b. *End* – Snap to the beginning of the curb radius return on the right side of SR 61 at the intersection, *Station* **713+68.58,** as shown on the right.
   c. Set the *Drop Interval* to **20** and accept the remaining prompts.

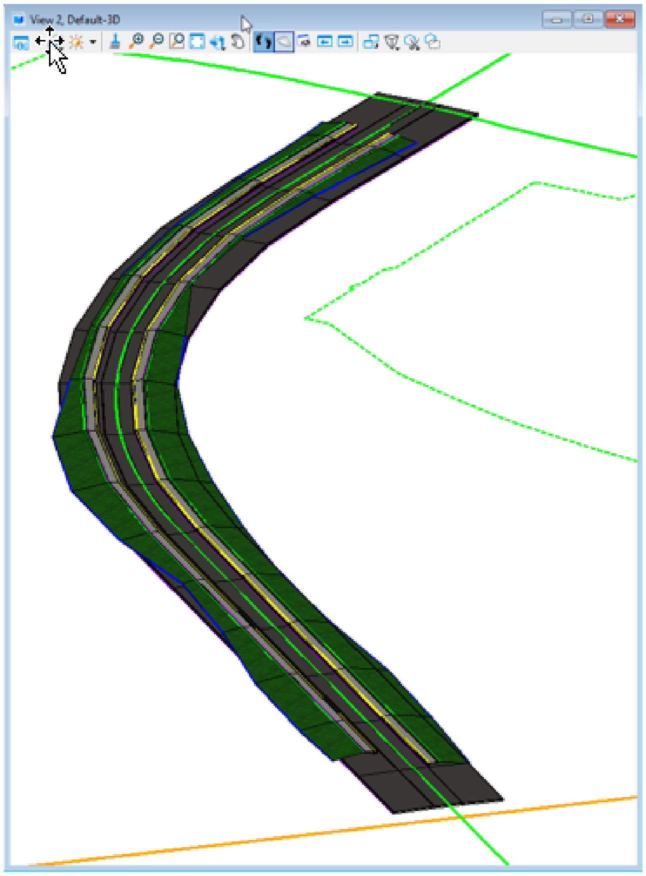
8. Repeat Steps 1-7 for the left side.

    a. Name the Corridor **SR 61 L** and pick the **SR 61 L** Template.



    b. Select the start and end points of the template drop based on the curb radius return points on the left side of the roadway. The stationing is listed below:

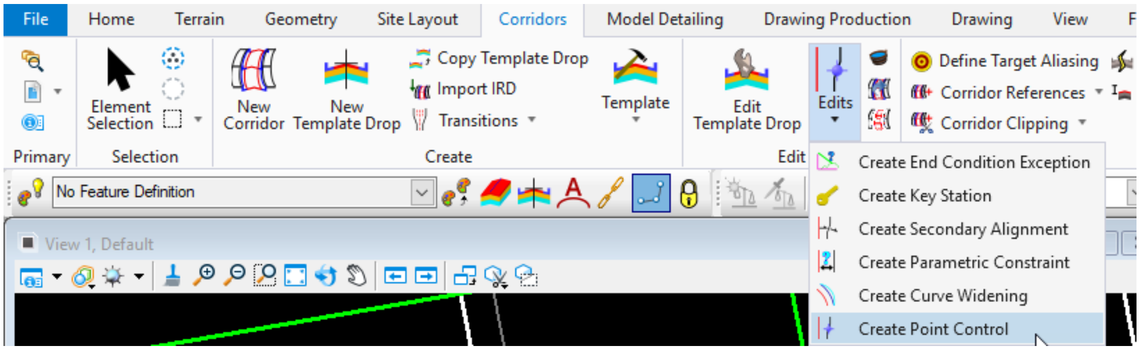
    Start – Station **701+34.00**
    End – Station **714+29.06**



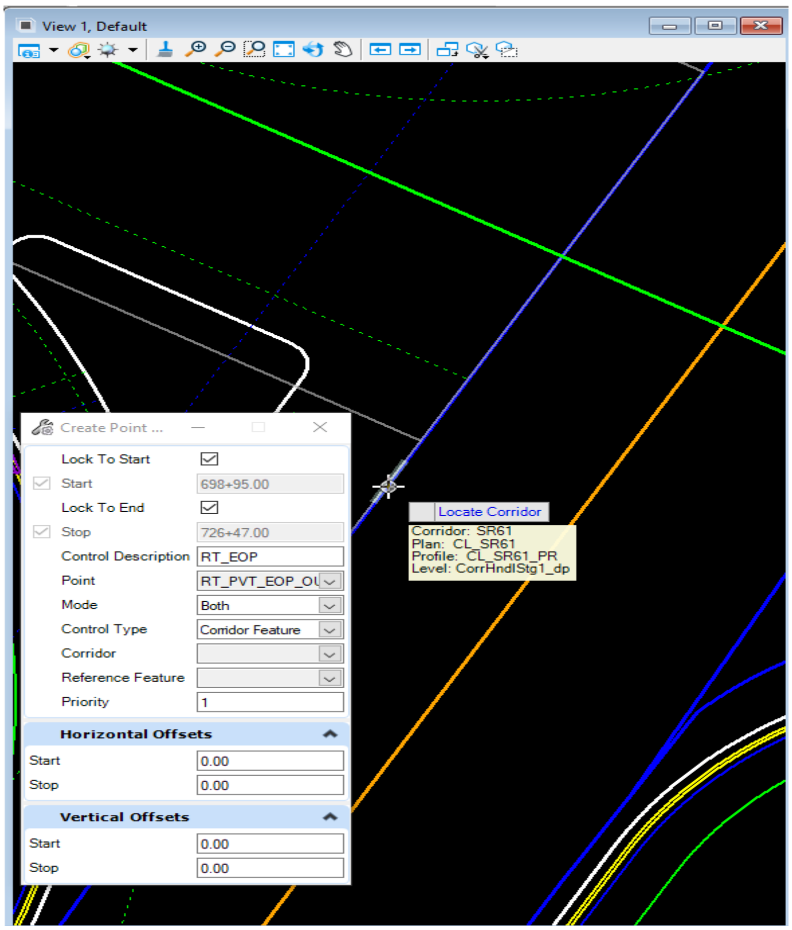
9. The corridor models will display in the 3D View but will be on top of the previously placed pavement model. This will be addressed in the next Exercise.

Exercise 2.10 Add Corridor Point Control, SR 61 End Conditions

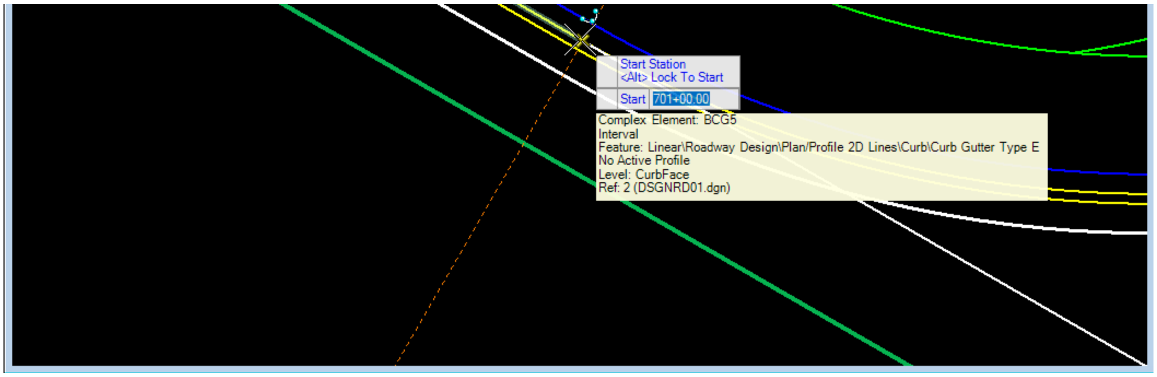
1. Use the **Corridors > Edit > Edits > Create Point Control** tool.



2. Identify the **Corridor Boundary** *handle* for the **SR 61 R** corridor.

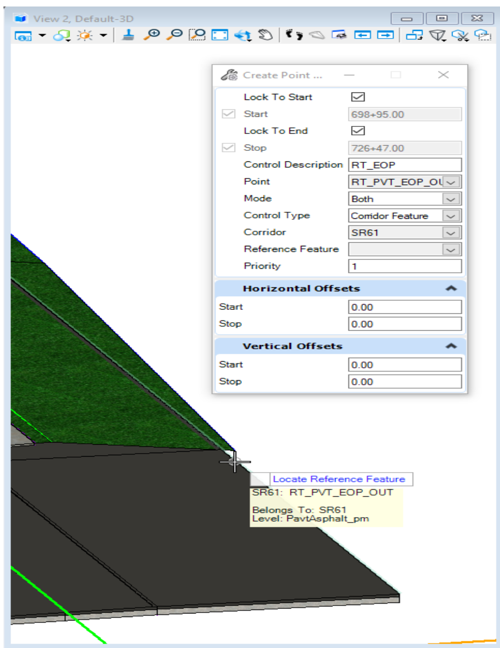


3. For the Start station, snap to the end of the radius return at Station 701+00.00.



4. Continue to define the *Create Point Control* dialog information. Enter and accept the following for the **SR61 R** Corridor:

- *End Station* **Lock to End**
- *Control Description* **EOP**
- *Point* **RT__PVT_EOP_OUT**
- *Mode* **Both**
- *Control Type* **Corridor Feature**

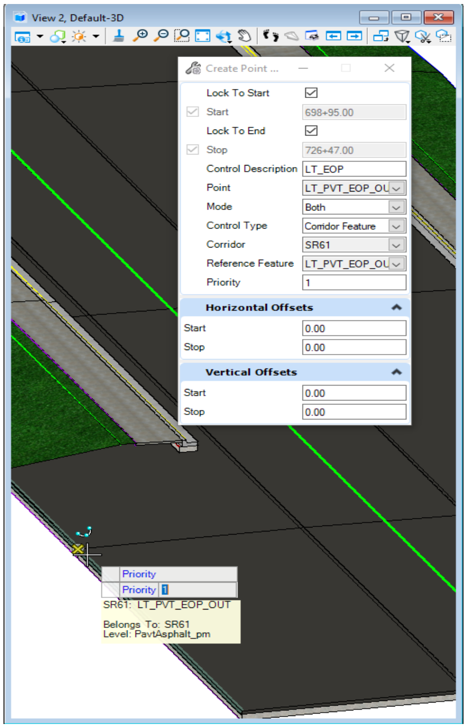


NOTE ***Do not select either the Point or the Reference Feature with the drop-down menu as ORD currently appears to have a defect where that will cause the point control to not display correctly. They must be selected in the 3D view.***

5. For the Corridor, select a handle on **SR 61** corridor developed for the inside (from *MODLRDMainline61.dgn*).

6. For the Reference Feature, select the **RT__PVT_EOP_OUT** line on the **SR 61** corridor (inside) in the 3D view, as shown on the right.

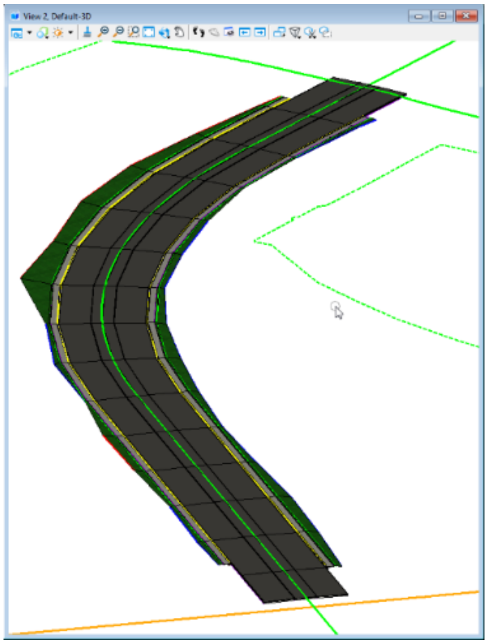
7. Accept the defaults for the remaining items. The 3D view will update to move the curb and sidewalk to match the edge of pavement of the **SR 61** corridor model.



8. Repeat Steps 1 through 7 to set a point control for the **SR 61 L** corridor, with the following differences in the dialog:

- Start Station: **701+34.00**
- *Control Description*: **EOP**
- *Point*: **LT_PVT_EOP_OUT**

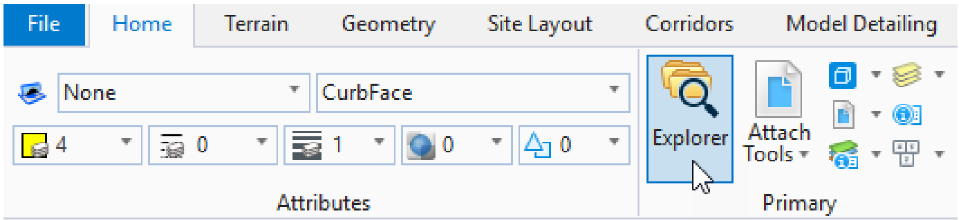
9. *For the Reference Feature*: select the **LT__PVT_EOP_OUT** line on the **SR 61** corridor (inside) in the 3D view, as shown on the right.



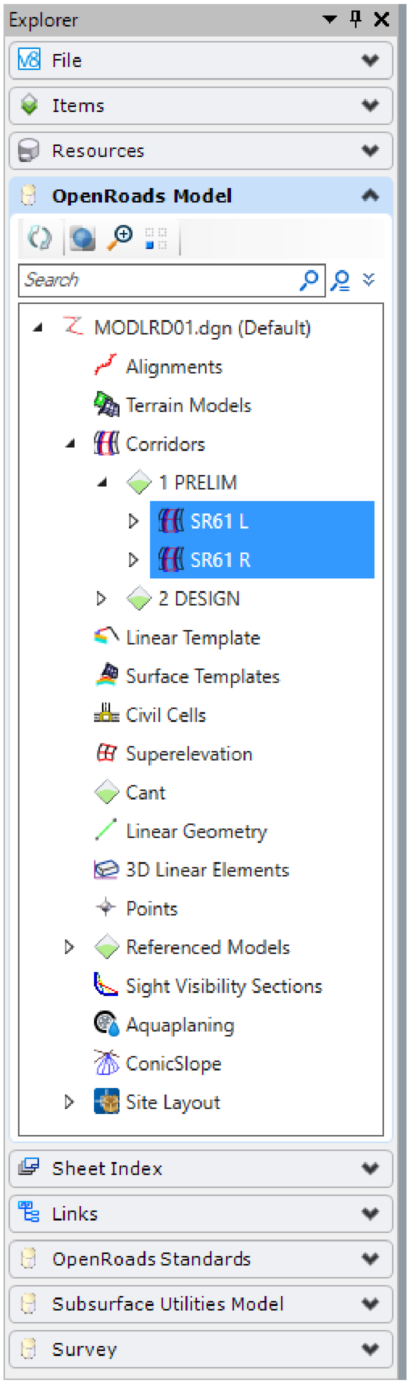
10. Repeat Step 6 to complete the point control. The model should look as shown on the left in the 3D view.

Exercise 2.11 *Change Corridor Feature Definition, SR61 End Conditions*

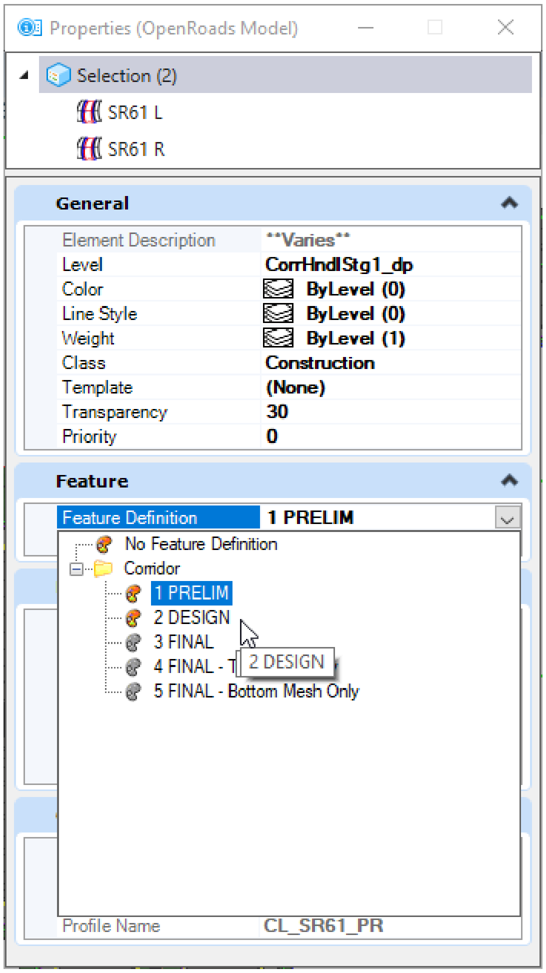
1. Open the **Explorer** pane from the Home tab or with the **F11** *Function Key.*



2. Expand the **OpenRoads Model** section of the **Explorer** window.

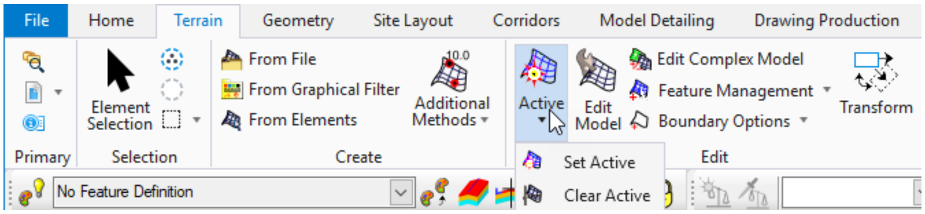


3. Expand **MODLRDDetail61.dgn (Default).**
4. Expand **1 PRELIM** under *Corridors.*
5. Right click on **SR61 L** and select *Properties*.
6. Hold down **Shift** or **Ctrl** and select **SR61 R**. The Properties window changes to show both Corridors selected.
7. Change the *Feature Definition* from **1 PRELIM** to **3 FINAL** as shown below. The 3D models for the outside corridors should redraw with a tighter interval.



Exercise 2.12 *Prepare to Create Corridor Model, US98*

1. Go to the FDOT ribbon and Choose Create File.
2. Create a new *MODLRDUS98.dgn* file. Select *Wakulla County*. Choose **Create/Open File**.
3. Reference the *SURVRD01, ALGNRD01,* and *DSGNRD01* files.
4. Use the **Terrain > Edit > Set Active** tool.



5. At the cursor prompt, select the **Terrain Boundary** green dashed line from the attached *SURVRD01 reference* file. This will set the *terrain model* as **Active**.
6. Move the cursor over the **US98** *Baseline Feature* and verify an **Active Profile**.
7. To set up the *Views* for viewing the **2D Plan** and 3D Model simultaneously in the FDOTConnect WorkSpace, Select the **F2** *Function Key* on the keyboard. This will open an Isometric View of the project.
8. Open the **Level Display** Browser.
9. With the 3D view active, turn off all levels in the *SURVRD01.dgn* reference, then turn on the **DTM_ex** level.
10. In the 2D view, right click and select **Turn Level Off By Element** to turn off the following levels in the *SURVRD01.dgn* reference by selecting the relevant elements:
    - All existing utility levels
    - Survey control points
11. Turn off all DTM levels in the *SURVRD01.dgn* reference except **DTM_ex.**
12. Save Settings.

Exercise 2.13 *Create Corridor, US98*

1. Use the *Corridors*, **New Corridor** tool.
2. Select the **US98 Baseline** in the Plan View when the *Locate Corridor Baseline* prompt comes up.
3. Reset to accept the **Active Profile**. This profile resides with the *US98 Civil Feature Baseline*.
4. Enter the *Corridor Name***, RRR98**, in the *Create Corridor* dialog.
5. OpenRoads will continue on to the **Create Template Drop** command. Either use the **icon** on the dialog <OR> select **ALT down arrow** to pick a template.
6. Pick the **RRR98 cross slope correction L control** *template* in the *Corridor Templates* folder of the active Project Template Library.
7. Snap the start and end stations to the milling limits shown in the *DSGNRD01.dgn* file.
8. Set the Drop Interval to 20 and accept the remaining prompts.

Exercise 2.14 *Add Corridor References, US98*

1. Create a selection set of the following lines from the *DSGNRD01.dgn* file:

   - All Milling lines
   - All Paved Shoulder lines
   - All Edge of Pavement lines

a. Open Level Display Manager.

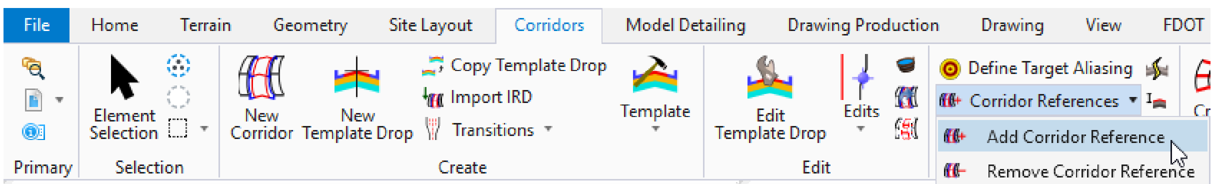
b. Turn off all levels but the Corridor handles in this file, and all but the needed levels in the *DSGNRD01.dgn* file.

c. Use the box selection tool to select everything shown.

d. Use the “-“ selection tool to remove the corridor handles from the selection set.

NOTE “Select all on level by element” does not work with references in ORD.

2. Use the **Corridors>Add Corridor References** tool.



3. Data point to add selection set as a corridor reference.

Exercise 2.15 *Additional Template Edits, SR61 (on your own)*

1. Add the sidewalk front and back lines as corridor references to the respective outside corridors.
2. Change the sidewalk buffer from **3 feet** to **0 feet** on both roadways.
3. Add the outside Edge of Pavement lines as a corridor reference line to the SR61 mainline corridor.

3 SUPERELEVATION

OVERVIEW

Superelevation rotates the pavement cross slopes through a curve so that vehicles can maintain stability and speed while on a turning roadway. Elevation banking is applied to help offset centrifugal force. Superelevation standards also define the transition length required to rotate from a normal crown to a fully banked curve and back again.

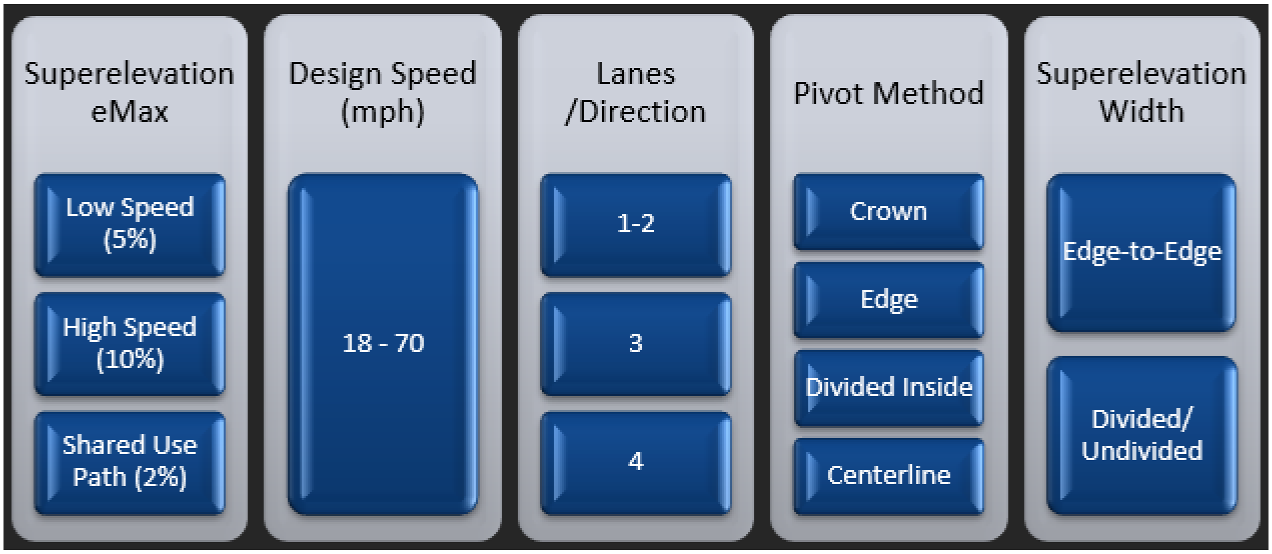
Superelevation can be calculated in two ways:

- *Rules-based* – using a set of preferences 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 should be stored in the ALGNRD DGN file, in the Superelevation model.

DATA NEEDED FOR SUPERELEVATION

The following should be determined before beginning the superelevation process on any project since OpenRoads will need the data input. For this training dataset, the correct inputs will be provided.



Exercise Overview - Superelevation

In these exercises, the SR61 Centerline has a single curve to define superelevation. Once the required superelevation is determined from a predefined FDOT rule file, it will be assigned to the SR61 corridor. The results will be reviewed in the Cross Section View and in the table editor. Reports will be generated as other methods to review data.

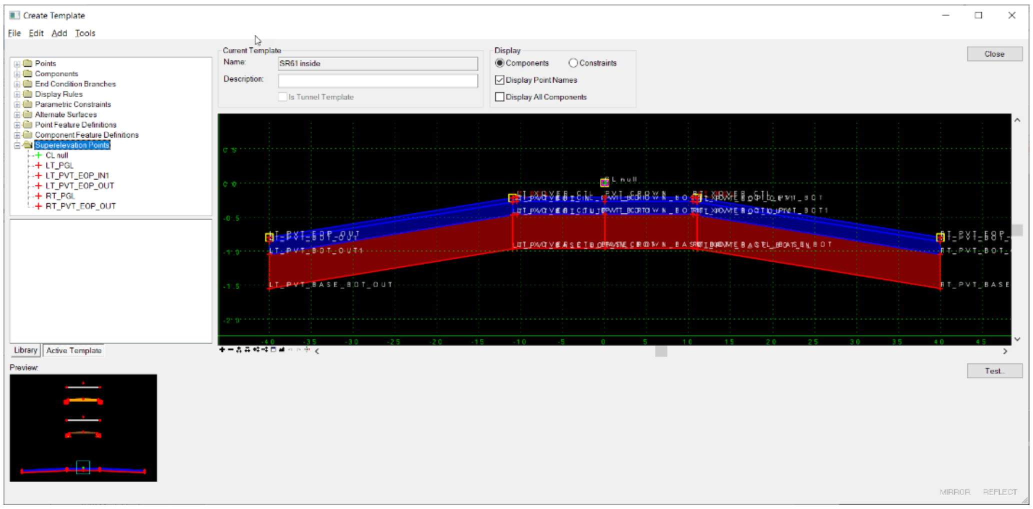
As an alternative to calculating supers with rules, we'll also import a dataset from a FDOT Curve Table (csv file generated from Excel).

The general workflow for superelevation is listed below.

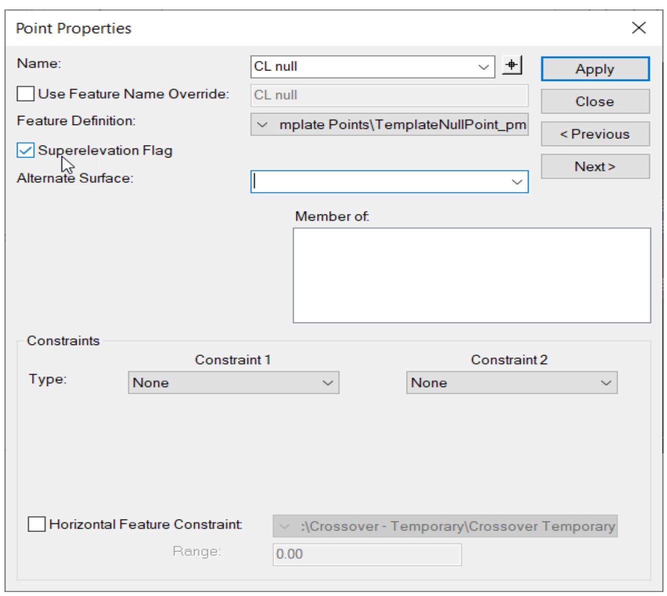
- Set up Superelevation Flags in Template Library
- Create Superelevation Sections and Lanes
- Calculate Superelevation Based on FDOT Tables
- Project Explorer Edits, Graphical Edits
- Superelevation Diagram and Reports
- Reference the Superelevation model of the ALGNRD File to the MODLRD file
- Assign Superelevation to Corridor, Associate Points
- Review superelevation in Cross Section View

Exercise 3.1 *Verify Template Superelevation Flags*

1. Open the *ALGRD01.dgn* file in the C:\Worksets\FDOT\22049555201\Roadway folder of the WorkSet.
2. Use the **Corridors > Create Template** tool.
3. Set active the **SR61 inside TS** *Template***.**
4. Switch to Active Template view and select the Superelevation Points folder to highlight the points in the template that will be affected by superelevation. Verify that all four **Pavement Edge** *Points* and the CL_null *Point* are highlighted.



5. Open any of the points *Properties* and verify the *Superelevation Flag* option is checked **ON**.

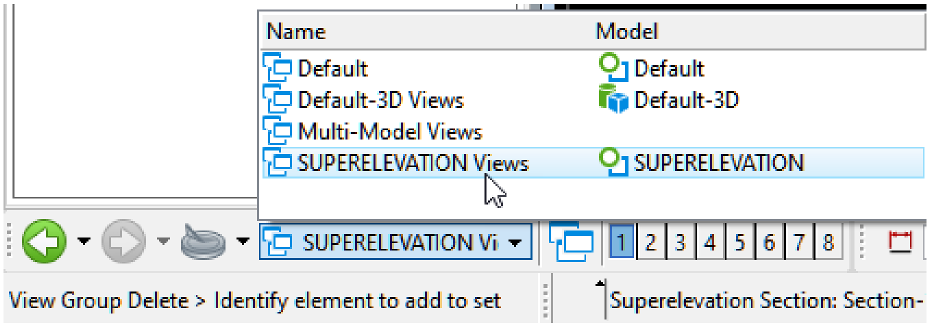


6. Repeat Steps 3-5 for the **SR61 Inside median curb** *Template*.
7. Close the *Create Template* dialog.

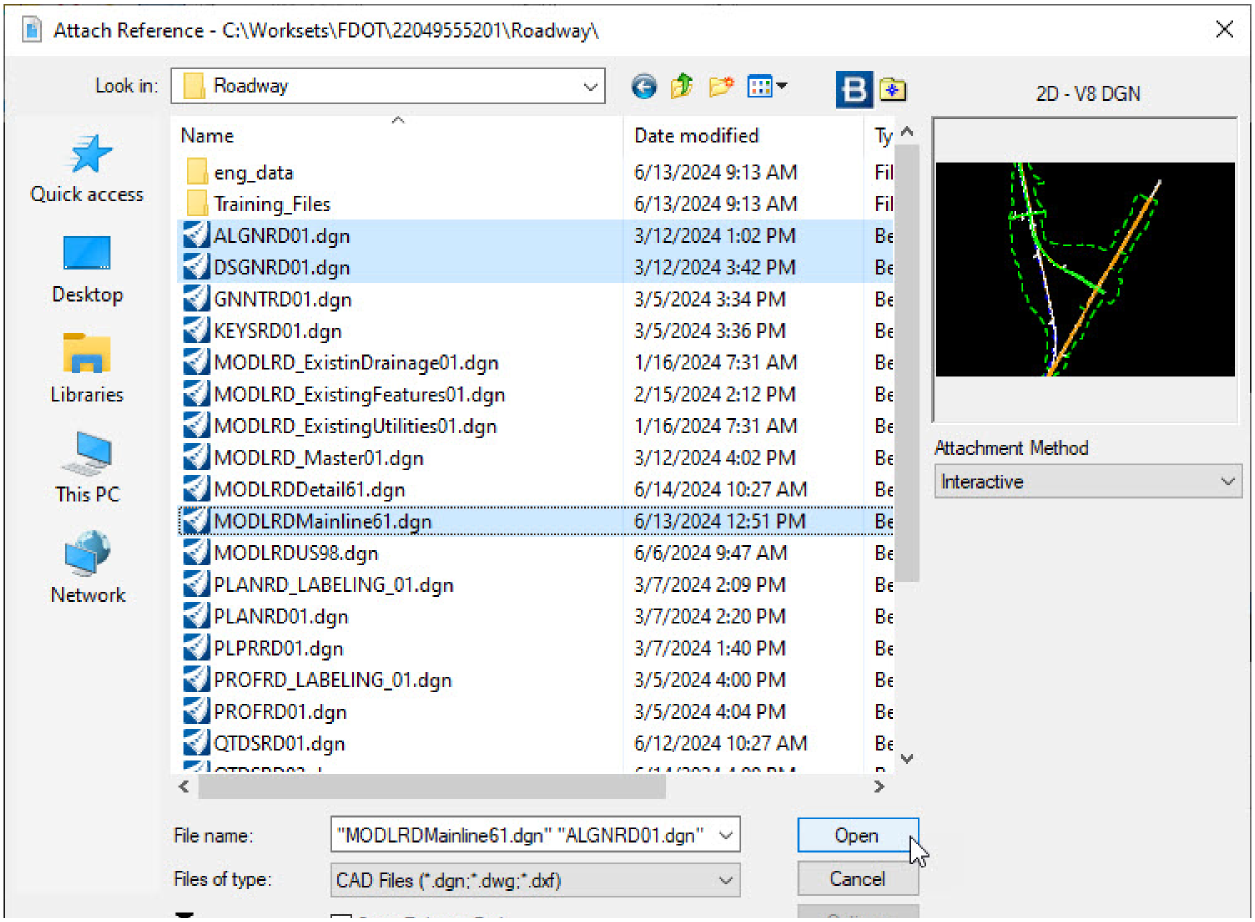
NOTE ***Any changes needed to the points or Superelevation Flags must be saved to the .itl file and synchronized with the template in the appropriate MODLRD file.***

Exercise 3.2 *Prepare Alignment File for Superelevation*

1. Locate the *View Group* toggle on the bottom left of the MicroStation window and change the *View Group/Model* to **Superelevation Views.**

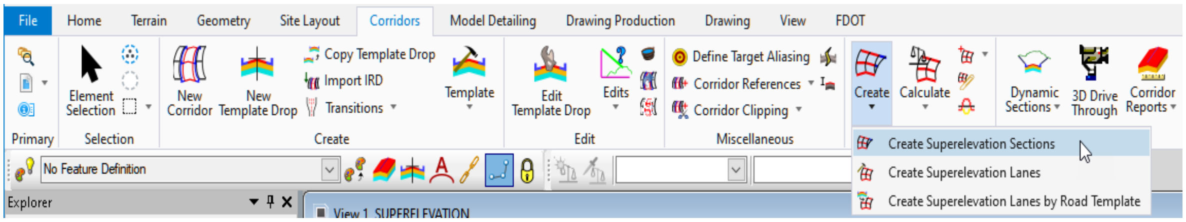


2. On the MicroStation **References** tool, attach the Default models of the *DSGNRD01, MODLRDMainline61,* and *ALGNRD01* files.



Exercise 3.3 *Calculate Superelevation from Corridor*

1. Use **Corridors > Superelevation > Create > Create Superelevation Sections** tool.



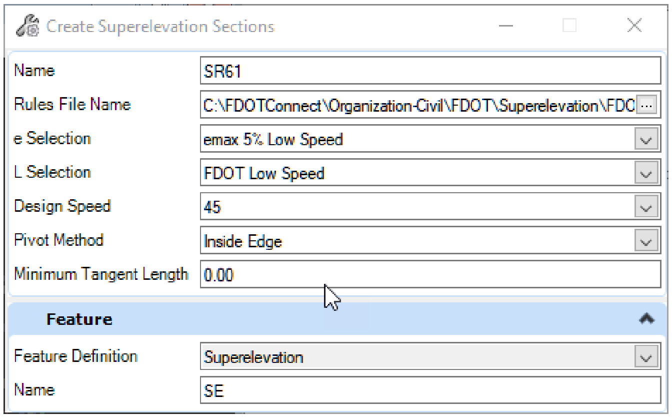
2. Enter *Name:* **SR61** and data point.

3. Select the **CL_SR61** corridor.

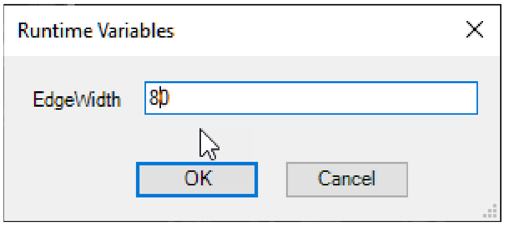
NOTE ***Selecting the CL_SR61 centerline also works, but selecting a corridor automates much of the remaining process, and eliminates the need for exercises 3.4 and 3.5.***

4. Select the *FDOT_Superelevation.xml* rules file.

5. Set all values as shown before accepting the Minimum Tangent Length value.



6. Enter **80** for the **EdgeWidth** Runtime Variable.



NOTE ***The EdgeWidth Runtime Variable is the width used to determine the superelevation transition and varies depending on the type of roadway being superelevated. For any Low Speed roadways or High Speed undivided roadways, this width ("W" in the Standard Plans) will be left pavement edge to right pavement edge including any median, since the median width is included. For High Speed divided roadways, this width (W) will be the outside pavement edge to inside pavement edge of one side.***

The section is drawn and the superelevation lanes automatically placed with the calculations.

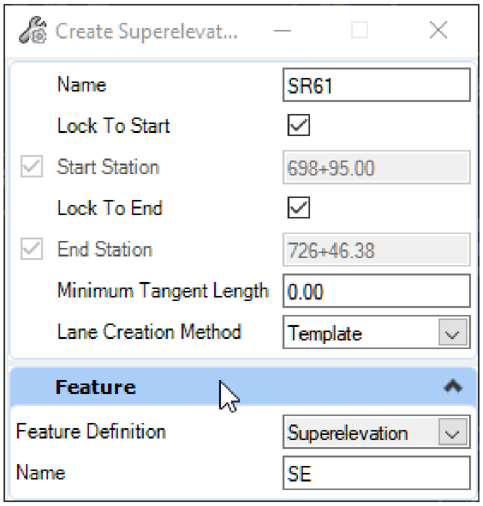
7. Skip to Exercise 3.6.

Exercise 3.4 Create Superelevation Sections (optional)

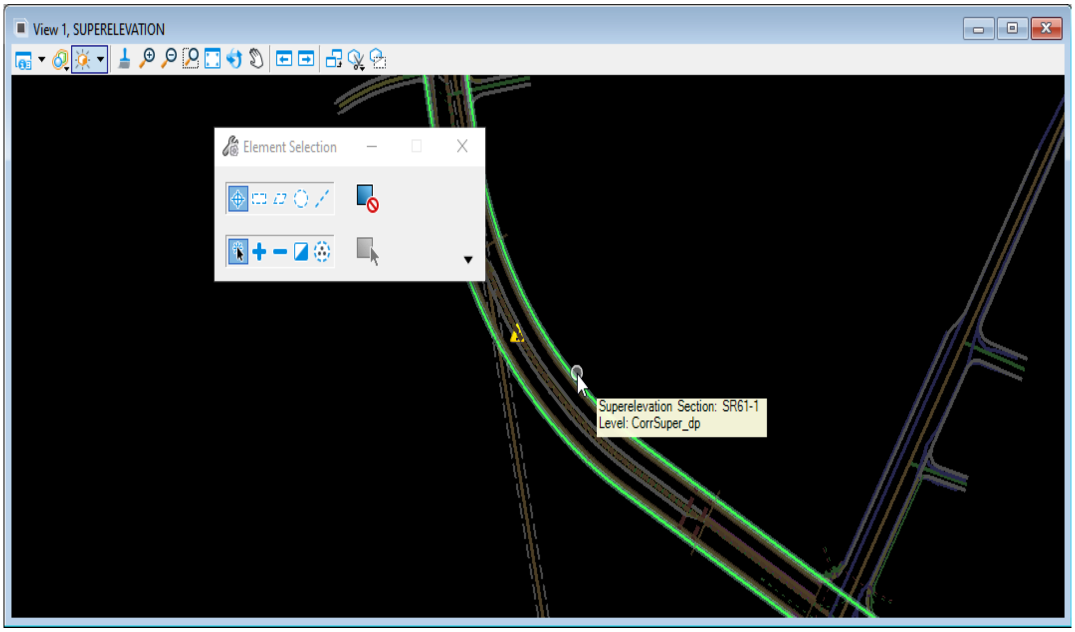
NOTE ***Only needed if selecting the centerline instead of the corridor.***

1. On the *Create Superelevation Sections* dialog, enter remaining values as shown below:

- *Start Station* **Alt to lock to Begin**
- *End Station* **Alt to lock to End**
- *Minimum Tangent* **0**
- *Lane Creation Method* **Template**
- *Feature:*
- *Feature Definition* **Superelevation**
- *Name* **SE**



1. The *Superelevation Sections* are drawn and the *Create Superelevation Lanes* dialog is launched.

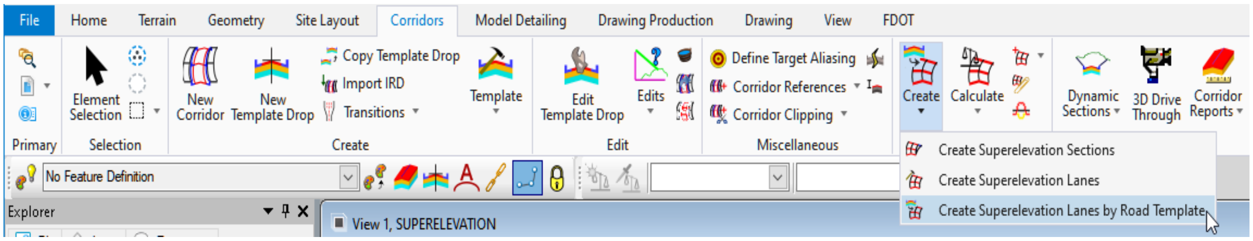


NOTE ***Use the Function Key F5 to dim the references.***

Exercise 3.5 Create Superelevation Lanes (optional)

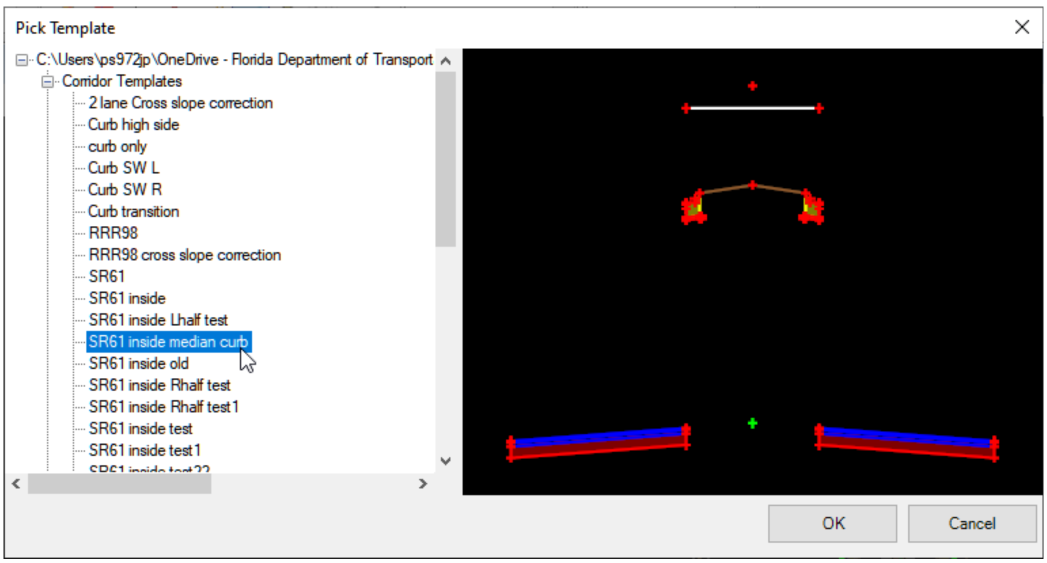
NOTE ***Only needed if selecting the centerline instead of the corridor in Exercise 3.3.***

1. (Optional, only needed if canceling out of previous command.) Use the **Corridors > Create Superelevation Lanes by Road Template** tool.

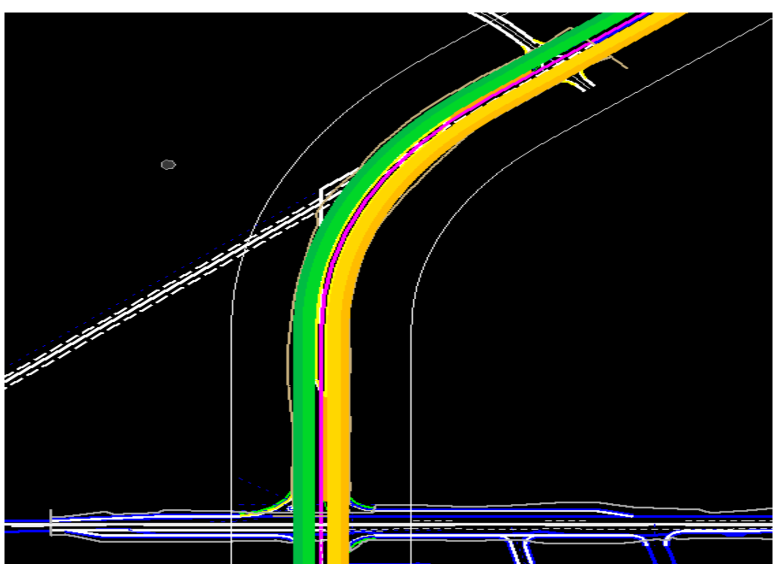


2. Select the **Superelevation Section** and reset to complete.

3. Select the **SR61 Inside Median Curb** Template as shown and click “**OK**” and **Accept**.



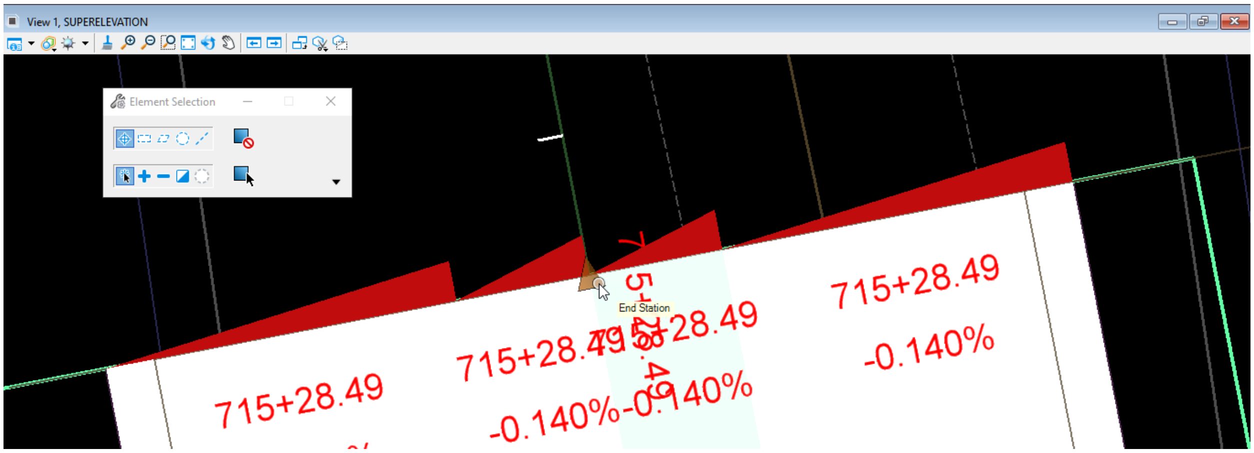
4. The *Superelevation Lanes* are drawn.



Exercise 3.6 Graphical Edits

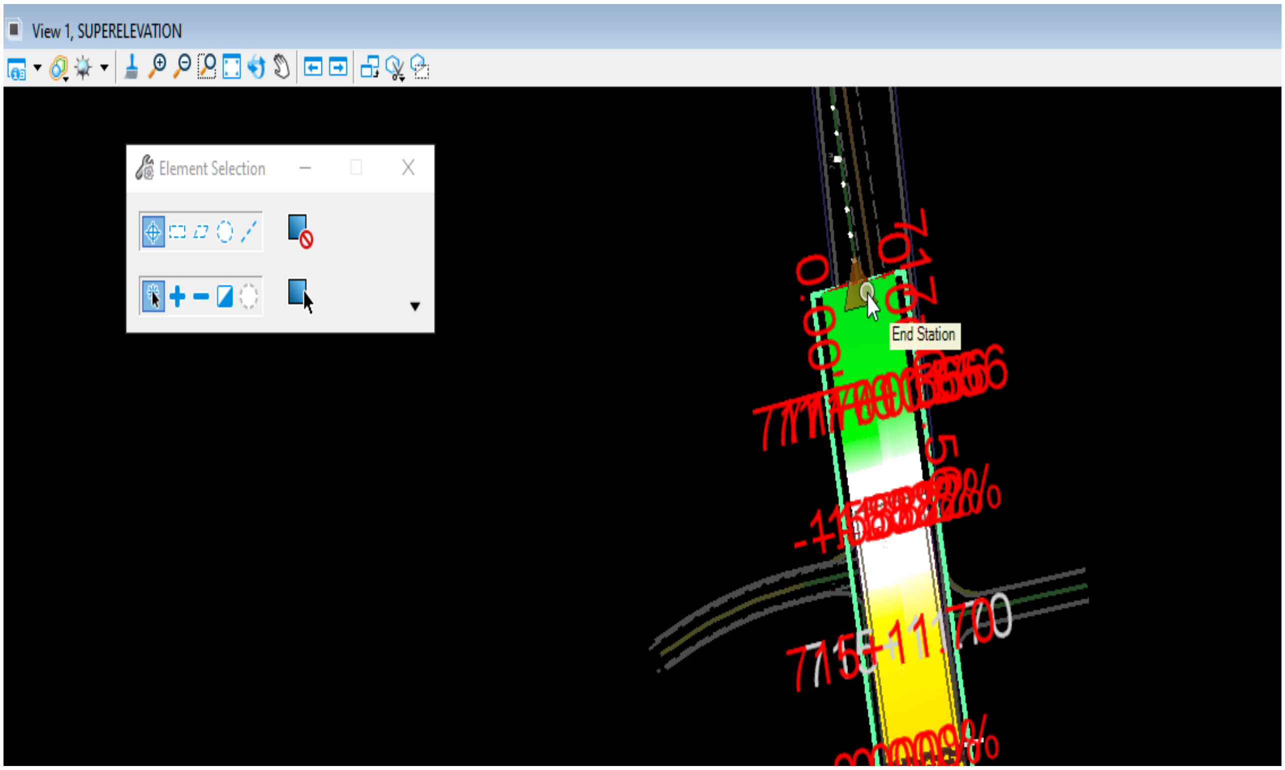
▶ *Superelevation Sections*

1. Use the MicroStation **Element Selection** tool and select the **Superelevation Section**. The *graphic handlers* now display.



NOTE ***Press the Tab key if necessary to select the superelevation section instead of referenced linework.***

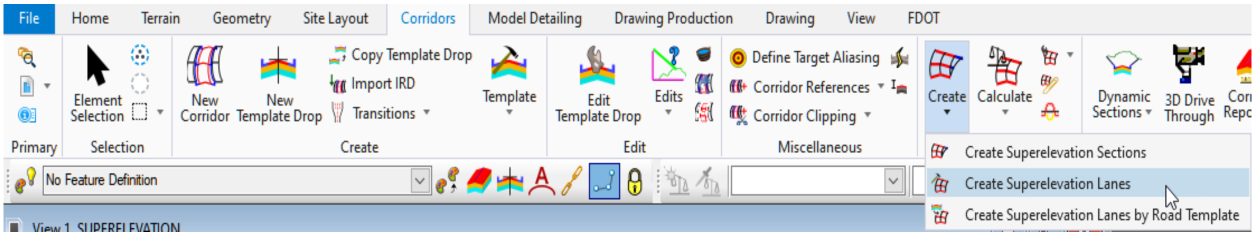
2. Zoom in on the end of the Superelevation Section, select the *End Station* manipulator, and drag to extend the Superelevation Section to near Station 717+00**.** The Section as well as the lanes will extend, and the calculation will update as shown below.



Exercise 3.7 Add Superelevation Lane for Curb

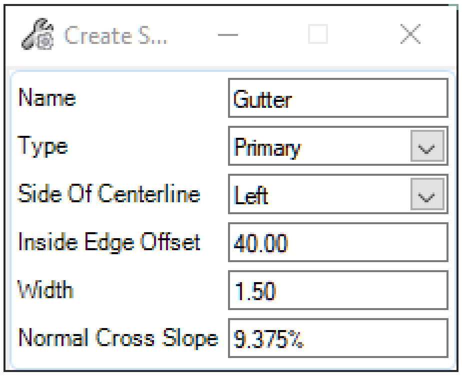
NOTE ***Curb slope needs to follow the high side of the roadway superelevation per Standard Plans 000-511. This can be accomplished through a point control, or it can be done with superelevation.***

1. Use the **Corridors > Superelevation > Create > Create Superelevation Lanes** Tool.



2. Select the *Superelevation corridor* and input the following values in the dialog:

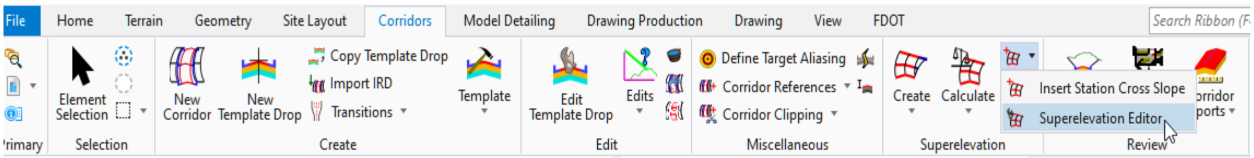
Name	**Gutter**
Type	**Primary**
Side of Centerline	**Left**
Inside Edge Offset	**40.00**
Width	**1.50**
Normal Cross Slope	**9.375%**



NOTE ***Normal Cross Slope should be calculated from the Standard Plans for the Edge of Pavement to Flowline based on curb type used. Curb and Gutter Type F is 9.375%.***

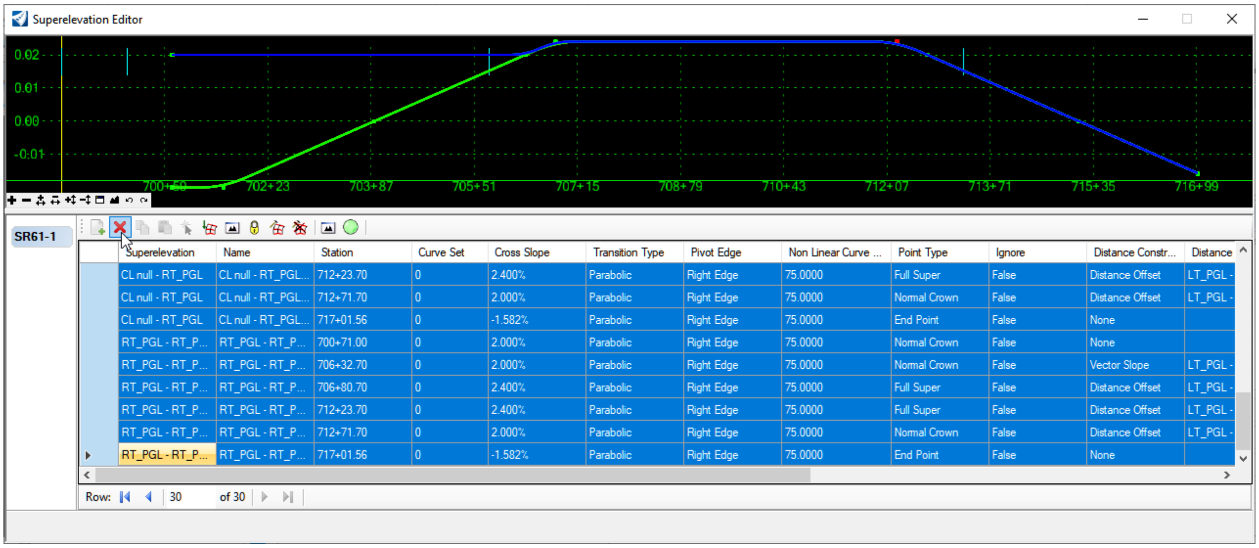
Exercise 3.8 Superelevation Editor

1. Select **Corridors > Superelevation > Superelevation Editor.**



2. The Superelevation Editor opens. Note that the right side does not transition back correctly, because the end transition was initially cut off before the end of the superelevation section.

3. Hold down the *Shift* key and select the last row. Click the Red **X** to delete all superelevation rows.

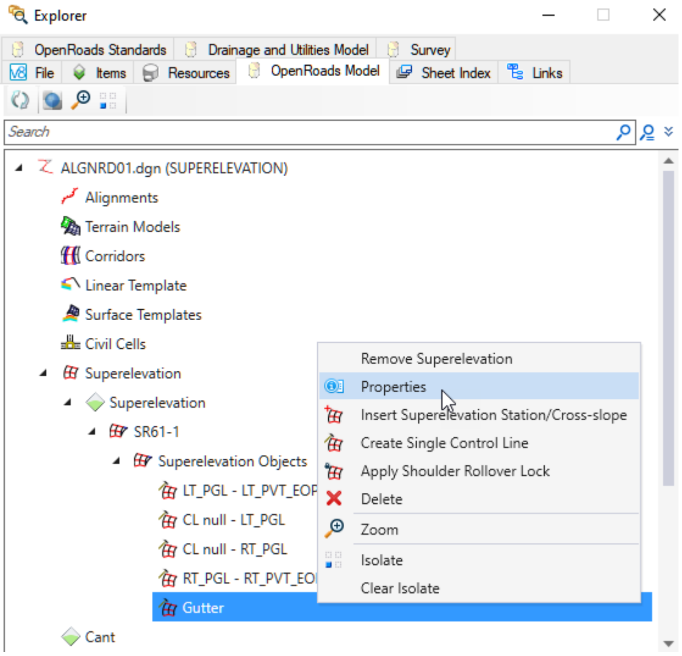


4. Close the **Superelevation Editor**.

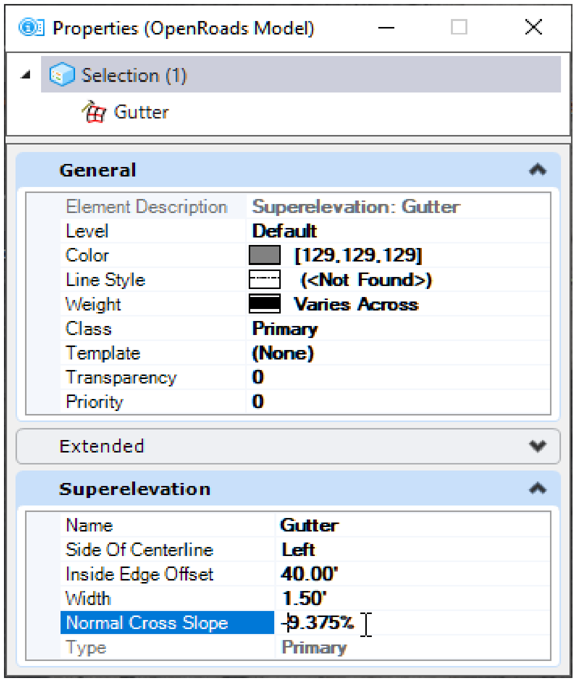
Exercise 3.9 *Project Explorer Edits*

1. Open Explorer, Select **F11** and select the **OpenRoads Model** tab.

2. Expand the *ALGNRD01.dgn (SUPERELEVATION)* data tree and navigate to **Superelevation > SR61-1 > Superelevation Objects > Gutter**. Right click and select **Properties**.



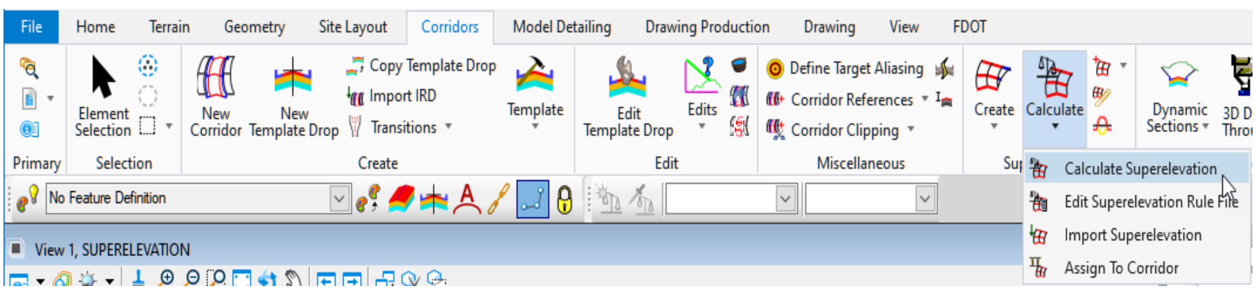
3. In the *Properties* dialog, review the **Superelevation Lane Properties**.



4. Change the *Gutter* Lane Normal Cross Slope to -9.375%.

Exercise 3.10 *Calculate Superelevation*

1. Use the **Corridors > Superelevation > Calculate > Calculate Superelevation** tool.

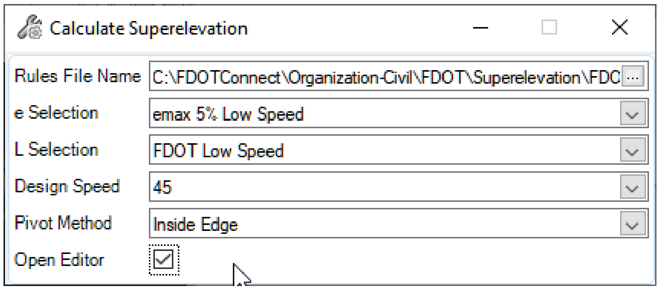


2. Select the Superelevation section.

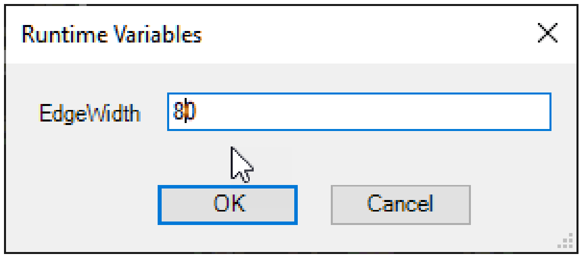
3. Select the Superelevation rule file *FDOT_Superelevation.xml*.

4. Enter the necessary dialog information as shown at the prompt and data point to accept data:

e Selection	**e_{max} 5% Low Speed**
L Selection	**FDOT Low Speed**
Design Speed	**45**
Pivot Method	**Inside Edge**
Open Editor	**No, unchecked**



5. Enter **80** for the **EdgeWidth** Runtime Variable.



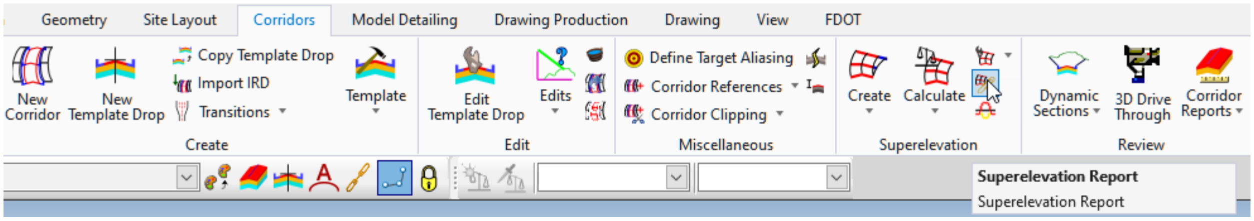
6. The *Superelevation Lanes* are now applied with **Superelevation**.

NOTE ***Bentley OpenRoads Connect Edition computes superelevation differently for each lane, using the offset to determine a different radius. As such, the only accurate calculations according to the FDOT method will be the center lanes, which both have the same calculated superelevation. Some edits in Excel will be required to copy the transitions and e rates from the center lane to the other lanes.***

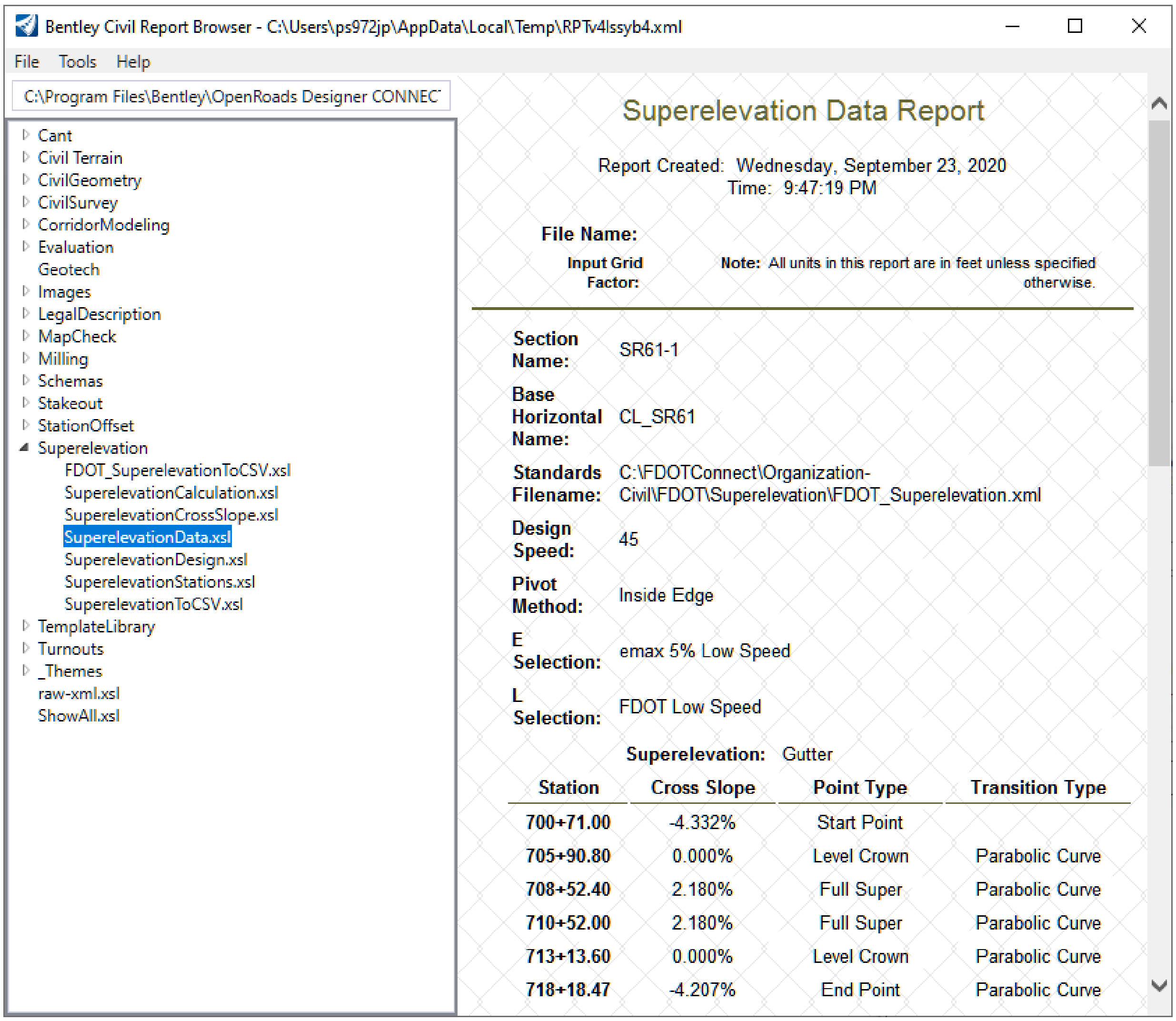
Exercise 3.11 *Superelevation Reports*

▶ *Create a Superelevation Report*

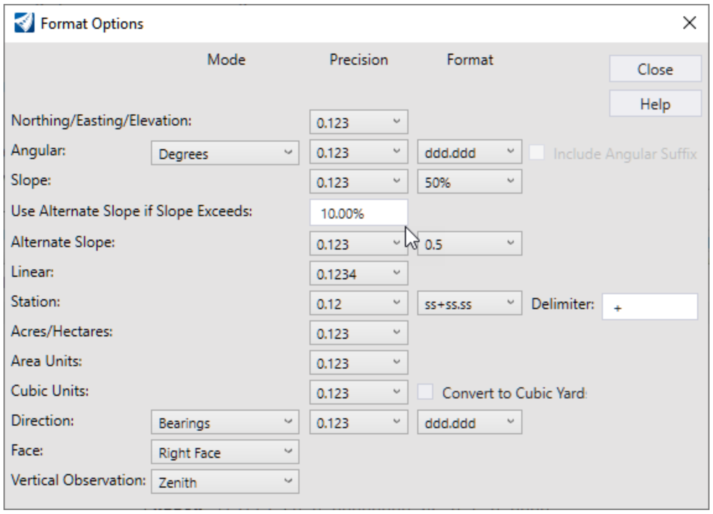
1. Use the **Corridor > Superelevation > Superelevation Report** tool.



2. Select the **SR61-1 Superelevation Section** and right click to **Accept**. The Report Browser opens.

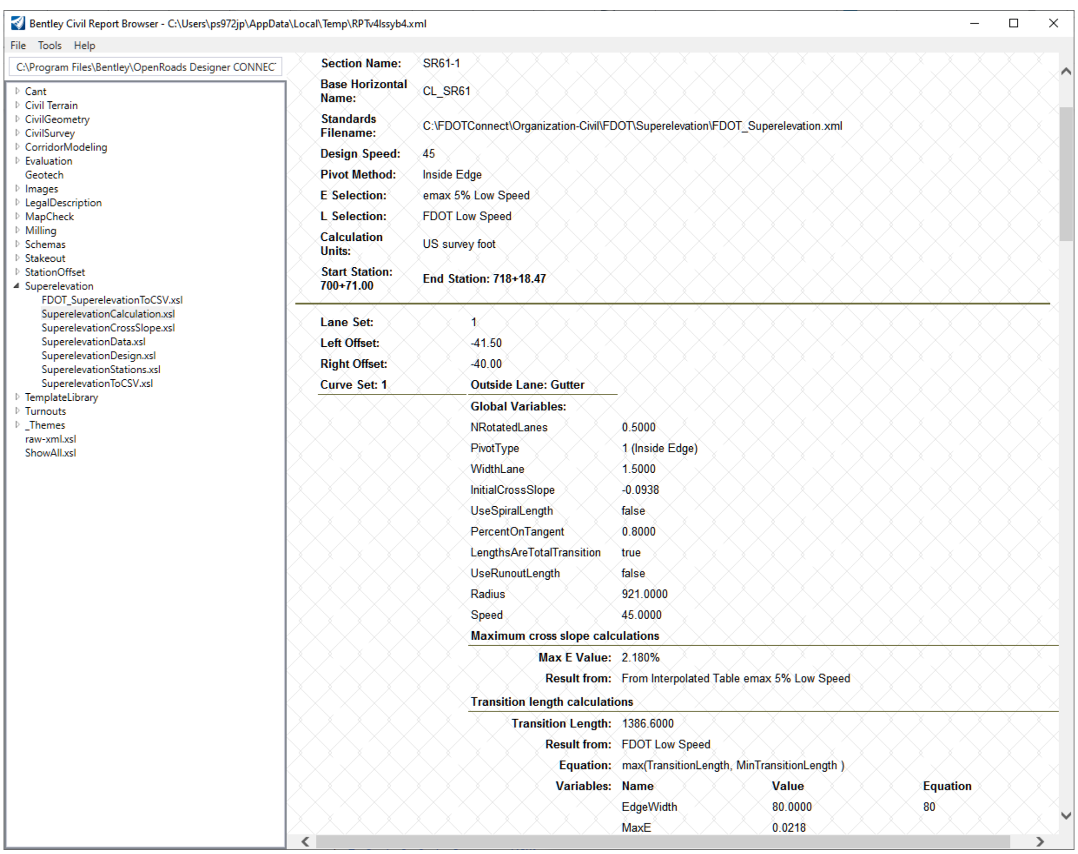


3. To adjust the formatting of the reports, go to *Tools*, **Format Options**. Set the Format Options as shown below:



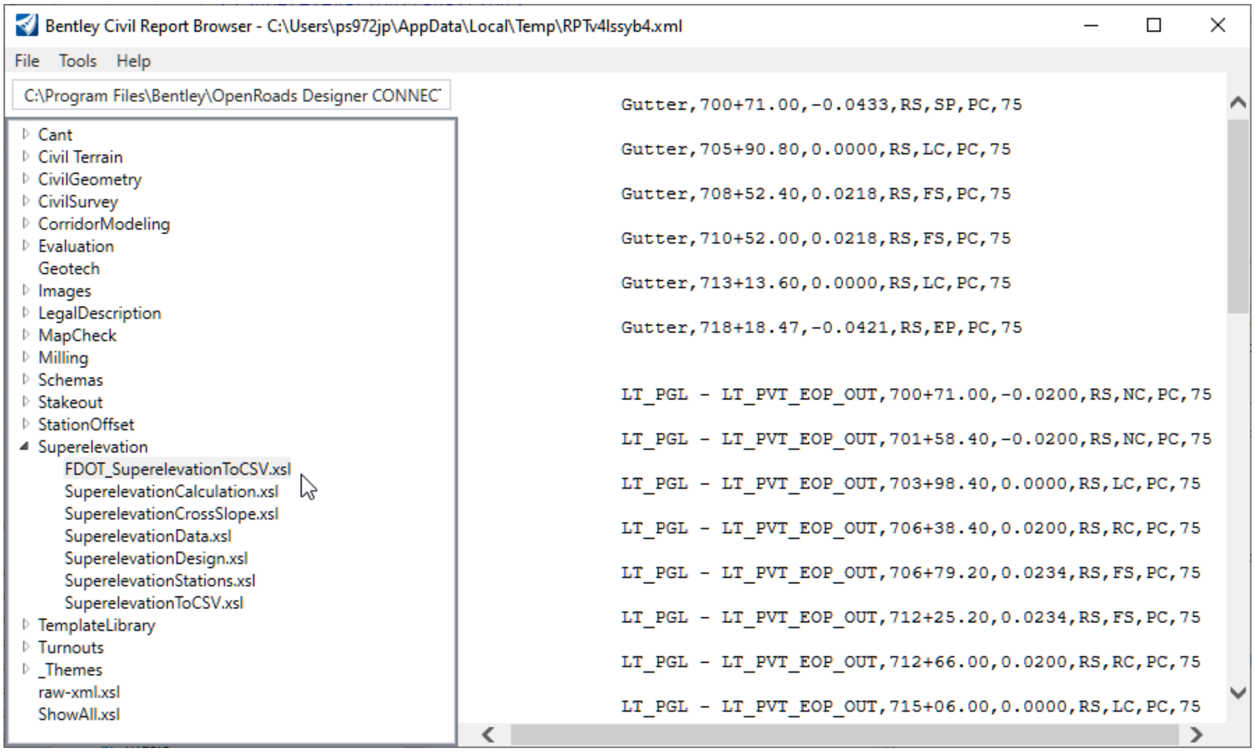
Slope Precision	**0.123**
Slope Format	**50%**
Alternate Slope	**0.10 (10%)**
Linear Precision	**0.1234**
Station Precision	**0.12**
Station Format	**ss+ss.ss**

4. In the Civil Report Browser, change the report format stylesheet to SuperelevationCalculation.xsl Scroll through the report and note the different radius measurements used for each lane. This will need to be corrected to meet FDOT criteria.



NOTE ***Calculations can be confirmed using this report as well, if needed to verify which lane uses the correct radius, a current OpenRoads defect.***

5. In the Civil Report Browser, change the report format stylesheet to FDOT_SuperelevationToCSV.xsl. Verify that Station and precision are showing properly.

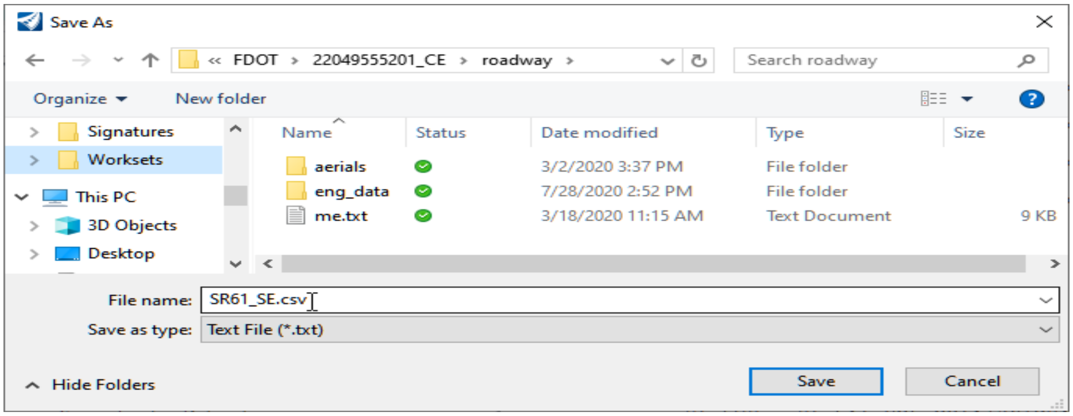


NOTE ***Cross Slope in this table uses the linear precision, as it cannot have a % symbol when importing back in to the editor.***

NOTE ***Any modified values of curve length (the last column), will not export properly due to OpenRoads limitations. The default value is exported in the FDOT_SuperelevationToCSV report.***

6. In the Civil Report Browser, select **File > Save As**.

7. Change the *path folder* to C:\Worksets\FDOT\22049555201\Roadway and the *File Name* to **SR61_SE.csv** use the *Save as type* **Text File (*.txt).**

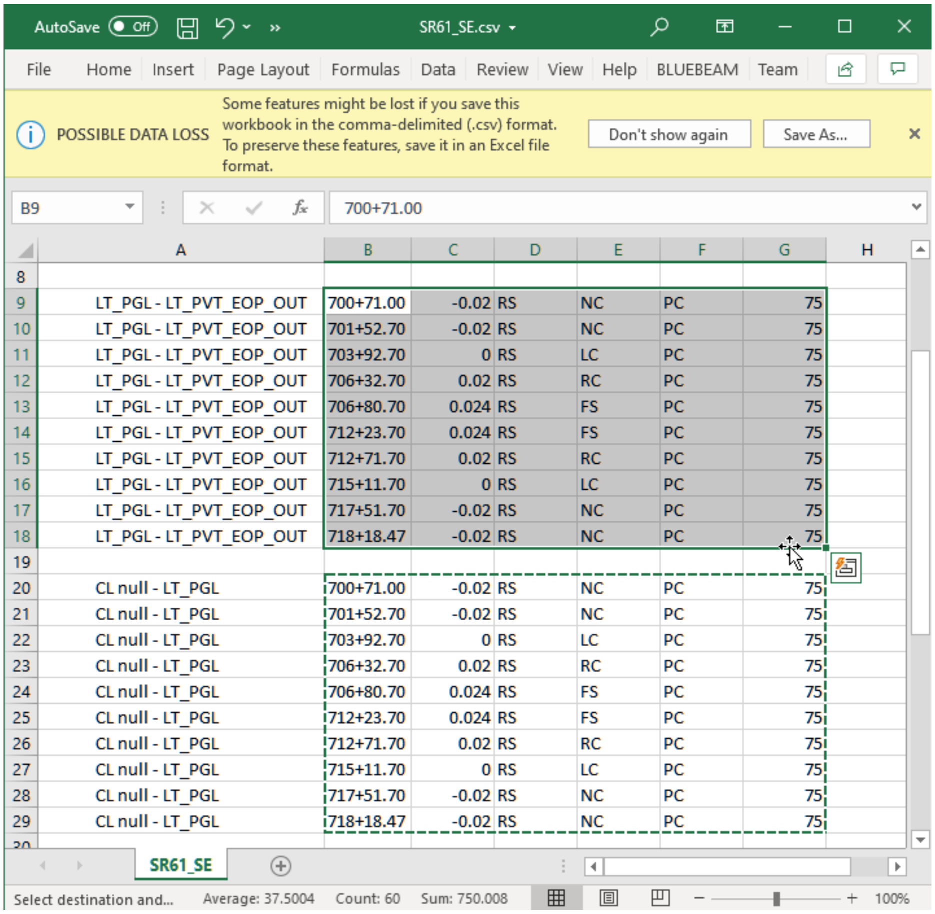


8. Choose **Save** and Exit the Civil Report browser.

Exercise 3.12 *Editing Superelevation .csv Report*

1. Open the .csv file in Excel to make edits.

2. Copy all values (columns B-G) from the CL null - LT_PGL lane to the LT_PGL – LT_PVT_EOP_OUT lane.



3. Modify Gutter Lane values to match the table below. This can be done with a combination of copy and paste as well as adding new rows.

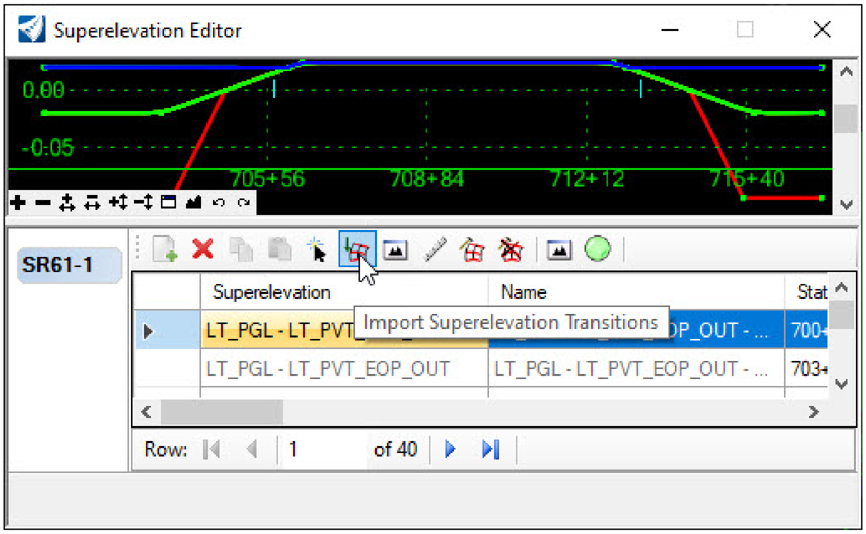
Gutter		**RS**	**NC**	**L**	**75**
Gutter		RS	**NC**	**L**	75
Gutter	**0**	RS	LC	**L**	75
Gutter		RS	FS	**L**	75
Gutter		RS	FS	**L**	75
Gutter	**0**	RS	LC	**L**	75
Gutter		RS	**NC**	**L**	75
Gutter		**RS**	**NC**	**L**	**75**

NOTE ***Station for the second and second-to-last NC (Normal Crown) can vary as desired to adjust the distance the gutter transitions from full depth to match the lane at the Level Crown station.***

4. Verify that all values appear correct, and close and save the .csv file.

Exercise 3.13 *Import Superelevation from .csv file*

1. Repeat Exercise 3.8, steps 1-3 to clear out the calculated superelevation. Leave the Superelevation Editor open.

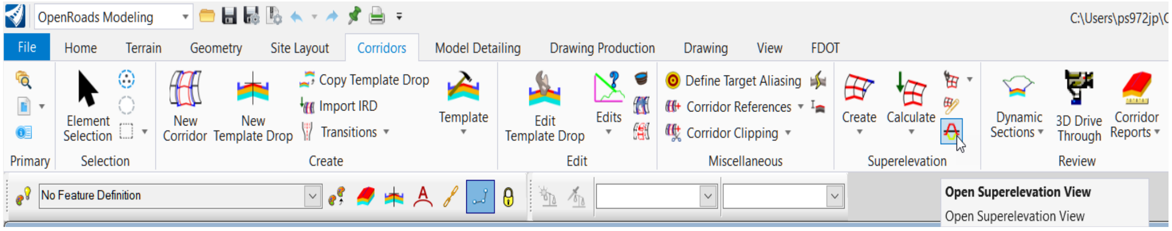


2. Select "**Import Superelevation Transitions**."

3. Locate the csv file in the Roadway directory and import the Superelevation.

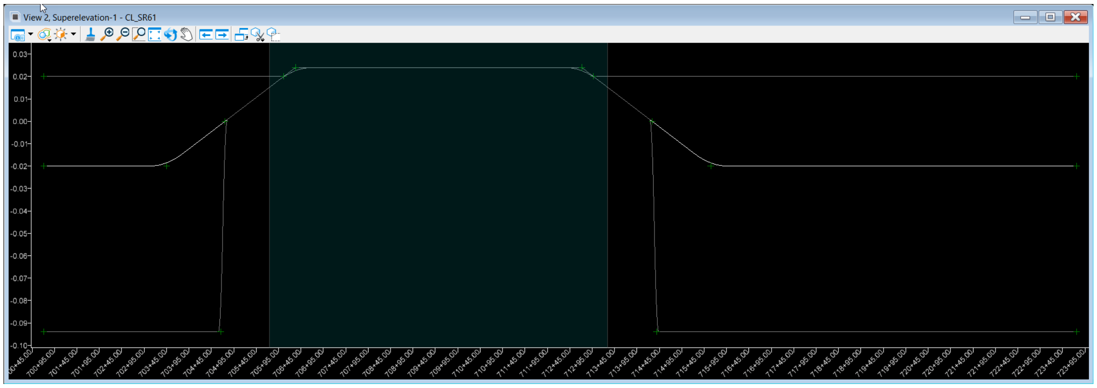
Exercise 3.14 *Superelevation Diagram*

1. Select **Corridors > Superelevation > Open Superelevation View.**



2. Select the Superelevation Section.

3. Open View 2 and select in the window. The Superelevation Diagram is placed in this view.

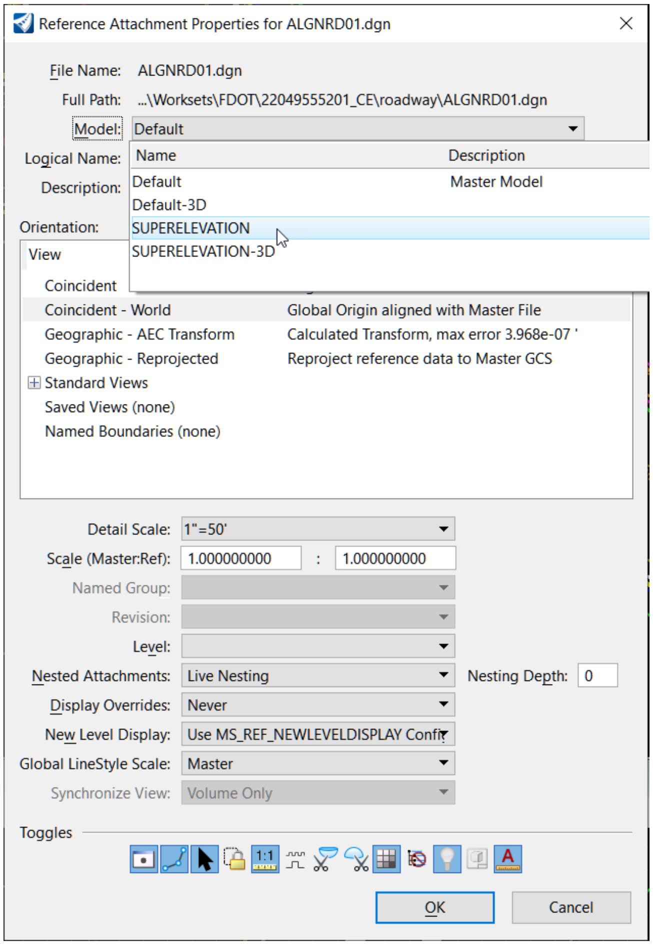


4. Save Settings.

Exercise 3.15 Attach Superelevation to Model File

1. Open the *MODLRDMainline61* file. Make sure the 2D view is active.

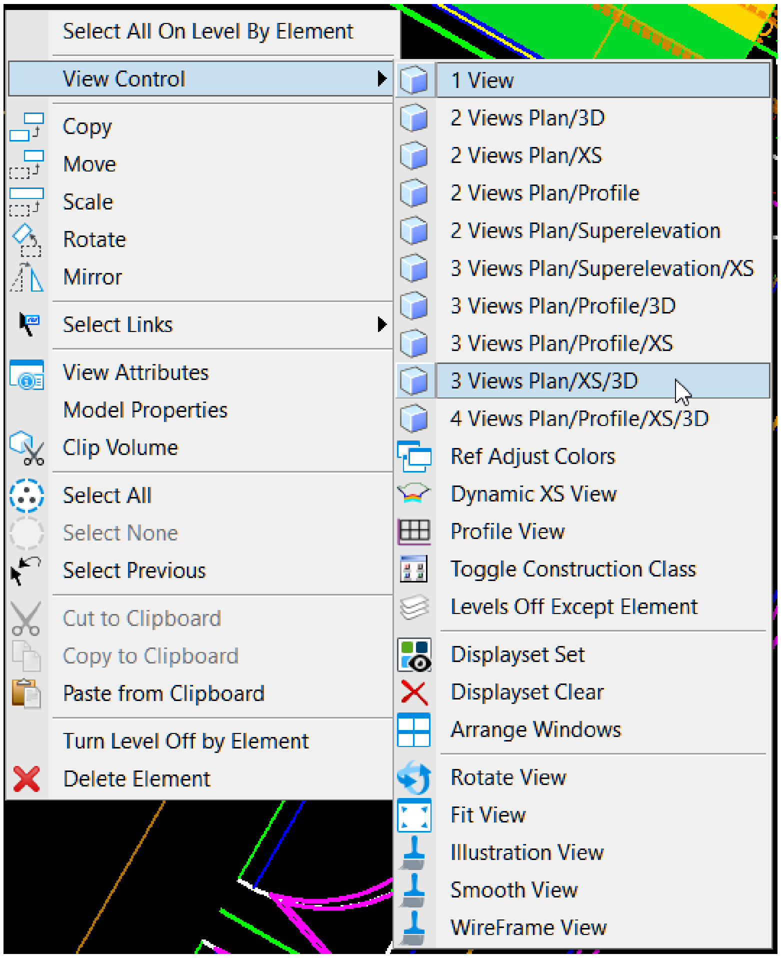
2. Attach the **Superelevation Model** from the *ALGNRD01*-file as a *Reference* file.



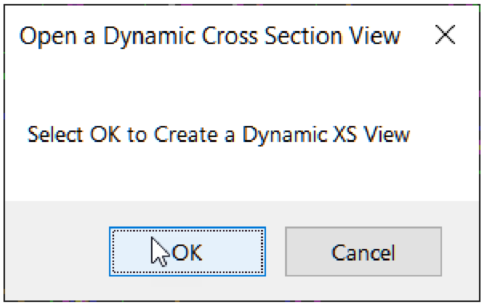
Exercise 3.16 *Set up Cross Section View*

▶ *Open a Cross Section View*

1. Right click and hold in one of the views and select **View Control** > **3 Views Plan/XS/3D**.



2. Select **OK** to create a dynamic cross section view.

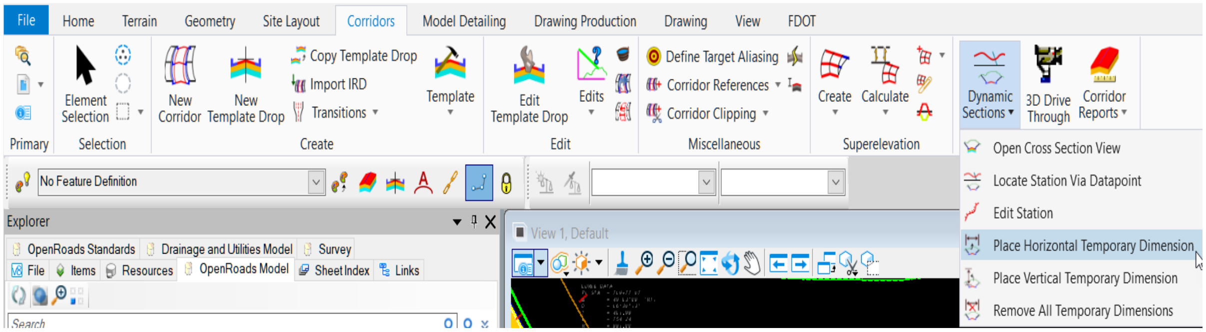


3. Select the **SR61** mainline corridor and click in **View 7** The cross section view should open in this view.

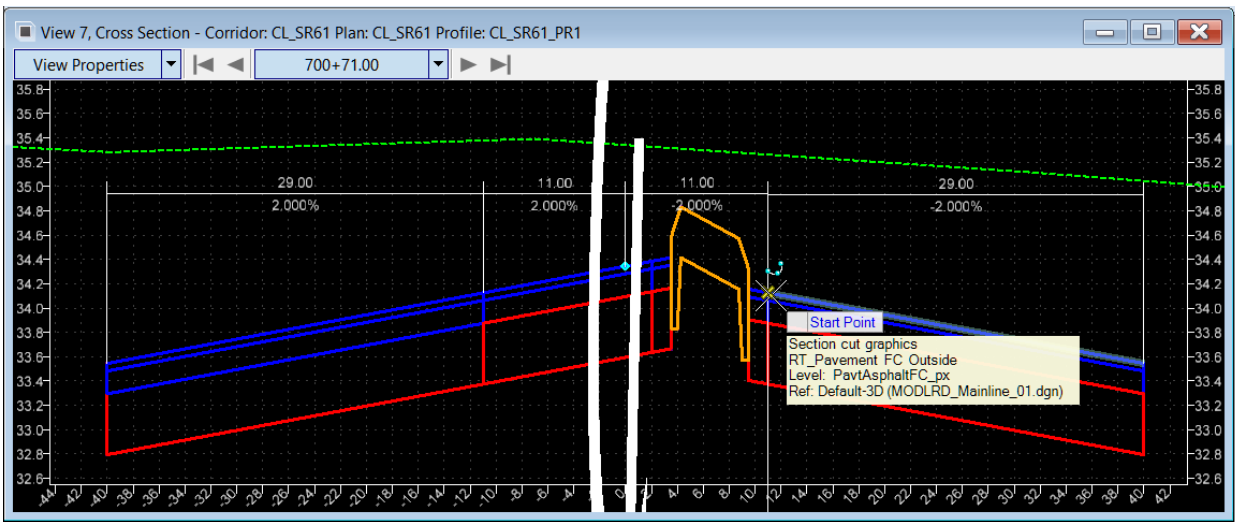
NOTE ***For this and some other tools, you will need to select the short corridor handle that recurs along the length of the corridor. The long template drop handles at the beginning and end of each template drop is not valid for this tool.***

▶ *Add Dimension Lines*

4. Use the **Corridors > Review > Dynamic Sections > Place Horizontal Temporary Dimension** tool.



5. Select **View 7** and dimension each Superelevation lane as shown below (Left Lane, Left Median, Right Median, Right Lane), making sure to select the *Blue Diamond* centerline point for the two median lanes.

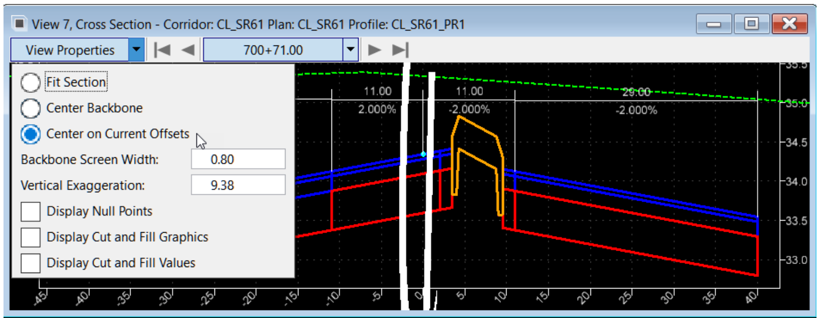


NOTE ***Make sure to select the point on top of the friction course on both sides. Zoom in as needed to see better. Ctrl+zoom with the mouse wheel will add vertical exaggeration if needed.***

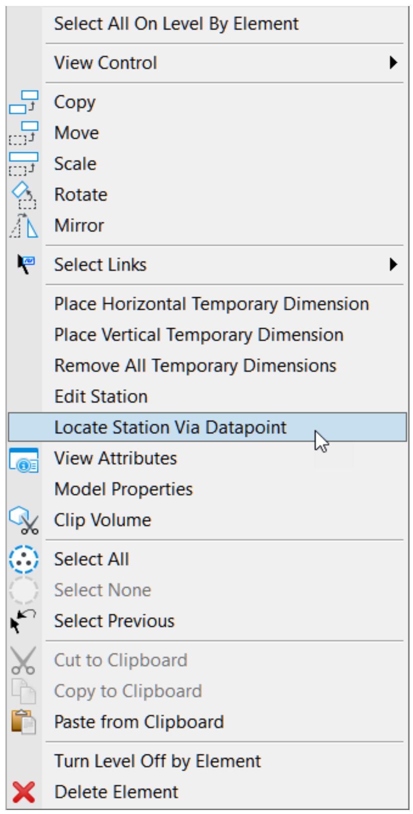
6. Adjust zoom as desired.

▶ *Change Station*

7. Select **View 7** *View Properties* > **Center on Current Offsets** as shown below.



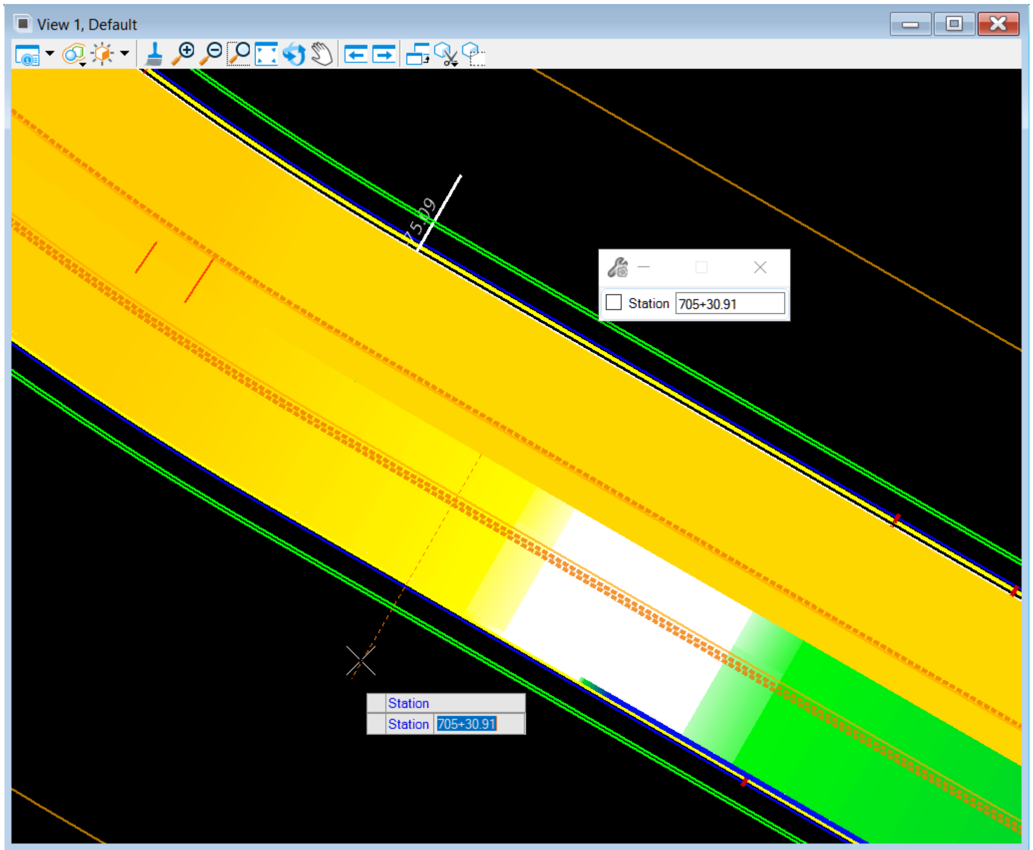
8. Right click and hold in **View 7** and select **Locate Station Via Datapoint** as shown on the right.



9. Select **View 1**.

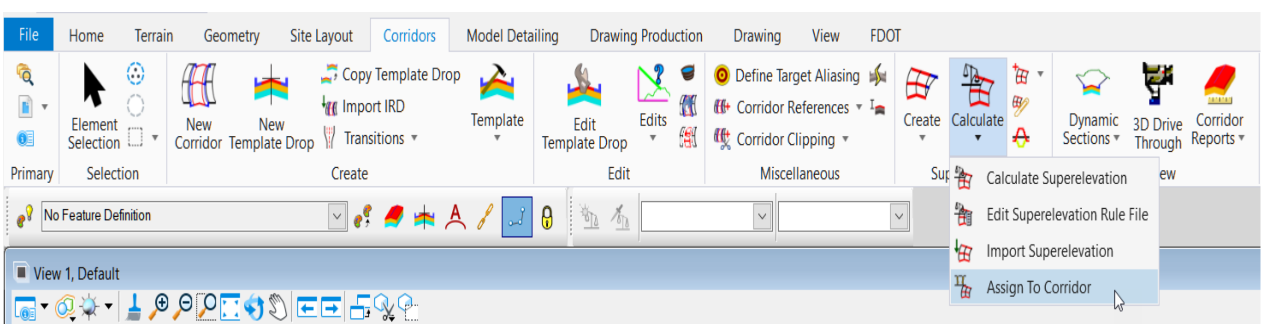
10. Select a station in the Superelevated area near the Superelevation Transition as shown below.

NOTE *The cross slope is still 2% since the Superelevation has not yet been assigned.*



Exercise 3.17 *Assign Superelevation to Corridor*

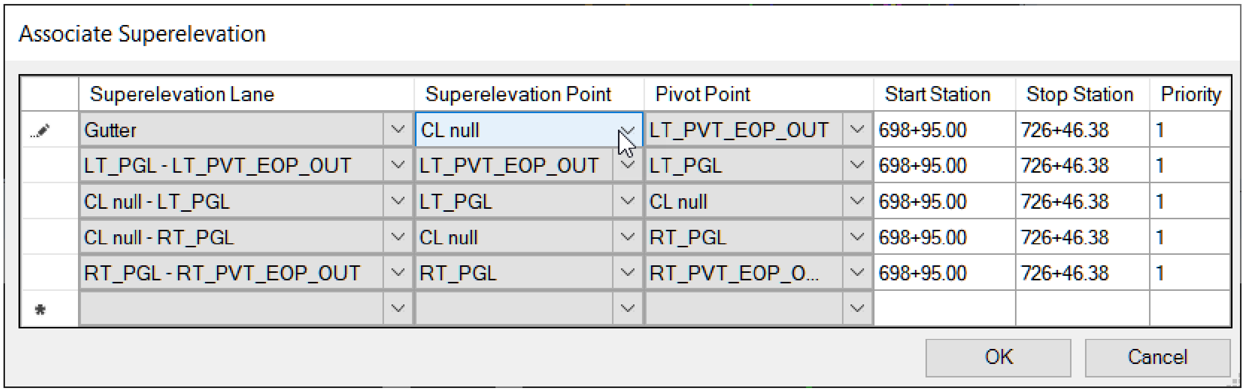
1. Use **Corridors > Superelevation > Calculate > Assign to Corridor** tool.



   a. Select the Superelevation section and *Reset* to accept.

   b. Select the **SR61** corridor.

   c. Verify that the **Superelevation** and **Pivot Points** are correct. For the Gutter Lane, choose any point for Superelevation and Pivot Point.



Associate Superelevation

	Superelevation Lane	Superelevation Point	Pivot Point	Start Station	Stop Station	Priority
	Gutter	CL null	LT_PVT_EOP_OUT	698+95.00	726+46.38	1
	LT_PGL - LT_PVT_EOP_OUT	LT_PVT_EOP_OUT	LT_PGL	698+95.00	726+46.38	1
	CL null - LT_PGL	LT_PGL	CL null	698+95.00	726+46.38	1
	CL null - RT_PGL	CL null	RT_PGL	698+95.00	726+46.38	1
	RT_PGL - RT_PVT_EOP_OUT	RT_PGL	RT_PVT_EOP_O...	698+95.00	726+46.38	1
*						

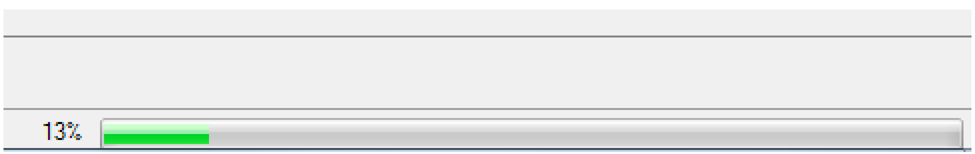
OK Cancel

NOTE ***Since the curve is to the right and we rotate about the inside edge, the Pivot Point should be the Template Point on the right while the Superelevation Point should be the Template Point on the left.***

d. Click **OK** on the *Associate Superelevation* Dialog, and then click **OK** on the error regarding Recursive Superelevation.

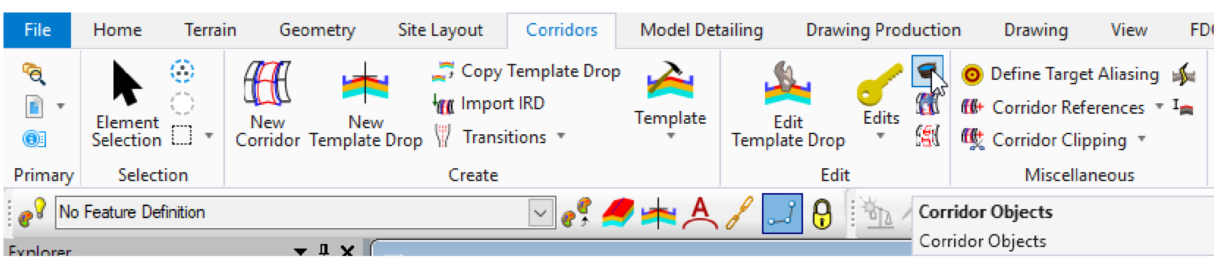
NOTE ***This error occurs because the Gutter Lane is not actually in the mainline template, and would not occur if we had the gutter in the same template as the mainline. Superelevation will not process correctly due to this error, but it is easy to resolve by manually deleting the extra point control, though.***

2. The *Corridor* will begin to process and display the new model.



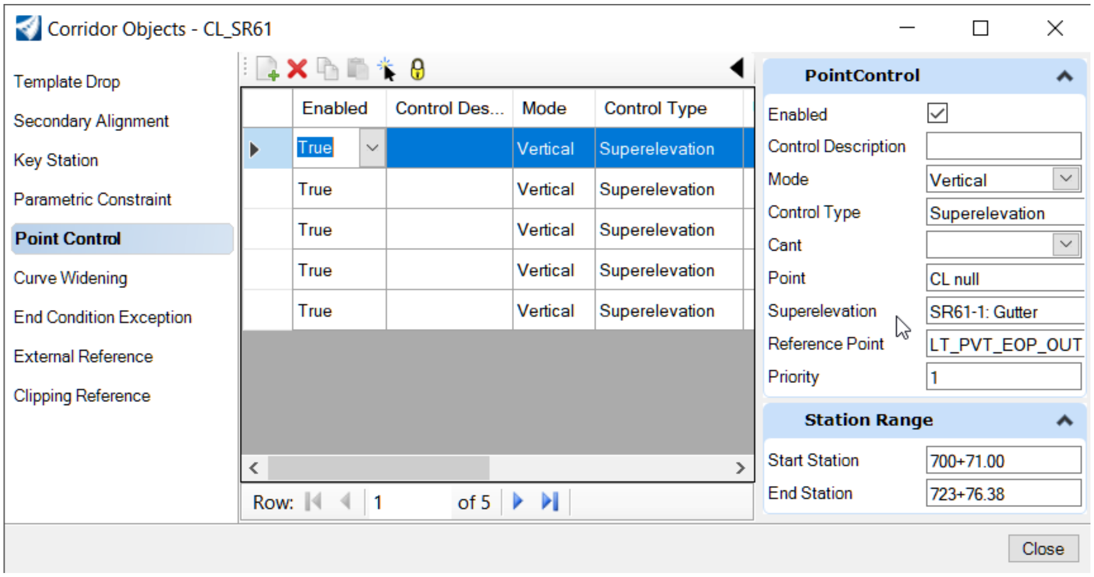
Exercise 3.18 ***Review Superelevation Point Controls***

1. Use the **Corridors > Edit > Corridor Objects** tool.



2. Identify the **Corridor Boundary** *handle* to open the *Corridor Objects* dialog.

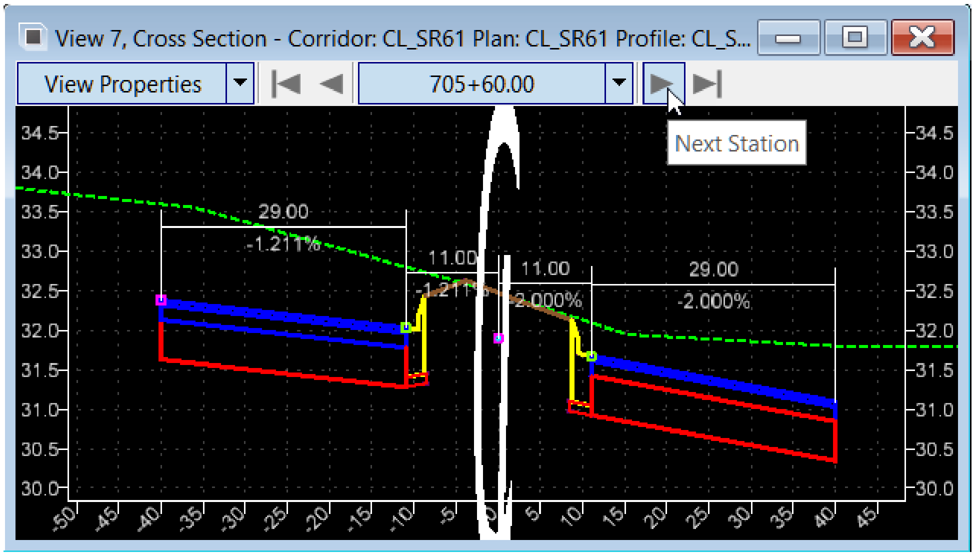
3. Select **Point Control**, and find the Superelevation control labeled SR61-1:Gutter. Select it.



4. Click the red **X** to delete. The superelevation reprocesses.

5. Close the *Corridor Objects* dialog.

6. Verify in the cross section view that the superelevation has been applied correctly. Move to the previous or next cross section using the arrows as shown below, or use the **Locate Station Via Datapoint** tool.



Exercise 3.19 Assign Gutter Superelevation, SR61 L

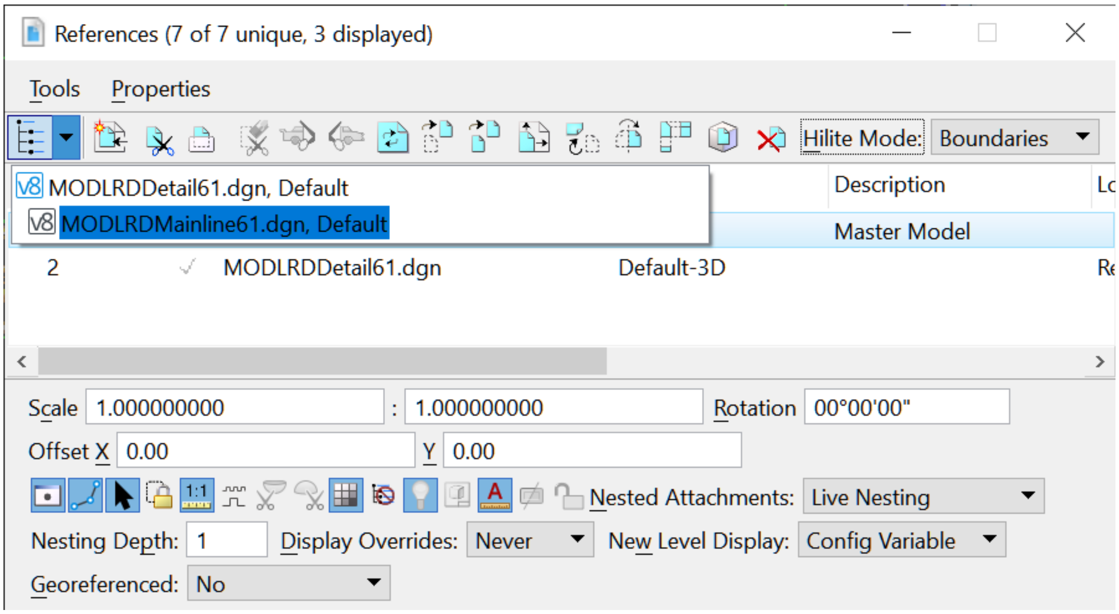
Turn on Display of Superelevation model

1. Open the *MODLRDDetail61.dgn* file.

2. Open the *References* dialog.

3. Set the 2D view active.

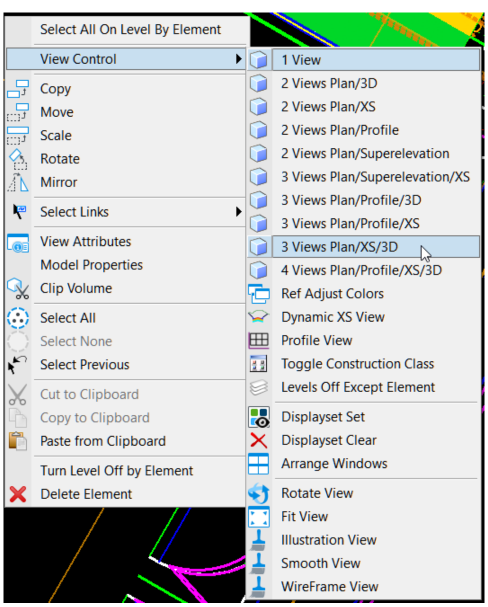
4. Use **Show Hierarchy**, select *MODLRDMainline61.dgn.*



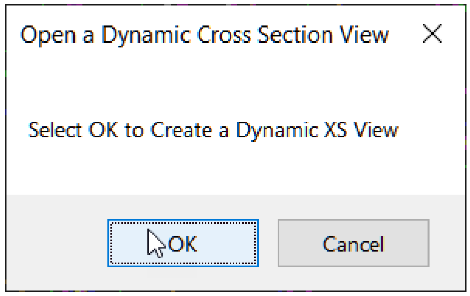
5. Turn on display of the *ALGNRD01.dgn* file, **SUPERELEVATION** model.

▶ *Set up Cross Section View*

6. Right click and hold in one of the views and select **View Control > 3 Views Plan/XS/3D**.



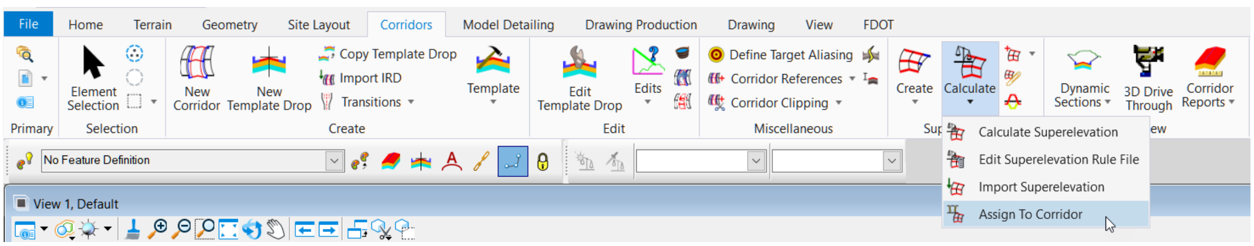
7. Select **OK** to create a dynamic cross section view.



8. Select the **SR61 L** corridor and click in **View 7.** The cross section view should open in this view.

▶ ***Assign Superelevation to Corridor***

9. Use **Corridors > Superelevation > Assign to Corridor** tool.

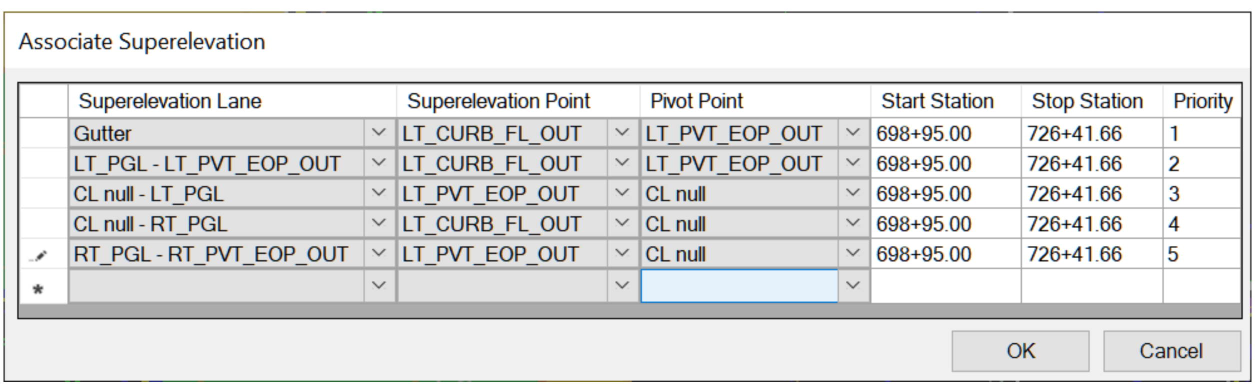


a. Select the Superelevation section and *reset* to accept.

b. Select the **SR61 L** corridor.

c. Verify that the **Superelevation** and **Pivot Points** are correct for the Gutter Lane. For the remaining lanes, choose any point for Superelevation and Pivot Point.

d. Set Priority for Gutter to 1 and the others consecutively as shown.



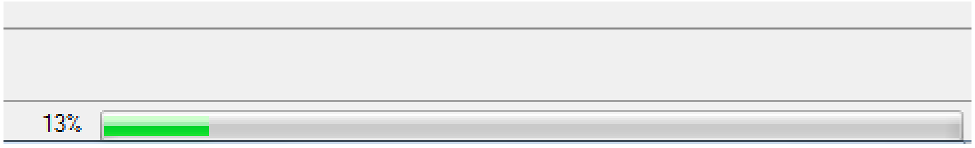
Associate Superelevation

Superelevation Lane	Superelevation Point	Pivot Point	Start Station	Stop Station	Priority
Gutter	LT_CURB_FL_OUT	LT_PVT_EOP_OUT	698+95.00	726+41.66	1
LT_PGL - LT_PVT_EOP_OUT	LT_CURB_FL_OUT	LT_PVT_EOP_OUT	698+95.00	726+41.66	2
CL null - LT_PGL	LT_PVT_EOP_OUT	CL null	698+95.00	726+41.66	3
CL null - RT_PGL	LT_CURB_FL_OUT	CL null	698+95.00	726+41.66	4
RT_PGL - RT_PVT_EOP_OUT	LT_PVT_EOP_OUT	CL null	698+95.00	726+41.66	5

NOTE ***Since the curve is to the right and we rotate about the inside edge, the Pivot Point should be the Template Point on the right while the Superelevation Point should be the Template Point on the left.***

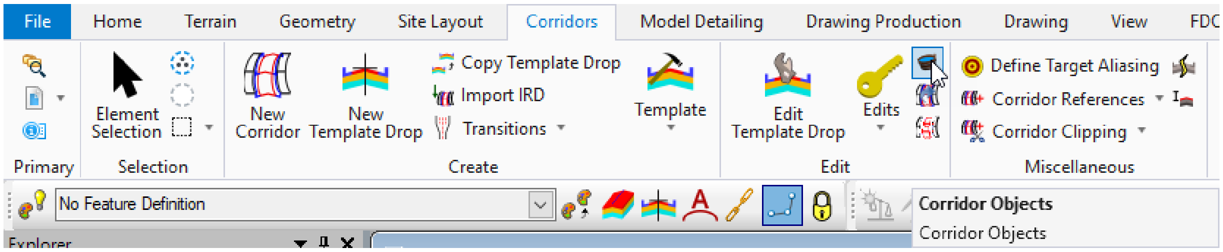
e. Click **OK** on the *Associate Superelevation* Dialog.

10. The *Corridor* will begin to process and display the new model.



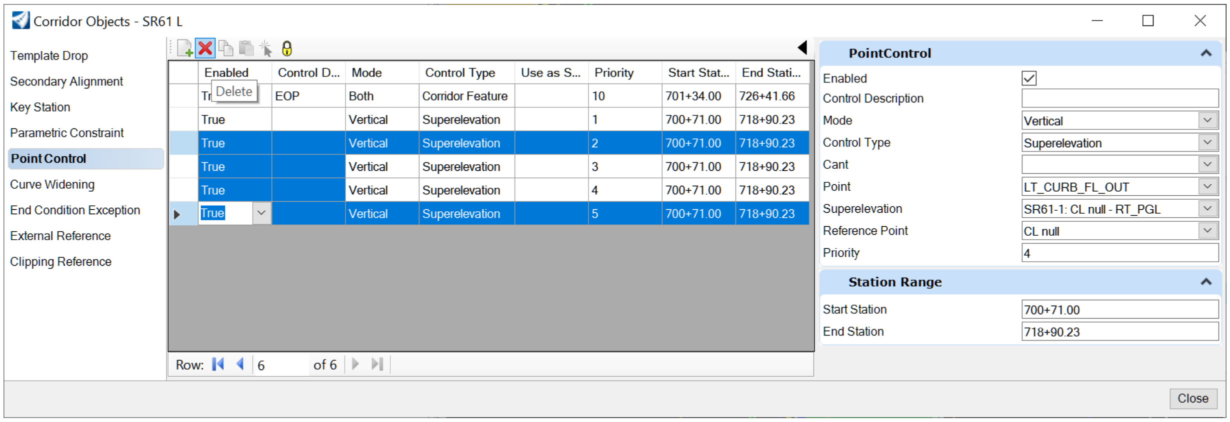
▶ *Review Superelevation Point Controls*

11. Use the **Corridors > Edit > Corridor Objects** tool.



12. Identify the **Corridor Boundary** *handle* to open the *Corridor Objects* dialog.

13. Select **Point Control**, and find the Superelevation control labeled *SR61-1:Gutter*. Select all the other Superelevation Point Controls.



14. Click the red **X** to delete. The superelevation reprocesses.

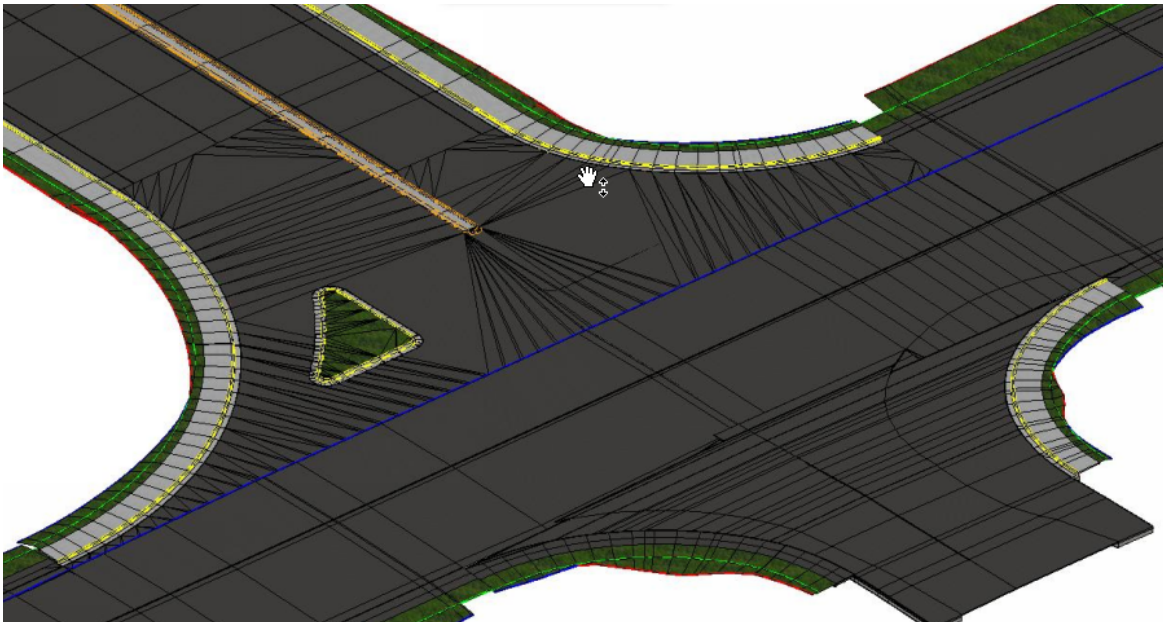
15. Close the *Corridor Objects* dialog.

16. Verify in the cross section view that the superelevation has been applied correctly, and that the gutter follows the outside lane slope when it reaches a positive superelevation. Move to the previous or next cross section using the arrows as shown below, or use the **Locate Station Via Datapoint** tool.

17. Turn off display of the *ALGNRD01.dgn* file, **SUPERELEVATION** model and close the *Reference* dialog.

18. Save Settings.

4 DETAIL MODELING



SR61 CORRIDOR DESIGN DETAILS EXERCISES

Curb Radii

- Add profiles for Edge of Pavement
- Add Point Control for End Conditions

Intersection Design

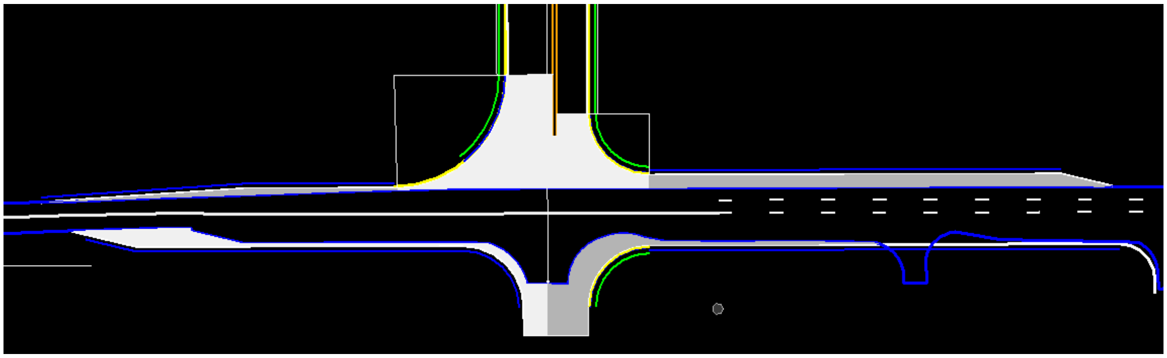
- Build Intersection Terrain at SR 61 and US 98
- ncluding TS Nose and Turn Island

OTHER DESIGN DETAILS

- Build Intersection Terrain at School Entrance
- Transition Template for the End of the Project
- Build Intersections for Friendship Road
- Add 3D Urban Driveway
- Add 3D Sidewalk Ramps
- Add 3D Rural Turn Out
- Superelevation Vector Offsets for the Median Widening and Curb Gutter Points
- Superelevation Vector Offsets for the Traffic Separator Widening

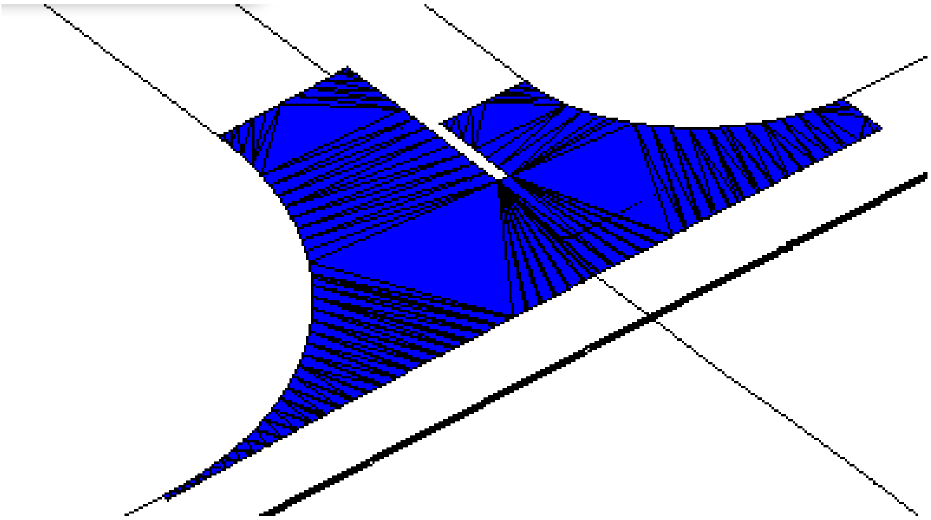
INTERSECTION DESIGN

The intersection can be built in parts as shown in the diagram:



The following exercises provide instructions on how to model these with Civil Tools other than the Normal Corridor Templates. The steps to design the SR61 intersection have been detailed in the exercises in this chapter. Once completed follow the same methodology to add further design details for the remainder of the project.

PLAN TO BUILD INTERSECTION TERRAIN AT BL98



The general methodology for building intersection design come from the concept of creating new 3D model boundary lines from profiles on the corridor surfaces and 3D lines. Transition profiles are easily produced with the civil tools for the radii.

These are the general steps to follow:

1. Develop a seam line between corridors through the intersection.
2. Create a switch or trigger line on the crossing corridor templates.
3. Remove outside corridor component elements through the limits of the intersection.
4. Construct 2D elements around the perimeter of the intersection.
5. Develop/design the profiles for each of the perimeter line.
6. Build an intersection terrain boundary using the 3D perimeter elements.
7. Add break lines to the intersection terrain.
8. Add surface templates to the intersection terrain.
9. Use linear templates along the perimeter edge lines to help transition corridors.
10. Use corridor clipping tool to clean overlaps between corridor and linear templates.

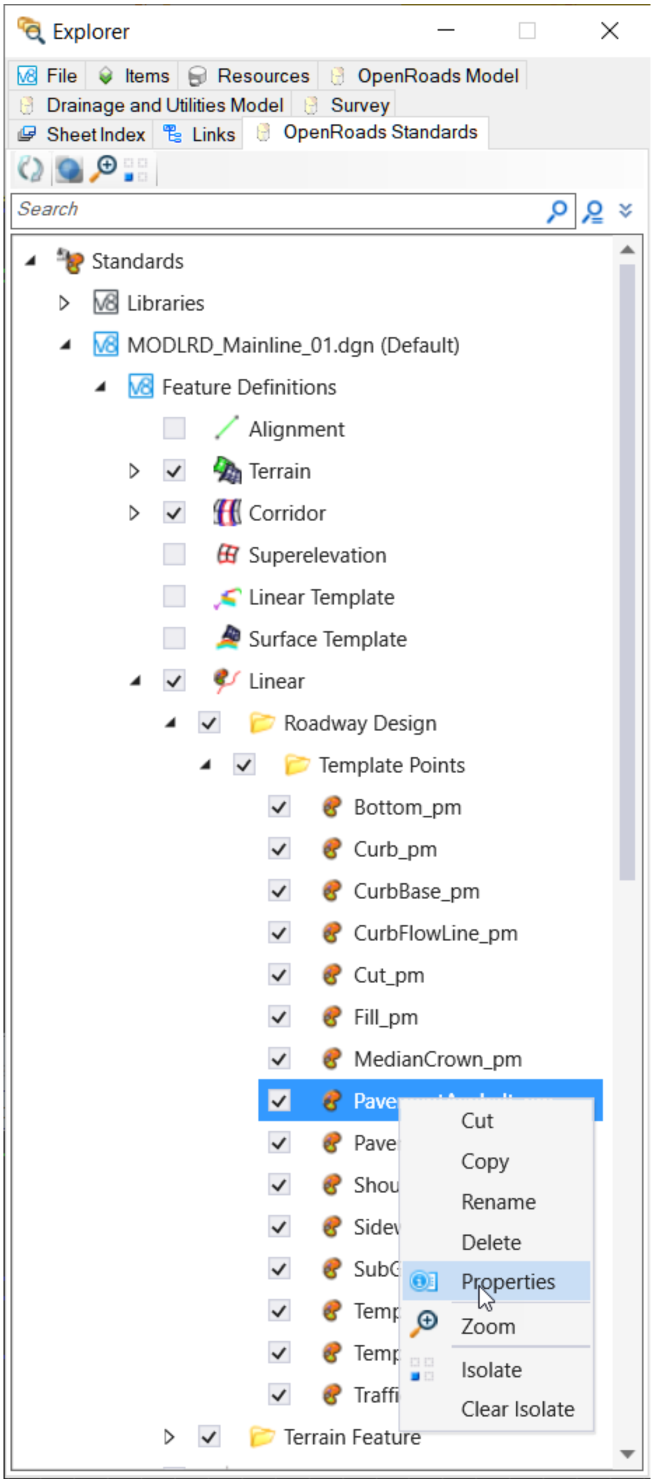
Exercise Overview

Exercise 4.1 *Create Template Geometry, RRR98*

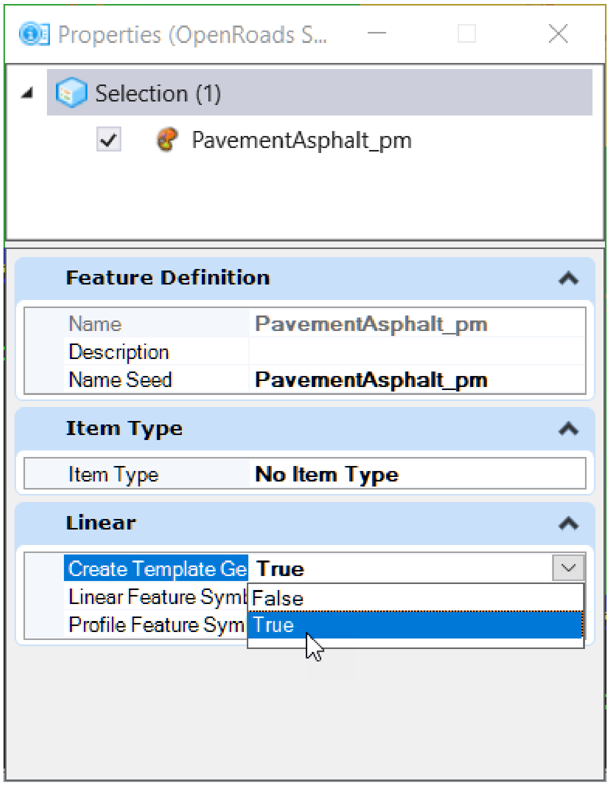
This exercise turns on the profiles needed to build profiles tied to the corridor model. We have implemented 2D Lines from the 3D model. In Explorer change the PavementAsphalt_pm feature property to True as shown below. Then re-process each corridor to see the resulting construction lines. These lines have profiles and can be used in lieu of the steps outlined in the exercise.

1. Open the *MODLRDUS98.dgn* file.

2. Go to Explorer, right click on **Feature Definitions > Linear > Roadway Design > Template Points >** *PavementAsphalt_pm* and select **Properties** as shown on the left.



3. Change **Create Template Geometry** to "**True**" as shown below.



4. Reprocess the corridor. Note the additional purple lines that show up in the 2D view.

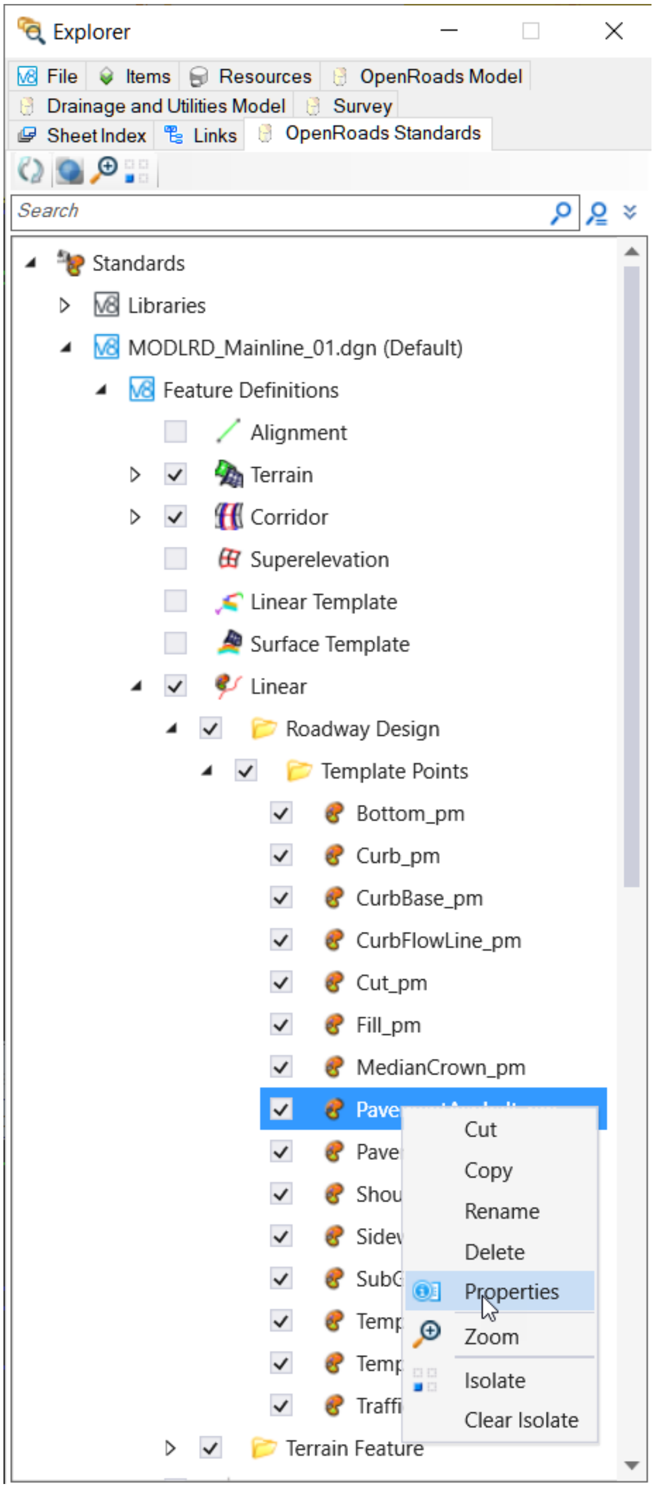
5. Add Key Stations at the radius return points on either side of the SR61 intersection.

Exercise 4.2 *Create Template Geometry, SR61*

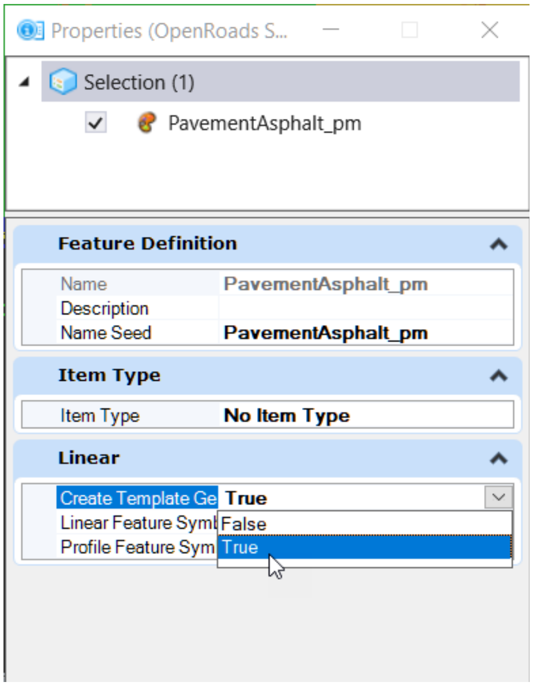
This exercise turns on the profiles needed to build profiles tied to the corridor model. We have implemented 2D Lines from the 3D model. In Explorer change the PavementAsphalt_pm feature property to True as shown below. Then re-process each corridor to see the resulting construction lines. These lines have profiles and can be used in lieu of the steps outlined in the exercise.

1. Open the *MODLRDMainline61.dgn* file.

2. Go to **Explorer**, right click on **Feature Definitions > Linear > Roadway Design > Template Points > PavementAsphalt_pm** and select **Properties** as shown below.



3. Change **Create Template Geometry** to *True* as shown below.

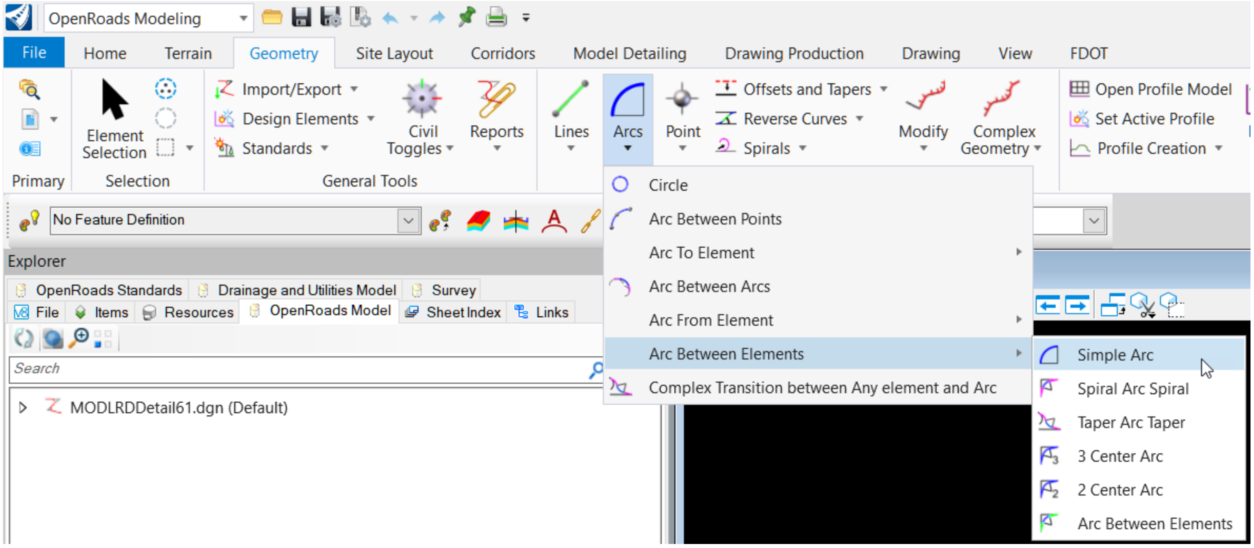


4. Reprocess the corridor. Note the additional purple lines that show up in the 2D view.

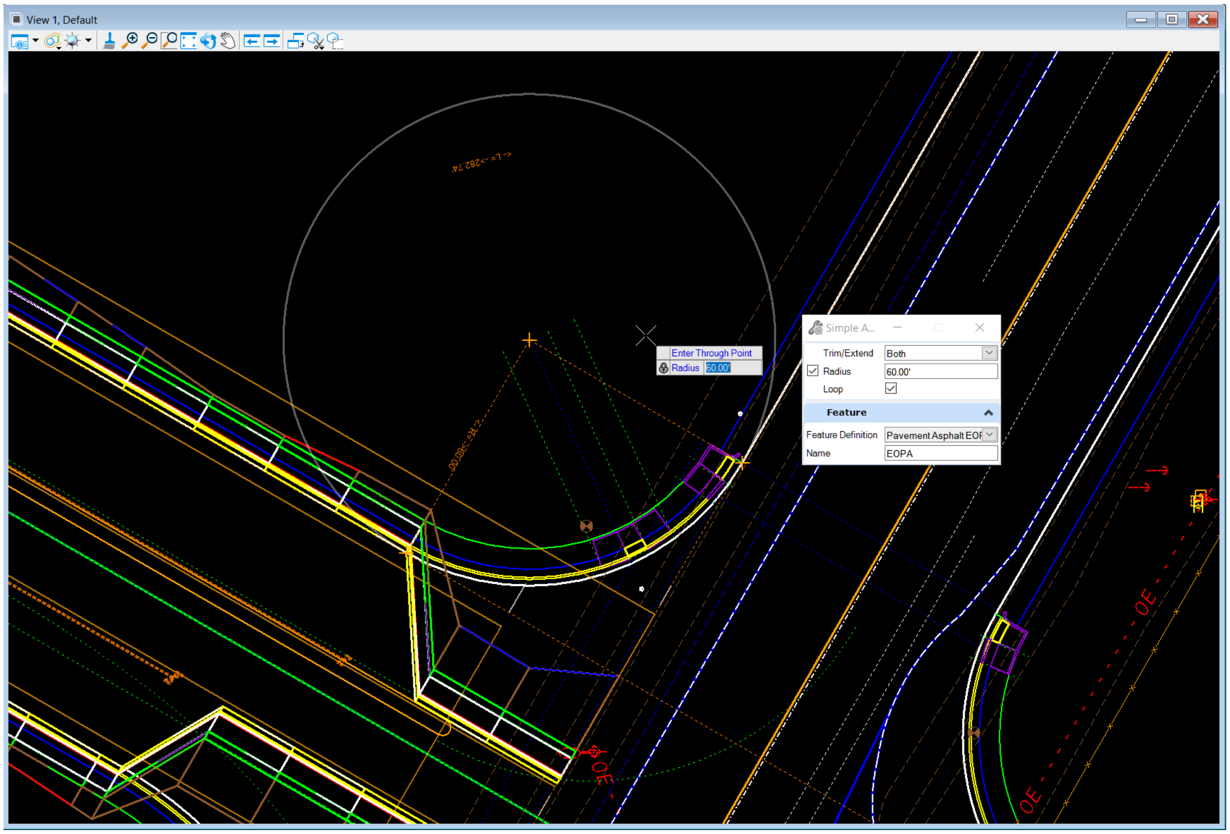
Exercise 4.3 *Construct 3D Radius Lines*

1. Open the *MODLRDDetail61.dgn* file and zoom in to the intersection of SR61 and US 98.

2. From *Geometry*, *Horizontal*, *Arcs > Arc Between Elements*, use the **Simple Arc** tool to create new **PavementAsphaltEOPA** features between the two *PavementAsphaltEOPA* edges on both corners.



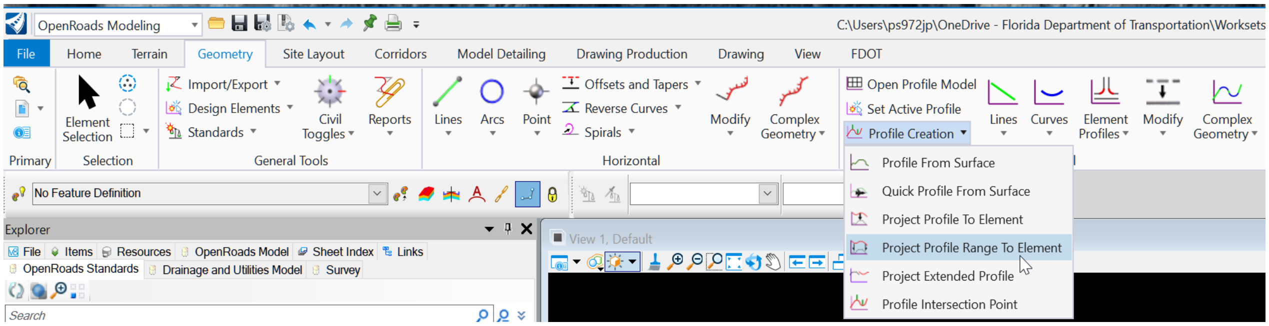
3. Use **110’** and **60’** for the radii to match the radius returns in the design file, as show below.



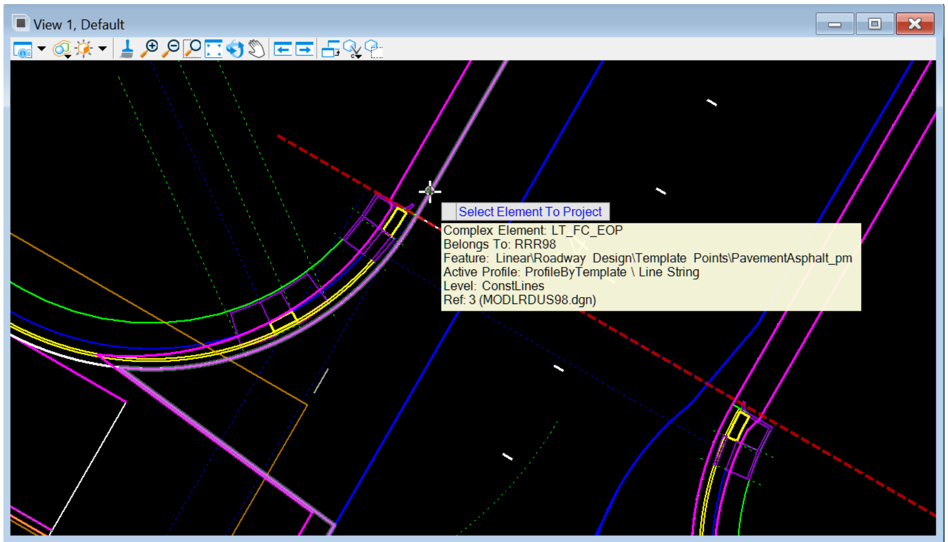
NOTE ***These will be used to help create automatic profiles for the 3D lines on the Radii.***

4. Open a Profile Model for the 60’ radius on the right side.

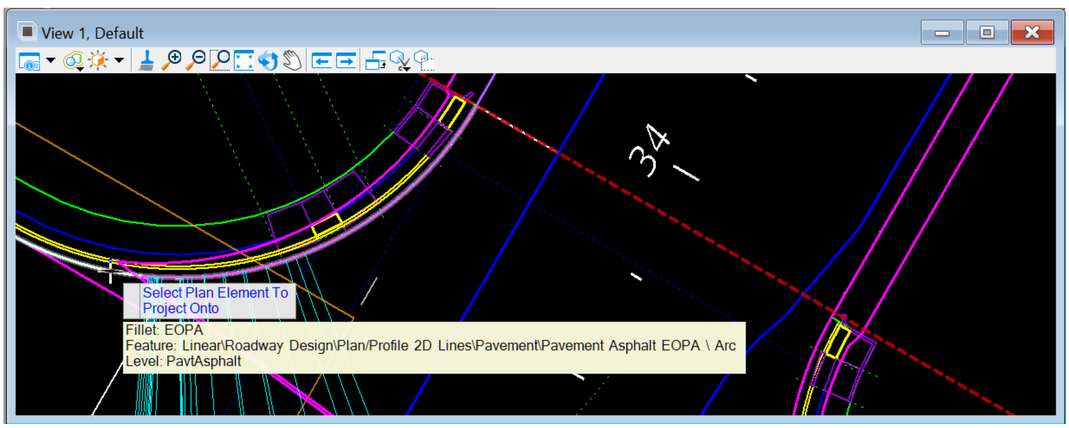
5. Use *Geometry*, *Profile Creation* > **Project Profile Range to Element** tool.



6. Select the **PavementAshpalt_pm** line to project as shown below.



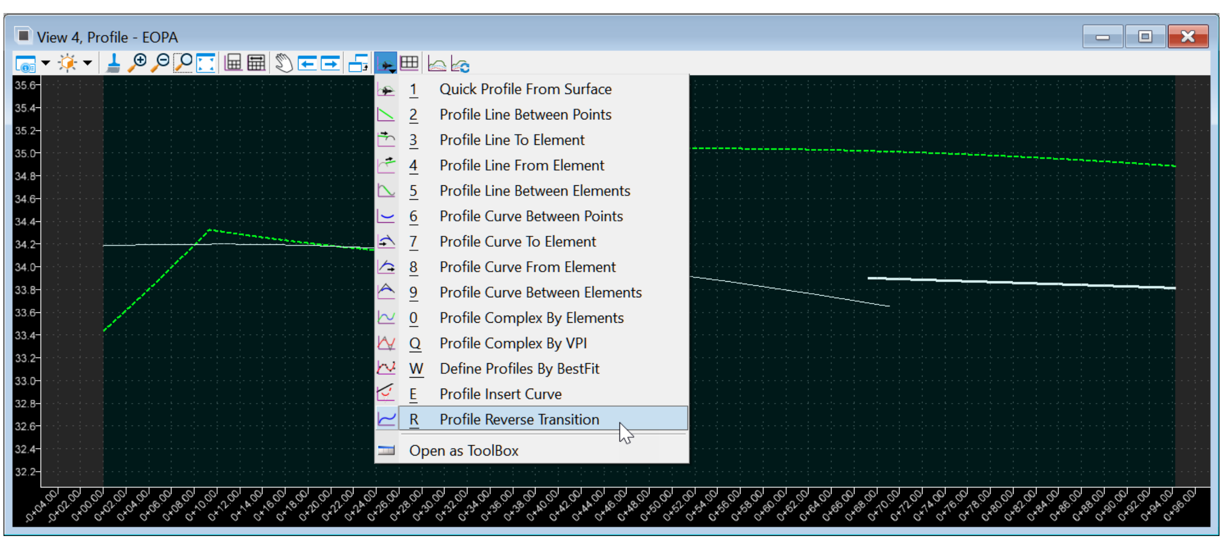
7. Select the **Pavement Asphalt EOPA** arc plan element to project onto.



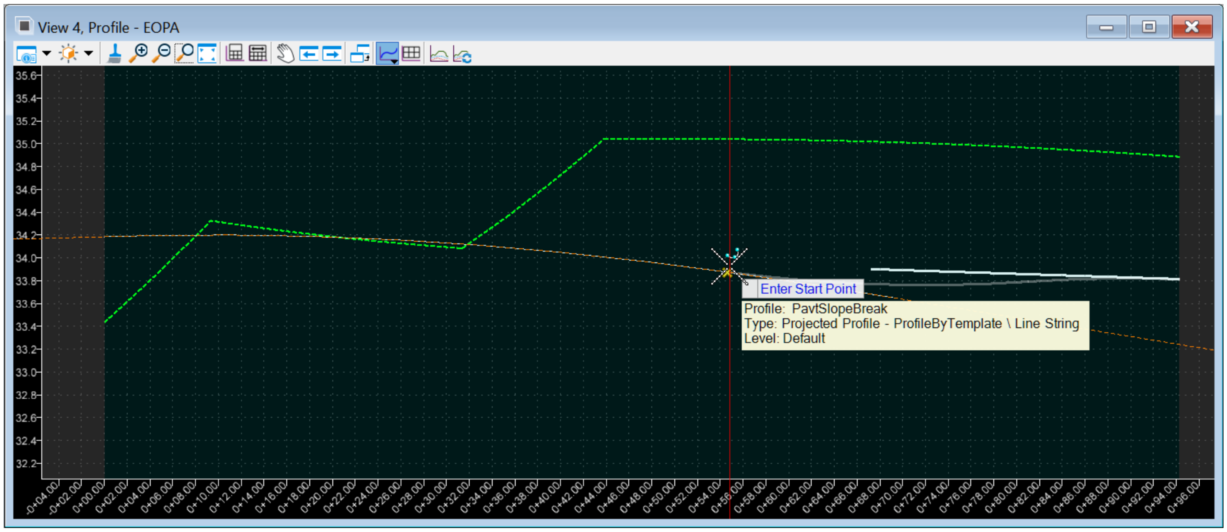
8. Set the range to match the length of the overlap of the two arcs, 0+00.00 to 0+69.11.

9. Repeat the command to project the **PavementAsphalt_pm** from the edge of the SR61 corridor onto the other end of the same arc. Snap from the beginning of the line, 0+67.23 to the end of the arc where it intersects the line, 0+94.25.

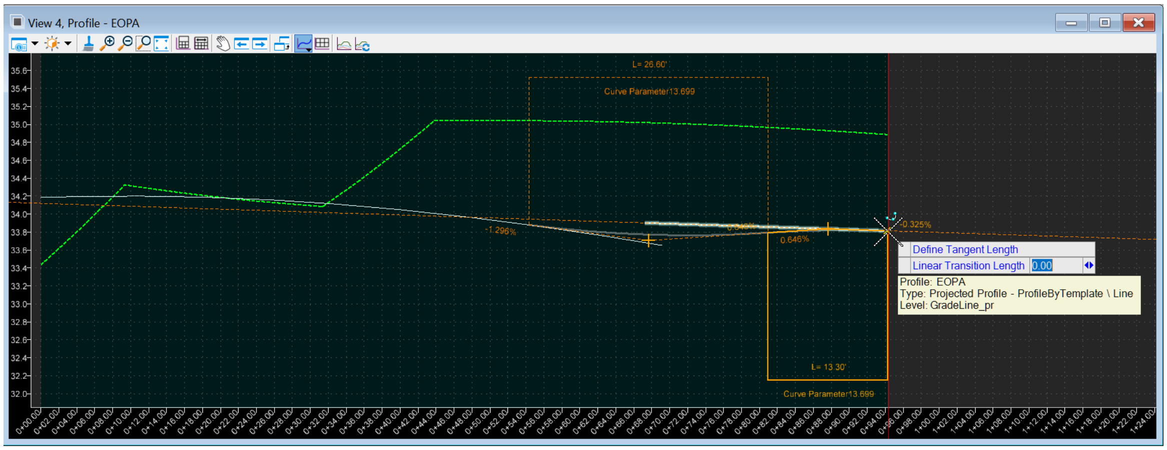
10. In the profile view, *Vertical Geometry Tools*, select **Profile Reverse Transition**.



11. Select the two projected profiles as the two elements, and set back and ahead offsets to 0. Set the Start Point such that it creates a low point in the vicinity of Station 0+68.

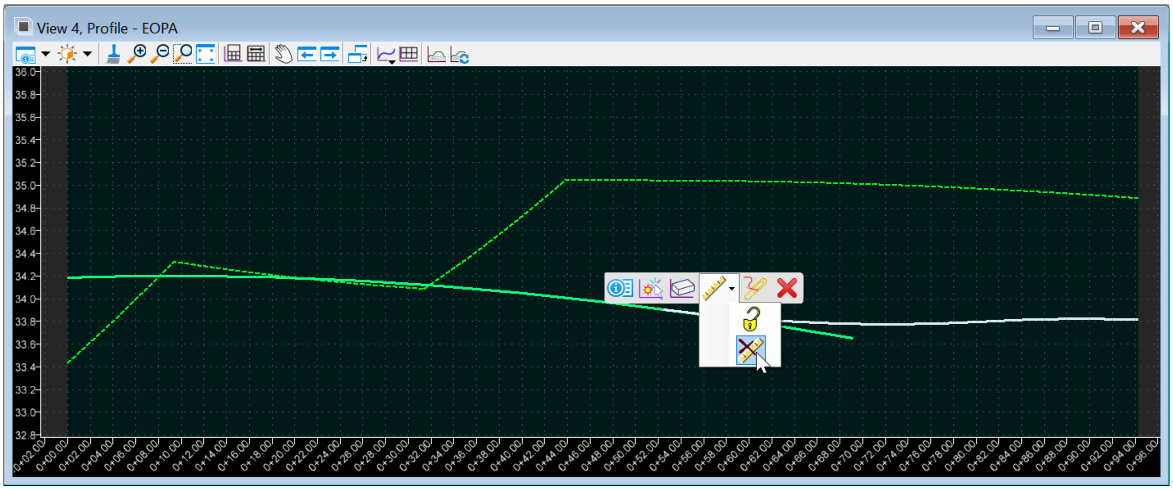


12. Snap the end point to the end of the profile as shown below.



13. Set Trim/Extend option to *Both*.

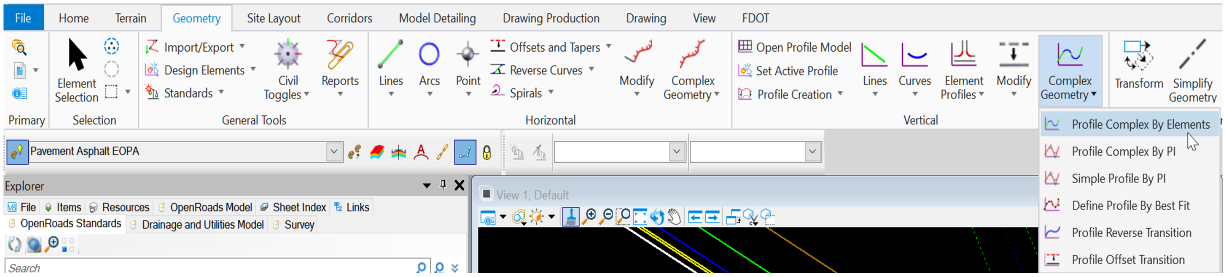
14. Remove the rule from the transition projected from the US98 corridor.



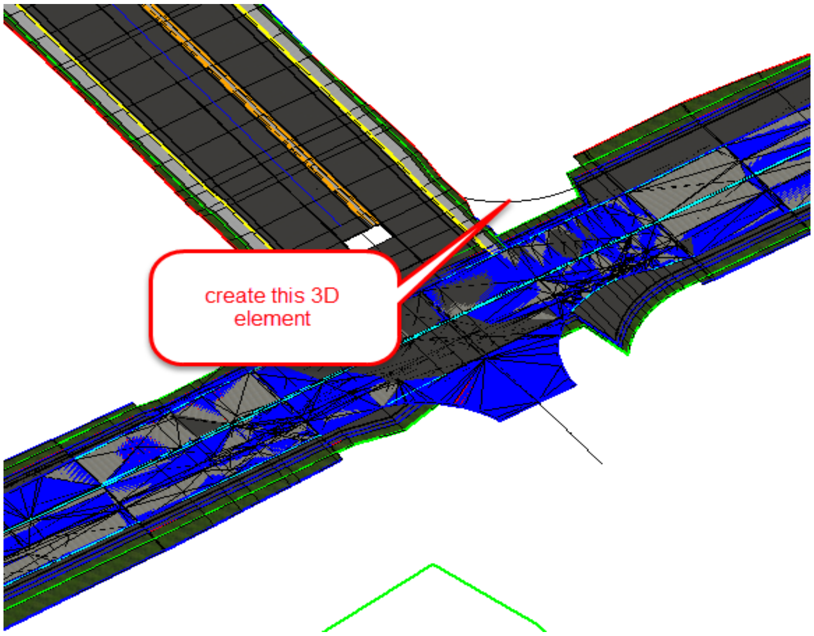
NOTE ***We will be removing the portion of the RRR98 corridor that the profile is built from later, so removing the rule here first will allow this change without breaking the profile for the radius return.***

15. Use the **Drawing > Modify >Trim to Element** tool to trim the projected profile to the reverse transition.

16. Use the **Geometry > Vertical > Complex Geometry > Profile Complex By Elements** command to complex the pieces into one profile.



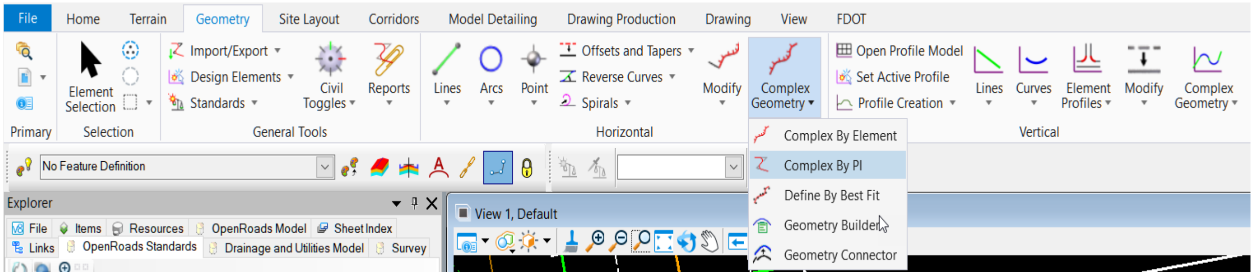
17. Select the new **Profile Line.** Select the **Set Active Profile** from the Context Menu and the *3D Line* will display.



18. Repeat steps 4-17 for the 110' radius on the other side of the intersection.

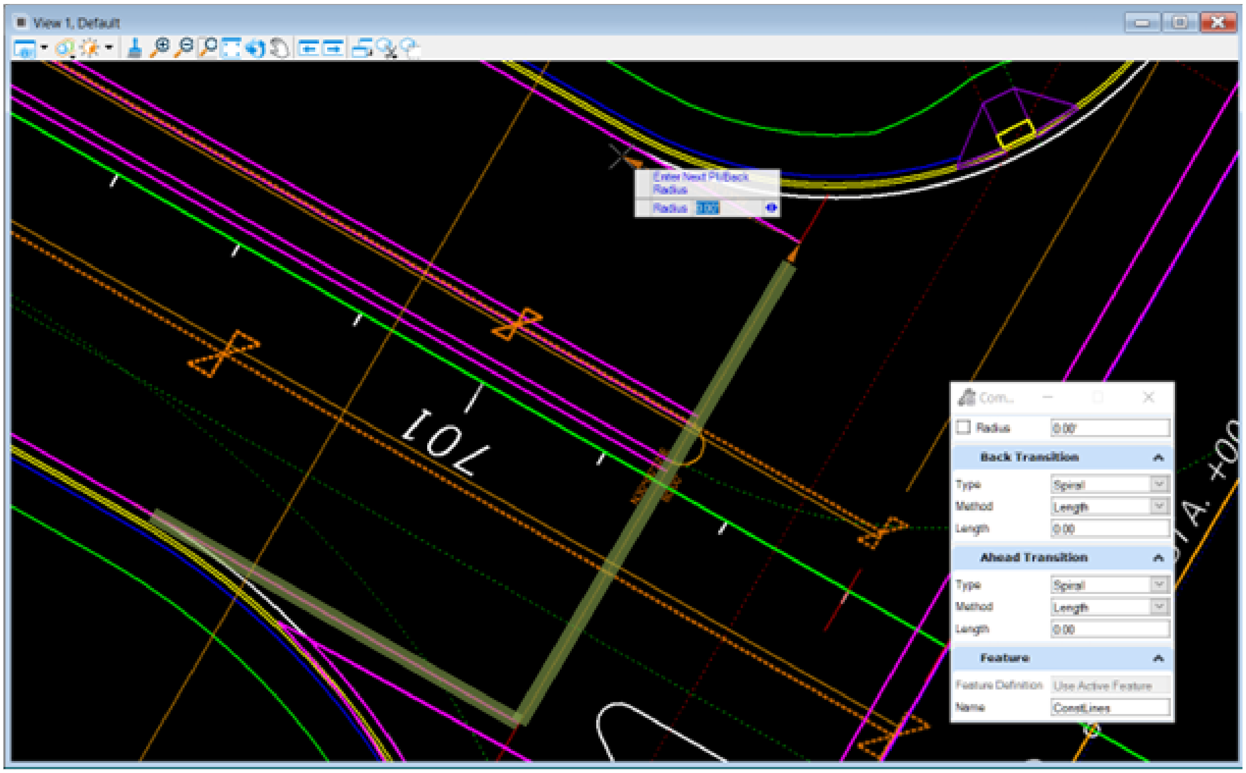
Exercise 4.4 *Construct 3D Intersection Limit Lines*

1. Use **Geometry > Horizontal > Complex Geometry > Complex By PI** tool.



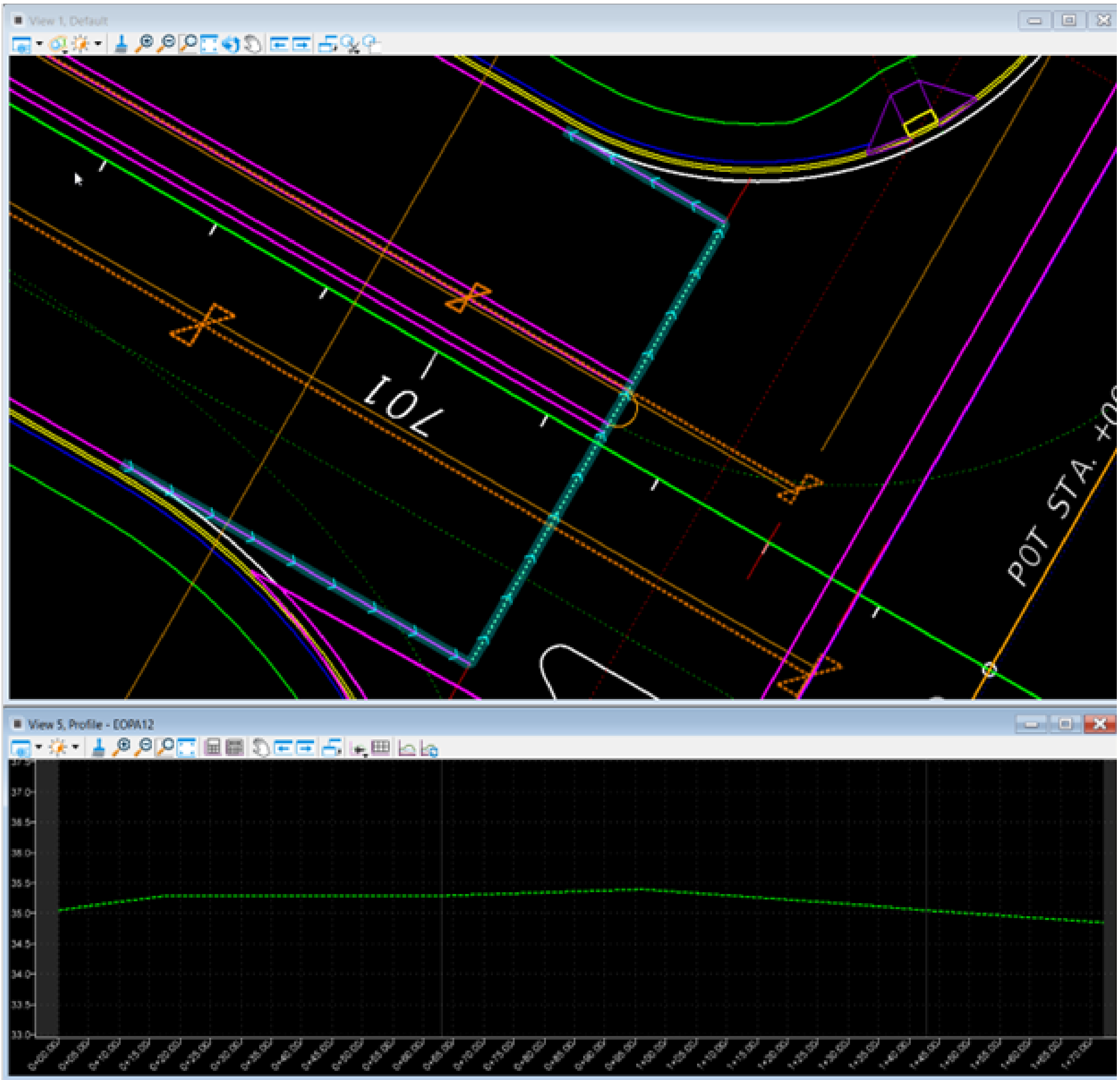
a. Use the Feature Definition PavtSlopeBreak.

b. Construct a complex line first along the left side of the mainline corridor from the EOP radius return to the beginning of the corridor (trace the PavementAshpalt_pm feature lines), then perpendicular to the Traffic Separator lines across the end of the corridor to the right side of the SR61 mainline corridor, then trace the PavementAsphalt_pm feature line to the EOP radius return point on the right side. In the picture below the first two segments of the complex element are highlighted in green, while the third is in progress near the snap point.

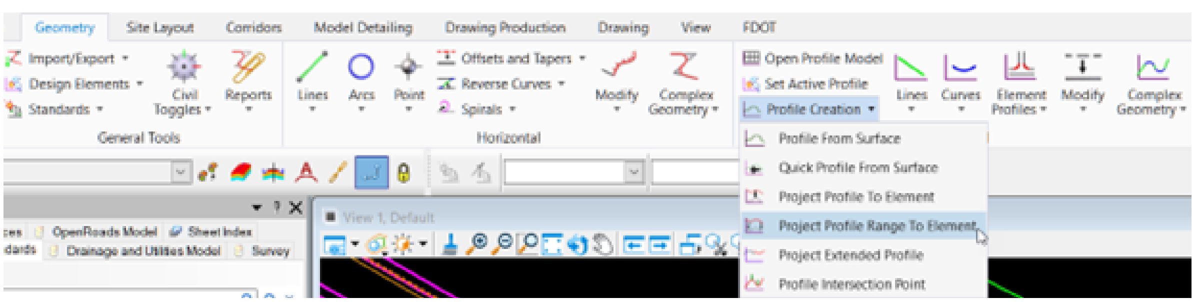


NOTE ***Turn off Level Display of the corridor elements from the mainline corridor, CorrPointControl_dp and TmpDrpHndlStg3_dp to make it easier to select the correct lines. Also, turn off display of DSGNRD01.dgn if necessary.***

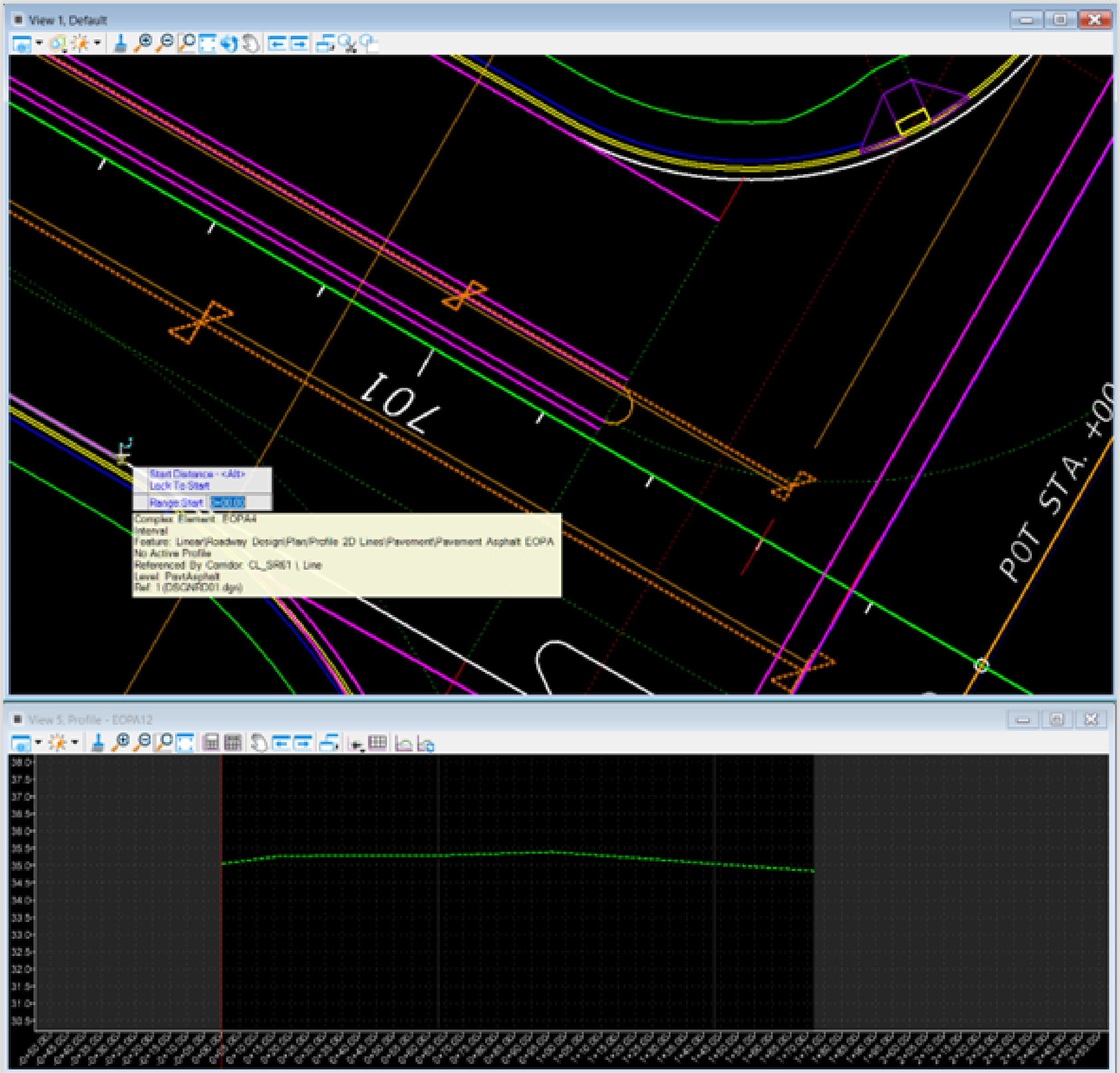
2. Use the **Geometry > Vertical > Open Profile Model** tool and select the newly constructed Complex line.



3. Use the **Geometry > Vertical > Profile Creation > Project Profile Range to Element** tool.

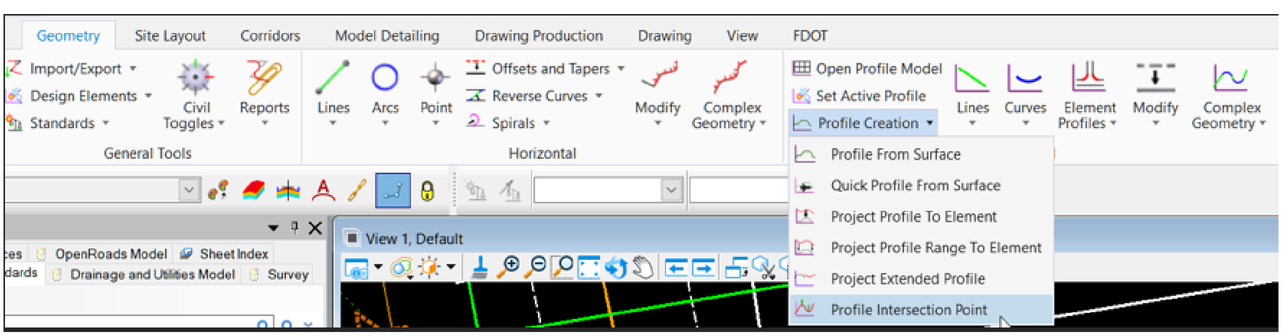


4. Select the *PavementAsphalt_pm* feature line on the left side and project it onto the ConstLines Green Dash complex element. Start the range at the EOP radius return and end at the beginning of the feature line and mainline corridor.

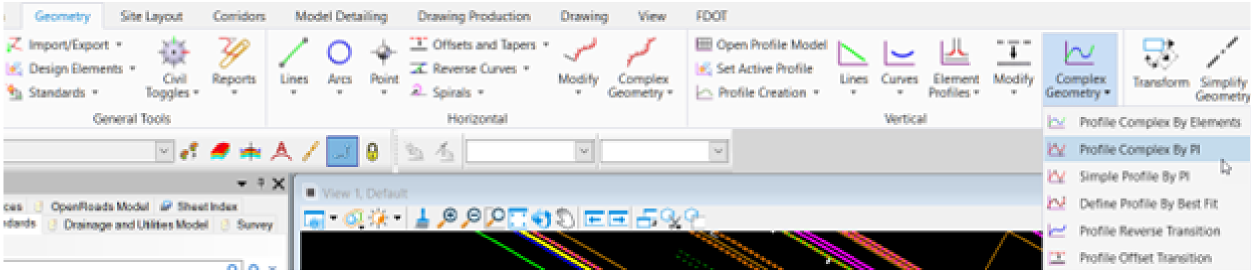


5. Repeat Steps 3-4 for the right side PavementAsphalt_pm feature line, starting the range at the beginning of the feature line/corridor and ending at the radius return.

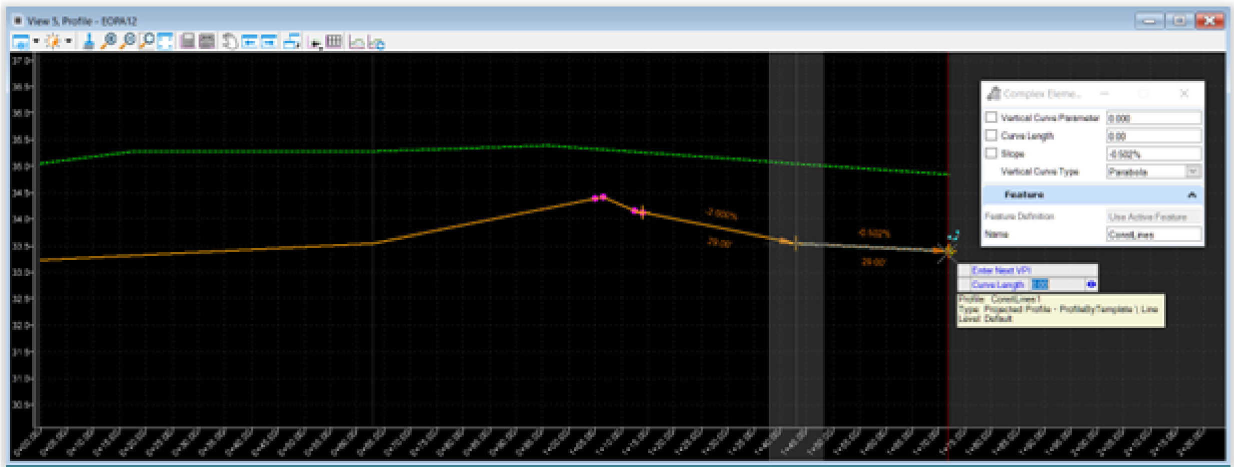
6. Use **Geometry > Vertical > Profile Creation > Profile Intersection Point** tool to add intersection points for the 4 PavementAsphalt_pm feature lines around the traffic separator.



7. Use the **Geometry > Vertical > Complex Geometry > Profile Complex By PI** command.

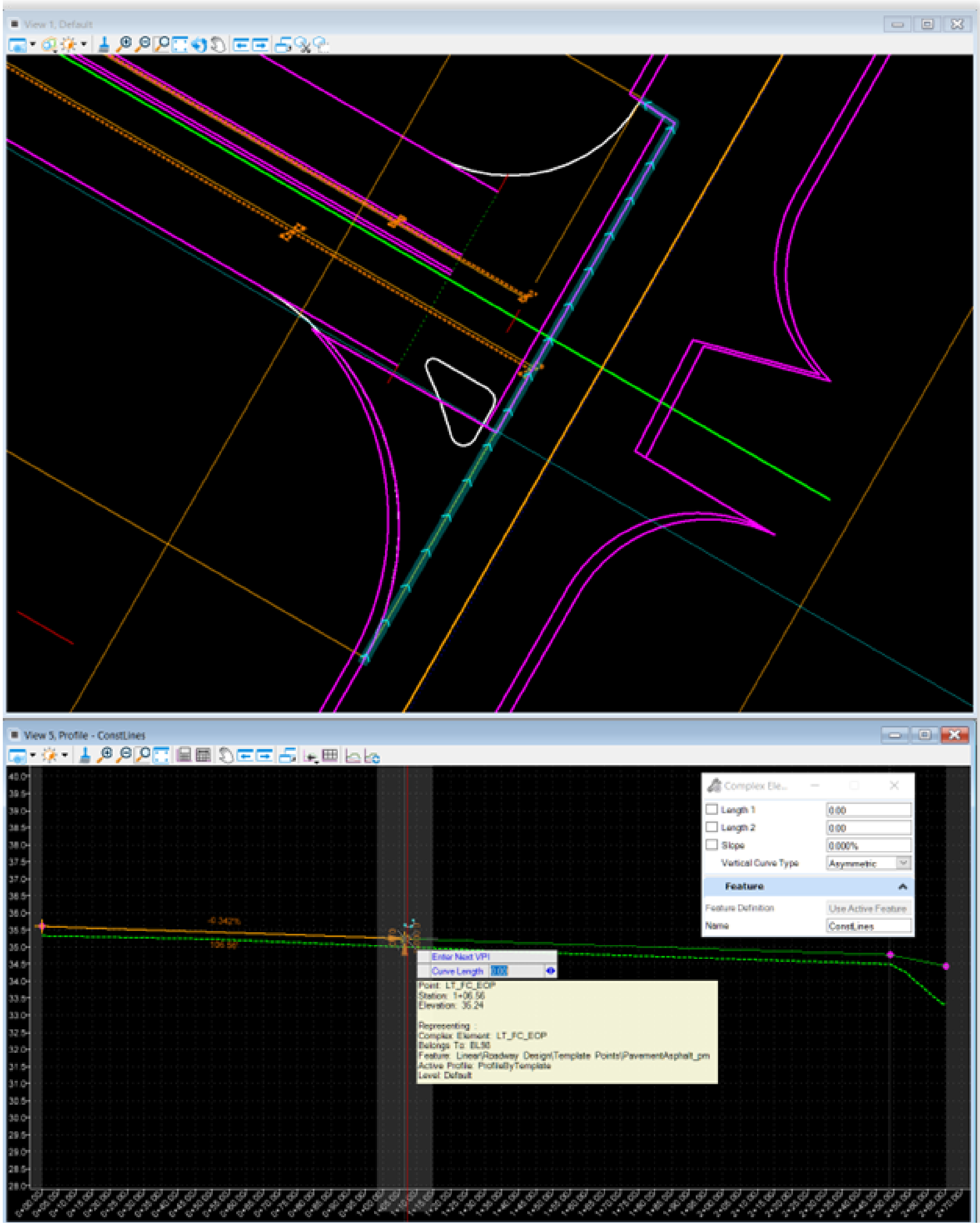


8. Start on the left and snap to all the lines and points shown in the profile.

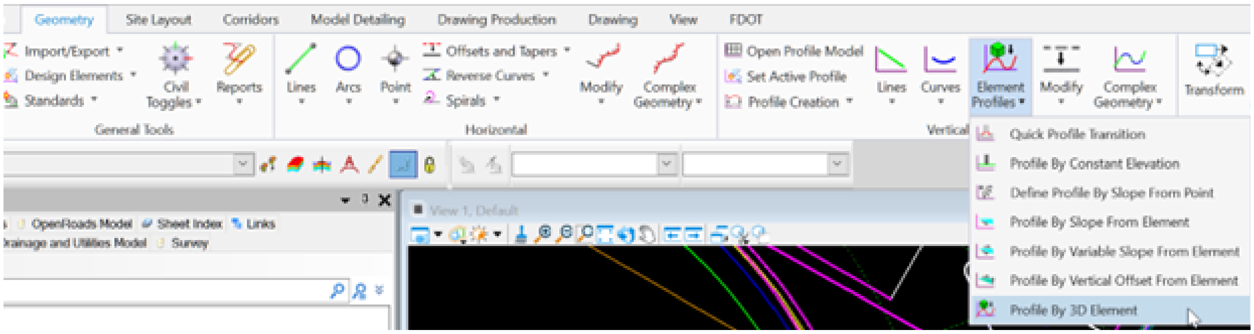


9. Use **Geometry > Set Active Profile** to set the newly created profile as active.

10. Repeat these steps to draw a complex element with a profile on the US 98 side of the intersection area. Use Project Profile Range to Element where lines with profiles overlap the lines, and Profile Intersection Point where lines cross or end. See image below for reference.



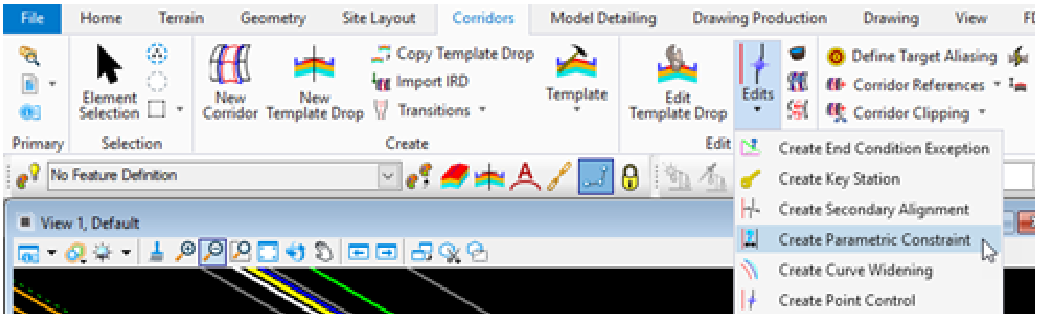
11. To create a profile for sections with neither an intersection nor overlapping profile from a template, use the **Geometry > Vertical > Element Profiles > Profile by 3D Element** tool. Select the element in this file to profile in the 2D view, and select the 3D element from the corridor model in the 3D view (ie LT_FC_IN on the RRR98 profile).

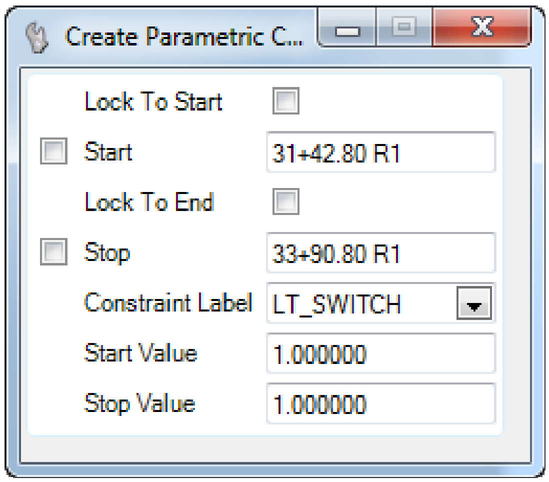


Exercise 4.5 *Add Parametric Constraint to RRR98 Template*

1. Open the *MODLRDUS98.dgn* file.

2. Use the **Bold Corridor > Edit > Edits > Create Parametric Constraint** tool.





a. At the prompt, select the **BL98 Corridor boundary**.

b. Snap to the SW Radius for the Start Station.

c. Snap to the NW Radius for the End Station.

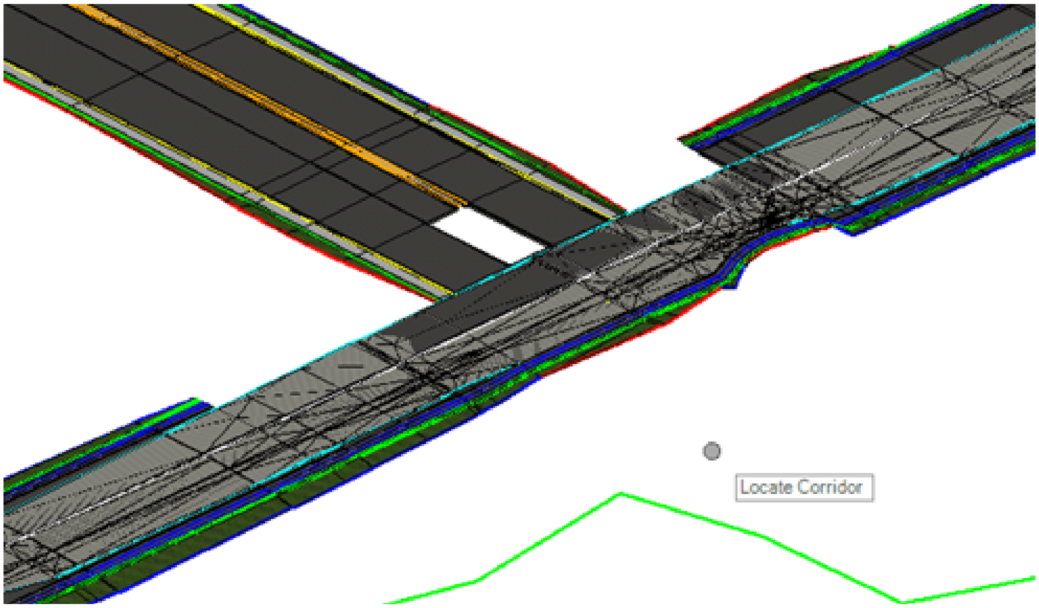
d. Pick the **LT_SWITCH** Constraint Label from the list.

e. Enter **1** for the Start Value.

f. Enter **1** for the Stop Value.

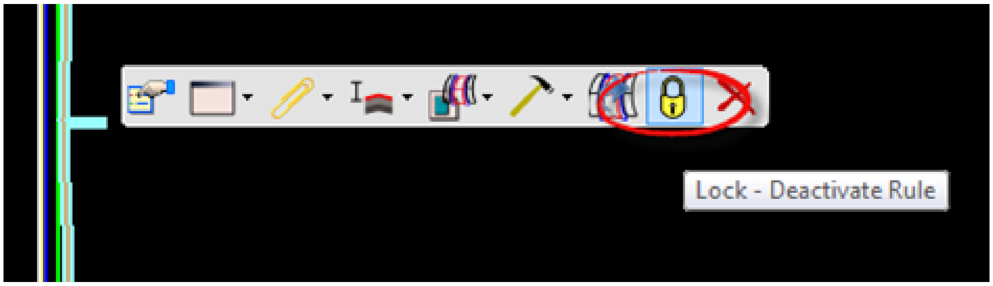
g. The corridor will re-process with the updated RRR98 Template.

3. The left outside components of the BL98 corridor are now turned off though the limits of the intersection.



▶ ***Turn OFF the Automatic Corridor processing of US98***.

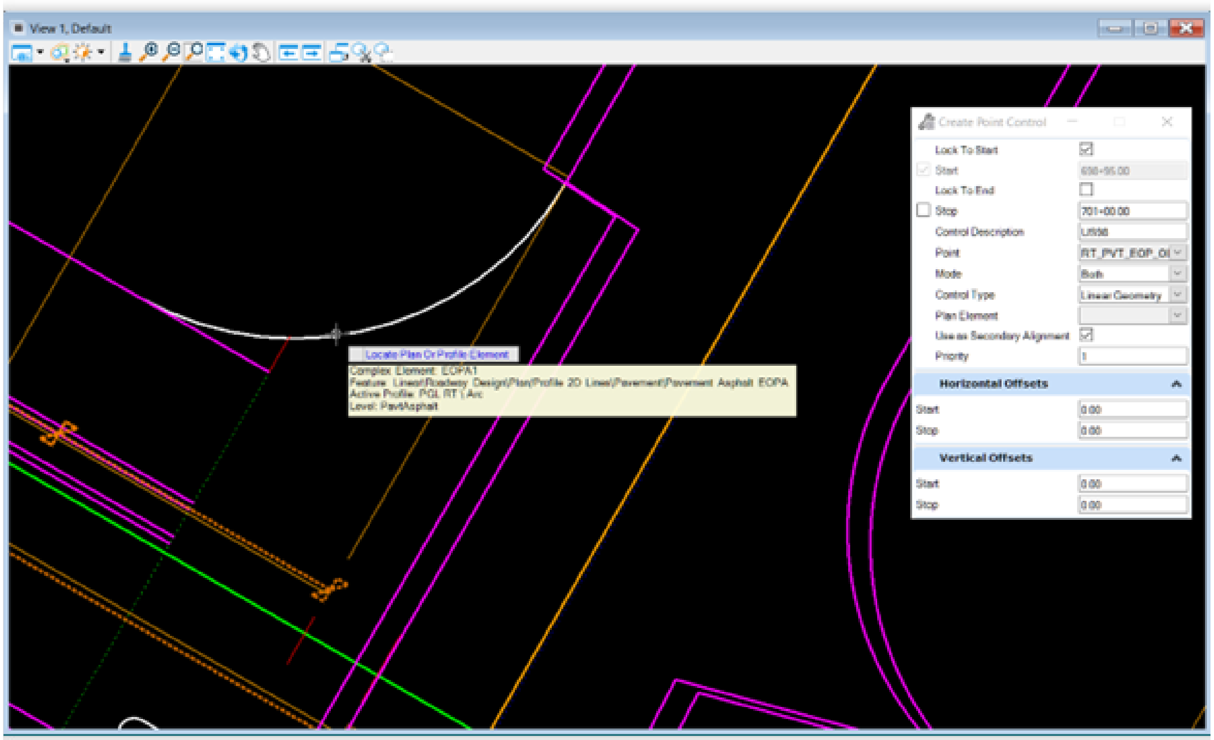
1. Select the **US98 Corridor** handle to display the Context Menu and select **Lock - Deactivate Rule**.



Exercise 4.6 *Model Curb and Sidewalk Around Radii*

1. Use the **Corridors > Edit > Edits > Create Point Control** tool.

2. Identify the Corridor Boundary handle for the SR 61 R corridor. Continue to define the *Create Point Control* dialog information.



   a. Lock to Start.

   b. Snap End station to the end of the radius return, where the other point control begins.

   c. Set Control Description to US98.

   d. Select the **RT_PVT_EOP_OUT** in the 3D View.

   e. Set Mode to Both.

   f. Set Control Type to Linear Geometry.

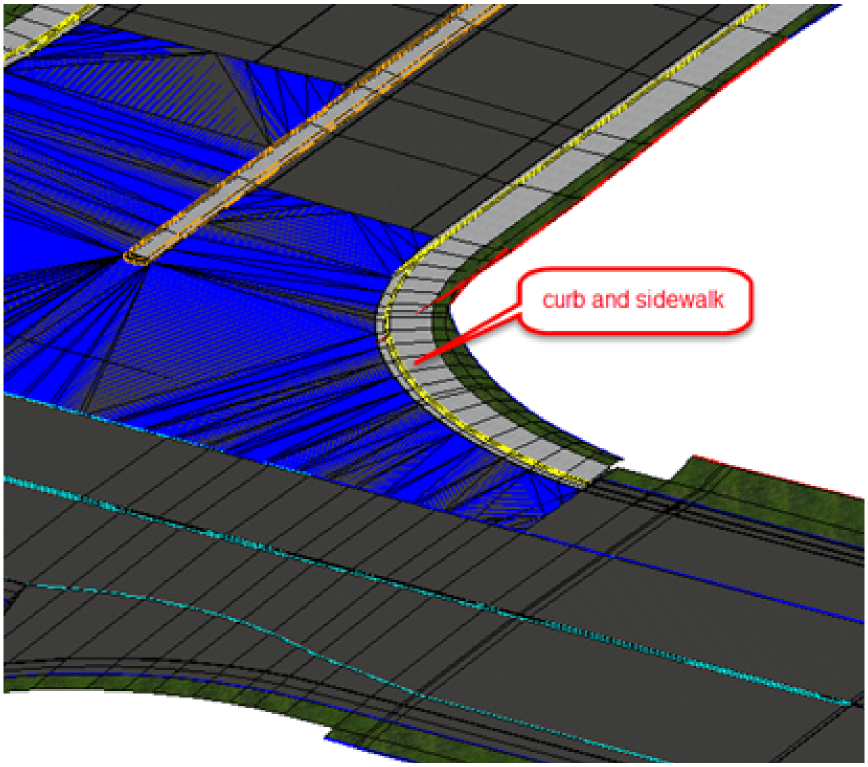
   g. Select the **Pavement Asphalt EOPA** radius return with the active profile.

   h. Set Use as Secondary Alignment.

NOTE ***Corridor intervals are normally drawn perpendicular to the alignment the corridor follows. Since the corridor was drawn along the roadway centerline, the sidewalk and curb intervals would not normally be perpendicular to the radius return pavement edge as it needs to be. Use as Secondary Alignment instructs the template drop to place the interval perpendicular to the element being used for a point control.***

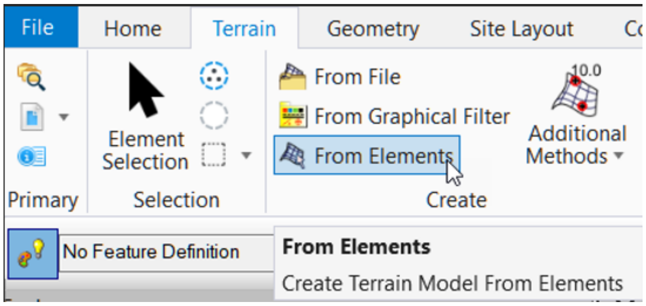
   i. Accept remaining values as shown above.

3. Repeat the steps above for the SR 61 L Corridor.

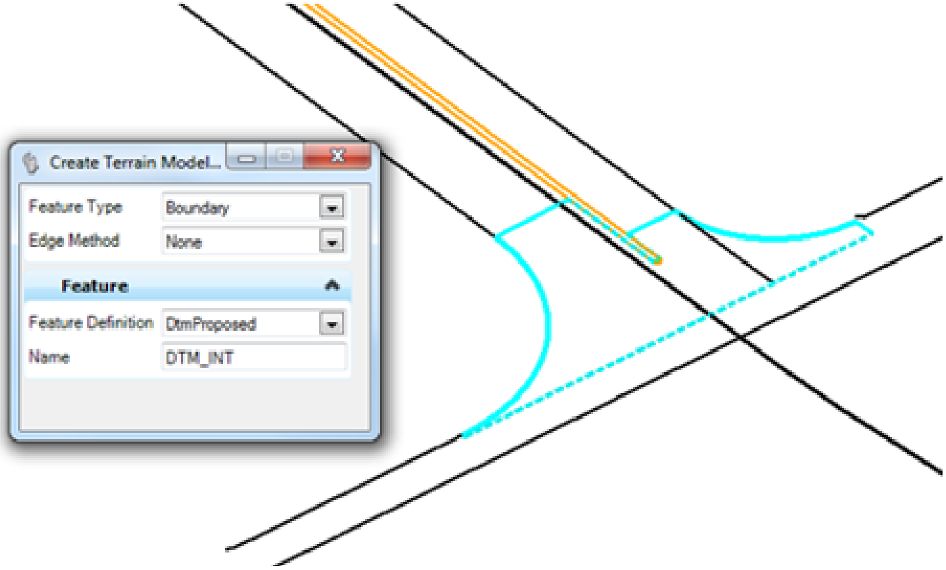


Exercise 4.7 *Build the Intersection Terrain from 3D Elements*

1. Use **Terrain > Create > From Elements** tool.

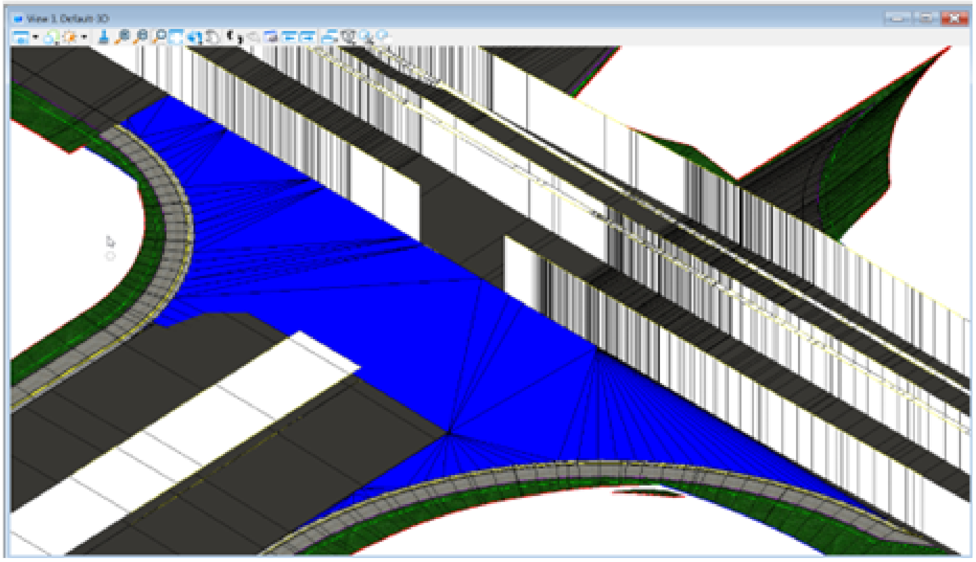


2. Select the boundary elements for the intersection.



3. Set the Feature Definition to DtmClipping.

4. Data point to accept. Press F7 to turn on Constructions in the 3D view if necessary to see the newly created terrain model.

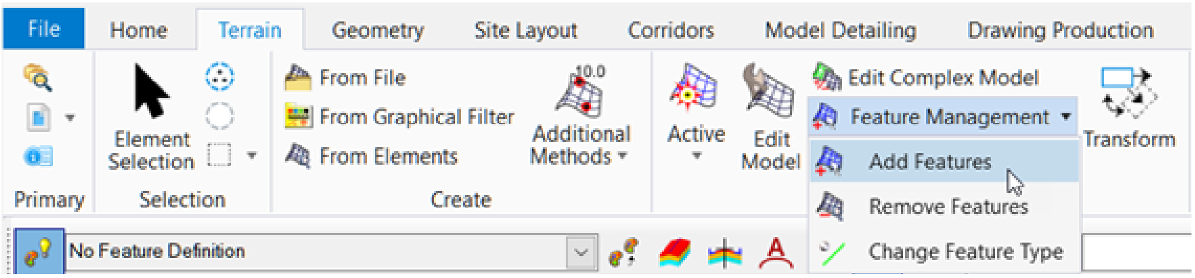


5. Verify that the boundary is correct by turning off reference displays and Mesh items in **Explorer > OpenRoads**.

▶ ***Add a breakline in the vicinity of the SR61 centerline connecting the traffic separator to US 98.***

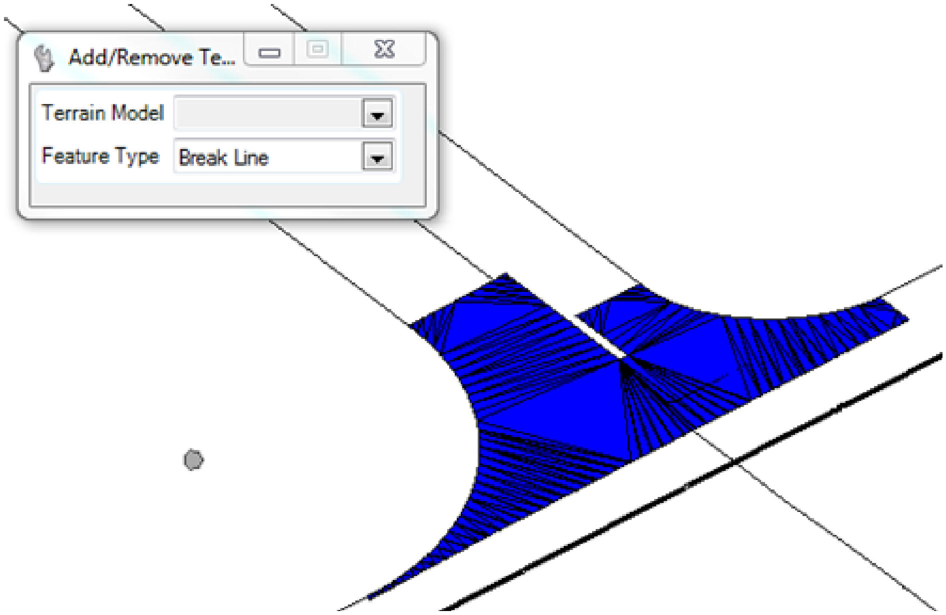
6. Construct a line using the horizontal geometry tools with an appropriate feature definition, such as PavtCrown. Use the vertical geometry tools, such as Profile Intersection Point, to create a profile for the horizontal line and set it active.

7. Use the **Terrain > Edit > Add Feature** tool.



8. Select the newly created terrain model.

9. Set *Feature Type* to **Break Line** and select a break line with an active profile.



NOTE ***To turn off the Blue triangles, toggle off Construction elements.***

10. Adjust stroking definition of the breakline in the *Properties* dialog to fine tune the surface as desired.

Exercise 4.8 *Clip Terrain for Right Turn Island*

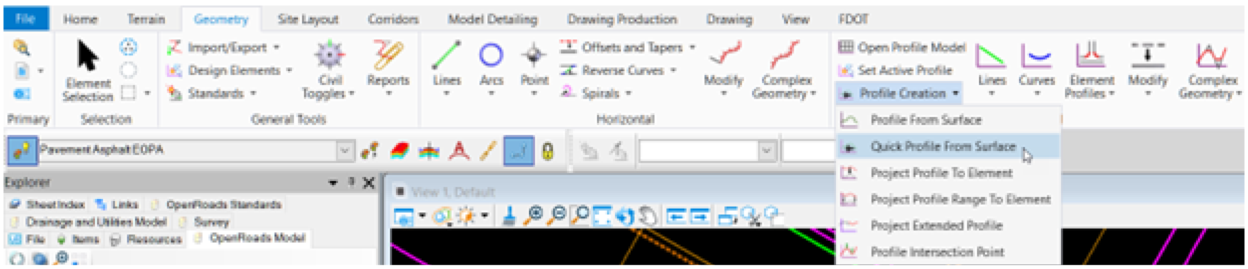
1. Create a selection set of EOP lines for the Right Turn Island and copy from the *DSGNRD01.dgn* reference into the *MODLRDDetail61* file.

2. Use **Geometry > Horizontal > Complex Geometry > Complex by Element** tool to complex all lines together into one complex element using the PavementAsphaltEOPA feature definition.

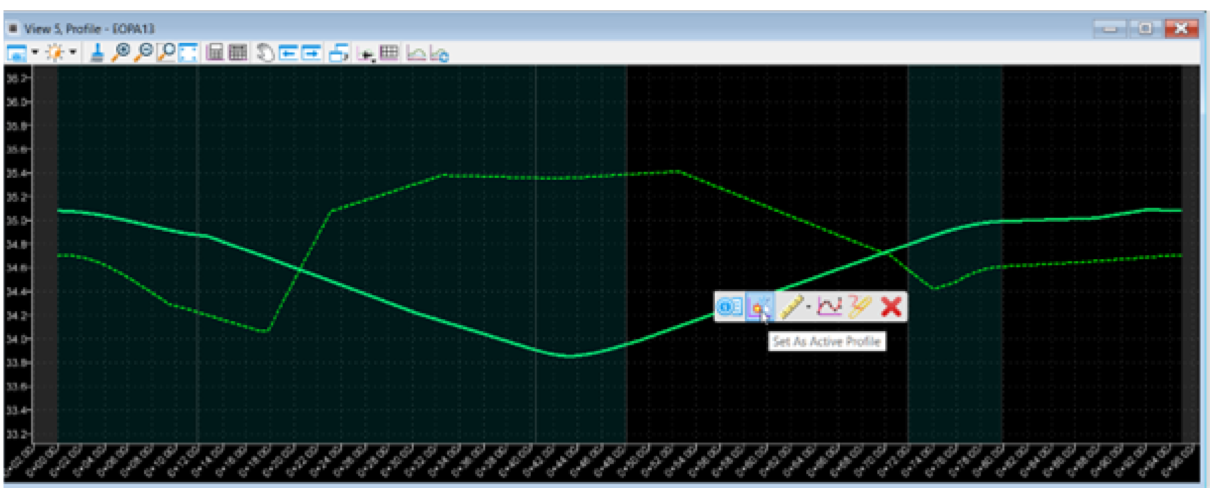
NOTE ***The Automatic method is easier, but either way works. If using the Manual method, click on the first half of each line to ensure that the Complex Geometry elements are all going in the same direction. Note the arrow on the end of each element that appears as you select it, indicating direction.***

3. Open a Profile model for the complex element.

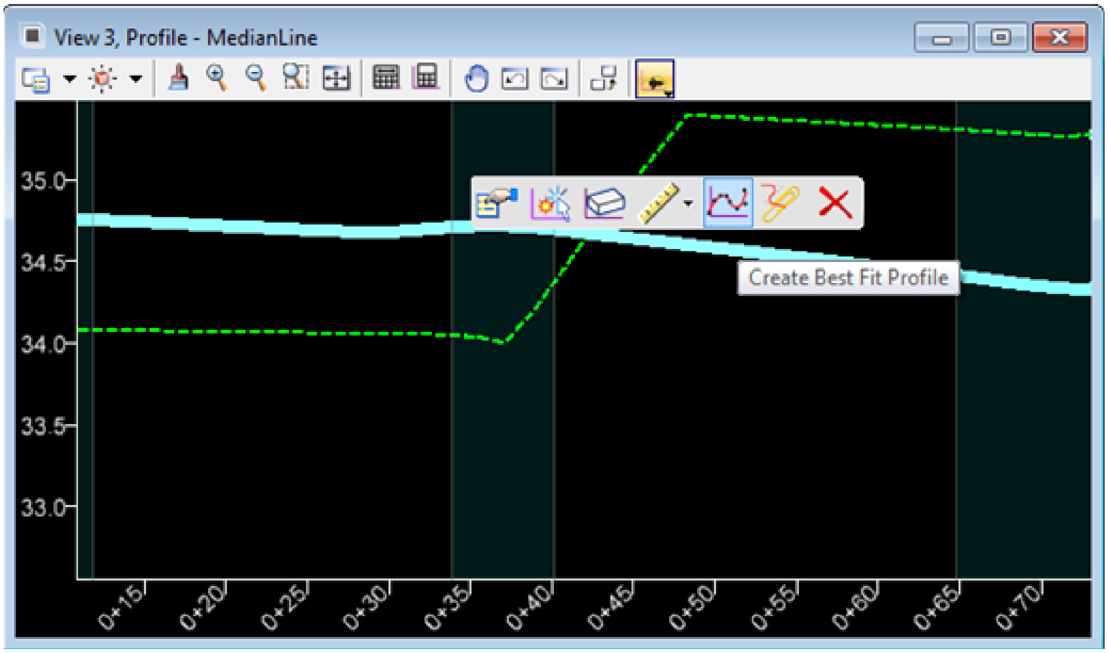
4. Use the **Geometry > Vertical > Quick Profile from Surface** tool and select the intersection terrain and the complex element in the plan view.



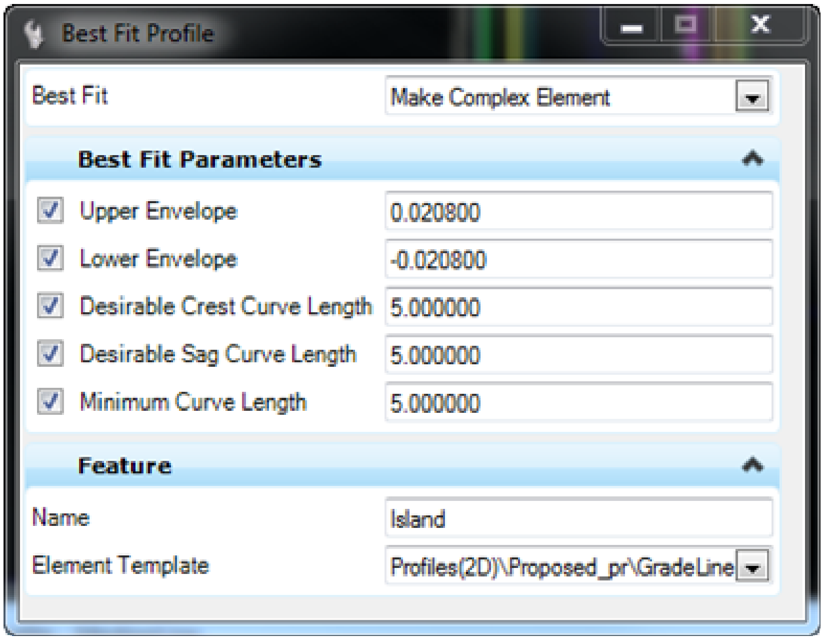
5. Set the newly created profile as **Active**.



6. <Optional> Select the Profile and select **Create Best Fit Profile**.



a. Enter the *BestFitParameters* as shown.

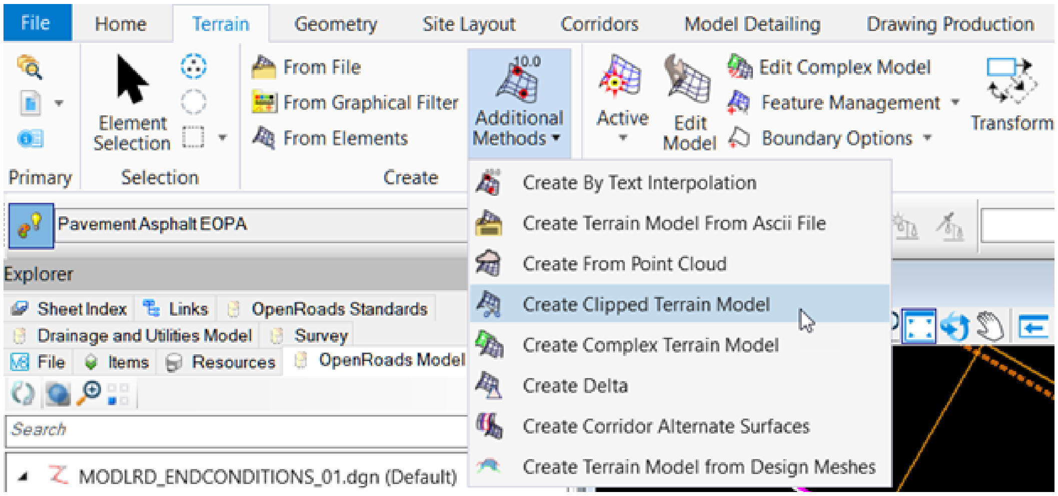


b. Create the Best Fit Profile, select the new Profile and select **Set As Active**.

c. The Island Boundary is created in the 3D Model.

▶ ***Clip Terrain***

1. Use the **Terrain > Create > Additional Methods > Create Clipped Terrain Model** tool.



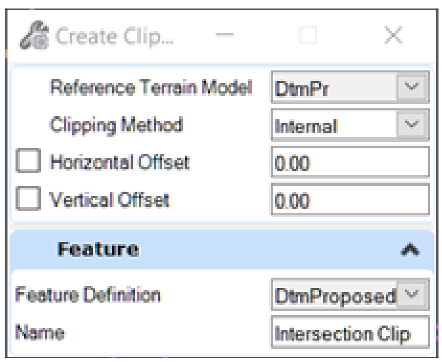
a. Select the intersection terrain in the 3D view.

b. Select the right turn island complex element and reset.

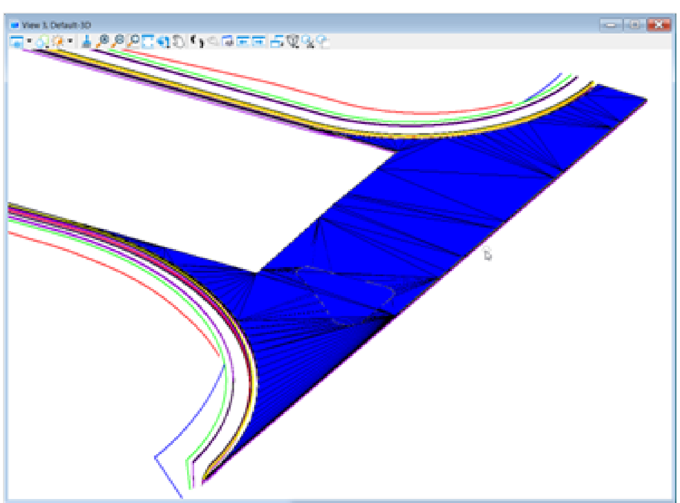
c. Set *Clipping Method* to Internal.

d. Name the terrain **Intersection Clip**.

e. Accept settings as shown on the right.

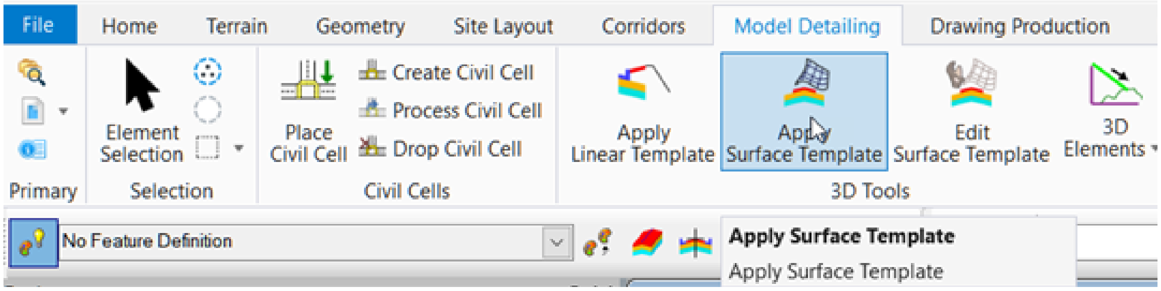


f. Clipped terrain will overlap with existing terrain but triangles should indicate that the new one stops at the right turn island.



Exercise 4.9 *Create an Intersection Pavement Surface*

1. Use Model Detailing, Apply Surface Template.

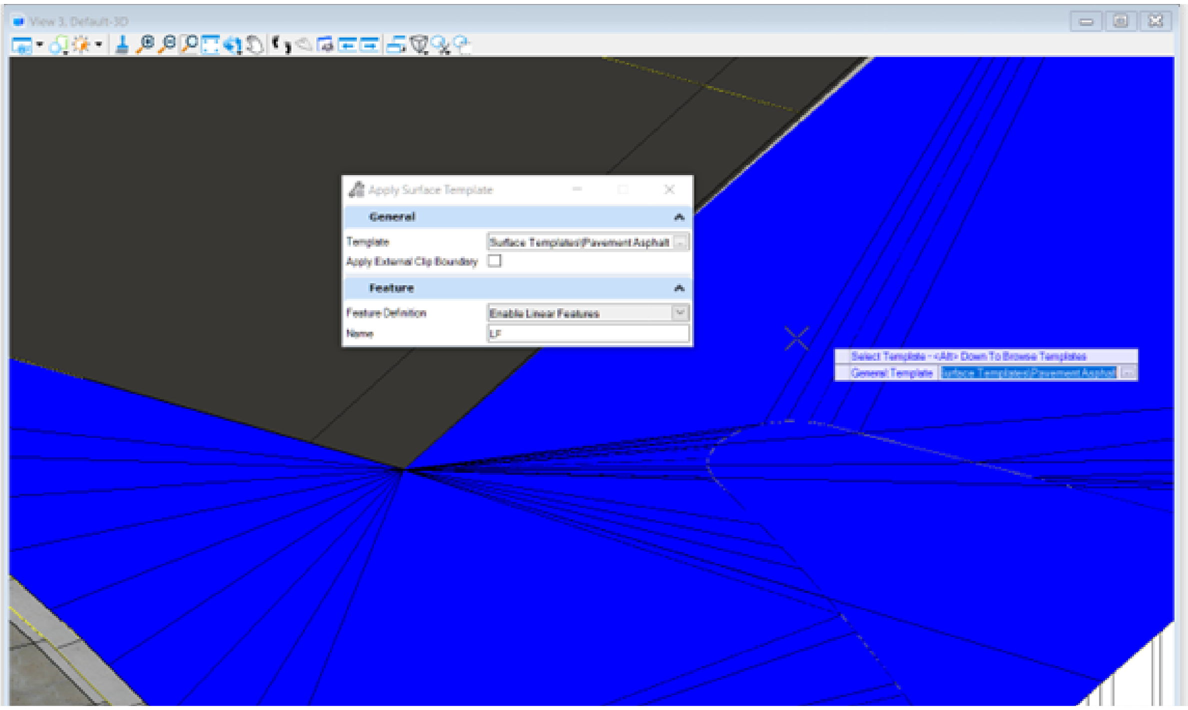


   a. Select **Pavement Asphalt Surface Template** from the Template Library.

   b. Select the Intersection Clip terrain to create pavement.

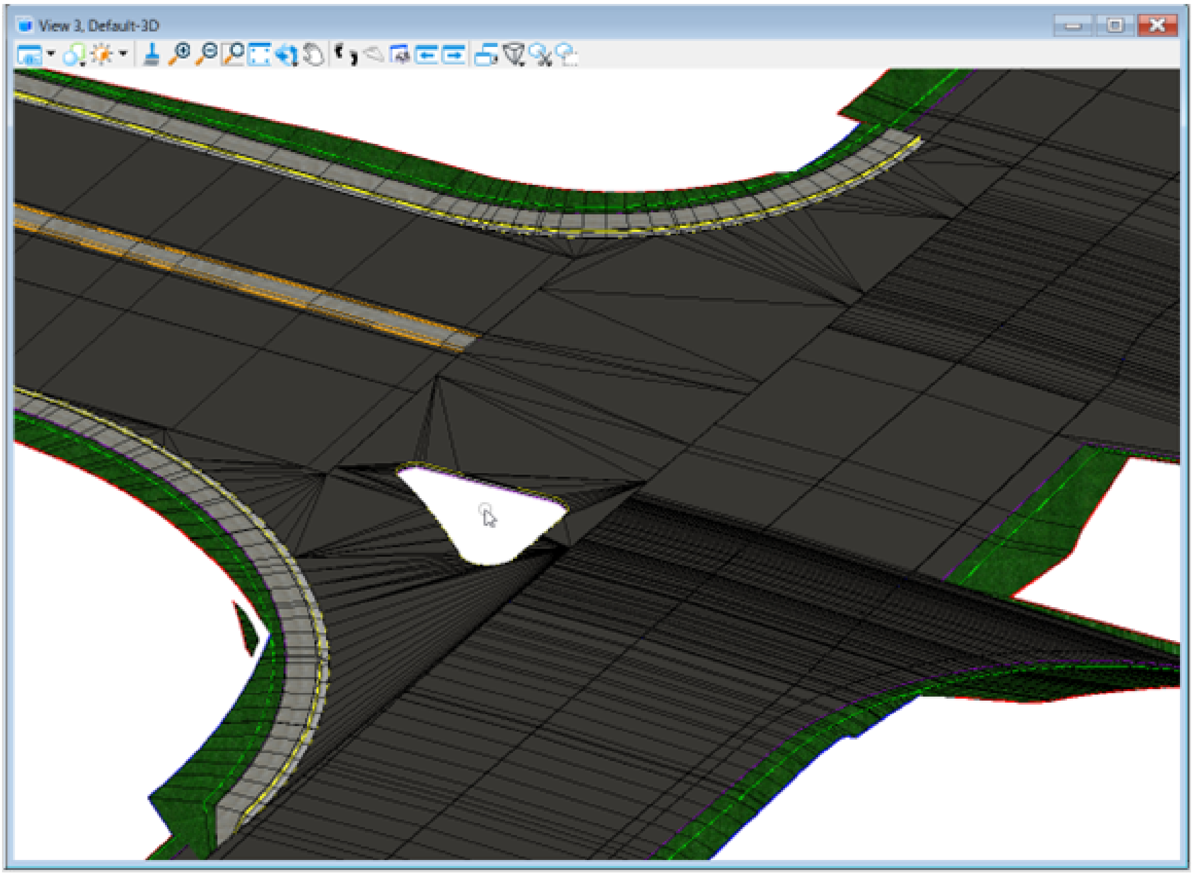
Hint ***Select one of the triangles in the 3D view that does not go through the right turn island.***

   c. Set *Feature Definition* to **Enable Linear Features**.



NOTE ***Using Enable Linear Features creates break lines that can be used to create the top and bottom surfaces in Chapter 5.***

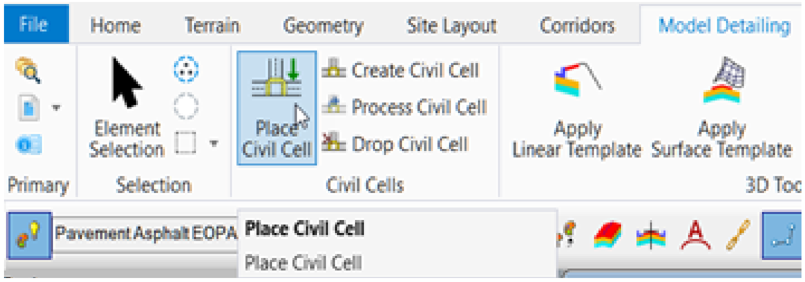
2. Turn off Construction lines to see the surface template without the terrain overlap.

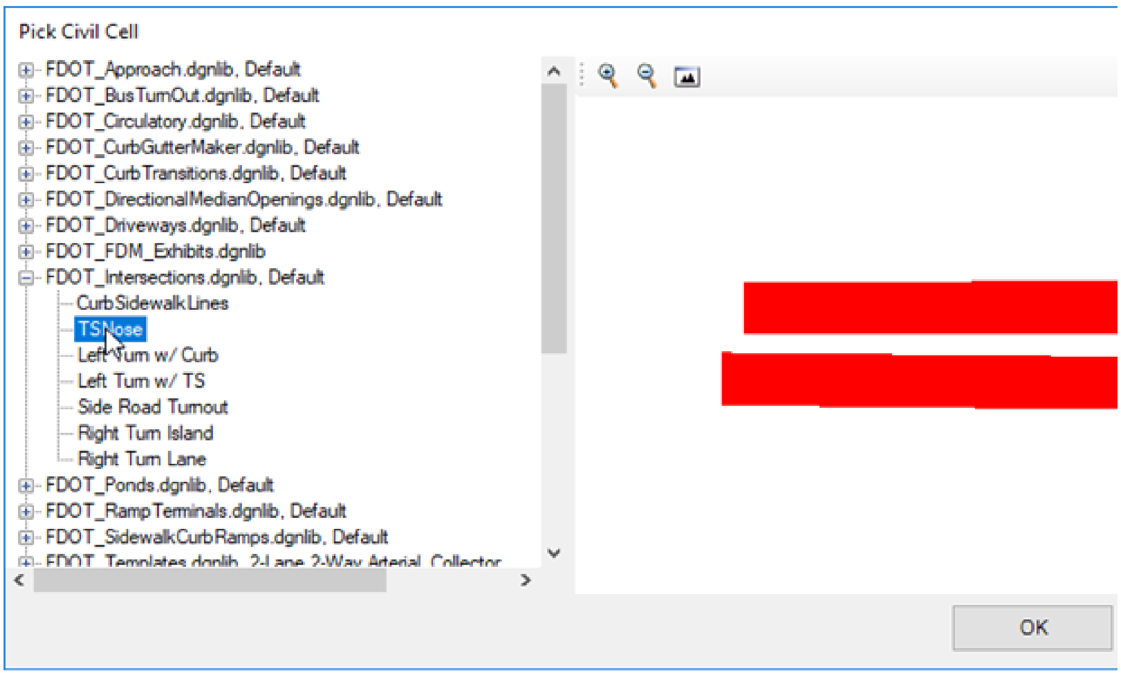


Exercise 4.10 *Traffic Separator Nose*

1. To add the Traffic Separator Nose use the **Model Detailing > Place Civil Cell** Tool.

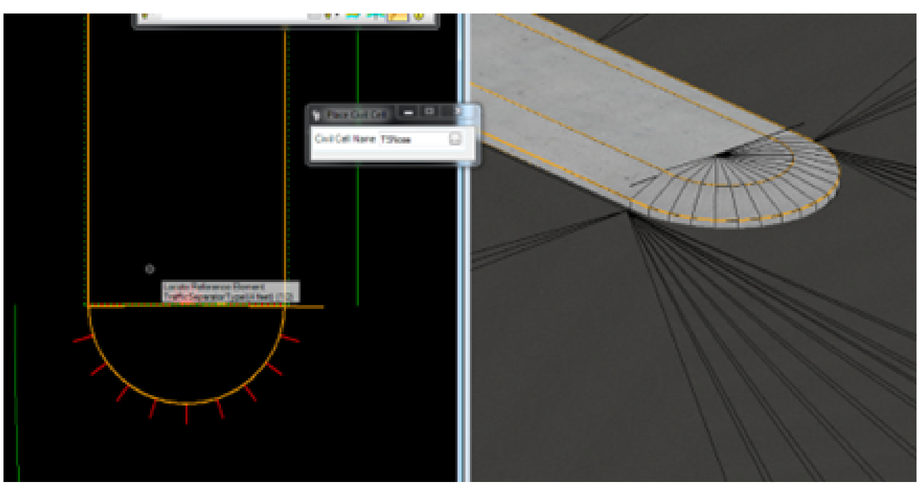
2. Select the **TSNose** Civil Cell.





3. Select the **PavementAsphalt_pm** line on the Right Side of the Traffic Separator in the Plan View, then select the line on the Left Side of the Traffic Separator.

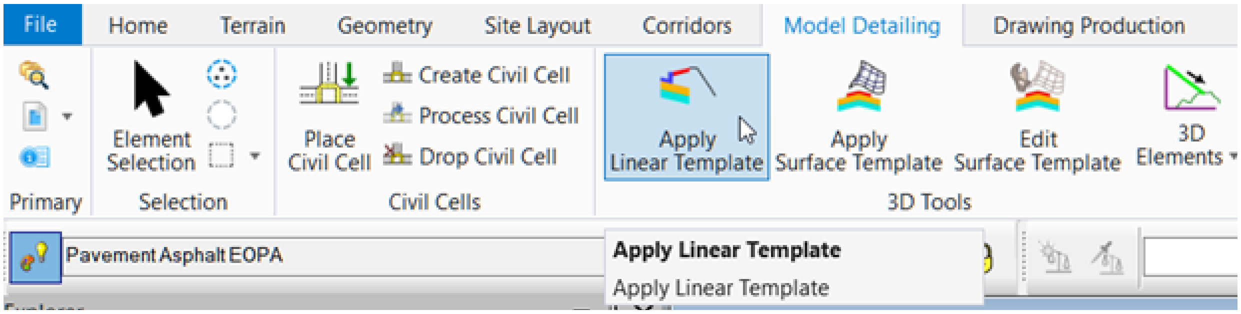
4. While hovering over each of the Reference lines, change the Reference Line direction arrow(triangle) on both elements until it fits on the lines.



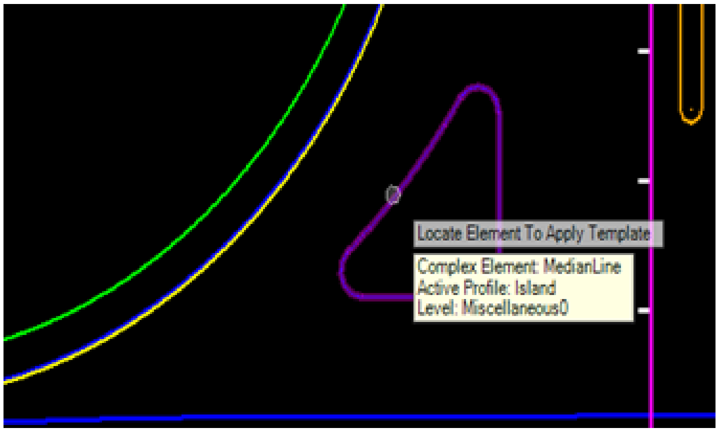
5. Data point to accept.

Exercise 4.11 *Right Turn Island*

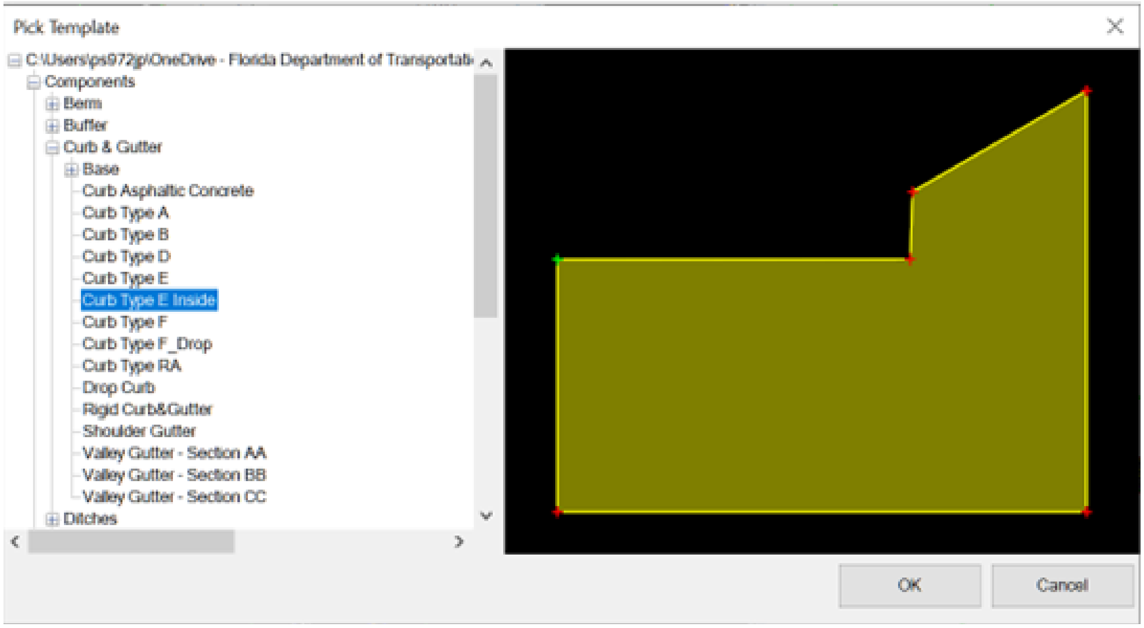
1. Use **Model Detailing > 3D Tools > Apply Linear Template** tool.



   a. At the prompt select the Island Line in the Plan View.



   b. Select **Alt down** arrow to select the **Template > Components > Curb & Gutter > Curb Type E Inside**. Data point to accept the Template.

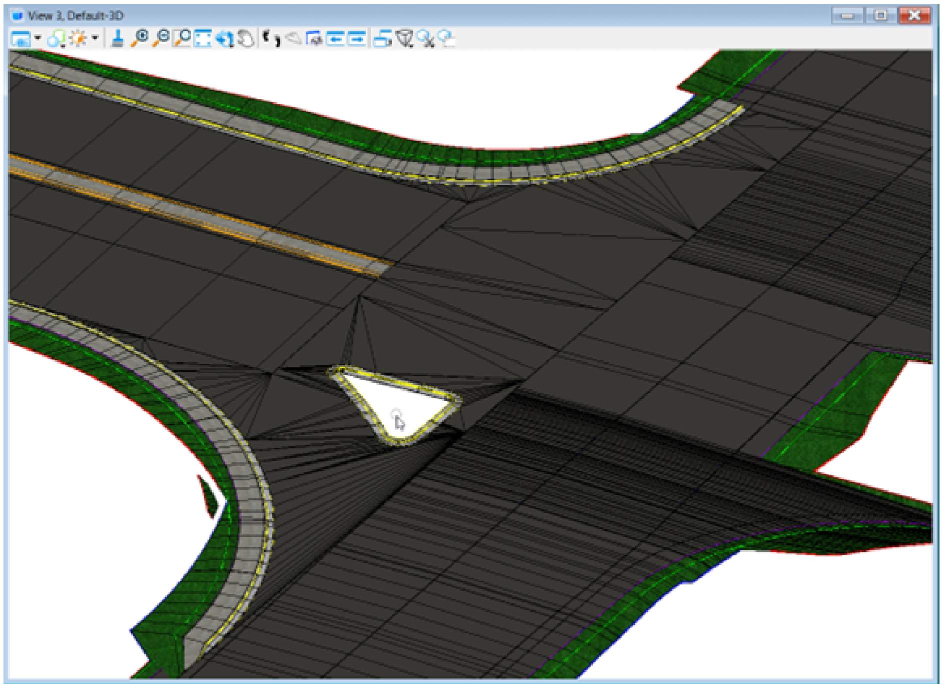


   c. Select **Alt** to lock the Start Station and data point to accept.

   d. Select **Alt** to lock the End Station and data point to accept.

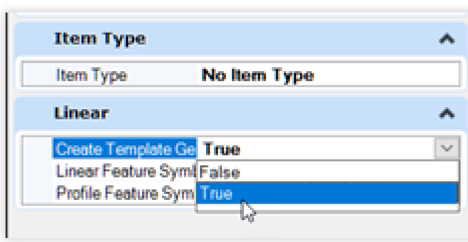
e. Data point to accept the Reflect Orientation on the inside of the island.

f. Data point to accept the Exterior Corner Sweep Angle.



2. Create Template Geometry for the back of curb line.

    a. Go to **Explorer**, right click on **Feature Definitions > Linear > Roadway Design > Template Points > Curb_pm** and select **Properties**.

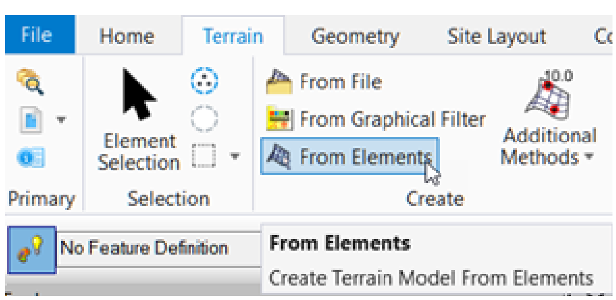


    b. Change *Create Template Geometry* to **True** as shown below.

    c. Reprocess the linear template.

3. To create the sod within the Traffic Island, create a Terrain from the 3D Top Back Curb line.

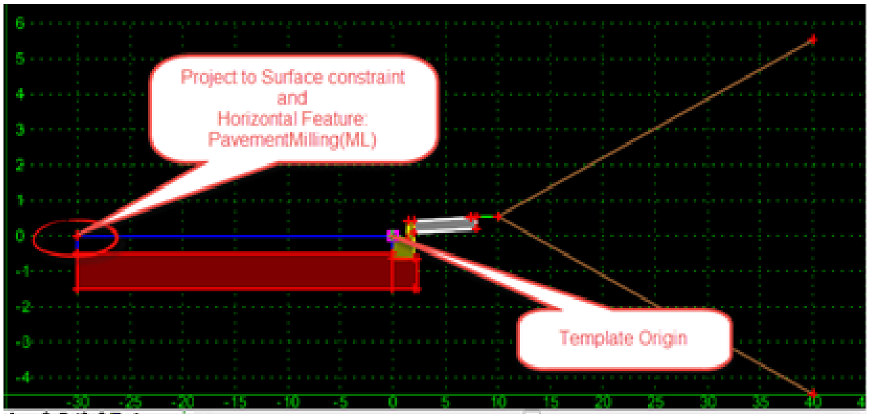
    a. Use **Terrain > Create > From Elements** tool.



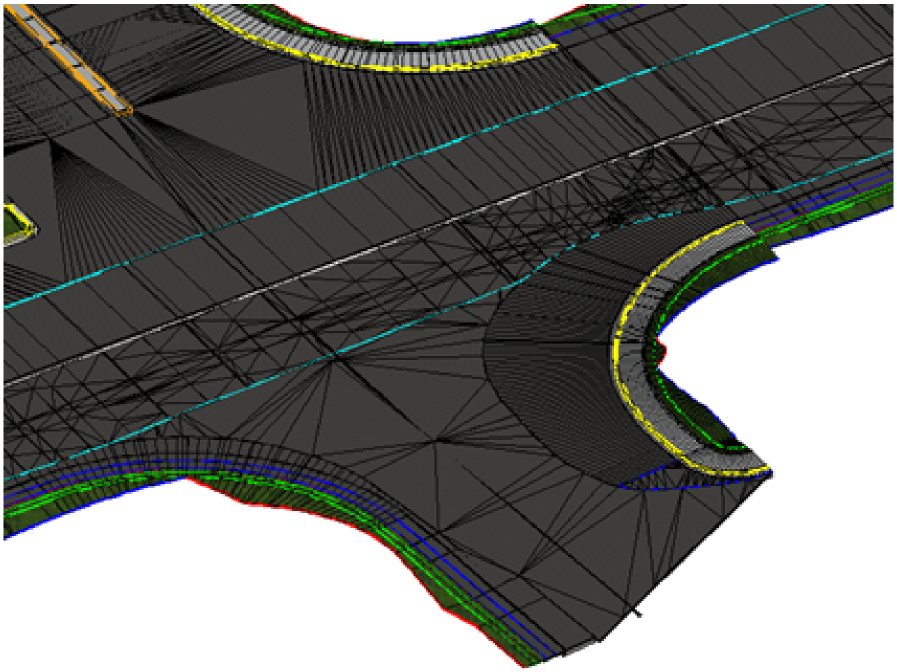
    b. Set *Feature Definition* to **DtmProposedSlopes**.

Exercise 4.12 *RRR98 Corridor-Build Intersection Terrain at School Entrance (On Your Own)*

1. Create a shape boundary of the perimeter of the School Driveway pavement to be resurfaced.
2. Use the **Create Clipped Terrain Model** tool to model the existing pavement.
3. Add a surface template to the Terrain in step 2.
4. Use the RT_Switch parametric constraint along the RRR98 corridor to remove the overlap components between radius points.
5. Add Key Station to near the radius points to create complete components.
6. Use Linear Template around the Radii to construct the curb, sidewalk, shoulder, etc.
    a. Set the Template Origin and Pavement Point as shown.



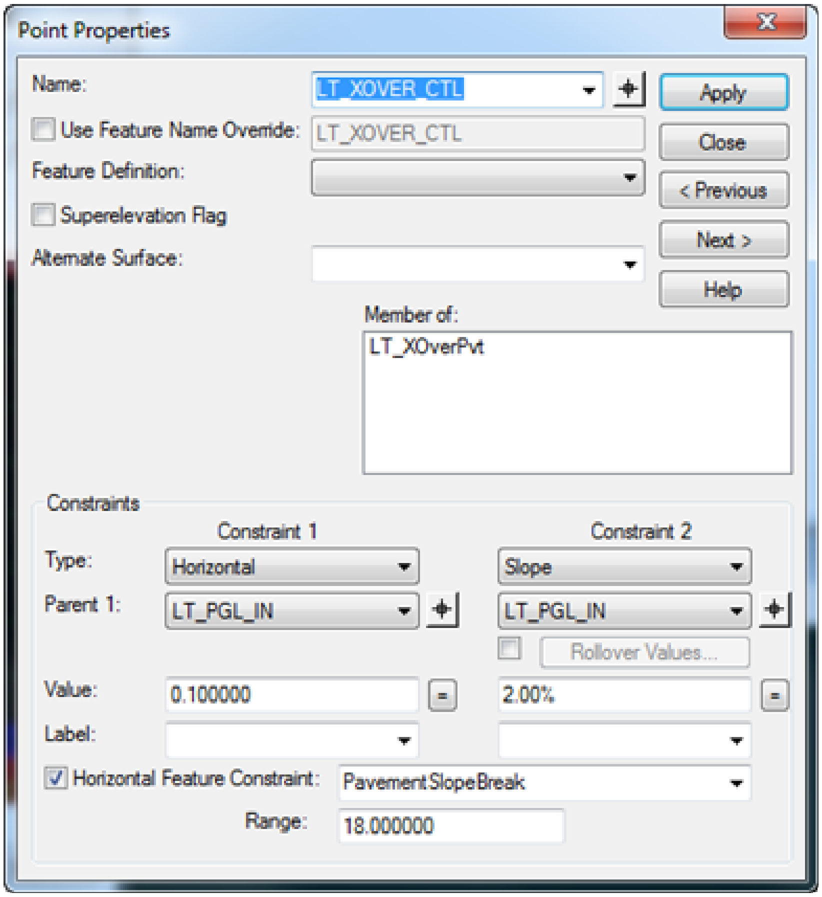
    b. Add the *PavementMilling(ML)* lines as a reference to the linear templates to complete the widening.

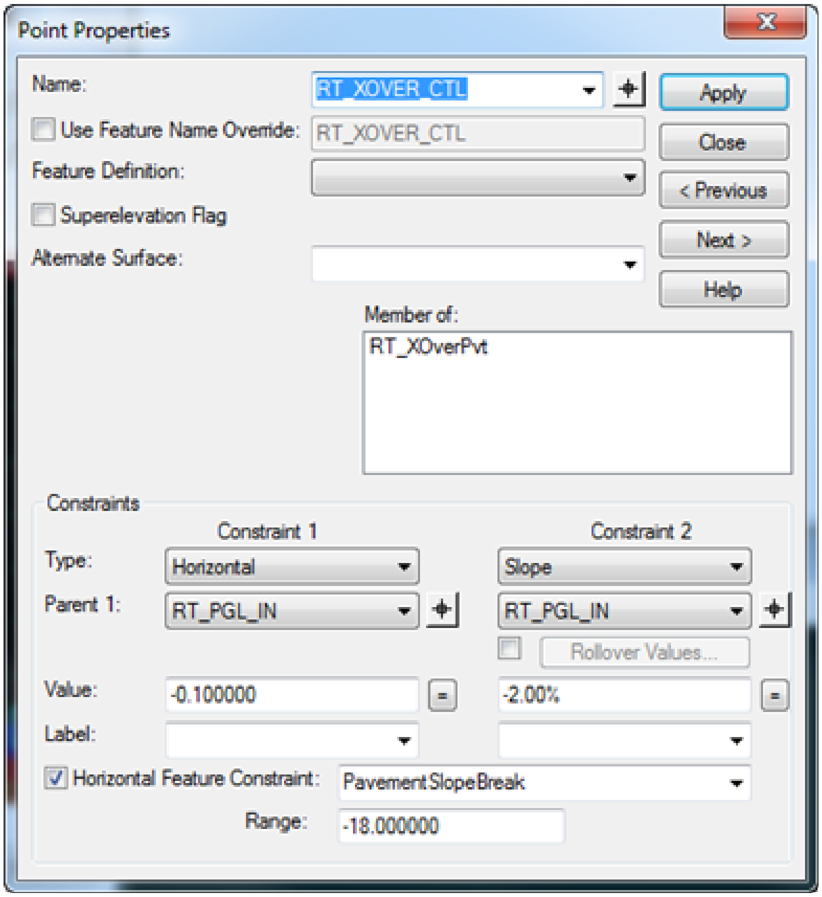


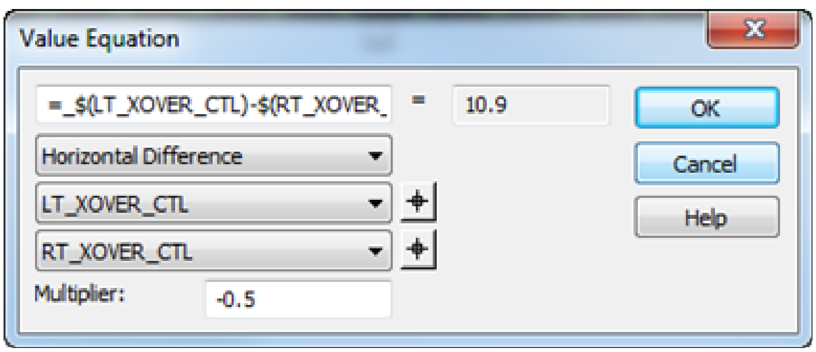
Exercise 4.13 *SR61 Corridor-Build Intersection Terrain at Friendship Road (On Your Own)*

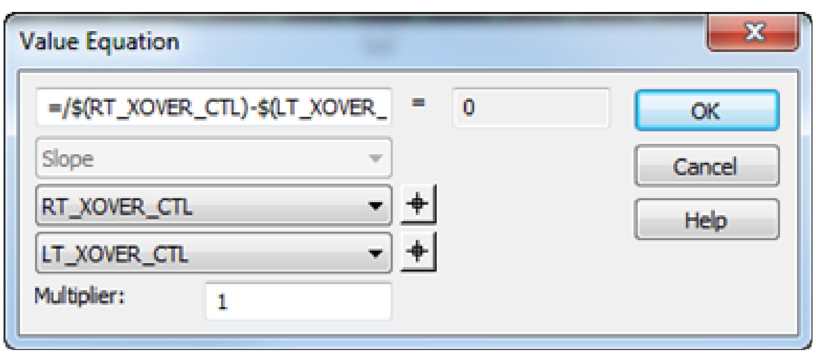
1. Drop the Complex Chain that makes up the EOP Lines and Radius.
2. Create a Corridor Model of the Friendship Road.
3. Edit the Template Drop and delete all Components outside of widening.
4. Project Profile to Element on the Curve EOP lines <OR> Quick Profile from Surface.
5. Construct a Profile from the Projected Surface Lines for the Curve Radii.
6. Use Linear Template around the Radii.
7. Create a Terrain from the 3D elements.

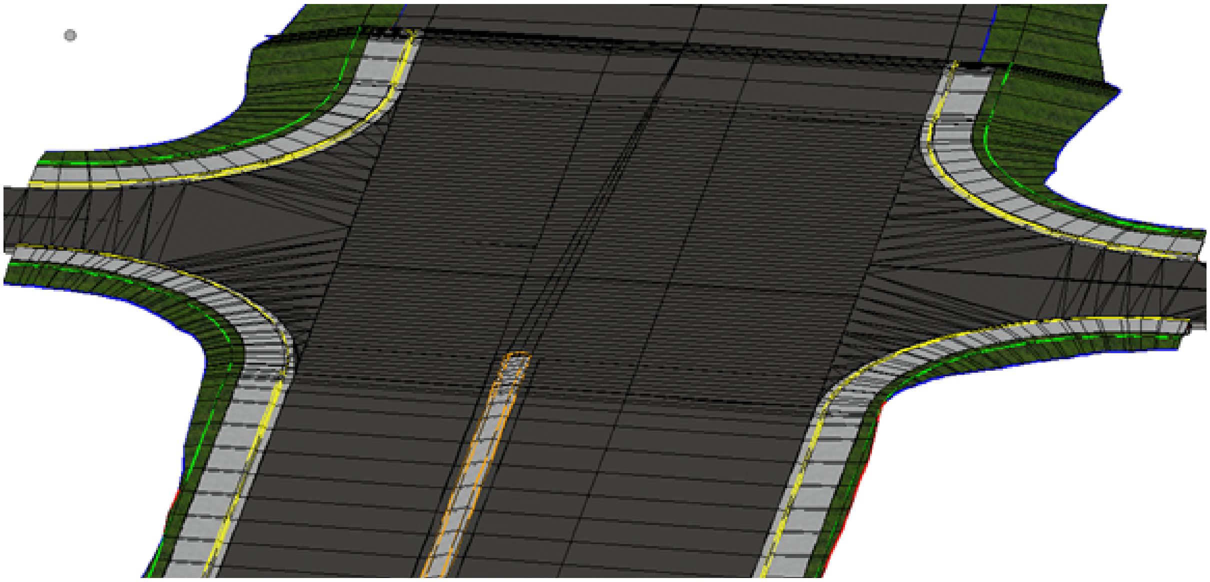
NOTE ***For the Traffic Separator to Pavement Crown Cross over median, set the LT_XOVER_CTL, RT_XOVER_CTL, and PVT_CROWN Properties as shown:***




Point Properties
Name:
RT_XOVER_CTL
Apply
Use Feature Name Override:
RT_XOVER_CTL
Close
Feature Definition:
< Previous
Superelevation Flag
Next >
Alternate Surface:
Help
Member of:
RT_XOverPvt
Constraints
Constraint 1
Constraint 2
Type:
Horizontal
Slope
Parent 1:
RT_PGL_IN
RT_PGL_IN
Rollover Values...
Value:
-0.100000
-2.00%
Label:
Horizontal Feature Constraint:
PavementSlopeBreak
Range:
-18.000000


Value Equation
=_$(LT_XOVER_CTL)-$(RT_XOVER_
=
10.9
OK
Horizontal Difference
Cancel
LT_XOVER_CTL
Help
RT_XOVER_CTL
Multiplier:
-0.5


Value Equation
=/$(RT_XOVER_CTL)-$(LT_XOVER_
=
0
OK
Slope
Cancel
RT_XOVER_CTL
Help
LT_XOVER_CTL
Multiplier:
1



5 CREATING 3D DELIVERABLE FILES

INTRODUCTION

This chapter will provide detailed instructions for producing the specific output files used by contractors for Automated Machine Guidance (AMG). Specifically:

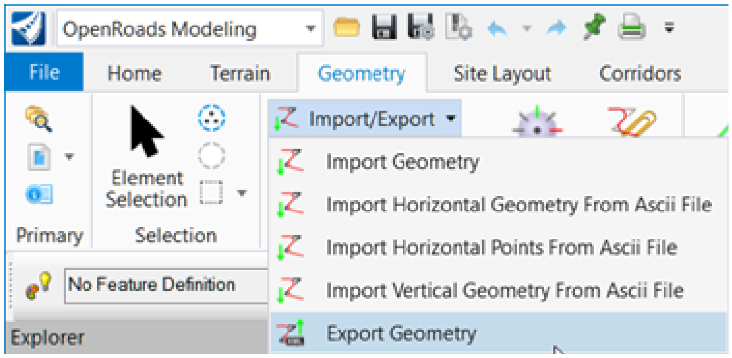
- Controlling Geometry Files
- 2D CADD files
- Proposed 3D Breakline CADD files
- Existing, Proposed and Subgrade/Earthwork surface XML files

Chapter 8 of the CADD Manual for FDOTConnect outlines the required 3D Deliverables. .

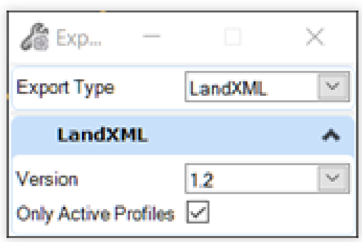
EXERCISE OVERVIEW

Exercise 5.1 ***You can export Alignments and Profiles directly from the elements in the DGN file.***

1. Open the *ALGNRDD01.dgn* file.
2. Switch to the Default Model view.
3. Use the **Geometry > General Tools > Import/Export > Geometry** tool.



4. Set *Export Type* to **LandXML**.
5. Select the *CL_SR61* centerline alignment.
6. Set the *Version* to 1.2 and check the box or select **Yes** to export *Only Active Profiles*.



7. The *Export to LandXML* dialog opens.
   a. Navigate to the 3DDeliverables directory.
   b. Enter the File name: *AMG-ALGNSR61.xml*
   c. Ensure that LandXML File (.xml) is the **Save as** type.
   d. Click **Save**.
   e. Repeat steps 3-7 for the US98 Baseline to create *AMG-ALGNBL98.xml*.

NOTE ***This will save both the Horizontal and Vertical (Profile) Geometry.***

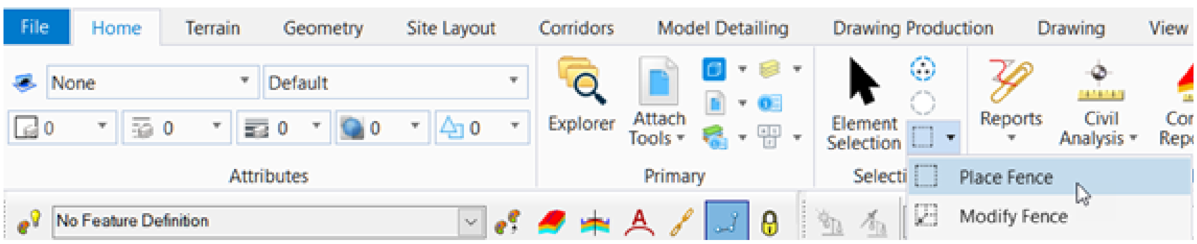
Exercise 5.2 *Creating 2D Proposed Planimetrics File for AMG*

Use the MicroStation **Save As** command to save copies of the Proposed Design files into the 3DDeliverables directory with AMG-2 names in DGN and DWG formats.

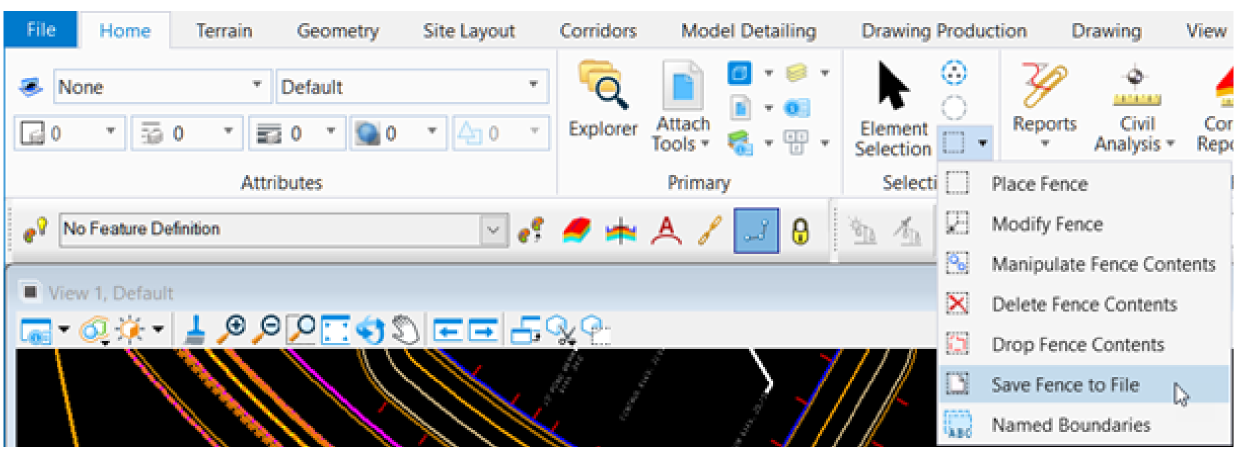
For example: *AMG-2DSGNRDxx.dgn*, *AMG-2DSGNRDxx.dwg*.

▶ ***Simplify MicroStation Elements***

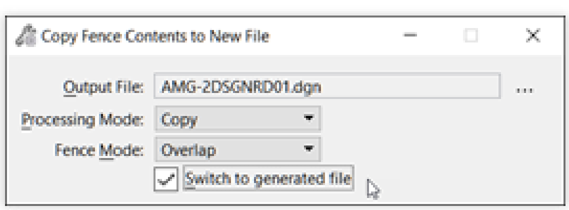
1. Open the *DSGNRD01.dgn* file.
2. Select the **Plan View** to make active. Select *Function Key* **CTRL F1** to open a Plan View.
3. In the **View Attributes**, turn Off Construction elements<OR> Select *Function Key* **F7**.
4. Turn Off reference file display.
5. Turn Off levels for Baseline, CLConstr., and Scratch.
6. Place a Fence around all the Elements. **Home > Selection > Fence Tools > Place Fence.**



7. Save the fence contents to a file, in 3DDeliverables*AMG-2DSGNRD01.dgn*. **Home > Selection > Fence Tools > Save Fence to File**



8. If converting to DWG, **check** the *Switch to generated file* box.



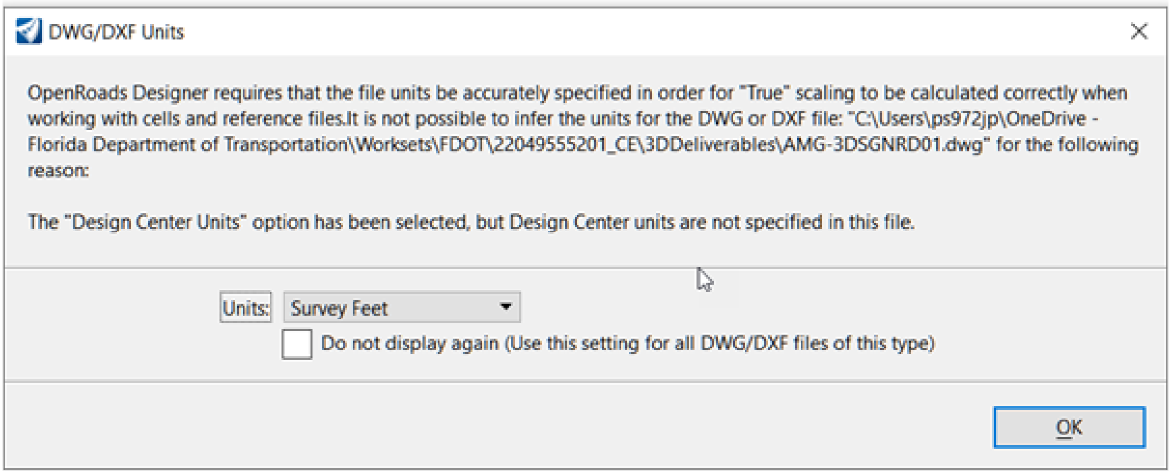
9. Data point to accept and verify the file is in the 3DDeliverables directory.

▶ ***Save as DWG(Optional)***

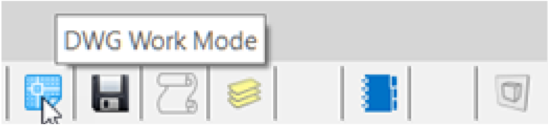
1. If not already open, open the ..\3DDeliverables*AMG-2DSGNRD01* design file.
2. Select **File > Save As** from the MicroStation menu.
3. Select **Autodesk(R) DWG** as the **Save as** type.

NOTE ***There is no need to set Options on the Save As dialog.***

4. Verify or Enter the File Name, *AMG-2DSGNRD01* and click **Save**.
5. Select the *Units* Survey Feet and click **OK**.



NOTE ***The file will open in DWG Work Mode, see the blue cross hairs icon in the bottom right of the MicroStation window.***



Exercise 5.3 *Create Master Model File*

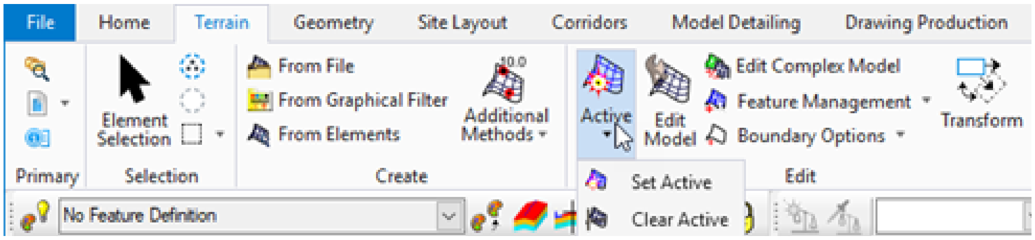
1. If not already done, set the *Corridor Feature Definition* to Final for all the corridors and linear templates.

2. Go to the FDOT ribbon and choose **Create File**.

3. Create a new *MODLRDMaster01.dgn* file. Select **Wakulla County**. Choose **Create/Open File**.

4. Reference the *MODLRDDetail61, MODLRDMainline61, MODLRDUS98, MODLRD_EXISTING_FEATURES01, MODLRD_EXISTING_DRAINAGE01, MODLRD_EXISTING_UTILITIES01, RWDTRD01, PDPLRD01, GDTMRD01, SURVRD01, ALGNRD01,* and *DSGNRD01* files.

5. Use the **Terrain > Edit > Active > Set Active** tool.



6. At the cursor prompt, select the Terrain Boundary green dashed line from the attached *SURVRD01* reference file. This will set the terrain model as Active.

7. Display **2D** and **3D** Views and Select *Function Key* **F2**.

8. Save Settings.

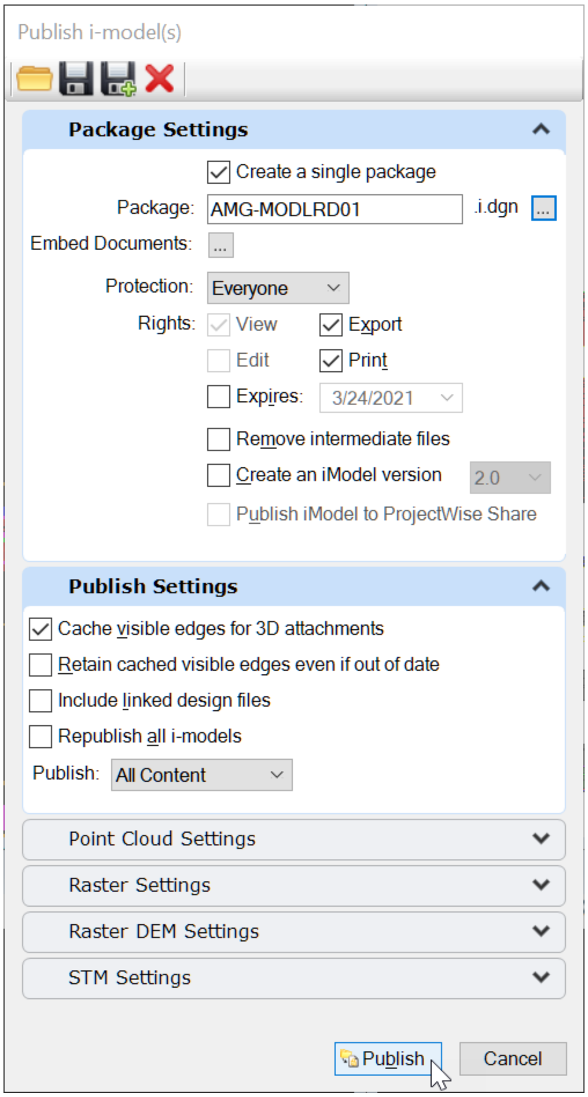
Exercise 5.4 *Export iModel*

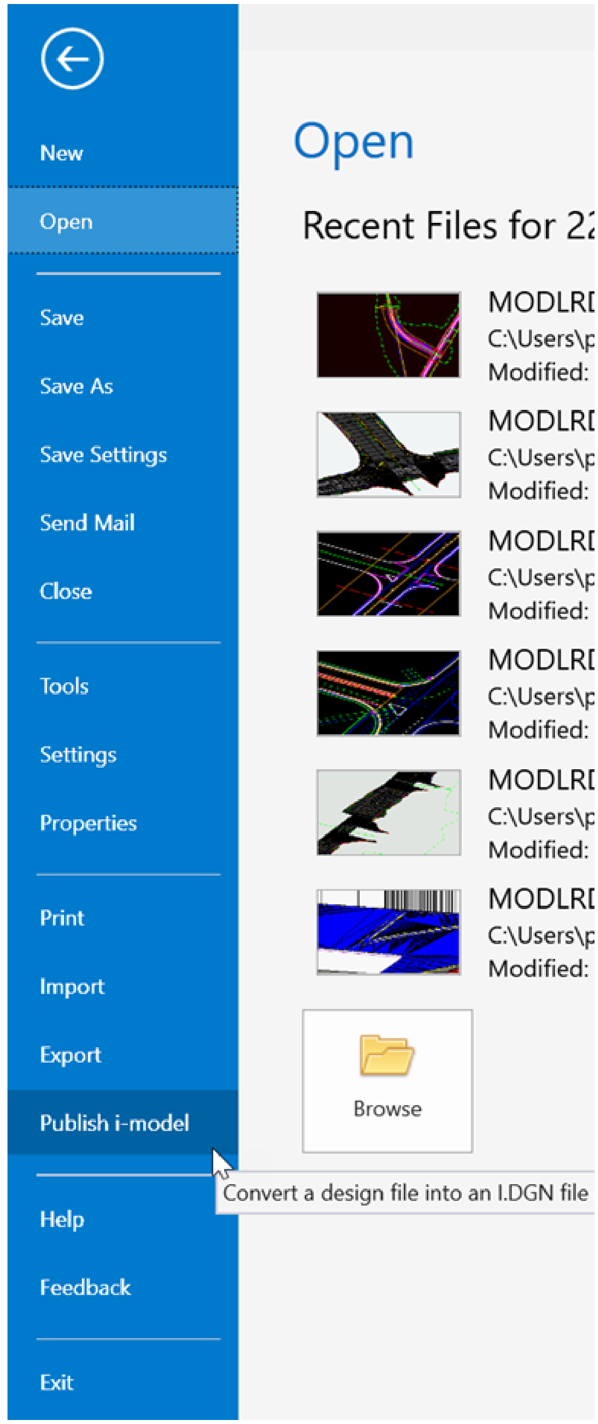
1. Go to File > Publish iModel as shown on the right.

2. Check the box to Create a Single Package.

3. In the *Package* name field, input *AMG-MODLRD01.i.dgn*. Click the **3 dots** beside the Package name and navigate to the 3DDeliverables folder.

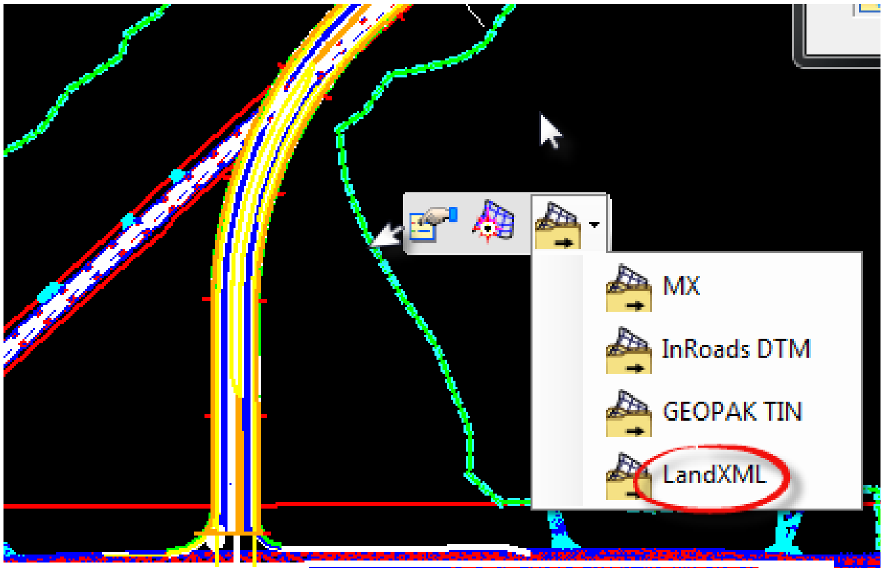
4. Review remaining settings and select **Publish**.



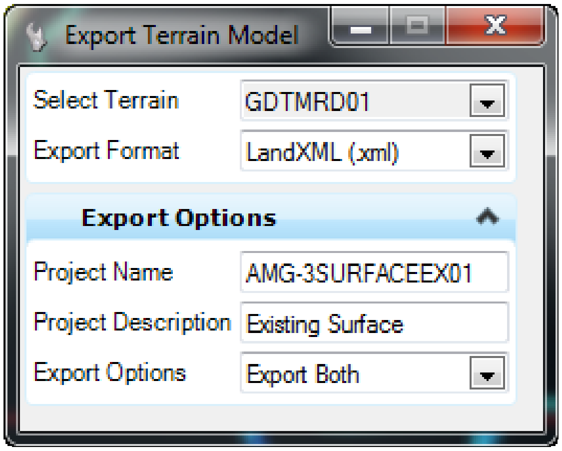


Exercise 5.5 *Creating 3D Existing Surface File for AMG*

1. Turn ON the Reference file display for *GDTMRD02* or *SURVRD01*.
2. Hover over the Existing Surface and then select **Export Terrain Model > LandXML**.



3. Select the Terrain.
4. Select the *Export Format*: **LandXML**
5. Enter the *Project Name*: **AMG-3SURFACEEX01**
6. Enter the *Project Description*: **Existing Surface**
7. Select the *Export Options*: **Export Both**



8. Save the *AMG-3SURFACEEX01.xml* file to the 3DDeleverables directory.

Exercise 5.6 *Creating 3D Proposed Top Breaklines Files for AMG*

This exercise outlines the steps to create the proposed surface of the project for use by contractors for automated machine guidance as follows:

Prepare the View for Exporting

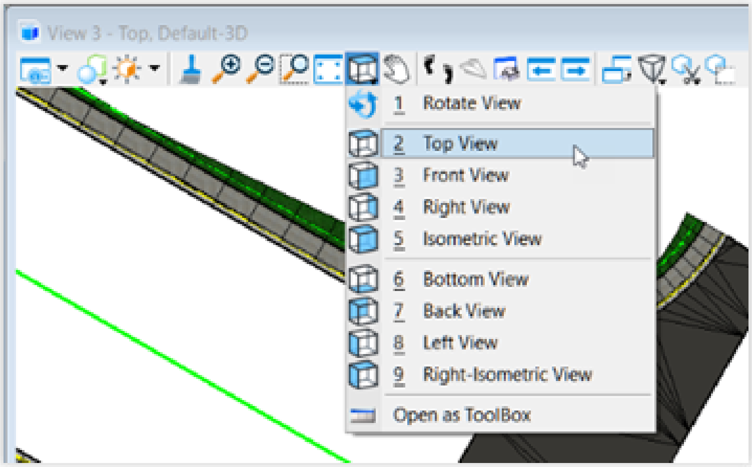
Exporting 3D Break Lines

Creating Proposed Surface Files for AMG

Delete extraneous triangles

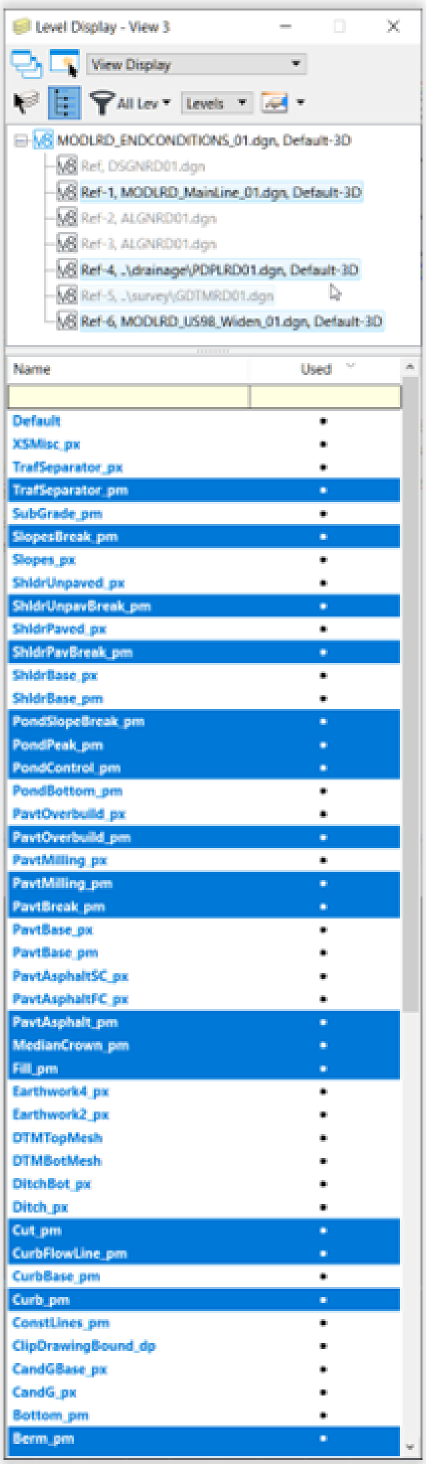
▶ *Prepare View for Exporting*

1. In the 3D view, turn OFF the Reference File display for:
    - *MODLRD_Existing_Features_01.dgn*
    - *GDTMRD01.dgn*
    - or *SURVRD01.dgn*
    - *ALGNRD01.dgn*
2. Maximize the View 2 – Default-3D.
3. Change the **View Rotation** to a Top view as shown below.



4. Use the *Function Key* **F7** to turn OFF all Construction elements in the 3D View.
5. Open **Level Display**. Ensure the 3D View is active.

6. Hold down Shift and select the *MODLRDMainline61.dgn, MODLRDDetail61.dgn, PDPLRD01.dgn*, and *MODLRDUS98.dgn* reference files. Turn off the following levels in the Default 3D View:



a. any proposed sub-surface features and other non-proposed surface features.

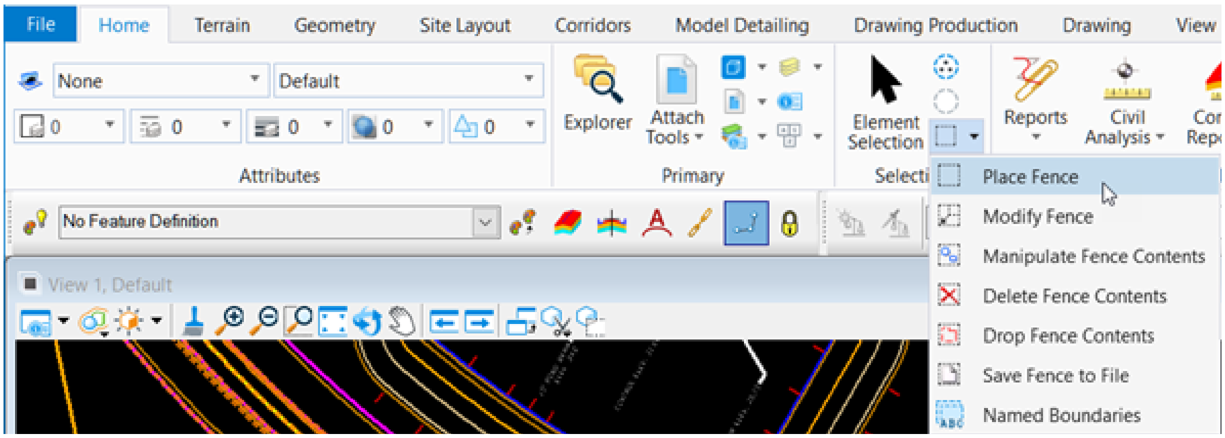
i.e. Bottom_pm,
Subgrade_pm
CurbBase_pm,
PavtBase_pm,
ShldrBase_pm,
TemplateMisc_pm,
TemplateNullPoint_pm.

b. Any used _px levels (meshes).

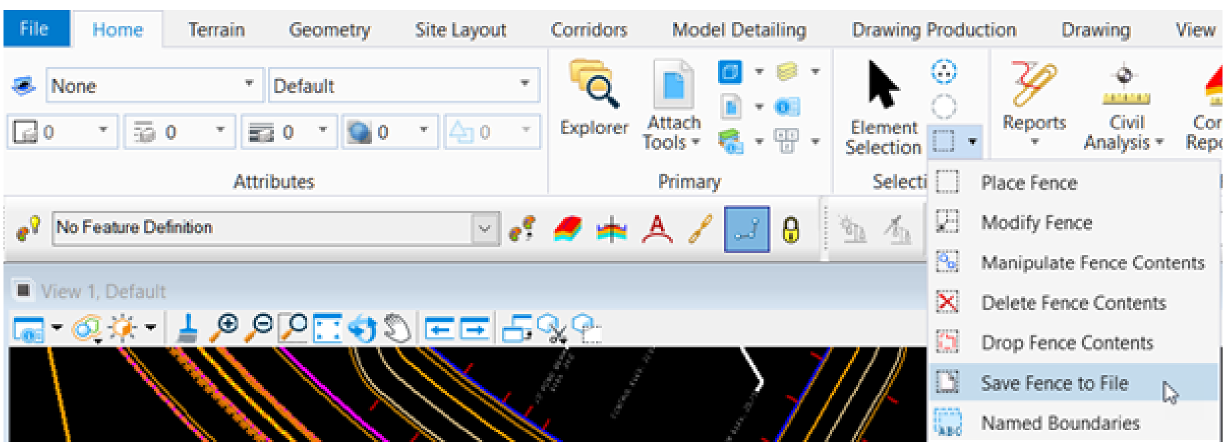
c. Remaining levels not needed for the 3D Proposed breakline surface. i.e. Default level, Scratch_dp, Miscellaneous, ConstLines.

▶ ***Exporting 3D Break Lines.***

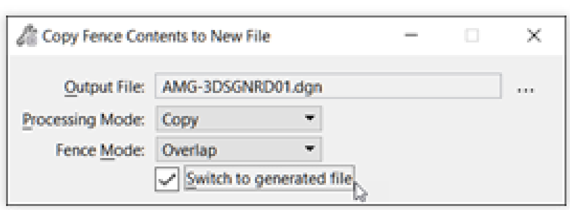
1. Place a Fence around all the Elements in the default-3D View. **Home > Selection > Fence Tools > Place Fence**



2. Save the fence contents to a file, in 3DDeliverables*AMG-3DSGNRD01.dgn*. **Home > Selection > Fence Tools > Save Fence to File**



3. If converting to DWG (below), check the *Switch to generated file* box.



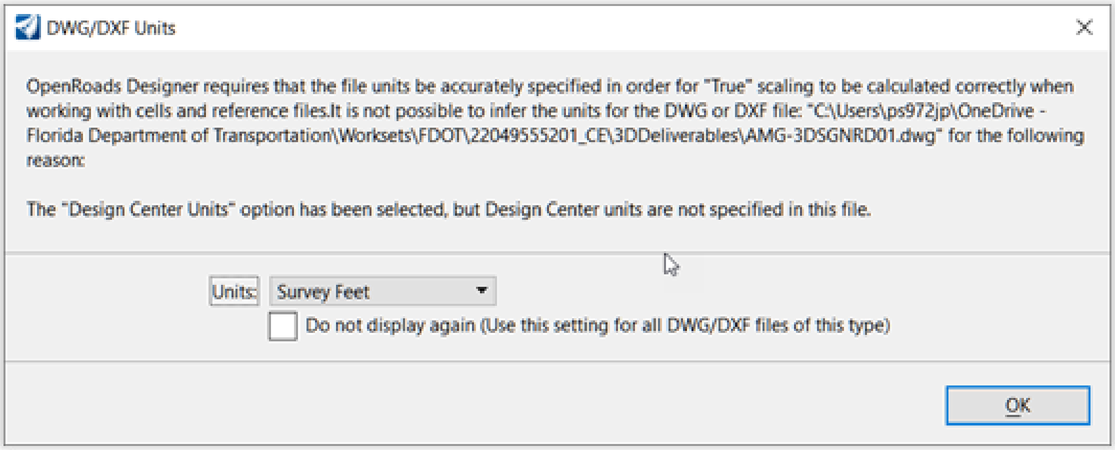
4. Data point to accept and verify the file is in the 3DDeliverables directory.

▶ *Save as DWG (Optional)*

1. If not already open, open the 3DDeliverables\AMG-3DSGNRD01 design file.
2. Select **File > Save As** from the MicroStation Menu.
3. Select **Autodesk(R) DWG** as the Save as type.

NOTE There is no need to set Options on the Save As dialog.

4. Verify or Enter the File Name, *AMG-3DSGNRD01.dwg* and click **Save**.
5. Select the *Units* Survey Feet and click **OK**.



NOTE The file will open in DWG Work Mode, see the blue cross hairs icon in the bottom right of the MicroStation window.

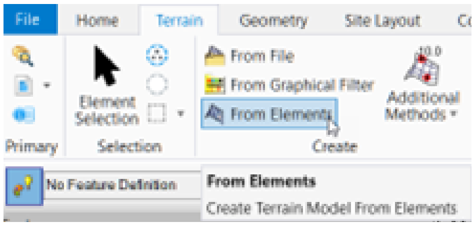
6. Trim extraneous elements as necessary. **Save** changes to the .dwg file, then **Save As** to overwrite the .dgn file.

Exercise 5.7 *Creating 3D Proposed Surface Files for AMG*

1. In FDOTCONNECT, Select **File > Open** to the *AMG-3DSGN01..dgn* file. Click **Open File** and click **OK**.

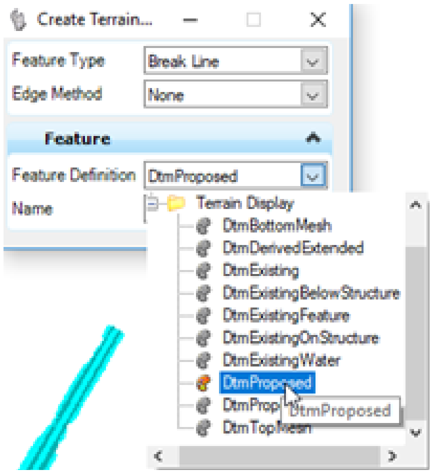
2. Create a Selection Set of all Elements.

3. Use **Terrain > Create > From Elements** tool.



4. Define the following in the *Create Terrain Model* dialog:

Feature Type:	**Break Line**
Edge Method:	**None**
Feature Definition:	**DTMProposed**
Name:	**AMG-3SURFACEPR01**



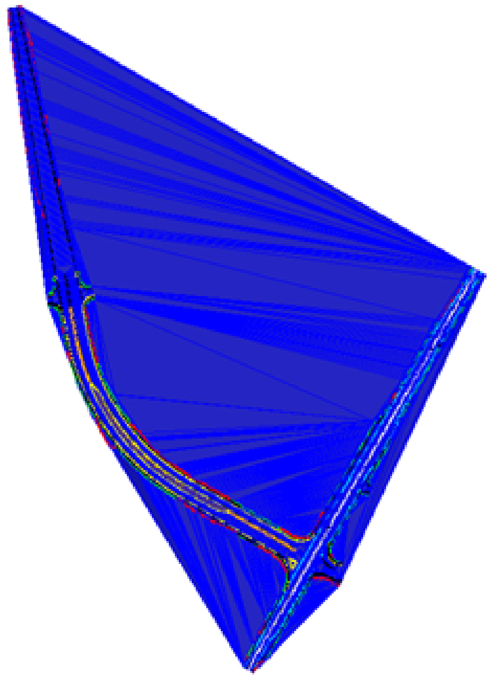
5. Data point through prompts to accept settings. A Surface is created. Use *Function Key* **F2** to turn **ON/OFF** the construction elements.

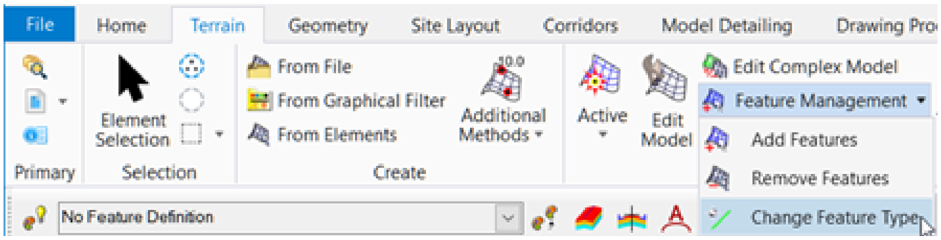
6. Notice the External Triangles must be trimmed.

7. Turn Off the **Level DTM_px** .

8. Create a **Selection Set** of all the **Cut_pm** and *Fill_pm* Lines defining the slope construction limits.

9. Use *Civil Tools* **Terrain > Edit > Change Feature Type** tool.





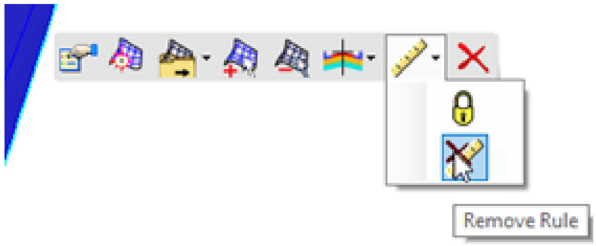
10. Set the *Feature Type* to **Boundary**.

11. When prompted left click twice to change all the selected lines to boundary elements for the External Limits of the Surface.

12. Turn **ON** the *DTM_px* level to see the results.

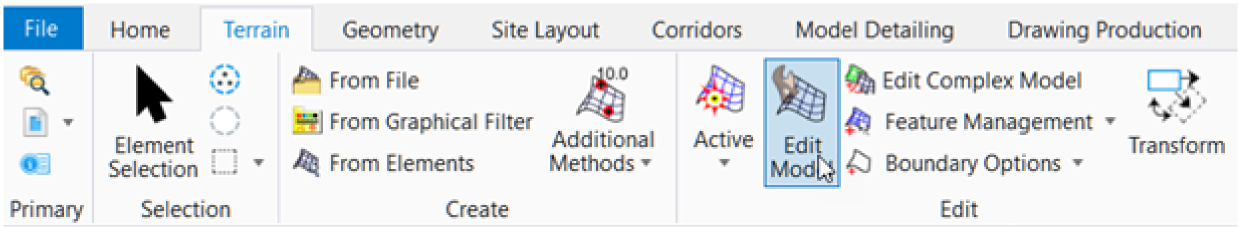
▶ *To delete extraneous triangles*

1. Select and hover over the Surface Terrain edge and then select **Rules > Remove Rule**.

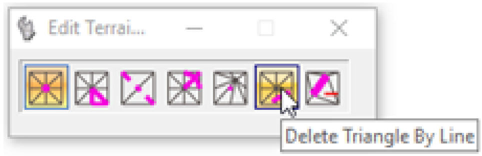


NOTE ***This will break the relationship to the 3D elements! Alternatively, build a 3D boundary connecting the gaps in the Cut_PM and Fill_PM lines and add the feature to the surface as a boundary, or use them to clip the terrain.***

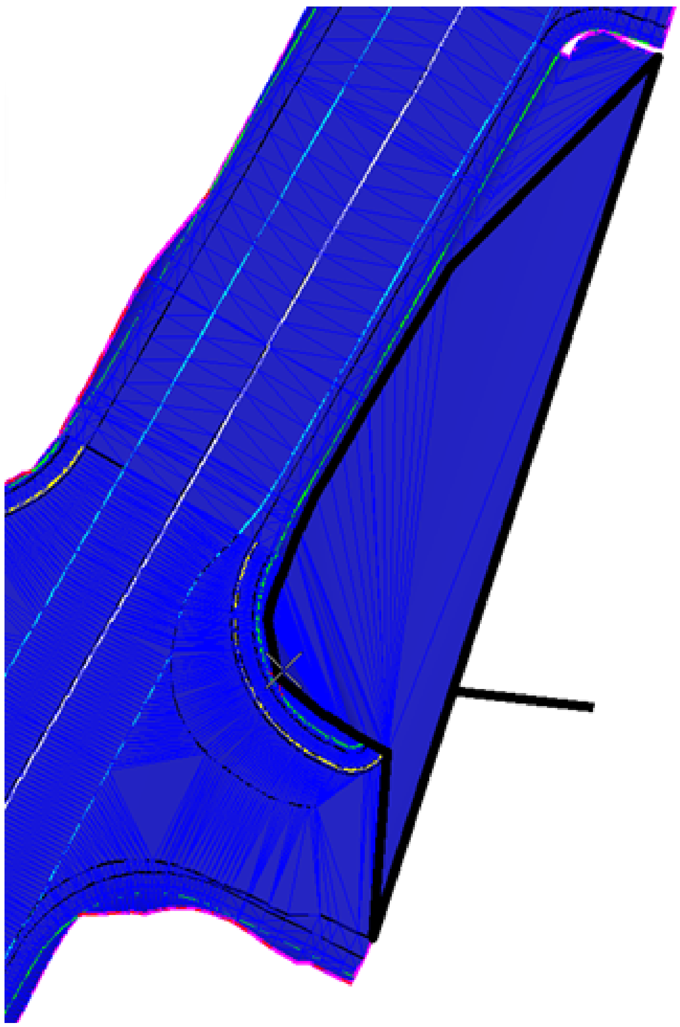
2. Use **Terrain > Edit > Edit Model** tool.



3. From the tool settings menu, select **Delete Triangle By Line**.

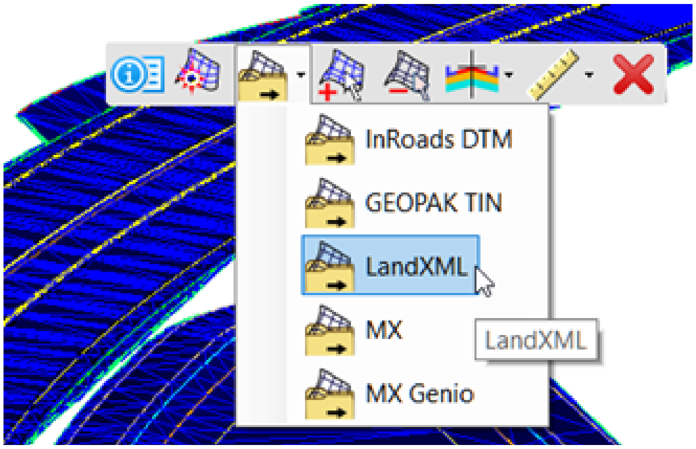


4. Draw a line (*two left clicks*) from outside the terrain across the erroneous triangle, then repeat as necessary.

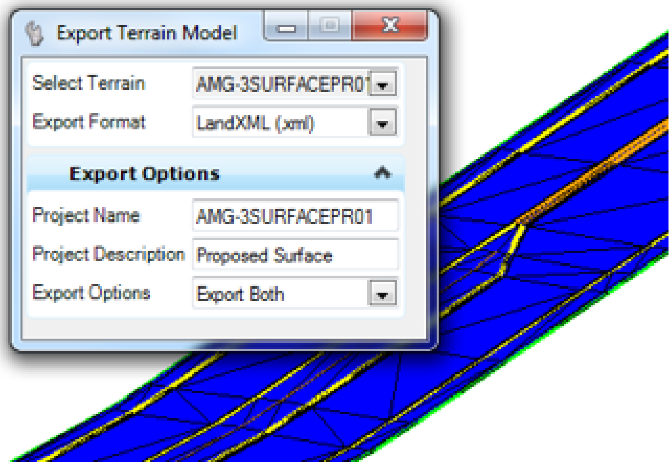


▶ *Save Terrain to Land XML file*

1. Select and hover over the Surface and then select **Export Terrain Model > LandXML**.



2. Select the Terrain.
3. Select the *Export Format*: **LandXML**
4. Enter the *Project Name*: **AMG-3SURFACEPR01**
5. Enter the *Project Description*: **Proposed Surface**
6. Select the *Export Options*: **Export Both**



7. Save the file to the 3DDeleverables directory with the filename *AMG-3SURFACEPR01.xml*.

Exercise 5.8 *Creating 3D Subgrade/Earthwork Breaklines for AMG*

This exercise outlines the steps to create the proposed surface of the project for use by contractors for automated machine guidance as follows:

Prepare the Templates for Subgrade Point definitions and Alternate Surfaces

Prepare the View for Exporting

Exporting 3D Break Lines

Creating Proposed Surface Files for AMG

Delete extraneous triangles

The 3D proposed finished subgrade surface to be exported as LandXML format from the \Roadway\MODLRD file. This file can be used to generate surface to surface earthwork volumes

The subgrade surface can be created from the 3D feature lines provided that they have been defined properly in the point definitions on all project corridor, linear and surface templates.

▶ *Prepare the Templates for Subgrade Point definitions and Alternate Surfaces*

In the *Create Template* dialog, edit each of the points defining the finished subgrade. Set the *Feature Definition* and *Alternate Surface* fields to SubGrade_pm and SUBGRADE, respectively.

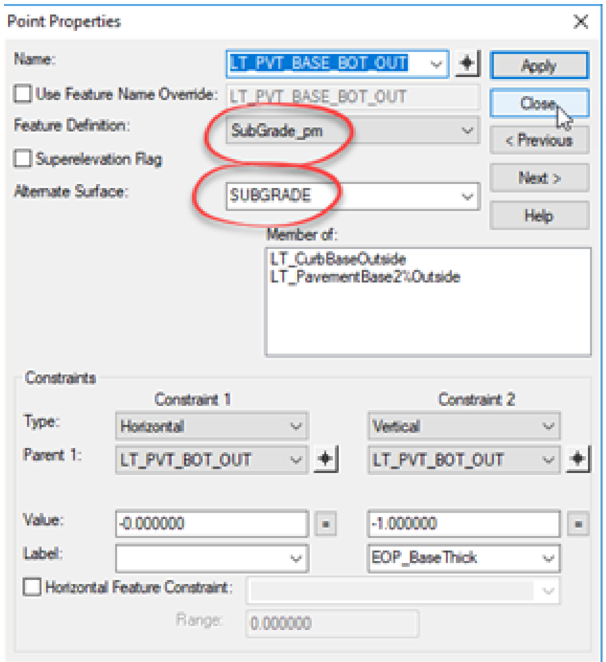
When creating surface terrains from 3D lines, there are two important TIN principles for consideration:

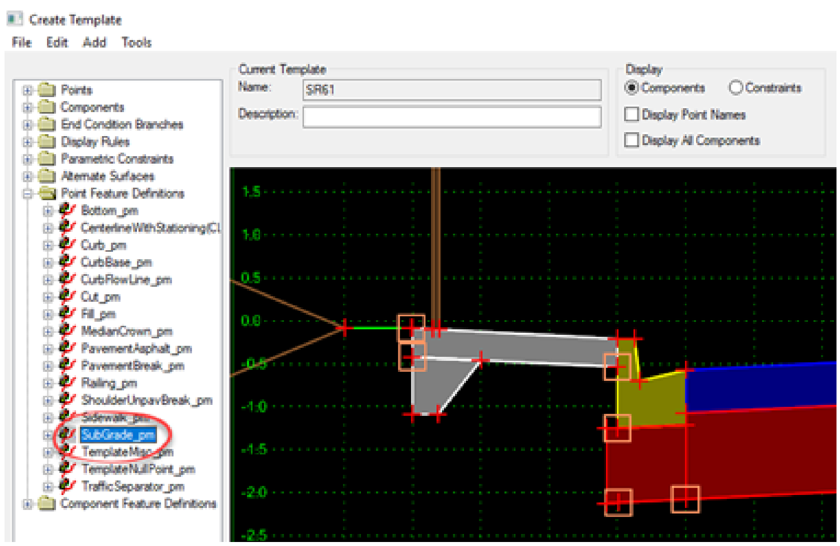
a. Vertical Faces – all lines must have different xy values. They cannot be stacked in the z plane. Therefore, set the horizontal offset value no less than .01 feet on vertical component points in the project templates

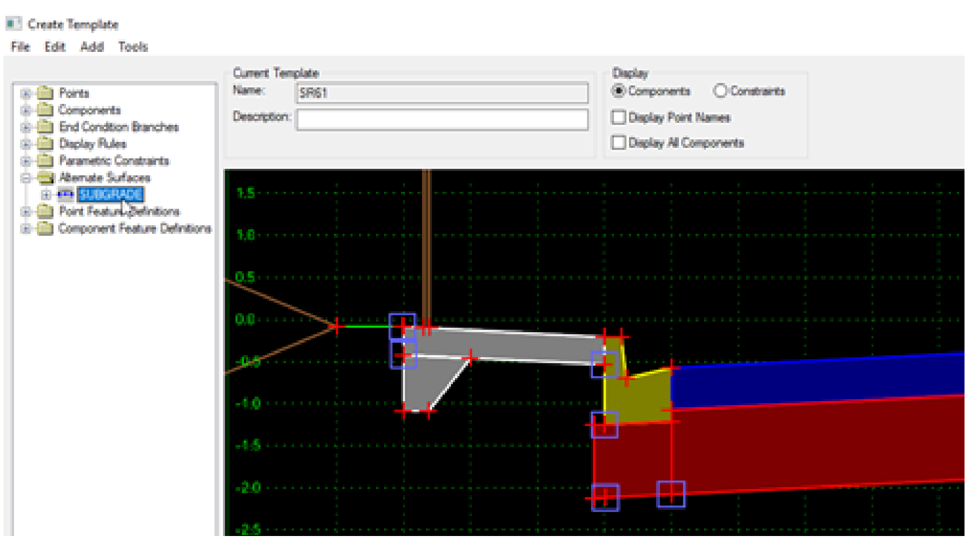
b. Caves/Cliffs – all lines must continue in the same direction. The TIN triangles will not reverse direction across a surface. Therefore, consider which points to use for the subgrade surface. I.E. base, base extensions, wall footers, etc. Additional template points may be needed to intercept the top surface in these areas. As a rule, it is better to include the base, base extensions, wall footers, etc for excavation and not to include base, base extensions, wall footers, etc for embankment.

NOTE ***These template accommodations are necessary to consider for ALL Corridor, Linear and Surface Templates used on the project.***

The following images are examples of the *Point Properties* dialog, highlighted Subgrade_pm Point Feature Definition, and the highlighted SUBGRADE Alternate surface. In this example the base extension is not included in the subgrade surface definition.







▶ *Prepare the View for Exporting*

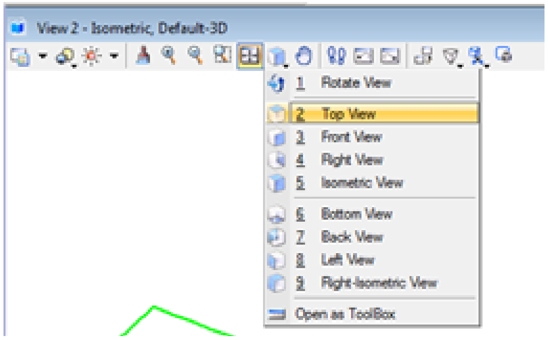
1. Open the *MODLRD_Master01.dgn* file. To Display 2D and 3D Views, select *Function Key* **F2**.

2. Turn **OFF** the Reference File display for:

    - *MODLRD_Existing_Features01.dgn*
    - *MODLRD_Existing_Drainage01.dgn*
    - *MODLRD_Existing_Utilities01.dgn*
    - *RWDTRD01.dgn*
    - *GDTMRD01.dgn*
    - *SURVRD01.dgn*
    - *ALGNRD01.dgn*
    - *PDPLRD01.dgn*

3. Maximize the View 2 – Default-3D.

4. Change the **View Rotation** to a **Top view**.



5. Use the *Function Key* **F7** to turn **OFF** all Construction elements in the 3D View.

6. Open **Level Display**. Ensure the 3D View is active.

7. Turn off display of Default level and PavementAsphalt_pm.

8. Hold down Shift or Shift Ctrl and select the *MODLRDMainline61.dgn, MODLRDDetail61.dgn, PDPLRD01.dgn, and MODLRDUS98.dgn* reference files.

a. Turn on only proposed subgrade feature levels:

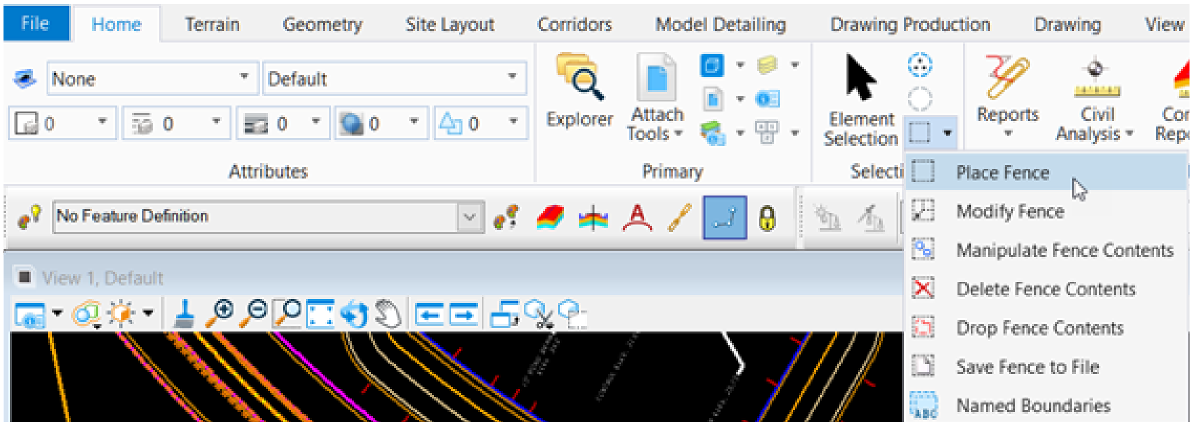
   i.e. Cut_pm,
   Fill_pm,
   MedianCrown_pm,
   ShoulderUnpavBreak_pm,
   Subgrade_pm,

b. Turn off any used _px levels (meshes)

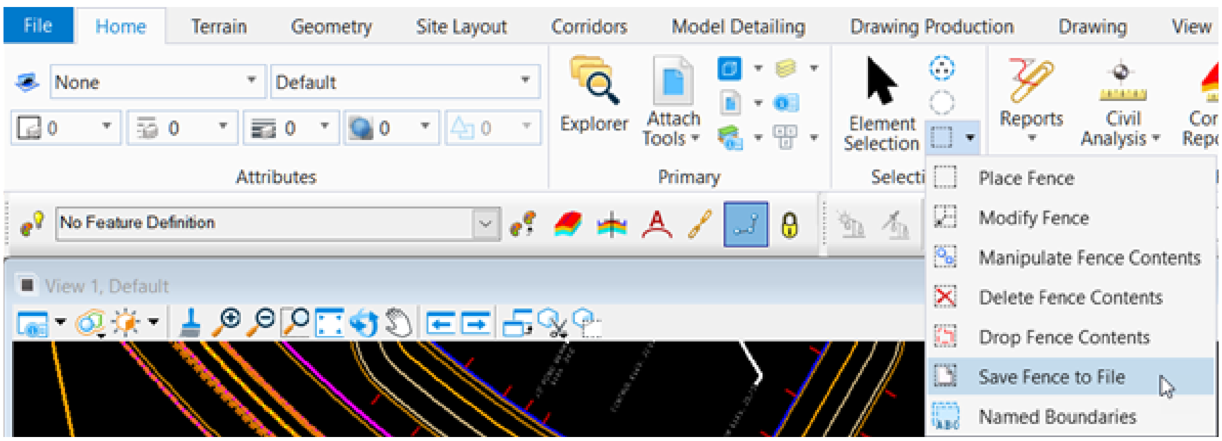
c. Turn off remaining levels not needed for the 3D Proposed breakline surface. i.e. Default level, Scratch_dp, Miscellaneous, ConstLines, and any levels not ending in _pm.remaining levels not needed for the 3D Proposed breakline surface. i.e. Default level, Scratch_dp, Miscellaneous, ConstLines, etc.

▶ *Exporting 3D Break Lines.*

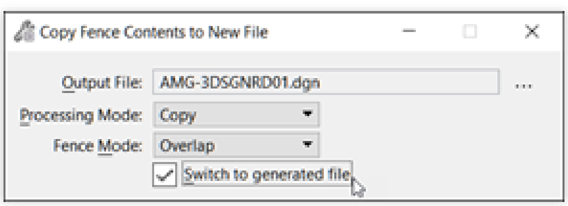
1. Place a Fence around all the Elements in the default-3D View. **Home > Selection > Fence Tools > Place Fence**



2. Save the fence contents to a file, in 3DDeliverables*AMG-3DSGNRDEW01.dgn*. **Home > Selection > Fence Tools > Save Fence to File.**



3. If converting to DWG (next page), check the *Switch to generated file* box.



4. Data point to accept and verify the file is in the 3DDeliverables directory.

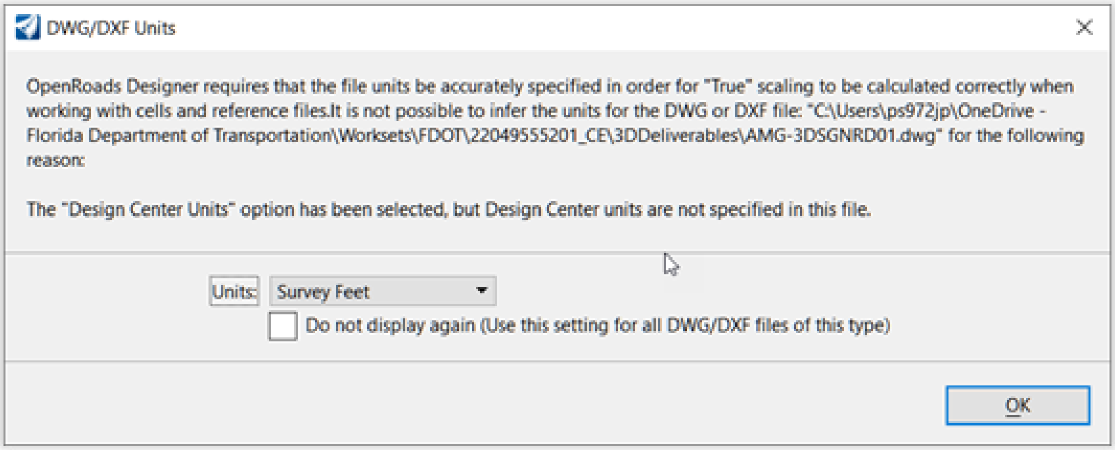
▶ *Save as DWG(Optional)*

1. Open the 3DDeliverables\ *AMG-3DSGNRDEW01.dgn* design file.
2. Select **File > Save As** from the MicroStation Menu.
3. Select **Autodesk(R) DWG** as the Save as type.

NOTE ***There is no need to set Options on the Save As dialog.***

4. Verify or Enter the File Name, *AMG-3DSGNRDEW01* and click **Save**.

5. Select the *Units* Survey Feet and click **OK**.



NOTE ***The file will open in DWG Work Mode, see the blue cross hairs icon in the bottom right of the MicroStation window.***

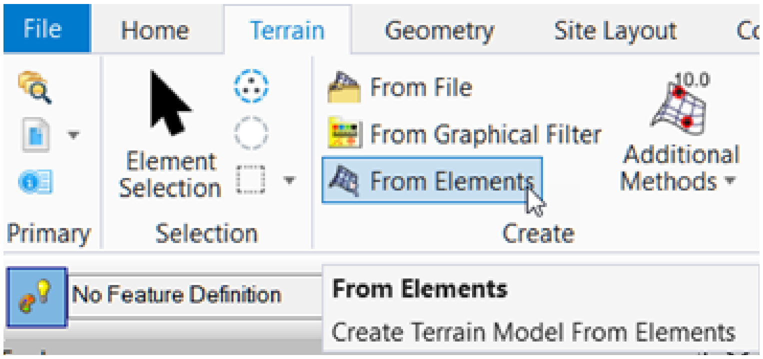
6. Trim extraneous elements as necessary. Save changes to the .dwg file, then “Save As” to overwrite the .dgn file.

Exercise 5.9 *Creating 3D Proposed Subgrade/Earthwork Surface Files for AMG*

1. In FDOTCONNECT, Select **File > Open** to the *AMG-3DSGNRDEW01.dgn* file. Click **Open File** and click **OK**.

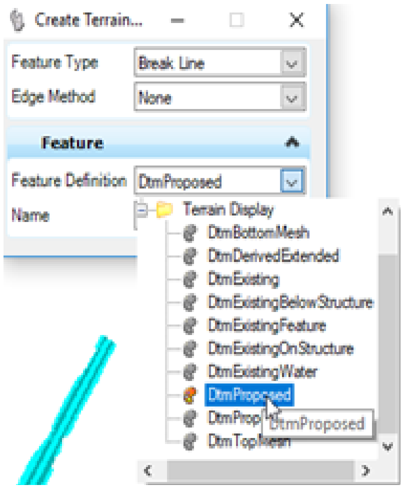
2. Create a Selection Set of all Elements.

3. Use **Terrain > Create > From Elements** tool.



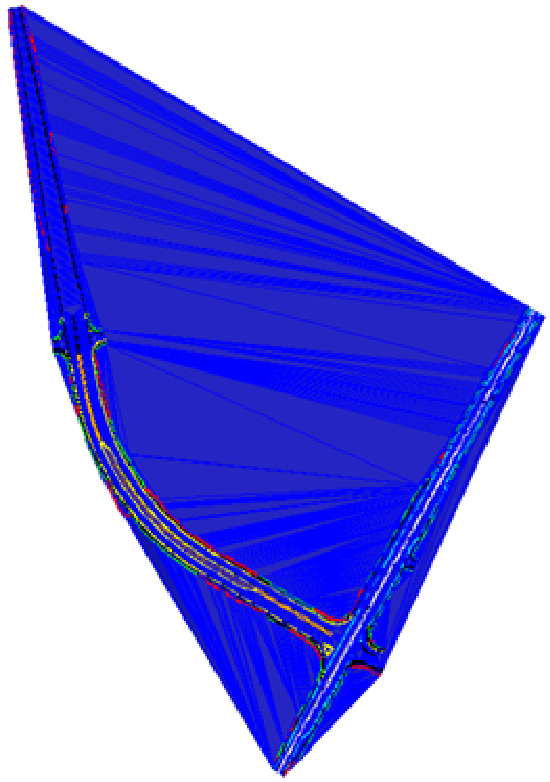
4. Define the following in the *Create Terrain Model* dialog:

- Feature Type: **Break Line**
- Edge Method: **None**
- Feature Definition: **DTMProposed**
- Name: **AMG-3SURFACEEW01**



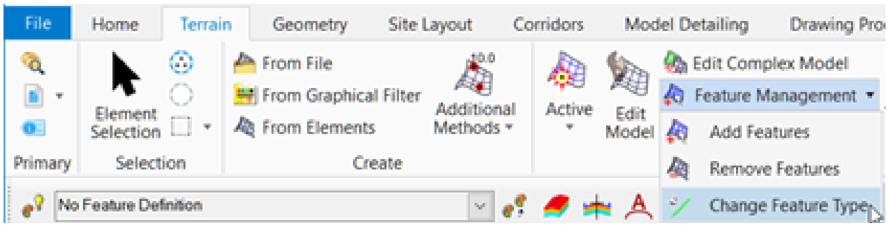
5. Data point through prompts to accept settings. A Surface is created. Use *Function Key* **F2** to turn **ON/OFF** the construction elements.

6. Notice the External Triangles must be trimmed.



7. Turn Off the Level DTM_px.

8. Use Civil Tools **Terrain > Edit > Change Feature Type** tool.

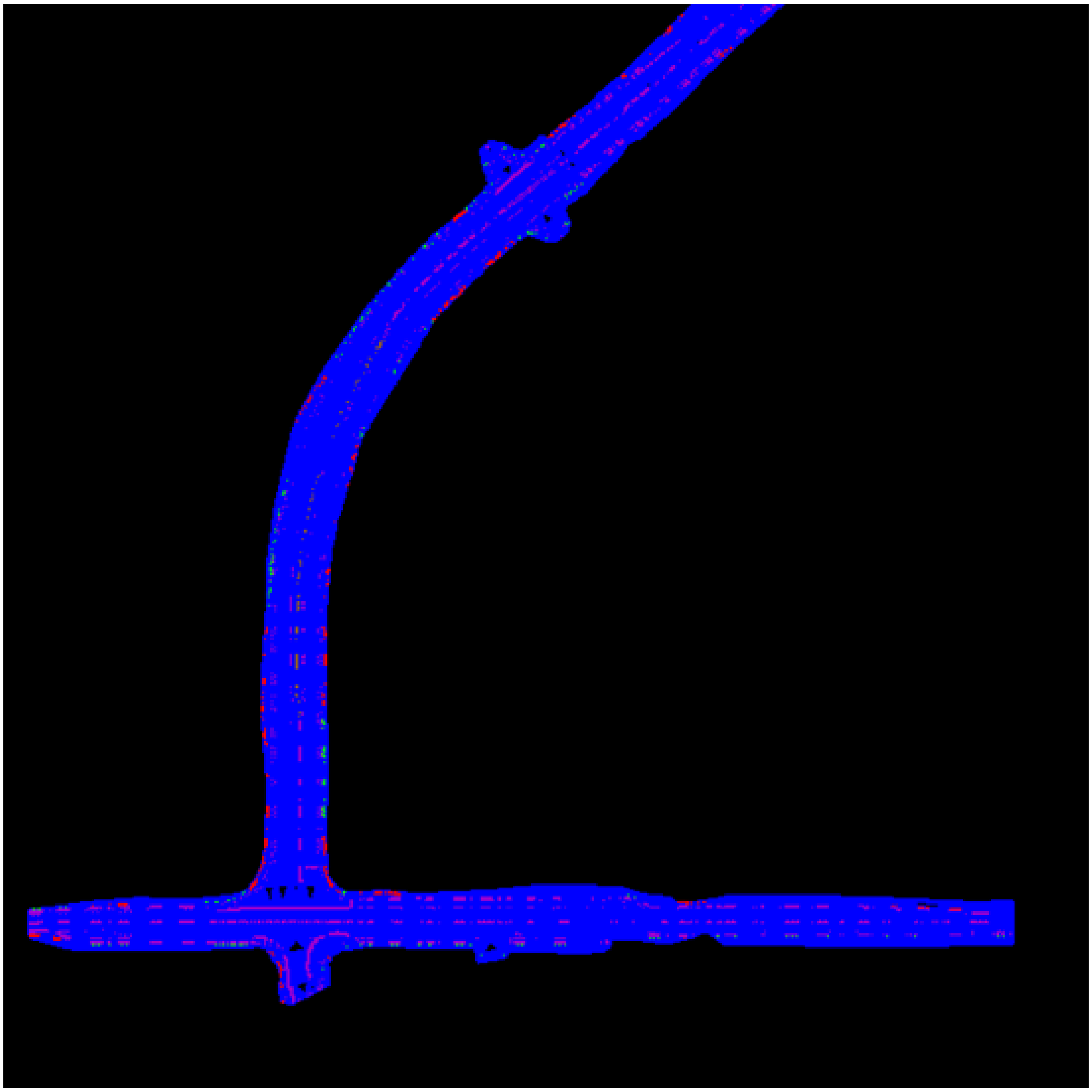


9. Set the *Feature Type* to **Boundary**.

10. Select each of all the Cut_pm and Fill_pm Lines individually defining the slope construction limits. Right click to finish when all the selected lines to boundary elements for the External Limits of the Surface.

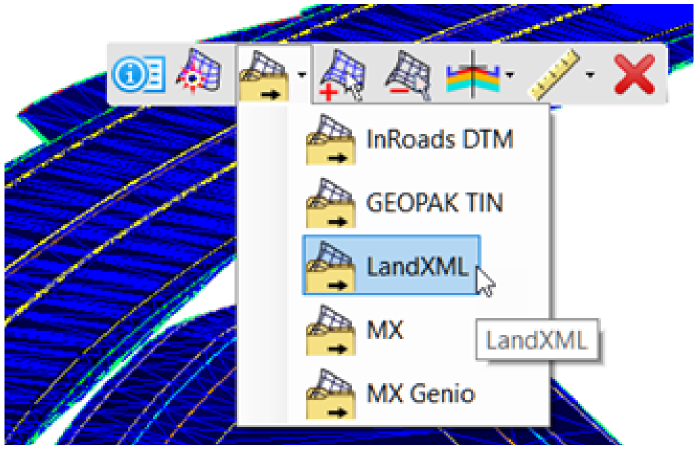
NOTE ***A Selection Set for Cut/Fill Lines does not produce the desired results for the creation of the Subgrade surface Terrain.***

11. Turn ON the DTM_px level to see the results.

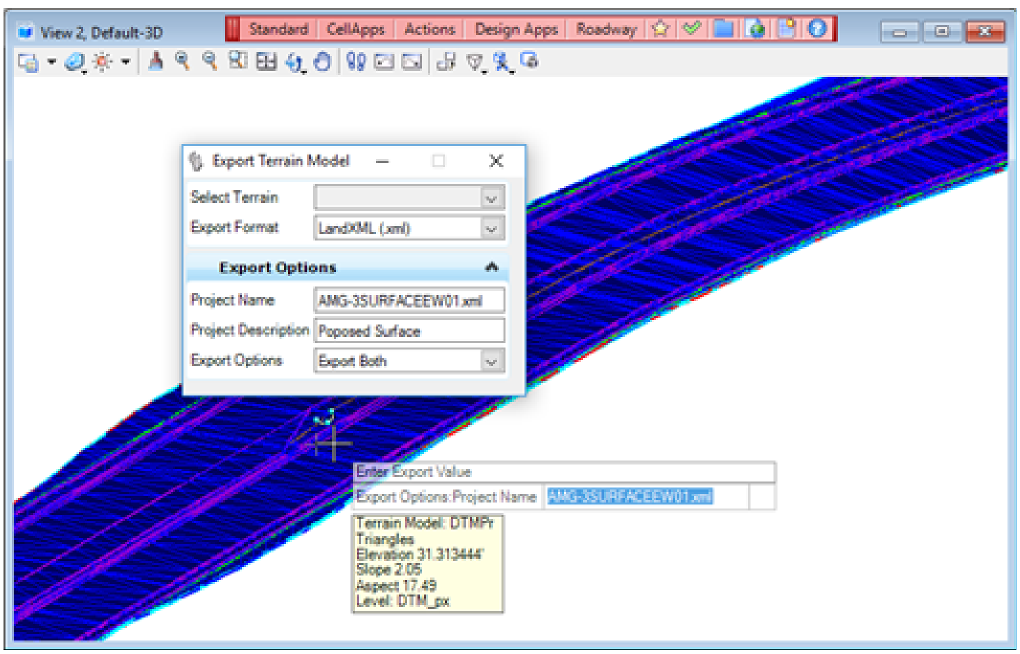


▶ ***Save Terrain to Land XML file***

1. Select and hover over the Surface and then select **Export Terrain Model > LandXML**.



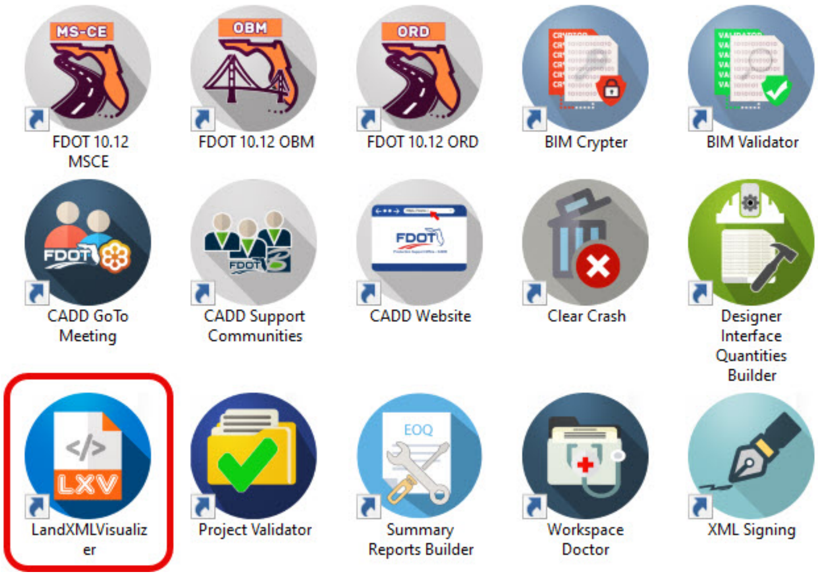
2. Select the Terrain.
3. Select the *Export Format*: **LandXML**
4. Enter the *Project Name*: **AMG-3SURFACEEW01.xm**l
5. Enter the *Project Description*: **Proposed Bottom Surface**
6. Select the *Export Options*: **Export Both**



7. Save the file to the 3DDeleverables directory with filename *AMG-3SURFACEEW01.xml*.

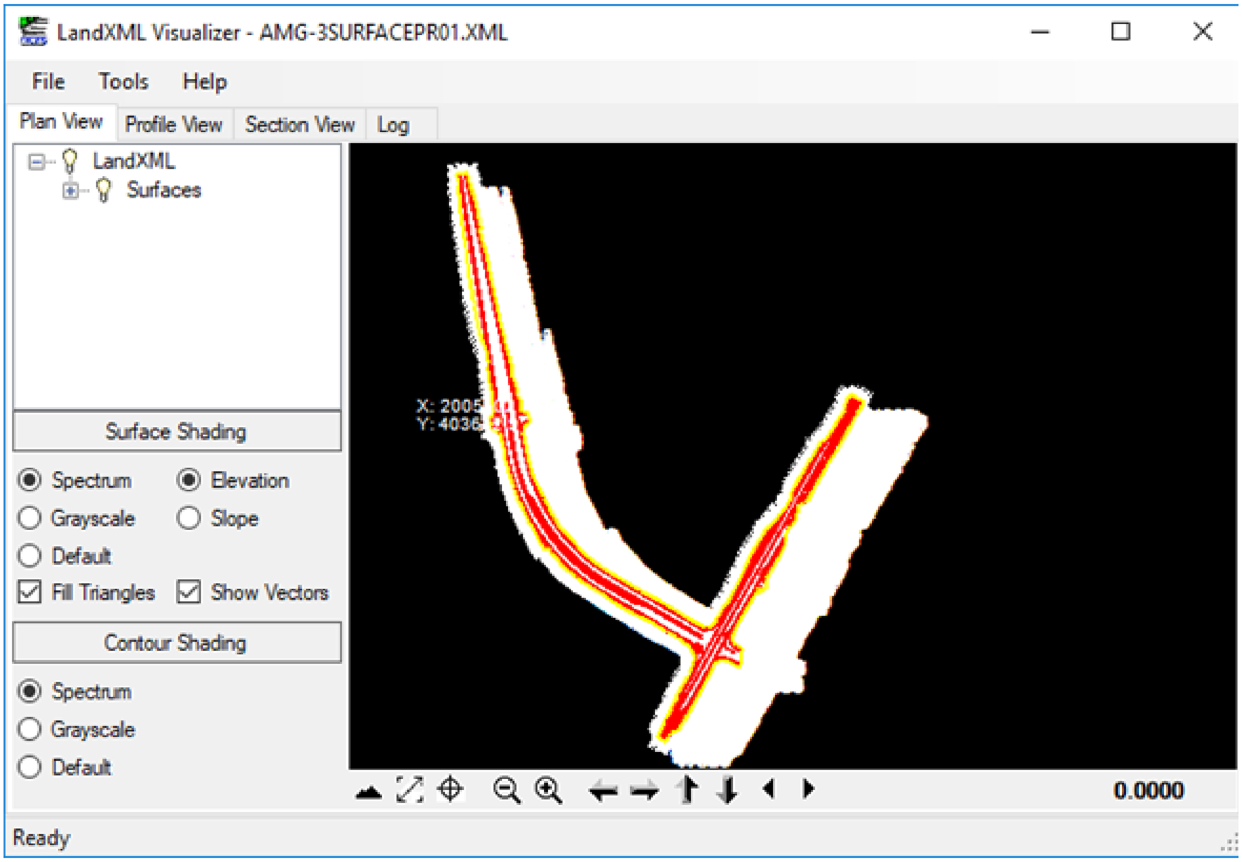
Exercise 5.10 *Use Land XML Visualizer to Validate Land XML File*

1. From the desktop locate and open the FDOTConnect product folder..

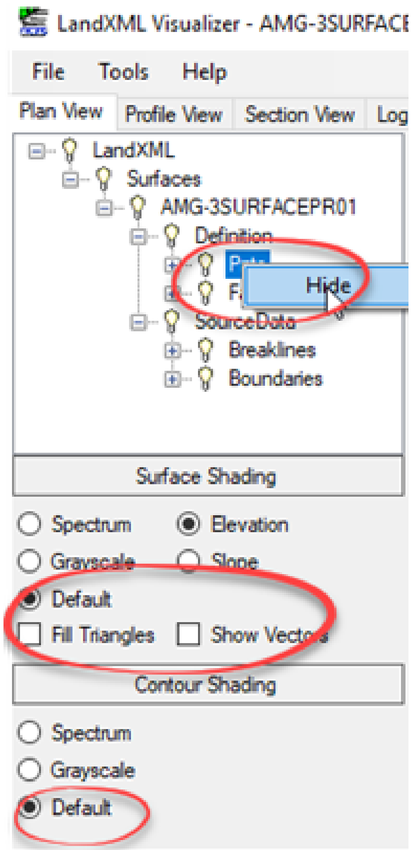


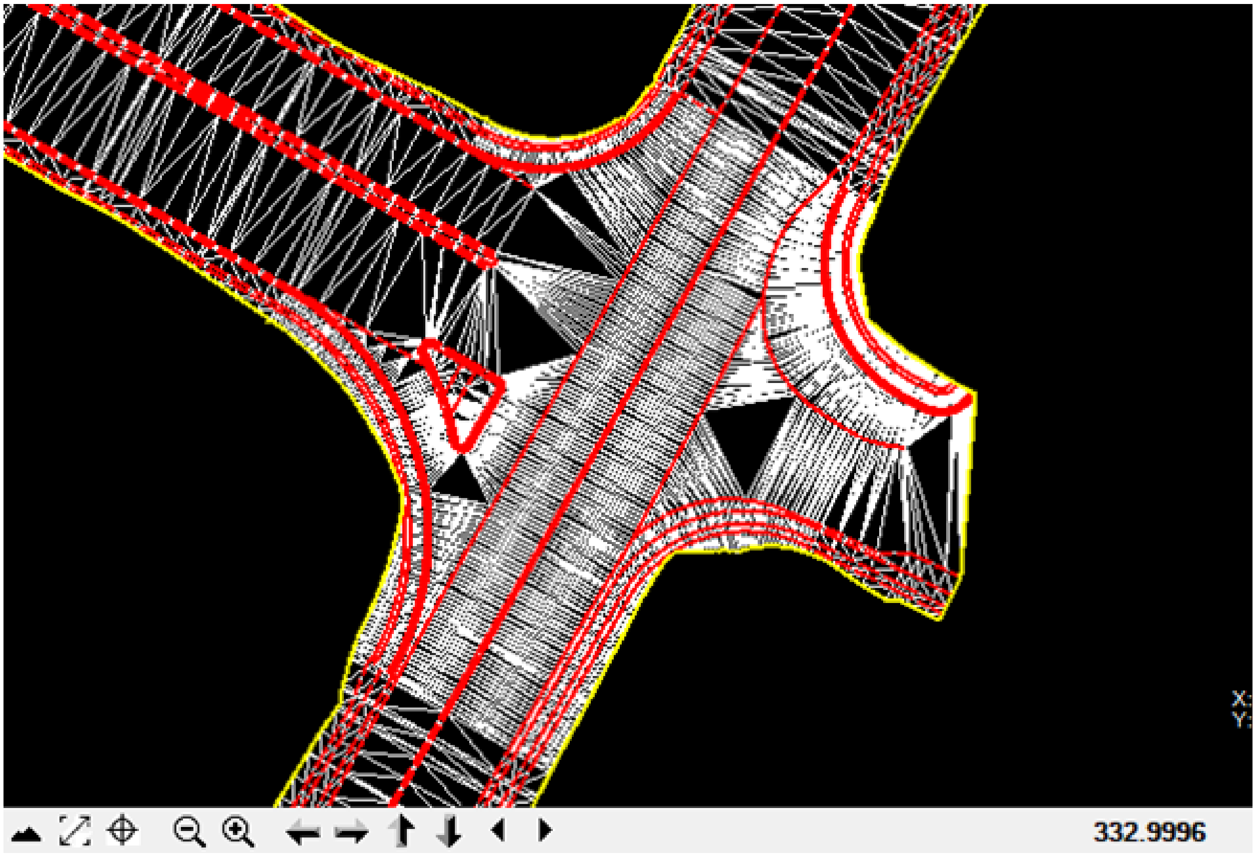
2. Open the **Land XML Visualizer** tool.

3. On the **LandXML Visualizer** tool, select **File Open**. Choose the *AMG-3SURFACEPR01.xml* file.



4. Change the *Plan View* Setting to Default, No Fill, No Vectors and No shading as shown below. Also, right click on the *Pnts* definition and choose **Hide**.





6 EARTHWORK

INTRODUCTION

In OpenRoads Designer, quantities are generally calculated from the 3D model. While most of the effort is covered in other training documents, there are some steps of earthwork calculation that tie in closely with the modeling process and will be covered in this chapter. Historically, earthwork quantities in roadway design have been calculated using the average end area method, calculating the volume as a prism with the ends being two cross sections. This has certain limitations to accuracy, particularly depending on the cross section interval. It assumes no changes happen between the cross sections. If the roadway is a bit asymmetrical about the centerline on a curve or the earthwork changes significantly between cross sections, the accuracy drops quickly. In contrast, with triangulated terrain models and modern computing power, it is easy to calculate the volume using the surface-to-surface comparison method. This calculates the actual volume between two surfaces by using all the points of each of the terrains, in a compute intensive method that would be impossibly time consuming to duplicate by hand. Sometimes the surface-to-surface comparison method is also used to create a third surface that is the difference between the other two surfaces. In this comparison surface, any elevation values less than zero would be cut while positive values would be fill.

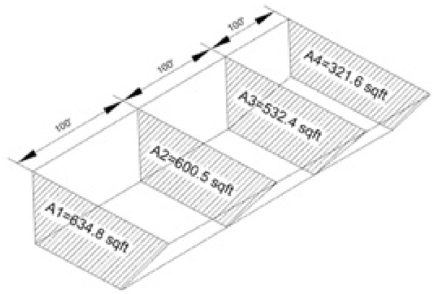


Figure 1. Average End Area.

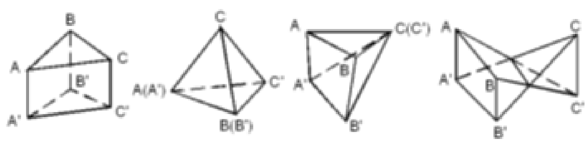


Figure 2. Surface-to-surface comparison.

The above figures illustrate the key differences in the volume calculations between average end area and surface-to-surface methods. Both are essentially calculating volumes of prisms, but the surface-to-surface prisms are enclosed by triangles based on the survey points and the triangles generated from the corridor components. The factors affecting volume accuracy are the detail level of the survey Digital Terrain Model and the interval spacing of the corridor model or the stroking definition of lines used for linear templates or surfaces. We can calculate much more accurate volumes from the 3D model by simply decreasing the interval spacing (i.e., on curves) and/or adding key stations in more complex areas such as intersections with radius returns in a way that seeks to maximize the tradeoff of performance vs accuracy. This is reflected in the requirements of the CADD manual table discussed in Chapter 2.

The average end area earthwork volumes can be calculated manually by scaling from plans, calculating the areas of cut and fill shapes in one cross section, then performing the same calculation on the next cross section and summing them up. The surface-to-surface comparison method, by contrast, is too computationally intensive to calculate by hand.

For engineers wanting to independently verify the quantity calculations, there are still a few options. One would be to import the surfaces into construction software such as Trimble and run the surface-to-surface comparison method in the other piece of software. This allows a different algorithm to independently check the calculations performed by OpenRoads Designer. Another might be to have OpenRoads calculate the volumes using the average end area as well, while recognizing that this figure will always differ to some degree due to its lower accuracy.

For the FDOT workflow we need to create the cut and fill volumes in the model files, and we cannot perform a surface to surface volume comparison until the proposed bottom surface is created. This chapter will focus on those two steps. Both are using the same approach to calculate the volumes, but one creates 3D shapes from the corridors and detail modeling, and the other calculates directly from two Digital Terrain Models.

EXERCISE OVERVIEW

For any projects with multiple alignments, the cut/fill 3D shapes need to be created in separate files for each alignment. This allows our quantity calculations to be tied to an alignment. Any file that is referenced in is included in the earthwork volume calculation, even if the display is off. Consequently, for these projects, care needs to be taken to not even clip one corridor to a corridor on another alignment. In the case of this dataset, earthwork volumes for each alignment will be created in the *MODLRDMainline61.dgn* and *MODLRDUS98.dgn* files respectively. *MODLRDMainline61.dgn* will need to reference *MODLRDDetail61.dgn*, but it does not need to reference *MODLRDUS98.dgn*, even though the detail file references it out of necessity. For intersections between different alignments, having a separate file for detail modeling may be the best model management plan.

Exercise 6.1 Create Cut and Fill Volumes

▶ *Prepare File for Cut and Fill Volumes*

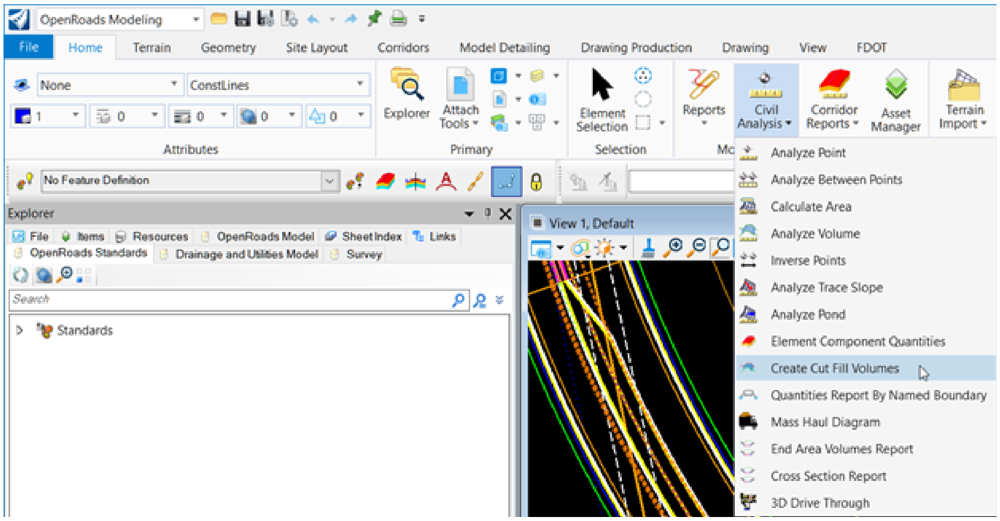
1. Open the C:\Worksets\FDOT\22049555201\Roadway*MODLRDDetail61.dgn* file of the WorkSet

2. With the 2D view active, attach the *MODLRDMainline61.dgn* file.

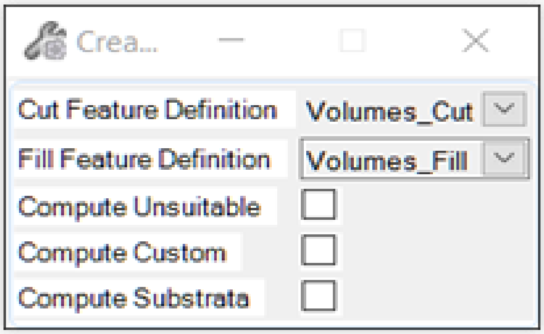
3. If not already open, open a 2D and a 3D view.

▶ *Create Cut and Fill Volumes, SR61*

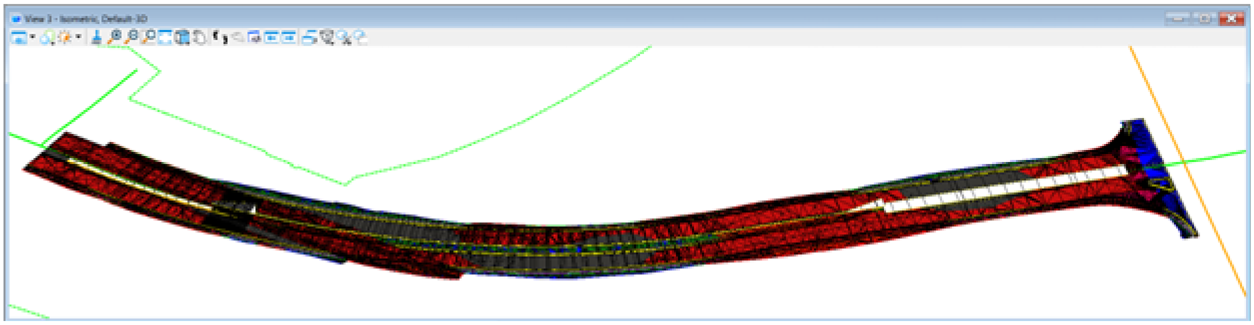
4. Use the **Home > Model Analysis and Reporting > Civil Analysis > Create Cut Fill Volumes** command.



5. Accept the default options in the dialog.



6. To see the cut and Fill Volumes, turn on Constructions in the 3D view.



NOTE ***Cut Volumes are in red and Fill Volumes are in blue. There should be two components, even if the cut and fill areas are not contiguous. These components do not show up in the OpenRoads Model, but can be toggled on and off in the OpenRoads Standards under Feature Definitions > Mesh > Volumes.***

▶ *Create Cut and Fill Volumes, US98*

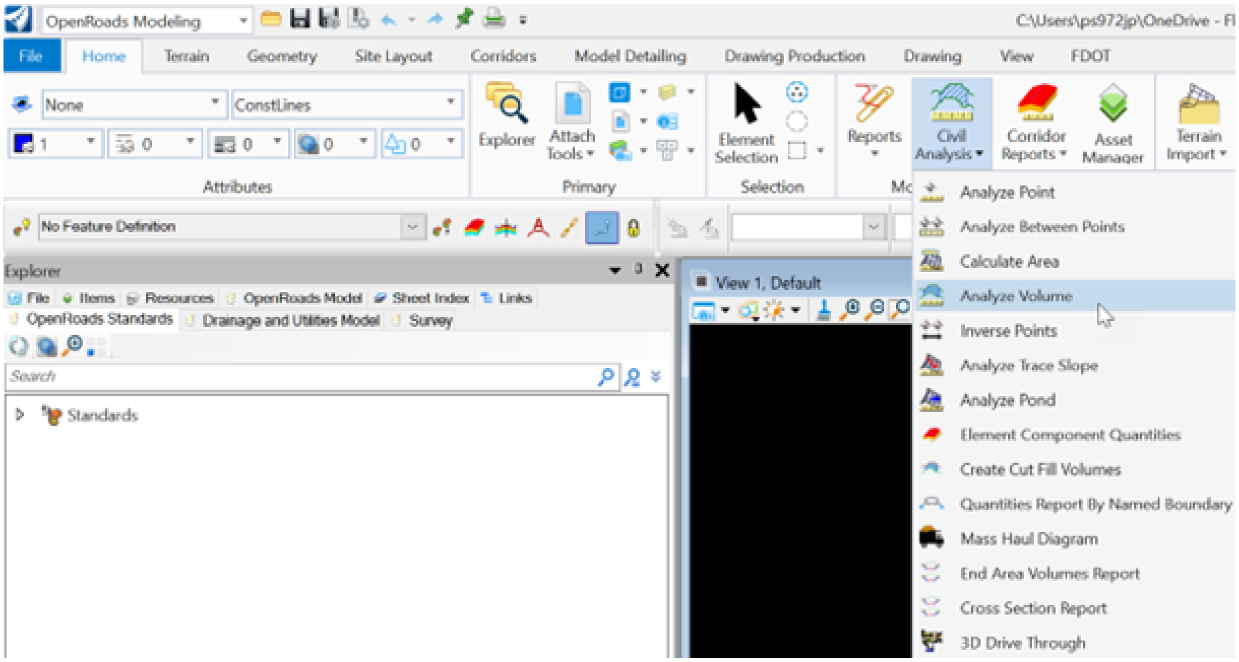
7. Open the C:\|Worksets\FDOT\22049555201_CE\Roadway*MODLRDUS98.dgn* file of the WorkSet.

8. Repeat Steps 3-6 to create Cut and Fill Volumes for the US98 corridor.

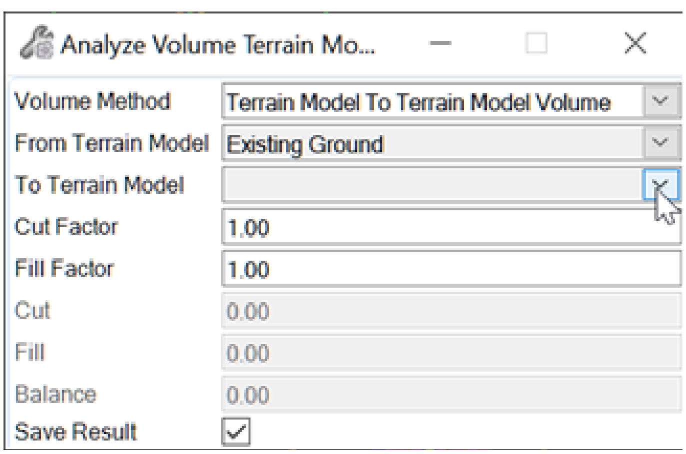
NOTE ***Ensure that the neither the MODLRDMainline61 nor the MODLRDDetail61 files are attached.***

Exercise 6.2 *Analyze Volume*

1. Open the *MODLRDMaster01.dgn* file.
2. Make the 2D View active.
3. Attach the *AMG-3DSGN01.dgn* and the *AMG-3DSGNRDEW01.dgn* files as references. Turn off display of all but DTM levels.
4. Use the **Home > Model Analysis and Reporting > Civil Analysis > Analyze Volume** tool.



5. Use the *Terrain Model to Terrain Model Volume Method*.
6. Set Existing Ground as the *From Terrain Model* as shown below.



7. Set *To Terrain Model* to the proposed subgrade surface AMG-3SURFACEEW01.
8. <Optional> Check the box to *Save Result* to insert the calculated volume as a text object in the dgn file.
9. Accept settings and view the volumes in the Civil Message Center.

NOTE ***Volumes calculated are in the file units, so should be cubic feet, not cubic yards.***

10. If *Save Result* was checked, insert the volume at desired location in the 2D View.

7 VISUALIZATION

INTRODUCTION

This section will cover several options for visualizing the model. These will help reviews performed in the CAD software, in LumenRT on a computer, or in LumenRT using a VR headset such as Oculus Rift.

EXERCISE OVERVIEW

Exercise 7.1 *Visualize Existing Ground*

▶ *Clip the Existing Ground Terrain*

1. Open the *MODLRDMaster01.dgn* file.

2. In the 3D view, turn *Constructions* on in order to see the terrains used to create surface templates.

3. Use the **Terrain > Create > Additional Methods > Create Clipped Terrain Model** tool.

   a. Select the Existing Ground for the Reference Terrain Model.

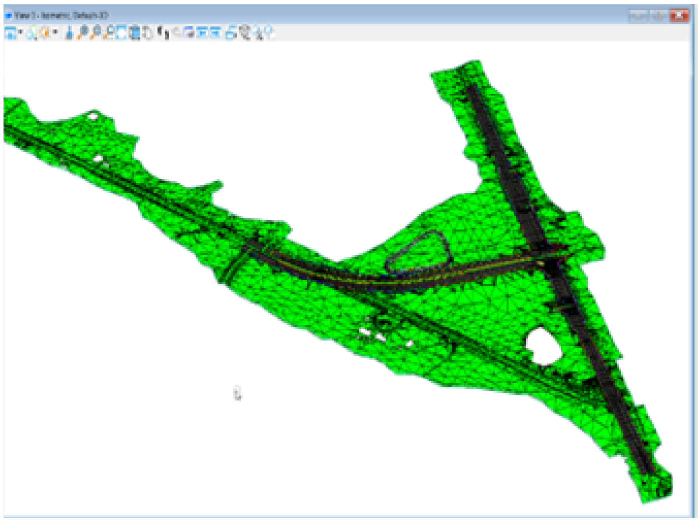
   b. Select all the corridor handles:

      - SR 61 L
      - SR 61 R
      - SR 61 Inside
      - US 98

   c. Select the DtmPr Terrain.

   d. Accept clipping features.

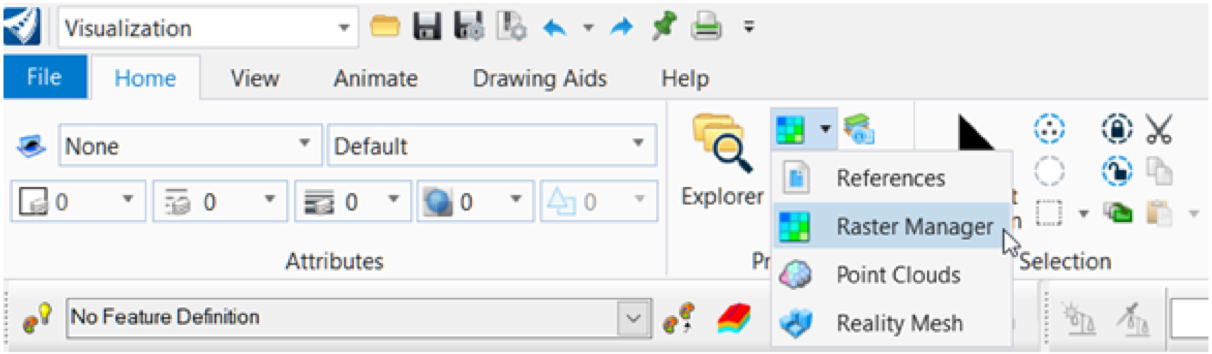
   e. Set Feature Definition to DCDrape. The triangles of the Existing Ground should now display without overlapping the proposed model.



▶ *Drape Aerials on Existing Ground*

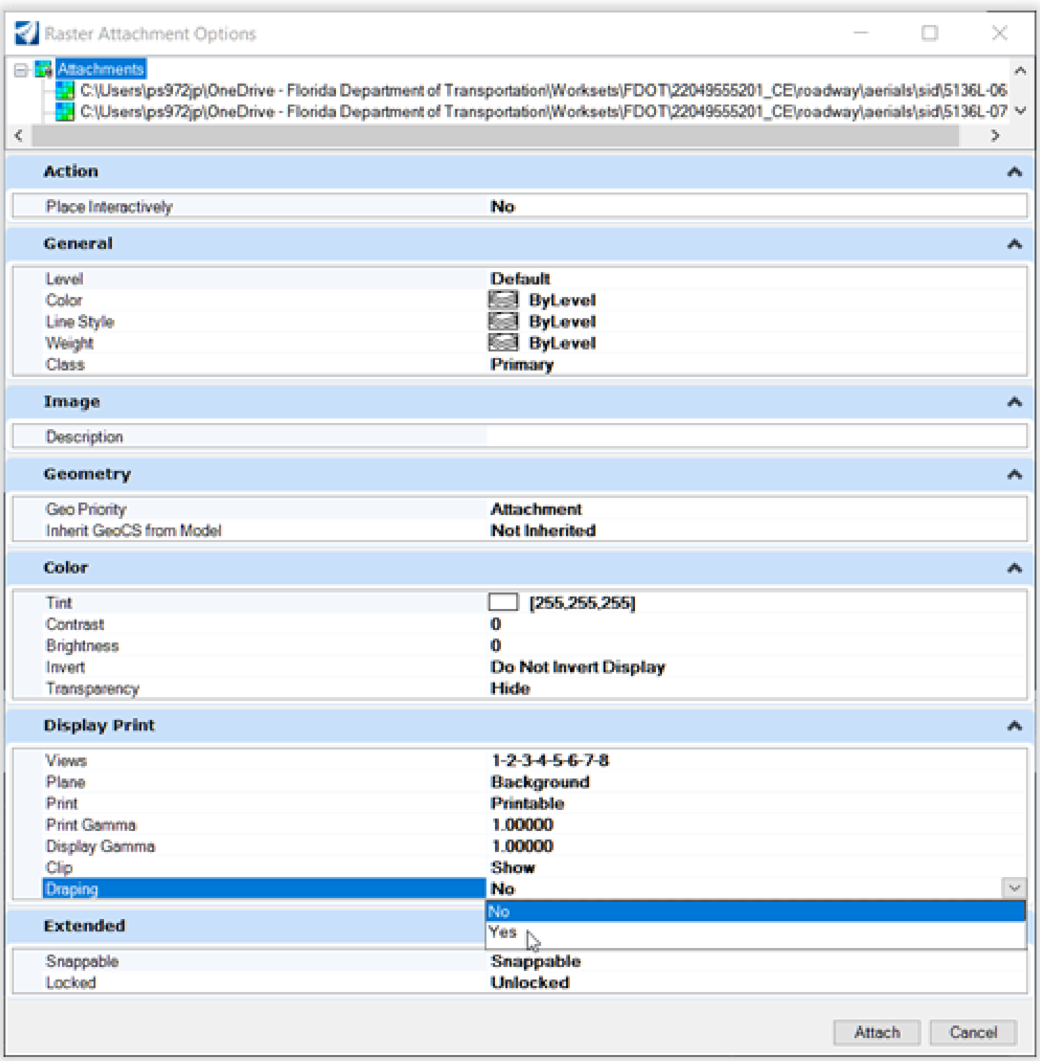
1. Ensure that the 3D View is active.

2. Use the **Primary > Attach Tools > Raster Manager** tool.

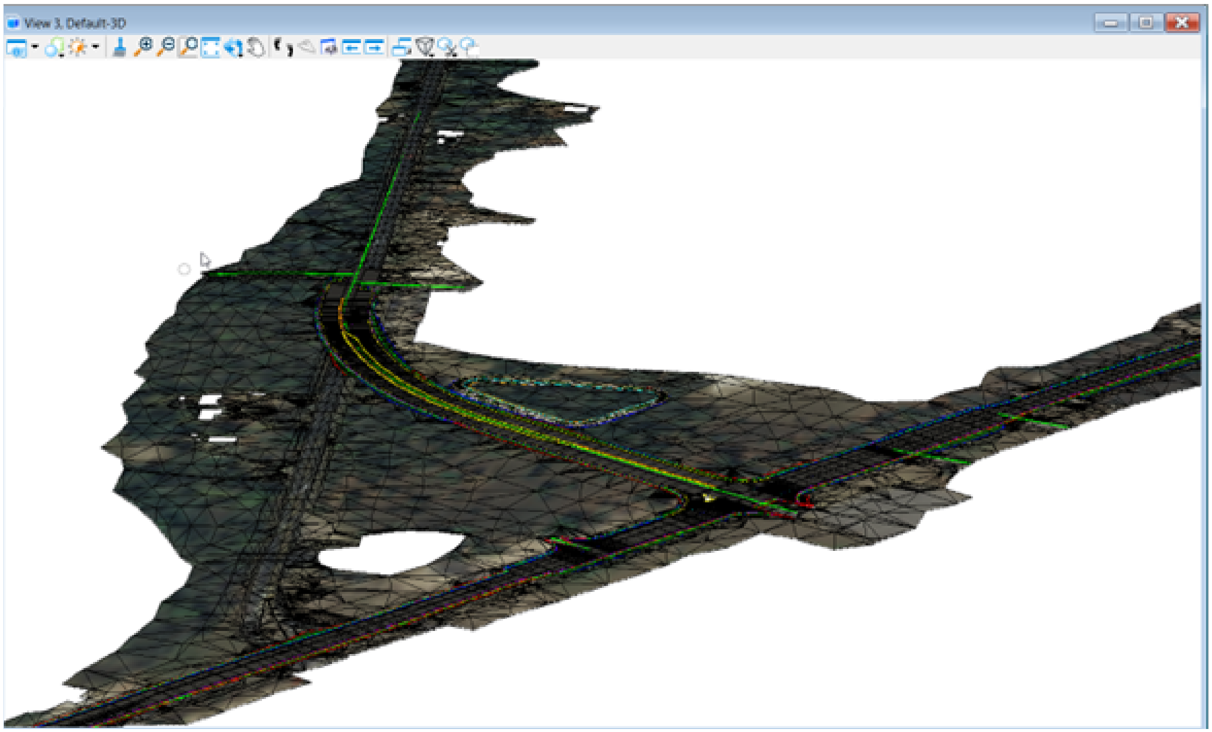


3. Attach the three *5136L-06.sdw*, *5136L-07.sdw*, and *5136L-08.sdw*f iles in C:\Worksets\FDOT\22049555201\Roadway\aerials\sid.

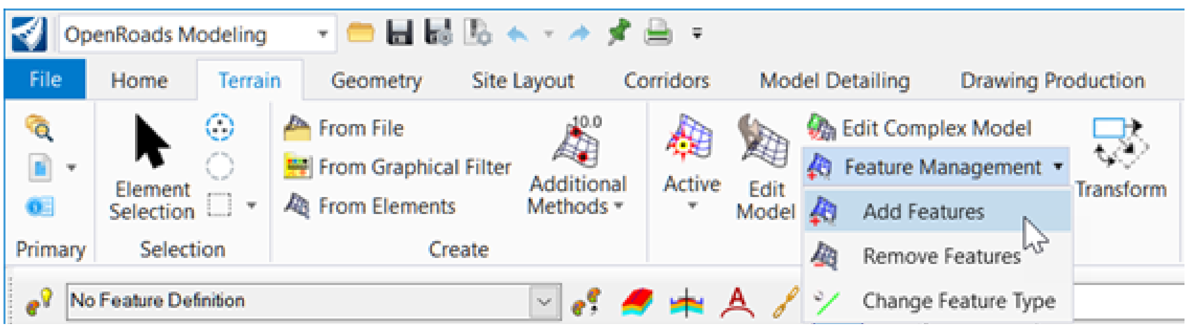
4. Set *Draping* to **Yes** as shown below and click **Attach**.



5. The existing ground will display on the terrain with the DCDrape Feature Definition.



6. Use **Terrain > Edit > Add Feature** to add the lines used to create the intersection surface in Chapter 4 to the new DCDrape terrain.



7. Set *Feature Type* to **Hole**.

NOTE ***Often the Hole Feature Type works, although because the profiles of those lines are not on the existing ground, it likely will not. Drape Void will work better as it essentially drapes the profiles to the existing ground before using them to clip the surface.***

8. Use **Terrain > Edit > Change Feature Type** to change the feature type of the lines to Drape Void until they are successfully removed from the terrain.

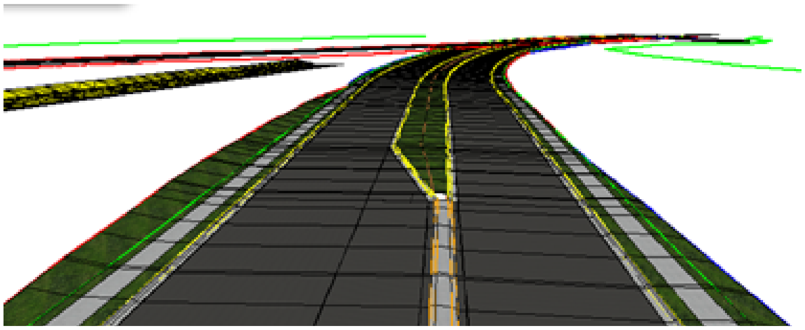
Hint ***Turn off display of reference file levels except for the Pavt Break and EOP from MODLRDDetail61.dgn in order to make it easier to select the lines for both these steps.***

9. If needed, edit the model to manually delete triangles overlapping with the proposed model.

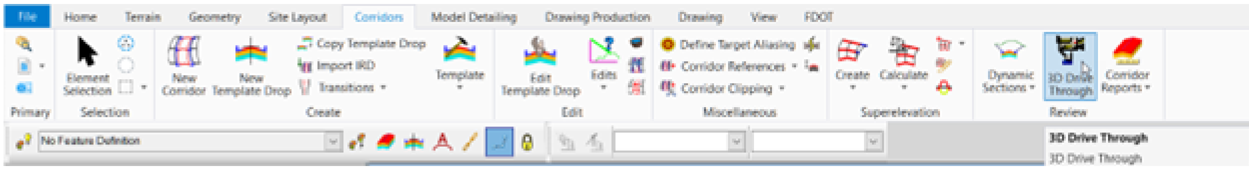
Exercise 7.2 *Create a 3D Drive-Through Animation*

Creating a drive through along the project requires a 3D view and a 3D path to follow. This exercise explains how to use the Drive Through tool in FDOTConnect along the proposed SR61 3D Model.

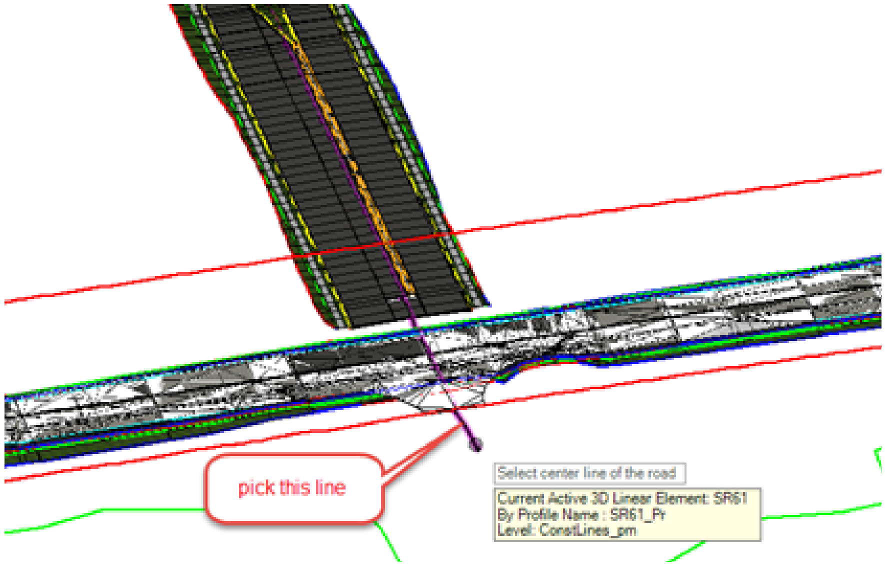
▶ *To Setup the Animation Drive Through*



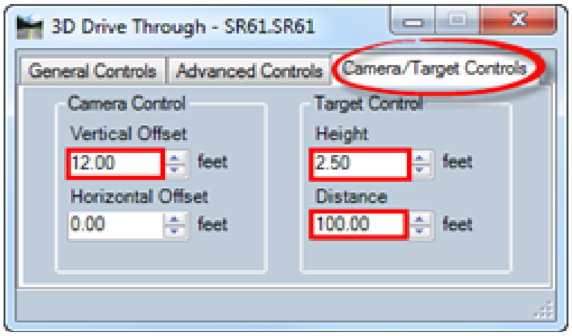
1. Open the *MODLRDMaster01.dgn* file.
2. Maximize View 2 Default-3D model to set it as the *Active View*.
3. Turn **OFF** the ConstLines and XSMisc_px levels.
4. Use **Corridors > Review > 3D Drive Through** tool.



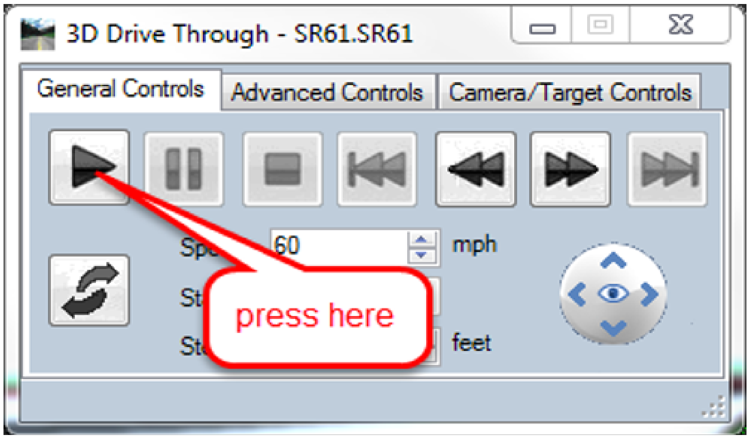
5. At the prompt, Select a 3D view, left click inside View 2.
   a. At the prompt, Select the center line of the road, pick the 3D line in the view shown below.



b. On the *3D Drive Through* dialog, change to the tab Camera/Target Controls and enter the values as shown below.



c. Change the tab back to the *General Controls* and Select the **Play Button** as shown below



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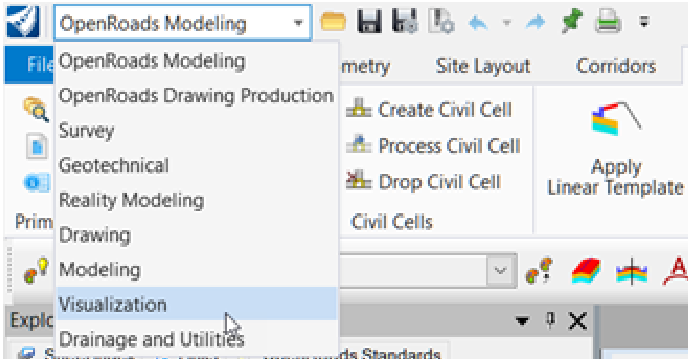
Exercise 7.3 *Export to LumenRT*

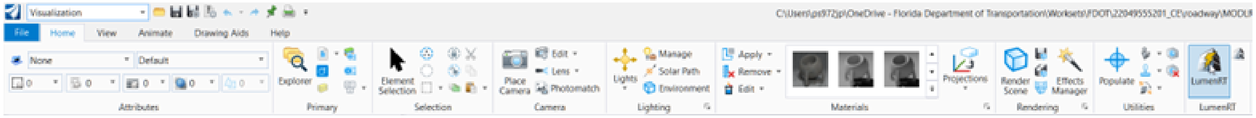
NOTE ***Ensure the system meets LumenRT requirements. CADD or District training laptops may not be able to process and may crash.***

1. Make the 3D View active.
2. Change the Active Workflow to **Visualization**.

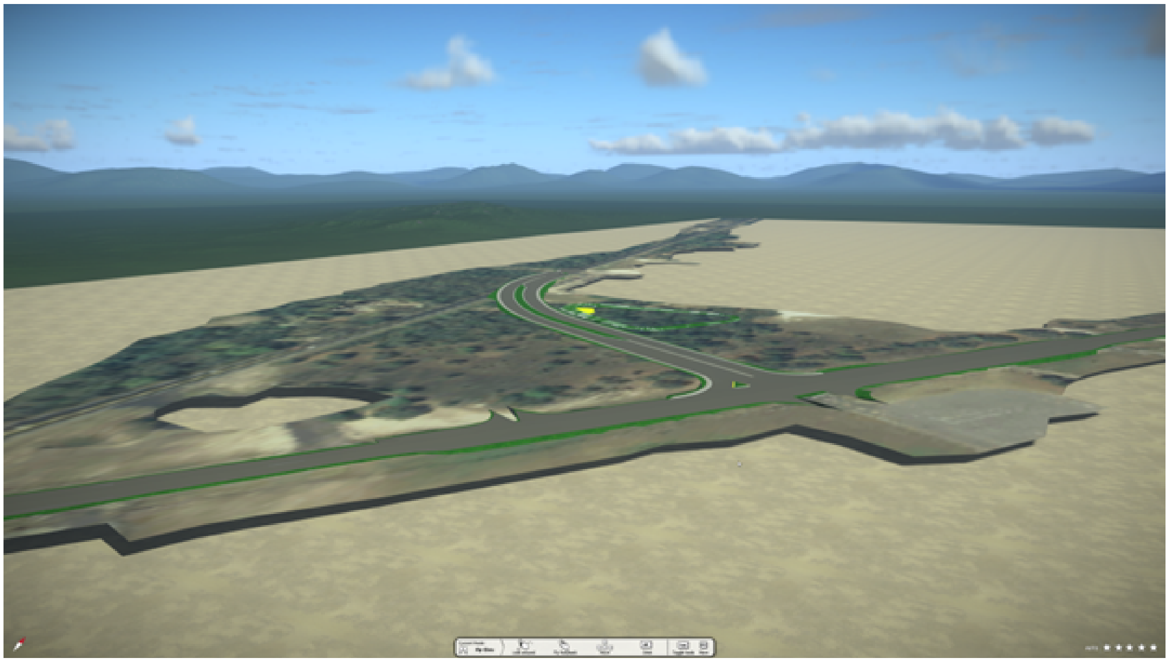


3. Turn off Existing Ground lines:
   a. Turn off display of *GDTMRDO1.dgn*.
   b. Turn off all levels in *MODLRDMaster01.dgn* except for DTM_ex and DTMTriangles_ep.

4. Use the **Home > LumenRT** tool.



5. LumenRT will open and the export will process.



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