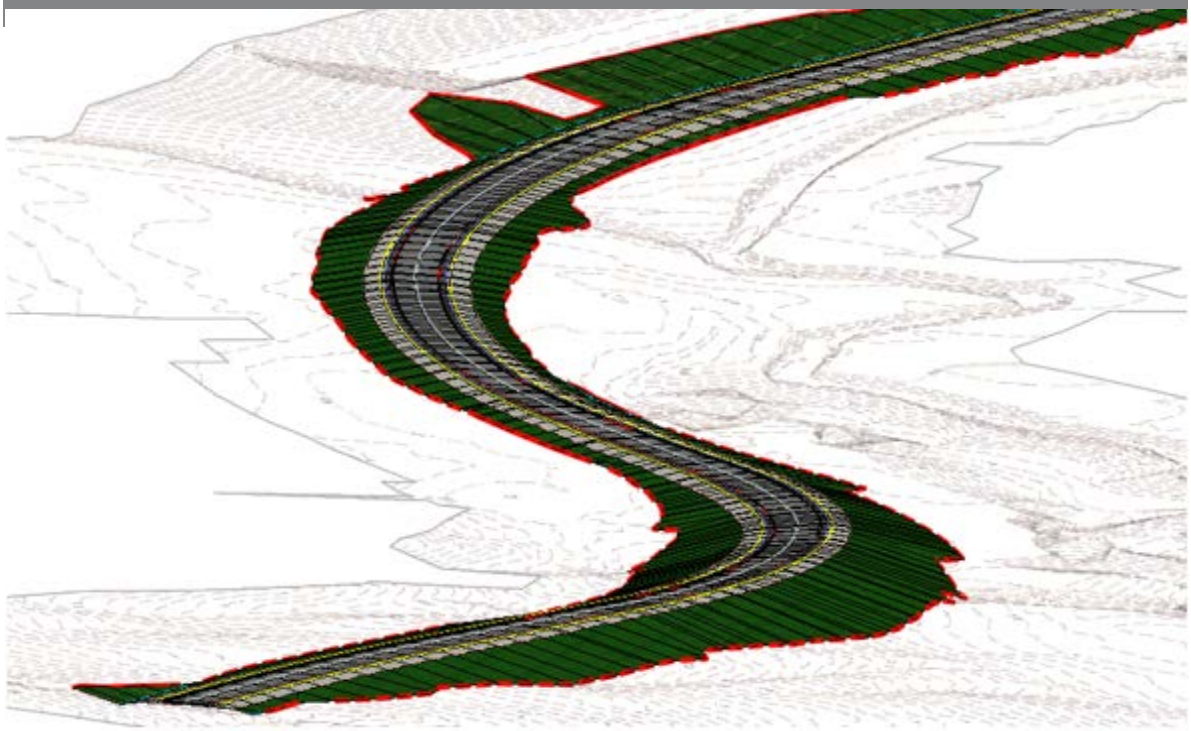
ROADWAY DESIGN I

OpenRoads Designer

(Formerly GEOPAK Road I)

CONNECT Edition



TDOT

Roadway Design Division

June 2022

TN TDOT Department of Transportation

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Preface

Purpose & Need

The ***ROADWAY DESIGN I*** OpenRoads Designer (ORD) Manual is the third document in a series of **six** training manuals released by the Tennessee Department of Transportation (TDOT) that is available through a digital, interactive **flipbook** format. Bentley's ORD software is being adopted and implemented statewide by TDOT as the new **3D modeling** design software, which will ultimately replace both MicroStation V8i and Geopak (SELECT Series 2). This manual provides an introduction to the ORD **3D modeling** workflow which includes civil geometry, corridor modeling, superelevation, proposed surfaces and sheet creation (Profiles and XS). For step-by-step instructions on creating a **TDOT plan set** in ORD utilizing the new workflows and updated CADD Standards, refer to the Requirements for Model-Centric Design document, which can be found on the TDOT CADD Support website under **OpenRoads Designer Information >> ORD Resources >> Requirements and Guidelines** section. For standardized naming convention methologies for ORD files, refer to the TDOT Standard **ORD File Naming** document, which is also located under the Requirements and Guidelines section.

Disclaimer

The ***ROADWAY DESIGN I*** Manual is developed based on OpenRoads Designer CONNECT Edition 2021 Release 2, Version **10.10.21.04**. The TDOT ORD workspace (**10.10.21.04_04.21.2022** complies with the latest CADD standards and should be used in conjunction with this manual. It can be downloaded on the TDOT CADD Support website under **OpenRoads Designer Information >> ORD Resources >> Support Files**. If you have any technical issues or recommendations for this manual, please contact TDOT CADD Support at TDOT.ORD@tn.gov.

Training Videos

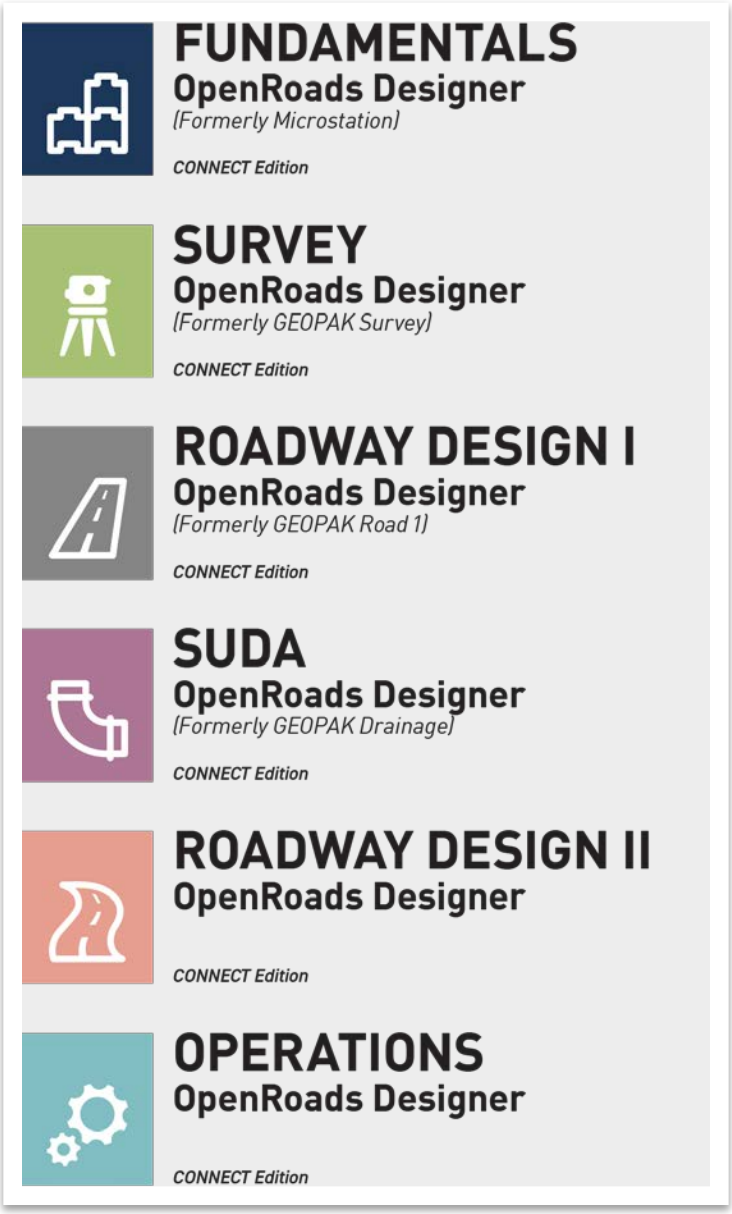
The ***ROADWAY DESIGN I*** Manual has accompanying training videos which are intended to be utilitzed as you go through the exercises. Video icons have been inserted throughout the flipbook, providing direct access to the applicable video. At a minimum, there is at least one video per chapter. In general, the videos contain instructional guidance and additional tips and tricks, as well as an informational bar at the bottom of the screen to help stay on track.

Revisions

The ***ROADWAY DESIGN I*** Manual will be revised over time as a result of future ORD software releases and procedural & workspace updates. All revisions will be documented by WSP/TDOT and included on the **Revision History** page at the end of the manual. TDOT CADD support will announce updated manual versions when they become available via emailed Instructional Bulletins. The updates will also be posted on the ORD TDOT webpage.

ORD Training Manuals

The ***ROADWAY DESIGN I*** Manual is one of **six** ORD training manuals available. Each manual has its own icon and color associated with it, which are maintained throughout the applicable manual and videos to help the user with wayfinding.



Chapter 1. Course Overview

Course Description and Objectives:

This course introduces users to the **design** functionality of the OpenRoads Designer (ORD) CONNECT software, which is Bentley's current drafting and civil design platform that has been adopted for use by TDOT.

At the conclusion of this course, participants will be able to:

1. Create an existing terrain model.
2. Create, import, and edit civil geometry (horizontal and vertical).
3. Add annotation for plan view geometry.
4. Create roadway corridor models using TDOT standard templates.
5. Create and manipulate new roadway templates.
6. Apply superelevation and create a report.
7. Create a proposed terrain model.
8. Create profile and XS named boundaries, add annotation and create a PDF.
9. Place guardrail/end terminals, pad slope limits, construction barrels and benching.
10. Navigate the civil labeler tool and store acquisition shapes

The topics covered in this class are:

1. Introduction to the OpenRoads Modeling Workflow
2. Terrain Models
3. Civil Geometry Tools and Annotation
4. Introduction to Corridor Modeling
5. Superelevation
6. Proposed Terrain Model Creation
7. Placing Named Boundaries (Profiles and XS)
8. Template Creation
9. Corridor Modeling Advanced Tools
10. Additional Design Features

Target Audience:

This course is designed for Project Development staff, or anyone using the modeling tools for highway design.

Pre-Requisites:

- Familiarity with TDOT's design policies, procedures, and standards.
- A working knowledge of Windows 10.
- Fundamentals (ORD) Manual and Survey (ORD) Manual.

Chapter 2. Introduction to the OpenRoads Modeling Workflow

It is important to first understand the basics of the 3D model-centric nature of ORD and where the modeling tools are located. This chapter provides some insight on the roadway **Feature Definitions**, as well as a high-level view of the **OpenRoads Modeling** workflow.

2.1 Objectives

At the conclusion of this chapter, participants will be able to:

1. Locate and navigate the ORD Explorer.
2. Locate the roadway feature definitions and settings.
3. Learn the overall model-centric design workflow.

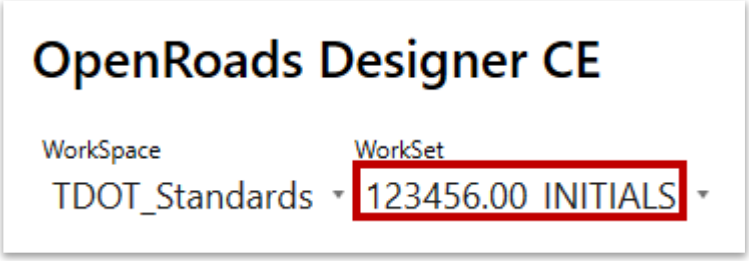
2.2 Exercise: File Creation

In this exercise, we will create a file utilizing the **123456.00_INITIALS** workset, which will then be used to explore the design feature definitions and the OpenRoads Modeling workflow, as well as for the upcoming exercises.

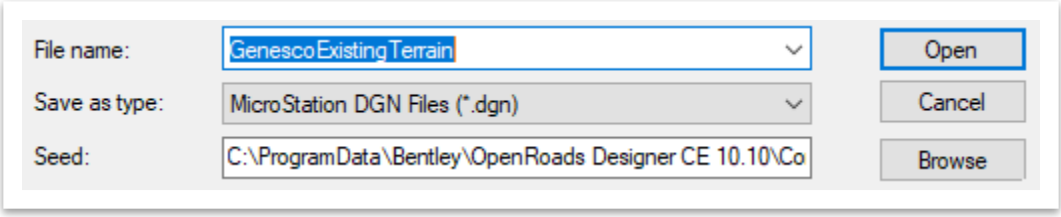
Take Note!

*On an actual project, remember to use the TDOT ORD naming convention when creating **all** design files. The file names used in this manual serve as general guidance for training purposes only. The procedures are intended to teach the necessary tools and TDOT's ORD workspace. For more information, refer to the TDOT ORD File Naming Convention Standards document.*

1. Open ORD from your desktop. The **TDOT_Standards** workspace should still be active after taking the Survey (ORD) training. Go ahead and select your **123456.00_INITIALS** workset created in the Fundamentals (ORD) training, which will be used for the duration of this manual.



2. Create a new file and name it **GenescoExistingTerrain**. Select the **TDOTSeed 3D.dgn** and click **Save**. **Note:** By default, the software should save the file in the workset dgn subfolder: **C:\ProgramData\Bentley\OpenRoads Designer CE 10.10\Configuration\WorkSpaces\TDOT_Standards\WorkSets\123456.00_INITIALS\dgn**.



3. Go ahead and move the provided **class files** to the following location within File Explorer: **C:\ProgramData\Bentley\OpenRoads Designer CE 10.10\Configuration\WorkSpaces\TDOT_Standards\WorkSets\123456.00_INITIALS\dgn**. These files will be utilized later in the manual.

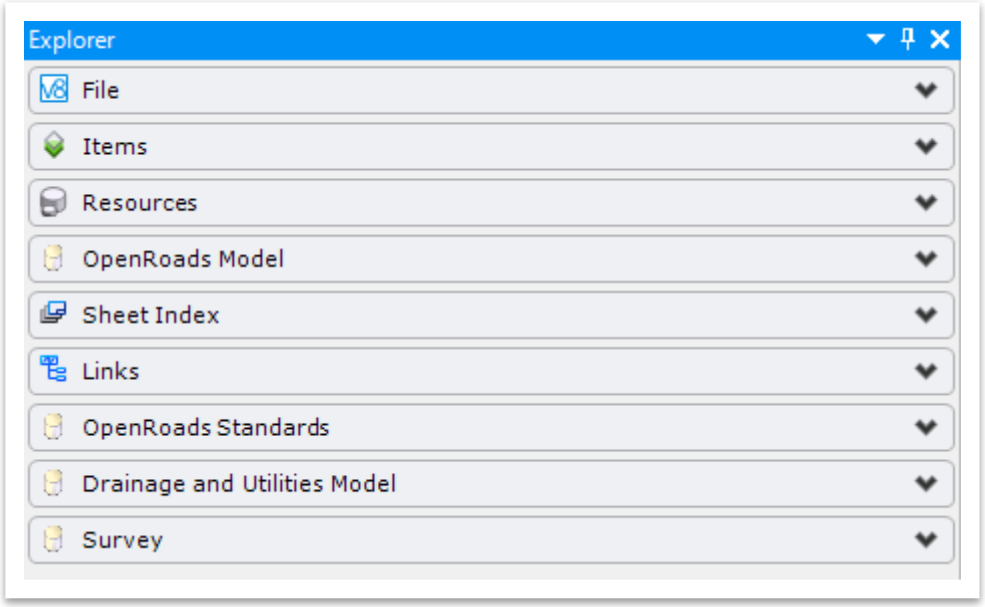
Take Note!

*Any pre-created class file that is opened in this manual will likely yield an alert about not belonging to a workset. Always select your **123456.00_INITIALS** workset and click **Open**.*

2.3 Lecture: Reviewing the ORD Explorer

The **Explorer** (Figure 1) should still be docked but can be opened within the **Primary** tools, if necessary. Refer to the Fundamentals (ORD) Manual for more insight on the **Explorer**. The **OpenRoads Model** and **Sheet Index** tabs will be reference predominantly in this manual and are the primary tabs utilized by roadway designers. Feature Definitions are contained within a library and are part of the overall workspace managed by TDOT CADD support. They cannot be edited, but we will quickly view the categories for the purpose of understanding the organization of design features.

FIGURE 1. EXPLORER TABS



2.4 Lecture: Feature Definitions

Feature Definitions essentially tell the software what each model object represents (e.g., mainline alignment versus sideroad alignment). Each Feature Definition has an associated **Feature Symbology** used to create the civil model both in 2D and 3D. Roadway Feature Definitions have been setup per the **TDOT CADD Standards** for appropriately setting symbology for the TDOT roadway design elements.

There are **13** types of Feature Definitions. Each type is used to control different elements of a civil design model. Table 1 on the next page displays a summary of all the Feature Definitions and their descriptions. TDOT has multiple feature definition libraries for survey, roadway, drainage and utilities. This manual will only cover those applicable to **Design**.

TABLE 1. SUMMARY OF ORD FEATURE DEFINITIONS AND DESCRIPTIONS

Feature Definition Type	Description
Alignment Features	A special type of linear feature used for horizontal and vertical alignments that can be assigned an annotation group. They can also have a template assigned to them to allow the program to automatically create 2D plan view geometry directly from the template.
Terrain Features	Used to allow the user to draw the digital terrain model properties, such as contours and triangles.
Corridor Features	Used to set the settings, which control model density based on stages of the project, such as conceptual, preliminary and final design. They are used to help with computer performance when using large data sets.
Superelevation Features	Used to define the symbology of superelevation objects, such as the setting for superelevation lane lines.
Linear Template Features	Similar to corridor features but used to set up the settings of linear templates.
Surface Template Features	Used by terrain models to draw or not draw the 3D break lines the surface templates used in the civil cells.
Linear Features	Used to define linear objects, such as edges of pavement, sidewalk, guardrail, etc.
Point Features	Used to define point elements, such as right-of-way markers, signs, survey points, etc.
Mesh Features	Used to define the outer surface of 3D solids created by ORD, such as top or bottom of pavement mesh.
Trace Slope Features	Used in tracing a path on a terrain model or mesh surface.
Aquaplaning Features	Also known as hydroplaning, these features control the symbology of both linear (water depth) and surface (delta terrain model) entities.
Sight Visibility	Used in the analysis of sight distance along a corridor.
Survey Features	Used by the survey settings to map physical features picked up in the field by survey staff.

2.4.1 Feature Definition Properties

All Feature Definitions must be given these three properties: **Name**, **Description** and a **Name Seed**. The name seed is the default name for that piece of geometry. If there are multiple elements with the same Feature Definition, the name seed is incremented by **1** with every new element placed. In addition to these three properties, many of the feature definitions may be assigned an **Item Type**. In the current TDOT workspace, some item types have been assigned to a feature definition. Item Types will continually be enhanced to better assist the user with annotation and pay items.

2.4.2 Feature Symbologies

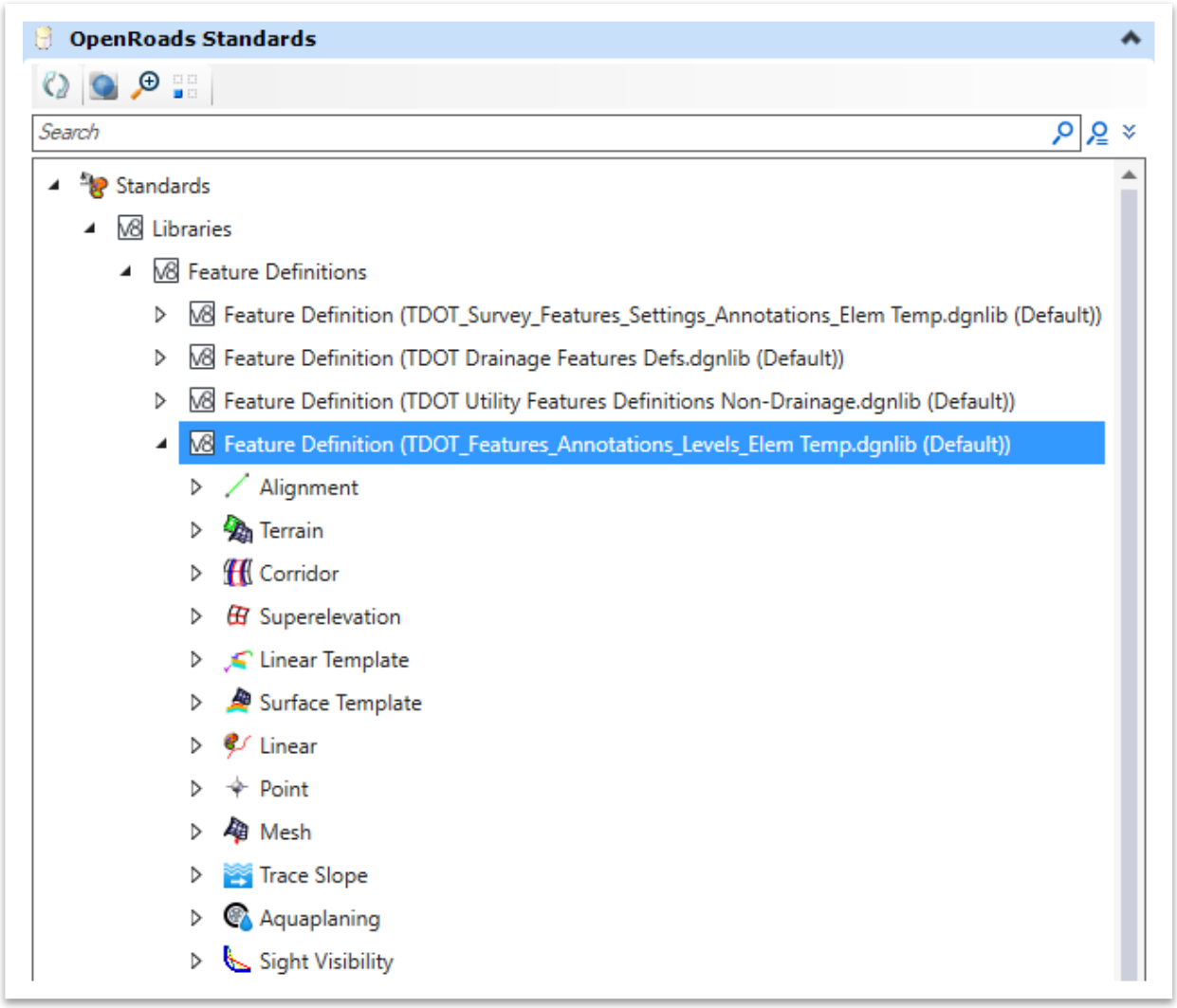
The settings for Feature Symbologies let the software know what element templates to assign to each Feature Definition. These settings determine how each element looks and what level to place the geometry. Depending on the element, there may be a symbology for 2D and/or 3D objects.

2.4.3 Roadway Feature Definitions

Roadway Feature Definitions are located within the **TDOT_Features_Annotations_ Levels_Elem Temp.dgnlib** file.

Within the **Explorer**, you can expand the **OpenRoads Standards** tab and browse to the following location: **Standards >> Libraries >> Feature Definitions >> TDOT_Features_ Annotations_ Levels_Elem Temp.dgnlib** (Figure 2). The feature definitions can be reviewed further if you expand each feature definition type.

FIGURE 2. EXPLORER – OPENROADS STANDARDS – ROADWAY FEATURE DEFINITIONS



Take Note!

A complete list of TDOT's Feature Definitions will be available in the TDOT CADD Standards Manual once completed.

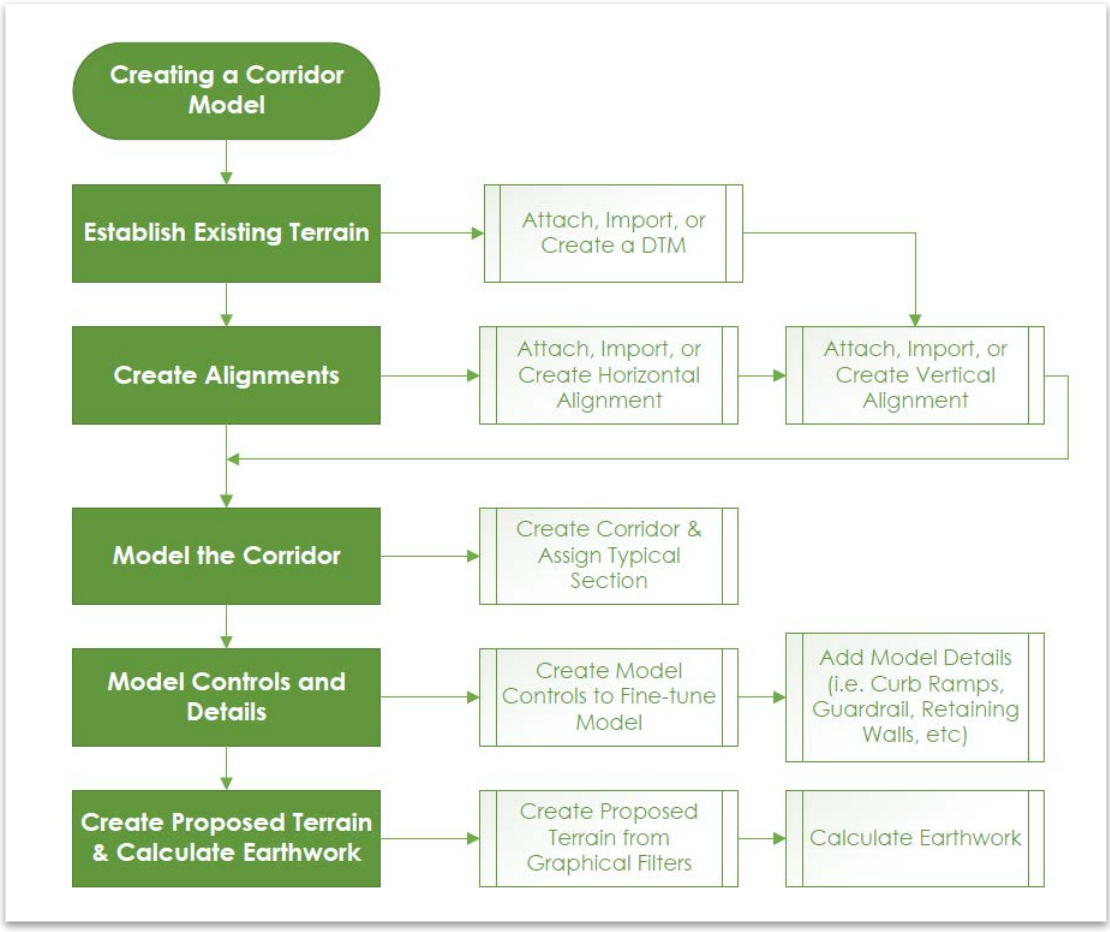
2.5 Lecture: OpenRoads Modeling Workflow

The **OpenRoads Modeling** workflow houses all tools needed for designing a roadway using a model-centric approach (Figure 3).

Regardless of whether it is a new design, or an existing project being converted to ORD, the workflow follows the same general process. Throughout this manual, we will examine each task within the workflow listed below.

1. Import or attach a digital terrain model.
2. Create, import, or attach previously created alignments and profiles.
3. Create a new corridor using TDOT standard templates (ITL).
4. Create model controls and model details.
5. Create a proposed terrain from graphical filters.
6. Calculate earthwork quantities.

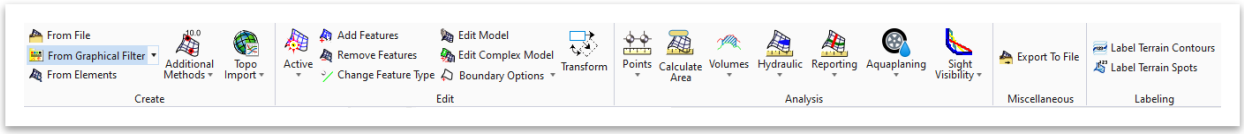
FIGURE 3. MODEL-CENTRIC ROADWAY DESIGN WORKFLOW



2.5.1 Terrain Modeling Tools

The **Terrain** tab houses all tools necessary to create, import, and/or edit digital terrain models (DTM's) (Figure 4). Terrain modeling tools will be covered in Chapter 3.

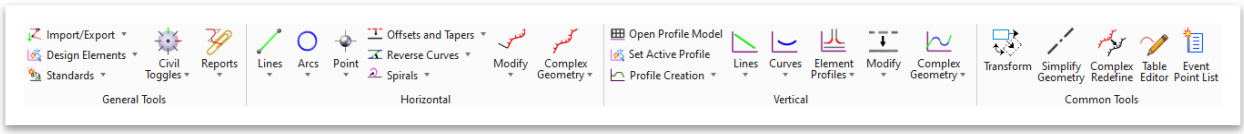
FIGURE 4. TERRAIN TAB



2.5.2 Geometry Tools

The **Geometry** tab houses all tools necessary to create, import, place, and/or manipulate alignments, profiles, and other smart geometry (Figure 5). All geometry placed with these tools is intelligent and can be assigned a feature definition.

FIGURE 5. GEOMETRY TAB

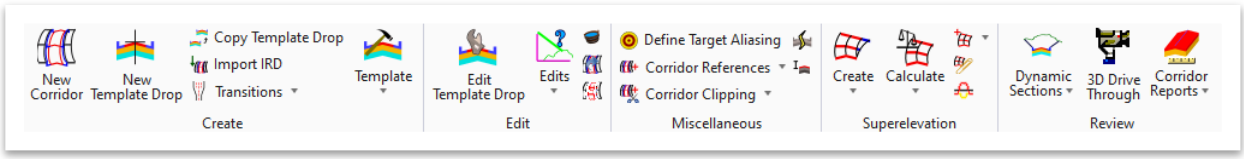


The TDOT modeling tools have been setup to allow the software to draw the plan view geometry automatically for most cases. However, there will be times when you may need to draw plan view geometry using the new civil geometry tools. Civil geometry will be covered in Chapter 4.

2.5.3 Corridor Modeling Tools

The **Corridors** tab houses all tools necessary for creating design models that represent a new roadway (Figure 6). These tools are highly interactive and dynamic. Corridor modeling tools will be covered in Chapters 5, 6 and 10 and Appendix A.

FIGURE 6. CORRIDORS TAB



Take Note!

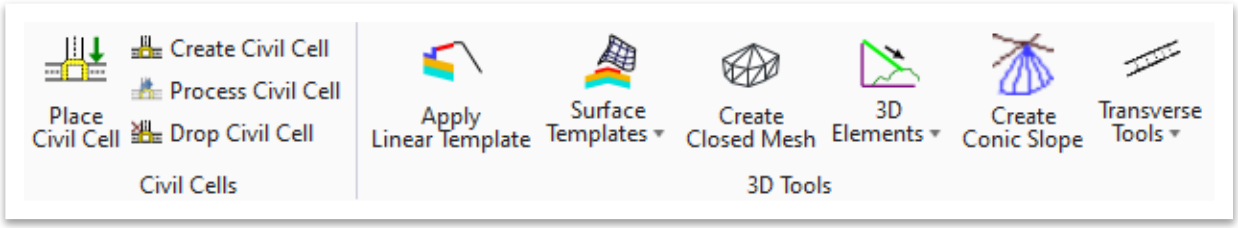
Plan view geometry is not required to exist in order to use the corridor modeling tools. In other words, the modeler will draw the lines in the plan view drawing after the model processes.

Make sure that a terrain, alignment and profile have been created before trying to create a corridor.

2.5.4 Model Detailing Tools

The **Model Detailing** tab houses additional 3D modeling tools that are used to augment corridor modeling (Figure 7). These tools include Civil Cells, Apply Linear Template, Apply Surface Template, Create Closed Mesh, and 3D Element tools. Model Detailing tools will be covered in Chapter 9 and Appendix A.

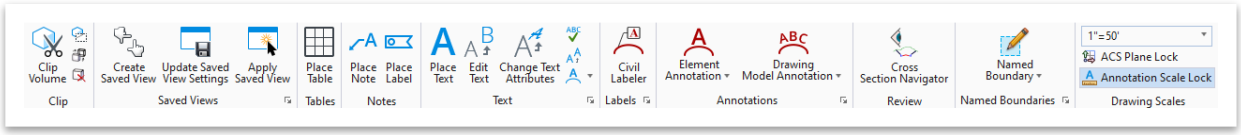
FIGURE 7. MODEL DETAILING TAB



2.5.5 Drawing Production Tools

The **Drawing Production** tab houses all tools necessary for sheet creation and annotation, as well as where to manipulate saved views (Figure 8). The software can self-annotate civil geometry using feature definition settings and then update automatically based on the active annotation drawing scale. Annotation tools will be covered in Chapter 4.

FIGURE 8. DRAWING PRODUCTION TAB



Chapter 3. Terrain Models

For an ORD project, the existing digital terrain model (DTM) will be provided by TDOT Survey. However, for projects converting to ORD, it is important for designers to also know how to import existing SS2 terrain models. In addition, terrain model editing will likely be needed at some point during a project.

Take Note!

ORD supports the following file types: XYZ, Lidar, InRoads DTM, GEOPAK TIN, GEOPAK DAT, LandXML, MX, DDF File, TIF File, DTED0 File, DTED1 File, DTED2 File, USG DEM File, Spot Dimap File, Erdas IMG File and MX Genio.

3.1 Objectives

At the conclusion of this chapter, participants will be able to:

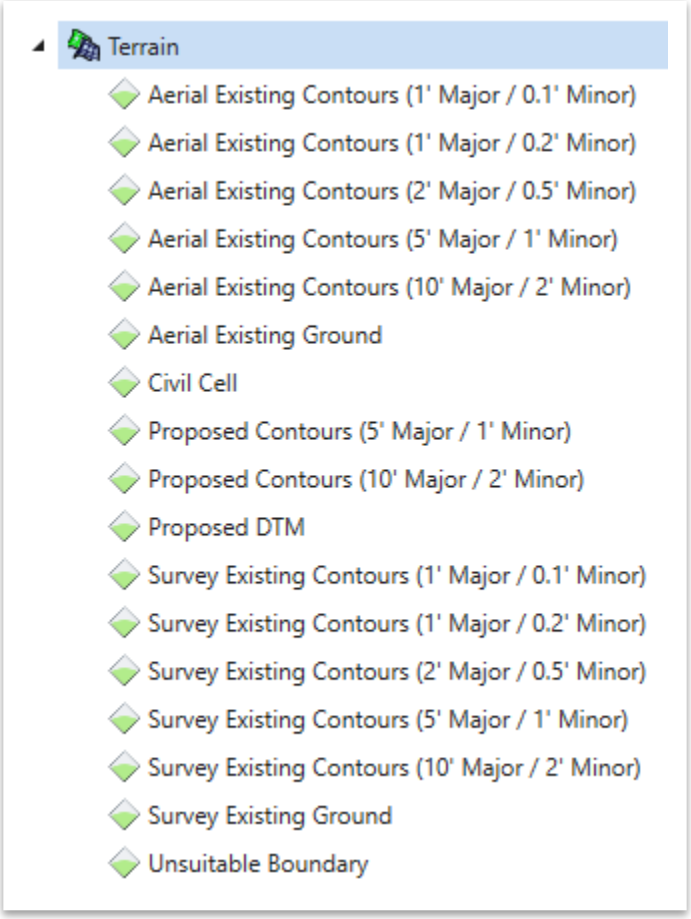
1. Describe and display terrain model properties.
2. Create an existing terrain model via TIN file.
3. Edit a terrain model.

3.2 Lecture: Terrain Feature Definitions and Properties

A **Terrain Model** is a set of 3D triangles mathematically computed from point data collected on the surface that is being modeled. Terrain Models are used to define regular and irregular surfaces (e.g., proposed finished grade, subsurface layers). In ORD, these models are recognized as **civil elements** within the drawing and represent the TIN. The Civil or Digital Terrain Model (DTM) is no longer an external file and can be referenced (e.g., attached) like any other design file. The DTM resides within the DGN file along with all its properties.

DTM's must be assigned a **Terrain** feature definition per TDOT standards to display the feature symbologies (e.g., contours, triangles, etc.). All terrain models created from field surveys should be set to **Survey Existing Ground**. Aside from Civil Cell, the TDOT workspace has **16** Feature Definitions available (Figure 9). Each feature definition has been setup with specific terrain settings for contours and triangles, as well as other elements.

FIGURE 9. TERRAIN FEATURE DEFINITIONS



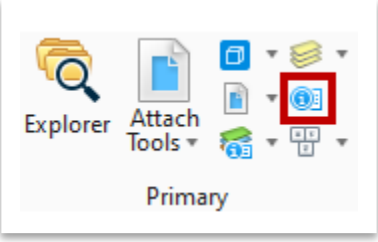
All terrain feature definitions have been setup to show the **boundary** and **triangles** by default, to allow for triangular editing tools to work properly. However, the user may turn on/off any property once the terrain has been created (e.g., major/minor contours).

In ORD, existing ground profiles and cross sections are children of the terrain model. This results in the software plotting/displaying the original ground line for profiles and cross sections using the terrain feature symbology.

3.2.1 Terrain Model Properties

After selecting the terrain boundary, its **properties** can be accessed via the heads-up display or within the **Primary** tools in the ribbon (Figure 10). The key terrain model properties will be examined in the upcoming sections.

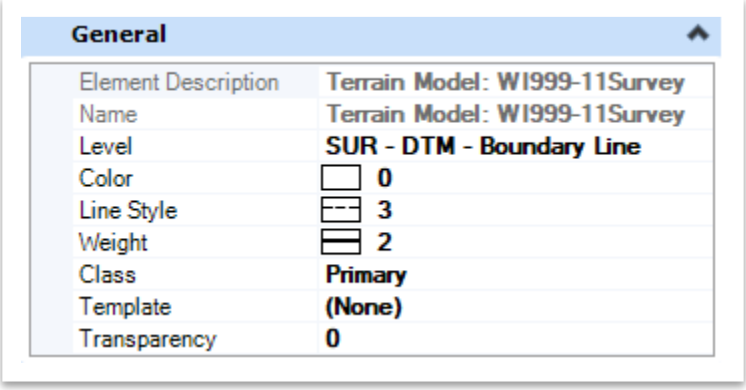
FIGURE 10. PROPERTIES TOOL



3.2.1.1 General

These properties show the name and description of the terrain model, and all the level symbology (Figure 11). It is not recommended to change these properties since they are tied to the feature definition and thus the TDOT standard.

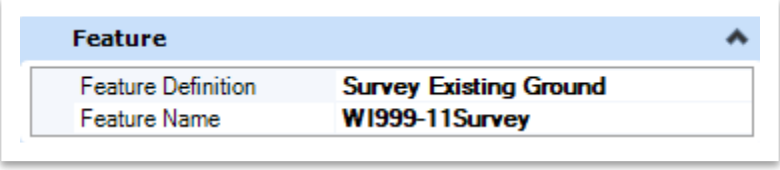
FIGURE 11. TERRAIN PROPERTIES - GENERAL



3.2.1.2 Feature

These properties show the feature definition and name, and allow the user to update both, if necessary (Figure 12).

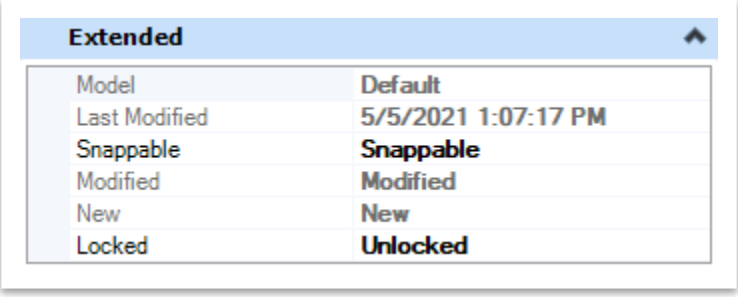
FIGURE 12. TERRAIN PROPERTIES - FEATURE



3.2.1.3 Extended

These properties allow the user to set the terrain to **Snappable** or **Not Snappable** and to **Locked** or **Unlocked** (Figure 13). It is recommended to lock the terrain model to avoid any changes to the original element.

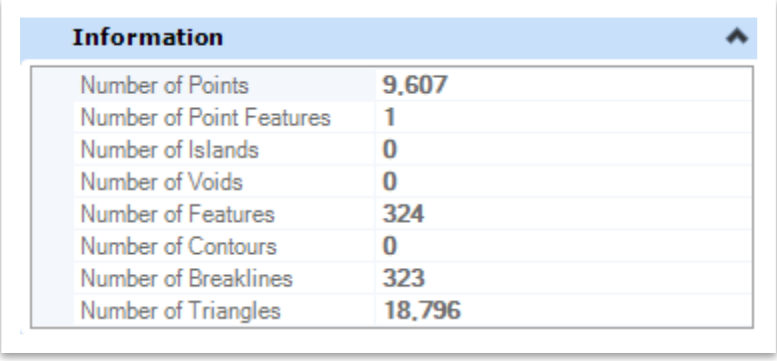
FIGURE 13. TERRAIN PROPERTIES - EXTENDED



3.2.1.4 Information

These properties show a summary of all the components that make up the terrain model (Figure 14).

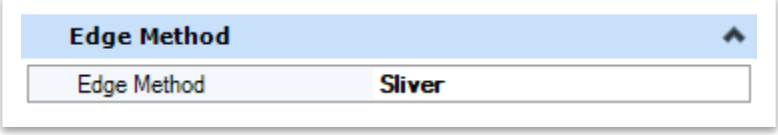
FIGURE 14. TERRAIN PROPERTIES - INFORMATION



3.2.1.5 Edge Method

This property allows the user to determine the triangulation of the DTM (Figure 15). The **Sliver** option dissolves long thin external triangles based on a formula that is hard coded within the software. The other two options are **None** and **Max Edge Length**. The **None** option keeps all external triangles, and the **Max Edge Length** option allows the user to set the maximum length for triangulating around the edge of a DTM.

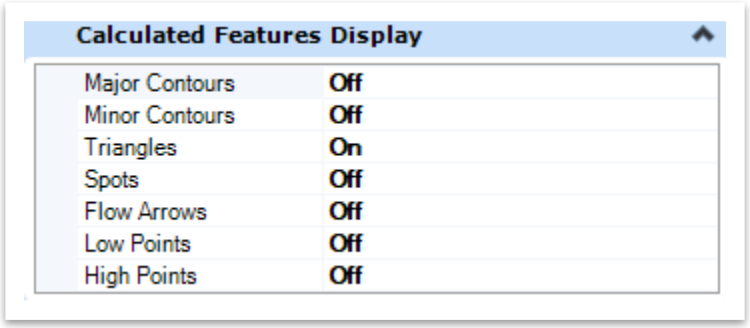
FIGURE 15. TERRAIN PROPERTIES - EDGE METHOD



3.2.1.6 Calculated Features Display

These properties allow the user to turn the display on/off for any features that are calculated from the terrain (Figure 16). In other words, these are features that are not collected in the field.

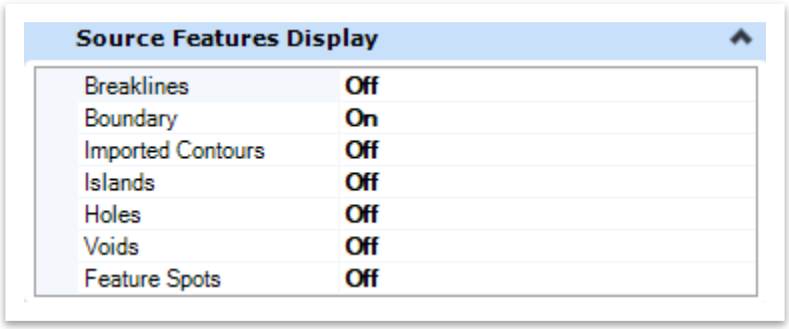
FIGURE 16. TERRAIN PROPERTIES - CALCULATED FEATURES DISPLAY



3.2.1.7 Source Features Display

These properties allow the user to turn the display on/off for any source data, or data that was created/collected in the field by using a survey feature code (Figure 17).

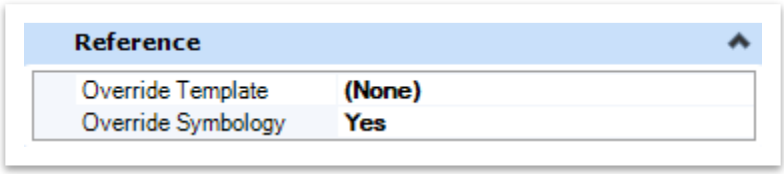
FIGURE 17. TERRAIN PROPERTIES - SOURCE FEATURES DISPLAY



3.2.1.8 Reference

These properties will only show if the terrain is referenced in a design file. The user must set the **Override Symbology** to **Yes** to manipulate the features of that terrain (Figure 18).

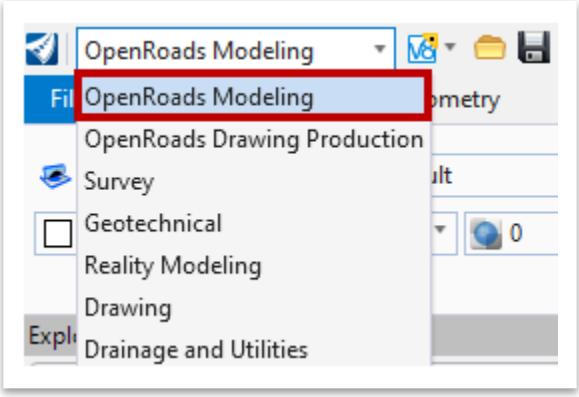
FIGURE 18. TERRAIN PROPERTIES - REFERENCE



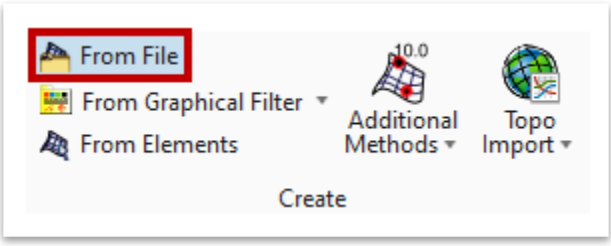
3.3 Exercise: Terrain Model Creation – TIN File

In this exercise, we will create a terrain model from a TIN file that will be applied throughout this manual. We will continue to utilize the same **GenescoExistingTerrain .dgn** file. **Note:** Refer to Chapter 3 in the Survey (ORD) Manual for other methods of terrain creation.

1. Make sure that the **OpenRoads Modeling** workflow is selected in the upper left corner of the ORD interface, which will be used throughout this manual.

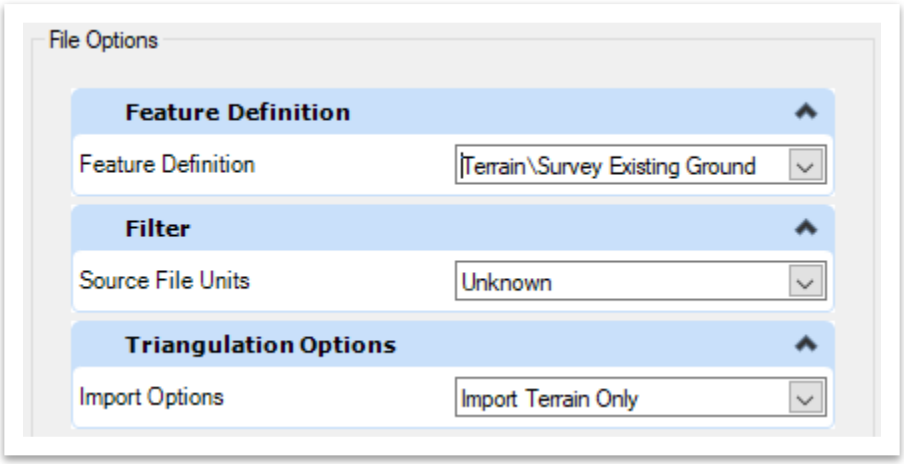


2. Click **Fit View** and notice the embedded survey data text. This is seen because the **TDOTSeed3D** file was utilized. Go ahead and delete all survey data, which is on the three **SUR** levels below, since it is not applicable for this file.
   - SUR - CTRL - Text
   - SUR - Project Information and Notes
   - SUR - UTL - Owners
3. Open the **From File** tool (**OpenRoads Modeling >> Terrain >> Create**).

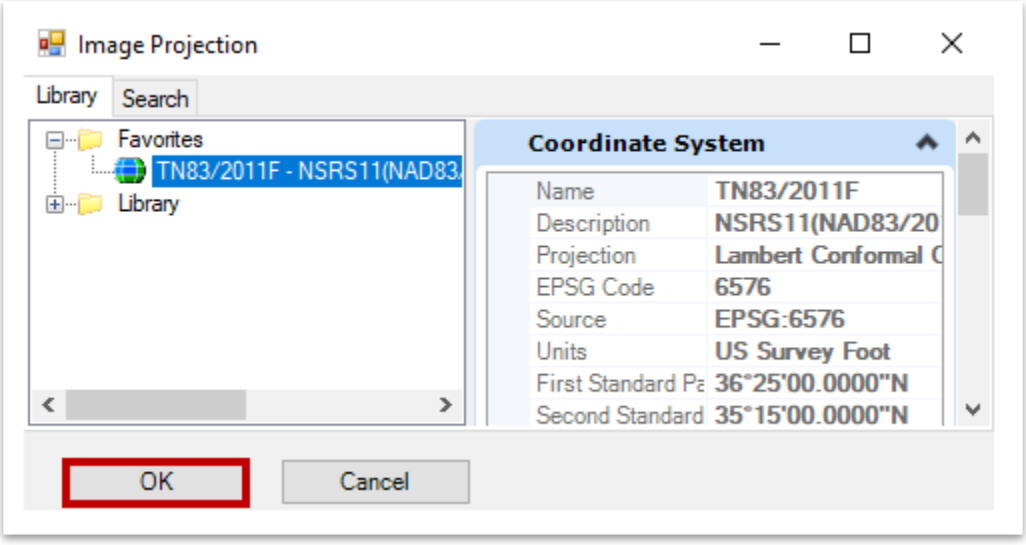


4. Select the **WI999-11Survey.tin** file within your **123456.00_INITIALS** workset dgn subfolder and click **Done**.

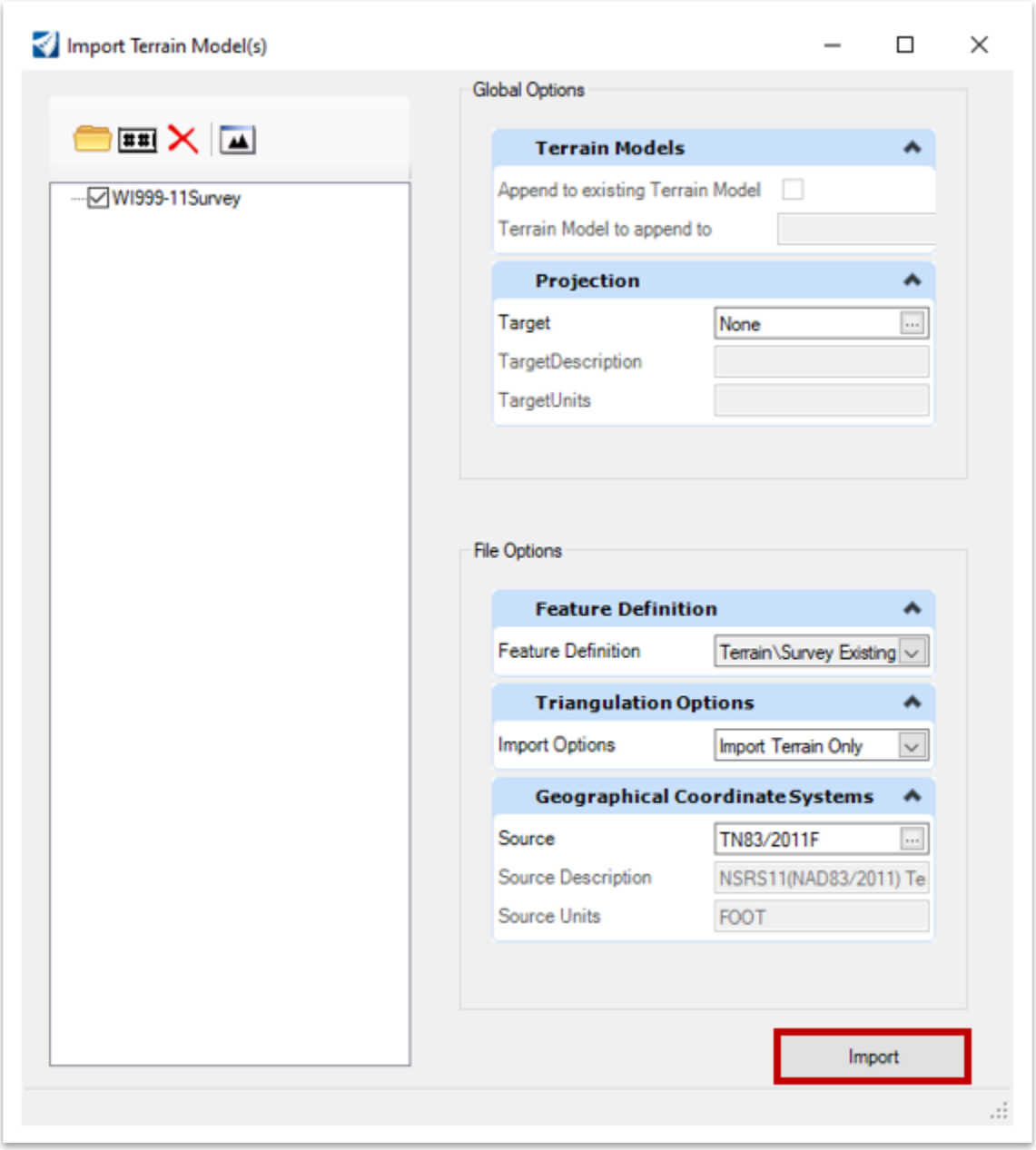
5. Under **File Options**, select the following settings.
    a. **Feature Definition:** Terrain\Survey Existing Ground
    b. **Source File Units:** Leave as-is. This field will take care of itself and disappear once the geographic coordinate system is selected in the next step.
    c. **Import Options:** Import Terrain Only



6. Under **Geographical Coordinate Systems**, click the ellipses next to the **Source** field. You should already have the correct coordinate system saved as a Favorite (**TN83/2011F – NSRS11 (NAD83/ 2011) Tennessee State Plane Zone, US Foot**). If not, you can browse to it here: **Library >> Projected (northing, easting, …) >> North America >> United States of America >> Tennessee**. Once selected, click **OK**.



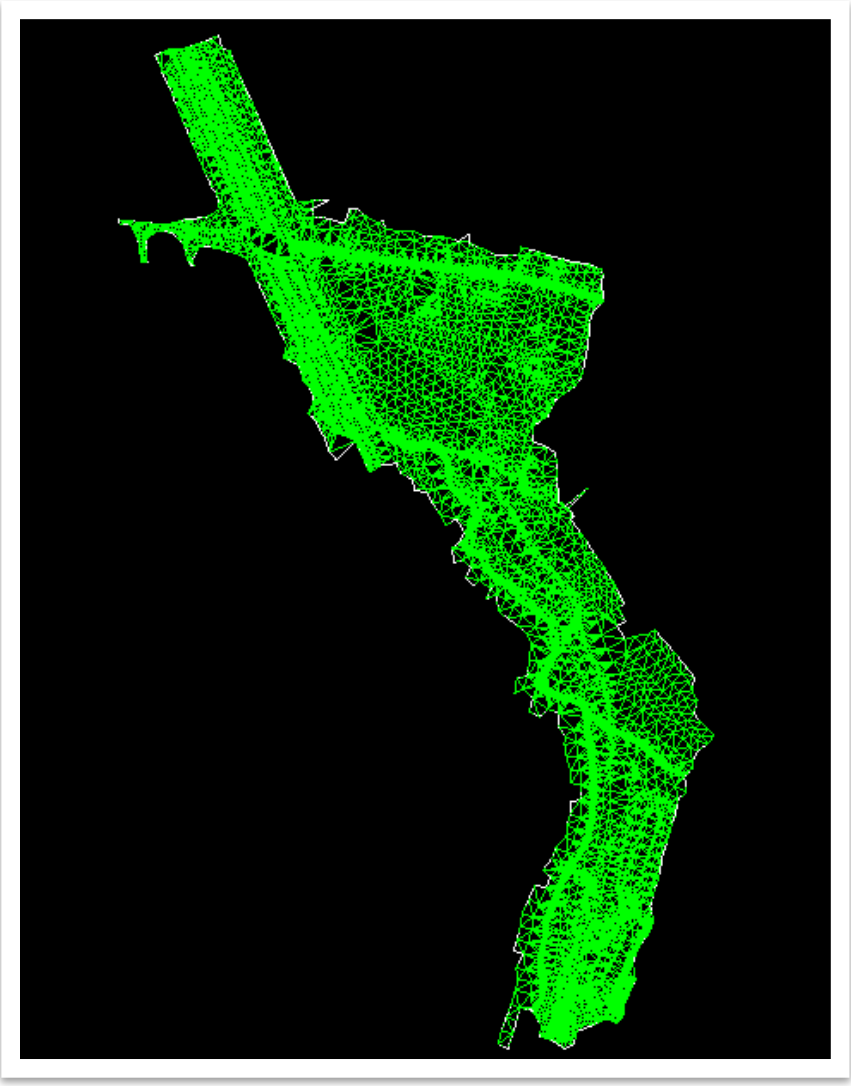
7. Next, click **Import** and then close the **Import Terrain Model(s)** dialog box once processed. **Note:** By selecting a Geographic Coordinate System, notice the **Source File Units** field disappeared. If no coordinate system was selected, then you would have filled in the field with **US Survey Feet**.



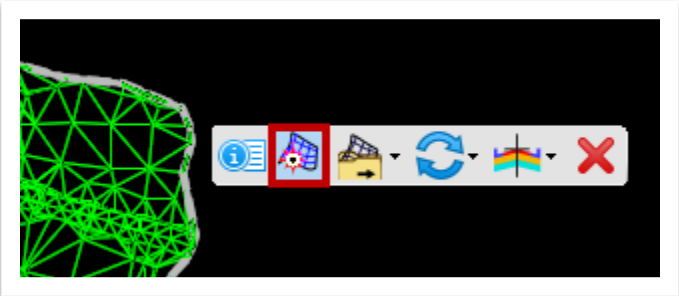
Take Note!

Do not *set a projection target for your TIN models or other DTM's. You only need to set up the Geographic Coordinate System, which will allow you to exchange data with GIS applications, such as ArcGIS and Google Earth.*

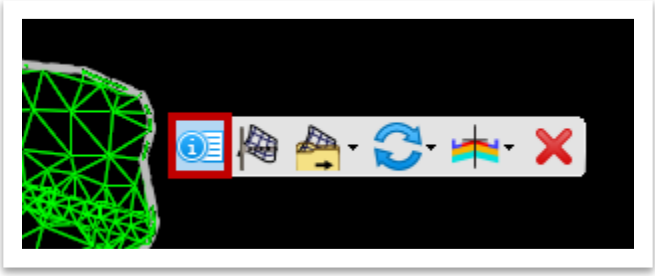
8. Click **Fit View** and review the model. It should look like the image below.



9. Left click on the terrain boundary and then hover over the boundary to see the heads-up display. Select **Set As Active Terrain Model** (highlighted in red) to activate the terrain model.



10. Open the heads-up display for the terrain boundary once again and this time, select **Properties** (highlighted in red).



11. Within the **Properties**, you can change what features are displayed. Go ahead and turn off the triangles for now and turn on both the **Spots** and **Breaklines**.

Name	Active Terrain Model: WI9
Number of Points	9,607
Number of Point Featu	1
Number of Islands	0
Number of Voids	0
Number of Features	324
Number of Contours	0
Number of Breaklines	323
Number of Triangles	18,796
Edge Method	Sliver
Major Contours	Off
Minor Contours	Off
Triangles	Off
Spots	On
Flow Arrows	Off
Low Points	Off
High Points	Off
Breaklines	On
Boundary	On
Imported Contours	Off
Islands	Off
Holes	Off
Voids	Off
Feature Spots	Off
Feature Definition	Survey Existing Ground
Feature Name	WI999-11Survey

12. The resulting terrain should look like the image below.

13. Once you have reviewed the terrain, turn off both the **Spots** and **Breaklines**, leaving just the terrain boundary visualized.

3.4 Lecture: Editing Terrain Tools

The **Edit Terrain** model tools can only be used with terrains imported using the create **From File** option (TIN, LandXML, point clouds, digital elevation models, etc.) (Figure 19).

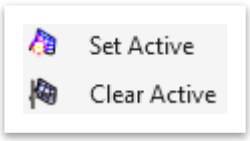
FIGURE 19. EDIT TERRAIN TOOLS

Take Note!

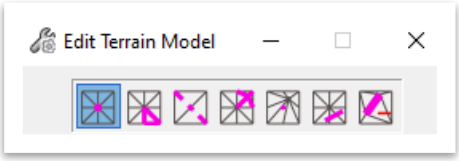
*Terrains created from survey field books **are not** editable unless the processing rules are **deactivated**. Either the survey data is editable (e.g., field codes, 3D geometry) or the terrain is editable, but not both.*

Once survey processing rules are deactivated, the terrain model will become editable. However, if the survey processing rules are activated again, all terrain edits will revert to the original survey data processed terrains.

Set/Clear Active: The most common editing terrain tool is the Set/Clear Active. This tool will allow the user to set or clear the DTM as the active terrain. An active terrain is required to cut existing profiles and create corridor designs.

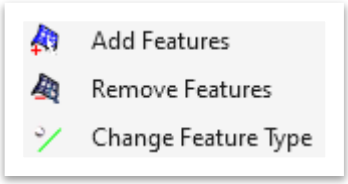


Edit Model: Opens the **Edit Terrain Model** tools, which allow the user to delete vertex or edge triangle, swap line, insert or move vertex, delete triangle by line and delete by feature.

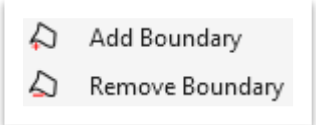


Edit Complex Model: Allows the user to edit a complex model by merging and appending individual terrains and adding or removing individual DTM components.

Feature Management Tool: Allows the user to add, remove or change feature types (e.g., breaklines or points). For example, if the user created a terrain using spot features with the create **From Elements** tool, the feature management tool can be opened to add breakline features to the terrain.



Boundary Options Tool: Allows the user to either add or remove a terrain boundary.

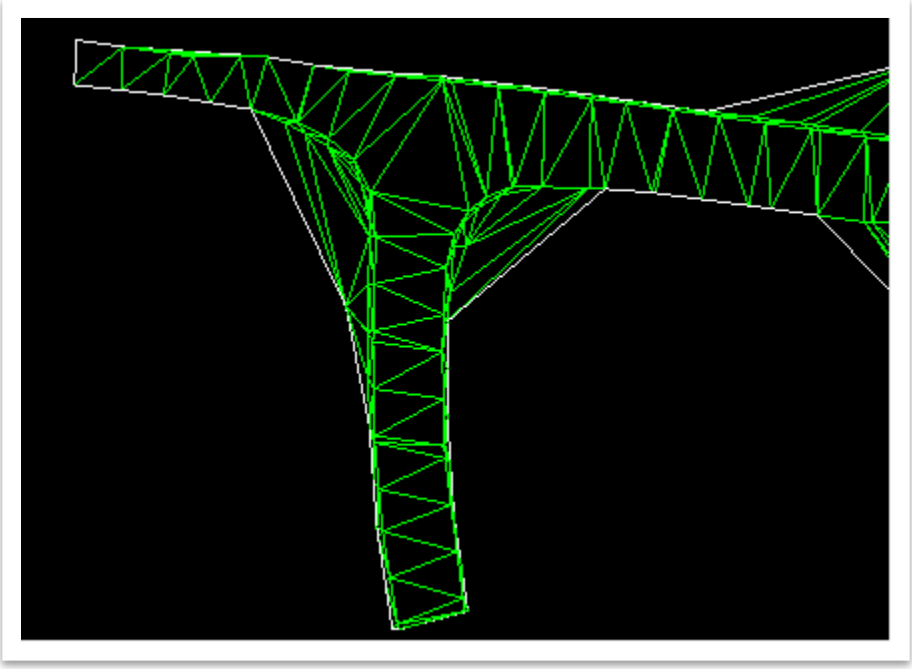


Transform Tool: Allows the user to transform a terrain to different projections and adjustments. This tool is used more for Survey.

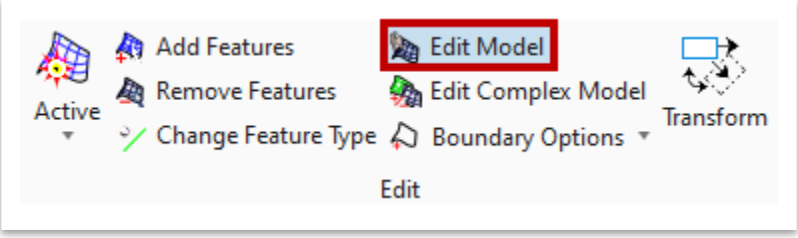
3.5 Exercise: Edit the Terrain

In this exercise, we will edit the terrain by deleting a vertex. We will continue to utilize the same **GenescoExistingTerrain.dgn** file.

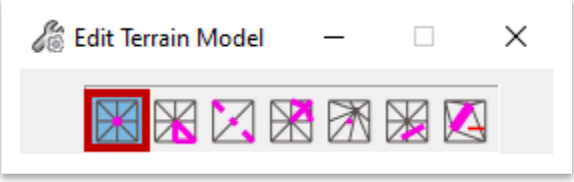
1. Zoom in to the upper left corner of the terrain where the T-intersection is located. Select the terrain boundary and open the **Properties**. Toggle the **Triangles** field back **On**.



2. Open the **Edit Model** tools (**OpenRoads Modeling >> Terrain >> Edit**) and notice a toolbar appears.

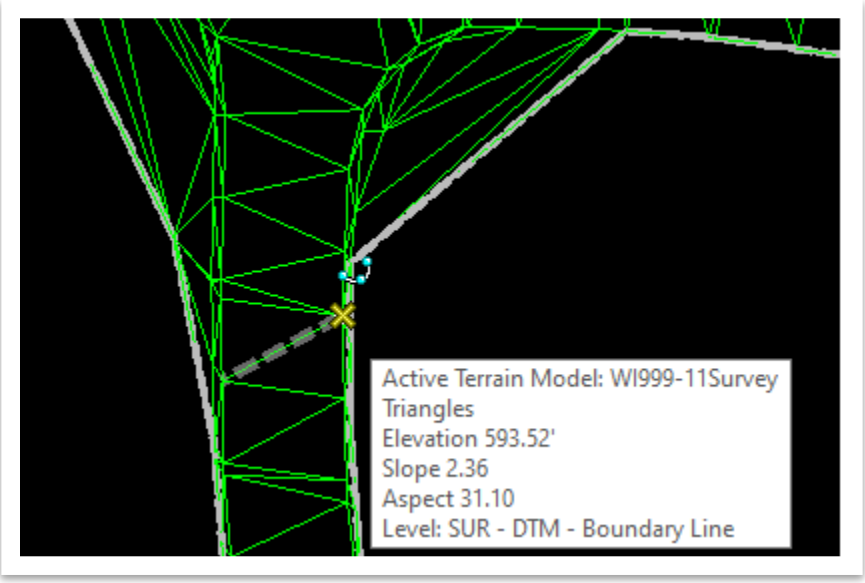


3. Within the **Edit Terrain Model** tools, select the first icon (**Delete Vertex**).

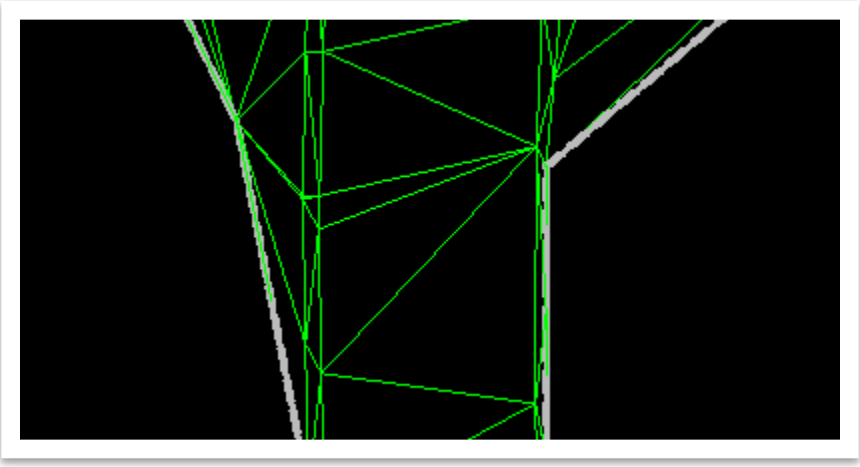


4. Notice the prompt in the lower left corner: **Select Terrain Model**. Select the terrain boundary or anywhere within the mesh.

5. Notice the next prompt in the lower left corner: **Accept Vertex/Reset to Select Terrain**. This prompt is asking to select what vertex you want to delete. Left click on any vertex. **Note:** You don't have to select the same vertex as shown in the image below.



6. Notice that the triangulation automatically updates after deleting the vertex. Hit **ESC** to clear the tool. **Note:** If ESC does not clear the tool, right click.



Take Note!

*All other **Edit Terrain Model** tools will work the same way, so we will move on to the next chapter. Most likely, these tools will not be used very often as the terrains are generated from the field books. However, designers may need to make some manual terrain edits when merging a proposed terrain within an existing terrain. Feel free to try the other terrain editing tools following Steps 3-6.*

Chapter 4. Civil Geometry Tools and Annotation

The Civil Geometry tools are located under the **Geometry** tab in the OpenRoads Modeling workflow. These are the necessary tools to create, import, place and/or manipulate alignments, profiles and other smart geometry. All geometry placed with these tools are intelligent and can be assigned a Feature Definition.

All **Civil Geometry** (e.g., points, lines, curves, alignments) is stored within the drawing elements themselves, so there is no need for any external files. Civil geometry is dynamic, interactive, and rules-based, which means all components are associated and preserve the original design intent. For example, an alignment will likely contain several points and curves. If a point moves or if a curve radius changes, the alignment automatically adjusts to reflect the change.

4.1 Objectives

At the conclusion of this chapter, participants will be able to:

1. Create civil geometry using Civil AccuDraw.
2. Import and edit civil geometry.
3. Annotate a proposed alignment.
4. Place intelligent labels.
5. Create different reports for civil geometry.

4.2 Lecture: Feature Definitions

All civil geometry should be assigned a **Feature Definition**. Feature definitions are the standards that let the software know the feature that the civil geometry represents (alignment, profile, edge of pavement, etc.). The Feature Definition also sets all the TDOT standard symbology and is directly linked to automatic annotation (e.g., stationing of an alignment). The user can simply assign the Feature Definition when creating the geometry, and ORD will apply the correct attributes (level, color, line style (or cell in the case of a point) and line weight).

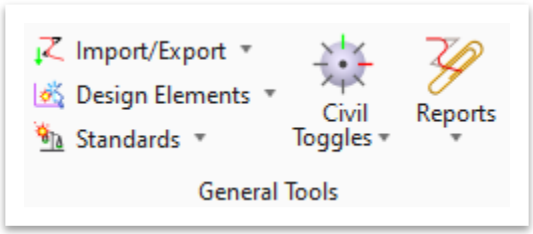
Take Note!

*Civil geometry can either be in the form of **point** or **linear** features. A feature is anything that can be seen or located and is a physical part of the design representing a real-world entity.*

4.3 Lecture: General Tools

The **General Tools** contain many tools that are used in combination with other tools in the ribbon and provide options for more accurate and precise models (Figure 20). We will only discuss the tools that are applicable to roadway design.

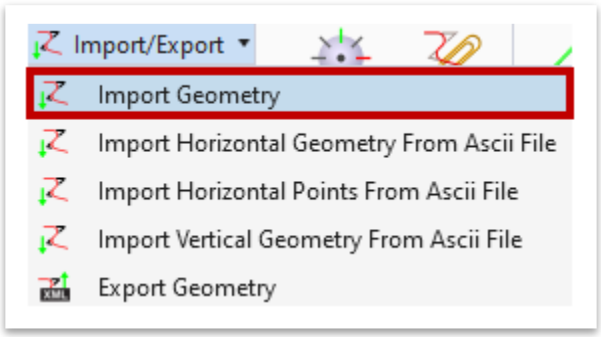
FIGURE 20. GENERAL TOOLS



4.3.1 Import/Export

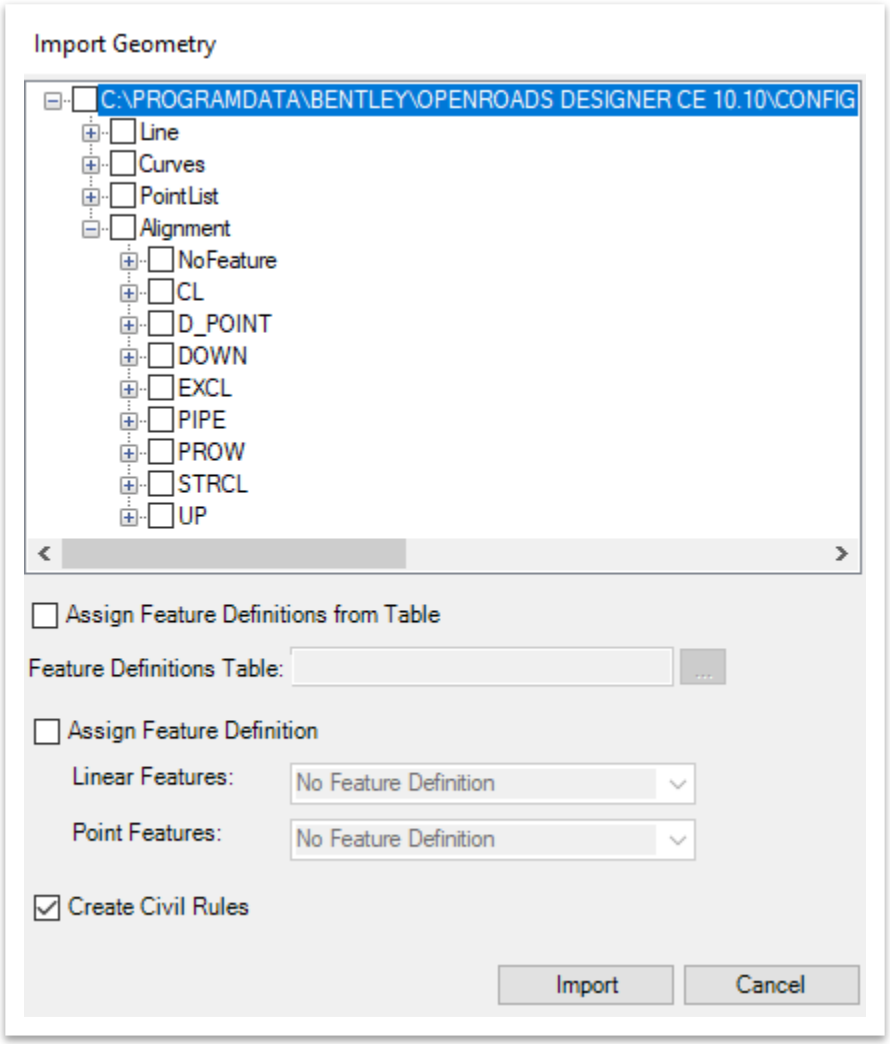
The **Import/Export** tools allow the user to import alignments and profiles from various sources and then export out of ORD. The **Import Geometry** option (Figure 21) allows importing from a GPK and LandXML and will be necessary when converting an existing SS2 project to ORD.

FIGURE 21. IMPORT/EXPORT TOOLS – IMPORT GEOMETRY



Within the **Import Geometry** dialog box, it is important to expand all boxes, as necessary, to import both horizontal and vertical geometry for a given alignment (Figure 22). In this chapter, we will first create an alignment utilizing the horizontal tools and then show how to import geometry.

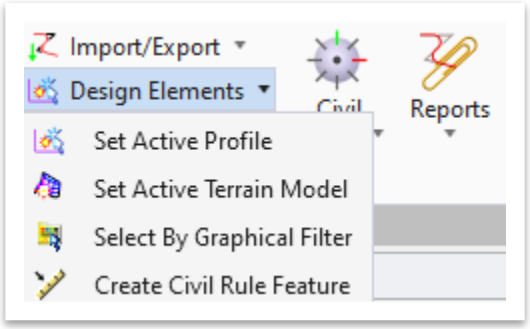
FIGURE 22. IMPORT GEOMETRY DIALOG BOX



4.3.2 Design Elements

The **Design Elements** tools allow the user to set active profiles and terrain models, select by graphical filter and create civil rules (Figure 23). The **Select By Graphical Filter** tool allows the user to select elements by specific Graphical Filters, which are used in design when creating proposed models, and will be covered in Chapter 7. The **Create Civil Rule Feature** tool gives the user the flexibility to assign civil geometry rules to elements that were created with basic Microstation tools, such as **Place Line**.

FIGURE 23. DESIGN ELEMENTS TOOLS



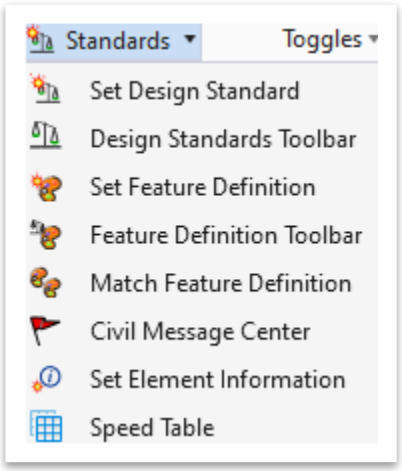
Take Note!

*Geometry created with non-civil tools **will not** have any intelligence and **will not** be recognized by any of the tools covered in this chapter, unless assigned a feature definition and civil geometry rules.*

4.3.3 Standards

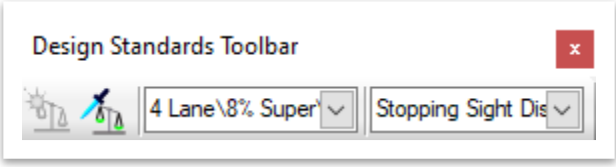
The **Standards** tools allow the user to set Feature Definitions and Design Standards and open the corresponding toolbars (Figure 24). The different options will be explained further below.

FIGURE 24. STANDARDS TOOLS



- **Set Design Standard:** Allows the user to apply the active design standard to an element. TDOT does not recommend using the design standard when designing vertical alignments because it is difficult to set a vertical curve by length.
- **Design Standards Toolbar:** Allows the user to set and then monitor geometric parameters as required by **TDOT** or **AASHTO** standards, such as minimum curve radius, K values for vertical curves, stopping sight distance, and profile grades based on design speeds (Figure 25). These standards are stored in a design library (dgnlib) and are part of the TDOT workspace.

FIGURE 25. DESIGN STANDARDS TOOLBAR

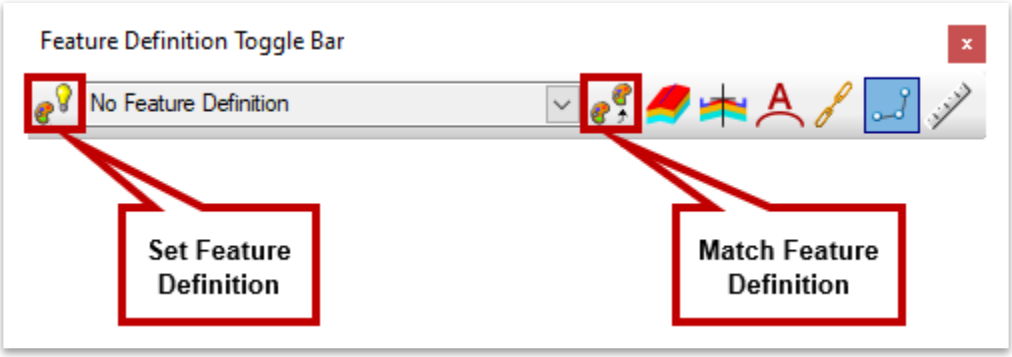


Take Note!

*The default AASHTO standards automatically create spirals at and above **50 MPH** design speeds. Default values such as max tangent length, radius and spirals will apply when drawing an alignment if the active design is set. An alignment will not change if a design standard is applied after an alignment is drawn.*

- **Set Feature Definition:** Allows the user to assign a feature definition to a civil geometry element or change an already assigned feature definition.
- **Feature Definition Toolbar:** Houses several key tools used to set and match feature definitions in addition to accessing other tools (Figure 26).

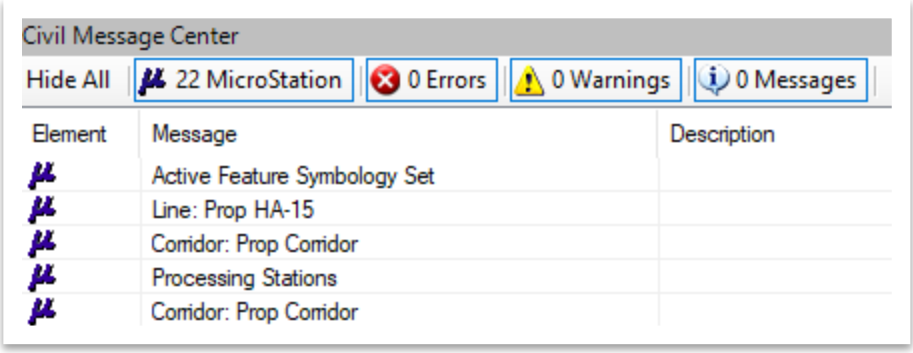
FIGURE 26. FEATURE DEFINITION TOOLBAR



- **Match Feature Definition:** Allows the user to match one element's feature definition attributes to another in the drawing.

- **Civil Message Center:** Opens a window with a list of ORD messages related to recent actions performed by the user (Figure 27). This can be useful for viewing errors in construction or design standards that have been violated.

FIGURE 27. CIVIL MESSAGE CENTER

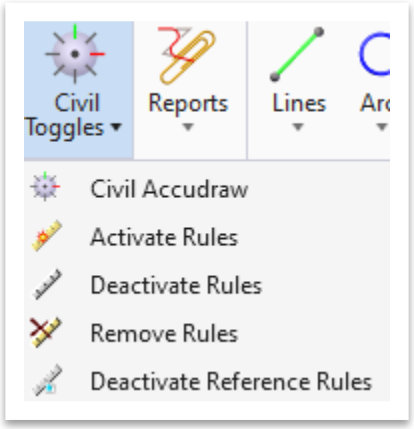


- **Set Element Information:** Allows the user to add a personal note to an element in the drawing.
- **Speed Table:** Creates a table of speeds and grades for alignments with multiple design speeds.

4.3.4 Civil Toggles

Geometry Civil Toggles can be helpful for quickly changing the way ORD behaves, allowing the user to spend less time adjusting settings (Figure 28).

FIGURE 28. CIVIL TOGGLES

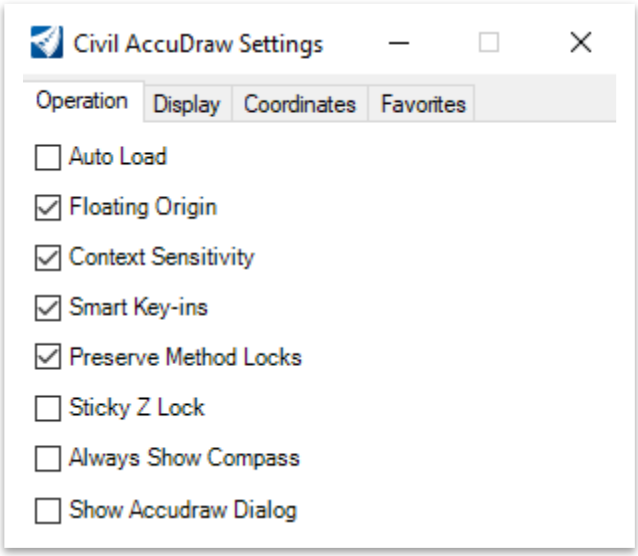


- **Civil AccuDraw:** Tools allowing the user to define elements by precise inputs (Figure 29). **Note:** You will only see the two options highlighted in red if you are using a **3D** seed.

FIGURE 29. CIVIL ACCUDRAW TOOLS

  - **Settings:** Allow the user to alter the look and feel of AccuDraw as well as the coordinate system (Figure 30). A list of shortcut key-ins can be accessed under the **Display** tab within the Civil AccuDraw Settings. To set Settings, go to the second icon in the Civil AccuDraw toolbar.

FIGURE 30. CIVIL ACCUDRAW SETTINGS



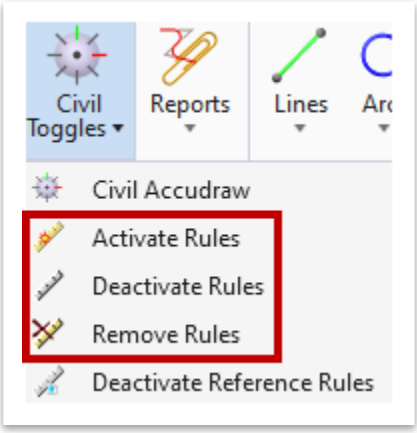
  - **Tools:** To activate/deactivate Civil AccuDraw, select the first icon. We will utilize some of these tools in the next exercise and explain in depth throughout this chapter.

Take Note!

Civil AccuDraw tools are intended to be used in combination with placing horizontal or vertical civil geometry. ***Civil AccuDraw CANNOT be running at the same time as Regular AccuDraw****, so make sure to deactivate regular AccuDraw before enabling Civil AccuDraw.*

- **Activate/Deactivate/Remove Rules:** The user can activate or deactivate rules to toggle whether manipulators are available for editing on selected elements (Figure 31). Rules can also be completely removed.

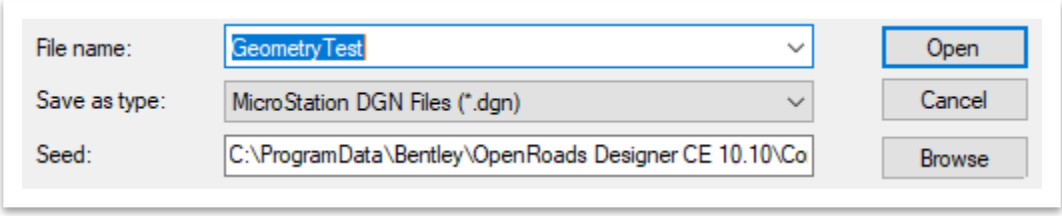
FIGURE 31. ACTIVATE/DEACTIVATE/REMOVE RULES



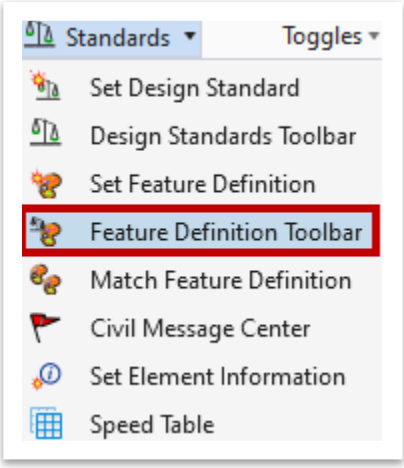
4.3.5 Exercise: Using Civil AccuDraw

In this exercise, we will create basic geometry utilizing some of the Civil AccuDraw tools.

1. Create a new file and name it **GeometryTest**. Select the **TDOTSeed2D.dgn** and click **Save**.

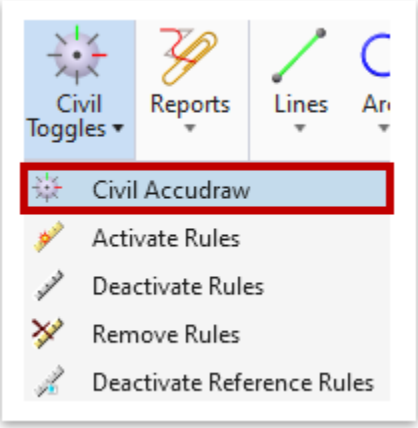


2. We will first set the active feature definition. Open the **Feature Definition Toolbar** (**OpenRoads Modeling >> Geometry >> General Tools >> Standards**) and then go ahead and dock it.

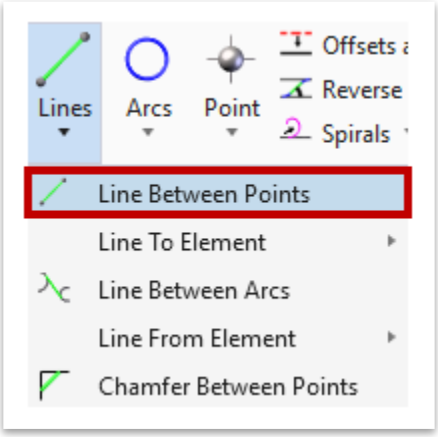


3. Select the following feature definition: **Alignment >> Prop HA Mainline**. Then, toggle on **Use Active Feature Definition** (highlighted in red).

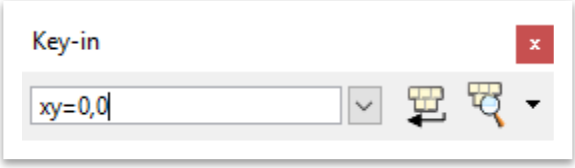
4. Go ahead and turn on **Civil AccuDraw** (**OpenRoads Modeling >> Geometry >> General Tools >> Civil Toggles**) and then select the **Distance-Direction** option within the **Civil AccuDraw** toolbar.



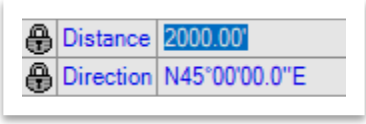
5. Next, open the **Line Between Points** tool (**OpenRoads Modeling >> Geometry >> Horizontal >> Lines**).



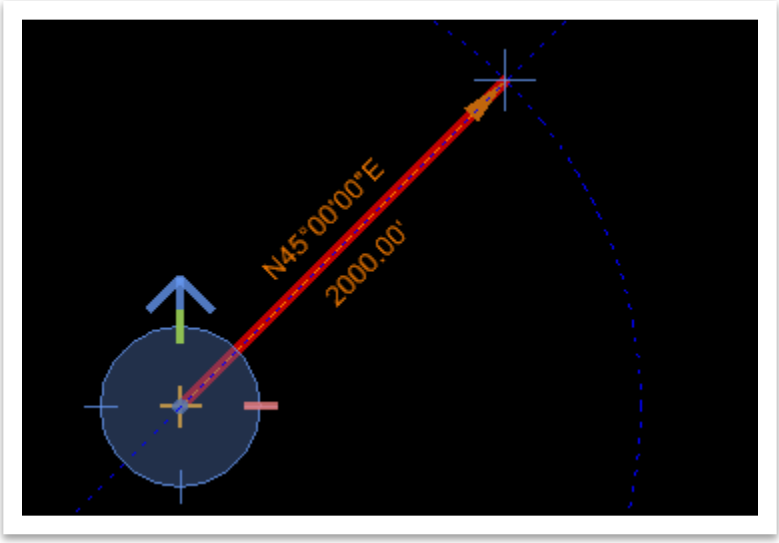
6. Open the **Key-in** tool (**OpenRoads Modeling >> Home >> Primary >> More**) and key-in **xy=0,0** and then hit **Enter**. This will set the starting point of the line.



7. Key-in a **Distance** of **2000.00'** and a **Direction** of **N45°00'00.0"E** (or key-in N45E) and then hit **Enter** to lock them in. **Note:** To toggle between fields, hit the **Tab** button.

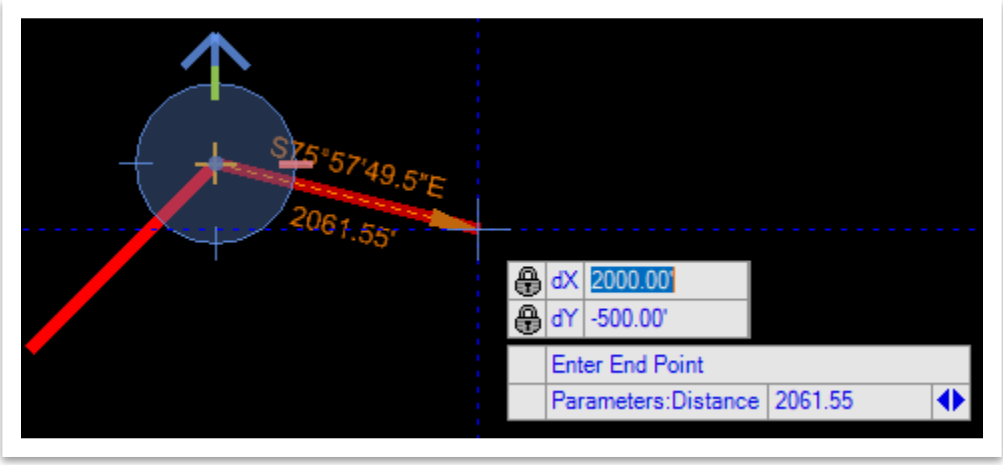


8. Left click anywhere within the drawing window to accept placement. Notice the symbology of the line. It represents a standard TDOT mainline centerline, since we had set the active feature definition in Step 3.

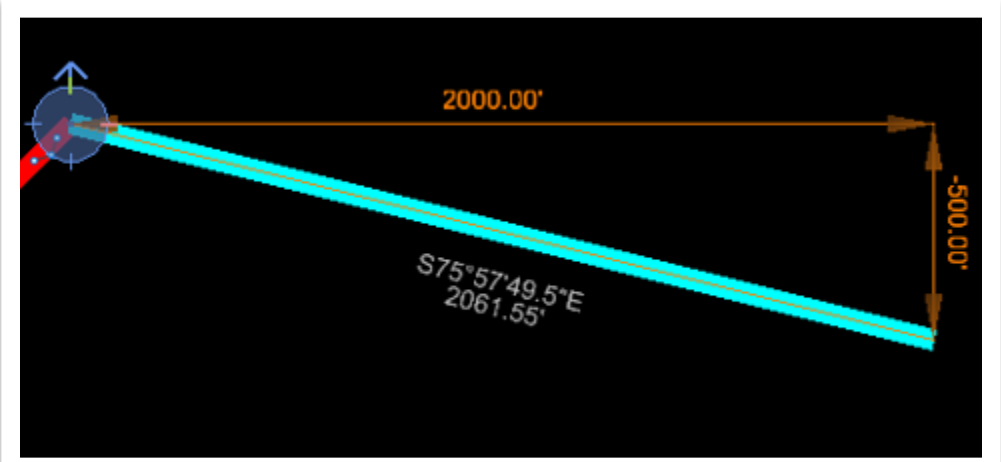


9. Now, switch to the **DX DY** option within the **Civil AccuDraw** toolbar.

10. With the **Line Between Points** tool still active, snap to the end of the first line and then key-in a **X Distance** of **2000.00'** and a **Y Distance** of **-500.00'** and then hit **Enter** to lock them in. Left click anywhere within the drawing window to accept placement.

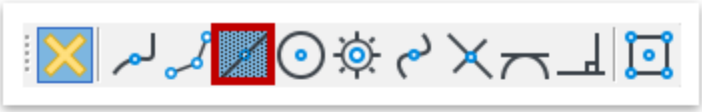


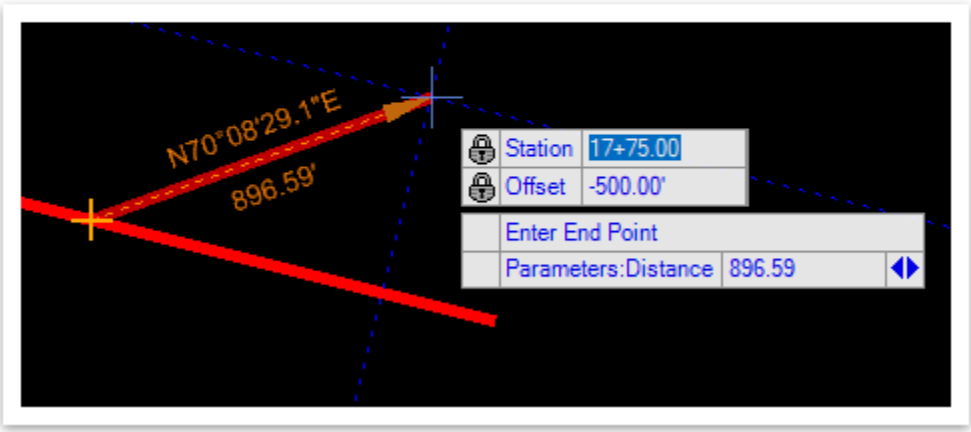
11. If you select the individual line segments, notice that the manipulators (orange text) change based on which Civil AccuDraw option was used to place the line.



12. Next, switch to the **Station-Offset** option within the **Civil AccuDraw** toolbar.

13. With the **Line Between Points** tool still active, toggle on the **Mid Point Snap** (highlighted in red) and then snap to the midpoint of the second line. Key-in a **Station** of **17+75.00** and an **Offset** of **-500.00'** and then hit **Enter** to lock them in. Left click anywhere within the drawing window to accept placement.

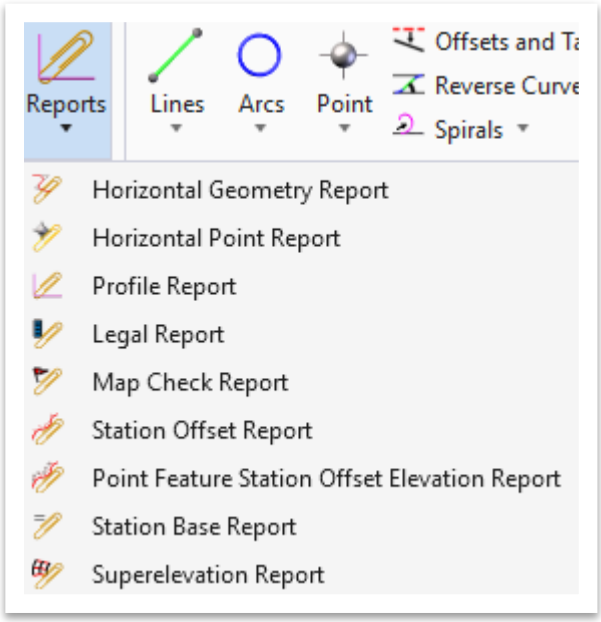




4.3.6 Reports

There are numerous report options within ORD that are available to describe specific information about civil elements and features (Figure 32). The most utilized reports are described below. **Note:** We will create a horizontal and vertical report at the end of this chapter once we have created the alignment and profile.

FIGURE 32. REPORT OPTIONS

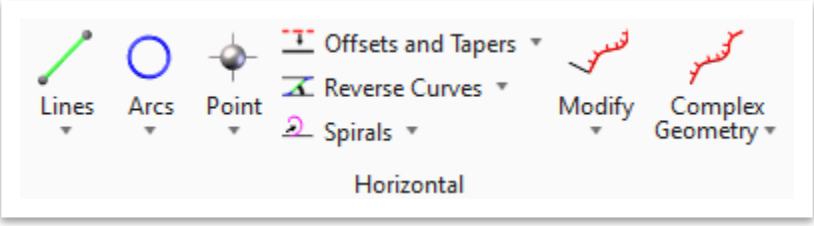


- **Horizontal Geometry Report:** Summarizes geometric information for the selected element(s) (horizontal and vertical).
- **Horizontal Point Report:** Summarizes the horizontal points showing point name, feature, description, northing, easting and elevation.
- **Profile Report:** Summarizes geometric information for the profile elements.
- **Map Check Report:** Summarizes precision information based on plotted data (e.g. lengths, directions, coordinates) in the drawing rather than the internal precision stored by the software. The plotted values are used during construction to determine closure errors based on plotted precision.
- **Point Feature Station Offset Elevation Report:** Summarizes stations/offsets from selected points to a baseline MicroStation, survey or civil element. The report contains point name, point feature, station and offset. Offsets are always measured perpendicular from the baseline element and the reported stationing is measured along the baseline element.

4.4 Lecture: Horizontal Civil Geometry

The **Horizontal Civil Geometry** tools house all the commands to create, modify and manipulate horizontal geometry, such as points, lines, all types of curves and spirals (Figure 33). Also, these tools offer options to combine, copy, offset and taper already placed geometry, and edit specific properties of alignments.

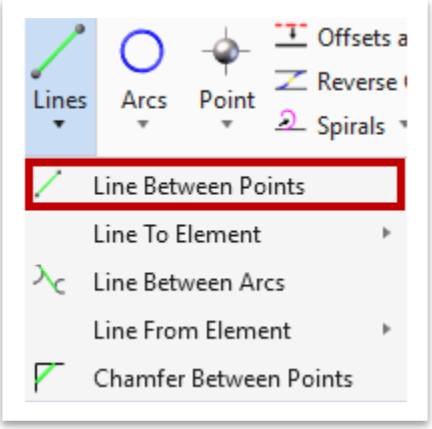
FIGURE 33. HORIZONTAL CIVIL TOOLS



4.4.1 Lines Tools

The horizontal **Lines** tools are used to create horizontal linework. (Figure 34). The most common method of placement is using the **Line Between Points** option.

FIGURE 34. LINES TOOLS



When a line is placed without the use of Snaps or Civil AccuDraw, the element has basic manipulators for moving the end points of the line, moving the entire line, or editing the distance and direction. If a line is placed with **Snaps** or **Civil AccuDraw**, the normal manipulators are replaced by Snap or AccuDraw manipulators (Figure 35 and Figure 36 respectively). Snap manipulators will automatically update the line as the snapped element updates unless the snap is broken. The orange text that you see below can be edited by the user.

FIGURE 35. LINE WITH KEYPOINT SNAP MANIPULATOR

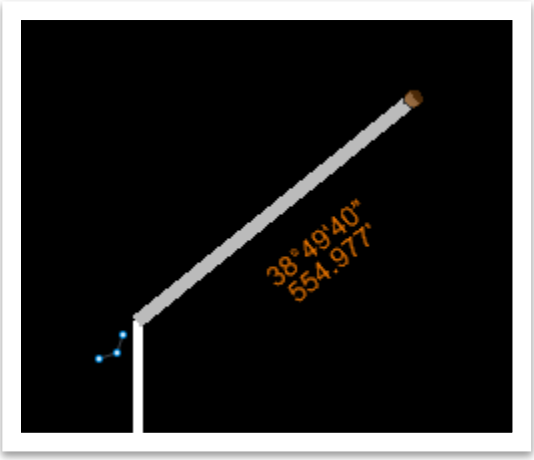
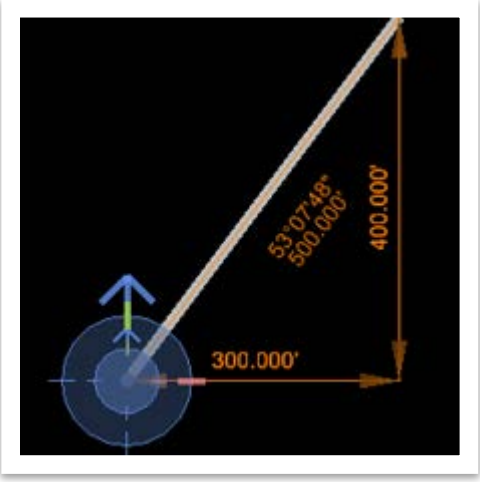


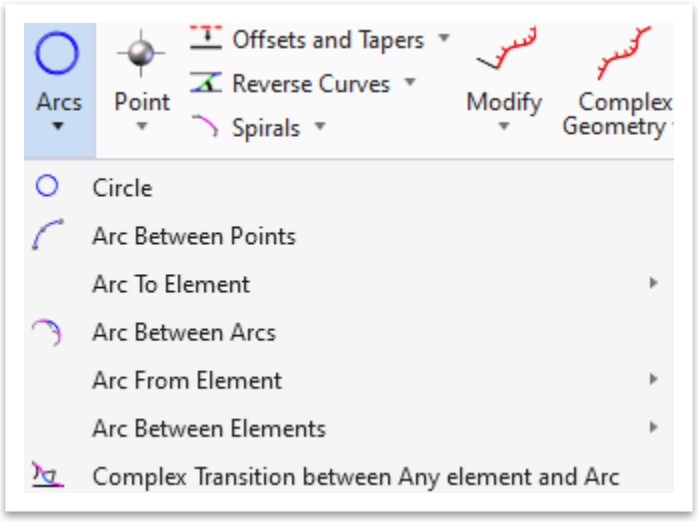
FIGURE 36. LINE WITH DX DY CIVIL ACCUDRAW MANIPULATOR



4.4.2 Arcs Tools

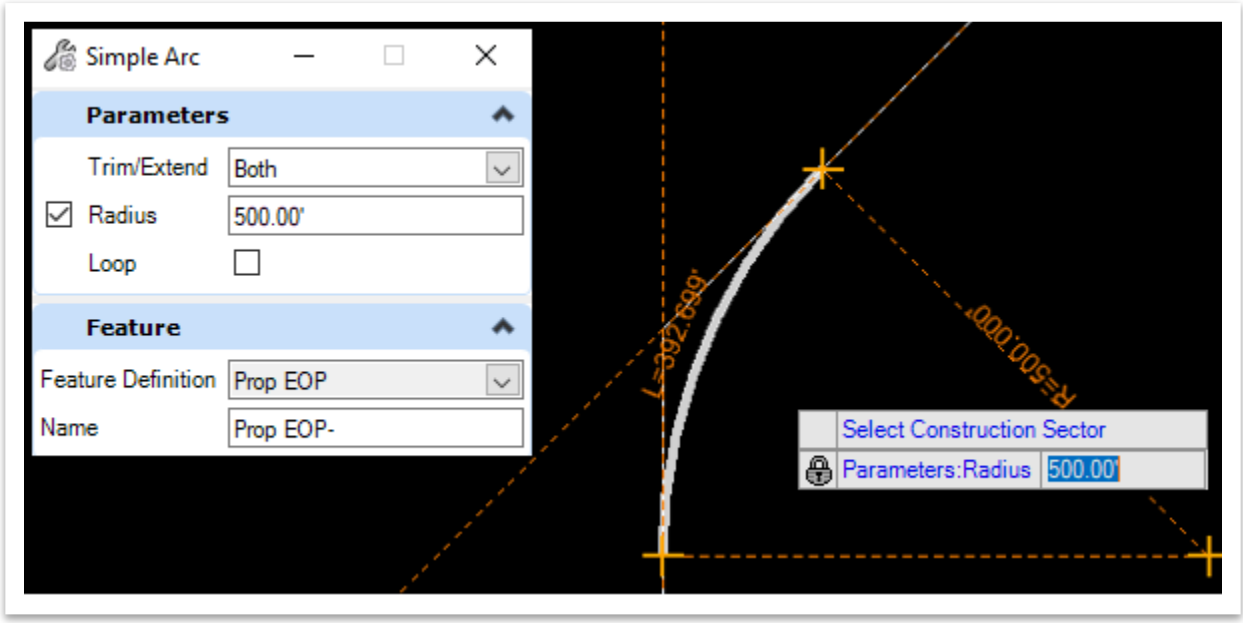
The horizontal **Arcs** tools are used to create horizontal simple curves and allow the user to create arcs in the drawing defined by various parameter combinations (Figure 37).

FIGURE 37. ARCS TOOLS



The most commonly used Arc tools are **Arc Between Points** and **Arc Between Elements** (Simple Arc) (Figure 38).

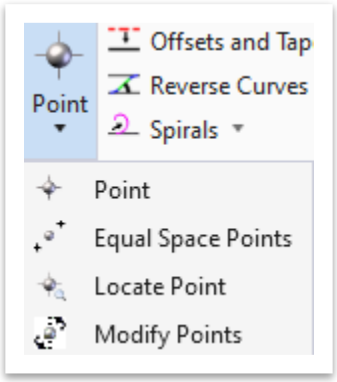
FIGURE 38. ARC BETWEEN ELEMENTS – SIMPLE ARC



4.4.3 Point Tools

The **Point** tools allow for the construction of civil point elements (Figure 39). The user can place a single point or multiple points at equal spacing plus locate and modify points.

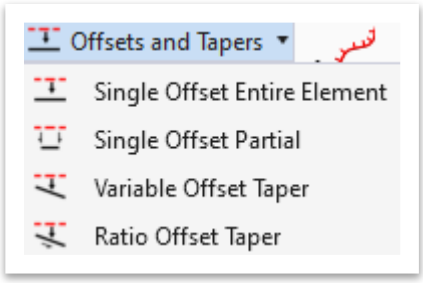
FIGURE 39. POINT TOOLS



4.4.4 Offsets and Tapers Tools

The **Offsets and Tapers** tools can be used to offset a copy of an element and create tapered offsets of elements (Figure 40). The user can offset a section of an element with the **Single Offset Partial** tool. The **Taper** offset tools allow the user to offset an element at a taper defined by a ratio or by two offset distances. Elements created by offset tools will have a rule linking them to the base element (e.g., if the base element is moved, the offset element will move with it). If the base element is modified in any way (lengthened, radius changed, etc.) the offset element will update to match while the offset rule is active.

FIGURE 40. OFFSETS AND TAPERS TOOLS



The most commonly used offset and taper tools are **Single Offset Entire Element** (Figure 41) and **Variable Offset Taper** (Figure 42). This is an ideal tool when placing Roadside Barriers, Traffic Control devices and EPSC devices to name a few.

FIGURE 41. SINGLE OFFSET ENTIRE ELEMENT

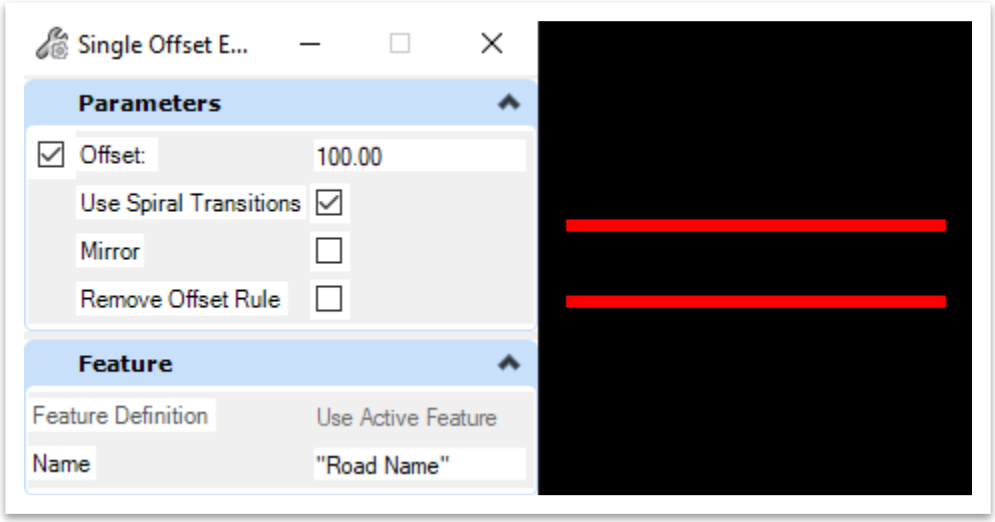
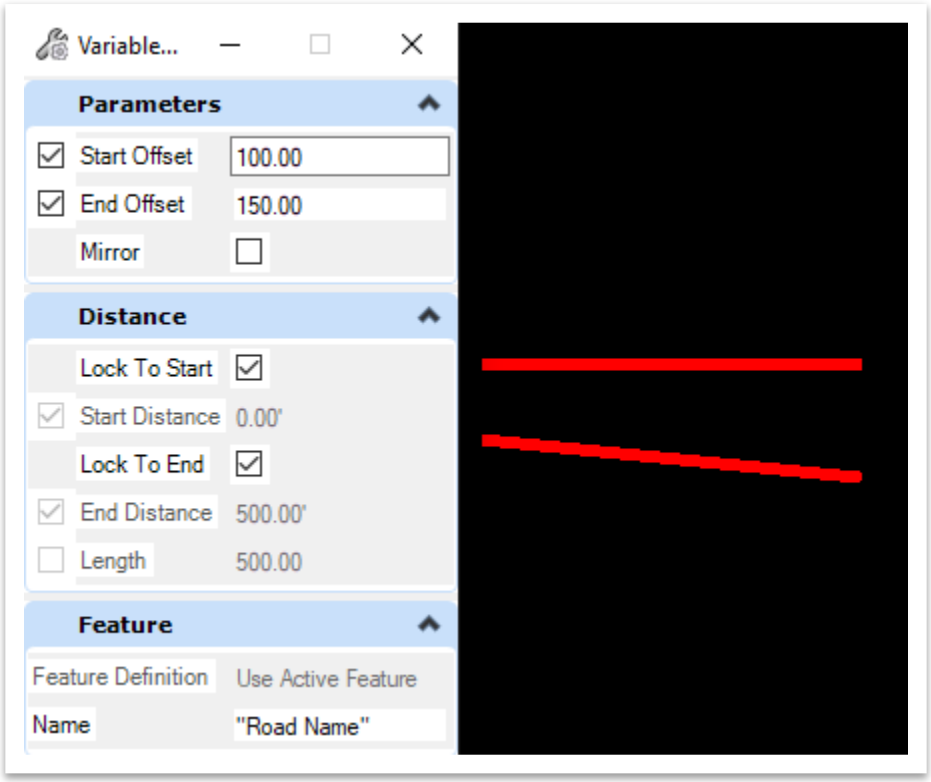


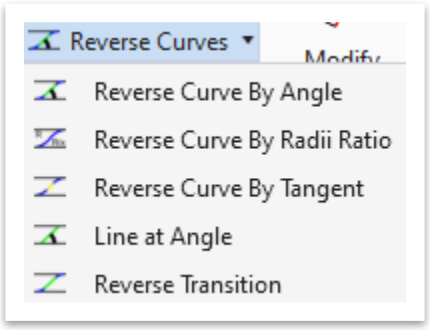
FIGURE 42. VARIABLE OFFSET TAPER



4.4.5 Reverse Curves Tools

The **Reverse Curves** tools can be used to create reverse curves (Figure 43). The most commonly used option for placing a reverse curve is the **Reverse Curve by Tangent**. Two referenced tangent lines must be already placed in the drawing to use this option. There is an optional setting for placing a transition length in between the reverse curves.

FIGURE 43. REVERSE CURVES TOOLS



4.4.6 Spirals Tools

Spirals can be created with the **Spiral From Element** tool, where an element defines tangency at one end of the spiral, or with the **Spiral Between Elements** tool, where a spiral is constructed between two elements that determine tangency (Figure 44). Figure 45 on the next page shows a spiral created between a line and an arc.

FIGURE 44. SPIRALS TOOLS

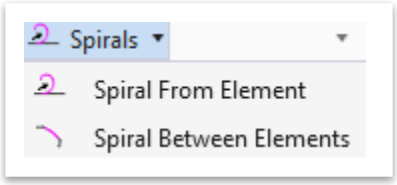
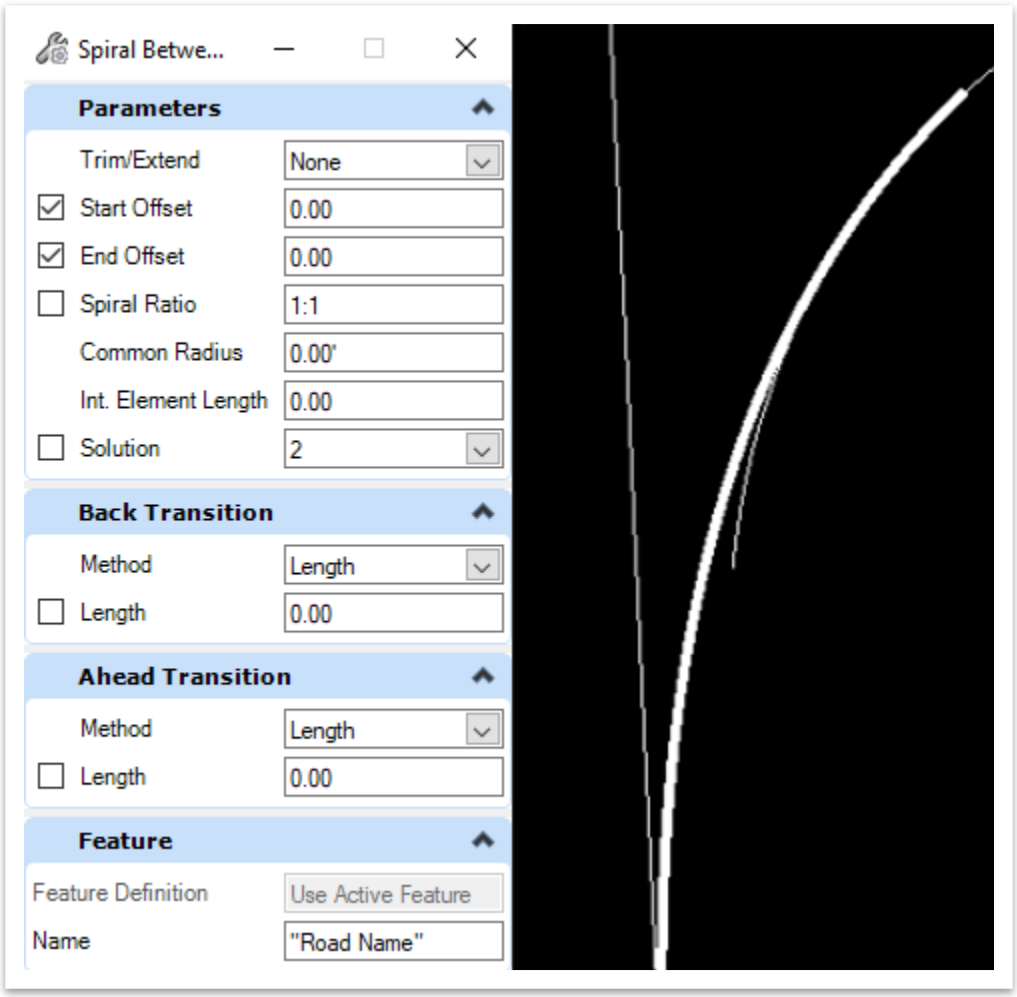


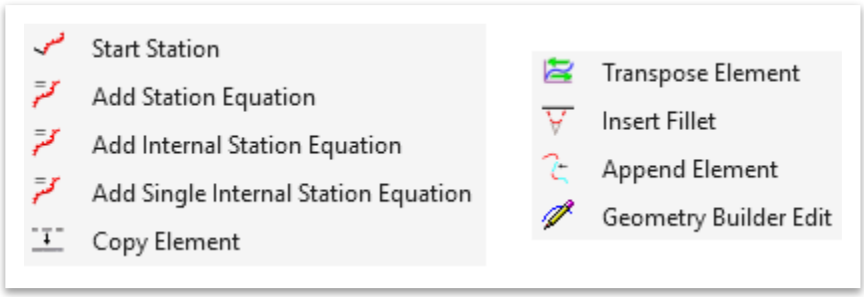
FIGURE 45. SPIRAL BETWEEN ELEMENTS



4.4.7 Modify Tools

The **Modify** tools allow the user to change basic aspects of a horizontal alignment, such as **stationing** (including inserting station equations), **copying**, **transposing** and **appending** elements (Figure 46). Also, the **Insert Fillet** tool allows the user to add a curve to a tangent section.

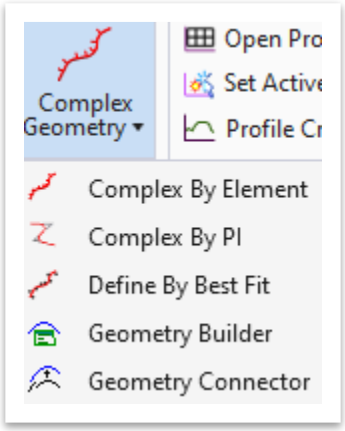
FIGURE 46. MODIFY TOOLS



4.4.8 Complex Geometry Tools

The **Complex Geometry** tools allow the user to create complex geometry elements through several methods (Figure 47). The **Complex By Element** tool allows the user to combine existing geometry elements into one complex element, and the **Complex By PI** tool allows the user to create a new complex element by defining points of intersection and radii.

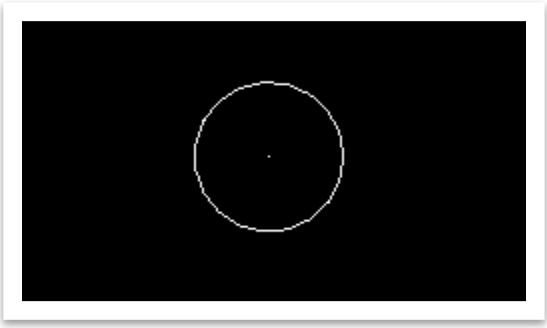
FIGURE 47. COMPLEX GEOMETRY TOOLS



4.4.9 Exercise: Horizontal Geometry Creation

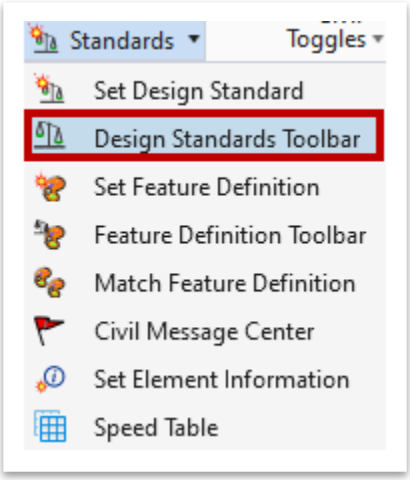
In this exercise, we will create a new horizontal alignment utilizing the horizontal civil geometry tools prior to importing an alignment in another exercise. We will continue to utilize the same **GeometryTest.dgn** file.

1. Attach the **GeometryStartingPoint.dgn** file as a reference using the **Coincident World** attachment method. It contains a white circle that we will snap to when placing the first line. Then, click **Fit View** and zoom in to the circle on the right side of the screen.

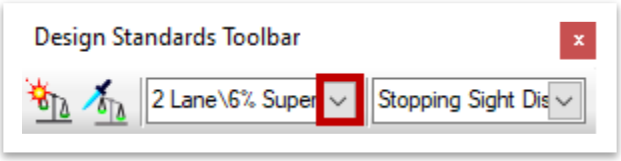


2. Select the following feature definition: **Alignment >> Prop HA Mainline**. Then, toggle on **Use Active Feature Definition** (highlighted in red). We also want to toggle on **Chain Commands** (highlighted in orange). This will allow you to place lines in sequence when creating the chain.

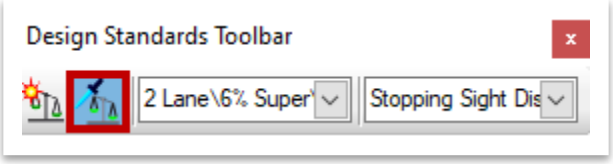
3. Next, we need to set the appropriate **Design Standards** for the geometry, which should be done at the beginning of any new ORD project. Open the **Design Standards Toolbar** (**OpenRoads Modeling >> Geometry >> General Tools >> Standards** and then go ahead and dock it.



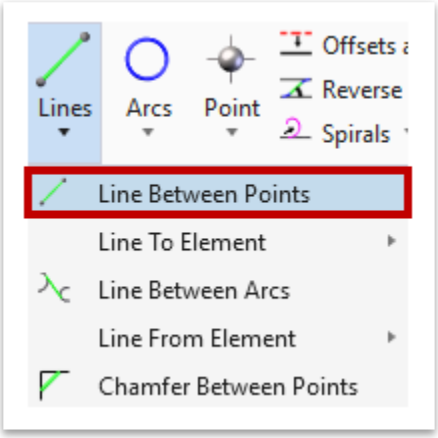
4. For this exercise, we will assume a **2-lane** road with a **45 MPH** design speed and a max **6%** superelevation. Within the **Design Standards Toolbar**, click the first drop-down arrow and select the following design standard: **2 Lane (AASHTO Design Standards 2018 - Imperial Design Library) >> 6% Super >> 45 MPH**.



5. You will notice that the second field is automatically populated with **Stopping Sight Distance**, which we will leave as-is. Go ahead and toggle on **Active Design Standard**. **Note:** If you select an element and then deselect it, the Active Design Standard will turn off and need to be re-selected.

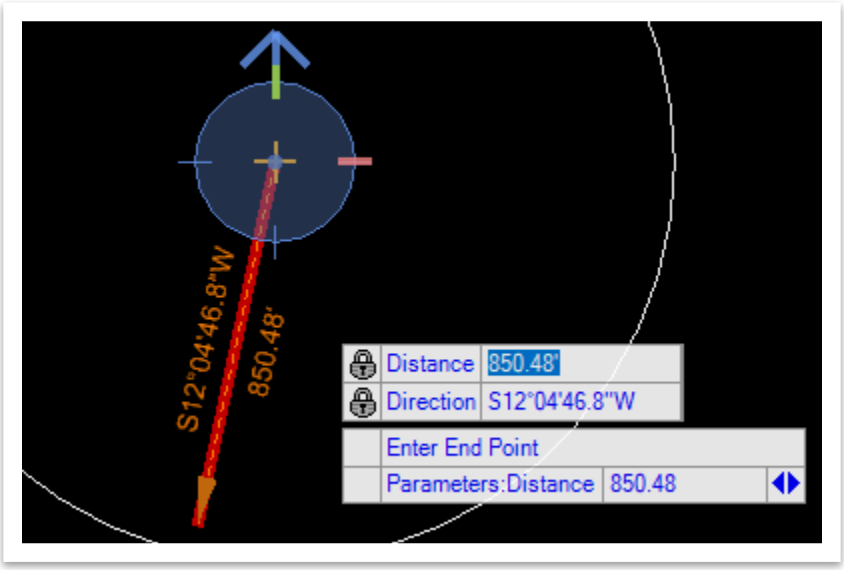


6. Now open the **Line Between Points** tool (**OpenRoads Modeling >> Geometry >> Horizontal >> Lines**).

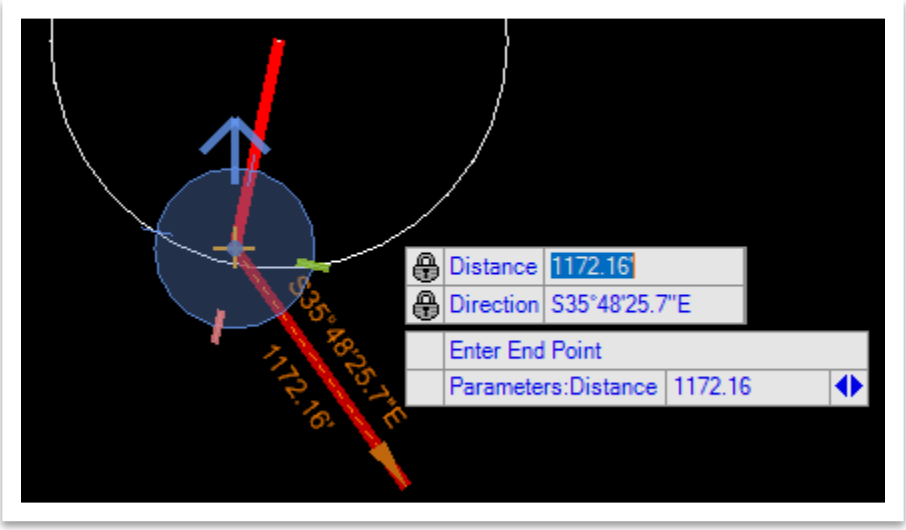


7. You should still have **Civil AccuDraw** toggled on. Select the **Distance-Direction** option within the **Civil AccuDraw** toolbar.

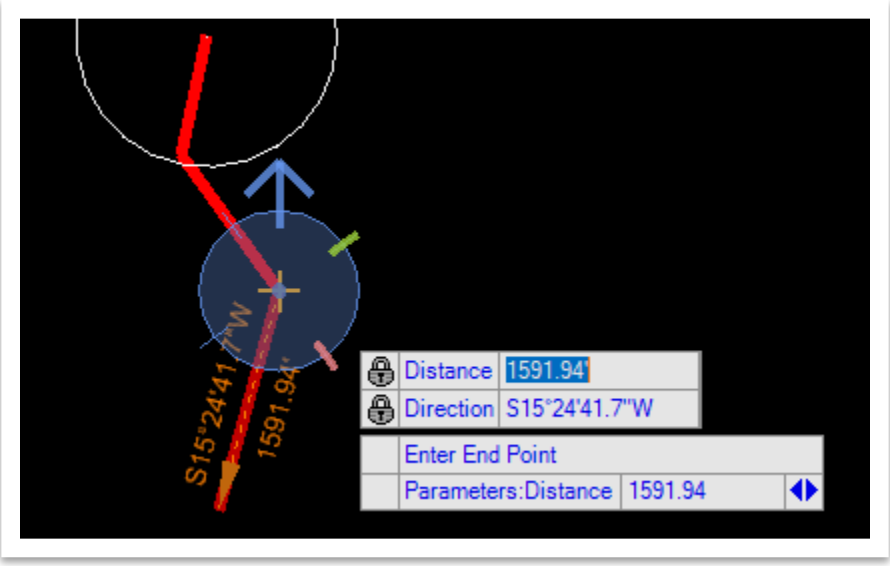
8. Snap to the center of the referenced white circle (white crosshair). Key-in a **Distance** of **850.48'** and a **Direction** of **S12^04'46.8"W** and then hit **Enter** to lock them in. Left click anywhere within the drawing window to accept placement.



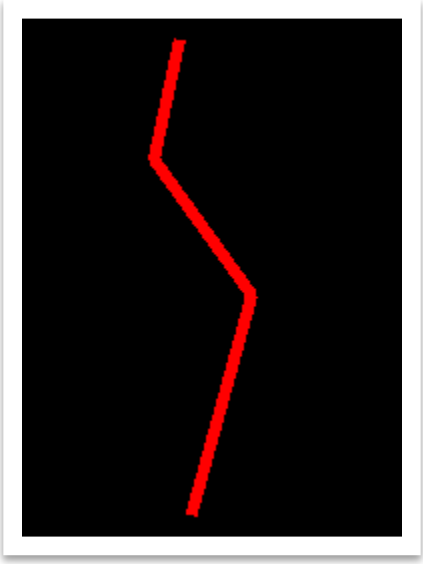
9. For the next line, key-in a **Distance** of **1172.16'** and a **Direction** of **S35^48'25.7"E** and then hit **Enter** to lock them in. Once again, left click anywhere within the drawing window to accept placement.



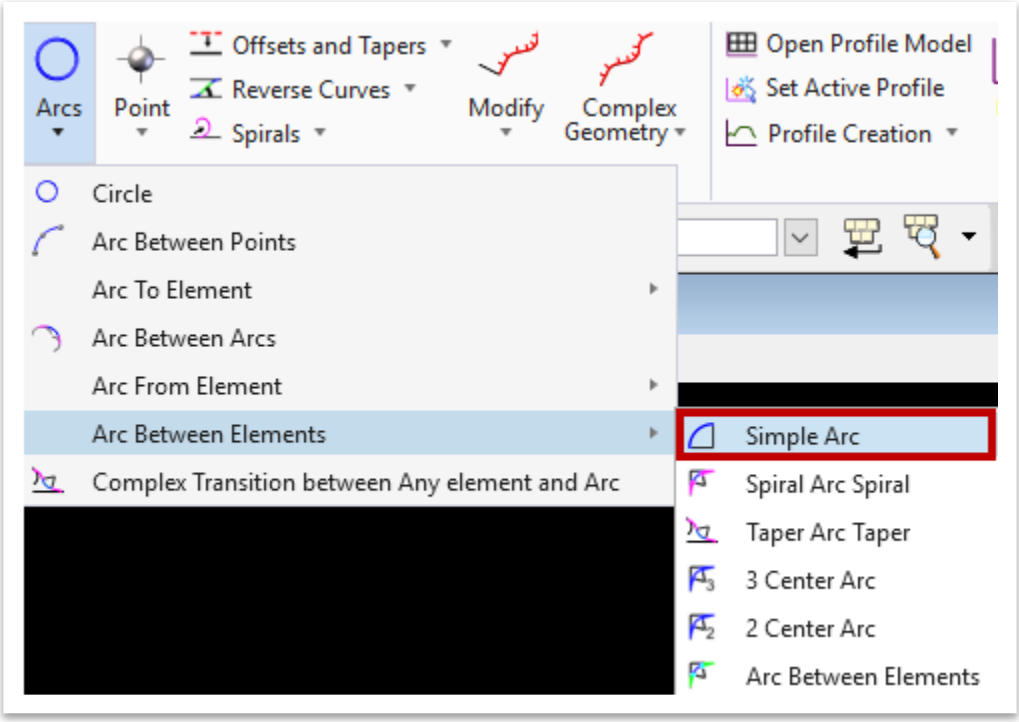
10. For the last line, key-in a **Distance** of **1591.94'** and a **Direction** of **S15^24'41.7"W** and then hit **Enter** to lock them in. Once again, left click anywhere within the drawing window to accept placement.



11. Go ahead and turn off the **GeometryStartingPoint.dgn** reference file and then activate the **Element Selection** tool to clear the previous tool. You should see the **3** red line segments as shown below.

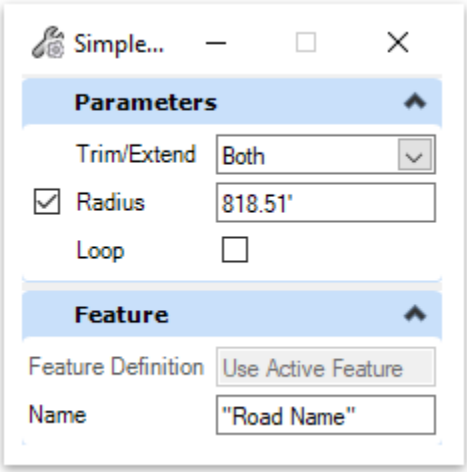


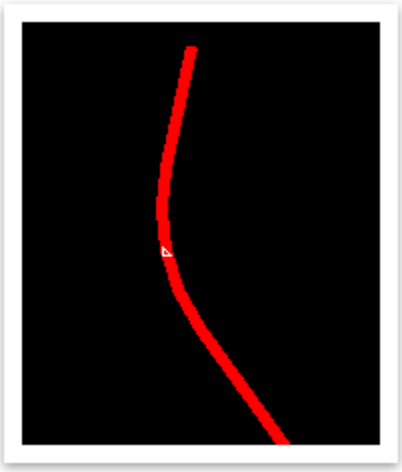
12. Now we will place two arcs between the elements. Open the **Simple Arc** tool (**OpenRoads Modeling >> Geometry >> Horizontal >> Arcs >> Arc Between Elements**).



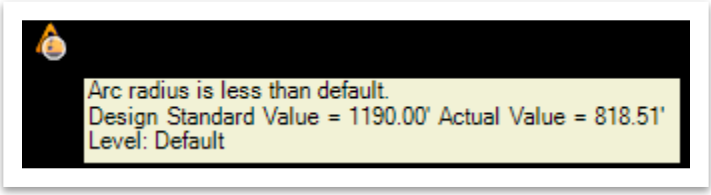
13. Notice the cursor prompt: **Locate First Element**. Select the first line segment (northernmost line). Notice the next cursor prompt: **Locate Second Element**. Select the second line segment (middle line). **Note:** If the cursor prompt does not say **Locate First Element**, simply close the tool and re-open it.

14. Within the **Simple Arc** dialog box, key-in a **Radius** of **818.51'** and make sure that the **Trim/Extend** option is set to **Both**, which will trim the arc on both ends. The **Feature Definition** should still be set to **Use Active Feature**. Left click on the inside of the two lines so that the arc will place correctly. Left click again to trim both elements.

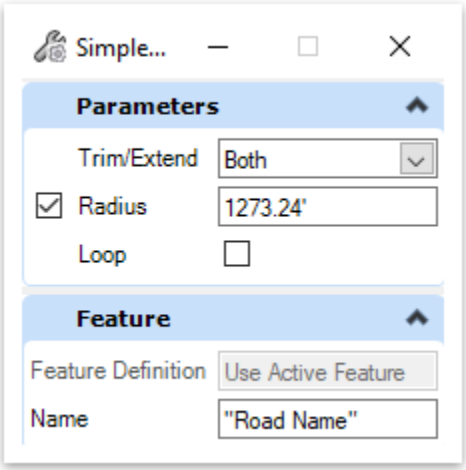


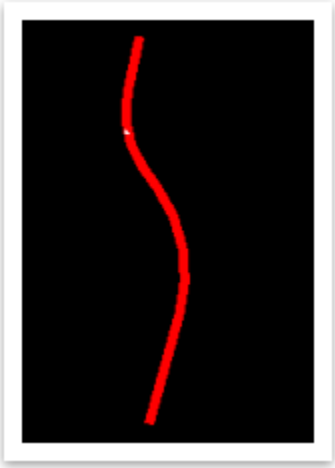


15. Zoom in to the arc that you just created and notice a yellow warning icon. If you turn off the **DES - CL - Proposed** level and then hover over the icon, you will see that the radius does not meet the design standard set for this alignment and would need to be adjusted. For the purpose of this exercise, we will ignore the alert.

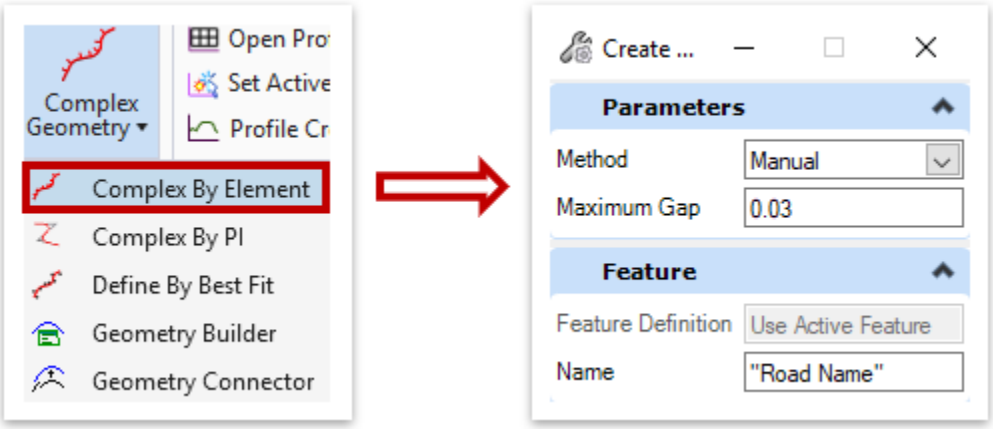


16. Turn back on the **DES - CL - Proposed** level and let's now place the second arc between the middle line and the southernmost line. Key-in a **Radius** of **1273.24'** and make sure that the **Trim/Extend** option is still set to **Both**. Once again, left click on the inside of the two lines so that the curve will place correctly. Left click again to trim both elements.

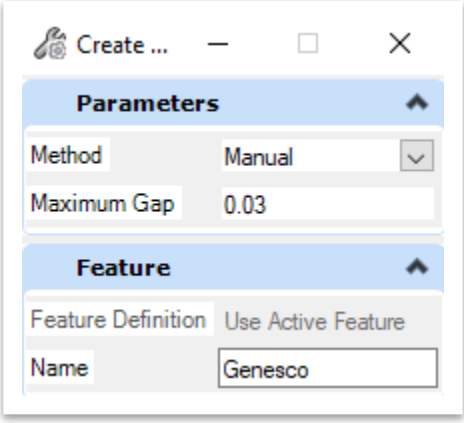




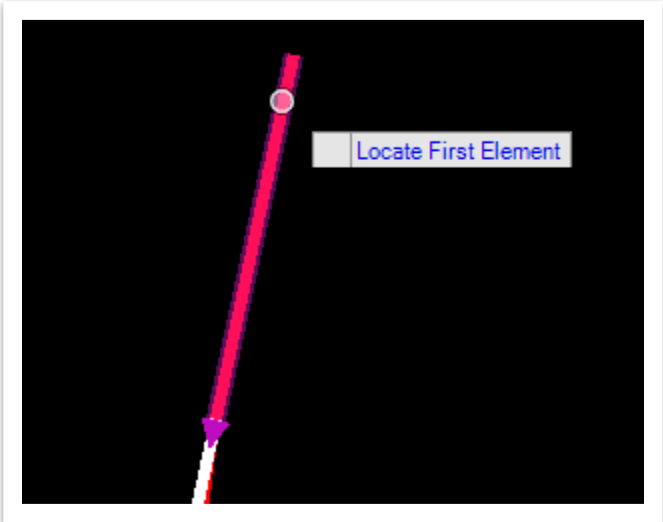
17. Now we need to create a **complex** alignment chain. Open the **Complex By Element** tool (**OpenRoads Modeling >> Geometry >> Horizontal >> Complex Geometry**). Notice that the **Create Complex Element** dialog box opens, which will allow us to combine the tangent and curve sections of the horizontal alignment.



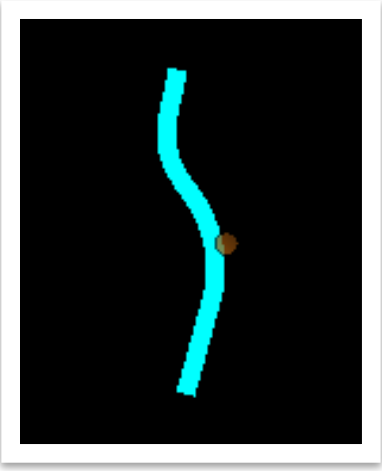
18. For this exercise, we will set the **Method** to **Manual** to show the process but for most horizontal alignment creations, it will be easier to set it to **Automatic**. Leave the **Maximum Gap** set to the default **0.03**. The **Feature Definition** should still be set to **Use Active Feature**. Go ahead and change the alignment **Name** to **Genesco**. **Note:** If no active feature definition was set, you could easily set it in this dialog box.



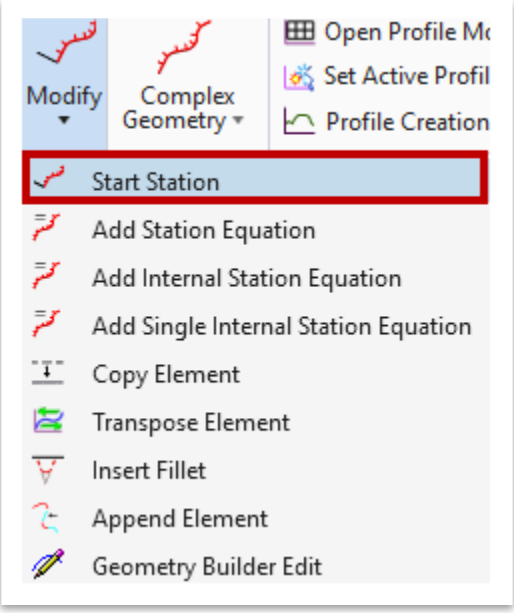
19. Notice the cursor prompt: **Locate First Element**. Select the northernmost element so that the proper direction is established. It is important to notice the purple directional arrow. That indicates which direction the alignment is intended to go. The arrow direction is the opposite of where your cursor is. In other words, if the alignment direction is south, the cursor will need to be on the north side of the element when selecting it, as shown below.



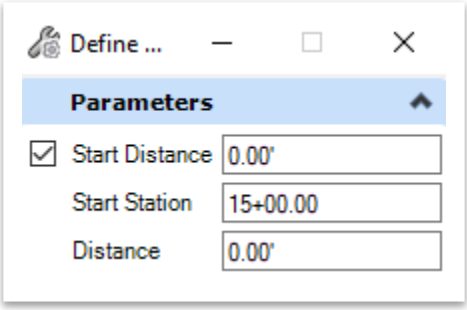
20. Notice the next cursor prompt: **Locate Next Element**. Select the first curve and make sure that the purple arrow is pointed in the correct direction. Continue selecting each of the remaining segments until all are in purple. Left click to complete the selection and then right click to complete the creation of the complex geometry and notice that the alignment is now one chain. Since the **Prop HA Mainline** feature definition was active, the symbology is correct. **Note:** You can select the alignment and then zoom in to see the geometry. You'll notice that there is overlapping orange geometric data, which has been logged as a defect with Bentley. The display handles do not work properly when using Civil AccuDraw. If you wanted to manually correct the issue, you could key-in a different X or Y coordinate and then change it back to the original coordinate to disable Civil AccuDraw on this element.



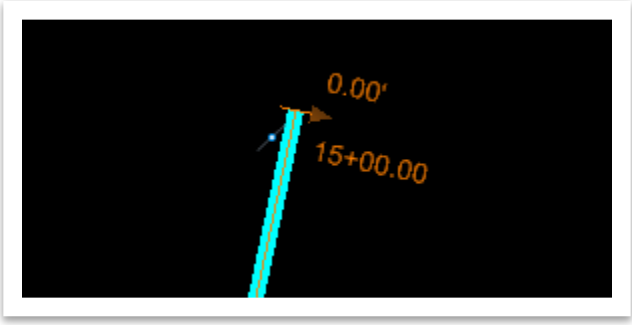
21. Next, let's change the start station of the alignment we just created. Open the **Start Station** tool (**OpenRoads Modeling >> Geometry >> Horizontal >> Modify**).



22. Within the **Define Starting Station** dialog box, set the **Start Distance** to **0.00'** and the **Start Station** to **15+00.00**.



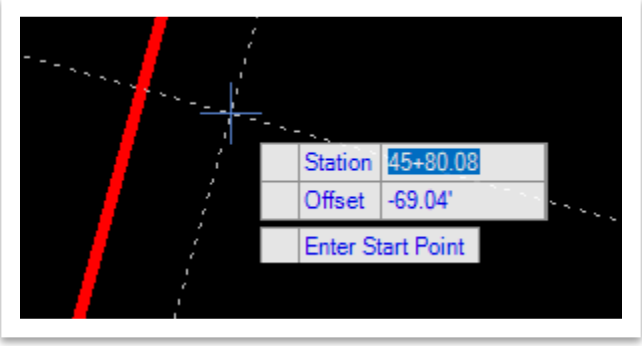
23. Notice the cursor prompt: **Locate Element**. Select the alignment and the left click through the prompts to accept the station update. Once completed, select the alignment using the **Element Selection** tool and notice that the stationing now starts at **15+00.00**.



4.4.10 Additional Civil AccuDraw Function

The Civil AccuDraw tools also allow the user to see the **Sta/Off** on the cursor. You would first select the **Sta/Off** option within the **Civil AccuDraw** toolbar. Then, open the **Line Between Points** tool and click **O** on your keyboard. Select the alignment that you want the Sta/Off to be based off and then you will see the fields populate (Figure 48). You can move your cursor around and snap to any point. This option will be useful once you have more linework in the design files. To clear the tool, click on the **Element Selection** tool.

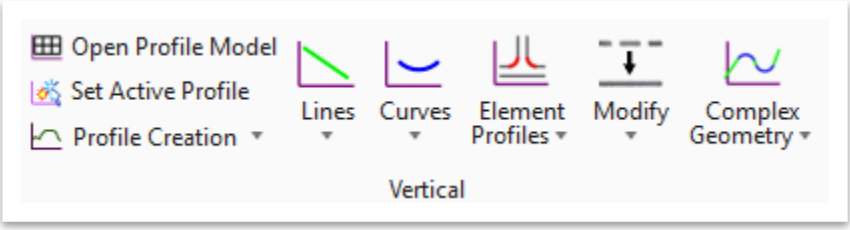
FIGURE 48. CIVIL ACCUDRAW – STA/OFF OPTION



4.5 Lecture: Vertical Civil Geometry

The **Vertical Civil Geometry** tools contain all the tools necessary to create profiles (Figure 49). An active existing terrain model must be available to create a profile from a surface. An active alignment must be available to create a proposed profile.

FIGURE 49. VERTICAL CIVIL GEOMETRY



4.5.1 Open Profile Model

In ORD, vertical civil geometry is viewed using the **Profile Model** within the file in which the alignment or plan view element is placed. Each horizontal geometry element can have its own profile view assigned to it.

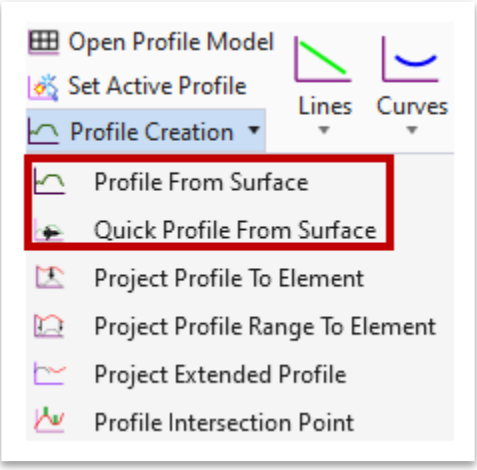
Take Note!

A profile model must be open to work with vertical geometry tools. This, however, is not a separate model space as the name implies but rather a view within the design model space. Also, an alignment must be stored in the current DGN file.

4.5.2 Profile Creation Tools

The **Profile Creation** tools allow the user to create a profile from the existing terrain (Figure 50). The two most common tools that designers will use for creating profiles are described on the next page.

FIGURE 50. PROFILE CREATION TOOLS

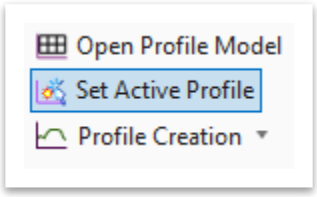


- **Profile from Surface:** Generates a profile whose elevations are determined by draping onto a surface. For example, this option would be used for creating an existing ground profile for an alignment or civil feature.
- **Quick Profile from Surface:** A companion tool that provides the same results as the Profile from Surface tool but simplifies the input by assuming that the entire element is draped and that the offsets are zero. This would be used to create a profile of a civil element by matching the slope and elevation of adjoining elements.

4.5.3 Set Active Profile

The **Set Active Profile** tool allows the user to set the active profile which will control the 3D model (Figure 51). A 3D spline is created for the 3D model representing the combination of the selected plan element and profile element.

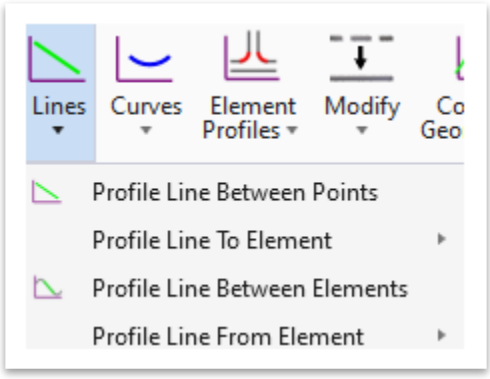
FIGURE 51. SET ACTIVE PROFILE TOOL



4.5.4 Lines Tools

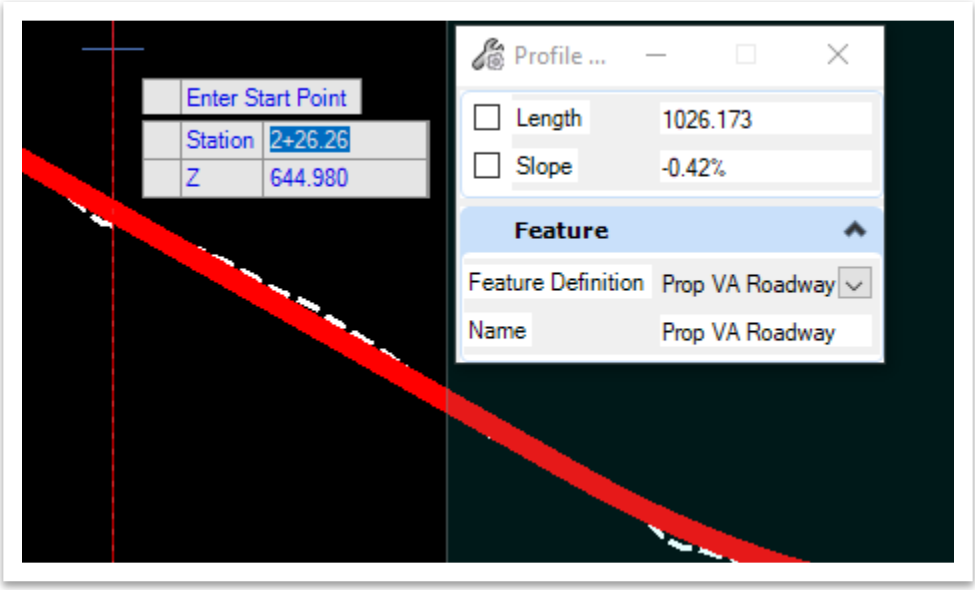
The vertical **Lines** tools are used to create profile tangents by using several options (Figure 52).

FIGURE 52. VERTICAL LINES TOOLS



- **Profile Line Between Points:** The most commonly used tool which generates a profile line between two user-defined points (Figure 53).

FIGURE 53. PROFILE LINE BETWEEN POINTS TOOL

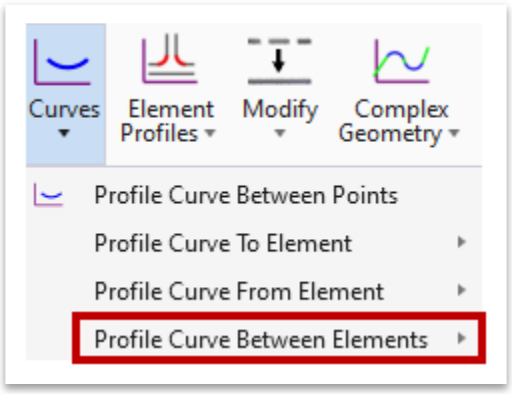


- **Profile Line To Element:** Generates a profile line at a delta slope from a specific location to a reference element.
- **Profile Line From Element:** Generates a profile line at a delta slope from a reference element to a designated location.
- **Profile Line Between Elements:** Generates a profile between two previously placed curves.

4.5.5 Curves Tools

The vertical **Curves** tools are used to create profile curves by using several options (Figure 54). The most commonly used option is the **Profile Curve Between Elements**, which constructs a vertical curve between two lines or elements.

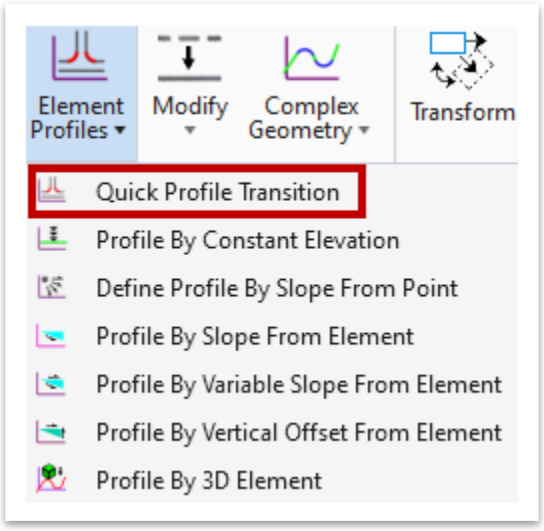
FIGURE 54. VERTICAL CURVES TOOLS



4.5.6 Element Profiles Tools

The **Element Profiles** tools are used to add profiles to elements by defining transitions, slopes or offsets (Figure 55). However, the most commonly used command is the **Quick Profile Transition**, which defines the profile of an element by matching the slope and elevation of adjoining elements.

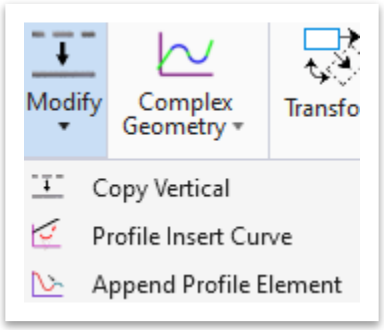
FIGURE 55. ELEMENT PROFILES TOOLS



4.5.7 Modify Tools

The **Modify** tools are used to copy or modify vertical profiles (Figure 56). The user can insert curves on tangent sections or add elements to existing complex profiles.

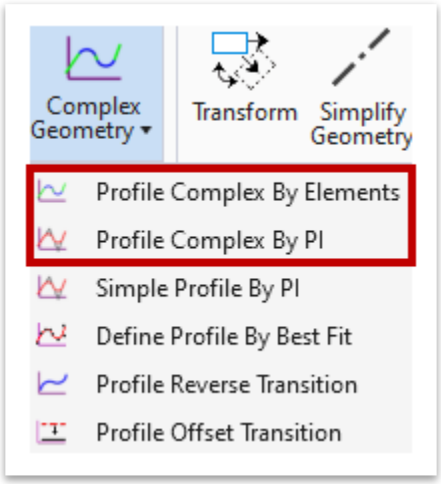
FIGURE 56. MODIFY TOOLS



4.5.8 Complex Geometry Tools

The **Complex Geometry** tools are used to create complex geometry elements through several methods (Figure 57).

FIGURE 57. COMPLEX GEOMETRY TOOLS



- **Profile Complex By Elements:** Used for combining existing geometry elements into one complex element.
- **Profile Complex By PI:** Used for creating a new complex element by defining points of intersection and radii.

4.5.9 Exercise: Vertical Geometry Creation

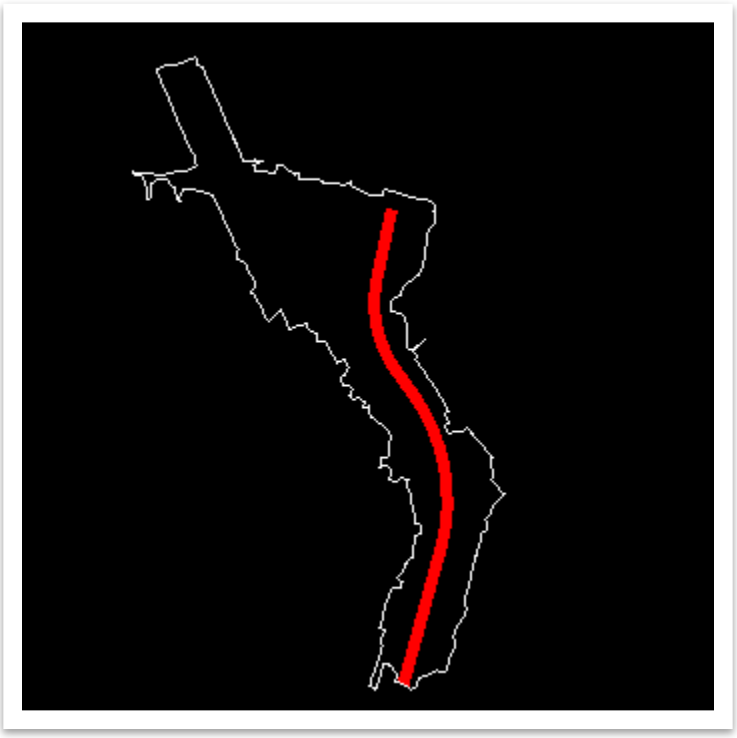
In this exercise, we will create a new vertical alignment utilizing the vertical civil geometry tools. We will continue to utilize the same **GeometryTest.dgn**.

Take Note!

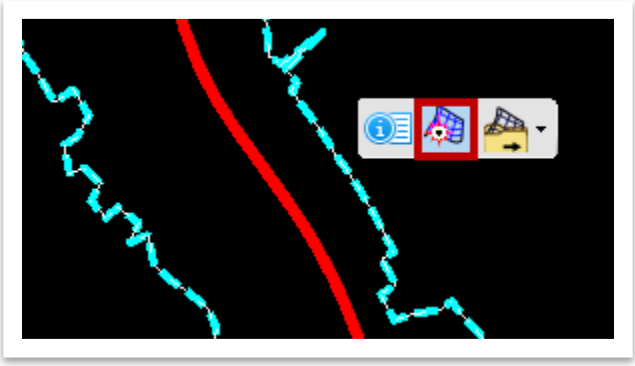
There are two requirements for creating an existing ground profile:

a. *An alignment must exist (the profile is a child of the alignment).*
b. *An existing DTM must be referenced and displayed in the file (the elevation for existing ground profiles comes from the DTM).*

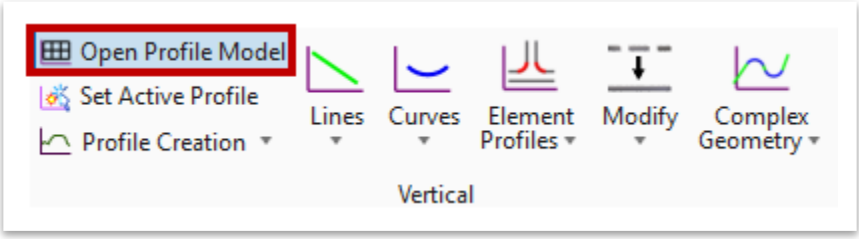
1. Attach the **GenescoExistingTerrain.dgn** file as a reference using the **Coincident World** attachment method. It contains the existing ground DTM. Go ahead and turn off the triangles and then zoom in to the area shown below. **Note:** As a reminder, to turn the triangles off, select the terrain boundary and open the **Properties**. Under the **Reference** tab, set the **Override Symbology** field to **Yes** and then toggle off the triangles under **Calculated Features Display**.



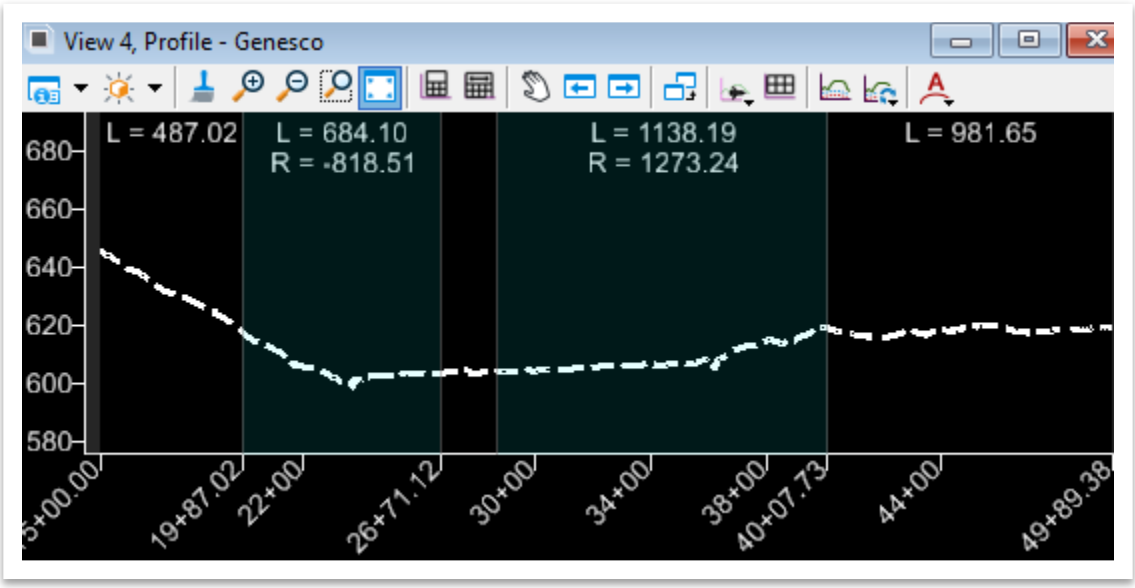
2. Next, select the **terrain** boundary and bring up the heads-up display. Click the second icon to **Set As Active Terrain Model**.



3. Now, open the **Open Profile Model** tool (**OpenRoads Modeling >> Geometry >> Vertical**). **Note:** You could also open it within the heads-up display (2nd icon).



4. Notice the cursor prompt: **Locate Plan Element**. The software is asking for the centerline. Select the **Genesco** centerline in plan view (View 1). Notice the next cursor prompt: **Select or Open View**. Left click anywhere within **View 4** and you should see the existing ground profile with the correct symbology. **Note:** Once the profile is created, it will always be in the file. You may have to re-visualize it if you close **View 4** at any time, by repeating Steps 3-4.



Take Note!

*The active terrain will automatically show in the profile view of any geometric element. If a profile view of an additional surface is needed, then utilize the **Quick Profile From Surface** tool to visualize that surface in the profile view.*

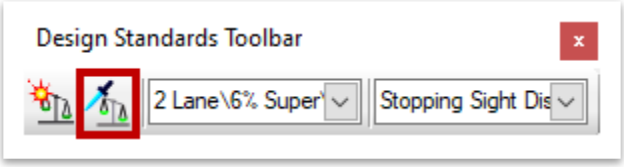
5. Now that we have the existing ground profile, we can create a proposed profile. Go ahead and select the **Prop VA Roadway** feature definition (**Linear >> Profiles >> Roadway >> Proposed**).

Take Note!

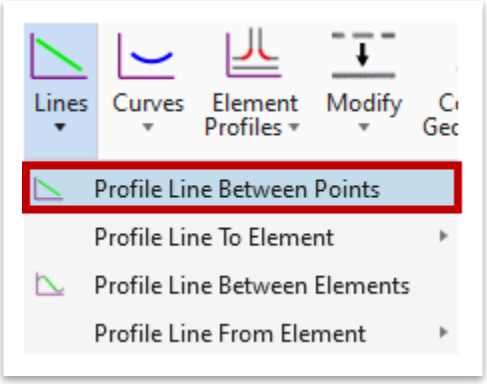
*Users should toggle the active design standards **off** prior to creating the vertical geometry. This will allow specific vertical curve **lengths** to be applied rather than K values, if needed. The active design standards should be toggled back on after the vertical geometry has been created and then re-applied so you can check for any errors.*

In general, when a design standard is selected, the vertical geometry is linked to a table of speeds and K values. The default K values are the minimum accepted values based on the selected design standard.

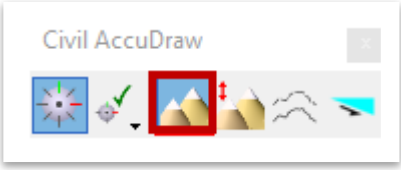
6. Within the **Design Standards Toolbar**, toggle off the **Active Design Standard**.



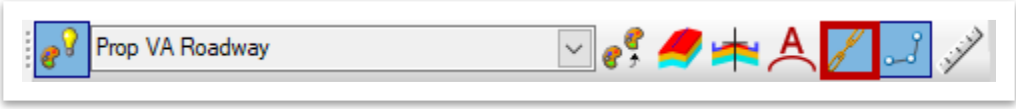
7. Open the **Profile Line Between Points** tool (**OpenRoads Modeling >> Geometry >> Vertical >> Lines**).



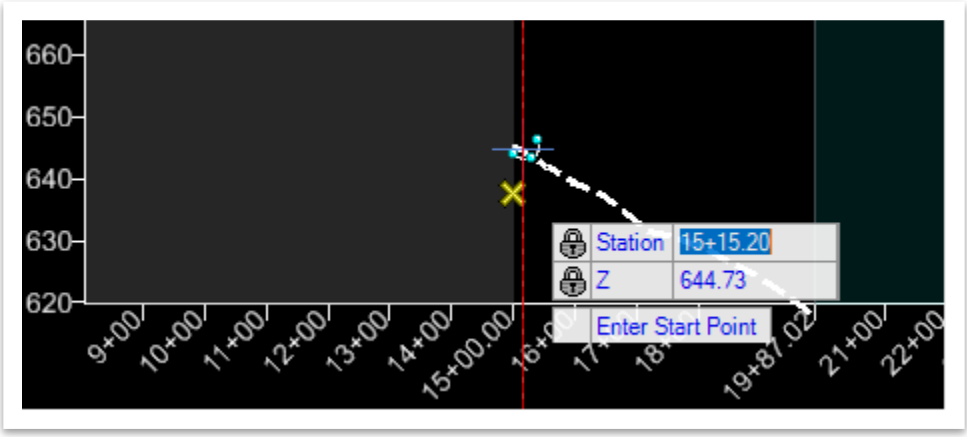
8. Turn on the **Z** Civil AccuDraw option, if not already on. **Note:** Since the profile view is active (View 4), it should show the profile Civil AccuDraw tools. If not, toggle Civil AccuDraw off and on until the correct tools appear.



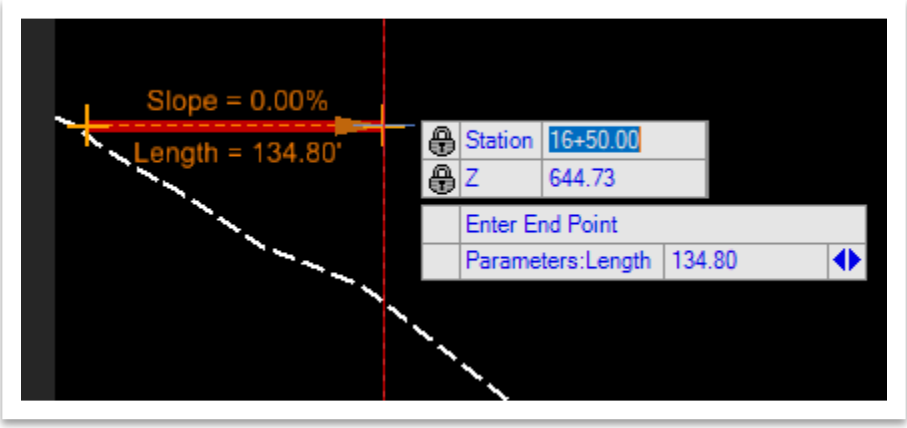
9. Make sure the **Chain Commands** option is still toggled on in the Feature Definition Toolbar.



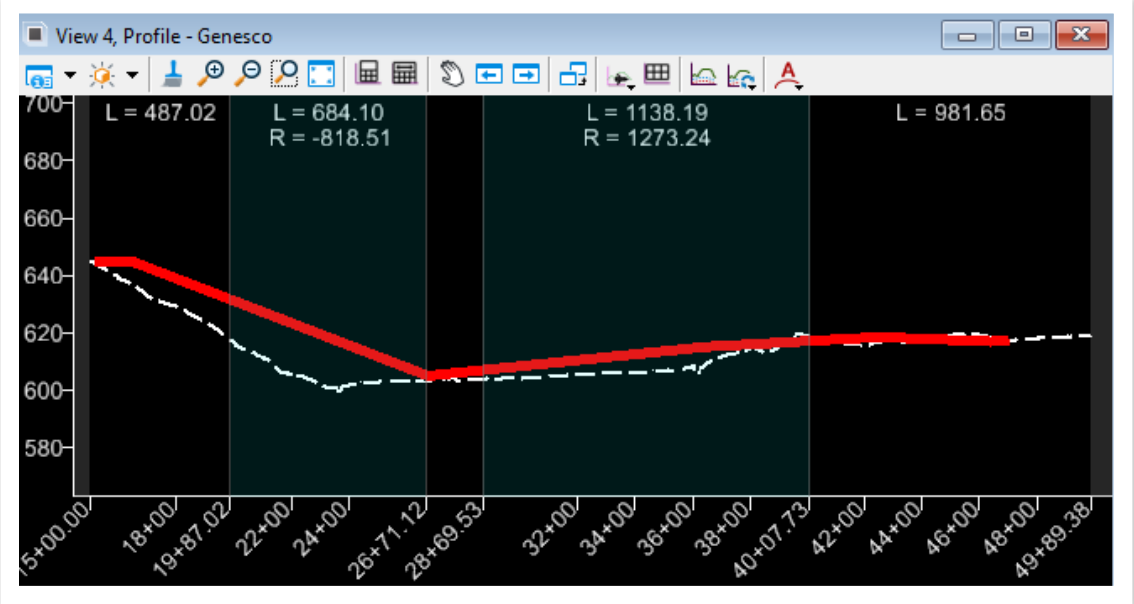
10. To start the profile, key-in station **15+15.20** and elevation **644.73** and then hit **Enter** to lock them in. Left click within the profile to accept placement.



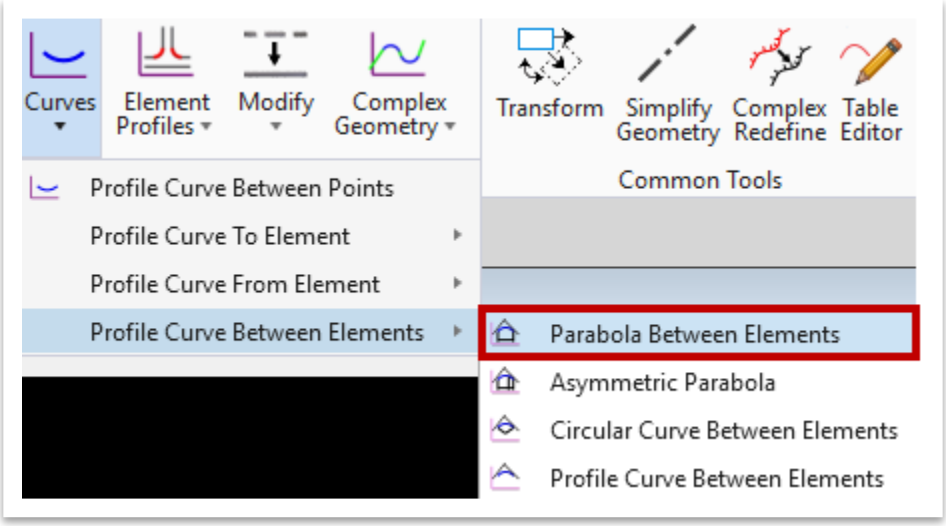
11. For the next VPI, key-in station **16+50.00** and elevation **644.73** and then hit **Enter** to lock them in. Once again, left click within the profile to accept placement. **Note:** Since we set the feature definition earlier, the symbology is correct.



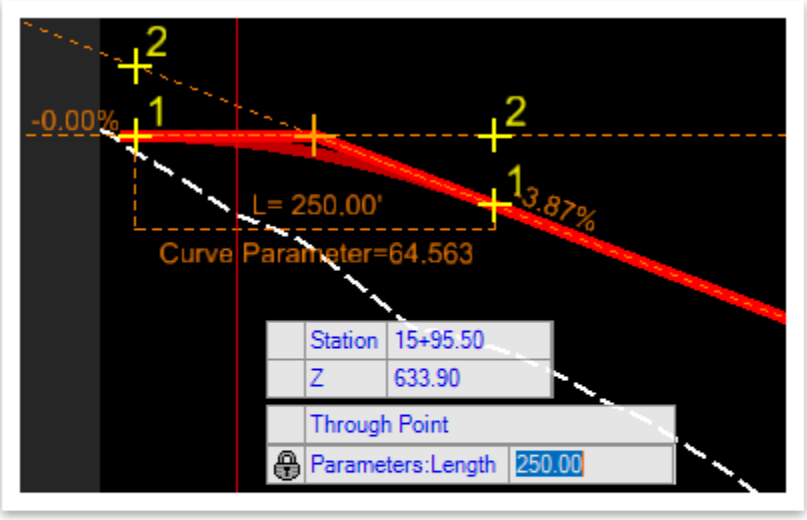
12. Repeat this process with a VPI at station **26+75.00** and elevation of **605.04**.
13. Repeat this process with a VPI at station **36+49.55** and elevation of **615.17**.
14. Repeat this process with a VPI at station **42+50.00** and elevation of **618.56**.
15. Repeat this process with a VPI at station **46+37.50** and elevation of **616.99**.
16. Repeat this process one final time with a VPI at station **47+00.00** and elevation of **617.42** and then activate the **Element Selection** tool to clear the previous tool.
17. Once completed, notice the segmented profile, as shown below.



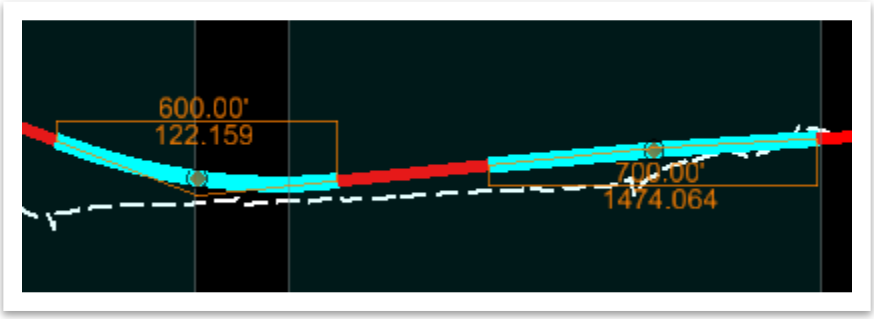
18. Next, we will add vertical curves, going from left to right along the profile. Open the **Parabola Between Elements** tool (**OpenRoads Modeling >> Geometry >> Vertical >> Curves >> Profile Curve Between Elements**).



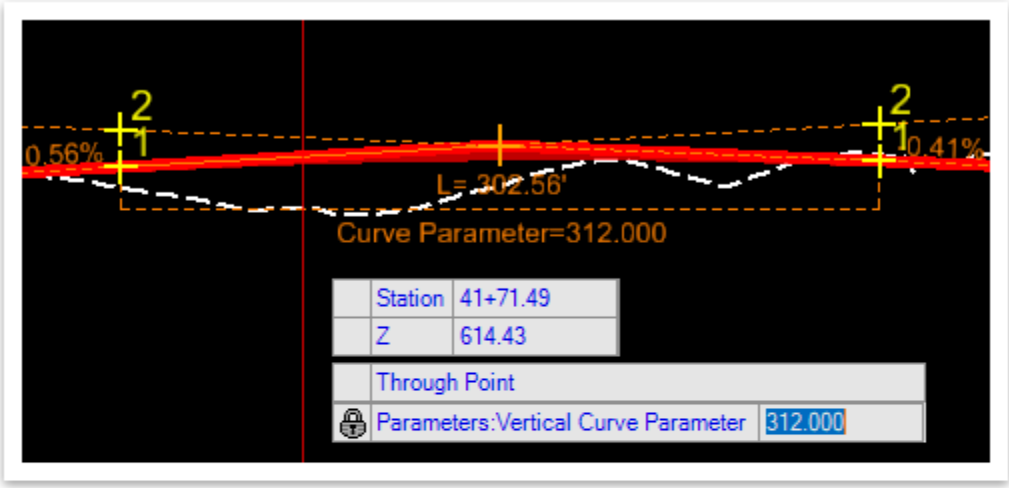
19. Notice the cursor prompt: **Locate First Profile Element**. Select the first line segment. Notice the next cursor prompt: **Locate Second Profile Element**. Select the second line segment. Key-in a vertical curve **Length** of **250'** and then hit **Enter**. Left click to accept placement and then left click again to trim **Both** elements. **Note:** The vertical curve should be placed on whichever side of the profile you click on. Also, your **Station** and **Z** value will be different depending on where your cursor is at any given time.

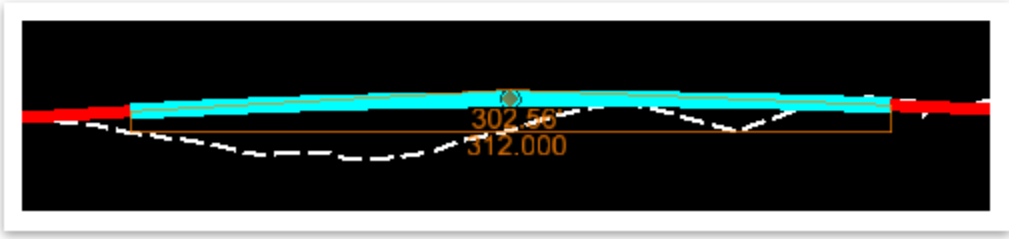


20. Repeat the previous step to place the next two vertical curves in sequence, with **Lengths** of **600'** and **700'** respectively. Remember to left click to accept each curve and left click again to trim **Both** elements. The two curves are highlighted below.

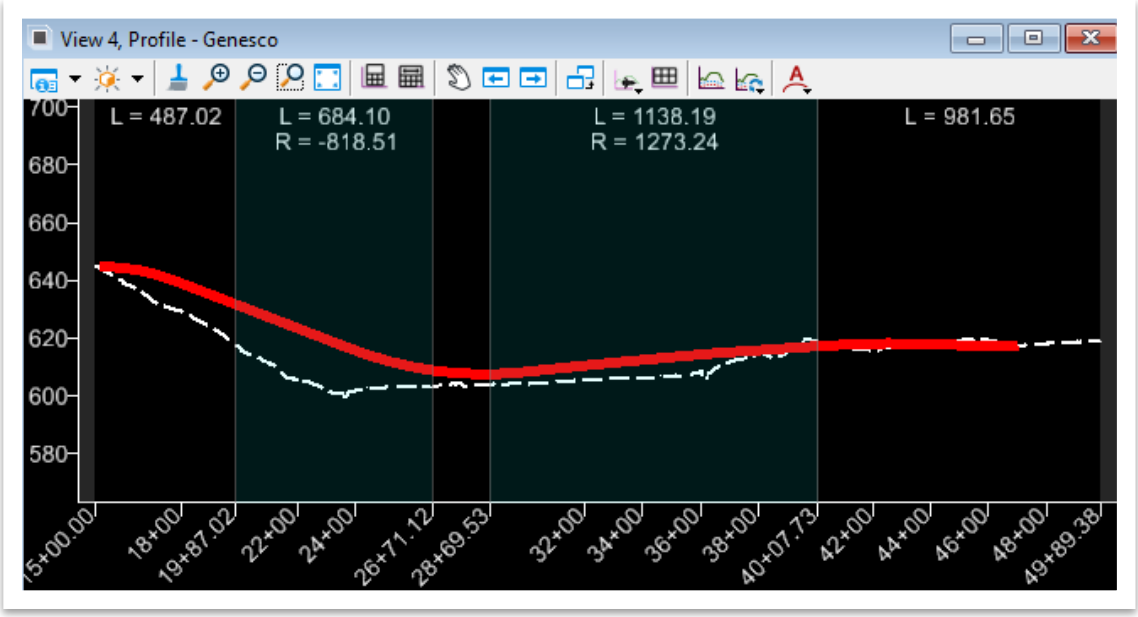


21. For the final two vertical curves, we will use the same **Parabola Between Elements** tool, but this time define the **Vertical Curve Parameter (K-value)** instead of the length. Key-in a **Vertical Curve Parameter** of **312** and then hit **Enter**. Left click to accept placement and then left click again to trim **Both** elements. **Note:** If you use the cursor prompts, you will need to use the right/left arrow key to toggle to the **Vertical Curve Parameter** field.

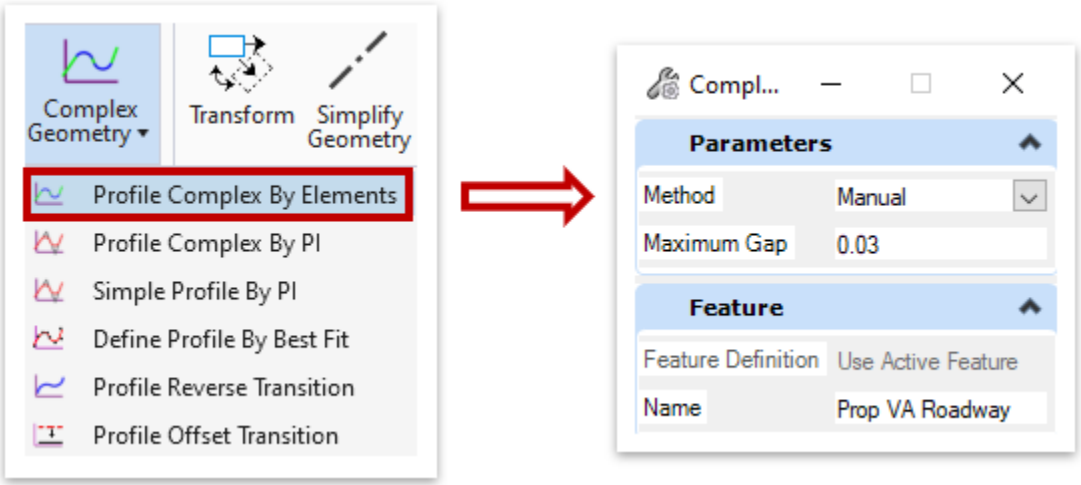




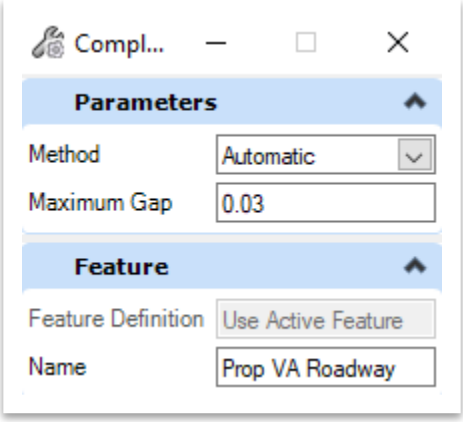
22. Repeat the previous step to create the last vertical curve. Key-in a **Vertical Curve Parameter** of **114** and trim **Both** elements. Your updated profile should look like what is shown below, with a series of lines and curves.



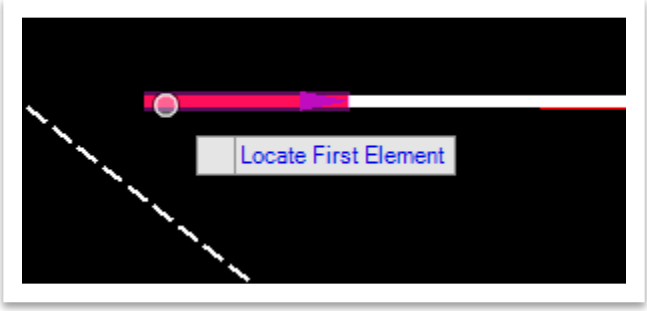
23. Now we need to create a complex profile chain. Open the **Profile Complex by Elements** tool (**OpenRoads Modeling >> Geometry >> Vertical >> Complex Geometry**) and notice the dialog box that opens. This tool will combine the tangent and curve sections of the profile.



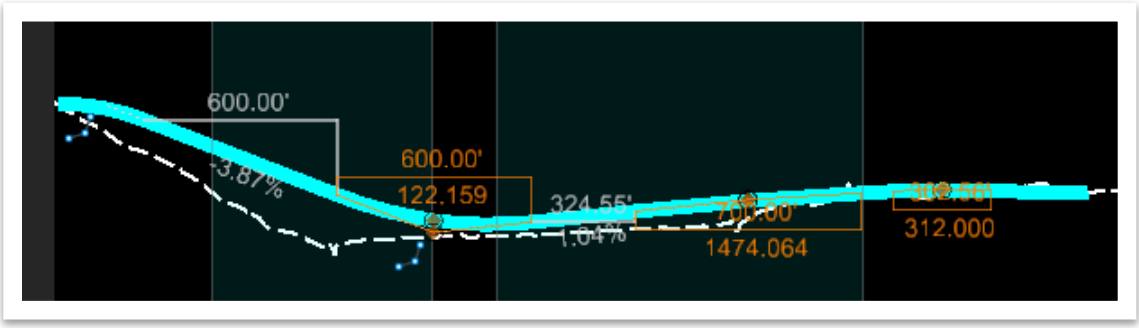
24. For this exercise, we will set the **Method** to **Automatic**. Leave the **Maximum Gap** set to the default **0.03**. The **Feature Definition** should still be set to **Prop VA Roadway**. Leave the default **Name** as-is.



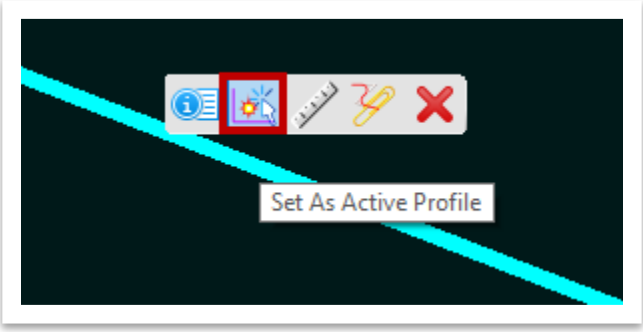
25. Notice the cursor prompt: **Locate First Element**. Select the first element so that the proper direction is established. Just like for horizontal geometry, it is important to notice the purple directional arrow, and make sure it is pointing towards the right.



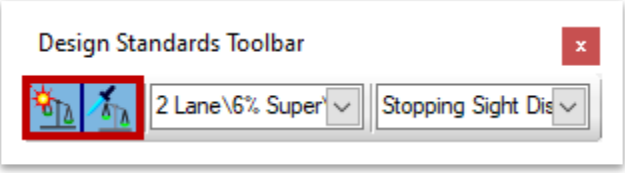
26. Notice the next cursor prompt: **Accept Complex**. Left click to accept and then open the **Element Selection** tool and select the complex profile chain to review its geometry. Since the **Prop VA Roadway** feature definition was active, the symbology is correct. **Note:** If the feature definition was not set, you can always set it after creation utilizing the **Set Feature Definition** tool (**OpenRoads Modeling >> Geometry >> General Tools >> Standards**) and following the prompts.



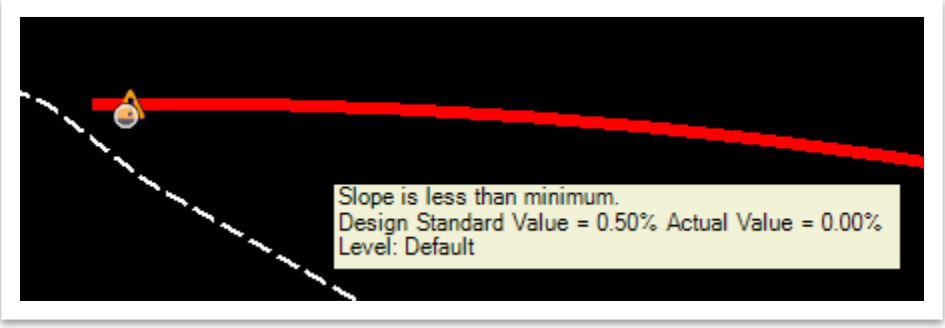
27. Next, let's make the profile active. With the profile still selected, bring up the heads-up display and click the second icon to **Set As Active Profile**.



28. Lastly, remember we had turned off the active design standards earlier in the exercise prior to creating the profile. Within the Design Standards Toolbar, toggle on both **Set Design Standard** and **Active Design Standard**. **Note:** If the **Set Design Standard** icon is greyed out, you can initiate it from the **Standards** tools (**OpenRoads Modeling >> Geometry >> General Tools**). If either tool is greyed out, try closing and re-opening the toolbar. If that still doesn't work, try closing and re-opening ORD.



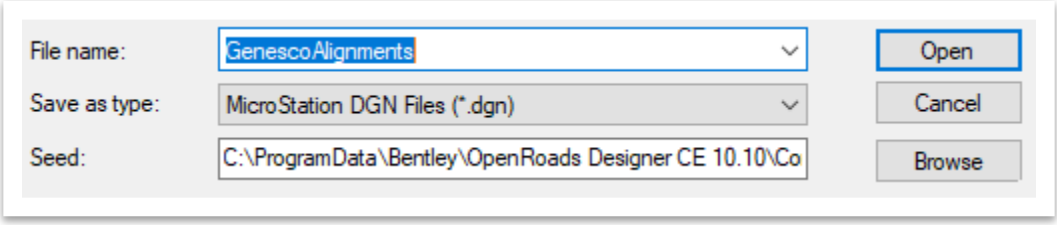
29. Notice the cursor prompt: **Select Element**. Select the profile to apply the active design standards. Open the **Element Selection** tool and then zoom in to the beginning of the profile and notice a yellow warning icon. Hover over the icon and you will see that the slope does not meet the design standard and would need to be adjusted. There is also a yellow warning icon at the end of the profile. For the purpose of this exercise, we will ignore the alerts.



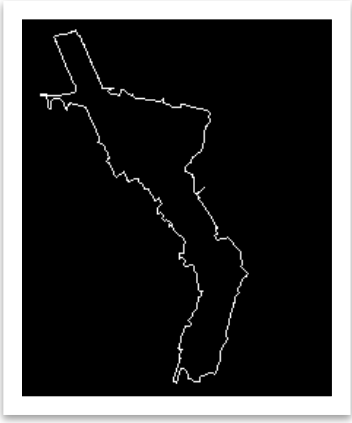
4.6 Exercise: Horizontal and Vertical Geometry Creation – Import

In this exercise, we will import horizontal and vertical alignments from a GPK, which would be the procedure if converting an existing SS2 project to ORD. This geometry will be utilized for the remainder of the manual to ensure that no issues carry over from the previous exercises.

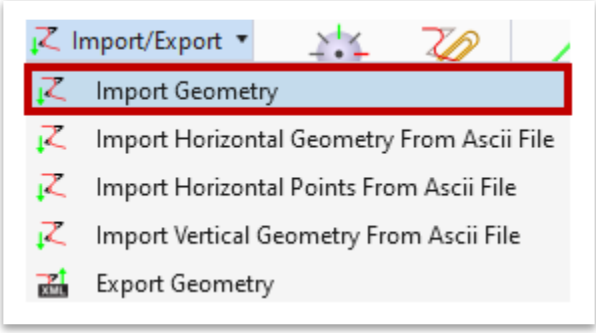
1. Create a new file and name it **GenescoAlignments**. Select the **TDOTSeed2D .dgn** and click **Save**.



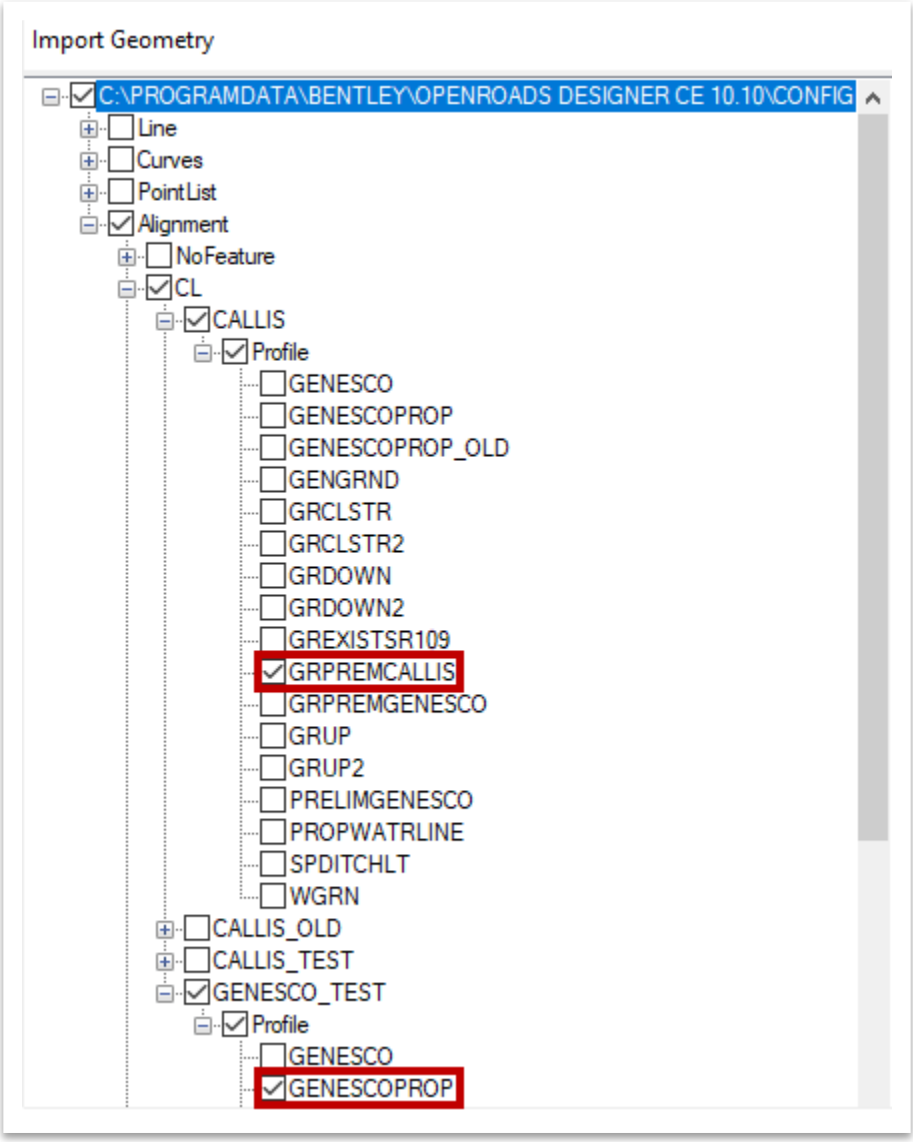
2. Attach the **GenescoExistingTerrain.dgn** file as a reference using the **Coincident World** attachment method. Click **Fit View** and go ahead and turn off the triangles. Then, set the terrain to **active**. **Note:** Refer to Exercise 4.5.9, Steps 1-2, if necessary.



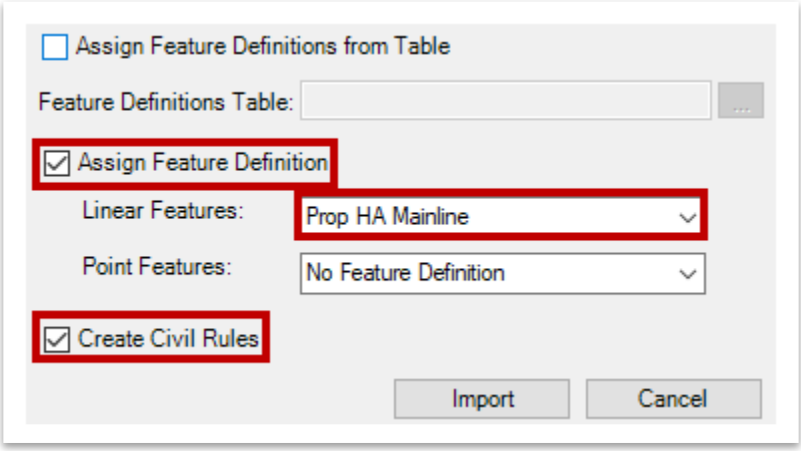
3. Open the **Import Geometry** tool (**OpenRoads Modeling >> Geometry >> General Tools >> Import/Export**).



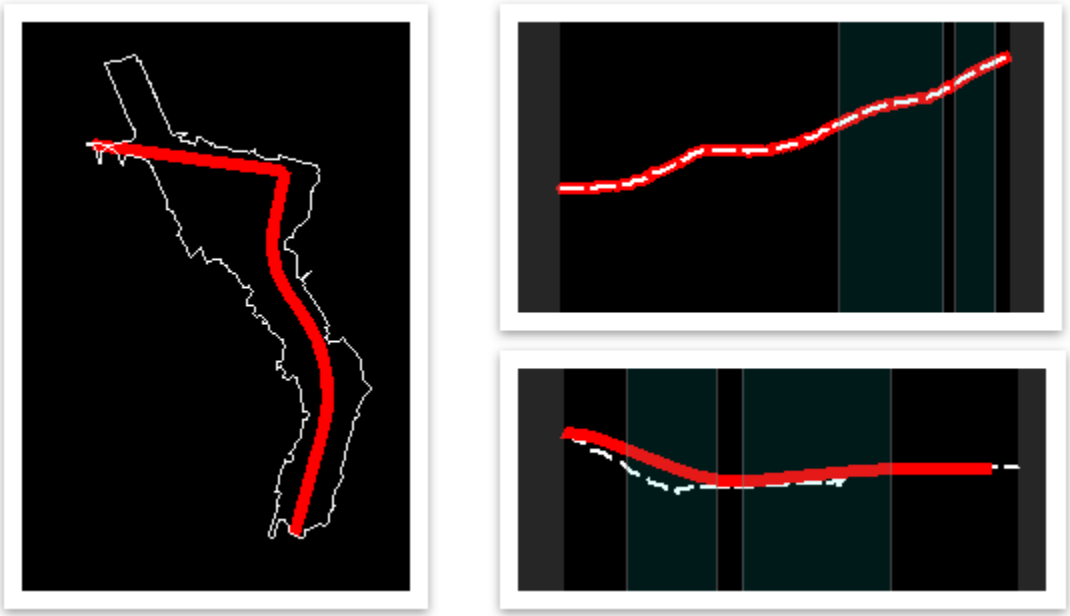
4. Select the **job32e.gpk** file within the **123456.00_INITIALS** workset dgn subfolder and click **Open**. Within the **Import Geometry** dialog box, under **Alignment >> CL**, toggle on **CALLIS >> Profile >> GRPREMCALLIS** and **GENESCO_TEST >> Profile >> GENESCOPROP**.



5. At the bottom of the dialog box, toggle on **Create Civil Rules**, which allows the element to be edited via manipulators. Also, toggle on **Assign Feature Definition** and set the **Linear Features** to **Alignment >> Prop HA Mainline**. Then, click **Import** and give it a second to process.

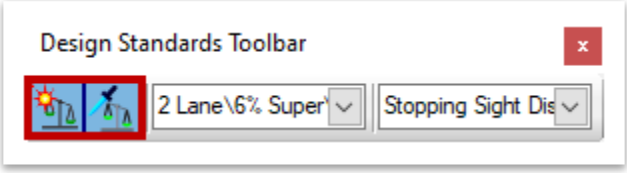


6. Click **Fit View** once again, if necessary. Confirm that both the horizontal and vertical alignments have the correct symbology, as shown below. Open the **Profile Model** for each alignment and then close the profile view windows once done.



7. Next, turn off the **GenescoAlignments.dgn** (**Default-3D**) reference file. **Note:** When utilizing the TDOTSeed2D, the 3D model is created automatically once a 3D element is created.

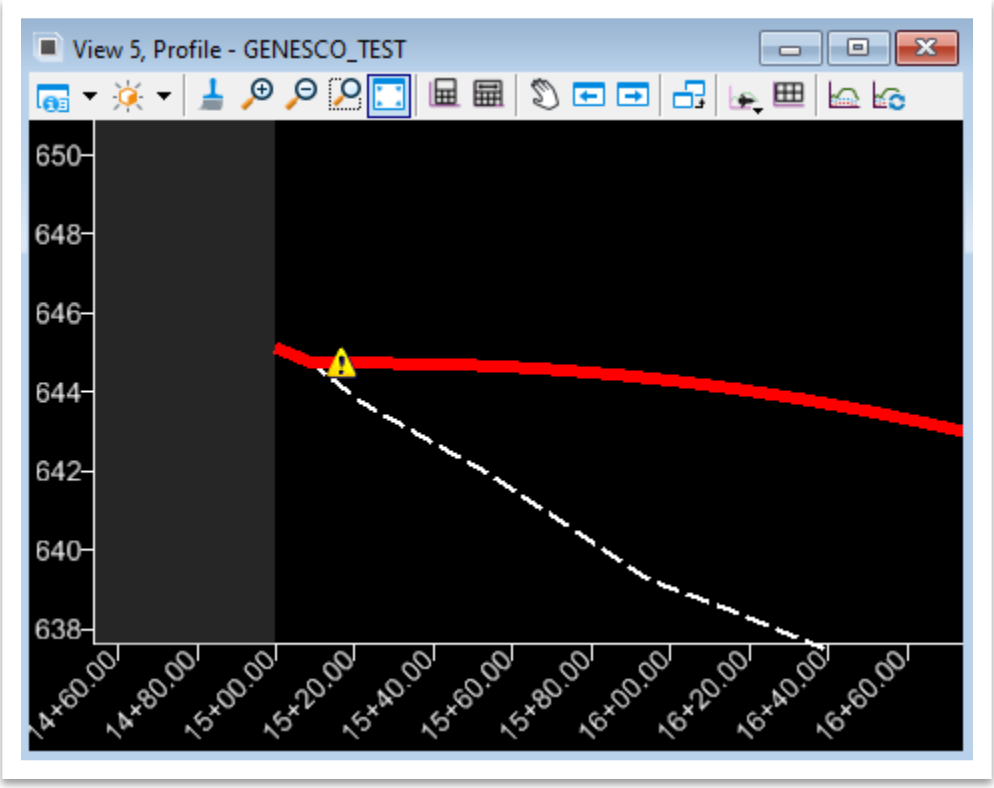
8. Like the last exercise, we will now apply the applicable **Design Standards** to the imported geometry as a check. The **Design Standard Toolbar** should still be open, but if not, go ahead and open it again (**OpenRoads Modeling >> Geometry >> General Tools >> Standards**). We will assume the same design standards as the previous horizontal and vertical exercises. Within the **Design Standards Toolbar**, click the first drop-down arrow and select the following design standard: **2 Lane (AASHTO Design Standards 2018 - Imperial Design Library) >> 6% Super >> 45 MPH**. Then, go ahead and toggle on both **Set Design Standard** and **Active Design Standard**.



9. Notice the cursor prompt: **Select Element**. Select only the **GENESCO_TEST** alignment to apply the active design standards. Open the **Element Selection** tool and then zoom in to the first horizontal curve and notice a yellow warning icon. Once again, the radius does not meet the design standard set for this alignment and would need to be adjusted. For the purpose of this exercise, we will ignore the alert.

10. Next, select the **GENESCO_TEST** alignment and then bring up the heads-up display and click the second icon to **Open Profile Model**. Open **View 5** and left click anywhere within the view. Select the proposed profile and bring up the heads-up display to make sure that the profile is set to **Active** (2nd icon). It should already be by default.

11. Lastly, apply the active design standards to the proposed profile utilizing the previous two steps. Zoom in to the beginning of the profile and once again, notice the yellow warning icon. There is also a yellow warning icon at the end of the profile. For the purpose of this exercise, we will ignore the alerts.



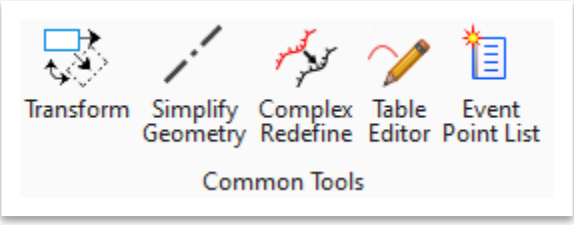
Take Note!

The civil geometry tools will be used to place proposed ROW lines and easements. We will create a proposed ROW line in Chapter 5.

4.7 Lecture: Common Tools

These tools should be used with caution and are used to simplify geometry, while also allowing for redefinition and removal of rules (Figure 58).

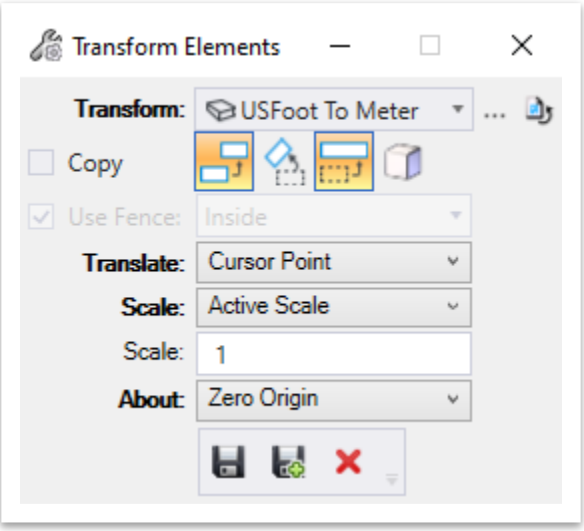
FIGURE 58. COMMON TOOLS



4.7.1 Transform

The **Transform** tool is used any time the user wants to translate, rotate or scale either regular or civil elements (Figure 59). Once civil elements are transformed, they become simplified elements, meaning if the element is a target of a rule then that rule is removed during the transformation process. A warning box appears if the civil elements are about to be transformed.

FIGURE 59. TRANSFORM ELEMENTS DIALOG BOX



4.7.2 Simplify Geometry

This tool allows the user to remove rules and intervals from horizontal and vertical geometry. In addition, it removes rules and relationships from other elements (e.g. snap rules, offset rules, etc).

4.7.3 Complex Redefine

This tool allows the user to redefine part of an existing complex alignment while preserving the name of the alignment so that all rules built off the original geometry will update with the new geometry.

4.7.4 Table Editor

This tool allows the user to edit complex alignments that have been created by defining points of intersection. The user can edit both **horizontal** and proposed **vertical** alignments (Figure 60 and Figure 61 respectively). To activate, simply select the tool and then the applicable centerline in the drawing.

FIGURE 60. ALIGNMENT TABLE EDITOR

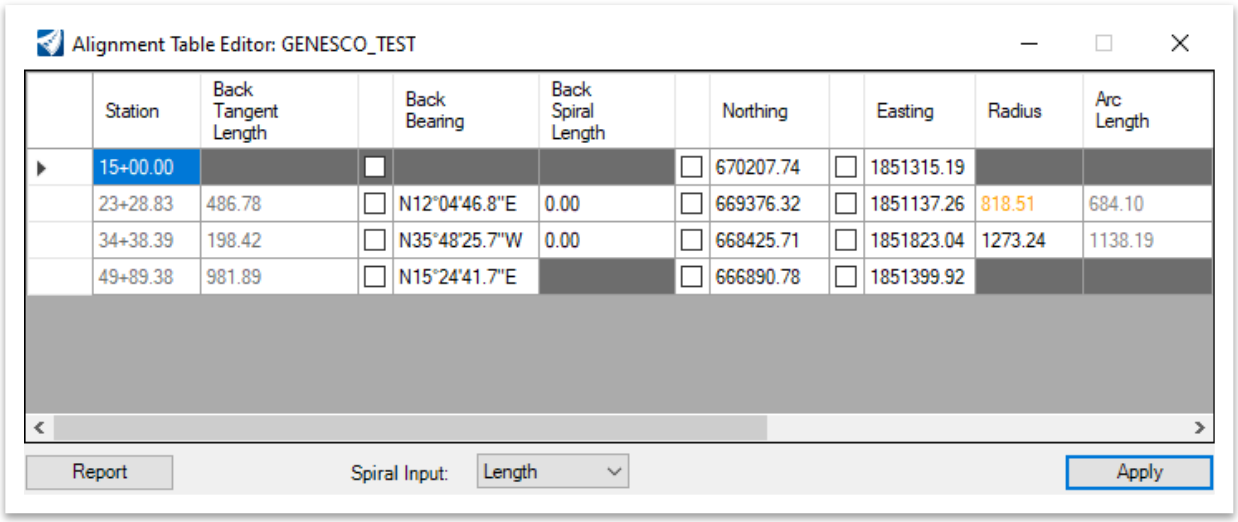
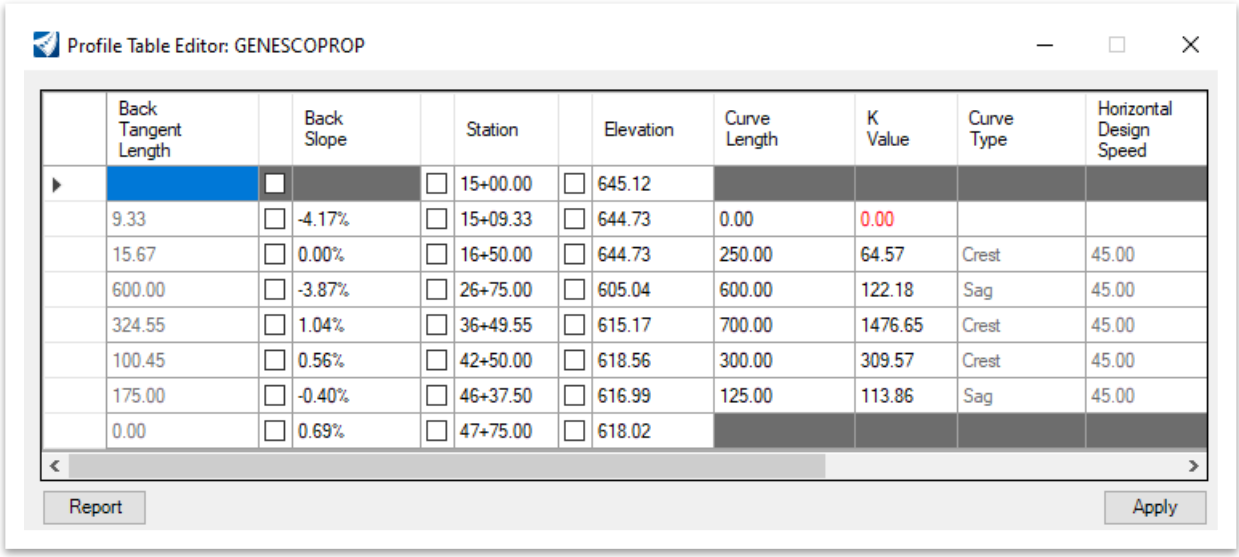


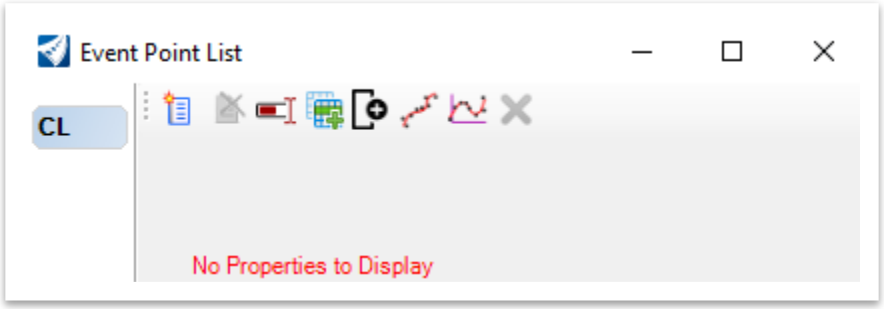
FIGURE 61. PROFILE TABLE EDITOR



4.7.5 Event Point List

This tool allows users to store specific points by **Station Offset** or **Northing Easting** as well as store both horizontal and vertical cardinal points (Figure 62). This tool is typically used in conjunction with creating specific cross sections.

FIGURE 62. EVENT POINT LIST



4.8 Lecture: Civil Annotation Tools

All civil geometry annotation placement will be done through the **Drawing Production** tab within the **OpenRoads Modeling** workflow. **Feature Definitions** have been set up to automatically annotate civil geometry using **Annotation Groups**. The feature definition **must** be set in order for both the element and model annotation tools to work. Elements placed with regular MicroStation tools **will not** be annotated using these tools. In addition, the use of the active annotation **Drawing Scale** will set all annotation to the applicable scale automatically. **Note:** The drawing scale should match the project scale.

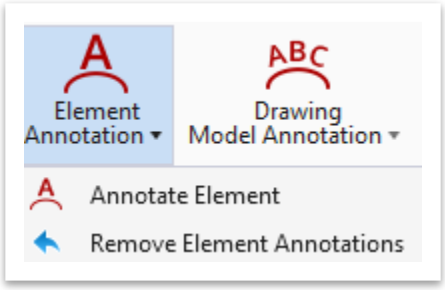
In ORD, two new levels have been setup for horizontal alignment stationing. When annotating, the software will place both sets of tick marks and stationing. The user simply must turn off the non-applicable level.

- **DES - CL - Proposed Text - Large** (50 scale or larger projects)
- **DES - CL - Proposed Text - Small** (40 scale or smaller projects)

4.8.1 Element Annotation

These tools apply or remove annotation by way of individual selection, selection sets (e.g., proposed mainline alignment) or entire models. (Figure 63). This option allows you to apply annotation to **All Elements in Model** and **Include References**. **Note:** This tool will only work in design and drawing models and will yield an alert message if utilized in sheet models.

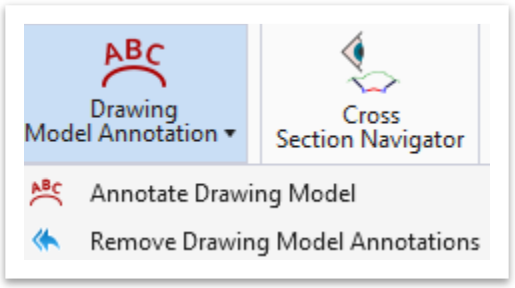
FIGURE 63. ELEMENT ANNOTATION TOOLS



4.8.2 Drawing Model Annotation

These tools apply or remove annotation of all elements within the **drawing** model at one time, such as cross section or profile views. (Figure 64). **Note:** This tool will only work in **drawing** models and will yield an alert if utilized in design or sheet models.

FIGURE 64. MODEL ANNOTATION TOOLS



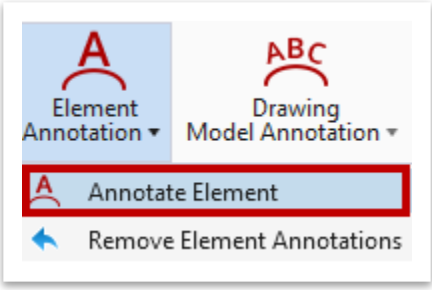
4.8.3 Exercise: Alignment Annotation

In this exercise, we will add proposed horizontal alignment annotation utilizing two different options. We will continue to use the **GenescoAlignments.dgn** file for this exercise, but if following TDOT standards, the alignments text would be in a different file.

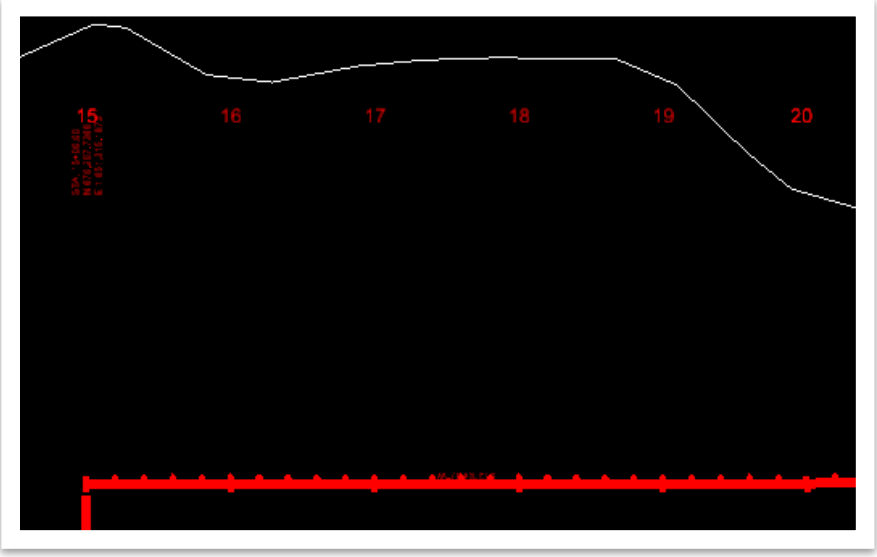
Take Note!

As a reminder, you must create a profile named boundary in order to place any profile annotation. The proposed profile annotation along the centerline will be placed automatically when the sheet models are created, utilizing the same underling annotation. You cannot add permanent annotation in the dynamic profile window.

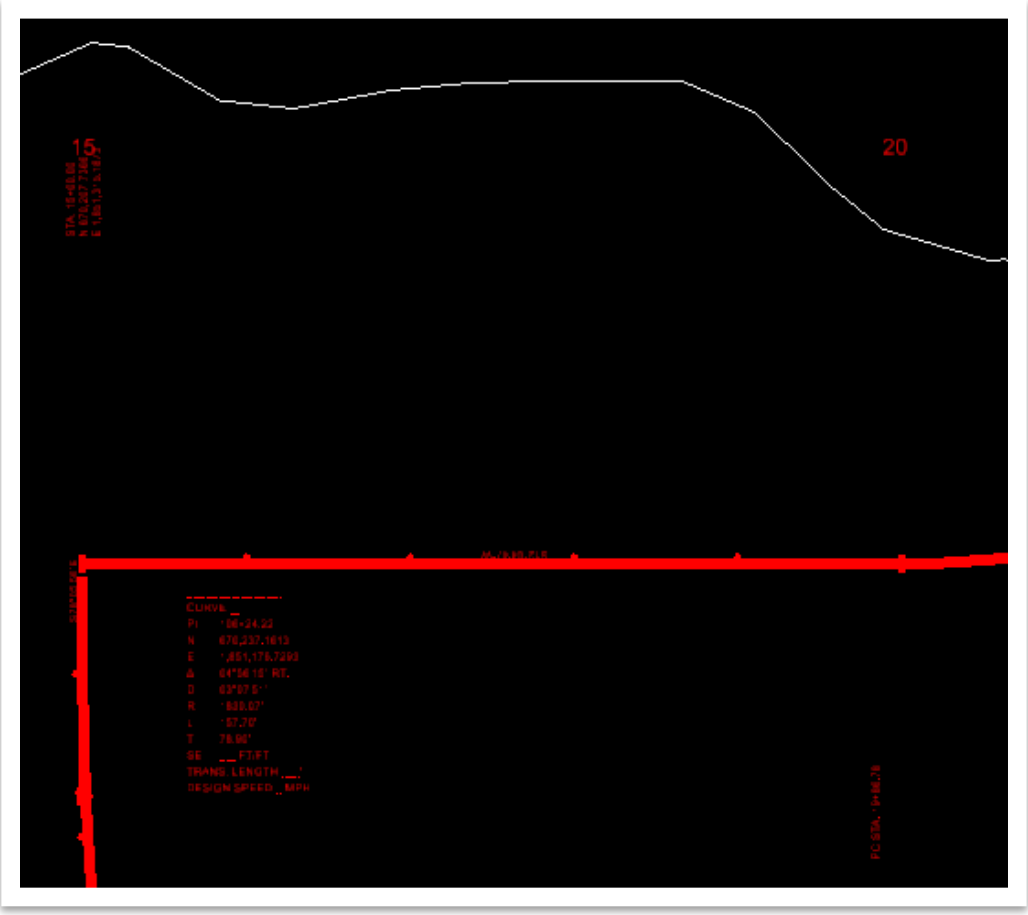
1. Go ahead and close the profile (**View 5**), and then open the **Annotate Element** tool (**OpenRoads Modeling >> Drawing Production >> Annotations >> Element Annotation**).



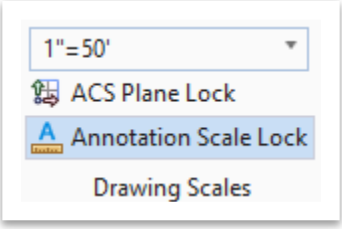
2. Notice the cursor prompt: **Locate Elements – Reset to Complete**. Select the **GENESCO_TEST** alignment and then right click to reset and accept annotation placement. Notice that the alignment annotation has been added for the selected element with the correct symbology. **Note:** The view was rotated for the purpose of the screenshot. Your view rotation does not need to match exactly.



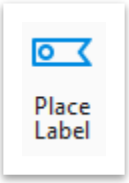
3. For this exercise, we will classify the project as **50** scale. Open the **Level Display** and turn off the **DES - CL - Proposed Text - Small** level. Zoom in and notice that the tick marks are now every **100'** and the stationing is every **500'**.



4. Make sure that the **Drawing Scale** is set to **1"=50'**, which can be accessed here: **OpenRoads Modeling >> Drawing Production >> Drawing Scales**. You can select different scales to see how the annotation changes size accordingly.



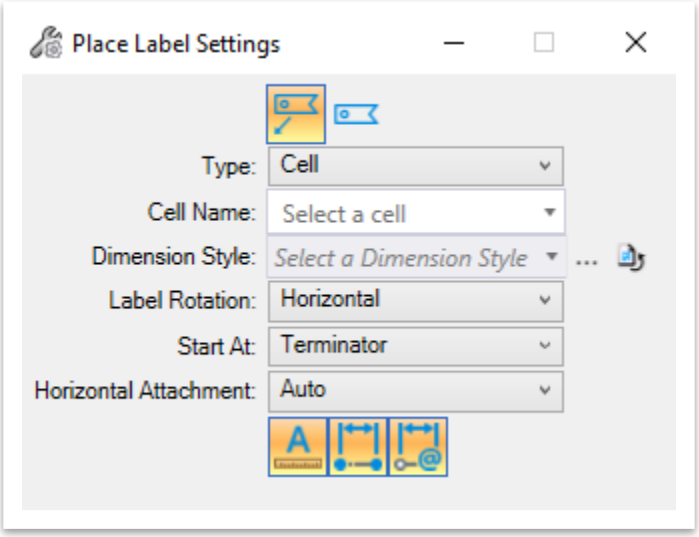
4.8.4 Intelligent Labels



All individual intelligent labels placed after your elements/models are annotated will be via the **Place Label** tool (**OpenRoads Modeling >> Drawing Production >> Notes**). Currently, you need to select the applicable **Element Template** first, which will apply the correct attributes. However, the intent is that the attributes are controlled by the cell label and dimension style selected as opposed to the Element Template. **Note:** There is a defect logged with Bentley regarding this issue. In a future software release, you should not need to select any Element Template prior to placing the label.

Element Templates were covered in the Fundamentals (ORD) Manual. By default, the Type should be set to **Cell** in the **Place Label Settings** dialog box (Figure 65). The user will select the appropriate input for each field shown below.

FIGURE 65. PLACE LABEL SETTINGS DIALOG BOX



Take Note!

*The **Civil Labeler** tool is new in 10.10 and largely replaces the Place Label tool. For more information on the Civil Labeler, see **Appendix A.6**.*

- **Place Label w/ Leader:** Used to place a label with a leader (e.g., station/offset). This is the most commonly used option.

- **Place Label w/o Leader:** Used to place a label without a leader (e.g., property line length, bearing).

- **Type:** Cell or Text Favorite. Automatic labels of both kinds have been setup as part of the TDOT workspace. Most **Text Favorites** are tied to annotation groups but will occasionally be selected here to place a label. The more common option will be a **Cell** label when utilizing the Place Label tool.
- **Cell Name / Favorite Name:** Field is dependent on the **Type** field. All cell names used here begin with an underscore (e.g. _**SUR**) and will be listed first in the drop-down menu. The software pulls from all cell libraries within the workspace so please be patient after opening the drop-down menu while the cells load.
- **Dimension Style:** The styles have been setup per TDOT standards (dimensions, text and leader properties, etc). The naming convention starts with the discipline abbreviation to align with the TDOT levels.
- **Label Rotation:** Sets the rotation of the label relative to the leader line (Horizontal, Vertical, Inline). **Note:** An enhancement has been logged with Bentley to add an **Along Element** option.
- **Start At:** Sets whether the label should start from the terminator or the cell. It is recommended setting this option to **Terminator**.
- **Horizontal Attachment:** Sets the leader attachment side (Auto, Left, Right). It is recommended setting this option to **Auto** so that your leader attachment side will be correct based on the angle of your label.
- **Annotation Scale:** Turns on the Annotation Scale. By default, this is taken from the model's annotation scale setting. It is recommended to always keep this enabled so that the labels will scale accordingly.

- **Place Label w/ Regular Association:** If this option is enabled and the Place Label w/ Relative Association is turned off, the label is placed with regular association. If you move the element, the label remains at the same place with only the leader line moving in conjunction with the element.

- **Place Label w/ Relative Association:** This option is enabled only when Place Label w/ Regular Association is enabled. If you move the element, the label will also move with it meaning that the label will stay at the same location relative to the original snap point.

Visually, you can see the linked fields (grey boxes) when placing intelligent labels, such as a proposed ROW station/offset label (Figure 66). **Note:** There is an erroneous circle that appears at the arrowhead when placing certain cell labels. This is a known annotation defect and has been logged with Bentley. Do not delete the circle or else the linked fields will disappear.

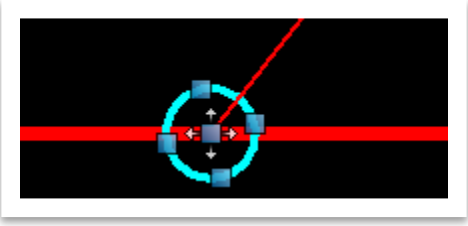
FIGURE 66. LINKED ANNOTATION FIELDS

If you associate the label with an element (e.g. centerline), the label will automatically update if the element moves regardless of whether the label is live in the file or referenced. If referenced, however, the label will not visually update until you re-open the reference file that it is in. If the associated element and label are both live in the file, then the label should update instantenously. The key for automatic updates is that the arrowhead snap point must be snapped to an element (e.g., line) as opposed to a point in space. Also, if there is no association with an element when initially placing the label, it will not update. Even after labels are placed, the user can always move the arrowhead to a new location, if necessary, and the label should then update accordingly.

Take Note!

*To move the arrowhead to a new location, you must first select it so that the blue square appears on the tip of the arrowhead (Figure 67). Normally, you would need to initiate the **Element Selection** tool and draw a square around the arrowhead for it to appear. However, since the erroneous circle exists, you can simply left click it. Then, you would left click the blue square and move the arrowhead to the new location. Of course, you could always delete the label and place it again.*

FIGURE 67. ARROWHEAD MOVEMENT

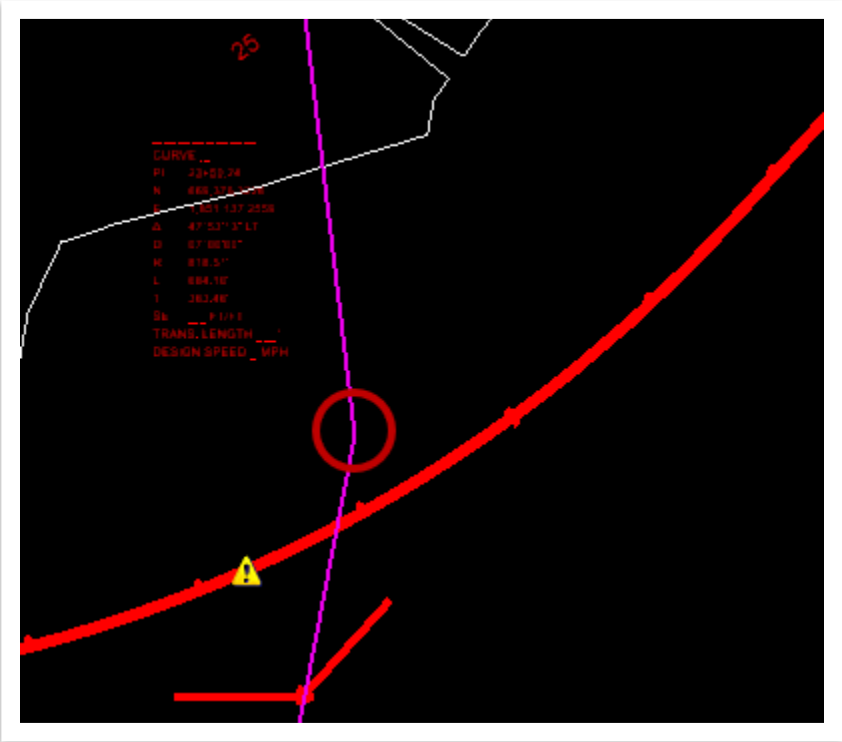


Plan labeling that is not included in the annotation groups will be placed in this manner in the survey **design** model. This method will also be used for profile labeling in the profile **drawing** model after the named boundary has been created.

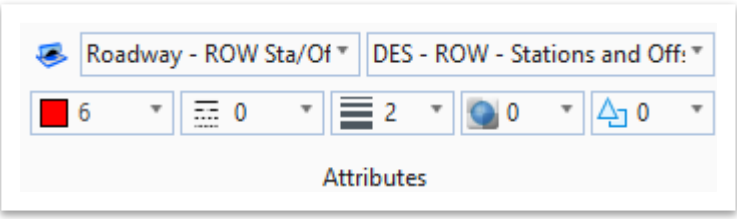
4.8.5 Exercise: Place Intelligent Label

In this exercise, we will place an intelligent ROW station/offset label and then make an alignment update to see the effect on the label. We will continue to utilize the same **GenescoAlignments.dgn** file.

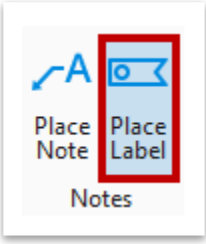
1. Attach the **WI999-11Survey.dgn** file as a reference using the **Coincident World** attachment method. Go ahead and turn off all levels except the following in the survey reference file. **Note:** This survey data was acquired pre-ORD so has old TDOT level names.
    - SURVEY - PROPERTY - Property Lines
    - SURVEY - PROPERTY - ROW Lines
2. Zoom in to the property line bend just to the left of **Sta 25** (highlighted with the red circle). **Note:** For this exercise, we will assume this is a ROW line.



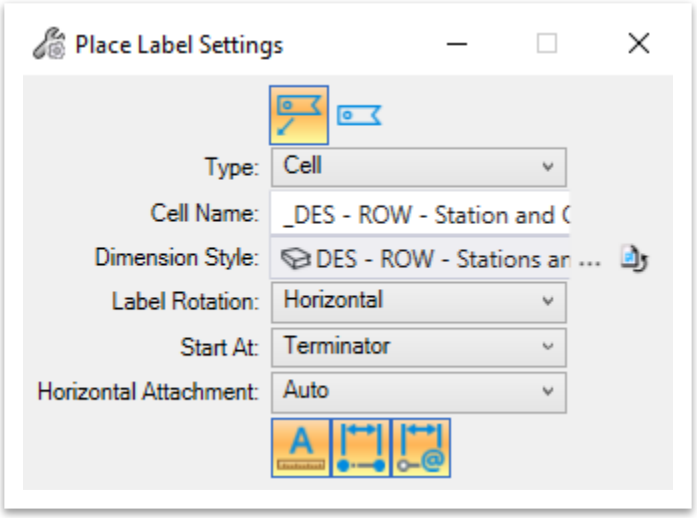
3. Next, select the **Roadway - ROW Sta/Off Text** element template (**Design >> Annotation >> Plan Sheets >> Proposed**) which will place the label with the correct symbology.



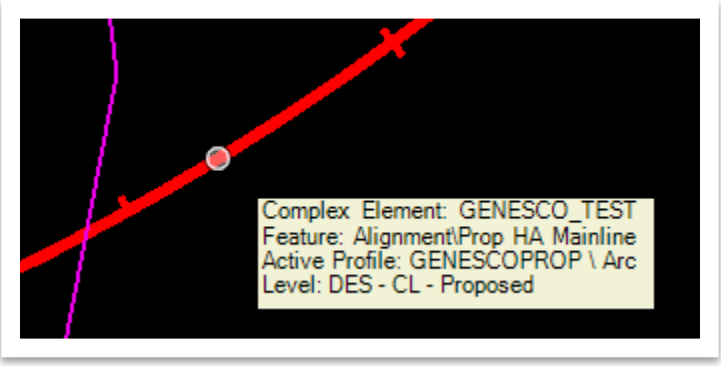
4. Now open the **Place Label** tool (**OpenRoads Modeling >> Drawing Production >> Notes**).



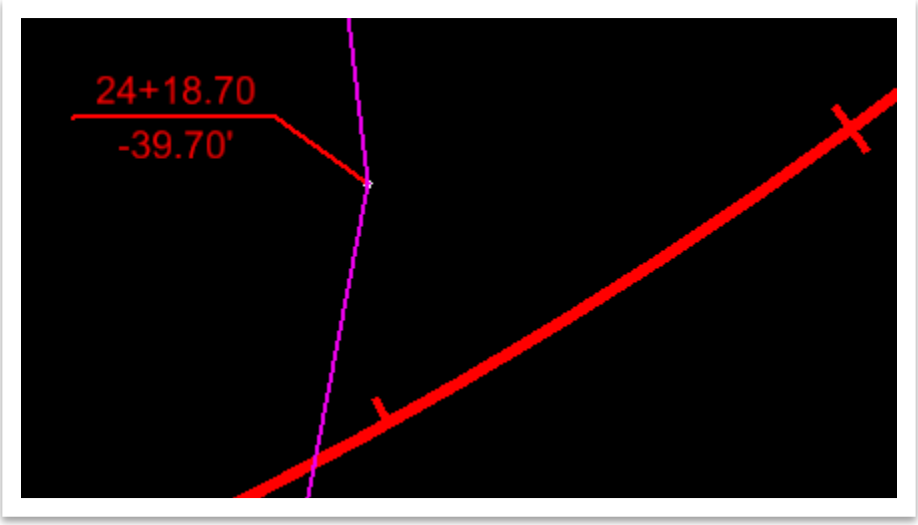
5. Within the **Place Label Settings** dialog box, select the following settings and leave the others as default. **Note:** When selecting the cell name, give the software a second to load since it is pulling from all cell libraries within the TDOT workspace.
    a. Select the **leader** icon at the top
    b. **Type:** Cell
    c. **Cell Name:** _DES - ROW - Station and Offset - FLAG
    d. **Dimension Style:** DES - ROW - Stations and Offsets
    e. **Label Rotation:** Horizontal
    f. **Start At:** Terminator
    g. **Horizontal Attachment:** Auto
    h. Keep the annotation scale and both element association icons on



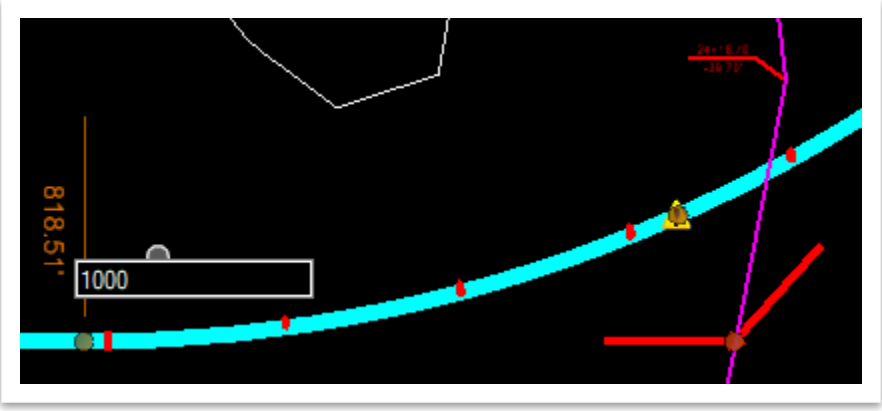
6. Notice the prompt in the lower left corner: **Identify Element or DataPoint**. Select the **GENESCO_TEST** alignment, which is the element that you want the sta/off label to be based off.



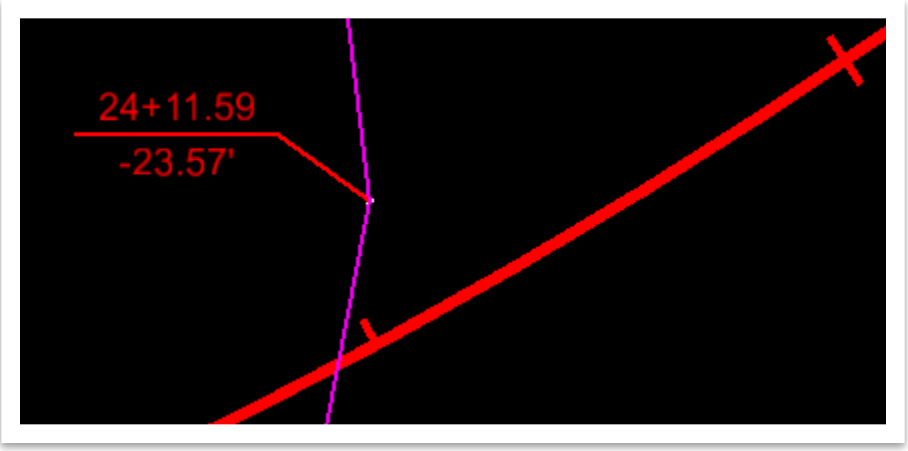
7. Notice the next prompt in the lower left corner: **Select Point Location**. Snap to the bend and then left click anywhere on the left side of the property line to place the label. You should get **24+18.70** / **-39.70'** for the Sta/Off. **Note:** The location of the label is based on where you move your cursor. Also, the label **will not** populate with the correct data until you have physically accepted the placement of the label.



8. Now that the label has been placed, let's make a modification to the **GENESCO_TEST** alignment. Select the alignment and notice the orange dynamic geometric data. Simply left click on the radius text (**818.51'**) and key-in a revised radius of **1000'**. Then, hit **Enter** or left click anywhere within the drawing window to accept the update.



9. Zoom in to the ROW Sta/Off label that was previously placed and notice that it updated, and the label now reads **24+11.59** / **-23.57'**.

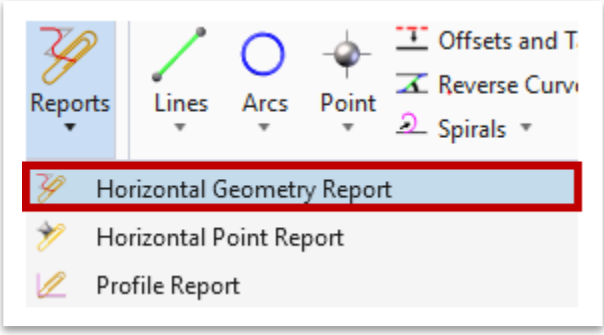


10. Now that you have observed the update, go ahead and change the alignment radius back to **818.51'** (following Step 8), and then delete the ROW Sta/Off label. Click **File >> Save Settings** and **File >> Save**.

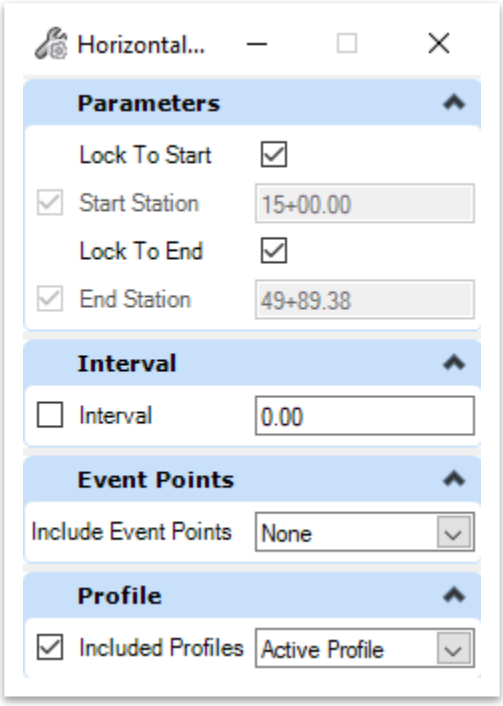
4.9 Exercise: Report Generation – Civil Geometry

In this exercise we will generate horizontal and vertical geometry reports. While these reports are not a TDOT submittal requirement, they serve as a good summarization when performing design quality control. We will continue to utilize the same **Genesco Alignments.dgn** file.

1. Open the **Horizontal Geometry Report** tool (**OpenRoads Modeling >> Geometry >> General Tools >> Reports**). **Note:** Only a portion of the report options are shown in the screenshot.

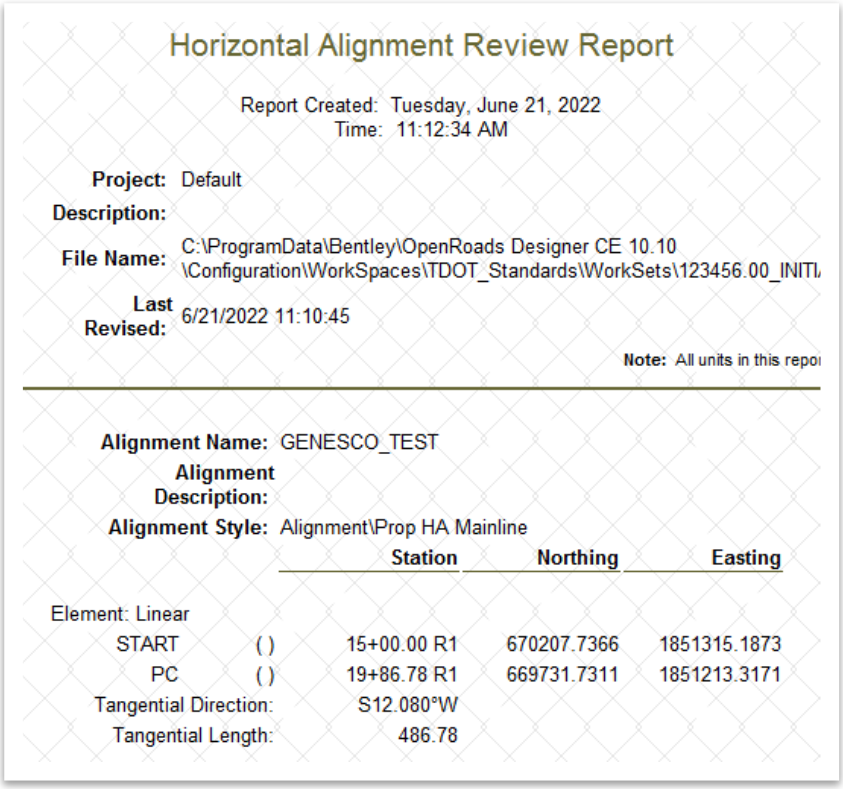


2. Within the **Horizontal Geometry Report** dialog box, select the following settings:
   a. **Lock To Start/End:** Toggle ON (**Note:** Ignore if your station fields look different. They will update automatically once the next steps are taken.
   b. **Interval:** 0.00 / **Include Event Points:** None / **Included Profiles:** Active Profile



3. Notice the cursor prompt: **Locate First Element**. Select the **GENESCO_TEST** alignment and then right click to complete.

4. Notice the next cursor prompt: **Locate Next Element – Reset To Complete**. You could select additional alignments to add to the report, but for this exercise, go ahead and right click to complete.
5. Left click to accept the remaining prompts and the **Horizontal Alignment Review Report** should automatically open (within the **Bentley Civil Report Browser**). **Note:** If you hadn't toggled on **Lock To Start/End**, you could have selected specific points graphically when prompted or keyed-in a station range within the dialog box. Also, if your report formatting needs updating (e.g., number of decimal places, station formatting, etc), go to **Tools >> Format Options** within the **Bentley Civil Report Browser**



Horizontal Alignment Review Report

Report Created: Tuesday, June 21, 2022
Time: 11:12:34 AM

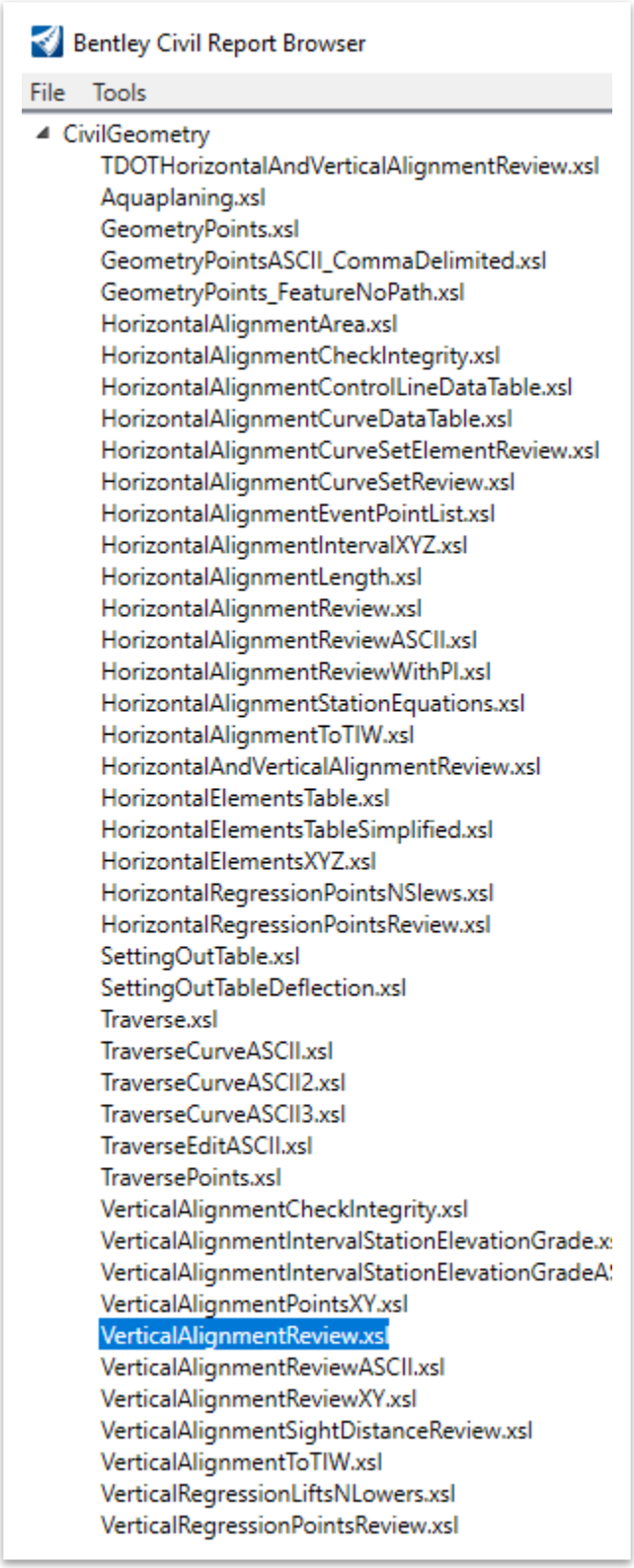
Project: Default
Description:
File Name: C:\ProgramData\Bentley\OpenRoads Designer CE 10.10 \Configuration\WorkSpaces\TDOT_Standards\WorkSets\123456.00_INITI
Last Revised: 6/21/2022 11:10:45

Note: All units in this repo

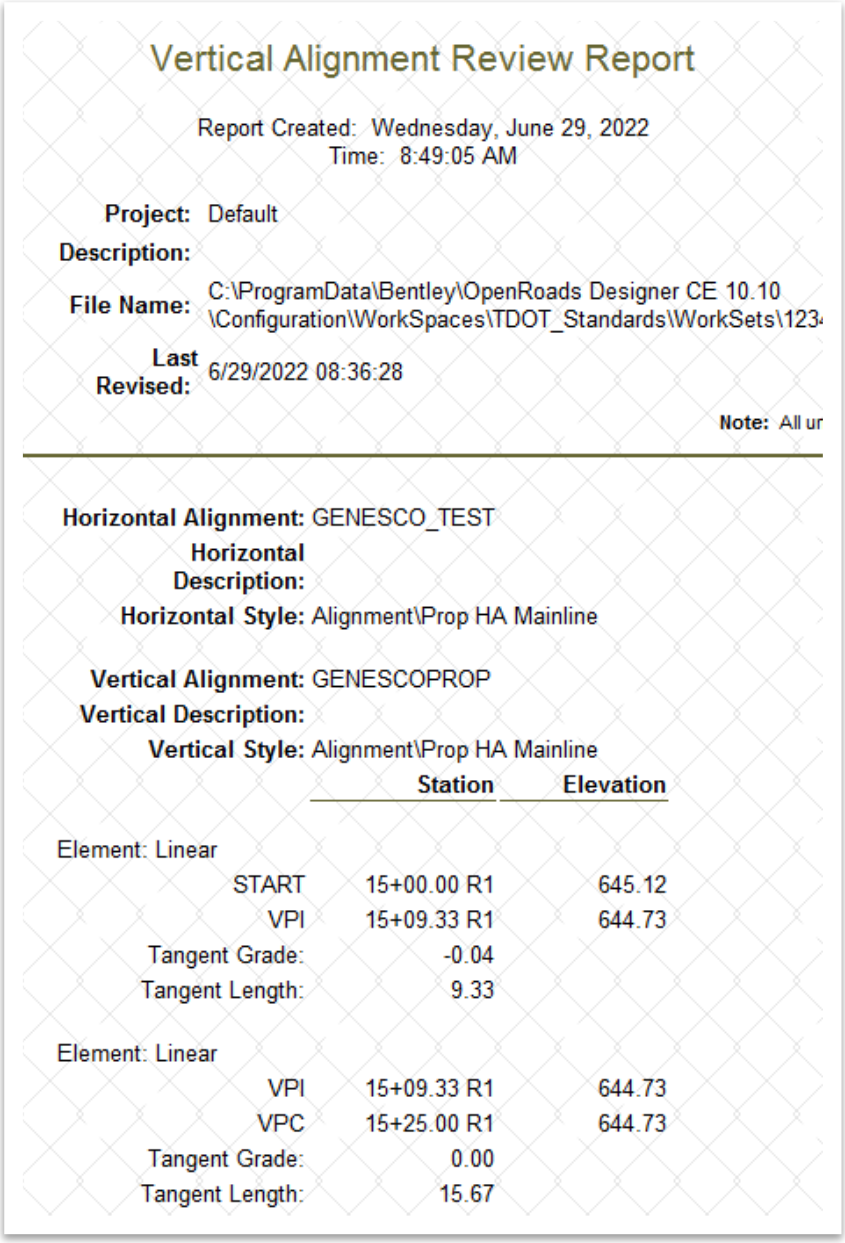
Alignment Name: GENESCO_TEST
Alignment Description:
Alignment Style: Alignment\Prop HA Mainline

		Station	Northing	Easting
Element: Linear				
START	( )	15+00.00 R1	670207.7366	1851315.1873
PC	( )	19+86.78 R1	669731.7311	1851213.3171
Tangential Direction:		S12.080°W		
Tangential Length:		486.78		

6. Next, let's look at the **Profile Report**. Within the **Bentley Civil Report Browser**, scroll down on the left side and left click on **VerticalAlignmentReview.xsl**.



7. Notice that the **Vertical Alignment Report Review** now appears for **GENESCO PROP**.



Vertical Alignment Review Report

Report Created: Wednesday, June 29, 2022
Time: 8:49:05 AM

Project: Default
Description:
File Name: C:\ProgramData\Bentley\OpenRoads Designer CE 10.10 \Configuration\WorkSpaces\TDOT_Standards\WorkSets\123
Last Revised: 6/29/2022 08:36:28

Note: All ur

Horizontal Alignment: GENESCO_TEST
Horizontal Description:
Horizontal Style: Alignment\Prop HA Mainline

Vertical Alignment: GENESCOPROP
Vertical Description:
Vertical Style: Alignment\Prop HA Mainline

	Station	Elevation
Element: Linear		
START	15+00.00 R1	645.12
VPI	15+09.33 R1	644.73
Tangent Grade:	-0.04	
Tangent Length:	9.33	
Element: Linear		
VPI	15+09.33 R1	644.73
VPC	15+25.00 R1	644.73
Tangent Grade:	0.00	
Tangent Length:	15.67	

Take Note!

*If this report is not automatically generated, open the **Profile Report** tool (**OpenRoads Modeling >> Geometry >> General Tools >> Reports**) and select the applicable profile in profile view to generate the report.*

Chapter 5. Introduction to Corridor Modeling

The primary Corridor Modeling tools are located under the **Corridors** tab in the OpenRoads Modeling workflow. These are the necessary tools to model a corridor and make minor edits, if necessary.

Corridor Modeling utilizes all civil data stored in the files up-to this point (existing terrain, horizontal, and vertical alignments) to apply templates (typical sections). This will allow the software to draw the 2D roadway linework, as seen on plan sheets, as well as the applicable 3D solids and surfaces. The **templates** are made of these solids and surfaces called **components** and are controlled using **constraints**. Constraints can be manipulated within a given template before placement or after corridor placement utilizing the **Edit Corridor** tools.

Superelevation will be covered in Chapter 6. More sophisticated corridor controls and edits are covered in the Roadway Design II (ORD) Manual.

5.1 Objectives

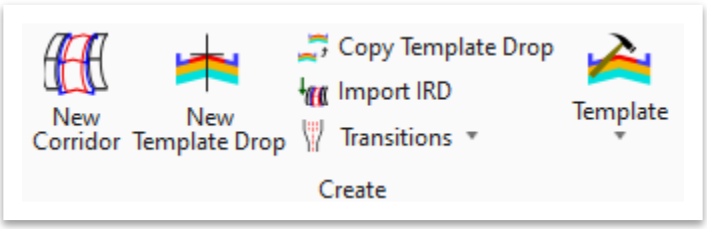
At the conclusion of this chapter, participants will be able to:

1. Create a corridor.
2. Navigate through the TDOT template library to find individual templates.
3. Create and edit a template drop.
4. Open dynamic cross sections.
5. Place a proposed ROW line (single offset of the corridor and manually).

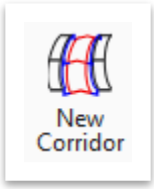
5.2 Lecture: Create Tools

Corridor design is a **model-centric** approach to roadway design, and it uses standard templates to define all the cross sectional parameters, such as pavement design, median barriers, shoulders, curb and gutter, and side slope conditions (Figure 68).

FIGURE 68. CREATE TOOLS



5.2.1 New Corridor



This tool is the first step in corridor design, and it allows the user to identify the controlling alignment, set the feature definition and name the corridor. Once the corridor has been created, the software automatically advances to the **New Template Drop** tool.

5.2.2 Heads-Up Display – Corridors

Once a corridor has been created, the user can utilize the heads-up display to access all the corridor tools (Figure 69). To access the heads-up display, select and hover over one of the corridor handles (tick marks perpendicular to the corridor on each side of the corridor).

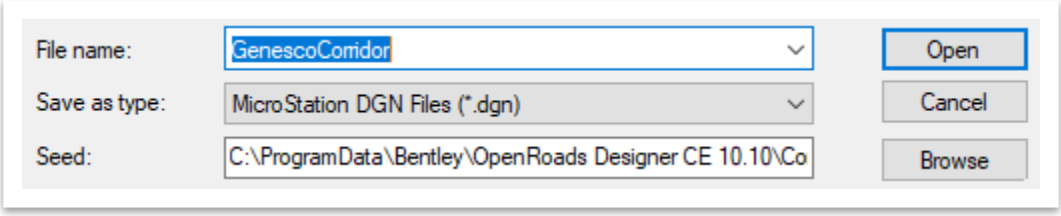
FIGURE 69. HEADS-UP DISPLAY – CORRIDORS

1. **Properties:** Opens the properties window for the selected element.
2. **Corridor Views:** Opens cross section models.
3. **Corridor Reports:** Allows access to some commonly used corridor reports such as Corridor Component Quantities, Design Input Report, Results Report, Milling Report.
4. **Corridor Overlay:** Used to adjust vertical alignments of corridors to optimize a vertical alignment for milling/overlay designs.
5. **Corridor References:** Add or remove corridor references and clipping references.
6. **Corridor Creation Tools:** Allows access to some commonly used corridor creation tools such as Corridor Objects, Create Template Drop, Create Transition, Create Secondary Alignment, Define Target Aliasing, Create Parametric Constraint, Create End Condition Exception, Create Point Control, Create Curve Widening, Key Station, and Assign Superelevation to Corridor**.**
7. **Process Corridor:** Forces the software to re-process the corridor. This is useful if an element that effects the template drop changes (e.g., terrain), but the model has not updated yet.
8. **Lock – Deactivate Rule:** Deactivates rules on the corridor.
9. **Zoom To:** Zooms to the selected corridor.
10. **Delete:** Deletes the selected element.

5.2.3 Exercise: Create a Corridor

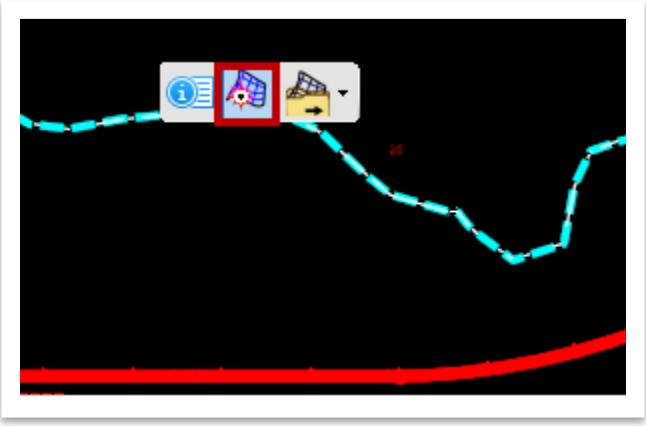
In this exercise, we will create a new corridor that will be the basis for the template drop.

1. Create a new file and name it **GenescoCorridor**. Select the **TDOTSeed2D.dgn** and click **Save**.

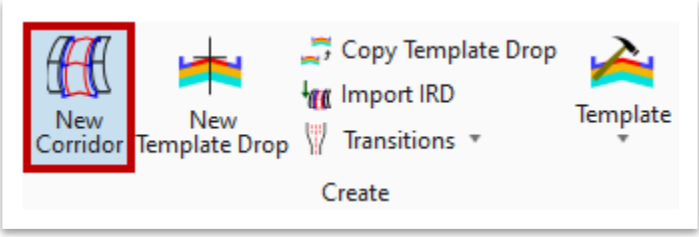


2. Attach the following reference files using the **Coincident World** attachment method. **Note:** At minimum, an existing terrain and an alignment are necessary to create a corridor).
    - GenescoAlignments.dgn (turn off **DES - CL - Proposed Text - Small** level)
    - GenescoExistingTerrain.dgn (turn off triangles)
    - WI999-11Survey.dgn (turn off if preferred)
3. Click **Fit View** and notice the linework from the previous exercises. **Note:** The view was rotated once again for the purpose of the screenshot. Your view rotation does not need to match exactly.

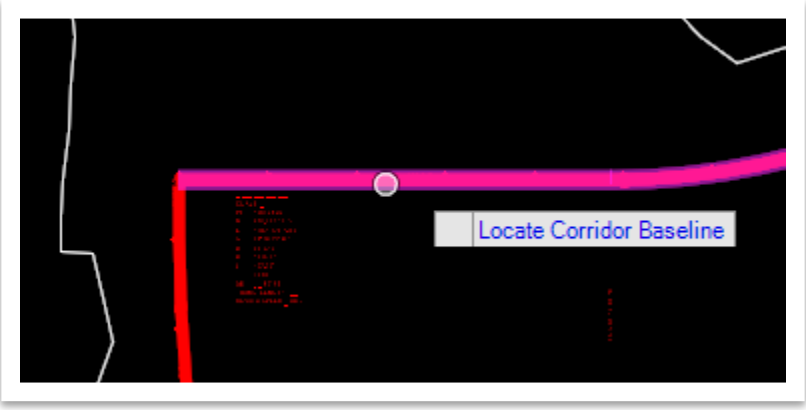
4. Next, left click the existing **terrain boundary**, and within the heads-up display, set the terrain as **Active**.



5. Now, open the **New Corridor** tool (**OpenRoads Modeling >> Corridors >> Create**).

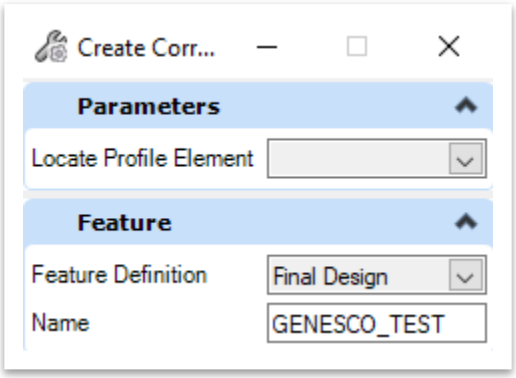


6. Notice the cursor prompt: **Locate Corridor Baseline**. Select the **GENESCO_TEST** alignment as the corridor baseline.

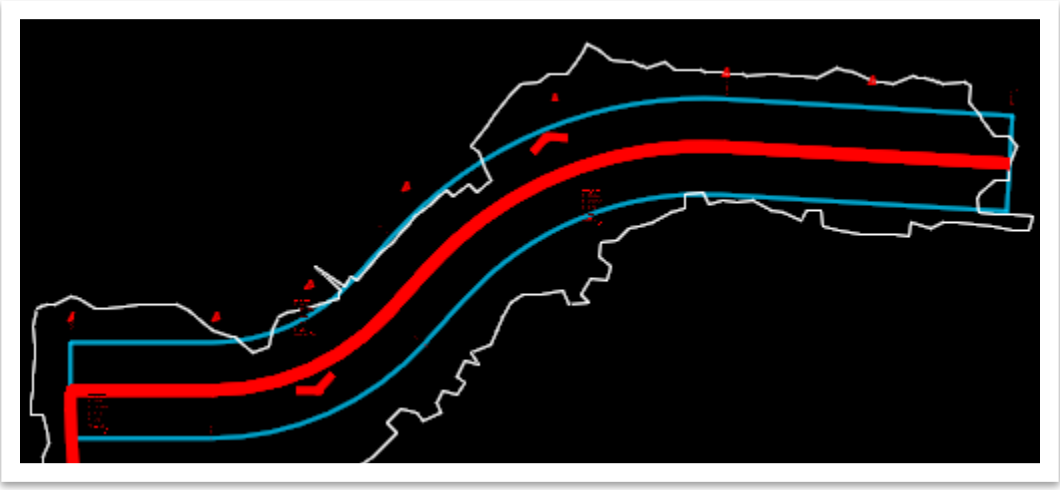


7. Notice the next cursor prompt: **Locate Profile-Reset For Active Profile**. Right click to use the active profile.

8. Within the **Create Corridor** dialog box, select the following settings.
    a. **Locate Profile Element:** Leave blank since we are using the active profile (If desired, you can select other saved profiles for a given alignment.)
    b. **Feature Definition:** Final Design
    c. **Name:** GENESCO_TEST (This will auto populate based on the selected alignment but will clear out if you change the feature definition.)



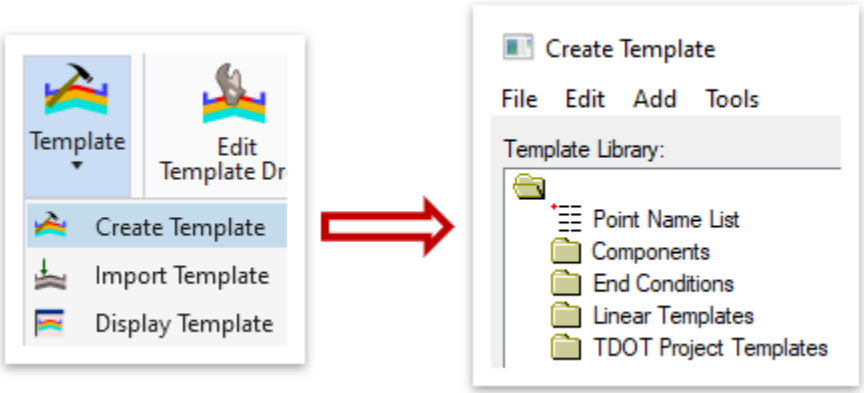
9. Left click to accept the settings and then notice that a blue corridor boundary is drawn in the file. Also, the **Create Template Drop** dialog box should automatically open, which would normally be the next step in the process. Go ahead and right click to close the dialog box for now. We will create a template drop in the next exercise after discussing the tool.



5.2.4 The Template Library

The template library contains the standard templates based on TDOT standard drawings and should serve as a strong foundation for all roadway design in ORD. To access the library, open the **Create Template** tool (**OpenRoads Modeling >> Corridors >> Create >> Template**) (Figure 70). Template edits will need to be made based on specific project scenarios. This will be covered in Chapter 9.

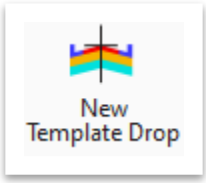
FIGURE 70. CREATE TEMPLATE TOOL AND LIBRARY



The TDOT template library contains four main folders: **Components**, **End Conditions**, **Linear Templates** and **TDOT Project Templates**.

- **Components:** Contains components of an overall typical section, which are used to build the roadway templates that align with the TDOT **RD11** standard drawings. These components can also be used by designers to modify a TDOT standard template. Examples of components are asphalt pavement layers, shoulders, curb and gutter, median barriers, etc.
- **End Conditions:** Typical section elements that are used to build side slope conditions, such as fills, cuts, ditches, berms, etc.
- **Linear Templates:** Contains all standard templates available in the library for placement along a linear element. These include TDOT typical sections, bridges, driveways, box culverts etc.
- **TDOT Project Templates:** An empty folder that serves as a placeholder for project specific templates. For an actual project, designers should copy any required standard TDOT template(s) into this folder and make the necessary edits to meet project specifications.

5.2.5 New Template Drop



This tool allows the user to apply a template (cross section) along a corridor. Template drop **limits** are defined by station ranges, which allow the user to have multiple different templates on the same corridor. If two different template drops are utilized, a **transition** would be necessary, which is covered in the Roadway Design II (ORD) Manual.

Drop Intervals specify the distance between each processed template in the model, which is essentially the length of interpolation or extrusion. TDOT recommends setting the drop interval at **25 feet** to improve slope line accuracy without slowing the model down significantly. The more frequent the drop interval, the slower the model will run and ultimately update.

Take Note!

If greater accuracy over a certain area is desired, it is recommended to utilize a separate template drop that has a smaller drop interval rather than change the drop interval for the entire corridor.

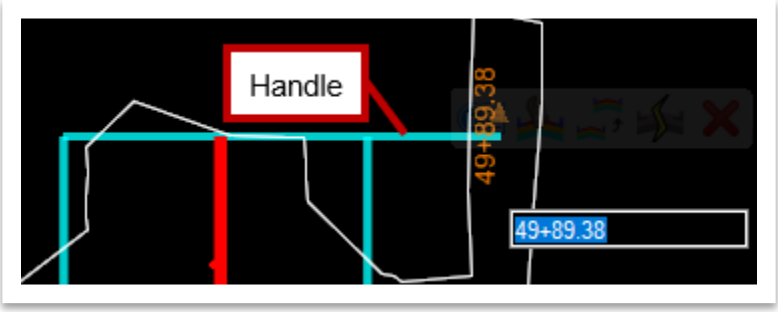
Likewise, if accuracy is required at spot locations, designers can utilize key-stations to force a template drop at the desired location.

To create a new template drop, the user would follow these steps:

1. Select a corridor in the drawing (which will be automatically selected if continuing from the New Corridor tool).
2. Select a template from the library.
3. Define a station range and enter a drop interval.

Once the template drop has been created, its location can be edited. Template drop **handles** (Figure 71) allow the start and end stations to be edited by **key-in** or **dynamic placement**. If two separate template drops are next to each other, both handles must be updated individually. The template drop also has a **heads-up display** menu that allows the user to see its properties or edit the template drop.

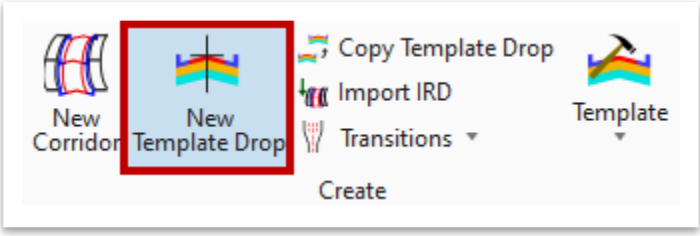
FIGURE 71. TEMPLATE DROP HANDLE



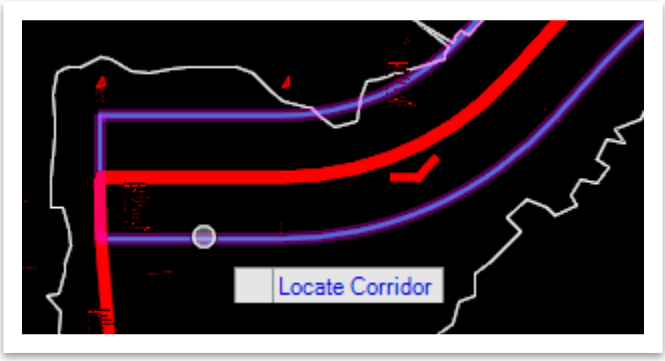
5.2.6 Exercise: Create a Template Drop

In this exercise, we will create a template drop along the corridor. We will continue to utilize the same **GenescoCorridor.dgn** file.

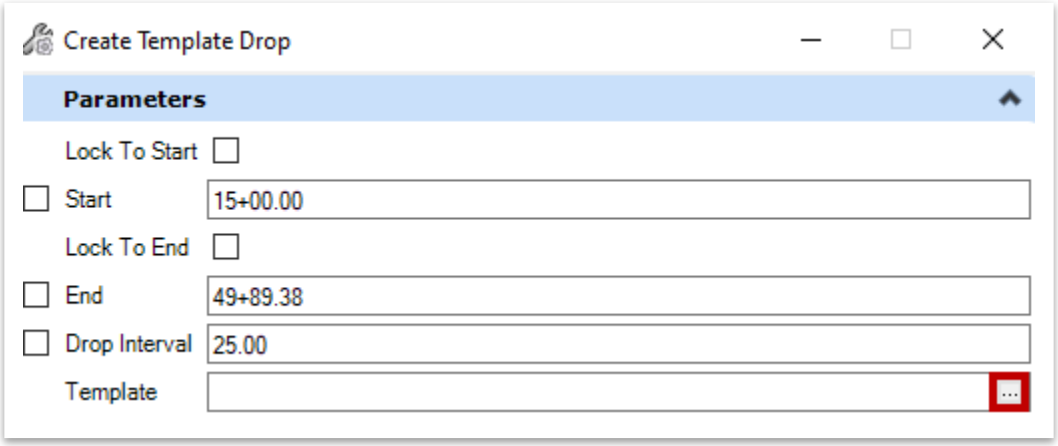
1. Open the **New Template Drop** tool (**OpenRoads Modeling >> Corridors >> Create**).



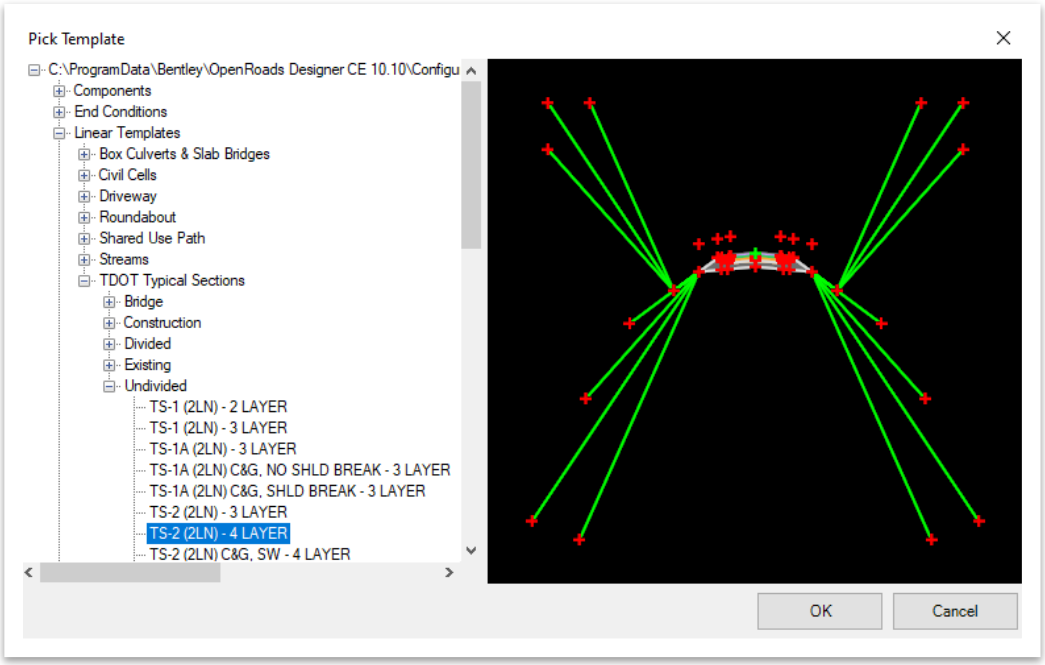
2. Notice the cursor prompt: **Locate Corridor**. Select the blue corridor boundary.



3. Within the **Create Template Drop** dialog box, select the following settings. **Note:** You could also follow the cursor prompts to select the settings before accepting each one.
    a. First let's select the template. Click the ellipses next to the **Template** field. **Note:** If you have varying data in the fields below, ignore for now and we will address as we go through this step.



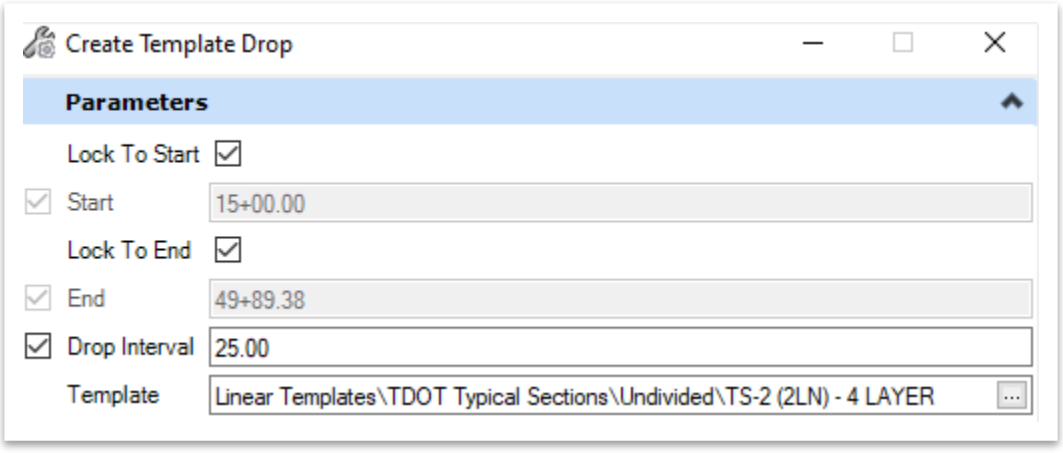
b. Select template **TS-2 (2LN) - 4 Layer** (**Linear Templates >> TDOT Typical Sections >> Undivided**) and then click **OK** and then left click to accept the template.



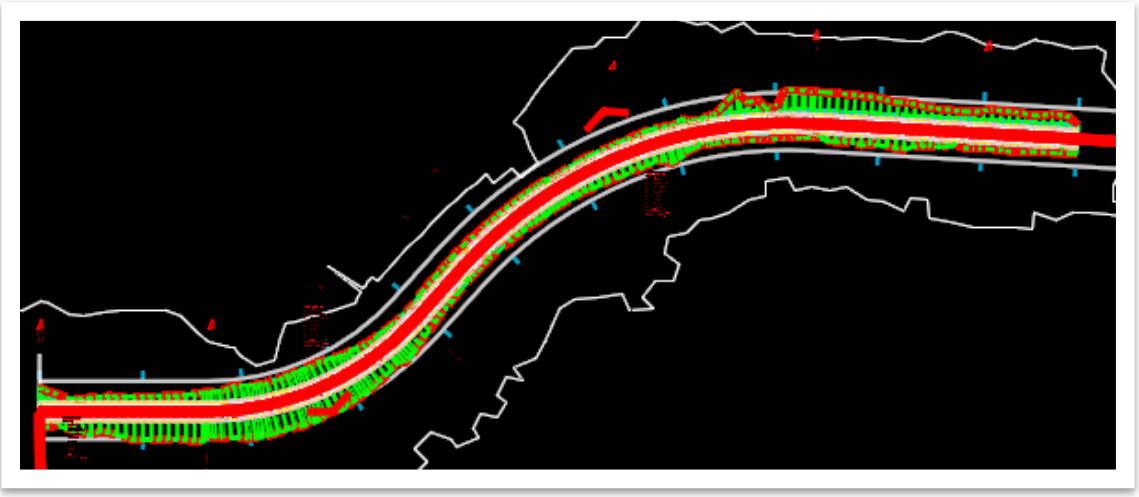
c. **Lock To Start:** Checkmark (**15+00.00**) (You could also lock the template drop to the start by hitting the **ALT** key within the cursor prompt.)

d. **Lock To End:** Checkmark (**49+89.38**) (You could also lock the template drop to the end by hitting the **ALT** key within the cursor prompt.)

e. **Drop Interval:** 25.00



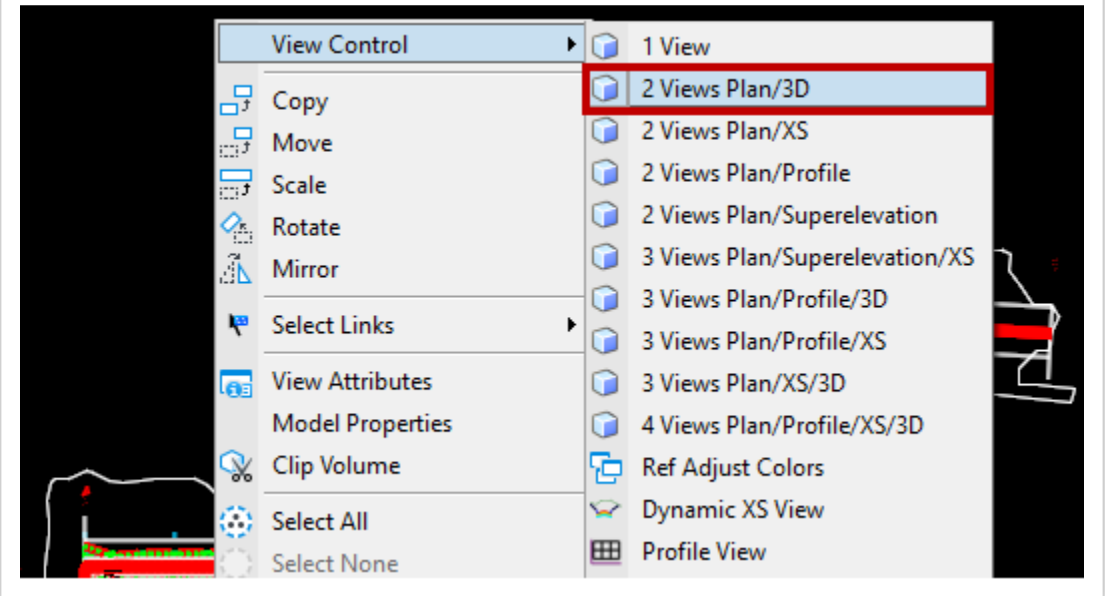
4. Left click through the prompts to accept the settings and give it a second to process. Notice that the template drop placed along the corridor.

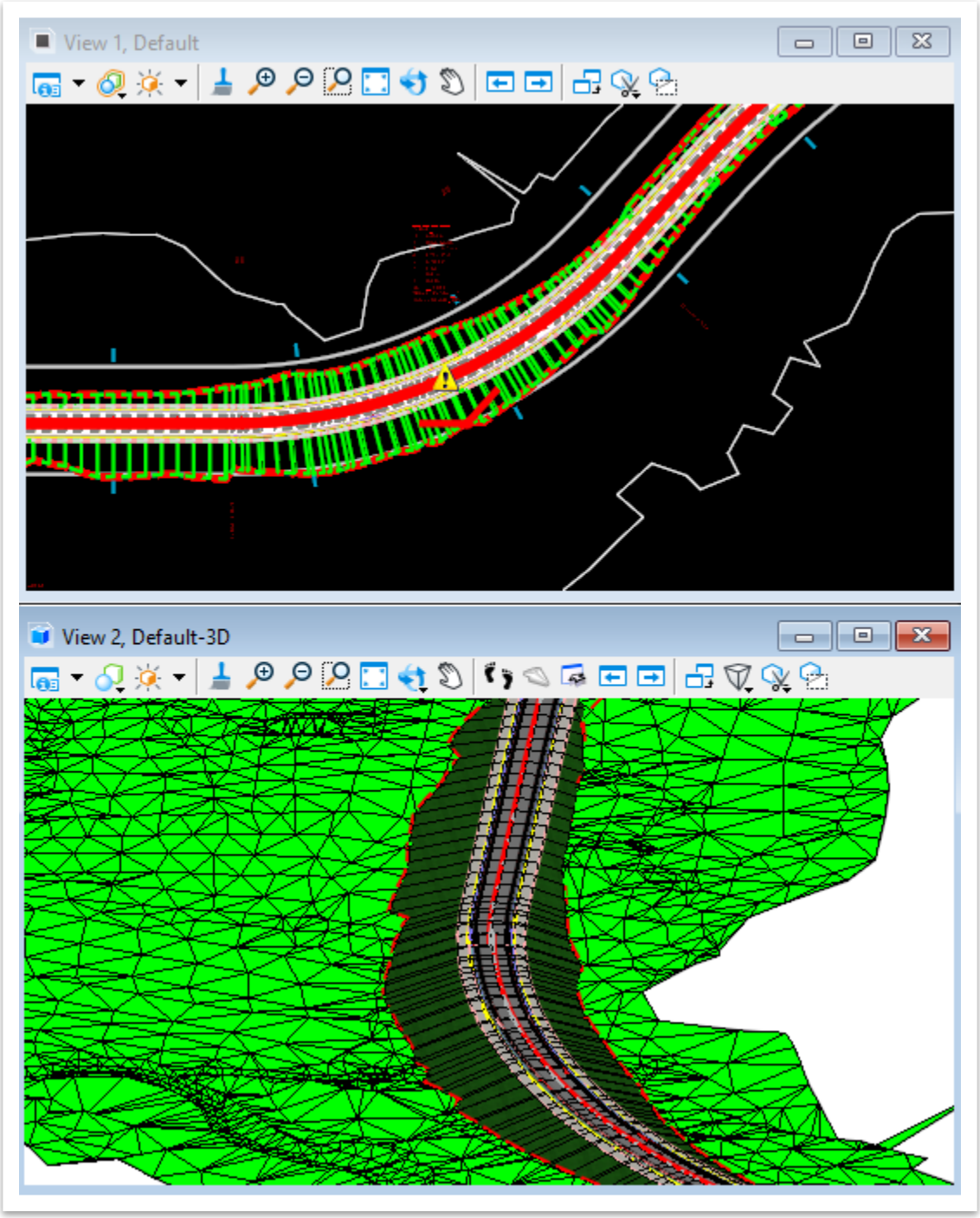


Take Note!

*The template drop interval can be edited at any time through the **Corridor Objects** tool, which will be described in Section 5.3.4. It can be opened by going to **OpenRoads Modeling >> Corridors >> Edit**.*

5. Review the template drop along the corridor in both **2D** and **3D** views. Right click and hold anywhere within **View 1** and select **View Control >> 2 Views Plan/3D** to open the split 2D/3D views, which are shown on the next page. Close the **3D** view once you are done reviewing. **Note:** The images have been stacked to better fit on the page.





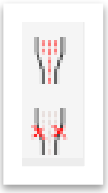
Take Note!

*Users can override the symbology of the terrain in the **3D** view to turn off the triangles and make the view more legible. It is recommended to turn the **display off for all features** in the **existing terrain file** and then save settings before exiting the file to keep from having to override symbology in every file that the terrain is referenced in.*

5.2.7 Copy Template Drop

This tool allows the user to **copy** an existing template to a new station range on the same alignment within the same corridor.

5.2.8 Transitions

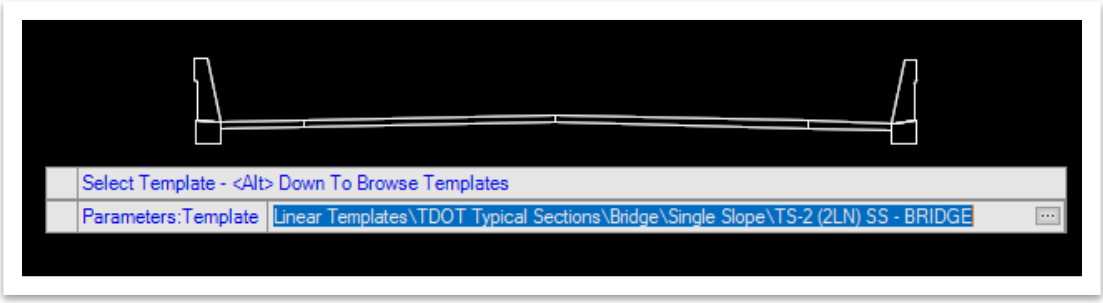


This tool allows the user to create a **transition** between two template drops. There must be a **gap** in the corridor without a template drop in order to use this tool. The transition section has its own handles allowing the user to change the length after it has been placed. The user can also edit how the backbone points of the first template connect to the backbone points of the second template. **End condition transitions** are managed by end condition exceptions.

5.2.9 Import and Display Template

The other **Template** tools are **Import Template** and **Display Template** (2nd and 3rd icons). The **Display Template** tool allows the user to place a sketch of the selected template in the drawing (Figure 72).

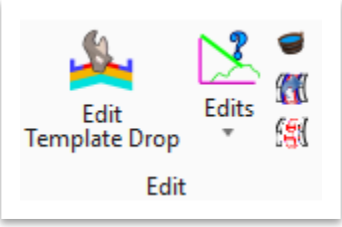
FIGURE 72. DISPLAY TEMPLATE PROMPT AND TEMPLATE PLACEMENT IN DRAWING



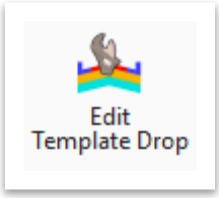
5.3 Lecture: Corridor Edit Tools

These tools allow the flexibility to edit a roadway design by adding complexity and new parameters. A user can also review corridor properties, and process and re-attach corridors (Figure 73).

FIGURE 73. CORRIDOR EDIT TOOLS



5.3.1 Edit Template Drop

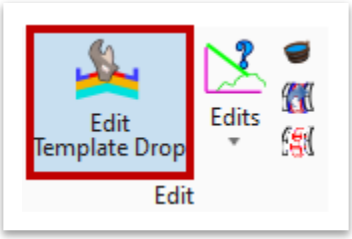


This tool allows the user to **modify** a specific template drop. It will open the current template library displaying the selected template drop that can then be edited. For example, the user may want to add an end condition slope along the entire template drop. These edits are not recommended because the resulting template is not saved within the project ITL. For projects, it is recommended to make edits to the template within the project ITL and then re-sync the template drop with the ITL.

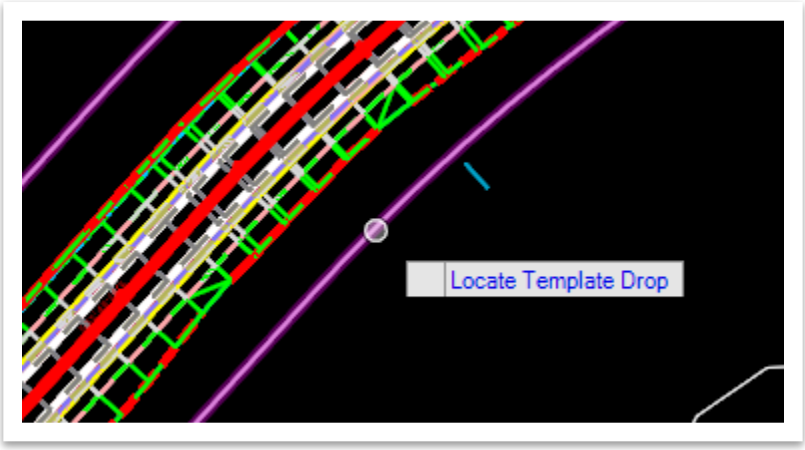
5.3.2 Exercise: Edit a Template Drop

In this exercise, we will edit the template that was placed in the previous exercise. We will continue to utilize the same **GenescoCorridor.dgn** file.

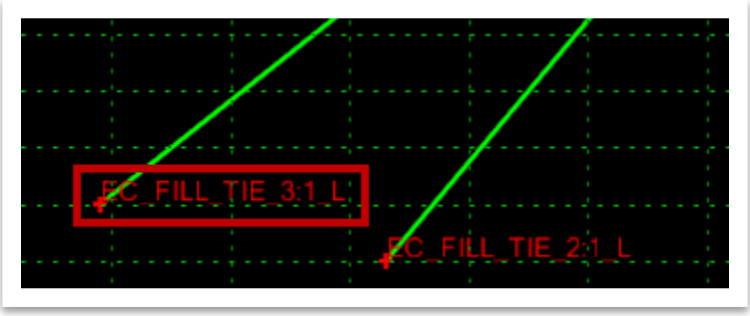
1. Zoom in to the corridor and open the **Edit Template Drop** tool (**OpenRoads Modeling >> Corridors >> Edit**).



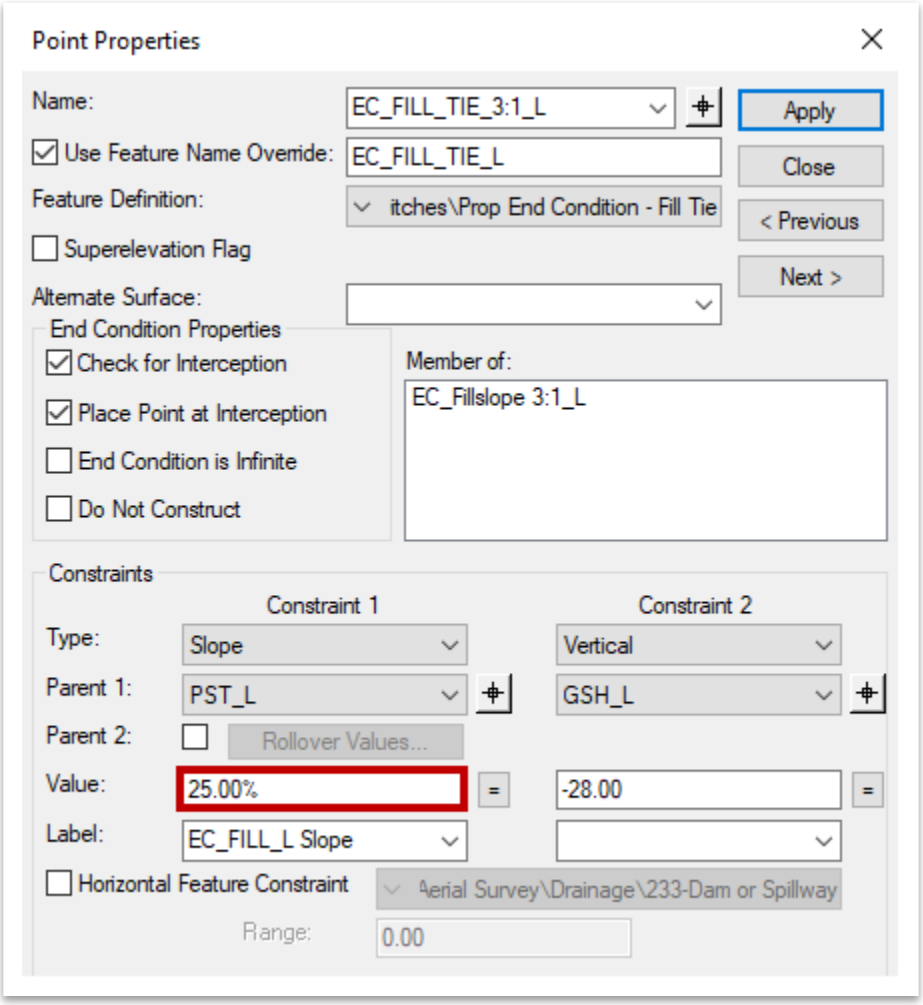
2. Notice the cursor prompt: **Locate Template Drop**. Select the **GENESCO_TEST** template drop, which is the white boundary around the corridor with blue tick marks on the outside.



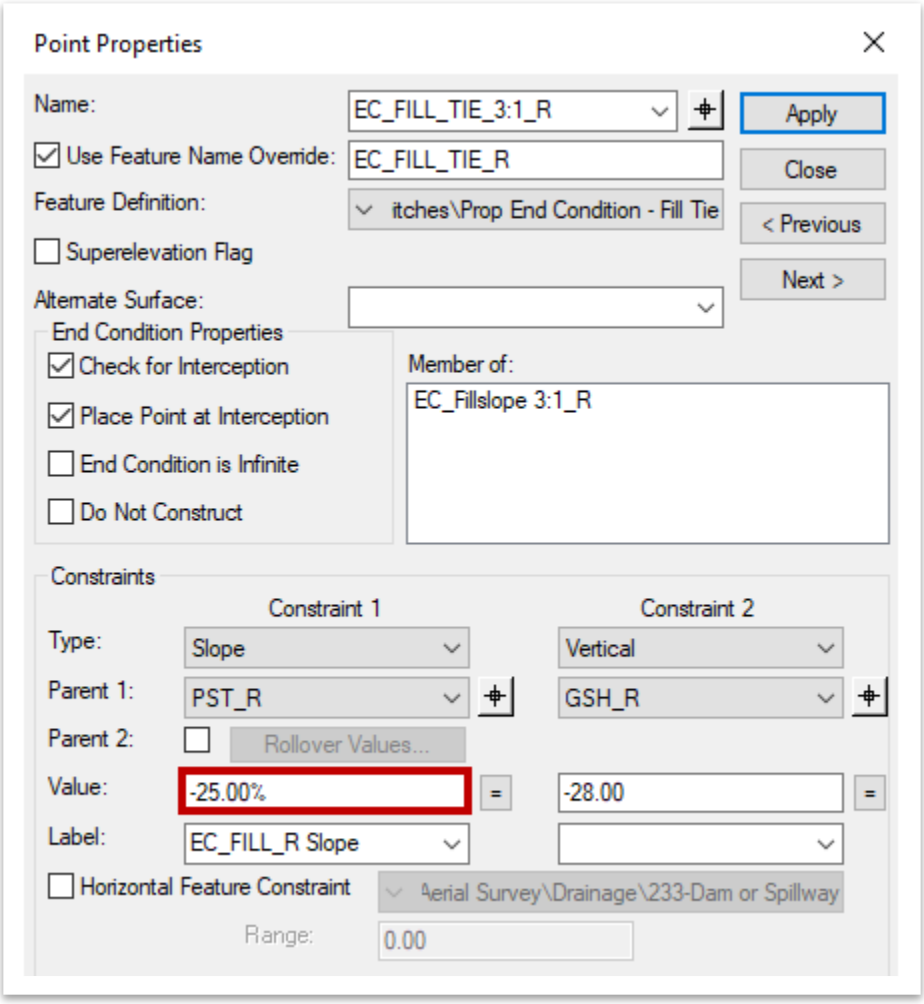
3. The **Editing Roadway Designer Template Drop** window should open automatically to the correct template. We will be editing the **left** side of the template. Zoom in to the **EC_FILL_TIE_3:1_L** point in the lower left corner of the template using your mouse wheel.



4. Double click on the point (red crosshair) to open the **Point Properties** dialog box. Change the **Value** for **Constraint 1** (Slope) to **25.00%** (4:1) by keying in **25**. Then, click **Apply** and **Close**. Notice that the fill line updated in the window.



5. We will now apply a similar update to the **right** side of the template. Zoom in to the **EC_FILL_TIE_3:1_R** point in the lower right corner of the template. Double click on the point to open the **Point Properties** dialog box. Change the **Value** for **Constraint 1** (Slope) to **-25.00%** (4:1) by keying in **-25**. Then, click **Apply** and **Close**. Once again, notice that the fill line updated in the window.

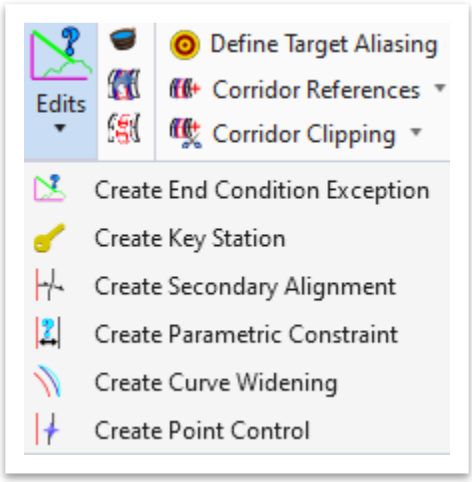


6. The previous updates will force the end-condition slope table to stop at **4:1** slopes. Click **OK** within the **Editing Roadway Designer Template Drop** window and it will automatically close. The model will re-process and you should see the fill slope updates along the corridor.

5.3.3 Edits Tools

These tools are utilized by designers to edit template drops that have been assigned to a corridor (Figure 74).

FIGURE 74. CORRIDOR EDITS TOOLS



5.3.3.1 Create End Condition Exception

This tool allows the user to modify end condition behavior within a station range without having to apply additional template drops. An **end condition exception** overrides and replaces the template drop end conditions on the left or ride side of the backbone. For example, the user may want to remove the side slope conditions at entrances, side roads or retaining walls. Also, end condition exception **transitions** create a smooth transition from no shoulder to shoulder or transitioning between slopes.

5.3.3.2 Create Key Station

This tool allows the user to add a cross section at a **particular station** that is not already being cut with the template interval or design settings to include external/cardinal points. This can be used to add a key station for determining the exact slope tie at a point of interest.

5.3.3.3 Create Secondary Alignment

This tool gives the user the option to modify the direction of the cross section processing. It is the equivalent of placing a **bent pattern** line to cut a cross section at a specific location or station range.

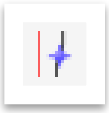
5.3.3.4 Create Parametric Constraint

This tool allows the user to set up constraint values that override the template defaults for specific station ranges. For example, a parametric constraint can be found on the **EC_FILL_TIE_L** point. The user is able to select the **EC_FILL_L Slope** constraint label to define the fill slope over a specific station range using parametric constraints on the corridor.

5.3.3.5 Create Curve Widening

This tool allows the user to automatically create and apply horizontal controls to **move** the **lane/edge** of pavement lines further away from the centerline around a curve. A curve widening table file is required to use this tool.

5.3.3.6 Create Point Control



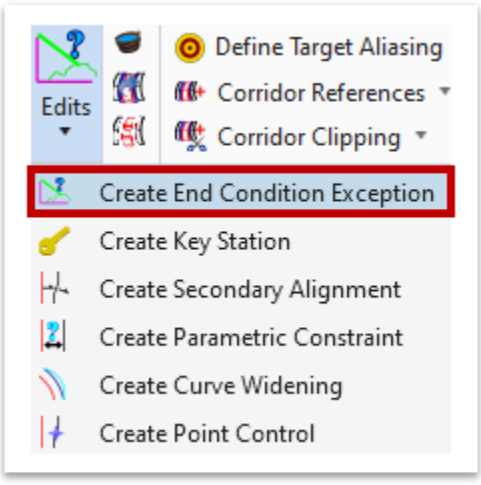
This tool allows the user to define either a horizontal or vertical point to control either the location or elevation in the model. For example, the user may want to control the elevation of a special ditch using a special ditch profile, in which case the user would assign a point control to the specific point in the template that defines that parameter.

5.3.3.7 Exercise: Edit a Corridor

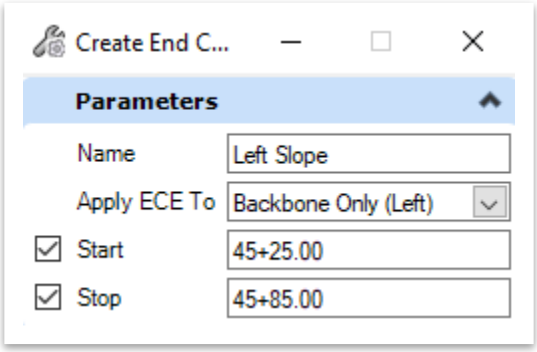
In this exercise, we will edit the corridor by adding an End Condition Exception, a Key Station at the driveway, and a Parametric Constraint to the corridor. We will continue to utilize the same **GenescoCorridor.dgn** file.

End Condition Exception

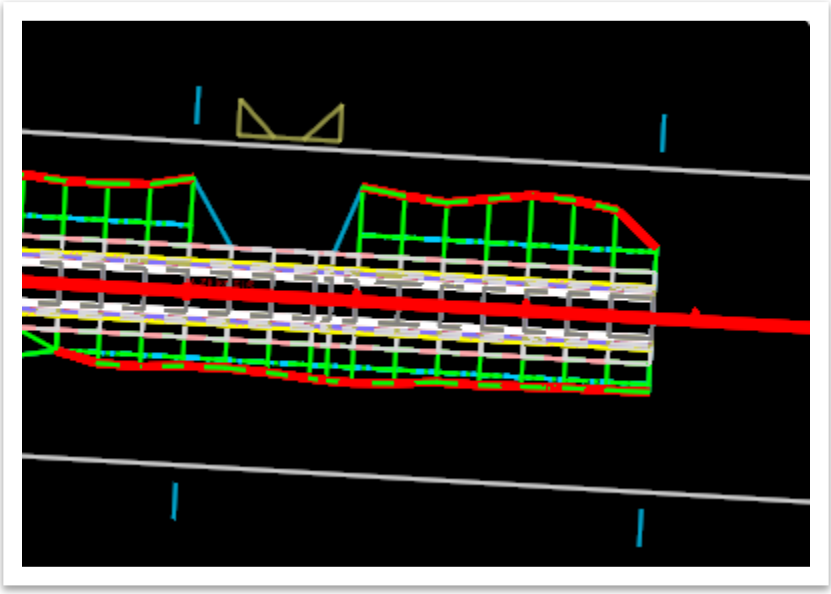
1. Open the **End Condition Exception** tool (**OpenRoads Modeling >> Corridors >> Edit >> Edits**).



2. Notice the cursor prompt: **Locate Corridor**. Select the **GENESCO_TEST** corridor. Within the **Create End Condition Exception** dialog box, select the following settings.
    a. **Name:** Left Slope
    b. **Apply ECE To:** Backbone Only (Left)
    c. **Start:** 45+25.00
    d. **Stop:** 45+85.00



3. Left click through the prompts to accept and notice the update on the left side of the template.

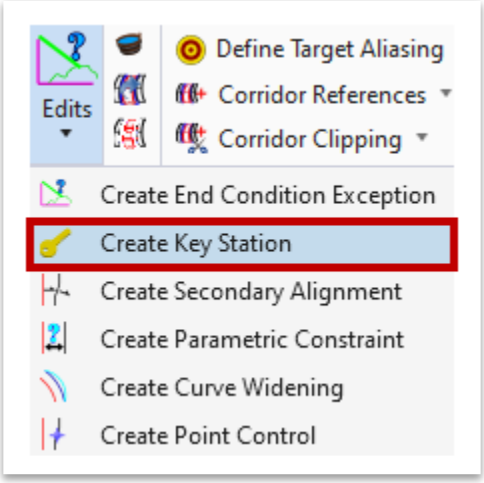


Take Note!

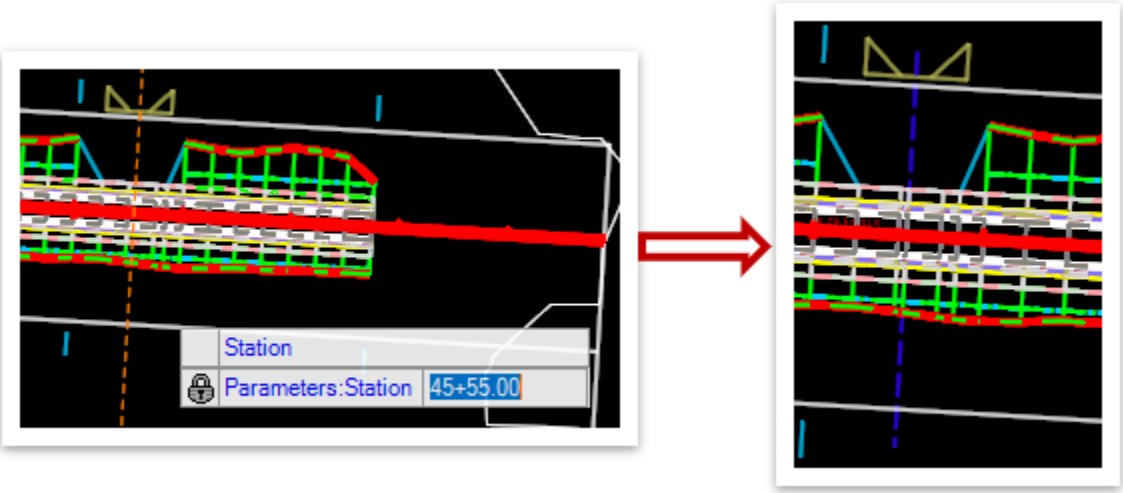
This will remove the end condition between the start and stop station on the left side of the template at the side road tie-in point, leaving only the backbone. It will also create a handle allowing the user to change the start and stop stations of the exception.

Create Key Station

1. Open the **Create Key Station** tool (**OpenRoads Modeling >> Corridors >> Edit >> Edits**).

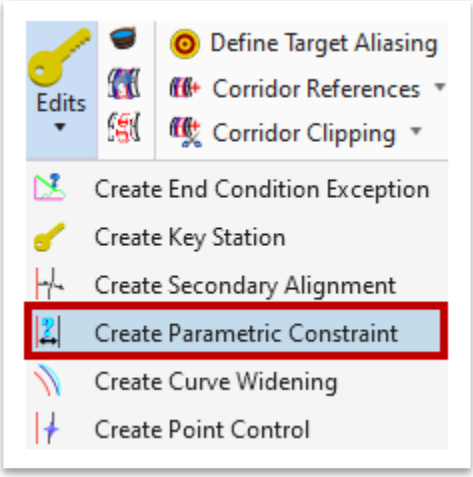


2. Notice the cursor prompt: **Locate Corridor**. Select the **GENESCO_TEST** corridor once again and create a key station at **45+55.00** (key-in the station). Hit **Enter** and left click to accept. This will add a key station to the corridor at 45+55.00 (driveway), in which a handle will be drawn with a blue dashed line and a template drop will be added.

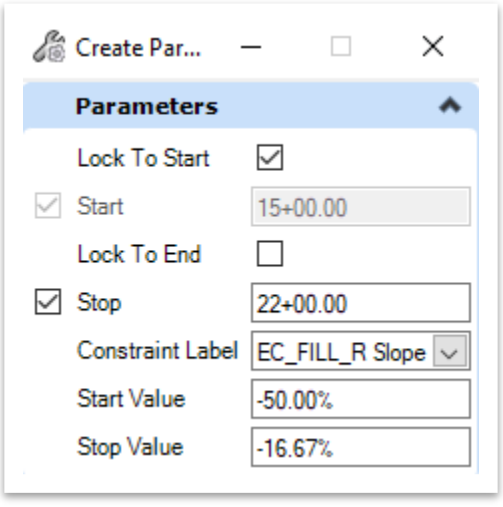


Parametric Constraint

1. Open the **Create Parametric Constraint** tool (**OpenRoads Modeling >> Corridors >> Edit >> Edits**).

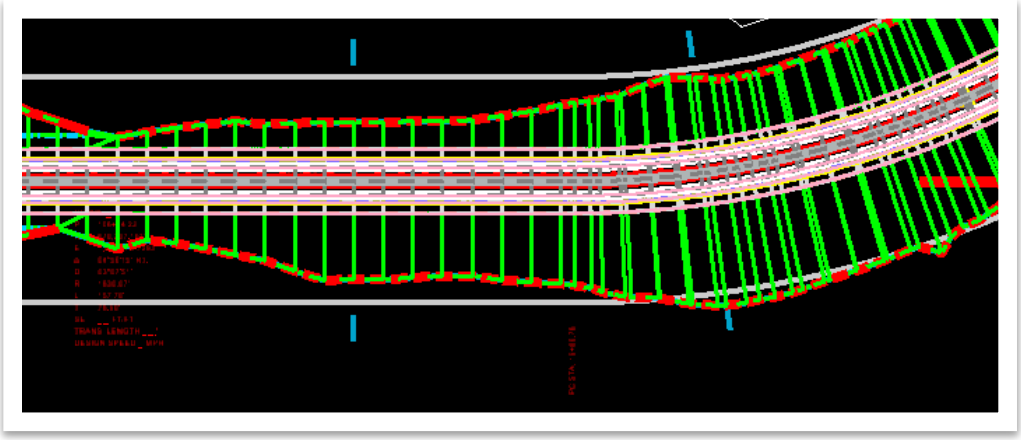


2. Notice the cursor prompt: **Locate Corridor**. Select the **GENESCO_TEST** corridor once again. Within the **Create Parametric Constraint** dialog box, select the following settings.
    a. **Lock To Start:** Checkmark (15+00.00)
    b. **Stop:** 22+00.00 (key-in)
    c. **Constraint Label:** EC_Fill_R Slope
    d. **Start Value:** -50.00% (2:1)
    e. **Stop Value:** -16.67% (6:1)

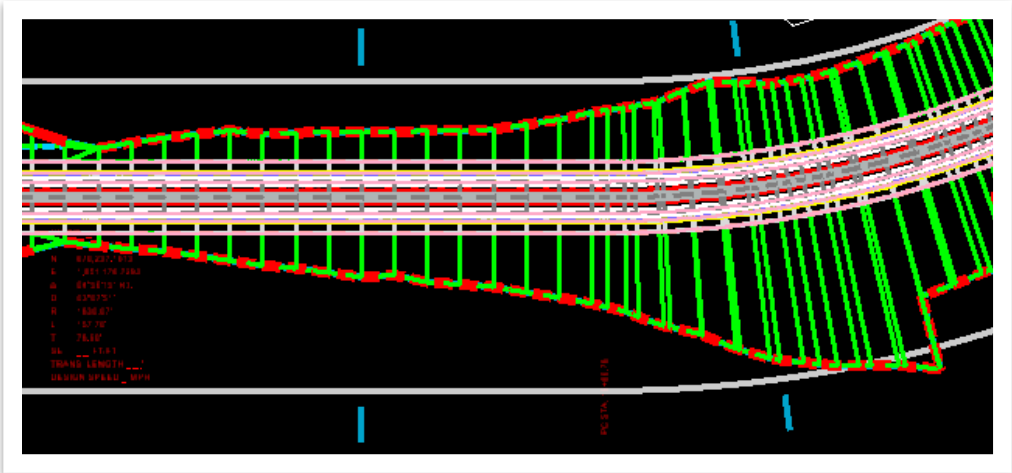


3. Left click through the prompts to accept and notice the update to the right fill slope at the beginning of the project.

Before:



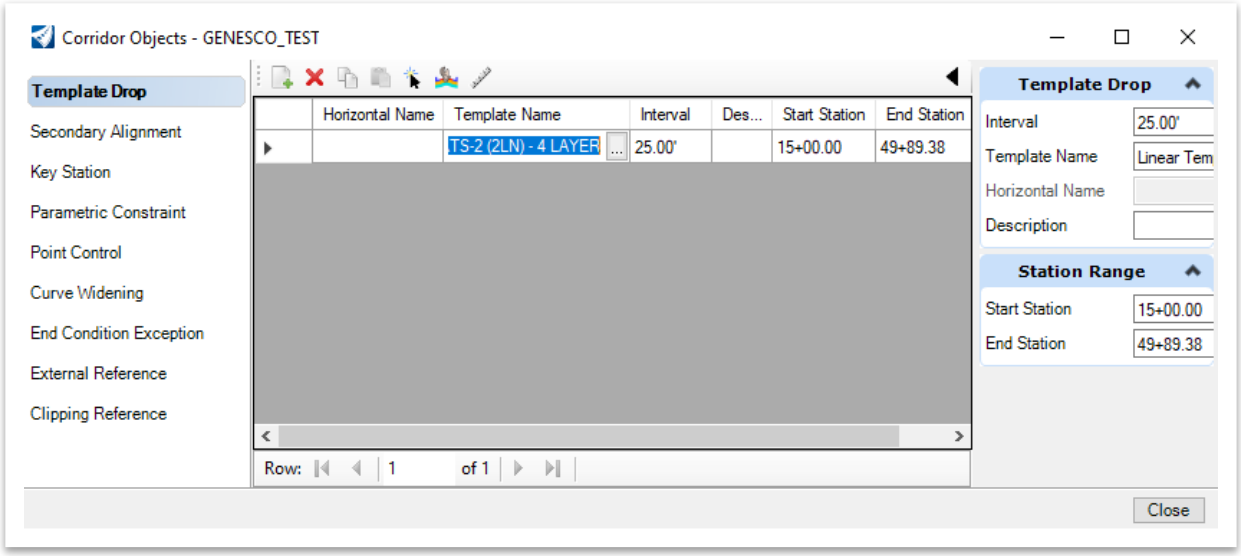
After:



5.3.4 Corridor Objects

This tool gives the user a one-stop location to view all the data and controls associated with the corridor model (Figure 75). This is a helpful tool to manage all corridor data since it lists all template drops, secondary alignments, key stations, parametric constraints, point controls, curve widening, end condition exceptions, external references, and clipping references within one dialog box.

FIGURE 75. CORRIDOR OBJECTS



5.3.5 Process and Reattach Corridor

The **Process Corridor** tool instructs the software to reprocess all objects in the selected corridor. This can be useful if the terrain has been updated or if the template drop interval has changed but the model has not updated to reflect those changes. The **Reattach Corridor** tool reattaches a corridor to a baseline and profile.

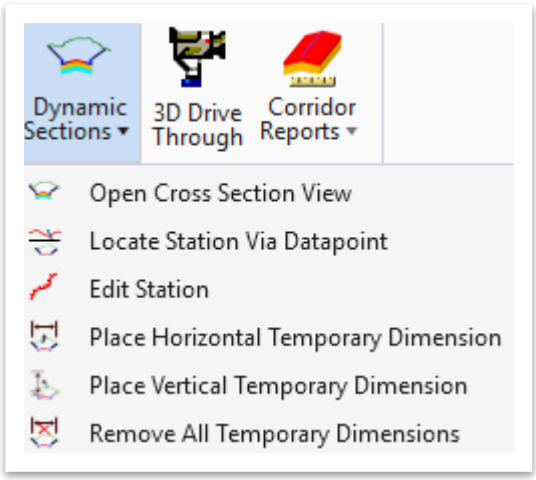
5.3.6 Synchronize Template

If the template library is updated and the user wants to apply the new templates, the **Synchronize Template** tool will reload <u>all</u> templates in the model from the library. <u>Any edits that had been made to templates in the corridor model **will be lost** upon activating this tool</u>. This tool is located in the **Miscellaneous** tools under **OpenRoads Modeling >> Corridors**.

5.4 Lecture: Dynamic Sections

The **Dynamic Sections** tools allow the user to view temporary cross sections for the corridor, including temporary dimensions (Figure 76). These cross sections are not what is shown on the cross section sheets and are used primarily for design review.

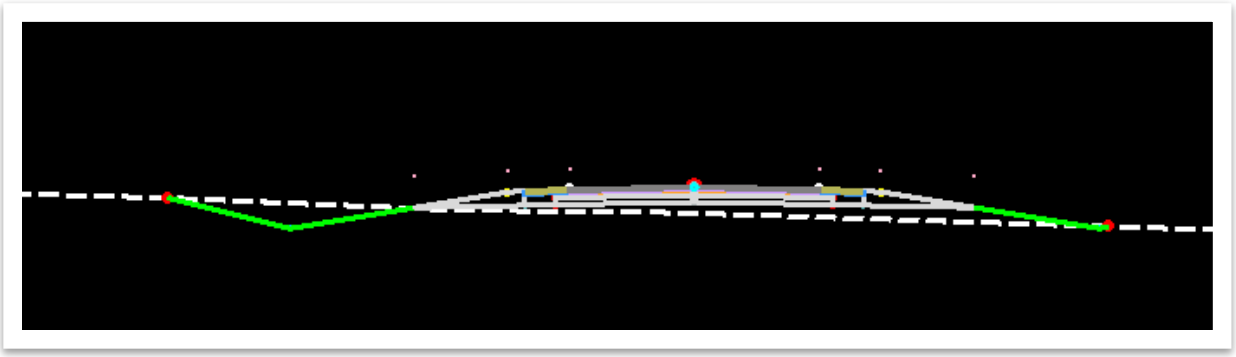
FIGURE 76. DYNAMIC SECTIONS



5.4.1 Open Cross Section View

This tool allows the user to open the dynamic **cross section view** of a corridor or alignment in a new view (Figure 77).

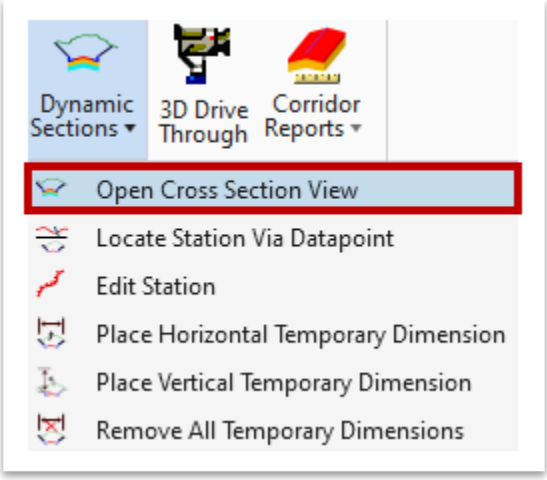
FIGURE 77. DYNAMIC CROSS SECTION



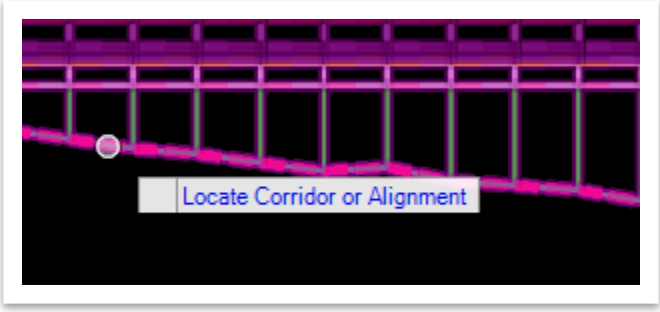
5.4.2 Exercise: Open Dynamic Cross Sections

In this exercise, we will open the dynamic cross section view. We will continue to utilize the same **GenescoCorridor.dgn** file.

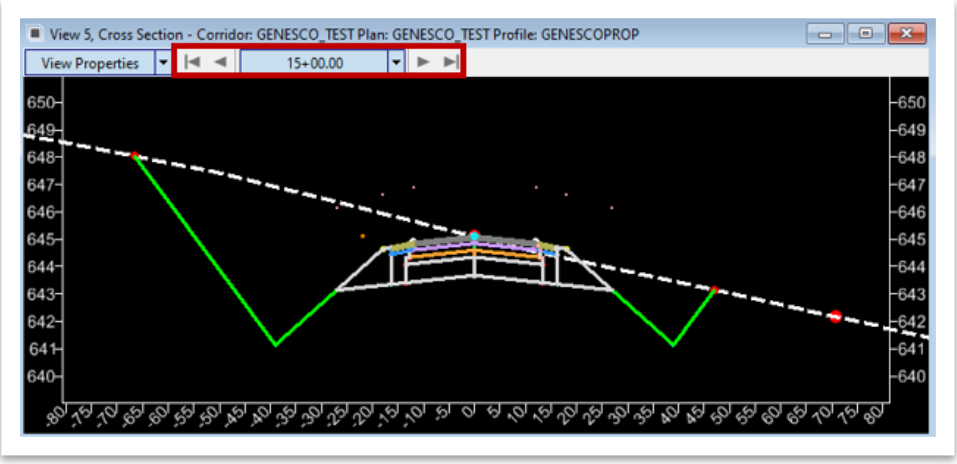
1. Open the **Open Cross Section View** tool (**OpenRoads Modeling >> Corridors >> Review >> Dynamic Sections**).



2. Notice the cursor prompt: **Locate Corridor or Alignment**. Select the **GENESCO_TEST** corridor (outer boundary), which should highlight in purple.



3. Notice the next cursor prompt: **Select or Open View**. For this exercise, select **View 5**. Notice that it automatically populates with the dynamic cross sections. You can utilize the cross section navigator at the top (highlighted) to review. Close **View 5** once you are done.



5.4.3 Locate Station Via Datapoint

This tool allows the user to data point a station in plan view and view the cross section at that station.

5.4.4 Edit Station

This tool allows the user to edit the template drop at one specific station, creating a new template drop for the edited station.

5.4.5 Place Horizontal Temporary Dimension

This tool allows the user to place a temporary dimension for a horizontal element in the dynamic cross section view.

5.4.6 Place Vertical Temporary Dimension

This tool allows the user to place a temporary dimension for a vertical element in the dynamic cross section view.

5.4.7 Remove All Temporary Dimensions

This tool removes all dimensions placed by the user in dynamic cross section views.

5.5 Lecture: Proposed ROW Lines

Once a template is placed and a terrain is set to active, the templates will automatically solve for the **slope lines**. In ORD, there will be **gaps** in between transitions from cut slopes to fill slopes. This is because the templates have different point names for cut and fill slopes, which is required in order to show different line styles. To fill these gaps, users can select the applicable cut or fill feature definition and draw a geometry line connecting the two. This will mimic what the software is doing in 3D with the transition template drop. The user can reduce the size of the transition by placing **key stations**.

The slope lines are placed in both the **2D** and **3D** models, just like every element placed with a template drop. We will utilize the 2D view when placing the proposed ROW linework. In this section, we will look at 2 different methods to place a proposed ROW line:

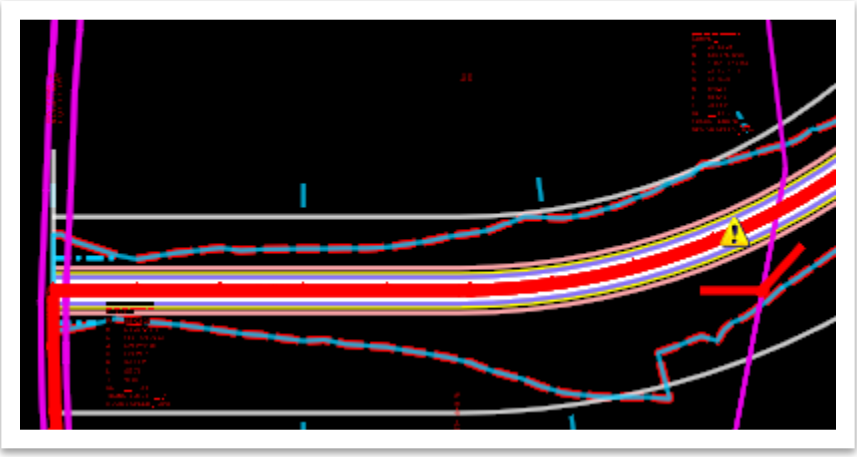
- Single Offset of an element
- Manual line creation using the Line Between Points tool

Once the line is created, we will label the proposed ROW line using intelligent labeling via the **Place Label** tool.

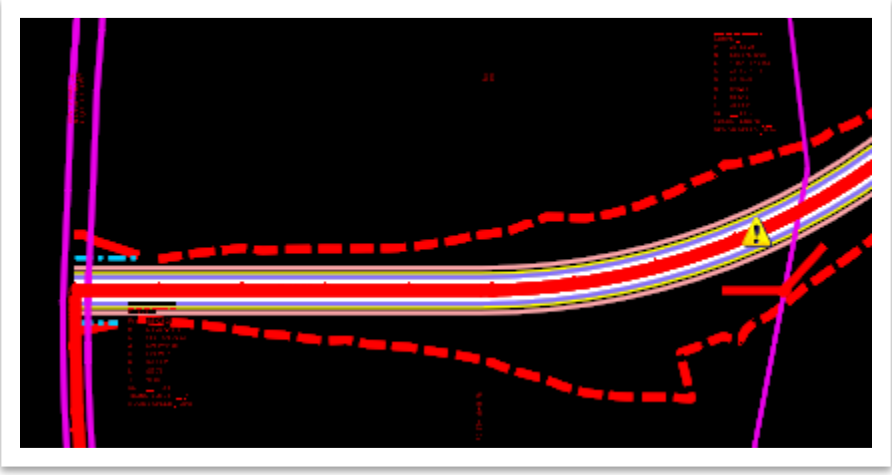
5.5.1 Exercise: Proposed ROW Line Creation – Single Offset

In this exercise, we will place a proposed ROW line and a slope line offset (for review purposes) using the single offset tool, and then add the applicable annotation to the ROW line. We will continue to utilize the same **GenescoCorridor.dgn** file.

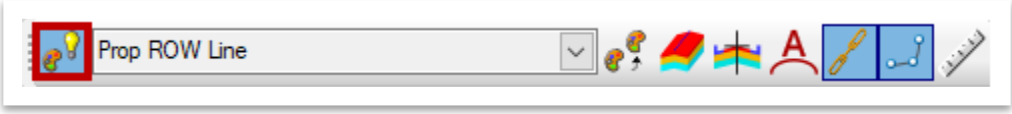
1. Turn off the **GenescoCorridor.dgn (Default-3D)** and **GenescoExistingTerrain .dgn** reference files and turn on the **WI999-11Survey.dgn** reference file.
2. Within the survey reference file, turn on the following 2 levels, if not already on.
    - SURVEY - PROPERTY - ROW Lines
    - SURVEY - PROPERTY - Property Lines



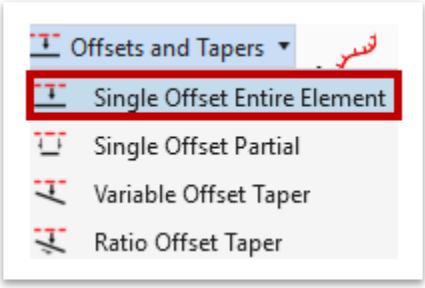
3. Within the active corridor file, turn off the following levels.
    - DES - CORRIDOR GRAPHICS - Controls
    - DES - CORRIDOR GRAPHICS - Design



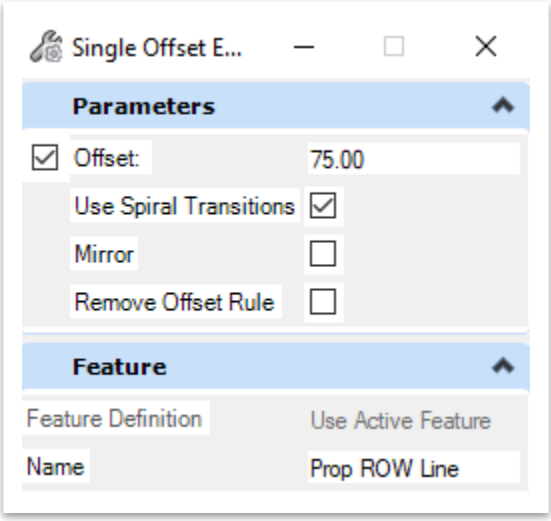
4. For this exercise, we will assume a **75'** offset for the proposed ROW line along the entire eastern length of the corridor, which is the left side if going upstation. Before we place the ROW line, select the **Prop ROW Line** feature definition (**Linear >> Right Of Way**) within the toolbar. If you do not have the feature definition toolbar docked, it can be accessed here: **OpenRoads Modeling >> Geometry >> General Tools >> Standards**. Make sure the **Use Active Feature Definition** icon is toggled on (highlighted).



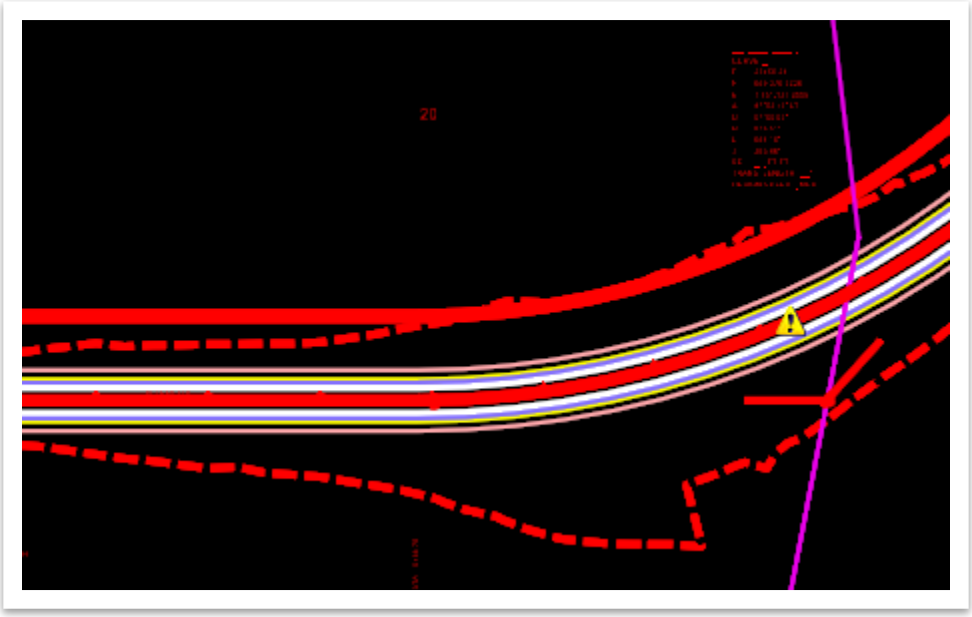
5. To place the proposed ROW line, we will utilize a horizontal civil geometry tool. Open the **Single Offset Entire Element** tool (**OpenRoads Modeling >> Geometry >> Horizontal >> Offsets and Tapers**).



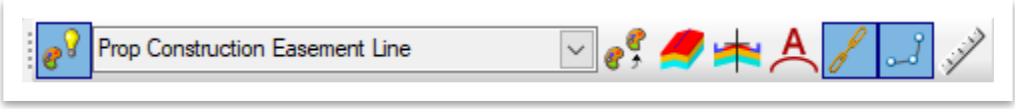
6. Within the **Single Offset Entire Element** dialog box, key-in an **Offset** of **75.00**. Leave the other settings as-is and notice that the feature definition is already set. **Note:** You do not have to key-in a negative sign because the offset is based on where you place your cursor relative to the alignment.



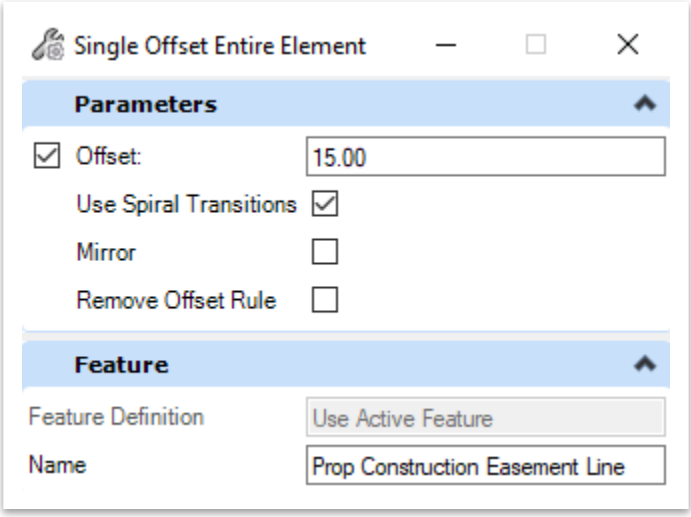
7. Notice the cursor prompt: **Locate Element**. Select the **GENESCO_TEST** alignment and then move your cursor to the left side of the alignment and left click to accept the offset. Left click again to accept **No Mirror** and the proposed ROW line will be placed.



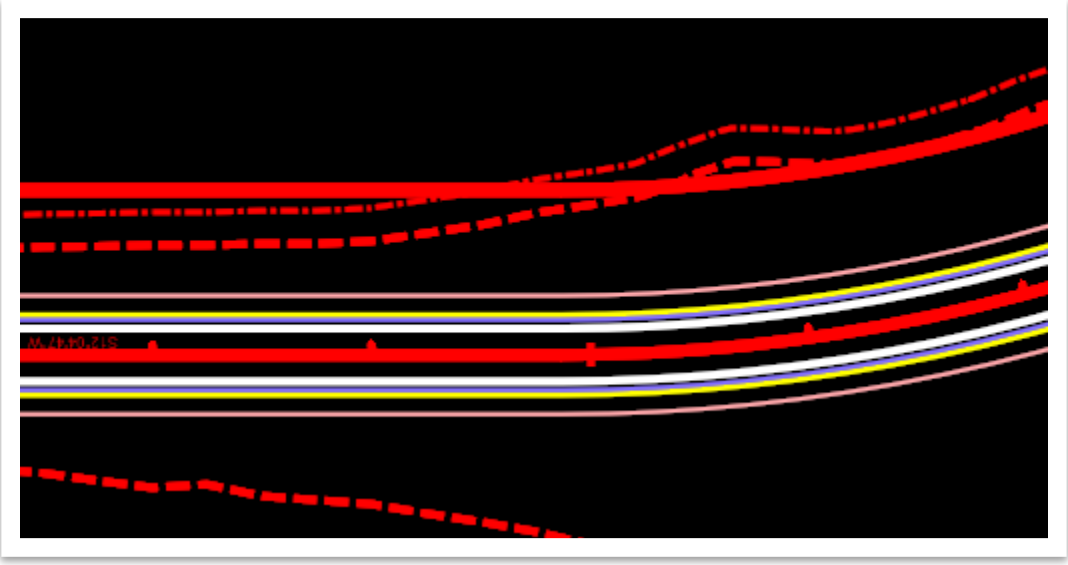
8. Notice that in some areas the minimum offset is not met between the toe of slope and the proposed ROW line. Let's create a **15'** offset from the slope line as a visual check. First, select the **Prop Construction Easement Line** feature definition (**Linear >> Right Of Way**).



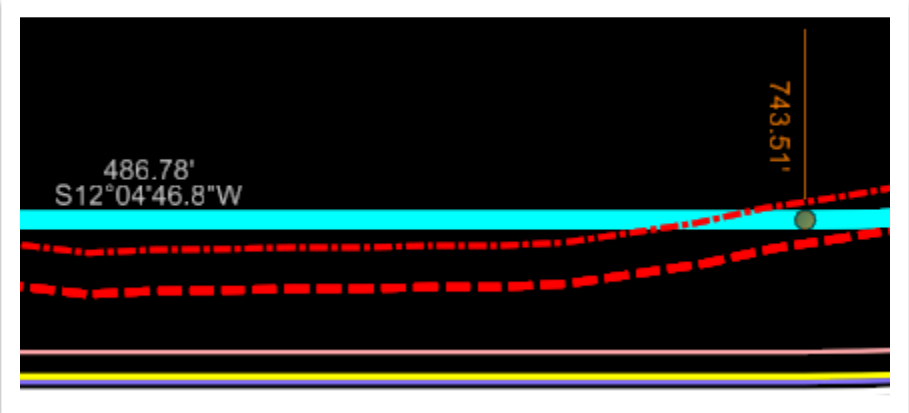
9. The **Single Offset Entire Element** tool should still be open. If not, open it again (**OpenRoads Modeling >> Geometry >> Horizontal >> Offsets and Tapers**). Key-in an offset of **15.00**.



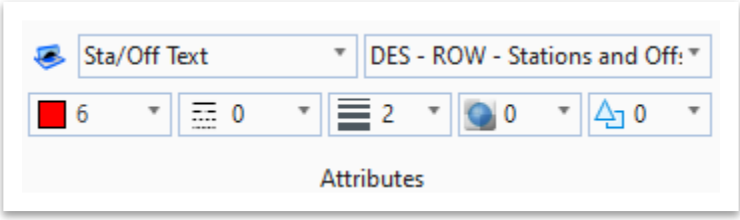
10. Notice the cursor prompt: **Locate Element**. Select the fill slope line on the left side of the alignment and then move your cursor to the left side of the same line and left click to accept the offset. Left click again to accept **No Mirror** and the construction easement will be placed. **Note:** This serves as an aide to understand if there is sufficient ROW using the standard offset. A slope or construction easement would be required if the proposed ROW line cannot be adjusted. Designers should reference the TDOT Design Guidelines when developing the ROW details for a project.



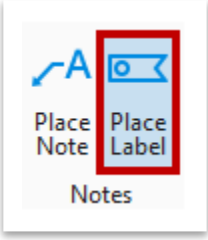
11. If you want to review the geometric details of the ROW line itself (e.g. lengths, bearings, radii), you would first need to use the **Simplify Geometry** tool (**Open Roads Modeling >> Geometry >> Common Tools**). This breaks the offset reference to the alignment and makes the ROW line a <u>standalone</u> complex element. <u>This is not recommended because now the line will not automatically update if there is an alignment revision</u>.



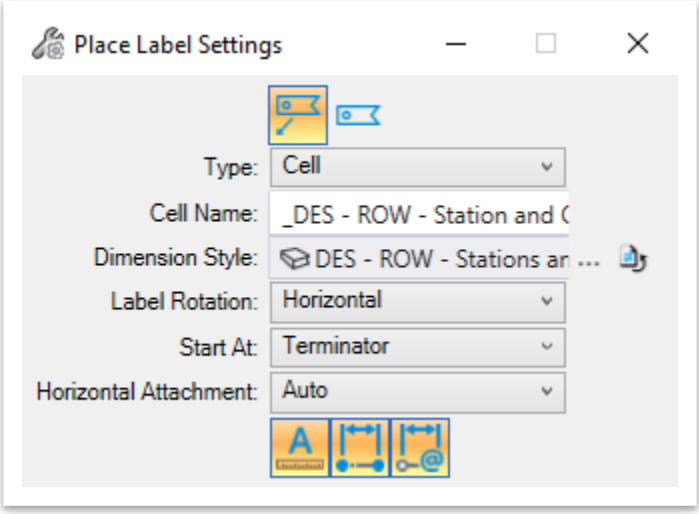
12. If you experimented with the previous step, click **Undo** so that the ROW line is not simplified. Now, let's label the ROW line (**sta/off**, **bearing/length**, **radius/length**) utilizing intelligent labels. For this exercise, make sure that the view is rotated along the alignment at the beginning of the project. For an actual project, you would need to make sure that the labels are rotated to the applicable sheet view.
13. First, we will place a **Sta/Off** label. Select the **Sta/Off Text** element template (**Right Of Way >> Annotation**).



14. Open the **Place Label** tool (**OpenRoads Modeling >> Drawing Production >> Notes**).

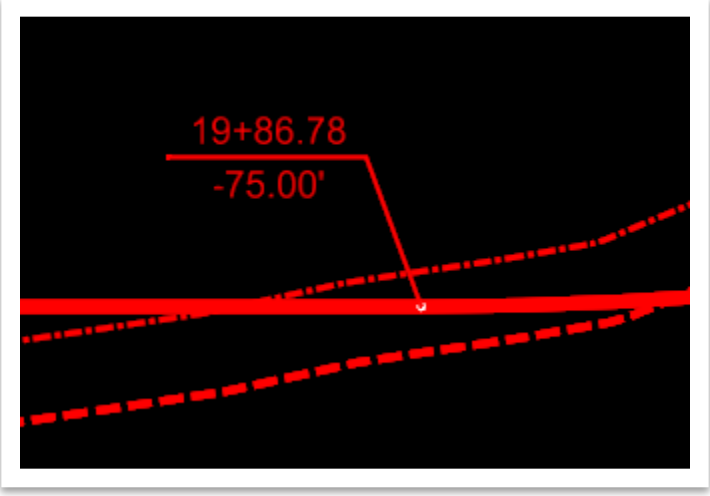


15. Within the **Place Label Settings** dialog box, select the following settings and leave the others as default.
    a. Select the **leader** icon at the top
    b. **Type:** Cell
    c. **Cell Name:** _DES - ROW - Station and Offset - FLAG
    d. **Dimension Style:** DES - ROW - Stations and Offsets



16. Notice the prompt in the lower left corner: **Identify Element or DataPoint**. Select the **GENESCO_TEST** alignment, which is the element that you want the sta/off label to be based off.

17. Notice the next prompt in the lower left corner: **Select Point Location**. Snap to the first point of curvature (**PC**) along the proposed ROW line and then left click above the line to place the label. You should get **19+86.78** / **-75.00'**. **Note:** It is recommended to use the **key-snap** button for easier snapping to the **PC** point.

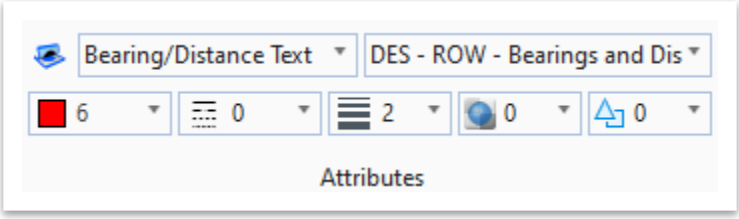


Take Note!

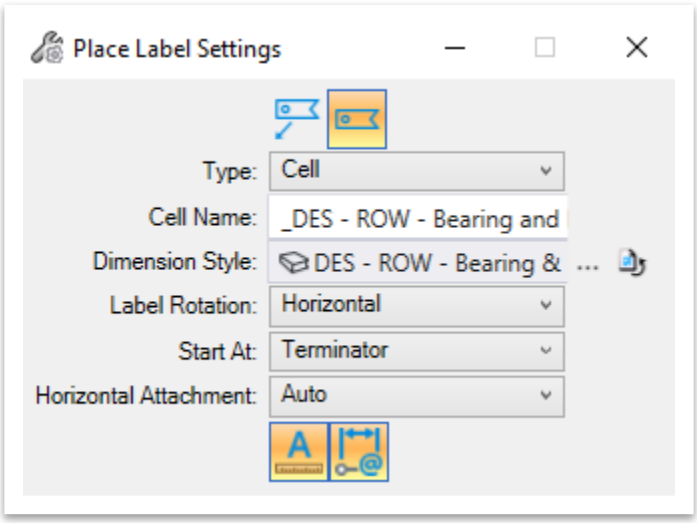
*Labels do not automatically update as you move along the alignment like in Geopak. In ORD, the label **will not** populate with the correct data until you have physically accepted the placement of the label.*

*Also, there is an erroneous white circle placed at each snap point, which is a known defect and has been logged with Bentley. The white circle can be turned off by turning off **Constructions** in the **View Attributes** tool.*

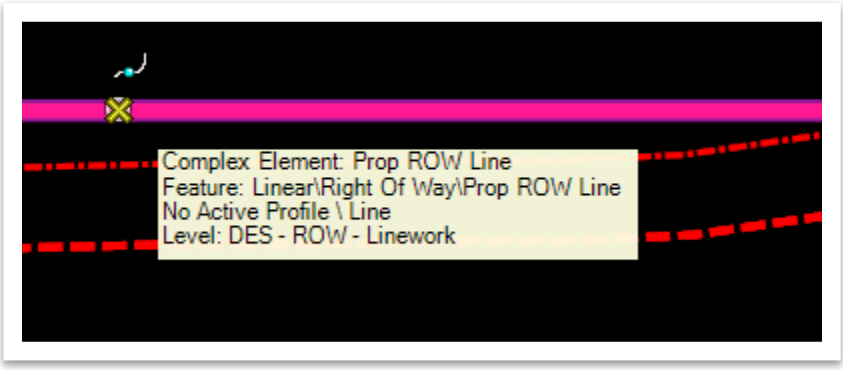
18. Next, let's place a **Bearing/Distance** label. Select the **Bearing/Distance Text** element template (**Right Of Way >> Annotation**).



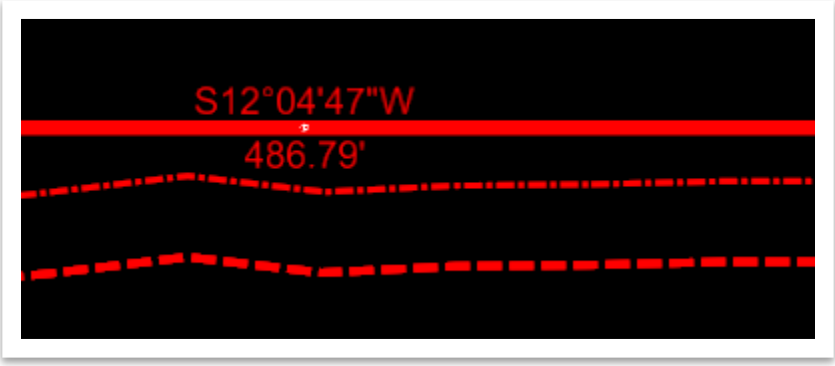
19. The **Place Label** tool should still be open (**OpenRoads Modeling >> Drawing Production >> Notes**). Within the **Place Label Settings** dialog box, select the following settings and leave the others as default.
    a. Select the **non-leader** icon at the top
    b. **Type:** Cell
    c. **Cell Name:** _DES - ROW - Bearing and Distance
    d. **Dimension Style:** DES - ROW - Bearing & Distances



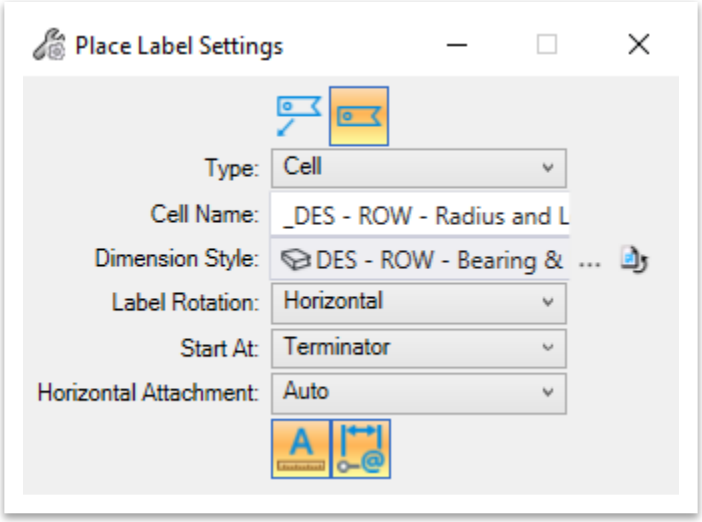
20. Notice the prompt in the lower left corner: **Identify Element or DataPoint**. Select the **proposed ROW line**, which is the element that you want the bearing/distance label to be based off.



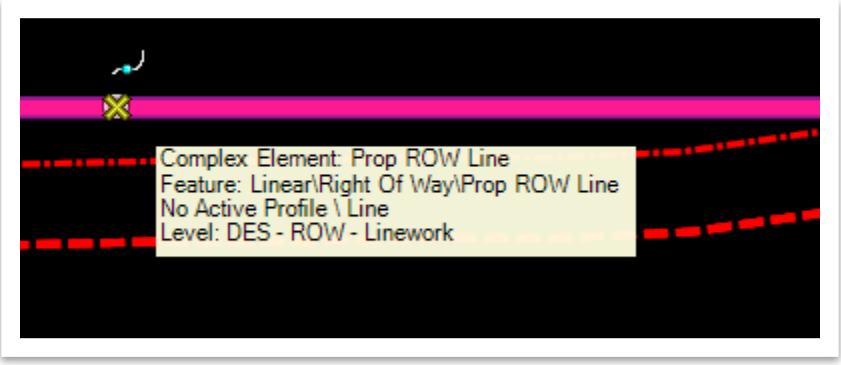
21. Notice the next prompt in the lower left corner: **Select Point Location**. Snap anywhere along the first tangent section of the proposed ROW line and then left click to place the label. You should get **S12°04’47”W** / **486.79’**. **Note:** The length is measured for each segment along the proposed ROW line. If the proposed ROW line length was needed between property lines, smaller ROW line segments would need to be drawn, breaking at each property line.



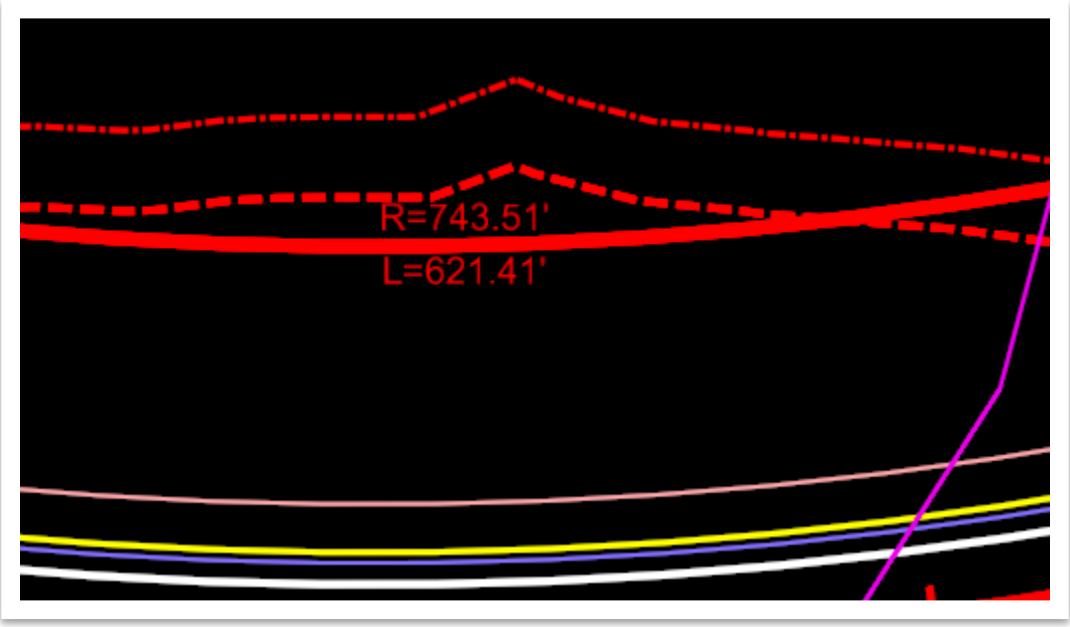
22. Now let’s place a **Radius/Length** label. The **Bearing/Distance Text** element template should still be active. The **Place Label** tool should still be open (**OpenRoads Modeling >> Drawing Production >> Notes**). Within the **Place Label Settings** dialog box, select the following settings and leave the others as default.
    a. Select the **non-leader** icon at the top
    b. **Type:** Cell
    c. **Cell Name:** _DES - ROW - Radius and Length
    d. **Dimension Style:** DES - ROW - Bearing & Distances



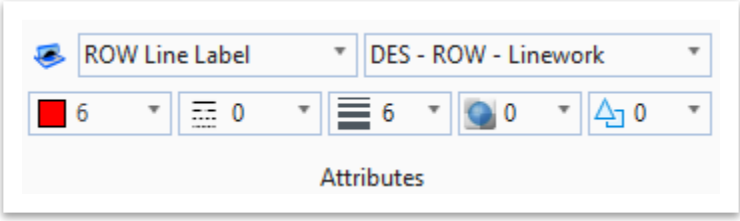
23. Notice the prompt in the lower left corner: **Identify Element or DataPoint**. Before selecting the element, let's rotate the view to align with the first proposed ROW curve. Currently, there is not a **Place Along** label rotation option within the **Place Label** tool. An enhancement has been logged with Bentley and should be available in a future release. Pick two points near the center of the curve to rotate the view. Then select the **proposed ROW line**, which is the element that you want the radius/length label to be based off.



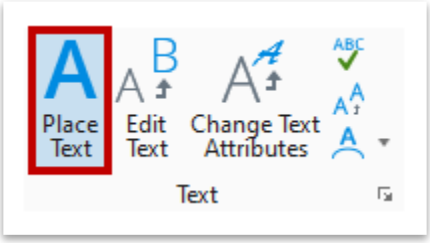
24. Notice the next prompt in the lower left corner: **Select Point Location**. Snap anywhere along the first curve of the proposed ROW line and then left click to place the label. You should get **R=743.51'** / **L=621.41'**.



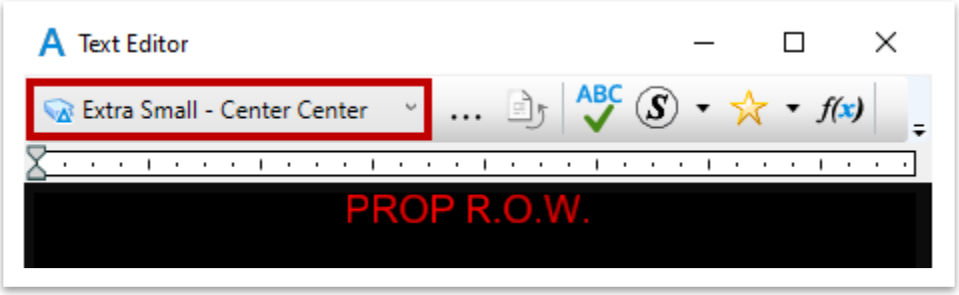
25. Lastly, we will label the proposed ROW line itself. Select the **ROW Line Label** element template (**Right Of Way >> Annotation**)



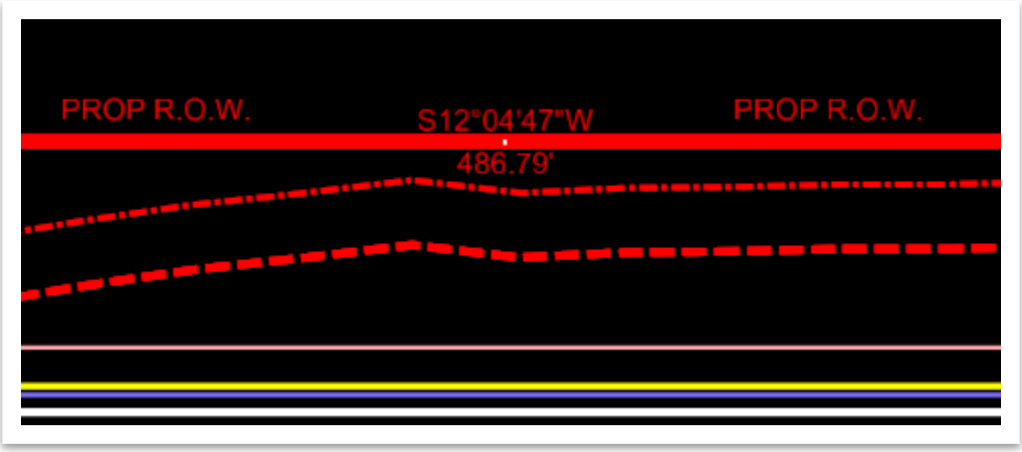
26. Rotate the view back to the previous rotation along the alignment at the beginning of the project. Open the **Place Text Along** tool (**OpenRoads Modeling >> Drawing Production >> Text**).



27. Within the **Text Editor**, select the **Extra Small - Center Center** text style (highlighted below). Key-in **PROP R.O.W.**



28. Place the label on either side of the bearing/distance label.



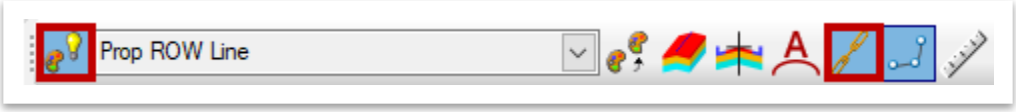
Take Note!

It is recommended to place all sta/off labels at once, all bearing/distance labels at once and so forth so you don't have to keep switching back and forth between labels and element templates.

5.5.2 Exercise: Proposed ROW Line Creation – Manual

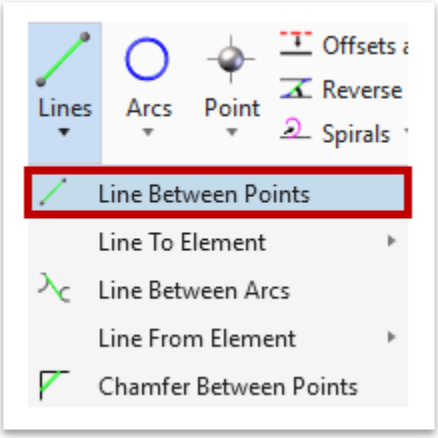
In this exercise, we will draw several ROW line iterations that are not direct offsets of the alignment using both civil geometry and MicroStation tools. We will then add bearing/distance labels and look at how the line tool effects annotation. We will continue to utilize the same **GenescoCorridor.dgn** file.

1. Before we place the ROW line, select the **Prop ROW Line** feature definition (**Linear >> Right Of Way**) within the toolbar. Make sure both the **Use Active Feature Definition** icon and **Chain Commands** icon are still toggled on (highlighted).

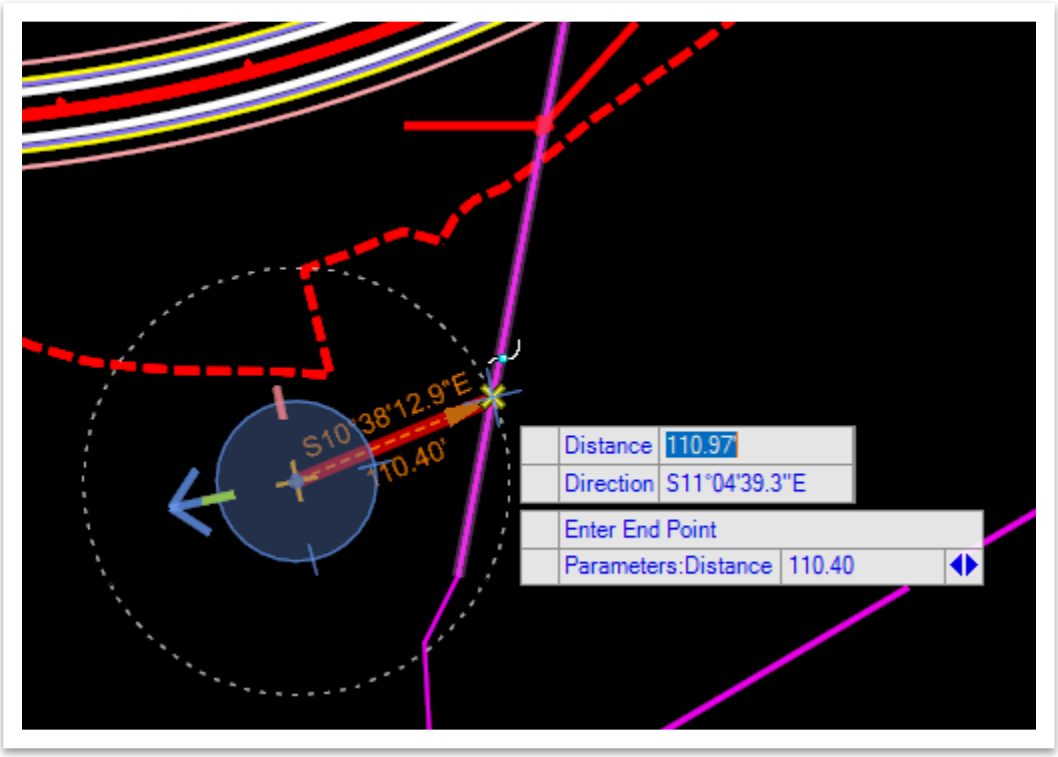


2. Turn on **CivilAccuDraw** if not already on (**OpenRoads Modeling >> Geometry >> General Tools >> Civil Toggles**). Select the **Distance-Direction** option within the **Civil AccuDraw** toolbar.

3. Open the **Line Between Points** tool (**OpenRoads Modeling >> Geometry >> Horizontal >> Lines**).



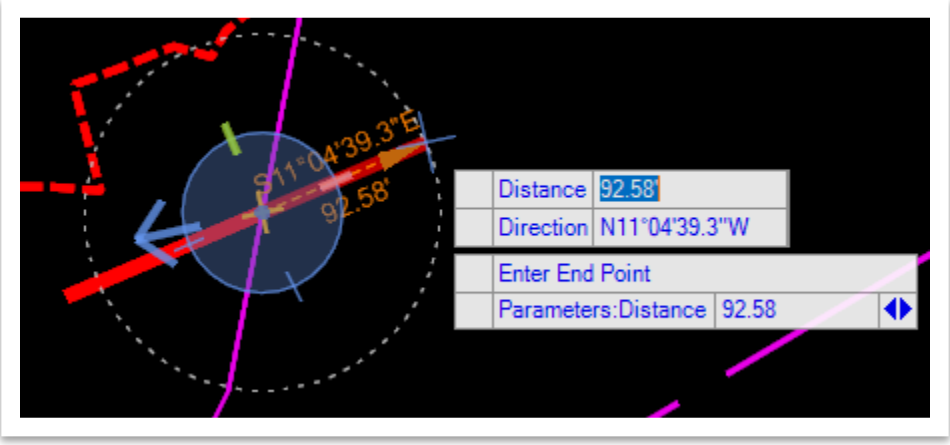
4. Open the **Line Between Points** tool (**OpenRoads Modeling >> Geometry >> Horizontal >> Lines**). On the right side of the alignment (around Sta. **22 - 23**), draw a short proposed ROW line starting anywhere on the left side of the property line and then snap to the property line to complete, as shown below.



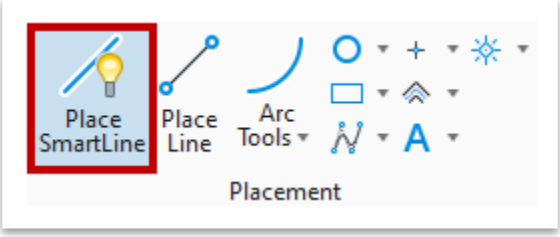
Take Note!

The elements drawn in this exercise are subjective and will be deleted at the end of the exercise. Don't worry about matching the direction or length exactly per the screenshots.

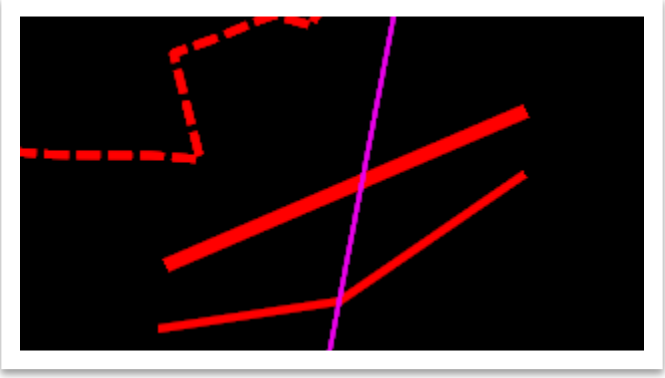
5. Since we had toggled on the **Chain Commands** icon in the feature definition toolbar, the **Line Between Points** tool should still be active and connected to the end of the first line. Draw another proposed ROW line on the right side of the property line a minimum of **50** ft in length, and then left click to accept. Notice that the bearing of the first line can be maintained for the second line since we had turned on Civil AccuDraw. Right click to clear the command.



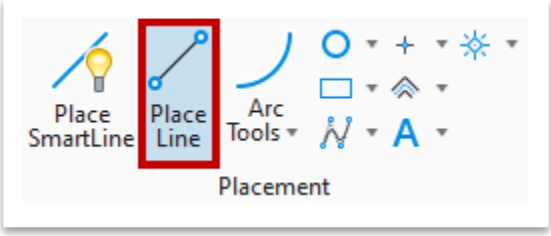
6. Next, we will place similar line segments below the proposed ROW line but utilize a MicroStation tool instead. Open the **Place SmartLine** tool (**OpenRoads Modeling >> Drawing >> Placement**).



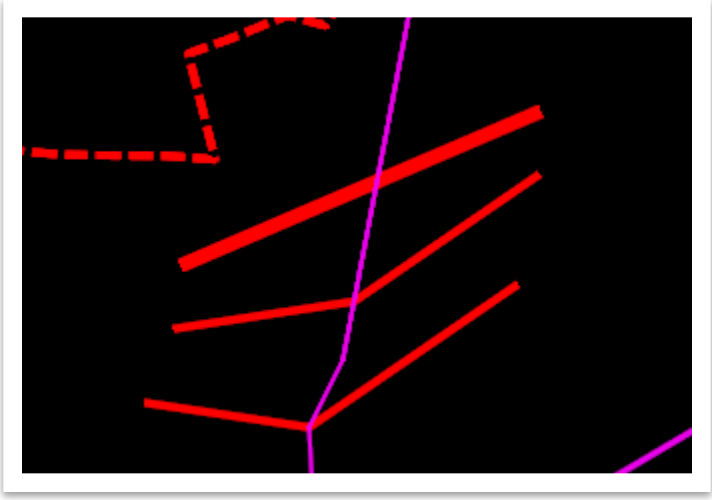
7. With **Civil AccuDraw** still **on**, place a smart line that starts anywhere on the left of the property line. Then, snap to the property line and place a second line to the right of the property line at a different bearing. Left click to accept and then right click to clear the command.



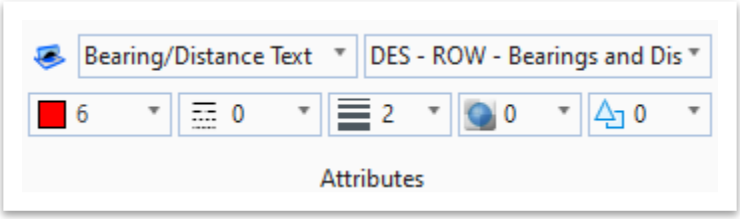
8. Now we will place similar line segments below both lines but utilize a different MicroStation tool. Open the **Place Line** tool (**OpenRoads Modeling >> Drawing >> Placement**).



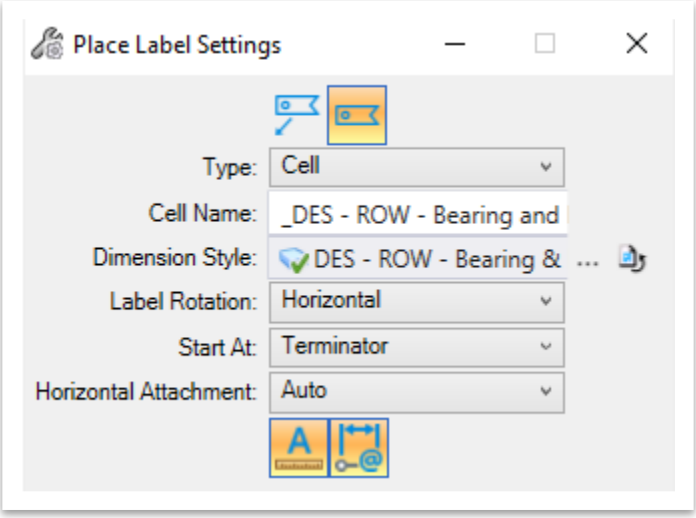
9. Once again, with **Civil AccuDraw** still **on**, place a smart line that starts anywhere on the left of the property line. Then, snap to the property line and place a second line to the right of the property line at a different bearing. Left click to accept and the right click to clear the command.



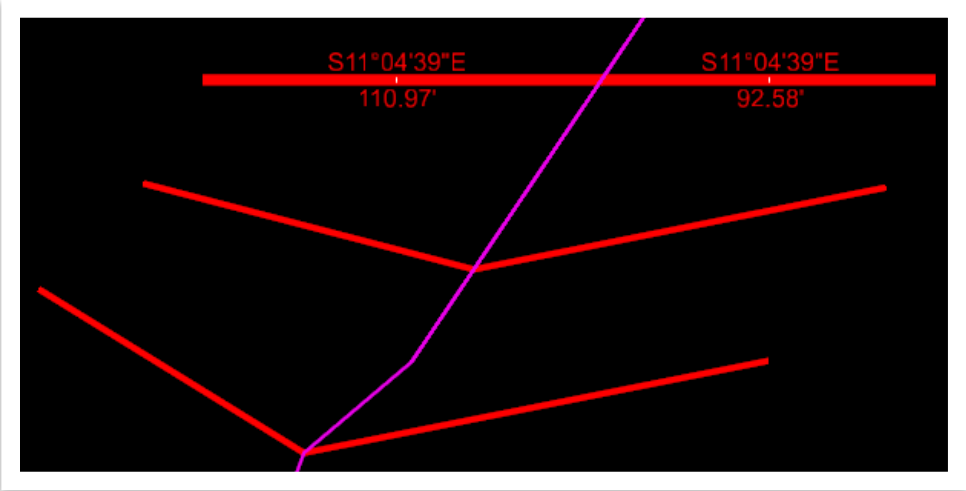
10. We are now going to add **Bearing/Distance** labels for each of the three lines. Keep in mind that each line was drawn using a different tool, and you will notice the effect that each tool has towards annotation in the upcoming steps. Go ahead and select the **Bearing/Distance Text** element template (**Right Of Way >> Annotation**).



11. Open the **Place Label** tool (**OpenRoads Modeling >> Drawing Production >> Notes**). Within the **Place Label Settings** dialog box, select the following settings and leave the others as default. **Note:** For **Label Rotation,** you may use the **Inline** option if you prefer.
    a. Select the **non-leader** icon at the top
    b. **Type:** Cell
    c. **Cell Name:** _DES - ROW - Bearing and Distance
    d. **Dimension Style:** DES - ROW - Bearing & Distance



12. Turn off **Civil AccuDraw**. Notice the prompt in the lower left corner: **Identify Element or DataPoint**. We will add the label to the top lines first. Select the **left** proposed ROW line and then left click to place the label and left click again to accept. Right click to clear the selection and then repeat the same process for the **right** proposed ROW line. Right click again to clear the selection. **Note:** You may rotate the view along the element prior to placing the label, as shown below. Also, your values will vary depending on the bearing and length of the lines you placed.



13. Repeat the previous step and add the same label for the other lines, as shown below. Notice that the **bearing** populated correctly for all elements, regardless of how they were drawn. However, the element **length** for the middle lines (placed via the Place SmartLine tool) did not populate because the label does not pull segment lengths. Keep this in mind when creating ROW details. **Note:** Again, your values will vary depending on the bearing and length of the lines you placed.

14. Before we go to the next chapter, go ahead and delete all linework and annotation added in this exercise and the previous exercise.

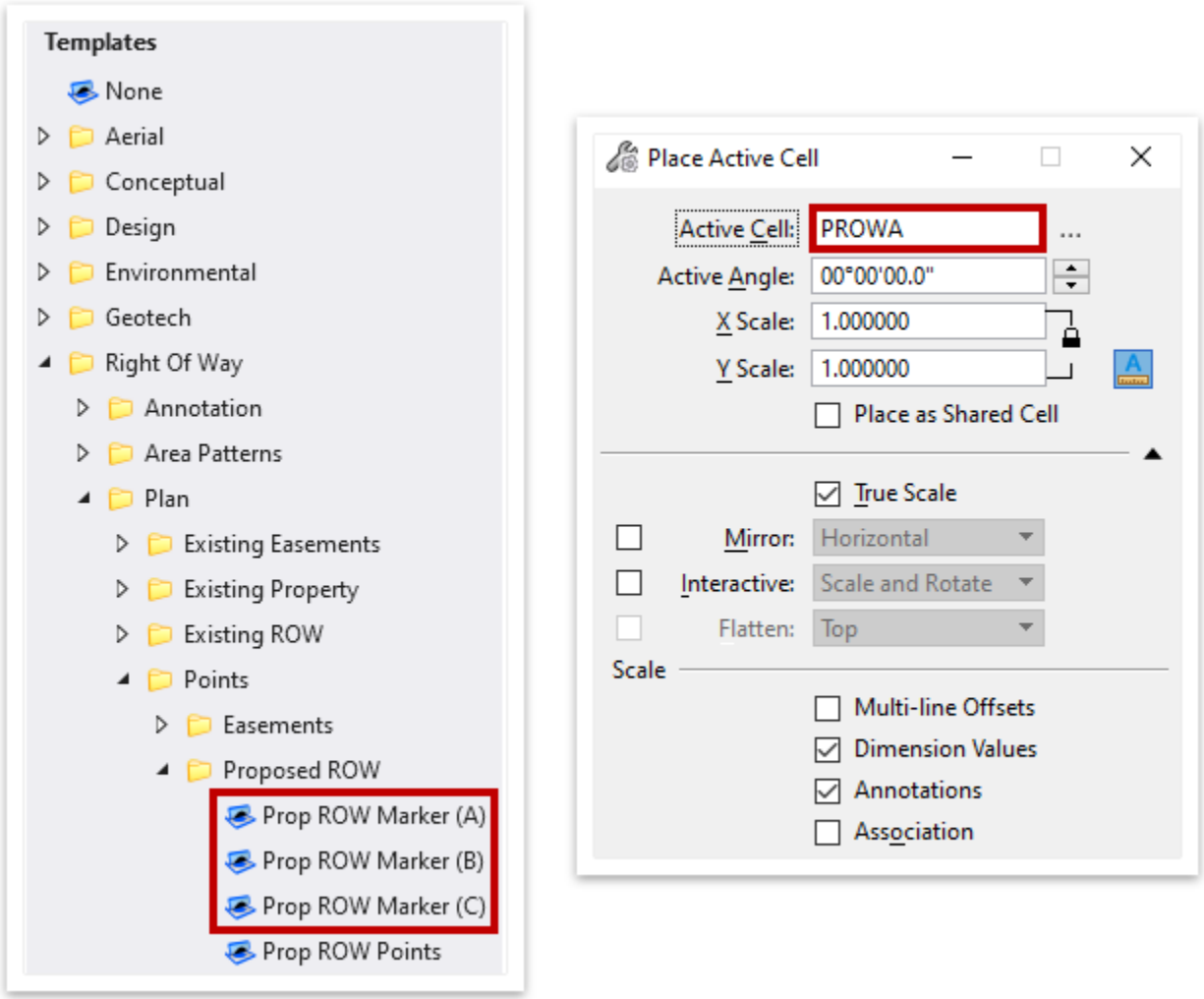
Take Note!

Proposed ROW lines and easements that follow an alignment must always be placed using geometric tools with an assigned feature definition for that type of line (ROW, Slope, Construction, Utility, Drainage). This is necessary to facilitate automatic annotation on cross section sheets. ROW details drawn using MicroStation tools will not show up on cross section sheets.

5.5.3 ROW Markers

To place a proposed ROW marker, the applicable **element template** should first be selected. An element template has been setup for the **Type A**, **Type B** and **Type C** ROW markers. Then, the user would open the **Place Active Cell** tool (**OpenRoads Modeling >> Drawing >> Placement >> Cells**), which is automatically linked to the correct cell, and place the ROW marker (Figure 78).

FIGURE 78. ROW MARKER ELEMENT TEMPLATES AND PLACE ACTIVE CELL DIALOG BOX (TYPE A)



Chapter 6. Superelevation

The Superelevation tools are located under the **Corridors** tab in the OpenRoads Modeling workflow. These are the necessary tools to create superelevation shapes automatically by selecting a corridor or a template. Inside each template point is a superelevation toggle that controls which components will create a superelevation shape using this method. Superelevation shapes can also be created manually by selecting an alignment and then building the shapes like how it's done in Geopak. In this manual, we will leverage the capability to create shapes automatically from the corridor so will not focus on the manual method.

The superelevation calculations are controlled by a rules file with a **.xml** extension. TDOT has developed their own rules file (**TDOT.xml**) based on tables within TDOT standard drawing **RD11-LR-1** and **RD11-LR-2**. The rules file is set up to round to the nearest even tenth of a percent of superelevation to match the TDOT tables. Users can also access the **AASHTO_2018_imperial.xml** rules file which will interpolate the superelevation rate based on **radii** and **speed**. It will not round to the nearest even tenth of a percent which could result in odd percentages. The minimum superelevation can be automatically calculated for corridors, and the user can edit aspects of the superelevation such as transition stations and cross-slopes once it has been created.

Superelevation will be created and stored in its own file, which is then referenced into the corridor file and assigned to the corridor to control points which have the superelevation flag toggled on.

6.1 Objectives

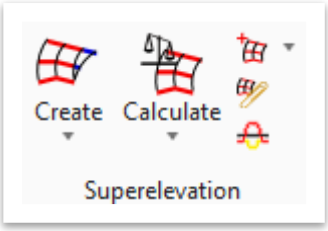
At the conclusion of this chapter, participants will be able to:

1. Create and calculate superelevation sections.
2. Assign superelevation to a corridor.
3. View the superelevation report.

6.2 Lecture: Superelevation Tools

The superelevation tools allow for the creation, calculation and editing of superelevation lanes (Figure 79). There are also tools available for importing data and creating reports. The most utilized superelevation tools will be described in the upcoming sections.

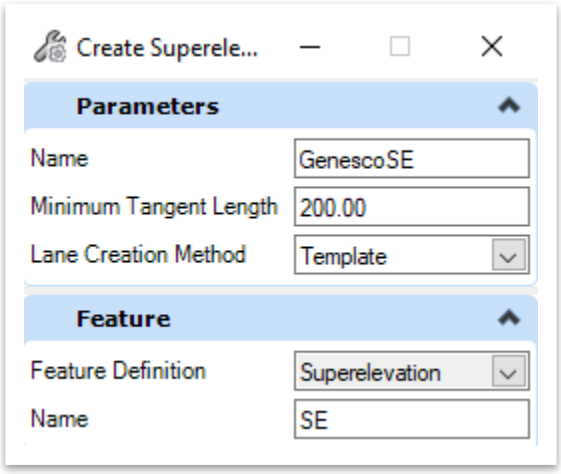
FIGURE 79. SUPERELEVATION TOOLS



6.2.1 Create Superelevation Sections

This tool allows the user to create superelevation **sections** along a corridor or an alignment (Figure 80). The user can change the minimum tangent length to determine the number of sections that are created. This tool will automatically advance to **Create Superelevation Lanes** after a section has been created.

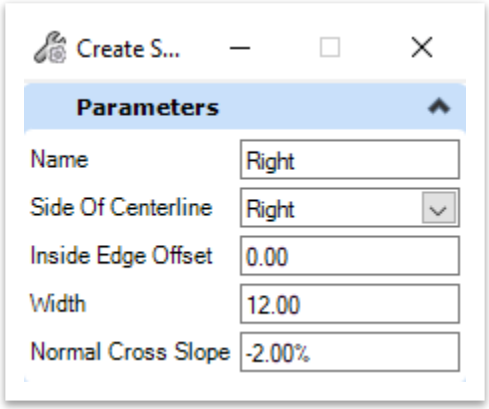
FIGURE 80. CREATE SUPERELEVATION SECTIONS



6.2.2 Create Superelevation Lanes

This tool allows the user to define the number of lanes on each side of the centerline, and their width and cross slope (Figure 81). After the lanes have been created, this tool will automatically advance to **Calculate Superelevation**.

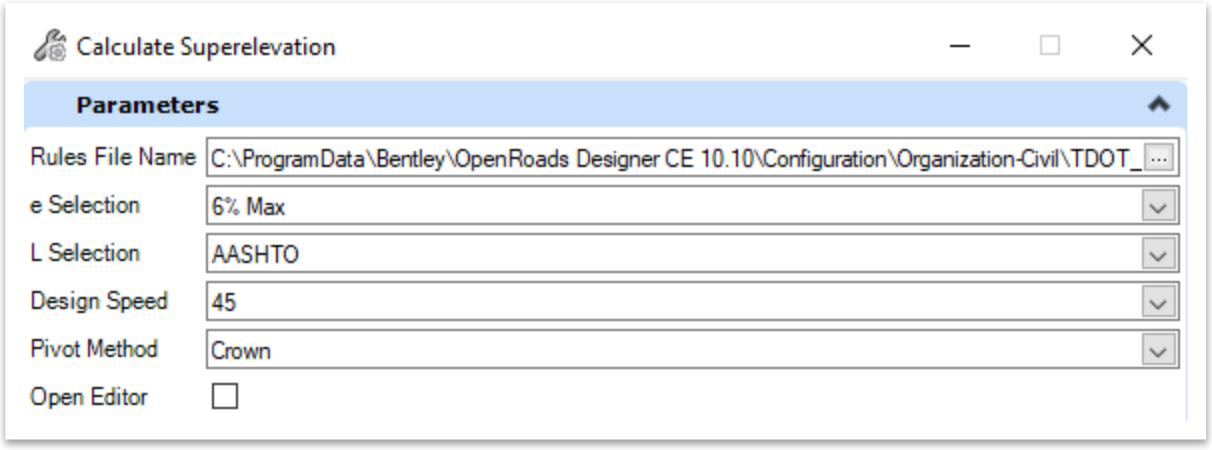
FIGURE 81. CREATE SUPERELEVATION LANES



6.2.3 Calculate Superelevation

This tool allows the user to calculate the minimum required superelevation based on the rules file selected (**TDOT.xml**) and design speed (Figure 82).

FIGURE 82. CALCULATE SUPERELEVATION



6.2.4 Assign to Corridor

This tool allows the user to assign superelevation to a corridor, updating the model to show the cross slopes associated with the superelevation rather than the template.

6.2.5 Superelevation Editor

This tool opens the superelevation editor, allowing the user to edit data in a table. Data in grey cannot be edited.

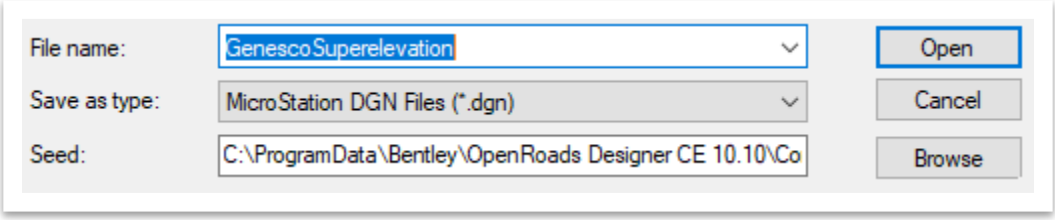
6.2.6 Superelevation Report

This tool creates reports for superelevation. Multiple superelevation sections can be selected at once for creating reports.

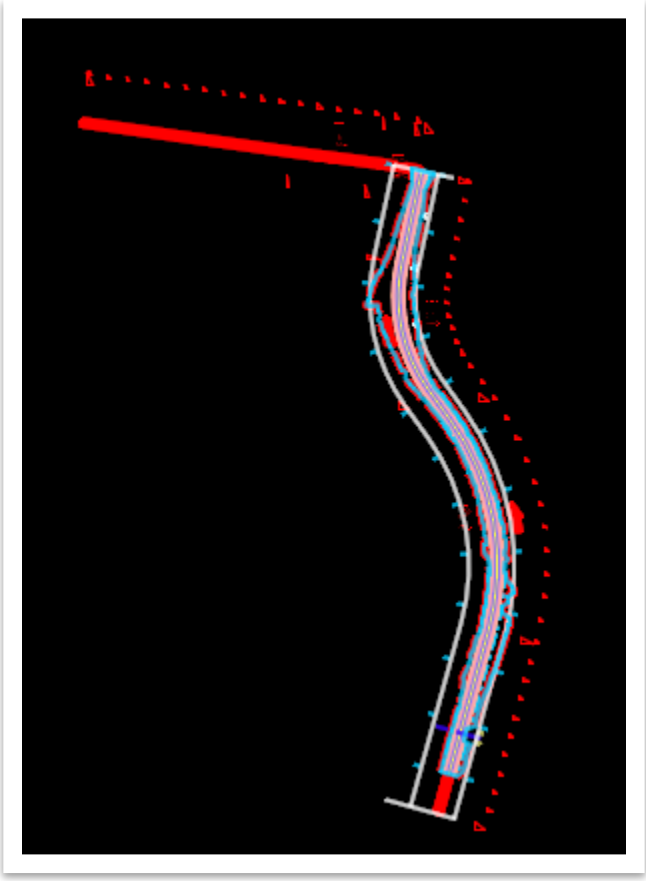
6.2.7 Exercise: Create and Calculate Superelevation Sections

In this exercise, we will create superelevation sections from the corridor reference.

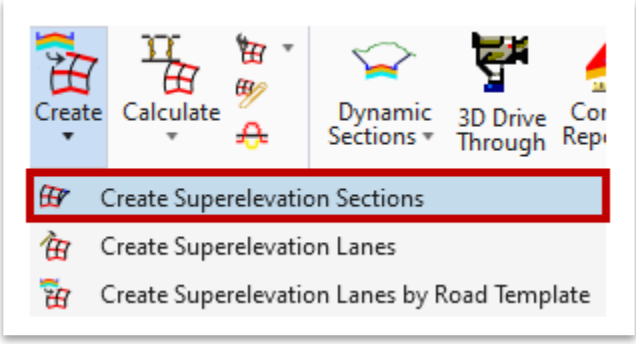
1. Create a new file and name it **GenescoSuperelevation**. Select the **TDOTSeed2D .dgn** and click **Save**.



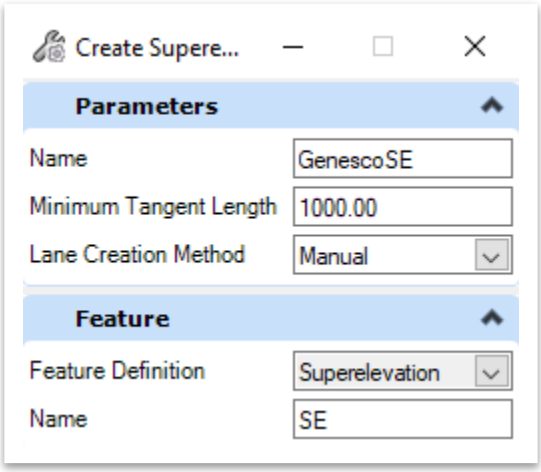
2. Attach the following reference files using the **Coincident World** attachment method.
    - GenescoAlignments.dgn
    - GenescoCorridor.dgn
3. Make sure the view is set to **Default** and then click **Fit View** and notice the linework from the previous exercises. It's OK if your view rotation differs from below.



4. We will now apply superelevation shapes to the **GENESCO_TEST** corridor. Open the **Create Superelevation Sections** tool (**OpenRoads Modeling >> Corridors >> Superelevation >> Create**).

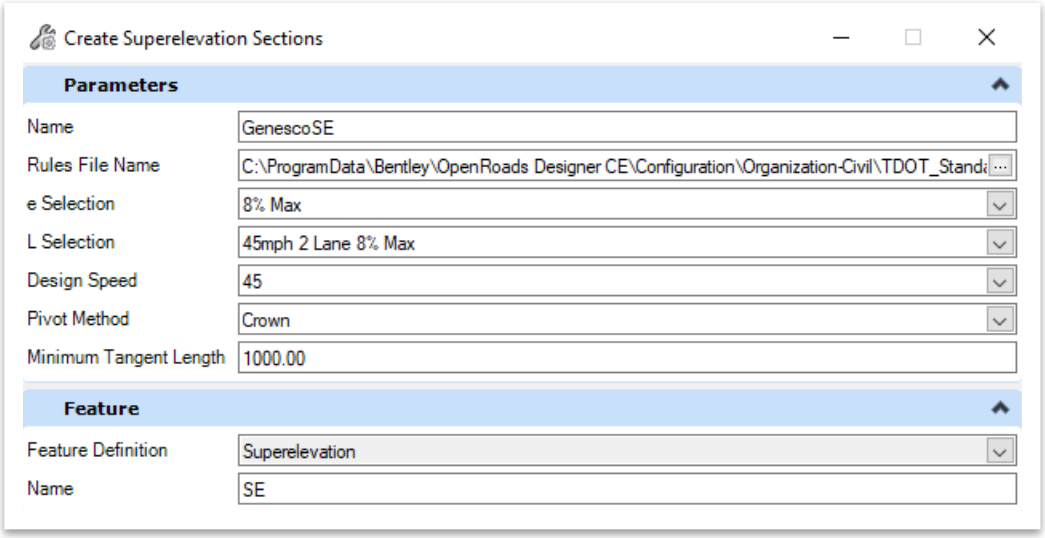


5. Within the **Create Superelevation Sections** dialog box, select the following settings.
    a. **Name:** GenescoSE
    b. **Minimum Tangent Length:** 1000.00
    c. **Lane Creation Method:** Manual
    d. **Feature Definition:** Superelevation
    e. **Name:** SE



6. Left click to accept the **Name**. Notice the next cursor prompt: **Locate Corridor or Alignment**. Select the **GENESCO_TEST** corridor. **Note:** If the corridor linework is not showing, turn on the **DES - CORRIDOR GRAPHICS** levels in the **Genesco Corridor.dgn** reference file.

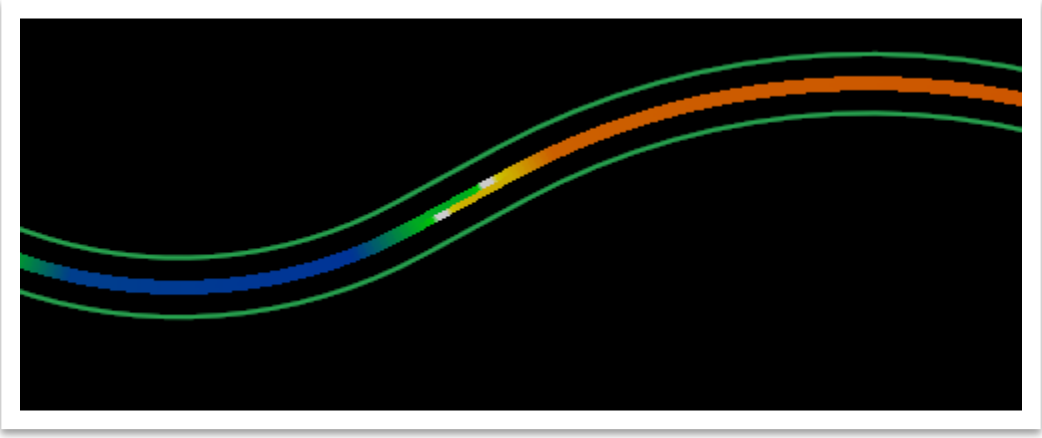
7. The **Create Superelevation Sections** dialog box should automatically open. Select the following settings.
    a. **Name:** GenescoSE
    b. **Rules File Name:** TDOT.xml
    c. **e Selection:** 8% Max
    d. **L Selection:** 45mph 2 Lane 8% Max
    e. **Design Speed:** 45
    f. **Pivot Method:** Crown
    g. **Minimum Tangent Length:** 1000.00



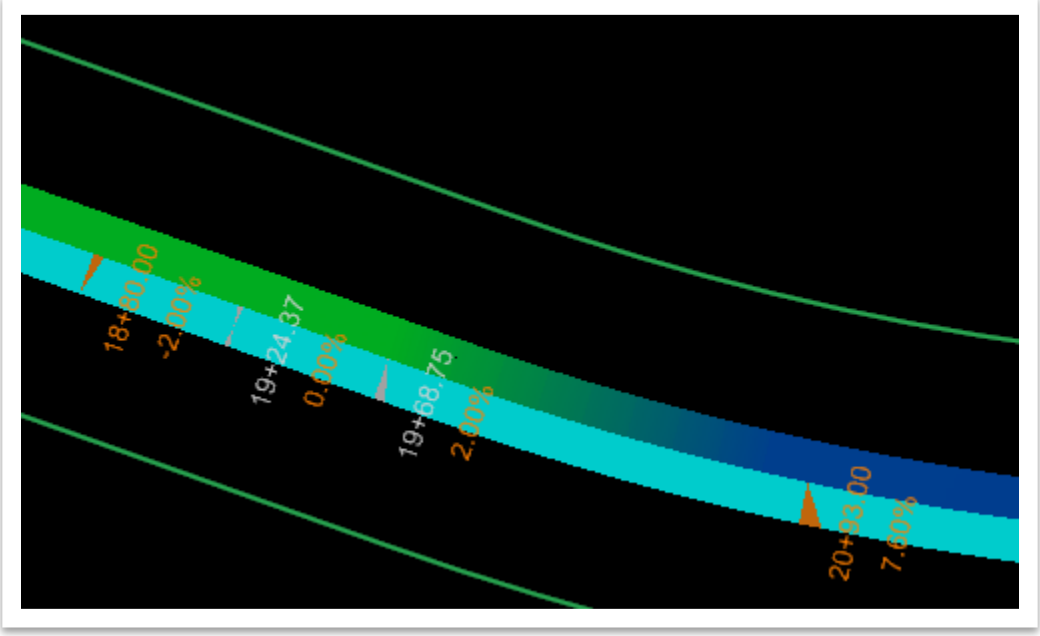
Take Note!

*When the software transitions from the **Create Superelevation Sections** tool to the **Calculate Superelevation** tool, the tool heading in the dialog box **will not** update. If you opened the Calculate Superelevation tool from the ribbon, then you would see the correct heading. Regardless, the tool works correctly in both scenarios.*

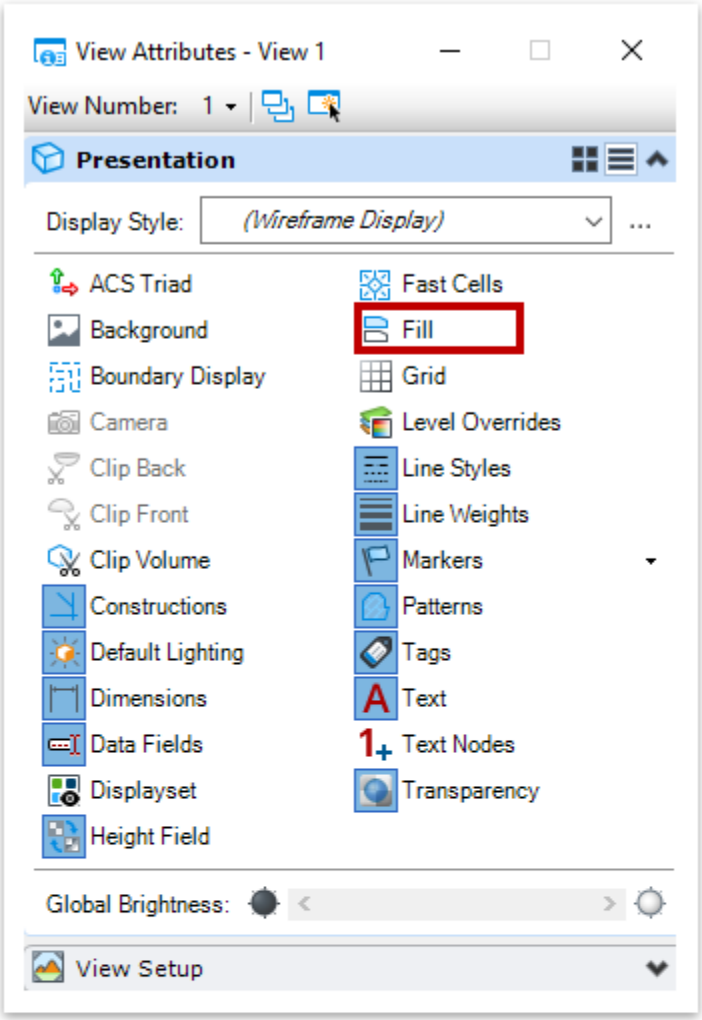
8. Left click to accept the prompts, which will run the superelevation calculation, and then hit **ESC** to clear the tool. Go ahead and turn off **all** reference files. You should now see a color fill gradient that represents the superelevation and transitions.

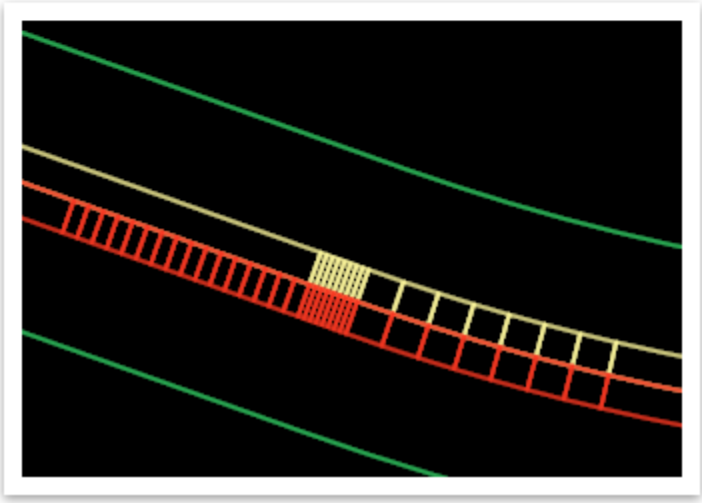


9. Zoom in and select one of the shapes on either side of the centerline and notice the dynamic text indicating the cross slopes and transition stations.

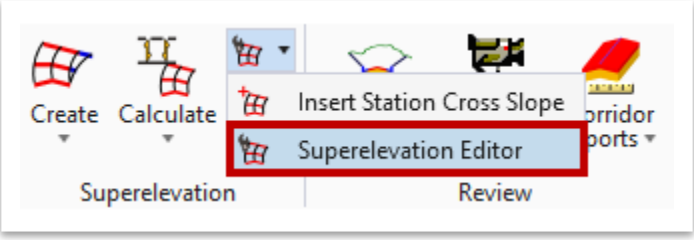


10. Open the **View Attributes** by hitting **CTRL** + **B** on your keyboard. Turn off the **Fill** and you should now see the transition segments that were previously hidden. Close the **View Attributes** once you are done.

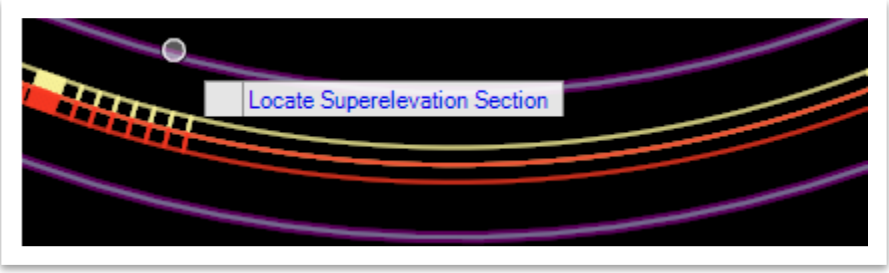




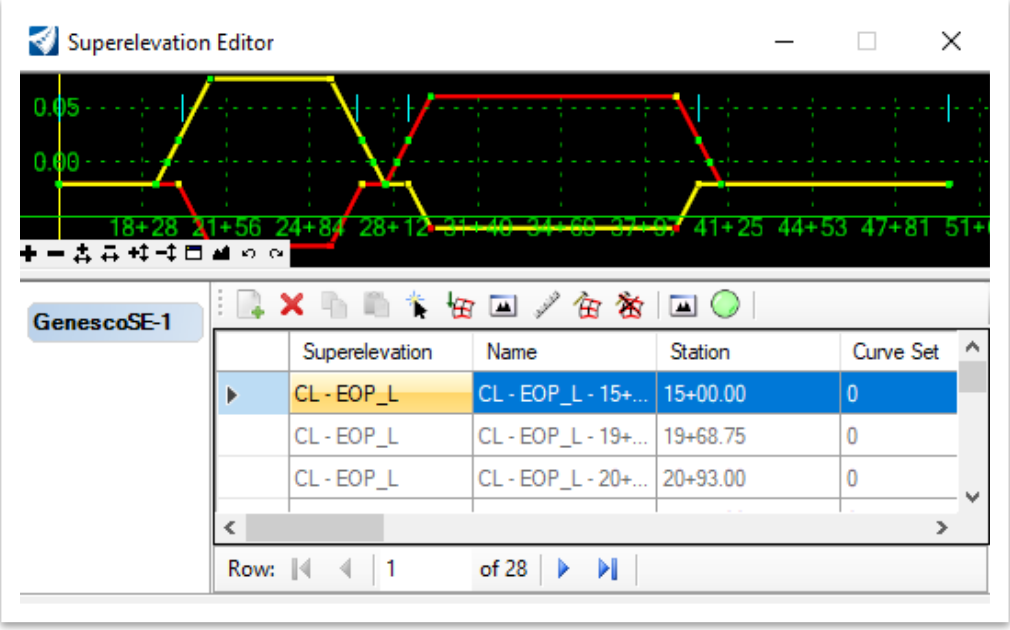
11. Next, open the **Superelevation Editor** tool (**OpenRoads Modeling >> Corridors >> Superelevation**).



12. Notice the cursor prompt: **Locate Superelevation Section**. Select the green boundary that represents the superelevation section.



13. Within the **Superelevation Editor**, any superelevation data can be edited, if necessary. For this exercise, we will not make any changes so go ahead and close.



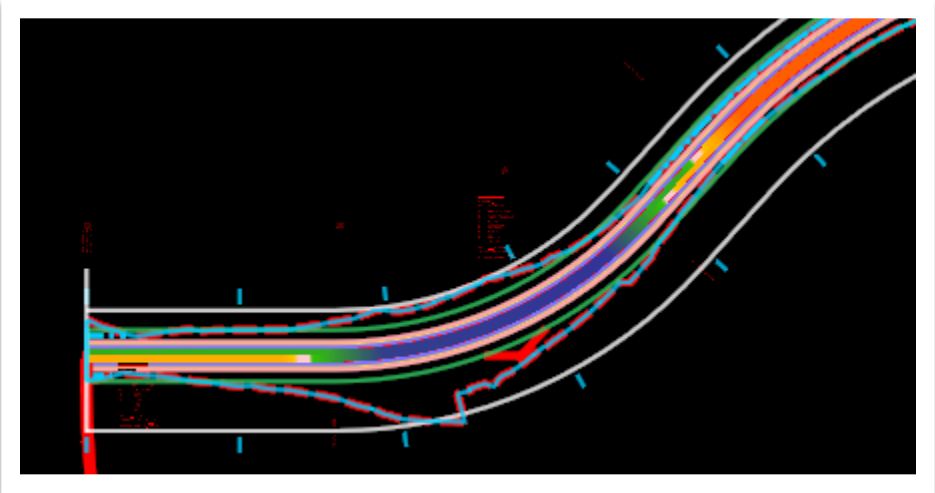
Take Note!

*In the Superelevation Editor, some lines are greyed-out and cannot be edited because the superelevation rules used to calculate the values are locked. Utilize the **Deactivate Rule** tool (measuring stick icon) to deactivate this rule lock and so you can edit a greyed-out value.*

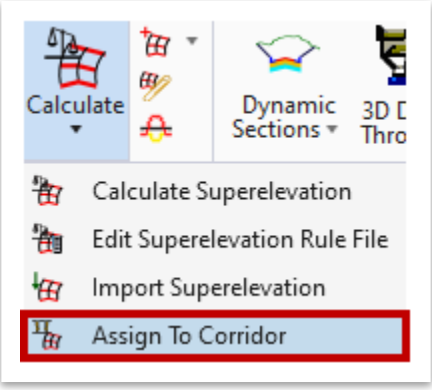
6.2.8 Exercise: Assign Superelevation to a Corridor

In this exercise, we will assign superelevation shapes to the corridor. We will open back up the **GenescoCorridor.dgn** file.

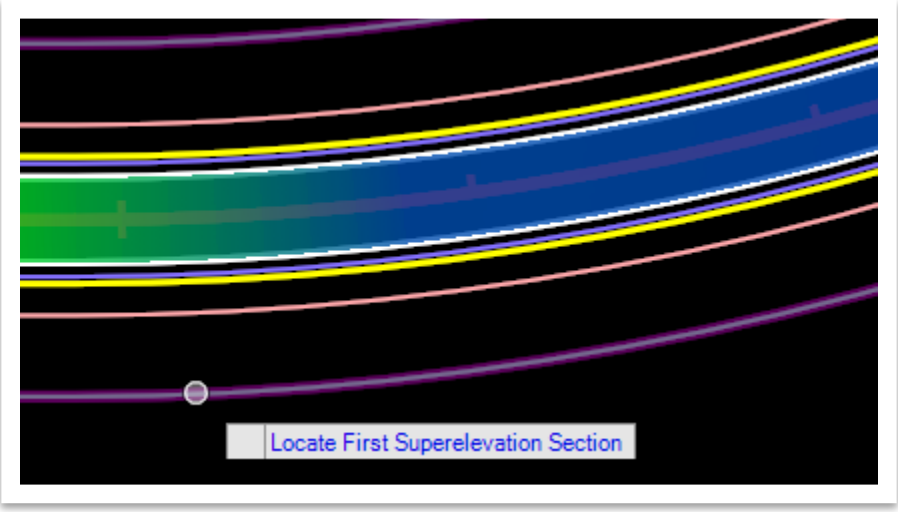
1. Attach the **GenescoSuperelevation.dgn** file as a reference using the **Coincident World** attachment method and then turn off the **WI999-11Survey.dgn** reference file.



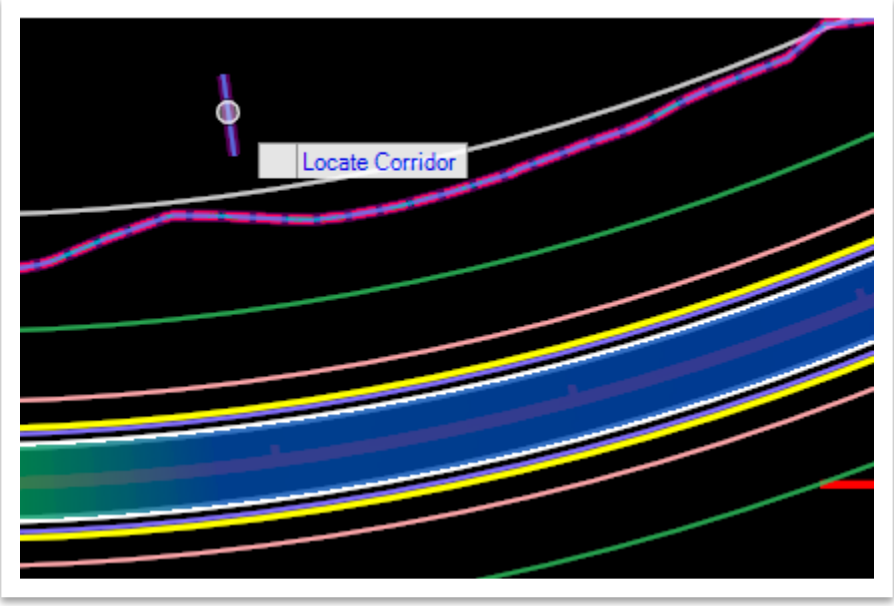
2. We will now apply the superelevation to the **GENESCO_TEST** corridor. Open the **Assign To Corridor** tool (**OpenRoads Modeling >> Corridors >> Superelevation >> Calculate**).



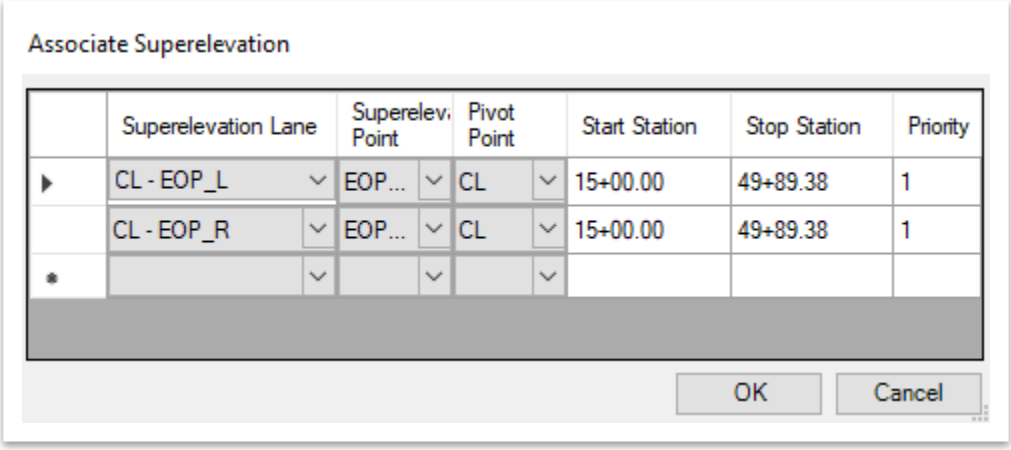
3. Notice the cursor prompt: Locate **First Superelevation Section**. Select the green boundary that represents the superelevation section and then right click to reset since there is only one superelevation section in this exercise.



4. Notice the next cursor prompt: **Locate Corridor**. Select the blue corridor handles. **Note:** If you don't see the handles, make sure the **DES - CORRIDOR GRAPHICS - Design** level is turned on.



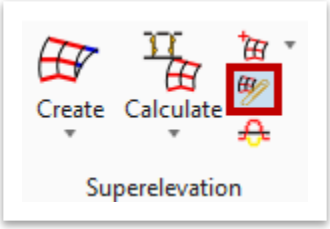
5. This will open the **Associate Superelevation** window. Click **OK** and the corridor will re-process to show the updated cross slopes and slope lines.



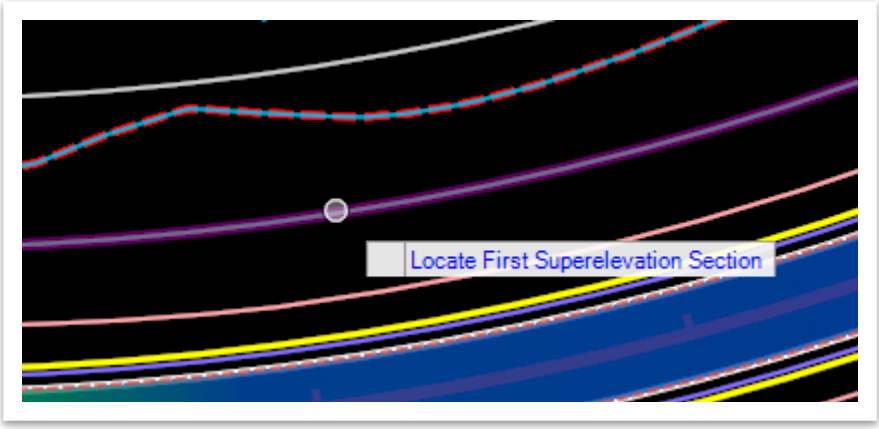
6.2.9 Exercise: Report Generation – Superelevation

In this exercise we will generate a superelevation report. We will continue to utilize the same **GenescoCorridor.dgn** file.

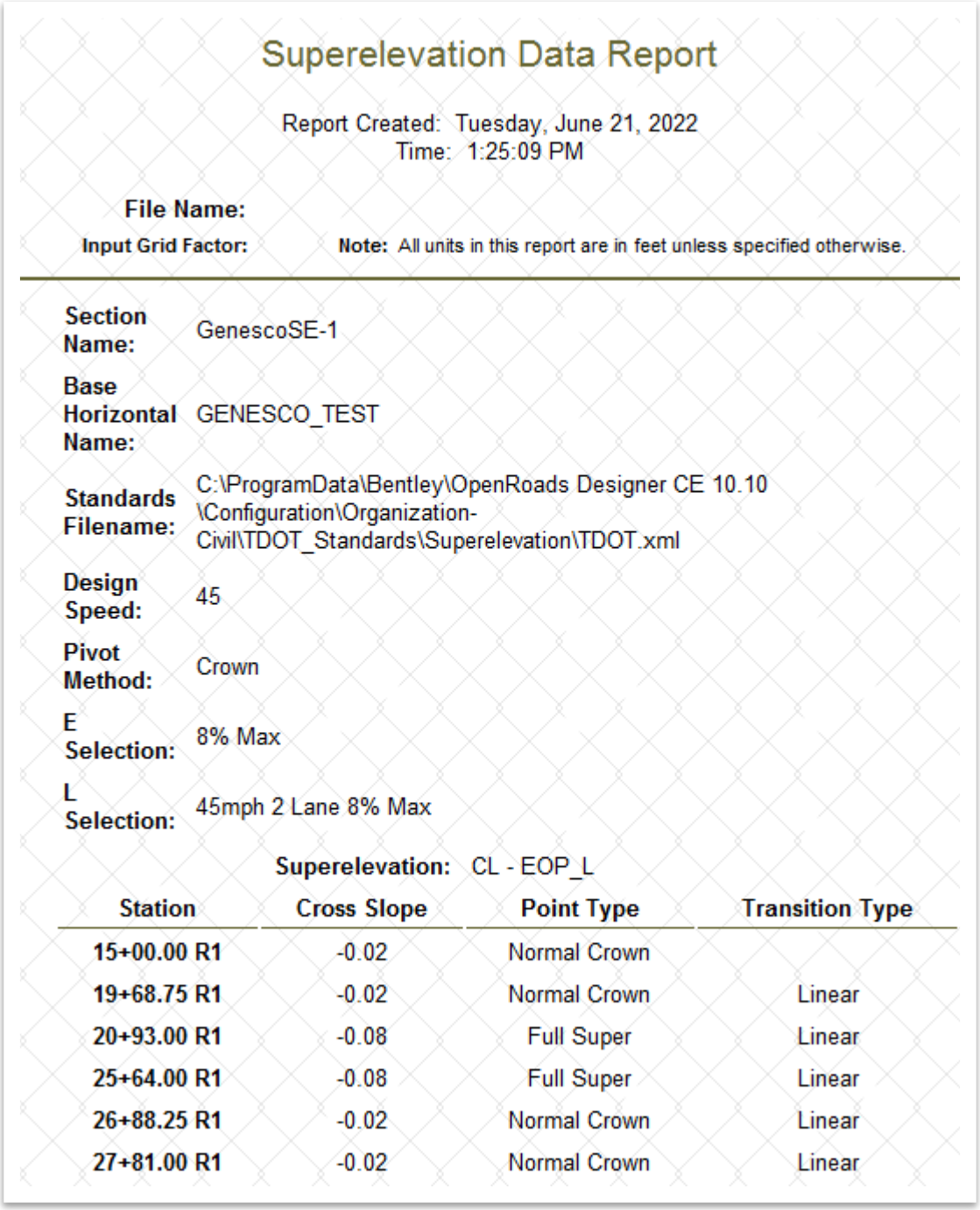
1. Open the **Superelevation Report** tool (**OpenRoads Modeling >> Corridors >> Superelevation**).



2. Notice the cursor prompt: **Locate First Superelevation Section**. Select the green boundary that represents the superelevation section and then right click to reset since there is only one superelevation section in this exercise.



3. Review the report and spot check the cross slopes. Close the report once you are done. **Note:** Remember, if your report formatting needs updating, go to **Tools >> Format Options** within the **Bentley Civil Report Browser**.



Superelevation Data Report

Report Created: Tuesday, June 21, 2022
Time: 1:25:09 PM

File Name:

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

Section Name:	GenescoSE-1
Base Horizontal Name:	GENESCO_TEST
Standards Filename:	C:\ProgramData\Bentley\OpenRoads Designer CE 10.10 \Configuration\Organization-Civil\TDOT_Standards\Superelevation\TDOT.xml
Design Speed:	45
Pivot Method:	Crown
E Selection:	8% Max
L Selection:	45mph 2 Lane 8% Max

Superelevation: CL - EOP_L

Station	Cross Slope	Point Type	Transition Type
15+00.00 R1	-0.02	Normal Crown	
19+68.75 R1	-0.02	Normal Crown	Linear
20+93.00 R1	-0.08	Full Super	Linear
25+64.00 R1	-0.08	Full Super	Linear
26+88.25 R1	-0.02	Normal Crown	Linear
27+81.00 R1	-0.02	Normal Crown	Linear

Chapter 7. Proposed Terrain Model Creation

In ORD, proposed digital terrain models (surfaces) will be created from the corridor using **graphical filters**. The Graphical Filter tool is located under the **Terrain** tab in the OpenRoads Modeling workflow. TDOT has a graphical filter library set up to pull multiple types of surfaces from a corridor model. Most often, designers will utilize the **Proposed Finish Grade** graphical filter. Other graphical filters have been set up for optional terrains for the purpose of Automated Machine Guidance (AMG) like **Proposed Grading Surface**.

The graphical filters work by searching a referenced corridor and looking for feature definitions assigned to point names within the TDOT templates. This is another reason why TDOT has built an extensive template library within the default ITL, so that designers can take full advantage of the powerful tools within ORD with minimal setup and adjustment to the default TDOT templates. If a designer needs to add a point to the standard TDOT graphical filters, they would do so in the **Graphical Filter Manager**. The proposed DTM created from graphical filters resides within the dgn file along with all its properties. It can be referenced (attached) like any other design file.

7.1 Objectives

At the conclusion of this chapter, participants will be able to:

1. Understand how graphical filters and graphical filter groups work to quickly create proposed terrains.
2. Create Proposed Terrain Models.
3. Create Proposed Complex Terrain Models (Merged).

7.2 Lecture: Graphical Filter Manager

The **Graphical Filter Manager** within the **Terrain >> Create** tools is powerful and can be utilized in many ways (Figure 83). When opening the tool, it is actually called the **Terrain Filter Manager** within the window (Figure 84). TDOT has set up the default graphical filters to work in conjunction with the TDOT templates, which look for breaklines generated by the corridor template point feature definitions to create a surface.

FIGURE 83. GRAPHICAL FILTER MANAGER TOOL

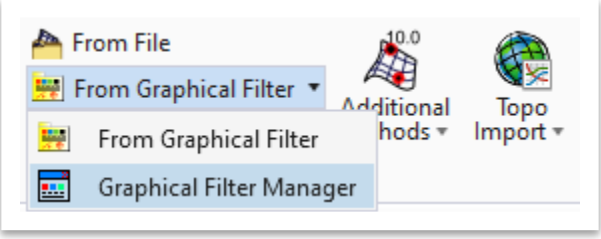
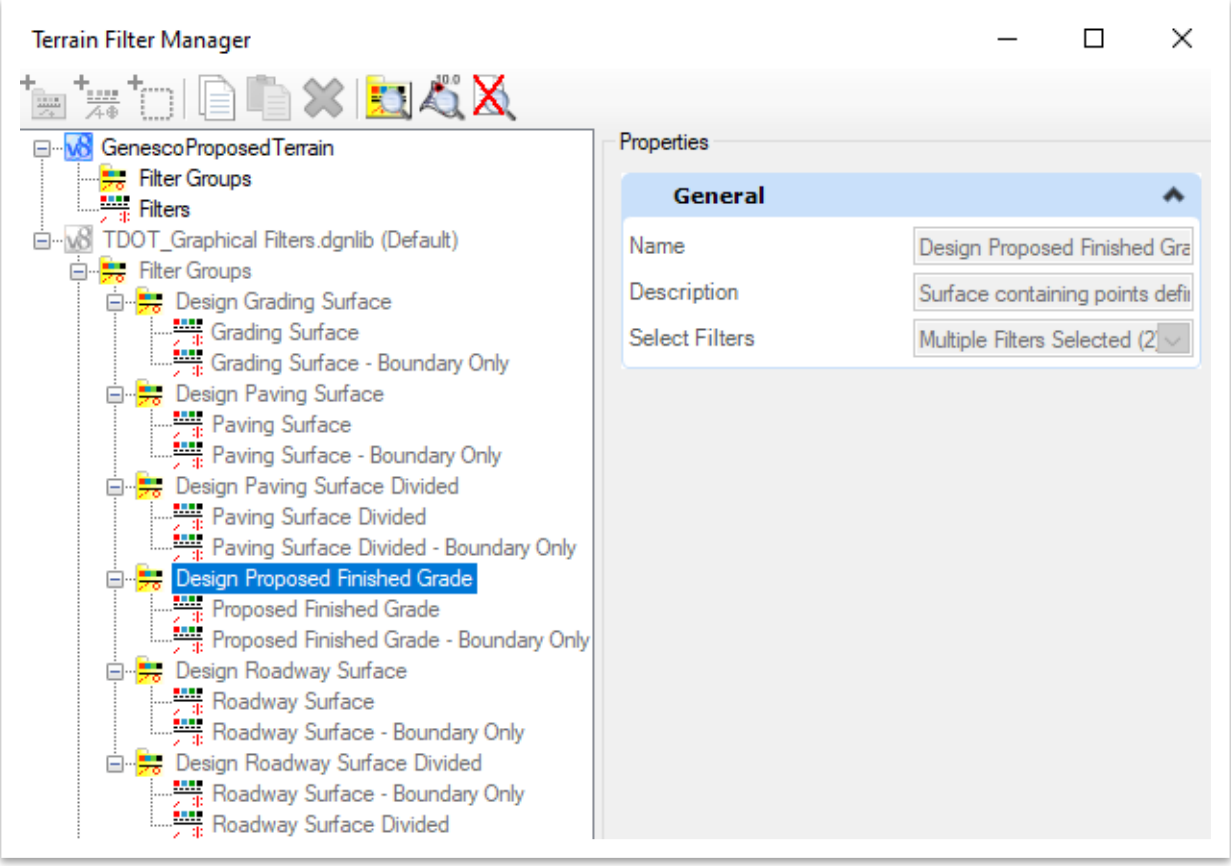


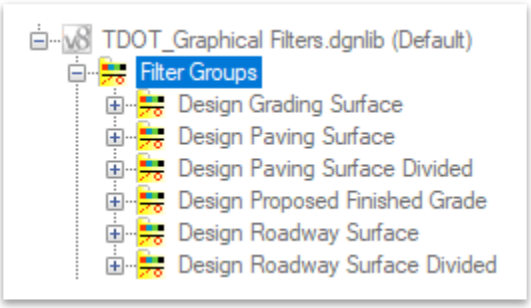
FIGURE 84. TERRAIN FILTER MANAGER



7.3 Lecture: Graphical Filter Groups

Graphical Filter Groups are two or more graphical filters working together to create a terrain (Figure 85). TDOT has set up its graphical filter groups to have one filter that looks for roadway items and one filter that confines the search based on a desired boundary like slope lines for a proposed finish grade. (e.g. Boundary Only).

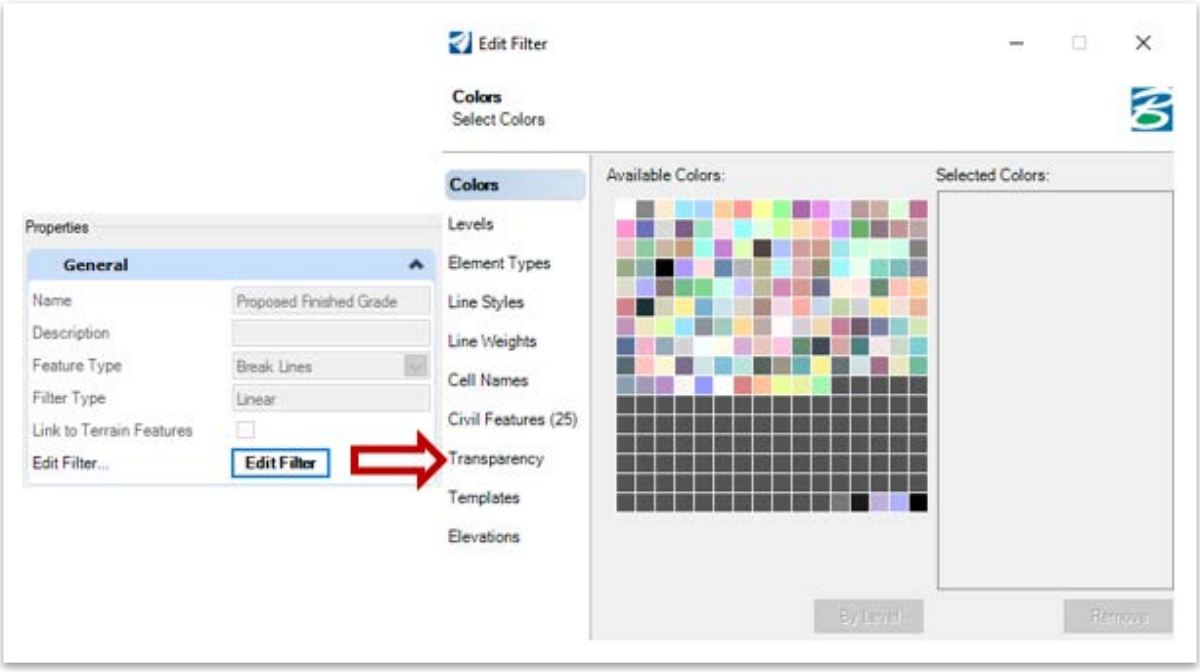
FIGURE 85. FILTER GROUPS



Once a graphical filter group has been selected from the **TDOT_Graphical Filters.dgnlib** (default) through the **From Graphical Filter** tool (**Terrain >> Create**), this group and its filters will be displayed under the active design file and can be edited.

Within the **Terrain Filter Manager**, a user can select **Edit Filter** to see what the graphical filter is searching for in the design file (Figure 86). The filters are setup to look for feature definitions assigned to point names within the TDOT templates. If you create a new template that has different feature definitions, you must add those here for the graphical filter to work properly.

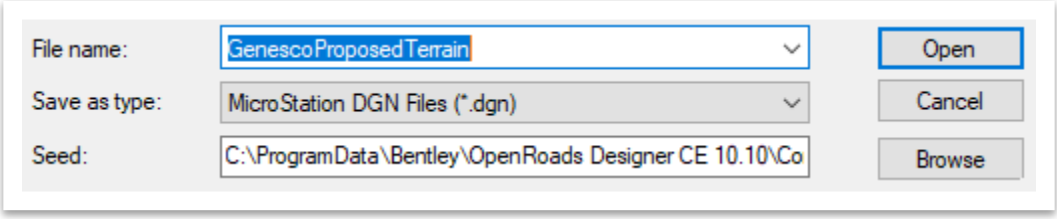
FIGURE 86. EDIT FILTER



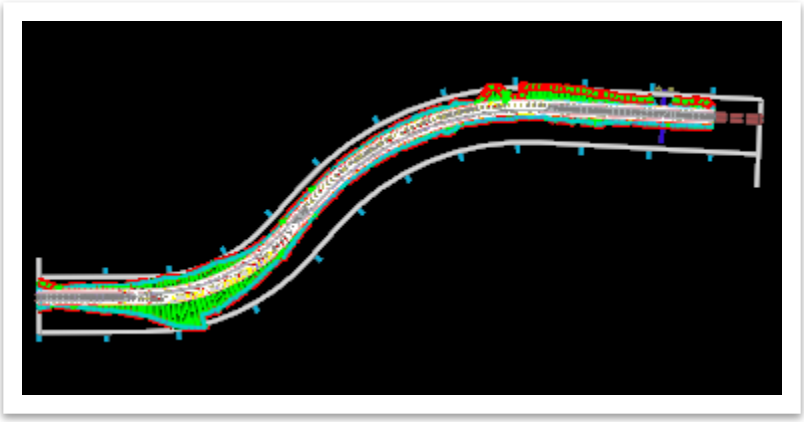
7.4 Exercise: Proposed Terrain Model Creation

In this exercise, we will create a proposed terrain model (surface) using a graphical filter.

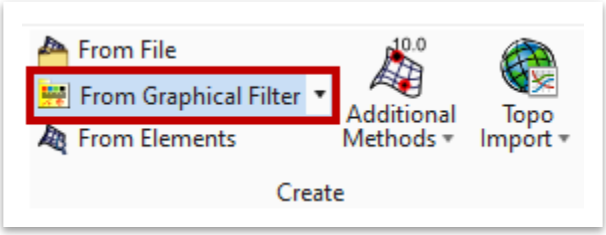
1. Create a new file and name it **GenescoProposedTerrain**. Select the **TDOTSeed 3D.dgn** and click **Save**. **Note:** All terrain models must be created in **3D** seed files.



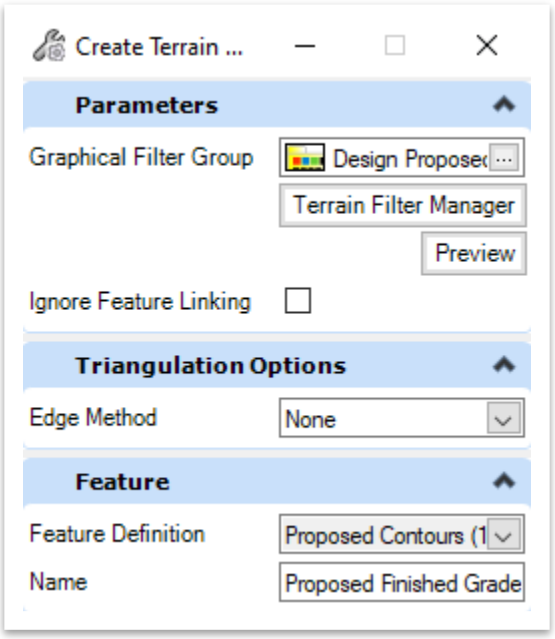
2. Attach the **GenescoCorridor.dgn** file as a reference using the **Coincident World** attachment method. Zoom in and delete the embedded survey data on the three **SUR** levels in the live file. Then, click **Fit View** to see the corridor extent. **Note:** The view has been rotated for the screenshot. Also, if you don't see the green perpendicular lines initially, you should once you initiate Step 3.



3. Open the **From Graphical Filter** tool (**OpenRoads Modeling >> Terrain >> Create**).

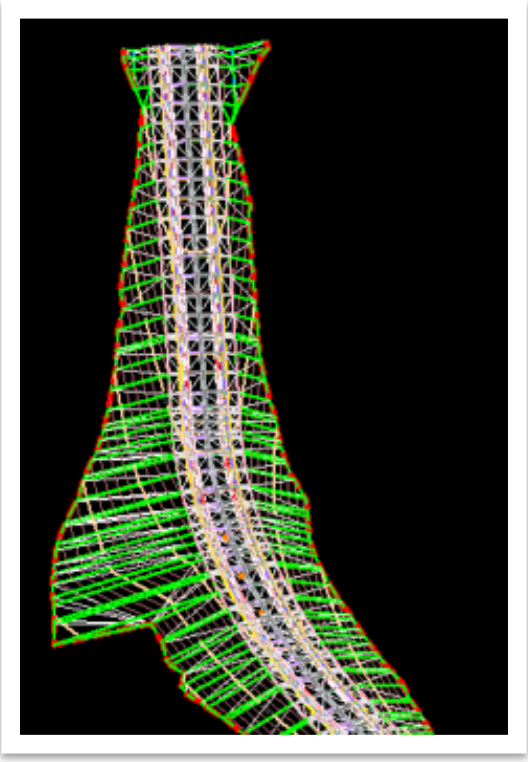


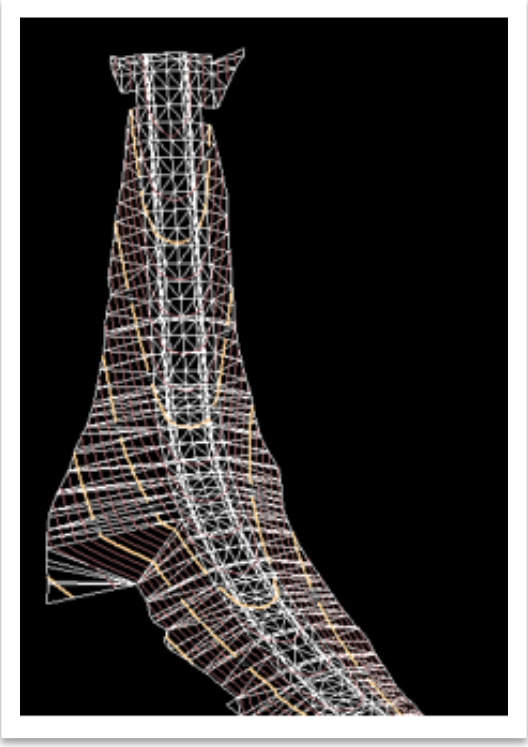
4. Within the **Create Terrain by Graphical Filters** dialog box, select the following settings.
    a. **Graphical Filter Group:** Design Proposed Finished Grade (click the ellipses to open the filter groups)
    b. **Ignore Feature Linking:** Unchecked
    c. **Edge Method:** None
    d. **Feature Definition:** Terrain >> Proposed Contours (10’ Major / 2’ Minor)
    e. **Name:** Proposed Finished Grade



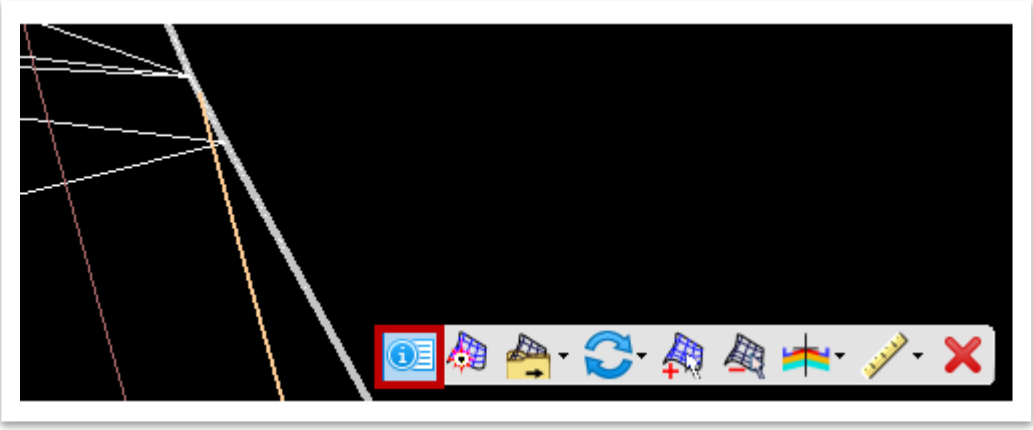
5. Left click to accept the **Edge Method** and then left click again to accept selection and give it a second to process. Once the terrain is created, the **Append To Terrain** option is activated in the dialog box and on the cursor. Since we are not creating a complex terrain in this exercise, go ahead and activate the Element **Selection** tool (or hit **ESC**) to close the tool.

6. Rotate the view dynamically and notice that the contours are draped along the surface of the corridor and the triangles have been created (first image). Then, turn off the corridor reference files and just view the contours (second image).

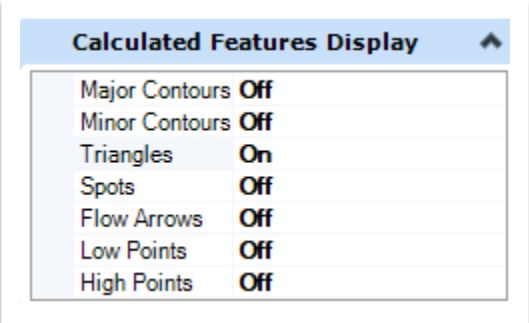




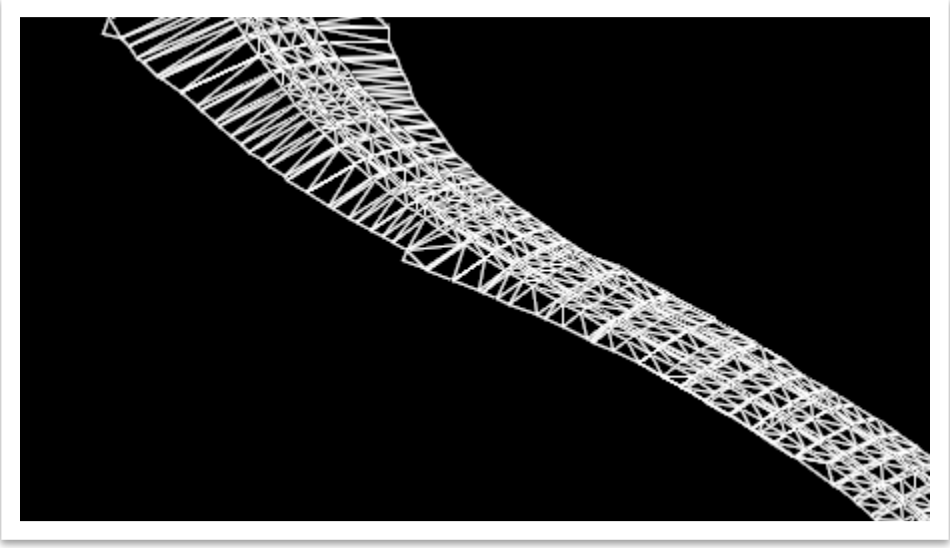
7. Next, select the terrain boundary and open the **Properties** within the heads-up display.



8. Keep the **Triangles** turned on and turn off the **Major** and **Minor Contours**.



9. Review the 3D **Proposed DTM** and then **Save Settings**.



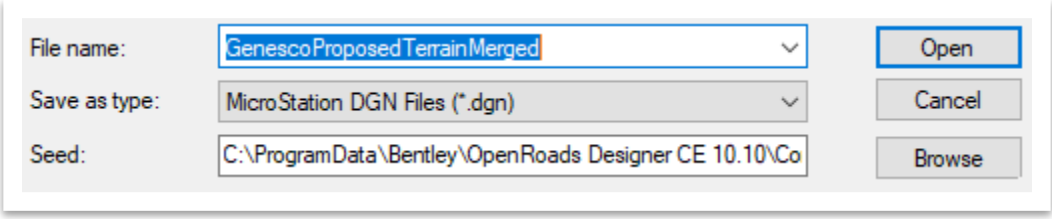
7.5 Exercise: Proposed Merged Terrain Model Creation

In this exercise, we will merge the proposed terrain model with the existing terrain model to create the **Proposed Merged Terrain**.

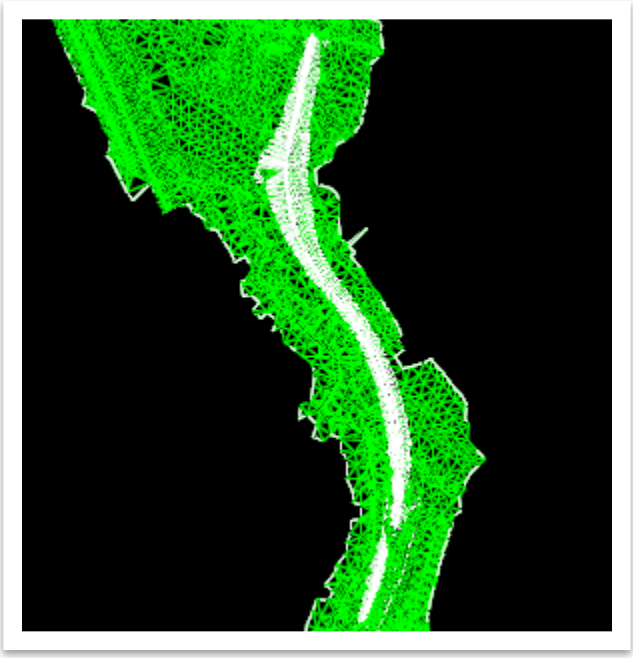
Take Note!

Any terrain model that needs to be combined, merged or appended must be attached as a reference and the Display must be on.

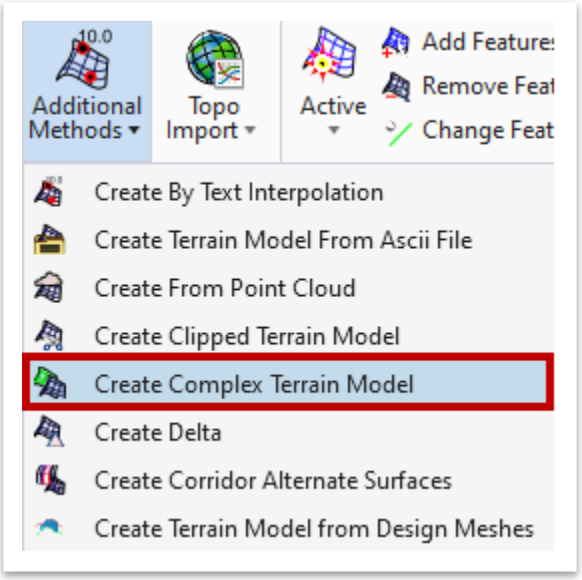
1. Create a new file and name it **GenescoProposedTerrainMerged**. Select the **TDOTSeed3D.dgn** and click **Save**.



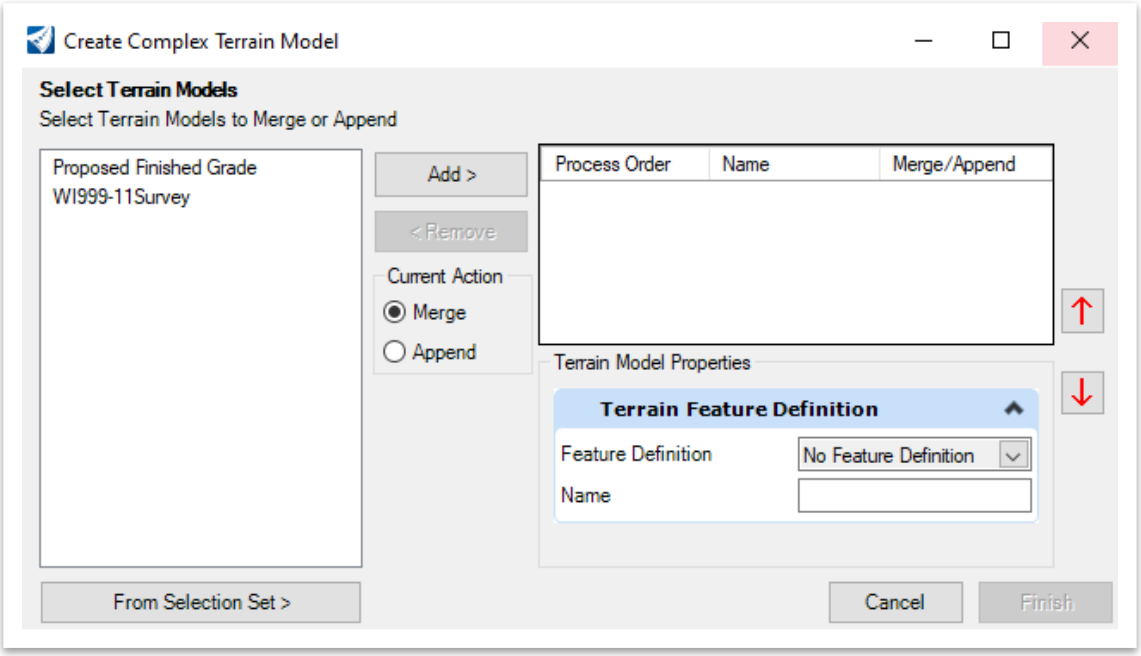
2. Attach the following terrain reference files using the **Coincident World** attachment method.
   - GenescoExistingTerrain.dgn
   - GenescoProposedTerrain.dgn
3. Make sure the view is set to **Default**. Zoom in and delete the embedded survey data on the three **SUR** levels in the live file. Then, click **Fit View** to see the corridor extent.



4. Open the **Create Complex Terrain Model** tool (**OpenRoads Modeling >> Terrain >> Create >> Additional Methods**).



5. Notice that the **Create Complex Terrain Model** dialog box appears showing the **Proposed Finished Grade** and the **WI999-11Survey** (existing terrain) on the left side.



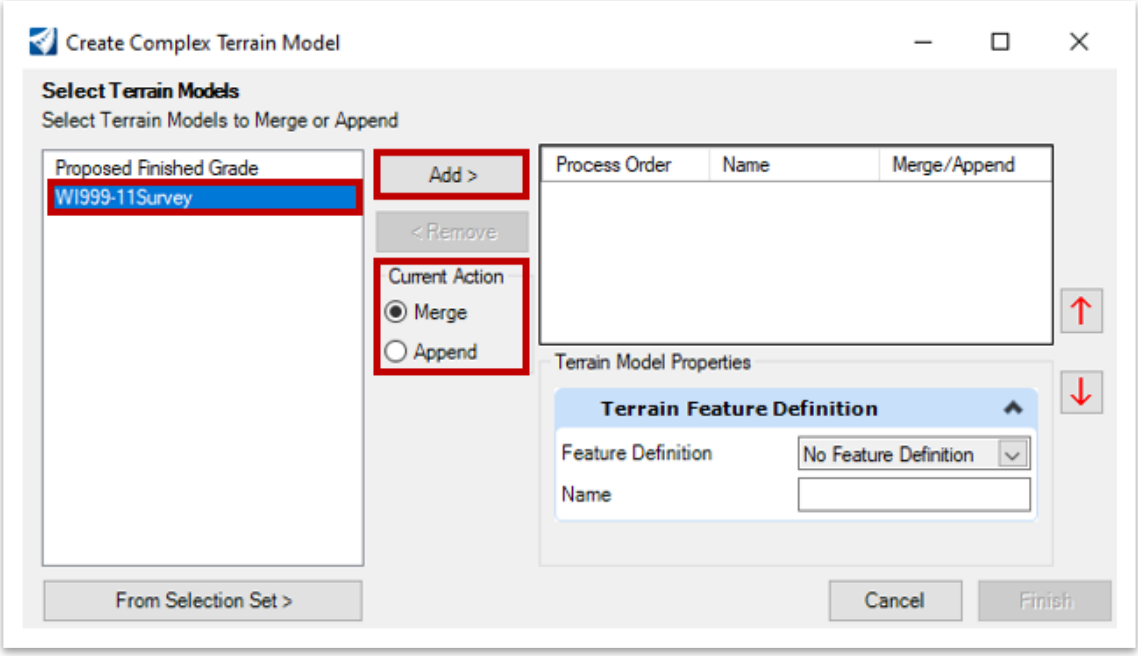
Take Note!

*There are two options to choose from: **Merge** or **Append**. Both options combine the data from the terrains but use different processes to yield different results.*

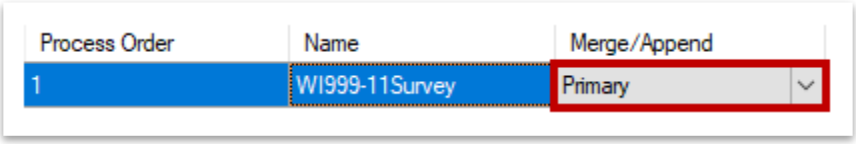
***Merge** combines the data only in the areas they do not overlap, and it requires there to be at least one point that overlaps between the two. If there is data in both models in an overlapping area, the data from the **primary** model is discarded, and only the data from the **merging** model is used. Therefore, it is critical to set the order correctly.*

***Append** triangulates the combined data from the terrains using all data from both models whether they overlap or are adjacent to each other.*

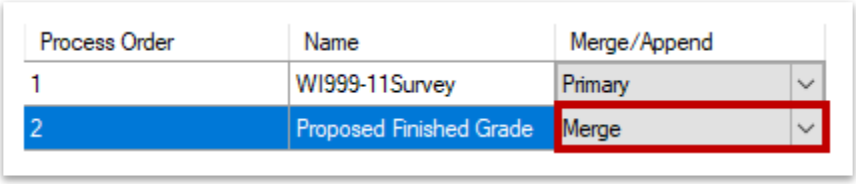
6. Select **WI999-11Survey** from the left side and **Add** it to the right side. Set the **Current Action** in the middle of the dialog box to **Merge**. **Note:** If you do not see **WI999-11Survey** listed, close the file and re-open.



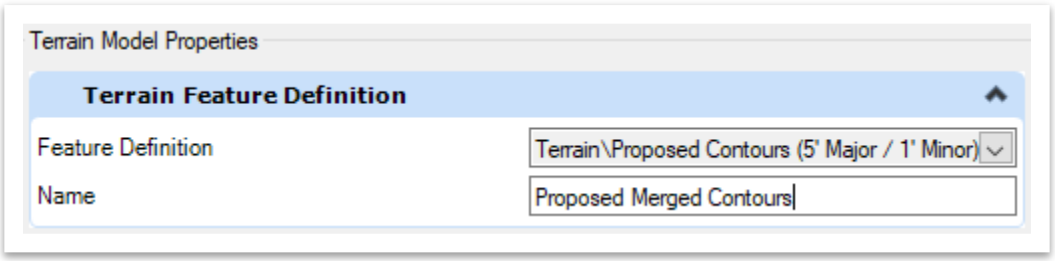
7. Make sure that the **Merge/Append** option is set to **Primary**.



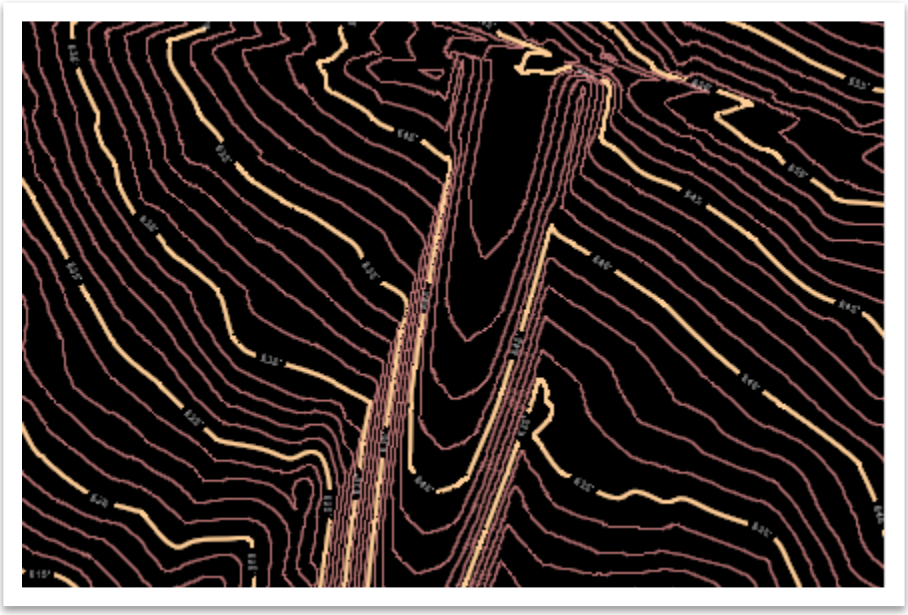
8. Next, select **Proposed Finished Grade** from the left side and **Add** it to the right side. This time set the **Merge/Append** option to **Merge**.



9. Under **Terrain Model Properties**, select the following settings and then click **Finish**.
    a. **Feature Definition:** Terrain >> Proposed Contours (5’ Major / 1’ Minor)
    b. **Name:** Proposed Merged Contours



10. When the process is completed, turn off the **GenescoExistingTerrain.dgn** and **GenescoProposedTerrain.dgn** reference files and you should see the **Proposed Complex DTM** (surface) shown below. **Note:** The triangles have been turned off for clarity. Also, to incorporate the gutter flow line, refer to Chapter 7 in the SUDA (ORD) Manual. This will be beneficial for accurate catch basin placement at the depression point of the gutter.



Chapter 8. Placing Named Boundaries (Profile and XS)

This chapter will only cover the creation of **Profile** and **Cross Section** sheets, in addition to **Earthwork**. For detailed information on the sheet index and Plan sheet creation, please refer to Chapter 10 in the Fundamentals (ORD) Manual. For detailed information on how to create 1:1 sheets, please refer to Chapter 11 in the Fundamentals (ORD) Manual.

8.1 Objectives

At the conclusion of this chapter, participants will be able to:

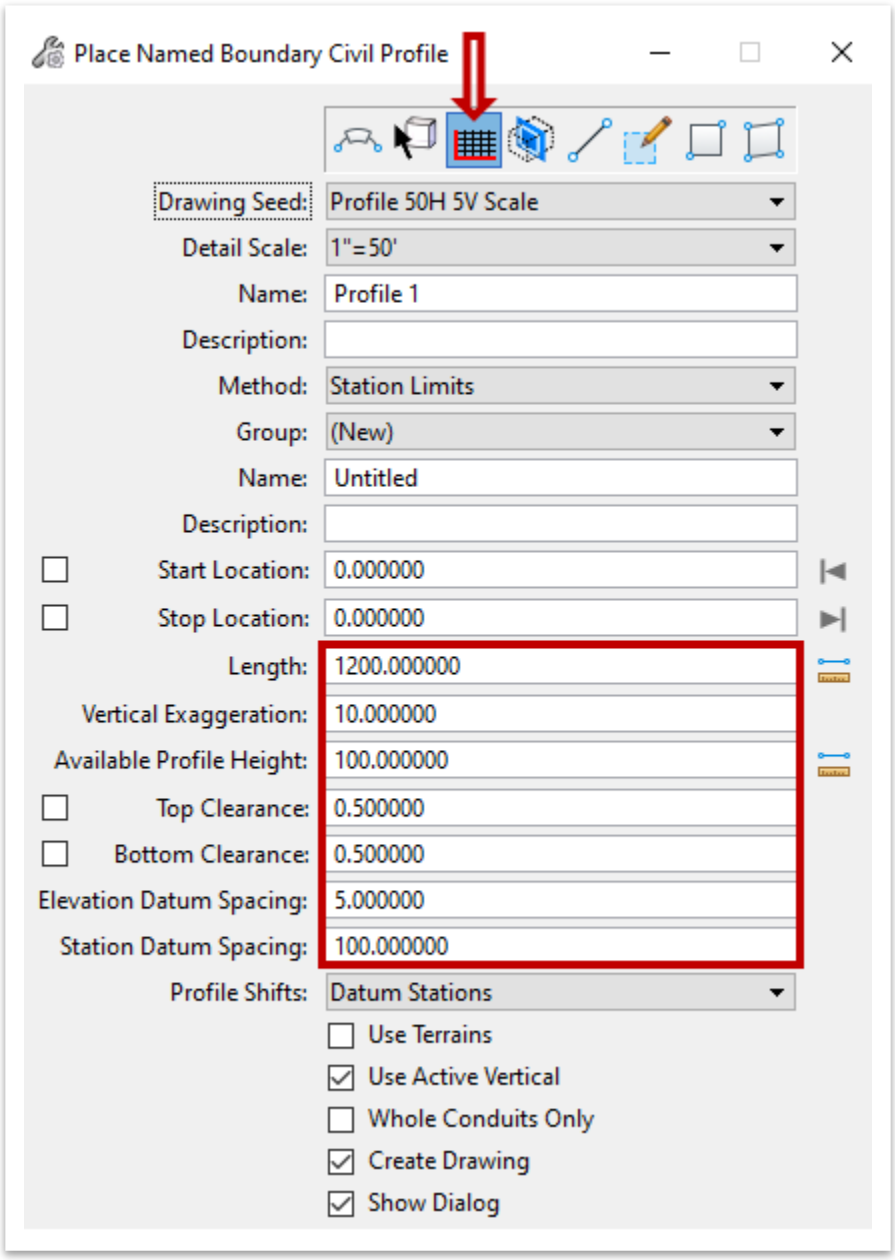
1. Create profile and XS sheets and add annotation.
2. Run earthwork and generate a report.
3. Create individual PDF's for the sheets (profile and XS).

8.2 Lecture: Placing Named Boundary for Profile Sheets

Creating profile sheets is very similar to creating plan sheets in ORD. In order to create a profile named boundary, a profile view must be open. After activating the **Place Named Boundary** tool, the user will select the **Civil Profile** option (Figure 87 on the next page). After the drawing seed is selected (**Profile 20H 2V Scale**, **Profile 50H 5V Scale** or **Profile 50H 10V Scale**), the user will be prompted in the bottom left corner of the ORD window to identify the profile view.

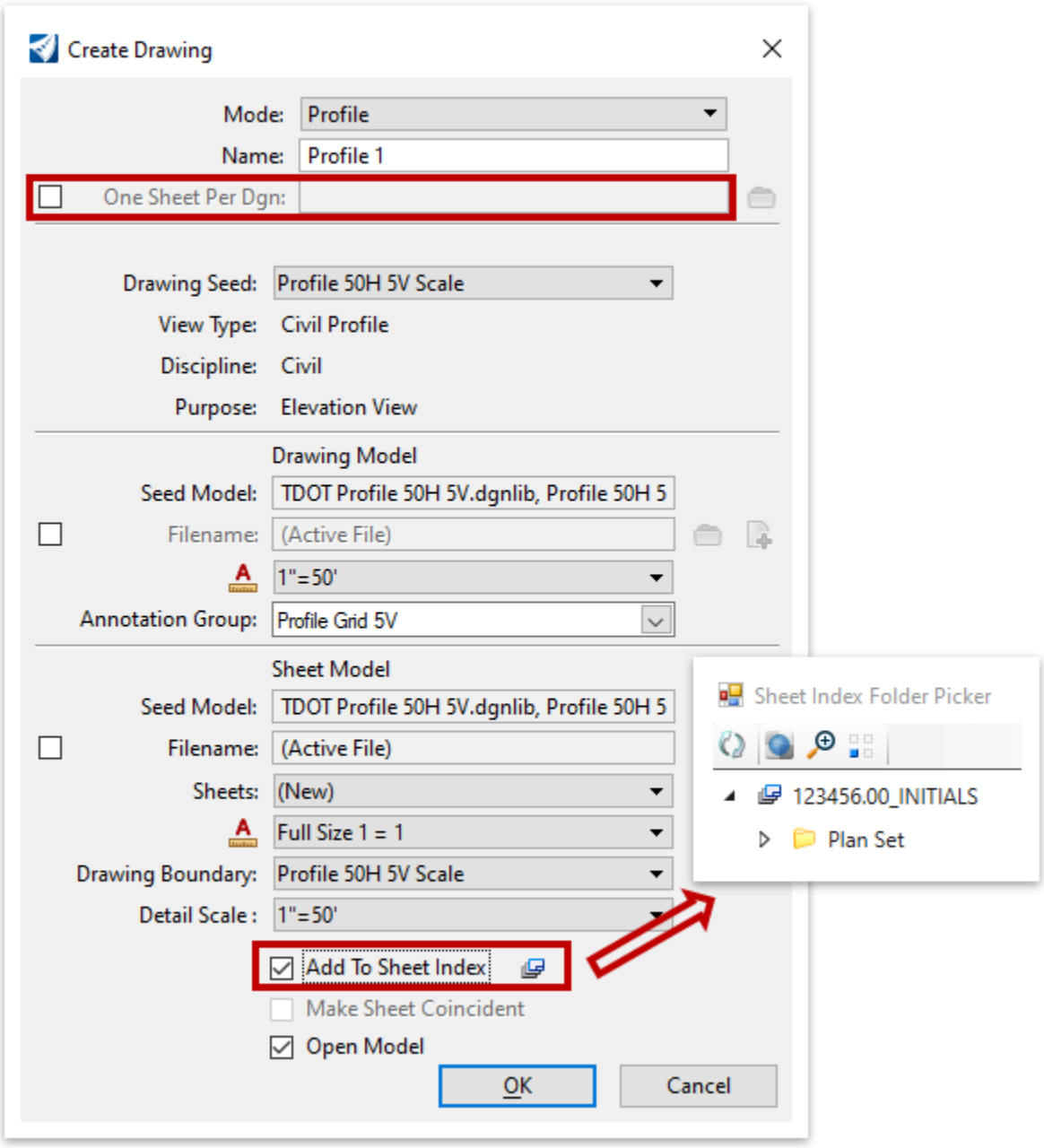
Once you select the profile view, the two **Name** fields will automatically populate. You can manually key-in whatever name you'd like after that. Just like for plan sheets, the user also needs to pick the start and stop locations of the clip boundaries. You can either key-in stations or manually select the extents with your mouse. If you want the clip shape to extend prior to the start or beyond the end of a project, you can control that by applying the offset into the station location. The clip extents (Figure 87 on the next page) are part of the sheet seed settings and should only be adjusted if you need to create a smaller clip length.

FIGURE 87. PLACE NAMED BOUNDARY WINDOW - CIVIL PROFILE

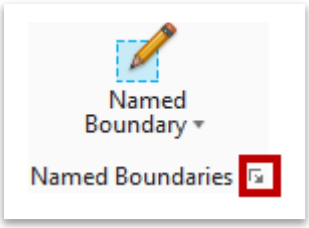


When creating the clip boundary, you should have **Create Drawing** checked. It will open the **Create Drawing** window (Figure 88) after following the prompts in the bottom left corner of the ORD window to accept settings. By default, all sheet models will be stored in one dgn file. However, you can set the software to create individual dgn files for each sheet model. Toggle on the option highlighted below and browse to the folder location in which you want to save the files.

FIGURE 88. CREATE DRAWING WINDOW

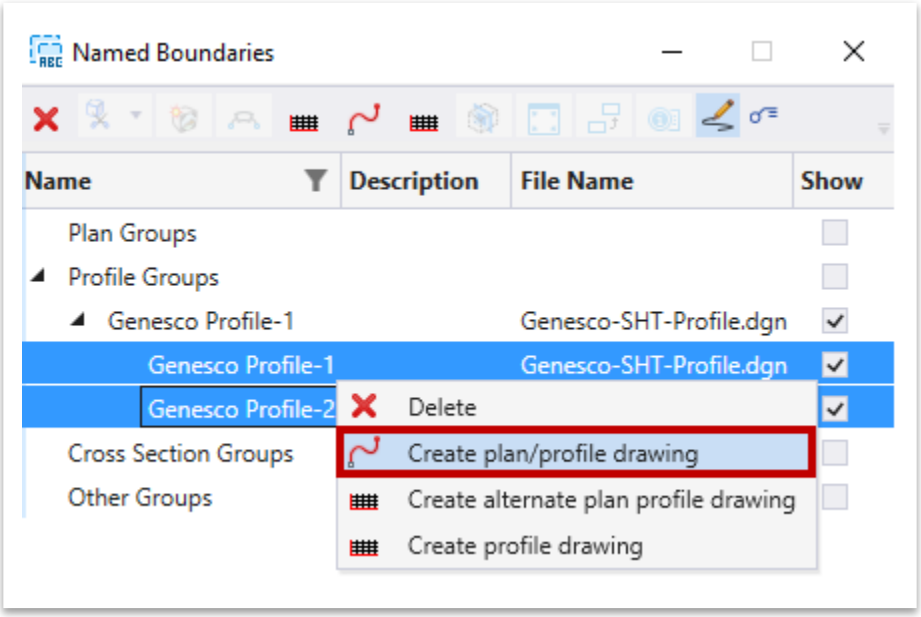


Once you checkmark **Add To Sheet Index** it will allow you to browse to the correct subfolder that the sheets need to be placed in. Click **OK** once selected.



If you have already established the clip boundaries in your dgn file, then you do not need to recreate the Named Boundaries. You can click the expand button (outlined in red) in the Named Boundaries option, which will then show the clipped sheets under **Profile Groups** (Figure 89). Toggle the **Show the Create Drawing Dialog** option on (outlined in red), and then right click on your selected sheets and select **Create Profile Drawing**. You will then add the sheets to the index thru the **Create Drawing** window in the same manner as described on the previous page.

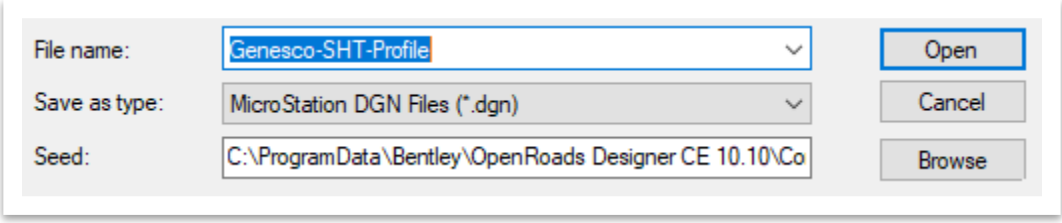
FIGURE 89. NAMED BOUNDARIES WINDOW



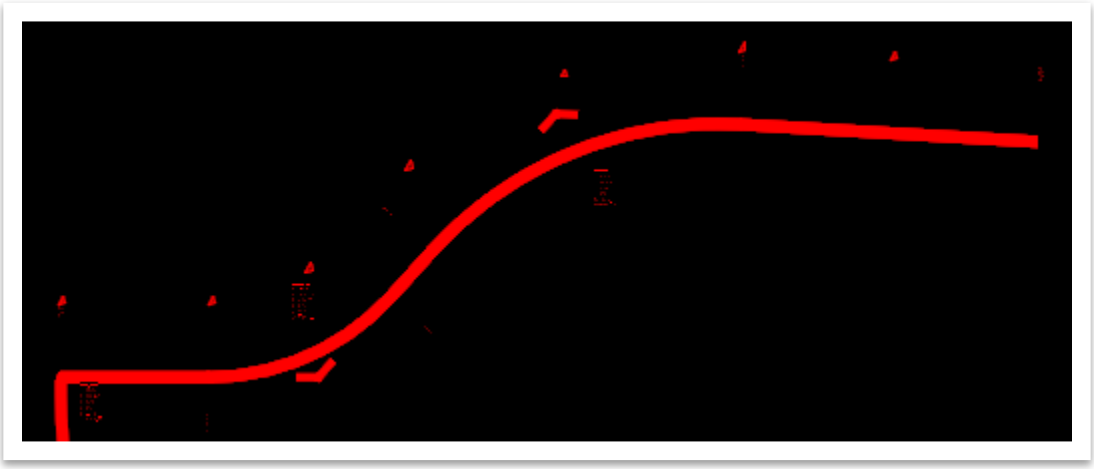
8.3 Exercise: Placing Named Boundary for Profile Sheets

In this exercise, we will create two profile named boundaries and setup the profile sheets for printing.

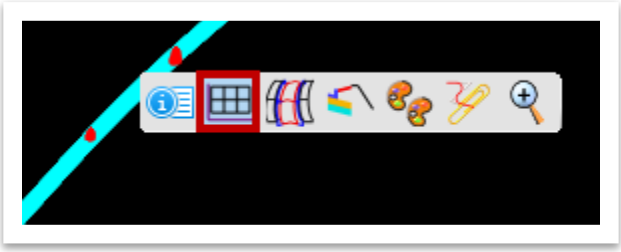
1. Create a new file and name it **Genesco-SHT-Profile**. Select the **TDOTSeed2D .dgn** and click **Save**.



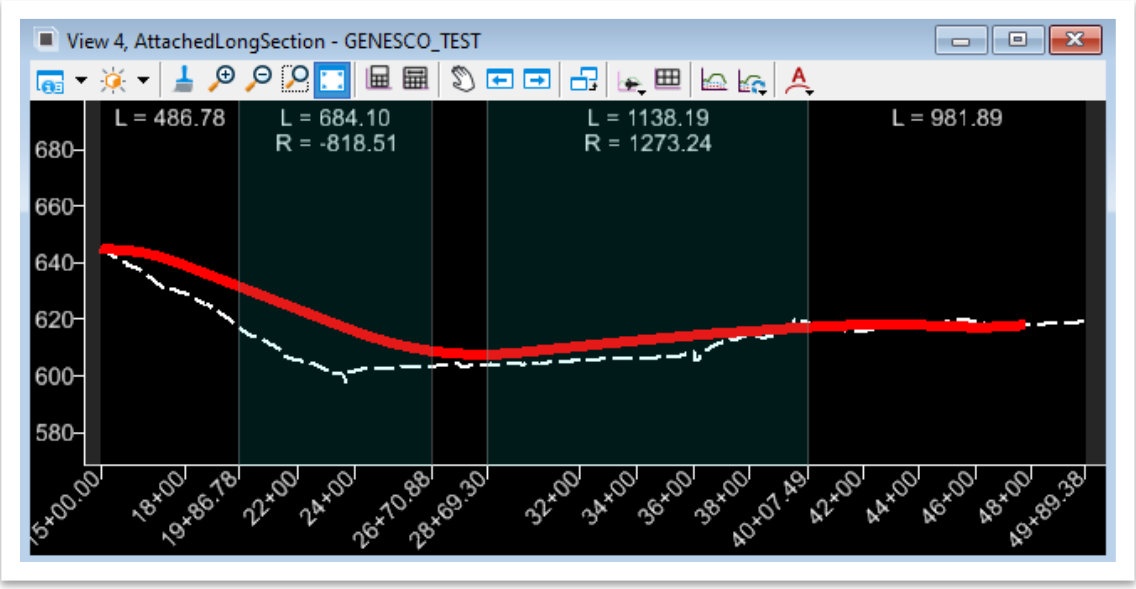
2. Attach the following reference files using the **Coincident World** attachment method. **Note:** The superelevation file needs to be referenced for the superelevation annotation group to work.
    - GenescoAlignments.dgn (turn off **DES - CL - Proposed Text - Small** level)
    - GenescoSuperelevation.dgn (turn-off)
3. Click **Fit View** to see the corridor extent. **Note:** The view has been rotated for the screenshot.



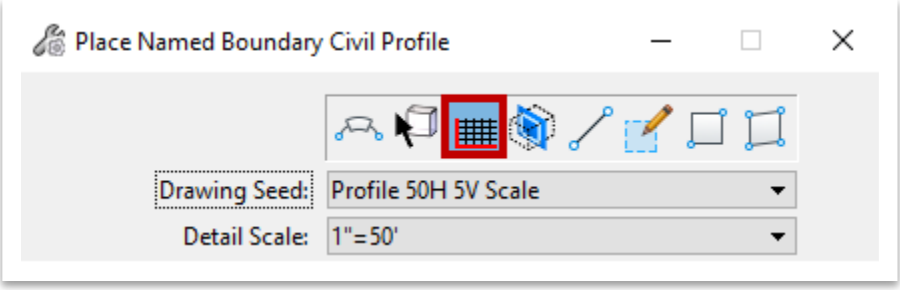
4. Select the **GENESCO_TEST** alignment and then select **Open Profile Model** from the heads-up display.



5. For this exercise, open **View 4** and left click within the view and notice the existing and proposed profiles.

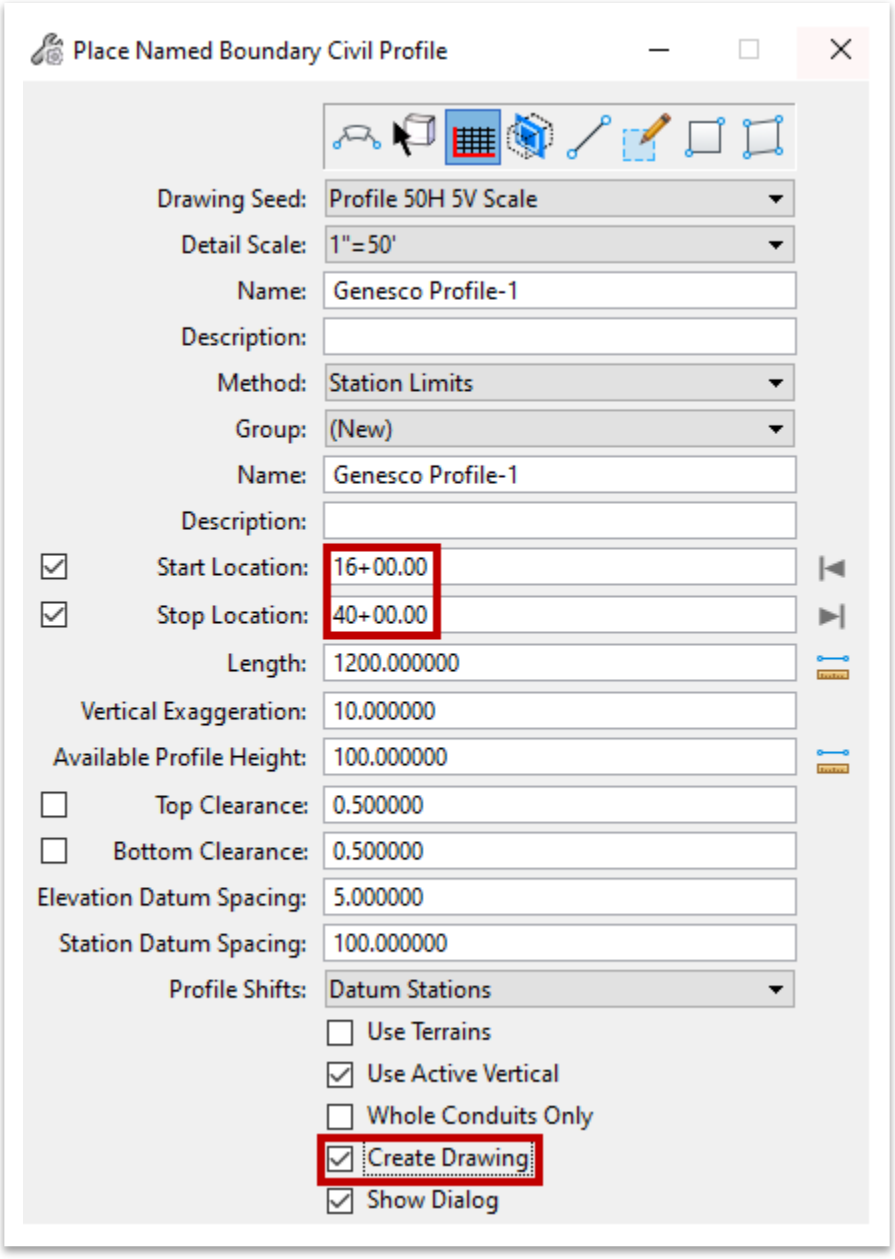


6. Next, open the **Place Named Boundary** tool (**OpenRoads Modeling >> Drawing Production >> Named Boundaries >> Named Boundary**). Make sure that the **Civil Profile** option is toggled on. Select **Profile 50H 5V Scale** for the Drawing Seed.

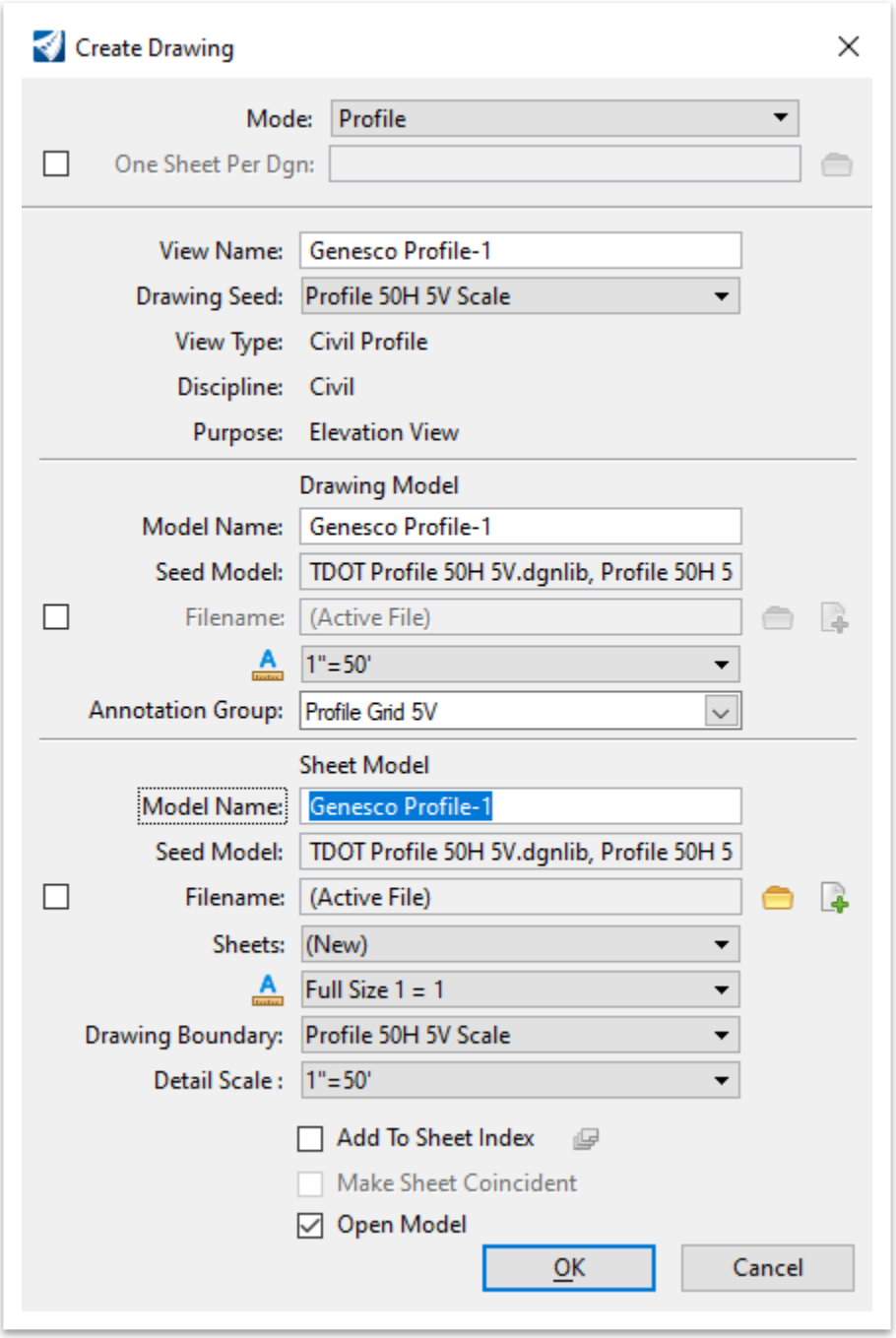


7. Notice the prompt in the lower left corner of the drawing window: **Identify Profile View**. Left click anywhere within **View 4**.

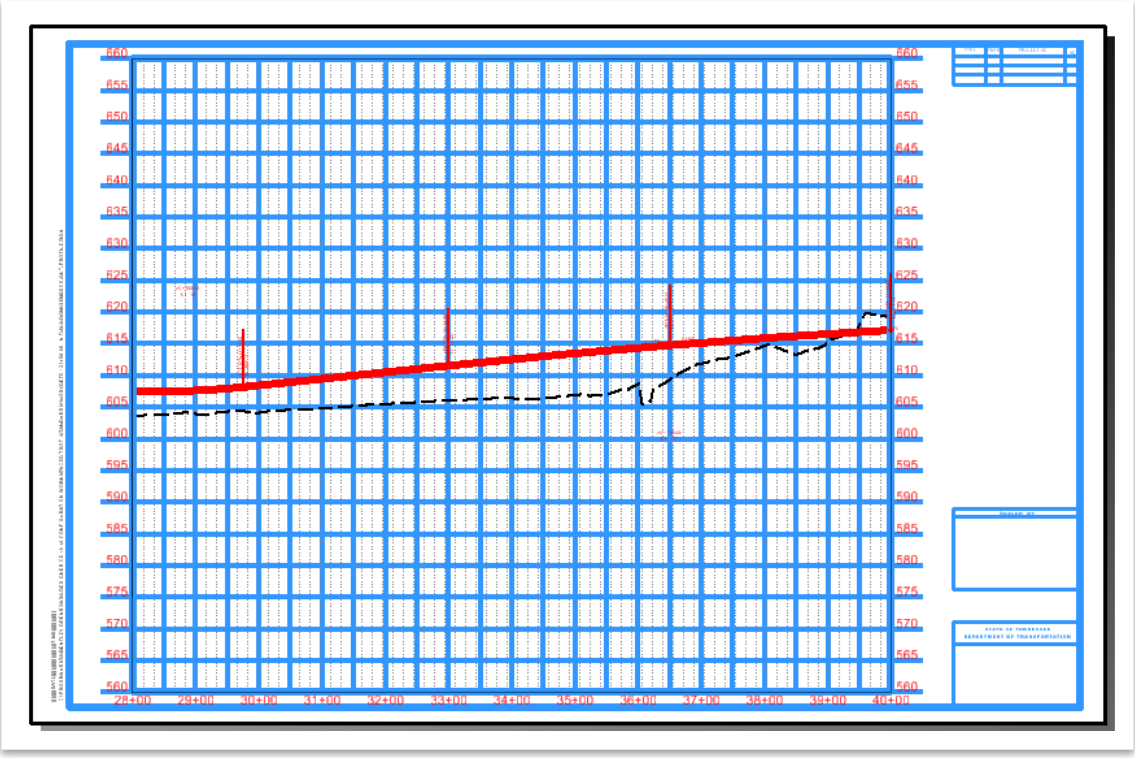
8. Edit the parameters below and leave all other default values as-is. Make sure that the **Create Drawing** option is toggled on at the bottom.
    a. **Name:** Genesco Profile-1
    b. **Start Location:** 16+00.00 (key-in)
    c. **Stop Location:** 40+00.00 (key-in)



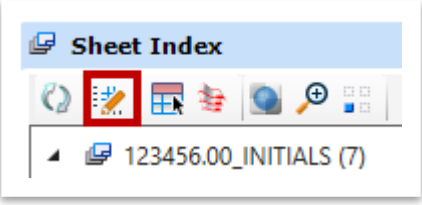
9. Left click anywhere within View 4 **three** times. Zoom out and you should see **two** profile named boundaries drawn into the file, represented by a white border. The **Create Drawing** window will appear automatically after creating the named boundary, since we toggled it on in the previous step. Click **OK** to accept all default settings. **Note:** If the **Name** fields shows the name twice, simply click in the field and remove.



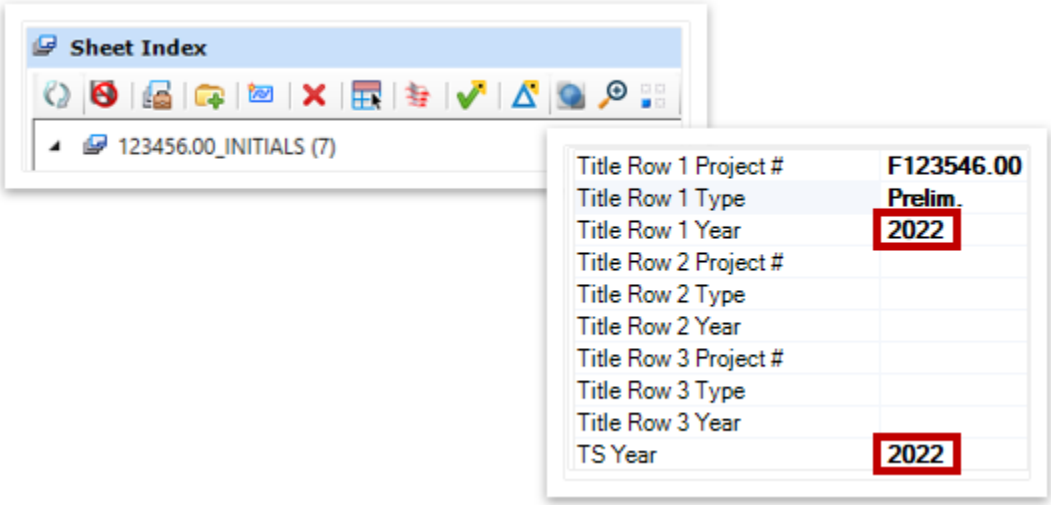
10. By default, the software should open to the second **sheet** model (**Genesco Profile-2 [Sheet]**) in **View 1**.



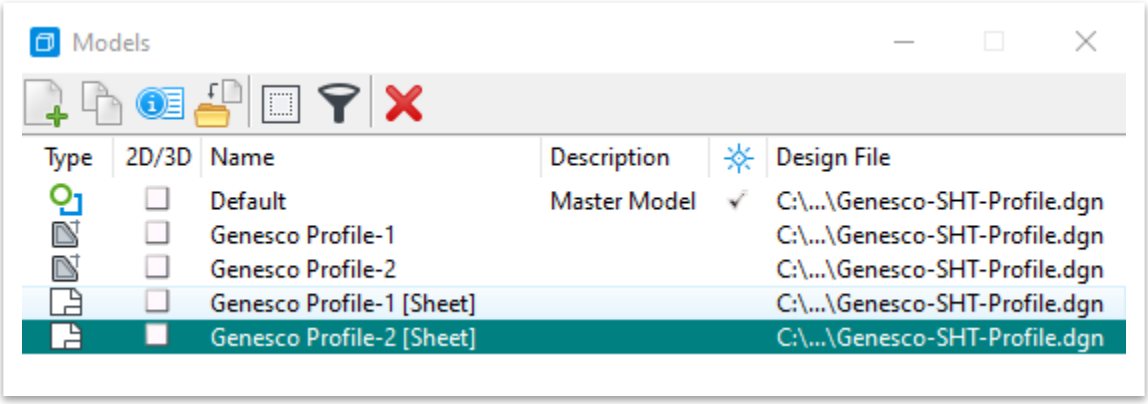
11. Now we need to add the 2 sheets to the overall sheet index for the **123456.00_ INITIALS** project workset. Since we are using the same workset as in the Fundamentals (ORD) Manual, you should still see the **7** sheets in the sheet index. Let's update the **Year** in the sheet index properties from 2020 to **2022**. First, open the **Sheet Index** for editing. **Note:** The assumption is that you are still using the same workset from the Fundamentals (ORD) Manual. However, if you have a varying number of sheets, that is OK for the purpose of this exercise.



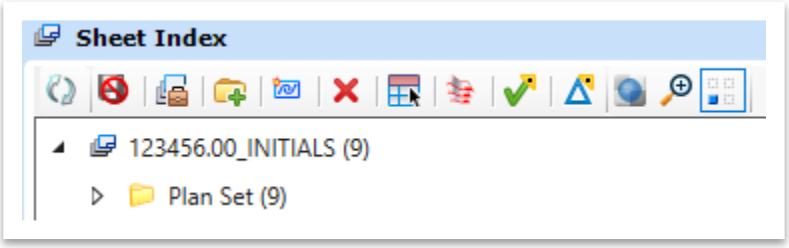
12. Highlight the **123456.00_INITIALS** workset in the sheet index. Within the **Properties**, update the **Title Row 1 Year** and **TS Year** fields to **2022**. **Note:** You may need to expand the **Index Properties** tab within the Sheet Index Properties to see the fields below.



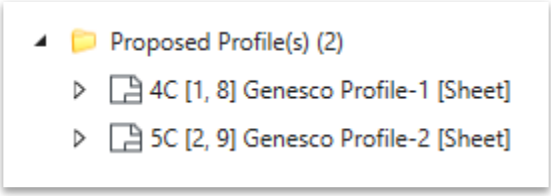
13. Next, open the **Models** window (**OpenRoads Modeling >> Home >> Primary**) and highlight the **Genesco Profile-1 [Sheet]** and **Genesco Profile-2 [Sheet]** models.



14. Hold the left mouse button down and drag the two models into the **Proposed Profile(s)** folder in the sheet index. Notice that the sheet index now has **9** files in it: **123456.00_INITIALS (9)**.



15. Expand the sheet index folder tree and notice that Sheets **4C** and **5C** have been added to the sheet index under **Proposed Profile(s)**. **Note:** You can double click on a sheet in the sheet index to open it.



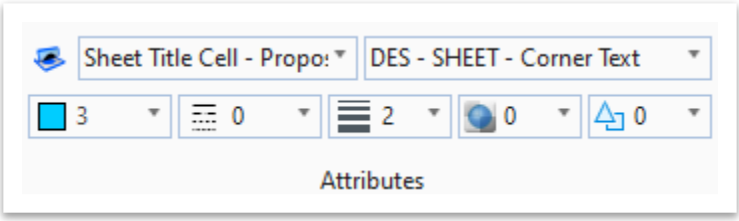
16. Zoom in to the upper right corner and notice that the sheet has automatically populated the **Type**, **Year** and **Project No**, which are tied to the sheet index properties. Also, the **Sheet Number** has automatically populated, which is tied to the Proposed Layout(s) folder sheet number controls.

TYPE	YEAR	PROJECT NO.	SHEET NO.
PRELIM.	2022	F123546.00	5C

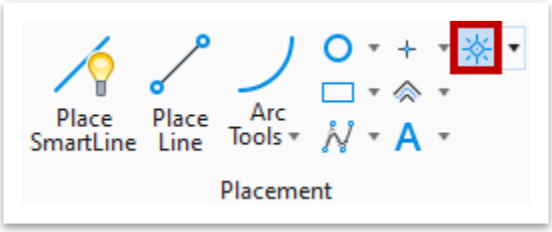
Take Note!

*If sheet models have already been added to the sheet index and you make a **sheet index property** update or a **folder sheet numbering control** update (e.g., different start number), the software does not update instantaneously. You must open a different model within the dgn file and then switch back to the sheet model to see the update.*

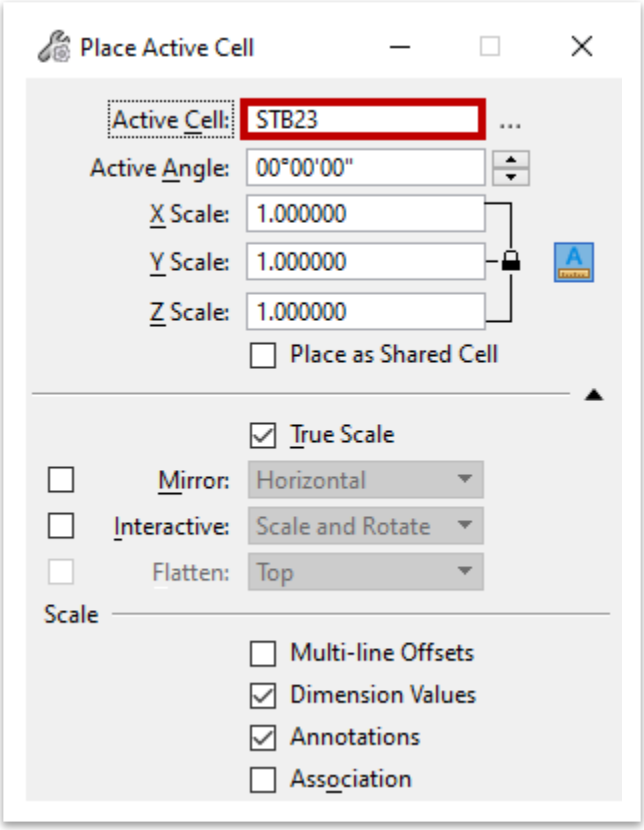
17. The next step is to place the **Sheet Title** cell in the lower right corner of the sheet. For Sheets **4C** and **5C**, we will place the **Proposed Profile Sta H V Scale** cell. Select the **Sheet Title Cell - Proposed Profile Sta H V Scale** element template (**Design >> Annotation >> Sheet Titles**).



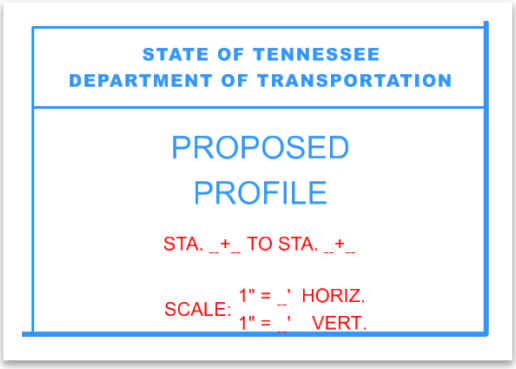
18. Next, open the **Place Active Cell** tool (**OpenRoads Modeling >> Drawing >> Placement >> Cells**).



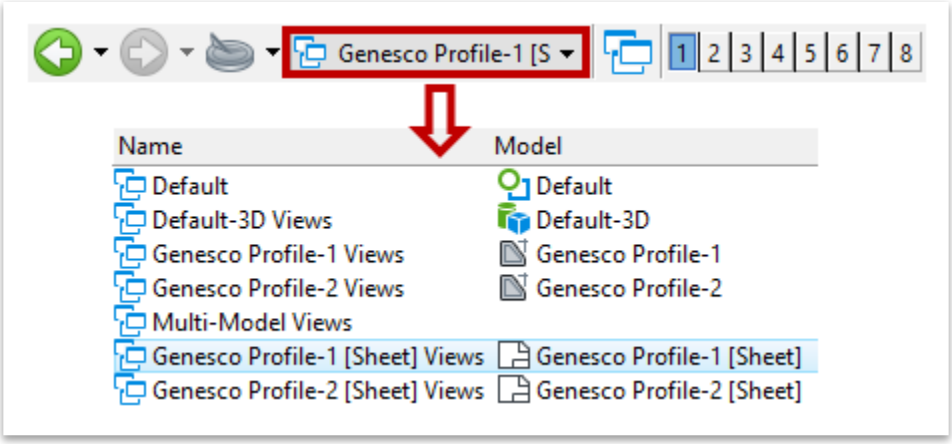
19. Notice in the **Place Active Cell** window it automatically calls the correct **Active Cell** (**STB23**). All cells in ORD are to be placed at a 1:1 scale so there is no need to adjust any settings.



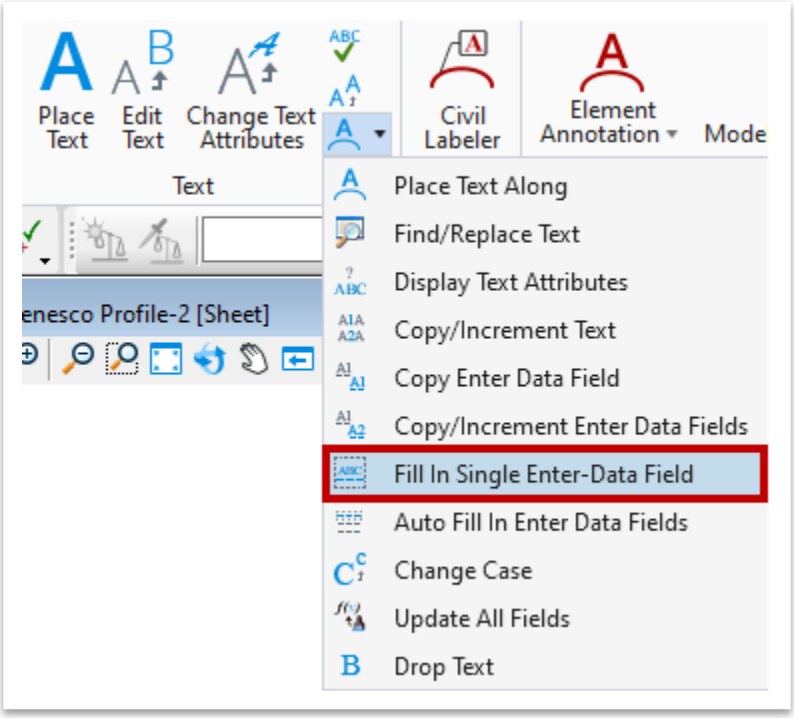
20. Place the cell on Sheets **4C** and **5C** by snapping to the upper left corner of the blue box located in the lower right corner.



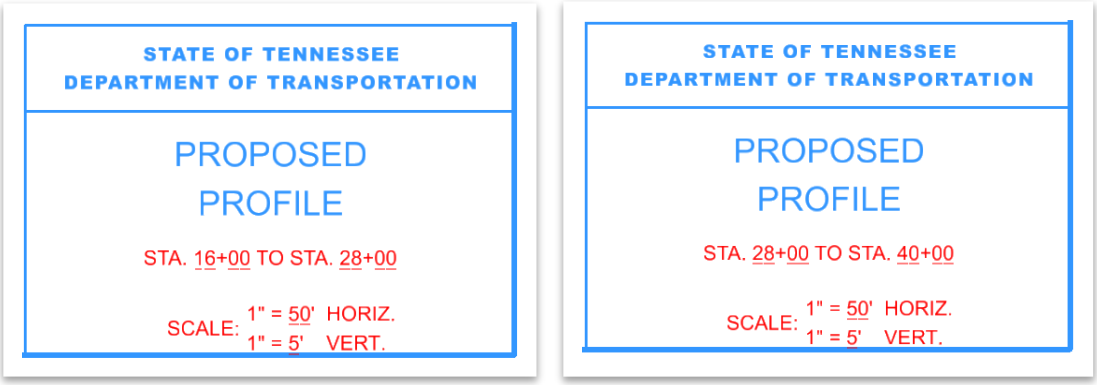
21. To switch between sheets, you can select the applicable sheet model in the **Models** window or in the lower left corner of the ORD window (shown below). You will need to open the **Place Active Cell** tool again, but the correct cell should still be linked.



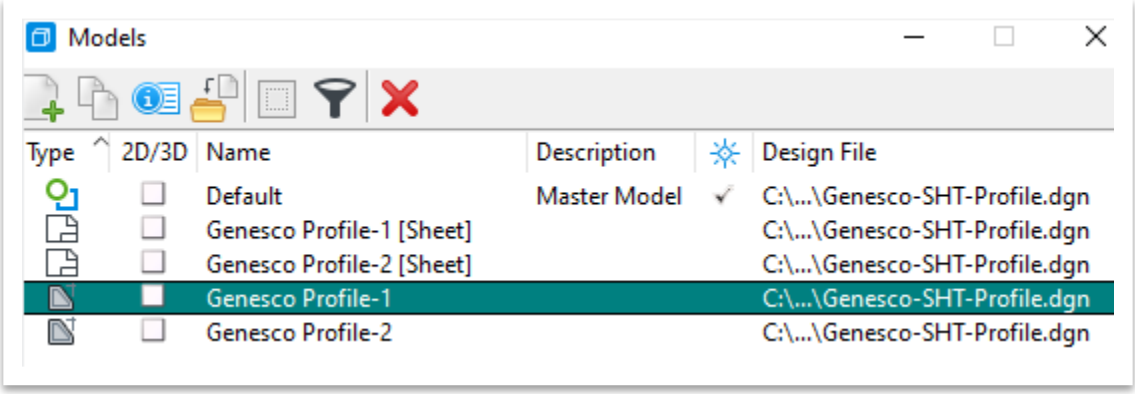
22. Once both cells have been placed, the data fields need to be manually filled in. Open the **Fill In Single Enter-Data Field** tool (**OpenRoads Modeling >> Drawing Production >> Text >> More**).



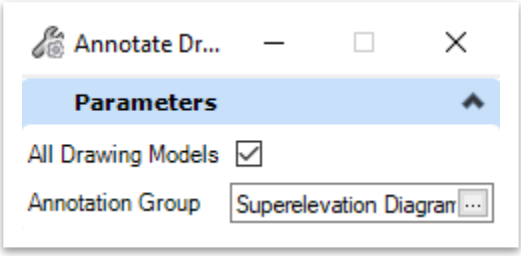
23. The **Edit Enter Data Field** window will open only after successfully clicking on the first data field in the label (e.g., STA. _ _). Fill in the sheet title cells for both **4C** and **5C** with respective station ranges (**16+00** – **28+00** and **28+00** – **40+00**) and the scale (1'=**50**' Horiz and 1" = **5**' Vert). **Note:** This can be tricky so click in the **upper area** of the data field to get the window to open.



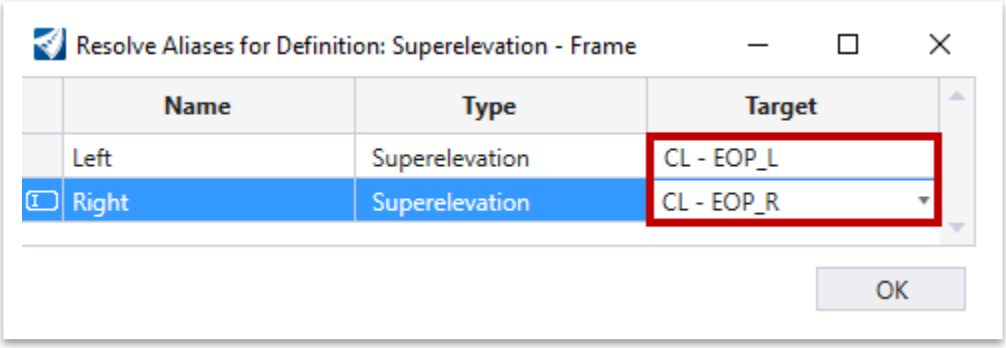
24. Now we will add the **superelevation** data to both profile sheets at once, which must be done in a drawing model (not a sheet model). Go ahead and switch to the **Genesco Profile-1** drawing model.



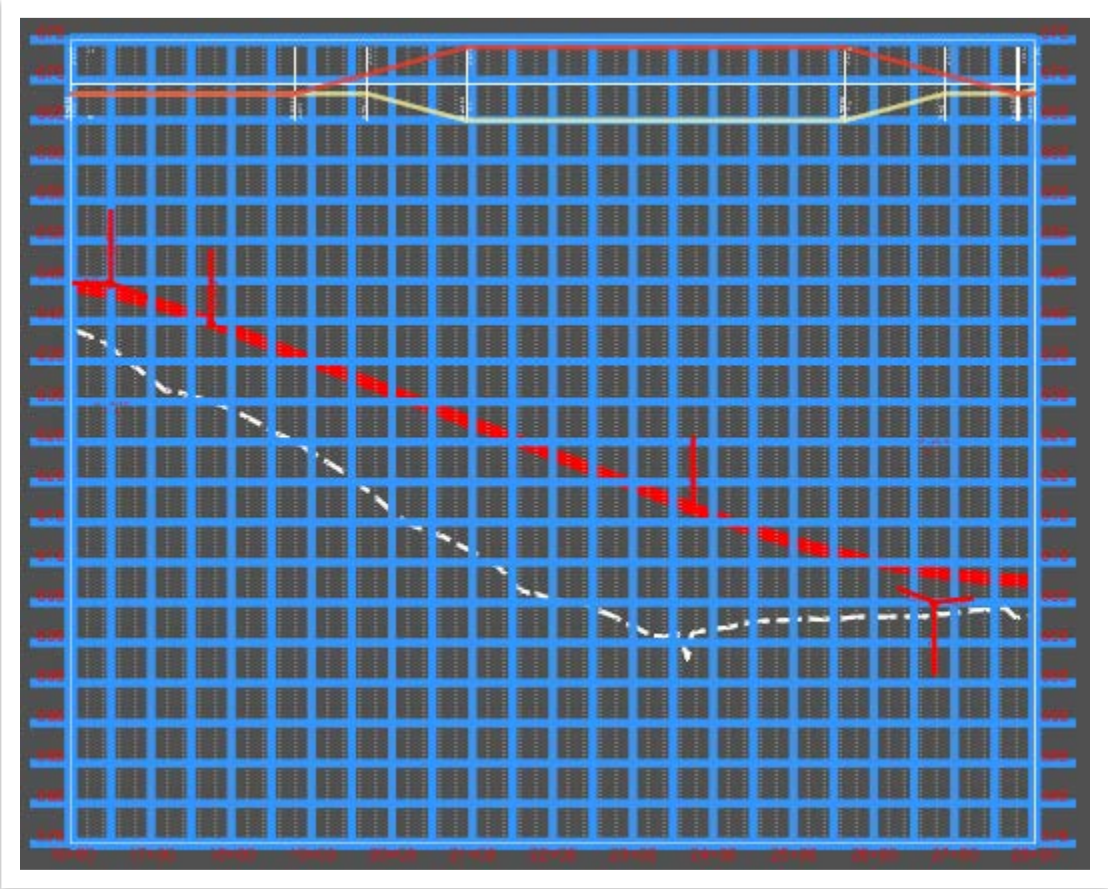
25. To label the superelevation, an annotation group has been setup to automatically place the labels. Open the **Annotate Drawing Model** tool (**OpenRoads Modeling >> Drawing Production >> Annotations >> Drawing Model Annotation**). Within the **Annotate Drawing Model** dialog box, checkmark **All Drawing Models**. Click the ellipses next to **Annotation Group** and select **Superelevation Diagram** (**Profile >> Drawing**).



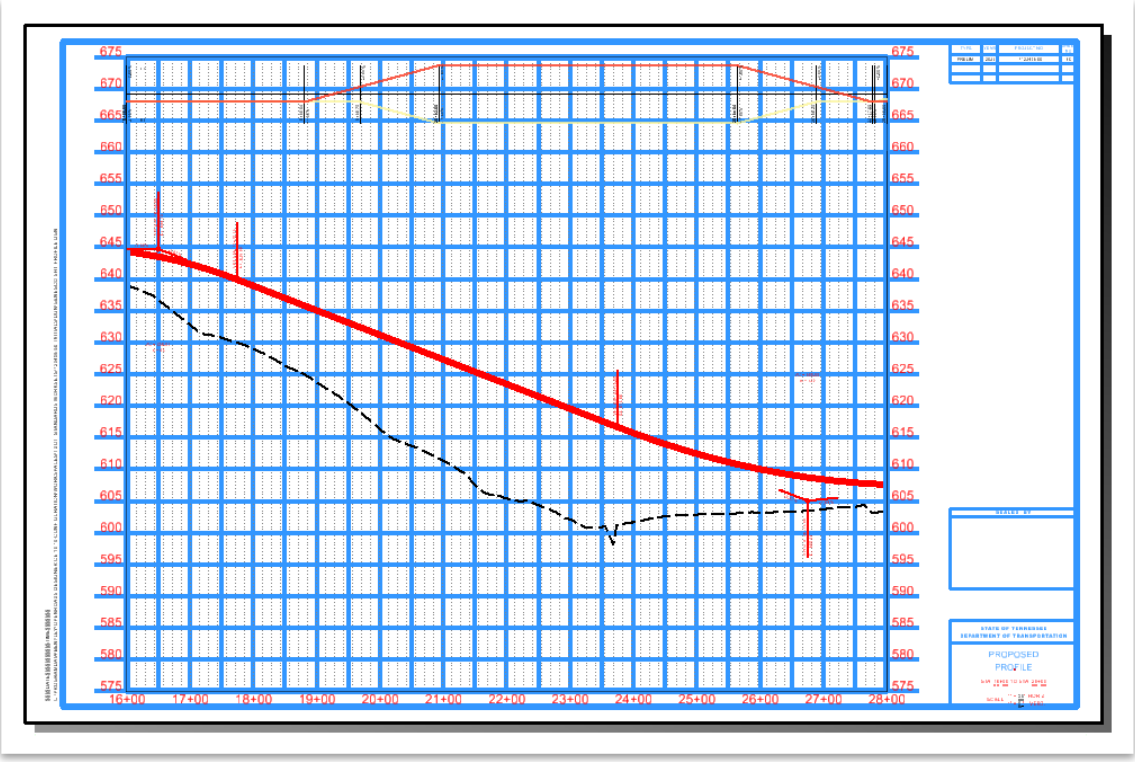
26. Left click twice to accept the settings. A **Resolve Aliases for Definition: Superelevation - Frame** window should appear automatically for the **Left** and **Right**. Left click within the **Target** column and select **CL - EOP_L** and **CL - EOP_R** for the left and right lanes respectively and then click **OK**.



27. Notice that the superelevation diagram and labels have been placed above the profile grid in both profile drawing models (**Genesco Profile-1** and **Genesco Profile-2**). You will need to open each profile drawing model and manually move the data down so that it falls within the grid. Open the **Genesco Profile-1** drawing model and select all the superelevation elements. Then, open the **Move** tool (**OpenRoads Modeling >> Drawing >> Manipulate**) and move them down, as shown below. Repeat the process for the **Genesco Profile-2** drawing model. Keep in mind, you will need to open each profile drawing model regardless to add other necessary annotation.



28. Next, switch back to the **Genesco Profile-1 [Sheet]** model and click **Fit View**. Open the **Level Display** and apply the **Sheets - Proposed Profile** filter. Sheet **4C** should look like the image below after applying the level filter. Go ahead and apply the same level filter to Sheet **5C** as well.



Take Note!

*The **date** and **time stamp** in the bottom left corner will not populate until the PDF is created. The file path stamp should automatically be updated in each sheet file. We will plot these sheets later in this chapter.*

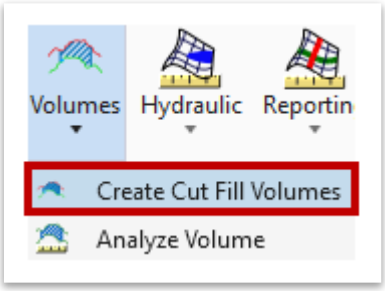
8.4 Lecture: Earthwork

In ORD, earthwork is calculated **volumetrically** without cross sections. To utilize the **average end area** method, however, cross sections are required. In general, earthwork needs to be run in two places: once in a separate Earthwork file where the volumetric data will be saved and once in the cross sections file (so that the **End Area Volume** annotation works correctly on the cross section sheets).

The earthwork volume tool is described below (**OpenRoads Modeling >> Terrain >> Analysis >> Volumes**) (Figure 90):

- **Create Cut Fill Volumes:** Calculates the cut and fill for a corridor when an active terrain is set, by generating a terrain on the corridor.

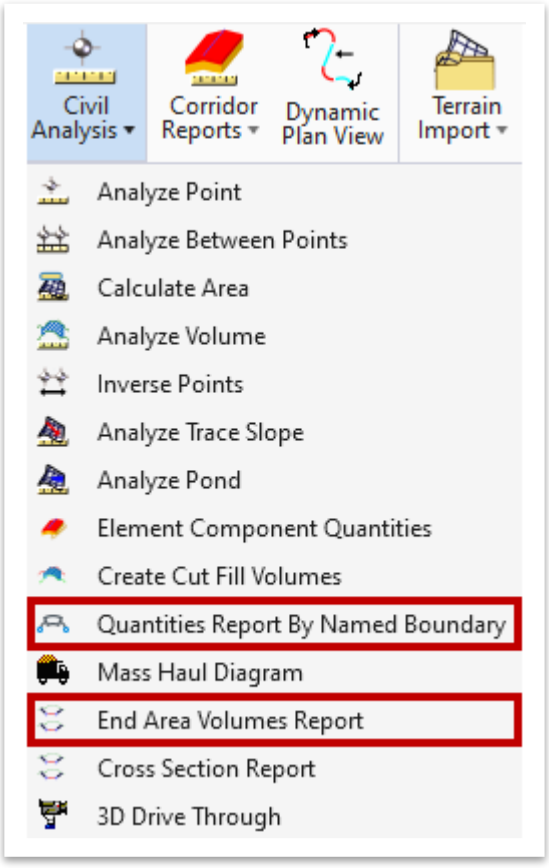
FIGURE 90. CREATE CUT FILL VOLUMES TOOL



The earthwork reports are described below (**OpenRoads Modeling >> Home >> Model Analysis and Reporting >> Civil Analysis**) (Figure 91):

- **Quantities Report by Named Boundary:** Takes a **Named Boundary** of the entire corridor and summarizes all cut and fill areas based on triangulation of the meshes. These are the values seen in the Properties when selecting a mesh in the earthwork file.
- **End Area Volumes Report:** Takes a **Named Boundary** from a cross section run and summarizes all end area cut and fill values into a table by station. It also allows volumes to be calculated with cross section exceptions.

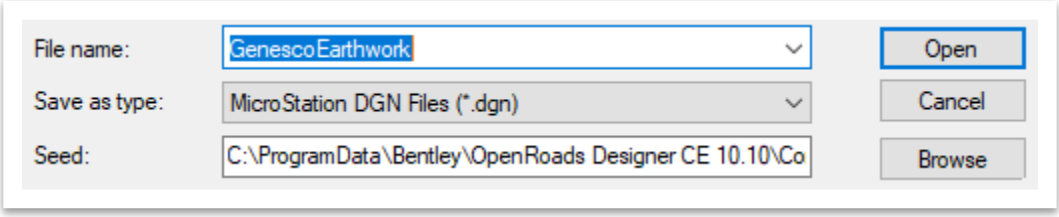
FIGURE 91. CIVIL ANALYSIS - EARTHWORK



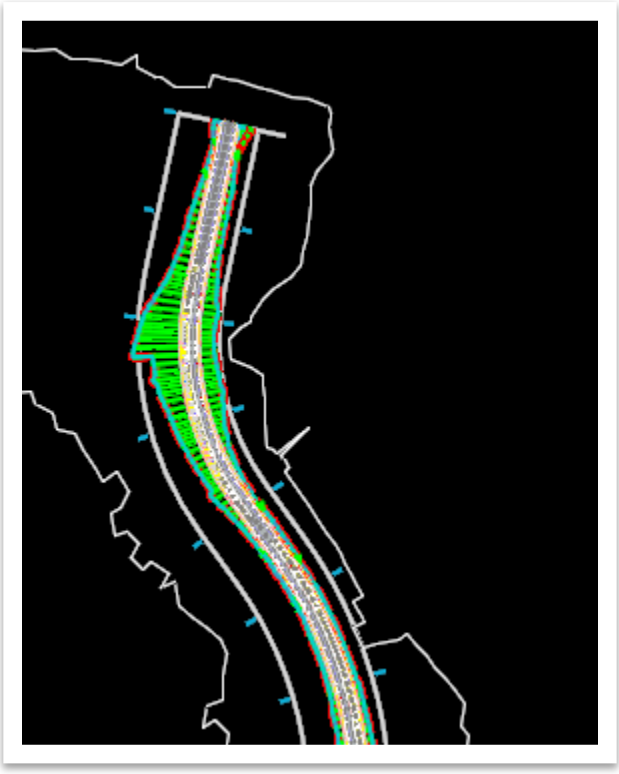
8.5 Exercise: Create Cut/Fill Volumes

In this exercise, we will create the cut and fill volumes from the proposed corridor.

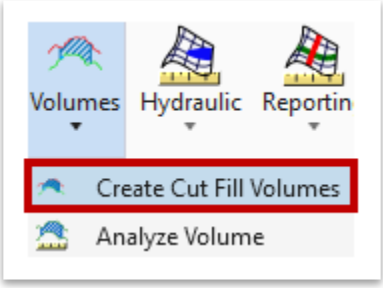
1. Create a new file and name it **GenescoEarthwork**. Select the **TDOTSeed3D.dgn** and click **Save**.



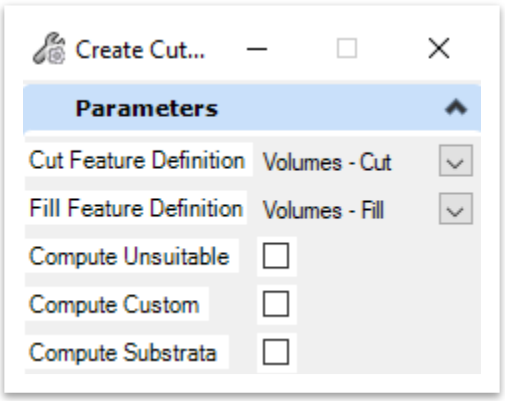
2. Attach the following reference files using the **Coincident World** attachment method.
    - GenescoCorridor.dgn
    - GenescoExistingTerrain.dgn (turn off triangles)
3. Zoom in and delete the embedded survey data on the three **SUR** levels in the live file. Then, click **Fit View** to see the corridor extent. Left click on the terrain boundary and select **Set As Active Terrain Model** within the heads-up display.



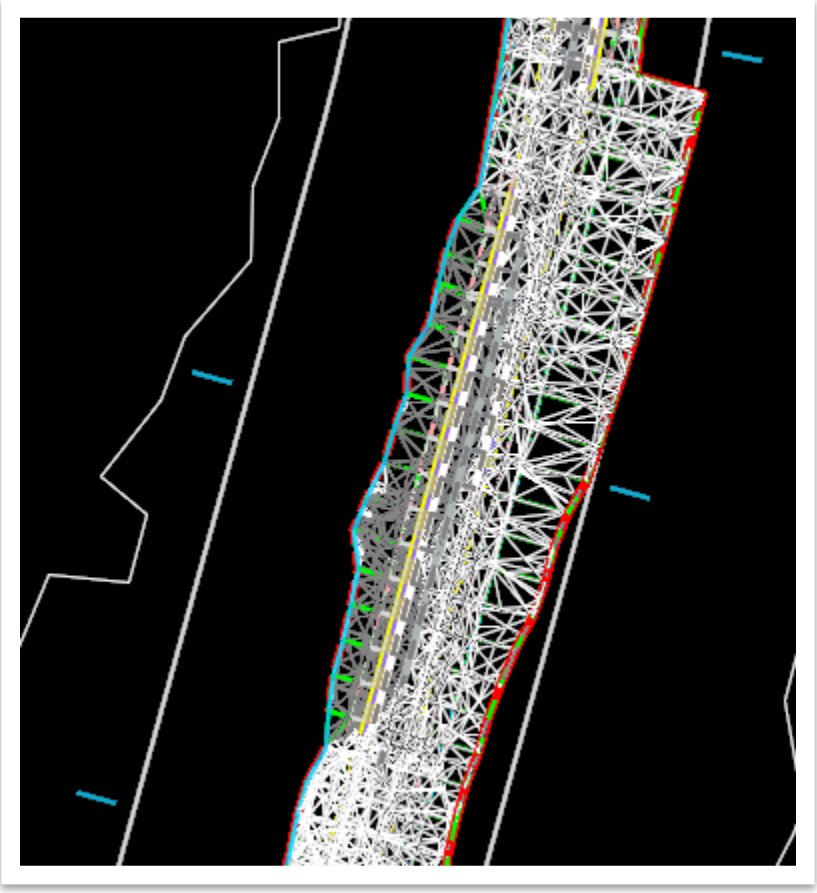
4. Open the **Create Cut Fill Volumes** tool (**OpenRoads Modeling >> Terrain >> Analysis >> Volumes**).



5. Within the **Create Cut & Fill Volumes** dialog box, select the following settings.
    a. **Cut Feature Definition:** Volumes - Cut (**Mesh >> Miscellaneous**)
    b. **Fill Feature Definition:** Volumes - Fill (**Mesh >> Miscellaneous**)
    c. **Compute Unsuitable:** Unchecked
    d. **Compute Custom:** Unchecked
    e. **Compute Substrata:** Unchecked



6. Left click through the prompts to accept and give the software a second to process. Notice that the volume elements (**meshes**) have been created for each cut and fill area represented by **white** and **grey triangles** respectively along the corridor. The mesh should fill the area between the slope lines for the entire project limits. **Note:** If you see a void in the mesh, try closing out of ORD and re-creating the Earthwork file.



Take Note!

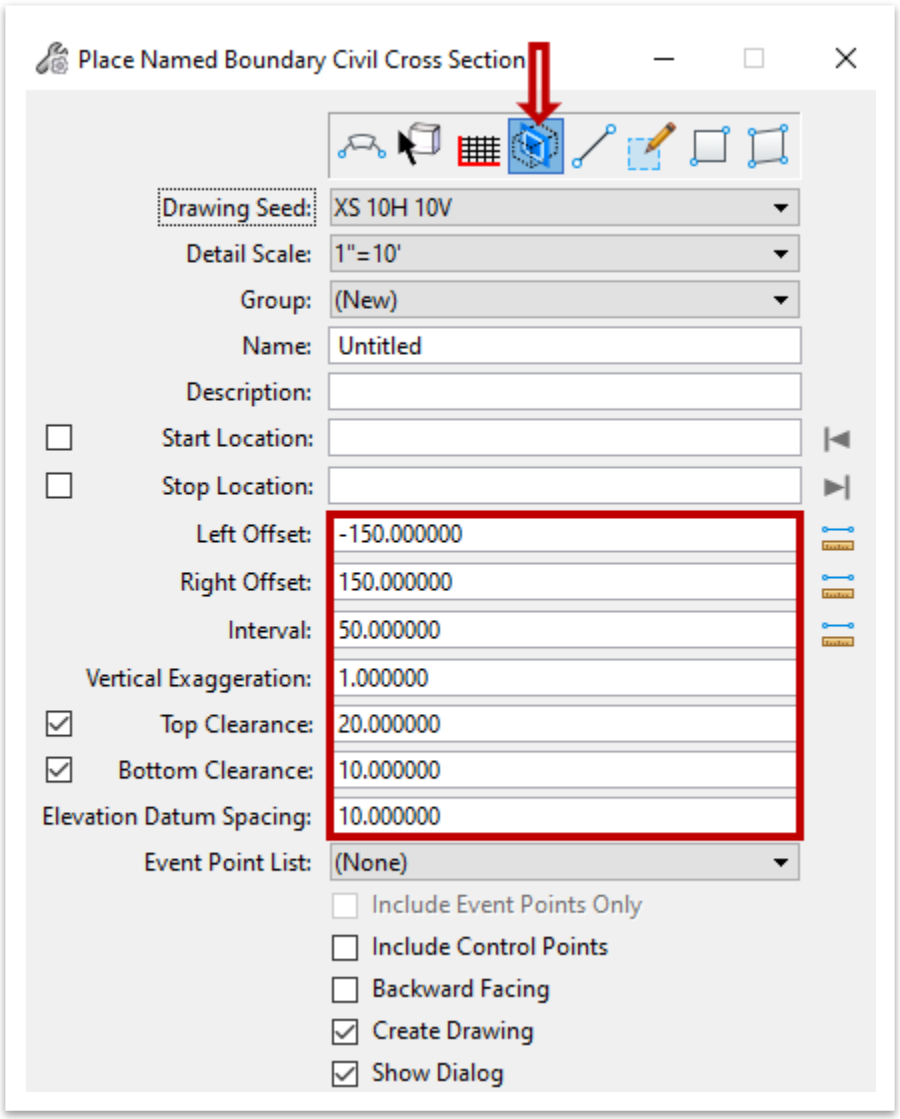
*Selecting the cut or fill mesh will show the respective total calculated volume in the **Properties**. The cut/fill volumes seen here are calculated based on **triangulation** of the meshes. In the next exercise, we will generate the cut/fill volumes via the **End Area** method, which is an approximation. The End Area method is easier to check but the volumetric calculation is more accurate. Therefore, the values calculated by both methods are expected to differ.*

8.6 Lecture: Placing Name Boundary for Cross Section Sheets and Earthwork

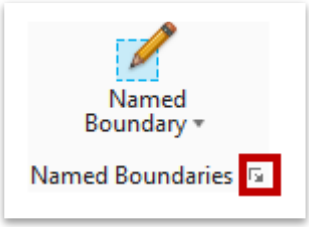
Creating cross section sheets is very similar to creating plan and profile sheets in ORD, except you must have both the **2D** and **3D** models open to view and create the sheets. To select the centerline, you must have the **2D** model activated and select it within that view. After activating the **Place Named Boundary** tool, the user will select the **Civil Cross Section** option (Figure 92 on the next page). Singular and dual column cross section seeds have been setup and should be used accordingly depending on the roadway width. The software plots individual grids with each cross section on a given sheet. After the drawing seed is selected (**XS 10H 5V**, **XS 10H 5V Stacked**, **XS 10H 10V**, **XS 10H 10V Stacked, XS 20H 10V, XS 20H 20V**), the user will be prompted in the bottom left corner of the ORD window to identify the path element (centerline).

Once you select the path element, the **Name** field will automatically populate. You can manually key-in whatever name you'd like after that. Just like for plan and profile sheets, the user also needs to pick the start and stop locations of the clip boundaries. You can either key-in stations or manually select the extents with your mouse. The clip extents (Figure 92 on the next page) are part of the sheet seed settings and should only be adjusted if you need to create a smaller clip length or adjust the cross section interval.

FIGURE 92. PLACE NAMED BOUNDARY WINDOW - CIVIL CROSS SECTION



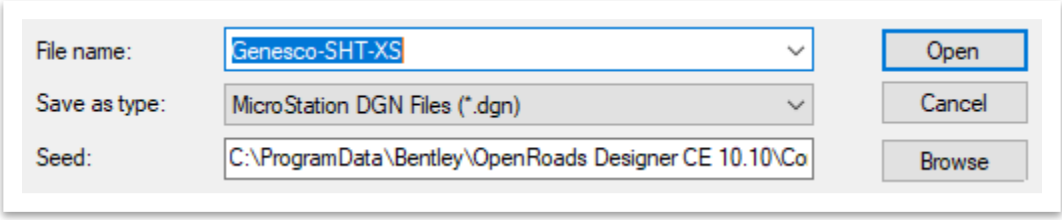
If the user is only cutting cross sections for earthwork purposes, you can uncheck **Create Drawing**. If you have already established the clip boundaries in your dgn file, then you do not need to recreate the Named Boundaries. You can click the expand button (outlined in red) in the Named Boundaries option, which will then show the clipped sheets under **Cross Section Groups**. Toggle the **Show the Create Drawing Dialog** option on, and then right click on your selected sheets and select **Create cross section drawing**. You will then add the sheets to the index thru the **Create Drawing** window.



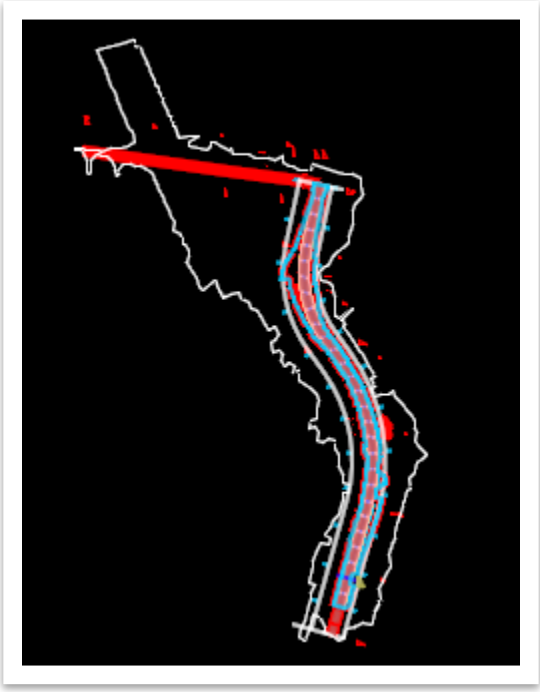
8.7 Exercise: Placing Named Boundary for Cross Section Sheets and Earthwork

In this exercise, we will create cross section named boundaries, calculate End Area Volumes, and setup two cross section sheets for printing.

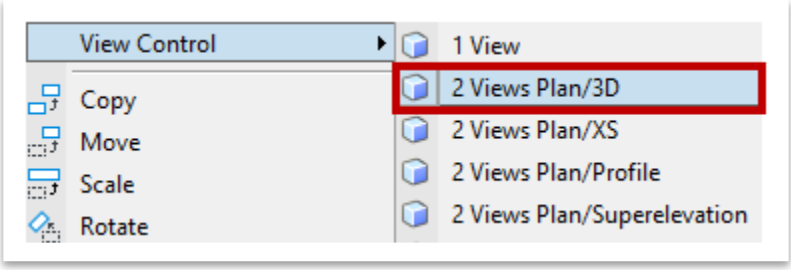
1. Create a new file and name it **Genesco-SHT-XS**. Select the **TDOTSeed2DMaster File.dgn** and click **Save**.



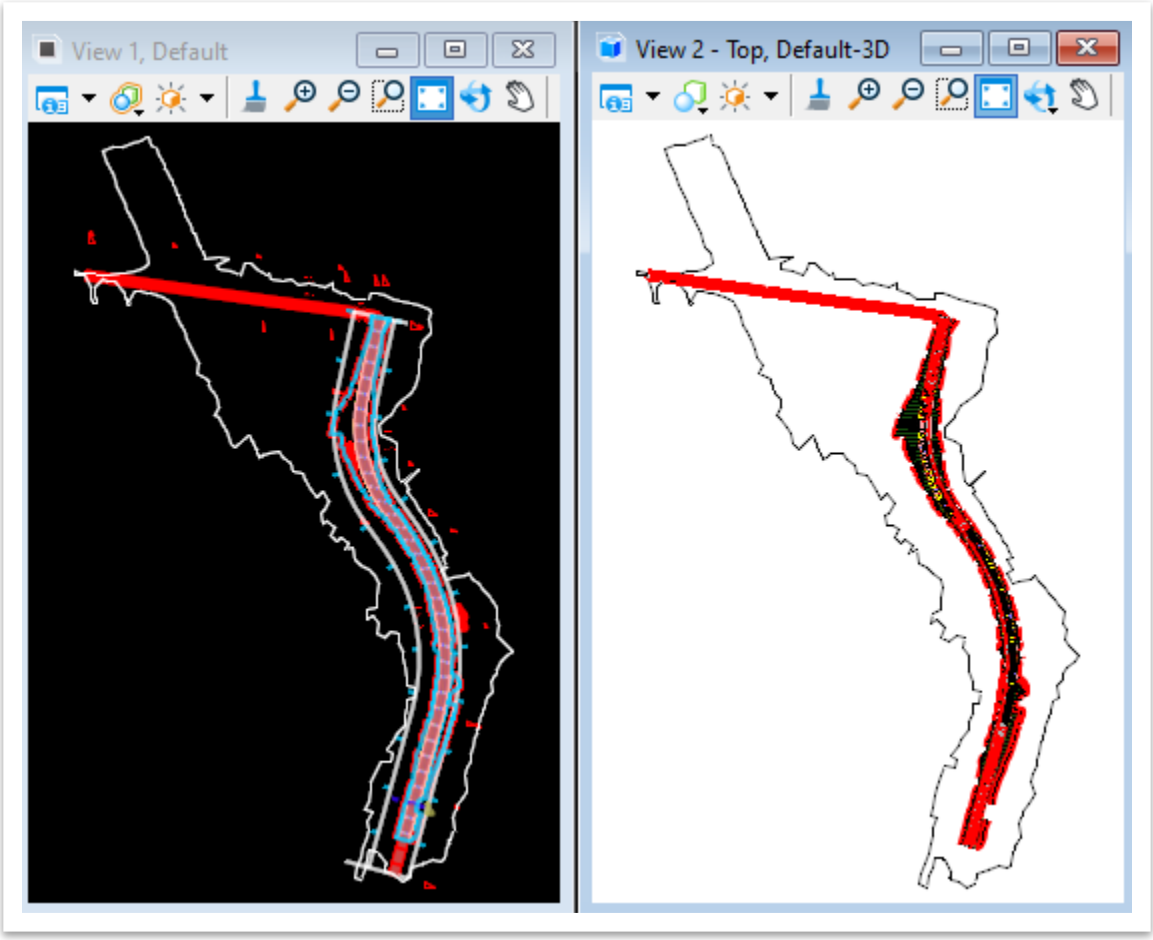
2. Attach the following reference files using the **Coincident World** attachment method.
    - GenescoAlignments.dgn (turn off **DES - CL - Proposed Text - Small** level)
    - GenescoCorridor.dgn
    - GenescoExistingTerrain.dgn (turn off triangles)
3. Click **Fit View** to see the corridor extent. Left click on the terrain boundary and select **Set As Active Terrain Model** within the heads-up display.



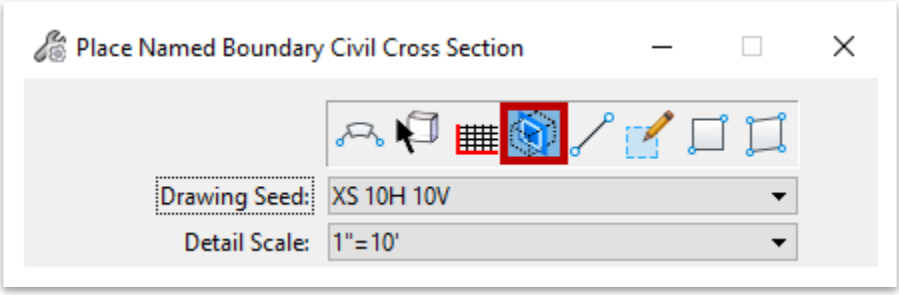
4. Next, right click and hold anywhere within **View 1** and select **View Control >> 2 Views Plan/3D** to open the split 2D/3D views. This will allow you to see the cross sections in both views at the same time.



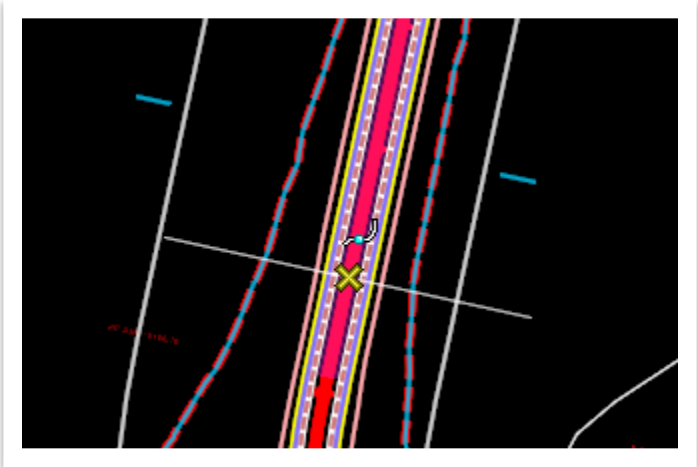
5. Within the **3D** view (View 2), turn off the triangles. **Note:** The **3D** view has been rotated to **Top**.



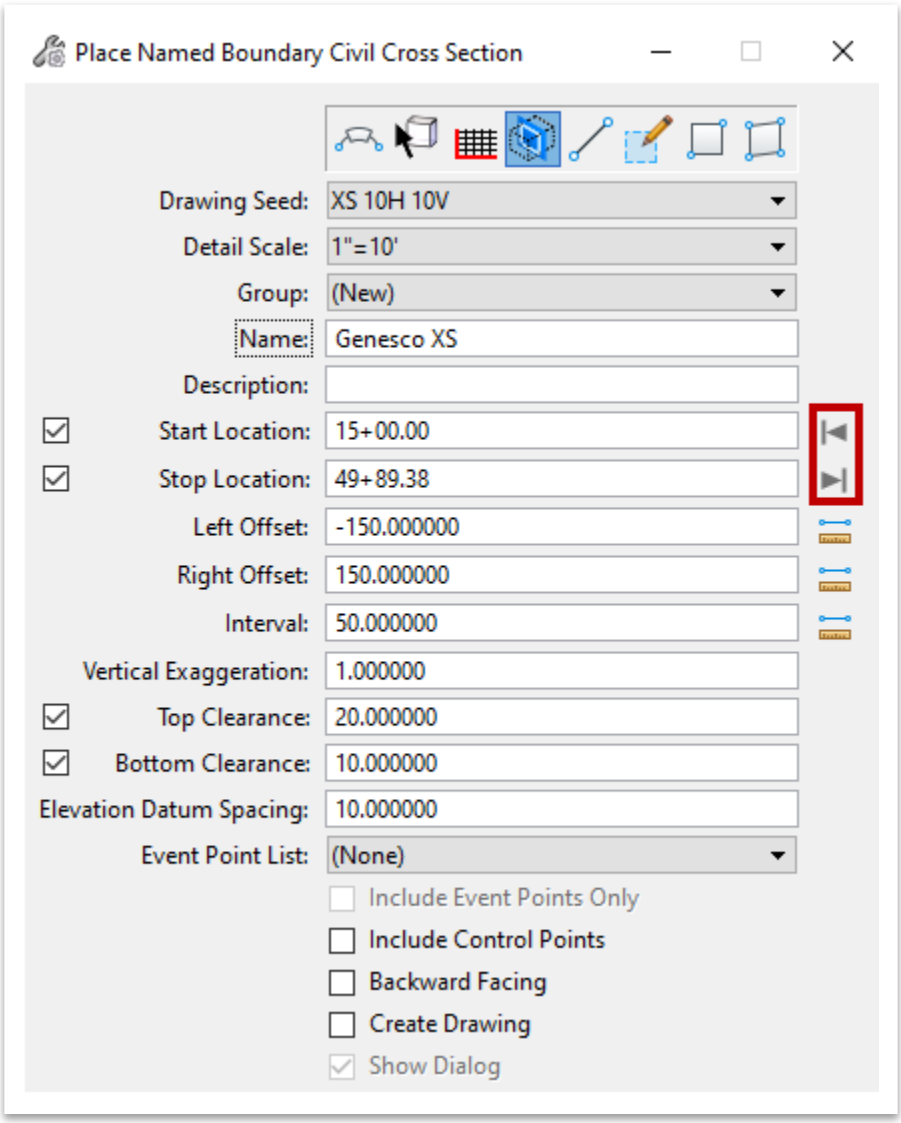
6. Now open the **Place Named Boundary** tool (**OpenRoads Modeling >> Drawing Production >> Named Boundaries >> Named Boundary**). Make sure that the **Civil Cross Section** option is toggled on. Select **XS 10H 10V** for the Drawing Seed.



7. Notice the prompt in the lower left corner of the drawing window: **Identify Path Element**. Select the **GENESCO_TEST** alignment in the **2D** view, not the 3D view. Notice there is now a line across your corridor, that moves with your cursor.



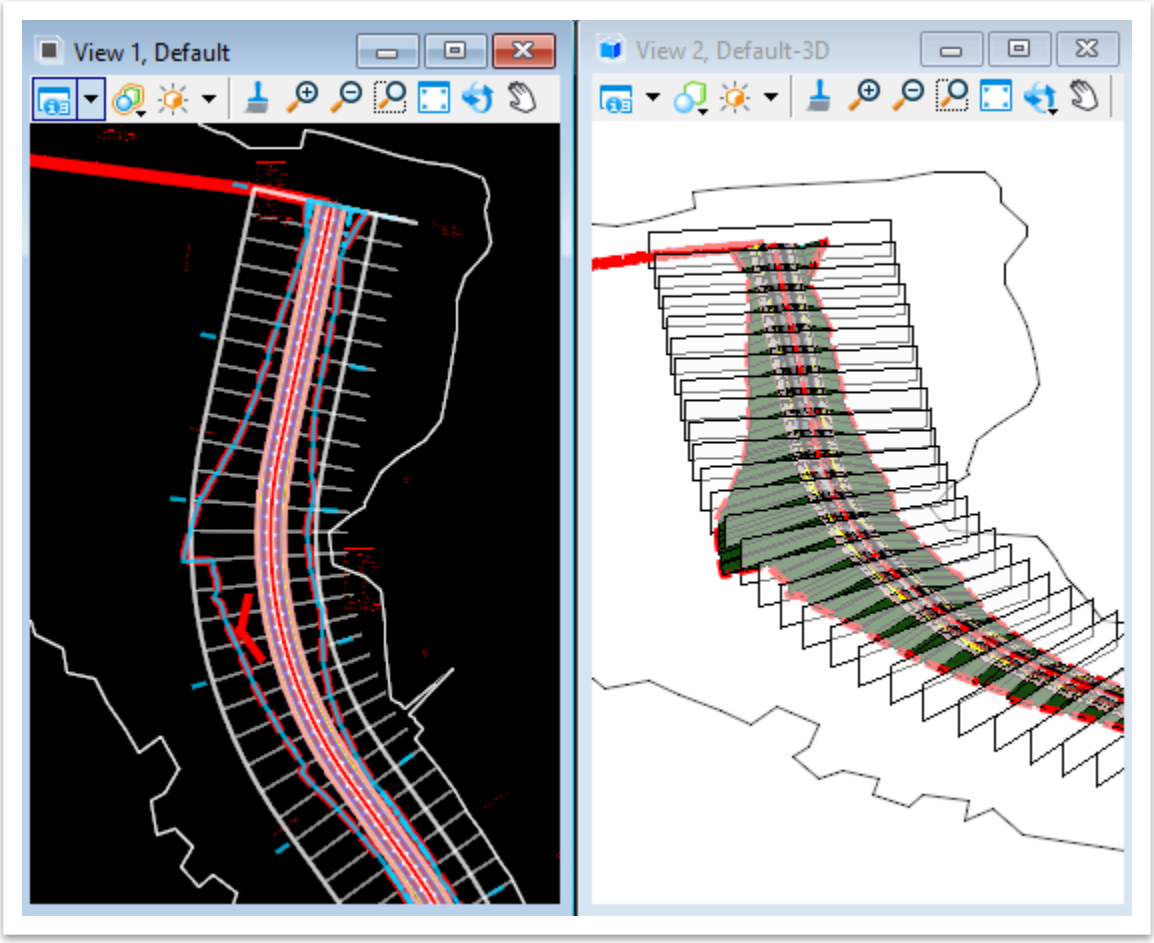
8. Edit the parameters below and leave all other default values as-is. Make sure that the **Create Drawing** option is **not toggled on** at the bottom. We will create sheet models for a few cross sections later in this exercise.
    a. **Name:** Genesco XS
    b. **Start Location:** 15+00.00 (Use the grey arrow to lock to Start)
    c. **Stop Location:** 49+89.38 (Use the grey arrow to lock to Stop)



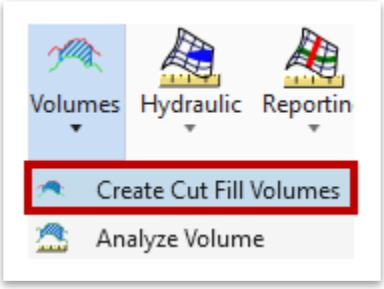
Take Note!

*To create an individual cross section, set the **Start** and **Stop Location** to the same station. If cross sections have already been created for your project, you can select the cross section group using the drop-down arrow next to the **Group** field, and your cross section will be added. Follow the remaining steps in this exercise to create the applicable model.*

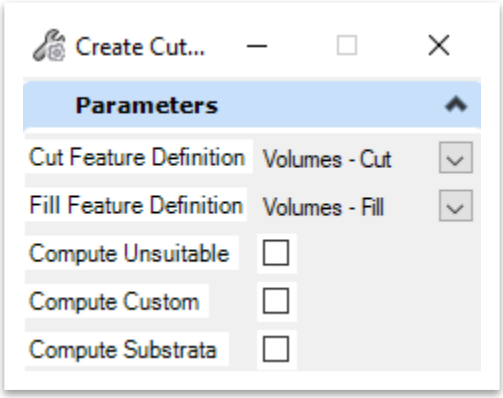
9. Left click anywhere within the **2D** view (View 1) **three** times. Notice the **2D** and **3D** cross section **slices**.



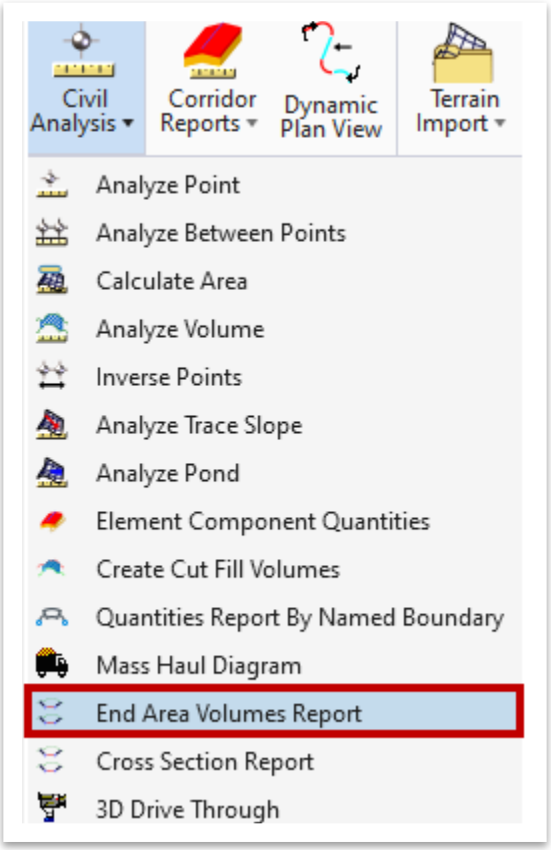
10. Next, we need to run earthwork again within this file in order for the annotation to plot on the XS Sheets. Open the **Create Cut Fill Volumes** tool (**OpenRoads Modeling >> Terrain >> Analysis >> Volumes**).



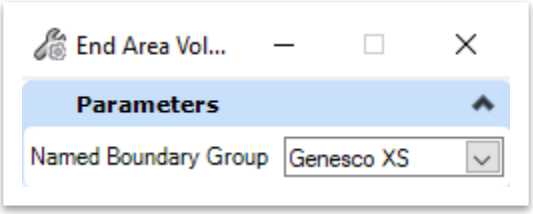
11. Within the **Create Cut & Fill Volumes** dialog box, select the following settings.
    a. **Cut Feature Definition:** Volumes - Cut (**Mesh >> Miscellaneous**)
    b. **Fill Feature Definition:** Volumes - Fill (**Mesh >> Miscellaneous**)
    c. **Compute Unsuitable:** Unchecked
    d. **Compute Custom:** Unchecked
    e. **Compute Substrata:** Unchecked



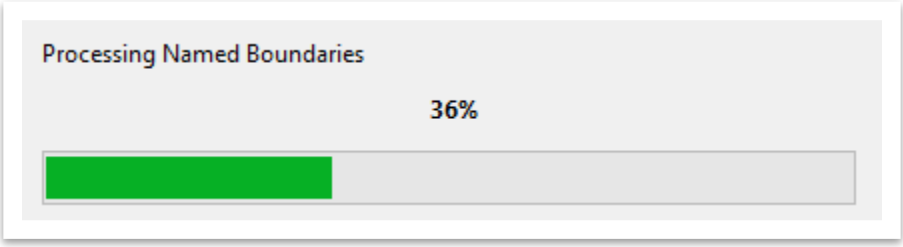
12. Left click through the prompts to accept and give the software a second to process. Now open the **End Area Volumes Report** tool (**OpenRoads Modeling >> Home >> Model Analysis and Reporting >> Civil Analysis**).



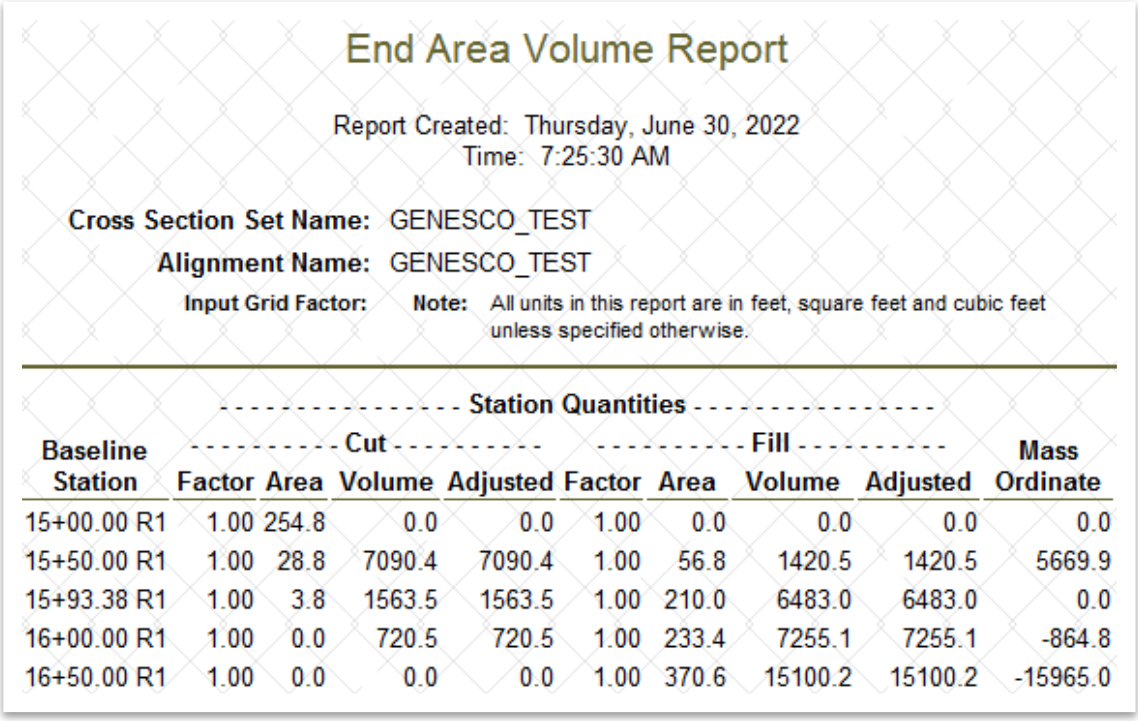
13. Within the **End Area Volumes Report** dialog box, select the **Genesco XS** Named Boundary Group.



14. Left click to accept. Since there are no exceptions, right click to complete. The software will then process the **Named Boundaries**.



15. The **End Area Volume Report** should automatically open (within the **Bentley Civil Report Browser**). **Note:** You can scroll to the bottom of the report to see the total cut/fill values.



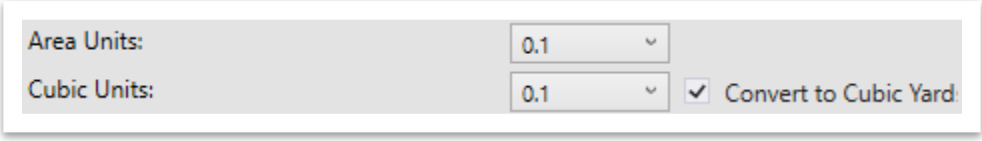
End Area Volume Report

Report Created: Thursday, June 30, 2022
Time: 7:25:30 AM

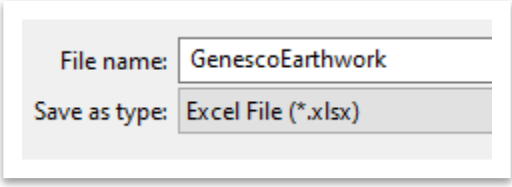
Cross Section Set Name: GENESCO_TEST
Alignment Name: GENESCO_TEST
Input Grid Factor: **Note:** All units in this report are in feet, square feet and cubic feet unless specified otherwise.

Station Quantities									
Baseline Station	Cut				Fill				Mass Ordinate
	Factor	Area	Volume	Adjusted	Factor	Area	Volume	Adjusted	
15+00.00 R1	1.00	254.8	0.0	0.0	1.00	0.0	0.0	0.0	0.0
15+50.00 R1	1.00	28.8	7090.4	7090.4	1.00	56.8	1420.5	1420.5	5669.9
15+93.38 R1	1.00	3.8	1563.5	1563.5	1.00	210.0	6483.0	6483.0	0.0
16+00.00 R1	1.00	0.0	720.5	720.5	1.00	233.4	7255.1	7255.1	-864.8
16+50.00 R1	1.00	0.0	0.0	0.0	1.00	370.6	15100.2	15100.2	-15965.0

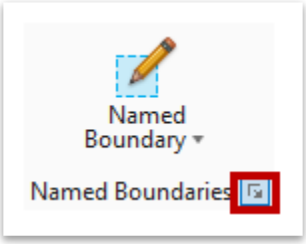
16. Notice that by default the cut/fill volume columns are in **cubic feet**. Let's go ahead and change them to **cubic yards**. Within the **Bentley Civil Report Browser**, click **Tools >> Format Options**. Checkmark the box next to **Convert to Cubic Yard**. Also, for this exercise, go ahead and change the precision for **Area Units** and **Cubic Units** to **0.1**. Click **Close** once you are done and notice that the report automatically updates.



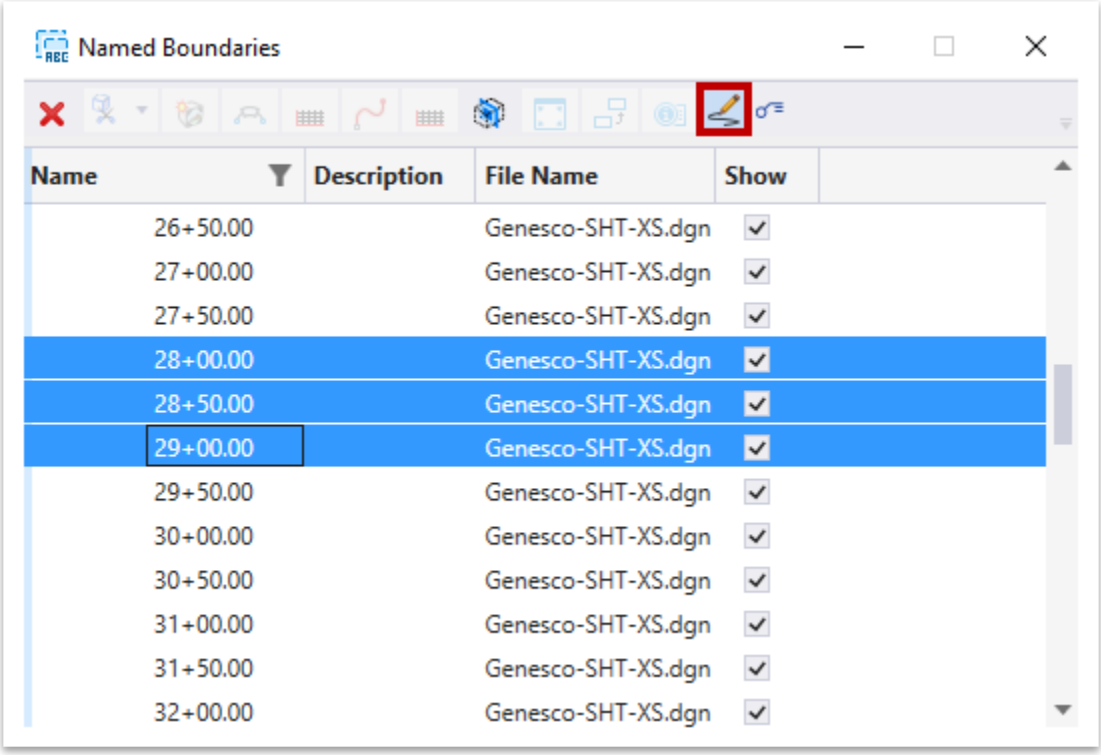
17. Now, within the **Bentley Civil Report Browser**, click **File >> Save As >> Microsoft Excel (*.xlsx)** and save the report in your 123456.00_INITIALS workset dgn subfolder. Name the file **GenescoEarthwork**. The file type should already be set accordingly.



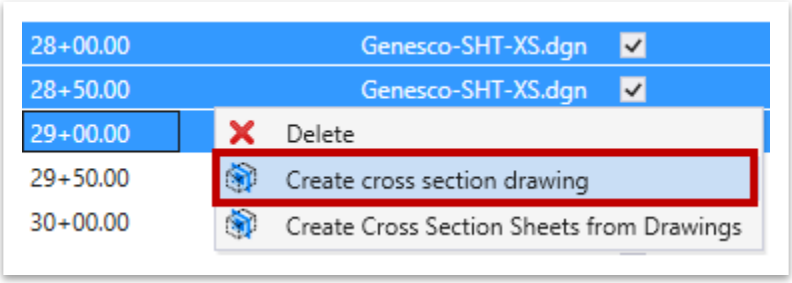
18. Once the file is created, browse to your 123456.00_INITIALS workset dgn subfolder in **File Explorer** and open the excel file to review it. Minimize the file once you have reviewed it so we can reference it later in the exercise. Also, go ahead and close the **Bentley Civil Report Browser** in ORD.
19. Next, we will create a few cross section sheets for a selected range to speed up the processing time. Select the expand button in the lower right corner of the **Named Boundaries** tools in the ribbon (**OpenRoads Modeling >> Drawing Production**).



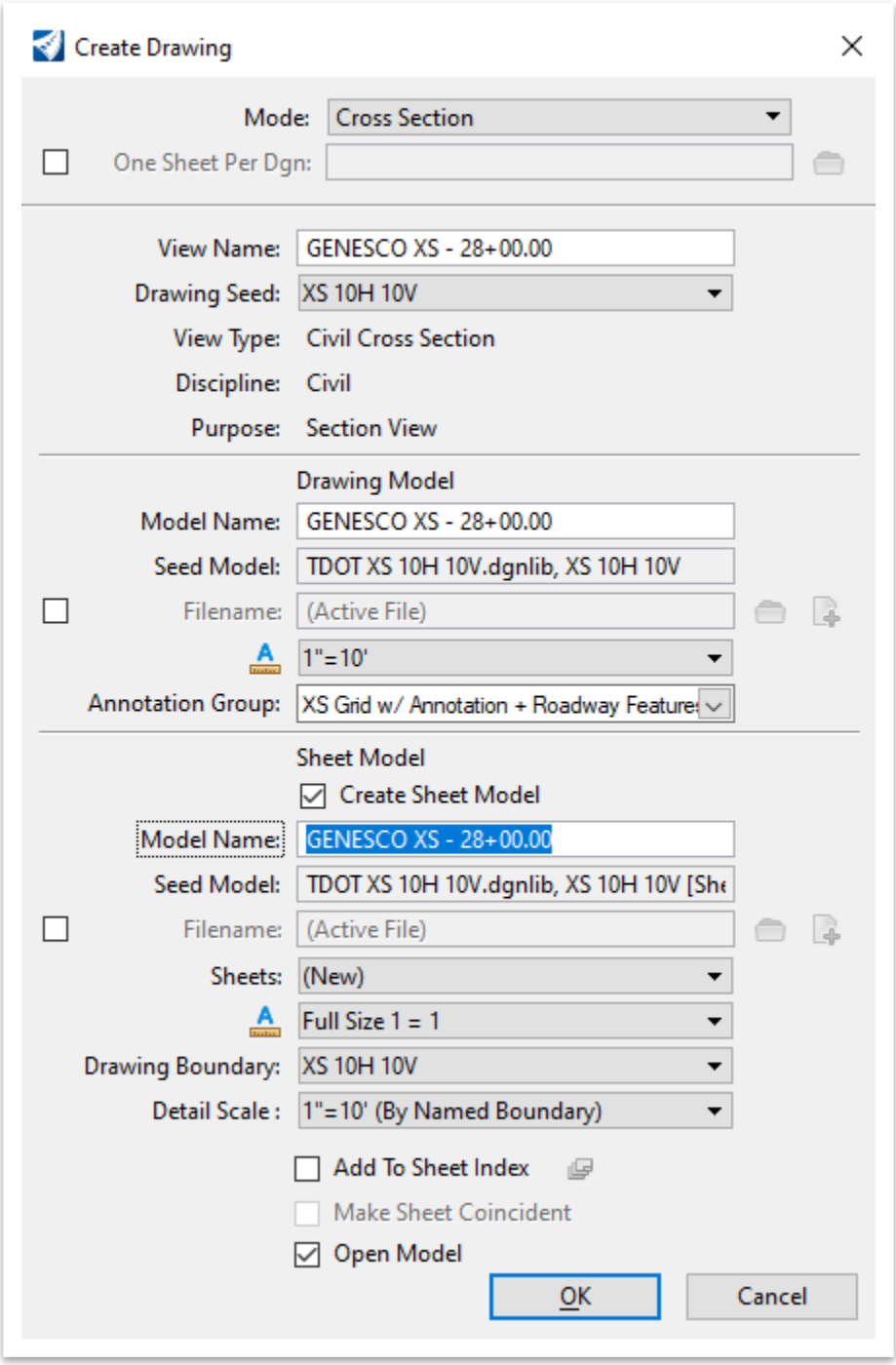
20. Within the **Named Boundaries** window, expand **Cross Section Groups >> Genesco XS** and notice that all of the 50' cross sections are listed within the station range that we set earlier. Scroll down and select **28+00.00 – 29+00.00**. Toggle the **Show the Create Drawing Dialog** option on (highlighted). **Note:** You must have both the 2D and 3D views open.



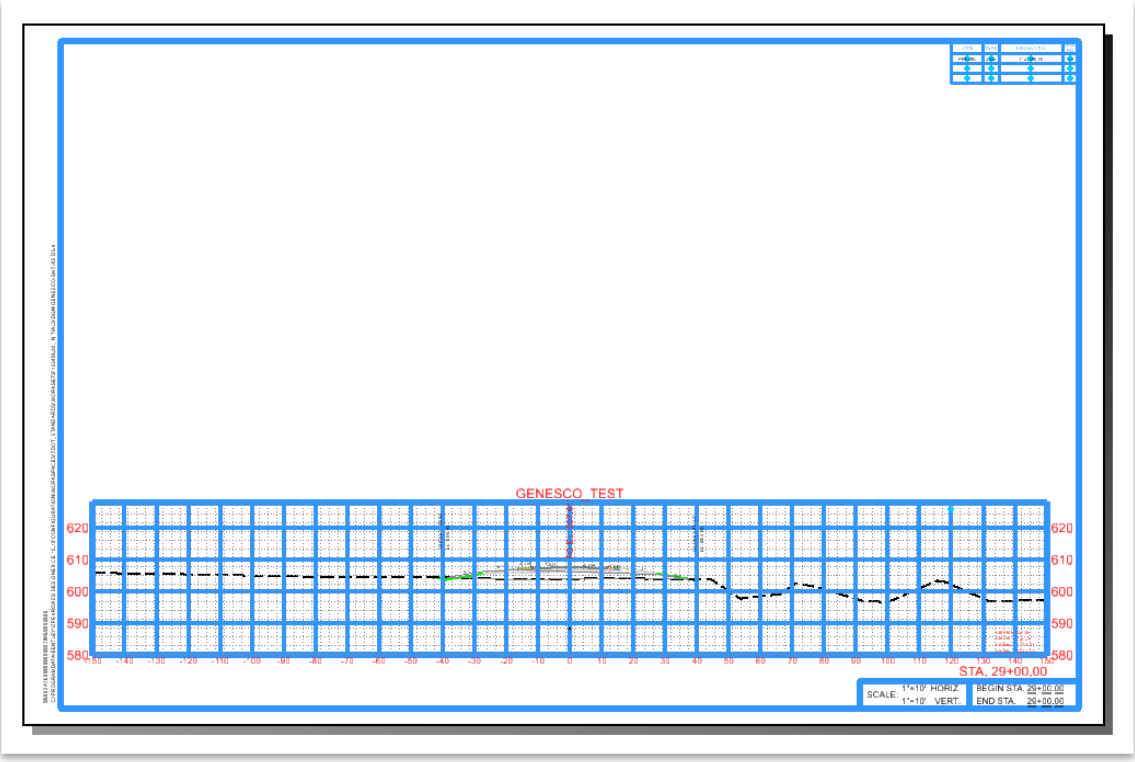
21. Right click on the selected cross sections and select **Create cross section drawing**.



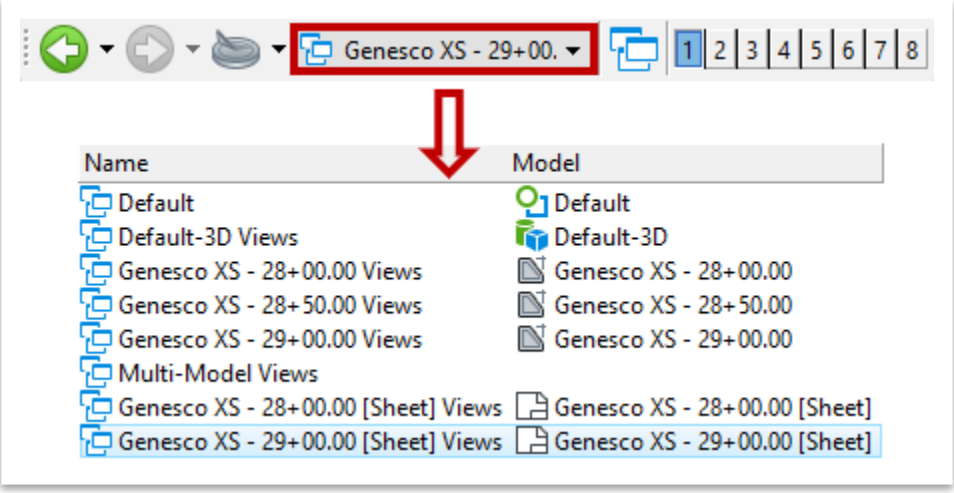
22. The **Create Drawing** window will open. Click **OK** to accept all default settings.



23. By default, the software should open to the second **sheet** model (**Genesco XS – 29+00.00 [Sheet]**) in **View 1**. Go ahead and close the **Named Boundaries** window.



24. In the lower left corner of the ORD window, notice that the applicable cross section **drawing** and **sheet** models have been created.

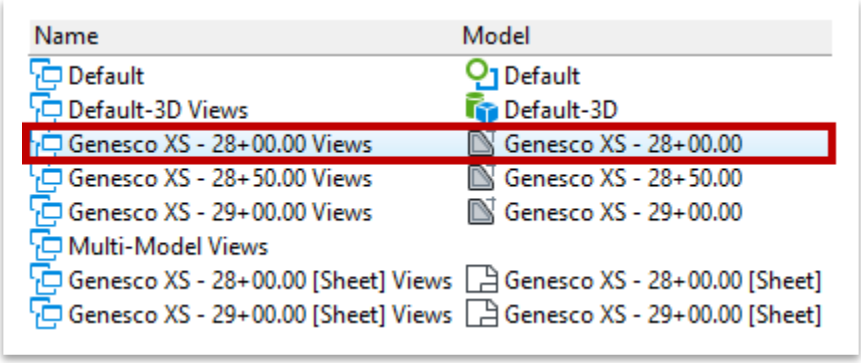


Take Note!

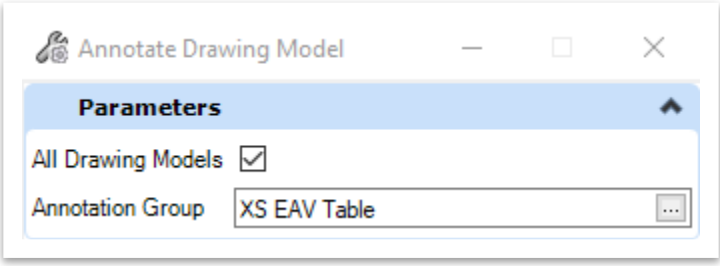
*There is not a 1:1 correlation with XS **drawing** and **sheet** models. There will always be a drawing model for every XS but not a sheet model since a single sheet model will likely have multiple XS. The sheet model name (e.g., 28+00.00) will be whatever the first XS station is on that sheet.*

*The number of XS views per sheet is automatically calculated based on the required XS view height and the remaining available sheet height. In most cases, the maximum number of XS views per sheet is **3**. If a **stacked** seed is used, the maximum number would be **6**. The required XS view height is a function of the **existing ground** and the required XS **annotation** height.*

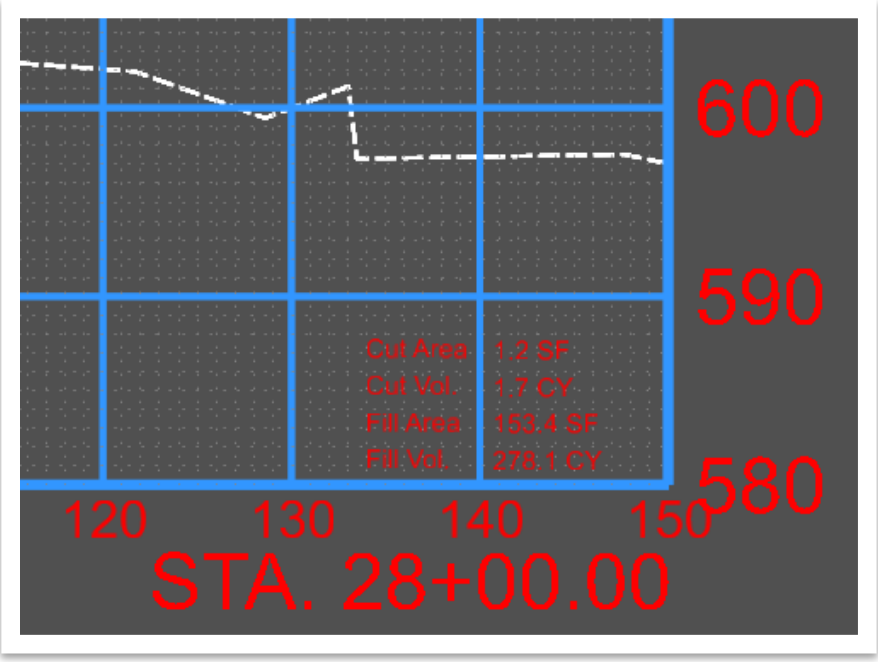
25. Go ahead and left click on the **Genesco XS – 28+00.00** drawing model to open.



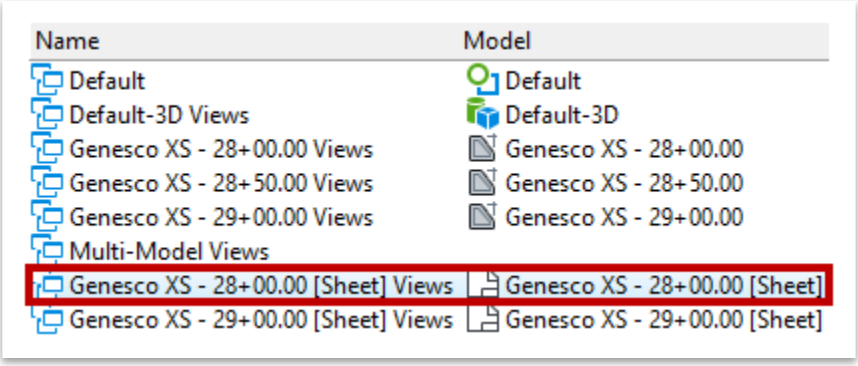
26. Now open the **Annotate Drawing Model** tool (**OpenRoads Modeling >> Drawing Production >> Annotations >> Drawing Model Annotation**). Within the **Annotate Drawing Model** dialog box, checkmark **All Drawing Models**. Click the ellipses next to **Annotation Group** and select **XS EAV Table** (**Cross Section >> Drawing**). **Note:** If you only need to annotate areas, an additional annotation group has been setup called **XS EAV Table - No Volume**.



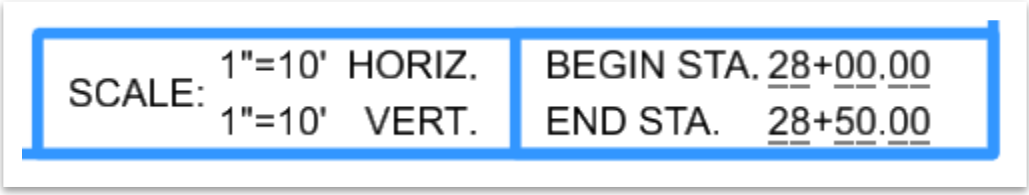
27. Left click twice to accept the settings. Notice that the cut/fill annotation has now been added to the lower right corner of the cross section. **Note:** Since we checkmarked **All Drawing Models** in the previous step, the label was added to the **28+50.00** and **29+00.00** drawing models as well.



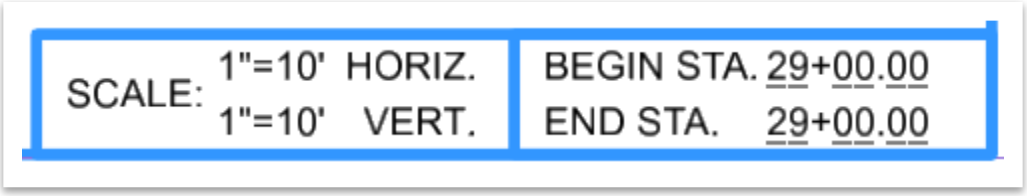
28. Next, open the **Genesco XS – 28+00 [Sheet]** model which contains the 28+00 and 28+50 cross-sections (this can be done by selecting this model in the view drop-down in the bottom left).



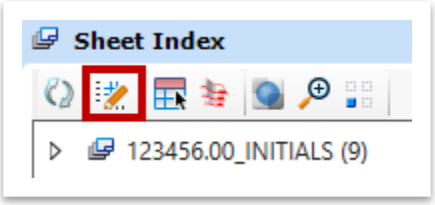
29. Zoom in to the lower right corner of the sheet. Using the **Element Selection** tool, double click on the **Begin Sta** / **End Sta** text to open the **Text Editor**. Key-in the applicable values, as shown below, and then left click anywhere within the sheet to accept.



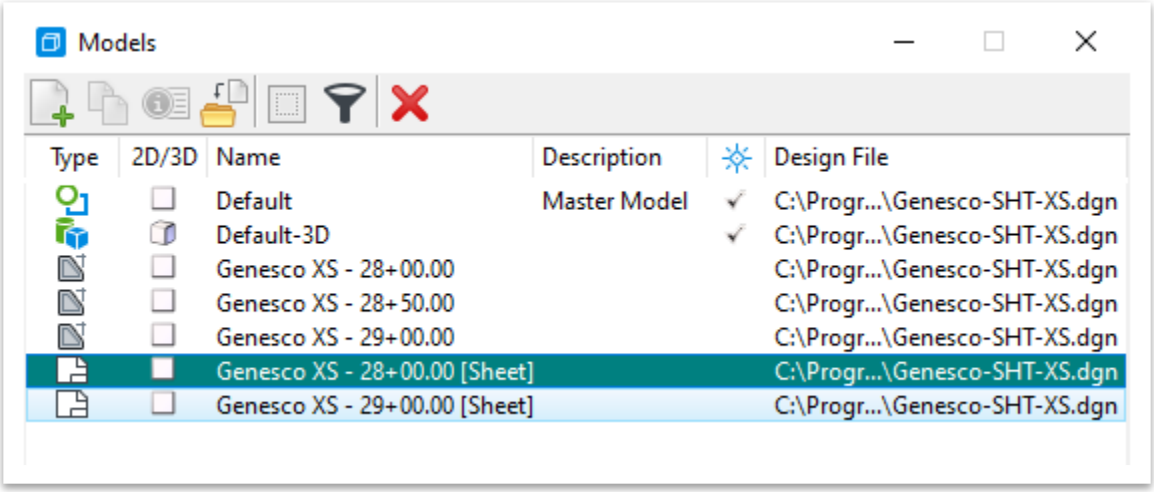
30. Go ahead and open the **Genesco XS – 29+00 [Sheet]** model and repeat the previous step.



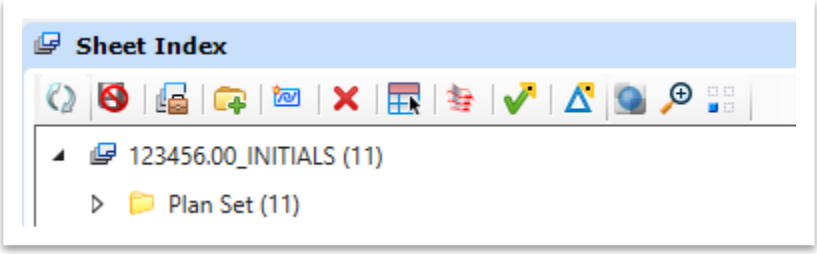
31. Now we need to add the 2 sheets to the overall sheet index for the **123456.00_ INITIALS** project workset. First, open the **Sheet Index** for editing.



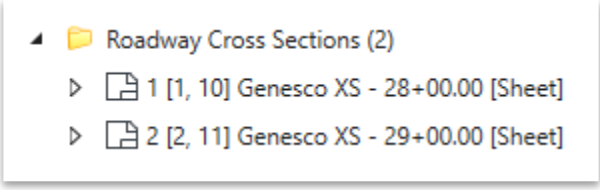
32. Next, open the **Models** window (**OpenRoads Modeling >> Home >> Primary**) and highlight the **Genesco XS – 28+00.00 [Sheet]** and **Genesco XS – 29+00.00 [Sheet]** models.



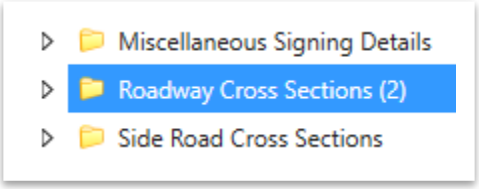
33. Hold the left mouse button down and drag the two models into the **Roadway Cross Sections** folder in the sheet index. Notice that the sheet index now has **11** files in it: **123456.00_INITIALS (11)**.



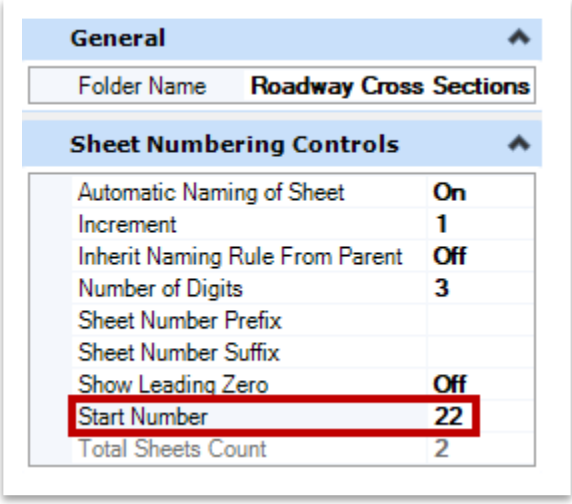
34. Expand the sheet index folder tree and notice that Sheets **1** and **2** have been added to the sheet index under **Roadway Cross Sections**. **Note:** Remember, you can double click on a sheet in the sheet index to open it.



35. Since cross section sheets are located after the proposed profile sheets, we must edit the **Start Number** in the **Sheet Numbering Controls** for the **Roadway Cross Sections** folder. By default, the start number is set to **1**. For this exercise, we will assume that the roadway cross sections start at **22**. Go ahead and highlight the **Roadway Cross Sections (2)** folder.

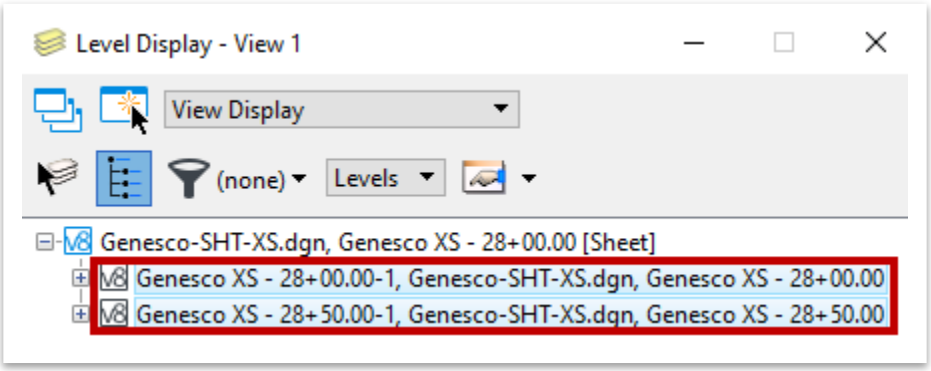


36. Within the **Properties**, expand the **Sheet Numbering Controls** tab and key-in a **Start Number** of **22**. **Note:** If you had closed the **Properties**, go to **OpenRoads Modeling >> Home >> Primary**.

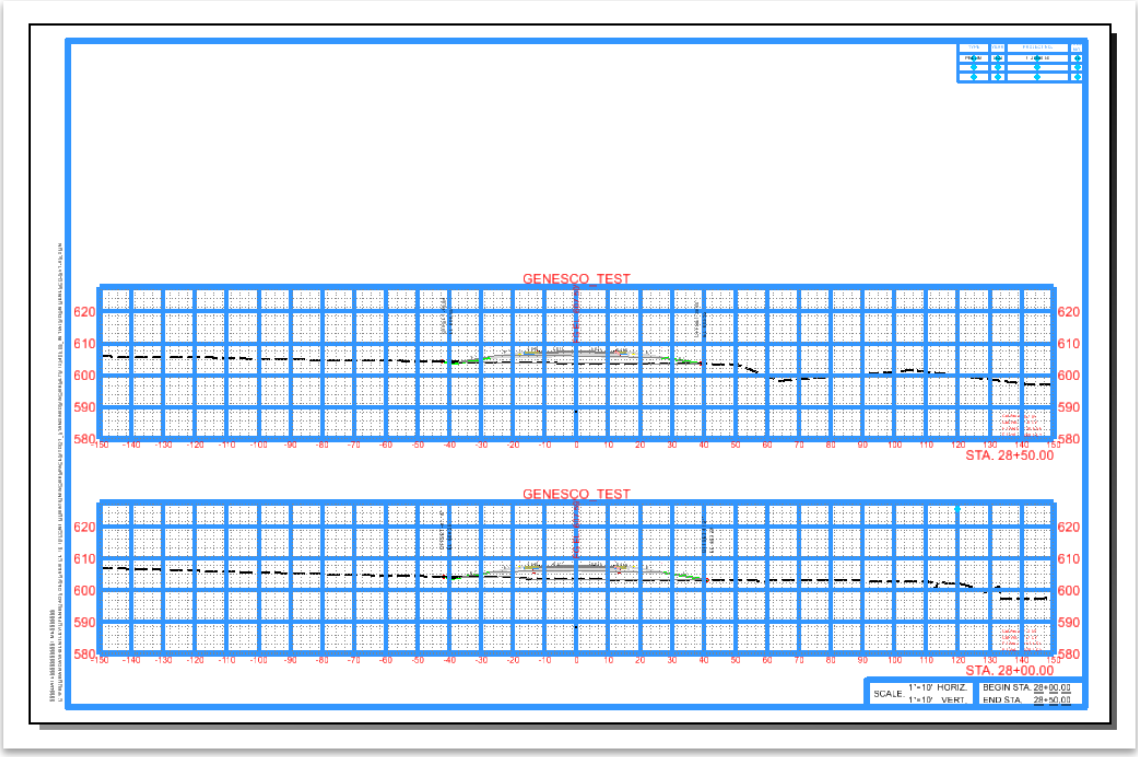


37. Zoom in to the upper right corner and notice that the sheet number did not update. The model needs to be refreshed, so simply switch to a different model and then back to the **Genesco XS – 28+00.00 [Sheet]** model and the sheet number should update.

38. Now, open the **Level Display** and highlight <u>both</u> XS references (highlighted in red) and turn off the **DES - XS - Earthwork - Shapes** level. That linework is not required on the final cross section sheets.



39. Sheet **22** is shown below. You can check that Sheet **23** has the correct sheet number as well.

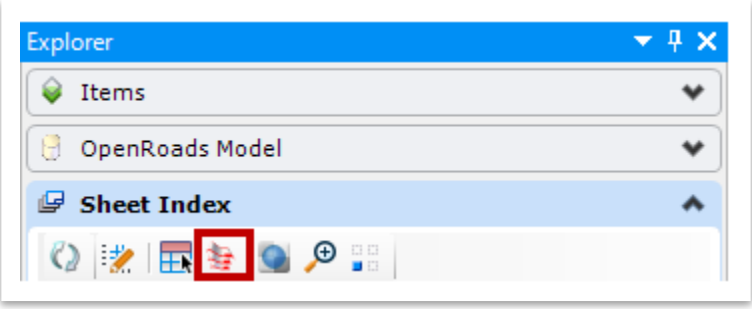


40. Lastly, open the **GenescoEarthwork.xlsx** report file once again that we created earlier in the exercise. Compare the cut/fill values at Stations **28+00.00**, **28+50.00** and **29+00.00**. The report values should match what is shown in the lower right corner for the applicable cross section.

8.8 Lecture: Plotting Sheets

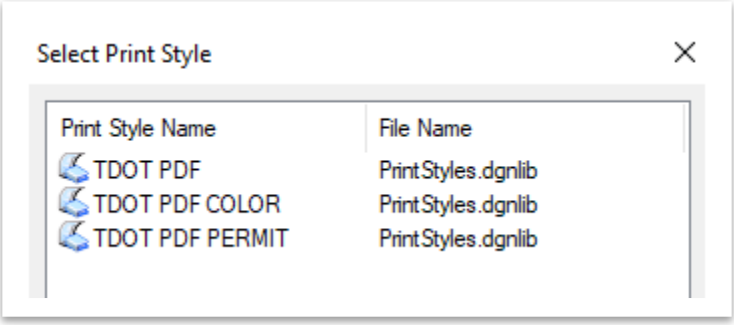
Plotting of all sheets will be done through the **Sheet Index** via the **Print Organizer** (Figure 93). Please note that the Sheet Index does not have to be open for editing to plot. You can select a single sheet, an entire subfolder(s) or the entire project. If you want multiple subfolders, highlight the subfolders you want first and then open the Print Organizer. **There will no longer be individual SHT files**. Instead, multiple sheets will be grouped together in like files (e.g., all profile sheets will be stored in a single dgn file). All sheet models will then be stored within the **dgnws** (workset) sheet index that is created for each project. Also, you may still use the **File >> Print** option to print individual sheets, if desired. The applicable print style would still need to be selected.

FIGURE 93. PRINT ORGANIZER



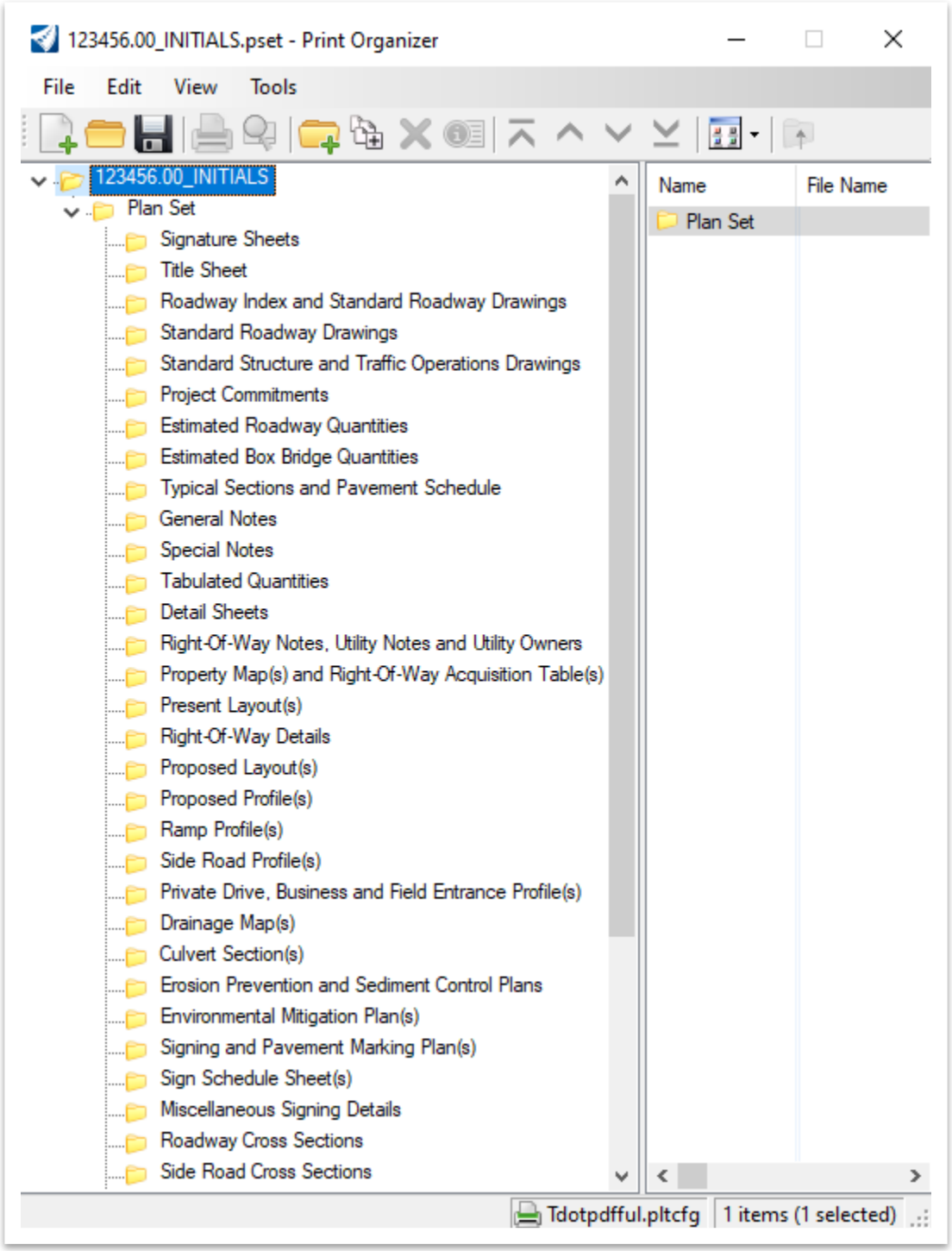
The user will then be prompted to select one of the TDOT **Print Styles** (Figure 94). Both **TDOT PDF** (black and white) and **TDOT PDF COLOR** are setup to plot at full size (34”x22”). **TDOT PDF PERMIT** (color) is setup to plot at letter size (8.5”x11”).

FIGURE 94. PRINT STYLES



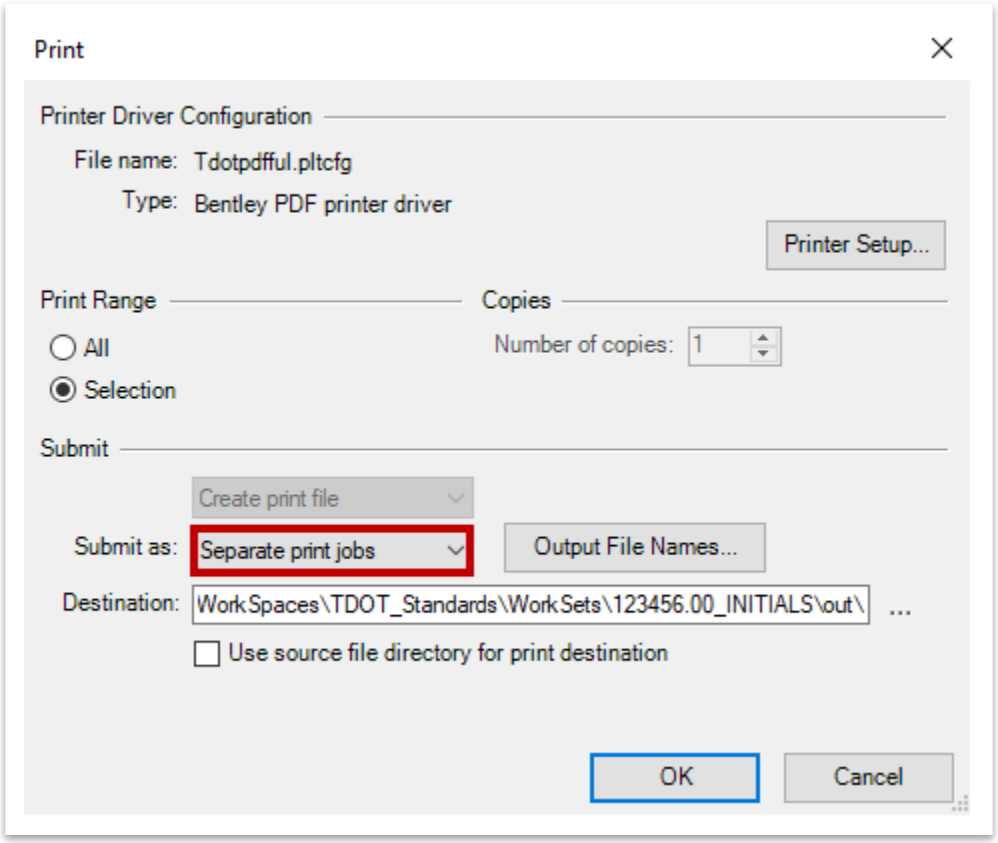
This will open the **Print Organizer** (.pset) window (Figure 95). You can select either a single sheet, an entire subfolder or the entire plan set folder to print (shown below). Any folder with an arrow next to it indicates that it contains at least one sheet model.

FIGURE 95. PRINT ORGANIZER



Once the file(s) or folder(s) are highlighted, the user will select **Print** (**4th** icon from the left or **File >> Print**) which opens the Print window (Figure 96) and then browse to the destination folder. The TDOT plot configuration file is automatically linked to the print style.

FIGURE 96. PRINT WINDOW



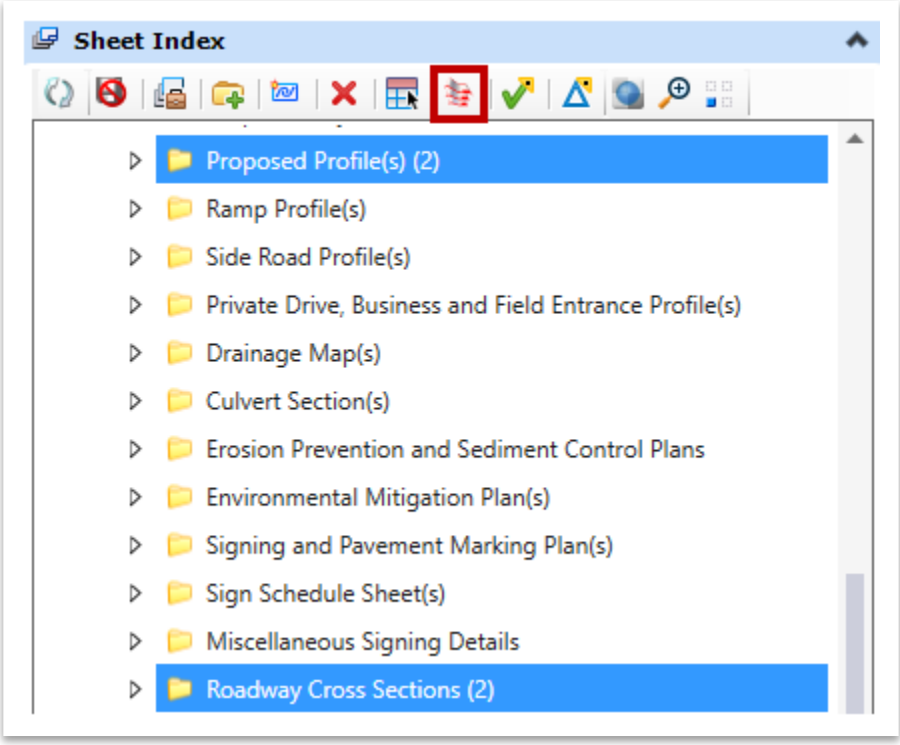
Take Note!

*When printing multiple sheets, the PDF's should be submitted as **Separate print jobs** and then combined into a single plan set outside of ORD. This is because the software will automatically combine them based on folder structure within the index and not the alphanumeric order. For example, sheets 4-10 collectively will be placed in order and then sheets 4A-10A will be placed afterwards (not 4, 4A, 5, etc).*

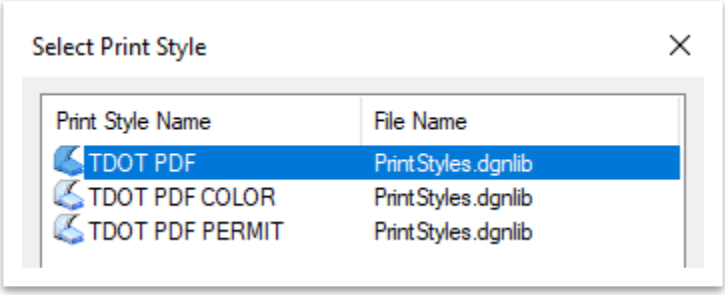
8.9 Exercise: Creating PDF's with Print Organizer

In this exercise, we will create 4 individual PDF files (2 profile sheets and 2 cross section sheets). We will continue to utilize the same **Genesco-SHT-XS.dgn** file.

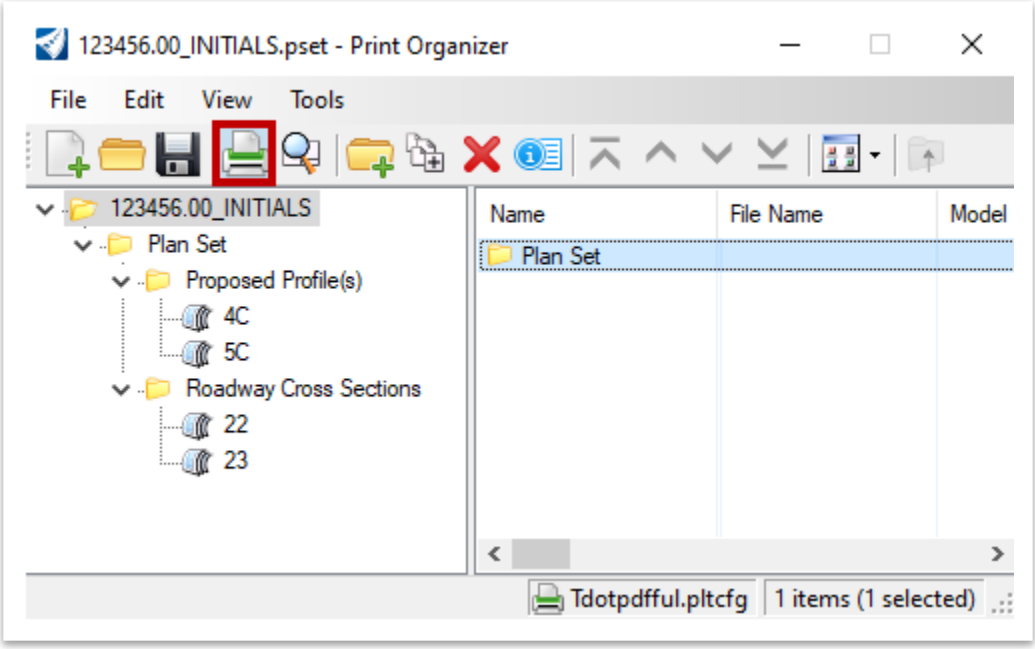
1. As a reminder, the plotting of all sheets will be done thru the **Sheet Index** via the **Print Organizer**. Scroll down in the Sheet Index and highlight only the **Proposed Profile(s) (2)** and the **Roadway Cross Sections (2)** folders. Then, open the **Print Organizer** by clicking on the icon (highlighted in red). **Note:** The Sheet Index is open for editing in the screenshot below but does not have to be in order to print.



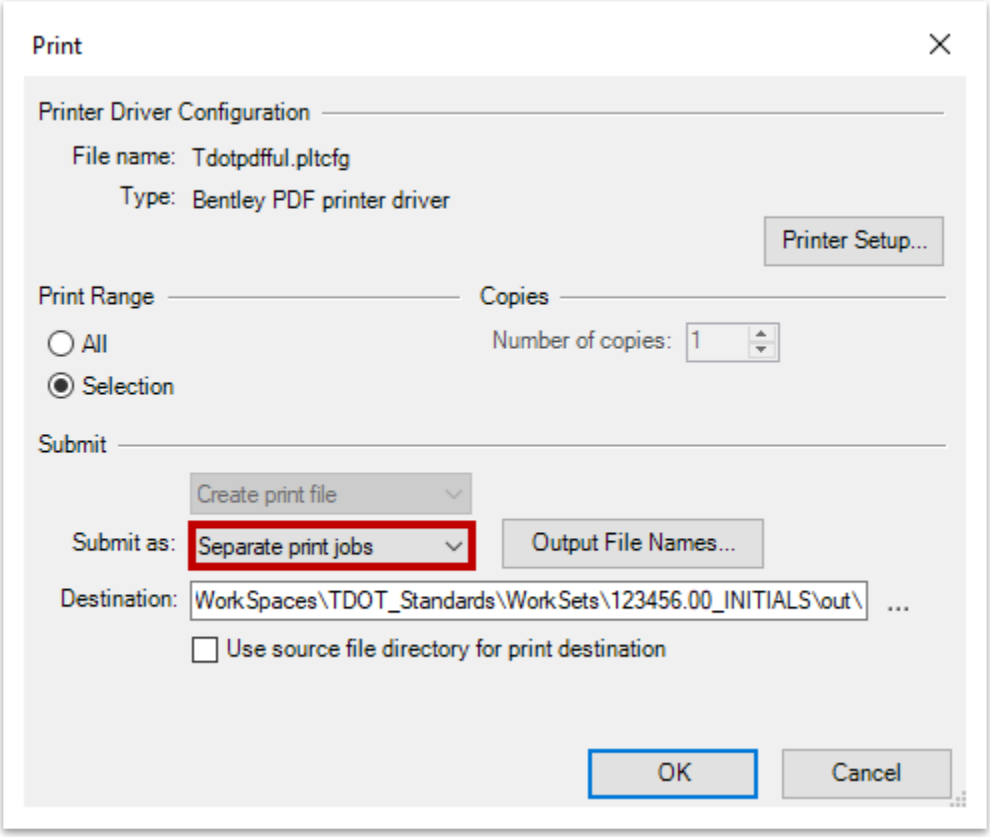
2. A **Select Print Style** window will open. Select the **TDOT PDF** print style (full size Black & White) and click **OK**.



3. This will open the **Print Organizer** (.pset) window. Notice only the 2 selected folders appear under the **Plan Set** folder (**Proposed Profile (s)** and **Roadway Cross Sections**). If you expand each folder, you will see the individual sheets that we previously created. Select the **Plan Set** folder and then click the **Print** icon (highlighted), which will print all sheets listed under that folder seen in this window.



4. This will open the **Print** window. The TDOT plot configuration file (Tdotpdfful.pltcfg) is automatically linked to the print style. By default, the PDF should save to the 123456.00_ INITIALS workset **out** subfolder. Go ahead and set the **Submit as** setting to **Separate print jobs**. Leave all other settings as-is and click **OK**. Give the software a minute to process.



5. Once completed, open **File Explorer** and browse to the 123456.00_INITIALS workset **out** subfolder. There should be **4** individual PDF files (2 profile sheets and 2 cross section sheets) to review. The date and time stamp should be populated on each sheet in the lower left corner.

Chapter 9. Template Creation

TDOT has built an extensive template library (**ITL**) to serve as a basis for all projects. For simpler projects, the base templates may be sufficient as-is or at most, only need minimal customization. For complex projects that deviate from TDOT standards, the user needs to understand how to create new templates and customize existing templates utilizing the ORD tools.

At the beginning of all projects, the user should open the **Create Template** tool and save a copy of the default TDOT ITL to the project workset folder. This ensures that the default ITL does not become corrupt or cluttered with templates from multiple projects. This also ensures that users will not lose project templates when the default ITL is updated by TDOT in the future. In addition, this sets the ITL file path inside the given design file. Users should always navigate to their project ITL when making any edits or when placing templates in future corridor files.

The **linear templates** that form the default TDOT templates are created from building blocks that are saved in the **Components** and **End Conditions** folders within the template library (**ITL**). This is the location where users should go to build additional template components. The default components already have TDOT point names, feature definitions, point constraints, and constraint labels assigned to speed up the template building process and to ensure compliance with TDOT standards and graphical filters. For example, if a point name is selected from the TDOT **Point Name List**, then the correct feature definition will automatically be assigned. For point **EOP_L**, it has the feature definition **Prop EOP** assigned so that whenever this point is placed in a template, the correct symbology for an **Edge of Pavement** line is drawn in the **2D** view. Utilizing the default TDOT templates and template components ensures compliance when submitting plan sets.

9.1 Objectives

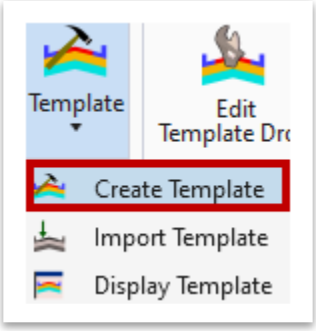
At the conclusion of this chapter, participants will be able to:

1. Save the default TDOT ITL to a project workset folder.
2. Copy and then modify default templates to meet project requirements.
3. Test the templates and then update the corridor
4. Open dynamic cross sections.

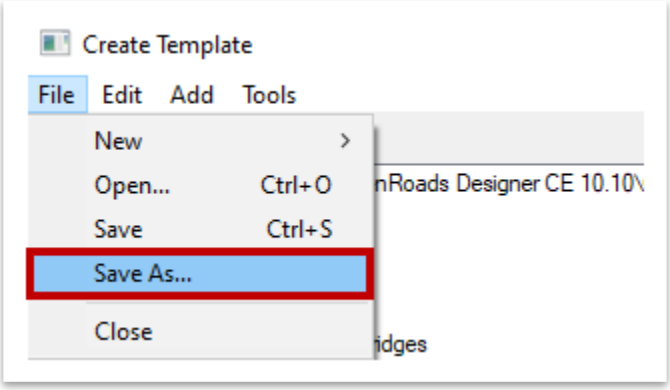
9.2 Exercise: Open the Create Template Tool

In this exercise, we will open the ITL and save it to our project workset folder. We will open back up the **GenescoCorridor.dgn** file to start with.

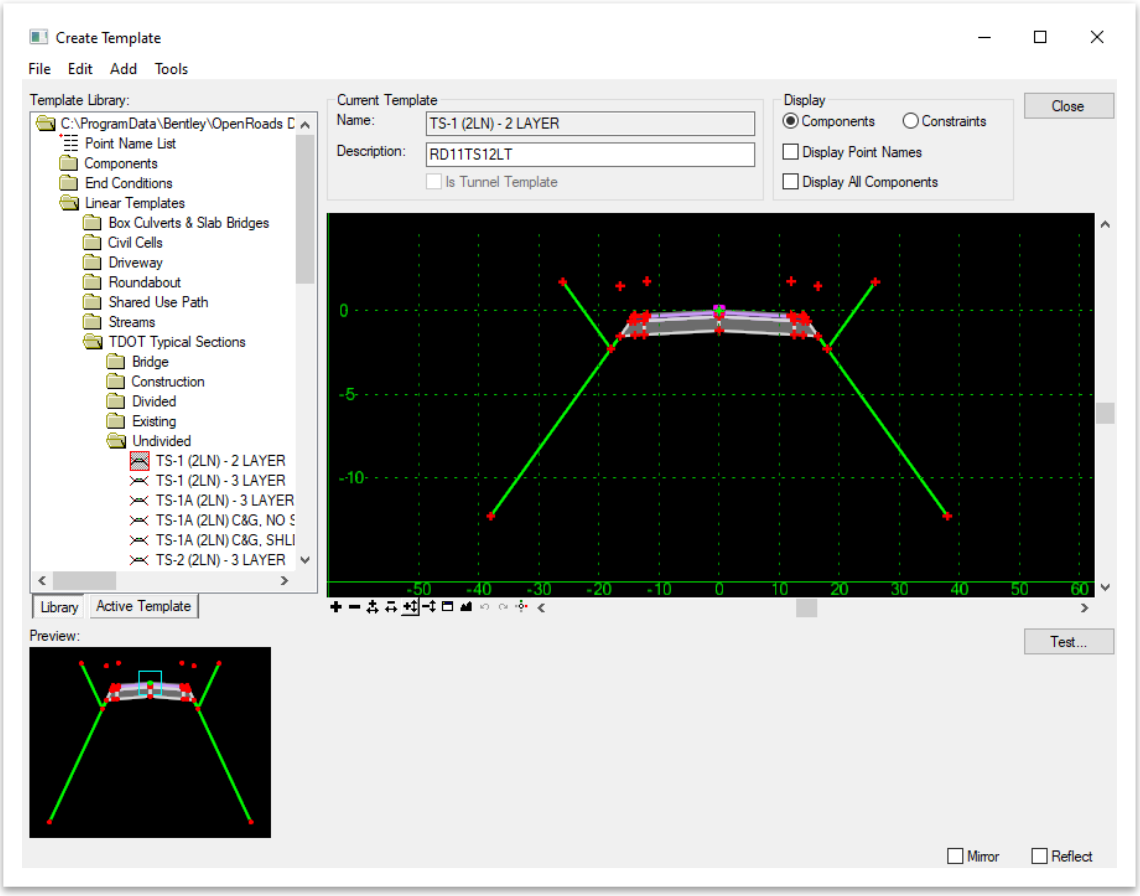
1. Go to **File >> Save As** and name it **GenescoCorridor_MOD**. This will allow us to make changes in this chapter without overriding the original corridor.
2. Then, open the **Create Template** tool (**OpenRoads Modeling >> Corridors >> Create >> Template**).



3. The **Create Template** window will open automatically and loads the default TDOT Template Library. Later in this chapter, we will be creating a new template, so we need to save a copy of the default template library (**ITL**) to the project workset folder so that the default ITL is not edited. Within the **Create Template** window, click **File >> Save As**.



4. Notice that by default, it opens to the applicable folder within your project workset (**123456.00_INITIALS >> Standards >> Template Library**). Click **Save** to accept the default file name. Now the ITL that you see is the project version and not the default ITL. **Note:** The **Display Point Names** have been turned off for the screenshot.

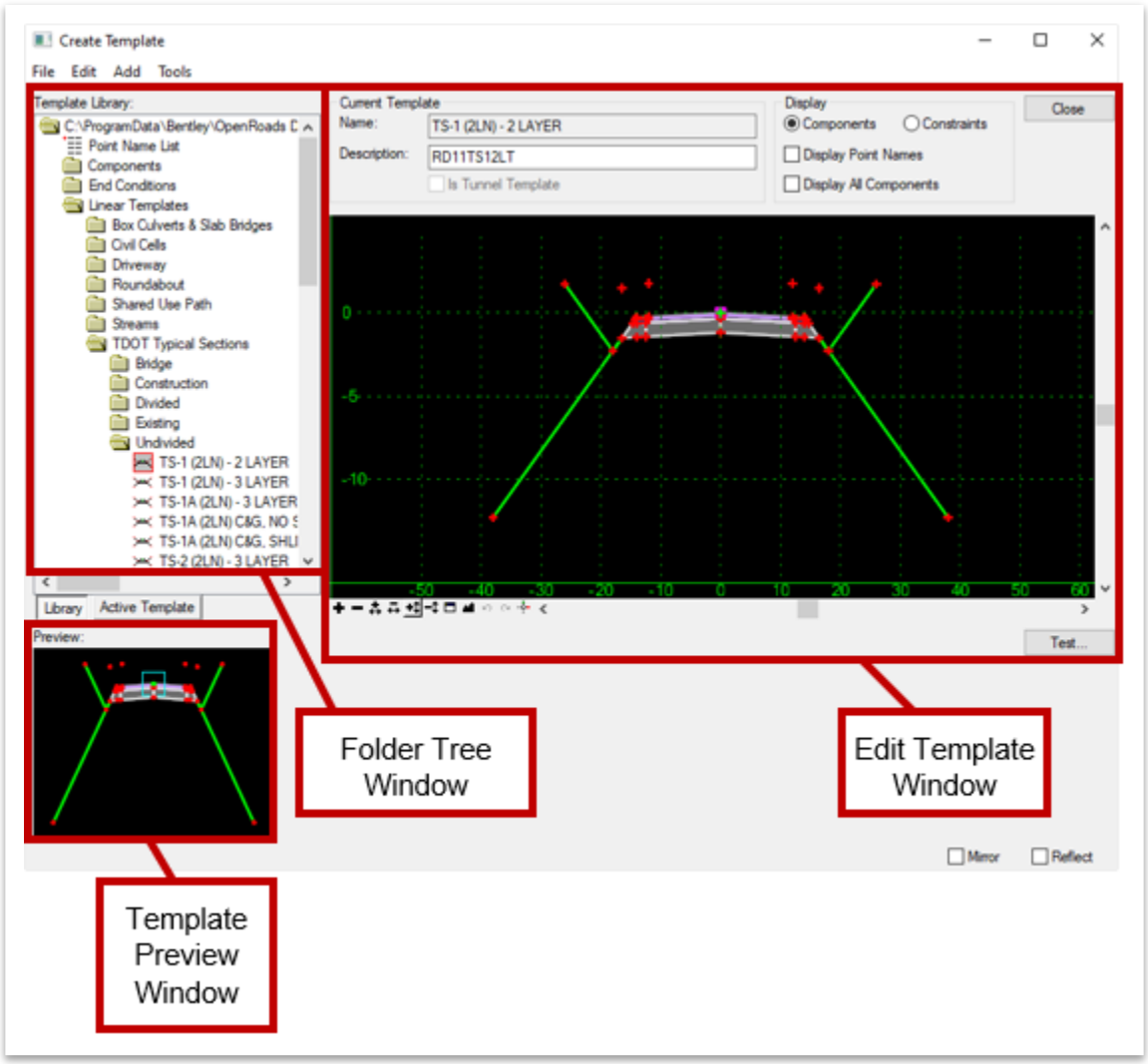


9.3 Lecture: Create Template Window

In general, each template contains a series of **points** and **components** that represent breaklines, which are used to create the roadway surfaces (**terrains**). All of these points, components and templates are stored in the template library (**ITL**).

The **Create Template** window has three major components: **Folder Tree Window**, **Edit Template Window**, and **Template Preview Window** (Figure 97).

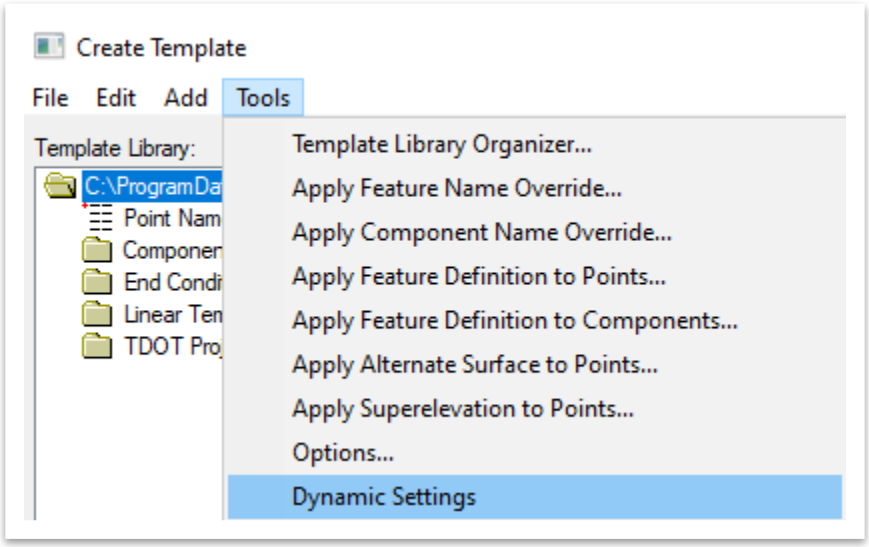
FIGURE 97. CREATE TEMPLATE WINDOW



9.3.1 Dynamic Settings

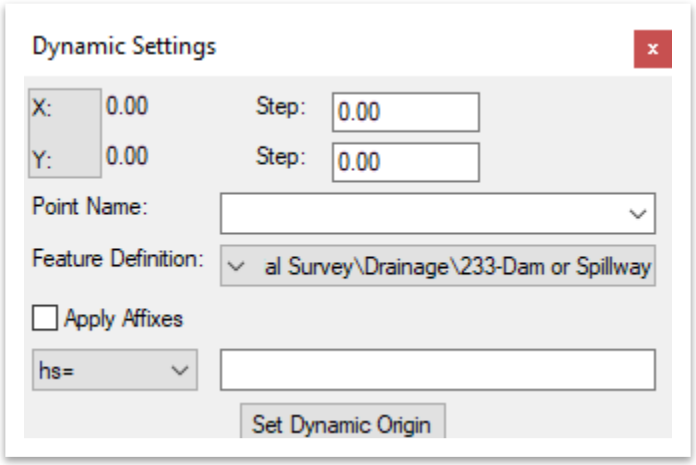
Like the Civil AccuDraw tool, the **Dynamic Settings** are used for precision input of the template components and to assign point names and styles when creating components. To open the Dynamic Settings, go to **Tools >> Dynamic Settings** within the **Create Template** window (Figure 98).

FIGURE 98. DYNAMIC SETTINGS TOOL LOCATION



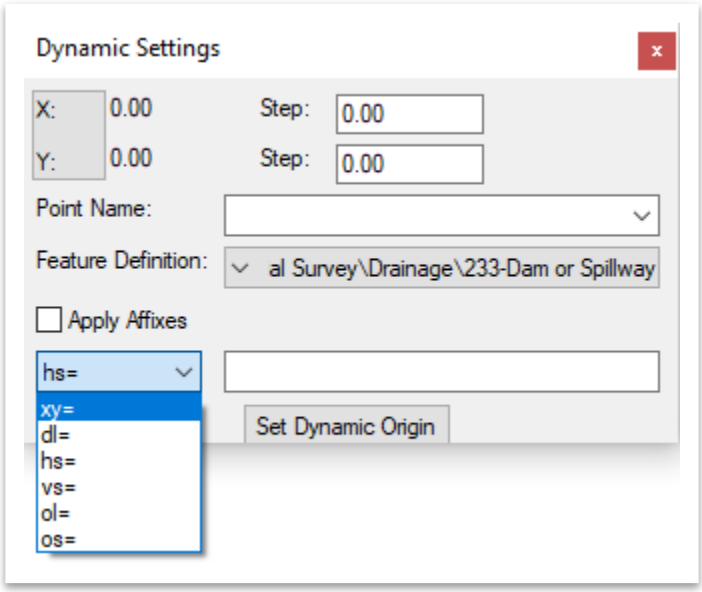
These settings also serve as a compass for the cursor location with respect to the dynamic origin (Figure 99). The dynamic origin can be modified by clicking the **Set Dynamic Origin** button at the bottom of the dialog box.

FIGURE 99. DYNAMIC SETTINGS TOOL



The drop-down menu lists different key-ins that can be used when defining a point or component (Figure 100).

FIGURE 100. DYNAMIC SETTINGS KEY-INS



Key-in Descriptions:

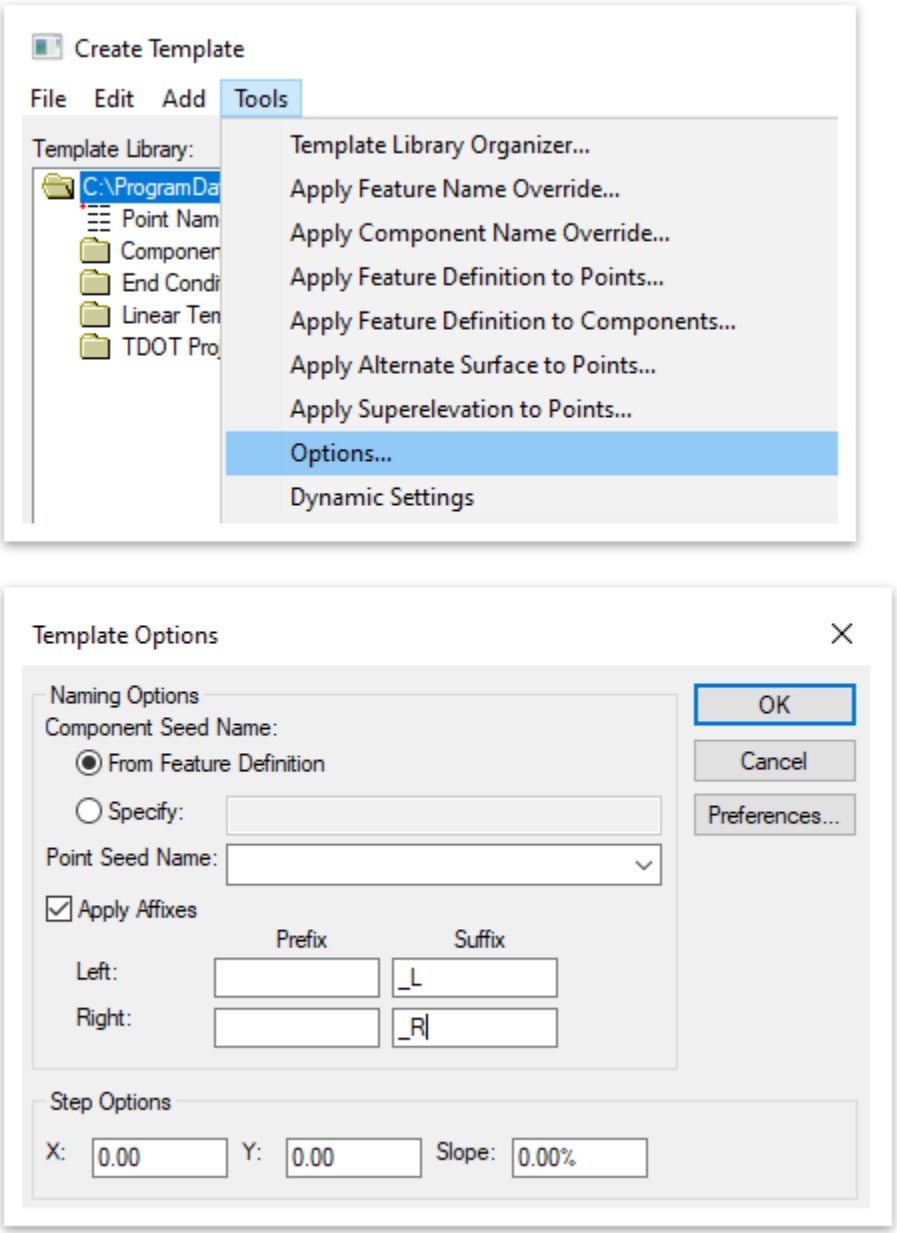
- **xy=** x value, y value – based on the grid template
- **dl=** delta x value, delta y value – from the previous point
- **hs=** delta x value, slope – from the previous point
- **vs=** delta y value, slope – from the previous point
- **ol=** delta x value, delta y value – from the Dynamic Origin
- **os=** delta x value, slope – from the Dynamic Origin

The **Dynamic Origin** is indicated by the magenta colored box and used as a reference for the step lock values, and the **ol=** and **os=** key-ins.

9.3.2 Apply Affixes

The **Apply Affixes** toggle can be controlled within the **Dynamic Settings** or within the **Template Options**. However, the affixes themselves are controlled only in the **Template Options** window (**Tools >> Options**) (Figure 101). If the user is creating a new template by dragging and dropping components from the components folder, they should checkmark **Apply Affixes** prior to template creation. TDOT template point naming standards have a suffix of **_L** for points to the left of template origin and **_R** for points to the right of the template origin.

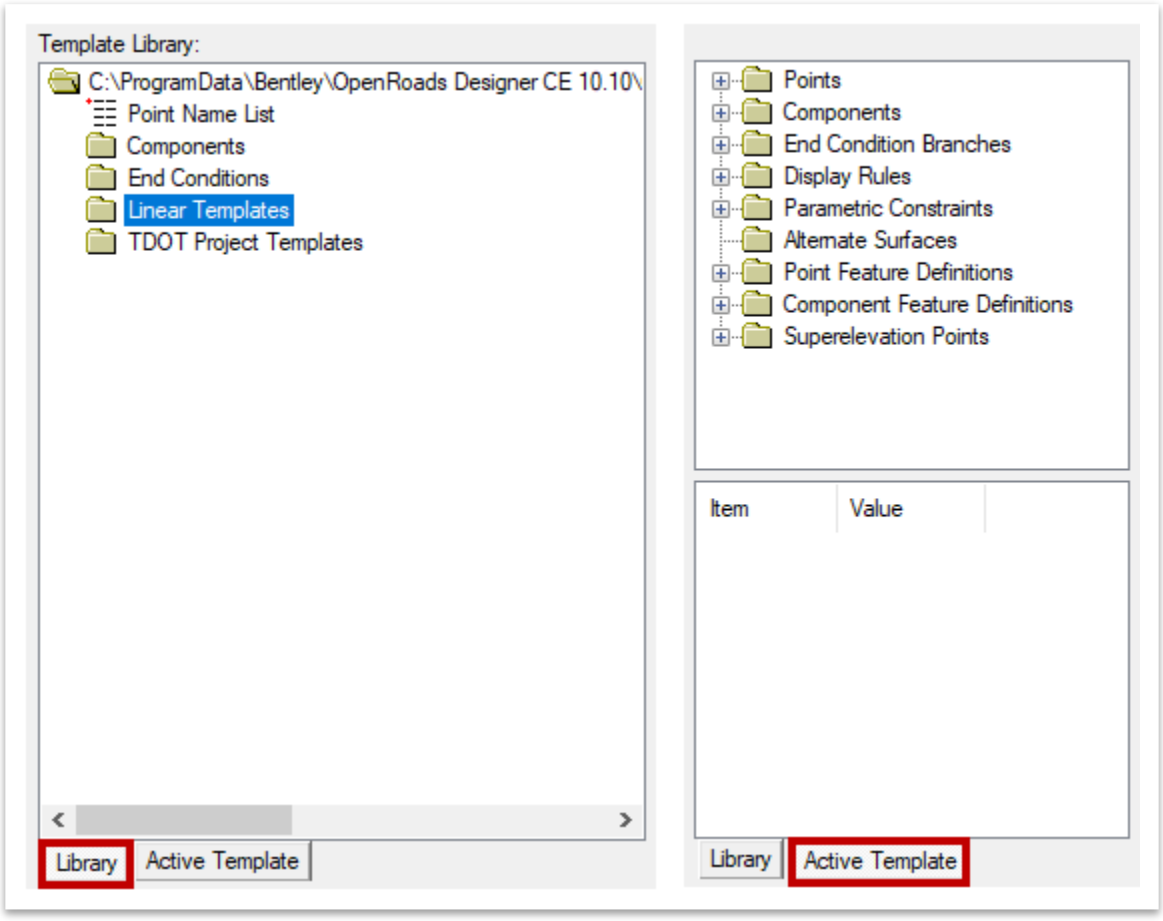
FIGURE 101. OPTIONS TOOL LOCATION AND SETTINGS



9.3.3 Folder Tree Window

The **Folder Tree Window** allows the user to navigate through both the selected template **Library** and the **Active Template** details (Figure 102).

FIGURE 102. LIBRARY AND ACTIVE TEMPLATE TABS



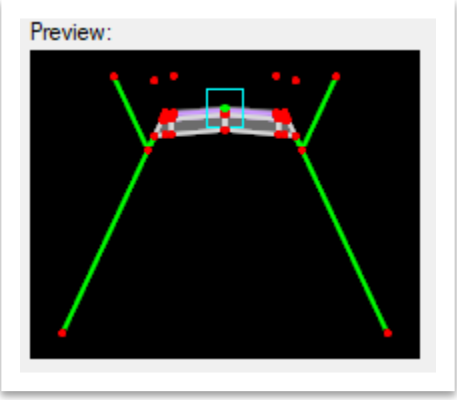
Within the **Library** tab, the user will find the **Point Name List** and the **Components**, **End Conditions**, **Linear Templates** and **TDOT Project Templates** folders. The folder structure was introduced earlier in the manual in Chapter 5. The **Point Name List** contains TDOT standard names that should be used during the creation of all new points when developing components and templates. Each point on a template must be unique, so **no point can have the same name**.

When an active template is selected, the **Active Template** tab will update with information that is pertinent to that template. Characteristics such as **Points**, **Components**, **End Conditions**, etc can be reviewed here to understand how the template was created when first developed.

9.3.4 Template Preview Window

The active template selected in the folder tree window is displayed in the **Template Preview Window** (Figure 103). A cyan colored box denotes the origin point for the template (or component) being displayed.

FIGURE 103. TEMPLATE PREVIEW WINDOW



9.3.5 Edit Template Window

The **Edit Template Window** is where templates are developed and edited. This window shows details about the active template, such as **Name**, **Description**, and **Display** information. The central window (graph) with the green X and Y grid is the primary location where the actual template development and edits are done. This window has its own graphics engine, and thus not a MicroStation window. The scale of the graph is dynamic and changes when you zoom in and out. The **Dynamic Origin** is indicated by the magenta-colored box and represents the center point of the window. It is used as a reference point and can be moved to any location within the graph.

The **Display** options contain two toggles for template information. The **Components** option shows the typical section template / components (Figure 104 on the next page) and the Constraints option shows how each point in the template / component is constrained to each other (Figure 105 on the next page). Constraints will be covered in Section 9.5.

FIGURE 104. DISPLAY OPTION – COMPONENTS

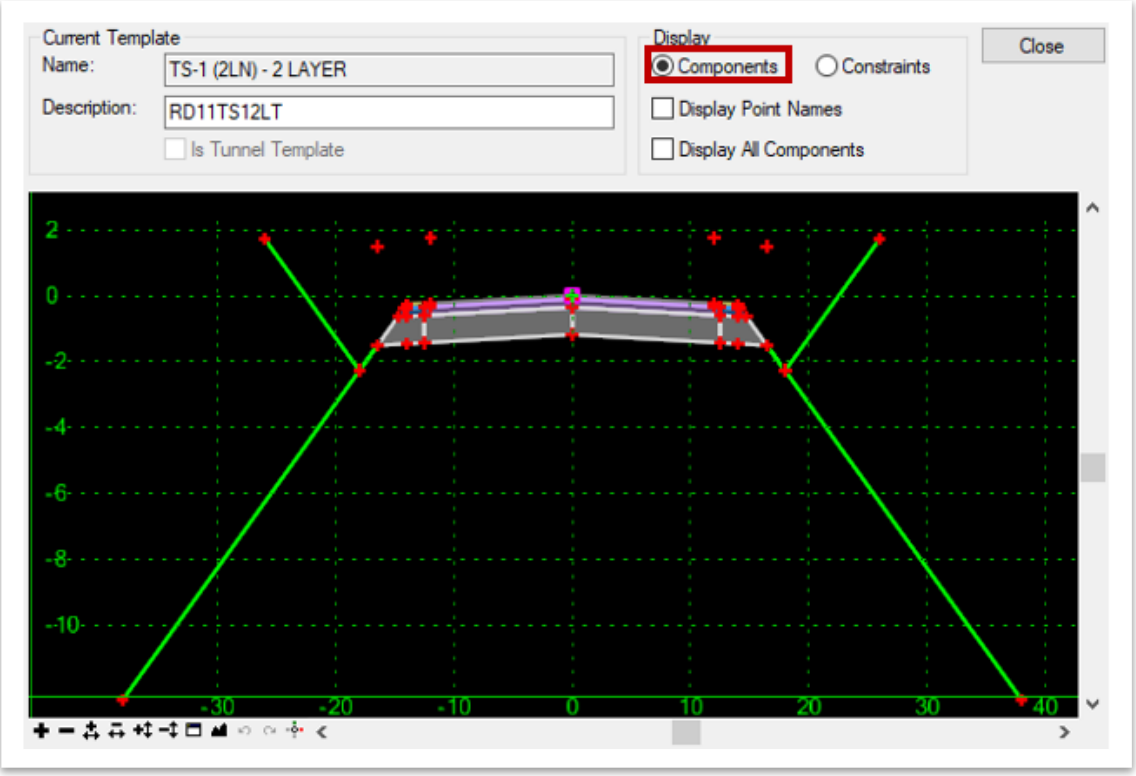
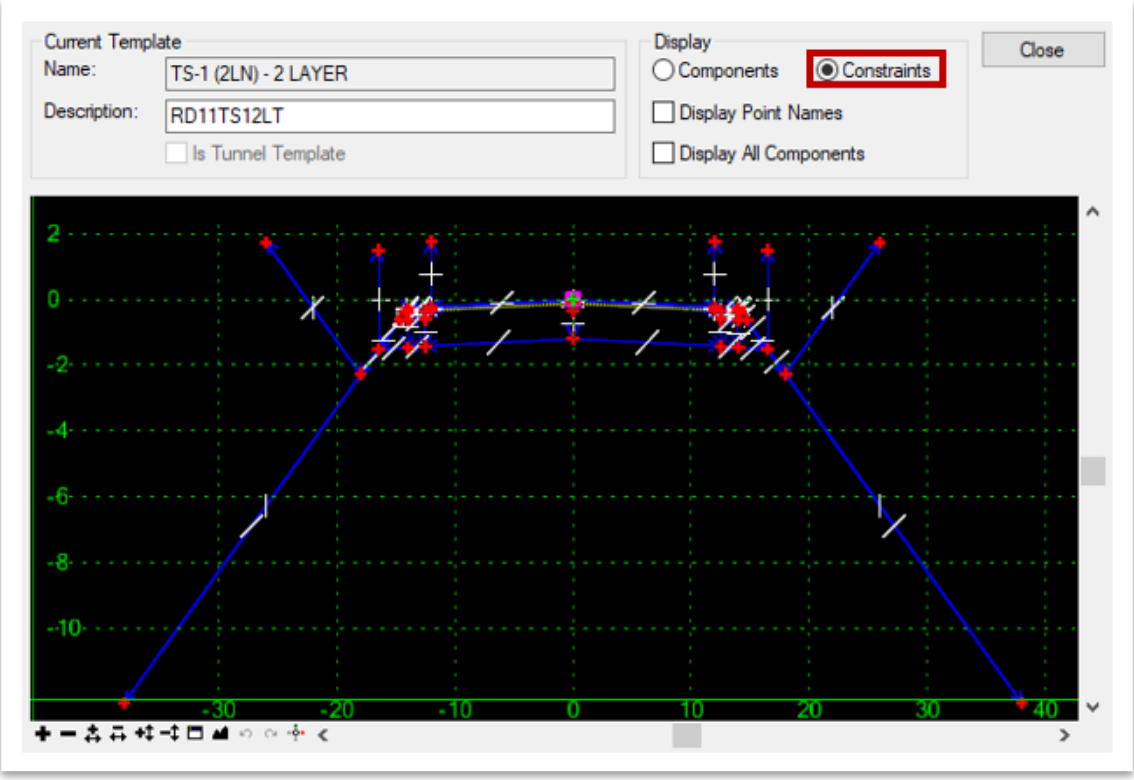


FIGURE 105. DISPLAY OPTION – CONSTRAINTS

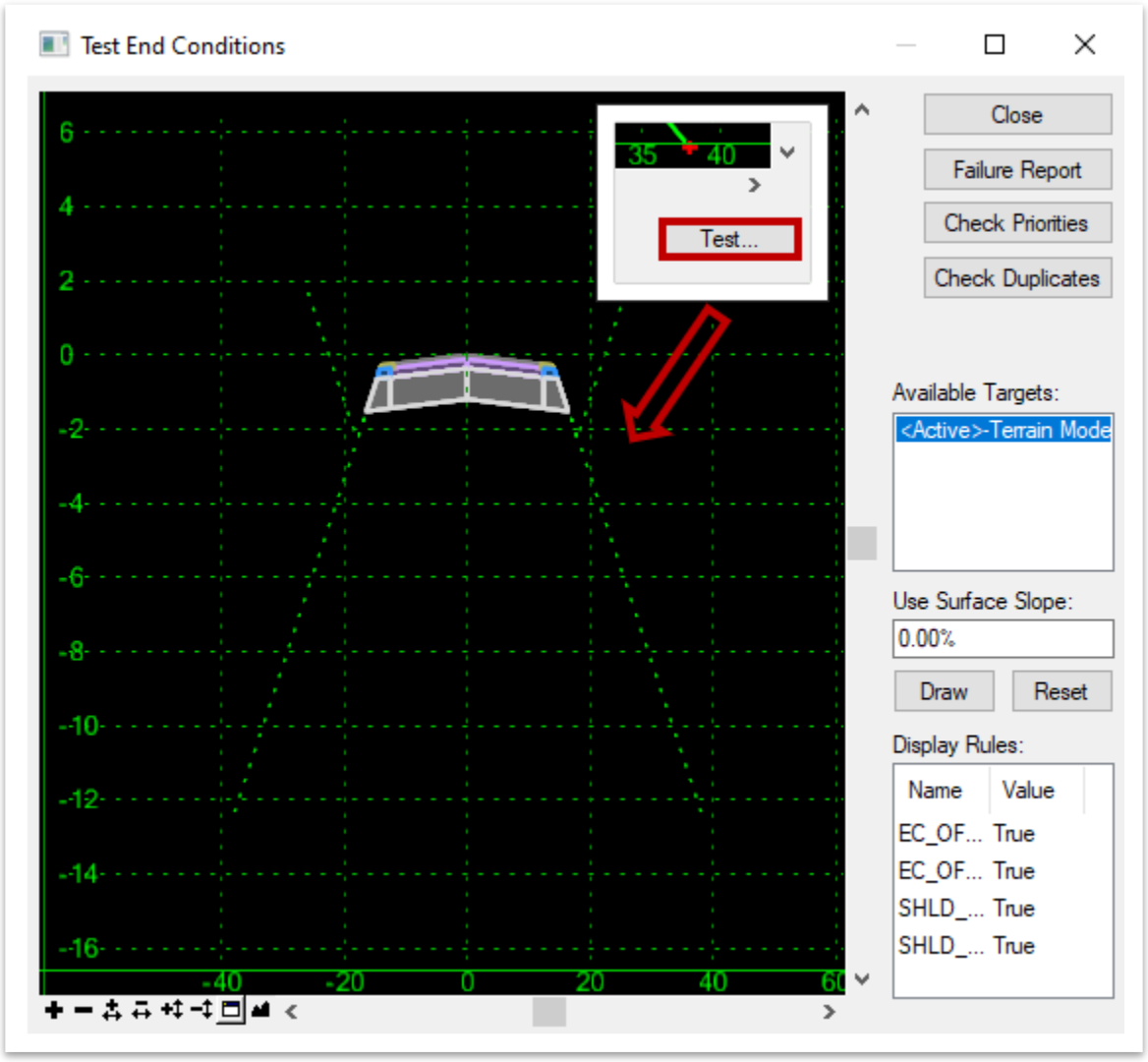


The **View Commands** located under the central window are like the MicroStation view commands (Figure 106). They allow the user to perform standard functions such as zoom in/out, zoom in/out in the x or y direction separately, fit view, undo, redo, and set the dynamic display.

FIGURE 106. VIEW COMMANDS

The **Create Template** window also allows the user to **Test** whether the template end conditions, and display rules will resolve based on a target terrain or another corridor (Figure 107). A terrain or corridor must be active in the drawing to use this tool. The **Test** button is located below the edit template window in the lower right corner.

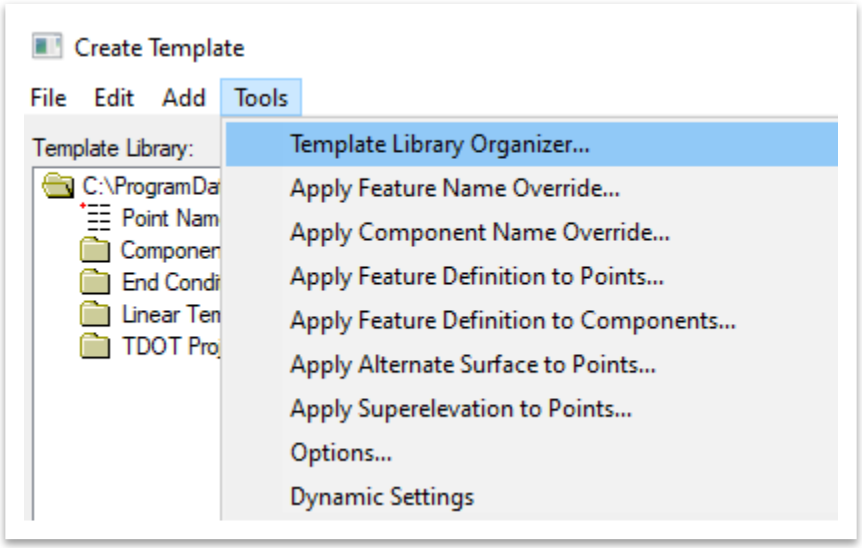
FIGURE 107. TEST END CONDITIONS WINDOW



9.3.6 Template Library Organizer

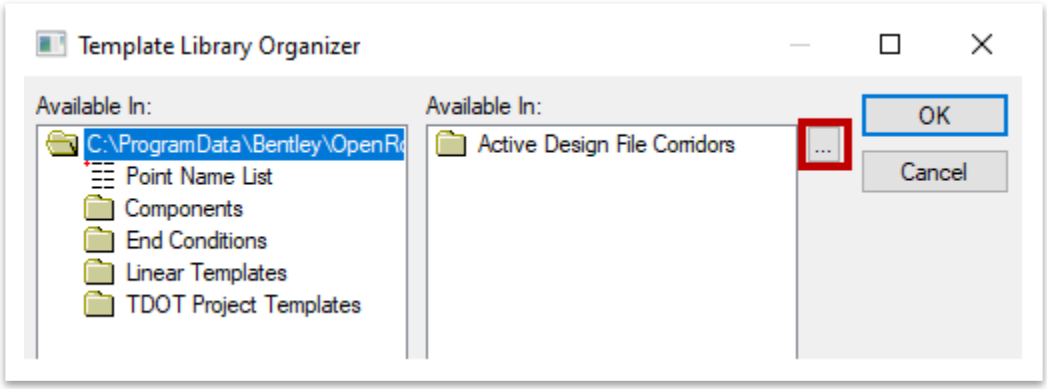
Templates can be copied from one template library to another utilizing the **Template Library Organizer** (Figure 108). This is beneficial for when a project-created template needs to be used on another project.

FIGURE 108. TEMPLATE LIBRARY ORGANIZER LOCATION



To copy templates from one template library to another, browse to the template **ITL** file available in the **Active Design File Corridors** folder. Drag and drop the template(s) over to the left side and then click **OK** (Figure 109).

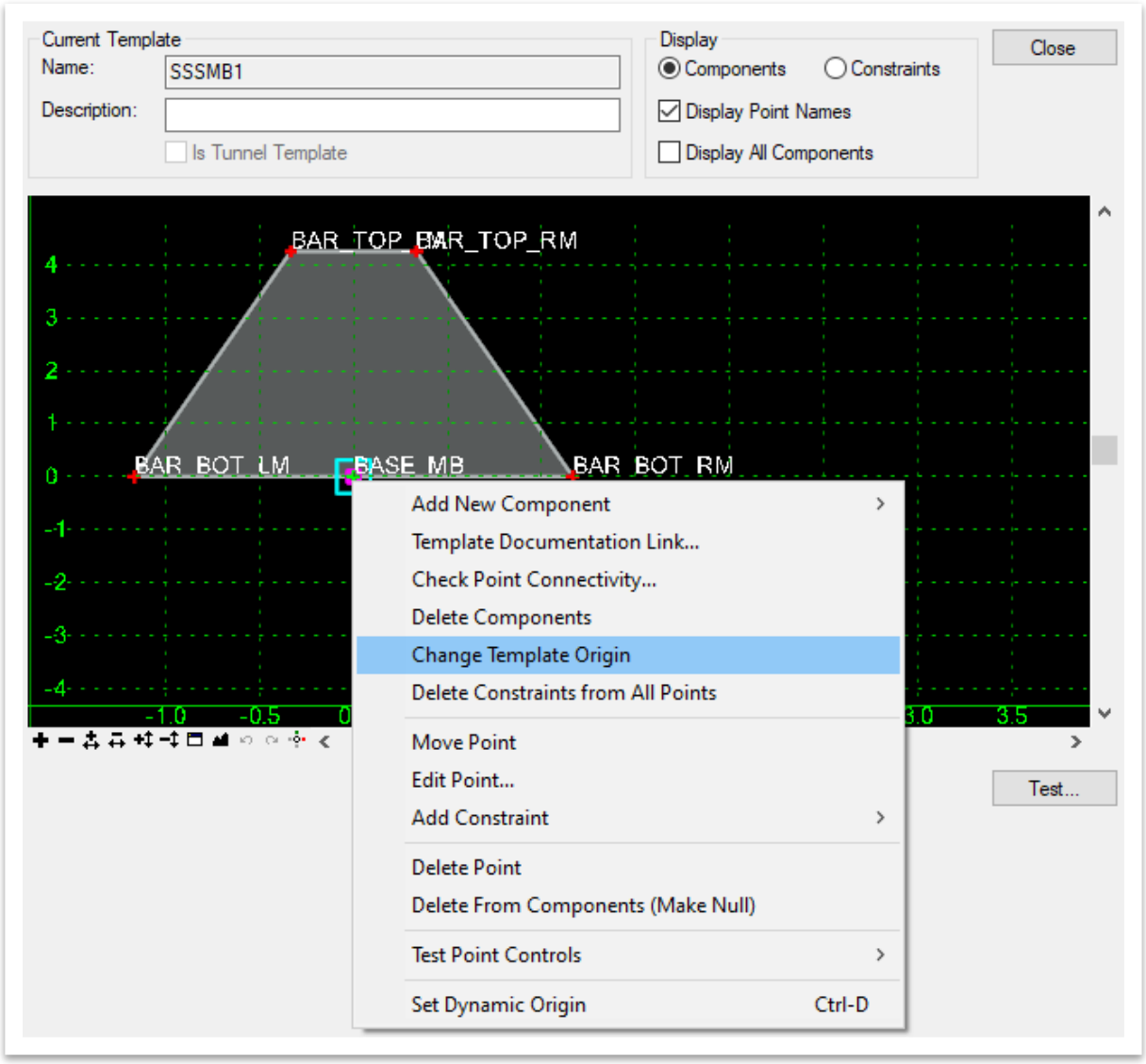
FIGURE 109. TEMPLATE LIBRARY ORGANIZER TOOL



9.3.7 Change Template Origin

The **Change Template Origin** tool is used to set the template origin location. To shift the entire template so that the selected point is at the origin (**0,0**), right click on the point in the edit template window and select the tool (Figure 110).

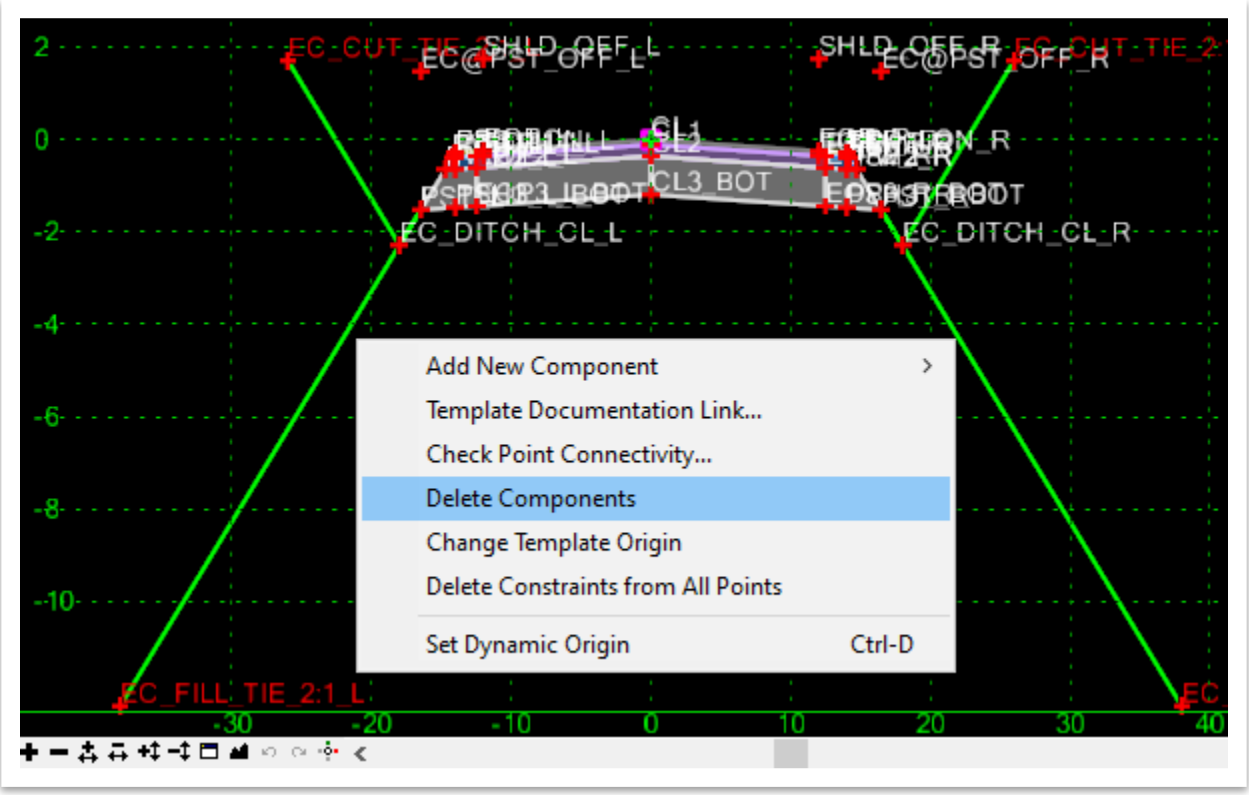
FIGURE 110. CHANGE TEMPLATE ORIGIN TOOL



9.3.8 Delete Components

A single template component can be deleted by first selecting it and then right clicking and choosing **Delete Component**. Multiple template components can be deleted together by first right clicking in the edit template window and choosing **Delete Components** (Figure 111).

FIGURE 111. DELETE COMPONENTS TOOL



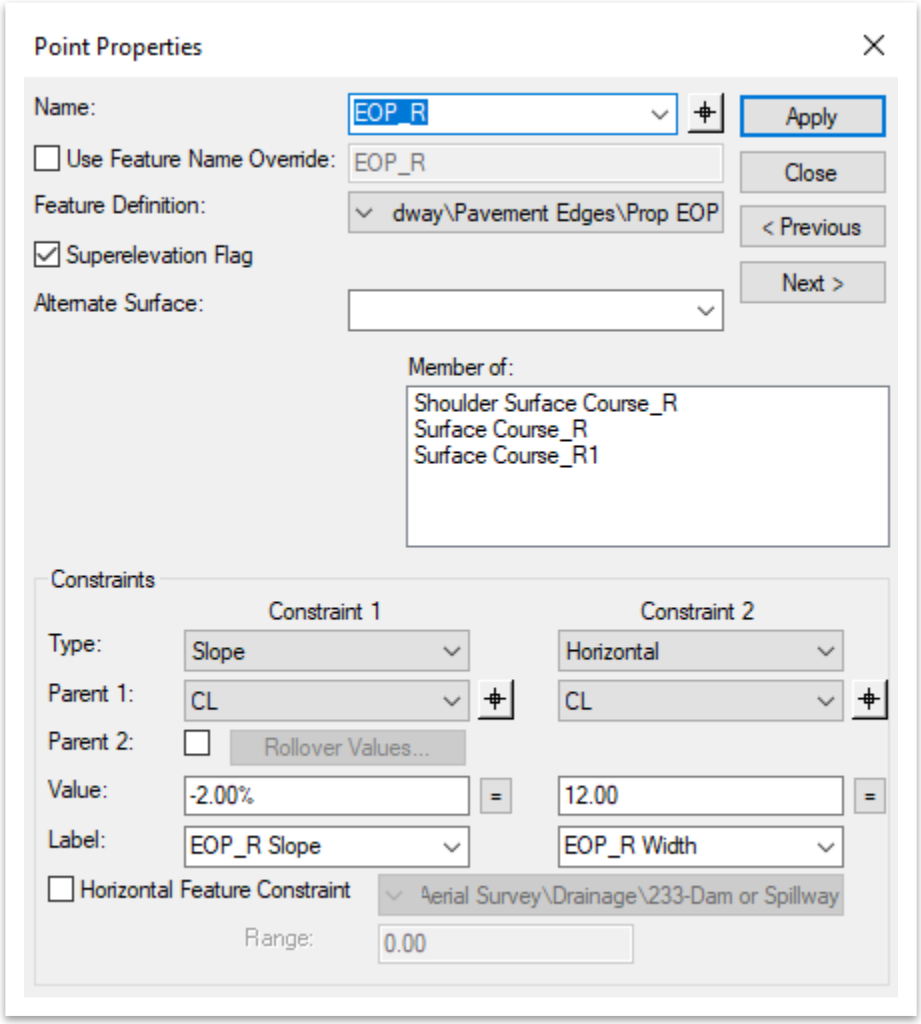
The user can then draw a line through the components that they wish to delete (Figure 112). You could also use this approach to delete single components, if preferred.

FIGURE 112. DELETE COMPONENT – LINE

9.4 Lecture: Point Properties

The **Point Properties** dialog box allows the user to edit the properties of a selected point (Figure 113). To access the dialog box, either **double click** on the point in the edit template window or **right click** on the point and select **Edit Point**. The dialog box controls everything about the point including the point feature definition, superelevation flag, alternate surface, constraints, and labels. The feature definitions can be found under the **Linear >> Roadway** folders.

FIGURE 113. POINT PROPERTIES



9.5 Lecture: Point Constraints

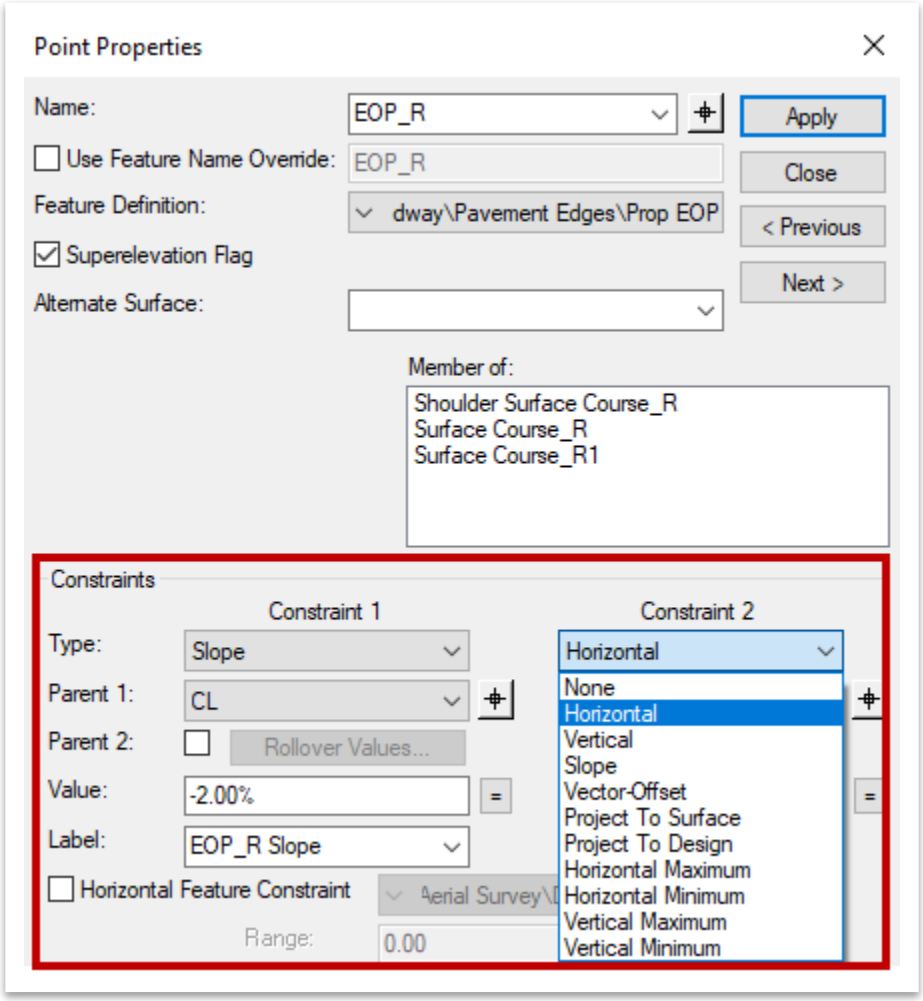
Templates and components consist of points that define their shapes. Thus, **point constraints** are used to manage the behavior of all the template points by creating relationships so that if one point moves, the others follow in a predictable manner. Once a template point has been created with or without constraints, it can still be modified such as **adding or deleting constraints** and **changing the type of constraint**.

Each template point is deemed fully constrained when set up with **two** constraints. However, if a point is only being controlled with one parameter, it is still partially constrained.

9.5.1 Types of Constraints

There are several types of constraints that can be used to create templates. Constraints are set in the **Point Properties** dialog box under **Constraints** (Figure 114).

FIGURE 114. POINT PROPERTIES – CONSTRAINTS



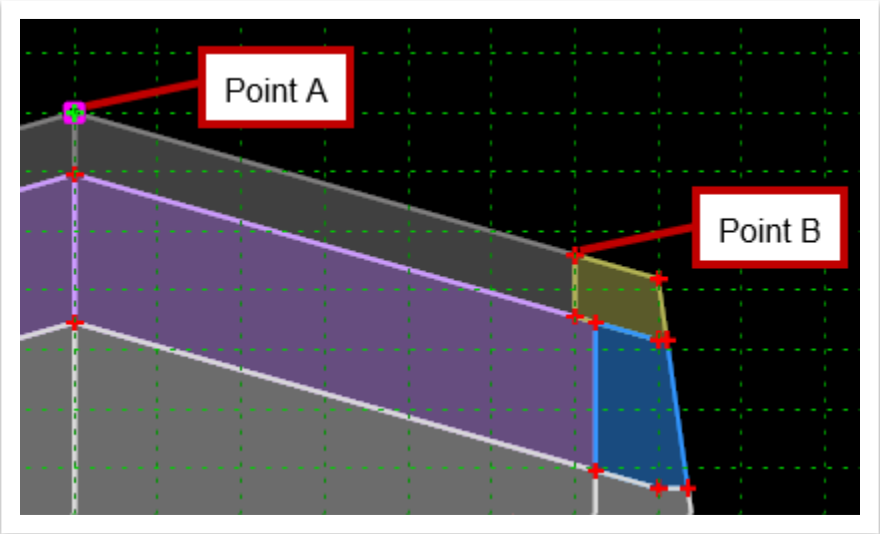
The most common constraints that are used in the templates are described below:

- **Horizontal:** The point is constrained by a horizontal distance from the parent, specified by the Value entered.
- **Vertical:** The point is constrained by a vertical distance from the parent, specified by the Value entered.
- **Slope:** The point is constrained by a slope from the parent, specified by the Value entered.
- **Vector Offset:** The point is constrained onto a vector as defined by the two parent points. The point may be offset perpendicular from the vector by entering a Value. Positive values are offset to the right of the vector whereas negative values are offset to the left.
- **Project to Surface:** The point projects in a direction, defined in the drop-down menu, until it intercepts the defined surface. A direction and surface value must be specified.

9.5.2 Parent-Child Point Relationship

When a template point is constrained by either one or two other points, it is considered the **Child** of those reference points. The reference points are then known as the **Parent** point(s). If the parent point moves (**Point A**), the child point (**Point B**) also moves based on the established constraints (Figure 115).

FIGURE 115. POINT B IS A CHILD OF POINT A

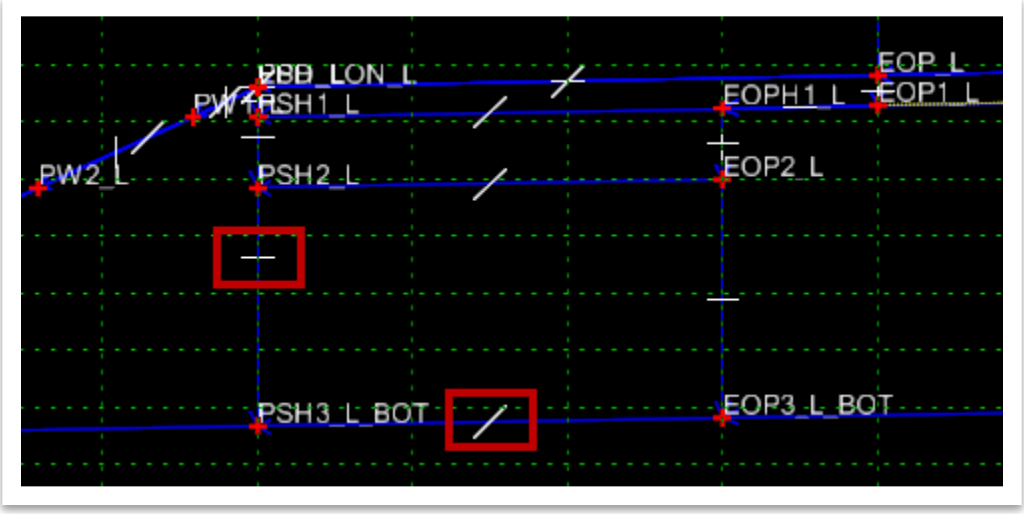


9.5.3 Visual Indicators for Vertical, Horizontal and Slope Constraints

Each template point can be constrained by **none**, **one** or **two** constraints from a parent. Within the edit template window under **Display**, the **Constraints** can be toggled on, which will give visual indicators for the constraints of each point.

Horizontal constraints are represented with horizontal white lines. **Vertical** constraints are represented with vertical white lines. **Slope** constraints are represented with a forward slash. In Figure 116, the **PSH3_L_BOT** point is constrained horizontally by the **PSH_LON_L** point and constrained by a slope from the **EOP3_L_BOT** point.

FIGURE 116. POINT CONSTRAINTS

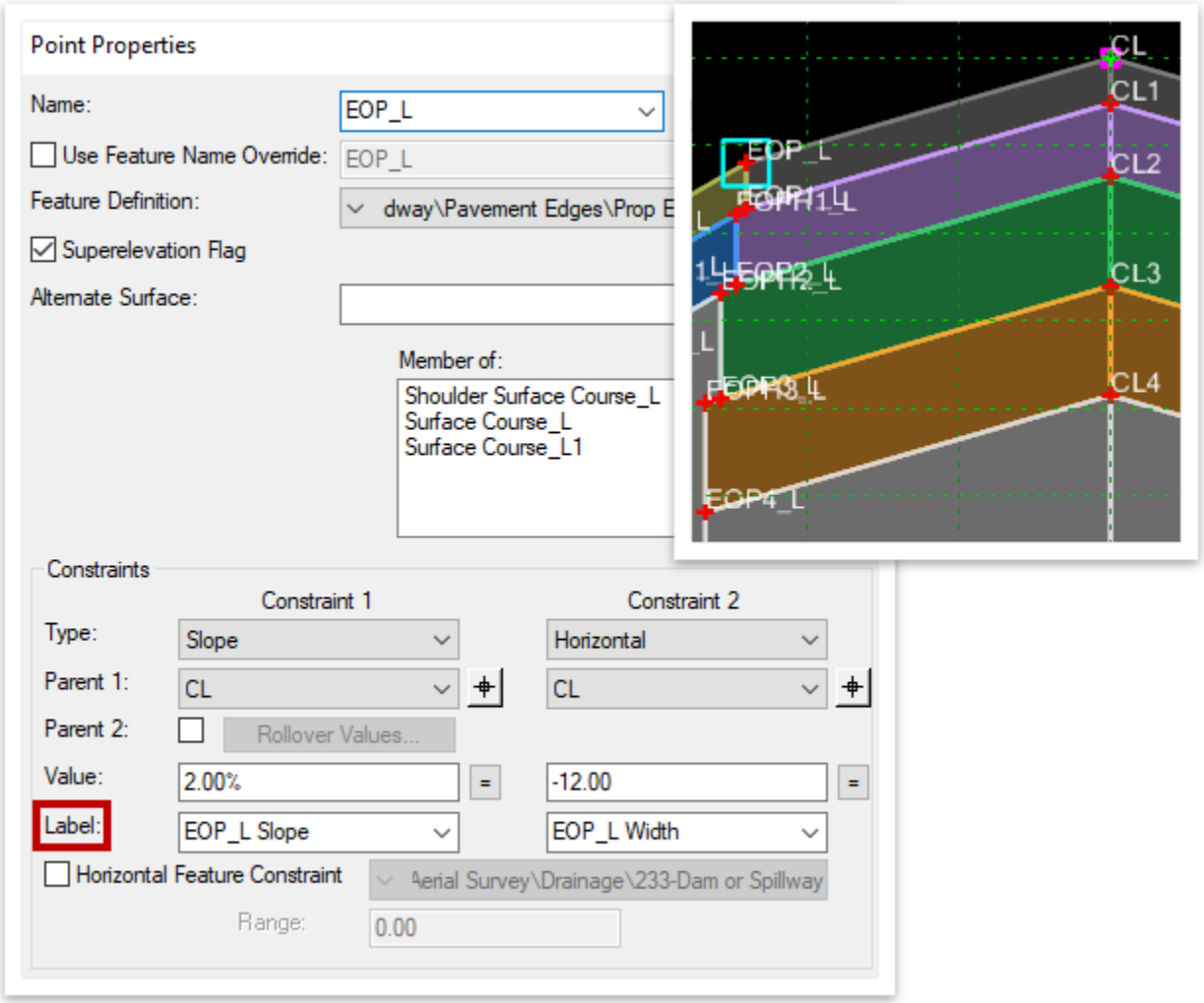


9.5.4 Point labels

All point constraints can have a label except for **Project to Design**. The label is required so that **Parametric Constraints** can be defined in the corridor model.

For example, in Figure 117, the **EOP_L** point has a label for both the **Slope** and **Horizontal** constraints. In the **Parametric Constraints** tool in the **Corridor Modeler**, the user can redefine the slope or horizontal value between two stations. This can be a consistent slope change (4% lane instead of 2%) or a lane taper (12' to 8' lanes).

FIGURE 117. POINT PROPERTIES



Labels must be the same name on the same point in successive templates, as the **Corridor Modeler** will look for a defined label between the start and stop station of the **Parametric Constraint** and will disregard a transition between two different template drops.

In the TDOT template library, the centerline pavement depth points have labels that define the pavement depth.

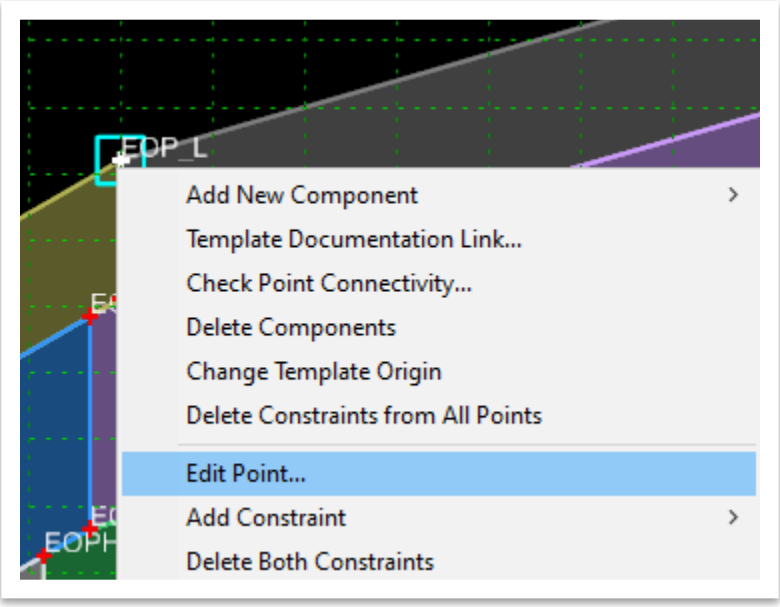
Take Note!

When setting up a template for a new project, it is recommended to assign the pavement depths inside the template before placing it in the model. This will ensure pavement depth consistency across the project. If this is not done, then users can key-in the final pavement depths as parametric constraints throughout the corridor after placement.

9.5.5 Editing Points

Once a template has been created, it may be edited by changing the properties of the points. As mentioned in Section 9.4, one option to open the **Point Properties** dialog box is to right click on the point that needs to be edited and select **Edit Point** (Figure 118).

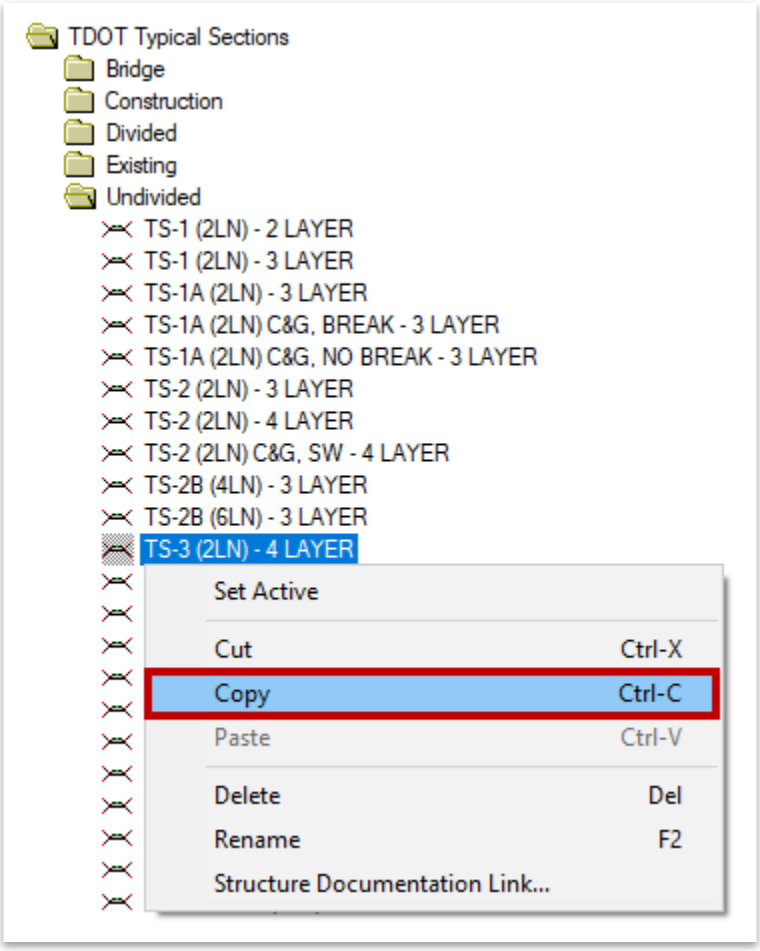
FIGURE 118. EDIT POINT OPTION



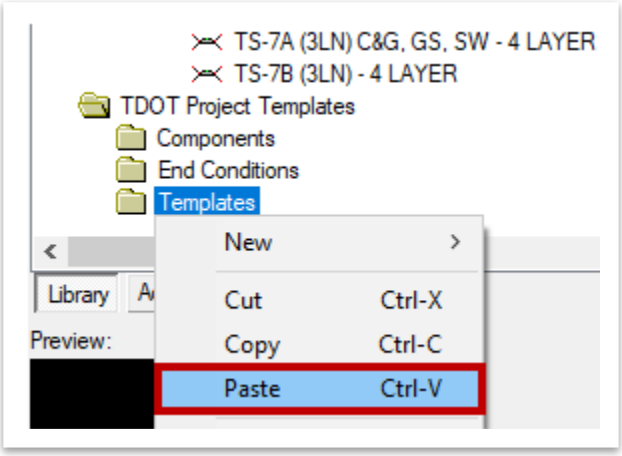
9.6 Exercise: Create a New Template

In this exercise, we will create a new roadway template in our project ITL by utilizing a TDOT standard template as the base and then editing point constraints. We will continue to utilize the same **GenescoCorridor_MOD.dgn** file.

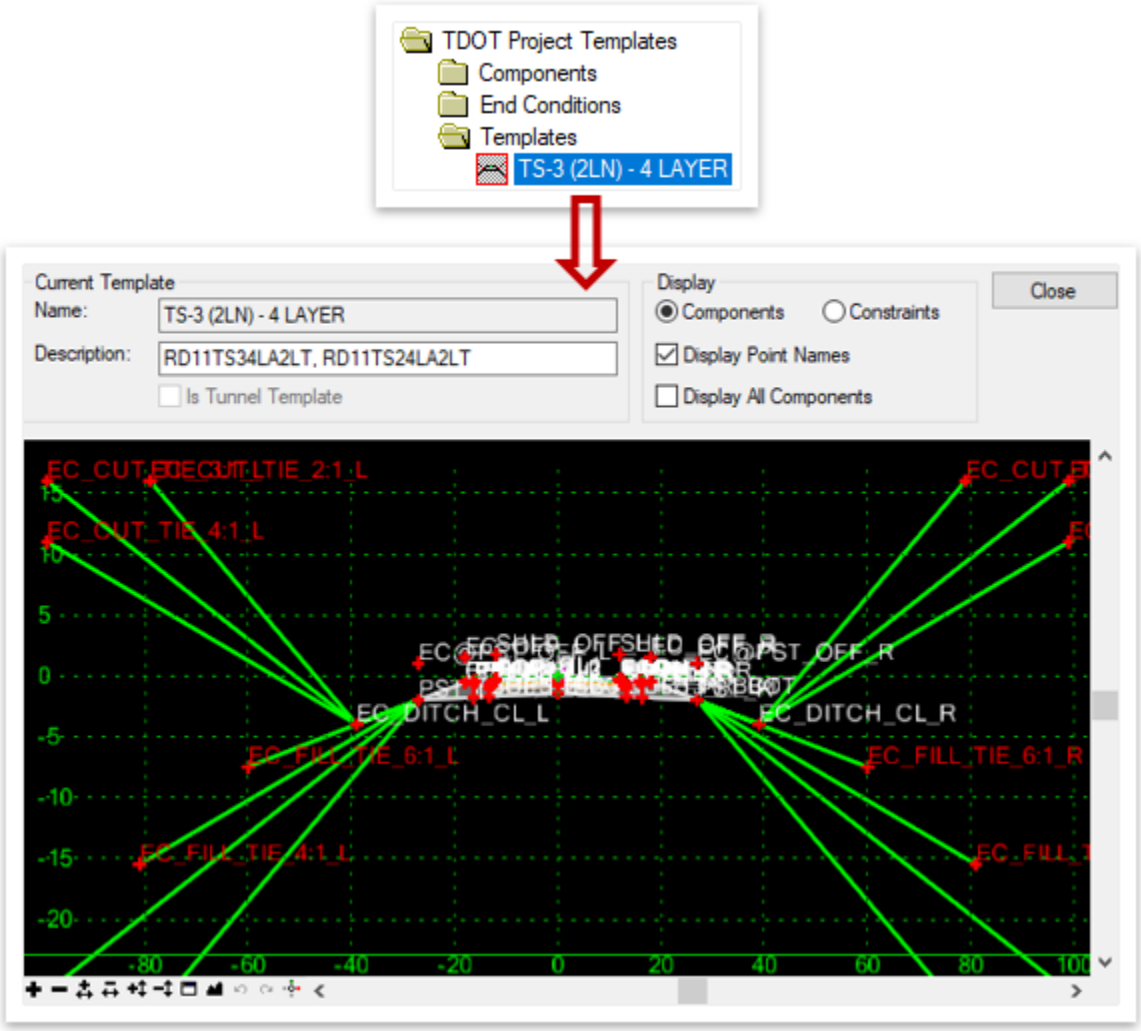
1. The **Create Template** window should still be open (**OpenRoads Modeling >> Corridors >> Create >> Template**). Scroll down to the **TS-3 (2LN) - 4 LAYER** template (**Linear Templates >> TDOT Typical Sections >> Undivided**). Right click on the template and select **Copy**.



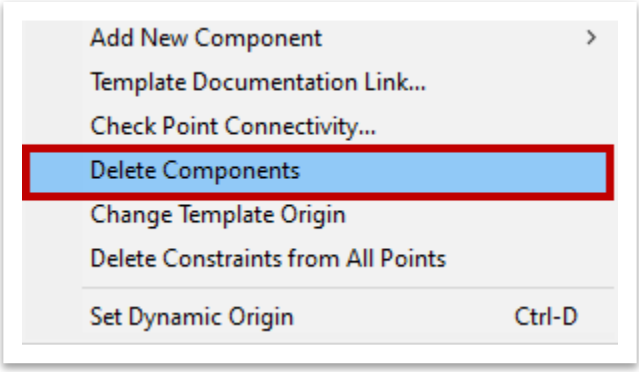
2. Scroll down to the bottom and **Paste** this template in the **TDOT Project Templates >> Templates** folder. **Note:** Right click the folder to paste.



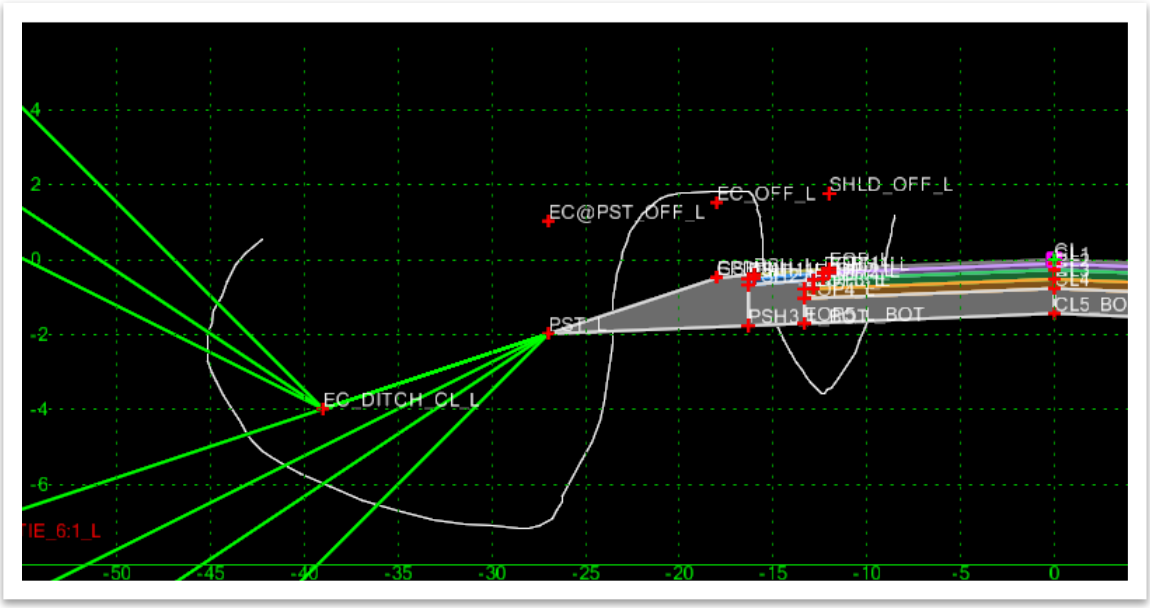
3. Double click on the template to open it in the edit template window.



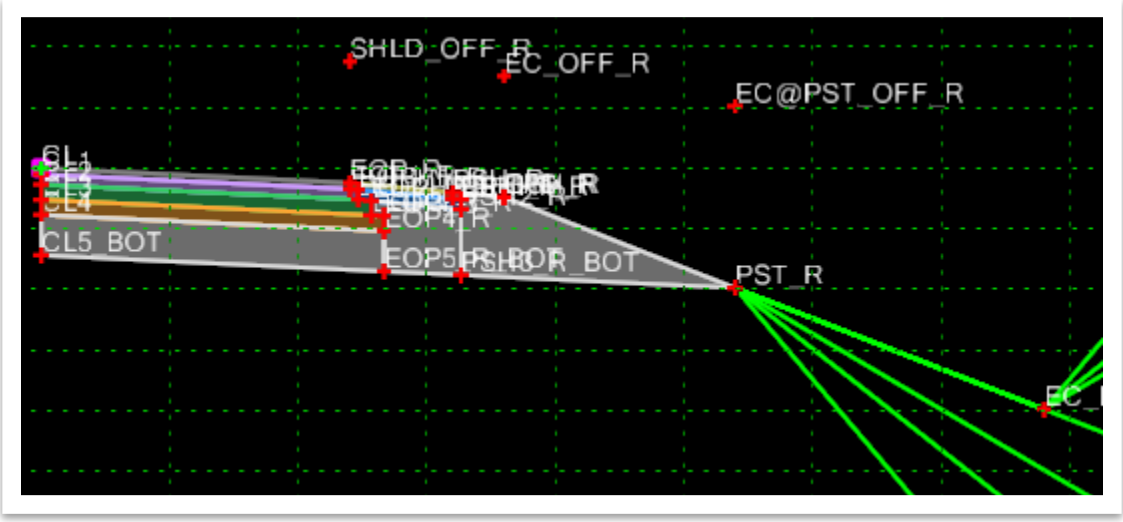
4. We are now going to delete all the components on the **left side of the centerline**. Right click anywhere within the edit template window and select **Delete Components**.



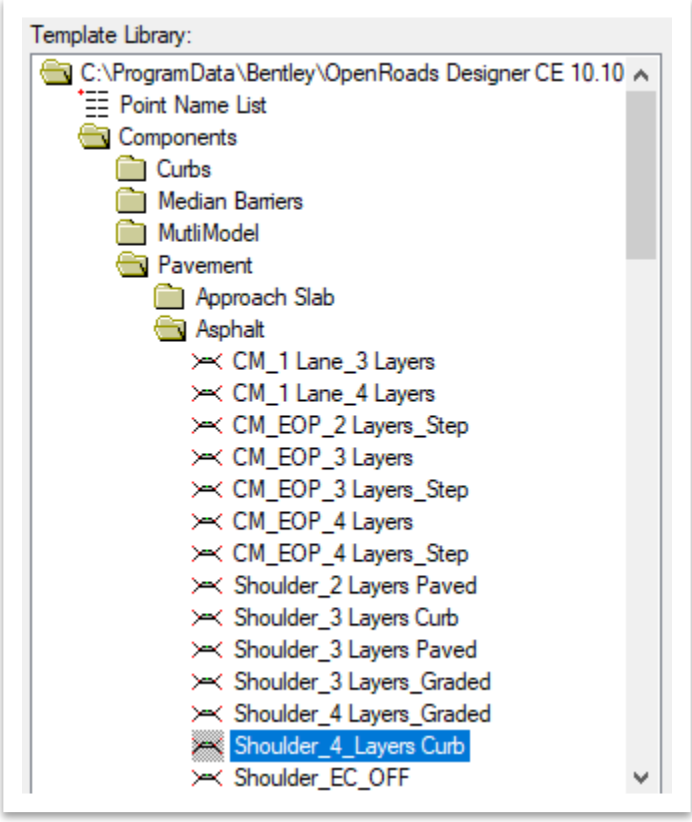
5. Left click and hold and draw a continuous line that crosses the components, as shown below. (You don't need to use the exact path below. It is more of a visual guide.) Once you release the hold, the components will delete. **Note:** If any components remain, simply repeat the process, and draw another line. Also, to fully delete the **EC_OFF_L**, **SHLD_OFF_L** and **EC@PST_OFF_L** points, you may need to right click on each point and select **Delete Point** and delete the components that appear that were controlled by those points.



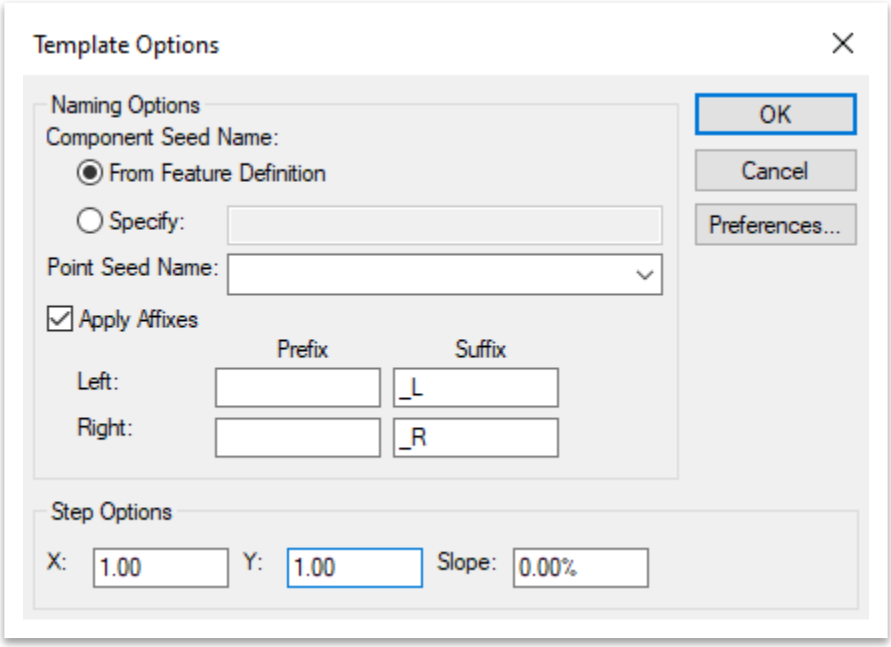
6. Once the left components have been deleted, your template should look like this.



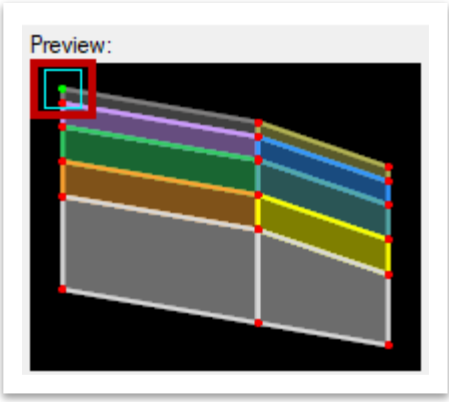
7. Next, scroll up to the default **Asphalt** folder (**Components >> Pavement**). Select the **Shoulder_4_Layers Curb** base component.



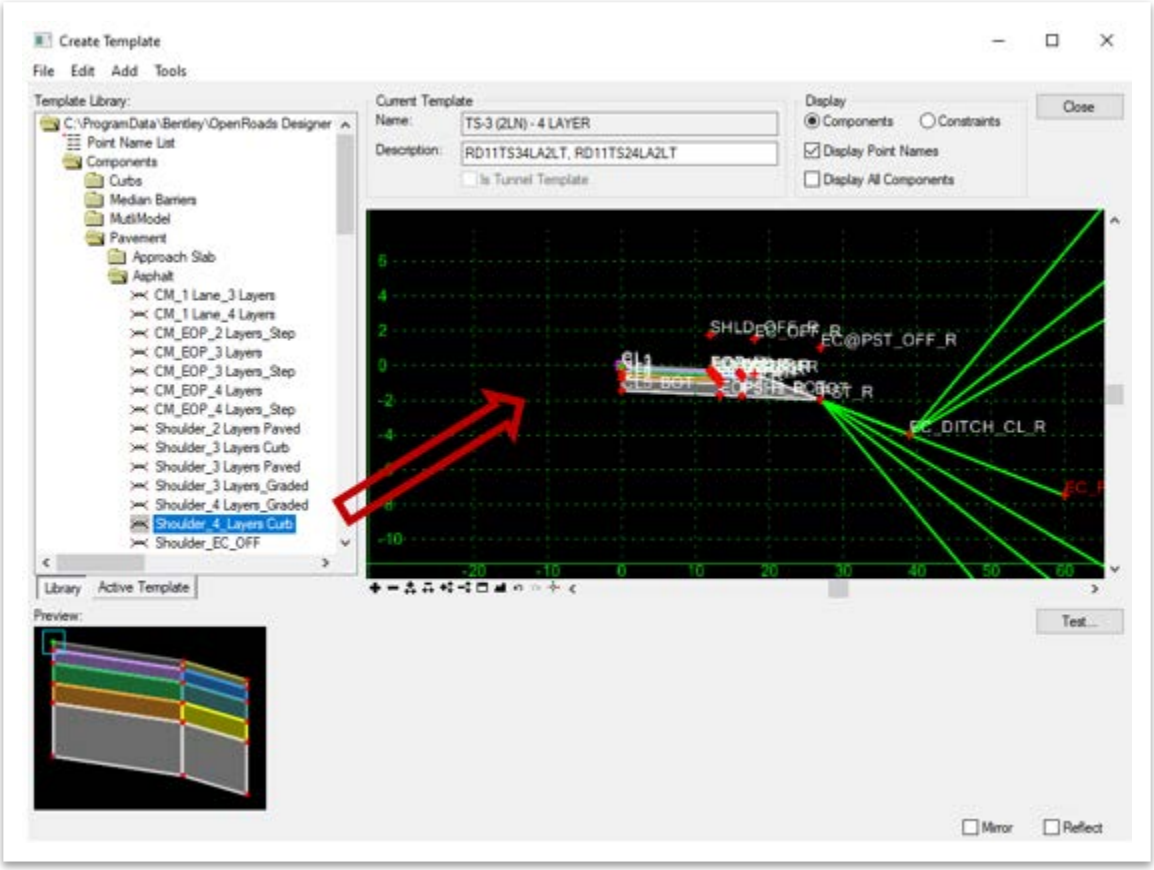
8. Before we add the component to the template, click **Tools >> Options**. Within the **Template Options** dialog box, select the following settings and leave the others as default. Click **OK** once you are done.
    a. **Apply Affixes:** Checkmark
    b. **Left Suffix:** _L
    c. **Right Suffix:** _R
    d. **Step Options (X) and (Y):** 1.00



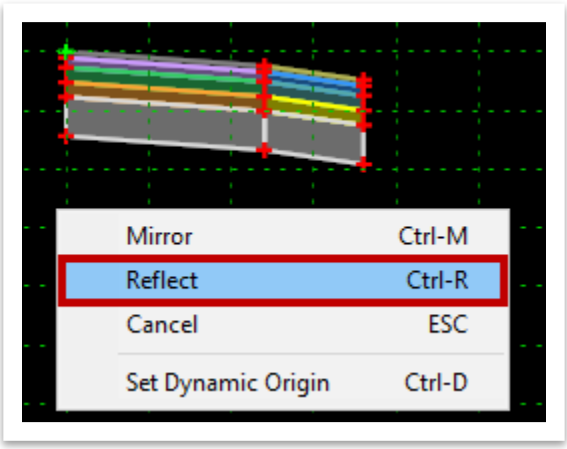
9. With the shoulder component selected, notice the cyan colored box within the **Template Preview Window** in the bottom left corner. This indicates the **origin point** of the component. By default, it should be the upper point, as shown below. If you needed to move the origin point, you would do so in the template preview window before placing the component in the template. For this exercise, leave the origin point as-is.



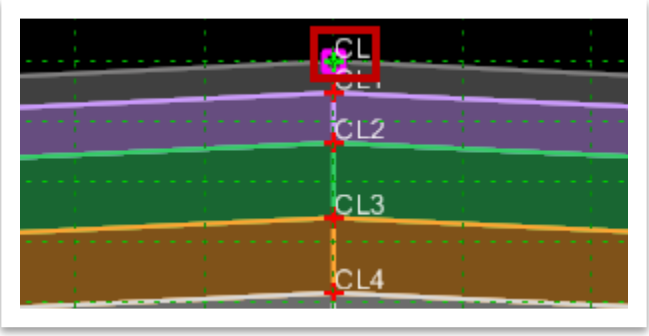
10. Now, left click and hold on the component name (highlighted in blue) and drag the selected shoulder component into the active template. **Do not release the hold**.



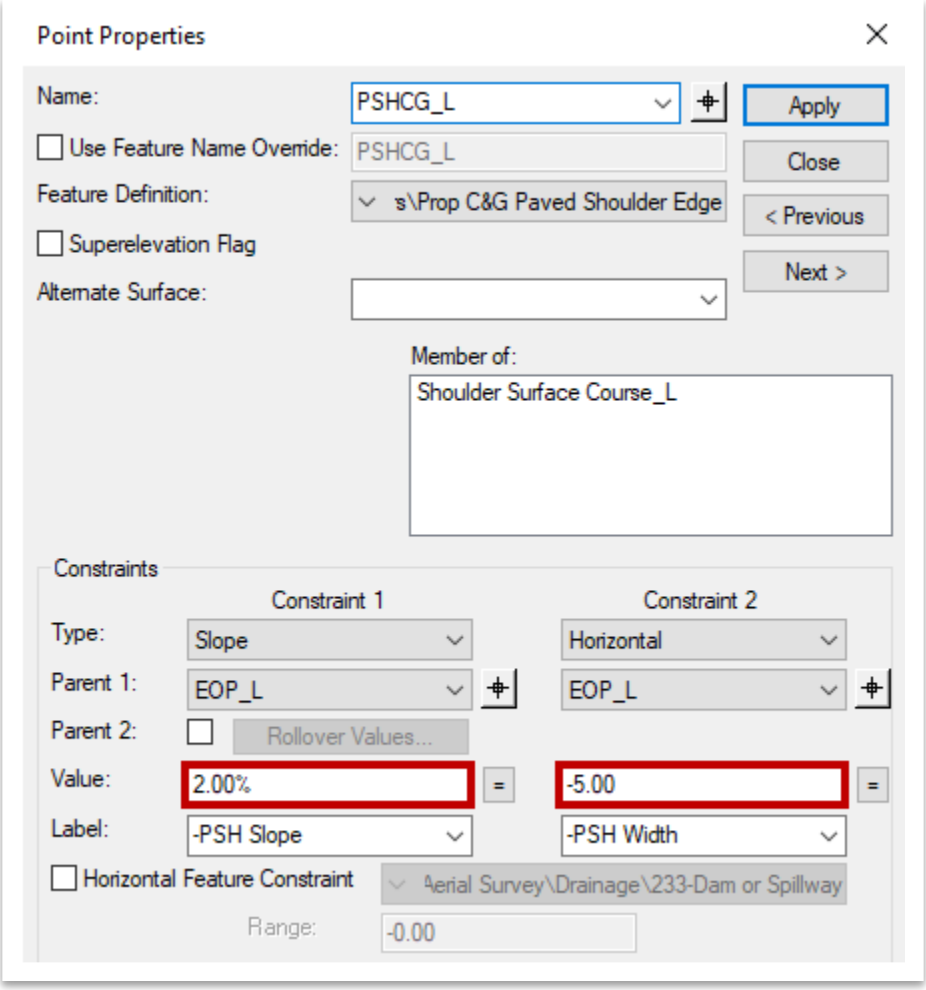
11. While still holding the left click button down, right click and select **Reflect**. **Note:** If you accidentally released the hold and placed the component prematurely, simply hit **CTRL+Z** to **Undo**.



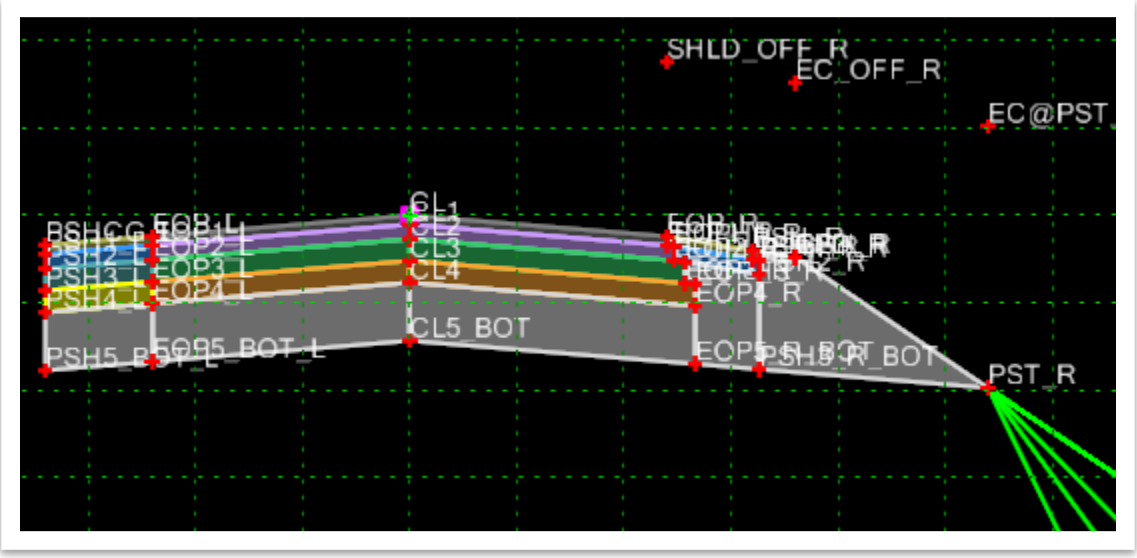
12. Align the component so that the right edge points match up with the CL points from the base template. **By default, the snap point should be CL**. Left click to accept placement.



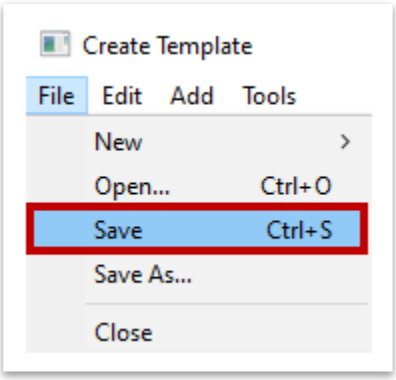
13. Zoom in to the left side of the template and double click on the **PSHCG_L** point to open the **Point Properties** dialog box. Change the **Value** for **Constraint 1** (Slope) to **2.00%**. Change the **Value** for **Constraint 2** (Horizontal) to **-5.00**. Then, click **Apply** and **Close**.



14. Review the template updates.



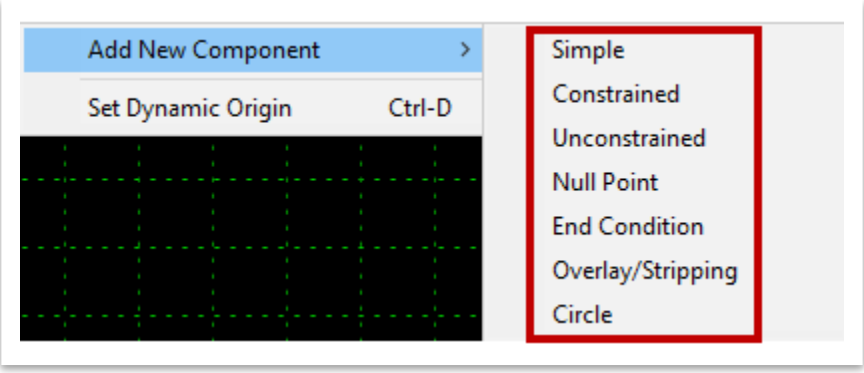
15. Lastly, save the template by clicking **File >> Save.**



9.7 Lecture: Template Components

Templates consist of several component groupings. Each **component** is a set of points that define an open or closed shape. Each shape represents a material for the typical section at a specific location. The components are given a name and assigned a **Feature Definition** and are classified as one of **seven** types: **Simple**, **Constrained**, **Unconstrained**, **Null Point**, **End Condition**, **Overlay/Stripping** and **Circle**. Once created, any of these components can be modified, if necessary. To create a new component, right click in the edit template window and select **Add New Component** (Figure 119). If you open an existing template, you will see additional options in between the Add New Component and Set Dynamic Origin options.

FIGURE 119. TYPES OF COMPONENTS



A template has no limit with regards to the number of points or components that it can contain. However, it is recommended to create templates that are not overly complicated. When the templates are assigned to a corridor, they will define the design surface for that corridor.

Take Note!

Templates are flexible design typical sections that allow the user to model simple 2-lane roadways or complex multi-lane highways with superelevated curves and variable side slopes.

9.7.1 Simple Component

A **Simple** component consists of **four** points that are constrained by a width, slope and thickness.

9.7.2 Constrained Component

A **Constrained** component is initially made up of points that the user places, where each point is constrained horizontally and vertically from the prior point.

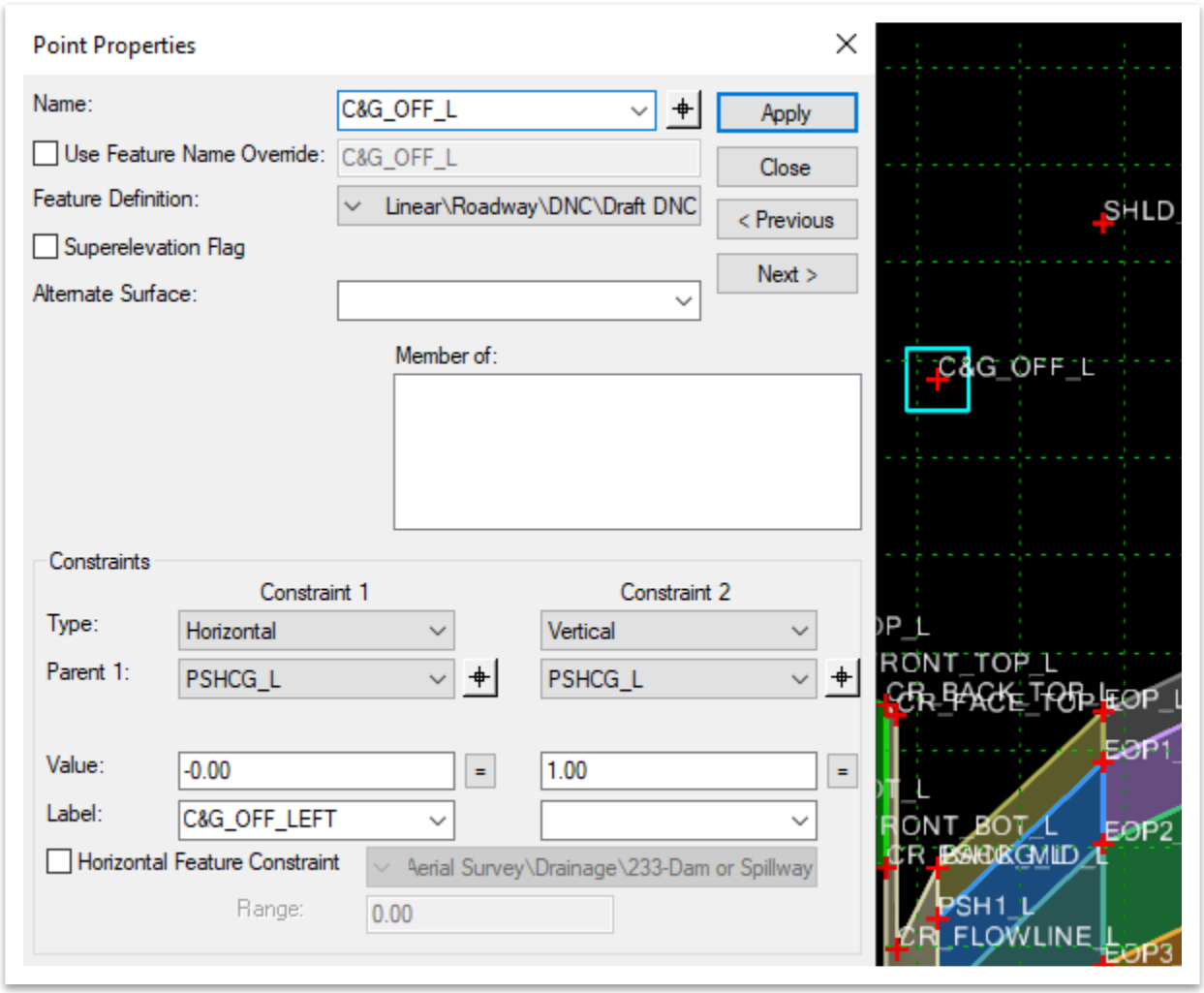
9.7.3 Unconstrained Component

An **Unconstrained** component is initially made up of points that the user places, where each point is unconstrained and can move independently of each other.

9.7.4 Null Point Component

A **Null Point** component is made up of one point that is initially unconstrained and can be used as a parent to other points to control various aspects of the template. For example, Figure 120 shows the null point component that all TDOT curb and gutter templates have. The null point **Label** constraint combined with the curb component display rules allow the user to use **Parametric Constraints** to turn on and off the curb and adjoining berms and sidewalks for intersections and roadways.

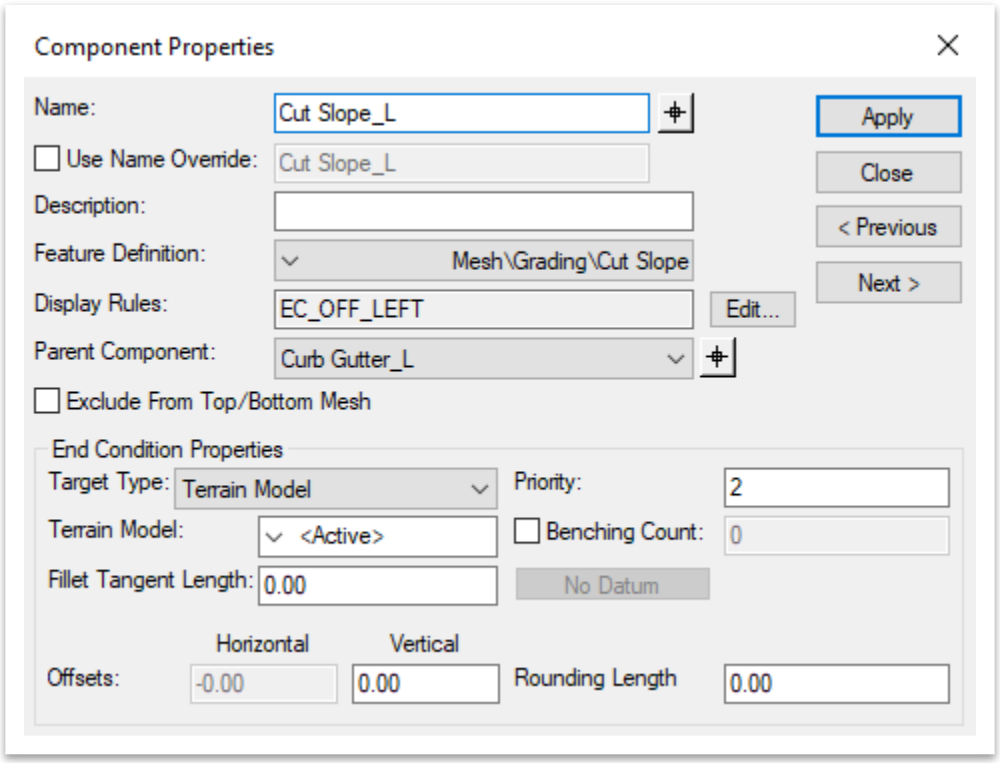
FIGURE 120. NULL POINT PROPERTIES



9.7.5 End Condition Component

An **End Condition** component can seek targets such as surfaces, alignments, linear features, and feature definitions. When multiple end conditions are used in a template, a priority needs to be set to determine which end condition is processed first. Priorities can be set to negative or positive numbers, with the lowest number solving first. Once placed, the user can review the end condition component properties (Figure 121) by double clicking on the end condition component itself.

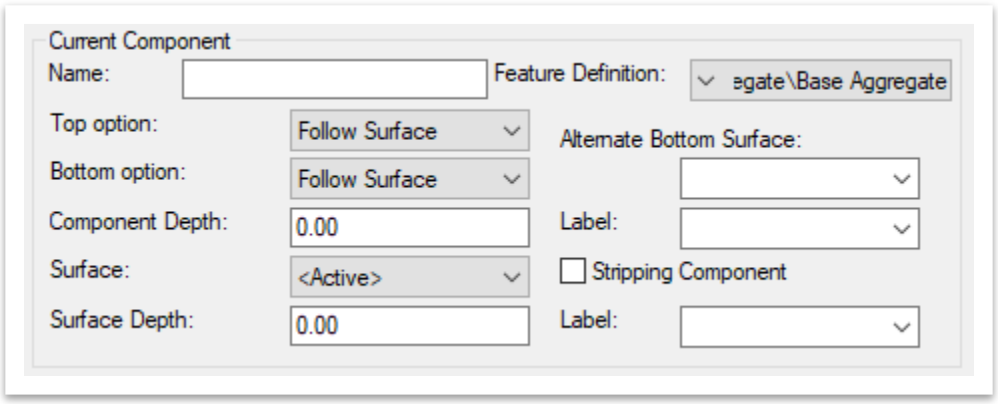
FIGURE 121. END CONDITION COMPONENT PROPERTIES



9.7.6 Overlay/Stripping Component

An **Overlay** component can be built to add a leveling course below the defined pavement course, and a **Stripping** component can be built to mill existing pavement. The component options appear below the edit template window (Figure 122). The **Stripping Component** option must be toggled off and then the user can define the milling surface and milling depth using component depths.

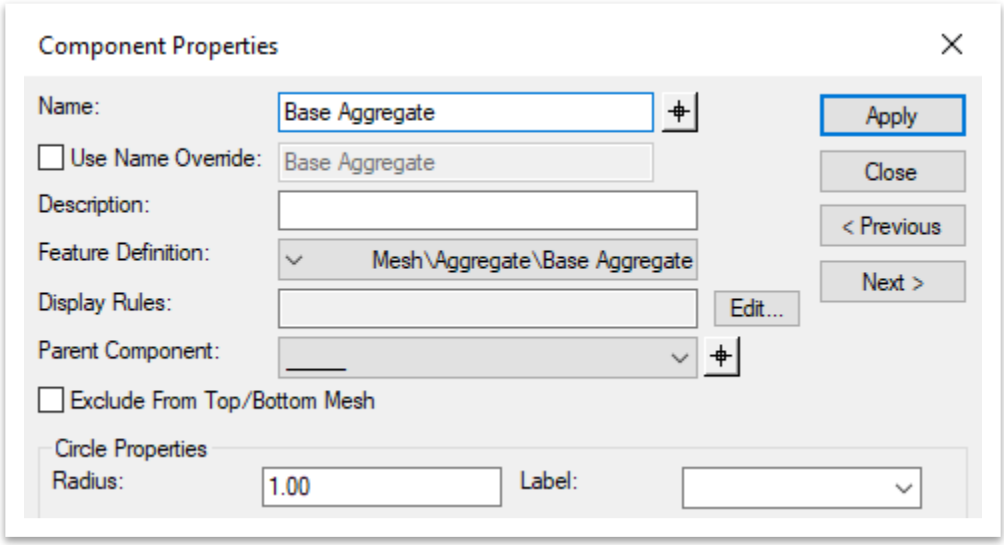
FIGURE 122. OVERLAY/STRIPPING COMPONENT PROPERTIES



9.7.7 Circle Component

A **Circle** component can be used to create circular and void shapes (Figure 123). Properties include radius control and the option to set a parametric label.

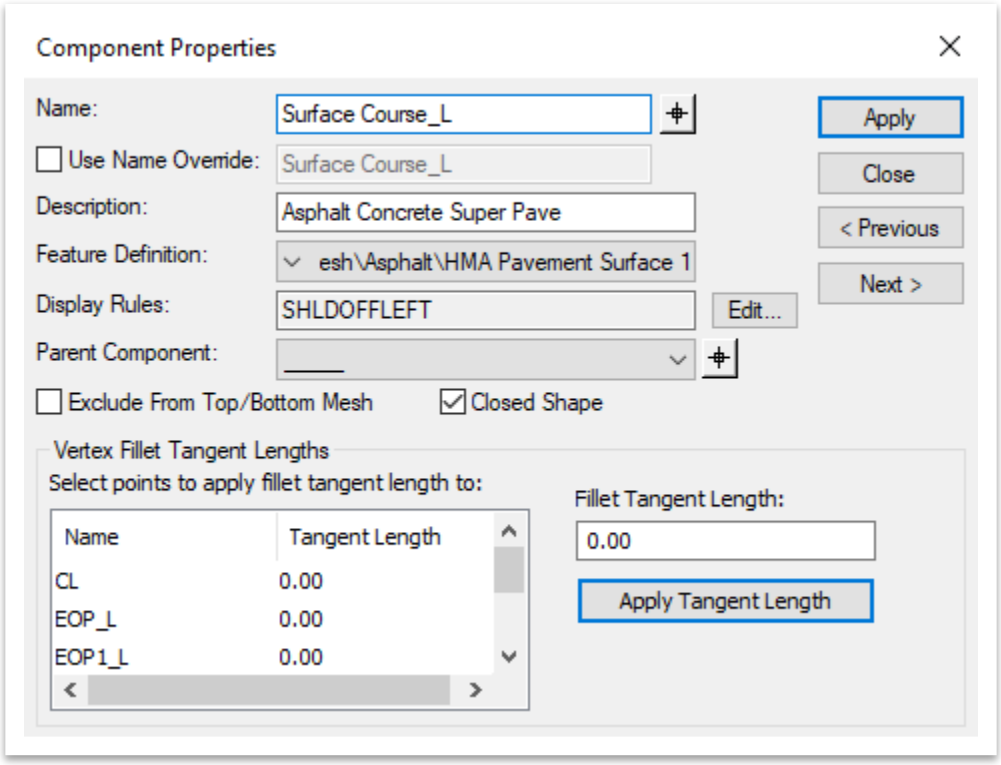
FIGURE 123. CIRCLE COMPONENT PROPERTIES



9.8 Lecture: Component Properties

Template components can be edited using the **Component Properties** dialog box. The dialog box controls the component feature definition, display rules, parent components, end condition priorities (on end condition components), exclusion from top/bottom mesh and vertex fillet tangent lengths. To open a component's properties, **double click** on the component itself in the edit template window (Figure 124).

FIGURE 124. COMPONENT PROPERTIES



Parent/Child relationships for components are the same as points and can be applied to either an end condition or a non-end condition component.

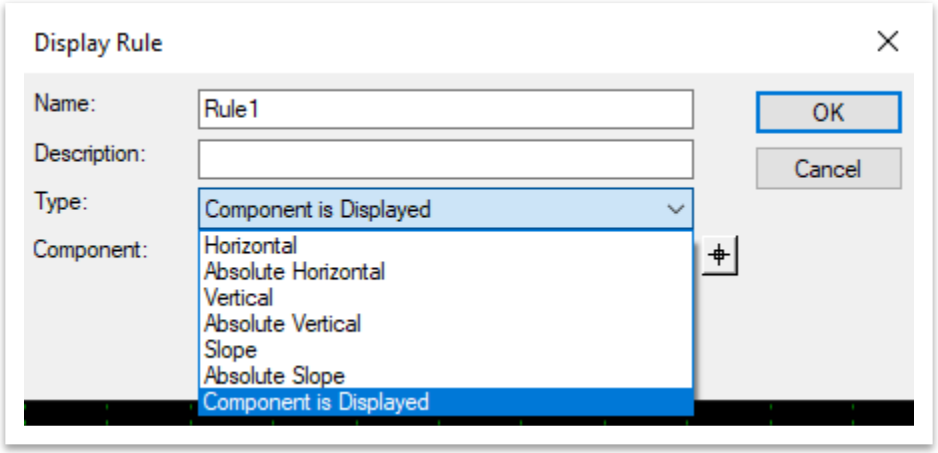
The **Exclusion From Top/Bottom Mesh** option can be toggled on if the component needs to be excluded from the top or bottom mesh.

9.8.1 Display Rules

Display Rules are conditional rules based on the relative position of two points within the template or null points. A display rule is set on a component and then set to either true or false to turn on or off the component respectively. Within the **Component Properties** dialog box, you would click on the **Edit** button next to the **Display Rules** field and then click on **Add**. There are **seven** types of conditions that a display rule can have (Figure 125):

- Horizontal
- Absolute Horizontal
- Vertical
- Absolute Vertical
- Slope
- Absolute Slope
- Component is Displayed

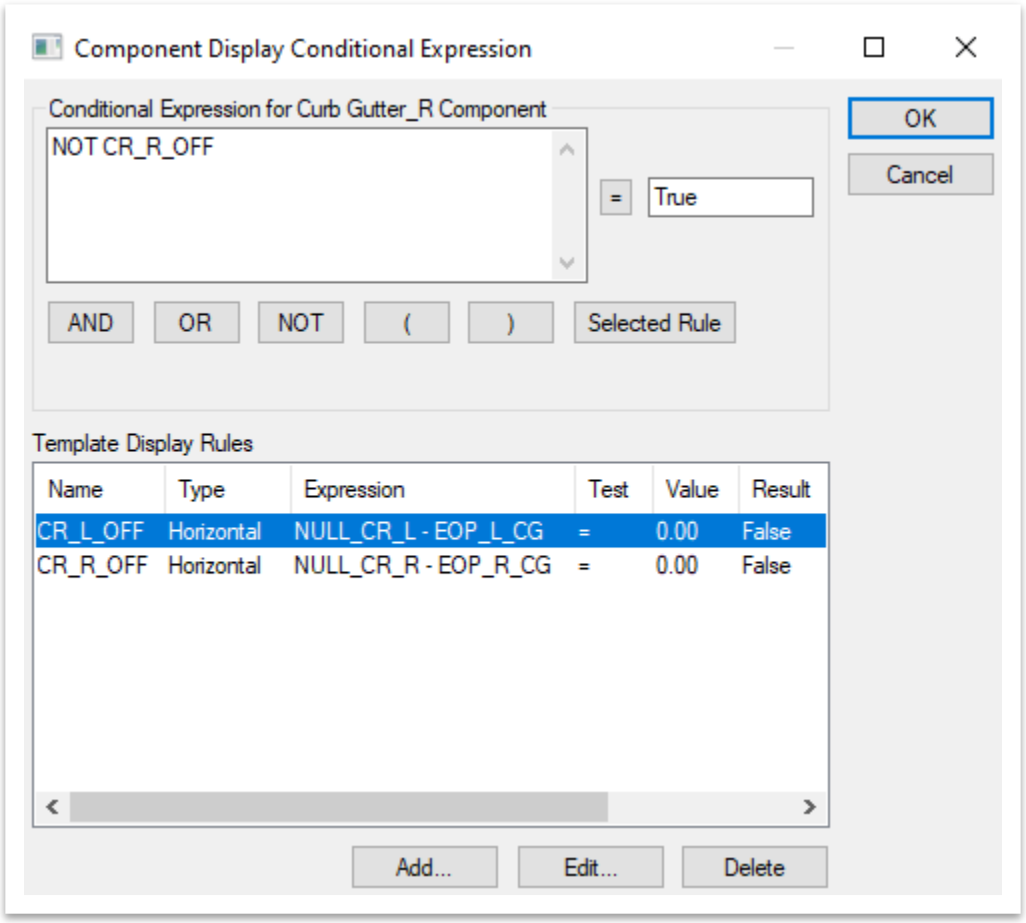
FIGURE 125. DISPLAY RULE TYPES



Display rules are used for conditional expressions for the components using **AND**, **OR**, **NOT** and **parentheses**. When a conditional expression is **True**, the component will turn on. When a conditional expression is **False**, the component will turn off. Using parametric constraints, point controls or target aliasing, the user can change the outcome of the conditional expression along the corridor to either True or False.

In the TDOT template, display rules are used to turn on and off the curb, shoulder and end conditions using null points with labels for parametric constraints (Figure 126).

FIGURE 126. DISPLAY RULES – CONDITIONAL EXPRESSIONS



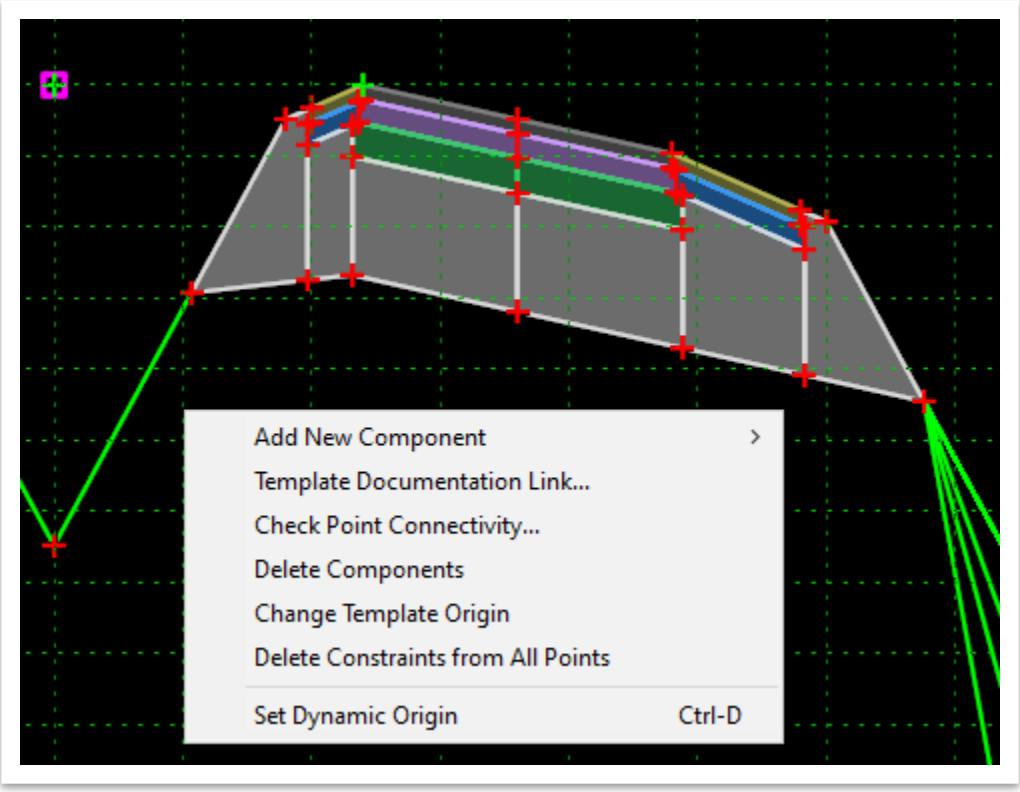
9.9 Lecture: Create Template from Components

Templates can be created by dragging and dropping components and end conditions from the folder tree window into the edit template window one at a time. Once again, each point on a template must be unique, so **no point can have the same name**. Thus, the user must assign a prefix or suffix to determine the **left** and **right** points when creating templates via the **Dynamic Settings**.

9.9.1 Editing Templates

Once a template has been created, it can be edited by right clicking in the blank area within the edit template window (Figure 127). You will see additional options if you right click on a point or a selected component.

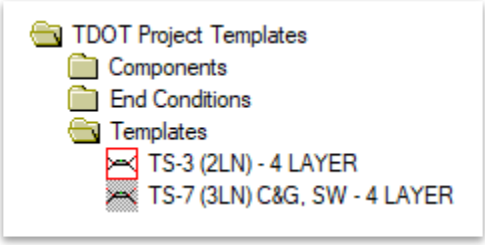
FIGURE 127. EDIT TEMPLATE OPTIONS



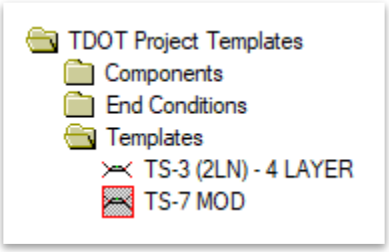
9.9.2 Exercise: Edit an Existing Template

In this exercise, we will once again create a new roadway template in our project ITL by utilizing a different TDOT standard template as the base. We will edit the template, including the addition of a grass strip, shared use path and end condition, before testing and updating the template, and then viewing the dynamic sections. We will continue to utilize the same **GenescoCorridor_MOD.dgn** file.

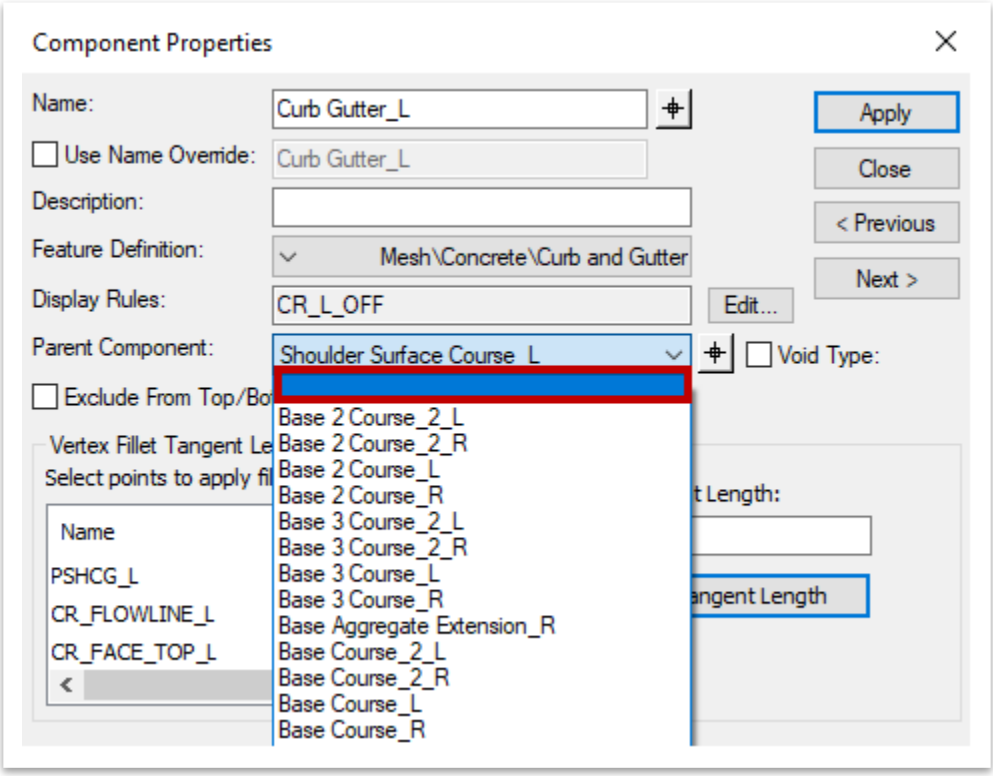
1. The Create Template window should still be open (**OpenRoads Modeling >> Corridors >> Create >> Template**). Scroll down to the **TS-7 (3LN) C&G, SW - 4 LAYER** template (**Linear Templates >> TDOT Typical Sections >> Undivided**). Right click on the template and select **Copy**. Scroll down to the bottom and **Paste** this template in the **TDOT Project Templates >> Templates** folder.



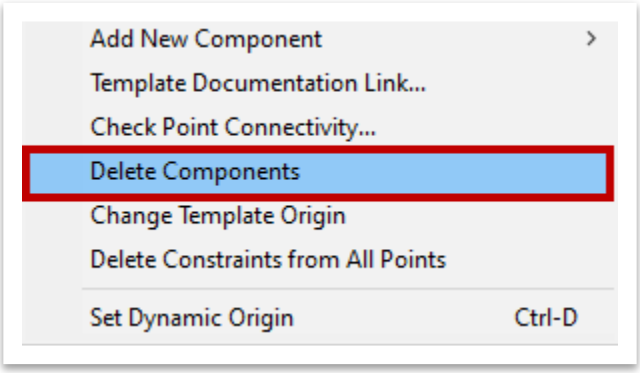
2. Right click on the **TS-7** template and select **Rename**. Rename the template **TS-7 MOD**. Then, double click on the template to open it in the edit template window.



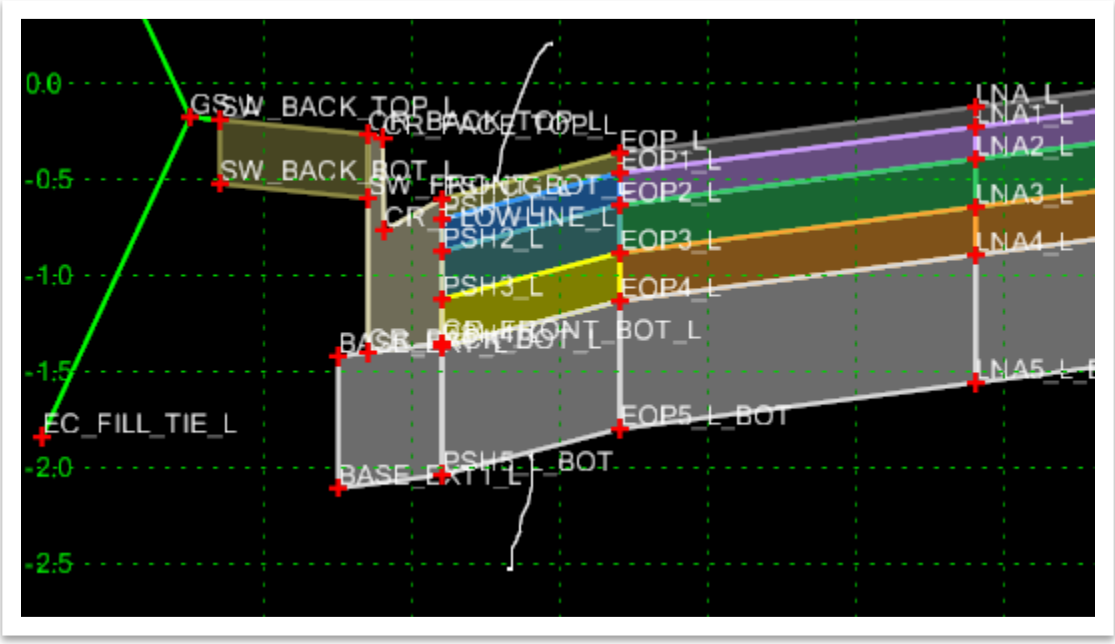
3. First, we need to remove the parent component of the curb by removing the shoulder and keeping the curb and end conditions. The shoulder surface course is the parent of the curb, thus allowing the display rules that have been set up to work properly. Double click on the **TS-7 MOD** template to active it, if necessary. Double click anywhere along the outer boundary of the **Curb Gutter_L** component to open the component properties. Remove the **Parent Component** by selecting the blank option in the drop-down menu. Click **Apply** and then **Close** the Component Properties dialog box.



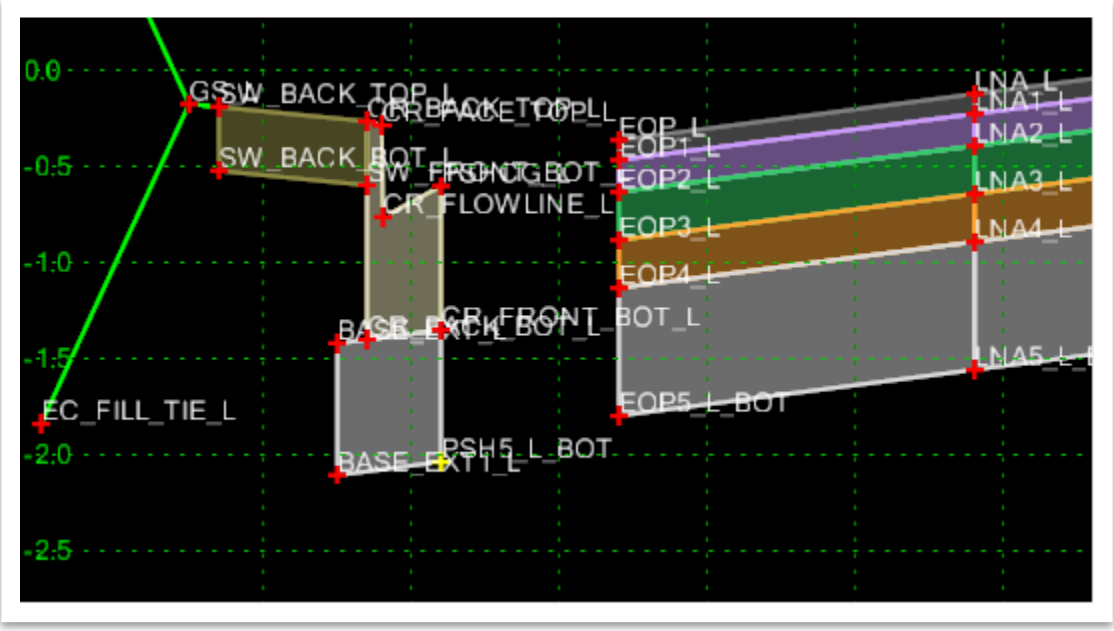
4. We are now going to delete the **left shoulder** and its subgrade layers. Right click anywhere within the edit template window and select **Delete Components**.



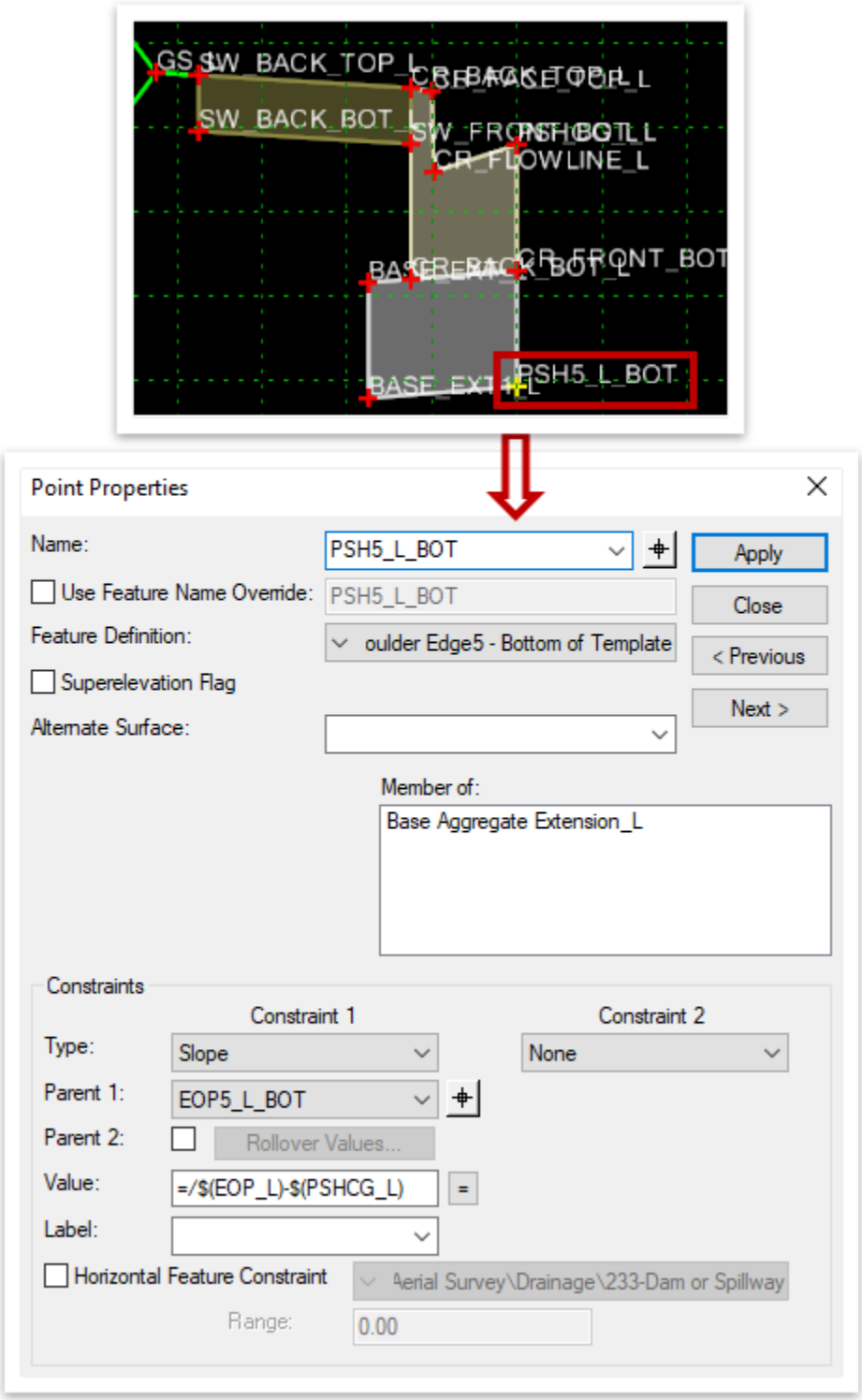
5. Left click and hold and draw a continuous line that crosses the shoulder and subgrade components, as shown below, and then release the hold.



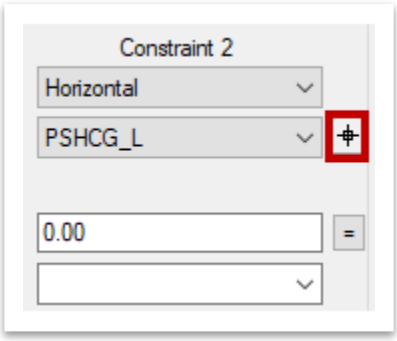
6. Once the components have been deleted, your template should look like this.



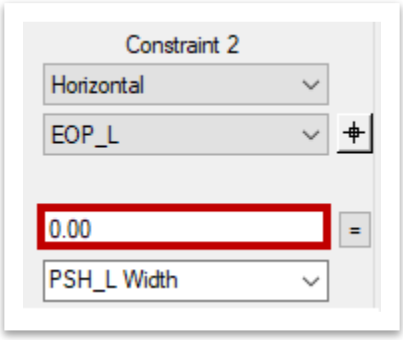
7. Next, double click on the **PSH5_L_BOT** point to open the **Point Properties** dialog box.



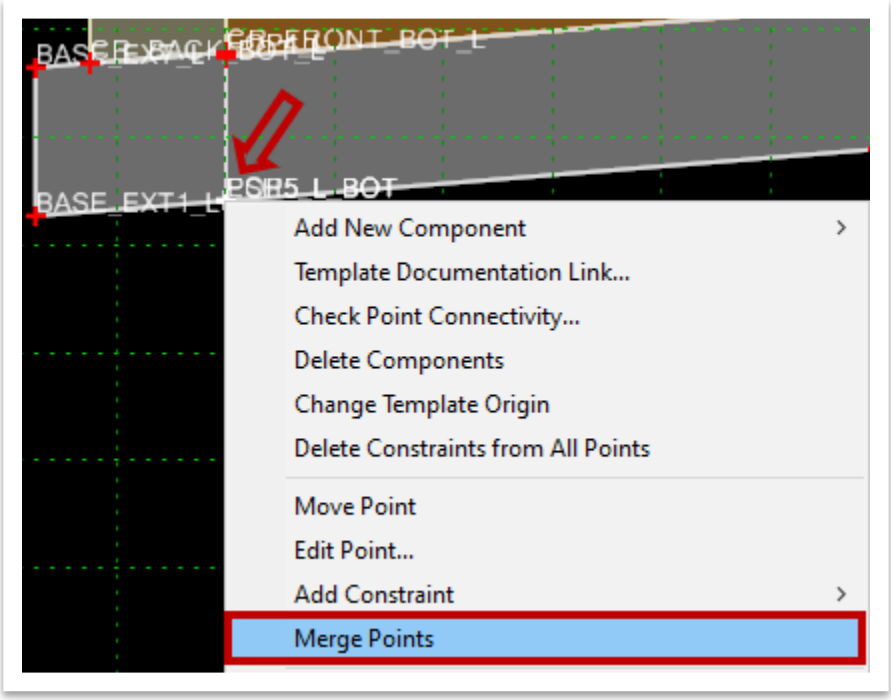
8. We are going to add a **Horizontal constraint** under **Constraint 2**. Select the following settings. Then, click **Apply** and **Close**.
    a. **Type:** Horizontal
    b. **Parent 1:** PSHCG_L (Parent point selection can be done by either utilizing the point selector, highlighted below, or the drop-down list.)
    c. **Value:** 0.00



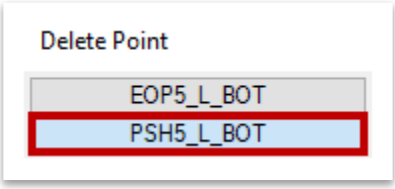
9. Now, double click on the **PSHCG_L** point. Change the **Value** for **Constraint 2** (Horizontal) to **0.00**. Then, click **Apply** and **Close**. **Note:** Its parent component should be **EOP_L**.



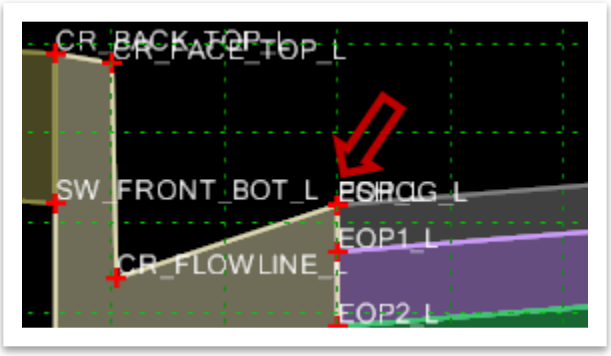
10. You should notice that there are overlapping points in some areas. To fix this, these points must be merged. Right click the **EOP5_L_BOT** point and select **Merge Points**.



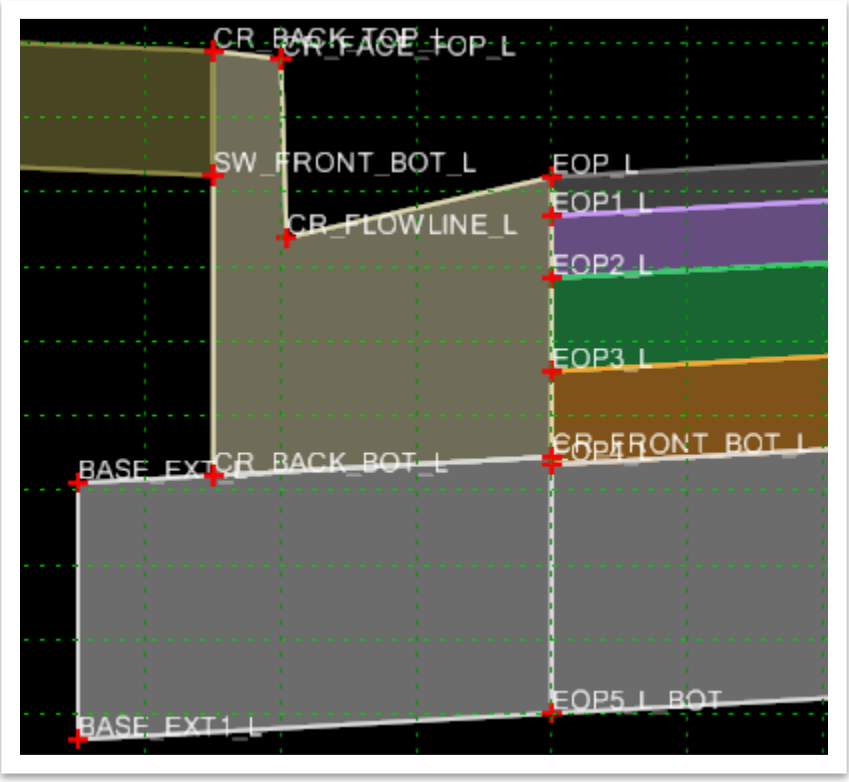
11. You are then prompted to pick which point you want to be deleted. We want to hold the original constrains of the **EOP5_L_BOT** point so we need to delete the **PSH5_L_BOT** point. Left click the **PSH** point and notice it is now deleted from the template.



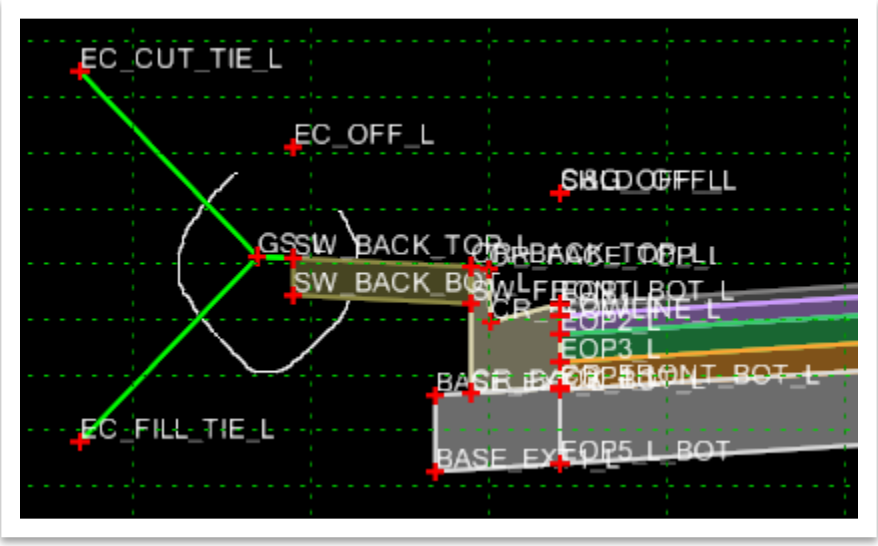
12. Repeat Steps 10-11 to merge the **PSHCG_L** and **EOP_L** points. Then, delete the **PSHCG_L** point.



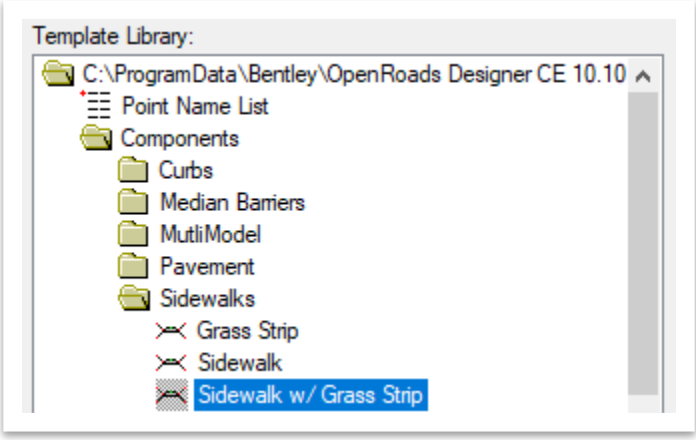
13. Once completed, the vertical points along the face of the gutter should look like what is shown below.



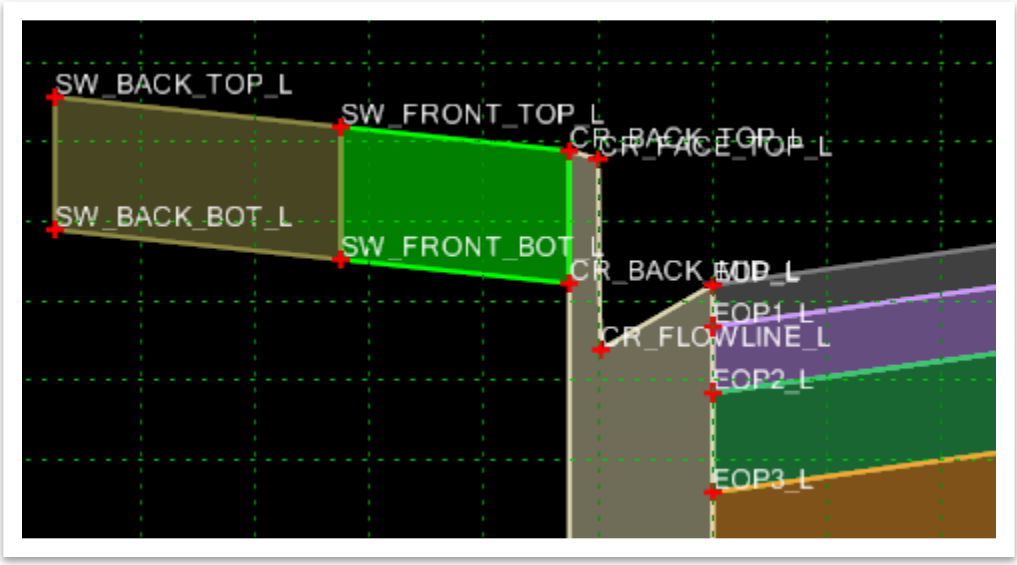
14. Next, we are going to add a **grass strip**. First, however, we need to delete the **left sidewalk** and **end condition**. Right click anywhere within the edit template window and select **Delete Components**. Left click and hold and draw a continuous line that crosses the components, as shown below, and then release the hold.



15. Scroll up to the default **Sidewalks** folder under **Components**. Select the **Sidewalk w/ Grass Strip** base component.



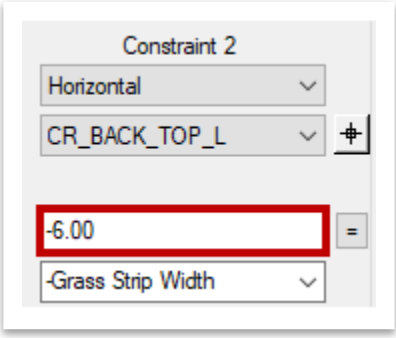
16. Now, left click and hold on the component name (highlighted in blue) and drag the selected shoulder component into the active template. The **Reflect** option should still be activated. Align the component so that the right edge of the grass strip aligns with the back of curb points from the base template. **By default, the snap point should be CR_BACK_ TOP_L**. Left click to accept placement.



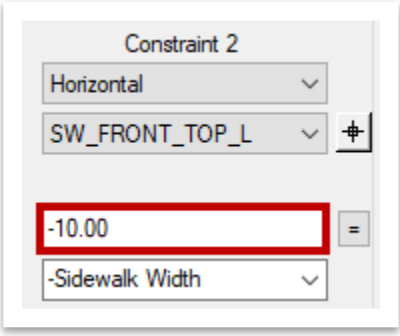
Take Note!

*Since the **Affixes** (**_L** and **_R**) were added in the previous exercise, they should still be applied here if you haven't closed out of the **Create Template** window. If you had closed out, then refer to Exercise 9.6, Step 8, because they should be set before placing the components so that the _**L** (or _R) is applied to the component points automatically.*

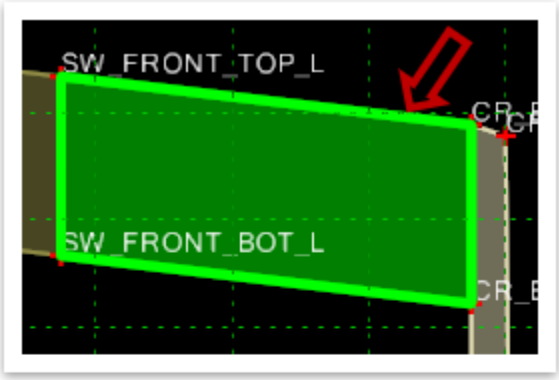
17. Double click on the **SW_FRONT_TOP_L** point to open the **Point Properties** dialog box. Change the **Value** for **Constraint 2** (Horizontal) to **-6.00**. Then, click **Apply** and **Close**.

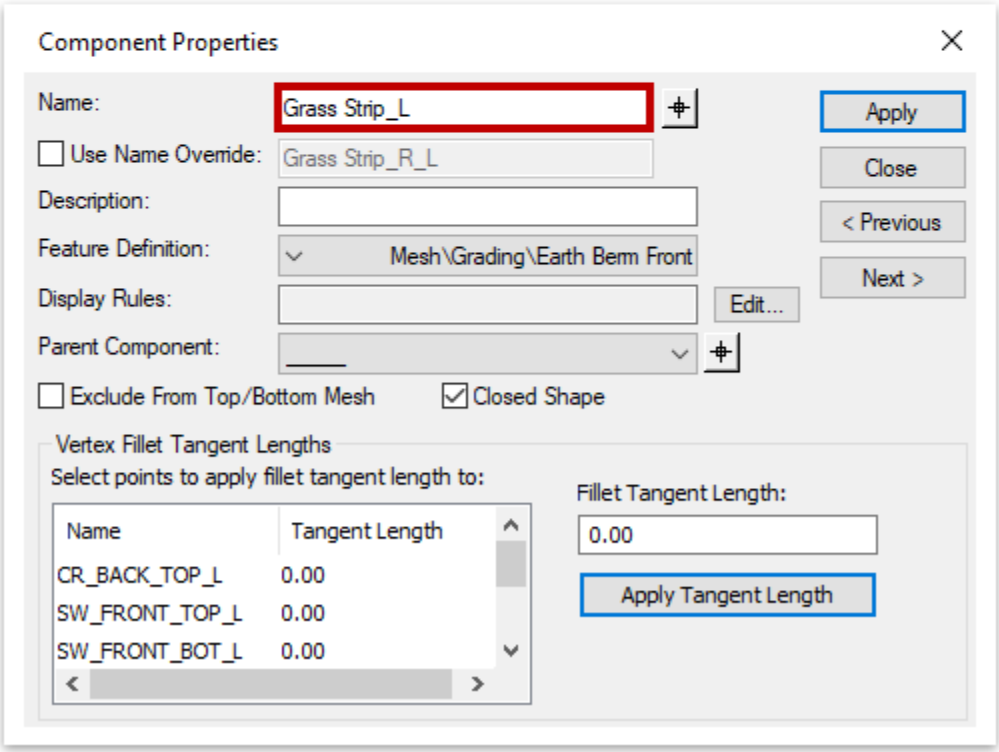


18. Next, double click on the **SW_BACK_TOP_L** point to open the **Point Properties** dialog box. Change the **Value** for **Constraint 2** (Horizontal) to **-10.00**. Then, click **Apply** and **Close**.

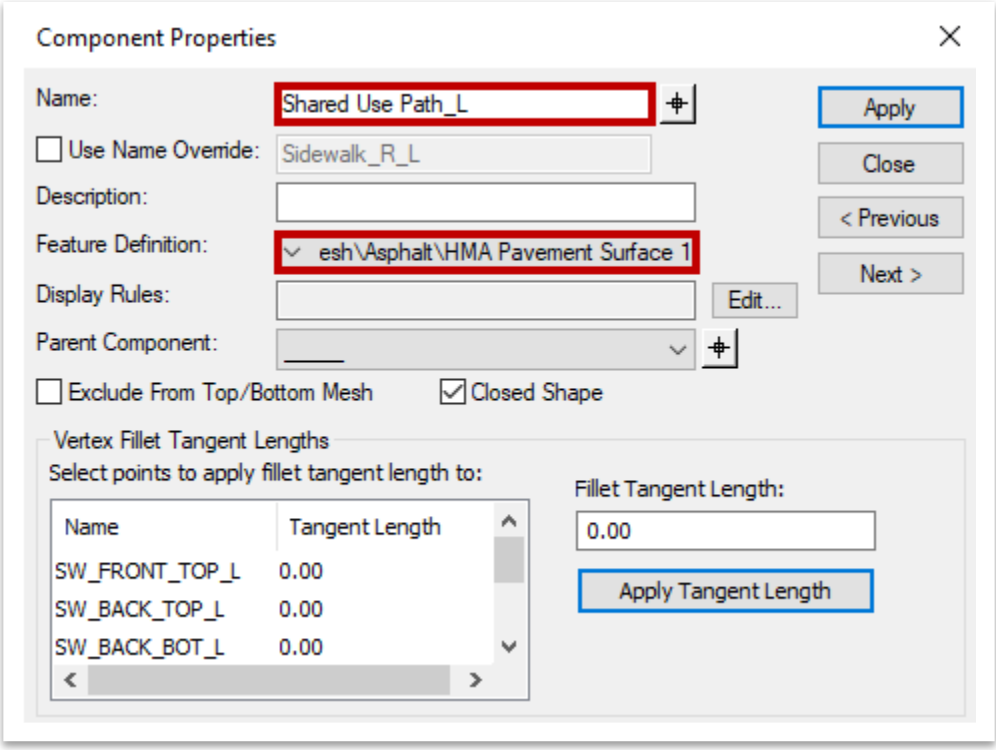


19. Now, let's look at the **component properties** for both the grass strip and sidewalk. Double click on the **Grass Strip** component to open the component properties. If not already done, go ahead and change the **Name** to **Grass Strip_L**. Then, click **Apply** and **Close**.

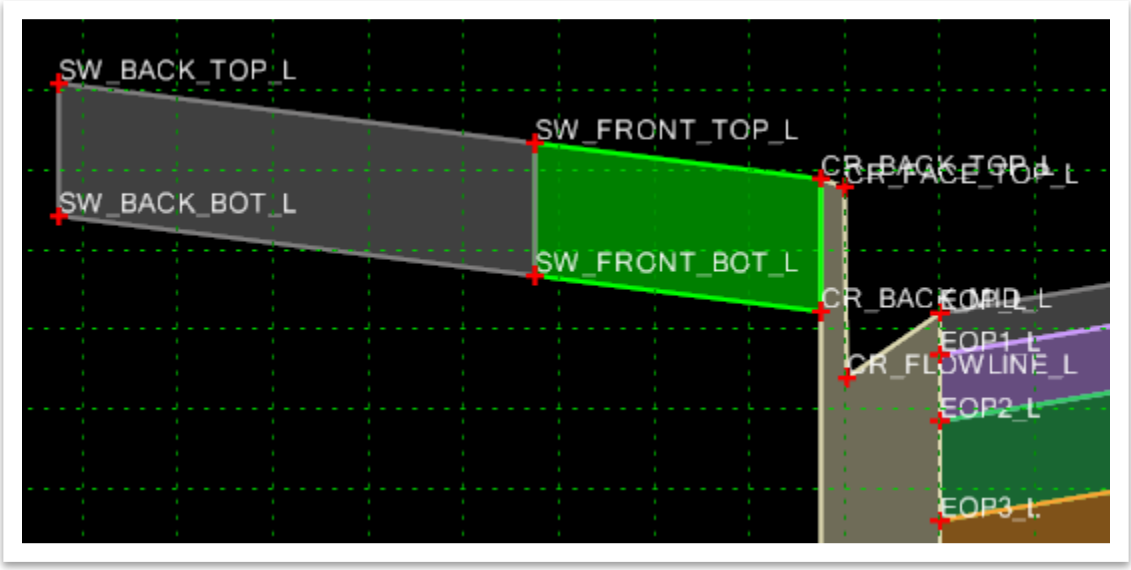




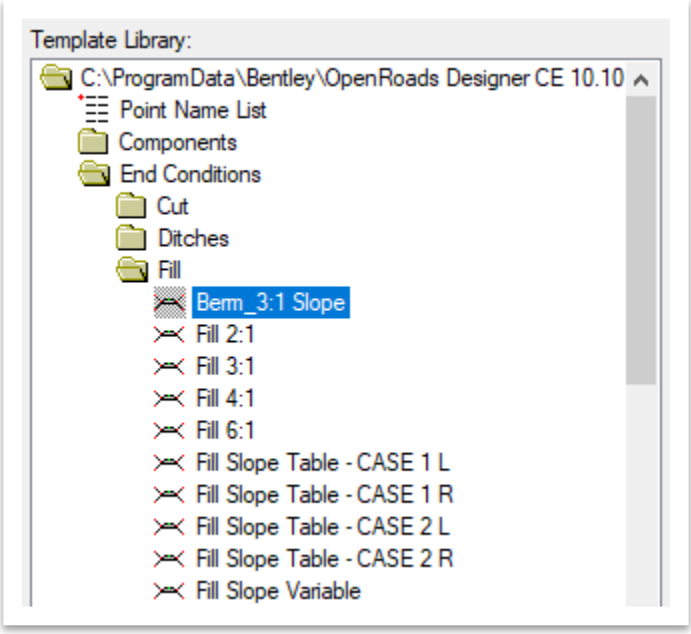
20. Then, open the **Sidewalk** component properties and change the **Name** to **Shared Use Path_L**. Also, change the component **Feature Definition** to **HMA Pavement Surface 1** (**Mesh >> Asphalt**). Then, click **Apply** and **Close**.



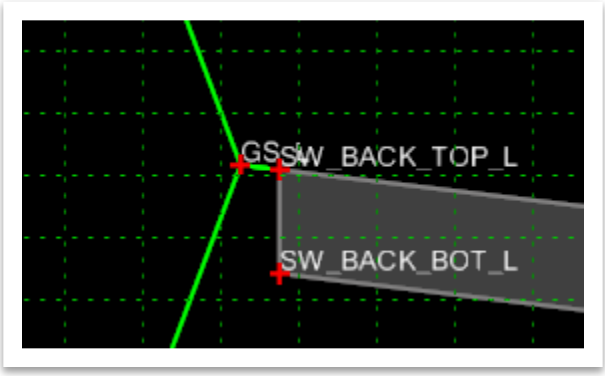
21. Once completed, the two components should look like what is shown below.



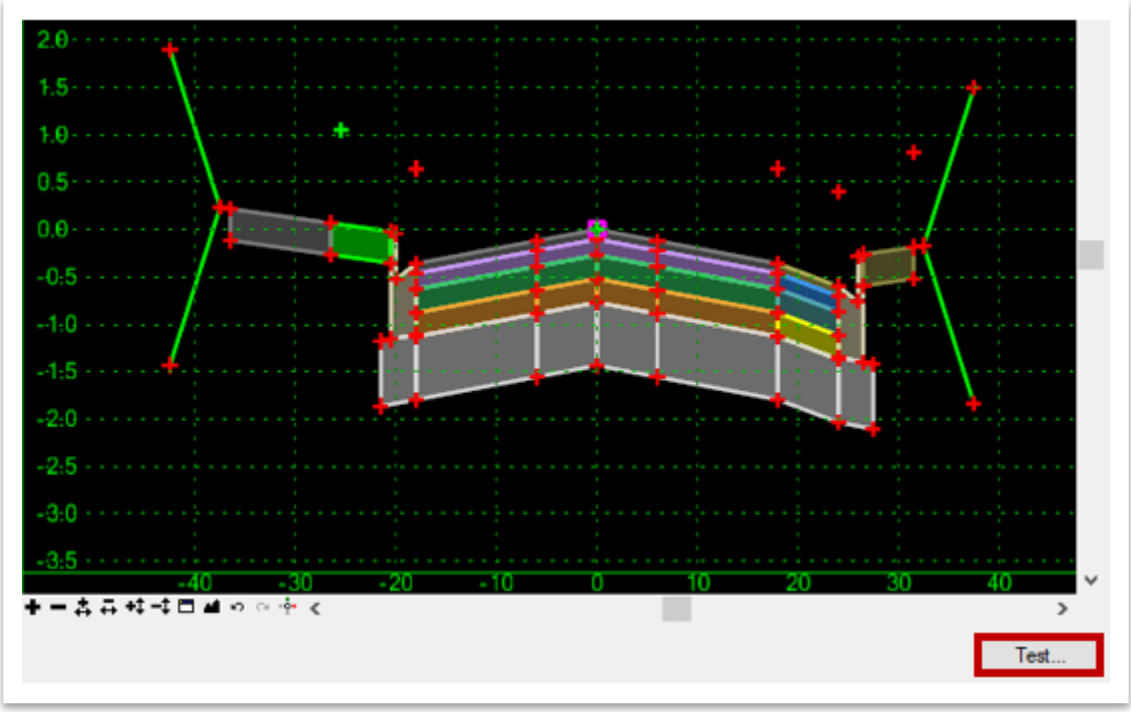
22. Next, we need to add an **end condition** to the shared use path. Scroll down to the default **End Conditions** folder. Within the **Fill** folder, select the **Berm_3:1 Slope** base end condition.



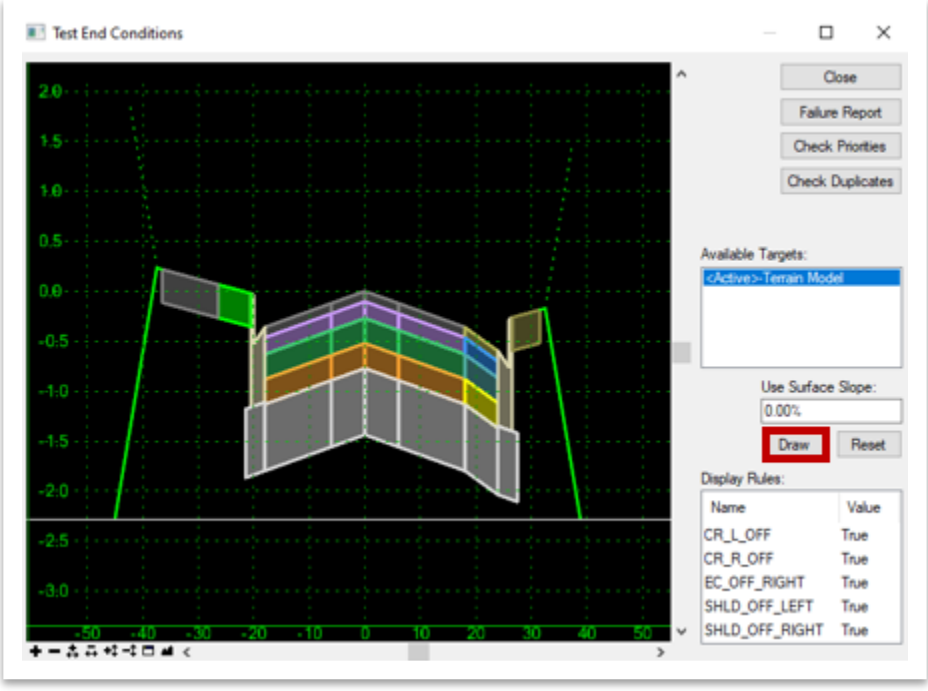
23. Once again, left click and hold on the component name (highlighted in blue) and drag the selected end condition into the active template. This time, however, de-select **Reflect**. **By default, the snap point should be SW_BACK_TOP_L**. Left click to accept placement.



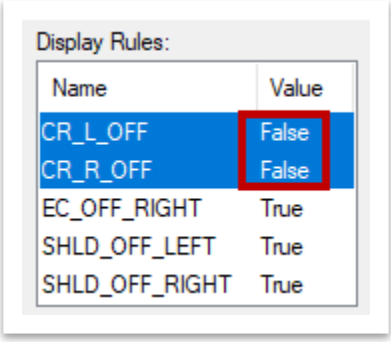
24. We will now test the template. Within the **Create Template** window, click **Test** in the lower right corner which will open the **Test End Conditions** window. **Note:** The **Display Point Names** have been turned off for the screenshot.



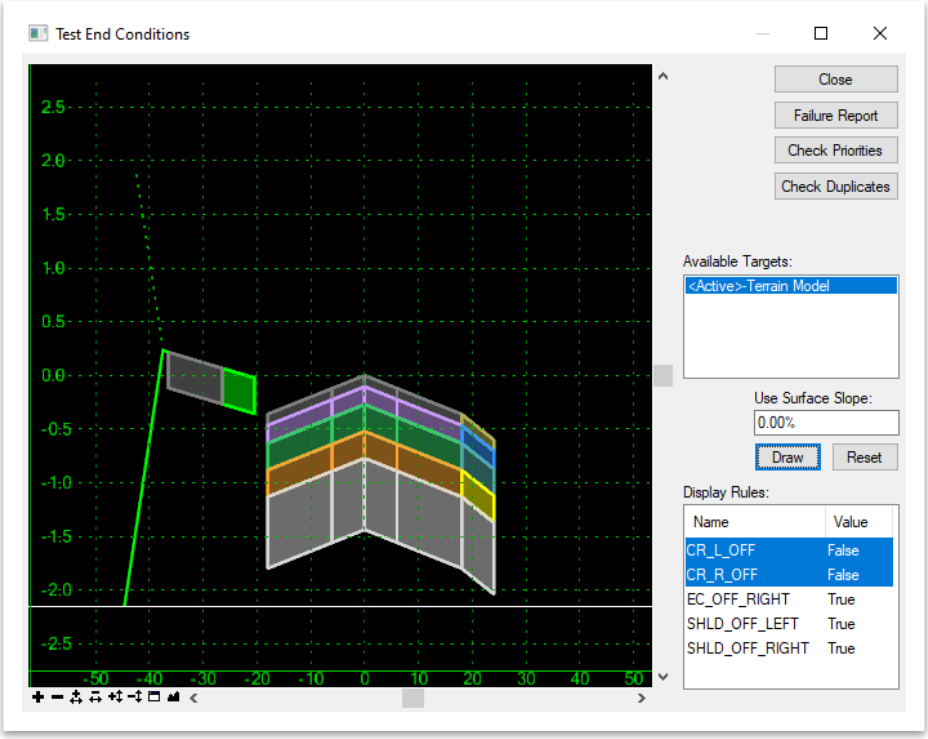
25. Click **Draw** and evaluate the new end condition to make sure that it is drawing as expected in both cut and fill scenarios. **Note:** Simply move your cursor up and down to see the test results along the end condition. The **Fill** test is shown below.



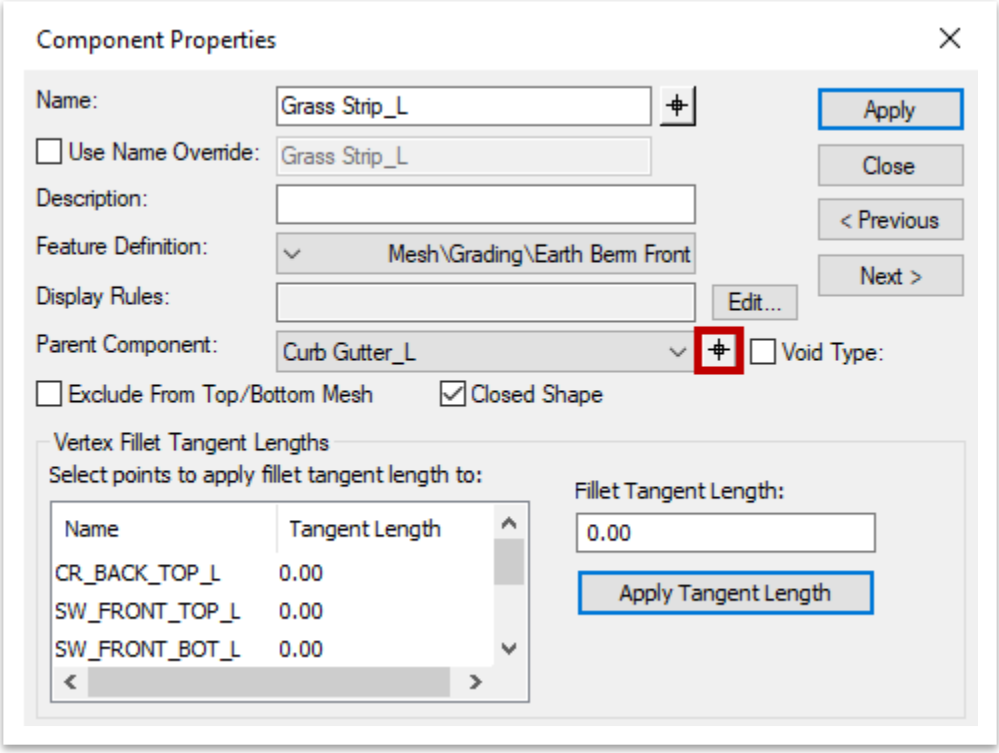
26. Notice the **Display Rules** in the lower right corner. Go ahead and set both **CR_L_OFF** and **CR_R_OFF** values to **False** by clicking within each field.



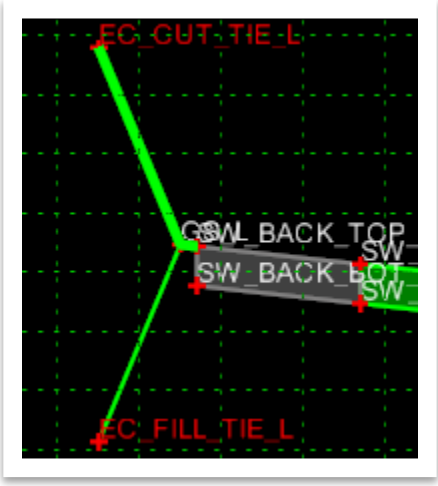
27. Notice on the right side of the template that the curb and gutter, sidewalk and end condition are now turned off. Notice on the left side of the template that the grass strip, shared use path and end condition did not turn off with the display rule. That is because we have not made those components **children** of the left curb and gutter component, which has the display rule assigned. Go ahead and click **Close** in the upper right once you are done.



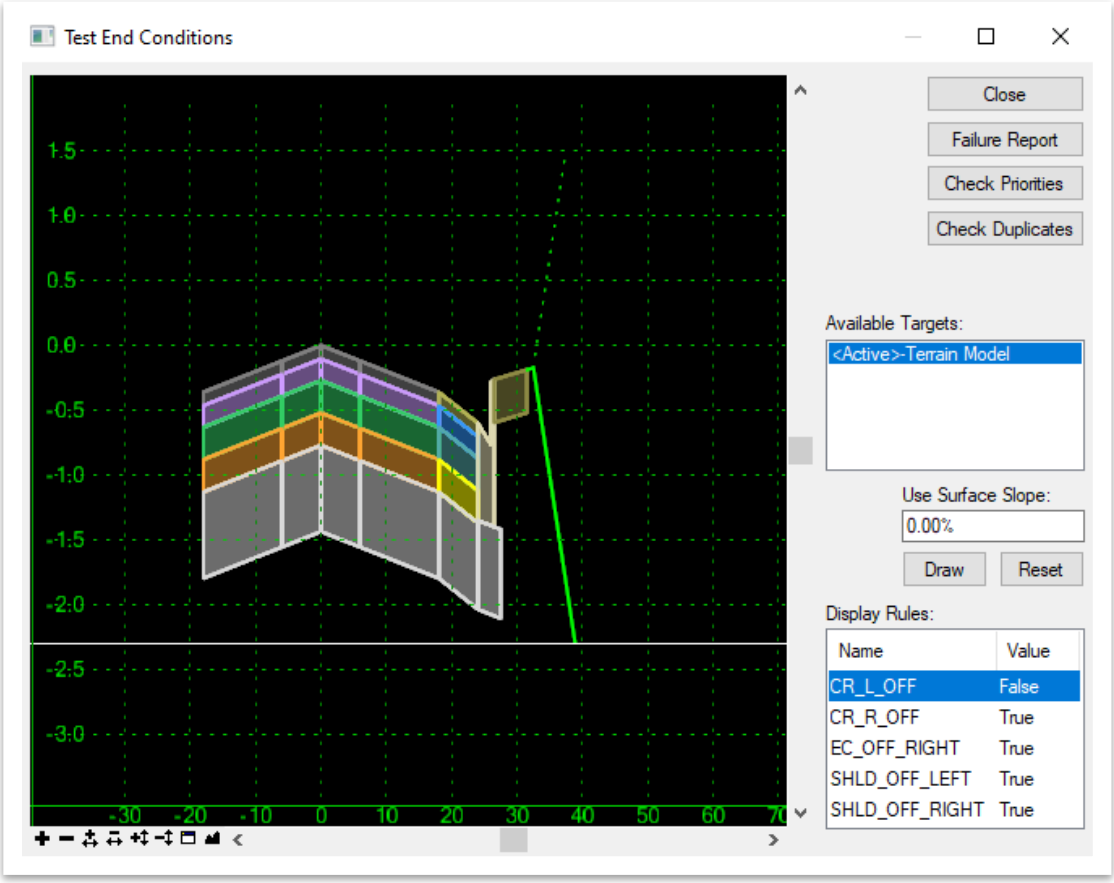
28. Double click on the **Grass Strip** component once again to open the component properties. We are going to add a **Parent Component**. Open the **point selector** (highlighted below) and then select the **Curb Gutter_L** component. Then, click **Apply** and **Close**. **Note:** To do this, physically select the outer boundary of the left curb and gutter component in the template.



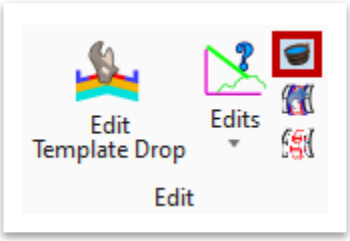
29. Repeat the previous step for the **Shared Use Path** and **End Condition** components. This will require 3 iterations because the end condition is comprised of two separate components (**Cut Slope_L** and **Fill Slope_L**). For example, when you select the cut component, that is the only end condition that highlights, as shown below.



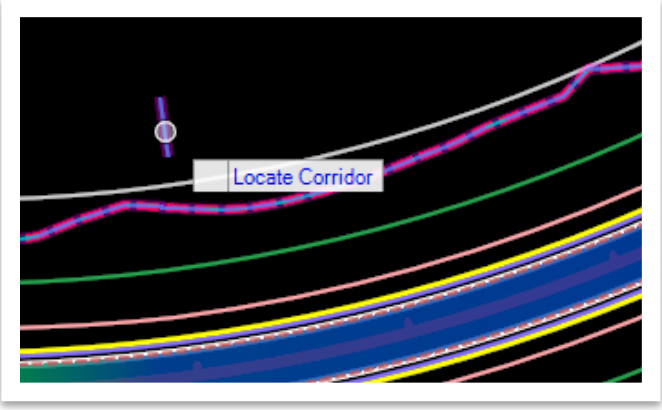
30. Re-test the template and make sure that the **Display Rules** are functioning correctly. If done correctly, the grass strip, shared use path and end condition should now turn off if the **CR_L_OFF** display rule is set to **False**. Go ahead and click **Close** in the upper right once you are done.



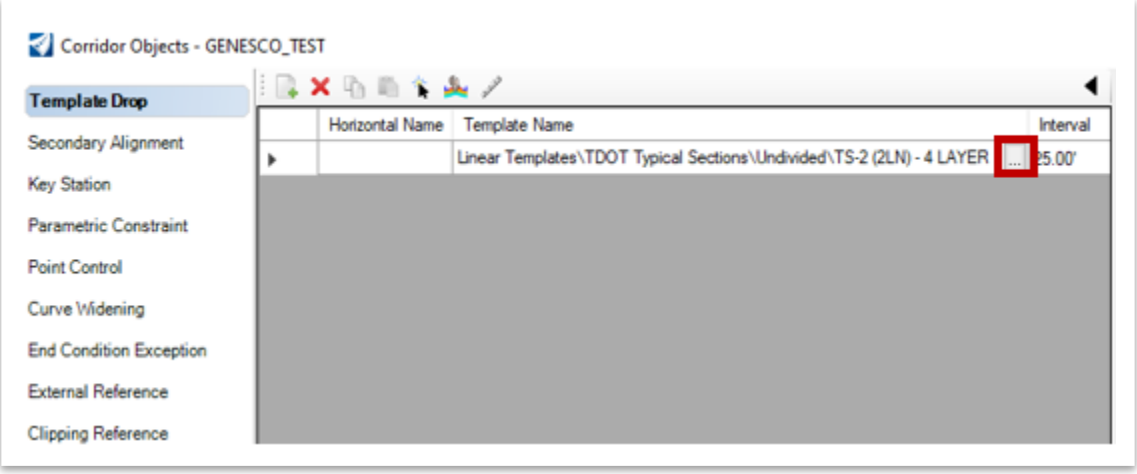
31. Before we close the ITL, let's save it. Go to **File >> Save** within the **Create Template** window. Then, click **Close** in the upper right corner.
32. Now we are going to apply the **TS-7 MOD** template to the corridor. Open the **Corridor Objects** tool (**OpenRoads Modeling >> Corridors >> Edit >> Corridor Objects**.



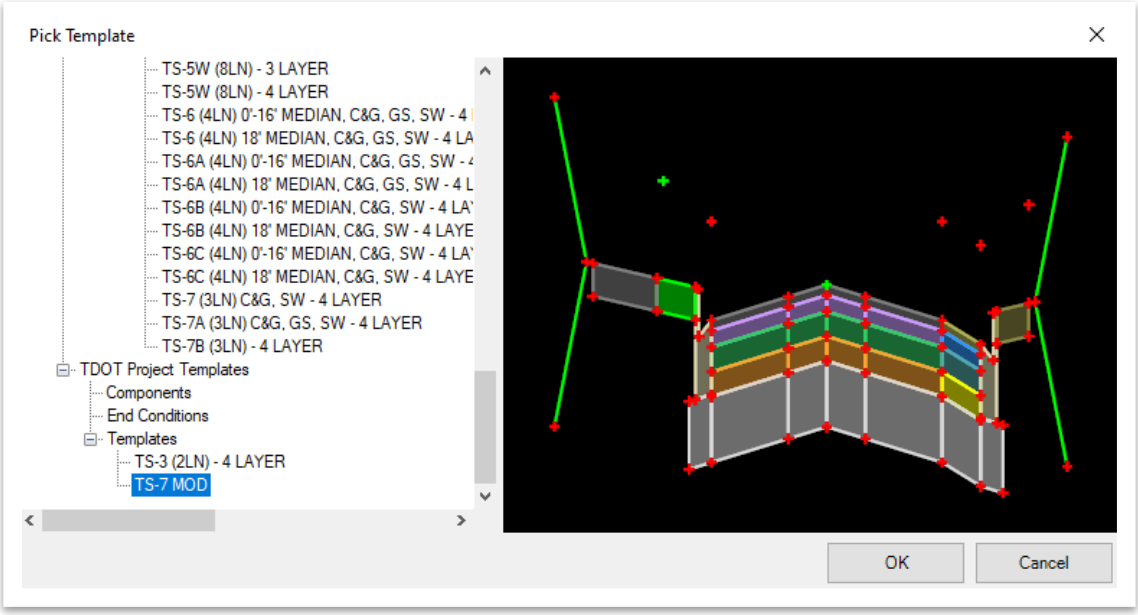
33. Notice the cursor prompt: **Locate Corridor**. Select the **GENESCO_TEST** corridor.

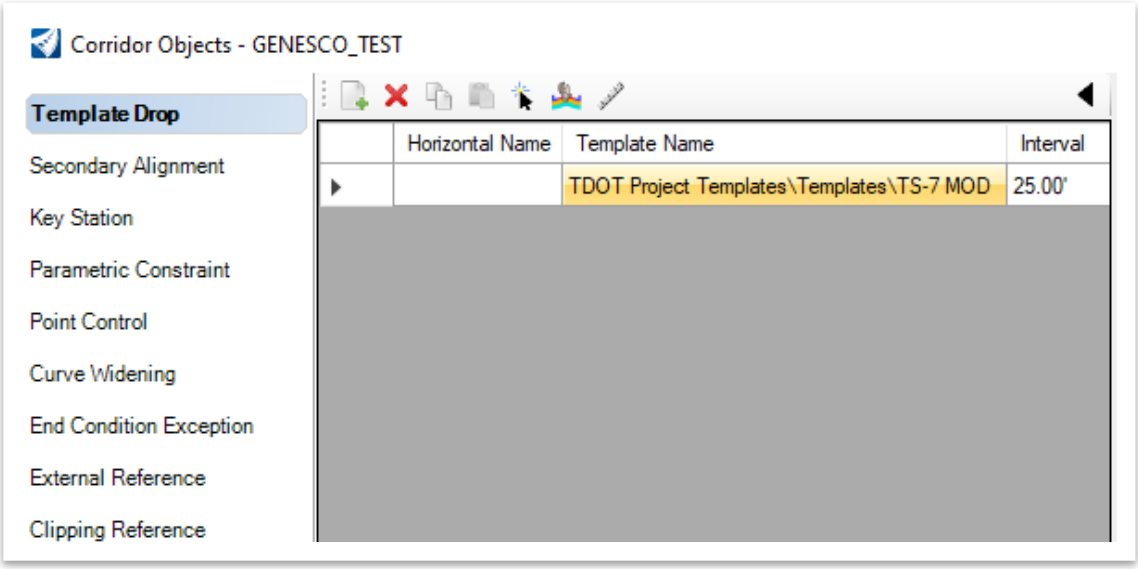


34. Here you can view the template drops of the corridor. Click the **Browse** button to open the template library so we can change the template. **Note:** If you don't see the **Browse** button, left click within the **Template Name** field and it will appear.

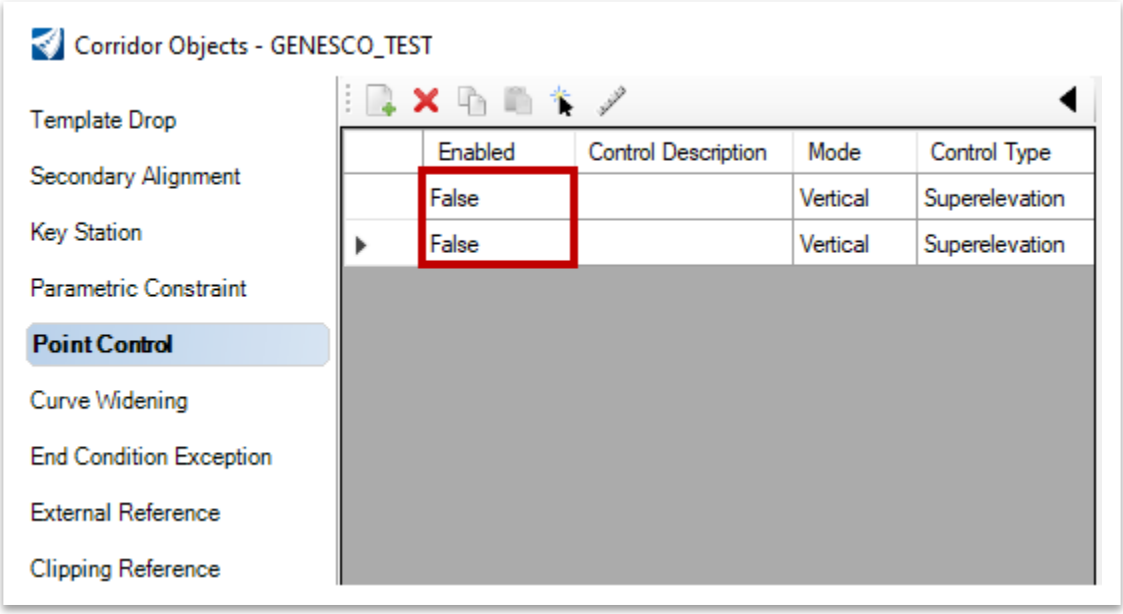


35. Scroll down to the bottom and select the newly created **TS-7 MOD** template (**TDOT Project Templates >> Templates**). The project ITL should open by default, as shown below. Click **OK** and give it a second to update.

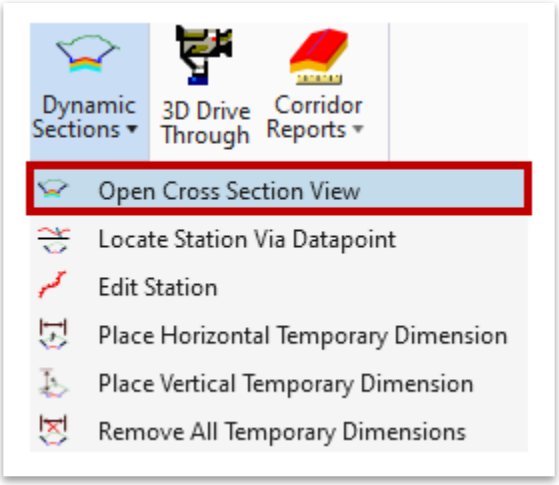




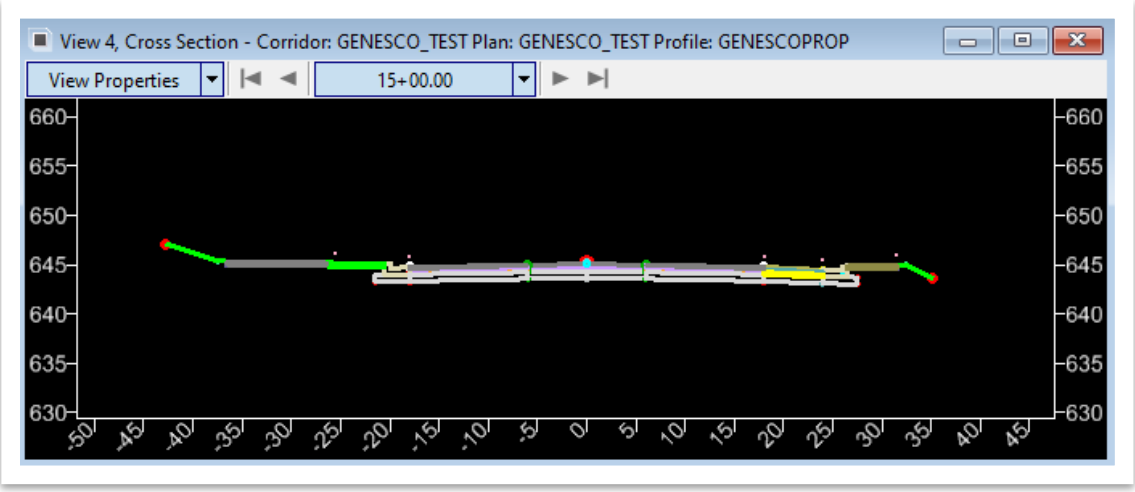
36. The new template has a different number of lanes than the original template, which means that we need to turn off the **superelevation** point controls for now. Click **Point Control** on the left sidebar and set the **Enabled** field to **False** for both controls. Close the **Corridor Objects** window once you are done.



37. Next, open the **Open Cross Section View** tool (**OpenRoads Modeling >> Corridors >> Review >> Dynamic Sections**).



38. Notice the cursor prompt: **Locate Corridor or Alignment**. Select the **GENESCO_TEST** corridor and then open **View 4**. Scroll through the dynamic sections to review the updated template along the corridor.



Chapter 10. Corridor Modeling Advanced Tools

The Corridor Modeling advanced tools are also located under the **Corridors** tab in the OpenRoads Modeling workflow. These are necessary tools to advance a corridor model beyond what was learned in Chapter 5. For even more advanced tools, refer to the Roadway Design II (ORD) Manual.

10.1 Objectives

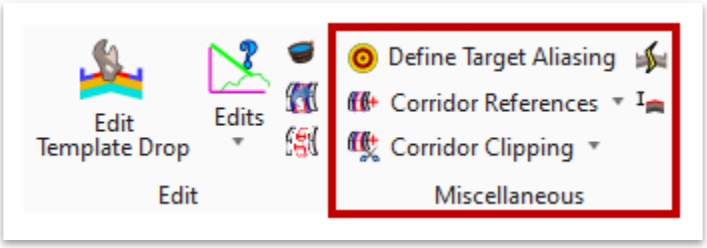
At the conclusion of this chapter, participants will be able to:

1. Add a corridor reference utilizing a referenced element.
2. Create an end condition exception and add target aliasing.
3. Add a corridor clipping reference to remove overlapping areas.

10.2 Lecture: Miscellaneous Tools

The primary **Miscellaneous** tools include Define Target Aliasing, Corridor References, Corridor Clipping and Overlay Vertical Adjustment, which should be used to enhance the corridor(s) as the design further develops (Figure 128).

FIGURE 128. MISCELLANEOUS CORRIDOR TOOLS

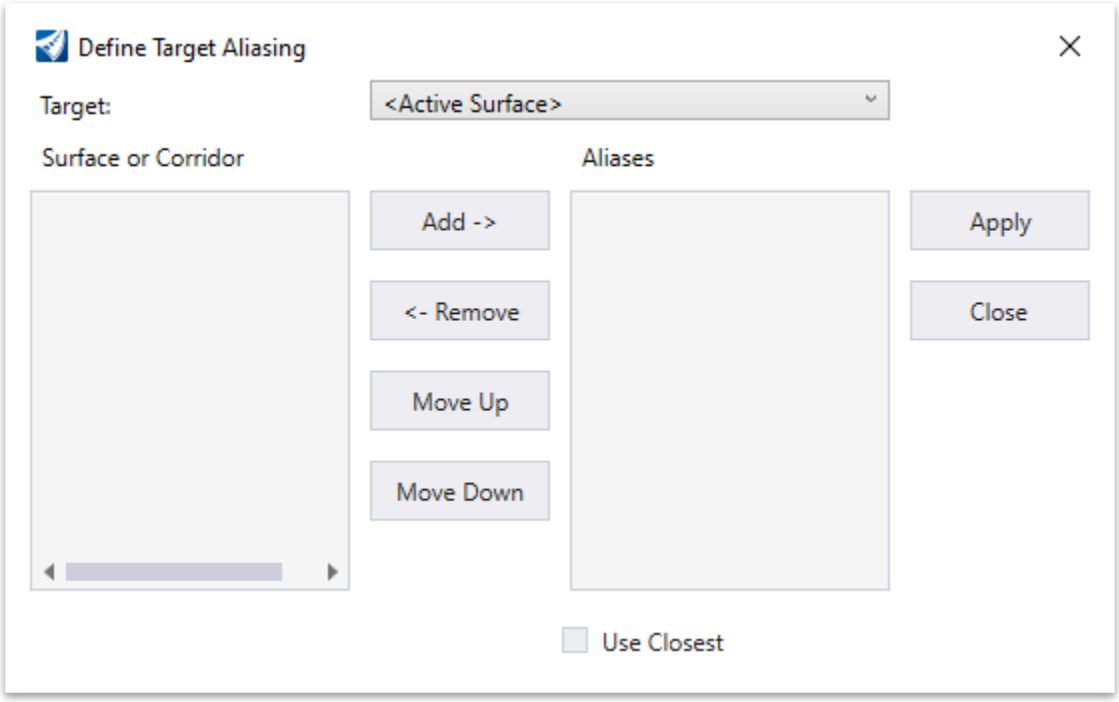


10.2.1 Define Target Aliasing

Target aliasing allows multiple corridor surfaces or features to be set up for end condition solutions (Figure 129). Targets are prioritized in the order listed in the **Aliases** section. Toggling on the **Use Closest** option will set the end conditions to target the closest terrain or corridor.

For example, if a large project has a surface that is broken up into multiple smaller surfaces, target aliasing can be used to point the corridor to the next closest surface automatically so that the user doesn't have to worry about creating a different template for each surface.

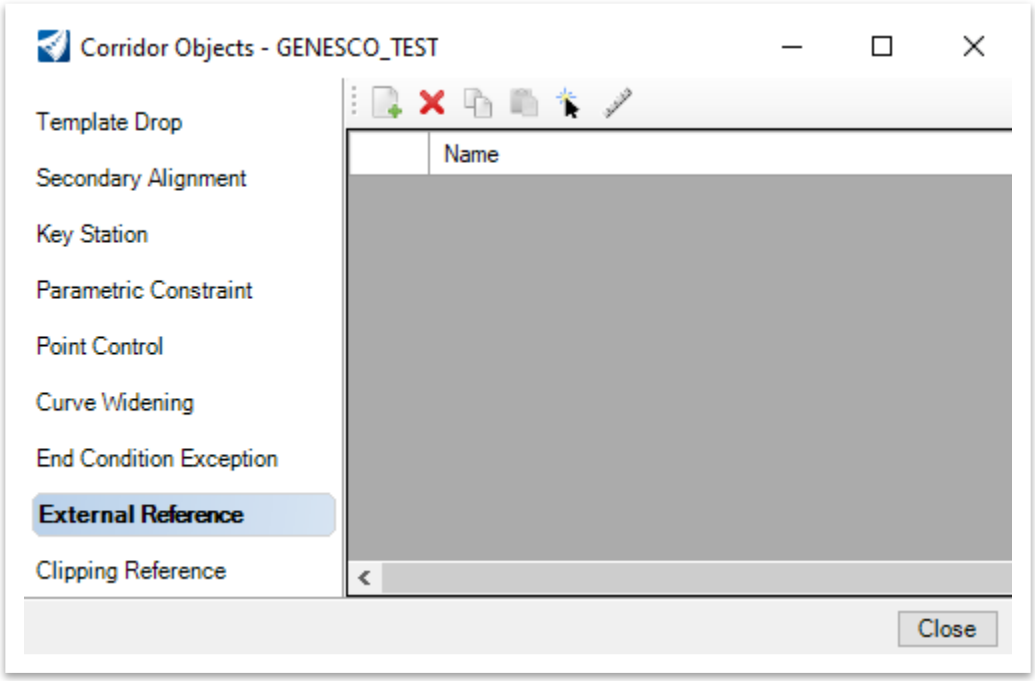
FIGURE 129. DEFINE TARGET ALIASING



10.2.2 Corridor References

The **Add** and **Remove Corridor Reference** tools allow the user to add or remove graphical elements to the corridor processing. If only the desired elements are added to the corridor, processing is accelerated. Any corridor references added will be listed under **External Reference** in the **Corridor Objects** (Figure 130).

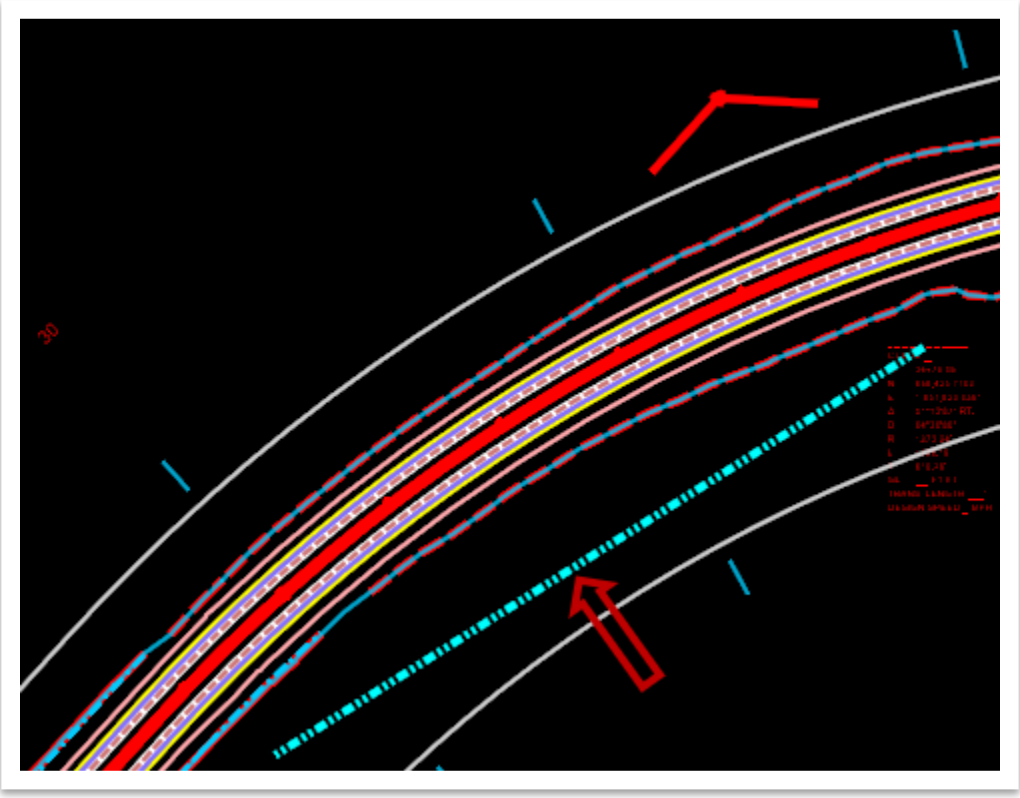
FIGURE 130. CORRIDOR OBJECTS



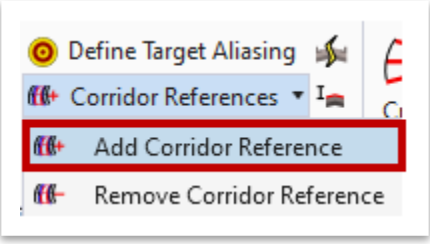
10.2.3 Exercise: Adding a Corridor Reference and Target Aliasing

In this exercise, we will add a corridor reference utilizing a referenced ditch alignment, create an end condition exception, and then add target aliasing. We will open back up the **GenescoCorridor.dgn** file.

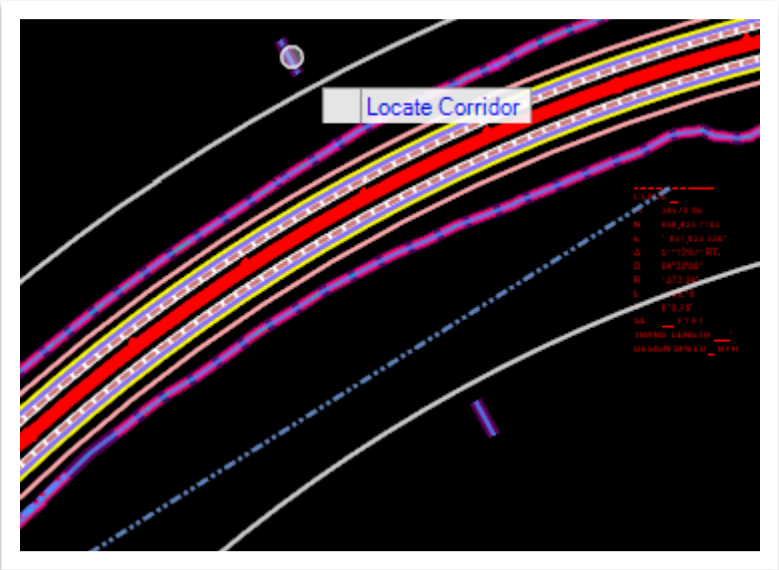
1. Attach the **GenescoClipDitch.dgn** file as a reference using the **Coincident World** attachment method. Turn off the **GenescoSuperelevation.**dgn reference file.
2. Locate the referenced ditch alignment named **Ditch Target** between Stations **29+00** and **36+00**.



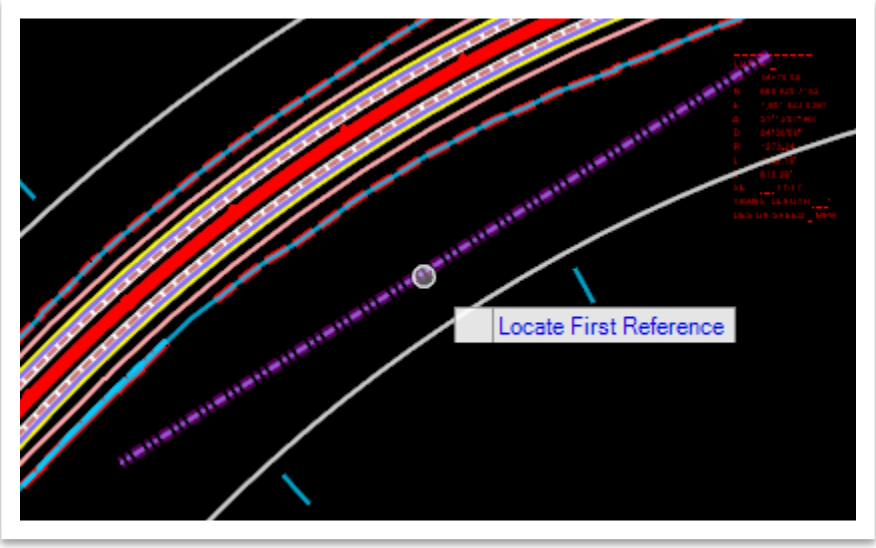
3. Next, open the **Add Corridor Reference** tool (**OpenRoads Modeling >> Corridors >> Miscellaneous >> Corridor References**).



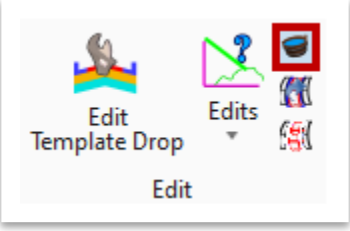
4. Notice the cursor prompt: **Locate Corridor**. Select the **GENESCO_TEST** corridor.



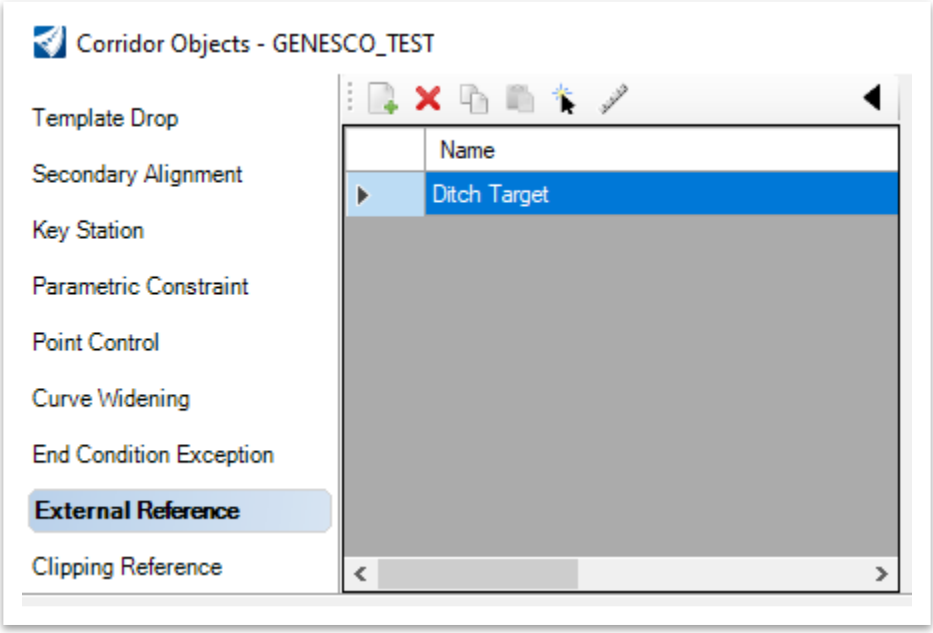
5. Notice the next cursor prompt: **Locate First Reference**. Select the ditch alignment (**Ditch Target**), and then right click to complete.



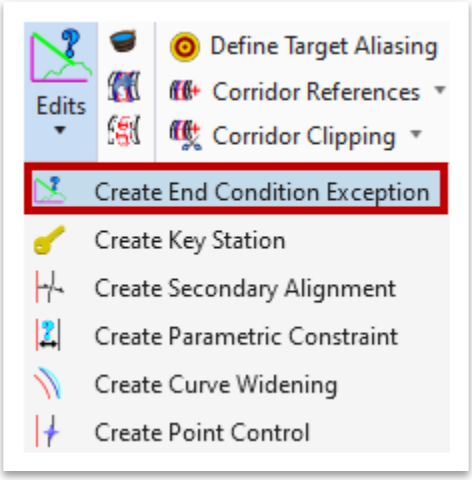
6. Now open the **Corridor Objects** tool (**OpenRoads Modeling >> Corridors >> Edit**) and view the External Reference tab to verify that Ditch Target is being referenced to the corridor.



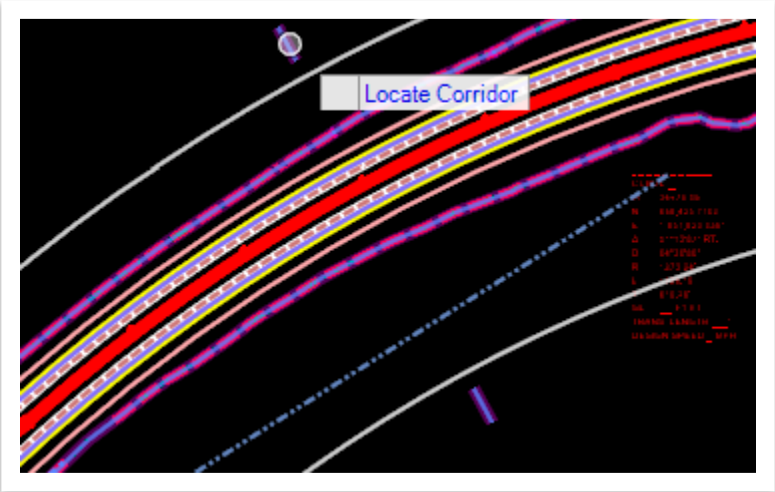
7. Notice the cursor prompt: **Locate Corridor**. Select the **GENESCO_TEST** corridor and then the **Corridor Objects** window should open automatically. Go ahead and select **External Reference** on the left side and you will see that the **Ditch Target** has been added. Close the **Corridor Objects** window once you are done.



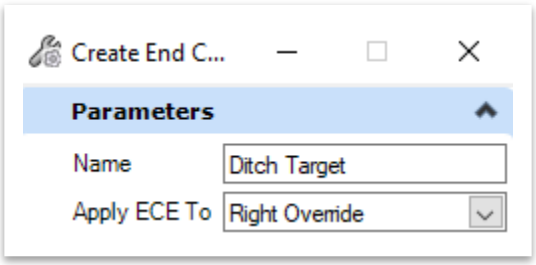
8. Next, we will create a ditch end condition that will target the roadway end condition. Open the **Create End Condition Exception** tool (**OpenRoads Modeling >> Corridors >> Edit > Edits**).



9. Notice the cursor prompt: **Locate Corridor**. Once again, select the **GENESCO_TEST** corridor.

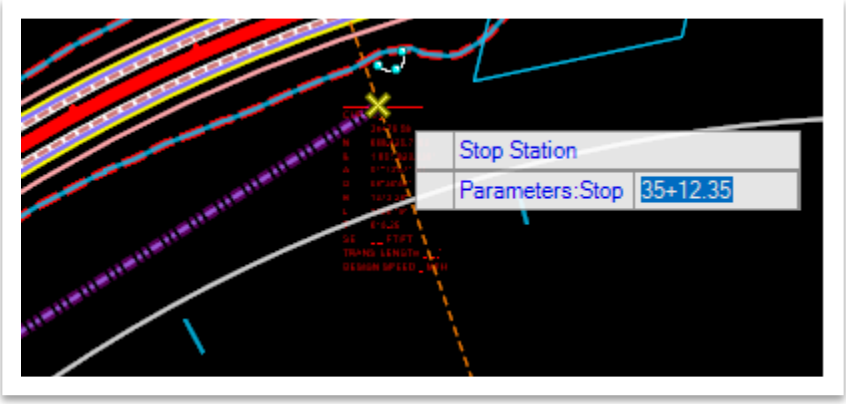


10. Within the **Create End Condition Exception** dialog box, fill in the first <u>two</u> settings and then left click to accept each setting.
    a. **Name:** Ditch Target
    b. **Apply ECE To:** Right Override.

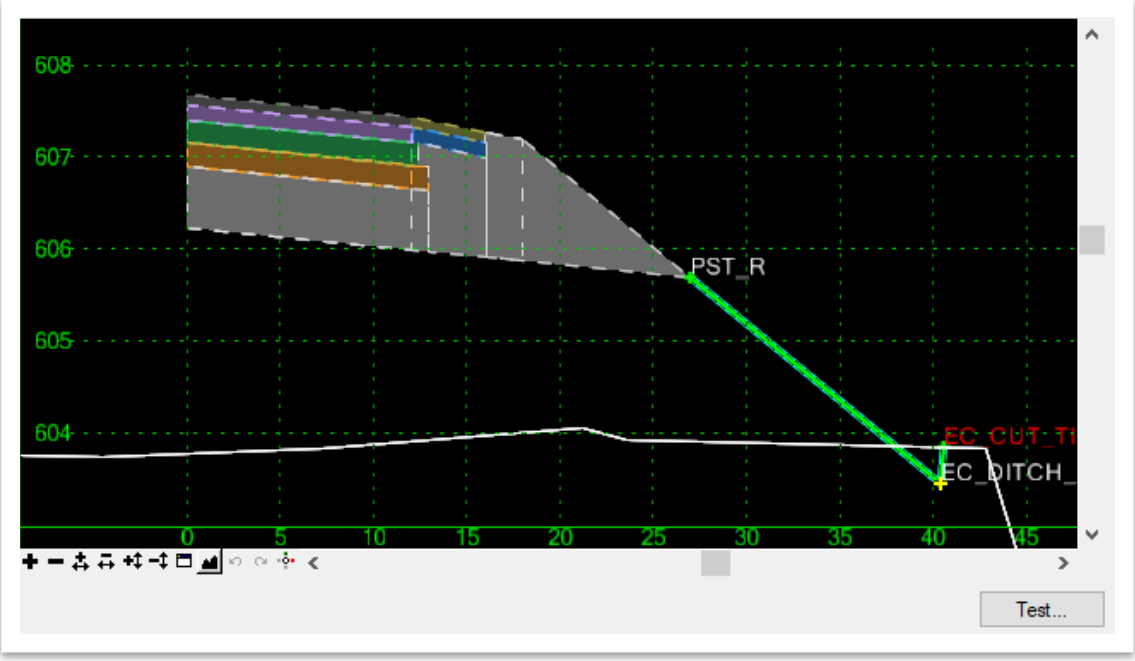


11. Uncheck both the **Start** and **Stop** fields (if they aren't already). For the **Start** station, snap to the beginning of the ditch alignment (Sta **29+13.00**). **Note:** <u>Do not key-in the station. That will not allow the template to create a transition between the end condition and the template</u>.

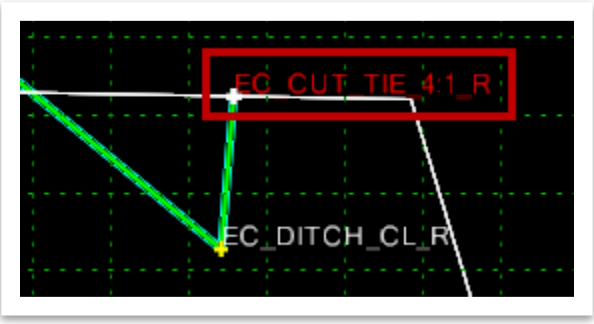
12. For the **Stop** station, snap to the end of the ditch alignment (Sta **35+12.35**). **Note:** Do not key-in the station. That will not allow the template to create a transition between the end condition and the template.



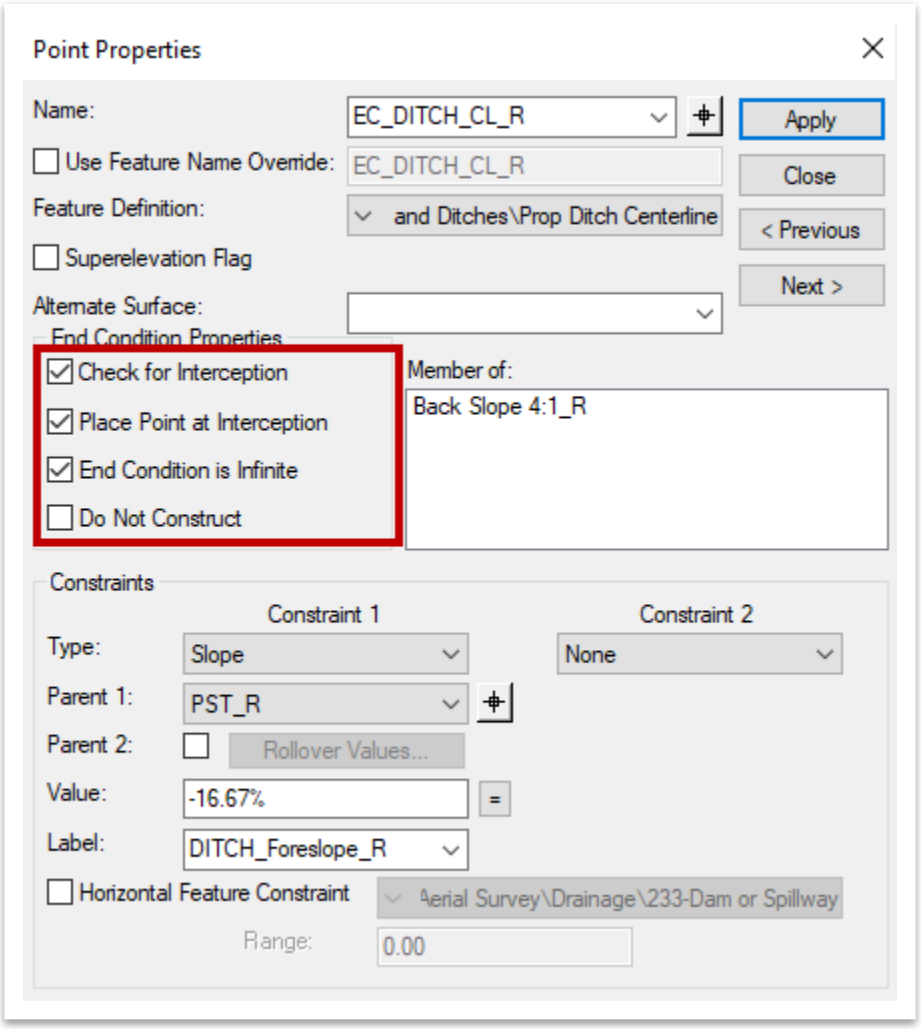
13. A **Right Override - 29+13.00 to 35+12.35** edit template window should appear.



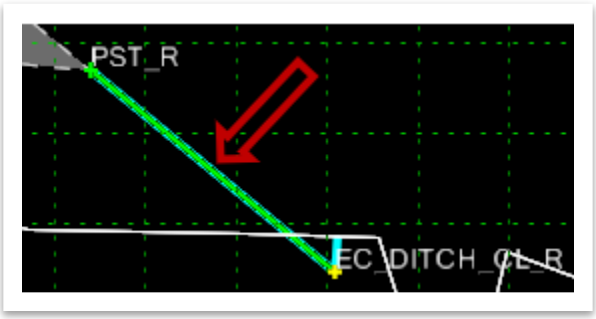
14. Right click on the **EC_CUT_TIE_4:1_R** point and select **Delete Point**.



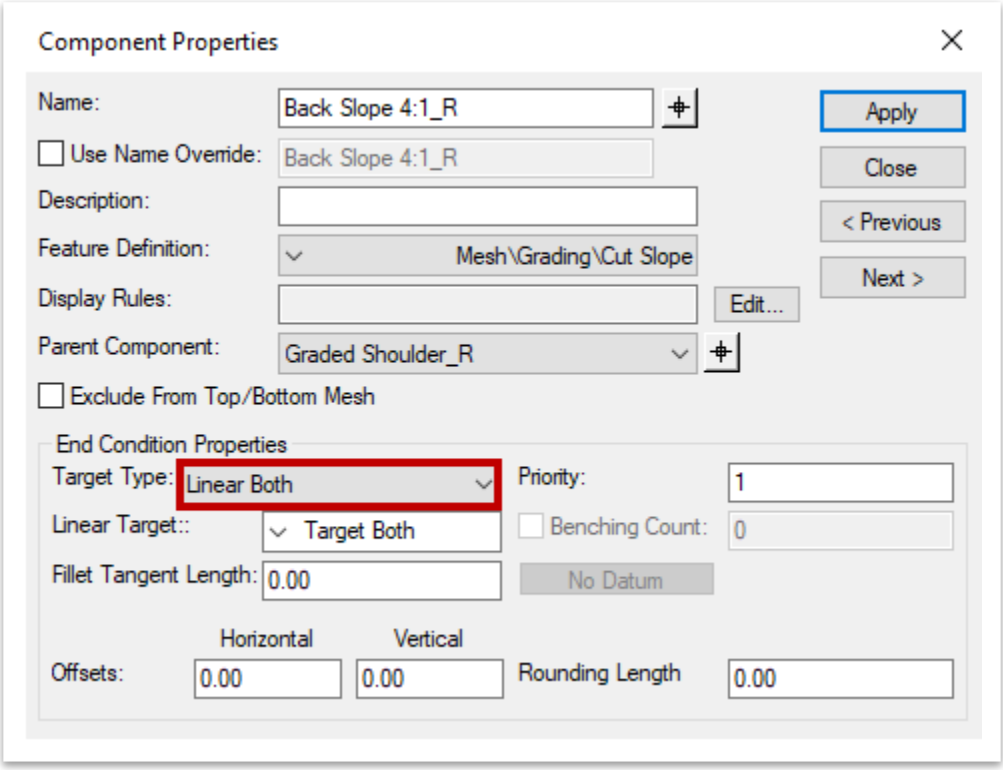
15. Now, double click on the **EC_DITCH_CL_R** point. Within the **Point Properties**, checkmark the following settings under **End Condition Properties**. Then, click **Apply** and **Close**.
    a. Check for Interception
    b. Place Point at Interception
    c. End Condition is Infinite



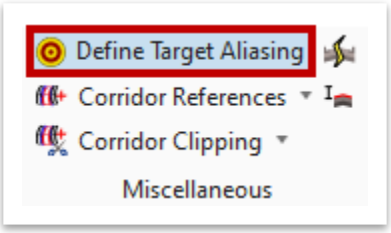
16. Next, double click the **Back Slope 4:1_R** end condition component.



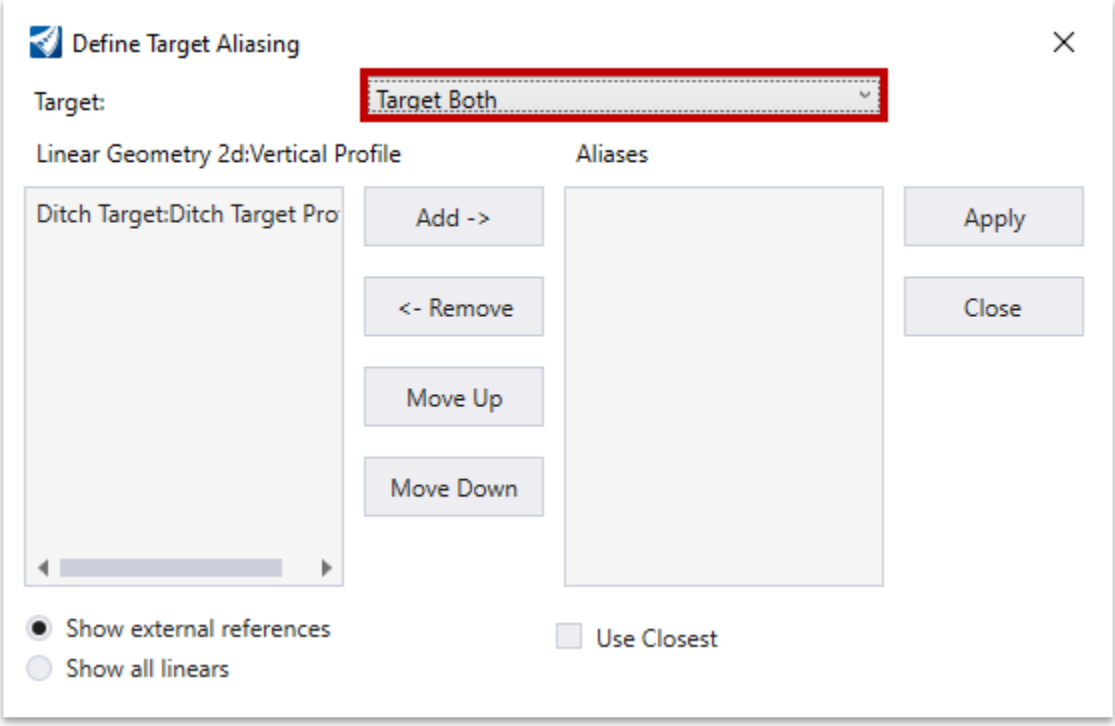
17. Within the **Component Properties**, set the **Target Type** to **Linear Both**. Then, click **Apply** and **Close**.



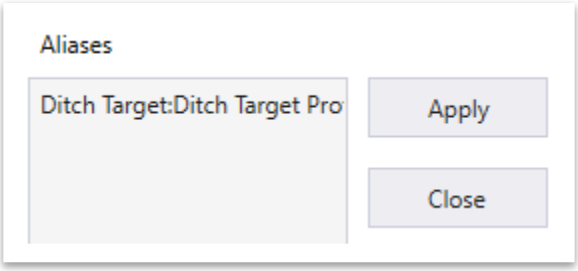
18. Go ahead and click **OK** to close the **Right Override - 29+13.00 to 35+12.35** edit template window. Then, open the **Define Target Aliasing** tool (**OpenRoads Modeling >> Corridors >> Miscellaneous**).



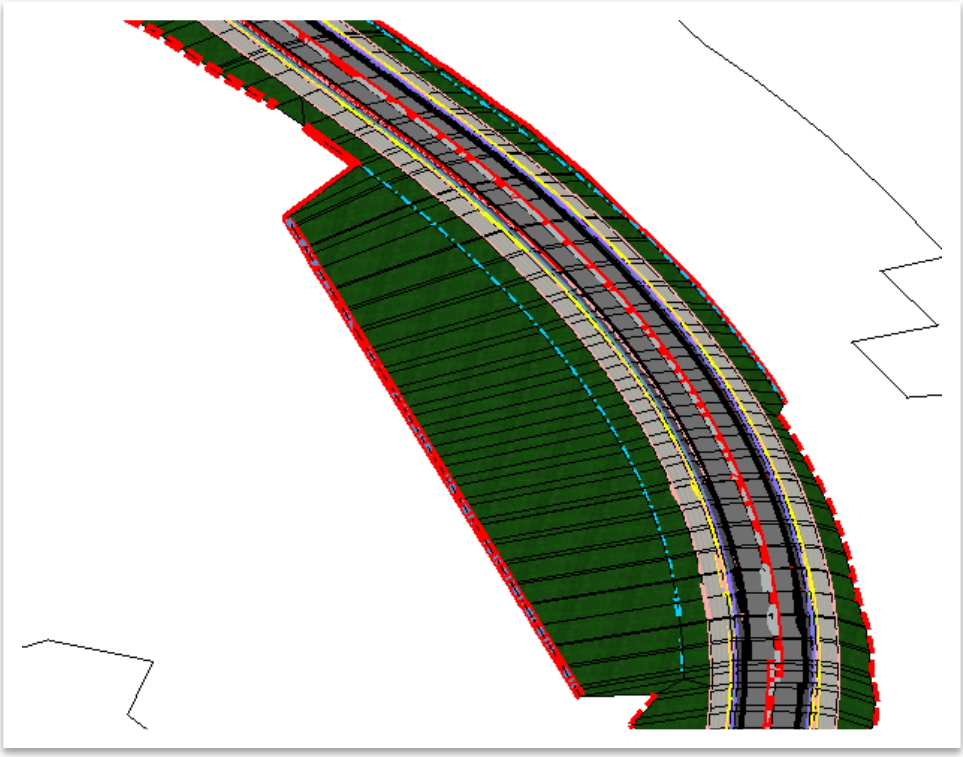
19. Notice the cursor prompt: **Locate Corridor**. Once again, select the **GENESCO_TEST** corridor. Within the **Define Target Aliasing** window, set the **Target** to **Target Both**.



20. Any corridor reference element will display on the left side. Go ahead and select **Ditch Target:Ditch Target Profile** and then click **Add** to add it under **Aliases** on the right side. Then, click **Apply** and **Close**.



21. Right click and hold anywhere within **View 1** and select **View Control >> 2 Views Plan/3D** to open the split 2D/3D views. Within the **3D** view, turn off the **GenescoExisting Terrain.dgn** reference file. You should notice where the update has occurred. Switch back to the **Default** view once you are done.



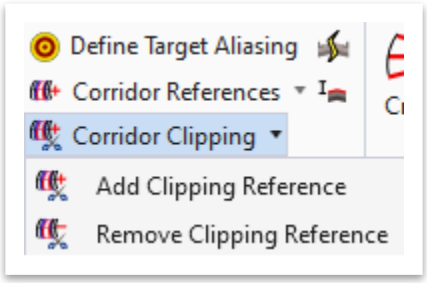
Take Note!

*This same result can be achieved without target aliasing. In Step 17, you would set the **Target Type** to **Feature Definition Both** and locate the desired feature definition that the component is searching for.*

10.2.4 Corridor Clipping

The **Corridor Clipping** tools allow the user to remove overlapping areas between multiple corridors on a single surface (Figure 131). This area will not be included in the corridor end area or component earthwork calculations.

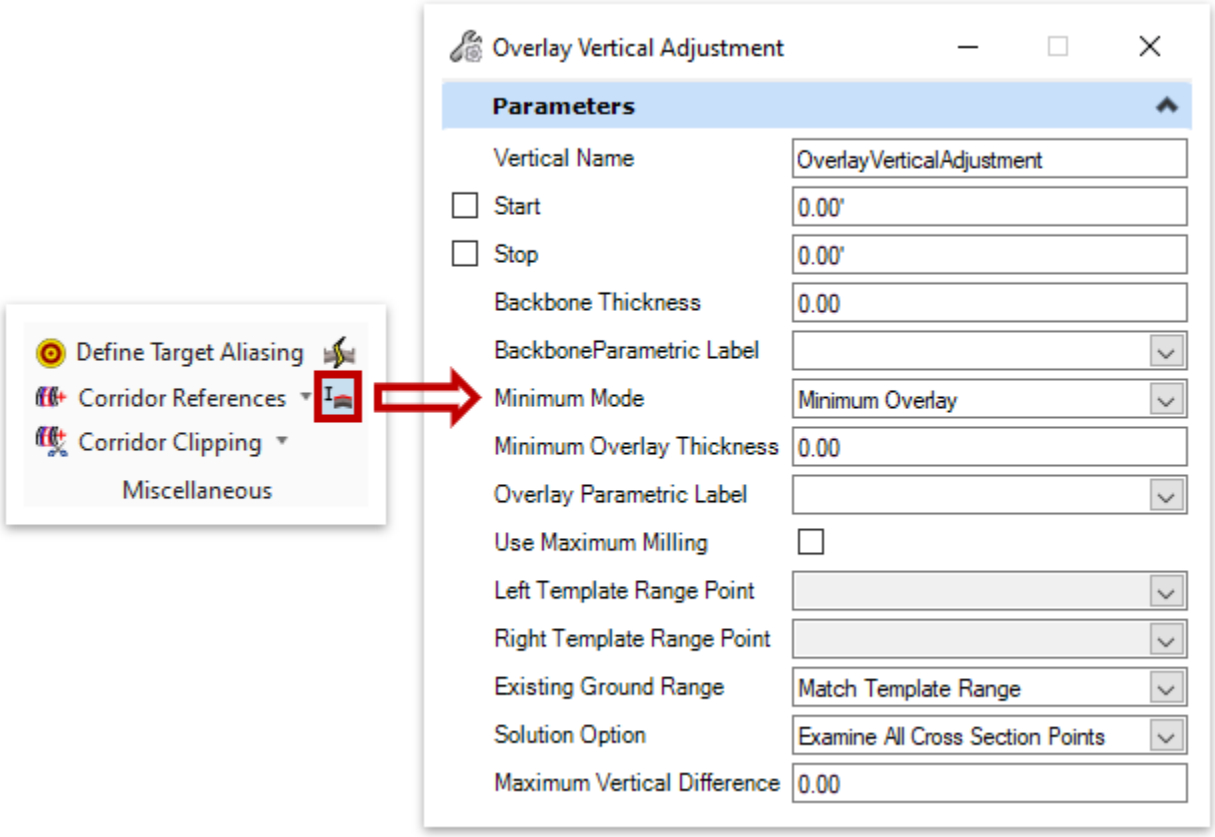
FIGURE 131. CORRIDOR CLIPPING TOOLS



10.2.5 Overlay Vertical Adjustment

The **Overlay Vertical Adjustment** tool creates a new vertical profile based on a minimum overlay thickness below specified template points (Figure 132). For example, a user would use this tool to create a new profile that would give a minimum vertical overlay thickness between a left and right template range point.

FIGURE 132. OVERLAY VERTICAL ADJUSTMENT TOOL



At a minimum, you must have both a **horizontal** and **vertical** alignment, and a **corridor** in the same file to use the tool. A few of the key settings are described below.

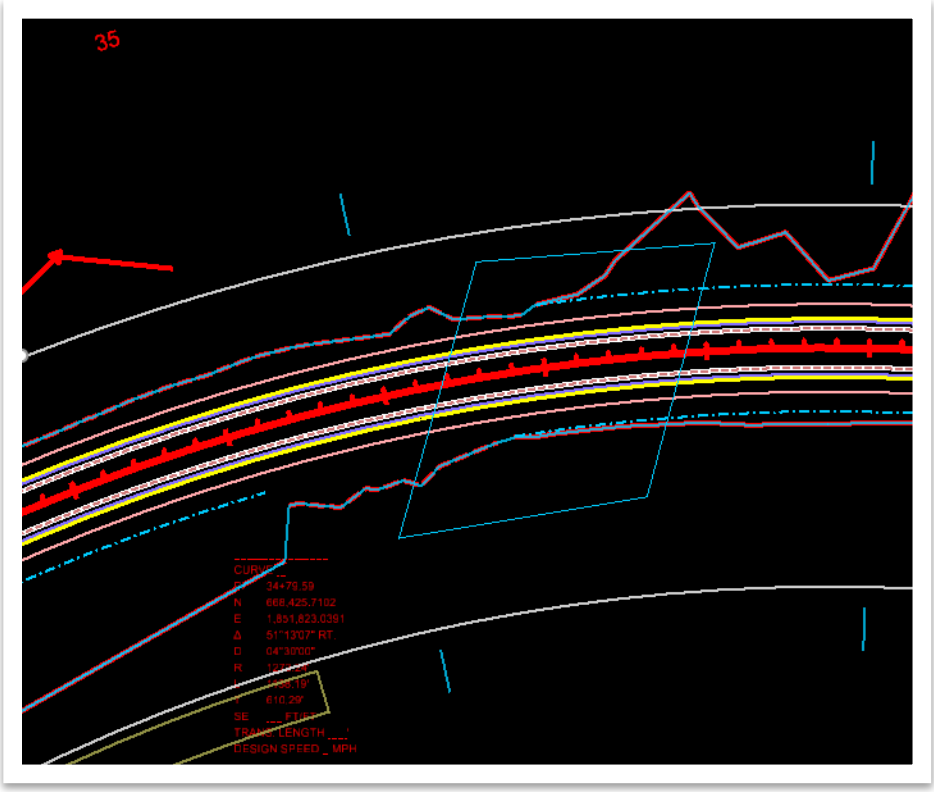
- **Backbone Thickness:** The depth below the backbone point, which is usually the centerline.
- **Minimum Mode:** This can be set to Minimum Overlay or Minimum Milling.
- **Minimum Overlay Thickness:** The minimum thickness of the left and right template range point.
- **Solution Option:** This can be set to Examine All Cross Section Points or Examine Template Points Only. It refers to the backbone and left and right template range points.

A second vertical profile will be created in the horizontal alignment. The corridor can then be reset to this vertical profile.

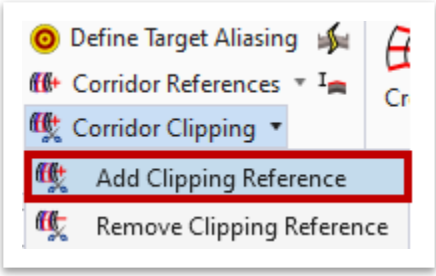
10.2.6 Exercise: Adding Corridor Clipping

In this exercise, we will add a clipping reference along the corridor and then examine the update in the 3D view. We will continue to utilize the same **GenescoCorridor.dgn** file.

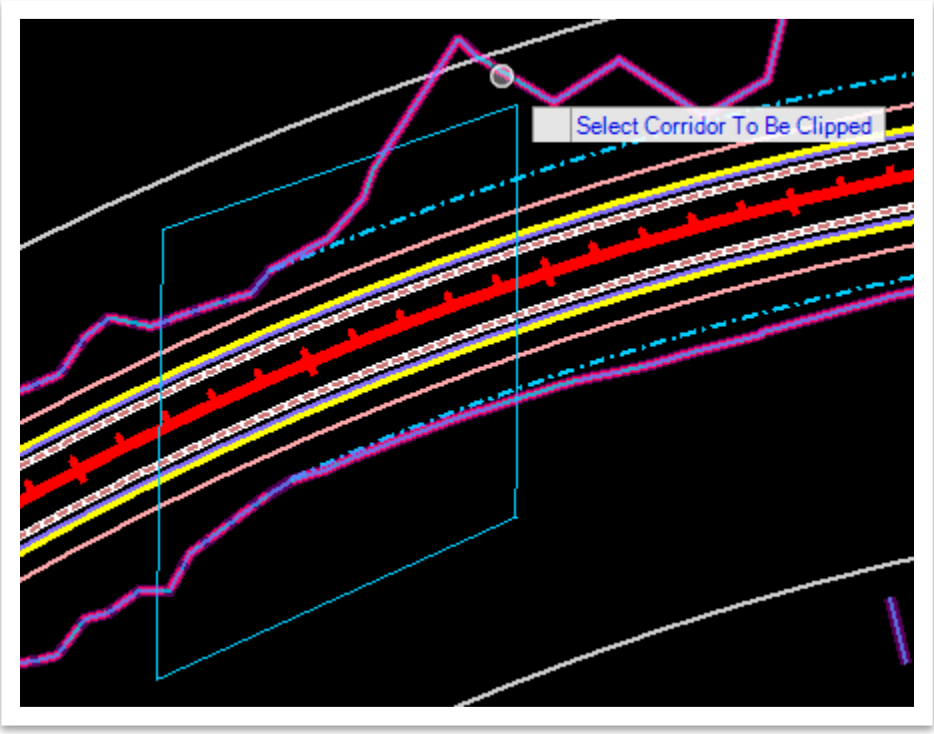
1. Locate the blue clip shape near Station **37+00**. **Note:** This shape is within the **GenescoClipDitch.dgn** reference file.



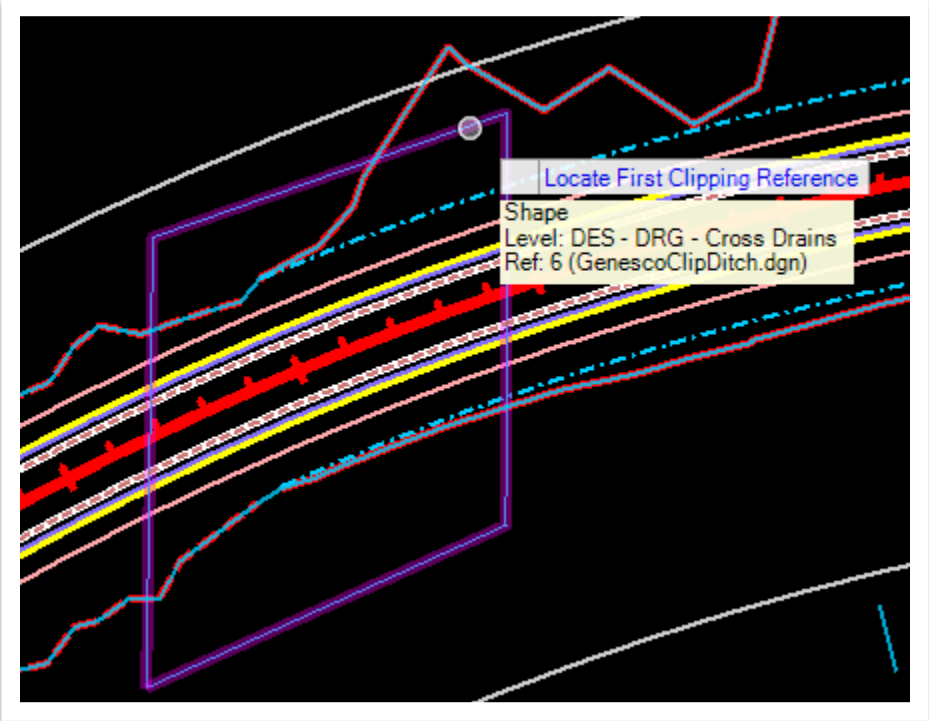
2. Open the **Add Clipping Reference** tool (**OpenRoads Modeling >> Corridors >> Miscellaneous >> Corridor Clipping**).



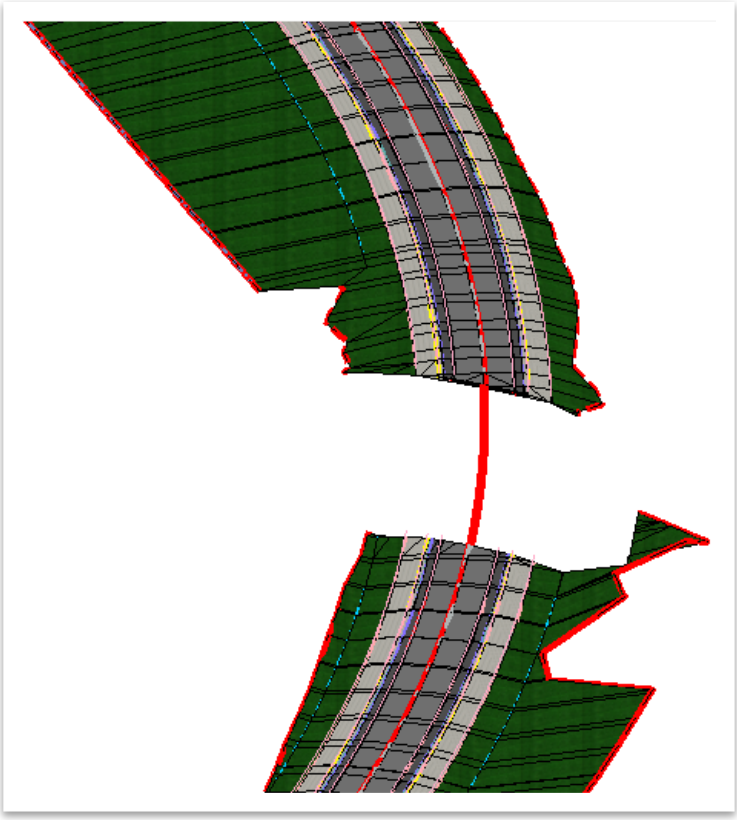
3. Notice the cursor prompt: **Select Corridor To Be Clipped**. Select the **GENESCO_TEST** corridor.



4. Notice the next cursor prompt: **Locate First Clipping Reference**. Select the blue clip shape and then right click to complete.



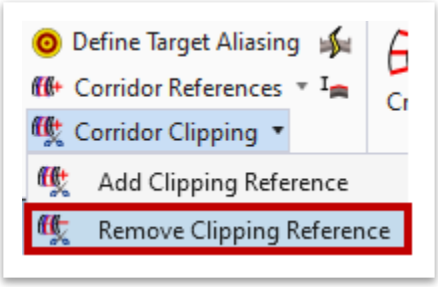
5. Right click and hold anywhere within **View 1** and select **View Control >> 2 Views Plan/3D** to open the split 2D/3D views. Within the **3D** view, notice that the corridor has been clipped.



Take Note!

*This feature only clips the **3D** view. The 2D view will show the original geometry from the initial template drop. To show the clipped view in plan view for sheet creation, the user will need to clip the corridor references in the sheet files.*

6. Now we will remove the corridor clipping. Open the **Remove Clipping Reference** tool (**OpenRoads Modeling >> Corridors >> Miscellaneous >> Corridor Clipping**). Select the **GENESCO_TEST** corridor and then the blue clip shape, and then right click to complete. Notice that the clipping reference has now been removed in the **3D** view.



Revision History

DATE (MONTH/YEAR)	AUTHOR/EDITOR	IB #	SECTIONS MODIFIED

Appendix A. Additional Design Features

The appendix will show some additional design features in ORD, where the workflow for placement has changed significantly compared to Geopak. For more advanced design features, refer to the Roadway Design II (ORD) Manual.

A.1 Objectives

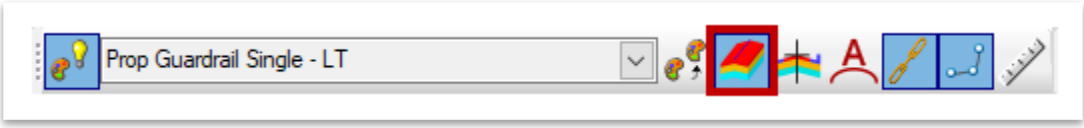
At the conclusion of this chapter, participants will be able to:

1. Place guardrail along a corridor and then add the end terminals.
2. Add pad slope limits.
3. Place 2D/3D traffic drums.
4. Create and edit a benching end condition for a rock cut.
5. Navigate the new civil labeler tool.
6. Store acquisition shapes.

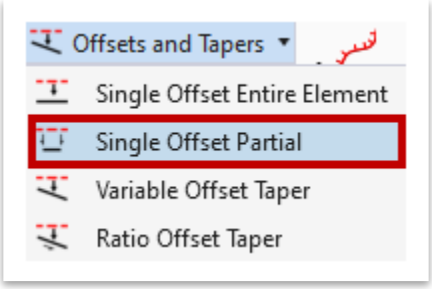
A.2 Exercise: Placing Guardrail and End Terminals

In this exercise, we will place guardrail and guardrail end terminals, which are both 3D features in ORD.

1. Open the **Appendix A Base File.dgn** file within the **123456.00_INITIALS** workset dgn\Appendix Files subfolder. Before we place the guardrail, we need to select the applicable feature definition. Go ahead and select the **Prop Guardrail Single - LT** feature definition (**Linear >> Roadside Barriers >> Cable Barriers and Guardrail**). Make sure the **Create 3D Automatically** toggle (highlighted) is still on. **Note:** You should still have the **Feature Definition Toolbar** docked, but if not, you can access it here: **OpenRoads Modeling >> Geometry >> General Tools >> Standards**.

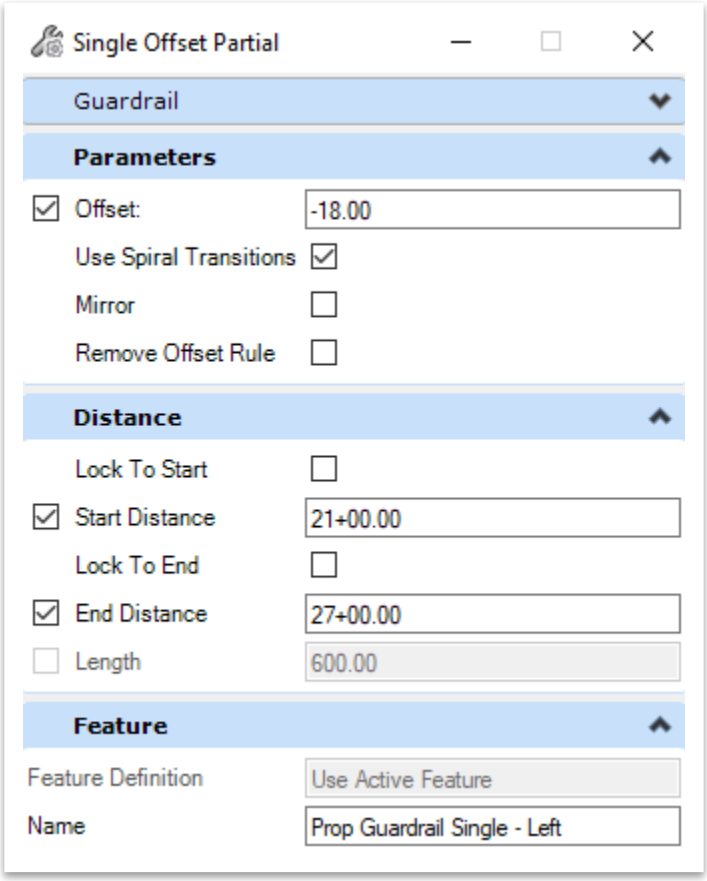


2. To place the guardrail, open the **Single Offset Partial** tool (**OpenRoads Modeling >> Geometry >> Horizontal >> Offsets and Tapers**.

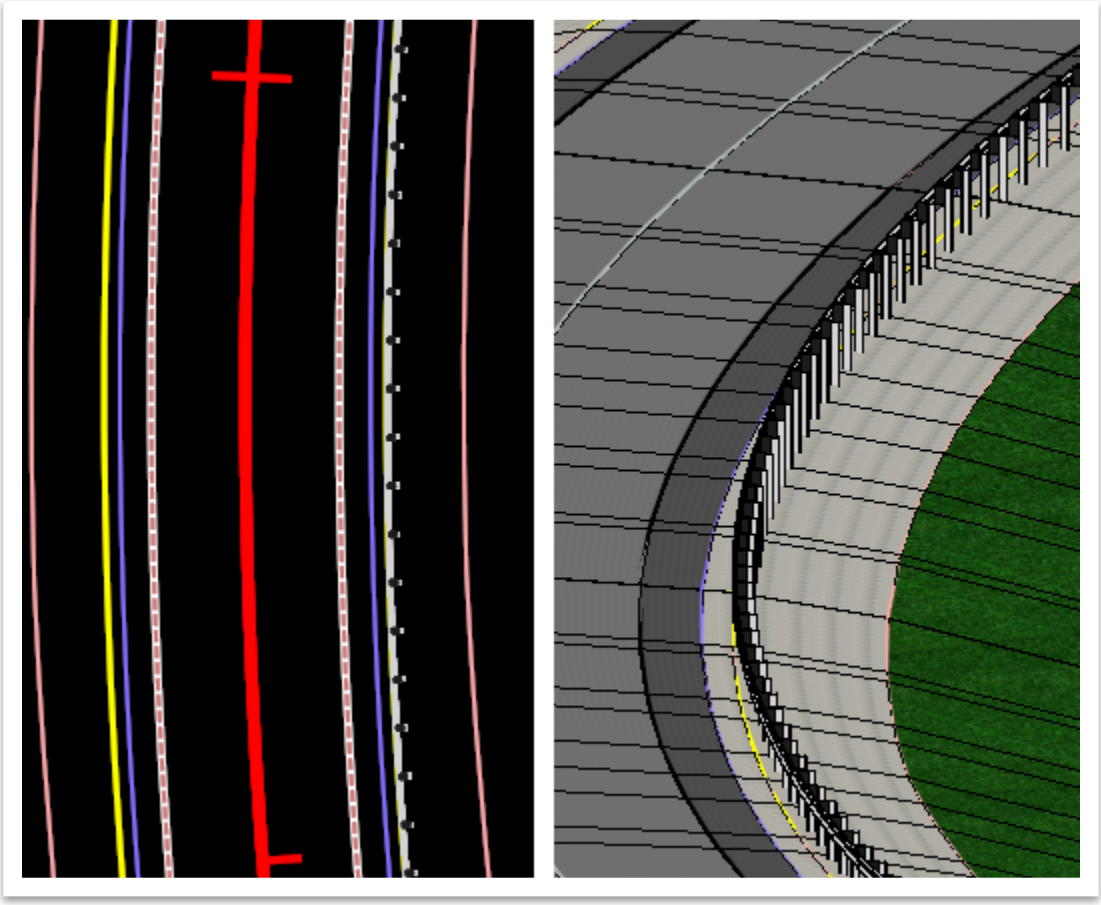


3. Notice the cursor prompt: **Locate Element**. Select the **GENESCO_TEST** alignment in the **2D** view, which we will offset the guardrail from.

4. Notice that the guardrail now appears on your cursor. Within the **Single Offset Partial** dialog box, select the following settings. **Note:** The **Guardrail** tab has been minimized and pertains to the applicable pay item, and thus automated quantities. For this exercise, however, we will leave those blank.
    a. **Offset:** -18.00 (this accounts for the 12’ travel lane + 6’ shoulder; the negative value indicates the left side of the alignment)
    b. **Start Distance:** 21+00.00
    c. **End Distance:** 27+00.00



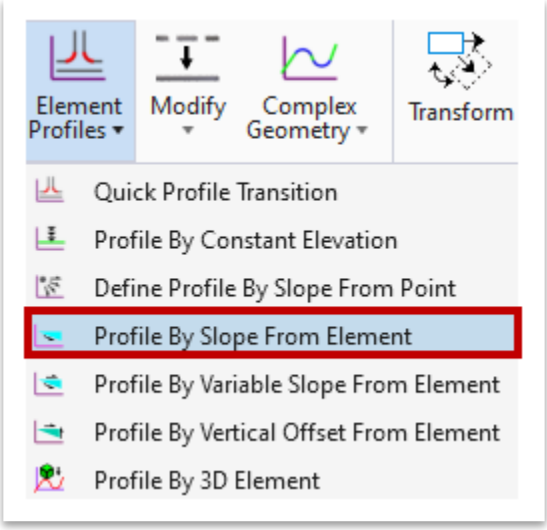
5. Left click through the prompts (on the correct side of the centerline) to accept the settings and give it a second to process. Notice that a **600'** segment of guardrail now appears in both **2D** and **3D** views. Hit **ESC** (or activate the **Element Selection** tool) to clear the tool. In the **3D** view, go ahead and turn off the **Genesco Alignments.dgn** reference file. **Note:** The cursor location ultimately determines the side of the centerline that the guardrail is placed on.



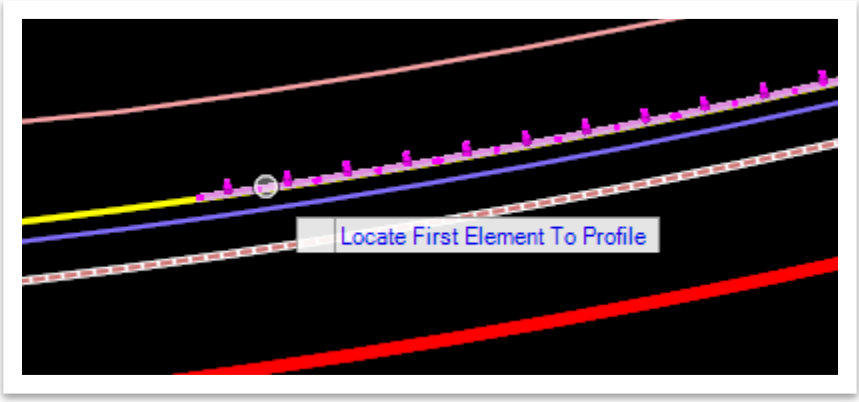
Take Note!

*By toggling on the **Create 3D Automatically** option within the **Feature Definition Toolbar**, the software utilizes a **Single Offset Profile** from the reference element selected. We selected the centerline alignment so that we could key-in specific stationing. However, this means that the guardrail is not at the required height off the edge of shoulder.*

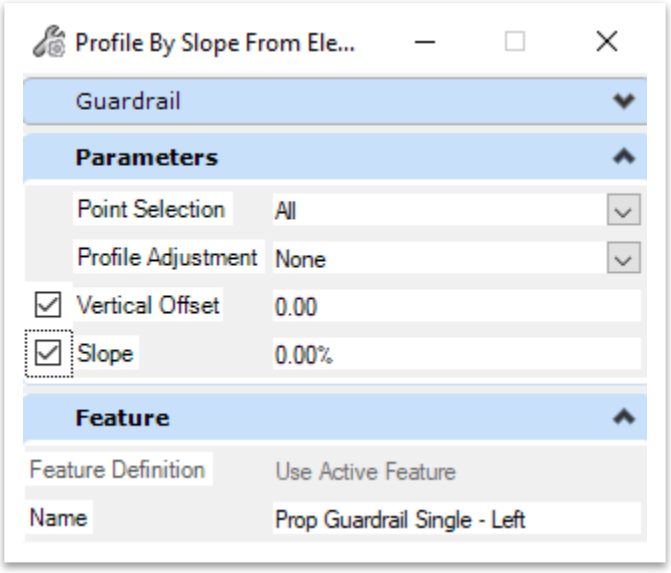
6. To ensure that the guardrail is placed at the proper height off the edge of shoulder, we need to re-profile the guardrail. Open the **Profile By Slope From Element** tool (**OpenRoads Modeling >> Geometry >> Vertical >> Element Profiles**).



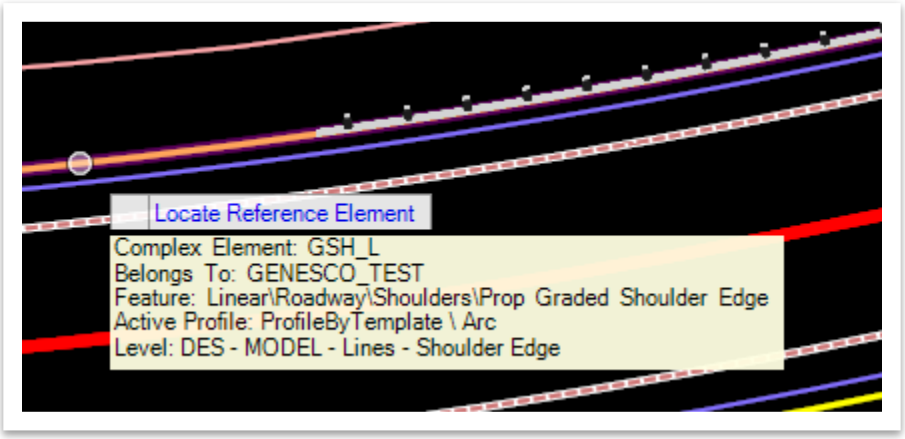
7. Notice the cursor prompt: **Locate First Element To Profile**. Select the guardrail in the **2D** view and then right click to reset.



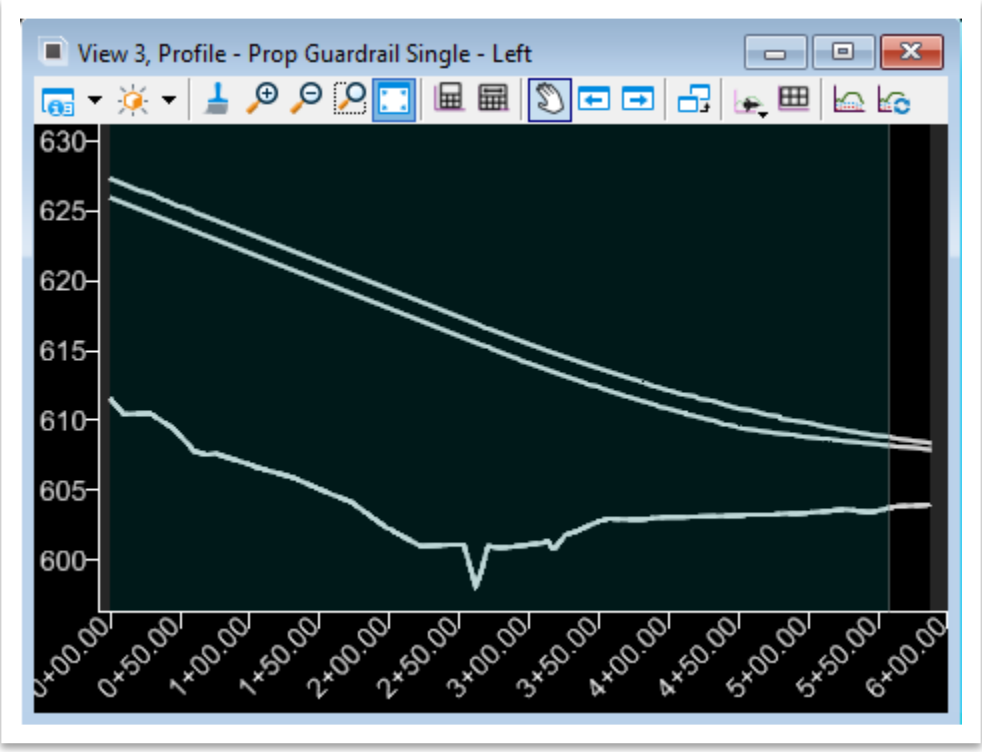
8. Within the **Profile By Slope From Element** dialog box, select the following settings under the **Parameters** tab, and leave the others as-is.
    a. **Point Selection:** All
    b. **Profile Adjustment:** None
    c. **Vertical Offset:** 0.00
    d. **Slope:** 0.00%



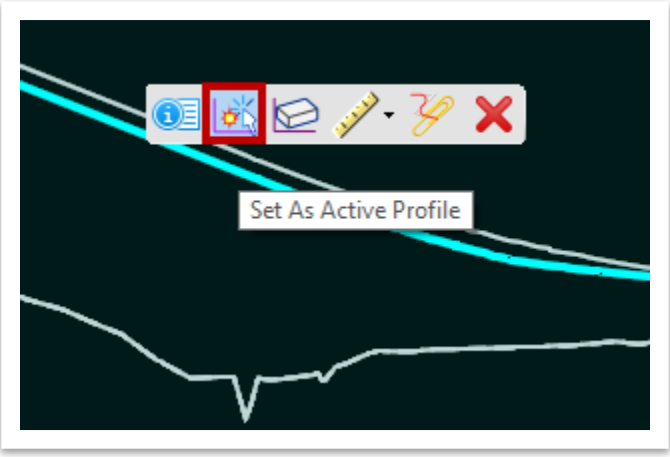
9. Notice the next cursor prompt: **Locate Reference Element**. Select the **GSH_L** line and then left click through the prompts to accept the settings. **Note:** The selected line represents the left graded shoulder (or edge of shoulder).



10. Next, open the **Open Profile Model** tool (**OpenRoads Modeling >> Geometry >> Vertical**) and select the guardrail in the **2D** view. Open **View 3** and left click within to view the profile.



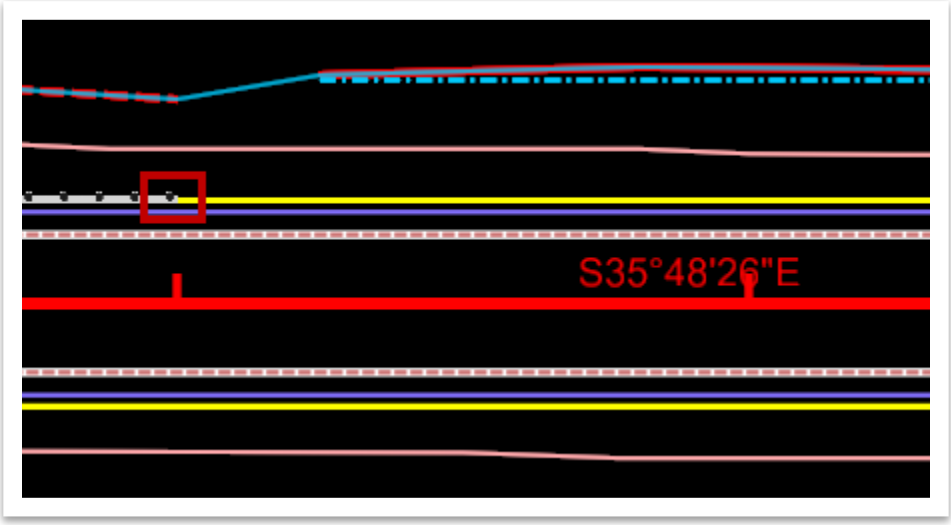
11. Notice there are 3 profiles shown, with one being the existing ground line. By default, the top profile (**SlopeOffset**) should be set to active and represents the initial profile created. The profile directly below represents the new profile we just created. Go ahead and select the new profile and then hover over it and **Set As Active Profile** in the heads-up display. Close **View 3** once you are done.



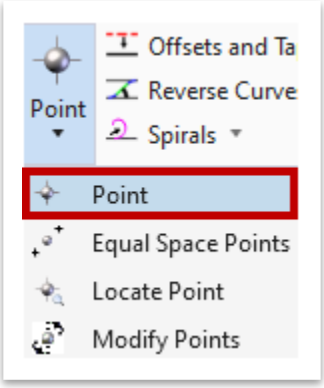
Take Note!

Profiling the guardrail in this manner ensures that it is at the required height above the edge of shoulder without having to do much work to account for superelevation or shoulder rollovers.

12. Now, let's place the end terminals. First, rotate the **2D** view to be in line with the **leading end terminal** (Sta 27+00.00).



13. Open the **Point** tool (**OpenRoads Modeling >> Geometry >> Horizontal >> Point**).

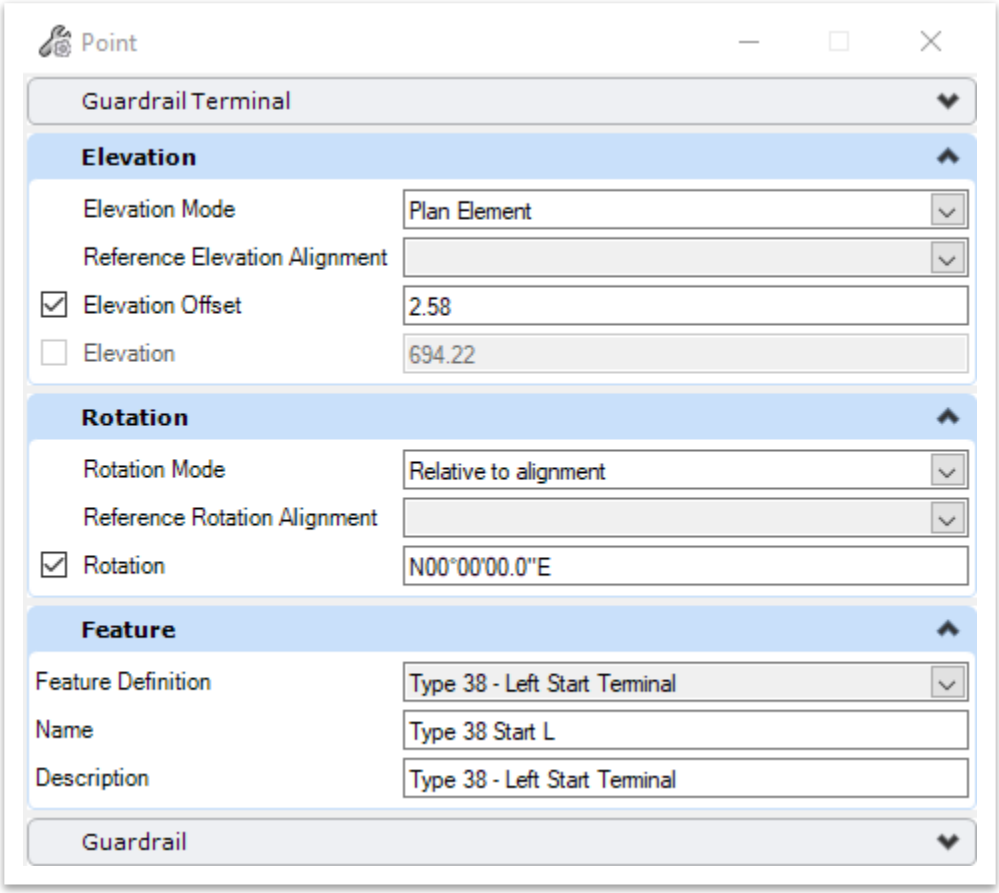


Take Note!

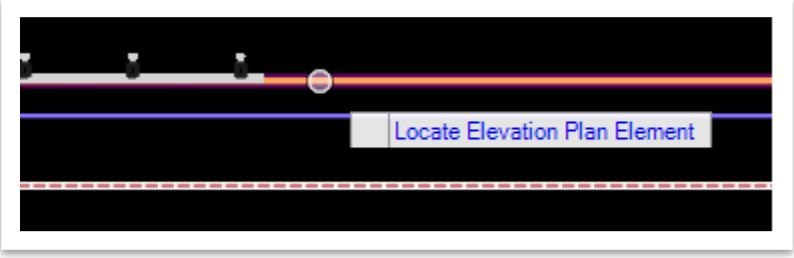
Terminal *feature definitions and cell names are based on the following:*

- ***Left/Right:*** *The side of the roadway centerline that the terminal is placed on when facing the direction of up-stationing.*
- ***Start/End:*** *Relative to the direction of travel that the guardrail is placed along.*

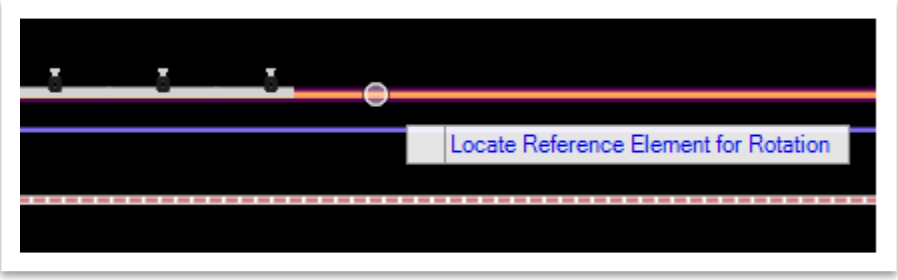
14. Within the **Point** dialog box, select the following settings. **Note:** Some of the fields will not show until you have selected a previous setting (e.g., Elevation Offset will not show until you select the Plan Element Elevation Mode).
    a. **Elevation Mode:** Plan Element
    b. **Elevation Offset:** 2.583 (31” height divided by 12)
    c. **Rotation Mode:** Relative to alignment
    d. **Rotation:** N00°00’00.0”E
    e. **Feature Definition:** Type 38 - Left Start Terminal (**Point >> Roadside Barriers >> End Terminals**)



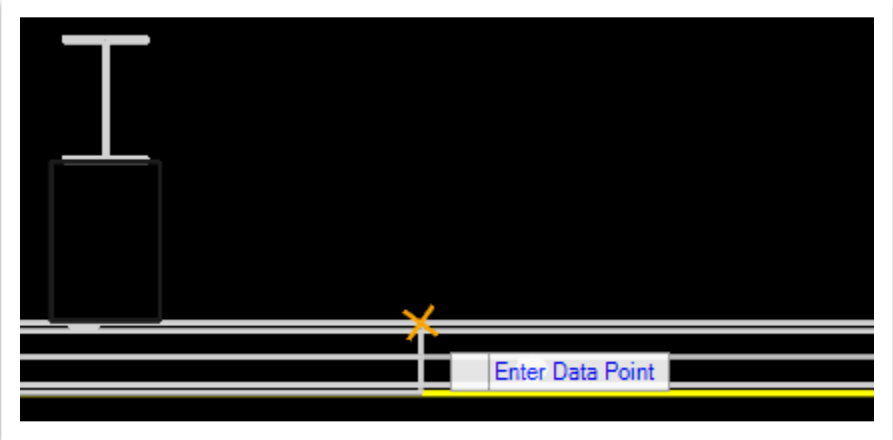
15. Notice the cursor prompt: **Locate Elevation Plan Element**. Select the **GSH_L** line (edge of shoulder).



16. Left click to accept the **Elevation Offset**. Notice the next cursor prompt: **Locate Reference Element for Rotation**. Select the **GSH_L** line (edge of shoulder) once again.



17. Notice the next cursor prompt: **Enter Data Point**. The end terminal should now be on your cursor. Position your cursor at the end of the guardrail, as shown below, and then left click to accept (see note below). Left click again to accept the **rotation** and then right click to clear the tool.

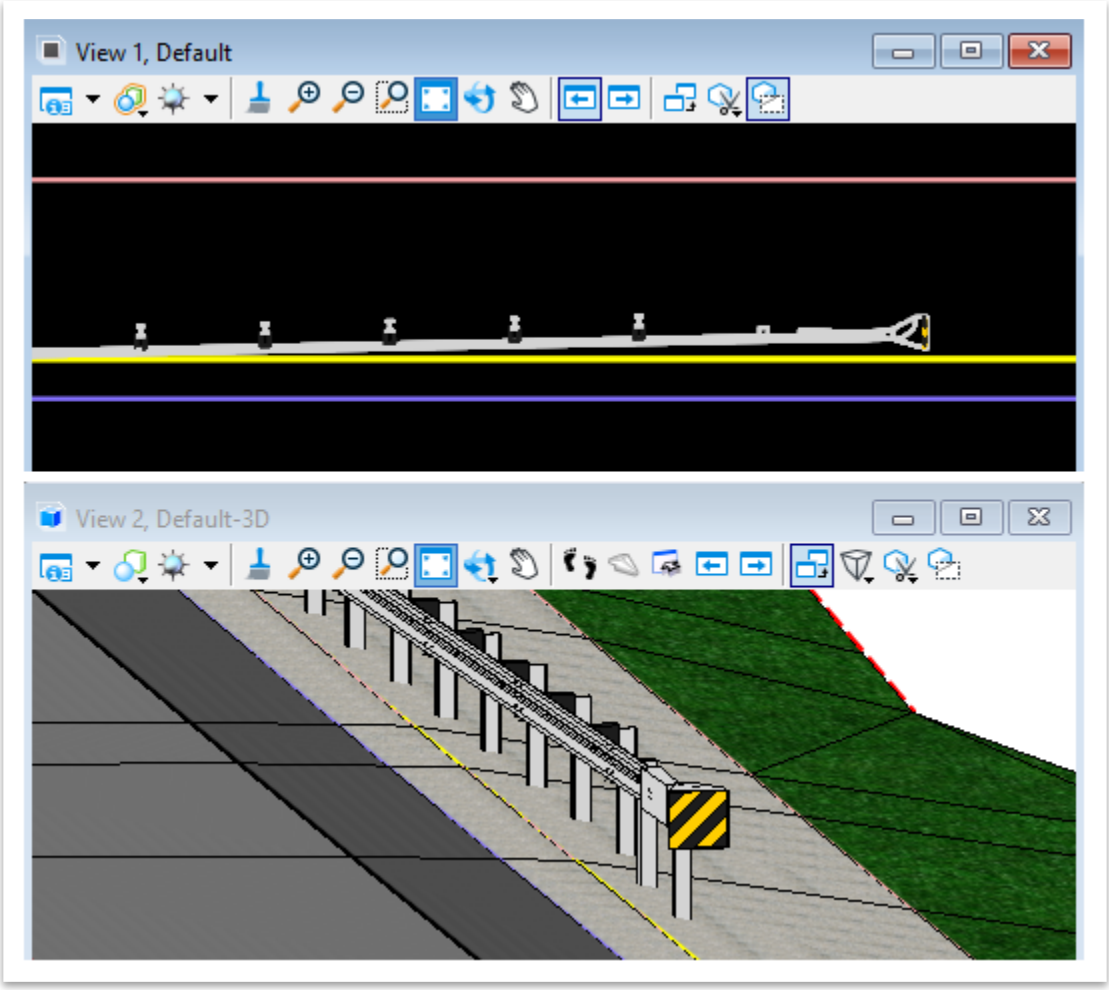


Take Note!

The terminal cells have been setup so that the cell origin is at the back top of the guardrail. This point should align with the back of the guardrail line style. ***You cannot snap*** *to this point, and this will always be an approximation. The terminal cells are for representative purposes only and don't need to be exact. The contractor will be held to the Standard Drawing and not the model.*

The terminal cells have been setup with the ***taper*** *from the standard drawing already implemented. Therefore, on a tangent section, no rotation is required. The cells are straight elements, so if a terminal is placed in a curve, then engineering judgement should be used to ensure that the terminal is properly positioned adjacent to the roadway. Likewise, if a user wanted to place the terminals tangentially and did not want a taper, the desired rotation could be entered to negate the default taper in the cell.*

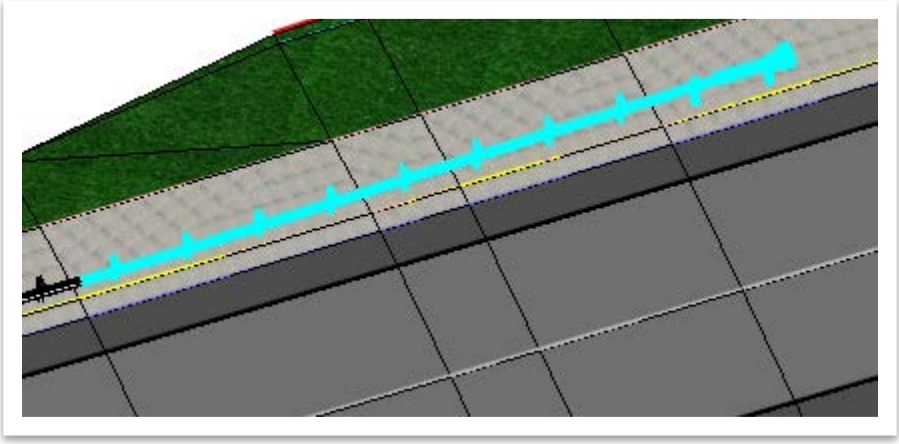
18. The guardrail terminal should now be visible in both the **2D** and **3D** view.



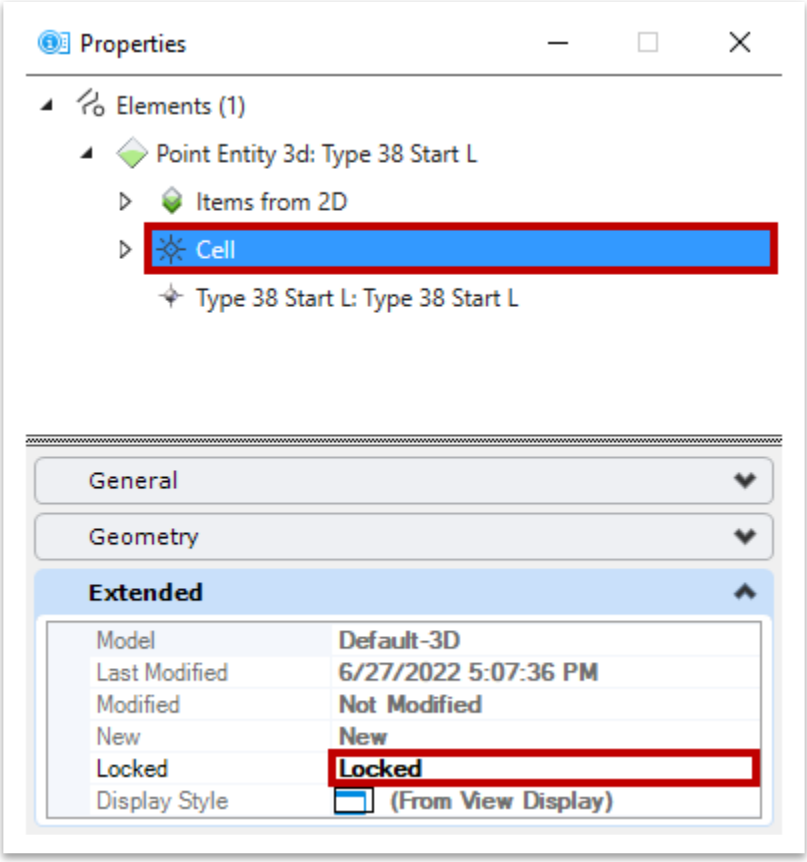
Take Note!

*The placement is correct in the 2D view. However, the placement in the 3D view is correct within the model but the profile of the cell is rotated upwards with respect to the roadway. This is because the terminal cells are placed as **point** cells and the elevation is pulled from the **origin point** and held constant across the length of the cell. Therefore, whenever the vertical profile is not level or in a vertical curve, the 3D cell will require some adjustment to correctly represent the guardrail height along the cell.*

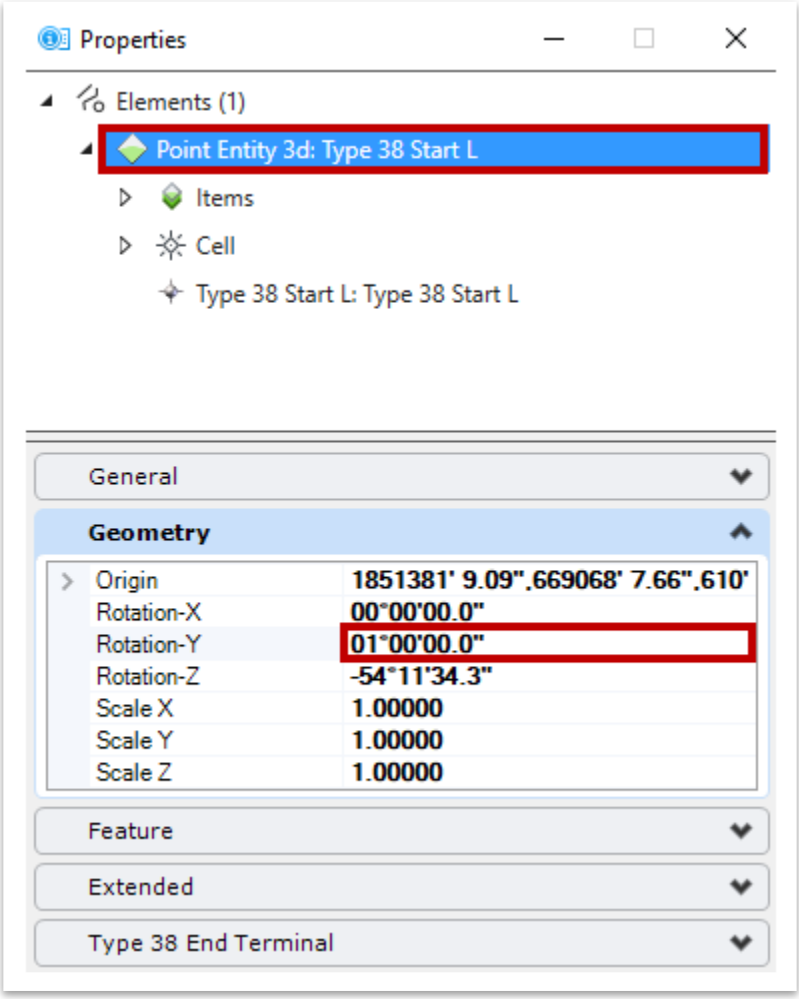
19. To fix the **3D** view, select the terminal cell in the **3D** view and open the **Properties** (if not already opened).



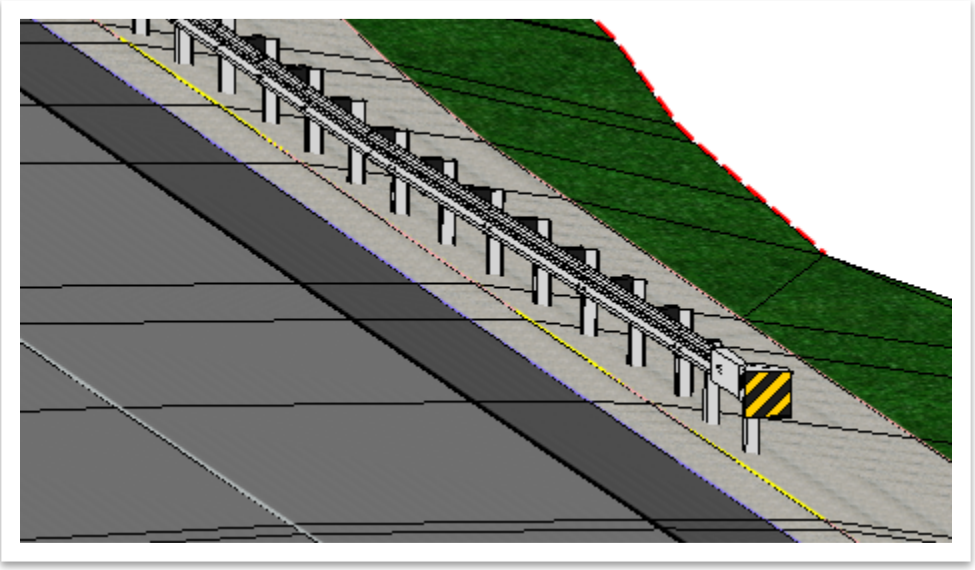
20. Within the **Properties** window, select the **Cell** at the top of the window. Expand the **Extended** tab and set the **Locked** field to **Locked**. **Note:** This removes the link between the 2D cell and its 3D visualization and allows for modifications that only affect the **3D** view.



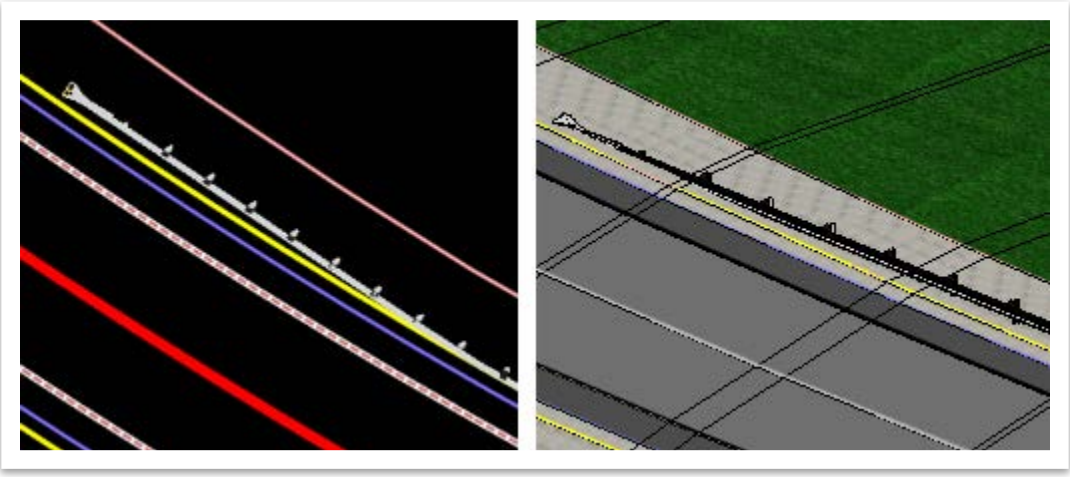
21. Next, select **Point Entity 3d: Type 38 Start L** at the top of the window. Expand the Geometry tab and set the **Rotation-Y** field to **01°00’00.0”**. **Note:** The rotation should be roughly equivalent to the **vertical alignment slope** of the roadway along this element.



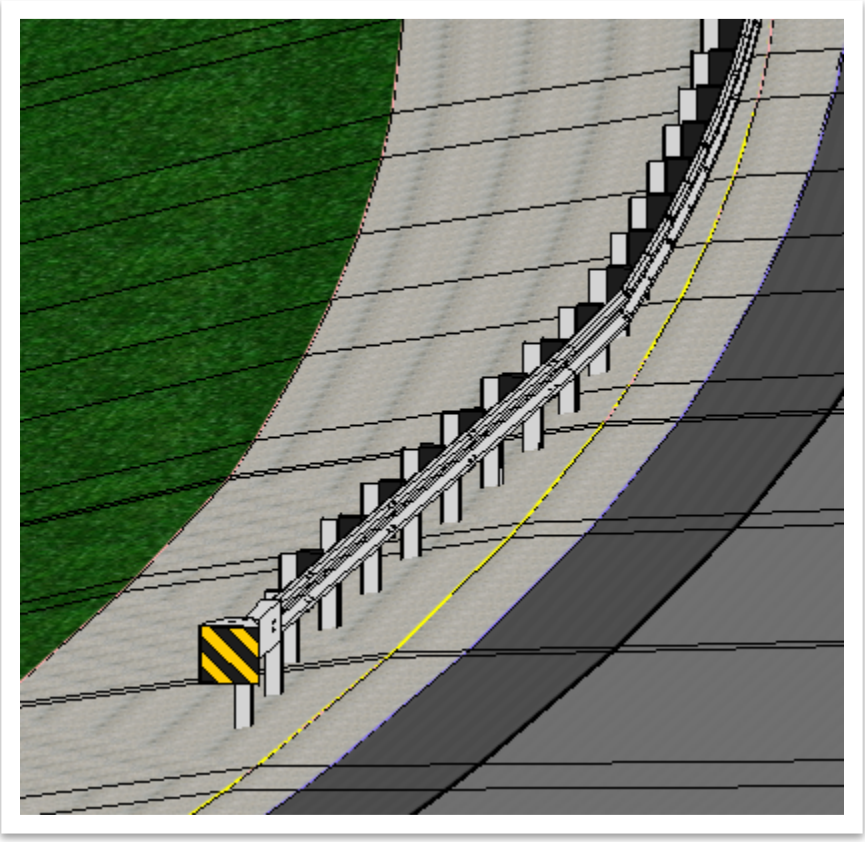
22. Left click anywhere within the **3D** view to deselect and then review the guardrail terminal.



23. Repeat Steps 13-18 to place a **Type 38 - Left End Terminal** at the end of the guardrail. Within the **Point** dialog box, make sure and select the equivalent feature definition to match (**Type 38 - Left End Terminal**). Since this terminal falls within a curved section of the roadway, the rotation angle cannot be N00°00'00"E. If you have trouble figuring out what rotation angle works in this scenario, go ahead and use **N02°55'34.8"E**. All other settings can remain the same as the starting terminal.
24. Once again, the guardrail terminal should now be visible in both the **2D** and **3D** view. Notice that the **3D** cell is digging into the corridor. This is because the **vertical alignment slope** of the roadway is rising along this element.



25. Repeat Steps 19-22 to fix the rotation of this cell in the **3D** view. For this cell, adjust the **Rotation-X** value instead of the Rotation-Y value and set it to **02°30'00.0"**.



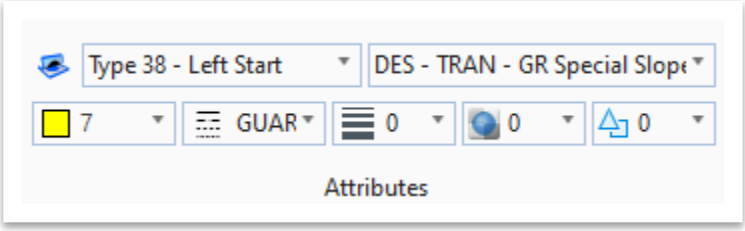
Take Note!

Determining the correct rotation for the terminal cell in 3D is an iterative process. In reality, the rotation is a combination of the X & Y rotation values. However, rotating elements relative to a model in two different planes is complex. It is usually sufficient to rotate the cell in either the X or Y plane to correct its visual representation. Remember, the contractor is held to the standard drawing and not the model and the 2D view is all that is represented on the plan sheets.

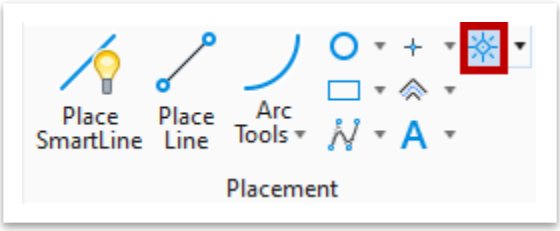
A.3 Exercise: Adding Pad Slope Limits

In this exercise, we will continue the guardrail end terminal placement process and add the pad slope limits to the corridor. We will continue to utilize the same **Appendix A Base File.dgn** file.

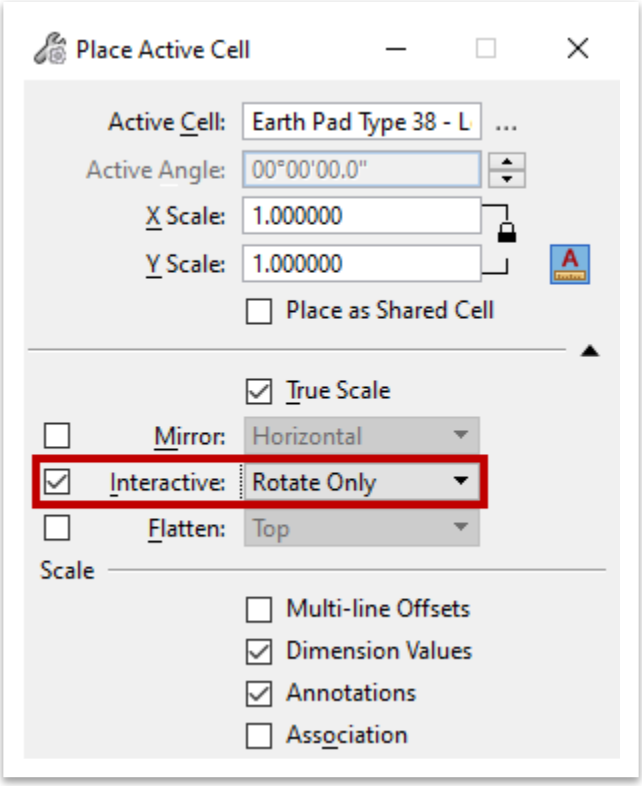
1. Before we place the guardrail terminal pad, we need to select the applicable element template. Go ahead and select the **Type 38 - Left Start** element template (**Design >> Roadside Barriers >> Cells >> Pad Slope Limits**).



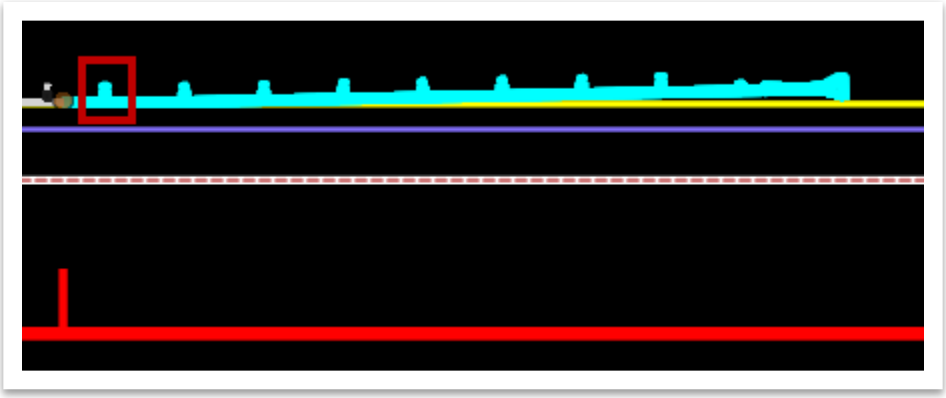
2. Next, open the **Place Active Cell** tool (**OpenRoads Modeling >> Drawing >> Placement >> Cells**). **Note:** Make sure the **2D** view is active.



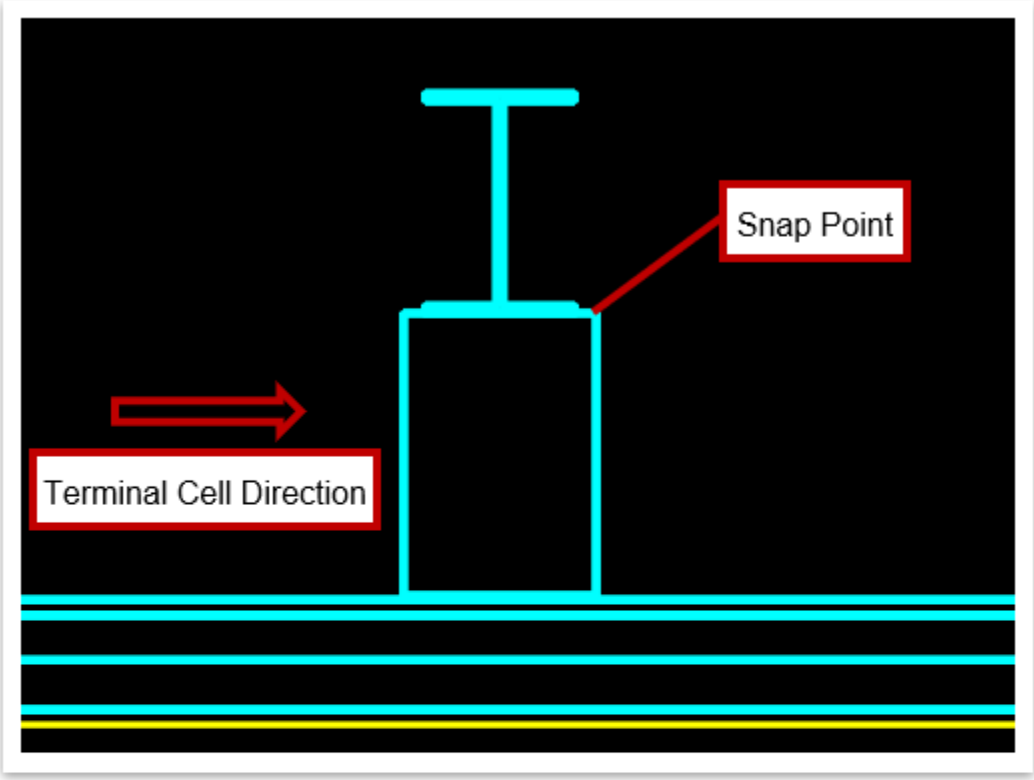
3. Notice in the **Place Active Cell** window it automatically calls the correct **Active Cell** (**Earth Pad Type 38 - Left Start Terminal**). Checkmark **Interactive** and select **Rotate Only**.

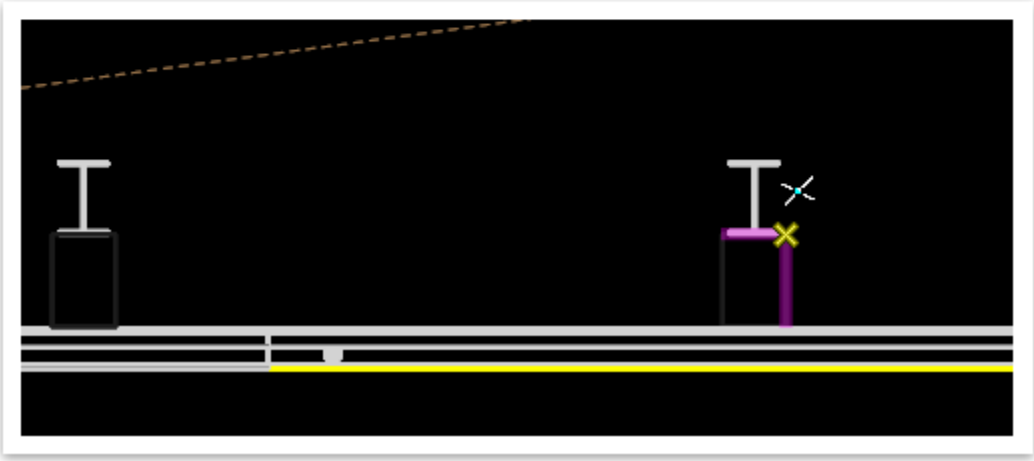


4. Zoom in to the first guardrail post within the **Type 38 - Left Start Terminal** cell (highlighted in red). **Note:** The terminal cell has been selected for easy identification in the screenshot. You do not need to select it.

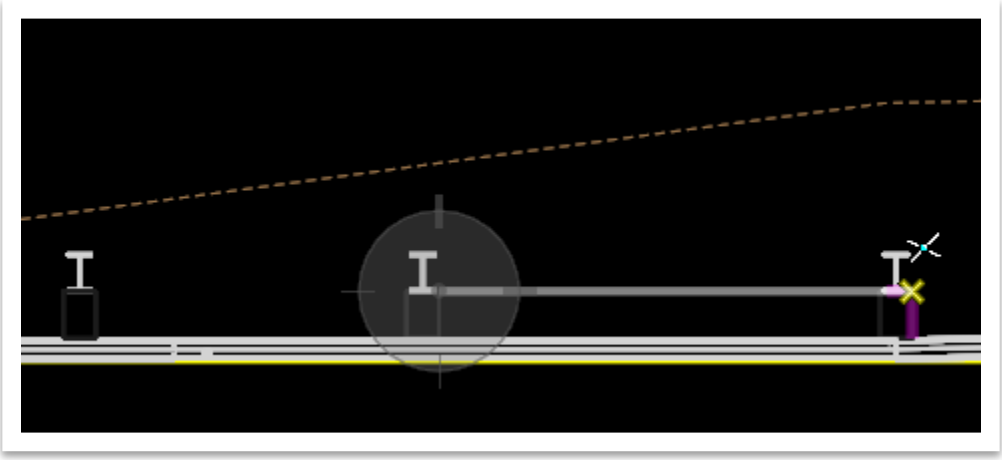


5. To place the pad slope limit cell in the correct location, snap to the back corner of the **blockout** attached to the first guardrail post of the linestyle, not the cell. **Note:** <u>All pad slope limit cells utilize this snap location</u>.

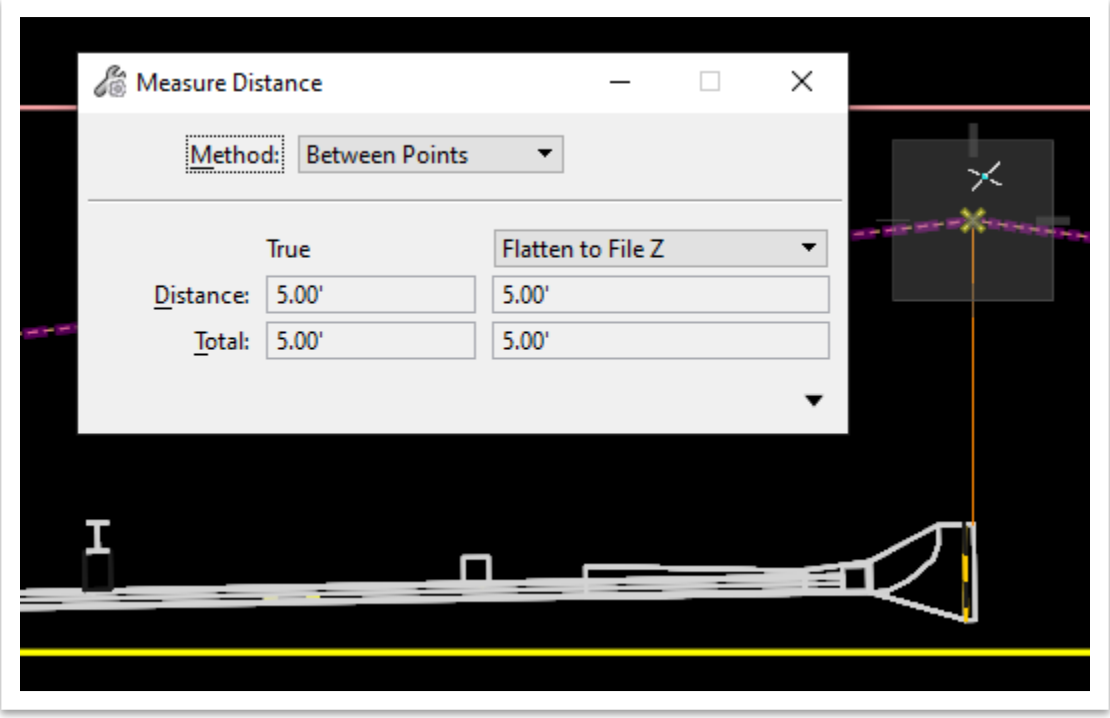




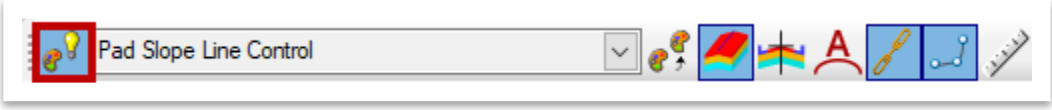
6. Now we need to input a **rotation** for the cell. The easiest thing to do is to snap to the back corner of the **blockout** attached to the next guardrail post, which will form a straight line between the two snaps. Right click to clear the tool.



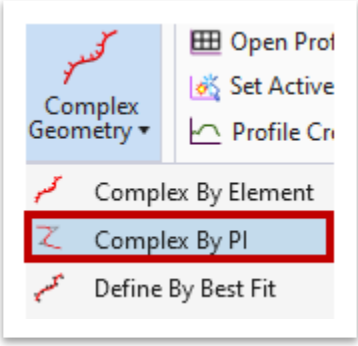
7. Let's review the placement of the cell. Open the **Measure Distance** tool (**OpenRoads Modeling >> Drawing >> Measure**) and make sure the **Method** is set to **Between Points**. Measure the distance from the edge of the terminal impact head to the edge of the pad slope limit line, which should be **5.00'** if the terminal was placed correctly.



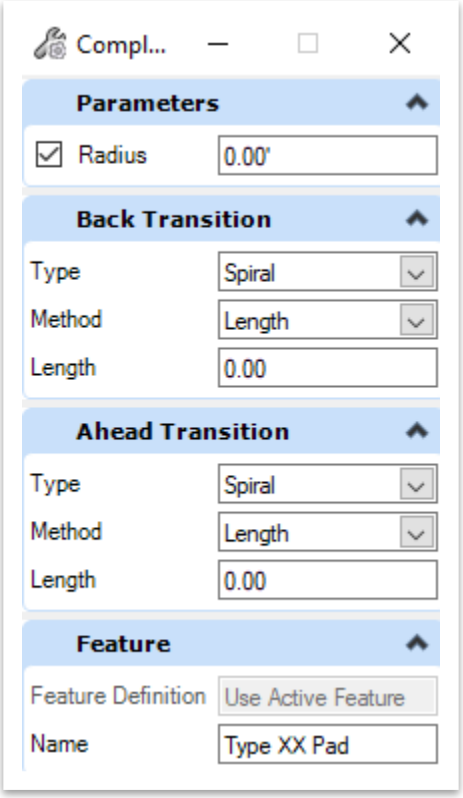
8. Next, we need to trace the pad slope limit line and create complex geometry. Select the **Pad Slope Line Control** feature definition (**Linear >> Roadside Barriers >> Pad Slope Limits**). Make sure that the **Use Active Feature Definition** is on.



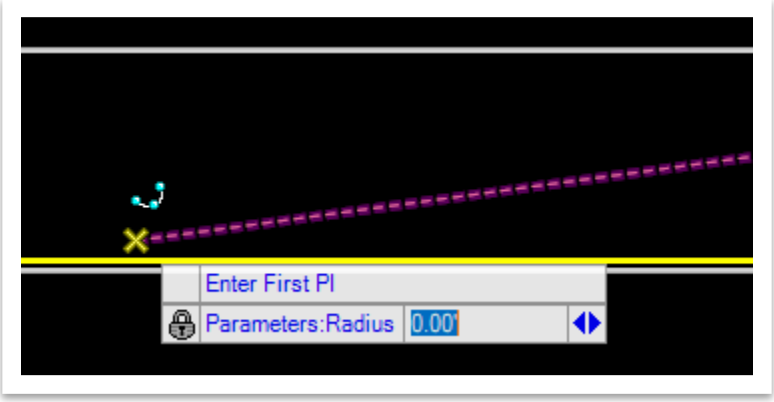
9. Open the **Complex by PI** tool (**OpenRoads Modeling >> Geometry >> Horizontal >> Complex Geometry**).



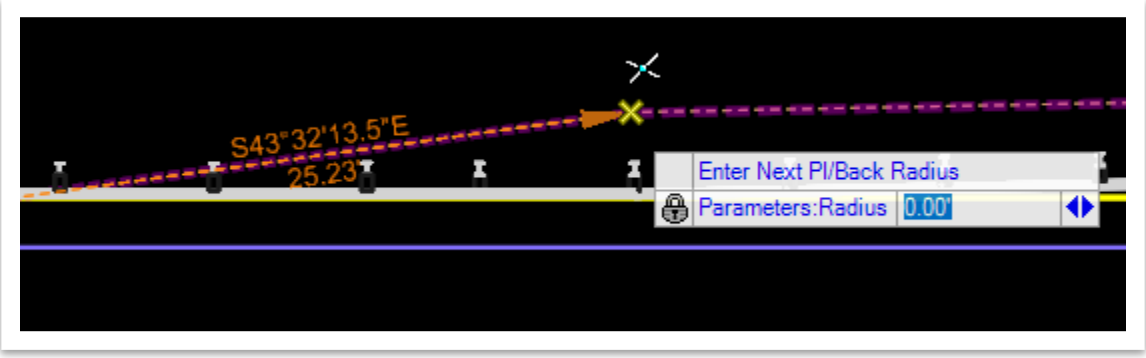
10. Within the **Complex Element By PI** dialog box, set the **Radius** to **0.00'**. Leave all other settings as-is.



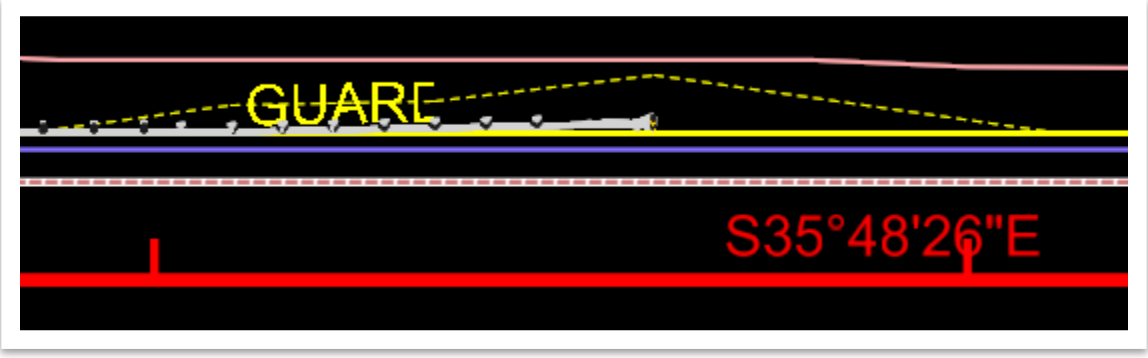
11. Notice the cursor prompt: **Enter First PI**. Select the first point, as shown below.



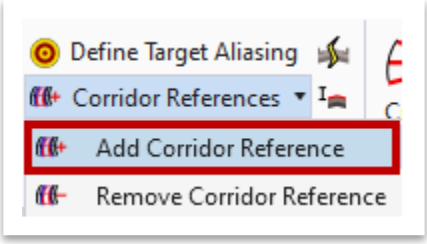
12. Trace over the remaining pad slope limits line by selecting each **PI** point and then right click to complete the complex geometry. **Note:** The second point is shown below.



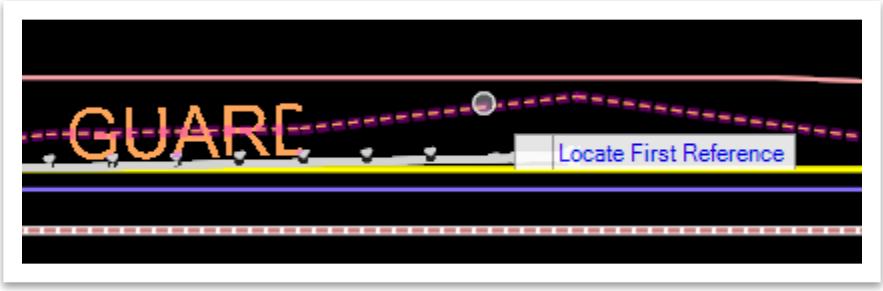
13. Go ahead and delete the original pad slope limits line (cell) that was placed earlier in the exercise. Its sole purpose was to serve as a guide so that the pad slope limit could be placed correctly with relation to the end terminal.



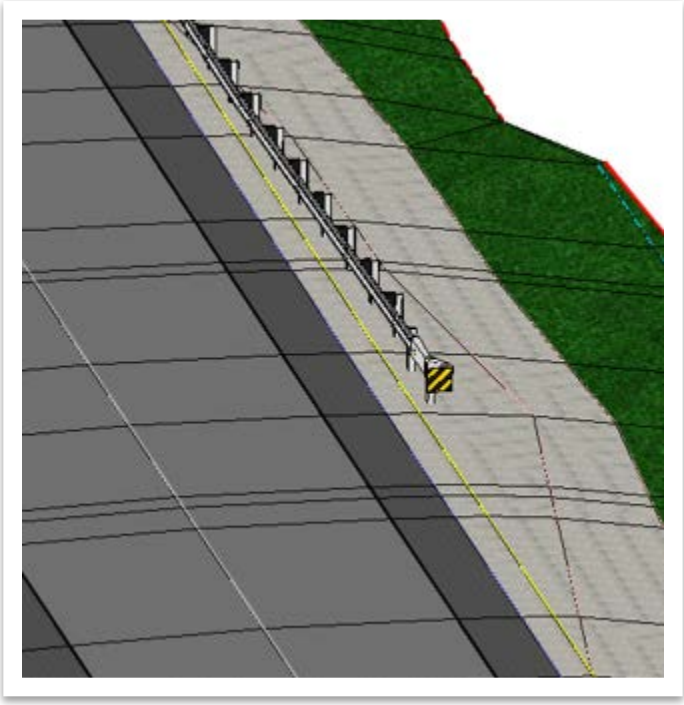
14. Now we need to add the pad slope limit to the corridor. Open the **Add Corridor Reference** tool (**OpenRoads Modeling >> Corridors >> Miscellaneous >> Corridor References**).



15. Notice the cursor prompt: **Locate Corridor**. Select the **GENESCO_TEST** corridor. Notice the next cursor prompt: **Locate First Reference**. Select the **pad slope limit** complex geometry and then right click to complete.



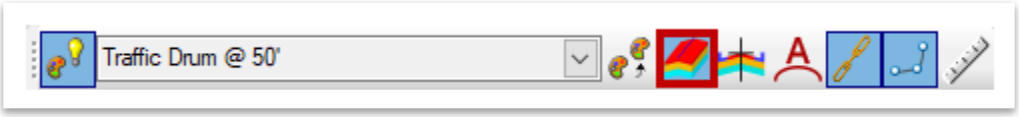
16. Both the **2D** and **3D** models should automatically update with the pad slope limits. **Note:** The complex geometry should not have a profile assigned. Also, if your model does not show the pad slope limit updates, close and re-open ORD.



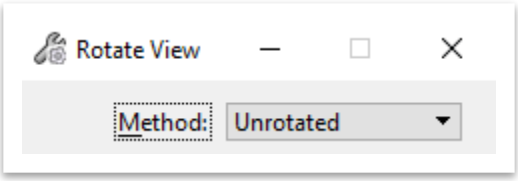
A.4 Exercise: Traffic Control – Placing Traffic Drums

In this exercise, we will place traffic drums along the corridor utilizing the new 3D line styles. We will continue to utilize the same **Appendix A Base File.dgn** file.

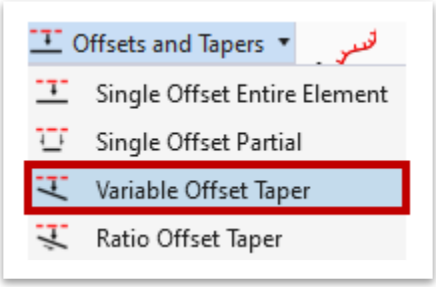
1. Before we place the traffic drums, we need to select the applicable feature definition. Go ahead and select the **Traffic Drum @ 50'** feature definition (**Linear >> Traffic Control**). Make sure the **Create 3D Automatically** toggle (highlighted) is still on.



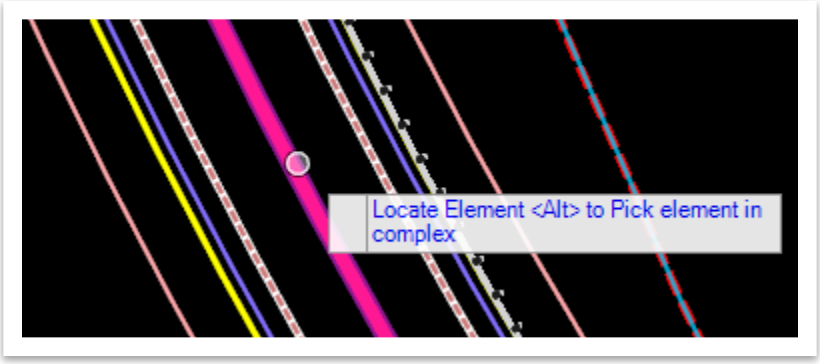
2. Make sure the **2D** view is active and then rotate the view by setting the **Method** to **Unrotated**.



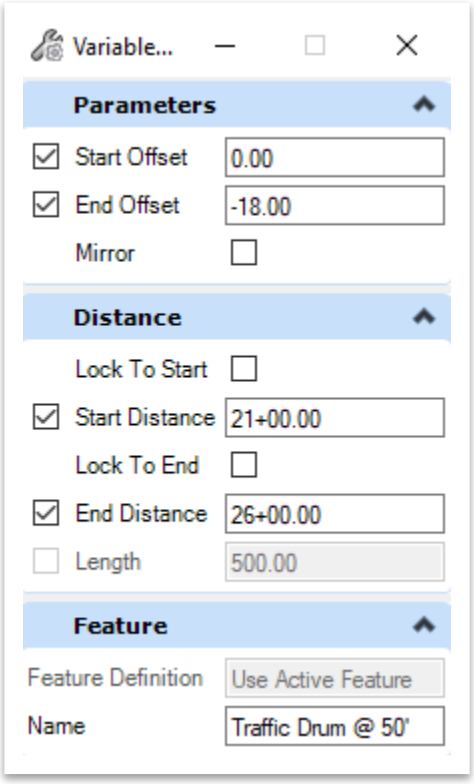
3. Now we will place the traffic drums in the **2D** view. Open the **Variable Offset Taper** tool (**OpenRoads Modeling >> Geometry >> Horizontal >> Offsets and Tapers**).



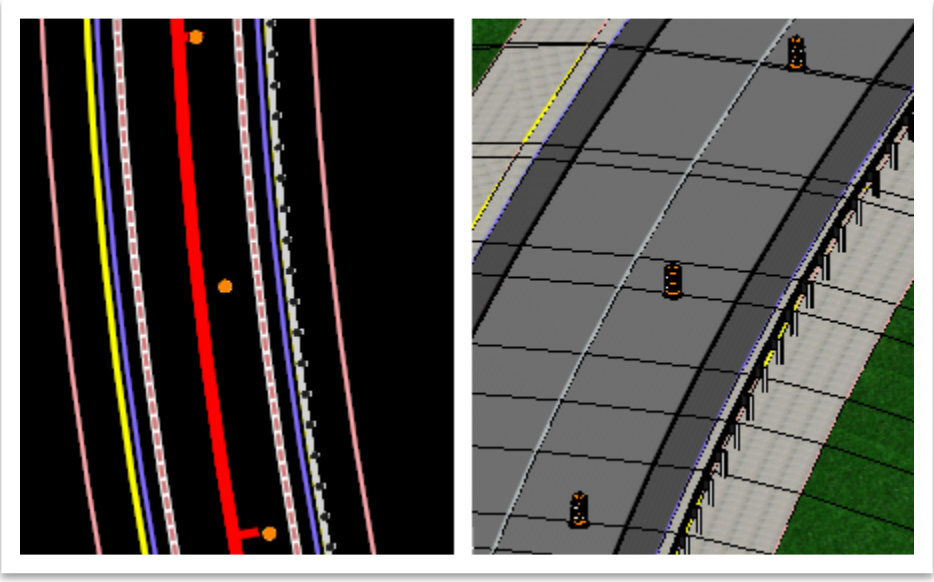
4. Notice the cursor prompt: **Locate Element**. Select the **GENESCO_TEST** alignment in the **2D** view.



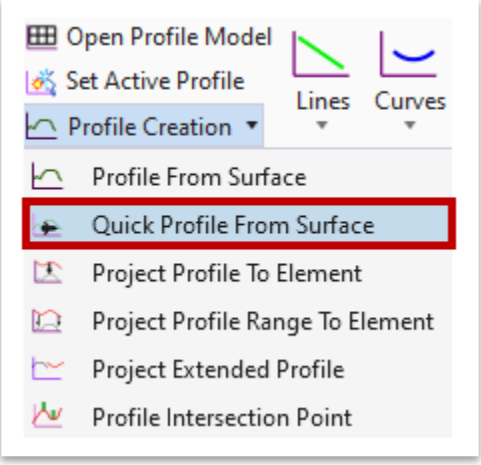
5. For this exercise, we are going to taper the **northbound** lane from **18’** down to **0’** over a **500’** length. Within the **Variable Offset Taper** dialog box, select the following settings.
    a. **Start Offset:** 0.00
    b. **End Offset:** -18.00
    c. **Start Distance:** 21+00.00
    d. **End Distance:** 26+00.00



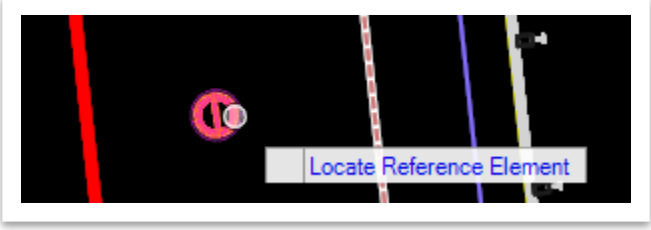
6. Left click through the prompts to accept the settings and give it a second to process. Notice that the **2D** and **3D** traffic drums now appear within the station range.



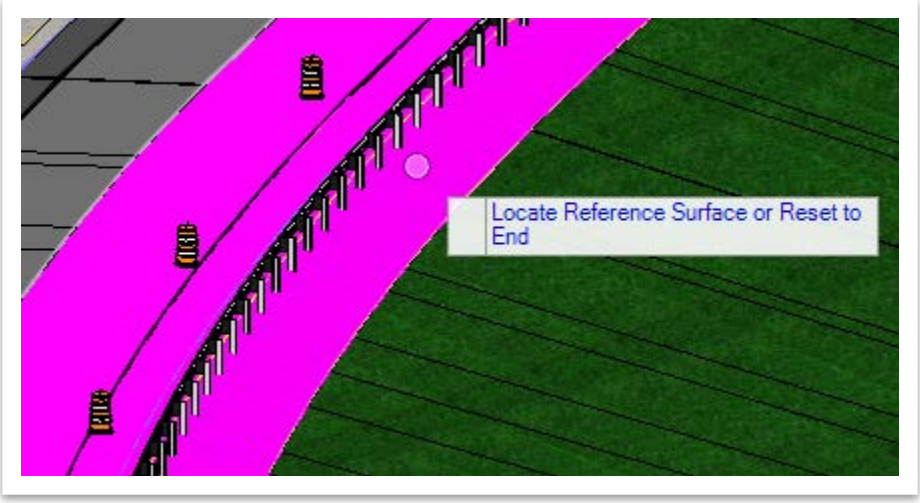
7. Due to the superelevation, the profile of the **3D** line does not follow the surface. To correct this, open the **Quick Profile From Surface** tool (**OpenRoads Modeling >> Geometry >> Vertical >> Profile Creation**).



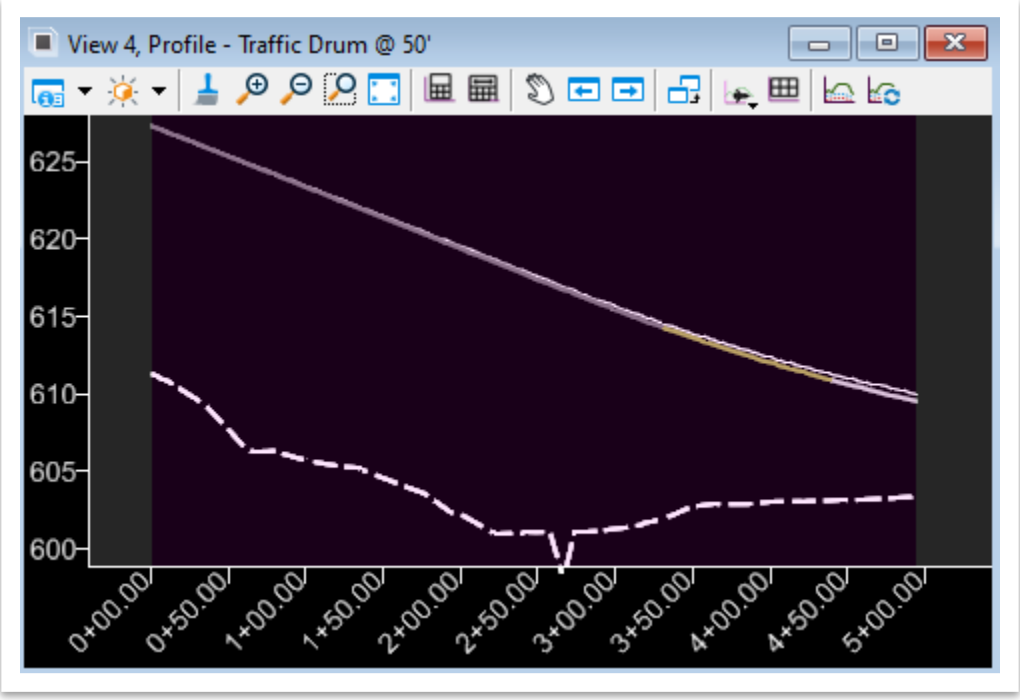
8. Notice the cursor prompt: **Locate Reference Element**. Select one of the traffic drums in the **2D** view to select the entire complex element.



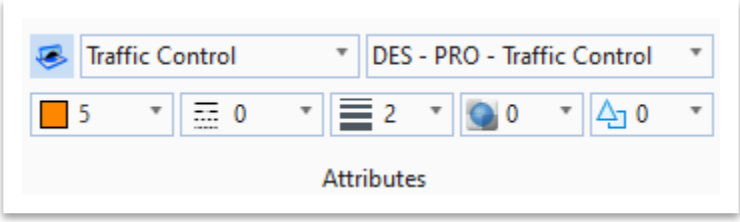
9. Notice the next cursor prompt: **Locate Reference Surface**. In the **3D** view, select all the corridor surface terrains that the traffic drum complex element crosses, which should be the **3** surface terrains to the right of the centerline. **Note:** To select, left click each terrain until all are highlighted. If you have any issues selecting the surface terrains, **reset** without selecting a surface and then repeat the process.



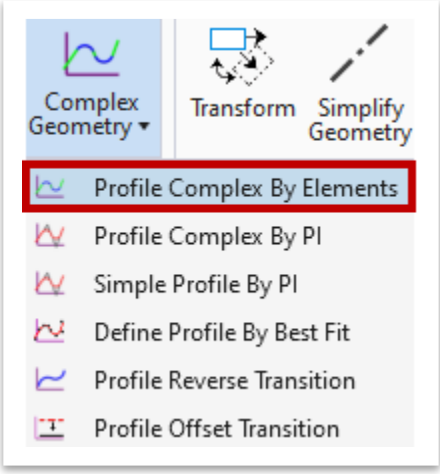
10. Once all terrains are selected, right click to complete and give it a second to process. Now, open the **Open Profile Model** tool (**OpenRoads Modeling >> Geometry >> Vertical**) and select the traffic drum complex element in the **2D** view. Open **View 4** and left click within to view the profile. Since 3 surface terrains were selected, you should see **3** individual profile lines (different colors) that make up the traffic drum profile.



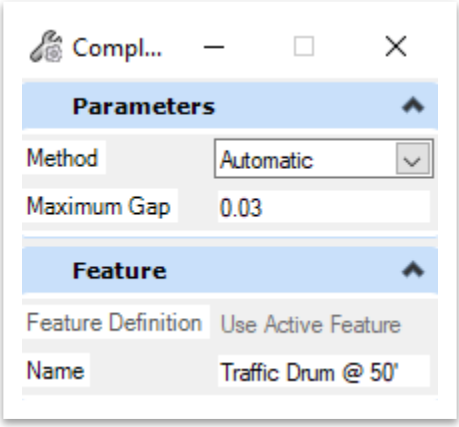
11. Next, we need to complex the three individual profile lines. First, however, select the **Traffic Control** element template (**Design >> Profiles >> Lines >> Traffic Control**).



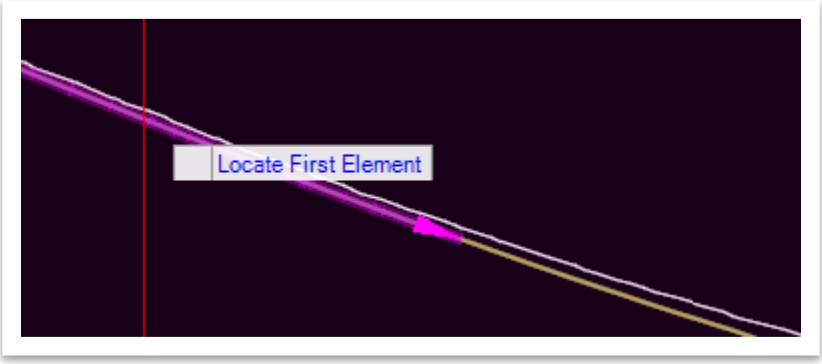
12. Open the **Profile Complex By Elements** tool (**OpenRoads Modeling >> Geometry >> Vertical >> Complex Geometry**).



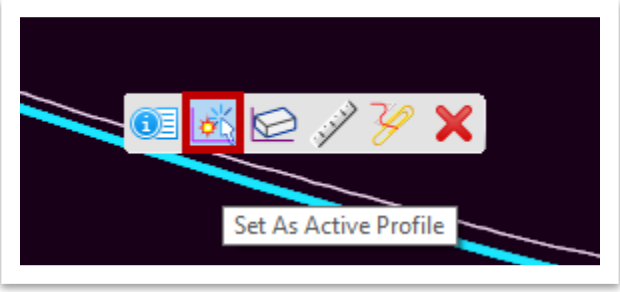
13. Within the **Complex Element** dialog box, set the **Method** to **Automatic** and leave all other settings as-is.



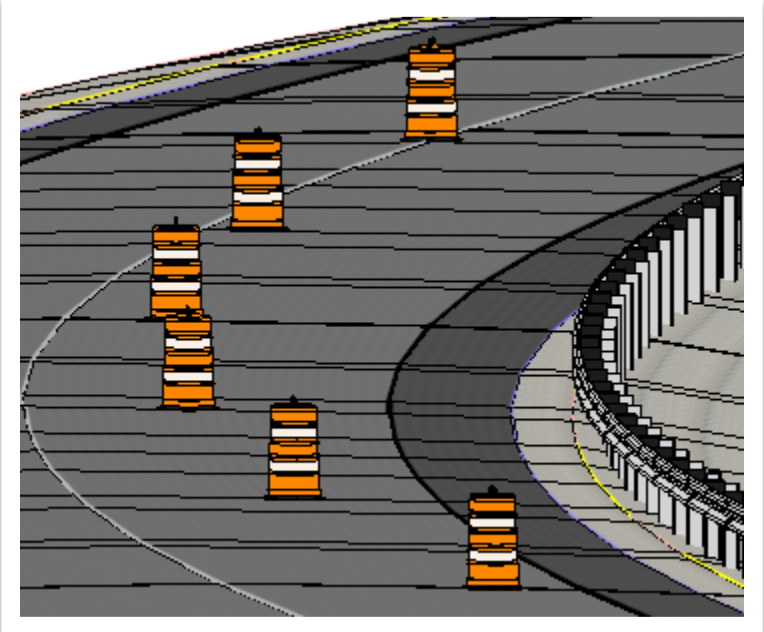
14. Notice the cursor prompt: **Locate First Element**. Select the first profile line of the traffic drum profile and then left click to accept complex.



15. Select the new complex traffic drum profile and then hover over it and **Set As Active Profile** in the heads-up display.



16. Close View 4 and notice that the traffic drums now follow the roadway surface.

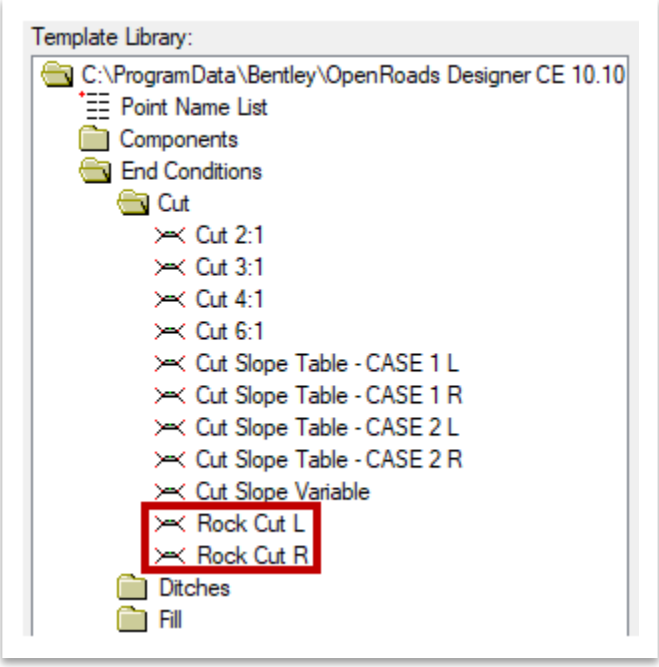


A.5 Lecture: Rock Cut Slopes and Catchments – Benching

A common requirement for rock cut slopes and catchments is to provide breaks along high cuts and fills with flatter sections known as **benches**. Project requirements will specify the height, slope and number of benches needed depending on the length or height of these slopes.

TDOT's default template library may not contain every required design scenario. It does, however, contain **Benching** templates that align with TDOT Standard **RD11-S-11B** with inputs for **WT** and **W1**. These templates (**Rock Cut L** and **Rock Cut R**) can be found in the **End Conditions >> Cut** folder and should be used in scenarios where no intermediate benching is required (Figure 133).

FIGURE 133. BENCHING TEMPLATES



For scenarios requiring intermediate benching, the user will need to build a template component based on the project site's geotechnical information, which will be demonstrated in the next exercise.

A.5.1 End Conditions - Benching

The software allows the user to define benching as an **End Condition** component, which seeks the existing ground by placing a flat bench (as set by user parameters) and repeating until the target is reached.

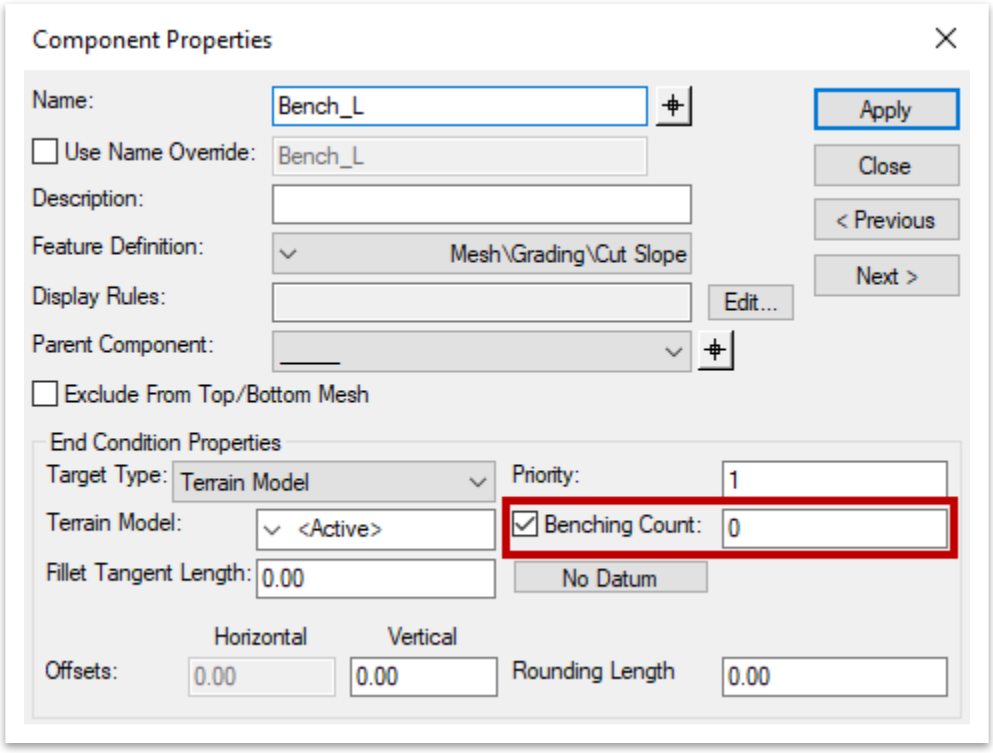
There are two methods that the bench elevation can be defined by:

- Relative to the hinge point of the end condition.
- Relative to a datum defined by the bench steps.

To create an end condition with benching, the user must toggle on **Benching Count** within the **Component Properties** under **End Condition Properties** (Figure 134). This will set the segment to repeat until a solution is found.

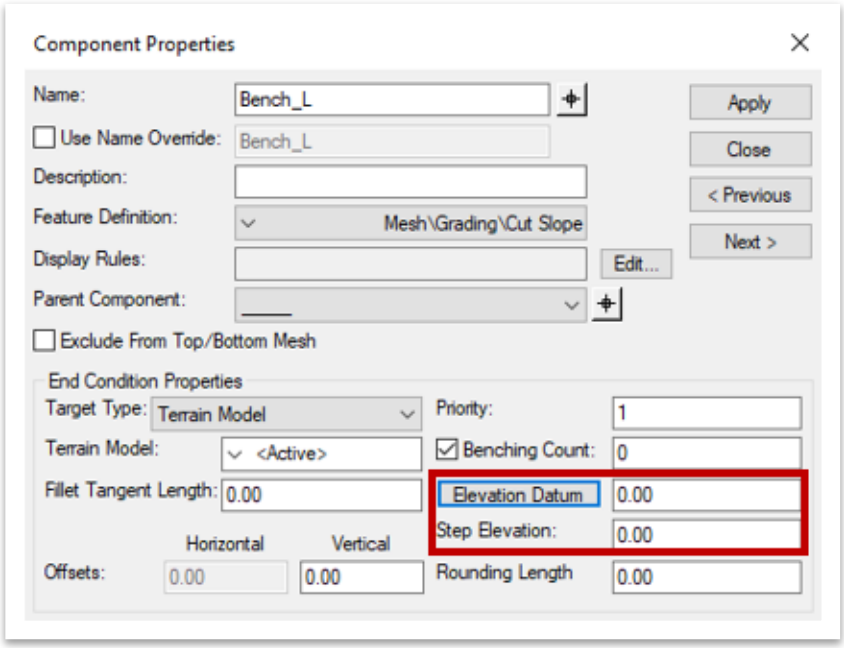
The **Benching Count** indicates the maximum number of times that the benching component will repeat. If the value is set to **0**, the repeat count is set to **infinity**, and the end condition must find the **Target Type** that is set within the **End Condition Properties** for it to solve. If the value is set to anything other than 0, the end condition will solve up to the benching count. If it still does not have a target, it will project until it reaches the target type without additional benches.

FIGURE 134. BENCHING COUNT TOGGLE



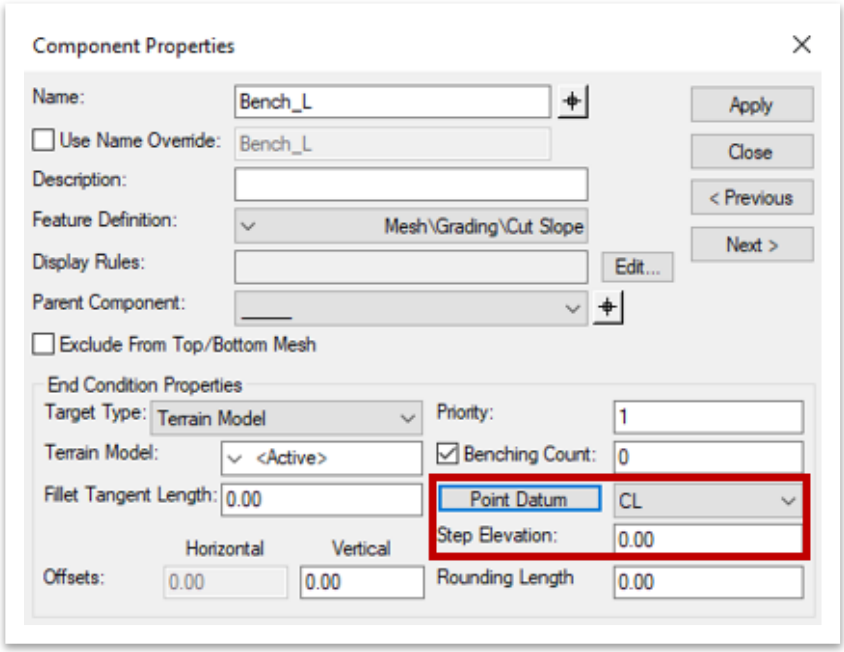
If enabled, the **Elevation Datum** will set the benching rather than using the defined end condition segments (Figure 135).

FIGURE 135. ELEVATION DATUM



The **Step Elevation** indicates the benching increment when a datum is being used. Each bench elevation is located at the end of the first segment of the benching end condition (Figure 136).

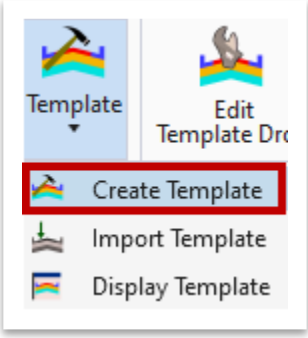
FIGURE 136. STEP ELEVATION



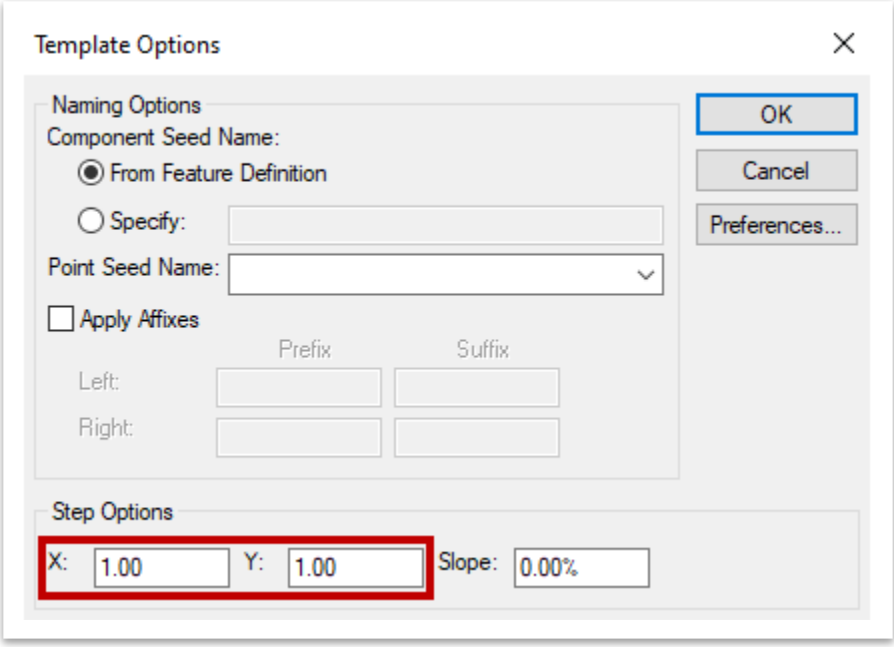
A.5.2 Exercise: Create an End Condition with Benching – Rock Cut

In this exercise, we will create a new end condition for a repeating bench slope in a rock cut scenario. We will continue to utilize the same **Appendix A Base File.dgn** file.

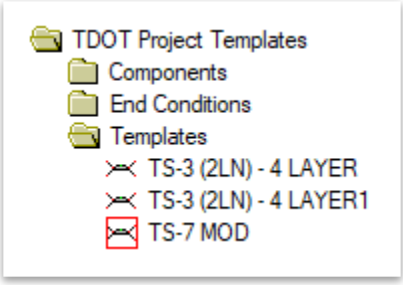
1. Open the **Create Template** tool (**OpenRoads Modeling >> Corridors >> Create >> Template**). **Note:** If the default TDOT ITL loads rather than your project ITL that we created earlier in the manual, go to **File >> Open** and browse to the **Civil Templates-TDOT.itl** file in the **123456.00_INITIALS >> Standards >> Template Library** folder.



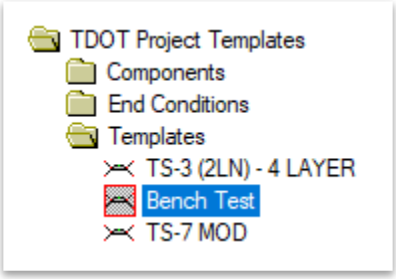
2. Within the **Create Template** window, go to **Tools >> Options** to open the **Template Options** dialog box. Set the **X** and **Y Step Options** to **1.00** and then click **OK**. **Note:** If you see that the default TDOT ITL has loaded rather than your project ITL that we created earlier in the manual, go to **File >> Open** and browse to the **Civil Templates-TDOT.itl** file in the **123456.00_INITIALS >> Standards >> Template Library** folder.



3. Scroll down to the **TS-3 (2LN) - 4 LAYER** template (**Linear Templates >> TDOT Typical Sections >> Undivided**). Right click on the template and select **Copy**. Scroll down to the bottom and **Paste** this template in the **TDOT Project Templates >> Templates** folder. **Note:** Refer to the Note in Step 1 if you don't see the other two custom templates, as shown below.

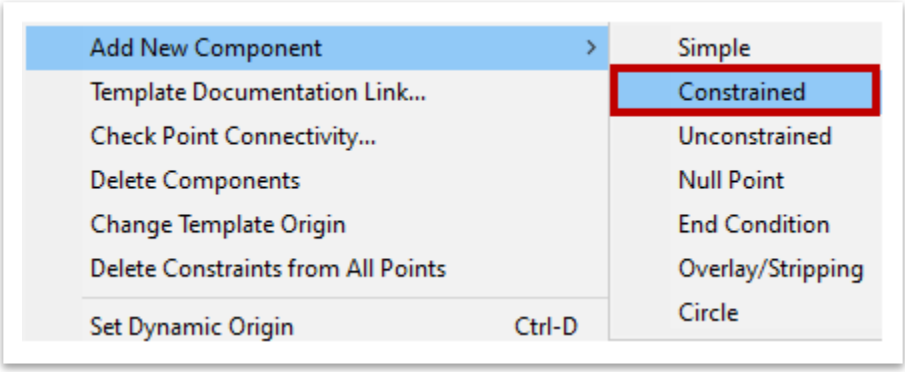


4. Right click on the **TS-3 (2LN) - 4 LAYER1** template and select **Rename**. Rename the template **Bench Test**. Then, double click on the template to open it in the edit template window.

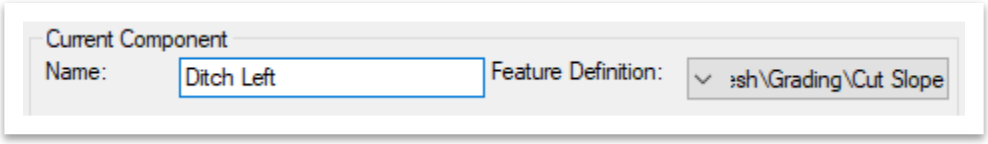


5. We are now going to delete the **left end condition** components. Right click anywhere within the edit template window and select **Delete Components**. Left click and hold and draw a continuous line that crosses the left end conditions, as shown below, and then release the hold.

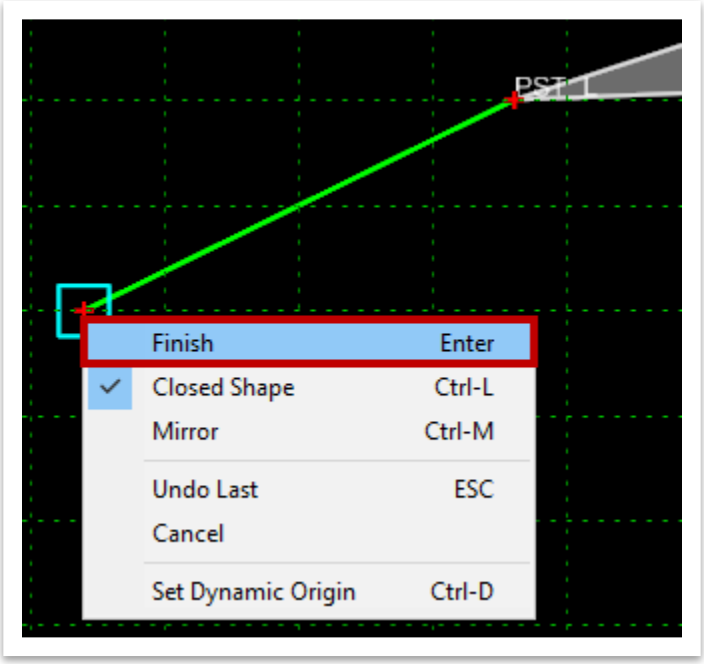
6. Next, let's create a constrained component. Right click anywhere within the edit template window and select **Add New Component >> Constrained**.



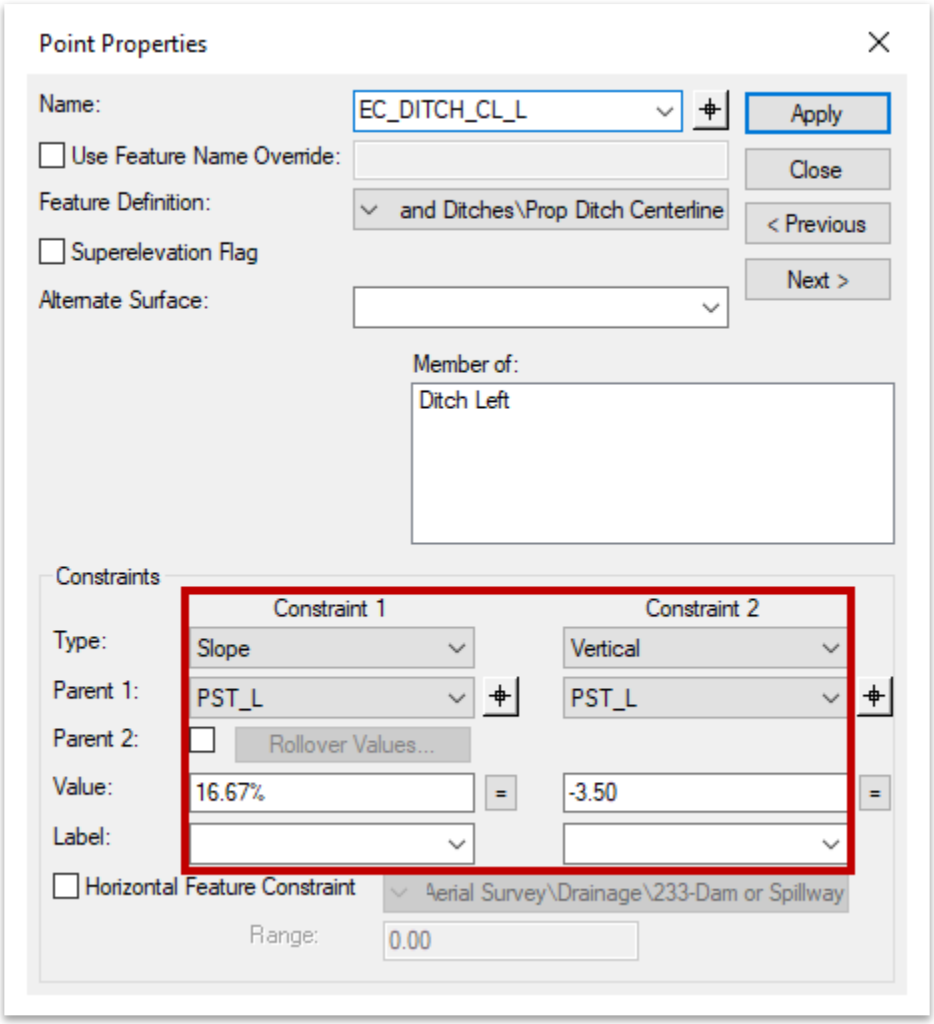
7. Below the edit template window, select the following settings under **Current Component**.
   a. **Name:** Ditch Left
   b. **Feature Definition:** Cut Slope (**Mesh >> Grading**)



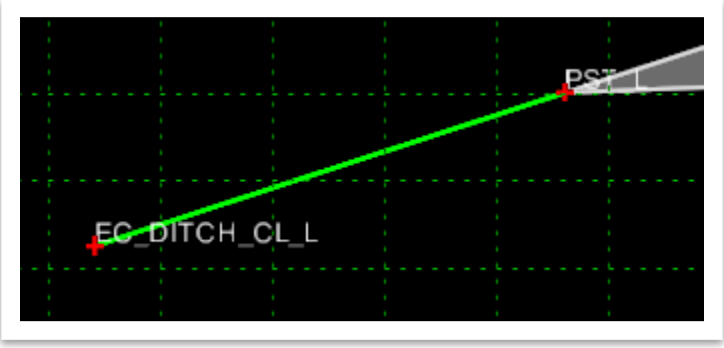
8. Snap to the **PST_L** point and then place one point to the left, as shown below. After placing the point, right click on the point and select **Finish**. **Note:** Don't worry about matching the exact point location. We will key-in specific constraints in the next step.



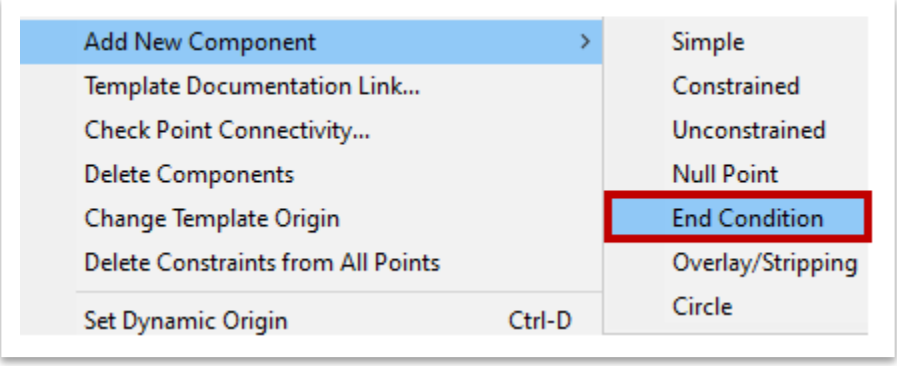
9. Now, double click on the new point to open the **Point Properties** dialog box and update the following settings. Then, click **Apply** and **Close**.
    a. **Name:** EC_DITCH_CL_L (select from drop-down list)
    b. **Feature Definition:** Prop Ditch Centerline (**Linear >> Roadway >> Grading and Ditches**)
    c. **Constraints 1 and 2:** Match highlighted section below



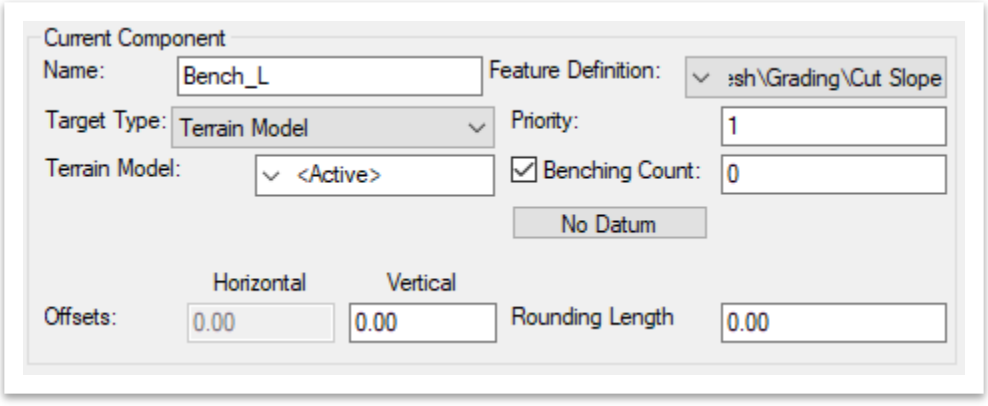
10. Notice that the new point has now been updated.



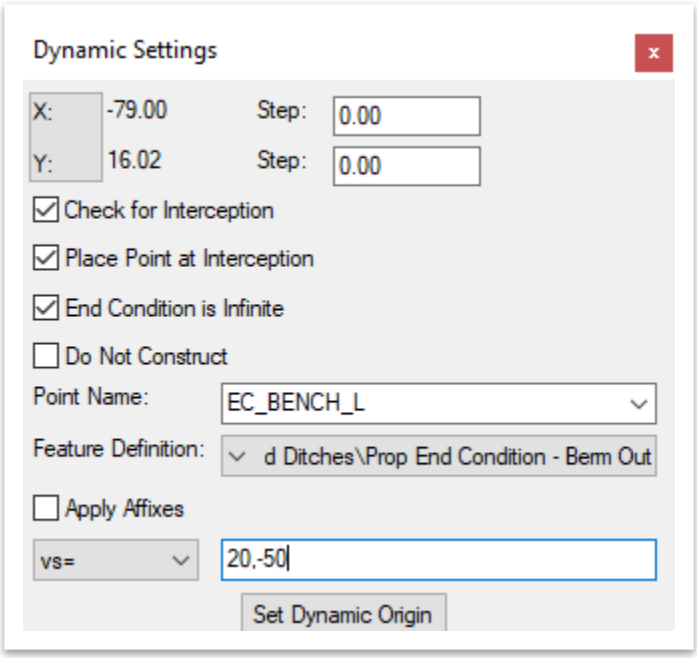
11. Next, let's create an end condition component. Right click anywhere within the edit template window and select **Add New Component >> End Condition**.



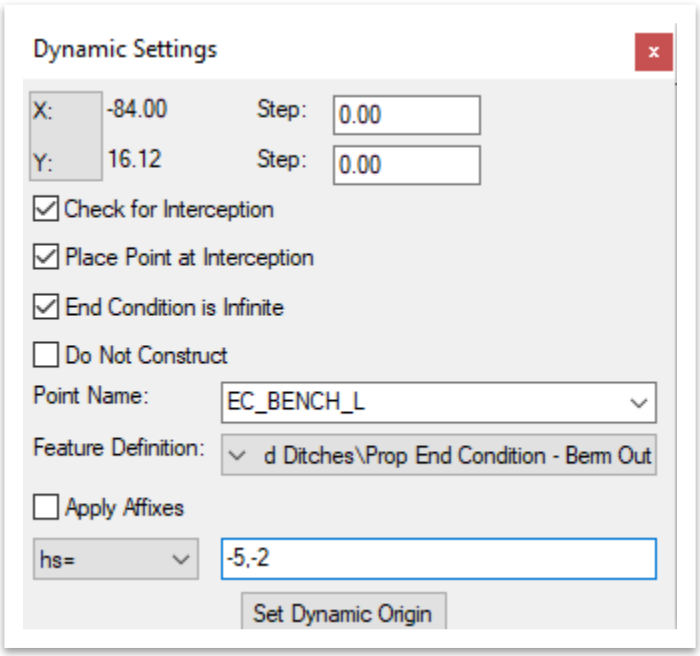
12. Below the edit template window, select the following settings under **Current Component**.
    c. **Name:** Bench_L
    d. **Feature Definition:** Cut Slope (**Mesh >> Grading**)
    e. **Benching Count:** Checkmark and set to 0



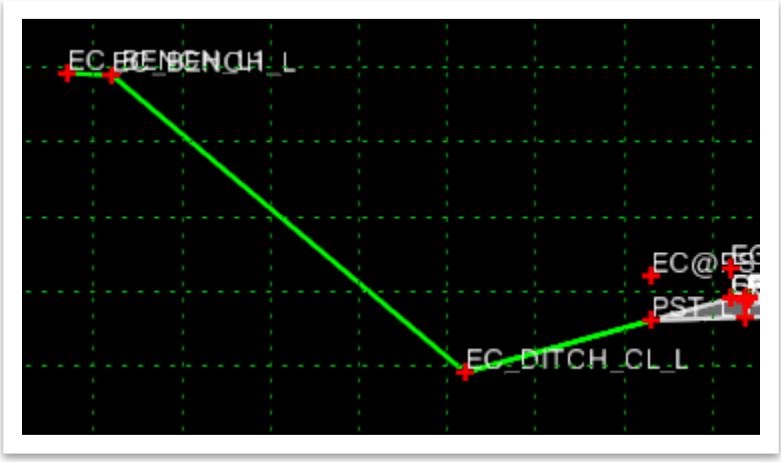
13. Within the **Create Template** window, go to **Tools >> Dynamic Settings** to open the **Dynamic Settings** dialog box. Snap to the **EC_DITCH_CL_L** point. While the command is still active, select the following settings within the **Dynamic Settings** dialog box and then hit **Enter** to place the point. **Note:** Ignore the **X,Y** values. They will populate based on where your cursor is and do not affect the point placement.
    a. **Check for Interception:** Checkmark
    b. **Place Point at Interception:** Checkmark
    c. **End Condition is Infinite:** Checkmark
    d. **Point Name:** EC_Bench_L (select from drop-down list)
    e. **Feature Definition:** Prop End Condition - Berm Out (This will auto-populate once the point name is selected from the point name list.)
    f. **vs=:** 20,-50



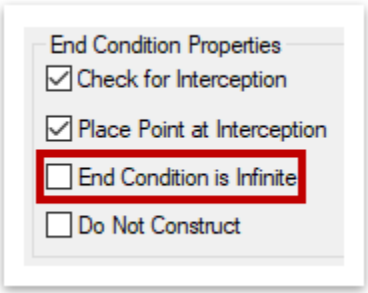
14. Now we will place another point. With the **Dynamic Settings** dialog box still active, select the following settings and then hit **Enter**. **Note:** Once again, ignore the **X,Y** values. They will populate based on where your cursor is and do not affect the point placement.
    a. **Check for Interception:** Checkmark
    b. **Place Point at Interception:** Checkmark
    c. **End Condition is Infinite:** Checkmark
    d. **Point Name:** EC_Bench_L (select from drop-down list)
    e. **Feature Definition:** Prop End Condition - Berm Out (This will auto-populate once the point name is selected from the point name list.)
    f. **hs=:** -5,-2



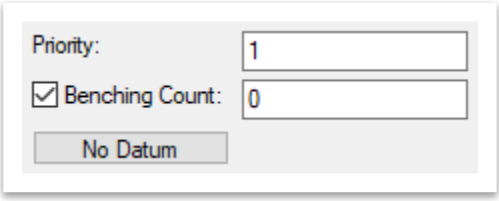
15. Right click and select **Finish** to stop placing points. Go ahead and close the **Dynamic Settings** dialog box.



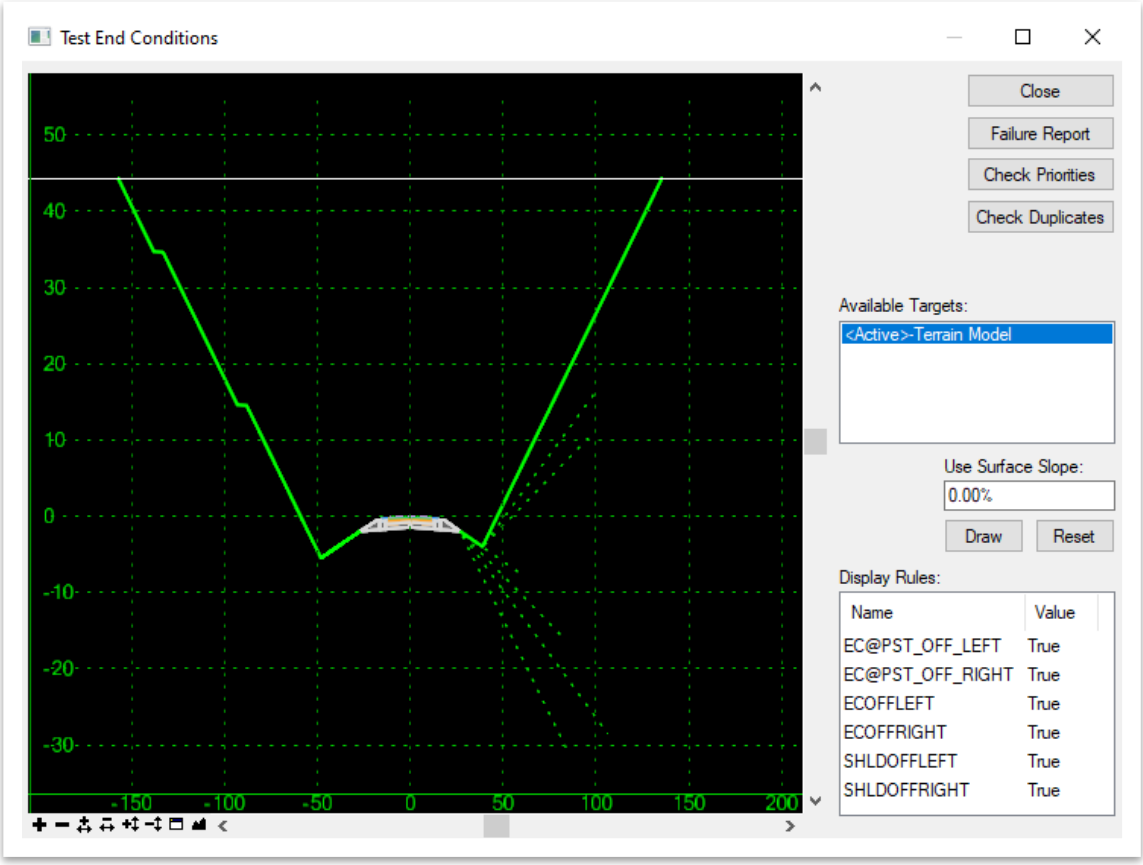
16. Next, double click on the **EC_Bench_L1** point to open the **Point Properties** dialog box. Deselect **End Condition is Infinite**. Then, click **Apply** and **Close**.



17. Now open the **Bench_L** end condition component and make sure that the **Benching Count** is set to **0**. Then, click **Apply** and **Close**.



18. Lastly, we will test the template and see how the end condition performs. Within the **Create Template** window, click **Test** in the lower right corner which will open the **Test End Conditions** window. Click **Draw** and evaluate the new end condition. Close the Test End Conditions window once you are done.



19. Within the **Create Template** window, go to **File >> Save** to save the ITL, and then close the window.

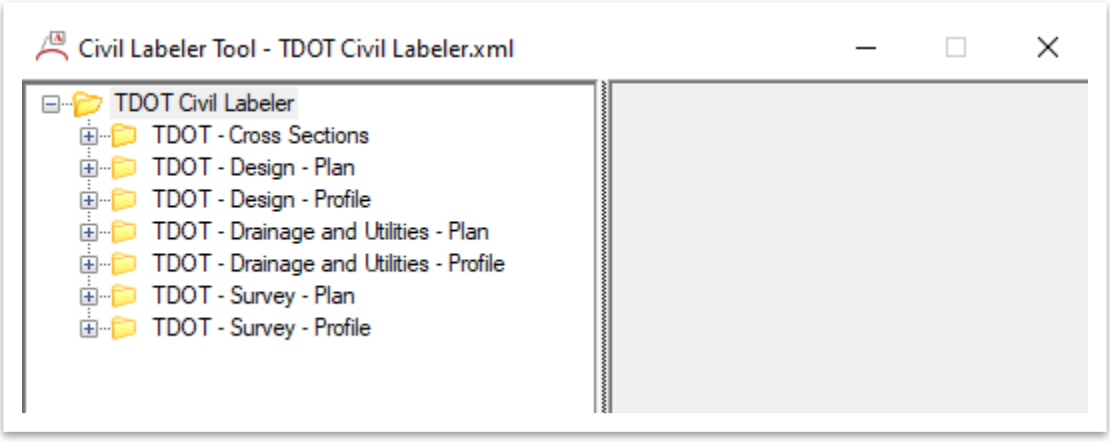
A.6 Civil Labeler Tool

The Civil Labeler is a new tool in OpenRoads Designer 10.10 Connect Edition. The Civil Labeler tool will eventually replace the place label tool. The TDOT Civil Labeler tool is built to replace the labels created for the Place Label tool on a 1 to 1 basis with additional labels created for the enhanced capabilities of the Civil Labeler tool.

The TDOT Civil Labeler tool is stored in the **TDOT Civil Labeler.xml** file and is broken down into the following seven sub folders (Figure 137):

- **TDOT - Cross Sections:** Contains labels that will work in cross section model views.
- **TDOT - Design - Plan:** Contains labels that will work in 2D plan views. These contain most of the labels that will be used for annotating plan sheets.
- **TDOT - Design - Profile:** Contains labels that will be used in profile model views.
- **TDOT - Drainage and Utilities - Plan:** Contains labels that will be used with SUDA modeling plus other drainage labels. There are three sub-folders: Existing, Proposed and Temporary. The primary differentiator is the level in which the label is placed on. These labels can be used in 2D plan and cross section views.
- **TDOT - Drainage and Utilities - Profile:** Contains labels that will be used with SUDA modeling plus other drainage labels. There are three sub-folders: Existing, Proposed and Temporary. The primary differentiator is the level in which the label is placed on. These labels can be used in a profile model view.
- **TDOT - Survey - Plan:** Contains labels that will work in 2D plan views for labeling existing elements such as property lines.
- **TDOT - Survey - Profile:** Contains labels that are used to identify survey elements in a profile model view.

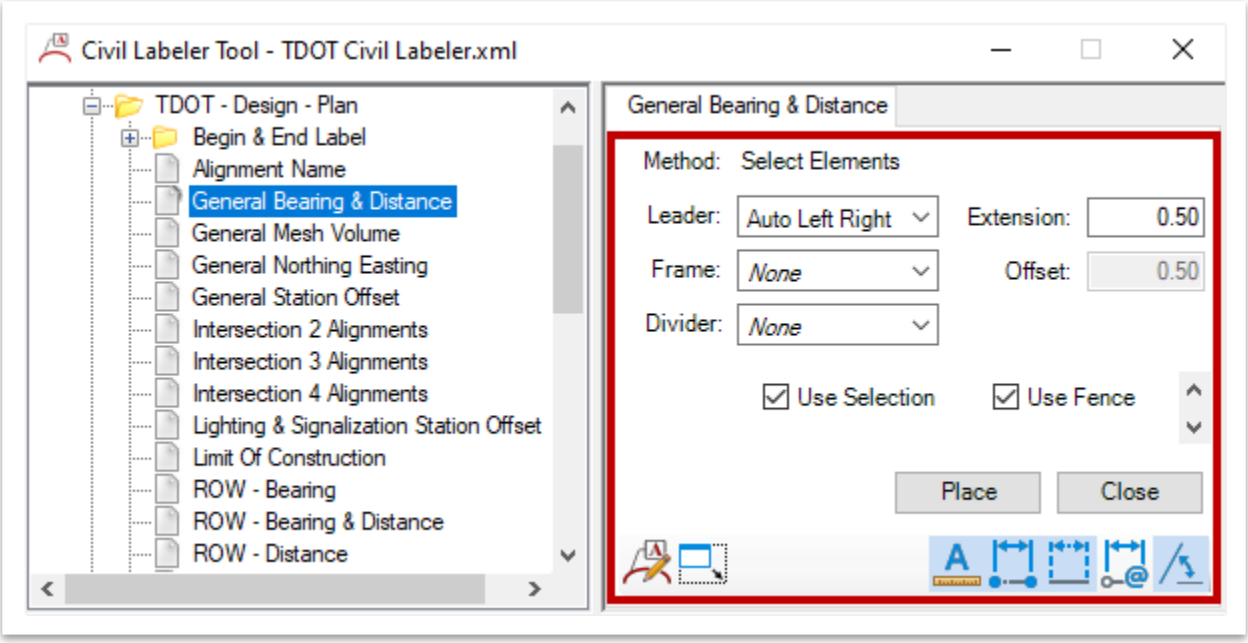
FIGURE 137. CIVIL LABELER TOOL



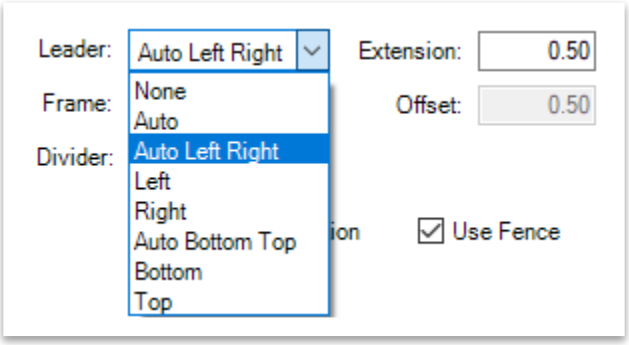
A.6.1 Navigating the Civil Labeler Tool

To place a label, open the applicable folder structure and select the desired label. A **placement options** dialog will open on the right side of the window (Figure 138). There are several drop downs and key ins within the dialog to modify how the label is placed. The TDOT Civil Labeler has default values, but the user may want to modify them in some cases.

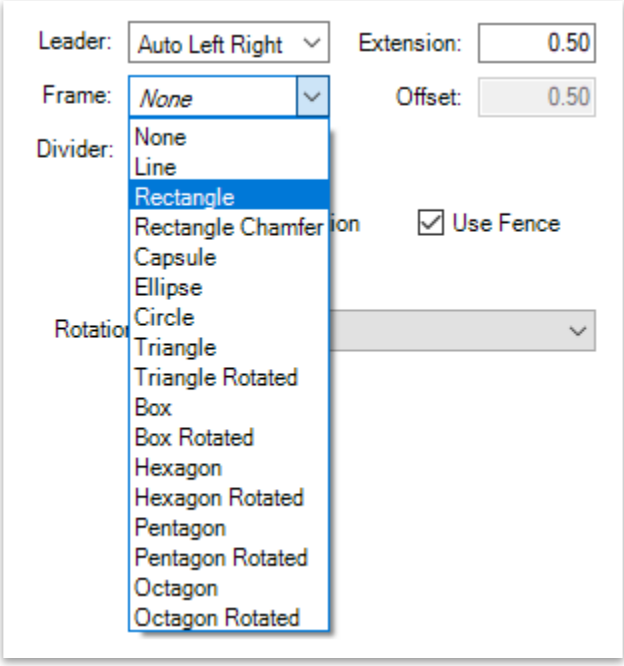
FIGURE 138. TDOT CIVIL LABELER - PLACEMENT OPTIONS



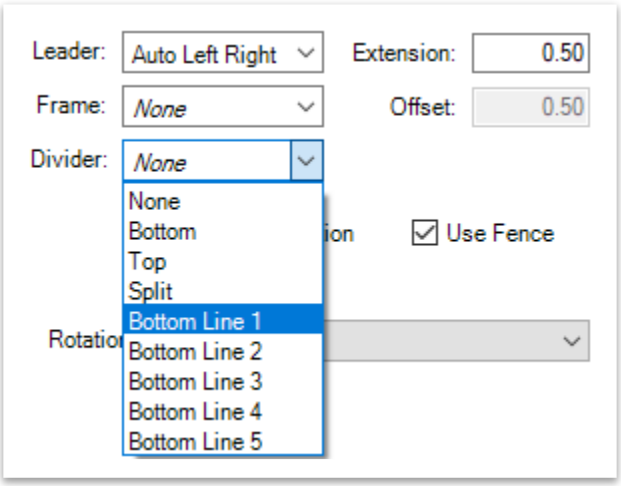
- **Method:** Set in the civil file manager and is determined by the type of label that is being placed. For most labels the Method will be ***Select Elements*** or ***Data Point***.
- **Leader:** Determines what kind of leader is placed with the label. The dimension style of the leader has been set in the civil file manager and all labels can be placed with a leader that has the same symbology as the label. Most labels with leaders are set to ***Auto Left Right*** by default.



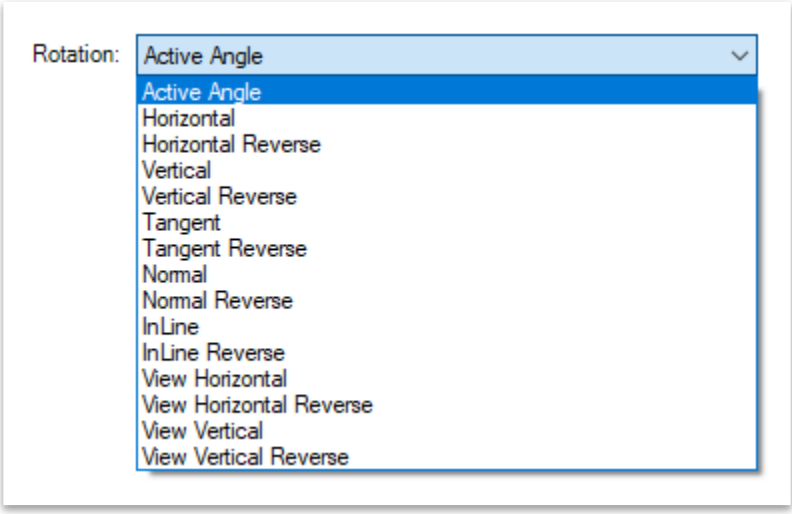
- **Extension:** Set only when a leader is active. This determines how much the leader extends from the label. Labels that have a leader and the Divider set to ***None*** will have an extension of **0.50**. Leaders with a divider will have an extension of **0.00**.
- **Frame:** Most labels do not have a frame. Some drainage labels will have a circular frame applied. The frame allows the user to place a shape around a label.



- **Offset:** Only applies to frames. Determines how far away from the label the frame is placed. All frames that are applied to labels have an offset of **0.50**.
- **Divider:** Set on labels with a delimiter line. It runs the length of the label and is the start of the leader line. Many labels have divider lines set to ***Bottom Line 1***, ***Bottom Line 2***, and ***Split***.



- **Rotation:** This drop down selects how the label will be rotated when placed. Most labels are set to Active Angle and will place at the angle the screen is rotated. Users might want to change this to *View Horizontal*, or *Tangent*, dependent on how the user wants that individual label placed.



Additional Toggles

- **Enable Label Manager:** This is one of two ways to access the Civil Label Manager. This location has more options on the Civil Label setup but shouldn't need to be accessed often.
- **Enable/Disable Collapse Mode:** Enabling this tool causes the Civil Labeler Tool to minimize once the Place button is clicked.
- **Annotation Tools:** These tools turn off the annotation scale of the labels or turn on/off the association of the labels. The **Relative Association** is off on the labels by default.
- **Place/Close:** The **Place** button activates the label. The user would then follow the prompts in the lower left corner to place the label. The **Close** button closes the Civil Labeler Tool.

A.7 ROW Acquisition Feature Definitions

TDOT has new feature definitions for assisting in the development of ROW acquisition tables. There are four **linear** feature definitions and one point feature definition that allow the user to develop shapes and reports for acquisition of ROW and easements. These feature definitions are not meant to be placed on ROW sheets but rather to document and store different acquisitions in a dgn file separate from the ROW linework dgn file.

The linear feature definitions below are all located within the **Linear >> Right of Way >> Acquisition Shapes** folder.

- **Prop Construction Easement Acquisition Shape:** Used for construction easement shapes.
- **Prop Drainage Easement Acquisition Shape:** Used for drainage easement shapes.
- **Prop ROW Acquisition Shape:** Used for ROW acquisition shapes.
- **Prop Slope Easement Acquisition Shape:** Used for slope easement shapes.

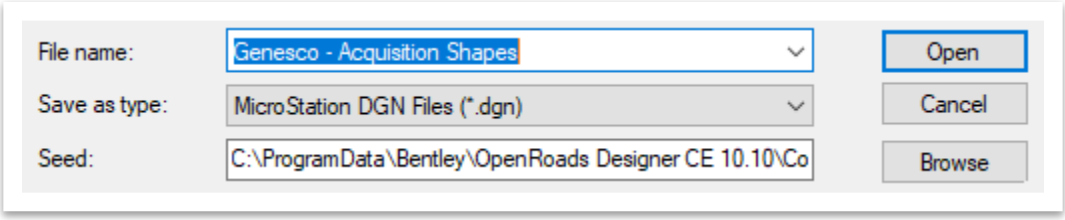
The point feature definition is located within the **Point >> Right Of Way** folder.

- **Prop ROW Acquisition Shape Point:** Contains a cell and is meant to be placed anywhere a change in direction is needed in the acquisition shape.

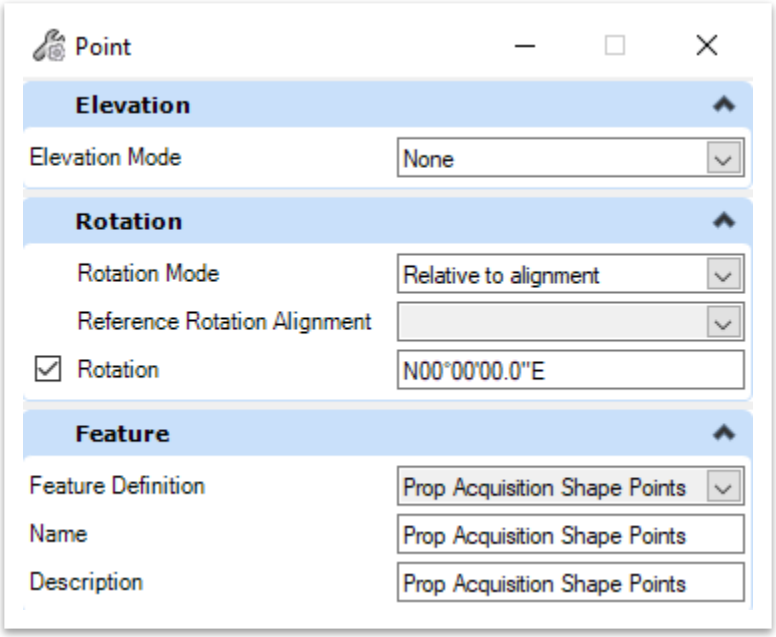
A.7.1 Exercise: Using the Geometry Tools to Store Acquisition Shapes

In this exercise, we will create an acquisition shape for a slope easement on one tract. For multiple tracts, each tract would have its own acquisition shape.

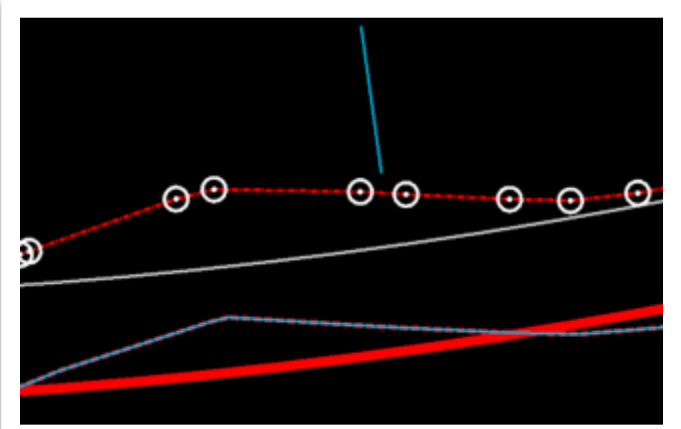
1. Create a new file and name it **Genesco – Acquisition Shapes**. Select the **TDOTSeed2D.dgn** and click **Save**.



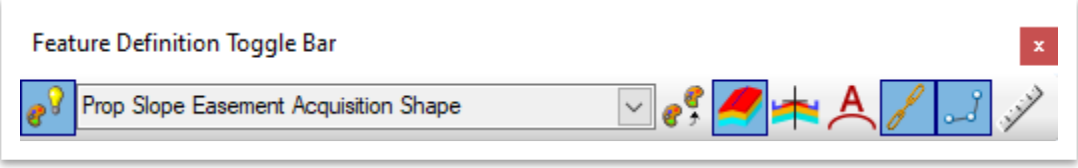
2. Attach the **GenescoCorridor.dgn** file as a reference using the **Coincident World** attachment method. Open the **Point** tool (**OpenRoads Modeling >> Geometry >> Horizontal >> Point**). Within the dialog box, select the following settings.
    a. **Elevation Mode:** None
    b. **Rotation Mode:** Relative to alignment
    c. **Rotation:** N00°00’00.0”E (toggle on)
    d. **Feature Definition:** Prop Acquisition Shape Points (**Point >> Right Of Way**)
    e. **Name / Description:** Prop Acquisition Shape Points



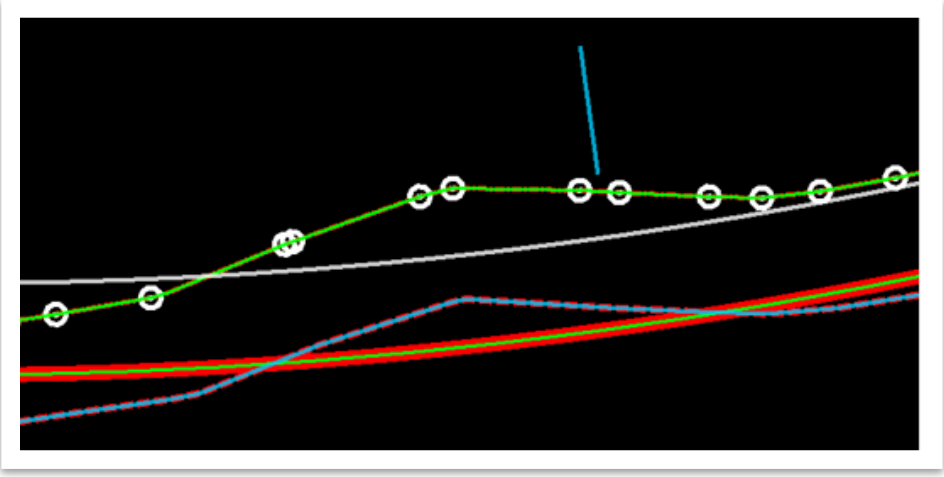
3. Notice the cursor prompt: **Locate Reference Element for Rotation**. Since the point is a **circle**, select any element for rotation. Notice the next cursor prompt: **Enter Data Point**. We will focus on the location starting around station **20+00** where the easement first crosses the proposed ROW. Place a point at every PI along the proposed easement that falls outside the proposed ROW. **Note:** Left click to accept the rotation angle for each point.



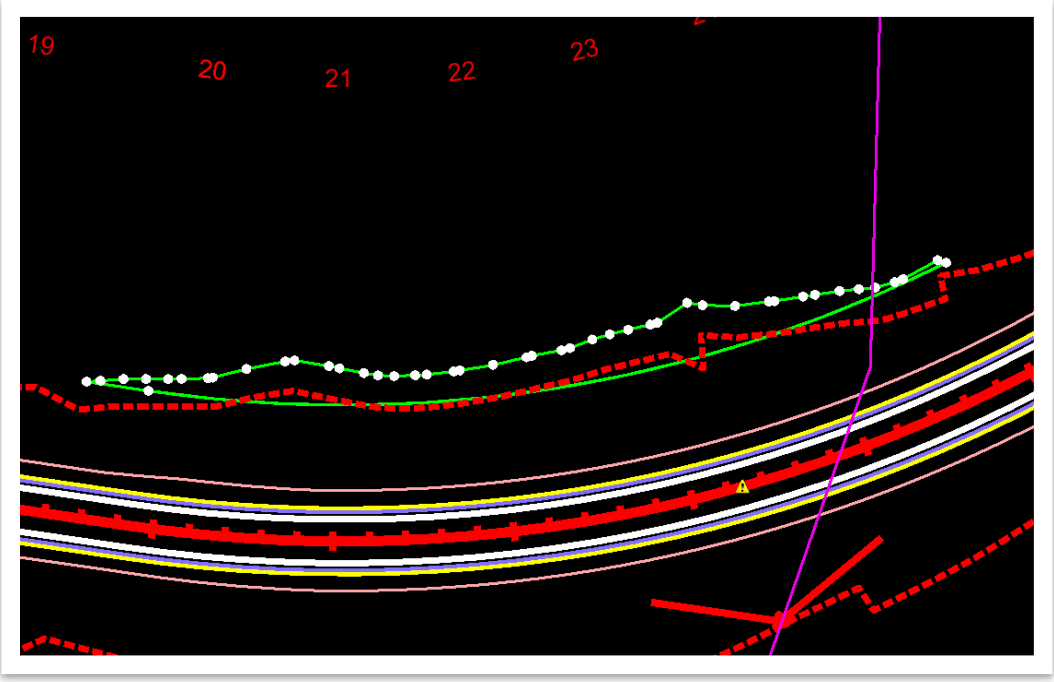
4. Now, select the **Prop Slope Easement Acquisition Shape** feature definition (**Linear >> Right of Way >> Acquisition Shapes**).



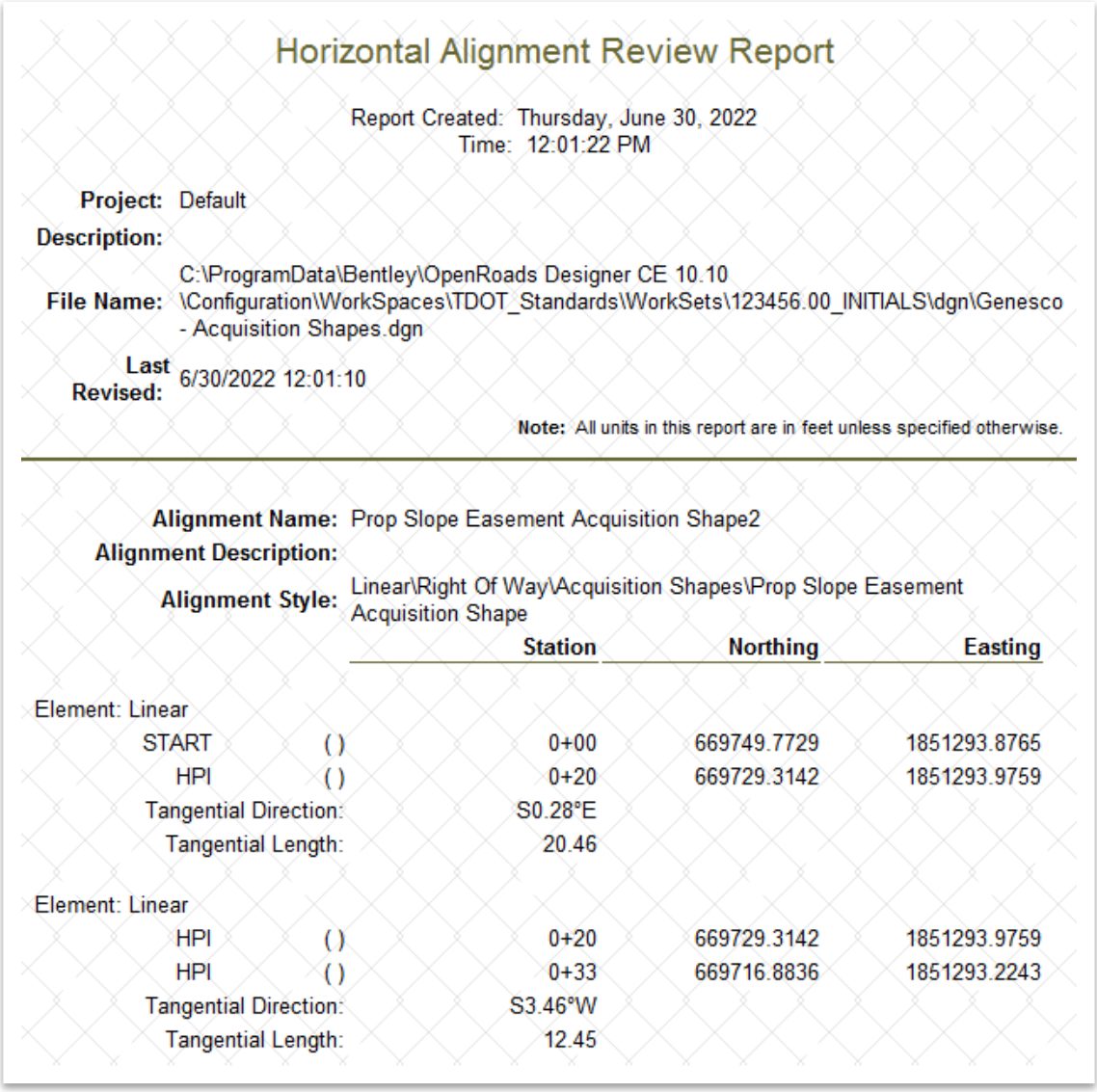
5. Now, open the **Single Offset Partial** tool (**OpenRoads Modeling >> Geometry >> Horizontal >> Offsets and Tapers**) and create an offset from the start point (the first acquisition point placed where the easement crosses the proposed ROW) to the end point (the last point placed where the easement crosses back over the proposed ROW). Then, offset the proposed ROW line from the first point to the last point. This will make an enclosed shape that we will now complex.



6. Complex the two lines together to form a shape using the **Complex By Element** tool (**OpenRoads Modeling >> Geometry >> Horizontal >> Complex Geometry**). The complex shape should now contain the area of the slope easement acquisition within the **Properties**. For an actual project, the **Feature Name** should be updated with the applicable Tract number. For this exercise, use **Slope Easement Tract XX**. Note that levels have been turned off for clarity.



7. Lastly, run the **Horizontal Geometry Report** (**OpenRoads Modeling >> Geometry >> General Tools >> Reports**) and select the complex line. Lock to the **Start** and **End**, and then click through the prompts to create the report.



Horizontal Alignment Review Report

Report Created: Thursday, June 30, 2022
Time: 12:01:22 PM

Project: Default
Description:
File Name: C:\ProgramData\Bentley\OpenRoads Designer CE 10.10 \Configuration\WorkSpaces\TDOT_Standards\WorkSets\123456.00_INITIALS\dgn\Genesco - Acquisition Shapes.dgn
Last Revised: 6/30/2022 12:01:10

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

Alignment Name: Prop Slope Easement Acquisition Shape2
Alignment Description:
Alignment Style: Linear\Right Of Way\Acquisition Shapes\Prop Slope Easement Acquisition Shape

		Station	Northing	Easting
Element: Linear				
START	( )	0+00	669749.7729	1851293.8765
HPI	( )	0+20	669729.3142	1851293.9759
Tangential Direction:		S0.28°E		
Tangential Length:		20.46		
Element: Linear				
HPI	( )	0+20	669729.3142	1851293.9759
HPI	( )	0+33	669716.8836	1851293.2243
Tangential Direction:		S3.46°W		
Tangential Length:		12.45		

8. To export the report, you would select **File >> Save** as and then select the export file type. For this exercise, we do not need to export.