CONNECTICUT DEPARTMENT OF TRANSPORTATION

DIGITAL DESIGN ENVIRONMENT GUIDE

CONNECT EDITION

Volume 3.3 – OpenRoads Designer Corridor Modeling

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Course Overview

This module will instruct users on how to create and edit roadway templates & Corridors.

Skills Taught

Learn how to:

- create and manipulate a Corridor.
- Assign template drops.
- apply the superelevation transitions to your corridor
- create, edit and review superelevation
- add multiple templates drops as you encounter intersections, driveways and turn lanes.
- use Horizontal and Vertical Geometry tools to create 2D and 3D geometric elements to lay out a complex intersection.
- Tools and techniques will be taught to accurately model a complex intersection in 3D. You will learn how to:
    - use Linear Templates to create the side slope grading along the curb returns.
    - use Surface Templates to apply material thickness to the pavement surface.
    - create a Finished Grade Terrain Model using Graphical Filters. Export Finished Grade Terrain Model to LandXML format.

Exercise 1 – Getting Started

1.1 Introduction

Corridor Modeling allows the user to create a dynamic, intelligent and powerful 3D model of their design. The 3D model is then used to create cross sections, terrain models and generate corridor quantities. A corridor is created first in 2D by assigning a horizontal and vertical alignment to the corridor and then assigning a template to the corridor at a defined interval along the horizontal alignment. Once the template is assigned to the corridor a 3D model is created.

A template represents the transverse geometry or typical section along the corridor. Templates are made up of points and components and are stored in a template library. When a corridor is processed the template points create 3D linear features (edge of pavement, shoulder, curb, sidewalk, cut/fill lines etc.) along the corridor and the template components create the 3D material meshes (i.e. pavement, shoulder, curb & gutter, sidewalk, side slope grading etc.) along the corridor.
The Corridor Modeling toolset is a group of commands used to create 3D designs that represent a new roadway or other types of surfaces. Designers work primarily in 2D files and OpenRoads tools automatically generate the 3D model. Tools for the design, creation, modification, management, and report functions are provided. The tools are accessed by choosing the Corridors tab from the OpenRoads modeling workflow as shown below.

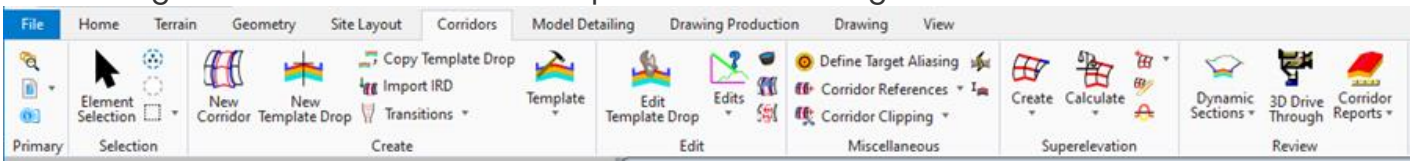


Figure 1 Corridors Tab

The 3D model will be generated from the 2D base model design file for CTDOT projects. It is recommended that users take a federated approach to store each corridor model in its own design file for projects that have several alignments and sites.Projects will use multiple files for the geometry, terrain, superelevation, and the 3D model. All these files can reference one another to present a complete model of the project.

Each road within the project is used to define a 3D corridor model representing the proposed design. A corridor consists of an alignment, profile, and a template defining the initial roadway typical section. Multiple templates may be applied within a corridor to better define the roadway. Additionally, transitions and other modifications to the template can be defined using various modification tools. As changes are made, the 3D corridor model is automatically updated.

Corridor Model 3D Graphics

When a corridor is processed, the 3D model is generated in a separate MicroStation model named "Default-3D". The corridor graphics consist of 3D line strings and 3D surfaces for each design component. The example below shows a portion of the pavement for a corridor with the individual pavement layers that were generated for the 3D model as well as a portion of the side slope.

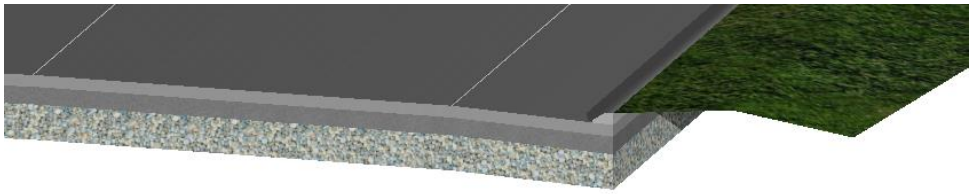


Figure 2 3D Graphics

When the template is processed, the template points are connected between template "drop" locations to form the longitudinal break lines that are used to create the proposed surface. An example of the longitudinal break lines plotted from a 3-dimensional design surface is shown below.

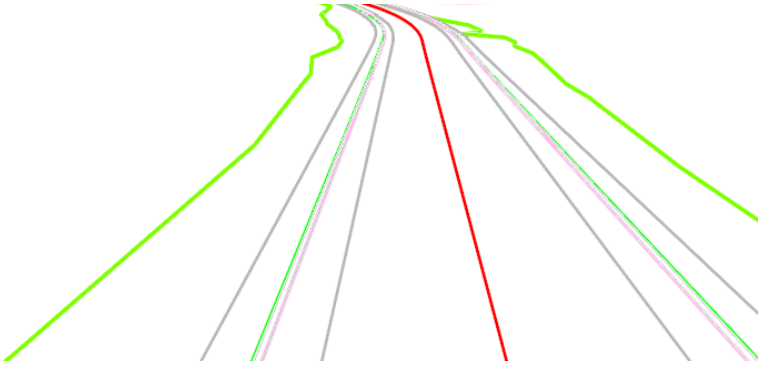


Figure 3 Template Points longitudinal break lines

Only the top template points are used to create the proposed surface mesh. Points below the surface are excluded from the proposed design surface.

The sub-surfaces can be included in the proposed cross sections as "components" or alternate surfaces. These components can be used for volume calculations. In addition to the 3D graphics, the corridor modeling process draws 2D plan view graphics. These graphics can be used to generate the plan sheets for the project. An example of the 2D plan-view graphics drawn as part of the corridor modeling process for the curbing, shoulders, snow shelves, and fill limits is shown below.

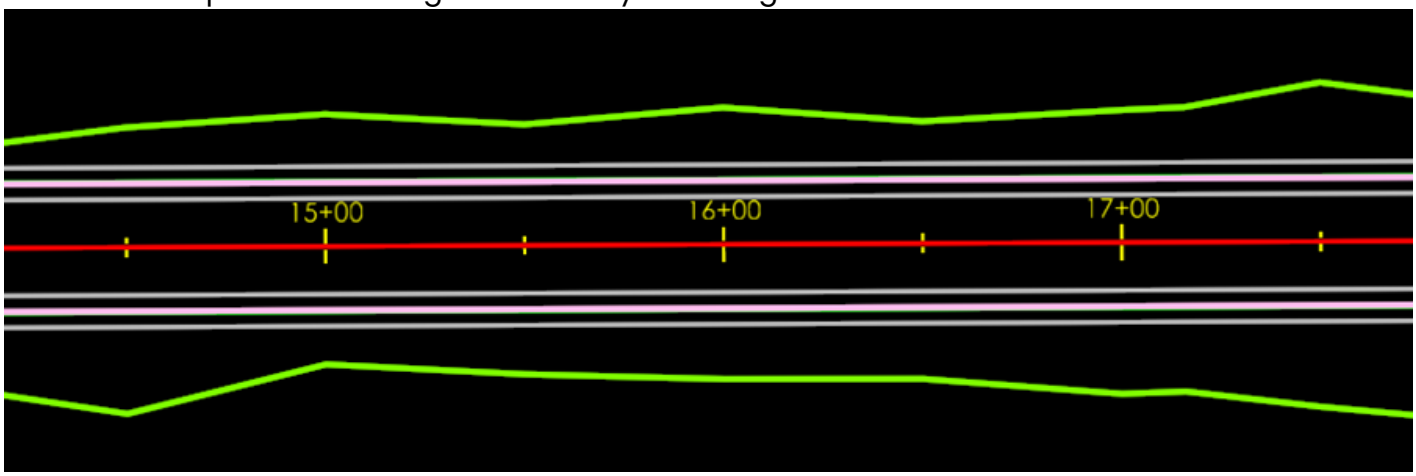


Figure 4 Corridor 2D Graphics

Corridor Modeling Workflow

1. Create a 2D dgn file (all corridor information is stored in a dgn file). Corridors always start in 2D. The 3D model is generated automatically.
2. Attach existing terrain model dgn as a reference file.
3. Activate terrain model if working on end conditions/grading.
4. Attach geometry dgn as a reference (horizontal and vertical geometry are required to create a corridor).
5. Create a corridor.
6. Add a template drop(s) to the corridor.
7. Assign horizontal and vertical controls to adjust template points (as needed).
8. Assign superelevation (as needed).
9. Review the 3D model.
10. Review the dynamic cross sections.

1.2 Opening the Application

Before starting this exercise:

1. The CTDOT CONNECT DDE synced through SharePoint
2. The COMPASS **Training** Project Synced (i.e. 9999-0001 – Design)

Notes for working on actual projects:

1. CTDOT users should have the CTDOT CONNECT DDE synced through SharePoint with the COMPASS Project Synced along with the CAD Configuration.
2. Consultants should have CTDOT DDE properly installed or be syncing to the CTDOT DDE SharePoint/COMPASS system.
3. Make note of the **Coordinate System** you will be working in. If you have existing survey data, you will need to find out what system is being used **(NAD 83/NAVD 88 or NAD 27/NAVD 29).**
4. Log on to the CONNECTION Client. *Bentley Connect licensing requires users to log into their Bentley account to secure a software license. CTDOT users should log in using your CTDOT email address and Bentley password. If you do not see the dialog box, select the ^ icon on the bottom Windows Screen. Click on the Connection Client Icon and select* ***Open*****.**

3. Launch the Application. On your desktop double click on the **Accounting Icon**.

Figure 5 5- CTDOT CAD Accounting Icon

4. On the CTDOT Accounting Menu there will be several applications to pick. In the ***Run Program*** field select the needed program:
   - **Compass OpenRoads CE**
   - for the Available Account select ***OVERHEAD*** for training proposes.
   - Click on the **Start** button to load the program.

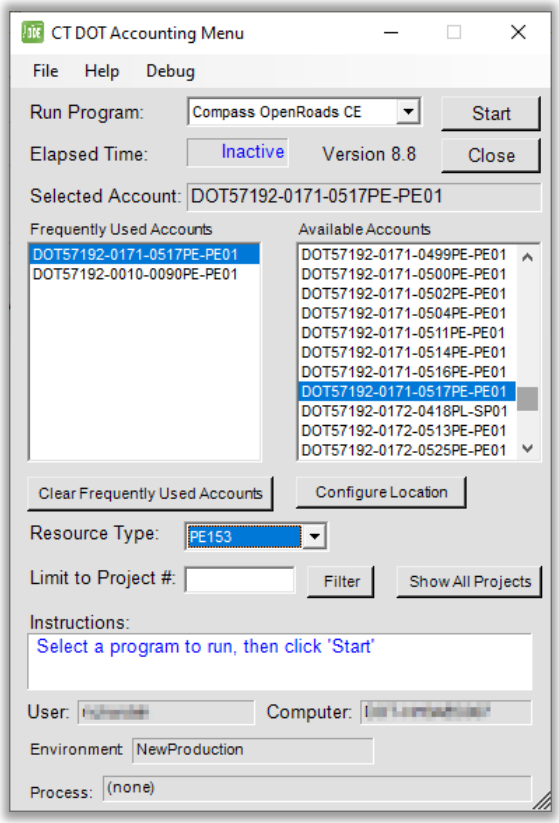


Figure 6 6- CTDOT CAD Account Dialog Box

5. After launching the program, a Welcome Screen for ***OpenRoads Designer*** will appear.
6. Ensure you are using the **Custom Configuration** and **CT_WorkSpace**, then select the relevant **WorkSet** (Training WorkSets start with 9999_0001, select the # that you were assigned) and **Role**.
7. Select the **Browse** icon, browse to: ***Highway/Base_Models/***

   Open the file named ***HW_CB_0047_0122_Exercise_1_ Corridor_Route140.dgn***

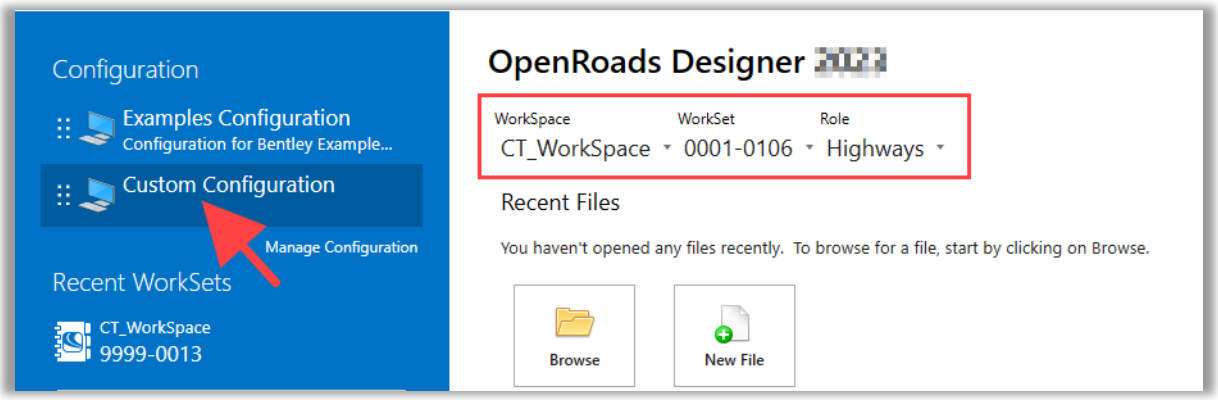


Figure 7 7– OpenRoads Start up Screen

8. In the upper left select the **OpenRoads Modeling** Workflow, and click on the **Corridors** tab. The commands are separated into five main categories:
    - Create
    - Edit
    - Miscellaneous
    - Superelevation
    - Review

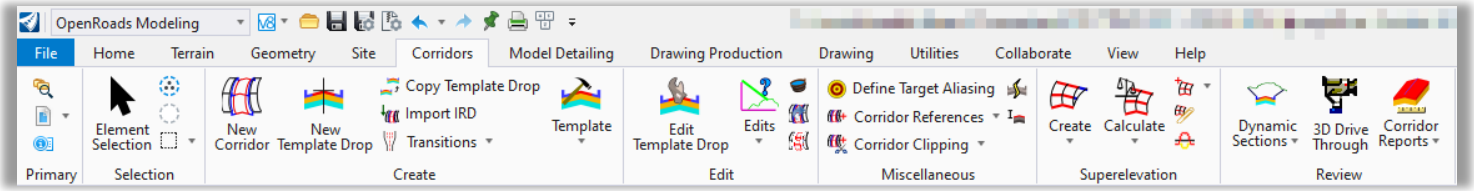


Figure 8 8– Corridor Tools

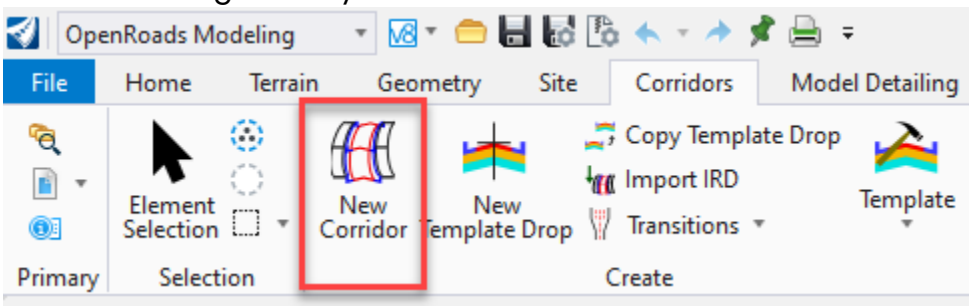
This file will contain a corridor base model design file for a project. Base model files will reside within the project folder structure the …\Highways\Base_Models folder. Depending on the complexity of the project one or more corridor base model files will be created. References files such as alignments, survey and terrain files are attached without nesting.

Exercise 2 - Create Corridor and Assign Template Drop

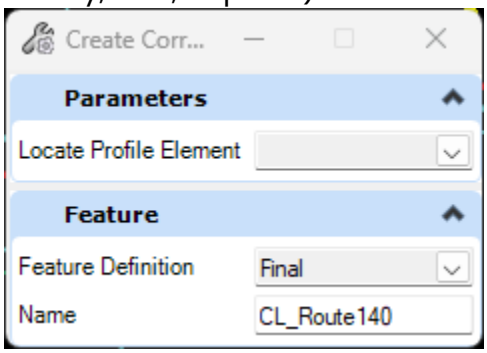
In this section, you will create a corridor along Route 140 using the template created in the previous DDE Exercise. **Stay in the Exercise 1 file.**

2.1 Create a Corridor for Route 140

1. Click anywhere in View 1 to make it active. Hold right click, view control, and "2 views Plan/Profile". Click the Route 140 alignment and open the profile in view 2. ***Hide the survey files to make the selection easier.***
2. Go to the **OpenRoads Modeling** workflow, **Corridors**, and **New Corridor** and select the **Route 140** centerline geometry.

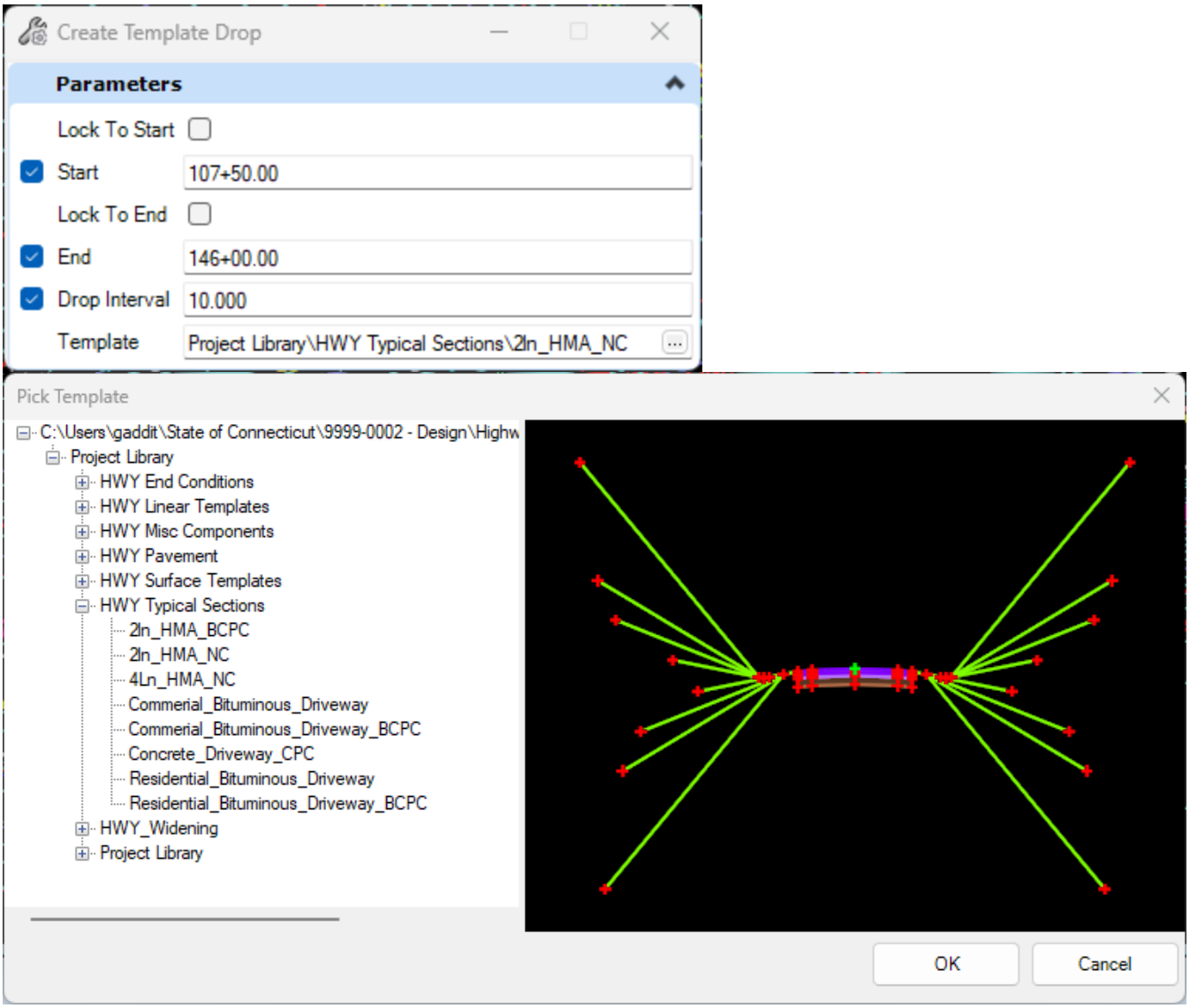


3. Set the Feature Definition to **Final** in the Create Corridor dialog. Feature Definitions for Corridors, control the accuracy and display settings of the Corridor. In this course you are going to use Final but other Feature Definitions are available. In the Name field key in: **CL_Route140** (The name may already be present from when you selected the centerline geometry, if so, skip this).



4. Once you have the feature definition and name set, left click the profile in the profile view and click to accept and create the corridor. Once the Corridor is created the **Create Template Drop** tool will appear automatically and the heads-up display will be prompting you to select a template. The **Create Template Drop** tool is used to assign a template(s) to the corridor at a defined interval along the roadway alignment.

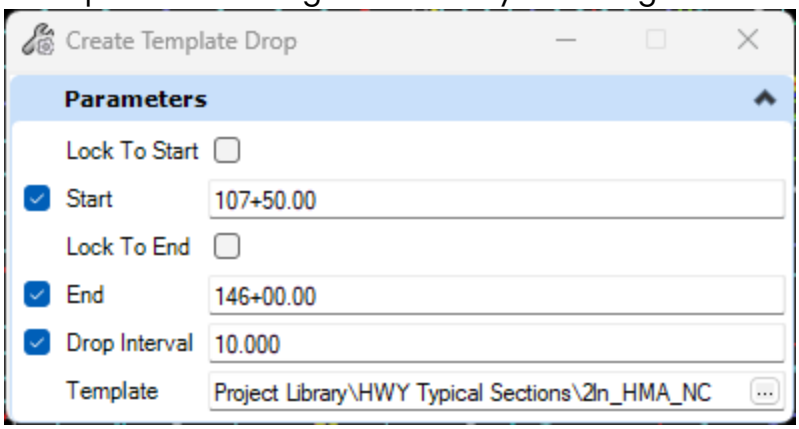
5. Following the heads up prompts, press ALT and the Down Arrow on your keyboard to browse the templates in the template library. The **Pick Template** window will appear. In the Pick Template window, click the + to expand the template library folders. Select Templates and click the + to expand the folder.



6. Now Select **2ln_HMA_NC**

   Select OK and Left click to accept.

   Following the heads up prompts (after each prompt, Left click to accept values and move to next prompt):

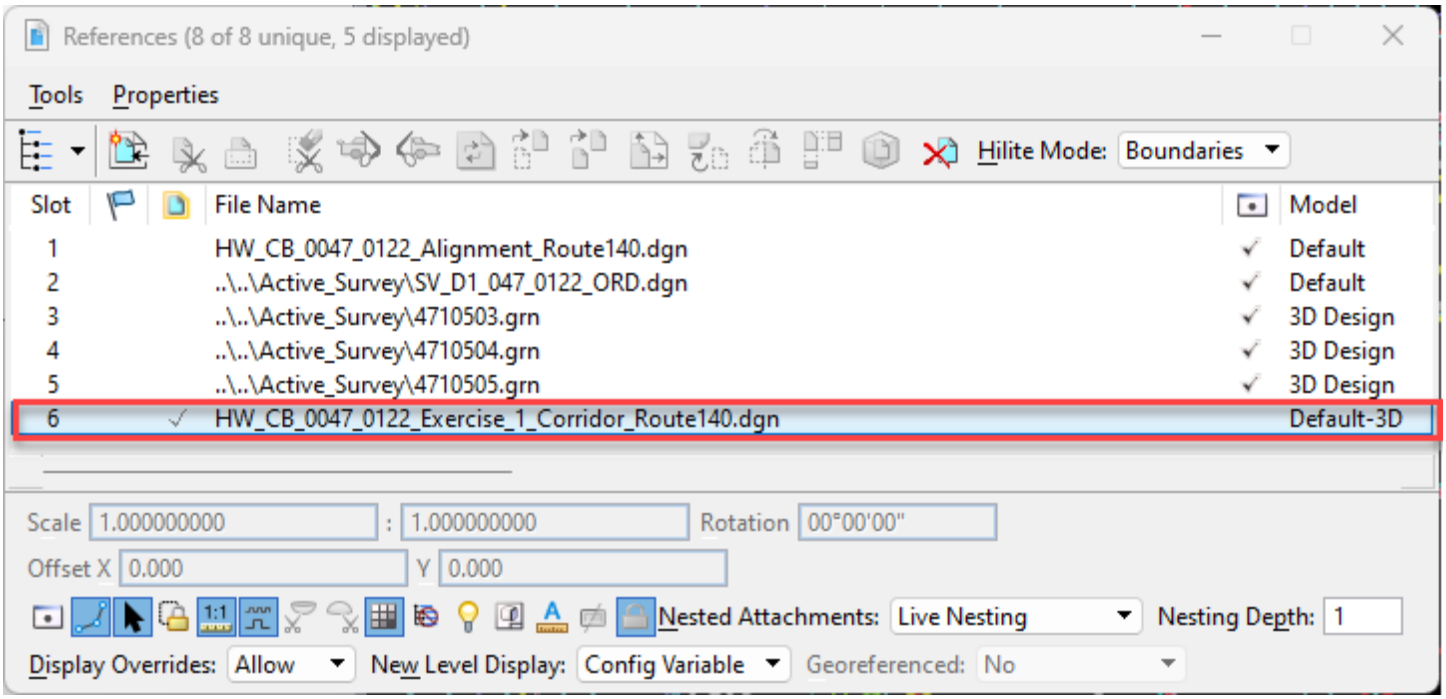


- Start Station: Press ALT to lock to Start
- End Station: **146+00.00**
- Drop Interval: **10**

The template drop has been assigned and the corridor is now created.

Notice there are now corridor elements drawn in the 2D and 3D views. The Corridor Object is created in the 2D view and the Corridor Model is created in the 3D view.

7. Turn off the display of the 3D model reference in the 2D view.
   a. Select the **References** tool (Home > Primary > Attach Tools > References)
   b. Select the **Corridor-Route140.dgn** Notice the Default-3D name in the model column.
   c. Click the **Display Reference** icon at the bottom of the window to turn off the file.
   d. Close the References window.

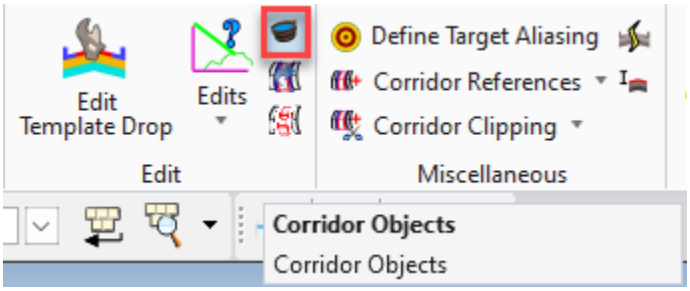


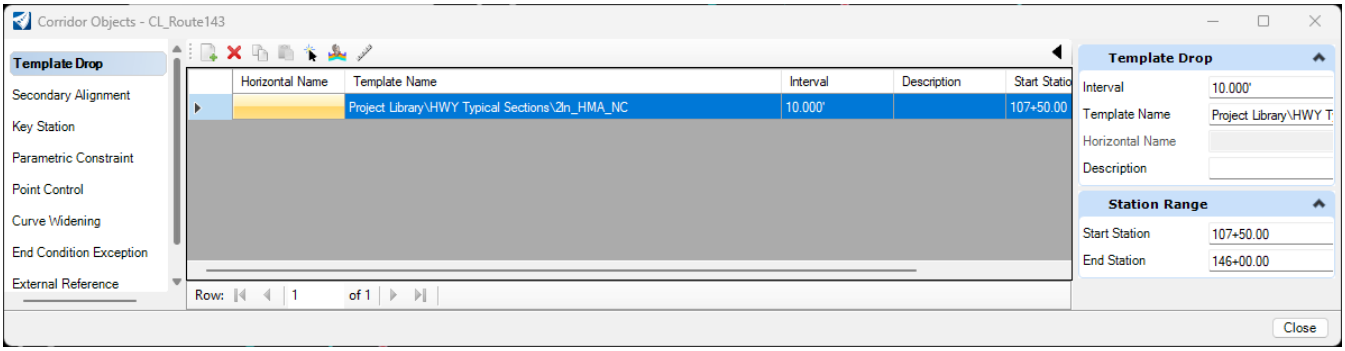
2.2 Review the Corridor in 2D view

In View 1 notice there is a 2D closed shape that is drawn along the corridor, this is the Corridor Object. The Corridor Object has properties of the corridor assigned to it that can be adjusted as needed.

1. To access the corridor properties, go to **ORD Modeling, Edits, and Corridor Object** tool.

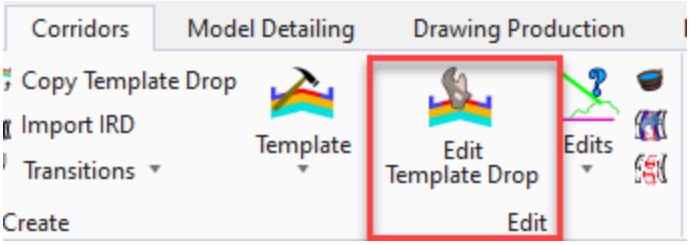
   Notice in View 1, the closed dashed shape drawn along the corridor. This shape represents the Template Drop along the corridor. It has the properties of the template drop assigned to it that you can adjust as needed.

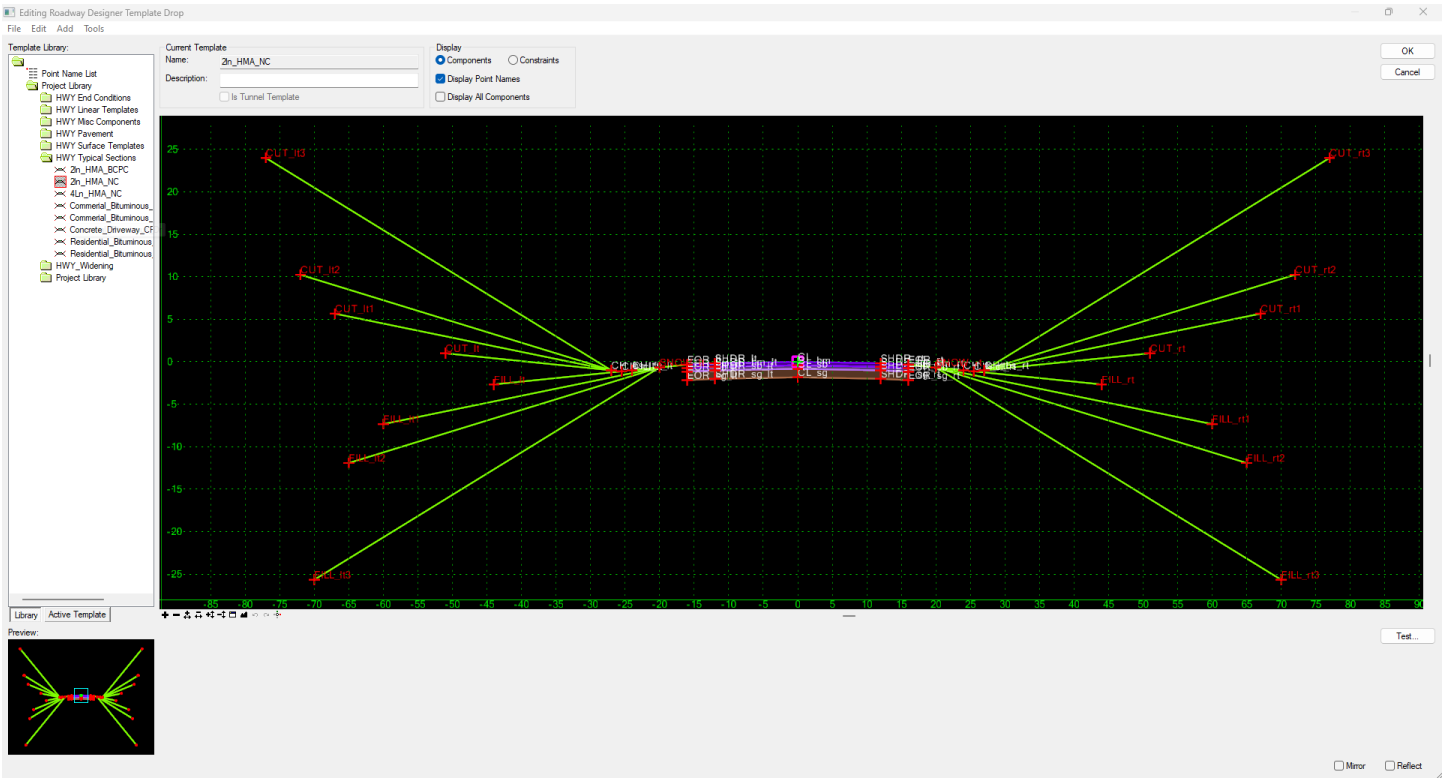




2. Review Template Drop Properties.
   a. To access the Template Drop Properties, go to **ORD Modeling, Corridors, and Edit Template Drop.**
   b. Hover your cursor over the boundary for a few seconds. A context sensitive toolbar will appear, giving you access to other template tools.
   c. Select the **Template Properties icon** on the toolbar to review the properties of the template drop.

      If you need to make changes to the template drop, the adjustments can simply be made in the dialog.



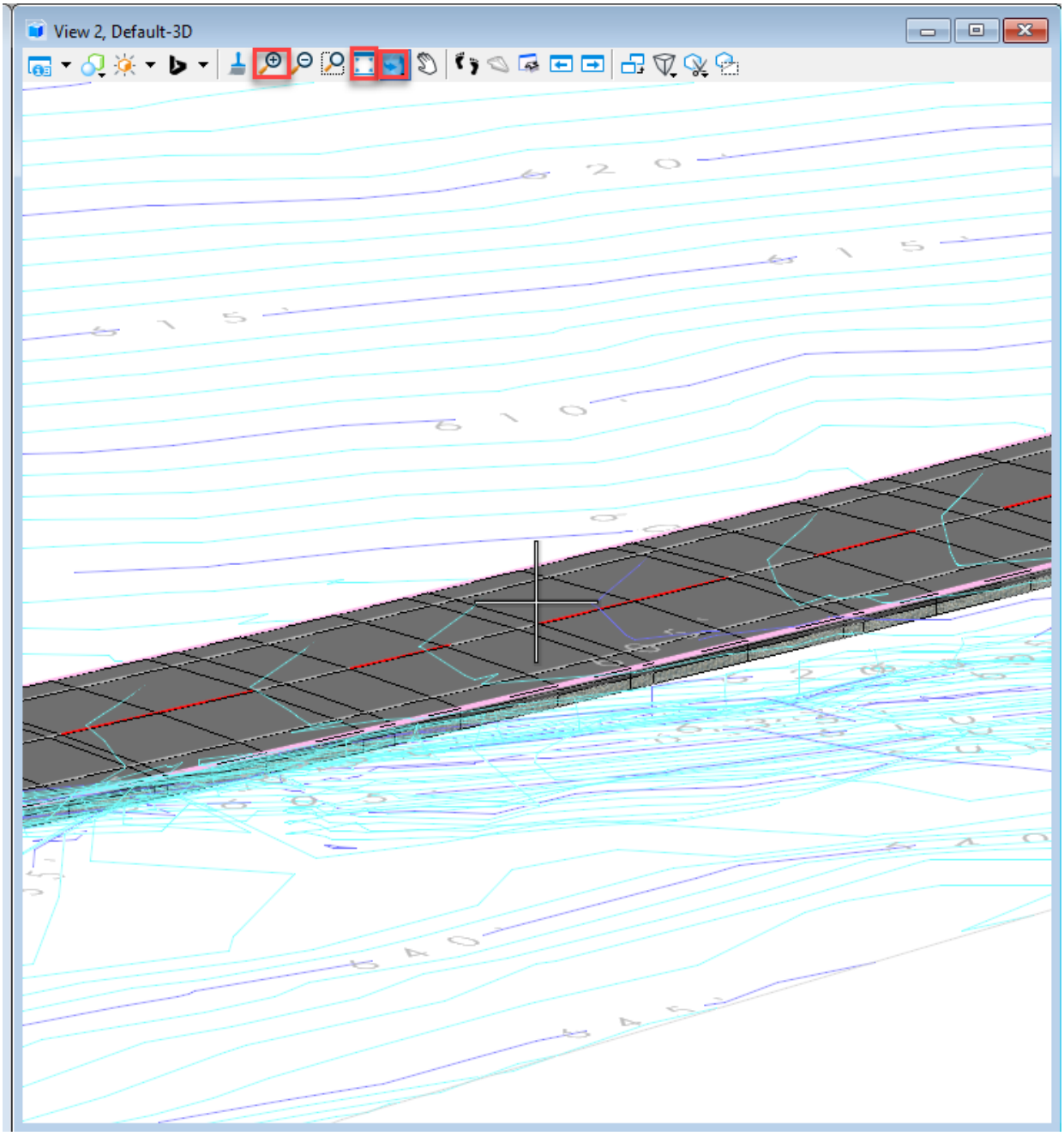


2.3 Review the 3D Corridor Model

The corridor modeling process builds the 3D Model of the corridor by default. Generally, you will be working in the Default 2D model most of the time. In this section you learn how to review the 3D model view.

1. Hold right click, hit view control and open the **2 Views Plan/3D view**. Click anywhere in View 2 Default 3-D to make it active.
2. Select **Fit View**
3. Select the **Zoom In** tool at the top of the view window to zoom in closer to the 3D Model.
4. Select the **View Rotation tool** at the top of the view window.
5. Left click and hold the left mouse button to begin view rotation. Slowly move your mouse up and down or side to side to rotate the view.
6. Release the left mouse button and Right click to reset.

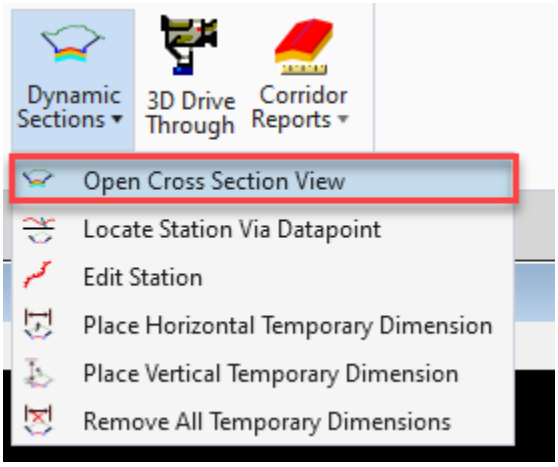
7. Use the wheel mouse button to zoom in and zoom out to review the 3D model.



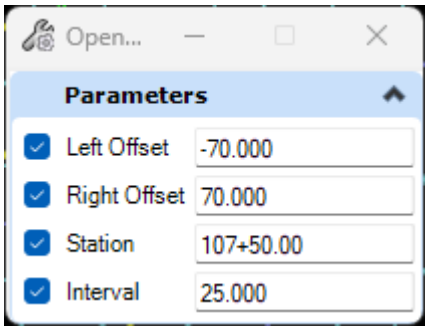
2.4 Dynamic Cross Sections

In this section, you will learn to view cross sections using the Dynamic Cross Sections tool. Cross sections are created directly from the 3D Model and can be viewed with the Dynamic Cross Sections tool. The interval of the cross sections is based on the template drop interval and any critical sections defined in the corridor feature definition. Dynamic Cross Sections are always created perpendicular to the alignment that is being used with the Corridor.

1. Go back to View 1. Select the Element Selection tool.
2. From the ribbon menu select **Corridors > Review > Dynamic Sections > Open Cross Section View tool.**

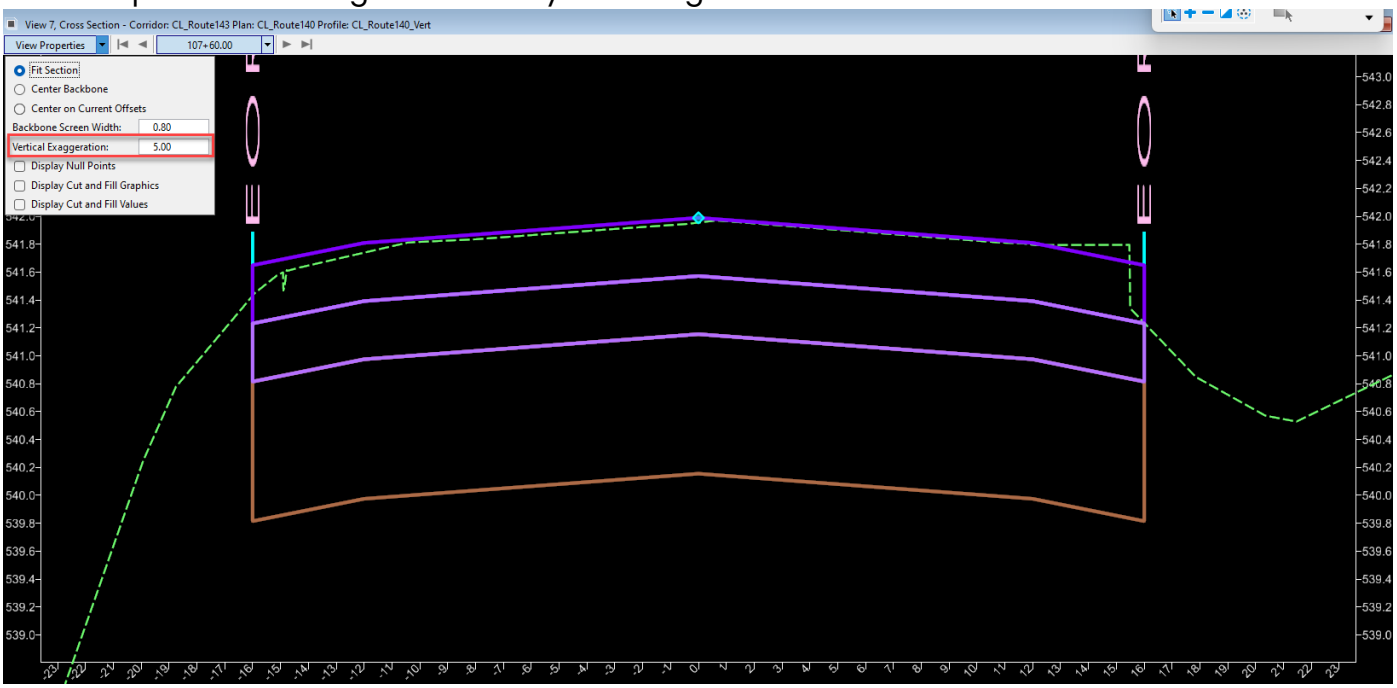


3. In View 1, Locate and select the **Route 140 Corridor.** Set these as the parameters in the pop up dialogue.



4. Open View 7 by selecting the view 7 button from the bottom of the screen. View 7 window will appear.
5. Click in View 7, a cross section should now appear.

   Note that Dynamic Cross Sections are displayed in specially defined cross section model views. Any view can be defined to display the dynamic cross sections.
6. In the upper left portion of the window select the down arrow next to View Properties.
7. Set the **Vertical Exaggeration to 5.**



8. Navigate through the cross sections by pressing the single right arrow to move to the next cross section.

   Experiment with navigating the cross sections forward and backward using the left and right arrows. Also, notice in plan view that a light blue line is displayed showing the current location the cross section is being displayed at.

2.5 Place Horizontal Temporary Dimensions

1. Left-click in the cross section view and hold down your right mouse button and select **Place Horizontal Temporary Dimension.**

   Place dimension on the right side of the cross section:

   a. Select the CL point.

   b. Select the EOP_R point.

   c. Select a height anywhere on the cross section.

      A temporary dimension line will be placed showing the width and slope.

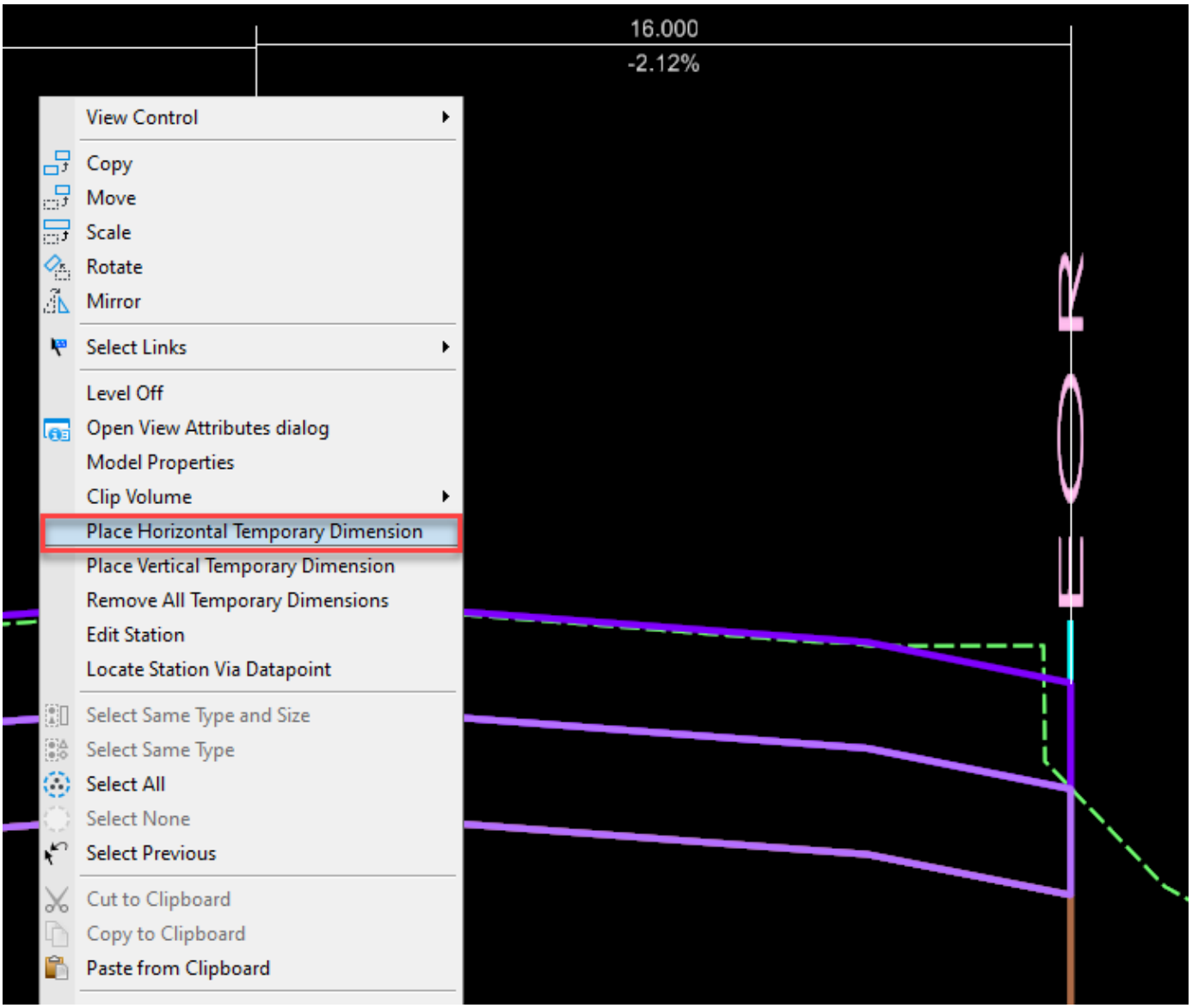
   Place temporary dimension line on the left side of the cross section:

   d. Select CL point.

   e. Select EOP_L point.

   f. Select a height anywhere on the cross section.

2. Navigate through the cross section.
3. Remove the dimensions:
   a. Select **Corridors > Review > Dynamic Sections > Remove All Temporary Dimensions**
   b. Left-click in the cross section view.



Exercise 3 - Superelevation

3.1 Overview

In this exercise, you will learn how to create superelevation for Route 140 using the superelevation tools.

Superelevation is the rotation of the pavement on the approach to and through a horizontal curve. Superelevation tools compute how the road will transition from normal cross slope to a fully superelevated section and back again.

3.1.1 Superelevation Overview and Terminology

Superelevation is the rotation of the pavement on the approach to and through a horizontal curve. Superelevation calculations are used to determine how the roadway pavement will transitionfrom normal cross slope to a fully superelevated section and back again.

The concept of superelevation is simple but many agencies and countries apply superelevation to their projects differently. Before getting started with superelevation a few basic terms need reviewing:

Maximum Superelevation Rate (emax): Based on local conditions, this is the maximum cross slope allowed for any curve for a given design speed.

Superelevation Rate (e): Indicates the design cross slope used for a given design speed, horizontal curve radius and emax.

Pivot Point (or Point of Rotation): Determines the point on the cross section that the superelevated lanes rotate about.

Relative Gradient (G): The slope of the edge of pavement relative to the axis of rotation. Used to determine the superelevation runoff length.

Runoff Length (Lr): Length required to transition a 0% cross slope to full superelevation.

Tangent Runout Length (Lt): Length required to transition from normal crown to 0% cross slope.

Location of Superelevation: Generally a certain percentage of the Runoff Length (Lr) or Total Length (Lr + Lt) is placed on the horizontal curve.

Adjustment Factors for Number of Lanes rotated (bw): Used to reduce the length of transition when multiple lanes are rotated to reduce excessively long transition lengths.

Superelevation XML Preferences (or Rules File): OpenRoads Designer uses an XML-formatted rules file to calculate various aspects of superelevation. The XML preferences file can calculate superelevation rates for each curve of an alignment and the transition

lengths needed to rotate the road from normal crown cross slope(s) to full superelevation cross slope.

Superelevation Section: Defines the limits of superelevation for a curve or set of curves. The section(s) are created based on the minimum tangent between curves.

Superelevation Lanes: Defines the number of pavement lanes and the width of the pavement lanes that superelevation calculations will be applied to.

3.1.2 Superelevation General Workflow

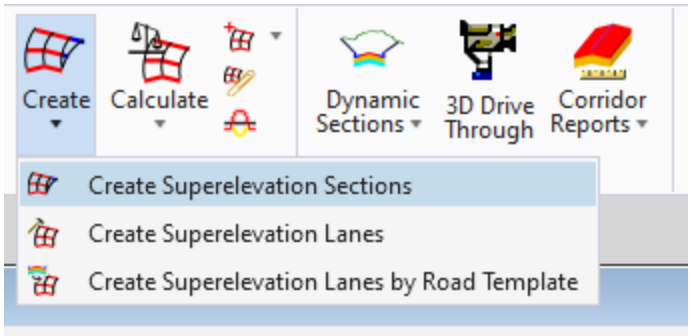
The typical steps for creating superelevation is as follows:

1. Create a 2D dgn file where the superelevation data will be stored
   TIP: A best practice is to create superelevation data in its own 2D dgn file.
2. Attach horizontal geometry reference file (Horizontal geometry is required to create superelevation).
3. Create the superelevation section(s).
4. Define the superelevation lanes.
5. Calculate superelevation transitions and cross slopes.
6. Review and edit as needed.
7. Assign superelevation to a corridor.

3.2 Create Superelevation 2 Lane Road

3.2.1 Create Superelevation Sections and Lanes

1. Open **Exercise_3_Superelevation_Route140.dgn**, the geometry file is already attached as reference file. You need the geometry file in order to create superelevation.
2. From the ribbon menu select **Corridors > Superelevation > Create > Create Superelevation Sections tool.**

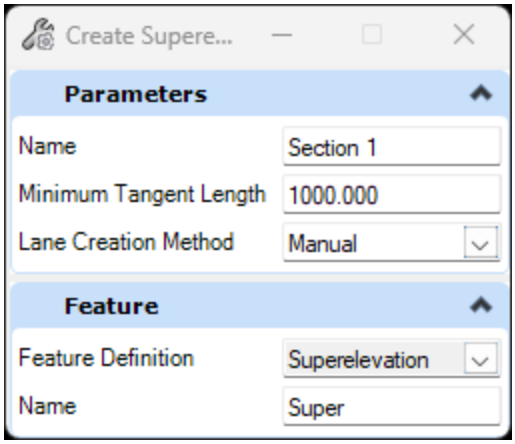


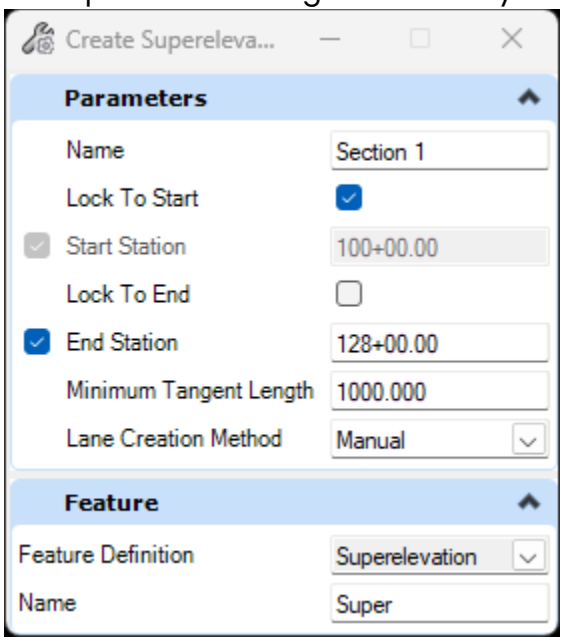
Set the Feature Definition to Superelevation and key-in SE in the Name field.

3. Follow the heads up prompts (key in the values listed below and Left click to accept and move to the next prompt):
    a. Name: Section 1
    b. Locate Corridor or Alignment: Select the **Route 140** horizontal alignment.
    c. Start Station: Press ALT to Lock To Start
    d. End Station: **128+00**
    e. Minimum Tangent Length: 10000

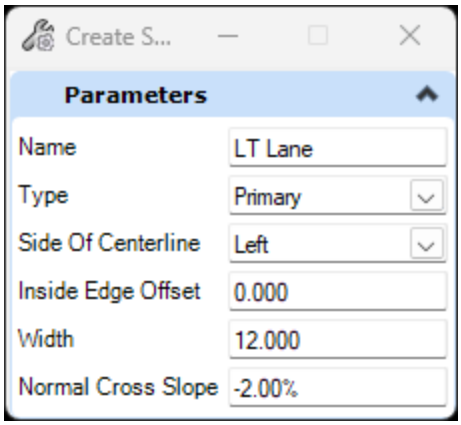
        The Minimum Tangent Length value is the determining factor on how superelevation sections are defined between curves along an alignment. Setting the value to 0.0 will typically create multiple superelevation sections for each curve along the horizontal alignment. Setting the minimum tangent length to a very large number will force only one superelevation section to be created along the entire length of the alignment.

    f. Lane Creation Method: Manual





4. Create Left Pavement Lane (continue following the heads up prompts).
   a. Enter Lane Name: LT Lane
   b. Type: Primary
   c. Side of Centerline: Left
   d. Inside Edge Offset: 0
   e. Width: 12
   f. Normal Cross Slope: -2.0%



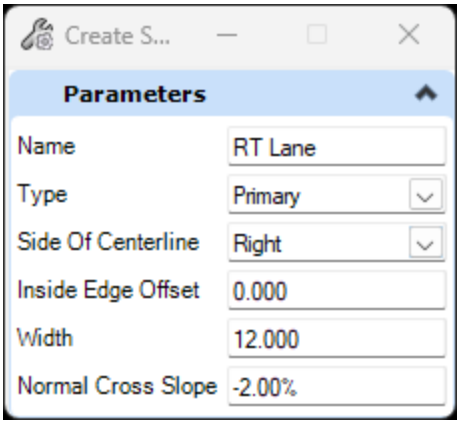
5. Create Right Pavement Lane (continue to follow the heads up prompts).
   a. Enter Lane Name: RT Lane
   b. Type: Primary
   c. Side of Centerline: Right
   d. Inside Edge Offset: 0

e. Width: 12

f. Normal Cross Slope: -2.0%

g. Right click or Reset to complete.

TIP: Lanes can also be created automatically using the Template method. The template method allows you to select a template from the template library to define the lane width and normal cross slope.



6. Calculate Superelevation Transitions (continue to follow the heads-up prompts).

a. Select Rules File: Press ALT and the Down Arrow on the keyboard to select **AASHTO_2018_with_October_2019_Errata_imperial.xml**

[**AASHTO_2018_with_October_2019_Errata_imperial.xml**], browse to C:\Users\gaddit\State of Connecticut\DOT CTDOT_DDE - CONNECT\CT_Configuration\Organization-BIM_CT_Civil Standards\Superelevation

In this example the eMax is calculated using the Values in the AASHTO Superelevation Speed Tables for a Design speed of 50 mph [80 kph] and emax of 6%.

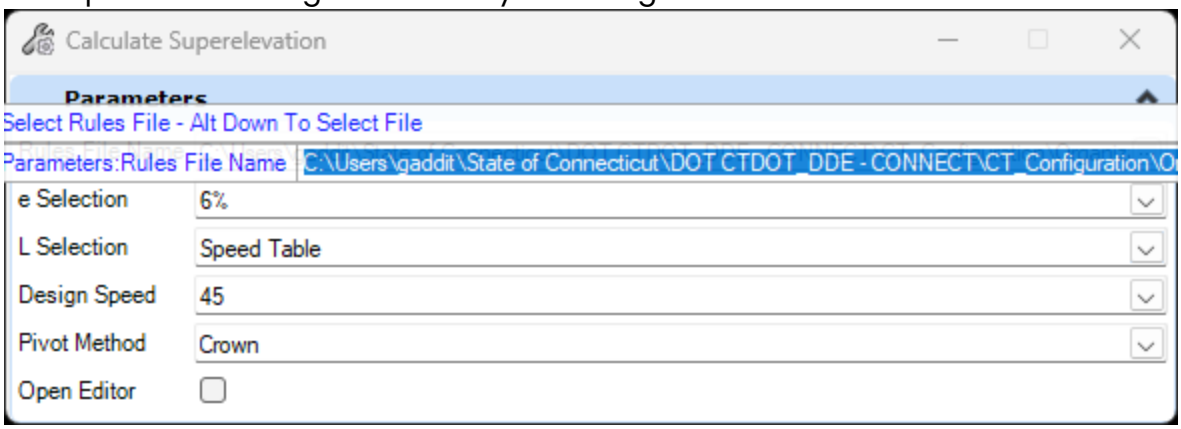
b. e Selection: 6%

c. L Selection: Speed Table

d. Design Speed: **45**

e. Pivot Method: Crown

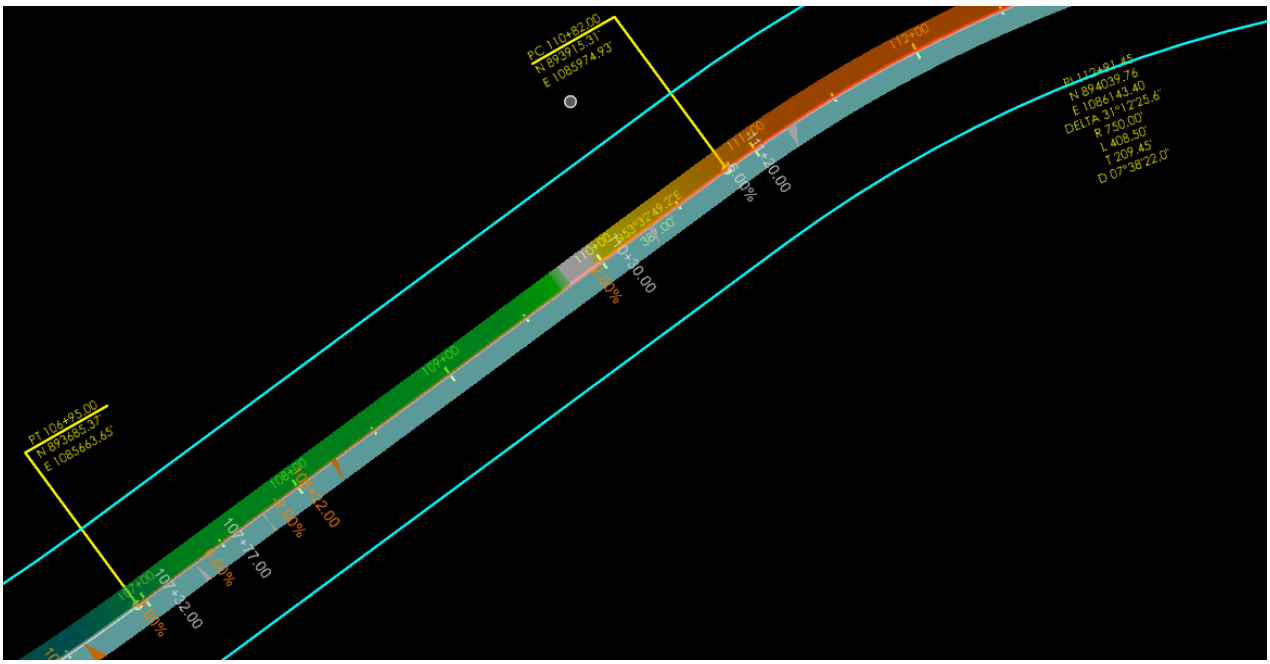
f. Open Editor: No



The Superelevation Section and Lanes are now displayed in View 1.

Upon completion, the superelevation section, lanes and transitions will be created along the alignment.

- The superelevation section is represented by a 2D closed shape drawn along the alignment.
- The superelevation lanes are drawn with rainbow-like colors that indicate various cross slopes.
- The superelevation transitions are assigned to the superelevation lanes.



7. Review the superelevation section properties.
   a. Select the superelevation shape.
   b. Hover your cursor over the superelevation section shape until the context sensitive menu appears.

c. Select the superelevation properties tool.

d. Review the superelevation properties.

8. Review the right lane superelevation transitions

   a. Select the right superelevation lane. Notice the stations and cross slopes now appear.

   b. Right click to de-select. Or Left click anywhere in the view to de-select.

9. Review the left lane superelevation transitions.

   a. Select the left superelevation lane. Again, review the stations and cross slope information.

   b. Right click to de-select. Or Left click anywhere in the view to de-select.

      TIP: To edit the station or cross slope, simply click on the station text or cross slope text and enter a new value in the edit field. Stationing can also be changed dynamically by selecting the wedge shape and dragging it to the desired station.

      The wedge shape also serves as a slope indicator showing the direction of the cross slope.

      The stationing and decimal place settings can be adjusted under File > Settings > File > Design File Settings, the Civil Formatting category listing has options for controlling display of element handlers. These settings are not unique to superelevation; the same settings are used throughout the Civil products.

      The superelevation lane fill settings can be adjusted under File > Settings > User > Preferences > View Options - Civil, Superelevation Settings listing has options for the superelevation fill.

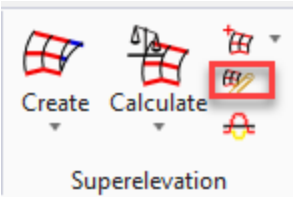
      Like many tools in the software, the Superelevation tools are “rule based”. When superelevation sections and lanes are created, rules and relationships are established that associate the superelevation sections and lanes to the horizontal geometry. If the horizontal geometry were to change, the superelevation sections and lanes would change and follow the new geometry.

      Since superelevation depends on the horizontal geometry reference file, you should never detach the horizontal geometry file. Doing so will break any rules and relationship that exist between the horizontal geometry and the superelevation data.

3.2.2 Create Superelevation Report and Review Transitions

In this section, you will learn to create the superelevation report and review the superelevation transitions.

1. Select the Element Selection tool.
2. From the ribbon menu select **Corridors > Superelevation > Superelevation Report**



3. Select the superelevation section and Right click to accept it.
4. Review the superelevation information in the report and close the window when finished.

   If you need to adjust the Station and Cross Slope format, go to **Tools > Format Options.**

3.2.3 `Create and Review the Superelevation Diagram

In addition to reviewing superelevation transitions via the superelevation lanes and via the superelevation report, the software also provides

the ability to view an editable superelevation control line diagram in a superelevation model view. In this section you learn how to create the superelevation model view and review the superelevation control lines..

1. Select the superelevation section.

   Hover your cursor over the superelevation section shape until the context sensitive menu appears.

   Select the Open SuperElevation Model tool.

   Open View 8 by selecting the view 8 button from the bottom of the screen.

   View 8 will appear displaying the superelevation control line diagram.

   Once the superelevation model view is open you will notice 2 superelevation control lines displayed in the view window. The control lines represent the superelevation transitions for the left and right lanes of the corridor. Each control line is created from the superelevation lane information and is “ruled” to each superelevation lane. Thus, changing the superelevation control lines will adjust the superelevation lane stations and slopes. Each control line can be graphically edited or reviewed by simply selecting it and editing the station and slope values.

2. Select one of the superelevation control lines in View 8. Notice graphical manipulators and dynamic text appear indicating the Stations and Slopes of the transitions. The stations and slopes can be edited by simply selecting the values and entering new values

3. Left click in View 8 to de-select the superelevation control line.

   Another thing to note is the shaded bands in the superelevation view window. Each shaded band indicates where a horizontal curve is located along the horizontal alignment. Also, the view is dynamic and the view exaggeration can be adjusted via the View Attributes.

3.2.4 Assign Superelevation to Corridor

In order to assign superelevation to a corridor the superelevation needs to be created in the corridor design file or attached as a reference file. Since you created the superelevation in a separate dgn file you will now learn how to attach it as a reference file and assign it to the corridor.

a. Open **HW_CB_0047_0122_Exercise_3_Corridor_Route140**

b. Click in View 1 to make sure it is the active view and Fit the view if necessary.

c. Attach Superelevation.dgn to Corridor.dgn

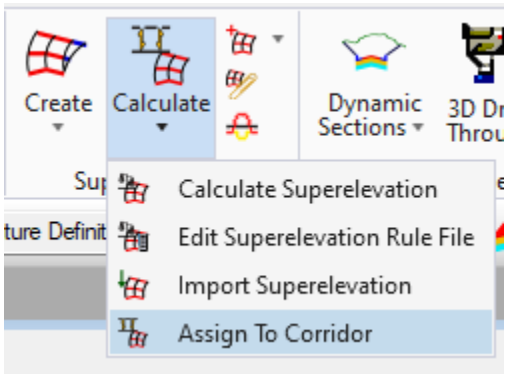
   a. From the ribbon menu select Home > Primary > Attach Tools > References

   b. Select Attach Reference

   c. Select the file **HW_CB_0047_0122_Exercise_3_Superelevation_Route140_Done.** Set Attachment method to Coincident World.

   d. Select Open to attach the file.

d. From the ribbon menu select **Corridors > Superelevation > Calculate > Assign to Corridor**



   a. Select superelevation section shape and Right click to accept it.

   b. Select the Corridor.

   c. Review the Associate Superelevation window and press OK

      This dialog shows the two template points that define each superelevation lane and which of those points the lane pivots about.

The template used for this project has the point CL defined as the superelevation pivot point and the points EOP_L and EOP_R as the points to be superelevated.

d. Right click to complete the process.

Now that the superelevation has been assigned to the corridor, the pavement will be superelevated based on the information in the superelevation file.

Also, be aware that when the superelevation file is assigned to the corridor it is now "ruled" or associated to the corridor. If the superelevation file is updated the corridor will also update.

3.2.5 Review Superelevation on the Cross Sections

Review the cross sections to make sure the superelevation has been applied correctly.

1. Select the Element Selection tool.
2. From the ribbon menu select Corridors > Review > Dynamic Sections > Open Cross Section View tool.
3. Locate and select the Corridor.
4. Open View 7 by selecting the view 7 button from the bottom of the screen. View 7 window will appear.
5. Click in View 7, a cross section should now appear.
   Note, the magenta boxes that appear at the left and right edge of pavement point locations on the cross sections. These boxes indicate a superelevation point control has been created and assigned to the corridor.
   Continually pressing the right arrow key at the top of the cross section view window moves to the next cross section station.
6. Press the right arrow to review the cross sections. As you are moving from cross section to cross section notice how the pavement cross slope is now being superelevated where necessary.
7. To review a specific cross section along the corridor, Right Click in the cross section view window. Select Locate Station Via Datapoint and follow the heads up prompts:
   a. Left click in the plan view or cross section view
   b. Station: 54+60 [5+140], Left click to accept. The cross section should now move to station 54+60 [5+140]

   Alternatively, selecting the down arrow next to the station field will allow you to enter a specific station to move to.
   As you can see the cross sections are now superelevated but how do you know what the cross slopes are? To display and review the cross slopes you will use the Place Horizontal Temporary Dimension Line tool.
8. Label the cross slopes.
   a. Left-click in the cross section view and hold down your right mouse button and select Place Horizontal Temporary Dimension.

b. Place dimension on the right side of the cross section:
   - Pick the CL point.
   - Pick the EOP_R point.
   - Pick a height anywhere on the cross section.

   A temporary dimension line will be placed showing the width and slope.

c. Place temporary dimension line on the left side of the cross section:
   - Pick CL point.
   - Pick EOP_L point.
   - Pick a height anywhere on the cross section.

9. Navigate through the cross sections and notice how the slopes change based on the superelevation that has been applied.
10. Remove the dimensions:
    a. Select Corridors > Review > Dynamic Sections > Remove Temporary Dimensions
    b. Left-click in the cross section view.
11. Review the Superelevation Point Controls that were assigned to the corridor.
    a. Select the Element Selection tool.
    b. Left click in View 1
    c. Select the Corridors > Edit > Corridor Objects tool.
    d. Select the Corridor.
    e. Select Point Control on the left side of the dialog. Review the Superelevation Point Control properties. Note that Superelevation Point Controls are created and defined as a Vertical point control.
    f. Close the Corridor Objects window.

3.3 Create Superelevation 4 lane Road

3.3.1 Create Superelevation Sections and Lanes

*10. Open **Exercise_4_Superelevation_Route140.dgn**, the geometry file is already attached as reference file. You need the geometry file in order to create superelevation.*

11. From the ribbon menu select Corridors > Superelevation > Create > Create Superelevation Sections tool.

Set the Feature Definition to Superelevation and key-in SE in the Name field.

12. Follow the heads up prompts (key in the values listed below and Left click to accept and move to the next prompt):

a. Name: Section 1

*b. Locate Corridor or Alignment: Select the **Route 140** horizontal alignment.*

c. Start Station: Press ALT to Lock To Start

d. *End Station*: ***128+00***

e. *Minimum Tangent Length*: *10000*

The Minimum Tangent Length value is the determining factor on how superelevation sections are defined between curves along an alignment. Setting the value to 0.0 will typically create multiple superelevation sections for each curve along the horizontal alignment. Setting the minimum tangent length to a very large number will force only one superelevation section to be created along the entire length of the alignment.

f. *Lane Creation Method*: *Manual*

13. *Create Left Pavement Lane (continue following the heads up prompts).*

a. *Enter Lane Name*: *LT Lane*

b. *Type*: *Primary*

c. *Side of Centerline*: *Left*

d. *Inside Edge Offset*: *0*

e. *Width*: *12*

f. *Normal Cross Slope*: *-2.0%*

14. *Create Right Pavement Lane (continue to follow the heads up prompts).*

a. *Enter Lane Name*: *RT Lane*

b. *Type*: *Primary*

c. *Side of Centerline*: *Right*

d. *Inside Edge Offset*: *0*

e. *Width*: *12*

f. *Normal Cross Slope*: *-2.0%*

g. *Right click or Reset to complete.*

TIP: Lanes can also be created automatically using the Template method. The template method allows you to select a template from the template library to define the lane width and normal cross slope.

15. *Calculate Superelevation Transitions (continue to follow the heads-up prompts).*

a. *Select Rules File: Press ALT and the Down Arrow on the keyboard to select AASHTO_2011_imperial.xml*

[AASHTO_2011_metric.xml], browse to c:\Bentley Training\QuickStart for Corridor Modeling-Road or other folder where you unzipped the dataset files to locate this file.

In this example the eMax is calculated using the Values in the AASHTO Superelevation Speed Tables for a Design speed of 50 mph [80 kph] and emax of 6%.

b. *e Selection: 6%*

c. *L Selection: Speed Table*

d. *Design Speed:* ***45***

e. *Pivot Method: Crown*

f. *Open Editor: No*

The Superelevation Section and Lanes are now displayed in View 1.

Upon completion, the superelevation section, lanes and transitions will be created along the alignment.

- *The superelevation section is represented by a 2D closed shape drawn along the alignment.*
- *The superelevation lanes are drawn with rainbow-like colors that indicate various cross slopes.*
- *The superelevation transitions are assigned to the superelevation lanes.*

16. *Review the superelevation section properties.*

a. *Select the superelevation shape.*

b. *Hover your cursor over the superelevation section shape until the context sensitive menu appears.*

c. *Select the superelevation properties tool.*

d. *Review the superelevation properties.*

17. *Review the right lane superelevation transitions*

a. *Select the right superelevation lane. Notice the stations and cross slopes now appear.*

b. *Right click to de-select. Or Left click anywhere in the view to de-select.*

18. *Review the left lane superelevation transitions.*

a. *Select the left superelevation lane. Again, review the stations and cross slope information.*

b. *Right click to de-select. Or Left click anywhere in the view to de-select.*

TIP: *To edit the station or cross slope, simply click on the station text or cross slope text and enter a new value in the edit field. Stationing can also be changed dynamically by selecting the wedge shape and dragging it to the desired station.*

The wedge shape also serves as a slope indicator showing the direction of the cross slope.

The stationing and decimal place settings can be adjusted under File > Settings > File > Design File Settings, the Civil Formatting category listing has options for controlling display of element handlers. These settings are not unique to superelevation; the same settings are used throughout the Civil products.

The superelevation lane fill settings can be adjusted under File > Settings > User > Preferences > View Options - Civil, Superelevation Settings listing has options for the superelevation fill.

Like many tools in the software, the Superelevation tools are "rule based". When superelevation sections and lanes are created, rules and relationships are established that associate the superelevation sections and lanes to the horizontal geometry. If the horizontal geometry were to change, the superelevation sections and lanes would change and follow the new geometry.

Since superelevation depends on the horizontal geometry reference file, you should never detach the horizontal geometry file. Doing so will break any rules and relationship that exist between the horizontal geometry and the superelevation data.

3.3.2 Create Superelevation Report and Review Transitions

3.3.3 Create and Review the Superelevation Diagram

3.3.4 Assign Superelevation to Corridor

3.3.5 Review Superelevation on the Cross Sections

Appendix

3.1 Corridor Creation

A corridor model is created by applying a template to selected horizontal and vertical geometry.

Corridor models are created by choosing the **New Corridor** command from the **Corridors** tab, or by selecting an alignment and choosing the Create Corridor command from the pop-up menu. When the command is selected, the software will step you through a series of prompts. These prompts appear on the cursor and can also be defined using the **Tool Settings** dialog.

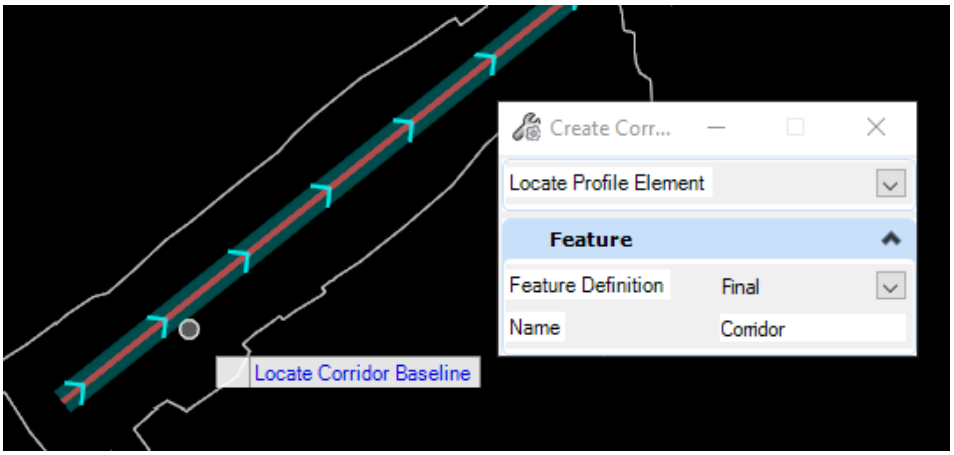


Figure 9 New Corridor Creation

You are prompted to define the following parameters:

Locate Profile – Reset For Active Profile - Select the profile name from the drop-down list or issue a reset button to accept the Active Profile that is defined for the Horizontal Alignment.

Corridor Name - Define the name for the corridor. It is recommended that you use same name as the horizontal alignment.

Design Stage - Design stages are used to define a variety of parameters to control the template drop interval as well as which elements are drawn in the 3D model (3D line strings, 3D components, surface meshes, etc). The design stages are defined in CV_Highway_Features_Levels_ElemTemp.dgnlib which is attached by a configuration variable.

The design stages can be reviewed in the Civil Standards tab of the Project Explorer dialog as shown below.

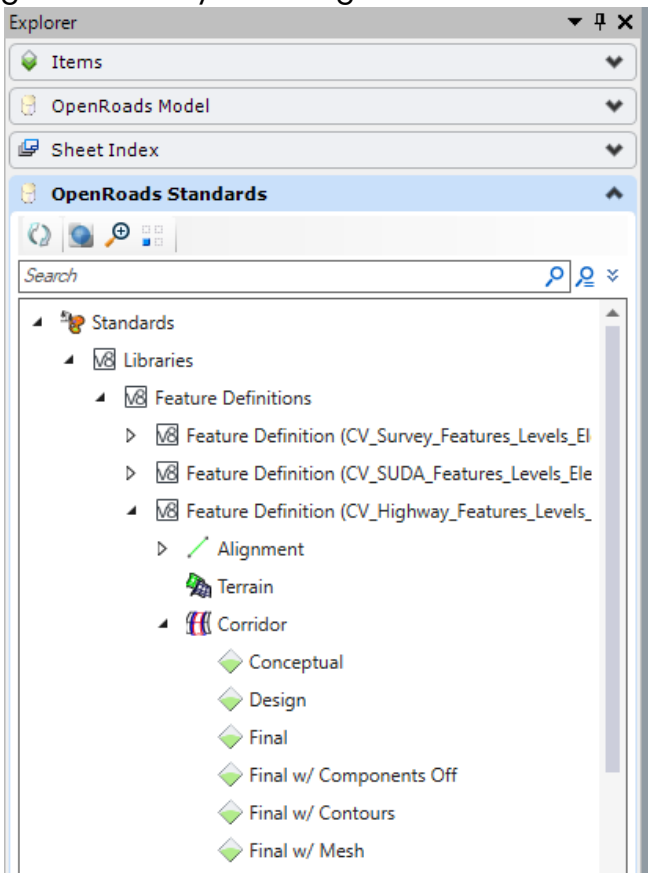


Figure 10 Design stages in Project Explorer

The design stage can be changed at any time throughout the corridor modeling process.

Each design stage is defined to provide more detailed information as you work from conceptual design for the final design. The settings for each design stage are defined in the CTHDOT standards and vary for each design stage.

Template Drop Interval Multiplier – When templates are applied to the horizontal and vertical geometry, the user is prompted to enter a template drop interval. CTDOT recommends an interval of 5. The Template Drop Interval Multiplier parameter is used to specify a multiplier, which is applied to the initial template drop interval, to determine the actual interval of each template drop location according to the selected design stage. This is useful to speed up processing for early design stages where less detailed information is required. The CTDOT design stages have been defined with the multiplier values shown in the table below.

Design Stage	Template Drop Interval Multiplier
Conceptual	5
Design	2
Final	1

After defining the **Profile, Corridor Name, and Design Stage**, you are prompted to define the Template Drop information as shown below.

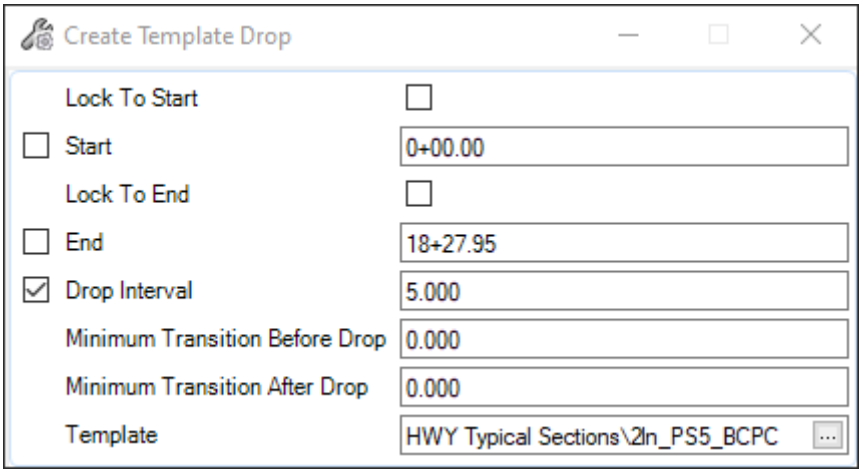


Figure 11 Template Drop Information Dialog Box

The parameters can be defined in the **Create Template Drop** window, as shown at above, or by dialogs floating on the cursor that will step you through the parameters.

Each parameter is defined below:

Lock to Start – Toggle this option on to lock the start of the corridor to the start of the horizontal alignment.

Start – Define the Start station for the corridor.

Lock to End –Toggle this option on to lock the end of the corridor to the end of the horizontal alignment.

End – Define the end station for the Corridor.

Drop Interval – This parameter is used to define the interval that the template will be applied to the corridor. We recommend a Drop Interval of 5 for CTDOT projects.

Minimum Transition Before Drop / Minimum Transition After Drop – If they are non-zero, then a transition drop is created at the beginning/end of the template drop with a length greater than or equal to the value entered. The actual length is determined by how far it is between the new drop and the drop before/after the new drop. If there isn't enough space to meet the minimum, then the previous/next drop is shortened to accommodate the transition. If there is no previous/next drop, then no transition drop is created.

Template – Define the template from the library to be applied to the alignment and profile. The … button to the right of the template name is used to browse the template library to choose the desired template.

After defining the Create Template Drop parameters, the template is applied to the selected horizontal and vertical alignments to create the corridor. A 3-Dimensional model

named Design-3D is automatically created in the active design file and referenced to the active model.

Note: The referenced graphics are not always desirable and can be turned off using the MicroStation Reference Attachment tools.

Different views can be displayed by holding down the right-mouse button in the MicroStation view until the pop-up menu appears, and then choose *the desired layout.*

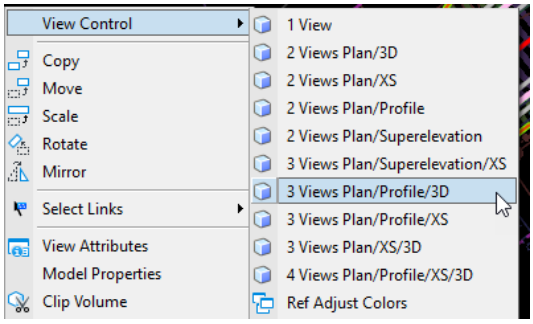


Figure 12 Setting up the Muli-Model View

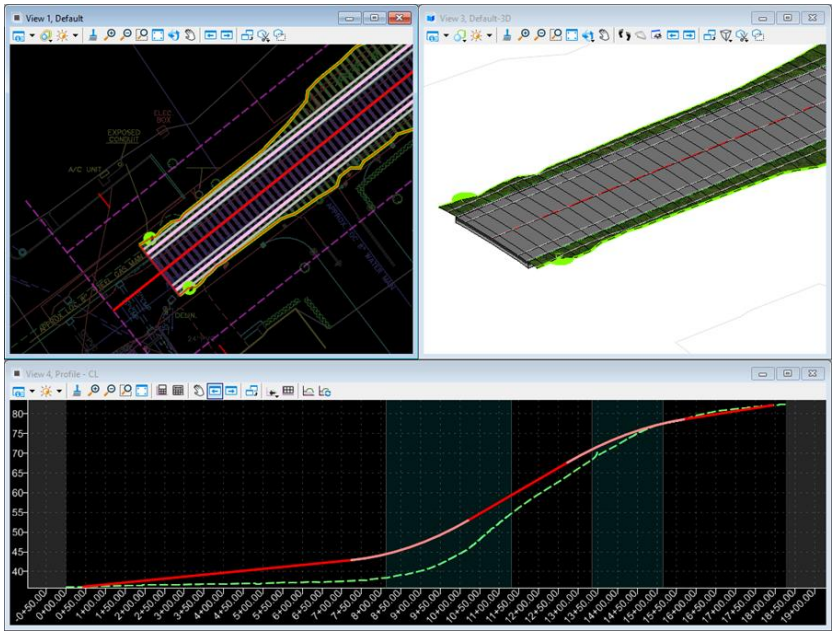


Figure 13 Setting up the Muli-Model View Windows

In addition to the 3d graphics, 2d graphics are drawn in the active model as described below:

- 2-Dimensional graphics are drawn in the active model as defined by the features assigned to the individual points in the template. The CTDOT feature definitions that are assigned to points on the surface of the template, such as the edge of pavement, shoulder, or ditches, are the only template features that draw these 2D plan graphics.
- Graphics representing the length of the corridor model and the template drop range are created in the active model. This graphic includes several "handles" at intervals along the length of the corridor that can be easily selected to identify the corridor model as shown below.

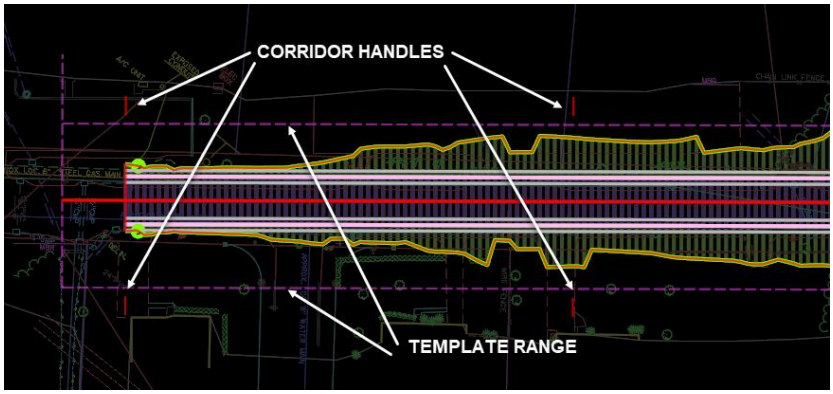


Figure 14 Corridor Handles and Template Ranges

- The corridor is added to the **OpenRoads Model**, which can be reviewed in the *Project Explorer* dialog.

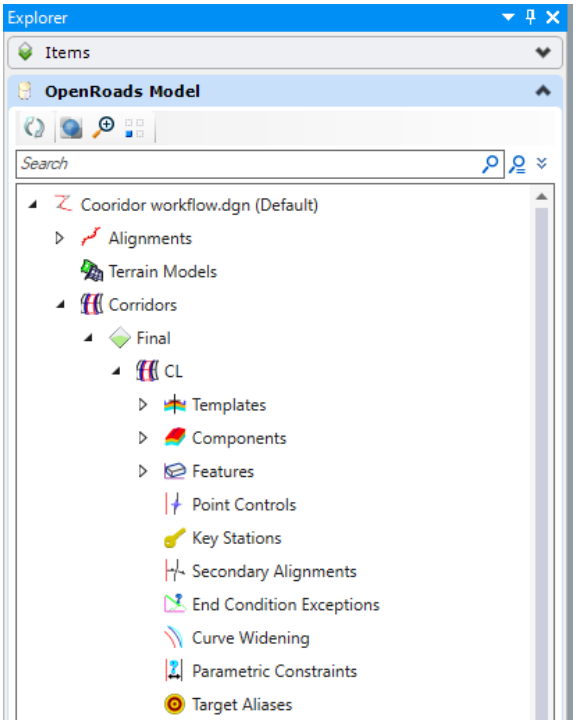


Figure 15 OpenRoads Model Check in Project Explorer

3.2 Corridor Editing

Select one of the corridor handles, as shown below, to access a menu of common corridor commands.

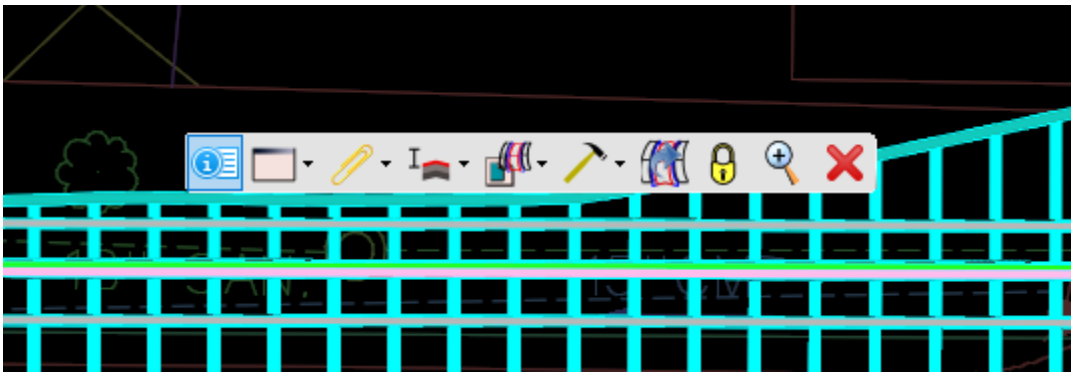


Figure 16 Corridor Editing Tools

The commands in the menu are grouped as follows:

- Properties
- Corridor Views
- Reports
- Corridor Overlay
- Corridor References
- Corridor Creation Tools
- Lock – Deactivate Rule
- Zoom To
- Delete

3.2.1 Corridor Properties

The corridor parameters can also be edited in the **Properties** dialog when a corridor is selected.

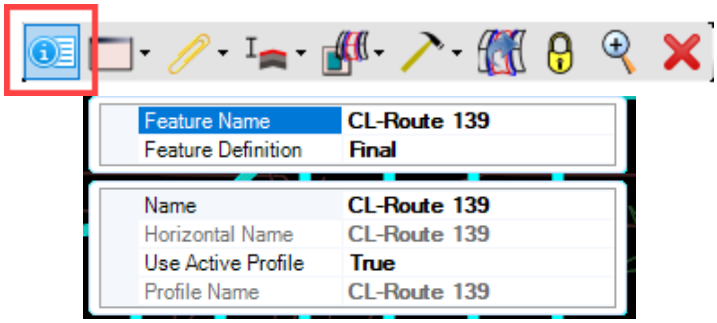


Figure 17 Properties dialog

3.2.2 Corridor Views

The **Corridor Views** icon has two commands, **Open Profile Model** and **Open Cross Section Model**. The **Open Cross Section Model** command is used to create a dynamic cross section view to review the model by scrolling through cross sections.

Figure 18 Open Profile Model and Open Cross Section Model Tools

When selected, you are prompted to **Open or Select View** for the cross-section display. In the example below, View 2 was selected to display the dynamic cross sections.

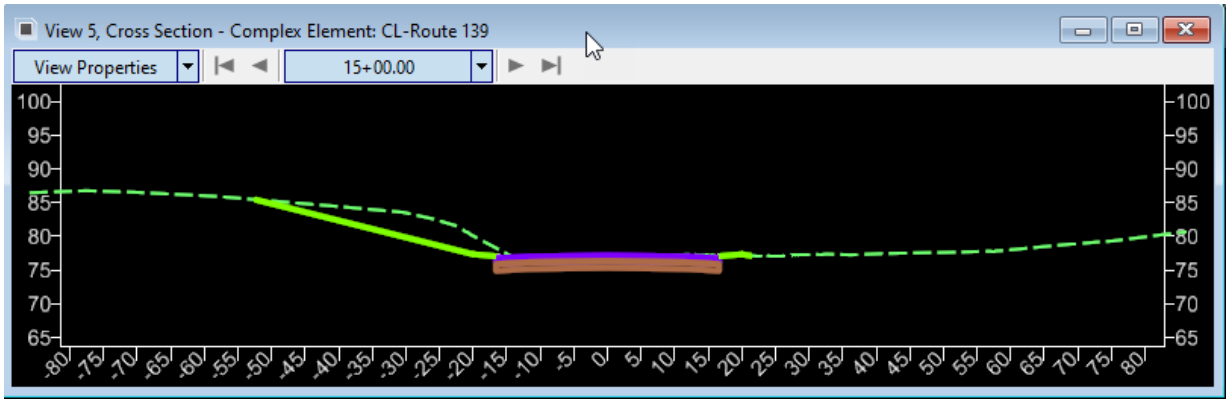


Figure 19 Cross Section View

This dynamic view is a temporary display of the cross sections. The sections are not written to the design file using this command.

The **View Properties** contains parameters for adjusting the cross section display, as shown at below.

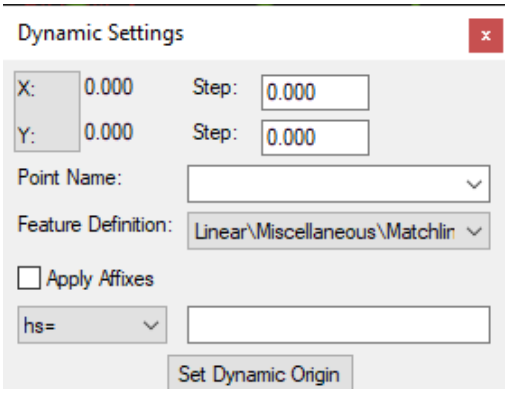


Figure 20 Dynamic Settings

Hold down the right mouse button in the cross section view to access the pop-up menu shown at right. Five additional commands relevant to cross sections are available. See the online help for additional information.

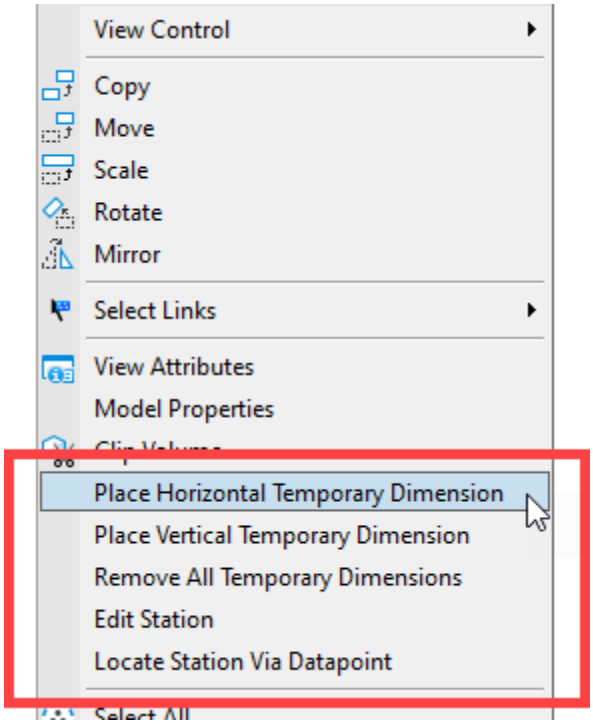


Figure 21 Place Horizontal Temporary Dimension

3.2.3 Reports

The Reports icon provides access to the following four reports:

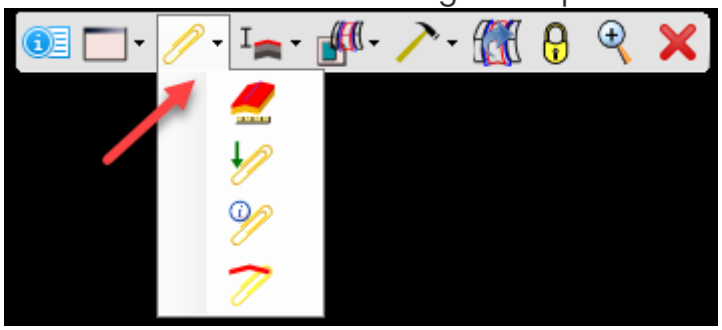


Figure 22 Report Tool

- Corridor Component Quantities
- Design Input Report
- Results Report
- Milling Report

The **Corridor Component Quantities** report is used to generate a quick cost estimate for the selected corridor by assigning a unit cost for each component in the corridor templates.

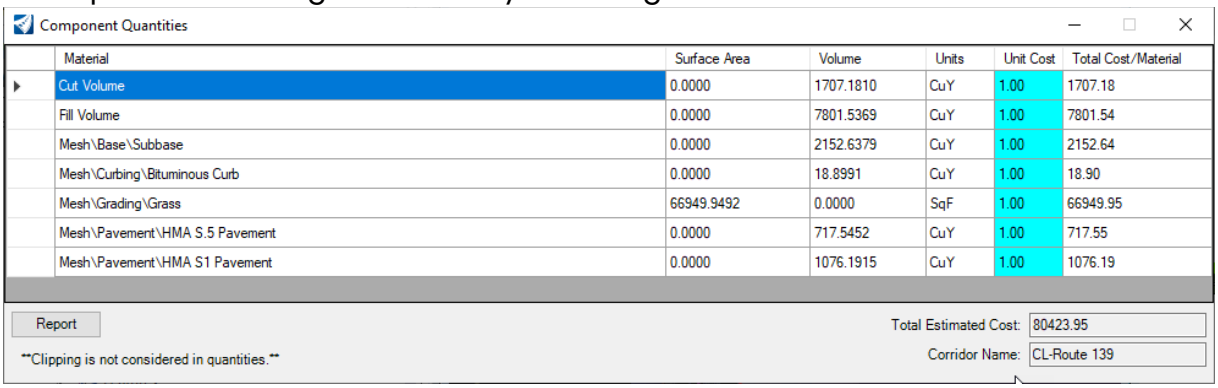


Figure 23 Corridor Component Quantities

3.2.4 Corridor Overlay

The **Corridor Overlay Vertical Adjustment** command determines the ideal PGL point based on the input criteria and the distance from the top of the template to the existing ground. See the online help for additional information.

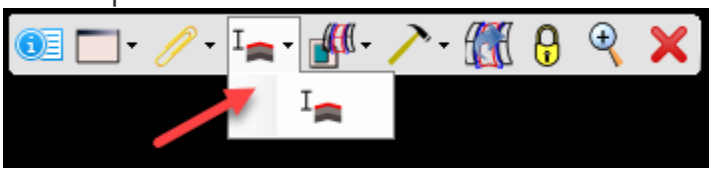


Figure 24 Corridor Overlay Vertical Adjustment

3.2.5 Corridor References

The following four **Corridor References** commands are available:

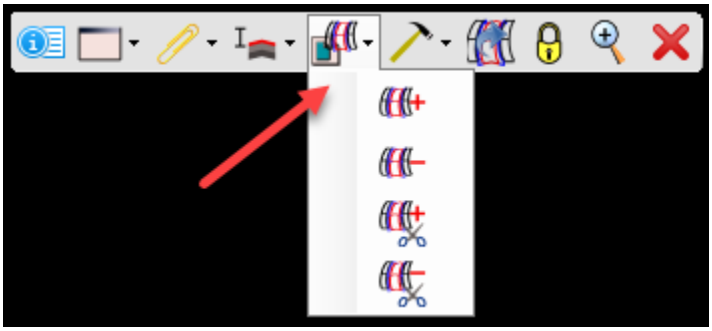


Figure 25 Corridor References

Add Corridor Reference – This tool is used to add graphical elements to the corridor processing. This must be done when a Feature is targeted in the template definition. This enables the software to process only the identified elements which speeds up processing. For example, if the template targets a right-of-way line, the right-of-way lines must be included as a Corridor Reference for the template to find the lines.

Remove Corridor Reference – This tool is used to remove graphical elements from the corridor processing.

Add Clipping Reference – This command is used to remove areas of overlap when working with multiple corridors. For example, in a corridor intersected by a crossing roadway, clipping is used to remove overlapping features within the intersection.

Remove Clipping Reference – This tool is used to remove any clipping references defied for a corridor.

3.2.6 Corridor Creation Tools

The Corridor Creation Tools menu contains commonly used corridor commands.

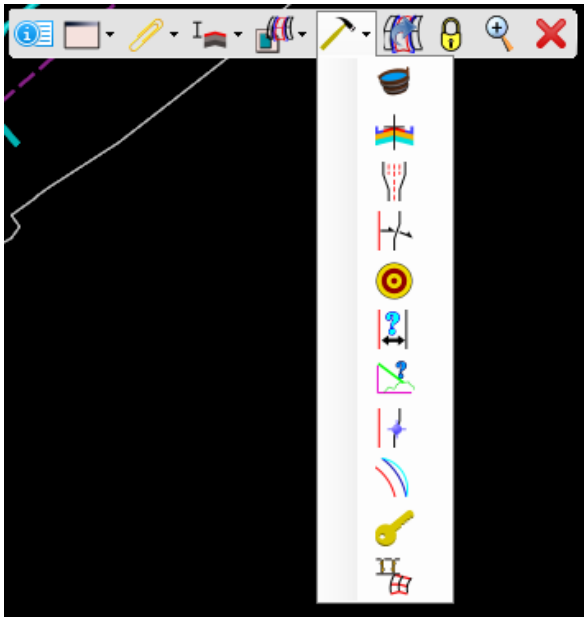


Figure 26 Corridor Commands Tools

Corridor Objects – This option is a one-stop shop to view, create, and edit corridor objects. Most of the options contained in the Corridor Creation Tools can be accessed from this dialog as shown below.

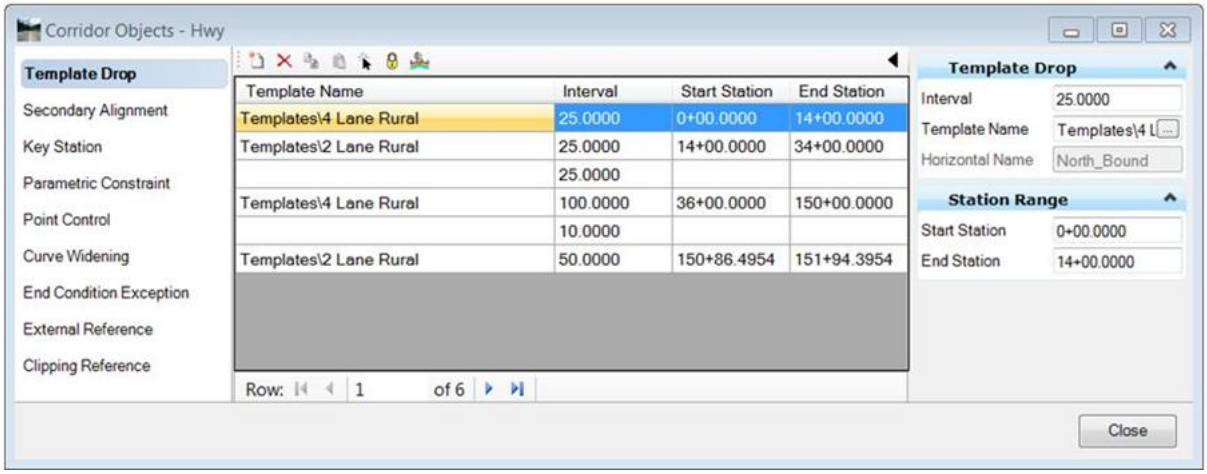


Figure 27 Corridor Objects

Create Template Drop - This tool is used to create a new template drop location on the corridor.

Create Transition - A transition is created between templates of different names, as templates generally don't instantaneously change from one template to another. This tool creates the transition by selecting the two templates drops which are adjacent to it. Once the transition location is created, it is up the user to define how the transition is applied. See the online help for more information.

Create Secondary Alignment - Secondary alignments are used to modify the direction of cross section processing. By default, at any given station, the cross section is created orthogonal to the main alignment. If a secondary alignment exists, then that portion of the cross section which lies outside the secondary alignment will be orthogonal to the secondary alignment instead of the main alignment. See the online help for more information.

Define Target Aliasing - Target aliasing allows you to target other corridor surfaces or features or to set up a prioritized target list for end condition solutions on surfaces, features and alignments. See the online help for more information.

Create Parametric Constraint - Parametric constraints can be used to change one or more labeled constraint values of a template while the template is being processed in the corridor modeler. See the online help for more information.

Create End Condition Exception - End Condition Exceptions are used to modify the behavior of an end condition solution without requiring the use of additional template drops. When an end condition exception is added, it must be edited to change its behavior. End condition exceptions come in two classes:

- **Overrides** allow you to replace or override the template drop end conditions on the left or right of the backbone. When you choose this option, you must edit the override to set up the new end condition. When the override exception is edited, the Create Template dialog is displayed allowing you to edit the end-condition.
- End condition **Transitions** are used where the end condition may change suddenly due to changes in the existing surface or other reasons, and you want the transition to be smooth over a specified station range rather than a sudden change over a short length.

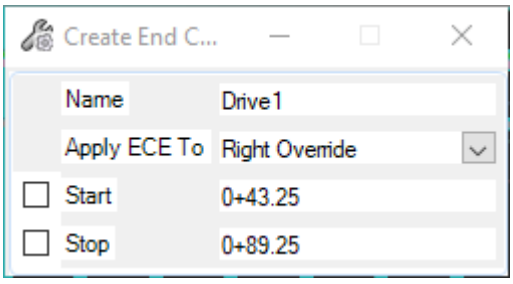


Figure 28 Transitions

Create Point Control – Point controls are used to override the normal locations of one or more points and or components in a cross section. Examples of this include lane widening, staying within the right-of-way, or maintaining a slope for a ditch.

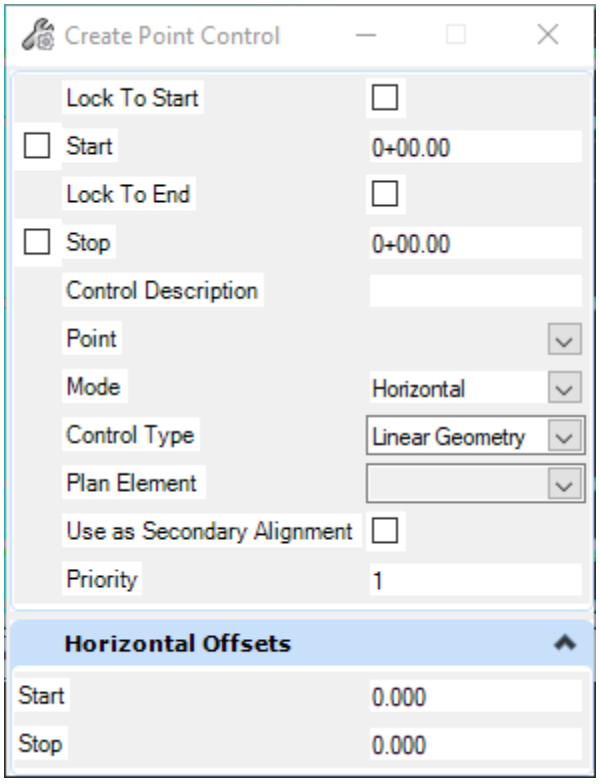


Figure 29 Create Point Control

Create Curve Widening – Curve widening is used to automatically create and apply horizontal controls to widen lane and/or edge of pavement lines around curves, moving them further away from the centerline at each curve of the controlling alignment. The tool is used in conjunction with an ASCII file (*.wid) which contains parameters to definethe widening. CTDOT does not provide curve widening tables currently. Use point controls to manually assign the station ranges and offsets for curve widening.

Key Station – This command is used to add stations that are not coincident to the template interval to the corridor processing. For example, a key station can be added at a drive or culvert location to ensure the template is processed at that station.

Assign Superelevation to Corridor – Superelevation is covered in another section of this training.

The last four tools on the bar are described below:

Figure 30 Corridor Editing Tools

Process Corridor - Select this icon to reprocess the corridor.

Lock - Deactivate Rule - This command can be used to temporarily deactivate processing rules on the corridor. This is useful when making edits so that the corridor does not automatically update as the edits are made. Once the edits have been completed, the rules can be turned back on, and the corridor reprocessed.

Zoom To - Select the command to zoom to the full extents of the corridor.

Delete - Select this command to delete the corridor.

3.2.7 Processing Order for Point Overrides

There are several ways in the corridor processing to override the template definition for various constraints using Parametric Constraints, Point Controls, and Horizontal Feature Constraints.

This is generally the order in which OpenRoads solves the location of points and components at each template drop:

1. Template is dropped, and points are placed according to the point constraints stored in the template.
2. Parametric constraints are applied as defined in the template, and in the corridor.
3. Horizontal Feature constraints are applied to move points if the feature is found in the specified range.
4. Point controls are applied to the assigned points, overriding the corresponding constraint, and all points that are constrained back to the point-controlled point will be recalculated.
5. Component display rules are solved based on the current position of all points.
6. End conditions are solved by extending designated segments along the specified slope to seek their targets.

3.3 Template Drops

3.3.1 Create Template Drop

The Create Template Drop tool is used to define what the cross sections of the roadway look like for that portion of the road based on user-defined station range.

You can access this tool from the following: **Ribbon: Corridors > Create > New Template Drop**

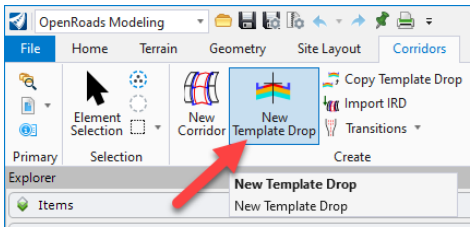


Figure 31 Create Template Drop

The Create Template Drop tool defines what the cross sections of the roadway look like for that portion of the road based on user-defined station range. A project may comprise a single template drop or multiple template drops. Often, transitions are used between two template drops, rather than an abrupt change from one template to another.

Before selecting the New Template Drop tool make sure the desired Template Library is connected, browse to select the needed library if it is not opened and close the Create Template Dialog box.

After selecting the New Template Tool, follow the prompts to select the wanted Corridor. The Select Template pop-up will appear, follow the prompts to select the needed roadway template.

Figure 32 Selected Template Name

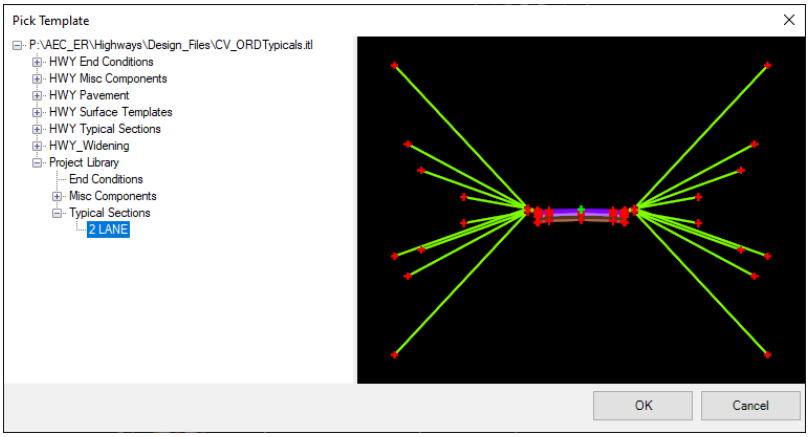


Figure 33 Pick Template

Careful consideration should be given for the Drop Interval used for a corridor, although it can be changed at any time. It specifies the distance between each processing of the template (in master units). Generally, this value is equal to or less than (but still a multiple) of the desired interval for the final cross sections, since cross section stations should be coincident with processing stations. It is not necessary to set the interval so small that it encompasses all desired cross section stations, as stations with particular project interest can be added to the model with the use of the Key Station tool. If the model is to be used in construction, the smaller the interval, the more detailed the model, but will require more processing time.

Minimum Transition Before Drop and Minimum Transition After Drop are inputs in the Create Template Drop tool. If they are non-zero, then a transition drop is created at the beginning/end of the template drop with a length greater than or equal to the value entered. The actual length is determined by how far it is between the new drop and the drop before/after the new drop. If there isn't enough space to meet the minimum, then the previous/next drop is shortened to accommodate the transition. If there is no previous/next drop, then no transition drop is created.

After completing the prompts, the corridor is automatically processed and can be viewed in both 2D and 3D views. The corridor can be rendered, if desired.

3.3.2 Edit the Template Range

When the template range graphic is selected, the range can be edited by accessing rule that defines the template drop location.

Figure 34 Edit the Template Range

The template range can be edited by selecting the station and editing the value of by selecting the arrow icon to dynamically mode the start (or end) of the template range.

3.3.3 Template Drop Context Menu

Select the template range graphic and let the cursor rest on the element to access the pop-up menu shown below.

Figure 35 Template Drop Context Menu

The following commands are available:

- Properties
- Edit Template Drop
- Copy Template Drop
- Synchronize with Library
- Delete

Properties

Pop-up display includes access to modify the Interval, Template Name, Description and Station range.

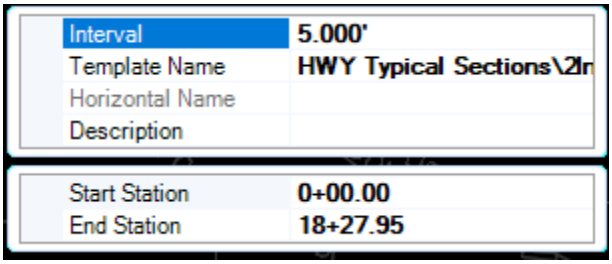


Figure 36 Properties

Edit Template Drop

When a template is applied to generate the corridor, the template definition is copied into the design file. The template definition can be edited in the design file, independent of the definition that is stored in the template library .itl file. Use this command to edit the template definition as applied to the corridor, not the template as defined in the library.

> ***Note:*** *When the command is selected, the* Editing Roadway Designer Template Drop *dialog is opened. This tool is useful when you wish to make local changes to the corridor without editing the template library definition. For consistency, CTDOT recommends making all changes to the template library and then using the* ***Synchronize with Library*** *command to apply the changes made in the library to the corridor model.*

Copy Template Drop

This tool is used to copy a template drop to a new station range along the alignment by defining the beginning and ending station for the new template drop range.

Synchronize with Library

Select this tool to synchronize the local copy of the template that has been applied to the corridor with any changes that have been made to the template in the library .itl file.

> ***Note:*** *Synchronizing the template with the library will override and changes that may have been made to the corridor's template definition by using the* ***Edit Template Drop*** *command. For consistency, CTDOT recommends making changes to*

the template library and using the Synchronize with Library command to apply template changes to the corridor.

Delete
Deletes the template drop.

3.3.4 Create Corridor and Apply Template Drop

Corridors represents one or more Templates being dropped along 3D Baseline to create a 3D Model. This module will instruct to Creating Corridor and Applying Template Drops.

If not already open, Open the previously created project Corridor Model file,

HW_CB_1234_1234_RoadwayModel.dgn and Load the Template Library for the project.

Activate the **OpenRoads Modeling** workflow from the pick list next to Quick access toolbar in the upper left corner if it is not already active. The ribbon menu will reflect the **OpenRoads Modeling** tools.

1. From the ribbon, select **Corridors** Tab.
2. From the **Create** Group Select **New Corridor**.

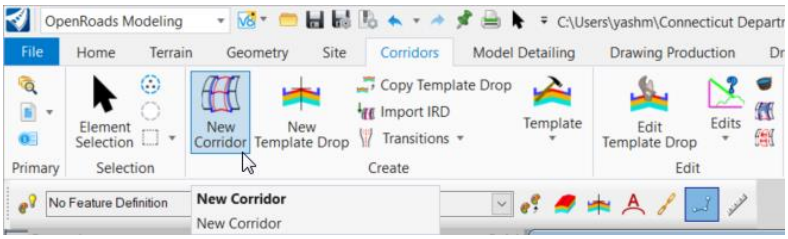


Figure 37 New Corridor

3. Create Corridor dialog will open.
   a. Select **Feature Definition > Final** (user can choose desired featured definition from the list)

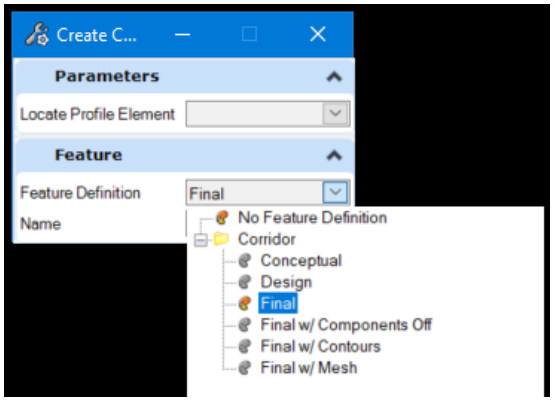


Figure 38 Corridor Feature Definition

b. Follow the prompts:

c. ***Locate Corridor Baseline***, select the **Horizontal Alignment** (The program will automatically generate or pick up the name of the selected alignment i.e. ***RTE1***)

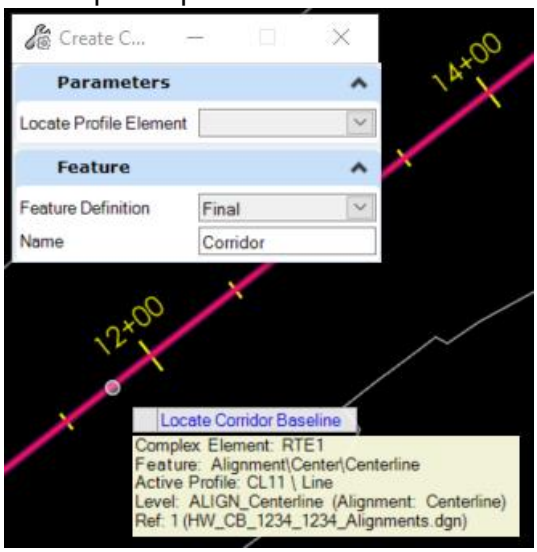


Figure 39 Locate Corridor Baseline

d. ***Locate Profile-Reset For Active Profile***, **right-click** to accept the Active profile associated with the Horizontal Alignment.

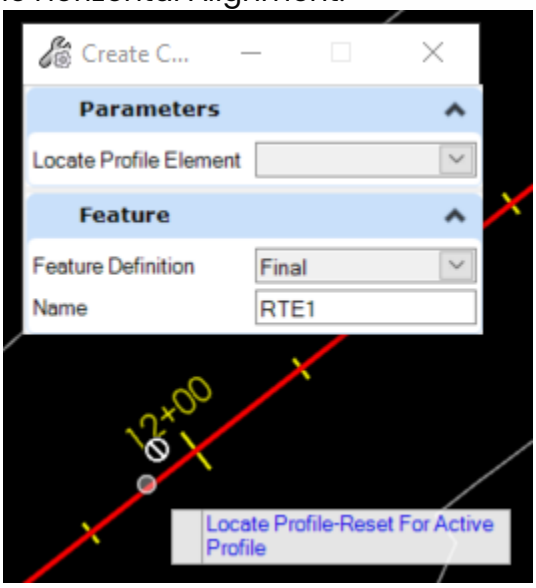


Figure 40 Locate Profile-Reset For Active Profile

e. ***Corridor Name> Feature: Name,*** **left-click** to accept the Active name ***RTE1*** or rename as desired then accept to create Corridor.

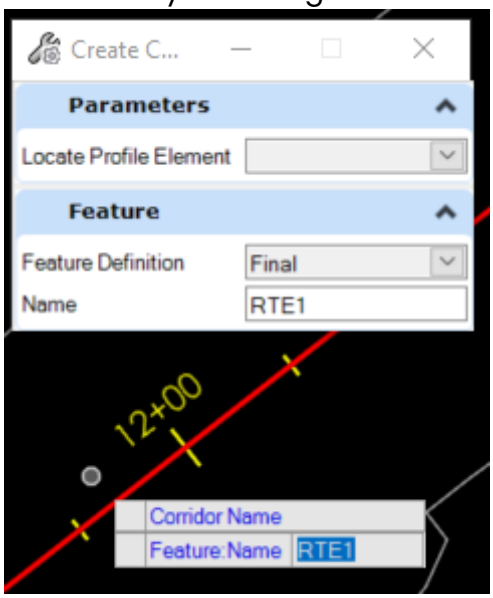


Figure 41 Corridor Feature: Name

f. Closed shape called **Corridor Object** is drawn along the alignment in 2D view.

g. Create Template Drop dialog will appear (skip to ***next Step***)

- If the Create Template Drop do not appear, it denotes that user have exited from the command and the plan will be like below.

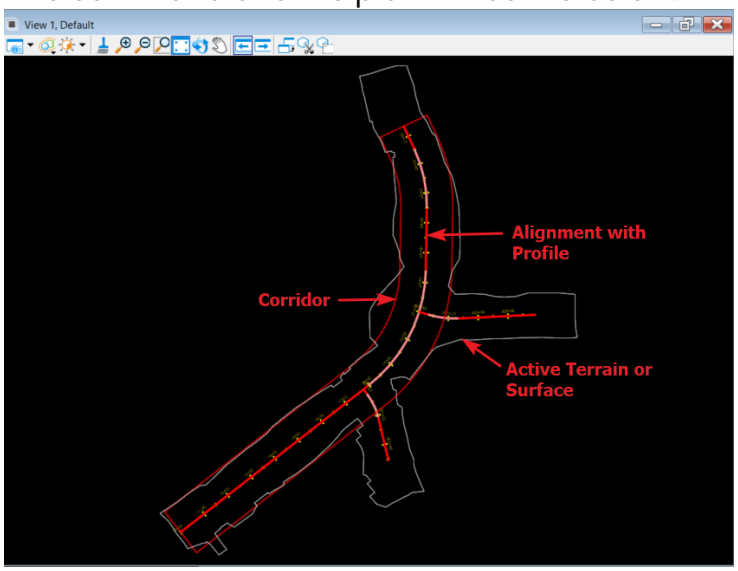


Figure 42 No Template Drop Created

- Corridor is created but there is no template applied to it. In order to apply the template(s) to the newly created corridor at a defined interval along the alignment, From **Corridors** Tab Ribbon then From the **Create** Group Select **New Template Drop**.

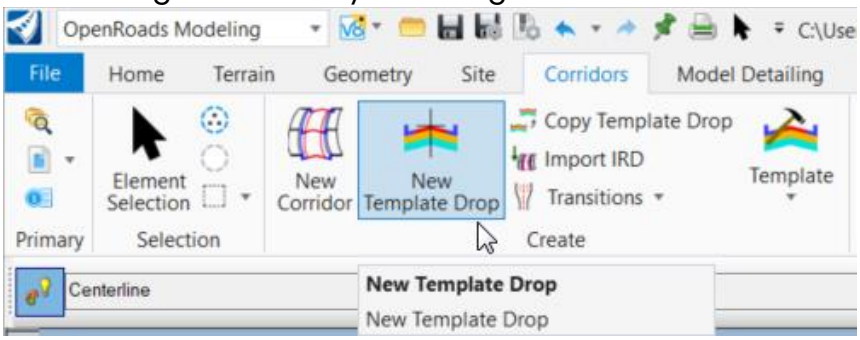


Figure 43 New Template Drop

- On ***Locate Corridor*** prompt, select the newly created corridor then follow the next steps below.

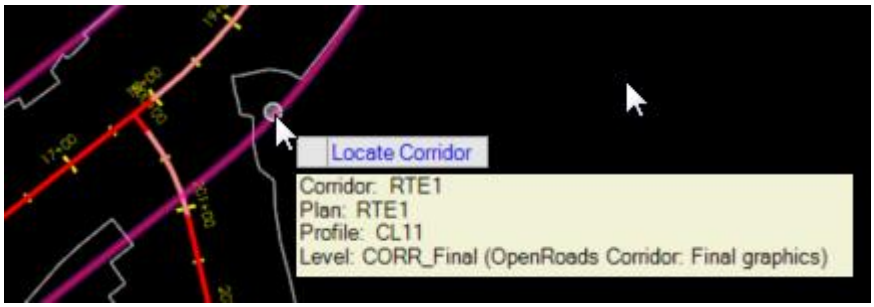


Figure 44 Locate Corridor

4. Follow prompts after **Create Template Drop** dialog opens.
   a. Click the **browse** button next to Template label to open Template library or **click** the **Alt** and **Down** to open Template library.

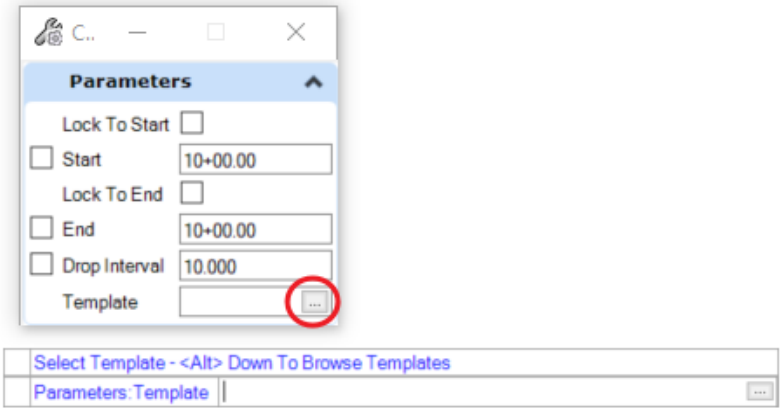


Figure 45 Select Template

   b. This opens the Pick Template dialog. Select the desired template prepared for the project and review. For this example, choose ***HWY Typical Sections > 2In_HMA_BCPC*** and click **OK**.

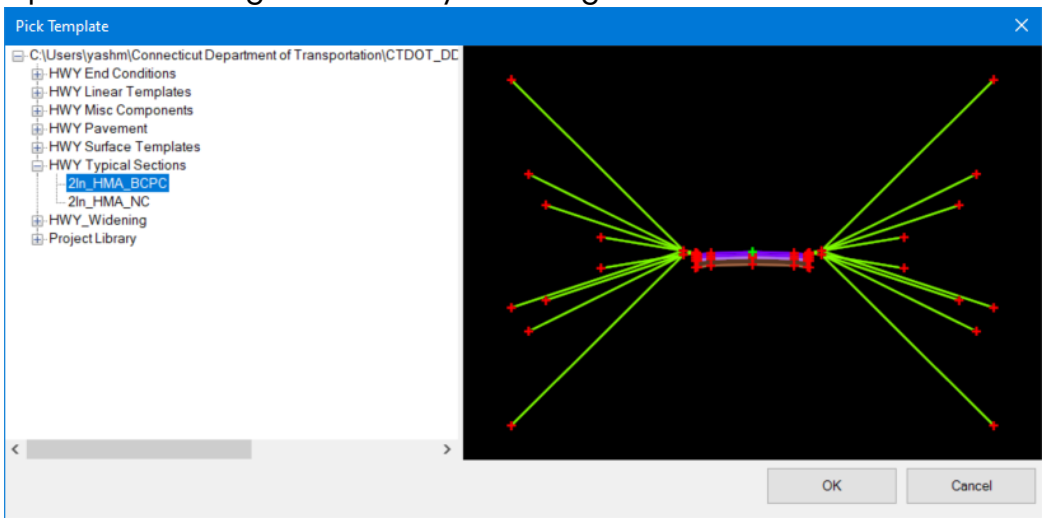


Figure 46 Pick Template

- **Template - *HWY Typical Sections > 2ln_HMA_BCPC***, **left-click** to accept the ***2ln_HMA_BCPC.***
- **Parameters: Start - *10+00*** (**Click** Alt to Lock to Start or type specific Station), **left-click** to accept .
- **Parameters: End - *27+36.69*** (**Click** Alt to Lock to End or type specific Station), **left-click** to accept.
- **Parameters: Drop Interval - *10*** (as desired), **left-click** to accept.
- **right-click** to exit command. New corridor with template drops associated with it is created.

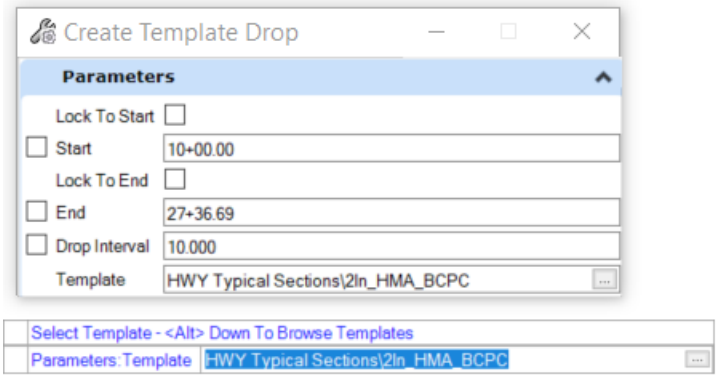


Figure 47

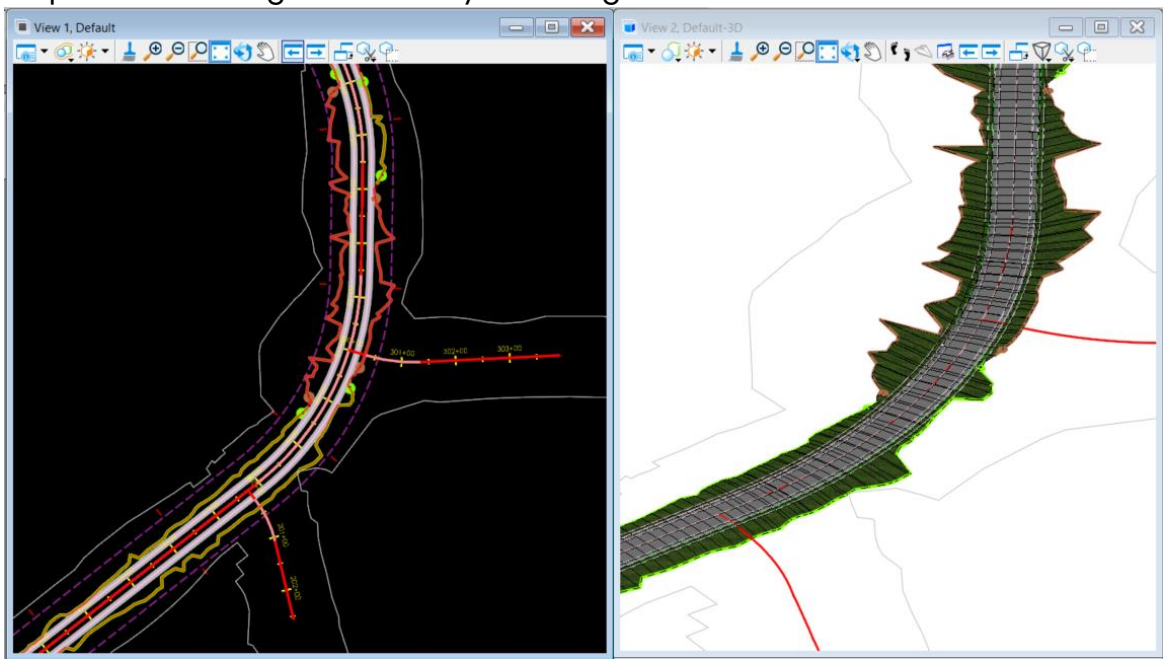


Figure 48 2D and 3D Views

5. Additional corridors can be created for the side roads following the steps described above.

3.3.5 Display Dynamic Cross Sections

Once Corridor is created, the cross sections can be created directly from the 3D Model and can be viewed with Dynamic Cross Sections tool. The interval of cross sections is based on the template drop interval. Dynamic Cross Sections are always created perpendicular to the alignment of the Corridor used.

1. Activate the **OpenRoads Modeling** workflow from the pick list next to Quick access toolbar in the upper left corner if it is not already active. From the ribbon, select **Corridors** Tab.

   From the **Review** Group Select ***Dynamic Sections*** **> Open Cross Section View.**

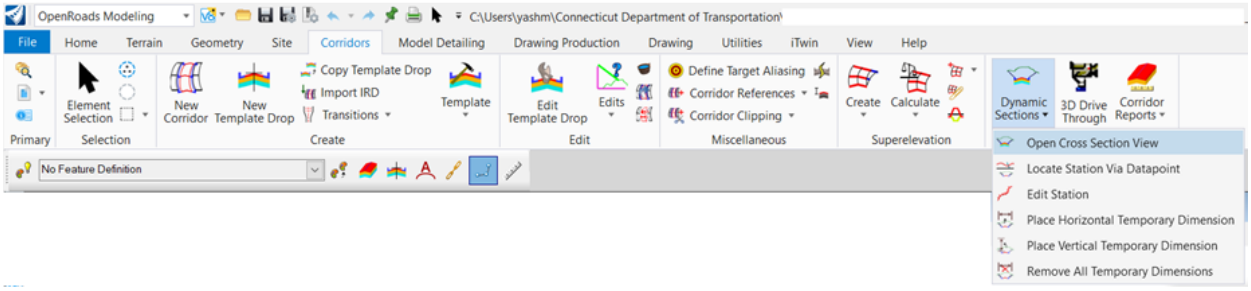


Figure 49 Corridors Tab

2. Follow the prompts.
   a. **Locate Corridor or Alignment:** Select ***RTE1*** Corridor.
   b. **Select or Open view:** **Open View 4** by selecting the view 4 button from the bottom of the screen.
   c. Click inside **View 4** window, a cross section will appear.

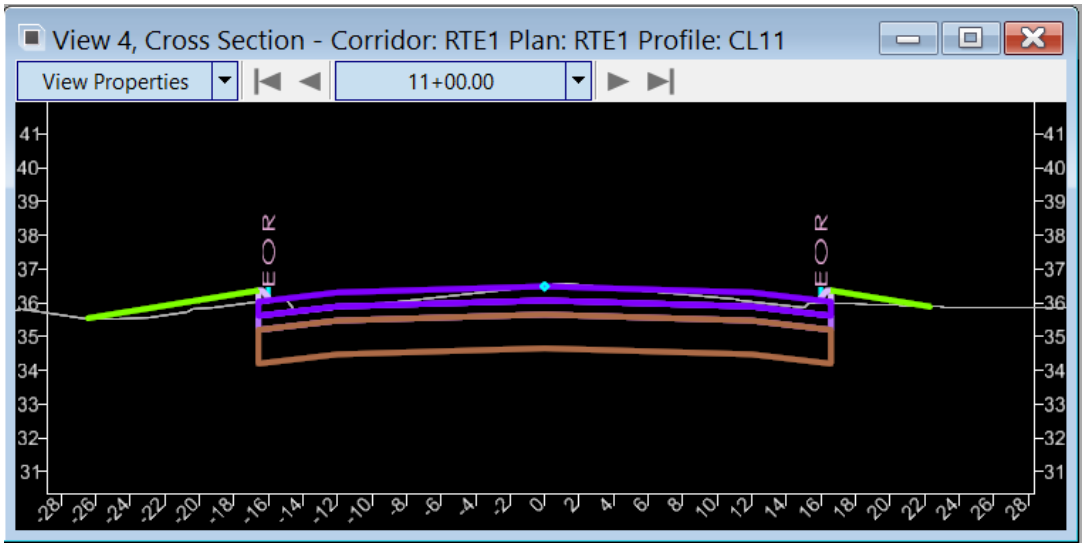


Figure 50 Cross Section Viewer

d. In the upper left portion of window, select the drop-down arrow next to ***View Properties.*** Here the view properties of the Cross Section view can be changed as needed.

e. User can press single left or right arrow to move to the previous or next cross section, respectively.

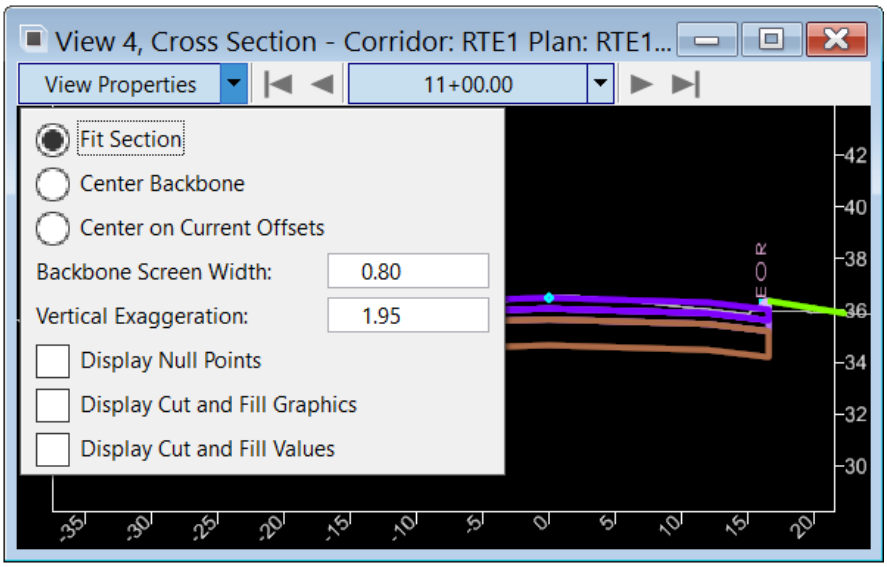


Figure 51 Cross Section Viewer Set View Properties

3.3.6 Modify Corridor

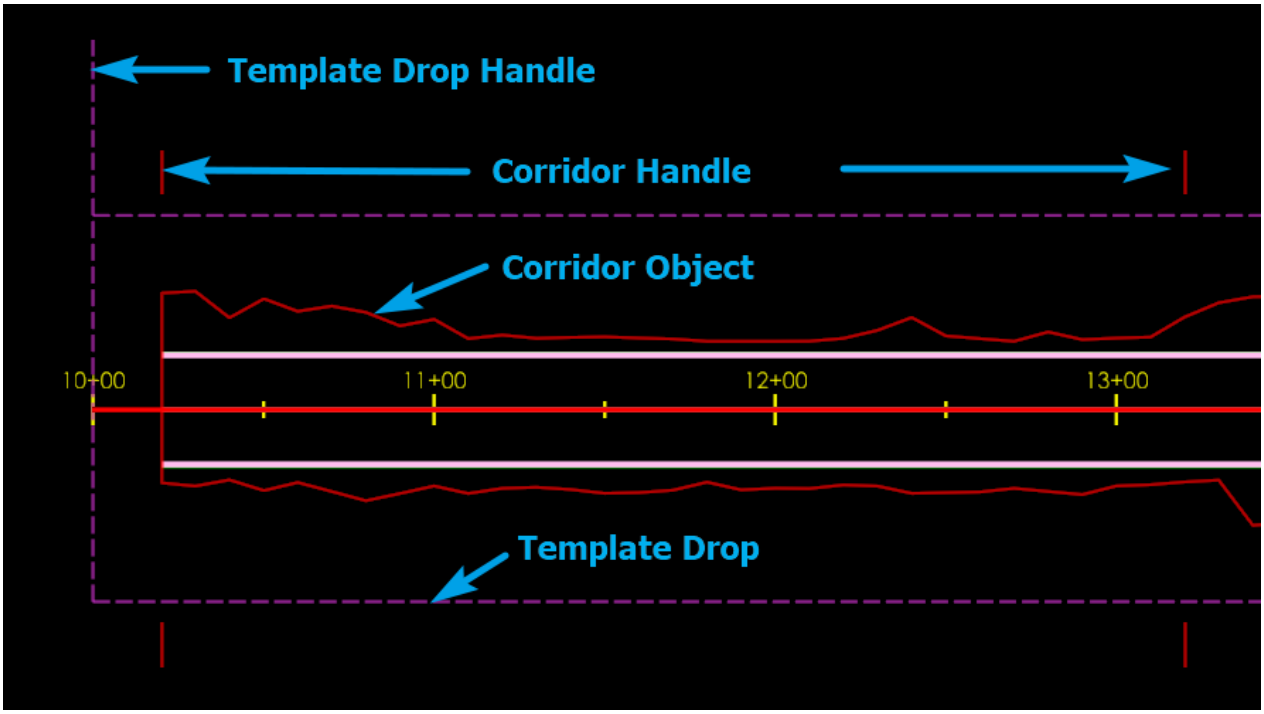


Figure 52 Corridor Handles and Objects

3.3.7 Copy and Replace Template Drop

This module instructs users how to copy and edit or replace existing Template in design file.

1. Load **Corridor (Roadway Model) file** and Load the **Template Library** for the project.
2. Activate the **OpenRoads Modeling** workflow from the pick list next to Quick access toolbar in the upper left corner if it is not already active. The ribbon menu will reflect the OpenRoads Modeling tools.
3. The Corridor file contains corridor ***RTE1*** with template drop ***2ln_HMA_BCPC*** from Sta. 10+00 to Sta. 16+00. When the Template Drop Range of ***Template Drop*** graphic is selected, range can be edited as needed. The range can also be edited form the properties window by changing ***Start*** and ***End Station***.
4. Copy ***Template Drop***. Select ***2ln_HMA_BCPC*** Template Drop and let the cursor ***rest*** on the element to access the context sensitive pop-up menu. Select **Copy Template Drop**.

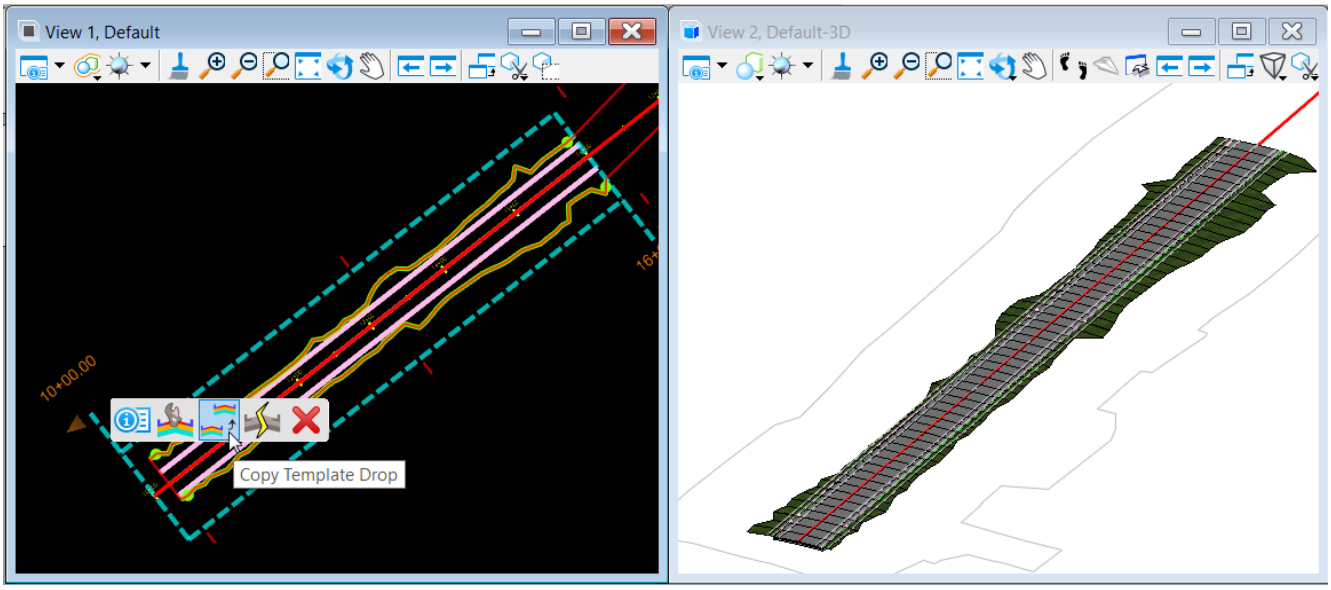


Figure 53 Copy and Replace Template Drop

Follow the prompts.m***Locate Corridor:*** Select ***RTE1*** Corridor.

- **Start Station:** ***13+00***, **left-click** to accept.
- **End Station:** ***16+00*** (**Click** Alt to Lock to End or type specific Station), **left-click** to accept.
- Corridor processes with new Template Drop.

5. Change or swap newly copied Template Drop. Replace template ***2ln_HMA_BCPC*** with template ***2ln_PS5_Curb_SW_Both.***
   a. Select ***2ln_HMA_BCPC*** Template Drop and let the cursor ***rest*** on the element to access the context sensitive pop-up menu. Select **Properties**.

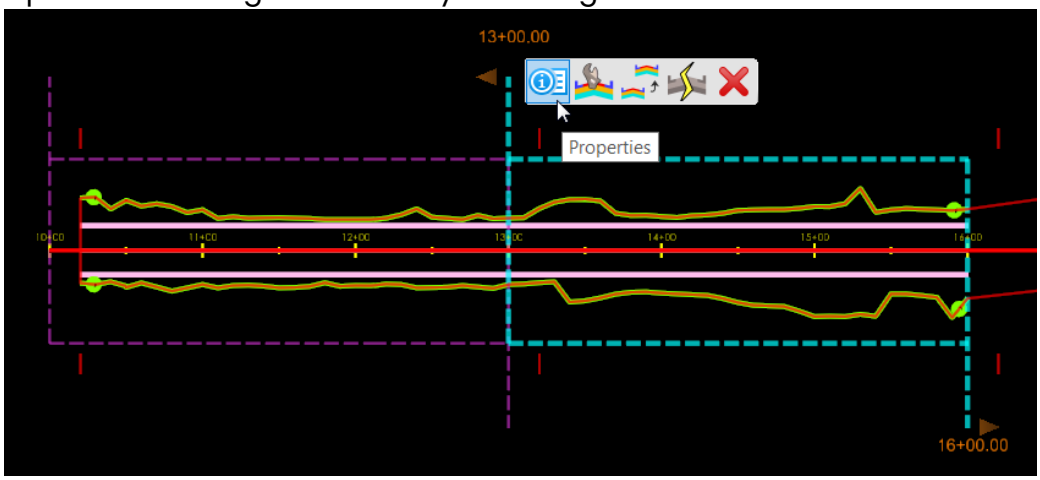


Figure 54 Properites

b. Click the **Browse** button in the right side of the ***Template Name*** label. This opens the Pick Template dialog.

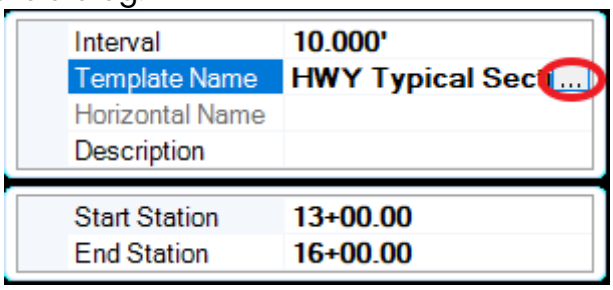


Figure 55 Browse to Select Template

c. Select the desired template prepared for the project and review. For this example, choose ***2ln_PS5_Curb_SW_Both*** (roadway with curb and sidewalk at both sides) and Click **OK**.

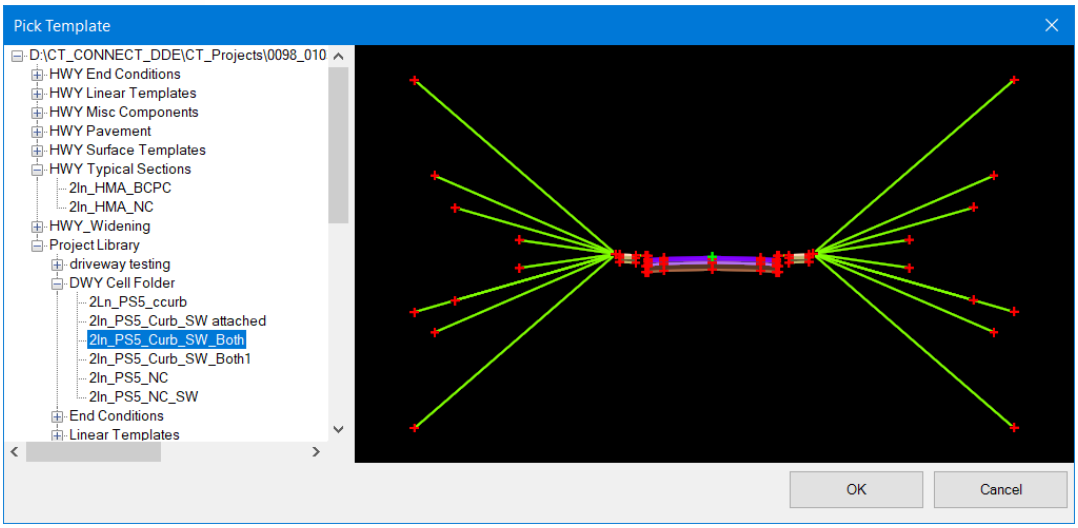


Figure 56 Select Template

d. The Corridor processes with new Template Drop. Notice the change in 3D view.

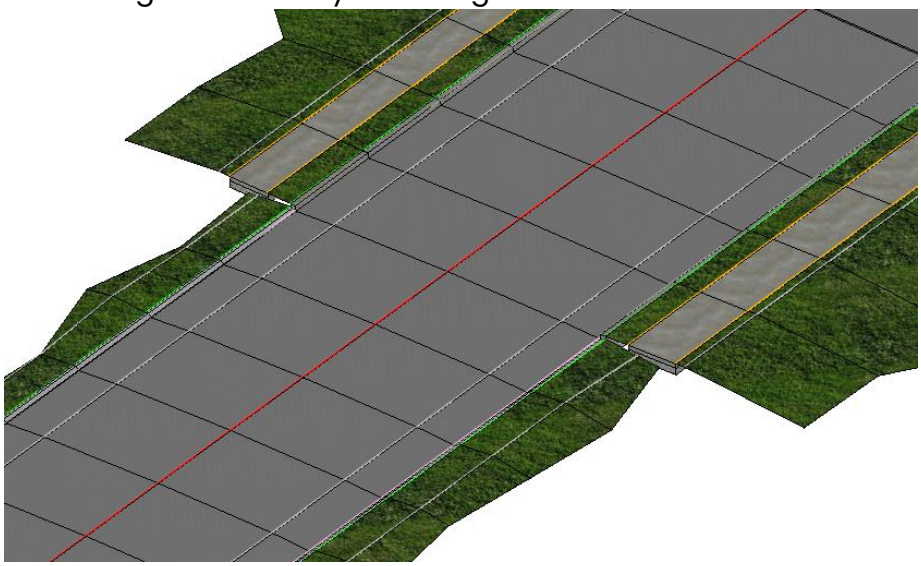


Figure 57 3D Model

3.3.8 Add Corridor Objects

Corridor Objects dialog is a summary of all corridor modeling objects and used to manage data. Clicking on the various categories located on the left side of the dialog displays the appropriate data in the center section. These data may be edited as needed, either from center section or from right side of the dialog.

1. Select **Corridor Handles** of ***RTE1*** Corridor and let the cursor ***rest*** on the element to access the context sensitive pop-up menu. Select **Corridor Creation Tools > Corridor Objects**.

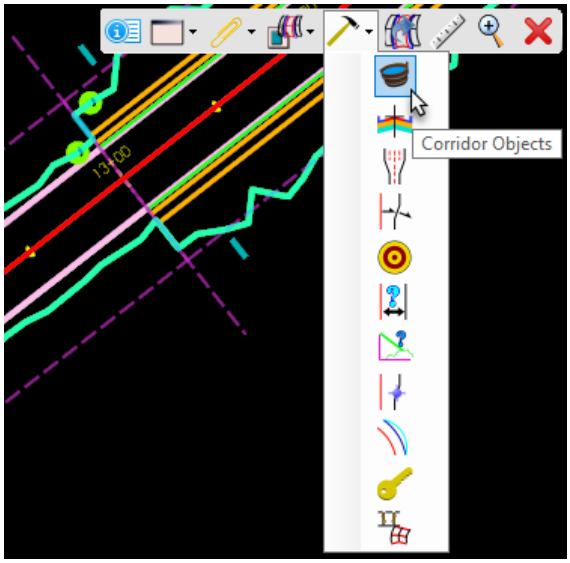


Figure 58 Corridor Objects Tools

2. Corridor Objects Window opens. In this window user can define or edit various categories. Select **Template Drop**, notice two Template Drop is applied to the ***RTE1*** Corridor. Here Template Drop can be replaced or the station can be edited easily.

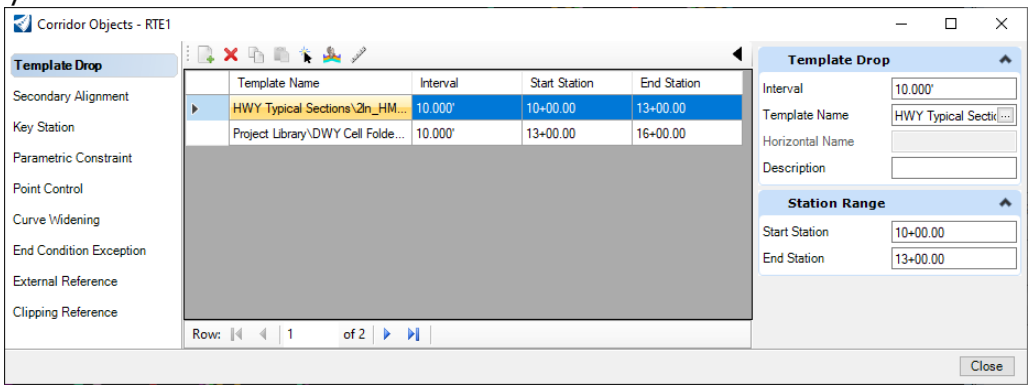


Figure 59 Corridor Objects Dialog Box

3.3.9 Create Parametric Constraint

Create Parametric Constraints tool allow user to override template point constraint values. The Create Parametric Constraints tool gives users the ability to vary pavement thickness, curb height, ditch widths, slopes, etc between any station range along a corridor. This module will show to override the subgrade depth of roadway structure from 1 foot to 6 inches using Create Parametric Constraints tool

a. Modify subgrade depth in a ***Template Drop*** named ***2ln_HMA_BCPC***
a. The constraint labels are created and assigned to template point(s). Looking into ***2ln_HMA_BCPC*** Template Drop, Bottom of the subgrade layer has ***Constraint Label*** named as **Subgrade_Depth** under ***Vertical Type Constraint***. Here points BOC_sg, EOR_sg, SHDR_sg and CL_sg are all assigned **Subgrade_Depth** label.

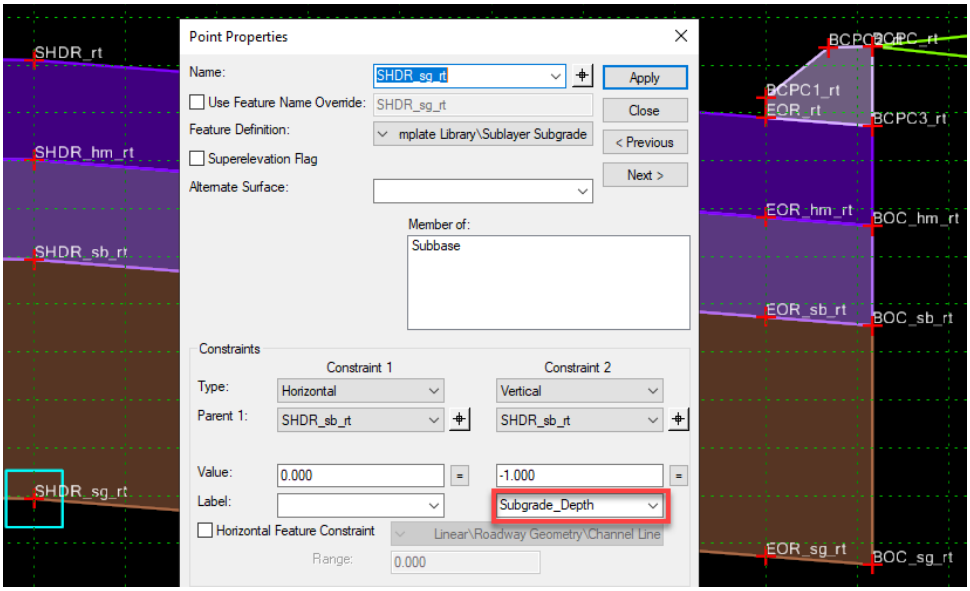


Figure 60 Point Properties Dialog Box

b. Select **Corridor Handles** of ***RTE1*** Corridor and let the cursor ***rest*** on the element to access the context sensitive pop-up menu. Select **Corridor Creation Tools > Create Parametric Constraint**.

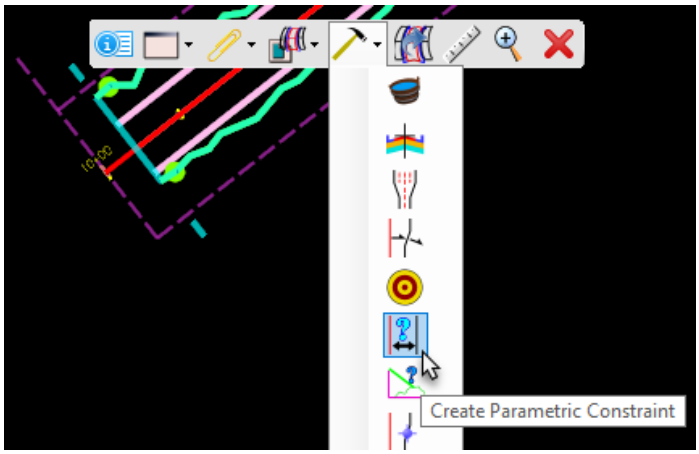


Figure 61 Create Parametric Constraint

c. **Create Parametric Constraint** window will appear. Follow the prompts.

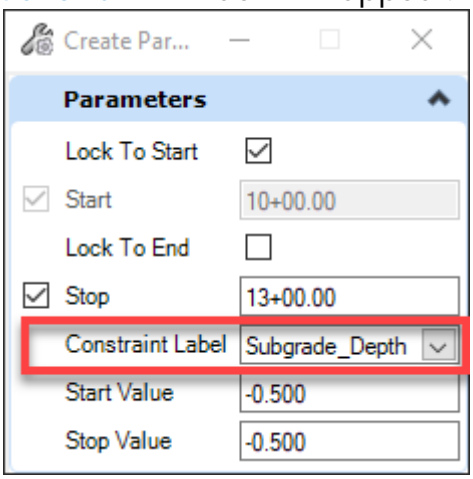


Figure 62 Create Parametric Constraint Parameters

- **Start Station:** **10+00**, (**Click** Alt to Lock to Start or type specific Station), **left-click** to accept.
- **End Station:** **13+00** (**Click** Alt to Lock to End or type specific Station), **left-click** to accept.
- **Constraint Label:** In the **Create Parametric Constraints** dialog, press the **down arrow** to display the list of available ***Constraint Labels*** that you can adjust and select **Subgrade_Depth.** Default value for **Subgrade_Depth** is currently set to **-1.000**, **left-click** to accept
- **Start Value:** ***-0.500,*** , **left-click** to accept.
- **End Value:** ***-0.500,*** , **left-click** to accept.
- The ***Corridor*** processes with new ***value***. Notice the change in 3D view.

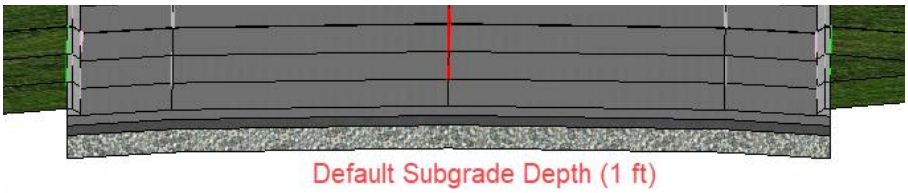


Figure 63 Original Depth 1 foot

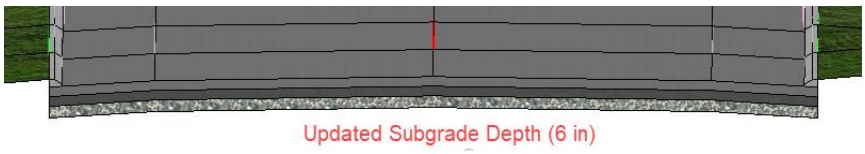


Figure 64 Updated Depth 6 inches

d. Review the dynamic cross section there are green boxes that appear along the bottom of the section. The green boxes indicate the locations where the ***Subgrade_Depth*** was adjusted.

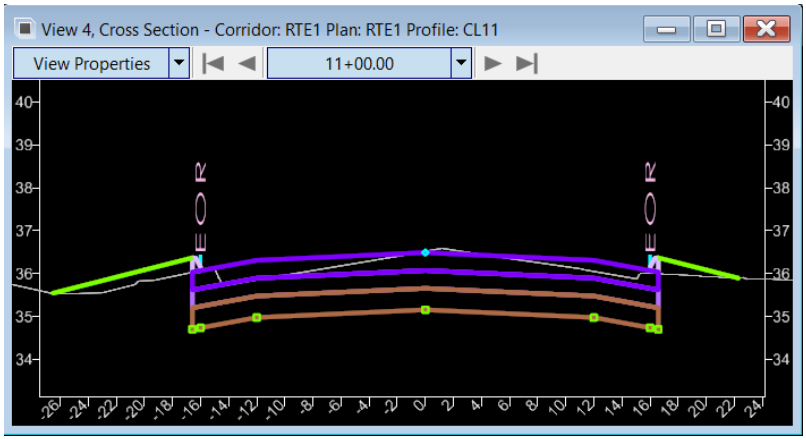


Figure 65 Cross Section Viewer Updated Depth

e. Review the ***Parametric Constraint*** with ***Corridor Objects*** tool.

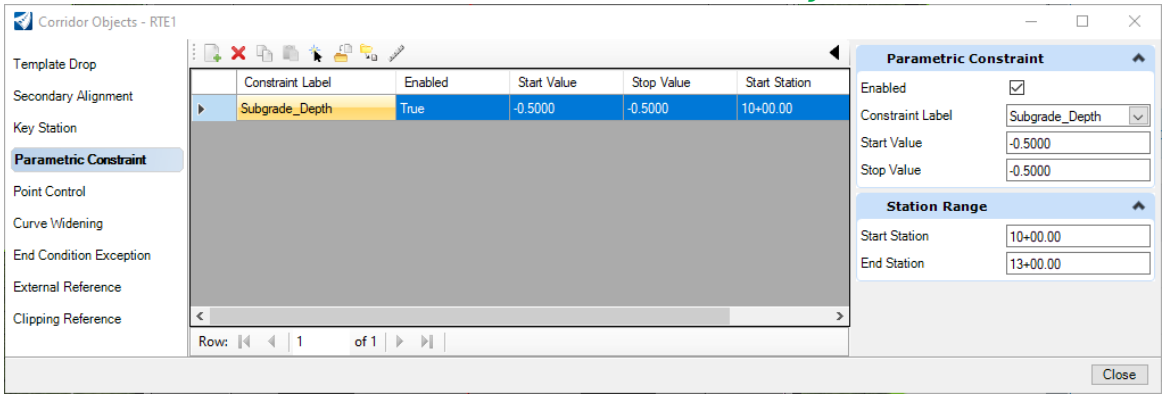


Figure 66 Parametric Constraint Dialog Box

If at any time user need to modify the values user can do it here.

3.3.10 Create Point Control

Create Point Control tool allow user to assign Point Control to Corridor which forces the cross-section template point to follow other information than what is set in the template. Point controls override the default location of template points. In this module user will create point controls for the right edge of road point: EOR_rt in 2ln_HMA_BCPC Template drop. Using Create Point Control tool shoulder will be tapered from 1 foot to 4 feet.

1. The Corridor file contains corridor ***RTE1*** with template drop ***2ln_HMA_BCPC*** from Sta 11+00 to Sta. 15+00.
2. ***New EOR_rt*** geometric element is drawn from Sta. 11+00 to Sta. 11+50 making shoulder width 1 foot and 4 feet, respectively.

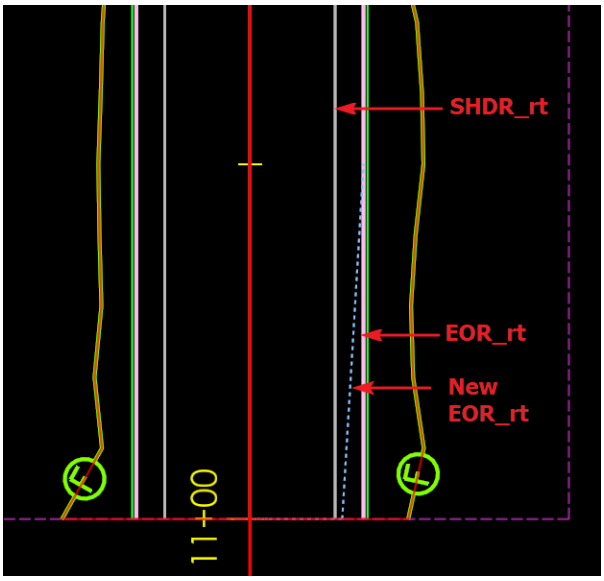


Figure 67 2D View Liner Feature Names

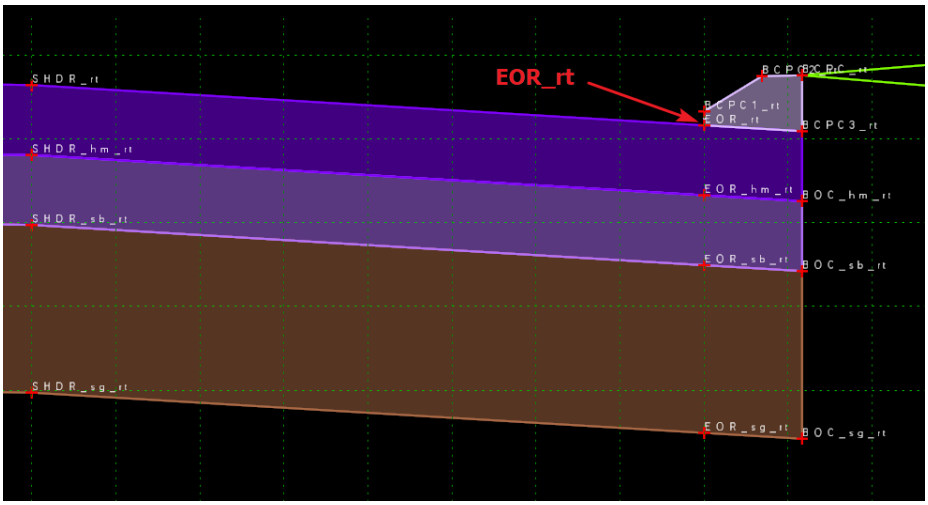


Figure 68 Cross Section Point Feature Names

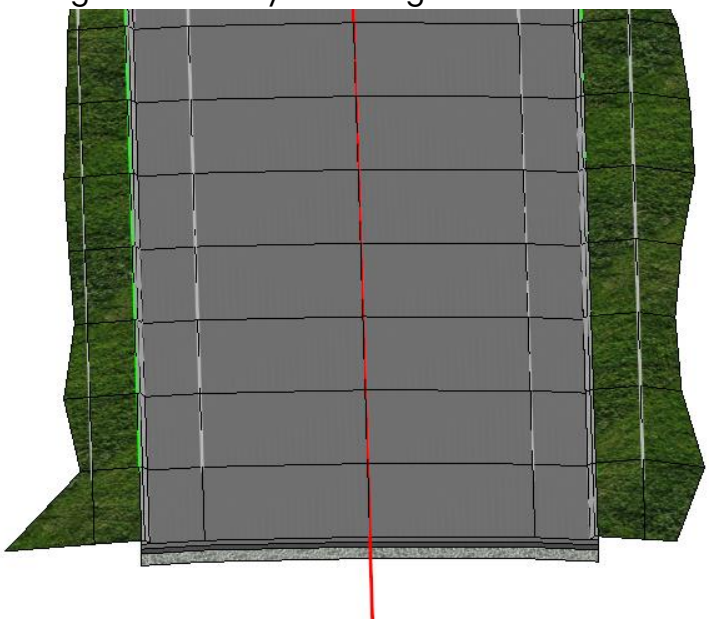


Figure 69 3D View

3. Create point control for point ***EOR_rt*** to follow the ***New EOR_rt*** geometric element
    1. Select **Corridor Handles** of ***RTE1*** Corridor and let the cursor ***rest*** on the element to access the context sensitive pop-up menu. Select **Corridor Creation Tools > Create Point Control**.

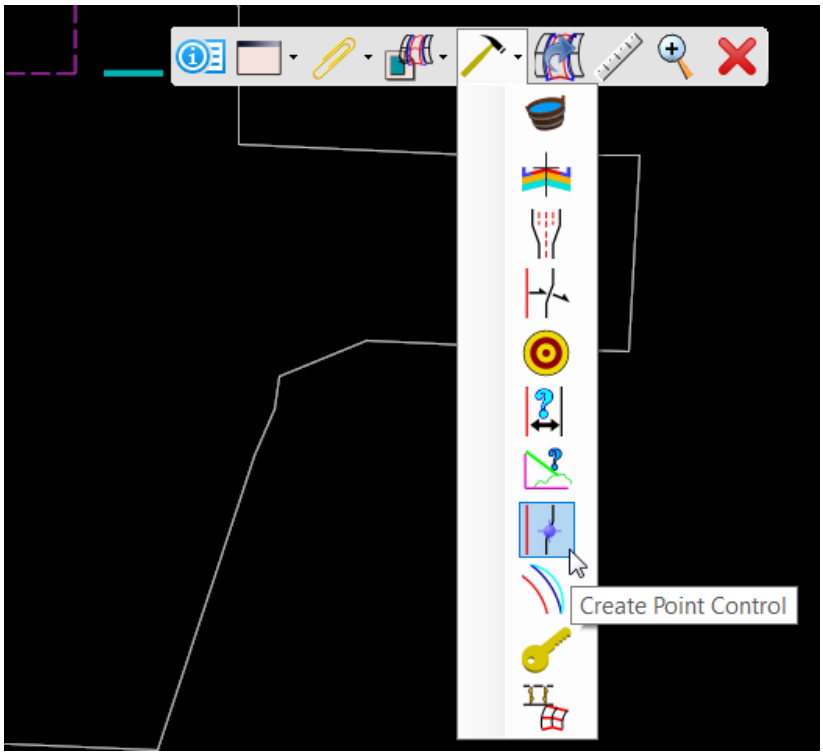


Figure 70 Create Point Control

b. Create Point Control window will appear. Follow the prompts (after each prompt, **left-click** to accept values and move to next prompt):

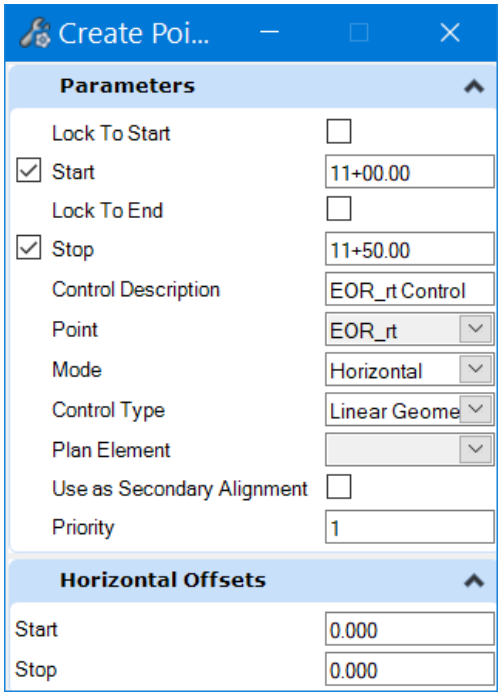


Figure 71 Create Point Control

- **Start Station:** ***11+00***
- **End Station:** ***11+50***
- **Control Description:** ***EOR_rt Control*** (name as needed)
- **Locate Point:** ***EOR_rt*** (Select EOR_rt element in View 1 or from cross section view)
- **Mode:** ***Horizontal***
- **Control Type:** ***Linear Geometry***
- **Locate Plan or Profile Element:** ***Select New EOR_rt*** geometric element (dashed blue line)
- **Use as Secondary Alignment:** ***Yes***
- **Priority:** ***1***
- **Start Offset:** ***0.000***
- **Stop Offset:** ***0.000***
- The *Corridor* processes and updates as per the point control.

c. Review point control in plan view, cross section view and 3D view.

- In plan view notice that ***EOR_rt*** linear feature now follows the New EOR_rt geometric element (blue cyan line).

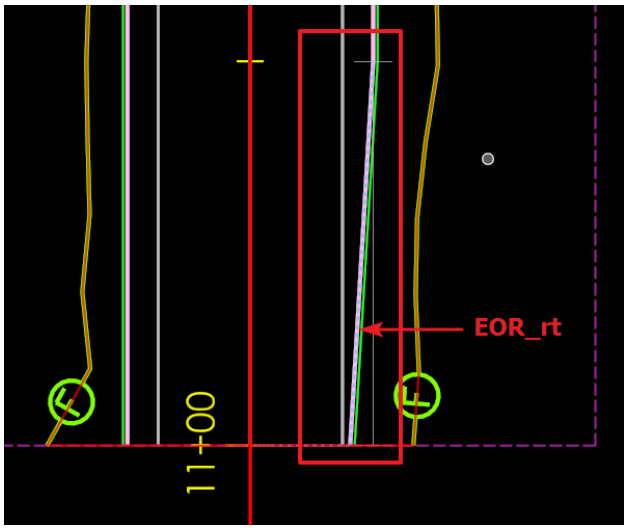


Figure 72 2D View Right Edge of Road

- In cross section view notice there is magenta box at ***EOR_rt*** point. This indicates that there is a point control to this point.

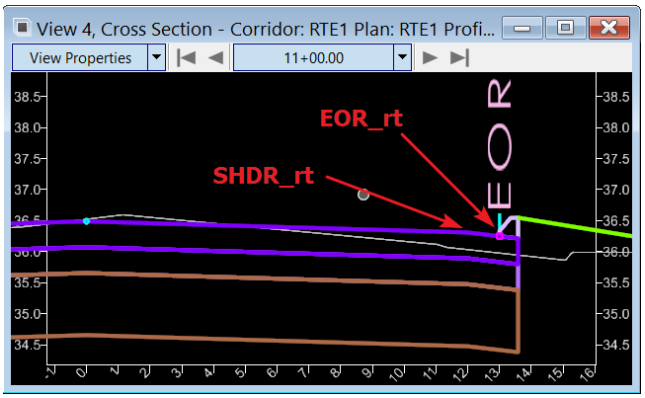


Figure 73 Cross Section View Point names

- Review 3D view, Right Edge of Road is tapered.

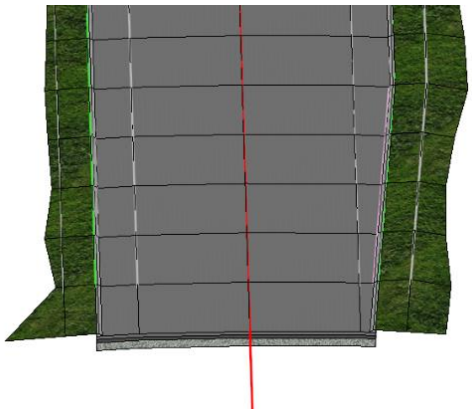


Figure 74 3D View

d. Review the **Point Control** with the **Corridor Objects** tool.

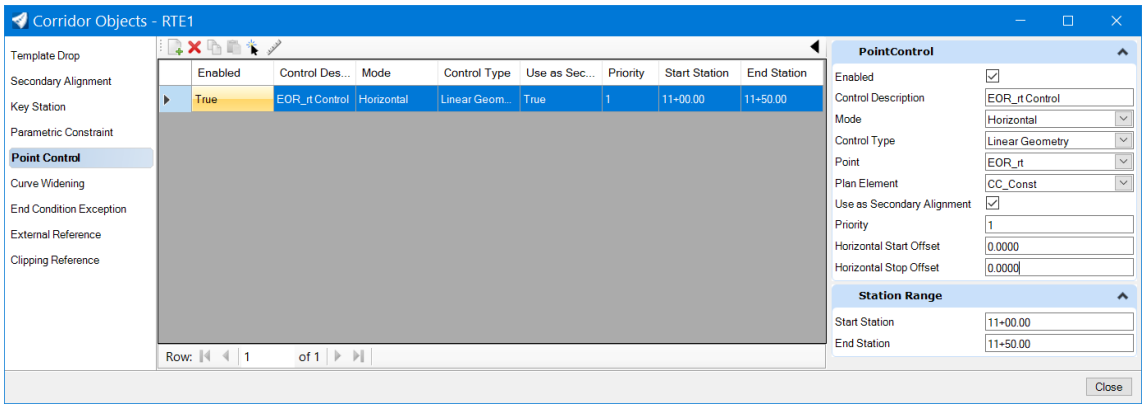


Figure 75 Corridor Objects Dialog Box

3.4 Applying Superelevation

The Superelevation tools calculate the amount of cross slope or "bank" that should be provided on a horizontal curve to counterbalance, in combination with side friction, the centrifugal force of a vehicle traversing the curve. These tools also compute the superelevation transition length which is the distance required to transition the roadway from a normal crown section to full superelevation. The superelevation transition length is the sum of the tangent runout (TR) and superelevation runoff (L) distances.

Pavement slopes are initially defined in the template.Superelevation is created and applied after the corridor is defined and the template drops have been assigned. This section will detail how superelevation is computed with OpenRoads as well as how to accurately model the shoulder break for the high side of Superelevation.

Superelevation calculations should be applied as defined in Chapter 8 of the Connecticut Department of Transportation Highway Design Manual.

The Superelevation tools are located in the Corridors tab, as shown below.

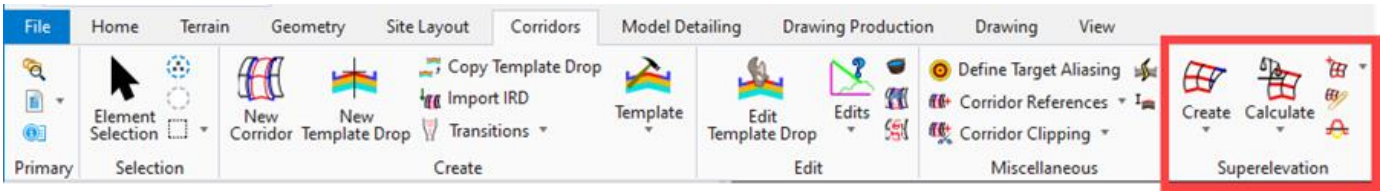


Figure 76 Superelevation Tools

The following tools are available:

- Create Superelevation Sections
- Create Superelevation Lanes
- Create Superelevation Lanes by Road Template
- Calculate Superelevation
- Edit Superelevation rule File
- Import Superelevation
- Assign to Corridor
- Insert Station Cross-Slope
- Superelevation Editor
- Superelevation Report
- Open Superelevation View

3.4.1 Create Superelevation Sections

Superelevation Sections for each alignment are normally placed in a separate design file with the Centerlines referenced in. The Create Superelevation tool creates a superelevation section for the specified station range on the centerline to demarcate a stretch of roadway for superelevation calculations.

In this tool the Civil horizontal geometry element is identified, and station limits of the superelevation are defined. Station limits are useful if the horizontal alignment is substantially longer than the project limits. The section is drawn using the selected Feature Definition.

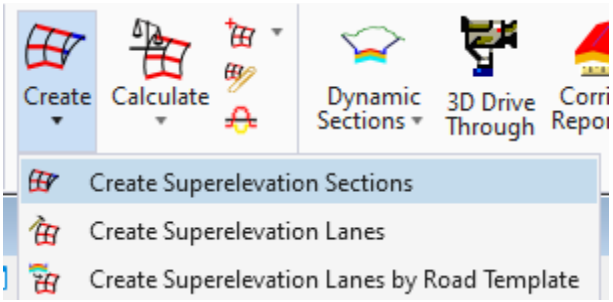


Figure 77 Create Superelevation Sections

The CTDOT XML-formatted rules file containing the superelevation standards/parameters is located in the following location:

...|State of Connecticut|DOT CTDOT_DDE - CONNECT|CT_Configuration|Organization-Civil|_CT_Civil Standards - Imperial|Superelevation

3.4.2 Assign Superelevation to Corridor

After the superelevation values have been computed, the next step in the process is to assign the superelevation sections to a corridor.

Before assigning the superelevation to the corridor, it is necessary to do the following:

- Attach the reference file containing the superelevation sections to the corridor model.
- Verify that the template being used in the corridor has the Superelevation Flag set for all pavement points used as candidate superelevation points. This flag is used for automatically setting the point controls.

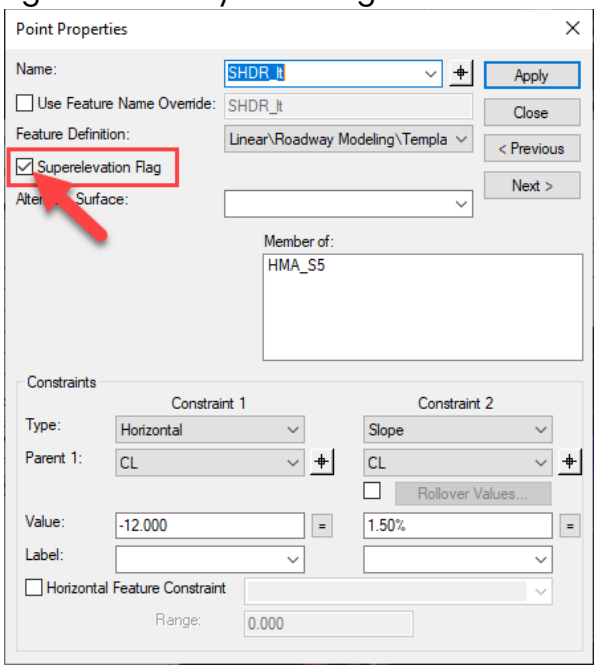


Figure 78 Superelevation Flag set for on template Points

The Assign Superelevation to Corridor tool applies the cross slopes defined on superelevation lanes to the corridor so the superelevated pavement is reflected in the corridor model.

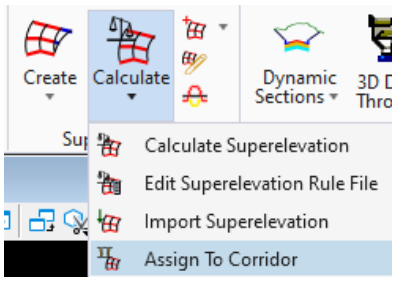


Figure 79 Assign Superelevation to Corridor

3.4.3 Adding Additional Lanes

Additional lanes can be added to an existing superelevation section by use of the **Create Superelevation Lanes** command.

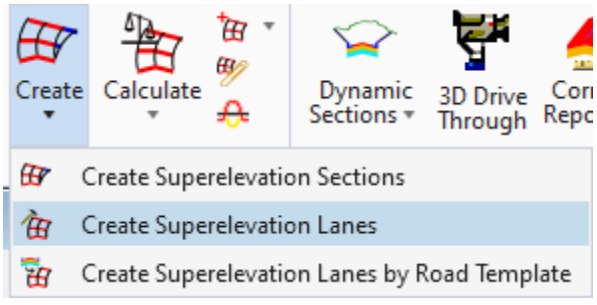


Figure 80 Create Superelevation Lanes

3.5 Placing Linear Templates

Templates represent typical cross-sectional geometry. Templates consist of points and components. Templates can be placed along any 3D line string using the **Apply Linear Template** tool. For example, a slope treatment template can be placed along a road corridor hinge point. A Template consisting of pavement lane, curb and side treatment can be placed along a pavement sawcut line. Applying a ***Linear Template*** is quick and easy, but it has its limitations during adjustments. Applying and editing ***Linear Template*** is less powerful compared to Placing and editing ***Corridors***.

LINEAR TEMPLATES

Linear Templates can be placed along a civil geometry element without a defined corridor. The "Apply Linear Template" tool will apply a template to a selected civil geometry element that has a profile associated with it. Most templates can be treated as linear templates like shoulder, curb, etc. and don't need a defined corridor to be placed. Once you have the profiled linear element (3D geometry), templates can be placed. After placing the template, a corridor for the linear template will be automatically generated. This corridor and linear template can be edited as needed.

The **Apply Linear Template** tool can be found on the OpenRoads Modeling workflow Ribbon:

Model Detailing Tab > **3D Tools** Group > **Apply Linear Template**

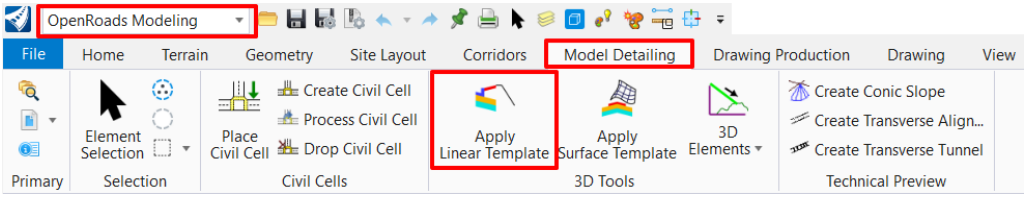


Figure 81 Apply Linear Template

Apply Linear Template will activate the Pick Template dialog then inserts the chosen template into the drawing relative to the selected linear element.

The Connecticut DOT has provided range of Linear Templates within its workspace. See figure below.

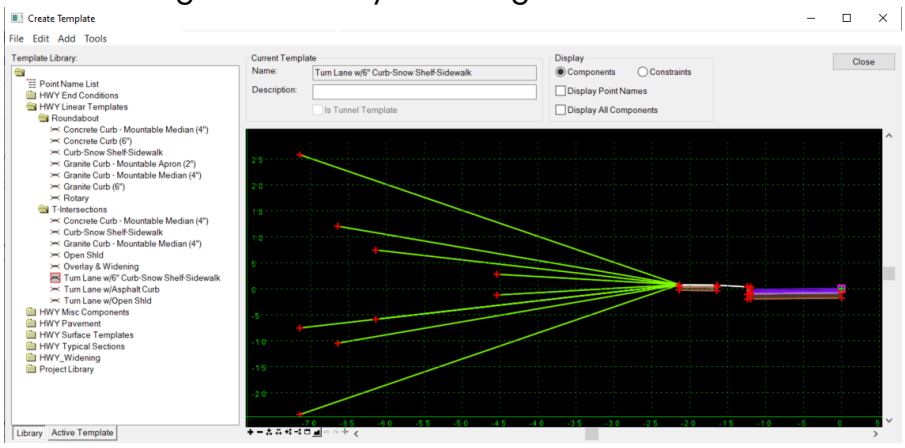


Figure 82 Available Linear Templates

3.5.1 Apply Linear Templates

This module instructs users how to place a linear template in a design file for a project. When placing linear templates, a corridor is not needed, linear templates can be applied to 3D elements.

1. Load **Corridor (Roadway Model) file** and Load the **Template Library** for the project.
2. Activate the **OpenRoads Modeling** workflow from the pick list next to Quick access toolbar in the upper left corner if it is not already active. The ribbon menu will reflect the OpenRoads Modeling tools.
3. The Corridor file contains corridor RTE1 with template drop 2Ln_HMA. The template drop applied only has two lane roadway surfaces without slope treatment.

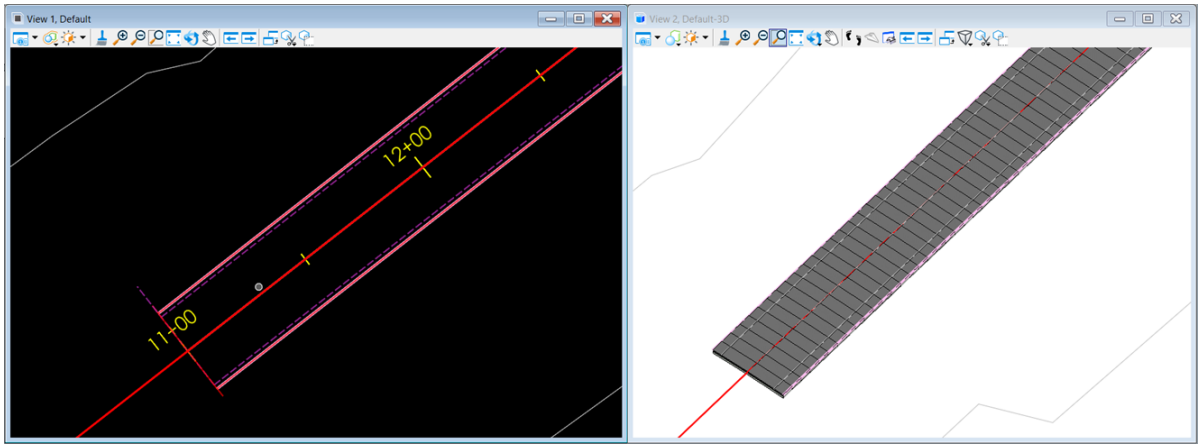


Figure 83 Apply Linear Templates

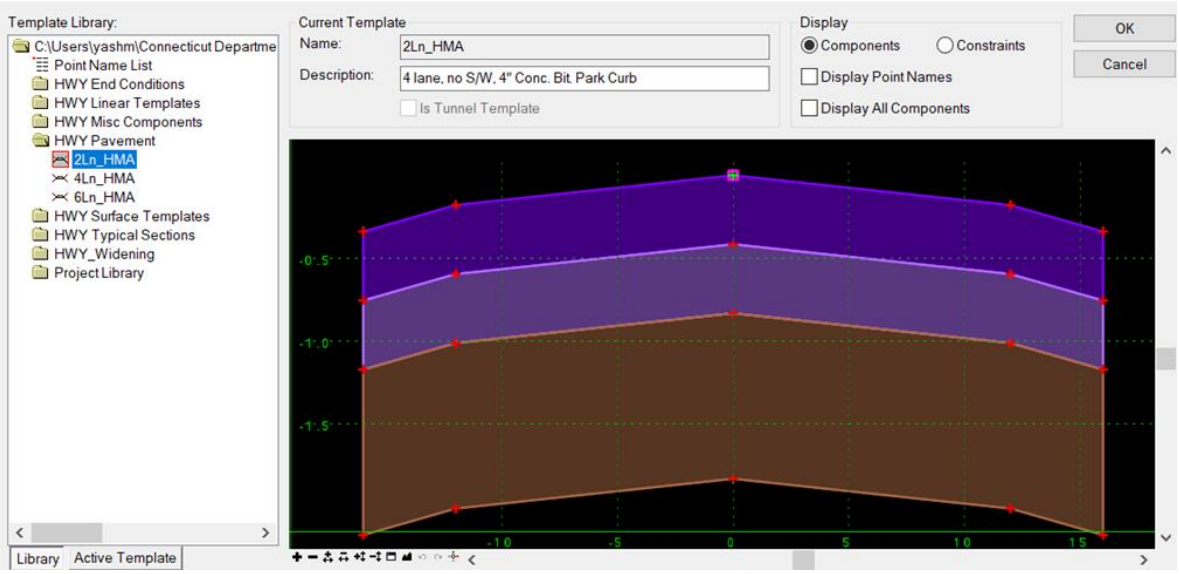


Figure 84 Template Library

4. Slope Treatment ***Linear Template*** can be applied to the edge of the road (***EOR_lt and EOR_rt***) as it is a 3D element with active profile.
5. Constructions option can be turned **ON** or **OFF** in the **View Attributes** window.
6. From **Model Detailing** tab within the **3D Tools** Group select: **Apply Linear Template.**

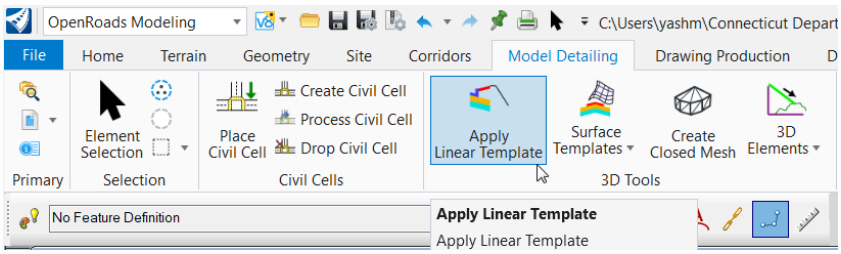


Figure 85 Apply Linear Template Tool

7. Apply Linear Template dialog will open. Fill as below and then follow the prompts.

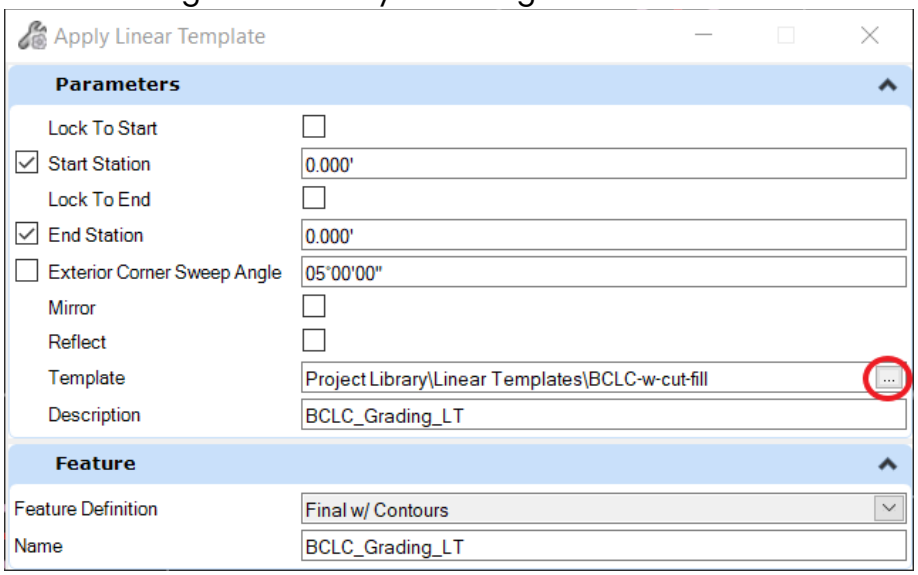


Figure 86 Browse to Select Template

a. **Locate Element To Apply Template**, click on the Left Edge of Roadway (***EOR_lt)***

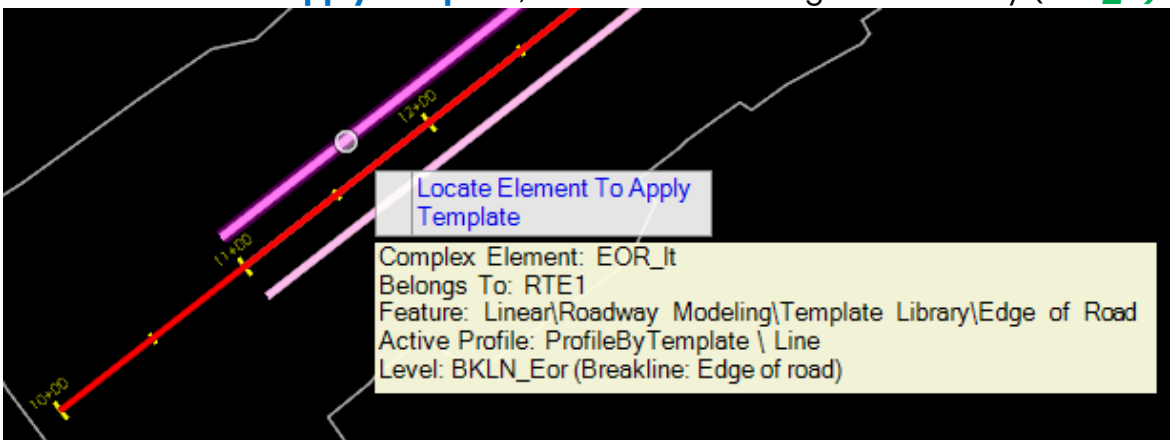


Figure 87 Locate Element To Apply Template

b. Click the **browse** button next to Template label to open Template library or **click** the **Alt** and **Down** to open Template library.

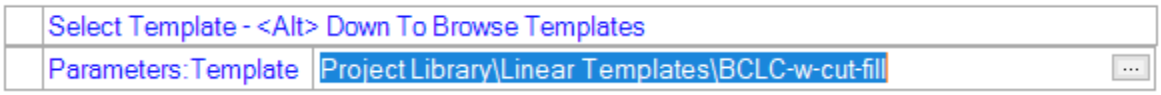


Figure 88 Selected Template

c. This opens the Pick Template dialog. Select the desired template prepared for the project and review. For this example, choose ***Project Library>Linear Templates>BCLC-w-cut-fill*** and click **OK**.

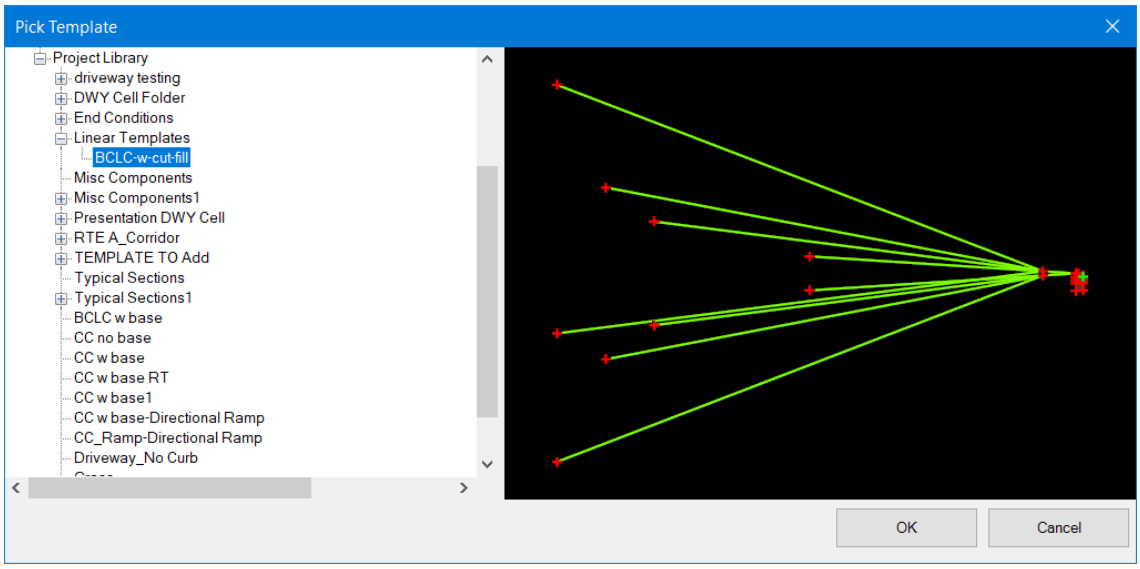


Figure 89 Pick Template

- **Template -** ***Project Library > Linear Template s> BCLC-w-cut-fill***, **left-click** to accept the BCLC-w-cut-fill
- **Start -** **0+00** (Click Alt to Lock to Start or type specific Station), **left-click** to accept. (This is same as **11+00** of ***RTE1*** Baseline)
- **End -** **3+00** (Click Alt to Lock to End or type specific Station), **left-click** to accept. (This is same as **14+00** of ***RTE1*** Baseline)

  NOTE: *Station entered here is the station related to EOR not the Base Line Station.*
- ***Select Side-Reflect Option Mirror-<Alt> Down To Select***, **hover** mouse right side of EOR_lt or as needed, **left-click** to accept.

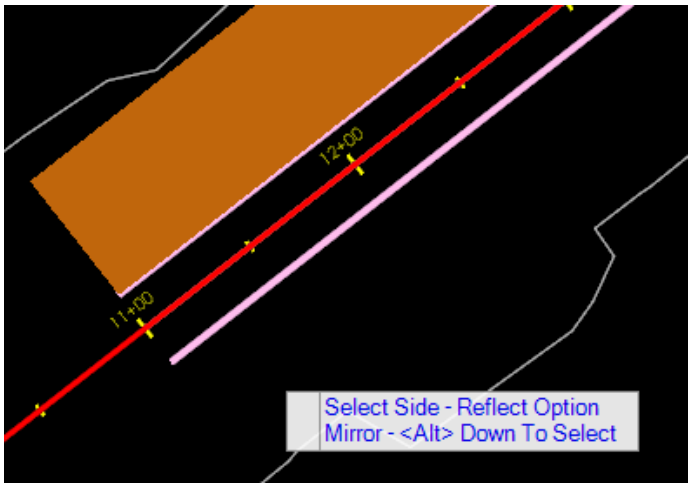


Figure 90 Select Side-Reflect Option Mirror-<Alt> Down To Select

- **Exterior Corner Sweep Angle** - ***05° 00'00"*** (Default value, change as needed), **left-click** to accept.
- **Description -** ***BCLC_Grading_LT***, **left-click** to accept.
- **Right-click** to exit command. Curb and Slope Treatment is generated at the Left Edge or Road. Corridor for the applied Linear template is automatically generated by the software.

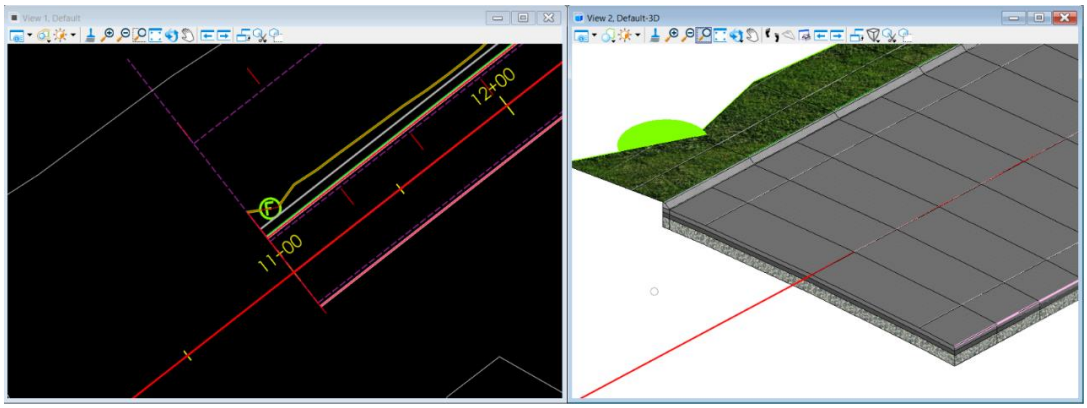


Figure 91 2D and 3D View of Liner Template

d. The newly applied Linear Template can be reviewed from ***Explorer Window > OpenRoads Model***.

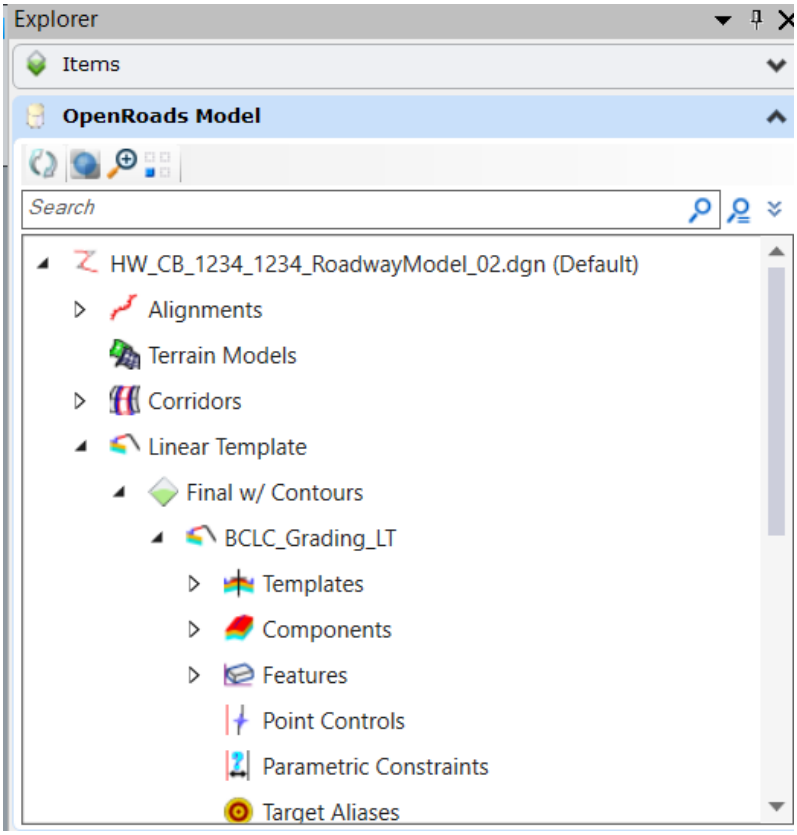


Figure 92 Explorer Window

8. Follow the same steps and **Apply Linear Template** at the Right Edge of Road.

3.5.2 Edit Linear Templates

Linear Templates can be edited as normal Templates, but it has its limitations. All the Corridor Parameter that can be edited for the Linear Template is less than that of Corridor. This module instructs users how to edit or replace an existing Linear Template in the design file. When placing a linear template, a corridor is not needed, it can be applied to a 3D element.

1. We are using a **Corridor (Roadway Model)** file that is used in above module.
2. An applied Linear Template cannot be copied, so it needs to be reapplied as needed. To show contrast, in the current file the
   - ***Linear Templates>BCLC-w-cut-fill*** (curb with slope treatment is applied at ***RTE1*** Sta. 10+00 to Sta. 14+00)
   - ***Linear Templates>BCLC-w base*** (only curb is applied at ***RTE1*** Sta. 14+00 to Sta. 27+00) are applied at the left side of the Edge of Road.

When the template range of the ***Linear Template*** graphic is selected, the range can be edited as needed. The range can also be edited from the properties window by changing ***Start*** and ***End Station***.

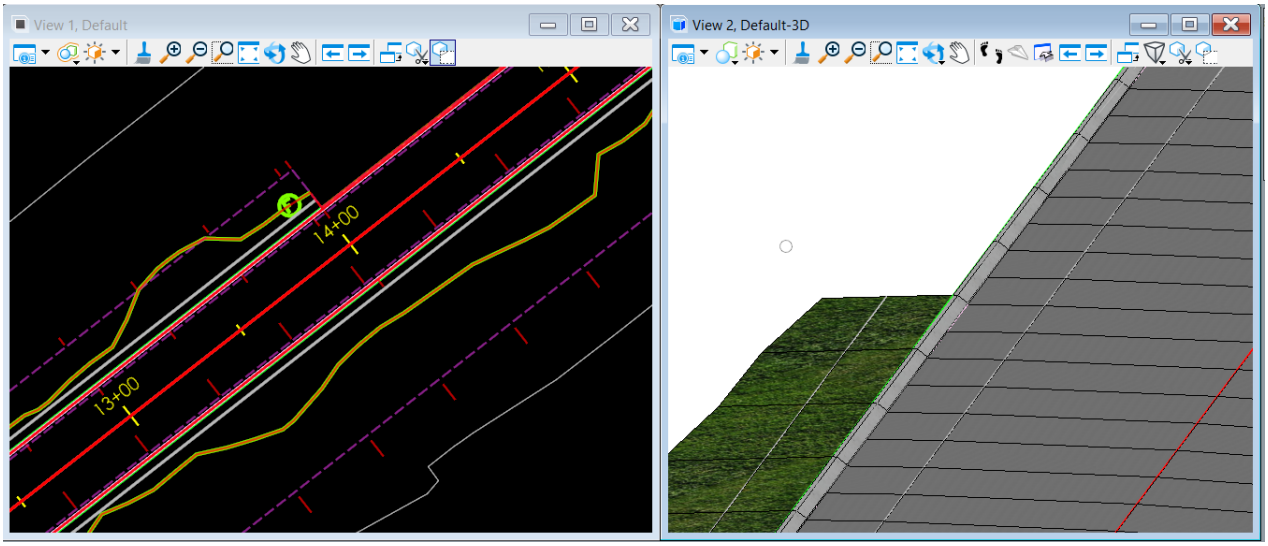


Figure 93 Edit Linear Templates

3. Change or swap the type of Linear Template, the ***BCLC-w-cut-fill*** to the ***cut-fill*** template.

   a. Select: ***BCLC-w-cut-fill*** template and let the cursor ***rest*** on the element to access the context sensitive pop-up menu. Select **Properties**.

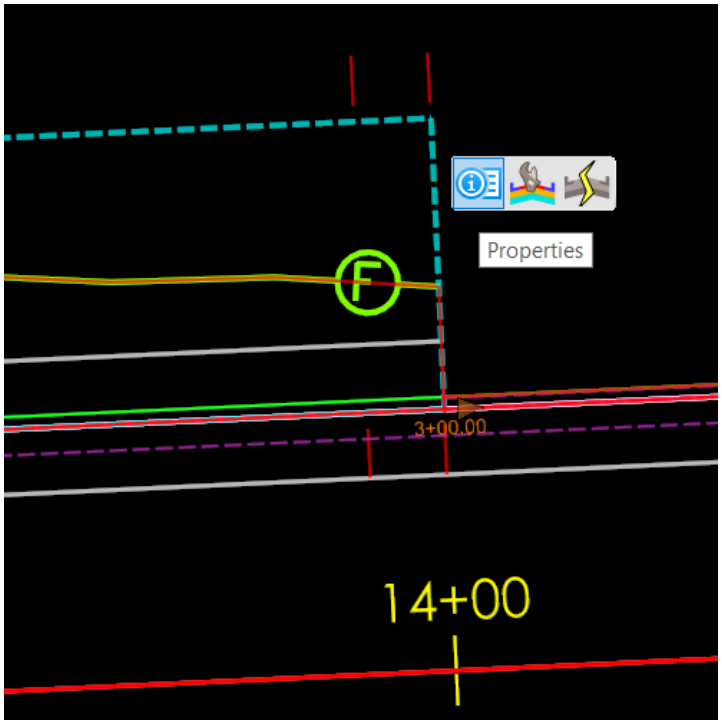


Figure 94 Properties

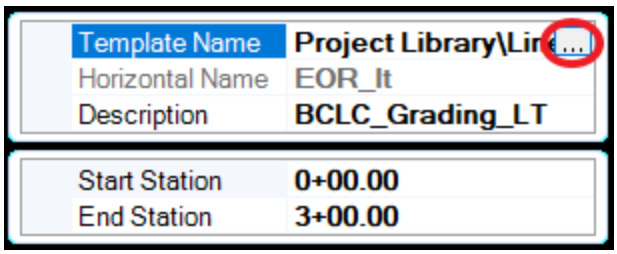


Figure 95 Browse to select Template

   a. Click the **Browse** button in the right side of the Template Name label. This opens the Pick Template dialog.

b. Select the desired template prepared for the project and review. For this example, choose ***Linear Templates>cut-fill*** (grading only no curb) and Click **OK**.

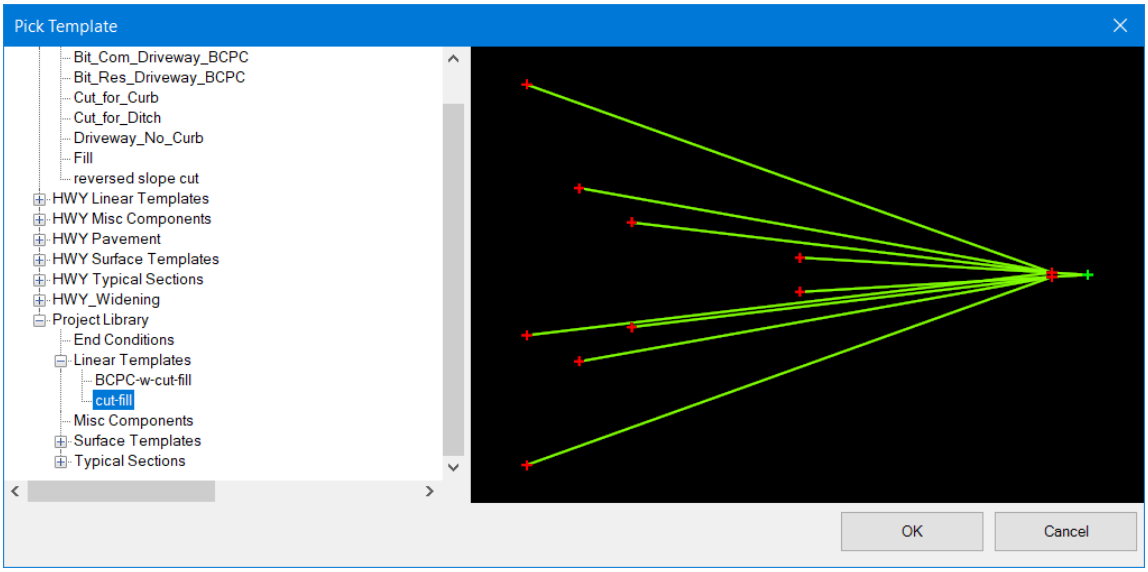


Figure 96 Select Tempale

c. The linear template processes with the new template. Notice the change in 3D view.

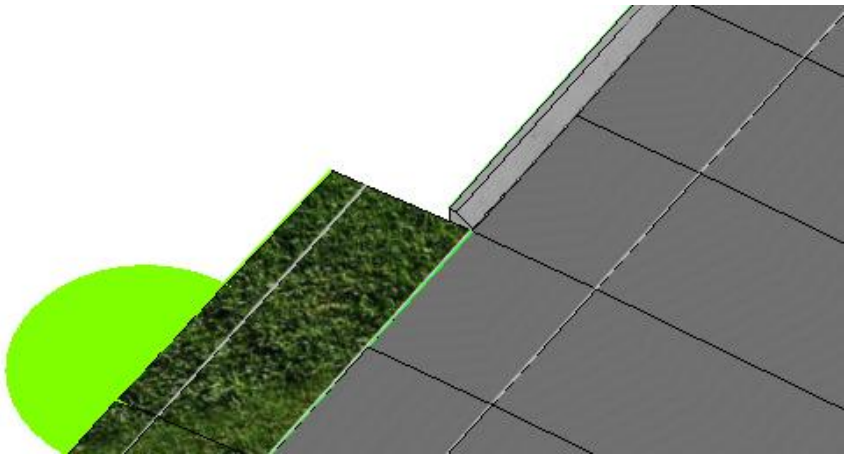


Figure 97 3D View

6. Edit linear template elements or parameters.
    a. Select: ***cut-fill*** template and let the cursor ***rest*** on the element to access the context sensitive pop-up menu. Select **Edit Template Drop**.

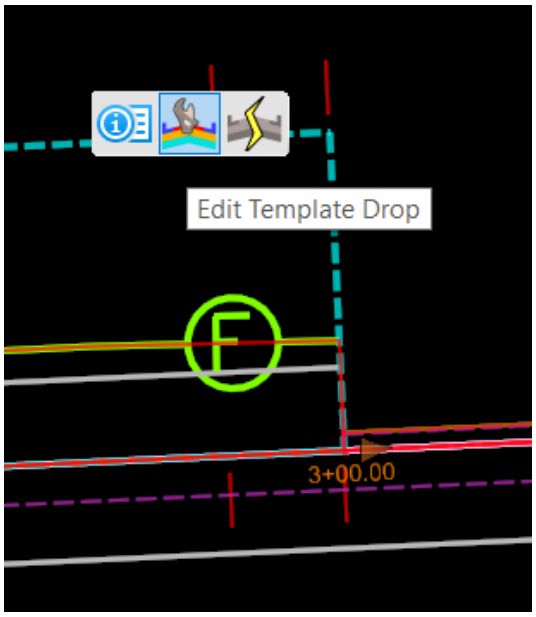


Figure 98 Edit Template Drop

    b. Editing Roadway Designer Template Drop Window appears along with the existing template used at the template window i.e. ***Linear Template>cut-fill***

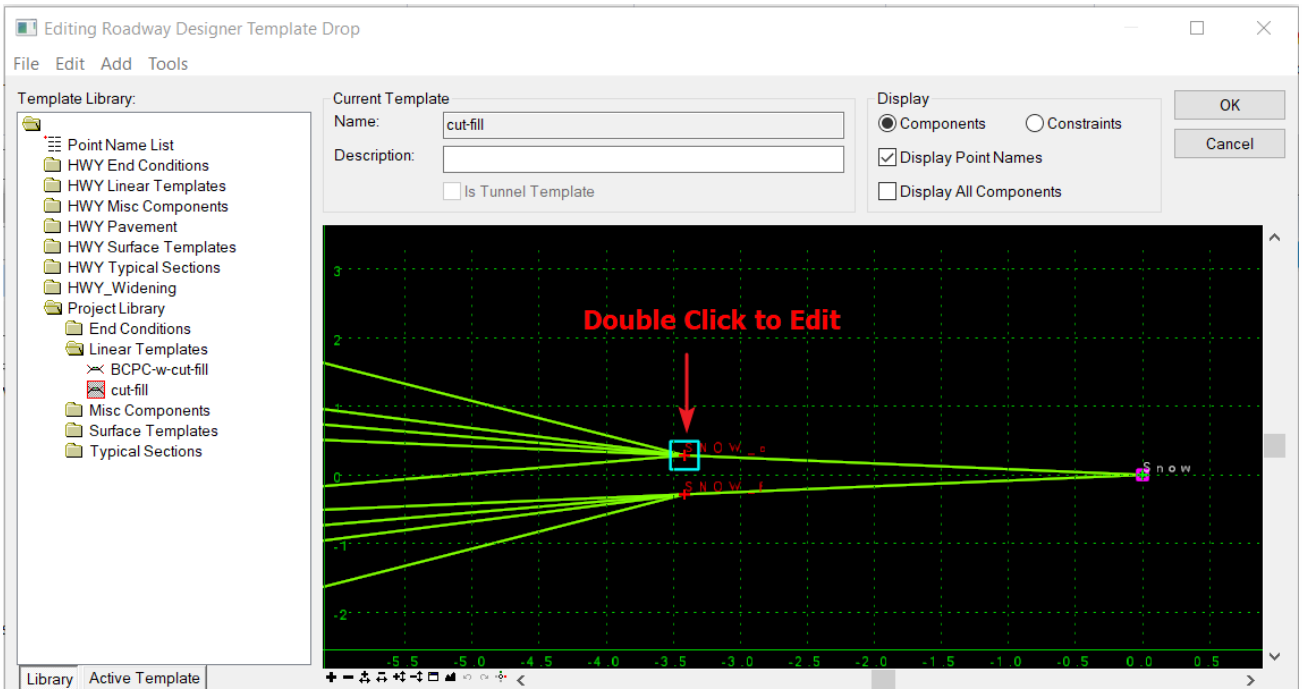


Figure 99 Editing Roadway Designer Template Drop Window

c. The Template can be edited in various ways and reviewed. For this example, Slope and Horizontal Distance of Snow shelf can be changed.

d. Double click on ***SNOW_c*** point.

e. In the Point Properties dialog, change Slope Value as desired under Constraint 1 and change Horizontal Value as desired under Constraint 2 and click **Apply**, and **Close**.

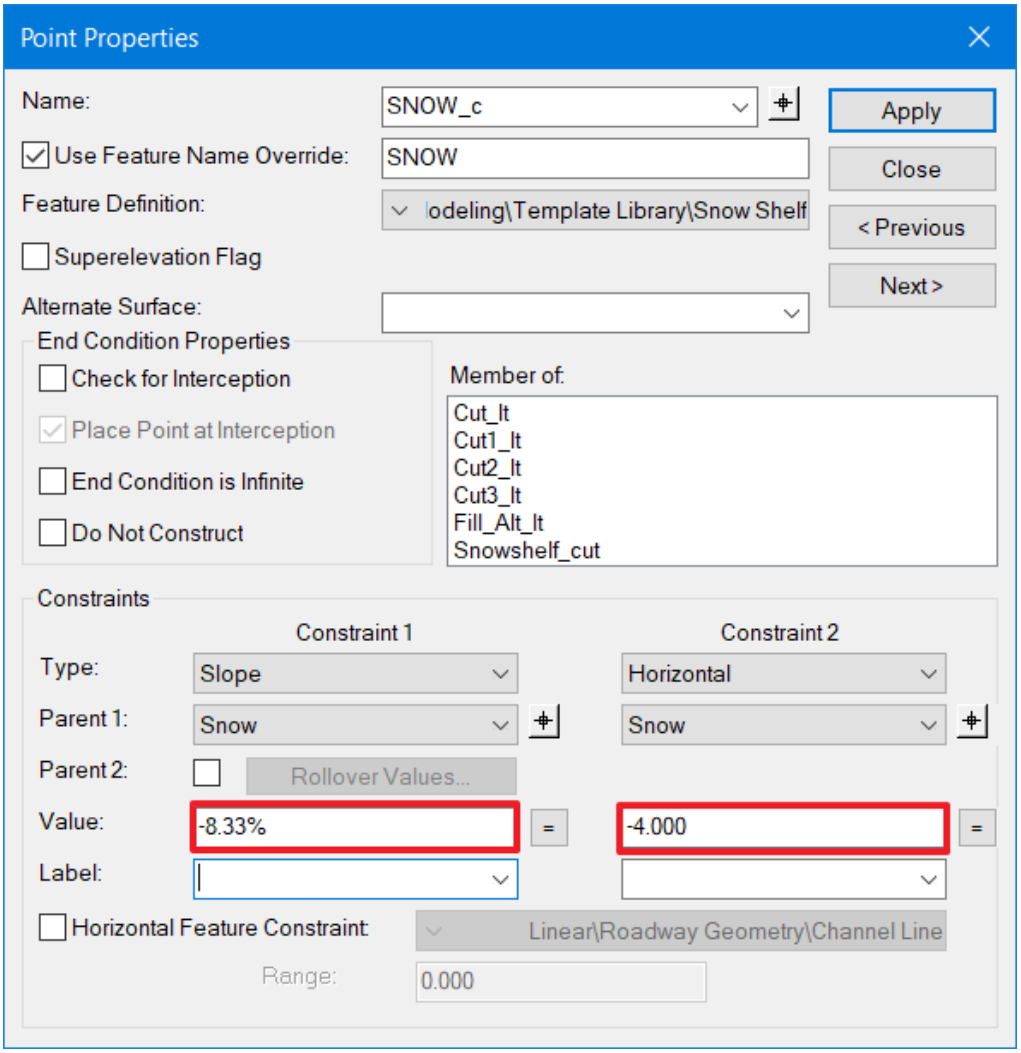


Figure 100 Point Properties

f. Click **OK** to close the Editing Roadway Designer Template Drop dialog. The linear template processes with the new value. Notice the change in slope and width of the snow shelf.

g. Other points or parameters of the ***Linear Template*** can be edited.

7. Edit the Corridor of a Linear Template. Select the Corridor Handles of the ***cut-fill*** template and let the cursor ***rest*** on the element to access the context sensitive pop-up menu. Select the **Corridor Creation Tools > Corridor Objects**.

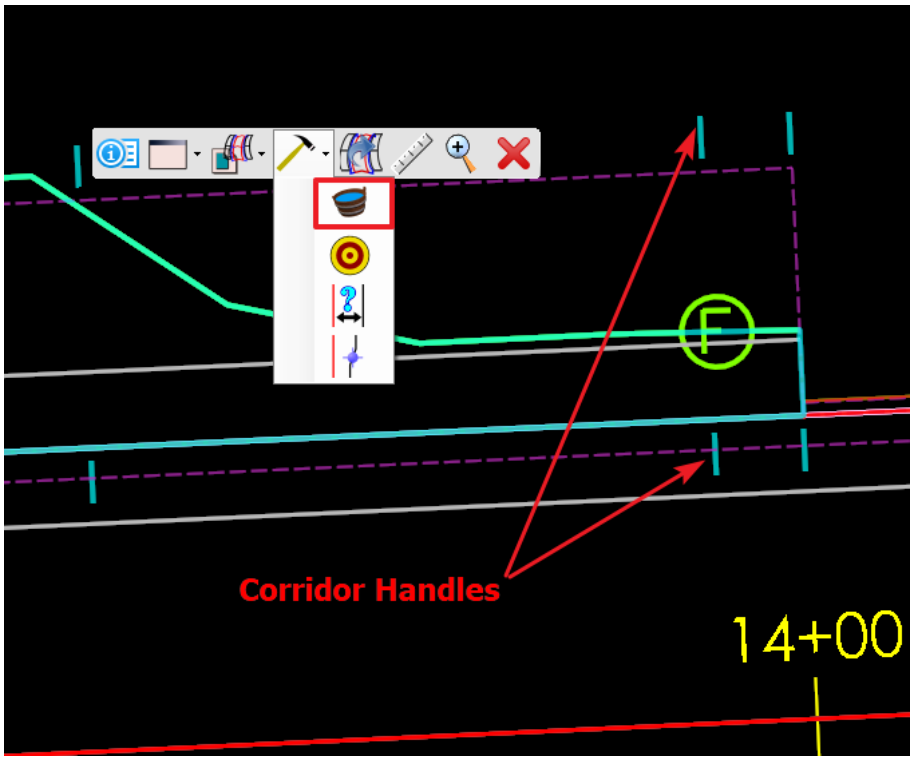


Figure 101 Corridor Handles

a. Corridor Objects Window will open. In this window the user can define four parameters as **Parametric Constraint, Point Control, External Reference, and Clipping Reference.**

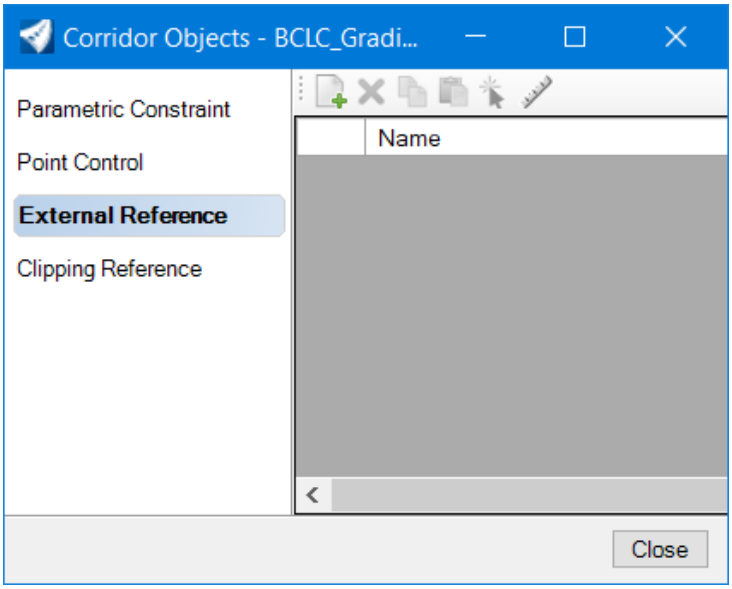


Figure 102 Corridor Objects Window

b. Corridor edits for ***Linear Templates*** is less powerful compared to Placing and editing ***Corridors*** (shown below).

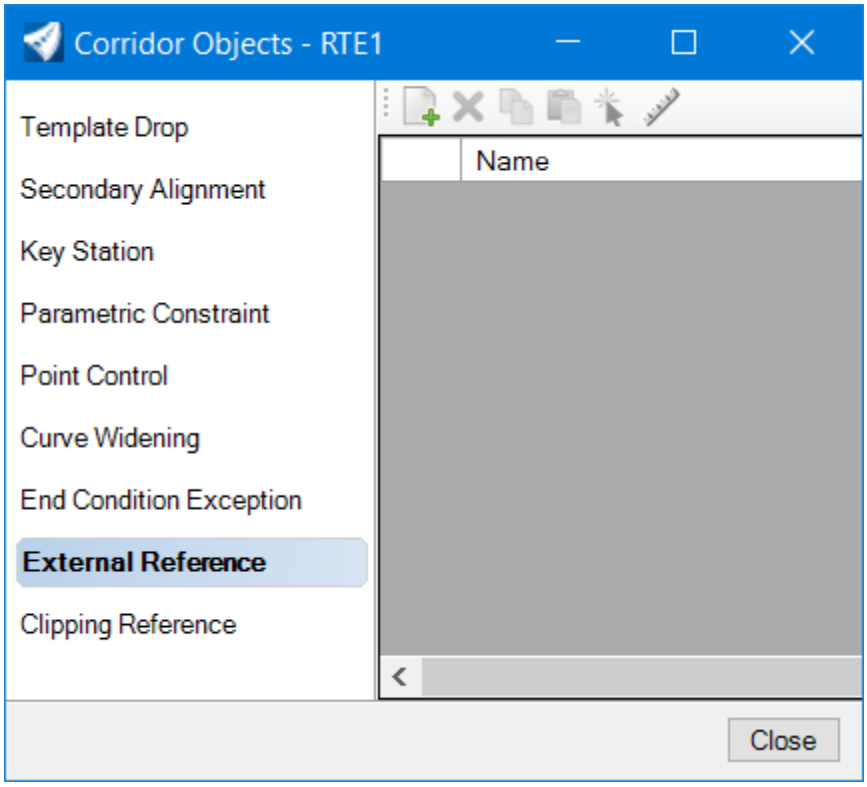


Figure 103 Corridor Objects External Reference

3.6 Placing Surface Templates

Terrain Models either existing or proposed do not have depth or material associated with them. A Surface Template is made up of various components and each component can be of various depth and is applied to a terrain model. Components for a surface template are closed shapes such as asphalt layer, aggregate layer, grass layer etc. The "Apply Surface Template" tool will apply a selected surface template from the template library to a terrain.

The **Apply Surface Template** tool can be found on the OpenRoads Modeling workflow Ribbon:

Model Detailing Tab > **3D Tools** Group > **Apply Surface Template**

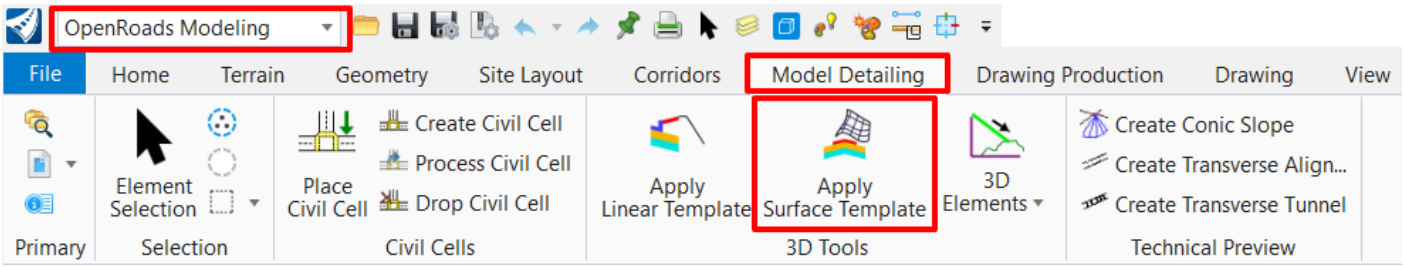


Figure 104 Apply Surface Template

Apply Surface Template will activate Pick Template dialog, then insert the chosen surface template into the drawing relative to a terrain model.

The Connecticut DOT has provided range of Surface Templates within its workspace. See figure below.

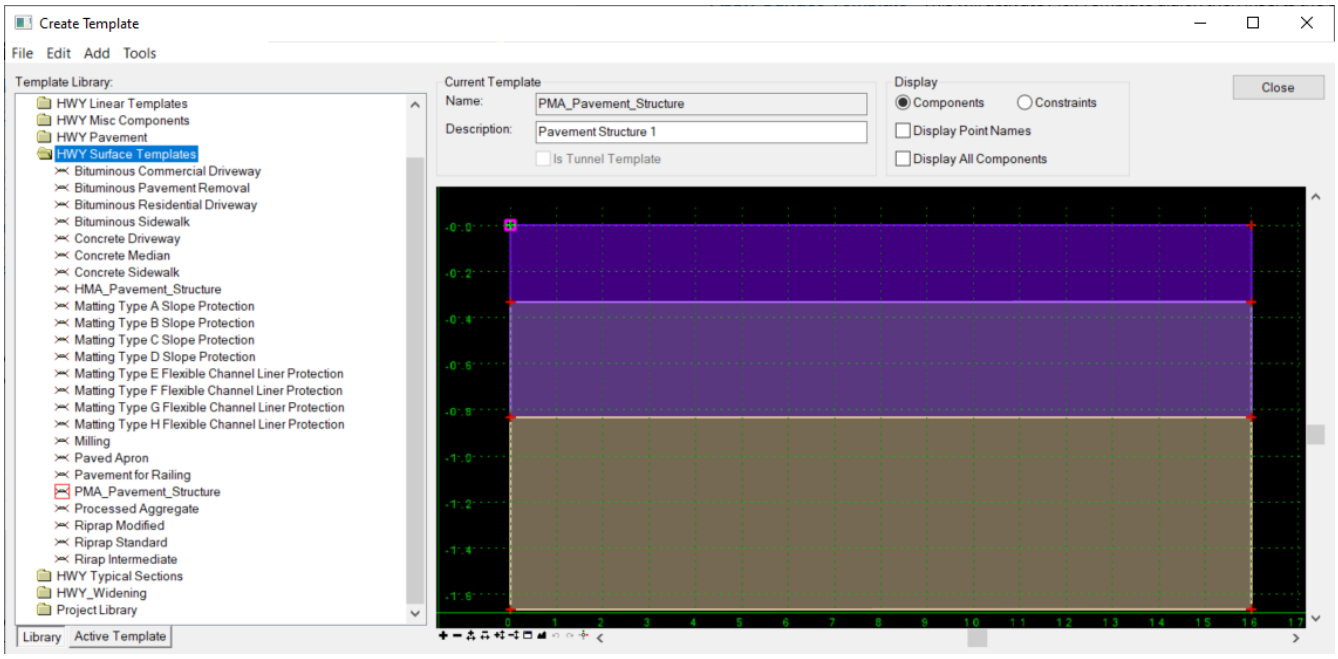


Figure 105 CTDOT Surface Templates

3.6.1 Apply Surface Templates

Surface Templates is a closed shaped component of a *Template.* A *Surface Templates* can be applied to a terrain using the Apply Surface Template tool. Surface Templates are used to apply material thickness to the terrain surface. A Surface Template can be of a single component or composed of different components.

This module instructs users how to place a surface template in a design file for a project. For placing surface template, a terrain is needed.

1. Open the **Corridor (Roadway Model) file** and the **Template Library** for the project.
2. Activate the **OpenRoads Modeling** workflow from the pick list next to Quick access toolbar in the upper left corner if it is not already active. The ribbon menu will reflect the **OpenRoads Modeling** tools.
3. The Corridor file contains Roadway corridor ***RTE1*** with a roadway template drop. Around ***Sta. 15+85***, a driveway is designed. We need to create a ***Terrain*** and apply a ***Surface Template*** to the Driveway in order to make it complete.

   NOTE: *Driveway Civil Cells can be placed and edited as needed at this location*

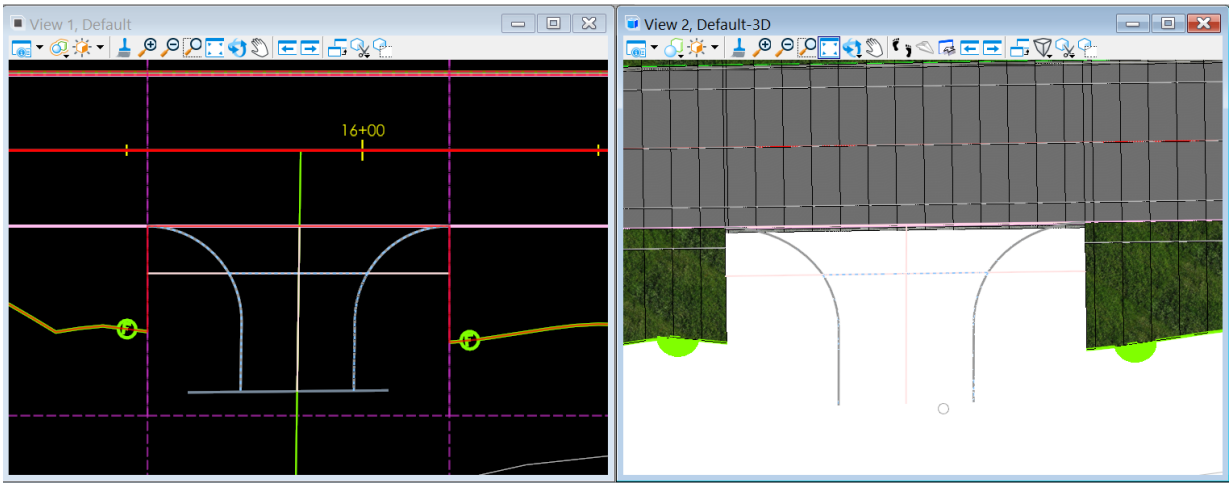


Figure 106 2D and 3D View

4. Create a Terrain out of the driveway components. Make sure that all the Driveway components have active profiles.
   a. From the Terrain Tab Ribbon and within the **Create** Group, select **From Elements.**

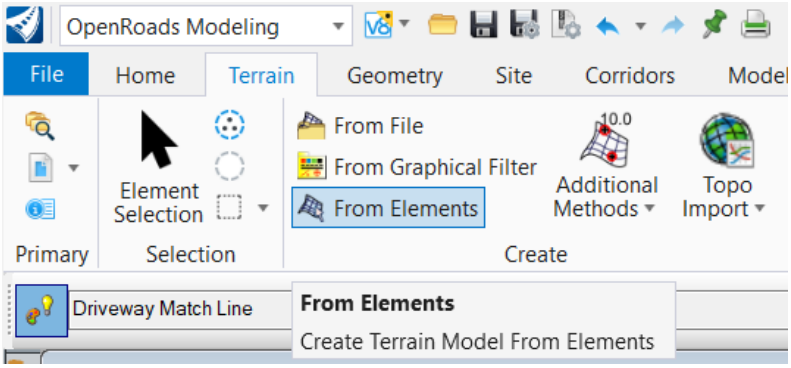


Figure 107 Create Terrain From Elements

   b. The **Create Terrain** dialog will open and then follow the prompts.
   c. Set the following on the dialog box:
      - **Feature Definition: *Design Top*** (User can change as required)
      - **Name: *P_DRV*** (or as required)

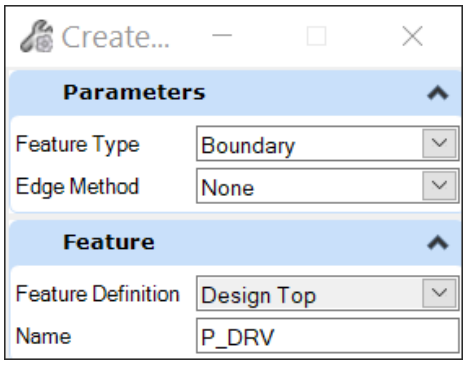


Figure 108 Create Terrain Dialog

   d. Follow the prompts.

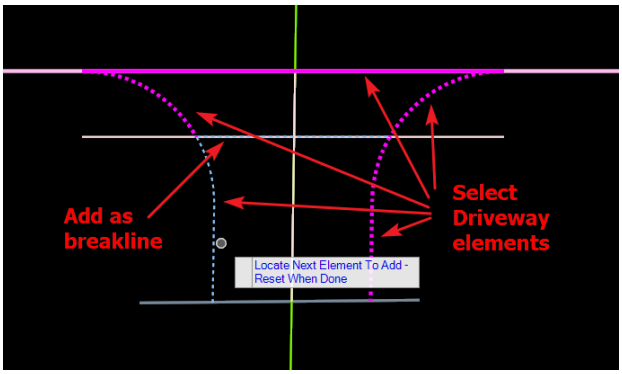


Figure 109 From Element graphical Features

- **Locate Element to Add:** Select all the sides of the ***Driveway*** (Front and sides of Driveway).
- **Locate Next Element to Add:** **Right-click** or reset.
- **Feature Type:** ***Boundary***
- **Edge Method:** ***None***
- **Left-click** to complete

e. The Add/Remove Terrain Model Features dialog will open. Follow prompts. Right-click to rest if there are no features to add or remove.

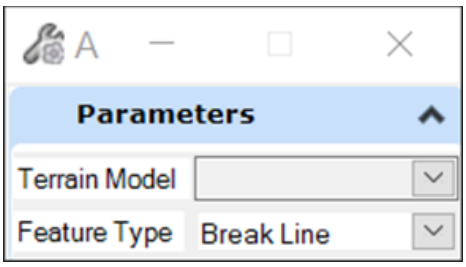


Figure 110 Parameters

- **Locate Element to Add:** Select **Driveway Shelf**
- **Locate Next Element to Add:** **Right-click** or reset
- **Feature Type:** ***Break Line***
- **Locate Element to Add:** **Right-click** or reset
- **Right-click** again to complete.

The ***P_DRV*** Terrain is created as shown in 3D view.

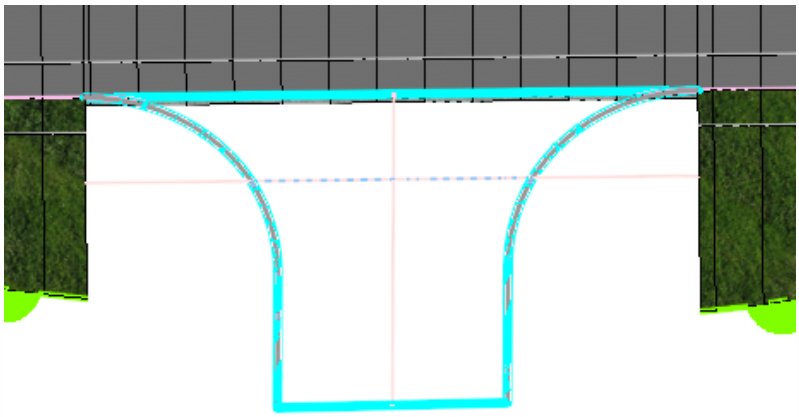


Figure 111 3D View

6. Apply the driveway surface template to ***P_DRV*** terrain
   a. From the Model Detailing Tab Ribbon and within the **3D Tools** Group select: **Surface Templates > Apply Surface Template.**

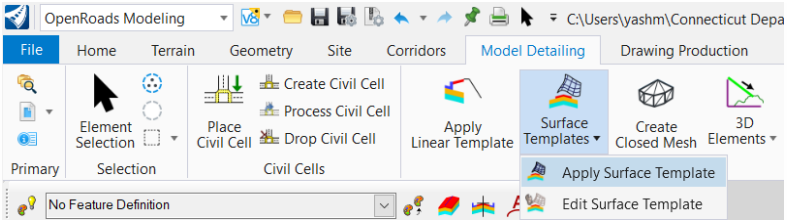


Figure 112 Apply Surface Template

   b. The **Apply Surface Template** dialog will open, follow the prompts.

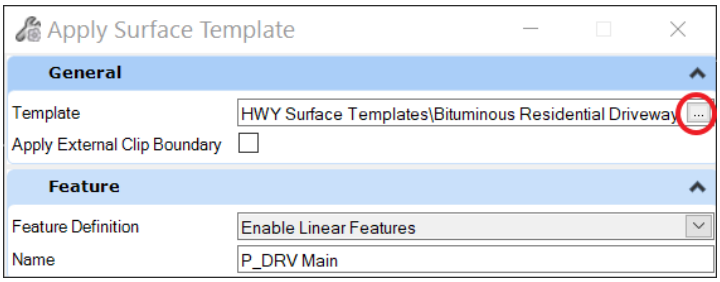


Figure 113 Browse to select Surface Template

   c. Set the following on the dialog box:

      Feature Definition: ***Enable Linear Features***

      Name: ***P_DRV Main*** (or as required)

   d. Follow the prompts.

      Locate a Terrain Model: Select ***P_DRV*** terrain (It is easier to select in 3D view)

      Apply External Clip Boundary: ***No***

      Select Template: click the **browse** button next to Template label

      The **Pick Template dialog box** will open, select ***HWY Surface Templates\|Bituminous Residential Driveway***

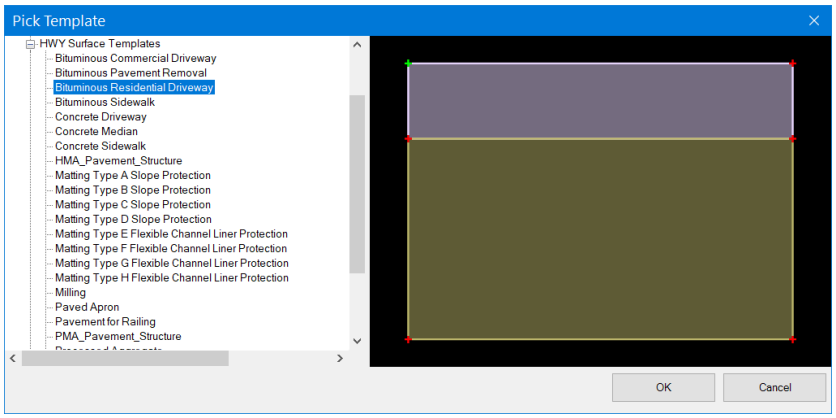


Figure 114 Select Surface Template

Click **OK** to close Pick Template dialog.

Left-click to complete selection.

Data Point to accept selection: **Left-click** to complete

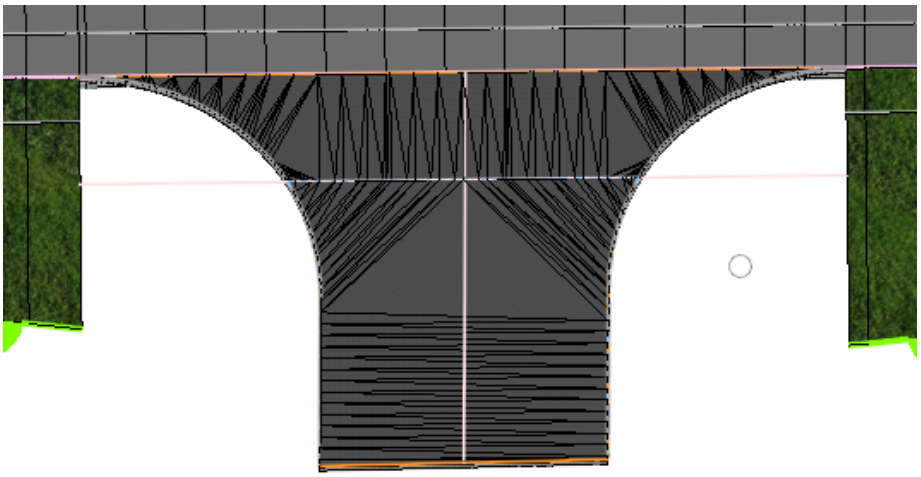


Figure 115 P_DRV Main surface template is created as shown in 3D view

7. Designers can create separate Terrains and apply Surface Templates to Driveway Shelf and Driveway Main separately. This is up to the Designers.

3.6.2 Edit Surface Templates

Surface Templates can be swapped or edited as per the project requirement. This module instructs users how to edit the ***Surface Template*** applied in a design file for a project.

1. Open the **Corridor (Roadway Model) file** and the **Template Library** for the project. In this file a Commercial Driveway Civil Cell is placed, and we will be editing the Surface Template applied to the Driveway. The Driveway consists of two separate Terrains (Driveway Shelf and Driveway Main) and the Bituminous Commercial Driveway Template is applied to both Terrains.
2. Click and select a ***Driveway Main Surface Template (1-P_DRV Main Surface Template)*** in the 3D View.

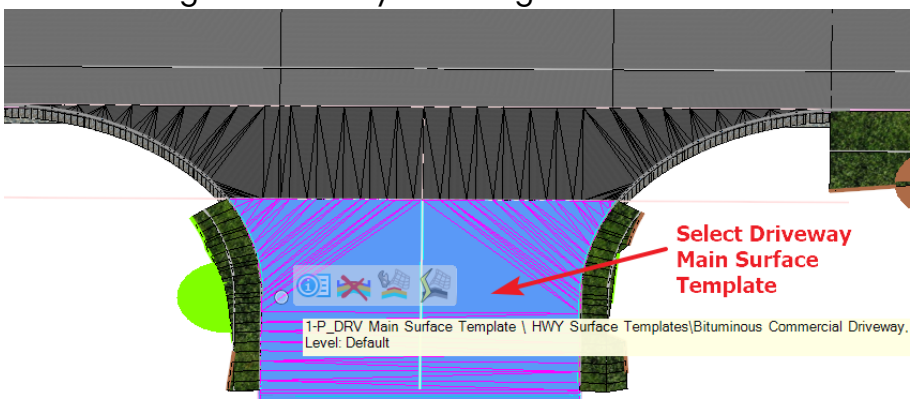


Figure 116 select Surface Template

a. Open the ***Properties*** dialog and expand the ***Mesh Template*** group. The current template is ***HWY Surface Templates> Bituminous Commercial Driveway.***

b. Click the **Browse** button at right side of the Template Name label. This opens the Pick Template dialog.

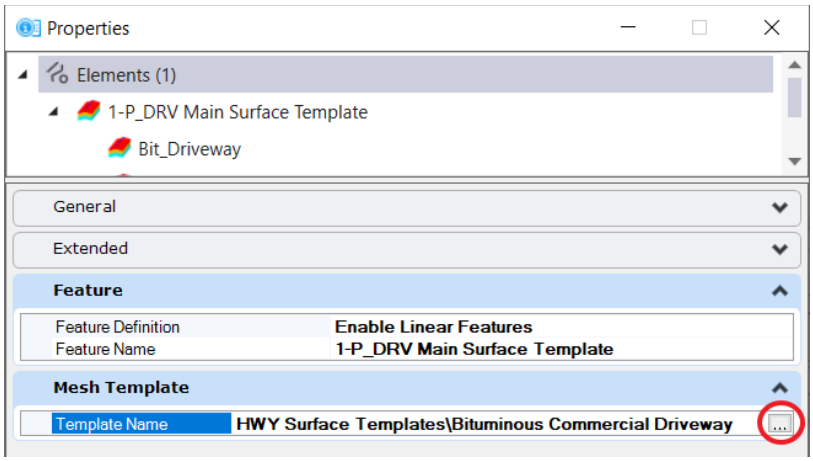


Figure 117 Browse to Select Surface Template

Alternatively, Select **Driveway Main Surface Template (1-P_DRV Main Surface Template)** in the 3D View and let the cursor rest on the surface to access the context sensitive pop-up menu.
Select **Properties**. **Quick Properties** opens, Click **Browse** button at right side of the Template Name label. This opens the Pick Template dialog.

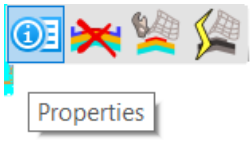


Figure 118 Properties

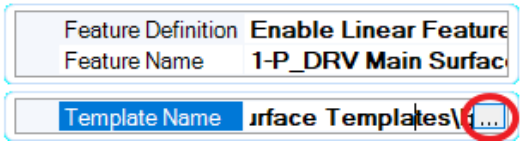


Figure 119 Browse to Select

c. Select the desired template prepared for the project and review. For this example, choose ***HWY Surface Templates> HMA_Pavement_Structure,*** Click **OK**.

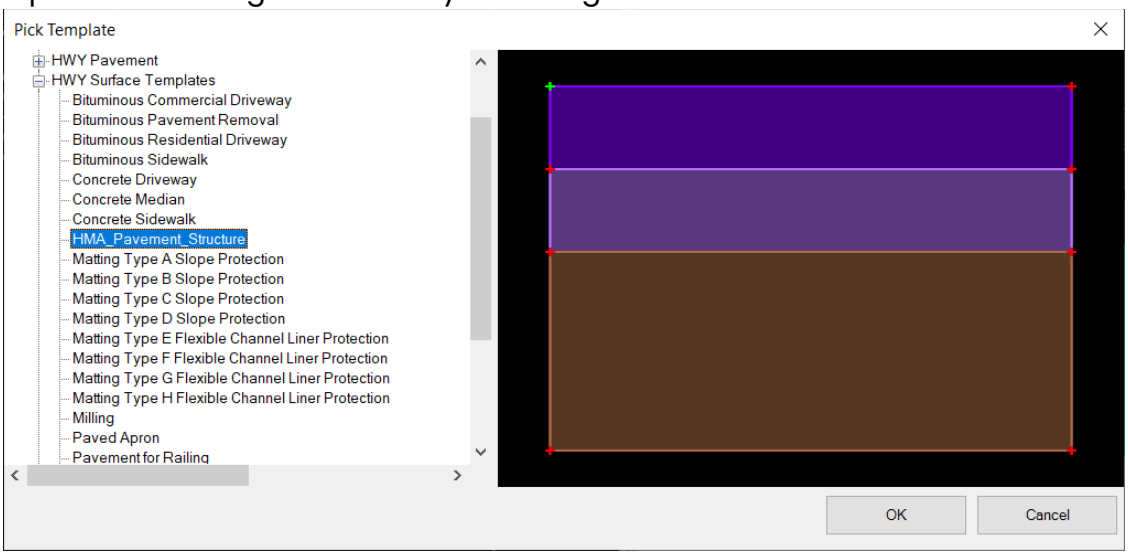


Figure 120 Select Template

The surface template processes with the new Template. Notice the change in the 3D view. The surface updated from 2 layers to 3 layers of pavement.

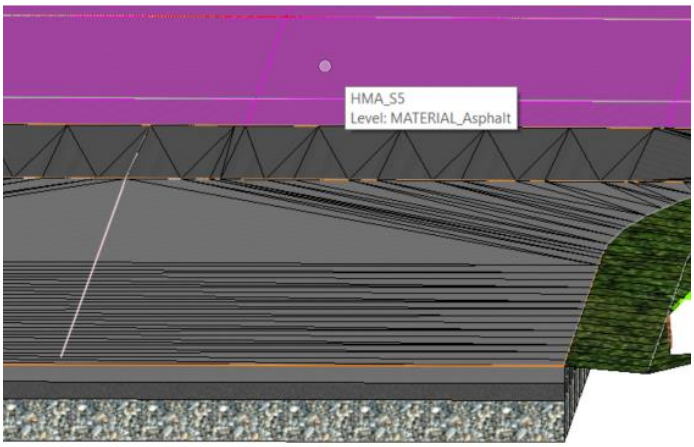


Figure 121

3. The User can edit the pavement thickness. Click and **rest cursor (hover)** over the ***Driveway Main Surface Template (1-P_DRV Main Surface Template)*** in the 3D View. From the Context Tool Bar, select **Edit An Applied Surface Template**.

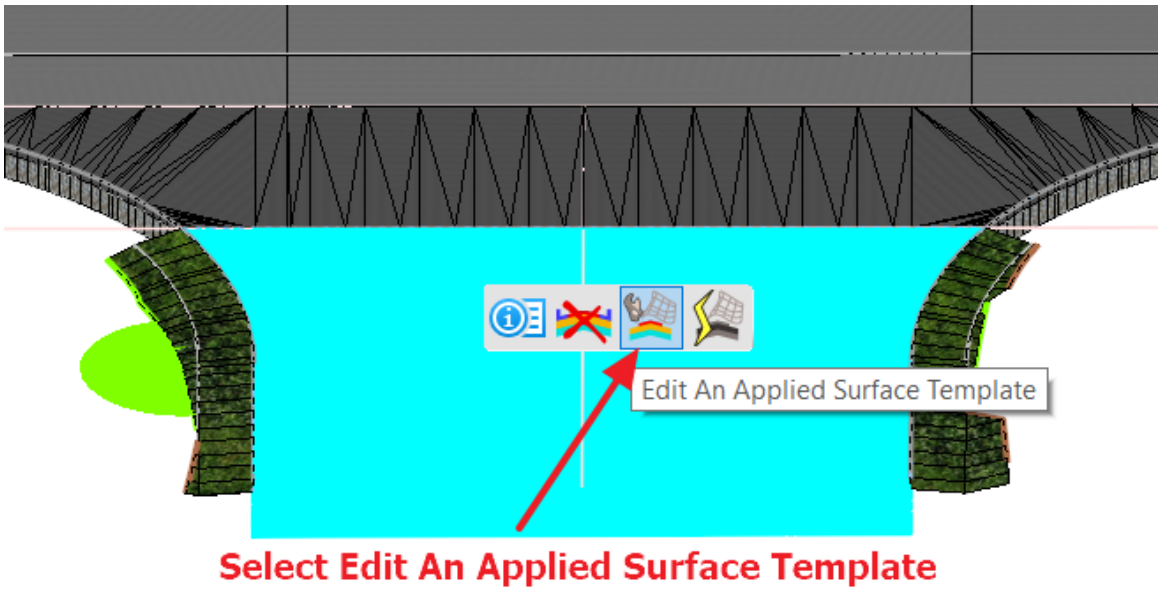


Figure 122 Select Edit on an Applied Template

a. In the Editing Roadway Designer Template Drop dialog, the pavement thickness can be edited. For this example, *EOR_sg_lt* and *EOR_sg_rt* points depth will be changed from 1' to 1.33'. Double click on **EOR_sg_lt** point.

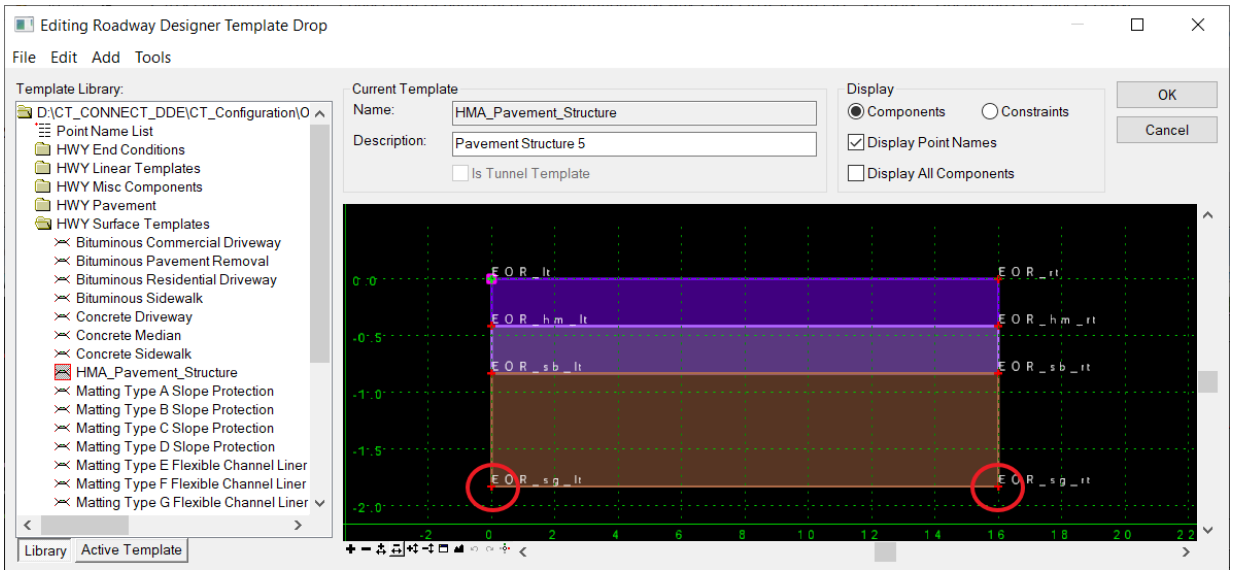


Figure 123 Edite Template Drop

b. In the Point Properties dialog, change Vertical Value from ***-1 to -1.333*** under Constraint 2 and click **Apply** then click **Close**.

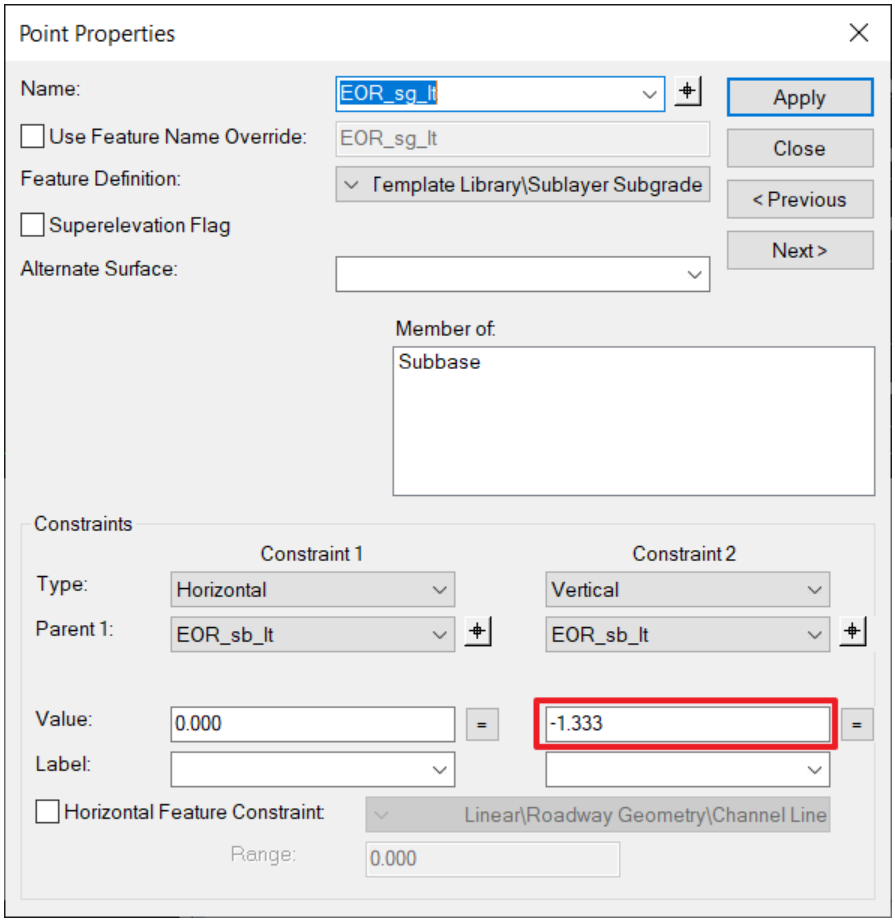


Figure 124 Point Properties

c. Double click on ***EOR_sg_rt*** point. In the Point Properties dialog, change Vertical Value from ***-1 to -1.333*** under Constraint 2 and click **Apply** then click **Close**.

d. Click **OK** to close the Editing Roadway Designer Template Drop dialog. The Depth of the bottom layer of the surface template is updated to the new value. You can see the change in the 3D view.