CONNECTICUT DEPARTMENT OF TRANSPORTATION

DIGITAL DESIGN ENVIRONMENT GUIDE

CONNECT EDITION

Volume 3.2 – OpenRoads Designer Roadway Templates

Volume 3.2 - OpenRoads Designer Roadway Modeling

Course Overview

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

Skills Taught

Learn how to:

- copy standard roadway templates into a project
- create and edit roadway templates

Introduction

Templates are made up of components which in turn are defined by points. One or more components combine to create a template. Components can be closed shapes such as an asphalt layer, or they can be open shapes such as cut and fill slopes. Examples of components include curbing, sidewalks, asphalt layers, aggregate layers, median barriers, or the side slopes to be used when in cut and fill areas.

Templates represent cross sectional geometry. A 3D model is created by extruding the template along a 3D geometric path. As the template is extruded the template points connect longitudinally to create 3D surfaces and meshes. Templates can be used along a road or rail centerline and profile grade line using Corridor tools to model a roadway but they can also be applied along any 3D geometry using the Apply Linear Template tool. For example, a curb template can be applied around a traffic island. Templates are stored in a Template Library File, which has the file extension .itl.

The Create Template command generates the transverse geometry that is the central to roadway design. A template is comprised of a series of points and components that represent breakline features that are later processed using the Roadway Designer command. Roadway features that have been processed are saved to the design surface. Templates are stored in a template library (*.itl). In simple terms, the template is a “smart” typical section that you “push” along an alignment to create the proposed 3D model. Template tools can be accessed by selecting **Corridors > Template > Create Template**

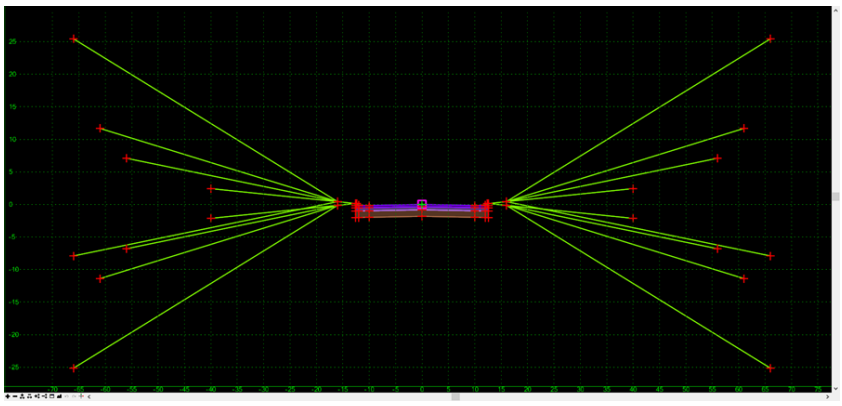

Figure 1 Example of a template for a 2-Lane undivided highway

Exercise 1 Base Model Creation

This section instructs users how to create 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 base model files can be created. References files such as alignments, survey and terrain files are attached without nesting.

1.1 Startup

Before attempting to open or create DGN files users should make sure the following is in place:

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.**

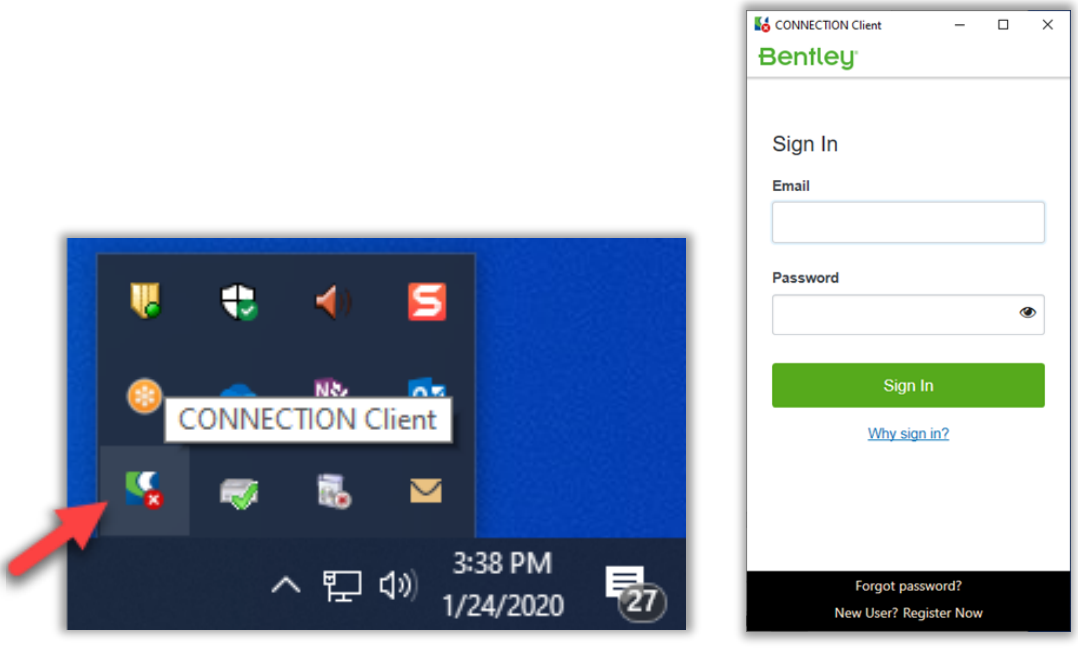

Figure 2 CONNECTION Client System tray

5. Launch the Application.
   - **CTDOT employees**
     On your desktop double click on the **CAD Accounting** icon.
   - **Consultants**
     Start the software via an appropriate **CTDOT DDE** icon
6. On the CT DOT Accounting Menu there will be select ***Compass OpenRoads CE***
   In the ***Run Program*** field select the needed program, the ***Available Account*** (funding source) and ***Resource Type***. Click on the **Start** button to load the program.

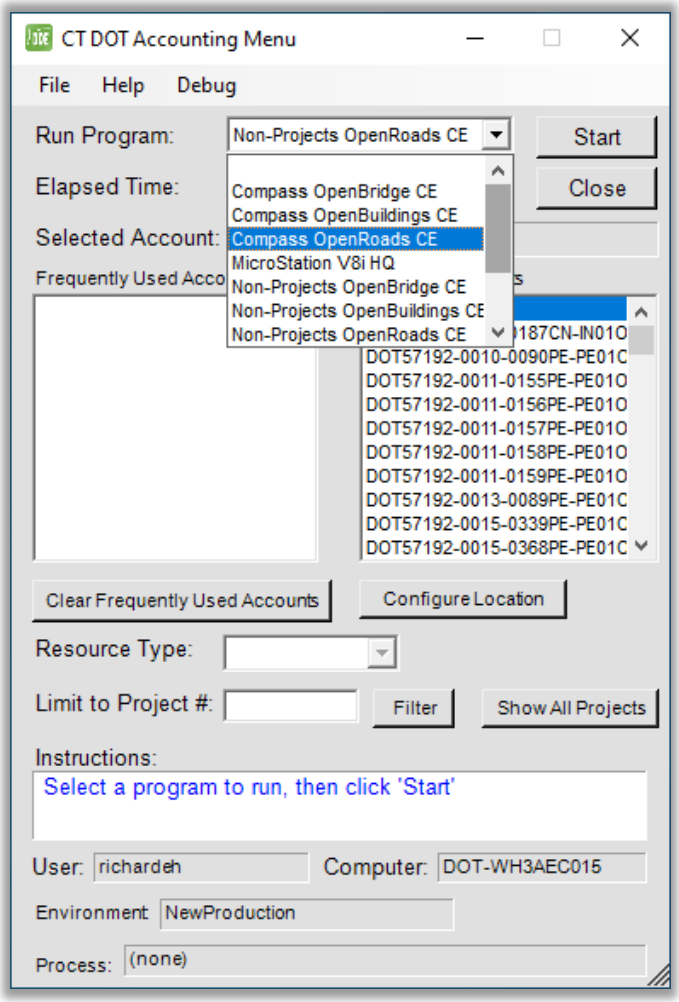

Figure 3 CAD Accounting dialog box

7. After launching the program, a Welcome Screen for ***OpenRoads Designer*** will appear.
8. Select **Custom Configuration**, using the small drop-down arrows select the Workspace **CT_Workspace**, the needed **WorkSet** and **Role**.

   Note: *For CTDOT Synced Projects - If you do not see the Project Number listed, please request a Compass/CAD Setup using this link* [*New CAD Project Request*]

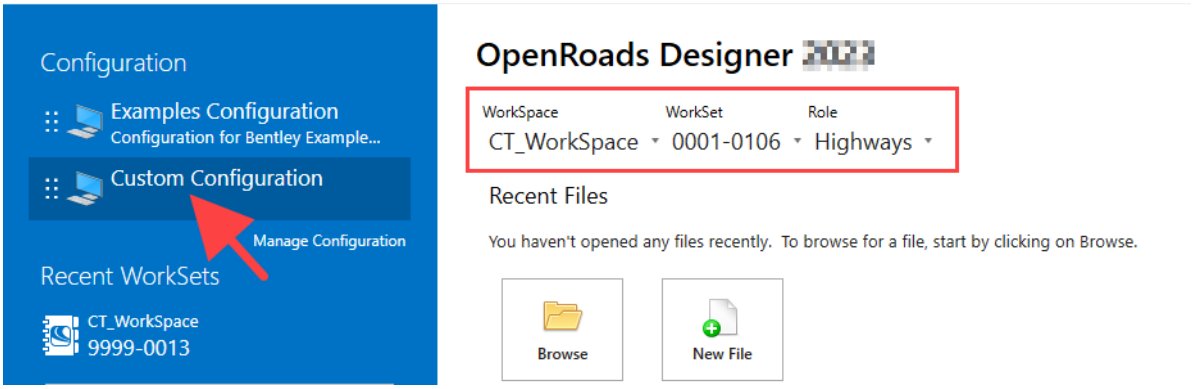

Figure 4

1.2 Creating a New File

1. Select the **New File** icon. Create a DGN file from the civil 2D seed and save it to the Base_Models folder. Use the file-naming conventions as described in Volume 16.

   Example: ***HW_1234_1234_CorridorRoute123.dgn***

   Warning: Do not copy DGN files created with V8i SELECTseries or InRoads SS2, SS3, SS4, or SS10 to the new CTDOT CONNECT Project/WorkSet folders.

2. On the New dialog box click the **Browse** button to select to select the proper seed file. ***...CT_Configuration|Organization|Seed|Road***

   If the survey was done in an old Datum, use the corresponding 2D Seed File in this folder: ***...CT_Configuration|Organization|Seed|GCS|***

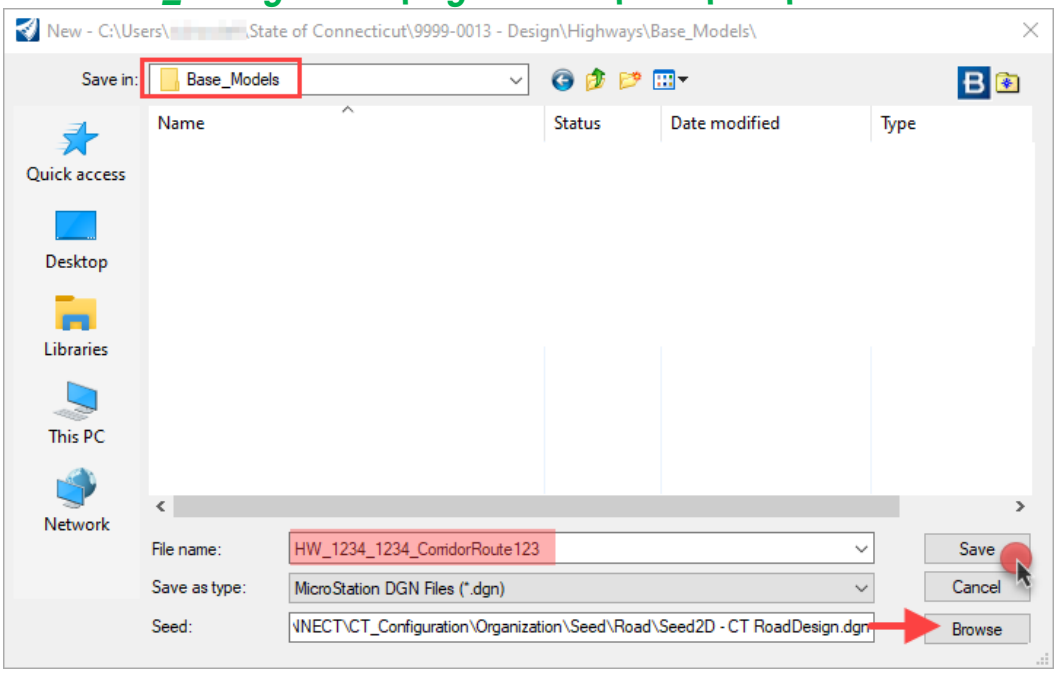

Figure 5 New File

3. After the DGN file is created open File Explorer and browse to the file, **right click hold** and select **View online**.

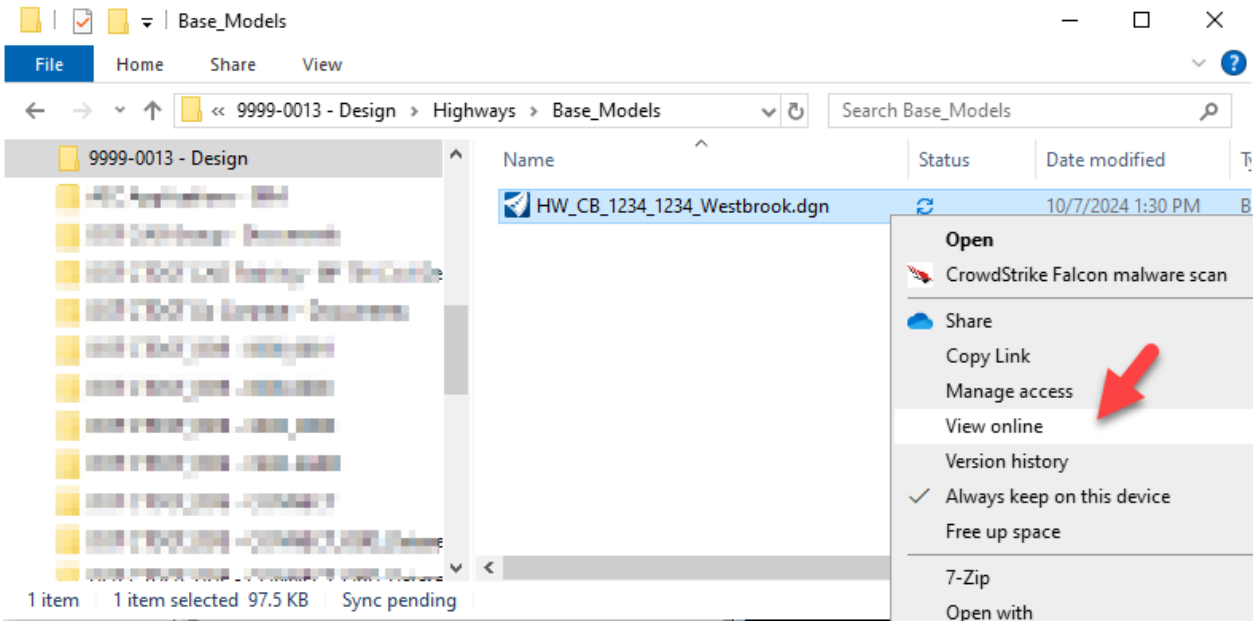

Figure 6 File Explorer View online tool

4. The Projects SharePoint site will open, sort by **Date**, click on the **three dots**, select ***More › Check Out.***

   Note: *When you are done working on the DGN file, exit the program and go back to the SharePoint Site and* ***Check In*** *the file.*

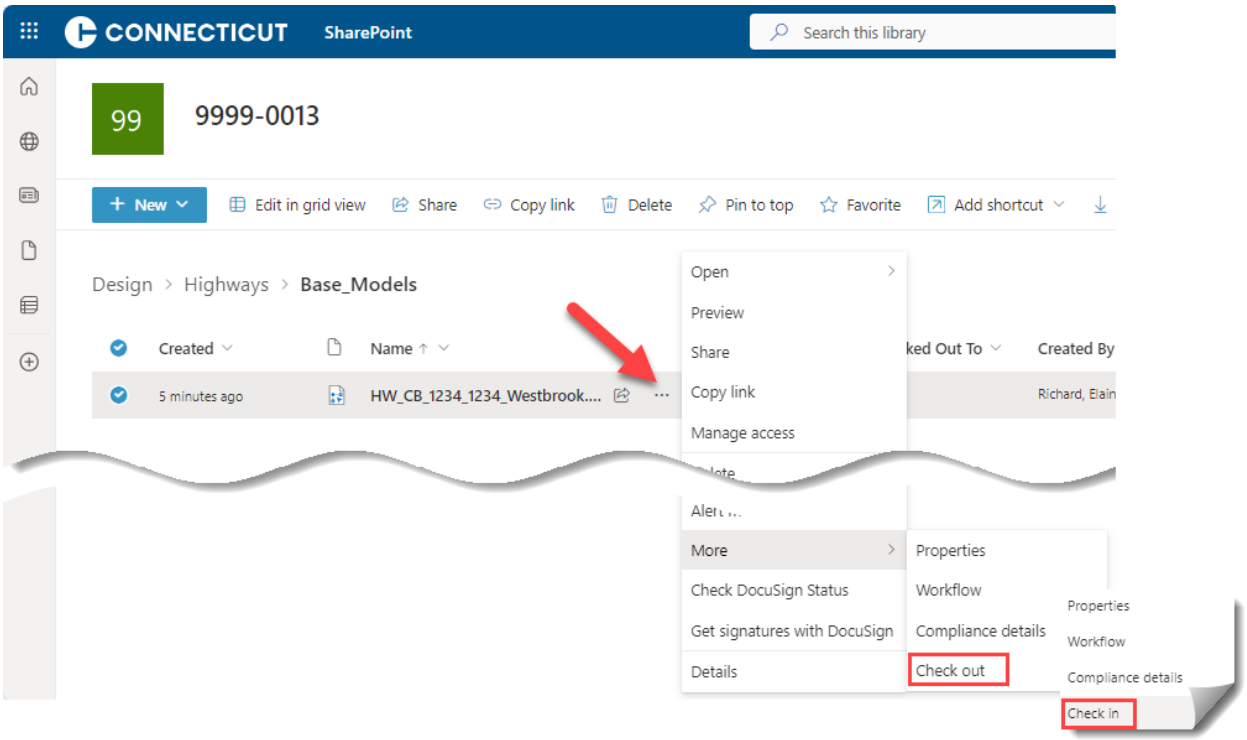

Figure 7 SharePoint Check out

Exercise 2 Utilizing the CTDOT Template Library

2.1 Setting up the Project Roadway Templates

Templates are used to define the typical section for each alignment. Multiple templates can be used to define different typical section designs, or the template geometry can be modified using a variety of corridor editing tools.

CTDOT provides a sample template library in the following folder:
...CT_Configuration|Organization-BIM|_CT_Civil Standards|Template Library|CV_ORDTypicals.itl

A blank ITL file can be found by default in the highway design folder ***...Highways/Eng_Data/Project_Typicals.itl***.

Required individual templates will be copied over from ***CV_ORDTypicals.itl*** to ***Project_Typicals.itl*** using the **Template Library Organizer**.

Please note: *Any other disciplines modeling a corridor can **copy** a blank ITL from **...CT_Configuration|Organization-BIM|_CT_Civil Standards|Template Library|Project_Typicals.itl** and paste the file into the discipline-specific folder for engineering data:*

Discipline project location of ITL:

- Bridge/Eng_Data/
- Envir/Eng_Data/
- F_Civil/Eng_Data/
- Geotech/Eng_Data/
- Hwy_Man/Eng_Data/
- Hwy_Ops/Eng_Data/
- Hydro/Eng_Data/
- Illumination/Eng_Data/
- Landscape/Eng_Data/
- Public_Trans/Eng_Data/
- R_Catenary/Eng_Data/
- R_Signals/Eng_Data/
- R_Track/Eng_Data/
- Traffic/Eng_Data/
- SVY_District/_Eng_Data/
- PMaps/
- SVY_Central/
- SVY_Consultant/

Warning:
Do not change the name or path of the Project_Typical.itl file.

If this file name gets modified after Templates are placed in a Corridor the **Synchronize with Library** tool will not be able to update itl edited templates.

This path is also set as a variable used across all projects so your file will always be read in.

1. Select **OpenRoads Modeling > Corridors > Template > Create Template**

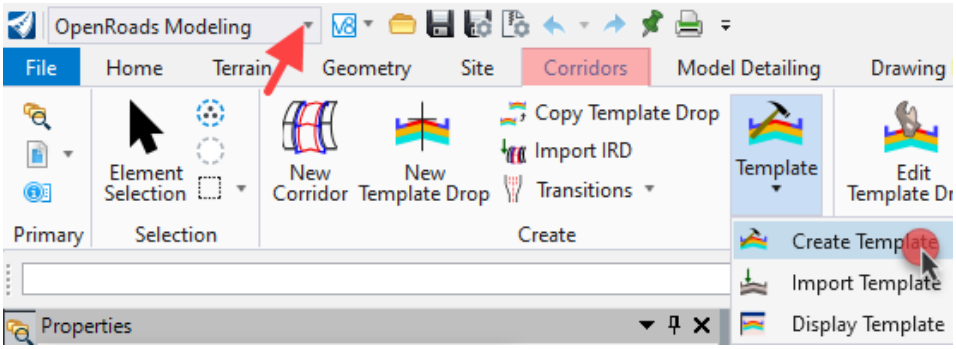

Figure 8 Create Template Tool

2. The Template Library will open to ***...Highways/Eng_Data/Project_Typicals.itl***.

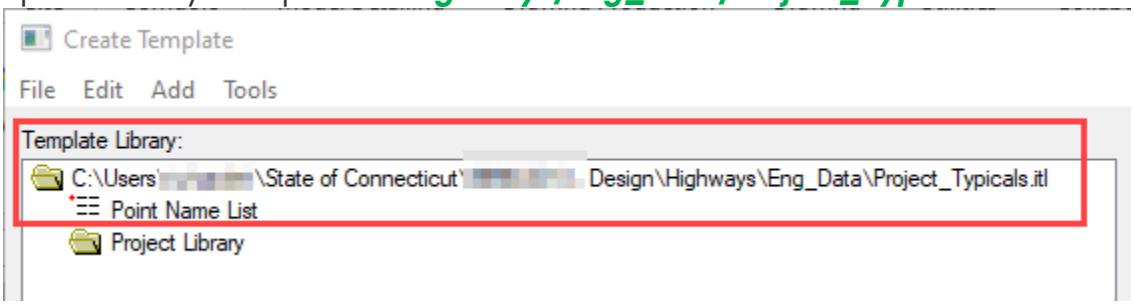

Figure 9 Project Typicasl File

   a. If the template library is pointing to a random place or file, go to file explorer and *copy* ***...CT_Configuration\Organization-BIM_CT_Civil Standards\Template Library\Project_Typicals.itl*** *and paste the file into* ***...Highways/Eng_Data/***

      Please note: *Any other disciplines modeling a corridor can* ***copy*** *a blank ITL from* ***...CT_Configuration\Organization-BIM_CT_Civil Standards\Template Library\Project_Typicals.itl*** *and paste the file into the discipline-specific folder for engineering data:*

   b. Now back in the Create Template select ***File > Open*** and open the ***.itl*** file you just copied to your project.

3. In the Create Template Dialog Box select ***Tools > Template Library Organizer...***

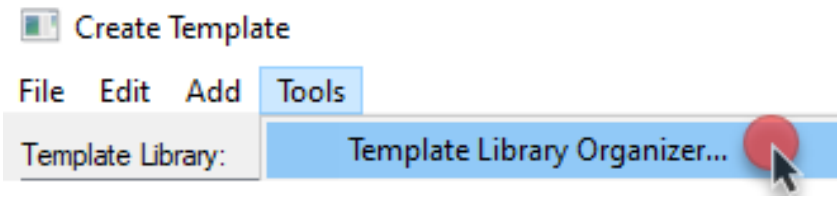

Figure 10 Template Library Organizer Pull Down Tool

4. Select ***Browse…***

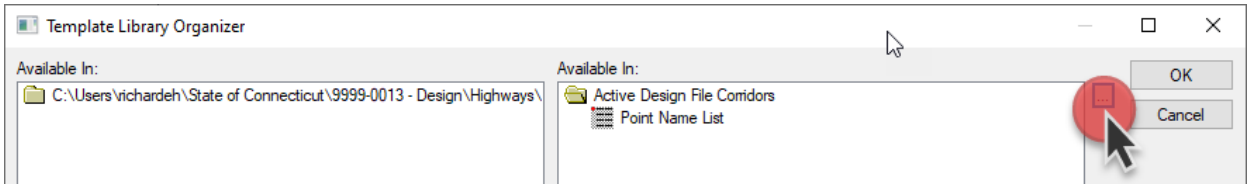

Figure 11 Template Library Organizer Browse Butoon

5. Select ***…CT_Configuration\|Organization-BIM\|_CT_Civil Standards\|Template Library\|OpenSite Templates Imperial.itl*** and click **Open**.
6. Expand the right hand ***Available in*** folders and copy the needed Templates to the Project Library on the left hand **Available in**.
7. *When complete click* **OK**.

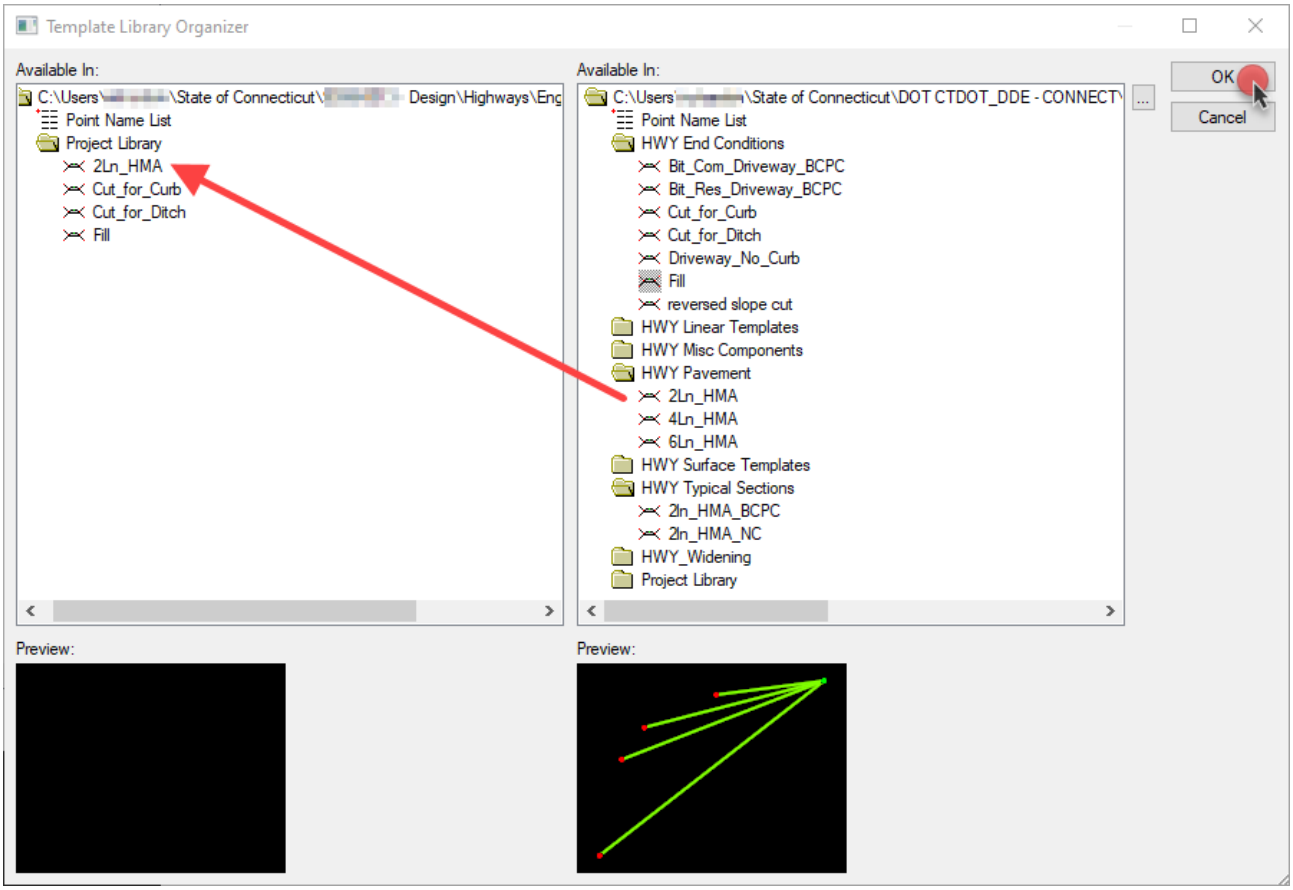

Figure 12 Template Library Organizer Dialog Box

2.2 Point Names and Features

CTDOT's template library is supplied with many template components defined that can be used as the starting point for creating and editing templates for a project. The folders in this library contain various Components and End Conditions that can be used to create completed templates. These components use CTDOT Standard Point Names, Component Names and Feature Definitions. If a user decides to create templates from scratch, it's important to remember that each point and component in the template is assigned a **Name** and a **Feature Definition**. It is imperative to ensure that the points and components are named and assigned features consistent with CTDOT standards.

Feature definitions for template points and components are defined in **CV_Highway_Features_Levels_ElemTemp.dgnlib**, which is attached by a configuration variable. As the template is applied to the corridor, 3D line strings are drawn in the design file by connecting the points from template drop to template drop by their **Name**. The symbology of these line strings is controlled by the **Feature Definition** that is assigned to each point. The CTDOT CONNECT DDE includes a multitude **Feature Definitions** that can be used for template points.

The point feature definitions can be reviewed by browsing to the following folder in the Civil Standards tab: ***Libraries > Feature Definitions > Linear > Roadway Modeling > Template Library***

Templates are defined by inserting Points, Components.

Template Points - The points of a template represent breakline features that will be created when the template is processed using the Roadway Designer command. Points have a name and feature style; there is no limit to the number of points in a template. Once processed in Roadway Designer as features, they are saved to the design surface.

Template Components - A component is a set of points that define an open or closed shape. Each component, whether open or closed, can represent a different material or area of interest. Components are named and have an assigned feature style. There are 6 types of components created in InRoads: *Simple, Constrained, Unconstrained, Null Point, End Condition, and Overlay/Stripping*.

Exercise 3 Creating Templates

Templates are created and edited in the template library by ***choosing Template > Create Template*** from the Corridors tab.

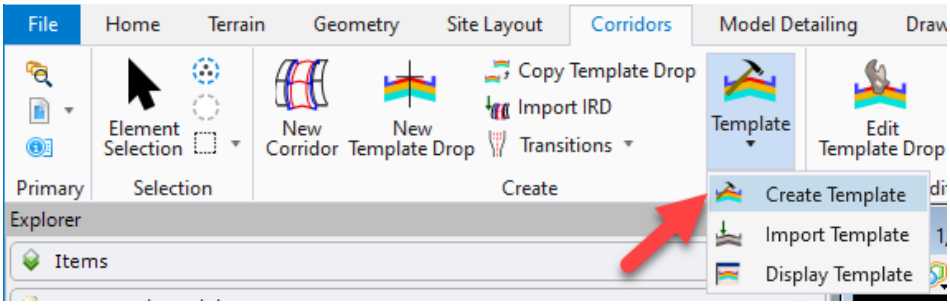

Figure 13 Create Template Tool

Basic Steps

While the process to create templates will have many variables, the general procedure to create templates is summarized below:

1. Copy the needed CTDOT Standard Roadway Templates to the Project's Master Library. Templates can be copied from one library to another by selecting ***Tools > Template Library Organizer*** from the *Create Templates* dialog.
2. Create a new template or copy a template.
3. Drag and drop template backbones or individual components into the active template.
4. Create/edit the components as necessary.
5. Merge components as desired.
6. Review the point names and point name overrides.
7. Review the component names and component name overrides.
8. Test the template behavior.
9. Save the template library.

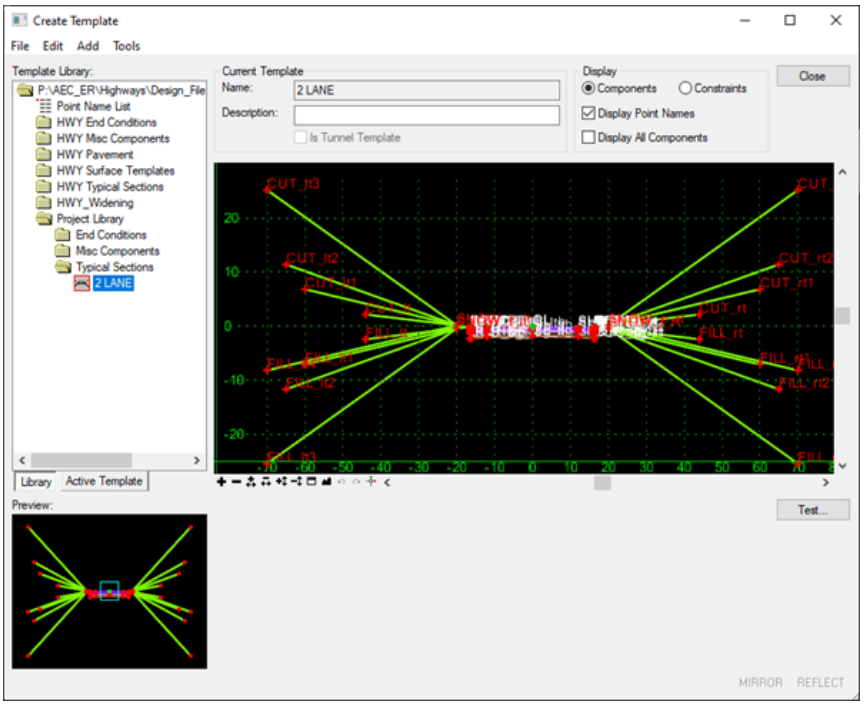

Figure 14 Create Template Dialog Box

3.1 Menu Commands

The dialog is split into several areas. Each area is briefly described below.

File – The File menu contains familiar commands for creating new Templates and new folders within the template library, as well as commands to save and open template libraries,

Edit – The Edit menu contains commands used when editing templates such as Undo, Redo, Cut, Copy, Paste, etc…

Add – The Add menu contains commands to add points and components to the active template.

Tools – The Tools menu contains various tools for template creation. The Options and Dynamic Settings menu items are described on the following page.

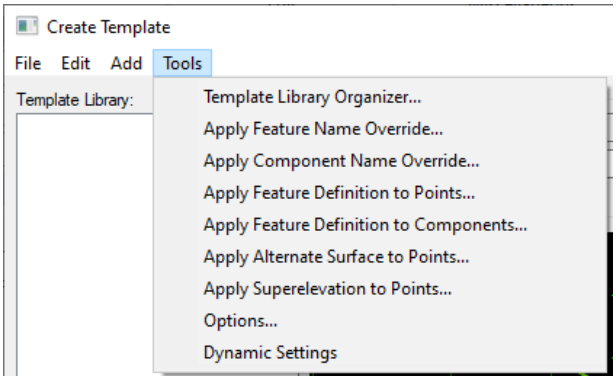

Figure 15 Create Template tools list

3.1.1 Options… Dialog

Tools > Options… displays the Template Options dialog which allows you to specify naming and step options for the current template. Use the Dynamic Settings dialog, detailed on the following page, to toggle these settings on/off as you design the template.

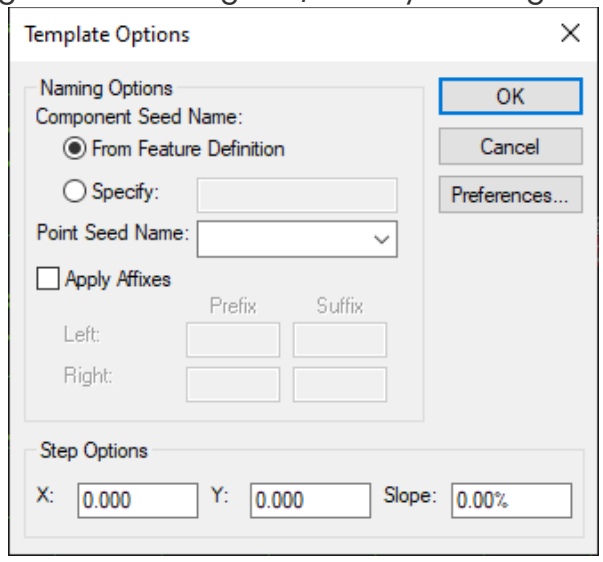

Figure 16 Template Options

Naming Options

Component Seed Name

- From Feature Definition indicates, when selected, the component name is derived from the style specified when the component is created.
- Specify indicates, when selected, the component name is specified in the field.
- Point Seed Name allows you to specify the seed name for point in the current template. Since point names must be unique, the seed name is appended with a different number each time a point is created.

Apply Affixes

Indicates, when on, that affixes are applied.

- Left Prefix/Suffix specifies which prefix/suffix should be added to a point or component when the value is on the left of 0.0 (absolute).
- Right Prefix/Suffix specifies which prefix/suffix should be added to a point or component when the value is on the right of 0.0 (absolute).

Step Options

These options are used to specify precision step input for components and points. These values can also be accessed from the Dynamic Settings dialog.

- **X Step** specifies the step increment for the X distance from the dynamic origin. If this value is non-zero, then the cursor moves to the horizontal increments of the specified value as measured from the dynamic origin.
- **Y Step** specifies the step increment for the Y distance from the dynamic origin. If this value is non-zero, then the cursor moves in vertical increments of the specified value as measured from the dynamic origin.
- **Slope -** specifies the step increment for slope from the dynamic origin. If this value is not 0, then the cursor moves in slope increments of the dynamic origin. Slope is applicable only when the dynamic settings are in horizontal/slope mode.

3.1.2 Dynamic Settings Dialog

Tools > Dynamic Settings... displays the Dynamic Settings dialog, which is used for precision input of template components and to assign point names and styles when defining components.

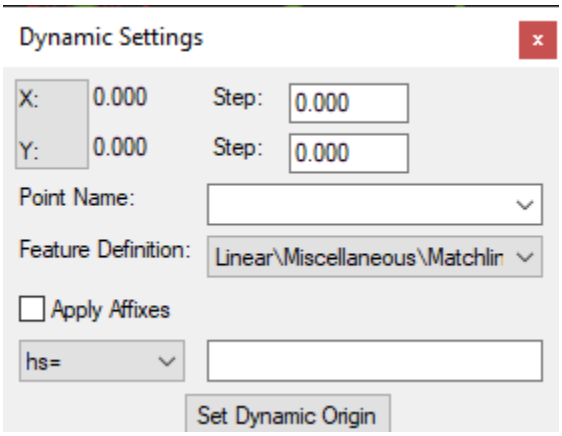

Figure 17 Dynamic Settings

X:Y/X:Slope toggles between X,Y step lock and X/Slope step lock.

X Value displays the current X distance from the dynamic origin.

X Step specifies the step increment. If this value is non-zero, then the cursor moves in horizontal increments of the specified value as measured from the dynamic origin.

Y value displays the current Y distance from the dynamic origin.

Y Step specifies the step increment. If this value is non-zero, then the cursor moves in vertical increments of the specified value as measured from the dynamic origin.

Point Name specifies the name of the point to be placed.

Apply Affixes specifies, when selected, that point name affixes (prefix or suffix) are to be applied to the point name when placing points. The Affixes are defined on the Template Options dialog. The **Key-in** pull down is used to specify the type of key in to be performed.

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

Set Dynamic Origin sets the location of the dynamic origin.

3.2 Template Library

On the left side of the *Create Template* dialog is the **Template Library** area which contains a Windows-like folder structure. This area is used to manage the content of the current template library. Two tabs are supported for the **Template Library** area as described below.

3.2.1 Folders and Template list

When the **Library** tab is selected, the **Template Library** displays the contents of the current template library in a familiar Windows folder structure as shown at right. The **Template Library** area also supports common Windows functions like drag, drop, cut, paste, etc..

- When a template is selected from the list, the Preview window is used to display a preview of the template.
- Double-click the template name to set it as the active template.

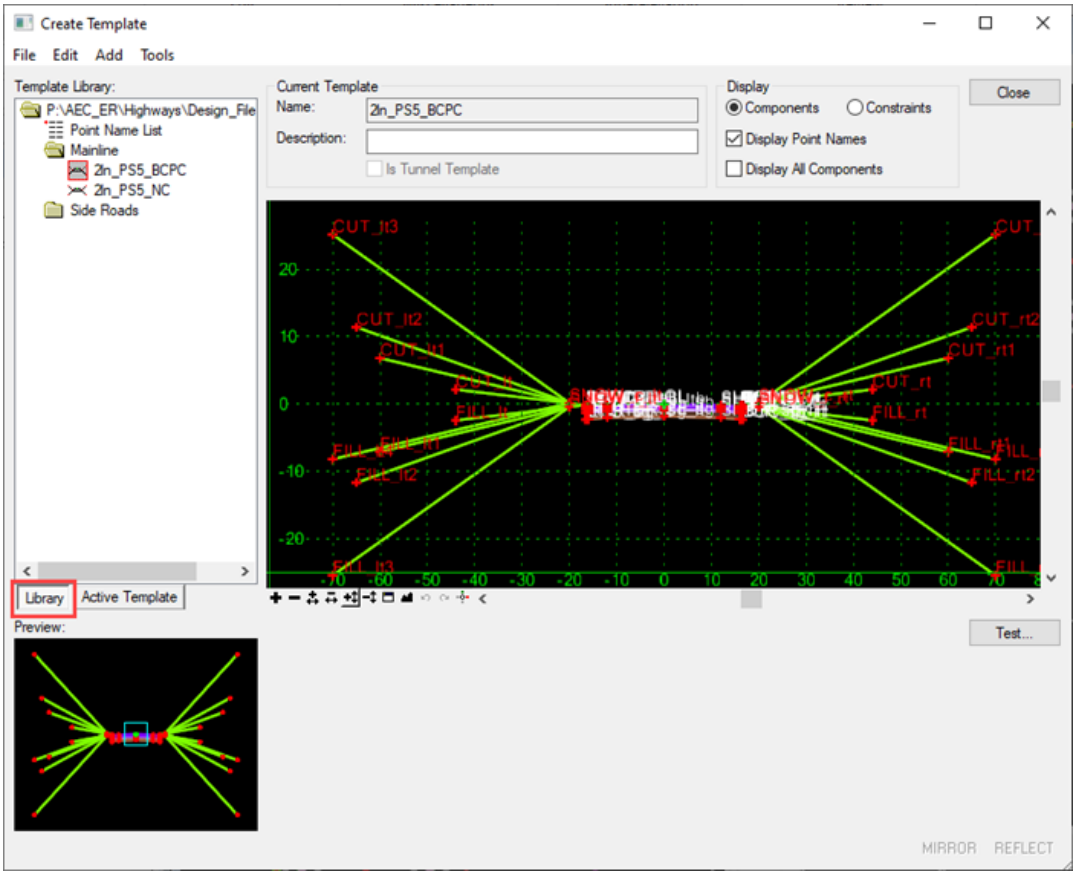

Figure 18 Roadway Template

3.2.2 Active Template

When this tab is selected, the Template Library area displays the contents of the active template as shown at right. The Active Template option is used to review and edit template points, components, and parameters in a table format.

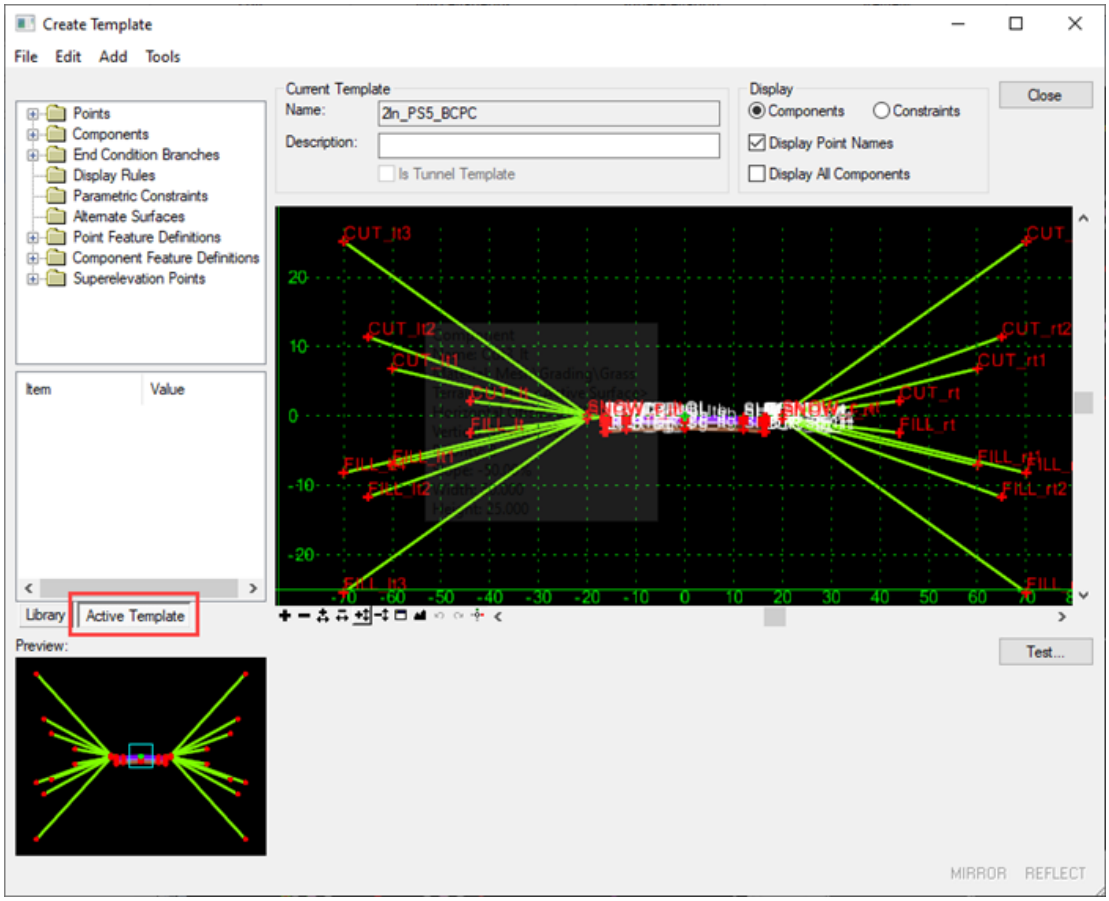

Figure 19 Active Template

3.2.3 Creating New Folders and Templates

Templates can be organized into folders in the Project Library. The Project Templates folder is intended to be used to create new folders and templates for a specific project.

- To create a new folder, right click on the Project Templates folder and choose the **New > Folder option**.
- To create a new template, right click on the folder and choose the **New > Template** option.
- You can also cut, copy and paste templates from the HWY folders to the desired Project Library folder.

3.2.4 Current Library

The right side of the Create Template dialog is used to display and edit the current template.

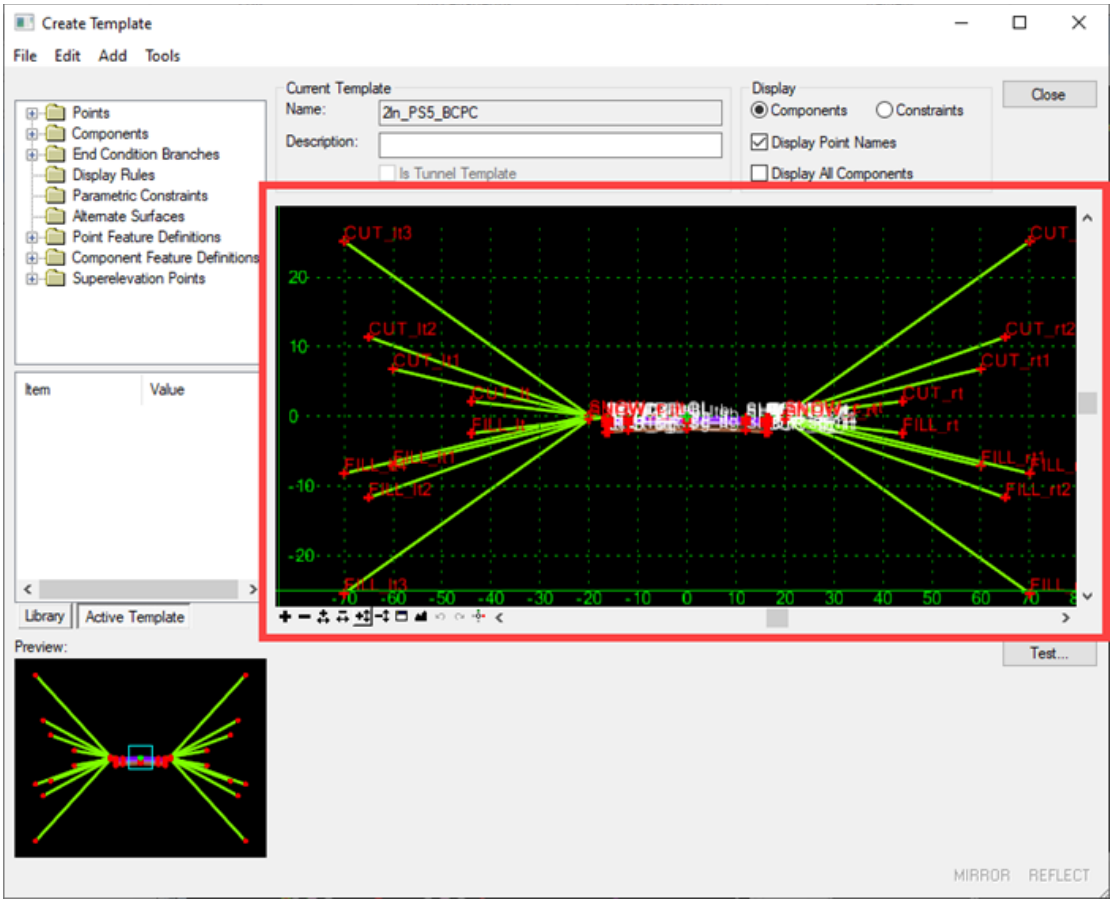

Figure Current Library

Name - Shows the name of the current template.

Description - Allows you to review/edit the current template description.

Display -

Components/Constraints - This option is used to set the display mode of the template. If Components is selected, then the template components are displayed. If Constraints is selected, then the point constraints for the template are displayed. Template points are always displayed.

Display Point Names - Toggle this option on to display the template point names.

Display All Components - When this option is checked on, any components that are "hidden" are displayed with dashed lines.

Current Template Window - The Current Template Window is used to display and edit the current template. The window uses its own graphics engine and is not a MicroStation view.

A magenta-colored box is used to designate the origin of the template.

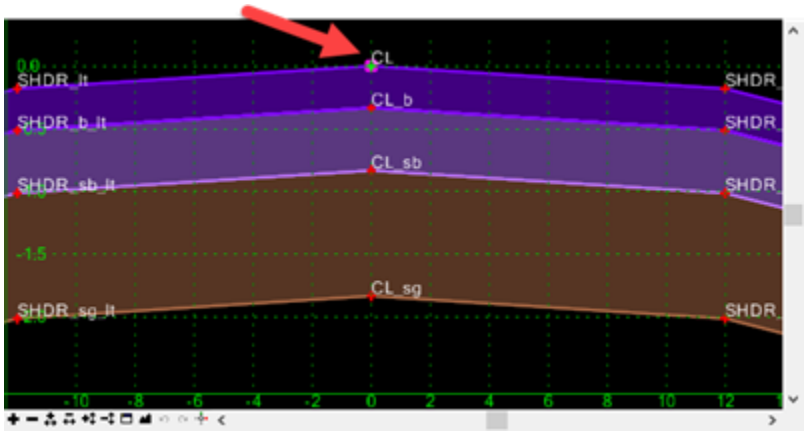

Figure 20 Origin of the template

At the bottom of the Current Template Window are view commands similar to the MicroStation view commands. The two buttons that look like MicroStation View Previous and View Next commands are undo and redo commands used on template operations. The CTRL-Z keyboard shortcut can also be used to undo the last template operation.

Within the **Current Template Window,** you can right-click to access commonly used template functions. You can also double click template components for editing purposes.

Figure 21 Current Template Window

Mouse Wheel Functions - The mouse wheel has the following functions when creating templates:

- Scroll the wheel to zoom in or out in the template window.
- Hold down the **Shift** key while scrolling the mouse wheel to zoom in or out in the vertical direction only.
- Hold down the **Ctrl** key while scrolling the mouse wheel to zoom in or out in the horizontal direction only.

Point Properties – Features can be reviewed and assigned in a variety of ways.

- The Name and Feature Definition can easily be edited the Point Properties dialog which is accessed by double-clicking the point in the Current Template window.

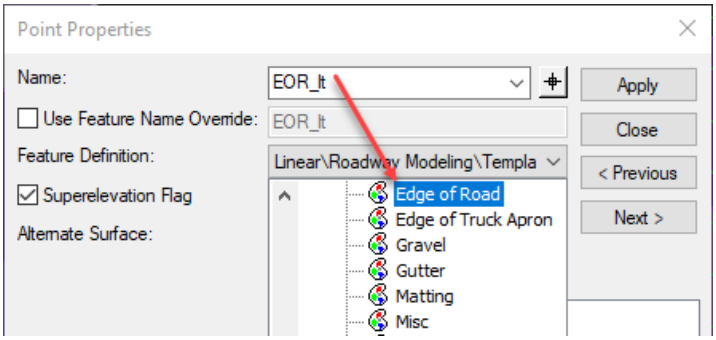

Figure 22 Point Properties

- The Dynamic Settings dialog can be used to define the Point Name that will be assigned to points as they are created. The Point Name field can be used to key-in a name for the point or to select a name from a predefined list as shown at right. It is recommended that you use the point names from this list when designing your templates. When a point name is selected from the list, the Point Style, which is the Feature Definition, is automatically set to the appropriate value. The Point Style list contains a list of all the Feature Definitions available in the CTDOT DDE.

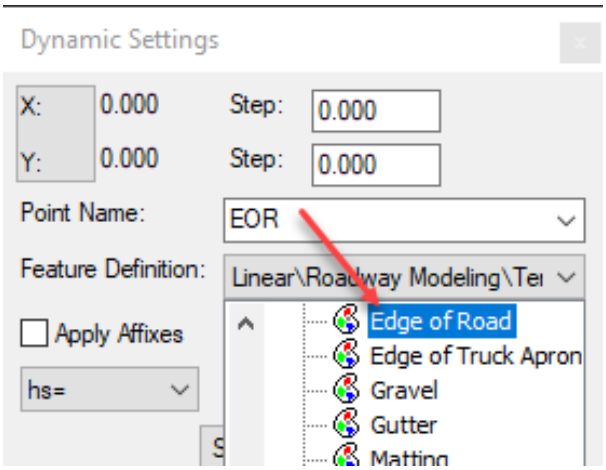

Figure 23 Point Name

3.2.5 CTDOT Point Names

An example of the standard point names with suffixes are listed below:

Point Name	Description
EOR	Edge of Road on Top Surface
EOR_b	Edge of Road on Pavement Base Course
EOR_sb	Edge of Road on Subbase
EOR_sg	Edge of Road at Subgrade
EOR_pa	Edge of Road on Processed Aggregate

List of Point Name (prefixes):

Prefix Point Name	Description
BCLC	Bituminous Concrete Lip Curbing
BCPC	Bituminous Concrete Park Curbing
BOC	Back of Curb
CC	Concrete Curb
CL	Centerline
CPC	Concrete Park Curb
CUT	Cut Slope Limit
DNC	Do Not Include
EOR	Edge of Road
FILL	Fill Slope Limit
GC	Granite Curb
GSC	Granite Slope Curb
SHDR	Shoulder
SNOW	Snow Shelf
TRWY	Travelway

3.2.6 CTDOT Component Names and Features

When creating new Components in the Template Library the Mesh Feature Definitions defined in ***CV_Highway_Features_Levels_ElemTemp.dgnlib*** should be used.

The component feature definitions can be reviewed by browsing to the following folder in the Civil Standards tab: ***Libraries > Feature Definitions > Mesh***

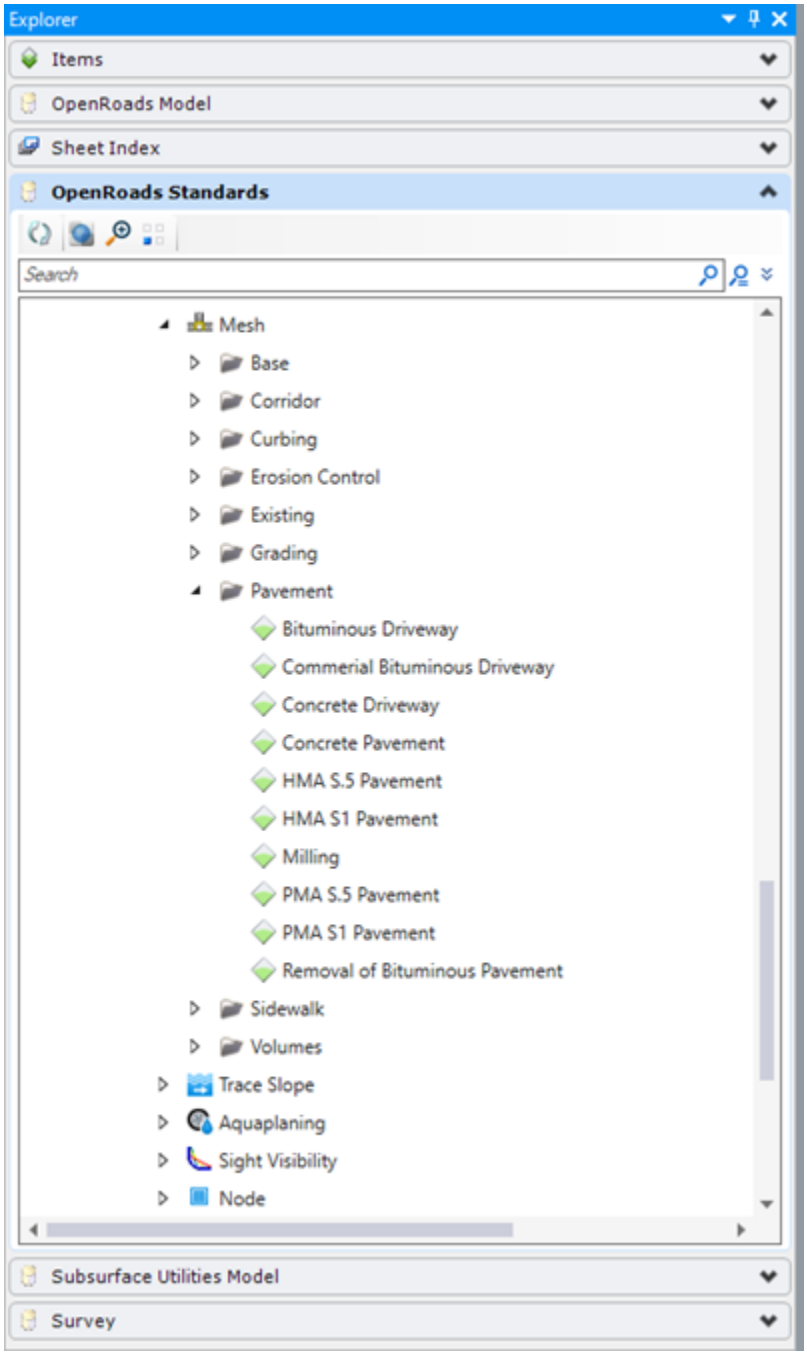

Figure 24 Component Names

Component Names and Features can be reviewed and edited by double-clicking on a component to open the Component Properties dialog.

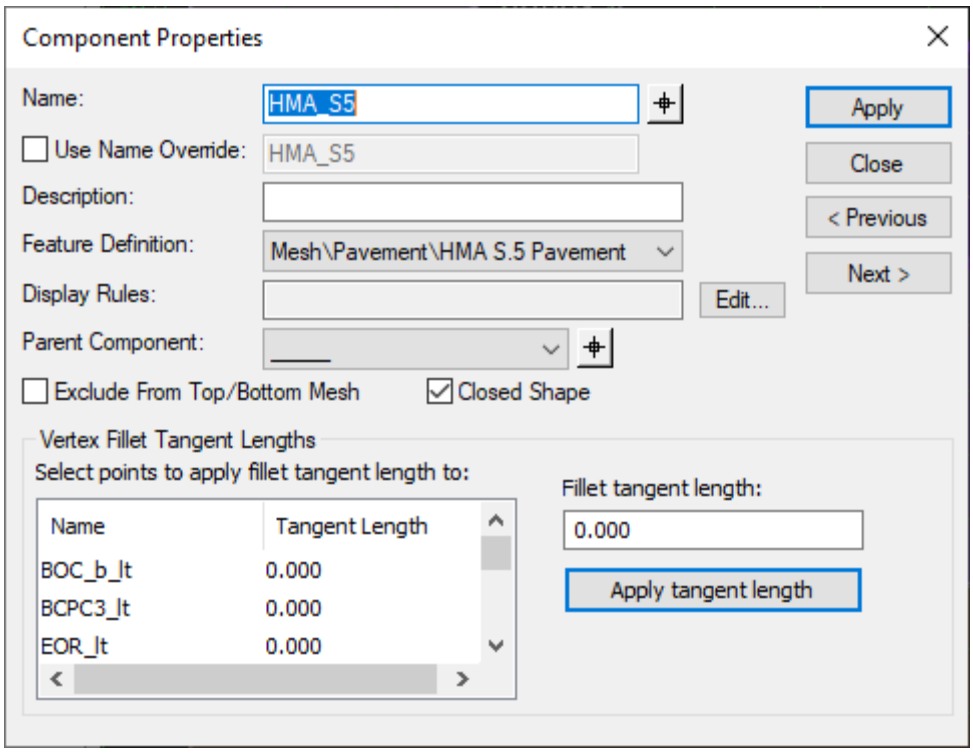

Figure 25 Component Properties

3.3 Template Points

When the template is processed using the corridor modeling command, the points of a template are connected to form breakline features. Each point will be connected longitudinally to the next template drop location to form 3D longitudinal breakline surface features. The breaklines are drawn using the symbology defined with the **Feature Definition** that is assigned to each point.

Since the template points are connected to generate the completed surface, establishing a standard name for template features that are used on each template is very important to the quality of the proposed design surface. For example, if a Shoulder point is named SHDR_lt on the first template, and it is named Shoulder_Left on the next, the software will not automatically connect these points to generate the breakline feature. **Following a point naming convention is important to obtain the best results with Corridor Modeling.**

It is equally important to ensure that the feature definition assigned to points is consistent from template to template.

Each template point name must be unique to the template. The software automatically appends a number to the point name if the same name is used during template creation.

There is no limit to the number of points in a template.

3.3.1 The Point Properties Dialog

The **Point Properties** dialog is used to review and edit various properties associated with the template points, including the definition of the point constraints. To access the **Point Properties** dialog, in the *Create Template* dialog double-click on the point in the **Current Template** window. The **Point Properties** dialog, shown below, is opened.

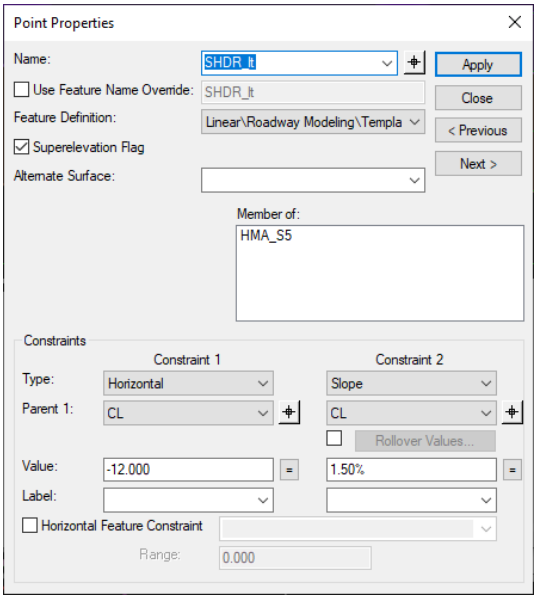

Figure 26 Point Properties

The dialog contains the following options:

Name displays the point name. The point name can be keyed-in or selected from the drop-down list. If the point name is selected from the list, the corresponding Feature Definition is automatically assigned. Point names must be unique to the template.

Use Feature Name Override displays the name of the feature that will be created in the surface to correspond to the point. This field is optional. If it is blank, then the point name will be used as the feature name.

- The option is intended primarily for end condition components to create connectivity from one station to the next when the template end conditions change. For example, if you want all surface tie-in points to belong to one feature, then set the feature name of all the ending end condition points on each side of the template to the same name (i.e. all Cut and Fill end points on the right would be given the feature name R-Tie and all the ones on the left would be given the feature name L-Tie).
- If the point has a Feature Name Override defined, the point name is displayed in red in the Template window.

Feature Definition is used to define the feature definition of the point. If no style is specified, then it comes from the first component of which the point is a member.

Superelevation Flag is used to identify the point as a candidate to be used for assigning superelevation control lines. This option should only be toggled on for pavement points on the surface of the pavement.

Alternate Surface allows you to specify the name of an alternate surface for a point. You may choose multiple alternate surface names. Select from the list of available surfaces in the active template.

Member Of indicates in which components the point is included.

Constraints - The Constraints portion of the Point Properties dialog allows you to review/edit the constraints on a point.

- Type specifies the constraint type: None, Horizontal, Vertical, Slope, Vector-Offset, Project to Surface, Project to Design, Horizontal Maximum, Horizontal Minimum, Vertical Maximum, Vertical Minimum, Angle Distance. The constraints are described in more detail below.
- Setting up the appropriate constraint types is critical to achieve the desired results when pavement layers, superelevation, and transitioning are introduced to the design.
- Label displays the optional label for the constraint. Constraints that are labeled can have their value changed during design processing. The same label name can be assigned to more than one constraint and more than one point. See Section 10.4 for details.

- Horizontal Feature Constraint is used to allow a point to target elements in the design file that are defined with the specified Feature Definition within a specific Range. Use of this option is not recommended.

3.3.2 Point Constraints

Point constraints are used to manage the behavior of points in a template. They are used so that if a point is moved in a template, either by the user editing the template or by the application of a horizontal or vertical control during design processing, all the points related to the point being moved behave in a rational and predictable manner.

For example, when a **Simple** component is inserted into the active template, it is comprised of four points which are connected to define the component as shown in the example below.

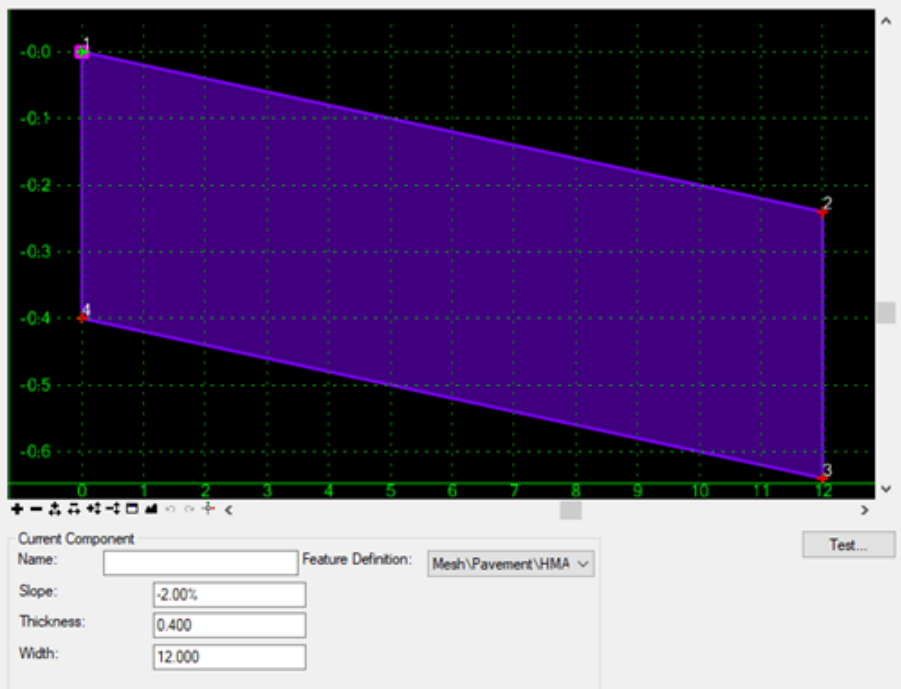

Figure 27 Point Constraints

The constraints for all the points in a template can be displayed by choosing the Display Constraints option on the Create Template dialog.

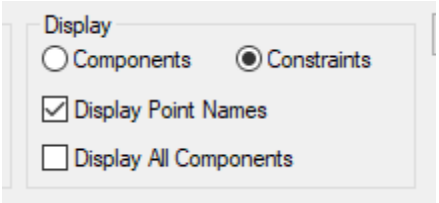

Figure 28 Display Constraints option

Three of the four points are constrained with relation to the insertion point. If the original insertion point is moved, the other three points move in relation to the first point.

- A point can have at most two constraints. If two constraints are defined, the point is said to be “fully constrained”. A point that is fully constrained is represented by a red plus sign. In the example above, points **2, 3,** and **4** are fully constrained.
- A point that is partially constrained, meaning that it has only one constraint on it, is shown as a yellow plus sign.
- An unconstrained point is shown as a green plus sign.

Point constraints are two-dimensional and one-way. Two-dimensional means that the constraints can only affect the points offset and elevation (x and y coordinates in the cross-section view). One-way means there is a child-parent relationship between points. In other words, if point 2 is constrained by point 1, point 1 is said to be the parent of point 2 and moving point 1 will affect point 2, but you cannot move point 2 to affect point 1. The example below shows a sample of this where the blue arrow indicates a parent/child relationship from point 1 to point 2:

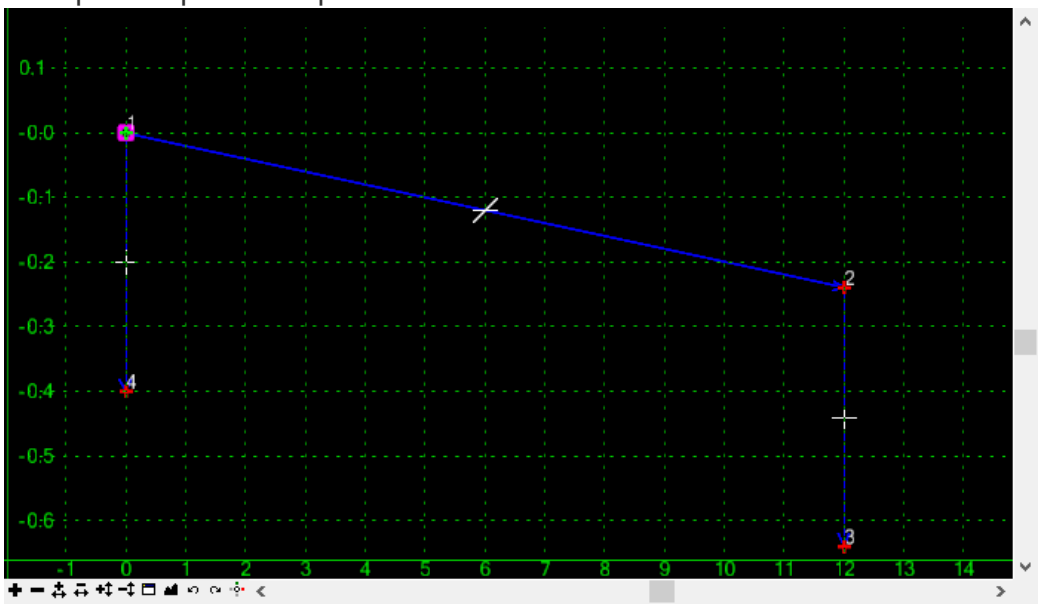

Figure 29 Point Constraints

Constraints are displayed as blue lines between the parent and the child point. At the midpoint of the constraint line, there is a short white line designating the constraint type as follows:

- Horizontal line = Horizontal Constraint
- Vertical line = Vertical Constraint
- Sloped line = Slope Constraint

Multiple lines will be shown for points with two constraints.

Floating the cursor over a point will temporarily display an arrow designating the direction of the constraint (the arrow points to the child point) and a pop-up menu displaying information about the point.

3.4 Point Constraint Types

Horizontal - The child point remains at the given horizontal distance from the parent point.

- In the example above, point B has been constrained to point A with one constraint as shown below.
- If point A is moved horizontally, point B will maintain its relative distance from point A.
- If point A is moved vertically, point B is unaffected.

Vertical - The child point remains at the given vertical distance from the parent point.

- In the example above, point B has been constrained to point A with one constraint as shown below.
- If point A is moved horizontally, point B is unaffected.
- If point A is moved vertically, point B will maintain its vertical relationship to point A.

Slope - The child point will maintain the given slope from the parent point.

- In the example above, point C has been defined with a Horizontal and a Slope constraint as shown below:
- Slope constraints are absolute. Slopes going from lower-left to upper-right are positive regardless of whether the child point is to the left or right of the parent.
- Slope constraints can also have Rollover Values assigned to them. Rollover values are used to set the slope constraint based on variety of high side and low side slope parameters. A Reference Point is specified which defines the controlling slope to the parent point.
- The example above documents the Rollover Values can as defined in CTDOT's example templates for the shoulder break point behavior. See the online help for more information on the available parameters.

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

Horizontal Minimum - The child point has two parent points and remains at the given horizontal distance from the parent point that is farthest to the left (has the minimum horizontal or X value).

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

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

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

Project to Surface - This constraint must be used in conjunction with one of the previously define constraints. The other constraint will define the projection direction. The child point will then be projected to the surface with the name or parametric label given when the design is processed. If the surface does not exist, or no solution is found, then the point will remain where it is placed in the template.

Project to Design - This constraint is like the Project to Surface, except that the point is projected to the design surface of the template. A projection value is given to indicate whether the projection is to be to the left or to the right. The point must also be constrained by one of the previous constraints, excluding the Project to Surface, so that a direction for the projection may be determined. A negative value limits the projection to the left of 0; a positive value limits the projection to the right. A value of 0 will seek to the left and to the right of 0 to project the point. If no solution is found, then the point will remain where it is placed in the template.

Angle Distance - This constraint takes two parent points, a distance, and an angle. The selected point is then fully constrained to the location defined by the first parent, and the angle from the first parent relative to the vector defined by the two parent points. This constraint creates a rigid-body rotation. When selected, no other constraint types are available.

3.4.1 Editing Points with the Left Active Template Window

In addition to the Point Properties dialog, points can be edited from a pop-up menu that is accessed by right-clicking on a point in the **Active Template** window. The menu is shown below.

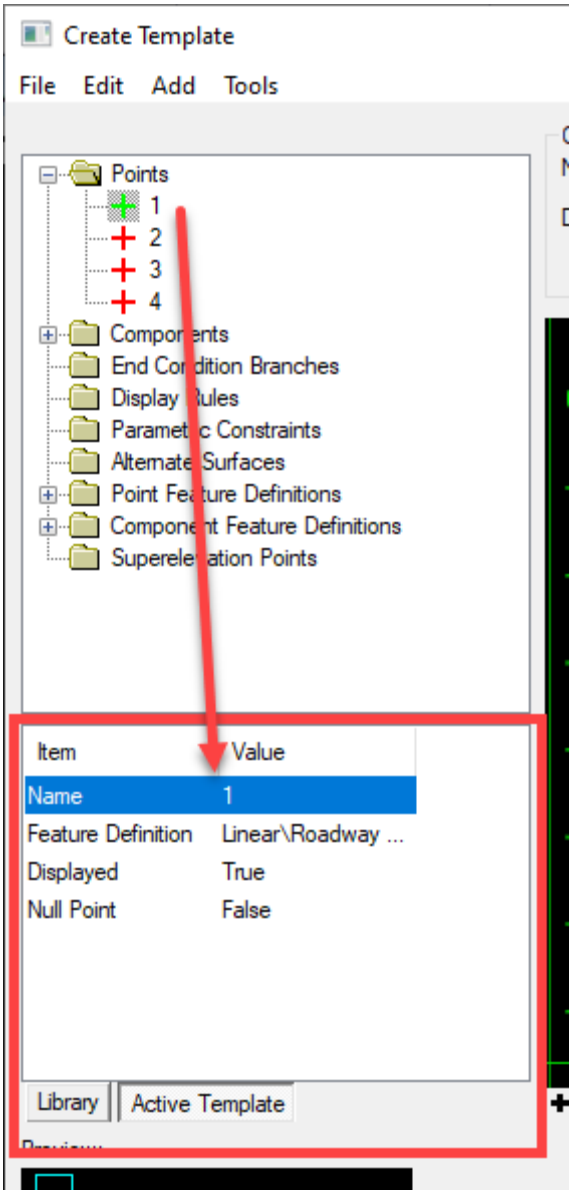

Figure 30 Editing Points with the Left Active Template Window

3.4.2 Null Points

A null point is a template point that is purposely not related to any particular component. It's most often used as a reference for controlling other points. To create a null point, right-click in the current template window and select ***Add New Component > Null Point***, or select ***Add > Null*** Point from the pull-down menu of the *Create Template* dialog to initiate the command.

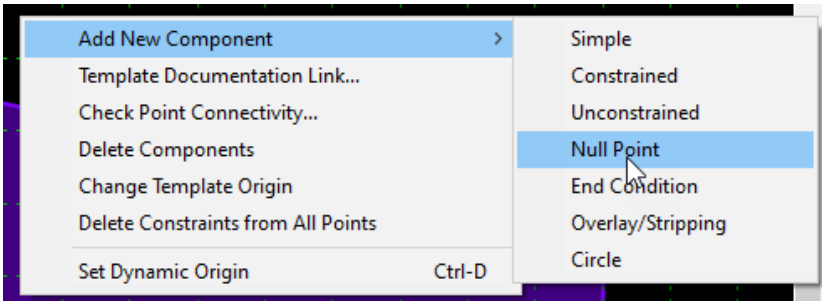

Figure 31 Null Points

3.4.3 Testing Point Controls

The behavior of fully constrained points can be tested by right-clicking on the point and selecting **Test Point Controls** as shown below. Select the desired option to test the behavior of a template as the point is moved either horizontally, vertically, or both at the same time.

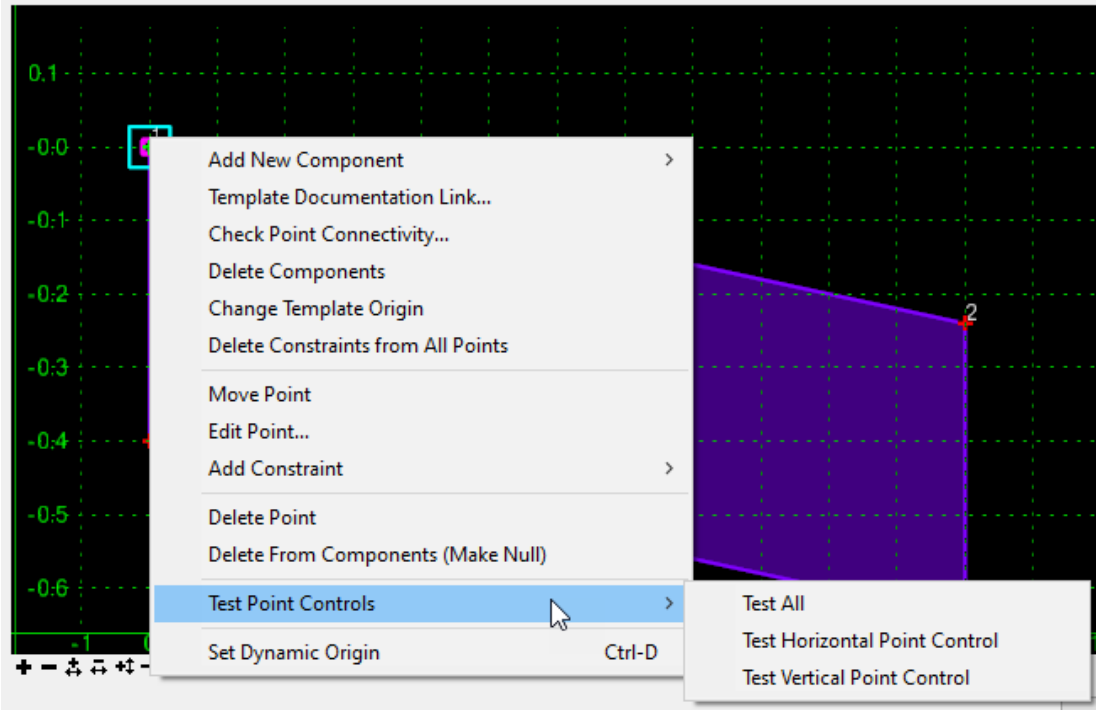

Figure 32 Testing Point Controls

3.5 Template Components

A component is a set of points that define an open or closed shape. Each component, whether open or closed, can represent a different material or area of interest. Components are named and have an assigned feature style. Component types are described below:

Simple Components - A simple component typically represents a section of pavement. It's a closed parallelogram (4 constrained points) that is defined by the slope and thickness.

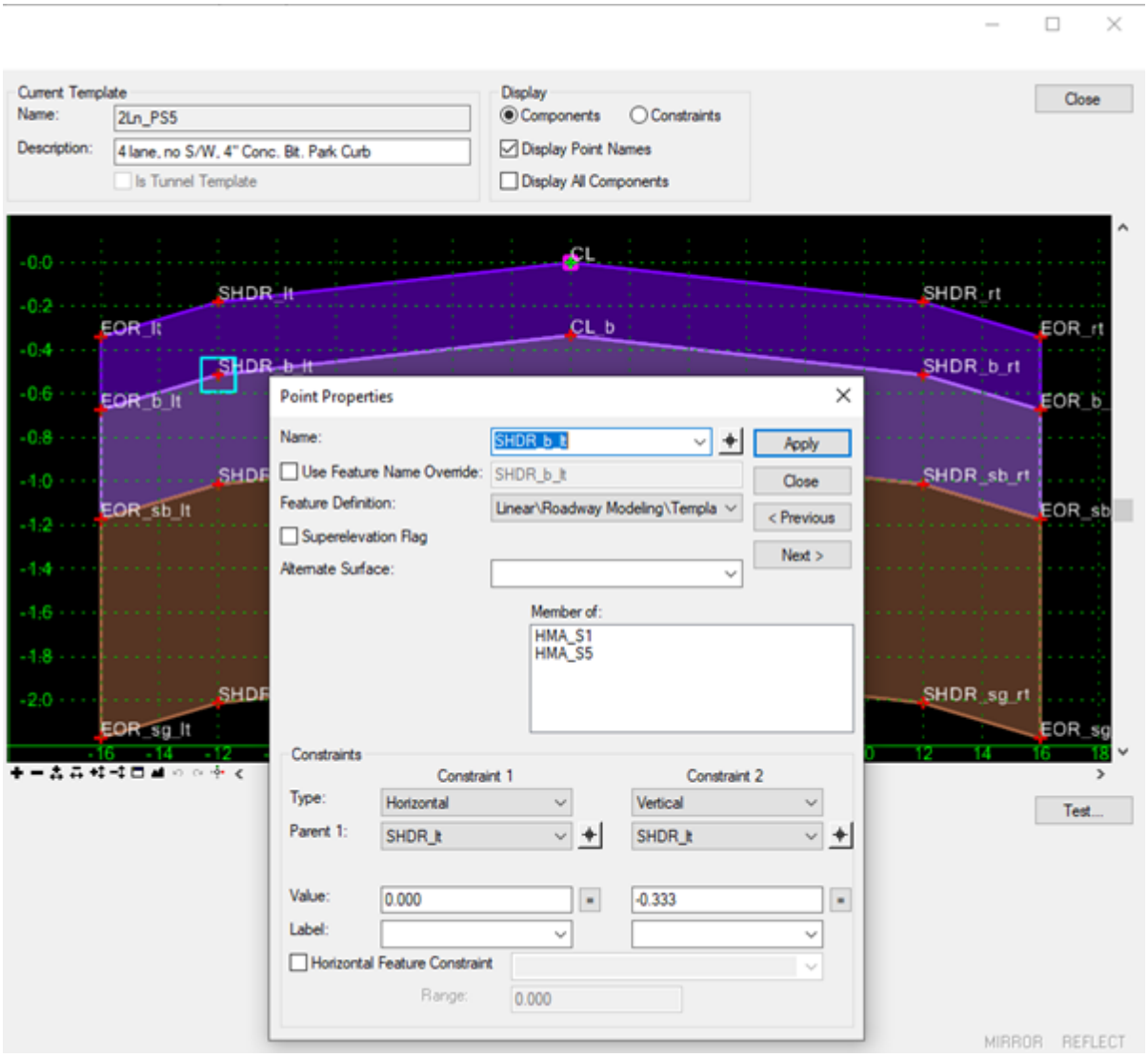

Figure 33 Template Components

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

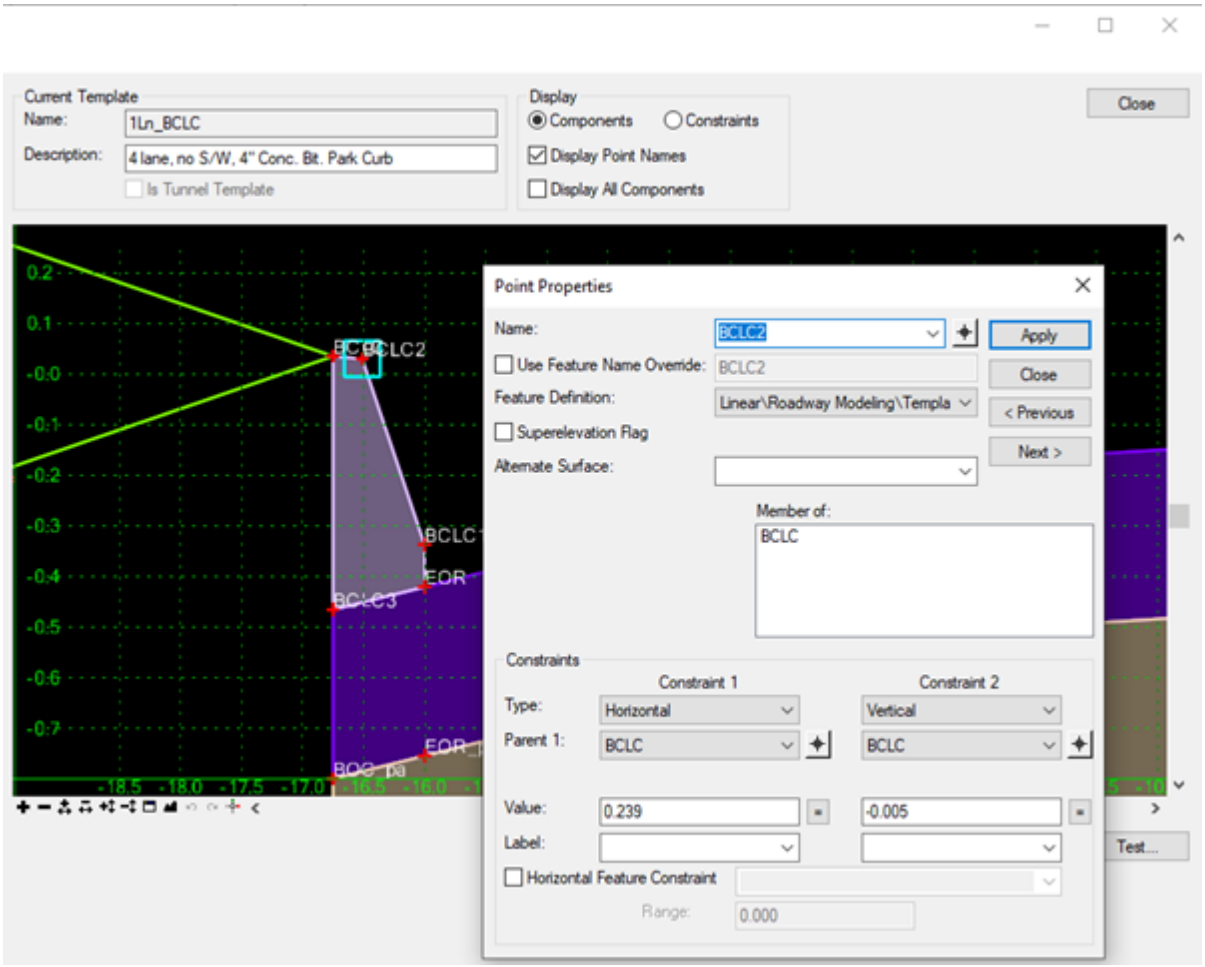

Figure 34 Constrained Components

Unconstrained Components - An unconstrained component is open or closed-shaped with no movement restrictions. Moving one point has no impact on the other points that make up the component.

Null Point - A null point is a template point that is purposely not related to a specific component. It's most often used as a reference for controlling other points.

End Condition - An end condition is a special open-shaped component that targets a surface, an elevation, or an alignment. End conditions are typically used to define cut and fill slope solutions.

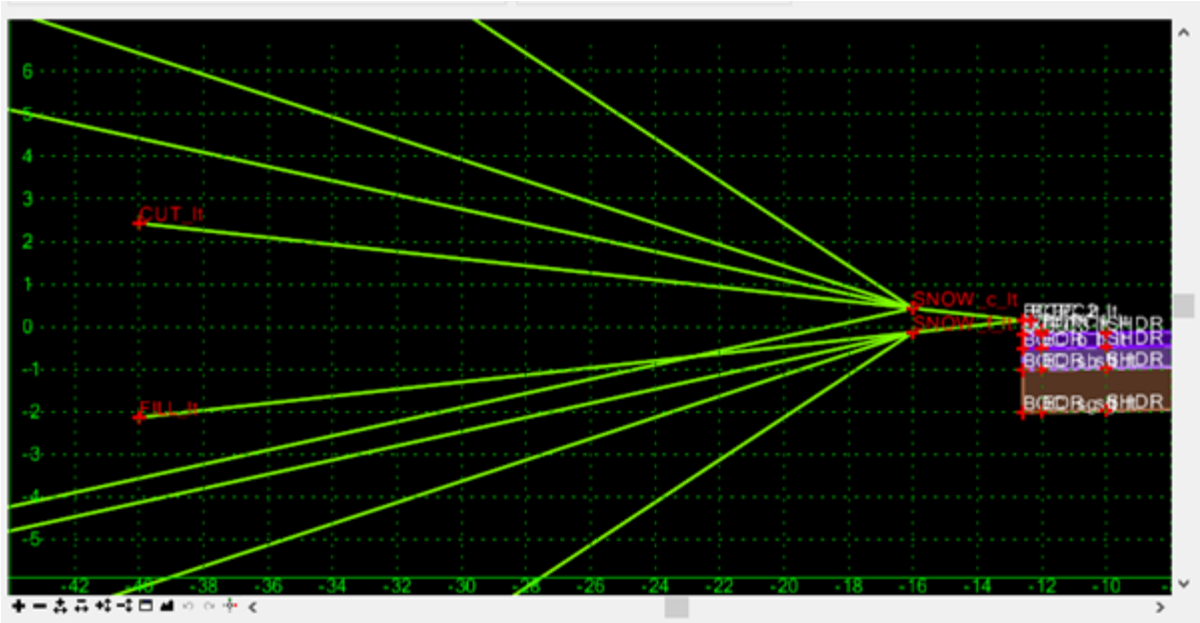

Figure 35 End Condition

Overlay/Stripping Components - A specialized component type that is used for defining pavement planning and overlay materials.

3.5.1 Creating Template Components

CTDOT provides an example template library that contains several commonly used components. These components can be used to build templates. It may also be necessary to make specialized components to meet specific project requirements.

To create a simple component, right-click in the active template window and select **Add New Component > Simple**, or **select Add > Simple** from the pull-down menu of the Create Template dialog to initiate the command.

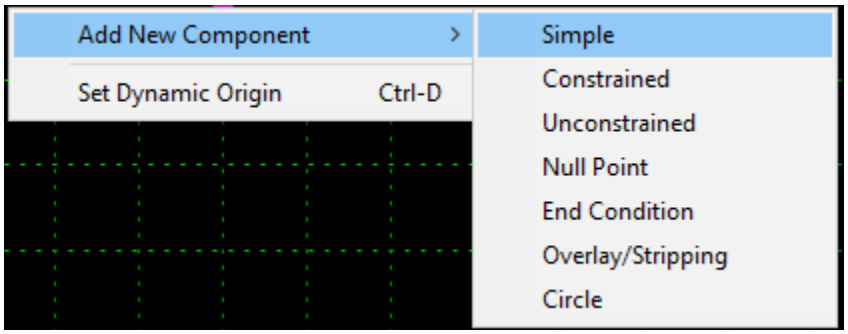

Figure 36 Creating Template Components

As new components are created, the Current Component portion of the Create Templates dialog is used to define the Name, Style, and any other relevant parameters for the component type being created. A simple component consists of four points defined by **Slope, Thickness, and Width**. The top points are constrained by **Horizontal** and **Slope** constraints. The lower points are constrained to the points directly above them by a **Horizontal** and **Vertical** constraint.

Define the **Name, Slope, Thickness, Width, and Feature** of the component before placing the component in the template.

The **Feature** is used to set the symbology for the graphics drawn to represent the component in the 3D model.

The *Dynamic Settings* dialog is used to facilitate component placement. The point names are derived from the **Point Name** selected in the *Dynamic Settings* dialog. Each point is appended with a number that is incremented. The points are assigned the **Point Style** feature that is active in the *Dynamic Settings* dialog.

Point names and the feature that is assigned to each point should be reviewed and edited after the component is placed.

In the example below, a simple component is created representing a single lane of pavement.

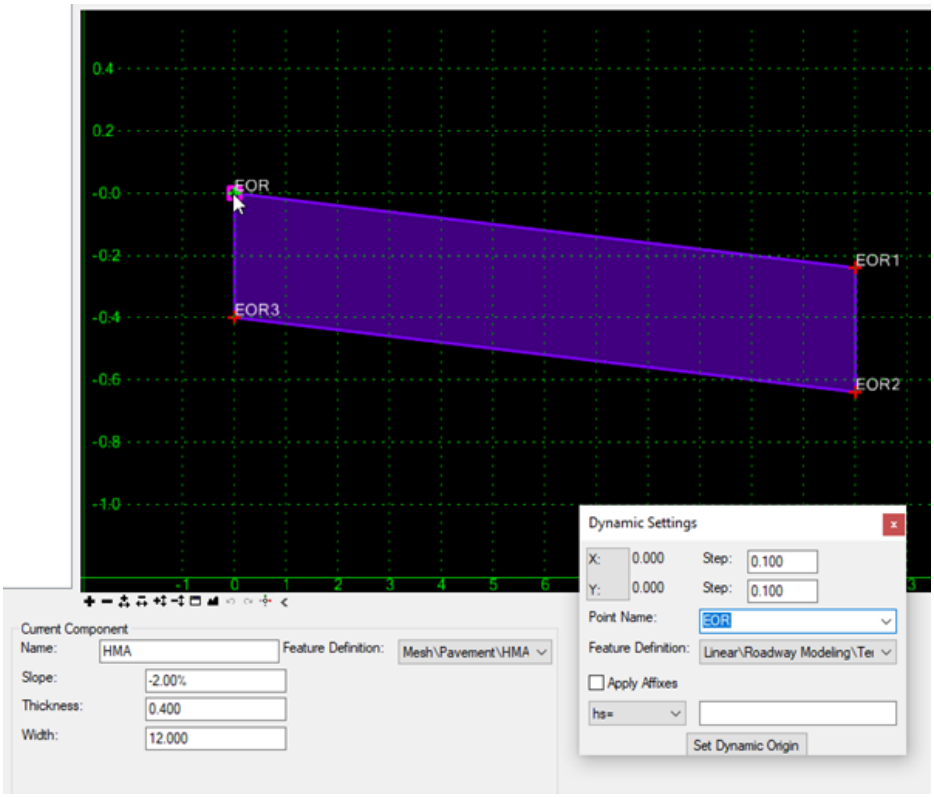

Figure 37 Dynamic Settings

Before placing the component in the template, various options are available to control how the template is placed by right-clicking in the template window to reveal the menu shown below.

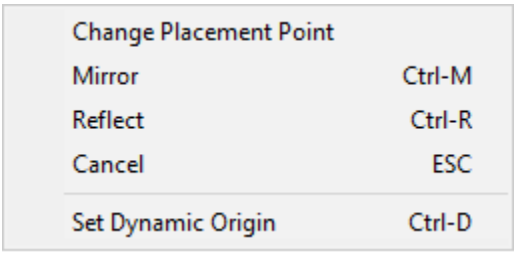

Figure 38 template placed by right-clicking

- **Change placement Point** can be used to change which component point is used as the point placed at the point you specify. Each time this command is selected, the placement point will move in a clockwise direction to the next point in the component.
- **Mirror** will create the original component as well as a mirrored component reflected horizontally about the template origin.
- **Reflect** will create a single component reflected about the template origin.

- The **Mirror** and **Reflect** options are toggles that are turned on or off and remain active. The on/off status of the **Mirror** and **Reflect** options is displayed at the bottom right corner of the Create Templates dialog.
- Select **Set Dynamic Origin** to set the location of the dynamic origin. The dynamic origin is indicated by the purple box in the template display window.

Creating Constrained and Unconstrained Components

Constrained or **Unconstrained** components can be used to create any open or closed shapes in the template such as curbing, median barriers, retaining walls, or complex pavement situations such as the shoulder break on the high side of superelevation.

Constrained Components

To create a constrained component, right-click in the current template window and select ***Add New Component > Constrained, or select Add > Constrained*** from the pull-down menu of the Create Template dialog to initiate the command. When constrained components are created, both horizontal and vertical constraints are applied to each point.

Unconstrained Components

To create an unconstrained component, right-click in the current template window and select ***Add New Component > Unconstrained, or select Add > Unconstrained*** from the pull-down menu of the Create Template dialog to initiate the command. When unconstrained components are created, no constraints are applied. This option is useful when you wish to define constraints other than Horizontal and Vertical constraints.

Dynamic Settings

The *Dynamic Settings* dialog can be for precision input when creating the component. In the example below, point **EOR** will be created at a defined horizontal distance and slope from point **CL** using a horizontal distance of 12 and a slope of -1.5% by using the **hs=12** option with a value of **12, -1.5%.** Use the **Enter** key to execute the command.

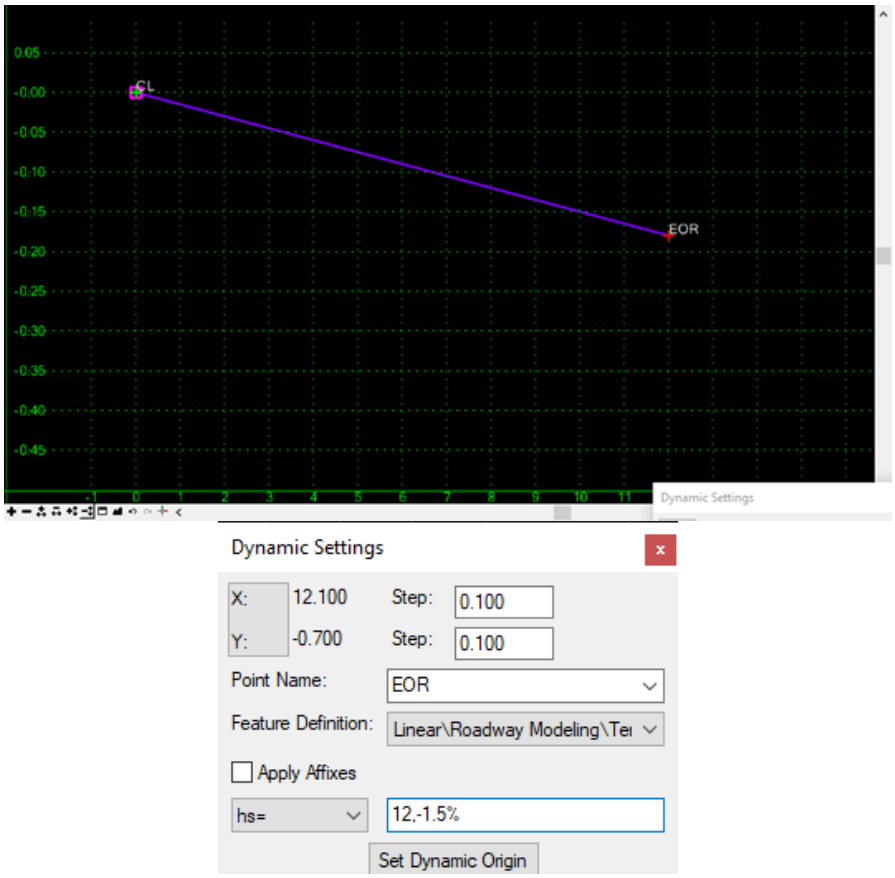

Figure 39 Dynamic Settings

Right-click in the current template window at any time during the component creation process to access the menu shown below:

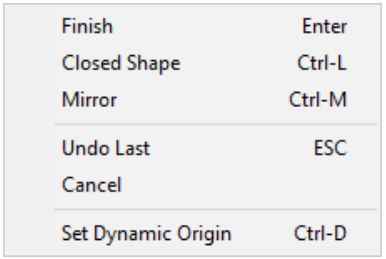

Figure 40 Right-click Menu

- Select Finish when you have completed creation of the component.
- Components can be created as open or closed shapes. To toggle on/off the option to placed closed shapes, select **Closed Shape**.

- Select **Mirror** to create two components at the same time. The second component is a mirror image of the one you are defining. The component is mirrored about a vertical line passing through the **Dynamic Origin** location.
- Select **Undo Last** to undo the last point that was added to the component.
- Select **Cancel** to terminate the component creation process.
- Select **Set Dynamic Origin** to specify the location of the dynamic origin.

3.5.2 Drag and Drop Component Operations

A previously created template component can be included in the active template by use of drag and drop operations. Select a previously drawn component from the active template library and drag the component into the **Current Template** window. The component dynamically floats on the cursor. Release the mouse button to drop the component at the desired location.

While dragging the component in the **Current Template** window, right-click anywhere in the **Current Template** window to access the placement options discussed previously (**Mirror, Reflect,** etc…)

When connecting two components by dragging a component into the active template, the connecting point will change to a white colored plus sign prior to placing the component to indicate that the points are coincident. The point name from the previously placed component will be retained. Point names can be edited at any time during the template creation process.

1. In the example below, a new blank template is created **New Template1**, this will be built with a left template having one lane and a right template having 2 lanes.
2. The Left side of the road is placed by dragging in the **1Ln_BCPC** component. It is dropped with **Apply Affixes** at the origin in the active template.
3. The right side of the road is then placed with the **Mirror** option is turned on, with **Apply Affixes** also toggled on, **2Ln_BCPC** component is also dropped at the origin.

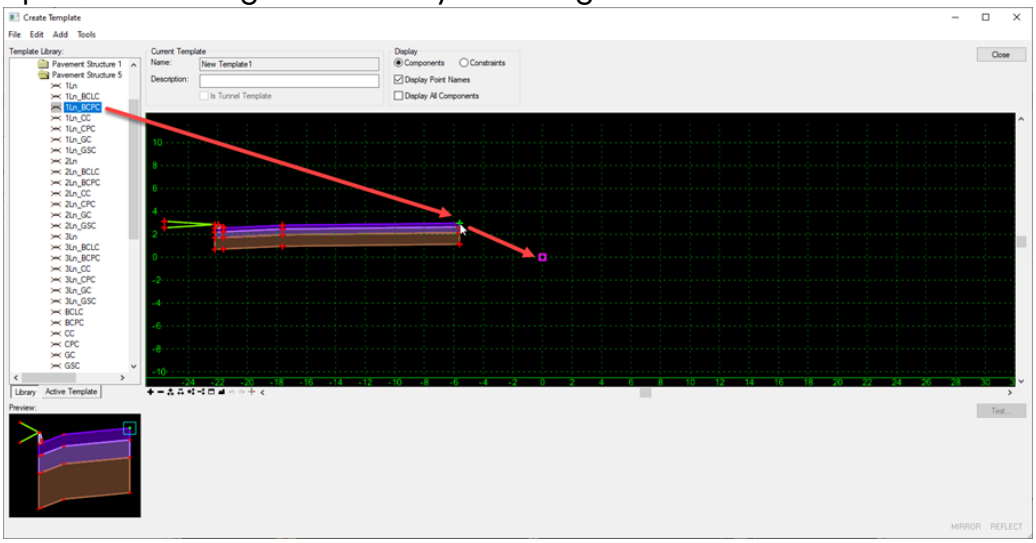

Figure 41 Create Template Drag Over

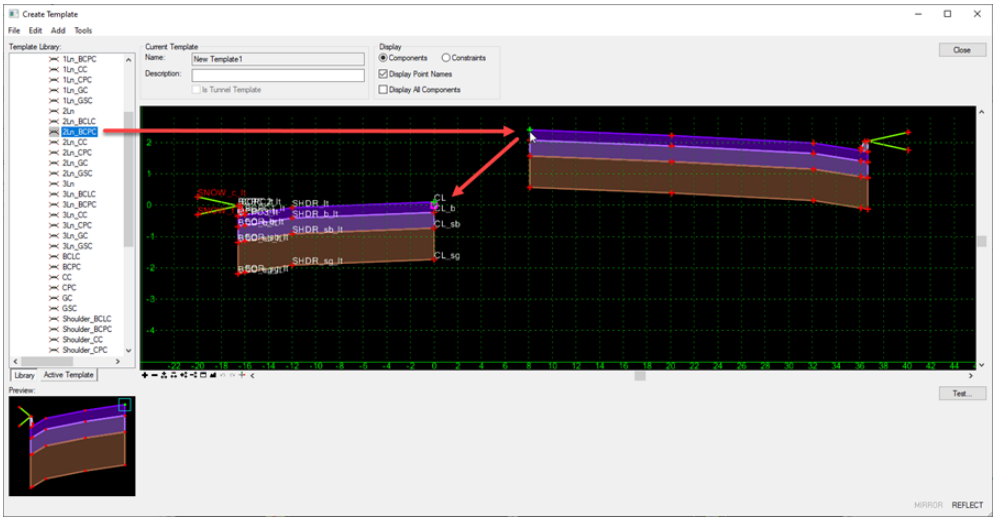

Figure 42 Create Template Drag In

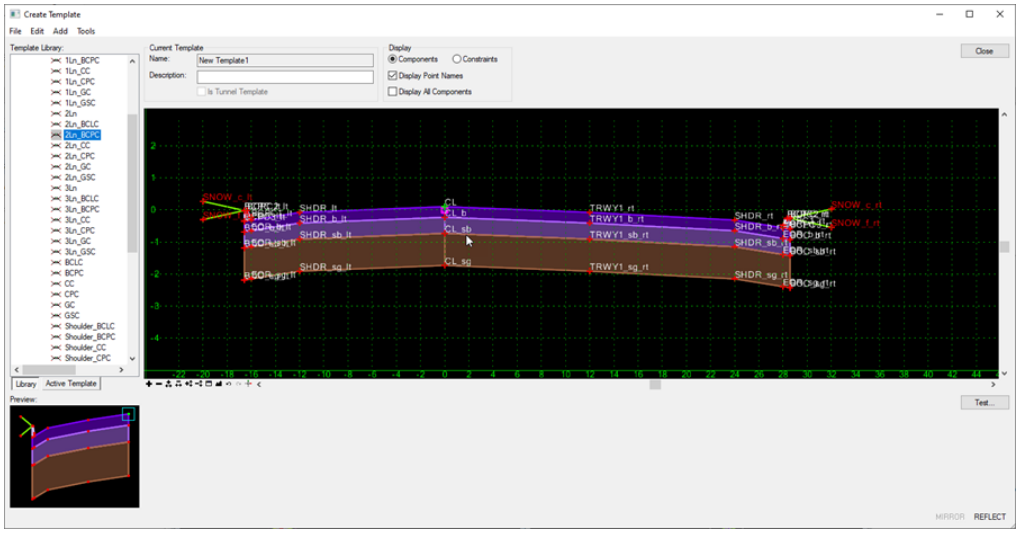

Figure 43 Create Template Drop

3.5.3 Affixes

The **Apply Affixes** option is used to add a user defined prefix or suffix to the point name. In the example below a simple component was added with the **Mirror** option toggled on (as the component is being placed, right-click to reveal a menu to choose the **Mirror** option). The prefix of "lt-" is applied to the points on the left side of the template. The prefix of "rt-" is applied to the points on the right side of the template.

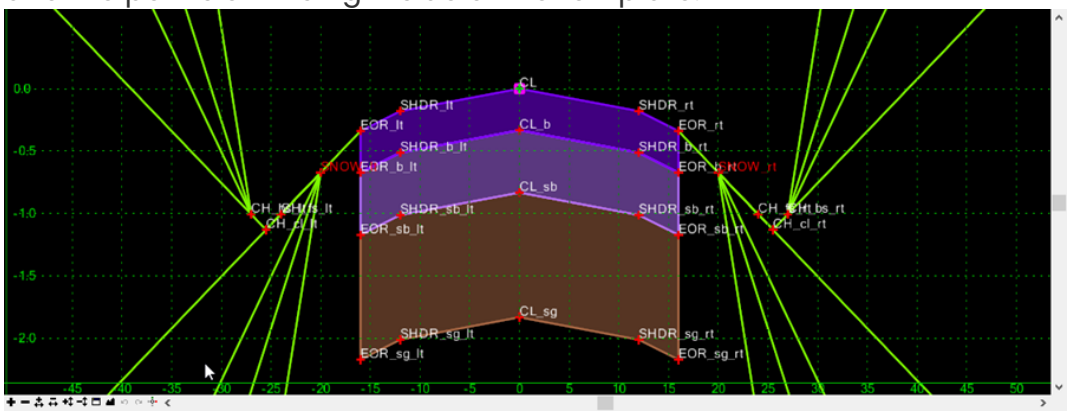

Figure 44 Apply Affixes

The affixes are defined in the Template Options dialog.

Tip: As a rule, affixes should not be applied to templates that contain individual components that will be used as "building blocks" for complete roadway templates. This is because the component maybe used on either the left or right side of the template. Affixes should always be applied when creating completed templates for use with Roadway Designer.

Note that all the points of the component are named using the currently defined **Point Name**. After the component is placed, it is necessary to rename the points and assigned feature definitions to ensure that the points and 3D line strings are drawn using the appropriate standards. This can be done by double-clicking on each point to access the *Point Properties* dialog shown below.

The **Name** can be typed in or selected from the drop-down list. If the **Name** is selected from the list, the associated **Feature Definition** is automatically defined. The Point Properties dialog is covered later in this document.

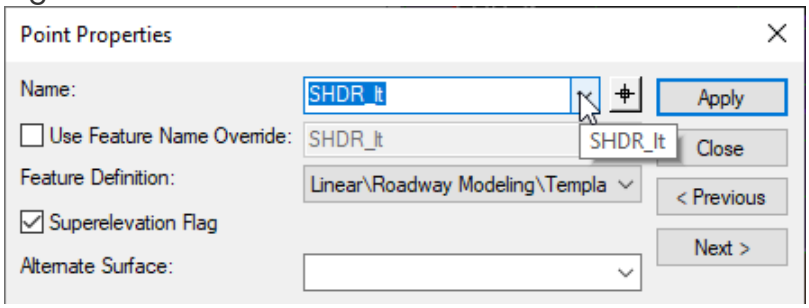

Figure 45 Point Properties

3.5.4 Merge Components

Deletes all the shared point line segments of two overlapping components and merge them into the selected component. The second component is deleted. Access this command with a right-click over a location that is above line segments from two overlapping components. The dialog appears only when 2 or more components share a common line.

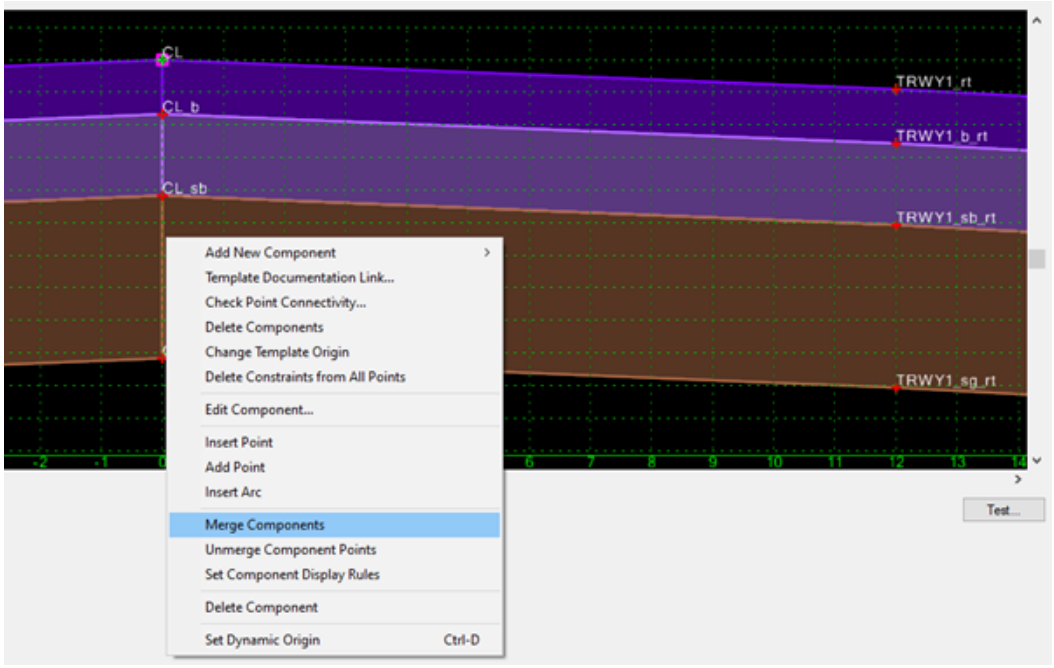

Figure 46 Merge Components

3.5.1 Component Editing

The properties of the component can be edited by double-clicking on the component. The Component Properties dialog is opened.

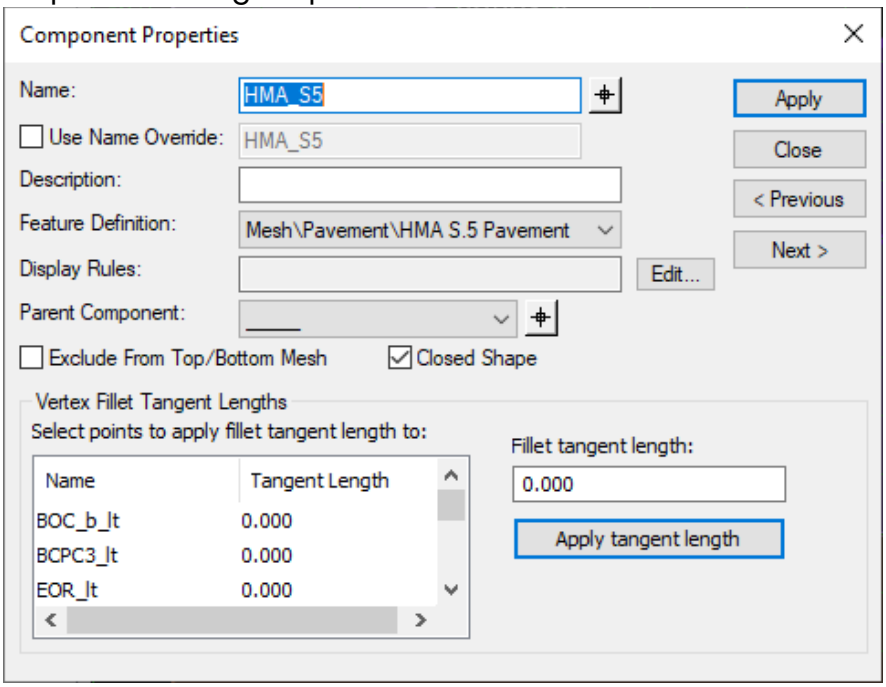

Figure 47 Component Editing

Name - Specifies the name of the current component. Select a different component using the locate button.

Use Name Override - The name override is used to specify the name used by the software to connect components from one template drop location to the next.

The option is intended to create connectivity from one station to the next when the template components change. For example, a template may contain more than one solution for a fill condition as shown below.

Two end conditions are defined for the fill slopes named R-FILL2 and R-FILL3. When the templates are processed, the software will evaluate each template drop location to determine whether the R-FILL2 or the R-FILL3 component is used. 3D Mesh elements are created by connect all the components by the name of the component. All the components named R-FILL2 will be connected to create 3D Mesh element, and all of the components named R-FILL3 will be connected to create another mesh element. This leaves a gap in components at the locations where the fill slope transitions from 3:1 to 2:1 since the components named R-FILL3 will not be connected to the components named R-FILL2. The solution is to assign the same **Override Name** for each component.

Description - Specifies an optional description of the component.

Feature Definition - Specifies the feature style of the component. This option is used for display and also to define the component's material. CTDOT has defined a specific group of styles to be used for components prefixed with the word "Component". When the components are plotted in MicroStation, either as a 3D model, or as cross sections, the symbology defined by the selected Style is used. Care should be taken to select the appropriate style for each template component.

Parent Component - Specifies the parent component. If a component has a parent component, then it is only displayed if the parent component is displayed. The parent component can be either a non-end condition component, or an end condition component. Specify the component or identify it using the locate button.

The **Active Template** listing can also be used to display and edit the parent child relationship between points and components. In the example at right, the Components category is open to show the parent/child relationship between the **components** in the tree. Drag and drop operations can be used to move one component under another.

Note: The component names are listed alphabetically, not from top to bottom as drawn in the template.

Exclude from Top/Bottom Mesh - Specifies that the component will be excluded from the top and bottom mesh elements that are created in the corridor modeling process.

Close Shape - This option is only available for non-End Condition components. Only closed shapes can be used to compute component quantities.

In this example the components were merged so the **Name** needs to be edited to remove the **_lt** suffix.

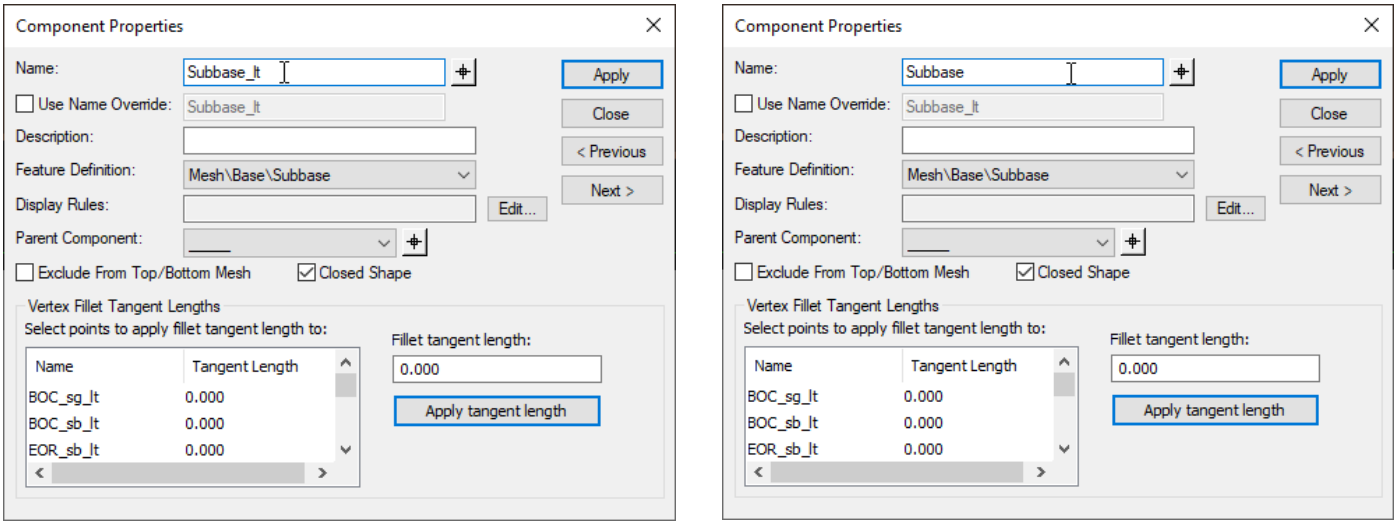

Figure 48 Close Shape

3.5.2 End Conditions

An end condition is a special open-shaped component that targets a surface, a feature of a surface, an elevation, or an alignment. End Conditions are commonly used for cut and fill definitions. End Conditions are added to the end of simple, constrained, or unconstrained components.

To create an end condition, right-click in the template window and select ***Add New Component > End Condition***, or select ***Add > End Condition*** from the *Create Template* dialog's pull-down menu.

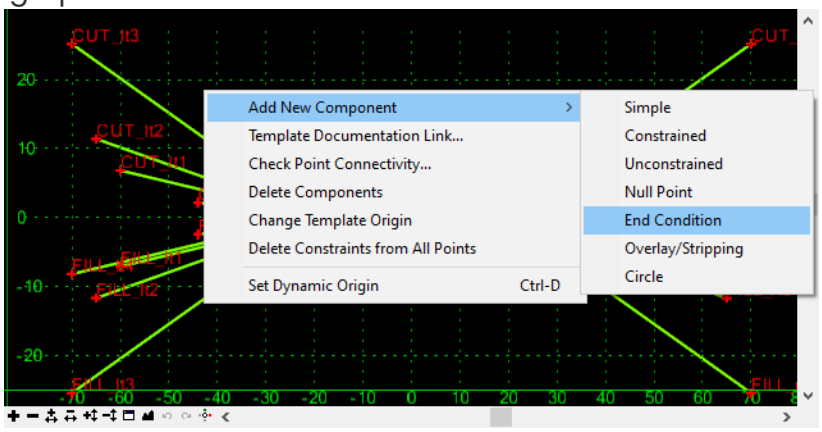

Figure 49 End Conditions

When adding an end condition to the current template, the **Current Component** portion of the Create Template dialog displays the following options:

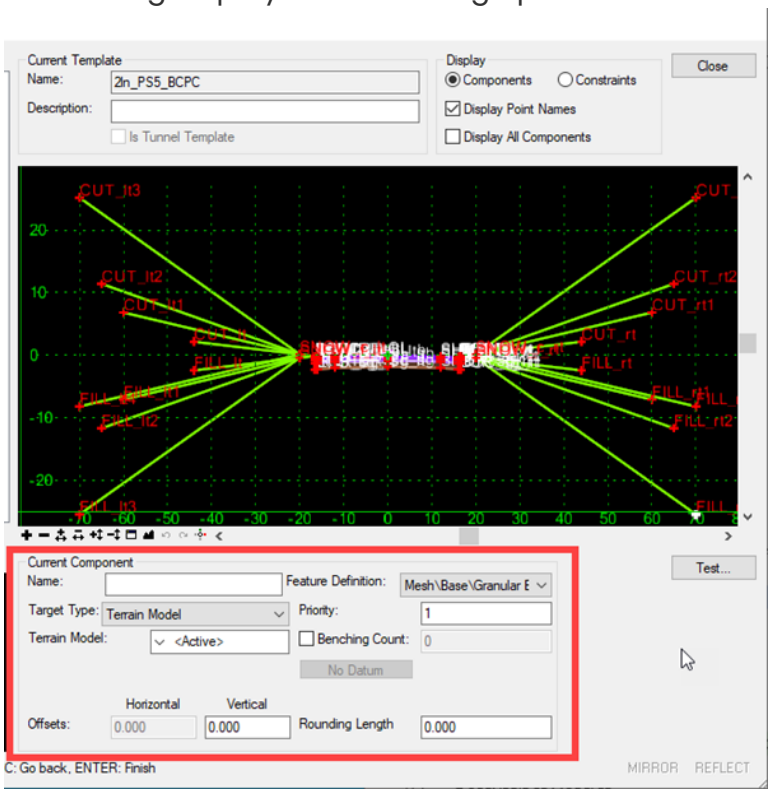

Figure 50 Current Component

The **Name** field is used to specify the user defined name for the component.

The **Feature Definition** is used to set the feature definition for the component.

Target Type specifies the type of target the End Condition is seeking. Targets include:

- Terrain Model – Seeks an OpenRoads Terrain Model.
- Elevation – Seeks a particular elevation.
- Linear Horizontal/Vertical/Both – Seeks the intersection with a particular linear element selected from a list.
- Feature Definition Horizontal/Vertical/Both – Seeks the intersection with a particular feature type.

Horizontal Offset specifies a horizontal offset from the target. This option only applies if the target is a horizontal target or has a horizontal aspect.

Vertical Offset specifies a vertical offset from the target. Applies only if the target is a vertical target or has a vertical aspect. For an elevation target, specify the elevation here.

Priority specifies the order in which end conditions are attempted in seeking a solution. Where more than one End Condition starts at the same point, this value determines the order in which End Conditions are attempted to find a solution. Lower numbers, which have a higher priority, are attempted first.

Benching Checkbox indicates, when on, the set of segments of the End Condition are repeated until a solution is found.

Benching Count indicates the maximum number of times that benching should occur. If this value is 0, then the repeat count is unlimited, and the benching End Condition must find its target for it to be valid. If any other number is entered, then if the benching is repeated for the specified count and if the target is not reached, the benching End Condition will still be considered successful if an End Condition attached to the end of the benching End Condition is successful.

From Datum indicates, when on, the benching will use a datum elevation and step elevation to set the benching rather than using the End Condition segments as they are defined.

Datum Elevation specifies the elevation that represents the basis for the step elevation. Datum + Current bench elevation = n * Step Elevation.

Step Elevation specifies the increment for benching when a datum is being used. Each bench elevation is always located at the end of the first segment (or the second point) of the benching End Condition.

Rounding Length specifies the length used to round the end condition. When this value is something other than 0.0, 4 additional points are added to the end of the end condition using a parabolic formula to smooth out the transition of the intersection of the end

condition with the surface. This rounding effect is only applied when the target is a terrain model or an elevation. Any other end conditions attached to the end of this one is attached to the end of the rounded section.

End Condition Priority

The end condition priority value is used when more than one end condition is defined starting at the same point. A simple end condition consisting of two fill lines is shown in the example below.

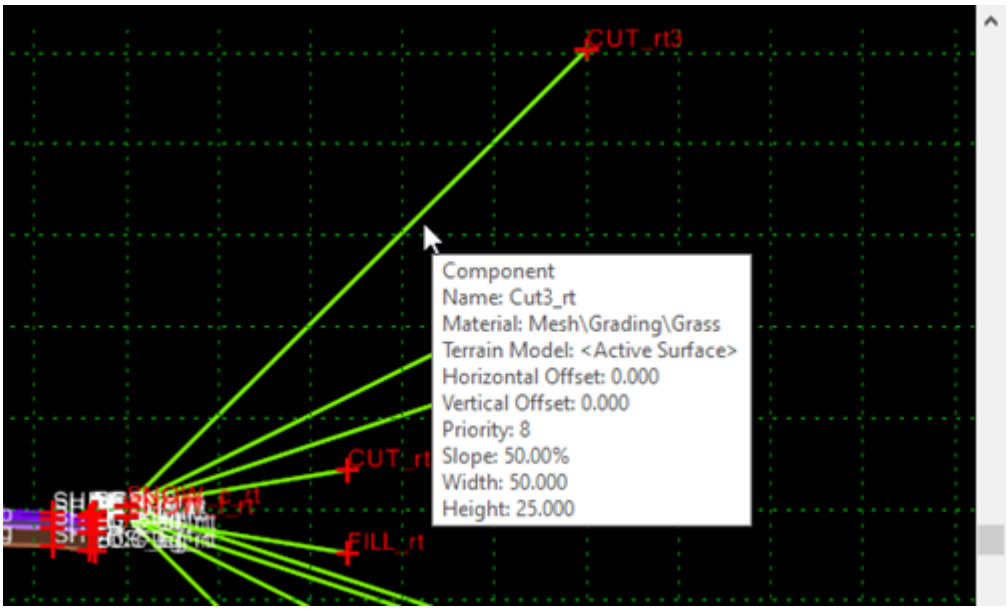

Figure 51 End Condition Priority

When the end condition is processed in corridor modeling, each end condition will be tested in the order specified by the user. The order is determined by the **Priority** value entered by the user during the end condition creation. The most desirable solution, and the first condition to be tested, is given a priority value of 1.

Double-clicking on a component will open the Component Properties dialog shown below. If the component is an end condition, the **End Condition Properties** are displayed. The **Priority** is set as shown below.

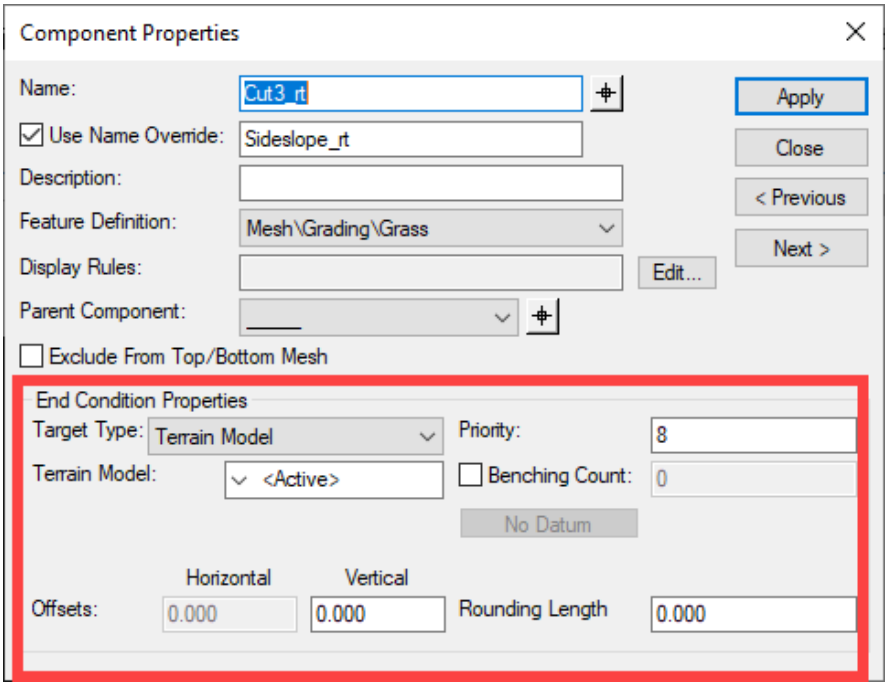

Figure 52 End Condition Properties

The properties for point CUT_rt2 were defined as shown Below. **Check for Interception** is toggled on, and **End Condition is Infinite** is toggled off. The point is defined with a 25% Slope for a horizontal distance of 45.0' from the snow shelf.

The properties for the point CUT_rt3 were defined to specify a 2:1 slope with the **End Condition is Infinite** option toggled on. The priority for the end condition component Cut3_rt is set to a value of 8.

With these settings, the end condition CUT_rt2 (Priority=7) will be tested before CUT_rt3 (Priority=8) for an interception with the surface within the horizontal distance of 45.0'. If an interception is found within the vertical distance, the end condition is used for the cross section and a point will be placed at the interception.

If no interception is found within 45.0' horizontally from the snow shelf, the condition fails and the software will test the next end condition, CUT_rt3, which has a Priority value of 8.

Since **End Condition is Infinite** is toggled on for point CUT_rt3, the solution will solve for an interception with the surface regardless of the vertical constraint definition.

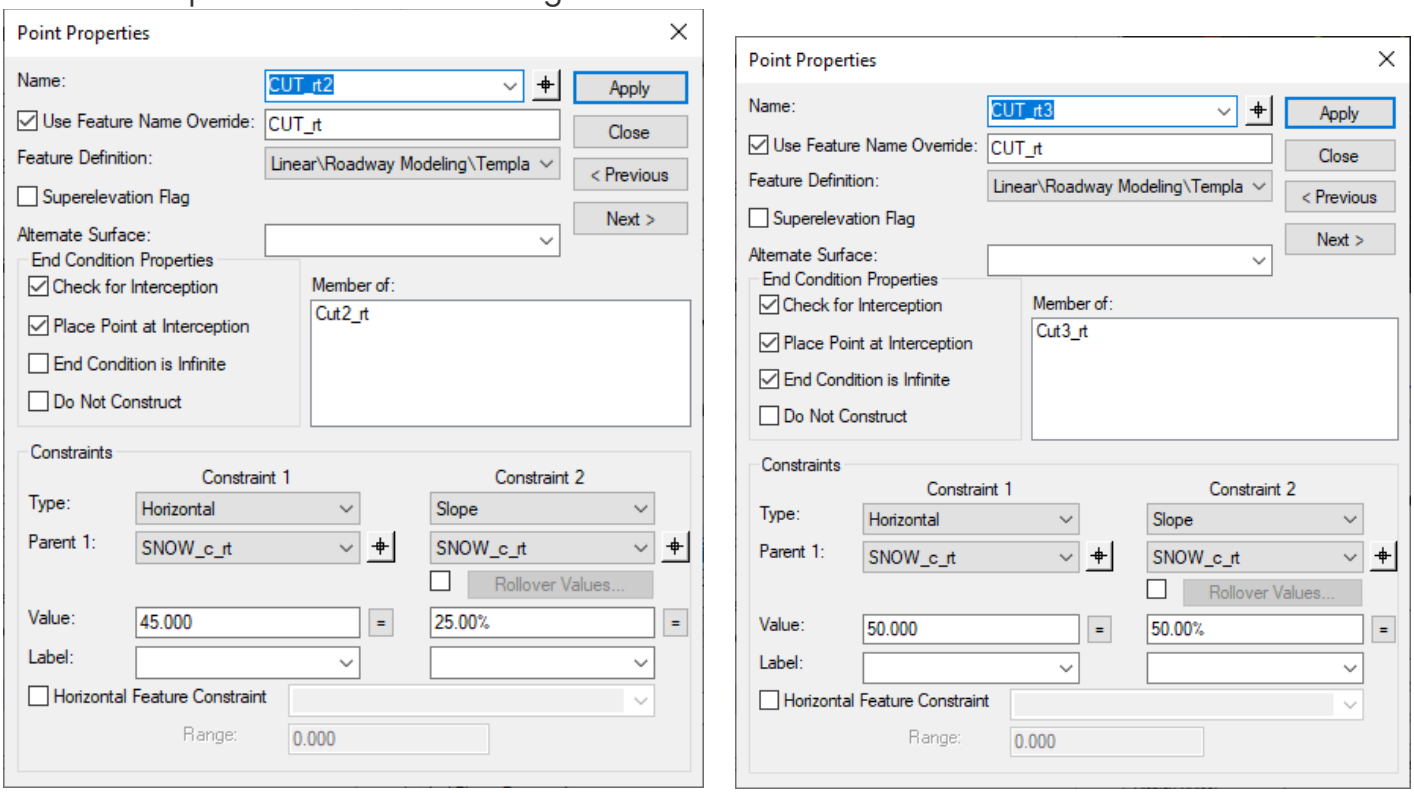

Figure 53 Point Property End Condition is Infinite

Testing End Conditions

End conditions can be tested in the Create Template dialog before processing the template with corridor modeling. Testing simulates how the end condition will behave when the corridor is processed.

This is extremely useful for complex end condition definitions with multiple solutions. To test the end condition, select the **Test** command, located below the **Current Template** window. The Test End Conditions dialog is opened.

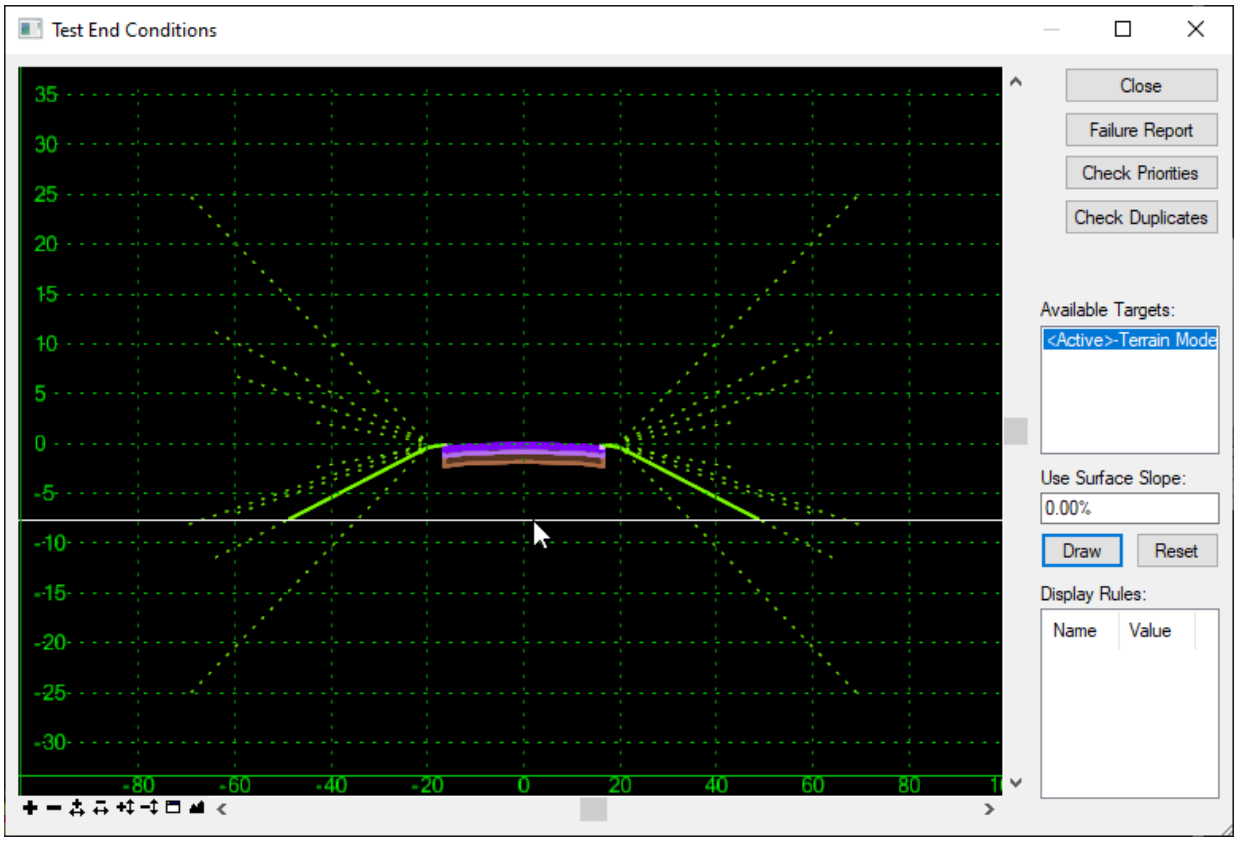

Figure 54 Testing End Conditions

The software will check for conflicts in the priorities defined in the template before opening the Test End Condition dialog. If conflicts exist, a warning is issued.

The dialog displays the current template. Non-solved end conditions, and their child components, are displayed in dashed lines. Normal components and solved end conditions are displayed as solid lines.

To test the end condition, select one of the available targets and then select the Draw button. Move your cursor over to the testing window. The end conditions will change from a dotted line to a solid line indicating the solution for the target interception.

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

Check Priorities tests the template for priority conflicts. When conflicts exist, a message is displayed indicating there are end conditions that start from the same point and have the same priorities. The End Condition Priority Conflicts dialog is displayed. If no conflicts exist, a message box indicating no conflicts is displayed.

Available Targets lists all of the targets applicable to the current template. You can select the desired target and draw it in the display.

Use Surface Slope specifies the slope of the surface that is being placed. This is useful in certain instances where an end condition intersects a surface more than once, such as a ditch profile.

Draw draws the selected target. Surfaces and elevations are drawn as horizontal lines. Features and alignments are drawn as a "+" mark. As you draw a target, the display dynamically updates to show the solution(s).

Reset clears all the drawn targets.

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

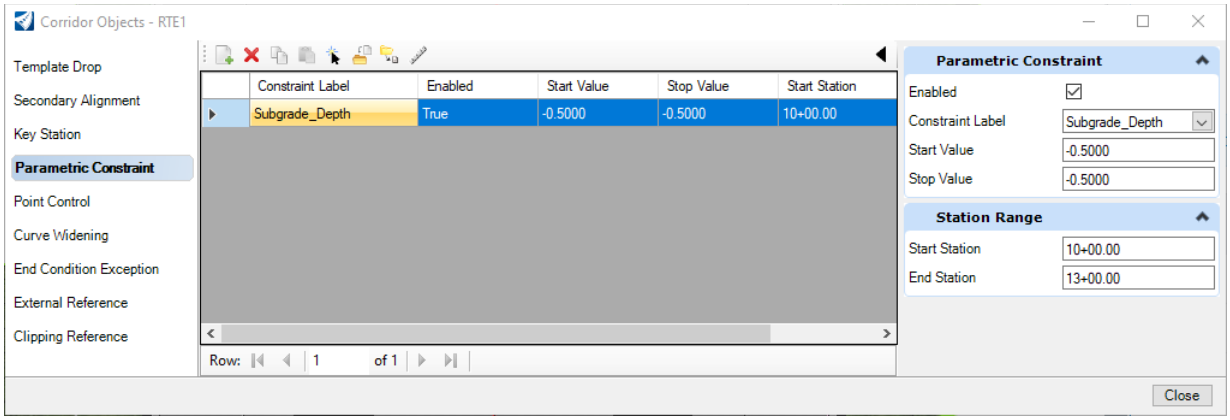

Figure 55 Display Rules

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

Revisions