

*State of Florida
Department of Transportation*



Comprehensive Template Design

Course Guide

December 11, 2018

PRODUCTION SUPPORT OFFICE - CADD

TALLAHASSEE, FLORIDA

<https://www.fdot.gov/cadd/>

FDOT Roadway Design and 3D Modeling

Comprehensive Template Design Training

Description

This is a 1-day training course to include Chapters 5 of the course guide. Participants will learn basic and advanced knowledge of the Create Template dialog within Bentley GEOPAK V8i SELECT Series4 (SS4) environment for design and modeling within the FDOTSS4 workspace. Most all of the Create Template dialog capabilities are included as follows:

- Template Library Basics
- Creating New Libraries, Folders and Templates
- Current Template Window
- Template Preview Window
- Current/Active Template Tab
- Dynamic Settings
- Create /Modify/ Delete Components, Points, etc.
- Point and Component Properties
- Constraint Types/ Labels
- Horizontal Feature Constraints
- End Conditions/ Targets/ Priorities
- Display Rules
- Testing Window
- Point Name and Component Name Overrides

Objectives

- *Create a New Project Template Library and Project Folders.*
- *Use Template Library Organizer to build Project Templates.*
- *Build a Resurfacing Template from Basic Components.*
- *Learn to Use the Variable Median PPM Templates.*
- *Configure Templates for Superelevation.*
- *Add and Test End Conditions.*
- *Build a Special Condition Component Sets for Displaying Walls, Guard Rails, Sidewalks, etc.*
- *Build a Special Condition Component Sets for Displaying Special Ditches with Variable Width and Constant Slopes.*
- *Adding Special Condition Component Sets to a Template.*
- *Practice Building Project Templates from Sample Project Typical Sections*

Audience

- *FDOT Roadway Designers and Engineers*

Prerequisites

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

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

FDOT Roadway Design and 3D Modeling - Basic Training.

Duration: 8 Hours

Professional Credit Hours: 8 PDHs

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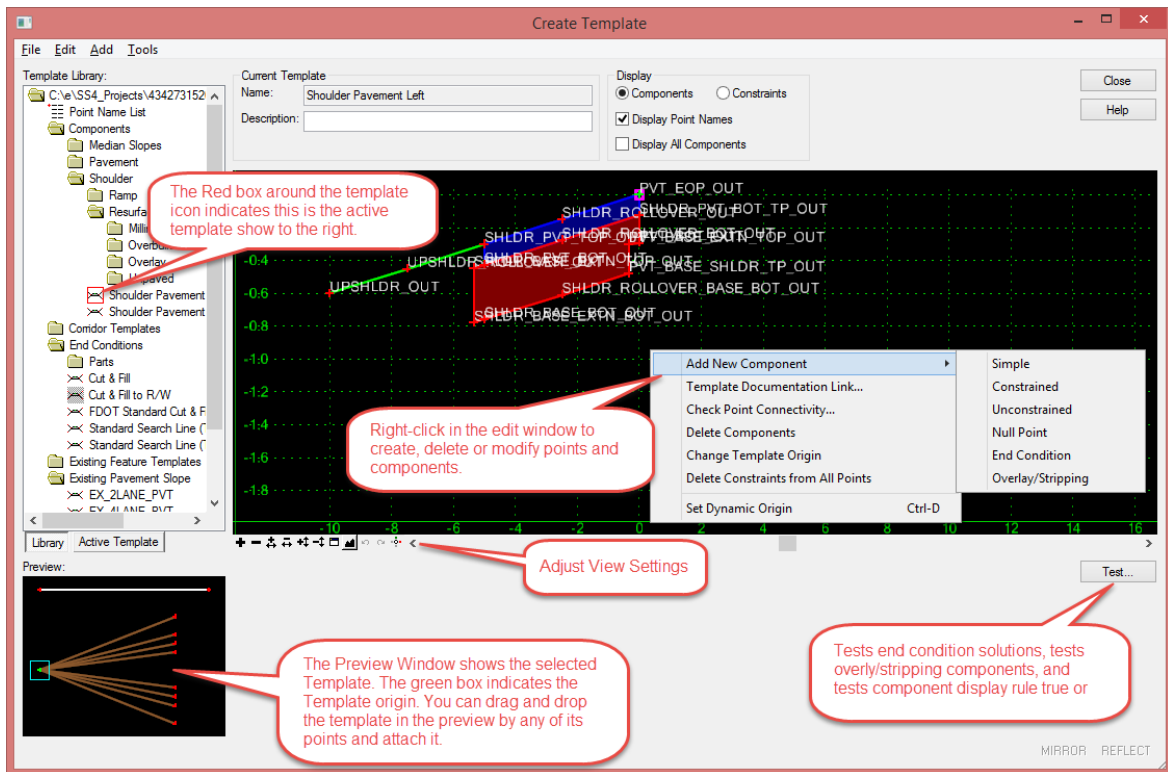
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1 GETTING STARTED

INTRODUCTION - BEST PRACTICES

1. Create a Project Template Library in the project folder.
2. Use TLO to copy FDOT Templates.
3. Organized Templates by corridor.
4. Version the Templates or organize by Template Drop Stations.
5. Use Apply Affixes when building new Templates (tools options).
6. One green point per Template (as a rule).
7. Remove Point Name Overrides, except on common tie down points (All white text).
8. Remove Component Name Overrides, except on common tie down components.
9. Use the same label on common Constraints.

CREATE TEMPLATE DIALOG



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

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

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

Most commonly-used commands can be accessed by right clicking on the folders and templates. If you double click a template, it becomes the Current Template and is signified by a red box around the *Template* icon. The Current Template is also identified in the Current Template

Current Template Window

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

In the center of the Create Template dialog is the main graph for creating templates. The graph is called the Current Template window. The Current Template window uses its own graphics engine and is not a MicroStation View.

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

At the bottom of the graph there are numerous view commands, which are similar to MicroStation View commands. There are two buttons that look like the MicroStation View Previous and View Next commands, however, they are used to undo and redo template creation operations. If your mouse has a scroll wheel, it can be used to pan and zoom. The CTRL-Z keyboard hotkey will undo your last edit or creation.

In the graph area you can right-click to access commands and you can double-click elements in the graph for editing purposes.

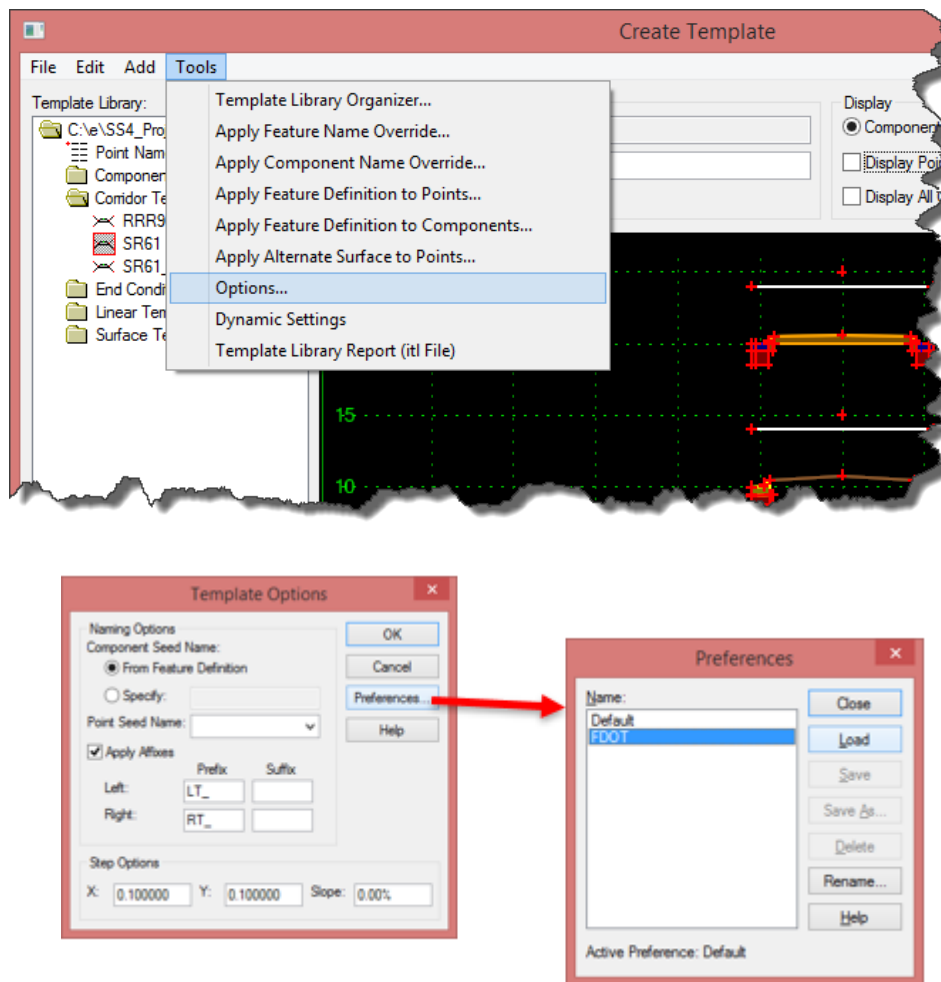
Template Preview Window

Under the Template Library area is the Preview area. When you highlight (single click) a template, the template is displayed in the Preview area. The Template Preview window previews Templates and Components:

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

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

SETTING PREFERENCES

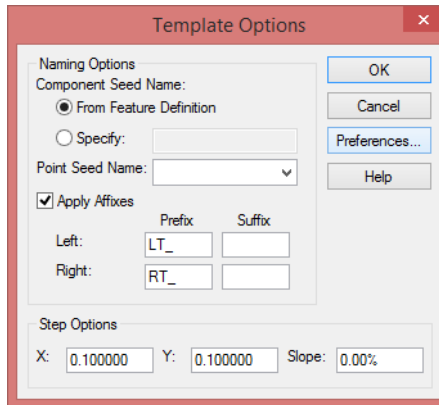


FDOT provides a collection of preferences definitions that should be applied before creating templates.

1. From the **Create Template** dialog select **Tools > Options**.
2. On the **Template Options** dialog click the **Preferences** button.
3. On the **Preferences** dialog select **FDOT** and click **Load** (or double-click FDOT).

Template Options

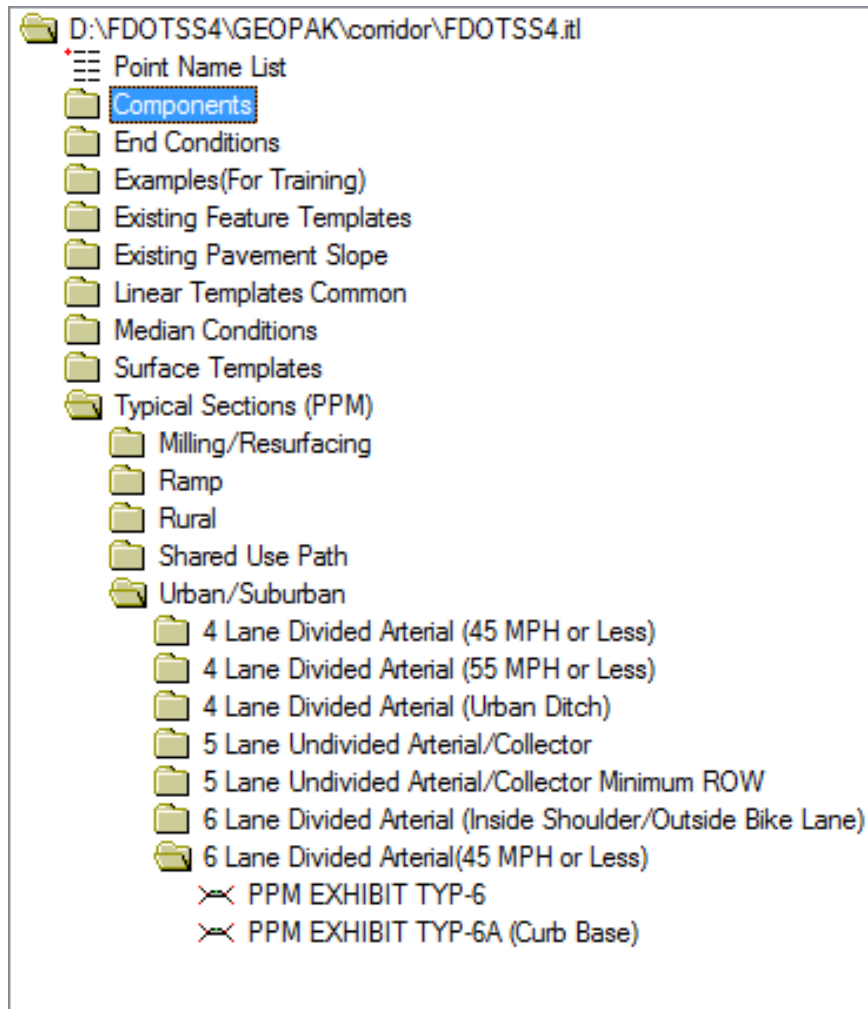
Specifies naming and step options for the current template.



- **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.
 - *Component Seed Name - Specify* - indicates, when selected, the component name is specified in the field.
 - *Points 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 - 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).
 - *Apply Affixes - 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 - specifies precision step input for components and points. These values can also be accessed from the [Dynamic Settings](#) dialog.**
 - *Step Options - 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.
 - *Step Options - Y Step* - specifies the step increment for the Y distance from the dynamic origin. If this value is non-zero, then the cursor moves to the vertical increments of the specified value as measured from the dynamic origin.
 - *Step Options - Slope* - specifies the step increment for slope from the dynamic origin. If this value is not 0, then the cursor moves to the slope increments of the dynamic origin. Slope is applicable only when the dynamic settings are in horizontal/slope mode.
- **Preferences - opens the Preferences dialog.**

TEMPLATE LIBRARY

FDOT provides a customized Template Library named: FDOTSS4.ITL, located in the \FDOTSS4\GEOPAK\Corridor directory. It contains a collection of Components and Templates that were developed from the FDOT Design Standards and PPM. These templates can be copied into a project specific ITL and customized to meet the needs and unique conditions of each project.



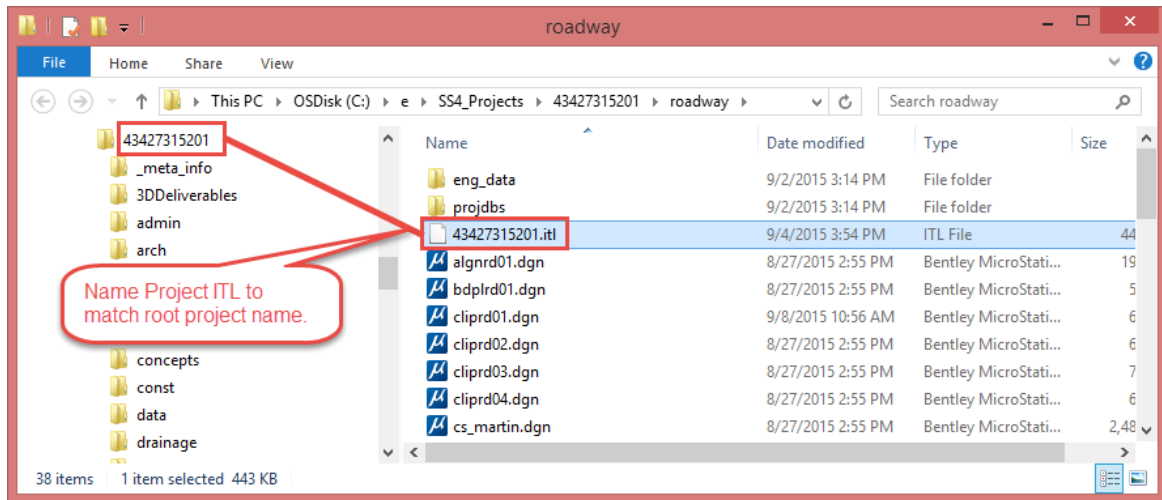
The FDOTSS4 workspace includes configuration variables that make FDOTSS4 .ITL the default template library unless a project specific ITL is found. If an ITL file name matches the project name then it will be defined as the default ITL.

The Components contained in the FDOT template library were developed using the criteria defined in the FDOT Design Standards.

The Templates delivered in the “Typical Sections (PPM)” folder of the ITL are static templates matching each Typical Sections defined in the Florida Design Manual (FDM).

Project ITL

The FDOTSS4.ITL file is normally located on the server where users have limited access. To customize the template library for a specific project it will be important to create a project ITL file and import the needed components and templates from the FDOTSS4.ITL file. The project ITL file can then be selected in the Corridor Modeler preferences to associate it with a specific project.



Note Create a Project ITL file to store customized templates.

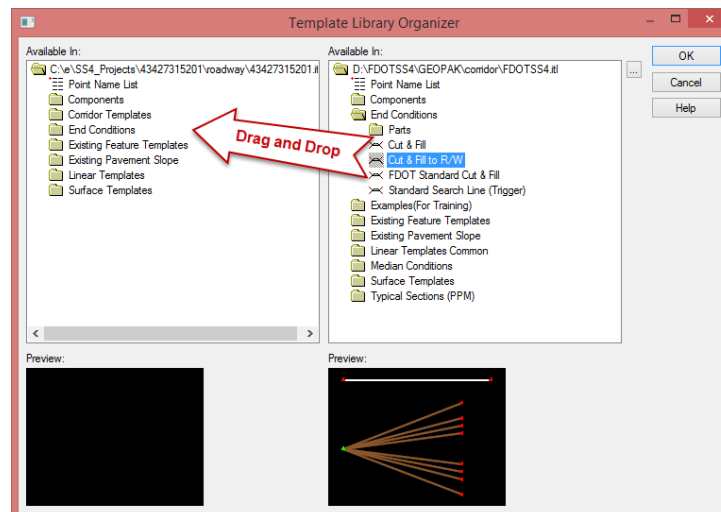
- A blank ITL containing only a folder structure is available in the `\FDOTSS4\GEOPAK\corridor\` directory on the server.
- Set name to `<ProjectNumber>.ITL` for easy access.

Template Library Organizer

After creating and opening the project specific template library you can import Templates and Components using the Template Library Organizer. On the Create Template dialog select **Tools > Template Library Organizer**.

The Template Library Organizer moves (drag and drop) templates from one template library to another. To copy or move a template or an entire folder, press and hold the left mouse button down over a template or folder, then drag the selected item to its new location either in the other library or the same library.

The default process is to copy the item. To move the item, hold down the shift key while releasing the left mouse button. The selected folder or template can also be deleted by pressing the delete key.



EXERCISES

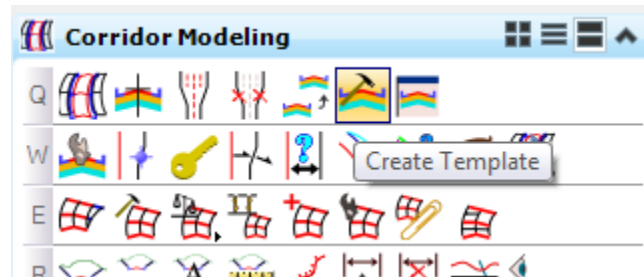
To prepare your computer for the next set of exercises:

- a) Delete the c:\e\projects\22049555201\ folder.
- b) Open the ComprehensiveTemplateDesign folder on the desktop and expand the DataSets folder.
- c) Extract the CT22049555201_Chapter1.zip file in the c:\e\projects\ folder.

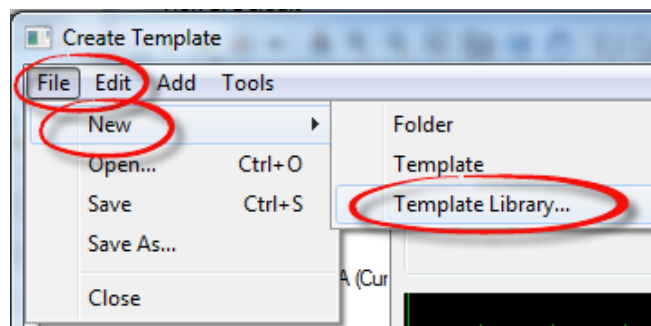
Exercise 1.1 Creating a New Project Template Library

In this exercise students will create a project specific template library. This new project Template Library is the container for all the components and templates used to develop the model for the project.

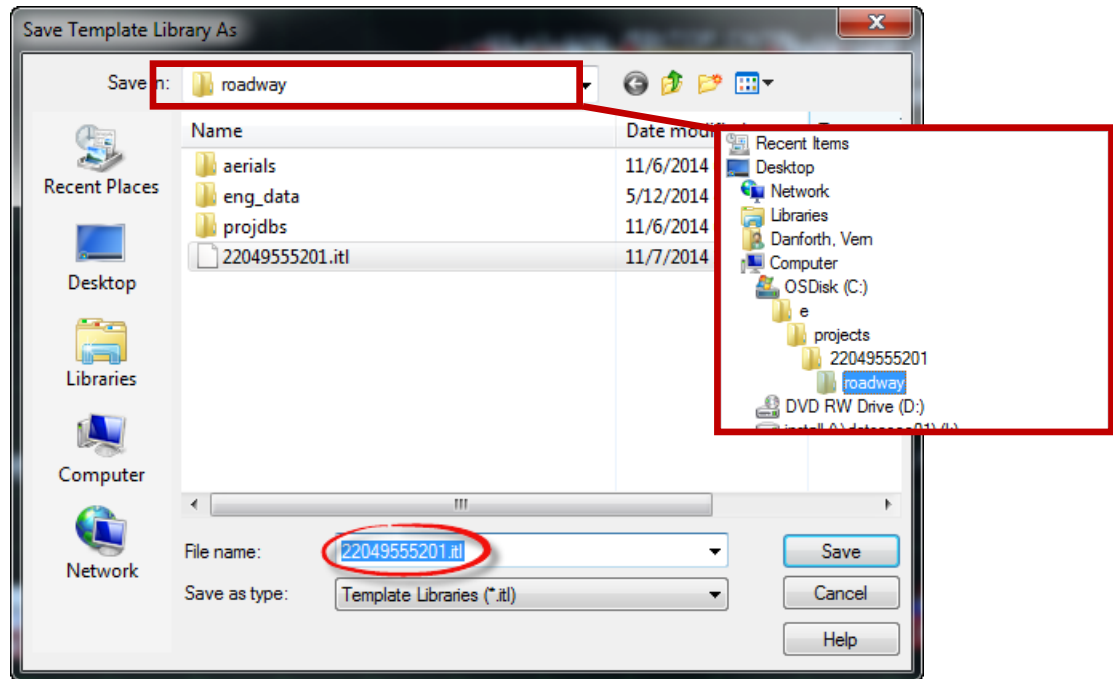
1. Open the *DSGNRD01.dgn* file of the c:\e\projects\22049555201\roadway\ folder in the FDOTSS4 Workspace in MicroStation.
2. Use *Corridor Modeling*, **Create Template** tool.



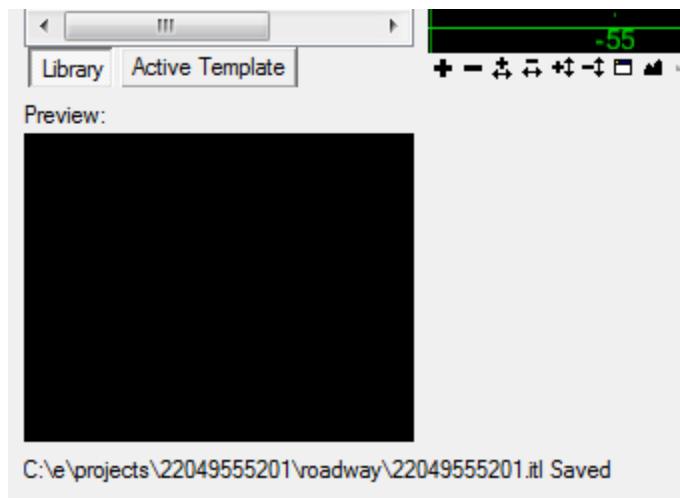
3. Open the Create Template dialog and select **File > New > Template Library**.



- Navigate to the Project **roadway** folder, C:\e\projects\22049555201\roadway\ and enter the new *Template Library Name*, **22049555201**. Press **Save**.



- Select **File > Save** again to verify, then close the Create Template dialog. Press **Close**.



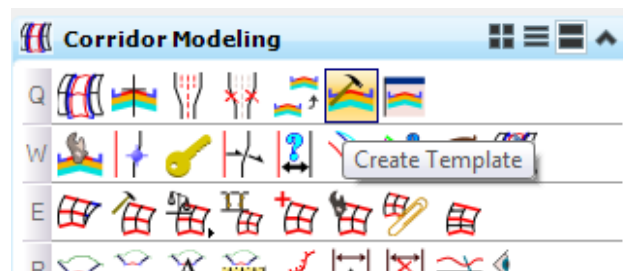
Exercise 1.2 Create Template Library Folders

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

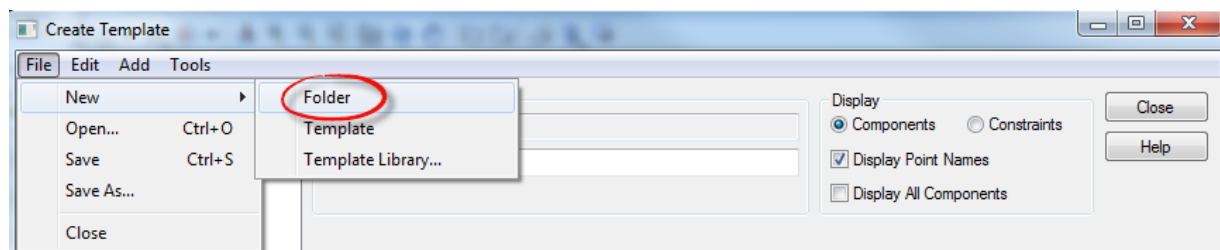
The Components, End Condition, Linear Templates, Surface Templates folders contain parts of the full Templates and is obtained from the FDOTSS4 Template Library.

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

1. Use Corridor Modeling, Create Template tool.

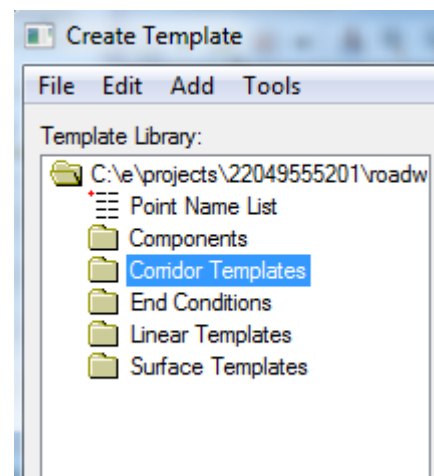


2. Create new folders in the Project Template Library by selection **File > New > Folder** from the menu or by right clicking on the root folder in the Create Template dialog and selecting New > Folder from the context menu.



3. Create and re-name five folders. Select the **Root** folder and repeat steps to include all the following folders:
 - Components
 - Corridor Templates
 - End Conditions
 - Linear Templates
 - Surface Templates

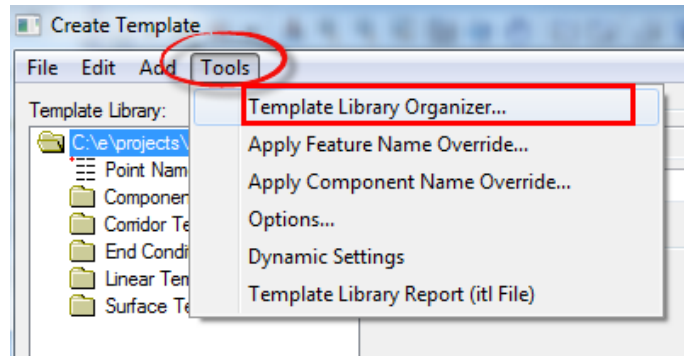
4. Select **File > Save** to save the project *Template Library .itl* file.



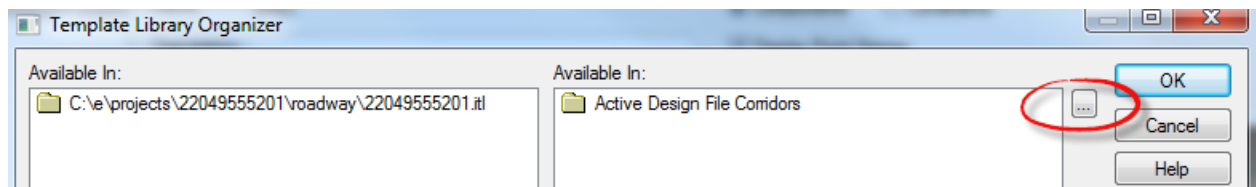
Exercise 1.3 Using the Template Library Organizer

Typically, the components and templates needed for your project can be copied from other Template Libraries and design files using the Template Library Organizer. This exercise uses the Template Library Organizer to copy the components need for this workshop into your project ITL file.

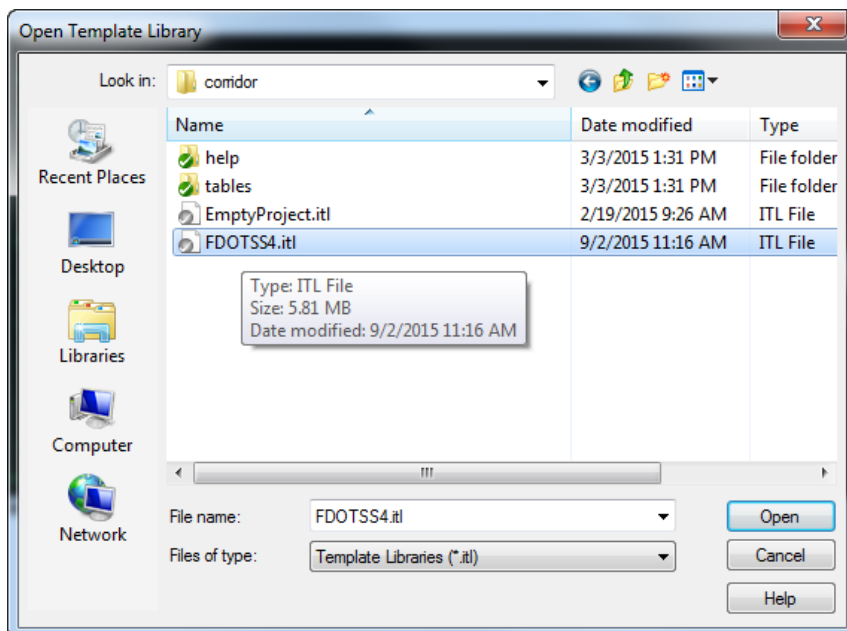
1. Use *Create Template* and select **Tools > Template Library Organizer**.



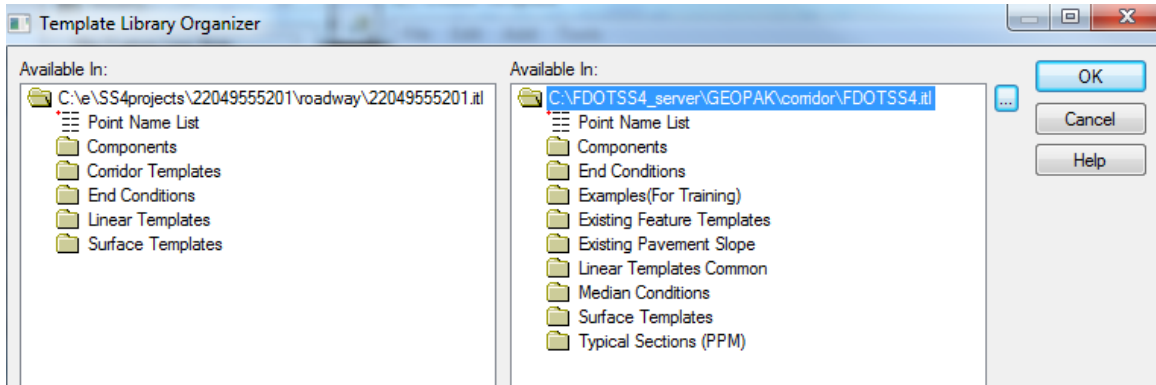
2. From the Template Library Organizer dialog, press the **Ellipses** icon next to the **OK** button. The Open Template Library window displays.



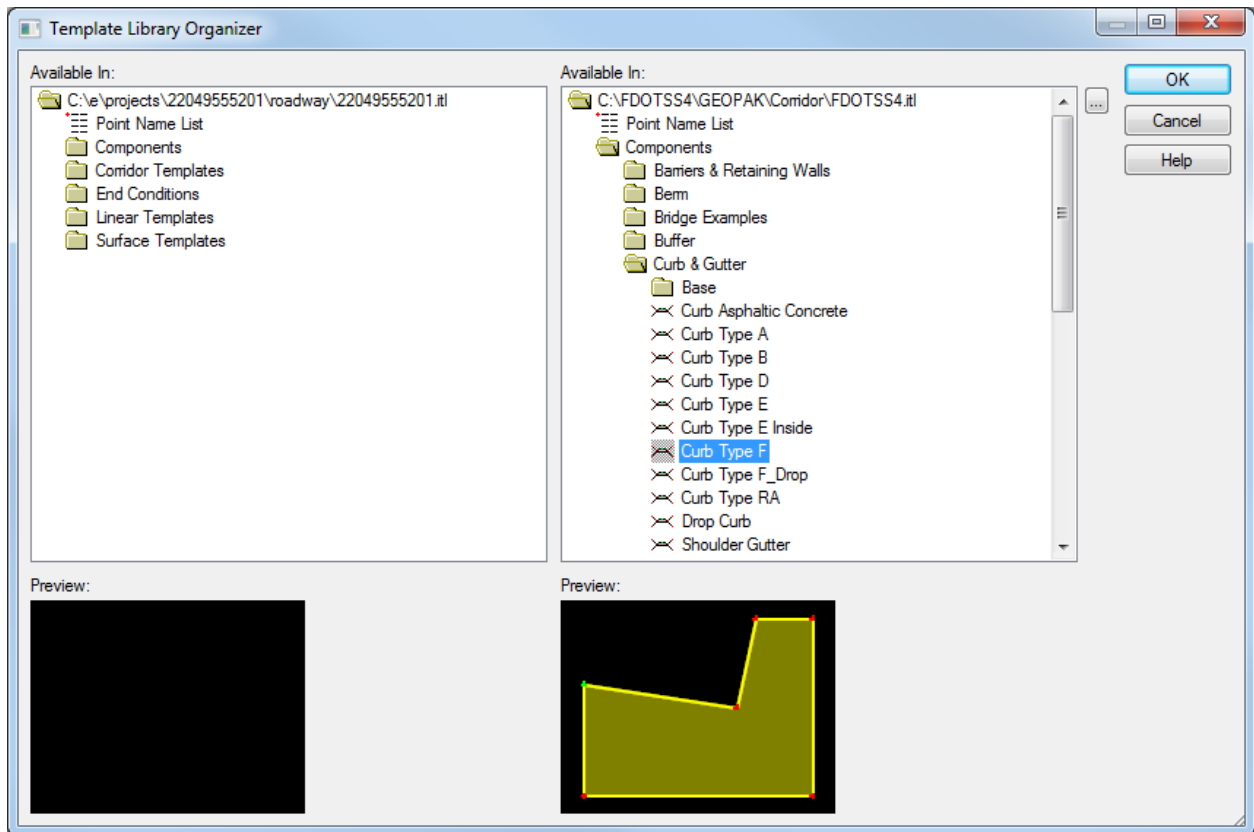
3. From Open Template Library, navigate to the c:\FDOTSS4\GEOPAK\corridor folder and select the **FDOTSS4.itl** Template Library file. Press **Open**.



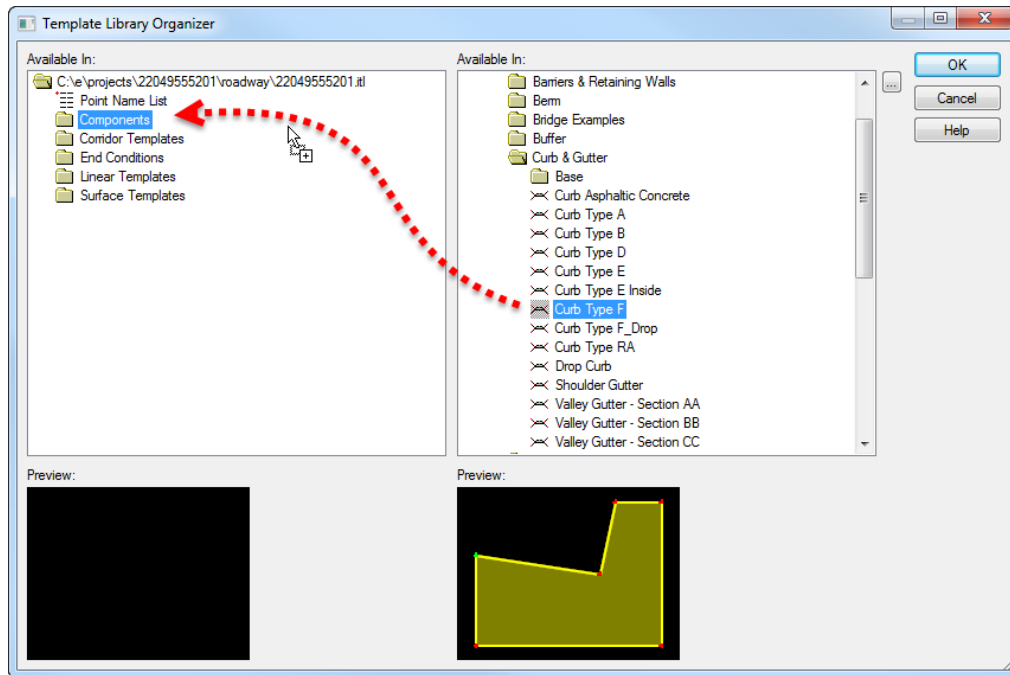
- The Template Library Organizer dialog displays with the *.itl* file listed in the right *Available In:* window pane.



- From the Template Library Organizer, navigate to the **Components\Curb & Gutter** folder shown below.
- Select **Curb Type F** to preview the template in the *Preview* window below the directory view.



7. Drag the **Curb Type F** component from the *right side* to the *left side* and drop it onto the *Components* folder for the project.



8. Collect the following items from the *FDOTSS4 Template Library* and drag them to the *Project Folders Locations* as shown below

FDOTSS4 Template Location	Project Folder Location
Components/Curb & Gutter	Curb Type F to Components
Components/Ditches	Common Ditch Left to Components
Components	Entire Null folder to Components
Components	Entire Pavement folder to Components
Components/Shoulder	Shoulder Pavement Left to Components
Components/Shoulder	Shoulder Pavement Right to Components
Components/Utility Strip	Utility Strip Left to Components
End Conditions	Entire Parts folder to End Conditions
End Conditions	Cut & Fill to End Conditions
End Conditions	Standard Search Line (Trigger) to End Conditions

9. Press **OK** to return to the **Create Template** dialog and press **Yes** to the *“Save data to file...”*
The FDOT Standard Items are now saved in the **Project Template Library**.
10. Close **MicroStation** so the FDOT workspace will recognize the new **Project ITL** file.

2 BUILD A STATIC TEMPLATE

TERMS

Component - a set of points that define an open or closed shape.



Template - a collection of points and components.



Template Library - Templates are stored in a Template Library (*.itl).

TEMPLATE COMPONENTS

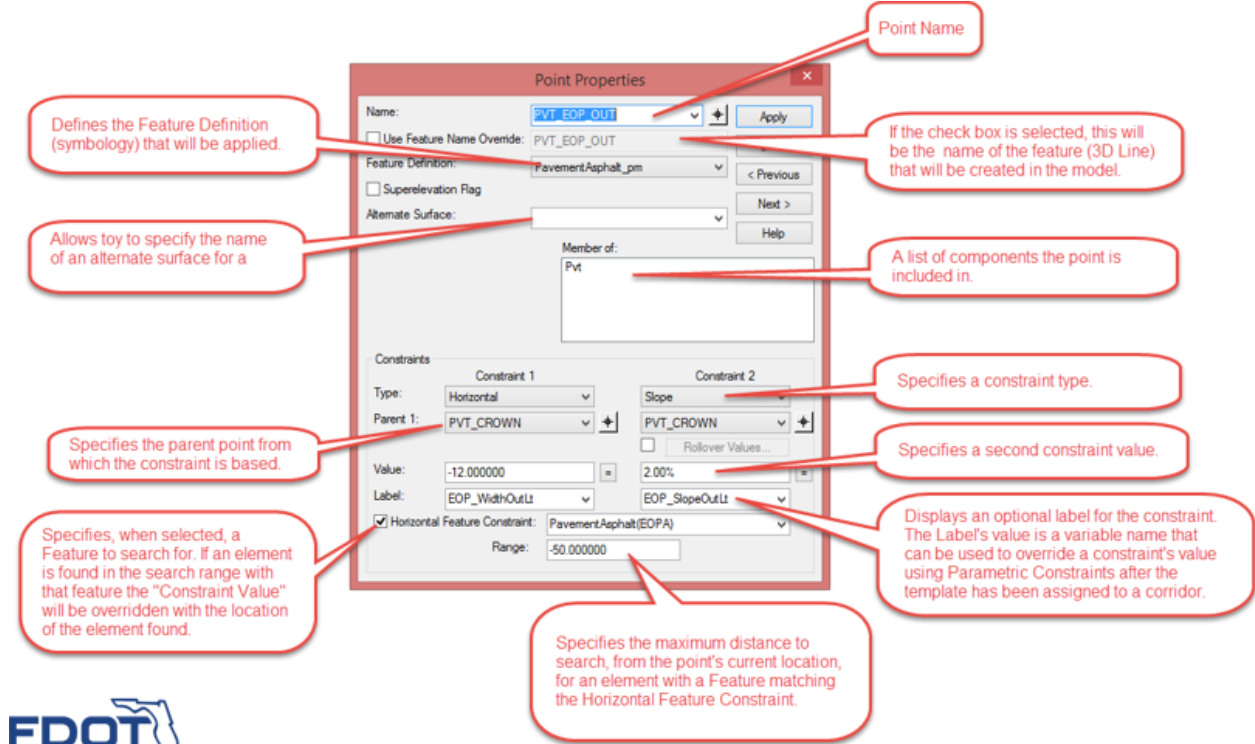
A component is a set of points that define an open or closed shape. Each component, whether open or closed, can represent a different material or area of interest. Components are named and have an assigned feature style.

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

There are 5 types of components created in Corridor Modeling: *Simple*, *Constrained*, *Unconstrained*, *Null Point*, *End Condition*, and *Overlay/Stripping*.

- **Simple Component** - typically represents a section of pavement. It's a closed parallelogram (4 constrained points) that is defined by the slope and thickness.
- **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).
- **Unconstrained Component** - an open or closed-shaped with no movement restrictions.
- **Null Point Component** - a template point that is purposely not related to any particular component. It's most often used as a reference for controlling other points.
- **End Condition Component** - a special open-shaped component that targets a surface, a feature of a surface, an elevation, or an alignment (it replaces the former Cut/Fill, Material, and Decision tables). The integrity of end conditions can now be routinely tested while the roadway template is being created.
- **Overlay/Stripping Component** - used to handle all milling/stripping operations and can be used to handle leveling (overlay) operations.

POINT PROPERTIES



Point Properties specifies properties associated with roadway template points:

- **Name** - displays the point name. The drop down list includes items from the Point Name List.
- **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.

Note While the Point name must be unique to the template, the Feature Name does not have to be. However, if the same feature name exists on more than one point for the solution at a given station, undesirable results will occur.

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 Tie_R and all the ones on the left would be given the feature name Tie_L).

- **Feature Definition** - displays the feature style of the point. If no style is specified, then it comes from the first component of which the point is a member.
- **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.
 - *End Condition Properties* - allows you to specify additional properties when a point is part of an end condition.
 - *Check for Interception* - specifies the preceding segment will be checked for interception of the target when the end-conditions are solved. If it is turned off, then the segment will be ignored when checking for interceptions.
 - *Place Point at Interception* - specifies that when an interception is found along the preceding line segment, the line segment will be drawn to the interception. Otherwise, if the interception is found, the line segment will be drawn to its maximum width.

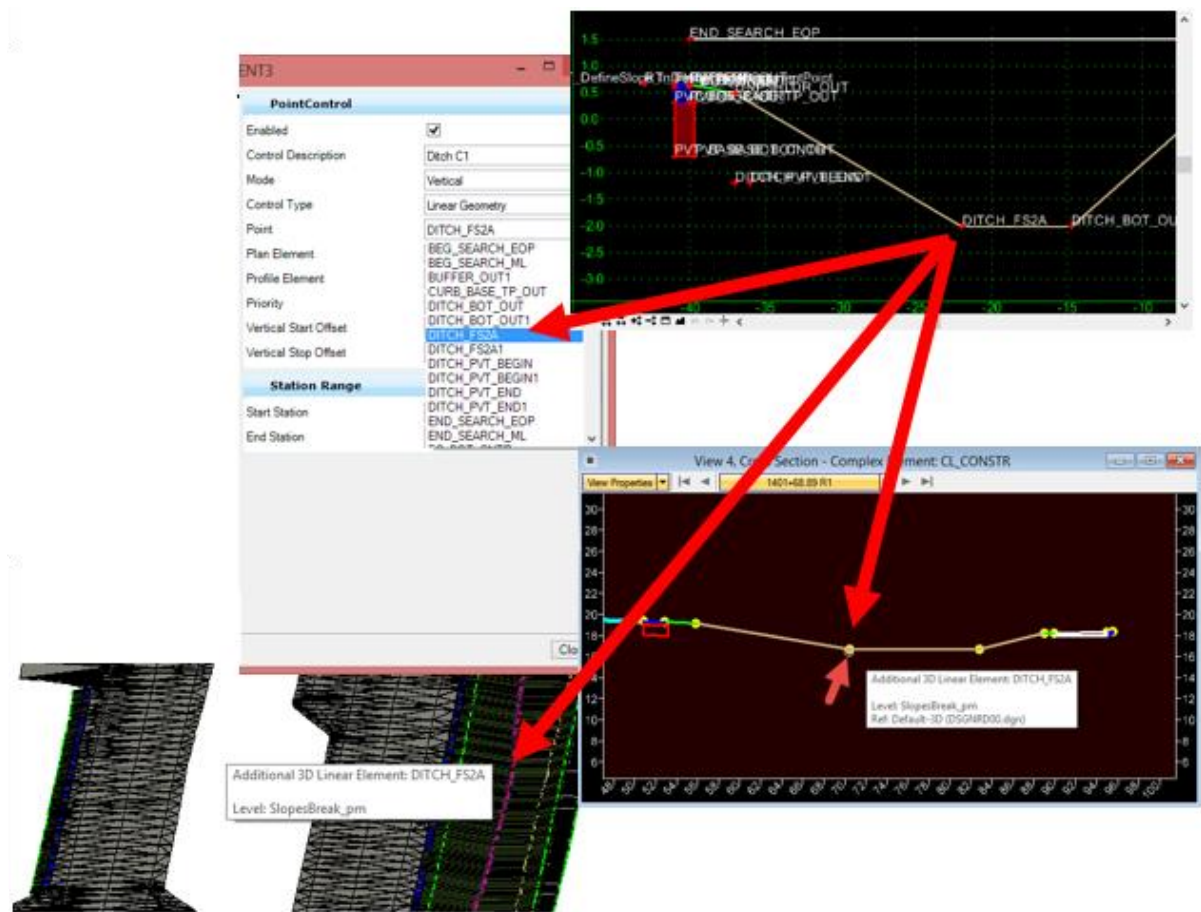
- *End Condition is Infinite* - specifies the last segment will be considered to be of infinite length when attempting to intercept the target. This option is applicable only to the last point on the end condition.
- *Do Not Construct* - specifies the point will be solved like all other points in the end-condition, but the point will be skipped when drawing the component segments.
- **Member Of** - indicates in which components the point is included.
- **Constraints** - 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.
 - *Parent 1* - specifies the constraint parent point.
 - *Parent 2* - displays the second parent point, only when applicable. Applicable to Horizontal and Vertical Maximum and Minimum constraints and Vector Offset Constraints.
 - *Rollover Values (checkbox and button)* - displays only for a slope constraint. These values are displayed in the Parent 2 field since the rollover reference point is the second parent point for the slope constraint. Selecting the checkbox activates the Rollover Values button. Selecting the button displays the [Rollover Point Properties](#) dialog.
 - *Value* - specifies the horizontal offset for horizontal type constraints. Negative values are to the left; positive values are to the right.
 - ✓ For Vertical type constraints, this is the vertical offset. Negative values are down; positive values are up.
 - ✓ For the Slope constraint, the value is the slope. Negative Values indicate a slope that goes from upper left to lower right; positive values indicate a slope from the lower right to upper left.
 - ✓ For the Vector Offset constraint, a negative value is an offset to the left of the vector going from the first parent to the second parent; positive values are to the right of the vector.
 - ✓ For the Project to Surface constraint, the value is the name of the surface (Note that a blank name will translate to the active surface).
 - ✓ For the Project to Design constraint, the value is the maximum distance to attempt to project to. Negative values imply the projection is to the left; positive values project to the right.
 - ✓ For variable constraints, the value is the difference between two points.
 - *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.
 - *Project to Surface* - allows you to limit the projection of a point to the surface: Any Direction (no restrictions), Down (point projects down from its original location only), Left (point projects to the left from its original location only), Right (point project to the right from it original location only), and Up (point projects up from its original location only). The Up and Down options are ignored when the other Constraint is Vertical. Similarly, the Left and Right options are ignored when the other Constraint is Horizontal.
 - *Style Constraint* - specifies, when selected, that the style constraint on a point overrides the point constraints if a feature or alignment with a matching style is found within a specified horizontal range. Activates the Style field which allows you to identify the style.
 - *Style Constraint (Type)* - allows you to select the constraint type: Horizontal, Vertical, or Both.
 - *Range* - specifies the maximum horizontal distance to search from the point's current location to any feature or alignment with the specified style. Only the active surface and active geometry project is searched. Negative values cause the search to be to the left; positive values to the right. A value of zero causes the search to find the closest instance of the style.
- **Apply** - saves changes to the current point.

Point Naming is Important

The Point Name is very important. There's no standard naming convention for the points but they should be named so that each point in a template has a unique name and is easily identifiable by it's name alone. Consistency in point naming is important too. If multiple templates will be applied to a corridor the names of common points in the templates should match.

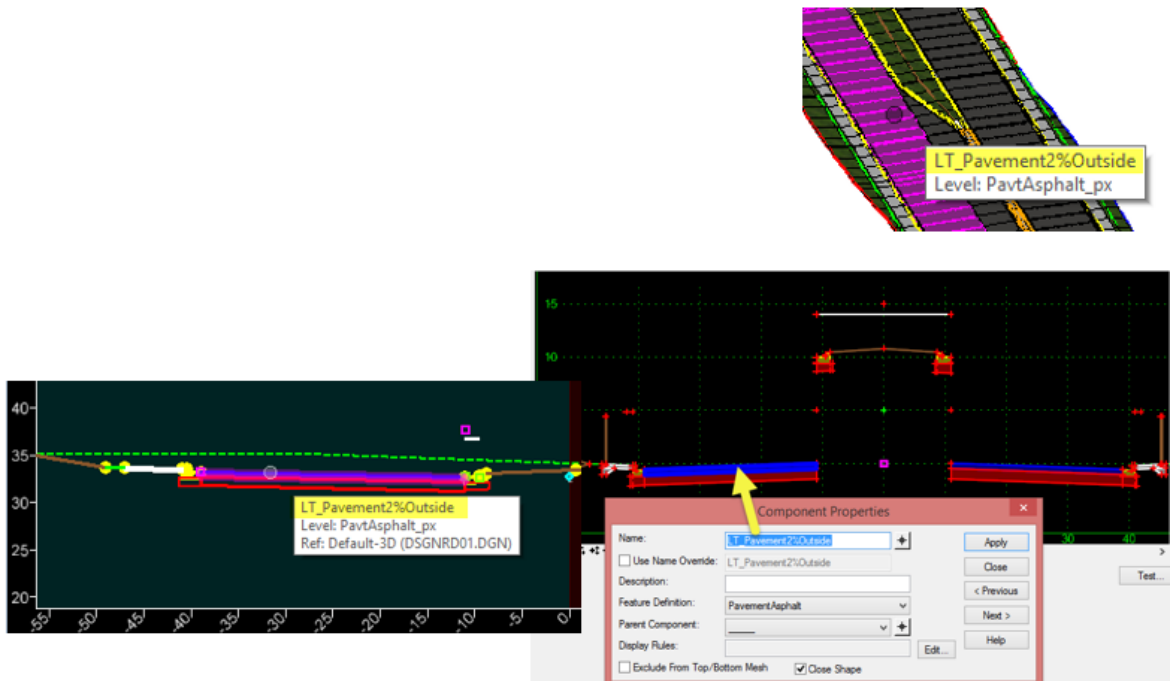
For example: If you have two templates for a given corridor and on the first template you name the point representing the outside edge of pavement on the left roadway LT_PVT_EOP_OUT then you will need to name the point the same thing on the second template as well. This will allow the corridor to transition smoothly from one template to the next.

Note Point Name overrides are sometimes necessary when using trigger sets or for template transitions but should only be used when necessary.



Component Naming

Individual Component Names also appear in the ensuing model. These components are used for volume calculations, so standard naming conventions should be applied to ensure consistent results. When transitioning between two templates (going from a two-lane to a four-lane roadway, for example), the corridor attempts to connect component points of the same name to model the transition.

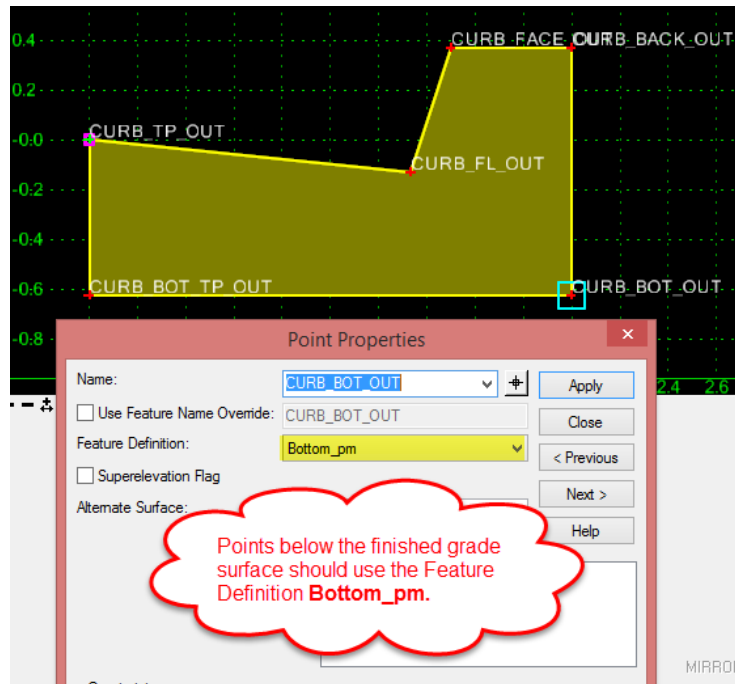


- Consistency is important
- Component naming is recommended to be consistent with the material type.
 - Used for identifying components
 - Template Transition

Point Feature Definitions

Feature Definitions define the symbology of the point and how it should be displayed in the various views.

- Points in a template should always have a `_pm` Feature Definition.
- `_pm` indicates that the element is shown in a Proposed Model view.
- `Bottom_pm` should be used for points below the finished grade so they can be easily turned off when producing 3D Deliverables or creating a finished grade surface.



FDOT’s Feature naming convention mirrors its level naming convention where the name is followed by an underscore and then two characters which represent the state of the element and the view it is displayed in. Since the elements in the template will be drawn into the 3D model and then cut into cross sections the features used will have a `_pm` (points) or `_px` (components) suffix.

The format of the Feature Name is: `feature_sv` (max. 18)

Where: (object = element type)_ (s = state)(v = view)

(S)tate Designations	(V)iew Designations
p (proposed)	p (plan)
d (drafting element)	r (profile)
e (existing)	x (cross section)
m (model)	

Note Features with no suffix are assumed to be proposed plan elements.

CONSTRAINTS ON POINTS

Point constraints are used to manage the behavior of points in a template. 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.

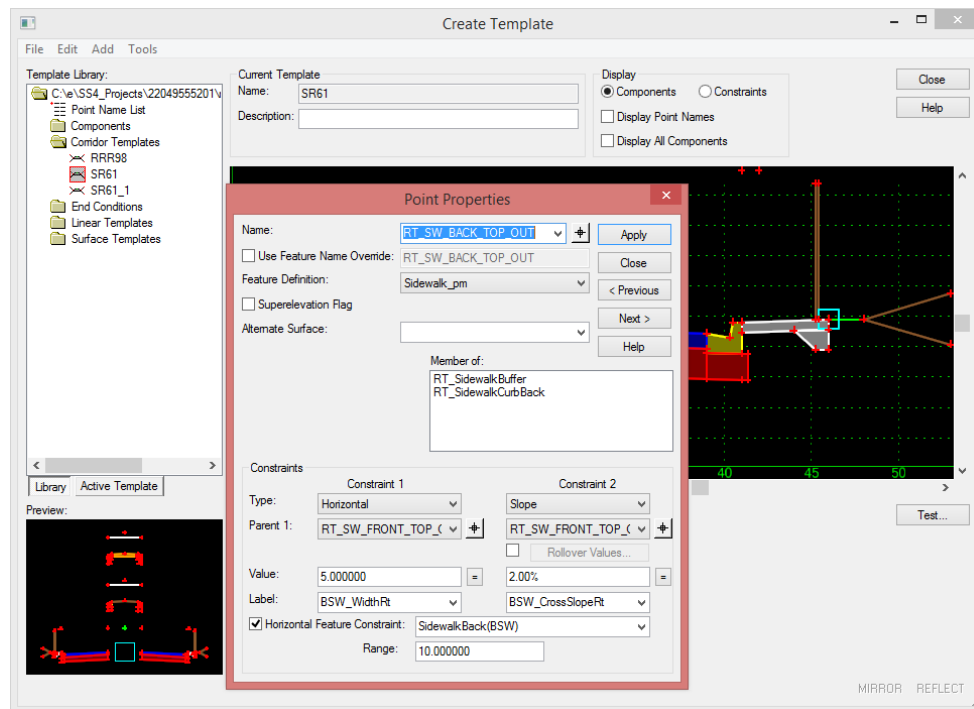
- A point can have, at most, 2 constraints on it. It is then “fully constrained”.
- A point with only one constraint is “partially constrained”
- A point with no constraints is “unconstrained” and the point is shown as a green plus sign

Note A rule of thumb is to have only one green point per template and all other points are red.

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 B is constrained by point A, point A is said to be the parent of point B and moving point A will affect point B, but you cannot move point B to affect point A. The example below shows a sample of this where the light blue arrow indicates a parent/child relationship from point A to point B.

- Point Constraints provide structure to the points making up each component.
- A Constraints basically defines where a point is located, relative to another “Parent” point.
- Constraints can have different parents.

Point Constraints Example



Constraint Types

There are a variety of constraint types that can be applied to a point's properties. By applying two of these constraints to a point structure defining the points relationship to others is established.

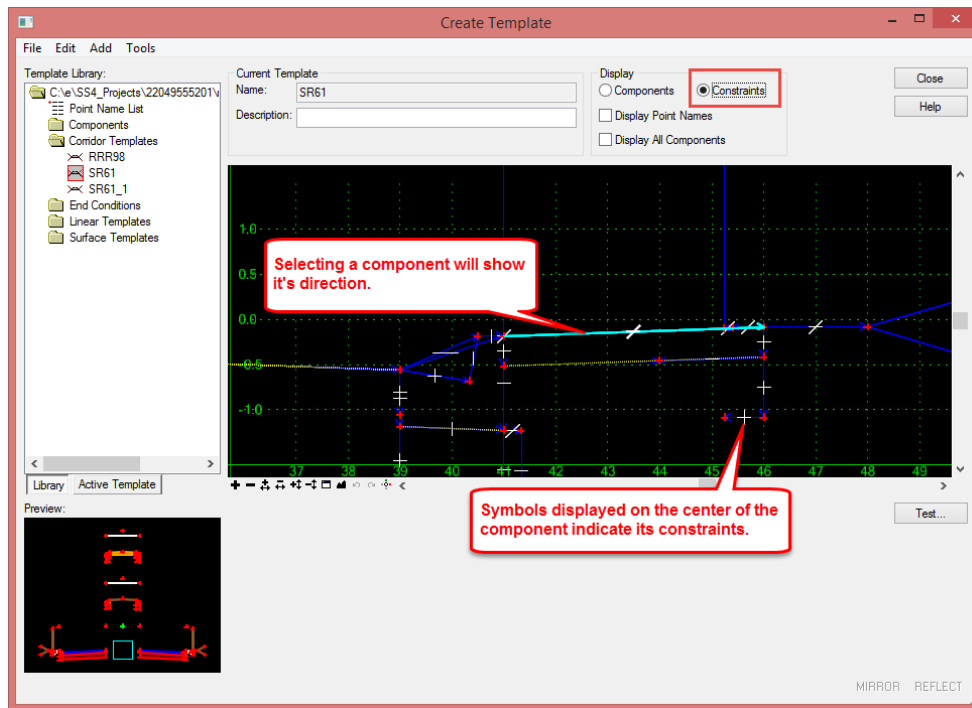
Corridor Modeling provides a variety of constraint types for roadway template design (*Horizontal, Horizontal Maximum, Horizontal Minimum, Vertical, Vertical Maximum, Vertical Minimum, Slope, Vector Offset, Project to Surface, Project to Design, Angle Distance*) as described as defined below:

- **Horizontal** - The child point remains at the given horizontal distance from the parent point.
- **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** - The child point remains at the given vertical distance from the parent point.
- **Vertical Maximum** - The child point has two parent points 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).
- **Slope** - The child point will maintain the given slope from the parent point. Slope constraints can, additionally, have rollover values assigned to them. Rollover values are used to set the slope constraint based on a high side slope difference and a low side slope difference, and a reference point which defines the controlling slope to the parent point. Slope constraints are absolute. Slopes going from lower-left to upper-right are positive regardless of whether the child point is to the left or right of the parent.
- **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 similar to 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 constraints types are available.

Display Constraints

Switching the Display mode from Components to Constraints will provide a graphical representation of the relationships of the points making up the template.



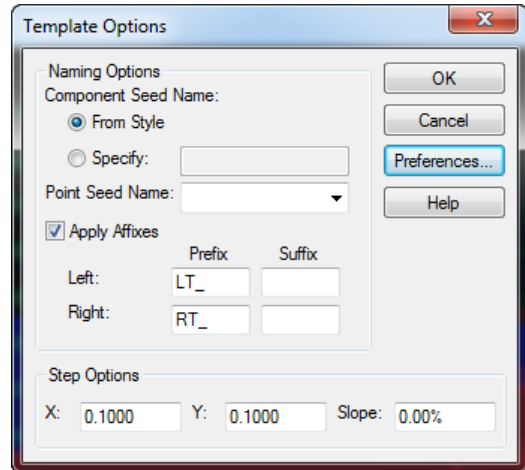
- **Components/Constraints** - Determines the display mode of the template. If the display components field is set, then the components is displayed. If the display constraints field is set, then the point constraints is displayed. Points are always displayed.
- **Display Point Names** - Specifies point names are displayed (in white), when this option is checked. If the point has a Feature Name Override (applied on the Point Properties dialog), it is displayed in red.
- **Display All Components** - Specifies all components that are hidden because of their display rules are displayed with dashed lines, when this option is checked. For more specific details on defining display rules, see the [Display Rule](#) help topic.

TEMPLATE OPTIONS

There are some options you will find helpful when working in the Create Template dialog.

➤ **To select the FDOT defined Preferences:**

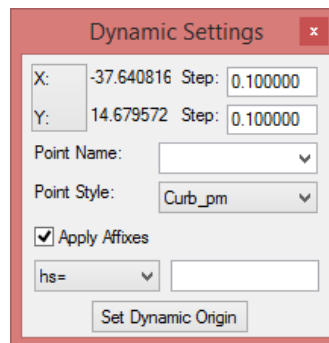
1. Select **Tools > Options** from the menu in the Create Templates dialog.
2. Click the **Preferences** button.
3. On the Preferences dialog select **FDOT** then click **Load** and **OK**.
4. Click **OK** to accept the options and **Close** the dialog.



DYNAMIC SETTINGS

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

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

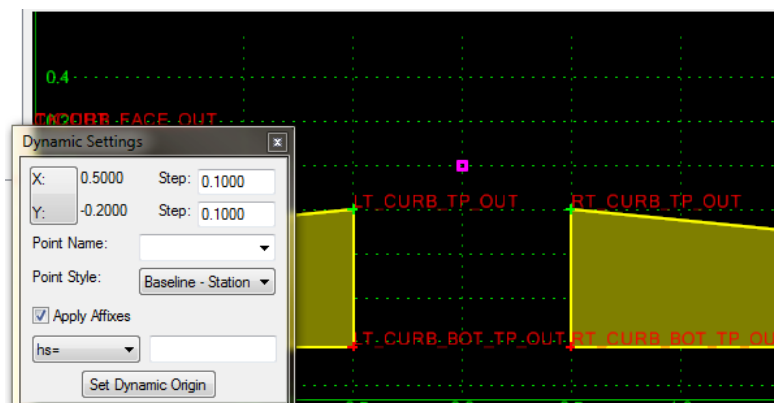
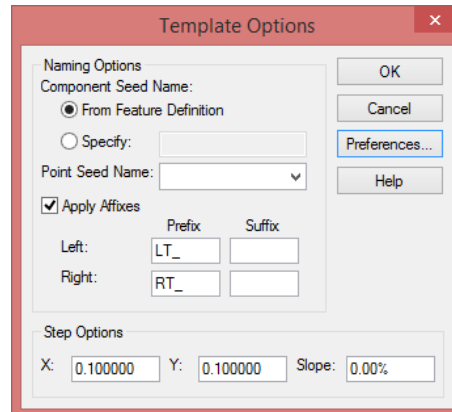


The Dynamic Settings dialog is accessed by selecting the menu option Tools > Dynamic Settings or using the *View Control* icons located below the Current Template window.

The Key-in pull-down specifies the type of key-in to be performed:

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

CONSTRUCTION OF TEMPLATES



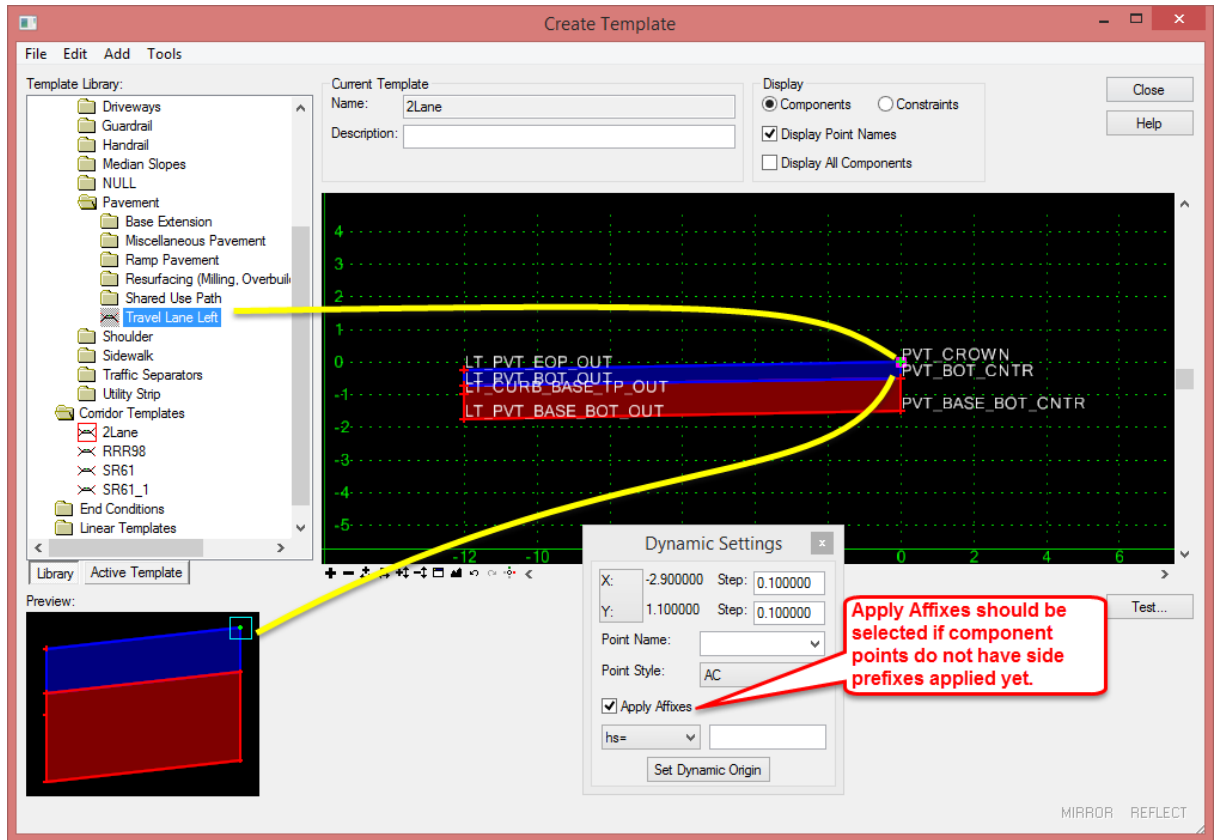
- **Components** - Building Blocks of Templates
 - Pavement
 - Curbs & Sidewalks
 - Tie Down & End Conditions
- Allows Drag & Drop
- Mirror/Reflect and Affixes
 - Components
 - Points (Including Overrides)
 - CDR's
- Allows for One Component

The Apply Affixes option can automatically insert a prefix or suffix to point names and components indicating the side of the road they were applied to. This is powerful because it allows a single component to be used on both sides of the road when used with the Mirror and Reflect placement options. More commonly, you can also select the Apply Affixes option on the dynamic settings dialog.

Note Thought needs to be given as to when this option should be selected. If you select it when creating a template and then also have it selected when applying the template you will have nested Affixes.

Building a Template from Components

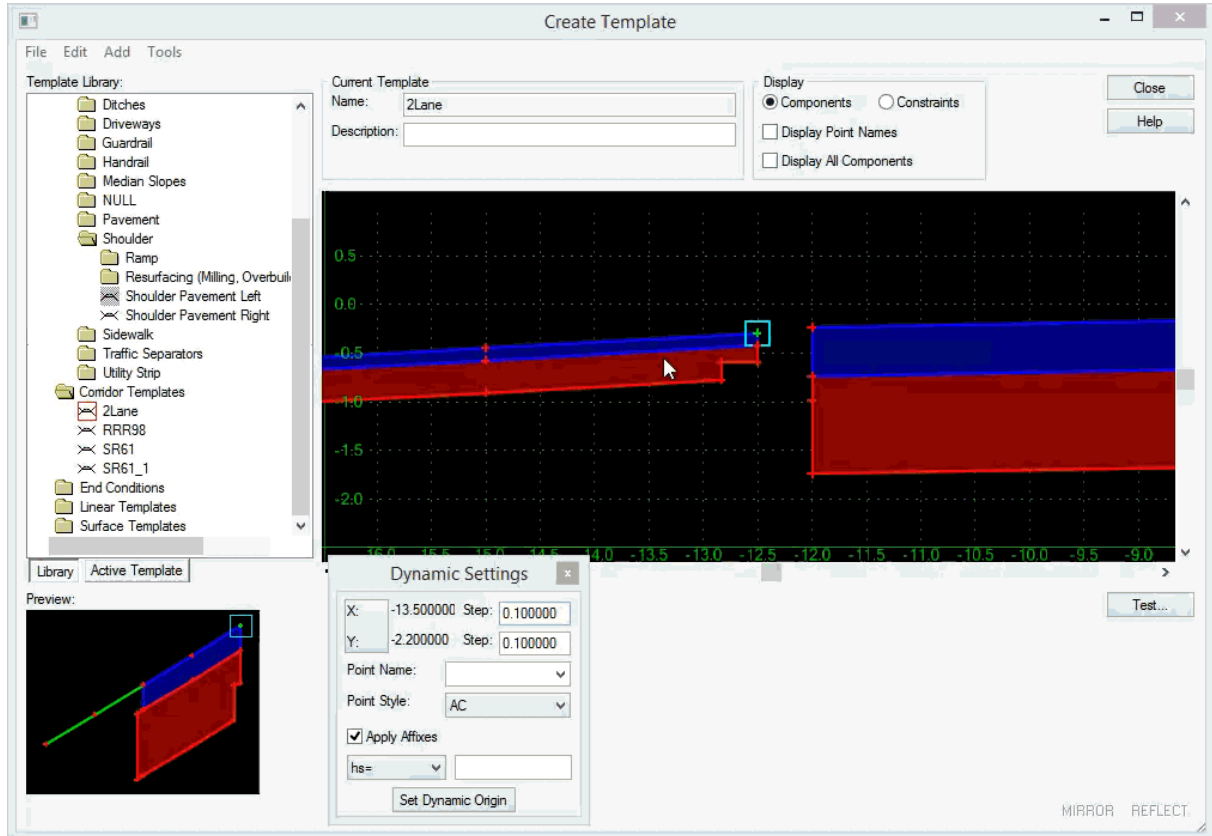
Drag components from Template Library folders or the Preview Window into the editing window.



Merging Points

Merges overlapping points into a single point. This command is available only if there is more than one point under the cursor. You are prompted to select the point to be deleted. Reset to exit the command.

Points will be merged automatically if a new component is attached directly to an existing component.

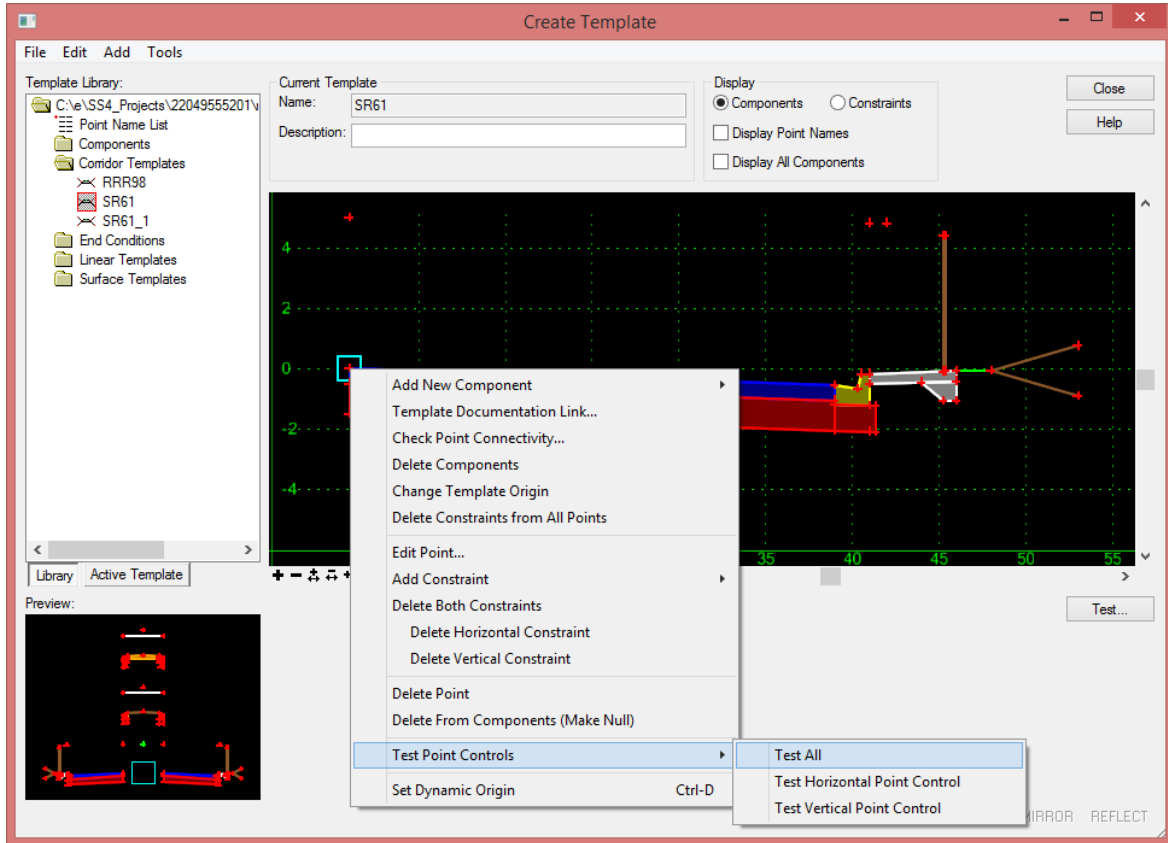


Note If the point remains green, you deleted the wrong one.

Testing Components

To test simple components, right-click on the points and select “Move Point” to see how the point constraints will react when points start dynamically moving.

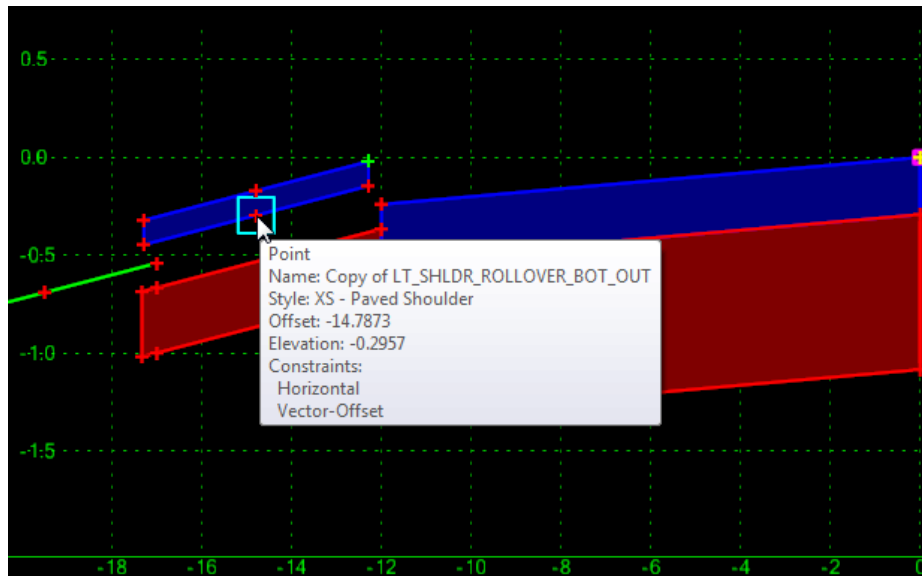
You can test constraints in components by moving points to see results.



Inserting Components

To insert a component between other components in a template you will need to Unmerge the components.

- Right-click on the component and select Unmerge Component points.
- Points in the component will be renamed, inserting “Copy of” before the name. This breaks other components constraints to the points allowing you to move the component.
- You can then insert the new component and rename the points of the unmerged components before attaching it to the inserted component(s).
- Previous constraints and attachments will have to be recreated and points should be merged after moving components into place.



EXERCISES

OPTIONAL: To prepare your computer for the next set of exercises:

- Delete the c:\e\projects\22049555201\ folder.
- Open the ComprehensiveTemplateDesign folder on the desktop and expand the DataSets folder.
- Extract the CT22049555201_Chapter2.zip file in the c:\e\projects\ folder.

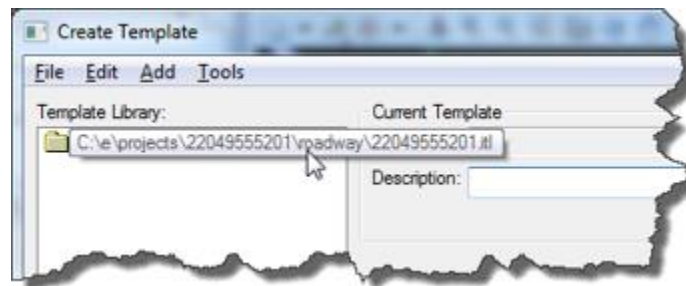
Exercise 2.1 Creating a Static Template

In this exercise students will create the backbone of a resurfacing template with widening and new shoulders.

Note Steps 1-7 (loading Create Template preferences) are only needed if MicroStation was closed and restarted.

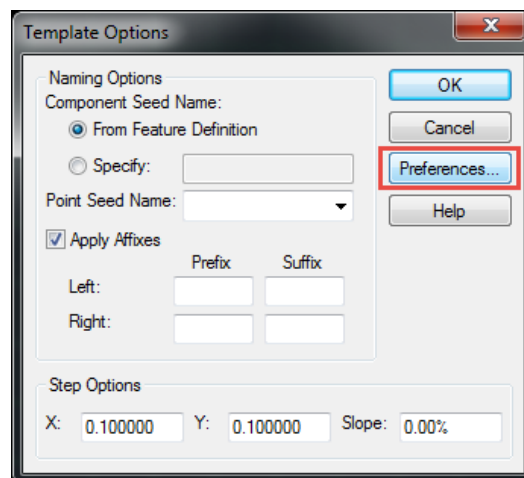
- Open the *DSGNRD01.dgn* file of the c:\e\projects\22049555201\roadway\ folder in the FDOTSS4 Workspace in MicroStation.
- Use the **F12** key to launch the Create Template dialog.

If the ITL is named properly the Project ITL file should already be loaded.



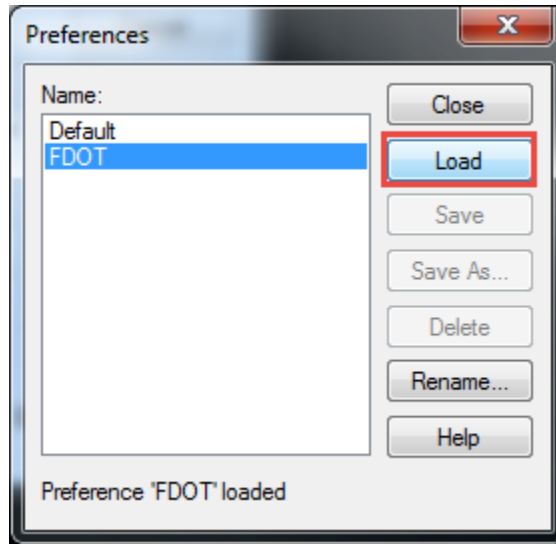
Note The FDOT workspace provides some predefined preferences that are useful when working with templates. These preferences should be loaded for each new MicroStation session.

- Select **Tools > Options** from the menu.
- On the Template Options dialog press the **Preferences** button.



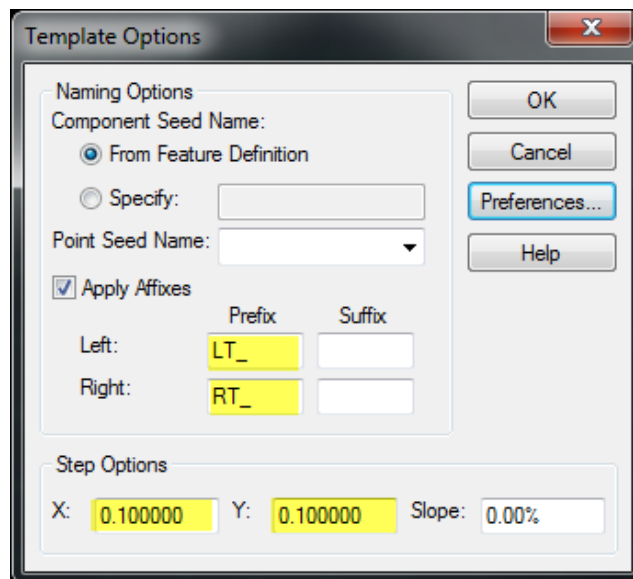
- On the Preferences dialog, select **FDOT** from the list and press **Load**.

Note You can also double-click **FDOT** to load the preferences.



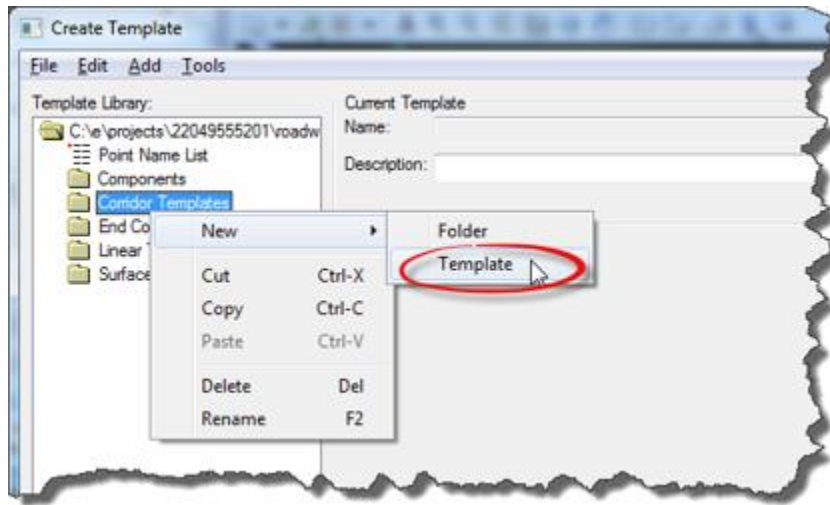
- Press the **Close** button to return to the Template Options dialog.

Notice that Left and Right Prefixes have been defined and the Step Options have been set to a tenth. The step options allow the components being dragged into the active template to snap onto the grid at one tenth of a foot intervals.

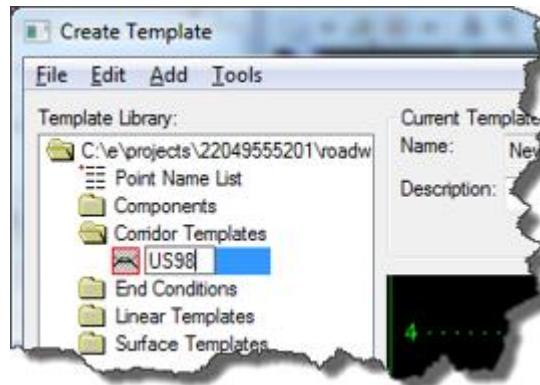


- Press **OK** to close the Template Options dialog.
- Back on the Create Template dialog, double-click on the root folder to expand it and view the contents.

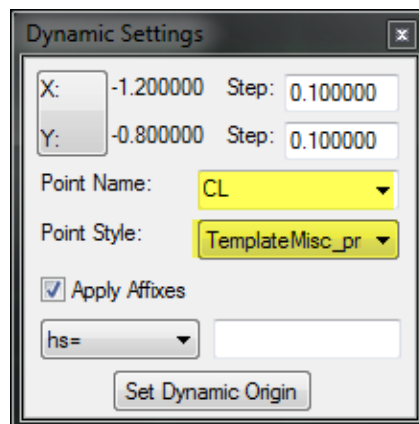
9. Right-click on the Corridor Templates folder and select **New > Template** from the context menu.



10. When prompted, enter the new template *name*: US98.

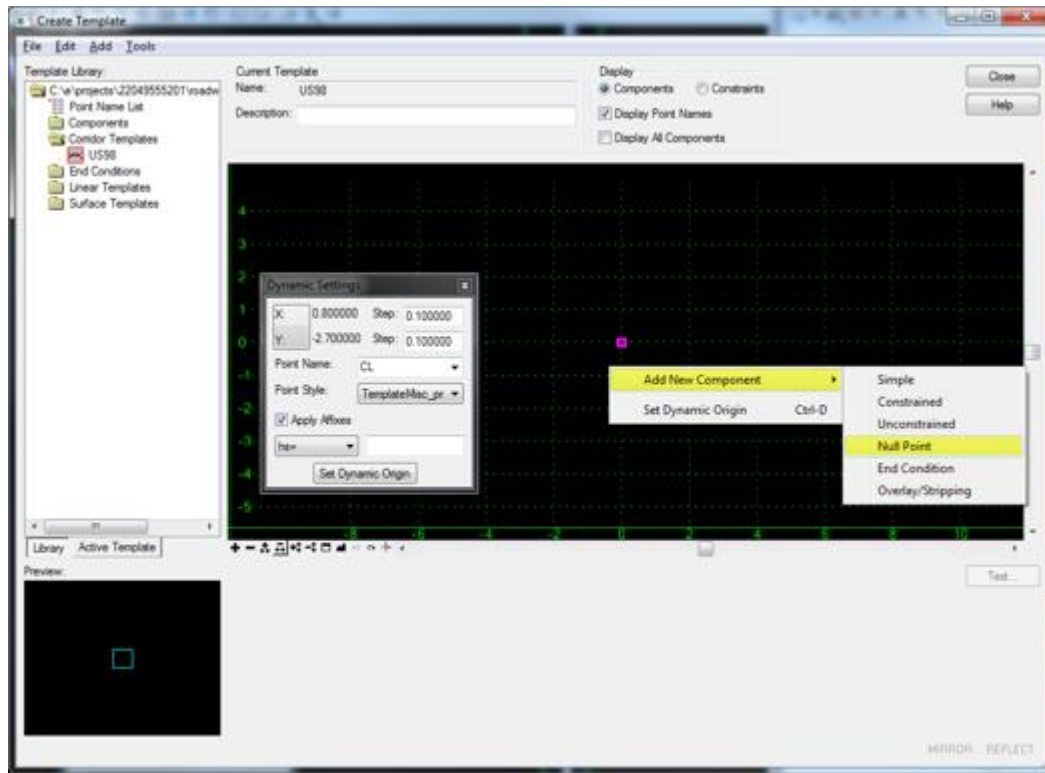


11. Select **Tools > Dynamic Settings** from the menu.
12. On the Dynamic Settings dialog, key-in **CL** in the *Point Name* field and select **TemplateMisc_pm** from the *Point Style* drop down.



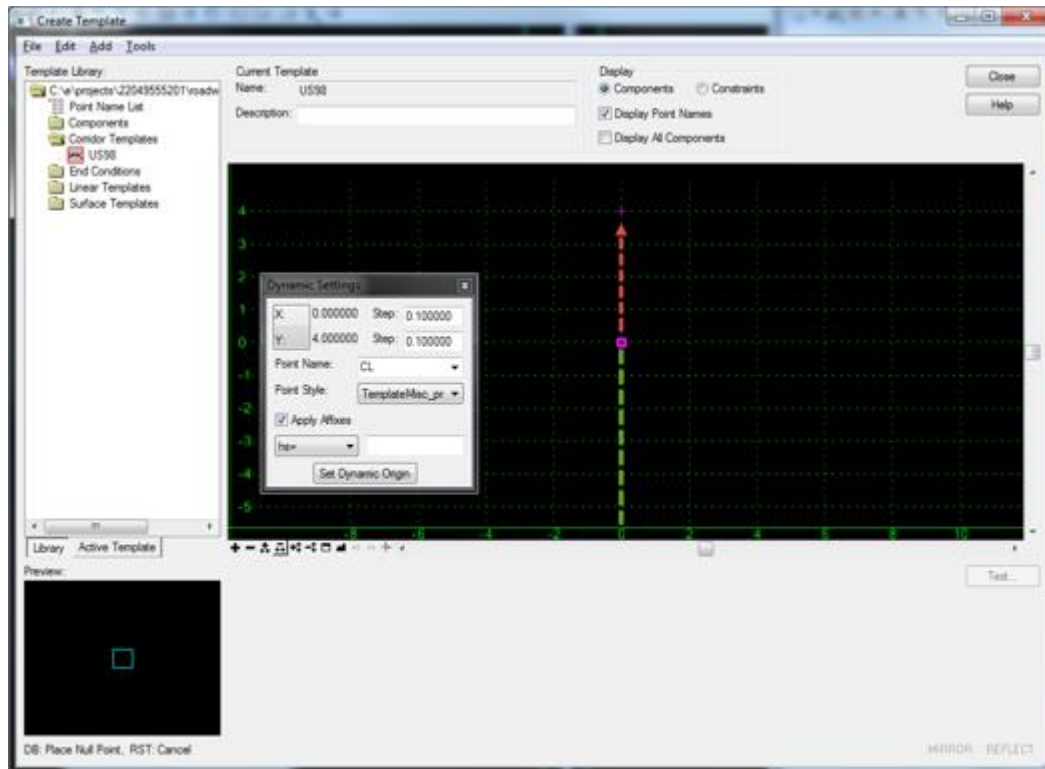
Note Null Point defines default properties for the creation of points.

- Right-click in the working area and select **Add New Component > Null Point** from the *context* menu.

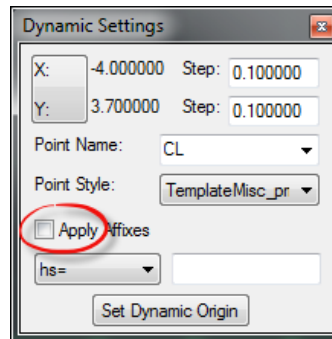


- Place the point above the magenta square at approximately **0' horizontal** and **4' vertically**.

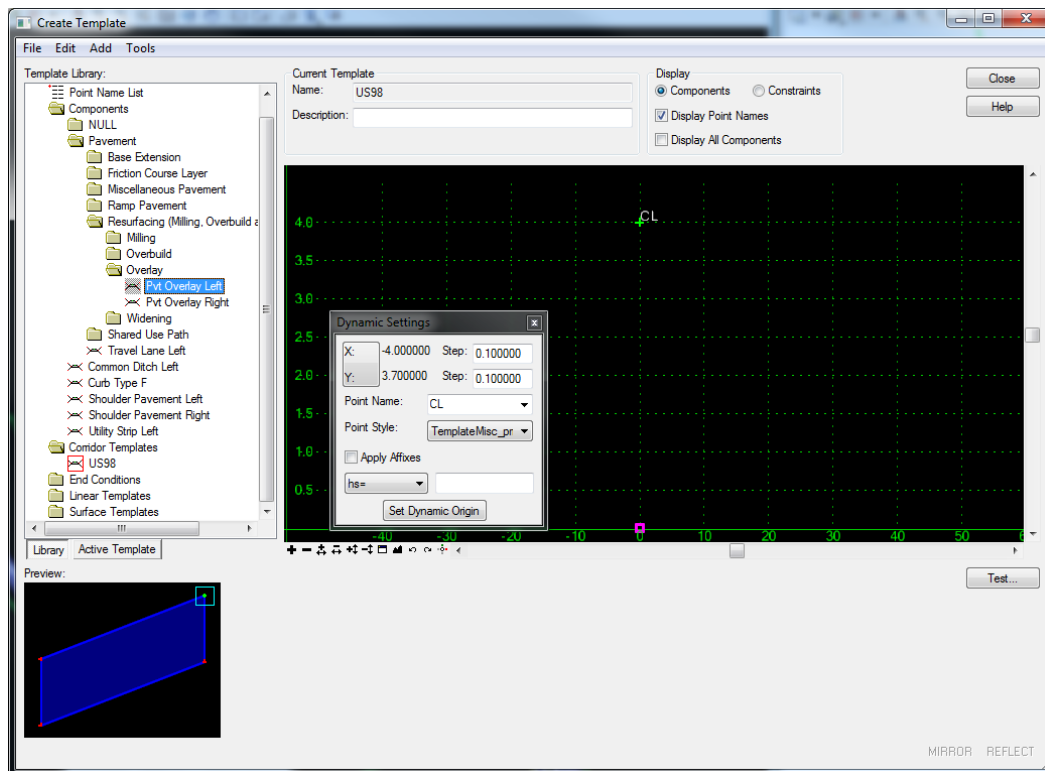
Note The magenta square indicates the template origin.



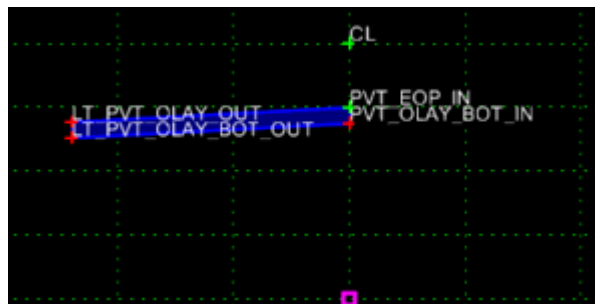
15. On the Dynamic Settings dialog, **Uncheck** the *Apply Affixes* check box so the prefixes will not be applied to point names and components when the next component is placed.



16. Navigate to the Components\Pavement\Resurfacing\Overlay folder and select the **Pvt Overlay Left** component.

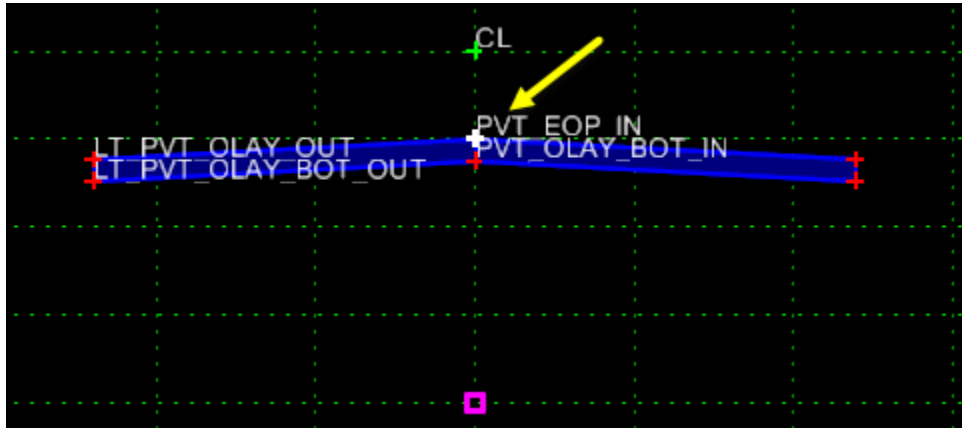


17. Drag the **Pvt Overlay Left** component into the working area and place it just below the *CL* point.



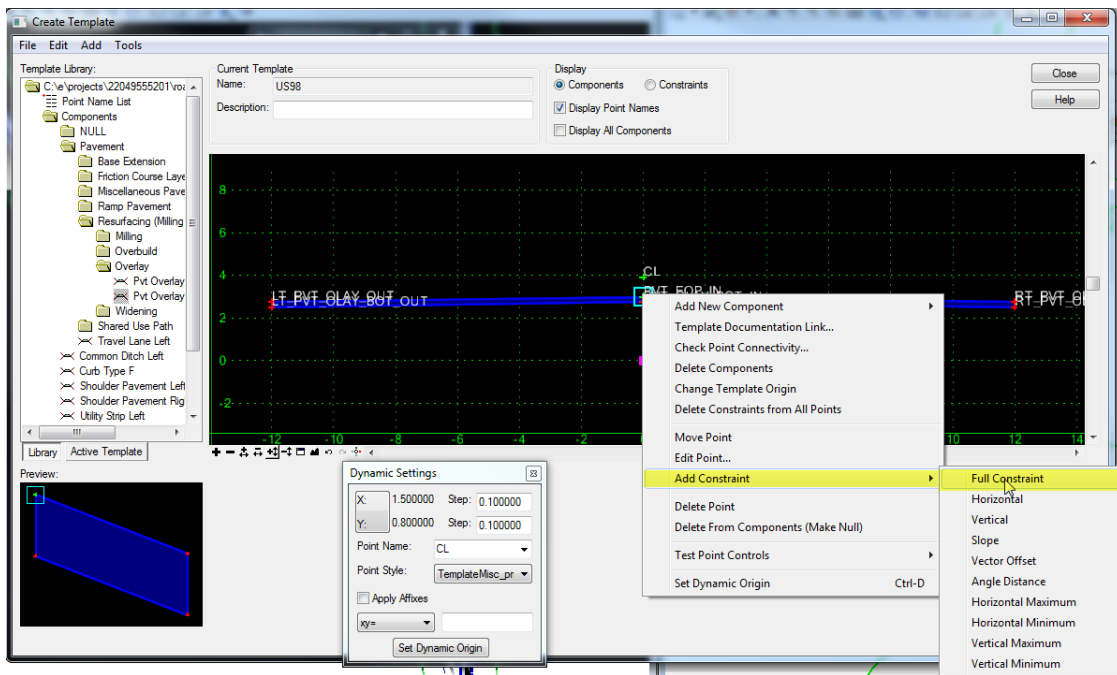
- Next select the **Pvt Overlay Right** component and snap it onto the green point of the component placed in the previous step.

When the green point turns wpressse you can drop the drag and the components will be joined. If the point is not wpressse when the component is released the points and components will not be merged together.

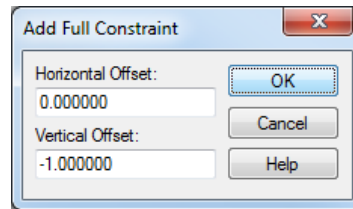


Note There should only be one green point per template so PAV_EOP_IN should be constrained to the CL point.

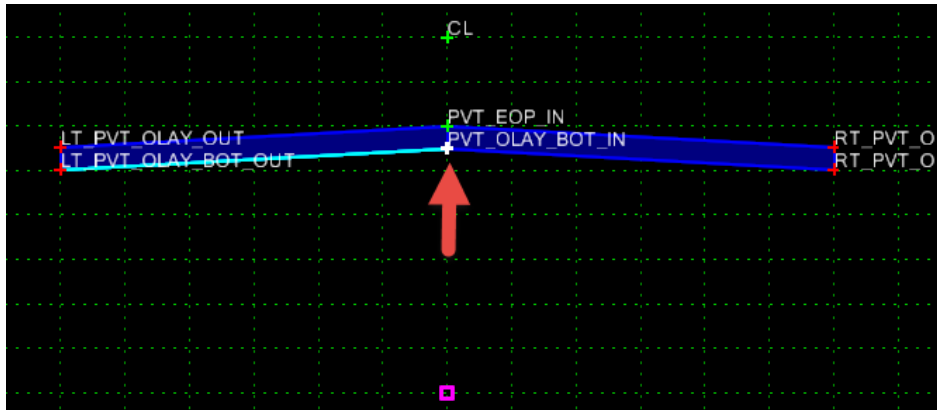
- Right-click on the **PVT_EOP_IN** point and select **Add Constraint > Full** from the context menu and then select on the **CL** point to define the point to constrain it to.



20. When prompted enter a *Horizontal Offset* of **zero** and a *Vertical Offset* of **-1** then press **OK**.



21. Navigate to the Components\Pavement\Milling folder and select the **Pvt Milling Left** component.
22. Drag and drop the **Pvt Milling Left** component onto the bottom of the *left overlay component*.

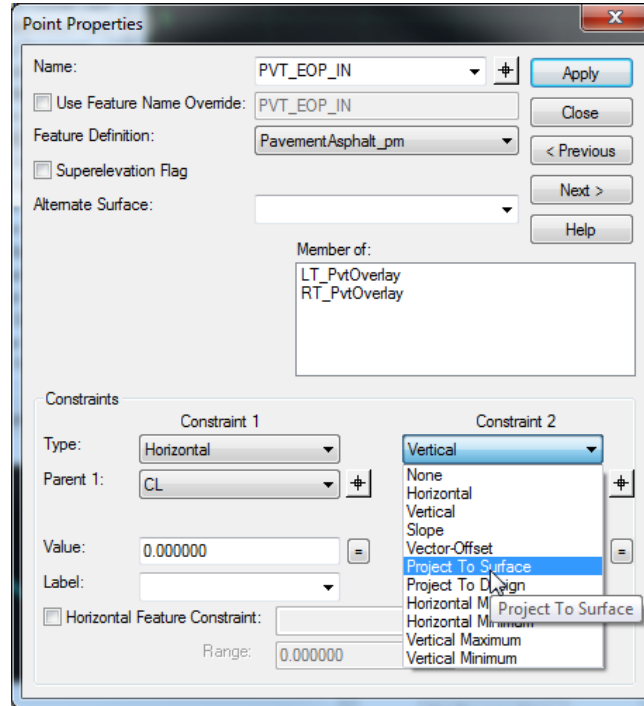


23. Drag and drop the **Pvt Milling Right** component onto the bottom of the right overlay component.

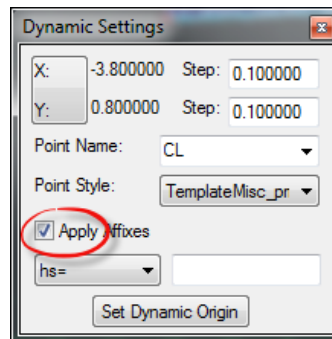
Exercise 2.2 *Configure Template to Match Existing Pavement Slopes*

To configure this template, match the existing pavement slopes the points on the top of the overlay components will need to be modified to target the surface.

1. Double-click on the point named PVT_EOP_IN to open its properties dialog.



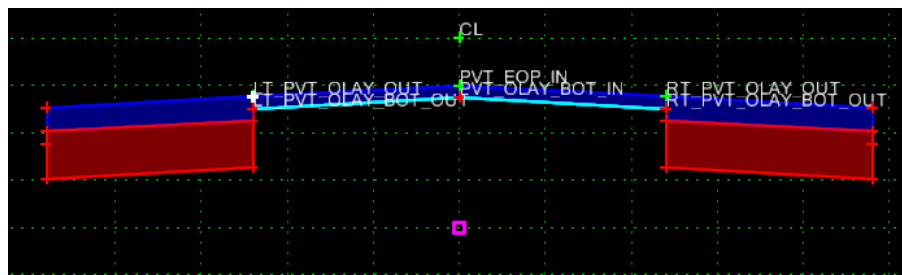
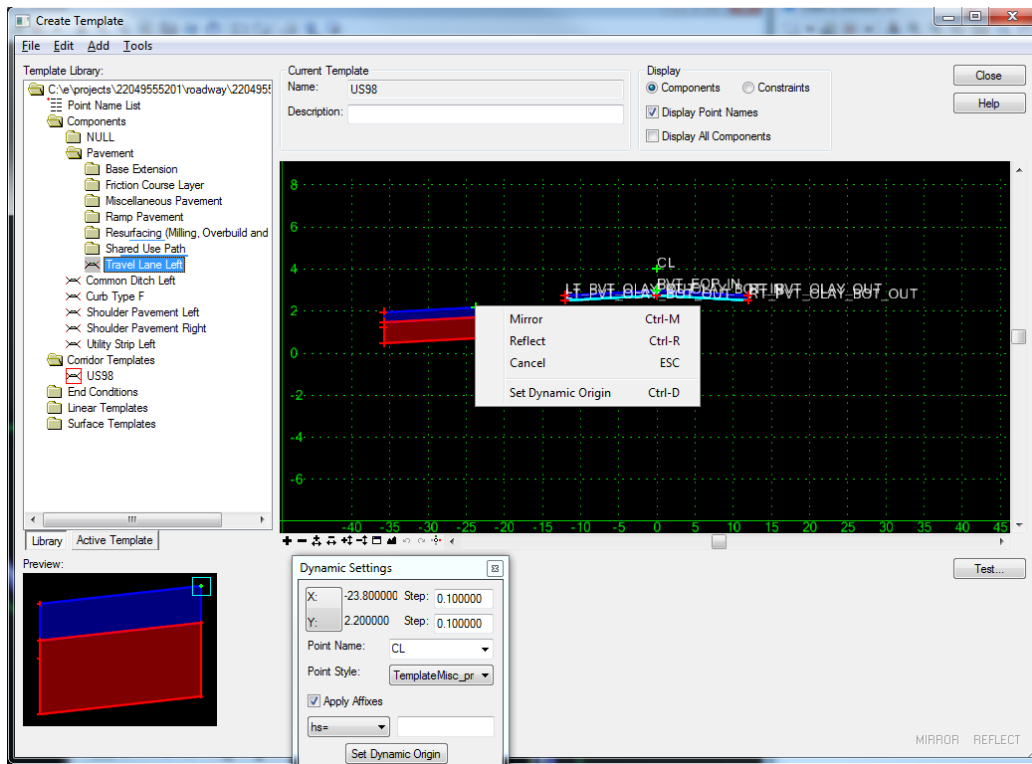
2. Change *Constraint 2 Type* to **Project to Surface**
3. Press **Apply** and then **Close** to return to the Create Template dialog.



4. Repeat *steps 1-3* for **LT_PVT_OLAY_OUT** and **RT_PVT_OLAY_OUT**.
5. On the **Dynamic Settings** dialog, **Check** the *Apply Affixes* box again to turn the point name prefixes back on.
6. Navigate to the **Components\Pavement\Milling** folder and select the **Travel Lane Left** component.

7. Drag and drop the **Travel Lane Left** component onto the top left point of the overlay. Right-click while dragging and select **Mirror** to attach the component to both sides at the same time.

Note *Ctrl + M will also toggle the Mirror function on and off during the drag and drop function.*



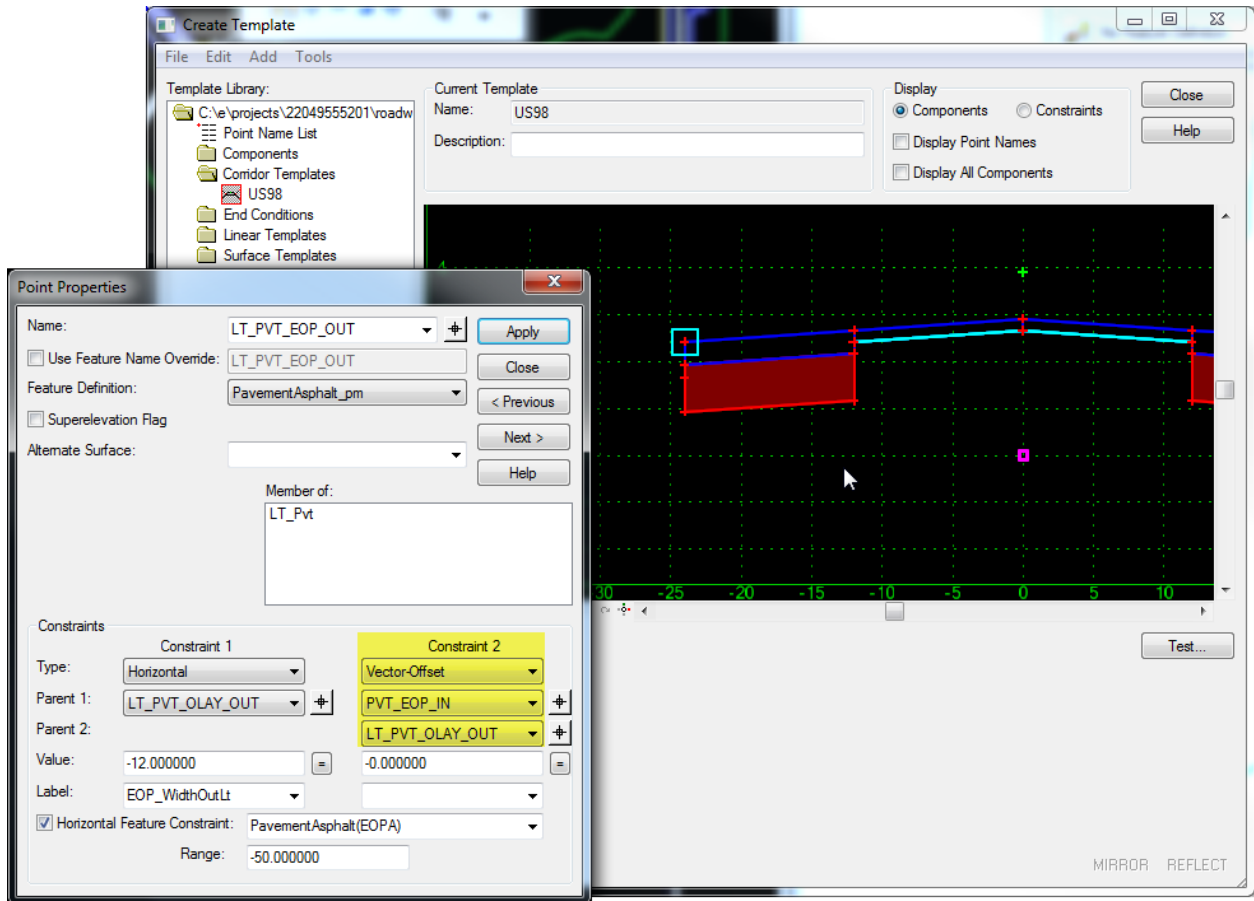
Exercise 2.3 *Configure Widening to Match Existing Pavement Slopes*

To make the widening follow the same slope as the existing pavement a Vector-Offset constraint must be applied.

1. Double-click on the **LT_PVT_EOP_OUT** point to edit its properties.
2. Change the **Constraint 2 Type** to a **Vector-Offset**

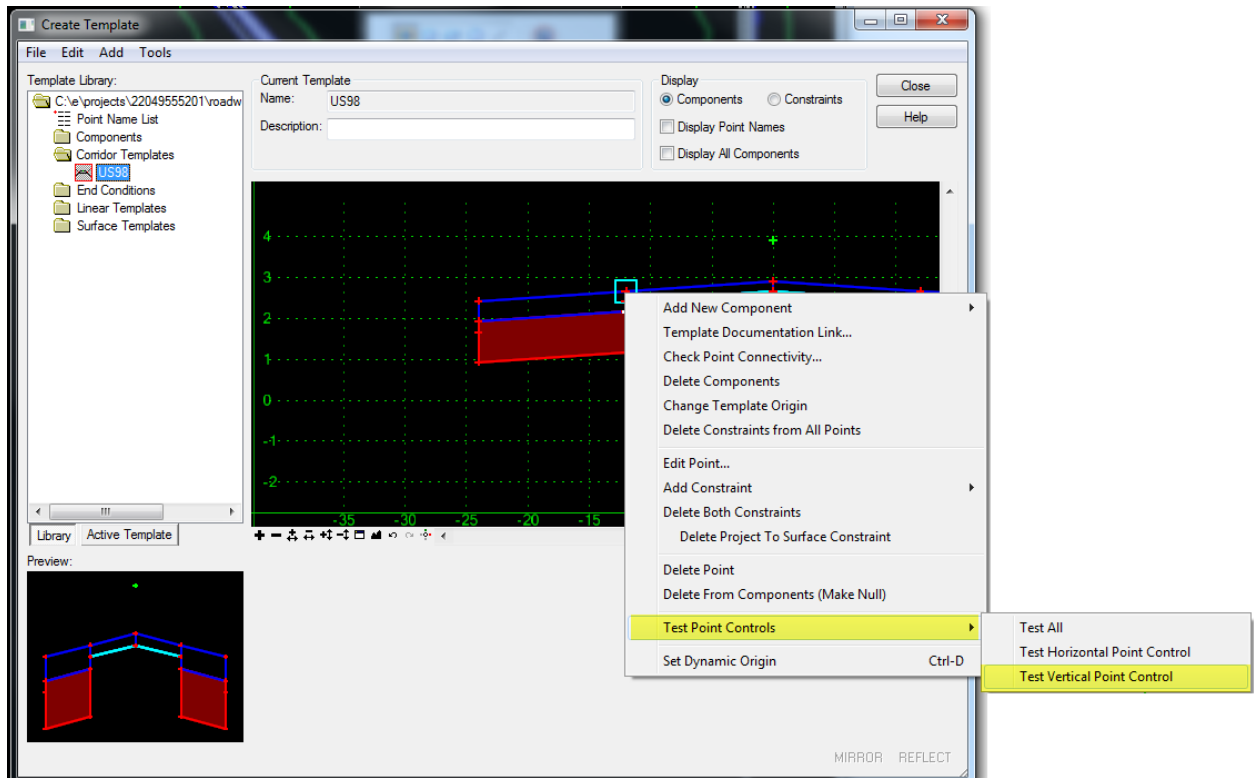
Parent 1 : PVT_EOP_IN

Parent 2 : LT_PVT_OLAY_OUT

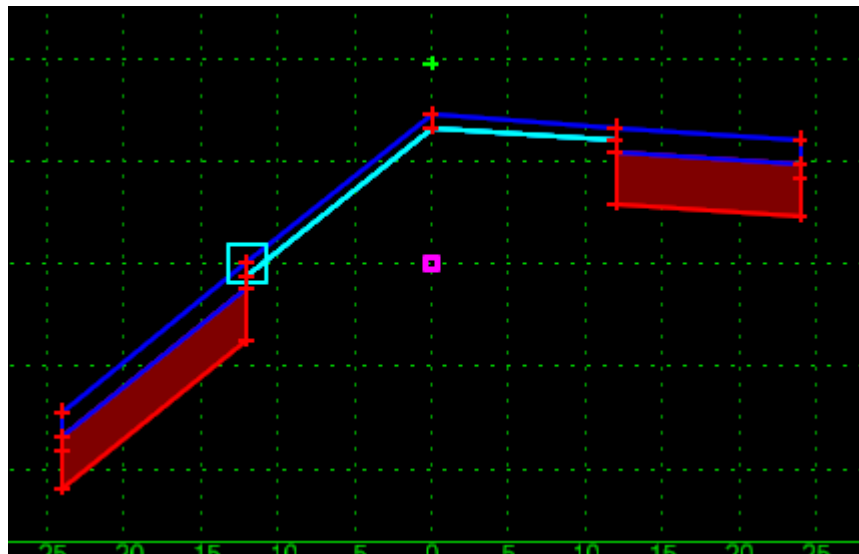


3. Press **Apply** and **Close** to return to the Create Template dialog.
4. Repeat **steps 30-32** for the widening on the right side of the template.

- To test the new constraints right-click on the top inside *widening point* and select **Test Point Controls** > **Test Vertical Point Control** from the *context* menu.

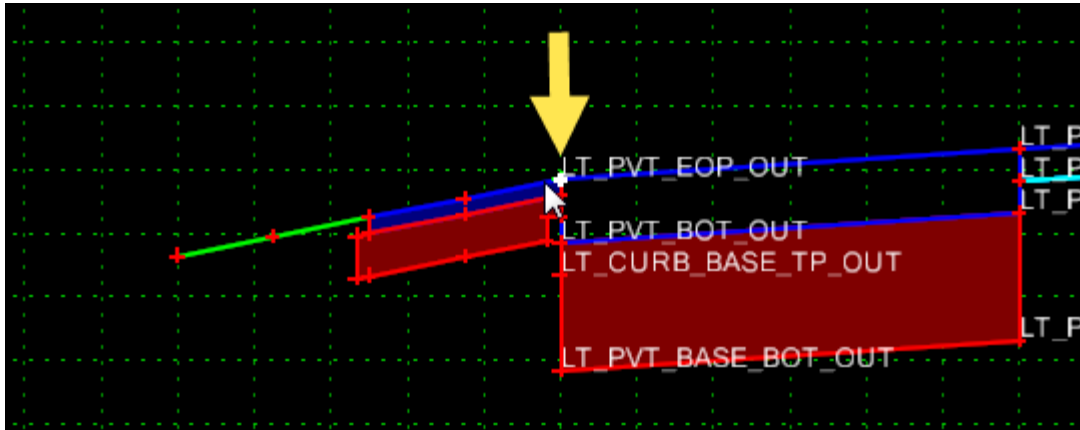


- Move the inside point up and down. This should cause the outside point to move as well to maintain the same slope as the resurfacing.

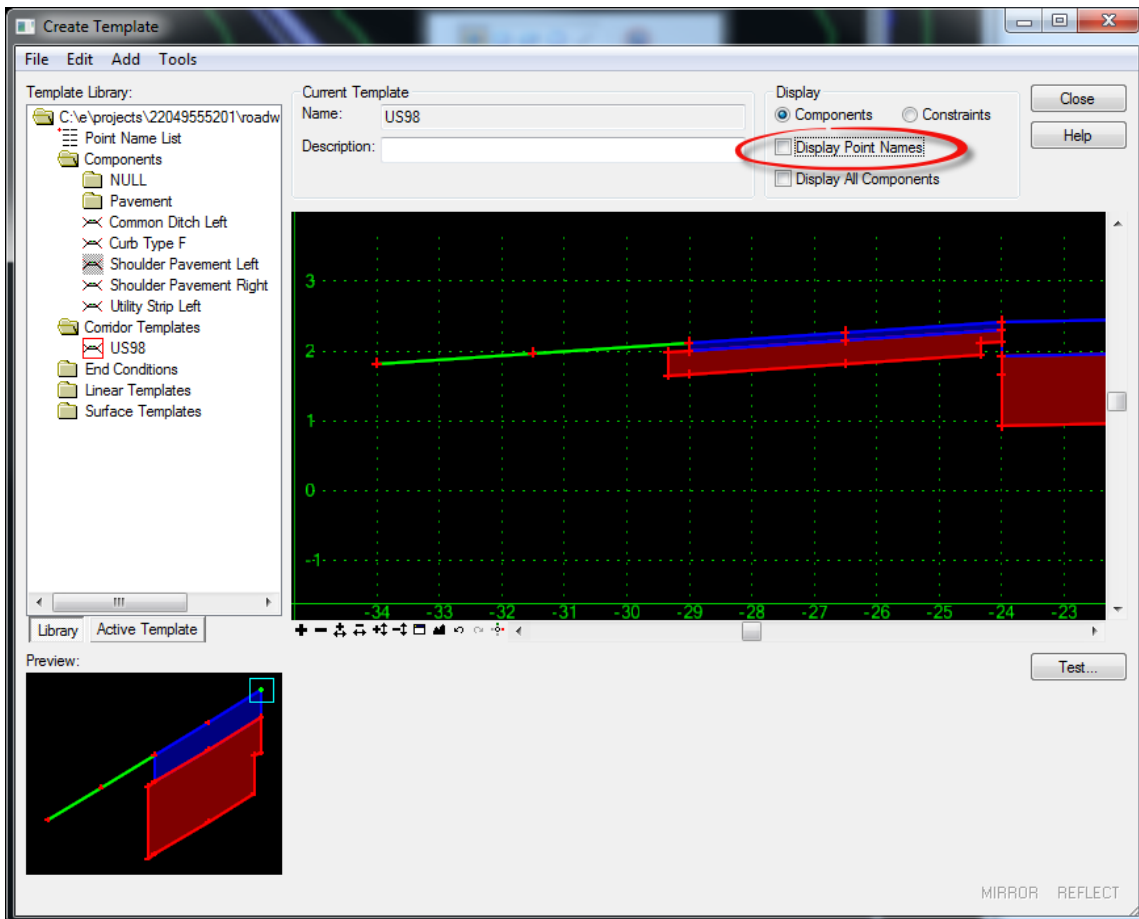


- Right-click to get out of the testing mode.

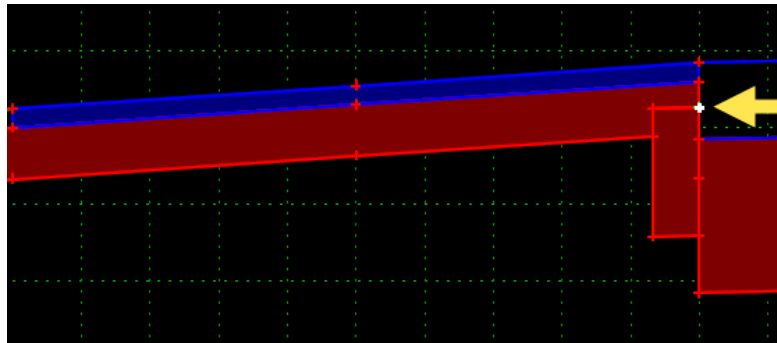
8. From the Components folder drag and drop the **Shoulder Pavement Left** component attaching it to the top left point on the widening component. Toggle **Off** the *Mirror* option using **Ctrl + F** while dragging.



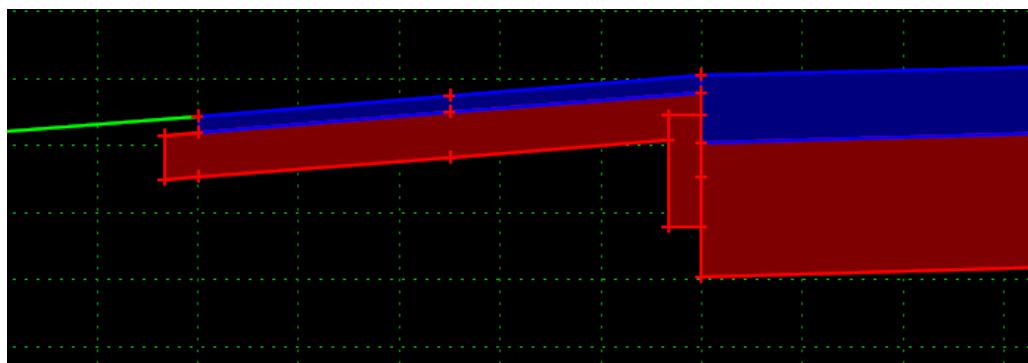
9. From the Components folder drag and drop the **Shoulder Pavement Right** component attaching it to the top right point on the widening component.
10. Uncheck **Display Point Names** to make the template more visible.



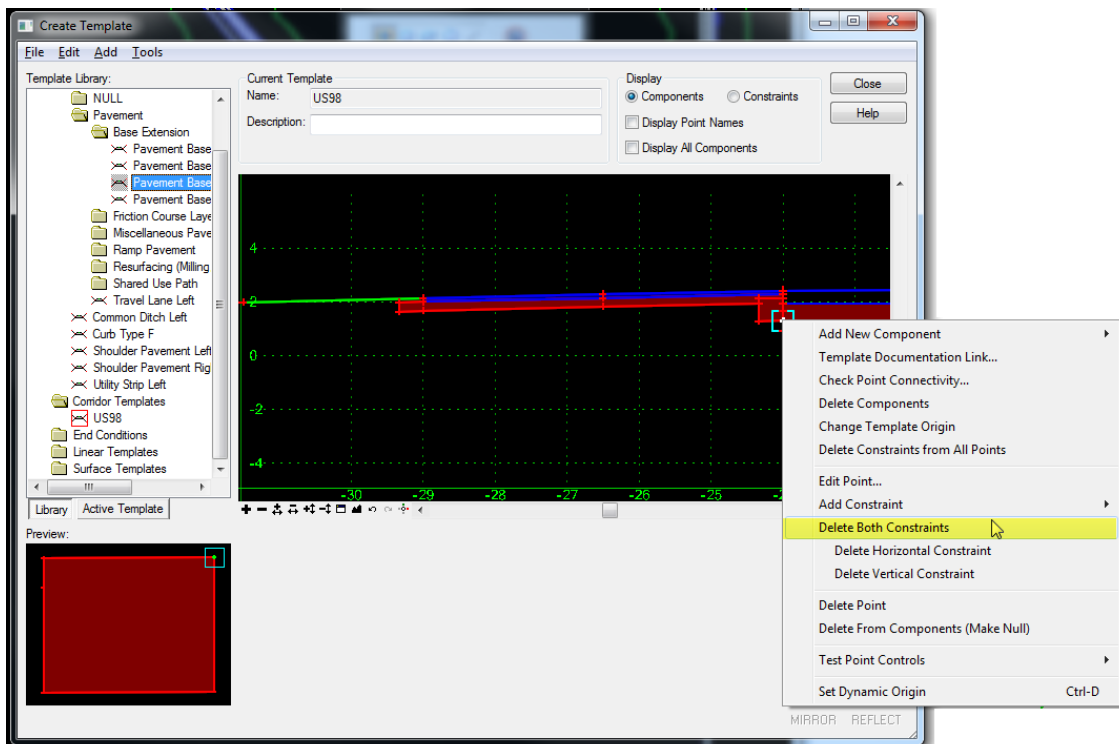
11. Navigate to the Components\Pavement\Base Extension folder and select the **Pavement Base**.



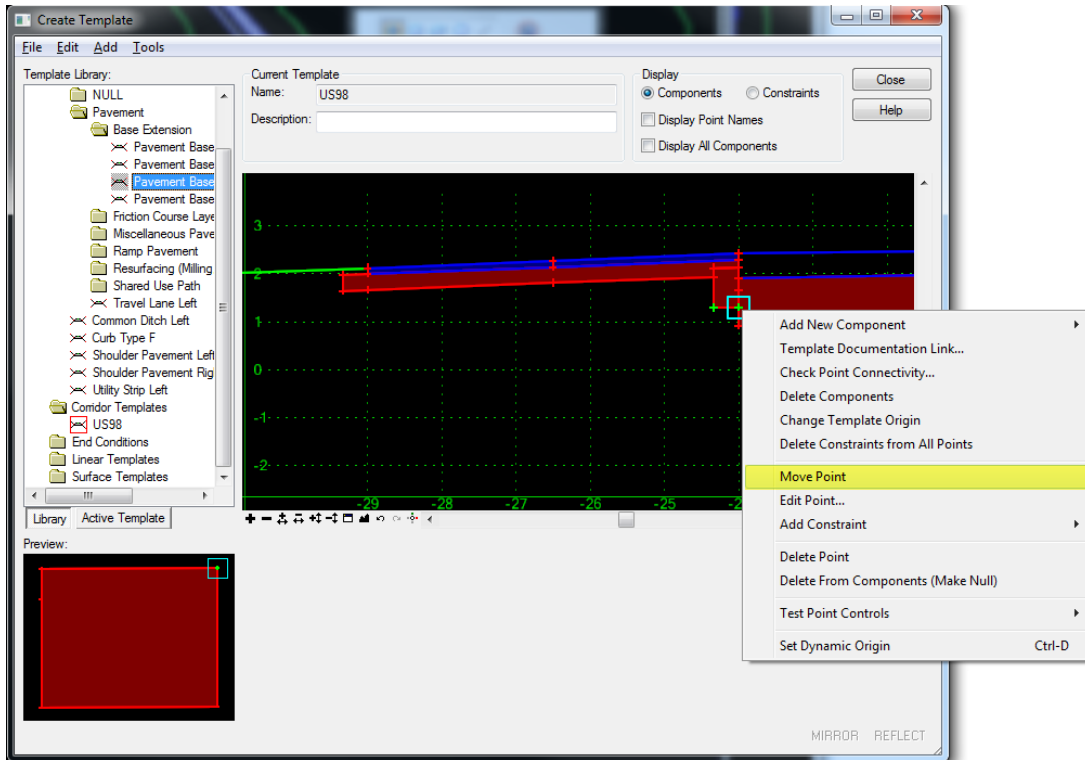
Note The component for the base extension is not the same depth as the pavement base so some adjustments will need to be made.



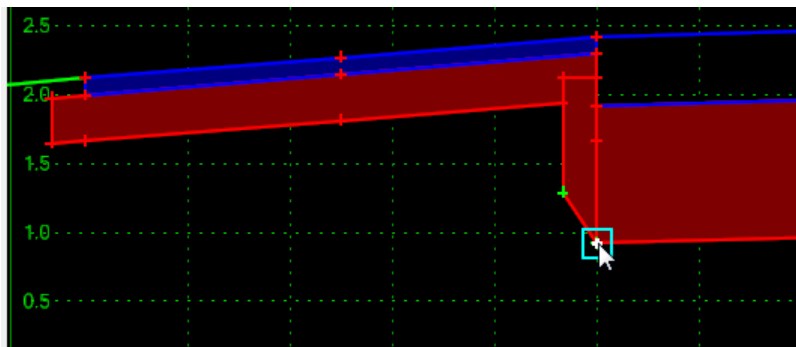
12. Right-click on the bottom inside point of the **base extension component** and select **Delete Both Constraints** from the *context* menu.



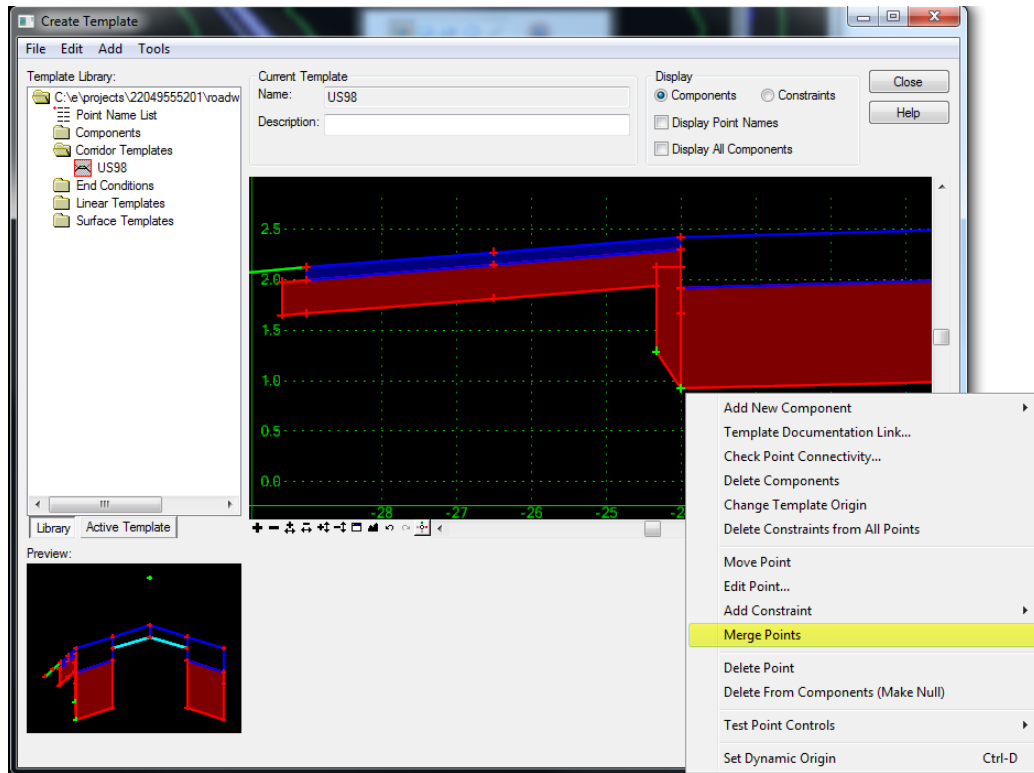
13. Right-click on the bottom outside point side point of the **base extension component** and select **Delete Both Constraints** from the *context* menu.
14. Right-click on the bottom inside point of the **base extension component** and select **Move Points** from the *context* menu.



15. Snap the **point** onto the bottom.

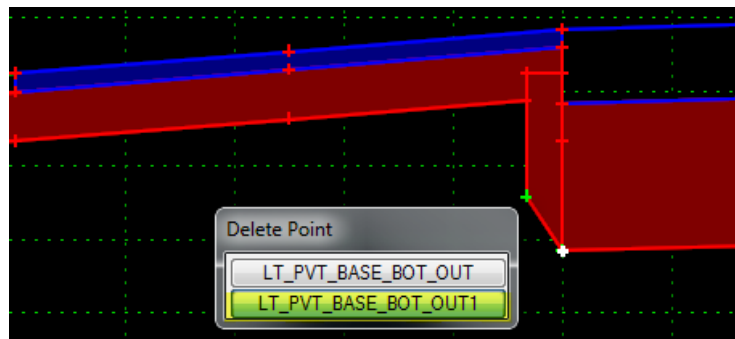


16. Right click on the **point** that was just moved and select **Merge Points** from the *context* menu.



17. When prompted, select **LT_PVT_BASE_BOT_OUT1**. This will delete one of the points sharing the same location combining that part of the components.

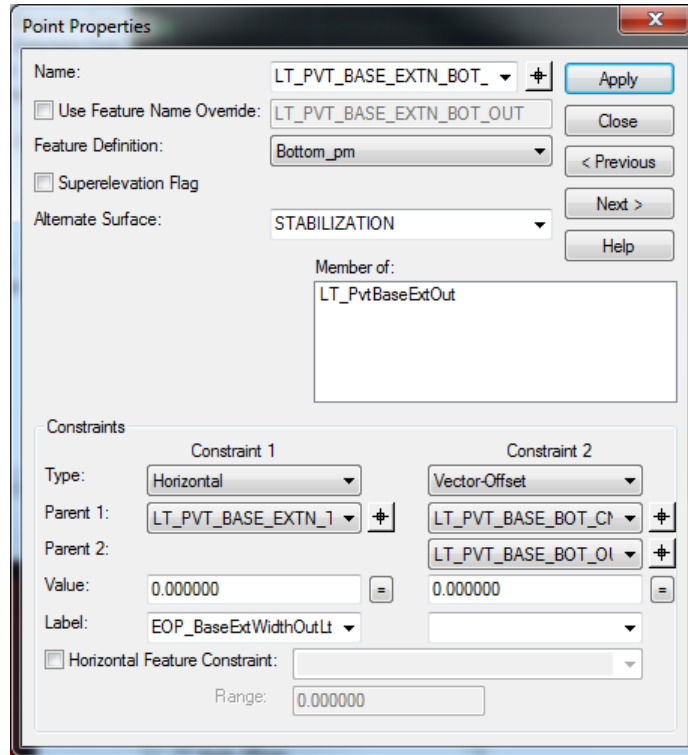
Note *If the remaining point is green then you deleted the wrong one.*



18. Double-click on the bottom outside point of the **base extension component** to edit its properties.

19. Edit the *points properties* as shown below:

Constraint 1		Constraint 2	
Type	Horizontal	Type	Vector-Offset
Parent 1	LT_PVT_BASE_EXTN_TOP_OUT	Parent 1	LT_PVT_BASE_BOT_CNTR
Parent 2		Parent 2	LT_PVT_BASE_BOT_OUT
Value	0.0	Value	0.0



Note The Vector-Offset constraint will force the bottom of the base extension to maintain the same slope as the base even if the slope changes for superelevation.

20. Repeat **steps 11-19** on the right side of the template to apply a base extension.
21. Once both sides are complete **Save** the template by selecting **File > Save** from the menu on the Create Template dialog and then **Close** the Create Template dialog.

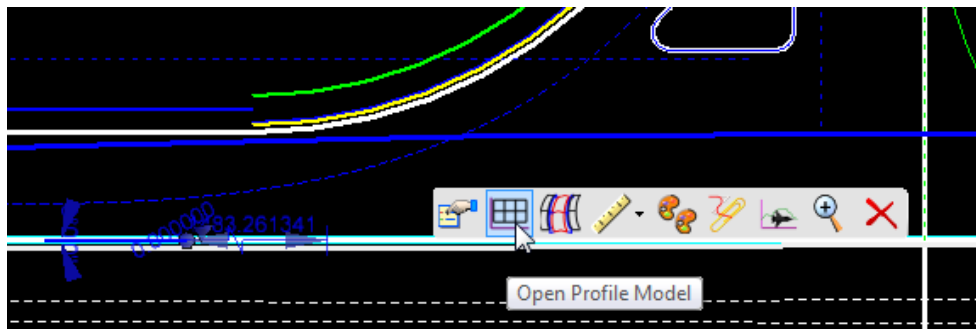
Exercise 2.4 Creating a Corridor

In this exercise students will create a corridor using the newly constructed template. To create a corridor you will need an alignment, a profile, and a surface. DSGNRD01.DGN contains the elements necessary but the active surface and profile must be defined.

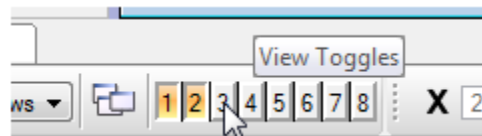
1. Begin by selecting the **green terrain boundary element** and then placing the cursor over the boundary to get the *context* menu. Select the second icon, **Set as Active Terrain Model**.



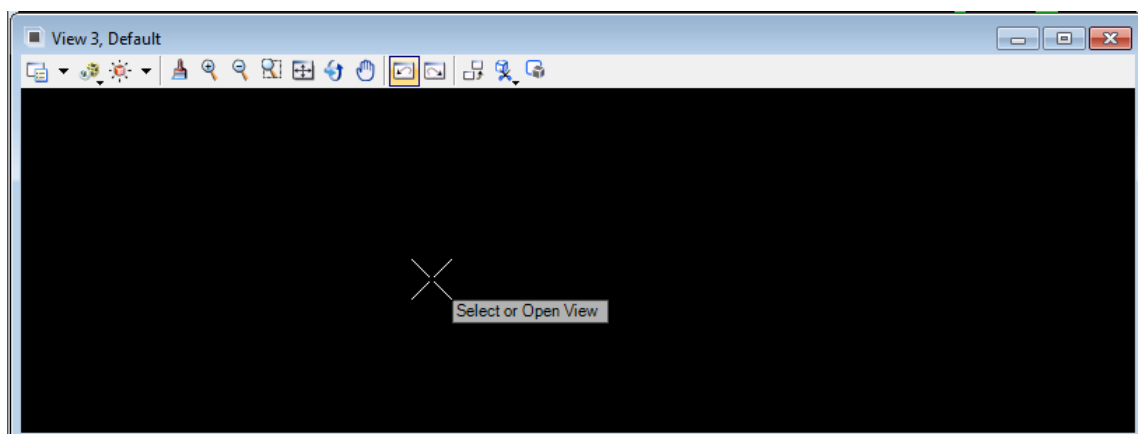
2. Open a *profile view* for the baseline of US 98 by selecting the **baseline** and then placing the cursor over the baseline to get the *context* menu. Select the second icon, **Open Profile Model**.



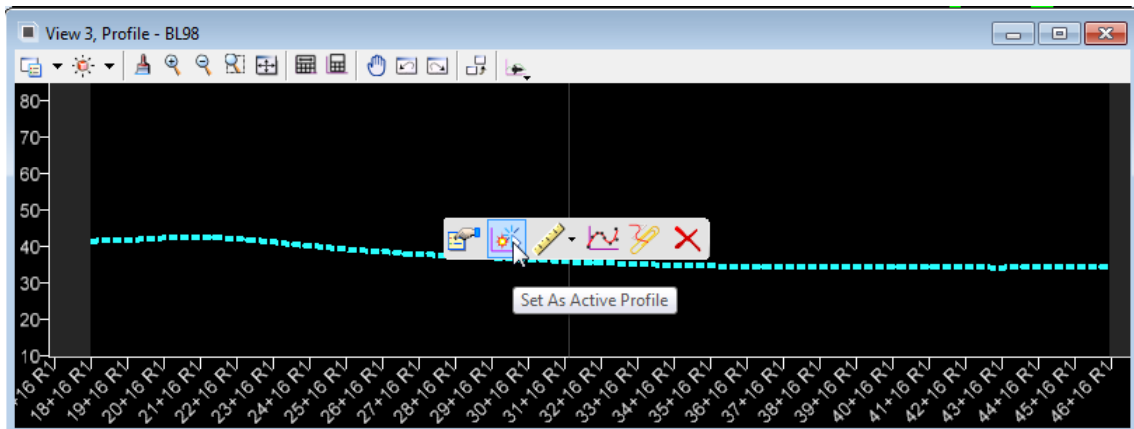
3. When prompted on the cursor to *select* or *open* a view, select **View 3** from the *View Toggles* toolbar.



4. Then select **View 3** to display the existing profile.

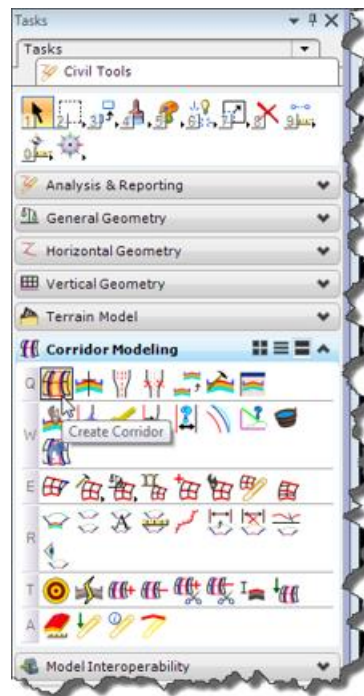


5. Select the **existing profile** and then hover the cursor over the profile to get the *context* menu. Select the second icon, **Set as Active Profile**.

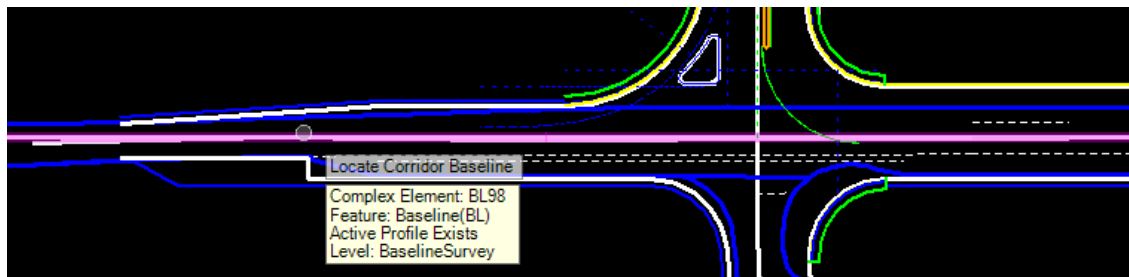


Note With the active profile and active terrain model defined a corridor can be easily created.

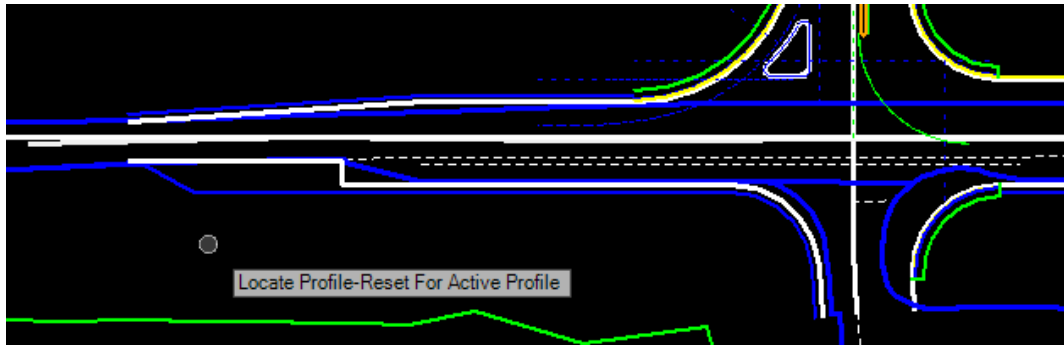
6. From the Civil Tools task menu, select **Corridor Modeling > Create Corridor**.



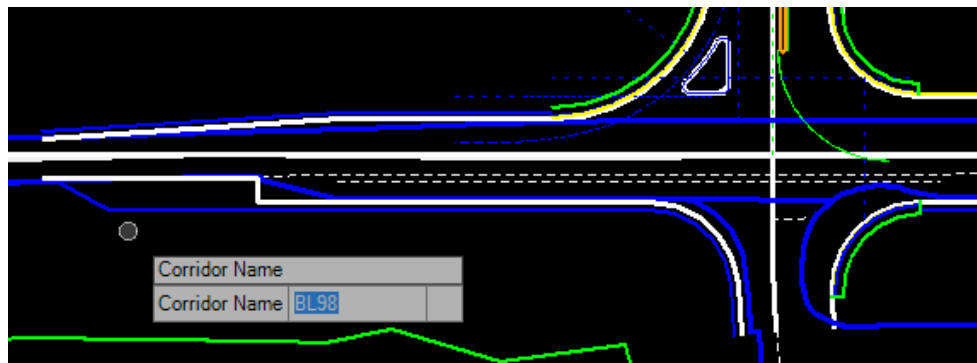
7. When prompted, select the **base line** of US 98.



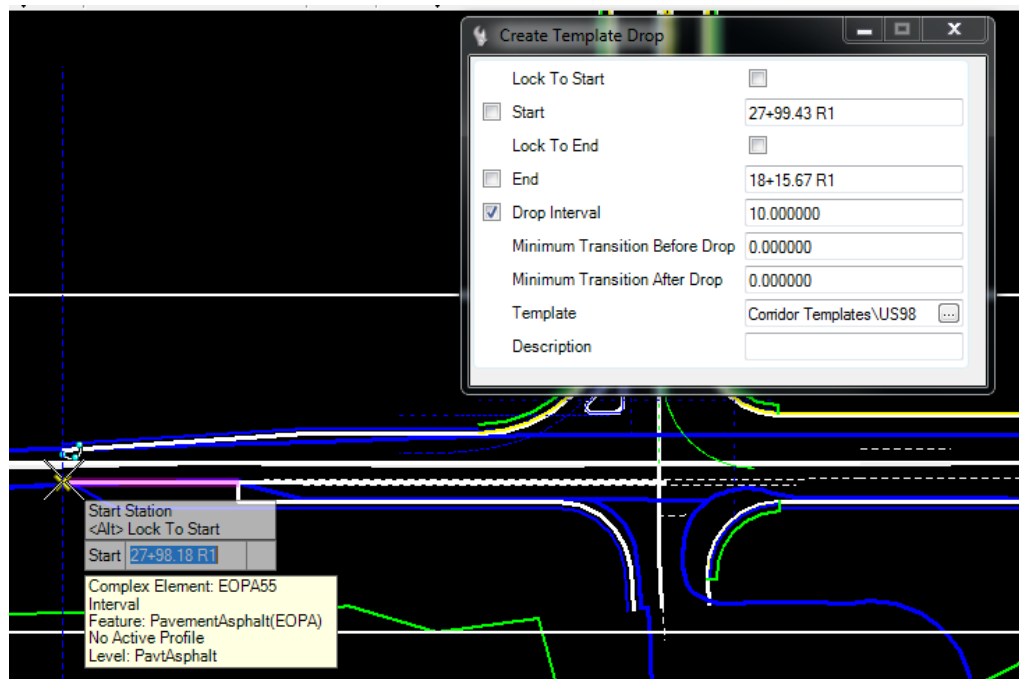
8. Next you will be prompted for a *profile*. Reset (right-click) to use the active profile for the baseline.



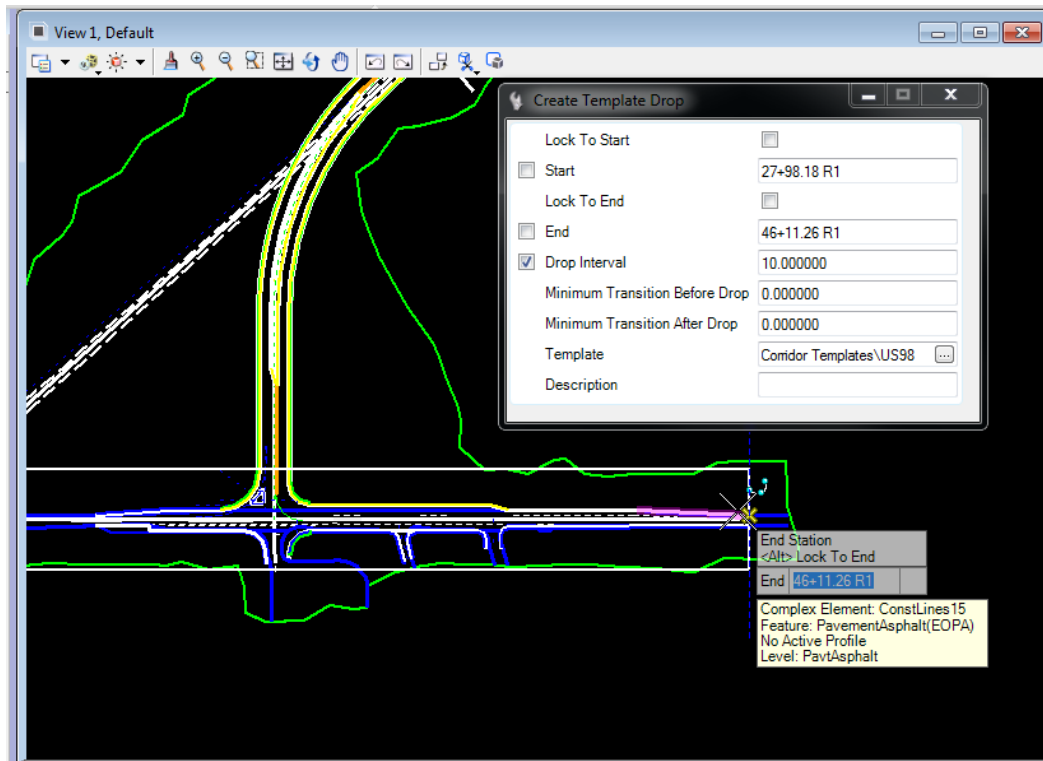
9. Next you will be prompted to *name* the corridor. Just Data Point (left-click) to accept the *default name* which matches the alignment name.



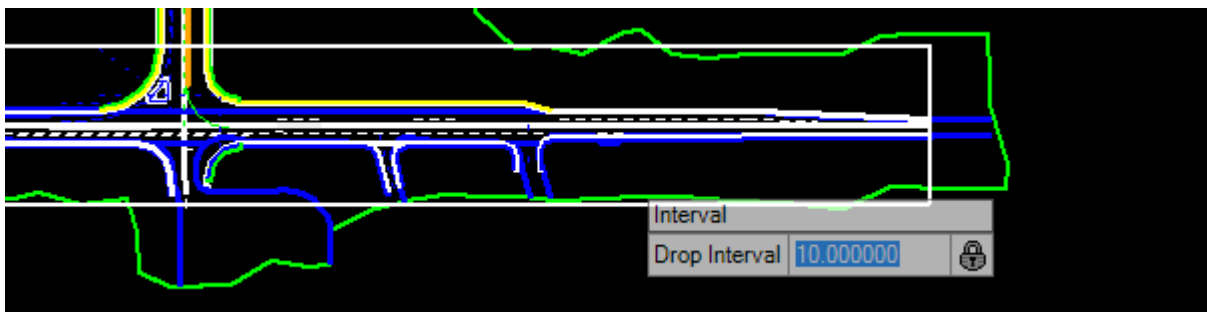
10. Next you will be prompted for the *Start Station* for the corridor. Make sure “**Lock to Start**” is **NOT** selected on the Create Template Drop dialog and then snap to the beginning of one of the *proposed edge of pavement lines* and **Data Point**.



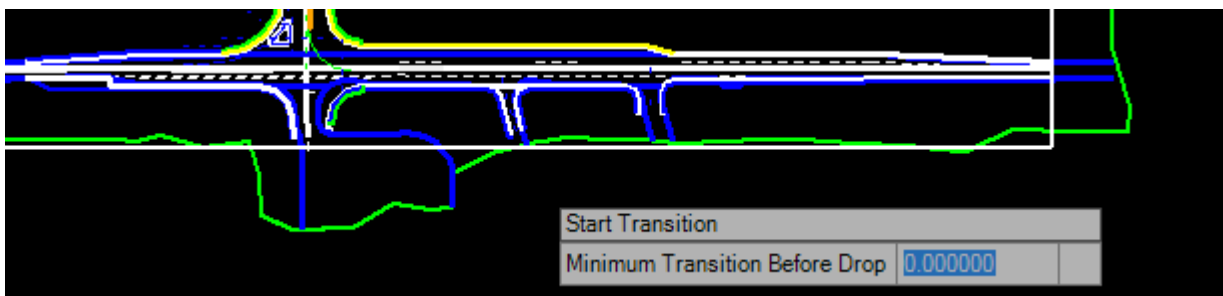
- Next you will be prompted for the *End Station*. Make sure **Lock to End** is **NOT** selected on the Create Template Drop dialog and then snap to the end of one of the *proposed edge of pavement* lines and **Data Point**.



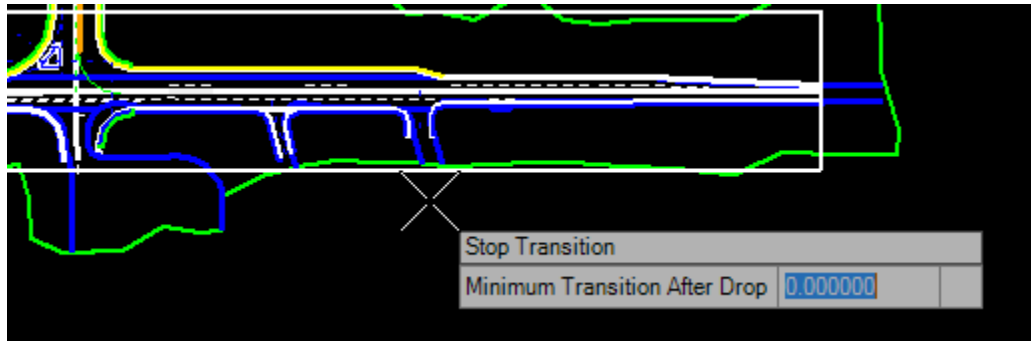
- When prompted for the *drop interval* key-in **10**, press **Enter** to lock the value, and then **Data Point** to accept.



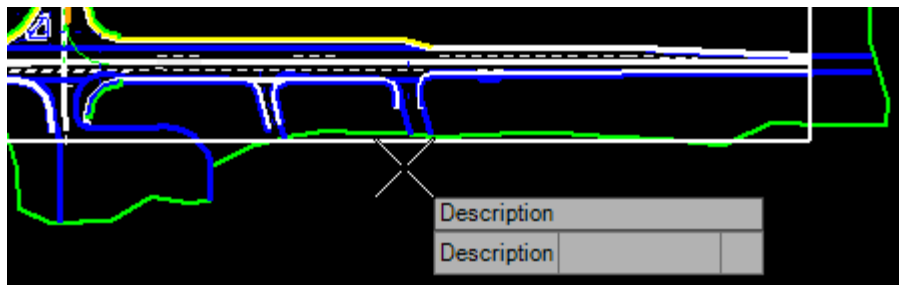
- Accept the default value of **Zero** for *Minimum Transition Before Drop* by using the **Data Point** to accept.



- Accept the default value of **Zero** for *Minimum Transition After Drop* by using the **Data Point** to accept.

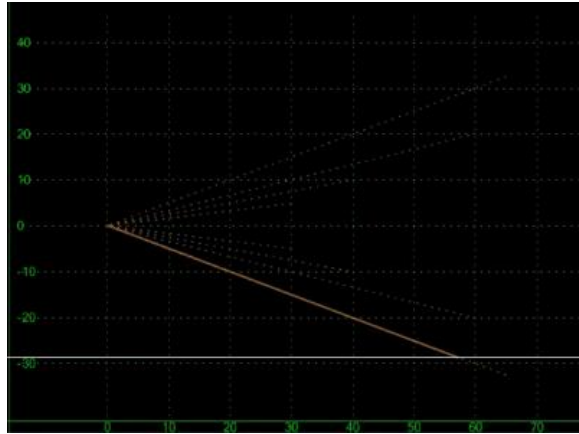


- Enter an optional *description* or leave it blank and **Data Point** to accept completing the corridor creation process.



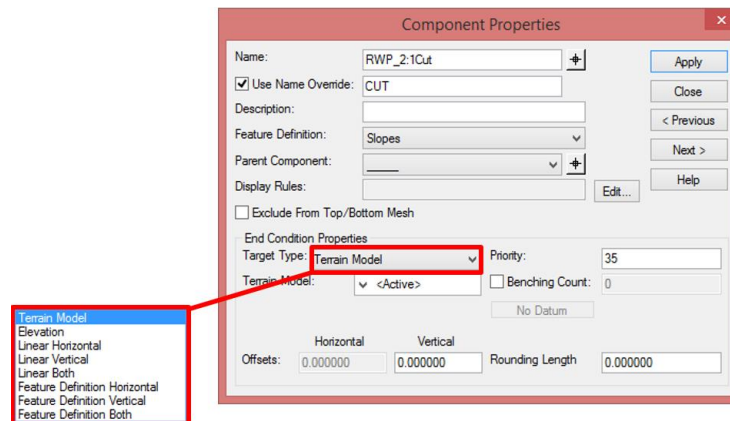
3

ADDING END CONDITIONS



END CONDITION PROPERTIES

End Conditions are different than simple, constrained, unconstrained, null point, and overlay/stripping components because they have the ability to target a surface or element with specific Features. End Condition Properties specify properties only visible for End Condition components.



- **Target Type** - specifies the type of target the End Condition is seeking. Targets include:
 - Surface - Seeks a surface
 - Elevation - Seeks a particular elevation
 - Feature XY - Seeks the horizontal location of a feature of a particular surface.
 - Feature Elevation - Seeks the vertical location of a feature of a particular surface.
 - Feature XYZ - Seeks the location of a feature of a particular surface. Overrides the slope constraint of the End Condition segment to seek the feature.
 - Alignment XY - Seeks the horizontal location of a particular alignment.
 - Alignment Elevation - Seeks the vertical location of a particular vertical alignment or, in the absence of a vertical alignment, uses horizontal geometry elevation.
 - Alignment XYZ - Seeks the location of a particular alignment. Overrides the slope constraint of the End Condition segment to seek the feature.

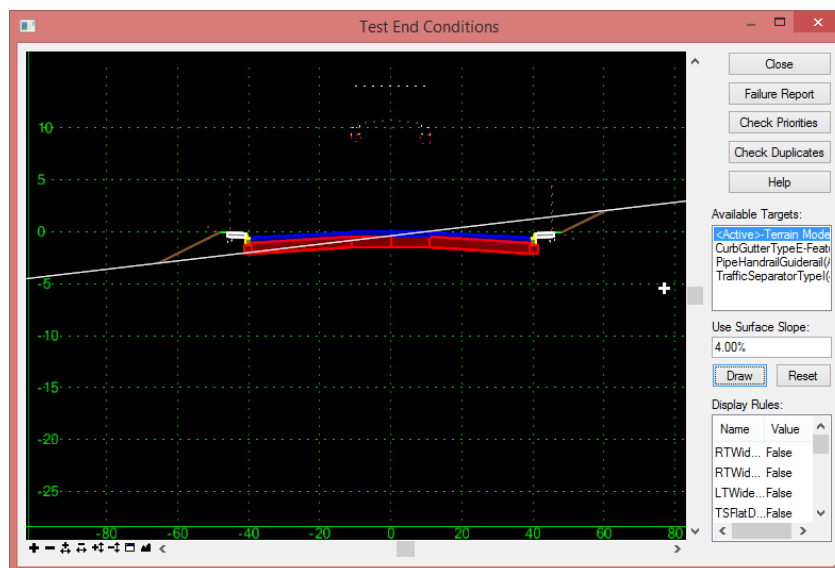
- **Surface/Feature/Alignment** - specifies the surface associated with the target type. Depending on the target type, Surface, Alignment, or Surface and Feature options are available that allow you to set the target information. If the target type is Elevation, then no field is displayed here.

Note *If the target type is Surface or one of the Feature target types, and you do not specify a surface name; then, the surface during the Roadway Designer session will be the active surface. See the Roadway Designer command for more information on Target Aliases.*

- **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 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.
- **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.
- **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 surface or an elevation. Any other End Conditions attached to the end of this one is attached to the end of the rounded section.

TESTING END CONDITIONS

End Conditions solutions and overly/stripping components can be tested to see how they react to the surface or other features and tests component display rule true or false flags from the Test End Conditions dialog.



- **<View Window>** - 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. The display has all the standard windowing commands and scrollbars.
- **Close** - dismisses the dialog.
- **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 points 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.
- **Check Duplicates** - checks for duplicate feature and component names for the given solution. If duplicate feature or component names are found, the Duplicate Feature Name List dialog is displayed. If no duplicates are found, a message to this effect is displayed.
- **Help** - displays help.
- **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 + marks. 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 over a value to toggle between True and False. Press the Reset button to restore the original Display Rules values.

EXERCISES

OPTIONAL: To prepare your computer for the next set of exercises:

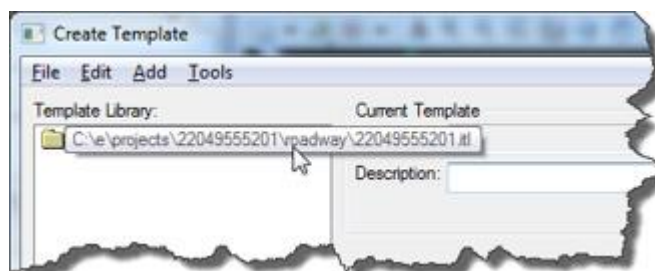
- a) Delete the c:\e\projects\22049555201\ folder.
- b) Open the *ComprehensiveTemplateDesign* folder on the desktop and expand the *DataSets* folder.
- c) Extract the *CT22049555201_Chapter3.zip* file in the c:\e\projects\ folder.

Exercise 3.1 Add End Conditions

In this exercise End Condition components will be added to the template so cut and fill lines will tie the proposed template to the existing ground.

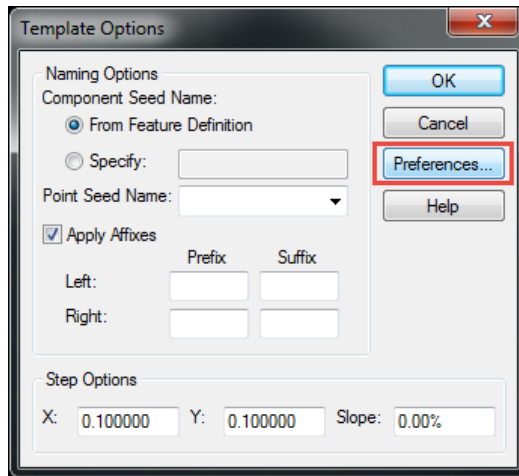
Note Steps 1-7 (loading Create Template preferences) are only needed if MicroStation was closed and restarted.

1. Open the *DSGNRD01.dgn* file of the c:\e\projects\22049555201\roadway\ folder in the FDOTSS4 Workspace in MicroStation.
2. Use the **F12** key to launch the Create Template dialog. If the ITL is named properly the Project ITL file should already be loaded.



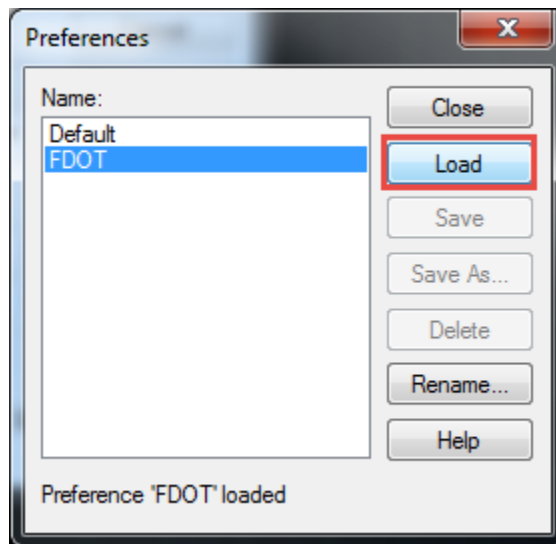
Note The FDOT workspace provides some predefined preferences that are useful when working with templates. These preferences should be loaded for each new MicroStation session.

3. Select **Tools > Options** from the menu.
4. On the Template Options dialog press the **Preferences** button.



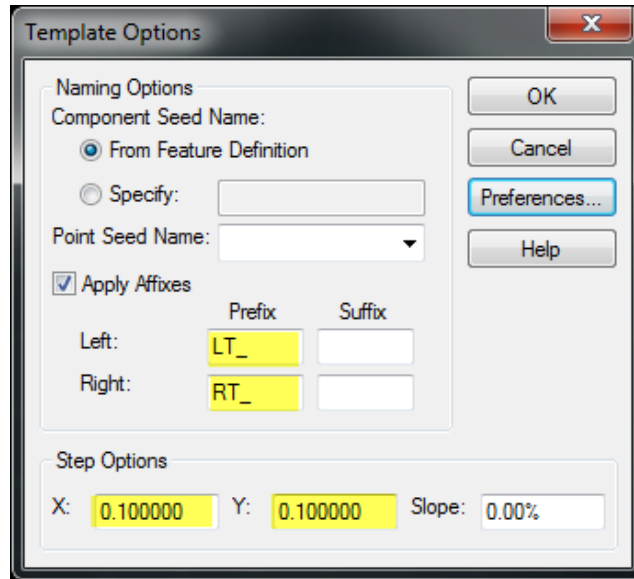
5. On the Preferences dialog, select **FDOT** from the list and press **Load**.

Note You can also double-click FDOT to load the preferences.



6. Press the **Close** button to return to the Template Options dialog.

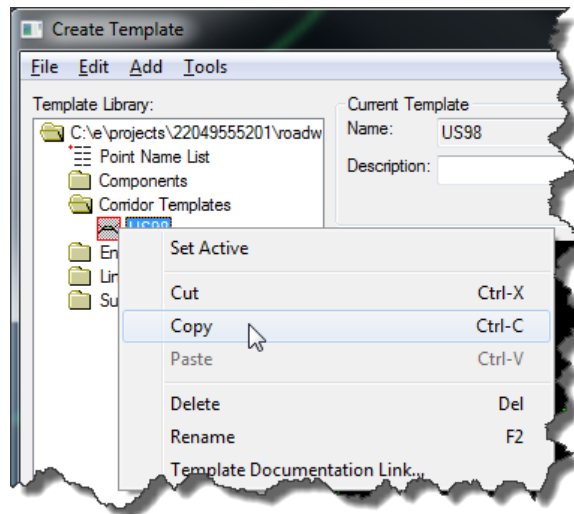
Note Notice that Left and Right Prefixes have been defined and the Step Options have been set to a tenth. The step options allow the components being dragged into the active template to snap onto the grid at one tenth of a foot intervals.



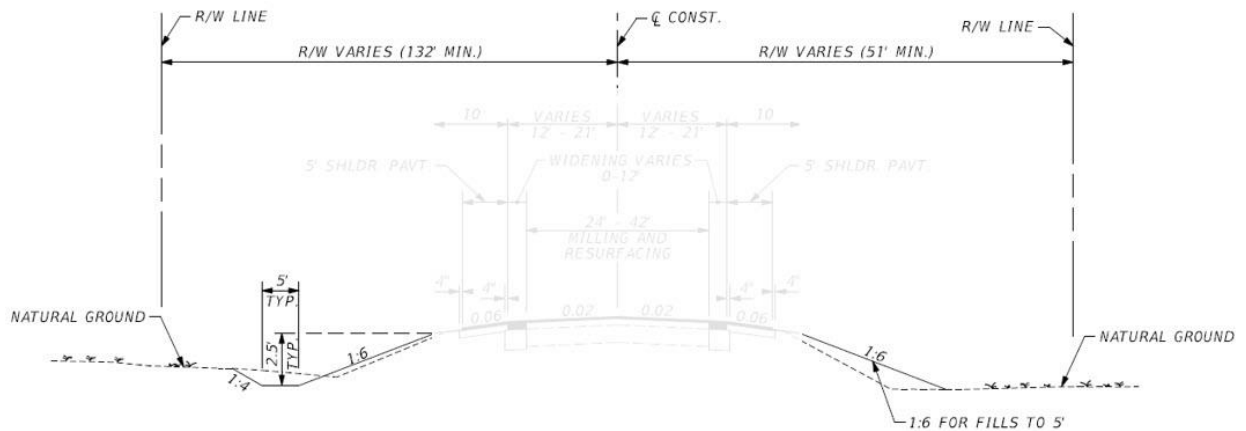
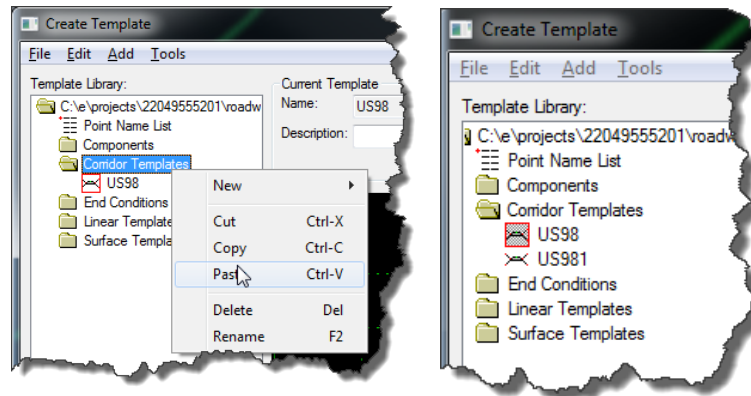
7. Press **OK** to close the Template Options dialog.

Note Before making major edits, it is recommended to make a copy in case you want to go back to a previous state.

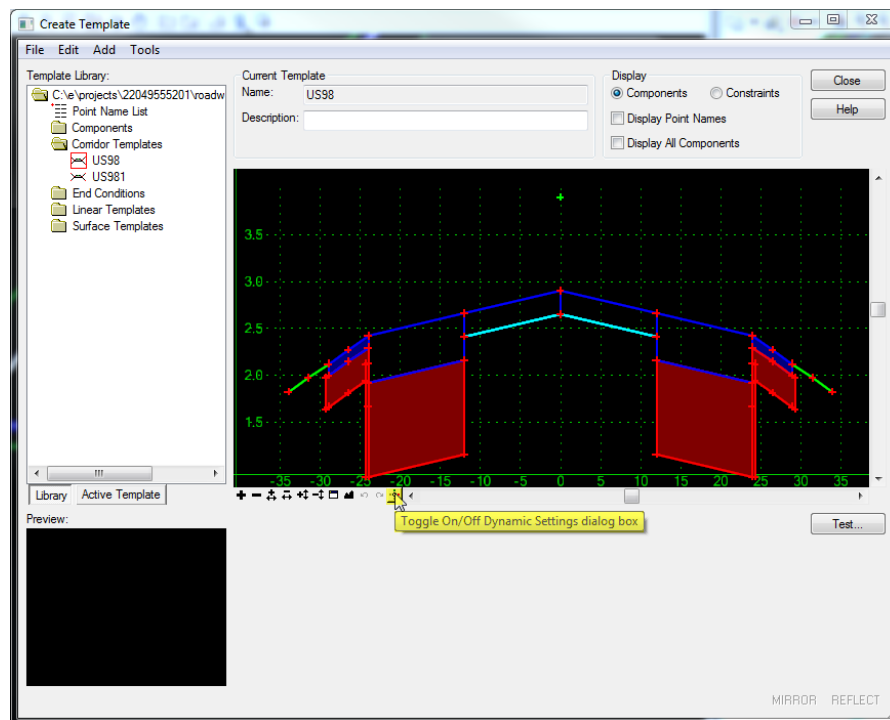
- 8. From the Create Template dialog, navigate to the Corridor Templates folder and double-click on the **US98** template to make it active.
- 9. Right-click on the **US98** template and select **Copy** from the context menu.



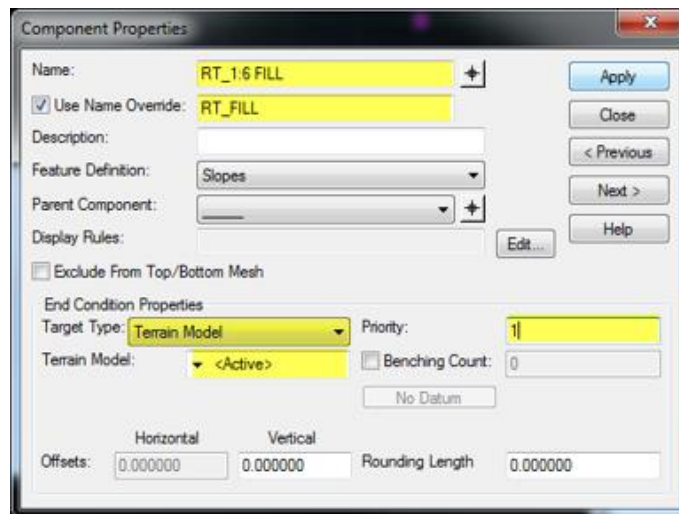
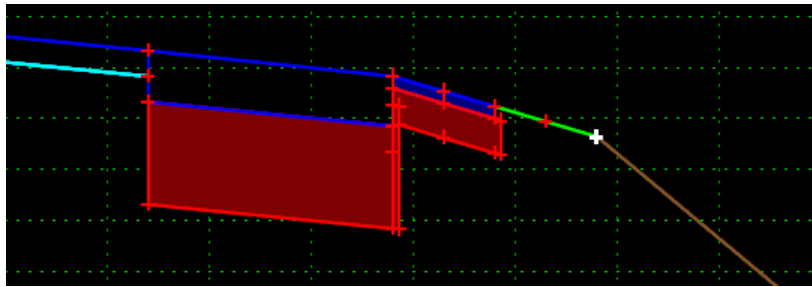
- Right-click on the Corridor Templates folder and select **Paste** from the *context* menu. A copy of the template will be made with a “1” appended to the name.



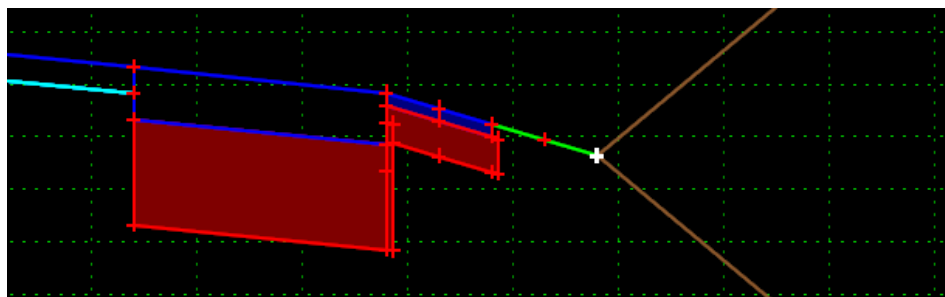
- Toggle **On** the Dynamic Settings dialog box using the icon in the *view controls*.



12. Uncheck the **Display Point Names** box.
13. Navigate to the **End Conditions > Parts** folder, then drag and drop the **6:1 FILL TO 5'** component on the unpaved shoulder on the right side of the template.



14. Drag and drop the **6:1CUT** component on the same unpaved shoulder on the right side of the template.



15. Double-click on the **right fill line** just placed to review the *Component Properties*.

Name: Begins with RT_
Name Override: Begins with RT_
Target Type: Terrain Model
Terrain Model: <Active>
Priority: 1

16. Press **Close** to return to the Create Template dialog.

17. Double-click on the **right cut line** to review the *Component Properties*. Change the *Priority* to **2** and press **Apply**.

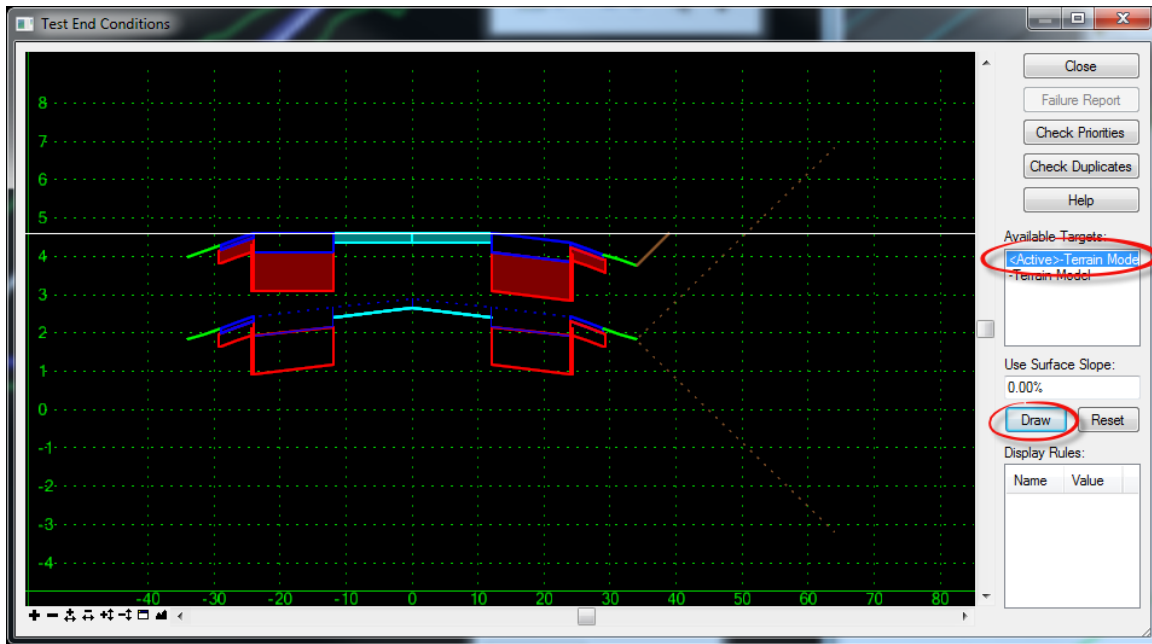
Name: Begins with RT_
Name Override: Begins with RT_
Target Type: Terrain Model
Terrain Model: <Active>
Priority: 2

18. Press **Close** to return to the Create Template dialog.

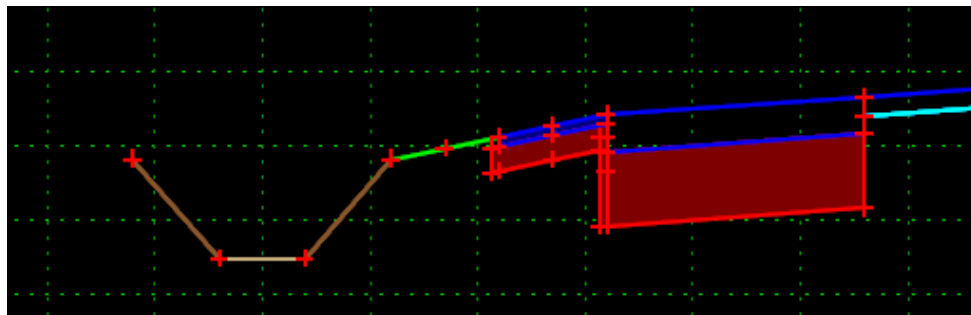
Exercise 3.2 Test End Conditions

The Create Template dialog provides a tool to test End Conditions before applying them to a corridor to make sure you get the expected results.

1. From the Create Template dialog click the **Test** button.
2. On the Test End Conditions dialog, select **<Active>-Terrain Model** from the *Available Targets* list and move the cursor above and below the template to see how the End Conditions react.



3. Press **Close** to return to the Create Template dialog.
4. Navigate to the Components folder, then drag and drop the **Common Ditch Left** component on the left shoulder component.

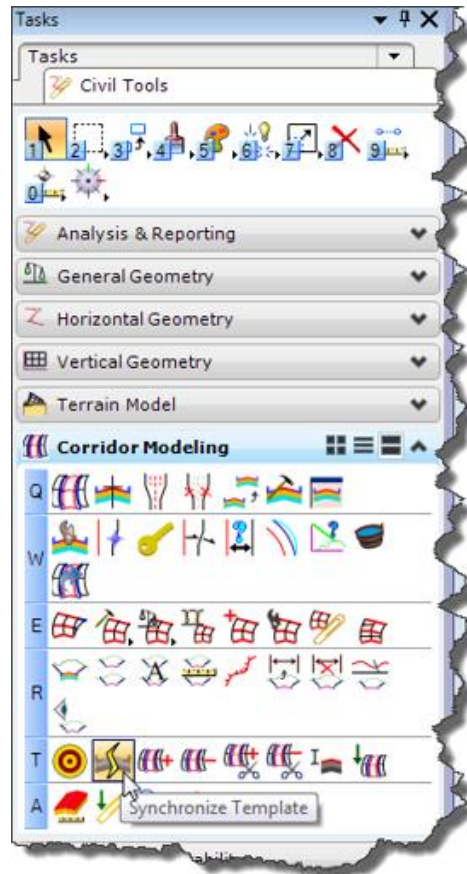


5. Select **File > Save** from the Create Template dialog.
6. Press the **Close** button to return to MicroStation.

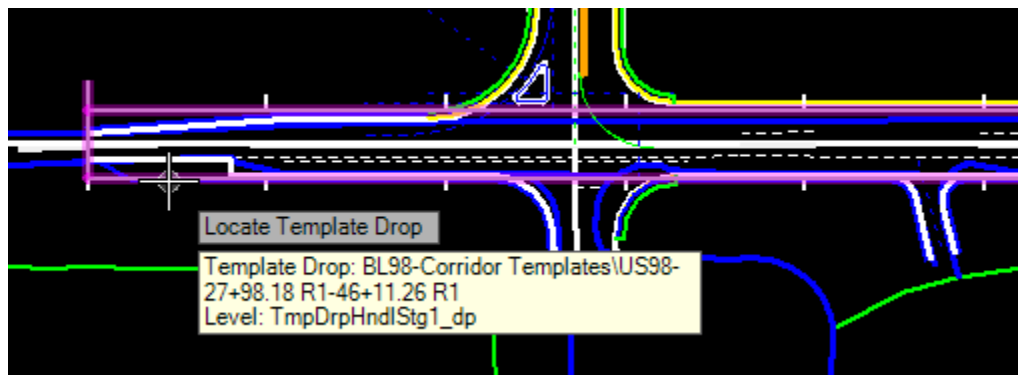
Exercise 3.3 Synchronized Template Changes in the Corridor

To see the changes in the model the changes to the template will need to be synchronized in the corridor.

1. From the Task menu select **Civil Tools > Corridor Modeling > Synchronize Template**.



2. When prompted on the cursor to *Locate Template Drop*, select the **corridor boundary**.



3. The corridor will process and you can evaluate the changes to the model.

4 HORIZONTAL FEATURE CONSTRAINTS

HIERARCHY OF CONSTRAINTS

A points location can be overridden in various ways to produce variable results from a single template. From lowest priority to highest:

- **Point Constraints** – Each point can have up to two constraints that define its location in relation to other points.
- **Horizontal Feature Constraint** – Each point can have a single Horizontal Feature Constraint that will allow a point to override the location defined by the Point Constraints.
- **Parametric Constraints** – Can be created to override Point Constraints within a defined station range. This will override Point Constraints and Horizontal Feature Constraints.
- **Point Controls** – A point control can be applied to any point on a template and forces the point to follow a particular geometric element in the file. This will override Parametric Constraints, Point Constraints and Horizontal Feature Constraints.
- **Superelevation** – A specialized point control that is created and applied using the superelevation tools. This will override all other constraints and controls.

HORIZONTAL FEATURE CONSTRAINT

Horizontal Feature Constraints provide the ability to override a points location when an element with the assigned Feature is found within the search Range, the maximum horizontal distance to search from the point's current location. The search distances in the Range field are based on the offset defined in the template, not where the parent point may be when applied to a corridor. Only elements that have been added to the corridor as “External References” are searched.

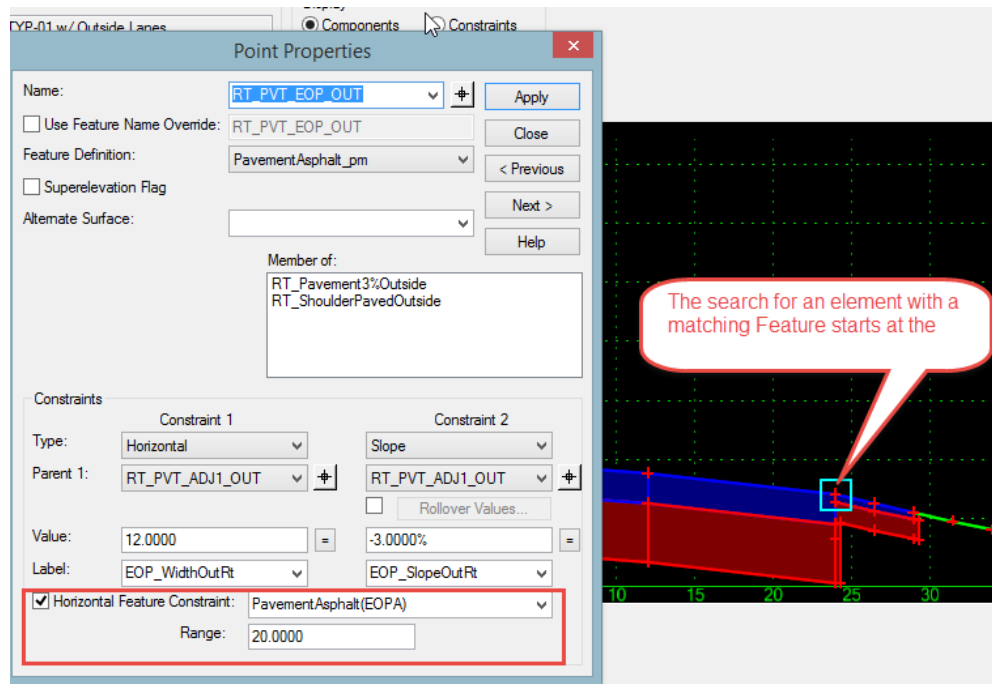
Note Regarding search range, negative values will search left. Positive values to the right. A value of zero causes the search to find the closest instance of the Feature.

The screenshot shows the 'Point Properties' dialog box. The 'Name' field is set to 'LT_PVT_EOP_IN'. The 'Feature Definition' is 'PavementAsphalt_pm'. The 'Constraints' section is expanded to show two constraints: 'Constraint 1' (Horizontal) with Parent 1 'LT_ML_IN_END_SEARC' and Value '0.000000', and 'Constraint 2' (Slope) with Parent 1 'LT_PVT_OLAY_OUT' and Value '2.00%'. A red box highlights the 'Horizontal Feature Constraint' section, which is checked and set to 'PavementMilling(ML)' with a 'Range' of '30.000000'.

➤ **How to make a milling component follow a milling limits line:**

1. Draw the milling limit lines in the plan view using the Feature “PavementMilling(ML)”.
2. Create a template assigning the Feature “PavementMilling(ML)” as a Horizontal Feature Constraint on the outside points of the overlay component.
3. Create a corridor using template
4. Add milling limit lines in the plan view as Corridor References using the “Civil Tools > Corridor Modeling > Add Corridor References” tool from the Task Menu.

Note *Horizontal Feature Constraints are the most common way to make a point follow a plan element like an edge of pavement as its horizontal location from the centerline varies.*

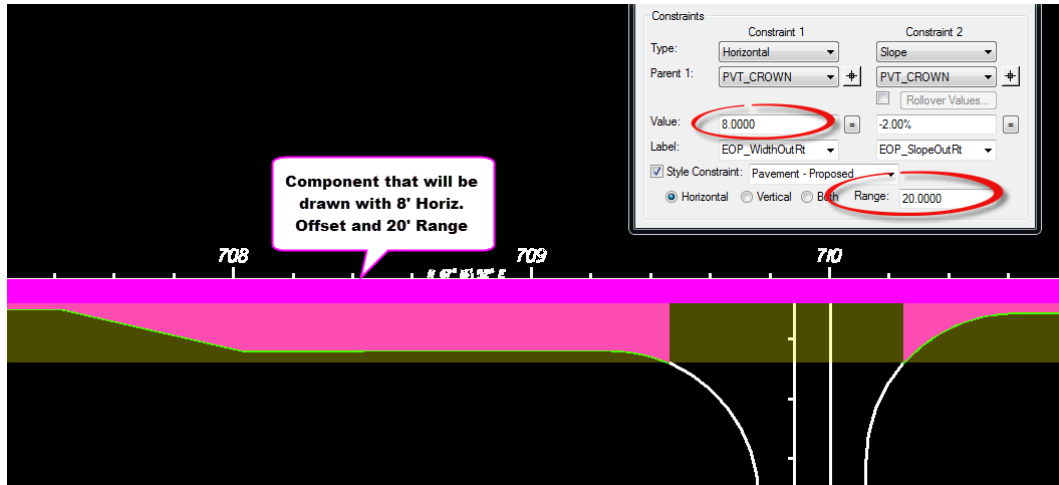


In the example above the horizontal constraint (Constraint 1) defines the width of the pavement but with the Horizontal Feature Constraint defined it will follow the EOP line as it transitions.

1. Apply “Feature” to the plan element defining its symbology.
2. Edit the template point you want to follow its plan element and select the Horizontal Feature Constraint to match the Feature applied to the plan element.
3. In the point properties define the Range or distance you expect the template to encounter the plan element.
4. When the corridor is created, the plan element will need to be added as a Corridor Reference in order for the template to see it.

The Range defines the distance from the points location it will search for a line with the Feature “PavementAsphalt(EOPA)”. If found the constraints will be overridden to that elements horizontal offset.

The Range or search distance begins from the points horizontal location in the template. The template will search from that location the distance defined in the Range property. Positive distances to the right and negative distances are to the left. This creates an envelope in which an element with the defined feature can be found. This keeps the system from finding like elements on the other side of the road.



The animation in this slide shows what happens to the edge of pavement when it is located within the search Range and how it defaults back to the defined point constraints when the edge of pavement falls outside the search Range.

EXERCISES

OPTIONAL: To prepare your computer for the next set of exercises:

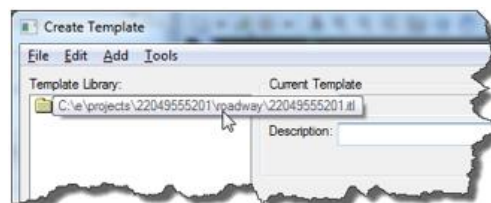
- a) Delete the c:\e\projects\22049555201\ folder.
- b) Open the ComprehensiveTemplateDesign folder on the desktop and expand the DataSets folder.
- c) Extract the CT22049555201_Chapter4.zip file in the c:\e\projects\ folder.

Exercise 4.1 Horizontal Feature Constraints

In this exercise Horizontal Feature Constraints will be applied to the corridor making it more flexible. Horizontal Feature Constraints are the first level of point overrides and provides the template with the flexibility to follow an edge of pavement of milling limits line.

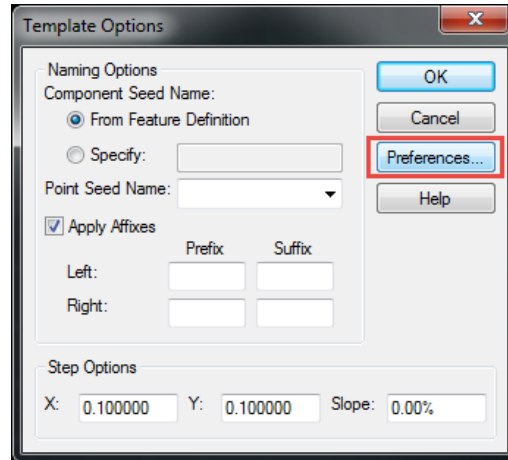
Note Steps 1-7 (loading Create Template preferences) are only needed if MicroStation was closed and restarted.

1. Open the DSGNRD01.dgn file of the c:\e\projects\22049555201\roadway\ folder in the FDOTSS4 Workspace in MicroStation.
2. Use the F12 key to launch the Create Template dialog. If the ITL is named properly the Project ITL file should already be loaded.



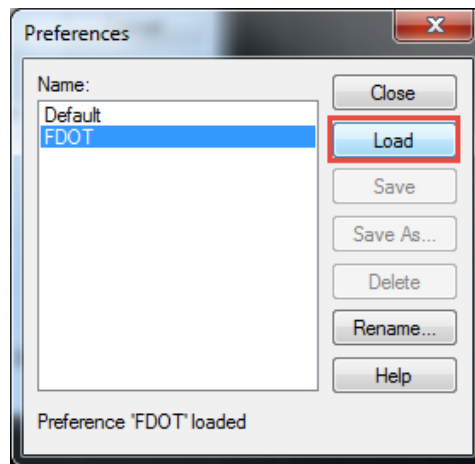
Note The FDOT workspace provides some predefined preferences that are useful when working with templates. These preferences should be loaded for each new MicroStation session.

3. Select **Tools > Options** from the menu.
4. On the Template Options dialog press the **Preferences** button.



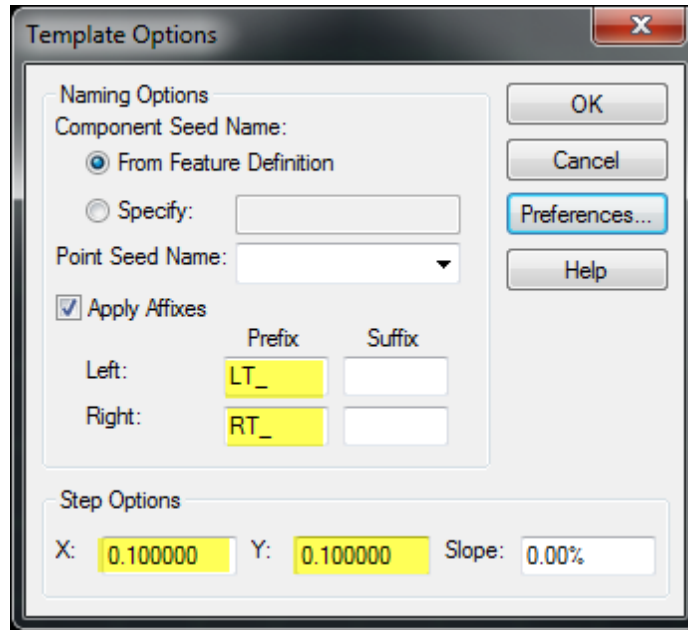
5. On the Preferences dialog, select **FDOT** from the list and press **Load**.

Note You can also double-click FDOT to load the preferences.



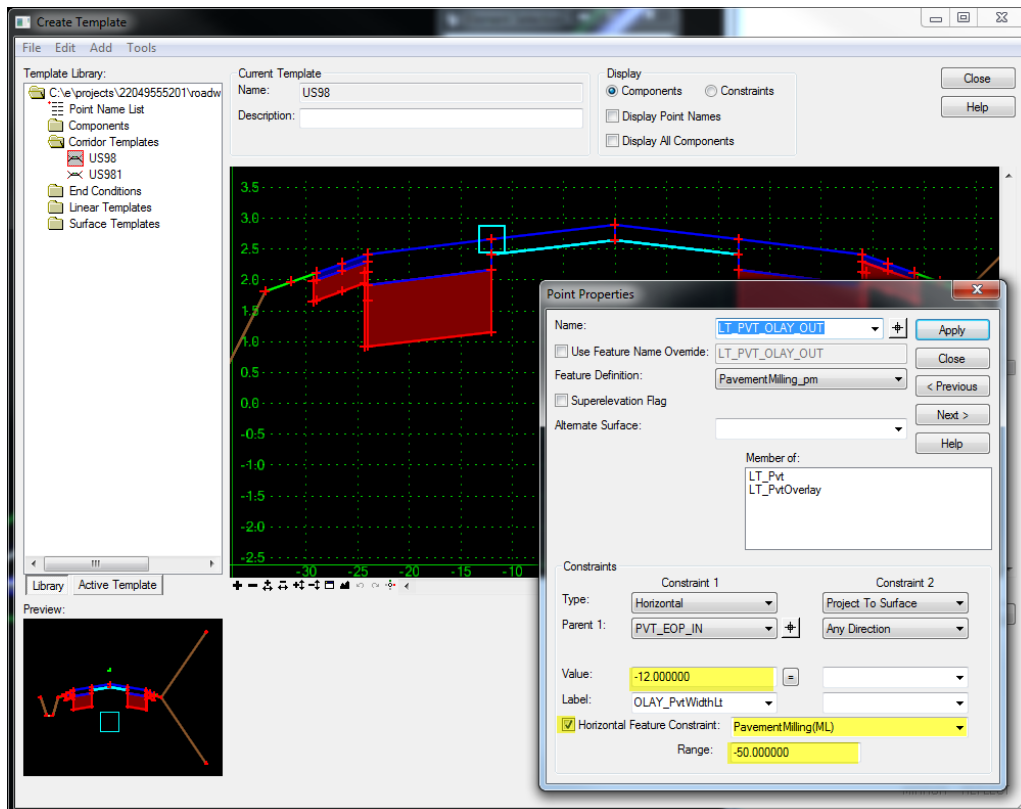
6. Press the **Close** button to return to the Template Options dialog.

Note Notice that Left and Right Prefixes have been defined and the Step Options have been set to a tenth. The step options allow the components being dragged into the active template to snap onto the grid at one tenth of a foot intervals.



7. Press **OK** to close the Template Options dialog.
8. Navigate to the Corridor Templates folder and double-click on the **US98** template to make it active.
9. Double-click on the **LT_PVT_OLAY_OUT** point to review its properties.

Note Notice the default Horizontal value for this point is -12 but a Horizontal Feature Constraint is applied with the Feature PavementMilling(ML) and a Range of -50'

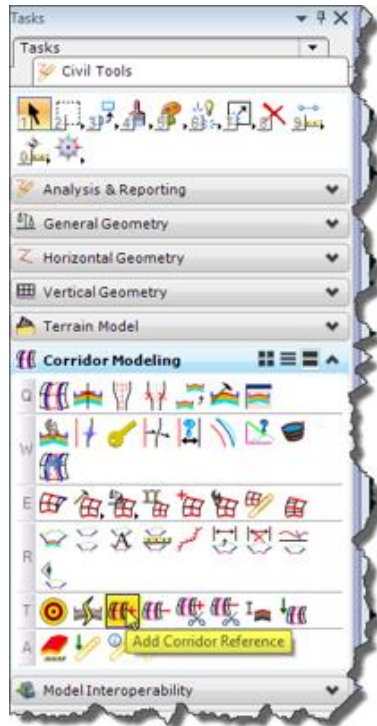


10. Close the *Point Properties* and *Create Template* dialogs.

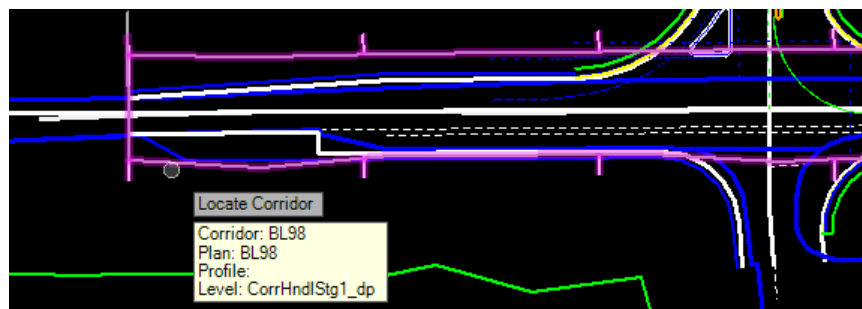
Exercise 4.2 Adding Corridor References

In order for a corridor to apply Horizontal Feature Constraints the horizontal geometry must be added to the corridor as external references. Without this the Horizontal Feature Constraints are ignored and the components are drawn at the horizontal Value.

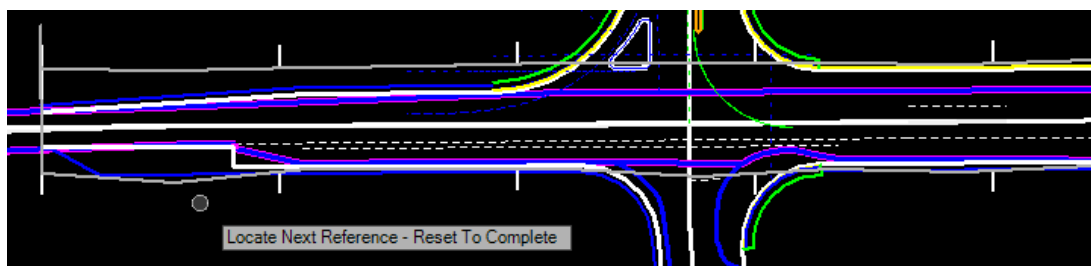
1. From the *Task* menu select **Civil Tools > Corridor Modeling > Add Corridor Reference**.



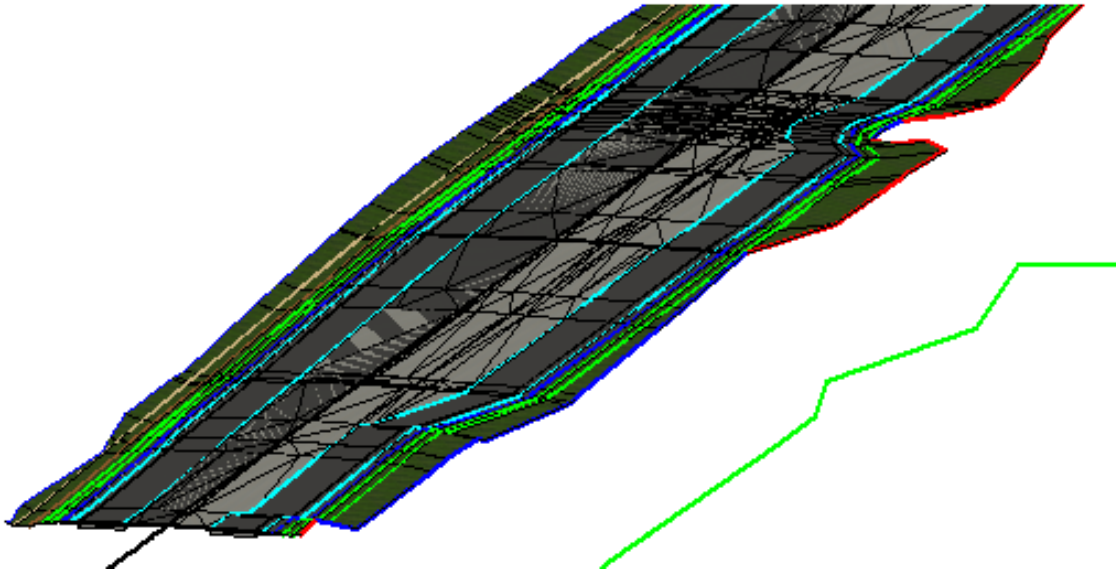
2. When prompted, left-click on the **corridor boundary** to locate it.



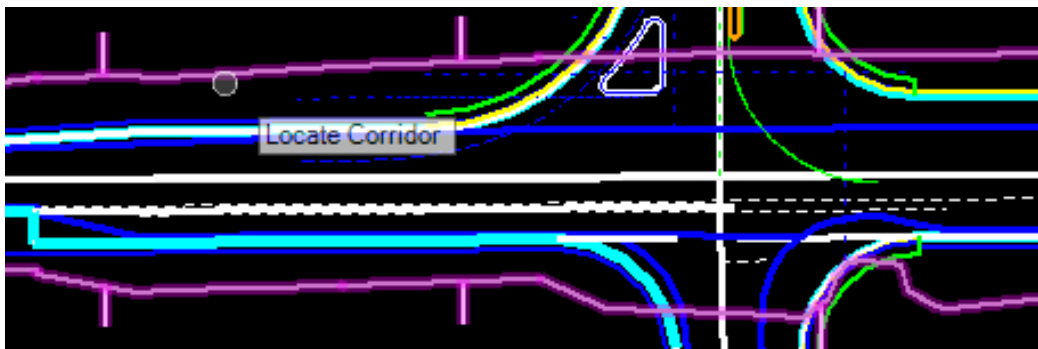
3. Next you will be prompted to “**Locate First Reference**”. Begin left-clicking all of the **Milling Limits lines** within the range of the corridor.
4. When all of the Milling Limits lines are selected right-click (**Reset**) to complete the process.



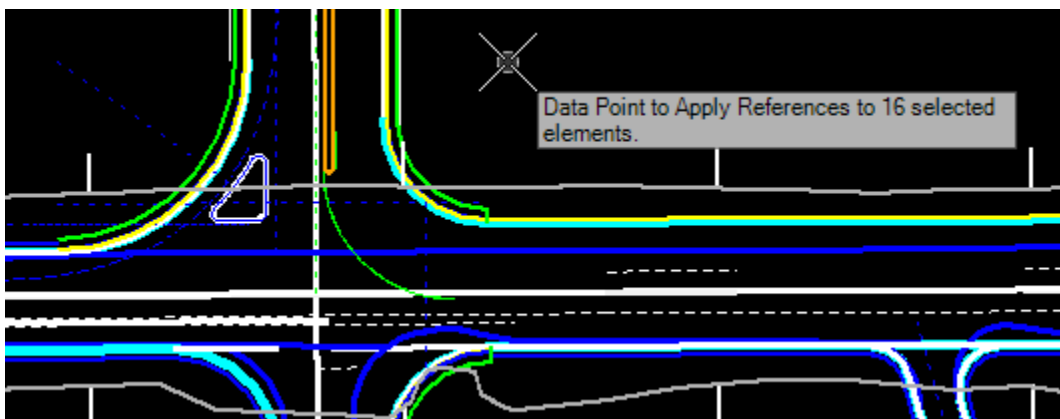
Note The corridor will reprocess and the shape of the model will begin to change.



5. Select **F6** to get out of the command and start the element selection tool.
6. Make a MicroStation *selection set* of all the **edge of pavement** lines within the range of the corridor.
7. From the *Task* menu select **Civil Tools > Corridor Modeling > Add Corridor Reference**.
8. When prompted, left-click on the **corridor boundary** to locate it.



9. When prompted **Data Point** (left-click) to apply selected elements as corridor references.

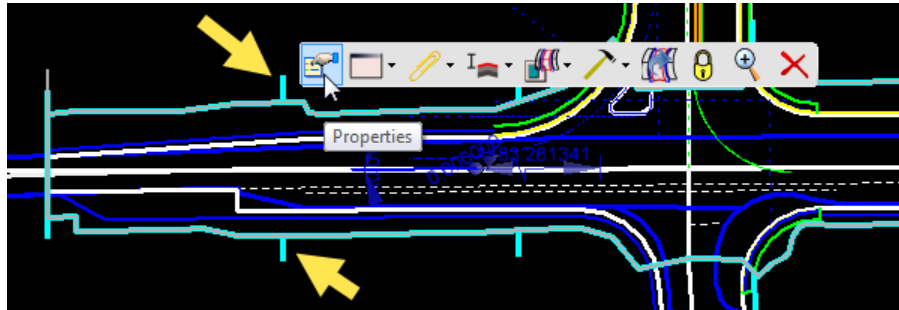


Note The corridor will process and the model will further change shapes.

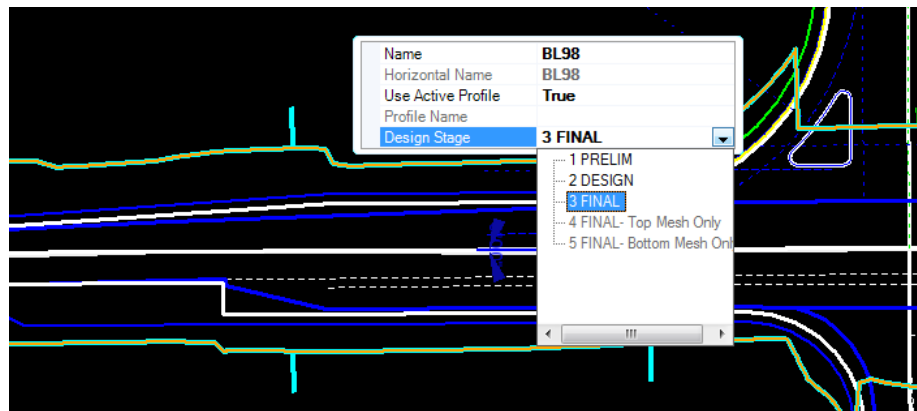
Exercise 4.3 Set Corridor Design Stage

This is a small corridor and changes in the horizontal geometry are occurring over short distances. To better see how the Feature Constraints are being applied the corridor Design Stage can be modified.

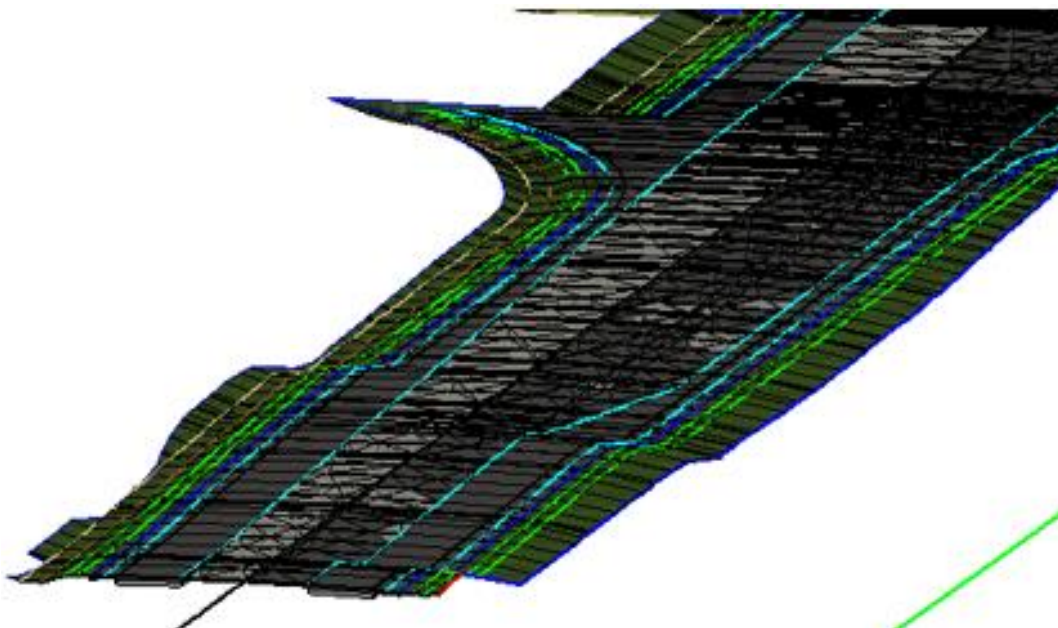
1. Select one of the **corridor handles** sticking out from the boundary and then hover over it to get the *context* menu. Select the first icon on the menu, **Properties**.



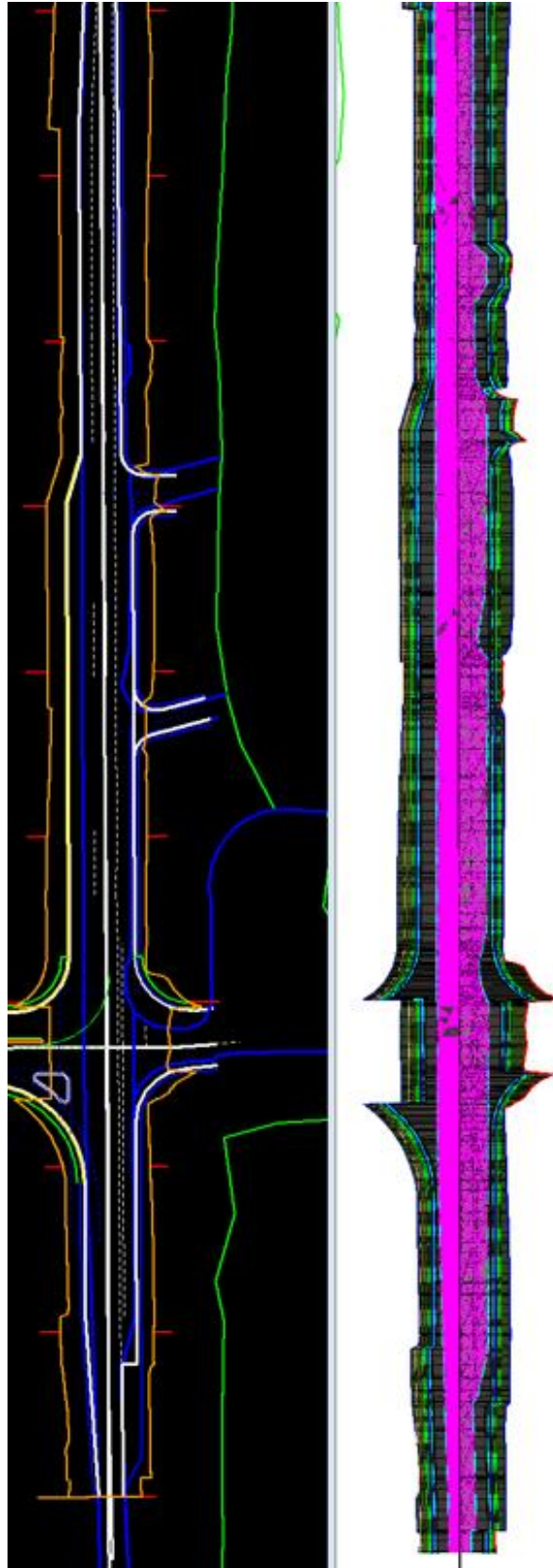
2. Using the drop-down arrow, change the *Design Stage* to “3 FINAL”.



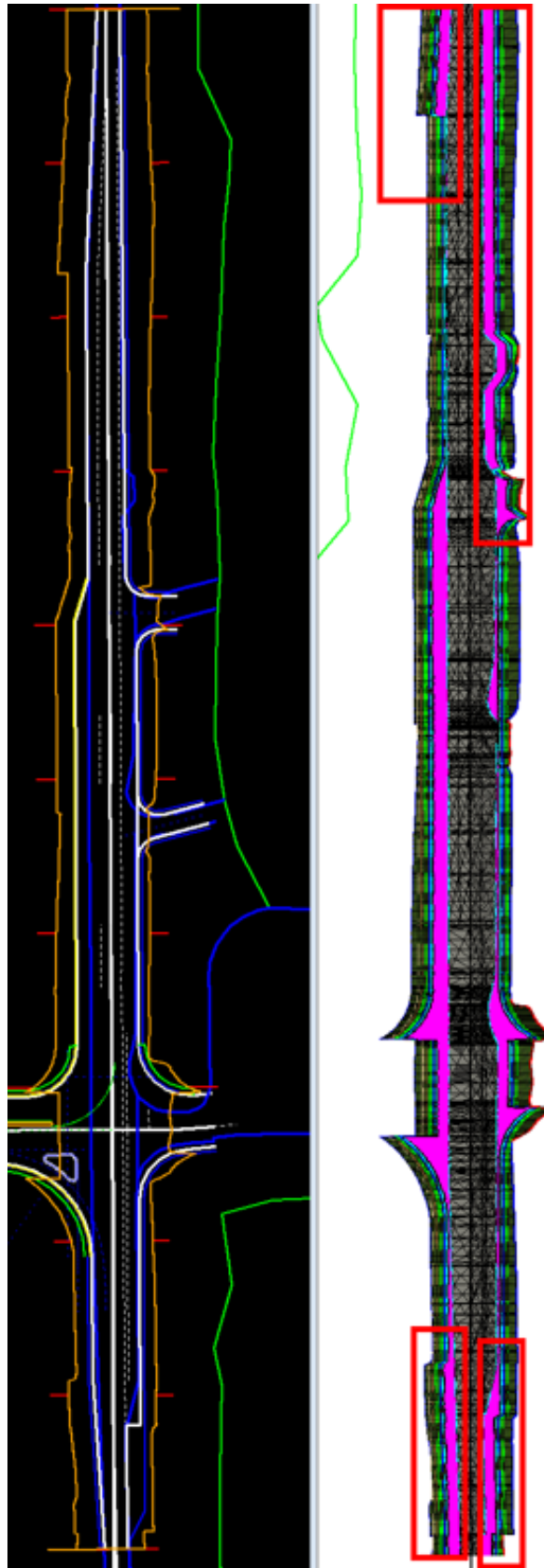
Note The corridor will reprocess again, providing further detail.



3. With the **overlay** component selected in the model you can see where the milling lines are now being located by the template in most locations.

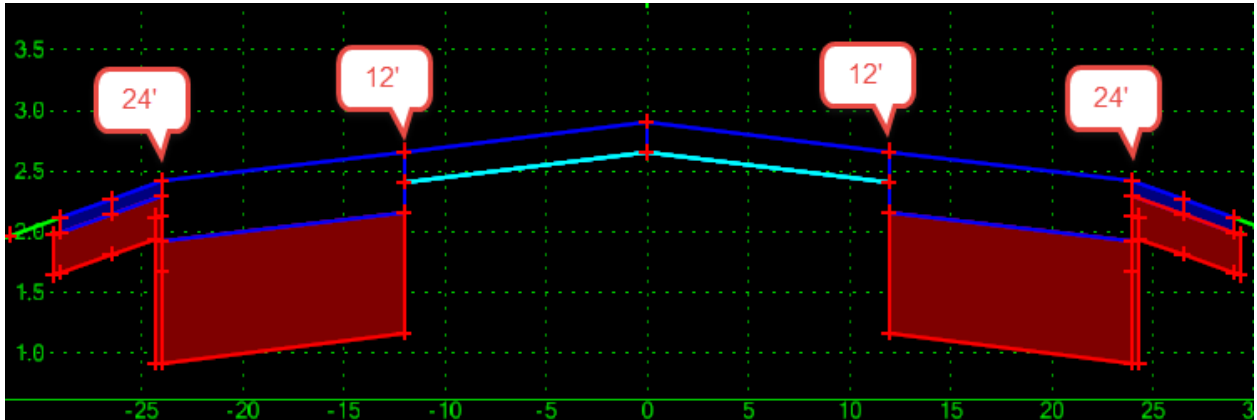


4. With the **widening components** selected you can identify locations at the beginning and ending of the corridor where the edges of pavement are not being located correctly.

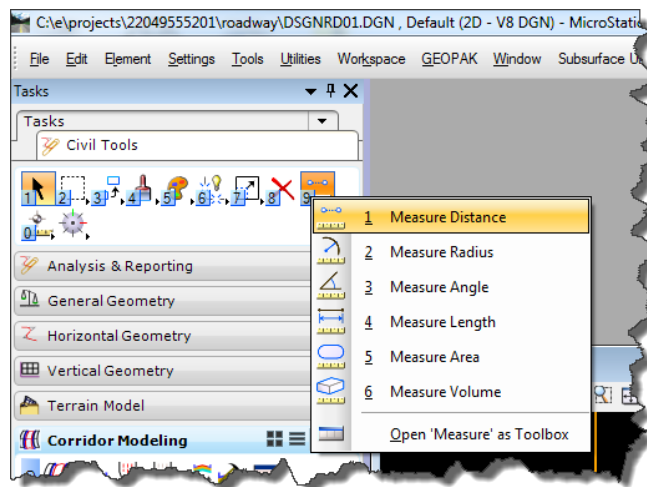


Exercise 4.4 Search Range

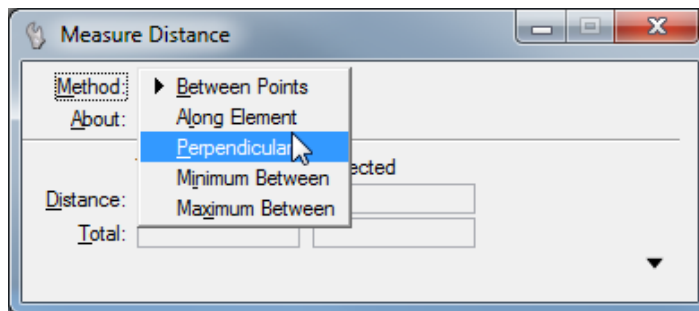
Ranges are a common issue when using Horizontal Feature Constraints. Since the beginning the search range is based on the points location in the template instead of the its relative position to other points when applied to the corridor.



1. Start the **Measure Distance** command from the *Main Task* menu.

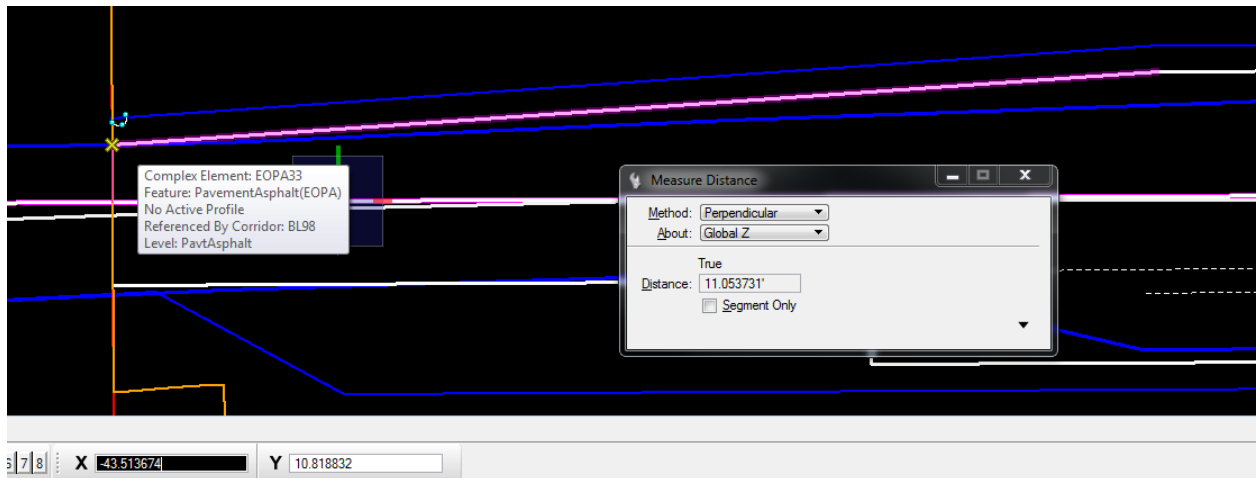


2. On the Measure Distance dialog select the **Perpendicular** Method.



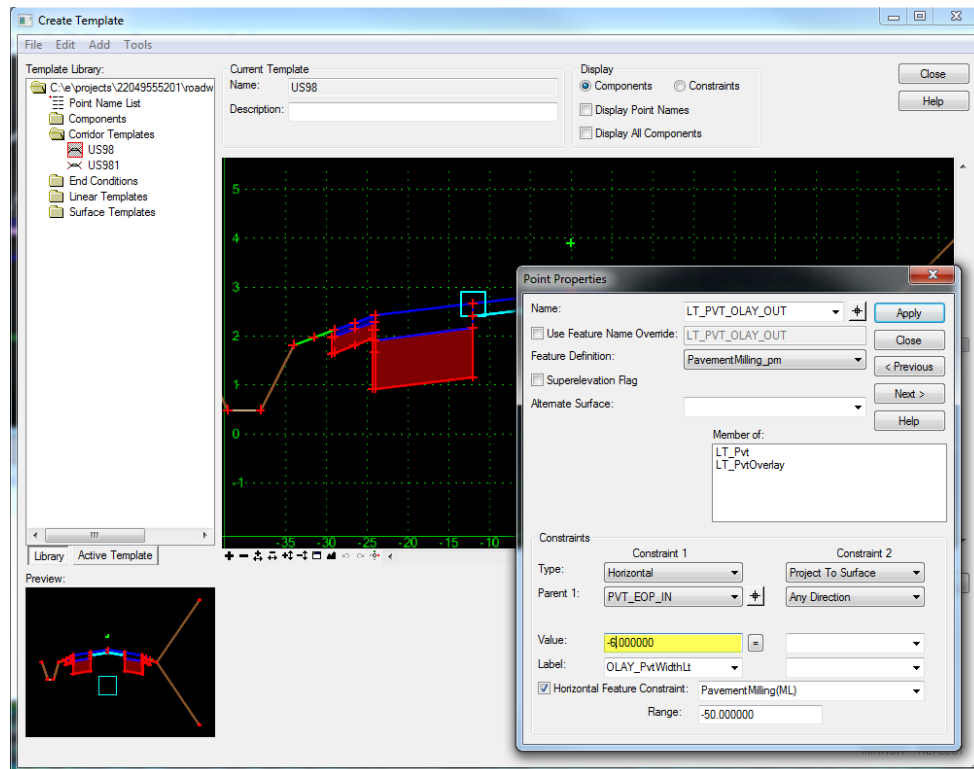
Exercise 4.5 Troubleshooting Ranges

Use the Measure Distance tool to identify the narrowest distance from the baseline to the milling limits and from the baseline to the proposed edge of pavement for the widening.

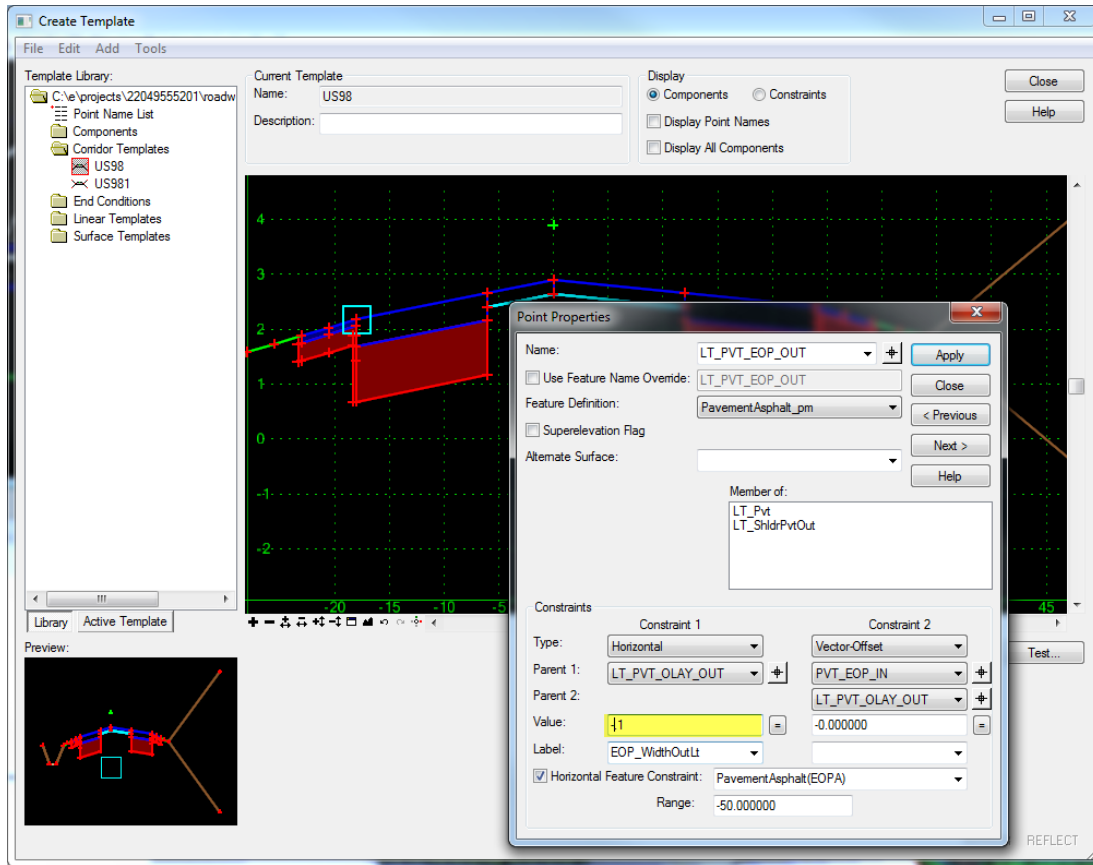


Note When working with multilane facilities, divide highways, interchanges, or the likes you will also want to identify the widest point for each search so you can limit the search range and not accidentally locate a matching feature from another lane.

1. Select **F12** to open the Create Template dialog.
2. Double-click on the *left milling limits point (LT_PVT_OLAY_OUT)* to edit its properties.
3. Change the value for the *Horizontal constraint* to be **-6**, then press **Apply** and **Close**.



4. Double-click on the *left outside widening point (LT_PVT_EOP_OUT)* to edit its properties.
5. Change the value for the *Horizontal constraint* to be **-1**, then press **Apply** and **Close**.

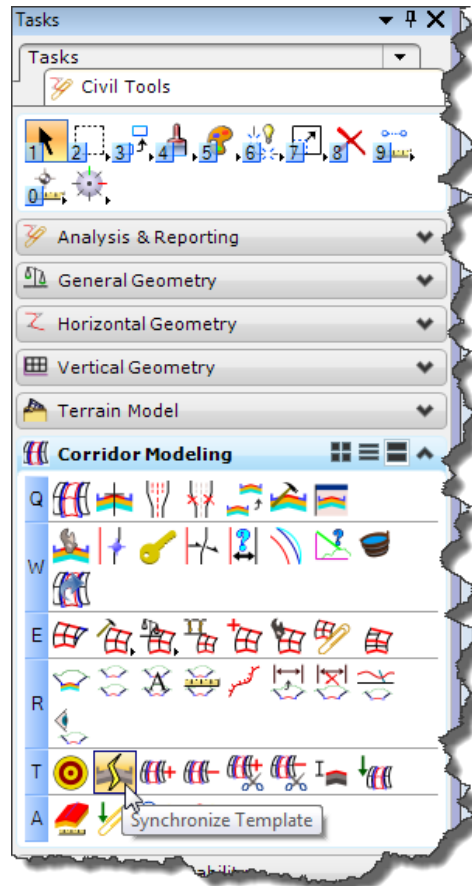


6. Repeat **Steps 2-5** for the right side of the template.
7. Select **File > Save** from the **Create Template** dialog.
8. Press the **Close** button to return to **MicroStation**.

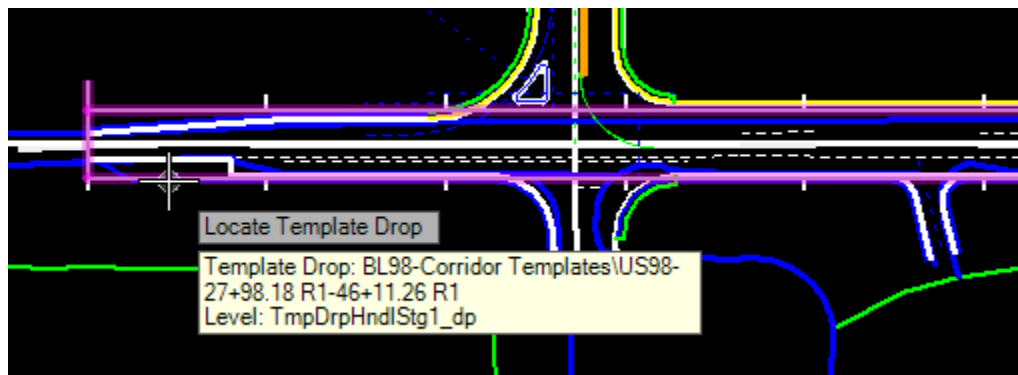
Exercise 4.6 Synchronize Template Changes with the Corridor

To see the changes in the model the changes to the template will need to be synchronized in the corridor.

1. From the *Task* menu select **Civil Tools > Corridor Modeling > Synchronize Template**.



2. When prompted on the cursor to *Locate Template Drop*, select the **corridor boundary**.



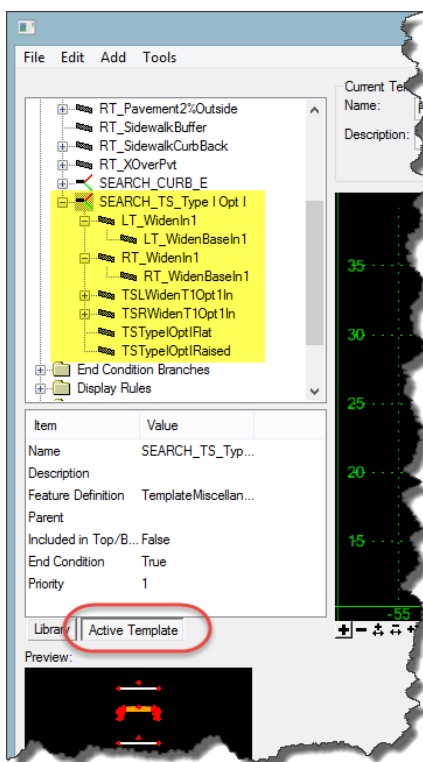
Note The corridor will process and you can evaluate the changes to the model.

5 SWITCHES

INTRODUCTION

In this exercise Switches will be used to turn off the display of components through areas like intersections or drives where detail modeling techniques will be used. Turning of the display of components in these areas is far more efficient when processing a corridor than clipping references.

PARENT \ CHILD RELATIONSHIPS

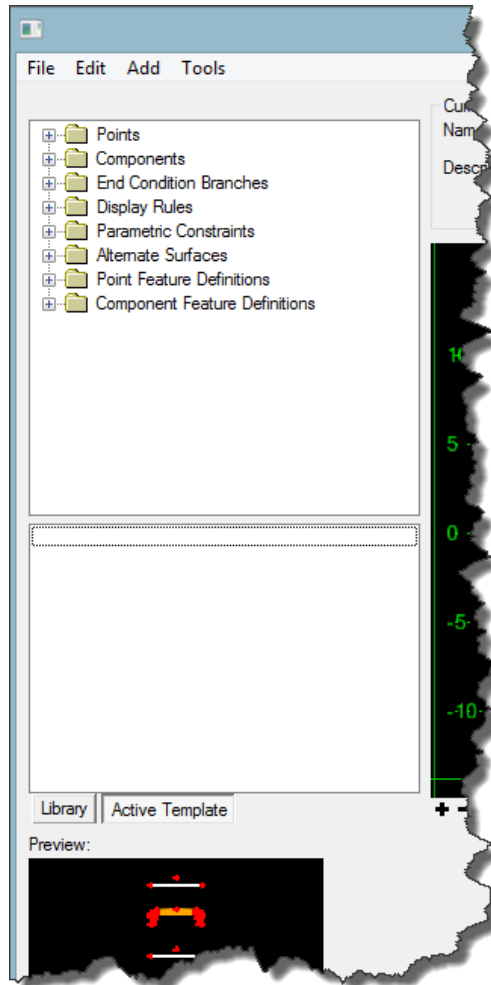


Defining a Parent\Child relationship between related components makes it much easier to manage their display in variable conditions.

- End Conditions, Switches, and Display Rules effect the parent effect children.
- Deleting a parent component deletes all children.
- Component Relationships can be viewed as a hierarchical tree using the Active Template tab on the Create Template dialog.
- Relationships can be created by dragging and dropping on the Active Template tab.

A well structured template will have parent\child relationships defined between components that go together. For example: the base component is a child of the pavement component. This becomes more important as variable conditions and display rules are added to the template. When properly structured you can apply the display rule to the parent component only instead of modifying each subcomponent individually.

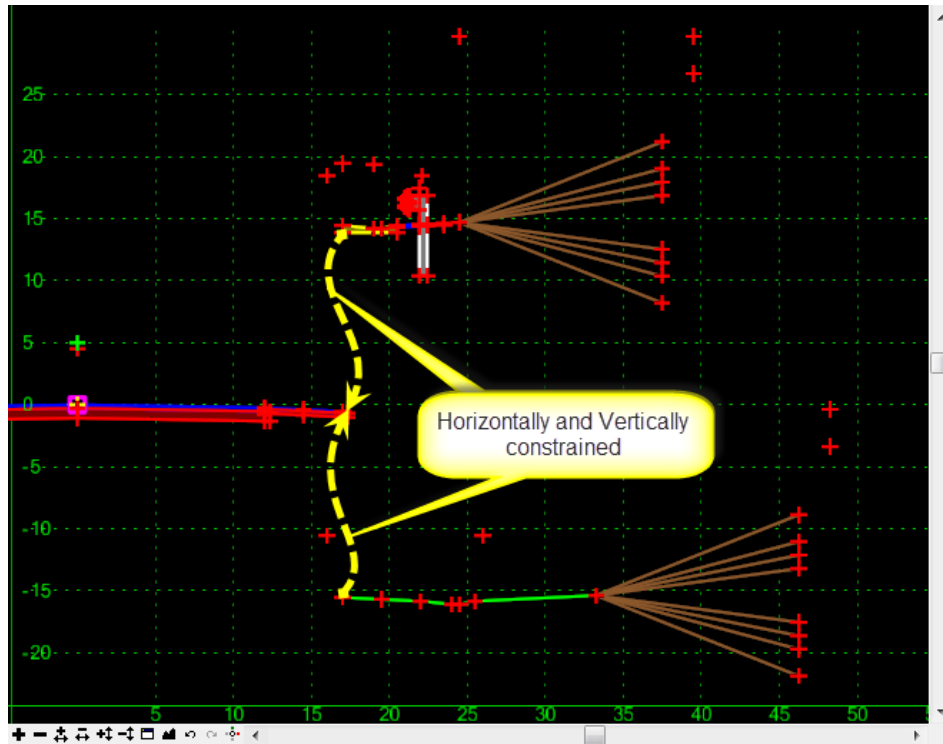
ACTIVE TEMPLATE VIEW



The Active Template view allows you to see and modify properties for all parts of the active template.

- **Points** - List of all points. Highlights the selected point in the template.
- **Components** – List of Components in hierarchical tree.
- **End Condition Branches** – List of end conditions in hierarchical tree.
- **Display Rules** – List of all Display Rules . Highlights the selected Display Rules in the template.
- **Parametric Constraints** – List of all Labels defined in the active template.
- **Alternate Surfaces** – List of all Alternate Surfaces and their components.
- **Point Feature Definitions** – List of Points categorized by Feature.
- **Component Feature Definitions** - List of Components categorized by Feature.

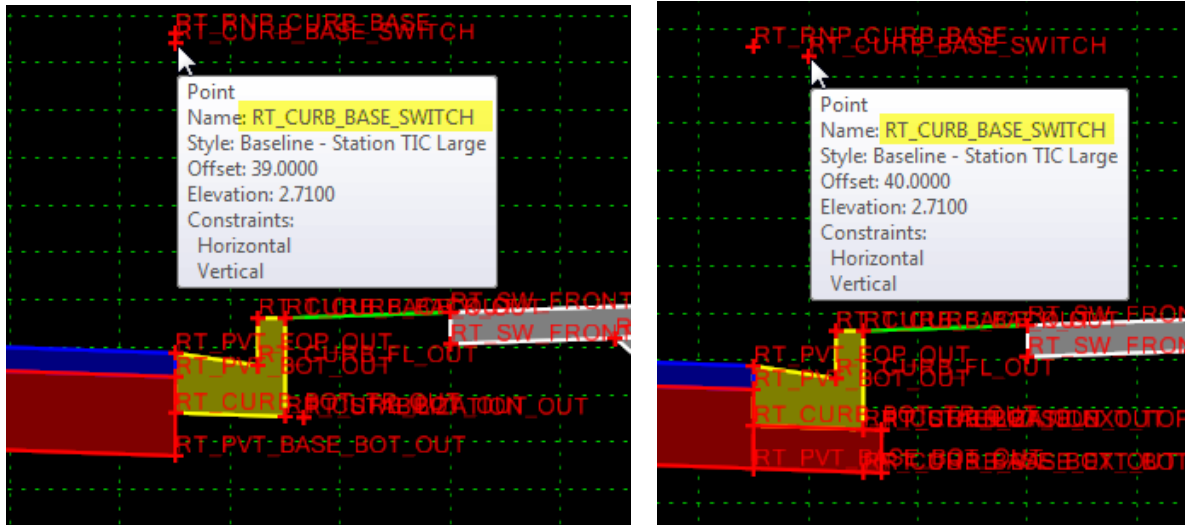
ORGANIZING \ STACKING CONDITIONS



- Instead of stacking the End Conditions on top of each other, they can be offset.
- All End Conditions can be attached using Horizontal and Vertical Constraints
- Parametric Constraints can be used to override the Horizontal and Vertical Constraints to zero values when applied to the corridor.

As more conditional components are added to make the template more dynamic, it gets very busy and hard to manage if all the components are on top of each other. We recommend placing the conditional trigger set above or below the connection point and then use parametric constraints to move the trigger sets into place when applied to a corridor.

SWITCHES



Switches are often used to switch the display of components On or Off. If a component or template has a point with the word 'SWITCH' in the point name, then the 'SWITCH' Points Horizontal value can be modified to change the components that are displayed.

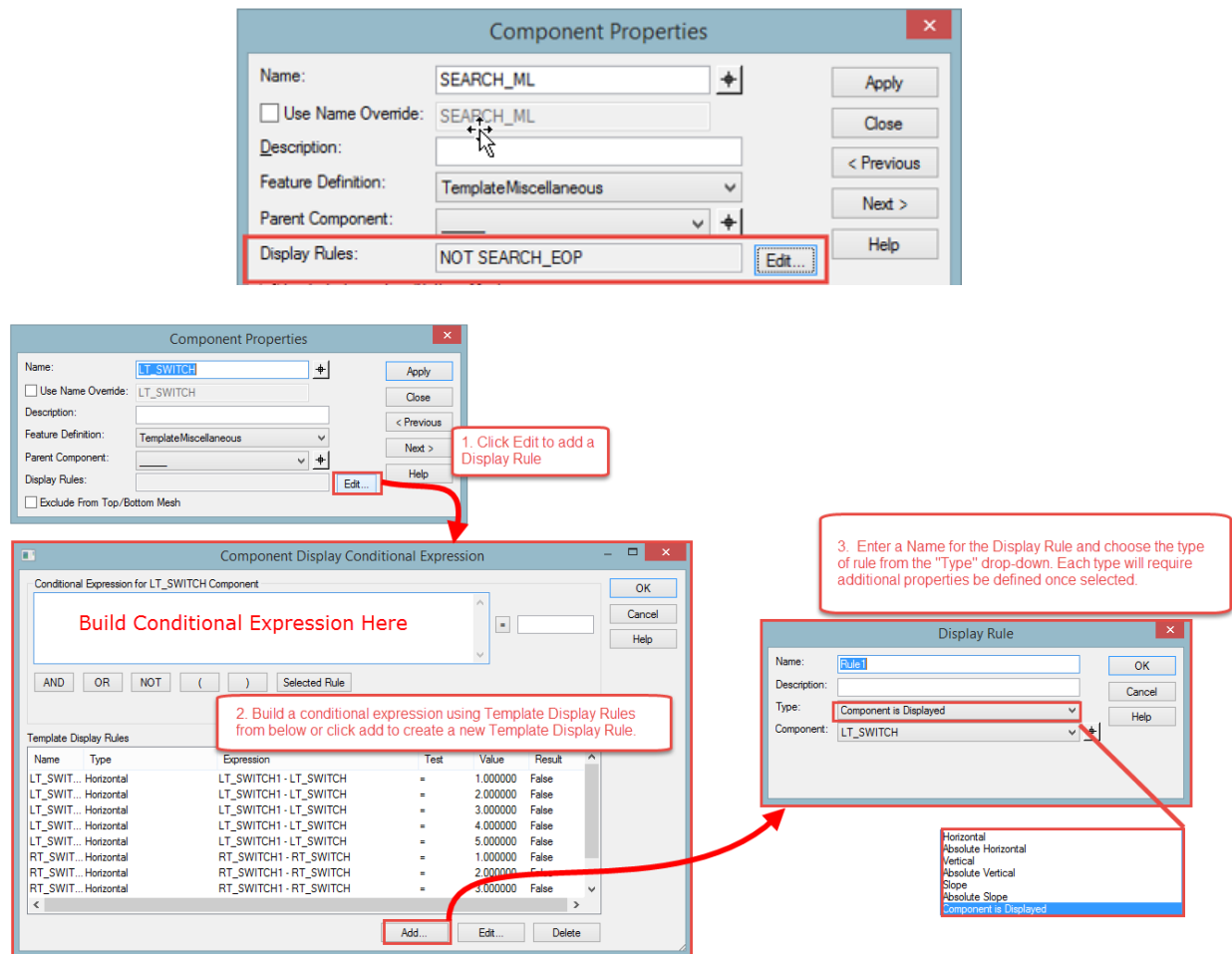
Switches are basically a series of if statements with a display rule added to each. Typically the 'if statement' measures the distance between two points and assigns a display rule to activate when the distance equals a specific number. This way each possibility can only occur in one condition.

- ✓ If the distance between LT_Switch and LT_Switch1 is 1' display a Type F Curb and Gutter
- ✓ If the distance between LT_Switch and LT_Switch1 is 2' display a Type E Curb and Gutter
- ✓ If the distance between LT_Switch and LT_Switch1 is 3' display a Drop Curb

Display Rules are applied to each of the possible conditions so as the distance changes one condition is turned Off and another is turned On.

Name	Type	Expression	Test	Value	Result
LT_SWITCH1	Horizontal	LT_SWITCH1 - LT_SWITCH	=	1.000000	False
LT_SWITCH2	Horizontal	LT_SWITCH1 - LT_SWITCH	=	2.000000	True
LT_SWITCH3	Horizontal	LT_SWITCH1 - LT_SWITCH	=	3.000000	False
LT_SWITCH4	Horizontal	LT_SWITCH1 - LT_SWITCH	=	4.000000	False
LT_SWITCH5	Horizontal	LT_SWITCH1 - LT_SWITCH	=	5.000000	False
RT_SWITCH...	Horizontal	RT_SWITCH1 - RT_SWITCH	=	1.000000	False
RT_SWITCH...	Horizontal	RT_SWITCH1 - RT_SWITCH	=	2.000000	False
RT_SWITCH...	Horizontal	RT_SWITCH1 - RT_SWITCH	=	3.000000	False
RT_SWITCH...	Horizontal	RT_SWITCH1 - RT_SWITCH	=	4.000000	False
RT_SWITCH...	Horizontal	RT_SWITCH1 - RT_SWITCH	=	5.000000	False

DISPLAY RULES



A Display Rule is a condition statement that can be assigned to a component. Once assigned, the component can only be displayed when the conditional statement is true. Each interval is evaluated by the Display Rule and the components and all the children are affected.

Note *Display rules are not applied in transitions. Transitions see only what is displayed at the beginning and end of the transition at the time the transition is created, and use that information to create the transition. Only components that are displayed are included in the transition.*

Creating Display Rules

To create a *Display Rule* click the **Edit** button on the parent **Component Properties** dialog. This opens the **Component Display Conditional Expressions** dialog that allows you to build a Conditional Expression by evaluating and selecting from a list of previously created Display Rules.

If there are no Display Rules listed yet, <OR> if the Display Rule needed does not appear in the list, click the **Add** button on the bottom of the dialog. This opens the **Display Rule** dialog that allows you to enter a name and a description to create a new Display Rule.

- **Name** - displays the rule name. In edit mode, this field is read only. However, you can rename the rule from the **Create Template > Active Template** tab.

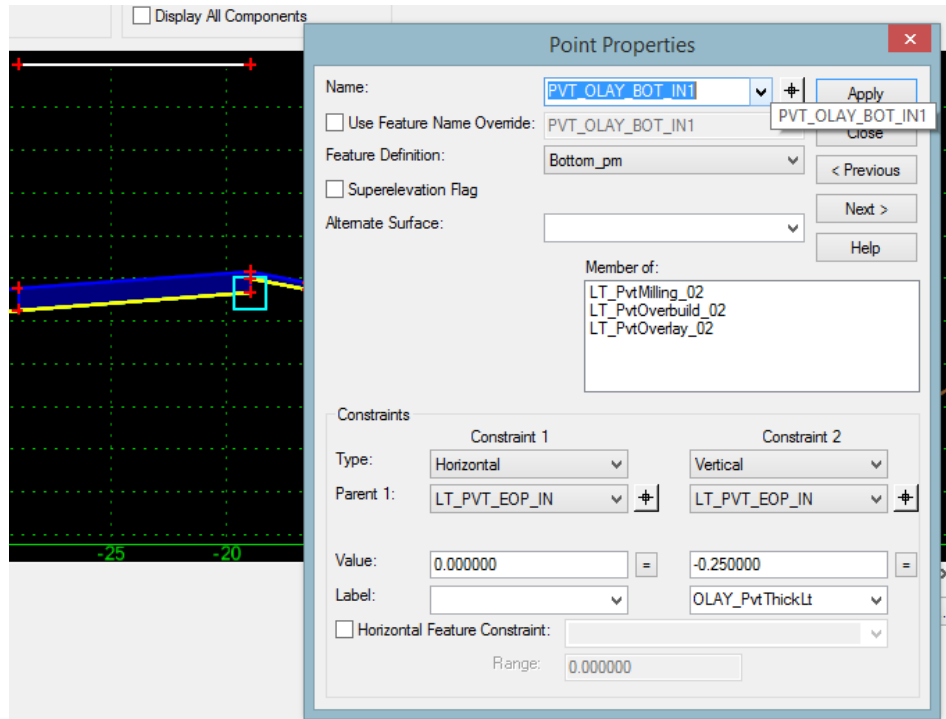
Note *Display Rules can not contain a left or right parenthesis, "(" or ")", or any of the following phrases in the rule name: AND, OR, NOT.*

- **Description** - specifies a description for the display rule.
- **Type** - displays the rule type.

Then you can choose from a list of Display Rule Types and define the properties associated with the Type.

- **Horizontal** - specifies the difference between the x values of the point (pt1.x - pt2.x).
- **Absolute Horizontal** - specifies $ABS (pt1.x - pt2.x)$.
- **Vertical** - specifies pt1.y - pt2.y.
- **Absolute Vertical** - specifies $ABS (pt1.y - pt2.y)$.
- **Slope** - specifies the slope from pt1 to pt2.
- **Absolute Slope** - specifies the absolute value of the slope from pt1 to pt2.
- **Component is Displayed** - list existing components. The rule is evaluated to True if the indicated component is displayed.
- **Between (1st point)** - specifies the first point for the conditional test. Does not apply for type Component is Displayed type.
- **And (2nd point)** - specifies the second point for the conditional test. Does not apply for type Component is Displayed.
- **(Expression)** - specifies the conditional expression (<, <=, =, >=, >).
- **(Value field)** - specifies the value that the expression is evaluated against.

DEFINING PARAMETRIC CONSTRAINTS (LABELS)



Parametric Constraints use the Label property defined on a points constraints to override the defined value over a specified station range. Labels for common constraints should be the same.

- ✓ Pavement Depth
- ✓ Lane Width
- ✓ Switches

Parametric Constraints

Parametric Constraints allows you to reset the values for all points using the selected label at once.

For example, Pavement Thickness could be defined on the inside and outside of every pavement component ion the template. For a six lane section with cross overs Pavement Thickness could be defined 14 times or more in a single template. If the pavement design changes you can quickly reset all of those values at once without having to edit each point's properties to redefine the vertical constraint.

➤ **To edit Parametric Constraints on the Create Template dialog:**

1. Select the "Active Template" tab.
2. Expand the Parametric Constraints folder
3. Double-click the Label name
4. Enter a value in the "Edit Default Parametric Value" dialog
5. Click OK.

Applying Parametric Constraints

Parametric constraints can also be used to change one or more labeled constraint values of a template while the template is being processed through the corridor.. Click Tools > Parametric Constraints. This allows you to use only one template to handle a number of different conditions. The process involves two steps.

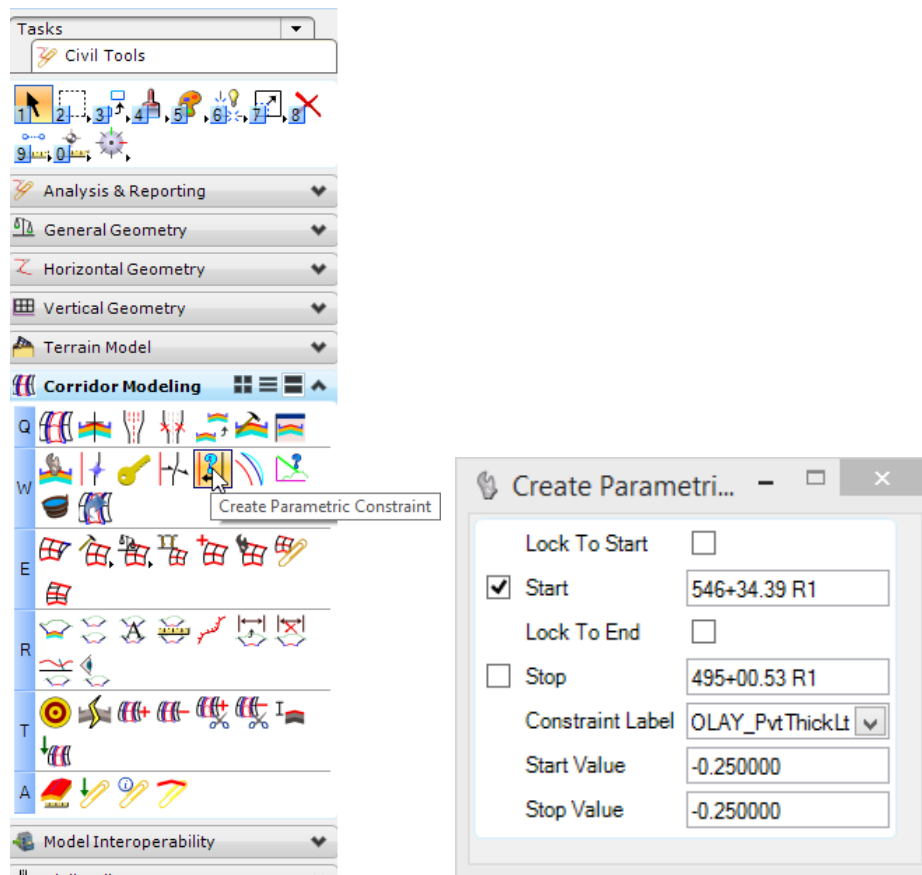
1. Add labels to the constraints that are to be controlled. This is done in the Create Template command.
2. Specify the new constraint value(s) and the station range over which they will be applied on the corridor.
This is most commonly used to change pavement thickness over a specified range.

All constraints can contain parametric labels.

For example, if the milling depth changes in the middle of the project you don't need to do multiple template drops. You can do a single template drop and add a Parametric Constraint each time the milling thickness changes.

➤ **To apply a parametric Constraint to a corridor**

1. Select Civil Tools > Corridor Modeling > Create Parametric Constraint from the Task menu.



2. After selecting the corridor you will be prompted for:
 - *Start station*
 - *Stop station*
 - *Constraint Label*
 - *Start Value*
 - *End Value*

EXERCISES

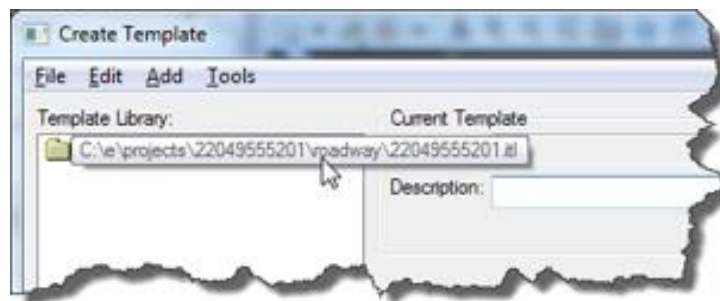
OPTIONAL: To prepare your computer for the next set of exercises:

- Delete the c:\e\projects\22049555201\ folder.
- Open the ComprehensiveTemplateDesign folder on the desktop and expand the DataSets folder.
- Extract the CT22049555201_Chapter5.zip file in the c:\e\projects\ folder.

Exercise 5.1 *Setting Preferences (Optional)*

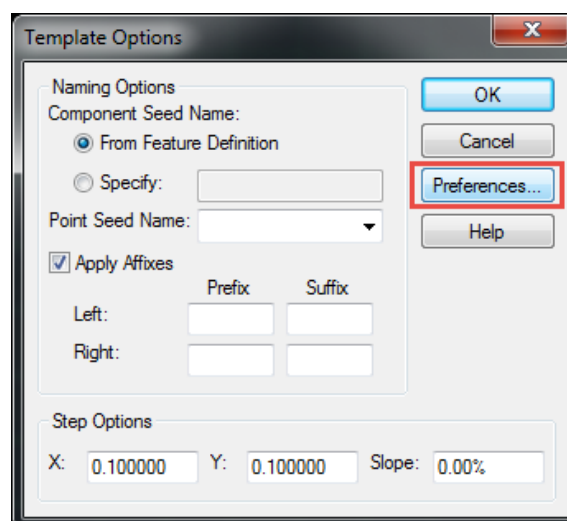
Note Steps 1-7 (loading Create Template preferences) are only needed if MicroStation was closed and restarted.

- Open the *DSGNRD01.dgn* file of the c:\e\projects\22049555201\roadway\ folder in the FDOTSS4 Workspace in MicroStation.
- Use the **F12** key to launch the Create Template dialog. If the ITL is named properly the Project ITL file should already be loaded.



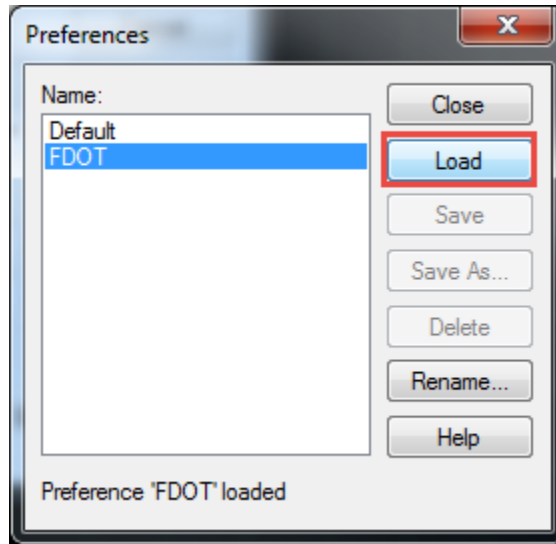
Note The FDOT workspace provides some predefined preferences that are useful when working with templates. These preferences should be loaded for each new MicroStation session.

- Select **Tools > Options** from the menu.
- On the Template Options dialog press the **Preferences** button.



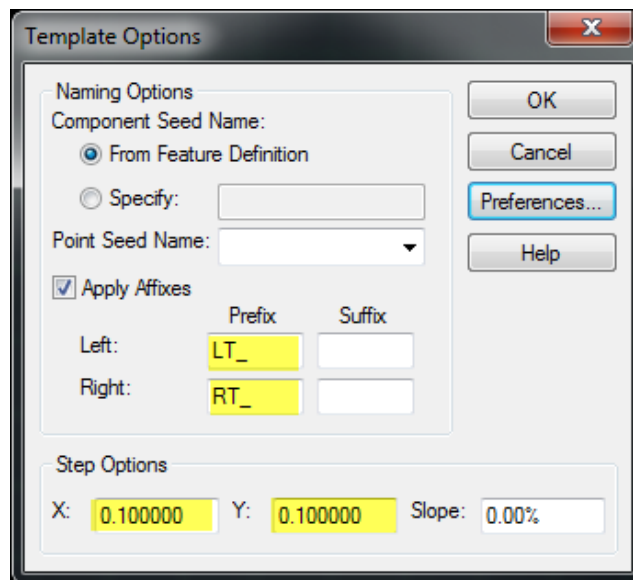
5. On the Preferences dialog, select **FDOT** from the list and press **Load**.

Note You can also double-click **FDOT** to load the preferences.



6. Press the **Close** button to return to the Template Options dialog.

Note Notice that Left and Right Prefixes have been defined and the Step Options have been set to a tenth. The step options allow the components being dragged into the active template to snap onto the grid at one tenth of a foot intervals.



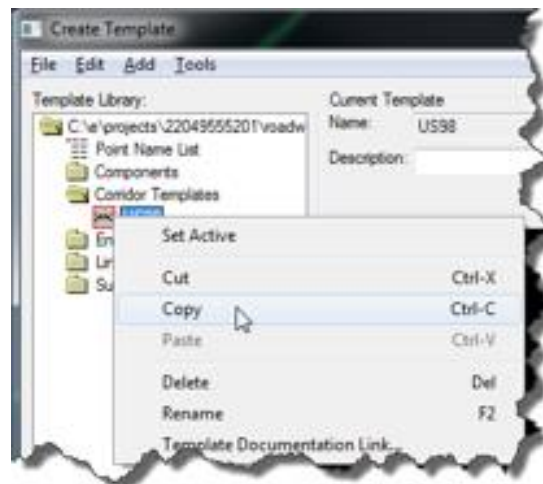
7. Press **OK** to close the Template Options dialog

Exercise 5.2 Parent \ Child Relationships

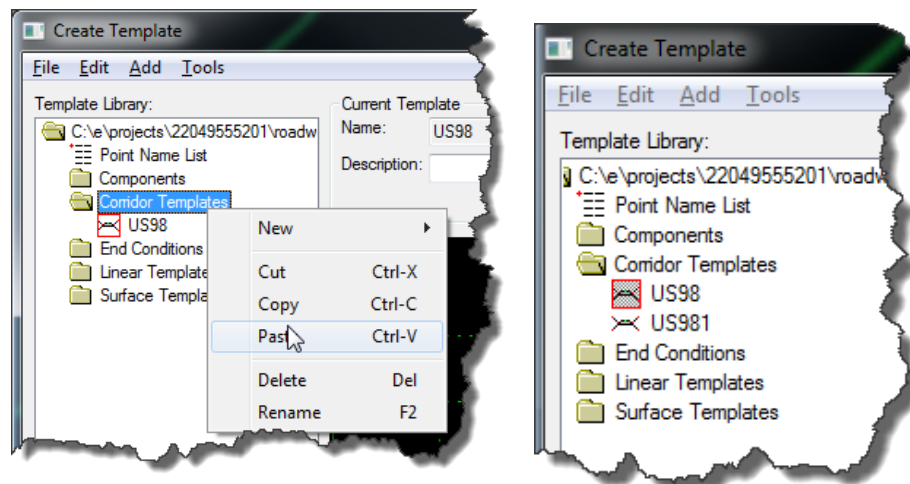
It is best to create parent \ child relationships between components so Display Rules can be applied to a single component instead of all components outside that location.

Note Before making major edits, it is recommended to make a copy in case you want to go back to a previous state.

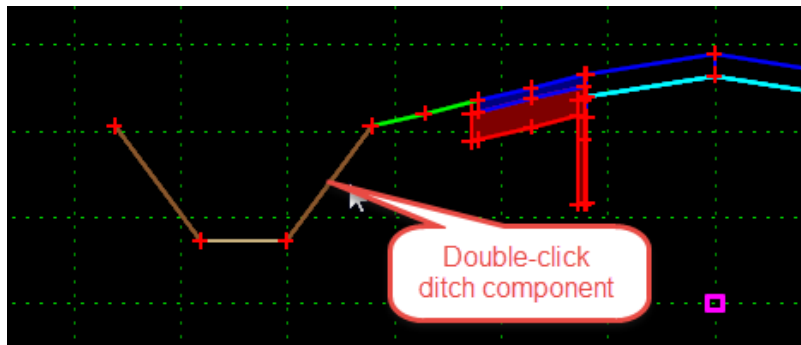
1. Navigate to the Corridor Templates folder and double-click on the **US98** template to activate.
2. Right-click on the **US98** template and select **Copy** from the *Context* menu.



3. Right-click on the Corridor Templates folder and select **Paste** from the *Context* menu. A copy of the template will be made with a '1' appended to the name.



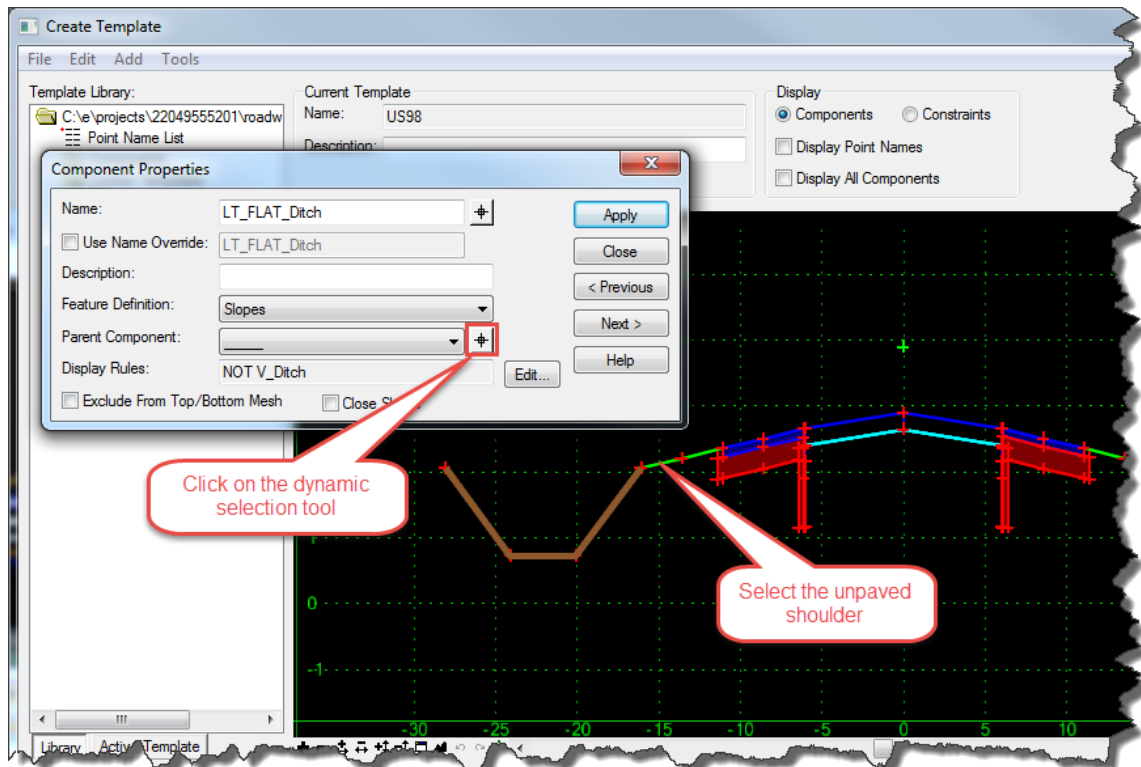
4. Double-click on the **ditch** component.



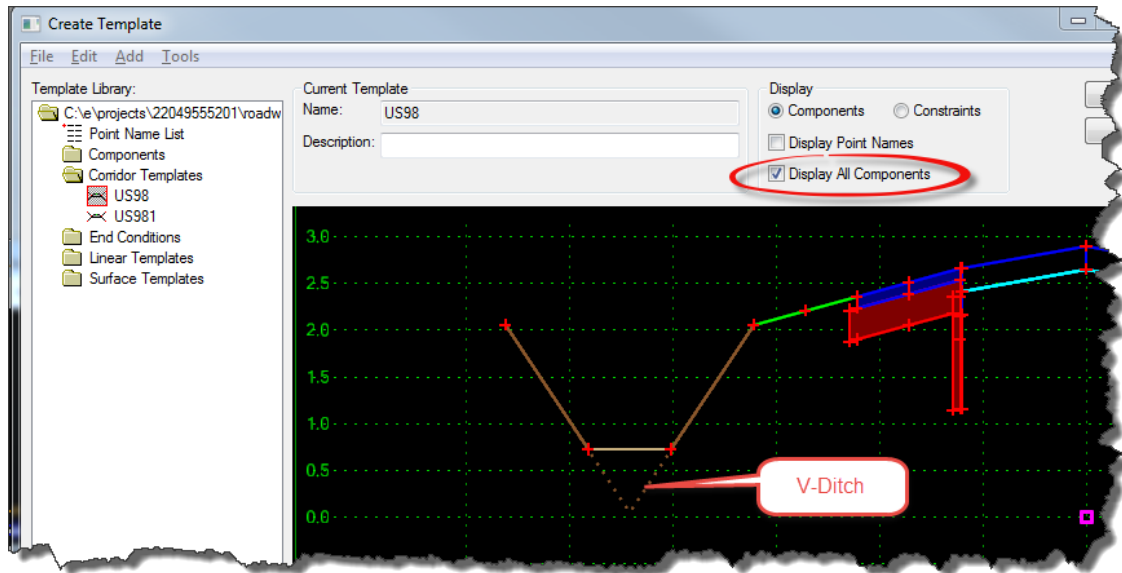
5. The Component Selection dialog opens indicating there are multiple components at that location. Select the **top** component.



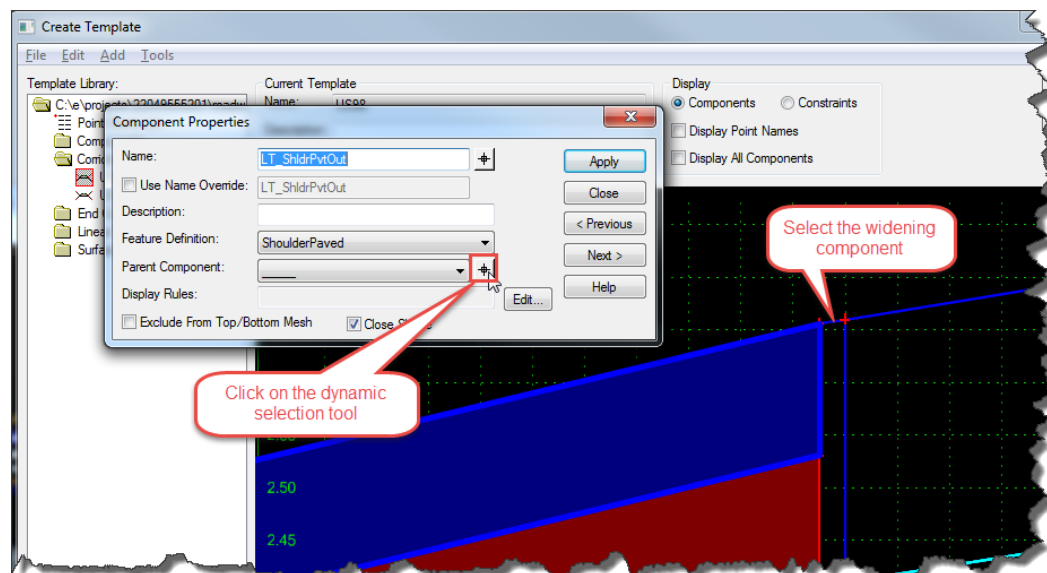
6. To assign a *Parent Component* select a component name from the *drop-down list* or select the parent *dynamically*. Select the **dynamic selection** tool and then select the **unpaved shoulder** component.



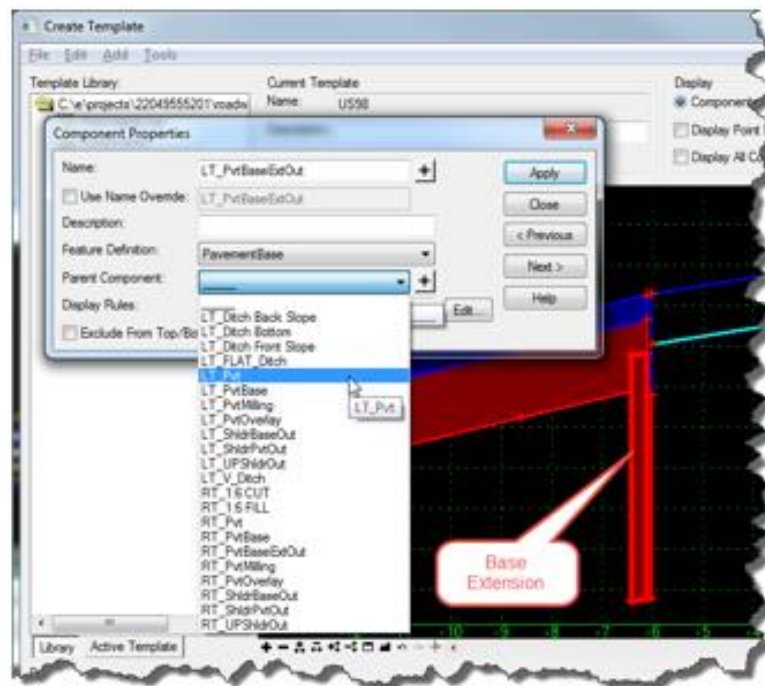
7. After selecting the unpaved shoulder press **Apply** and **Close** to return to the Create Template dialog.
8. Double-click on the **ditch** component again; this time selecting the bottom component when prompted.
9. Make the **unpaved shoulder** the *parent component* of the **second ditch** component by repeating steps 3 and 4.
10. Check the **Display All Components** option in the Create Template Display settings.



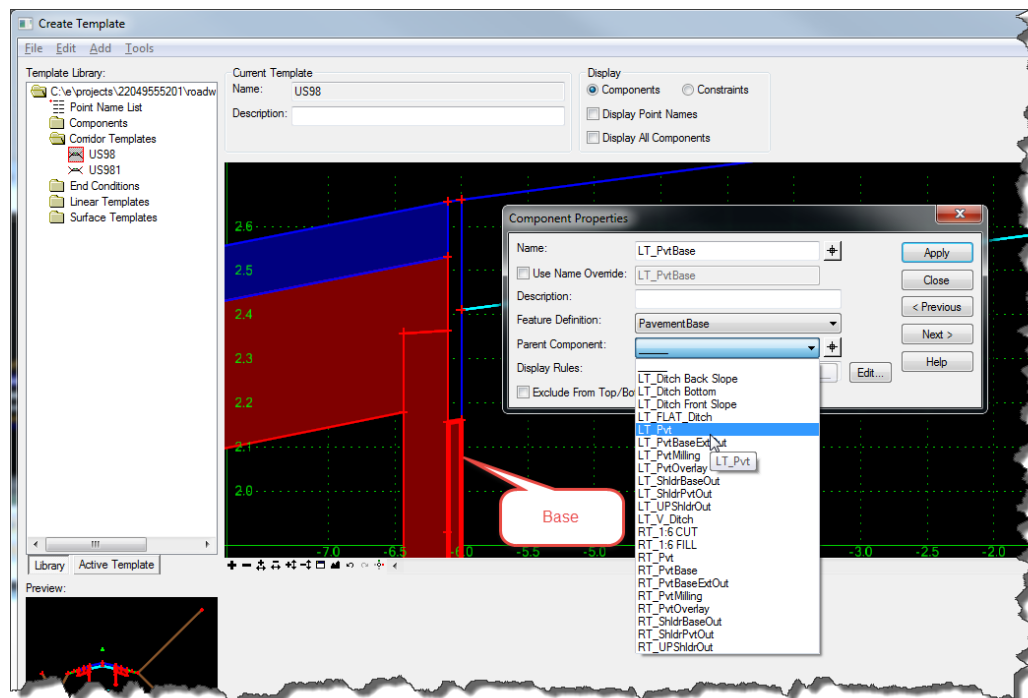
11. Double-click on the **V ditch** component.
12. Make the **unpaved shoulder** the *parent component* of the **V ditch** component by repeating steps 3 and 4.
13. Uncheck the **Display All Components** option in the Create Template Display settings.
14. Zoom in to the area where **paved shoulder** component attaches to the **widening** component.
15. Double-click on the **paved shoulder** component and use the **dynamic selection** tool to select the **widening** component (**LT_Pvt**) as the *Parent Component*.



16. Press **Apply** and **Close** to return to the Create Template dialog.
17. Double-click on the **base extension** for the left side and use the *Parent Component* drop-down list to select **LT_Pvt**.



18. Press **Apply** and **Close** to return to the Create Template dialog.
19. Double-click on the **left pavement base component** and use the *Parent Component* drop-down list to select **LT_Pvt**.



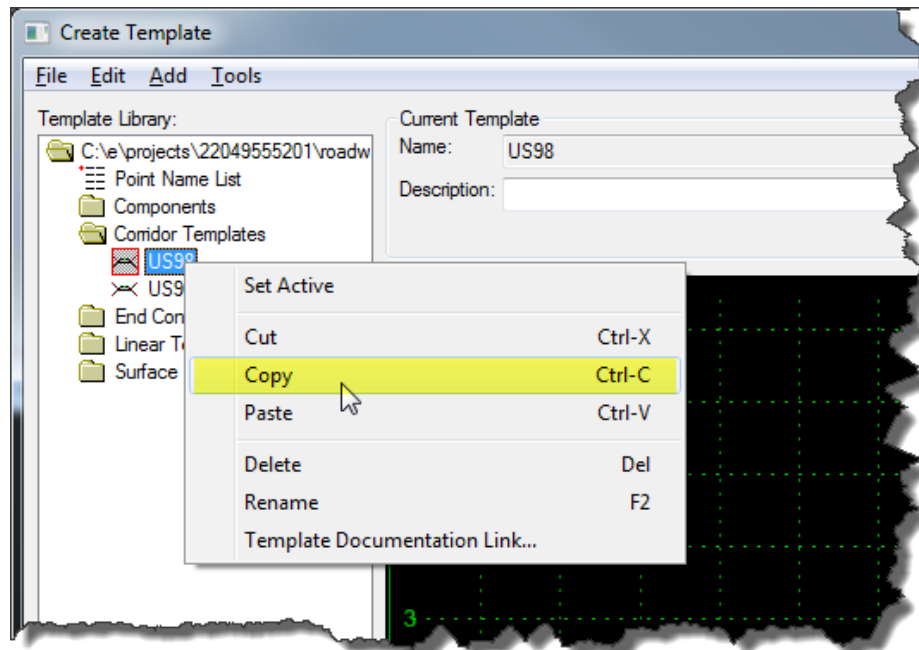
20. Press **Apply** and **Close** to return to the Create Template dialog.

Exercise 5.3 Add Switches and Display Rules

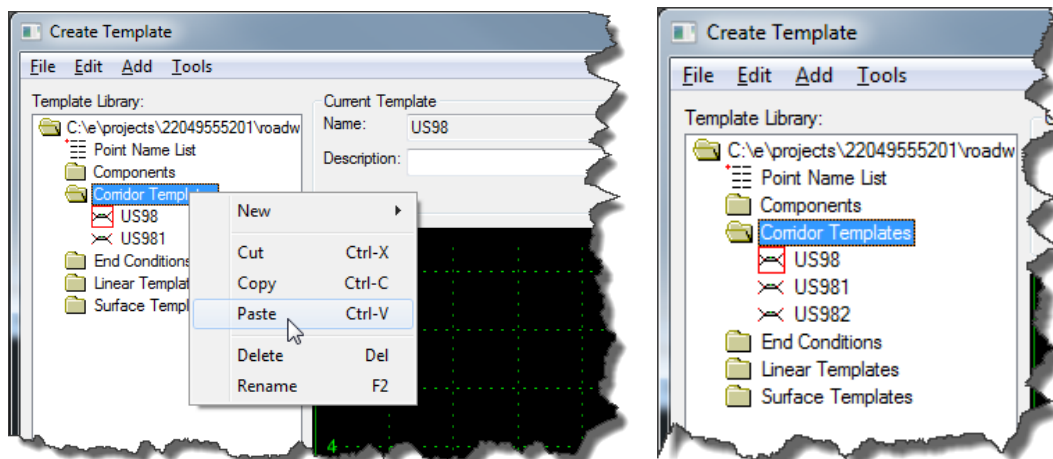
The FDOTSS4.ITL provides a prebuilt “Switches” component that contains the controlling points and related display rules for 5 conditions on each side of the template.

Note When making major edits it is recommended to make a copy in case you want to go back.

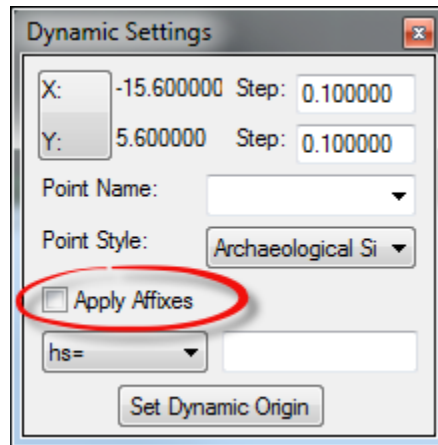
1. Navigate to the Corridor Templates folder and double-click on the **US98** template to active.
2. Right-click on the **US98** template and select **Copy** from the *context* menu.



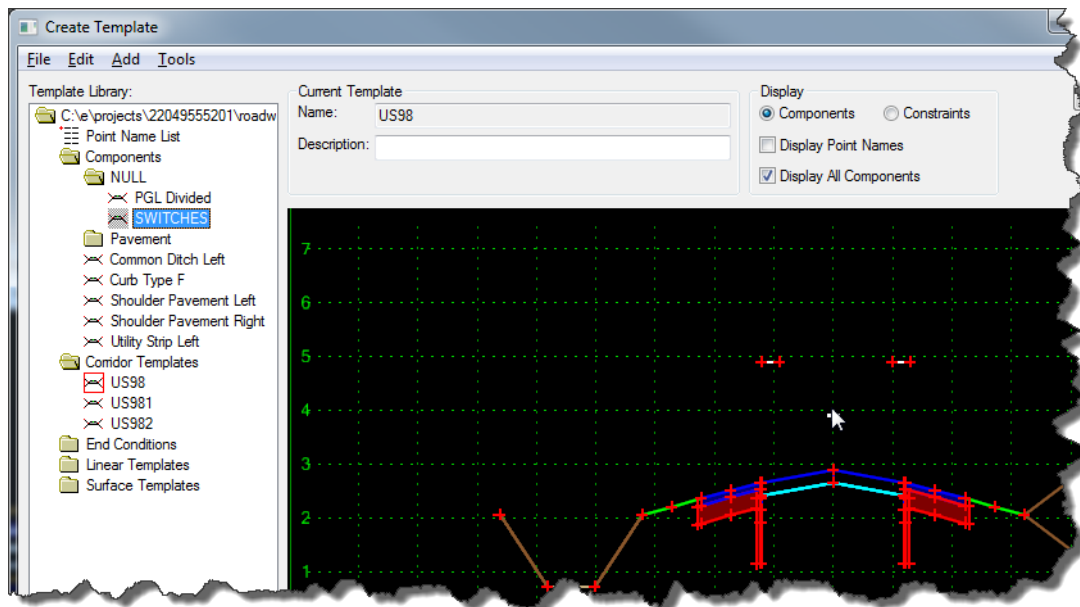
3. Right-click on the Corridor Templates folder and select **Paste** from the *context* menu. A copy of the template will be made with a '2' appended to the name.



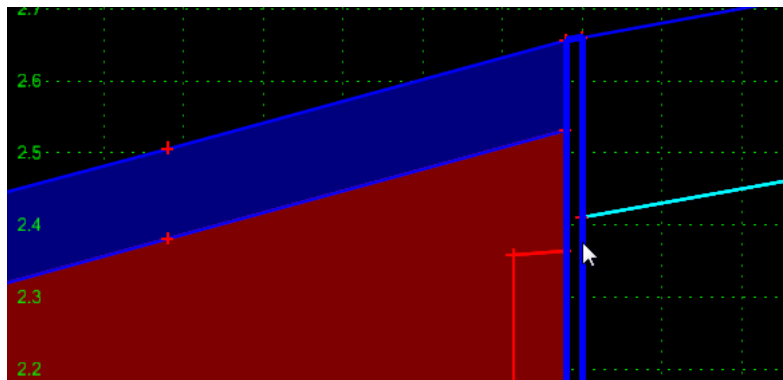
- Open the **Dynamic Settings** dialog if necessary (**Tools > Dynamic Settings**) and ensure the **Apply Affixes** box is unchecked.



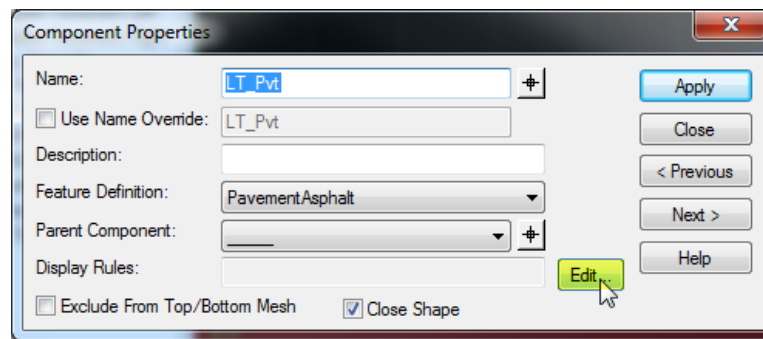
- Navigate to the **Components\Null** folder and select the **SWITCHES** component.
- Drag it onto the active template and drop it onto the **green CL point**.



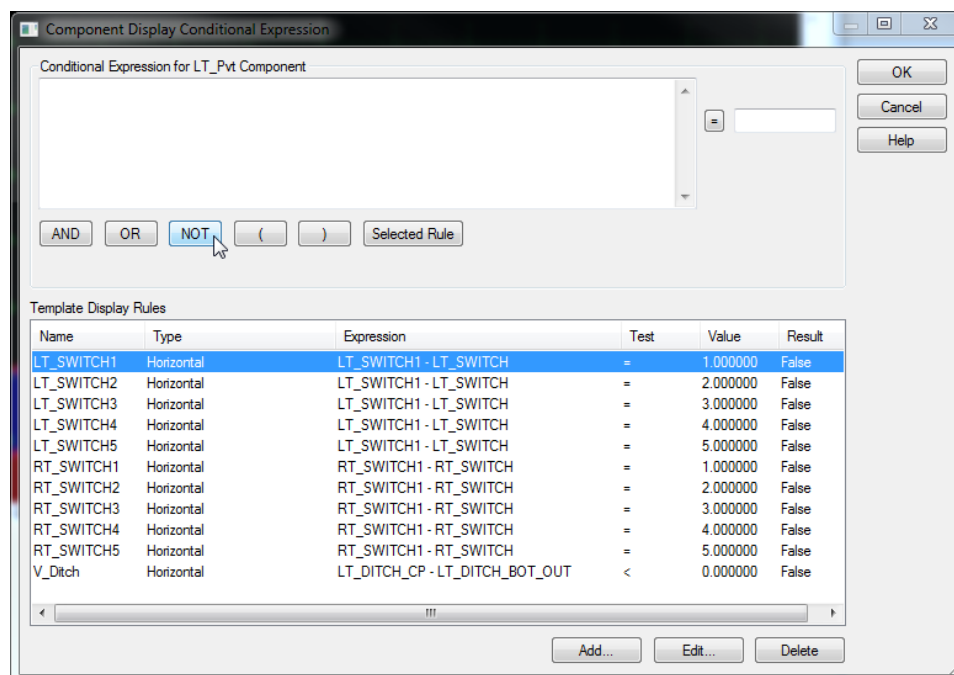
- Double-click on the **widening** component to edit its properties.



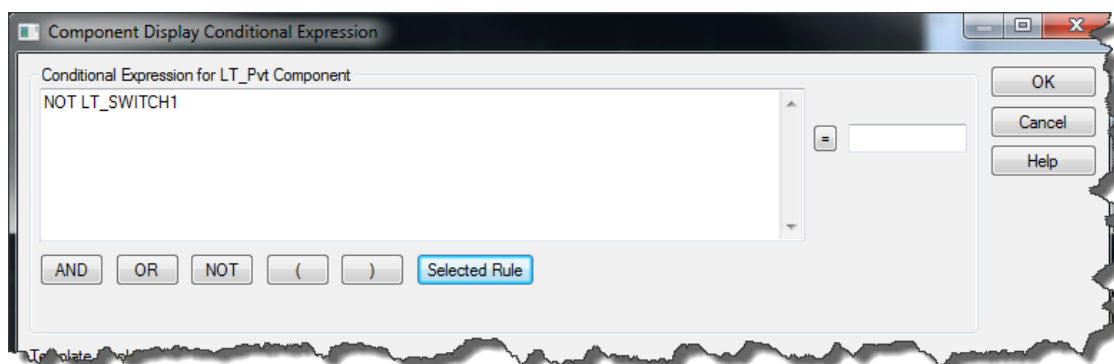
8. On the Component Properties dialog, press the *Display Rules* **Edit** button.



9. On the Component Display Conditional Expression dialog select the *rule in the list* then press the **NOT** button and the **Selected Rule** button.

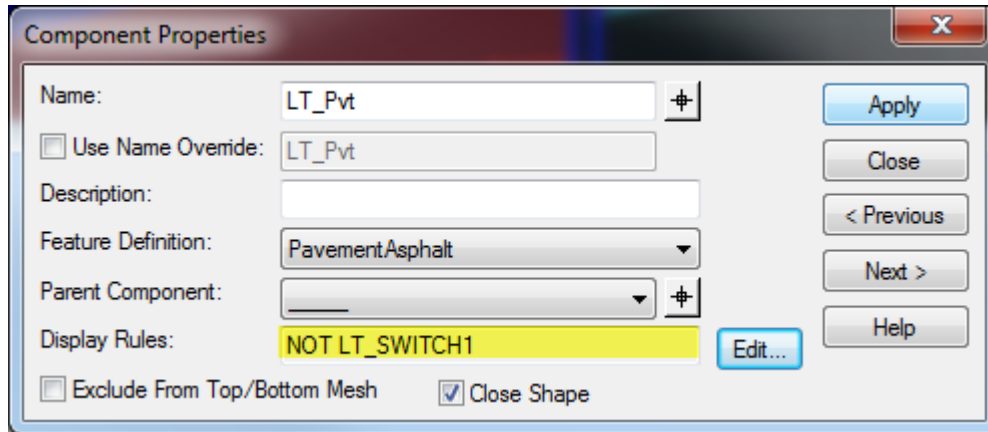


10. This builds the statement “**NOT LT_SWITCH1**”. Press **OK** to apply this *Display Rule*.

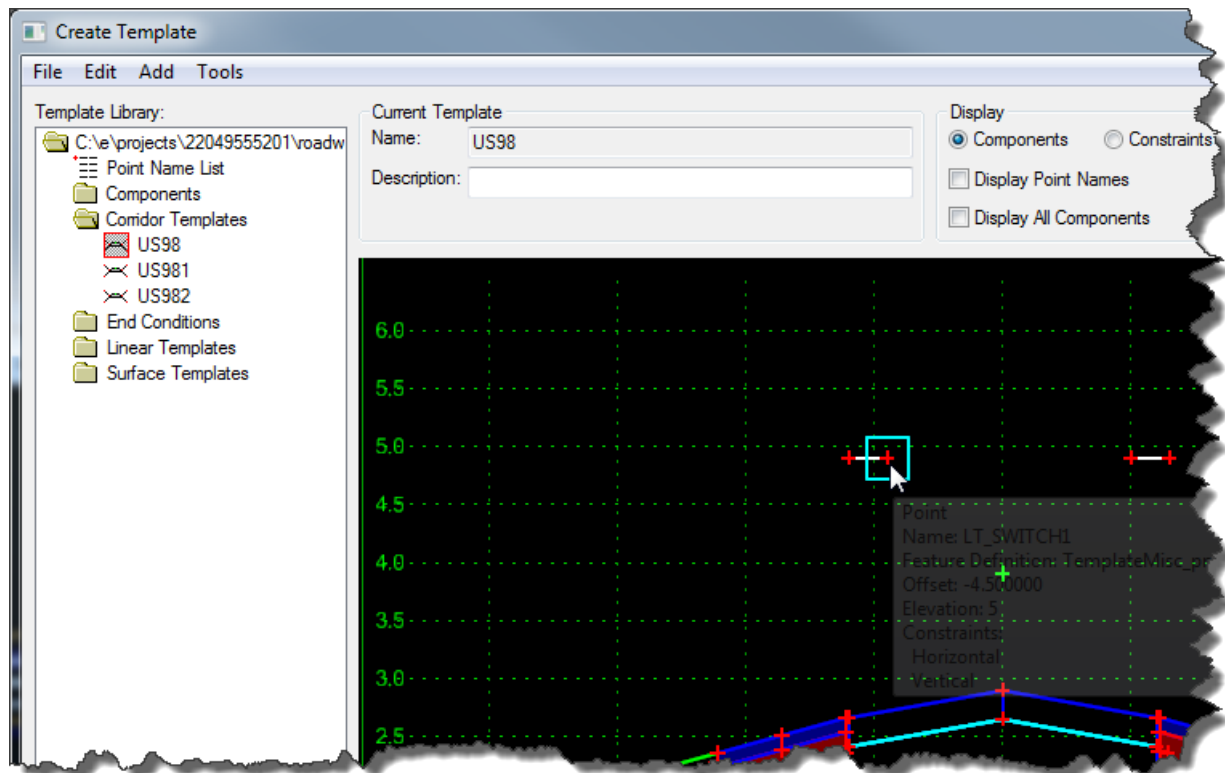


Note Back on the Component Properties dialog you will see that the Display Rules field has been populated.

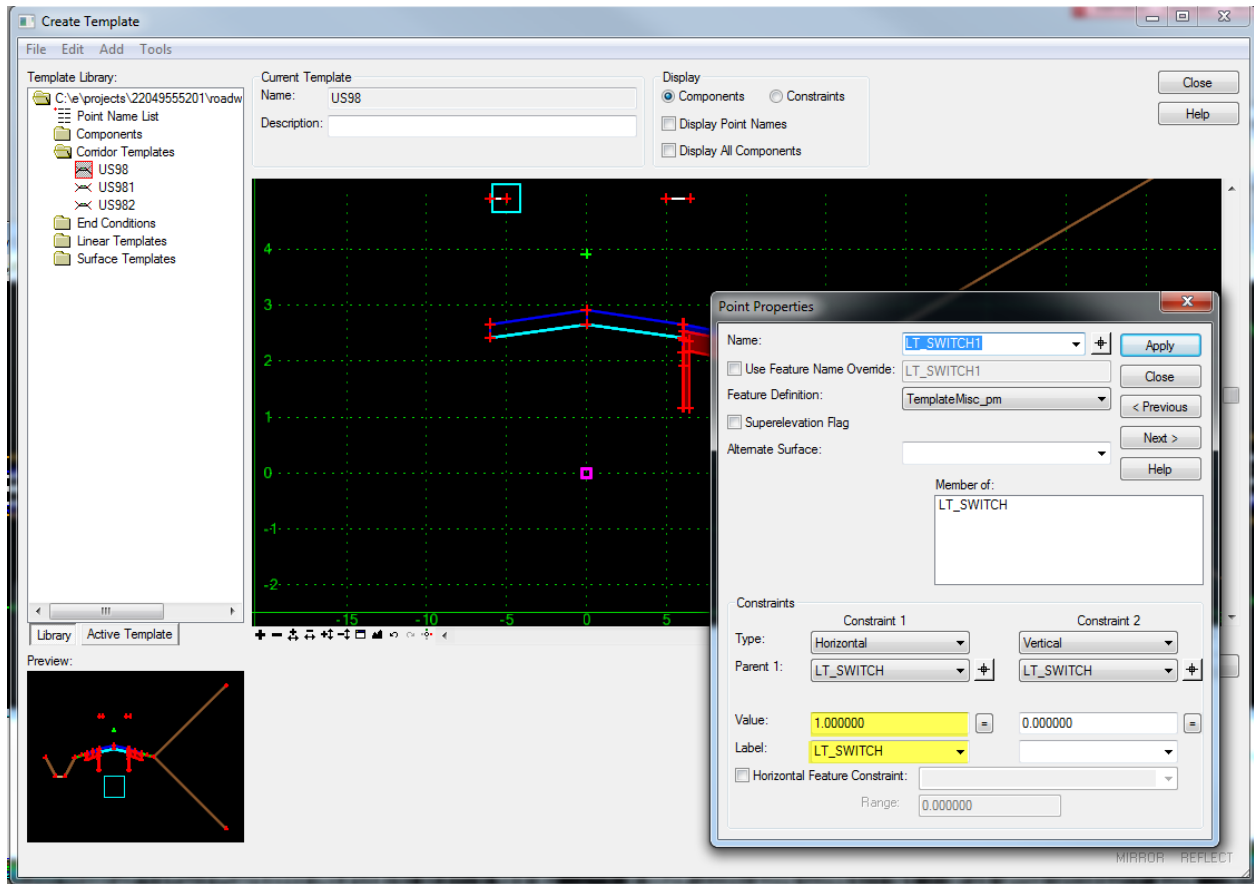
11. Press **Apply** and then **Close** to return to the Create Template dialog.



12. Double-click on the inside point of the *left switch component* (LT_SWITCH1).



- Set the *Horizontal Value* to **1** and press **Apply**. Notice how everything to the left of the resurfacing is turned Off.



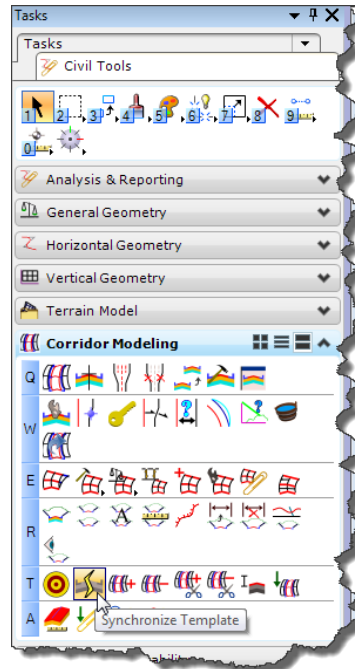
Note Take note that a Label named *LT_SWITCH* has been applied to the Horizontal constraint. This Label can be used to change the Horizontal Value through user defined station ranges by applying Parametric Constraints to the corridor.

- Set the *Horizontal Value* back to **1.5** then press **Apply** and **Close**.
- On the Create Template dialog select **File > Save** from the menu and then **Close** to return to MicroStation.

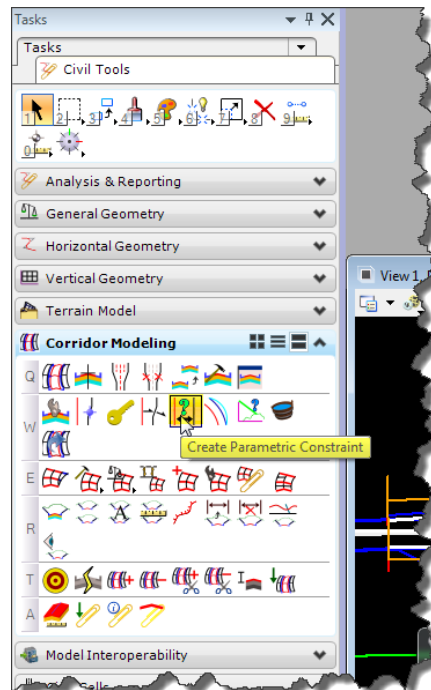
Exercise 5.4 Apply Parametric Constraints

Parametric Constraints can be applied to a corridor to override the value of point constraints if a label has been defined in the point properties. This exercise will use this functionality to turn off the display of components through the intersection.

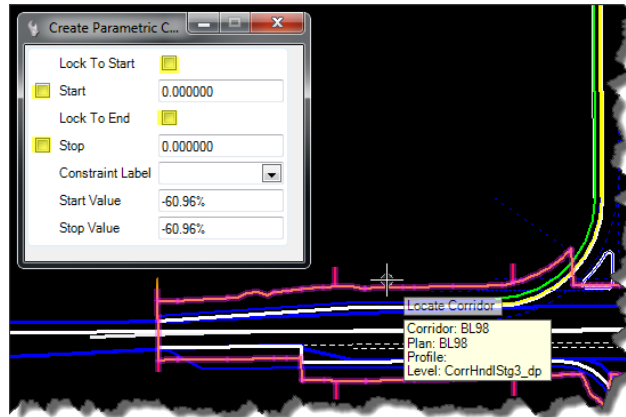
1. From the *Task* menu select **Civil Tools > Corridor Modeling > Synchronize Template**.



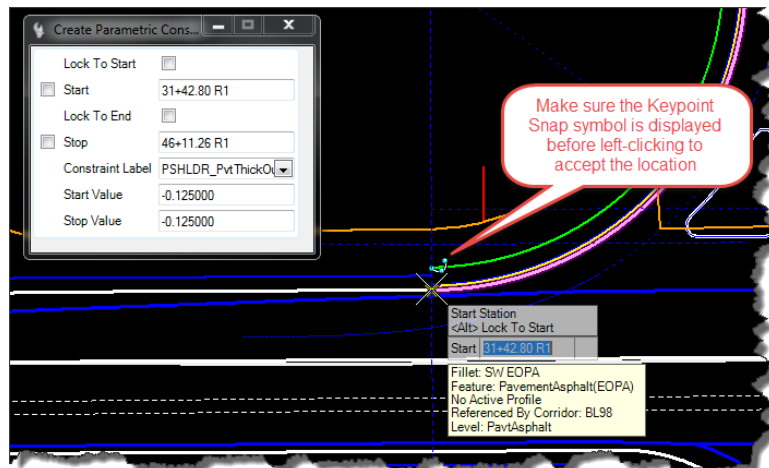
2. From the *Task* menu select **Civil Tools\Corridor Modeling\Create Parametric Constraint**.



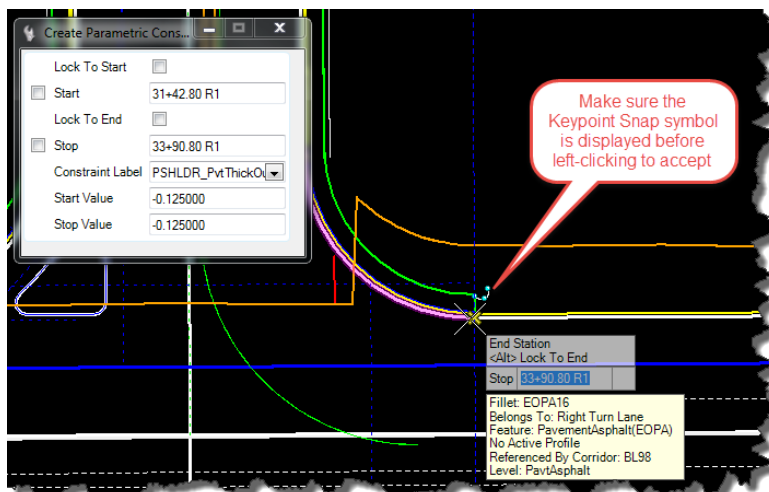
- Ensure that the *start and end values* are **not locked** in on the Create Parametric Constraint dialog and select the *corridor boundary to Locate Corridor* as prompted on cursor.



- When prompted for the *Start Station* use AccuSnap to snap to the first return of the **SR 61 intersection** and then **Data Point** (left-click) to Accept.

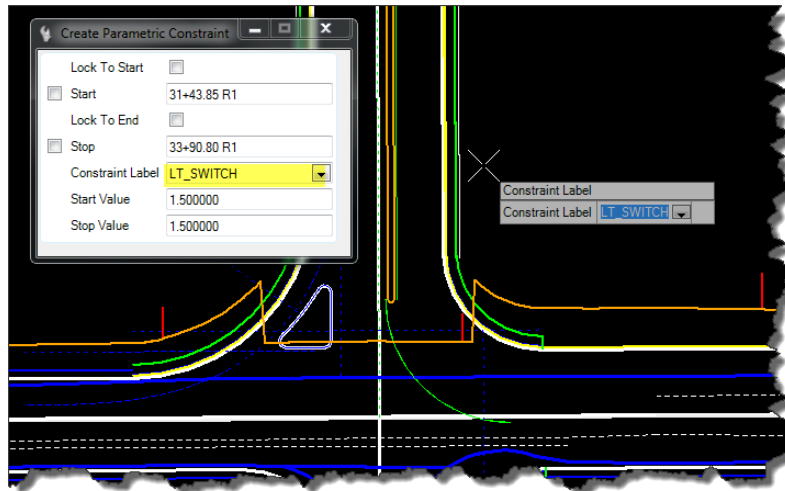


- When prompted for the *End Station* use AccuSnap to snap to the opposite return of the **SR 61 intersection** and then **Data Point** (left-click) to Accept.

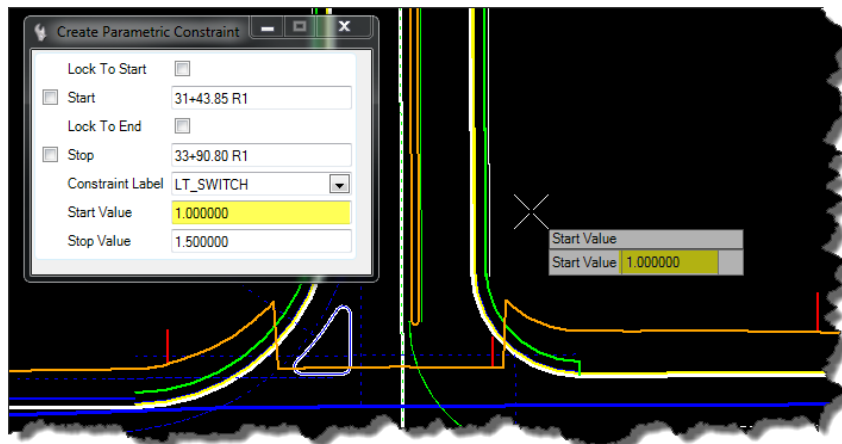


- When prompted for the *Constraint Label* choose **LT_SWITCH** from the drop-down on the Create Parametric Constraint dialog

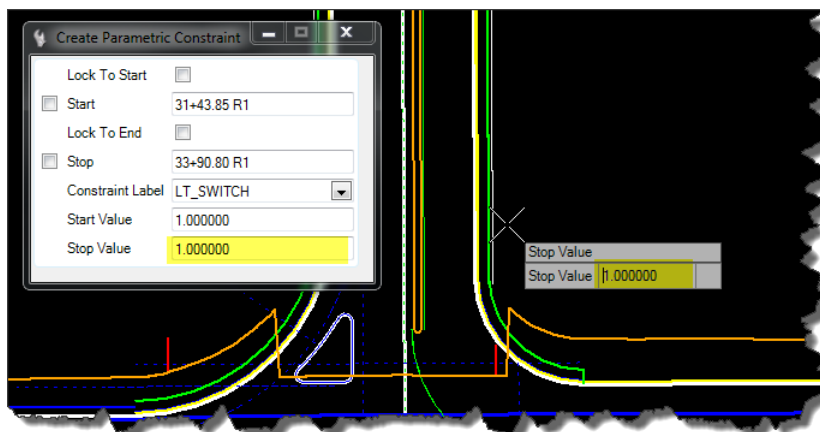
<OR> use the up and down arrows on the key board to select **LT_SWITCH** from the cursor and then **Data Point** (left-click) to Accept.



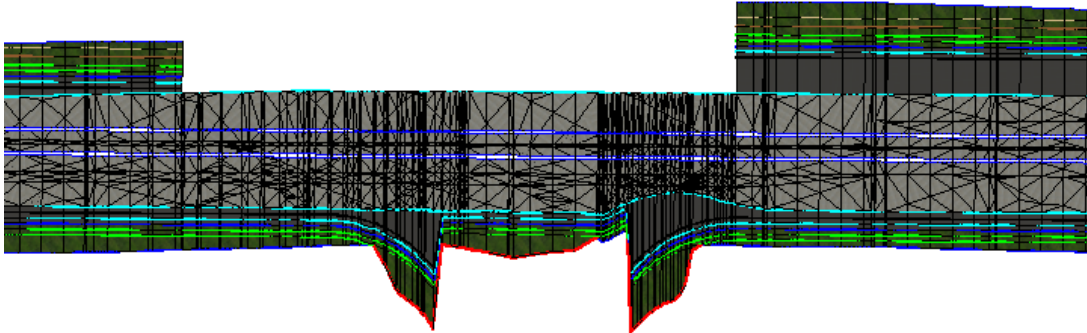
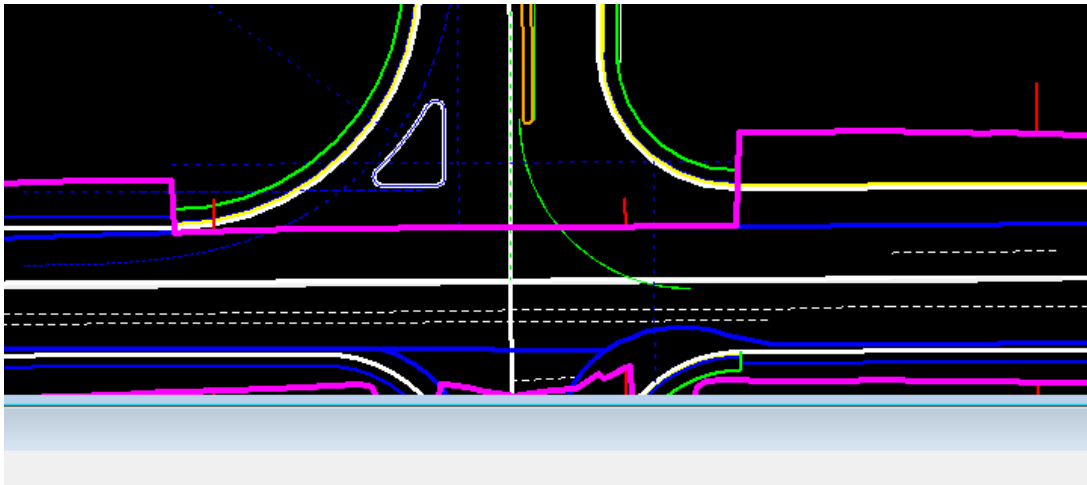
- When prompted for the *Start Value* key in **1** and press **Enter** then **Data Point** (left-click) to Accept.



- When prompted for the *Stop Value* key in **1** and press **Enter** then **Data Point** (left-click) to Accept.



Note Notice how, using the Parametric Constraint to make the statement in display rule true, turns off the components through the station range defined.

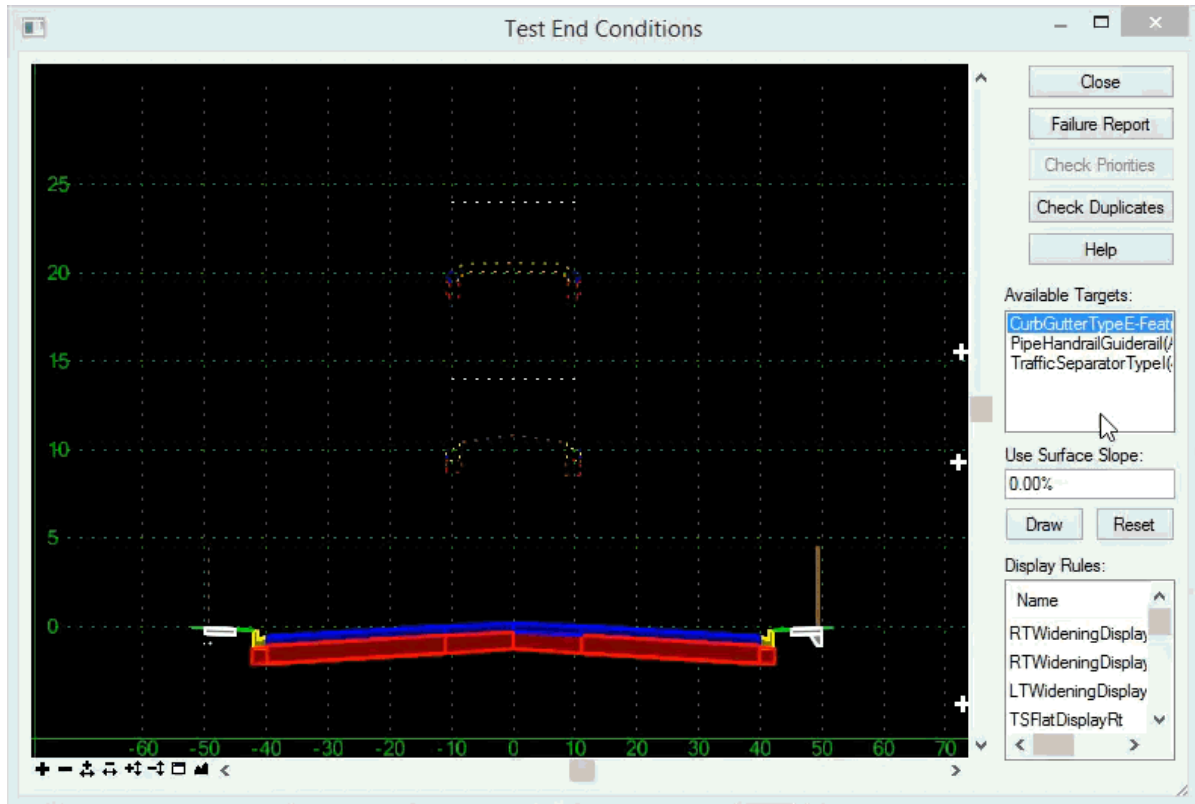


9. Press **F6** on the key board to get out of the current command and return to *Element Selection*.
10. Select one of the **returns** and change the *radius* to see how that effects the model. By snapping to the returns for start and stop locations the model will automatically heal itself if changes to geometry are made.
11. Use **Ctrl+Z** to *Undo* the change to the return.

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6 TRIGGER LINES

INTRODUCTION

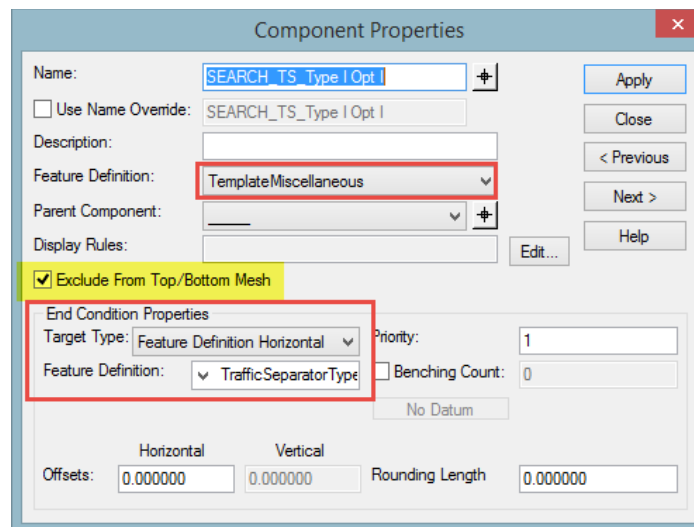
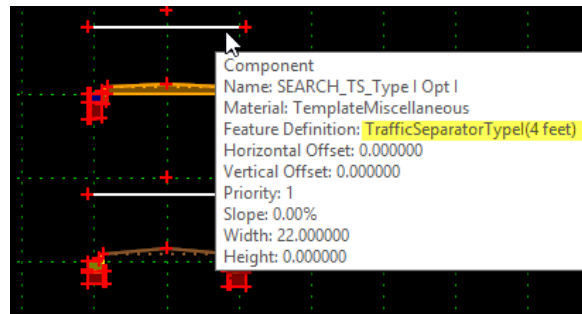


- Make Trigger Line the Parent of related components.
- An End Condition (Trigger Line) is configured to search for a specific Target.
- When Target is located, all related components of a Trigger Line will display, but not displayed if Target is not found.
- Exclude Trigger Lines from triangulation.

“Trigger Line” is a term for the use of End Conditions as display controls. Trigger Lines are used to make a template dynamic by including multiple possibilities in a single template. This reduces the number of template drops required along a corridor and is especially useful in urban areas where conditions change frequently.

Trigger Lines are End Condition components used to search for “Corridor References” with a specific Feature. End Conditions are only displayed when the defined condition is true. All child components of an End Condition are displayed when the End Condition is True.

Creating Trigger Lines



To create a Trigger Line you can right-click in the editor and select “Add New Component > End Condition” and draw a line horizontally from where you want to begin the search to a point in the direction of the search. You could then set the Target Type to “Feature Definition Horizontal” and the choose the desired target Feature Definition.

➤ To Use the Predefined Standard Search Line (Trigger)

A default Trigger Line is provided in the FDOTSS4.ITL file. It is named “Standard Search Line (Trigger)” and can be found in the End Conditions folder.:

1. Drag the *Standard Search Line (Trigger)* component into your template.
2. Set the *Target Feature* in the trigger line properties.
3. Edit the component to be controlled by the trigger line and make the trigger line the *parent component*.

EXERCISES

In this exercise Trigger Lines are used to change from a paved shoulder to a curbed section through the turn lane.

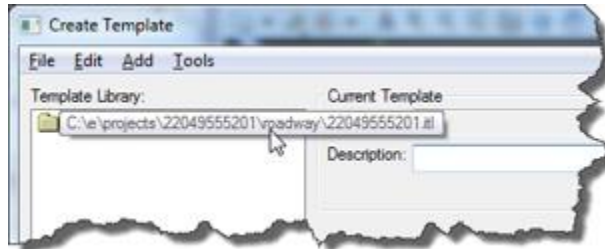
OPTIONAL: To prepare your computer for the next set of exercises:

- a) Delete the c:\e\projects\22049555201\ folder.
- b) Open the ComprehensiveTemplateDesign folder on the desktop and expand the DataSets folder.
- c) Extract the CT22049555201_Chapter6.zip file in the c:\e\projects\ folder.
- d) Note the paved shoulder on US 98 has been changed to Type F Curb and Gutter along the right turn lane.

Exercise 6.1 Setting Preferences (Optional)

Note Steps 1-7 (loading Create Template preferences) are only needed if MicroStation was closed and restarted.

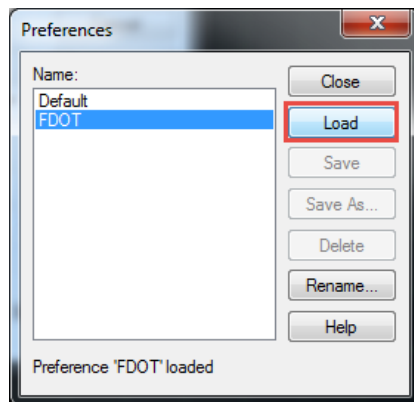
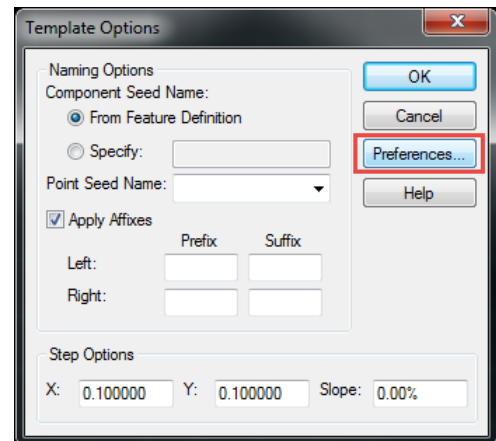
1. Open the *DSGNRD01.dgn* file of the *c:\e\projects\22049555201\roadway* folder in the FDOTSS4 Workspace in MicroStation.
2. Use the **F12** key to launch the Create Template dialog. If the ITL is named properly the Project ITL file should already be loaded.



Note The FDOT workspace provides some predefined preferences that are useful when working with templates. These preferences should be loaded for each new MicroStation session.

3. Select **Tools > Options** from the menu.
4. On the Template Options dialog press the **Preferences** button.
5. On the Preferences dialog, select **FDOT** from the list and press **Load**.

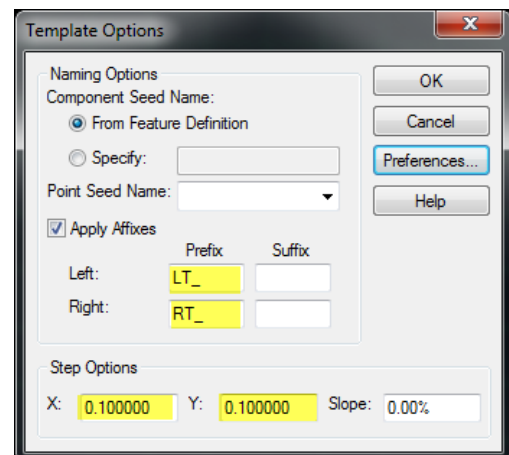
Note You can also double-click FDOT to load the preferences.



6. Press the **Close** button to return to the Template Options dialog.

Note Notice that Left and Right Prefixes have been defined and the Step Options have been set to a tenth. The step options allow the components being dragged into the active template to snap onto the grid at one tenth of a foot intervals.

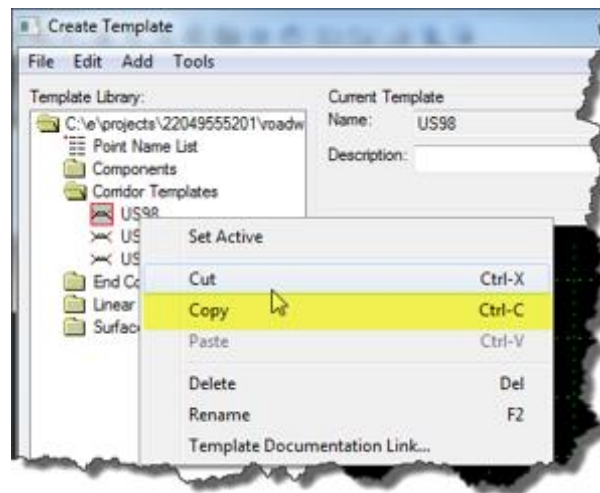
7. Press **OK** to close the Template Options dialog



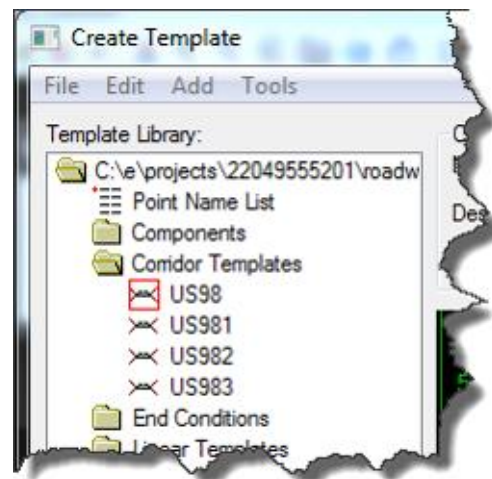
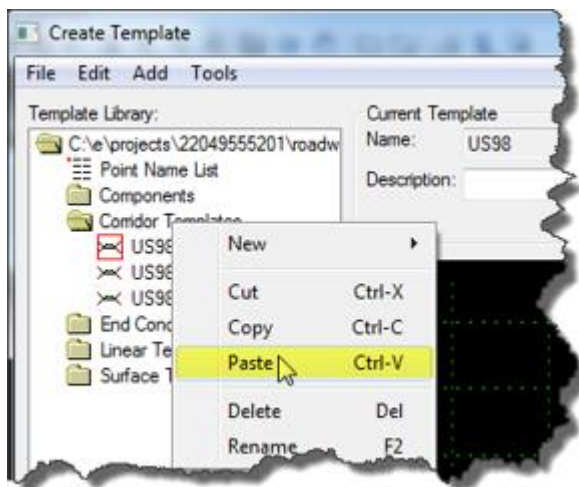
Exercise 6.2 Stacking Conditions

To make for easy maintenance of the template it is a best practice to stack variable conditions above or below the connection point instead of putting multiple components on top of each other. This exercise will be adding a second condition that can be triggered on as needed.

1. Use **F12** to open the Create Template dialog.
2. Navigate to the Corridor Templates folder and double-click on the **US98** template to make it active.
3. Right-click on the **US98** template and select **Copy** from the *context* menu.



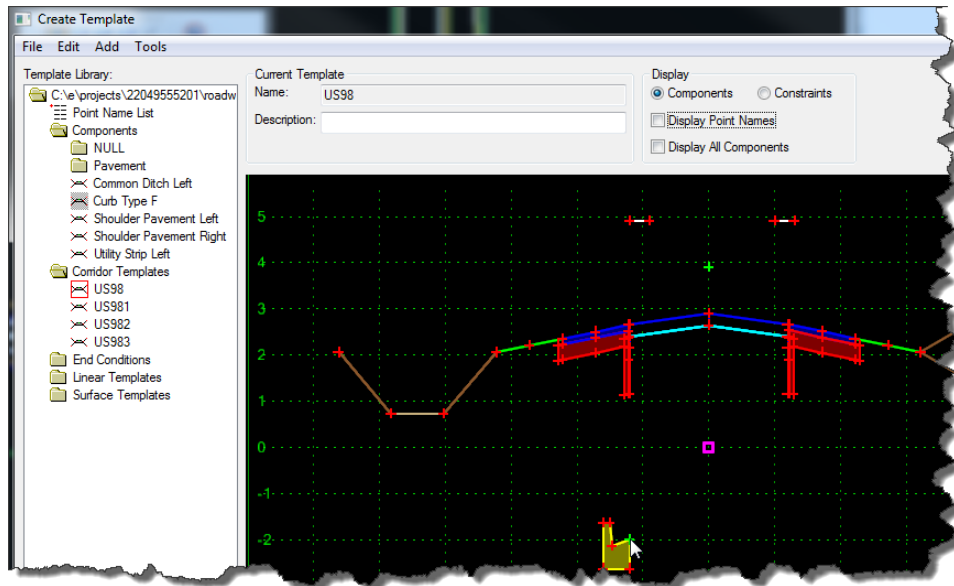
4. Right-click on the Corridor Templates folder and select **Paste** from the *context* menu. A copy of the template will be made with a 3 appended to the *name*.



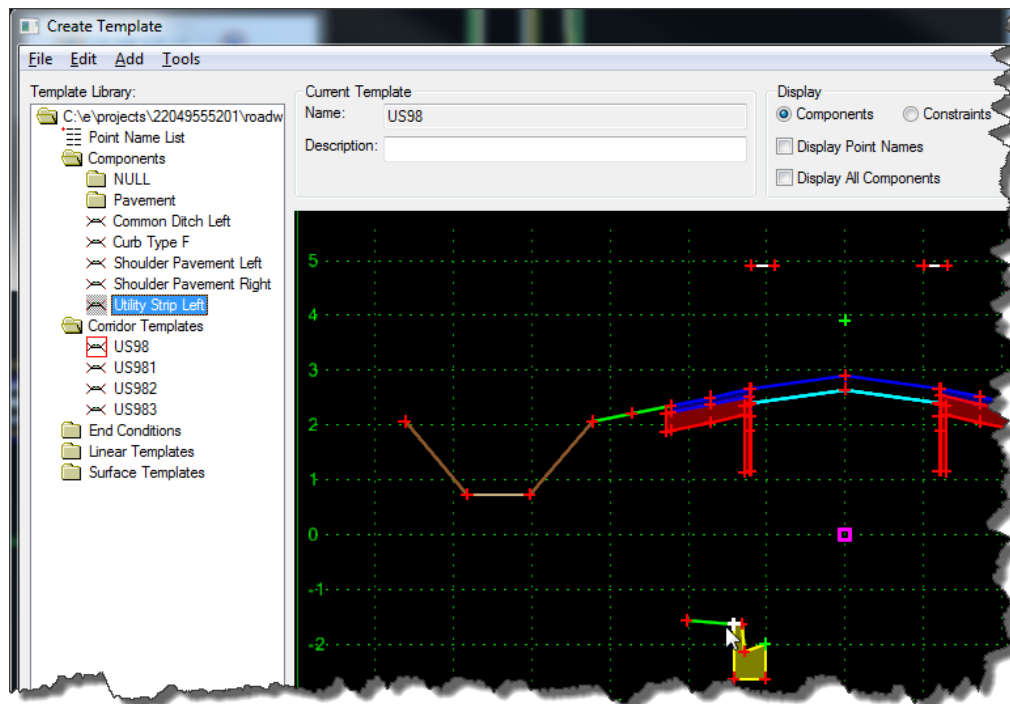
Exercise 6.3 Type F Curb & Gutter Condition

The right turn lane has Type F Curb and Gutter instead of paved shoulders so another condition needs to be accounted for in the template.

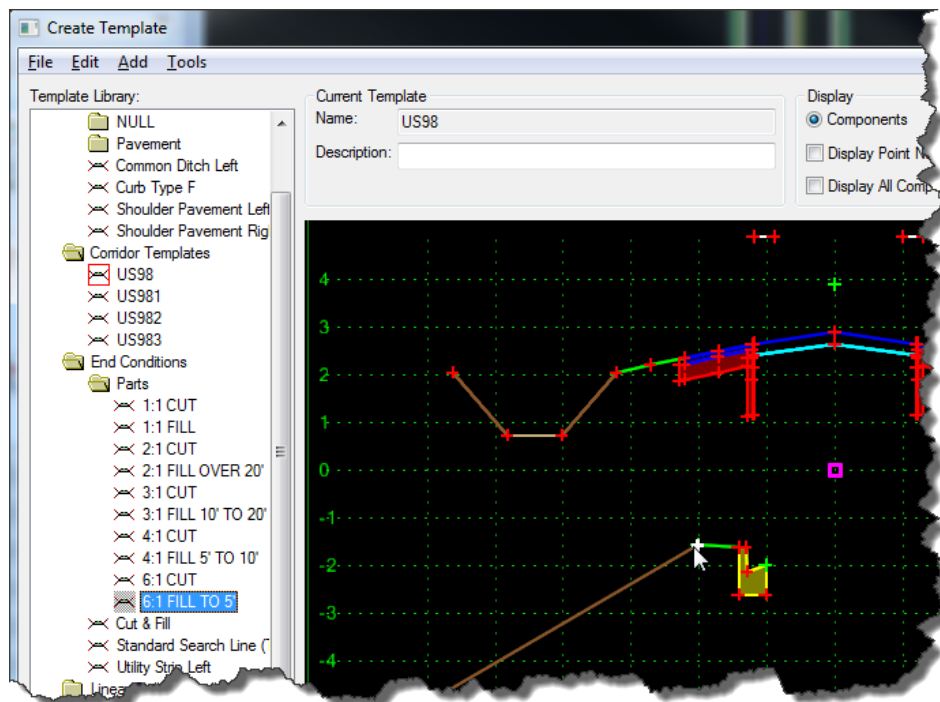
1. Navigate to the *Components* folder and select the **Curb Type F** component.
2. While dragging the **Curb Type F** into the template press **Ctrl+R** on the keyboard to *Reflect* the component and then drop it a couple feet below the paved should component.



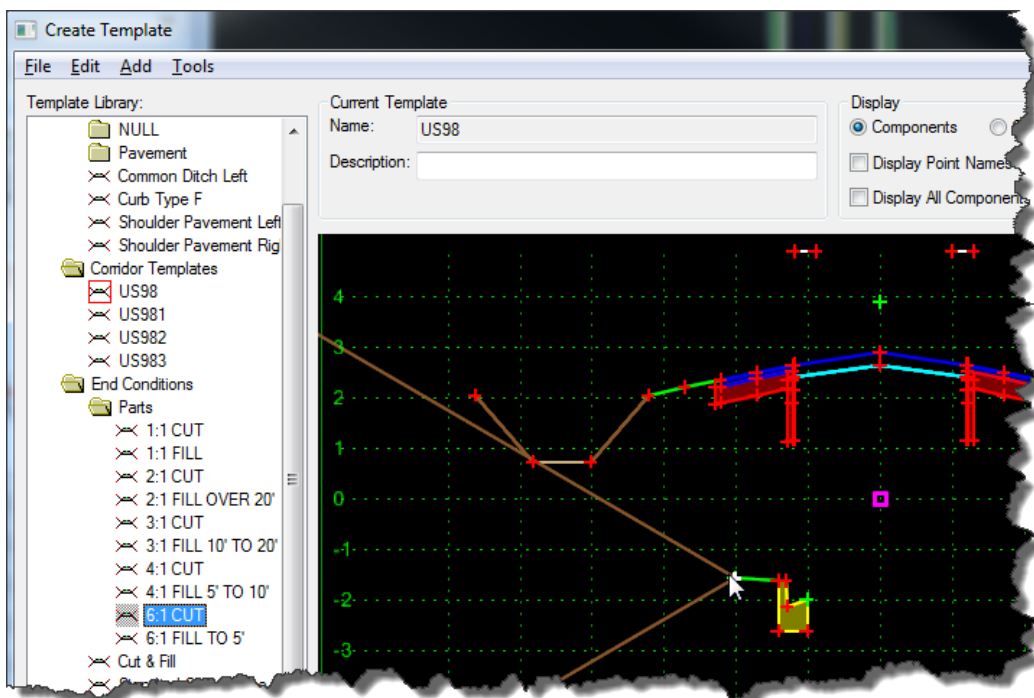
3. Navigate to the *Components* folder and select the **Utility Strip Left** component.
4. While dragging the **Utility Strip** into the template press **Ctrl+R** on the keyboard to toggle **Off Reflect** and then drop it on the back of curb.



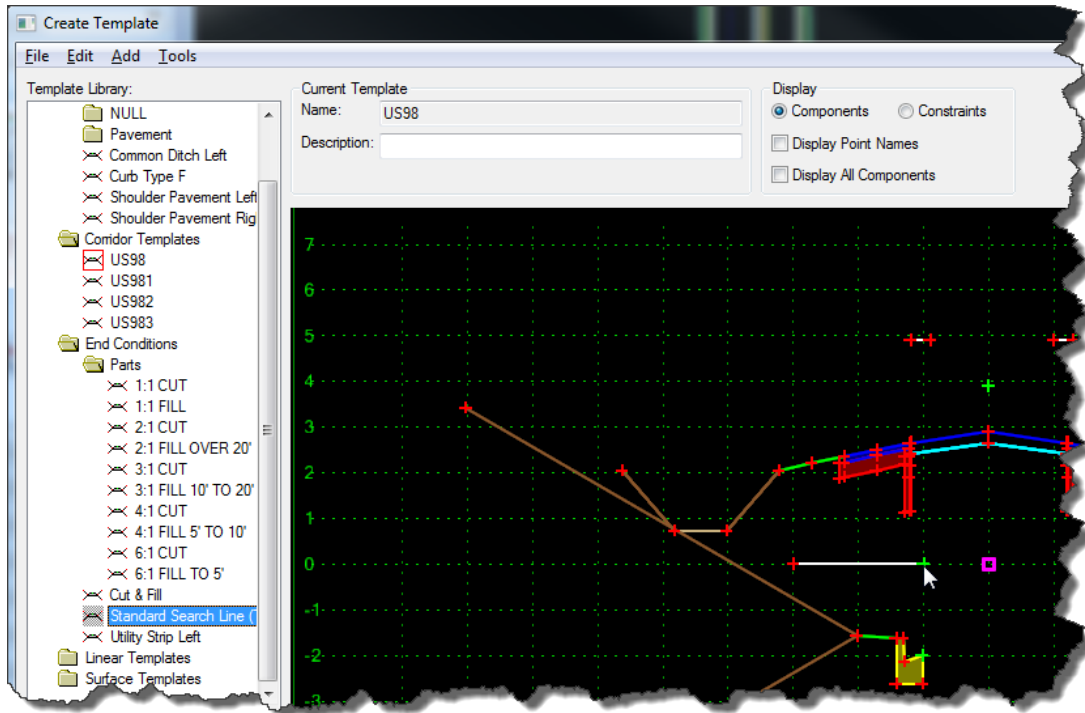
5. Navigate to the End Conditions\Parts folder and select the **6:1 Fill TO 5'** component.
6. While dragging the **6:1 Fill TO 5'** into the template press **Ctrl+R** on the keyboard to toggle **On Reflect** and then drop it on the utility strip component.



7. Navigate to the End Conditions\Parts folder and select the **6:1 CUT** component.
8. While dragging the **6:1 CUT** into the template press **Ctrl+R** on the keyboard to toggle **On Reflect** and then drop it on the utility strip component.



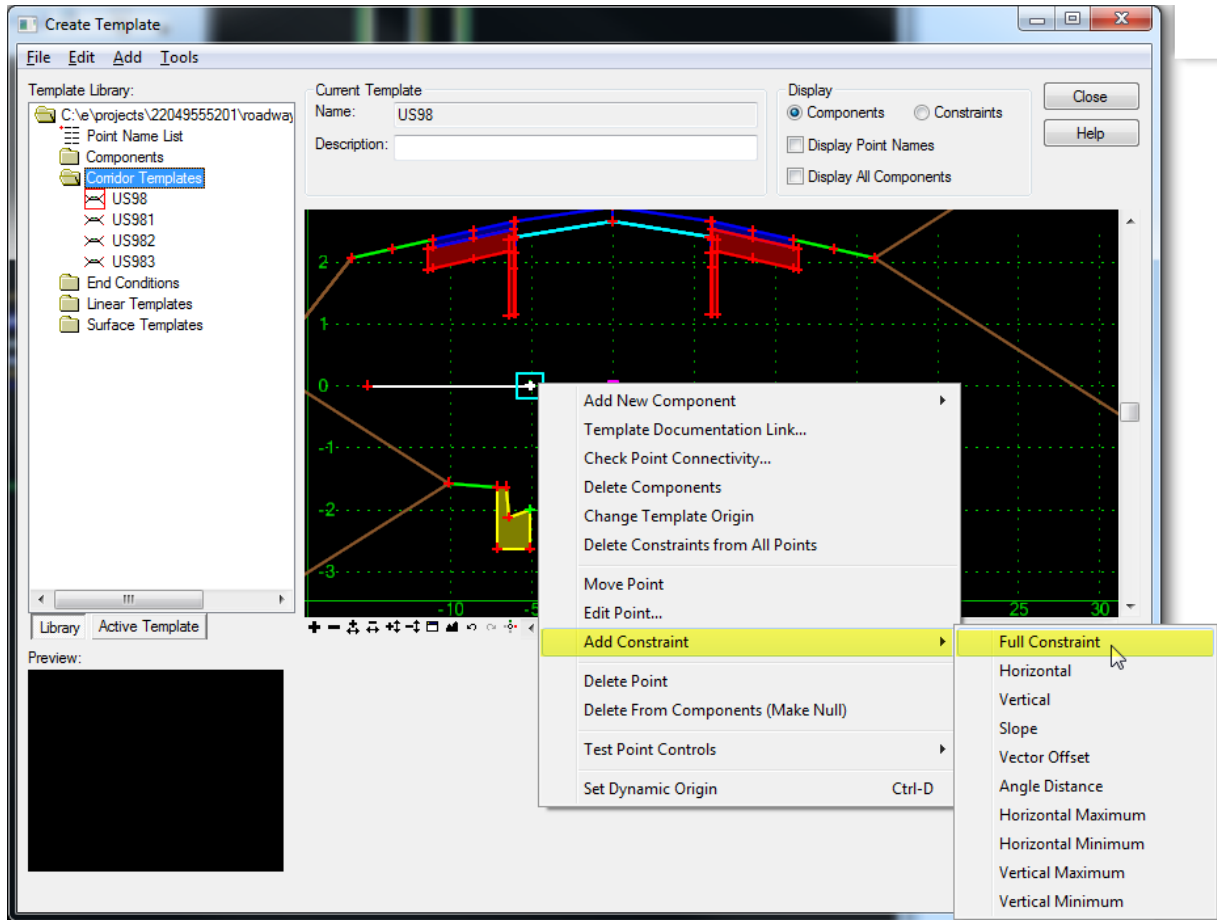
9. Navigate to the End Conditions folder and select the **Standard Search Line (Trigger)** component.
10. Drag the **Standard Search Line (Trigger)** and drop it just above the **Type F Curb** component.



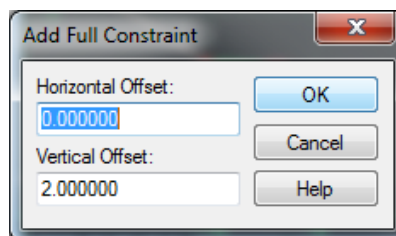
Exercise 6.4 *Constraining Conditions Together*

Now that the additional components have been placed, point constraints must be defined tying the new components to the original template. This way each of the conditions will be constrained to the proper location.

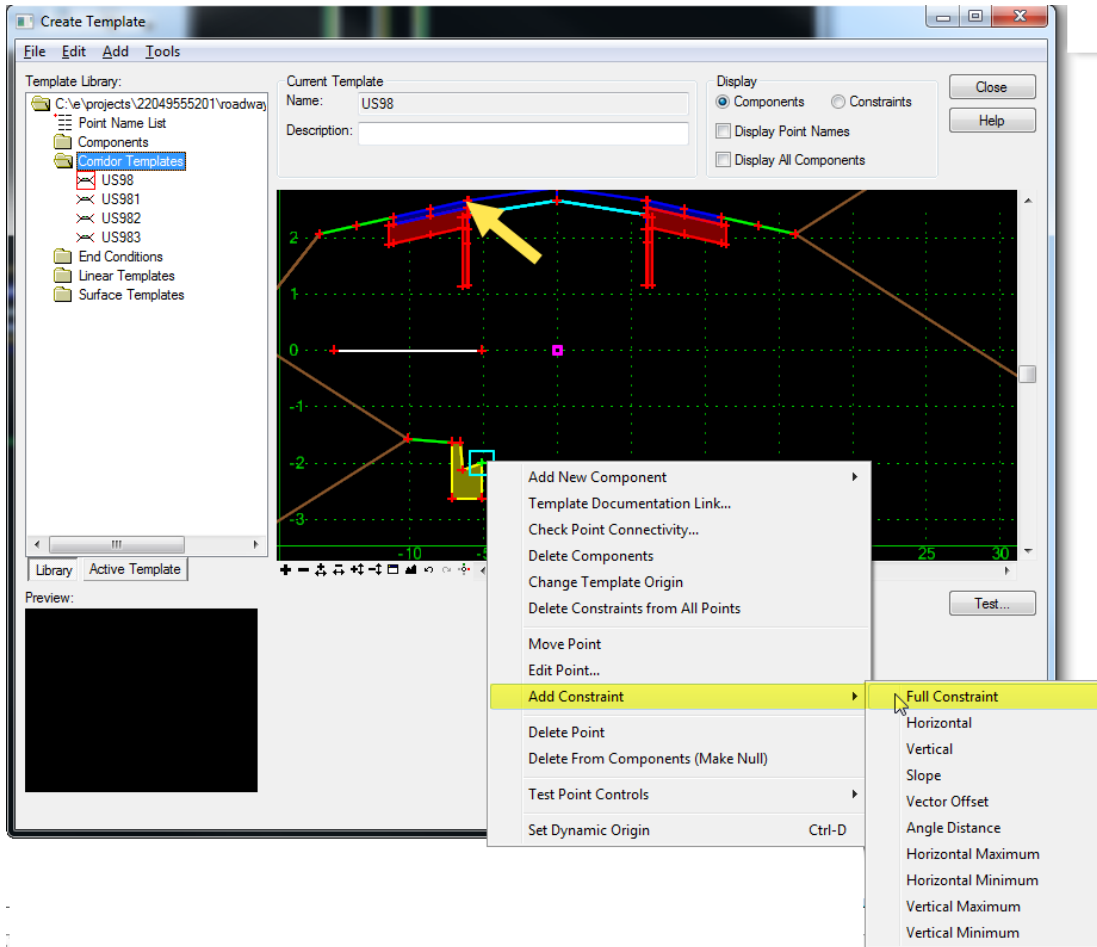
1. Right-click on the **green point** on the *trigger line* and select **Add Constraint > Full Constraint** from the *context* menu then select the **green point** on the *Curb Type F component*.



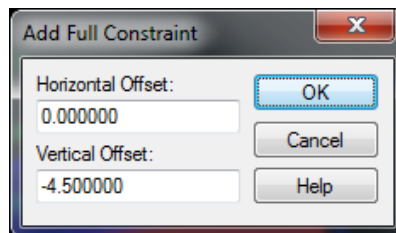
2. Set the *Horizontal Offset* value to **Zero** and the *Vertical Offset* Value to **2.0** and press **OK**.



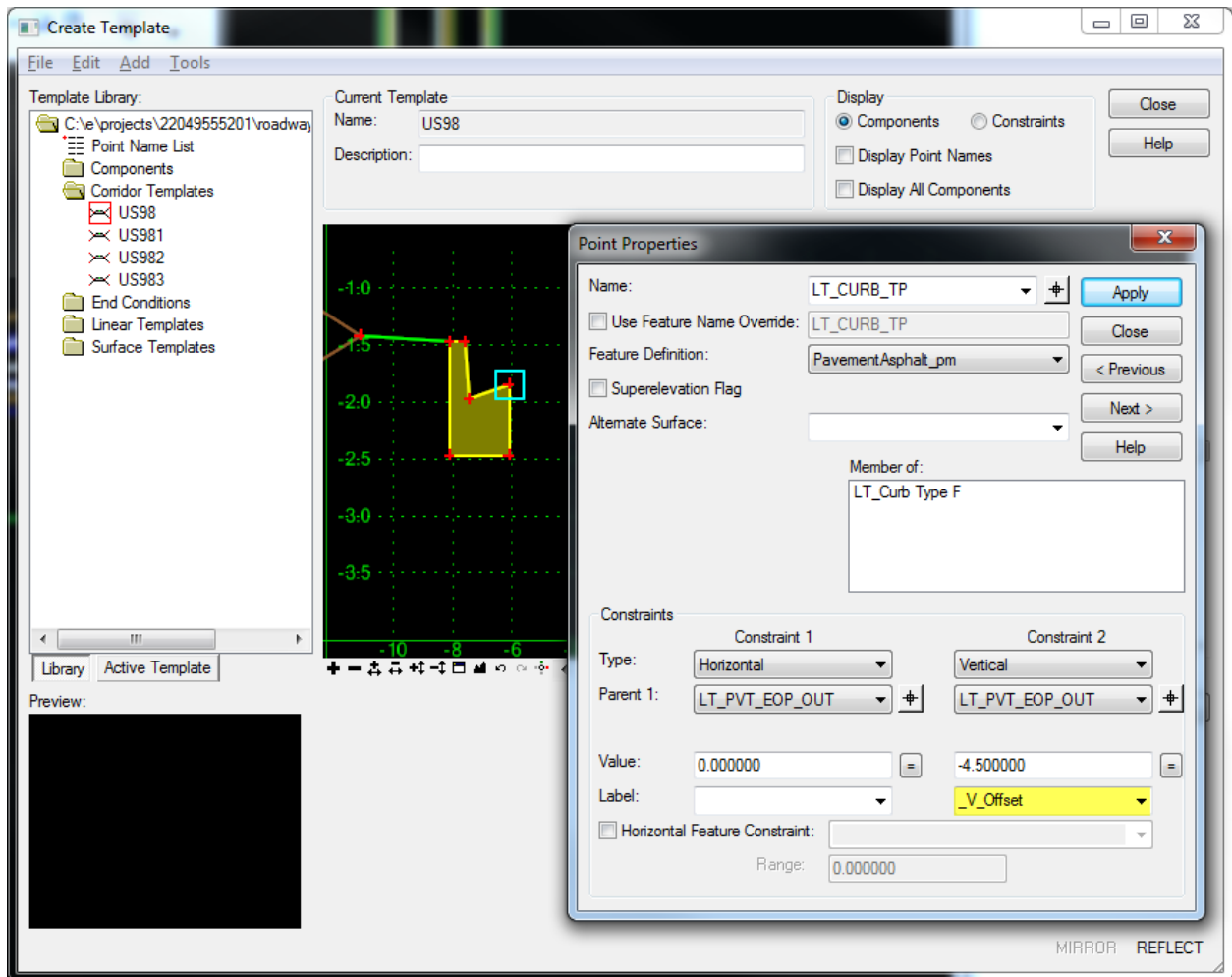
- Right-click on the **green point** on the *curb* and select **Add Constraint > Full Constraint** from the *context* menu then select the top outside point of the **widening component** where the curb should be placed when displayed.



- Set the *Horizontal Offset* value to **Zero** and the *Vertical Offset* value to **-4.5** and press **OK**.



5. Double-click on the **LT_CURB_TP** and add the **Label_V_Offset** to the *Vertical constraint*. This will allow you to override the Vertical Value with a Parametric Constraint Value of zero in the corridor making all of the components move to their correct location.

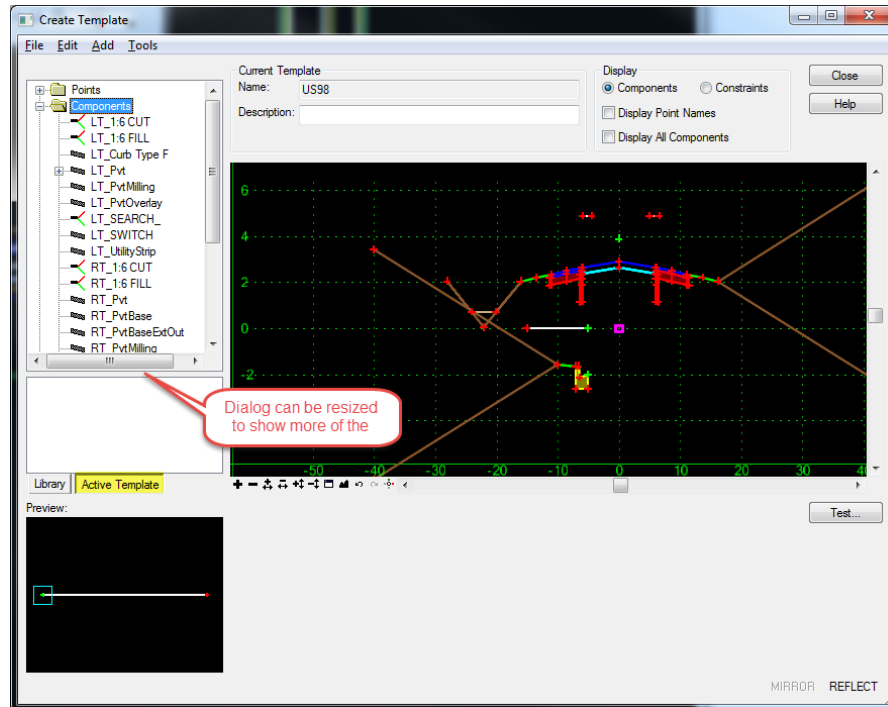


6. Press **Apply** and then **Close** to return to the Create Template dialog.

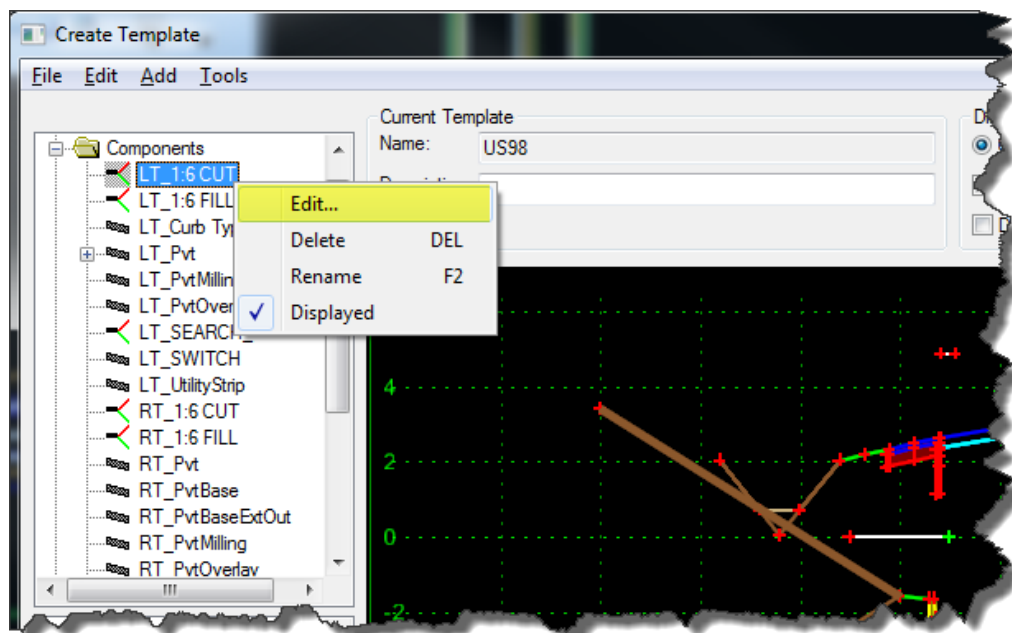
Exercise 6.5 Defining Parent \ Child Relationships

Now that the points are properly constrained, parent\child relationships must be defined. This will make for easier management of the template because display rules only need to be applied to the upper most relationship in the hierarchy.

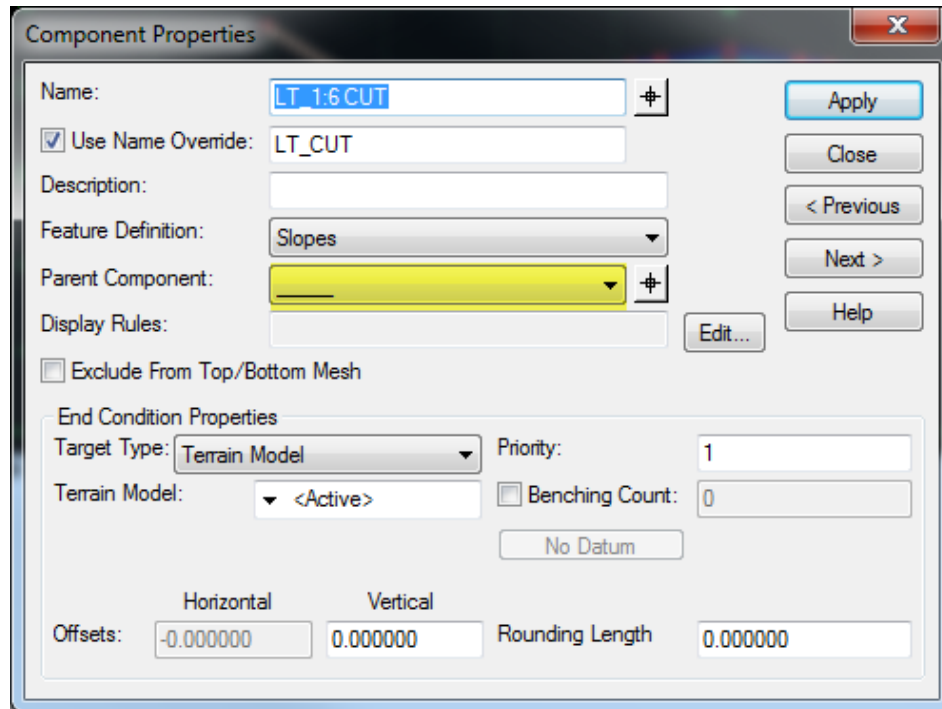
1. Select the **Active Template** tab and expand the Components folder.



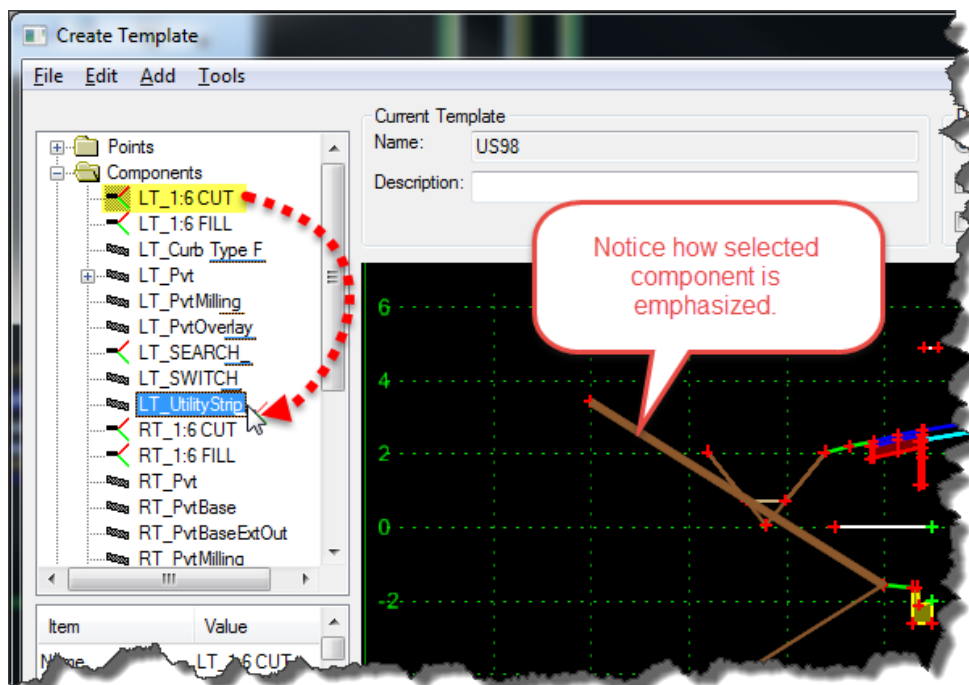
2. Left-click on the **LT_1:6 CUT** component and select **Edit** from the context menu.



- On the Component Properties dialog, notice that *Parent Component* is undefined. Press **Close** to return to the Create Template dialog.

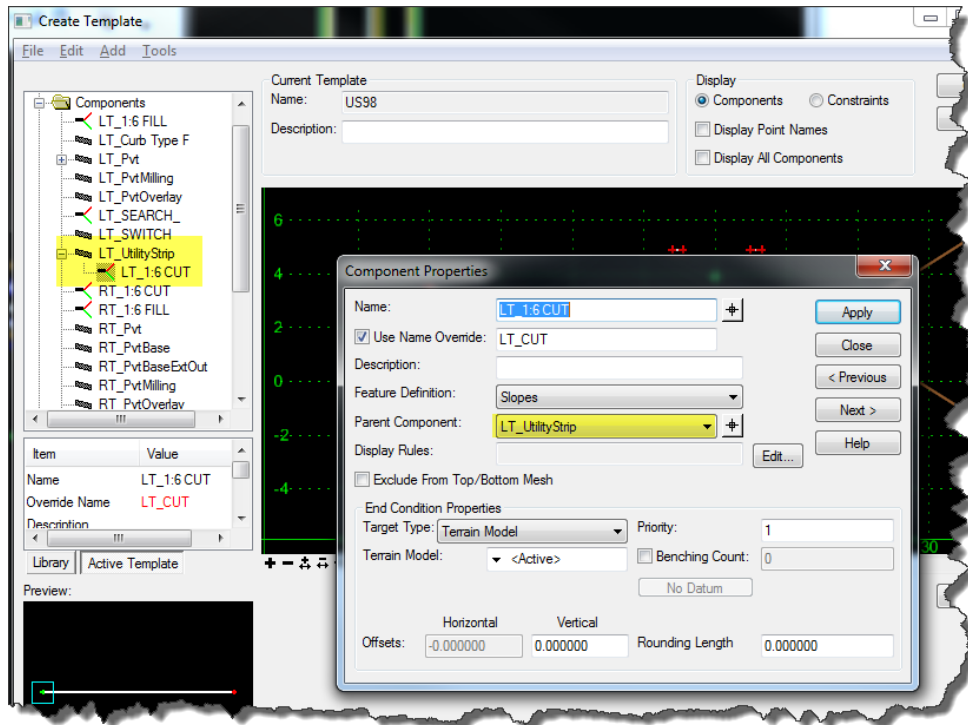


- Select the *LT_1:6 CUT* component.
- Drag and drop *LT_1:6 CUT* on the *LT_UtilityStrip* component.

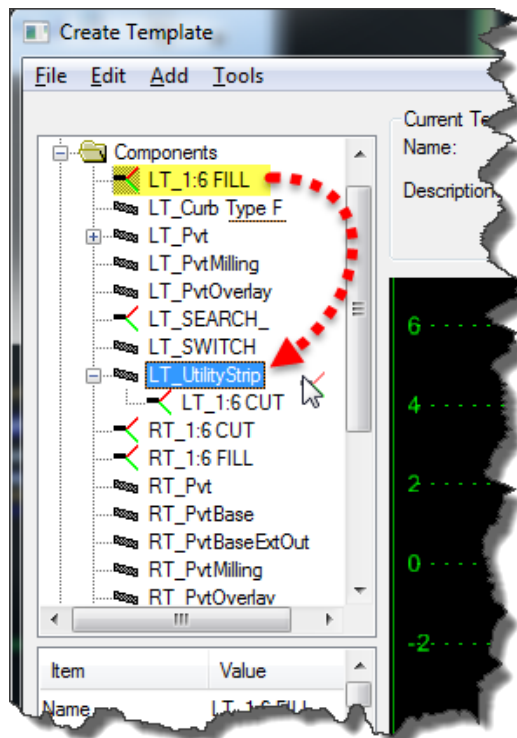


- Left-click on the *LT_1:6 CUT* component and select **Edit** from the *context* menu.

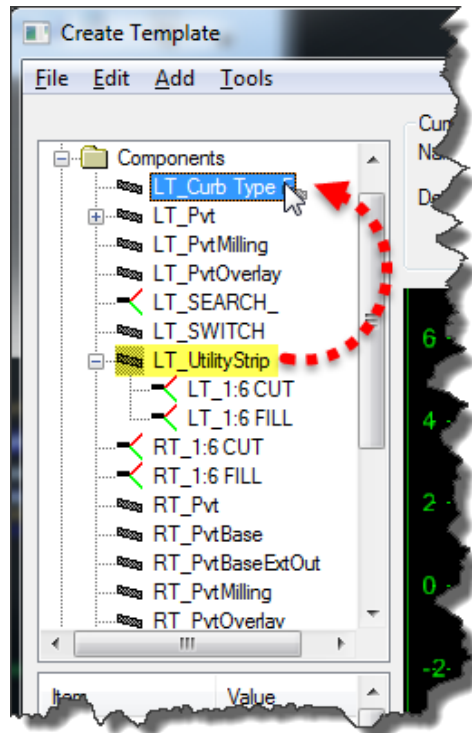
- On the Component Properties dialog, notice that *Parent Component* is now *LT_UtilityStrip*. Press **Close** to return to the Create Template dialog.



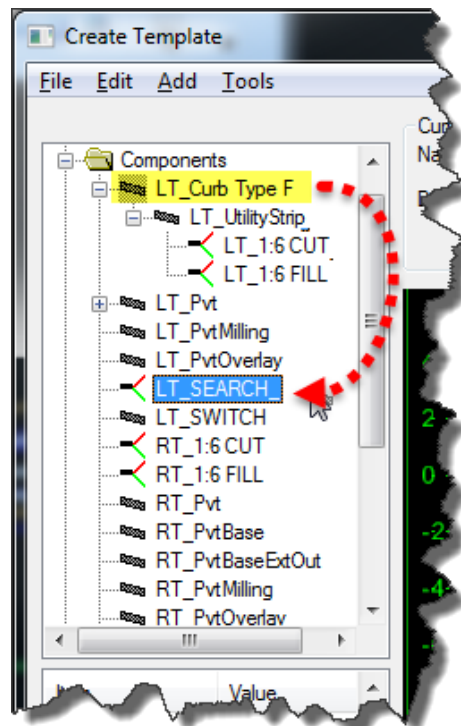
- Drag and drop **LT_1:6 FILL** on the *LT_UtilityStrip* component.



9. Drag and drop **LT_UtilityStrip** on the **LT_Curb Type F** component.



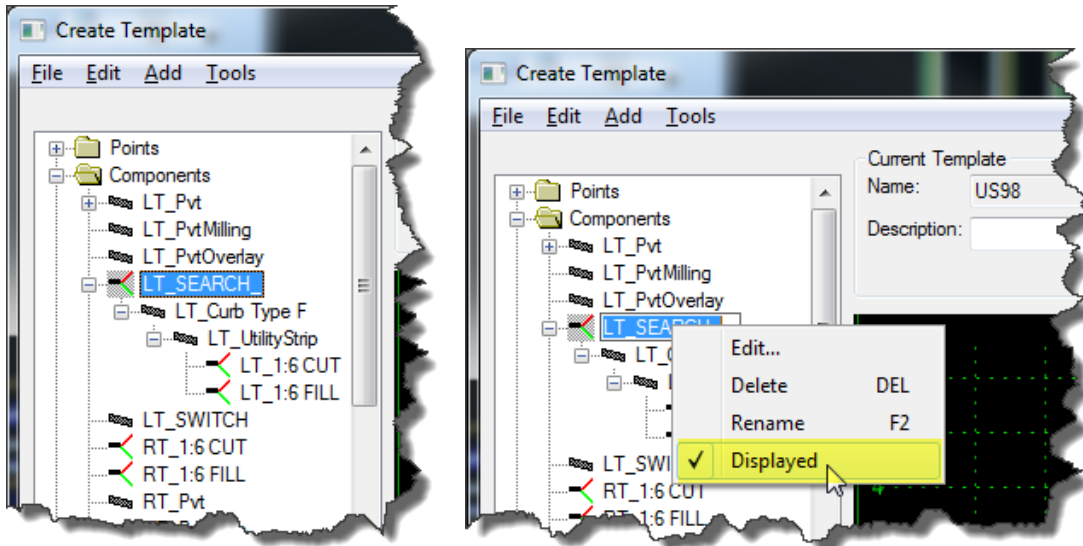
10. Drag and drop **LT_Curb Type F** on the **LT_SEARCH_** component.



Exercise 6.6 Testing Relationships

Now everything should be constrained as shown below. To test the relationships the display of the LT_SEARCH_ component can be toggled Off. If properly configured, the new curb and everything connected to it will disappear.

1. Right-click on **LT_SEARCH_** and toggle **Off Displayed** to see what all turns off.



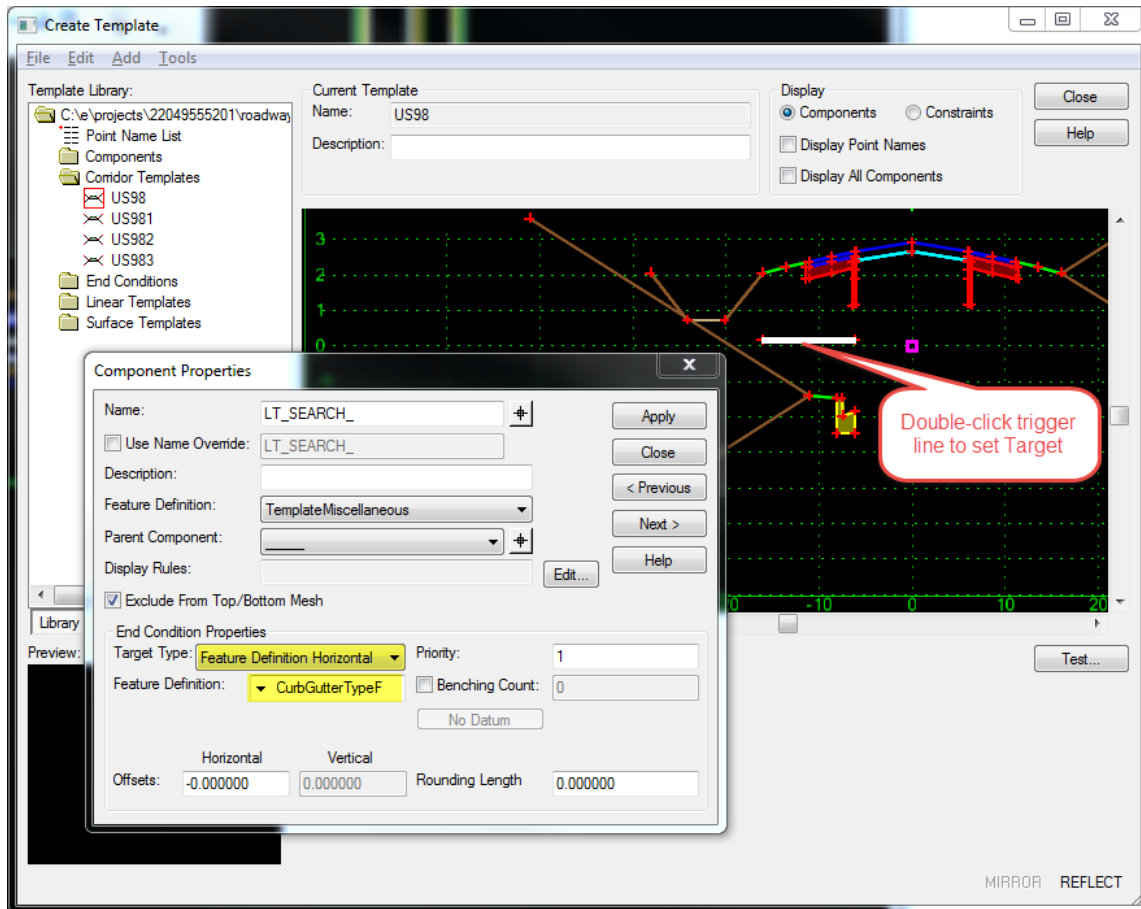
Note You can see how turning off the “Trigger Line” (LT_SEARCH_) turns off all related components.

2. Right-click on **LT_SEARCH_** and toggle **On Displayed**.

Exercise 6.7 Configuring Trigger Line Component

Now that the relationships are defined, the trigger line needs to be configured to search for a specific Feature or Element.

1. Double-click on the *trigger line* (**LT_SEARCH_**)
2. Ensure **Target Type** is *Feature Definition Horizontal* and select **CurbGutterTypeF** from the *Feature Definition* drop-down list.

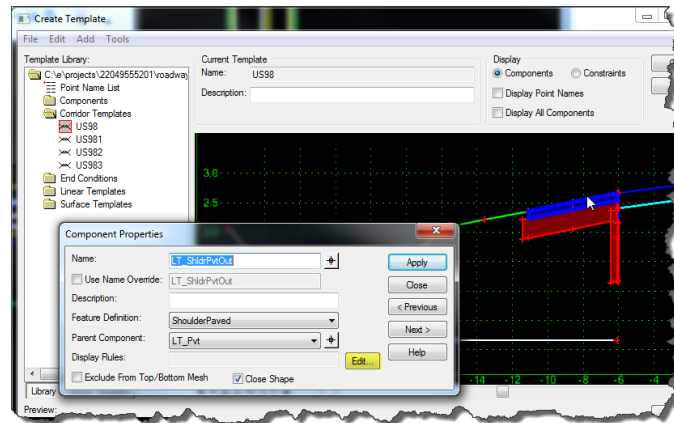


3. Press **Apply** and **Close** on the Component Properties dialog to return to the Create Template dialog.

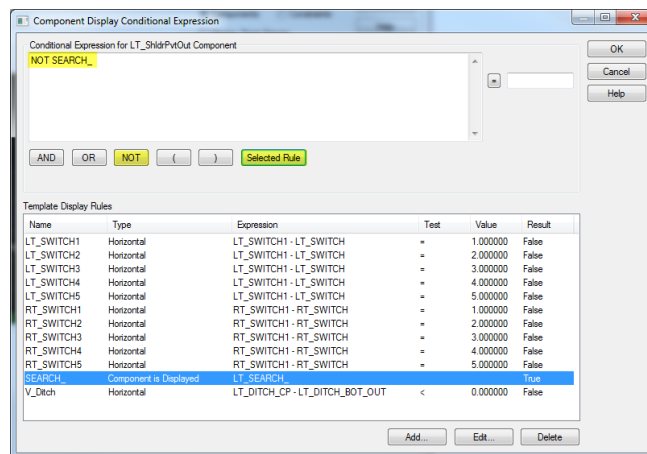
Exercise 6.8 Display Rule

With the trigger line configured to turn on when a line with the Feature CurbGutterTypeF is found, the paved shoulder needs to be updated to turn off when the curb turns on. This will be handled by creating a Display Rule on the paved shoulder that checks for the trigger line.

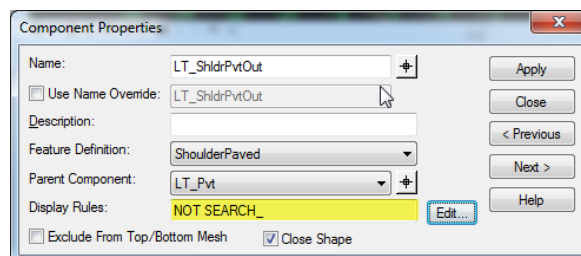
1. Double-click on the **shoulder pavement component**.
2. On the Component Properties dialog press the **Edit** button.



3. Select the **SEARCH_Display Rule**, press **NOT** and then press **Selected Rule**.
4. When the *Conditional Expression* reads **NOT SEARCH_** press **OK** to return to the Component Properties dialog.



5. Back on the Component Properties dialog, you will see that the *Display Rules* field has been populated. Press **Apply** and then **Close** to return to the Create Template dialog.

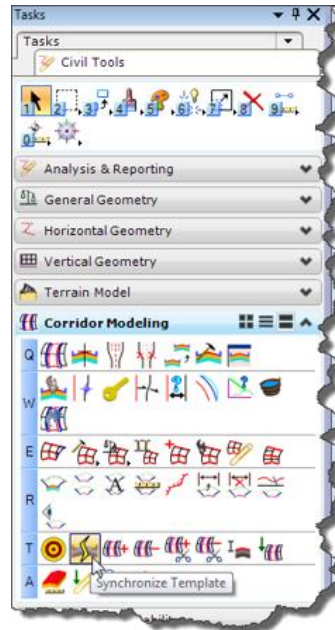


6. Select **File > Save** from the menu and **Close** the Create Template dialog.

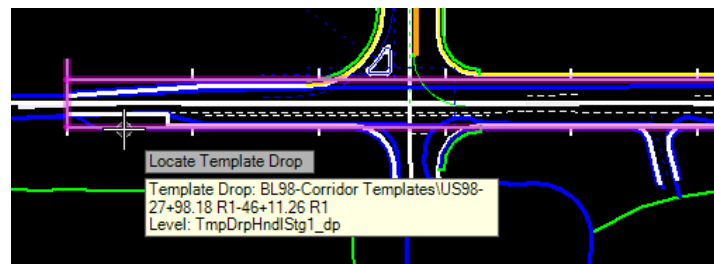
Exercise 6.9 Adding Corridor References

To see the changes the template must be synchronized and a corridor reference must be added so the trigger line can see the curb and gutter.

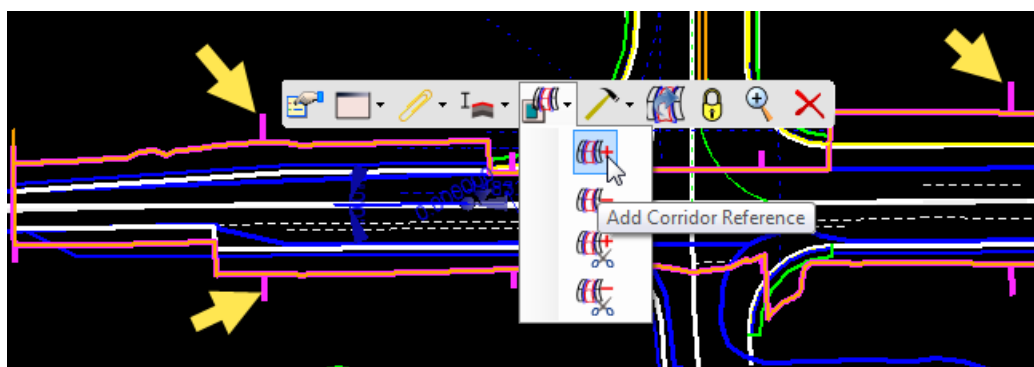
1. From the *Task* menu select **Civil Tools > Corridor Modeling > Synchronize Template**.



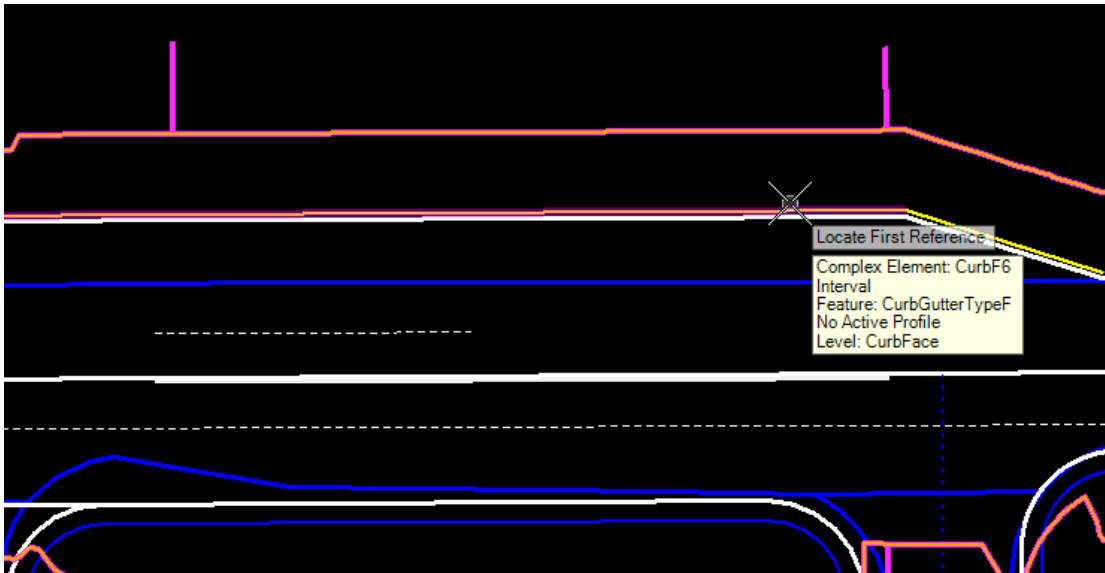
2. When prompted on the cursor to *Locate Template Drop*, select the **corridor boundary**.



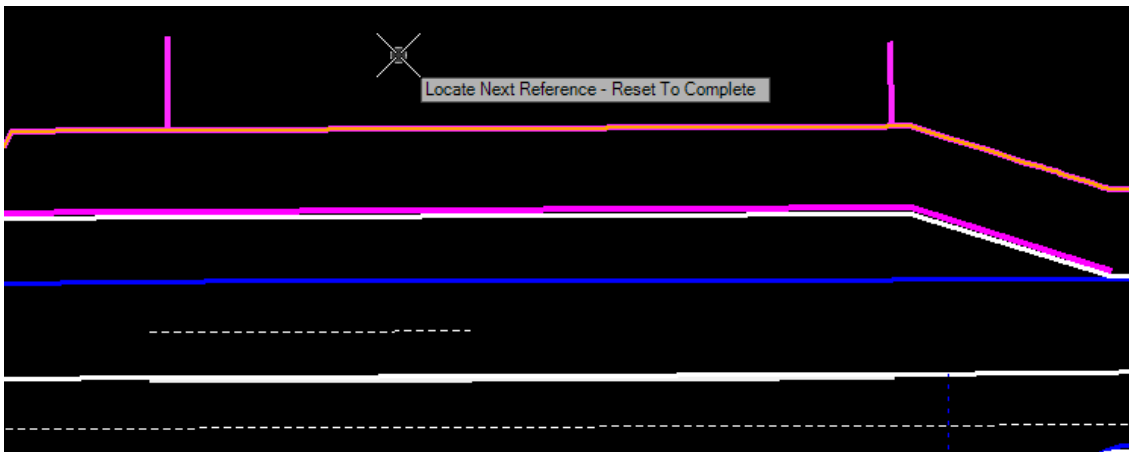
3. Press **F6** on the keyboard to get out of the current command and start the **Element Selection** tool.
4. Select a **corridor handle** sticking out from the boundary and then hover the mouse over it to get the *context* menu.
5. Select the **5th icon** on the *context* menu to open the dropdown and select **Add Corridor Reference**.



- When prompted, select both of the **curb lines** on the *right turn lane*.



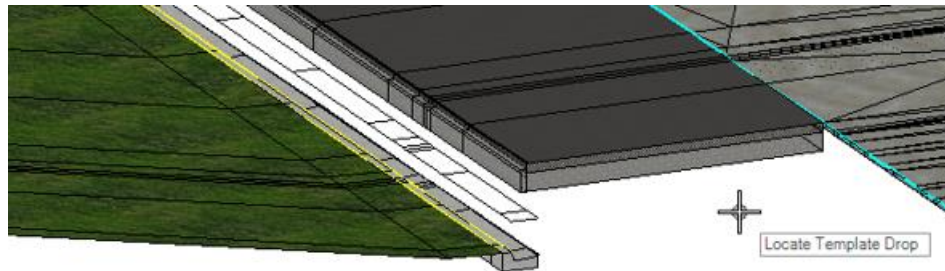
- When both are selected, **Reset** (right-click) to complete the process.



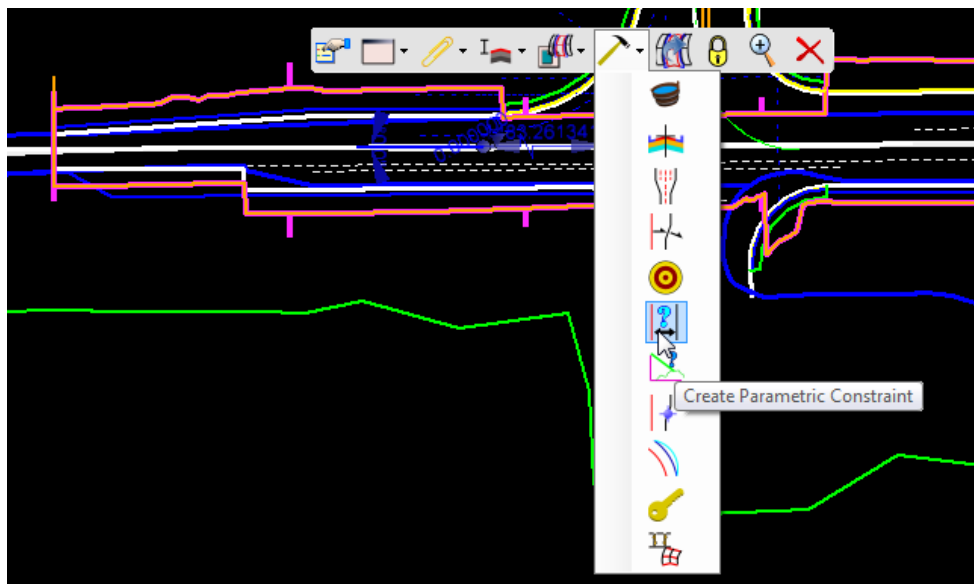
Exercise 6.10 Fixing Vertical Offset with Parametric Constraints

The corridor will reprocess showing the Curb section. The Vertical Offset from the template will remain until a Parametric Constraint is applied.

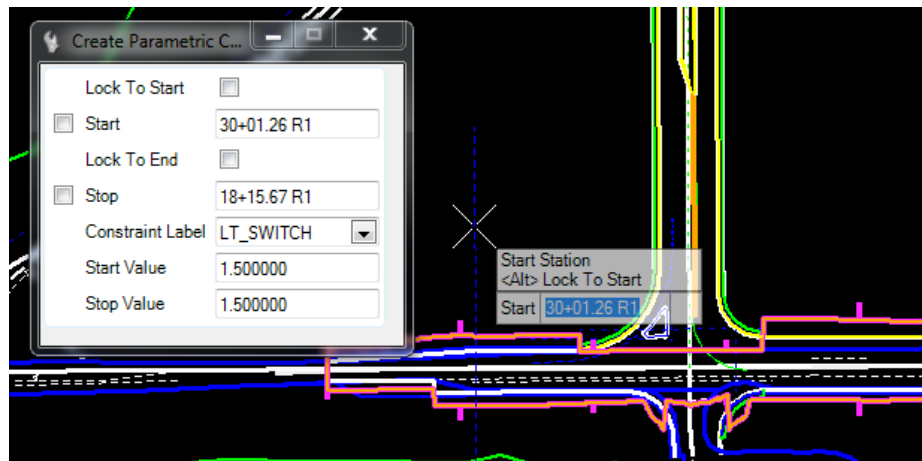
1. Select a **corridor handle** sticking out from the boundary and then hover the mouse over it to get the *context* menu.



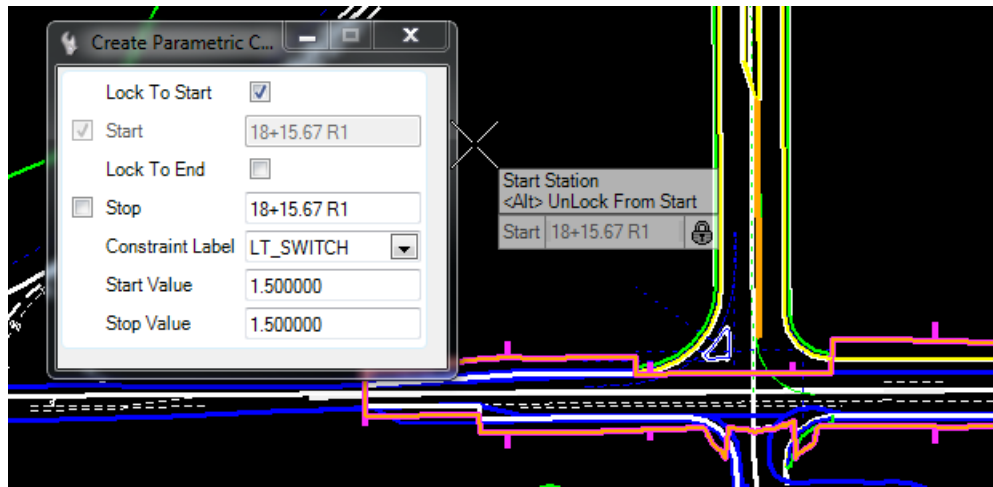
2. Select the 6th icon on the *context* menu to open the dropdown and select **Create Parametric Constraint**.



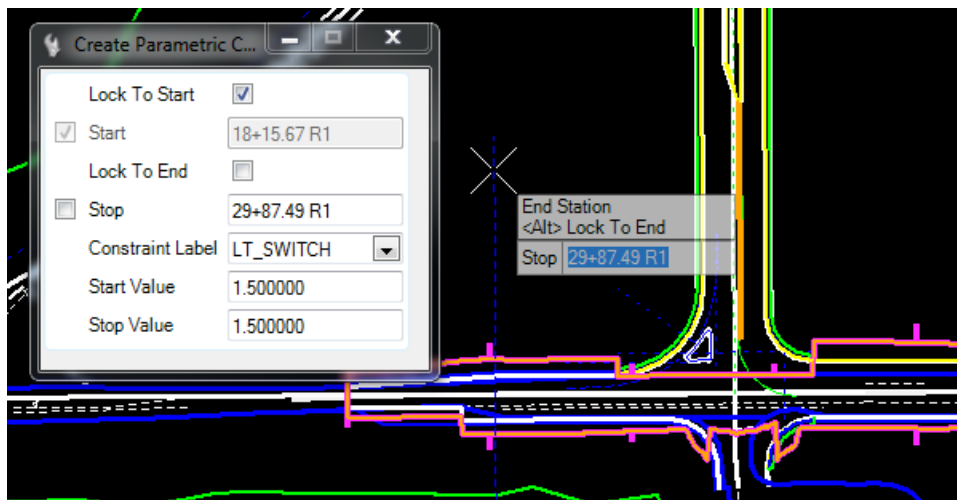
3. When prompted for the *Start Station*, press the **Alt** key on the keyboard to lock the station to the beginning of the corridor.



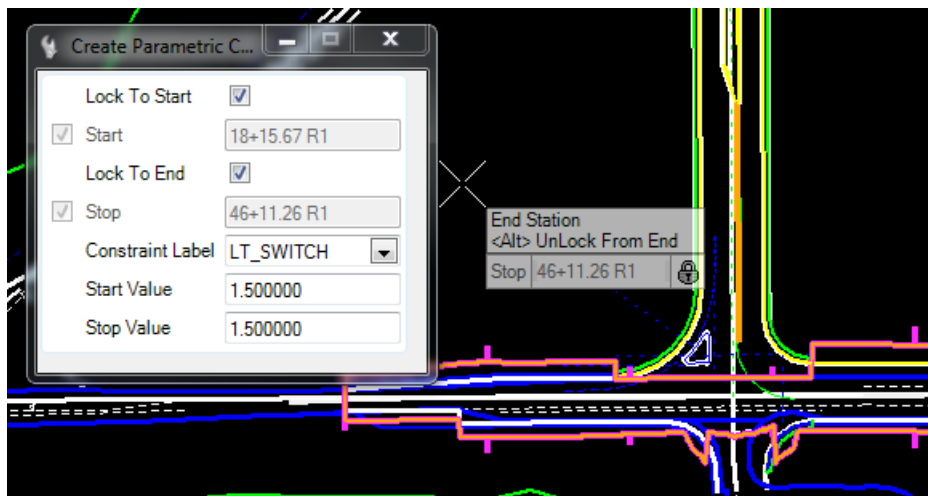
4. **Data Point** (left-click) to accept the *Start Station*.



5. When prompted for the End Station, press the Alt key on the keyboard to lock the station to the end of the corridor.

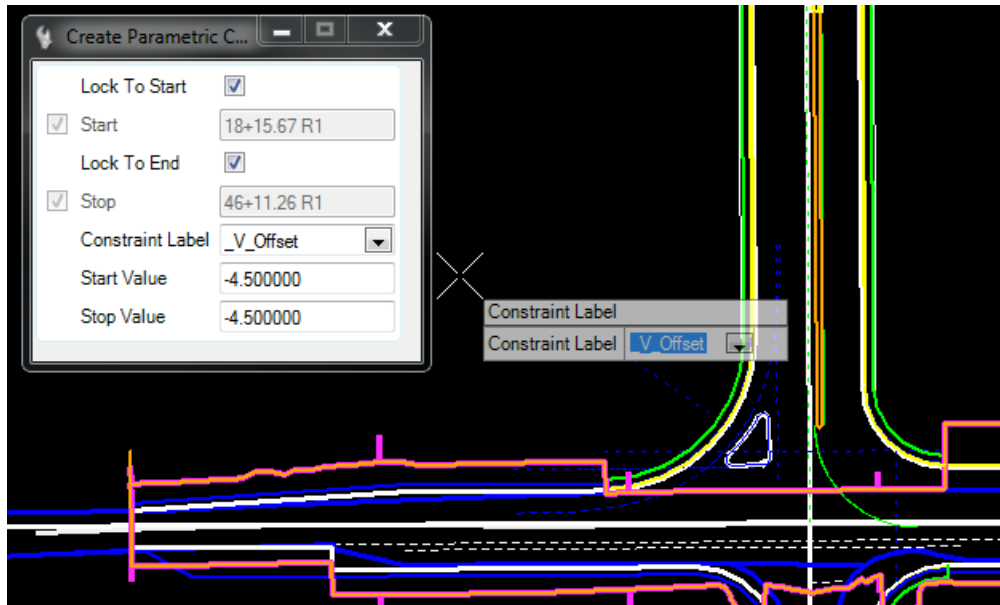


6. **Data Point** (left-click) to accept the End Station.

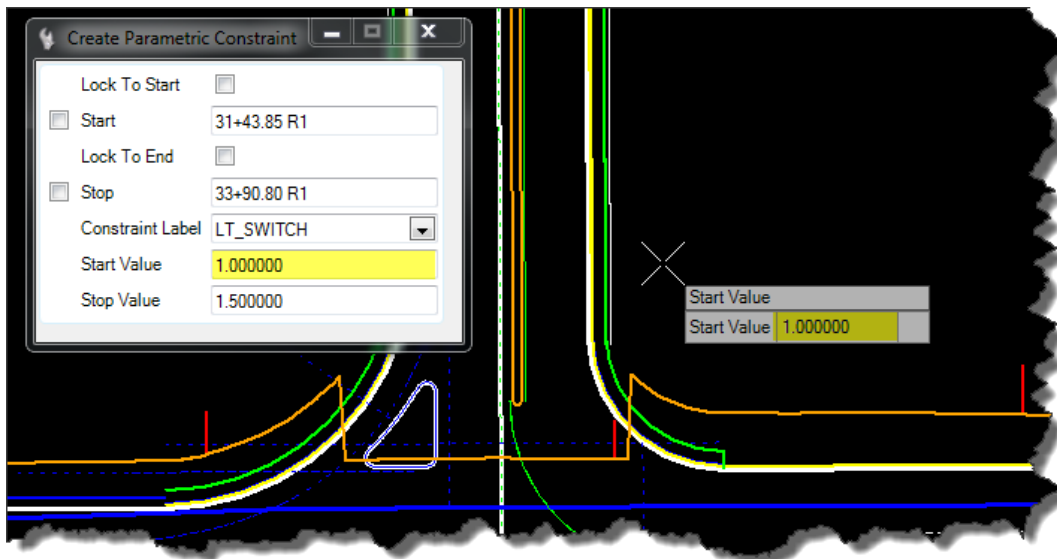


- When prompted for the *Constraint Label* choose **_V_Offset** from the drop-down on the Create Parametric Constraint dialog

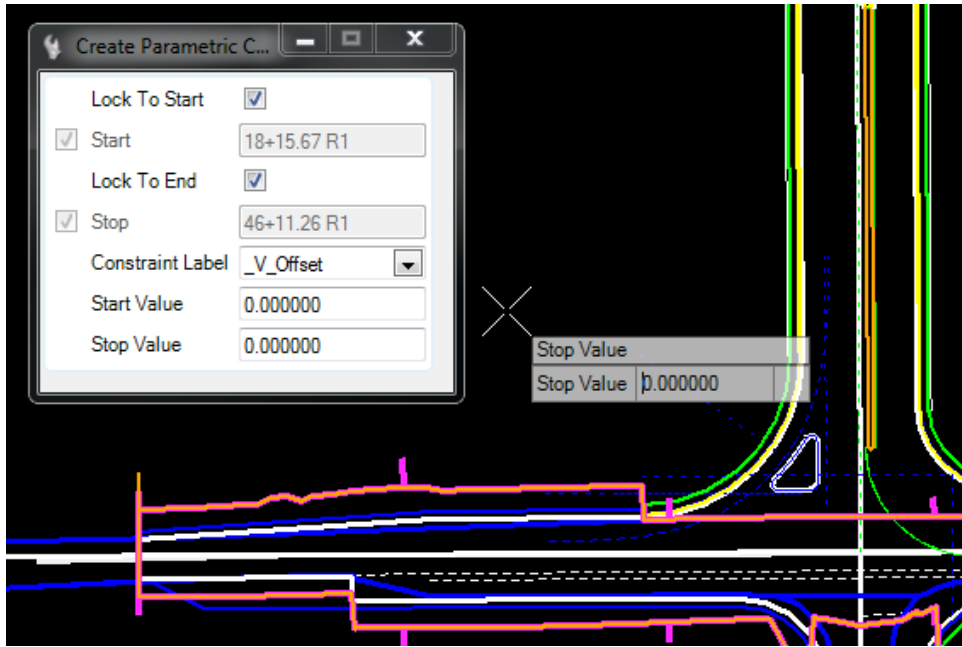
<OR> use the up and down arrows on the key board to select **_V_Offset** from the cursor and then **Data Point** (left-click) to Accept.



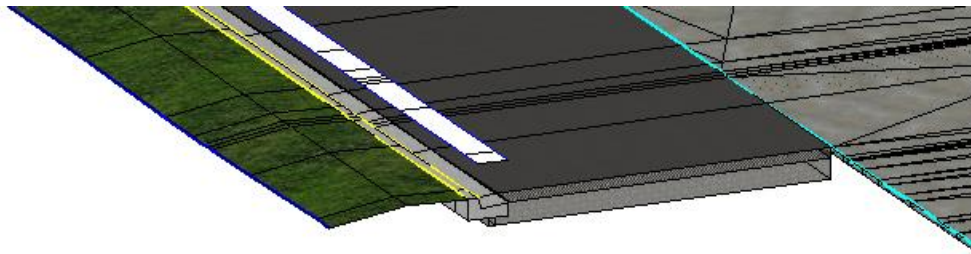
- When prompted for the *Start Value* key in **Zero** and press **Enter** then **Data Point** (left-click) to Accept.



- When prompted for the *Stop Value* key in **Zero** and press **Enter** then **Data Point** (left-click) to Accept.



Note The corridor will reprocess attaching the curb to the pavement.



- Click on the **title bar** of *View 2* to give it focus and then press **F7** to turn **Off construction elements**.

