Chapter 9 - Typical Sections

Whether you work on roadways or retaining walls, typical sections (known as ***templates*** in InRoads V8i) provide the tools necessary for creating 3D models for your proposed designs. Anything that can be defined by a typical cross section and horizontal and vertical alignments (not just roadways) can be modeled with templates. For example: channels, walls, ditches and dams can all be modeled using this approach.

The way a template and its points are defined is critical to how it will behave during the modeling process. The resulting model created from the templates is used to provide critical information to Construction. This information is generated from various reports like the Cross Section staking report (see the *Roadway Modeling* and *Reports* chapters for more information).

Typical sections are stored in a template library (ITL) which is saved on the hard drive with an extension of *.itl. A standard template library file is based on the ***CDOT Roadway Design Guide 2005*** and the ***CDOT M&S Standard Plans 2006 Edition***.

Chapter Objectives:

- To become familiar with how typical sections fit into CDOT's design process.
- To learn how to match the CDOT standard templates to your design criteria.
- To gain an understanding of when to use the completed templates included in the default template library on your projects.
- To learn how to prepare typical sections that match your design criteria if the standard ones do not.

Template Library

Section Objectives:

- To create a project-specific template library using the CDOT standard template library.
- To copy templates from other jobs for use in a project-specific template library.
- To become familiar with the Create Template interface for creating and editing templates.

Templates are stored in a template library (.itl). CDOT has created a standard template library that contains several CDOT-specific templates. These CDOT standard templates are based on:

- Typical sections shown in the ***CDOT 2005 Roadway Design Guide*** manual
- Roadway components or features shown in the ***CDOT M&S Standard Plans 2006 Edition***
- Clear Zone criteria
- CDOT's Cut and Fill slope requirements

Standard Template Library

The CDOT standard templates are developed and maintained to facilitate the design process for CDOT projects. The path for CDOT's standard template library is ***C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Templates\ CDOT_Template-Library.itl***. The library consists of models of typical sections as defined in the ***CDOT 2005 Roadway Design Guide*** and other typical sections commonly encountered by CDOT designers.

Project Template Library

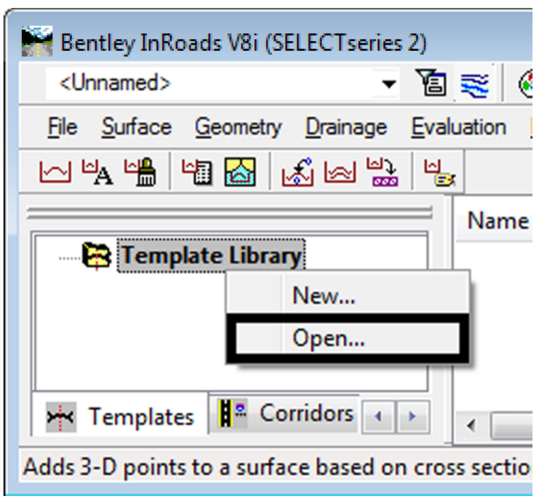
The CDOT library should be copied to the project folder and modified as needed for a particular project or design situation. This is accomplished by copying the ***CDOT_Template-Library.itl*** to the ***C:\Projects\JPC#\ Discipline\InRoads*** folder before editing.

Important! Changes made to the standard ***CDOT_Template-Library.itl*** in the ***\Standards-Global*** folder will be overwritten by CDOT's file management software ***ServerCop*** during log in.

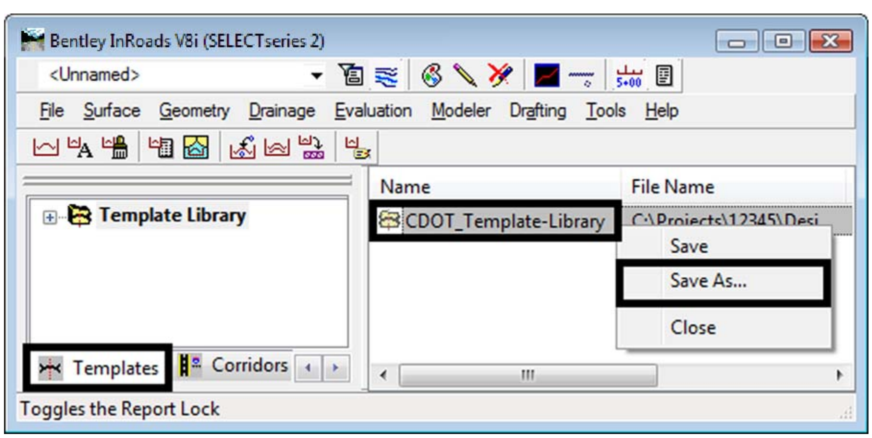
Creating a Project Template Library

To create a project specific template library:

1. From the InRoads main menu, select the **Templates** bottom tab.
2. **<R>** on **Template Library** in the InRoads Explorer and select **Open** from the menu.



3. Navigate to **C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Templates**.
4. Highlight the ***CDOT_Template-Library.itl*** file and ***<D>*** **Open.**
5. **<R>** on the ***CDOT_Template_Library.itl*** file in the information pane and select **Save As**.

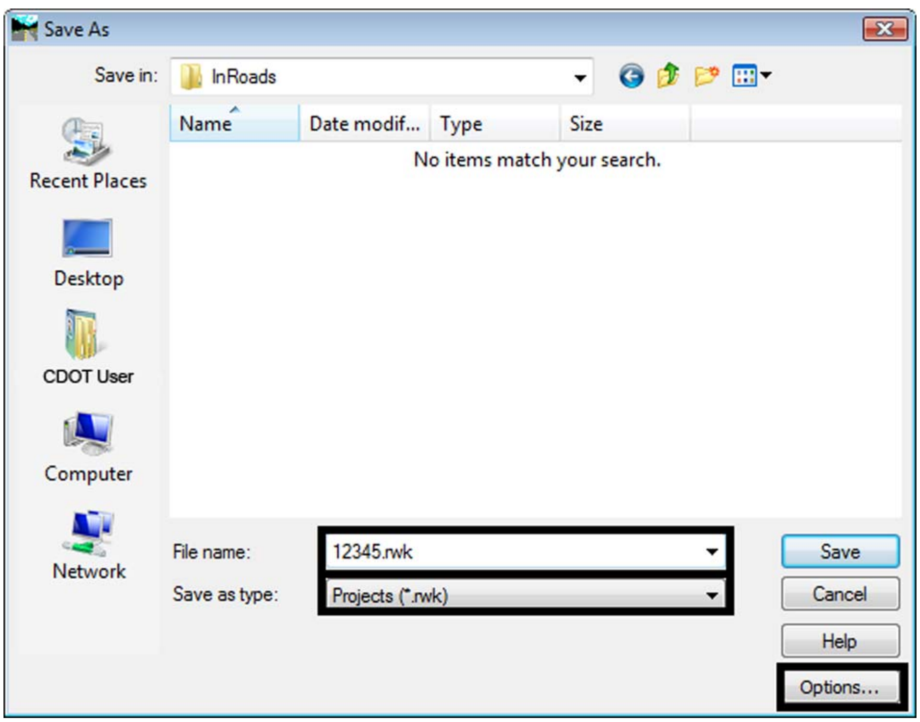


6. Navigate to the project's InRoads folder (***C:\Projects\12345\Design\InRoads*** in this example).
7. In the ***Save As*** dialog box, key in the desired ***Name*** such as ***12345_Template-Library.itl.***
8. **<D> Save**.

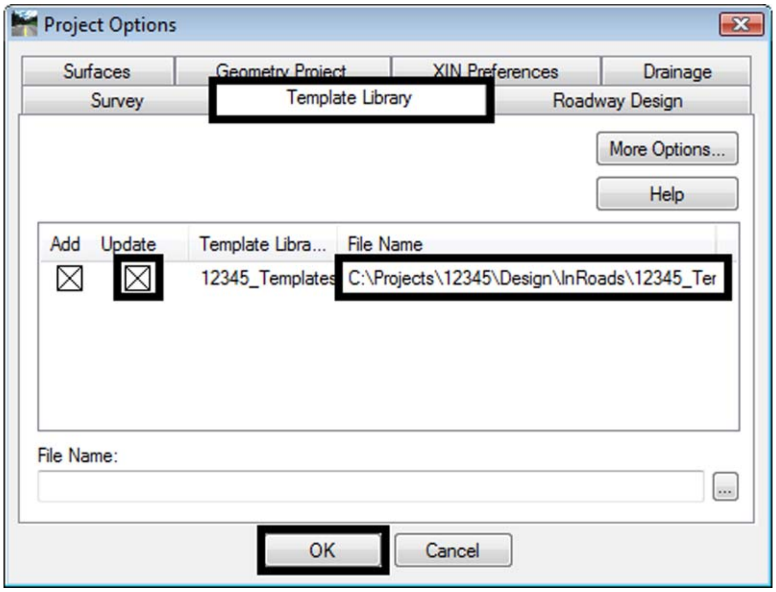
   Note: The file may also be copied using Windows commands.

Update the *.rwk file to load the new template library. This ensures the new template library will open with the other InRoads data for the project.

9. From the InRoads main menu choose **File > Save As**.
10. In the Project ***Save As*** dialog box, navigate to the design folder (***C:\Projects\12345\Design\InRoads*** in this example).
11. Choose **Projects (*.rwk)** from the ***Save as type***: field
12. Choose an existing project file from the ***Save As*** dialog box by highlighting it or key in the name of a new project file. (For this example **12345.rwk** is used.)
13. Click on the ***Options*** button.



14. From the ***Template Library*** tab of the Project Options dialog box, verify the filename of the template library is correct and toggle on **Update**. (The **Add** automatically toggles on as well.)



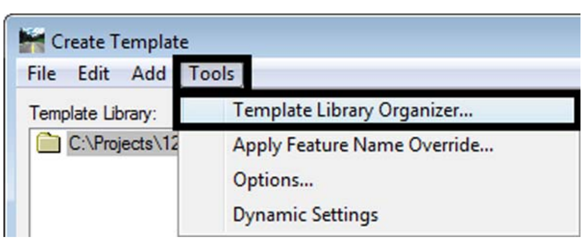
15. Click **OK** to accept the changes in the ***Project Options*** dialog box.
16. Click **Save** to save the ***InRoads Project*** file.
17. Click **Cancel** to dismiss the ***Save As*** dialog box.
18. To load the project template library from this point on, open the Project file (***12345.rwk***).

Copying existing Templates to a Project Template Library

Templates created for previous projects can be used in the current project. These templates should be copied from their original libraries into the current project's library. This avoids confusion and the possibility of altering the wrong template.

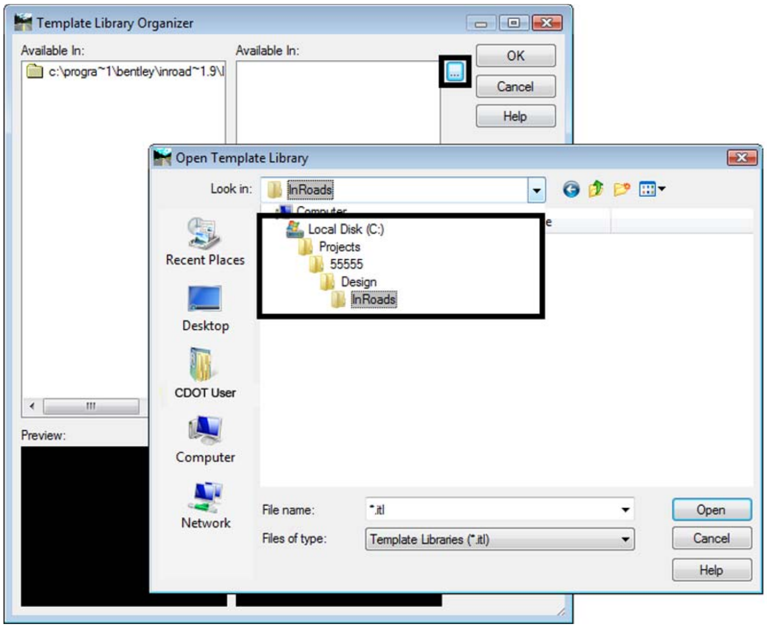
To copy a template into the project template library from another library:

1. Select **Modeler > Create Template** from the InRoads menu bar.
2. From the ***Create Template*** menu bar, select **Tools > Template Library Organizer**.



3. In the ***Template Library Organizer*** dialog box, **<D>** the button.

4. In the ***Open Template Library*** dialog box, navigate to the folder of the source template library (***C:\Projects\55555\Design\InRoads*** in this example).



5. Highlight the source template library and **<D> Open**. The selected library is displayed in the right ***Available In*** area of the ***Template Library Organizer*** dialog box.

6. Expand the right template library to show the template you want to copy.

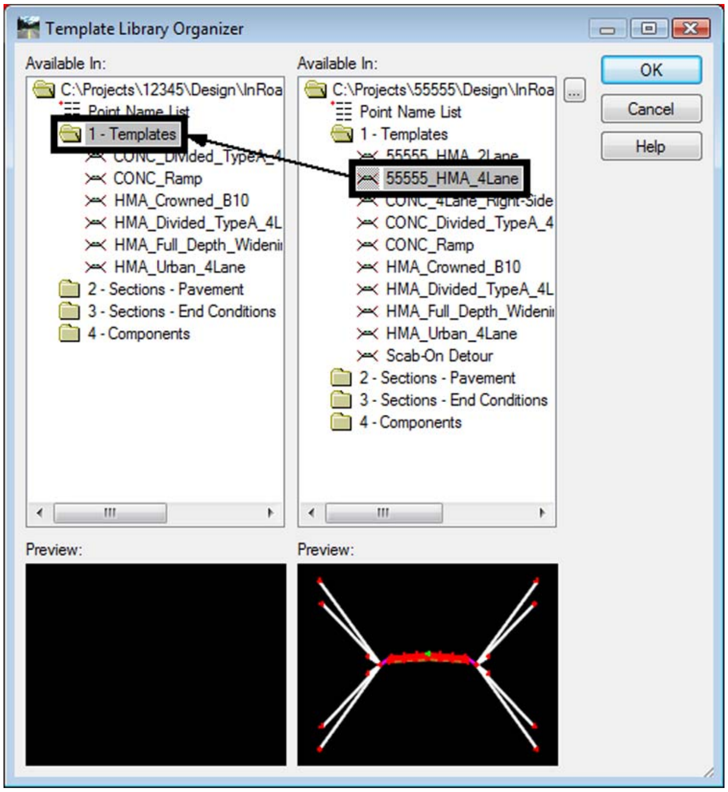
7. Expand the left template library to show where you want the template to reside.

8. Drag the desired template from the right library and drop it in the left (***55555_HMA_4Lane*** in this example).

   Note: Be certain to drop the template in the correct location. If it is dropped 'in space' and not in a folder, the template is not copied.

9. Repeat for any other templates you need to copy.

10. **<D> OK** when finished.



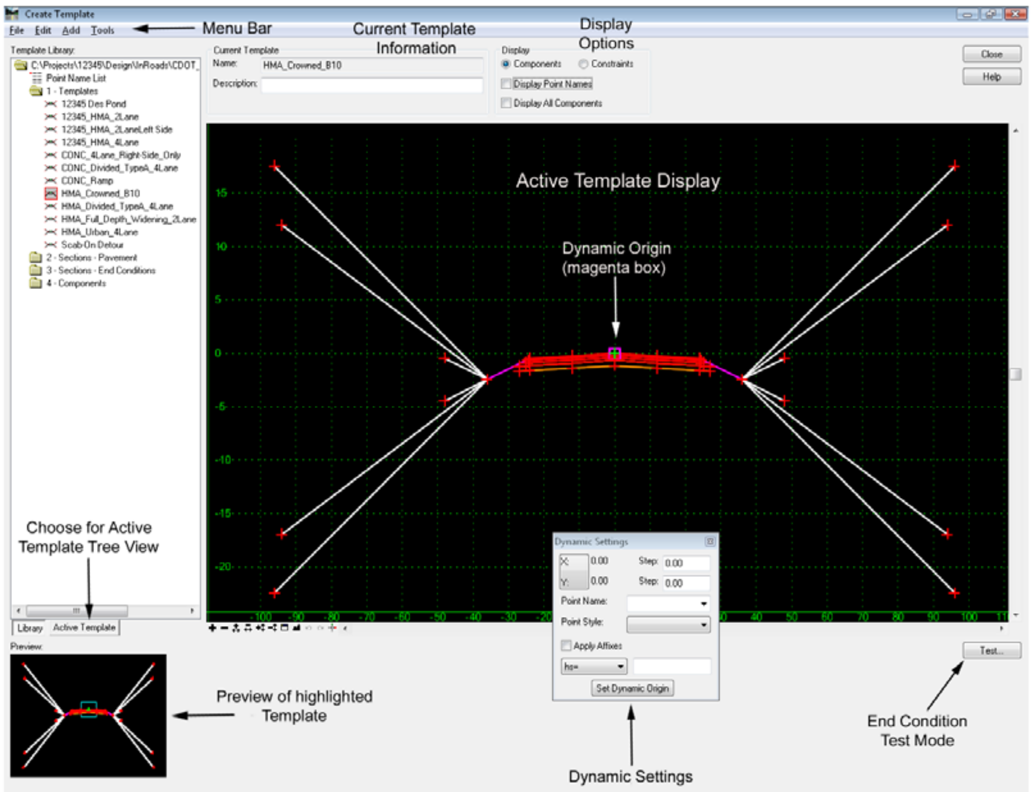
Note: The left ***Available In*** pane is the library currently loaded in InRoads. Templates can be copied from the left library to the right as well.

Note: Templates are copied into the IRD file when setting up Template Drops (see the *Roadway Modeling* chapter for details). If a template you need resides in the IRD, you can open the IRD file here and copy template(s) from the IRD into your ITL.

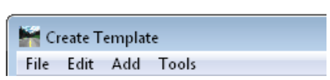
Create Template

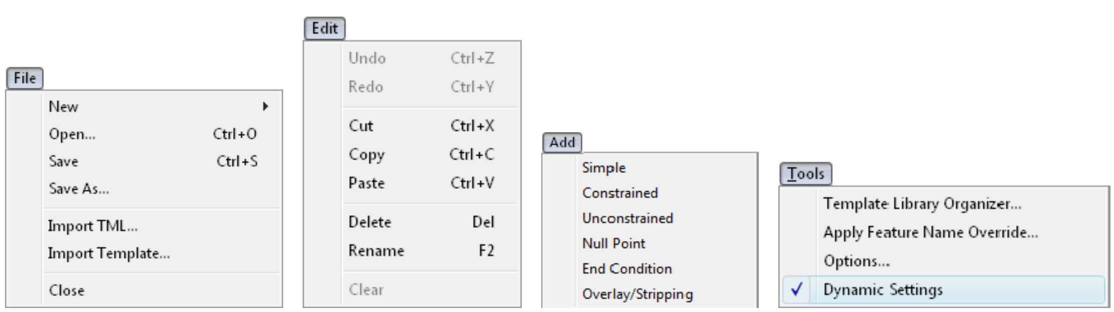
The ***Create Template*** dialog (accessed from **Modeler > Create Template**) is used to create or edit templates within the loaded template library. It is a visual interface that allows you to see the template as it's being created and to test the end conditions prior to using the template in ***Roadway Designer***.

The ***Create Template*** dialog contains several areas as shown and described below.



Menu Bar





The Menu Bar consists of four pull-down menus.

File Menu

The File menu is used to create, load and save the template library (ITL).

Important! While working in ***Create Template***, you are working in your computer's memory and you should periodically save your ITL file, such as after any major template edits. If you do not save changes to your ITL file, you will be asked to save upon exiting from the dialog. Once you have closed the dialog, unsaved changes are lost.

To translate a previous InRoads version TML file (InRoads V8.5 and earlier) to the new ITL format, select **File > Import TML** and specify the TML file.

Important! Be careful! Templates are drastically different in this version of InRoads than in 8.5 and prior versions. If you convert a template you must carefully check every aspect of the components and points to ensure they converted properly. In most instances, you are better off creating the template in the current version rather than converting.

To import a template from graphics, you can use **File > Import Template**. You must first draw the template with MicroStation, then make a selection set from the graphics before selecting this option.

Edit

- The ***Edit*** menu contains standard edit functions that apply to the highlighted template or folder. See the *Edit Commands* section in the *InRoads Online Help* for more information.

Add

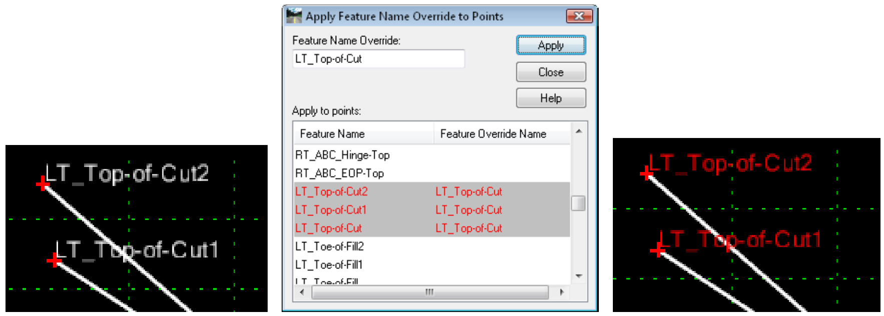
- **Add > Simple**, **Constrained**, **Unconstrained**, **Null Point**, **End Condition** and **Overlay/Stripping**: Used to create new components in the active template.

Note: Each of the above ***Add*** options is described in greater detail in the *Components* section of this chapter.

Tools

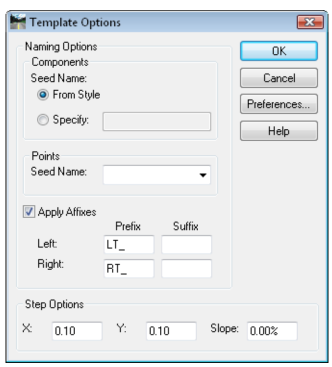
- **Tools > Template Library Organizer**: Allows templates, point names and folders to be copied between two libraries. See the previous section on *Copying existing Templates to a Project Template Library* for additional details.

- **Tools > Apply Feature Name Override**: Allows multiple point names in a template to create one feature in the resulting surface. Highlight the point names in the dialog and key in the name you want the combined feature to have, then **<D> Apply**. For example, use this when multiple Cut or Fill slopes would normally result in multiple features, but the desired result is one continuous feature instead. The feature names turn red in the template display to note the override is used. This can also be accomplished in the ***Point Properties*** for each of the points in question.



This option may also be useful when transitioning between two templates using different named points that you want to result in one continuous feature. For example, if the two templates use CL and Centerline, respectively, you may toggle on ***Apply Feature Name Override*** for both and use the same name for the resulting feature.

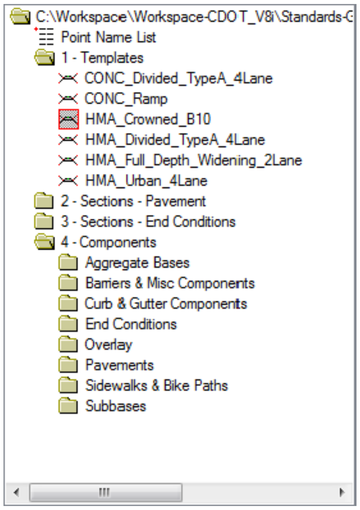
- **Tools > Options**: Allows the setting of default naming options for components and points. It also controls whether ***Affixes*** are used and if so, what they are. Steps can be set here for the placement of points and components on a grid, similar to MicroStation's Grid lock.



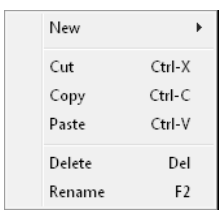
- **Tools > Dynamic Settings**: Toggles on or off the ***Dynamic Settings*** box. See the *Dynamic Settings* section of this chapter for additional information.

Library Tree

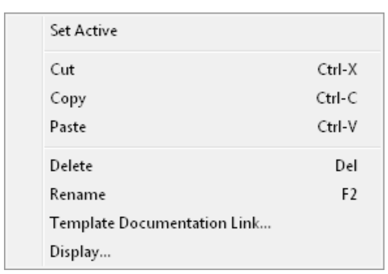
The Library tree is shown on the left pane of the ***Create Template*** dialog. Folders may be expanded or collapsed as necessary to see the template(s) available for copying or editing. The active template has a red box around its icon and is shown in the large template view at right. The highlighted template is shown in the Preview below the tree.



- Right-click on a folder to create a new folder or template, or access several of the ***Edit*** functions. See the *Edit Commands* section in the *InRoads Online Help* for more information.



- Right-click on a template to access several of the ***Edit*** functions. In addition, you can use:

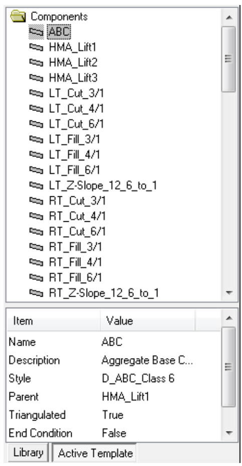


  - **Set Active:** Makes the template active (available for editing and shown in the large template view at right).
  - **Template Documentation Link...**: Assigns a link to the template. This is very useful for documenting the template, section or individual component in the template. You can link a template to almost any type of file, including a word processor document, spreadsheet, text files or web page that explains or defines the template. The file is for reference only and does not affect the processing of the template.

- **Display**: Brings up the template display dialog, allowing the display of the template on a grid in the MicroStation file. This can be used as the basis for your typical section drawing as an alternative to the CDOT Typical Section Program.

Active Template Tree

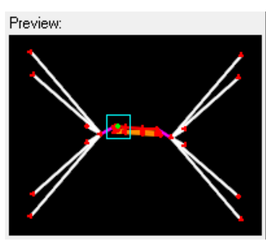
The pane on the left of ***Create Template*** can also be used to access the ***Active Template*** tree. At the bottom of the pane, select ***Active Template***. Then, expand the portion of the template you want to access: either ***Points***, ***Components*** or ***Display Rules***. For each option, you can right-click and ***Edit*** or ***Delete*** the individual items.



Note: This is the only place where you can change the name of a ***Display Rule***.

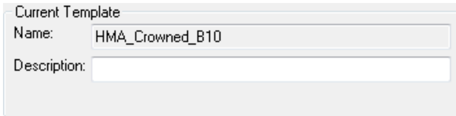
At the bottom of the pane, there is an box displaying information about the highlighted item. It is informational only.

Preview



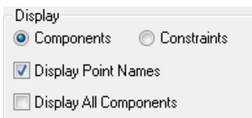
The pane at the left bottom of ***Create Template*** displays a preview of the highlighted template. From this pane, you can drag the template into the ***Active Template*** view to make a copy. You can drag it by the default drag-point (shown as a cyan box) or by any other point in the template. Dragging a template into itself is allowed.

Current Template Information



The Current Template information is listed for the active template. In this area, you can add or change the template description but not the name. To change the name, right click the template in the library tree and choose ***Rename***.

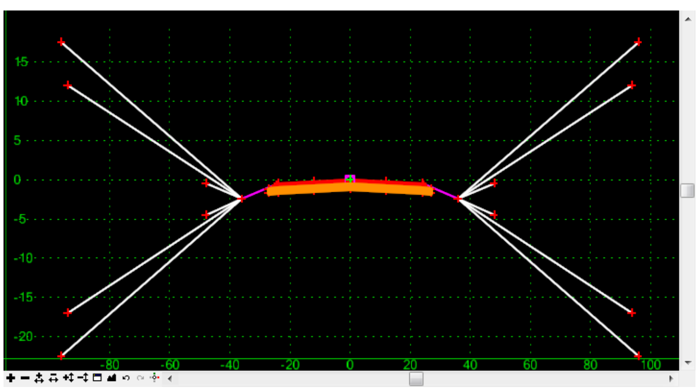
Display Options



The active template may be shown as ***Components*** (typical) or as ***Constraints*** (usually used when analyzing the constraints assigned). ***Point Names*** may be toggled on or off as desired. ***Display All Components*** will show any components in the template that are currently not displayed because of ***Display Rules***. These components appear as dashed lines.

Important! When reviewing an unfamiliar template, it is always good to toggle on ***Display All Components*** so you can see any hidden components.

Active Template Display



This view shows the active template. You may delete or rename templates in the list at left, but in order to make changes to a template it must be shown in this view. A template can be activated by double-clicking it in the library tree or by right-clicking on the template and choosing **Set Active**.

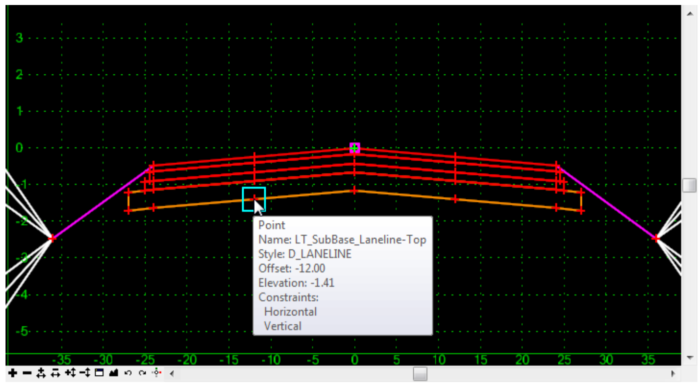
- At the bottom left of the view are the active template ***View Controls***

  These MicroStation-like controls allow you to ***Zoom In***, ***Zoom Out***, change the exaggeration in X or Y, ***Window Area*** and ***Fit*** the template in the window. Also on this set of commands are short-cuts to ***Undo*** and ***Redo*** as well as the toggle for ***Dynamic Settings***. The ***Undo*** and ***Redo*** buffers are cleared when another template is activated or you close the dialog.

- Mouse Controls

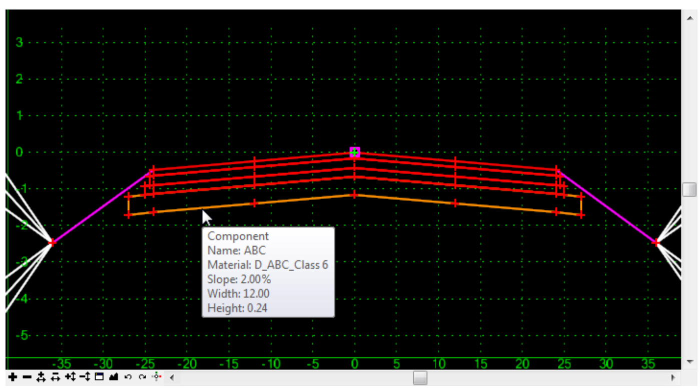
  The mouse wheel may be used to zoom in and out in this view. Clicking the wheel and holding it down while moving the mouse pans.

- Hover Options
  - ♦ Over a Point



    Hovering over a point brings up a pop-up of point information.

  - ♦ Over a Line (component)

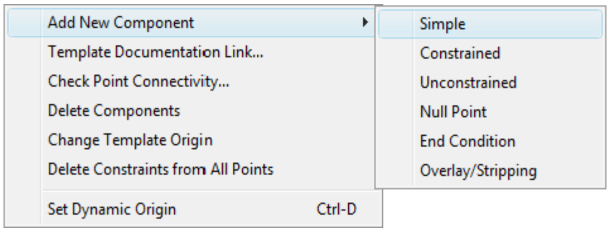


    Hovering over a line of a component brings up a pop-up of component and segment information.

- Right-click menus

  Right-clicking in the ***Active Template Display*** area brings up a menu. There are different menus available, depending upon where and when you click: in a clear area, on a point, on a line (component), while creating a component or while dragging component. Some of the commands are also found on the pull-down menus. When a right-click menu is active, the commands may be selected using either the left **<D>** or right **<R>** mouse button.

- Right-click in a clear area.

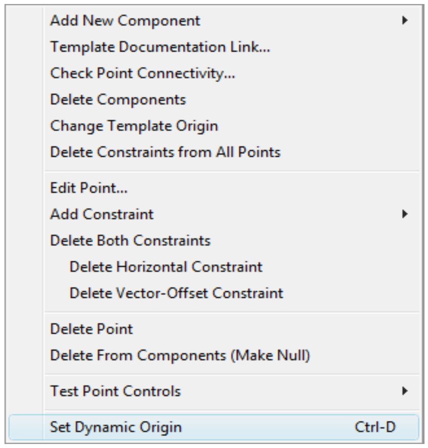


  - **Add New Component > Simple, Constrained, Unconstrained, Null, End Condition and Overlay/Stripping**: Used to create a new component in the active template. See the *Component* section for details.
  - **Template Documentation Link...**: Assigns a link to the template. See the description in the previous section.
  - **Check Point Connectivity...**: Checks the template to see if any two points are closer together than the specified ***Tolerance***. If there are, a box appears that lists the points for a specific location and allows you to choose which is to be deleted. If you want to keep both, choose ***<Esc>***. Then, the next set of points are brought up. This is the same as ***Merging Points***, but it seeks out the points for merging rather than having to select them individually.
  - **Delete Components**: Notice this is plural, which means you can **<D>** and drag your cursor across any number of components and they are deleted when you 'let go'.
  - **Change Template Origin**: While this command is on all three right-click menus, it functions differently depending upon whether it is selected while right-clicking on a point or not. On a point, it moves the template so that the point selected is at the 0,0 coordinate. If not on a point, it prompts you to identify the point you want to move to the 0,0 coordinate.

    Note: Remember, the 0,0 coordinate is where the template is applied to the horizontal and vertical alignment.
  - **Delete Constraints from All Points**: Removes all constraints from all points regardless of how they are set.
  - **Set Dynamic Origin**: This allows the ***Dynamic Origin*** (magenta box) to be moved to a different location. See the ***Dynamic Settings*** section later in this chapter for more details.

Important! The ***Dynamic Origin*** (magenta box) is ***not*** where the template is applied to the horizontal and vertical alignment.

- Right-click on a point.



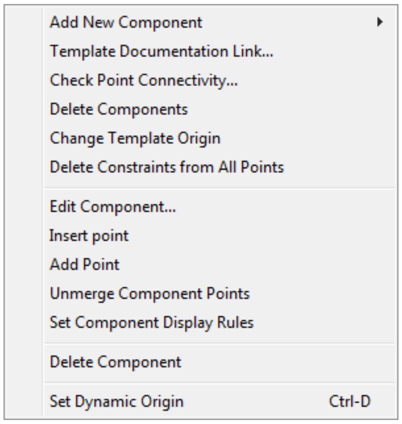
All of the clear area right-click options, plus:

- **Move Point**: Allows the point to be moved graphically, or if ***Dynamic Settings*** is active the key-ins can be used. This command is only available for points that have no constraints (appear green and can be moved anywhere) or one constraint (appear yellow and must hold the value of the one constraint, e.g. if it has a slope constraint, it must be moved along that slope).

  Note: Red points cannot be moved unless at least one constraint is released. You can, however, ***Edit*** the constrained point and move it by changing the constraint value(s).

- **Edit Point**: Brings up the ***Point Properties*** dialog and allows the editing of ***Names***, ***Styles***, ***Constraints***, etc. See the section on *Points* for details.
- **Add Constraint**: Allows the addition of a constraint to the point and prompts for the identification of the parent for the constraint, along with the value for the constraint. ***Add Full Constraint*** adds ***Horizontal*** and ***Vertical*** constraints at the same time. See the section on *Point Constraints* for additional details on available constraints and when to use each.
- **Delete Constraints**: Menu options change depending upon the constraints currently assigned to the point. Allows the deletion of both or of individual constraints.
- **Delete Point**: Removes the point from the template. If the point is between two points in a component, the remaining points are connected.
- **Delete From Components (Make Null)**: Removes the association of the point from the its component(s), but leaves the point along with its constraints intact.
- **Test Point Controls:** Allows testing of constraint behavior as if external controls are applied to the point.

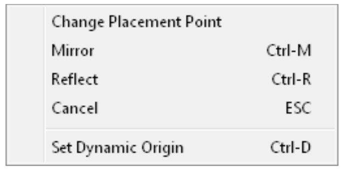
♦ Right-click on a line.



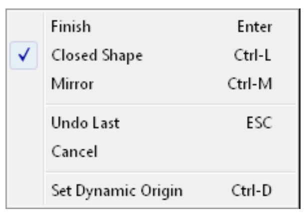
All of the clear area right-click options, plus:

- **Edit Component**: Brings up the ***Component Properties*** dialog and allows the editing of ***Name***, ***Description***, ***Styles***, etc. See the section on *Components* for details.
- **Insert Point**: Allows the placement of a new point in between two existing points. The point may be placed graphically or with key-ins using the ***Dynamic Settings*** box.
- **Add Point**: Only available when right-clicking on a segment of an open component. Allows the placement of a new point at the end of the component closest to where you click.
- **Unmerge Component Points**: Any common points between the component selected and other components are copied so that each component has only unique points. The copied points are named Copy of [original name]. Has no effect if the component does not share points with other components.
- **Set Component Display Rules**: Brings up the ***Component Display Conditional Expressions*** dialog, which allows the creation or editing of ***Display Rules***, and/or the assigning of Rules to the component selected. See the section on *Display Rules* for additional details.
- **Delete Component:** Notice this is singular, which means it will delete only the component selected. If the line selected is common to multiple components, you are prompted for which you want to delete.

- Right-click while using **Add > Simple**:



  - **Change Placement Point**: By default, the **Add > Simple** command places the component by the upper left point of the parallelogram. Choosing this command moves the placement point to each of the other points successively around the component.
  - **Mirror**: Creates a second identical component (except for naming) mirrored about a vertical line at the 0 horizontal coordinate.
  - **Reflect**: Creates the component in the opposite direction.
  - **Cancel**: Stops the command without creating a component.
  - **Set Dynamic Origin**: See the ***Dynamic Settings*** section later in this chapter for more details.
- Right-click while using **Add > Constrained**, **Unconstrained**:



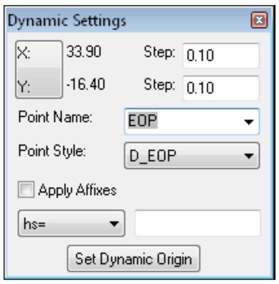
  - **Finish**: Stops the placement of the component. Use this after the last point is entered.
  - **Closed Shape**: Makes the component being placed a closed shape.

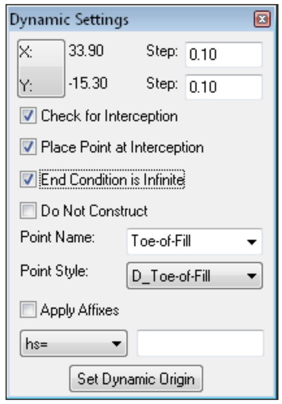
Important! Leaving ***Closed Shape*** toggled off and drawing the component closed is ***NOT*** the same as having ***Closed Shape*** toggled on. This is a component property and may be changed later, however. Components must be listed as ***Closed*** in order for them to be used in end-area volume calculations.

  - **Mirror**: Creates a second identical component (except for naming) mirrored about a vertical line at the 0 horizontal coordinate.
  - **Undo Last**: Removes only the last point created. This is very useful when you enter a wrong point, but don't want to start over or wait until finished to correct the error in point properties.
  - **Cancel**: Stops the command and does not keep any entered points.
  - **Set Dynamic Origin**: See ***Dynamic Settings*** below.
- Right-click while dragging a template into the ***Active Template View***. All of these commands are the same as described in the ***Right-click while using Add > Simple*** section above.

Dynamic Settings

The ***Dynamic Settings*** dialog can be very helpful when creating and editing templates. You can toggle on the dialog by selecting **Tools > Dynamic Settings** or by choosing the **Dynamic Settings** icon on the view controls toolbar in the ***Active Template*** view. The dialog changes depending upon if you are dealing with general components (as shown on the left) or end conditions (as shown on the right).





There are several options within the ***Dynamic Settings***:

- The read-out can be shown as either ***X:*** and ***Y:*** or **<D>** on the label and it converts to ***X:*** and ***Slope:***. This readout is from the ***Dynamic Origin*** which is shown as the small magenta box.
- **Steps**: Lists the steps or intervals as defined in **Tools > Options** and may also be entered here, either in ***X*** and ***Y*** master units or in ***X*** and ***Slope***, depending upon the readout selected.
- **Point Name**: When creating a new point, the name listed is used. It may be chosen from the drop-down (which comes from the ***Point Name List***) or keyed in. If a component is created, this name is used as the seed name for all the points.
- **Point Style**: If the ***Name*** is chosen from the drop-down, the ***Style*** is populated automatically from the ***Point Name List***. If the name is keyed in, the ***Style*** may be chosen from the drop-down (which comes from the ***Styles*** in the current XIN). This style is assigned to the corresponding feature when the design surface is created by ***Roadway Designer***.
- **Apply Affixes**: Toggles on or off the ***Affixes***, which are set in **Tools > Options**.
- **Key-ins**: The drop-down menu lists the different key-ins that can be used when locating a point or component:
  - ***xy=*** x-value,y-value – based on the template grid
  - ***dl=*** delta x-value,delta y-value – from the previous point
  - ***hs=*** delta x-value,slope – from the previous point
  - ***vs=*** delta y-value,slope – from the previous point
  - ***ol=*** delta x-value,delta y-value – from the ***Dynamic Origin*** (magenta box)
  - ***os=*** delta x-value,slope – from the ***Dynamic Origin*** (magenta box)

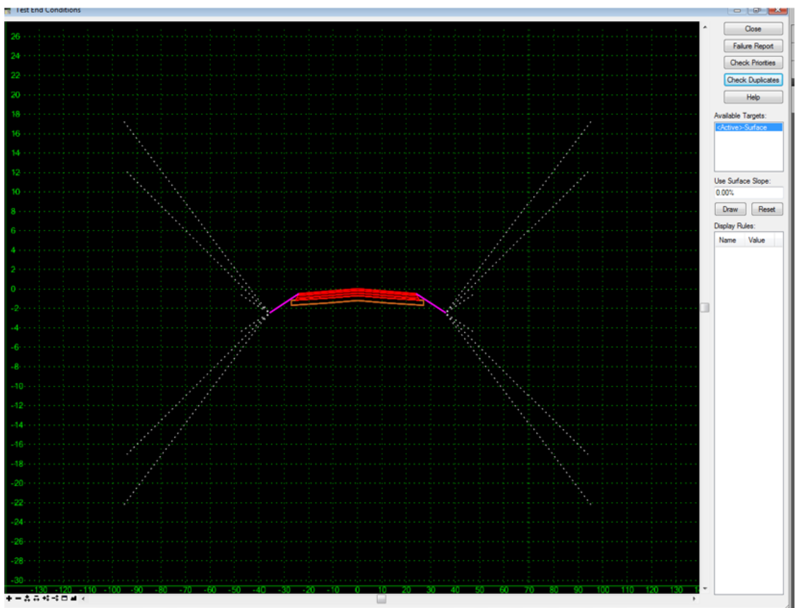
♦ **Set Dynamic Origin**: This allows the ***Dynamic Origin*** (magenta box) to be moved to a different location. Use this when the point being placed is offset a known x and y or x and slope from a point that is not the previous one located. Set the ***Dynamic Origin*** on the reference point, then use the ***ol*** or ***os*** key-ins listed above to locate the new point.

Important! The ***Dynamic Origin*** is ***not*** where the template is applied to the horizontal and vertical alignment. The template is applied at the 0,0 coordinate in the template grid. For clarity, you can keep the ***Dynamic Origin*** at the 0,0 coordinate when not using it as noted above.

Additional options for ***End Condition Points*** are described in the *CDOT End Conditions* area of this chapter.

Test Mode

This command activates the ***Test End Conditions*** dialog as shown.



To test the end conditions:

1. Choose the command while the template in question is active. If there are priority conflicts you will first be asked to choose the order of processing for the end conditions.
2. Select a target from the list of ***Available Targets*** (generated from the active template's end conditions).
3. Choose **Draw** and place the target in the desired position. If more than one target is listed, you may need to place all the targets before seeing a result.
4. After drawing the targets, you may select **Failure Report** for a list of end conditions that did not meet their targets.
5. **Check Priorities** allows the order of end conditions to be changed.
6. **Check Duplicates** checks the solution to see if there are multiple occurrences of the same feature name.

7. In the ***Display Rules*** area, there is a list of the ***Display Rules*** found in the template. To force a temporary ***True*** or ***False*** results to see the outcome, select the rule and **<D>** on the ***True/False*** toggle.

8. **Reset** removes the targets and starts the process of testing over again.

Section Summary:

- The CDOT standard template library can be copied to start your project-specific library.
- Templates can be copied from previous projects.
- The ***Create Template*** dialog is used to create and edit templates.
- Right-click menus are available in the ***Create Template*** dialog. The commands they contain are context sensitive and depend upon where you are and what you are doing when you right click, for example: in a clear area, on a point or on a line of a component.
- The ***Dynamic Settings*** box allows you to use key-ins for precision placement of points and components.
- The ***Dynamic Origin*** (magenta box) is not where the template is applied. The 0,0 coordinate of the template is applied to the horizontal and vertical alignments.

Organization of the Template Library

Section Objectives:

- To learn how the CDOT standard template library is structured and where to look for the necessary templates for your project.
- To learn how to modify the standard templates if necessary to meet your design criteria.
- To become familiar with the standard templates, sections and components available by reviewing how the standard templates are put together.
- To learn how the templates will work based on their component and point properties.

The ***CDOT_Template-Library*** is structured with complete templates at the top of the folder structure and individual template pieces (called components) at the bottom. The purpose of this folder structure is to:

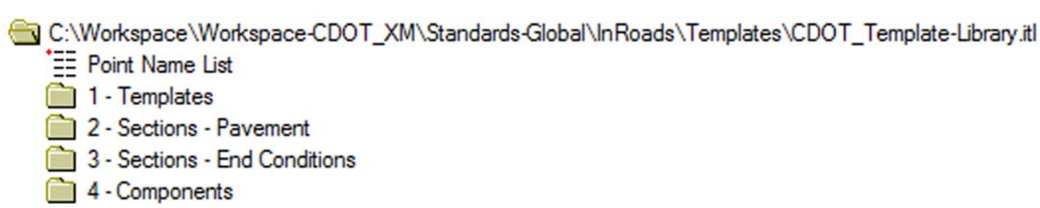
1) Make completed templates more accessible in Roadway Designer and

2) To emphasize that when building a new template, the first step is to create an empty template.

Note: In InRoads terminology, a template refers to everything in the template library that is not a folder or the point name list. To help with communication and training, CDOT has further categorized the contents of the template library into templates, sections, and components based on the completeness of the data they contain.

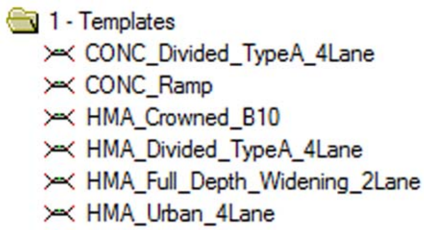
Each folder level in the template library (***Templates***, ***Sections***, and ***Components***) refers to the completeness of the template as follows:

- ***1 – Templates*** folder contains complete templates with the basic components of roadway cross sections.
- ***2 – Sections – Pavement*** folder contains portions of a roadway cross section including pavement and sub base for lanes, shoulders, curb and gutter, and medians.
- ***3 – Sections - End Conditions*** folder contains Z-slope components, cut and fill slopes, and curb and gutter templates.
- ***4 – Components*** contain individual building blocks for defining sections or templates.
- The illustration below shows the standard template library's top level folder structure as it appears in the ***Create Template*** dialog box.



Templates

This folder contains standard templates based on the ***CDOT 2005 Roadway Design Guide***. Modify these templates as needed. Save new or copied complete templates to this folder. InRoads V8i allows great flexibility in designing templates. With the advent of components, the design models used for CDOT's V04.00.00 configurations adhere as much as possible to the CDOT 2005 Roadway Design Guide and the CDOT Standard Plans- M&S Standard 2006 Edition.



The illustrations on the next several pages show the six templates included in the Templates folder as they appear in the ***Create Template*** dialog box.

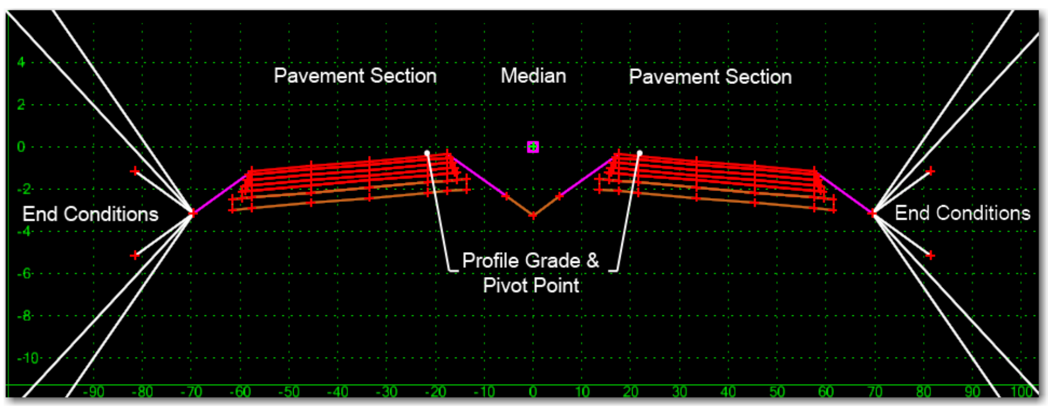


Figure 1: HMA_Divided_TypeA_4Lane

- ***HMA_Divided_TypeA_4Lane*** – This is the typical design for a four lane divided highway based on ***Figure 4-1*** of the ***2005 Roadway Design Guide***. Each ***Pavement Section*** contains:
  - ♦ 12 ft lanes (two lanes)
  - ♦ 4 ft inside shoulders
  - ♦ 12 ft outside shoulders
  - ♦ Normal Crown Cross slope

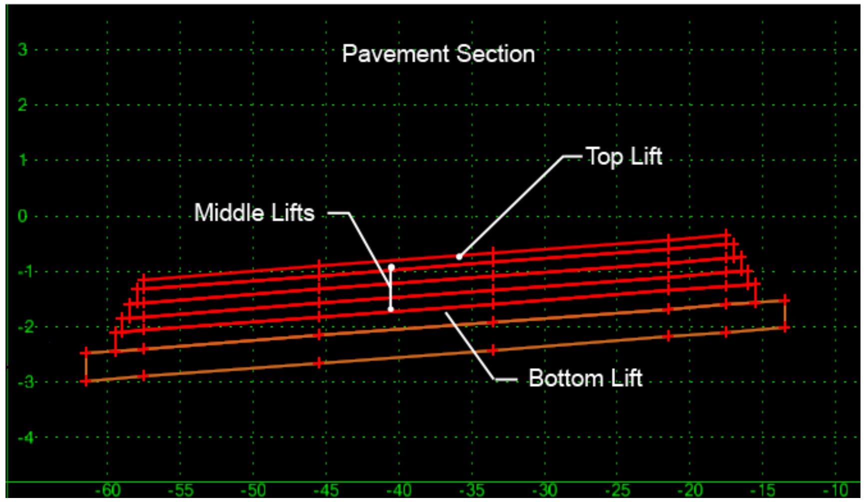


Figure 2: Pavement Section Detail from "Figure 1:HMA_Divided_TypeA_4Lane" on page 200

- The Hot Mix Asphalt pavement is 15" thick, made up of five lifts:
  - 2 in top lift
  - 3 in middle lifts (three lifts)
  - 4 in bottom lift
  - 6 in layer of Aggregate Base Course Class 6

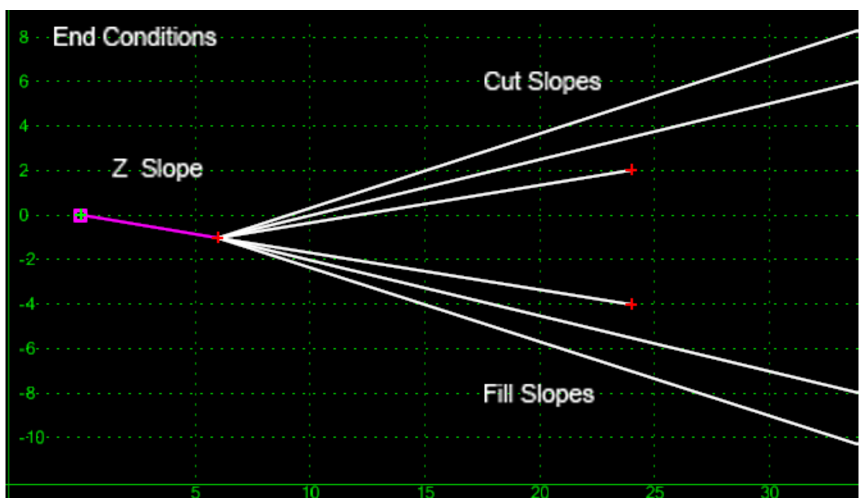


Figure 3: End Conditions Detail

The ***end conditions*** show the ***clear zone treatment*** and possible ***cut and fill slopes*** based on 6:1, 4:1 and 3:1 slopes. Please refer to the *End Conditions* section of this manual for a detailed discussion on the subject.

"Figure 3:End Conditions Detail" on page 201 defines possible cut and fill solutions that tie the pavement section to the existing ground and are based on ***Table 4-2 Fill Slopes*** of the ***2005 Roadway Design Guide***. This end condition includes:

- Z-Slope with a horizontal measurement of 12' from the edge of pavement and a slope of 6 to 1
- (3) fill slopes; 6 to 1, 4 to 1, and 3 to 1
- (3) cut slopes; 6 to 1, 4 to 1, and 3 to 1

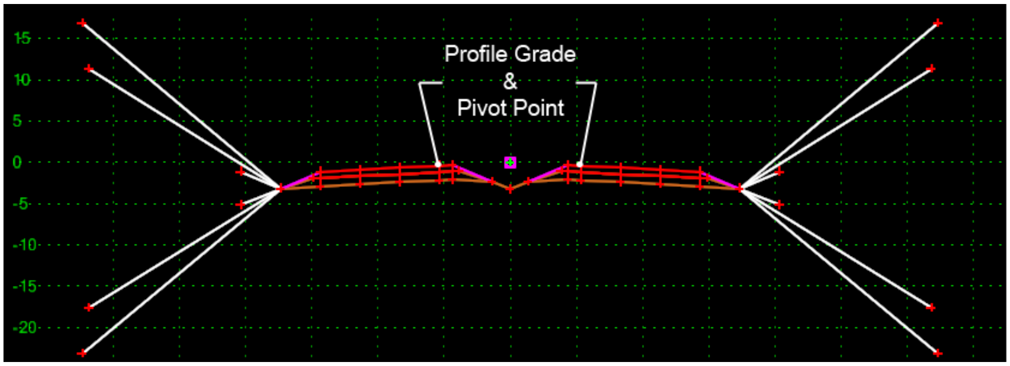


Figure 4: CONC_Divided_TypeA_4Lane

- ***CONC_Divided_TypeA_4Lane*** – This is the typical design for a four lane concrete highway based on ***Figure 4-2*** of the ***2005 Roadway Design Guide***. Each pavement section contains:
  - 12 ft lanes (two lanes)
  - 4 ft inside shoulders
  - 12 ft outside shoulders
  - The concrete thickness is 9 in
  - 12 in ABC Class 6 base extends 2 ft past the edge of concrete and tapers down to the POSS as shown in the detail below
  - End condition treatments are as shown from ***HMA_Divided_TypeA_4Lane***

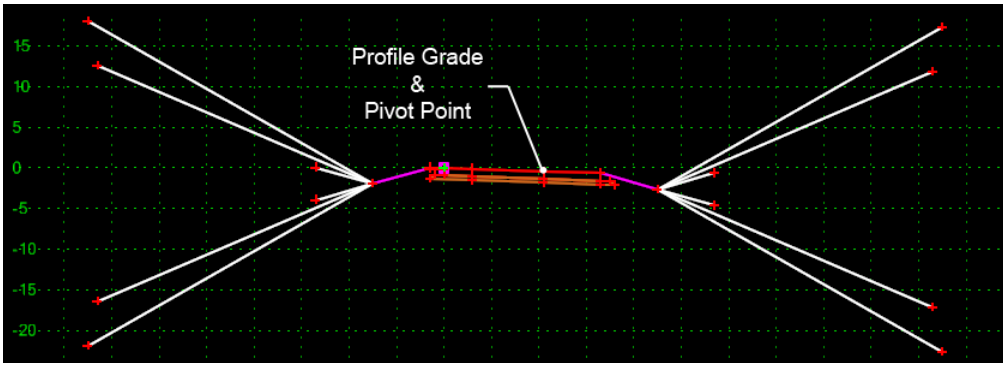


Figure 5: CONC_Ramp

- ***CONC_Ramp*** – The ramp template based on ***Figure 4-3*** of the ***2005 Roadway Design Guide***. The typical standard pavement section for single lane ramp for CDOT has a 15 ft lane, 4 ft and 6 ft shoulders. The pavement section contains:
  - ♦ 15 ft lane
  - ♦ 12 ft inside shoulder
  - ♦ 6 ft outside shoulder
  - ♦ The concrete pavement is 11 in thick
  - ♦ 3 ft wide Hot Mix Asphalt pavement for guardrail type 3, 2 in thick, is placed along the shoulder edge. Refer to ***CDOT M&S Standards M-606-1.***
  - ♦ End condition treatments are as shown for ***HMA_Divided_TypeA_4Lane***

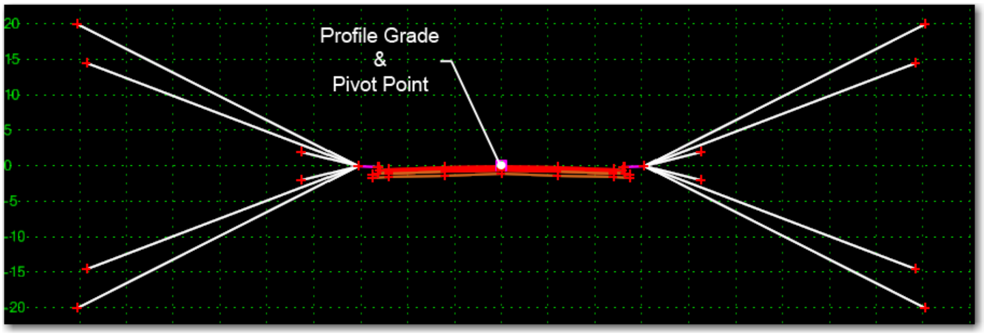


Figure 6: HMA_Urban_4Lane

- ***HMA_Urban_4Lane*** – This urban highway template is based on ***Figure 4-4*** of the ***2005 Roadway Design Guide***. It contains:
  - ♦ 12 ft lanes in each direction in a normal crown (two lanes)
  - ♦ The asphalt pavement is 8 in thick, made up of:
    - ○ 2 in top lift
    - ○ 3 in middle lift
    - ○ 3 in bottom lift
  - ♦ 6 in layer of ABC Class 6 base runs under the asphalt to 12 in past the curb and gutter
  - ♦ Type2-IIB curb section is used at the edge of pavement. This type of curb and gutter section allows the slope of the gutter pan to match the pavement cross slope for cross slopes greater than +4% or less than -4%

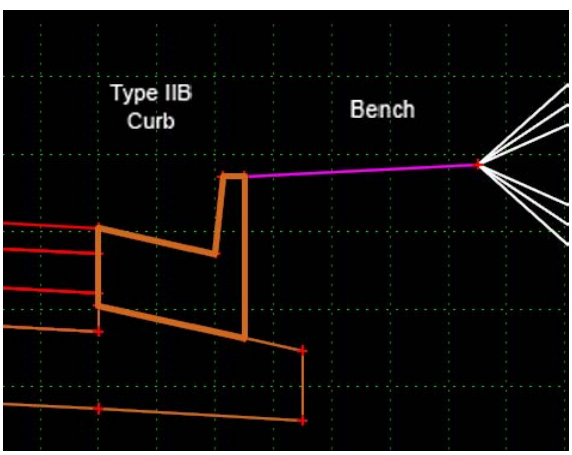


Figure 7: Type2-IIB Curb Section

Note: To see the all the attached sections toggle on ***Display All Components*** in the ***Display*** section of the ***Create Template*** dialog box. The template is developed this way so that the end conditions connect properly to the top back of curb. Refer to Curb and Gutter discussions under the Pavement Sections of this manual for additional discussion on Curb and Gutter.

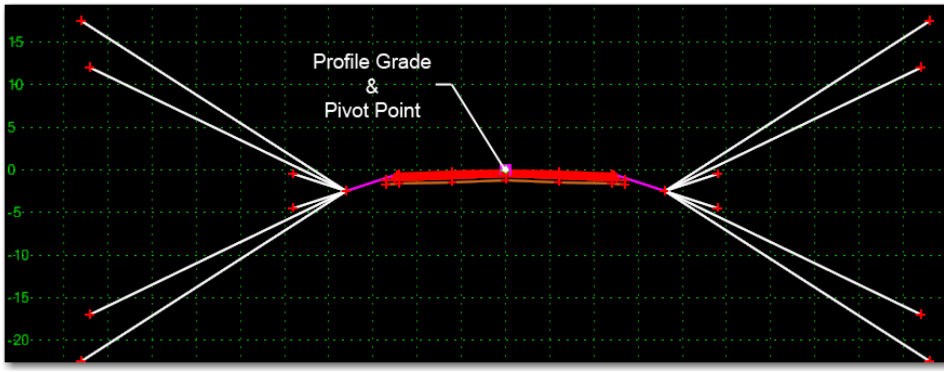


Figure 8: HMA_Crowned_B10

- ***HMA_Crowned_B10*** – This is a typical two lane normal crown template based on ***Figure 4-5*** of the ***2005 Roadway Design Guide***. It contains:
  - (1) 12 ft lane in each direction
  - 12 ft Shoulders
  - The asphalt pavement is 8 in thick, made up of:
    - 2 in top lift
    - 3 in middle lift
    - 3 in bottom lift
  - A 6 in layer of ABC extends 2 ft past the bottom lift on each side
  - End condition treatments are as shown for ***HMA_Divided_TypeA_4Lane***

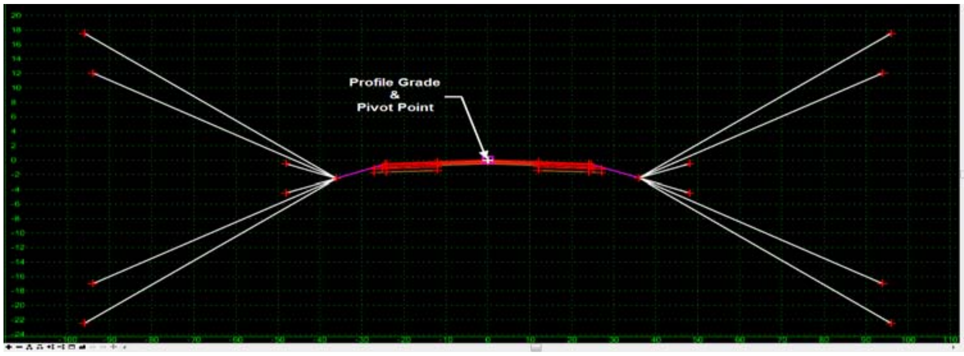
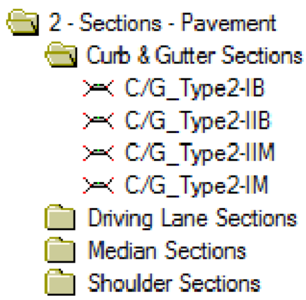


Figure 9: HMA_Full_Depth_Widening_2Lane

- ***HMA_Full_Depth_Widening_2Lane*** – This template is for use on widening and resurfacing projects based on the ***Edge of Pavement Detail*** in ***Figure 4-5*** of the ***2005 Roadway Design Guide***. It contains:
  - ♦ 12 ft lane overlay to each side of the centerline
  - ♦ 12 ft shoulders built to a full depth of 8 in of asphalt
  - ♦ HMA is a 2 in thick overlay pavement and 8 in thick at the shoulders. It is made up of:
    - ○ 2 in top lift that extends 24 ft to each side of the centerline
    - ○ 4 in leveling layer under the 2 inch top lift 12 ft to each side of centerline
    - ○ A stripping component that can be adjusted to define milling depth.
    - ○ 3 in middle lift under the new 12 ft shoulders
    - ○ 3 in bottom lift under the new 12 ft shoulders
    - ○ A 6 in layer of ABC Class 6 under the shoulders extends 2 ft past the bottom lift on each side
  - ♦ End condition treatments are as shown for ***HMA_Divided_TypeA_4Lane***

Pavement Sections

The ***2 - Sections - Pavement*** folders contain full depth segments of the roadway pavement cross section of a template. Pavement sections are partial templates. They represent one segment of the total pavement. For example, sections from the ***Driving Lane Sections*** folder represent a single pavement section from the finished grade to the subgrade. The reader is encouraged to explore the contents of the ***Pavement Sections*** sub-directories since only some of the sections are displayed or discussed below. The folder structure for pavement sections is shown in the illustration below.



Curb and Gutter

The ***Curb and Gutter Sections*** folder shown above contains Curb and Gutters as defined in the ***CDOT Standard Plans-M&S Standards M-609-01***.

In the folder;

- ***C/G_Type2-IB*** is curb and Gutter Type 2 (Section IB)
- ***C/G_Type2-IIB***, is curb and Gutter Type 2 (Section IIB)
- ***C/G_Type2-IM*** is curb and Gutter Type 2 (Section IM) and
- ***C/G_Type2-IIM*** is curb and Gutter Type 2 (Section IIM)

The Curb and Gutters are modeled such that:

1. When the curb and gutter is attached to pavement with cross slope of less than 4% while more than -4%, the gutter cross slope will be as defined in ***CDOT M&S Standards M-609-1***.

2. When the curb and gutter is attached to pavement with cross slope greater than 4% or less than -4%, the gutter cross slope will match the cross slope of the pavement.

Important! The desire to have the gutter match the cross slope of the pavement is not a given. This is a design decision left up to the CDOT designer or engineer in charge of the project. While the curb and gutter sections in the CDOT standard template library reflect this decision, they can be modified for other design situations. See the section Display Rules and Parent Components on how to use different design criteria with these sections.

Gutter Pan Cross Slope example

The ***CDOT M&S Standard M-609-1*** was used to model the ***Type2-IIB*** curb and gutter section. The ***Type2-IIB*** curb and gutter section shown here is a good example of how the new software is used to accommodate CDOT design decisions.

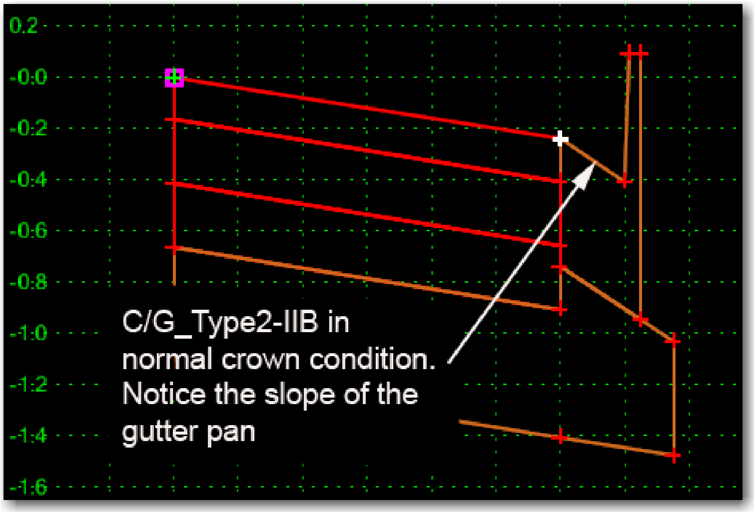


Figure 10: C/G_Type2-IIB Pavement Less Than 4%

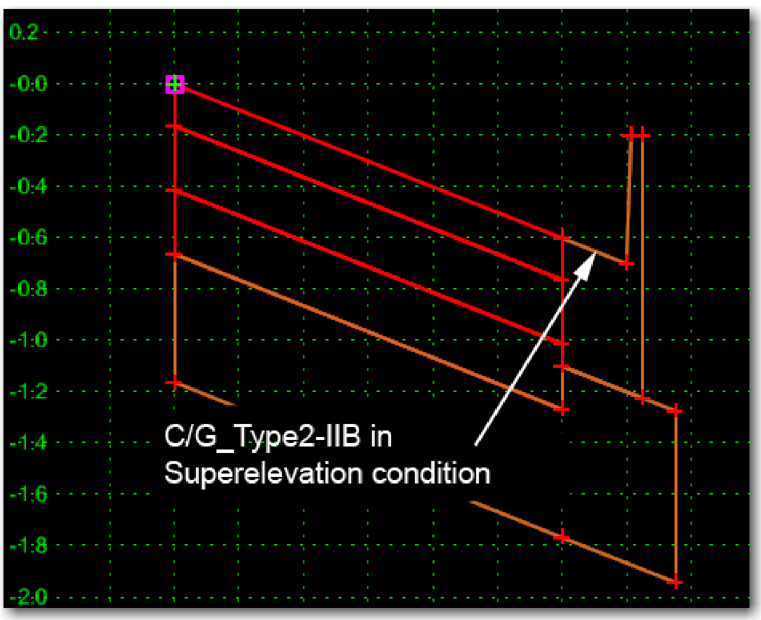


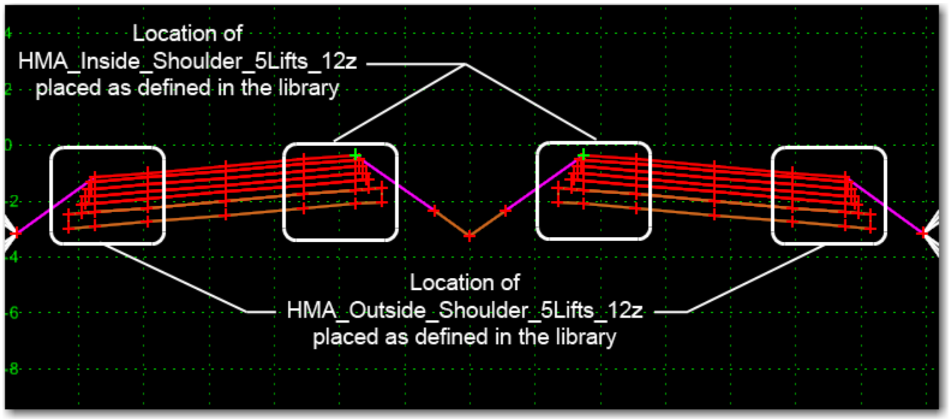
Figure 11: C/G_Type2-IIB Pavement Greater Than 4%

- *Figure 10:C/G_Type2-IIB Pavement Less Than 4%* - 10 shows ***C/G_Type2-IIB*** in a normal cross slope condition and
- *Figure 11:C/G_Type2-IIB Pavement Greater Than 4%* - ***C/G_Type2-IIB Pavement Greater Than 4%*** shows ***C/G_Type2-IIB*** in a superelevated cross slope condition.

Shoulder Sections

Shoulders

The figure below shows standard shoulder sections and how they are applied to a template design.

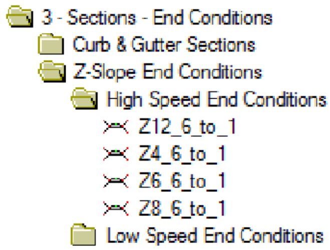


- ***HMA_Inside_Shoulder_5Lifts-12z*** and ***HMA_Outside_Shoulder_5Lifts-12z*** – The “stair-step” design of the pavement edge is based on the ***Edge of Pavement Detail*** in ***Figure 4-5*** of the ***CDOT 2005 Roadway Design Guide.*** Both sections contain:
  - 12 ft wide outside shoulder
  - The Hot Mix Asphalt pavement is 15 in thick, made up of five lifts:
    - 2 in top lift
    - 3 in middle lifts (three lifts)
    - 4 in bottom lift
  - 6 in layer of ABC, Class 6 base

  Both inside and outside shoulders are created for the right side of the pavement section. The ***Mirror*** or ***Reflect*** command is used to place the left side version for this shoulder section.

End Conditions Sections

The ***3 - Sections – End Conditions*** folder contains predefined sections for end conditions complete with multiple cut and fill solutions. This folder is divided into groups for Curb and Gutter side slopes and Z slopes.



End conditions refer to roadside designs associated with the unpaved ***clear zone*** area or roadside safety items like ***Guardrail type 7***, ***Guardrail type 3*** and ***cut and fill slopes***.

End Conditions treatment or the selection of roadside safety items is influenced by several factors. These factors will vary even within the project.

Below are some of the factors that will influence End conditions or component selection:

1. Clear Zone requirements
2. Design Speed and traffic volumes
3. Roadway Category or designation
4. Local terrain
5. Structures and obstructions
6. Right of Way limitations
7. Drainage requirements
8. Project budget
9. Local preferences

For CDOT, the primary reference material for the determination of End Conditions requirements based on Clear Zone, design speed and traffic volume is the ***Roadside Design Guide, 2006 Edition***, published by American Association of State Highway and Transportation Officials (AASHTO). Other references include:

- ***CDOT 2005 Roadway Design Guide***
- ***CDOT Standard Plans - M&S Standards***

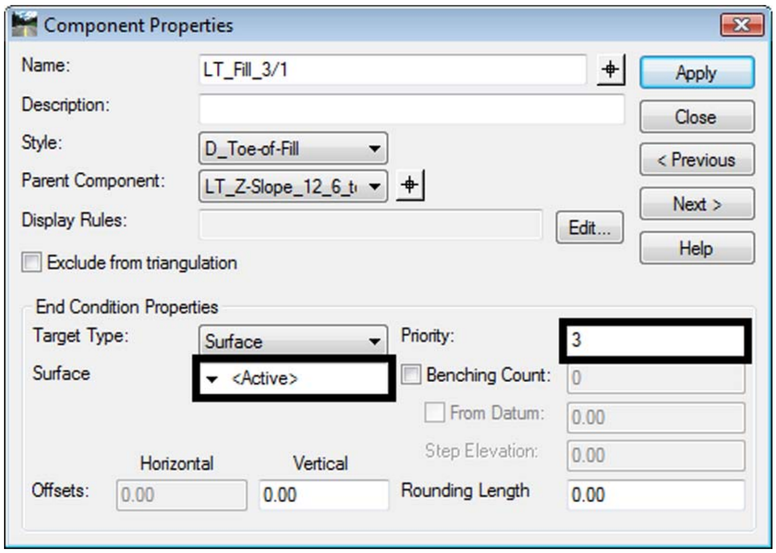
The designer needs to be familiar with the project, factors influencing design decisions and the above references.

Z-Slope End Conditions

Z-Slope End Condition sections describe the horizontal width and slope of the Z-Slope component. For Example, ***Z12_6_to_1*** defines a Z-Slope component that measures 12' horizontally and has a slope of 6 to 1. The dimensions for the Z-Slope components come from ***Figures 4-1*** and ***4-5*** of the ***CDOT 2005 Roadway Design Guide***. Cut and fill slopes are based on ***Table 4-2 Fill Slopes*** of the ***CDOT 2005 Roadway Design Guide***.

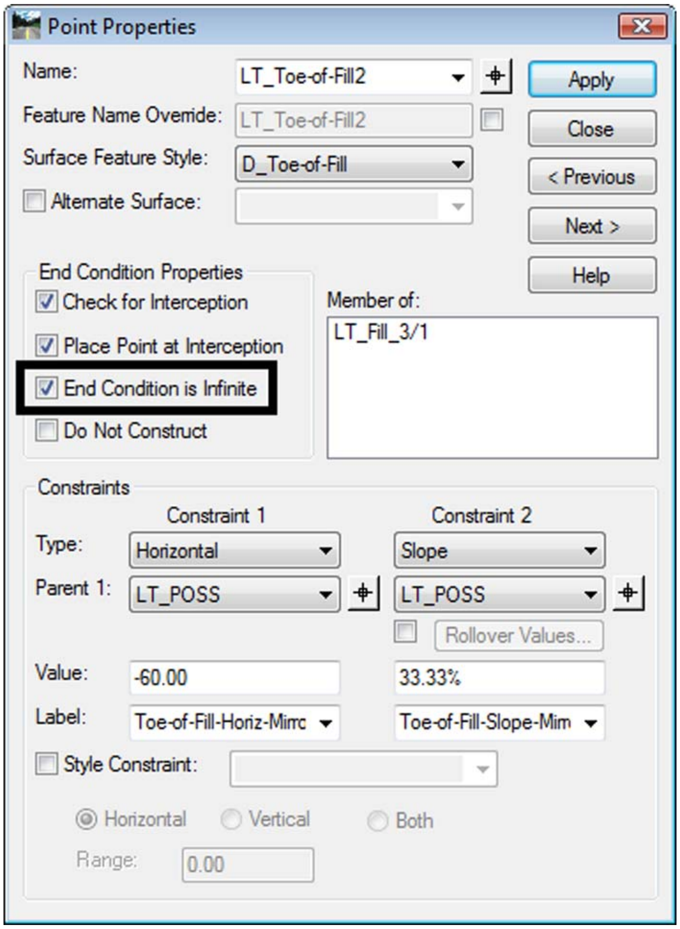
Component and Point Properties

Component and ***Point Properties*** are major factors in determining how components are modeled. These properties are covered in more detail in later sections of this document but for now it is necessary to mention a few details regarding some of these properties.



In the ***Component Properties*** dialog, all of the cut and fill components have their ***Target*** set to the active surface. This allows the same end condition to be used on multiple projects without having to edit each component that lists the target.

When multiple end condition components begin at the same location in the template, the ***Priority*** determines the order of processing. The lowest numbered Priority is used first. If the slope does not intercept the existing ground (or other listed target), the next lowest priority is tried, and so on. Once a solution is found, processing stops for that location and no other slopes are tried. If no solution is found, the end condition fails and no sideslope is formed for that location. Processing occurs at each station where a template is 'dropped'. See the *Roadway Modeling* chapter for more details on ***Template Drops***.



One differentiating factor for end condition sections is whether or not the checkbox for ***End Condition Is Infinite*** point property is toggled on.

- When toggled off, the maximum length of the end condition is determined by its constraint.
- When on, the end condition can extend past the distance defined in the constraint.

Standard fill height maximums for each slope were used to determine the default horizontal measurement (the horizontal constraint value in the Point Properties dialog box) for each slope. The horizontal measurement is not important for slopes that are allowed to be infinite, although it cannot be 0.00.

Following is an example end condition section.

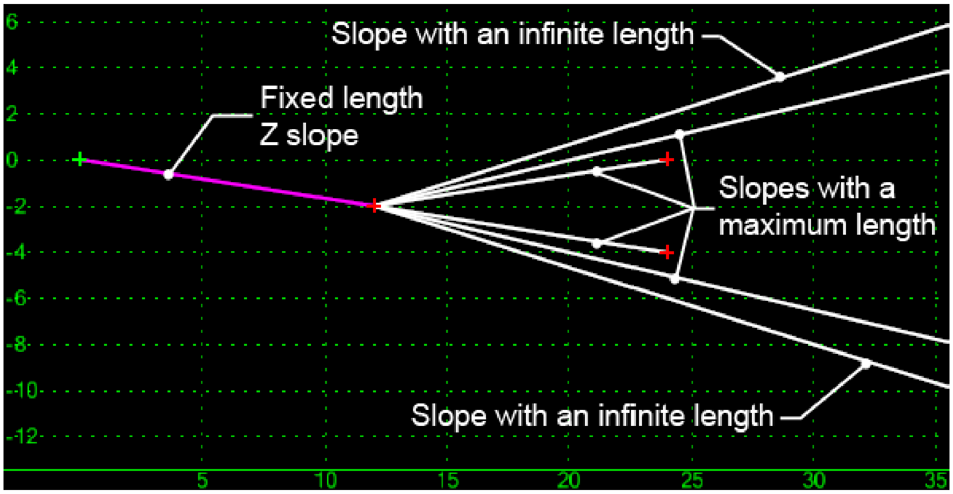
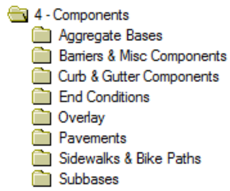


Figure 12: Z12_6_to_1 End Condition Detail

- ***Z12_6_to_1*** – This section contains:
  - ♦ (1) Fixed Z-Slope component measuring 12' horizontally and a slope of 6 to 1.
  - ♦ (1) 6 to 1 fill slope measuring 12' horizontally. ***Priority*** is set to 1.
  - ♦ (1) 4 to 1 fill slope measuring 58' horizontally. ***Priority*** is set to 2.
  - ♦ (1) 3 to 1 fill slope measuring 60' horizontally. ***End Condition is Infinite*** is toggled on. ***Priority*** is set to 3.
  - ♦ (1) 6 to 1 cut slope measuring 12' horizontally. ***Priority*** is set to 4.
  - ♦ (1) 4 to 1 cut slope measuring 58' horizontally. ***Priority*** is set to 5.
  - ♦ (1) 3 to 1 cut slope measuring 60' horizontally. ***End Condition is Infinite*** is toggled on. ***Priority*** is set to 6.

Components

This folder contains the components used to build sections and complete templates. They are sorted into subfolders based on their use. The illustration below shows the subfolder structure of the ***4 – Components*** folder of the standard template library as it appears in the Create Template dialog box.



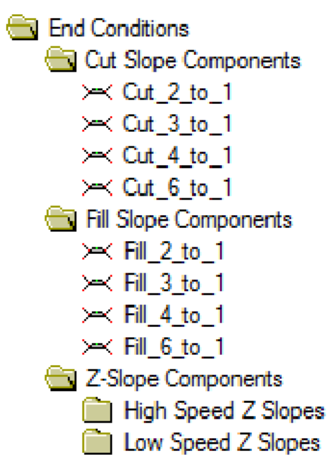
The standard components can be grouped into three functional categories:

- linear elements
- fixed shape elements
- variable shape elements

The examples below represent typical component designs from each of these categories and the unique elements of the different component types.

Linear Elements

Components in the ***End Conditions*** folder fall into the ***linear elements*** category. These components are simple linear elements generally used to define options for side slopes.



A typical end condition component, like the one illustrated below, is a single line segment. The right point is constrained to the origin (the left point) with a ***horizontal*** and a ***slope*** constraint. The information for defining end condition components comes from ***Chapter 4*** of the ***2005 Roadway Design Guide.***

Figure 13: Fill_6_to_1

- ***Fill_6_to_1*** – The typical end condition component, like the one illustrated above, is a single line segment. Its properties are:
  - Check for Interception
  - Place Point at Interception
  - Horizontal constraint with a Value of 12
  - Slope constraint with a Value of -16.67%
  - Both constraints have the point POSS as the Parent

Fixed Shape Elements

The majority of the remaining components are classified as fixed shape elements. Fixed shape elements typically remain constant throughout a model unless design criteria dictates otherwise, in which case they are modified by Superelevation Controls, Points Controls or Parametric Constraints. See the *Roadway Modeling* chapter for additional details. The shape may be a polygon or it may be more complex like curb and gutter.

Important! These components have the component property ***Close Shape*** toggled on in order to be used in End-Area Volume calculations.

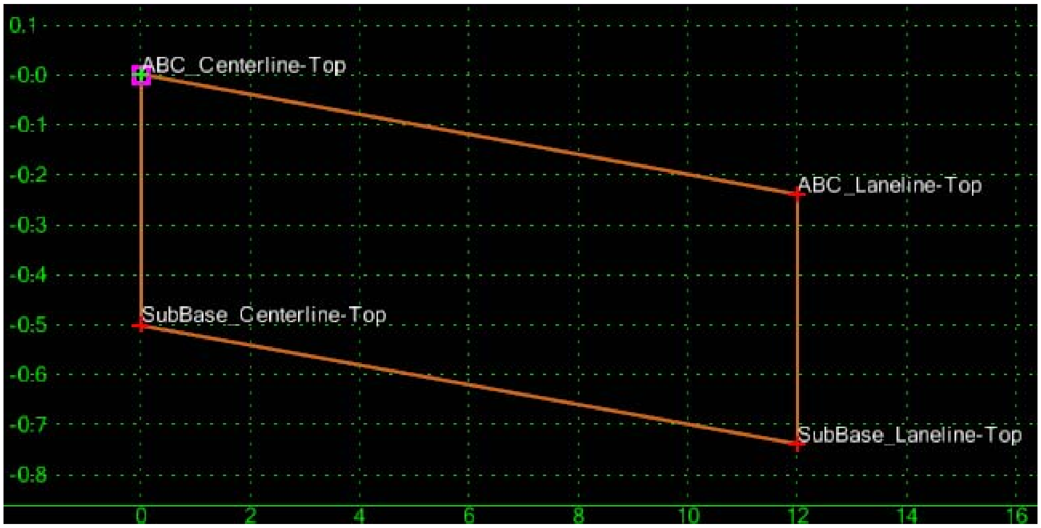
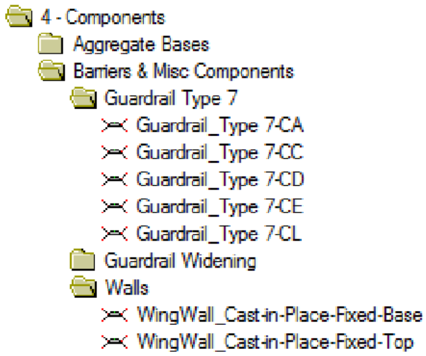


Figure 14: Typical Fixed Shape Element

- ***ABC_Lane*** – This component is typical of most surfacing and subbase components. It contains:
  - ♦ 4 points
  - ♦ The top right point is constrained to the origin with horizontal and slope constraints. The value of the horizontal constraint is 12. The value of the Slope constraint is -2.00%.
  - ♦ The two bottom points are constrained to the points above by horizontal and vertical constraints. The value of the horizontal constraint is 0. The value of the vertical constraint is -0.50. These values are the same on both points.

Variable Shape Elements

There are few exceptions to the previous example. Currently those exceptions are limited to the ***Guardrail Type 7-CE*** component in the ***\Barriers & Misc Components\Guardrail Type 7*** folder and both ***Wing Wall_Cast-in-Place*** components in the ***\Barriers & Misc Components\Walls*** folder.



Shapes of variable components are not fixed but depend on other design criteria and are used in areas of the project where a variety of field conditions require on-demand changes to the component design. The two component types previously mentioned are illustrated below.

Median Barrier Example

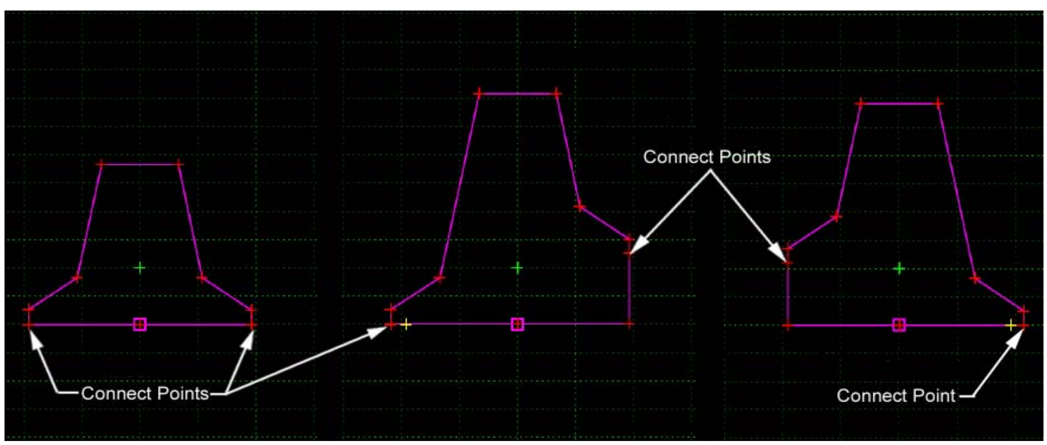


Figure 15: Guardrail Type 7-CE

Guardrail_Type 7-CE – This illustration shows how the shape of the barrier varies with the elevation changes of the travelways on either side of the median in a divided highway. This barrier has base width of 23" at a height of 34"or less. When the height is 34" or more, the base varies in width from 23" to a maximum of 26.75". The design is based on the ***CDOT M-606-13 Guardrail Type 7 F-Shape Barrier*** standard.

Details of this component include:

- Two points on the bottom of the barrier are tied to the elevation on their respective side of the median.
- The barrier height and width vary with the elevation difference between the two sides.
- To learn how to apply this median barrier, see Lab 3.4 in the *Labs for InRoads V8i* guide.

Wing Wall Example

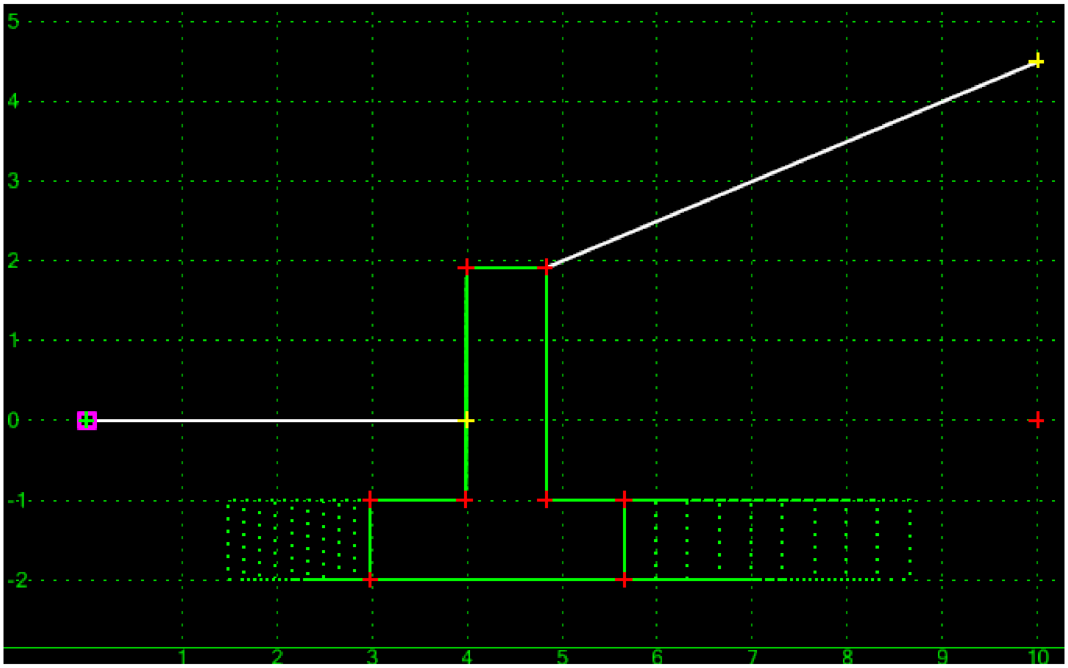


Figure 16: WingWall Cast-in-Place Fixed Base

WingWall_Cast-in-Place-Fixed-Base - This component is set up to adjust the wall height from pavement surface to the top of the wall based on maximum fill heights. It is used when the wall rises above the level of the roadway surface. Its sister component, ***WingWall_Cast-in-Place-Fixed-Top*** is used when the wall drops below the level of the roadway surface.

- ♦ The design of this component is based on the ***CDOT M-601-20 Wingwalls for Pipe or Box Culverts*** standard. As the maximum fill height for a wall height is reached, the wall height rises and the base of the wall expands to set base widths.
  - Is made up of 10 wall components with different base widths.
  - ***Display Rules*** are used that only allow the display of the proper wall component based on the height of the wall.

Section Summary:

- The CDOT standard template library is organized into ***Templates***, ***Pavement Sections***, ***End Condition Sections*** and ***Components***.
- There are several example templates in the completed template folders that you can use 'as-is' or modify to fit your design criteria.
- ***Pavement Sections*** contain multiple components and can be used to build completed templates if one of the standard templates does not fit your design criteria.
- ***End Condition Sections*** match CDOT's the standard sideslope design criteria.
- ***Components*** are the basic building blocks that can be used to build sections and templates.

Template Development

Section Objectives:

- To become familiar with the different areas of the standard template library and how the sections and components can be used to create templates.
- To develop a background knowledge of how ***Points*** and ***Point Constraints*** work so the CDOT standard templates can be used more effectively.
- To learn the differences between ***Component*** types and how each is used in the CDOT template library.
- To learn how to apply basic ***Component Properties*** to control their display in the plan and cross sections.
- To learn how to create more complex components using the ***Parent*** and ***Display Rule*** component properties.

When constructing a template in InRoads, it is best to use the largest assembly that meets the design criteria. For example, if a 2 lane road with paved shoulders is required, the ***HMA_Crowned_B10*** template may be used and lane, shoulder widths and lift thicknesses adjusted as required. If a standard template is used, it should be copied and renamed prior to editing. This will identify the template as being used for the project.

It should be noted, however, that because the surfacing components are merged most templates are not suitable for a major overhaul. It would be tedious to add an additional lane to the ***HMA_Crowned_B10*** template, for example. Therefore, the sample templates should only be used if they are very close to the desired design.

If there is not a template that will work, the sections should be used to create the desired template. There are sections available that cover most design situations with minor modifications. Modifications to the sections should be done prior to placing the section in the template. Editing the section before placing it in the template will reduce the amount of editing required if the section is used more than once.

It should be noted that most sections are set up to be placed on the right side of the origin. To place a section to the left of the origin, ***Reflect*** the section during placement. If the template design is symmetrical, the section can be placed on both sides using the ***Mirror*** option.

Certain specialty components may be required for a project (***Type 7 Guardrail*** and ***Walls***, for example). The component folders also contain these special components as well as all of the parts used to create the sections and templates. Components can be used in the template or used to build a new section, if required.

Finally, if there is not a component that can be used, a new component can be built. If the new component is a single unique part, it can be built directly in the template. If the new component is used multiple times, it should be created by itself in the proper component folder. This makes it easier to place the component in a template multiple times, or to place the component in multiple templates.

The information presented below is in reverse order to the sequence presented above. This was done so that the templates can be explained from the smallest building block to the complete template.

Components

This section describes how template components are made and how they are edited. Examples from the template library are used to highlight key points.

Template Points

All components are made up of points. The points used to define a template become breakline features in the resulting design model. A template point is assigned a name and a style (which, in turn has a named symbology assigned) that determine the name and the style of the feature when the design surface is created with ***Roadway Designer***. The features are then saved as part of the surface. Each point on the template must have a unique name. If the same name is used twice, it is appended with a numeric counter.

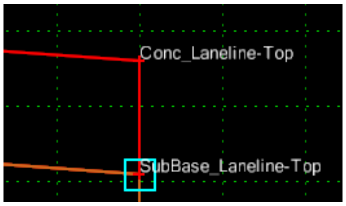
Point Constraints

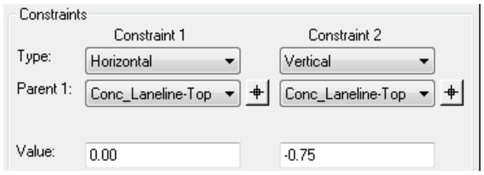
Each point in a template can have constraints to determine how the points are allowed to move and their connectivity within a template. Many of the constraints have values such as distances or slopes from reference points. These reference points are called ***Parents***. When a point moves, any point that lists it as a ***Parent*** is affected. Since the affected point may also be a parent for other points, there is a domino-type effect. Depending upon the constraint, 0, 1 or 2 parent(s) may be required. Parent points do not have to reside in the same component as the affected point.

Important! ***Point Controls*** and ***Parametric Constraints*** override ***Point Constraints***. For more information, see *Point Controls* and *Parametric Constraints* in the *Roadway Modeling* chapter.

Points may be:

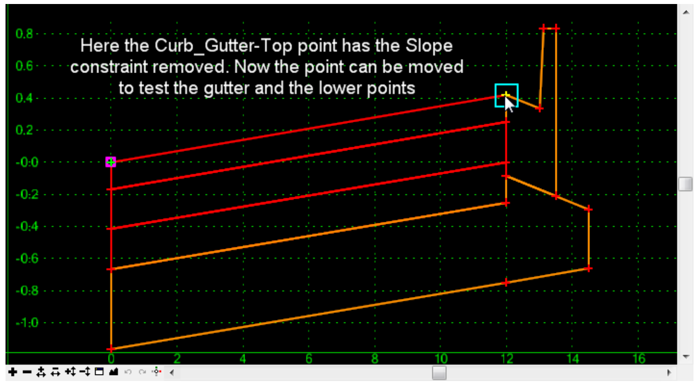
- ***Fully*** constrained (two constraints). Fully constrained points appear as ***RED*** plus signs on the template. Most points on a standard template should be fully constrained.





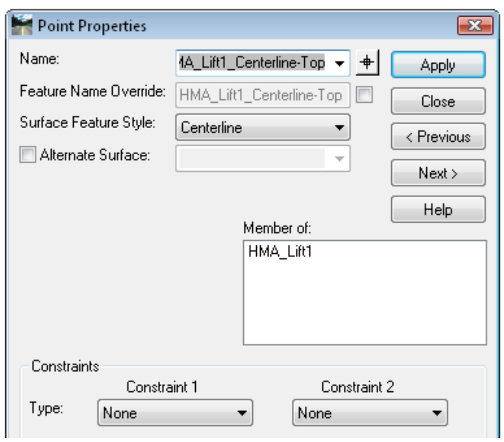
An example of a fully constrained point is shown here. The ***SubBase_Laneline-Top*** point is constrained Horizontally and Vertically to the ***Conc_Laneline-Top*** point. When the ***Conc_Laneline-Top*** moves, the ***SubBase_Laneline-Top*** point moves with it, maintaining horizontal and vertical distances as defined by the constraint values.

- ***Partially*** constrained (one constraint). Partially constrained points appear as ***YELLOW*** plus signs on the template. It is sometimes beneficial to remove one constraint from a fully constrained point just for testing.

  For example, you may remove the slope constraint, then move a point to ensure the points below follow (as during superelevation), or that a ***Display Rule*** works correctly.

- ***Unconstrained*** (no constraints). Unconstrained points appear as ***GREEN*** plus signs on the template.

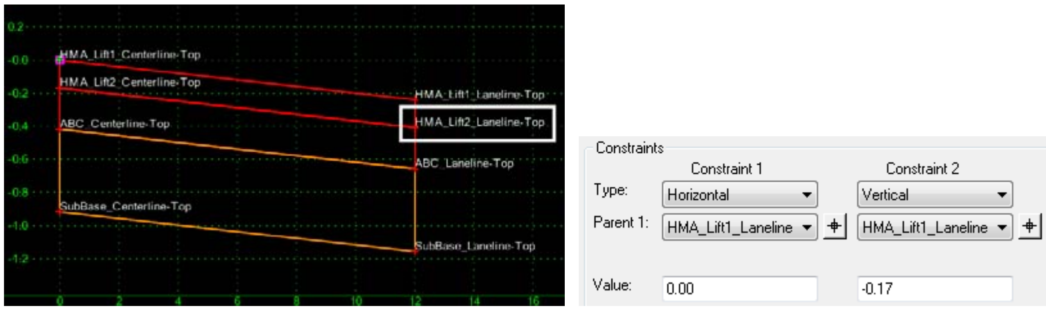
  

  Typically unconstrained points are points that will be assigned to follow a certain path, such as the Centerline of the template which follows the horizontal and vertical alignments. Other points that you know are to be controlled with point controls, such as the centerline of another set of lanes (as in a divided highway) following different horizontal and vertical alignments may also be unconstrained.

In general, points other than the centerline should be fully constrained unless there are special circumstances dictating otherwise. For an example, see the ***Point Controls*** section of the *Roadway Modeling* chapter.

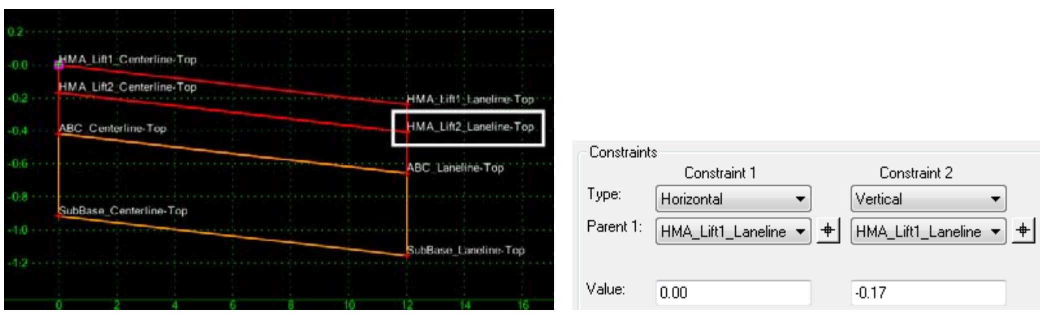
There are several different types of constraints you can place on points:

- ***Horizontal***: Requires 1 Parent. The point is locked by a horizontal distance from the parent, as specified by the ***Value*** entered.



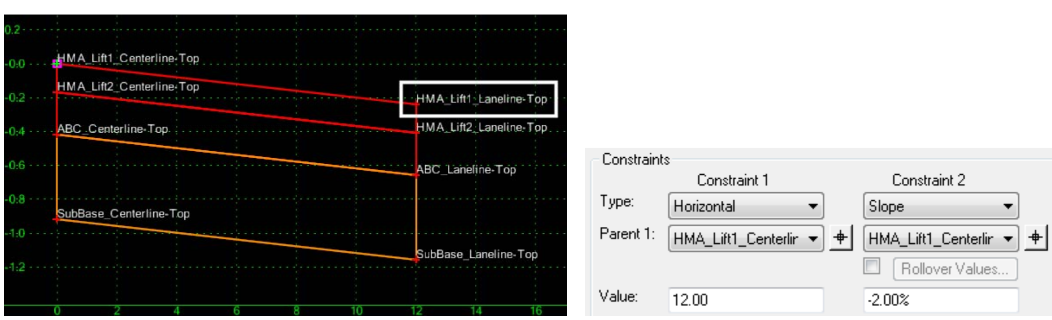
An example can be found in most of the CDOT templates including the Section ***HMA_DrivingLane-2Lifts***. Here, the ***HMA_Lift2_Laneline-Top*** point is horizontally constrained to the ***HMA_Lift1_Laneline-Top*** parent point by a value of 0.00, meaning it will always have the same width from centerline as its Parent.

- ***Vertical***: Requires 1 Parent. The point is locked by a vertical distance from the parent, as specified by the ***Value*** entered.



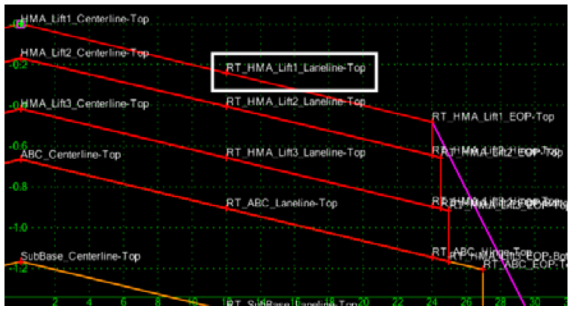
An example can be found in most of the CDOT templates including the Section ***HMA_DrivingLane-2Lifts***. Here, the ***HMA_Lift2_Laneline-Top*** point is vertically constrained to the ***HMA_Lift1_Laneline-Top*** parent point by a value of -0.167, meaning it always maintains this depth from the top.

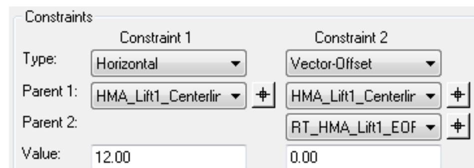
- ***Slope***: Requires 1 Parent. The point is locked by a slope from the parent, as specified by the ***Value*** entered.



An example can be found in most of the CDOT templates including the Section ***HMA_DrivingLane-2Lifts***. Here the ***HMA_Lift1_Laneline-Top*** point is slope constrained to the ***HMA_Lift1_Centerline-Top*** parent point by a value of -2.0%.

- ***Vector Offset***: Requires 2 Parents. The point is locked onto a vector as defined by the 2 parents. The point may be offset perpendicular from the vector by entering a ***Value***. Positive values are offsets to the right of the vector, Negative values to the left.

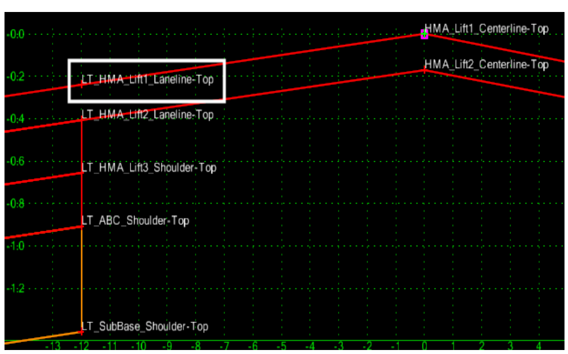


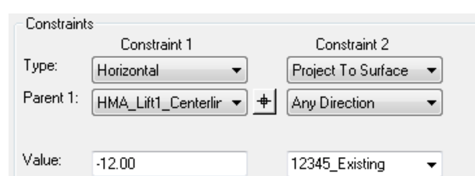


An example can be found in many of the CDOT templates including ***HMA_Crowned_B10***. Here the ***RT_HMA_Lift1_Laneline-Top*** point is locked onto the vector defined by ***HMA_Lift1_Centerline-Top*** to ***RT_HMA_Lift1_EOP-Top, with a 0.00 Offset***.

Note: The Parent points defining the vector do not have to be on either side of the constrained point, nor do they have to be in the same component. They are simply used to define a vector and can be anywhere in the template. This is most often used when the Parents form a vector that is variable during modeling, such as in superelevation, and you want the constrained point to follow the variable vector.

- ***Project to Surface***: No Parent *point* is required, but a parent direction and a surface value must be specified. The point projects in the direction selected until it intercepts the surface listed.

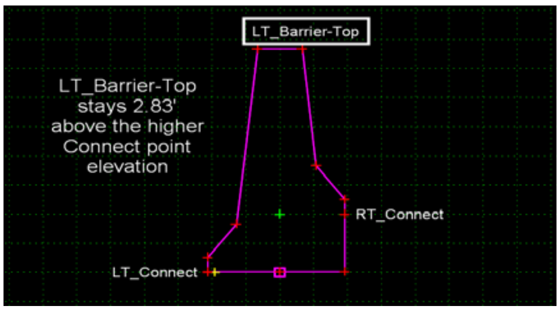


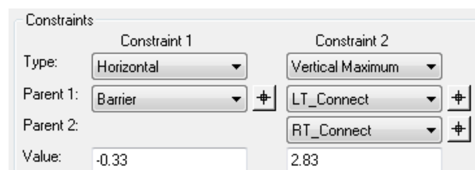


An example can be found in several of the CDOT templates.

Important! If two adjacent points in the same component project to the same surface, the component will 'trace' the surface in between the points.

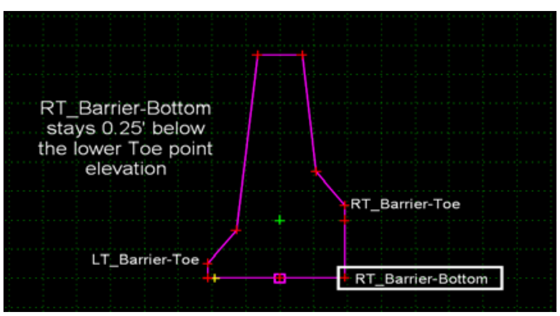
- ***Project to Design***: No Parent is required. The point is projected at the slope or vector defined by the second constraint and stops when it encounters the design model. This is most often used when a subgrade must tie to a variable sideslope. The Value listed determines the maximum distance the projection can go and a positive value forces the projection to the right, negative to the left. A zero Value allows an unlimited distance to either the right or left, whichever interception is closer.
- ***Horizontal Maximum***: Requires 2 Parents. The point is locked to a horizontal distance from whichever parent is further to the right, with the distance specified by the ***Value***.
- ***Horizontal Minimum***: Requires 2 Parents. The point is locked to a horizontal distance from whichever parent is further to the left, with the distance specified by the ***Value***.
- ***Vertical Maximum***: Requires 2 Parents. The point is locked to a vertical distance from whichever parent is higher, with the distance specified by the ***Value***.

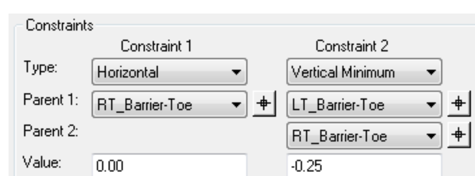




An example can be found in the CDOT template ***Guardrail_Type 7-CE***. This barrier is designed to be used as a median barrier in a divided highway. The barrier changes height based on the elevations of the different connect points, but must maintain a certain height above whichever connect point is higher. The constraints for the ***Barrier Top*** are shown. When this barrier is used between sets of lanes that follow different verticals, the top of the barrier will always remain a set height above the higher of the vertical alignments.

- ***Vertical Minimum***: Requires 2 Parents. The point is locked to a vertical distance from whichever parent is lower, the distance specified by the ***Value***.





An example can be found in the CDOT template ***Guardrail_Type 7-CE.*** This barrier is designed to be used as a median barrier in a divided highway. The barrier changes height based on the elevations of the different connect points, but the base must be below whichever connect point is lower. The constraints for the ***Barrier Toe*** are shown. (The parents are the ***Barrier Toe*** points which are derived from the ***Connect*** points.)

- ***Angle Distance***: Requires 2 Parents. The point is locked to an angle from the line defined by the two parents and a distance along the defined angle from Parent 1. This is used when you want to maintain a rigid shape, even when the base rotates. An example would be a rigid barrier sitting on pavement that rotates in superelevation.
- ***Style***: No Parent is required. The ***Style*** constraint overrides the other constraints as needed. When toggled on, a Style is specified. When the template is used in Roadway Designer, the active surface and geometry project are searched for an alignment or feature with the specified style. If found, the template point follows the feature or alignment. If the ***Horizontal*** toggle is on, this overrides the constraint controlling the horizontal placement of the point. If the ***Vertical*** toggle is on, this overrides the constraint controlling the vertical placement of the point. If the ***Both*** toggle is on, this overrides both of the listed point constraints and a variable slope and width is used to connect with the feature or alignment. A negative range value sets a horizontal limit and forces a search to the left, positive to the right. If the range is set to 0, the closest instance of the Style is found.

Labels

All of the constraints with the exception of ***Style*** and ***Project to Design*** can have a ***Label***. A ***Label*** is a variable that can be assigned start and stop values (by station range) in Roadway Designer using ***Parametric Constraints***. If a ***Parametric Constraint*** is assigned for the label, the value in the template is ignored. If no ***Parametric Constraint*** is assigned for the label, the value listed for the constraint in the template is used.

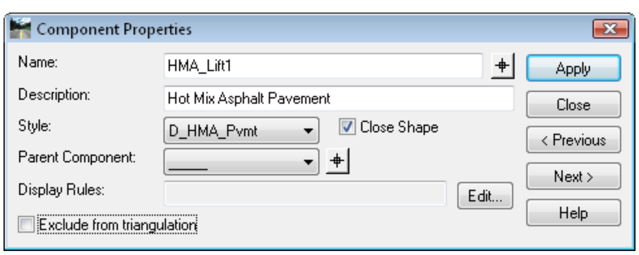
For example, you can assign the same label to each of the lower points in a lift, then with one entry in the ***Parametric Constraints*** dialog, you can change the lift depth for the entire alignment or any station range, even across multiple templates as long as the same labels are used in the different templates.

Labels must be keyed in for the first use in a template, then are available in the drop-down in for future use in that template.

See the ***Parametric Constraints*** section of the *Roadway Modeling* chapter for details.

Creating Components

A component is a series of points that forms either an open or closed shape used in defining a typical section or template. Components typically represent different types of roadbed materials or sideslopes (asphalt lifts, aggregate base, subgrade, cut, fill, etc.). Components are named and assigned styles (materials).



The ***Style*** assigned to the component controls its display in ***Create Template***, ***Roadway Designer*** and ***Cross Sections***. In addition, the ***Style*** associated with the component assigns the category of the volume if the component is used in end-area volumes.

There are six different methods of adding new components: ***Simple***, ***Constrained***, ***Unconstrained***, ***Null Point***, ***End Condition*** and ***Overlay/Stripping***.

The first three of these methods create standard components. With each, the first point placed is unconstrained unless it is snapped onto an existing point that already has constraints. The method used to create a general component does not stay with the component once it is created. The points created with either of these methods can be edited or deleted and new points can be inserted.

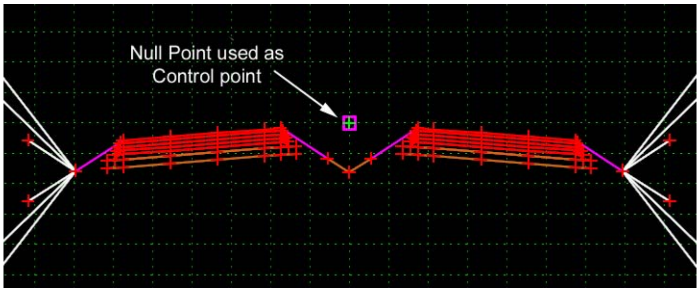
- A component created with the ***Simple*** command initially consists of four points that form a parallelogram. The shape is defined by slope, width and thickness (default values: 2%, 12 ft and 0.4 ft, respectively). The ***Simple*** method can be used to create a pavement lift, for example. The upper-right point is constrained to the placement point by slope and horizontal constraints, while the two lower points are constrained to the points above them by horizontal and vertical constraints.

With the following options, you can either sketch in the points that you want, then edit or add constraints to determine the precise locations of each point, or you can use the key-ins available through the ***Dynamic Settings***. See the previous section on *Dynamic Settings* for key in details.

- A component created with the ***Constrained*** command is initially made up of points where each is constrained to the previous one with horizontal and vertical constraints, so that if the initial point is moved, all of the other points move as well.
- A component created with the ***Unconstrained*** command consists of points with no constraints (the points can move independent of each other).

There are three specialized components:

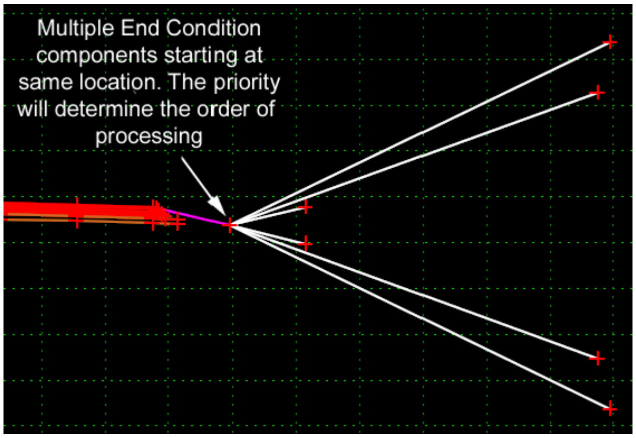
- A ***Null Point*** is a component made up of one point that is initially unconstrained. ***Null Points*** can be Parents for points in other components, in effect being used for reference. For example, a ***Null Point*** can be assigned to follow a right-of-way limit (alignment or feature) using ***Point Controls*** in ***Roadway Designer***, then used as the horizontal constraint for a sideslope preventing it from exceeding the limit.



Another example is when the control point on a divided highway is the imaginary point where the two pavement sections would intercept in the middle, such as the ***Control*** point in the ***HMA_Divided_TypeA_4Lane*** CDOT template. In this case, the template is based off the ***Control*** point, but the point is not part of any of the components.

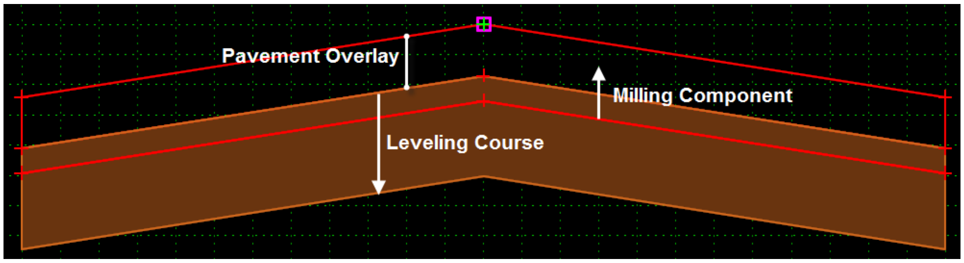
Note: ***Null Points***, by definition, are *not* triangulated. They may, however, be added to the design surface as non-triangulated features when using the ***Create Surface*** command. See the *Roadway Modeling* Chapter for additional details.

- ***End conditions*** are components that can seek targets like surfaces, alignments or features, and typically form the sideslopes of the design.



Multiple end conditions may be used together to form a complete sideslope and multiple sideslopes or alternates may begin at the same location on the template. When this occurs, the end conditions are assigned a priority determining the order in which they are processed with the first one able to form a complete sideslope being the one that is used at that location while any other sideslopes are discarded. *CDOT End Conditions* are discussed in the following section.

- Overlay/Stripping components can be built to either add leveling courses below pavement overlays or as stripping components to mill existing pavement.



Typical CDOT Surfacing Component

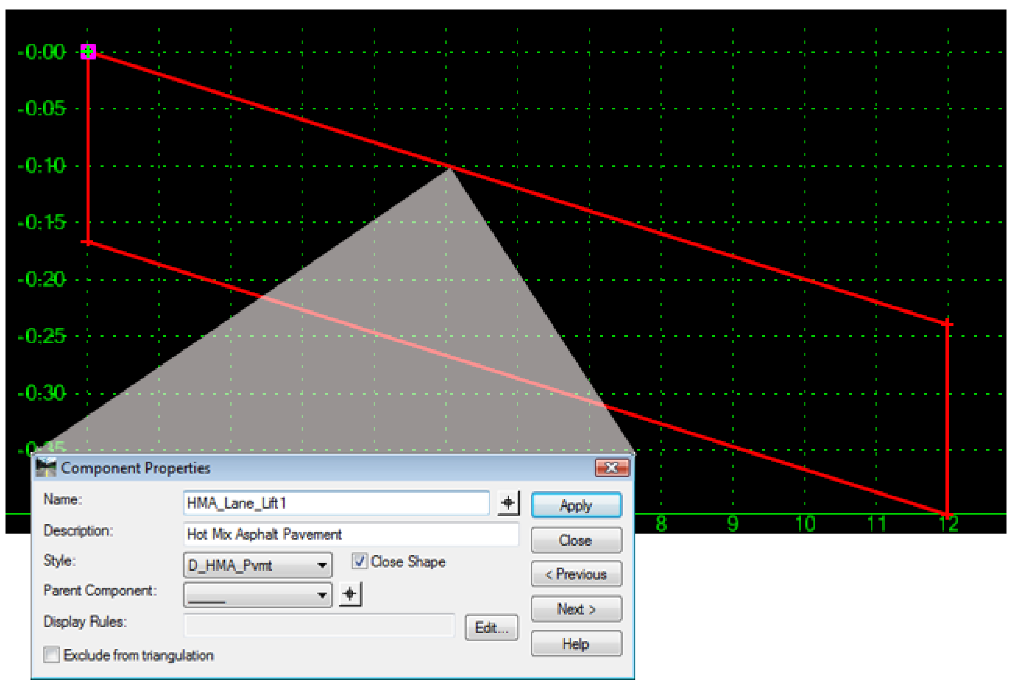
The average surfacing component is a closed shape of four points. It defines a single layer of a specific material (in this example it's hot mix asphalt). Both the points and the shape itself have a list of attributes called properties.

Component Properties

The following steps illustrate how to change component attributes. To edit the component properties:

1. **<R>** on a line of the shape and choose **Edit Component** from the menu (you can also **<D><D>** on the line to display the ***Component Properties*** dialog).
2. Key in the desired ***Name***.
3. Key in the desired ***Description***.
4. Select the desired ***Style*** from the drop down menu.
5. **<D> Apply** to accept the changes.

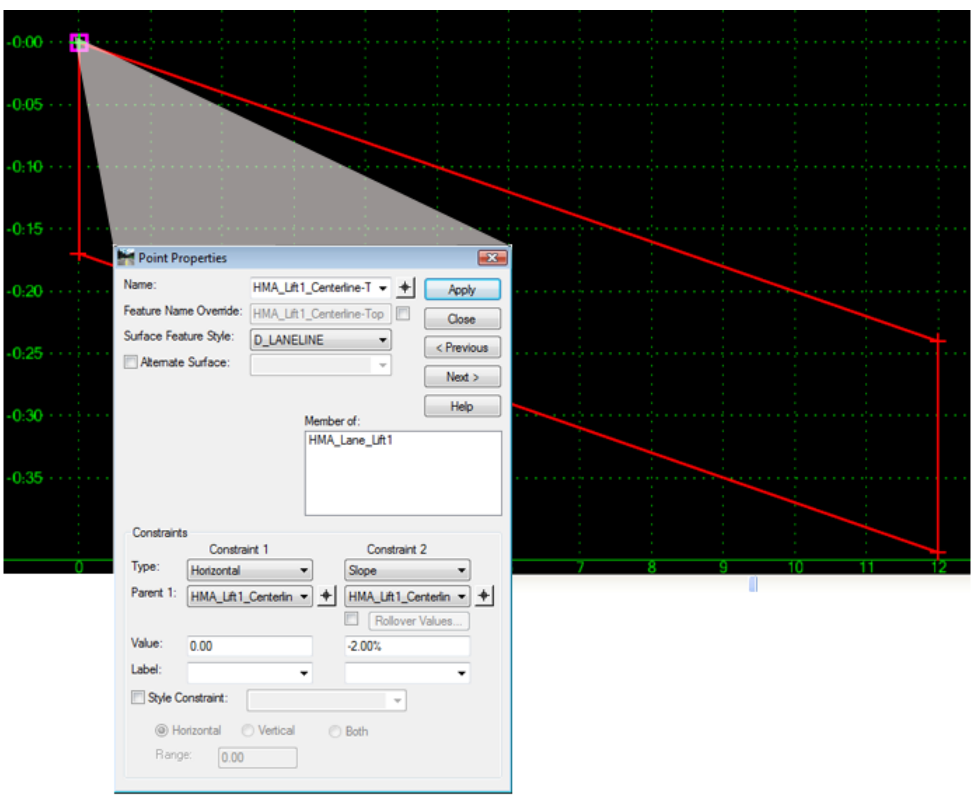
Note: Components use generic styles for the material they represent. Access styles for specific grades of material (based on the ***Pay Item Code Book***) through the ***Component Properties*** dialog.



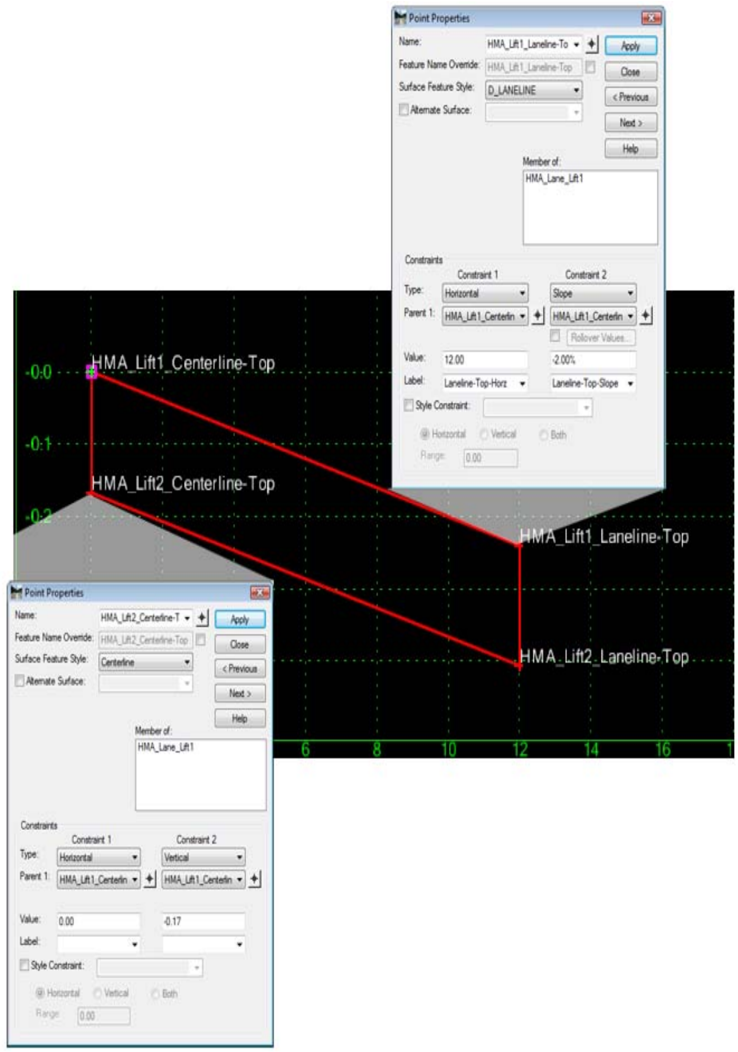
Point Properties

The following steps illustrate how to change point attributes.

1. **<R>** on the point and choose **Edit Point** from the menu to access the ***Point Properties***. (You can also **<D><D>** on the Point to display the ***Point Properties*** dialog.)
2. Key in the desired ***Name***. The name can also be selected from the drop down menu. Selecting a name from the menu also changes the ***Surface Feature Style***. Names selected from the menu can then be edited if necessary.
3. Select the desired ***Surface Feature Style***.
4. Select a ***Type*** for ***Constraint 1***. See the previous section on constraints for additional information on the options available.
5. Select a ***Parent 1*** using the drop down menu or the target button. Select the ***Parent 2*** if required by the constraint type.
6. Key in a ***Value***.
7. Key in a ***Label*** if desired. See the previous section on ***Labels*** for more information.
8. **<D>** ***Apply*** to accept the change.
9. **<D> Close** to dismiss the ***Point Properties*** dialog.



Point properties for the example surfacing component:



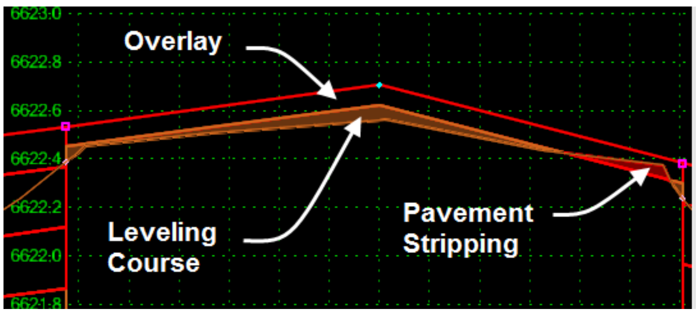
- The point ***HMA_Lift1_Laneline-Top*** has two constraints (which makes it fully constrained).
  - Constraint 1 is a ***Horizontal*** constraint measured from the point ***HMA_Lift1_Centerline-Top*** with a ***Value*** 0f ***12***. This sets the width of the component.
  - Constraint 2 is also measured from ***HMA_Lift1_Centerline-Top***. It is a ***Slope*** constraint that defines the cross-slope of the component, which is set to a ***Value*** of ***-2.00%***. Horizontal and slope constraints are typically used when defining the top point of a component.
- The point ***HMA_Lift2_Centerline-Top*** also has two constraints.
  - Constraint 1 is a ***Horizontal*** constraint with a ***Value*** of ***0***, which places the point directly under its Parent 1 (***HMA_Lift1_Centerline-Top***).

- ○ Constraint 2 has a ***Value*** of ***0.17*** (2") that defines the thickness of the component (measured from its Parent 1 point, ***HMA_Lift1_Centerline-Top***). The point ***HMA_Lift2_Laneline-Top*** has the same constraints as ***HMA_Lift2_Centerline-Top***, except the Parent 1 is ***HMA_Lift1_Laneline-Top*** for both constraints.

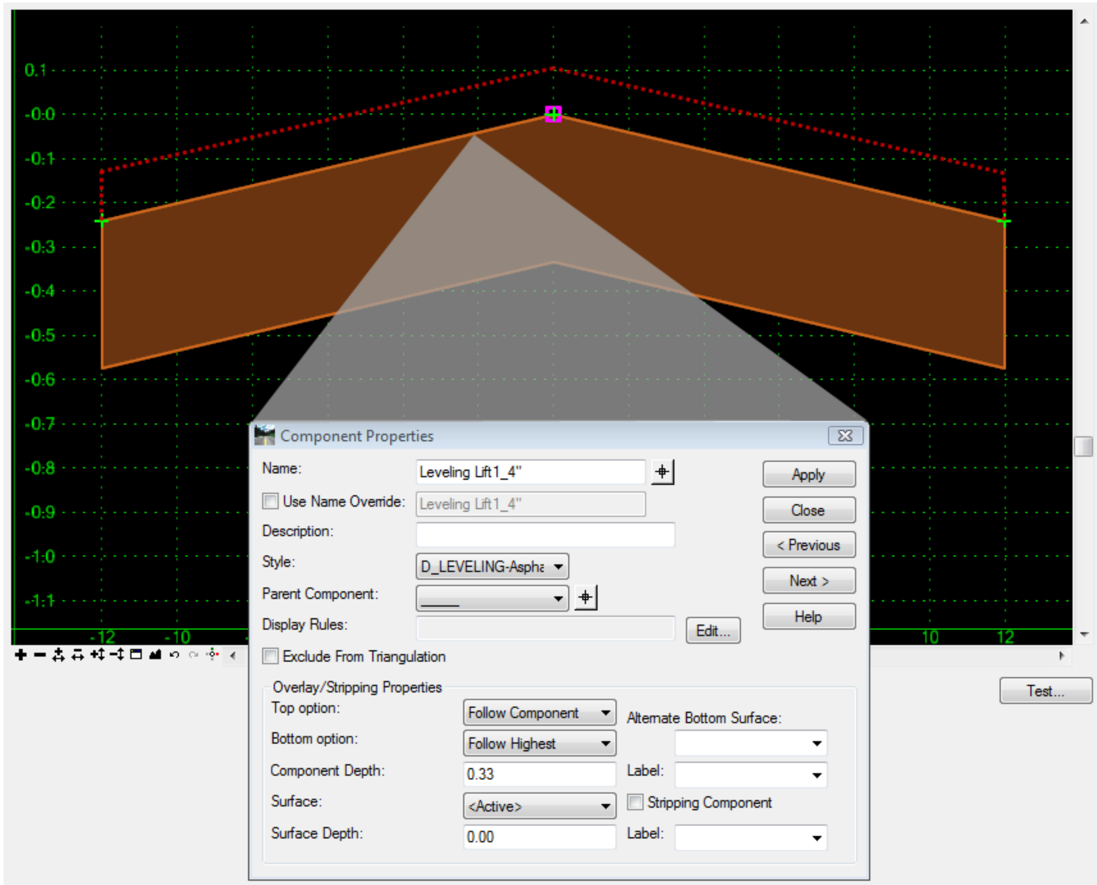
- ♦ This configuration of point constraints is the most efficient set-up for pavement components. It allows the user to change the width of the component by controlling a single point (***HMA_Lift1_Laneline-Top***) while maintaining a constant pavement thickness.

Complex Surfacing Component

On resurfacing projects its common that a leveling course is required below the pavement overlay lift. Additionally pavement stripping (milling) is also a common requirement.

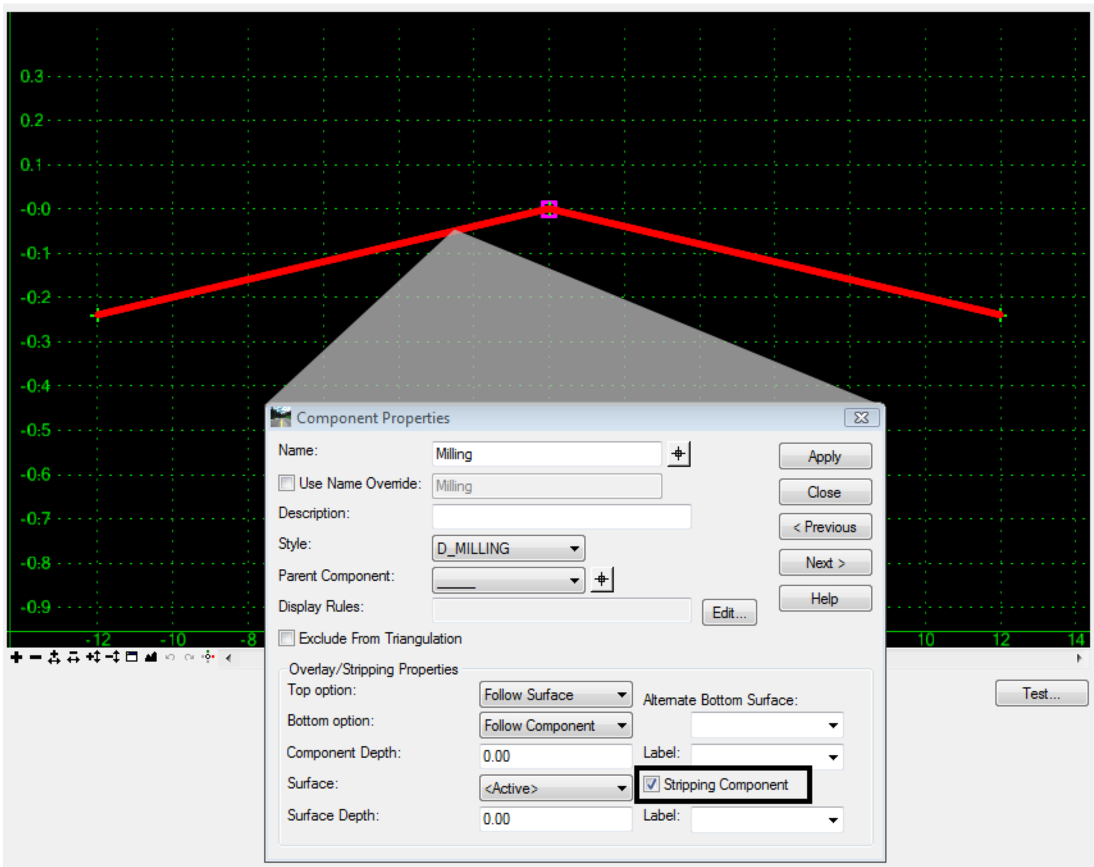


A leveling course or courses can be added to define the depth and composition (component style) of material to be placed.

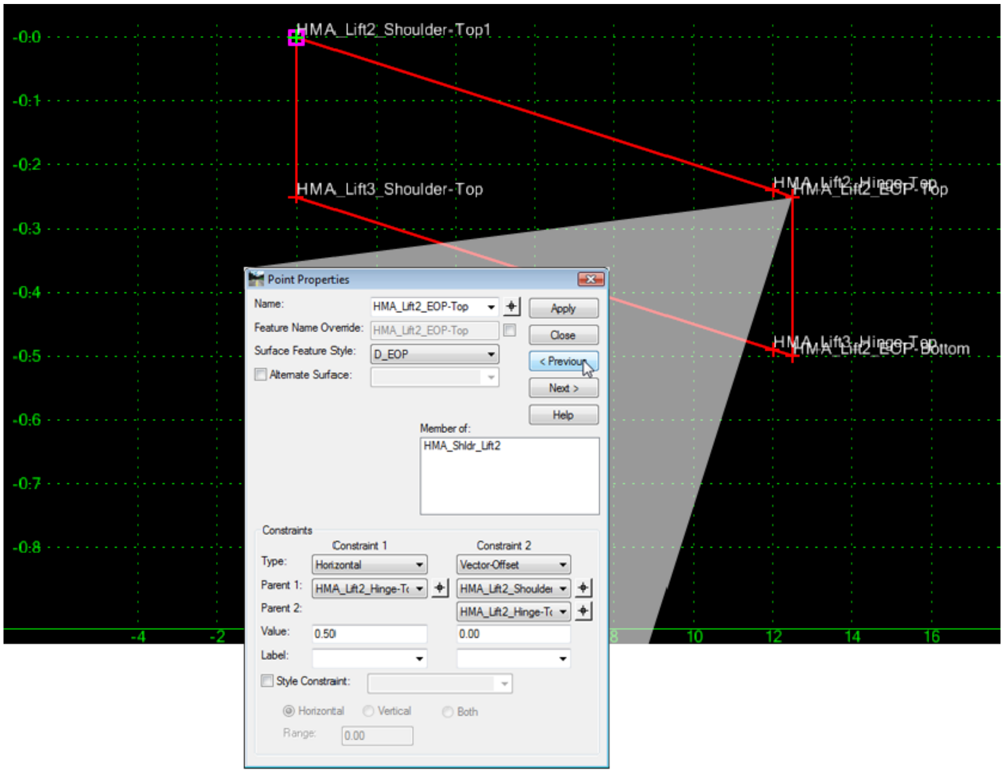


The above illustration contains a single leveling course designed to a maximum depth of 4 inches. Based on project needs this component can be configured to achieve either a maximum depth or achieve variable depths. Through various top/bottom options it allows the flexability to provide a multitude of solutions. The intent of the shown component is to have the top constrained to a overlay component allowing the leveling course to follow superelevation or other controls applied to the overlay course. The bottom option can specifiy a defined depth or be configured with a zero depth causing the bottom of the leveling course to follow existing conditions at any depth. As defined, the bottom of the leveling course will tie into the higher of existing conditions, or 4 inches below the bottom of the overlay.

A stripping component is unique that it is defined by it's bottom, constructs vertically and overlays other components in the template. This component also contains options for contraining it's vertical limit to meet project needs. The critical part of building a stripping component is to activeate the toggle that defines it as a stripping component (vs. a leveling component).



A variation of a typical surfacing component is ***HMA_Outside_Shldr-Lift2***. This component has two additional points that define the stair-step found at the edge of asphalt.

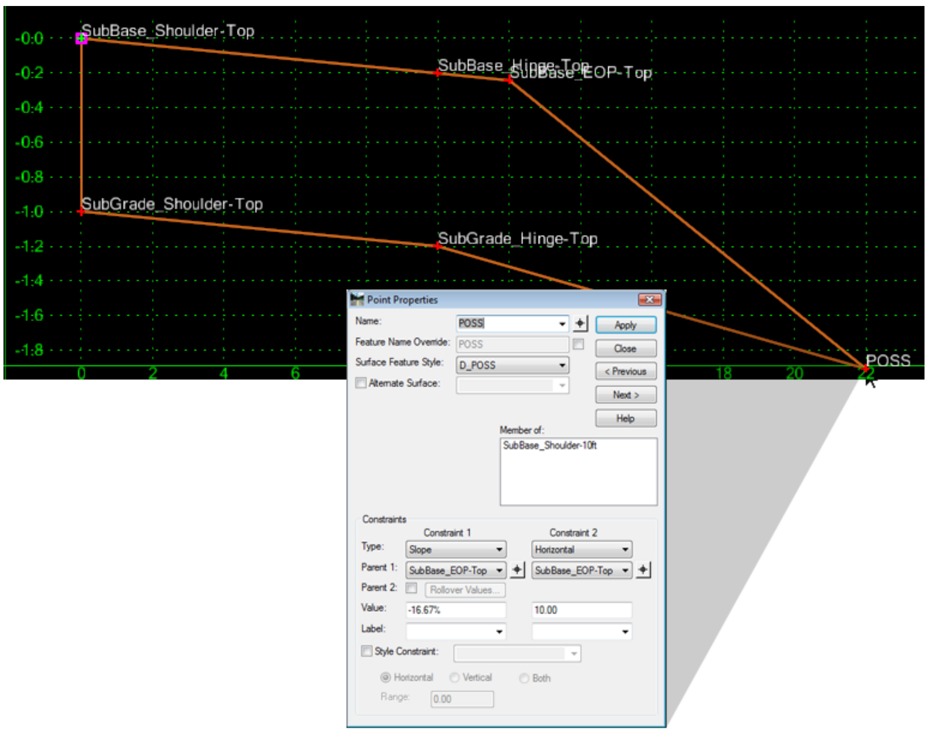


The three bottom points are defined in the same manner as a typical surfacing component for the point ***HMA_Lift2_Laneline-Top***. Also, ***HMA_Lift2_Hinge-Top*** is defined like ***HMA_Lift1_Laneline-Top*** above. However, the constraints on point ***HMA_Lift2_EOP-Top*** are different. Constraint 2 uses ***Vector-Offset***. This type of constraint projects a line through the two parent points (***HMA_Lift2_Shoulder-Top*** and ***HMA_Lift2_Hinge-Top***). The ***Value*** defines a perpendicular offset to that projected line (a positive value is to the right and a negative value is to the left). Because the value in this example is '0', the child point is placed on the projected line.

This constraint forces the segment between points ***HMA_Lift2_Hinge-Top*** and ***HMA_Lift2_EOP-Top*** to match the cross-slope of the segment to its left and maintain the continuity of the cross-slope, even through transitions for super elevation.

Subbase component

Subbase components have many of the same features used in surfacing components. The ***SubBase_Outside_Shoulder*** component has five points that define the subbase under the shoulder. They are set up like the corresponding points in ***Surfacing Example 2***. However, the ***POSS*** uses a ***Horizontal*** and a ***Slope*** constraint. This is done in order to maintain the slope from the ***Subbase_EOP-Top*** to the ***POSS***.

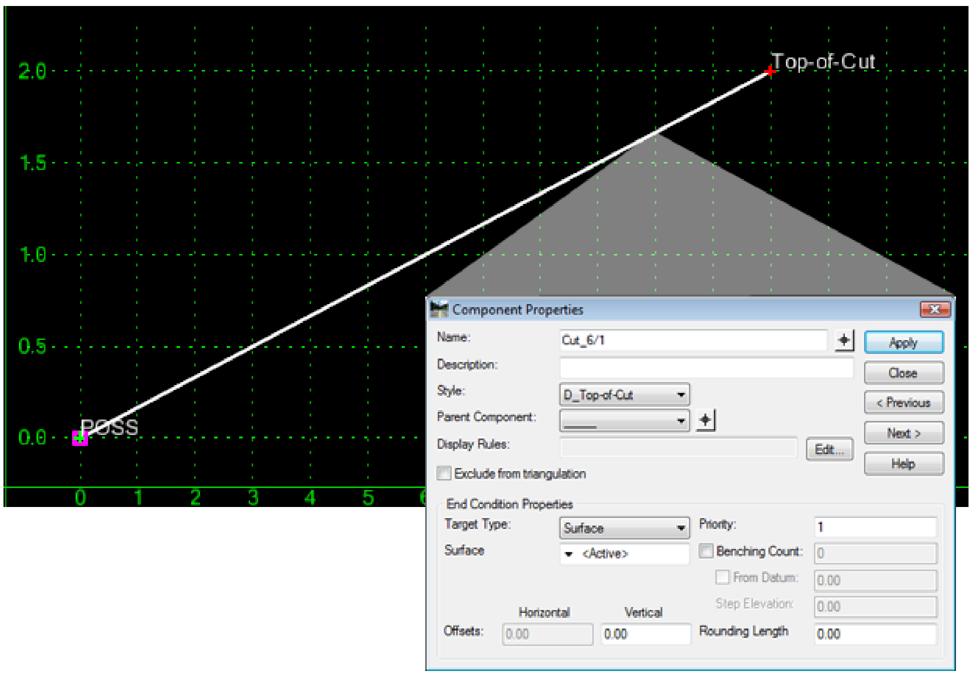


End Condition components

End condition components are used to form the sideslopes of the design. For example, they project from the design pavement to the existing ground. Therefore, they have some unique component and point properties.

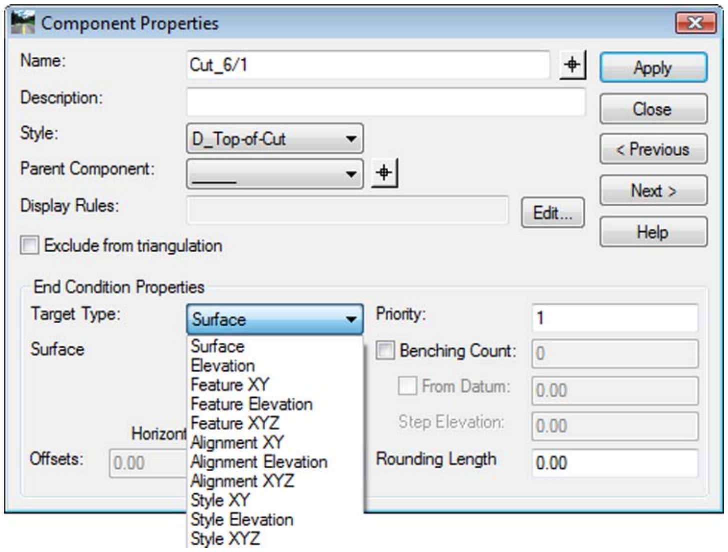
Component Properties

The component properties for End Conditions have an additional area for ***End Condition Properties***. These properties list the ***Target Type*** and ***Priority*** for processing end condition components.



Target Type

This property determines what the end condition will try to intercept. The ***Target Type*** affects the way the side slope is constructed. ***Feature XYZ***, ***Alignment XYZ***, and ***Style XYZ*** will override the slope constraint and use whatever slope is necessary to tie to the target location. All other ***Target Types*** observe the slope constraint to locate the point.



Additional drop down menus are displayed below the ***Target Type***. These are used to list the target of the type specified in the ***Target Type***.

The information required for each ***Target Type*** is:

- ***Surface*** – Set to ***Active*** (which will tie to whatever surface is active) or to a specific surface. Surface is the most common ***Target Type*** and used by most CDOT standard sideslopes.
- ***Elevation*** – Enter the target elevation in the ***Vertical Offset*** field. This can be useful for setting elevations of benches, for example.
- ***Feature XY***, ***Feature Elevation***, and ***Feature XYZ*** – Identify a surface (***Active*** can be used) and the ***Feature Name*** that you want to seek. For example, you may need to tie into an existing curb or an existing ditch feature.
- ***Alignment XY***, ***Alignment Elevation***, and ***Alignment XYZ*** – All must have a horizontal alignment specified. ***Alignment Elevation*** and ***Alignment XYZ*** also need the Vertical Alignment identified. For example, ***Alignment Elevation*** can be used to tie a special ditch into the elevation of a vertical alignment.
- ***Style XY***, ***Style Elevation***, and ***Style XYZ*** – Specify a ***Style***. These targets work just like the previous Feature and Alignment targets, except the sideslope looks for a ***Style*** used in the ***active surface*** or ***geometry project*** instead of a *specific* feature or alignment listed by name. For example, if you are wanting to tie into an existing curb, but the curb is made up of multiple features, you can tie into the style for the curb and the sideslope finds the first occurrence at each template drop.

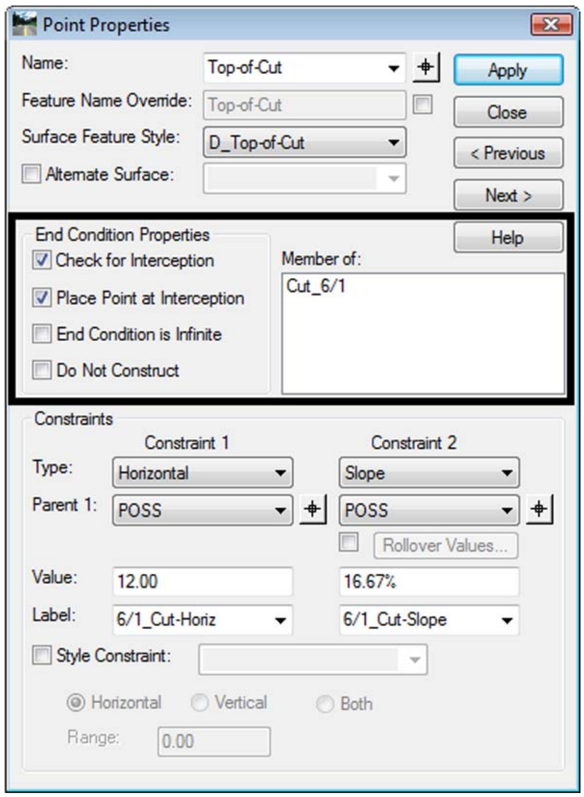
Note: The most often used Target Type is ***Surface***.

Priority

- This property determines the order in which end condition components are processed. The processing order is from the lowest numbered priority to the highest. The flattest slopes are set to the lowest numbered priority so that they are processed first. If you do not set the priorities ahead of time, they can be set when the end conditions are tested.

Point Properties

For points that are part of an end condition, four additional check boxes for ***End Condition Properties*** are added to the ***Point Properties***.



- ***Check for Interception*** - If on, the point checks for an interception of the target between the previous point and this one. In general, turn this option on for the last point in a cut or fill definition. An example of where it would be turned off is for the foreslope of a ditch that has a flat bottom.
- ***Place Point at Interception*** - When on, the point will be constructed where it contacts the target. When off, the point is constructed as defined by its constraints. Turn on this option in most cases when ***Check for Interception*** is on.
- ***End Condition is Infinite*** – When on, the point will extend past its defined width in order to contact its target. When off the point must reach its target within its defined width in order to be constructed. This option is used for the steepest cut and fill slope defined in the template. Since it is off for shallower sideslopes, they will not extend beyond their constrained horizontal distance.
- ***Do Not Construct*** – When on, the point will be solved for as normal, but will not be used when creating the component.

Display Rules and Parent Components

Display Rules and ***Parent Components*** are component properties that determine when a component is displayed. They are often useful for turning off and on different components based on what is happening in other areas of the template and therefore can be used to assist in changing the template based on certain CDOT design decisions.

Display Rules are conditional expressions defined by horizontal or vertical offsets between specified points, the slope between two points, or the display of another component. For example, when the distance between two inside edges in a divided template is > X, a median ditch component can be 'turned on'; when it is < X, a barrier can be 'turned on' and the median ditch 'turned off'.

A ***Parent Component*** controls the display of associated components. For example, a specific component is displayed *only* when its Parent component is displayed.

- Use ***Display Rules*** to change the basic shape or type of a component used under certain conditions, as in the *Curb & Gutter through superelevation* example below.
- Use ***Display Rules*** to have InRoads decide between a series of components, such as testing the height of wall needed and using different, but standard width bases based on that height, as in the *Wing Wall* example below.
- Use ***Parent*** components for a group of components that operate as a unit and are turned on or off together, as illustrated in the *Benching* example.

Curb & Gutter through superelevation

An example of a design decision being built into a template can be found in the CDOT typical section library in the curb and gutter sections. The Curb and Gutters are modeled with unique elements. The elements unique to the Curb and Gutter section are the two curb components attached; one component is modeled with a standard cross slope for the gutter pan and the other is modeled to match the cross slope of the pavement. If this is not desired, see the note at the end of the section on changing or eliminating this decision.

The assumed design decision is:

- When the cross slope is between +4% and - 4%, a -1" per foot slope is used for the gutter.
- When the cross slope is greater than +4% or less than - 4%, the slope of the gutter pan matches the cross slope of the driving lanes.

Conforming to the design standard or design decision in this case is accomplished using ***Display Rules***. Display Rules are a list of criteria that determine when a particular component is displayed. The ***Parent Component*** property is also used. Components that are associated with a Parent component are only displayed when the Parent Component is displayed. In this example the curb components are parents to the ABC components. This insures that the proper ABC components are displayed together with their respective curb components. This is necessary due to the different slope constraints of the two components described in the previous section.

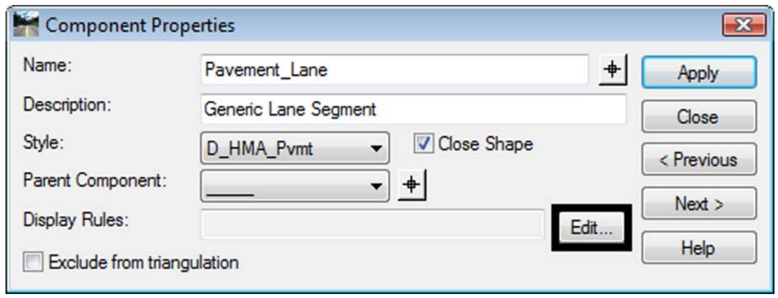
In this example, using the component ***C/G_Type2-IIB***, the slope of the gutter pan changes based on the cross slope of the driving lanes (typically needed through superelevated areas). This would be extremely difficult to modify the component using point controls. However this can be accomplished easily using ***Display Rules***.

To create a ***Display Rule***:

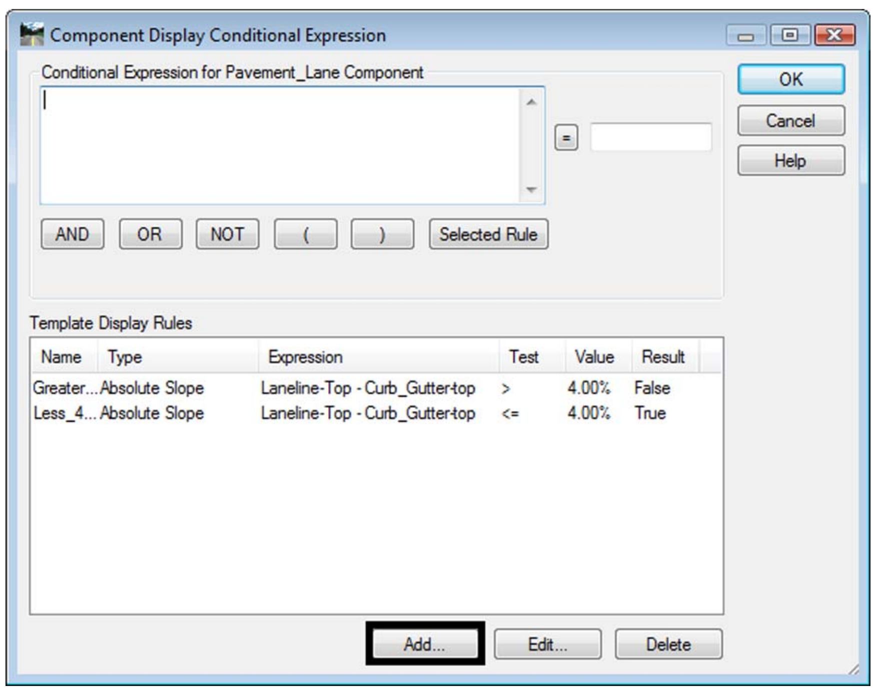
1. **<R>** on the component and select **Edit Component**.

   Note: ***Display Rules*** can be created while editing any component in the template, then assigned to other components as necessary.

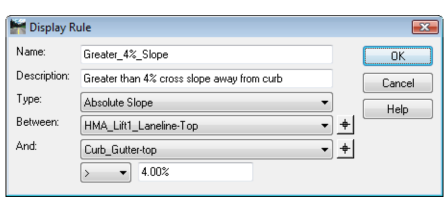
2. **<D>** the **Edit** button next to the ***Display Rules*** field. This displays the ***Component Display Conditional Expression*** dialog box.



3. To create a new rule, **<D> Add**. This will bring up the ***Display Rule*** dialog box.



Note: The ***Template Display Rules*** at the bottom of this dialog list all the rules available in the active template. The area at the top of the dialog show the rules assigned to the particular component being edited.



4. Key in a ***Name*** for the rule (spaces are removed from the name automatically).

   Note: The ***Display Rule*** name cannot be changed in this dialog once it has been created. To change the name, go to the active template tree, right-click on the Display Rule and choose ***Edit***.

5. Key in a ***Description***.

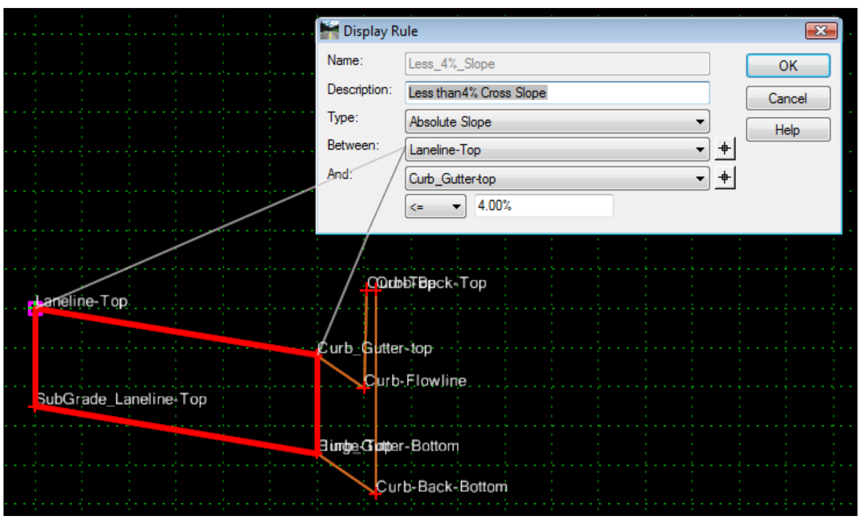
6. Select the ***Type*** from the drop down menu. Select the component or point names as required. For the ***Component Is Displayed*** type, a component name is selected. For all other types, first and second points are selected.

   Note: For a list of the different ***Types*** available and how they are used, see the ***Display Rule*** section of the *InRoads Online Help*.

7. Select the mathematical expression to be used.

8. Key in the ***Value*** that the expression is tested against.

9. **<D> OK**. This dismisses the ***Display Rule*** dialog box.

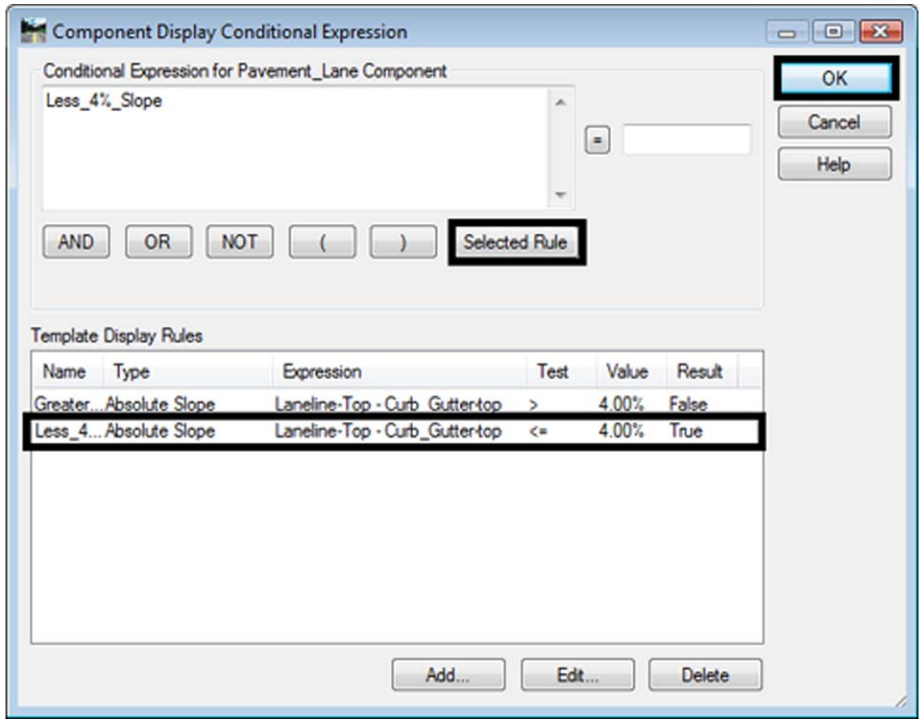


In the rule displayed above, if the slope between point ***Laneline-Top*** and point ***Curb-Gutter-top*** is less than or equal to +4.00% or -4.00% (because ***Absolute*** Slope is used) then the component will be displayed. This is determined at every template drop during processing.

10. Back on the ***Component Display Conditional Expression*** dialog box, highlight the desired rule from the ***Template Display Rules*** list.

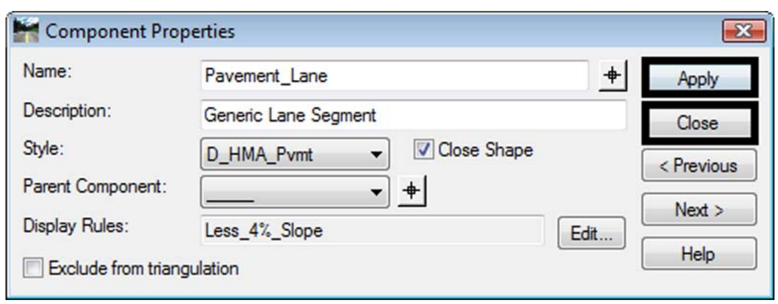
11. **<D>** the ***Selected Rule*** button. This adds the rule to the ***Conditional Expression***.

12. **<D> OK**.



13. In the ***Component Properties*** dialog box, **<D> Apply**.

14. **<D> Close** to complete the process.



This component will now be displayed while the pavement component has a cross slope between +4% and -4%.

Important! If the decision is made that the gutter must match the pavement cross slope at a different slope, edit each of these rules and change the value to a different slope. If you do not want the match the pavement slope in super, edit the section, toggle on Display All Components and delete the two dashed-line components. Then, Delete the two Display Rules or remove them from the two components.

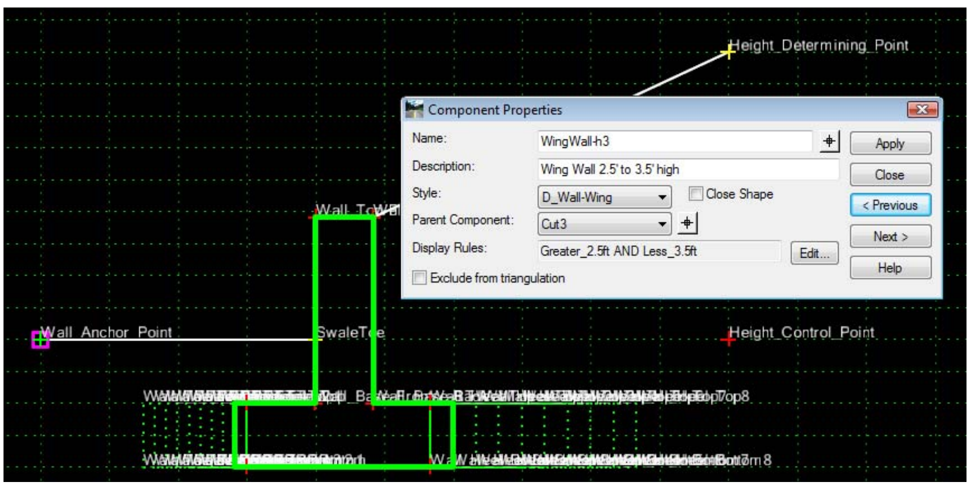
Wing walls

Multiple ***Display Rules*** can be used to further define when a component is to be displayed. In the component ***WingWall_Cast-in-Place-Fixed-Base***, a number of separate components have been used to define the base of the wall. The particular component used is determined by the height of the wall. As in the previous example, this involves an assumed design decision and can be changed as needed.

The component ***WingWall-h3*** uses two Display Rules.

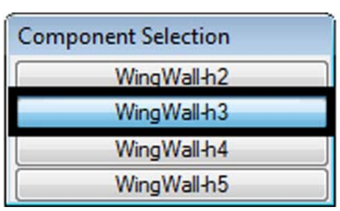
- ***Greater_2.5ft***, displays the component if the vertical difference between points ***Wall_Top-Front*** and ***Swale Toe*** is greater than 2.5 feet.
- ***Less_3.5ft***, displays the component if the difference between the points ***Wall_Top-Front*** and ***Swale Toe*** is less than or equal to 3.5 feet.

The ***And*** between the rules means that both rules must be true before the component can be displayed.



To add multiple display rules to a component:

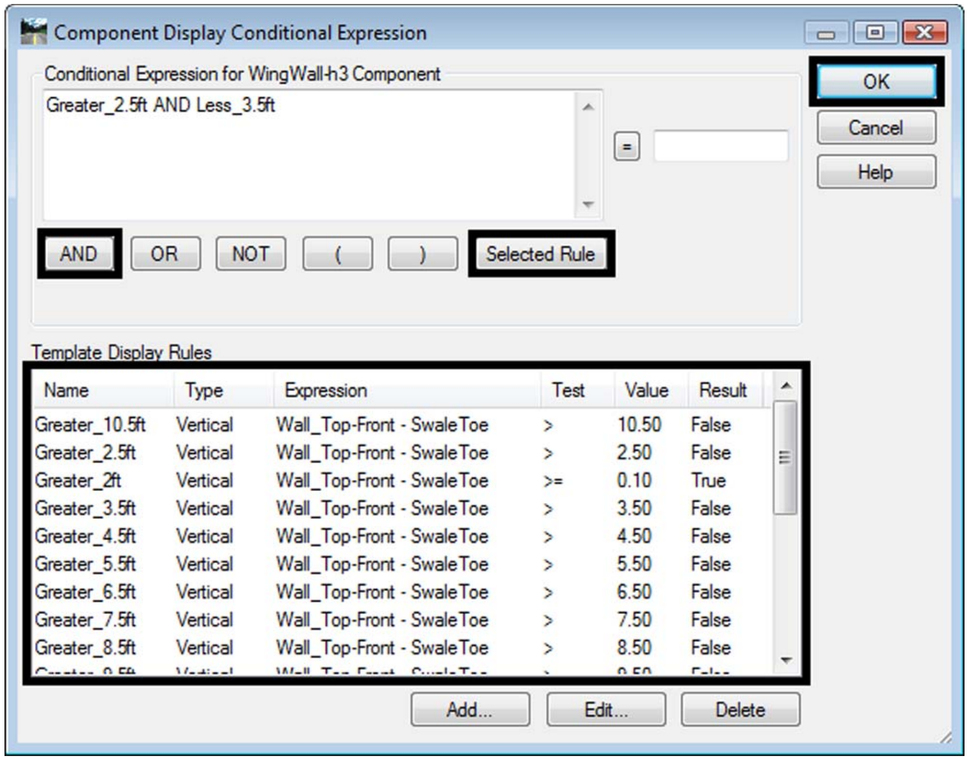
1. **<R>** on the component and select ***Edit Component***.
2. **<D>** the ***WingWall-h3*** component.



3. **<D>** the Edit button next to the ***Display Rules*** field. This displays the ***Component Display Conditional Expression*** dialog box.
4. Highlight the desired rule from the ***Template Display Rules*** (**Greater_2.5ft** in the example).
5. **<D>** the **Selected Rule** button.

6. **<D>** the desired ***Boolean Operator*** button (**AND** in the example).
7. Highlight the next display rule to be used (**Less_3.5ft** in the example).
8. **<D>** the **Selected Rule** button.
9. Repeat steps 5, 6, and 7 until all the desired rules are added.

10. <D> OK.



11. **<D> Apply** on the ***Component Properties*** to save the display rule.

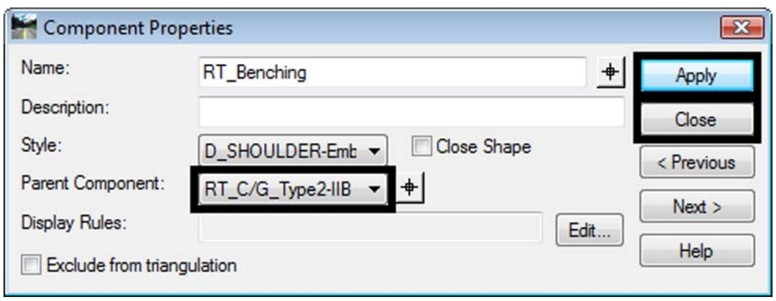
Note: Rules can also be grouped using the parentheses.

Benching

The display of one component can be tied to the display of another by setting a ***Parent Component***. Using the ***HMA_Urban_4Lane*** template as an example, the Benching components are children of the ***C/G_Type2-IIB*** components (and the cut and fill components are children of the benching components). This displays the sideslopes attached to the curb with the 1" per foot gutter slope only when that curb is displayed. The parent component must exist within the template.

To select a parent component:

1. **<R>** on the 'child' component and select **Edit Component**.
2. Select the ***Parent Component*** using the drop down menu or the target button.
3. **<D> Apply** on the ***Component Properties*** dialog box to save the change.
4. **<D> Close** to dismiss the ***Component Properties*** dialog box.



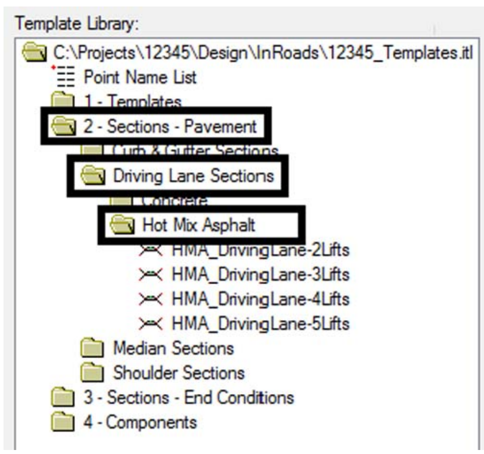
Sections

Components are used to build larger assemblies in the CDOT standard ITL called ***Sections*** (which are used in turn to build templates). A section is a combination of components that are copied from within the template library and pasted into the new section. Any time a group of components will be used more than once (in the same template or in other templates) it should be built as a section. Building sections makes it easier to assemble templates because multiple components are placed at one time.

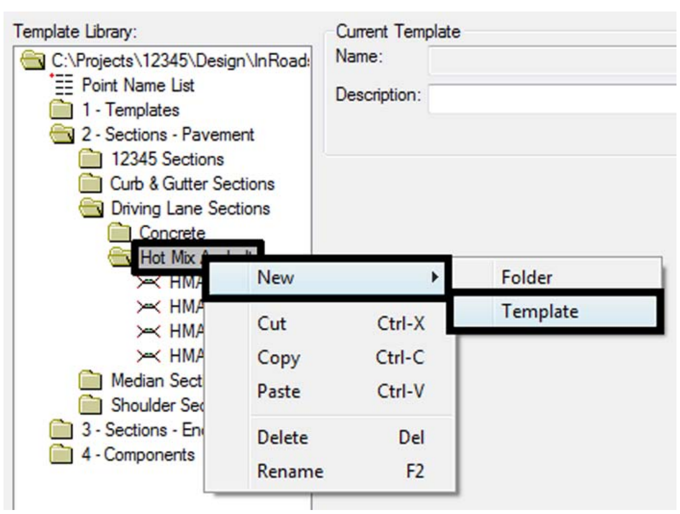
Using Components to Build a Section

This example illustrates the steps used to create an 11' driving lane section with three lifts of asphalt and an aggregate base.

1. Expand the template library folder structure to show **2 – Sections –Pavement > Driving Lane Sections > Hot Mix Asphalt.**

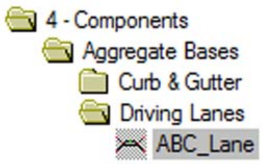


2. **<R>** on the **Hot Mix Asphalt** folder and select **New > Template** from the menu.



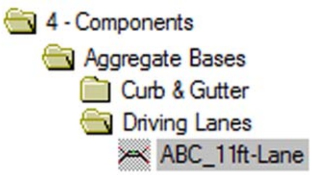
3. Key in the name for the new section (***HMA_11ft_DrivingLane-3Lifts*** in this example).

4. Expand the template library folder structure to show **4 – Components > Aggregate Bases > Driving Lanes.**



5. **<R>** on **ABC_Lane** and select **Rename**.

6. Key in the new name (***ABC_11ft-Lane*** for this example).



7. **<D> <D>** on the **ABC_11ft-Lane** component in the template library to make the ABC_11ft-Lane active.

8. **<D> <D>** on the **ABC_Laneline-Top** point to edit the Point Properties.

9. Change the ***Value*** of ***Constraint 1*** (the Horizontal constraint) to ***11***.

10. **<D> Apply**, then **<D> Close**.

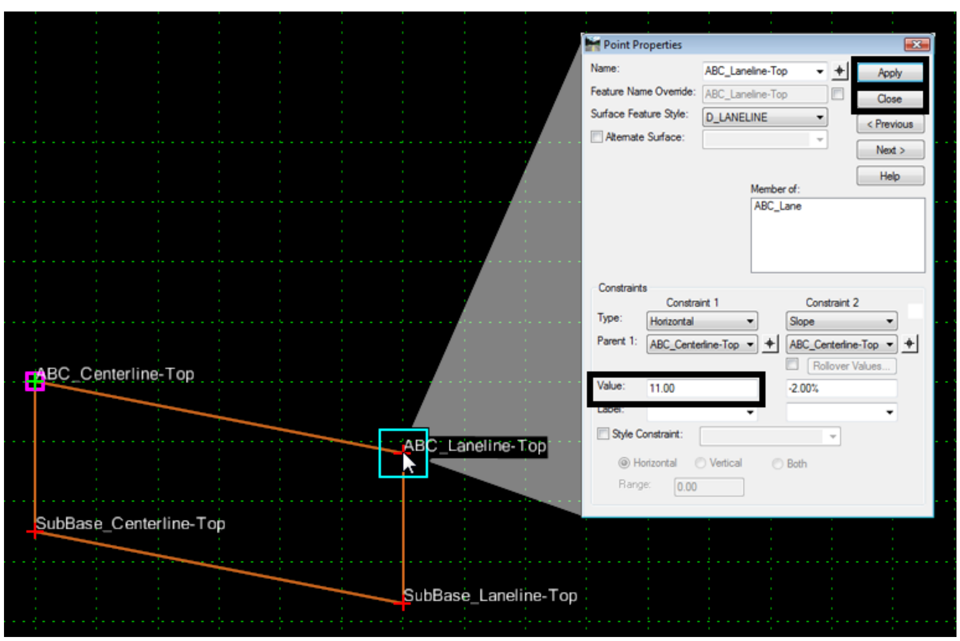


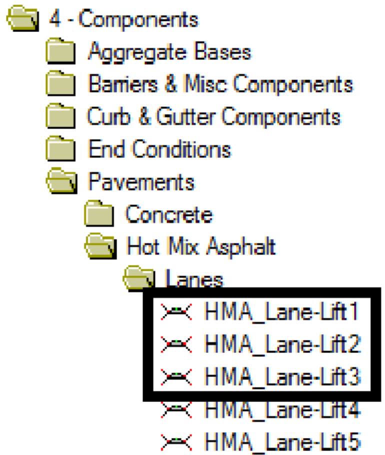
Figure 17: Set Horizontal Constraint

Note: To change the thickness of the component, edit the Vertical constraint on the two bottom points of the component.

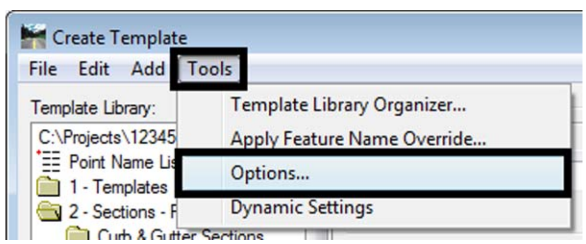
The aggregate base component is ready for use. Next, modify the asphalt lane components.

11. Expand the template library folder structure to show **4 – Components > Pavements > Hot Mix Asphalt > Lanes.**

12. Repeat steps 5 through 10 above for **HMA_Lane-Lift1**, **HMA_Lane-Lift2**, and **HMA_Lane-Lift3**. Rename the lanes and change the value of Constraint 1 to 11.



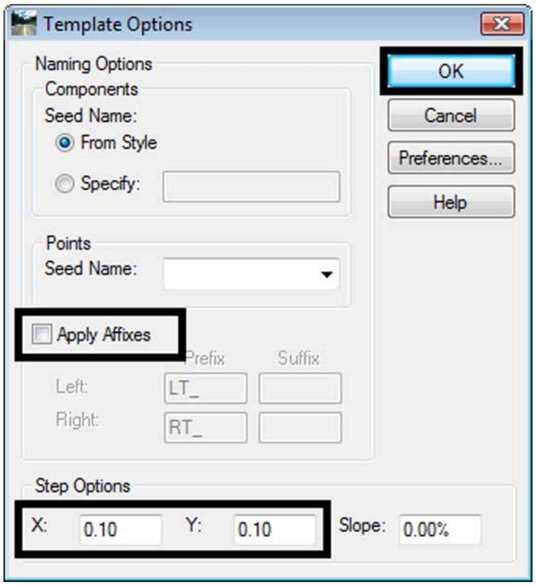
13. Select **Tools > Options** from the ***Create Template*** menu bar.



14. Turn off the ***Apply Affixes*** check box.

15. Set the Step Options to ***0.1*** for both ***X*** and ***Y***.

16. **<D> OK**.



17. Select **Tools > Dynamic Settings**.

    Steps 13 through 17 make it easier to place data into a new section. Turning off the affixes prevents getting LT_LT_ and RT_LT_, etc. appended to point names. The Step options create an invisible grid that helps when placing components. The Dynamic Settings is a dialog box where the step interval can be changed and precision key-ins can be used to place components.

    The next steps place the components into the new section.

18. **<D> <D>** on the new section (***HMA_11ft_DrivingLane-3Lifts***).

19. **<D>** on the **HMA_11ft- Lane-Lift1**. This will display the component in the ***Preview*** window.

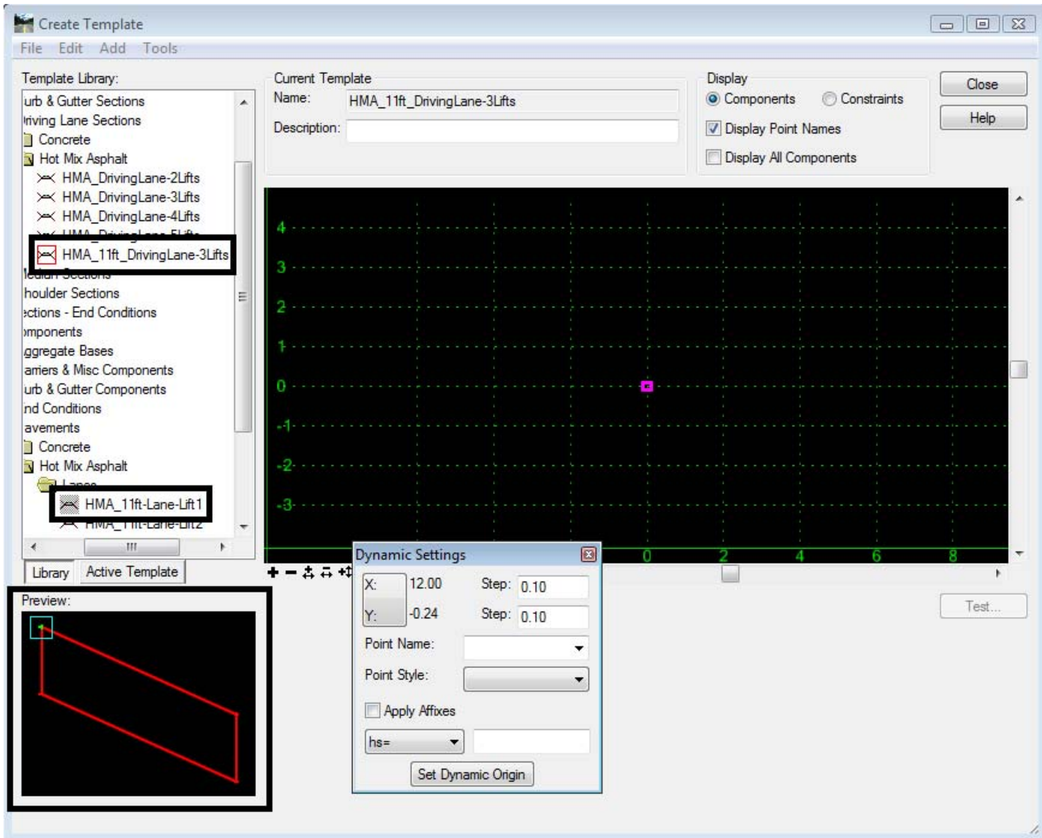
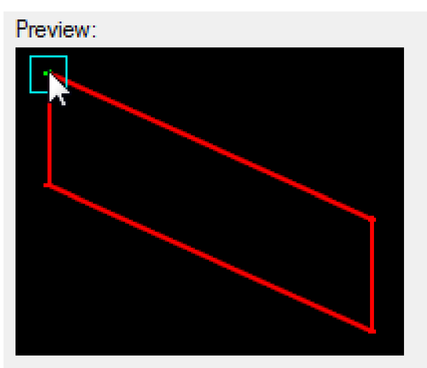


Figure 18: HMA_11ft-Lane-Lift1 Component

20. **<D>** and hold on the green"**+**" in the ***Preview*** window.



21. Move the pointer into the magenta square in the ***Template View Window***. The ***Dynamic Settings*** dialog box will show "***0.00***" for ***X*** and ***Y*** when the pointer is on the template origin.

    Important! This assumes the magenta square is located at the 0,0 coordinate in the template view. If it is not, you can use ***Set Dynamic Origin*** to move it there, or make certain you drop the template on the 0,0 coordinate. You can also right-click on the insertion point after it's dropped and choose ***Set Template Origin*** to move it to 0,0.

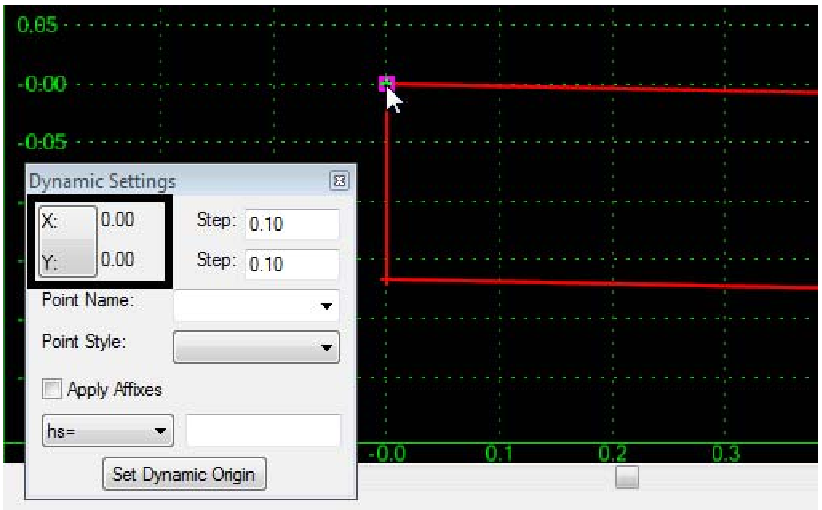


Figure 19: Place First Component

22. Release the left mouse button to place the component.

23. **<D>** on the **HMA_11ft- Lane-Lift2**. This will display the component in the ***Preview*** window

24. **<D>** and hold on the green"**+**" in the ***Preview*** window.

25. Move the pointer onto the ***HMA_Lift2_Centerline-Top*** point. The "**+**" turns white to indicate that the points are in the same location.

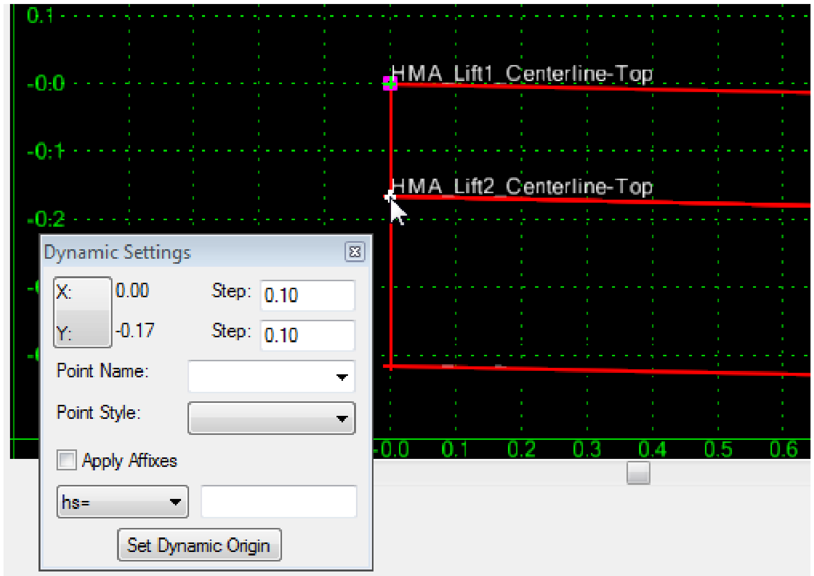


Figure 20: Place Second Component

26. Release the left mouse button to place the component.

27. Repeat steps 23 through 26 for ***HMA_11ft- Lane-Lift3*** and ***ABC_11ft-Lane***.

28. All of the components that make up the section are now placed. However, the point names used between lift 3 and the ABC need to be changed. When components are connected, shared points take the point name of the component placed first.

29. **<D> <D>** on the point **HMA_Lift4_Centerline-Top** to display the ***Point Properties*** dialog box.

30. Use the ***Name*** drop down menu to select **ABC_Centerline-Top**.

31. **<D> Apply**.

32. **<D> Close** to dismiss the ***Point Properties*** dialog box.

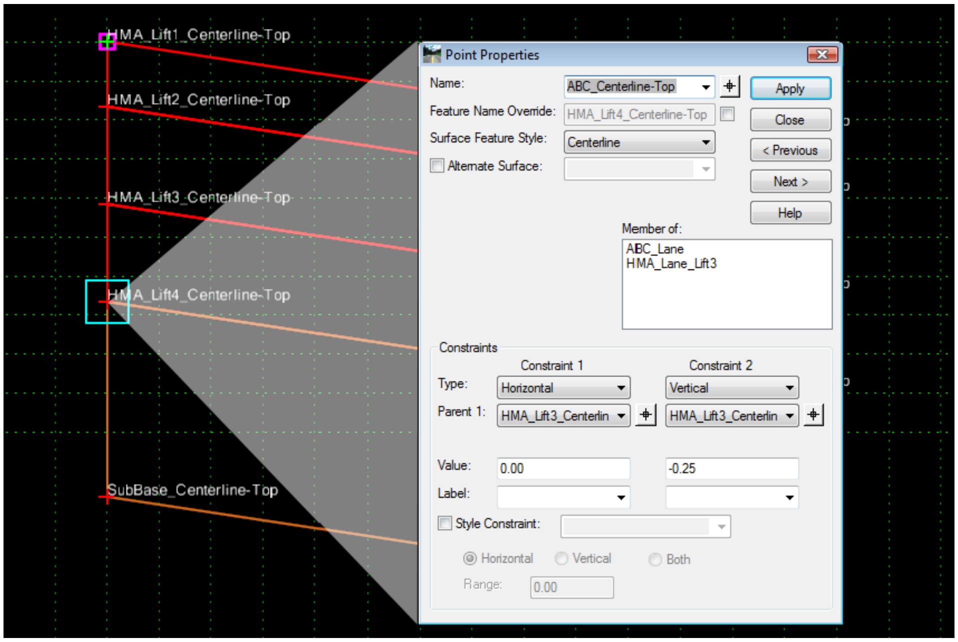


Figure 21: Change Point Properties

33. **<D> <D>** on **HMA_Lift4_Laneline-Top** to display the ***Point Properties*** dialog box.

34. Use the ***Name*** drop down menu to select **ABC_Laneline-Top**.

The section is now ready for use in a template.

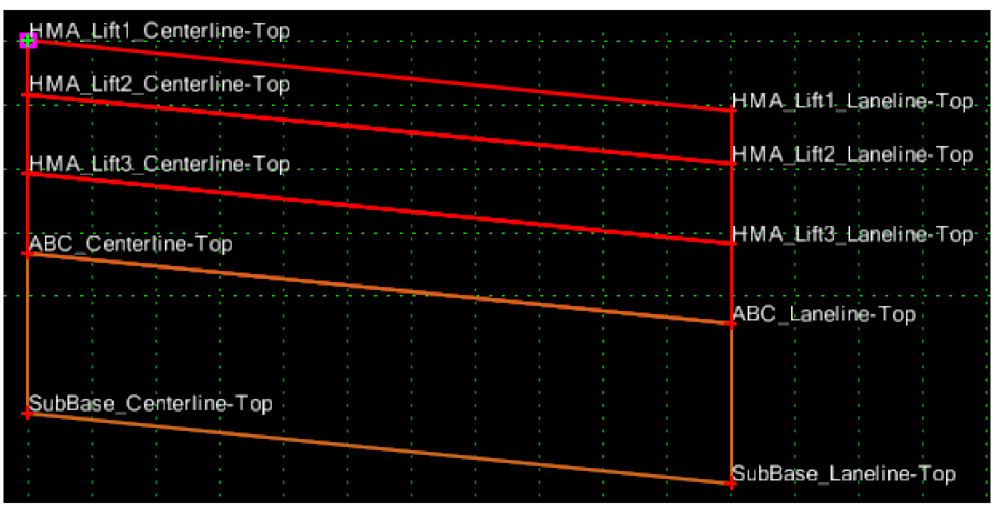


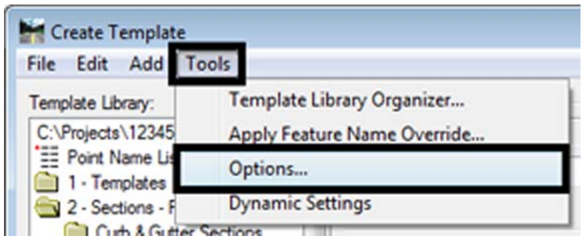
Figure 22: Final HMA_11ft_DrivingLane-3Lifts

Templates

Building a symmetrical template

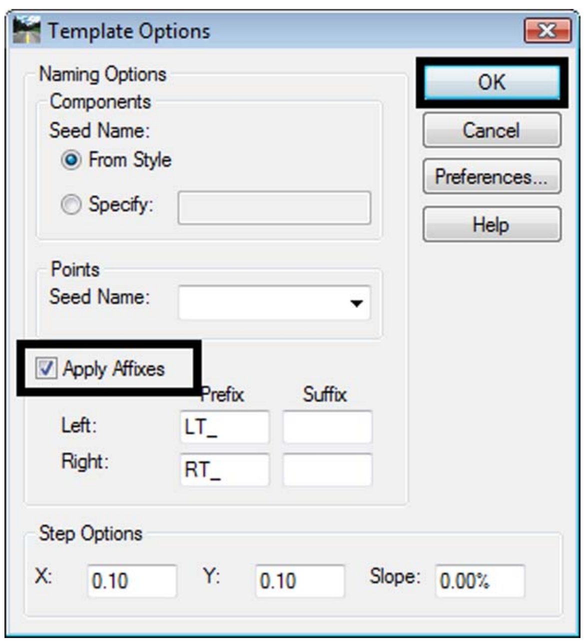
This example uses the lane section created above along with modified shoulder sections and end conditions to create a complete two lane template.

Select **Tools > Options** from the ***Create Template*** menu bar.



1. Turn on the ***Apply Affixes*** check box.

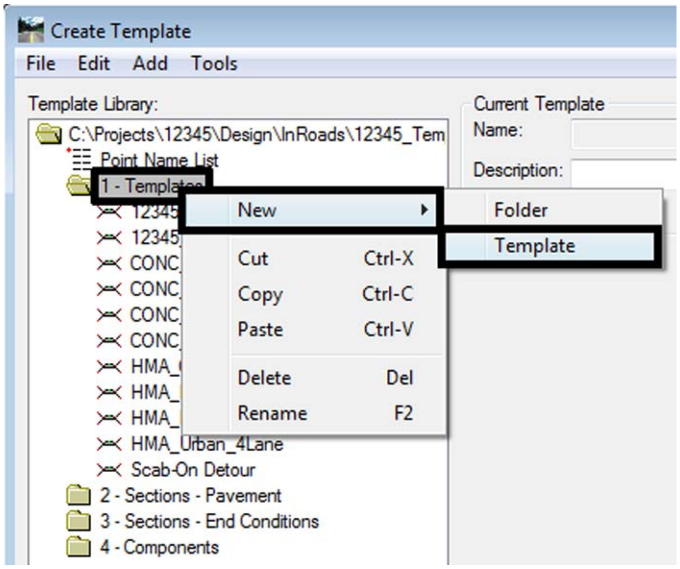
2. **<D> OK**.



When ***Sections*** and ***Components*** are placed, the point names are appended with ***LT_*** and ***RT_***. This will replace the default 1, 2, etc. that is affixed to duplicate point names.

3. Expand the template library folder structure to show **1 – Templates**.

4. **<R>** on the **1- Templates** and select **New > Template**.

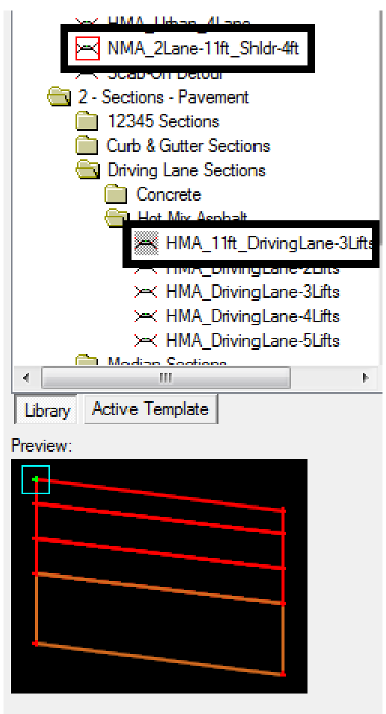


5. Key in a ***Name*** for the template (***HMA_2Lane-11ft_Shldr-4ft***).

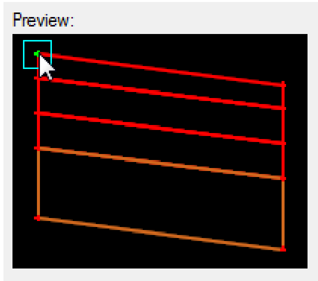
6. **<D> <D>** on **HMA_2Lane-11ft_Shldr-4ft**. This makes the new template active.

7. Expand the template library folder structure to show **2 – Sections - Pavements > Driving Lane Sections > Hot Mix Asphalt.**

8. **<D>** on the **HMA_11ft_DrivingLane-3Lifts** section so that it is displayed in the ***Preview*** window.

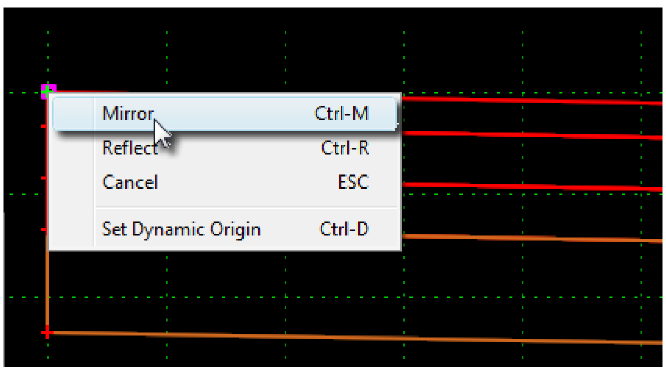


9. In the ***Preview*** window, **<D>** and hold the green “**+**”.

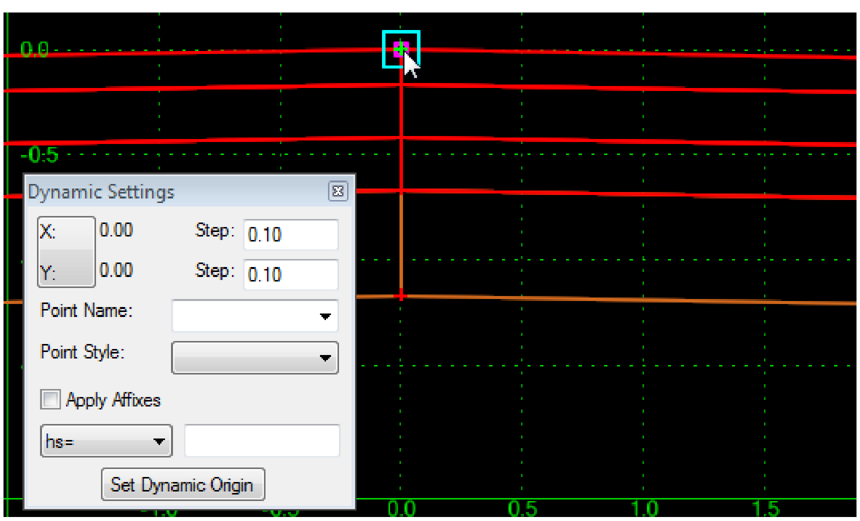


10. Move the pointer into the ***Template View*** window and **<R>** while still holding the left mouse button. This displays a right click menu. When the right click menu is displayed, the left mouse button can be released.

11. Select **Mirror** (using either the left or right mouse button).



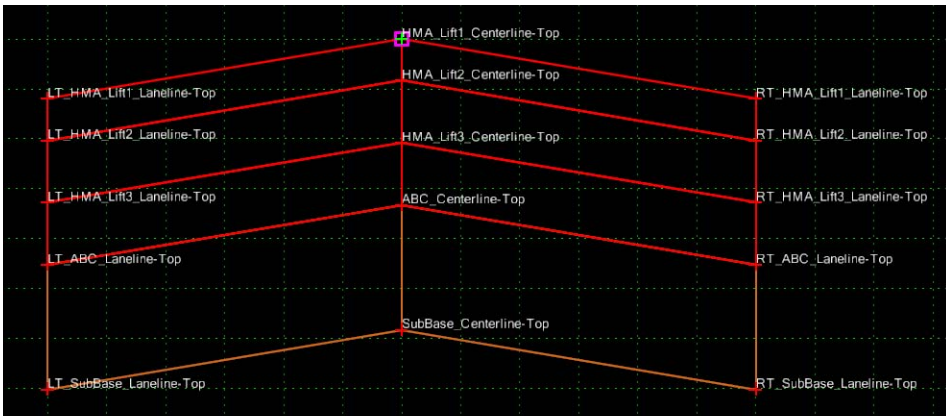
12. Move the pointer to the template origin (magenta square). The ***Dynamic Settings*** dialog box will show “***0.00***” for ***X*** and ***Y*** when the pointer is on the template origin.



Important! This assumes the magenta square is located at the 0,0 coordinate in the template view. If it is not, you can use ***Set Dynamic Origin*** to move it there, or make certain you drop the template on the 0,0 coordinate. You can also right-click on the insertion point after it's dropped and choose ***Set Template Origin*** to move it to 0,0.

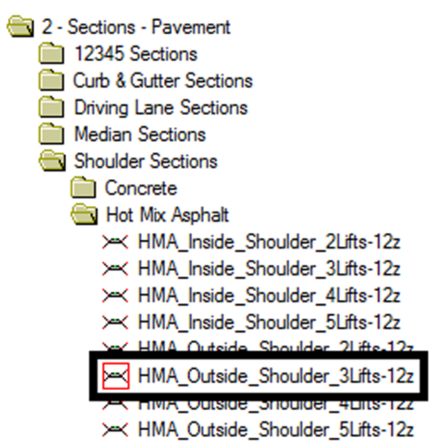
13. **<D>** to place the sections.

    By selecting ***Mirror*** from the right click menu, both the left and right driving lanes were placed at the same time. Turning on the ***Affixes*** labeled the left side points with the ***LT_*** prefix and the right side points with the ***RT_*** prefix.



14. Expand the template library folder structure to show **2 – Sections - Pavements > Shoulder Sections > Hot Mix Asphalt.**

15. **<D> <D>** on the **HMA_Outside_Shoulder_3Lifts-12z**. The section is displayed in the window.



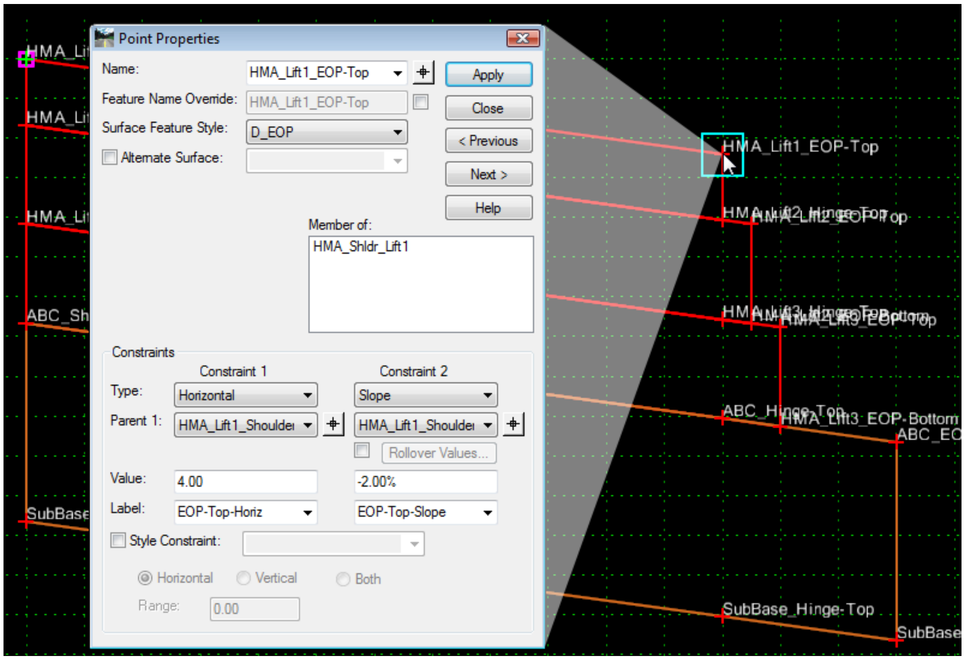
This section models a shoulder to match the pavement section as well as the proper edge of pavement configuration. However, the 12 foot width must be reduced to 4 feet.

16. **<D> <D>** on the point **HMA_Lift1_EOP-Top** to display the ***Point Properties*** dialog box.

17. Change the ***Value*** of ***Constraint 1*** (the Horizontal constraint) to ***4.00***.

18. **<D> Apply**.

19. **<D> Close**.



Notice that by changing a single point (***HMA_Lift1_EOP-Top***), all of the lifts in the section were modified.

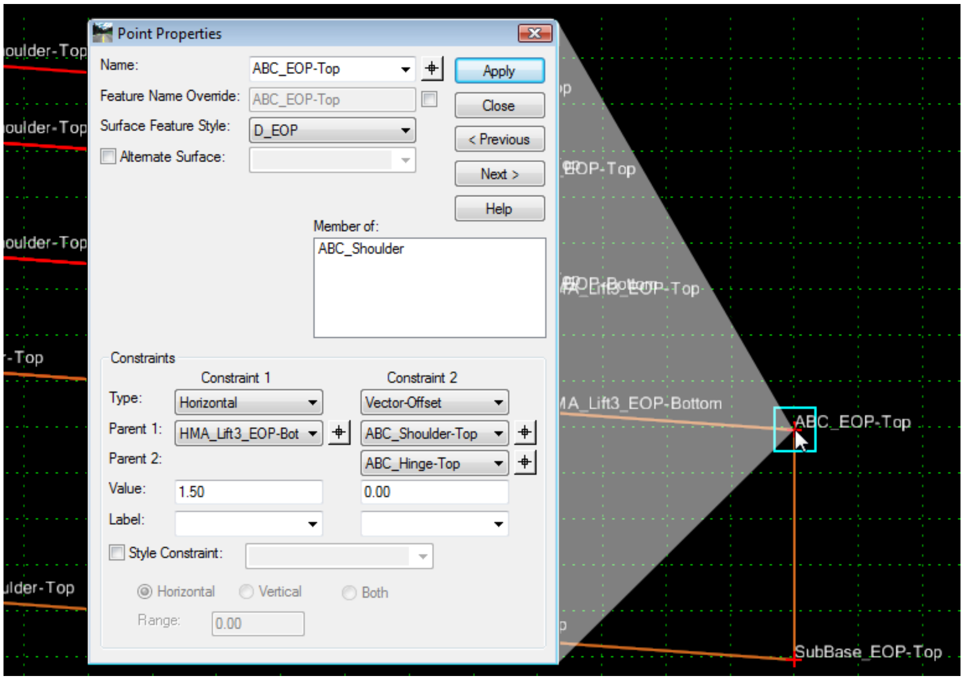
The width of the ABC lift must be modified, otherwise, it will protrude above the finished grade of the side slope.

20. **<D> <D>** on the point **ABC_EOP-Top** to display the ***Point Properties*** dialog box.

21. Change the ***Value*** of ***Constraint 1*** (the Horizontal constraint) to ***1.50***.

22. **<D> Apply**.

23. **<D> Close**.



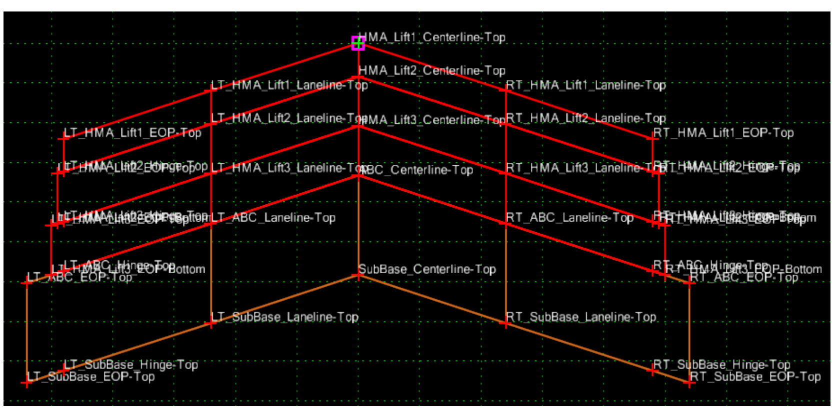
Next, add the shoulders to the driving lanes.

24. **<D> <D> HMA_2Lane-11ft_Shldr-4ft**.

25. **<D>** on the **HMA_Outside_Shoulder_3Lifts-12z**.

26. In the ***Preview*** window, **<D> and hold** on the green "**+**".

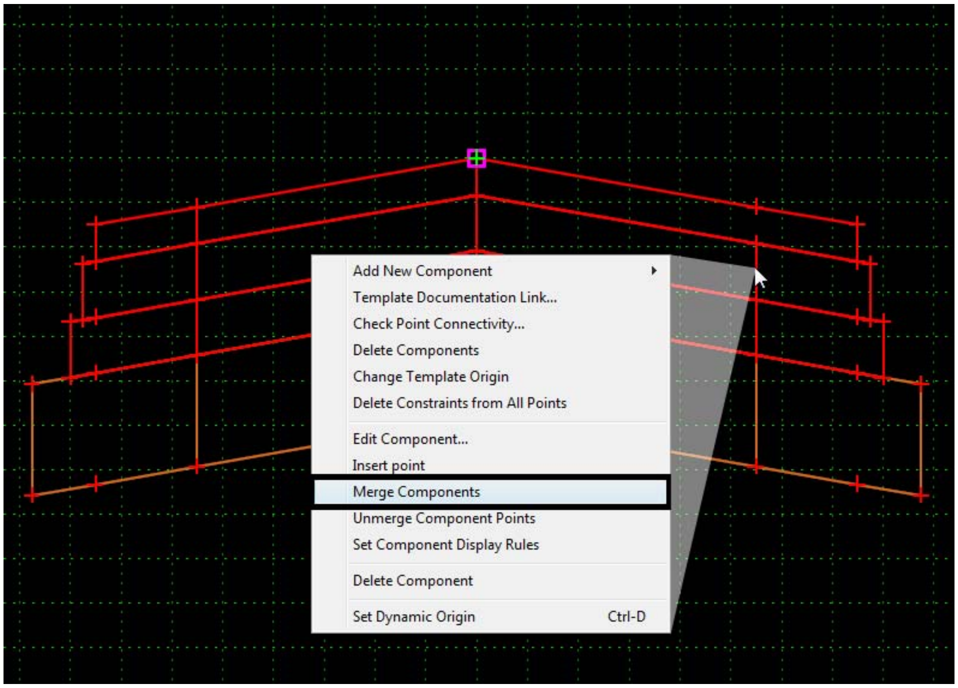
27. Move the pointer onto the point **RT_HMA_Lift1_Laneline-Top** so that the "**+**" turns white then release the left mouse button.



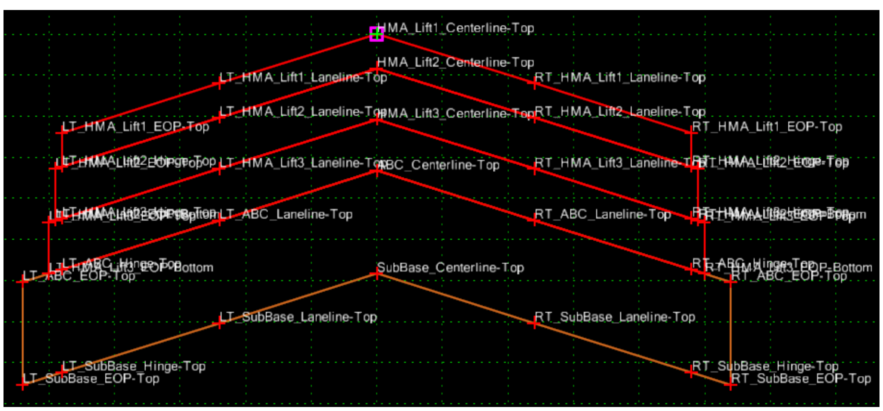
Note: Mirror is still on, so both shoulders are placed.

All of the components that make up the driving surface have been placed. Next, the vertical lines inside the template are removed. This will make each lift a single component.

28. Place the pointer on one of the vertical lines and **<R>** to display the right click menu.
29. Select **Merge Components**. This removes the vertical line from the template.



30. Repeat steps 25 and 26 for all of the vertical lines inside the template. The final result is illustrated below:

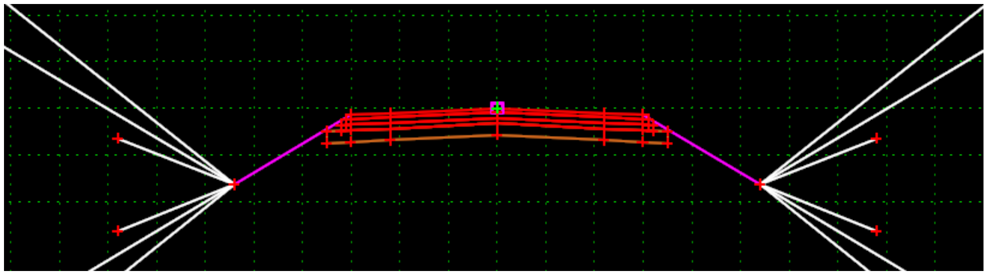


Finally, the end conditions are added to the template.

31. Expand the template library folder structure to show **3 – Sections – End Conditions > Z-Slope End Conditions > Low Speed End Conditions.**
32. **<D>** on the **Z12_4_to_1** section.
33. In the ***Preview*** window, **<D>** and hold on the green "**+**".

34. Move the pointer onto the point **RT_HMA_Lift1_EOP-Top** so that the "**+**" turns white then release the left mouse button.

    Both end conditions are placed and the template is complete.



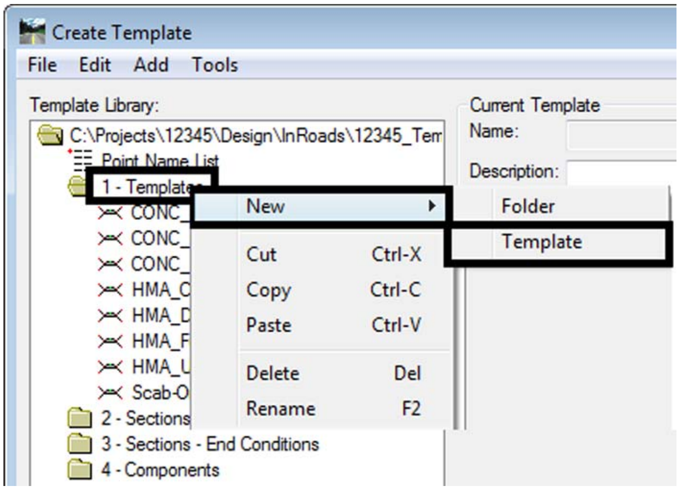
Note: The vertical lines that appear inside the template in the illustration above are actually the point symbols. The points themselves are not connected vertically since the components were merged.

Building an Asymmetrical Template

This example builds one half of a divided highway. It has two 12' driving lanes, a 4' shoulder on the right and a 10' shoulder on the left. The pavement is 12" concrete.

Start by creating an empty template.

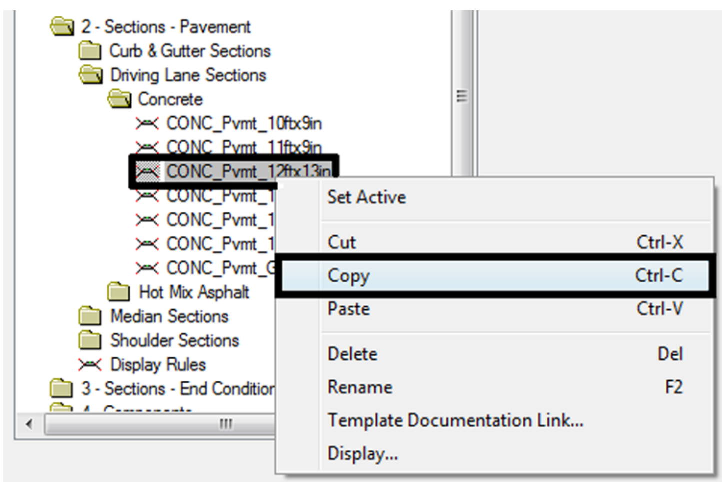
1. Expand the template library folder structure to show **1 – Templates.**
2. **<R>** on the **1- Templates** folder and select **New > Template**.



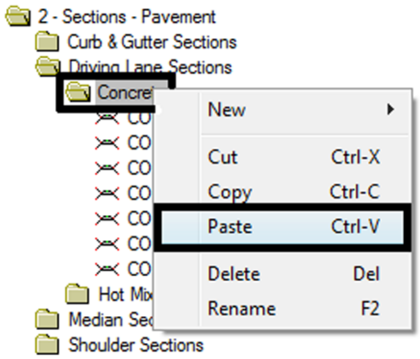
3. Key in a name for the template (***CONC_Divided_4Lane_Left-Side***).

Make a copy of a concrete pavement section and edit the copy to match the pavement design.

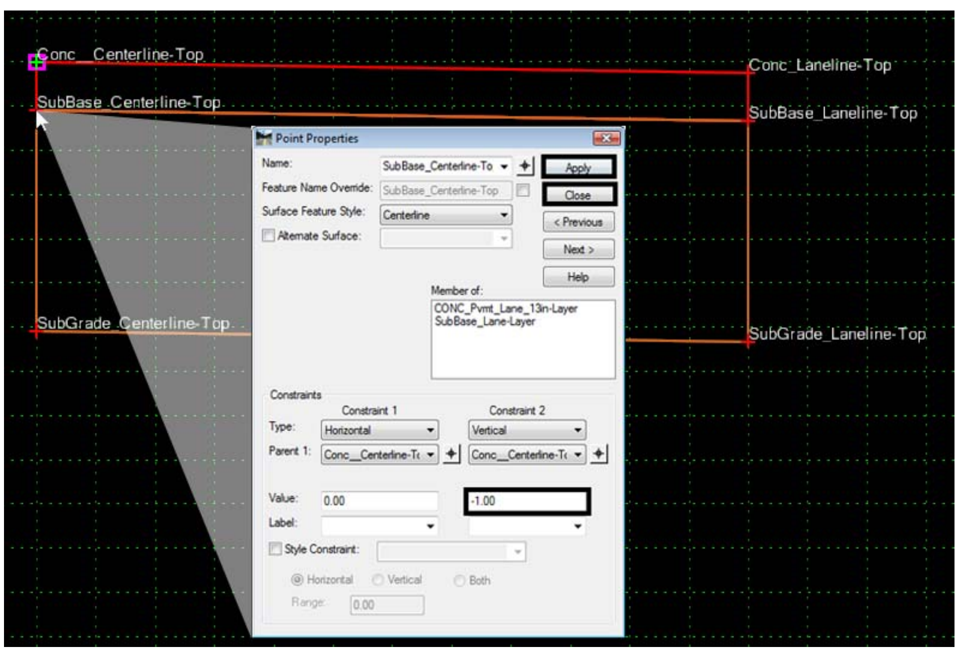
4. Expand the template library folder structure to show **2 – Sections - Pavements > Driving Lane Sections > Concrete.**
5. **<R>** on the **CONC_Pvmt_12ftx13in** section and select **Copy** from the right click menu.



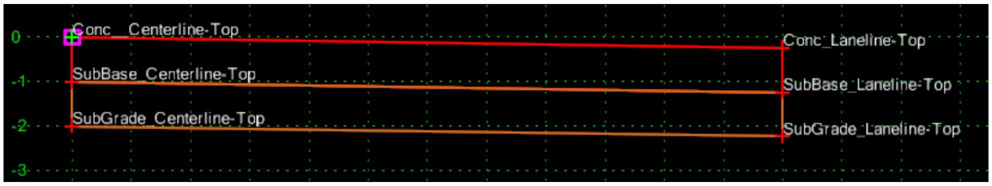
6. **<R>** on the **Concrete** folder and select **Paste** from the right click menu.



7. **<R>** on the **CONC_Pvmt_12ftx13in1**section (this is the copy created in steps 5 and 6) and select **Rename** from the right click menu.
8. Key in a new name (**CONC_Pvmt_12ftx12in**).
9. **<D> <D>** on the **CONC_Pvmt_12ftx12in** section.
10. **<D> <D>** on the **SubBase_Centerline-Top** point.
11. Change the ***Value*** for ***Constraint 2*** (the Vertical constraint) to ***-1.00***.
12. **<D> Apply**.
13. **<D> Close**.

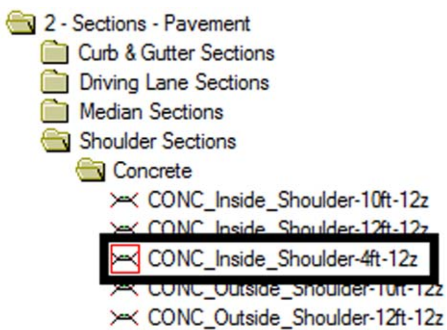


14. Repeat steps 10 through 13 for the point **SubBase_Laneline-Top**, **SubGrade_Centerline-Top**, and **SubGrade_Laneline-Top**.



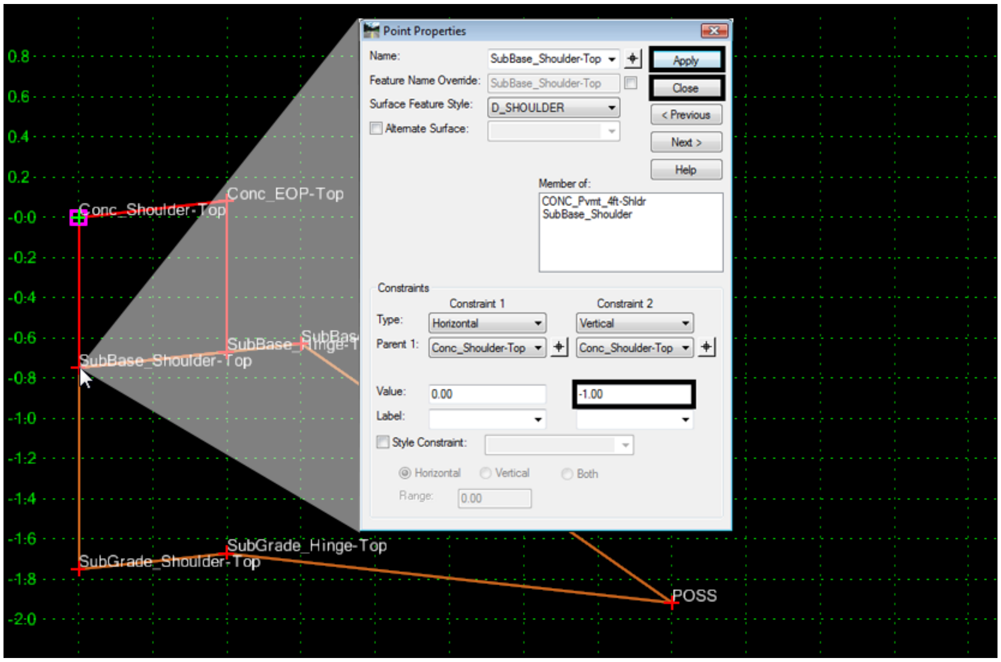
Edit existing concrete shoulder sections to match the pavement design.

15. Expand the template library folder structure to show **2 – Sections - Pavements > Shoulder Sections > Concrete**.
16. **<D> <D>** the **CONC_Inside_Shoulder-4ft-12z** Section.



17. **<D> <D>** on the **SubBase_Shoulder-Top** point.
18. Change the ***Value*** for ***Constraint 2*** (the Vertical constraint) to ***-1.00***.
19. **<D> Apply**.

20. **<D> Close**.



21. Repeat steps 10 through 13 for the point **SubBase_Hinge-Top**.

22. **<D> <D>** on the **CONC_Outside_Shoulder-10ft-12z** section.

23. Repeat steps 17 through 21 for the same points in this section.

Assemble the template from the modified sections and add the appropriate end conditions.

24. Expand the template library folder structure to show **1 – Templates**.

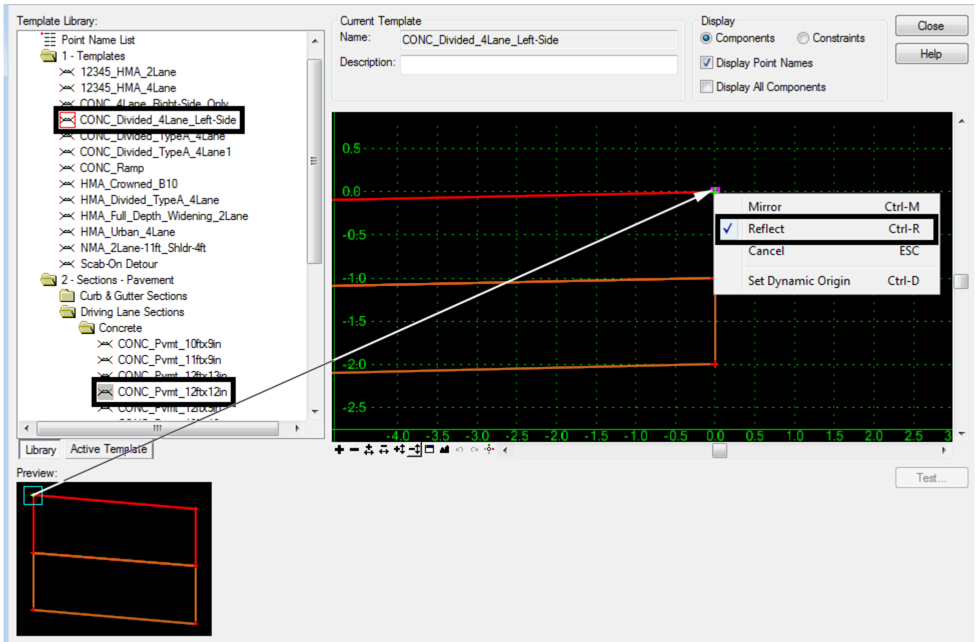
25. **<D> <D>** on the **CONC_Divided_4Lane_Left-Side** template.

26. **<D>** on the **CONC_Pvmt_12ftx12in** section.

27. In the ***Preview*** window, **<D>** and hold on the green "**+**".

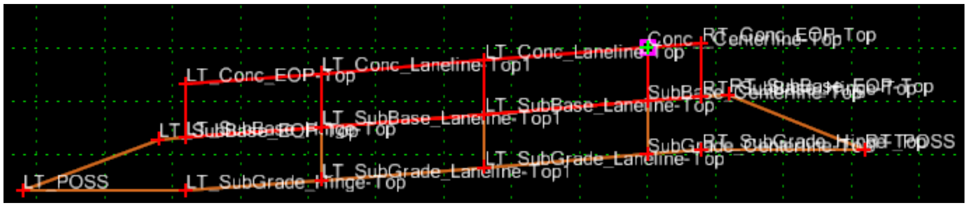
28. Move the pointer into the ***Template View*** window and **<R>** while still holding the left mouse button. This displays a right click menu. When the right click menu is displayed, the left mouse button can be released.

29. Select **Reflect** (using either the left or right mouse button).



30. If ***Mirror*** is on, **<R>** on **Mirror** to turn it off.
31. Move the pointer to the template origin and **<D>** to place the section.
32. In the ***Preview*** window, **<D> and hold** on the green "**+**". Note: the same section is used to place the second driving lane.
33. Move the pointer onto the **LT_Conc_Laneline-Top** point and release the left mouse button to place the section.
34. **<D>** on the **CONC_Outside_Shoulder-10ft-12z** section.
35. In the ***Preview*** window, **<D> and hold** on the green "**+**".
36. Move the pointer onto the **LT_Conc_Laneline-Top1** point and release the left mouse button to place the section.
37. **<D>** the **CONC_Inside_Shoulder-4ft-12z** section.
38. In the ***Preview*** window, **<D>** and hold on the green "+".
39. Move the pointer into the ***Template View*** window and **<R>**. Select **Reflect**. This turns the reflect option off.

40. Move the pointer onto the **Conc_Centerline-Top** point. **<D>** to place the section. All of the components for the driving surface have been placed. The template looks like the illustration below.



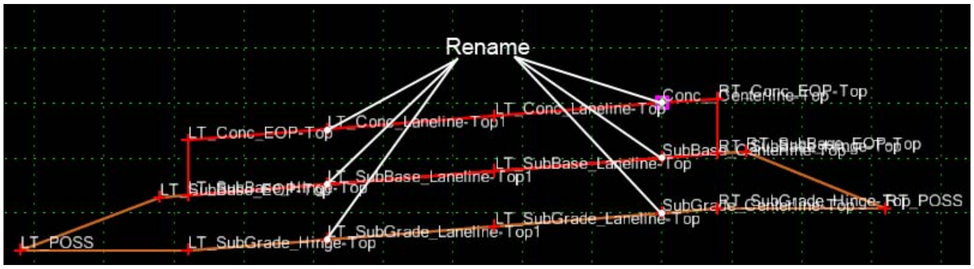
Remove the vertical lines from inside the template.

41. Place the pointer on one of the vertical lines and **<R>** to display the right click menu.

42. Select **Merge Components**. This removes the vertical line from the template.

43. Repeat steps 41 and 42 for all of the vertical line inside the template.

44. Rename points (indicated in the illustration below) to reflect their location.

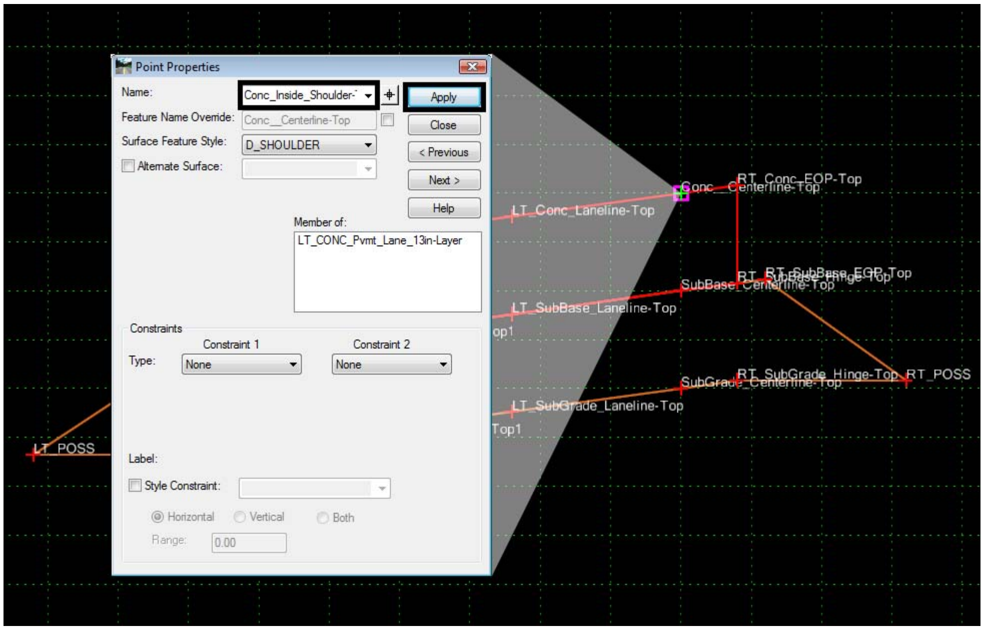


45. **<D> <D>** on the **Conc_Centerline-Top** point.

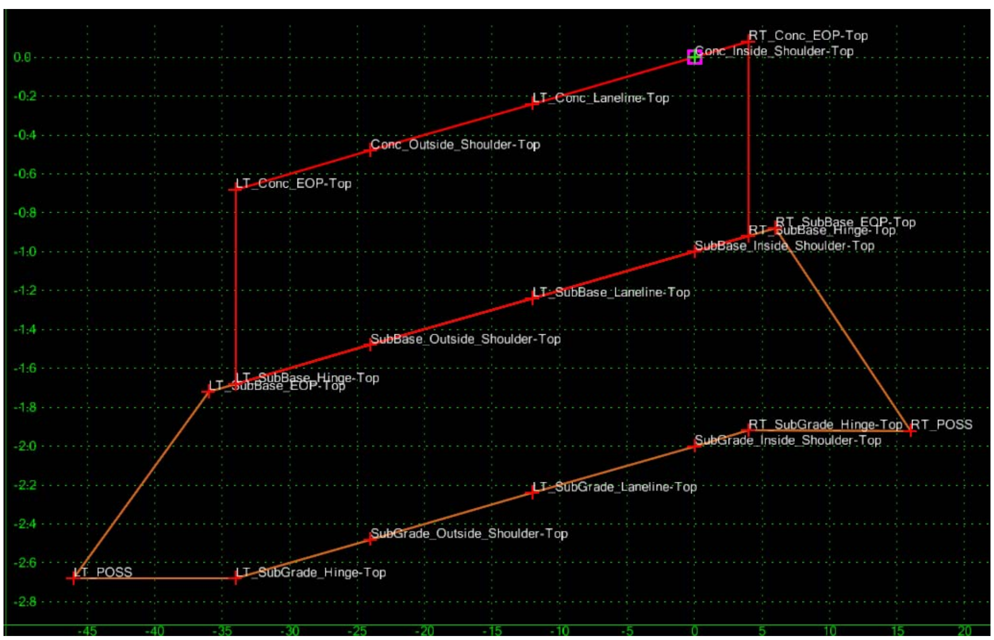
46. Select **Conc_Shoulder-Top** from the ***Name*** drop down menu.

47. Change the name to ***Conc_ Inside_Shoulder-Top***.

48. **<D> Apply**.



49. Repeat steps 44 through 47 for the other five points. Select the appropriate material name for each point. Substitute ***Outside_*** for the three left-most points and ***Inside_*** for the three right-most points. The template should look like the illustration below.

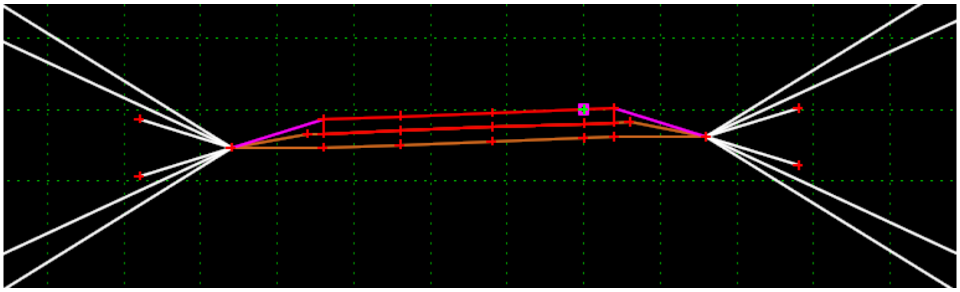


50. **<D> Close** to close the ***Point Properties*** dialog.

Finish the template by attaching the end conditions.

51. Expand the template library folder structure to show **3 – Sections – End Conditions > Z-Slope End Conditions > High Speed End Conditions**.

52. **<D>** on the **Z12_6_to_1** section.
53. In the ***Preview*** window, **<D> and hold** on the green "**+**".
54. Move the pointer onto the **RT_Conc_EOP-Top** point. Release the left mouse button to place the end condition.
55. Using the same end condition section in the ***Preview*** window, **<D> and hold** on the green "**+**".
56. Move the pointer into the ***Template View*** window and **<R>**. Select **Reflect**. This turns the **Reflect** option on.
57. Move the pointer onto the **LT_Conc_EOP-Top** point. **<D>** to place the section. This completes the template.



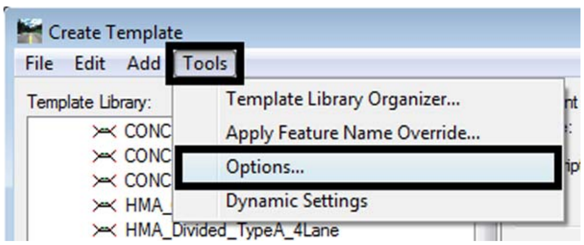
Modifying Templates to Fit a Project

In some instances, the sample templates can be used for a project with only minor modifications. The first example uses the ***HMA_Urban_4Lane*** template and modifies it by adding a sidewalk component behind the curb. The second example starts with the ***HMA_Crowned_B10*** template and adds a new component for ***Lime Treated Subgrade***.

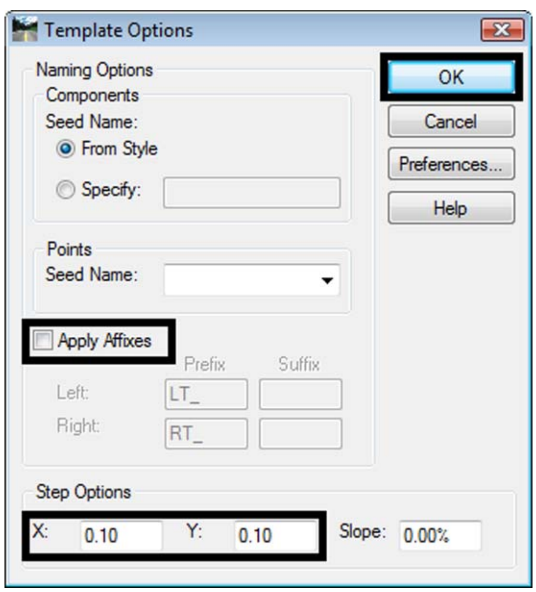
Adding Sidewalk to a Curb & Gutter Template

This example builds a new section containing the ***4"_CONC_Sidewalk*** component with the ***Bench_4_6_to_1*** end condition section attached. Next, the ***HMA_Urban_4Lane*** template is copied and the end conditions are deleted from the copy. Finally, the Sidewalk and End Condition section is added to the template.

1. Select **Tools > Options** from the ***Create Template*** menu bar.

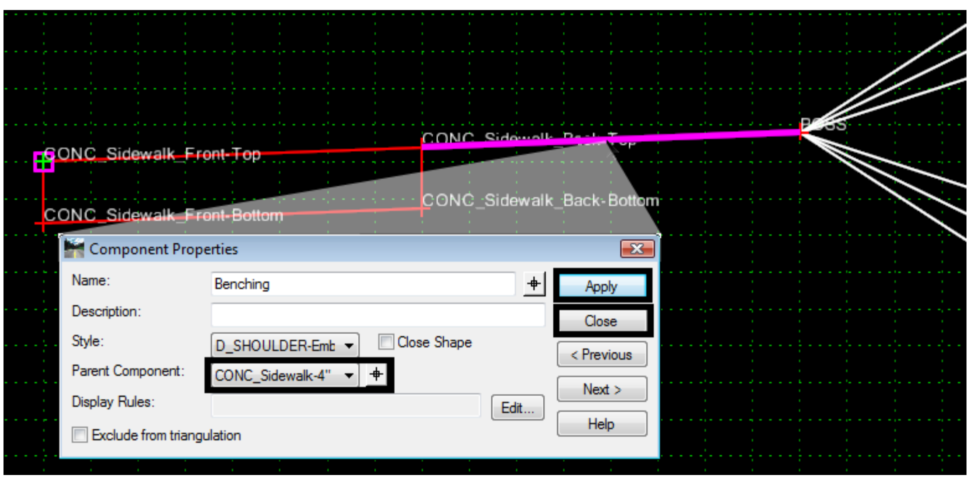


2. Turn off the ***Apply Affixes*** check box.
3. Set the ***Step Options*** to **0.10** for both ***X*** and ***Y***.
4. **<D> OK**.



5. Expand the template library folder structure to show **4 – Components > Sidewalks & Bike Paths > Sidewalks**.
6. **<R>** on the **4"_CONC_Sidewalk** component and select **Copy** from the menu.

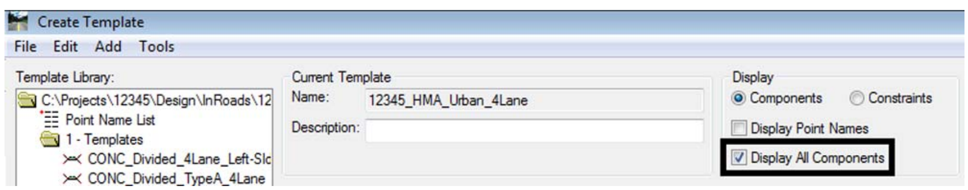
7. Expand the template library folder structure to show **3 – Sections – End Conditions – Curb & Gutter Sections.**
8. **<R>** on the **Curb & Gutter Sections** folder and select **Paste**.
9. **<R>** on the **4"_CONC_Sidewalk** component, that is in the ***Curb & Gutter Sections*** folder, and select **Rename**.
10. Key in a ***Name*** (***4"_CONC_Sidewalk_End-Cond*** for this example).
11. **<D> <D>** on the **4"_CONC_Sidewalk_End-Cond** section.
12. **<D>** on the **Bench_4_6_to_1** section.
13. In the ***Preview*** window, **<D> and hold** on the green "**+**".
14. Move the pointer onto the **CONC_Sidewalk_Back-Top** point. Right-click and toggle make certain **Reflect** and **Mirror** are both off. Release the left mouse button to place the end condition.
15. **<D> <D>** on the **Benching** component to display the ***Component Properties*** window.
16. Set the ***Parent Component*** to **CONC_Sidewalk-4".**
17. **<D> Apply**.
18. **<D> Close.**



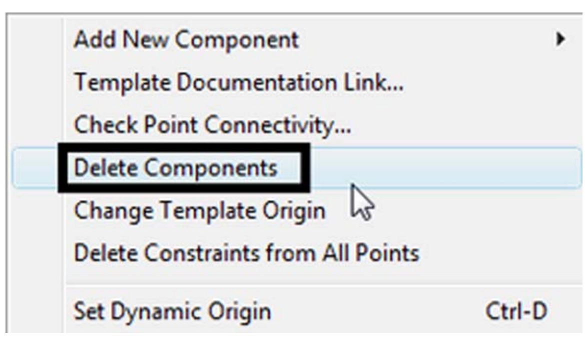
Setting up the parent/child relationships for the section will make it easier to continue the process when the sections are added to the template. Each Curb & Gutter section has two Curb components (one for a normal cross slope and one to match the cross slope of the driving lanes) and the sidewalk/end condition section has to be attached to each. By setting the parent/child relationship in the section, when the section is placed in the template, only one component will have to be edited to make the template work properly.

Next, the ***HMA_Urban_4Lane*** template is copied and the existing end conditions are removed.

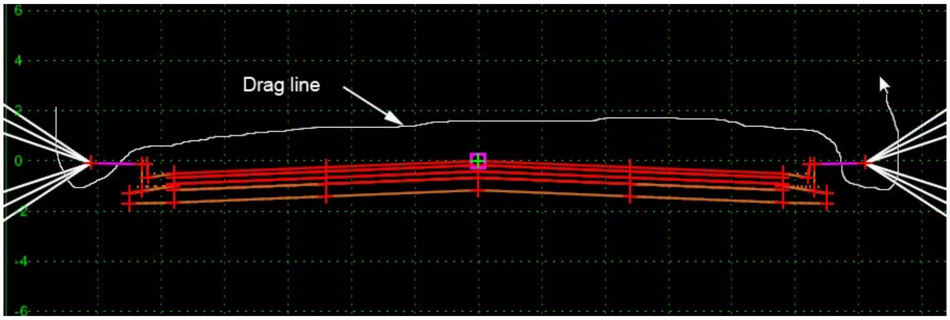
19. Select **Tools > Options** from the ***Create Template*** menu bar.
20. Toggle on the **Apply Affixes** check box.
21. **<D> OK**.
22. Expand the template library folder structure to show **1 – Templates**.
23. **<R>** on the **HMA_Urban_4Lane** template and select **Copy** from the menu.
24. **<R>** on the **1 – Templates** and select **Paste** from the menu.
25. **<R>** on the **HMA_Urban_4Lane1** template and select **Rename** from the menu.
26. Key in a ***Name*** (***12345_ HMA_Urban_4Lane*** for this example).
27. **<D> <D>** on the **12345_ HMA_Urban_4Lane** template.
28. Toggle on the ***Display All Components*** check box. This will show components currently hidden by ***Display Rules***.

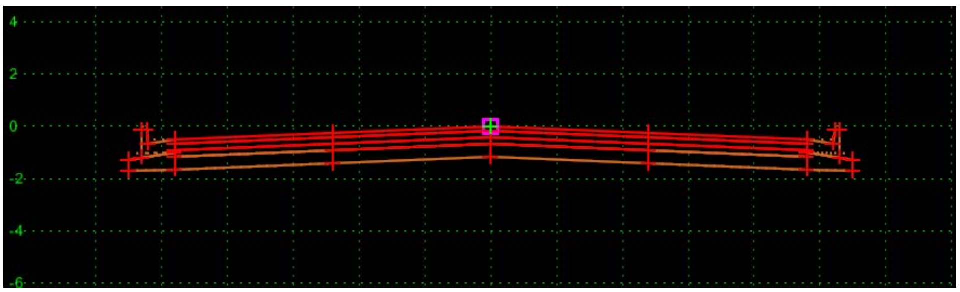


29. Move the pointer into the ***Template View*** window (but not on a component) and **<R>**.
30. Select **Delete Components** from the menu.



31. Position the pointer near the component(s) to be deleted, **<D> and hold**. Drag through the component(s). Release the left mouse button to complete the process.





Important! Be careful not to touch components that are to be kept. The ***Delete Components*** command is only in effect through one drag operation. Once the left mouse button is released, the command must be picked again to delete more components.

Note: If a component is deleted by mistake, select **Edit > Undo** (or Ctrl+Z) to replace the deleted components.

To complete the template, add the sidewalk/end condition section and make the sidewalk component a child of the curb.

32. Expand the template library folder structure to show **3 – Sections – End Conditions – Curb & Gutter Sections**.

33. Make certain **Apply Affixes** is toggled on.

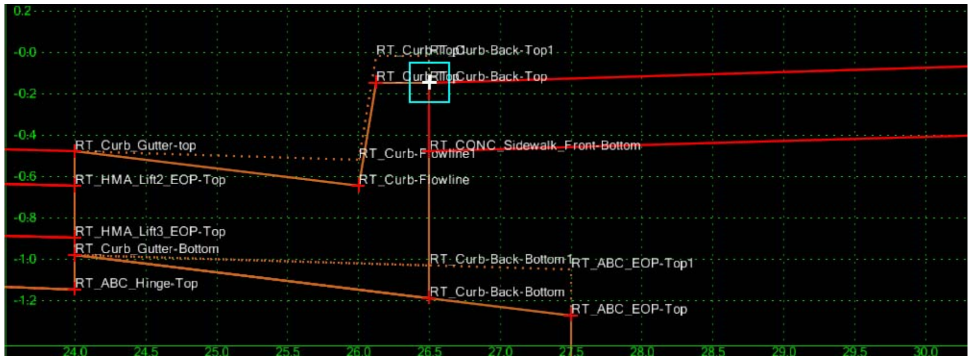
34. **<D>** on the **4"_CONC_Sidewalk_End-Cond** section.

35. In the ***Preview*** window, **<D> and hold** on the green "**+**".

36. Move the pointer into the ***Template View*** window and **<R>** while still holding the left mouse button. This displays a right click menu. When the right click menu is displayed, the left mouse button can be released.

37. Select **Mirror** (using either the left or right mouse button).

38. Move the pointer onto the **RT_Curb-Back-Top** point and release the left mouse button to place the section.



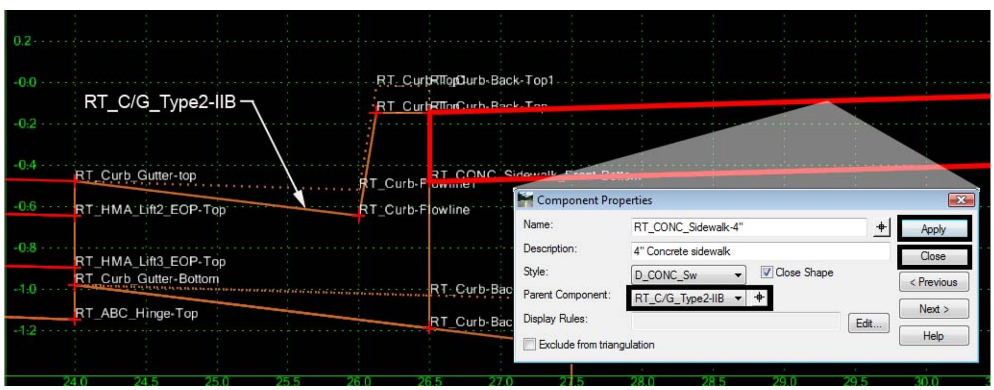
39. **<D> <D>** on the **RT_CONC_Sidewalk-4"** component.

40. In the ***Component Properties*** dialog box, set the ***Parent Component*** to **RT_C/G_Type2-IIB**.

41. **<D> Apply**.

42. **<D> Close**.

43. Repeat steps 38 through 41 on the corresponding components on the left side.

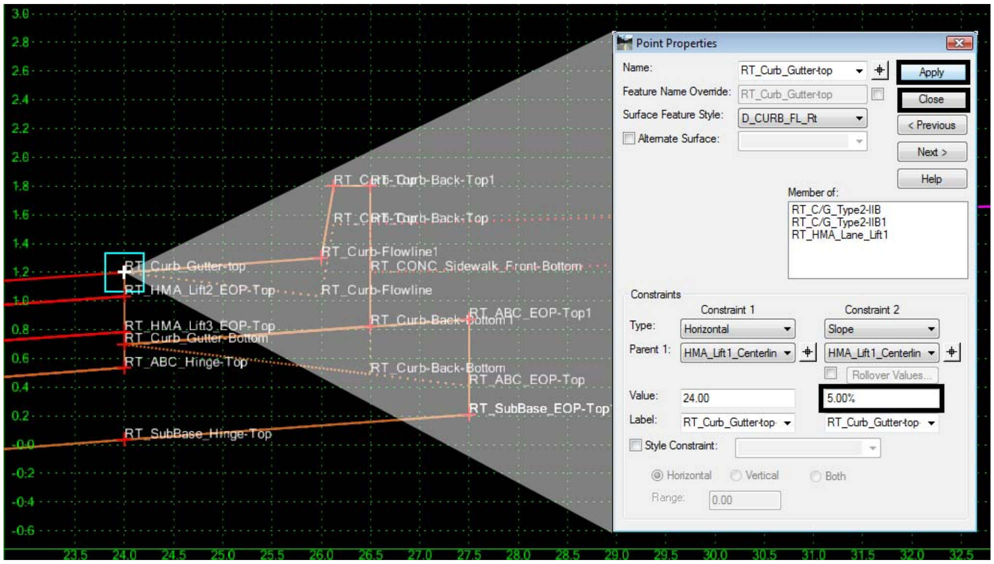


44. **<D> <D>** on the **RT_Curb_Gutter-top** point.

45. Change the ***Value*** of ***Constraint 2*** (the Slope constraint) to ***5.00%.***

46. **<D> Apply**.

47. **<D> Close**.



48. Repeat steps 43 through 46 on the **LT_Curb_Gutter-top** point (the slope ***Value*** will be ***-5.00%*** on this side).

    Changing the slope constraint will imitate a supered condition causing the normal curb and its child components not to be displayed. It will activate the display of the supered curb. These steps will form the pavement into a "V". This will make it easier to place the remaining sidewalk/end condition sections. The pavement will be rotated back to its normal position after the sections are placed.

49. Using the same section in the ***Preview*** window, **<D> and hold** on the green "**+**".

50. Move the pointer onto the **RT_Curb-Back-Top1** point and release the left mouse button to place the section.

51. **<D> <D>** on the **RT_CONC_Sidewalk-4"1** component.

52. In the ***Component Properties*** dialog box, set the ***Parent Component*** to **RT_C/G_Type2-IIB1.**

53. **<D> Apply**.

54. **<D> Close**.

55. Repeat steps 50 through 53 on the corresponding components on the left side.

56. **<D> <D>** on the **RT_Curb_Gutter-top** point.

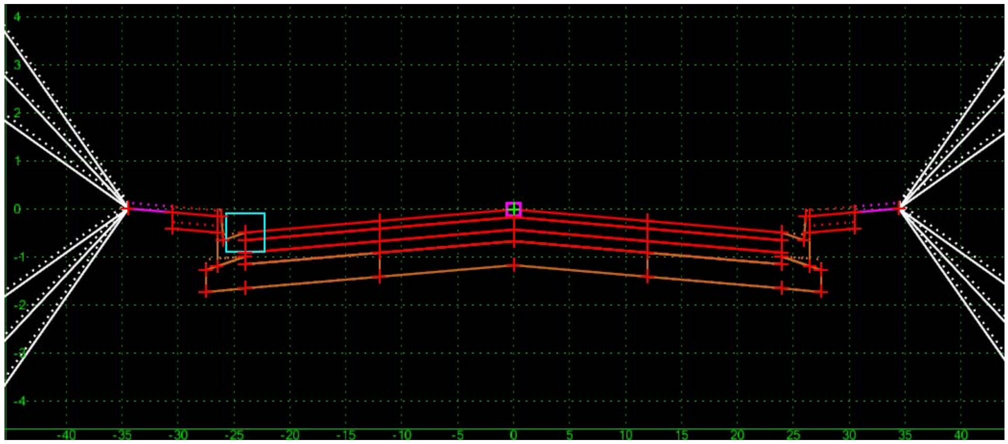
57. Change the ***Value*** of ***Constraint 2*** (the Slope constraint) to ***-2.00%.***

58. **<D> Apply**.

59. **<D> Close**.

60. Repeat steps 43 through 46 on the **LT_Curb_Gutter-top** point (the slope ***Value*** will be ***2.00%*** on this side).

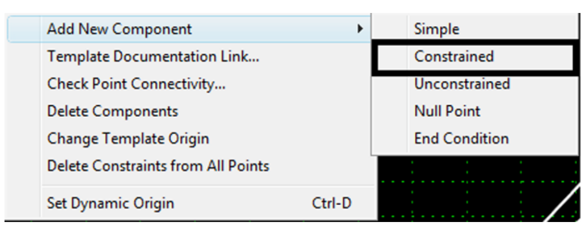
The template is now complete.



Adding a Subgrade Component to a Template

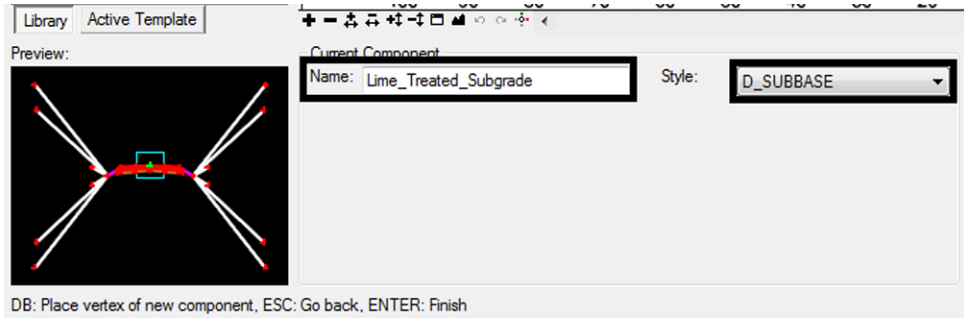
The ***HMA_Crowned_B10*** template will be modified by creating a new component. This component, representing lime treated subgrade, will be 1' thick and the width of the ABC component that is already in the template.

1. Expand the template library folder structure to show **1 – Templates**.
2. **<R>** on the **HMA_Crowned_B10** template and select **Copy** from the menu.
3. **<R>** on the **1 – Templates** and select **Paste** from the menu.
4. **<R>** on the **HMA_Crowned_B101** template and select **Rename** from the menu.
5. Key in a ***Name*** (***12345_ HMA_Crowned_B10*** for this example).
6. **<D> <D>** on the **12345_ HMA_Crowned_B10** template.
7. Move the pointer into the ***Template View*** window (but not on a component) and **<R>**.
8. Select **Add New Component > Constrained** from the menu.



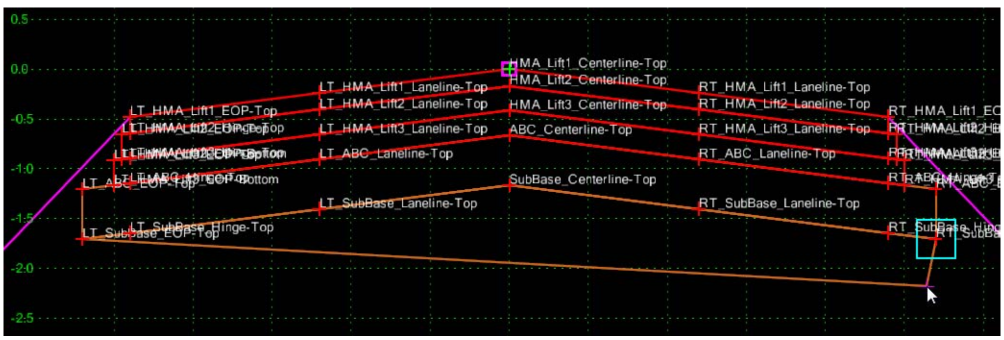
9. In the ***Name*** field of the ***Current Component*** area, key in a name for the new component (***Lime_ Treated_Subgrade*** in this example).

10. Use the drop down menu to select the desired Style (**D_Subbase** for this example).



11. Move the pointer onto the ***LT_SubBase_EOP-Top*** point and **<D>**.

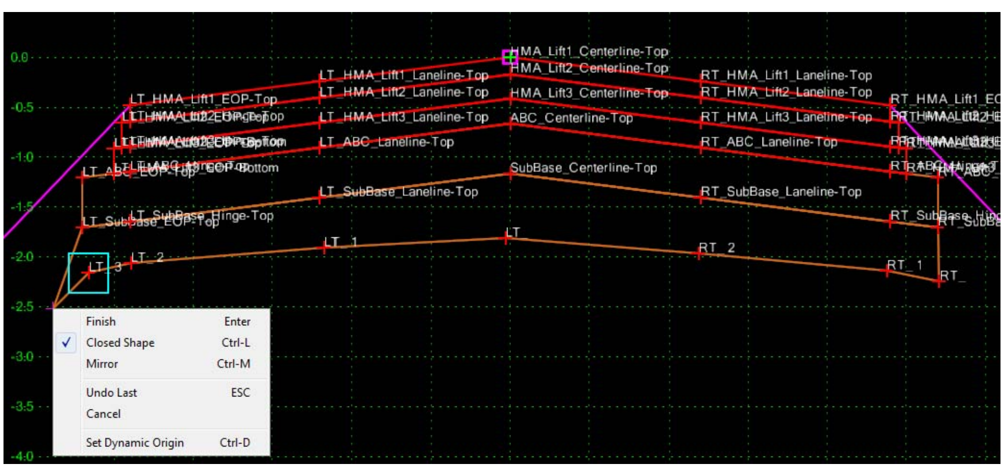
12. Continuing to the right, **<D>** on each point across the bottom of the existing ABC component.



13. **<D>** the same number of new points (in this case 7) below the ABC component.

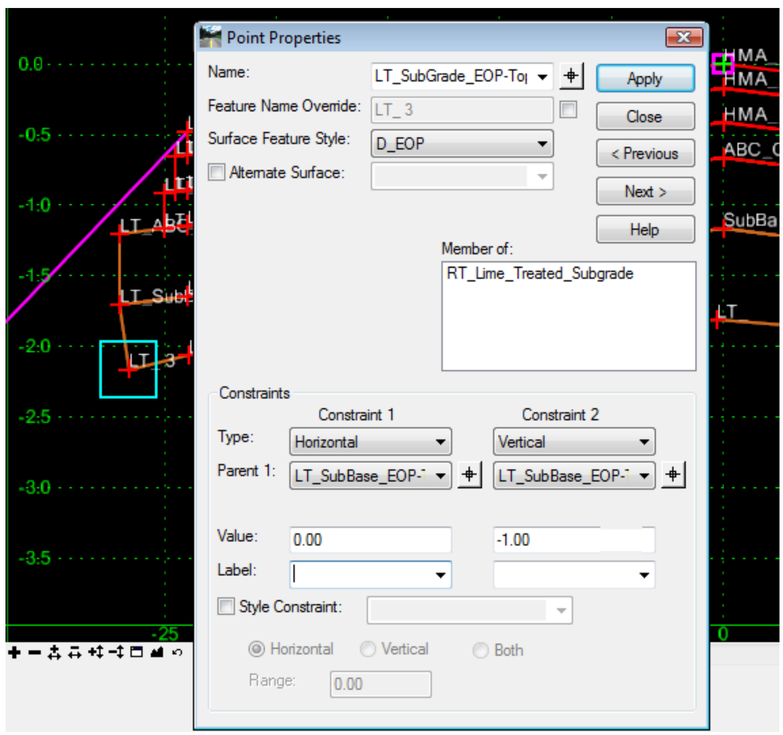
14. **<R>** in the ***Template View*** window (but not on a component).

15. Select **Finish** from the menu.



All of the points are contained in the new component. Editing the point constraints will move each point to its proper location.

16. **<D> <D>** on the point **LT_3** to display the ***Point Properties*** dialog box.
17. Select **SubGrade_EOP-Top** from the ***Name*** drop down menu.
18. Append ***LT_*** to the name so that it reads ***LT_SubGrade_EOP-Top***.
19. Under ***Constraint 1*** (the Horizontal constraint), set the ***Parent 1*** to **LT_SubBase_EOP-Top**.
20. Set the ***Value*** to ***0***.
21. Under ***Constraint 2*** (the Vertical constraint), set the ***Parent 1*** to **LT_SubBase_EOP-Top**.
22. Set the ***Value*** to ***-1***.
23. **<D> Apply**.
24. **<D> Close**.



25. Repeat steps 16 through 24 for each of the remaining points. Choose an appropriate name for each of the points. The ***Parent 1*** is the same for the ***Horizontal*** and the ***Vertical*** constraint. The parent point is the point directly above the edited point. The Values for the constraints are the same for all points.

The completed template is shown below.

Section Summary:

- ***Components*** are the building blocks for ***Sections*** and ***Templates***.
- There are 5 methods of creating components, but only 3 types of components: ***General***, ***Null*** and ***End Conditions***.
- ***Component Properties*** allow the editing of names, styles, etc. and help define how the components react in different situations.
- ***Component Properties*** for ***End Condition*** components contain the target information.
- ***Components*** are made up of ***Points***.
- ***Points*** are constrained to other points to define the shape of the components and therefore the template. Changing the constraints may affect more than one point, since the constrained point may also be a parent of another point.
- There are many different types of ***Constraints*** and it is very important to use the correct ones when creating a new point.
- ***Display Rules*** and ***Parent/Child*** components can be used to turn on and off components during modeling based on the occurrence of other components, or the result of a mathematical expression derived from the differences between points (horizontal, vertical, slope, etc.)
- Start a new template with the most complete example available that fits your design needs.
- Standard templates may be copied and modified by changing component properties and/or point properties.
- Standard sections may be copied into a new template to create a project-specific design.
- Standard components may be copied into a new template to create a new section.
- Even if your design requires a template that is not completed, many of the components and sections are found in the standard template library and may be used to create new templates.

Chapter Summary:

- The default template library is located in the ***C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Templates*** folder
- The CDOT template library contains several categories of templates in various stages of development, including: ***Components*** (the building blocks), ***Sections*** (multiple components forming partial templates, such as all the lifts for a lane), and ***Finished Templates*** (multiple components that form a complete typical section).
- When evaluating the typical sections needed for a project, you should look first to the standard template library to save time and effort in building your typicals.
- For non-standard and more complex typicals, the building blocks and /or tools are available to create your own templates to accomplish your design.